

SECTION 00 01 01

CONTRACT DOCUMENTS FOR CITY OF FLAGLER BEACH

3580 SOUTH CENTRAL AVENUE CITY PROJECT NO: 238

CITY INVITATION TO BID NO: FB-240111

NOVEMBER 2024

VOLUME 2
TECHNICAL SECTIONS

CITY OF FLAGLER BEACH
WWTF SLUDGE MANAGEMENT IMPROVEMENTS
2000 AVENUE A
CITY PROJECT NO: 238

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THESE DOCUMENTS ARE ATTACHED AS INDIVIDUAL DOCUMENTS.

SECTION 01000 PROJECT REQUIREMENTS

1. GENERAL

1.01 Description

A. Scope of Work

- 1. The Work to be done consists of the furnishing of all labor, materials, and equipment, and the performance of all Work included in this Contract.
- 2. A summary of the Work associated with this Project is presented in Section 01010, *Summary of Work*.

B. Work Included in the Project

- 1. The Contractor shall furnish all labor, superintendence, materials, plant power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion of the Work. The Contractor shall obtain and pay for all necessary local building permits except as provided in Section 01065, Permits and Fees. The Contractor shall perform and complete the Work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the Engineer, and in strict accordance with the Contract Documents.
- 2. The Contractor shall clean up the Work and maintain it during and after construction, until accepted, and shall do all Work and pay all costs incidental thereto. The Contractor shall repair or restore all structures and property that may be damaged or disturbed during performance of the Work.
- 3. The cost of incidental Work described in these Project Requirements, for which there are no specific Contract Items, shall be considered as part of the general cost of doing the Work and shall be included in the prices for the various Contract Items. No additional payment will be made therefore.

- 4. The Contractor shall provide and maintain such modern plant, tools, and equipment as may be necessary, in the opinion of the Engineer, to perform in a satisfactory and acceptable manner all the Work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his workmanship, materials, and equipment, prior approval of the Engineer notwithstanding.
- 5. The work shall be carried out in such a way as to limit interruption of operation of existing utilities and treatment facilities to less than four (4) hours during low demand periods (10 pm 6 am) and absolutely no interruption of water, wastewater, reclaimed water or other service to the Owner's customers will be allowed. All required temporary power, control, bypasses, and other appurtenances shall be provided by the Contractor as part of the cost of performing the Work.

C. Public Utility Installations and Structures

- 1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, vaults, manholes, and all other appurtenances and facilities pertaining thereto whether owned or controlled by the Owner, other governmental bodies, or privately owned by individuals, firms, or corporations, used to serve the public with transportation, traffic control, gas, electricity, telephone, wastewater, drainage, water, or other public or private property which may be affected by the Work shall be deemed included hereunder.
- 2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his own investigations to inform himself fully of the character, condition, and extent of all such installations and structures as may be encountered and as may affect the construction operations.
- 3. The Contractor shall protect all public utility installations and structures from damage during the Work. Access across any buried public utility installation or structure shall be made only in such locations and by means approved by the Engineer. The Contractor shall so arrange his operations as to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor shall be repaired by the Contractor, at his expense. No separate payment shall be made for such protection or repairs to public utility installations or structures.
- 4. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Contract Drawings to be removed, relocated, replaced, or rebuilt by the Contractor shall be considered as a part of the

general cost of doing the Work and shall be included in the prices bid for the various Contract Items. No separate payment shall be made therefor.

- 5. Where public utility installations of structures owned or controlled by the Owner or other governmental body are encountered during the course of the Work, and are not indicated on the Contract Drawings or in the Specifications, and when, in the opinion of the Engineer, removal, relocation, replacement, or rebuilding is necessary to complete the Work under this Contract, such Work shall be accomplished by the utility having jurisdiction, or such Work may be ordered, in writing by the Engineer, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously, and the Contractor shall give full cooperation to permit the utility to complete the removal, relocation, replacement, or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement.
- 6. The Contractor shall, at all times in performance of the Work, employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of public utility installations and structures; and shall, at all times in the performance of the Work, avoid unnecessary interference with, or interruption of, public utility services, and shall cooperate fully with the owners thereof to that end.
- 7. The Contractor shall give written notice to the Owner and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations, at least <u>seventy-two (72) hours</u> in advance of breaking ground in any area or on any unit of the Work.
- 8. The maintenance, repair, removal, relocation, or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the owners of such utilities.
- 9. Contractor responsible for determining utilities that may be encountered in the area.

1.02 Drawings and Project Manual

A. Contract Drawings

1. When obtaining data and information from the Contract Drawings, figures shall be used in preference to scaled dimensions, and large-scale drawings in preference to small-scale drawings. Specifications shall generally supercede information given on the Contract Drawings but in all cases, the more stringent or costlier option shall be assumed to govern in the Bid. The Owner shall exercise his right, as a tax-exempt entity, to recover sales tax in accordance with Article 1.37 of Section 00100, Instructions to Bidders, Article 1.04 of Section 00300, Bid Form, and State Law.

B. Copies Furnished to the Contractor

1. After the Contract has been executed, the Contractor will be furnished one (1) complete set of Contract Drawing (22 inches by 34 inches) and Project Manuals (contract requirements and specifications) and all addenda, upon request.

C. Supplementary Drawings

- 1. When, in the opinion of the Engineer, it becomes necessary to explain more fully the Work to be done or to illustrate the Work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the Engineer, and the Contractor will be furnished one (1) complete set of reproducible Contract Drawings (22 inches by 34 inches) and one (1) reproducible copy of the specifications.
- The Supplementary Drawings shall be binding upon the Contractor with the same force as the Contract Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of Work, credit to the Owner or compensation therefor to the Contractor shall be subject to the terms of the Agreement.

D. Contractor to Check Drawings and Data

1. The Contractor shall verify all dimensions, quantities, and details shown on the Contract Drawings, Supplementary Drawings, Schedules, Specifications, or other data received from the Engineer, and shall notify him of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts, or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction, or improper operation resulting therefrom, nor from rectifying such conditions at his own expense. The Contractor will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Engineer, should such errors or omissions be discovered.

2. All schedules are given for the convenience of the Engineer and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility or the making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

E. Specifications

- 1. The Technical Specifications consist of three (3) parts: General, Products, and Execution.
- 2. The General part of a Specification contains "General Requirements" which govern the Work.
- 3. The Products and Execution parts modify and supplement the General Requirements by detailed requirements for the Work and shall always govern whenever there appears to be a conflict.

F. Intent

- 1. All Work called for in the Specifications applicable to this Contract, but not shown on the Contract Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Contract Drawings or in the Specifications, but involved in carrying out their intent or in the complete and proper execution of the Work, is required and shall be performed by the Contractor as though it were specifically delineated or described.
- 2. The apparent silence of the Specifications as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used, the interpretation of these Specifications shall be made upon that basis.

1.03 Accident Prevention

- A. Precautions shall be exercised at all times for the protection of person and property. The safety provisions of applicable laws, building and construction codes shall be observed.
- B. The Contractor shall comply with the Trench Safety Act as listed in the Bid and the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596), and under Hours and

Safety Standards Act Section 107 of the contract Work. Hours and Safety Standards Act (PL 91 - 54), except where state and local safety standards exceed the federal requirements and except where state safety standards have been approved by the Secretary of Labor in accordance with provisions of the Occupational Safety and Health Act, shall be complied with.

C. First Aid

1. The Contractor shall keep upon the site, at each location where work is in progress, a completely equipped first aid kit and shall provide ready access thereto at all times when workers are employed on the Project.

1.04 Materials and Equipment

A. Manufacturer

- 1. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request and at the Engineer's option, that the manufacturer or subcontractor deal directly with the Engineer.
- 2. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
- 3. Any two (2) or more pieces of material or equipment of the same kind, type, or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery

- 1. The Contractor shall deliver materials in ample quantities to ensure the most speedy and uninterrupted progress of the Work so as to complete the Work within the allotted Contract Time.
- 2. The Contractor shall also coordinate deliveries in order to avoid delay in, or impediment of, the progress of the work of any related Contractor.

C. Tools and Accessories

1. The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind, or size of equipment, one (1) complete set of suitably marked

high grade special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment. Such tools and appliances shall be furnished in approved corrosion resistant thermoplastic cases, properly labeled (indelible and weatherproof) and equipped with good grade cylinder locks and duplicate keys.

- 2. Spare parts shall be furnished as specified herein, and in the individual equipment specification sections, and as recommended by the manufacturer necessary for the operation of the equipment, not including materials required for routine maintenance.
- 3. Each piece of equipment shall be provided with a substantial nameplate (indelible and weatherproof), securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight, and principal rate data.

D. Service of the Manufacturer's Engineer

- 1. The Contract Prices for equipment shall include the cost of furnishing a competent and experienced engineer or superintendent who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test, and place in operation, the equipment in conformity with the Contract Documents.
- 2. After the equipment is placed in permanent operation by the Owner, such engineer or superintendent shall make all adjustments and tests required by the Engineer to prove that such equipment is in proper and satisfactory operating condition, and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

1.05 Inspection and Testing

A. General

- For tests specified to be made by the Contractor, the testing personnel shall make
 the necessary inspections and tests, and the reports thereof shall be in such form
 as will facilitate checking to determine compliance with the Contract Documents.
 An electronic copy (PDF) of the reports shall be submitted, and authoritative
 certification thereof must be furnished to the Engineer as a prerequisite for the
 acceptance of any material or equipment.
- 2. If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof, and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the Work and replace it with acceptable material, without cost to the Owner.

- 3. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with the recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.
- 4. The Contractor shall be fully responsible for the proper operation of equipment during testing and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

B. Costs

- 1. All inspection and testing of materials furnished under this Contract will be provided by the Contractor, unless otherwise expressly specified.
- 2. The cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents shall be borne by the Contractor, and such costs shall be deemed to be included in the Contract Price.
- 3. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract may be tested by the Owner for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment which are rejected for non-compliance.

C. Certificate of Manufacture

- The Contractor shall furnish to the Engineer authoritative evidence in the form of a certificate of manufacture that the materials to be used in the Work have been manufactured and tested in conformity with the Contract Documents.
- 2. An electronic certificate (PDF) shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

D. Shop Tests

 Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function, or special requirements are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents. Shop tests, where specified, shall be witnessed by the Engineer.

- 2. An electronic copy (PDF) of the manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company and/or independent laboratory, shall be submitted to the Engineer for approval.
- 3. The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment shall be borne by the Contractor.

E. Start-up Tests

- 1. As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make start-up tests of equipment.
- 2. If the start-up tests disclose any equipment furnished under this Contract which does not comply with the requirements of the Contract Documents, the Contractor shall, prior to demonstration tests, make all changes, adjustments, and replacements required. The furnishing Contractor shall assist in the start-up tests as applicable.

F. Demonstration Tests

- 1. Prior to Contractor's request for a Substantial Completion inspection, all equipment and piping installed under this Contract shall be subjected to demonstration tests as specified or required to prove compliance with the Contract Documents.
- 2. The Contractor shall furnish labor, fuel, energy, water, and all other materials, equipment, and instruments necessary for all demonstration tests, at no additional cost to the Owner. The Contractor shall assist in the demonstration tests as applicable.

1.06 Lines and Grades

A. <u>Grade</u>

- 1. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Contract Drawings, or as given by the Engineer. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
- 2. The Engineer will establish bench marks and baseline controlling points. Reference marks for lines and grades as the Work progresses will be located by the Contractor to cause as little inconvenience to the prosecution of the Work as possible. The

Contractor shall so place excavation and other materials as to cause no inconvenience in the use of the reference marks provided. He shall remove any obstructions placed by him contrary to this provision.

B. Surveys

- 1. The Contractor shall furnish and maintain, at his own expense, stakes and other such materials.
- 2. **The Contractor shall check such reference marks** by such means as he may deem necessary and, before using them, shall call the Engineer's attention to any inaccuracies.
- 3. The Contractor shall, at his own expense, establish all working or construction lines and grades as required from the reference marks set by the Engineer, and shall be solely responsible for the accuracy thereof. He shall, however, be subject to the check and review by the Engineer. Field engineering and surveying shall be in accordance with Section 01050, Field Engineering.

C. Safeguarding Marks

- The Contractor shall safeguard all points, stakes, grade marks, monuments, and bench marks made or established on the Work, bear the cost of reestablishing them if disturbed, and bear the entire expense of rectifying work improperly installed due to not maintaining or protecting or to removing without authorization such established points, stakes, and marks.
- 2. The Contractor shall safeguard all existing and known property corners, monuments, and marks adjacent to but not related to the Work and shall bear the cost of re-establishing them if disturbed or destroyed.

1.07 Adjacent Structures and Landscaping

A. Responsibility

- The Contractor shall be entirely responsible and liable for all damage or injury as a result of his operations to all other adjacent public and private property, structures of any kind and appurtenances thereto met with during the progress of the work.
- 2. Protection of public and private property shall be provided by the Contractor as specified in the General and Supplementary Conditions and as specified herein.

- 3. The cost of protection, replacement in their original locations and conditions or payment of damages for injuries to such adjacent public and private property and structures affected by the work, whether or not shown on the Contract Drawings, and the removal, relocation and reconstruction of such items called for on the Contract Drawings or specified shall be included in the various Contract Items and no separate payments will be made therefor.
- 4. The Contractor is expressly advised that the protection of buildings, structures, tanks, pipelines, monitoring wells, etc. and related work adjacent and in the vicinity of his operations, wherever they may be, is solely his responsibility.
- 5. Conditional inspection of buildings or structures in the immediate vicinity of the project which may reasonably be expected to be affected by the Work shall be performed by and be the responsibility of the Contractor. Reference is made to the requirements of Section 00800, Supplementary Conditions, the pre-existing condition survey described in this section, Section 01380, Construction Photographs, and Section 01390, Preconstruction Video Recording.
- 6. The Contractor shall, before starting operations, make an examination of the adjacent structures, buildings, facilities, etc., and record by notes, measurements, photographs, etc., conditions which might be aggravated by open excavation and construction.
- 7. Repairs or replacement of all conditions disturbed by the construction shall be made to the satisfaction of the Engineer and to the satisfaction of the Owner. This does not preclude conforming to the requirements of the insurance underwriters. Copies of surveys, photographs, reports, etc., shall be given to the Owner.
- 8. Prior to the beginning of any excavations the Contractor shall advise the Engineer of all structures on which he intends to perform work or which performance of the project work will affect.

B. Protection of Trees

- 1. All trees and shrubs shall be adequately protected by the Contractor with boxes and otherwise and in accordance with ordinances governing the protection of trees.
- 2. Excavated materials shall be placed so as not to injure such trees or shrubs.
- Trees or shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age, at its proper season and at the sole expense of the Contractor.

C. Lawn Areas

- 1. Lawn areas shall be left in as good condition as before the starting of the work.
- 2. Where sod is to be removed, it shall be carefully removed, and later replaced, or the area where sod has been removed shall be restored with new sod.

D. Restoration of Fences

- 1. Any fence, or part thereof, that is damaged or removed during the course of the work shall be replaced or repaired by the Contractor and shall be left in as good a condition as before the starting of the work.
- 2. The manner in which the fence is repaired or replaced and the materials used in such work shall be subject to the approval of the Owner and Engineer.
- 3. The cost of all labor, materials, equipment, and work for the replacement or repair of any fence shall be deemed included in the appropriate Contract Item or items, or if no specific item is provided therefor, as part of the overhead cost of the work, and no additional payment will be made therefor.

1.08 Protection of Work and Public

A. Barriers and Lights

- 1. During the prosecution of the work, the Contractor shall put up and maintain at all times such barriers and lights as will effectually prevent accidents.
- 2. The Contractor shall provide suitable barricades, red lights, *danger* or *caution* or *street closed* signs and watchmen at all places where the work causes obstructions to the normal traffic or constitutes in any way a hazard to the public.

B. Noise

- The Contractor shall eliminate noise to as great an extent as practicable at all times. Air compressing equipment shall be equipped with silencers and the exhaust of all gasoline motors or other power equipment shall be provided with mufflers. The Contractor shall construct sound barriers as necessary to eliminate noise.
- 2. In the vicinity of hospitals and schools, special care shall be used to avoid noise or other nuisances. The Contractor shall strictly observe all local regulations and ordinances covering noise control.

- 3. Except in the event of an emergency or for critical tie-ins to existing utilities, work shall restricted to between the hours of 7:00 a.m. and 5:00 p.m., Monday through Friday except for legal or City holidays.
- 4. Proper and efficient prosecution of the work, particularly to avoid unacceptable shutdown of existing utility service, may require operations during the night. Written permission of the Owner shall be obtained before starting such items of the work.
- 5. No deliveries are to be made to the site before 8:00 a.m. nor after 3:00 p.m. Delivery vehicles may not arrive before 8:00 a.m. and are to be limited to normal work days.
- 6. The Contractor shall not create a public nuisance in accordance with Article 1.33 of Section 01120, *Special Project Procedures*.

C. Access to Public Services

1. Neither the materials excavated nor the materials or equipment used in the construction of the work shall be so placed as to prevent free access to all fire hydrants, valves or manholes.

D. Dust Prevention

1. The Contractor shall prevent dust nuisance from his operations or from traffic by keeping the roads and/or construction areas sprinkled with water at all times.

1.09 Cutting and Patching

A. The Contractor shall do all cutting, fitting and patching of his portion of the Work that may be required in accordance with Section 01045, *Cutting and Patching*.

1.10 Cleaning

A. The Contractor shall execute cleaning, during progress of the Work, and at completion of the Work, as required by the General Conditions and Section 01710, *Cleaning*, and Section 01800, *Miscellaneous Work and Cleanup*.

1.11 Miscellaneous

A. Protection against Siltation and Bank Erosion

- 1. The Contractor shall arrange his operations and construct erosion control devices to minimize siltation and bank erosion on the construction site and on existing or proposed water course and drainage channels.
- 2. The Contractor, at his own expense, shall remove any siltation deposits and correct any erosion problems as directed by the Engineer which results from his construction operations.
- 3. The Contractor shall review the requirements of Section 01560, *Environmental Protection*, and Section 01570, *Temporary Erosion and Sedimentation Control*.
- 4. The Contractor shall properly dispose of all surplus material, including soil, in accordance with local, state and federal regulations.

B. Protection of Wetland Areas

- 1. Under no circumstances shall surplus material be disposed of in wetland or watercourse areas as defined by the Florida Department of Environmental Protection (FDEP) or the wetland or watercourse areas surrounding the Project Site.
- 2. The Contractor shall review the requirements of Section 01560, *Environmental Protection*, and Section 01570, *Temporary Erosion and Sedimentation Control*.

C. Existing Facilities

1. The Work shall be conducted to maintain all Owner utilities and traffic lanes in operation during the Project.

D. Use of Chemicals

- 1. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfection, polymer, reactant, or of other classification, must show approval of either EPA or USDA.
- 2. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

E. Cooperation with Other Contractors and Forces

- 1. During progress of work under this Contract, it may be necessary for other contractors and persons employed by the Owner to work in or about the project.
- 2. The Owner reserves the right to put such other Contractors to work and to afford such access to the Site of the Work to be performed hereunder at such times as the Owner deems proper.
- 3. The Contractor shall not impede or interfere with the work of such other Contractors engaged in or about the Work and shall so arrange and conduct his work that such other contractors may complete their work at the earliest date possible.
- 4. The Contractor shall review the requirements of Section 01040, *Project Coordination*.
- F. Construction shall be conducted and shall result in construction of the improvements of this Project in full accordance with the conditions of the permits granted for this Project.

1.12 Owner's Representatives

A. The Owner will appoint the Resident Project Representative (RPR) and Project Manager (PM) as the Owner's representative as defined in the General and Supplementary Conditions.

1.13 Pre-Existing Conditions

- A. The Contractor shall conduct a pre-existing conditions survey of each of the existing structures, adjacent properties, and existing land improvements in the vicinity of or potentially affected by the Work. The survey shall establish the state of the property before construction as a basis for any claims of damage that may occur.
- B. This survey shall include comprehensive photography and video recording of structures; spot elevations of grades and tops of walls; nearby water courses, wetlands, landscape features; driveways and walkways; and shall make note of any identified previously damaged areas. Photographs and video tape shall be subject to review and approval by the Owner and shall be in accordance with Section 01380, Construction Photographs and Section 01390, Preconstruction Video Recording.

- 1.14 Proposed Construction Sequencing NOT USED
- 1. PRODUCTS NOT USED
- 2. EXECUTION NOT USED

END OF SECTION

SECTION 01010 SUMMARY OF WORK

1. GENERAL

1.01 Work Covered by Contract Documents

- A. The Work to be performed under this Contract consists of the construction of **Sludge Management System Improvements at the Flagler beach WWTF** (2000 Ave A Flagler Beach, FL 32136) for the City of Flagler Beach, Florida as shown on the Contract Drawings and as specified herein. The Work consists of furnishing all materials, equipment, tools, overhead, and labor for the construction of the facilities consisting of, but not limited to, the following:
 - 1. Chemical feed and pumping systems
 - 2. Dechlorination System
 - 3. Biosolids dewatering system and associated improvements
 - 4. Electrical, controls, instrumentation and SCADA system improvements
 - 5. Site work, yard piping, stormwater management system improvements, plant internal roadway improvements, demolition, signage, sodding, and miscellaneous appurtenances and ancillaries.
- B. All fees, permits and licenses for the permanent construction which are required by regulatory agencies or authorities, including fees for the review of Contract Documents prior to construction, shall be procured by the Contractor.
- C. The Contractor shall perform the work complete, in place, and ready for service, and shall include repairs, testing, clean-up, replacements and restoration required as a result of damages caused during this construction.
- D. The Contractor shall be required to obtain and pay for a building permit from the City of Flagler Beach Building Department for the improvements to be constructed as part of this Contract.

E. The Contractor shall also be responsible for all fees associated with the City of Flagler Beach and any Florida Power and Light (FPL) inspections and energizing of services and equipment.

1.02 Contract

- A. This Project shall be constructed under a "lump sum" contract.
- B. Construct the Project for the total price stipulated in the agreement subject to authorized change orders only. A written change order will be required authorizing and ordering the work and specifying the amount and terms of payment "*prior*" to execution of any extra, additional or changed work.
- C. If the Contractor proceeds performing additional, extra or changed work without an executed Change Order, it is understood and agreed by the parties that the Owner has no obligation to subsequently pay for the extra or additional work under a subsequent claim or any other basis and that by executing the Agreement, the Contractor waives rights to make subsequent claims for extra or additional work if he proceeded without a signed Change Order in performing the work.

1.03 Project Work Sequence

- A. The Contractor shall consider the proposed construction sequence, identified in Article 1.14 of Section 01000, *Project Requirements*, when making his Bid and incorporate all related costs in the Bid Price.
- B. The "down" time of any "existing" infrastructure shall be minimized as the Flagler Beach WWTF still needs to process the raw wastewater generated from the Flagler Beach Wastewater Management System.
- C. The Contractor shall establish his work sequence based on the use of crews to facilitate completion of construction and testing within the specified Contract Time identified in the Agreement.
- D. The detailed work sequence, including the Contractor's plans for provision of temporary facilities, shall be submitted to the Engineer *no later than ten (10) calendar days after the Notice to Proceed*.
- E. The Engineer reserves the right to change the construction sequence during construction, if in the opinion of the Engineer and Owner, that the change is made in a timely manner that allows the Contractor adequate time to schedule materials, equipment and labor for the execution of the Work involved in the sequence of the Work from that stated in the Contractor's submitted construction schedule/sequence.

1.04 Contractor Use of Premises

- A. The Contractor shall confine operations at the Project Site to the areas permitted by the City of Flagler Beach, the Contract Documents and all applicable laws, ordinances, and permits. If additional storage or work areas are required, they shall be obtained by the Contractor at no additional cost to the Owner.
- B. The Contractor shall not unreasonably encumber the site with materials or equipment. The City and Engineer shall designate all areas that can be used by the Contractor.
- C. The Contractor shall not load structures with weight that will endanger the structure.
- D. The Contractor shall assume full responsibility for the protection and safekeeping of products and materials at the job site.

1.05 Construction Schedule

- A. Within ten (10) calendar days after the Notice to Proceed (NTP), the Contractor shall submit a detailed Construction Schedule of all major activities needed to complete the project in accordance with the details outlined in the Contract Documents.
- B. Construction Schedules shall be generated in accordance with the requirement of Section 01311, Construction Progress Schedules".

1.06 Preconstruction Meeting

- A. The Engineer will schedule a preconstruction meeting no later than ten (10) calendar days after the date of the Notice to Proceed (NTP). This meeting shall be attended by the Engineer, Contractor, and Owner. The purpose of the meeting shall be to review shop drawing procedures, construction methods, administrative procedures, project site conditions, to establish a construction schedule, etc.
- B. <u>Location of the Meeting</u>: A central site, convenient for all parties designated by the Engineer.
- C. The Contractor shall refer to Section 01200, *Project Meetings*, for further details.

1.07 Progress Meetings

- A. Progress meetings will be held every thirty (30) days or less with the first meeting thirty (30) days after the preconstruction meeting or thirty (30) days or less after the date of Notice to Proceed.
- B. Location of the meetings: Project field office of the Contractor.
- C. The Contractor shall refer to Section 01200, *Project Meetings*, for further details.

1.08 Coordination

- A. The Contractor shall be fully responsible for the coordination of his work and the work of his employees, subcontractors, manufacturers' representatives, and suppliers and to assure compliance with schedules.
- B. The coordination requirements of this Section are in addition to the requirements of the Section 1040, *Project Coordination*, Section 00700, *General Conditions* Section 00800, *Supplementary Conditions* and Sections 00805 and 00806, *FDEP Supplementary Conditions*.
- C. It is the Contractor's responsibility to coordinate with all the utilities regarding locates, testing or relocations.

1.09 Work under Other Contracts

A. There are no other major contractual construction operations that are known to be occurring at during the period when the Contractor will be constructing the *Flagler Beach WWTF Sludge Management System Improvements* Project.

1.10 Facility Security Requirements

- A. Prior to beginning construction activity, the Contractor must provide the Owner's Utility Department and the Engineer with a name list and pictures of all personnel (including subcontractors) expected to be on-site during the construction of this Project.
- B. The Contractor and major subcontractor's permanent employees **shall be required to** carry ID cards (photo, company name, position, person's name, etc.) with them at all times during project construction. Non-identified personnel will not be allowed at the Facility to perform work. Any missed time, cost and loss of construction schedule due

- to Contractor employees not being identified, shall be borne solely by the Contractor and the Contract Time and Cost will not be adjusted.
- C. Contractor personnel may, from time to time, be required to show state-issued identification in order to be allowed entrance to the facility. Vehicles and personnel may be searched prior to obtaining access to the site. Personnel not on the Contractors list will not be allowed access to the facility. As such, the Contractor is highly encouraged to keep and maintain a current list of personnel expected to be on-site on a daily basis.
- D. All delivery drivers **must** check in with the Contractor and provide a valid state driver's license as identification. Delivery vehicles will not be allowed in the facility unless identification is provided.
- E. Any missed time, cost and loss of construction schedule due to Contractor employees not being identified, shall be borne solely by the Contractor and the Contractor Time and Cost will not be adjusted.

1.11 Subcontractors

- A. The Contractor shall not employ any subcontractors against whom the Owner or the Engineer may have a reasonable objection.
- B. The name, addresses and experiences of the proposed project subcontractors shall be submitted with the Bid and also to the Engineer for the Engineer's review prior to any Work being performed by the subcontractor.

1.12 Working Hours

- A. Working hours for the Resident Project Representative (RPR) are an eight (8) hour period between the hours of 8:00 a.m. and 5:00 p.m., Monday through Friday. Any work beyond this time period is to be requested, *in writing*, at least seventy-two (72) hours in advance and paid for by the Contractor (in advance) within five (5) days of the additional work at the standard billing rate for the RPR times a multiplier of 1.50.
- B. Any work required on Saturday or Sunday shall be requested in writing <u>at least seventy-two (72) hours in advance</u>. All requests must be approved by the Engineer and Owner in advance. Under emergency conditions, a verbal request may be made with a follow-up written request. This additional RPR time shall be paid for by the Contractor (in advance) within five (5) days of the additional work at the standard billing rate for the RPR times a multiplier of 2.00.

1.13 Contractor's Superintendent

- A. The Contractor's Superintendent shall have a *minimum of ten (10) years of related* construction experience of the nature required by this Construction Project and shall be <u>English-speaking</u>. The Contractor shall submit the résumé of the superintendent to Engineer for approval prior to the Preconstruction Meeting.
- B. The Contractor shall have a *superintendent on-site at all times* Work is being performed by the Contractor or subcontractors at the Project Site. The Superintendent does not have to be on-site during the maintenance of the Contractor's equipment.

1.14 Operation of Existing Utilities

- A. Existing utilities (water, wastewater, reclaimed water, etc.) must remain operational during the construction of the Project Work.
- B. The Contractor shall coordinate all construction activities with the Owner and all applicable utilities.
- C. The Engineer and Owner shall be given a "written" seventy-two (72) hour notification regarding tie-ins to existing utilities as part of this Project. The Contractor shall conduct such activities in accordance with the Owner's requirements relating to the operation of utility systems.

1.15 Demolition

- A. Remove all materials and equipment from areas indicated for demolition. Seal abandoned lines that remain in place. Remove all existing unused wires.
- B. Dispose of all removed materials and unwanted equipment (as directed by the Owner) and dispose of them in a legal manner.
- C. Disconnect existing electrical services and controls to items being removed or relocated.

1.16 Damage

A. All damage to buildings, structures, pipes, ducts, equipment, fixtures, etc. shall be properly repaired by the Contractor, to the satisfaction of the Owner and Engineer, *at no additional cost to the Owner*.

1.17 Electrical Interlocks

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, the Contractor shall provide wiring diagrams and coordinate between the various subcontractors and suppliers so that proper wiring of the equipment involved is effected.

1.18 Disturbed Areas

- A. Restore all areas disturbed by construction to a condition at least equal to the preconstruction condition including, but not limited to, all landscaping, grassing, driveways, roads, fences, irrigation systems, traffic control devices, and other improvements.
- B. Maintain ingress and egress to the treatment facility site and all properties adjacent to the construction and minimize inconvenience to abutting property occupants.

1.19 Cutting and Patching

- A. Cutting and patching for inspection and testing and the payment therefor shall be as specified in Section 00700, *General Conditions*, and Section 00800, *Supplementary Conditions*.
- B. The Contractor shall, at no additional expense to the Owner, perform cutting and patching necessary to the completion of the Project. The Contractor shall perform cutting and patching in a manner to prevent damage to the structure or previously completed work.
- C. The Contractor shall refinish all surfaces as necessary to provide an even finish. Refinish continuous surfaces to the nearest intersection.

1.20 Owner Furnished Products

A. The Owner shall exercise his right, as a tax-exempt entity, to recover sales tax in accordance with Article 1.37 of Section 00100, *Instructions to Bidders*, Article 1.04 of Section 00300, *Bid Form* and State Law.

- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01019 CONTRACT CASH ALLOWANCES

1. GENERAL

1.01 Description

- A. This Section discusses the contract cash allowances for the following items:
 - 1. Treatment System compliance monitoring equipment.
 - 2. Computer hardware, software, printers, scanners, etc.
 - 3. Project building permit and miscellaneous equipment and materials.
- B. The Contract Cash Allowance funds are owned by and are, property of, the City of Flagler Beach and may or may not be used during the construction of the proposed improvements.
- 1.02 Cash Allowance for the Operating and Compliance Monitoring Equipment, Computer Hardware/Software, Building Permit and Miscellaneous Equipment and Materials
 - A. Costs included in the Allowance
 - 1. Direct costs to the Contractor for:
 - a. The purchase of "new" treatment system operational and compliance monitoring equipment, computer hardware/software, printers, laboratory glassware/equipment, refrigerators, the project building permit, cleaning and maintenance and cleaning items, and other miscellaneous equipment, materials and ancillaries required for completion, implementation and optimization of Flagler Beach WWTF Sludge Management System Improvements requested by the Owner or Engineer.
 - b. Delivery of the aforementioned materials/equipment to the Project Site.

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- c. Installation of the equipment, materials, etc., as required, when directed by the Engineer.
- All costs directly or indirectly related to the costs outlined in Article 1.02(A)(1) above including taxes, overhead, profit, insurance, bonds, supervision and equipment rental provided such costs are identified and approved by the Owner and Engineer prior to the start of the Work.
- 3. Cost of Shop Drawings, product data, and procedure description submission to the Engineer for approval, as necessary.
- B. Compliance Monitoring and Miscellaneous Equipment and Materials Cash Allowance
 - 1. Included on the Bid form, as Item No. 7, is the sum of \$100,000 for the purchase of the items identified above in Article 1.02(A)(1) Flagler Beach WWTF Sludge Management System Improvements as requested and approved by the Owner and Engineer.

1.03 Payment

- A. Upon receipt of approved invoice from the Engineer submit an electronic copy (PDF) of the equipment manufacturer's invoice with the next application for payment.
- B. The City of Flagler Beach, Florida, is exempt from State and local sales taxes. The Contractor is responsible for reviewing the pertinent State statutes involving sales tax and complying with all requirements.
- C. Pay the invoice within ten (10) calendar days of receipt of payment from the Owner.
- D. Any of the miscellaneous cash allowance funds not spent during the course of the project shall be <u>deducted</u> from the Contractor's final application for payment via a Project "Close-out" Change Order.
- 1. PRODUCTS NOT USED
- 2. EXECUTION NOT USED

END OF SECTION

February 2024 Contract Cash Allowances

SECTION 01025 MEASUREMENT AND PAYMENT

1. GENERAL

1.01 Payment

- A. Payment for all work done in compliance with the Contract Documents, inclusive of furnishing all labor, equipment, materials, tools and performance of all operations relative to construction of this Project, will be made on a lump sum basis for the quantity of work installed as outlined on the Bid Form (Section 00300) and under the Pay Items listed herein. Work for which there is not a Pay Item will be considered incidental to the Contract, and no additional compensation will be allowed.
- B. The Total Base Bid Amount for the Work is intended to establish a total price for completing the Work in its entirety.
- C. Additions, deletions, modifications or changes to the Work, as defined by this Contract, will be performed by Change Order according to the General and Supplementary Conditions and will be paid for on the basis of the Cost of the Work.

1.02 General

A. The Owner reserves the right to alter the Contract Drawings, modify incidental work, as may be necessary, and increase or decrease quantities of work to be performed to accord with such changes, including deduction or additions to the Scope of Work outlined in the Contract Documents. Changes in the work shall not be considered as a waiver of any conditions of the Contract nor invalidate any provisions thereof. Changes resulting in changes in the scope or quantities of Work or time or other conditions of work will be basis for consideration of a Change Order which is to be negotiated and executed before proceeding with the work. A supplemental agreement between the Contractor and the Owner will be required when such changes involve a net increase or decrease of more than twenty-five percent (25%) in the total contract amount. Work which has not been authorized by a written Change Order will not be subsequently considered for additional payment.

- B. Any items not shown or omitted that are required for a complete installation shall be furnished and installed by the Contractor at no additional cost to the Owner.
- C. Quantities necessary to complete the work, as shown on the Contract Drawings or as specified herein, shall govern over those shown on the Bid Form.
- D. The Engineer will make measurements and determinations as necessary to classify the Work within Pay Items and determine the quantities for pay purposes. Such decisions shall be final after three calendar (3) days if the Contractor does not submit a written notice as defined below.

"If the Contractor differs with the Engineer's classification of the Pay Items or determination of quantities of the Pay Items, he must notify the Engineer, in writing, within three (3) calendar days of the time that the Contractor is informed of the Engineer's decision. Otherwise, the Owner will not consider any such difference as a claim for payment."

If the Owner or Engineer determines that the quantities for each respective Pay Item does not represent the work completed and accepted to date, the application for payment will be returned to the Contractor for revision. The Contractor may submit, in writing, an explanation to justify the quantities used in the application. The Contractor only needs to address the Pay Items not approved by the Owner or Engineer. Further review by the Owner and Engineer will determine the quantities allowed on the pay application.

- E. Work shall not be considered complete until all testing has been satisfactorily completed and the item of work has demonstrated compliance with Contract Drawings and Documents (specifications).
- F. A *preliminary* monthly application for payment shall be submitted to the Engineer for review *five (5) days prior to the submittal* for approval of the Contractor's monthly payment request.
- G. The quotations for the Work are intended to establish a total price cost for completing Work in its entirety.
- H. Thrust blocks or mechanical restraints are not separate pay items.
- I. No additional payment will be made for sheeting and shoring, well pointing or other methods of dewatering excavations.
- J. Payment for repair and replacement of existing utilities will be included in the "*lump sum*" or "*unit price*" Bid Amount for the related construction Bid Item.

- K. Payment for lump sum items shall be on a percentage of the completed and accepted work for a particular item, as determined by the Engineer.
- L. Failure on the part of the Contractor to construct any item to the plan or authorized dimensions within the specification tolerances shall result in: (1) Reconstruction to acceptable tolerances at no additional cost to the Owner; (2) Acceptance at "no pay"; or (3) Acceptance at a reduced final lump sum payment, all at the discretion of the Engineer.
- M. The Contractor shall take no advantage of any apparent error or omission in the Contract Drawings or Specifications, and the Engineer shall be permitted to make corrections and interpretations, as may be deemed, necessary for fulfillment of the intent of the Contract Documents. The Contractor shall verify the quantities in the field "prior" to ordering materials. The Owner and Engineer shall not be responsible for restocking fees resulting from the Contractor over-ordering materials or from ordering materials/equipment prior to Engineer "approved" shop drawings.
- N. The quantity for a payment item will be revised only in the event that it is determined to be substantially in error or if the City is attempting to recover sales tax on large ticket items. An error shall be deemed substantial if the quantity will increase or decrease in excess of five percent (5%) of the original quantity for that item or the amount due for that item will increase or decrease in excess of \$1,000 (whichever is smaller). In general, such revisions will be determined by final measurement or plan calculations or both as additions to or deduction from plan quantities specified within these Contract Documents.

O. Use of Procurement Cards - NOT USED

P. Taxes

- The City of Flagler Beach is exempt from state and local sales tax. The City of Flagler Beach, Florida, has the following tax exemption certificates assigned:
 - a. Certificate of Registry for tax-free transactions under Chapter 32, Internal Revenue Codes.
 - b. Florida Sales & Use Tax Exemption Certificate

Q. Sale Tax Recovery

1. The City reserves the right to delete items within the Solicitation and purchase said items directly from a supplier (Owner Direct Purchase) without further competition in an effort to benefit from the City's tax exempt status.

2. Sales Tax Recovery

- a. The Owner reserves the right to purchase materials associated with any project in order to recover sales tax in the exercise of its tax free status.
- b. The Owner shall exercise his right, as a tax-exempt entity, to recover sales tax in accordance with Article 1.37 of Section 00100, *Instructions to Bidders*, and State Law with respect to, but not limited to, the following equipment (not a complete list):

Division No.	Potential Owner Direct Purchase (ODP) Items
0 0:	Yard Piping
2 - Sitework	Sod and Irrigation System
2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Precast Concrete Structures
3 - Concrete	Cast-in-Place Concrete
4 - Masonry	Masonry/Reinforced Unit Masonry
	Metal Stairs and Walkways
5 - Metals	Handrails and Accessories
	Grating, Plates and Frames
0 W 1 1 D 1	Double-Wall Chemical Storage Tanks
6 - Wood and Plastics	Fiberglass Grating
11 – Equipment	Dewatering Screw Press
т – Ечиртоп	Chemical Feed Skids

Division No.	Potential Owner Direct Purchase (ODP) Items
	Process Instrumentation and Control Systems
13 - Special Construction	Control Panels
	SCADA System improvements
	PLC's
	Piping and accessories
15 - Mechanical	Valves and appurtenances
	Wires and Cables
	Raceways and Fittings
	Motors
	MCC's
16 - Electrical	Panelboards
	Fiber Optic systems
	Lighting Systems
	Grounding Systems
	Lightning protection systems

- 3. The Contractor shall be fully responsible for all matters relating to the receipt, protection and risk of loss of Owner Direct Purchase (ODP) Items the same as if such items were purchased by the Contractor. Direct purchase of materials by the City in no way relieves the Contractor of responsibility regarding the compliance with specification requirements, coordination, protection, scheduling, installation or warranty.
 - a. At a minimum, the Contractor shall verify correct quantities, condition of the items received, compliance of the shipment with the purchase order, verify documentation, coordinate and expedite delivery, obtain and verify warranties required by the Contract Documents, inspect and accept or refuse each item at the time of delivery, unload, handle and store the accepted item(s).
 - b. As Owner Direct Purchase Items are delivered to the job-site, the *Contractor* shall visually inspect, receive all shipments, verify and reconcile supplier's shipping documents and invoice with the purchase order.

- 1) The Contractor shall assure that each delivery of Owner Direct Purchase Items is accomplished by documentation adequate to identify the Purchase Order against which the purchase was made.
- 2) The Contractor will forward approve invoices to the City's Representative for payment.
- c. If the Contractor discovers defective or non-conforming items he/she shall promptly notify the Owner of the defect or nonconformity and assist the Owner to obtain repair or replacement of the item.
 - 1) The Contractor shall not be relieved of its obligation to ensure that materials requested for purchase have been reviewed by the Engineer and are released for purchase complying with the shop drawing and submittal procedures.
 - 2) The Contractor shall warrant Owner Direct Purchase Items and provide indemnification to the City as germane to all other materials and equipment furnished by the Contractor.
 - 3) Nothing in this Section shall alter or modify the Contractor obligations under the Contract relative to warranties and patent indemnification.
 - 4) The Contractor shall be liable for any interruption or delay in connection with Owner Direct Purchase Items.
- 4. The Contractor shall maintain records of all Owner Direct Purchase Items incorporated into the Work. These records shall be available for inspection by the Owner and Engineer upon request.

R. Partial Pay Request

- 1. The installation of pipe and fittings includes backfilling, compaction, hydrostatic testing, fine grading, property restoration, clean-up and placing facilities into operation.
- 2. When measurements of the amount of Work constructed each month are made, for the purpose of partial payment, these items will be considered.
- No less than five percent (5%) of the Contract Price shall be retained until the Record Drawings, Operational and Maintenance Manuals, and Shop Drawings are delivered and accepted by the Engineer.

S. Description of Pay Items

- 1. The description of Pay Items is presented in Part 2 of this specification section and is a brief summary of the Work to be accomplished for the Pay Items in the Bid Form and the way to measure for payment purposes.
- 2. Each Pay Item will include labor, installation, clean-up, testing, and placing into operation.
- 3. The summary is not intended to describe all items in detail, but to clarify the items on which the price is to be based.
- 4. The summary does not relieve the Contractor of his responsibility to supply all items complete, operational and fully functional.

T. Related Work Specified Elsewhere

1. Application and Certificate for Payment Form: Section 00680

2. General Conditions: Section 00700

3. Supplementary Conditions: Section 00800

4. FDEP Supplementary Conditions: Sections 00805 / 00806

5. Applications for Payment: Section 01030

6. Construction Progress Schedules: Section 01311

7. Schedule of Values Section 01370

8. Mobilization / Demobilization: Section 01510

2. DESCRIPTION OF PAYMENT ITEMS

2.01 Mobilization, Demobilization, Bonds, Insurance, Trailers, etc. (Bid Item No. 1)

A. <u>Description</u>

 The Work of this Measurement and Payment Item includes preparatory work and operations in mobilizing for beginning work on the Project, including, but not limited to, those operations necessary for the movement of personnel, equipment, supplies and incidentals to the Project site, construction photography, bonds, insurance, Contractor's site office/trailers, temporary facilities, obtaining of the necessary project permits, preparation for commencement of work onsite and upon completion of construction and miscellaneous general items necessary for completion of the project and final cleanup and demobilization as described on the Contract Drawings and in the Contract Documents.

B. Measurement

1. Unit of measure for this Bid Item shall be on a lump sum basis.

C. Basis of Payment

- 1. Payment for this item shall be split into two applications. The first, seventy-five percent (75%) of the Bid Item, shall be paid in the first application for payment following the completion of the project mobilization. The second, twenty-five percent (25%), shall be held until the final application for payment.
- 2. Payment for mobilization or any part thereof, shall not exceed three percent (3%) of the total contract price.

2.02 Survey, Layout and As-Built Information (Bid Item No. 2)

A. Description

1. The Work for this Measurement and Payment Item consists of furnishing all labor, equipment, and materials required to provide surveying, layout, and As-Built information, as required by the Contract Drawings and Contract Documents.

B. Measurement

1. Surveying, layout and As-Built information shall be paid for using the Contract Lump Sum Contract Amount.

C. Basis of Payment

 Surveying, layout and As-Built information will be paid for at the contract lump sum price, for work completed to include all work items in the description. Fifty percent (50%), of the Bid amount for this item shall be paid at the time of the initial survey and layout. 2. The remaining *fifty percent (50%) shall be paid upon the receipt and acceptance of the Contractor's As-Builts* for the completed project.

2.03 Preconstruction High-Definition (HD) Recording (Bid Item No. 3)

A. Description

 The work for this Measurement and Payment Item consists of furnishing all labor, equipment, and materials required for a preconstruction High Definition (HD) recording, for both on and off-site construction, as required by the Contract Documents.

B. Measurement

1. The Preconstruction HD recording shall be paid for on a lump sum basis.

C. Basis of Payment

1. The Preconstruction HD Recording will be paid for at the Contract Lump Sum Price, for a completed and Engineer/Owner accepted HD recording (BD/DVD).

2.04 3D High Definition Laser Survey (Bid Item No. 4)

A. Description

 The work for this Measurement and Payment Item consists of all labor, equipment, and materials required to conduct a 3D High-Definition Laser Survey of the "entire" Southwest Regional WRF following completion of the proposed project improvements and provide the Engineer and Owner with a hard-copy and digital version of the 3D high-definition laser survey.

B. Measurement

1. The unit of measurement for this item shall be at the Lump Sum amount.

C. Basis of Payment

1. The 3D High Definition Laser Survey will be paid for at the contract lump sum price, for a completed survey. The "pre-negotiated price for the work is \$16,000 (CPH, Inc.) and is included in the Total Base Bid Lump Sum Amount.

2.05 Project Cash Allowance (Bid Item No. 5)

A. Description

 The work for this Measurement and Payment Item consists of furnishing a project allowance for the Flagler Beach WWTF Sludge Management Systems Improvements Project.

B. Measurement

1. The unit of measurement for this item shall be at the Lump Sum amount.

C. Basis of Payment

 Payment for this item shall be based on approval of allowance use by the Owner for the project. An allowance of \$100,000.00 is included in the Total Base Bid Lump Sum Amount. Any monies not used for project allowance during the course of the construction project will be deducted from the Contractor's Contract Price via a Close-out Change Order. Payment will be based on the Contract Lump Sum Contract amount of \$100,000.

2.06 Lump Sum Price for Indemnification (Bid Item No. 6)

A. Description

1. The work for this pay item shall be for indemnification as specified in the General and/or Supplementary Conditions.

B. Measurement

1. The unit of measurement for this item shall be at the Lump Sum amount.

C. Basis of Payment

1. Payment will be based on the Contract Lump Sum Contract amount of \$1,000.

2.07 Sludge Dewatering System (Bid Item No. 7)

A. Description

- 1. The work for this Measurement and Payment Item consists of, but is not limited to, all earthwork, excavation, backfilling, compaction, grading, concrete work, metal work, installation of all equipment (screw presses, chemical feed systems, piping, fittings, valves, waterproofing systems, painting, testing, associated equipment, appurtenances and any miscellaneous items necessary for Project completion as shown on the Contract Drawings and described in the Contract Documents.
- 2. Screw Press is furnished by Owner.

B. Measurement

1. The unit of measurement for this item will be Lump Sum for work completed and accepted.

C. Basis of Payment

1. Payment will be based on the Contract Lump Sum Value for work properly installed, tested and accepted or a percentage thereof.

2.08 Electrical, Controls and Instrumentation Improvements (Bid Item No. 8)

A. <u>Description</u>

 Work under this Measurement and Payment Item consists of, but is not limited to, project electrical, controls and instrumentation improvements, facility lighting, power distribution and feeding, and other associated equipment/appurtenances associated with the improvements, necessary for Project completion as shown on the Contract Drawings and described in the Contract Documents.

B. Measurement

1. The unit of measurement for this item will be Lump Sum for work completed and accepted.

C. Basis of Payment

1. Payment will be based on the Contract Lump Sum Value for work properly installed, tested and accepted or a percentage thereof.

2.09 SCADA System Modifications (Bid Item No. 9)

A. Description

 Work under this Measurement and Payment Item consists of, but is not limited to, installation of a facility SCADA system and shall encompass all of the equipment being supplied and installed as part of this Project and shall be designed, supplied, connected and tested to ensure total integration, compatibility and functionality as identified on the Contract Drawings and as detailed in the Contract Documents.

B. Measurement

1. The unit of measurement for this item will be Lump Sum for work completed and accepted.

C. Basis of Payment

1. Payment will be based on the Contract Lump Sum Value for work properly installed, tested and accepted or a percentage thereof.

END OF SECTION

SECTION 01030 APPLICATIONS FOR PAYMENT

1. GENERAL

1.01 Description

A. Scope of Work

1. Submit Applications for Payment to the Engineer in accordance with the schedule established by the Conditions of the Contract and the Agreement between the Owner and the Contractor. The Contractor shall use the Application for Payment Form, included in Section 00680, *Application and Certificate for Payment Form*, as the official payment request form.

B. Related Work Specified Elsewhere

Specification Section	Title
00662	Contractor's Partial Release of Lien Form
00663	Contractor's Final Release of Lien Form
00664	Subcontractor's/Suppliers Final Release of Lien Form
00680	Application and Certificate for Payment Form
00805 / 00806	FDEP Supplementary Conditions
00807	Classification and Wage Determination (Davis Bacon Act)
00809	American Iron and Steel (AIS)
01025	Measurement and Payment
01311	Construction Progress Schedule
01370	Schedule of Values
01380	Construction Photographs
01700	Project Closeout
01720	Project Record Documents
01740	Warranties and Bonds
General and Supplementary	Conditions: Progress Payments, Retainage and Final Payment

C. Measurement and Payment - General Provisions

- 1. The Contractor shall receive and accept compensation provided for in the Bid and the Contract, in compliance with the Contract Documents, as full payment for furnishing all materials, labor, equipment, tools, appurtenances, accessories and incidentals, for performing all operations necessary to complete the Work under the Contract, and also in full payment for all loss or damages arising from the nature of the Work, or from the action of elements or from any unforeseen difficulties that may be encountered during the prosecution of the Work until Final Project Acceptance by the Owner.
- 2. The quotations for the Work are intended to establish a total price for completing the Work in its entirety.
- 3. Payment for all lump sum items shall be based on the percentage of completion of the particular item (actual work installed and accepted) until the work item is completed. Upon completion of the work item, one hundred percent (100%) of the lump sum price may be paid, less any retained amounts.
- 4. For unit price items, the Contractor shall be paid for the actual amount of work installed and accepted during the period of construction. After the Work is completed and before final payment is made, the Owner's Representative shall make final measurements to determine the actual quantities of the various items of work installed and accepted as the basis of final payment for the unit priced item, less any retained amounts.
- 5. Work for which there is not a Bid/Pay Item will be considered incidental to the Contract and no additional compensation will be allowed.
- Additions, deletions, modifications or changes to the Work, as defined in this Contract, will be performed by Change Order according to the General Conditions, as amended by the Supplementary Conditions, and will be paid for on the basis of the Cost of the Work.
- 7. Any items not shown or omitted from the Contract Documents that are required for a complete installation shall be furnished and installed by the Contractor at no additional cost to the Owner.
- 8. No additional payment shall be made for well pointing or other methods of dewatering.
- 9. Payment for repair and replacement of existing utilities will be included in the Lump Sum Bid Amount for the related new construction Bid item.

- 10. The approved Contract Schedule of Values shall be the basis for making monthly progress payments.
- 11. Payments for Work "in progress" shall not constitute acceptance of the Work component, the Work item, or the Bid Item.
- 12. Prior to submitting any Application for Payment, the Contractor's superintendent or other authorized representative of the Contractor shall meet with the Engineer's Resident Project Representative (RPR) and determine the quantities of unit price and/or lump sum price work accomplished and/or completed during the period for which the Application for Payment is being submitted.
- 13. A "preliminary" monthly application for payment (PDF) shall be submitted to the Engineer for review approximately five (5) days prior to the submittal for approval of the Contractor's monthly Application for Payment.
- 14. Payment to the Contractor will be made for the actual work completed and accepted in accordance with the Contract Documents.
- 15. No payment shall be made for materials delivered and not installed, unless specifically agreed upon by the Engineer and Owner *prior* to delivery of such materials.
- 16. The Contractor shall take no advantage of any apparent error or omission in the Contract Drawings or Specifications, and the Engineer shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.
- 17. The Owner and Engineer reserve the right to alter the Contract Drawings, modify incidental work as may be necessary, and increase or decrease quantities of work to be performed to accord with such changes, including deduction or cancellation of any one or more of the Pay Items in the Schedule of Values. Changes in the Work shall not be considered as a waiver of any conditions of the Contract nor invalidate any provisions thereof.
- 18. Failure on the part of the Contractor to construct any Project Item to plan or authorized dimensions within the specification tolerances shall result in reconstruction to acceptable tolerances at no additional cost to the Owner; acceptance at no pay; or, acceptance at reduced final pay quantity, all at the discretion of the Engineer.
- 19. Work shall not be considered complete (100%) until all testing has been satisfactorily completed and the item of work has demonstrated compliance with the Contract Drawings and Documents/Specifications.

1.02 Format Required

- A. Submit applications for payment on the form provided in Section 00680, *Contractor's Application for Payment Form*, in an electronic format (PDF), with itemized data typed on 8½-inch x 11-inch white paper continuation sheets. Provide itemized data on continuation sheets of format, schedules, line items, and values specified on the Application and Certificate for Payment Form.
- B. The Contractor shall use the item descriptions and contract values included in the Schedule of Values, approved and accepted by the Engineer, as a basis for preparation of the Application for Payment Form.

1.03 Preparation of Application for Each Progress Payment

A. Application Form

- 1. Fill in the required information, including that for any Change Orders executed prior to date of submittal of application.
- 2. Fill in the percentage (%) complete for each "*lump sum*" activity item and dollar values to agree with respective percentages. Fill in quantities installed, using the correct set of units, for each "*unit price*" activity item and use the Contractor's unit prices to determine the dollar amount to be paid for said activity item.
- 3. Execute certification of the Application for Payment with the signature of a responsible officer of the Contractor in accordance with the Project Contract Documents.

B. Continuation Sheets

- 1. Fill in the total list of all scheduled component items of the Work, with item number and scheduled dollar value for each item.
- 2. Fill in the dollar value in each column for each scheduled line item when the Work has been performed or products stored. Round off the values to the nearest dollar, or as specified for the Schedule of Values.
- 3. List each Change Order executed, prior to the date of submission, at the end of the continuation sheets. List by Change Order Number, and description, as for an original component item of the Work.
- 4. To receive approval for payment on component material stored on the project site, the Contractor shall submit copies of the "original invoices" with the Application for

Payment. Any materials stored on-site that are included in the payment request must be installed prior to the next pay request submitted.

- 5. As provided for in the Application Payment Form, the Contractor shall certify, for each current Application for Payment, that all previous progress payments received from the Owner, under this Contract, have been applied by the Contractor to discharge in full, all obligations of the Contractor in connection with the Work covered by prior Applications for Payment, and all materials and equipment incorporated into the Work are free and clear of all liens, claims, security interest, and encumbrances.
- 6. The Contractor shall attach to each Application for Payment like affidavits by all Subcontractors. The Contractor shall otherwise list the name and amount of any monies owed to subcontractors, suppliers, or equipment manufacturers, whose charges have been previously paid for by the Owner, on the appropriate area of the application form.
- 7. Applications for Payment, all associated documentation and certifications shall be submitted in accordance with Article 1.06 herein.

1.04 Substantiating Data for Progress Payments

- A. The Contractor shall submit suitable information, in an electronic format (PDF), with a cover letter identifying the following:
 - 1. Project Name.
 - 2. Application for Payment number and date.
 - 3. A detailed list of enclosures.
 - 4. For stored products
 - a. Item number and identification as shown on the application.
 - b. A description of the specific material.
 - c. A copy of the material invoice showing the actual amount paid by the Contractor for the stored item.
- B. Submit one (1) copy of data and a cover letter for each copy of application in an electronic format (PDF).

- C. The Contractor is to maintain an updated set of drawings to be used as Record Drawings in accordance with Section 01720, Project Record Documents. As a prerequisite for monthly progress payments, the Contractor is to exhibit the updated record drawings for review by the Owner and the Engineer. If the Project Record Documents are not up-to-date, the monthly progress payment will not be processed, by the Engineer, until the Contractor has updated, and the Engineer has approved, said documents.
- D. As a prerequisite for payment, each monthly application for payment shall incorporate, the corresponding "monthly progress status report" and updated construction schedule, prepared in accordance with the requirements of Section 01311, Construction Progress Schedules.
- E. As a prerequisite for payment, the Contractor shall submit a duly executed letter from it's Surety consenting to payment due and progress-to-date.
- F. As a prerequisite for payment, the Contractor shall submit, with the application for payment, construction photographs in accordance with Section 01380, "Construction Photographs". If the construction photographs are not submitted with the monthly Application for Payment, the monthly progress payment will not be processed, by the Engineer, until the Contractor has submitted, and the Engineer has approved, said construction photographs.
- G. As a prerequisite for payment, the Contractor shall submit, with the Application for Payment, copies of the weekly certified payroll in compliance with the Davis Bacon Act and with Appendix C of the FDEP Supplementary Conditions (Sections 00805 and 00806). If the certified payroll is not submitted with the monthly Application for Payment, the monthly progress payment will not be processed, by the Engineer, until the Contractor has submitted, and the Engineer has approved, said construction photographs.

1.05 Preparation of Application for Final Payment

- A. Fill in the application form as specified for progress payments. Provide the information as required by Section 00700, *General Conditions* and Section 01700, *Project Closeout*.
- B. Furnish evidence of completed operations and insurance in accordance with the General Conditions.
- C. Submit the Contractor's and Subcontractor/Supplier's Final Release of Lien Forms (Sections 00663 and 00664) and other close-out submittals as required by the General and Supplementary Conditions.

1.06 Submittal Procedure

- A. Submit Applications for Payment to the Engineer, in an electronic format (PDF), between the first (1st) and the tenth (10th) day after the end of each calendar month for which payment is requested as stipulated in the Agreement.
- B. Review the percentages complete (lump sum items) and/or unit quantities installed (unit price items), for each item of work, with the Engineer and resolve any conflicts or discrepancies.
- C. The Contractor shall submit the Application for Payment, and all supporting documentation, in an electronic format (PDF). These completed forms shall provide the basis upon which payment will be made to the Contractor.
- D. Processing of the monthly Application for Payment will not proceed if the electronic version of the Application for Payment or any other required documentation, is not provided to the Engineer.
- E. When the Engineer finds the Application and Certificate for Payment Form is properly completed and correct, he will execute the Certificate for Payment and transmit the forms to the Owner, with a copy to the Contractor.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01040 PROJECT COORDINATION

1. GENERAL

1.01 Work Included

- A. The Contractor shall furnish personnel and equipment that will be efficient, appropriate and large enough to secure a satisfactory quality of work and a rate of progress that will insure the completion of the Work within the time stipulated in the Agreement.
- B. If at any time, such personnel appear to the Engineer to be inefficient, inappropriate or insufficient for securing the quality of work aforementioned, he may order the Contractor to increase the efficiency, change the character or increase the personnel and equipment, and the Contractor shall conform to such order. Failure of the Engineer to give such an order shall in no way relieve the Contractor of his obligations to secure the quality of the Work and rate of progress.
- C. Several areas of construction under this Contract must be coordinated with the Engineer and Owner's Operating personnel and accomplished in a logical order to maintain the treatment level and capacity of the existing facility and to allow construction to be completed within the time allowed by the Contract Documents.
- D. During the construction of the Project Work and modification of existing facilities, incoming wastewater must continue to flow into Flagler Beach WWTF and be treated to meet FDEP Operations Permit requirements. Wastewater treatment, filtration, disinfection, reclaimed water production, biosolids management facilities, reject facilities and associated support facilities must remain in service at all times.
- E. When facilities are being upgraded or replaced, the new facilities shall be fully operational before the existing facilities are shutdown for modification, demolition, or decommissioning.
- F. The Contractor shall provide a detailed construction schedule in accordance with Section 01311, *Construction Progress Schedules*. The schedule shall incorporate the information in this section.

1.02 Private Land and other Public Properties

A. The Contractor shall not enter or occupy private or public land outside of the Flagler Beach WWTF facility, except with written permission of the appropriate owners. The Contractor shall provide the Owner with a copy of such written permission.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 Pipe Locations

- A. All pipes shall be located substantially as indicated on the Contract Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons.
- B. Where fittings are noted on the Contract Drawings, such notation is for the Contractor's convenience and does not relieve him from laying and jointing different or additional items where required.

3.02 Open Excavations

- A. All open excavations shall be adequately safeguarded, on a daily basis, by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons, and damage to property.
- B. *All open excavations shall comply with applicable OSHA Standards*. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings for accommodating travel by workmen, the Owner and the Engineer.

3.03 Test Pits

A. Test pits for the purpose of locating underground pipelines or structures in advance of the construction shall be excavated and backfilled by the Contractor. Test pits shall be backfilled and compacted immediately after their purpose has been satisfied and maintained in a manner satisfactory to the Engineer. *The costs for such test pits shall be borne by the Contractor.*

3.04 Care and Protection of Property

- A. The Contractor shall be responsible for the preservation of all public and private property, and shall use every precaution necessary to prevent damage thereto.
- B. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before the damage was done, or he shall make good the damage in another manner acceptable to the Engineer.

3.05 Cooperation within this Contract

- A. The Contractor shall, prior to interrupting a utility service (water, wastewater, effluent, reclaimed water, etc.) for the purpose of making tie-ins to the existing lines or for any other purposes, contact the Owner and Engineer and make arrangements for the interruption that will be satisfactory with the Owner and Engineer. Written notification shall be made at least seventy-two (72) hours prior to the interruption of the utility service. All tie-ins shall be made during "low-flow" periods.
- B. The Contractor shall sequence and schedule the work in a manner to preclude delays and conflicts between the work of various trades and contractors. Each trade shall keep informed as to the work of other trades on the project and shall execute their work in a manner that will not interfere with the work of other trades.
- C. The Contractor shall be fully responsible for the coordination of his work and the work of his employees, subcontractors, and suppliers with the Owner, and regulatory agencies, and assure compliance with schedules.
- D. The Contractor shall verify that the utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate the Work of various sections, having interdependent responsibilities for installing, connecting to, and placing into service, such equipment.
- E. Coordinate space requirements, supports and installation of mechanical and electrical Work which are indicated diagrammatically on the Contract Drawings. Follow the routing shown for pipes, ducts and conduit, as closely as practicable; place runs parallel with lines of the building/structure. Use spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.
- F. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. *Coordinate locations of fixtures and outlets with finish elements*.

G. General Scheduling Considerations

- 1. Coordinate scheduling, submittals, and Work of the various Sections of the specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- 2. The Contractor shall take the following items into consideration when creating the construction schedule required by Section 01311, *Construction Progress Schedules*:
 - a. The Contractor shall schedule the work so that the existing utilities can be maintained in operation at all times. The Contractor shall provide access to all existing facilities at all times during the construction period for operation and maintenance purposes.
 - b. The Contractor shall ensure that vehicular and pedestrian traffic will be maintained at all times, in accordance with Section 01550, Maintenance of Traffic, during installation of the Project improvements. Roadways throughout the facility and access roads shall be kept free of obstructions to facilitate deliveries and operations and maintenance activities.
 - c. The Owner's monitoring and instrumentation system at the Flagler Beach WWTF and shall remain operational at all times during construction and integration.
 - d. The Contractor shall generate and submit to the Engineer, for review and approval, a schedule identifying all process "tie-ins" that are to be made within thirty (30) days of the Notice to Proceed. The "tie-in" schedule shall be detailed and provide, at a minimum, the following:
 - 1) Detailed description of the tie-in.
 - 2) Location of the tie-in.
 - 3) Length of time required to complete the tie-in.
 - e. One (1) week prior to any tie-in, the Contractor shall meet with the Engineer and Owner to discuss the work to be completed during the "tie-in" process. The Contractor, Engineer and Owner shall review the "detailed" written schedule of the events to take place during the tie-in. The schedule will be discussed in detail and changes to the schedule shall be made as required. All tie-ins shall be organized and constructed to minimize disruption of operations at the treatment facility. All ancillary work, equipment, etc. required to complete the tie-in shall be included in the Contractor Bid.

- f. All raw wastewater, potable water and reclaimed water tie-ins will be performed during periods of low flow (10 p.m. to 5:30 a.m.).
- g. Coordinate with the activities of all utility companies with equipment in the construction area and with the Contractor's and/or subcontractor's work.
- h. Coordination with other ongoing construction activities on the Project Site. See Section 01010, Summary of Work, Article 1.09.

3.06 Cooperation with other Contracts - NOT USED

3.07 Diagrammatic Nature of Drawings

- A. Where layout of work is diagrammatic, such as pipelines, conduits, ductwork, etc., it shall be followed as closely as other work will permit. Changes from diagrams shall be made as required to conform to the construction requirements.
- B. Before running lines, carefully verify locations, depths and sizes and confirm that lines can be run as contemplated without interfering with other construction. Any deviation shall be referred to the Engineer for approval before lines are run. Minor changes in location of the equipment, fixtures, piping, etc., from those shown on the Contract Drawings, shall be made without extra charge if so directed by the Engineer before installation.
- C. Determine the locations and sizes of equipment, fixtures, conduit, ducts, openings, etc., in order that there will be no interference in the installation of the work or delay in the progress of other work. In the event that interferences develop, the Engineer's decision regarding relocation of work will be final.
- D. Any changes made necessary through failure to make proper arrangements to avoid interference **shall not** be considered as extras. Cooperate with those performing other work in preparation of interference drawings, to the extent that the location of piping, ductwork, etc., with respect to the installations of other trades shall be mutually agreed upon by those performing the work.

3.08 Provisions for Later Installation

A. Where any work cannot be installed as the construction is progressing, provide for boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the

- omitted work during later phases of construction. Arrange for chases, holes, and other openings in the masonry, concrete or other work and provide for subsequent closure after placing equipment.
- B. Arrangement for and closure of openings shall be subject to the approval of the Engineer and all costs therefor shall be included in the contract price for the work.

3.09 Protection of Construction and Equipment

- A. All newly constructed work shall be carefully protected from injury in any way. No wheeling or walking or placing of heavy loads on it shall be allowed and all portions damaged shall be reconstructed by the Contractor at his own expense.
- B. The Contractor shall protect all structures and shall be protected in a manner approved by the Engineer. Should any of the floors or other parts of the structures become heaved, cracked or otherwise damaged, all such damaged portions of the work shall be completely repaired and made good by the Contractor at his own expense and to the satisfaction of the Engineer and Owner. If, in the final inspection of the work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required.
- C. The Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein, for at least the guarantee period described in the contract.
- D. The Contractor shall take all necessary precautions to prevent damage to any structure due to water pressure during and after construction and until such structure is accepted and taken over by the Owner.

3.10 Maintenance of Traffic

- A. Unless permission to close a street or road within the treatment facility is received in writing from the proper authority (City, County, FDOT, etc.), all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer.
- B. Detours around construction will be subject to the approval of the Owner and the Engineer. Where detours are permitted, the Contractor shall provide all necessary

barricades and signs as required to divert the flow of traffic. While traffic is detoured, the Contractor shall expedite construction operations and periods when traffic is being detoured will be strictly controlled by the Owner. All maintenance of traffic plans required for construction shall be approved by the local governmental entity having jurisdiction.

C. The Contractor shall take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. The Contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

3.11 Miscellaneous

- A. The Contractor shall provide for the coordination of his Work with the required work of the Public Agencies and Utilities.
- B. Changes in the intended design of the Project as a result of improperly coordinated Construction Work will not be tolerated. Delays in the Work caused by rejections of installed materials due to improper coordination, and as otherwise specified, will not be considered valid justification for extensions of Contract Time.

END OF SECTION

SECTION 01045 CUTTING AND PATCHING

1. GENERAL

1.01 Description

A. Scope of Work

- The Contractor shall be responsible for all cutting, fitting, and patching, including attendant excavation and backfill, required to complete the Work, or to:
 - a. Make several parts fit together properly.
 - b. Uncover portions of the Work to provide for installation of ill-timed work.
 - c. Remove and replace defective work.
 - d. Remove and replace work not conforming to the requirements of the Contract Documents.
 - e. Remove samples of installed work as specified for testing.
 - f. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.
- 2. The Contractor shall coordinate, in a satisfactory manner, with the Engineer and in accordance with the Contract Drawings and Specifications all work of this nature.
- 3. The work must be done by competent workmen skilled in the trade required by the restoration.

B. Related Requirements Described Elsewhere

Specification Section	Title
00700	General Conditions
00800	Supplementary Conditions

Specification Section	Title
00805 / 00806	FDEP Supplementary Conditions
01010	Summary of Work
Division	Information
2	Sitework
3	Concrete

1.02 Submittals

- A. Submit a written request to the Engineer within ten (10) calendar days prior to executing any cutting or alteration that affects:
 - 1. Work of the Owner or any separate Contractor.
 - 2. Structural value or integrity of any element of the Project.
 - 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 4. Efficiency, operational life, maintenance or safety of operational systems.
 - 5. Visual qualities of sight-exposed elements.
- B. The written request shall include, but not be limited to, the following:
 - 1. Identification of the Project.
 - 2. Description of the Work.
 - 3. The necessity for cutting, alteration or excavation.
 - 4. Effect on work of the Owner or any separate Contractor, or on structural or weatherproof integrity of the Project.
 - 5. <u>Description of the proposed work</u>
 - a. Scope of the cutting, patching, alteration or excavation.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of the refinishing to be done.

- 6. Alternatives to cutting and patching.
- 7. Cost proposal, when applicable.
- 8. Written permission of any separate Contractor whose work will be affected.
- C. Submit the written notice to the Engineer designating the date and the time that the Work will be uncovered and then completed.

2. PRODUCTS

2.01 Materials

A. Comply with the Contract Documents, specifications and standards for each specific product involved.

3. EXECUTION

3.01 Inspection

- A. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching. Reference is made to the requirements of Section 00800, Supplementary Conditions, Sections 00805 and 00806, FDEP Supplementary Conditions, the pre-existing condition survey, Section 01380, Construction Photographs, and Section 01390, Preconstruction Video Recording.
- B. After uncovering the Work, inspect conditions affecting installations of products, or performance of the Work.
- C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the Work until the Engineer has provided further instructions.

3.02 Preparation

A. Provide adequate temporary support as necessary to assure structural value or integrity of the affected portion(s) of the Work.

- B. Provide devices and methods to protect other portions of the Project from damage.
- C. Provide protection from elements for that portion of the Project that may be exposed by cutting and patching work, and maintain excavations free from water.

3.03 Performance

- A. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
- B. Execute excavating and backfilling by methods that will prevent settlement or damage to other work.
- C. Employ the original Installer or Fabricator to perform cutting and patching for:
 - 1. Weather-exposed or moisture resistant elements.
 - 2. Sight-exposed finished surfaces.
- D. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- E. Restore work that has been cut or removed; install new products to provide completed Work in accordance with the requirements of the Contract Documents.
- F. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- G. Refinish entire surfaces, as necessary, to provide an even finish to match adjacent finishes:
 - 1. For continuous surfaces, refinish to the nearest intersection.
 - 2. For an assembly, refinish the entire unit.

END OF SECTION

SECTION 01050 FIELD ENGINEERING

1. GENERAL

1.01 Description

A. Scope of Work

- 1. The Contractor shall provide and pay for all field engineering services for the **Project**, including, but not limited to, the following:
 - a. **Survey work** required in execution of the Work and completion of the Project Record Documents.
 - b. *Civil, structural, or other professional engineering services* specified or required to execute the Contractor's construction methods.
 - c. The method of field staking for the construction of the Work shall be at the option of the Contractor. The Owner has provided the engineering survey necessary to establish reference points which in his judgement are necessary to enable the Contractor to proceed with his work.
 - d. The accuracy of any method of staking shall be the responsibility of the Contractor. All engineering for vertical and horizontal control shall be the responsibility of the Contractor.
 - e. The Contractor shall be held responsible for the preservation of all stakes and marks. If any stakes or marks are carelessly or willfully disturbed by the Contractor, the Contractor shall not proceed with any work until he has established such points, marks, lines, and elevations as may be necessary for the prosecution of the Work.
 - f. The Contractor shall retain the services of a registered land surveyor licensed in the State of Florida to:
 - 1) Identify existing control points and property corner stakes indicated on the Contract Drawings, as required.

- 2) Verify all existing surface locations and all proposed building and structure corner locations, tank locations and equipment locations.
- 3) Maintain an accurate location of all buried piping and associated lines.
- 4) Maintain a survey during construction and for Record Drawing purposes.

B. Related Requirements Described Elsewhere

Specification Section	Title
00700	General Conditions
00800	Supplementary Conditions
00805 / 00806	FDEP Supplementary Conditions
01010	Summary of Work
01030	Applications for Payment
01720	Project Record Documents

1.02 Qualifications of the Surveyor or Engineer

- A. A qualified engineer or registered land surveyor, in the State of Florida, that shall be acceptable to the Owner and the Engineer.
- B. A registered professional engineer, if selected to provide services to the Contractor, shall be of the discipline required for the specific service on the Project, currently licensed in the State of Florida, and acceptable to the Owner and Engineer.
- C. The 3D high-definition final survey of the Flagler Beach WWTF, to be completed after the construction of all project improvements, shall be conducted by the current surveyor of record for the project and treatment facility, CPH, LLC, no equal. The cost for the 3D survey shall be included in the Contractor's Bid price.

1.03 Survey Reference Points

A. Existing basic horizontal and vertical control points for the Project are those designated on the Contract Drawings.

- B. The Contractor shall locate and protect control points prior to starting site work, and preserve all permanent reference points during construction. The Contractor shall:
 - 1. Make no changes or relocations without prior written notice to the Engineer.
 - 2. Report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - 3. The surveyor shall be required to replace Project control points which may be lost or destroyed at no additional cost to the Owner. Establish replacement control points based on the original survey control.

1.04 Project Survey Requirements

- A. The Contractor shall establish a minimum of two (2) permanent bench marks at each the Project construction site, referenced to data established by survey control points.
 - Record locations, with horizontal and vertical data, on the Project Record Documents.
 - 2. One of these should be on the east side of the project construction site; the other on the west side.
- B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:
 - 1. All improvements (on-site, off-site, rights-of way, etc.)
 - a. Stakes for grading, fill, and topsoil replacement.
 - b. Utility piping slopes, invert elevations, fitting locations and elevations, manhole locations and elevations. etc.
 - c. Final site elevations.
 - d. Stormwater structures.
 - e. Locator balls, if used.
 - 2. Batter boards for structures.
 - 3. Building foundations, column locations, and floor elevations.

- 4. Controlling lines and levels required for mechanical and electrical trades.
- C. On a monthly basis, verify layouts by the same methods.
- D. Establish all lines and grades prior to construction of line work for all force mains, potable water mains, wastewater/process mains, reclaimed water mains and transmission and distribution mains at 50-foot intervals and at defined breaks in grade.

1.05 Project Records

- A. Maintain a complete and accurate log of all control and survey work as it progresses.
- B. Update the Project Record Drawings, on a monthly basis, based on the work performed during the month ending with the Contractor's Application for Payment as a condition for approval of monthly progress payment requests.
- C. At the end of the project, submit a certified site survey, at scales to be approved by the Engineer (overall view at 1-inch = 40 feet; individual process diagrams at 1-inch equals 20 feet), on reproducible tracing sheets 22 inches by 34 inches, indicating the building corners and location of all structures and road intersections, horizontal and vertical location of all piping, valves, fittings existing utilities encountered, equipment and appurtenances, locator balls, etc. in accordance with the Engineer's instructions. The Contractor shall also submit the survey and other certified surveying record documents to the Engineer, in AutoCAD (latest version), on a CD/DVD/BD or flash drive.
- D. Project Records shall conform to Section 01720, *Project Record Documents*.

1.06 Submittals

- A. Submit the name, address, telephone number, and e-mail address of the registered surveyor and/or professional engineer to be used by the Contractor on the Project to the Engineer in accordance with Section 01300, *Shop Drawings, Submittals and Samples*.
- B. On request of the Engineer, submit documentation to verify the accuracy of the field engineering work.
- C. Submit a certificate signed by the registered engineer or surveyor being used by the Contractor on the Project certifying that elevations and locations of improvements are in conformance with the Contract Documents, or if not in conformance, certify as to the variances from the Contract Documents.

- D. At the end of the project, and prior to final payment, submit certified drawings (signed and sealed by the registered land surveyor) and a CD/DVD containing all certified drawings in AutoCAD (latest version) of the items listed below. These drawings shall be included with, and made part of, the Project Record Documents:
 - 1. Certified site survey at 1-inch equals 40-foot scale or larger, but not greater than 1-inch equals 20-foot scale, on reproducible tracing sheet(s), that are 22-inch x 34-inch, indicating building corners, sidewalks, roadways, paved areas, existing utilities encountered and the location of all above ground structures within the facility or project site.
 - 2. **Certified drawings** showing the location, lines and grades of all lines 1-inch in diameter and larger, buried and exterior to buildings and other buried facilities (e.g., valves, fittings, tanks, vaults, etc.) installed as a result of the work. This shall be at the same scale as the Engineer's yard pipe drawing and submitted on reproducible paper.
 - 3. Certified survey at the same scale as the Engineer's line drawings (e.g., wastewater lines, force mains, potable water lines, reclaimed water lines, etc.) indicating lines, grades, elevations, and stationing at 50-foot intervals. Provide elevations of structure bottoms, pipe inverts, flow lines, rim elevations, etc. on all structures, manholes and vaults.
- E. Submit drawings showing locations of all structures, piping, valves, fittings, locator balls, etc., constructed. These drawings shall be included with the Project Record Documents.

1.07 3D High Definition Laser Survey: Post-Construction

- A. A 3D High-Definition Laser Survey of the entire Flagler Beach WWTF property shall be completed after the construction of all Project improvements at the facility.
- B. The 3D High-Definition Laser Survey shall be conducted by the current surveyor of record for the project and treatment facility, CPH, LLC, no equal. The fee for the 3D High-Definition Laser Survey has been negotiated with the "Surveyor of Record" in the amount of \$16,000 and has been included in the Total Base Bid Lump Sum Amount.
- C. The 3D Surveyor shall conduct a topographic survey as per Rule Chapter 5J-17 of the Florida Administrative Code in compliance with the minimum technical standards of surveying and mapping of the State of Florida using a high-definition laser scanner.

- D. The 3D Surveyor shall:
 - 1. Provide a topographic information survey of the scope area (see figure below).
 - 2. Locate all existing visible ground structures, buildings, manholes, other infrastructure and visible utilities within the scope area (see figure below).
 - 3. Provide a signed and sealed survey.
- 2. PRODUCTS (NOT USED)
- 3. EXECUTION (NOT USED)

END OF SECTION

SECTION 01060 REGULATORY REQUIREMENTS

1. GENERAL

1.01 Description

- A. Work Specified Herein
 - 1. Regulatory requirements.

B. Related Work Specified Elsewhere:

Specification Section	Title
00700	General Conditions
00800	Supplementary Conditions
00805 / 00806	FDEP Supplementary Conditions
01065	Permits and Fees

1.02 Requirements of Regulatory Agencies

- A. All piping installed within the right-of-way of any City, County, State, or Federal Highway or railroad shall be in accordance with a permit to construct issued by the controlling agency and obtained by the Owner. In no case shall an open trench be constructed within a railroad right-of-way unless otherwise indicated.
- B. Whenever the Contract Drawings and/or Specifications conflict with the requirements of the permit, then the requirements of the permit shall govern and the cost of abiding by the provisions of the permit shall be considered incidental to the Contract.

- C. All electrical apparatus and wiring pertaining to a piece of equipment or an appliance furnished and installed under this Contract shall comply with the National Electrical Code (NEC) and shall be listed by Underwriters Laboratories (UL) or bear the approval of a recognized Testing Laboratory approved by the Engineer.
- D. The Contractor shall follow all conditions and provisions of all applicable permits, applications, regulations, and approvals as a part of this project work.

END OF SECTION

SECTION 01065 PERMITS AND FEES

1. GENERAL

1.01 Description

- A. The work covered by this Section consists of furnishing all labor, materials, equipment and performing work required to comply with all conditions of the permits, where applicable, for this Project.
- B. The Contractor shall secure and pay for all permits and licenses related to his work, including but not limited to, the necessary construction permits, as provided for in Section 00700, General Conditions; Section 00800, Supplementary Conditions; and Sections 00805 and 00806, FDEP Supplementary Conditions; except as otherwise provided herein.
- C. The Contractor shall schedule all inspections and obtain all written approvals from all agencies required by the permits and licenses.
- D. If dewatering is required, the Contractor shall provide a Dewatering Plan to the Engineer that complies with the local water management district rules and regulations in a timely manner for review by the Engineer (14-day review period) and obtaining all required permits. If a permit is required for the dewatering operations, the Contractor shall be responsible for preparing, applying for, paying for, and obtaining said permit prior to construction activities.
- E. Permits regulating the construction of this Project are as follows:
 - 1. <u>Florida Department of Environmental Protection</u>: Domestic Wastewater Treatment Facility Construction and Operations Permit for the Flagler Beach WWTF (Permit No. FL0026611).

F. FDEP Clearance

1. The Contractor shall conform to the requirements of FDEP to obtain proper clearance of any completed Work prior to placing any portion of the Work into active public service.

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G. Local Permits

- 1. All required City of Flagler Beach local permits shall be applied for and obtained by the Contractor prior to commencement of the Work, and shall be in accordance with the approved site plan previously described.
- The application fees for these local permits shall be paid by the Contractor after the amounts are determined. The Contractor shall contact the City of Flagler Beach for tree removal, land clearing and demolition requirements, if necessary, and contact the City of Flagler Beach Building Department for a construction permit.
- H. It is the responsibility of the Contractor to ensure that all required permits are obtained before beginning construction activities associated with said permits.
- I. The Contractor shall review and become familiar with *all* permits for the Project, complete all conditions, attachments, exhibits, and permit modifications.
- J. A copy of all permits for the Project shall be maintained by the Contractor at the **Project sites**, and shall be available for review upon request.
- K. The Contractor shall be fully responsible to abide by all provisions and conditions of the permits. The Contractor is responsible for the selection, implementation and operation of all measures required by the permits, including the maintenance of said measures as necessary during construction. No additional compensation shall be allowed for any work associated with permit requirements.
- L. Violations of the permit conditions can potentially result in up to a maximum fine of \$25,000 levied against the Contractor per day, per violation. The costs and fines associated with permit violations shall be borne strictly by the Contractor and shall be incidental to the Contract.
- M. In addition, the Contractor shall be held responsible for any fines levied against the Owner as a result of these violations, as well as legal fees, engineering fees, administrative fees and restoration costs associated with these violations.

1.02 Submittals

A. The Contractor shall be responsible to submit to the Engineer, for review, various permit condition material, as applicable, within fourteen (14) calendar days after the Notice to Proceed.

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B.	The Contractor shall not submit permit condition information directly	to an
	agency prior to the review and concurrence of the Engineer and Owner.	

- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

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SECTION 01070 ABBREVIATIONS AND SYMBOLS

1. GENERAL

1.01 Standards and Abbreviations

A. Referenced Standards

- Any reference to published specifications or standards of any organization or association shall comply with the requirements of the specification or standard which is current on the date of the Advertisement for Bids. In case of a conflict between the referenced specifications or standards, the one having the more stringent requirements shall govern.
- 2. In case of a conflict between the referenced specifications or standards and the Contract Documents, the Contract Documents shall govern.

B. Abbreviations

- 1. In addition to the abbreviations listed in the General Conditions, the following is a list of abbreviations for standards and other terms referenced in the Contract Documents.
- 2. If an abbreviation is not explained below, it shall be as explained in ANSI Y1.1.

ABBREVIATION	TERM
Α	Ampere or Area
AA	Aluminum Association
AAA	American Arbitration Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials

ABBREVIATION	TERM
AB	Anchor Bolt / Aggregate Base
ABA	American Bar Association
ABAN	Abandoned
ABC	Asphalt Base Course
ABMA	American Boiler Manufacturers Association
ABPA	Acoustical and Board Products Association
ABT	About
AC	Acre / Asphaltic Concrete / Alternating Current / Air Conditioning
ACCU	Air Cooled Condensing Unit
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ACP	Asbestos-Cement Pipe
ACPA	American Concrete Pipe Association
ACU	Air Conditioning Unit
AD	Access Door
ADDL	Additional
AE	Architect - Engineer
AEIC	Association of Edison Illuminating Companies
AF	Air Filter / Ampere Frame
AFBMA	Anti-Friction Bearing Manufacturers Association
AGA	American Gas Association
AGC	Associated General Contractors of America
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHD	Ahead
AHU	Air Handling Unit
Al	The Asphalt Institute

ABBREVIATION	TERM
AIA	American Institute of Architects / American Insurance Association
AICS	Amperes Interrupting Capacity, Symmetrical
AIEE	American Institute of Electrical Engineers (now IEEE)
AIMA	Acoustical and Insulating Materials Association
AIR FIX	Compressed Air
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AL	Aluminum
ALIGN	Alignment
ALM	Alarm
ALTN	Alternate
AMB	Ambient
AMCA	Air Movement and Control Association
AMP	Ampere
ANCH	Anchor
ANG	Angle
ANSI	American National Standard Institute
APA	American Plywood Association
API	American Petroleum Institute
APPROX	Approximate
APWA	American Public Works Association
AR	Argon
ARCH	Architecture / Architectural
AR/CH ₂	Argon-Methane Mix
AREA	American Railway Engineering Association
ARI	American Conditioning and Refrigeration Institute

ABBREVIATION	TERM
ARV	Air Release Valve
ARVV	Air Release / Vacuum Valve
AS	Alum Solution
ASA	American Standards Association (now ANSI)
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASPH	Asphalt
ASSCBC	American Standard Safety Code for Building Construction
ASSY	Assembly
ASTM	American Society for Testing and Methods
ATS	Automatic Transfer Switch
AVE	Avenue
AVG	Average
AWA	American Welding Association
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPB	American Wood Preservers Bureau
AWPI	American Wood Preserver Institute
AWS	American Welding Society
AWWA	American Water Works Association
BaV	Ball Valve
ВВ	Back-to-Back
ВС	Beginning of Curve / Back of Curve / Bolt Circle

ABBREVIATION	TERM
BCR	Begin Curb Return
BCS	Building Contractor Standards (Florida Statutes)
BEG	Begin
BETW	Between
BF	Blind Flange
ВНМА	Builders Hardware Manufacturers Association
ВНР	Brake Horsepower
BIA	Brick Institute of America (formerly SCPI)
вк	Back / Brake
BKR	Breaker
BL	Base Line
BLDG	Building
BLK	Block
ВМ	Benchmark / Beam
BNR	Biological Nutrient Removal
ВО	Blowoff
ВОСА	Building Officials Code Administration International, Inc.
BOD	Biochemical Oxygen Demand
вот	Bottom
BP	Baseplate
BR	Bronze / Batch
BRG	Bearing
вт	Buried Telephone
BTN	Button
вти	British Thermal Unit
BUR CBL	Buried Cable
BV	Butterfly Valve

ABBREVIATION	TERM
BVC	Begin Vertical Curve
BW	Block Wall
С	Conduit / Celsius
C ₂ H ₂	Acetylene
CAB	Crushed Aggregate Base
CAGI	Compressed Air and Gas Institute
CANTIL	Cantilevered
CAP	Capacity
CATV	Cable Television
СВ	Catch Basin / Circuit Breaker
СС	Cooling Coil
C-C	Center-to-Center
ССВ	Concrete Block
ССР	Concrete Cylinder Pipe
ccs	Central Control Station
CD	Cross Drain / Condensate Drain / Ceiling Diffuser
CDA	Copper Development Association
CEM	Cement
CF	Cubic Feet / Curb Face
CFH	Cubic Feet per Hour
CFM	Cubic Feet per Minute
CFS	Cubic Feet per Second
CG	Ceiling Grill / Compressed Gas
C & G	Curb & Gutter
СН	Chiller
CHG	Change
CHKD PL	Checkered Plate

ABBREVIATION	TERM
CI	Cast Iron
CIP	Cast Iron Pipe
CISP	Cast Iron Soil Pipe
CISPI	Cast Iron Soil Pipe Institute
Cl	Construction Joint
CL	Centerline / Class / Clearance
CLR	Clear
CMAA	Crane Manufacturers Association of America
СМС	Cement Mortar Lined or Coating
CML	Cement Mortar Lined or Lining
CMLCSP	Cement Mortar Lined and Coated Steel Pipe
СМР	Corrugated Metal Pipe
СМРА	Corrugated Metal Pipe Arch
CMU	Concrete Masonry Unit
со	Cleanout / Conduit Only
COL	Column
СОММ	Communication
COMP	Composite
COMPL	Complete
CONC	Concrete
CONN	Connection
CONST	Construct or Construction
CONT	Continuous
CONTR	Contractor
COORD	Coordinate / Coordinated
СОР	Copper
COR	Corner

ABBREVIATION	TERM
CPLG	Coupling
CPU	Central Processing Unit
CRES	Corrosion Resistant Steel
CRSI	Concrete Reinforcing Steel Institute
cs	Commercial Standard / Carbon Steel / Chlorine Solution
CSP	Corrugated Steel Pipe
СТ	Center Top / Current Transformer
СТС	Coating
CTR	Center
CTV	Cable Television
CULV	Culvert
CV	Check Valve
CY	Cubic Yards
CYL	Cylinder
D	Degree of Curvature
DB	Direct Buried / Decibel
DBL	Double
DC	Direct Current
DEPT	Department
DET	Detail / Detour
DF	Diesel Fuel
DG	Decomposed Granite
DHI	Door and Hardware Institute
DI	Drop Inlet / Ductile Iron
DIA	Diameter
DIAG	Diagonal
DIM	Dimension

ABBREVIATION	TERM
DIMJ	Ductile Iron Mechanical Joint
DIP	Ductile Iron Pipe
DIPRA	Ductile Iron Pipe Research Association
DISCH	Discharge
DIST	Distance
DIV	Divide / Division
DMH	Drop Manhole
DN	Down
DO	Dissolved Oxygen
DOT Spec	Std Specification For Road and Bridge Construction, latest edition
DP	Differential Pressure
DPI	Differential Pressure Indicator
DPNL	Distribution Panel
DR	Drain / Door
DSL	Diesel
DWG	Drawing
DWY	Driveway
E	East
EA	Each
EC	End of Curve
ECC	Eccentric
ECR	End of Curb Return
ED	Equipment Drain / External Distance
EDA	Economic Development Association
EDUC	Eductor
EE	Each End
EEI	Edison Electric Institute

ABBREVIATION	TERM
EF	Each Face / Exhaust Fan
EFF	Effluent / Efficiency
EFL	Effluent
EG	Exhaust Grill
EGL	Energy Grade Line
EL	Elevation / Each Layer
E/L	Easement Line
ELEC	Electrical
ELEV or EL	Elevation
ELP	Elliptical
EMB	Embankment
ENC	Encasement
ENCL	Enclosure
ENG	Engine
ENGR	Engineer
ЕОР	Edge of Pavement
EOS	Equivalent Opening Slze
EOTW	Edge of Traveled Way
EP	Explosion Proof / Edge of Pavement
EPA	Environmental Protection Agency
EQ	Equation
EQL	Equal
ESMT	Easement
EST	Estimate or Estimated
ETC	And so forth
ETM	Elapsed Time Meter
EVAP	Evaporator

ABBREVIATION	TERM
EVC	End Vertical Curve
EW	Each Way
EWC	Electric Water Cooler
EXC	Excavate or Excavation
EXP	Expansion
EXIST	Existing
EXP	Expansion
EXT	Extended / Exterior / Extension
F	Fahrenheit / Floor
FAA	Federal Aviation Administration
FAB	Fabricate
FBRBD	Fiberboard
FC	Foot-Candle
FCC	Federal Communications Commission / Filter Control Console
FCI	Fluid Control Institute
FCO	Floor Cleanout
FCV	Flow Control Valve
FD	Floor Drain
FDEP	Florida Department of Environmental Protection
FDN	Foundation
FDOT	Florida Department of Transportation
FDOT Index	FDOT Roadway and Traffic Design Standards, latest edition
FDOT Specification	FDOT Standard Specification for Road and Bridge Construction, Florida Department of Transportation, latest revision
FE	Filtered Effluent / Flanged End
Fed Spec	Federal Specification
FF	Finished Floor / Flat Faced
FG	Finished Grade

ABBREVIATION	TERM
FHY	Fire Hydrant
F&I	Furnish and Install
FIG	Figure
FIN	Final
FIT	Fitting
FL	Floor / Flow Line
FLEX	Flexible / Flexure
FLG	Flange
FLT	Float
FLUOR	Fluorescent
FM	Force Main (Wastewater) / Factory Mutual
FMH	Flexible Metal Hose
FNSH	Finish
FOC	Face of Concrete
FOS	Face of Stud
FPC	Flexible Pipe Coupling
FPM	Feet per Minute
FPS	Feet per Second
FPT	Female Pipe Thread
FS	Finished Surface / Floor Sink / Federal Standards / Florida Statutes
FSTNR	Fastener
FT	Feet or Foot
FTG	Footing
FUT	Future
FW	Finished Water
FWY	Freeway
G	Gas

ABBREVIATION	TERM
GA	Gauge
GAL	Gallon
GALV	Galvanized
GAS	Gasoline
GB	Grade Break
GDR	Guard Rail
GE	Grooved End
GEN	Generator
GENL	General
GFI	Ground Fault Interrupter
GM	Gas Main
GMT	Greenwich Mean Time
GND	Ground
GPD	Gallons per Day
GPM	Gallons per Minute
GR	Grade
GRTG	Grating
GS	Galvanized Steel
GSKT	Gasket
GSP	Galvanized Steel Pipe
GUT	Gutter
GV	Gate Valve
GWB	Gypsum Wall Board
GWBX	Gypsum Wall Board, Fire-Rated
GYP	Gypsum
н	Humidistat
H_2	Hydrogen

ABBREVIATION	TERM
HARN	Harness
НВ	Hose Bibb
НС	Heating Coil
HD	Heavy Duty
HDPE	High Density Polyethylene
He	Helium
HEPA	High Efficiency Particulate Air
HGL	Hydraulic Grade Line
HGT	Height
HID	High Intensity Discharge
НМІ	Hoist Manufacturers Institute
НОА	Hand-Off-Automatic
HOR	Hand-Off-Remote
HORIZ	Horizontal
НР	Horsepower / High Pressure
HPAC	High Pressure Air - Copper
HPAG	High Pressure Air - Galvanized
HPS	High Pressure Sodium
НРТ	High Point
HR	Hour / Handrail
нѕ	High Strength
HSBII	Hartford Steam Boiler Inspection and Insurance Co.
HTG	Heating
HTR	Heater
HV	Hose Valve
HVAC	Heating, Ventilating and Air Conditioning
HVY	Heavy

ABBREVIATION	TERM
HW	Headwall / Hot Water
HWL	High Water Level
HWY	Highway
HYDR	Hydraulic
HZ	Hertz (cycles per second)
I	Intersection Angle
ICBO	International Conference of Building Officials
ID	Inside Diameter or Identification
IE	Invert Elevation
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IN	Inches
INCAND	Incandescent
INCL	Include
INF or INFL	Influent
INL	Inlet
INS	Insulating
INSTL	Install or Installation
INTR	Interior / Intersection
INV	Invert
IP	Iron Pipe
IPCEA	Insulated Power Cable Engineers Association
IPS	Iron Pipe Size
IPT	Iron Pipe Thread
IRI	Industrial Risk Insurers
IRR	Irrigation

ABBREVIATION	TERM
ISA	Instrumentation, Systems and Automation Society
J	Joist / Joule
JB	Junction Box
JCT	Junction
JN	Join
JT	Joint
KG	Kilogram
KM	Kilometer
KIPS	Thousands of Pounds
KV	Kilovolt
KVA	Kilovolt-Ampere
KW	Kilowatt
KWH	Kilowatt-Hour
кwнм	Kilowatt-Hour Meter
L	Length of Curve / Long / Left
LATL	Lateral
LAV	Lavatory
LB	Pound
LBR	Lumber
LCL	Local
LF	Linear Feet
LG	Long
LI	Level Indicator
LLO	Long Leg Outstanding
LOC	Location / Locate
LOS	Lockout Stop
LP	Light Pole

ABBREVIATION	TERM
LPT	Low Point
LR	Long Radius
L/R	Slenderness Ratio
LS	Lime Solution / Lift Station / Lump Sum
LT	Left / Light
LTG	Lighting
LWC	Lightweight Concrete
LWIC	Lightweight Insulating Concrete
LWL	Low Water Level
MA	Milliampere
MAG	Magnet / Magnetic
MANF	Manufacturer
MATL	Material
MAX	Maximum
МВ	Machine Bolt / Megabyte / Millibar
МВН	Thousand BTU per Hour
MBR	Membrane Bioreactor
MC	Metal Channel
MCC	Motor Control Center
MCM	Thousand Circular Mils
МСР	Motor Circuit Protector
MD	Motorized Damper
MECH	Mechanical
MFR	Manufacturer
MG	Million Gallons
MGD	Million Gallons per Day
МН	Manhole

ABBREVIATION	TERM
МНІ	Materials Handling Institute
MHZ	Megahertz
MI	Malleable Iron / Mile
MIL	Military Specifications
MIN	Minimum
MISC	Miscellaneous
MJ	Mechanical Joint
ML	Mixed Liquor
MLSS	Mixed Liquor Suspended Solids
MLVSS	Mixed Liquor Volatile Suspended Solids
ММА	Monorail Manufacturers Association
МО	Motor Operator / Motor Operated / Masonry Opening
MOD	Modification
MON	Monument
МОТ	Motor / Maintenance of Traffic
MPT	Male Pipe Thread
MSL	Mean Sea Level
MSS	Manufacturer's Standardization Society
MTD	Mounted
MUTCD	Manual of Uniform Traffic Control Devices
N	North / Neutral / Nitrogen
N ₂	Nitrogen
N ₂ O	Nitrous Oxide
NA	Not Applicable
NAAMM	National Association of Architectural Metal Manufacturers
NBFU	National Board of Fire Underwriters
NBHA	National Builders' Hardware Association

ABBREVIATION	TERM
NBS	National Bureau of Standards
N & C	Nail & Cap
NC	Normally Closed
NCPI	National Clay Pipe Institute
NCSA	National Crushed Stone Association
NCSPA	National Corrugated Steel Pip Association
NE	Northeast
NEBB	National Environmental Balancing Bureau
NEC	National Electric Code
NECA	National Electrical Contractors' Association
NEMA	National Electrical Manufacturers' Association
NF	Nanofiltration
NFC	National Fire Code
NFPA	National Fire Protection Association
NG	Natural Grade
NIC	Not In Contract
NIP	Nipple
NLA	National Lime Association
NO	Number / Normally Open
NOM	Nominal
NPC	National Plumbing Code
NPT	National Pipe Threads / National Pipe Taper
NPW	Non-potable Water
NRS	Non-Rising Stem
NSC	National Safety Council
NSF	National Sanitation Foundation
NTS	Not to Scale

ABBREVIATION	TERM
NW	Northwest
NWL	Normal Water Level
OA	Overall / Outside Air
ос	On Center / Overcurrent
OD	Outside Diameter
ODP	Open Dripproof / Owner Direct Purchase
OE	Or Equal
OF	Outside Face
OHE	Overhead Electric
OPER	Operator
OPNG	Opening
OPP	Opposite
ORIG	Original
OSA	Outside Air
OSHA	Occupational Safety and Health Administration
0 TO 0	Out to Out
OVFL	Overflow
OVHD	Overhead
P	Pole
PARA	Paragraph
РВ	Push Button / Pull Box
PC	Point of Curvature / Programmable Controller
PCA	Portland Cement Association
PCC	Point of Compound Curvature / Portland Cement Concrete
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PE	Plain End / Polyethylene / Professional Engineer

ABBREVIATION	TERM
PEN	Penetration
PERF	Perforated
PF	Power Factor
PFMA	Power Fan Manufacturer's Association
PG	Pressure Gauge
PI	Point of Intersection
PJTN	Projection
PKWY	Parkway
PL	Plate / Property Line
PLATF	Platform
PLF	Pounds Per Lineal Foot
PNL	Panel
РОВ	Point of Beginning
POC	Point of Connection
POJ	Push-On Joint
PP	Power Pole / Polypropylene
РРВ	Parts Per Billion
PPM	Parts Per Million
PR	Pair
PRC	Point of Reverse Curvature
PRESS	Pressure
PRL	Parallel
PROP	Proposed
PROV	Provisions
PRPSD	Proposed
PRVC	Point of Reverse Vertical Curve
PS	United States Products Standards or Polymer Solution

ABBREVIATION	TERM
PSI	Pounds per Square Inch
PSIA	Pounds per Square Inch - Absolute
PSIG	Pounds per Square Inch - Gauge
PSF	Pounds Per Square Foot
PT	Pressure Treated / Point of Tangency
PV	Plug Valve
PVC	Polyvinyl Chloride
PVMT	Pavement
PW	Potable Water
PWR	Power
Q	Flow Rate
QTY	Quantity
R	Right / Radius
RAD	Radius / Radial
RAF	Return Air Fan
RAG	Return Air Grille
RAS	Return Activated Sludge
RC	Reinforced Concrete
RCB	Reinforced Concrete Box
RCP	Reinforced Concrete Pipe
RCPA	Reinforced Concrete Pipe Arch
RD	Road
RDC	Reduce
RDCR	Reducer
RDWY	Roadway
RED	Reducer
REF	Reference

ABBREVIATION	TERM
REINF	Reinforce / Reinforced
RELOC	Relocated
REQ	Required / Requirement
REQD	Required
REUSE	Reuse Water
REV	Revise / Revision
RF	Raised Face
RH	Relative Humidity
RND	Round
RJ	Restrained Joinit
RLG	Railing
RO	Reverse Osmosis
RPM	Revolutions per Minute
RR	Railroad
RST	Reinforced Steel
RT	Right
RTD	Resistance Temperature Detector
RW	Raw Water
R/W	Right-of-Way
RWM	Reclaimed Water Main
RWW	Raw Wastewater
S	South / Sewer / Slope in Feet Per Foot
SAE	Society of Automotive Engineers
SAN	Sanitary
SAR	Supply Air Register
SBC	Standard Building Code
SBCCI	Southern Building Code Congress International

ABBREVIATION	TERM
sc	Seal Coat
SCFM	Standard Cubic Feet per Minute
SCHED	Schedule
SCR	Silicon-Controlled Rectifier
SCRN	Screen
SCUM	Scum
SD	Storm Drain
SDG	Siding
SDI	Steel Deck Institute
SDWK	Sidewalk
SE	Southeast
SECT	Section
SEFF	Secondary Effluent
SF	Square Feet
SGL	Single
SH	Sheet / Shoring / Shielded
SIM	Similar
SJI	Steel Joists Institute
SJRWMD	St. Johns River Water management Project
SLP	Slope
SLV	Sleeve
SM	Sheet Metal
SMACNA	Sheet Metal and AC Contractor's National Association
sNdN	Simultaneous Nitrification/Denitrification
SOL	Solenoid
sov	Solenoid-Operated Valve
SP	Space / Steel Pipe / Static Pressure / Spare

ABBREVIATION	TERM
SPCG	Spacing
SPEC	Specification
SPLC	Splice
SPRT	Support
sq	Square
SQ FT	Square Foot
SR	Short Radius
SS	Stainless Steel
SSE	Substandard Effluent
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
SSPC	Structural Steel Painting Council
SST	Stainless Steel
ST	Street
STA	Station (100 ft)
STBY	Standby
STD	Standard
STK	Stake
STL	Steel
STN STL	Stainless Steel
STR	Straight
STR:	Structural
STRUCT	Structure
STS	Storm Sewer
STGR	Stringer
STWY	Stairway
SURF	Surface

ABBREVIATION	TERM
SW (S/W)	Southwest / Sidewalk
SWD	Side Water Depth
SWG	Swing
SY	Square Yard
SYMM	Symmetrical
SYS	System
Т	Ton / Tangent Length of Curve / Telephone
TAN	Tangent
T/B	Top of Beam
ТВ	Top of Bank / Terminal Board
T & B	Top and Bottom
TBG	Tubing
ТВМ	Temporary Bench Mark
TC	Top of Curb
TD	Time Delay
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
TEFC	Totally Enclosed Fan Cooled
TEFF	Tertiary Effluent
TEL	Telephone
TEMP	Temperature / Temporary
TENV	Totally Enclosed Non-Ventilated
тн	Total Head
ТНВ	Thrust Block
THD	Thread or Threaded
тнн	Thrust Harness
тнк	Thick

ABBREVIATION	TERM
TIR	Total Indicator Reading
то	Turnout
T/O	Top of
тос	Top of Concrete / Total Organic Carbon
TOF	Top of Floor
TOS	Top of Slab
тот	Total
TP	Telephone Pole / Total Phosphorus
TRA	Tread
TRD	Tie Rod Assembly
TRANS	Transformer
TS	Tube Steel
TV	Television
ТҮР	Typical
UBC	Uniform Building Code
UD	Underdrain
UE	Underground Electric
UG	Underground
UH	Unit Heater
UL	Underwriter's Laboratories, Inc,
ULT	Ultimate
UNO	Unless Noted Otherwise
UPS	Uninterruptible Power Supply
UR	Urinal
USASI	United States of America Standards Institute
USGS	United States Geological Survey
UT	Underground Telephone

ABBREVIATION	TERM
UTC	Underground Telephone Cable
UTR	Up Through Roof
V	Vent / Valve / Volt
VAC	Vacuum / Volts - Alternating Current
VC	Vertical Curve
VCP	Vitrified Clay Pipe
VEL	Velocity
VERT	Vertical
VFD	Variable Frequency Drive
VOL	Volume
VPC	Vertical Point of Curve
VPI	Vertical Point of Intersection
VPT	Vertical Point of Tangency
VSS	Volatile Suspended Solids
VTR	Vent Through Roof
W	Water Line / West / Watt / Wide / Water
W /	With
WAS	Waste Activated Sludge
wc	Water Closet
wco	Wall Cleanout
WG	Water Gauge
WH	Wall Hydrant
WL	Water Line
WLD	Welded
WM	Water Main / Water Meter
W/O	Without
WP	Waterproof/Working Point

ABBREVIATION	TERM
WRGWB	Water-Resistant Gypsum Wallboard
WSE	Water Surface Elevation
WSP	Water Stop
WT	Weight
WTR	Water
WWF	Welded Wire Fabric
wwm	Woven Wire Mesh
XFMR	Transformer
XFR	Transfer
YCO	Yard Cleanout
YD	Yard
YP	Yield Point
YR	Year
YS	Yield Strength

- C. Additional abbreviations and symbols are shown on the Contract Drawings. If an abbreviation or symbol is used that is not defined, inquire of the Engineer as to its meaning or intent.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION



SECTION 01075 REFERENCE SPECIFICATIONS

1. GENERAL

1.01 Description

A. Applicable Publications

- 1. Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes.
- 2. No requirements set forth herein or shown on the Contract Drawings shall be waived because of any provision of or omission from said standards or requirements.

B. Assignment of Specialists

- 1. In certain instances, a specification test requires (or implies) that specific work is to be assigned to specialist or expert entities who must be engaged for the performance of the Work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option.
- These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work. They are not intended to interfere with local union jurisdiction settlements and similar conventions.
- 3. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as an "expert" for the indicated construction processes or operations.
- 4. The final responsibility for fulfillment of the entire set of Contract requirements remains with the Contractor.

1.02 Reference Specifications, Codes and Standards

- A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of such referenced documents which are not in conflict with the requirements of these Specifications or applicable codes.
- B. References herein to "Building Code" shall mean the Florida Building Code (FBC). The latest edition of the code as approved and used by the local agency as of the date of award as adopted by the agency having jurisdiction shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, Contract Drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or labor. The Contractor shall bid the most stringent requirements.

D. Applicable Standard Specifications

- 1. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed.
- E. The Contractor shall ensure that the Work complies to all codes, standards and regulations as they apply to the Project whether or not specifically referenced elsewhere.
- F. In the absence of specified agencies, associations, councils, etc., the Contractor shall conform to the requirements of the most widely recognized standards for each particular portion of the Work.

1.03 FDOT Standards and Requirements

- A. The Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, latest English Units edition (Standard Specifications) and Roadway Traffic and Design Standards, latest English Units edition (Design Standards) are referenced herein as source documents for applicable technical specifications and construction details to be used in the construction of this Project.
- B. Where the FDOT Standard Specifications use the reference *Department*, replace *Department* with *Owner*, except for when such reference is to Department Standards and evaluation criteria.

- C. The Design Standards are referenced herein as a source document for applicable construction items and details called for in the Contract Documents for which a specific plan detail is not provided. The Contractor shall construct the items called for in the Contract Documents in accordance with the *Design Standards* unless otherwise defined or detailed in the plans or as directed by the Owner, Engineer or authorized representative.
- D. In case of conflict, all technical specification sections provided within the Project Manual (Divisions 2-16) take precedence over FDOT specifications for a particular construction requirement.
- E. Copies of the Florida Department of Transportation Standard Specifications are on file with the Plans and other Contract Documents at the Engineer's office. Copies of the Florida Department of Transportation Standard Specifications may be purchased from FDOT for a nominal charge. Copies are also available on the Internet at "www.dot.state.fl.us/specificationsoffice".
- F. The Contractor shall inform the Owner and Engineer in writing of any specification which the Contractor feels is ambiguous or conflicting with other Contract Drawings and details prior to the construction of the associated item. The Engineer will determine which information is to be used for construction. The Contractor is responsible for the removal and replacement of any item improperly constructed resulting from a misinterpretation of the specifications, at no additional cost to the Owner.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION



SECTION 01120 SPECIAL PROJECT PROCEDURES

1. GENERAL

1.01 Scope of Work

- A. The Work included in this Project, as described in the General Requirements, is to be turned over to the Owner upon final completion. As such, this section describes the special project procedures that must be followed to meet the concerns and special needs of the Owner.
- B. The Contractor shall follow these procedures and no specific pay item is provided for this. The cost for the labor, equipment, and materials associated with meeting these requirements, including requirements of Federal, State, and local agencies with jurisdiction over the work, is considered incidental to the contract. Therefore, the Contractor shall bear any costs associated with them.
- C. Failure to comply with these provisions shall be adequate grounds to withhold payment requests and issue a stop work order at no cost to the Owner.

1.02 Workmanship, Material and Equipment

- A. When a particular product is specified or called for, it is intended and shall be understood that the proposal tendered by the Contractor included those products in his Bid. Should the Contractor desire equal to those specified, the Contractor shall furnish information as described in the General Conditions, Supplementary Conditions and the Bid Form. The alternate product or products proposed and submitted by the Contractor shall meet the requirements of the specifications and shall, in all respects, be equal to the products specified by name herein.
- B. The Contractor shall refer to and review the following specification sections with respect to materials and equipment specified: Section 00100, *Instructions to Bidders*, Section 00300, *Bid Form*, and the individual equipment sections.
- C. All materials and manufactured articles for incorporation into the Work shall be the new and unused standard products of recognized reputable Manufacturers.

1.03 Responsibility of the Contractor

- A. The Contractor shall be responsible for all of the Project Work determined by the Contract Drawings, Technical Specifications and Contract/Agreement from the date of the starting of the Work (Notice to Proceed) until Final Project Acceptance (Completion Certificate) by the Owner. The Contractor shall be responsible for removals, renewals and replacements due to action of the elements and all other causes except as otherwise provided in the Specifications.
- B. The Contractor shall keep the Contract under his own control and it shall be his responsibility to see that the Work is properly supervised and carried on faithfully and efficiently. The Contractor shall supervise the work personally or shall have a competent, English speaking superintendent or representative, who shall be on the site of the project at all working hours, and who shall be clothed with full authority by the Contractor to direct the performance of the work and make arrangement for all necessary materials, equipment and labor without delay.
- C. Renewals or repairs necessitated because of defective materials or workmanship, or due to action of the elements or other natural causes, including fire and flood, prior to the acceptance as determined by the Completion Certificate, shall be done anew in accordance with the Contract and Specifications at the expense of the Contractor.

1.04 Services of the Manufacturer's Field Service Technician

- A. Bid prices for project equipment furnished under Divisions 5 through 16 shall include the cost of a competent field service technician of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. The approved manufacturer's operation and maintenance data as specified in Section 01730, Operation and Maintenance Data, shall be delivered to the Contractor prior to instructing the Owner's personnel. This supervision may be divided into two or more time periods as required by the installation program or as directed by the Engineer.
- B. After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, *the manufacturer's field service technician shall inspect, operate, test and adjust the equipment*. The inspection shall include at least the following points where applicable:
 - 1. Soundness (without cracked or otherwise damaged parts).
 - 2. Completeness in all details, as specified and required;
 - 3. Correctness of setting, alignment and relative arrangement of various parts.

- C. Upon completion of this work, the manufacturer's field service technician shall submit, in triplicate, to the Engineer a complete, signed report of the results of his/her inspection, operation, adjustments and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified and suggestions for precautions to be taken to ensure proper maintenance.
- D. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit shall be submitted prior to the startup and performance demonstration hereinafter specified. The certificate shall indicate date and time that the instruction was given and names of operating personnel in attendance. This certification shall be submitted on the certification sheet, a sample of which is presented at the end of this Section.
- E. The Contractor is referred to the detailed specification sections, Section 01430, *Manufacturer's Services*, Section 01600, *Materials and Equipment*, and Section 01650, *Systems Start-Up and Demonstration*, for additional requirements for furnishing the services of the manufacturer's field service technician.
- F. For equipment furnished under other Divisions, unless otherwise specified, furnish the services of accredited field services technicians of the manufacturer only when some evident malfunction or over-heating makes such services necessary in the opinion of the Engineer.

1.05 Operating and Maintenance Data

- A. Operating and maintenance data covering all equipment furnished under Divisions 5 through 16 shall be delivered directly to the Engineer: Benjamin M. Fries, Vice-President, CPH, LLC, 500 West Fulton Street, Sanford, FL 32771.
- B. Data shall be prepared and submitted in full conformance with Section 01300, *Shop Drawings, Submittals and Samples*, and Section 01730, *Operation and Maintenance Data*.
- C. Submissions of Project Operation and Maintenance Data shall be in accordance with Section 00980, O & M Manual Submittal Form.
- D. Final approved copies of Operation and Maintenance data shall have been delivered to the Engineer prior to scheduling the instruction period with the Owner.

1.06 FDOT and Rights-of-Way

- A. The Contractor shall strictly adhere to the requirements of FDOT, the City of Flagler Beach and Flagler County where construction work is in a right-of-way under the jurisdiction of the State of Florida, the City of Flagler Beach or Flagler County and shall abide by applicable local ordinances and rules that govern work performed in right-of-ways under the City's/County's jurisdiction.
- B. The Contractor shall take care to avoid any unreasonable traffic conflicts due to the work in road rights-of-way, and shall provide appropriate detour equipment, barricades, flagmen, and safety equipment to protect the public and direct the smooth flow of traffic around work areas. The Contractor is referred to the General and Supplementary Conditions and Section 01040, *Project Coordination*, for other traffic related requirements.

1.07 Notification of Work to Begin

- A. Before commencing work, the Contractor shall notify the Owner, in writing, at least ten (10) calendar days in advance of the date he proposes to commence such work.
- B. The Contractor shall provide at his own cost all necessary temporary facilities for access to, and for protection of, all existing structures. The Owner's personnel must have ready access at all times to existing work areas.
- C. The Contractor is responsible for all damage to existing structures, equipment, and facilities caused by his construction operations, and must repair all such damage when and as ordered by the Owner.

1.08 Installation of Equipment

A. Special care shall be taken to ensure proper alignment of all equipment with particular reference to mechanical equipment such as pumps, blowers and electric drives, etc. The units shall be carefully aligned on their foundations by qualified millwrights after their sole plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved by the manufacturer, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations and after confirmation of all alignments, the sole plates shall be finally grouted in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping, and under no circumstances, will "pipe springing" be allowed.

B. All wedges, shims, filling pieces, keys, packing, red on white lead grout, or other materials necessary to properly align, level and secure apparatus in place shall be furnished by the Contractor. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the Contractor.

1.09 Sleeves and Openings

- A. The Contractor shall provide all openings, channels, chases, etc. and install anchor bolts and other items to be embedded in concrete, as required to complete the Work under this Contract, together with those required by subcontractors and shall do all cutting and patching, except cutting and patching of materials of a specified trade and as stated otherwise in the following Article.
- B. The Contractor shall coordinate with the subcontractors to provide all sleeves, inserts, hangers, anchor bolts, etc. of the proper size and material for the execution of the Work. Be responsible for any corrective cutting and refinishing required to make the necessary openings, chases, etc. In no case shall beams, lintels or other structural members be cut without the written approval of the Engineer.

1.10 Relocations

A. The Contractor shall be responsible for the relocation of structures, including but not limited to, light poles, signs, sign poles, fences, piping, conduits and drains that interfere with the positioning of the Work as set out on the Contract Drawings. The cost of all such relocations shall be included in the Bid for the Project and shall not result in any additional cost to the Owner.

1.11 Obstructions

- A. The attention of the Contractor is drawn to the fact that during excavation at the Project site, the possibility exists of the Contractor encountering various water, chemical, electrical, or other lines not shown on the Contract Drawings.
- B. The Contractor shall exercise extreme care before and during excavation to locate and flag these lines so as to avoid damage to the existing lines. Should damage occur to an existing line, the Contractor shall repair the line *at no cost to the Owner*.

C. It is the responsibility of the Contractor to ensure that all utility or other poles, the stability of which may be endangered by the close proximity of excavation, are temporarily stayed in position while work proceeds in the vicinity of the pole and that the utility or other companies concerned be given reasonable advance notice of any such excavation by the Contractor.

1.12 Provisions for Control of Erosion

- A. Sufficient precautions in accordance with Section 01570, *Temporary Erosion and Sedimentation Control*, shall be taken during construction to minimize the run-off of polluting substances such as silt, clay, fuels, oils, bitumen, calcium chloride, sodium hypochlorite or other polluting materials harmful to humans, fish, or other life, into the supplies and surface waters of the State.
- B. Control measures must be adequate to assure compliance with federal, state, and local regulations and permit conditions. Special precautions shall be taken in the use of construction equipment to prevent operations that promote erosion.
- C. Erosion and sedimentation control shall conform to the requirements of the Owner, Lake County, St. Johns River Water Management District and the State of Florida.
- D. Submit background readings to the Engineer prior to the start of construction activities in any area.

1.13 Provisions for the Control of Dust

- A. Sufficient precautions shall be taken during construction to *minimize the amount of dust created*.
- B. Wetting down the site may be required or as directed by the Engineer to prevent dust as a result of vehicular traffic.
- C. The Contractor shall be referred to the requirements in these specifications, particularly Section 01560, "Environmental Protection".

1.14 Architectural Coatings

A. Maintain coordination among all Sections (windows, window walls, louvers, doors and frames, etc) requiring PVC and PVF coatings. All coatings shall match to the satisfaction of the Engineer with regard to color and texture. Items rejected by the Engineer shall promptly be removed from the job site.

1.15 "On-Site" Storage

- A. The Contractor's attention is directed to the special storage requirements and possible charges for "noncompliance" of "on-site" storage requirements for materials and equipment as specified in Section 01600, *Materials and Equipment*.
- B. All material delivered to the job site shall be properly protected from dirt, dust, dampness, UV, water and any other combination detrimental to the life of the materials from the date of delivery to the time that the material is installed and the Owner assumes beneficial occupancy (Final Project Acceptance by the Owner).

1.16 Tropical Storm / Hurricane Preparedness Plan

- A. Within fifteen (15) calendar days of the date of Notice to Proceed, the Contractor shall submit to the Engineer a Tropical Storm / Hurricane Preparedness Plan. The Plan should outline the necessary measures which the Contractor proposes to perform, at no additional cost to the Owner, in case of a tropical storm or hurricane warning. Such measures shall be in accordance with local and state requirements.
- B. In the event of inclement weather, the Contractor will, and will cause subcontractors to protect carefully the Work and materials against damage or injury from the weather.
- C. If, in the opinion of Engineer, any portion of Work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or subcontractors to so protect the Work, such Work and materials shall be removed and replaced at the expense of Contractor.

1.17 Valve Indices

- A. The Contractor shall furnish and install tags for all valves, weir gates and slide gates required on the Work. Tags for buried valves shall be in accordance with Article 2.01 (G) of Section 09905, Piping, Valve and Equipment Identification System.
- B. Submit to the Engineer for review, two (2) samples of each type of tag proposed and the manufacturer's standard color chart and letter styles. Tags shall have stamped or engraved on them the information shown on the Contract Drawings and the data described herein. Submit to the Engineer for approval, within sixty (60) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work. The schedule shall contain a list of abbreviations used for each valve, the location, type, a number, words or abbreviations to identify the valve's function and the normal operating position.

- C. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- D. The information contained in the valve schedules shall be coded on the tags in a system provided by the Owner.
- E. Above ground valve tags shall be furnished with **stainless steel (Type 316) wire** for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.

1.18 Testing, Disinfection and Clearance

- A. It shall be the responsibility of the Contractor to perform all pressure tests, water main disinfection and preparation for subsequent bacteriological testing by the Contractor's designated laboratory (Owner approved). The Contractor shall review the Contract Documents for specific requirements for flushing, pressure tests and disinfection.
- B. Disinfection shall be performed in accordance with AWWA standards, FDEP and Florida Department of Health regulations and Section 15041, *Disinfection of Piping and Structures*. Disinfection is required for both new potable water facilities installed, and existing potable water facilities which are modified.
- C. *The Contractor shall follow the potable water main clearance* procedure described in the Florida Department of Environmental Protection's regulations.
- D. It shall be the responsibility of the Contractor to provide a "flushing plan" to the Owner and Engineer at the preconstruction conference. This plan shall clearly indicate the volumes to be flushed and the disposal methodology for the flush water. Further, it shall be the responsibility of the Contractor to obtain any permits associated with the flushing activity.
- E. Testing shall be in accordance with Section 15044, Pressure Testing of Piping.
- F. The Contractor shall be entirely responsible to coordinate and schedule the full diameter flushing activity and shall provide written notification to the Owner a minimum of forty-eight (48) hours prior to commencing the flushing activity. All temporary piping associated with the flushing shall be provided and installed by the Contractor.
- G. Clean, disinfect and bacteriologically test and clear in accordance with applicable Florida Department of Health and FDEP regulations all water supply facilities affected by this Project which shall come into contact with raw water, water being treated or treated water prior to placing the facility in operation. The above statement shall apply to both new water facilities installed and existing water facilities that are or may be modified.

- H. The cost of all disinfection work and bacteriological clearance tests shall be included in the Bid.
- I. The Contractor shall employ a disinfection method approved by the Engineer and Owner and shall fully satisfy the Owner that adequate disinfection has been achieved prior to placing a potable water facilities on-line.
- J. Neither the Owner nor the Engineer shall be held responsible for delays to the Contractor awaiting a "Letter of Clearance" or "Release for Use" from the Florida Department of Environmental Protection (FDEP) to operate either the "new" facilities (water, wastewater and reclaimed water).
- K. It shall be the responsibility of the Contractor to make provisions for the time to obtain these releases from FDEP when planning his construction progress schedule.

1.19 Connections to Existing Systems

- A. Perform all work necessary to locate, excavate and prepare for connections to the terminus of the existing systems (potable water, wastewater and reclaimed water) all as shown on the Contract Drawings, or where directed by the Engineer.
- B. The cost for this Work and for the actual connection of the existing mains (potable water, wastewater and reclaimed water) shall be included in the Bid for the Project and shall not result in any additional cost to the Owner.

1.20 Utility Crossings

- A. It is intended that wherever existing utilities such as gas, potable water, wastewater, reclaimed water, storm drain, chemical, electrical or other service lines must be crossed, deflection of the pipe within recommended limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Contract Drawings.
- B. However, when in the opinion of the Engineer, this procedure is not feasible, the Contractor may direct the use of fittings for a utility crossing as detailed on the Contract Drawings.

1.21 Watertightness

A. Special precautions shall be taken in the curing of concrete to reduce concrete cracking as called for in Section 03300, *Cast-in-Place Concrete*.

B. The procedure and manner in which any leaks are repaired must meet the approval of the Engineer.

1.22 Utilities Infrastructure Maintenance and Protection

- A. Existing utilities are shown in their approximate locations. Locate and protect all utilities whether shown on Contract Drawings or not.
- B. The Contractor shall contact other utility companies at least seven (7) days before starting construction so maintenance personnel can locate and protect facilities, if required by the utility company.
- C. Throughout the entire duration of the construction process and within the construction project boundaries, it shall be the responsibility of the Contractor to maintain the location of all active Owner utility service lines and all utility lines that are pressurized (whether presently owned or to be owned in the future by the Owner) by identifying, by preserving, and by protecting all valves (with their associated boxes and lids) and manholes. These locations must remain visible and accessible to the Owner's personnel.
- D. Protection shall be provided in the form of a four (4) inch PVC conduit with a minimum burial of four (4) feet and a minimum above-ground exposure of four (4) feet. The entire circumference of the top two (2) feet of the pipe shall be color coded using blue paint to indicate potable water, green paint to indicate wastewater, and purple paint to indicate reclaimed water.
- E. Protection shall be installed by the Contractor after the Notice to Proceed but prior to any work (including preliminary clearing and grubbing) being performed within the construction project limits. *Until the required protection is installed, the Contractor is strictly prohibited from performing any preliminary clearing or grubbing or excavating in areas that are adjacent to or include Owner's utilities.*
- F. Protection of utility lines that are to be removed and/or abandoned shall be removed only after the following conditions are met:
 - 1. The replacement line is in service and approved for operation by the Florida Department of Environmental Protection (FDEP) and the Engineer and accepted by the Owner.
 - 2. All service connections have been relocated from the utility line to be abandoned to the utility line that has been placed in active service, if any, with approvals from the Florida Department of Environmental Protection, the Engineer, and the Owner.
 - 3. The utility line to be taken out of service has been depressurized, if any.

- G. With respect to the utility lines that are to be the final utility lines in service at the completion of construction, the protection shall be removed by the Contractor only after the final site restoration (including final sodding and/or seeding and mulching of all disturbed areas) has been accepted by the Engineer.
- H. The Contractor shall be responsible for adjusting all manholes, valve boxes, lids, water meters, reclaimed water meters, and similar structures to match the final project finished grade, regardless of whether other utility work is performed.
- I. The Contractor shall be responsible for the relocation of structures, including but not limited to light and power poles, signs, sign poles, fences, piping, conduits (and wire), drains and other obstructions that interfere with the positioning of the work as set out in the Contract Drawings. The cost of all such relocations shall be included in the Contractor's Bid. The Contractor shall install any test pits required to identify potential points of interference.
- J. It shall be the responsibility of the Contractor to relocate or adjust all of the Owner's utilities in accordance with the approved plans. Should a conflict arise between the relocated or existing utilities and the subsequent construction of the work as shown on the Contract Documents, it shall be the responsibility of the Contractor to relocate or adjust the utilities, providing the necessary piping, bends, tees, and fittings to resolve the conflict. Relocations of this nature shall be approved in advance of said work by both the Engineer and the Owner and shall be reflected on the "As-Built" drawings upon completion of the actual installation. The Contractor is to assume the cost of providing permanent or temporary utility work to resolve conflicts and is to bear all costs associated with the installation of various bends and fittings that are installed on new or existing water, wastewater and reclaimed water mains.
- K. It shall be the responsibility of the Contractor to provide all sheeting, bracing, shoring, and other forms of support when working adjacent to or directly on the Owner's utilities. This provision applies to both existing and proposed utilities that are presently or are to be owned by the Owner.

1.23 Warranties

- A. All equipment supplied under this Project Contract shall be warranted by the Contractor and the equipment manufacturers for a period of two (2) years, unless longer periods are identified in individual specification sections. The Warranty period shall commence on the date of Final Project Acceptance by the Owner.
- B. The Guarantee shall cover all necessary labor, equipment, materials, and replacement parts resulting from faulty or inadequate equipment design, improper assembly or erection, defective workmanship and materials, leakage, breakage or other failure of all equipment and components furnished by the manufacturer or the Contractor.

- C. The Contractor shall be responsible for obtaining certificates for equipment warranties for all major equipment specified under Division 11, *Equipment*; Division 13, *Special Construction*; Division 15, *Mechanical*; and Division 16, *Electrical*; and which has at least a 1.0 hp motor or which lists for more than \$1,000.
- D. The Engineer reserves the right to request warranties for equipment not classified as major. The Contractor shall still warrant equipment not considered to be "major" in the Contractor's *two-year warranty period* even though certificates of warranty may not be required (commencing at the time of Final Project Acceptance by the Owner).
- E. The Owner shall incur no labor or equipment cost during the guarantee period.

1.24 Final Guarantee

- A. All work shall be guaranteed by the Contractor for a period of two (2) years, unless longer periods are specified in individual specification sections, commencing at the time of Final Project Acceptance of the work by the Owner.
- B. If, within the guarantee period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Engineer, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, promptly upon receipt of notice from the Owner and without expense to the Owner, do the following.
 - 1. Place in satisfactory condition all guaranteed work and correct all defects therein.
 - 2. Make good all damage to the site, buildings, structures, equipment or contents thereof, which, in the opinion of the Engineer, is the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the contract.
 - 3. Make good any work or material, or the equipment and contents of any buildings or structures on the Project Site disturbed in fulfilling any such guarantee.
- C. If the Contractor, after notice, fails within ten (10) calendar days to proceed to comply with the terms of this guarantee, the Owner may have the defects corrected, and the Contractor and his/her surety shall be liable for all expense incurred, provided, however, that in case of an emergency where, in the opinion of the Owner, delay would cause loss or damage, repairs may be started without notice being given to the Contractor and the Contractor shall pay the cost thereof.
- D. All special guarantees or warranties applicable to specific parts of the work, as may be stipulated in the Contract Documents, or other papers forming a part of this Contract

shall be subject to the terms of this paragraph during the first year of life of each such guarantee. All special guarantees and manufacturers' warranties shall be assembled by the Contractor and delivered to the Engineer, along with a summary list thereof, as specified in Section 01740, *Warranties & Bonds*, before the acceptance of the Work.

1.25 Archeological Finds

- A. Notwithstanding anything to the contrary herein, in the event any archeological artifacts within the Project are discovered during the course of the work, *the Owner shall have and retain all right, title, and interest to such artifacts* and shall have the further right, during the course of the Contract, to examine or cause to have examined, the site of the work for any such artifacts and to perform or have performed archeological excavations and all other related work to explore for, discover, recover and remove such artifacts from the site of the work.
- B. In the event the work or archeological examination and related work delays the Contractor's work, he/she shall be entitled to an extension of time to complete the work equal to the number of days he/she is thus delayed. Such delay shall be considered an excusable delay as defined in Section 00800, *Supplementary Conditions*.

1.26 Electrical Devices and Voltage Ratings of Motors

- A. All motors, switches, controllers, panels, switchgear and other electrical devices shall be UL and/or CSA labeled and/or listed or shall be inspected and labeled in the field by an Owner approved certifying testing laboratory.
- B. Unless otherwise specified, motors in excess of A-horsepower shall be nameplate rated for 460 Volt, 3 Phase, 60 Hz current. Motors of A-horsepower or less shall be suitable for operation on 115 Volt, single phase, 60 Hz current.

1.27 Maintenance of Existing Utility Service and Existing Treatment Facility Operation

- A. Cooperate at all times with the Owner in order to maintain utility operations (water, wastewater, reclaimed water, stormwater, etc.) with the least amount of interference and interruption possible. Public health and safety considerations shall exceed all others and the Contractor's schedule, plan and work shall, at all times, be subject to alteration and revision if necessary for public health and safety considerations.
- B. Interruptions of the Owner's operations must be kept to a minimum of less than four (4) hours during low demand periods. However, no interruption of service to

the Owner's customers will be allowed. The Contractor is to assume that water, wastewater and reclaimed water mains being replaced or temporarily bypassed are the only means of servicing existing customers and that no alternative water source or backfeed or wastewater collection system is available.

- C. It is the responsibility of the Contractor to schedule all shutdowns, <u>at least seventy-two (72) hours in advance (Monday through Friday)</u>, in writing, with the Engineer and Owner. The Owner reserves the right to approve or disapprove said request.
- D. Should the Contractor create an unscheduled interruption of utility service, then the Contractor shall be directly responsible for performing the necessary repairs in order to restore service. In addition, the Contractor shall be billed for subsequent repair work performed by the Owner, and shall be held liable for any claims related to the service interruption.
- E. If the requested "System Shut Down" is approved by the Owner, then it shall be the responsibility of the Contractor to notify all affected customers that will experience a disruption in service, if any. Notification shall indicate the date and time limits of the interruption an must be provided to affected customers, *in writing*, *a minimum of forty-eight (48) hours in advance* while simultaneously providing two (2) duplicate copies of all said notifications to the Engineer. In lieu of written notification, the Contractor may opt to install signage in the affected area indicating the same information stated above.
- F. The Owner reserves the right to require the Contractor to perform utility "tie-ins" during periods of "low flow" conditions in order to minimize service disruptions. "Tie-ins" of this nature are typically required to begin no sooner than 10 p.m. and be completed no later than 5:30 a.m. "Tie-ins" of this nature that are required by the Owner shall be performed by the Contractor at no additional cost to the Owner.
- G. In no case will the Contractor be permitted to interfere with any existing service until all materials, supplies, equipment, tools and incidentals necessary to complete the Work are on the job site.
- H. The Contractor shall perform all work necessary to locate, excavate and prepare for connections to the terminus of the existing systems (potable water, wastewater and reclaimed water) all as shown on the Contract Drawings, or where directed by the Engineer.
- 1. The cost for this Work and for the actual connection of the existing mains (potable water, wastewater and reclaimed water) shall be included in the Bid for the Project and shall not result in any additional cost to the Owner.

J. No interference with service shall be made until the Engineer approves the method and schedule for completing the work.

1.28 Equipment Data List

- A. Obtain, prepare and submit a complete, detailed listing of equipment and motor data for all electrical items furnished under this Contract. This listing shall be submitted on Equipment Data Sheets, a "sample" of which is at the end of this Section.
- B. Submit the Equipment Data List, at least thirty (30) calendar days prior to the start-up and performance demonstration hereinafter specified.
- C. Upon approval of the data sheets by the Engineer, the Contractor shall supply the appropriate number of each (number of items provided under the Contract), laminated in a heavy plastic with a non-metallic fastening system for attachment to each piece of equipment.

1.29 Protection Against Electrolysis

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resulting electrolysis.
- B. The insulating material shall be bituminous impregnated felt, heavy bituminous coatings, non-metallic separators or washers, or other approved materials.

1.30 Damage on Account of High Water

A. The Contractor shall be responsible for all damage done to his/her work by heavy rains or floods and he/she shall take all reasonable precautions to provide against damages by building such temporary dikes, channels, or shoring to carry off storm water as the nature of the work may require.

1.31 Tools

A. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation and maintenance of any equipment shall be furnished with the respective equipment.

1.32 Grease, Oil, Fuel, Electrical Power and Testing Equipment

- A. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. Electric power and all equipment and tools required for testing of equipment shall be furnished by the Contractor, the cost of which shall be included in the prices quoted in the Bid Form.
- B. The Owner shall be furnished with a two (2) year supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied under Divisions 11, *Equipment*; Division 13, *Special Construction*; Division 15, *Mechanical*; and Division 16, *Electrical*.

1.33 Emergency Phone Numbers and Accident Reports

- A. Emergency phone numbers (fire, medical, police) shall be posted at the Contractor's phone and its location known to all.
- B. Accidents shall be reported immediately to the Engineer, Owner and appropriate authorities by messenger or phone.
- C. All accidents shall be documented and a fully detailed written report submitted to the Engineer after each accident. The Contractor shall use the reporting form presented in Section 00852, *Construction Accident Report Form*.

1.34 Construction Conditions and Subsurface Investigation

- A. The Contractor shall strictly adhere to the specific requirements of the governmental unit(s) or agency(ies) having jurisdiction over the Work. Wherever there is a difference in the requirements of a jurisdictional body and these Specifications, the more stringent shall apply.
- B. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his Bid, the nature and location of the Work, the conformation of the ground, the character and quality of the substrata, the types and quantity of materials to be encountered, the nature of the groundwater conditions, the character of equipment and facilities needed preliminary to and during the prosecution of the Work, the general and local conditions and all other matters which can in any way affect the Work under this Contract. The prices established for the Work to be done will reflect all costs pertaining to the Work. Any claims for extras based on substrata, groundwater table, and other such conditions will not be allowed.

- C. From investigations, including surveys made at the site, it is assumed that physical conditions are approximately as indicated on the Contract Drawings, but the nature of the materials below the surface, the depth to satisfactory foundations, or the stability of beds or banks, are not guaranteed.
- D. Certain information regarding the reputed presence, size, character and location of existing underground structures, pipes and conduits has been shown on the Contract Drawings. There is no certainty of the accuracy of this information, and the location of underground structures shown may be inaccurate and other obstructions than those shown may be encountered. The Contractor hereby distinctly agrees that the Owner and Engineer are not responsible for the correctness or sufficiency of the information given; that in no event is this information to be considered as a part of the Contract; and that he shall have no claim for delay or extra compensation on account of incorrectness of information regarding obstructions either revealed or not revealed by the Contract Drawings; and that he shall have no claim for relief from any obligation or responsibility under this Contract in case the location, size, or character of any pipe or other underground structure is not as indicated on the Contract Drawings, or in case any pipe or other underground structure is encountered that is not shown on the Contract Drawings, as determined by the Owner and/or Engineer.
- E. Subsurface Investigation Data NOT USED

1.35 Public Nuisance

- A. The Contractor shall not create a public nuisance including, but not limited to, the following:
 - 1. Encroachment on adjacent lands.
 - 2. Flooding or pollution of adjacent lands.
 - Excessive noise.
- B. Sound levels measured by the Engineer shall not exceed 45 dBA from 7:00 p.m. to 7:00 a.m. or 50 dBA from 7:00 a.m. to 7:00 p.m. This sound level shall be measured at the Owner's property line.
- C. Levels at the equipment shall not exceed 50 dBA at any time. Sound levels in excess of these values are sufficient cause to have the Work halted until equipment sound levels are in compliance with this Section.

- D. Work stoppage by the Engineer, Owner, or the local governmental agency for excessive noise shall not relieve the Contractor for any delays of other portions of the Contract including, but not limited to, completion dates and Bid amounts. The work stoppage shall not be grounds for any claims by the Contractor.
- E. **No extra charge may be made** for time lost due to work stoppage resulting from the creation of a public nuisance or for temporary or permanent sound attenuation systems.
- F. **No claim shall be made** by the Contractor for lost time due to work stoppage resulting from the creation of a public nuisance by the Contractor.

G. Pollution control

- 1. For pollution control, use water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Comply with the governing regulations.
- 2. Take all necessary measures and means to provide dust, dirt, debris and paint abatement methods to prevent damage to surrounding residential properties, onsite structures and private property.
- 3. Clean "on-site" structures and improvements of all dust, dirt and debris caused by construction operations as directed by the Engineer. Clean or repair all "off-site" residential and private property as directed by the Engineer. Return all areas to the conditions existing prior to the commencement of the Project Work.

1.36 Suspension of Work Due to Weather

- A. During inclement weather, all work which might be damaged or rendered inferior by such weather conditions shall be suspended. *The decisions of the Engineer as to suspensions shall be "final"*.
- B. During suspension of the work from any cause, the work shall be suitably covered and protected so as to preserve it from injury by the weather; and, all rubbish, debris and surplus materials shall be removed and legally disposed of.
- C. The Contractor is referred to the General Conditions, Supplementary Conditions, FDEP Supplementary Conditions and Article 1.16, *Tropical Storm/Hurricane Preparedness Plan*, herein, for additional requirements.
- D. A certain amount of "bad weather" days are to be expected for work in this Project location, especially due to rain or high winds.

1.37 Permits

- A. Upon issuance of the Notice of Award (NOA), the Contractor shall immediately apply for all applicable permits not previously obtained by the Owner to do the work from the appropriate governmental agency or agencies.
- B. No work shall commence until all applicable permits have been obtained and copies delivered to the Engineer.
- C. The costs for obtaining all permits shall be borne by the Contractor. Existing permits are identified in Section 01065, *Permits and Fees*.

1.38 Pumping / Dewatering

- A. The Contractor, with his own equipment, shall do all pumping necessary to prevent flotation of any part of the structures during construction operations.
- B. The Contractor, with his own equipment, shall do all bypass pumping necessary to make tie-ins to structures, piping systems, etc.
- C. The Contractor shall, for the duration of the Contract and with his own equipment, pump out water that may seep or leak into manholes and other appurtenances. All construction shall be kept dry at all times. The extent of pumping required shall be determined by the Engineer.
- D. If dewatering is needed, a Dewatering Plan must be prepared and certified by a Registered Professional Engineer in the State of Florida and be submitted and approved by the Engineer and the local water management district prior to commencement of work. The Contractor shall, for the duration of the Contract and with his own equipment, pump out water that may seep or leak into the excavations or structures. Any permitted dewatering and compliance with dewatering regulations shall be the responsibility of the Contractor.
- E. The Contractor shall not be allowed to pump water off-site or to area wetlands.
- F. The Contractor shall meet all of the requirements specified in Section 02075, Dewatering and Drainage.
- G. No additional payment shall be made for pumping or other difficulties encountered due to water.
- H. No additional payment shall be made for sheeting and shoring.

1.39 Easement for Work on Private Property

- A. The Owner will secure easements for the construction of the lines across private property as shown on the Contract Drawings, if any. The Owner will not secure additional easement for additional working room. Bidders should base their Bids upon these conditions.
- B. Work performed in such easements shall be subject to the provisions of the easement agreement on file and open to inspection in the office of the Owner.
- C. In general, these easement agreements provide for restoring the property to the condition existing before construction began.
- D. Any damage to private property outside of easement shall be repaired or restored at the Contractor's expense.

1.40 Project Cleaning

- A. The Contractor shall execute cleaning, during the progress of the Work and at the completion of the Work, as required by the General and Supplementary Conditions, Section 01710, *Cleaning*, Section 01800, *Miscellaneous Work and Cleanup*, and as indicated herein.
- B. Control of blowing litter caused by any regrading by the Contractor shall be the responsibility of the Contractor.

1.41 Discrepancies in the Contract Documents

- A. In accordance with the Instructions to Bidders, it was the responsibility of the Contractor to alert the Owner, in writing, within forty-eight (48) hours of discovery of any apparent discrepancies in the Bid Documents prior to submission of Bids so that any required addendums can be issued to address these concerns. Given circumstances where it can be shown that a Contractor is aware of discrepancies in the Bid Documents and fails to formally alert the Owner in writing prior to the Bid Opening, the Contractor shall not be permitted additional compensation to comply with the Owner and Utility Design Engineer's intended requirements of the Bid Documents.
- B. Should the discrepancy in the Bid documents be discovered by the Contractor after the Bid Opening, it shall be the responsibility of the Contractor to alert the Engineer in writing within forty-eight (48) hours of the discovery of the discrepancy so that it can be addressed promptly to minimize impact on the project schedule. Failure of the Contractor to follow procedure shall forfeit any and all possibility for the Contractor to

request additional time for the completion of construction. Further, failure of the Contractor to provide written notification of the discrepancy to the Engineer shall be regarded as an attempt by the Contractor to create an intentional delay in the construction and no additional compensation shall be allowed.

C. Items of material, equipment, machinery and the like may be specified on the Contract Drawings and not in the Contract Specifications. Such items shall be provided by the Contractor in accordance with the specification on the Contract Drawings.

1.42 Claims for Property Damages and Citizen's Complaints

- A. In the event of any indirect or direct damage to public or private property caused in whole or in part by an act, omission or negligence on the part of the Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable, the Contractor shall at his own expense and cost promptly remedy and restore such property to a condition equal to or better than that existing before such damage was done.
- B. The Contractor shall perform such restoration by underpinning, repairing, rebuilding, replanting, or otherwise restoring as may be required or directed by the Engineer or Owner, or shall make good such damage in a satisfactory and acceptable manner.
- C. In case of failure on the part of the Contractor to promptly restore such property or make good such damage, the Engineer or Owner may, upon five (5) calendar days written notice, proceed to repair, rebuild or otherwise restore such property as may be necessary and the cost thereof, or a sum sufficient in the judgement of the Engineer or Owner to reimburse the owners of the property so damaged, will be deducted from any monies due or to become due the Contractor under the Contract.
- D. The Contractor shall designate a responsible member of his organization at the site whose sole duty shall be the prevention and resolution of citizen complaints and the protection of material, equipment, and private property. This person shall be someone other than the Contractor's superintendent.

1.43 Jurisdictional Disputes

A. It shall be the responsibility of the Contractor to pay all costs that may be required to perform any of the Work shown on the Contract Drawings or specified herein in order to avoid any work stoppages and delays due to jurisdictional disputes.

B. The basis for subletting Work in question, if any, shall conform with precedent agreements and decisions on record with the Building and Construction Trades Department, AFL-CIO, dated June, 1973, including any amendments thereto.

1.44 Hauling and Construction Operations on Facility Property

- A. The Contractor shall conduct access, hauling, filling, and storage operations as specified herein and as shown on the Contract Drawings.
 - On-site borrow areas shall not be allowed. All borrow material required shall be provided by the Contractor from off-site locations with all costs associated with the material being borne by the Contractor.
 - 2. On-site spoil areas will become the property of the Contractor and removed from the site and legally disposed of by the Contractor at no additional cost to the Owner.
- B. Construct all fill areas so that runoff will not flood improved areas.

1.45 Start-up and Acceptance of the Facilities and Related Systems

A. General Requirements

- 1. Successfully execute the step-by-step procedure of Start-Up and performance demonstration specified hereinafter.
- 2. The Start-Up and performance demonstration shall be successfully executed prior to substantial completion and acceptance by the Owner.
- 3. All performance tests and inspections shall be scheduled, in writing, at least five (5) calendar days in advance or as otherwise specified with the Engineer and the Owner. All performance tests and inspections shall be conducted during the work week of Monday through Friday, unless otherwise specified.

B. Preparation for Start-Up

1. All mechanical and electrical equipment shall be checked to ensure that it is in good working order and properly connected. Preliminary run-ins of the various pumps, compressors, and other remaining equipment shall be made. All systems shall be purged as required. All sumps, tanks, basins, chambers, wet wells, and pipe lines

which are hydraulically checked shall be drained and returned to their original condition once the testing is complete.

- 2. All instruments and controls shall be calibrated through their full range. Any other adjustments required for proper operation of all instrumentation and control equipment shall be made.
- 3. Perform all other tasks needed for preparing and conditioning the treatment facilities for proper operation.
- 4. No testing or equipment operation shall take place until it has been verified by the Engineer that all specified safety equipment has been installed and is in good working order.
- 5. No testing or equipment operation shall take place until it has been verified by the Engineer that all lubricants, tools, maintenance equipment, spare parts, and approved equipment operation and maintenance manuals have been furnished as specified.

C. Start-up and Final Performance Demonstration

- 1. As soon after the satisfactory completion of the performance tests for the various system components, equipment, etc., make the appropriate connections and begin operation of the "new" facilities.
 - a. Demonstrate seven (7) consecutive, 24-hour days of successful operation of the "new" facilities and systems as a prerequisite of substantial completion and acceptance.
- 2. In the event of failure to demonstrate satisfactory performance of the treatment facilities and systems on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facilities and systems have operated continuously to the satisfaction of the Owner and Engineer, for the specified duration.
- 3. The Contractor will furnish all operating personnel (other than vendor's or subcontractor's service personnel), electricity, chemicals, water, etc., needed to operate equipment during the final performance test period.

- 4. Until the performance tests are completed and the units and systems are accepted by the Owner as "substantially complete", the Contractor shall be fully responsible for the operation and maintenance of all new facilities and systems.
- At no time during performance tests shall the Contractor allow the facilities and systems to be operated in a manner which subjects any equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.
- 6. Startup and the final performance demonstration test shall not begin until all new treatment facilities, systems and equipment have been tested as specified and are ready for operation.
- 7. The Owner shall receive spare parts, safety equipment, tools and maintenance equipment, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction at least five (5) calendar days prior to startup.
- 8. All valve tagging, as specified in the Contract Documents, shall also be complete prior to testing.

1.46 Delivery of Locator Ball Detector Devices

- A. The Contractor shall provide locator ball detector devices for all underground utilities, both new and relocated in accordance with Section 09905, *Piping*, *Valve and Equipment Identification System*, Article 2.01(E).
- B. The Contractor shall be responsible for providing the Owner with water, wastewater and reclaimed water marker balls and an electronic marker locator and probe package as part of the construction contract.
- C. All electronic marker locators and probes shall be delivered by the Contractor to the Owner through the Engineer no later than thirty (30) days after the Notice to Proceed is issued. Failure to comply with this provision shall be adequate grounds for Engineer to withhold payment requests and issue a stop work order at no cost to the Owner.
- D. In addition, the Owner shall not perform any field utility locates for the Contractor nor allow any subsurface excavation in the vicinity of existing Owner utilities until the locator ball devices are provided to the Owner and are determined to be fully functional and acceptable.

1.47 Demolition, Salvage and Disposal

- A. The Contractor shall exercise the appropriate care necessary to remove and stockpile all existing utilities of the Owner (including, but not limited to, all piping, bends, valves, tees, fittings, hydrants, and appurtenances) in such a manner as to preserve the materials for future use.
- B. Salvaged materials, that the Owner wishes to keep, shall be removed and stock piled, hauled, unloaded and stored at the direction of the Owner in an orderly manner by the Contractor at a location to be provided by the Owner. Those that the Owner does not want, shall be removed from the Project Site and legally disposed of by the Contractor. The Contract shall be inclusive of all costs associated with the item description provided above.
- C. The Contractor shall contact the Owner to arrange for the delivery of any salvaged materials to the location designated by the Owner. The condition of the materials cannot be guaranteed as they shall be subject to the normal excavation and handling procedures used on the project.
- D. The Contractor shall be responsible for the removal and legal disposal of the materials associated with the demolition of the any buildings, structures, all abandoned utilities of the Owner that are damaged and/or deemed unsalvageable by the Owner and all unsuitable materials from the development of the site and shall dispose of them in a legal manner. The cost associated with the legal disposal of the above referenced materials shall be included in the Contractor's Bid Price.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

WARRANTY FOR EQUIPMENT ITEM				
Location of Project	Flagler Beach WWTF			
Owner	City of Flagler Beach			
Project No.				
Equipment Item				
Section No. / Item No.				
Supplier				
Supplier's Address				
Suppliers Phone No.				
Supplier's Reference No.				
in material and workmanship, fully meets the type, quality, design and performance requirements defined in the Contract Documents of the above project, and that the equipment will in actual operation satisfactorily perform the functions for which it is installed. The undersigned agrees to repair, replace, or otherwise make good, any defect in workmanship or materials in the above described equipment which may develop within a <i>period of two (2) years from the date of Final Project Acceptance by the Owner</i> of the above named Project. Two (2) years from the date of Substantial Completion:				
	(Insert date of Substantial Completion)			
Company:				
Company Address:				
Phone / FAX:				
Ву:				
Title:				
Signed:				
Date:				

EQUIPMENT DATA SHEET		
Name		
Nomenclature		
Location		
Manufacturer		
Manufacturer's Local Representative		
Address		
Phone / FAX No.		
Equipment Data		
Serial No.:	Model No.:	
Size:	Lubricant:	
If the equipment is a pump, complete the	following:	
Pump Capacity (gpm):	Material:	
Pump TDH (ft):	Packing Gland:	
Motor Speed (rpm):	Seal:	
Impeller Diameter (in):		
Motor Data		
Manufacturer:		
Serial No.:	Frame:	
Model No.:	Туре:	
Volts:	Hertz:	
Phase:	Amps:	
Amps:	Horsepower (hp):	
Motor Speed (rpm):	Rating:	
Insulation Class:	Max. Ambient:	
Service Factor:	Max. Temp. Rise:	
Code Letter:	NEMA Design:	
Shaft End Bearing No.:	Front Bearing No.:	

EQUIPMENT DATA SHEET			
Coupling Data			
Manufacturer:			
Serial No.:	Model No.:		
Туре:			
Driver or Reducer Data			
Manufacturer:			
Serial No.:	Model No.:		
Horsepower (hp):	RPM In:		
RPM Out:	Ratio:		
Туре:	Bearings:		
Lubricant:			

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING AND INSTRUCTION		
Owner	City of Flagler Beach	
Project Location	Flagler Beach WWTF	
Contract No.		
CPH Project No.		
Equipment Specification Section		
Equipment Description		
I(P	, authorized representative of rint Name)	
(Print Man	ufacturer's Name)	
(Print equipment na	ame and model with Serial No.)	
installed for the subject Project has (have) been installed in a satisfactory manner, has (have) been satisfactorily tested, is (are) ready for operation, and the Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the unit(s) on		
Certified by: (Signature of Man	Date: ufacturer's Representative)	

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION				
I (we) the undersigned, authorized representatives of Operating Personnel have received classroom and and maintenance of the subject equipment and prefor the equipment.	hands on instruction on the operation, lubrication,			
<u>NAME</u>	<u>DATE</u>			
	·			

SECTION 01200 PROJECT MEETINGS

1. GENERAL

1.01 Description

- A. The Contractor shall cooperate and coordinate with the Engineer to schedule and administer the preconstruction meeting, monthly progress meetings, coordination meetings and specifically called meetings throughout the progress of the Work.
- B. The Engineer shall schedule and administer a preconstruction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work.
 - 1. Prepare agenda for meetings.
 - 2. Make physical arrangements for meetings.
 - 3. Preside at meetings.
- C. Representatives of the Contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- D. The Contractor shall record all progress meetings in their entirety, and shall provide the Engineer with an audio copy of each such recording, having good quality and clarity, and an "electronic" version (Word or WordPerfect) of the manuscript of the minutes of each meeting. The "draft" minutes of each meeting shall be delivered to the Engineer, electronically (e-mail), no later than five (5) business days after the meeting. If the meeting minutes are not delivered within this time period, the current and all future applications for payment shall not be processed by the Engineer and Owner until the minutes are delivered. All delays in processing applications for payment, associated with a delay in the delivery of meeting minutes, shall be borne solely by the Contractor.
- E. The Owner and Engineer shall review the "draft" minutes and shall provide comments to the Contractor, if any, within five (5) business days after receipt. The Contractor shall then make all corrections and changes to the "draft" minutes, based on the Engineer's and Owner's comments, and shall distribute "final" meeting minutes, in an "electronic" format, within five (5) calendar days following receipt of the comments.

F. The Owner shall attend meetings to ascertain that the Work is expedited consistent with the Contract Documents and construction schedules.

G. Related Work Specified Elsewhere

Specification Section	Title
01040	Project Coordination
01300	Shop Drawings, Submittals and Samples
01311	Construction Progress Schedules
01720	Project Record Documents

1.02 Preconstruction Meeting

- A. The Engineer will schedule a preconstruction meeting no later than fourteen (14) days after the date of the Notice to Proceed (NTP). The purpose of the meeting is to:
 - 1. Designate responsible personnel and establish a working relationship.
 - 2. Discuss matters of Project coordination and procedures for handling all construction related activities and to establish a construction schedule.
- B. This meeting shall be attended by the following:
 - 1. Owner's representative.
 - 2. Engineer and his professional consultants.
 - 3. Resident project representative (RPR).
 - 4. Contractor's Project Manager and superintendent.
 - 5. Major subcontractors.
 - 6. Representatives of major suppliers and manufacturers, as appropriate.
 - 7. Government representatives, as appropriate.
 - 8. Representative of the various utilities, as appropriate.
 - 9. Others as requested by the Contractor, Owner, and Engineer.

C. Location

- 1. A central site, convenient for all parties designated by the Engineer.
- D. The Engineer shall preside at the preconstruction meeting. The Contractor shall provide for keeping all project meeting minutes and distribution of the minutes to the Owner, Engineer, and others as identified in Article 1.01(D-E). The purpose of the preconstruction meeting is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.
- E. The agenda for the Preconstruction Meeting would include, but is not limited to, the following:
 - 1. Distribution and discussion of:
 - a. List of major subcontractors and suppliers.
 - b. Projected schedules.
 - c. Schedule of Values (SOV).
 - 2. Discussion of Owner Direct Purchase of Materials and Equipment (for tax savings purposes).
 - 3. <u>Critical work sequencing</u>: Relationships and coordination with other contracts and/or work and continuing operation of the existing utilities.
 - 4. Major equipment deliveries and priorities.
 - 5. Project Coordination: Designation and responsible personnel.
 - 6. Procedures and processing of:
 - a. Field decisions, field orders and work directives.
 - b. Proposal requests.
 - c. Requests for Information (RFI)
 - d. Submittals.
 - e. Change Orders.
 - f. Applications for Payment.

- 7. Submittals of Shop Drawings, Project Data and Samples.
- 8. Adequacy of distribution of Contract Documents
- 9. Procedures for maintaining project record documents.
- 10. Use of Premises
 - a. Office, work and storage areas.
 - b. Owner's requirements.
 - c. Access and Traffic Control.
- 11. Construction facilities, controls and construction aids.
- 12. Temporary utilities.
- 13. Housekeeping procedures.
- 14. Check of required Bond and Insurance certifications.
- 15. Completion Time for the Contract and Liquidated Damages.
- 16. Request for Extension of the Contract Time.
- 17. Procedures for monthly progress meetings, for all involved.
- 18. Security Procedures.
- 19. Procedures for making partial payments.
- 20. Guarantees on completed work.
- 21. Equipment to be used.
- 22. Project Layout and staking of Work.
- 23. Project Inspection.
- 24. Labor requirements.
- 25. Laboratory testing of material requirements.
- 26. Provisions for material stored on-site and monthly inventory of materials stored.

- 27. Requirements of other organizations such as utilities, railroads, highway departments, building departments.
- 28. Rights-of-way and easements.
- 29. Housekeeping procedures.
- 30. Liquidated Damages.
- 31. Posting of signs and installation of a Project Sign.
- 32. Pay request submittal dates.
- 33. Equal Opportunity Requirements.
- 34. Safety and First Aid Procedures.
- 35. Requirements of Special Conditions and Contract Forms.
- 36. Process Safety Management Procedures.
- 37. Contractor's Storage Area and Trailer Location(s).
- F. The Contractor shall furnish a list of emergency telephone numbers for the Project Manager, Superintendent and all supervisors and major Subcontractors.

1.03 Progress Meetings

- A. The Engineer shall schedule regular progress meetings. The progress meetings will be held a minimum of once every thirty (30) days and at other times as required by the progress of the work. The first meeting shall be held within thirty (30) days after the preconstruction meeting or thirty (30) days after the Notice to Proceed.
- B. The Engineer or authorized representative shall hold called progress meetings as required by progress of the work.
- C. Location of the meetings
 - 1. The Contractor's construction trailer at the Project Site (See Section 01500, "Temporary Facilities").

D. Attendance

- 1. Engineer and his professional subconsultants as needed.
- 2. Resident Project Representative (RPR).
- 3. Contractor's Project Manager and Superintendent.
- 4. Owner's representatives.
- 5. Subcontractors (Active on the site and as appropriate to the agenda).
- 6. Suppliers and manufacturers, as appropriate to the agenda.
- 7. Others as appropriate to the Agenda.
- E. The Engineer or authorized representative shall preside at the meetings. The Contractor shall be responsible for keeping all project meeting minutes and distribution of the minutes to the Owner, Engineer, RPR, and others as identified in Article 1.01(D - E). The purpose of the meetings will be to review the progress of the Work.
- F. The suggested agenda for the progress meetings will include, but is not limited to, the following:
 - 1. Review, approval of minutes of previous meeting.
 - 2. Review of Work progress since the previous meeting and the Work scheduled (3-week look ahead schedule).
 - 3. Field observations, problems and conflicts.
 - 4. Problems which impede the construction schedule.
 - 5. Review of off-site fabrication and delivery schedules.
 - 6. Corrective measures and procedures to regain the projected schedule.
 - 7. Status of the approved Construction Schedule and revisions to construction schedule as appropriate.
 - 8. Progress, schedule during the succeeding work period.

- 9. Coordination of schedules.
- 10. Review the status of submittals and submittal schedules; expedite as required.
- 11. Maintenance of quality standards.
- 12. Pending changes and substitutions.
- 13. Shop Drawing Problems.
- 14. Review proposed changes for:
 - a. Effect on the construction schedule and on the completion date.
 - b. Effect on other contracts of the Project.
- 15. Critical/long lead times.
- 16. Other business.
- G. The Contractor is to attend all progress meetings and is to study the previous meeting minutes and current agenda items, and be prepared to discuss pertinent topics and provide specific information including, but not limited to, the following:
 - 1. Status of all submittals and what specifically is being done to expedite them.
 - 2. Status of all activities behind schedule and what specifically will be done to regain the schedule.
 - 3. Status of all material deliveries.
 - 4. Latest contact with equipment manufacturers.
 - 5. Specific actions taken to expedite material delivery.
 - 6. Status of open deficiencies and what is being done to correct the same.
- H. The Contractor shall provide a current submittal log at each progress meeting in accordance with Section 01300, *Shop Drawings, Submittals and Samples*.

- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01300

SHOP DRAWINGS, SUBMITTALS AND SAMPLES

1. GENERAL

1.01 Scope of Work

A. The Contractor shall submit to the Engineer for review and approval, such Shop Drawings, Test Reports, and Product Data on materials and equipment (hereinafter in this Section called Product Data), and material samples (hereinafter in this Section called Samples) as are required for the proper control of work, including but not limited to those Shop Drawings, Product Data, and Samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.

B. Shop Drawings

- 1. Shop Drawings are original drawings, prepared by the Contractor, a subcontractor, supplier, or distributor, which illustrate some portion of the work; showing fabrication, layout setting, or erection details. Refer to Article 1.04 herein.
- Shop drawings shall be prepared by a qualified detailer and shall be identified by reference to sheet and detail numbers on the Contract Drawings. *Reproductions* for submittal shall be "full-size" prints (22" x 34") or other print acceptable to the Engineer. Reduced size prints will not be reviewed or approved.

C. Product Data

- 1. Product data are manufacturer's standard schematic drawings and manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.
- 2. Standard drawings shall be modified to delete information which is not applicable to the project and supplemented to provide additional information applicable to the project.
- 3. Catalog sheets, brochures, etc., shall be clearly marked to identify pertinent materials, products, or models.
- D. Samples are physical examples to illustrate materials, equipment, or workmanship and to establish standards by which work is to be evaluated.

- E. Within fourteen (14) calendar days after the Notice to Proceed, the Contractor shall submit to the Engineer a complete list of preliminary product data on items for which shop drawings are to be submitted, in an electronic format (PDF). Included in this list shall be the names of all proposed manufacturers furnishing specified items. Review of this list by the Engineer shall in no way, expressed or implied, relieve the Contractor from submitting complete shop drawings and providing materials, equipment, etc., fully in accordance with the Contract Documents. This procedure is required to expedite final review of shop drawings.
- F. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the Owner and the Engineer. This log should include the following items:
 - 1. Submittal description and number assigned.
 - 2. Date shop drawings/product data/samples were submitted to the Engineer.
 - 3. Date shop drawings/product data/samples were returned to the Contractor.
 - 4. Status of submittal (Approved, Approved as Noted, Revise and Resubmit, etc.)
 - 5. Date of resubmittal and return (as applicable).
 - 6. Date material released (for fabrication).
 - 7. Projected date of fabrication.
 - 8. Projected date of delivery to the Project Site.
 - Status of O&M Manual submittals.
 - 10. Specification Section and Contract Drawing sheet number.
- G. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Integrator for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF and JPEG formats, no exceptions.

- H. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "on-line" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the treatment facility SCADA System.
- I. Related Requirements Described Elsewhere

Specification Section	Title	
00700	General Conditions	
00800, 00805 and 00806	Supplementary Conditions and FDEP Supplementary Conditions	
00950	Shop Drawing Submittal Form	
00980	O&M Manual Submittal Form	
01311	Construction Progress Schedules	
01600	Materials and Equipment	
01720	Project Record Documents	
01730	Operating and Maintenance Data	
01740	Warranties and Bonds	
Division	Information	
0	Conditions of the Contract	
11, 13, 15 and 16	Equipment	

1.02 Contractor's Responsibility

A. It is the responsibility of the Contractor, prior to submission to the Engineer, to thoroughly check all shop drawings, product data and samples for completeness and for compliance with the Contract Drawings. The Contractor shall verify all dimensions and field conditions and shall coordinate the shop drawings with the requirements for other related work. The electronic (PDF) shop drawings and product data shall bear the Contractor's stamp showing that they have been so checked. Electronic shop drawings (PDF format) submitted to the Engineer without the Contractor's stamp will be "rejected" and returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from the requirements of the Contract Documents. If the Contractor takes exception to the specifications, the Contractor shall note the exception in the letter of transmittal to the Engineer.

- B. The Contractor's responsibility for errors and omissions in submittals is not relieved by the Engineer's review of the submittals.
- C. The Contractor shall notify the Engineer, in writing, at the time of submission, of deviations in submittals from the requirements of the Contract Documents and is not relieved by the Engineer's review of submittals, unless the Engineer gives written acceptance of specific deviations.

D. Determine and verify:

- Field measurements.
- 2. Field construction criteria.
- 3. Catalog numbers and similar product data.
- 4. Conformance with the Specifications.
- E. The Contractor shall furnish the Engineer a schedule of Shop Drawing submittals fixing the respective dates for the submission of shop and working drawings, the beginning and ending of manufacture, testing, and installation of materials, supplies, and equipment. This schedule shall indicate those that are critical to the progress schedule.
- F. The Contractor shall not begin any of the work covered by a Shop Drawing, Product Data, or a Sample until the Engineer has returned to the Contractor an *approved* shop drawing submittal with his initials or signature.
- G. The Contractor shall submit to the Engineer all drawings and schedules sufficiently in advance of construction requirements to provide no less than *thirty (30) calendar days* for checking and appropriate action from the time the Engineer receives them.
- H. All submittals shall be accompanied with a transmittal letter, all in an **electronic format** (**PDF**), containing the following information:
 - 1. Date.
 - 2. Project Title and Number.
 - 3. Contractor's name and address.
 - 4. The number of each Shop Drawing, Project Data, and Sample submitted.
 - 5. Notification of Deviations from Contract Documents
 - a. The Contractor shall indicate in **bold type** at the top of the cover sheet of the submittal of shop drawing if there is a deviation from the Contract Drawings, Specifications, or referenced specifications or codes.

- b. The Contractor shall also list any deviations from the Contract Drawings, Specifications, or referenced specifications or codes and identify in "blue" ink prominently on the applicable Shop Drawings.
- 6. Submittal Log Number.
- 7. Specification Section Number and Contract Drawing Number(s).
- I. No partial submittals will be reviewed. Submittals not deemed complete will be stamped "Rejected" and returned to the Contractor for resubmittal. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items for:

 - 1. Systems. 3. As indicated in specific specification sections.
 - 2. Processes.
- J. All drawings, schematics, manufacturer's product data, certifications and other shop drawing submittals required by a system specification shall be submitted at "one time" as a package to facilitate interface checking.
- K. The Contractor shall submit all shop drawings, submittals, copies of descriptive or product data information to the Engineer in an electronic (PDF) format. Failure to submit the shop drawings and associated documents in an electronic (PDF) format will delay the review process at the Contractor's expense. The Engineer shall submit electronic copies to the Owner and any relevant subconsultant for a simultaneous review. The Engineer will incorporate all comments onto the electronic review set, electronically stamp the submittal as required, and e-mail the parties indicated above with a "Shop Drawing Review" set of review comments for the Contractor to implement for resubmittal or to proceed with ordering equipment and materials.
- L. The Contractor shall be responsible for and bear all costs of damages which may result from the ordering of any material or from proceeding with any part of Work prior to the completion of the review by the Engineer of the necessary shop drawings.
- M. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposes to supply both as it pertains to his own work and any work affected under other parts, headings, or divisions of the Contract Drawings and Specifications.
- N. The Contractor shall not use Shop Drawings as a means of proposing alternate items to demonstrate compliance with the Contract Drawings and Specifications.

- O. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer, *prior* to ordering the materials or equipment.
- P. Each submittal shall bear a "stamp of approval" certifying that they have been checked and approved for submittal to the Engineer and that the Contractor has satisfied the Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal as illustrated in the figure below.
- Q. Submittals without the Contractor's initialed or signed certification "stamp of approval" and submittals which, in the Engineer's opinion, are incomplete, contain numerous errors or have not been properly checked, will be returned unchecked by the Engineer for resubmission. The Contractor shall mark his corrections in blue ink and the Engineer's comments shall be noted in red ink.
- R. Submittals for each type of work shall be numbered consecutively, and the numbering system shall be retained throughout all revisions. Resubmittals shall utilize the same number with a modifying letter. For example, two different submittals for Section 15050 would initially be submitted as submittal number 15050-1 and 15050-2. Resubmittals would therefore be 15050-1A and 15050-2A.

Owner's Name:	City of Flagler Beach, Florida		
Project Name:	Flagler Beach WWTF Sludge System Improvements		
CPH Project Number:			
Shop Drawing No.:			
Specification Section:	Contract Drawing No.:		
The Engineer's review and approval is only for general conformance with the design concept of the Project and the requirements of the Contract Documents. The review and approval of submittals shall not relieve the Contractor from any obligation contained in the Contract Documents, does not authorize any deviation from the requirements of the Contract Documents, and does not relieve the Contractor from errors or omissions in the submittal. The review and approval shall not constitute approval of any dimensions, quantities, installation instructions, equipment performance, construction means, methods techniques, sequencing or any safety precautions or procedures. The approval of a specific item shall not indicate approval of an assembly of which the item is a component.			
Submittal Review:			
CPH, LLC			
By: Authorized Signature	gnature Date:		

- S. Drawings and schedules shall be checked and coordinated with the work of all trades and sub-contractors involved, before they are submitted for review by the Engineer and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.
- T. Submittals shall be clearly legible and note only the items to be reviewed. If a submittal lists several options or models, the Contractor shall specifically indicate what he proposes to furnish. If the item is not identified, the shop drawing will be "rejected".
- U. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

1.03 Engineer's Review of Shop Drawings

- A. The Engineer's review of Shop Drawings, Product Data, and Samples as submitted by the Contractor will be to determine if the item(s) generally conforms to the information in the Contract Documents and is compatible with the design concept. The Engineer's review, and exceptions, if any, *will not* constitute an approval of means, methods, techniques, sequences, procedures of construction, safety precautions, dimensions, connections, quantities, and details of the material, equipment, device, or item shown.
- B. The review and approval of a separate item will not constitute approval of the assembly in which the item functions.
- C. The Engineer's review of submittals shall not be construed as a complete check and shall not relieve the Contractor from responsibility for complete compliance with the Contract requirements. The review of drawings and schedules will be general, and shall not be construed as:
 - 1. Permitting any departure from the Contract Documents.
 - 2. Relieving the Contractor of responsibility for any errors, including details, dimensions, and materials.
 - 3. Approving departures from details furnished by the Engineer, except as otherwise provided herein.
- D. No corrections, changes, or deviations indicated on submittals reviewed by the Engineer or other supplementary reviewing agency shall be considered as a Change Order.

- E. According to the requirements of the particular local regulatory agency having jurisdiction or the requirements of the Owner or utility company, there may be required a review of the shop drawings by the local regulatory agency, or the Owner, or utility company in addition to the review by the Engineer. This supplementary review will be considered part of the normal processing and approval process and will be accomplished without additional compensation.
- F. If the drawings or schedules as submitted describe variations, per Article 1.02(M), and show a departure from the Contract Documents which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
- G. When reviewed by the Engineer, each of the Shop Drawings will be identified as having received such review being so stamped and dated. Shop Drawings will be stamped with one of the following:

Stamp	Description
Approved	The submittal is approved as submitted and in accordance with the Contract Documents.
Approved as Noted	The Contractor shall incorporate the Engineer's comments into the submittal before release to the manufacturer. The Contractor shall send a letter to the Engineer acknowledging the comments and their incorporation into the Shop Drawing.
Revise and Resubmit	The Contractor shall resubmit the shop drawing to the Engineer. The resubmittal shall incorporate the Engineer's comments highlighted on the shop drawing.
Rejected	The Contractor shall resubmit the shop drawing with materials or equipment meeting the specifications for review by the Engineer.

- H. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing or on resubmitted shop drawings, to revisions other than the corrections requested by the Engineer on previous submissions. *The Contractor shall address and make any corrections required by the Engineer.*
- I. Only the Engineer shall utilize the color "red" in marking Shop Drawing submittals.
- J. Shop drawing and submittal data shall be reviewed by the Engineer for each original submittal and the first resubmittal. Thereafter review time for subsequent resubmittals shall be charged to the Contractor and the Contractor shall reimburse the Engineer for services rendered by the Engineer as specified below:

- 1. Reimbursements shall be based on a factor of five (5) times the Engineer's payroll cost plus reimbursable expenses at cost and shall be "paid in full", by the Contractor, PRIOR to the Engineer's release of the submittal back to the Contractor, regardless of whether the submittal is "approved" or "denied".
- 2. Failure to reimburse the Engineer for his time, with regard to the evaluation of additional submittals, will constitute a breach of the Project Contract/Agreement and all Work will be *suspended* until the Engineer is reimbursed and *no additional time or Cost will be added to the Contract Time and Price*.
- K. Distribution of copies of "acceptable" submittals will be as mutually determined by the Contractor, Owner and Engineer on an individual item basis during or following the preconstruction conference.
- L. If the submittal is "not satisfactory", the Engineer shall notify the Contractor and appropriate action shall be taken.

1.04 Shop Drawings

- A. When used in the Contract Documents, the term "shop drawing" shall be considered to mean the Contractor's plans for materials and equipment which become an integral part of the Project.
- B. Shop drawings shall be complete and detailed and shall consist of fabrication, erection and installation, layout, setting and schedule drawings, manufacturer's scale drawings, wiring and control diagrams, catalog cuts, catalogs, pamphlets, descriptive literature, mix design, performance and test data, and all other drawings and descriptive data pertaining to materials, equipment, piping, duct and conduit systems, and methods of construction as may be required to show that the materials, equipment or systems, and the positions thereof conform to the Contract requirements. As used herein, the term "manufactured" applies to standard units usually mass-produced; and "fabricated" means items specifically assembled or made out of selected materials to meet individual design requirements.
- C. Shop drawings shall establish the actual detail of all manufactured or fabricated items, indicate proper relation of adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual conditions. Shop drawings shall be drawn to scale and shall be completely dimensioned.

- D. If shop drawings cover more than one piece of equipment or components, the shop drawings shall show the entire assembly and the relationship and connections between all components.
- E. The Contractor shall coordinate the shop drawings from different manufacturer's and supplies so that all equipment and material will fit and work together.
- F. The Contract Drawings are "diagrammatic" and are intended to indicate the "general arrangement" of equipment, ducts, conduits, piping, and fixtures. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposes to supply both as pertains to his own work and any work affected under other parts, headings, or divisions of drawings and specifications. **Changes shall be reviewed in advance by the Engineer.**
- G. Manufacturer's data shall include all standard published information describing the products, systems, methods and performance. Include the manufacturer's name, address, telephone number, e-mail address and standards to which the products comply. Manufacturer's catalog sheets, brochures, diagrams, illustrations, and other standard descriptive data shall be clearly marked to identify pertinent materials, products, or models. *Delete information which is not applicable to the Work by striking or cross-hatching*.
- H. Drawings and schedules shall be checked and coordinated with the Work of all trades involved, before they are submitted for review by the Engineer and shall bear the Contractor's "stamp of approval" as evidence of such checking and coordination. Drawings or schedules submitted without this "stamp of approval" shall be returned to the Contractor for resubmission.
- I. Each shop drawing shall be submitted with the shop drawing submittal form presented in Section 00950, "Shop Drawing Submittal Form".
- J. Shop drawings, including manufacturer's literature, catalog cuts, or other printed material shall be entitled with the name of the project on each sheet and shall otherwise be identified by listing the particular Division, Section, Article, or reference of the work pertaining thereto. Differing items **shall not** be submitted on the same sheet.
- K. Product data on materials and equipment shall include, without limitation, materials and equipment lists, catalog data sheets, catalog cuts, performance curves, diagrams, verification of conformance with applicable standards or codes, materials of construction, and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish, and all other pertinent product data.
- L. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the manufacturer, equipment name, address, e-mail address and phone

- number of the manufacturer and his representative and service company so that service and/or spare parts can be readily obtained.
- M. If drawings show variations from the Contract requirements because of standard shop practice or for other reasons, the Contractor shall describe such variations in his letter of transmittal. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such drawings have been reviewed.
- N. All manufacturers or equipment suppliers who propose to furnish equipment or products shall submit an installation list to the Engineer along with the required shop drawings. The installation list shall include at least five (5) installations where identical equipment has been installed and has been in operation for a period of at least two (2) years unless specified otherwise in the Specification Section applicable.
- O. Shop drawings shall include specific information related to the installation proposed for this Project. Special shop drawings shall be submitted when necessary to show all details and requirements for anchorage, interface with other equipment, special fabricated products, and other information not shown on the standard manufacturer's submitted data.
- P. Certifications or test reports that may be required for submission in accordance with the technical specifications, shall contain the name (or signature), address, telephone number and e-mail address of the person(s) responsible for the certification or test who shall be authorized to make such certifications.
- Q. The Contractor shall utilize "**blue ink**" in marking shop drawing submittals. The Engineer shall utilize "**red ink**" in reviewing and marking shop drawing submittals.

1.05 Working Drawings

- A. When used in the Contract Documents, the term "Working Drawings" shall be considered to mean the Contractor's plan for temporary structures such as temporary bulkheads, support of open cut excavation, support of utilities, ground water control systems, forming and falsework; for underpinning; installation drawings; and for such other work as may be required for construction but does not become an integral part of the Project.
- B. Copies of working drawings, as noted in Article 1.05(A) above, shall be electronically submitted to the Engineer where required by the Contract Documents or requested by the Engineer, and shall be **submitted at least thirty (30) calendar days** (unless otherwise specified by the Engineer) **in advance of their being required for the Work**.

However, the Contractor shall require each manufacturer to provide complete installation instructions that include all information required to complete the installation of the equipment and which can be used as a guide for checking for conformance after installation.

- C. Working Drawings shall be signed by a licensed, registered Professional Engineer, currently licensed to practice in the State of Florida, and shall convey, or be accompanied by, calculation or other sufficient information to completely explain the structure, machine, or system described and its intended manner of use.
- D. Prior to commencing such work, working drawings must have been reviewed without specific exceptions by the Engineer, which review will be for general conformance and will not relieve the Contractor in any way from his responsibility with regard to the fulfillment of the terms of the Contract. All risks to new or existing work are assumed by the Contractor; the Owner and Engineer shall have no responsibility therefor.

1.06 Samples

- A. The Contractor shall furnish, for the approval of the Engineer, samples required by the Contract Documents or requested by the Engineer to illustrate materials, equipment or workmanship and to establish standards by which the work is to be evaluated. Samples shall be delivered to the Engineer as specified or directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in the Work until approved by the Engineer.
- B. Samples shall be of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture, and pattern.
 - 3. A minimum of three (3) samples of each item shall be submitted.
- C. Each sample shall have a label indicating:
 - 1. Name of Project.
 - 2. Name of Contractor and subcontractor.
 - 3. Material or equipment represented.
 - 4. Place of origin.

- 5. Name of producer/supplier and brand (if any).
- 6. Location in the Project.
- 7. Submittal, specification and Contract Drawing numbers.
- D. Samples of finished materials shall have additional marking that will identify them under the finished schedules.
- E. The Contractor shall prepare a transmittal letter and a description sheet for each shipment of samples. The description sheet shall contain the information required in Articles 1.06(B) and 1.06(C) above. He shall enclose a copy of the letter and description sheet with the shipment and send a copy of the letter and description sheet to the Engineer. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Contract requirements.
- F. Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the Work. Approved samples of the hardware in good condition will be marked for identification and may be used in the Work. Materials and equipment incorporated in the Work shall match the approved samples. Samples which failed testing or were not approved will be returned to the Contractor, at his expense, if so requested at time of submission.

1.07 Schedule of Operations

- A. The Contractor shall submit a schedule of operations to the Engineer, in an electronic format (PDF), for approval within ten (10) calendar days after the Notice to Proceed (NTP) and prior to any construction operations.
- B. Inform the Engineer of any changes in the schedule and allow ample time for the Owner to alter operations as required by the construction of the various components of the work.
- C. Approval of traffic control and schedules shall be obtained from the governmental entity having jurisdiction over the area of the Work.

1.08 Operation and Maintenance Manuals

A. Submittal Requirements

1. The Contractor shall be submit a "preliminary draft" and "final" O&M Manuals in accordance with Article 1.07, Section 01730, Operation and Maintenance Data.

- 2. The form of Operation and Maintenance Manual submittals shall be in accordance with Article 1.03, Section 01730, *Operation and Maintenance Data*.
- 3. The content of the Operation and Maintenance Manuals shall be in accordance with Articles 1.03 1.06, Section 01730, *Operation and Maintenance Data*.
- 4. Operation and Maintenance Manuals specified herein are in addition to any operation, maintenance, or installation instructions by the Contractor to install, test, and start-up equipment.
- 5. Manuals shall be provided for each piece of equipment including individual components and subsystems of complete assemblies. The section of the manual on operation shall describe the function of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.
- 6. Instruction of the Owner's personnel shall be in accordance with Article 1.08, Section 01730, *Operation and Maintenance Data*.
- 7. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Integrator for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF and JPEG formats, no exceptions.
- 8. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "on-line" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the SCADA System at the treatment facility.
- B. The Contractor is directed to thoroughly review Section 01730, *Operation and Maintenance Data*, for additional detailed information with respect to O&M Manuals.
- C. Failure to meet the deadlines for submittal of the "preliminary" and "final" versions of the Operation and Maintenance Manuals shall be cause for the Project to be "shut down" until such time as the documents are provided, in the proper format, to the Engineer. Any lost construction time and Contractor associated construction costs shall be borne by the Contractor based on his failure to meet the above referenced deadlines.

1.09 Project Record Documents

- A. Maintain at the project construction site for the Engineer , one (1) record copy of each of the following:
 - 1. Contract Drawings.
 - 2. Contract Specifications.
 - 3. Addenda.
 - 4. Change Orders and Other Modifications to the Contract.
 - 5. Engineer's Field Orders or Written Instructions.
 - 6. Approved Shop Drawings, Working Drawings and Samples.
 - 7. Field Test Records.
- B. *The Contractor shall maintain a set of Record and As-Built documents* in accordance with the General Conditions and the requirements herein.
- C. As the Project work progresses, the Contractor shall mark on a set of Contract Documents all changes from the Contract Documents using standard symbols listed in the legend.
- D. The Contractor is directed to thoroughly review Section 01720, *Project Record Documents*, for additional detailed information with respect to Project Record Documents, Recording, and submittals.

1.10 Maintenance of Documents and Samples

- A. Store documents and samples in the Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide a locked cabinet for secure storage space for storage of samples.
- B. File documents and samples in accordance with CSI format.
- C. Maintain documents in clean, dry, legible, condition and in good order. **Do not use** record documents for construction purposes.

- D. Make documents and samples available at all times for inspection by the Engineer.
- E. As a prerequisite for monthly progress payments, the Contractor is to exhibit the currently updated "Project Record Documents" for review by the Engineer and Owner.

1.11 Marking Devices

- A. Provide **"green"** ballpoint pens for recording information on the Project Record Documents.
- B. The Contractor **shall not** use pencils or "**red**", "**blue**", or "**black**" colored pens to record information on the record documents.

1.12 Recording

- A. Label each document "PROJECT RECORD" in neat, large printed letters.
- B. Record information concurrently with construction progress.

C. Contract Drawings

- 1. The Contractor is directed to thoroughly review Section 01720, *Project Record Documents*, for additional "detailed" information with respect to Project Record Documents, Recording, and submittals.
- 2. Legibly mark to record actual construction:
 - a. Depths of various elements of foundation in relation to finish floor datum.
 - b. All underground piping with elevations, dimensions, pipe size, pipe material, class, etc.
 - c. All changes to piping location.
 - d. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - e. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 - f. Field changes of dimension and detail.

- g. Changes made by Field Order or by Change Order.
- h. Details not on the "original" Contract Drawings.
- Equipment and piping relocations.
- j. Major architectural and structural changes.

D. Specifications Addenda

- 1. Legibly mark each Specification Section to record:
 - a. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - b. Manufacturer's and local representatives name, address, e-mail address and telephone and FAX numbers.
- c. Changes made by Field Order or by Change Order.

E. Shop Drawings

1. After final review and approval, **submit one** (1) **electronic set and three** (3) **paper sets of record drawings** for process equipment, structures, piping, appurtenances, electrical, and instrumentation systems.

1.13 Project Closeout

- A. At Project Closeout, deliver all Project Record Documents to the Engineer, in good condition and free from any extraneous notations.
- B. Accompany the Project Closeout submittal with transmittal letter in triplicate, containing:
 - 1. Date.
 - 2. Project Title and Number.
 - 3. Contractor's Name and Address.
 - 4. Title and Number of Each Record Document.
 - 5. Signature of Contractor or his Authorized Representative.

2. PRODUCTS - NOT USED

3. EXECUTION - NOT USED

END OF SECTION

SECTION 01311

CONSTRUCTION PROGRESS SCHEDULES

1. GENERAL

1.01 Scope of Work

- A. Within ten (10) calendar days after the Contract Award, the Contractor shall prepare and submit to the Engineer an estimated construction progress schedule (electronic copy PDF and 11" x 17" sheets) demonstrating complete fulfillment of all Contract requirements utilizing a Critical Path Method (hereinafter referred to as CPM) in planning, coordinating, and performing the Work under this Contract (including all activities of subcontractors, equipment vendors, and suppliers).
- B. The principles and definition of CPM terms used herein shall be as set forth in the Associated General Contractors of America (AGC) publication, <u>Construction Planning & Scheduling Manual</u>, latest edition, but the provisions of this Specification shall govern the planning, coordinating, and performance of the Work.
- C. Development of the CPM construction schedule, the cost loading of the schedule, monthly payment requisitions and project status reporting requirements of the contract shall employ "computerized" CPM scheduling. The CPM construction schedule shall be cost loaded based on the schedule of values or unit bid prices or combination thereof.
- D. Submit a revised progress schedule, in an electronic (PDF) format, to the Engineer on a monthly basis. No progress payments shall be approved until there is an approved construction progress schedule on hand.
- E. The schedule shall include sufficient time for final inspection and completion of punchlist items and all physical work prior to the contract completion date.
- F. The construction schedule shall be in accordance with the requirements of Section 00700, *General Conditions*, Section 00800, *Supplementary Conditions*, and Sections 00805 and 00806, *FDEP Supplementary Conditions* and shall be developed utilizing software specified and submitted for initial approval in accordance with the General and Supplementary Conditions.

G. Related Work Specified Elsewhere

Specification Section	Title
01010	Summary of Work
01030	Applications for Payment
01200	Project Meetings
01300	Shop Drawings, Submittals and Samples
01370	Schedule of Values
Division	Information
0	Conditions of the Contract

1.02 Qualifications

- A. A statement of computerized CPM capability shall be submitted in writing prior to the Award of the Contract and shall verify that either Contractor's organization has "in-house" capability to use the CPM technique or that Contractor will employ a CPM consultant who is so qualified.
- B. "In-house" capability shall be verified by description of construction projects that the Contractor or Contractor's consultant has successfully applied computerized CPM and shall include at least three (3) projects valued at least three-quarters the expected value of this Project.

1.03 Form of Schedules

- A. Prepare construction progress schedules in the form of a horizontal bar chart and as follows:
 - 1. Provide a separate horizontal bar for each trade or operation within each structure or item.

2. Horizontal Time Scale

a. Show starting and completion dates for each activity in terms of the number of days after Notice to Proceed. All completion dates shown shall be within the period specified for contract completion.

- b. See the General and Supplementary Conditions for stipulations for schedules submitted with earlier completion dates less than the specified completion time.
- c. Identify the first work day of each month.

3. Scale, Spacing and Maximum Sheet Size

- a. Sufficient to allow space for notations and future revisions.
- b. Twenty-two (22) inches by thirty-four (34) inches.

B. Format of Listings

1. The chronological order of the start of each item of work for each structure/system.

C. Identification of Listings

- 1. By major specification section numbers as applicable and by structure.
- D. Construction Progress Schedules shall be computer generated using software equal to Primavera Project Planner for Windows by Primavera Systems, Inc., Bala Cynwyd, P.A., or approved equal.

1.04 Initial Schedule Submittals

- A. The Contractor shall **submit two (2) short-term schedule documents at the Preconstruction Conference,** in a PDF format, which shall serve as the Contractor's plan of operation for the initial 60-day period of the contract time and to identify the manner in which the Contractor intends to complete all work within the contract time.
- B. The Contractor shall submit, in an electronic format (PDF):
 - 1. A sixty (60) day narrative plan of operation, describing in detail how contract operations will be conducted.
 - 2. A project overview bar-chart type plan for all work as indicated below.

C. Sixty (60) Day Narrative Plan of Operation

1. During the initial sixty (60) days of the contract time, conduct contract operations in accordance with the sixty (60) day detail narrative and bar chart plan of operation.

 The bar chart shall show the accomplishment of the Contractor's early activities (mobilization items, permits, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial site work, and other submittals and activities required in the first sixty days).

D. Comprehensive Project Overview Bar Chart

- The comprehensive overview bar chart shall indicate the major components
 of the Project Work and the sequence relations between major components
 and subdivisions of major components. The overview bar chart shall indicate the
 relationships and time frames in which the various components of the work will be
 substantially complete and placed into service in order to meet the project
 milestones.
- Sufficient detail shall be included for the identification of subdivisions of major components into such activities as potholing, excavation, bedding and pipe installation, backfilling, surface restoration, tunneling, structures, relocations, improvements, and other important work identified in the overall project scope and Contract Documents.
- 3. Indicate planned durations and start dates for each work item subdivision. Plot each major component and subdivision component on time scale **sheets not exceeding 22 inches by 34 inches in size**. Do not use more than four (4) sheets to represent this overview information.

1.05 Content of Schedules

A. Construction Progress Schedule

- 1. Show the complete sequence of construction by activity and by structure/system.
- 2. Show the dates for the beginning and completion of each major element of construction in no more than a two (2) week increment scale. Specifically list, but do not limit the construction progress schedule to, the following:
 - a. Shop Drawing Schedule.
 - b. Installation of temporary facilities.
 - c. Site clearing.
 - d. Site utilities.

- e. Demolition.
- f. Excavation.
- g. Foundation work.
- h. Structural framing.
- i. Subcontractor work.
- j. Equipment installations.
- k. Finishings.
- I. Instrumentation.
- m. SCADA.
- n. Electrical.
- o. Painting.
- p. Operator training and receipt of operation and maintenance manuals.
- q. Equipment testing.
- r. Equipment and Process Start-up.
- s. Receipt of Spare Parts.
- t. Project Closeout.
- 3. Show the projected percentage of completion for each item, as of the first day of each month.
- 4. Clearly show progress made on the construction schedule and actual "S" curves on a monthly basis.
- 5. Show the projected dollar cash flow requirements for each month of construction and for each activity as indicated by the approved Schedule of Values and as specified in the General and Supplementary Conditions.
- B. Submittals for construction progress schedules shall be in accordance with Section 01300, *Shop Drawings*, *Submittals and Samples*. Indicate on the construction progress schedule the following:

- 1. The dates for the Contractor's submittals.
- 2. The dates submittals will be required for Owner-furnished products, if applicable.
- 3. The dates approved submittals will be required from the Engineer.
- C. A computer-generated list of all long lead time items (equipment, materials, etc.).
- D. To the extent that the progress schedule or any revised progress schedule shows anything not jointly agreed upon or fails to show anything jointly agreed upon, it shall not be deemed to have been approved by the Engineer. Failure to include any element of the Work required for the performance of this Contract shall not excuse the Contractor from completing all work required within any applicable completion date, notwithstanding the Engineer's approval of the progress schedule.

E. Scheduling Constraints

- 1. The Work within the Owner's treatment facility must be completed within the maximum number of calendar days, start to finish, as indicated in the Contract Agreement.
- 2. Additionally, the Work must proceed on a continuous basis, without stoppages, except for nights and weekends. There shall be no lapses between phases of construction.
- F. Submit a preliminary Schedule of Values for the components that make up the Project, in accordance with Section 01370, *Schedule of Values*.

1.06 Progress Revisions

- A. Indicate the progress of each activity to date of submission.
- B. Show changes occurring since the previous submission of schedule, including, but not limited to, the following:
 - 1. Major changes in the scope.
 - 2. Activities modified since the previous submission.
 - 3. Revised projections of progress and completion.
 - 4. Other identifiable changes.

- C. Provide a narrative report as needed to define the following:
 - 1. Problem areas, anticipated delays, and the impact on the schedule.
 - 2. Corrective action recommended, and its effect.
 - 3. The effect of changes on schedules of other contractors.
- D. If the Work falls behind the critical path schedule by two (2) weeks or more, the Contractor shall prepare a recovery schedule.

1.07 Submissions

A. Submittal Requirements

- 1. Submittals shall be in accordance with the requirements detailed within the specification section.
- 2. Logic network and/or time-phased bar chart, computer generated, with critical path(s) identified.
- 3. Computerized network analysis
 - a. Sort by early start.
 - b. Sort by float.
 - c. Sort by predecessor/successor.
- 4. Narrative description of the logic and reasoning of the schedule.
- B. The CPM construction schedules shall indicate dates for important activities, including, but not limited to, the following:
 - 1. A logical succession of work from start to finish. This logical succession, when accepted, is the Contractor's work plan and is only designated as early start to accommodate standard computerized systems.
 - 2. Detailed definition of each activity.

- 3. A logical flow of work crews/equipment (crews are to be defined by labor category and labor hours; equipment by type and hours).
- Shop drawings submittals and reviews.
- Decisions.
- 6. Product procurement and delivery.
- 7. Beginning and completion of each element of construction.
- 8. Critical coordination dates.
- 9. Submittal of record drawings and equipment manuals.
- 10. Cleanup, final inspection, etc.
- 11. Any project milestones or phases of work that affect important dates.
- C. Submit the construction schedules and provide the following:
 - 1. Activity sorted by Early Start (ES) and organized by related elements.
 - 2. Activities sorted by Float (F) and organized by related elements.
 - 3. Activities sorted by predecessor/successor.
 - 4. Narrative description of the logic and reasoning of the schedule.
 - 5. Resource allocation by activity.
 - 6. A list of cost-loaded activities that identifies the specific cost amount for each activity in the CPM construction schedule.
- D. Show constraints between interrelated activities.
- E. The initial schedule shall include the following minimum data for each activity:
 - 1. Activity numbers.
 - 2. Estimated duration.
 - 3. Activity description.

- 4. Early Start and Early Finish dates (calendar dated).
- 5. Late Start and Late Finish dates (calendar dated).
- 6. Status (whether "critical").
- 7. Float.
- 8. Cost of the activity.
- 9. Other resources including equipment hours by type, labor by craft or crew, and materials by units.
- F. Where float time exists in activities, show the activities with early start/early finish times.
- G. The construction schedule shall include a title block with the project title, the Contractor's business name, the date of submittal or revision, and the signature of the Contractor's authorized representative attesting to his review and accuracy of the submittal.
- H. The duration indicated for each activity shall be in calendar days and shall represent the single best time considering the scope of the work and resources planned for the activity including time for inclement weather. Except for certain non-labor activities, such as curing concrete or delivering materials, activity durations shall not exceed fourteen (14) days, be less than one day, or exceed \$200,000 in value unless otherwise accepted by the Owner's Representative.

I. <u>Time of Submittals</u>

- 1. Within ten (10) working days after the Notice to Proceed (NTP), the Contractor shall submit network diagrams, in an electronic format (PDF) describing the activities to be accomplished in the overall Project and their dependency (predecessor/successor) as well as a tabulated schedule as herein defined.
- The total length of time indicated on the initial CPM schedule shall equal the
 exact number of days in the Contract Time as defined in the Agreement (Spec.
 Section 00500). The schedule produced and submitted shall also indicate calendar
 dates, including project starting and completion dates, based on the Contract
 Commencement and completion dates indicated in the Notice to Proceed.
- 3. The Engineer will complete the review of the complete schedule within fifteen (15) working days after receipt. During the review process, the Engineer may meet with a representative of the Contractor to review the proposed plan and schedule to discuss any clarifications, that may be necessary.

J. Within ten (10) working days after the conclusion of the Engineer's review period, the Contractor shall revise the network diagrams, as required, and resubmit the network diagrams, in an electronic format (PDF), and a tabulated schedule produced therefrom. The revised network diagrams and tabulated schedules shall be reviewed and accepted or rejected by the Engineer within fifteen (15) working days after receipt. The network diagrams and tabulated schedules, when accepted by the Engineer, shall constitute the project work schedules unless revised schedules are required due to substantial changes in the Work, a change in Contract Time or a recovery schedule is required and requested.

K. Acceptance

- 1. The finalized schedule will be acceptable to the Engineer when, in the opinion of the Engineer, it demonstrates an orderly progression of the Project Work to completion in accordance with the contract documents and requirements, adequately defines the Contractor's work plan, provides a workable arrangement for processing the submittals in accordance with the project specification requirements, and properly allocates resources (labor, equipment and costs) to each activity (free of unbalances in resources).
- 2. Review of the Contractor's project schedule is for conformance to the requirements of the Contract Documents only. Review by the Engineer of the Contractor's project schedule does not relieve the Contractor of any of its responsibility whatsoever for the accuracy or feasibility of the project schedule, or of the Contractor's ability to meet the interim milestone date(s) and the contract completion date, nor does such review and acceptance imply or expressly warrant, acknowledge, or admit the reasonableness of the logic, durations, labor, or equipment loading of the Contractor's project schedule.
- 3. Such acceptance will neither impose on the Engineer responsibility for the progress or scheduling of the Work nor relieve the Contractor from full responsibility therefore.
- 4. The finalized schedules of shop drawing submittals will be acceptable to the Engineer when, in the opinion of the Engineer, it demonstrates a workable arrangement for processing the submittals in accordance with the requirements.
- 5. The finalized Schedule of Values (lump sum price breakdown), as applicable, will be acceptable to the Engineer as to form and content when, in the opinion of the Engineer, it demonstrates a substantial basis for equitably distributing the Contract Price.
- 6. When the network diagrams and tabulated schedules have been accepted, the Contractor shall submit the following to the Engineer in an electronic format (PDF):

- a. The time-scaled network diagrams.
- b. A computerized tabulated schedules in which the activities have been sequenced by numbers.
- c. A computerized tabulated schedules in which the activities have been sequenced by early starting date.
- d. A computerized, tabulated schedules in which activities have been sequenced by total float.
- e. Sorted by predecessor/successor.

L. Revised Work Schedules / Schedule Revisions

- The Contractor, if requested by the Engineer, shall provide revised work schedules if, at any time, the Engineer considers the completion date to be in jeopardy because of "activities behind schedule".
- 2. The revised work schedules shall include a new diagram and tabulated schedules conforming to the requirements of Article 1.10 herein, designed to show how the Contractor intends to accomplish the Work to meet the completion date. The form and method employed by the Contractor shall be the same as for the original work schedules.
- 3. An activity that cannot be completed by its original latest completion date shall be deemed to be behind schedule.
- 4. No change may be made to the sequence, duration, or relationships of any activity without the approval of the Engineer.
- 5. No payment will be made if activities fall more than two (2) weeks behind schedule and a revised work schedule is not furnished.
- 6. The Contractor shall revise or update the Project schedule upon the occurrence of any of the following:
 - a. When delay in completion of an activity or group of activities indicates an overrun of the contract time or control point requirement by ten (10) working days or ten percent (10%) of the remaining duration, whichever is less.
 - b. Delays in submittals, deliveries, or work stoppage are encountered which make re-planning or rescheduling of the work necessary.

- c. The schedule does not represent the actual prosecution and progress of the Project as being performed in the field and progress for any activity is five (5) working days behind the current schedule.
- d. The Contractor will be performing work at an earlier date than is shown on the schedule and the work will require additional inspection and/or testing personnel.
- 7. In the event of any change to the Contract, submit a time analysis of the effect on the Critical Path. If the Contractor maintains there is no impact, he shall submit a statement to that effect.
- 8. The cost of revisions to the construction schedule, resulting from Owner-initiated contract changes, shall be included in the cost for the change in the work and shall be paid as part of the total cost of the change through the contract allowable percentages for changed work.
- 9. The cost of revisions to the construction schedule not resulting from authorized changes in the work shall be the responsibility of the Contractor.
- 10. Submittal of an "updated" construction progress schedule shall be a condition for approval of the Contractor's monthly progress payment.

1.08 Distribution

A. Distribute copies of the revised construction progress schedules as follows:

Distribution	No. of Copies
Engineer	3
Contractor jobsite files	As required
Subcontractors	As required
Other concerned parties	As required

B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

1.09 Change Orders

A. Upon approval of a change order, the approved changes shall be reflected in the next scheduled, revision or update submittal of the construction progress schedules by the Contractor.

1.10 CPM Standards

- A. CPM, as required by this Section, shall be interpreted to be generally as outlined in the Associated General Contractor's (AGC) publication, <u>Construction Planning & Scheduling Manual</u>, latest edition.
- B. Work schedules shall include a graphic network and computerized, tabulated schedules as described below. To be acceptable the schedule must demonstrate the following:
 - 1. A logical succession of work from start to finish.
 - 2. Definition of each activity. Activities shall be identified by major specification section numbers, as applicable, and by major structure.
 - 3. A logical flow of work crews/equipment (crews are to be defined by manpower category and man-hours; equipment by type and hours).
 - 4. Show all work activities and interfaces including submittals as well as major material and equipment deliveries.

C. Networks

- The CPM network or diagram, shall be in the form of a time-scaled diagram of the customary activity-on-type and may be divided into a number of separate pages with suitable notation relating the interface points among the pages. Notation on each activity line shall include a brief work description and a duration, as described herein.
- 2. All construction activities and procurement shall be indicted in a time-scaled format, and a calendar shall be shown on all sheets along the entire sheet length. Each activity arrow shall be plotted so that the beginning and completion dates of said activity can be determined graphically by comparison with the calendar scale. All activities shall be shown using the symbols that clearly distinguish between critical path activities, non-critical path activities, and float for each non-critical activity. All non-critical path activities shall show estimated performances time and float time in scaled form.

D. The duration indicated for each activity shall be in calendar days and shall represent the single best time considering the scope of the work and resources planned for the activity including time for inclement weather. Except for certain non-labor activities, such as curing concrete or delivering materials, activity durations shall not exceed fourteen (14) days nor be less than one (1) day unless otherwise accepted by the Engineer.

E. Tabulated Schedules

- 1. The initial schedules shall include the following minimum data for each activity:
 - a. Activity Beginning and Ending Numbers (i-j numbers) (single activity numbers may be used).
 - b. Duration.
 - c. Activity Description.
 - d. Early Start Date (Calendar Dated).
 - e. Late Start Date (Calendar Dated).
 - f. Early Finish Date (Calendar Dated).
 - g. Late Finish Date (Calendar Dated).
 - h. Identified Critical Path(s).
 - i. Total Float (Note: No activity may show more than 20 days float).
 - j. Cost of Activity.
 - k. Equipment Hours, by type; manpower hours, by crew or trade.

F. Project Information

- 1. Each tabulation shall be prefaced with the following summary data:
 - a. Project Name.
 - b. Contractor.
 - c. Type of Tabulation (Initial or Updated).
 - d. Project Duration.

- e. Project Contract Completion Date.
- f. Effective or Starting Date of the Schedule.
- g. New Project Completion Date and Project Status (if an updated or revised schedule).
- h. Actual Start Date and Actual Finish Date (for all updated schedules).

G. Float Time

1. Definition

- a. Unless otherwise provided herein, float as referenced in these Contract Documents is "Total Float". Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it, and its succeeding activities, become part of the "critical path".
- b. If a "non-critical" path activity is delayed beyond its float period, that activity then becomes part of the critical path and controls the end date of the project. Thus, the delay of the "non-critical" path activity beyond its float period will cause delay to the project itself.

2. Float Ownership

- a. **Neither the Owner nor the Contractor owns the float time. The Project owns the float time.** As such, liability for delay of the Project completion date rests with the party actually causing delay to the project completion date.
- b. For example, if Party X uses some but not all of the float time and Party Y later uses the remainder of the float time as well as additional time beyond the float time, Party Y shall be liable for the costs associated with the time that represents a delay to the Project's completion date. Party X would not be responsible for any costs since it did not consume all of the float time and additional float time remained; therefore, the Project's completion date was unaffected.

1.11 Schedule Monitoring

A. At not less than monthly intervals or when specifically requested by Engineer, the Contractor shall submit to the Engineer a computer printout of updated schedules for those activities that remain to be completed.

- B. The updated schedules shall be submitted with the application for payment as specified below.
- C. The updated schedules shall be submitted in the form, sequence, and number of copies requested for the initial schedule.

1.12 Progress Meetings

- A. For the monthly progress meeting, the Contractor shall submit a revised CPM schedule and three-week look-ahead schedule, showing all activities completed, in progress, uncompleted, or scheduled to be worked during the weeks.
- B. The three-week look-ahead schedule shall include the current week plus the next two (2) weeks.
- C. All activities shall be from the approved CPM and must be as shown on the CPM unless behind or ahead of schedule.
- D. Revised CPM schedules shall be submitted with each copy of that month's Application for Payment, in an electronic format (PDF).

1.13 Applications for Payment

- A. A revised CPM schedule shall be submitted with each copy of that month's Application for Payment in an electronic format (PDF).
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01370 SCHEDULE OF VALUES

1. GENERAL

1.01 Description

A. Work Specified Herein

- Submit to the Engineer a detailed Schedule of Values (SOV), in an electronic format (PDF), allocated to the various lump sum and unit price portions of the Work, at the Preconstruction Conference, and as otherwise specified or requested to be submitted earlier as evidence of the Apparent Low Bidder's qualifications.
- 2. The Contractor shall support the values with data that will substantiate their correctness. The data shall include, but not be limited to, quantity of materials, all sub-elements of the activity, and their units of measure. The values should reflect the Contractor's Bid Form detail sheets.
- 3. The Schedule of Values shall establish the actual value for each activity of the Work to be completed taken from the "approved" Critical Path Method (CPM) Construction Schedule, and shall be used as the basis for the Contractor's Applications for Payment.

B. Related Work Specified Elsewhere

Division	Information
0	Conditions of the Construction Contract

1.02 Form and Content of the Schedule of Values

A. Generate the **Schedule of Values in a computer-generated format**. Submittals shall be in an electronic format (Excel or PDF).

February 2024 Schedule of Values

- B. Identify the Schedule of Values with the following:
 - 1. Title of the Project and Location.
 - 2. Owner and Purchase Order No.
 - 3. Engineer and Project No.
 - 4. Name, address, phone number and e-mail address of the Contractor.
 - 5. Contract Designation.
 - 6. Date of Submission.
- C. The Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing item prices for progress payments during construction.
- D. Identify each line item with the number and the title of the respective section of the Specifications.
- E. For each major item of the Work, list sub-values of major products or operations under the major item.
- F. For the various portions of the Work:
 - 1. The amount for each item shall reflect a total installed cost including a directly proportional amount of the Contractor's overhead and profit.
 - 2. For items on which progress payments will be requested for stored materials, break down the value into the following:
 - a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials. Payment for materials shall be limited to the invoiced amount only.
 - b. The total installed value.
- G. Round off all figures to the nearest dollar.
- H. The sum of the costs of all items listed in the schedule shall equal the total Contract Price.
- I. For each item that has an installed value of more than \$1,000, provide a breakdown of costs to list major products or operations under each item.

February 2024 Schedule of Values

- J. The ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through "cost loading" of the CPM schedule activities. The Contractor shall provide a sufficient detailed breakdown to meet this requirement. The Engineer shall be the sole judge of acceptable numbers, details, and the description of values established. If, in the opinion of the Engineer, a greater number of schedule of values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the Engineer as a condition to processing the Contractor's monthly applications for payments.
- K. Following acceptance of the "detailed" Schedule of Values, the Contractor shall incorporate the values into the cost loading portion of the CPM schedule. The CPM activities and logic shall have been developed concurrent with development of the "detailed" Schedule of Values; however, it shall be necessary to adjust the "detailed" Schedule of Values to correlate to individual schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the CPM schedule activities, where interfacing these two documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the CPM schedule activities. Where such instances arise, the Contractor shall propose changes to the Schedule of Values and to the CPM schedule activities to satisfy the CPM schedule "cost loading" requirements.

1.03 Incorporation of the Schedule of Values into the CPM Schedule

A. In conjunction with each submittal of the construction schedule, submit a cash flow projection indicating estimated earnings by month during the entire contract period and a Schedule of Values of the Work using the Schedule of Values described herein, including quantities and prices. The aggregate of these extended prices shall equal the contract price. Costs shall include all materials, labor, equipment, and appurtenant items necessary to accomplish the work in accordance with the contract documents. This schedule shall be satisfactory in form and substance to the Engineer and shall subdivide the work into the specified component parts. Upon review by the Engineer, the Contractor shall incorporate the Schedule into the form for Application for Payment. The Engineer and Owner reserve the right to delete (or add) items of work from the contract and the total contract amount shall be reduced (or increased) by the total amount shown in the Schedule of Values.

February 2024 Schedule of Values

B. **Develop the Schedule of Values and incorporate it into the cost-loading function of the CPM schedule**. Determine monthly progress payment amounts from the monthly progress updates of the CPM schedule activities. Develop the Schedule of Values independent, but simultaneous with, the development of the CPM schedule activities and logic.

C. Cross-Reference Listing

- 1. To assist in the correlation of the Schedule of Values and the CPM schedule, provide a cross-reference listing, furnished in two parts. The first part shall list each scheduled activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective scheduled activity or activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the schedule of values), the total cost for each scheduled item should be indicated.
- 2. Update and submit these listings in conjunction with each CPM monthly submittal.
- 3. Incorporate executed Change Orders reflected in the CPM schedule into the Schedule of Values as a single unit identified by the Change Order number.

1.04 Schedule of Unit Material Values

- A. Submit a separate schedule of unit prices for materials to be stored on-site and for those materials incorporated into the Work for which progress payments will be requested.
- B. The format shall be approved by the Engineer; however, it shall parallel that shown in Section 00845, *Materials Stored On-Site Form*.
- C. The unit values for the materials shall be broken down into the following:
 - 1. Cost of the material, delivered and unloaded at the site, with taxes paid.
 - 2. Copies of the paid invoices for component material shall be included with the payment application in which the material first appears.
- D. Only materials unique to the Project may be billed when stored on-site. Materials of standard use such as conduit, wire, small-diameter pipe, steel, etc., shall not be accepted for payment.

February 2024 Schedule of Values

E. The installed value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

1.05 Review and Resubmittal

- A. The Contractor shall submit the Schedule of Values, in an electronic format (PDF), to the Engineer for approval.
- B. The Contractor and the Engineer shall meet and jointly review the Schedule of Values and make any adjustments in value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major work components. *Front-end loading will not be permitted.* The Engineer may require reallocation of major work components if, in the opinion of the Engineer, such reallocation is necessary. This review and any necessary revisions shall be completed within fifteen (15) days from the date of the notification of the required reallocation.
- C. After review by the Engineer, the Contractor shall revise and resubmit the Schedule of Values and the Schedule of Unit Material Values as required.
- D. Resubmit the revised schedules in the same manner.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

February 2024 Schedule of Values

SECTION 01380 CONSTRUCTION PHOTOGRAPHS

1. GENERAL

1.01 Description

A. Scope of Work

1. The Contractor shall provide professional quality construction record digital photographs prior to the start of work and periodically throughout the course of the Work as specified herein.

B. Related Requirements Described Elsewhere

Specification Section	Title
01010	Summary of Work
01720	Project Record Documents

1.02 Photography Required

- A. Digital Photographs taken in conformance with this Section shall be furnished to the Engineer, digitally, with each Application for Payment, or every month if no application for payment is initiated in a month. Monthly Applications for Payment will not be processed without submittal of the digital photographs outlined herein.
- B. Provide still photography of the general work area and any and all adjacent areas to be impacted by the construction activities, prior to commencing any work on any property. These photographs, in addition to the Preconstruction Video, will be used as a basis for settling any potential damage claims.
- C. Once work has begun, provide digital photographs at each of the major stages or events of construction related to the work performed and as directed by the Engineer or Resident Project Representative (RPR).

D. High-Resolution digital photographs (> 10 MP) shall be provided as herein specified. No low-resolution (< 10 MP), poorly light, digital photographs, will be acceptable.

E. Views and Quantities Required

- 1. A minimum of four (4) digital photographs, at 90 to one another, of each preexisting condition of an area where work is to begin.
- 2. A minimum of four (4) digital photographs of each construction activity as directed by the RPR per week.
- 3. One (1) digital photograph each of six (6) views (minimum) of the overall project site on a weekly basis, as directed by the Representative Project Representative (RPR).
- 4. One (1) digital photograph, per side, of each structure on the Project Site where construction activities are present weekly.
- 5. Once per day, the Contractor shall take at least one (1) photograph of the same overall view (location and view to be determined by the Engineer) as previously photographed.
- 6. Drone Shots of the Treatment Facility
 - a. Drone aerial photography shall be conducted at the Flagler Beach WWTF, prior to, during and after the construction work, as described below. The drone photography shall be provided by the Contractor.
 - b. Pre-Construction Drone Aerial Photography
 - 1) Preliminary drone aerial photography of the Project Site prior to commencement of construction activities.
 - 2) The Contractor shall provide two (2) prints each of three (3) preliminary drone aerial views (16" x 20"), as selected by the Engineer, of the Project Site prior to commencement of construction activities.
 - c. Monthly During Construction of the Project Improvements
 - 1) Drone aerial photography of the Project Site every month for the duration of the project.
 - 2) The Contractor shall provide *two* (2) *prints each of three* (3) *preliminary drone aerial views* (16" x 20"), as selected by the Engineer, of the Project Site every month for the duration of construction activities.
 - d. Post-Construction Drone Aerial Photography

- Post-construction drone aerial photography of the Project Site after the completion of construction activities, the new Sludge Management System improvements are operational and the final site work (sodding, etc.) has been completed.
- 2) The Contractor shall provide six (6) prints of the selected final aerial drone photographs, enlarged and framed (1.5" wide, minimum, oak frame to be selected by the Engineer from samples provided by the Contractor) from the completed project set of drone aerial photographs (to be selected by the Engineer). Final print sizes shall be 18" x 24" with the frames to match this sizing.

F. Digital Photography

- 1. The digital photographs shall be taken using a digital camera that has, at a minimum, the following characteristics:
 - a. 10.0 megapixel image sensor, minimum.
 - b. *Minimum* resolution: 1920 x 1080.
 - c. Precision digital zoom lens with high speed scan AutoFocus.
 - d. Flash capabilities.
- 2. The photographer shall take photographs of the views and quantities indicated above in Article 1.02(E)(1-5). The digital photographs shall be taken in the "high resolution" mode (> 10 MP). **No low resolution digital photographs (< 10 MP)** will be allowed
- 3. The "high resolution" digital photographs shall be downloaded onto a CD/DVD/BD or flash drive each month, in accordance with Article 1.02(A), and shall be indexed, digitally labeled (photo ID name) and categorized in folders with distinctive names to be determined in the Preconstruction Conference. The monthly submittal will contain digital photographic CD/DVD/BD's or flash drives as required by Article 3.03(D).

1.03 Cost of Photography

- A. *The Contractor shall pay all costs for the specified digital photography*. The cost for the photography shall be included in the Contractor's Bid for this Project.
- B. The digital camera to be used by the Contractor **shall be submitted for approval prior** to construction activities to ensure that it meets the criteria identified herein.

2. PRODUCTS

2.01 Aerial Drone Photography Prints

A. Type of Print

1. Paper: Single weight, full color print paper.

2. Camera and Film: High Resolution, High Definition Camera

3. Finish: Smooth surface, glossy.

- B. Identify each print on the back, utilizing a printed label (bleed-proof), listing the following:
 - 1. Name of the Project.
 - 2. Project Location.
 - 3. Description and orientation of the view.
 - 4. Date and time of exposure.

C. Aerial Photographs

- 1. Each aerial drone photograph shall be scaled to picture the facility site within no less than eighty percent (80%) of the print total area.
- 2. Each selected enlarged final aerial print shall be provided mounted within an solid oak frame, with a non-glare glass front, behind a minimum 2-inch wide, two-tone, double beveled mat (color to be selected by the Engineer).

2.02 Digital Camera (NOT IN CONTRACT)

1. EXECUTION

1.01 Technique

- A. Factual Presentation
- B. Correct Exposure and Focus

- 1. High Resolution/sharpness.
- 2. Maximum depth-of-field.
- 3. Minimum Distortion

1.02 Views Required

- A. Photograph from locations, at the Project Site, to adequately illustrate the condition of construction and state of progress.
- B. Consult with the Engineer at each period of photography for instructions concerning the views required.

1.03 Delivery of Digital Photographs

- A. Deliver the herein described digital high resolution photographs digitally to the Engineer, with each Application for Payment or in the event of no Application for Payment, once per month.
- B. All digital photographs shall be filed electronically in folders with appropriate titles for each of the pictures as approved by the Engineer in the Pre-construction Conference and the Monthly Progress Meetings. Digital photograph submissions not meeting the requirements of this specification section will be rejected and the monthly application for payment will not be processed until the proper photographs and format are provided to the Engineer.
- C. Distribute the digital construction photographs as follows:

Entity	Description
Owner	1
Engineer	1
Project Record File	One (1) set to be stored by the Contractor until the end of the Project that shall be delivered with the Project Record Documents.
Contractor	As required per Contractor

END OF SECTION

SECTION 01390

PRECONSTRUCTION VIDEO RECORDING

1. GENERAL

1.01 Description

- A. Provide all material, equipment, transportation, labor and incidentals to prepare a continuous, "high resolution" digital HD video recording of all construction, utility and roadways areas at the Flagler Beach WWTF prior to the start of the Work.
- B. The Contractor shall engage the services of a competent, professional videographer to provide "*high quality*", digital HD recording, in color, of the construction areas.
- C. The purpose of this digital audio-video preconstruction survey is to serve as a record of pre-construction conditions and to establish a basis for defense against claims for damage to property owned by private or public entities, including the City of Flagler Beach, Flagler County, other utilities, businesses and residences, etc.
- D. All DVD's/BD's and written records shall become the property of the Engineer/Owner.

E. Related work specified elsewhere

Specification Section	Title
00700 / 00800	General and Supplementary Conditions
01010	Summary of Work
01700	Project Closeout

F. The high-resolution HD digital audio-video system and the procedures employed in its use shall be such as to produce a finished product that will be admissible as evidence in a legal or administrative proceeding involving the Project. The video portion of the recording shall produce bright, *high-resolution (1920 x 1280 minimum video resolution)* clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection. The audio portion of the recording shall clearly produce the commentary of the HD digital recording device operator and be free from distortion.

1.02 Videographer Qualifications

- A. The high resolution digital HD video documentation shall be performed by a responsible commercial firm, subcontracted by the Contractor, known to be skilled and regularly engaged in the business of "professional" pre-construction, color, high-quality digital audio/video documentation.
- B. The Engineer and Owner will approve the "high-quality" digital HD audio/video recording company providing the service. The recording company shall furnish such information as the Owner deems necessary to determine the ability of that company to perform the work in accordance with the contract specifications. Under no circumstances will the Contractor be allowed to do this HD filming.
- C. The preconstruction "high-quality", digital HD audio/video filming shall be of professional quality that will clearly log an accurate visual description of existing conditions. Any portion of the DVD/BD not acceptable for the determination of the existing conditions shall be re-filmed at no additional cost to the Owner.
- D. The videographer shall be prepared to serve as a consultant or witness for the Owner in any litigation, public hearing or other legal or administrative proceeding involving the Project.
- E. Include the names, addresses, e-mail addresses and telephone numbers of two (2) references where the videographer has performed color, high-resolution, digital HD audio/video filming on projects of a similar nature, including one (1) within the last six (6) months.

1.03 Submittals

- A. All submittals shall be in accordance with Section 01300, *Shop Drawings, Submittals and Samples*.
- B. The Contractor shall submit, at a minimum, the following:
 - 1. The qualifications and references of the videographer.
 - 2. A sample high-resolution HD digital audio/video color DVD/BD meeting the exact Contract requirements.
- C. It will be upon this sample DVD/BD that the job quality standards will be based and judged. This sample DVD/BD shall be submitted to the Engineer and Owner in sufficient time to allow the DVD/BD to be played back for viewing and audio results prior to beginning the actual video recording required by the Contract.

2. EQUIPMENT

2.01 General

- A. The total high-resolution digital HD audio/video recording system and the procedures employed in its use shall be such as to produce a finished product that will fulfill the technical requirements of the project.
- B. The high-resolution digital HD video portion of the recording shall produce bright, sharp (1080p), clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection.
- C. The audio portion of the recording shall produce the commentary of the HD digital recording device operator with proper volume, clarity, and be free from distortion.

2.02 HD Digital Recording Device

- A. The "high quality" HD digital recording device used in the recording system, shall have the *minimum* characteristics:
 - 1. Full HD capability

2. Aspect Ratio: 16:9

3. Video Format: MPEG-4

4. "Minimum" Video Resolution: 1920 x 1280

5. Maximum Frame Rate: 60 fps

6. Video System: NTSC

7. Sound System: Dolby Digital

8. Optical/Digital Zoom: 10X / 200 X

B. All digital media to be provided to the Owner and Engineer shall be "high-resolution" DVD/BD.

3. EXECUTION

3.01 Coverage

- A. The HD recordings shall contain coverage of all surface features located within the construction's zone of influence. The construction's "zone of influence" shall be defined as follows:
 - 1. Flagler Beach WWTF Project Site and adjacent properties.
 - 2. Area within the permanent and temporary easements or ROW, and areas adjacent to these areas that may be affected by routine construction operations.
 - 3. By the direction of the Engineer.
- B. The surface features within the construction's zone of influence shall include, but not be limited to, all roadways, pavements, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, buildings, treatment structures, utilities (water, power, etc.), landscaping, trees, shrubbery, grassed areas, waterways, ponds, structures, tanks, fences, overhead projections, poles, signs, railroad tracks, etc.
- C. Panning, zoom-in and zoom-out rates shall be controlled to maintain a clear view of the Project.
- D. With respect to roadway construction or waterways, filmed coverage shall be limited to one side of the street or waterway at any one time and shall include all surface conditions located within the "zone of influence" of construction supported by appropriate audio description when dealing with work along roadways. When filming open areas, the entire region shall be videotaped in its entirety.

3.02 Audio Content

- A. The HD recording of each video shall be a simultaneous recorded audio recording. This audio recording, exclusively containing the commentary of the HD digital recording device operator, shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the feature being shown in the video portion of the recording.
- B. The audio recording also shall be free from any conversations between the HD digital recording device operator and any other production technicians that are not pertinent to the Project.

3.03 Recording Schedule

- A. The HD recording shall be performed **prior** to the placement of any construction materials or equipment on the proposed construction site.
- B. The Contractor shall coordinate the *high resolution*, digital HD video recording with the construction schedule so that those portions of the construction that will be completed first will be recorded first.
- C. The recording company shall deliver the *high-resolution*, digital HD video recordings to the Contractor upon their completion. The Contractor shall submit the *high resolution*, digital HD video recordings to the Engineer in accordance with Section 01300, *Shop Drawings*, *Submittals and Samples*.
- D. Upon delivery of the high resolution, digital HD video recordings to the Engineer, transfer of ownership of those DVD's/BD's shall be made to the Owner.

3.04 Visibility

- A. All HD recordings shall be performed during times of good visibility. No HD recording shall be conducted during periods of significant precipitation, mist, or fog.
- B. The HD recording shall only be done when sufficient sunlight is present to properly illuminate the subject, and to produce bright, sharp digital HD recordings of those subjects.
- C. No HD filming shall be performed when more than ten percent (10%) of the area to be taped contains debris or obstructions unless otherwise authorized by the Engineer.

3.05 Continuity of Coverage

- A. To increase the continuity of the coverage, the coverage shall consist of a single, continuous, unedited filming which begins at one end of a particular construction area.
- B. The coverage shall consist of an organized, interrelated sequence of HD recordings at various positions along that proposed construction area.
- C. The complete coverage of all building and structure surfaces is required per this contract to document their "existing" condition (due to project compaction operations).

3.06 HD Digital Recording Device Operation

A. <u>HD Digital Recording Device Stability</u>

The HD digital recording device shall be firmly mounted or held, such that transport
of the recording device during the recording process will not cause an unsteady or
jumpy picture.

B. <u>HD Digital Recording Device Control</u>

- The HD digital recording device pan, tilt, zoom-in, an zoom-out rates shall be sufficiently controlled such that recorded objects will be clearly viewed during playback.
- 2. In addition, all other recording device and recording system controls (lens, focus, aperture, white balance, etc.) shall be properly controlled or adjusted to maximize picture quality.

3.07 Viewer Orientation Techniques

- A. The "high resolution", digital HD video/audio recording shall maintain viewer orientation. To this end, overall establishing views and visual displays of all surface to determine their "existing" condition is critical to this component of the Project.
- B. In areas where the proposed construction location will not be readily apparent in the HD recording device viewer, highly visible yellow flags shall be placed, by the Contractor, in such a fashion as to clearly indicate the proposed centerline of construction.
- C. The horizontal location of the HD recordings shall be documented by linear measurement, utilizing a fifth "wheel" measuring device, relating the recording to the Project Stationing.

3.08 DVD/BD Identification and Security

- A. All DVD's/BD's shall be permanently labeled and shall be properly identified by DVD/BD number, Project Title and date(s) of the recording.
- B. To preclude the possibility of tampering or editing in any manner, all HD recordings must, by electronic means, display continuously and simultaneously generated transparent digital information to include the date and time of recording. The date information shall contain the month, day and year. The time information shall consist of hours, minutes and seconds, separated by colons (i.e., 13:24:10). This transparent information shall appear on the screen.

3.09 DVD/BD Logs

A. Each DVD/BD shall have a log of that DVD's/BD's contents. The log shall describe the various segments of coverage contained on that DVD/BD in terms of the names of streets, waterways or easements, structures, coverage beginning and end, directions of coverage, and DVD/BD counter numbers when possible, and the date of the recording.

3.10 Contractor's Responsibilities

- A. All "high resolution", digital HD recordings shall be performed during regular business hours, unless otherwise specified by the Engineer. The Contractor shall enter and leave private property in a professional and orderly, workmanlike manner.
- B. The Contractor shall provide for an audio-visual presentation for review. The Engineer and Owner shall have the authority to reject all or any portion of the high resolution, digital HD video recording not conforming to Specifications. *Any coverage not acceptable to the Engineer and Owner shall be re-filmed at no additional charge*. The Contractor shall reschedule unacceptable coverage within five (5) calendar days after being notified. Submit complete audio-visual DVD's/BD's to the Engineer no less than fifteen (15) calendar days before commencement of construction in areas to be filmed.

END OF SECTION

SECTION 01400 QUALITY CONTROL

1. GENERAL

1.01 Description

A. This Section discusses quality control and quality assurance measures required by the Contractor during execution of the construction activities associated with this Project.

B. Related Work Specified Elsewhere:

Specification Section	Title
00700	General Conditions
00800	Supplementary Conditions
00805 / 00806	FDEP Supplementary Conditions
01040	Project Coordination
01075	Reference Specifications
01300	Shop Drawings, Submittals and Samples
01410	Testing and Testing Laboratory Services
01430	Manufacturer's Services
01600	Materials and Equipment
01650	Systems Start-Up and Demonstration
01710	Cleaning
Division	Information
6, 10 and 11	Equipment
15	Mechanical
13 and 16	Electrical, Controls and Instrumentation

1.02 Quality Control

- A. It is the Contractor's responsibility to perform all work to a degree and in a manner that satisfies and complies with the Project requirements. To fulfill this responsibility, the Contractor is required to have an approved Quality Control Program (QCP), including testing, as part of his Contract work in accordance with the Contract Documents and to submit details of his Program to the Engineer for review and approval prior to commencing any construction operations. The submittal shall include detailed information on locations and number of all tests, etc., that will be necessary for compliance with the Contract Documents and the Project requirements.
- B. As part of the Contractor's Quality Control Program (QCP) included as part of his work under this Contract, the Contractor shall employ and pay for an independent, approved testing laboratory to perform testing services outlined in these Contract Documents. The Contractor shall meet all of the requirements outlined under Section 01410, "Testing and Testing Laboratory Services".
- C. The Contractor's Quality Control Program (QCP) shall include, but not be limited to, the following in addition to the type and frequency of tests as required by the individual technical specification sections:
 - 1. Piping and structural excavation, bedding and backfill materials and density quality control testing.
 - 2. Determination of the compactive effort needed for compliance with the density requirements.
 - Portland cement concrete and asphalt paving quality control testing including design mix review, materials, field slump and air content, and field and lab cured strength samples and testing.
 - 4. Removal and legal disposal of all trash from the project site.
- D. In addition to Quality Control Testing, the Contractor shall be responsible for required testing or approvals for any work (or any part thereof) if laws or regulations of any public body having jurisdiction specifically require testing, inspections or approval. The Contractor shall pay all costs in connection therewith and shall furnish the Engineer the required certificates of inspection, testing or approval. The Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Owner or Engineer acceptance of a supplier of materials or equipment proposed to be incorporated into the work.
- E. Any design or testing laboratory utilized by the Contractor shall be an independent laboratory acceptable to both the Owner and the Engineer, *approved in writing*, and

complying with the latest edition of the "<u>Recommended Requirements for Independent Laboratory Qualification</u>", published by the American Council of Independent Laboratories.

- F. Testing laboratories, shall promptly notify the Engineer and the Contractor of irregularities or deficiencies of work which are observed during performance of services.
- G. Laboratories shall submit copies of all reports in accordance with Section 01410, Testing and Testing Laboratory Services.

1.03 Quality Assurance

- A. **The Contractor shall monitor quality control** over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. The Contractor shall comply with all manufacturer's instructions, including each step in sequence.
- C. Should the manufacturer's instructions conflict with the Contract Documents, the Contractor shall request clarification from the Manufacturer first, followed by the Engineer prior to proceeding.
- D. The Contractor shall comply with the specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship. The Work shall comply with all local, State and Federal Building Codes and regulations, and the Florida Building Code.
- E. The Contractor shall perform the Work with persons qualified to produce the required and specified quality.
- F. The Contractor shall verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. The Contractor shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
- H. The Contractor shall comply with all of the quality assurance standards and criteria specified within the individual specification sections.

1.04 Tolerances

- A. The Contractor shall monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. The Contractor shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. The Contractor shall adjust products to their appropriate dimensions and positions before securing them in place.

1.05 Testing of Materials

- A. Unless otherwise specified in the Contract Documents, all materials shall be sampled and tested in accordance with the latest published standard methods of ASTM in effect at the time the Bids are received. If no ASTM Standards apply, applicable standard methods of the Federal Government or of other recognized agencies shall be used.
- B. Testing of materials shall be made by an authorized testing laboratory/manufacturer's representative, employed and paid for by the Contractor, unless otherwise provided.
- C. Testing of equipment shall be the responsibility of the Contractor or an authorized manufacturer's representative. All test results shall be furnished to the Engineer in writing in accordance with Section 01410, "Testing and Testing Laboratory Services".
- D. *The Contractor shall provide facilities required to collect and forward samples.* The Contractor shall furnish the required samples without charge.
- E. The Contractor shall not make use of or incorporate into the Work, the materials represented by the sample until tests have been made and the material found to be in accordance with the requirements of the Specifications.
- F. Materials to be tested and the applicable test procedure shall be as outlined in the individual sections of these Specifications or detailed by the Engineer.

1.06 References and Standards

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

- B. Conform to reference standards by date of issue, current on the date for receiving Bids, except where a specific date is established by code.
- C. Referenced Standards are identified in Section 01075, *Reference Specifications* and the individual specification sections. The Contractor shall obtain copies of and comply with all reference standards.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in the Contract, nor those of the Engineer, shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.07 Source and Quality of Materials and Equipment

- A. The source of materials to be used shall be in accordance with the Contract Documents and as approved by the Engineer before delivery. The approval of the source of any material shall continue as long as the material conforms to the Specifications.
- B. All material not conforming to the requirements of the Specifications shall be considered as defective and shall be removed from the Project Site. If in place, faulty materials shall be removed by the Contractor, at his expense, and replaced with acceptable material. No defective materials which have been subsequently corrected shall be reused until approval has been given.
- C. Upon failure of the Contractor to comply immediately with any order of the Engineer to remove and replace defective material, the Owner shall have authority to remove and replace defective materials, and to deduct the cost of removal and replacement from any monies due or to become due to the Contractor. Failure to reject any defective materials or work at the time of installation shall in no way prevent later rejection when such defects are discovered, nor obligate the Owner to final acceptance.

1.08 Manufacturer's Field Services

- A. When specified in individual specification sections, material, product or equipment suppliers or manufacturer's may be required to provide qualified staff personnel to:
 - 1. Observe site conditions.
 - 2. Conditions of surfaces.
 - 3. Installation.

- 4. Quality of workmanship.
- 5. Start-up of equipment.
- 6. Testing, adjusting and balancing of equipment.
- 7. Operation of equipment.
- 8. Provide Operation and Maintenance training to the Owner's personnel.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to the manufacturer's written instructions.
- C. The Contractor shall refer to the individual specification sections for Contract required manufacturer's field services.
- D. The Contractor shall refer to Section 01300, *Shop Drawings, Submittals and Samples*, Section 1430, *Manufacturer's Services*, Section 01600, *Materials and Equipment*, and Section 01650, *System's Start-Up and Demonstration*.

1.09 Additional Testing

A. In addition to soils laboratory and material testing, the Contractor shall perform other testing called for in the Contract Documents, including, but not limited to, piping, pressure, leakage, infiltration and exfiltration, as appropriate.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 Examination

- A. The Contractor shall verify that the site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means Contractor acceptance of existing conditions.
- B. The Contractor shall verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

- C. The Contractor shall examine and verify specific conditions described in the individual specification sections.
- D. The Contractor shall verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 Preparation

- A. Clean substrate surfaces prior to applying the next material or substance.
- B. Clean all cracks or openings of substrate prior to applying the next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to apply any new material or substance in contact or bond.
- D. Refer to Section 01710, *Cleaning*, and follow all contractual requirements and procedures.

END OF SECTION

SECTION 01410

TESTING AND TESTING LABORATORY SERVICES

1. GENERAL

1.01 Description

A. Scope of Work

- 1. The Contractor will employ and pay for the services of an independent, qualified, state-certified testing laboratory to perform testing specifically indicated on the Contract Documents or specified in the Specifications and may at any other time elect to have materials and equipment tested for conformity with the Contract Documents.
- 2. The Contractor shall cooperate with the laboratory to facilitate the execution of its required services.
- 3. The Contractor shall provide the Engineer with all test results herein within two (2) calendar days of receipt in an electronic format.
- 4. Employment of any particular laboratory shall in no way relieve the Contractor's obligations to perform the Work of the Contract or cooperate with the selected laboratory, following the sampling methods and means required.

B. Related Requirements Described Elsewhere

- 1. General Conditions and Requirements of the Contract.
- 2. Respective Sections of the Specifications: Certification of products.
- 3. Each Specification Section listed: Laboratory test required, and standards for testing.
- 4. Testing laboratory inspection, sampling and testing is required for, but not limited to, the following:

Specification Section	Title
02200	Earthwork
02220	Excavation, Backfilling and Compacting
02610	Stabilized Sub-Base
03300	Cast-in-Place Concrete
15000	Mechanical - General Requirements

C. The following schedule defines the responsibilities and extent of various tests required for the Project. The Contractor shall notify the Owner in advance of any new work so that arrangements can be made with the testing laboratory for the required sampling.

TEST	NOTES	PAID FOR BY
Soil Compaction	<u>Pipe Work:</u> Every 150 feet at each lift of compaction, minimum	
	Beneath Structures: Each 2,000 ft², each lift of compaction, minimum	Contractor
	Strip/Column Foundation Work: Every 100 feet at each lift of compaction, minimum	
Pressure	As specified in Section 15044, Pressure Testing of Piping	Contractor
Bacteriological	As required by the local and state agencies and as specified in Division 15, <i>Mechanical</i>	Contractor
LBR (Limerock Bearing Ratio)	Each 600 ft ² of pavement, minimum	Contractor
Concrete	Slump Test: Each delivery, minimum	
	Compression Test: Five (5) cylinders every 50 yd³, minimum	Contractor
	Additional tests per Section 03300, <i>Cast-in-Place Concrete</i>	
Leak Tests	As specified in Section 03800, Leakage Testing of Hydraulic Structures	Contractor
Electrical Tests	As specified in Division 16, <i>Electrical</i>	Contractor
Instrumentation Tests	As specified in Division 13, Special Construction	Contractor

D. Additional Tests

- 1. **The Contractor shall pay for all tests** to ensure that the applicable material specification is met.
- 2. If the first test samples do not meet the specification requirements, the Contractor shall take measures to conform the material and equipment to the Specifications.

1.02 Laboratory Duties: Limitations of Authority

- A. The Contractor shall submit, within fifteen (15) calendar days after the Notice to Proceed, the name of the testing laboratory that he is proposing to use on the Project.
- B. The testing laboratory **shall be "approved"** by the Owner and Engineer prior to commencement of any Project Work.
- C. The testing laboratory shall cooperate with the Engineer and Contractor and provide qualified personnel promptly on notice to perform the required testing.
- D. The testing laboratory shall perform specified inspections, sampling and testing of materials and methods of construction to:
 - 1. Comply with specific standards, including, but not limited to, ASTM, other recognized authorities, and as specified.
 - 2. Determine and report on compliance with the requirements of Contract Documents.
- E. *The testing laboratory shall immediately notify the Engineer and Contractor* of any material or operations that do not meet the Project specifications.
- F. The testing laboratory shall promptly submit electronic copies (PDF) of all reports or inspections and tests to the Engineer. Each report or inspection shall include, at a minimum, the following:
 - 1. Date issued.
 - 2. Project title and Engineer's Project No.
 - 3. Testing Laboratory's name, address, telephone, contact person and e-mail address.
 - 4. The name and signature of the inspector.

- 5. The date of inspection or sampling.
- 6. A record of temperature and weather.
- 7. Date of the test.
- 8. Identification of the Product and Specification Section.
- 9. Location in the project.
- 10. The type of inspection or test.
- 11. Observations regarding the compliance with the Contract Documents (or not).
- G. The testing laboratory may also be instructed to perform additional services as required by the Owner.
- H. The Engineer and Owner "approved", independent, qualified, state-certified testing laboratory is not authorized to:
 - 1. Release, revoke, alter, enlarge or give interpretations on the requirements of the Contract Documents.
 - 2. Approve or reject any portion of work.
 - 3. Perform any duties of the Contractor.

1.03 Contractor's Responsibilities

- A. Cooperate with the Engineer's representative and laboratory personnel. Provide access to the Work and the manufacturer's operations.
- B. Provide to the laboratory the preliminary design mix proposed to be used for concrete, if to be placed, and other material mixes which require control by the testing laboratory.
- C. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacturer or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The Engineer may require the Contractor to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality

and workmanship indicated in the Contract Documents. All costs of providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.

- D. Furnish incidental labor and facilities:
 - 1. To provide access to the Work to be tested.
 - 2. To obtain and handle samples at the Project Site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
 - 5. For delivery of samples.
- E. Notify the Engineer "approved", independent, qualified, state-certified testing laboratory a minimum of three (3) working days in advance of operations to allow for the laboratory assignment of personnel and scheduling of the required tests. Any Contractor "down-time" and expenses incurred by the Contractor due to his negligence or inability to have the testing laboratory perform tests when required shall not be compensated by the Owner.
- F. The Contractor shall employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the Contractor's convenience and as approved by the Engineer.
- G. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the Contractor shall pay for the laboratory costs directly to the testing firm, at no additional expense to the Owner.
- H. If, in the making of any test of any material or equipment, it is ascertained by the Engineer that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the work and replace it with acceptable material, without additional cost to the Owner.
- I. The Contractor shall assure that tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.

J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner normally takes over the operation thereof.

1.04 Costs of Shop Tests and Substitute Equipment

- A. Field testing of materials furnished under this Contract will be provided by the Contractor, unless otherwise specified.
- B. The cost of shop tests of equipment and certain other tests specifically called for in the Contract Documents shall be borne by the Contractor and such costs shall be deemed to be included in the Contract Bid Price.

C. Shop Tests

- 1. Testing for pressure, duty, capacity, rating, efficiency, performance, function or special requirements which are specified shall be tested in the shop of the maker in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.
- 2. No such equipment or materials shall be shipped to the Project Site until the Engineer notifies the Contractor, in writing, that the results of such tests are acceptable.
- 3. **Electronic copies (PDF)** of the manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to be a responsible official of the manufacturing company and/or independent laboratory, shall be forwarded to the Engineer for approval.
- 4. The cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment *shall be borne by the Contractor*.
- D. Materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract, if allowed by the Contract Documents, may be tested by the Owner for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment to verify equitable products are provided.

1.05 Final Tests and Inspection

A. Final Demonstration Tests

- Upon completion of the work and prior to final payment, all equipment and piping installed under this Contract shall be subjected to acceptance tests as specified or required to provide compliance with the Contract Documents.
- The Contractor shall furnish labor, fuel, energy, water and all other materials, equipment and instruments necessary for all acceptance tests, at *no additional* cost to the Owner. The finishing Contractor shall assist in the final field tests as applicable.

B. <u>Final Inspection</u>

- 1. During such final inspections, the work shall be clean and functional.
- In no case will the final pay estimate be prepared until the Contractor has complied
 with all requirements set forth and the Engineer and Owner have made their final
 inspection of the entire work and are satisfied that the entire work is properly and
 satisfactorily constructed in accordance with the requirements of the Contract
 Documents.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01430 MANUFACTURER'S SERVICES

1. GENERAL

1.01 Description

A. Work Specified Herein

- 1. Mechanical start-up services.
- 2. Process start-up services.
- 3. Training services.

B. Related work specified elsewhere

Specification Section	Title
01600	Materials and Equipment
01650	Systems Start-Up and Demonstration
Division	Information
6, 10, 11 and 15	Equipment
13 and 16	Electrical, Controls and Instrumentation

1.02 Definitions

The following definitions shall apply wherever used herein and elsewhere in the Specifications:

- A. <u>Factory Serviceman</u>: A person trained by the manufacturer of the equipment and experienced in the installation, maintenance, start-up and operation of the specified equipment.
- B. <u>Factory Process Specialist</u>: A person trained and experienced in adjusting and optimizing the operation of the specified equipment to assure proper operation of the equipment as a part of the system in which it is installed.

- C. <u>Factory Trained Specialist</u>: A person trained and experienced in the operation and maintenance of the specified equipment and capable of training the Owner's personnel in the operation and maintenance of the equipment and systems.
- D. <u>Eight-Hour Working Day</u>: A minimum of eight hours of on-site work, exclusive of travel time to and from the project location. Consecutive days include the five (5) working days in a week, exclusive of Saturday and Sunday.

1.03 Submittals

A. At the time of submittal of shop drawings and product data, the Contractor shall submit the names and qualifications of the manufacturer's personnel who will perform manufacturer's services as specified here and elsewhere. Failure to provide this information with the shop drawings will lead to "rejection" of that shop drawing submittal.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 General

- A. All manufacturers' services shall be performed in the presence of the Engineer and a representative of the Owner.
- B. The Contractor shall be responsible for scheduling and coordinating the manufacturer's site visits with the Owner and the Engineer. The Owner and the Engineer shall be given a minimum of ten (10) calendar days written notice prior to the site visit and shall be given a minimum of three (3) calendar days written notice of cancellation of a site visit. The time of written notification of the Owner and Engineer shall mean from the date of receipt of the notification by the Engineer and Owner, not the date that the Contractor issued the written notification. Any time delay, loss of work or increase in contract cost due to the Contractor not providing the required notification shall be incidental to the Contract.
- C. Mechanical start-up services shall be performed following complete installation of the equipment item or system.
- D. Process start-up services shall be performed at the time the equipment item or system is required by the treatment process.

- E. Initial training services shall be performed at the time of process start-up and Section 01730, Operation and Maintenance Data.
- F. Follow-up training and check-out services shall be performed at the times requested in writing by the Owner during the period of one (1) year after Final Project Acceptance by the Owner.
- G. The manufacturer's services specified herein are in addition to the guarantee requirements in Section 00700, *General Conditions*, Section 00800, *Supplementary Conditions*, and Sections 00805 and 00806, *FDEP Supplementary Conditions*.

3.02 Mechanical Start-Up Services

- A. Mechanical start-up services shall consist of checking the installed equipment electrically and mechanically to insure it has been installed correctly, wired correctly, properly lubricated, and is ready to operate.
- B. Mechanical start-up services shall be performed by a Factory Serviceman and shall consist of a minimum of the number of consecutive eight (8) hour working days specified in the individual equipment Specifications.
- C. The Contractor shall be responsible for arranging for or providing, at no additional cost to the Owner, all required equipment, supplies, and services, including power, water, wastewater, sludge, air, compressed gases, etc., and the availability of subcontractors and skilled tradesmen as necessary for mechanical start-up services.
- D. Mechanical start-up will not be considered complete until all installation and material difficulties have been corrected. Upon completion of the mechanical start-up services, the manufacturer shall submit to the Engineer a letter certifying that the equipment has been properly installed and is ready for process start-up. Process start-up will not be allowed without prior receipt of the above certification.
- E. As part of the above certification letter, the manufacturer shall submit to the Contractor and the Engineer written interim operation and maintenance activities required to ensure that the equipment will remain in operating condition between the mechanical start-up service and process start-up. This information is in addition to information submitted to the Engineer for preparation of an operation and maintenance manual for the Owner. The Contractor shall be responsible for all interim operation and maintenance activities.

3.03 Process Start-Up Services

- A. Process start-up services shall consist of start-up of the equipment at the time required by the treatment process and final adjustment, calibration, etc., required to optimize operation of the equipment. Process start-up shall also consist of the additional services specified in the individual equipment specifications.
- B. **Process start-up services shall be performed by a Factory Process Specialist** and shall consist of a minimum of the number of consecutive eight (8) hour working days specified in the individual equipment specifications.
- C. The Contractor shall be responsible for arranging for or providing, at no additional cost to the Owner, all required equipment, supplies, and services, including power, water, wastewater, air, compressed gases, etc., and the availability of subcontractors and skilled tradesmen as necessary for process start-up services.
- D. Upon completion of the process start-up services, the manufacturer shall submit to the Engineer a letter, in an electronic format, certifying that the equipment is operating properly.

3.04 Training Services

- A. Training services shall consist of the following:
 - 1. Initial instruction of the Owner's personnel in the operation and maintenance of the equipment consisting of the number of consecutive eight (8) hour working days of classroom and hands-on training specified in the individual equipment specifications.
 - 2. Follow-up equipment check-out and instruction of the Owner's personnel during the first year of operation, consisting of the number of trips and eight (8) hour working days of training specified in the individual equipment Specifications.
- B. Training shall be performed by a Factory Trained Specialist from the manufacturer. Training materials shall be supplied to the Owner at least seven (7) calendar days prior to the date of the training by the Factory Trained Specialist.
- C. All training shall be performed at the Owner's facilities, unless otherwise specified.
- D. Each manufacturer's training service shall be filmed, in a minimum 1080p HD, by a professional filming firm, at no additional cost to the Owner, for the purpose of O&M training. Upon completion, three (3) copies of the video (labeled and indexed) shall be submitted to the Engineer for distribution in accordance with the requirements and conditions of Section 01390, Preconstruction Video Recording.

END OF SECTION

SECTION 01500 TEMPORARY FACILITIES

1. GENERAL

1.01 Description

A. Scope of Work

- 1. Provide temporary facilities at the Project Site as specified in the General and Supplementary Conditions (Division 0), with the addition of the requirements set forth herein. The Contractor shall meet the requirements for all temporary facilities as specified in the General Conditions including, but not limited to, the following:
 - a. Temporary telephone and internet service.
 - b. Storage sheds.
 - c. Temporary water service.
 - d. Temporary lighting.
 - e. Temporary electrical service.
 - f. Temporary sanitary facilities.
 - g. Temporary fire protection.
 - h. Safety precautions.
 - i. Contractor's Field Office.
- 2. No temporary facilities of any type are to be provided by the Owner as part of the proposed project improvements identified within the Contract Documents.

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B. \]All construction temporary facilities and controls shall remain the property of the Contractor establishing them and shall be maintained in a safe and useful condition until removed from the Project.

1.02 Temporary Water

- A. The Contractor shall furnish and install temporary water service(s) for use throughout construction period, including, but not limited to, the following:
 - 1. Water for construction purposes (compaction, concrete, testing, dust control, etc.).
 - 2. Water for other purposes
 - a. Testing.
 - b. Temporary sanitary facilities.
 - c. Cleaning.
 - d. Potable water source (separate).
- B. Maintain adequate volume of water for all purposes.
- C. Water Source
 - 1. Supplier: Owner
 - 2. Potable water used shall be separately metered and protected with approved back flow prevention devices. *Potable water used will be paid for by the Owner*.
- D. The Contractor shall maintain strict supervision over the use of temporary services, including, but not limited to, the following:
 - 1. Enforce conformance with applicable codes and standards.
 - 2. Enforce sanitary practices.
 - 3. Prevent the waste of water.
 - 4. Prevent abuse of services.
- E. Costs of Installation and Operation
 - 1. The Contractor shall obtain all permits required by governing authorities. Permit fees shall be paid for by Owner.
 - 2. Potable water used shall be separately metered and protected with an approved back flow prevention device(s). Potable water used shall be controlled.

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F. Requirements of Regulatory Agencies

- 1. The Contractor shall obtain and pay for all permits, and all fees and deposits required by governing authorities.
- 2. Comply with the National Electric Code (NEC).
- 3. Comply with federal, state and local codes and regulations and with utility company requirements.
- 4. Comply with the County Health Department regulations.

1.03 Temporary Electricity

- A. The Contractor shall furnish and install temporary electric power service for all construction needs throughout the construction period including, but not limited to, the following:
 - 1. Power centers for miscellaneous tools and equipment used in construction work.
 - a. Locate so that power is available at any desired point with no more than a 100-foot extension.
 - b. Provide a weatherproof distribution box with a minimum of four (4), 20 amp, 120 volt grounded outlets with GFCI protection.
 - c. Provide circuit breaker protection for each outlet.
 - d. Provide equipment grounding continuity for the entire system.
 - e. Users shall provide grounded, Underwriters Laboratories, Inc. (UL) approved extension cords from the power center to points of operations.
 - 2. Power for construction equipment.
 - 3. Power for testing and checking equipment.
 - 4. Power for welding units and for other equipment having special power requirements.
 - Power for Contractors and Subcontractors.
 - 6. Power for all field offices.

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B. Capacity

- 1. Adequate electrical service for construction use by all trades at the Project Site during the entire construction period.
- 2. Notify the Power Company if unusually heavy loads such as welding, and other special power requirements, will be connected.
 - a. Provide special circuits for heavy load requirements.
 - b. Do not overload any circuit.

C. Power Source

- 1. Supplier: Florida Power and Light (FPL)
- 2. Provide minimum 120/240 volt, single phase, 60 hertz power service to the Project site. The use of portable generators is allowed, however, it is recommended to disconnect the temporary power from the power company metered power supply prior to using portable generators. If fuel powered generators are used, ConVault type fuel containment systems shall be utilized for fuel storage.

D. Maintain strict supervision of use of temporary services

- 1. Enforce conformance with applicable standards.
- 2. Enforce safe practices.
- 3. Prevent abuse of services.

E. Costs of Installation and Operation

1. The Contractor shall pay all costs of installing, maintaining and removing temporary electrical power. The Owner shall pay for utility.

F. Requirements of Regulatory Agencies

- 1. The Contractor shall obtain permits as required by all governing authorities.
- 2. Comply with applicable codes including, but not limited to, the following:
 - a. National Electrical Code (NEC).

- b. National Electrical Safety Code (NESC).
- c. National Fire Protection Association (NFPA).
- d. Federal, state and local codes and utility company regulations.

1.04 Temporary Sanitary Facilities

A. Furnish and install temporary sanitary facilities for use throughout the construction period. Existing facilities, private property facilities, school facilities and the Owner's facilities, if any, shall not be used. The temporary facilities herein, include, but are not limited to, the following:

1. Potable water for construction personnel

- a. Portable containers to dispense drinking water. Provide cups for use by all employees at the Project Site.
- b. Maintain the temperature between $45\Box F$ (7.5 $\Box C$) and $55\Box F$ (13 $\Box C$).
- 2. Enclosed toilet facilities for construction personnel.
- 3 General employee washing facilities.
- 4. The Owner's facilities shall not be used by any construction personnel.

B. Minimum number of fixtures

1. Toilets and Urinals

- a. For less than 20 employees: One (1) toilet.
- b. For 20 or more employees: One (1) toilet and one (1) urinal per 40 workers.

2. Washing Facilities

a. Adequate for the number of employees and for the type of work requiring washing facilities.

C. Maintain strict supervision of use of facilities

1. Enforce conformance with applicable standards.

- 2. Maintain, service and clean facilities.
- 3. Enforce proper use of sanitary facilities.
- 4. Prohibit Contractor/subcontractor use of the Owner's facilities.

D. Cost of Installation and Operation

- 1. Pay the costs of temporary sanitary facilities, including costs of installation, maintenance and removal.
- 2. Costs of Water: As specified in Article 1.02(C)(2) and 1.02(E)(2), herein.
- 3. Pay the service charges for the use of portable sanitary units.

E. Facility Locations

- 1. Within each project site at a location(s) approved by the Owner and Engineer.
- 2. Drinking Water: Convenient to work stations.
- 3. Toilet and washing facilities
 - a. Secluded from public observation.
 - b. Convenient for use of personnel in relation to work stations.
- 4. Obtain acceptance of facility locations from the Owner and Engineer.

F. Enclosure for Toilet Facilities

- 1. Weatherproof, sight-proof, sturdy temporary enclosures.
- 2. Insect-proof screening, adequate natural ventilation.

G. Requirements of Regulatory Agencies

- 1. Obtain and pay for all permits as required by governing authorities.
- 2. Comply with federal, state, and local codes.

1.05 Temporary Ventilation

- A. The Contractor shall provide, operate and furnish power for temporary ventilation required for:
 - 1. The proper installation and curing of materials.
 - 2. Installation of materials and equipment in confined spaces.
 - 3. The safety of the workmen.

1.06 Temporary Fuel Supply

- A. The Contractor shall provide for all temporary fuel supply needs and specified herein and the General Conditions. A temporary fuel supply, for all types of fuel, shall be supplied as needed for running Contractor furnished tools and equipment
- B. Temporary fuel supply tanks and equipment shall be of the double wall containment type with delivery systems that prevent accidental spillage of fuel.
- C. Road capable vehicles or portable equipment that require fuel shall not be fueled onsite.
- D. Accidental spills shall be cleaned up immediately. Any site impact containment of soils shall be remediated to the satisfaction of all governing agencies at the Contractor's cost.

1.07 Temporary Internet

- A. The Contractor shall provide, for himself, at least one of the following:
 - 1. Cellular phone service for the site superintendent/foreman.
- B. The Contractor shall have *high-speed internet* service at the field construction office.
- C. The Contractor shall pay for all telephone bills resulting from the use of services from the Contractor's Field Office(s) as part of the Contract. The bills to be paid shall include, but are not limited to, installation charges, monthly telephone service, all telephone calls (local and project-related long distance calls), monthly "high speed" internet service, throughout the entire construction period.

1.08 Temporary Pumping, Site Drainage, Erosion and Mud Control

- A. The Contractor shall refer to Section 01570, *Temporary Erosion and Sedimentation Control* for detailed erosion control requirements.
- B. The Contractor shall **keep the project site free from water at all times** to permit continuous access and to prevent damage to the Work.
- C. The Contractor shall comply with all of the requirement presented in Section 02075, *Dewatering and Drainage*.
- D. Provide for the drainage of stormwater onto or off of the Project site in performance of the work. Drainage facilities shall be adequate to prevent damage to the work, project sites, and adjacent properties.
- E. Existing drainage channels and conduits shall be cleaned, enlarged or supplemented as permitted by drainage control agencies to carry all runoff attributable to Contractor's operations. Dikes shall be constructed to divert runoff from entering adjacent property (except in natural channels), to protect City's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided to prevent downstream flooding and waterway contamination.
- F. Install silt barriers, turbidity curtains and screens for capturing sediment/solids from erosion and liquids from temporary pumping and dewatering activities.
- G. Prevent erosion of soil on the Project Site and adjacent properties resulting from the Contractor's construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection. Install silt barriers or screens for capturing sediments/solids from erosion and dewatering activities.
- H. Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.
- I. Perform dust and mud control operations to prevent construction operations at the Project construction site from producing dust and mud in amounts harmful to persons or causing a nuisance to persons living nearby or occupying buildings in the vicinity of the work. The Contractor shall use water or a dust preventative to control dust during throughout the construction period. Their supply and application shall be at the expense of the Contractor. The Contractor shall take all steps necessary to prevent the tracking of mud onto facility roadways, adjacent streets and highways.
- J. The Contractor shall be responsible for procuring and paying for all required permits associated with temporary pumping and site drainage.

1.09 Material Hoists and Cranes

- A. Provide material hoists required for normal use by all trades and employ skilled hoist operators. Provide all necessary guards, signals, safety devices, etc., required for safe hoist operation.
- B. The construction and operation of material hoists shall be in accordance with the applicable ANSI Standards, the "Manual Code of Accident Prevention in Construction" of the Associated General Contractors of America, OSHA, and of other Federal, State, and municipal codes or ordinances.
- C. The Contractor shall prohibit the use of hoists for transporting personnel. Hoists shall be located to avoid risk of damage to completed work.
- D. Special rigging and hoisting facilities shall be provided by each trade requiring their use.
- E. The Contractor shall employ a crane and certified operator, as necessary, from a local professional crane firm, to facilitate the Work in accordance with the Contract Documents.

1.10 Temporary Runways, Chutes, Scaffolding and Ladders

- A. Provide temporary ladders, chutes, ramps, and runways as required for performance and inspection of the Work. The above facilities shall be constructed and maintained in accordance with the applicable Federal, State, and Municipal regulations and codes.
- B. Furnish, erect, and maintain all scaffolding required for the Project Work. Scaffolding shall be constructed and maintained in accordance with applicable State and Federal laws and local ordinances. Scaffolding shall be promptly removed after serving its purpose.
- C. The structural strength and safety of scaffolding, runways, chutes, covers, railings, ladders, stairs, etc., and compliance with all laws and regulations shall be the sole responsibility of the Contractor.
- D. No materials shall be dropped from structures except through enclosed wooden or metal chutes which shall be provided and maintained as required for the performance of the work by the various trades.

1.11 Temporary Roadways and Parking Areas

- A. Construct temporary roadways and parking areas within the Project Site as required to provide proper access to the site for delivery of material and equipment of all trades.
- B. Construct temporary parking areas for the Contractor's Field Office(s), at the Project Site, in accordance with Article 2.06 of this Specification Section.
- C. At completion of the Project Work or when directed by the Engineer, surfacing and sub-base material used for the temporary road and parking areas shall be removed, unless otherwise approved by the Engineer, disposed of in a legal manner and the area restored to its natural condition as required by the Owner.

1.12 Project Signs

- A. As soon as practicable after Award of the Contract, the Contractor shall furnish and erect one (1) sign for the Project at the entrance of the project site, placed at a location to be determined by Engineer and Owner.
- B. The Project sign shall be erected before the Work is started and shall be suitably supported, braced, and maintained, and shall be removed upon completion of the project or when directed by the Engineer. The Project Sign shall meet the requirements presented in Section 01580, *Project Identification and Signs*.
- C. **The Contractor shall submit**, in accordance with Section 01300, Shop Drawings, Submittals and Samples, and Section 01580, Project Identification and Signs, an 11-inch x 17-inch AutoCAD drawing of the project sign **to the Engineer for approval prior to final preparation of the sign and installation**.
- D. No other signs will be permitted.

1.13 Security

A. The Contractor shall, at all times, be responsible for the security required in all project areas and shall provide all reasonable protection to prevent damage, injury or loss to employees on the Work and all other persons who may be affected thereby; all the work materials and equipment to be incorporated therein, whether in storage on or off the project site, under the care, custody or control of the Contractor or any subcontractors; and any other property under the care, custody or control of the Contractor or any subcontractors. The Contractor shall be responsible for such security and safety until final acceptance of the Work

B. Full-time watchmen *will not* be specifically required as a part of the Contract, but the Contractor shall provide inspection of work area daily and shall take whatever measures are necessary to protect the safety of the public, workmen, and materials, and provide for the security of the site, both day and night.

1.14 Construction Solid Waste Disposal

A. The Contractor shall provide at least one (1) roll-off container for construction debris for the duration of the construction contract.

1.15 Fire Danger

- A. The Contractor shall minimize fire danger in the vicinity of and adjacent to the Project construction site. The Contractor shall provide labor and equipment to protect the surrounding private property from fire damage resulting from construction operations.
- B. All costs arising from fire or the prevention of fire shall be at the expense of the Contractor.

1.16 Construction Staking

A. The Contractor shall provide all construction staking for the Work.

2. PRODUCTS

2.01 Materials

- A. Materials may be new or used, but must be adequate for the purpose required, sanitary and must not violate requirements of applicable codes.
- B. At the Contractor's option, patented specialty products may be used, in compliance with applicable codes.

2.02 Electricity

A. Refer to Article 1.03 within this Specification Section.

- B. Comply with the requirements of Division 16, *Electrical*.
- C. Provide the required facilities, including transformers, conductors, poles, conduits, raceways, breakers, fuses and switches.
- D. Provide the appropriate enclosures for the environment in which used, in compliance with NEMA standards.

2.03 Temporary Sanitary Facilities

- A. Refer to Article 1.04 within this Specification Section.
- B. <u>Drinking Water Facilities (Portable Containers)</u>
 - 1. Tightly closed, and equipped with dispensing tap.
 - 2. Clearly label contents.
 - 3. Do not use for any other purposes.
 - 4. Provide single-service disposable cups, with a sanitary container for unused cups, and waste receptacles for used cups.

C. Toilet Facilities

- 1. Portable Toilets shall be either: (1) chemical toilets; (2) recirculating toilets; or (3) combustion toilets.
- 2. Toilet Tissue: Provide at each toilet, on a suitable dispenser.

2.04 Contractor's Field Office(s) and Facilities

A. Specific Requirements

- 1. Provide either a separate building or a trailer of adequate floor space for the Contractor's use at the Project Site.
- 2. The trailer(s) shall be weather-tight, have a tight level floor at least eight (8) inches off the ground, shall be insulated, have suitable screened ventilation and a solid door. The Contractor shall provide temporary wooden steps and a landing with handrailing for ingress and egress to the office. The landing, steps and handrailing shall be constructed using new pressure treated lumber in accordance with local building codes and ordinances.

- 3. The office shall be provided with a weekly janitor service, heating equipment, water, approved fire extinguisher(s), electrical wiring, outlets and fixtures suitable to light the tables and desks adequately.
- 4. Toilet facilities are to be included with a holding tank to be pumped clean daily by the Contractor. Garbage shall be collected daily and clean-up of the trailer(s) shall be provided at least three (3) times per week.

5. Lighting and Temperature Control

- a. Central heat and air-conditioning system capable of maintaining the trailer(s) between 65□F and 80□F with a heat strip and thermostat control (minimum 12,000 BTU (1-ton) rating).
- b. The trailer(s) shall be provided with sufficient ceiling mounted lights per current lighting standards.

B. Furniture and Equipment

- 1. The office(s) shall have the following furniture and equipment:
 - a. Telephone: The Contractor shall provide one (1) cellular phone service for the site superintendent/foreman.
 - b. Internet: *High-speed internet access is required*.
 - c. Racks and file for Project Record Documents.
 - d. Other furniture and furnishings: Contractors' option.
- C. Within ten (10) days after issuance of the Notice to Proceed, submit a sketch showing the proposed number and locations; including storage sheds and trailers.
- D. The Contractor shall locate all temporary construction offices and storage trailers in locations approved by the Owner and the Engineer.

2.05 Engineer's Field Office

A. An Engineer's field office trailer will not be required on this project. An office space in the Contractor's Field office/trailer shall be provided for the Engineer resident project representative.

2.06 Temporary Parking

- A. Provide a location, approved by the Engineer, for a gravel (12-inch minimum depth) or other suitable surface for the Contractor's employees, Engineer's representatives and visitor parking. Personal vehicles will be restricted from the work area.
- B. Provide gravel parking space at the Contractor's trailer(s) for a minimum of four (4) vehicles.

2.07 Security Lighting

A. Provide for adequate pole-mounted flood lights for the parking area at the Contractor field office area. Maintain lighting on a photocell or timer.

2.08 Temporary Structures

A. Temporary Fences/Structures

- 1. If, during the course of the work, it is necessary to remove or disturb any needed fence or structure, or part thereof, the Contractor shall provide a suitable temporary fence or structure at his own expense.
- The original fence or structure shall be replaced to at least its original condition, once the work is completed. The Project site shall remain secure at the perimeter at all times during the construction.

B. Temporary Controls/Power

1. If, during the course of the work, it is necessary to provide temporary means to control or power existing or new equipment until the final equipment is completed, the Contractor shall provide a suitable temporary equipment at his own expense.

C. Responsibility for Temporary Work

 In accepting the Contract, the Contractor assumes full responsibility for the sufficiency and safety of all temporary work and for any damage which may result from their failure or their improper construction, maintenance or operation and will indemnify and hold harmless the Owner and Engineer from all claims, suits or actions and damages or costs of every description arising by reason of failure to comply with the above provisions.

3. EXECUTION

3.01 General

- A. Install the Work in a neat and orderly manner.
- B. Make structurally sound throughout.
- C. Maintain to provide continuous service.
- D. Modify and extend services as the Project Work progress requires.
- E. The Contractor's Field Office shall be delivered to the Project Site and made suitable for occupation (all facilities and services specified herein shall be fully operational) within ten (10) days after the Notice to Proceed.
- F. The Contractor's Field Office shall be removed from the Project Site at Final Project Acceptance by the Owner and the area fully restored to its natural condition prior to construction and in a manner approved by the Engineer.

3.02 Temporary Water

- A. Locate piping and outlets
 - 1. Provide service convenient to work stations.
 - 2. Avoid interference with:
 - a. Traffic and work areas.
 - b. Materials handling equipment.
 - c. Storage areas.
- B. Do not run piping on the floor or on the ground.
- C. When necessary to maintain pressure, provide temporary pumps, tanks, and compressors.

3.03 Temporary Electricity

A. Service and distribution may be overhead or underground.

- B. Locate temporary electricity to avoid interference with the following:
 - 1. Traffic, work and storage areas.
 - 2. Cranes.
 - 3. Material handling equipment
- C. Do not run branch circuits on the floor or on the ground.
- D. Wire all safety devices specified for final operation of the equipment.
- E. Check the operation of all safety devices.

3.04 Temporary Sanitary Facilities

A. Portable Toilets

- 1. Erect toilets securely and anchor them to prevent dislocation or tipping over.
- 2. All sanitary waste shall be collected from the sanitary facilities a minimum of three (3) times per week by a licensed sanitary waste management contractor to prevent accumulation of wastes and creation of unsanitary conditions and odors.
- 3. Portable toilet shall be used unless wastewater and water service can be provided to site.

B. Washing Facilities

1. Provide faucets, drains and other washing facilities suitable for the type of work requiring washing.

3.05 Location of Construction Trailer(s)

- A. The Contractor shall locate the field office and construction trailer(s) where indicated on the Contract Drawings or as indicated by the Engineer and Owner.
- B. A "staging area" for delivered equipment stored outdoors, or for temporary storage trailers and sheds, shall be separated from the trailer area, as located on the Contract Drawings or as indicated by the Engineer and Owner.

3.06 Temporary Fuel Systems

- A. Install and maintain temporary diesel fuel tanks in a manner to avoid accidental spillage of fuel.
- B. Facilities shall be kept out of the path of normal vehicular traffic, including temporary fuel feed lines.

3.07 Removal of Temporary Materials and Equipment

- A. Completely remove all temporary materials, equipment, facilities, services and controls and legally dispose of them upon completion of construction.
- B. Clean, and repair damage caused by installation of the temporary facilities and restore the area to the specified, or original condition. All areas shall be solid sodded, after removal of temporary materials, equipment and construction trailer(s), in accordance with Section 02815, *Solid Sodding*.

END OF SECTION

SECTION 01510

MOBILIZATION / DEMOBILIZATION

1. GENERAL

1.01 Description

- A. Mobilization shall include the costs of obtaining all permits, insurance and bonds, moving onto the Project sites; all facets of construction for the Project, furnishing and erecting facilities, equipment, systems, temporary buildings, and other construction facilities; all facets of construction activities on the Project Site all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:
 - 1. Move onto the site all Contractor's plant and equipment required for the first month's operations.
 - 2. Install temporary construction power, wiring, and lighting facilities.
 - 3. Establish a fire protection plan and safety program (shall meet all local, state and federal requirements).
 - 4. Secure a construction water supply.
 - 5. Provide field office trailer(s) for the Contractor as specified. *The office/trailer shall be set-up and complete within ten (10) days after the Notice to Proceed.*
 - 6. Provide on-site sanitary facilities and potable water facilities as specified.
 - 7. Arrange for and erect the Contractor's work and storage yard and employee's parking facilities.
 - 8. Submit all required insurance certificates and bonds.
 - 9. Obtain all required permits.
 - 10. Post all OSHA, FDEP, EPA, Department of Labor, and all other required notices.

- 11. Have the Contractor's *English-speaking* superintendent at the job site "full time".
- 12. Submit a detailed construction CPM schedule acceptable to the Engineer as specified.
- 13. Submit a Schedule of Values (SOV) for the Work as specified.
- 14. Submit a schedule of submittals as specified.
- 15. All employees shall:
 - a. Pass a Criminal Background Check.
 - b. Have **state-issued identification badges** prior to coming "on-site".

1.02 Demobilization

A. Demobilization is the timely and proper removal of all Contractor owned material, equipment or plant, from the job site and the proper restoration or completion of work necessary to bring the site into full compliance with the Contract Documents.

1.03 Payment for Mobilization/Demobilization

- A. The Contractor's attention is directed to the condition that *payment for mobilization/demobilization or any part thereof, shall not exceed three (3) percent of the Total Contract Price.*
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01530 CONSTRUCTION AIDS

1. GENERAL

1.01 Description

A. Scope of Work

- 1. Furnish, install and maintain required construction aids for completion of the work associated with the Project.
- 2. Remove all construction aids on completion of Work.

B. Related Requirements Described Elsewhere

Specification Section	Title
01010	Summary of Work

C. Comply with the applicable requirements specified in the Project Contract Documents.

2. PRODUCTS

2.01 Materials

A. Materials may be new or used, suitable for the intended purpose, but must not violate the requirements of applicable codes, standards, and regulations.

2.02 Construction Aids

A. Provide construction aids and equipment required by personnel and to facilitate execution of the Work: scaffolds, staging, ladders, stairs, ramps, runways, platforms,

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- railings, hoists, cranes, chutes and other such facilities and equipment such as temporary valves and fittings. Refer to respective specification sections for the particular requirements for each trade.
- B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.
- C. Maintain facilities and equipment in a "first-class" condition.

3. EXECUTION

3.01 Preparation

A. Consult with the Engineer, review site conditions and factors which affect the construction procedures and construction aids, which may be affected by execution of the Work.

3.02 General

- A. Comply with applicable requirements specified in the Project Contract Documents.
- B. Relocate construction aids as required by the progress of construction, by storage of work requirements and to accommodate legitimate requirements of Owner and other contractors employed at the site.

3.03 Removal

- A. Completely remove temporary materials, equipment and services:
 - 1. When construction needs can be met by use of permanent construction.
 - 2. At completion of the Work.
- B. Clean and restore areas damaged by installation and by use of temporary facilities.
 - 1. Remove foundations and underground installations for construction aids.
 - 2. Grade and grass areas of the site affected by temporary installations to required elevations, slopes, ground cover and clean the area.

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C. Restore permanent facilities used for temporary purposes to the specified condition or in kind if not specified.

END OF SECTION

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SECTION 01550 MAINTENANCE OF TRAFFIC

1. GENERAL

1.01 Scope of Work

A. This Section covers procedures for developing and implementing traffic control and regulation measures and maintenance of traffic in and around the construction area to provide for safe and efficient protection and movement of vehicular and pedestrian traffic/through and adjacent to the construction site areas.

B. Related Work Specified Elsewhere

Specification Section	Title
01500	Temporary Facilities
Division	Information
2	Sitework

1.02 Terminology

A. The term "*Maintenance of Traffic*" as used herein, shall include all facilities, devices, traffic control personnel, and operations as are required for the safety and convenience of the public as well as for minimizing public nuisance.

1.03 References

A. Codes, Specifications and Standards

 Any reference to published specifications or standards of any organization or association shall comply with the requirements of the specification or standard which is current on the date of the Advertisement for Bids. In case of a conflict between the referenced specifications or standards, the one having the more stringent requirements shall govern.

- 2. Codes, specifications, and standards referred to by number or title shall form a part of this Specification to the extent required by the reference thereto. Latest revisions shall apply, unless other wise shown or specified.
- 3. In case of a conflict between the referenced specifications or standards and the Contract Documents, the Contract Documents shall govern.
- 4. The publications listed in Table 01550-1 form a part of the Specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

Table 01550-1: Referenced Publications	
	FDOT Manual State of Florida Manual of Traffic Control and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations
	FDOT Specifications Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition
	FDOT Standards Florida Department of Transportation Roadway and Traffic Design Standards, Latest Edition
	Manual on Uniform Traffic Control Devices

1.04 Submittals

- A. All items associated with maintenance of traffic and this Project shall be submitted to the Engineer for approval in accordance with Section 01300, *Shop Drawings, Submittals and Samples*, prior to construction.
- B. Before closing or restricting traffic flow through any thoroughfare or the internal roadway(s) within the treatment facility site, the Contractor shall give written notice to and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction over the thoroughfare. The Contractor shall also notify the applicable law enforcement, fire, and emergency services having jurisdiction in the area. Notice shall be given no less than seventy-two (72) hours in advance of the time when it may be necessary in the process of construction to close or restrict traffic to such thoroughfare, or as may be otherwise required by the governing authority.
- C. The Contractor shall prepare and submit a Maintenance of Traffic (MOT) Plan or Traffic Control Plan (TCP). The MOT shall comply with County Code and Federal and State criteria, specifically MUTCD and FDOT 600 Series Indexes. Each MOT shall include, but not be limited to, the following:
 - 1. Each MOT shall show the posted speed limits.

- The MOT for work outside the travel lanes can consist of the legible dimensioned sketch of field conditions, position and type of traffic control devices and a brief description of intended work, type of right of way encroachment, time and work duration.
- 3. The MOT requiring a full or partial closure will provide full information as above, and dimensioned legible sketch of conditions and MOT. Based on the complexity of the project, the Engineer may require a Professional Engineer (P.E.) sign and seal plans. This requirement may be satisfied if the MOT is prepared by a company having trained and design certified personnel.
- 4. The MOT for larger projects (i.e., subdivision entrance with deceleration lanes and overlay) will require that the plans be signed and sealed by a Professional Engineer (P.E.) The MOT shall detail individual phases.
- 5. The TCP shall include the listing of all agencies (police, fire, emergency, utilities) and phone numbers to be contacted (72 hours) before and during MOT.
- 6. During the construction of the Project, an MOT trained and certified person shall be present. The level of certification depends on type and complexity of the job (flagman, ATSSA Certified Worksite Traffic Supervisor, etc.).
- 7. Any changes in the MOT shall be supervised by trained and responsible personnel (i.e., ATSSA Inspector). It includes active to non-active, day to night and phasing.
- 8. The Contractor may choose to provide professional services from such firms as Bob's Barricades, Traffic Control Devices, Inc., Control Specialists, Inc., etc. The TCP and onsite MOT shall clearly display the names and emergency phone number of the MOT responsible person.

1.05 Site Conditions

- A. The Contractor shall plan construction operations such that existing local traffic access can be maintained and shall maintain during the construction such barricades, lights, flagmen, and other protective devices as appropriate, whether specified for the project or required by the local governing authority. Traffic control devices used for maintenance of traffic shall comply with the FDOT Manual.
- B. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community or within the treatment facility site. Insofar as it is practicable,

- excavated material and spoil banks shall not be located in such manner as to obstruct traffic. The traveled way of all streets, roads, and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary.
- C. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate proper construction and shall be maintained by the Contractor in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the Engineer and the Owner and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or properly resulting from his work.
- D. The Contractor shall make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters. The Contractor shall immediately cart away all offensive matter, exercising such precaution as may be directed by the Owner. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks) fences) and adjacent property of all kinds. The Contractor may be required to erect suitable barriers to prevent such inconvenience or injury.
- E. Unless otherwise required by the governing authority, maintenance of traffic in and around the construction zone shall conform to Section 102 of the FDOT Specifications, and 600 Series Roadway Design Standards drawings of the FDOT Standards, as applicable.

1.06 Qualifications

- A. Provide at least one (1) employee in the field (superintendent or foreman) who holds an IMSA (International Municipal Signal Association) Work Zone Traffic Control Safety Certification.
- B. This certified employee shall be on the job site when the traffic control measures are installed and when work is occurring within the zones.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 Site Preparation

- A. Contact property owners affected by the construction. Coordinate temporary driveway closures and sequencing. Maintain access for all property owners during construction.
- B. Remove existing pavement markings, as required, and remove or relocate existing signs as necessary to implement traffic control.
- C. Install signs, markings, barricades in accordance with approved traffic control plan.
- D. Implement lane closures in accordance with the "approved" traffic control plan.
- E. Perform work in a manner that will cause minimum interruptions to traffic.
- F. Place excavated material outside roadway clear zones, and away from pedestrian facilities.
- G. All trenches shall be backfilled each day prior to the completion of construction activities.
- H. Where special hazards exist, install traffic control through the use of lighted concrete barriers, barricades, or other such traffic control facilities as needed to ensure public safety.

3.02 Maintenance

- A. Inspect traffic control devices on a daily basis to ensure placement of barricades and function of lights is maintained throughout construction.
- B. Wet unstabilized areas as necessary to control dust.
- C. Adjust traffic control devices as required under emergency conditions.

END OF SECTION

SECTION 01560

ENVIRONMENTAL PROTECTION

1. GENERAL

1.01 Description

A. Work Specified Herein

- 1. Environmental Protection References
- 2. Submittals
- 3. Environmental Protection Requirements
- 4. Quality Assurance
- 5. Natural Resources
- 6. Erosion and Sediment Control
- 7. Solid and Sanitary Wastes
- 8. Hazardous Wastes
- 9. Dust
- 10. Abrasive Blasting

B. Related work specified elsewhere

Specification Section	Title
01000	Project Requirements
01300	Shop Drawings, Submittals and Samples
01570	Temporary Erosion and Sedimentation Control
Division	Information
2	Sitework

1.02 Scope of Work

A. Furnish all labor, materials, and equipment to perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract.

For the purpose of this Section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents that adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.

- B. The control of environmental pollution requires consideration of air, water and land, and involves the management of noise and solid waste, as well as other pollutants.
- C. The Contractor shall schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the Work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching or other special surface treatments as are required to prevent silting and muddying streams, rivers, canals, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 01570, Temporary Erosion and Sedimentation Control.
- D. This Section is intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.
- E. All phases of sedimentation and erosion control shall comply with and be subject to approval of the Florida Department of Environmental Protection (FDEP). The Contractor shall prepare sedimentation and erosion control drawings to minimize the impact of the construction activities and meet the requirements of the FDEP. These drawings and control methods must be submitted to the Engineer, and approved, prior to the beginning of Project construction activities. The Contractor shall be responsible for implementing the approved program and meeting all local, state and federal requirements.

1.03 References

A. The publications listed in Table 01560-1 form a part of the Specifications to the extent referenced. The publications are referred to in the text by the basic designation only.

TABLE 01560-1: REFERENCED PUBLICATIONS	
CODE	DESCRIPTION
29 CFR 1910.94 (SubPart G)	Occupational Health and Environmental Control
40 CFR 112	Oil Pollution Prevention
40 CFR 261	Identification and Listing of Hazardous Waste

TABLE 01560-1: REFERENCED PUBLICATIONS	
CODE	DESCRIPTION
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities
40 CFR 403	General Pretreatment Regulations for Existing and New Sources of Pollution
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Tables and Hazardous Materials Communications Regulations
49 CFR 178	Shipping Container Specifications
PL 96-510	Comprehensive Environmental Response Compensation and Liability Act of 1980

1.04 Definitions

A. Chemical Wastes: Salts, acids, alkalies, herbicides, pesticides, and organic

chemicals.

B. Debris: Combustible and noncombustible wastes such as ashes and

waste materials resulting from construction or maintenance and

repair work, leaves, and tree trimmings.

C. <u>Garbage</u>: Refuse and scraps resulting from consumption of food.

D. <u>Hazardous Materials</u>: As defined in DOT regulation 49 CFR 171 and listed in

49 CFR 1 72.

E. <u>Hazardous Substances</u>: As defined in EPA PL 96-510.

F. <u>Hazardous Wastes</u>: Hazardous substances as defined in 40 CFR 261 or as

defined by applicable state and local regulations.

G. <u>Landscape Features</u>: Trees, plants, shrubs and ground covers.

H. Oily Wastes: Petroleum products and bituminous materials.

I. Rubbish: Combustible and noncombustible wastes including paper, boxes,

glass, crockery, metal, lumber, cans and bones.

J. Sediment: Soil and other debris that have eroded and have been transported

by runoff water or wind.

K. Solid Wastes: Rubbish, debris, and other discarded solid materials, except

hazardous waste as defined in paragraph entitled, 'Hazardous Waste, resulting from industrial, commercial, and agricultural

operations and from community activities.

L. Wastewater: "Sewage" or waste characterized as domestic sanitary sewage.

1.05 Submittals

A. Submit an Environmental Protection Plan (EPP) for the Project Site, in accordance with Section 01300, Shop Drawings, Submittals and Samples, of these Contract Documents.

- B. The Environmental Protection Plan (EPP) shall include at a minimum, but is not limited to, the following:
 - 1. Submit the proposed Environmental Protection Plan (EPP) including a preconstruction survey, to the Engineer within fifteen (15) days after the Notice to Proceed.
 - 2. Identify the hazardous wastes expected to be generated and submit a management and disposal plan before commencing work.
 - 3. Submit a copy of a laboratory analysis of debris collected as a result from abrasive blasting operations before disposing of debris.
 - 4. Submit details of Dewatering and Drainage Plan in accordance with Section 02075, *Dewatering and Drainage*.

1.06 Notifications

A. The Engineer will notify the Contractor, in writing, of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor, in writing, through the Engineer, of any non-compliance with local, state or federal requirements. After receipt

of such notice from the Engineer or from the regulatory agency through the Engineer, the Contractor shall immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose.

- B. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken.
- C. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.
- D. Failure to notify the Contractor of any non-compliance by the Engineer does not relieve the Contractor of the responsibility to comply with the foregoing provisions.

1.07 Quality Assurance

A. Environmental Protection Requirements

- 1. Provide and maintain, during the life of the contract, environmental protection as specified.
- 2. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice.
- 3. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project.
- 4. Comply with Federal, state and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances and noise pollution.

1.08 Implementation

- A. Prior to commencement of the Work, the Contractor shall meet with the Engineer to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control program.
- B. Remove temporary environmental control features, when approved by the Engineer, and incorporate permanent control features into the Project at the earliest practicable time.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 Asbestos

- A. Materials containing asbestos should not be located on the Project site.
- B. Notify the Engineer immediately if asbestos materials are encountered.

3.02 Erosion Control

- A. Provide positive means of erosion control such as shallow ditches around construction activities to carry off surface water. The Contractor shall refer to Section 01570, *Temporary Erosion and Sedimentation Control*.
- B. Erosion control measures, such as siltation basins, hay check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate.
- C. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas.
- D. At the completion of the work, ditches shall be backfilled and the ground surface restored to the original condition or as proposed on the Contract Drawings.

3.03 Protection of Streams and Surface Waters

- A. Take all precautions to prevent, or reduce to a minimum, any damage to any stream, drainage channel, canal or surface water from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such natural resources.
- B. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the surface waters shall not be directly returned to the surface water. Divert such waters through a settling basin or filter before being directed into surface waters.

- C. Do not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.
- D. Take all preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the FDEP. Submit two (2) copies of approved contingency plans to the Engineer for review and approval.
- E. Water being flushed from structures or pipelines after disinfection, with a chlorine residual of 0.01 mg/L or greater, **shall be treated with a dechlorination solution**, in a method approved by the Engineer, prior to discharge.

3.04 Protection of Land Surfaces

- A. Restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of construction, that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Contract Drawings or as identified by the Engineer and/or Owner.
- B. Outside of areas requiring earthwork for the construction of the new facilities, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall, in any event, be responsible for any damage resulting from such use.
- C. Before beginning operations near them, protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by placing barricades, constructed in accordance with local requirements or as indicated by the Engineer, around them. Monuments and markers shall be protected similarly.
- D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored, as nearly as possible, to their original condition. The Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of. The cost of treating, healing, removing, disposal of and replacement of trees or other landscape features shall be incidental to the Contract.

- All scars made on trees by equipment, construction operations, or by the removal
 of limbs larger than 1-inch in diameter shall be coated as soon as possible with an
 approved tree wound dressing. All trimming or pruning shall be performed in an
 approved manner by experienced workmen with saws or pruning shears. Tree
 trimming with axes will not be permitted..
- 2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced. **Costs shall be incidental to the Contract**.
- E. The locations of the Contractor's storage and other construction buildings, required temporarily in the performance of the Work, shall be cleared portions of the job site or areas to be cleared as shown on the Contract Drawings and approved by the Engineer and shall not be within wetlands or flood plains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Contract Drawings showing storage facilities shall be submitted for approval of the Engineer.
- F. If the Contractor proposes to construct temporary roads or embankments and excavations for facility and/or work areas, he shall submit the following for approval at least ten (10) days prior to scheduled start of such temporary work:
 - 1. A layout of all temporary roads, excavations, embankments and drainage to be constructed within the work area.
 - 2. Details of temporary road construction.
 - 3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.
 - 4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.
- G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials,

or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions that will permit the growth of vegetation thereon. The disturbed areas shall be prepared and sodded as described in Section 02815, *Solid Sodding* or as approved by the Engineer.

H. All debris and excess material will be disposed of outside wetland or flood plain areas in a legal and environmentally sound manner.

3.05 Protection of Air Quality

A. Burning

1. The use of burning at the Project Sites for the disposal of refuse is prohibited.

B. Dust Control

- The Contractor will be required to maintain all excavations, embankment, stockpiles, access roads, facility sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.
- C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. *The use of petroleum products is prohibited*. The use of chlorides may be permitted with prior approval from the Engineer.
- D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor must have sufficient competent equipment on the job to accomplish this.
- E. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.06 Noise Control

A. Make every effort to minimize noises caused by the construction operations.

- B. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.
- C. Noise levels shall not exceed those indicated in Section 01120, *Special Project Procedures*.

3.07 Miscellaneous Provisions

- A. Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore the natural resources to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified by the Engineer/Owner.
- B. Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Take precautions to ensure that no oil or other hazardous material is released to the water or land or sanitary sewer system. Environmental requirements for the prevention of oil spills are contained in 40 CFR 112. For oil and hazardous substance spills which may be large enough to violate Federal, State or Local Regulations, verbally notify the Engineer and the Florida Department of Environmental Protection (FDEP) immediately. Immediately clean up spills of oil or hazardous substances which result from the Contractor's operations. The cost of the cleanup shall be borne entirely by the Contractor and shall be incidental to the Contract.
- C. Do not disturb fish and wildlife. Do not alter water flows or otherwise disturb the native habitat on or adjacent to the project, which is critical to the survival of fish and wildlife, except as indicated or specified.
- D. Preserve, and verbally report immediately to the Engineer, items having possible historical or archaeological interest which are discovered in the course of work. Protect monuments, markers, and works of art.
- E. Borrow pit areas, on the Owner's property, shall not be allowed.
- F. Immediately finish the earthwork to its final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.
- G. *Pick up solid wastes, and place in containers which are regularly emptied*. Prevent contamination of the site and other areas where handling and disposing wastes. On completion, leave the areas clean. *Control and dispose of all wastes in a legal manner.*

- H. The Contractor shall transport all wastes off the Project Site and dispose of them in a legal manner that complies with federal, state & local requirements at no additional cost to the Owner.
- I. Where the construction project is located in an area where garbage collection is accomplished on a scheduled basis, the Contractor shall place garbage in an appropriate container. In areas where there is no scheduled garbage collection, the Contractor shall transport the garbage to a pickup point or disposal area. The preparation, cooking, and disposing of food are strictly prohibited on the Project sites.
- J. Conduct the fueling and lubricating or equipment and motor vehicles to protect against spills and evaporation. Dispose of lubricants and excess oils in a legal manner.
- K. As indicated previously, keep dust down at all times, including during non-working periods. Do not use dry power brooming, vacuuming, wet mopping, wet sweeping, or wet power brooming is acceptable. Air blowing will be permitted only cleaning non-particulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not shake bags of cement, concrete mortar, or plaster.
- L. Provide tarpaulin drop cloths and windscreens to enclose abrasive blasting operations to confine and collect dust, abrasive agent, paint chips, and other debris. Dispose of abrasive blasting debris.
- M. Perform work involving removal of blasting debris in accordance with 29 CFR 1910.94, SubPart G. Dispose of abrasive blasting debris containing lead in accordance with 40 CFR 262, 40 CFR 263, and 264. Collect dust, sand, paint, and other debris resulting from sandblasting operations and store in fifty-five (55) gallon drums with watertight lids. Take a representative sample of this material, and test for EP toxicity with respect to lead, chromium, and cadmium content. Perform sampling and testing in accordance with 40 CFR 261. Debris shall be transported only by a transporter licensed and permitted for transportation of toxic materials. Dispose of toxic debris in an EPA-approved and permitted facility.

3.08 Maintenance of Pollution Control Facilities During Construction

A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

END OF SECTION

SECTION 01570

TEMPORARY EROSION AND SEDIMENTATION CONTROL

1. GENERAL

1.01 DESCRIPTION

A. Scope of Work

- 1. The Work specified in this Section consists of designing, providing, maintaining and removing temporary erosion and sedimentation controls as required by Rules and Regulations and permit conditions.
- 2. Temporary erosion controls include, but are not limited to, grassing, mulching, setting, watering and reseeding on-site surfaces and soil and borrow area surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the Owner and/or permit conditions.
- 3. Temporary sedimentation controls include, but are not limited to, silt dams, traps, barriers, and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the Engineer and Owner and/or permit conditions.
- 4. The Contractor is responsible for providing effective temporary erosion and sediment control measures during construction or until final controls become effective. The Contractor shall be responsible for removing and legally disposing of the erosion and sediment control measures installed as part of the Project.

B. Related Work Described Elsewhere

Specification Section	Title
02220	Excavation, Backfilling and Compaction
02815	Solid Sodding

2. PRODUCTS

2.01 Erosion Control

- A. Sodding and grassing are specified in Section 02815, Solid Sodding.
- B. Netting shall be fabricated of material acceptable to the Engineer and Owner.

2.02 Sedimentation Control

- A. Bales shall be clean, seed-free cereal hay type.
- B. Netting shall be fabricated of material acceptable to the Engineer and Owner.
- C. Filter stone shall be crushed stone which conforms to Florida Department of Transportation (FDOT) specifications.
- D. Concrete block shall be hollow, non-load bearing type.
- E. Concrete shall be exterior grade not less than one (1) inch thick.

3. EXECUTION

3.01 Erosion Control

- A. The minimum acceptable procedures for grassing are:
 - 1. Scarify slopes to a depth of not less than six (6) inches and remove large clods, rock, stumps, roots larger than ½-inch in diameter and debris.
 - 2. Sod within twenty-four (24) hours after the ground is scarified.
 - 3. Roll and water grassed areas in a manner which will encourage the growth of grass. Resod areas which exhibit unsatisfactory growth. Backfill and resod eroded areas.

3.02 Sedimentation Control

A. Install and maintain silt dams, traps, barriers, and appurtenances as shown on the approved descriptions and working drawings.

B. Hay bales which deteriorate and filter stone which is dislodged shall be replaced.

3.03 Performance

A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results that comply with the requirements of the State of Florida and/or the U.S. EPA, or the Engineer or Owner, the Contractor shall immediately take whatever steps are necessary to correct the deficiency at his own expense.

3.04 Inspection and Maintenance

- A. During construction, the Contractor shall provide, at a minimum, weekly or within twenty-four (24) hours of any storm event of 0.25 inches or greater, an inspection of the temporary erosion and sedimentation controls. Inspection and maintenance practices shall be at a minimum as follows:
 - 1. No more than twenty-five percent (25%) of the Project Site shall be denuded at any point in time.
 - 2. All measures will be maintained in good working order; if a repair is necessary, it will be initiated within twenty-four (24) hours of report.
 - 3. Built up sediment will be removed from silt fences when it has reached one third (A) of the height of a fence.
 - 4. Silt fences will be inspected for:
 - a. Depth of sediment.
 - b. Tears.
 - c. To see if the fabric is securely attached to the fence posts.
 - d. To see that the fence posts are firmly in the ground.
 - 5. Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.

- 6. A maintenance inspection report will be made after each inspection. A copy of the report shall be submitted to the Engineer and shall be keep with the stormwater pollution prevention plan. A copy of the report form to be completed by the inspector shall be included in the stormwater pollution prevention plan.
- 7. The site superintendent will select three (3) individuals who will be responsible for inspections, maintenance and repair activities, and filling out the inspection and maintenance report.
- 8. Personnel selected for inspection and maintenance practices necessary for keeping the erosion and sediment controls used onsite in good working order.
- 9. The site superintendent will select an individual who will be responsible for the recording of the dates when major grading activities occur, when construction activities temporarily or permanently cease on a portion of the site, and when stabilization measures are initialized. These records will be kept with the stormwater pollution prevention plan.

END OF SECTION

SECTION 01580

PROJECT INFORMATION AND SIGNS

1. GENERAL

1.02 Project Informational Signs

- A. One (1) painted sign with lettering, size, color and construction in accordance with the local, state and/or federal requirements at the treatment facility site.
- B. Erect the Project Site sign at a location of high public visibility as approved by the Engineer and the Owner prior to placement.

C. Sign Information

- 1. Information on each Project Sign shall contain, at a minimum, the following:
 - a. Project name (Flagler Beach WWTF Sludge Management System Improvements).
 - b. Treatment Facility Name (Flagler Beach WWTF).
 - c. Owner (City of Flagler Beach) title and logo.
 - d. Design Engineer (CPH, LLC) title and logo.
 - e. Contractor's title and logo.
 - f. Funding Agencies (Florida Department of Environmental Protection) and logo.
- 2. The size of the lettering for the Project Sign shall be as required by the Engineer and the Owner.

3. Project Sign Colors

a. All surfaces of the sign shall initially be painted with three (3) coats of white exterior grade paint.

- b. The signage, lettering and logos will be painted with two (2) coats of exterior grade paint as follows:
 - 1) Logo: Colors to match logos of the Owner, Engineer, Contractor, etc.
 - 2) Lettering: Black Lettering
- 4. The Project Sign materials shall be as identified in Article 2.01(A-C) of this Specification Section.

1.01 Description

A. Scope of Work

- 1) Furnish, install and maintain project signs at the Project construction site.
- 2) Remove the signs on completion of construction.
- 3) Install additional project signs that are designed, approved and fabricated by the Owner, at the location requested by the Owner.
- 4) Allow no other signs to be displayed.

B. Related Requirements Described Elsewhere

Specification Section	Title
01010	Summary of Work
09900	Painting

1.03 Quality Assurance

A. Sign Painter: Professional experience in the type of work required.

B. Finishes, Painting: Adequate to resist weathering and fading for the scheduled construction period.

1.04 Informational Signs

A. Painted signs with painted lettering, or standard products

1. Size of signs and lettering: As required by the Engineer and Owner, or as

appropriate to usage - 4 foot x 8 foot (Submit

shop drawings).

2. Color: As required by the Engineer and Owner,

otherwise of uniform colors throughout Project.

B. *Erect at a location, as approved the Owner and Engineer*, to provide the required information.

C. Information

- 1. Contractor's name and home office address.
- 2. A list of subcontractors and type of subcontract work.

1.05 Submittals

A. An 11-inch by 17-inch AutoCAD drawing of all Project Sign's (every type) shall be submitted to the Engineer for approval prior to final preparation of the Project signs.

2. PRODUCTS

2.01 Sign Materials

A. Structure and Framing

- 1. New wood or metal, in sound condition, structurally adequate and suitable for the specified finish.
- 2. The framing structure shall be designed to provide an even, uniform, smooth-surface without waves or buckles.

B. Sign Surfaces

1. Exterior softwood plywood with medium density overlay, standard large sizes to minimize joints.

- 2. The sign thickness shall be as required by standards to span framing members, to provide an even, smooth-surface without waves or buckles.
- C. All hardware shall be galvanized.
- D. All paint to be used shall be exterior quality, waterproof paint as specified in Section 09900, *Painting*.
- E. The Contractor shall submit shop drawing of all signs to the Engineer for approval, identifying all sign materials and layouts, prior to sign preparation.

3. EXECUTION

3.01 Project Information Signs

- A. Paint the exposed surface of supports, framing and surface material; one (1) coat of primer and one (1) coat of exterior paint.
- B. Paint all graphics in the size, styles, and colors selected by the Engineer.

3.02 Sign Maintenance

- A. Maintain signs and supports in a neat and clean condition.
- B. Repair any damage to the structures, framing or signs.

3.03 Sign Removal

A. Remove signs, framing, supports and foundations at the completion of the Project.

END OF SECTION

SECTION 01600 MATERIALS AND EQUIPMENT

1. GENERAL

1.01 Description

A. Scope of Work

- 1. In general, the material and equipment incorporated into the Work shall meet the requirements of the General Conditions as well as the following minimum requirements:
 - a. Conform to applicable specifications and standards.
 - b. Comply with size, make, type and quality specified, or as specifically approved in writing by the Engineer.

c. Manufactured and fabricated products

- 1) Design, fabricate and assemble in accordance with the best engineering and shop practices.
- 2) Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
- 3) Any two (2) or more items of the same kind, type or classification, and being used for identical types of service, shall be manufactured by the same manufacturer.
- 4) Products shall be suitable for service conditions intended supplied with all accessories, trim, finish, safety guards, and other devices needed.
- 5) Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
- 6) Only new, unused, and undamaged materials and equipment shall be incorporated into the Work.

- d. Do not use material or equipment for any purpose other than that for which it is designed or specified.
- e. The proposed manufacturers, material suppliers, and dealers who are to furnish materials and equipment for this Project shall be listed on the Bid Form.
- f. Substitute equipment for items not listed in the Bid Form shall be subject to the procedures specified in the General and Supplementary Conditions and as specified herein and must be approved by the Engineer.
- g. All transactions with the manufacturers or subcontractors shall be through the Contractor, unless the Contractor shall request, in writing to the Engineer, that the manufacturer or subcontractor deal directly with the Engineer. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.

1.02 Approval and Samples of Materials and Equipment

- A. Only "new" materials and equipment shall be incorporated in the work. All materials and equipment furnished by Contractor shall be subject to the inspection and approval of Engineer. No material shall be delivered to the site without prior approval of Engineer.
- B. Within fifteen (15) days after the Notice to Proceed, the Contractor shall submit to Engineer, data relating to materials and equipment he proposes to furnish for the work. Such data shall be in sufficient detail to enable Engineer to identify the particular product to form an opinion as to its conformity to the specifications.
- C. Materials other than those designated within the Specifications or approved by the Engineer shall not be delivered to the Project Site.
- D. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by Contractor. If the Engineer requires, either prior to beginning or during progress of the work, the Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the specifications. Such samples shall be furnished, stored, packed and shipped as directed at the Contractor's expense. Except as otherwise noted, the Contractor will make arrangements for and pay for the tests.
- E. The Contractor shall submit data and samples sufficiently early to permit consideration and approval before materials are necessary for incorporation in the work. Any delay of approval resulting from the Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against the Owner or Engineer.

- F. To demonstrate the proficiency of workers or to facilitate the choice among several textures, types, finishes and surfaces, the Contractor shall provide such samples of workmanship or finish as may be required.
- G. The materials and equipment used on the Work shall correspond to the approved samples or other data.

1.03 Substitutions and Product Options

- A. The intent of these Specifications is to provide the Owner with a quality facility without discouraging competitive bidding. Substitutions may be submitted and will be evaluated as specified herein, within Division 0, *Contract Requirements*, and Division 1, *General Requirements*.
- B. For products specifically listed in the Bid Form, the Contractor shall designate which manufacturer or supplier was used to form the basis of the bid by selecting one of the named manufacturers. No substitution shall be allowed after the Bid is awarded without significant benefit to the Owner being demonstrated, or in the case of product unavailability or other condition beyond the control of the Contractor. Requests for substitutions prior to the Bid must be made in the form of questions well in advance of the Bid date as indicated in the Instruction to Bidders. A formal submittal of product data similar to that referred to herein will be required.

1.04 Manufacturer's Instructions for Installation

- A. When Contract Documents require that installation of work shall comply with the manufacturer's printed instructions, obtain and distribute copies of such instructions to all parties involved in the installation, including two (2) copies and an electronic copy (searchable PDF) to the Engineer. Maintain one (1) set of complete instructions at the job site during installation and until Project completion.
- B. Handle, install, connect, clean, condition and adjust products in strict accordance with the manufacturer's instructions and recommendations and in conformity with specified requirements. Should job conditions or specified requirements conflict with the manufacturer's instructions or recommendations, the Contractor shall consult with Engineer for further instructions. Do not proceed with work without clear instructions.
- C. Perform all work in accordance with the manufacturer's instructions and recommendations. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by the Contract Documents.

1.05 Transportation and Handling

- A. Arrange deliveries of products in accordance with construction progress schedules. The Contractor shall coordinate to avoid conflict with work, conditions at the site, and avoid long term storage on-site
- B. Do not store materials on-site for more than thirty (30) days before installation.
- C. Deliver materials to the Project Site in ample quantities to insure the most speedy and uninterrupted progress of the Work so as to complete the Work within the allotted time frame.
- D. Coordinate delivery to ensure the minimum holding time for items that are flammable, hazardous, easily damaged, sensitive to deterioration, or subject to theft.
- E. Ship and handle products in accordance with the manufacturer's recommendations, using means and methods that prevent damage, deterioration, and theft.
- F. **Deliver products in an undamaged condition**, in the manufacturer's original containers or packaging, with identifying labels intact and legible, and instructions for handling, storage, unpacking, protecting, and installing readily available.
- G. Immediately on delivery, inspect shipments to assure compliance with the requirements of Contract Documents and approved submittals, and that products are properly protected and undamaged.
- H. Provide equipment and personnel to handle the products/equipment by methods to prevent soiling or damage to products or packaging. All materials shall be received by the Contractor and it shall be the Contractor's responsibility to provide the equipment to load, unload, and store all materials.
- I. Structural members and metal fabrications shall be handled to prevent overstress and damage of any kind. Any damaged or misformed members that can not be satisfactorily repaired at the site, without compromising the integrity of the item, shall be returned to the manufacturer for correction or replacement at no additional cost to the Owner.

1.06 Storage and Protection

A. The Contractor shall furnish a covered, weather-protected storage structure providing a clean, dry, non-corrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into this Project. Storage of equipment shall be in strict accordance

with the *Instructions for Storage* of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc. *Corroded, damaged or deteriorated equipment and parts will not be accepted by the Engineer or Owner, at any time during the construction period, and shall be replaced before acceptance of the Project at no additional cost to the Owner. Improperly stored equipment and materials shall not be included in an application for payment.*

- B. Store products in accordance with the manufacturer's instructions and recommendations, with seals and labels intact and legible.
- C. Store products subject to damage by the elements in weather-tight enclosures, off the floor, with adequate ventilation to prevent condensation. Maintain temperature and humidity with the ranges required by the manufacturer's instructions.
- D. **Store all products above the ground on blocks or skids** and prevent soiling or staining. Cover products outside, which are subject to deterioration, with impervious sheet coverings and provide adequate ventilation to avoid heat buildup and/or condensation.
- E. Miscellaneous metals, reinforcement bars, welded wire fabric, and masonry reinforcement materials shall be stored to prevent contact with the ground and from being damaged by its own weight or by other loads. Reinforcement which has become muddy shall be cleaned by the Contractor before use.
- F. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- G. Store heavy materials or equipment with adequate support structures that maintain their integrity throughout the storage period.
- H. Store cementitious materials in a weather-protected storage structure on an elevated floor away from damp surfaces.
- I. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft or damage of any kind whatsoever to the material or equipment.
- J. Cement, sand and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural and miscellaneous steel, and reinforcing steel, shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of "standing water" and to minimize "rusting". Beams shall be stored with the webs

vertical. Precast concrete beams shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, chipping, cracking and spalling to a minimum.

- K. All materials, which, in the sole opinion of the Engineer, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the work, and the Contractor shall receive no compensation for the damaged material or its removal.
- L. The Contractor shall not use and shall dispose of any materials that have been stored for longer than their maximum recommended shelf life or beyond their recommended shelf date.
- M. Arrange storage in a manner to provide easy access for inspection and inventory counting of stored materials or equipment. Make periodic inspections of stored products to assure that products are maintained under specified conditions, free from damage or deterioration, and verify the inventory.

N. Protection After Installation

- 1. **Provide substantial coverings as necessary to protect installed products** from damage from traffic and subsequent construction operations.
- 2. Remove covering when no longer needed.
- 3. Periodically rotate and oil moving parts as needed and recommended.
- O. The Contractor shall be responsible for all material, equipment and supplies sold and delivered to the Owner under this Contract until final inspection of the work and acceptance thereof by the Owner. In the event any such material, equipment and supplies are lost, stolen, damaged or destroyed prior to final inspection and acceptance, the Contractor shall replace same without additional cost to the Owner.
- P. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract within seven (7) days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering and any other costs associated with making the necessary corrections.

1.07 Storage and Handling of Equipment on Site

- A. Because of the long period allowed for construction, special attention shall be given to the storage and handling of equipment on-site. As a minimum, the procedure outlined below shall be followed:
 - Materials shall not be shipped until approved by the Engineer. The intent of
 this requirement is to avoid unnecessary delivery of unapproved materials and to
 reduce on-site storage time prior to installation and/or operation. Under no
 circumstances shall major equipment or finish products be delivered to the
 site more than thirty (30) days prior to installation without written authorization
 from the Engineer.
 - 2. Materials shipped to the site, or temporarily stored off-site in approved locations, shall be stored in accordance with Article 1.06, herein.
 - 3. All equipment having moving parts such as gears, electric motors, etc., and/or instruments shall be stored in a temperature and humidity controlled building approved by the Engineer, until such time as the equipment is to be installed.
 - 4. All equipment shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer.
 - 5. The Manufacturer's storage instructions shall be carefully studied by the Contractor and reviewed with the Engineer by him. These instructions shall be carefully followed and a written record of this kept by the Contractor.
 - 6. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half the load, once weekly for an adequate period of time to insure that the equipment does not deteriorate from lack of use.
 - 7. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and final acceptance of the Project.
 - 8. Mechanical equipment to be used in the work, if stored for longer than ninety (90) days, shall have the bearings cleaned, flushed and lubricated prior to testing and startup, at no additional cost to the Owner.
 - Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by

the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be "defective". It shall be removed from the site and replaced with same at the Contractor's expense.

10. The Contractor shall be responsible to protect the factory finish of equipment and materials from damage during construction operations and until Final Project Acceptance by the Owner. Satisfactorily restore any finishes that become stained or damaged to the acceptance of the Engineer and Owner.

1.08 Warranty

- A. For all major pieces of material, provide warranties, maintenance agreement, irrevocable letters of credit, and bonds as specified in Section 01740, *Warranties and Bonds*.
- B. The manufacturer's warranty period shall be concurrent with the Contractor's for a minimum of two (2) years after Final Project Acceptance by the Owner, or as specified in each specification section.

1.09 Spare Parts and Special Tools

- A. The Contractor shall, unless otherwise stated in the Contract Documents, furnish with each type, kind or size of equipment, one complete set of suitably marked *high grade special tools and appliances which may be needed to adjust, operate, maintain or repair the equipment*. Such tools and appliances shall be furnished in approved thermoplastic cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.
- B. Spare parts shall be furnished as specified in the individual technical specifications. *The Contractor shall develop a complete list of spare parts for the Project, prior to turning over any spares to the Owner*, that shall be used as the official check off sheet for spare parts verification. See Section 01700, *Project Closeout* for additional requirements for spare parts inventory.

- C. In addition, the Contractor shall furnish, to the Engineer, an inventory table listing all spare parts for the project, prior to turning them over to the Owner, including, but not limited to, the following:
 - 1. Name of the spare part.
 - 2. The equipment or system that the spare part is associated with.
 - 3. The SKU or stock number associated with each spare part.
 - 4. The name, address, telephone and fax numbers, and e-mail address of the supplier.
 - The delivered cost of each item.
- D. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivered cost.
- E. **Each piece of equipment shall be provided with a permanent, corrosion-resistant nameplate**, securely fastened in place and clearly inscribed with the manufacturer's name, product name, year of manufacture, model and serial numbers, weight and principal rate data. Locate on an accessible but inconspicuous surface.
- F. Do not attach or imprint non-essential manufacturer's or product's trademarks or logos. Product labels or warning labels that are required should be located where required for observation after installation, as inconspicuously as allowable.

1.10 Grease, Oil and Fuel

- A. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a two (2) year's supply of the required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.
- B. The lubricants shall be provided in containers or packages with identifying indelible labels, legible and intact, that indicate the type of lubricant and the equipment that it is to be used on.
- C. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment after initial break-in of the equipment, which in no event shall be any longer than three (3) weeks of operation.

1.11 Services of the Manufacturer's Representative

- A. The Contract prices for equipment shall include the cost of furnishing a competent and experienced representative who shall represent the manufacturer and shall assist the Contractor, when required, to install, adjust, test, certify and place into operation, the equipment in conformity with the Contract Documents.
- B. After the equipment is placed into permanent operation by the Owner, the manufacturer's representative shall make all adjustments and tests required by the Engineer, and these Contract Documents, to prove that such equipment is in proper and satisfactory operating condition, and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.
- C. The Contractor shall review and conform to all of the requirements of Section 01430, *Manufacturer's Services*.

1.12 Equipment Selection and Serviceability

- A. Locate and install all equipment so that it may be serviced. Demonstrate, during the shop drawing review process, that there is room to remove all parts, shafts, bearings, filters, pumps and motors and similar equipment.
- B. Equipment that is too large or poorly located to permit servicing shall be replaced or repositioned at no additional cost to the Owner.
- C. Where piping, control diagrams or sequencing differ from the recommended piping arrangements of the equipment manufacturer, and will directly affect the equipment performance, the manufacturer's recommendations shall be submitted in writing to the Engineer for review prior to purchasing the equipment involved. Obtain such recommendations from the manufacturers in order to effect correct and perfect operation of the equipment at the capacities and temperatures indicated.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01650

SYSTEM'S START-UP AND DEMONSTRATION

1. GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. Demonstrate to the Owner and Engineer that the Work functions as a complete and operable system under normal and emergency operating conditions.

B. Related Work Described Elsewhere

Specification Section	Title
00865	Check-Out Form
00866	Certification of Completed Demonstration Form
01311	Construction Progress Schedules
03800	Leakage Testing of Hydraulic Structures
Division	Information
0	Miscellaneous Forms
11	Equipment
13	Special Construction - PICS
15	Mechanical
16	Electrical

1.02 Applicable Codes

A. All work shall be acceptable to the State Health Authority, Florida Department of Environmental Protection (FDEP) and the U.S. EPA. If any requirements of this Section

are in conflict with the requirements of the State Health Authority, Florida Department of Environmental Protection (FDEP), or the U.S. EPA, those of the Authority shall govern.

1.03 Qualifications

- A. All work performed shall be under the direction of an experienced supervisor.
- B. All equipment used shall be in proper working condition, meet the requirements of the manufacturer/supplier and shall be adequate for the specified work.

1.04 Requirements

- A. Equipment testing and facility start-up is requisite to satisfactory completion of the Contract and, therefore, shall be completed within the required Contract Time for Substantial Completion.
- B. The Contractor shall furnish all personnel, power, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests.
- C. The Contractor shall provide all water or purchase water from the Owner, if available, required for testing of equipment, process subsystems, and facility start-up. The Contractor shall notify the Owner of the amount of water required for the test at the time the testing is scheduled. If the Owner is providing the water to the Contractor, the Owner reserves the right to limit the amount of water or set the time of day and dates of the deliveries of water to the Contractor if deliveries of such water unduly affects Owner 's system operation and to maintain customer service. The Contractor shall provide a ten (10) calendar day, written notice to the Engineer, for the scheduling of the process water for testing purposes. If the Owner is unable to deliver the water for process startup, a time extension may be provided. This extension shall be equal to the time the process startup was delayed.

D. Disposal of Non-Acceptable Water

- 1. It shall be the sole responsibility of the Contractor to dispose of facility flow produced during any equipment, process subsystem, and facility startup testing in a manner approved by regulatory agencies and to the satisfaction of the Owner.
- 2. The Contractor shall identify the disposal method in its testing protocol submittal.

E. Prior to commencement of any discharge from equipment testing and facility start-up, the Contractor shall obtain all regulatory approval, in writing, and submit it to the Engineer. If only the Owner may apply for a specified permit regarding the disposal of testing water, the Contractor shall notify the Owner and furnish all the regulatory requirements. The Contractor shall prepare all necessary regulatory agency submittals for the Owner to review and execute.

1.05 Start-Up Guidelines

A. The Contractor shall startup and test all equipment, subsystems, and the complete facility under the guidelines listed below. The startup and testing shall be performed in the following segments:

1. Individual Equipment Units

- a. The startup and testing of the individual equipment units shall not commence until all flushing, and pressure testing of pipelines, hydraulic structures, and equipment is complete and the Engineer has accepted the results. All potable water lines shall be disinfected and pressure tested prior to acceptance by the Engineer and Owner.
- b. The sequence shall be determined by the Contractor and approved by the Engineer and Owner. The description and requirements for startup and testing of individual equipment units are located under the equipment's individual specification section.

2. Process Subsystems

- a. The startup and testing of the process subsystems shall not commence until the startup and testing of the individual equipment units is complete and the manufacturer has determined the unit(s) to be "ready" for operation.
- b. The sequence shall be determined by the Contractor and approved by the Engineer and Owner. The description of startup and testing of process subsystems is located under the system's specification section or herein as noted.

3. Sludge Management System Startup

a. The startup of the Sludge Management System shall not commence until the startup and testing of the process subsystems are complete and approved by the Engineer.

b. This segment shall demonstrate operation of the facility for a specified length of time and provide evidence of satisfactory Sludge Dewatering performance in accordance with the requirements defined in Section 11553, Dewatering Screw Press.

4. Performance Testing

- a. Performance testing of the entire Sludge Dewatering system shall not commence until the startup of the Sludge Dewatering system, and its associated infrastructure (including the dewatering screw press, sludge cake pump, sludge transfer pump, polymer feed system, etc.), are complete.
- b. This segment shall demonstrate that the entire Sludge Dewatering System is functioning properly and reliably as a system and that the system will function to meet the specified standards over the stated period of time.

2. PRODUCTS

2.01 Testing

A. The Contractor shall provide all necessary equipment, appurtenances and instrumentation required for proper completion of the testing.

2.02 Start-up Plan

- A. **Submit for approval by the Engineer, an electronic copy (searchable PDF)** of a detailed start-up plan outlining the schedule and sequence of all tests and start-up activities, including, but not limited to, the following:
 - 1. Checkout forms
 - 2. Demonstration test procedures, start-up, demonstration and testing
 - 3. Certification of completed demonstration and training.
- B. Start-up and commissioning of the Flagler Beach WWTF Sludge Management System Improvements may not begin until the Start-Up Plan (SUP) is approved by the Engineer and Owner and a clearance is received from FDEP.
- C. Provide adequate chemicals and materials to perform start-up services. After completion and acceptance of the performance testing, all bulk chemical tanks shall be completely filled (at the Contractor's cost).

3. EXECUTION

3.01 Component Test and Check-out

A. Start-up Certification

- Prior to system start-up, successfully complete all the testing required of the individual components of the Work. Submit an electronic copy (PDF) of Check-out Form's (Section 00865) for each individual component or piece of equipment, signed by the Contractor or the subcontractor and the manufacturer's representative.
- 2. All copies of the Operation and Maintenance Manuals must be provided before start-up may begin and in accordance with Section 01730, Operation and Maintenance Data. These forms shall be completed and submitted before Instruction in Operation to the Owner and his personnel or a request for initiating any final inspections.
- 3. Insert one (1) copy of this form into the applicable section of each Operation and Maintenance Manual.
- B. Demonstrate to the Engineer and the Owner's representative(s), that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their own controls as designated and specified.
- C. Coordinate start-up activities with the Owner and with the Engineer prior to commencing system start-up. Utilize the Owner's/Engineers's standard start-up request form given in the Special Conditions of the General Requirements or one provided by the Engineer.
- D. Initiate O&M Training in accordance with Section 01730, *Operation and Maintenance Data*, prior to Start-Up. Training shall include the use of the facility Operation and Maintenance Manuals, handouts and any instructions received from the Engineer or Owner.

3.02 Start-Up

- A. Confirm that all equipment is properly energized, that the valves, gates, infrastructure and ancillary equipment are set to their "normal" operating condition and that the flow path through the Work is unobstructed.
- B. Confirm that all process subsystems have been tested and are ready for operation.

- C. Receive all letters of clearance from the appropriate regulatory agencies and provide proof of such clearance to the Owner.
- D. **Receive approval from the Engineer and Owner to begin start-up** of any equipment after notification is given through the standard start-up request form.
- E. Slowly initiate the operation of the process streams, and fill each hydrostatic structure in the process.
- F. Initiate start-up and training in accordance with and with the use of the facility Operation and Maintenance Manuals and any instructions received from the Engineer or Owner in accordance with Section 01730, *Operation and Maintenance Data*.
- G. Observe the component operation and make adjustments as necessary to optimize the performance of the Work.
- H. Coordinate with the Engineer and Owner for any adjustments desired or operational problems requiring debugging. Make adjustments as necessary to provide a complete and functional system.

3.03 Start-Up Demonstration and Testing

- A. After all Work components have been constructed, field tested, and started up in accordance with the individual specification sections and manufacturer requirements, and after all Check-Out Forms have been completed and submitted, perform the Start-Up and Demonstration Testing in the presence of the Engineer, Owner and Owner's representatives. The demonstration period shall be held upon completion of all systems at a starting date to be agreed upon, in writing, by the Engineer and Owner. *Prior to beginning the start-up demonstration testing, the Contractor shall submit a detailed schedule of operational circumstances for approval by the Engineer.* The schedule of operational circumstances shall describe, in detail, the proposed test procedures for each piece of equipment. Provide similar test procedure forms for each piece of equipment or section of the Work to include all particular aspects and features of that equipment or section of the Work and as specified in the Technical Sections of the Specifications.
 - B. The Start-Up and Demonstration Testing of the Sludge Management System will be conducted for eight (8) hours. The Work must operate successfully during the testing period in the manner intended and in accordance with Specification 11553 as acceptable to the Owner, Engineer and FDEP in accordance with the regulatory mandate, requirements for biosolids treatment and management. If the Work does not operate successfully, or if the start-up is interrupted due to other contracts, the problems will be corrected and the test will start over from day one. The party causing the interruption will be subject to the assessment of actual damages due to delay. During the start-up tests, instruct designated facility operating personnel in the function and operation of the Work. The Contractor is referred to

Specification Section 11553, Dewatering Screw Press.

- C. During the start-up demonstration period for the Sludge Management System (independent start-ups and 30-day Demonstration Testing periods), operate the Work, instruct designated facility operating personnel in the function and operation of the Work, and cause various operational circumstances to occur. Demonstrate the essential features of the equipment and its relationship to other equipment. As a minimum, these circumstances will include average, maximum and peak daily flows, random equipment or process failures, tank overflows, surcharges, interlocks and bypasses. Demonstrate the essential features of the equipment and its relationship to other equipment. The approved schedule of operational circumstances and Demonstration Test Procedures Forms will be used as the agenda during the Start-Up Demonstration Testing period for all equipment and sections of the Work. Coordination of the Demonstration Test schedule shall be accomplished through the Engineer.
- D. The Demonstration Test procedures shall follow the sample test procedures form provided in Section 00870, *Demonstration Test Procedures*. Provide similar test forms for each section of the Work to cover all aspects and features specified.
- E. Acceptability of the Work's performance will be based on the Work performing as specified under these actual and simulated operating conditions, to provide potable water, wastewater, reclaimed water, water reclamation facility and biosolids management systems, and other utilities functioning as intended and as defined in the Contract Documents. The intent of the start-up demonstration and testing is for the Contractor to demonstrate to the Owner and the Engineer that the Work will function as a complete and operable system under normal, as well as emergency operating conditions, and is ready for final acceptance.
- F. Demonstrate the essential features of the whole system as it applies to the Work, including the mechanical equipment, piping, structures, finishes, controls, instrumentation, SCADA system, power distribution and lighting systems. Use the approved procedures and circumstances to demonstrate the system. Any minor deficiencies found shall be noted and included on a punch-list attached to the Certificate of Completed Demonstration. The system shall be demonstrated after completion of "start-up" tests. If circumstances arise that interrupt the test procedures (such as weather, unforeseen process problems, or problems caused by the Contractor whether or not the problems are the fault of the Contractor, etc.) then the test shall be terminated and rescheduled to a later date after the problem is corrected. The test shall be run in its entirety, if so directed by the Engineer.
- G. Demonstrate the essential features of all the mechanical systems including, but not limited to, the following as they apply to the Work:
 - 1. Chemical Storage and Feed Systems.
 - 2. Dechlorination Systems.

- 3. Biosolids Dewatering System and associated equipment.
- 4. Flow metering systems.
- 5. Controls and Instrumentation.
- 6. Mechanical Systems.
- 7. Electrical Systems.
- 8. Computer and SCADA Systems.
- G. Demonstrate the essential features of all electrical systems including, but not limited to, the following as they apply to the Work:
 - 1. Electrical systems controls and equipment
 - a. Electrical power equipment.
 - b. Motor control devices.
 - c. Relays.
 - d. Special transformers.
 - e. Starting devices.
 - 2. <u>Lighting fixtures</u>
 - a. Safety fixtures.
 - b. Outdoor fixtures.
 - 3. Panelboards
 - a. Distribution panels.
 - b. Lighting panels.
 - c. Main panels and power panels.
 - d. Switchboards.
 - 4. Wiring devices

- a. Face plates.
- b. Low-voltage controls.
- c. Convenience and special purpose outlets.
- d. Regular and time switches.
- H. Upon successful completion of the Start-up and Demonstration and Testing, the Owner's personnel shall receive the specified training for each system. *Training of the Owner's personnel will not be considered valid unless it takes place using a system that has successfully passed the Start-up, Demonstration and Testing.*
- I. Upon completion of all Demonstration Testing, the Contractor shall submit an electronic copy (PDF) of the Certificate of Completed Demonstration Form to the Engineer, for each item of equipment or system in the Work, signed by the Contractor, Subcontractor, Engineer, and the Owner. Insert one (1) copy of this form in the applicable section of each Operation and Maintenance Manual. A sample Certificate of Completed Demonstration Form is presented in Section 00866.

END OF SECTION

SECTION 01700 PROJECT CLOSEOUT

1. GENERAL

1.01 Description

A. Scope of Work

1. Comply with the requirements stated in Conditions of the Contract and in the Specifications for administrative procedures in closing out the Work.

B. Related Requirements Described Elsewhere

Specification Section	Title
00848	Certificate of Substantial Completion
00880	Certificate of Final Inspection
00883	Certificate of the Engineer
01650	Systems Start-up and Demonstration
01710	Cleaning
01720	Project Record Documents
01730	Operation and Maintenance Data
01740	Warranties and Bonds
01800	Miscellaneous Work and Cleanup

1.02 Substantial Completion

A. The Work at the Flagler Beach WWTF will not be declared *substantially complete*, and the Contractor may not request an inspection for a *Certification of Substantial Completion* inspection unless the following submittals and Work are completed:

- 1. All Operation and Maintenance Manuals have been submitted and "approved" to the requirements of Section 01730, Operation and Maintenance Data.
 - 2. **All equipment has been "checked-out"** by the equipment manufacturer and Certificates of Manufacturer's Check-Out have been submitted as required by Specification Section 01650, Systems Start-Up and Demonstration.
 - 3. All start-up and demonstration testing has been completed and Certificates of Completed Demonstration have been submitted in accordance with the requirements of Section 01650, System's Start-Up and Demonstration.
- 4. **Project Record Documents are complete and have been submitted and reviewed** in accordance with the requirements of Section 01720, *Project Record Documents*.
- 5. All tools, spare parts, extra stocks of material and similar physical items have been delivered to the Owner and all spare parts delivery sheets have been certified by the Contractor, Engineer and Owner.
- 6. **The entire Project Site has been thoroughly cleaned** in accordance with the Section 01800, *Miscellaneous Work and Cleanup*.
- 7. All training of the Owner's personnel has been completed and the high-quality HD recordings have been submitted in accordance with the Contract Documents.
- 8. All areas to be used and occupied are safe, operable in "automatic" and complete.
- 9. **All building occupancy certificates have been issued** by the appropriate building permitting agency.
- 10. All temporary facilities and services have been removed from the Project Site along with construction tools, mock-ups, and similar elements.
- 11. All painting, finishes, fencing, cleanup, final grading, sodding, grassing, sidewalk construction and paving have been completed and are ready for inspection.
- 12. *All marred, exposed surfaces have been touched-up* and otherwise repaired and/or restored.
- 13. All deficiencies noted on inspection reports or non-conformances are corrected or the correction plan approved.
- 14. **Punchlist items that remain**, as identified by the Engineer and Owner, shall be completed within thirty (30) consecutive calendar days.

- B. Work cannot be considered to be "Substantially Complete" until **all regulatory agency letters of clearance** for placing systems into service are received by the Owner.
- C. When the conditions of Article 1.02(A) are met, the Contractor shall submit the following to the Engineer:
 - 1. A written notice that they consider the Work at the Flagler Beach WWTF, or portion thereof, is substantially complete, and requests an inspection.
 - 2. A punchlist of items to be completed or corrected (uncompleted work which is not related to the safe, effective, efficient use of the Projects may be allowed on the punchlist with the Engineer's approval) and explanations thereof.
- D. Within a reasonable time after receipt of such notice, the Engineer will make an inspection to determine the status of Project Completion.
- E. Should the Engineer determine that the Work is not *substantially complete*:
 - 1. The Engineer will promptly notify the Contractor, in writing, giving the reasons therefore.
 - 2. The Contractor shall remedy the deficiencies in the Work and send another written notice of substantial completion to the Engineer.
 - 3. The Engineer will, within a reasonable time, reinspect the Work. The Contractor will be liable for reinspection fees as described in Article 1.04, herein.
- F. When the Engineer finds that the Work is "substantially complete", he will:
 - Schedule a walk-through of the treatment facility site to include the Owner.
 The Engineer shall determine the completeness of the punchlist and readiness of the facility for occupancy by the Owner.
 - 2. **Prepare and deliver to the Owner a tentative Certificate of Substantial Completion** (Section 00848) with the tentative punchlist of items to be completed or corrected before final inspection.
 - 3. After consideration of any objections made by the Owner, as provided in the Conditions of the Contract, and when the Engineer considers the Work substantially complete, he will execute and deliver to the Owner and the Contractor a definite "Certificate of Substantial Completion" for the treatment facility site, with a revised tentative list of items to be completed or corrected. Any incomplete work allowed on a punchlist must be reinspected upon completion and any deficiencies found will be added to the punchlist.

1.03 Final Inspection

- A. Prior to the Contractor's request for a final inspection, the following submittals and work must be complete:
 - 1. Project Record Documents must be approved.
 - 2. All spare parts, special tools and expendables have been transferred to the **Owner** with a full accounting of the quantities and amounts due per the requirement of the technical sections of the specifications.
 - 3. The Project *Operation and Maintenance materials must be suitably delivered* to the Owner per the requirements of the technical sections of the specifications and Section 01730, *Operation and Maintenance Data*.
 - 4. The Contractor must submit evidence of compliance with the requirements of the governing authorities.
 - 5. All punchlist items identified during the substantial completion inspection shall be finished to the satisfaction of the Engineer and Owner.
 - 6. Grease, dirt, dust, paint or plaster splatter, stains, labels, grease pencil markings, fingerprints, and other foreign materials shall have been removed from ALL exposed surfaces.
 - 7. The Contractor shall have repaired, patched, and touched-up ALL marred surfaces to the specified finish and match adjacent surfaces.
 - 8. All exterior paved driveways and parking areas shall have been broom cleaned.
 - 9. All sidewalks, loading areas, structures and other contiguous areas shall have been hosed down and cleaned.
 - 10. The interior and exterior of all buildings shall be thoroughly cleaned and clean of all debris, garbage, dirt, dust, etc.
- B. After satisfying the requirements of Article 1.03(A) and when the Contractor considers the Work at the treatment facility site complete, he shall submit written certification that:
 - 1. The Contract Document requirements have been met.
 - 2. The Work has been inspected for compliance with the Contract Documents.
 - 3. The Work has been completed in accordance with the Contract Documents.

- 4. Equipment and systems have been tested in the presence of the Owner's representative and are operational.
- 5. The entire project site has been thoroughly cleaned, in accordance with the General and Supplementary Conditions, and Section 01710, *Cleaning*.
- 6. All punchlist items have been corrected or completed and the Work is ready for final inspection.
- 7. FDEP Certificates of Completion of Construction or Letter of Release have been received.
- 8. Warranties, maintenance bonds, and other legal documents have been turned over to the Owner.
- C. The Engineer will, within reasonable time, make an inspection to verify the status of completion with reasonable promptness after receipt of such certification.
- D. Should the Engineer consider that the Work is "incomplete" or "defective":
 - 1. The Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
 - 2. The Contractor shall take immediate steps to remedy the stated deficiencies, and send another written certification to the Engineer that the Work is complete.
 - 3. The Engineer will, within a reasonable amount of time, reinspect the Work and the Contractor shall be liable for reinspection fees as described in Article 1.04, herein.
- E. When the Engineer finds that the Work is acceptable under the Contract Documents, he shall prepare a Certificate of Final Inspection (Section 00880) and request that the Contractor make all closeout submittals.

1.04 Reinspection Fees

- A. Should the Engineer perform re-inspections due to failure of the Work to comply with the claims of status of completion made by the Contractor:
 - 1. The Contractor will compensate the Engineer for such additional services.
 - 2. The reinspection fee will be the Engineers actual salary rate times a multiplier of 5.0 (8 hr minimum) plus any reimbursable expenses.

- 3. The Contractor shall make payment directly to the Engineer within three (3) calendar days from the date of the reinspection.
- 4. Failure to reimburse the Engineer for his time, with respect to reinspection of equipment and systems, will constitute a breach of the Project Contract/Agreement and all Work will be suspended until the Engineer is reimbursed and no additional time will be added to the Contract Time.
- 5. All lost Project time and money due to the Contractor's failure to reimburse the Engineer shall be the sole responsibility of the Contractor. No additional Contract Time shall be added to the Contract.

1.05 Contractor's Closeout Submittals

- A. Upon completion of the Project, or portions thereof, and prior to final payment, the Contractor shall transfer to the Engineer and Owner all applicable items accumulated throughout the Project Construction Period. These submittals include, but are not limited to, the following:
 - 1. Spare parts and special tools, as required by the Contract Documents.
 - 2. Submit the Manufacturer's Warranties and Bonds in accordance with Specification Section 01740, *Warranties and Bonds*, and letters of coverage extending beyond the time limitations of the Contractor's guarantee.
 - 3. Submit, in accordance with the requirements of the General and Supplementary Conditions, all Release of Lien Form and affidavits from the Contractor, subcontractors and all material suppliers.
 - 4. Certificate of Insurance for Products and Completed Operations.
 - 5. Salvaged materials or materials and equipment borrowed from the Owner.
 - 6. Project Record Documents of the completed facilities in accordance with Section 01720, *Project Record Documents*.
 - 7. Releases of liens from the Contractor plus copies of releases of lien from all subcontractors and suppliers.
 - 8. All keys to all doors, gates and equipment.
 - 9. Statements from the manufacturer's representatives as called for in the Contract Documents.

- 10. Releases of Liens from the Contractor plus copies of Releases of Lien from all subcontractors and suppliers.
- B. The closeout requirements of this Section are in addition to the requirements of other Sections, and the General and Supplementary Conditions.

1.06 Final Adjustment of Accounts

- A. Submit a final statement of accounting to the Engineer.
- B. The Final Statement of Accounting shall reflect all adjustments to the Contract Sum including, but not limited to, the following:
 - 1. The original Contract Sum.
 - 2. Additions and deductions resulting from:
 - a. Previous change orders or written amendments.
 - b. Allowances.
 - c. Unit prices, if applicable.
 - d. Deductions for uncorrected work.
 - e. Deductions for liquidated damages.
 - f. Deductions for reinspection payments.
 - g. Any other adjustments.
 - 3. The Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. The Sum remaining due.
 - 6. Evidence that all spare parts, special tools and expendable have been transferred to the Owner with a full accounting of the quantities and amounts due per the requirement of the technical sections of the specifications.

C. The Engineer will prepare a final Change Order, if necessary, reflecting the approved adjustments to the Contract Sum which were not previously made by Change Orders, and prepare a Certificate of the Engineer and a Certificate of Final Completion.

1.07 Final Application for Payment

A. The Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

2. PRODUCTS - NOT USED

3. EXECUTION - NOT USED

END OF SECTION

SECTION 01710 CLEANING

1. GENERAL

1.01 Description

A. Execute cleaning, during the progress of the Work and at the completion of the Work, as required by the General and Supplementary Conditions and as indicated herein.

1.02 Related Work

A. Cleaning for specific products or work may be identified in individual specification sections.

1.03 Disposal and Cleaning Requirements

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

2. PRODUCTS

2.01 Materials

- A. Use only those cleaning materials which will not create hazards to health or property and that will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by the cleaning material manufacturer.

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3. EXECUTION

3.01 Cleaning during Construction

- A. During construction of the work, the Contractor shall, at all times, *keep the site of the Work and adjacent premises as free from material, debris and rubbish as is practicable* and shall remove the same from any portion of the site if, in the opinion of the Owner and Engineer, such material, debris, or rubbish constitutes a nuisance or is objectionable.
- B. The Contractor shall remove from the site all of his surplus materials and temporary structures when no further need therefore develops. The Contractor shall be responsible and liable for all spillage and incur all associated costs including, but not limited to, costs related to repair and maintenance resulting from damages thereof, and fines that may be levied as a result of citations given by State or local regulatory agencies.
- C. The Contractor shall, at all times, execute daily cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations or personal activities.
- D. Provide an on-site, securely "lidded" metal dumpster and containers for the collection of waste materials, debris and rubbish. No construction waste materials shall be buried on-site.
- E. Remove waste materials, debris and rubbish from the site *a minimum of twice per week* or move frequently if necessary, or as directed by the Engineer or Owner, and dispose of at legal disposal areas away from the site.
- F. All hazardous material shall be disposed of in a manner specified by local and state regulations. Site personnel shall be instructed in these practices.

3.02 Dust Control

- A. The Contractor shall employ construction techniques that minimize the production and distribution of dust.
- B. Clean all interior spaces prior to the start of finish painting and continue cleaning on an as needed basis until painting is finished.
- C. The Contractor shall schedule operations so that dust and other contaminants resulting from the cleaning process will not fall on wet or newly-coated surfaces.

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3.03 Off-Site Vehicle Tracking

- A. The Contractor shall take all necessary measures to remove <u>sediment and/or sludge</u> from vehicles before leaving the Project Site to reduce vehicle tracking of sediment both "on-site" and "off-site". Any <u>sediment and/or sludge</u> buildup shall be immediately cleaned and removed by the Contractor at no additional cost to the Owner.
- B. Measures include, but may not be limited to, vehicle shaking device and/or wheel washing facility.
- C. The Contractor shall maintain areas of site ingress and egress and surrounding off-site public rights-of-way from the buildup of sediment and/or sludge. Any sediment and/or sludge buildup in these areas shall be immediately cleaned and removed by the Contractor at no cost to the Owner.

3.04 Final Cleaning

- A. The Contractor shall employ skilled workmen for the final cleaning process.
- B. At the conclusion of the work, all erection plant, tools, temporary structures and materials belonging to the Contractor shall be promptly taken away, and he shall remove and promptly dispose of all water, dirt, rubbish or any other foreign substances in a legal manner.
- C. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, writing on stainless steel, aluminum and other metal surfaces, and other foreign materials from sight-exposed interior and exterior surfaces.
- D. The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver such materials and equipment undamaged in a bright, clean, polished and new operating condition.
- E. Wash and shine glazing and mirrors.
- F. Polish glossy surfaces to a clear shine.
- G. The Contractor shall be responsible for the removal of excess dust and mud created by the construction project from all sidewalks, roadways, streets, and highways as directed by the Engineer. Equipment to clean these surfaces shall be subject to approval by the Engineer and Owner.
- H. Broom-clean exterior paved surfaces; rake-clean other surfaces of the grounds.

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I. Ventilating Systems

- 1. Clean permanent filters and replace disposable filters if units were operated during construction.
- 2. Clean ducts, blowers and coils if units were operated without filters during construction.
- J. Prior to final completion, or Owner occupancy, the Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces and all work areas, to verify that they are clean.

END OF SECTION

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SECTION 01720 PROJECT RECORD DOCUMENTS

1. GENERAL

1.01 Description

A. Scope of Work

- 1. Maintain at the site during construction, for the Engineer and Owner, one (1) project record copy of:
 - a. Contract Drawings.
 - b. Contract Specifications.
 - c. Addenda.
 - d. Change Orders and other modifications to the Contract.
 - e. Engineer's Field Orders or written instructions.
 - f. Approved Shop Drawings, Working Drawings and Samples.
 - a. Field Test records.
 - h. Construction photographs and the Preconstruction HD Videos (DVD/BD's).
 - i. Field engineering records for compliance with field engineering submittals.
 - An updated Project Schedule.

B. General Requirements

1. As the Work progresses, the Contractor shall be responsible for recording information on the approved Contract Documents (Contract Drawings and Technical Specification Sections) concurrently with construction progress.

- 2. The Contractor shall mark on the Contract Drawings all changes in direction and location of structure, piping, equipment, electrical, and mechanical work.
- 3. The Contractor shall mark on the Technical Specification Sections the manufacturer, trade name, catalog, and supplier of each product actually installed, and mark changes made by Change Order, Word Directive or Field Order.
- 4. All Record Drawings shall be prepared by the Contractor in AutoCAD format (latest version) using the construction plan sheets provided by the Engineer. As-built information shall be field verified, measured, added to the AutoCAD files of the construction plan sheets provided by the Engineer, and certified, signed and sealed by the Contractor's licensed Surveyor who will be responsible for the accuracy of all dimensions and elevations.
- 5. Record Drawings shall clearly show all field changes of dimension and detail including changes made by Field Order, Work Directive or Change Order.
- 6. The licensed surveyor shall identify the X, Y and (Z) location based on the coordinate system Florida East Zone State Plane Coordinate Feet NAVD 83, of all piping, valves (center of pipe) and valve boxes, hydrants (grade), blow offs (grade), sample points (grade), meter boxes (grade), foundations, structures, etc. and shall be clearly shown on the Project Record Documents. Acceptable position accuracy shall be sub-meter or better for compatibility with Global Positioning System (GPS) equipment. The vertical datum used shall be NAVD 88 unless otherwise shown on the Contract Documents.
- 7. **The licensed surveyor shall provide the GIS coordinates** of all installed process equipment, structures, vaults, manholes, etc. as part of this Project (to be used in the City's asset management program).

C. Related Work Specified Elsewhere

Specification Section	Title
01010	Summary of Work
01030	Applications for Payment
01050	Field Engineering
01200	Project Meetings
01300	Shop Drawings, Submittals and Samples
01380	Construction Photographs

Specification Section	Title
01390	Preconstruction Video Recording
01700	Project Closeout

1.02 Maintenance of Documents and Samples

- A. Store documents and samples in the Contractor's field office apart from all documents used for construction.
- B. Provide files and racks for storage of documents.
- C. Provide locked cabinets or secure storage space for storage of samples.
- D. File documents and samples in accordance with CSI format with Section numbers as provided herein.
- E. Maintain project documents in a clean, dry, legible, condition and in good order. **Do not use Project Record Documents for construction purposes**.
- F. Make documents and samples available at all times for inspection by the Engineer or the Owner.
- G. As a prerequisite for monthly Progress payments, the Contractor is to exhibit the currently updated "Project Record Documents" for review by the Engineer and Owner. Payment will be withheld if the project record documents are not satisfactorily maintained.

1.03 Marking Devices

A. Provide marking pens for recording information in the color code designated by the Engineer.

1.04 Recording

- A. Label each document "PROJECT RECORD DOCUMENT" with a rubber stamp having one (1) inch high letters, using "red ink".
- B. Record information concurrently with construction progress.

C. Do not conceal any work until the required information is recorded.

D. Project Record Drawings

- 1. Legibly and clearly mark, to scale, each drawing to record actual "As-Built" construction as follows:
 - a. All final grading elevations per the required project final survey.
 - b. Horizontal locations and vertical elevations of all structures, equipment, valves, fittings, electrical and mechanical work, connection points, etc.
 - c. All utility structure top and invert elevations (including pipe inverts, etc.).
 - d. Depths of various elements of foundation in relation to finish first floor datum.
 - e. All underground piping with pipe sizes, material, elevations and dimensions. Changes to piping location. Horizontal and vertical locations of underground utilities, valves and appurtenances (valves, fittings, marker locator balls, etc.), referenced to at least two (2) permanent points (surface improvements), and vertical locations of underground utilities and appurtenances, referenced to a permanent point.
 - f. Vertical elevations of all pipelines at crossings of potable water mains (whether the water main is existing or new) to document that the minimum required vertical separation has been met.
 - g. Horizontal offsets from adjacent potable water mains (whether the water main is existing or new) in order to document that the minimum required horizontal separation has been met.
 - h. Utility pipelines tied horizontally to the edge of pavement and right-of-way lines, located every 25 feet plus all changes in horizontal offset.
 - i. Pavement width and elevations at the centerline and edge of pavement every twenty (20) feet plus at all changes in longitudinal slope, cross slope, inlet locations, and at all driveway and street intersections. For parking areas, record centerline and edge of pavement elevations along all drive aisles and islands.
 - j. Lift station surveyed layout (horizontal and vertical) of all structures, valves, panels, conduits, piping, corners of all concrete pads and slabs, and bollards.
 - k. New Building construction or building modification exterior dimensions and horizontal reference to property lines.
 - I. New Building construction or building modification finish floor elevations.

- m. Concrete pad dimensions and elevations at each corner.
- n. The material, diameter, length, elevations and actual slope of all piping installed.
- o. All abandoned in-place facilities including the extent and method of abandonment.
- p. Horizontal and vertical data for any construction that deviates from the approved engineering drawings.
- q. Where the Contract Documents contain specific horizontal location data, such as station and offset, the as-built drawings are to reflect the actual horizontal location.
- r. Where the Contract Documents contain specific vertical elevation data, the "As-Built" drawings are to reflect the actual measured vertical elevation.
- s. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
- t. Field changes of dimension and detail.
- u. Changes to the Project made by Field Order, Work Directive or Change Order.
- v. Details not on the original Contract Drawings.
- w. Equipment and piping relocations.
- x. Stormwater pond top of berm and pond bottom elevations and horizontal dimensions measured at a minimum of twenty (20) locations per pond and at locations designated by the Engineer. The top of pond horizontal dimensions are also to be tied to property corners, easements, and rights-of-way.
- y. Stormwater control structure dimensions, horizontal locations and elevations, including all weirs, slots, orifices, grates, and skimmers.
- z. Stormwater conveyance systems including dimensions, horizontal locations, elevations, contours, and cross sections.
- aa. Actual installed pipe material, class, pipe size, etc. shall be included.
- bb. Major architectural and structural changes including relocation of doors, windows, etc.
- cc. Architectural schedule changes according to Contractor's records and shop drawings.

- dd. Bronze plaque revisions according to the actual installation.
- ee. Mechanical and electrical changes.
- 2. For electrical work, as a minimum, show the following:
 - a. Location of stub outs, dimensioned from permanent building lines.
 - b. Location and depth of under-slab and in-slab raceways.
 - c. The routing of all raceways even though they may not have been shown in the drawings.
 - d. Corrected panelboard and equipment schedules.
 - e. Corrected circuit numbers as they appear on panelboard directories.
 - f. Corrected motor horsepower or full load amperages.
- 3. Show elevations to the nearest hundredth of a foot for:
 - a. Top of pipe for water mains and force mains at deflection points and every twenty-five (25) feet along straight runs.
 - b. Top of pipe for water mains and force main fittings.
 - c. Top of pipe for connection to existing facilities.
 - d. Top of operating nut for valves.
 - e. Top of pipe of water and wastewater facilities where they cross other facilities (drainage, telephone, cable TV, electric, etc.).
- 4. Show elevations to the nearest hundredth of a foot for:
 - a. Maintenance access structure (manhole) rims.
 - b. Inverts of every gravity sewer pipe and force main connection to maintenance access structures.
 - c. Structure top of slab, bottom, influent pipe invert, etc.
 - d. Lift station top of slab, bottom of wetwell, influent pipe invert and control set points.

E. Specifications and Addenda

- 1. Legibly mark each section to record:
 - a. Manufacturer, trade name, catalog number of Supplier of each product and item of equipment actually installed.
 - b. Model number and serial number of each piece of equipment and all electrical data (motor size, horsepower, voltage, etc.).
 - c. Changes made by Field Order, Work Directive or Change Order.

F. Shop Drawings (after final review and approval)

- 1. Provide three (3) sets of "record" shop drawings, and an electronic searchable PDF, within the Operation and Maintenance Manual, for each piece of process equipment, piping (including casings), electrical system and instrumentation system.
- 2. The Contractor shall review the requirements of Section 1730, *Operation and Maintenance Data*.
- G. Certified site survey, below ground piping survey, and line elevations and stationing at 25-foot increments per Section 01050, Field Engineering.
- H. Certified 3D High Definition Laser survey of the Flagler Beach WWTF site, after project completion, conducted by the "current" surveyor of record for the project and treatment facility (CPH, LLC, no equal) for a "pre-negotiated" price.

1.05 Final Surveys and CADD Files

- A. Prepare and submit four (4) copies of the following "certified" surveys for the Project:
 - 1. Site Survey.
 - 2. Below-ground piping survey.
 - 3. Line elevations and stationing at 25-foot increments.
 - 4. Building and structure elevations.
- B. The "As-Built's" shall be *certified, signed and seal by a registered land surveyor in the State of Florida* who will be responsible for the accuracy of all dimensions and

- elevations in accordance with the "Minimum Technical Standards" and Section 01050, *Field Engineering*.
- C. Each sheet of "As-Built" drawings shall be signed and sealed by the registered land surveyor. The cover sheet shall contain the following statement: "I hereby certify that the "As-Built" location information of the water and sewer facilities shown on these drawings conforms to the minimum technical standards for land surveying in the State of Florida, Chapter 61G17-6 (Florida Administrative Code), as adopted by the Department of Business and Professional Regulation, Board of Professional Surveyors and Mappers in September 1981, and that said As-Built's are true and correct to the best of my knowledge and belief as surveyed under my direction." The cover sheet shall include the land surveyor's name, business name, surveyor's number, address and telephone number.
- D. During the course of the Work, if any computer-aided drafting design files are created or used for shop drawings, working drawings, installation drawings, or other details of the Project, a CD/DVD/BD of such files and a "full-size" reproducible copy of the file shall be given to both the Engineer and Owner.

1.06 Submittals

- A. Record Drawings are to be prepared by the Contractor, certified by the Contractor's registered surveyor and delivered to the Engineer.
- B. Submit "initial" Project Record Documents, listed herein, to the Engineer with the Contractor's Request for Substantial Completion. *Also deliver a CD/DVD/BD containing the Project Record Drawings, in AutoCAD format, latest version, to the Engineer.* The required field engineering submittals certified by a registered land surveyor, are listed in Section 01050, *Field Engineering*.
- C. At Contract closeout, the Contractor shall submit the "final" Project Record Documents to the Engineer for the Owner with a claim for Final Completion and Readiness for Final Payment. The "final" Record Drawings submittal shall contain three (3) copies of the following:
 - 1. Signed and sealed copies of the Record Drawings on 22" x 34" paper.
 - 2. AutoCAD files of the Record Drawings (latest version of AutoCAD).
 - 3. PDF and JPEG copies of the Record Drawings on a CD/DVD/BD or flash drive.
- D. At Contract closeout, submit the "approved" Shop Drawings to the Engineer for the Owner with a claim for Final Completion and Readiness for Final Payment. The "approved" Shop Drawings submittal shall contain the following:

- 1. PDF and JPEG copies of the Record Drawings on a CD/DVD/BD or flash drive.
- E. Accompany the closeout submittal with a letter of transmittal (LOT) in duplicate, containing, but not limited to, the following.
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. Title and number of each Record Document.
 - 5. Signature of Contractor or his authorized representative.
- F. If the Record Drawings are found to be incomplete or inaccurate, the drawings will be returned to the Contractor for correction.
- G. In cases where the Owner determines partial clearances from permitting agencies are beneficial to the Owner for completed portions of the project, provide preliminary record drawings (AutoCAD, PDF and JPEG formats) to the Engineer for its use in preparing the partial clearance applications for the Owner.
- H. Complete signed and sealed Record Drawings are required to be delivered to the Engineer prior to final inspection of the Project. Final inspections will only be scheduled upon receipt of signed and sealed Record Drawings that have been reviewed by the Engineer and delivered by the Engineer to the Owner.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

1. GENERAL

1.01 Description

A. Scope of Work

- Compile product data and related information appropriate for the Owner's operation and maintenance of products furnished under the Contract (whether the materials or products were purchased by Owner or Contractor). Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications.
- 2. Instruct the Owner's personnel in the maintenance of products and in the operation of the installed equipment and systems.

B. Related Work Specified Elsewhere

Specification Section	Title	
00980	O & M Manual Submittal Form	
01300	Shop Drawings, Submittals and Samples	
01650	Systems Start-up and Demonstration	
01700	Project Closeout	
01720	Project Record Documents	
Division	Information	
6, 10, and 11	Equipment	
13	Special Construction - PICS	
15	Mechanical	
16	Electrical	

1.02 Quality Assurance

- A. Preparation of the data shall be performed by personnel who are:
 - 1. *Trained and experienced* in the operation and maintenance of the described products.
- 2. Familiar with the requirements of the Specification Section(s).
 - 3. **Skilled as technical writers** to the extent required to communicate the essential data associated with the referenced equipment and products.
 - 4. Skilled as draftsmen competent to prepare the required drawings.

1.03 Form of Submittals

- A. Prepare *ALL* data in the form of an instructional manual (hard copy paper) and in electronic formats (PDF and JPEG), for use by the Owner's personnel.
- B. Data Format

1. Size: 8 ½ " x 11"

2. Paper Weight/Color: 24 pound minimum, bright white paper (99* on the

paper brightness scale).

3. Text: Manufacturer's printed data, or neatly typewritten.

- 4. Drawings
 - a. Provide a reinforced punched binder tab; bind in with text.
 - b. Reduce larger drawings to 11" x 17" and fold them to an 8 $\frac{1}{2}$ " x 11" size.
- 5. Provide a fly-leaf for each separate product, or each piece of operating equipment:
 - a. Provide a typed description of the projects and major component parts of the equipment.
 - b. Provide summary data sheets for each separate product or each piece of operating equipment.
 - c. Provide identified and indexed tabs.

6. Provide an electronic copy of the complete O&M Manual from each manufacturer/supplier in <u>both</u> PDF (searchable) and JPEG formats (on CD/DVD/BD) to the Engineer.

7. Cover and Spine

a. Identify each volume with the following printed title, based on the facility for which the O&M materials are being provided, on the binder cover and spine:

FLAGLER BEACH WASTEWATER TREATMENT FACILITY

SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS

"OPERATION AND MAINTENANCE MANUAL"

[Owner's Logo] [Engineer's Logo] [Contractor's Logo]

[Date of Completion]

Volume No.

- b. Also identify on the binder cover, the following:
 - Identity of separate structure as applicable.
 - 2. Identification of general subject matter covered in the Manual.
 - 3. Identification of the Consulting Engineer (CPH, LLC) for the project and their corporate logo.
 - 4. Identity of the general contractor for the project and their corporate logo.

C. Binders

1. Commercial quality, three D-ring View-type binders with durable and cleanable white plastic covers. Binders shall be of the presentation quality type with clear vinyl covers on front, back and spine. The Binders shall include two (2) sheet lifters and two, horizontal inside pockets.

- 2. Maximum D-ring width: **2.5 inches**
- 3. When multiple binders are used, correlate the data into related consistent groupings.

1.04 Content of Manual

- A. Each volume of the Operation and Maintenance Manual shall include, but is not limited, to the following:
 - 1. A neatly computer-generated Table of Contents for each volume, arranged in a systematic order by division, as listed within the product specifications. Each binder shall have a <u>complete Table of Contents for all volumes</u>.
 - 2. Equipment Data sheets shall be provided for all project equipment and shall be developed in the format required by the Engineer. A copy of the equipment data sheets shall be provided in both PDF (searchable) and JPEG formats (on CD/DVD/BD), to the Engineer, as previously referenced herein.
 - 3. Contractor, name of responsible principal, address, telephone number and e-mail address.
 - 4. A list of each project item required to be included, indexed to content of the volume.
 - 5. List the following:
 - a. Subcontractor, manufacturer and installer name, addresses and telephone numbers and e-mail addresses.
 - b. Each product item required to be included, indexed to the content of the volume.
 - c. Identification of the area of responsibility of each product.
 - d. Local source of supply for parts and replacement equipment including company name, contact person, address, telephone number and e-mail address.
 - 6. Identify each product item by product name and other identifying symbols as set forth in Contract Documents.

B. Product Design

1. **Provide hydraulic and engineering design criteria** for each product as it pertains to a particular unit operation/process (submit searchable PDF and JPEG formats).

2. **Provide a "detailed" description** of each normal product operation as it pertains to a particular unit operation/process (submit searchable PDF and JPEG formats).

C. Product Data

1. Include only those sheets which are pertinent to the specific product. Hydraulic and engineering design criteria, information and procedures required for normal control, process control and performance evaluations, emergency operation, start-up and shut down operations, listing of spare parts required, maintenance and repair instructions, safety and personnel requirements and a detailed "troubleshooting" problem guide shall be included in the manual. References to related products, manufacturer and equipment histories, product catalogs, etc. shall not be included within the content of the Operation and Maintenance Manual.

2. Annotate each sheet to:

- a. Clearly identify the specific product or part installed.
- b. Clearly identify the data applicable to installation.
- c. Delete references to inapplicable information.
- 3. Provide operation and maintenance information as herein specified.
- 4. "Record" and "approved" shop drawings as submitted and approved, by the Engineer, with all corrections made for each product. Include "As-Built" data and modifications with shop drawings for each product. This data shall also be provided in both PDF (searchable) and JPEG formats (on CD/DVD/BD).

D. Drawings

- 1. **Supplement the product data with drawings** as necessary to clearly illustrate:
 - a. Relations of the component parts of equipment and systems.
 - b. Product assembly and disassembly for maintenance and repair procedures.
 - c. Control and flow diagrams.
 - d. Representation of the manufacturer's recommended spare parts and their associated SKU or part numbers and current cost.
- 2. Coordinate the drawings with information in Project Record Documents to assure the correct illustration of the completed installation.

- 3. Do not use Project Record Documents as <u>maintenance</u> drawings.
- E. A written text, as required to supplement product data for the particular installation including, but not limited to, the following:
 - 1. Organize in a consistent format under separate headings for different procedures.
 - 2. Provide a logical sequence of instruction of each procedure.
- F. A copy of each warranty, bond and service contract issued. Provide an information sheet for the Owner's personnel, presenting:
 - 1. The proper step-by-step procedures in the event of product failure.
 - 2. Safety instructions for facility personnel in the handling of failed equipment.
 - 3. Instances which might affect the validity of the warranties or bonds.
- G. List of all serial numbers of the equipment furnished.
- H. Tabulation of the motor nameplate horsepower, nameplate current, field-measured current, overload relay setting, and catalog number for polyphase motors.
- I. List of fuses, lamps, seals and other expendable equipment and devices. Specify the size, type and ordering description. List the name, address, e-mail address, FAX number and telephone number of the vendor.
- J. A complete valve tag list including the name and function of the pipe in which the valve is mounted and I/O list (including all tags).

1.05 Manual for Materials and Finishes

- A. Submit four (4) copies of the complete Operation and Maintenance Manual in final form per Article 1.07 of this specification section.
- B. Content for architectural products, applied materials and finishes
 - 1. Manufacturers' data, giving full information on products
 - a. Catalog number, size, and composition.

- b. Color and texture designations.
- c. Information required for reordering special manufacturing products (Include SKU or product numbers).

2. Instructions for care and maintenance

- a. Manufacturers' recommendation for types of cleaning agents and methods.
- b. Cautions against cleaning agents and methods which are or may be detrimental to the product.
- c. Recommended schedule for cleaning and maintenance.

C. Content for moisture protection and weather-exposed products

- 1. Manufacturers' data, giving full information on products
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
- 2. Instructions for inspection, maintenance and repair of products.
- D. Additional requirements for maintenance data can be found in the respective Sections of the Specifications.

1.06 Manual for Equipment and Systems

- A. Submit three (3) copies of the complete Operation and Maintenance Manual in final form per Article 1.07 of this specification section.
- B. Provide a Table of Contents (TOC) for each item of equipment and/or system.
 - 1. List in its entirety, all sections pertinent to equipment operation and maintenance.
 - 2. Provide a fly-leaf for each individual section identified by corresponding section number.

C. Content for each unit of equipment and system (as appropriate)

1. <u>Description of unit and component parts</u>

- a. Provide general mechanical and process descriptions, function, normal operating characteristics, and limiting conditions.
- b. Performance curves, engineering data and tests as it pertains to the performance requirements as listed in the respective specification sections.
- c. Complete nomenclature and commercial number of replaceable parts.
- d. Summary of information listed on equipment and motor data plates.

2. Operating procedures

- a. Start-up, break-in, routine and normal operating instructions.
- b. Regulation, control, stopping, shut-down and emergency instructions.
- c. Summer and winter operating instructions.
- d. Special operating instructions in the event of equipment failure or emergency situations to insure uninterrupted facility operation. Provide step-by-step instructions to initiate process alternatives.

3. Maintenance Procedures

- a. Provide instructions for maintenance procedures during routine operations.
- b. Provide a thorough, *detailed and complete* "*troubleshooting guide*" for all facility equipment and operational systems.
- c. Detailed procedures for disassembly, repair and reassembly.
- d. Detailed procedures for alignment, adjusting and checking.
- 4. Servicing and lubrication schedules required, to insure maximum product performance.
- 5. The manufacturer's printed operating and maintenance instructions.
- 6. A description of the sequence of operation by the control manufacturer.

- 7. The original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance. Also include the following in the submittal:
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts with manufacturers part or SKU number and the current cost for each item.
- 8. As-installed control diagrams by the control's manufacturer.
- 9. Each Contractor's coordination drawings: As-installed, color coded piping diagrams.
- 10. Charts of valve tag numbers identifying the location and function of each valve.
- 11. List of the original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage.
- 12. Other data, as required, under the respective specification sections.
- 13. "Approved" record shop drawings with all corrections made, and a copy of the warranty statement, checkout memo, demonstration test procedures and demonstration test certification.
- D. Content for each electric and electronic system (as appropriate)
 - 1. Description of the system and component parts
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - 2. Circuit directories and panelboards
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 - 3. As installed color coded wiring diagrams.

4. Operating procedures

- a. Start-up, routine, normal, shut-down and emergency operating instructions (at a minimum).
- b. Sequences required.
- c. Special operating instructions.

5. Maintenance Procedures

- a. Provide instructions for maintenance procedures during routine operations.
- b. Provide a thorough, *detailed and complete "troubleshooting guide"* for all facility equipment and systems.
- c. Detailed procedures for disassembly, repair and reassembly.
- d. Detailed procedures for alignment, adjusting and checking.
- 6. The manufacturer's printed Operation and Maintenance instructions.
- 7. List of original manufacturers' spare parts, SKU/Part numbers, manufacturers' current prices, and recommended quantities to be maintained in storage.
- 8. Other data, as required, under the respective Specification Sections.
- 9. "Approved" record shop drawings with all corrections made, and a copy of the warranty statement, checkout memo, demonstration test procedures and demonstration test certification.
- E. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.

F. Additional requirements for Operation and Maintenance Data

- 1. Additional requirements for maintenance data can be found in the respective Sections of the Specifications.
- 2. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Integrator for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest

version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF (searchable) and JPEG formats, no exceptions.

3. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "on-line" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the SCADA System at the Flagler Beach WWTF.

1.07 Submittal Schedule

- A. Submit two (2) copies of a "preliminary draft" of proposed formats and outlines of contents of the Operation and Maintenance Manuals to the Engineer within one hundred twenty (120) days after the Notice to Proceed.
- B. Submit two (2) copies of the completed data in "Preliminary Form" no later than sixty (60) days following the Engineer's review of the last shop drawing of a product and/or other submittal specified under Section 01300, Shop Drawings, Submittals and Samples, but no later than the delivery of equipment. One (1) copy will be returned with comments to be incorporated into the final O&M Manual copies and the other copies will be retained by the Engineer.
- C. Submit three (3) copies of the <u>"approved" Operation and Maintenance Manuals, in "Final Form" (hard copy and electronic formats {searchable PDF and JPEG})</u>, directly to the offices of the Engineer (CPH, LLC) within ten (10) days after the reviewed copy or last item of the reviewed copy is returned.
- D. Provide three (3) copies of addenda to the Operation and Maintenance Manuals as applicable and certificates, as specified, within thirty (30) days after final inspection, if any.
- E. Failure to meet the deadlines for submittal of the "preliminary" and "final" versions of the Operation and Maintenance Manuals shall be cause for the Project to be "shut down" until such time as the documents are provided, in the proper format, to the Engineer. Any lost construction time and Contractor associated construction costs shall be borne by the Contractor based on his failure to meet the above referenced deadlines.
- F. All submittals shall be accompanied by the O&M Manual Submittal Form, Section 00980, in the Contract Documents.

1.08 Instruction of Owner's Personnel

- A. **Prior to the demonstration tests**, **fully instruct the Owner's designated Operations and Maintenance personnel** in operation, adjustment and maintenance of products, equipment and systems.
- B. The Contractor shall provide a *minimum ten (10) calendar day notification, in writing,* to the Engineer of instruction of the Owner's personnel on products, equipment and systems using the form provided in Section 00980. *Operation and Maintenance Manuals shall constitute the basis of instruction*. Review the contents of the O&M Manuals with the Owner's Operations and Maintenance personnel in full detail to explain all aspects of operations and maintenance.
- C. The Instructors shall be fully qualified personnel of the manufacturer of the equipment as outlined within the individual equipment specification sections. If no specific training specifications are listed with the equipment, the Contractor shall provide the instruction with qualified Contractor personnel.
- D. The Contractor shall provide a list to the Engineer and Owner indicating the date, time and the name of the instructors that will be present for all training sessions with the notification described in Article 1.08(B).
- E. The instructors shall provide for and prepare lesson scopes and handouts for up to twelve (12) individuals designated by the Owner, and including the Engineer, that outline the items to be covered. Separate sessions for operation and maintenance instruction shall be provided consecutively. Handouts shall be submitted to the Engineer with at least fourteen (14) calendar day's notice prior to the training sessions for review and approval.
- F. All instruction sessions shall be filmed with a "high-quality" HD digital recording camcorder (1080p) and DVD's/BD's supplied by the Contractor. Filming shall be conducted by a competent, professional filming firm, under the direction of the Engineer and Owner, to provide "high quality" digital HD video recordings (1080p), in color. The Contractor shall then provide three (3) copies of each filmed session to both the Engineer and Owner for final distribution.
- G. Videographer qualifications and Camera requirements are presented in Articles 1.02, 2.01 and 2.02 of Section 01390, *Preconstruction Video Recording* of these Contract Documents.
- 2. PRODUCTS NOT USED
- 3. EXECUTION NOT USED

END OF SECTION

SECTION 01740 WARRANTIES AND BONDS

1. GENERAL

1.01 Description

A. Scope of Work

- 1. Compile specified warranties and bonds, as in the *General Conditions* and as specified in these specifications.
- 2. Co-execute submittals when so specified.
- 3. Review submittals to verify compliance with the Contract Documents.
- 4. Submit warranties and bonds to the Engineer for review and transmittal to the Owner.

B. Related work specified elsewhere includes:

Specification Section	Title
00610	Performance Bond
00620	Labor and Materials Payment Bond
00625	Material and Workmanship Bond
00700	General Conditions
00800	Supplementary Conditions
00805 / 00806	FDEP Supplementary Conditions
01300	Shop Drawings, Submittals and Samples
01700	Project Closeout
Division	Information
11	Equipment

C. A two (2) year Maintenance Bond, or a Letter of Credit or Similar Instrument Satisfactory to the Owner, Equal to Ten Percent (10%) of the final construction costs shall be posted before Final Project Acceptance by the Owner and final payment can be made to the Contractor.

1.02 Submittal Requirements

- A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Number of original signed copies required: Two (2) each.
- C. Table of Contents (TOC)
 - 1. The Table of Contents (TOC) shall be *computer generated*, neat and presented in an orderly sequence. Provide complete and detailed information for each item including, but not limited, to the following:
 - a. Product of work item.
 - b. Firm, name of responsible principal, address, telephone number and e-mail address.
 - c. Scope.
 - d. Date of beginning of warranty, bond or service and maintenance contract.
 - e. Duration of warranty, bond or service maintenance contract.
 - f. Provide the following information for the Owner's personnel:
 - 1. Proper and detailed procedures to be followed in case of a failure.
 - 2. Instances which might affect the validity or warranty or bond.
 - g. Contractor, name of responsible principal, address, telephone number and e-mail address.

1.03 Form of Submittals

A. The Contractor shall provide two (2) bound documents to the Engineer no later than sixty (60) calender days prior to Final Project Acceptance by the Owner.

B. Format

- 1. Size: 8-½" x 11" (*bright white paper*, 99⁺ on the paper brightness scale), punch sheets for standard three (3) ring, D-ring view binder.
- 2. Fold larger sheets to $8\frac{1}{2}$ " x 11" to fit into the binders.

C. Cover and Spine

1. Identify each volume with the following printed title, based on the facility for which warranties and bonds are being provided, on the binder cover and spine:

FLAGLER BEACH WASTEWATER TREATMENT FACILITY

SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS (YEAR XXXX)

"WARRANTIES AND BONDS"

[Owner's Logo]	[Engineer's Logo]	[Contractor's Logo]
	Volume No	

Engineer's and Contractor's Names and Addresses

D. Binders

- 1. Commercial quality, three (3) D-ring type view binders with durable and cleanable white plastic covers and maximum D-ring width of two and one-half (2½) inches.
- 2. The binders shall be presentation type with clear vinyl covers (front/back) and spine.
- 3. The binders shall include two (2) sheet lifters and two (2) horizontal inside pockets.

E. Electronic Submittal

1. The Contractor shall provide an "electronic" submittal of the Warranty and Bond Binder, to the Engineer no later than sixty (60) calender days prior to Final Project Acceptance by the Owner. The electronic submittal shall be in both PDF and JPEG formats.

1.04 Warranty Submittal Requirements

- A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for a period of two (2) years, unless otherwise specified, commencing at the time of Final Project Acceptance by the Owner.
- B. The Contractor shall be responsible for obtaining certificates for equipment warranties for all major equipment specified under Division 11, *Equipment*; Division 13, *Special Construction*; Division 15, *Mechanical*; and Division 16, *Electrical*; and which has at least a 1.0 hp motor or which lists for more than \$1,000. The Engineer reserves the right to request warranties for equipment not classified as major. *The Contractor shall still warrant equipment not considered to be "major" in the Contractor's two (2) year warranty period even though certificates of warranty may not be required (commencing at the time of Final Project Acceptance by the Owner).*
- C. In the event that the equipment manufacturer or supplier is unwilling to provide a two (2) year warranty commencing at the time of Final Project Acceptance by the Owner, the Contractor shall obtain from the manufacturer a *three (3) year warranty commencing at the time of equipment delivery to the job site*. This three (3) year warranty from the manufacturer shall not relieve the Contractor of the two (2) year warranty, starting at the time of Final Project Acceptance by the Owner.
- D. The Owner shall incur no labor or equipment cost during the guarantee period.
- E. The Guarantee shall cover all necessary labor, equipment, materials, and replacement parts resulting from faulty or inadequate equipment design, improper assembly or erection, defective workmanship and materials, leakage, breakage or other failure of all equipment and components furnished by the manufacturer or the Contractor.
- 1. PRODUCTS NOT USED
- 2. EXECUTION NOT USED

END OF SECTION

SECTION 01800

MISCELLANEOUS WORK AND CLEANUP

1. GENERAL

1.01 Description

- A. This Section includes operations which cannot be specified in detail as separate items but can be sufficiently described as to the kind and extent of work involved.
- B. The Contractor shall furnish all labor, materials, equipment and incidentals to completely and thoroughly clean the Project Site at the completion of the Work.
 - C. The work of this Section includes, but is not limited to, the following:
 - 1. Removal and legal disposal of all broken concrete, wood, scraps, wire, packaging materials, forms, debris, scaffolds and other objectionable rubble created during construction operations.
 - 2. Cleaning of spilled mortar, concrete and metal work.
 - 3. Removal of all temporary manufacturer's labels from and washing of all equipment.
 - 4. Restoring of driveways and fences.
 - 5. Crossing utilities.
 - 6. Relocation of existing water lines, low pressure gas lines, telephone lines, electric lines, cable TV lines and storm drains.
 - 7. Restoring easements and rights of way.
 - 8. Incidental work.

1.02 Qualifications

A. All work shall be completed in a workmanlike manner by competent workmen in full compliance with all applicable sections of these Specifications.

2. PRODUCTS

2.01 Materials

- A. Materials required for this Section shall be of at least the same type and quality as materials that are to be restored, if any.
- B. Where possible, the Contractor shall reuse undamaged, existing materials that are removed and then replaced, if any.

3. EXECUTION

3.01 Restoring of Fences

- A. At several locations it may be necessary for the Contractor to remove, store and replace existing fences during construction. Only the sections directed by the Engineer shall be removed.
- B. If any section of fence is damaged due to the Contractor's negligence, it shall be replaced with fencing equal to or better than that damaged, and the work shall be satisfactory to the Engineer.
- C. All restoration/repair shall be provided by the Contractor at no additional cost to the Owner.

3.02 Crossing Utilities

A. This item shall include any extra work required in crossing culverts, watercourses, drainage ditches, drains, water mains, reclaimed water mains, wastewater lines and other utilities, including all sheeting, shoring and bracing, extra excavation and backfill, or any other work required for the crossing, whether or not shown on the Contract Drawings.

3.03 Relocations of Existing Gas Lines, Telephone Lines, Electric Lines and Cable, Utility Lines and Cable TV Lines

A. The Contractor shall notify the proper authority of the utility involved when relocation of these lines is required.

B. The Contractor shall coordinate all work by the utility so that the progress of construction will not be hampered.

3.04 Restoring Easements and Rights-of-Way

- A. The Contractor shall be responsible for all damage to City and private property due to his operations and shall fix all damage immediately at his own cost.
- B. The Contractor shall protect from injury all walls, fences, cultivated shrubbery, pavement, underground facilities, such as water pipe, or other utilities which may be encountered along the easement.
- C. If removal and replacement are required, it shall be done in a workmanlike manner so that the replacement is equivalent to that which existed prior to construction.
- D. Existing lawn surfaces damaged by construction shall be **regraded and resodded**. These areas shall be maintained until Final Project Acceptance by the Owner.

3.05 Clean up

- A. The Contractor shall remove all construction material, buildings, equipment and other debris remaining on the job as the result of construction operations and shall render the site of the work in a neat and orderly condition.
- B. All garbage, debris, trash, unsuitable material, etc., shall be disposed of in a legal manner by the Contractor at no additional cost to the Owner.
- C. Remove excess dust and mud created by the construction of the facilities.
- D. All suitable excess excavated material, as determined by the Engineer and Owner, shall be the property of the Owner and shall remain on-site.

E. Cleanup During Construction

- 1. During execution of the work, the Contractor shall clean the site, adjacent properties and public access roads and dispose of waste materials, debris, and rubbish to assure that building, grounds and public properties are maintained free from accumulations of waste materials and rubbish.
- 2. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

- 3. Provide containers for collection and disposal of waste materials, debris and rubbish.
- 4. Cover or wet excavated material leaving and arriving at the Project Site to prevent blowing dust. Clean the public access roads to the site of any material falling from haul trucks.

F. Final Cleanup

- 1. At the completion of all Project Work and immediately prior to final inspection, the Contractor shall clean the entire Project Site.
- 2. Clean, sweep, wash and polish all work and equipment including finishes.
- 3. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed interior and exterior finished surfaces.
- 4. Repair, patch and touch-up all marred surfaces to match the adjacent surfaces.
- 5. Broom clean paved surfaces and rake clean all landscaped areas.
- 6. Remove from the Project Site all temporary structures and all materials, equipment and appurtenances not required as a part of, or appurtenant to, the completed work.
- G. The Contractor must also meet all conditions and requirements identified in Section 01560. *Environmental Protection*.

3.06 Incidental Work

- A. The Contractor shall do all incidental work, not otherwise specified, but obviously necessary for the proper completion of the Contract as specified and as shown on the Contract Drawings.
- B. All incidental work shall be accounted for in the Contractor's Bid Price for the Project.

END OF SECTION

SECTION 02050 DEMOLITION AND SALVAGE

1. GENERAL

1.01 Scope of Work

A. Furnish all material, labor, tools, equipment, plant, appliances and services necessary to complete all demolition, modification, salvage and removal work required above and below grade as shown on the Contract Drawings and as specified herein.

The Contractor shall examine the various Contract Drawings, visit the Project site and determine the extent of work affected therein and all conditions under which the work is to be performed.

- B. The Contractor shall fill in all voids in the subgrade created as a result of the removal or demolition of all materials, etc. identified in the Contract Documents.
- C. The Contractor shall remove all of the demolished materials and spoils from the Project Site and dispose of them in a legal manner.
- D. The Contractor shall transport designated salvage material and equipment to be retained by the Owner, if any, as directed by the Engineer in accordance with the Contract Documents.

E. Work Specified Herein and Elsewhere

1. Related work specified elsewhere includes:

Division	Information
2	Sitework
11	Equipment
15	Mechanical
16	Electrical
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

A. Permits and Licenses

- 1. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and runoff control.
- 2. Obtain all necessary permits and licenses for performing the Work and furnish a copy of the same to the Engineer prior to commencing the Work.
- 3. The Contractor shall pay all associated fees including disposal costs.
- 4. Comply with the requirements of all permits.

B. Notices

- 1. Issue written notices of planned demolition, a minimum of fourteen (14) calendar days prior to starting the work, to companies or local authorities owning utility
 - conduit, wires, pipes, etc. running to or through the project site. Comply with all of their requirements.
- 2. Submit copies of said notices to the Engineer.

C. <u>Utility Services</u>

- 1. Notify the Owner, utility companies or local authorities furnishing gas, water, electrical, telephone or wastewater service, a minimum of fourteen (14) calendar days prior to starting the work, to remove any equipment owned by them in structures to be demolished and to remove, disconnect, cap or plug their services to facilitate demolition.
- 2. Comply with all utility company or local authority requirements.

D. General

- 1. Do not close or obstruct roadways, sidewalks, or fire hydrants without appropriate permits.
- 2. Conform to applicable regulatory procedures when hazardous or contaminated materials are discovered.

1.03 Job Conditions

A. Sequence of Construction

- 1. Interruption of facility operations must be kept to a minimum and no interruption of service to the Owner's customers shall be allowed.
- Coordinate demolition, removal and modification work with the Engineer and Owner and agree upon a sequence of construction designed to minimize down time in operations and avoid any interruption of service.
- B. **The cost for all demolition work**, including material, labor, tools, equipment, plant, appliances, transportation, disposal costs and all appurtenances and services necessary to complete all demolition, modification, salvage and removal work **shall be accounted for in the Contractor's Bid.**
- C. Facility operation shall not be interrupted during the demolition activities unless authorized by the Engineer and Owner. The Contractor shall submit to the Engineer, in writing, any request for interruption of facility service, at least seven (7) calendar days
 - prior to the proposed activities. The request may or may not be approved. A rejection of the request does not relieve the Contractor from completing the work.

1.04 Project Conditions

- A. Structures to be demolished will be discontinued in use and vacated by the Owner prior to starting the demolition Work.
- B. The Owner assumes no responsibility for the condition of structures, materials, equipment, and ancillaries to be demolished or salvaged.
- C. The conditions existing at time of inspection for Bidding purposes will be maintained by the Owner as practicable. Variations within structures, equipment, etc. may occur by the Owner's removal and salvage operations prior to start of demolition work.
- D. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to the Contractor shall be removed from the Project site.
- E. Storage or sale of removed items on site will not be permitted, unless otherwise directed by the Owner, and shall not interfere with other work specified in Contract Documents.
- F. Explosives **shall not** be brought to the site or used to demolish structures.

1.05 Disposition of Demolished Materials

- A. All demolished materials shall be legally disposed of by the Contractor.
- B. Store salvaged materials designated as property of the Owner in areas indicated by the Owner and transport them to a final storage site, if any, as directed by the Owner. The Contractor shall promptly remove all other materials from the site.
- C. All costs associated with the legal disposal of demolished materials shall be incorporated into the Contractor's Bid.

1.06 Project Record Documents

- A. The Contractor shall accurately record actual locations (horizontal and vertical) of all capped utilities and subsurface obstructions that will remain after demolition.
- B. Record documentation shall be in accordance with Section 01720, *Project Record Documents*.

2. PRODUCTS - NOT USED

3. EXECUTION

3.01 Preparation

A. All existing pipelines and utilities shown on the Contract Drawings are not to be interpreted as the exact location or as the only obstacles that may occur on the site. The Contractor shall verify all existing conditions, prior to construction activities, and proceed with caution around anticipated features.

B. Safety

- Provide, erect, and maintain temporary safety barriers, erosion control devices, and other safety and security devices, as shown on the Contract Drawings, or as necessary, to protect the public and project personnel from injury due to the demolition work.
- 2. Protect from damage all existing work, "new" project work, landscaping materials, equipment and improvements and appurtenances that are to remain and restore all damage caused by the demolition work at no additional cost to the Owner.

- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as needed.
- D. **Mark the location of all utilities**. Protect and maintain, in safe and operable condition, all utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized, in writing, by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to the Owner and any governing authorities.

E. Salvage

- 1. The Contractor **shall not proceed** with the removal of any equipment, piping, or appurtenances without specific approval of the Engineer and Owner. Any equipment, piping or appurtenances removed without proper authorization, which are necessary for the operation of the existing system or of the proposed facilities, shall be replaced to the satisfaction of the Engineer at the Contractor's expense.
- 2. Any materials to be salvaged shall be identified by the Owner. The Contractor shall furnish all labor and material to identify, clean, protect, crate, box and deliver/store any salvaged materials as part of the Project Work.
- 3. Pieces of equipment weighing 150 pounds or more shall be provided with suitable skids before storing.
- 4. Wherever piping is removed for disposition, adjacent pipe, and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.
- 5. Equipment to be retained by the Owner shall be carefully removed from the present location, cleaned, and immediately stored "on-site" or delivered to their final destination by the Contractor, as designated by the Owner, at no additional cost to the Owner.
- 6. The Contractor shall take all necessary precautions against damaging the material and equipment to be stored. The Contractor shall repair any damage resulting from his operations, as directed by and to the satisfaction of the Engineer, at no additional cost to the Owner. Itemized lists of materials removed and stored shall be given to the Engineer daily. An electronic copy of a final itemized list shall be furnished to the Engineer at the completion of construction. The list shall include items, method of packaging, and place of storage.

F. Equipment to be Retained

- 1. All equipment removed shall remain the property of the Owner unless designated otherwise by the Owner. Designated items to be salvaged shall be identified by the Owner, prior to the commencement of demolition operations, if any.
- 2. If the Owner elects not to retain ownership of a certain item, the item shall become the property of the Contractor and shall be removed from the site at the Contractor's expense and legally disposed of.

3.02 Performance

A. General

- Completely remove and dispose of existing structures and appurtenances from the site as indicated on the Contract Drawings and/or specified herein. Bring in clean, organic-free, compactable fill for filling those areas where in-ground structures will be removed. All fill shall be compacted in accordance with these specifications.
- 2. Salvage all items indicated by the Owner, if any, and clean up the site after completion of the demolition work.
- 3. Perform demolition and removal in compliance with applicable laws and ordinances and in such a manner as to avoid hazard to persons and property and to prevent spread of dust and flying particles.
- 4. Conduct demolition operations to minimize interference with adjacent structures, walls/fencing or pavements.
- Cease demolition operations immediately if adjacent structures appear to be in danger. Immediately notify the Owner/Engineer and authority having jurisdiction.
 Do not resume demolition operations until directed by the Engineer or governing authority.
- 6. Conduct operations with a minimum of interference to public or private access. Maintain ingress and egress at all times.
- 7. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.
- 8. **Sprinkle demolition work with water to minimize the generation of dust**. Provide hoses and water connections for this purpose.
- 9. Locate demolition equipment and remove materials so as to prevent excessive loading to supporting walls, floors, or framing.

- 10. Demolish concrete and masonry in small sections.
- 11. Comply with governing regulations pertaining to environmental protection.
- 12. Clean and/or repair all adjacent structures and improvements of dust, dirt, debris and damage caused by the demolition operations. Return adjacent areas to their "original" condition existing prior to start of work, or to a "new" condition.
- 13. The Contract Documents identify major structures and items to be demolished. Include incidental demolition to completely demolish structures whether indicated on the Contract Documents or not.

B. Equipment Removal

1. Prior to demolition of structures, remove all mechanical and electrical equipment installed therein and carefully remove all items that are to be salvaged, if any.

C. Concrete Slabs and Vaults

- 1. Remove and cap all piping as indicated on the Contract Drawings.
- 2. Remove concrete slabs, foundation walls and concrete vault walls and tops as indicated on the Contract Documents.

D. Piping and Valves

- 1. Remove all process and yard piping and valves which are in conflict with the proposed work and are not to remain in service.
- 2. Salvage valves identified by the Owner, if any, and remove all piping, fittings and valves from the property, unless otherwise noted, and dispose of them in a legal manner at the Contractor's expense.

E. Asphalt Pavement

- 1. Remove existing asphalt paving where shown on the Contract Drawings. Where only part of the pavement is to be removed, first mechanically saw cut the pavement along the limits of removal to prevent damage to the remaining pavement.
- 2. Remove the demolished material/debris from the Project site and legally dispose of the materials at no additional cost to the Owner.

F. Sidewalks/Walkways

- 1. Remove existing concrete sidewalks and/or walkways where shown on the Contract Drawings.
- 2. Where only part of the sidewalk/walkway is to be removed, first mechanically saw cut the concrete sidewalk and/or walkway along the limits of removal to prevent damage to the remaining concrete sidewalk and/or walkway.
- 3. Remove the material from the Project site and legally dispose of the materials at no additional cost to the Owner.

G. Modifications

- 1. Cut and remove all existing Work necessary for modifications and installation of the new Work with a minimum of damage to the Work that is to remain.
- 2. Repair or restore any damage done to existing facilities which are to remain, at no cost to, and to the satisfaction of the Owner.
- Remove on a daily basis all debris created within facilities which are to remain in service during the modification work, and clean the area at the end of each day's operation.
- 4. Do not subject personnel, homeowner's or the citizens of the area in which the work is to be completed to hazardous areas while performing their duties to maintain the systems in service.
- 5. Follow other specific instructions for the modification work given in other Sections of these Specifications and as shown on the Contract Drawings.

3.03 Filling of Voids

- A. Completely fill all below grade areas and voids resulting from demolition or removal of structures, pipelines, underground fuel storage tanks, wells, cisterns, etc., using approved select fill materials consisting of clean fill, stone, gravel, and sand free from debris, trash, frozen materials, roots, and other organic matter.
- B. Ensure that areas to be filled are free of standing water, frost, or unsuitable material, trash, and debris prior to fill placement.
- C. Place fill materials in accordance with Division 2, *Sitework*, unless subsequent excavation for new Work is required.

D. Grade the surface to match adjacent grades and to provide positive flow of surface drainage after placement of fill and compaction. Solid sod shall then be placed.

3.04 Cleanup

- A. Clean the Project site to a condition satisfactory to the Engineer, free from demolished materials, rubbish or debris. Grade the site to meet adjacent contours and provide a positive flow for surface drainage.
- B. Restore items intended to remain that have been damaged by demolition work at no cost to, and to the satisfaction of the Owner.
- C. Return all interrupted utility services to their pre-demolition state and disconnect temporary services, unless otherwise specified.

3.05 Disposal of Demolished Materials

- A. **Remove from the Project Site and legally dispose** of all debris, structures, piping, fittings, valving, pumps, miscellaneous metals, rubbish, concrete and other materials resulting from the demolition operations.
- B. No burning of any material, debris, or trash on-site or off-site will be allowed.
- C. Transport materials removed from the demolition operations with appropriate vehicles and legally dispose of them off-site to areas which are approved for disposal by governing authorities and appropriate property owners, at no additional cost to the Owner.

END OF SECTION

SECTION 02075 DEWATERING AND DRAINAGE

1. GENERAL

1.01 Description

- A. The Work to be performed under this Section shall include the design and installation of a temporary dewatering and drainage system until completion of project construction to remove subsurface/storm waters from structure/utility trench excavations as required.
- B. **The Contractor shall be responsible for all permitting activities, including permit fees**, associated with obtaining applicable permits from the State Water Management District having jurisdiction over the installation and operation of the dewatering systems.
- C. Structures, water pipes, sanitary pipes, sanitary structures, building foundations, process structures, etc., may require dewatering. It is the Contractor's responsibility to determine the extent of the dewatering area and requirements for construction.

D. Related Work Specified Elsewhere

Specification Section	Title	
01500	Temporary Facilities	
01560	Environmental Protection	
01570	Temporary Erosion and Sedimentation Control	
02200	Earthwork	
02220	Excavation, Backfilling and Compaction	
Contract Drawings and General Provisions of the Contract		

1.02 Responsibility

A. The Contractor is solely responsible for the design, permitting, installation, operation, and subsequent removal of dewatering systems, including well point systems, and their safety and conformity with local codes and regulations.

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- B. All costs for Project dewatering operations, if necessary, shall be incidental to the Contract and shall be included in the Contractor's Bid.
- C. **No additional payment will be made for any supplemental measures** to control seepage, groundwater, or artesian head.

1.03 Quality Assurance

A. Qualifications

- 1. The temporary dewatering system shall be designed by a firm who regularly engages in the design of dewatering systems and who is fully experienced, reputable and qualified in the design of such dewatering systems.
- 2. The firm shall have a successful record of operation for a *minimum of five (5)* years prior to the Bid date. The design firm shall supply the Engineer with previous installation details of at least five (5) successful dewatering operations of a similar nature in the State of Florida.
- B. In lieu of experience, the Contractor shall provide a performance and warranty bond for **one hundred fifty percent (150%)** of the total installed cost of the temporary dewatering system. This bond shall be executed prior to Award of the Project and/or Contract execution.

C. Standards

- 1. The dewatering of any excavation areas and the disposal of water during construction shall be in strict accordance with all local and state government rules and regulations.
- 2. If a Consumptive Use Permit (CUP) is required by the water management district, the Contractor shall be responsible for obtaining said permit and all associated costs therein.

1.04 Submittals

A. Submit to the Engineer for review and approval, within fourteen (14) days of the Notice to Proceed and before the installation of the dewatering system, the proposed method of dewatering (Dewatering Plan). The Engineer's review shall be for method only. The Contractor shall remain responsible for the adequacy and safety of the methods.

- B. Submittals shall be in accordance with Section 01300, *Shop Drawings, Submittals and Samples,* and shall include the following:
 - 1. Design Notes and Drawings.
 - 2. Descriptive literature of the temporary dewatering system.
 - 3. Layout of all piping involved.
 - 4. Observation well locations, if used
 - Bill of materials.

1.05 Dewatering System Criteria

- A. The dewatering system shall be developed to the point that is capable of dewatering such that pipe, structures, etc., can be installed and the surrounding fill compacted satisfactorily as shown on the Contract Drawings.
- B. Each wellpoint system shall be capable of dewatering and maintaining groundwater levels at the respective structures, pipelines or excavations.
- C. Observation wells shall be constructed for the purpose of testing each system.
- D. Dewatering System Design
 - 1. Design and provide a dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. Design the dewatering system to prevent differential hydrostatic head which would result in floating out soil particles in a manner termed as a "quick" or "boiling" condition.
 - 2. The dewatering system shall not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation's stability.

E. Observation Wells

Prior to excavation, the Contractor shall install groundwater observation wells
at locations as directed by the Contractor's Geotechnical Engineer, who shall be
registered in the State of Florida, and as approved by the Engineer, adjacent to
structures under construction for the purpose of measuring water levels during

excavations. The observation well shall consist of screen, casing and cap of approved size and material of construction. The observation well shall be placed in a 2½-inch borehole which shall be carried to an elevation at least to the final bottom grade of the structure(s). The annular space surrounding the intake point and the riser pipe shall be sealed in such a way as to prevent infiltration from surface water. The observation well shall be developed in such a manner as to ensure proper indication of subsurface water levels adjacent to the well.

- 2. The Contractor shall be responsible for maintaining the observation wells and for observing and recording the elevation of groundwater in them until the adjacent structures and utilities are completed and backfilled. *Each observation well shall be observed and recorded daily. Measurements shall be supplied daily to the Engineer.* The Engineer may require that the observation wells reflect true groundwater levels by adding water to the well, recording the drop in the level from the time the water was added. Any plugged observation well shall be redeveloped, if necessary, to indicate true groundwater levels.
- Observation wells shall be abandoned when directed by the Engineer, and in a manner acceptable to the Engineer, and applicable regulatory agencies. *Abandoned observation wells shall be backfilled with neat cement grout* in accordance with the Chapter 40C-3 requirements of the State Water Management District.

1.06 Pumping and Drainage

- A. The Contractor shall, at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such an extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels.
- B. The Contractor shall submit to the Engineer, for review, a plan for dewatering systems prior to commencing Work (Dewatering Plan). The dewatering systems installed shall be in conformity with the overall construction plan, and certification of dewatering systems shall be provided by a Geotechnical Engineer (at the Contractor's expense). The Geotechnical Engineer shall be required to monitor the performance of the dewatering systems during the progress of the Work and require such modifications as may be required to assure that the systems are performing satisfactorily.

- C. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed bottom of the excavation and to preserve the integrity of adjacent structures. As a minimum, the water level shall be two and one-half (2.5) feet below the trench, structure or excavation bottom. Well or sump installations shall be constructed with proper sand filters to prevent the drawing of fine-grained soil from the surrounding ground.
- D. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
- E. The Contractor shall take all additional precautions or prevent uplift of any structure during construction.
- F. The conveying of water in "open" ditches or trenches shall not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the Controlling Authority and Owner. No flooding of streets, driveways, or private property will be permitted. Any requirements and costs for such use shall be the responsibility of the Contractor. However, the Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and the Contractor shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored at no additional cost to the Owner.
- G. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of the dewatering system.
- H. Removal of the dewatering equipment shall occur after the Contractor and the Engineer agree that the system is no longer required; the material and equipment constituting the system, shall be removed by the Contractor.
- I. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater or receiving water quality.
- J. The Contractor shall be responsible for and shall repair, without cost to the Owner, any damage to work in place, or other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation, including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.

2. PRODUCTS

2.01 General

- A. The equipment specified herein shall be standard dewatering equipment of proven ability as designed, manufactured, and installed by firms having experience in the design and production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with the best practices and methods.
- B. The Contractor shall engage a Geotechnical Engineer registered in the State of Florida to design the temporary dewatering system for all structures. The Contractor shall submit a conceptual plan for the dewatering system prior to commencing Work (Dewatering Plan). The dewatering system installed shall be in conformity with the overall construction plan and certification of this shall be provided by the Geotechnical Engineer. The Geotechnical Engineer shall be required to monitor the performance of the dewatering system at the Contractor's expense during the progress of the work and require such modifications as may be required to assure that the systems will perform satisfactorily.
- C. The Dewatering System(s) shall be designed in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the proposed structures or utilities and to preserve the integrity of any adjacent structure(s).
- D. <u>Dewatering equipment shall be electrically driven</u> in lieu of diesel engine driven to avoid possible problems associated with spillage of fuel. Equipment shall have a noise (audible) limit of 67 dB at fifteen (15) feet from the equipment. No equipment is to be located within fifty (50) feet of a residential or commercial building unit.

3. EXECUTION

3.01 General Requirements

- A. The Contractor shall control, by acceptable means, all water regardless of source and be fully responsible for disposal of the water.
- B. Discharge water in accordance with acquired permits (if required), the regulations of any and all regulatory authorities, and the Contract Documents.
- C. Commence dewatering prior to any appearance of water in the excavation operations and continue until the Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.

- D. The Contractor shall control groundwater in a manner that preserves the strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods. The water level shall be maintained a minimum of two and a half (2½) feet below the trench, structure or excavation bottom.
- E. Install wells and/or wellpoints, if required, with suitable screens and filters, so that continuous pumping of fines does not occur. During normal pumping, and upon development of well(s), levels of fine sand or silt in the discharge water shall not exceed five (5) ppm. Install a sand tester on the discharge of each pump during testing to verify that these levels are not exceeded.
- F. Control grading around excavations to prevent surface water from flowing into excavation areas.
- G. **Remove subgrade materials rendered unsuitable** by excessive wetting and replace with approved backfill material at no additional cost to the Owner.
- H. Walls shall not be exposed to water pressure before the structural work, at the next higher level, has properly cured and the cantilever action of walls is eliminated.

3.02 Installation

A. <u>Dewatering</u>

- 1. The Contractor shall install a temporary dewatering system for the removal of subsurface water and stormwater encountered during construction of the proposed structures, piping, utilities, etc.
- 2. **Dewatering shall be a continuous operation**. Interruptions due to power outages, or any other reason will not be permitted.
- 3. The Contractor shall provide a standby system for emergency operation in case of failure of the primary power source or mechanical failure of the system. If the dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.
- 4. System maintenance shall include, but not be limited to, 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavations in a dewatered condition.

B. Consumptive Use Permit (CUP)

- 1. If dewatering and pumping requirements exceed any of the following regulatory limits, the Contractor shall pay for and obtain a CUP from the local water management district for such pumped volumes:
 - a. Dewatering volume greater than 100,000 gpd.
 - b. Dewatering system pump capacity greater than 1.0 MGD.
 - c. Pump volute equal to or greater than six (6) inches.

3.03 Inspection and Testing

- A. The Contractor's Geotechnical Engineer shall be required to assure that the dewatering system is operating properly.
- B. *The Contractor's Geotechnical Engineer shall monitor the performance* and instruct any adjustment to the Contractor during construction of the Work.

3.04 Protection and Site Clean-Up

- A. Continuously maintain excavations in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.
- B. At all times during the progress of the work, the Contractor shall use all reasonable precautions to prevent either tampering with the wellpoints, if used, or the entrance of foreign material.
- C. Immediately upon completion of the Project dewatering operations, the Contractor shall remove all of his equipment, materials and supplies from the site of the work, remove all surplus materials and debris, fill in all holes or excavations, and grade the site to elevations of the surface levels which existed before the work started or as dictated on the Contract Drawings. The site shall be thoroughly cleaned and graded as directed by the Engineer.
- D. Wells shall be removed or cut off a minimum of three (3) feet below final grade, capped, and abandoned in accordance with regulations by agencies having jurisdiction and/or the Engineer.

END OF SECTION

SECTION 02100 SITE PREPARATION

1. GENERAL

1.01 Description

- A. Work under this Section includes, but is not limited to the following items:
 - 1. Protection of bench marks.
 - 2. Layout of work.
 - 3. Protection of trees to remain.
 - 4. Clearing and grubbing.
 - 5. Stripping.
 - 6. Disposal of debris.

B. Related work specified elsewhere:

Specification Section	Title
01120	Special Project Procedures
01560	Environmental Protection
01570	Temporary Erosion and Sedimentation Control
02200	Earthwork
02210	Site Grading
02220	Excavation, Backfilling and Compaction
Contract Drawings and General Provisions of the Contract	

- C. This Section covers clearing, grubbing, and stripping of the Project Site, complete as specified herein, and disposal of the cleared and grubbed material. The Contractor is expected to visit the site of the work and determine the extent of the clearing and grubbing necessary for the construction operations.
- D. The Contractor's attention is directed to any Soil Erosion and Sediment Control Ordinances in force. The Contractor shall comply with all applicable sections of these ordinances.

- E. The Contractor shall clear and grub all of the area within the limits of actual construction as required, which includes, but is not limited to, roadways, trenchwork, structures, and open areas. The width of the area to be cleared shall be approved by the Engineer prior to the beginning of any clearing.
- F. A line locate for any and all utilities is to be conducted prior to clearing and grubbing operations at the Project Site. The Owner of the utility or utilities known to be in the vicinity of the work is to be contacted by the Contractor to request a line locate. If lines are not located properly before work begins and the Contractor damages the line in any way, the Contractor shall pay for repair and/or replacement of the utility at no additional cost to the Owner. Once lines are located, the Contractor is to take care not to damage the existing utilities. Again, if the Contractor damages the line in any way, the Contractor shall pay for repair and/or replacement of the utility at no additional cost to the Owner.

1.02 Terminology

- A. Clearing: Remove and dispose of shrubs, brush, limbs, and other vegetative growth. Remove all evidence of their presence from the surface including sticks and branches. Remove and dispose of trash piles and rubbish that currently is scattered over the construction site or collects there during construction. Protect trees, shrubs, vegetative growth, and fencing which are not designed for removal. Clearing operations shall be conducted so as to prevent damage to existing structures and installations, and to those under construction, so as to provide for safety of employees and others.
- B. <u>Grubbing</u>: Grubbing shall consist of the complete removal of all stumps, roots larger than one (1) inch in diameter, matted roots, brush, timber, logs, and any other organic or metallic debris remaining after clearing not suitable for foundation purposes, resting on, under or protruding through the surface of the ground to a depth of twenty-four (24) inches below the subgrade. All depressions excavated below the original ground surface for or by the removal of such objects, shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.
- C. <u>Stripping</u>: Remove and dispose of all organics and sod, topsoil, grass, and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. Grass, grass roots and organic material in areas to be excavated or filled shall be stripped to the depth as noted in the soils report. In areas so designated, topsoil shall be stockpiled. Strippings and unsuitable material, such as organic material, shall be disposed of by the Contractor unless directed otherwise by the Engineer.

1.03 Bench Marks and Monuments

A. Maintain all existing bench marks, monuments and other reference points; if destroyed, replacement costs will be deducted from payments due the Contractor.

1.04 Laying Out Work

- A. Permanent base lines, property lines, easement lines and bench marks have been established and are shown on the Contract Drawings. If disturbed as a result of construction activities, the Contractor shall reestablish such items at his expense.
- B. The Contractor shall stake out the construction, establish lines and levels, temporary bench marks, batterboards, centerlines and reference points for the work, and verify all dimensions relating to interconnection with existing features. The Contractor shall be held responsible for any errors in these lines and levels.
- C. The Contractor shall report any inconsistencies in the proposed grades, lines and levels, dimensions and locations to the Engineer before commencing work.
- D. Unless otherwise directed by the Owner or Engineer, the Contractor is expected to contain all construction activities within the right-of-way, easements, and property secured by the Owner, as shown on the Contract Drawings. At no time shall the Contractor disturb surrounding properties or travel on surrounding properties without written consent from the property owner. Any repair or reconstruction of damaged areas in surrounding properties shall be repaired by the contractor on an immediate basis. All costs for repairs shall be the responsibility of the Contractor.

1.05 Utilities in the Area

- A. The Contractor shall notify all utility owners which have utilities in the project area and coordinate with them to avoid service interruptions and/or safety hazards.
- B. Contact "Sunshine 811" to determine if there are other utilities in the area, and their location.

1.06 Preservation and Protection of Trees and Shrubs

A. Existing decorative trees, shrubbery, and other vegetative material may not be shown on the Contract Drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preserve, in place, trees that are specifically shown on the Contract Drawings and designated to be preserved or undisturbed.

B. Preservation of Trees, Shrubs and Other Plant Material

- 1. All plant materials (trees, shrubbery and plants) beyond the limits of clearing and grubbing shall be saved and protected from damage resulting from the Work.
- 2. No filling, excavating, trenching, or, stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as "a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants". To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
- 3. When trees are close together, restrict entry to area within the drip line by fencing. In areas where no fence is erected, the trunks of all trees two (2) inches or greater in diameter shall be protected by encircling the trunk entirely with boards held securely by 12-gauge wire and staples (other Engineer-approved methods of protection may be used) before any work is started. This protection shall extend from ground level to a height of six (6) feet.
- 4. Cut and remove tree branches where such cutting is necessary to affect construction operation. Remove branches other than those required to affect the work to provide a balanced appearance of any tree. Scars resulting from the removal of branches shall be treated with a tree sealant.

1.07 Relocation of Utilities

- A. Active utilities which do not interfere with the work shall be supported and protected from damage.
- B. After obtaining the Engineer's approval, relocate or remove active utilities which will interfere with the Work as indicated.
- C. The Contractor shall pay for all damage to active utilities and for relocation or removal of all interfering utilities which are ascertainable from Contract Drawings, surveys, site inspection or encountered during construction.

- D. Inactive or abandoned utilities and appurtenant structures encountered shall be filled or removed to avoid interference as directed by the Engineer. Exposed ends of abandoned lines shall be plugged or capped in a water-tight manner.
- E. The Contractor shall construct the "new" stormwater management system at the Project Site, as identified on the Contract Drawings, and bring in clean fill, as necessary, to bring the project to the elevations indicated.

2. PRODUCTS - NOT USED

3.0 EXECUTION

3.01 Clearing and Grubbing

- A. All excavation areas associated with the proposed improvements shall be cleared and grubbed in accordance with the Contract Drawings and Contract Documents.
- B. Remove trees outside of these areas only as indicated on the Contract Drawings or as approved in writing by the Engineer.
- C. All debris and refuse from the site preparation shall be removed from the Project Site and legally disposed of by the Contractor.

D. Clearing

- 1. The surface of the ground, for the area to be cleared and grubbed shall be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish, and all other objectionable obstructions resting on, or protruding through, the surface of the ground.
- 2. Those trees which are designated by the Engineer shall be preserved as specified herein
- 3. Clearing operations shall be conducted so as to prevent damage to existing structures and installations, and to those under construction, so as to provide for the safety of employees and others.

E. Grubbing

- Grubbing shall consist of the complete removal of all stumps, roots larger than one
 (1) inch in diameter, matted roots, brush, timber, logs, and any other organic or
 metallic debris not suitable for foundation purposes, resting on, under or protruding
 through the surface of the ground to a depth of twenty-four (24) inches below the
 subgrade.
- 2. All depressions excavated below the original ground surface for or by the removal of such objects, shall be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

F. Clearing and Grubbing Limits

Area	Clearing and Grubbing Limits
Roadway and Paved Area	Two (2) feet below existing grade and replace with compacted backfill
Proposed Structures	Two (2) feet below existing grade within a five (5) foot margin of each structure and replaced with compacted backfill as specified herein.
Building Site Areas Not Specifically Noted Above	Two (2) feet below existing grade within a five (5) foot margin of each structure and replaced with compacted backfill as specified herein.
All other Areas	One (1) foot below the completed surface within a five (5) foot margin of each structure and replaced with compacted backfill as specified herein.

G. The Contractor shall exercise extreme care during the clearing and grubbing operations to not damage existing structures, pipes or utilities.

3.02 Stripping

- A. All areas to be occupied by the proposed improvements shall be stripped of all brush, weeds, grass, roots and other material to a depth of four (4) inches.
- B. Stockpile areas shall also be stripped.
- C. Remove all loamy, organic topsoil suitable for seeding and planting to whatever depth encountered and store separately from other excavated material. Stockpile in areas designated by the Engineer and Owner and provide for proper drainage of said materials. Cover storage piles as required to prevent windblown dust.

- D. Stripped materials suitable for topsoil shall be stockpiled and shall be protected until it is replaced. Any topsoil remaining after all of the work is complete shall remain the property of the Owner.
- E. In the event that inadequate space within the Project Site or work area is available for stock-piling topsoil without interfering with other construction operations, the Contractor shall contact the Owner for determination of another storage location. *Transportation costs for "off-site" storage and retrieval of said materials shall be incidental to the Contract.*
- F. Dispose of unsuitable topsoil and stripping as specified in Article 3.04 of this Specification Section.
- G. Any topsoil remaining after all of the work is complete shall remain the property of the Owner. The excess "good" topsoil shall be relocated on the project site per the Owners directions.

3.03 Burning

A. Burning is not allowed!

3.04 Disposal of Debris

- A. The Contractor is responsible for the removal and legal disposal of the accumulated debris, refuse, etc. at the Project Site.
- B. Any costs associated with impacts to the normal operation of the treatment facility, effluent quality, or construction activities **shall be borne solely by the Contractor and shall be deducted from his Pay Application**.
- C. All other project debris and materials resulting from Project operations shall become the property of the Contractor and shall be "legally" removed and disposed of "off-site" at the Contractor's cost.

3.05 Preservation or Removal of Trees

A. Trees outside the limits of construction shall be carefully protected from damage. The Contractor shall erect such barricades, guards, and enclosures as may be considered necessary for him for the protection of the trees during all construction operations,

including damage from piled material, contact with equipment, subsurface damage to roots, soil contamination, and general construction operations. Care shall be taken to prevent damage not only to the tree trunk, but also the root system and overhanging branches and limbs.

- B. When trees are close together, the Contractor shall restrict entry to the area within the drip line by fencing. In areas where no fence is erected, the trunks of all trees two (2) inches or greater in diameter shall be protected by encircling the trunk entirely with boards held securely by 12-gauge wire and staples. This protection shall extend from ground level to a height of six (6) feet above grade.
- C. Cut and remove tree branches where such cutting is necessary to affect the construction operation. Remove branches other than those required to affect the work to provide a balanced appearance of any tree. Scars resulting from the removal of branches shall be treated with a tree sealant approved by a tree surgeon.
- D. If found necessary, removal or trimming of trees within the limits of construction shall be in accordance with applicable local ordinances. The Contractor shall apply for and pay for all costs associated with the permitting of and removal of trees from the proposed developed area. The Contractor is required to repair or replace trees damaged or removed during construction.
- E. Cutting of branches, limbs, and roots, when deemed necessary, shall be subject to the approval of the Engineer. All cutting shall be smoothly and neatly done without splitting or crushing. Cut or injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint. Such cutting or repairing shall be performed by a qualified tree surgeon. All costs shall be incidental to the Contract.

END OF SECTION

SECTION 02200 EARTHWORK

1. GENERAL

1.01 Description

A. Scope of Work

1. This section includes materials, testing, and earthwork for excavations, fills, and embankments not under roads, in trench work, or under buildings or structures.

B. Related Work Specified Elsewhere

Site Grading: Section 02210
 Excavation, Backfilling and Compaction: Section 02220

1.02 SUBMITTALS

- A. Submit excavation and shoring drawings for worker protection in accordance with Section 00700, *General Conditions*, Section 00800, *Supplementary Conditions* and Section 01300, *Shop Drawings, Submittals and Samples*.
- B. Submit three (3) copies of a certified report from a testing laboratory verifying that the material used for all backfilling, fills and structural backfills meets the specified criteria and gradation and contains less than one percent (1%) asbestos, by weight.

1.03 TESTING REQUIREMENTS

- A. <u>Laboratory Moisture-Density Relationship</u>
 - 1. Determination of laboratory moisture-density relationship and maximum density shall be by the Modified Proctor Method of ASTM D-1557.

2. At least one (1) test per soil type shall be made.

B. In-Place Soil Density

1. In-place soil density shall be determined by one of the following methods:

a. Nuclear Density Meter: ASTM D-2922

b. Drive Sleeve Method ASTM D-2937

- 2. In place field densities shall be taken, in accordance with Article 1.01(C) of Section 01410, "Testing and Testing Laboratory Services" and at not greater than one (1) foot vertical intervals for all fill areas under structures and pavement. Density tests are required for all pipe and foundation work in accordance with the aforementioned Article in Section 01410.
- C. Fill material from "off-site" shall be tested using a minus 200 sieve wash to check grain size. At least one (1) such test shall be run per one hundred (100) cubic yards of material brought from "off-site" locations.
- D. Sample backfill materials by ASTM D-75.
- E. Determine the relative density of cohesionless soils by ASTM D-2049.
- F. Compaction shall be deemed to comply with the Specifications when no tests fall below the specified relative compaction. The Contractor shall pay the costs of any retesting of work not conforming to the Specifications.
- G. "Relative compaction" is defined as the ratio, expressed as a percentage, of the in-place density to the laboratory maximum density.
- H. Density tests will be made for determination of specified compaction by an independent testing laboratory provided and paid for by the Contractor, as part of this Contract, and as approved by the Engineer and Owner as specified in Section 01410, Testing and Testing Laboratory Services. Testing shall be performed in locations reviewed and approved by the Engineer. If any tests are unsatisfactory, the Contractor shall re-excavate and re-compact the fill or backfill until the desired compaction is obtained. Additional compaction tests will be taken on each side of an unsatisfactory test at locations approved by the Engineer to determine the extent of re-excavation and re-compaction necessary.

- The testing report shall clearly indicate the exact location of all testing, either referenced to a visible monument or on a scaled drawing. The vertical location of all tests shall be referenced to both finish grade and with respect to the depth of fill placed.
- J. The Contractor shall pay for each failed compaction test and for each additional test taken to determine the extent of re-excavation and re-compaction as previously described and there shall be no cost to the Owner and the Contract Time shall not be increased due to failed compaction tests.
- K. If based on the Geotechnical Engineers testing reports and inspection, fill which has been placed is below the density required by the Contract Documents, the Contractor shall provide additional compaction and testing prior to commencing further construction in the area. Copies of the testing reports and inspections shall be provided to the Engineer in an electronic format (PDF). Should the fill not meet the compaction requirements identified in Section 02220, Excavation, Backfilling and Compaction, the Contractor shall remove the unsuitable fill and replace it with clean fill that will meet the compaction requirements, at no additional cost to the Owner.

2. PRODUCTS

2.01 Fill and Backfill

A. Fill and backfill shall be clean, granular sand that is free from organic matter, roots, debris, and rocks lager than two (2) inches in the greatest dimension and having less than 10 percent (10%) passing the No. 200 U.S. sieve size.

B. Water for Compaction

- 1. Water shall be free of acid, alkali, or organic materials and shall have a pH between 7.0 and 9.0, a maximum chloride concentration of 250 mg/L and a maximum sulfate concentration of 250 mg/L.
- 2. The Contractor shall provide all of the water needed for earthwork.
- 3. The Contractor shall provide all temporary piping and valves to convey water from the source to the point of use.
- 4. The Contractor shall provide any meters and ancillary equipment necessary, if the water is taken from the Owner's potable or reclaimed water distribution line. *The Contractor shall pay for all water taken from the Owner at the Owner's standard rate or a negotiated monthly fee*.

3. EXECUTION

3.01 Compaction Requirements

- A. Unless otherwise specified or shown on the Contract Drawings, compact fill, embankments, and backfills in grassed or landscaped areas in accordance with Section 02220, Excavation, Backfilling and Compaction.
- B. Following clearing and grubbing, the exposed ground surface shall be proof-rolled with a heavy self-propelled vibration roller. Proof-rolling shall involve multiple overlapping passes to achieve 95% relative compaction (98% relative compaction beneath structures and paved areas) for a depth of one (1) foot or more below finished grade. Groundwater should be lowered as necessary to two (2) feet below stripped or excavated grade elevation prior to proof-rolling.

C. Dewatering

- 1. Provide and operate equipment adequately to keep excavations and trenches free of water in accordance with Section 02075, *Dewatering and Drainage*.
- 2. Remove water during the period when concrete is being deposited, when pipe is being laid, during the placing of structural fill and backfill, and for inspection/testing of the structural subgrade.
- 3. Maintain the groundwater level a minimum of two and one-half (2½) feet below the bottom of the excavation for all structures and open excavations.
- 4. Avoid settlement or damage to adjacent property.
- 5. Dispose of water to an on-site drainage system, if applicable.
- 6. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation.
- 7. Comply with all permit conditions, if any, for the dewatering operations.
- 8. The Contractor shall provide and maintain pumps, sumps, well points, suction and discharge lines and other dewatering system components as necessary.
- D. Excavation is unclassified. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction.

E. Placing and Compacting Fill Material

1. Excavated material which conforms to the specifications may be used for fill or backfill.

- 2. Place all materials at optimum moisture content.
- 3. Place fill in lifts, as specified in the Contract Documents (Table 02220-1, Section 02220, *Excavation, Backfilling and Compaction*), and compact each lift to the extent specified.

F. Foundation Requirements

- 1. All structure foundation bottoms shall be re-compacted and retested after excavation to densify soils loosened in the excavation process.
- 2. Soils placed adjacent to footings or walls shall be carefully compacted to avoid damaging the footing or wall. Approved structural sand fills placed in footing excavations above the bearing level, in the trench of pipeline excavations within the structure area plus ten (10) feet beyond the perimeter walls, and in other areas which are expected to provide slab support and/or foundation embedment constraint shall be placed in loose lifts not exceeding six (6) inches.
- 3. Compaction requirements are presented in Table 02220-1 of Section 02220, *Excavation, Backfilling and Compaction*.

G. Moisture Control of the Earth Material

- 1. During the compaction operations, maintain the optimum practicable moisture content required for compaction purposes in each lift of the material.
- 2. Maintain a uniform moisture content throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the material.
- 3. At the time of compaction, the water content of the material shall be at optimum water content or within two (2) percentage points above optimum.
- 4. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.
- 5. Moisture contents greater than two percent (2%) above optimum or below optimum will be permitted only if it can be clearly demonstrated, to the satisfaction of the Engineer, that satisfactory compaction is being achieved.
- 6. Flooding or puddling with water to consolidate backfill is unacceptable.

H. Site Grading

- 1. Perform earthwork to the lines and grades shown on the Contract Drawings. Shape, trim and finish slopes to conform with the lines, grades and cross-sections as shown on the Contract Drawings.
- 2. Make slopes free of exposed roots and loose rocks exceeding two (2) inches in diameter.
- 3. Round tops of banks to circular curves as shown on the Contract Drawings.
- 4. Neatly and smoothly trim rounded surfaces. Do not over-excavate and backfill to achieve the proper grade.
- 5. Final grades shall be within ±0.02 feet of the required elevation.

I. <u>Disposal of Excess Excavation</u>

- 1. Dispose of excess excavated suitable materials at designated on-site soil areas indicated on the Contract Drawings, if any, or as directed by the Engineer.
- 2. If on-site disposal is not indicated or directed by the Engineer, *legally dispose of excess excavated materials off-site at no additional cost to the Owner*.
- 3. The Contractor shall make his own arrangements for the legal disposal of all excess suitable or unsuitable material and bear all costs associated with said disposal.

J. Temporary Stabilization

- 1. Where construction activity ceases for at least fifteen (15) days and the top soil has been disturbed, the Contractor shall stabilize the affected areas with temporary seed and mulch.
- 2. Temporary stabilization shall be in accordance with a Stormwater Pollution Prevention Plan (SPPP) to be submitted to the Engineer.

K. Off-Site Vehicle Tracking

 The Contractor shall take all necessary measures to remove truck sediment before leaving the site to reduce vehicle tracking of sediment off-site. Measures may include, but are not limited to, vehicle shaking devices and/or a wheel washing facility.

2. The Contractor shall maintain areas of site ingress and egress and surrounding offsite public rights-of-way from the build-up of sediment. Any and all sediment build-up on these areas shall be immediately cleared and removed by the Contractor at no cost to the Owner.

END OF SECTION

SECTION 02210 SITE GRADING

1. GENERAL

1.01 Description

A. The Work in this section consists of furnishing all necessary labor, equipment, material, transportation and ancillaries necessary to bring the roads, drives, proposed buildings and structures, paved areas, open areas and the remainder of the project site to the lines and grades shown on the Contract Drawings.

B. Related Work Specified Elsewhere

Specification Section	Title
02100	Site Preparation
02200	Earthwork
02215	Finish Grading
02220	Excavation, Backfilling and Compaction
02815	Solid Sodding
Contract Drawings and General Provisions of the Contract	

C. The Contractor shall be responsible for the determination of earthwork quantities and the volume of material required for the site.

D. Terminology

1. Open Areas: Open areas are those areas that do not include building

sites, paved areas, limerock areas, access and road rights-

of-way and parking areas.

2. Maximum Density: Maximum weight, in pounds per cubic foot, lb/ft³ (pcf), of a

specific material.

3. Optimum Moisture: Percentage of water in a specific material at maximum

density.

4. Rock excavation: Excavation of any hard natural substance which requires the

use of explosives and/or special impact tools such as, jackhammers, sledges, chisels, or other similar devices specifically designed for use in cutting or breaking rock, but

exclusive of trench excavating machinery.

1.02 Submittals

A. Submit four (4) copies of a report from a certified testing laboratory, in accordance with Section 01300, *Shop Drawings, Submittals and Samples*, verifying that off-site borrow material, if used, conforms to the gradation specified.

1.03 Protection

A. Prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement, structures, and utility lines. The Contractor shall correct any damage at no cost to the Owner.

1.04 Testing Requirements

- A. Determination of laboratory moisture-density relationship and maximum density shall be by the Modified Proctor Method of ASTM D-1557. At least one (1) test per soil type shall be made.
- B. In-place soil density shall be determined either by use of a Nuclear Density Meter per ASTM D-2922, Sand Cone Method per ASTM D-1556 or by use of the Drive Sleeve Method per ASTM D-2937. In-place field densities shall be taken in accordance with Article 1.01(C) of Section 01410, *Testing and Testing Laboratory Services, and* at not greater than one (1) foot vertical intervals for all fill areas under structures and pavement. One (1) density test is required for each pad or isolated footing and for every twenty (20) linear feet of strip/wall footing length.
- C. All fill placed and compaction requirements shall be in accordance with Section 02220, *Excavation, Backfilling and Compaction*.
- D. Compaction shall be deemed to comply with the Specifications when no tests fall below the specified relative compaction. The Contractor shall pay the costs of any retesting of work not conforming to the Specifications at no additional cost to the Owner.

- E. Relative compaction is defined as the ratio, expressed as a percentage, of the in-place density to the laboratory maximum density.
- F. Density tests will be made for determination of specified compaction by an independent testing laboratory provided by the Contractor and as approved by the Engineer and Owner as specified in Section 01410, *Testing and Testing Laboratory Services*. Testing shall be performed in locations reviewed and approved by the Engineer. If any tests are unsatisfactory, the Contractor shall re-excavate and re-compact the fill or backfill until the desired compaction is obtained. Additional compaction tests will be taken on each side of an unsatisfactory test at locations approved by the Engineer to determine the extent of re-excavation and re-compaction necessary.
- G. The Contractor shall pay for each failed compaction test and for each additional test taken to determine the extent of re-excavation and re-compaction as previously described and at no additional cost to the Owner.

2. PRODUCTS

2.01 Materials

A. Suitable Materials

- 1. Suitable materials for fills shall be classified as A-1, A-3 or A-2-4 in accordance with AASHTO Designation M 145 and shall be free from vegetation and organic material.
- 2. Not more than 10 percent (10%) by weight of fill material shall pass the No. 200 sieve.
- 3. The Contractor shall furnish all additional fill material required for the Project from legal **off-site** locations.

B. Suitable Materials to be Placed in Water

1. Suitable material for fills to be placed in water shall be classified as A-1 or A-3 in accordance with AASHTO Designation M - 145.

C. Unsuitable Materials

1. Unsuitable materials are classified as A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, A-8 or any material not specified in Article 2.01(A) above in accordance with AASHTO Designation M - 145.

D. Water for Compaction

- 1. Water shall be free of acid, alkali, or organic materials and shall have a pH between 7.0 and 9.0, a maximum chloride concentration of 250 mg/L and a maximum sulfate concentration of 250 mg/L.
- 2. The Contractor shall provide all of the water needed for earthwork.
- 3. The Contractor shall provide temporary piping and valves and a means to convey water from the source to the point of use.
- 4. The Contractor shall provide any meters and ancillary equipment necessary, if the water is taken from the Owner's potable or reclaimed water distribution line. *The Contractor shall pay for all water taken from the Owner at the Owner's standard rate or a negotiated monthly fee*.

3. EXECUTION

3.01 Preparation

A. The Contractor shall follow the requirements of Section 02100, *Site Preparation* and Section 02200, *Earthwork*.

3.02 Performance

A. Unless otherwise specified or shown on the Contract Drawings, compact fill, embankment and backfills to Modified Proctor Density specified in Section 02220, *Excavation, Backfilling and Compaction*.

B. Excavation

- 1. Excavation shall conform to the limits indicated on the Contract Drawings or specified herein. This work shall include shaping and sloping and other work necessary in bringing the earthwork to the required grade, alignment and cross section.
- 2. All suitable materials removed from the excavation shall be used as far as practicable in the formation of the embankments, subgrades, shoulders, building sites and other places as directed. Excavated material shall not be wasted without permission, and where necessary to waste such material, it shall be at the direction

of the Engineer. Unsuitable material shall be removed to the required depth and replaced to the satisfaction of the Engineer with suitable material. Unsuitable material existing in open areas may remain, and these open areas may be used for disposal areas for any excess suitable material only when and as directed by the Engineer.

3. All excess excavated *suitable* material or borrow fill shall be considered property of the Owner and disposed of as directed by the Owner or Engineer. *Excess unsuitable material shall be legally disposed of by the Contractor at no additional cost to the Owner.*

C. Fills

- 1. Fills shall be formed of suitable material placed in layers in accordance with Section 02220, Excavation, Backfilling and Compaction, measured loose and rolled and/or vibrated with suitable equipment until compacted. Thickness of layers may be increased provided the equipment and methods used are proven by field density testing to be capable of compacting thicker layers to specified densities. Layer thickness shall be decreased if equipment and methods used are proven to be incapable of compacting the layers to specified densities.
- 2. Rock that will not pass through a two (2) inch diameter ring shall not be placed within the top twelve (12) inches of the surface of the completed fill. Rock that will not pass through a one (1) inch diameter ring shall not be placed within the top four (4) inches of the completed fill. Broken concrete or asphaltic pavement shall not be used in fills.
- 3. Muck or other unsuitable material shall not be used in any areas on the Project site.
- 4. All fill placed as part of the improvements defined under this Project shall be compacted in maximum lifts and to a density as specified in Section 02220, *Excavation, Backfilling and Compaction*.
- 5. Final elevations shaft be within ±0.02 feet of the required elevation and surfaces shall be sloped to drain as shown on the Contract Drawings.
- D. Siltation barriers and other erosion control and pollution and erosion control measures required by regulatory agencies are to be accomplished as part of the work without additional compensation.

E. Subgrades

1. The construction of subgrades shall conform to the requirements set forth hereinafter and shall consist of bringing the top of the roadway subgrade between

the outer limits of the base course, to a surface conforming to the grades, lines and cross section shown on the Contract Drawings, of uniform density, ready to receive the base course.

- 2. All material of the subgrade within the indicated limits shown on the Contract Drawings which provide a Limerock Bearing Ratio of less than 40 shall be stabilized as specified under Section 02610, *Stabilized Sub-Base*.
- 3. In areas of pavement removal, the existing base material shall be removed and, if uncontaminated by unsuitable material, may be stock-piled for use in the proposed subbase. Excavated base material may not be utilized as base material on new pavement areas. The existing subgrade must then be reworked to meet the subgrade requirements specified herein.
- 4. After the subgrade has been properly shaped and stabilized, if required, it shall be brought to a firm, unyielding surface by rolling the entire area with an approved three (3) wheel power roller weighing not less than ten (10) tons. All areas inaccessible to the roller shall be thoroughly compacted with hand tampers weighing not less than fifty (50) pounds, the face of which shall not exceed one hundred square inches (100 in²) in area. Unless the subgrade material at the time of the rolling contains sufficient moisture to insure proper compaction, it shall be watered as directed and then compacted. Subgrade material containing excess moisture, as determined by the Engineer, shall be permitted to dry to the proper consistency before being compacted.
- 5. The top twelve (12) inches of the subgrade, including cut and fill sections, shall be compacted to the density specified in Section 02220, *Excavation, Backfilling and Compaction*.
- 6. After the subgrade has been prepared, the Contractor shall maintain it free of ruts, depressions and damage resulting from the hauling and handling of any material, equipment, tools, etc. Ditches or drains shall be constructed and maintained along the completed subgrade section. Just before the base course is laid, the subgrade shall be checked for crown and elevation. The final elevation of the subgrade shall be within ±0.02 feet of the required elevation.
- 7. Slope the grade away from buildings/structures at a minimum rate of ¼-inch per foot for ten (10) feet or a minimum of two (2) inches, whichever is greater), unless indicated otherwise on the Contract Drawings.
- 8. Cultivate subgrade to a depth of four (4) inches, where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted the subsoil.

3.03 Topsoil

- A. Topsoil shall be material obtained from stripping or excavation free of roots, brush, stumps or other debris and suitable for or capable of supporting the growth of grass or other plant life.
- B. When this topsoil material is available from the on site excavation operations, the topsoil shall be placed to a depth of four (4) inches in all areas of new grading and in areas where seeding, sodding and grading is to occur in lieu of topsoil shipped to the site.
- C. Topsoil shall be spread evenly and compacted to a thickness of not less than four (4) inches (twelve (12) inches in landscaped areas) and to the proposed elevations and grades. Grade flush with walks, curbs, and paving, or to the elevations indicated on the Contract Drawings.
- D. Topsoil around trees, plants, buildings and structures shall be spread manually to prevent damage that may be caused by grading equipment. The Contractor shall be responsible to repair any and all damages at no additional cost to the Owner.
- E. Topsoil specifications and placement are presented in Section 02215, *Finish Grading*, Articles 2.02 and 3.02, respectively.

3.04 Finish Grading

- A. After site grading is completed, the disturbed areas shall be finish graded as specified in Section 02215, *Finish Grading*.
- B. Any lumber, undesirable materials and rocks larger than the one (1) inch size shall be removed from the surface and the surface shall be prepared for sod and/or seeding and mulching.
- C. The completed surface shall be shaped and sloped to drain as indicated on the Contract Drawings.
- D. The completed surface shall be within ±0.02 feet of the finish elevations shown on the Contract Drawings, unless otherwise approved by the Engineer.

3.05 Moisture Control of Earth Material

A. During the compaction operations, maintain optimum practicable moisture content required for compaction purposes in each lift of material.

- B. Maintain moisture content uniform throughout the lift.
- C. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the material.
- D. At the time of compaction, the water content of the material shall be at optimum water content or within two (2) percentage points above optimum.
- E. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.

END OF SECTION

SECTION 02215 FINISH GRADING

1. GENERAL

1.01 Description

- A. The Work in this section consists of furnishing all necessary labor, equipment, and material necessary to bring the project site to the lines and grades shown on the Contract Drawings, including, but not limited to:
 - 1. Finish grade subsoil.
 - 2. Cut out areas to receive stabilizing base course materials.
 - 3. Place, finish grade and compact topsoil.

B. Related Work Specified Elsewhere

Specification Section	Title
02100	Site Preparation
02200	Earthwork
02210	Site Grading
02220	Excavation, Backfilling and Compaction
02720	Concrete Sidewalks
02815	Solid Sodding
Contract Drawings and General Provisions of the Contract	

1.02 Protection

A. Prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement, structures, and utility lines. *The Contractor shall correct any damage at no cost to the Owner*.

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1.03 Quality Assurance

A. When requested, the Contractor shall provide the necessary certification that the topsoil conforms to the requirements of Article 2.02 of this specification section.

2. PRODUCTS

2.01 General

A. The Contractor shall provide topsoil for use under all sodded areas.

2.02 Topsoil

- A. Topsoil shall be fertile, friable, natural loam topsoil typical of the area, from well drained sites, free from subsoil, stones, plants, roots, grass, excessive amounts of weeds, or other extraneous material and shall not be used while muddy or frozen.
- B. Where possible, topsoil removed during the clearing and grubbing stage shall be used. The topsoil shall be free of roots, brush, stumps or other debris and suitable for or capable of supporting the growth of grass or other plant life.
- C. Topsoil shall contain not less than eight percent (8%) nor more than twenty-five percent (25%) organic matter (AASHTO T-194) with an acidity range (pH) of 5.5 to 7.5. The topsoil shall consist of either natural topsoils typical of the locality and free from coarse stone aggregate or surface soils stripped from the site and enriched with humus at a rate of eight percent (8%) by volume. The soil mixture prepared by mixing surface soils and humus shall be free of oil, cinders, coarse stone, and woody root material.
- D. Topsoil sample tests, if required, shall be made at the discretion of the Engineer.

3. EXECUTION

3.01 Subsoil Preparation

A. Rough grade subsoil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. Remove subsoil that has been contaminated with petroleum products.

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- B. Cut out areas to subgrade elevation, which are to receive stabilizing base for paving, driveways, sidewalks, etc.).
- C. Bring the subsoil to the required levels, profiles, and contours. *Make gradual changes in grade. Blend slopes into level areas.*
- D. Slope the grade away from buildings and structures a minimum of two (2) inches in ten (10) feet unless indicated otherwise on the Contract Drawings.
- E. Cultivate subgrade to a depth of four (4) inches, where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted the subsoil.
- F. All finish grading shall be done in a manner that provides positive drainage.

3.02 Placing Topsoil

- A. Place topsoil in all areas of new grading and in areas where sodding, grading, planting and landscaping is to occur. Topsoil shall be spread evenly and compacted to the following minimum depths:
 - 1. Twelve (12) inches in landscaped areas.
 - 2. Six (6) inches for seeded areas, if any.
 - 3. Four and one-half $(4\frac{1}{2})$ inches for sodded areas.
 - 4. Four (4) inches everywhere else.
- B. The topsoil shall be relatively dry and placed during dry weather.
- C. Remove stone roots, grass, weeds, debris and other foreign material while spreading.
- D. Topsoil around trees, plants, buildings and structures shall be spread manually to prevent damage that may be caused by grading equipment. The Contractor shall be responsible to repair any and all damages at no additional cost to the Owner.
- E. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.
- F. Grade flush with walks, curbs, and paving, or to the elevations indicated on the Contract Drawings.

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G. Lightly compact placed topsoil.

3.03 Surplus Material

- A. All excess *suitable* material, subsoil, topsoil or borrow fill shall be considered property of the Owner and moved to either a storage location on-site or at an off-site location as directed by the Owner. *Excess unsuitable material shall be "legally" disposed of by the Contractor at no additional cost to the Owner.*
- B. Leave stockpile areas and the entire Project Site clean and raked, ready to receive landscaping, solid sodding or loaming, seeding and mulching.

END OF SECTION

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SECTION 02220

EXCAVATION, BACKFILLING AND COMPACTION

1. GENERAL

1.01 Description

A. Scope of Work

 The Work in this section consists of dewatering, excavating, trenching, sheeting/shoring, grading, backfilling, and compacting those soil materials required under, adjacent to, and for the construction of buildings, structures, piping, utilities, roads, appurtenances and the stormwater management systems as shown on the Contract Drawings and specified herein.

B. Related Work Specified Elsewhere

1.	Dewatering and Drainage:	Section 02075
2.	Site Preparation:	Section 02100
3.	Site Grading:	Section 02210
4.	Finish Grading:	Section 02215
5.	Reinforced Concrete Pipe and Fittings:	Section 02612
6.	Ductile Iron Pipe and Fittings:	Section 15060

C. The Contractor shall be responsible for the determination of earthwork quantities and the volume of material required for the site.

D. Terminology

1. Maximum Density: Maximum weight, in pounds per cubic foot, lb/ft3 (pcf), of a

specific material.

2. Optimum Moisture:

<u>Content</u>

The optimum moisture content shall be determined by ASTM D-1557 specified to determine the maximum dry density for relative compaction. Field moisture content shall be determined on the basis of the fraction passing the ¾-inch

sieve.

3. Rock Excavation: Excavation of any hard natural substance which requires the use

of explosives and/or special impact tools such as, jack hammers, sledges, chisels, or other similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench

excavating machinery.

4. Suitable: Suitable materials for fills shall be a non-cohesive, non-plastic,

granular local sand (classified as A-1, A-3 or A-2-4 in accordance with AASHTO Designation M - 145) that shall be free from vegetation, organic material, marl, silt or muck. Not more than ten (10) percent by weight of fill material shall pass the No. 200 Sieve. The Contractor shall furnish all additional fill

material required.

5. <u>Unsuitable</u>: Unsuitable materials are highly organic soil (peat or muck)

classified as A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, and A-B in

accordance with AASHTO Designation M - 145.

E. Plan for Earthwork

- 1. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his Bid, the conformation of the ground, the character and quality of the substrata, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the Work, the general and local conditions and all other matters that can, in any way, affect the work under this Contract according to Section 00700, *General Conditions*.
- 2. Prior to commencing the excavation, the Contractor shall submit a plan (Earthwork Plan) of his proposed operations to the Engineer for review. The Contractor shall reflect the equipment and methods to be employed in the excavation. Prices established in the Proposal for the Work to be done will reflect all costs pertaining to the Work. No claims for extras based on substrata or groundwater table conditions will be allowed.

F. Trench Safety Act

- 1. The Contractor shall comply with all of the requirements of the Florida Trench Safety Act (Chapter 90-96, CS/CB 2626, Laws of Florida). The Contractor shall acknowledge that included in various items of his Bid proposal and in the Total Bid Price are costs for complying with the provisions of the Act (Section 00430).
- Additionally, the Contractor is required to break out the costs for complying with the Florida Trench Safety Act. FAILURE TO COMPLY WITH THE REQUEST IN THIS SECTION SHALL RESULT IN THE BID BEING DECLARED NON-RESPONSIVE.

3. Failure to comply with the provisions of the Act shall result in a per item penalty, of a dollar amount dictated by the governing authority (\$1,000 minimum), per day that the work is out of compliance.

1.02 Applicable Publications

A. All publications and standard specifications referred to herein are the latest or current issue of that publication or specification as of the specification date.

1.03 Quality Assurance

- A. The requirements for testing and laboratory services are specified in Section 01410, *Testing and Testing Laboratory Services*.
- B. A Testing Laboratory employed by the Contractor, as part of this Contract, and *approved by the Engineer and Owner*, shall make such tests that are deemed advisable.
- C. The Contractor shall schedule his work so as to permit reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of his progress.
- D. Costs for all testing shall be paid by the Contractor and be included in the Contract Price. Any and all tests that have to be repeated, because of failure of the tested material to meet specification, shall be paid for by the Contractor.

1.04 Federal and State Regulatory Requirements

A. All trench excavations which exceed four (4) feet in depth shall comply with the applicable trench safety standards as stated in the OSHA Excavation Safety Standards, 29 CFR S.1926.650, Subpart P, as regulated and administered by the Florida Department of Labor and Employment Security as the "Florida Trench Safety Act".

1.05 Job Conditions

A. If, in the opinion of the Engineer, conditions encountered during construction warrant a change in the footing elevation, or in the depth of removal of unsuitable material from that indicated in the geotechnical investigation (soils report), an adjustment may be made in the Contract Price, as provided in the General and Supplementary Conditions.

- B. Locate existing underground utilities in areas of work. Provide adequate means of support and protection during earthwork operations.
- C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, if any, consult the utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner at no additional cost to the Owner.
- D. Do not interrupt existing utilities serving occupied facilities.
- E. The use of explosives is not permitted.
- F. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by vibration, settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

1.06 Pre-Construction Survey

- A. Prior to commencing excavation, backfill or dewatering, the Engineer and Contractor shall jointly conduct a survey of those existing structures which, in the opinion of the Engineer, may be subject to settlement or distress resulting from excavation or dewatering operations. This shall include both private and public property, both on the project site(s) and in and adjacent to the project right-of-ways.
- B. The Contractor will monitor the structures surveyed to ascertain evidence of settlement or distress. If settlement or distress becomes evident the Contractor shall be required to repair the structures to their previous condition, to the satisfaction of the Engineer. Costs shall be paid by the Contractor and shall be considered to be incidental to the Contract.

1.07 Submittals

- A. Submit to the Engineer, for review, the proposed methods of construction, including dewatering, excavation, sheeting and shoring, bedding, filling, compaction and backfilling for the various portions of the Work.
- B. The Engineer's review shall be for *method* only.
- C. The Contractor shall remain responsible for the adequacy and safety of the methods.

2. PRODUCTS

2.01 Materials

A. General

- 1. All fill material from "on-site" and "off-site" sources shall be subject to the approval of the Engineer and shall contain less than 1.0% asbestos by weight or volume.
- All fill material shall be unfrozen and free of organic material, trash, or other objectionable material. Excess or unsuitable material, as designated by the Engineer, shall be removed in a legal manner from the job site by the Contractor at no additional cost to the Owner and shall be considered incidental to the Contract.

B. Soil Materials

- 1. Satisfactory soil materials are ASTM D-2487 soil classification groups GW, GP, SW and SP.
- 2. Unsatisfactory soil materials are ASTM D-2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH and PT.

C. Sub-Base Materials

1. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.

D. Drainage Fill

1. Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with one hundred percent (100%) passing a 1½-inch sieve and not more than five percent (5%) passing a No. 4 sieve.

E. Common Fill Material

- Common fill shall be sand not containing stones, rock, concrete or other rubble larger than one (1) inch in diameter. It shall have physical properties which allow it to be easily spread and compacted.
- 2. The Contractor shall utilize as much suitable excavated material as possible for reuse in accordance with the Contract Drawings and Specifications or as directed by the Engineer.

3. The Engineer shall direct the Contractor on the type of material allowed in certain sections of the earthwork operations.

F. Structural Fill

1. Structural Fill shall be well graded sand to gravelly sand having the following gradation:

U.S. Sieve Size	Percent Passing by Weight
1-inch	100
No. 4	75 - 100
No. 40	15 - 80
No. 100	0 - 30
No. 200	0 - 10

G. Class I Soils

- 1. Class I soils are not defined in ASTM D-2487.
- 2. Class I soils shall be manufactured angular, granular material, ¼-inch to 1½ inches (6 to 40 mm) in size, including materials having significance such as crushed stone or rock, broken coral, crushed slag, cinders, or crushed shells. Sieve analysis for crushed stone is given below separately.
- 3. Crushed Stone shall consist of clean mineral aggregate free from clay, loam or organic matter, conforming with ASTM C-33 stone size No. 89 and with particle size limits as follows:

U.S. Sieve Size	Percent Passing by Weight
1/2	100
3/8	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 50	0 - 5

H. Class II Soils

- 1. Class II soils shall be in accordance with ASTM D-2487, Class II soils shall have less than five percent (5%) passing a No. 200 sieve as presented below:
- 2. **GW**: Well-graded gravels and gravel-sand mixtures with little or no fines. Fifty percent (50%) or more retained on No. 4 sieve and more than ninety-five percent (95%) retained on a No. 200 sieve. All material shall be clean.
- 3. **GP**: Poorly graded gravels and gravel-sand mixtures with little or no fines. Fifty percent (50%) or more retained on No. 4 sieve and more than ninety-five percent (95%) retained on a No. 200 sieve. All material shall be clean.
- 4. **SW**: Well-graded sands and gravelly sands with little or no fines. More than fifty percent (50%) passes a No. 4 sieve. More than ninety-five percent (95%) retained on a No. 200 sieve. All material shall be clean.
- 5. **SP**: Poorly graded sands and gravelly sands with little or no fines. More than fifty percent (50%) passes a No. 4 sieve. More than ninety-five percent (95%) retained on a No. 200 sieve. All material shall be clean.

Coarse Sand

 Coarse sand shall consist of clean mineral aggregate with particle size limits as follows:

U.S. Sieve Size	Percent Passing by Weight
No.10	100
No. 20	0 - 30
No. 40	0 - 5

J. Other Material

1. All other material, not specifically described, but required for proper completion of the work shall be selected by the Contractor and approved by the Engineer.

3. EXECUTION

3.01 Preparation

- A. Clearing and grubbing shall be performed in accordance with Section 02100, *Site Preparation*.
- B. Strip and dispose of topsoil off-site, unless otherwise directed to stockpile the material by the Engineer.

3.02 Sheeting, Shoring and Bracing

- A. Furnish, put in place, and maintain sheeting and bracing as required to support the sides of excavations, to prevent movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling. If the Owner is of the opinion that sufficient or proper supports have not been provided, he may order additional supports be installed at the expense of the Contractor, and compliance with such order shall not relieve or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids beside the sheeting, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional cost to the Owner.
- B. The Contractor shall construct sheeting outside the neat lines of the foundation unless deemed otherwise for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall withstand all pressure to which the structure or trench will be subjected. Any deformation shall be corrected by the Contractor, at his own expense, so as to provide the necessary clearances and dimensions.
- C. Where sheeting and bracing is required to support the sides of excavations for structures, the Contractor shall engage a Professional Structural Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall conform with the design, and certification of this shall be provided by the Professional Structural Engineer.
- D. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.

- E. The Owner may direct the Contractor, in writing, to leave in place at any time, during the progress of the Work for the purpose of preventing injury to structures, utilities, or property, whether public or private.
- F. Steel sheeting shall be of adequate strength for the purpose intended. Where conditions permit, steel drag shields or trench boxes may be used. Voids left by the advancement of the shield shall be carefully backfilled and compacted in accordance with trench backfill requirements.
- G. Steel sheeting above the crown elevation of pipe may be completely removed when sufficient backfill has been placed to prevent damage to the Work and/or existing structures. Care shall be exercised to prevent the opening of voids during the extraction process.
- H. All sheeting placed below the crown elevation of pipe shall be cut off above the pipe crown elevations and left in place.
- I. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction, or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted for that purpose, or otherwise directed by the Owner.
- J. The right of the Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
- K. The Contractor shall comply with all applicable safety regulations and laws.
- L. The structural strength and safety of all sheeting, shoring, and bracing shall be the sole responsibility of the Contractor. The Contractor shall repair any damage resulting from failure to provide adequate supports at his expense.

3.03 Dewatering and Drainage

A. The Contractor shall at all times during construction, where groundwater level affect the construction activities, provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory, undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels as stipulated in Section 02075, Dewatering and Drainage.

- B. The Contractor shall engage the services of a Professional Geotechnical Engineer, registered in the State of Florida, to design the dewatering systems for all structures. The Contractor shall submit to the Engineer, for review, a plan for dewatering systems prior to commencing Work (Dewatering Plan) in accordance with Section 02075, "Dewatering and Drainage". The installed dewatering system shall be in conformity with the overall construction plan, and certification of this shall be provided by the Professional Geotechnical Engineer. The Professional Geotechnical Engineer shall be required to monitor the performance of the dewatering systems during the progress of the Work and require such modifications as may be required to assure that the systems are performing satisfactorily.
- C. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the bottom of the excavation and to preserve the integrity of adjacent structures. Well or sump installations shall be constructed with proper sand filters to prevent intermixing of finer grained soil from the surrounding ground.
- D. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
- E. All water pumped or drained from the excavated area shall be disposed of in a suitable manner without undue interference with other work, without damage to the surrounding property, and in accordance with pertinent rules and regulations.
- F. The Contractor shall take all additional precautions to prevent buoyant uplift of any structure during construction.
- G. No construction, including pipe laying, shall be allowed in water. Groundwater levels shall be maintained at least thirty (30) inches below the excavation. No water shall be allowed to come into contact with masonry or concrete within twenty-four (24) hours after being placed. The Contractor shall constantly guard against damage due to water and take full responsibility for all damage resulting from his failure to do so.
- H. The conveying of dewatered liquids in open ditches or trenches will not be allowed. Permission to use any storm sewers or drains for water disposal purposes shall be obtained fro the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. The Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the Owner or the authority having jurisdiction, at no cost to the Owner.
- I. The Contractor shall be required, at his expense, to excavate below grade and refill with approved fill material if the Owner determines that adequate drainage has not been provided.

- J. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
- K. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system, shall be removed by the Contractor.
- L. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater quality.
- M. The Contractor shall review all of the requirements of Section 02075, *Dewatering and Drainage*, as well as the General and Supplementary Conditions (Division 0).

3.04 Excavation for Structures and Utilities

- A. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.
- B. Excavation shall be made to such dimensions as will give suitable room for bracing and supporting, for pumping and draining, for installing the pipelines, and for all other work required. Conform to the elevations and dimensions shown on the Contract Drawings within a tolerance of ± 0.02 feet.
 - 1. Excavation for precast or prefabricated structures shall be carried to an elevation two (2) feet lower than the proposed outside bottom of the structure to provide space for the structural backfill material.
 - 2. Excavation for structures constructed or cast-in-place in dewatered or dry excavations shall be carried down to an elevation two (2) feet below the bottom of the structure where dewatering methods are such that a dry evacuation bottom is exposed and the naturally occurring material at this elevation leveled and left ready to receive construction. Material disturbed below the founding elevation in dewatered excavations shall be replaced with No. 57 stone or Class B concrete.
- C. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.
- D. Encounters with subsurface obstructions shall be hand excavated.

- E. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Contract Drawings and should anticipate the encounter of unknown obstructions during the course of the Work.
- F. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of structures, as a result of inadequate dewatering or other construction methods, shall be undercut a minimum of twelve (12) inches and replaced with FDOT No. 57 Stone as required by the Engineer at the Contractor's expense.
- G. The bottom of excavations shall be rendered firm and dry before placing any structure or pipe. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor in a legal manner at no additional cost to the Owner. The bedding schedule for pipes shall be as shown in Table 02220-2 presented at the end of this specification section.
- H. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.
- 1. All structure and pipe locations and elevations as required herein, must be permanently documented by the Contractor, on the Project Record Drawings prior to the Engineer's approval of the Application for Payment for that Work.
- J. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered. No excavated material or other construction material shall be placed within thirty (30) feet of the edge of pavement of any roadway.

3.05 Undercut

A. If the bottom of any excavation is below that shown on the Contract Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due the Contractor's excavation methods, he shall refill to normal grade with fill at his own cost. Fill material and compaction method shall be as directed by the Engineer.

3.06 Stabilization

A. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact.

- B. Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. Not more than a ½-inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations shown on the Contract Drawings.
- C. All stabilization work shall be performed by and at the expense of the Contractor.

3.07 Fill and Compaction

A. <u>Materials</u>

- 1. To the maximum extent available, excess earth obtained from structure and trench excavation shall be used for the construction of fills and embankments.
- 2. Materials used as backfill shall be free from rocks or stones larger than one (1) inch in their greatest dimension; brush, stumps, logs, roots, debris, and organic or other deleterious materials; and must be acceptable to the Engineer.
- Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials be in any backfill, fill or embankment.

B. <u>Placement and Compaction</u>

- Backfill materials shall be placed in approximately horizontal layers in accordance with Table 02220-1, in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.
- 2. Each layer of material being compacted shall have the best practicable uniform moisture content to ensure satisfactory compaction. The Contractor will be required to add water and harrow, disc, blade, or otherwise work the material in each layer to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted by rolling or other method acceptable to the Engineer, to the densities indicated in Table 02220-1 (ASTM D1557, latest revision).

- 3. Whenever a trench passes through a backfill or embankment, material shall be placed and compacted to an elevation twelve (12) inches above the top of the pipe before the trench is excavated.
- C. Compact and backfill excavations and construct embankments for structures according to the schedule listed in Table 02220-1 provided at the end of this specification section. Backfill schedule for pipes is listed in Table 02220-2 also presented at the end of this specification section (Modified Proctor shall be ASTM D-1557, latest edition).
- D. Pipe shall be laid in open trenches unless otherwise indicated on the Contract Drawings or elsewhere in the Contract Documents.
- E. Excavations shall be backfilled to the original grade or as indicated on the Contract Drawings. Deviation from this grade because of settling shall be corrected. Backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.
- F. Embankments shall be constructed true to lines, grades and cross sections shown on the Contract Drawings or ordered by the Owner. Embankments shall be placed in successive layers of not more than the maximum lift thickness identified in Table 02220-1, of loose measure, for the full width of the embankment. As far as practicable, traffic over the work during the construction phase shall be distributed so as to cover the maximum surface area of each layer.
- G. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such a request shall be in writing to the Engineer. Approval will be considered only after the Contractor has performed tests, at the Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. The Engineer's approval will be in writing.

H. Foundation Preparation

1. The existing ground beneath proposed tankage, building foundations and equipment base slabs and slabs on grade shall be removed and the area proof-rolled. Proof-rolling should consist of at least ten (10) passes of a self-propelled vibrator compactor capable of delivering a minimum impact force of 40,000 pounds per drum to the soils. To minimize the effects of compaction induced vibrations on adjacent existing structures, the compaction operation shall be limited to a distance no closer than twenty-five (25) feet from the existing structures. Each pass should overlap the preceding pass by thirty percent (30%) to insure complete coverage.

Backfilled areas shall be compacted, in maximum lift thicknesses (loose measure) and to the densities (ASTM D1557, (latest)) identified in Table 02220-1, for a depth of not less than two (2) feet below the bottom of the foundations or concrete slabs. Any unsuitable foundation material shall be removed and replaced with suitable material.

3. Slabs On Grade

- a. Subgrades for concrete slabs shall be removed, backfilled, and compacted to the required grade.
- b. The top two (2) feet of concrete slab subgrade in cut sections and all fill material shall be compacted, in maximum lift thicknesses (loose measure) and to the densities (ASTM D1557, (latest)) identified in Table 02220-1.

3.08 Trench Excavation

A. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the Work. One hundred (100) feet shall be the maximum length of open trench on any line under construction. All trench excavation shall be open cut from the surface. The Contractor shall review the typical pipe trench sections in earth presented as Figure 02220-1 through 02220-4 at the end of this Section.

1. Alignment, Grade, and Minimum Cover

- a. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes.
- b. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith shall be in conformity with requirements of the section covering installation of pipe.
- 2. Where pipe grades or elevations are not definitely fixed by the Contract Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of forty-two (42) inches where in paved or graded streets where surface grades are definitely established and thirty-six (36) inches in other locations. Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades.
 - a. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.

B. Limiting Trench Widths

1. Trenches shall be excavated to a width that will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. However, minimum permissible sidewall clearances between the installed pipe and each trench wall, expressed in inches, shall be as follows:

Pipe Size (inches)	Minimum Sidewall Clearance (inches)
60	24
54	21
48	19
≤ 36	12

- 2. Stipulated minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required.
- 3. Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interface with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one (1) foot above the top of the pipe.

C. Mechanical Excavation

- The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, and other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.
- 2. Mechanical equipment used for trench excavation shall be of the type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one (1) foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench.
 - a. Undercutting the trench sidewall to obtain clearance will not be permitted.

D. Pavement Cutting

- Cuts in concrete pavement, asphalt pavement, and asphalt base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with an asphalt or concrete saw in a manner which will provide a clean groove for the full depth of pavement along each side of the trench and along the perimeter of cuts for structures.
- 2. Asphalt pavement and asphalt base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than six (6) inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. The trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the centerline of the trench.
- 3. Pavement removed for connections to existing lines or structures shall not be greater than necessary for the installation as determined by the Engineer.
- 4. The Contractor shall review and conform to the requirements of Section 02505, Pavement Removal and Restoration.

E. Artificial Foundations in Trenches

- 1. Whenever so ordered by the Engineer, the Contractor shall excavate to such depth below grade as the Engineer may direct and the trench bottom shall be brought to grade with such material as the Engineer may order installed.
- 2. All piling, concrete, or other foundations made necessary by unstable soil shall be installed as directed by the Engineer.
- Compensation for extra excavation and piling, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the Contract provisions for extra work.
- 4. Additional work and materials must be approved by the Owner and Engineer, in writing, prior to the Contractor performing said work and placing materials, or the Contractor shall not be paid for these items.

F. Bell Holes

 Bell holes shall provide adequate clearance for tools and methods used in installing pipe. 2. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

3.09 Tests

- A. As stipulated in the quality control section and Section 01410, *Testing and Testing Laboratory Services*, all tests required for preliminary review of materials shall be made by an independent testing laboratory supplied by the Contractor and approved by the Engineer and Owner.
- B. Two initial gradation tests shall be made for each type of backfill material and one additional gradation test shall be made for each additional three hundred (300) tons of each material by the independent testing laboratory.
- C. Moisture-density (Proctor) tests and relative in-place density tests on the materials, and all in-place field density tests, **shall be made at the expense of the Contractor**.
- D. Testing is specified in Section 01410, Testing and Testing Laboratory Services.

3.10 Drainage Maintenance

- A. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway to prevent impounding water after the pipe has been laid.
- B. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches.
- C. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original sections, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3.11 Final Grading

A. After other outside work has been finished, and backfilling completed and settled, all areas on the site of the Work which are to be graded shall be **brought to grade with**

the tolerance of ± 0.02 feet at the indicated elevations, slopes, and contours where sodding or seeding is not required or, where sodding is required within three (3) inches of finished grade.

- B. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise shown, a slope of at least one (1) percent shall be provided.
- C. After grading and where sodding or seeding is required, topsoil shall be evenly spread to a minimum depth as indicated in Article 3.02(A) of Section 02215, *Finish Grading*. Topsoil shall be from an Engineer approved source and shall be clear of trash, debris and surface vegetation.
- D. Grading and surfacing shall be completed to the satisfaction of the Engineer.

3.12 Excess Excavated Materials

- A. Insofar as needed, suitable excavated materials shall be used in fills and embankments shown on the Contract Drawings. All suitable excess excavated material shall be placed at an "on-site" stockpile area as directed by the Owner.
- B. The Contractor shall segregate different types of excavated materials (i.e. sands, clayey sands, etc.) as possible in the stockpile area. All debris, junk, stones, logs, stumps, roots, and other unsuitable materials shall be disposed of by the Contractor off-site in a legal manner and at no cost to the Owner.
- C. The Contractor shall slope and compact the stockpile with a light roller type vehicle to maintain stability. The Contractor shall maintain proper soil and erosion control measures.

3.13 Settlement

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in Section 00700, *General Conditions*.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Engineer or Owner.

END OF SECTION

TABLE 02220-1 COMPACTION AND BACKFILL SCHEDULE FOR STRUCTURES

Area	Material	Maximum Lift Thickness	Compaction *
Beneath structures, foundations, slabs, and pavements (minimum 5-foot depth below concrete foundation	ndations, slabs, and Structural Fill rements (minimum 5-foot pth below concrete [Article 2.01(F)]		Compacted to 98% of the soil's Modified Proctor maximum dry density. Fill should not be placed over any in-place soils until those layers have been compacted to 98% of the soil's Modified Proctor maximum dry density.
Around structures, foundations and slabs (minimum 5-foot spacing)	Structural Fill	8-inch	Compacted to 98% of the soil's Modified Proctor maximum dry density. Use light rubber-tired or vibratory plate compactors
From cleared existing surface to subgrade for paved and gravel roadway surfaces	Common Fill [Article 2.01(E)]	12-inch	Compacted to 98% of the soil's Modified Proctor maximum dry density.
Disturbed area requiring solid sodding	Topsoil	12-inch	Compacted to 95% of the soil's Modified Proctor maximum dry density.
Disturbed area requiring seeding and mulching	NOT USED		NOT USED

^{*} Percentage of the maximum density at optimum moisture content as determined by the Modified Proctor Method, ASTM D-1557 (latest revision) / AASHTO T-180.

TABLE 02220-2 BACKFILL SCHEDULE FOR GRAVITY AND PRESSURE PIPING

				Pipe Envelope				
Pipe Material	Pipe Size		Trench Bedding Condition Material	Primary Zone		Secondary Zone		Others
matorial	OILO	Containen		Material	Depth ^c	Material	Depth	
	< 16"	Normal ^a	Compacted Common Fill	Coarse Sand	0.50 O.D.	Coarse Sand	0.5 O.D. + 12"	
Ductile Iron, Stainless Steel,		Special ^b	Class I	Coarse Sand	0.50 O.D.	Coarse Sand	0.5 O.D. + 12"	
Culvert Pipe and Prestressed Concrete Cylinder Pipe		Normal ^a	Class II	Common Fill	0.25 O.D.	Common Fill		Class II Material should not have
	≥ 16"	Special ^b	Class I	Common Fill	0.25 O.D.	Common Fill		stones (size > 2"). Organic content <1.1% by wt.
	< 16" ≥ 16"	Normal ^a	Coarse Sand	Coarse Sand	0.70 O.D.	Coarse Sand	0.3 O.D. + 12"	
Fiberglass, PVC and other		Special ^b	Class I	Coarse Sand	0.70 O.D.	Coarse Sand	0.3 O.D. + 12"	
Plastic Pipe		Normal ^a	Class II	Class II	0.70 O.D.	Class II	0.3 O.D. + 12"	
		Special ^b	Class I	Class II	0.70 O.D.	Class II	0.3 O.D. + 12"	
DOD 1 00D	< 48"	Normal ^a	Class II	Class II	0.50 O.D.	Common Fill		
RCP and CCP		Special ^b	Class I	Class II	0.50 O.D.	Common Fill		

TABLE 02220-2 BACKFILL SCHEDULE FOR GRAVITY AND PRESSURE PIPING

				Pipe Envelope				
Pipe Material	Pipe Size	Trench Condition	Bedding Material	Primary Zone		Secondary Zone		Others
				Material	Depth ^c	Material	Depth	
RCP and CCP	> 401	Normal ^a	Class II	Class II	0.25 O.D.	Common Fill with max. stone size ≤2"	0.75 O.D. + 12"	
(Cont'd)	≥ 48"	Special ^b	Class I	Class II	0.25 O.D.	Common Fill with max. stone size ≤2"	0.75 O.D. + 12"	
Pipe laid in rock (min. trench req's) except for fiberglass and PVC Pipe		Rock	Class I	Class II	0.50 O.D.	Common Fill with max. stone size ≤2"	0.50 O.D. + 12"	
Gravity Pipe (not specified above)		Normal	Coarse Sand	Coarse Sand	0.50 O.D.	Common Fill	0.50 O.D. + 12"	
Pressure pipe (not specified above)		Normal	Suitable undisturbed Earth or compacted common fill	Common fill with max. stone size ≤ 2"	0.50 O.D.	Common Fill with max. stone size ≤2"	0.50 O.D. + 12"	

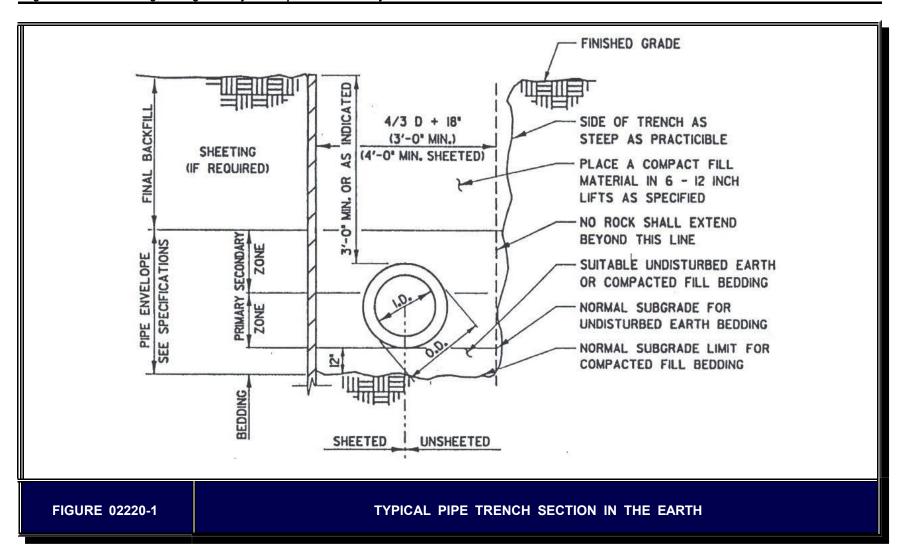
a Dry Soils

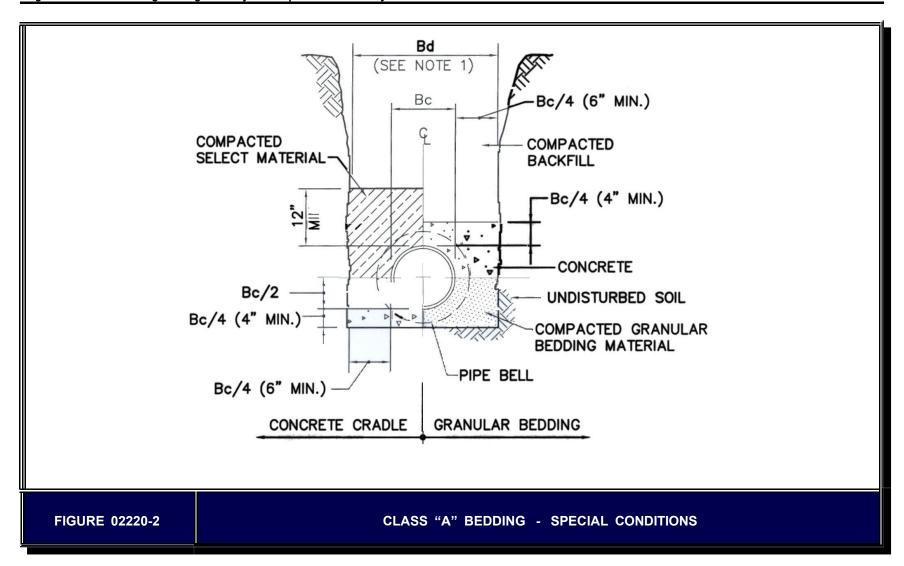
b Saturated Soils

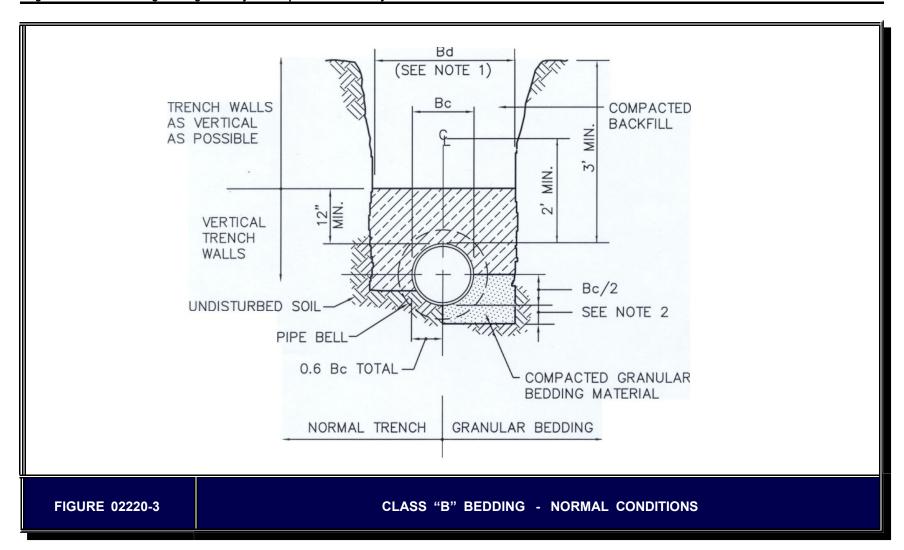
c Outside Diameter of pipe = O.D.

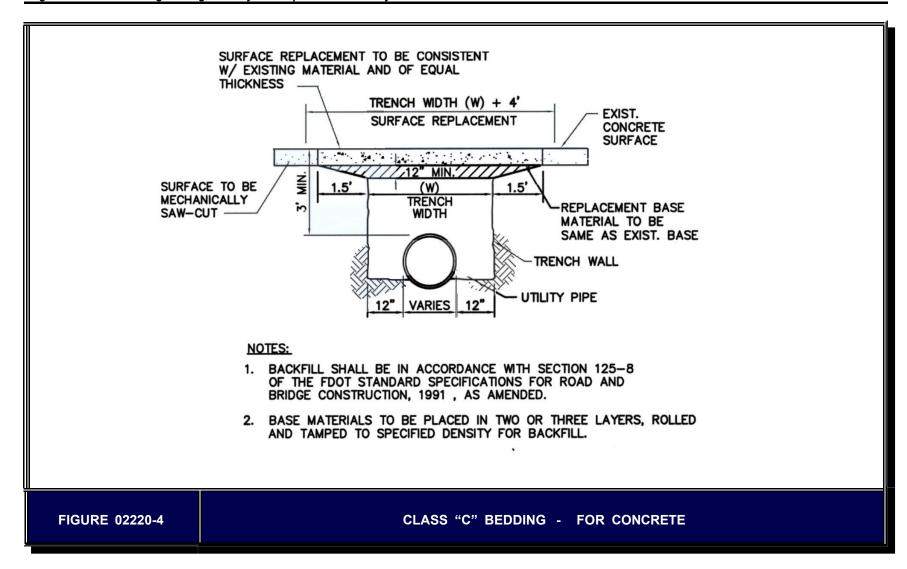
Notes

- 1. No special bedding shall be required in the case of suitable undisturbed earth type trench bottom.
- 2. Bedding thickness shall be twelve (12) inches unless specified otherwise.
- 3. The backfill shall be compacted to 98% Modified Proctor maximum dry density and shall be placed in 6-inch lifts for the pipe envelope and in 12-inch lifts from the secondary zone to grade. Common fill shall be used as final backfill material.
- 4. It is intended that additional excavation be conducted to remove unsuitable material below the pipe bedding level which prevents bedding compaction as required herein and replace such materials with suitable materials. Over excavation, geotextile fabric, gravel blanket, granular fill and other acceptable stabilization methods shall be placed within four (4) feet of the bedding level or within ten (10) feet of the existing ground (whichever is greater depth) at no additional cost to the Owner. Construction required beyond these limits shall be executed in accordance with the General Conditions, as amended by the Supplementary Conditions. When indicated on the Contract Drawings, the Contractor shall remove unsuitable material below bedding level to the limits indicated and replace them with coarse sand or other acceptable stabilization method up to the bedding level without any additional compensation to the Owner.









BEDDING AND TRENCHING NOTES

1. B_c = Pipe O.D.

 B_d = Trench Width at Top of Pipe

 $Max. B_d = B_c + 24"$

 $Min B_c$ = Max. dimension of bell + 8-inches (unsheeted trench)

= Max. dimension of bell + 12-inches (sheeted trench)

- 2. The depth of removal of unsuitable material shall be as required to reach a suitable foundation for non-cushioning material. The depth shall be a minimum of six (6) inches below the bottom of the utility.
- 3. Sheeting shall be driven below the utility invert if required for lateral support or unsuitable removal where driven below the pipe invert. Sheeting shall be cut off a minimum of twelve (12) inches above the top of the pipe, or higher as authorized by the Engineer, and left in place. In no case shall sheeting left in place extend higher than thirty (30) inches below the surface grade unless specifically approved. Bracing shall be provided as required by the Contractor.
- 4. Protective concrete slabs are required whenever the depth of cover is less than thirty-six (36) inches and shall be in accordance with Division 3.
- 5. Backfill shall be compacted to 98% density of AASHTO T-180 modified proctor in areas to be paved or receive concrete and 95% in lawn and landscaping areas. All other areas shall be compacted in accordance with this specification section.

SECTION 02276

GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

1. GENERAL

1.01 Description

A. Scope of Work

1. The Work included in this Section consists of all labor, materials testing and installation of gravel and crushed rock bases for structures (manholes, vaults, etc.).

B. Related Work Specified Elsewhere

Specification Section	Title			
00700	General Conditions			
00800	Supplementary Conditions			
01410	Testing and Testing Laboratory Services			
02200	Earthwork			
02220	Excavation, Backfilling and Compaction			
03300	Cast-in-Place Concrete			
Contract Drawings and General Provisions of the Contract				

1.02 Submittals

A. Submit three (3) copies of a report from a testing laboratory verifying that material contains less than one percent (1%) asbestos by weight or volume and conforms to the specified gradations or characteristics.

B. Submit the above referenced report in accordance with Section 01300, *Shop Drawings, Submittals and Samples.*

1.03 Testing for Compaction

- A. **The Contractor shall test for compaction** as described below and in accordance with Section 01410, *Testing and Testing Laboratory Services* and Section 02220, *Excavation, Backfilling and Compaction*.
- B. **Determine the density of the gravel and rock**, in place, by the sand cone method, ASTM D-1556 or D-2167.
- C. Determine the relative density of the gravel and rock by ASTM D-4253 and D-4254.
- D. Sample backfill materials by ASTM D-75.
- E. Compaction shall be deemed to comply with the specifications when no more than one test of any three consecutive tests falls below the specified relative compaction. The one test shall be no more than three percentage points below the specified compaction. The Contractor shall pay the costs of retesting work not conforming to the specifications.

2. PRODUCTS

2.01 Gravel and Crushed Rock

A. Crushed rock base and gravel are defined as natural or crushed rock, free from organic matter and containing less than one percent (1%) asbestos by weight or volume, and meeting the following gradation:

Sieve Size	Percent Passing By Weight
1½ inches	100
³/₄-inch	90 - 100
No. 4	35 - 55
No. 30	10 - 30
No. 200	0 - 5

B. The Durability Index shall be at least 40 per ASTM D-3744.

3. EXECUTION

3.01 General

- A. Place crushed rock or gravel base beneath all structures, as required by the conditions, or as directed by the Engineer.
- B. Excavate a minimum of twenty-four (24) inches below the required grade for the bottom of the structure and refill with crushed rock or gravel as specified above. Compact the base as follows unless otherwise indicated:

Lift	Relative Density
Lower lift	98%
Upper lifts	98%

C. Place base material in maximum lifts of eight (8) inches.

END OF SECTION

SECTION 02505

PAVEMENT REMOVAL AND RESTORATION

1. GENERAL

1.01 Scope of Work

- A. The Contractor shall furnish all labor, materials, tools, transportation, equipment, and incidentals required for cutting, removing, protecting and replacing existing pavements of the various types encountered, including, but not limited to, roadways, driveways, sidewalks, curb combination curb as shown on the Contract Drawings and/or specified herein.
- B. This Section does not include the construction of new roadway, driveway, sidewalk or curb and gutter surfaces or the complete restoration of an existing roadway.

C. Related Work Specified Elsewhere

Shop Drawings, Submittals and Samples: Section 01300
 Concrete Sidewalks, Driveways and Pads: Section 02720

1.02 Permits

- A. The Contractor shall obtain the necessary permits prior to any roadway work.
- B. The Contractor shall provide advance notice to the appropriate authority, as required, prior to construction operations.

1.03 Protection of Existing Improvements

A. The Contractor shall be responsible for the protection of all pavements, sidewalks and other improvements within the work area. All damage to such improvements, as a result of the Contractor's operations, beyond the limits of the work of pavement replacement as described herein, shall be repaired by the Contractor at his expense.

1.04 Jurisdictional Requirements

- A. All work within City of Flagler Beach public thoroughfares and easements shall conform to the City's Land Development Code, these specifications, and details contained in the Contract Drawings.
- B. All work within City of Flagler Beach public thoroughfares and easements shall conform to the County's Land Development Code, these specifications, and details contained in the Contract Drawings.
- C. Portions of the Standard Specifications for Road and Bridge Construction of the Florida Department of Transportation and Supplement, latest revisions, hereinafter referred to as the FDOT Specifications, are referred to herein and amended, in part, and the same are hereby made a part of this Contract to the extent of such references, and shall be as binding upon the Contract as though reproduced herein in their entirety.

1.05 Miscellaneous Provisions

- A. The Contractor shall refer to Sections 01380, *Construction Photographs*, and 01390, *Preconstruction Video Recording* relative to photographs and videotaping required prior to construction.
- B. All damage done, as a result of work under this Project, shall be repaired in a manner satisfactory to the Engineer. Bid prices shall include the furnishing of all labor, materials, equipment, and incidentals necessary for the cutting, repair, and restoration of the damaged areas unless pay items for specific types of repair are included in the Bid Form.
- C. The Contractor shall keep the surface of the backfilled area of excavation in a safe condition and level with the remaining pavement until the pavement is restored in the manner specified herein. All surface irregularities that are dangerous or obstructive to traffic are to be removed. The repair shall conform to applicable Owner or State requirements for pavement repair and as described herein.
- D. All surface irregularities that are dangerous or obstructive to traffic are to be removed. The repair shall conform to applicable Owner or State requirements for pavement repair and as described herein.
- E. **All materials and workmanship shall be "first class"** and nothing herein shall be construed as to relieve the Contractor from this responsibility. The Owner reserves the right to require soil bearing or loading tests or materials tests, should the adequacy of the foundation or the quality of materials used be questionable. Costs of these tests shall be borne by the Contractor.

F. All street and road repair shall be made in accordance with the details indicated on the Contract Drawings and in accordance with the applicable requirements of these Specifications and meeting the approval of affected local and State agencies.

2. PRODUCTS

2.01 Materials

- A. Materials, including limerock, bituminous prime and tack coat, and asphaltic concrete for the above work shall meet the requirements established therefore by the FDOT Specifications.
 - 1. Limerock shall be Miami or Ocala Limerock.
 - 2. Bituminous prime coat material shall be cutback asphalt Grade RC-70.
 - 3. Bituminous tack coat material shall be emulsified asphalt Grade RS-2.
 - 4. Asphaltic concrete shall be conform to FDOT specifications for Superpave 12.5 mm traffic level "C" asphaltic concrete, with PF76-22 Polymer Modified Binder

3. EXECUTION

3.01 Preparation

A. Where the work crosses or interferes with pedestrian crossings, extreme care shall be taken by the Contractor to insure the safety of pedestrians.

3.02 Performance

A. Removals

1. Asphaltic Pavement Removal

a. Where small amounts of existing pavement are to be removed, the surfacing shall be by mechanical saw cut prior to trench excavation, leaving a uniform and straight edge, with minimum disturbance to the remaining adjacent surfacing. The width of cut for this phase of existing pavement removal shall be minimal.

- b. Where large amounts of existing pavement are to be removed from construction planned along the length of various streets, bike paths or parking lots, the surfacing shall be removed by milling. All removed material shall be stockpiled as needed to restore the lower level of road base in place of limerock up to three (3) inches thick. All milling shall be in accordance with Section 327 of the FDOT specifications.
- c. Immediately following the specified backfilling and compaction, a temporary sand seal coat surface shall be applied to the cut areas. This temporary surfacing shall provide a smooth traffic surface with the existing roadway and shall be maintained until final restoration. Said surfacing shall remain for ten (10) days in order to assure the stability of the backfill under normal traffic conditions. Following this period and prior to fifteen (15) days after application, the temporary surfacing shall be removed and final roadway surface restoration accomplished.
- d. In advance of final restoration, the temporary surfacing shall be removed and the existing pavement mechanically sawed straight and clean to the stipulated dimensions. Following the above operation, the Contractor shall proceed immediately with final pavement restoration in accordance with the requirements set forth in the governing authority's Land Development Code and these requirements.

2. Sidewalk, Drive and Curb Removal

- a. Concrete sidewalks, curbs, combination curb and gutter, walks, drive ribbons, or driveways shall be removed by initially sawing the structure, with a suitable power saw, as specified above for pavement.
- b. When a formed joint in the concrete exists within three (3) feet of the proposed saw cut and parallels the proposed saw cut, the removal line shall be extended to the formed joint. After sawing, the material shall be removed from the site and legally disposed of by the Contractor.

B. Restorations

1. General

- a. Street or roadway pavement cut and removed in connection with trench excavation shall be replaced or restored in an "equal" or "better" condition than the original condition and as shown on the Contract Drawings.
- b. The Contract Drawings indicate minimum requirements.

2. Asphaltic Pavement Restoration

- a. The limerock base course shall be a twelve (12) inch layer compacted to not less than one hundred percent (100%) of maximum density as determined by AASHTO Designation T-180. The field density of limerock base in place shall be determined by AASHTO Designation T-238.
- b. Construction methods and equipment shall generally meet the requirements therefor as established in the FDOT Specifications, but shall be modified to meet any relatively narrow strip construction conditions. Any such modifications shall be approved by the Engineer prior to their use.
- c. After the application of the prime coat on the base, the prime coat shall be allowed to cure without sanding for a period of twenty-four (24) hours. The Contractor shall take all necessary precautions to protect the primed surface against damage during this interval. If, at the end of the twenty-four (24) hour period, it is not proposed to proceed at once with the application of the surface course, the primed surface shall be given a light application of clean sand and opened to traffic.
- d. **Joints with existing surface and base shall be straight and neat**. If necessary to obtain a straight neat joint, the Contractor shall cut out sufficient existing material and replace it with new material.
- e. The upper surface of the completed base course shall be compacted to an elevation to permit the full depth of the surface course to be constructed without deviating from the grade of the pavement surface. The completed surface shall match the line and grade of the existing surface.
- f. When pavement is removed to the edge of the roadway, the replaced base course shall extend **not less than six (6) inches beyond the edge of the surfacing**.

3. Asphaltic Driveway Restoration

- a. Driveway pavement, with a limerock base, cut and removed in connection with project excavation shall be replaced or restored as specified above for street or roadway pavement, except the new limerock base course shall equal the existing base course in thickness.
- b. However, *in no case shall new driveway base course be less than twelve* (12) *inches in thickness*. Remove and replace any muck or unsuitable material found under existing driveway construction.

4. Concrete Sidewalk, Walkway, Driveway Ribbon and Curb Restoration

- a. Concrete sidewalks, walkways, driveways, driveway ribbons and curbs required to be removed for the installation of facilities under this Contract shall be restored
- b. Class B concrete with a 28-day compressive strength of 3,000 psi, as specified in Section 03300, *Cast-in-Place Concrete*, shall be used in all cases.
- c. Replaced portions of these items shall conform to the lines, grades and cross sections of the removed portions. Concrete sidewalks and walkways shall have a thickness of four (4) inch thickness; concrete driveways and driveway ribbons shall have a thickness of six (6) inches and heavy duty concrete pavement shall have a thickness of eight (8) inches. Replaced concrete curb and/or gutter shall joint neatly to the remaining section.

5. Concrete Pavement Restoration

- a. Rigid pavement shall be replaced, in kind, with Class B concrete, using high early strength cement.
- b. The base course for rigid pavement shall be limerock base material and compacted to a thickness to match the existing base.
- 6. Non-surfaced streets, alleys and driveways shall be restored with eight (8) inches of compacted limerock base material placed in the top of the trench.

3.03 Heavy Duty Concrete Pavement

A. Heavy duty concrete pavement, where shown on the Contract Drawings, shall be constructed as detailed in Figures 02505-1 through 02505-3.

3.04 Adjusting Existing Structures

A. Existing structures within the limits of the proposed Work, which do not conform to the finished grade of the proposed pavement or the finished grade designated on the Contract Drawings for such structure shall be cut down or extended and made to conform to the new grade. The materials and construction methods for this work shall be approved by the Engineer.

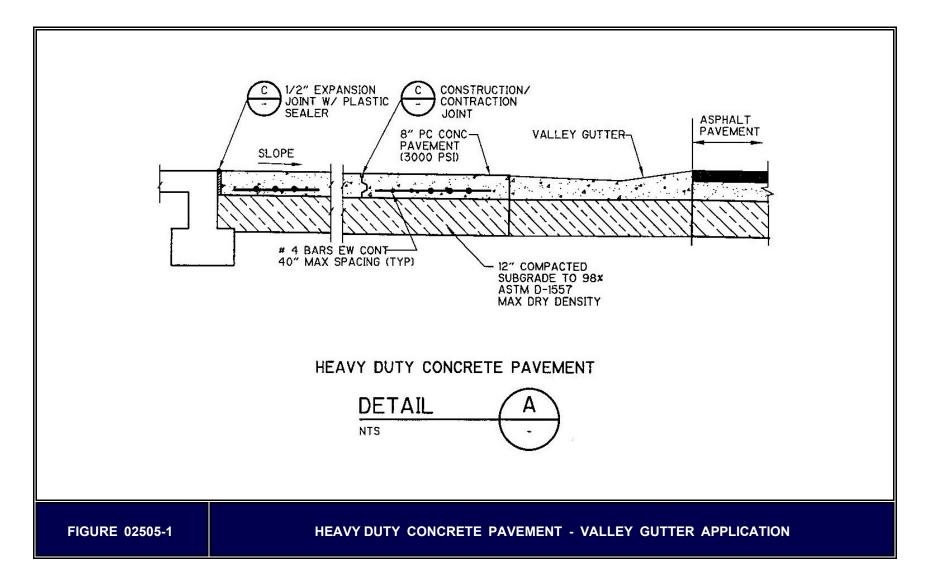
3.05 Miscellaneous Restoration

A. *Grassed yards, shoulders and parkways shall be restored to match the existing sections with sod*, as indicated on the Contract Drawings or as specified by the Engineer, of a type matching the existing grass.

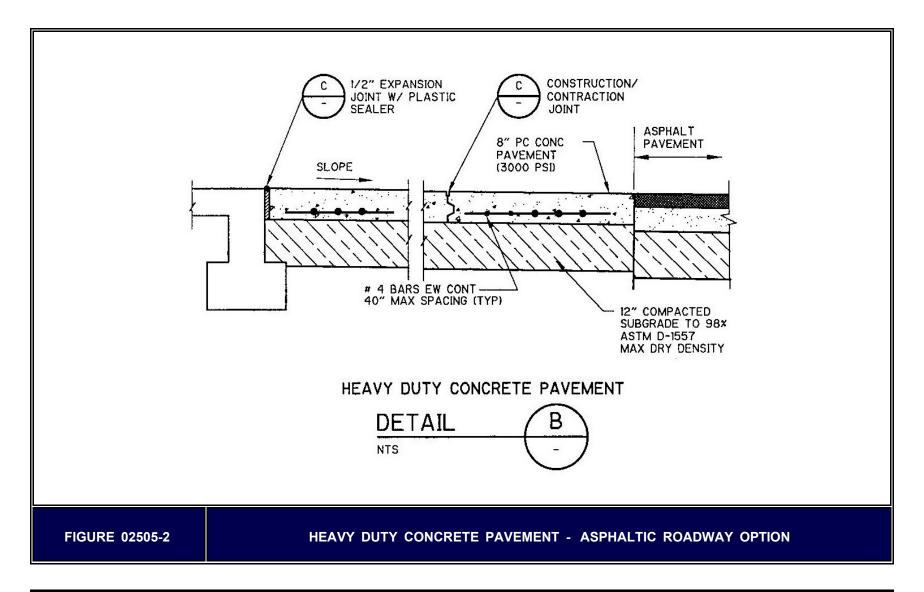
3.06 Cleanup

- A. After all repair and restoration or paving has been completed, all excess asphalt, dirt, and other debris shall be removed by the Contractor and disposed of in a legal manner.
- B. All existing storm sewers and inlets shall be checked and cleaned of any construction debris.

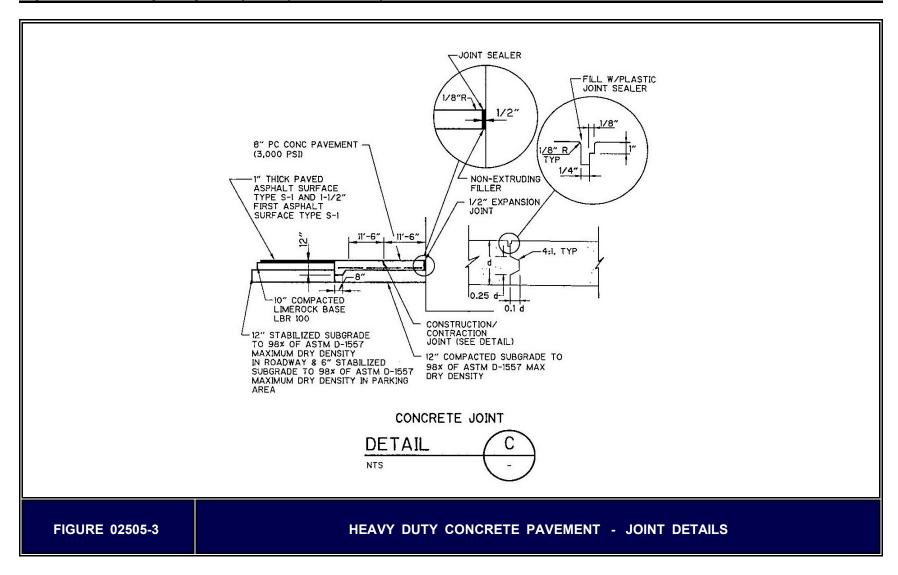
END OF SECTION



February 2024 Pavement Removal and Restoration



February 2024 Pavement Removal and Restoration



February 2024 Pavement Removal and Restoration

SECTION 02610 STABILIZED SUB-BASE

1. GENERAL

1.01 Description

A. The work included in this Section consists of furnishing all labor, material, equipment, transportation, tools and testing and for the construction of a firm and unyielding stabilized sub-base as shown on the Contract Drawings.

2. PRODUCTS

2.01 Materials

A. Use local or hauled-in clean sand or sand and clay.

2.02 Stabilizers

- A. Use high bearing-value soil, sand-clay, ground limestone or crushed limestone.
- B. Do not use muck, trash, hardpan, material having a plasticity index of more than 10 or a liquid limit greater than 40.

3. EXECUTION

3.01 Construction Methods

A. Test local material for compliance with the required Florida Bearing value. If the natural in-place soils do not meet the required stability, uniformly mix, to depth shown in the Contract Documents, or as recommended by the Contractor's geotechnical engineer, sufficient borrow material for stabilization with the in-place soils to produce the required bearing value.

February 2024 Stabilized Sub-Base

- B. Compact the stabilized sub-base in both cuts and fills to a density of ninety-eight percent (98%) of the relative density as required by AASHTO T-180 (Modified).
- C. Shape the sub-base to within ¼-inch of the cross section grade shown on the Contract Drawings prior to making the density tests. *Make the density tests before other work proceeds*.
- D. Maintain the required density and cross section until the base or pavement has been laid or until the aggregate materials for the base or pavement course have been spread in place.

3.02 Required Bearing Value

A. Unless otherwise specified in the Contract Documents or shown on the Contract Drawings, *stabilized sub-base shall have a minimum Florida Bearing Value of 40*.

3.03 Tests

- A. Density and bearing value tests shall be made by an independent testing laboratory in accordance with Section 01410, *Testing and Testing Laboratory Services* (Minimum testing at intervals not more than one hundred (100) feet in roadways or 1,000 ft² in area paving, whichever is less).
- B. If any test results are unsatisfactory, re-excavate and recompact the sub-base until the desired compaction is obtained. Make additional tests on each side of an unsatisfactory test to determine the extent of re-excavation, re-mixing and recompaction necessary.

END OF SECTION

February 2024 Stabilized Sub-Base

SECTION 02720

CONCRETE SIDEWALKS, DRIVEWAYS AND PADS

1. GENERAL

1.01 Scope of Work

A. The work included in this Section consists of furnishing all labor, material, equipment, transportation, and tools for the construction of the concrete sidewalks, walkways, driveways, pads and related items to the lines and grades as shown on the Contract Drawings.

B. Related Work Described Elsewhere

Specification Section	Title	
02200	Earthwork	
02210	Site Grading	
02215	Finish Grading	
02220	Excavation, Backfilling and Compaction	
03100	Concrete Formwork	
03200	Concrete Reinforcement	
03300	Cast-in-Place Concrete	
Contract Drawings and General Provisions of the Contract		

C. Construct all sidewalks four (4) inches thick, driveways six (6) inches thick, and heavy duty concrete pavement eight (8) inches thick, after being thoroughly consolidated in place in accordance with the Contract Documents, unless indicated otherwise on the Contract Drawings.

1.02 Submittals

A. Submit to the Engineer, as provided in the General Conditions and in accordance with Section 01300, *Shop Drawings, Submittals and Samples*, shop drawings showing dimensions and layouts of sidewalks and reinforcement for concrete work.

B. All materials specified shall be certified by the producer or manufacturer that the furnished material meets the specific requirements of the Contract Documents.

1.03 Testing

- A. Testing requirements and frequencies for concrete sidewalks, walkways, driveways, pads and related items shall be as outlined in Section 03300, *Cast-in-Place Concrete*.
- B. Sample backfill materials by ASTM D-75.
- C. "Relative compaction" is defined as the ratio, expressed as a percentage, of the in-place density to the laboratory maximum density.
- D. Compaction shall be deemed to comply with the Specifications when no tests fall below the specified relative compaction. The Contractor shall pay the costs of any retesting of work not conforming to the Specifications.
- E. Density tests will be made for determination of specified compaction by an independent testing laboratory provided by the Contractor and as approved by the Engineer as specified in Section 01410, Testing and Testing Laboratory Services. Testing shall be performed in locations reviewed and approved by the Engineer and as specified in the Contract Documents.
- F. If any tests are unsatisfactory, the Contractor shall re-excavate and re-compact the fill or backfill until the desired compaction is obtained. Additional compaction tests will be taken on each side of an unsatisfactory test at locations approved by the Engineer to determine the extent of re-excavation and re-compaction necessary. All testing shall be incidental to the Contract.
- G. The Contractor shall pay for each compaction test, each failed compaction test and for each additional test taken to determine the extent of re-excavation and re-compaction as previously described.

2. PRODUCTS

2.01 Concrete

A. All concrete, for whatever final purpose, shall be Class B concrete with a minimum 28-day compressive strength of 3,000 psi and a maximum slump of four (4) inches as specified in Section 03300, Cast-In-Place Concrete.

- B. Construct all sidewalks and walkways to a thickness of four (4) inches and all driveways to a minimum thickness of six (6) inches in accordance with Article 1.01(C), after being thoroughly consolidated in place, in accordance with the Contract Documents, unless indicated otherwise on the Contract Drawings.
- C. Concrete driveways, pads and related items shall be constructed, after being thoroughly consolidated in place, to the thickness indicated on the Contract Drawings.
- D. Concrete shall comply with the requirement of Division 3, *Concrete*.

2.02 Welded Wire Fabric

- A. Welded wire fabric shall conform to the requirements of Section 03200, *Concrete Reinforcement*.
- B. Welded wire fabric shall conform to ASTM Specification A-185, galvanized for Welded Steel Wire Fabric for Concrete Reinforcement.
- C. Welded wire fabric, where required, shall be furnished in flat sheets, rolled welded wire fabric *is not* permitted.

2.03 Driveways

- A. Heavy Duty Concrete Pavement Driveways for Commercial Vehicles and Trucks
 - 1. Use deformed bars conforming to ASTM A-615, Grade 60, free from loose rust and scale. No welding is permitted.
- B. Driveways for Passenger Vehicles and Light Trucks
 - 1. Use welded wire mesh in accordance with Article 2.02 above.

2.04 Forming

- A. Use forms of either wood or metal with a depth equal to the plan dimensions for the depth of concrete being deposited against them.
- B. Forms shall be straight, free from warp, bends or defects, and of sufficient strength when staked to resist the pressure of the concrete without deviation from line and grade.

- C. Clean the forms each time they are used, and oil or saturate with water prior to placing the concrete.
- D. **Provide stakes and bracing materials** to hold the forms securely in place.

2.05 Preformed Joint Filler

- A. Preformed Joint Filler shall be non-extruding, of the resilient bituminous type and shall conform to the requirements of ASTM Designation D-1751.
- B. Expansion joint filler shall be of the bituminous type, ½-inch thick, and shall conform to the requirements of ASTM Designation D-994 and AASHTO.

2.06 Membrane Curing Compound

- A. The Membrane Curing Compound used shall be a clear fugitive dye and shall conform to the requirements of AASHTO Designation M-148, Type 1-D.
- B. Use only compounds that will not affect the bond of coatings or toppings that may be applied.

2.07 Gravel and Crushed Rock Base

A. Where called for on the Contract Drawings, gravel or crushed rock shall meet the requirements of Section 02276, *Gravel and Crushed Rock Base for Structures*.

3. EXECUTION

3.01 Foundation

- A. Excavation or backfill to the required depth.
- B. The finished subgrade shall be maintained in a smooth, compact condition and any areas which are disturbed prior to placing of the concrete shall be restored at the Contractor's expense. *The subgrade shall be moist at the time the concrete is placed.* Water shall be uniformly applied ahead of the pouring operations.

- C. Large boulders and other obstructions shall be removed to a minimum depth of six (6) inches below the finished subgrade elevation, and the space shall be backfilled with clean sand. Base course material or other suitable material shall be thoroughly compacted by rolling or tamping.
- D. The subgrade shall be accurately trimmed to the required elevation with a ¼-inch tolerance. High areas shall be trimmed to proper elevation. Low areas may be filled with suitable material and compacted to the specified density or filled with concrete integrally with the placing of the pavement.
- E. Compact the foundation material upon which the concrete is to be set to at least ninety-eight percent (98%) of the maximum density as determined by AASHTO T-180, with an even surface, true to line, grade and cross section.

3.02 Forms

- A. Set the forms straight, free from warp or bends, true to line and grade, such that they rest firmly, throughout their entire length upon the compacted subgrade surface. Set forms with a ¹/₁₆-inch per foot cross slope or as existing.
- B. Forms shall be joined neatly and tightly and braced to resist the pressure of the concrete and the finished operations.
- C. All mortar or dirt shall be completely removed from forms that have been previously used.
- D. Construct all sidewalks four (4) inches thick, driveways six (6) inches thick, and heavy duty concrete pavement eight (8) inches thick, unless indicated otherwise on the Contract Drawings.
- E. The alignment and grade of all forms shall be approved before and immediately prior to the placing of concrete.
- F. All forms shall be oiled as specified in Section 03100, *Concrete Formwork* and Section 03300, *Cast-in-Place Concrete*, before placing concrete.

3.03 Welded Wire Fabric

A. All wire fabric shall be stored off the ground and shall be protected from moisture and be kept free from dirt, oil, or injurious coatings.

- B. Before being placed in position, wire fabric shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy its bonding capability. Where there is delay in depositing concrete after reinforcement is in place, wire fabric shall be reinspected and cleaned when necessary.
- C. Set mesh in form and support so concrete will flow under it.
- D. Wire mesh shall be properly supported at regular intervals so mesh will not be displaced during concrete placement.
- E. Splices in welded wire fabric shall be lapped not less than 1½ courses or twelve (12) inches, whichever is greater. Wire fabric splices shall be tied together with galvanized or stainless steel wire ties, as approved by the Engineer, spaced no more than twenty-four (24) inches on center. Support, as approved by the Engineer, in the middle of slab.
- F. Welded wire fabric shall be in accordance with Section 03200, Concrete Reinforcement.
- G. In no case shall wire fabric be covered with concrete until the amount and position of the fabric have been checked by the Engineer or RPR and his permission given to proceed with the concreting.

3.04 Heavy Duty Concrete Pavement

A. Heavy duty concrete pavement, where shown on the Contract Drawings, shall be constructed as detailed in Figures 02720-1 through 02720-3.

3.05 Placing

- A. Concrete shall be mixed in accordance with the requirements of Section 03300, *Cast-in-place Concrete*.
- B. The concrete shall be distributed on the subgrade to such depth that, when it is consolidated and finished, the thickness required by the Contract Drawings or Specifications will be obtained at all points and the surface will at no point be below the grade specified for the finished surface.
- C. The concrete shall be deposited on the subgrade in a manner which will require as little rehandling as possible.
- D. Placing of the concrete shall be continuous between transverse joints, without the use of intermediate bulkheads.

- E. Reinforcement shall be placed as shown on the Contract Drawings or as specified in the Contract Documents and shall be maintained at this location during the placing and finishing operations.
- F. Concrete shall be thoroughly consolidated against and along the faces of all forms by means of vibrators.

G. Vibrators

- 1. Vibrators are used, they shall not be permitted to come in contact with the subgrade or a side form. Vibration at any one location shall not continue so long as to produce puddling or the accumulation of excessive grout on the surface.
- 2. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

3.06 Finishing Concrete

A. *Immediately after the placing, the concrete shall be struck off, consolidated and finished*, to produce a finished product conforming to the cross section, width and surface finish required by the Contract Drawings and Specifications. Strike off the concrete by means of a wood or metal screed used perpendicular to the forms in order to obtain the required grade, and remove surplus water and laitance.

B. Straightedging and Surface Corrections

- 1. After floating has been completed and the excess water removed, but while the concrete is still in a plastic state, the surface of the concrete shall be tested for trueness with an accurate ten (10) foot straightedge. The straightedge shall be furnished by the Contractor. The straightedge shall be held in successive positions parallel to the walk center line, in contact with the surface, and the whole area tested from one side of the slab to the other as necessary. The advance along the walk shall be in successive stages of not more than one-half the length of the straightedge.
- Any depressions shall be immediately filled with freshly mixed concrete and struck-off, consolidated and refinished. High areas shall be cut down and refinished.
- 3. Straightedge testing and surface correction shall continue until the entire surface appears to conform to the required grade and cross section. All surface irregularities exceeding ¼-inch in a ten foot straightedge span shall be corrected.

C. Preliminary Finish

- 1. Finishing operations shall be delayed until all bled water and water sheen have left the surface, and concrete has started to stiffen.
- 2. After the water sheen has disappeared, edging operations shall be completed. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float.
- Immediately following floating, the surface shall be steel troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity.

D. Final Finish

- 1. As soon as the water sheen has disappeared and just before the concrete becomes non-plastic, the concrete shall be given a light broom finish perpendicular to the forms.
- 2. All edges, including expansion joint edges, shall be finished with an edging tool having a radius of 1/4-inch.
- 3. Where a new sidewalk, driveway or concrete pavement section is replacing an existing sidewalk, driveway or concrete pavement section, the Contractor shall match the finish of the existing sidewalk, driveway or concrete pavement section.

3.07 Joints

A. The Contractor shall provide control joints at right angles to the run of the sidewalk, driveway or concrete pavement section and at spacing equal to the width, unless otherwise noted on the Contract Drawings.

B. Transverse Construction Joints

- 1. Transverse construction joints shall be constructed at the end of all pours and at other locations where the pouring operations are stopped for as long as thirty (30) minutes.
- 2. Construction joints shall not be placed within five (5) feet of any other transverse joint or of either end of a section of walk.
- 3. If sufficient concrete has not been placed to form a slab at least five (5) feet long, the excess concrete, back to the last preceding joint, shall be removed.

- 4. The joints shall be formed by placing a wood or metal bulkhead accurately and securely in place, in a plane perpendicular to the profile and center line of the walk.
- 5. Construction joints shall have tooled edges with a 1/4-inch radius.

C. Transverse Contraction (Control) Joints

- 1. Transverse contraction joints shall be formed at five (5) foot intervals and shall consist of planes of weakness created by an edging tool.
- 2. Contraction joints shall be formed as soon as possible after the concrete has set.
- 3. The cut in the fresh concrete, a slot approximately $^{3}/_{16}$ -inch wide, shall be perpendicular to the surface of the walk, shall extend to a depth of $1\frac{1}{2}$ -inches below the top surface, and shall have $\frac{1}{4}$ -inch radius tooled edges.

D. Transverse Expansion Joints

- 1. One-half ($\frac{1}{2}$) inch expansion joints shall be formed by placing preformed joint filler around all structures, walls, curbs, other fixed objects or one another.
- 2. Locate expansion joints at intervals not exceeding forty (40) feet.
- 3. Place expansion joints where sidewalks and driveways intersect themselves.
- 4. Extend expansion joints the full width and depth of the joint, protecting the top edge which shall not be more than c-inch below the finished surface.

3.08 Concrete Curing

- A. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete shall be covered and cured with membrane curing compound.
- B. Apply clear membrane curing compound by a hand sprayer in a single coat continuous film at a uniform coverage in accordance with the manufacturers recommendation. Thoroughly agitate the curing compound prior to application and during application as necessary to prevent settlement. Recoat immediately any cracks, checks or other defects appearing in the coating.
- C. Curing compound shall not be applied during periods of rainfall. Should the film become damaged from any cause within the required curing period, the damaged portions shall

be repaired immediately with additional compound. Upon removal of side forms the sides of the slabs exposed shall immediately be coated to provide a curing treatment equal to that provided for the surface.

- D. Continuously cure the concrete for a period of at least seventy-two (72) hours. Replace immediately any curing material removed or damaged during the seventy-two (72) hour period. Curing will be done by the membrane curing compound method.
- E. The concrete shall be protected from traffic and weather for at least three (3) days.

3.09 Form Removal

- A. After the concrete has sufficiently set a minimum of twelve (12) hours, the Contractor shall remove the forms and shall backfill the space on each side.
- B. The earth shall be compacted and graded in a satisfactory manner without damage to the concrete work. Place and thoroughly compact suitable fill material to ninety-eight percent (98%) of the maximum density as determined by AASHTO T-180.
- C. Honeycombs shall be filled with sand cement mortar.
- D. Plastering will not be allowed on the face of the walk.

3.10 Testing

- A. Sample and cure the concrete in accordance with ASTM C-31, except take not less than two (2) 6-inch by 12-inch cylinders for each ten (10) cubic yards poured or each day's pour if less than five (5) cubic yards.
- B. Take slump tests as the concrete is discharged from the mixer/truck at the point of placing. Slump tests shall be made in accordance with ASTM C-143, and test cylinders in accordance with ASTM C-39 and the requirements of Division 3, *Concrete*.

3.11 Concrete Rejection

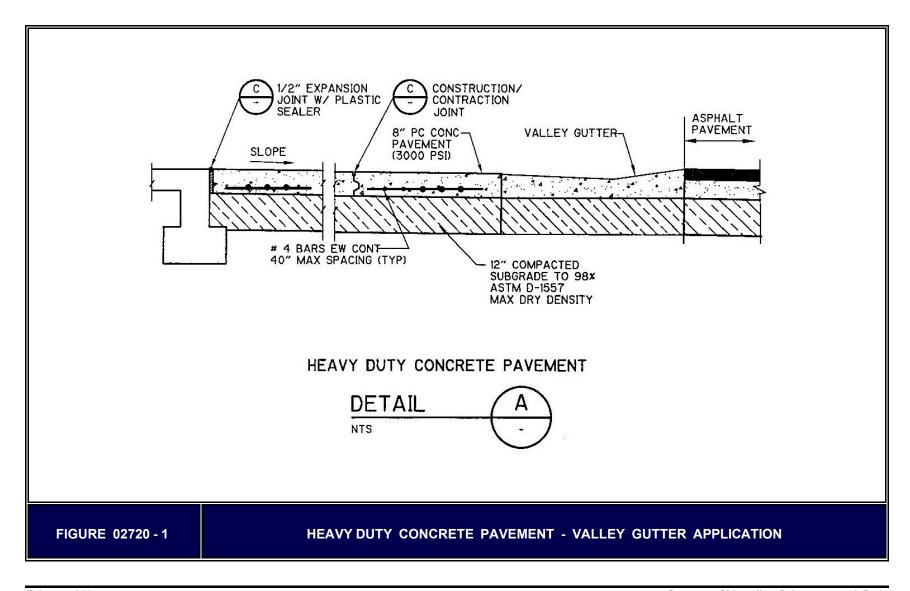
A. Finished sidewalks, walkways, driveways, pad and related items **shall be within** ± **0.02 feet** of the elevations shown on the Contract Drawings, and no crack other than at contraction joints.

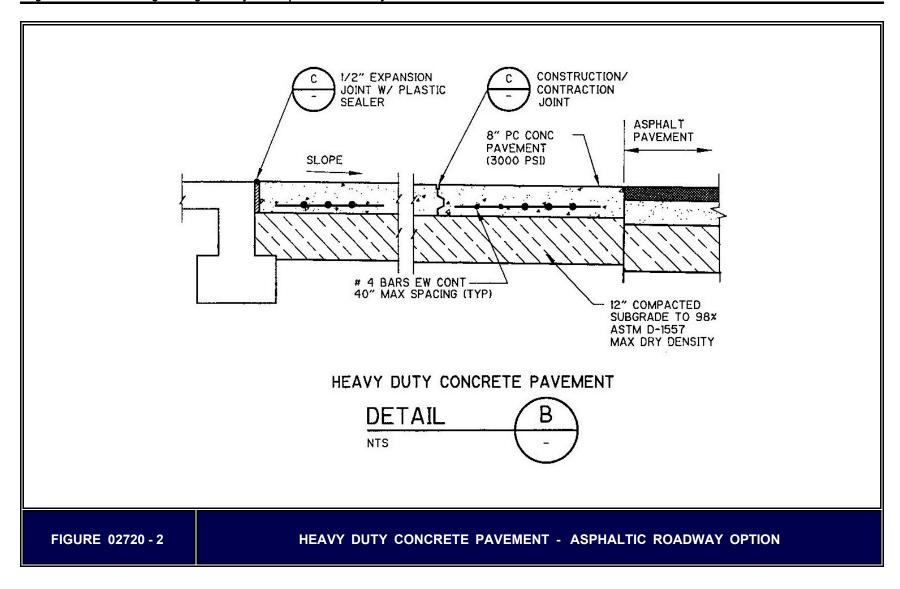
- B. Remove and replace all sidewalks, walkways, driveways, pad and related items that do not meet the above requirements.
- C. Rejected concrete sidewalks, walkways, driveways, pad and related items shall be removed and *replaced by the Contractor without additional compensation*.

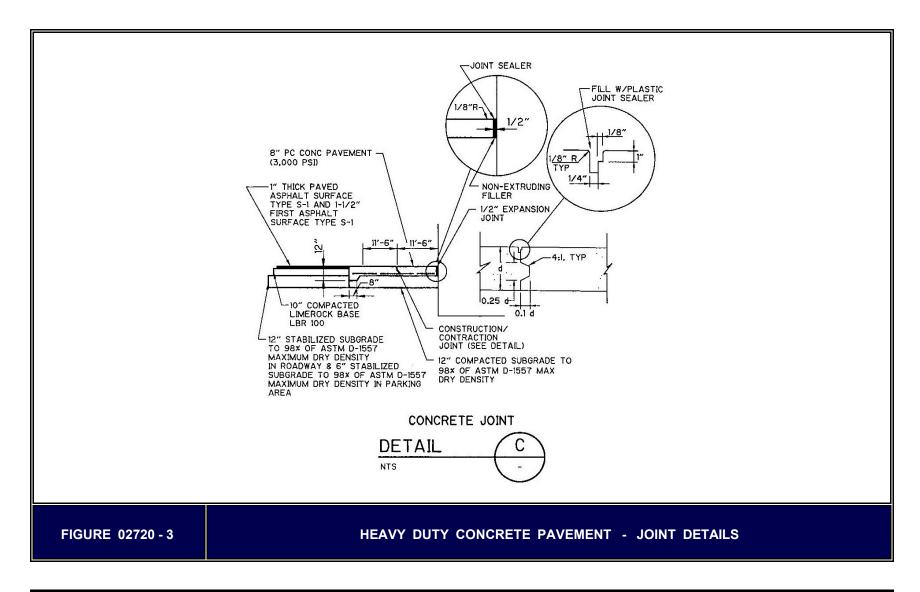
3.12 Cleanup

A. At the completion of the Work, the Contractor shall clean up all scraps, rubbish and surplus materials caused by this Work and haul them away from the site and legally dispose of them and leave the job site in a neat, clean and orderly condition.

END OF SECTION







January 29, 2023 Concrete Side

SECTION 02815 SOLID SODDING

1. GENERAL

1.01 Description

- A. The Work specified in this Section consists of furnishing and placing sod and the furnishing and placing of fertilizer, water staples and stakes required for placing of sod within those areas specified on the Contract Drawings.
- B. The Work shall include, but is limited to, delivery, storage, protection to the public, inspections excavation, installation, grading, backfilling, fertilizing, sod installation, rolling, sanding, watering, mowing, cleanup, maintenance and guarantee.
- C. *The sod shall be Argentine Bahia* where indicated on the Contract Drawings. The sod shall be well matted with grass roots and free of weeds and insects.

D. Related Work Specified Elsewhere

Specification Section	Title	
02100	Site Preparation	
02200	Earthwork	
02210	Site Grading	
02215	Finish Grading	
02220	Excavation, Backfilling and Compaction	
Contract Drawings and General Provisions of the Contract		

1.02 Quality Assurance

A. The Engineer's Landscape Architect shall have the right, during any phase of the Work operations, to reject any and all Work and materials which do not meet the requirements of the Contract Documents.

B. Rejected Work and materials shall be immediately removed from the project area and replaced with acceptable work and material within seven (7) calendar days or as approved by the Engineer's Landscape Architect.

C. Standards

1. Botanical and common names for sod, including varieties, have been derived from accepted names of the landscape industry.

2. Grade Standards

- a. Sod shall be nursery grown and shall comply with required inspections, grading standards and plant regulations as set forth by the Florida Department of Agriculture.
- b. Quality grade shall be based on the standards of sod quality grades of Premium, Standard or Commercial as established by the Turfgrass Producers Association of Florida, Inc.

1.03 Submittals

- A. Submit shop drawings in accordance with the General and Supplementary Conditions and Section 01300, *Shop Drawings, Submittals and Samples*.
- B. The Contractor shall submit certificates from the sod producer stating that the sod meets the requirements for "Florida Standard Grade" as defined by the Turfgrass Producers Association of Florida, as set forth in the Article 2.01 of this specification. The certification of sod quality shall be delivered to the Engineer ten (10) days prior to use.
- C. Fertilizer manufacturer's certificate of analysis including nitrogen, phosphorus, potash, and complete micro-nutrients in accordance with Article 2.02 of this specification.
- D. Submit a copy of the certificate(s) with each delivery.

1.04 Applicable Publications

- A. Portions of the publications listed below form a part of this specification only to the extent referenced:
 - 1. Florida Department of Transportation, "Standard Specification for Road and Bridge Construction", (FDOT Specification, "Grassing" (latest edition).

- 2. Florida Department of Transportation, "Utility Accommodation Guide", Section 5, Paragraphs K, L, and M, except delete "as directed by the Maintenance or Resident Engineer." and delete "or otherwise, to the satisfaction of the Maintenance or Resident Engineer.", latest version.
- 3. Turfgrass Producers Association of Florida, "Standards of Sod Quality".
- 4. Florida State Plant Board Specifications.

1.05 Records

- A. **Submit written weekly records** to the Engineer and Owner of all grassed areas for use in determining the beginning and ending of the maintenance period for each area.
- B. The records shall indicate the date of grassing, fertilization and mowing, the sod type, quantity (ft², yd², or acres) and location of grassing.

2. PRODUCTS

2.01 Solid Grass Sod

A. Grass Sod shall be Argentine Bahia where indicated on the Contract Drawings. The quality grade of the sod shall be "**Standard Grade**" based on the standards of sod quality established by the Turfgrass Producers Association of Florida, Inc. The sod shall be well matted with grass roots and of firm, tough texture having a compact top growth and heavy root development. The allowable weed content shall be as follows based on the Standards for Premium and Commercial grades:

1. <u>Premium Grade</u>: No weeds or any other grasses allowed. Only the species of

sod specified.

2. Standard Grade: No casually visible broadleaf weeds, no obvious patches of

weeds and no more than two percent (2%) of any other

grass or weed in the total canopy.

3. Commercial Grade: Any sod that does not meet the weed restrictions of Premium

or Standard Grade sod.

Sod sections shall be strong enough to support their own weight and retain their size (12" x 24", minimum) and shape when suspended vertically from a firm grasp on the upper ten percent (10%) of the section. Sod shall be moist and relatively free of thatch.

The soil embedded in the sod shall be a clean earth, free of stones and debris. The sod shall be a *minimum of 2-inches thick, live, fresh and uninjured at time of planting*.

B. The sod shall be certified to meet the Florida State Plant Board specifications, absolutely true to varietal type and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.

C. Mowing

1. The sod shall have been mowed three (3) times with a lawn mower with the final mowing not more than seven (7) calendar days prior to the sod being cut into uniform dimensions.

D. Cutting

- Sod shall not be harvested when the moisture content (excessively dry or wet) may adversely affect its survival and shall be live, fresh and uninjured at the time of placement.
- 2. After approval of the source, mow and rake as necessary to remove excessive top growth and debris.
- 3. Cut the sod with mechanical sod cutters, retaining native soil mat of sufficient thickness to withstand handling. The sod shall be provided in commercial pad sizes measuring not less than 12-inches by 24-inches with a uniform thickness two (2) inches in thickness and shall be live, fresh and uninjured at the time of planting.
- E. The sod shall be harvested, delivered, and installed within a period of seventytwo (72) hours. Sod older than this shall not be delivered to the Project site and shall be deemed "unacceptable".
- F. The sod shall be planted as soon as possible after being dug and shall be shaded and kept moist until it is planted.

2.02 Backfill/Planting Soil

A. The topsoil shall be as described in Articles 2.02 and 3.02 of Section 02215, *Finish Grading*.

2.03 Water

A. The water used in the grassing operations shall be supplied and paid for by the Contractor and obtained as provided for in Section 01500, *Temporary Facilities*. The Contractor shall provide permanent or temporary piping and valves, and temporary trucks to convey water from the source to the point of use.

2.04 Fertilizer

- A. Commercial fertilizer shall comply with all State and Federal fertilizer laws.
- B. The fertilizer shall be of the granular type having an analysis of 12-6-8, derived from the following sources.

Element	Percentage	Derived From
Total Nitrogen	12%	Activated sludge urea-form, sulfur coated urea and potassium nitrate
a. Nitrate	75%	
b. Ammonia	0.0%	
c. Water Soluble	10.25%	
d. Water Insoluble	1.00%	
Phosphoric Acid	6.0%	Triple super phosphate
Water Soluble Potash	8%	Sulphate of potash magnesium, potassium nitrate, sulphate of potash, and activated sludge
Total Magnesium	2.41%	Sulphate of potash magnesium
a. Water Soluble	2.41%	
Total Manganese	0.77%	Manganese oxide
Total Boron	0.02%	Sodium borate
Total Copper	0.07%	Copper oxide
Total Zinc	0.08%	Zinc oxide
Total Iron	1.00%	Iron oxide and ferrous sulphate
Total Chlorine	2.00%	

C. The fertilizer shall be granular, uniform in composition, dry and free flowing, suitable for application by equipment intended for the purpose. Deliver the fertilizer in unopened bags fully labeled with the manufacturer's analysis.

- D. Store all fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.
- E. Comply with all State of Florida fertilizer laws.

2.05 Stakes and Staples

- A. Stakes shall be manufactured of softwood, ¾-inch x ¾-inch by 8 inches long and shall be unpainted and untreated.
- B. Staples shall be of manufactured of 11 gage metal type, approximately ten (10) inches long and one (1) inch wide.

2.06 Sod Transportation

A. Comply with all current restrictions for transporting sod from or through quarantine areas for the white fringed beetle, witchweed, and West Indian sugar cane borer weevil, as issued by the Division of Plant Industry, Florida Department of Agriculture and the Animal and Plant Health Inspection Service, U.S. Department fo Agriculture.

3. EXECUTION

3.01 General

- A. Solid sod grassing shall be provided on all non-traffic areas not covered by pavement or structures that are disturbed or damaged by the construction operation and/or as specified on the Contract Drawings.
- B. Inspect surfaces indicated to receive sod and verify that related preceding Work has been completed. Do not proceed with placement until conditions are satisfactory.
- C. Construct a good healthy stand of grass as specified, free of weeds and foreign growth. Unless otherwise shown on the Contract Drawings or specified, all disturbed areas are to be solid sodded.
- D. The Contractor shall be responsible to see that all planted areas receive sufficient water until *Final Project Acceptance* by the Owner.

3.02 Preparation

- A. Remove stones, sticks, rubbish and other extraneous matter from areas to be sodded. Eliminate voids and rough areas and produce a smooth, evenly graded surface.
- B. If weed growth is present in the area to be sodded, remove the top three (3) inches of existing material and weed growth.

3.03 Construction Methods for Grassing

A. General

- Solid sodding shall only be applied when the soil is moist in proper condition to induce growth. Do not sod when the ground is unduly wet or otherwise not in a tillable condition.
- When a suitable length of roadway slopes or adjacent areas has been graded and made ready, sodding in accordance with these specifications can commence. Incorporate solid sod grassing into the Project at the earliest possible time in the life of the Contract.

B. Sequence of Operations

1. The several operations involved in the work shall proceed in the following sequence: preparation and fertilizing of the ground, sodding, watering and maintaining.

C. Preparation of Areas to be Sodded

- Prepare by disk-harrowing the ground over which the grassing is to be done, and thoroughly pulverize the soil to a depth of at least eight (8) inches. The prepared soil shall be loose and reasonably smooth.
- 2. Where the soil is sufficiently loose and clean, the Engineer, at his discretion, may authorize the elimination of ground preparation.
- 3. Areas to be sodded shall be cleared of all rough grass, weeds, and debris and the ground brought to an even grade as shown on the Contract Drawings.
- 4. Spread planting soil over the area to be sodded to a uniform depth of two (2) inches.

- 5. The area shall be raked smooth, to the grades indicated on the Contract Drawings, and reasonably free of large clods, roots, debris, and other material which will interfere with the work or subsequent mowing and maintenance operations. Hand picking may be required.
- 6. No subsequent operations shall be commenced until the Engineer has approved the condition of the prepared areas.

D. Application of Fertilizer

- 1. Before applying fertilizer, the soil pH shall be brought to a range of 6.0 to 7.0. Soil samples shall be analyzed by a local certified laboratory to confirm that the soil pH is within the required range.
- 2. The fertilizer shall be spread uniformly over the area to be grassed at the rate of five hundred twenty-five (525) pounds per acre, or twelve (12) pounds per 1,000 ft², or as recommended by the manufacturer. The Contractor shall use a mechanical spreader capable of uniformly distributing the material at the specified site. Immediately after spreading, the fertilizer shall be mixed with the soil to a depth of approximately two (2) inches.
- 3. On steep slopes, or other areas where machine-spreading may not be practicable, the fertilizer shall be spread by hand and raked in and thoroughly mixed with the soil to a depth of approximately two (2) inches.
- E. The areas shall then be brought to proper grade, free of sticks, stones, or other foreign matter over one (1) inch in diameter or dimension. The surface shall conform to the finish grade identified on the Contract Documents, less the thickness of the sod, free of water-retaining depressions, the soil friable and of uniformly firm texture.

3.04 Placing Sod

- A. The areas designated on the Contract Drawings and those areas which have been disturbed and/or damaged as a part of this Project are to be sodded.
- B. Incorporate sodding into the Project at the earliest practical time in the life of the contract. Sod that has been cut for more than seventy-two (72) hours shall not be used. Sod that has not been planted within twenty-four (24) hours after cutting shall be stacked in an approved manner and maintained and properly moistened. The sod panels shall, at all times, be protected from excessive drying and unnecessary exposure of the roots to the sun. Any pieces of sod which, after placing, show an appearance of extreme dryness shall be removed and replaced by fresh, uninjured pieces.

- C. After completion of the soil conditioning as specified in Article 3.03 above, place the sod panels on the moistened, prepared surface and lay them tightly together (edges in close contact, firmly and smoothly imbedded by length) so as to make a solid sodded lawn area. On mounds or other slopes, the long dimension of the sod panel shall be laid perpendicular to the slope.
- D. Where sodding is used in drainage ditches, or on slopes of 4:1 or greater, the setting of the pieces shall be staggered such as to avoid a continuous seam along the line of flow. Along the edges of such staggered areas, the offset of individual strips shall not exceed six (6) inches.
- E. The sod shall be immediately pressed firmly into contact with a 500 pound hand roller or other suitable equipment, approved by the Engineer, that will produce a 90 psi compression grading. The rolling operation shall provide a true and even surface and ensure knitting without displacement of sod or deformation of the surfaces of the sodded area. Hand tamp those areas inaccessible to the roller. The edges of the sodded area shall be staggered in a corresponding manner providing the offset along the edge does not exceed six (6) inches. All vertical edging adjacent to sodded area shall be tamped so as to produce a feathered edge.
- F. On areas where the sod may slide due to height and slope, and on slopes greater than 2:1, the Contractor shall peg the sod with wooden pegs driven through the sod blocks into firm earth at suitable intervals. Remove any pieces of sod which, after placing, show an appearance of extreme dryness.
- G. Sodding shall not be performed when weather and soil conditions are, in the Engineer's opinion, unsuitable for proper results.
- H. Bring the sod edge into a neat, clean manner to the edge of all paving, landscaping areas, sidewalks, roadways, concrete pads, valve and meter vault locations, etc.

I. Sanding

- 1. Top dressing with approved, clean, weed free sand shall be required to give the finished product a smooth finish.
- 2. The Contractor shall pay particular attention to the need for a light layer of sand along the edges of each piece of sod. *There shall be no holes, ruts, depressions in the sodded lawn.*

3.05 Watering

A. Water the sodded areas initially to develop uniform coverage and deep water penetration of at least six (6) inches.

- B. The Contractor shall provide continuous watering of the sod in order to achieve optimum growth conditions for establishment. A minimum of one (1) inch of water per week shall be applied to the sodded areas. The Contractor shall apply water to the sod on a regular basis until Final Project Acceptance by the Owner.
- C. The Contractor shall be responsible for the costs related to watering the grassed areas.

3.06 Cleanup

- A. Immediately clean spills from paved and finished surface areas.
- B. The Contractor shall remove fertilizer containers, sod pallets and sodding debris and excess materials from the Project Site and legally dispose of them.
- C. The Contractor shall sweep sod waste, soil and fertilizer from paved areas, curbs, driveways, sidewalks, pads and walks.
- D. Cleaning and cleanup shall be in accordance with Section 01800, *Miscellaneous Work and Cleanup*.

3.07 Maintenance

- A. The Contractor shall, at his expense, maintain the planted areas immediately after the sod is installed and continue, in a satisfactory condition, until *Final Project Acceptance* by the Owner.
- B. Such maintenance shall include watering, mowing, and filling, leveling, repairing of any damaged areas where the establishment of the grass stand does not appear to be developing satisfactorily, or where erosion has washed away an area and filling and leveling are required.
- C. Replanting shall be performed at the Contractor's expense except when it is determined that such replacement was due to circumstances beyond the Contractor's control.
- D. The Engineer may require replanting or of any areas in which the establishment of the grass stand does not appear to be developing satisfactorily within sixty (60) days of planting or where necessary due to the Contractor's negligence, carelessness or failure to provide routine maintenance and shall be at the Contractor's expense.

E. Mowing and Edging

- 1. Mowing and edging shall be performed at least once every ten (10) days during the Project from the date of installation of the sod.
- 2. Upon final Project Acceptance by the Owner, the Contractor shall provide a final mowing and edging of the grass.

F. Insecticides

- The Contractor shall apply all insecticides as needed, for complete control of pests and diseases. The materials and methods shall be in accordance with highest standard horticultural practices and as recommended by the County Agent, and approved by the Engineer, prior to implementation.
- 2. When a chemical is being applied, the person using it shall have in their possession all labeling associated with the chemical. Also, the chemical shall be applied per the manufacturer's instructions and recommendations.
- 3. The spraying of insecticides and other such chemicals are to be confined to he infected area. Spraying techniques, which may introduce the material being sprayed beyond the immediate area of the individual plant, are strictly prohibited.
- 4. The implementation of control measures for pests and disease infestations shall be in strict compliance with all federal and local regulations. Upon request, the Contractor shall furnish documentation of such compliance.
- 5. All insecticides shall be applied by a licensed/certified operator only. The operator shall have the license/certification in their possession when insecticides are being applied.
- G. After the sod has been laid, tamped and top dressed, areas which fail to show uniform growth and health, shall be re-sodded, as often as necessary, until all sodded areas are covered with a satisfactory lawn. Damage resulting from erosion, gullies, washouts, or other causes shall be repaired by filling with topsoil, tamping, re-fertilizing, and resodding by the Contractor at his expense.
- H. Sodded areas shall be protected against trespassing and damage. Sod that has been damaged or injured shall be treated or replaced as directed, in compliance with the Specifications, at no additional cost to the Owner.
- I. Keep sidewalks, curbs and gutters, drainage structures, driveways, parking areas, streets, terraces, decks and pavers free of grass cuttings.

- J. Material rejected during the course of construction shall be removed within ten (10) calendar days and replaced before an inspection for completion will be scheduled.
- K. The Contractor shall be responsible for the proper maintenance and the survival and condition of the sod from the time a landscape item is installed until Final Project Acceptance by the Owner.
- L. Replacement of sod shall be the responsibility of the Contractor including the possible replacement of sod resulting from removal by theft or vandalism or acts of negligence on the part of others. Sod shall be alive and in good growing condition at the time of Final Project Acceptance by the Owner.

END OF SECTION

February 2024 Solid Sodding

SECTION 03100 CONCRETE FORMWORK

1. GENERAL

1.01 Description

A. The Work included in this Section consists of providing all labor, materials and equipment necessary for providing and installing formwork for concrete.

B. Work Specified Herein

- 1. General formwork.
- 2. Forms, form liners, and coatings.
- 3. Form ties and accessories.

C. Related Work Specified Elsewhere

Specification Section	Title
02200	Earthwork
03200	Concrete Reinforcement
03250	Concrete Accessories
03300	Cast-in-Place Concrete
Contract Drawings and General Provisions of the Contract	

1.02 General Design and Responsibility

A. All forms and shoring shall be designed at the Contractor's expense by a Professional Engineer registered in the State of Florida. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes.

- B. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete. The Contractor shall be responsible for safety in its construction, use and removal.
- C. Provide camber as necessary to compensate for anticipated deflection in the formwork and concrete due to weight and pressure of fresh concrete and other construction loads.

1.03 Quality Assurance

A. Qualifications

- 1. Formwork shall be constructed in accordance with the specified standards, as well as all pertinent codes and regulations.
- 2. Where provisions of pertinent codes conflict with the requirements of this Section of the Specifications, the more stringent provisions shall govern.

B. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Concrete Inst	titute (ACI)	
ACI 117	Specifications for Tolerances for Concrete Construction and Materials	
ACI 301	Specifications for Structural Concrete	
ACI 318	Building Code Requirements for Reinforced Concrete	
ACI 347	Guide to Formwork for Concrete	
American Plywood Association (APA)		
	Material grades and designations as specified	
Building Codes		
	Florida Building Code	
	Local Codes and Regulations	

C. Pre-Placement Checklist

- 1. The Contractor, as part of his Quality Control Plan, shall develop and submit for approval a Pre-Placement Checklist form to cover the following items:
 - a. Reference Drawings covering the placement for all trades and disciplines.
 - b. Date and time scheduled for placement and the actual date and time of placement.
 - c. Foreman name, placement number, number of truckloads and number of cylinders.
 - d. Checklist items such as embeds (list each), subgrade, rebar, forms, alignment, plumbness, etc.
 - e. Signoff's for foreman, Contractor's Quality Control representative, each subcontractor foreman (major subs, mechanical, electrical, plumbing, etc.) and Engineer.
- D. No concrete may be placed until the checklist is properly and completely signed off. Failure to comply with this provision can be grounds for rejecting the work. The checklist shall be weather protected and located with the foreman or at the foreman's station.

1.04 Submittals

- A. Submit shop drawings and product data, in an electronic format (PDF), in accordance with Section 01300, *Shop Drawings, Submittals and Samples*, showing materials of construction and details of installation for:
 - 1. Submit manufacturer's literature for form ties, form release agent, spreaders, corner formers, form coatings and bond breakers.
 - 2. Location and sequence of the concrete placements. Indicate locations of joints and panel sizes and patterns. Show location of form ties on architectural surfaces.
 - 3. Review of the pour sequence, form system, and panel layout shall be for appearance and strength of the completed structure only. Review by the Engineer of forming plans or procedures shall not relieve the Contractor of responsibility for the strength, safety or correctness of methods used, the adequacy of equipment, or from carrying out the work in full compliance with the requirements of the Contract Drawings and Specifications.

B. Samples

- The Contractor shall demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise furnished and will not affect the forming material.
- C. Submit the manufacturer's literature for form ties, spreaders, corner formers, form coatings, and bond breakers.

2. PRODUCTS

2.01 Form Construction and Design

- A. Design forms according to the applicable portions of ACI 347, *Guide to Formwork for Concrete*. Form all concrete, except as specified otherwise.
- B. Provide form windows or stage forms to allow visual observation at all times of the concrete being placed and vibrated. Provide a formwork design and placement schedule that will limit the free fall of concrete in walls as follows:

Wall Thickness	Maximum Free Fall of Concrete (feet)
8 inches or less	4.0
Greater than 8 inches	6.0

The total vertical lift made in a single pass shall not exceed two (2) feet in height.

C. Notify the Engineer, a minimum of seventy-two (72) hours prior to the placement of concrete.

- D. For multi-storied structures, the shoring and reshoring diagrams and procedures shall be signed and sealed by a registered Engineer in the State of Florida. These diagrams and procedures shall take into account the effect of the loads on the uncured concrete and the construction load on each floor.
- E. Steel forms shall be 24 gauge, tongue and groove joints, complete with steel stakes and splice plates.

2.02 Classes of Forms

A. Class I Forms

- 1. Use steel forms, ply form, or smooth surface plywood ¾-inch minimum thickness for straight surfaces and ½-inch minimum thickness for curved surfaces.
- 2. Coat the face and edges of the forms with a two-coat system of one component polyurethane coating applied by roller at the rate of five hundred square feet (500 ft²) per gallon.

B. Class II Forms

- 1. Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints.
- 2. The Forms shall be oiled.
- 3. Class II forms may be used for exterior concrete surfaces which are one (1) foot or more below finished grade. Use Class I forms for all other surfaces.
- C. Coat all forms with a form-release agent.

2.03 Form Material

- A. Use plywood, lumber, steel or other approved materials as identified herein of sufficient strength and surface smoothness to produce the specified finish.
- B. Tape, gasket, plug, and/or caulk joints, gaps, and apertures in forms so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.

C. Lumber

- 1. The Lumber used in form construction shall be either:
 - a. Douglas fir, No. 2 grade, S4S, Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau; or
 - b. Southern Yellow Pine, No. 2, S4S, Standard Grade Rules Southern Pine Inspection Bureau.

2. All boards shall be six (6) inches or more in width and seasoned on all sides.

D. <u>Plywood</u>

- 1. Plywood used in form construction shall be Grade B-B, Class I plyform, sanded on both sides in conformance with U.S. Product Standard PS-1, mill-oiled and edge sealed, and bearing the label of the American Plywood Association.
- 2. The minimum thickness of the plywood shall be ³/₄-inch.

E. Medium Density Overlay (MDO) Plywood Forms

- 1. PS-1, B-B High Density Concrete Form Overlay, Class 1, unoiled.
- 2. Butt form panels, make contact surface fully flush and seal butting holes with sponge form tape. Chamfer edges of beams and ceilings.
- 3. Where medium density overlay (MDO) plywood is used to form beams, use no piece of MDO plywood that has been patched or damaged.

F. Drip Forms

1. Varnished ponderosa pine or equally rigid non-staining plastic, ½-inch wide on each leg.

G. Steel Forms

- 1. Uncoated steel, ³/₁₆-inch minimum thickness, fabricated to close tolerances, protected only by the specified release agent, braced so as not to bend, dent or dimple under wet concrete loads, vibrator impact, and tool impact.
- 2. Maintain steel forms in a "rust-free" condition by use of steel wool and light grinding, followed by coats of specified release agent. Use forms that can be adjusted into true alignment without stops or ridges.

H. Glass Fiber Reinforced Plastic (FRP) Forms

1. Smooth coated forms, braced so as not to bend, dent or dimple under wet concrete loads, vibrator impact and tool impact, and at least 0.11-inch thick. Design forms for external bracing at piers and columns, without use of form ties.

I. Circular Column Forms

- 1. Fabricated of two pieces, clamped watertight using gaskets and without horizontal joints
- 2. Install horizontal construction joints only where indicated or as directed by the Engineer.

J. Beam Forms

1. Provide as one length without form joints and suitable for cambering up to $\frac{1}{60}$ of the span without distortion of profile or opening of seams.

K. Forms for Hammerhead Pier Caps

- 1. Provide in one length with adjustable soffits, bulkhead and screeds, as necessary, to accommodate different hammerhead beam configurations.
- 2. Provide no construction joints in hammerhead pier caps.
- Where three or fewer identical hammerhead pier caps occur within a line section, steel braced High Density Overlay (HDO) plywood forms may be substituted for steel forms if:
 - a. Working drawings of the formwork are submitted.
 - b. Internal form ties are regularly spaced no less than forty-eight (48) inches each way, and are made watertight.
 - c. Form ties have removable cones, which are filled to match the concrete.
 - d. Joints in panels are fully watertight.
 - e. The resulting surface matches the appearance of steel formed hammerhead caps, with no visible discoloration due to form leakage.

L. Styrofoam Board

1. Expanded polystyrene extruded into board foam, closed cell, moisture resistant, and capable of maintaining the indicated clear space between concrete structures.

2.04 Form Ties

A. Locate form ties on exposed surfaces in a uniform pattern or as indicated on the Contract Drawings. Construct form ties so that the ties remain embedded in the concrete except for a removable portion at each end and do not leave an open hole through the concrete. Form ties shall have conical or spherical type inserts with a maximum diameter of one (1) inch. Construct form ties so that no metal is within one (1) inch of the concrete surface when the forms, inserts, and tie ends are removed. Ties shall withstand all pressures and maintain forms within acceptable deflection limits.

B. Wire ties and wood spreaders will not be permitted.

- C. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of one (1) inch and sufficient dimensions to permit patching of the tie hole.
- D. Ties for water-holding structures or dry structures with access, such as basements or pipe galleries, that are below finish grade shall have an integral steel waterstop that is tightly and continuously welded to the tie. The waterstop shall be at least two times (2X) larger in area than the tie cross-sectional area and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. Construct the ties to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.
- E. Tapered form ties shall be tapered through-bolts at least one (1) inch in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of the same minimum size.

2.05 Control Joint Filler

A. Use epoxy joint filler equal to Burke Epoxy Joint Filler to fill all voids left by saw cuts and to resist against spalling caused by vehicle traffic in concrete slabs.

2.06 Inserts

A. Galvanized cast steel or galvanized welded steel, complete with anchors to concrete and fittings such as bolts, wedges and straps. Provide hanger inserts spaced to match the grid of suspended ceilings.

2.07 Shoring

A. As designed and executed by the Contractor to support all loads.

2.08 Bond Breaker

A. Bond breaker shall be a **non-staining** type which will provide a positive bond prevention, such as Tilt Seal, an manufactured by Hunt Process Co., Santa Fe Springs, CA; Silcoseal 77, as manufactured by Dayton Superior Corp., Miamisberg, Ohio; or approved equal.

2.09 Form Release Agent

- A. Coat all forming surfaces in contact with concrete using a form release agent that shall effectively prevent absorption of moisture by the form and prevent bond with the concrete. The form release agent shall be *non-staining*, *non-residual*, *water based*, free of taste and odor, leave concrete with a coatable surface, and be *non-toxic* after thirty (30) days.
- B. For steel forms, the form release agent shall prevent discoloration of the concrete due to rust.

2.10 Chamfer Strips and Moldings

- A. Chamfer strips shall be polyvinyl, metal or PVC strips or approved equal, designed to be nailed in the forms to provide a ¾-inch chamfer at all exposed edges of concrete members, unless otherwise indicated on the Contract Drawings.
- B. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Contract Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.

3. EXECUTION

3.01 General

A. Forms shall be sufficiently strong and watertight, in accordance with ACI 301 and 347, to withstand the pressure resulting from the placement and vibration of concrete and shall be sufficiently hard and rigid to resist indentation and scratching while maintaining specified tolerances, and with *maximum deflection between form supports of* ¹/₂₄₀th of the span length.

- B. Design, erect, shore, brace and maintain formwork, according to ACI 301, to support vertical, lateral, static and dynamic loads, and construction loads that might be applied, until the structure can support such loads.
- C. Construct formwork so that concrete members and structures are of the size, shape, alignment, elevation and position indicated, within the tolerance limits of ACI 117.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt and gradual, as follows:
 - 1. <u>Class A</u>: c-inch (3.2 mm) for smooth-formed finished surfaces.
 - 2. <u>Class B</u>: ¼-inch (6 mm) for rough-formed finished surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 (horizontal) to 1 (vertical).
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve the required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where the interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine the sizes and locations from trades providing such items.
- K. Coordinate with other trades and properly place and locate in position all necessary chases, dowels, bolts, anchors, anchor slots, inserts, sleeves, openings, hangers, metal ties and other fastening devices required for attachment and support of adjacent work. Securely anchor all embedded items.

- L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- M. Coat contact surfaces of the forms with a form-release agent, according to the manufacturer's written instructions, prior to placing reinforcing. Keep form coatings off steel reinforcing, items to be embedded and previously placed concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.02 Form Erection

- A. Use facing materials that produce a hard uniform texture on the concrete. Do not use facing materials with raised grain, torn surfaces, worn edges, patches, dents or other defects. Use facing materials with maximum deflection, as reflected in concrete surfaces, **not in excess of** ¹/₂₄₀ th **of the span** between the structural members.
- B. Provide means for holding adjacent edges and ends of form panels and sections tight and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Forms shall be tight and shall prevent the loss of mortar and fines during placing and vibration of concrete.
- C. Insure that the forms may be removed without injury to the surface of the finished concrete.
- D. Provide exterior corners in concrete members with bevels as specified.
- E. Provide a positive means of adjustment of shores and struts. Insure that all settlement is taken up during concrete placing.
- F. Do not embed any form-tying device or part thereof other than metal in the concrete.
- G. Locate the large end of a taper tie on the "wet" side of the wall.
- H. Use only form or form-tying methods which do not cause spalling of the concrete upon form stripping or tie removal.
- I. Form $\frac{3}{4}$ -inch x $\frac{3}{4}$ -inch chamfers at all exposed edges of concrete members unless otherwise noted on the Contract Drawings.
- J. Form surfaces of concrete members except where placement of the concrete against the ground is shown in the Contract Drawings or as indicated below. The dimensions of concrete members shown in the Contract Drawings apply to formed surfaces, except

where otherwise indicated. Add two (2) inches of concrete where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and other non-exposed concrete and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

- K. At construction joints, overlap the contact surfaces of the form sheathing over the hardened concrete by not more than one (1) inch. Hold forms against the hardened concrete to prevent offsets or loss of mortar.
- L. Provide temporary openings in wall forms to limit the free fall of concrete to a maximum of six (6) feet unless an elephant trunk is used. Locate such openings to facilitate placing and consolidation, and space no more than eight (8) feet apart. Provide temporary openings in the bottom of the wall and column forms and elsewhere as necessary to facilitate cleaning and observation immediately prior to cleaning.

M. Runways

1. Provide smooth and rigid runways, if needed, for moving equipment and concrete. Support runways directly on formwork or on grade and in no case on reinforcing steel or bar supports.

3.03 Form Surface Preparation

- A. After each use and prior to placing reinforcing, clean form surfaces to be in contact with concrete of any mortar, grout and other foreign material.
- B. Coat form surfaces in contact with concrete with a form release agent prior to form installation. Do not allow the form release agent to stand in puddles in the forms, to come into contact with hardened concrete against which fresh concrete is to be placed, or with reinforcing steel and items to be embedded.

3.04 Formwork Reuse

- A. Reuse only forms which provide a hard uniform surface texture on exposed concrete surfaces. Do not use facing materials with raised grain, torn surfaces, worn edges, patches, dents or other defects.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply light sanding or other surface treatment between uses to obtain such uniform texture. Apply new form-release agent.

- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.
- D. Plug unused tie rod holes with corks, shave flush, and sandpaper the concrete surface side. Do not patch forms other than filling tie rod holes, except in the case of Class II forms.
- E. Do not use metal patching discs on Class I forms.
- F. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

3.05 Metal Forms

- A. Metal forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish.
- B. All forms shall have the contact surfaces coated with a release agent.

3.06 Shores and Reshores

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for the design, installation and removal of shoring and reshoring.
- B. Do not remove shoring or reshoring until the measurement of slab tolerances is complete.
- C. In multistory construction, extend the shoring and reshoring over a sufficient number of stories to distribute loads in such a manner that no floor member will be exclusively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- D. Plan the sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.07 Tolerances

A. Concrete Tolerances

- 1. Vertical, lateral, and level alignments and cross-sectional dimensions shall comply with ACI 117.
- 2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

Description	Maximum Tolerance
Sleeves and Inserts	+ 1/4-inch to - 1/4-inch
Projected Ends of Anchors	+ 1/4-inch to 0-inch
Anchor Bolt Setting	+ 1/4-inch to - 1/4-inch
Finished Concrete, all locations	+ 1/4-inch to - 1/4-inch in 10 feet

3. The planes and axes from which the above referenced tolerances are to be measured shall be as follows:

Description	Measurement Datum
Sleeves and Inserts	Centerline of Sleeve or Insert
Projected Ends of Anchors	Plane perpendicular to the end of the anchor as located on the Contract Drawings
Anchor Bolt Setting	Centerline of the anchor bolt
Finished Concrete, all locations	The concrete surface as located on the Contract Drawings

- 4. Where equipment is to be installed, comply with the manufacturer's tolerances if more severe than above.
- 5. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. **Rejected work shall be repaired or replaced at no additional cost to the Owner**.

B. Form Tolerances

1. Forms shall be surfaced, designed, and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.

2. Formed Surface Exposed to View

- a. Edges of all form panels in contact with concrete shall be flush within $^{1}/_{32}$ -inch and forms for plane surfaces shall be such that the concrete will be plane within $^{1}/_{16}$ -inch in four (4) feet.
- b. Forms shall be tight to prevent the passage of mortar, water and grout.
- c. The maximum deviation of the finish wall surface at any point shall not exceed \(^1\)/-inch from the intended surface as shown on the Drawings.
- d. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number or seams.
- 3. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.
- 4. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement, and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be ± 1-inch.

5. Formed Concrete Surfaces to Receive Paint

- a. Surface deflections shall be limited to $^{1}/_{32}$ -inch at any point and the variation in wall deflection shall not exceed $^{1}/_{16}$ -inch per four (4) feet.
- b. The maximum, deviation of the finish wall surface at any point shall not exceed c-inch from the intended surface as shown on the Contract Drawings.
- C. Formed Openings shall be of sufficient size to permit final alignment of the items within it without deflection or offsets of any kind and to allow space for packing where the items pass through the wall to ensure water tightness around openings so formed. Provide openings with continuous keyways with waterstops where required, and provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated and specified. Reinforcing steel shall be at least two (2) inches clear from the opening.

D. Embedded Items

- Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions and directions furnished with the items to be embedded.
- 2. Install anchor rods, accurately located, to the elevations required and complying with the tolerances in Section 7.5 of AISC's *Code of Standard Practice for Steel Buildings and Bridges*, and hold securely in position in the forms until the concrete is placed and set
- 3. Install reglets to receive waterproofing and to receive through-wall flashings in the outer face of the concrete frame at exterior walls, where flashing is shown at lintels, shelf angles and other conditions.
- 4. Install dovetail anchor slots in concrete structures as indicated.
- 5. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting.
- 6. Check all nailing, blocks, plugs and strips necessary for the attachment of trim, finish and similar work prior to concreting.
- 7. Coordinate with other trades for items to be embedded in the concrete and not shown on the Contract Drawings.

E. Pipes and Wall Spools Cast in Concrete

- 1. Install wall spools, wall flanges and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.
- 2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will be possible during construction.
- 3. Pipes or spools located below operating water level shall have waterstop ring collars and shall be cast in place. Do not block out such piping and grout after the concrete section is cast. Pipes fitted with thrust rings shall be cast in place.

F. Beveled Edges (Chamfer)

1. Form ¾- inch beveled edges on exposed concrete edges and corners, beam soffit corners, and where indicated on the Contract Drawings.

- 2. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the Drawings.
- 3. The top edges of slabs, walkways, beams, and walls may be beveled with an edging trowel in lieu of using chamfer strips.

3.08 Aluminum Surfaces in Contact with Concrete

A. Coat all aluminum surfaces in contact with concrete in accordance with Section 09900, *Painting*.

3.09 Removal of Forms

- A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347.
- B. Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore.
- C. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed. The time periods indicated in the table include all days except those in which the temperature falls below 40 TF:

Description	Normal Strength Concrete	Normal High-Early Strength Concrete	Min. Compressive Strength for Form Removal (% Design Strength)
Cantilevers	12 days	7 days	90%
Over 20 ft between supports	12 days	7 days	90%
Stairways	10 days	5 days	80%
Floor slabs	10 days	5 days	80%
Free standing walls, columns and piers	10 days	5 days	80%
Walls, piers, columns, sides of beams, footings, slabs on grade, and vertical surfaces	2 days	1 day	80%
Front face form of curbs	1 day	0.5 day	70%

D. Do not remove forms from concrete which has been placed with an outside air temperature below 50 F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

3.10 Inspection

- A. The Engineer shall be notified when the forms are complete and ready for inspection at least twenty-four (24) hours prior to the proposed placement of concrete.
- B. Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with the requirements of these specifications, shall be grounds for rejection of that portion of the concrete work.
- C. Rejected concrete shall be repaired or replaced as approved by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of these specifications and approval of the Engineer.

END OF SECTION

SECTION 03200 CONCRETE REINFORCEMENT

1. GENERAL

1.01 Description

- A. The work in this Section consists of providing all labor, materials, equipment and incidentals required to install all steel bars, steel wire and wire fabric required for the reinforcement of concrete, as shown on the Contract Drawings, and as specified herein.
- B. Work Specified Herein: Provisions of all reinforcement
- C. Related Work Specified Elsewhere:

Specification Section	Title
03100	Concrete Formwork
03250	Concrete Accessories
03300	Cast-in-Place Concrete
03400	Precast Concrete Structures
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Con	crete Institute (ACI)	
ACI 117	Standard Tolerance for Concrete Construction and Materials	
ACI 301	Specifications for Structural Concrete for Buildings	

STANDARD	DESCRIPTION	
American Concrete Institute (ACI) - Cont'd		
ACI 315	Details and Detailing of Concrete Reinforcement Manual	
ACI 318	Building Code Requirements for Reinforced Concrete	
ACI 350R	Environmental Engineering Concrete Structures	
American Soci	ety for Testing and Materials (ASTM)	
ASTM A82	Specification for Steel Wire, Plain, for Concrete Reinforcement	
ASTM A184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement	
ASTM A185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement	
ASTM A496	Specification for Steel Wire Deformed, for Concrete Reinforcement	
ASTM A497	Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement	
ASTM A615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement	
ASTM A767	Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement	
ASTM A775	Specification for Epoxy-Coated Reinforcing Steel Bars	
ASTM A884	Specification for Epoxy-Coated Steel Wire & Welded Wire Fabric for Reinforcement	
American Weld	ding Society (AWS)	
AWS D1.4	Structural Welding Code - Reinforcing Steel	
Concrete Reinforcing Steel Institute (CRSI)		
	CRSI Manual of Standard Practices	
Building Codes	5	
	Florida Building Code	
	Local Codes and Regulations	

1.03 Submittals

- A. **Submit shop drawings** for review in accordance with Section 00700, *General Conditions*, Section 00800, *Supplementary Conditions*, and Section 01300, *Shop Drawings, Submittals and Samples*. All shop drawings shall be submitted in an electronic format (PDF).
- B. **Submit mill test certifications** identifying chemical and physical analyses for each load of reinforcing steel delivered. All submittals shall be in an electronic format (PDF).

- C. **Submit reinforcing bending lists and placing drawings for all reinforcing**. Placing drawings shall include wall elevations, plan views, and sections to clearly show the reinforcing placing procedures. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and reinforcement supports.
- D. Placing drawings shall indicate all openings (mechanical, electrical, equipment and architectural), including additional reinforcing at openings and intersecting wall, beam and footing arrangements as indicated on the structural drawings and specified herein. Placing drawings shall be coordinated with the concrete placing schedule.
- E. Each bending list and placing drawing submitted shall be complete for each major element of a structure (grade slabs, footings, walls, deck, floor, beams or roof slabs), including all dowels and other bars required. Furnishing such lists shall not be construed that the list will be reviewed for accuracy.
- F. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified herein.
- G. Coordinate placing drawings with concrete placing schedule.

1.04 Product Delivery, Storage and Handling

- A. Reinforcement shall be shipped to the Work with bars of the same size and shape fastened in bundles with metal identification tags with waterproof markings giving size and mark securely wired on.
- B. The identification tags shall be labeled with the same designation as shown on the submitted bar lists and shop drawings.
- C. All bars shall be stored off of the ground and shall be protected from moisture and be kept free from dirt, oil, or injurious contaminants.

2. PRODUCTS

2.01 Reinforcement

A. Reinforcement Bars

1. Concrete reinforcement in Sizes No. 3 (d- inch) and larger shall be deformed steel bars of the same sizes and shapes indicated on the Contract Drawings. The steel

shall be newly rolled stock of domestic manufacture, substantially free from mill scale, rust, dirt, grease, or other foreign matter. Bars shall be of intermediate grade, deformed billet steel conforming to ASTM Specification A-615, Grade 60, deformed, including all supplementary requirements.

- 2. Fabricate reinforcing steel in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute (CRSI).
- 3. Bend all reinforcing steel cold.
- 4. Rail-steel bars will not be allowed in the work.
- 5. Reinforcement shall be accurately fabricated to the dimensions indicated on the Contract Drawings. Particular care shall be exercised not to have stirrups oversized in order to maintain proper coverage of concrete. Stirrups and tie bars shall be made around a pin having a diameter not less than two (2) times the maximum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than five (5) times the minimum thickness of the bar except for bars larger than one (1) inch, in which case the bends shall be made around a pin of eight (8) bar diameters. Bars reduced in section or with kinks or bends not shown on the Contract Drawings will not be accepted.
- 6. Deliver all reinforcing steel to the Project Site bundled and tagged with identifying tags.

2.02 Welded Wire Fabric (WWF)

- A. Welded wire fabric shall conform to ASTM Specification A-185, galvanized for Welded Steel Wire Fabric for Concrete Reinforcement.
- B. Welded wire fabric shall be furnished in flat sheets, rolled welded wire fabric is not permitted.
- C. Where welded wire fabric is shown but not sized on the Contract Drawing, the Contractor shall use 6 x 6 x W2.1 x W2.1 WWF.

2.03 Wire Tie

A. Wire tie shall be 16-gauge minimum, zinc coated annealed, conforming to ASTM Specification A82.

2.04 Bar Supports

- A. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place shall be provided and used.
- B. Manufacture bar supports from steel wire, plastic or precast concrete according to CRSI's *Manual of Standard Practice*, of greater compressive strength than the concrete as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-coated steel wire or CRSI Class 2 stainless steel bar supports.

2.05 Bar Couplers

- A. Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice, DYWIDAG, Erico Products, Inc. or approved equal and where approved by the Engineer.
- B. Use couplers which develop 125% of the specified yield strength of the reinforcing bars.
- C. Make field demonstrations and sample splicing prior to splicing bars being included into the work.

2.06 Dowels

- A. Smooth dowels shall be ASTM A615, Grade 60 plain-steel bars.
- B. Cut bars true to length with the ends square and free of burrs.
- C. Threaded dowels shall be ASTM A36.

2.07 Reinforcing Steel Accessories

Bar Supports	CRSI Bar Support Specifications
Plastic Protected	Class 1 - Maximum Protection
Stainless Steel Protected	Class 2 - Maximum Protection
Precast Concrete Block	Precast Blocks

2.08 Fabrication

- A. Do not commence fabrication until receipt of the approved shop drawings from the Engineer.
- B. Fabricate reinforcing steel in accordance with all requirements of the specified standards and within CRSI tolerances, and unless otherwise indicated, with the following: (1) Provide standard books; (2) *Extend bottom bars a minimum of six (6) inches into supporting members*; (3) Provide cover indicated to the outermost stirrup, tie or bar; (4) Provide splices only where indicated on the Contract Drawings.

3. EXECUTION

3.01 Installation

A. General

- On porous subgrade or beddings, provide a vapor barrier as specified in Section 03300, Cast-in-Place Concrete and Section 07050, Vapor Barrier. Do not cut or puncture the vapor barrier. Repair any damage and reseal the vapor barrier prior to placing concrete.
- 2. Comply with CRSI's *Manual of Standard Practice* and ACI 315 for placing concrete reinforcement.
- B. Securely tie and support reinforcement to prevent displacement during concrete placement.

C. Fastening Devices for Other Work

- 1. Coordinate with other trades and properly place and locate in position all necessary reinforcement, dowels, bolts, anchors, anchor slots, inserts, hangers, metal ties, and other fastening devices required for attachment and support to adjacent work.
- 2. Securely anchor all fixtures and embedded items.
- D. Surface condition, bending, spacing, and tolerances of placement of reinforcement shall comply with the Concrete Reinforcing Steel Institute (CRSI). The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Contract Drawings.
- E. Place reinforcing in accordance with the following, unless otherwise indicated on the Contract Drawings:

- 1. Reinforcement indicated on the Contract Drawings is continuous throughout the structure(s) to the farthest extent possible.
- 2. Unless otherwise shown, *install reinforcement with the following clearances for concrete coverage*:

Description	Minimum Clearance
Beams and Girders	Two (2) inches outside of ties
Solid Slabs and Joists	Two (2) inches top and side; Three (3) inches cover placed against earth
Columns	Two (2) inches outside of ties
Walls	Two (2) inches top and sides
Grade Beams and Footings	Three (3) inches outside of steel, side and bottom, when cast against earth two (2) inches top and sides

- 3. Reinforcing steel, before being positioned and just prior to placing concrete, shall be free from loose mill and rust scale, earth, ice, foreign materials and from any coatings that may destroy or reduce the bond. Clean reinforcing steel by sandblasting or wire brushing and remove mortar, oil, paint, or dirt to remove materials that may reduce the bond.
- 4. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- 5. **Do not straighten or rebend reinforcing steel in the field**. Do not use reinforcing with bends not shown on the Contract Drawings.
- 6. Place reinforcement a minimum of two (2) inches clear of any metal pipe or fitting, unless noted otherwise on drawings.
- 7. Position reinforcing steel in accordance with the Contract Drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to provide the specified concrete coverage. Bars additional to those shown on the Contract Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position, shall be provided by the Contractor at no additional cost to the Owner.
- 8. **Set wire ties with ends directed into the concrete**, not towards exposed concrete surfaces.

- 9. **Securely support and tie reinforcing steel to prevent movement during concrete placement** by using zinc coated wire ties of not less than No. 16 gauge or suitable clips at intersections. Secure dowels in place before placing concrete.
- 10. Place reinforcement a minimum of two (2) inches clear of any metal pipe or fittings, unless noted otherwise on drawings.
- 11. **Secure reinforcing dowels in place prior to placing concrete**. Do not press dowels into the concrete after the concrete has been placed.
- F. Support and tie wire mesh to prevent movement during concrete placement.
- G. Wire dowels in position prior to placing concrete. Position dowels for masonry walls to occur at reinforced block cells.
- H. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Contract Drawings or specified, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.
- I. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference, shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- J. Placement of flat sheet welded wire mesh
 - 1. Install welded wire mesh reinforcement in the longest practicable lengths on supports spaced to minimize sagging.
 - 2. Support and tie mesh to prevent movement during concrete placement.
 - 3. Support welded wire fabric by high chairs or bolster with baseplates, all plastic supports, and concrete blocks.
 - 4. It is not permissible to place the WWF on the subbase and pull it up or lay the WWF on top of the concrete and walk it into the concrete.
 - 5. Extend fabric to within two (2) inches of the edges of the slab and lap splices at least in accordance with ACI 318 but not less than twelve (12) inches. Tie laps and splices securely at ends and at least every twenty-four (24) inches with 16 gauge annealed steel wire.

- 6. Do not extend fabric through expansion joints or construction joints in slabs on grade except as otherwise indicated.
- K. Reinforcing steel bars shall not be field bent except where shown on the Contract Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as approved by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Contract Drawings.

3.02 Additional Reinforcement around Openings

- A. Unless specific additional reinforcement around openings is shown on the Contract Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening.
- B. The bars shall have sufficient length to develop a bond at each end beyond the opening or penetration.

3.03 Splicing of Reinforcement

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be thirty (30) bar diameters, but not less than twelve (12) inches. The lap splice length for column vertical bars shall be based on the bar size in the column above. Splice horizontal bars in circular structures forty (40) bar diameters. Provide splices and laps in columns, piers and struts in a manner sufficient to transfer full stress bond. When splicing bars of different diameters, the length of lap is based on the larger bar. Stagger splices in adjacent bars.
- B. Tension lap splices shall be provided at all laps in compliance with the applicable tables in ACI 315. Splices in adjacent bars shall be staggered. Class A splices shall be used when 50 percent (50%) or less of the bars are splices within the required lap length. Class B splices shall be used at all other locations.
- C. Except as otherwise indicated on the Contract Drawings, splices in circumferential reinforcement in circular walls shall be Class B tension splices and shall be staggered. Adjacent bars shall not be spliced within the required lap length.
- D. *Install wire fabric in as long lengths as practicable*. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than twelve

(12) inches. The spliced fabrics shall be tied together with wire ties spaced not more than twenty-four (24) inches on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.

3.04 Accessories

- A. The Contractor shall be solely responsible for determining, providing and installing accessories such as chairs, chair bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Contract Drawings or specified.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 Inspection

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained.
- B. The Engineer shall be given at least twenty-four (24) hours advance notice of the readiness of placed reinforcement for observation.
- C. The forms shall be kept open until the Engineer has finished his observations of the reinforcing steel.

END OF SECTION

SECTION 03250 CONCRETE ACCESSORIES

1. **GENERAL**

1.01 **Description**

- A. The Work included in this Section consists of all labor, materials and equipment necessary to install expansion joints, construction joints, and waterstops.
- B. Work Specified Herein
 - Construction and Expansion joints
 Waterstops

- 2. Anchors and inserts
- C. Related Work Specified Elsewhere

Specification Section	Title
03100	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
07900	Joint Sealants
Contract Drawings and General Provisions of the Contract	

1.02 **Submittals**

A. Materials

1. Submit manufacturer's literature, materials and samples of waterstops and supports for reinforcing bars in accordance with the Section 00700, General Conditions, Section 00800, Supplementary Conditions, and Section 01300, Shop Drawings, Submittals and Samples, including a statement of compliance with ASTM and U.S. Federal Specifications.

- 2. The manufacturer shall demonstrate a minimum of five (5) years of continuous, successful experience in their product line.
- 3. Provide product data including catalog cut sheets, technical data, storage requirements, splicing methods, installation and application requirements, location of use, product life, and conformance to ASTM standards for the following items:
 - a. Waterstops.
 - b. Premolded Joint Fillers.
 - c. Bond Breaker and Bonding Agents.
 - d. Expansion Joint Dowels (include, in addition to the above, complete assembly including dowels, coatings, lubricants, spacers, sleeves, expansion caps).
 - e. Compressible Joint Filler.
 - f. Tongue and Groove Joint Forms.
- B. The Contractor shall provide certifications from the manufacturers that all materials used within the joint system are compatible with each other.
- C. Provide technical data sheets for the Contractor's personnel, Engineer and the Owner covering joint preparation, priming, and sealant materials application.
- D. Submit layouts for construction joints as noted on the Contract Drawings.
- E. All submittals shall be in an electronic format (PDF).

1.03 Reference Standards

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM)		
ASTM A615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement	
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete	

STANDARD	DESCRIPTION		
American Society for Testing and Materials (ASTM) - Cont'd			
ASTM C1059	Latex Agents for Bonding Fresh to Hardened Concrete		
ASTM D1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction		
ASTM D1752	Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction		
U.S. Army Corps of Engineers (CRD)			
CRD C572	Specification for Polyvinylchloride Waterstops		

1.04 Delivery, Storage and Handling

- A. Store all products in accordance with the manufacturer's recommendations.
- B. Waterstops shall be protected from moisture, oil, dirt, sunlight and other contaminants.

1.05 Manufacturer's Services

A. Prior to joint preparation for joints receiving sealant materials, the Contractor shall require that the joint manufacturer's technical representative demonstrate, at the Project Site, joint preparation, priming, and sealant materials application for the Contractor's personnel performing joint work.

2. PRODUCTS

2.01 PVC Waterstop

- A. Provide ribbed, dumbell-type waterstops at construction joints exposed to water pressure, including groundwater pressure, and other joints as indicated on the Contract Drawings.
- B. **All waterstop shall be embedded in concrete** to prevent the passage of fluids through joints and shall be resistant to oils, solvents and chemicals.
- C. Waterstops shall comply with U.S. Army Corps of Engineers Specification CRD-C-572.
- D. Waterstops shall be such that any cross section will be dense, homogeneous, free from porosity and other imperfections, and shall be symmetrical in shape.

- E. Waterstops shall be extruded from a PVC compound and shall be 9 inches x ½-inch, non-tapered, ribbed profile for wall thicknesses of 12-inches and greater, and 6 inches x d-inch for wall thicknesses less than 12 inches. Provide a 6-inch split-ribbed waterstop with center bulb at all connections of new concrete structures with existing concrete.
- F. All waterstop material shall be extruded from virgin elastomeric PVC compound, resistant to chemical action-with portland cement, alkalies, acids, and not affected by mildew or fungi. It shall show no effect when immersed for ten (10) days in a 10% solution of sulfuric or hydrochloric acid, saturated lime solution or salt water.
- G. Subject to compliance with requirements, manufacturer's offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. The Burke Company
 - 2. Greenstreak Plastic Products Company
 - 3. Meadows, Inc.
 - 4. Progress Unlimited, Inc.
 - 5. Schlegel Corporation
 - 6. Vinylex Corporation
 - 7. Or approved equal
- H. When tested in accordance with Federal Standard No. 601, the material shall meet the following minimum requirements:

Requirement	ASTM Specification
Tensile strength (2,000 psi)	D 638
Hardness, Shore Durometer (65 - 80)	D 2240
Elongation, ultimate (280%)	D 638
Water absorption, dry wt, maximum (48 hours) - 0.32%	D 570
Specific gravity, 1.3	D 792
Stiffness in flexure, 920 psi	D 747
Cold brittleness, -35∏F	D 746
Tear resistance, 290 lbs/inch	D 624

1. The use of reworked PVC or other substitute material will not be permitted.

2.02 Joint Sealant for Concrete Structures

- A. Joint sealant for continuous immersion shall be a multi-part, gray, non-staining non-sagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber.
- B. The joint sealant shall meet U.S. Federal Specification TT-S-00227E(3) Type I, Class A self-leveling for horizontal joints and Type II, Class A, non-sag for vertical joints.
- C. In addition, the joint sealant must be recommended by the manufacturer for continuous immersion in water and said certification submitted to the Engineer along with the shop drawing submittal.
- D. Provide sealants as manufactured by Products Research and Chemical Corporation, Mameco International, The Burke Company, W.R. Meadows, or approved equal.

E. <u>Technical Requirements</u>

Parameter	Requirement	
Consistency	Gun grade	
Tack free time	24 hours at 75∏F and 50% R.H.	
Pot life	1 - 3 hours	
Hardness	35 Shore A, ±15	
Elongation	500%	
Tensile strength, ASTM D 412	300 psi	
Peel strength on concrete	No loss of bond after 24 hours at 150% elongation	
Temperature service range	-40 <u></u> F to +155 <u></u> F	
Immersion in water	Continuous	

2.03 Backing Rod for Expansion Joints

- A. Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware, or approved equal.
- B. The rod shall be ¼-inch larger in diameter than the joint width. Where possible, provide full length sections for the joint and minimize splices. Apply backup rod and bond breaker tape in expansion joints.

2.04 Bond Breaker Tape

- A. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler material or concrete surface as required.
- B. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.
- C. Bond breaker for concrete other than where tape is specifically called for shall be either bond breaker tape or a *non-staining* type bond prevention coating.

2.05 Preformed Control Joint

- A. Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex. Corp., Knoxville, TN, or equal.
- B. Provide the preformed control joint material in full length *unspliced* pieces.

2.06 Premolded Joint Filler

A. Structures

- 1. Joint filler shall be preformed, non-extruded type constructed of closed-cell neoprene conforming to ASTM D 1752, Type I, as manufactured by W. R. Grace Company of Cambridge, MA; W. R. Meadows, Inc., Elgin, IL; or approved equal.
- 2. The thickness shall be ¾-inch, minimum.

B. Sidewalk and Roadway Concrete Pavements

- 1. Joints where fiber is specifically noted on the Contract Drawings, shall be asphalt-impregnated fiber board. Joint filler shall conform to ASTM D 1751.
- 2. Thickness shall be ¾-inch unless otherwise shown on the Contract Drawings.
- C. Bituminous type, if approved, shall conform to the requirements of ASTM D 994.

2.07 Expansion Joint Dowels

- A. Steel expansion joint dowels shall conform to one of following:
 - 1. Epoxy coated steel bar dowels with a 12-mil coating thickness. Steel bar dowels shall conform ASTM A-615, Grade 60. The epoxy coating shall be in conformance with ASTM A 775; or
 - 2. Stainless-steel bar dowels conforming to ASTM A Type 302.
- B. Dowels shall be straight and clean, free of loose flaky rust and loose scale.
- C. Expansion joint shall be thoroughly greased prior placing adjoining wall or slab concrete.
- D. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end.

2.08 Epoxy Adhesive

- A. Epoxy adhesive shall be a two-component, solvent-free, moisture insensitive, epoxy resin material for use on dry or damp surfaces, conforming to ASTM C881. Provide the material type, grade and class to suit Project requirements.
- B. Subject to compliance with requirements, products that may be incorporated in the Work, include, but are not limited to, the following:
 - 1. Burke-Epoxy M.V., The Burke Company
 - 2. Spec-Bond 100, Conspec Marketing and Manufacturing Company
 - 3. Resi-Bond (J-58), Dayton Superior
 - 4. Euco Epoxy System #452 or #620, Euclid Chemical Company
 - 5. Epoxtite Binder 2390, A.C. Horn, Inc.
 - 6. Concressive Standard Liquid, Master Builders, Inc.
 - 7. Rezi-Weld 1000, W.R. Meadows, Inc.
 - 8. Sikadur 32 Hi-Mod, Sika Corporation
 - 9. Or approved equal

2.09 Bonding Agent

A. Bonding agent shall be a non-reemulsifiable, acrylic emulsion or styrene butadiene conforming to ASTM C1059. Provide the material type, grade and class to suit Project requirements.

- B. Subject to compliance with requirements, products that may be incorporated in the Work, include, but are not limited to, the following:
 - 1. Acrylic Bondcrete, The Burke Company
 - 2. Strongbond, Conspec Marketing and Manufacturing Company
 - 3. Day-Chem Ad Bond, Dayton Superior
 - 4. SBR Latex, Euclid Chemical Company
 - 5. Hornweld, A.C. Horn, Inc.
 - 6. Acryl-Set, Master Builders, Inc.
 - 7. Intralok, W.R. Meadows, Inc.
 - 8. Daraweld, W.R. Grace & Company
 - 9. Or approved equal.

2.10 Compressible Joint Filler

- A. The joint filler shall be a non-extruded watertight strip material used to fill expansion joints between structures. The material shall be capable of being compressed at least forty (40) percent for seventy (70) hours at 68 and subsequently recovering at least twenty (20) percent of its original thickness in the first one-half hour after unloading.
- B. Compressible Joint Filler shall be Evasote 380 E.S.P., by E-Poxy, Ravena, NY, or equal.

2.11 Fuel Resistant Joint Sealant

A. Sealant shall conform to Federal Specification SS-S-1614.

2.12 Styrofoam Filler Block

A. Styrofoam filler blocks for future construction and expansion joints shall be Styrofoam SM brand as manufactured by Dow Chemical Company, or approved equal.

2.13 Precast Concrete Block Supports for Reinforcing Bars

- A. Comply with the requirements of ACI 318.
- B. Provide blocks with No. 4 dowels bent 90 to support top bars.

2.14 Vapor Barrier

A. The vapor barrier for the Project Work is specified in Section 07050, Vapor Barrier.

2.15 Tongue and Groove Joint Forms

A. Twenty-four (24) gauge steel forms complete with steel stakes and splice plates, designed for joints not to receive a poured seal, and equal to Burke Keyed Kold Joint as manufactured by The Burke Company.

2.16 Inserts

A. Galvanized steel to fit the proposed hanger and support

3. EXECUTION

3.01 Vapor Barrier

- A. Examine the substrate and the conditions under which the vapor barrier work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Proceed with installation of the vapor barrier only after substrate construction and penetrating work have been completed.
- C. The vapor barrier shall be applied parallel with the direction of the concrete pour, lapping adjacent sides and ends a minimum of twelve (12) inches. Do not puncture the vapor barrier. The Contractor shall refer to Section 07050, Vapor Barrier.
- D. Seal all joints with continuous approved 2-inch wide plastic tape.

3.02 Precast Concrete Block Supports for Reinforcing Bars

A. Provide in sufficient quantity to support reinforcing bars in slabs formed on earth at a spacing not to exceed four (4) feet on centers in both directions.

- B. **Provide blocks with dowels to support top bars**. Block supports are not required in slabs formed on tremie concrete, but may be used at the Contractor's option.
- C. Blocks are not required for reinforcing bars properly supported from formwork.
- D. At other locations, the Contractor shall refer to ACI 315 and CRSI MSP-1.

3.03 PVC Waterstops

- A. Waterstops shall be of the shapes, dimensions, and profiles presented herein.
- B. Waterstops shall be properly heat spliced at ends and intersections to ensure continuity. Construct forms for construction joints in such a manner as to prevent injury to waterstops. Install waterstops in construction and expansion joints in hydraulic structures which will contain liquid or resist the entry of groundwater.
- C. **Make field splices with a thermostatically controlled heating iron** in conformance with the manufacturer's current recommendations. Allow at least ten (10) minutes before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80% of the unspliced materials.
- D. Center waterstop in the construction joint and secure water in the correct position using hog rings or grommets spaced at twelve inches (12") on center along the length of the waterstop and wire tie to the adjacent reinforcing steel.
- E. Provide factory made waterstop fabrications for all *changes of direction*, *intersections*, *and transitions* leaving only straight butt joint splices for the field.
- F. Protect waterstops from dirt, oil, foreign materials and concrete spatter.

3.04 Joints

A. General

1. Construct joints true to line and faces perpendicular to the surface plane of the concrete.

B. Construction Joints

1. Locate and install construction joints so that they do not impair the strength or appearance of the concrete and/or structure, as acceptable to the Engineer.

Place joints perpendicular to the main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through the sides of strip placements of floors and slabs.

- 2. Form keyed joints as indicated. Form keyways by beveled strips or boards placed at right angles to the direction of shear. Embed keys at least three (3) inches into concrete.
- Locate joints for beams, slabs, joists, and girders in the *middle third of spans*.
 Offset joints in girders a minimum distance of twice the beam width from a beam girder intersection.
- 4. Locate horizontal joints in walls and columns at the underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- 5. **Use a bonding agent** at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 6. Provide construction joints where shown on the Contract Drawings, or as recommended by the Contractor and approved by the Engineer. In the event of an emergency, place additional construction joints. An interval of forty-five (45) minutes between two (2) consecutive batches of concrete shall constitute cause for an emergency construction joint.
- 7. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material, and expose clean aggregate by sandblasting the surface of construction joints before placing the new concrete. At least two (2) hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After the glistening water disappears, the joints shall be given a thorough coating of neat cement slurry mixed to a consistency of very heavy paste. The surface shall receive a coating of at least c-inch thick, well scrubbed-in by means of stiff bristle brushes where possible. New concrete shall be deposited before the neat cement dries.
- 8. Layout of construction joints shall be in accordance with the following guidelines:
 - a. Provide horizontal construction joints at the top of foundation members and slabs on grade and at the soffit of supported slabs and beams.
 - b. Space the corner vertical construction joints between 4 8 feet from the corner of walls or intersections, unless noted otherwise on the Drawings.
 - c. Space the construction joints at a maximum horizontal distance of twenty-five (25) feet and a maximum vertical distance of sixteen (16) feet, unless noted otherwise on the Contract Drawings.

d. Space horizontal construction joints at least eight (8) inches below the bottom of slabs, unless noted otherwise on the Contract Drawings.

C. Waterstops

Provide waterstops in construction joints as indicated. *Install waterstops to form a continuous diaphragm in each joint*. Support and protect exposed waterstops during the progress of the Work.

D. Contraction Joints in Slabs-on-Grade

1. Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth (1/4) of concrete thickness as follows:

a. Sawed Joints

- 1) Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades.
- 2) Cut c-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks

E. Isolation Joint in Slabs-on-Grade

- After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- 2. Extend joint-filler strips full-width and the depth of the joint, terminating flush with finished concrete surface, unless otherwise indicated.
- 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

F. Doweled Joints

- 1. Install dowel bars and support assemblies at joints where indicated.
- 2. Lubricate or asphalt coat one-half $(\frac{1}{2})$ of the dowel length to prevent concrete bonding to one side of the joint.

- G. For control joints of nonstructural slabs, provide partial depth plastic strips set flush with finished surface or c-inch-wide joints cut with a diamond saw. Use control joints one-quarter to one-third the depth of the slab unless otherwise indicated.
- H. For slabs-on-grade that are not subject to hydraulic loading, use formed construction joints. Maximum size of pour shall be fifteen (15) feet each way for slabs with wire mesh reinforcement and thirty (30) feet each way for slabs with bar reinforcement. Allow 24 hours between pours of adjacent slabs. Provide joints as specified or shown. Set continuous expansion joint strips between slabs and abutting vertical surfaces.
- I. When it is necessary to make a joint because of an emergency, furnish and place reinforcing dowels across the joint. Embed dowels 48 bar diameters each side of the joint. The size and number of dowels shall match the reinforcing in the member. Furnishing and placing such reinforcing steel shall be at the Contractor's expense.

3.05 Bonding at Construction Joints

- A. Before depositing new concrete on or against concrete that has set, thoroughly clean the surfaces of the set concrete so as to expose the coarse aggregate and remove laitance coatings, foreign matter and loose particles.
- B. Retighten the forms.
- C. Dampen, but do not saturate the hardened concrete of joints and then thoroughly cover with a coat of cement grout of similar proportions to the mortar in the concrete.
- D. Place the fresh concrete before the grout has attained its initial set.

3.06 Expansion Joints

- A. Construct joints true to line and faces perpendicular to the surface plane of the concrete.
- B. Provide expansion joints with continuous edge reservoirs, which shall be filled with a joint sealant. Leave the material used for forming the reservoirs in place until immediately before the grooves are cleaned and filled with joint sealant.
- C. After removing edge forms from the reservoir, remove grout, loose concrete, and fins; then sandblast the slots. Allow the reservoirs to become thoroughly dry; then blow out the reservoirs and immediately prime and fill with the expansion joint sealant and backup materials. The primer used shall be supplied by the same manufacturer supplying the joint sealant.

3.07 Time Between Pours

- A. At least two (2) hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon.
- B. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system.

3.08 Installation of Premolded Joint Filler

- A. Install in joint accurately as indicated in the manufacturer's instructions.
- B. Attach the premolded joint filler to the concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

3.09 Installation of Joint Sealants

- A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
- B. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.
- C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
- D. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
- E. After the sealant has been applied, remove the masking tape and any sealant spillage.

3.10 Cracking

A. **Saw joints in slabs before the formation of uncontrolled cracking** (i.e., cracking that occurs at locations other than construction, control, or contraction joints) and as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing. Saw joints both during the day and night as required.

B. If concrete cracks at locations other than construction, control, or contraction joints, the Contractor may be required to remove and replace the defective work (cracked concrete) in accordance with the provisions of this section, all at no additional cost to the Owner.

END OF SECTION

SECTION 03250 CONCRETE ACCESSORIES

1. GENERAL

1.01 Description

A. The Work included in this Section consists of all labor, materials and equipment necessary to install expansion joints, construction joints, and waterstops.

B. Work Specified Herein

- 1. Construction and Expansion joints
- 2. Anchors and inserts
- 3. Waterstops

C. Related Work Specified Elsewhere

Specification Section	Title
03100	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
03800	Leakage Testing of Hydraulic Structures
07900	Joint Sealants
Contract Drawings and General Provisions of the Contract	

1.02 Submittals

A. Materials

1. Submit manufacturer's literature, materials and samples of waterstops and supports for reinforcing bars in accordance with the Section 00700, *General Conditions*,

Section 00800, Supplementary Conditions, Sections 00805 and 00806, FDEP Supplementary Conditions, and Section 01300, Shop Drawings, Submittals and Samples, including a statement of compliance with ASTM and U.S. Federal Specifications.

- 2. The manufacturer shall demonstrate a minimum of five (5) years of continuous, successful experience in their product line.
- 3. Provide product data including catalog cut sheets, technical data, storage requirements, splicing methods, installation and application requirements, location of use, product life, and conformance to ASTM standards for the following items:
 - a. Waterstops.
 - b. Premolded Joint Fillers.
 - c. Bond Breaker and Bonding Agents.
 - d. Expansion Joint Dowels (include, in addition to the above, complete assembly including dowels, coatings, lubricants, spacers, sleeves, expansion caps).
 - e. Compressible Joint Filler.
 - f. Tongue and Groove Joint Forms.
- B. The Contractor shall provide certifications from the manufacturers that all materials used within the joint system are compatible with each other.
- C. Provide technical data sheets for the Contractor's personnel, Engineer and the Owner covering joint preparation, priming, and sealant materials application.
- D. Submit layouts for construction joints as noted on the Contract Drawings.

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1.04 Delivery, Storage and Handling

- A. Store all products in accordance with the manufacturer's recommendations.
- B. Waterstops shall be protected from moisture, oil, dirt, sunlight and other contaminants.

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- A. Provide ribbed, dumbell-type waterstops at construction joints exposed to water pressure, including groundwater pressure, and other joints as indicated on the Contract Drawings.
- B. *All waterstop shall be embedded in concrete* to prevent the passage of fluids through joints and shall be resistant to oils, solvents and chemicals.
- C. Waterstops shall comply with U.S. Army Corps of Engineers Specification CRD-C-572.
- D. Waterstops shall be such that any cross section will be dense, homogeneous, free from porosity and other imperfections, and shall be symmetrical in shape.

- E. Waterstops shall be extruded from a PVC compound and shall be 9 inches x ½-inch, non-tapered, ribbed profile for wall thicknesses of 12-inches and greater, and 6 inches x 3/8-inch for wall thicknesses less than 12 inches. *Provide a 6-inch split-ribbed waterstop with center bulb at all connections of new concrete structures with existing concrete*.
- F. All waterstop material shall be extruded from virgin elastomeric PVC compound, resistant to chemical action-with portland cement, alkalies, acids, and not affected by mildew or fungi. It shall show no effect when immersed for ten (10) days in a 10% solution of sulfuric or hydrochloric acid, saturated lime solution or salt water.
- G. Subject to compliance with requirements, manufacturer's offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. The Burke Company
 - 2. Greenstreak Plastic Products Company
 - 3. Meadows, Inc.
 - 4. Progress Unlimited, Inc.
 - 5. Schlegel Corporation
 - 6. Vinylex Corporation
 - 7. Or approved equal
- H. When tested in accordance with Federal Standard No. 601, the material shall meet the following minimum requirements:

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Hardness, Shore Durometer (65 - 80)	D 2240
Elongation, ultimate (280%)	D 638
Water absorption, dry wt, maximum (48 hours) - 0.32%	D 570
Specific gravity, 1.3	D 792
Stiffness in flexure, 920 psi	D 747
Cold brittleness, -35[F	D 746
Tear resistance, 290 lbs/inch	D 624

1. The use of reworked PVC or other substitute material will not be permitted.

2.02 Joint Sealant for Concrete Structures

- A. Joint sealant for continuous immersion shall be a multi-part, gray, non-staining non-sagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber.
- B. The joint sealant shall meet U.S. Federal Specification TT-S-00227E(3) Type I, Class A self-leveling for horizontal joints and Type II, Class A, non-sag for vertical joints.
- C. In addition, the joint sealant must be recommended by the manufacturer for continuous immersion in water and said certification submitted to the Engineer along with the shop drawing submittal.
- D. Provide sealants as manufactured by Products Research and Chemical Corporation, Mameco International, The Burke Company, W.R. Meadows, or approved equal.

E. Technical Requirements

Parameter	Requirement	
Consistency	Gun grade	
Tack free time	24 hours at 75∏F and 50% R.H.	
Pot life	1 - 3 hours	
Hardness	35 Shore A, ±15	
Elongation	500%	
Tensile strength, ASTM D 412	300 psi	
Peel strength on concrete	No loss of bond after 24 hours at 150% elongation	
Temperature service range	-40[]F to +155[]F	
Immersion in water	Continuous	

2.03 Backing Rod for Expansion Joints

- A. Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware, or approved equal.
- B. The rod shall be ¼-inch larger in diameter than the joint width. Where possible, provide full length sections for the joint and minimize splices. Apply backup rod and bond breaker tape in expansion joints.

2.04 Bond Breaker Tape

- A. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler material or concrete surface as required.
- B. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.
- C. Bond breaker for concrete other than where tape is specifically called for shall be either bond breaker tape or a *non-staining* type bond prevention coating.

2.05 Preformed Control Joint

- A. Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex. Corp., Knoxville, TN, or equal.
- B. Provide the preformed control joint material in full length *unspliced* pieces.

2.06 Premolded Joint Filler

A. Structures

- 1. Joint filler shall be preformed, non-extruded type constructed of closed-cell neoprene conforming to ASTM D 1752, Type I, as manufactured by W. R. Grace Company of Cambridge, MA; W. R. Meadows, Inc., Elgin, IL; or approved equal.
- 2. The thickness shall be ¾-inch, minimum.

B. Sidewalk and Roadway Concrete Pavements

- 1. Joints where fiber is specifically noted on the Contract Drawings, shall be asphalt-impregnated fiber board. Joint filler shall conform to ASTM D 1751.
- 2. Thickness shall be ¾-inch unless otherwise shown on the Contract Drawings.
- C. Bituminous type, if approved, shall conform to the requirements of ASTM D 994.

2.07 Expansion Joint Dowels

- A. Steel expansion joint dowels shall conform to one of following:
 - Epoxy coated steel bar dowels with a 12-mil coating thickness. Steel bar dowels shall conform ASTM A-615, Grade 60. The epoxy coating shall be in conformance with ASTM A 775; or
 - 2. Stainless-steel bar dowels conforming to ASTM A Type 302.
- B. Dowels shall be straight and clean, free of loose flaky rust and loose scale.
- C. Expansion joint shall be thoroughly greased prior placing adjoining wall or slab concrete.
- D. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end.

2.08 Epoxy Adhesive

- A. Epoxy adhesive shall be a two-component, solvent-free, moisture insensitive, epoxy resin material for use on dry or damp surfaces, conforming to ASTM C881. Provide the material type, grade and class to suit Project requirements.
- B. Subject to compliance with requirements, products that may be incorporated in the Work, include, but are not limited to, the following:
 - 1. Burke-Epoxy M.V., The Burke Company
 - 2. Spec-Bond 100, Conspec Marketing and Manufacturing Company
 - 3. Resi-Bond (J-58), Dayton Superior
 - 4. Euco Epoxy System #452 or #620, Euclid Chemical Company
 - 5. Epoxtite Binder 2390, A.C. Horn, Inc.
 - 6. Concressive Standard Liquid, Master Builders, Inc.
 - 7. Rezi-Weld 1000, W.R. Meadows, Inc.
 - 8. Sikadur 32 Hi-Mod, Sika Corporation
 - 9. Or approved equal

2.09 Bonding Agent

A. Bonding agent shall be a non-reemulsifiable, acrylic emulsion or styrene butadiene conforming to ASTM C1059. Provide the material type, grade and class to suit Project requirements.

- B. Subject to compliance with requirements, products that may be incorporated in the Work, include, but are not limited to, the following:
 - 1. Acrylic Bondcrete, The Burke Company
 - 2. Strongbond, Conspec Marketing and Manufacturing Company
 - 3. Day-Chem Ad Bond, Dayton Superior
 - 4. SBR Latex, Euclid Chemical Company
 - 5. Hornweld, A.C. Horn, Inc.
 - 6. Acryl-Set, Master Builders, Inc.
 - 7. Intralok, W.R. Meadows, Inc.
 - 8. Daraweld, W.R. Grace & Company
 - 9. Or approved equal.

2.10 Compressible Joint Filler

- A. The joint filler shall be a non-extruded watertight strip material used to fill expansion joints between structures. The material shall be capable of being compressed at least forty (40) percent for seventy (70) hours at 68 F and subsequently recovering at least twenty (20) percent of its original thickness in the first one-half hour after unloading.
- B. Compressible Joint Filler shall be Evasote 380 E.S.P., by E-Poxy, Ravena, NY, or equal.

2.11 Fuel Resistant Joint Sealant

A. Sealant shall conform to Federal Specification SS-S-1614.

2.12 Styrofoam Filler Block

A. Styrofoam filler blocks for future construction and expansion joints shall be Styrofoam SM brand as manufactured by Dow Chemical Company, or approved equal.

2.13 Precast Concrete Block Supports for Reinforcing Bars

- A. Comply with the requirements of ACI 318.
- B. Provide blocks with No. 4 dowels bent 90 to support top bars.

2.14 Vapor Barrier

A. The vapor barrier for the Project Work is specified in Section 07050, Vapor Barrier.

2.15 Tongue and Groove Joint Forms

A. Twenty-four (24) gauge steel forms complete with steel stakes and splice plates, designed for joints not to receive a poured seal, and equal to Burke Keyed Kold Joint as manufactured by The Burke Company.

2.16 Inserts

A. Galvanized steel to fit the proposed hanger and support

3. EXECUTION

3.01 Vapor Barrier

- A. Examine the substrate and the conditions under which the vapor barrier work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Proceed with installation of the vapor barrier only after substrate construction and penetrating work have been completed.
- C. The vapor barrier shall be applied parallel with the direction of the concrete pour, lapping adjacent sides and ends a minimum of twelve (12) inches. Do not puncture the vapor barrier. The Contractor shall refer to Section 07050, Vapor Barrier.
- D. Seal all joints with continuous approved 2-inch wide plastic tape.

3.02 Precast Concrete Block Supports for Reinforcing Bars

A. Provide in sufficient quantity to support reinforcing bars in slabs formed on earth at a spacing not to exceed four (4) feet on centers in both directions.

- B. **Provide blocks with dowels to support top bars**. Block supports are not required in slabs formed on tremie concrete, but may be used at the Contractor's option.
- C. Blocks are not required for reinforcing bars properly supported from formwork.
- D. At other locations, the Contractor shall refer to ACI 315 and CRSI MSP-1.

3.03 PVC Waterstops

- A. Waterstops shall be of the shapes, dimensions, and profiles presented herein.
- B. Waterstops shall be properly heat spliced at ends and intersections to ensure continuity. Construct forms for construction joints in such a manner as to prevent injury to waterstops. Install waterstops in construction and expansion joints in hydraulic structures which will contain liquid or resist the entry of groundwater.
- C. *Make field splices with a thermostatically controlled heating iron* in conformance with the manufacturer's current recommendations. Allow at least ten (10) minutes before pulling or straining the new splice in any way. The finished splices shall provide a cross section that is dense and free of porosity with tensile strength of not less than 80% of the unspliced materials.
- D. Center waterstop in the construction joint and secure water in the correct position using hog rings or grommets spaced at twelve inches (12") on center along the length of the waterstop and wire tie to the adjacent reinforcing steel.
- E. Provide factory made waterstop fabrications for all *changes of direction*, *intersections*, *and transitions* leaving only straight butt joint splices for the field.
- F. Protect waterstops from dirt, oil, foreign materials and concrete spatter.

3.04 Joints

A. General

1. Construct joints true to line and faces perpendicular to the surface plane of the concrete.

B. Construction Joints

1. Locate and install construction joints so that they **do not impair the strength or appearance of the concrete and/or structure**, as acceptable to the Engineer.

Place joints perpendicular to the main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through the sides of strip placements of floors and slabs.

- 2. Form keyed joints as indicated. Form keyways by beveled strips or boards placed at right angles to the direction of shear. Embed keys at least three (3) inches into concrete.
- Locate joints for beams, slabs, joists, and girders in the *middle third of spans*.
 Offset joints in girders a minimum distance of twice the beam width from a beam girder intersection.
- 4. Locate horizontal joints in walls and columns at the underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- 5. **Use a bonding agent** at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 6. Provide construction joints where shown on the Contract Drawings, or as recommended by the Contractor and approved by the Engineer. In the event of an emergency, place additional construction joints. An interval of forty-five (45) minutes between two (2) consecutive batches of concrete shall constitute cause for an emergency construction joint.
- 7. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material, and expose clean aggregate by sandblasting the surface of construction joints before placing the new concrete. At least two (2) hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After the glistening water disappears, the joints shall be given a thorough coating of neat cement slurry mixed to a consistency of very heavy paste. The surface shall receive a coating of at least 1/8-inch thick, well scrubbed-in by means of stiff bristle brushes where possible. New concrete shall be deposited before the neat cement dries.
- 8. Layout of construction joints shall be in accordance with the following guidelines:
 - a. Provide horizontal construction joints at the top of foundation members and slabs on grade and at the soffit of supported slabs and beams.
 - b. Space the corner vertical construction joints between 4 8 feet from the corner of walls or intersections, unless noted otherwise on the Drawings.
 - c. Space the construction joints at a maximum horizontal distance of twentyfive (25) feet and a maximum vertical distance of sixteen (16) feet, unless noted otherwise on the Contract Drawings.

d. **Space horizontal construction joints at least eight (8) inches below the bottom of slabs**, unless noted otherwise on the Contract Drawings.

C. Waterstops

Provide waterstops in construction joints as indicated. *Install waterstops to form a continuous diaphragm in each joint*. Support and protect exposed waterstops during the progress of the Work.

D. Contraction Joints in Slabs-on-Grade

1. Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth (1/4) of concrete thickness as follows:

a. Sawed Joints

- 1) Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades.
- 2) Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

E. Isolation Joint in Slabs-on-Grade

- 1. After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- 2. Extend joint-filler strips full-width and the depth of the joint, terminating flush with finished concrete surface, unless otherwise indicated.
- 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

F. Doweled Joints

- 1. Install dowel bars and support assemblies at joints where indicated.
- 2. Lubricate or asphalt coat one-half (½) of the dowel length to prevent concrete bonding to one side of the joint.

- G. For control joints of nonstructural slabs, provide partial depth plastic strips set flush with finished surface or 1/8-inch-wide joints cut with a diamond saw. Use control joints one-quarter to one-third the depth of the slab unless otherwise indicated.
- H. For slabs-on-grade that are not subject to hydraulic loading, use formed construction joints. Maximum size of pour shall be fifteen (15) feet each way for slabs with wire mesh reinforcement and thirty (30) feet each way for slabs with bar reinforcement. Allow 24 hours between pours of adjacent slabs. Provide joints as specified or shown. Set continuous expansion joint strips between slabs and abutting vertical surfaces.
- I. When it is necessary to make a joint because of an emergency, furnish and place reinforcing dowels across the joint. Embed dowels 48 bar diameters each side of the joint. The size and number of dowels shall match the reinforcing in the member. Furnishing and placing such reinforcing steel shall be at the Contractor's expense.

3.05 Bonding at Construction Joints

- A. Before depositing new concrete on or against concrete that has set, thoroughly clean the surfaces of the set concrete so as to expose the coarse aggregate and remove laitance coatings, foreign matter and loose particles.
- B. Retighten the forms.
- C. Dampen, but do not saturate the hardened concrete of joints and then thoroughly cover with a coat of cement grout of similar proportions to the mortar in the concrete.
- D. Place the fresh concrete before the grout has attained its initial set.

3.06 Expansion Joints

- A. Construct joints true to line and faces perpendicular to the surface plane of the concrete.
- B. Provide expansion joints with continuous edge reservoirs, which shall be filled with a joint sealant. Leave the material used for forming the reservoirs in place until immediately before the grooves are cleaned and filled with joint sealant.
- C. After removing edge forms from the reservoir, remove grout, loose concrete, and fins; then sandblast the slots. Allow the reservoirs to become thoroughly dry; then blow out the reservoirs and immediately prime and fill with the expansion joint sealant and backup materials. The primer used shall be supplied by the same manufacturer supplying the joint sealant.

3.07 Time Between Pours

- A. At least two (2) hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon.
- B. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system.

3.08 Installation of Premolded Joint Filler

- A. Install in joint accurately as indicated in the manufacturer's instructions.
- B. Attach the premolded joint filler to the concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

3.09 Installation of Joint Sealants

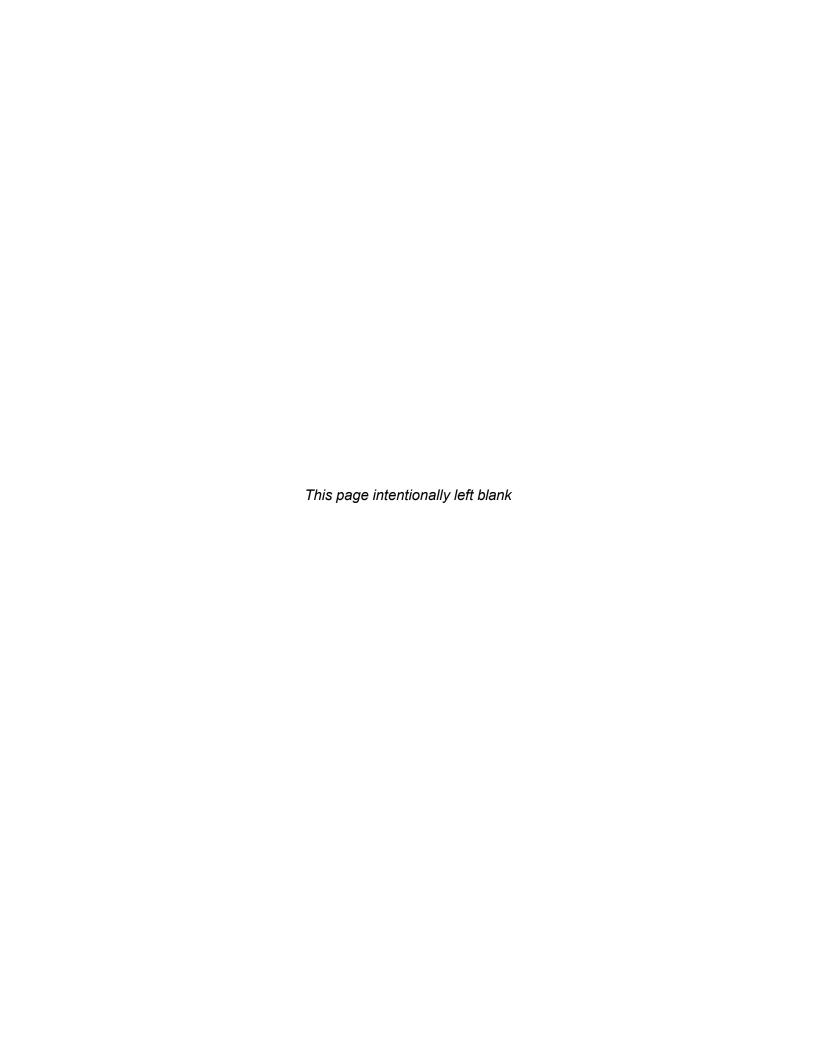
- A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
- B. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.
- C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer
- D. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
- E. After the sealant has been applied, remove the masking tape and any sealant spillage.

3.10 Cracking

A. **Saw joints in slabs before the formation of uncontrolled cracking** (i.e., cracking that occurs at locations other than construction, control, or contraction joints) and as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing. Saw joints both during the day and night as required.

B. If concrete cracks at locations other than construction, control, or contraction joints, the Contractor may be required to remove and replace the defective work (cracked concrete) in accordance with the provisions of this section, all at no additional cost to the Owner.

END OF SECTION



SECTION 03300 CAST-IN-PLACE CONCRETE

1. GENERAL

1.01 Description

- A. The Contractor shall furnish all labor and materials required and install cast-in-place concrete complete as shown on the Contract Drawings and as specified herein. The Work specified herein includes, but is not limited to, concrete mixtures, mixing, transporting, placement schedule, depositing, consolidating, slab finishing, curing, and formed surface finishing.
- B. All concrete to be used in the construction of the Flagler Beach WWTF Sludge Management System Improvements project shall be *Class A concrete* (see *Table 3300-A*) and shall have a 28-day compressive strength of *4,000 psi* (unless otherwise noted on the Contract Drawings).

C. Related Work Specified Elsewhere

Specification Section	Title
02200	Earthwork
02720	Concrete Sidewalks, Driveways and Pads
03100	Concrete Formwork
03200	Concrete Reinforcement
03250	Concrete Accessories
03400	Precast Concrete Structures
07900	Joint Sealants
09900	Painting
Contract Drawings and General Provisions of the Contract	

D. Cementitious Materials shall be defined as Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.02 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the latest revision of the following codes, specifications and standards, except where more stringent requirements are shown or specified:

STANDARD	DESCRIPTION		
American Concr	American Concrete Institute (ACI)		
ACI-211	Proportions for Normal, Heavyweight and Mass Concrete		
ACI-212	Guide for Use of Admixtures in Concrete		
ACI-301	Specifications for Structural Concrete for Buildings		
ACI-304	Guide for Measuring, Mixing, Transporting, and Placing Concrete		
ACI-305	Hot Weather Concreting		
ACI-306	Cold Weather Concreting		
ACI-308	Standard Practice for Curing Concrete		
ACI-309	Recommended Practice for Consolidation of Concrete		
ACI-318	Building Code Requirements for Reinforced Concrete		
ACI-347	Guide for Concrete Formwork		
ACI-350	Environmental Engineering Concrete Structures		
American Societ	American Society for Testing and Materials (ASTM)		
ASTM-C31	Making and Curing Concrete Test Specimens in the Field		
ASTM-C33	Concrete Aggregates		
ASTM-C39	Compressive Strength of Cylindrical Concrete Specimens		
ASTM-C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete		
ASTM-C94	Standard Specification for Ready-Mix Concrete		
ASTM-C143	Slump for Portland Cement Concrete		
ASTM-C150	Standard Specification for Portland Cement		
ASTM-C171	Standard Specification for Sheet Materials for Curing Concrete		
ASTM-C172	Standard Practice for Sampling Freshly Mixed Concrete		
ASTM-C173	Air Content of Freshly Mixed Concrete by the Volumetric Method		
ASTM-C231	Air Content of Freshly Mixed Concrete by the Pressure Method		
ASTM-C260	Air Entraining Admixtures for Concrete		

STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM) - Cont'd		
ASTM-C309	Liquid Membrane-Forming Compounds for Curing Concrete	
ASTM-C494	Chemical Admixtures for Concrete	
ASTM-C618	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete	
Other Standards and Codes		
	Florida Building Code	
	Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice"	

B. Manufacturer's Qualification

- A firm experienced in the manufacturing of ready-mixed concrete products and that complies with ASTM C-94/C-94M requirements for production facilities and equipment.
- 2. The manufacturer shall be certified according to NRMCA's *Certification of Ready Mixed Concrete Production Facilities* and ASTM C-94.

C. Installer Qualifications

- 1. A qualified installer who employs project personnel qualified as ACI-certified Flatwork Technicians and Finishers and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- 2. The Concrete Installation Firm shall have at least five (5) years of experience, under the current corporate name, in performing concrete work of high quality, including forming, color, texture and finishing and of the size and complexity of this Project.

D. Evaluation and Acceptance of Concrete

- 1. Evaluation and acceptance of concrete will be in accordance with ACI-318.
- 2. All structures that will contain either water or wastewater shall be watertight and shall be free from any perceptible leakage, as determined by the Engineer.

E. <u>Testing Agency Qualifications</u>

1. An independent agency, qualified according to ASTM C-1077 and ASTM E-329 for the testing indicated, as documented according to ASTM E-548.

- 2. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01, or an equivalent certification program.
- Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. The Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- 4. Provide testing in accordance with Section 01410, *Testing and Testing Laboratory Services* and Article 3.11 of this Section. The Contractor shall keep the testing laboratory informed of the testing schedule.
- 5. The Contractor shall engage a qualified testing agency to perform evaluation tests and to design concrete mixtures.

F. Source Limitations

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

1.03 Submittals

A. Shop Drawings, Samples and Certifications

 Samples and certifications shall be submitted in accordance with Section 00700, General Conditions, Section 00800, Supplementary Conditions, and Section 01300, Shop Drawings, Submittals and Samples, and as directed by the Engineer. Unless otherwise indicated, submit certifications for all products and samples as may be specifically requested by the Engineer.

B. <u>Plant Qualification</u>

1. Submit certification from the National Ready Mixed Concrete Association indicating compliance with the specified qualification requirements and ASTM C-94.

C. Materials

1. Satisfactory evidence shall be submitted indicating that the materials to be used, including cement, aggregates, admixtures, etc., meet the specified requirements.

- 2. Provide catalog data, chemical and mechanical analyses, and conformance with ASTM requirements for the following:
 - **2.01** Sources of cement, pozzolan and aggregates.
 - **2.02** Air-entraining admixture.
 - **2.03** Water reducing admixture.
 - 2.04 High range water-reducing admixture (plasticizer).
 - **2.05** Sheet curing material.
 - **2.06** Liquid curing compound.
- 3. Provide certificates that aggregates comply with ASTM C33 and contain no asbestos. State weathering region limits of coarse aggregates (severe, moderate, or negligible). State the basis of determining that potential reactivity is negligible. Identify certifications and tests actual materials to be used in the Work. Provide additional tests and certifications for each change in material source. Provide an alternate material source of aggregate if test indicate that aggregates are reactive or possess severe weathering potential. Submit a gradation analysis with the concrete design mixes.

4. Design Mix

- **4.01** Prepare mix designs in accordance with ACI 318-95, Chapter 4, except as modified herein. The design mix(es) to be used shall be prepared by qualified persons and submitted for approval at least fifteen (15) days before placing any concrete. The design of the mix is the responsibility of the Contractor subject to the limitations of the Specifications.
- **4.02** Approval of this submission will be required only in that the minimum requirements of the specifications have been met. Such approval will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the specifications relative to strength and slump.
- **4.03 Provide a certificate** that the cement used complies with ASTM C-150 and these specifications.
- **4.04** Submit alternate design mixtures when the characteristics of materials, project conditions, weather, test results or other circumstances warrant adjustments.

4.05 Indicate amounts of mixing water to be withheld for later addition at the Project Site.

D. Delivery Tickets

- 1. **Provide delivery tickets for ready-mix concrete**, per ASTM C-94, indicating the following:
 - **1.01** Date and time leaving the plant.
 - 1.02 Truck number
 - **1.03** Type of cement and weight
 - **1.04** Weight of each size aggregate
 - **1.05** Quantity of water and time added
 - 1.06 Water/cement Ratio
 - **1.07** Admixtures and weight
 - 1.08 Class of Concrete
 - 1.09 Site arrival time
 - **1.10** Site leaving time
 - **1.11** Type of fly ash and weight.

E. Epoxy Bonding Compound

- 1. Provide epoxy bonding compound manufacturer's specific instructions for use.
- 2. Provide manufacturer's certifications as to the suitability of the product to meet the job requirements with regard to surface, pot life, set time, vertical and horizontal application, and forming restrictions.

F. Non-Shrink Grout

- 1. Provide non-shrink grout manufacturer's certificate of compliance with these specifications.
- 2. Provide non-shrink grout manufacturer's specific instructions for use.
- G. **Submit a report from a testing laboratory, in a PDF format,** verifying that aggregate and gravel material contains no asbestos and conforms to the specified gradations and characteristics.

H. Placement Schedule Certification

- 1. Submit at least twenty-four (24) hours before placing concrete, a signed certification providing the following:
 - **1.01** Exact location and portion of the structure to be placed.
 - **1.02** Date and time that the concrete is to be placed.
 - **1.03** The type of concrete to be used (mix) and the method to be used in placing the concrete.
 - **1.04** The estimated quantity of concrete to be placed.
 - **1.05** That the line and grade have been checked and grade properly compacted.
 - **1.06** That location, type, size and spacing of reinforcement has been checked and conform to the Contract Drawings.
 - **1.07** That any waterstops, construction joints, contraction and expansion joints, or seals have been placed and conform to the Contract Documents.
 - **1.08** That any embedded pipes have been placed, are the correct size and type and conform to the Contract Documents.
 - 1.09 That any embedded conduits, grounding wires or receptacles have been placed, are the correct size and type and conform to the Contract Documents.
 - **1.10** That any embedded anchor bolts, bearing plates, dowels, etc., are in place, are of the correct size and are located as indicated on the Contract Documents.
 - **1.11** That all forms are properly located and adequately braced.
- I. Hot and Cold Weather concreting plans shall be submitted in accordance with Article 1.05 of this specification section.
- J. A pouring plan shall be submitted by the Contractor to the Engineer for approval showing the location of all construction joints.

1.04 Sample Pattern Concrete Wall Panel - NOT USED

1.05 Hot, Cold and Adverse Weather Conditions

- A. Hot and cold weather concreting plans shall include the curing method and specific curing plan, ready-mixed supplier plan, contingency plans, and materials list as a minimum.
- B. All hot weather plans shall meet the requirements of ACI 305.
- C. All cold weather plans shall meet the requirements of ACI 306.
- D. Do not mix salt, chemicals, or other foreign materials with the concrete to prevent freezing without approval of the Engineer. Maintain the temperature of concrete above 50°F for five (5) days after placement. When high early strength portland cement concrete is used, the temperature shall not be less than 70°F for two (2) days or 50 °F for three (3) days. Transition the concrete to the outside temperature at a rate of 1°F each hour for the first twenty-four (24) hours and 2°F each hour thereafter.
- C. In no case shall the temperature of the concrete exceed 90°F at the time of placement. If insulated forms are used, the temperature of the concrete mixture shall not exceed 80 F at time of placement.
- D. If the Engineer determines that heat of hydration may cause excessive concrete temperatures and subsequent detrimental effects, the concrete mixture shall not exceed 60 TF at time of placement for critical pours.

1. PRODUCTS

1.01 Cementitious Material

- A. Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C-150 Type I, Type II, or Type III, gray.
- B. Type I cement may be used for buildings, pipe encasements and tremie concrete. All manholes, wet wells, valve/meter vaults, pumping stations, and structures exposed to water or wastewater shall be constructed with Type II cement. Type III cement for high early strength concrete shall be used only for special locations and only with the approval of the Engineer.

- C. Only one (1) brand of cement shall be used in any individual structure unless approved by the Engineer. Cement which has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container which contains such cement will be rejected. No salvaged or reclaimed cement shall be used.
- D. The maximum tricalcium aluminate content shall not exceed eight (8) percent. The maximum percent alkalies shall not exceed 0.6%.

1.02 Fly Ash

- A. Fly ash shall be Class F conforming to the requirements of ASTM C-618, including the requirements of Table 1 except the loss of ignition, LOI, shall be limited to three percent (3%), maximum.
- B. Fly ash shall not exceed twenty percent (20%) of the cementitious content of the mix.
- C. Use one brand of cement and fly ash throughout the Project unless otherwise acceptable to the Engineer.

1.03 Aggregates

- A. Aggregates shall comply with ASTM C-33 and shall contain no asbestos and be free from any substances that will react with the cement alkalies.
- B. Coarse aggregates shall be Size No. 67 (¾-inch). Use Size No. 8 for filling of the cells of masonry units.
- C. Fine aggregate shall be free of materials with deleterious reactivity to alkali in cement.
- D. In addition to requirements of ASTM C-33 for structures exposed to wastewater the following shall apply:

Description	Maximum Content
Soft particles	< 2.0 %
Chert as a soft impurity (defined in Table 3 of ASTM C-33)	< 1.0 %
Total of soft particles and chert as a soft impurity	< 2.0 %
Flat and elongated particles (Long dimension greater than 5 times short dimension)	< 15.0 %

E. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.

1.04 Water and Ice

- A. **Use water and ice that is of potable water quality**, clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities that might reduce the strength, durability, or otherwise adversely affect the quality of the concrete.
- B. Water shall be in compliance with the requirements of ASTM C-94 / C-94M.

1.05 Air Entraining Admixture

- A. **The concrete shall contain an air entraining admixture**. The admixture shall conform to ASTM C-260, except it shall be **non-toxic** after thirty (30) days and shall **contain no chlorides**, and shall be certified by the manufacturer to be compatible with other required admixtures.
- B. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Monex Air or Monex NVR, Monex Resources, Inc.
 - 2. Air-Tite, Cormix Construction Chemicals
 - 3. Air-Mix or Perma-Air, Euclid Chemical Company
 - 4. Darex AEA or Daravair, W.R. Grace & Company
 - 5. MB-VR or Micro-Air, Master Builders, Inc.
 - 6. Sealtight AEA, W.R. Meadows, Inc.
 - 7. Sika AER, Sika Corporation
 - 8. Or Equal

1.06 Water Reducing and Retarding Admixtures

A. Water-Reducing Admixture

- 1. Water Reducing Admixtures shall conform to ASTM C-494, Type A or D.
- 2. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Monex Resources, Inc.
 - b. Chemtard, ChemMasters Corporation
 - c. PSI N, Cormix Construction Chemicals
 - d. Eucon WR-75, Euclid Chemical Company
 - e. WRDA, W.R. Grace & Company
 - f. Pozzolith Normal or Polyheed, Master Builders, Inc.
 - g. Metco W.R., Metalcrete Industries
 - h. Prokrete-N, Prokrete Industries
 - i. Plastocrete 161, Sika Corporation
 - j. Or Equal
- 3. The admixtures shall be *non-toxic* after thirty (30) days and *contain no calcium chloride*.

B. <u>High-Range Water Reducing Admixture</u>

- 1. Water Reducing Admixtures shall conform to ASTM C-494, Type F or G.
- 2. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Monex SP or Mighty RD, Monex Resources, Inc.
 - b. Super P, Anti-Hydro Company, Inc.
 - c. Eucon 37, Euclid Chemical Company
 - d. WRDA 19 or Daracem, W.R. Grace & Company
 - e. Rheobuild or Polyheed, Master Builders, Inc.
 - f. Superslump, Metalcrete Industries
 - g. Sikament 300, Sika Corporation
 - h. Or Equal
- 3. The admixtures shall be non-toxic after thirty (30) days contain no calcium chloride.

C. Manufacturers Job Site Representation

- 1. Provide services of a competent field service representative from the manufacturer of each of the admixtures selected for use to provide at the job site advice and consultation on the use of the admixture materials.
- 2. The manufacturer's representative will be responsible to recommend the maximum discharge time for the superplasticizer and to recommend the method and procedure to induce the superplasticizer into the mixer, and the effect on the concrete in place.
- 3. The manufacturer's representative will be responsible to recommend quantities of admixtures to be used if variations are required because of temperature, humidity, wind, or other environmental considerations.
- 4. The manufacturer's representative shall be available on call at any time requested by the Owner, Engineer, Contractor, or concrete producer.

1.07 Curing Materials

A. Evaporation Retarder

- 1. Waterborne, mono-molecular film forming, manufactured for application to fresh concrete.
- 2. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Spray-Film. ChemMasters
 - b. Confilm, MBT Protection and Repair, Division of ChemRex
 - c. SikaFilm, Sika Corporation, Inc.
 - d. Or equal.

B. Absorptive Cover

1. Burlap cloth made from jute or kenaf, weighing approximately 9 oz./yd³ when dry, complying with AASHTO M - 182, Class 2.

C. Moisture Retaining Cover

1. The moisture retaining cover shall comply with ASTM C-171 and shall be one of the following:

- a. Polyethylene film
- b. Polyethylene coated burlap
- c. Waterproof paper
- D. The curing agent shall be a colorless, odorless, non-toxic, non-combustible, non-flammable, free of VOC's material such as Ashford Formula as manufactured by Curecrete Distribution, Inc. or approved equal.

2.08 Repair Materials

A. Repair Underlayment

- 1. A cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8-inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
- 2. <u>Cement Binder</u>: ASTM C-150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C-219.
- 3. <u>Primer</u>: Product of the underlayment manufacturer recommended for substrate, conditions, and application.
- 4. Aggregate: Well-graded, washed gravel, 1/8-inch to ½-inch or coarse sand as recommended by the underlayment manufacturer.
- 5. Compressive Strength: Not less than 5,000 psi at 28 days when tested according to ASTM C-109/C-109M.

B. Repair Overlayment

- 1. A cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8-inch and that can be feathered at edges to match adjacent floor elevations.
- 2. <u>Cement Binder</u>: ASTM C-150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C-219

- 3. <u>Primer</u>: Product of the underlayment manufacturer recommended for substrate, conditions, and application.
- 4. <u>Aggregate</u>: Well-graded, washed gravel, 1/8-inch to ½-inch or coarse sand as recommended by the underlayment manufacturer.
- 5. Compressive Strength: Not less than 5,000 psi at 28 days when tested according to ASTM C-109/C-109M.
- C. The quantity of mixing water shall be no more than necessary for handling and placing.

2.09 Miscellaneous Materials

A. Vapor

1. Vapor barrier shall be polyethylene film, *ten (10) mils thick*, and shall conform to Product Standard PS-17 and the requirements of Section 07050, *Vapor Barrier*.

B. Non-Slip Aggregate

- 1. Aggregate for non-slip finish shall be well graded between $^{1}/_{32}$ -inch to $^{1}/_{4}$ -inch size and composed of a minimum of sixty percent (60%) aluminum oxide or silicon carbide abrasive bonded by a vitreous ceramic material.
- 2. Aggregate shall be hard, homogeneous, non-glazing, rust-proof, and shall not be affected by freezing, moisture, or cleaning compounds.

C. Floor Hardener and Sealer

 Floor hardener and sealer shall be a colorless liquid acrylic or chlorinated rubber formulated to comply with Federal Specifications TT-C-800A for Magnesium and Zinc Fluorosilicate Floor Hardeners and with Corps of Engineers Specification CE204.

E. Epoxy Resin Floor Leveler

 Epoxy resin floor leveler shall be Sikadur Lo-Mod by Sika Chemical Corp., Epoxtite 2390 by W. R. Grace and Co., Euco Epoxy 460 by Euclid Chemical Co., or approved equal.

F. Silicon Water Repellent

1. Silicon water repellent shall be a 5% Silicon Solution complying with Fed. Spec. SS-W-110 and manufactured by W. R. Grace, W. R. Meadows, Euclid Chemical Co., or approved equal.

G. Granular Fill

1. Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D-448, Size 57, with one hundred percent (100%) passing a 1½-inch (37.5 mm) sieve and 0 - 5% passing a No. 8 (2.36 mm) sieve.

H. Fine-Graded Granular Material

- 1. Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D-448, Size 10, with one hundred percent (100%) passing a 3/8-inch (9.5 mm) sieve, 10 30% passing a No. 10 (0.15mm) sieve, and at least 5% passing a No. 200 (0.075 mm) sieve; complying with deleterious substance limits of ASTM C-33 for fine aggregates.
- I. Burlap Mats shall conform to AASHTO Specification M-182.

2.10 Bonding Compounds

A. Bonding Compounds and Epoxy Adhesives are specified in Articles 2.08 and 2.09 of Section 03250, *Concrete Accessories*.

2.11 Powdered Epoxy Coating for Anchor Bolts

A. Powdered epoxy resin as manufactured by the 3M Company, Scotchkote No. 213, Armstrong No. R349, or approved equal.

2.12 Concrete Mixtures

A. General

 Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both as specified in ACI 301, ACI 211 and ACI 350. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

- 2. Concrete mix design shall comply with the Florida Building Code requirements.
- 3. Concrete not indicated otherwise shall be Class A concrete.
- 4. Conform to ASTM C-94, except as modified by these specifications.
- 5. Limit water-soluble, chloride content in hardened concrete to 0.1 percent (0.1%) by weight of cement.
- 6. Air content as determined by ASTM C-231 and shall be $4\% \pm 1\%$.
- 7. Limit the use of fly ash to not exceed twenty percent (20%) of the total cementitious content by weight. Fly ash shall be used as an admixture and will not be allowed to replace cement. Fly ash shall be used in all structural concrete.
- 8. Submit written reports to the Engineer of each proposed mix for each class of concrete at least fifteen (15) days prior to the start of the Work, in a PDF format. Do not begin concrete production until proposed mix designs have been reviewed by the Engineer.

9. Mix Design

- a. Provide concrete with compressive strengths at 28 days as presented in Table 03300 A.
- b. Measure slump in accordance with ASTM C-143. The maximum allowable slump of the concrete, without superplasticizer, shall be as presented in Table 03300 B.

Table 03300 - A Compressive Strengths for Various Class Concretes			
Class	Type of Work	28-day Compressive Strength (psi)	Minimum cement content (lb/yd³)
А	Concrete for all structures and concrete not otherwise specified. Mat foundations, footings, tanks, ditches, pumping stations, tremie concrete, precast structures, structural, water retaining structures, and other structures in contact with treated waters.	4,000	564
В	Slab on grade, masonry filled cell, grout, encasements, thrust blocks, pipe supports, concrete curbs, fills and sidewalks, etc., not in contact with treated waters.	3,000	500
С	Floor grout, miscellaneous non-reinforced concrete	2,500	376
D	Prestressed concrete	5,000	630
Е	Precast Concrete	5,000	630

Table 03300 - B Allowable Concrete Slump (without Superplasticizer)			
Description	Maximum Allowable Slump		
Slab on Grade or heavy sections wider than 3 feet	3 inches (max)		
Footings, walls, suspended slabs, beams, columns	4 inches (max)		
Pavement	2 inches (max)		
Floor Grout	4 inches (max)		

c. Slump

- 1) Proportion and produce the concrete to have a maximum slump as presented in Table 03300 B. Slump shall be measured prior to the addition of the superplasticizer.
- 2) A tolerance of up to one (1) inch above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent ten (10) batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.
- d. Variations to the maximum allowable slump are as follows:

Concrete Type	Allowable Slump
Class A and B concrete with superplasticizer	7 inches ± 1 inch
For Tremie concrete	6 inches ± 1 inch

10. Aggregate Size

- a. Aggregate size shall be ¾-inch maximum for slabs and sections eight (8) inches thick and less.
- b. Aggregate size shall be one (1) inch maximum for slabs and sections greater than eight (8) inches thick and smaller than seventeen (17) inches.
- c. Aggregate size shall be $1-\frac{1}{2}$ inches maximum for all larger slabs and sections. Aggregate size for floor grout shall be a maximum of 3/8-inch. Coarse aggregate shall be limited to prevent harshness and honeycombing.
- 11. Combined aggregate grading shall be as shown in the following table:

5	Maximum Aggregate Size			
Description	1½"	1"	3/4"	3/8"
Aggregate Grade per ASTM C-33	467	57	67	8

Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

13. Water-to-Cement Ratio

Concrete Type	Water-to-Cement Ratio
Concrete with superplasticizer	0.37
Class A concrete without superplasticizer	0.45
Class B concrete without superplasticizer	0.55
Class C concrete without superplasticizer	0.65

B. Admixtures

1. General

a. Use admixtures in accordance with the manufacturer's written instructions.

2. Air Entraining Admixture

a. Use air entraining admixtures in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete, at the point of placement, having a total air content of $4\% \pm 1\%$.

3. Water Reducing and Retarding Admixture

- a. Use water-reducing and retarding or plasticizing admixture in concrete, as required, for placement and workability.
- b. Use water reducing admixtures in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, *concrete required to be watertight*, and concrete with water-cement ratios below 0.50.
- c. The addition of the water reducing and retarding admixture shall be separate from the air entraining mixture.
- d. Admixtures shall be stored, handled and batched in accordance with the recommendations of ACI 212 and ASTM C-94.
- C. In addition to the information required by ASTM C-94, delivery tickets shall indicate the parameters identified in Article 1.03(D) of this specification section. Furnish the delivery ticket for each batch of ready-mixed concrete delivered to the site.

D. <u>Temperatures</u>

1. The temperature of the concrete upon delivery from the truck **shall not exceed 90°F**, otherwise ice, or another approved method, shall be used to reduce the temperature of the concrete as recommended by ACI.

E. Modifications to the Mix

- 1. No modifications to the mix shall be made in the plant or on the job that will decrease the cement content or increase the water/cement ratio beyond that specified.
- 2. Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by the Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Engineer before using in the Project Work.
- 3. Addition of water must be approved by the Engineer. Added water shall be incorporated by additional mixing of at least fifty (50) revolutions. All water added shall be metered and the amount of water added shall be shown on the delivery ticket. Addition of water shall be in accordance with the procedures of ASTM C-94 for slump adjustment.

2.13 Concrete Workability

- A. The concrete shall be of such consistency and composition that it can be worked readily into the forms and around the reinforcement without excessive vibrating and without permitting the materials to segregate or free water to collect on the surface.
- B. The proportions shall be adjusted to secure a plastic, cohesive mixture, and one that is within the specified slump range.
- C. To avoid unnecessary changes in consistency, obtain the aggregate from a source with uniform quality, moisture content, and grading. Handle materials to minimize variations in moisture content that would interfere with production of concrete of the established degree of uniformity and slump.

2.14 Fabricating Reinforcement

A. Fabricate steel reinforcement according to CRSI's Manual of Standard Practice" and the requirements of Section 03200, *Concrete Reinforcement*.

2.15 Ready-Mixed Concrete

- A. Ready-Mixed Concrete shall be measured, batched, mixed and delivered according to ASTM C-94/C-94M, and batch ticket information shall be furnished.
- B. When the air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1½ hours to 75 minutes.
- C. When the air temperature is above 90 F, reduce mixing and delivery time to sixty (60) minutes.

3. EXECUTION

3.01 Preparations

- A. **No concrete shall be placed until the approval of the Engineer has been received.**Approval will not be granted until the forms are thoroughly clean, and reinforcing and all other items required to be set in the concrete have been placed and thoroughly secured.
- B. The Engineer shall be notified a minimum of twenty-four (24) hours before the concrete is to be placed.

C. Subgrade Preparation

- 1. Compact the subgrade and/or bedding in accordance with Section 02220, *Excavation, Backfilling and Compaction* and the requirements of the specifications.
- 2. The subgrade free of frost. If placement is allowed at temperatures below freezing, provide temporary heat and protection as required to remove all frost.
- 3. Saturate the subgrade approximately eight (8) hours before placement and sprinkle ahead of the placement of concrete in areas where vapor barrier is not used.
- 4. Remove all standing water, ice, mud, and foreign matter before the concrete is deposited.

D. Granular Base

1. Where indicated on the Contract Drawings or Documents, install a granular base beneath the slab on grade or a structural foundation.

2. Place the granular material on a compacted subgrade and compact the granular base to the same density as the subgrade.

E. Vapor Barrier

- 1. Place under structural slabs and buildings, or where indicated on the Contract Drawings or Documents.
- 2. Lay vapor barrier sheets with twelve (12) inch edge laps and tape or seal with mastic in accordance with Section 07900, Vapor Barrier.
- 3. Stretch and weight edges and laps to maintain their positions until concrete is placed. Coordinate with placement of reinforcement specified in Section 03200, Concrete Reinforcement.

3.02 Site-Mixed Concrete

- A. Site-mixed concrete shall conform to ACI-304 as modified by these specifications.
- B. Use a batch-type mixer capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and capable of discharging the mixture without segregation.
- C. Use equipment that can accurately proportion cement, coarse and fine aggregates, admixtures, and water. Proportion cement and aggregate by weight.
- D. Discharge each entire batch before recharging. Do not allow any batch to exceed the manufacturer's rated capacity of the mixer.
- E. Mixing time shall be as follows:
 - 1. For mixer of a capacity of one (1) cubic yard or less, one and one-half minutes after batching is completed.
 - 2. For mixers of capacities larger than one (1) cubic yard, one and one-half minutes plus one-half minute for each additional one-half cubic yard capacity or fraction thereof in excess of one (1) cubic yard.
 - 3. The mixer shall revolve at a uniform rate as specified by the manufacturer for the mixing equipment.

3.03 Ready-Mixed Concrete

- A. Provide central-mixed concrete conforming to ASTM C-94/C-94M as modified by these specifications.
- B. Convey concrete from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete.
- C. Place no concrete more than ninety (90) minutes after mixing has begun for that particular batch.
- D. If it is necessary to add water to obtain the specified slump, add water per ASTM C-94, but do not exceed the water content of the reviewed design mix.
- E. Use dry-batched concrete or jobsite mix only when the haul time is excessive. Do not retemper partially hardened concrete.
- F. Keep a record showing time and place of each pour of concrete, together with transit-mix delivery tickets certifying the contents of the pour.

3.04 Conveying

A. Buckets and Hoppers

- 1. Buckets and hoppers shall be provided that have discharge gates with a clear opening equal to no less than one-third of the maximum interior horizontal area, or five (5) times the maximum aggregate size being used.
- 2. Side slopes shall be no less than sixty degrees (60/).
- 3. Controls on gates shall be provided to permit opening and closing during the discharge cycle. It is suggested that the Contractor provide one (1) standby bucket and hopper for use in case of equipment failure.

B. Runways

- 1. Provide runways as specified in Section 03100, *Concrete Formwork*.
- 2. Extreme care shall be exercised to avoid displacement of reinforcing during the placing of concrete.

C. Elephant Trunks

1. Hoppers, elephant trunks or drop chutes shall be used to *prevent the free fall of concrete for more than six (6) feet*.

D. Chutes

- 1. Chutes shall be metal or metal lined, and shall have a slope not exceeding one (1) vertical to two (2) horizontal, and not less than one (1) vertical to three (3) horizontal.
- 2. Chutes more than twenty (20) feet long and chutes not meeting the slope requirements, may be used only if they discharge into a hopper before distribution.

E. Pumping Equipment

- 1. Pumping equipment and procedures, if used, shall conform to the recommendations contained in the report of ACI Committee 304 on "Placing Concrete by Pumping Methods", ACI 304.2R.
- 2. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1½ inches.

F. Conveying Equipment Construction

1. Do not use aluminum or aluminum alloy pipe for tremies or pump lines and chutes, except for short lengths at the truck mixer.

G. Cleaning

1. Conveying equipment shall be cleaned at the and of each concrete operation.

3.05 Placing of Concrete

A. General

- 1. Before placing concrete, verify that installation of formwork, reinforcement and embedded items is complete and that all required inspections have been performed.
- 2. Placement of concrete shall conform to ACI 304, *Measuring, Mixing, Transporting and Placing Concrete*, as modified by these specifications.

- 3. Concrete shall be placed in accordance with the requirements of ACI 318 and as nearly practicable to its final position. Place concrete only during normal working hours unless the Engineer is notified at least forty-eight (48) hours in advance. Concrete shall not be placed until the Engineer has approved the formwork, reinforcement, and embedded items and debris has been removed.
- 4. Coordinate in advance of concrete placement the sequence of placement to assure that construction joints will occur only as designed. Provide the Engineer with a copy of the sequence of placement at least seven (7) calendar days prior to placement. Alternate sections of concrete walls and slabs may be cast simultaneously. Do not place adjacent sections of walls and slabs until seven (7) calendar days after placement of the first placed concrete.
- 5. Notify the Engineer of the readiness, not just intention, to place concrete in any portion of the Work. This notification shall be at least twenty-four (24) hours in advance of the placement of the concrete such that the Engineer can observe and inspect the Work at the location of the proposed concrete placing. Failure of sufficient advance notification will be cause for a delay in the placing of the concrete until the observation and inspection of the Work can be completed. Forms, steel, screeds, anchors, ties, inserts, waterstop, and other embedded items shall be in place before the Contractor's notification of readiness is given. Any delay of concrete placing due to improper Contractor notification or incomplete preparation/work will not be grounds for the addition of time to the Contract Construction period.
- 6. **The Contractor shall schedule sufficient equipment for continuous concrete placing**. Provide for backup equipment and procedures to be taken in case of an interruption in placing. Provide for backup concrete vibrators at the Project Site. Test all concrete vibrators the day before placing concrete.
- 7. Do not place concrete until all free water has been removed or has been diverted by pipes or other means and carried out of the forms, clear of the work. Do not deposit concrete underwater, and do not allow free water to rise on any concrete until the concrete has attained its initial set. Do not permit free or stormwater to flow over the surface of the concrete so as to injure the quality or surface finish.
- 8. When a vapor (moisture) barrier is installed, do not puncture the moisture barrier by stakes or any other concrete accessory.
- 9. **Do not place concrete during rainstorms**. Protect concrete placed immediately before rainstorms to prevent rainwater from coming into contact with freshly placed or uncured concrete. Keep sufficient protective covering ready at all times for this purpose.

B. Placement of Concrete

- Deposit concrete continuously in one layer or in horizontal layers of such thickness such that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness, or cold joints. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
 - a. Deposit concrete in horizontal layers of a depth not to exceed formwork design pressures (no deeper than 24 inches) and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while the preceding layer is still plastic to avoid cold joints.
 - b. **Consolidate placed concrete by mechanical vibrating equipment** supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
 - c. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least six (6) inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit the duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing the mixture constituents to segregate. A spare vibrator shall be "onsite" for emergency use at all times.
- 2. **Deposit and consolidate concrete for floors and slabs in a continuous operation**, within the limits of construction joints or expansion joints, until placement of a panel or section is complete.
 - a. Consolidate concrete during placement operations so concrete is thoroughly worked around the reinforcement and other embedded items and into corners.
 - b. Maintain reinforcement in position on chairs during concrete placement.
 - c. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - d. Slope surfaces uniformly to drains where required.
 - e. Begin initial floating using bull floats or darbies to form a uniform and opentextured surface plane (free of humps and hollows), before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

C. Hot Weather Placement of Concrete

- During hot weather, give proper attention to the ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation in accordance with the provisions of ACI 301 and ACI 305 and the provisions herein. As much as possible, concrete should be placed during cooler hours of the day.
- 2. Maintain concrete temperature below 90°F (32°C) at the time of placement be eliminate early setting of the concrete. Chilled mixing water or chopped ice may be used to control temperature, provided the water equivalent of the ice is calculated into the total amount of mixing water. Using liquid nitrogen to cool the concrete is the Contractor's option.
- 3. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedding concrete.
- 4. Fog-spray forms, steel reinforcement and subgrade just before placing the concrete. Keep the subgrade uniformly moist without standing water, soft spots or dry areas.
- 5. Use water-reducing retarding admixtures when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to the Engineer.
- 6. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

D. Cold Weather Placement of Concrete

- 1. The Contractor shall provide adequate equipment for heating concrete materials and protecting the concrete work from physical damage or reduced strength that could be caused by frost, freezing action or low temperatures and shall comply with the provisions of ACI-301 and ACI-306.
- 2. When the air temperature has fallen to or is expected to fall below 40°F, uniformly heat water (< 140°F) and aggregates before mixing to obtain a concrete mixture temperature of not less than 55°F and not more than 80°F, at the point of placement. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.
- 3. Do not use frozen materials or materials containing ice. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

- 4. Do not use salt, or other materials containing anti-freeze agents or chemical accelerators unless otherwise accepted in mix designs. Calcium chloride will not be allowed.
- 5. Maintain the air and the forms in contact with the concrete at temperatures above 40°F for the first five (5) days after placing, and above 35°F for the remainder of the curing period. The Contractor shall provide thermometers to indicate the ambient temperature and the temperature two (2) inches inside the concrete surface.
- 6. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in cold weather.

E. Supported Elements

1. At least two (2) hours shall elapse after depositing concrete in columns or walls before depositing in beams, girders, or slabs supported thereon.

F. Concrete Fill and Tank Bottom Slab

1. Concrete fill for the tank bottoms, where shown on Contract Drawings, shall be placed within the tolerances described in this Section and as per the equipment manufacturer's recommendations for the clearance required by the mechanical equipment.

G. Seals and Tremie Concrete

1. General

- a. Wherever practicable, all foundation excavations shall be dewatered and the concrete deposited in the dry. Where conditions are encountered which render it impracticable to dewater the foundation before placing concrete, a concrete foundation seal shall be placed. The foundation shall then be dewatered, and the balance of the concrete placed in the dry.
- b. When seal concrete is required to be placed, the satisfactory performance of the seal in providing a watertight excavation for placing structural concrete shall be the responsibility of the Contractor. Seal concrete placed by the Contractor, which subsequently fails to perform properly, shall be repaired as necessary to perform its required function, at the expense of the Contractor.

2. Method of Placing

- a. Concrete deposited under water shall be carefully placed in the space in which it is to remain by means of a tremie, a closed-bottom dump bucket of not less than one (1) cubic yard capacity, or other approved method, and shall not be disturbed after it is deposited.
- b. All seal concrete shall be deposited in one (1) continuous pour.
- c. No concrete shall be placed in running water.
- d. All form work designed to retain concrete under water shall be watertight, and the design of the form work and excavation sheeting shall be by a Professional Engineer, registered in the State of Florida.

3. Use of Tremie

- a. The tremie shall consist of a tube having a inside diameter of ten (10) inches, and shall be constructed in sections having tight joints. No aluminum parts which have contact with the concrete will be permitted.
- b. The discharge end shall be entirely seated at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper the tremie shall be slightly raised (but not out of the concrete at the bottom) until the batch discharges to the bottom of the hopper, after which the flow shall be stopped by lowering the tremie.
- c. The means of supporting the tremie shall be such as to permit the free movement of the discharge end over the entire top surface of the work, and shall permit it being lowered rapidly when necessary to choke off or retard the flow. The flow shall preferably be continuous and in no case shall be interrupted until the work is completed. Special care shall be exercised to maintain still water at the point of deposit.

4. Use of Bottom-dump Bucket

- a. When the concrete is placed by means of a bottom-dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the concrete already placed.
- b. The bucket shall then be raised very slowly during the discharge travel; the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture. Aluminum buckets will not be permitted.

5. Time of Beginning Pumping

a. Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than seventy-two (72) hours after placement of the concrete.

H. Consolidating Concrete

1. General

- a. Concrete, with the exception of slabs less than eight (8) inches thick, shall be consolidated by means of internal vibrators operated by competent workmen.
- b. Concrete for slabs less than eight (8) inches shall be consolidated with vibrating screeds. Slabs eight (8) inches to twelve (12) inches thick shall be compacted with internal vibrators and, optionally, with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.

2. Vibrators

a. Vibrators shall have a minimum head diameter of at least two (2) inches, a minimum centrifugal force of seven hundred (700) pounds and a minimum frequency of 8,000 vibrations per minute (vpm).

3. Vibrators for Confined Areas

a. In confined areas, the specified vibrators shall be supplemented by others having a minimum head diameter of 1½ inches, a *minimum centrifugal force* of three hundred (300) pounds and a minimum frequency of 9,000 vibrations per minute.

4. Spare Vibrator

a. One (1) spare vibrator for each-three (3) in use shall be kept on the site during all concrete placing operations. *There shall be a minimum of at least one (1) spare vibrator on-site during all concrete placing operations*.

5. Use of Vibrators

a. Vibrators shall be inserted and withdrawn at points approximately eighteen (18) inches apart. The duration of each insertion shall be from 5 - 15 seconds.

- b. Concrete shall not be transported in the forms by means of vibrators.
- c. Consolidation of concrete shall be in conformance with ACI 309.

I. Protection

- 1. Rainwater shall not be allowed to increase the mixing water, nor to damage the surface finish.
- 2. Concrete shall be protected from construction overloads. Design loads shall not be applied until the specified strength has been attained.

J. Construction Joints

- Except as otherwise indicated on the Contract Drawings, horizontal construction joints shall be provided at top of foundation members and slabs on grade and at the soffit of supported slabs and beams.
- 2. Other horizontal and vertical construction joints shall be located as indicated on the Contract Drawings. Joints will not be permitted except in the locations shown, unless recommended by the Contractor and approved by the Engineer.

K. Bonding

- 1. Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coating, foreign matter and loose particles.
- 2. Forms shall be retightened.
- The hardened concrete of joints shall be dampened, but not saturated, and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete.
- 4. The grout shall be as thick as possible on vertical surfaces and at least ½-inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.

L. Embedded Items

 In addition to steel reinforcement, pipes, inserts and other metal objects as shown, specified or ordered shall be built into, set in or attached to the concrete. All necessary precautions shall be taken to prevent these objects from being displaced,

broken or deformed. Before the concrete is placed, care shall be taken to determine that all embedded parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter.

- 2. Pressure test embedded pipes for leakage, as specified elsewhere, before the concrete is placed.
- 3. Wrap metal rainwater leaders, firelines and other such piping with at least two (2) thicknesses of thirty (30) pound roofing felt before placing the concrete.
- 4. No wood shall be embedded in the concrete.
- 5. The concrete shall be packed tightly around pipes and other metal work to prevent leakage and to secure proper adhesion. Drains shall be adequately protected from intrusion of concrete.

M. Bonding to Existing Surfaces

- 1. Clean existing concrete surfaces that are to have new concrete bonded thereto of all grease, oil, dust, dirt and loose particles and coat with an epoxy bonding agent just prior to placing of the new concrete.
- 2. Apply the bonding agent as recommended by the manufacturer and allow the agent to become "tacky" before the new concrete is placed.
- 3. Do not allow the bonding agent to overlap or be spilled on the surfaces to be exposed after the work is completed.

3.06 Concrete Finishing

A. As soon as the forms can safely be removed, all irregular projections shall be chipped off flush with the concrete surfaces. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush, with the concrete surface immediately after removal of the forms and water cured to prevent shrinkage. Honeycombing shall be cut out to expose a sound concrete surface prior to pointing. The use of mortar pointing or patching shall be confined to the repair of small defects in relatively green concrete. Where in the opinion of the Engineer substantial repairs are required, the defective concrete shall be cut out to sound concrete and repaired with gunite or the concrete shall be removed and reconstructed as directed.

B. Finishing Formed Surfaces

1. Smooth-Formed Finish

- a. Provide a smooth-formed finish on all formed concrete surfaces or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, painting, or another similar system.
- b. This is an "as-cast" concrete surface texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections completely, and leave a smooth finish.
- c. The finish shall be a Class A in accordance with ACI-347.

2. Related Unformed Surfaces

a. At the tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

C. Finishing Floors and Slabs

1. Comply with ACI-302.1R recommendations for screeding, restraightening and finishing operations for concrete surfaces. Do not wet concrete surfaces.

2. Scratch Finish

- a. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of ¼-inch (6 mm) in one direction.
- b. Apply a scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

3. Float Finish

a. Apply a float finish to monolithic slab surfaces to receive a trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

- b. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
- c. Restraighten, cut down high spots and fill low spots.
- d. Consolidate the surface with power-driven floats or by hand-floating if the area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 25 (floor flatness) and F(L) 20 (floor levelness) measured according to ASTM E-1155/E-1155M.
- e. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- f. The class of surface shall be a Class C surface in accordance with ACI 347-R.

4. Trowel Finish

- a. After applying a float finish, apply the first troweling and consolidate the concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until the surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1) Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, paint or another thin-film finish coating system.
 - 2) Finish and measure the surface so that a gap at any point between the concrete surface and an unleveled, freestanding, 10-foot (3.05 m) long straightedge resting on two (2) high spots and placed anywhere on the surface does not exceed ³/₁₆-inch (4.8 mm)

5. Trowel and Fine-Broom Finish

- a. Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either the thick-set or thin-set method. While the concrete is still plastic, slightly scarify the surface with a fine broom.
- b. Comply with the flatness and levelness tolerances for trowel finished floor surfaces.

6. Non-slip Broom Finish

a. Apply a non-slip, light broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated, before the surface sets.

b. Immediately after float finishing, yielding a smooth surface (relatively free of defects), slightly roughen the concrete surface by brooming with a fiber-bristle broom perpendicular to the main traffic route. Coordinate the required final finish with the Engineer before application.

D. Finishing Tolerance

1. All surfaces shall be uniform in texture and appearance and plane to a tolerance of 1/8-inch in ten (10) feet as determined by a ten (10) foot straightedge placed anywhere on the slab in any direction.

E. Saw Cut Joints

1. Joints that are to be saw cut shall be cut not sooner than two (2) hours after the concrete is poured and not later than eight (8) hours after the pour.

3.07 Miscellaneous Concrete Items

A. Filling In

- 1. Fill in all holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.
- 2. Mix, place, and cure concrete as specified to blend with "in-place" construction.
- 3. Provide all other miscellaneous concrete filling indicated or required to complete the Work.
- 4. All grout shall be of the "non-shrink" type.

B. Curbs

1. Provide a monolithic finish to interior curbs by stripping forms while the concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations

1. Provide machine and equipment bases and foundations as shown on the Contract Drawings.

2. **Set anchor bolts for machines and equipment at the correct elevations**, complying with diagrams or templates from the manufacturer furnishing the machines and equipment.

3. Grouting Machinery Foundations

- a. Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown on the Contract Drawings or required by the equipment manufacturer.
- b. After the machinery has been set in position and placed at the proper elevation by steel wedges, the space between the bottom of the machinery base and the original pour of concrete shall be filled with a pourable non-shrink grout.
- c. The grout and grouting procedure shall be in accordance with AAPI 686, Chapter 4, paragraphs 3.6 and 3.7, and Chapter 5.

D. Steel Pan Stairs

1. Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in safety inserts and accessories as shown on Contract Drawings. Screed, tamp, and trowel finish concrete surfaces.

E. Backfill Against Walls

- Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.
- 2. Do not backfill the walls of structures laterally restrained or supported by suspended slabs on grade until the slab is poured and the has reached the specified compressive strength.

3.08 Curing and Protection

A. General

 Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation control material. Apply according to manufacturers instructions after screeding and bull floating, but before power floating and troweling. Comply with ACI 305 and 306 for protecting and curing concrete in hot and cold weather.

- 2. **Fresh concrete shall be protected from rain** in accordance with this specification section.
- B. Start initial curing as soon as the free water has disappeared from concrete surfaces after placing and finishing. Keep continuously moist for not less than fourteen (14) days as required due to weather.
- C. Where the concrete surface is scheduled to receive a sealed concrete finish, the curing is to be accomplished using an application of the Ashford Formula in strict accordance with the manufacturer's recommendations.

D. Moisture Curing

- 1. Cure concrete according to ACI-308, "Standard Practice for Curing Concrete".
- 2. Provide moisture curing by the following methods:
 - a. Keep concrete continuously wet by covering with water for not less than fourteen (14) days with one of the following materials:
 - 1) A continuous water-fog spray.
 - 2) An absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place the absorptive cover to provide coverage of concrete surfaces and edges, with a twelve (12) inch lap over adjacent absorptive covers.
- 3. Provide moisture-retaining cover curing as follows:
 - a. Cover concrete surfaces with a moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least four (4) inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

E. Evaporation Retarder

- 1. Apply evaporation retarder to unformed concrete surfaces if hot, dry or windy conditions cause moisture loss approaching 0.2 lb/ft² x h (1.0 kg/m² x h) before and during finishing operations.
- 2. Apply according to the manufacturer's written instructions after placing, screeding and bull floating or darbying concrete, but before float finishing.

F. Formed Surfaces

- 1. Cure formed concrete surfaces, including the underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until the forms are removed.
- 2. As soon as initial set has occurred, place a soil soaker hose along the tops of all walls to keep concrete forms wet during the curing period.
- 3. If forms are removed, continue curing by methods specified above, as applicable, for the remainder of the curing period. If forms are removed before the end of the curing period, then the concrete shall be continuously moist for the remainder of the curing period by fog spraying or covering with water-saturated absorptive covers or moist burlap.

G. Unformed Surfaces

- Begin curing unformed surfaces including floors and slabs, concrete floor toppings and other flat surfaces, immediately after finishing the concrete by applying the appropriate curing method.
- H. Final cure concrete surfaces to receive finish flooring with a moisture retaining cover, unless otherwise directed.
- I. Water cure cast-in-place concrete for hydraulic walls, slabs, channels, and footings by for a minimum period of fourteen (14) days prior to applying other curing methods. Do not submerge concrete placed in the dry until it has attained sufficient strength to adequately sustain the stress involved nor subject it to flowing water across its surface until it has cured. Start the curing of concrete as soon as possible without damaging the surface and not later than two (2) hours after placing.
- J. Cure concrete surfaces in accordance with the methods specified herein for the different parts of the work. These methods are considered to be the "minimum" for curing. The conditions that exist in the field during placement and curing may require additional curing procedures and efforts to ensure proper protection and curing of the concrete. The Contractor shall be responsible for selecting and implementing the appropriate curing method commensurate with climatic conditions and the nature of the concrete structure being constructed (exposed surface, water bearing surface, submerged surface, coatings being applied to the surface, etc.) and shall take the appropriate measures for curing as described in ACI 305 and 306 for protecting and curing concrete during hot and cold weather.
- K. Where wooden forms are used, wet forms immediately before concreting and keep moist by sprinkling until removed. Keep exposed surfaces of formed concrete moist until the appropriate curing method is applied.

L. Use proper concrete placing and curing methods at all times to limit the amount of hazing and cracking of the structures during initial setting and shrinking of the concrete. Repair all shrinkage cracks.

3.09 Removal of Forms

A. Removal of forms shall be in accordance with Section 03100, *Concrete Formwork*, Article 3.08, *Removal of Forms*, of these specifications.

3.10 Concrete Surface Repairs

A. Defective Concrete

1. Repair and patch defective areas when approved by the Engineer. Remove and replace concrete that cannot be repaired and patched to the Engineer's approval.

B. Patching Mortar

1. Mix dry-pack patching mortar, consisting of one part Portland cement to two and one half (2½) parts fine aggregate passing a No. 16 (1.18 mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces

- 1. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - a. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½-inch (13 mm) in any dimension in solid concrete, but not less than one (1) inch (25 mm) in depth. Make edges of cuts perpendicular to the concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - b. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match the surrounding color. Patch a test area at inconspicuous locations to verify the mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

c. Repair defects on concealed formed surfaces that affect the concrete's durability and structural performance as determined by the Engineer. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces

- Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
 - a. Repair finished surfaces containing defects that affect the concrete's durability. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets and other objectionable conditions.
 - b. After the concrete has cured at least fourteen (14) days, correct all high areas by grinding.
 - c. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to the Engineer.
 - d. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of ¼-inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to the manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- E. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a ¾-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of the same materials and mixture as the original concrete except without the coarse aggregate. Place, compact, and finish to blend with the adjacent finished concrete. Cure in the same manner as the adjacent concrete.
- F. Repair random cracks and single holes one (1) inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply a bonding agent. Place patching mortar before the bonding agent has dried. Compact patching mortar and finish to match the adjacent concrete. Keep patched area continuously moist for at least seventy-two (72) hours.

- G. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- H. Repair materials and installation, not specified above may be used, subject to Engineer's approval.

3.11 Quality Control Testing During Construction

A. Testing

- 1. The Contractor will engage a qualified testing agency to perform field testing of the concrete and prepare test reports. These costs shall be borne by the Contractor.
- 2. Tests shall be in accordance with this Section and Section 01410, *Testing and Testing Laboratory Services*" and as specified herein.
- 3. The testing agency shall be approved by the Engineer and Owner.
- 4. Any retesting due to unacceptable work or materials shall be at the Contractor's expense.

B. Inspections

- 1. Steel reinforcement placement.
- 2. Steel reinforcement welding.
- Headed bolts and studs.
- 4. Verification of use of required design mixture.
- 5. Concrete placement, including conveying and depositing.
- 6. Curing procedures and maintenance of curing temperature.

C. Concrete Tests

- 1. Testing of composite samples of fresh concrete shall be performed according to the following requirements:
 - a. Sampling of Fresh Concrete
 - 1) Sampling of fresh concrete shall be in accordance with ASTM C-172, except as modified for slump to comply with ASTM C-94.

b. <u>Testing Frequency</u>

- 1) Standard laboratory *compressive test cylinders* will be obtained by the laboratory when concrete is discharged at the point placing (i.e., discharge end of pumping equipment), and cylinders will be made and cured.
- 2) Obtain one (1) composite sample for each day's pour of each concrete mixture exceeding five (5) yd³, but less than twenty-five (25) yd³, plus one (1) set for each additional fifty 50 yd³ or fraction thereof.
- Sampling and curing of concrete cylinders shall be in accordance with ASTM C-31

c. Air Content

 Air content of the concrete mixture will be tested on every truck in accordance one of the following methods, prior to depositing in the forms:

a) Pressure Method: Per ASTM C-231

b) Volumetric Method: Per ASTM C-173

d. Slump

- 1) Slump tests shall be in accordance with ASTM C-143.
- 2) One (1) test shall be performed on each delivery truck of ready-mix concrete at the point of discharge, *prior to depositing in the forms*.
- 3) The Contractor shall perform additional tests when the concrete consistency seems to have changed or as directed by the Engineer.

e. Concrete Temperature

- 1) The concrete temperature shall be taken in accordance with ASTM C-1064, "Standard Test Method For Temperature of Freshly Mixed Concrete".
- 2) The temperature of the concrete mixture will be tested on **every** truck and one test for each set of compressive strength specimens. The temperature shall be tested **prior to depositing the concrete in the forms**.

f. Compression Test Specimens

- 1) Tests shall be in conformance with ASTM C-31/C-31M.
- 2) Cast and laboratory cure two (2) sets of two (2) standard cylinder specimens for each composite sample.
- 3) Cast and field cure two (2) sets of two (2) standard cylinder specimens for each composite sample.

g. Compressive Strength Tests

- 1) Compressive Strength Tests shall comply with ASTM C-39/C-39M.
- 2) Test one set of two laboratory cured specimens at seven (7) days and one set of two specimens at twenty-eight (28) days.
- 3) Test one set of two field-cured specimens at seven (7) days and one set of two specimens at twenty-eight (28) days.
- 4) A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- h. When the strength of field-cured cylinders is less than eighty-five percent (85%) of companion laboratory-cured cylinders, the Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- i. The strength of each concrete mixture will be satisfactory if every average of any three (3) consecutive compressive-strength test results equal or exceed the specified compressive strength and no individual compressive-strength test result falls below the specified compressive strength by more than 500 psi (3.4 MPa).
- j. Test results shall be reported, in writing, to the Engineer, ready-mix producer, and Contractor within twenty-four (24) hours of testing. Reports of compressive-strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in the Work, design compressive strength at twenty-eight (28) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven (7) and twenty-eight (28) day tests.

k. Nondestructive Testing

 Impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer but will not be used as sole basis for approval or rejection of concrete.

I. Additional Tests

- 1) The testing agency shall make additional tests of concrete when test results indicate that specified concrete strengths and other characteristics have not been attained in the structure/work, as directed by Engineer.
- 2) The testing agency may conduct tests to determine the adequacy of concrete by cored cylinders complying with ASTM C-42/C-42M or by other methods as directed by the Engineer. These additional tests shall be at the Contractor's expense.
- m. Additional testing and inspecting shall be at the Contractor's expense and shall be performed to determine compliance of replaced or additional work with the specified requirements.
- n. The Contractor shall correct all deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents, at no additional cost to the Owner.

3.12 Field Control

- A. The Contractor shall advise the Engineer of his readiness to proceed at least twenty four (24) working hours prior to each concrete placement. The Engineer will inspect the preparations for placement of the concrete including the preparation of previously placed concrete, the reinforcing, embedded items, waterstop and the alignment and tightness of formwork. No placement shall be made without the prior approval of the Engineer.
- B. The Contractor's Superintendent shall submit a certification that indicates his preparedness to place concrete and is in accord with the Contract Drawings and Specifications.
- C. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of the test(s) on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work. The coring tests shall be incidental to the Contract.

D. The Contractor shall cooperate in obtaining cores by allowing free access to the Work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. The Contractor shall repair all core holes at no additional cost to the Owner.

3.13 Failure to Meet the Requirements

- A. Should the strengths shown by the test specimens made and testing in compliance with the previous provisions fall below the values given in Section 2.12(A)(9), the Engineer shall have the right to require changes in proportions outlined to apply on the remainder of the Work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In cases of failure to meet strength requirements the Contractor shall adjust the concrete mix to meet contract requirements.
- B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C-42 and C-39. In case of failure of the core, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. *The tests need not be made until the concrete has aged sixty (60) days*.

3.14 Miscellaneous Work

- A. All bolts, anchors, miscellaneous metals or other sleeves and steel work required to be set in the concrete forms for attachment of masonry, structural, and mechanical equipment shall be set or installed under this Section. The Contractor shall be fully responsible for the setting of such materials in the forms and shaft correct all such not installed in a proper location or manner at his own expense. The Contractor shall coordinate the activities of other trades for installation of these item.
- B. Electric, instrumentation and controls conduits shall be installed in the concrete as required by the Contract Drawings and specified elsewhere in these Specifications. Outlet boxes and fixtures shall be located in reference to the final floor, wall or ceiling finish and shall be as secured that they will not be displaced by concrete placing.

- C. Pipes or conduits, for embedment, other than those merely passing through shall not be larger in outside diameter than one-third the thickness of the slab, wall, or beam in which they are embedded, unless indicated on the Contract Drawings, nor shall they be spaced closer than three (3) diameters on center, nor so located as to unduly impair the strength of the construction. The Engineer shall approve the location of all conduits and fixtures.
- D. Concrete foundations, supports and bases for all equipment and machinery shall be built to the equipment manufacturer's requirements, as approved by the Engineer, with anchor bolts installed.

E. Sealed Finish

- 1. Where indicated, apply three (3) coats of floor hardener and sealer in accordance with manufacturer's printed directions. Use the quantity recommended by the manufacturer.
- 2. The surface shall be clean and dry before hardener and sealer is applied. Upon completion, leave concrete surfaces clean and without discoloration or traces of excess sealer.

F. Watertightness of Concrete Structures

- 1. All concrete structures which will contain liquid or are located below groundwater level shall be leak-tested in accordance with Section 03800, "Leakage Testing of Hydraulic Structures", and made watertight.
- 2. Repair all cracks and defects that allow leakage during the guarantee period at no additional cost to the Owner.

3.15 Clean-Up

- A. All concrete floor construction shall have the surfaces thoroughly scrubbed and cleaned with clear water. Cleaning shall be done immediately before application of finish flooring or coating. After cleaning, the slabs shall be protected until they are accepted for floor finishing work.
- B. Clean all surfaces affected by the Concrete Work. No extraneous concrete or discoloration shall be left on any construction.

END OF SECTION

SECTION 03400 PRECAST CONCRETE STRUCTURES

1. GENERAL

1.01 Description

A. The work under this Section includes the design, casting, delivery and erection of precast concrete structures/manholes as indicated on the Contract Drawings.

B. Related Work Specified Elsewhere

Specification Section	Title	
02075	Dewatering and Drainage	
02220	Excavation, Backfilling and Compaction	
03200	Concrete Reinforcement	
03300	Cast-in-Place Concrete	
07100	Waterproofing	
09900	Painting	
Contract Drawings and General Provisions of the Contract		

1.02 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM)		
ASTM C-33	Standard Specification for Concrete Aggregates	
ASTM C-91	Standard Specification for Masonry Cement	

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STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM) - Cont'd		
ASTM C-150	Standard Specification for Portland Cement	
ASTM C-230	Standard Specification for Grout and Mortar	
ASTM C-330	Standard Specification for Lightweight Aggregates for Structural Concrete	
ASTM C-478	Standard Specification for Precast Reinforced Concrete Manhole Sections	
ASTM C-857	Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures	
ASTM C-858	Standard Specification for Underground Precast Concrete Utility Structures	
ASTM C-890	Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures	
ASTM C-891	Standard Practice for Installation of Underground Precast Concrete Utility Structures	
ASTM C-913	Standard Specification for Precast Concrete Water and Wastewater Structures	
ASTM C-923	Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes	
ASTM C-1037	Standard Practice for Inspection of Underground Precast Concrete Utility Structures	
American Conc	rete Institute (ACI)	
ACI 318	Building Code Requirements for Reinforced Concrete	
Other Applicable Standards		
PCI MNL 116	Manual for Quality Control for Plants and Production of Precast Concrete Products	
Building Codes		
	Florida Building Code	

2. Plant Inspection

a. Notify the Engineer seven (7) calendar days before the units are cast and seven (7) calendar days before shipment is made to the Project Site to provide for an inspection of the plant, if the Engineer so directs.

1.03 Submittals

- A. Submit the following information to the Engineer for approval in accordance with Section 01300, *Shop Drawings, Submittals and Samples*. All submittals shall be in an electronic form (PDF).
- B. The Contractor shall not begin fabrication of any precast concrete structures/manholes until the shop drawing submittal for each structure is approved by the Engineer.

C. Submit satisfactory evidence shall be submitted that plant and production methods of the precasting company meet the requirements of PCI MNL 116, *Manual for Quality Control for Plants and Production of Precast Concrete Products*.

D. Design Submittal

- 1. Submit the following:
 - a. Manufacturer's catalog data and design data on each precast concrete item.
 - b. Dimensions of structures, thicknesses of walls, floors and top slabs
 - c. Indicate all reinforcing steel and wire.
 - d. Show materials of construction by ASTM reference and grade.
 - e. Manufacturer's design calculations (including shear, moment, buoyancy, camber calculations, etc.) and certification signed and sealed by a professional structural engineer registered in the state of Florida that the structure design and construction comply with the specified design load conditions and the referenced specifications.
 - 1) The design water table shall be assumed to be at the finished grade.

E. Submit tabulated drawings and schedule showing the following:

- 1. Plan and profile views of structure sections.
- 2. Plan showing locations and sizes of equipment access hatches, cover plates, grating, handrails and ladders and stairs, as appropriate to the Project.
- 3. Foundation plan, showing location and sizes of sumps, floor drains, pipe penetrations, pipe hangers and equipment anchors.
- 4. Sections or elevations showing locations and sizes of wall penetrations for pipes. Pipe penetrations shall meet the requirements of these specifications (Division 15).
- 5. Order of installation and closures.
- 6. Transportation handling and installation instructions.
- F. **Submit erection drawings and diagrams for each structure**. Submit calculations verifying the base anchor/foundation assemblies indicated in the drawings are adequate

to accommodate the project-specific structure reactions. Show column base anchor details and anchor bolt sizes. Show all wall bracing.

- G. Submit the manufacturer's product data showing successful projects within the State of Florida over the past five (5) years of similar size.
- H. Manufacturer's data sheets shall be submitted on the following:
 - 1. Joint mastic and gaskets.
 - 2. Pipe connections.
 - 3. Grout material.
 - 4. Protective coatings.
 - 5. Hatches, access frames and covers.

1.04 Delivery, Storage and Handling

- A. Use only qualified personnel, using proper equipment for transportation, handling and storage of the units.
- B. Lifting and supporting shall be done only at points indicated on the shop drawings.
- C. Before shipment, inspect precast components/units to make certain that materials and workmanship conform to the requirements of these specifications and the manufacturer's recommendations.
- D. Transport precast components to the Project site so as to prevent damage to the structures/units.
- E. Any damaged structures/units shall be shipped back to the precast manufacturer and new structures/units fabricated at no additional cost to the Owner. Any lost time due to re-fabrication shall be at the Contractor's expense.

1.05 Qualified Manufacturer's

- A. Qualified precast concrete structure manufacturers shall include, but are not limited to, the following:
 - 1. Taylor Precast
 - 2. Mack Concrete Industries
 - Oldcastle Precast, Inc.
 - 4. Or approved equal

2. PRODUCTS

2.01 Materials and Fabrication

A. Precast Concrete Structures

- 1. Precast concrete structures (manholes, wet wells, valve vaults, meter vaults, etc.) shall consist of precast reinforced concrete sections with flat top sections and base sections conforming, in general, to the details shown on the Contract Drawings. Design loads shall consist of dead load, live load, impact, soil loads and loads due to water table, as well as other loads that may be imposed under the structure. The precast concrete structures shall be designed and manufactured in accordance with ASTM C-478, C-858, C-890, C-891 and C-913. The concrete thickness for the precast structures shall be determined by the precast manufacturer based on the requirements of this specification section, the referenced standards, the depth and size of structure required as shown on the Contract Drawings, soil loads, and the location of the groundwater table as identified in Article 1.03(D)(1)(e)(1). However, in no instance shall the minimum wall thicknesses shall be less than eight (8) inches.
- 2. Provide a minimum wall thickness of eight (8) inches for manholes, pump stations and wet wells with an internal diameter up to seven (7) feet, a minimum of ten (10) inches for internal diameters of eight (8) to ten (10) feet and a minimum of twelve (12) inches for internal diameters greater than ten (10) feet.
- Hydrostatic calculations, structure base thickness design and flotation calculations shall be generated using a design high groundwater table elevation at the finished grade for each structure and assuming that structure is both void of water and any associated equipment and appurtenances.
- 4. All precast concrete structure shall be "watertight".
- 5. All precast concrete structures shall be **designed to withstand an HS-20 live load** in addition to the maximum soil and hydraulic pressure for the conditions of installation.
- 6. Top slabs for pumping station wet wells may be precast or cast-in-place with flat top slabs. Steel reinforcing shall be as required to meet the requirements of this section and the referenced standards. Concrete for top slabs shall have a compressive strength of 5,000 psi at 28 days. The thickness and reinforcement of concrete for the top slabs of wet wells and valve vaults shall be designed to withstand an HS-20 loading and shall be a minimum of twelve

(12) inches thick.

- 7. Cast the bottom slab of pumping stations monolithically with the lower wall section and extend the longitudinal reinforcement into the slab.
- 8. Forms used for precast concrete shall be of metal and sufficiently designed and braced to maintain their alignment under pressures of the concrete during placing. The base and first section of the precast structure shall be an integral cast.

9. Aggregates

- a. All aggregates, fine and coarse, other than lightweight aggregate, shall conform to ASTM C-33.
- b. Lightweight aggregates, fine and coarse, shall conform to ASTM C-330.
- c. Aggregates shall be free of deleterious substances causing reactivity with oxidized hydrogen sulfide.
- d. Both types of aggregate shall be graded in a manner so as to produce a homogenous concrete mix.
- e. All materials are to be accurately weighed at a central batching facility for mixing.

10. Concrete

- a. The concrete for precast concrete structures shall be in conformance with ASTM C-150, Type II cement for structures exposed to water and Type I for all other structures.
- b. The minimum compressive strength of concrete used for precast concrete structures shall be 5,000 psi at 28 days (Class E, per Section 03300, Cast-in-Place Concrete).
- c. The maximum allowable absorption of the concrete shall not exceed eight percent (8%) of the dry weight.
- d. Coat concrete and steel in contact with aluminum fabrications, aluminum grating, or other aluminum items with two (2) coats of a bituminous epoxy coating (12 mil minimum, each coat).
- e. The precast manufacturer may provide air entraining and water reducing concrete admixtures as specified in Section 03300, *Cast-in-Place Concrete*.

11. Reinforcement

- a. Design reinforcement with a *minimum protective cover of two (2) inches*.
- b. Reinforcing steel shall be sufficiently tied to withstand any displacement during the pouring operation.
- c. Reinforcing steel shall be ASTM A-615 Grade 60 deformed bar, ASTM A-82 wire. or ASTM A-185 welded wire fabric.

12. Castings

- a. Wall pipes, access hatches, grating, frames and other miscellaneous items required shall be cast into the precast concrete structure at the appropriate elevation as indicated on the Contract Drawings.
- b. Aluminum access hatches shall be provided for wet wells and valve vaults as indicated on the Contract Drawings. Aluminum access doors shall be as specified in these Contract Documents.
- c. Covers and frames shall be machined to provide plane, smooth surfaces for uniform seating and interchangeability. Rings and covers that provide imperfect seating will be rejected.
- d. Steps and ladders, if specified for installation on the Contract Drawings, shall be manufactured of non-corrosive materials and shall be provided and cast in place by the precast manufacturer.

13. Placing

- a. All concrete shall be handled from the mixer or transport vehicle to the place of final deposit in a continuous manner, as rapidly as practicable, and with segregation or loss of ingredients, until the approved unit is completed.
- b. The maximum elapsed time from batching to placement shall be two (2) hours.
- c. Concrete shall be placed in layers not over two (2) feet deep. Each layer shall be compacted by mechanical internal or external vibrating equipment.
- d. The duration of the vibration cycle shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation.

14. Curing

- a. For purposes of early reuse of forms, precast concrete may be steam cured after an initial set has taken place. The steam temperature shall not exceed 160°F, and the temperature shall be raised from normal ambient temperatures at a rate not to exceed 40°F per hour.
- b. The steam cured unit shall not be removed from the forms until sufficient strength is obtained for the unit to withstand any structural strain. To which it may be subjected during the form stripping operation. After the stripping of the forms, further curing by means of water spraying or a membrane curing compound may be used, and shall be of a clear or white type, conforming to ASTM C-309.

15. Joints

- a. Joints shall be tongue and groove pipe ends sealed one (1) inch butyl rubber gaskets conforming to Federal Specifications No. SS-5-00210-A and AASHTO-198 and shall be compounded of 100% solids, or by a flexible preformed bitumastic sealing materials equal to Ram-Nek as manufactured by R.K. Snyder and Co., Houston, TX.
- b. If rubber joint ring gaskets are used, interior and exterior voids in the pipe joints shall be sealed with the flexible sealing material specified above and installed in strict accordance with the manufacturer's printed instructions.
- c. If sections are sealed with a flexible preformed bitumastic sealing material, adequate material shall be applied so that "squeeze out" occurs at the interior and exterior of the joint.
- d. Rubber joint ring gaskets and flexible preformed bitumastic sealing material shall be provided by the wet well manufacturer.
- e. All precast concrete structures shall be watertight.

16. Sealing Compound and Grout

- a. Butyl rubber sealing compound shall comply with ASTM C-990.
- Plastic sealing compound shall comply with Federal Specification SS-S-00210.
- c. Mortar shall comply with ASTM C-387, Type S, or use grout complying with Section 3600, *Grout*.

17. Crushed Rock for Precast Concrete Structure Base

- a. Crushed Rock shall be used for precast concrete structure bases. The rock for concrete structure bases shall be ¾-inch.
- 18. Eccentric precast concrete cone sections shall be manufactured of precast concrete with reinforcing and joints as specified above for straight riser sections.
- 19. **Lifting holes through the structures are not permitted**. Equally spaced lifting lugs, rings or non-penetrating inserts shall be provided.
- 20. Inverts for pipelines shall be precast into the concrete structure or manhole base section by the manufacturer unless prior approval is obtained from the Engineer to construct inverts in the field. The drop from inlet to outlet shall be a minimum of one (1) inch unless approved by the Engineer. The channel height of the manhole invert shall match the crown of the exit sewer. Manhole benches shall be sloped a minimum of one (1) inch per foot from the outside periphery of the manhole to the edge of the invert channel.
- 21. Sump pumps, *where required in precast concrete structures*, shall be provided by the Contractor as part of the Project and shall be included in his Bid.

B. Pipe Connections

- 1. Pipe connections for wet wells and manholes shall be resilient, waterproof connections designed in accordance with ASTM C-923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
- 2. Resilient pipe connectors shall be either cast into the manhole wall or installed following casting in a cored section of the manhole wall. Resilient connectors shall either be a gasket type connector equal to the A-Lok pipe to manhole seal, a flexible neoprene boot with stainless steel clamps equal to the KOR-N-SEAL system as manufactured by the Dukor Corporation, or approved equal. All connectors shall be "chemically" resistant to the material entering the concrete structure.
- 3. When the pipe is installed in the resilient structure connector, *the pipe shall be capable of a 2*[minimum deflection in any direction.
- 4. Pipe connections for wall penetrations for meter and valve vaults shall be provided with wall sleeves and link seals.
- 5. All locking rings or clamps used shall be Type 304 stainless steel.

C. Standard Concrete Structure Frames and Covers

- 1. Cast iron frames and covers shall be provided for all concrete structures as indicated on the Contract Drawings.
- 2. Standard frames and covers shall be gray cast iron castings conforming to ASTM A48, Class 30B for Gray Iron Castings and shall be smooth, true to pattern, free from blow holes, sand holes, projections and other harmful defects.
- 3. Frames and covers shall be designed and manufactured for H20 (heavy truck traffic) live load.
- 4. The seating surfaces of both the frame and cover shall be machined so that the cover will not rock after it has been seated. The cover shall be provided with a precisely machined dovetail groove with a neoprene O-ring gasket to provide a self-sealing cover. The gasket shall be glued in-place at the foundry.
- 5. The structure cover shall be solid with two non-penetrating pick holes. Frames and covers shall be coated on all non-machined surfaces with three (3) coats of a protective bituminous. Manhole frames and covers shall be U.S. Foundry and Manufacturing Corp., No. 170-E.
- 6. Covers shall be embossed with Owner information to be approved by the Engineer prior to foundry casting.

7. Anchor Bolts

- a. Anchor bolts for bolting the frame to the precast concrete structure or manhole shall be ¾-inch diameter galvanized all thread steel rods with a five (5) inch hook for embedment in the precast manhole top.
- b. The bolts shall be of sufficient length to provide a minimum 2-inch thread projection through the flange of the structure or manhole frame. Two (2) anchor bolts shall be cast into the precast concrete structure or manhole top section or slab, positioned at 180°, at the time of manufacture.
- c. Frames shall be drilled to match the bolt setting prior to coating.

D. Coatings

Exterior surfaces of precast structures shall be coated with a primer coat and three

 (3) finish coats of a protective bituminous epoxy for a finished minimum dry film thickness of thirty (30) mils.

- 2. Interior surfaces of the precast structures shall be coated with a primer coat and three (3) finish coats of protective bituminous epoxy coating, using alternating colors for each coat, for a *finished minimum dry film thickness of thirty (30) mils*.
- E. Before leaving the foundry, clean all castings and subject them to a hammer inspection.
- F. Wetwell Liner NOT USED
- G. Parking Bumpers NOT USED
- H. Splash Pads NOT USED
- I. Concrete Sills and Copings NOT USED

3. EXECUTION

3.01 Inspection and Tolerances of Individual Elements

A. Fabrication

- Warped, cracked or broken precast concrete units shall not be used. Use precast components with size and dimensions within the following tolerances at the time they are placed:
 - a. Overall length of members: \pm 1/8-inch per ten (10) feet.
 - b. Cross-Sectional Thickness Dimensions
 - 1) Sections less than 3 inches: $\pm \frac{1}{16}$ inch
 - 2) 3 inches < Section \leq 18 inches: \pm 1/8- inch
 - 3) Sections > 18-inches: $\pm \frac{1}{4}$ inch
 - c. Deviations from straight-line in Long Member: ± ½-inch or less in 20 feet

B. Erection

1. The alignment of the precast concrete units shall be \pm 1/8-inch per ten (10) feet, vertical and horizontal.

C. The following imperfections shall be considered injurious and cause for rejection:

1. <u>Cracked Unit</u>: A single crack in the wall of a precast unit, extending

through the entire thickness, regardless of the length of such crack; a single crack which extends through one-fifth $\binom{1}{5}$ of the wall thickness and is over three

(3) inches long.

2. Surface Imperfections: Surface imperfections such as lumps, blisters, pits, or

flakes on the interior surface.

3. Broken Unit: A precast concrete unit section with a piece broken

from it.

D. Any damaged structures/units shall be shipped back to the precast manufacturer and new structures/units fabricated at no additional cost to the Owner. Any lost time due to re-fabrication shall be at the Contractor's expense.

3.02 Installation

- A. The Contractor shall prepare an excavation large enough to accommodate the structure and permit sealing of openings, waterproofing, and backfilling operations. The earthwork shall conform to the applicable sections of Division 2, *Earthwork*.
- B. Precast concrete structures shall be constructed in a workmanlike manner at the locations and dimensions indicated on the Contract Drawings. *Precast structures shall be set on a foundation of crushed stone, a minimum of twenty-four (24) inches thick as specified herein.* Crushed stone material shall be a well-graded crushed stone or crushed gravel meeting the requirements of ASTM C-33, Gradation No. 67 (¾-inch to No. 4 sieve). The crushed stone base material shall extend one (1) foot beyond the outside edge of the concrete structure. The precast structures shall be constructed such that the structure will not transmit dead or live loads to the piping. Care shall be taken to prevent earth and other material from entering the precast structures.
- C. Fill all interior and exterior joints between precast sections with a joint sealant, as recommended by the precast structure manufacturer.

D. Installing Precast Sections

1. Set each precast concrete unit plumb on a bed of sealant to make a watertight joint at least ½-inch thick with the concrete base or with the preceding unit. Point the inside joint and wipe off the excess sealant.

- 2. Assemble units so that the cover conforms to the elevations shown on the Contract Drawings.
- 3. Pipe connections at precast structures shall be provided at the locations shown on the Contract Drawings. *Connections shall be resilient and waterproof*.
- 4. All voids in interior and exterior manhole section joints and lift holes for manhole sections shall be filled with a non-shrinking, non-metallic grout. Grout shall be applied and cured in strict accordance with the manufacturer's recommendations. The grout shall be finished smooth and flush with the wall surface of the manhole.

E. Manhole Flow Channels and Bench Walls

- 1. Unless prior approval is obtained from the Engineer, manhole flow channels (inverts) and bench walls shall be precast into the manhole based section as specified above in Article 2.01(A)(20).
- 2. Upon prior approval from the Engineer, manhole inverts may be constructed in the field. Invert channel bottoms shall be smooth and semi-circular in shape conforming to the inside of adjacent sewer sections. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in the size and grade of the channels shall be made gradually and evenly to give a smooth uninterrupted flow pattern through the manhole. Channel height shall match the crown of the connection sewer pipe exiting the manhole.
- 3. Manhole bench walls shall be smooth and shall slope one (1) inch per foot from the edge of the invert channel to the precast manhole wall. Invert channels may be constructed by forming in concrete or by building up brick and mortar to form the manhole bench walls on each side of the channel, and plastering over bricks with cement mortar with a minimum thickness of ½-inch. Manhole invert construction shall only be performed by experienced and qualified workmen.
- 4. Bricks used to construct manhole invert channels and bench walls shall be standard size (2½" (H) x 4" (W) x 8" (L)) brick in conformance with ASTM C32, "Sewer and Manhole Brick (made from clay and shale)". Mixing shall be as follows: One (1) volume of Type II Portland Cement with three (3) volumes of sand and sufficient clean water to produce a rich mass of approved consistency. Mixing mortar on the ground or any paved surface shall not be permitted. Sand to be used in making mortar shall be clean, well-graded, and shall pass a No. 4 sieve.

F. Setting Frames and Covers

1. Unless otherwise indicated on the Contract Drawings, in unpaved areas the tops of concrete structures/manholes shall be set 0.20 feet above finished grade and the

tops of wet wells and valve vaults shall be set 0.50 feet above finished grade, unless otherwise indicated on the Contract Drawings. In paved areas, the top of the cover shall be flush with the paving surface.

- 2. The top of all precast concrete structures/manholes may be brought to the proper grade for receiving the precast concrete structure/manhole frame by using not more than three (3) courses of brick or precast concrete grade rings. Bricks and mortar used for manhole top adjustment shall be as specified above in Article 3.01(E)(4). Precast concrete grade rings shall be precast with steel reinforcement in conformance with ASTM C-478 and concrete with a compressive strength of 4,000 psi in twenty-eight (28) days. Precast concrete grade rings shall be manufactured in half annular shapes for ease of handling. The grade ring dimensions shall be two (2) inches thick with an annular width of eight (8) inches and an inside diameter of twenty-four (24) inches.
- 3. Masonry construction shall be performed by experienced and qualified workmen only. All work shall be laid plumb, straight, level, square and true. Brick shall be laid in full beds of mortar and shoved into place. All joints shall be full and not more than ½-inch in thickness. The Contractor shall set in place and bond in the masonry all necessary anchor bolts and miscellaneous items specified elsewhere. The masonry walls shall be plastered on the inside and outside with a ½-inch coat of Portland Cement mortar.
- 4. Following curing of any masonry construction required for structure top adjustment, set the frame in a bed of ¼-inch to ½-inch thick flexible bitumastic sealing material (Ram-Nek) and anchor in place with two ¾-inch diameter anchor bolts, which shall be securely embedded in the top of the manhole. Seal the flange of the structure ring to the top of the structure with cement mortar.
- G. Install piping, equipment, access frames, covers, pump guide bars, etc., in accordance with the instructions and approved shop drawings furnished by the manufacturer and as shown on the Contract Drawings.
- H. All openings for pipes and joints between concrete sections shall be sealed watertight.
- I. The interior coating system, if called for, shall be applied following installation of the precast structures and any piping or equipment that will penetrate or attach to the walls. Surface preparation and application of the coating system shall be in strict accordance with the manufacturer's recommendations.
- J. After the structure and all appurtenances are in place and approved by the Engineer and Owner, backfill shall be place to the original ground elevation or to the limits designated on the Contract Drawings. Backfill material shall consist of sand or loose earth, free from stones, clods, and other deleterious material. It shall be placed in

horizontal layers not exceeding twelve (12) inches in depth, and shall be moistened and thoroughly compacted to a minimum relative density according to the requirements of Division 2, *Earthwork*.

- K. Where an HDPE liner has been specified, the liner shall be installed per the manufacturer's recommendations. Seams shall be heat fused at the factory where practical. All field welds shall be performed by a factory trained technician and be fully warrantied for a period of five (5) years.
- L. Parking Blocks NOT USED
- M. Splash Pads NOT USED
- N. Concrete Sills and Copings NOT USED

END OF SECTION

SECTION 03600 GROUT

1. GENERAL

1.01 Description

A. Provide all labor, materials, tools, manpower, and equipment and perform all grouting as specified hereinafter and as indicated on the Contract Drawings.

B. Related Work Described Elsewhere

Specification Section	Title
03300	Cast-in-Place Concrete
03400	Precast Concrete Structures
Division	Description
Division 11	Description Equipment

1.02 Submittals

- A. The Contractor shall submit manufacturers' literature for review on the following items in accordance with Section 01300, *Shop Drawings, Submittals and Samples*:
 - 1. Non-shrink grout data and shall include grout properties, mixing, surface preparation, and installation instructions.
 - 2. Portland Cement Grout
 - 3. Mix design for all other types of grout.

All submittals shall be in an electronic format (PDF).

1.03 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM)		
ASTM C-33	Standard Specification for Concrete Aggregates	
ASTM C-109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars	
ASTM C-150	Standard Specification for Portland Cement	
ASTM C-191	Standard Test Method for Time of Setting of Hydraulic Cement	
ASTM C-1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)	
U.S. Army Corps of Engineers (COE)		
CRD-C-588	Standard Specification for Grout	
CRD-C-621	Standard Specification for Grout	
Building Codes		
	Florida Building Code	

1.04 Product Delivery, Storage and Handling

- A. Grouting materials shall be delivered and stored in unbroken containers with seals and labels intact as packaged by the manufacturer.
- B. Prevent damage to or contamination of the grouting materials.

1. PRODUCTS

1.01 Materials

A. Portland Cement Grout

1. To be used for grouting CMU cells and similar items.

a. Grout Characteristics

1) Portland Cement: ASTM C-150, Type I

2) Sand: ASTM C-33, Fine Aggregate

3) Water: Potable

4) Pea Gravel: ASTM C-33; coarse aggregate, graded so that at least 90%

passes a 3/8-inch sieve and 90% is retained by a No. 4

sieve.

2. Grout Mortar for use as fillets and leveling.

a. Grout Characteristics

1) Portland Cement: ASTM C-150, Type I

2) Sand: ASTM C-33, Mason's Sand

3) Water: Potable

4) Mix: One (1) part Portland cement to three (3) parts sand.

B. Non-Shrink Grout

- 1. Non-shrink grout shall conform to the Corps of Engineers Specification for Non-shrink Grout, CRD-C-588, CRD-C-621, ASTM C-1107 and to these specifications.
- 2. Use only a nongas-lubricating type, cement base, pre-mixed product requiring only the addition of water for the required consistency. Components shall be "inorganic".
- 3. Non-shrink grout for setting bearing plates for structural steel, machinery and other equipment shall be mixed as recommended by the manufacturer to give the necessary consistency for placing and to give a minimum compressive strength of 3,000 psi in three (3) days, and 6,800 psi in twenty-eight (28) days.
- 4. Subject to compliance with requirements, non-shrink grout shall be:
 - a. Master Flow 713, Master Builders, Co.
 - b. Euco N-S, Euclid Chemical Co.
 - c. Five Star Grout, Five Star Products, Inc.

d. Or equal.

C. Non-shrink, Metallic Grout

1. Master Builders Embeco 636 Grout, pre-mixed type, or equal.

D. Expansive Grout

1. Premixed, cementitious mixture with a minimum 28-day strength of 3,500 psi. Provide air entraining content as recommended by the manufacturer.

E. Epoxy Grout

1. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions. Use sand that is oven dry and meets the following gradation requirements for epoxy grout:

Sieve Size	No. 8	No. 50	No. 100
% Passing	100	30 ± 15	5 ± 5

2. Sikadur 42 Grout-Pak, or equal, for grouting sleeves for anchor bolts, etc.

3. EXECUTION

3.01 Procedures

A. Installation methods and procedures shall be approved by the Engineer and shall be in accordance with the manufacturer's printed specifications before work is begun.

3.02 Preparation

- A. Surface preparation shall be in accordance with the manufacturer's written instructions.
- B. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from the concrete surfaces to be grouted by bush-hammering, chipping, or other similar means, until a sound, clean concrete surface is achieved.
- C. Lightly roughen the concrete, but not enough to interfere with the proper placement of the grout. Cover concrete areas with a waterproof membrane until ready to grout. Immediately before grouting, remove the waterproof membranes and clean any contaminated surfaces.

- D. **Remove all foreign materials from metal surfaces in contact with grout**. Align, level and maintain final positioning of components to be grouted.
- E. **Saturate concrete surfaces with clean water**; remove excess water and leave none standing.

3.03 Placing of Grout

A. Non-shrink Grout

- 1. Non-shrink, non-metallic grout shall be used for grouting column base plates, concrete wall panel connections, anchor bolts, reinforcing bars, pipe sleeves, machinery supports and pump base plates. Use epoxy grout for anchor bolts, etc., where indicated on the Contract Drawings.
- 2. Non-shrink grout shall be mixed and placed as recommended by the manufacturer. After the grout has been mixed, do not add any more water for any reason.
- 3. Grout shall be mixed as close to the work area as possible and transported quickly to its final position in a manner that will not permit segregation of materials.
- 4. Place grout in accordance with the manufacturer's written instructions.
- 5. *Place non-shrink grout quickly and continually by the most practical means* permissible; pouring, pumping or under gravity pressure.
- 6. **Apply grout from one side to avoid entrapping air**. The final grouting installation shall be thoroughly compacted and free from air pockets.
- 7. Do not vibrate the placed grout mixture or allow it to be placed if the area is being vibrated by nearby equipment.
- 8. Do not remove leveling shims for at least twenty (20) days after the grout has been placed. After shims have been removed, fill all voids with Portland cement grout.
- 9. After non-shrink grout has reached initial set, rake out exposed edges approximately one (1) inch into the grouted area and paint with Portland cement mortar.

3.04 Grouting Machinery Foundations

A. Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown on the Contract Drawings.

- B. After the machinery has been set in position and wedged to the proper elevation by steel wedges, the space between the bottom of the machinery base and the original pour of concrete shall be filled with a pourable non-shrink grout.
- C. Grout and grouting procedures shall be in accordance with API 610, Seventh Edition, Appendix L.

3.05 Curing

- A. Non-shrink grout shall be cured with water saturated burlap for at least three (3) days or with Super Rez Seal cure and seal compound, or equal, applied immediately after grout placement.
- B. Machinery set on grout pads shall not be operated until the grout has cured for at least thirty-six (36) hours.

END OF SECTION

SECTION 03800

LEAKAGE TESTING OF HYDRAULIC STRUCTURES

1. GENERAL

1.01 Description

A. Description of Work

1. Hydrostatically test all concrete hydraulic structures, dichlorination chamber, that are intended to contain liquid to determine that they are watertight and free of detectable leaks as described herein.

2. PRODUCTS

2.01 General

A. <u>Water</u>: Reclaimed Water (tertiary effluent after filtration and disinfection).

B. <u>Piping</u>: As required to fill and empty structures.

C. <u>Equipment</u>: As required to fill and empty structures.

3. EXECUTION

3.01 Inspection and Testing

- A. **Prior to testing, clean all exposed surfaces** by thoroughly hosing and removing all surface laitance and loose matter from the walls, slabs and/or structures.
- B. **Remove wash water and debris from the structures** by means other than washing through the plant piping.

- C. Conduct testing before backfill is placed against walls and after all concrete has attained the specified compressive strength, the concrete has cured, and the joint sealants have set and cured a minimum of fourteen (14) days. The Contractor shall use the form presented in Section 00965, Concrete Tank Hydraulic Test Form.
- D. Fill the hydraulic structure(s) to be subjected to leakage tests with water to the normal liquid level line. Filling shall not exceed three (3) feet of water depth per day, unless otherwise approved by the Engineer. Filling shall be at a uniform rate over a twenty-four (24) hour period with continuous monitoring. For structures with adjacent bays, fill all bays simultaneously. Empty adjacent bays alternately. Repair any running leaks that appear during filling before continuing.
- E. As required by the Project Engineer, seed the floor slab of each hydraulic structure with one bag of cement per 1,000 square feet of surface area. Seeding shall take place after the test filling has reach eighteen (18) inches in depth. Detect leaks in construction and expansion joints with the aid of a diver, as required by the Engineer. Stir cementitious deposits on the floor. Observe cement deposits flowing toward leaks and repair where the defect is located.
- F. After the structure has been kept full for forty-eight (48) hours, it will be assumed, for the purposes of the test, that the absorption of moisture by the concrete in the structure is complete. Then, close all valves and gates to the structure and measure the change in water surface elevation each day for a five (5) day period.
- G. During the test period, examine all exposed portions of the structure, and *mark all visible leaks or damp spots*. Repair such leaks or damp spots after dewatering. If the drop in the water surface in a twenty-four (24) hour period exceeds 0.03 percent (0.03%) of the normal volume of liquid contained in the structure, the leakage will be considered excessive.
- H. Evaporation and precipitation rates shall be independently measured, by an Engineer-approved consultant, as part of the leakage test. Subtract the water loss due to evaporation and add the water gain due to precipitation from the measured water elevation in the structure to determine the water loss due to leakage.
- I. If the leakage is excessive, drain the structure, repair leaks and damp spots, refill the structure and again test for leakage. Continue this process until the drop in water surface elevation in a twenty-four (24) hour period, with the structure full, is less than 0.03 percent (0.03%) of the normal volume of liquid in the structure.
- J. Repair any running or flowing leaks, whether leakage exceeds the allowable leakage rate or not.
- K. Repairs and additional filling and testing (including the cost of the water) shall be made by the Contractor at no additional cost to the Owner.

L. Apply specified coatings only after acceptance of leakage testing by the Engineer and in accordance with the coating manufacturer's specific instructions.

3.02 Repair Methods

A. Repair concrete not passing the leakage test in conformance with the applicable provisions of Division 3, *Concrete*, and to the satisfaction of the Engineer and Owner.

END OF SECTION



SECTION 05025

METAL MATERIALS, METHODS AND FASTENING

1. GENERAL

1.01 Description

- A. This Section includes the basic materials and methods required for the work of Division 5, *Metals*.
- B. Related work specified elsewhere includes:

Specification Section	Title	
03300	Cast-in-Place Concrete	
05140	Structural Aluminum	
05500	Metal Fabrications	
05510	Metal Stairs and Walkways	
05520	Handrails and Accessories	
05530	Grating, Plates and Frames	
05570	Miscellaneous Metal Assemblies	
09900	Painting	
Contract Drawings and General Provisions of the Contract		

1.02 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

Standard	Description		
American Institute of Steel Construction (AISC)			
	Code of Standard Practice for Steel Buildings and Bridges		
	Specification for the Design, Fabrication and Erection of Structural Steel for Buildings		
Steel Structures Painting Council (SSPC)			
	Surface Preparation Specifications		
American Society for Testing and Materials (ASTM)			
ASTM A-36	Standard Specification for Structural Steel		
ASTM A-53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless		
ASTM A-123	Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products		
ASTM A-307	Standard Specification for Carbon Steel Externally Threaded Standard Fastener		
ASTM A-325	Standard Specification for High Strength Bolts for Structural Steel Joints		
ASTM A-500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes		
ASTM A-501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing		
American Welding Society (AWS)			
AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding		
AWS D1.1	Structural Welding Code - Steel		
Building Codes			
	Florida Building Code		
	Local Building Code		

1.03 Submittals

- A. Submit shop drawings in accordance with the General Conditions, Supplementary Conditions, and Section 01300, *Shop Drawings, Submittals and Samples*. All submittals shall be in an electronic format (PDF).
- B. Submit manufacturer's catalog data for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.

C. Submit shop drawings detailing fabrication and erection of each metal fabrication item indicated. The shop drawings should include plans, elevations, sections, and details of metal fabrications and their connections. Show all anchorage and accessory items. Provide templates for all anchors and bolts specified for installation under other sections.

1.04 Delivery, Storage and Handling

- A. Deliver all hardware (anchors, bolts, nuts, washers, eyebolts, etc.) to the Project Site in sufficient time to permit their timely installation. Provide proper setting drawings, templates, and directions for their installation. Store all hardware in the manufacturer's original, unopened, waterproof containers, properly labeled with the type of hardware, ASTM designation, and the location that the hardware is to be installed.
- B. Store all structural metal members above the ground on platforms, skids or other supports. Keep the material free from dirt, grease, and other foreign matter and protect from corrosion.
- C. Cover all metalwork in protective polyethylene wrap to avoid exposure to the elements until the material is to be installed.

1. PRODUCTS

1.01 Metal Surfaces - General

- A. For metal fabrications exposed to view in the completed work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. The Contractor, prior to the punchlist walkthrough, shall clean all metal surfaces and remove all dust, dirt, grease, foreign matter, construction markings, etc.

1.02 Steel

- A. Steel plates, shapes and bars shall comply with ASTM A-36 / A-36M, unless otherwise specified.
- B. Rolled Steel Floor Plates, if used, shall comply with ASTM A-786 / A-786M.

C. Steel tubing

1. <u>Cold-Formed Steel Tubing</u>: ASTM A-500, Grade B

Hot-Formed Steel Tubing: ASTM A-501.

a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A-53

D. Steel pipe

- 1. Steel pipe shall comply with ASTM A-53, standard weight (Schedule 40), unless otherwise indicated, or another weight required by structural loads.
 - a. Black finish, unless otherwise indicated.
 - b. Galvanized finish for exterior installations and where indicated.
- E. Gray-Iron Casting shall comply with ASTM A-48, Class 30, unless otherwise indicated on the Contract Drawings.
- F. Malleable-Iron Casings shall comply with ASTM A-47, Grade 3510 (ASTM A47M, Grade 22010).
- G. Cast-in-Place Anchors shall be of corrosion resistant material capable of sustaining, without failure, the load imposed within a safety factor of 4.0, as determined by testing per ASTM E-488, conducted by a qualified independent testing agency.
- H. Welding Rods and Bare Electrodes shall be selected according to AWS Specifications for the metal alloy to be welded.
- I. Structural Steel Sheet shall be hot-rolled, ASTM A-570, or cold-rolled ASTM A611, Class 1; of the grade required for the design loading.
- J. Galvanized Structural Steel Sheet shall comply with ASTM A-446, and be of the grade required for the design loading. Coating designation as indicated, or if not indicated, G-90.
- K. Brackets, Flanges, and Anchors shall be cast or formed metal of the same type material and finish as the supported rails, unless otherwise indicated.
- L. Concrete Inserts shall be of the threaded or wedge type, galvanized ferrous castings, either ASTM A-47 (ASTM A-47M) malleable iron or ASTM A-27 (A-27M) cast steel. Provide bolts, washers, and shims as required, hot-dip galvanized, ASTM A-153.

M. Galvanized sheet metal shall be commercial quality with 0.20 percent copper, ASTM A-525; G-90 hot-dip galvanized, mill phosphatized where indicated for painting; 24 gauge thickness except as otherwise indicated.

1.03 Stainless Steel

A. Stainless steel shall comply with ASTM A-167, Type 304 or 316, as specified herein and in the Contract Documents.

1.04 Aluminum

- A. Aluminum for structural and rolled shapes shall be Aluminum Association alloy 6061-T6.
- B. Aluminum for extruded shapes shall be Aluminum Association alloy 6063-T6.
- C. Aluminum for pipe shall be Aluminum Association alloy 6063-T6.
- D. Aluminum for castings shall be Aluminum Association alloy F-514, or approved equal.

1.05 Fasteners

A. **Provide plated stainless steel fasteners** complying with ASTM B-633, Class Fe/Zn 25 for electro-deposited zinc coating, **for exterior use or where built into exterior walls**. Select fasteners for the type, grade, and class required.

B. Bolts and Nuts

1. Regular hexagon-head stainless steel bolts, ASTM A-307, Grade A (ASTM F-568, Property Class 4.6), with hex nuts, ASTM A-563 (ASTM A-563M), and, where indicated, stainless steel flat washers.

C. Stainless Steel Bolts

- 1. Stainless steel bolts shall be ASTM A-193, Grade B8M or ASTM F 593, Type 316, unless specified otherwise
- 2. Nuts shall be ASTM A 194, Grade 8M or ASTM F 594, Type 316. Use ASTM A 194 nuts with ASTM A 193 bolts; use ASTM F 594 nuts with ASTM F 593 bolts.
- 3. Provide washer for each nut and bolt head. Washers shall be of the same material as the nuts.

D. Machine Screws

1. Machine screws shall comply with ANSI B18.6.3.

E. Lag Bolts

1. Lag bolts shall comply with ANSI B18.2.1 (ANSI B18.2.3.8M).

F. Wood Screws

1. Wood screws shall be of the flat head type, Type 316 stainless steel, and shall comply with ANSI B18.6.1

G. Plain washers

- 1. Plain washers shall be round, Type 316 stainless steel, and shall comply with ANSI B18.22.1.
- 2. Washers for American Standard beams and channels shall be square or rectangular, tapered in thickness, smooth, hot-dipped galvanized, and conforming to ASTM F 436.

H. Lock Washers

1. Lock washers shall be of the helical, spring type, Type 316 stainless steel, and shall comply with ANSI B18.21.1.

I. Expansion Anchors

- Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6.0 times (6X) the load imposed when installed in unit masonry and equal to 4.0 times (4X) the load imposed when installed in concrete as determined by testing per ASTM E-488 conducted by a qualified independent testing agency.
 - a. Stainless steel components, zinc plated to comply with ASTM B-633, Class Fe/Zn 5.
 - b. Group 1 Alloy, Type 316 stainless steel bolts and nuts complying with ASTM F-593 (ASTM F-738M) and ASTM F-594 (ASTM F-836M).

J. Toggle Bolts

1. Toggle bolts shall be FS FF-B-588, tumble-wing type, Class and Style as required.

K. Beveled Washers

1. Washers for American Standard beams and channels shall be square or rectangular, tapered in thickness, smooth, and Type 316 stainless steel.

L. <u>Drilled Anchors</u>

- 1. Unless otherwise indicated on the Drawings, drilled anchors shall be Type 316 stainless steel wedge anchors as manufactured by Hilti, or approved equal.
- 2. Anchors shall have ICBO-approved testing.

M. Anchor Bolts

- 1. Anchor bolts and connection bolts for aluminum shall be Type 316 stainless steel.
- 2. Steel anchor bolts shall conform to ASTM F1554, Grade 36, galvanized.

N. Epoxy Anchors

- 1. Epoxy anchors shall be Type 316 stainless steel threaded rod adhesive anchors, unless specified otherwise.
- 2. Epoxy adhesive shall comply with ASTM C 881, Type IV, Grade 3, Class B or C.
- 3. Adhesive shall be Rawl Power-Fast, Hilti HSE 2421, Simpson Epoxy-tie with SET epoxy, Hilti HY-200, or equal.
- 4. Epoxy anchor assemblies shall be ICBO approved.

O. Embedded Eyebolts

1. Eyebolts shall be of the welded-eye or forged type, Type 316 stainless steel.

P. Threaded Carbon Steel Lifting Eyes

Threaded carbon steel lifting eyes shall comply with ASTM A-489, Type 1, Style B.

Q. Threaded Alloy Steely Eyebolts

1. Threaded alloy steel eyebolts shall comply with ASTM F-541 and ASME/ANSI B18.5, Type 1, long length.

1.06 Welding Electrodes

A. Filler metal for welding shall comply with AWS D1.1, Structural Welding Code.

1.07 **Grout**

A. Grout for bedding and grouting structural steel shall be non-shrink grout as specified in Section 03600, *Grout*.

1.08 Fabrication

A. General

- 1. Fabricate all metal parts to comply with the design indicated on the Contract Drawings. Make field measurements and prepare templates as required to ensure proper fit. Assemblies shall be fitted together in the shop and delivered to the site complete and ready for installation.
- 2. Form metal shapes with sharp lines and angles, and finish with smooth surfaces. Shearings and punchings shall be clean and true. In general, holes for bolts shall be drilled or reamed ¹/₁₆-inch larger than the diameter of the bolt. Holes for anchor bolts shall be 1A times the anchor bolt diameter.
- 3. Metal thicknesses, assembly details, and supports shall provide ample strength and stiffness. Joints shall be designed to prevent trapping of moisture.

B. Shop Coatings

- 1. Prepare and shop prime ferrous metal in compliance with Section 09900, *Painting*. Do not shop prime stainless steel, aluminum, galvanized or plated metals, bronze, or machined bearing surfaces.
- 2. Anchors, sleeves, and metal parts built into masonry or concrete shall be stainless steel

- 3. Castings for exterior exposure shall be cleaned and coated per Section 09900, *Painting*.
- 4. Hot-dip galvanizing for products fabricated from steel shapes, plates, bars, and strips shall comply with ASTM A-123. Hot-dip galvanizing for assembled steel products shall comply with ASTM A-386. Except for bolts and nuts for field assembly, galvanize all subassemblies immediately after fabrication. Hardware shall be galvanized in compliance with ASTM A-153.
- 5. Aluminum in direct contact with dissimilar metals, concrete, or masonry shall be covered with a neoprene gasket, non-absorptive insulating tape, or coated with a heavy-bodied bituminous paint. The method used must be approved by the Engineer prior to placement or application.

C. Fasteners and Connections

- 1. Provide fastening devices as required, as specified herein, and in compliance with the Drawings and shop drawings. Provide welded shop connections or concealed fastenings wherever practicable.
- 2. Power-driven fasteners shall be of the types and sizes recommended by the manufacturer for the particular application. Power-driven fasteners that will be exposed to view shall be set through a steel finishing disc. When set in concrete or masonry, the minimum penetration of power-driven fasteners shall be six (6) times the diameter of the shank.
- 3. **Structural joints made using high strength bolts, hardened washers, and nuts** tightened to a high bolt tension shall comply with the "Specification for Structural Joints Using ASTM A-325 or A-490 Bolts", issued by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
- 4. Welded joints shall comply with AWS D1.1, Structural Welding Code, and AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings". All welds shall be made by operators who have been previously qualified as prescribed by AWS B3.0, Welding Procedure and Performance Qualification. All welds exposed to view shall be dressed smooth.
- 5. Anchor holes in concrete or masonry for grouted bolts shall be a minimum of 1½ times the bolt shank diameter. Anchor holes in concrete and masonry for expansion type anchor bolts shall comply with the bolt manufacturer's recommendations.
- 6. Lock washers and nylock washers shall be provided to prevent nut loosening.

1.09 Templates, Leveling Plates, and Appurtenances

A. Provide all templates, leveling plates, and appurtenances required for the installation of metal work.

3. EXECUTION

3.01 Delivery, Storage and Handling of Materials

A. Delivery, storage and handling of all materials shall be in accordance with Article 1.04 of this Specification Section.

3.02 Galvanizing

A. Other than A325 bolts, zinc coating for bolts, anchor bolts, and threaded parts shall be in accordance with ASTM A 153.

3.03 Installing Connection Bolts

- A. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.
- B. Install washers per AISC Specification for ASD.
- C. Bolt holes in structural members shall be \$^1/_{16}\$-inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.
- D. Slotted holes, if required in the Contract Documents, shall conform to AISC Specifications, Chapter J, Section J3, Table J3.1.
- E. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts or washers shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.

F. Bolts shall be of the length that will extend entirely through but not more than ¼-inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened.

3.04 Installing Anchor Bolts

- A. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, and blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.
- B. For static items (storage tanks and heat exchangers), use preset anchor bolts or drilled anchors with ICBO report data.
- C. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.
- D. The *minimum* depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown on the Contract Drawings.
- E. The *minimum* depth of embedment of epoxy anchors shall be as recommended by the manufacturer, but no less than that shown on the Contract Drawings.
- F. Prepare holes for drilled and epoxy anchors in accordance with the anchor manufacturer's recommendations prior to installation.

3.05 Erection

- A. Before starting work, verify locations and elevations of bearings and anchor bolts. Immediately report inaccuracies.
- B. Work under this Section includes responsibility for accurate bearing of steel and correct location of anchorage.
- C. Erection shall be in accordance with the requirements of the specified standards.
- D. Weld field connections or bolt as indicated.

E. Bolting

1. As erection progresses, bolt up work to take care of all dead loads, construction live loads, lateral forces and erection stresses.

- 2. Unless otherwise noted, erection bolts used in welded construction may be either tightened securely and left in place or removed and the holes filled with plug welds.
- 3. Drift pins may be used for assembling parts provided the metal is not distorted or holes enlarged. Ream holes requiring enlargement to admit bolts. Misaligned holes will subject members to rejection.
- 4. Make all metal to metal connections by high strength bolting except where field welding is specifically shown. Provide not less than two ¾-inch bolts per connection and use not less than ¼-inch thick clip angles (Type 316 stainless steel).
- 5. Tighten bolted connections designated as beating-type connections to the snug tight condition. Where specified, tighten other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening.
- 6. Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in its proper location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.
- 7. 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.

F. Welding

- 1. Field welding shall be done only where shown or specified and only be certified welders qualified for the procedures used. No welding shall be done when surfaces are wet, exposed to rain or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.
- 2. Each certified welder shall be assigned an identification mark. This mark shall be made at each completed connection with a paint stick.

G. Temporary Bracing

- 1. Introduce, wherever necessary, temporary bracing to provide for all loads to which the structure is subjected including erection equipment and its operation.
- 2. Leave the temporary bracing in place until it is no longer required for safety.
- 3. Make proper provisions for construction loads, piles of materials, equipment, etc., carried by the structural frame during erection.

- H. After erection, clean all fixed connections (bolts and welds) and the structural members and repair as necessary.
- I. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, air compressors, etc.), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.
- J. For static items (storage tanks and heat exchangers), use preset anchor bolts or drilled anchors.
- K. After the anchor bolts have been embedded, protect their threads by applying grease and by having the nuts screwed on until the time of installation of the equipment or metalwork.

3.06 Inspection

- A. The Engineer shall have free access to the Work. The Contractor shall notify the Engineer in writing four (4) days in advance of any welding or high strength bolting operations.
- B. High-strength bolting may be visually inspected. All high-strength bolts shall have the turned portion marked with reference to the metal being connected after the nut has been made snug and prior to final tightening. These marks shall be considered in the inspection. Rejected bolts shall be either replaced or retightened as required. In cases of disputed bolt installations, the bolts in question shall be checked by a calibrated wrench certified by an independent testing laboratory selected by the Engineer.
- C. Field welding will be inspected visually by AWS certified welding inspectors provided by the Contractor. Magnetic particle testing or ultrasonic testing may be used in the inspection, if deemed necessary, by the welding inspector. A welding certification report shall be submitted to the Engineer based on the results of the welding inspection. The Contractor shall comply with all requests of inspector to correct deficiencies.
- D. All costs for testing and inspection required as a result of defection work, repairs, or retests shall be paid for by the Contractor and are incidental to the Contract.
- E. Any material or workmanship which is rejected by the Engineer, either at the shop, mill or building must be promptly replaced by the Contractor to the Engineer's entire satisfaction, at no additional cost to the Owner.
- F. The fact that metal work has been accepted at the shop and mill shall not prevent its final rejection at the site, or even after it has been erected, if it is found to be defective in any way.

G. Any metal work rejected at the site shall be removed by the Contractor from the premises within ten (10) working days from the time the Contractor is notified of the rejection.

3.07 Field Quality Control

A. Erection Tolerances

1. Erect individual pieces so that the deviation from plumb, level and alignment shall not exceed 1:500.

END OF SECTION

SECTION 05120 STRUCTURAL STEEL

1. GENERAL

1.01 Description

- A. The work in this Section includes providing all labor, materials, equipment and incidentals necessary for fabrication and erection of structural steel, including framing members, support members, base plates, bearing plates, beams, columns and miscellaneous shapes and plates, bracing, welding, bolting, shimming and grouting required as shown on the Contract Drawings and specified herein.
- B. Furnish anchor bolts with templates to be installed under Division 3, *Concrete*. Furnish and install nuts and washers for anchor bolts.
- C. Install portions of masonry ties to be welded to structural steel as shown on the Contract Drawings and as specified herein.
- D. Structural Steel is defined as elements of structural steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges", that support design loads.

E. Related Work Specified Elsewhere

Specification Section	Title
01410	Testing and Laboratory Services
03300	Cast-in-Place Concrete
03600	Grout
04050	Masonry
05025	Metal Materials, Methods, and Fastening
05500	Metal Fabrications
05570	Miscellaneous Metal Assemblies
09900	Painting

Contract Drawings and General Provisions of the Contract

1.02 Quality Assurance

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

Standard	Description	
American Institu	te of Steel Construction (AISC)	
	Code of Standard Practice for Steel Buildings and Bridges and Commentary	
	Load and Resistance Factor Design Specification for Structural Steel Bldg's	
	Specification for the Design of Steel Hollow Structural Sections	
	Specification for Load and Resistance Factor Design of Single-Angle Members	
	Specification for the Design, Fabrication and Erection of Structural Steel for Buildings and including the "Commentary" and "Supplements" thereto	
Steel Structures	Steel Structures Painting Council (SSPC)	
	Surface Preparation Specifications	
American Societ	American Society for Testing and Materials (ASTM)	
ASTM A-6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling	
ASTM A-36	Standard Specification for Structural Steel	
ASTM A-53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	
ASTM A-108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished	
ASTM A-123	Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products	
ASTM A-153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware	
ASTM A-307	Standard Specification for Carbon Steel Externally Threaded Standard Fastener	
ASTM A-325	Standard Specification for High Strength Bolts for Structural Steel Joints	
ASTM A-436	Standard Specification for Austenitic Gray Iron Castings	
ASTM A-490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength	
ASTM A-500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes	
ASTM A-501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing	
ASTM A-563	Standard Specification for Carbon and Alloy Steel Nuts	

Standard	Description	
American Society for Testing and Materials (ASTM) - Cont'd		
ASTM A-568	Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for	
ASTM A-572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel	
ASTM A-847	Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance	
ASTM C-1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)	
American Welding Society (AWS)		
AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding	
AWS D1.1	Structural Welding Code - Steel	
Other Standards and Building Codes		
	RCSC's "Spec. for Structural Joints using ASTM A-325 or A-490 Bolts"	
	Florida Building Code	

B. Any material or operation specified by reference to the published specification of a manufacturer shall comply with the requirements of the standards listed herein. In case of a conflict between the referenced specification and the Contract Documents, the Contract Documents shall govern

C. AISC Code of Standard Practice

- 1. Make the following modifications:
 - a. Delete Paragraph 3.3. and substitute the following: "All things which, in the opinion of the Contractor, appear to be deficiencies, omissions, contradictions or ambiguities in the Contract Documents shall be brought to the attention of the Engineer. The Contract Documents will be corrected or a written interpretation of the alleged deficiency, omission, contradiction or ambiguity will be made by the Engineer *before* the effected work proceeds."

b. Qualifications for Welding Work

1) Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure".

 Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous twelve (12) months. If re-certification of welders is required, re-testing shall be the Contractor's responsibility.

c. Quality Control

 The Contractor is responsible for all quality control. The Contractor shall be responsible to correct structural steel which does not conform to the specified requirements.

d. Quality Control Monitoring

1) The Contractor will monitor quality control by means of employing an testing agency to provide inspection, testing and reports as specified below:

a) High Strength Bolted Connections

- (i) Inspect and test in accordance with AISC "Specification for Structural Joints".
- (ii) The Contractor is solely responsible to perform the work in accordance with the Contract Documents and all referenced standards and requirements. The Contractor shall promptly remove and replace materials or fabricated components which do not comply with requirements of the Contract Documents.

b) Design of Connections

- (i) The Contractor is responsible for the design and adequacy of all connections that are not designed on the Contract Documents.
- (ii) **The Contractor shall retain a professional engineer** registered in the state of Florida to design and be responsible for all connections not shown or only partially shown on the Contract Documents.
- (iii) Design beam connections to support half of the allowable load on the beam, defined in the AISC Beam Tables as Wc/2L, or the reaction shown on the Contract Documents, whichever is greater.

c) <u>Detailing of Members</u>

 (i) All details shown are typical, similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the Project site wherever possible without causing delay in the Work.

(ii) Promptly notify the Engineer whenever the design of members for any portion of the structure is not clearly indicated.

D. <u>Installer Qualifications</u>

1. A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

E. Fabricator Qualifications

1. A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.

F. Shop-Painting Applicators

- 1. Qualified according to AISC's Sophisticated Paint Endorsement P2 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators".
- G. Fabrication and erection shall be performed by a qualified fabricator and erector approved by the Engineer. Preparation of shop drawings shall not begin until the fabricator and erector have been approved.

1.03 Submittals

- A. Submit shop drawings for the work in accordance with the General Conditions, Supplementary Conditions, and Section 01300, Shop Drawings, Submittals and Samples.
- B. Complete shop drawings, including material lists, fabrication, schedules for fabrication and shop assembly, data for all structural steel, working drawings and erection drawings shall be submitted for review. Drawings shall bear the seal of professional Engineer registered in the State of Florida. Approval will be for strength only and shall not relieve the Contractor of responsibility for proper fit of members, of connections not detailed on the Drawings, or for supplying all material required by the Contract Documents. Mark numbers painted on the shop assembled pieces of steel shall be the same mark numbers used on the detailed shop and erection drawings.
 - 1. Include details of cuts, connections, splices, camber, holes and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

- 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
- 5. Provide setting drawings, templates and directions for the installation of anchor bolts and other anchorages to be installed under other Section of Work.
- 6. Erection drawings and shop details shall clearly show the capacity of the connection.
- 7. The Engineer's review of Shop Drawings is for general conformance with design concepts only. Compliance with the requirements for materials, fabrication and erection of structural steel is the Contractor's responsibility.

C. Mill Test Reports

- 1. **Certified mill test reports, signed by the manufacturer's** certifying that the following products comply with the requirements:
 - a. Structural steel including chemical and physical properties.
 - b. Bolts, nuts and washers including mechanical properties and chemical analyses.
 - c. Non-shrink grout.
- D. Certifications that welders are qualified, in accordance with AWS D1.1, on the shop and field welding procedures to be used.
- E. Fabrication shall not be approved until the shop drawing submission has been approved.

1.04 Delivery, Storage and Handling

- A. Deliver materials to the site at such time intervals to insure uninterrupted progress of the Work.
- B. Deliver anchor bolts and other anchorage devices which are to be embedded in cast-inplace concrete or masonry, in sufficient time to permit their timely installation. Provide proper setting drawings, templates and directions for installation of these items.
- C. Store materials to permit easy access for inspection and identification. Keep steel members above the ground and spaced by using pallets, platforms or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

- D. **Store fasteners in a protected place**. Clean and relubricate bolts and nuts that become dry or rusty before use.
- E. Do not store materials on the structure in a manner that may cause distortion, damage, or overload to members or supporting structures.
- F. Store all fasteners and welding electrodes in a weather-tight and dry place until ready for use.
- G. Store packaged materials in their original containers.
- H. Repair or replace damaged materials or structures as directed.

2. PRODUCTS

2.01 Materials

- A. All steel shall be manufactured in the United States of America and shall meet all ASTM codes, standards and requirement.
- B. W-Shapes
 - 1. ASTM A-572 / A-572M, Grade 50 (345).
- C. Channels, Angles and Shapes
 - 1. ASTM A-36 / A-36M.
- D. Plate and Bar
 - 1. ASTM A-36 / A-36M.
- E. Cold-Formed Hollow Structural Sections
 - 1. ASTM A-500, Grade B, structural tubing.
- F. Corrosion Resisting Cold-Formed Hollow Structural Sections
 - 1. ASTM A-847, structural tubing.

G. Steel Pipe Columns

1. ASTM A-53, Grade B.

H. Hollow Structural Stainless Steel Tubing

1. Hollow structural stainless steel tubing shall conform to ASTM A-554, Grade MT-316.

I. Stainless Steel Plate and Members

- 1. Except where otherwise specified, stainless steel shall be Type 316, ASTM A-24 0. Stainless steel pipe conform to ASTM A-312, Grade TP316.
- 2. Wrought stainless fittings shall conform to ASTM A-403, Class WP316.

J. Welding Electrodes

- 1. Welding electrodes for structural steel shall conform to AWS Requirements.
- 2. Welding electrodes for stainless steel shall conform to AWS Requirements. Use electrodes as follows:

Stainless Steel Material	Welding Electrode Material
Type 304	E-308
Type 304L	E-347
Type 316	E-316
Type 316L	E-318

K. <u>Drilled-in Expansion Bolts</u>

- 1. Drilled in expansion bolts shall be "Kwik Bolts" by Hilti; "Redhead Anchors" by ITT Phillips Drill Co.; WEJ-IT by WEJ-IT Corporation or approved equal.
- 2. Diameter and minimum capacity shall be as indicated on the Contract Drawings, or if not shown, *the Contractor shall be responsible for the design and adequacy of all connections* that are not designed on the Contract Documents.
- 3. A "minimum" safety factor of four (4) shall be provided.

2.02 Bolts, Connectors and Anchors

A. High-Strength Bolts, Nuts, and Washers (HDZC)

- 1. ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts.
- 2. ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts.
- 3. ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
- 4. <u>Finish</u>: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

B. High-Strength Bolts, Nuts, and Washers

- 1. ASTM A 490 (ASTM A 490M), Type 1, heavy hex steel structural bolts.
- 2. ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts
- 3. ASTM F 436 (ASTM F 436M) hardened carbon-steel washers, plain.

C. <u>Headed Anchor Rods</u>

- 1. ASTM A-307, Grade A (ASTM F-568M, Property Class 4.6), straight.
 - a. Nuts: ASTM A-563 (ASTM A-563M) heavy hex carbon steel.
 - b. Plate Washers: ASTM A 36 / A-36M carbon steel.
 - c. Washers: ASTM F-436 (ASTM F-436M) hardened carbon steel.
 - d. Finish: Hot-dip zinc coating, ASTM A-153 / A-153M, Class C.

D. Clevises and Turnbuckles

1. ASTM A-108, Grade 1035, cold-finished carbon steel.

E. Eye Bolts and Nuts

1. ASTM A-108, Grade 1030, cold-finished carbon steel.

F. Sleeve Nuts

1. ASTM A-108, Grade 1018, cold-finished carbon steel.

2.03 Primer

A. SSPC-Paint 25, Type II, iron oxide, zinc oxide, raw linseed oil, and alkyd.

2.04 Non-Metallic, Shrinkage-Resistant Grout

- A. The non-metallic, shrinkage-resistant grout shall comply with ASTM C-1107.
- B. Factory-packaged, non-metallic aggregate grout, non-corrosive, non-staining, mixed with water to the consistency suitable for application and a thirty (30) minute working time.
- C. Non-shrink grout shall be used under steel base plates and bearing plates.
- D. All grouting shall be performed in accordance with the recommendations of ACI and the grout manufacturer's printed specifications and instructions for site preparation, product mixing and placing.
- E. The minimum compressive strength of non-shrinking grout when tested in accordance with ASTM C-109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)", shall be 7,000 psi after seven (7) days.

2.05 Fabrication

- A. Fabrication shall be in accordance with the specified standards.
- B. Splices not indicated on the Contract Drawings will not be permitted.
- C. Fabricate and assemble structural steel in the shop to the greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges", AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings" and the final "approved" shop drawings.
 - 1. Camber structural steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A-6/ A-6M and maintain markings until the structural steel has been erected.
 - 3. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling materials.

- Ream unmatched holes in shop assembly of field connections. Reject and replace with new pieces any piece weakened by reaming to a point where the strength of the joint is impaired.
- 5. Complete structural steel assemblies, including welding of the units, before starting shop-priming operations.
- 6. Where shop painting is required, complete the assembly, including welding of units, before the start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs and other defects.

D. Thermal Cutting

- 1. Perform thermal cutting by machine to greatest extent possible.
- 2. Plane thermally cut edges to be welded to comply with requirements AWS D1.1.
- E. Weld connections or bolt as indicated. Weld shop connections not otherwise shown. Eccentric connections are not permitted unless shown in detail on the structural Drawings. Bolted connections shall have a minimum of two (2) bolts.

F. Bolt Holes

1. Cut, drill or punch standard bolt holes perpendicular to the metal surfaces.

G. Finishing

1. Accurately finish the ends of columns and other members transmitting bearing loads.

H. Cleaning

1. Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning".

I. Holes

1. Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

- 2. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
- 3. <u>Base-Plate Holes</u>: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
- 4. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 Shop Connections

A. Bolt field connections, except where welded connections or other connections are included on the Drawings. Provide high-strength threaded fasteners for all bolted connections.

B. High-Strength Bolts

- 1. Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A-325 or A-490 Bolts" for the type of bolt and type of joint specified except that "X" type bearing connections shall not be used.
- 2. All bolts shall be tightened to the "snug-tight" condition in accordance with Supplement No. 1 of the AISC Code.

C. Weld Connections

- 1. Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
- 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

2.07 Shop Priming

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of two (2) inches (50 mm).
 - 2. Surfaces to be field welded.

B. Surface Preparation

- Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - a. Steel Structures Painting Council (SSPC) SP 2, "Hand Tool Cleaning".

C. Priming

- Immediately after surface preparation, apply primer according to the manufacturer's written instructions and at rate recommended by SSPC to provide a *uniform dry film thickness of not less than 2.0 mils (0.051 mm)*. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- 2. Apply two (2) coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from the first coat.

D. <u>Painting</u>

 Apply a one (1) coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems", to provide a *dry film thickness of not less than 2.0 mils (0.051 mm)*.

2.08 Galvanizing

A. Hot-Dip Galvanized Finish

- 1. Apply a zinc coating by the hot-dip process to structural steel according to ASTM A-123 / A-123M.
- 2. Fill vent holes and grind smooth after galvanizing.

2.09 Source Quality Control

- A. The Contractor will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports. Provide a testing agency with access to places where structural steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections

1. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

D. Welded Connections

1. In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. <u>Ultrasonic Inspection</u>: ASTM E-164, "Standard Practice for Ultrasonic

Contact Examination of Weldments".

b. Radiographic Inspection: ASTM E-94, "Standard Guide for Radiographic

Examination".

3. EXECUTION

3.01 Examination

- A. Verify elevations of concrete and masonry-bearing surfaces and locations of anchor rods, anchor bolts, bearing plates, and other embedments, with the steel erector present, for compliance with the requirements.
- B. Examine the areas and conditions under which structural steel work is to be installed, and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Storage of Materials

A. Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.03 Preparation

- A. Prepare temporary shores, guys, braces and other supports during erection to keep structural steel secure, plumb, an in alignment against temporary construction loads and loads equal in intensity to the design loads.
- B. Remove temporary supports when permanent structural steel, connections and bracing are in place, unless otherwise indicated.
- C. All Work under this Section includes responsibility for accurate bearing of steel and correct location of anchorage.

3.04 Fabrication and Erection

- A. Fabricate miscellaneous metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated in the Contract Drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded.
- B. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.
- C. Set embedded metalwork accurately in position when concrete is placed and support rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03300, Cast-in-Place Concrete.
- D. 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 "Commentary" as modified herein; "Load and Resistance Factor Design Specification for Structural Steel Buildings"; and the requirements of all other specified standards.

E. Base and Bearing Plates

1. Clean concrete- and masonry-bearing surfaces of bond reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean the bottom surface of base and bearing plates.

- 2. Set loose and attached base plates and bearing plates for structural members on wedges, shims, setting nuts or other adjusting devices. Tighten the anchor bolts after the supported members have been positioned and plumbed. Weld plate washers to the top of base plate.
- 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
- 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates to ensure that no voids remain. Neatly finish exposed surfaces; protect installed materials and allow grout to cure. Comply with the manufacturer's written installation instructions for shrinkage resistant grouts.
- F. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".
- G. Set structural frames to the lines and elevations indicated. Align and adjust various members forming part of the 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.
 - 1. **Level and plumb individual members** of the structure within specified AISC tolerances.
 - 2. *Make allowances for difference between the temperature* at the time of erection and the mean temperature when the structure is completed and in service.

H. Bolting

- 1. Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in place work.
- 2. Furnish templates and other devices, as necessary, for presetting bolts and other anchors to accurate locations.
- 3. As erection progresses, bolt up work to take care of all dead loads, construction live loads, lateral forces and erection stresses.
- 4. Unless otherwise noted, erection bolts used in welded construction may be either tightened securely and left in place or removed and the holes filled with plug welds.

- 5. Drift pins may be used for assembling parts provided the metal is not distorted or holes enlarged. Ream holes requiring enlargement to admit bolts. Misaligned holes will subject members to rejection.
- 6. Make all steel to steel connections by high strength bolting except where field welding is specifically shown. Provide not less than two ¾-inch bolts per connection and use not less than ¼-inch thick clip angles.
- 7. Tighten bolted connections designated as bearing-type connections to the snug tight condition. Where specified, tighten other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening.
- 8. Install expansion bolts in strict accordance with the manufacturer's recommendations including spacing and edge distances.

I. Welding

- 1. Field welding shall be done only where shown or specified and only be welders qualified for the procedures used. No welding shall be done when surfaces are wet, exposed to rain or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.
- 2. **Each welder shall be assigned an identification mark**. This mark shall be made at each completed connection with a paint stick.
- 3. **Perform welding on steel by the shielded metal arc welding (SMAW) process**. Welding shall conform to the AWS Structural Welding Code-Steel, D1.1-98, except as modified in AISC Section J2.
- 4. **Perform welding on stainless steel by the gas tungsten arc (TIG) process**. All welds shall be full penetration and smooth unless otherwise indicated on the Contract Drawings. Provide inert gas on the inside of pipe during welding to reduce oxidation.
- 5. Provide a minimum of two (2) passes for metal in excess of $\frac{5}{16}$ -inch thickness.

6. Welds

- a. **Produce welds, uniform in width and size**, throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal.
- b. Avoid irregular surface, non-uniform bead pattern, and high crown.

c. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping and grinding of welds in a manner that will not gouge, groove or reduce the base metal thickness.

J. Temporary Bracing

- 1. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads including erection equipment and its operation.
- 2. Leave in place until no longer required for safety.
- 3. Make proper provisions for construction loads, piles of materials, equipment, etc., carried by structural frame during erection.
- 4. Remove temporary members and connections when permanent members are in place and final connections made.
- 5. Provide temporary guy wires to achieve proper alignment of the structures as erection proceeds.
- K. Provide temporary planking and working platforms as necessary to effectively complete the Work.
- L. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment and the removal of paint on surfaces adjacent to welds.
- M. Do not use gas cutting torches in the field for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members which are not under stress only when approved by the Engineer. Finish gas-cut sections equal in accordance with the requirements of Section 3.2.2 of AWS D1.1 when permitted.
- N. Splice members only where indicated.
- O. No alterations will be performed in the field without the written approval of the Engineer.

3.05 Field Connections

A. <u>High-Strength Bolts</u>

1. Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A-325 or A-490 Bolts" for the type of bolt and type of joint specified except that "X" type bearing connections shall not be used.

2. All bolts shall be tightened to the "snug-tight" condition in accordance with Supplement No. 1 of the AISC Code.

B. Weld Connections

- 1. Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
- Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
- 3. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3.06 Field Quality Control

A. Testing Agency

1. The Contractor will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Welded Connections

- 1. Field welds will be visually inspected according to AWS D1.1.
- 2. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Ultrasonic Inspection: ASTM E-164, "Standard Practice for Ultrasonic

Contact Examination of Weldments".

b. Radiographic Inspection: ASTM E-94, "Standard Guide for Radiographic

Examination".

- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents at no additional cost to the Owner.
- D. Erect individual pieces so that the deviation from plumb, level and alignment shall not exceed 1:500.

3.07 Repairs and Protection

A. **Repair damaged galvanized coatings on galvanized items** with galvanized repair paint according to ASTM A-780 and the manufacturer's written instructions.

B. Touch-up Painting

- 1. After installation, promptly clean, prepare, and prime or reprime field connections (bolts and welds), rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
- 2. Clean and prepare surfaces by SSPC-SP 2 hand tool cleaning or SSPC-SP 3 power tool cleaning.
- 3. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.
- 4. Finish painting shall be as specified in Section 09900, *Painting*.
- 5. Zinc coating which has been burned by field welding, abraded, or otherwise damaged shall be cleaned and repaired after erection of the structural steel. The damaged area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two (2) coats of zinc oxide-zinc dust paint.

3.08 Inspection

- A. The Engineer shall have free access to the Work. The Contractor shall notify the Engineer, in writing, four (4) days in advance of any welding or high strength bolting operations.
- B. High-strength bolting may be visually inspected. All high-strength bolts shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. These marks shall be considered in the inspection. Rejected bolts shall be either replaced or retightened as required.
 - In cases of disputed bolt installations, the bolts in question shall be checked by a calibrated wrench certified by an independent testing laboratory selected by the Owner.
- C. All costs for testing and inspection required as a result of defection work, repairs, or retests shall be paid for by the Contractor.

- D. Any material or workmanship which is rejected by the Engineer either at the shop, mill or building must be promptly replaced by the Contractor to the Engineer's entire satisfaction.
- E. The fact that steel work has been accepted at the shop and mill shall not prevent its final rejection at the site, or even after it has been erected, if it is found to be defective in any way.
- F. Any steel work rejected at the site shall be removed by the Contractor from the premises within ten (10) working days from the time the Contractor is notified of the rejection.

END OF SECTION

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October 20, 2023 Structural Steel

SECTION 05140 STRUCTURAL ALUMINUM

1. GENERAL

1.01 Description

A. The work in this Section includes providing all labor, materials, equipment and incidentals necessary for fabrication and erection of structural aluminum, tubing, sheets, checkered plate, etc. as shown on the Contract Drawings and specified herein.

B. Related Work Specified Elsewhere

1. Related work specified elsewhere includes:

Specification Section	Title
01300	Shop Drawings, Submittals and Samples
03300	Cast-in-Place Concrete
03600	Grout
05025	Metal Materials, Methods, and Fastenings
05500	Metal Fabrications
05510	Metal Stairs and Walkways
05520	Handrails and Accessories
05570	Miscellaneous Metal Assemblies
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM)		
ASTM A-167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip	
ASTM B-209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate	
ASTM B-221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes	
ASTM B-241	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube	
ASTM B-308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles	
Other Standards and Building Codes		
	OSHA	
	Aluminum Construction Manual, latest edition, by the Aluminum Association	
	Florida Building Code	

B. Fabrication and erection shall be performed by a qualified fabricator and erector approved by the Engineer. Preparation of shop drawings shall not begin until the fabricator and erector have been approved.

C. Quality Control

 The Contractor is responsible for all quality control. The Contractor shall be responsible to correct structural aluminum which does not conform to the specified requirements.

D. Quality Control Monitoring

- 1. The Contractor will monitor quality control by means of employing an testing agency to provide inspection, testing and reports as specified below:
 - a. High Strength Bolted Connections
 - 1) Inspect and test structural aluminum joints for compliance with referenced bolting connection industry standards for the proposed applications.
 - 2) The Contractor is solely responsible to perform the work in accordance with the Contract Documents and all referenced standards and requirements. The Contractor shall promptly remove and replace materials or fabricated components which do not comply with requirements of the Contract Documents.

b. Design of Connections

- 1) The Contractor is responsible for the design and adequacy of all connections that are not designed on the Contract Documents.
- 2) The Contractor shall retain a professional engineer registered in the State of Florida to design and be responsible for all connections not shown or only partially shown on the Contract Documents.
- 3) Design beam connections to support the allowable load on the beam, or the reaction shown on the Contract Documents, whichever is greater.

c. <u>Detailing of Members</u>

- All details shown are typical, similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the Project site wherever possible without causing delay in the Work.
- 2) Promptly notify the Engineer whenever the design of members for any portion of the structure is not clearly indicated.
- E. Fabrication and erection shall be performed by a qualified fabricator and erector approved by the Engineer. Preparation of shop drawings shall not begin until the fabricator and erector have been approved.

1.03 Submittals

A. Shop Drawings

- 1. Submit shop drawings for the work in accordance with the General Conditions, Supplementary Conditions, and Section 01300, *Shop Drawings, Submittals and Samples*. All submittals shall be in an electronic format (PDF).
- 2. Complete shop drawings, including material lists, fabrication and erection drawings shall be submitted for review. Complete shop drawings, including material lists, fabrication, schedules for fabrication and shop assembly, data for all structural aluminum, working drawings and erection drawings shall be submitted for review. Drawings shall bear the seal of professional Engineer registered in the State of Florida. Approval will be for strength only and shall not relieve the Contractor of responsibility for proper fit of members, of connections not detailed on the Drawings, or for supplying all material required by the Contract Documents. Mark numbers painted on the shop assembled pieces of aluminum shall be the same mark numbers used on the detailed shop and erection drawings.

- a. Include details of cuts, connections, splices, camber, holes and other pertinent data.
- b. Include embedment drawings.
- c. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
- d. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
- e. Provide setting drawings, templates and directions for the installation of anchor bolts and other anchorages to be installed under other Section of Work.
- f. Erection drawings and shop details shall clearly show the capacity of the connection.
- g. The Engineer's review of Shop Drawings is for general conformance with design concepts only. Compliance with the requirements for materials, fabrication and erection of structural aluminum is the Contractor's responsibility.
- 3. Fabrication shall not be approved until the shop drawing submission has been approved.

1.04 Delivery, Storage and Handling

- A. Deliver materials to the site at such time intervals to insure uninterrupted progress of the Work.
- B. Deliver anchor bolts and other anchorage devices which are to be embedded in cast-inplace concrete or masonry, in sufficient time to permit their timely installation. Provide proper setting drawings, templates and directions for installation of these items.
- C. Store materials to permit easy access for inspection and identification. Keep aluminum members above the ground and spaced by using pallets, platforms or other supports and spacers. Protect aluminum members and packaged materials from erosion and deterioration.
- D. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
- E. Do not store materials on the structure in a manner that may cause distortion, damage, or overload to members or supporting structures.

- F. Store all fasteners and welding electrodes in a weather-tight and dry place until ready for use.
- G. Store packaged materials in their original containers.
- H. Repair or replace damaged materials or structures as directed.

2. PRODUCTS

2.01 Materials

A. Aluminum Sheet

1. Aluminum sheet shall conform to ASTM B-209, Alloy 3003, H 14 temper.

B. Structural Aluminum

- 1. Aluminum Structural members shall conform to ASTM B-308, Alloy 6063-T6.
- 2. Aluminum bars and rods shall conform to ASTM B-221, Alloy 6063-T6.

C. Aluminum Tubing

1. Aluminum seamless pipe and tubing shall conform to ASTM B-241, Alloy 6063-T6. Wall thickness shall be Schedule 80, per ANSI H35.2, unless otherwise shown on the Drawings.

D. Standard Threaded Fasteners

 Fasteners shall be manufactured of stainless steel, shall comply with ASTM A-167, Type 316 and shall be in accordance with Section 05025, *Metal Materials, Methods and Fastening*.

E. Welding Electrodes

1. Welding electrodes for aluminum shall be ER 4043 filler metal.

F. Checkered Plate

 All checkered plates shall be aluminum, mill finish, and designed for a live load of 150 pounds per square foot of the gross projected area and a 250 pound concentrated load, with the limits for deflections as specified in Federal Specification RR-G-6610.

- 2. Aluminum checkered plates shall have a minimum thickness of 3/8-inch standard pattern "non-slip" plates of minimum 3/8-inch thickness and sizes shown on the Contract Drawings. Stiffener angles (aluminum) shall be provided as required to meet the superimposed live load requirements specified above. Stiffeners, if utilized, shall be concealed. All checkered plate sections shall be cut to the dimensions shown on the Contract Drawings. Flush type lifting handles shall be provided for each plate, unless otherwise noted on the Contract Drawings.
- 3. **Plate shall be 6063-T6 alloy aluminum**. Raised lugs shall be diamond shaped and have an angled and opposed pattern.
- Provide U-bolt lifting handles located on opposite ends on each removable section.
 Steel plates, including angle edgings, support angles, and lifting handles shall be Type 316 stainless steel.

2.02 Fabrication

- A. Fabrication shall be in accordance with the specified standards.
- B. Splices not indicated on the Contract Drawings will not be permitted.
- C. Fabricate miscellaneous aluminum metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations.
- D. Surface Treatment is required only if indicated on the Contract Drawings.

3. EXECUTION

3.01 Examination

- A. Verify elevations of concrete and masonry-bearing surfaces and locations of anchor rods, anchor bolts, bearing plates, and other embedments, with the aluminum erector present, for compliance with the requirements.
- B. Examine the areas and conditions under which structural aluminum work is to be installed, and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Preparation

- A. Prepare temporary shores, guys, braces and other supports during erection to keep structural aluminum secure, plumb, an in alignment against temporary construction loads and loads equal in intensity to the design loads.
- B. Remove temporary supports when permanent structural aluminum, connections and bracing are in place, unless otherwise indicated.
- C. All Work under this Section includes responsibility for accurate bearing of aluminum and correct location of anchorage.

3.03 Erection

A. Erection shall be in accordance with the specified standards and as indicated on the Contract Drawings.

B. 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 the bottom surface of base and bearing plates.
- Set loose and attached base plates and bearing plates for structural members on wedges, shims, setting nuts or other adjusting devices. Tighten the anchor bolts after the supported members have been positioned and plumbed. Weld plate washers to the top of base plate.
- Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
- 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates to ensure that no voids remain. Neatly finish exposed surfaces; protect installed materials and allow grout to cure. Comply with the manufacturer's written installation instructions for shrinkage resistant grouts.
- C. Set structural frames to the lines and elevations indicated. Align and adjust various members forming part of the 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.

- 1. Level and plumb individual members of the structure within specified tolerances.
- 2. **Make allowances for difference between the temperature** at the time of erection and the mean temperature when the structure is completed and in service.

D. Bolting

- 1. Furnish anchor bolts and other connectors required for securing structural aluminum to foundations and other in place work.
- 2. Furnish templates and other devices, as necessary, for presetting bolts and other anchors to accurate locations.
- 3. As erection progresses, bolt up work to take care of all dead loads, construction live loads, lateral forces and erection stresses.
- 4. Unless otherwise noted, erection bolts used in welded construction may be either tightened securely and left in place or removed and the holes filled with plug welds.
- 5. Drift pins may be used for assembling parts provided the metal is not distorted or holes enlarged. Ream holes requiring enlargement to admit bolts. Misaligned holes will subject members to rejection.
- 6. Make all aluminum to aluminum connections by high strength bolting except where field welding is specifically shown. Provide not less than two ¾-inch bolts per connection and use not less than ¼-inch thick clip angles.
- 7. Tighten bolted connections designated as bearing-type connections to the snug tight condition. Where specified, tighten other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening.
- 8. Install expansion bolts in strict accordance with the manufacturer's recommendations including spacing and edge distances.
- E. Maintain erection tolerances of structural aluminum within specified standard practices.

F. Welding

- 1. Welding on aluminum shall be performed by the Gas Metal Arc (MIG) or Gas Tungsten Arc (TIG) Process. Welding shall conform to the AWS Structural Welding Code Aluminum, D1.2-90.
- 2. Provide a minimum of two (2) passes for metal in excess of $^{5}/_{16}$ -inch.

- 3. Produce a weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base material. Avoid irregular surface, non-uniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.
- G. Fabricate miscellaneous aluminum metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be true in alignment. Unless specifically indicated on the Drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fasteners wherever possible. Built-up parts shall be free from warp. Exposed ends and edges of metal shall be slightly rounded.
- H. Clean the surfaces of aluminum metalwork to be in contact with concrete, rust, dirt, grease and other foreign substances before placing concrete.
- I. Set embedded metalwork accurately in position when concrete is placed and support rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03600, *Grout*.
- J. No painting is required.

3.04 Corrosion Protection of Aluminum Surfaces

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 09900, Painting, before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- B. Where the contact of dissimilar metals may cause electrolysis and where aluminum will come into contact with dissimilar metals, except stainless steel, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers. Where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated using not less than one (1) coat of zinc chromate primer and one (1) heavy coat of aluminum pigmented asphalt paint on each surface; or where deemed necessary by the Engineer, not less than one (1) course of asphalt saturated cotton fabric cemented to both metals with flashing cement, shall be used.

- C. Finished works shall be cleaned and excess cement removed.
- D. All work shall be adequately anchored in place at proper elevations, planes and locations. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- E. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets.

END OF SECTION

SECTION 05500 METAL FABRICATIONS

1. GENERAL

1.01 Description

A. The work in this Section includes providing all labor, materials, equipment and incidentals necessary to install miscellaneous metals, shapes and sheets, metal items and fasteners not specified elsewhere in these Specifications.

B. Related Work Specified Elsewhere

Specification Section	Title
00700	General Conditions
01300	Shop Drawings, Submittals and Samples
03300	Cast-in-Place Concrete
03600	Grout
05025	Metal Materials, Methods and Fastening
05510	Metal Stairs and Walkways
05520	Handrails and Accessories
05570	Miscellaneous Metal Assemblies
09900	Painting
Division	Information
8	Doors and Windows
Contract Drawings and General Provisions of the Contract	

C. All materials, practices and workmanship shall conform to the Florida Building Code.

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1.02 Submittals

A. Shop Drawings

- 1. Submit shop drawings for the work in accordance with the General Conditions, Supplementary Conditions, and Section 01300, *Shop Drawings, Submittals and Samples.*
- Submit product data for non-slip aggregates and non-slip aggregate surface finishes, prefabricated building columns, cast nosings, treads and thresholds, steel floor plate, paint products, and grout.
- 3. The Contractor shall submit shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show sizes of members, fastenings, supports, clearances, and anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
- 4. The Contractor shall provide samples representative of the materials and finished products as may be requested per Section 01300, *Shop Drawings*, *Submittals and Samples*.
- 5. The Contractor shall submit welder certificates, signed by the Contractor, certifying that the welders to be used on this Project comply with the requirements specified under Article 1.03 of this Specification Section ("Quality Assurance").
- 6. The Contractor shall submit Qualification data for firms and persons specified in Article 1.03 of this Specification Section ("Quality Assurance") to demonstrate their capabilities and experience. Include a list of completed projects with project names, addresses, names and addresses of engineer's, architect's and Owner's, and other information specified.
- 7. Shop drawings shall be approved by the Engineer before fabrication begins.

1.03 Quality Assurance

A. Fabricator Qualifications

1. Firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce the required units without delaying the Work.

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B. Welding Standards

- 1. Comply with, at a minimum, the applicable provisions of:
 - a. AWS D1.1 "Structural Welding Code-Steel".
 - b. AWS D1.2 "Structural Welding Code-Aluminum".
 - c. AWS D1.3 "Structural Welding Code-Sheet Steel".
- 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

C. Inserts and Anchorages

- 1. Furnish inserts and anchoring devices that must be set in concrete or built into masonry for installation of miscellaneous metal work. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices. Coordinate delivery with other-work to avoid delay.
- 2. See Concrete and Masonry Sections (Divisions 3 and 4) of these Specifications for installation of inserts and anchorage devices.

D. Shop Assembly

- 1. Pre-assemble items in shop to the greatest extent possible to minimize field splicing and assembly.
- 2. Disassemble units, only as necessary, for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.04 Project Conditions

- A. Where metal fabrications are indicated to fit walls and other construction, the Contractor shall verify dimensions by accurate field measurements before fabrication and indicate said measurements on the shop drawings.
- B. Coordinate the fabrication schedule with the construction progress schedule to avoid delaying the Work.

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C. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

2. PRODUCTS

2.01 General

A. For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.02 Ferrous Metals

- A. Miscellaneous steel plates, shapes, bars and connections shall conform to the requirements of ASTM A-36 / ASTM A-36M.
- B. Rolled steel floor plates shall conform to the requirements of ASTM A-786 / ASTM A-786M.
- C. Hot-Rolled Carbon Steel Bars (and Bar size shapes) shall conform to ASTM A-575, grade as selected by fabricator.
- D. Hot-Rolled Carbon Steel Sheets and Strips shall conform to ASTM A-568 and ASTM A-569, pickled and oiled.
- E. Cold-Rolled Carbon Steel Sheets shall conform to ASTM A-366.
- F. Galvanized Carbon Steel Sheets shall conform to ASTM A-526 with 1.25 oz. *commercial* galvanizing per ASTM A-525.

G. Steel Tubing

- 1. Product type (manufacturing method) and as follows:
 - a. Cold-formed Steel Tubing shall conform to the requirements of ASTM A-500.
 - b. Hot-formed Steel Tubing shall conform to the requirements of ASTM A-501.
- 2. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A-53.

H. Steel Pipe

- 1. Steel pipe shall comply with ASTM A-53, standard weight, Schedule 40, unless otherwise indicated, or another weight required by structural loads.
 - a. Black finish unless otherwise indicated.
 - b. Galvanized finish where indicated or directed by the Engineer.
- I. Malleable-Iron Casting shall conform to ASTM A-47, Grade 32510 (ASTM A-47M, Grade 22010).

J. Masonry Anchorage Devices

- 1. Expansion shields as follows:
 - a. Lead expansion shields for machine screws and bolts ¼-inch and smaller, head-out embedded nut type, single unit class.
 - b. Lead expansion shields for machine screws and bolts larger than ¼-inch in size, head-out embedded nut type, multiple unit class.
- K. Welding rods and bare electrodes shall be selected according to AWS specifications for the metal alloy to be welded.

2.03 Stainless Steel

- A. Except where otherwise specified use Type 316, ASTM A-167 stainless steel plate, members, and hardware and washers.
- B. Use ASTM A-193, Grade B8M bolts and ASTM A-194, Grade 8M nuts.

2.04 Structural Aluminum

- A. The Contractor shall refer to the requirements of Section 05140, *Structural Aluminum*.
- B. Aluminum Structural members shall conform to ASTM B-308, Alloy 6063-T6.
- C. Aluminum bars and rods shall conform to ASTM B-221, Alloy 6063-T6.

- D. Structural shapes and plates shall conform to ASTM B-241, Alloy 6063-T6.
- E. Aluminum Extrusions shall conform to ASTM B-221 / ASTM B-221M, alloy 6063-T6.
- F. Aluminum-alloy rolled tread plate shall conform to ASTM B-632 / ASTM B-632M, Pattern 1, alloy 6061-T6.

2.05 Cast-in-Place Anchors in Concrete

- A. Unless otherwise indicated on the Drawings, use Type 316 stainless steel wedge anchors as manufactured by Phillips Drill Company or approved equal.
- B. Where steel anchors are indicated, use a one-piece design with expander ring consisting of steel zinc coated and chrome plated as manufactured by McCullough Industries, Inc., Kwik Bolt, or approved equal.
- C. Anchors shall be capable of sustaining, without failure, a load equal to four (4) times the design load imposed when installed in concrete, as determined by testing per ASTM E-488, conducted by a qualified independent testing agency.

2.06 Fasteners

A. General

- Provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with electro-deposited zinc coating complying with ASTM B-633, Class Fe/Zn 25, unless specified otherwise, where built into exterior walls. Select fasteners for type, grade, and class required.
- 2. Bolts for securing equipment, above grade piping and aluminum structures shall be stainless steel.
- B. Bolts and Nuts shall be regular hexagon-head bolts, ASTM A 325, Type I, heavy hex steel structural bolts and heavy hex carbon steel nuts.
- C. Anchor Bolts shall comply with ASTM F-1554, Grade 36.
- D. Machine Screws shall comply with ASME B18.6.3 (ASME B18.6.7M).
- E. Lag bolts shall comply with ASME B18.2.1 (ASME B18.2.3.8M).

- F. Toggle bolts shall comply with FS FF-B-588 and shall be of the tumble-wing type, class and style as required.
- G. Wood screws shall be of the flathead, carbon steel type and shall comply with ASME B18.6.1.
- H. Plain washers shall be of the round, carbon steel type and shall comply with ASME B18.22.1 (ASME B18.22M).
- I. Lock washers shall be of the helical, carbon steel, spring type and shall comply with ASME B18.21.1 (ASME B18.21.2M).

J. Expansion Anchors

- Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry, as determined by testing per ASTM E-488, conducted by a qualified independent testing agency.
 - a. Material for Anchors in Exterior Locations shall be Alloy Group 1 (A1) stainless steel bolts complying with ASTM F-593 (F-738M) and nuts complying with ASTM F-594 (ASTM F-836M).
 - b. Material for Anchors in Interior Locations shall be carbon steel components, zinc-plated, to comply with ASTM B-633, Class Fe/Zn 5.

2.07 **Paint**

A. Shop Primer for Ferrous Metal

- 1. Organic zinc-rich primer, complying with SSPC Paint 20 and compatible with topcoat.
- 2. The Contractor is also referred to Section 09900, Painting.

3. Products

- a. Subject to compliance with requirements, provide one of the following:
 - 1) Carboline 621; Carboline Company.
 - 2) Aguapon Zinc-Rich Primer 97-670; PPG Industries, Inc.

- 3) Tneme-Zinc 90-97; Tnemec Company, Inc.
- 4) Or approved equal.

B. Galvanizing Repair Paint

1. High-zinc-dust content paint for regalvanizing welds in galvanizing steel, with a dry film containing not less than ninety-four percent (94%) zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

C. Bituminous Paint

1. Cold-applied asphaltic mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.08 **Grout**

- A. Grout shall be of the non-shrink, non-metallic type and shall be factory-packaged, non-staining, non-corrosive, non-gaseous and comply with ASTM C-1107.
- B. Provide grout specifically recommended by the manufacturer for interior and exterior applications.

2.09 Galvanizing

- A. Galvanizing shall comply with ASTM A-153 for galvanizing iron and steel hardware.
- B. Galvanizing shall comply with ASTM A-123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip c-inch thick and heavier.
- C. Galvanizing shall comply with ASTM A-386 for galvanizing assembled steel products.

2.10 Fabrication - General

A. Shop Assembly

1. **Preassemble items in the shop to the greatest extent possible** to minimize field splicing and assembly.

- 2. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Form metal fabrications from materials of the size, thickness and shapes indicated but not less than that needed to comply with the performance requirements indicated. Work to the dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for various components of each metal fabrication.
- C. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- D. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss:
 - 1. Temperature Change: 100☐F (55.5☐C)
- E. Shear and punch metals cleanly and accurately. Remove burrs.
- F. Ease exposed edges to a radius of approximately \$^1/32\$-inch (0.8 mm), unless otherwise indicated. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.
- G. Remove sharp or rough areas on exposed traffic surfaces.
- H. Weld corners and seams continuously 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. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of the type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

- J. Provide for anchorage of the type indicated and coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- K. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.11 Loose Bearing and Leveling Plates

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of the required thickness and bearing area.
- B. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.12 Loose Steel Lintels

- A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit where indicated.
- C. Size loose lintels for equal bearing of one (1) inch per foot (85 mm per m) of clear span but not less than eight (8) inches (200 mm) bearing at each side of openings, unless otherwise indicated. The minimum size shall be 5" x 3½" x 5/16" for each four (4) inch thickness of masonry supported.
- D. Galvanize loose steel lintels located in exterior walls.

2.13 Shelf and Relieving Angles

A. Fabricate shelf and relieving angles from steel angles of the sizes indicated and for attachment to concrete framing. Provide slotted holes to receive ¾-inch (19mm) bolts, spaced not more than six (6) inches (150 mm) from ends and not more than twenty-four (24) inches (600 mm) on-center, unless otherwise indicated.

- B. For cavity walls, provide vertical channel brackets to support shelf/relieving angles from back-up masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity wall exterior wythe.
- C. Galvanize shelf angles to be installed on exterior concrete framing.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.14 Miscellaneous Framing and Supports

- A. Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
- C. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Except as otherwise indicated, space anchors twenty-four (24) inches (600 mm) on-center and provide minimum anchor units in the form of steel straps 1¼ inches (32 mm) wide by ¼-inch (6 mm) thick by eight (8) inches (200 mm) long.
- D. Galvanize miscellaneous framing and supports in the following locations:
 - 1. Exterior locations.
 - 2. Interior locations, where indicated.

2.15 Miscellaneous Steel Trim

- A. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices wherever possible.
- B. Provide cutouts, fittings, and anchorages as required to coordinate assembly and installation with other Work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than six (6) inches (150 mm) from each end, six (6) inches (150 mm) from corners, and twenty-four (24) inches (600 mm) on-center, unless otherwise indicated.

- C. Galvanize miscellaneous steel trim in the following locations:
 - Exterior locations.
 - 2. Interior locations, where indicated.

2.16 Floor Plate

- A. Fabricate raised-pattern floor plates from rolled-steel floor plate or aluminum (location and material as indicated on the Contract Drawings) of the thickness and in the pattern indicated below:
 - 1. Thickness: 3/8-inch, minimum
 - 2. Pattern: As selected from manufacturer's standard patterns.

2.17 Bollards (Truck Guards)

- A. Provide truck guards (bollards) and covers where indicated on the Contract Drawings.
- B. The bollards shall be 7-inch (galvanized) standard weight steel pipe as specified in ASTM A-53.
- C. Anchor posts in concrete as indicated and fill solidly with Class B (3,000 psi) concrete conforming to Section 03300, *Cast-in-Place Concrete*.

D. Bollard Covers

- 1. The bollard cover (post sleeve) shall be of the blow molded type, constructed from 1/8-inch thick High Density Polyethylene (HDPE) for weather resistant durability and long service life.
- 2. The bollard covers shall have a bright "safety yellow" color with UV stabilizers for protection from the sun and dual 3M "red" reflective-tape bands shall be integrally provided for enhanced visibility for day and night protection.
- 3. The bollard covers shall be as manufactured by Thermoprene, Inc., or equal.

2.18 Abrasive Metal Nosings, Treads and Thresholds

A. Abrasive stair nosings shall be provided for all concrete stairs.

- B. Nosings shall extend the full width of the stair.
- C. Cast-Metal Units shall be *cast aluminum*, with an integral abrasive finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in sizes and configurations indicated and in lengths necessary to accurately fit openings or conditions.
- D. Nosings shall be cross-hatched units, three (3) inches (75 mm) wide safety groove treads with a one (1) inch (25 mm) lip, for casting into concrete steps. The nosings shall Type 46 aluminum as manufactured by one of the following manufacturers:
 - 1. American Safety Tread Co., Inc.
 - 2. Wooster Products, Inc.
 - 3. Balco, Inc.

- 4. Barry Pattern & Foundry Co., Inc.
- 5. Safe-T-Metal Co.
- 6. Or approved equal.
- E. Provide anchors for embedding units in concrete, as standard with manufacturer.
- F. Apply bituminous paint to concealed bottoms, sides, and edges of cast-metal units set into concrete.

2.19 Finishes - General

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.20 Steel and Iron Finishes

A. Galvanizing

- 1. For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:
 - a. ASTM A-153 / A-153M, for galvanizing iron and steel hardware.
 - b. ASTM A-123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip, 0.0299-inch (0.76 mm) thick or thicker.

B. Preparation for Shop Priming

1. Prepare uncoated ferrous metal surfaces to comply with the minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

a. Exteriors (SSPC Zone 1 B): SSPC-SP 6/NACE No. 3 "Commercial Blast

Cleaning."

b. Interiors (SSPC Zone 1A): SSPC-SP 3 "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA 1, "Paint Application Specification No. 1" for shop painting.

2.21 Aluminum Finishes

A. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish

1. AA-M10 (Mechanical Finish: as fabricated, unspecified).

3. EXECUTION

3.01 Preparation

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to Project site.
- B. Center nosings on tread widths with noses flush with riser faces and tread surfaces.
- C. **Set sleeves in concrete with tops flush with finish surface elevations**. Protect sleeves from water and concrete entry.

3.02 Installation

A. Fastening to In-Place Construction

- Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- 2. Provide setting drawings, templates, instructions and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay.
- 3. Do not use concrete anchors set in holes drilled in the concrete after the concrete is placed in place of cast-in-place anchor bolts.
- After anchor bolts have been embedded, protect their threads by applying grease and by having the nuts screwed on until the time of installation of the equipment or metalwork.
- B. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Set embedded metalwork accurately in position when concrete is placed and supported rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with grout in conformance with Section 03600, *Grout*.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. 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.
- F. Comply with the following requirements for all field welding:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - a. Welding on steel shall be performed by the Shielded Metal Arc Welding (SMAW) process. Welding procedures shall comply with AWS B3.0.

- b. Welding on aluminum shall be performed by the Gas Metal Are (MIG) or Gas Tungsten Arc (TIG) process, per the AWS Welding Handbook.
- 2. Provide a minimum of two (2) passes for metal of $^3/_{16}$ -inch thickness plus one (1) additional pass for each additional 1/8-inch in metal thickness. Produce a weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and under-cuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.
- 3. Obtain fusion without undercut or overlap. Remove welding flux immediately.
- 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- 5. Pre-assemble items in the shop to the 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.
- 6. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately ¹/₃₂-inch unless otherwise shown. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.
- 7. Weld corners and seams continuously, complying with the AWS recommendations. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.
- 8. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- 9. Cut, reinforce, drill, and tap miscellaneous metal work as required to receive finish hardware, screws, and similar items.

3.03 Installing Miscellaneous Framing and Supports

A. Install framing and supports to comply with the requirements of the items being supported, including the manufacturers' written instructions and requirements indicated on the "approved" shop drawings, if any.

- B. Anchor supports for operable partitions securely to and rigidly brace from the building structure.
- C. Support steel and aluminum on solid grouted masonry or concrete. Secure with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates.

3.04 Setting Loose Plates

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve the bond to surfaces. Clean the bottom surface of the bearing plates.
- B. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
 - Use non-shrink, metallic grout in concealed locations where not exposed to moisture; use non-shrink, non-metallic grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.05 Installing Pipe Bollards

- A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into the sleeves, fill the annular space between the bollard and sleeve solidly with non-shrink, non-metallic grout, mixed and placed to comply with the grout manufacturer's directions.
- B. Fill bollards solidly with concrete, mounding the top surface.
- C. **Clean the exterior of the bollards** of all concrete spoils, debris and other materials. **Install the pipe bollard covers** in accordance with the manufacturers instructions.

3.06 Painting and Protective Coatings

A. All ferrous metal, except stainless steel and galvanized surfaces, shall be properly cleaned and given one shop cost of primer compatible with the coating system specified in Section 09900, *Painting*.

- B. Anchors that are built into masonry shall be coated with asphalt paint unless specified to be galvanized.
- C. Metal work to be encased, in concrete shall be left unpainted unless specified or noted otherwise.
- D. Where hot-dip galvanized or zinc coated metal is specified or shown, it shall be shop primed unless specifically not required.
- E. Castings that are to be left unpainted shall be cleaned and coated with a coal-tar-pitch varnish.
- F. Aluminum to be placed adjacent to masonry shall be protected with an isolating coating of bitumastic, and/or neoprene or felt.

3.07 Dissimilar Metal Contact

- A. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated using not less than one (1) coat of zinc chromate primer and one (1) heavy coat of aluminum pigmented asphaltic paint on each surface; or where deemed necessary by the Engineer, not less than one (1) course of asphalt saturated cotton fabric cemented to both metals with flashing cement, shall be used.
- B. Finished works shall be cleaned and excess cement removed.
- C. All work shall be adequately anchored in place at proper elevations, planes and locations.

3.08 Adjusting and Cleaning

- A. Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Section 09900, *Painting*.
- B. Galvanized Surfaces
 - 1. Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner.
 - 2. Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A-780.

3. The materials referred to above shall be applied in accordance with the manufacturer's instructions.

END OF SECTION



SECTION 05520 HANDRAILS AND ACCESSORIES

1. GENERAL

1.01 Description

A. This Section includes providing all labor, materials and equipment necessary to fabricate and install aluminum railings and accessories. All handrails shall consist of two (2) horizontal rails.

B. Related Work Specified Elsewhere

Specification Section	Title	
01300	Shop Drawings, Submittals and Samples	
03300	Cast-in-Place Concrete	
05025	Metal Materials, Methods, and Fastenings	
05500	Metal Fabrications	
05510	Metal Stairs and Walkways	
Contract Drawings and General Provisions of the Contract		

1.02 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

Standard	Description
American National Standards Institute (ANSI)	
A21.1	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
A58.1	Minimum Design Loads in Buildings and Other Structures

Standard	Description		
American National Standards Institute (ANSI) - Cont'd			
A117.1	Specifications for Making Buildings and Facilities accessible to and Usable by Physically Handicapped People		
Z97.1	Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Building		
American Societ	American Society for Testing and Materials (ASTM)		
ASTM B-26	Standard Specification for Aluminum-Alloy Sand Castings		
ASTM B-108	Standard Specification for Aluminum-Alloy Permanent Mold Castings		
ASTM B-209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate		
ASTM B-210	Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes		
ASTM B-214	Standard Test Method for Sieve Analysis of Metal Powders		
ASTM B-221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes		
ASTM B-247	Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings		
ASTM B-429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube		
Occupational Sa	fety and Health Administration (OSHA)		
	OSHA Standards, latest edition		
Aluminum Assoc	ciation (AA)		
AA 30	Specifications for Aluminum Structures		
	Aluminum Construction Manual, latest edition		
American Societ	American Society of Civil Engineers (ASCE)		
ASCE 7	Minimum Design Loads for Buildings and Other Structures		
ASCE 8	Specifications for the Design of Cold-Formed Stainless Steel Structural Members		
Miscellaneous			
ABH-21	Aluminum Brazing Handbook		
ASD-1	Aluminum Standards and Data		
DAF-45	Designation System for Aluminum Finishes		
SAA-46	Standards for Anodized Architectural Aluminum		
	Life Safety Code 101		
	AWS "Structural Welding Code"		
	Florida Building Code (Design standards may exceed OSHA Design Standards).		

- B. Obtain each type of handrail, railing and kickplate through one source from a single manufacturer.
- C. Welding, if required depending on the type of handrail identified in this specification section, shall be in accordance with AWS "Standard Qualification Procedure".
- D. The Contractor shall verify handrail and railing dimensions by field measurements prior to preparation of shop drawings and fabrication. Coordinate the fabrication schedule with the construction progress to avoid delaying the Work. Where field dimensions cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails, railing and kickplate without field measurements. Coordinate construction to ensure that the actual dimensions correspond to the established dimensions.
- E. Preassemble items in the shop to the greatest extent possible, so as to minimize splicing and assembly of units at the Project Site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinate installation.

1.03 Performance Requirements

- A. Structural Performance of Handrails and Railing
 - Provide handrails and railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for handrails, railings, anchors, and connections:
 - a. Top rail of guards shall be capable of withstanding the following loads applied as indicated:
 - 1) Concentrated load of 200 lb_f (890 N) applied at any point and in any direction.
 - 2) Uniform load of 50 lb_r/ft (730 N/m) applied horizontally and concurrently with a uniform load of 100 lb_r/ft (1460 N/m) applied vertically downward.
 - 3) Concentrated and uniform loads above need not be assumed to act concurrently.
 - b. Handrails not serving as Top Rails shall be capable of withstanding the following loads applied as indicated:

- 1) Concentrated load of 200 lb_f (890 N) applied at any point and in any direction.
- 2) Uniform load of 50 lb/ft (730 N/m) applied in any direction.
- 3) Concentrated and uniform loads above need not be assumed to act concurrently.
- c. The infill area of guards shall be capable of withstanding a *horizontal* concentrated load of 200 lb_f (890 N) applied to one (1) ft² (0.09 m²) at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.
 - 1) The load above need not be assumed to act concurrently with loads on top rails in determining stress on guard.

B. Thermal Movements

- Provide handrails, railings and kickplate 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 connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
 - a. <u>Temperature Change (Range)</u>: 120 F (67 C), ambient; 180 F (100 C), material surfaces.

C. Control of Corrosion

1. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 Submittals

A. Materials, Shop Drawings and Product Data

- 1. Shop drawings, calculations and product data for aluminum handrailing and accessories shall be submitted for review in conformance with Section 01300, *Shop Drawings, Submittals and Samples*. All shop drawing submittals shall be submitted in an electronic format (PDF). The submittal shall include, at a minimum:
 - a. Layout of fabricated sections.

- b. Removable handrailing and gate details.
- c. Kickplate details.
- d. Safety chain details, if used.
- e. Expansion joint details.
- f. Connection and joining methods and details.
- g. Materials and finishes.
- 2. Show dimensions and reference materials of construction by ASTM designation and grade. Show design criteria.
- Submit erection drawings that indicate locations of the handrail, kickplate, safety chains, etc. Reproductions of the Contract Drawings will not be accepted for this purpose.
- 4. All shop drawings and calculations shall bear the signature and seal of a Professional Engineer registered in the State of Florida.
- 5. Fabrication shall not begin until the Engineer's review is complete and the shop drawings are approved.

1.05 Delivery and Storage

- A. Deliver packaged materials to the site in the manufacturer's original, unopened containers. Arrange deliveries to provide sufficient quantities to permit continuity of erecting of any phase of work.
- B. Deliver such items to the Project Site in time for installation.
- C. Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports in a well ventilated, weather-tight place.
- D. Keep the material free from dirt, grease, and other foreign matter and protect from corrosion.
- E. Stacking shall be done in a way which will prevent bending.
- F. Cover the handrails, railing and kickplate in protective polyethylene wrap to avoid damage to the finish. Keep handling on site to a minimum.

1.06 Coordination and Scheduling

- A. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
- B. Schedule installation so that handrails, railings and kickplate are mounted only on completed walls.
- C. Do not support temporarily by any means that does not satisfy structural performance requirements.

2. PRODUCTS

2.01 Handrails

A. Provide aluminum handrails, railings, kickplate and swing gates where indicated on the Contract Drawings. Railings shall be two-rail, non-welded, forty-two (42) inches high, and of the configurations indicated on the Contract Drawings. *Centerlines of posts and rails shall be in the same plane*.

B. Aluminum

Alloy and temper recommended by the aluminum producer and finisher for the type
of use and finish indicated, and with not less than the strength and durability
properties of alloy and temper designated below for each aluminum form required.

ltem	Material
Extruded Aluminum Bar and Tube	ASTM B-221, Alloy 6063-T5
Extruded Aluminum Structural Pipe and Tube	ASTM B-429, Alloy 6063-T6, minimum nominal diameter of 1½-inches (O.D. of 1.9 inches)
Drawn Aluminum Seamless Tube	ASTM B-210, Alloy 6063-T832
Aluminum Plate and Sheet	ASTM B-209, Alloy 6061-T6
Aluminum Die and Hand Forgings	ASTM B-247, Alloy 6061-T6
Aluminum Casting	ASTM B-108, Alloy 214
Finish	Anodized

- C. Fittings shall be fastened to pipe members by either inert gas shielded metal arc welding as per Alcoa's Welding Alcoa Aluminum, latest edition, or by internal, mechanical, self tapping screws, combined with a stainless steel, blind, rivet-locking component fastener system.
- D. Railings and posts shall be joined by either mechanically-fastened slip-type fittings or an inner-wedge type system. All fittings, elbows, wall returns, and caps shall be flush type. Exposed fasteners shall be set flush or recessed. Post spacing shall not exceed five (5) feet for horizontal railing and four (4) feet for stair railing.
- E. **Posts and rails shall be continuous throughout their sectional lengths**. Curved members shall be formed to true radii, free from dye marks or surface abrasions. Furnish railings in shop fabricated sections, complete with accessories, including gates, hardware, closure caps for rail terminations, base trim, and anchorages. Provide expansion joints at not greater than twenty-four (24) foot spacing.
- F. Provide drain holes in all railings and posts to prevent trapping of moisture.
- G. **Safety Chains at openings between sections of railing will not be allowed**. The Contractor shall provide either a removable section of handrail at these areas or fabricate a hinged swing gate with a locking hasp.
- H. Handrails attached to walls shall be mounted with Type 316 stainless steel brackets. Each bracket shall be fastened with a minimum 3/8-inch diameter stainless steel stud set into the wall and tapped into the bracket. Brackets shall have a 3-inch projection from the wall and shall be uniformly spaced approximately four (4) feet with the end brackets not more than 12-inches from the ends of the handrail.
- I. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work, include, but are not limited to, the following:
 - 1. Golden Railings
 - 2. Alumaguard
 - 3. Craneveyor Corporation
 - 4. Superior Aluminum Products
 - 5. Aluminum Tube Railings
 - 6. Moultrie Manufacturing
 - 7. Or approved equal.

2.02 Kickplates

A. Aluminum kickplates shall be furnished and installed at the edges of all walkways and landings unless noted otherwise on the Contract Drawings

- B. **Clear anodized aluminum kickplates** fabricated of ¼-inch angle or plate stock, depending on the specific walkway edge detail, meeting OSHA requirements and shall project four (4) inches above the walkway surface. Kickplates shall be fabricated from the same material as that of the handrailing. All mounting brackets and hardware shall be Type 316 stainless steel.
- C. Aluminum kickplates and accessories shall be anodized with a clear architectural Class I satin finish. The anodic coating shall be a minimum thickness of 0.7 mils and a minimum coating weight of thirty-two (32) milligrams per square inch, in accordance with the Aluminum Association Designation AA-M12-C22A41.
- D. The kickplates shall not infringe on the minimum walkway width and shall not interfere with the removal of the grating panels.

2.03 Removable Handrailing and Swing Gates

- A. Provide aluminum removable handrailing and swing gates where indicated on the Contract Drawings.
- B. The Contractor shall submit shop drawings of the removable handrailing and swing gates shown on the mechanical drawings. The handrailing shall be of the same material and details required by these specifications.
- C. Aluminum removable handrailing and swing gates shall be anodized with a clear architectural Class I satin finish. The anodic coating shall be a minimum thickness of 0.7 mils and a minimum coating weight of 32 milligrams per square inch, in accordance with the Aluminum Association Designation AA-M12-C22A41.
- D. Removable railings shall have vertical pipe supports fastened as indicated on the Contract Drawings. Unless otherwise indicated, fabricate removable railings in unit sections not over ten (10) feet long with at least three vertical supports, including one at each end.

2.04 Stainless Steel Handrail Safety Chains

- A. Handrail safety chains, where applicable, shall be fabricated from Type 316 stainless steel.
- B. Safety chains shall be of the proof coil style, $^3/_{16}$ -inch in diameter with at least twelve (12) links per foot and with snaphooks at each end. Snaphooks shall be fabricated from Type 316 stainless steel.

2.05 Fasteners and Anchoring

A. Anchorage of Handrails and Railing to Other Construction

1. For aluminum handrailing, use fasteners fabricated from Type 316 stainless steel.

B. Interconnecting Handrails and Railing Components

- 1. Use fasteners fabricated from the same basic material as the fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
- 2. Provide concealed fasteners for interconnecting handrail and railing components and for attaching them to other work, unless otherwise indicated.

C. Cast-in-Place and Post-Installed Anchors

1. Anchors of the type indicated below, fabricated from corrosion resistant materials with the capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry and equal to four (4) times the load imposed when installed in concrete, as determined by testing per ASTM E-488 conducted by a qualified independent testing agency.

2.06 Grout and Anchoring Cement

- A. Non-shrink, non-metallic grout shall be premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C-1107. Provide grout specifically recommended for this type of application.
- B. Erosion resistant Anchoring Cement shall be factory-packaged, non-shrink, non-staining, hydraulically-controlled expansion cement formulation for mixing with water at the Project Site to create pourable anchoring, patching, and grouting compound. Provide a formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by the manufacturer for exterior use

2.07 Fabrication

A. Fabricate handrails and railings to comply with the requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

- B. Assemble handrails and railings in the shop to the greatest extent possible to minimize field splicing and assembly. Disassemble unit only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain the structural value of joined pieces.
- C. Form changes in direction of railing members as follows:
 - 1. As detailed.
 - 2. By bending.
 - 3. By radius bends of the radius indicated.
 - 4. By flush radius bends.
 - 5. By mitering at elbow bends.
 - 6. By inserting prefabricated flush-elbow fittings.
 - 7. By any method indicated above, applicable to the change in direction involved.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- E. Welded Connections NOT USED
- F. Non-welded Connections
 - 1. Fabricate handrails and railings by connecting members with concealed mechanical fasteners and fittings, unless otherwise indicated.
 - 2. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 3. Fabricate splice joints for field connection using an epoxy structural adhesive where this is the manufacturer's standard splicing method.
- G. Welded Connections for Aluminum Pipe NOT USED
- H. Brackets, Flanges, Fittings, and Anchors
 - 1. Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.
- I. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.

- J. For railing posts set in concrete, provide preset sleeves of galvanized steel not less than five (5) inches (150 mm) long with inside dimensions not less than ½-inch (12 mm) greater than the outside dimensions of post, and steel plate forming bottom closure.
- K. For removable railing posts, fabricate slip-fit sockets from steel tube whose ID is sized for a close fit with the posts; limit movement of post without lateral load, measured at the top, to not more than one-fortieth (1/40) of the post height. Provide socket covers designed and fabricated to resist being dislodged.
 - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate as indicated in Article 2.04 herein.
- L. Shear and punch metals cleanly and accurately and remove burrs from exposed edges.
 - M. Ease exposed edges to a radius of approximately $^{1}/_{32}$ -inch (0.8 mm), unless otherwise indicated. Form bent-metal comers to the smallest radius possible without causing grain separation or otherwise impairing the Work.
 - N. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.
 - O. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
 - P. Fabricate joints that will be exposed to weather in a watertight manner.
 - Q. Close exposed ends of handrail and railing members with prefabricated end fittings.
 - R. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is ¼-inch (6 mm) or less.

S. Fillers

- 1. Provide fillers made from suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
- 2. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- T. All work shall be square, plumb, straight and true, accurately fitted with tight joints and intersections. Exposed work shall be finished smooth. The completed work shall conform to both OSHA Standards.

2.08 Aluminum Finishes

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Handrailing, posts, kickplate, and fittings shall be **anodized with a clear architectural Class I satin finish**. The anodic coating shall be a minimum thickness of 0.7 mils and a minimum coating weight of thirty-two (32) milligrams per square inch, in accordance with the Aluminum Association Designation AA-M12-C22A41.

3. EXECUTION

3.01 Examination

- A. Examine all handrails, railing and kickplate. Any damaged materials shall be immediately returned and new materials supplied at no additional cost to the Owner.
- B. Examine the areas and conditions under which handrails, railing and kickplate are to be installed and correct any conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 Dissimilar Metals

- A. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated using not less than one (1) coat of methacrylate lacquer (zinc chromate) primer and one (1) heavy coat of aluminum pigmented asphalt paint on each surface; or where deemed necessary by the Engineer, not less than one (1) course of asphalt saturated cotton fabric cemented to both metals with flashing cement, or neoprene shall be used.
- B. When bronze and aluminum components come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with a heavy coat of a proper primer to be recommended/approved by the aluminum manufacturer.
- C. Finished works shall be cleaned and excess cement and markings removed.

3.03 Preparation

A. Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous

- items having integral anchors which are to be embedded in concrete or masonry construction.
- B. Set embedded metalwork accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete.
- C. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03300. *Cast-in-Place Concrete*.
- D. Coordinate the delivery of such items to the Project site in accordance with the Project Work Schedule.

3.04 Installation

- A. Install handrails, railing and kickplate in accordance with the "approved" shop drawings and the manufacturer's instructions.
- B. Erect work horizontal or parallel to rake of steps or ramps and concrete walls, free from distortion or defects detrimental to appearance or performance.
- C. Perform cutting, drilling, and fitting required for installation of handrails, railing and kickplate. Set the work accurately in location, alignment, and elevation, plumb, level, true and free from rack, measured from established lines and levels.
- D. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
- E. Railings shall be installed by the fabricator or in strict compliance with the fabricator's instructions. Install railings plumb and within a tolerance of \$^1/_{16}\$-inch maximum deviation either side of the longitudinal centerline.
- F. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/8-inch in 12 feet.
- G. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
- H. Posts embedded in concrete shall be set in sleeves with quick-setting non-shrink grout.

- Removable railing units shall be installed freestanding in close fitting pipe sleeves of the same material as the railing. Removable railings shall not be attached to walls or other railings, unless otherwise indicated.
- J. Kickplates shall be installed on all handrailing throughout the Project.

3.05 Railing Connections

A. Non-welded Connections

- 1. Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings.
- 2. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of handrails and railings.
- B. Welded Connections NOT USED

C. Expansion Joints

- 1. Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement.
- 2. Provide slip-joint internal sleeve extending two (2) inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within six (6) inches (150 mm) of post.

3.06 Anchoring Posts

- A. Anchor posts in concrete by means of pipe sleeves set and anchored into the concrete. Provide galvanized steel pipe sleeves, not less than five (5) inches long and having an inside diameter not less than ½-inch greater than the outside diameter of the inserted pipe post. Provide galvanized steel plate closures secured to the bottom of the sleeve and of a width and length of not less than one (1) inch greater than the outside diameter of the sleeve. After the posts have been inserted into the sleeves, fill the annular space with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover the anchorage joint with an aluminum flange finished to match the post.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

- 1. For aluminum pipe railings, attach posts as indicated using fittings designed and engineered for this purpose.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.07 Anchoring Railing Ends

- A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with post-installed anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces using non-welded connections.

3.08 Attaching Handrails to Walls

- A. Attach handrails to wall with wall brackets. Provide a bracket with 1½-inch (38-mm) clearance from the inside face of handrail and finished wall surface.
- B. Locate the brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.09 Protection

- A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Project Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units at no additional cost to the Owner.

3.10 Cleaning

- A. Aluminum Handrails, Railing and Kickplate
 - 1. **Clean all aluminum handrails, railing and kickplate** by washing them thoroughly with clean water and soap and rinsing with clean water.
 - 2. Do not use an acid solution, steel wool or other harsh abrasives.
 - 3. If the stain remains after washing, the piece shall be removed and replaced at no additional cost to the Owner.
- B. Clean all aluminum handrails, railing and kickplate completely and remove all miscellaneous markings and debris prior to the punchlist inspection by the Engineer and Owner.

3.11 Repair of Defective Work

A. Remove stained or otherwise defective work and replace with material that meets the specification requirements, at no additional cost to the Owner.

END OF SECTION

SECTION 05530 GRATING, PLATES AND FRAMES

1. GENERAL

1.01 Description

A. Furnish all labor, materials, and incidentals required to install the aluminum grating, plates and frames, access hatches, structural supporting members, angles, connections, fastenings and concrete inserts attached to or supporting the grating, plates and frames or those structural members as shown on the Contract Drawings, or specified herein.

B. Related Work Specified Elsewhere

Specification Section	Title
05025	Metal Materials, Methods, and Fastenings
05140	Structural Aluminum
05510	Metal Stairs and Walkways
05570	Miscellaneous Metal Assemblies
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION
American Society for Testing and Materials (ASTM)	
ASTM A-240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

STANDARD	DESCRIPTION
American Society for Testing and Materials (ASTM) - Cont'd	
ASTM A-666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM B-209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B-210	Standard Specification for Aluminum & Aluminum-Alloy Drawn Seamless Tubes
ASTM B-221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B-308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B-429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
National Association of Architectural Metal Manufacturers (NAAMM)	
	Metal Bar Grating Manual, latest edition
Aluminum Association	
	Aluminum Construction Manual, latest edition
Miscellaneous	
	AWS "Structural Welding Code"
	Florida Building Code

- B. Obtain each type of material (grating, plates, checkered plate) through one source from a single manufacturer.
- C. Welding, if required depending on the type of handrail identified in this specification section, shall be in accordance with AWS "Standard Qualification Procedure".
- D. The Contractor shall verify all dimensions for grating, plates, checkered plate, etc. by field measurements prior to preparation of shop drawings and fabrication. Coordinate the fabrication schedule with the construction progress to avoid delaying the Work. Where field dimensions cannot be made without delaying the Work, establish dimensions and proceed with fabricating said materials without field measurements. Coordinate construction to ensure that the actual dimensions correspond to the established dimensions.

1.03 Submittals

A. **Submit shop drawings** for review in accordance with Section 00700, *General Conditions*, Section 00800, *Supplementary Conditions*, and Section 01300, *Shop Drawings*, *Submittals and Samples* and in an electronic format (PDF).

- B. Submit drawings of fabricated items, such as grating, access covers, cover plates, etc. Show dimensions and reference the materials of construction by ASTM designation and grade. The Contractor shall also show the design criteria.
- C. Submit structural calculations for the design of the supporting system for all grating, plates and materials identified in this specification section.
- D. Submit *complete fabrication, placing and erection drawings showing the locations of all fabricated items*. Reproductions of the Contract Documents will not be accepted for this purpose.
- E. All shop drawings and structural calculations shall bear the signature and seal of a Professional Engineer registered in the State of Florida.
- F. Fabrication shall not begin until the Engineer's review is complete and the shop drawings have been approved.

1.04 Design Criteria

A. Aluminum grating, floor plates and miscellaneous cover plate systems shall be designed for a *live load of one hundred-fifty pounds per square foot (150 psf) of gross projected area* with a deflection *not to exceed* ¹/₃₆₀ *of the span*.

2. PRODUCTS

2.01 Aluminum Gratings, Floor Plates, Frames and Miscellaneous Cover Plates

- A. All bar grating, frames and miscellaneous cover plates shall be aluminum, unless otherwise indicated on the Contract Drawings. Provide attachment anchors, bearing frames, saddle clips, and all other necessary fastening devices subject to the approval of the Engineer. The design criteria for the grating, frames and plates is detailed in Article 1.04(A) of this specification section.
- B. Provide fastening devices for all gratings adjacent to removable sections and at all locations where the lateral movement of gratings is not otherwise restrained. Sections of grating designated to be removable shall not be fastened.
- C. No single piece of grating, floor plate, etc., **shall weigh more than eighty (80) pounds**.
- D. The length of individual pieces **shall not exceed 1.5 times the width**, unless limited by the installation, and approved by the Engineer.

E. Field measure grating and cover plates for proper cutouts and sizes.

F. Configuration

1. Grating shall be pressure locked aluminum having "I" shaped bearing bars spaced at 1³/₁₆-inch centers with swage-locked crossbars at four (4) inches on center. The grating shall be banded on all sides and at all openings for piping and conduits. Unless otherwise indicated on the Contract Drawings, the size of bearing bars shall be as follows:

Maximum	I-Bar	Rectangular ½" Thick Fran		ne Angle Size
Clear Span	Size	Bar Size	Vertical Leg	Horizontal Leg
3' - 6"	11/4" x 1/4"	1 1/4" x 3/ ₁₆ "	1½"	2"
5' - 0"	1¾" x ¼"	1-3/ ₄ " x 3/ ₁₆ "	2"	2½"
6' - 6"	21/4" x 1/4"	2 1/4" x 3/ ₁₆ "	2½"	3"
7' - 0"	2½" x ¼"	2½" x ³/ ₁₆ "	23/4"	3"

- 2. All grating surfaces shall be of the "slip-resistant" serrated type.
- 3. The minimum width of individual grating pieces shall be fifteen (15) inches, except for locations requiring a single piece and for designated removable sections.

G. Extruded Aluminum Grating

1. In lieu of aluminum bar grating, extruded aluminum grating of the interlocking type may be used, if approved by the Engineer. Extruded grating shall be manufactured from 6063-T6 aluminum alloy and assembled into three (3) foot wide sections. The depth of extruded aluminum grating shall be as follows:

Maximum Clear Span	Grating Depth	Frame Angle Size
2' - 6"	3/4"	1"
4' - 0"	1 1/4"	1½"
5' - 6"	13/4"	2"
7' - 0"	2 1/4"	2½"

H. Materials

- 1. Bearing bars shall be of extruded aluminum meeting all requirements of ASTM B-221-76, Alloy 6061-T6 or 6063-T6. Cross bars shall be drawn or extruded aluminum meeting all requirements of ASTM B-210-76 or B-221-76.
- 2. The frames and supports of gratings shall be aluminum alloy 6061-T6, 6063-T6, or Type 316 stainless steel with a mill finish. Unless otherwise indicated on the Contract Drawings, frames and supports shall be ¼-inch thick with 1-inch by ¼-inch by eight (8) inch long bent bars welded to the frame at eighteen (18) inch centers for embedment in concrete. Corners of embedded angle frames shall be mitered and welded with the welds ground smooth.
- 3. Fabrication shall meet all of the requirements of the NAAMM Metal Bar Grating Manual. The finish shall be mill finish.

4. Welding Electrodes

- a. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 Series.
- b. Welding electrodes for aluminum shall be ER4043 filler metal.
- c. Welding electrodes for stainless steel shall conform to AWS A5.4. Use Electrodes E-308 for Type 304 stainless steel and E316 for Type 316 stainless steel.
- I. Aluminum in contact with concrete or dissimilar metals shall be protected as indicated in Article 3.04(B) of this specification section.

2.02 Aluminum Sheet

A. Aluminum Sheet shall conform to ASTM B-209, Alloy 3003, H-14 temper.

2.03 Aluminum Shapes

- A. Aluminum shapes shall be as indicated on the Contract Drawings and as detailed in Section 3 of the Aluminum Construction Manual.
- B. All aluminum shapes shall meet the requirements of ASTM B-209 or B-308 for Alloy 6061-T6.

2.04 Aluminum Fastenings

- A. Aluminum fasteners shall not be permitted.
- B. All connections of aluminum to aluminum shall be Type 316 stainless steel as required under Article 2.09, Stainless Steel Fastenings, of this Specification Section.

2.05 Access Hatches - NOT USED

2.06 Aluminum Checkered Cover Plates

- A. All checkered plates shall be aluminum, mill finish, and designed for a *live load of 150* pounds per square foot of the gross projected area and a 250 pound concentrated load, with the limits for deflections as specified in Federal Specification RR-G-6610.
- B. All checkered plates shall be fabricated of aluminum and shall have a minimum thickness of 3/8-inch, standard pattern "non-slip" plates of the sizes and shapes shown on the Contract Drawings. Stiffener angles (aluminum) shall be provided as required to meet the superimposed live load requirements specified above. Stiffeners, if utilized, shall be concealed. All checkered plate sections shall be cut to the dimensions shown on the Contract Drawings. Flush type lifting handles shall be provided for each plate, unless otherwise noted on the Contract Drawings.
- C. Aluminum checkered plate shall be 6063-T6 alloy aluminum. Raised lugs shall be diamond shaped and have an angled and opposed pattern.
- D. Provide U-bolt lifting handles located on opposite ends on each removable section. Steel plates, including angle edgings, support angles, and lifting handles shall be Type 316 stainless steel.

2.07 Stainless Steel Shapes

- A. Stainless steel members supporting aluminum grating or members embedded in concrete shall be stainless steel plate AISI, Type 316, formed as indicated.
- B. Anchor straps shall be stainless steel shop welded to the stainless steel shapes.

2.08 Stainless Steel Plate and Members

A. Except where otherwise noted, stainless steel plate and members shall be Type 316 or 316L and shall be in accordance with ASTM A-240 or ASTM A-666.

2.09 Stainless Steel Fastenings

A. Connections of stainless steel to aluminum or concrete shall be stainless steel bolts of AISI Type 316. Nuts shall be AISI Type 430 stainless steel.

2.10 Steel Gratings and Frames - NOT USED

2.11 Checkered Floor Plate

- A. Checkered floor plate shall be fabricated of aluminum or Type 316 stainless steel (as noted on the Contract Drawings) and shall have a non-skid surface pattern approved by the Engineer and shall have a minimum thickness of 3/8-inch.
- B. Plates shall be of such strength and size necessary to carry superimposed vehicular or pedestrian loads. Unless otherwise indicated, *minimum pedestrian live load capacity shall be 150 psf and a 250 pound concentrated load*.
- C. **Deflection under load shall not exceed** $\frac{1}{360}$. Stiffeners, if utilized, shall be concealed.

3. EXECUTION

3.01 Storage of Materials

- A. Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports.
- B. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 Installation and Erection

A. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.

- B. Set grating seats and frames and checkered plate frames and supports accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 03300, Cast-in-Place Concrete.
- C. Set seat angles for grating so that the grating will be flush with the floor. Maintain the grating and floor plates flush with the floor. Seat angles and anchors shall be stainless steel or aluminum, unless otherwise indicated in the drawings.

3.03 Welding

- A. Perform welding on steel by the shielded metal arc welding (SMAW) process. Welding shall conform to the AWS Structural Welding Code-Steel, D1.1-88, except as modified in AISC Section J2.
- B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS Structural Welding Code-Aluminum, D1.2-90.
- C. Perform welding on stainless steel by the gas tungsten arc (TIG) process. All welds shall be full penetration and smooth. Provide inert gas on the inside of pipe during welding to reduce oxidation.
- D. Provide a minimum of two (2) passes for metal in excess of ⁵/₁₆-inch thickness.
- E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, non-uniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.

3.04 Corrosion Protection of Aluminum Surfaces

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 09900, *Painting*, before installation.
- B. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated

using not less than one (1) coat of zinc chromate primer and one (1) heavy coat of aluminum pigmented asphalt paint on each surface; or where deemed necessary by the Engineer, not less than one (1) course of asphalt saturated cotton fabric cemented to both metals with flashing cement, or neoprene shall be used.

- C. Finished works shall be cleaned and excess cement removed.
- D. All work shall be adequately anchored in place at proper elevations, planes and locations. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- E. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets.

END OF SECTION

SECTION 05570

MISCELLANEOUS METAL ASSEMBLIES

1. GENERAL

1.01 Description

A. Scope of Work

1. This Section includes providing all labor, materials and equipment to install miscellaneous metals, shapes and sheets, fittings, plates, lintels, angles, fasteners, wirework, Contractor fabricated pipe and equipment supports, frames, manual barscreens, stop plates, truck guards, etc., not specified elsewhere in these specifications.

B. Related Work Specified Elsewhere

Specification Section	Title	
01300	Shop Drawings, Submittals and Samples	
03300	Cast-in-Place Concrete	
03600	Grout	
05025	Metal Materials, Methods, and Fastenings	
05140	Structural Aluminum	
05500	Metal Fabrications	
05510	Metal Stairs and Walkways	
05520	Handrails and Accessories	
05530	Grating, Plates and Frames	
09900	Painting	
Contract Drawings and General Provisions of the Contract		

1.02 Quality Assurance

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION		
Steel Structures Painting Council (SSPC)			
	Surface Preparation Specifications		
American Societ	ty for Testing and Materials (ASTM)		
ASTM A-36	Standard Specification for Structural Steel		
ASTM A-53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless		
ASTM A-123	Standard Specification for Zinc (Hot-Dipped Galv'd) Coatings on Iron and Steel Products		
ASTM A-167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip		
ASTM A-193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service		
ASTM A-194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both		
ASTM A-500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes		
ASTM A-501	Std Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing		
ASTM B-209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate		
ASTM B-221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes		
ASTM B-241	Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube		
ASTM B-308	Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles		
American Welding Society (AWS)			
AWS A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding		
AWS D1.1	Structural Welding Code - Steel		
Other Standards	Other Standards and Building Codes		
	OSHA Standards		
	AISC Specifications for the Design, Fabrication & Erection of Structural Steel for Bldgs		
	Aluminum Construction Manual, latest edition, by the Aluminum Association		
	Florida Building Code		

1.03 Submittals

- A. **Submit shop drawings** for review in accordance with Section 00700, *General Conditions*, Section 00800, *Supplementary Conditions*, and Section 01300, *Shop Drawings, Submittals and Samples*. All submittals shall be in an electronic format (PDF).
- B. Submit drawings of fabricated miscellaneous metal assemblies/items and show, at a minimum, the following:
 - 1. Assembly dimensions, sizes of members, method of assembly, anchorage, and connection to other members.
 - 2. Reference the materials of construction by ASTM designation and grade.
 - 3. Assembly design criteria.
- C. The Contractor shall submit complete fabrication, placing and erection drawings showing the locations of all fabricated items. Reproductions of the Contract Documents will not be accepted for this purpose.
- D. All shop drawings and structural calculations shall bear the signature and seal of a Professional Engineer registered in the State of Florida.
- E. Fabrication shall not begin until the Engineer's review is complete and the shop drawings have been approved.

1.04 Coordination and Scheduling

- A. The work of this Section shall be completely coordinated with the work of other Sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items specified herein.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.
- C. 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, as necessary for the miscellaneous metal assemblies.
- D. Do not support temporarily by any means that does not satisfy structural performance requirements.

1.05 Delivery, Storage and Handling

- A. Deliver packaged materials to the site in the manufacturer's original, unopened containers. Deliver materials to the site at such time intervals to insure uninterrupted progress of the Work.
- B. Deliver anchor bolts and other anchorage devices which are to be embedded in cast-inplace concrete or masonry, in sufficient time to permit their timely installation. Provide proper setting drawings, templates and directions for installation of these items.
- C. Store materials to permit easy access for inspection and identification. Store miscellaneous metal assemblies, either plain or fabricated, above ground on platforms, skids, or other supports in a well ventilated, weather-tight place.
- D. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
- E. Do not store materials on the structure in a manner that may cause distortion, damage, or overload to members or supporting structures.
- F. Store all fasteners and welding electrodes in a weather-tight and dry place until ready for use.
- G. Keep the material free from dirt, grease, and other foreign matter and protect from corrosion
- H. Store packaged materials in their original containers. Stacking shall be done in a way which will prevent bending or damage to the materials or their finishes.
- I. Repair or replace damaged materials or structures as directed.

2. PRODUCTS

2.01 Structural Steel

A. Miscellaneous steel plates, shapes, bars, etc., and connections shall conform to the requirements of ASTM Designation A-36 and shall be galvanized by the hot dip method after fabrication in accordance with ASTM Designation A-123.

2.02 Steel Pipe

A. Steel pipe used for miscellaneous members and connections shall conform to the requirements of ASTM Designation A-53, Schedule 40, galvanized, except as noted.

2.03 Hot-Dip Galvanizing (Zinc Coatings)

- A. Hot dip galvanizing or zinc coatings applied on products fabricated from rolled, pressed or forged steel shapes, plates, bars and strips shall comply with ASTM A-123. The weight of coatings shall be designated in the ASTM Standard for the class and thickness of material to be coated.
- B. Galvanized surfaces for which a shop coat of paint is specified shall be chemically treated to provide a bond for the paint.
- C. Except for bolts and nuts, all galvanizing shall be done after fabrication.

2.04 Stainless Steel

- A. Except where otherwise specified, use Type 316, ASTM A-167 stainless steel plate, members and washers.
- B. Use ASTM A-193, Grade B8M bolts and ASTM A-194, Grade 8M nuts.

2.05 Structural Aluminum

- A. The Contractor shall refer to the requirements of Section 05140, *Structural Aluminum*.
- B. Aluminum Structural members shall conform to ASTM B-308, Alloy 6063-T6.
- C. Aluminum bars and rods shall conform to ASTM B-221, Alloy 6063-T6.
- D. Miscellaneous structural aluminum shapes and plates shall conform to ASTM B-241, Alloy 6063-T6.
- E. Aluminum sheet shall conform to ASTM B-209, Alloy 3003, H 14 temper.
- F. Aluminum seamless pipe and tubing shall conform to ASTM B-241, Alloy 6063-T6. Wall thickness shall be Schedule 80, per ANSI H35.2, unless otherwise shown on the Drawings.

2.06 Welding Electrodes

A. Welding electrodes for structural steel shall conform to AWS A5.5, E70XX. Use 4043 filler metal for aluminum.

- B. Use a type E308 electrode where the base metal is Type 304 stainless steel and type E309 where the base metal is Type 316 stainless steel or when stainless steel is welded to carbon steel.
- C. Field welding of galvanized steel shall not be acceptable.

2.07 Materials, Fabrication, and Connections

- A. Materials, fabrication, shop coatings, and fasteners and connections shall comply with Section 05025, *Metal Materials, Methods and Fastening*.
- B. Bolts for securing equipment, above grade piping and aluminum structures shall be stainless steel.

C. Anchor Bolts and Fasteners

- Anchor bolts securing equipment or any assemblies subject to vibrations or movements, shall be stainless steel hook anchors conforming to ANSI 316 and ASTM A-193, Grade B8M, unless otherwise noted. Hook anchors shall be to the farthermost layer of reinforcing.
- 2. The minimum length protruding from the face of the concrete shall be six (6) inches and the minimum length of the hook shall be six (6) inches. All dimensions and sizes of anchor bolt shall comply with the manufacturer's recommendations.
- 3. Anchor bolts and fasteners not securing equipment or assemblies subject to vibrations or movements, shall be stainless steel wedge or adhesive anchors conforming to ANSI 316 and ASTM A-193, Grade B8M, unless otherwise noted. Wedge anchors shall be as manufactured by "HILTI" or approved equal. Adhesive anchors shall consist of a self-contained vinylester adhesive cartridge and anchor rods. Adhesive anchors shall be AVA adhesive anchoring system as manufactured by "HILTI", or approved equal.
- 4. Where steel anchors are indicated, use a one-piece design with expander ring consisting of steel zinc coated and chrome plated as manufactured by McCullough Industries, Kwik Bolt, or equal.

2.08 Caged Ladder - NOT USED

2.09 Aluminum Stairs

A. The Contractor shall refer to Specification Section 05510, *Metal Stairs and Walkways*.

2.10 Aluminum Stair Treads and Nosings

A. The Contractor shall refer to Specification Section 05510, *Metal Stairs and Walkways*.

2.11 Castings - NOT USED

2.12 Lintels, Plates, and Miscellaneous Angles

- A. Provide lintels, plates, and miscellaneous angles as indicated on the Contract Drawings or required.
- B. Lintels shall have a minimum eight (8) inch bearing at each end unless otherwise indicated. Weld or bolt members together to form a complete assembly.
- C. Install plates and angles as indicated on the Contract Drawings. Where bolts and straps are shown, attached to plates, angles, and lintels, provide a 1¾-inch diameter by fifteen (15) inch long anchor bolt or 2¼-inch by one (1) inch by eight (8) inch long strap anchor at each end, unless otherwise indicated on the Contract Drawings.
- D. Properly embed fasteners into concrete or masonry.

2.13 Equipment Supports

- A. Provide equipment supports as indicated on the Contract Drawings or required to support and anchor mechanical equipment, including roof-mounted items.
- B. The Contractor shall **verify with the equipment manufacturer** that the supports are ample for the equipment being supported.
- C. A certification letter from the equipment supplier and Contractor shall be submitted to the Engineer during the shop drawing review process.

2.14 Fabricated Frames

A. Provide fabricated frames for openings in floors and walls as indicated on the Contract Drawings. Construct frames of channels, angles, and flat or bent plates or combinations of shapes and materials as detailed using non-corrosive materials for the environment in which they are to be constructed.

- B. Frames shall be accurately squared, mitered, butted, or coped as necessary, shall be fully welded, and all welds on exposed surfaces shall be ground smooth.
- C. Weld straps or anchors of sizes and spacing indicated to the back of frames for anchoring into concrete or masonry. Where size and spacing of anchors are not indicated, use 1/4-inch x 2" x 8" straps with ends hooked two (2) inches, and space the straps not more than eighteen (18) inches apart.
- D. Frames shall be aligned and accurately leveled to finish flush with adjacent surfaces.

2.15 Pit and Trench Covers and Frames

- A. Provide frames and non-skid plate covers where indicated on the Contract Drawings. Unless otherwise indicated, provide one (1) inch x eight (8) inch long bent bar anchors, welded to frames and spaced not more than eighteen (18) inches on center.
- B. Frames shall be aligned and accurately leveled to finish flush with adjacent surfaces. Covers shall be in sections not more than four feet long and shall abut adjacent cover leaving no discernable gaps. The covers shall have a minimum thickness of 3/8-inch.
- C. Provide hinges and suitable lift-holes near the ends of each section of cover.
- D. **Provide H-20 loading covers where indicated** on the Contract Documents.
- E. The Contractor is responsible for providing the design and structural support for all frames and covers.

2.16 Bollards (Truck Guards)

- A. Provide truck guards (bollards) and covers where indicated on the Contract Drawings. *The bollards shall be 7-inch (galvanized) standard weight steel pipe* as specified in ASTM A-53.
- B. Anchor posts in concrete as indicated and fill solidly with Class B (3,000 psi) concrete conforming to Section 03300, *Cast-in-Place Concrete*.

C. Bollard Covers

1. The bollard cover (post sleeve) shall be of the blow molded type, constructed from 1/8-inch thick High-Density Polyethylene (HDPE) for weather resistant durability and long service life.

- 2. The bollard covers shall have a bright "safety yellow" color with UV stabilizers for protection from the sun and dual 3M "red" reflective-tape bands shall be integrally provided for enhanced visibility for day and night protection.
- 3. The bollard covers shall be as manufactured by Thermoprene, Inc., or approved equal.

2.17 Stainless Steel Safety Chains

- A. Safety chains shall be fabricated from *Type 316 stainless steel, proof coil style,*³/₁₆-*inch diameter, with a minimum of twelve (12) links per foot*, and with snap hooks
 on each end and installed where indicated on the Contract Drawings.
- B. Snap hooks shall be boat type and eye bolts for attachment of chains shall be fabricated of Type 316 stainless steel 3/8-inch bolt with 3/4-inch eye diameter, anchored as indicated.
- C. Two (2) chains, four (4) inches longer than the anchorage spacing, shall be supplied for each guarded area and shall be mounted 3.5 feet and 2.0 feet above the floor.
- 2.18 Manual Barscreen NOT USED
- 2.19 Drain Trays NOT USED
- 2.20 Catch Basin Grating NOT USED
- 2.21 Guard Rails NOT USED

2.22 Stop Plates and Grooves

A. Stop Plates for weirs and baffles shall be fabricated from 3/8-inch minimum aluminum alloy 6061-T6 or 6063-T6 or fiberglass, as indicated on the Contract Drawings. Corners shall be rounded approximately 1/8-inch radius for smooth sliding.

- B. Stop Plate Grooves for weirs and baffles shall be extruded aluminum alloys 6061-T6 or 6063-T6 as indicated on the Contract Drawings. Grooves shall be one piece, have integral concrete anchors and welded miter corners, and be designed for the thickness of stop plates plus 1/8-inch. Grooves shall be as manufactured by Washington Aluminum Co., Baltimore, MD; Neenah Foundry Co., Neenah, WI; or equal. All aluminum in contact with or embedded in concrete shall be protected in accordance with the AA Specification.
- C. Aluminum Angles shall be attached in pairs to form grooves on the face of existing concrete. Use 2-inch by 2-inch by 3/8-inch angles and expansion anchors, unless otherwise indicated on the Contract Drawings. Protect all aluminum in contact with dissimilar materials in accordance with AA recommendations.

3. EXECUTION

3.01 Installation

A. <u>General</u>

- 1. Insofar as possible, fabricated material shall be fitted and shop assembled ready for erection.
- 2. Welding and equipment shall conform to the American Welding Society's (AWS) Code for Welding in Building Construction, latest edition.
- 3. All work shall be square, plumb and true, accurately fitted with tight joints and intersections. Exposed work shall be finished smooth with welds ground smooth.

B. Fabrication and Erection

- Fabricate miscellaneous metal items to straight lines and true curves. *Drilling and punching shall not leave "burrs" or "deformations"*. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth.
- 2. **Joints shall have a close fit** with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded. All bolt holes shall be ¹/₁₆-inch in diameter larger than bolt size.

- 3. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.
- 4. Clean the surfaces of metalwork to be in contact with concrete of any rust, dirt, grease, and other foreign substances before placing concrete.
- Set embedded metalwork accurately in position when concrete is placed and supported rigidly to prevent displacement or undue vibration during or after the placement of concrete.
- 6. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with grout in conformance with Section 03600, *Grout*.

C. Welding

- 1. Welding on steel shall be performed by the Shielded Metal Arc Welding (SMAW) process. Welding procedures shall comply with AWS B3.0.
- 2. Welding on aluminum shall be performed by the Gas Metal Arc (MIG) or Gas Tungsten Arc (TIG) process, per the AWS Welding Handbook.
- 3. Provide a minimum of two (2) passes for metal of $^{3}/_{16}$ -inch thickness plus one (1) additional pass for each additional 1/8-inch in metal thickness.
- 4. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal.
- 5. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size.
- 6. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.

D. Anchor Bolts and Anchors

- Preset bolts and anchors by the use of templates. Do not use concrete anchors set in holes drilled in the concrete after the concrete is placed in place of cast-inplace anchor bolts.
- 2. After anchor bolts have been embedded, protect their threads by applying grease and by having the nuts screwed on until the time of installation of the equipment or metalwork.

E. Control of Flame Cutting

- 1. Do not use flame cutting by the use of a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing.
- 2. Use a flame-cutting torch only on minor members when the member is not under stress.

F. Repair of Galvanized Surfaces

- 1. The Contractor shall repair or replace all metal with damaged galvanized surfaces at no additional cost to the Owner.
- 2. The repair of galvanized surfaces shall be affected by use of the following, or equal, applied in accordance with the manufacturer's instructions:
 - a. DRYGALV as manufactured by the American Solder and Flux Company.
 - b. Cold Galvanizing Repair Compound as manufactured by Rust-O-leum.

G. Painting and Protective Coating

- 1. All ferrous metal, except stainless steel and galvanized surfaces, shall be properly cleaned and given one shop coat of the fabricator's standard primer (compatible with the metal being used).
- 2. Anchors that are built into masonry shall be coated with asphalt paint unless specified to be galvanized.
- 3. Metal work to be encased in concrete shall be left unpainted unless specified or noted otherwise.
- 4. Where hot-dip galvanized or zinc coated metal is specified or shown, it shall be shop primed unless specifically not required.
- 5. Castings that are to be left unpainted shall be cleaned and coated with a coal-tarpitch varnish.
- 6. Aluminum to be placed adjacent to masonry or dissimilar metals shall be protected with an isolating coating of bitumastic and/or felt.
- 7. The Contractor is referred to Section 09900, *Painting*, for any additional painting and/or protective coating requirements.

H. Dissimilar Metal Contact

- 1. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be separated using not less than one (1) coat of zinc chromate primer and one (1) heavy coat of aluminum pigmented asphalt paint on each surface; or where deemed necessary by the Engineer, not less than one (1) course of asphalt saturated cotton fabric cemented to both metals with flashing cement, shall be used. Neoprene can also be used as approved by the Engineer.
- 2. Finished works shall be cleaned and excess cement removed.
- All work shall be adequately anchored in place at proper elevations, planes and locations.

I. <u>Installing Pipe Bollards</u>

- 1. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into the sleeves, fill the annular space between the bollard and sleeve solidly with non-shrink, non-metallic grout, mixed and placed to comply with the grout manufacturer's directions.
- 2. Fill bollards solidly with concrete, mounding the top surface.
- 3. Clean the exterior of the bollards of all concrete spoils, debris and other materials. Install the pipe bollard covers in accordance with the manufacturers instructions.
- J. Clean all miscellaneous metal assemblies and remove any markings by washing them thoroughly with clean water and soap and rinsing with clean water. Do not use an acid solution, steel wool or other harsh abrasives. If any staining remains after washing, the piece shall be removed and replaced at no additional cost to the Owner.
- K. Remove stained or otherwise defective work and replace with material that meets the specification requirements, at no additional cost to the Owner.

END OF SECTION

SECTION 06600 FABRICATED FIBERGLASS REINFORCED PLASTIC (FRP) PRODUCTS

1. GENERAL

1.01 Description

- A. This Section covers Fiberglass Reinforced Plastic (FRP) products for use on this Project. Applications include, but are not limited to, miscellaneous shapes, structural components and other specified items for use in reclaimed water, wastewater and sodium hypochlorite disinfection processes.
- B. Related Work Specified Elsewhere
 - 1. Equipment: Division 11

1.02 Qualifications and Experience of the Manufacturer

- A. The Manufacturer shall be a specialist in the design and fabrication of Fiberglass Reinforced Plastic (FRP) products intended for use in wastewater and biosolids applications, and **shall have at least five (5) years experience in this specialty**.
- B. The Manufacturer shall have such production facilities as will insure prompt manufacture and shipment of these fiberglass products. The Manufacturer shall continually monitor production in order to insure that the control of quality is maintained. Upon request, the Manufacturer shall furnish certified test reports on the raw materials used in fabrication.
- C. The Manufacturer shall have on his staff a full-time registered professional engineer having no less than five (5) years experience in the design and fabrication of fiberglass reinforced plastic products, who will be in responsible engineering charge of the work to be done. All shop drawings shall carry the seal of such registered Professional Engineer.

1.03 Quality Assurance

A. Reference Standards

1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

STANDARD	DESCRIPTION		
American Society for Testing and Materials (ASTM)			
ASTM D-570	Standard Test Method for Water Absorption of Plastics		
ASTM D-635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position		
ASTM D-638	Standard Test Method for Tensile Properties of Plastics		
ASTM D-695	Standard Test Method for Compressive Properties of Rigid Plastics		
ASTM D-732	Standard Test Method for Shear Strength of Plastics by Punch Tool		
ASTM D-790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials		
ASTM D-792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement		
ASTM E-84	Standard Test Method for Surface Burning Characteristics of Building Materials		
Other Standards			
	National Bureau of Standards, Voluntary Product Standard PS 15		
	Florida Building Code		

1.04 Shop Drawings

A. Shop Drawings and Manufacturers Literature

- For all fiberglass reinforce plastic components and products to be furnished under this section, the Contractor shall submit all material required to establish compliance with this Section and Section 01300, Shop Drawings, Submittals and Samples. All submittals shall be in an electronic format (PDF).
- 2. The Shop Drawings shall indicate the specific dimensions and thicknesses.
- 3. A detail of the intended support members with certification demonstrating their adequacy for the application and intended loads.

- 4. Submit color samples for selection of colors.
- 5. The Shop Drawings must be approved by the Engineer before production may proceed.
- B. The Manufacturer shall secure from the appropriate regulatory agencies, approval for the use of its Fiberglass Reinforced Plastic (FRP) products for use in wastewater, reclaimed water and sodium hypochlorite disinfection applications, if required by the Project.

1.05 Design

- A. The assembled Fiberglass Reinforced Plastic (FRP) products, anchoring systems and each of their structural components, both laminated and prefabricated, **shall be designed for all live and dead loads, including 140 mph winds**.
- B. Empirical designs of assembled Fiberglass Reinforced Plastic (FRP) products shall be acceptable provided they are substantiated by a satisfactory service history of **no less than ten (10) years**.

1.06 Warranty and Guarantees

- A. The Manufacturer shall guarantee workmanship and materials on the finished fiberglass reinforced plastic products for a period of five (5) years from the date of Final Project Acceptance by the Owner.
- B. If defects appear within the five (5) year period, the Manufacturer shall proceed to replace said components or equipment, upon written notice from the Owner that such defects have been found, immediately, and at no additional cost to the Owner.
- C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.
- D. Refer to the General Conditions for additional guarantee and warranty requirements as well as Section 01740. *Warranties and Bonds*.

1.07 Product Delivery, Storage and Handling

A. The manufacturer shall examine all FRP products and components prior to packaging and delivery to the Project Site and shall provide a letter to the Engineer, submitted at

the time of shipping, indicating that the products produced meet the requirements of the specifications, were examined prior to delivery, and were shipped free of defects and of high workmanship quality.

- B. All equipment and accessories shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is complete and the equipment is ready for operation.
- C. Upon delivery of the FRP components to the Project Site, the Contractor shall inspect the components for damage during transit. *If damage has occurred, the FRP components shall be returned to the manufacturer and components shall be provided at no additional cost to the Owner*.
- D. The Contractor shall handle the FRP components during delivery, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved written instructions and in accordance with instructions given on-site by the manufacturer's representative.

1. PRODUCTS

1.01 Resins

A. Polyester Resin

- 1. The Resin shall be a polyester material, possessing inherent UV (UV-8 or greater), fire, and chemical resistance. The resin material shall be fire rated for Class I flame spread and flammability ratings as per ASTM E-84 and D-635.
- 2. **The resin shall be of a commercial grade** that has been evaluated by the testing of previous service, and found to be acceptable for the specific environment.
- 3. The resin shall be resistant to the corrosive nature and action of water, wastewater, and sodium hypochlorite disinfected reclaimed water.

B. Catalyst

- 1. The polyester resin shall be cured by polymerization in a hard, rigid, solid product.
- 2. The catalyst used for polymerization shall be MEK peroxide, Reichhold 46-700 or approved equal.

C. Gel Coat

- 1. Gel Coat shall consist of polyester resin, a catalyst, and a colorant. White gel coat shall be Ferro VF-4060, or approved equal.
- 2. Green gel coat shall be Ferro VF8640, or approved equal.

1.02 Glass Fiber Reinforcing Materials

- A. Glass fiber reinforcing materials shall be of commercial grade.
- B. To insure chemical adherence between the glass reinforcement and the polyester resin, a special silane treatment shall be applied to the glass filaments. One or more of the following glass fiber reinforcing materials shall be used:

1. Chopped Roving

a. Multiple strands of monofilament glass fibers made into a continuous untwisted ribbon and automatically chopped to approximately one (1) inch lengths, and placed by machine in the spray-up method of fiberglass manufacture.

2. Reinforcing Mat

- a. Made from roving chopped to approximately two (2) inch lengths, then uniformly dispersed and manufactured into a smooth mat with weights ranging from ¾ oz. to 1½ oz. per square foot, suitable for the hand lay-up method of fiberglass manufacture.
- b. In the manufacture of the reinforcing mat, the glass strands shall be bonded together into the mat shape with a styrene soluble binder.

3. Woven Roving

a. Made from continuous roving, and woven into a heavy fabric suitable for the hand lay-up method of fiberglass manufacture.

4. Woven Cloth and Tape

a. Made from twisted yarns of glass fiber strands, and woven into a light fabric suitable for the hand lay-up method of fiberglass manufacture.

1.03 Laminated Fiberglass Components

A. Laminate Construction

- 1. Laminated fiberglass components shall be manufactured by a combination of the spray-up method and the hand lay-out method.
- The laminate shall consist of a series of resin and glass reinforcement applied upon a mold made specifically for the end product being manufactured. The surface of the mold shall be free of cracks, pits and crazing. The mold shall have a smooth surface finish.
- 3. The initial coating placed against the mold shall be a gel coat of no less than 20 to 25 mils thick. VF-4060 white gel coat shall be used for molded surfaces which will be exposed to the weather. VF-8640 green gel coat shall be used for molded surfaces that may be exposed to wastewater or domestic biosolids.
- 4. The second layer in the laminate shall be no less than twenty-five (25) mils thick and shall consist of polyester resin reinforced with no less than thirty percent (30%) chopped roving and reinforcing mat.
- 5. The remaining thickness of the laminate shall be designed and manufactured to provide the strength necessary to meet tensile and flexural requirements and shall consist of layers of polyester resin and any one of a combination of glass fiber reinforcing materials described under Article 2.02 herein.
- 6. If multiple layers of woven roving or woven cloth are used, a layer of chopped roving shall be placed in alternate layers.
- 7. The glass fiber content of the completed laminate shall be no less than thirty percent (30%) by weight. Throughout the laminate, the resin shall thoroughly saturate the glass fiber reinforcement.

B. Laminate Appearance

- 1. **The fiberglass product shall be of uniformly high quality**. The finished mold surface shall be free of visual defects, foreign inclusions, dry spots, crazing, air bubbles, pin holes and delaminations. The edges shall be straight and true.
- 2. The finished lay-up surface shall be smooth and shall be thoroughly coated with gel coat. There shall be no exposed glass fibers or sharp projections. All cut edges shall be straight, and shall be coated with gel coat so that no glass fibers are exposed, and so that all voids are filled.

C. Laminate Thickness

- 1. The fiberglass reinforced plastic laminate shall have **a thickness of no less than 1/4-inch**.
- 2. At no point in the laminate shall the thickness be less than this minimum.

D. Laminate Properties

1. The fiberglass reinforced plastic laminate shall have the following physical properties, and where required, shall be tested in accordance with the ASTM Standards indicated:

Physical Property	Value	ASTM Standard
Water Absorption, 24 hours	0.50%	D-570
Ultimate Tensile Strength	30,000 psi	D-638
Ultimate Compressive Strength	30,000 psi	D-695
Ultimate Shear Strength	15,000 psi	D-732
Ultimate Flexural Strength	30,000 psi	D-790
Specific Gravity	1.5	D-792

2. The design of all components shall use a factor of safety of 4.0 based on the ultimate strength.

3. The average Barcol hardness of the laminate shall be no less than 30. The Barcol Impressor, Model GYZJ 934-1, shall be used for the determination of the hardness. Calibration of the Barcol instrument shall be verified by comparing a blank specimen having a known hardness reading of 85 - 87. For each fiberglass component, ten (10) readings on the clean laminate surface shall be made. After eliminating the two high and two low readings, the average of the remainder shall be the reported hardness reading.

1.04 Prefabricated Fiberglass Structural Components

A. Prefabricated structural components used in the manufacture of all fiberglass products shall be made of polyester resin reinforced with glass fibers and produced by a continuous forming process.

B. Prefabricated structural components shall have the following physical properties:

Physical Property	Value	ASTM Standard
Water Absorption, 24 hours	0.75%	D-570
Ultimate Tensile Strength	30,000 psi	D-638
Ultimate Compressive Strength	30,000 psi	D-695
Ultimate Shear Strength	4,500 psi	D-732
Ultimate Bearing Strength	30,000	
Specific Gravity	1.5	D-792
Barcol Hardness	50	

C. The design of all components shall use a factor of safety of 4.0 based on the ultimate strength.

1.05 Fasteners

A. Chemical Application Areas

 All fasteners used in the assembly and erection of fiberglass reinforced plastic products, in chemical application areas, shall be *chemical and corrosion resistant fasteners*, provided by the manufacturer, for the particular type of chemical being used in an area.

B. Non-Chemical Application Areas

- 1. All fasteners used in the assembly and erection of fiberglass reinforced plastic products, in non-chemical application areas, shall be Type 316 stainless steel.
- C. A ratio of fastener diameter to fiberglass thickness (D/t) of no less than one (1) shall be used.

3. EXECUTION

3.01 Inspection

- A. The FRP products shall be inspected by the manufacturer prior to delivery and by the Contractor at time of delivery to ensure that the products are free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burrs, air bubbles and pits.
- B. Any defective or improperly fabricated FRP products shall either not be shipped from the manufacturer or shall be returned to the manufacturer, by the Contractor, at the time of delivery. All FRP products shall be "new" and any defective grating or ancillary materials shall be rejected and replaced immediately at no additional cost to the Owner.

3.02 Installation

- A. The Contractor shall install all grating and ancillary materials in strict accordance with the manufacturer's instruction and erection drawings. Fiberglass products shall be installed at the locations shown on the Contract Drawings.
- B. All work shall be erected level and plumb, and shall meet required heights, layout and details precisely. All work shall be adequately fastened, anchored or braced. All fasteners shall be corrosion resistant and compatible for use with the fluid or chemical being used in the area of erection. All fasteners shall be as indicated in Article 2.05 herein.
- C. All work shall be executed in accordance with the best practices of the trade, by persons skilled in the craft.
- D. Installation shall be in strict accordance with the manufacturer's instructions and recommendations

3.03 Inspection and Testing

A. A final acceptance test shall demonstrate that the fiberglass products have been properly installed, are structurally sound and secure, are in the correct alignment and meet the loading requirements specified herein.

END OF SECTION

SECTION 06605

FIBERGLASS REINFORCED PLASTIC (FRP) GRATING

1. GENERAL

1.01 Description

A. Furnish all labor, materials, equipment and incidentals to design, fabricate and install a fiberglass reinforced plastic (FRP) grating system, and associated miscellaneous items specified herein, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings (covering of pipe trench) and as specified herein, and in accordance with the requirements of the Contract Documents.

1.02 Quality Assurance

A. Reference Standards

1. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

STANDARD	DESCRIPTION		
American Society for Testing and Materials (ASTM)			
ASTM D-635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position		
ASTM E-84	Standard Test Method for Surface Burning Characteristics of Building Materials		
Other Standards			
	National Bureau of Standards, Voluntary Product Standard PS 15		
	OSHA Standards (pertaining to worker safety and walking/working surfaces)		
	Florida Building Code		

- B. Obtain each type of material (grating, embedding frames, supports, plates, etc.) through one source from a single manufacturer.
- C. The Contractor shall verify all dimensions for grating, plates, supports, etc. by field measurements prior to preparation of shop drawings and fabrication. Coordinate the fabrication schedule with the construction progress to avoid delaying the Work. Where field dimensions cannot be made without delaying the Work, establish dimensions and proceed with fabricating said materials without field measurements. Coordinate construction to ensure that the actual dimensions correspond to the established dimensions.

1.03 Qualifications and Experience of the Manufacturer

- A. The Manufacturer shall be a specialist in the design and fabrication of fiberglass reinforced plastic (FRP) grating and structural shapes intended for use in wastewater applications, and **shall have at least five (5) years experience in this specialty**.
- B. The Manufacturer shall have such production facilities as will insure prompt manufacture and shipment of these fiberglass products. The Manufacturer shall continually monitor production in order to insure that the control of quality is maintained. Upon request, the Manufacturer shall furnish certified test reports on the raw materials used in fabrication.
- C. The Manufacturer shall have on his staff a full-time registered professional engineer having no less than five (5) years experience in the design and fabrication of fiberglass reinforced plastic products, who will be in responsible engineering charge of the work to be done. All shop drawings shall carry the seal of such registered Professional Engineer.

1.04 Shop Drawings

- A. Prior to beginning fabrication, the Manufacturer shall submit a complete set of detailed shop drawings for the FRP products to be furnished in accordance with Section 01300, *Shop Drawings, Submittals and Samples* and in an electronic format (PDF). The shop drawings shall include, at a minimum, the following:
 - 1. Structural engineering calculations and a structural grating support design by a Structural Engineer registered in the State of Florida.
 - 2. Load and deflection tables.
 - 3. Material sizes, types and styles, dimensions and thicknesses.

- 4. The manufacturer shall provide color samples for selection by the Engineer and Owner.
- 5. Part or catalog numbers.
 - 6. The Contractor shall submit complete fabrication, placing and erection drawings showing the locations of all fabricated items including location, type and sizes of fasteners, clips, angles, member sizes and connection details. Reproductions of the Contract Documents will not be accepted for this purpose.
 - B. The Contractor shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.
 - C. The Contractor shall submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.
 - D. The shop drawings must be approved by the Engineer before production may proceed.

1.05 Product Delivery and Storage

- A. The manufacturer shall examine all FRP products and components prior to packaging and delivery to the Project Site and shall *provide a letter to the Engineer*, submitted at the time of shipping, indicating that the products produced meet the requirements of the specifications, were examined prior to delivery, and were shipped free of defects and of high workmanship quality.
- B. All equipment and accessories shall be *properly protected so that no damage or deterioration will occur during a prolonged delay* from the time of shipment until installation is complete and the equipment is ready for operation.
- C. Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer.
- D. Upon delivery of the FRP components to the Project Site, *the Contractor shall inspect the components for damage during transit*. If damage has occurred, the FRP components shall be returned to the manufacturer and components shall be provided at no additional cost to the Owner.

- E. The Contractor shall handle the FRP components during delivery, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved written instructions and in accordance with instructions given on-site by the manufacturer's representative. All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage.
- F. Store items in an enclosed area, *off of the ground*, and free from contact with soil and water.
- G. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility between 70 and 85 F (21 and 29 C) until they are required.

1.06 Warranty and Guarantee

- A. The Manufacturer shall guarantee workmanship and materials on the finished fiberglass reinforced plastic products for a minimum period of five (5) years from the date of Final Project Acceptance by the Owner.
- B. If defects appear within the warranty/guarantee period, the *Manufacturer shall* proceed to replace said components or equipment, upon written notice from the Owner that such defects have been found, immediately, and at no additional cost to the Owner.
- C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.
- D. Refer to the General Conditions for additional guarantee and warranty requirements as well as Section 01740, *Warranties and Bonds*.

2. PRODUCTS

2.01 General

- A. Products shall be furnished by manufacturers having a minimum of five (5) years experience in the manufacture of similar items with a record of successful installations.
- B. Support members shall be as designed for the particular application by the fabricator to ensure functionality, integrity and structural stability.

2.02 Materials

A. Grating

- 1. Reference is made here to Division 5, *Metals*, for requirements of material fastenings. All metal fastening systems and hardware shall be corrosion resistant and suitable for use with sodium hypochlorite, biosolids and raw wastewater.
- 2. All fiberglass grating, located where indicated on the Contract Drawings, shall be a minimum of 1½-inches in depth, and able to withstand a 350 lb. concentrated load and a 150 lb/ft² uniformly distributed load on a four (4) foot span with a deflection no greater than 0.15 inches under the concentrated load.
- 3. The depth of the fiberglass grating shall be determined by the manufacturer in accordance with the span and load requirements shown on the Contract Drawings.
- 4. The fiberglass grating shall be pulltruded from standard fiberglass chemical resistant vinylester resin which meets ASTM E-84, Class 1, Flame Rating, and self-extinguishing requirements of ASTM D-635.
- 5. Cut edges or cut openings shall be sealed.
- 6. The grating shall be manufactured with an integral grit molded into the surface to provide an non-skid walking surface. Color shall be selected by the Owner.
- 7. Grating support members shall be of similar resin material as grating, fastened to concrete as per manufacturer's recommendations.
- 8. FRP grating, supports and associated ancillary materials shall be as manufactured by Fibergrate Composite Structures, Inc.; American Grating; Safe-T Grate, Seasafe, Inc.; Imco Reinforced Plastics; or equal.

B. Fiberglass Structural Shapes (as applicable)

- 1. Structural FRP members supplied under this specification section shall be manufactured using the "pulltrusion" process. The composite shall consist of a glass fiber reinforced vinylester resin matrix, approximately fifty percent (50%) resin to glass ratio.
- 2. Glass reinforcement shall be of three varieties:
 - a. A surface mat shall be used on all exterior surfaces for maximum chemical resistance.
 - b. Continuous strand mats shall be used internally for transverse strength.

- c. Continuous glass strand rovings shall be used internally for longitudinal strength.
- 3. Resin shall be a polyester material, possessing inherent ultraviolet (UV-8), fire, and chemical resistance. Material shall be fire rated for Class I flame spread and flammability ratings as per ASTM E-84 and D-635.
- 4. The following minimum mechanical properties shall apply:

Mechanical Property	Value
Ultimate Tensile Strength (longitudinal direction)	30,000 psi
Ultimate Tensile Strength (transverse direction)	9,000 psi
Ultimate Tensile Strength (full section in bending)	25,000 psi
Ultimate Compressive Strength (longitudinal direction)	30,000 psi
Ultimate Compressive Strength (transverse direction)	18,000 psi
Ultimate Compressive Strength (full section in bending)	25,000 psi
Ultimate Shear Strength (either direction)	4,500 psi
Ultimate Bearing Strength (either direction)	30,000 psi
Modulus of Elasticity (full section in bending)	2.8 x 10 ⁶
Barcol Hardness Test	50

2.03 Fabrication

A. Measurements

- 1. Grating supplied shall meet the dimensional requirements and tolerances as shown or specified.
- 2. The Contractor shall provide and/or verify measurements "in the field" for work fabricated to fit field conditions as required by grating manufacturer to complete the Work.

B. Layout

1. Each grating section shall be readily removable by a single man without any mechanical assistance, except where indicated on Contract Drawings.

- 2. The manufacturer shall provide openings and holes where located on the contract drawings or as required to meet the requirements of this specification section.
- Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- 4. All FRP grating shall be fabricated free from warps, twists, or other defects which affect appearance and serviceability.

C. Sealing

- 1. All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance.
- 2. All field fabricated grating cuts shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.

D. Hardware

1. Chemical Application Areas

a. Chemical and corrosion resistant hold-down clips shall be provided by the grating manufacturer, for the particular type of chemical being used in an area, and spaced at a maximum of four (4) apart with a minimum of four (4) per piece of grating, or as recommended by the manufacturer.

2. Non-Chemical Application Areas

a. **Type 316 stainless steel hold-down clips** shall be provided and spaced at a maximum of four (4) apart with a minimum of four (4) per piece of grating, or as recommended by the manufacturer.

3. EXECUTION

3.01 Inspection

A. The grating shall be inspected by the manufacturer prior to delivery and by the Contractor at time of delivery to ensure that the grating is free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin

burrs, air bubbles and pits. The surface of the grating shall have an integral grit finish so as to provide a non-skid walking surface.

B. Any defective or improperly fabricated grating shall either not be shipped from the manufacturer or shall be returned to the manufacturer, by the Contractor, at the time of delivery. *All grating shall be "new"* and any defective grating or ancillary materials shall be rejected and replaced immediately at no additional cost to the Owner.

3.02 Installation

- A. The Contractor shall install all grating and ancillary materials in strict accordance with the manufacturer's instruction and erection drawings.
- B. All work shall be erected *level and plumb*, and shall meet required heights, layout and details precisely. *All work shall be adequately fastened, anchored or braced. All fasteners shall be corrosion resistant and compatible* for use with the chemicals (sodium hypochlorite, sodium hydroxide, sulfuric acid, etc.), domestic biosolids or raw wastewater being used in the area of erection.
- C. All work shall be executed in accordance with the best practices of the trade, by persons skilled in the craft.
- D. Fiberglass grating, fiberglass structural members and other fiberglass products shall be designed and installed at the locations shown on the Contract Drawings.

3.03 Final Inspection and Testing

A. A final acceptance test shall demonstrate that the fiberglass products have been properly installed, are structurally sound and secure, are in the correct alignment and meet the loading requirements specified herein.

END OF SECTION

SECTION 06702

DOUBLE WALL CHEMICAL STORAGE TANK

1. GENERAL

1.01 Description

A. Scope of Work

1. Furnish all labor, materials, appurtenances and accessories required to install "new" and "unused", upright, high density linear polyethylene (HDLPE) double walled, flat bottom chemical storage tanks for the following chemicals at the following locations as shown on the Contract Drawings and as specified herein.

No. of Tanks	Volume (gal)	Chemical
1	500	Polymer
1	500	Sodium Bisulfite Dechlorination of Facility Effluent

- 2. The tanks shall be manufactured and equipped for storage and use of the aforementioned chemical(s) and shall have a specific gravity of 1.9.
- B. The double walled tank(s) shall consist of an inner *primary* tank and one outer *secondary* tank. Each tank shall be of the vertical extrusion wound type. The tank(s) are designed for above-ground, vertical installation and shall be capable of containing chemicals at atmospheric pressure. The tank system(s) shall be designed to prevent rainwater from entering the containment tank.
- C. The design shall allow direct primary tank base retention for up to Seismic Zone 4 conditions per UBC code requirements. The containment tank shall be designed to hold a minimum of 108% of the normal fill capacity of the primary tank.
- D. The tank(s) shall be manufactured and equipped for the storage of chemicals as noted.

- E. The chemical storage tank(s) and all associated piping shall meet the requirements of ANSI/NSF Standard 14 or Standard 61 and German DVS 2205.
- F. All above grade chemical piping shall be insulated using polyurethane foam with a density of 2.0 3.0 lb/ft³ with a "R" value of 8.33/in and a nominal thickness of 1-inch.
- G. Related Work Specified Elsewhere

1. Materials and Equipment: Section 01650

2. Piping and Fittings: Division 15

1.02 Quality Assurance

A. Standards

- 1. All work shall be executed and installed in accordance with the requirements of applicable codes.
- 2. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Society	for Testing and Materials (ASTM)	
ASTM D-618	Conditioning Plastics and Electrical Insulating Materials for Testing	
ASTM D-638	Tensile Properties of Plastics	
ASTM D-790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials	
ASTM D-883	Definitions of Terms Relating to Plastics	
ASTM D-1505	Density of Plastics by the Density-Gradient Technique	
ASTM D-1525	Test Method for Vicat Softening Temperature of Plastics	
ASTM D-2837	Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials	
ASTM D-3892	Practice for Packaging/Packing Plastics	
ASTM F-412	Definitions of Terms Relating to Plastic Piping Systems	
Association of Ro	Association of Rotational Molders (ARM) Standards	

STANDARD	DESCRIPTION	
	Low Temperature Impact Resistance (Falling Dart Test Procedure)	
American National Standard Institute (ANSI)		
B-16.5	Pipe Flanges and Flanged Fittings	
Occupational Safety and Health Administration (OSHA) Standards		
29 CFR 1910.106	Flammable and Combustible Liquids	
Other Standards		
	Florida Building Code	
	Uniform Building Code (Latest Edition)	

B. Chemical Compatibility

- 1. Chemical compatibility shall be according to the following chemical resistance guides:
 - a. Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers", Compass Publications.
 - b. Pruett, Kenneth M., "Compass Corrosion Guide II", Compass Publications.
- 2. These references shall be considered as general guidelines only.

C. Equipment Manufacturer

- 1. All chemical storage tanks required as part of this project shall be provided by one (1) manufacturer that has at least five (5) years prior experience in construction of extrusion wound polyethylene tanks for similar applications and comparable size.
- 2. All tanks shall meet the requirements of DVS 2205.
- 3. The chemical storage tanks shall be as manufactured by one of the following manufacturers:
 - a. Houston PolyTank
 - b. Snyder Industries
 - c. Approved equal

1.03 Submittals

A. Shop Drawings and Manufacturers Literature

- 1. For all equipment to be furnished under this Section, the Contractor shall submit all material required to establish compliance with this Section and Section 01300, *Shop Drawings, Submittals and Samples*, including, but not limited to, the following:
 - a. Dimensions of tank, fittings and attachments.
 - b. Locations of fittings, anchor bolts, attachments and joints.
 - c. Resin used and description of chemical.
 - d. Weight of tanks.
 - e. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction. Include complete resin system information.
 - f. Design calculations and inspection records, if requested. DVS 2205 design calculations shall be provided and shall be for record only.
 - g. The manufacturer shall present a certificate of theoretical and practical training in hot gas hand welding and hot gas extrusion welding of polyethylene completion, if requested.
 - Written instructions for handling, storage, and installation of tanks. These
 instructions shall include bolt torque values and detailed instructions for pipe
 connections.
 - i. A detail of the intended support members with certification demonstrating their adequacy for the application and intended loads.
 - j. Submit color samples for selection of colors and manufacturer's recommendations for the chemical(s) being stored in said tank(s).

2. Quality Control Submittals

- a. A copy of the manufacturer's quality assurance program.
- b. Quality Control Inspection Report, prepared by the manufacturer's quality assurance supervisor. The report shall include, as minimum:
 - 1) The names of production personnel who worked on the tank.

- 2) The type and quantity of materials used for the tank construction.
- 3) The visual inspection results for individual components taken before and after assembly.
- c. A Factory Test Report, prepared by the manufacturer's quality assurance supervisor, including certification by signature of results.
- d. A Field Inspection and Test Report available if applicable, prepared by manufacturer's shop inspector.

1.04 Product Marking, Packing and Packaging

- A. Each chemical storage tank shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. Each chemical storage tank shall be shipped with a 3 of 9, HRI bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.
- B. The proper caution or warning signs, as prescribed by OSHA standard 29 CFR 1910.106, shall be provided.
- C. All packing, packaging, and marking provisions of ASTM Practice D-3892 shall apply to this standard.
- D. Each tank shall be shrink-wrapped and bagged prior to delivery.

1.05 Product Delivery, Storage and Handling

- A. The high density linear polyethylene tank(s) (HDLPE) and all accessories shall be factory assembled and tested and shall be delivered to the site for installation fully assembled.
- B. The high density linear polyethylene (HDLPE) tanks shall be capable of being set in place and field erected by the Contractor with only minimal field assembly.
- C. Flange faces shall be covered with plastic flange covers.
- D. All equipment and accessories shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is complete and the equipment is ready for operation.

- E. Tanks shall be mounted on padded cradles, skids or protective framework so constructed as to provide for easy handling for crane, fork truck or similar.
- F. Upon delivery of the tank(s) to the Project Site, the Contractor shall inspect the tank(s) for damage during transit. If damage has occurred, the tank(s) shall be returned to the manufacturer and a new tank(s) shall be provided at no additional cost to the Owner.
- G. Nozzles, manholes, or other fittings shall not be used for lifting.
- H. The Contractor shall handle during deliver, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved written instructions and in accordance with instructions given on-site by the manufacturer's representative.

1.06 Warranty and Guarantees

- A. All equipment supplied under this Section shall be warranted for a period of five (5) years by the manufacturer and Contractor. The warranty period shall commence upon Final Project Acceptance by the Owner.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during warranty period, it shall be replaced at no expense to the Owner.
- C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed. Refer to the General Conditions for additional guarantee and warranty requirements as well as Section 01740, Warranties and Bonds.

2. PRODUCTS

2.01 General

- A. The chemical storage tank(s) and all equipment, accessories and hardware shall be non-corrosive and compatible with the chemical being stored.
- B. The chemical storage tank(s) shall be complete including all specified accessories. The tanks shall be designed and proportioned to have liberal strength, stability and stiffness and to be especially adapted to the work to be done and chemical to be stored.

- C. *The finished surfaces shall be free from visual defects* such as foreign inclusions, air bubbles, pin holes and craters.
- D. The chemical storage tank(s) shall be constructed of high density linear polyethylene (HDLPE) with welded components, suitable for installation as shown on the Contract Drawings.
- E. Each tank shall have a diameter and height or length (straight side) and minimum capacity as specified herein. *Flexible connections to the tanks shall be provided by the Contractor in accordance with the manufacturer's recommendations*.

F. Design Requirements

- 1. Design of polyethylene equipment for fabrication under these specifications shall be provided by the manufacturer. The design shall allow for the most severe combinations of conditions in accordance with DVS 2205 and ASTM requirements. Tank design calculations determined using the RITA tank design program in accordance with German DVS 2205 standard will become part of each design package. Where applicable, calculations shall include, but are not limited to, the following considerations:
 - a. Design and upset temperatures.
 - b. Specific gravity of material.
 - c. Wind loading.
 - d. Flanges, lugs, or ring supports.
 - e. Configuration: Flat-bottom, flat top, vertical
- The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
- 3. Secondary containment tanks shall be designed to the proper thickness to support its own weight in an upright position without any external support. The secondary containment tank shall be configured to allow shipment of the primary tank inside of the secondary tank. The shipment shall be done without the aid of additional spacer blocks.
- 4. Tanks in excess of 2,000 gallons of capacity shall have a minimum of three (3) lifting lugs integrally molded into the top head. The lifting lugs shall be designed to

- allow erection of an empty primary and secondary tank. The tanks shall be capable of being lifted into position as a unit (primary and secondary tanks).
- 5. The minimum thickness of the top head shall be equal to the top of the straight wall. The primary tank top shall be configured to prevent rainwater from entering the secondary containment tank. The primary tank shall be keyed to the secondary tank preventing primary tank rotation. The secondary containment tank shall have a capacity of one hundred eight percent (108%) of the normal fill capacity of the primary tank.
- 6. The tank shall be designed to provide a minimum of four (4) tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading situations without tank damage. The primary/secondary tank unit shall be configured to allow direct primary tank base retention for seismic load conditions. The base retention unit shall be anchor bolted to an appropriate structure and not require additional spacer blocks. The Contractor is referred to Article 2.04(J) for tank tie-down accessories.

G. Dimensions and Tolerances

- 1. All dimensions shall be taken with the tank in the vertical position, unfilled. The tank dimensions will represent the exterior measurements.
- 2. The tolerance for the outside diameter, including out of roundness, shall be per ASTM D-1998.
- 3. The tolerance for fitting placements shall be ± 0.5 inches in elevation and 2 ° radial at ambient temperature.

H. Test Methods

1. Test specimens shall be taken from fitting location areas.

2. Low Temperature Impact Test

- a. Test specimens shall be conditioned at -40 °F for a minimum of two (2) hours.
- b. The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D-1998.
 - 1) Test specimens with a thickness less than ½-inch shall be tested at 100 ft-lb.
 - 2) Test specimens with a thickness greater than ½-inch shall be tested at 200 ft-lb.

3. Ultrasonic Tank Thickness Test

- a. All tanks shall be measured for tank wall thickness at 6-inches, 1 foot, 2 feet and 3 feet on the tank sidewall height at 0° and 180° around the tank circumference with 0° being the tank manway and going counter-clockwise per ANSI standard drafting specifications.
- b. All tanks shall meet design thickness requirements and tolerances and a test report provided upon delivery of the tank(s).

4. Hydrostatic Water Test

a. The hydrostatic water test shall consist of filling the tank to brim full capacity for a minimum of four (4) hours and conducting a visual inspection for leaks.

I. Workmanship

- 1. The finished tank wall shall be free of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delamination that will impair the serviceability of the vessel.
- 2. All cut edges where openings are cut into the tanks shall be trimmed smooth.
- J. The tank supports shall be able to withstand normal lifting and handling loads without distortion or cracking.
- K. All materials shall be compatible and non-corrosive with the chemical being stored within.

L. Tank Specifics

1. The extrusion wound, high density linear polyethylene double wall tank(s) required shall be ANSI/NSF 61 certified and shall meet the following specifications:

2. Chemical Storage Tank Characteristics

Property	Polymer ¹	Bisulfite ²
Type of Tank		ottom, double- ontainment
No. of Tanks	1	1
Diameter, ID - Primary Tank (inches)	48	48
Height - Primary Tank (inches)	103	103

Property	Polymer ¹	Bisulfite ²
Diameter, ID - Secondary Tank (inches)	50	50
Height - Secondary Tank (inches)	104	104
Working Capacity, each (gallons)	500	500
Full Capacity, each (gallons)	500	500
Specific Gravity	1.9	1.9
Exterior Access Ladder	Yes	Yes
Exterior Handrail	None	None
Exterior Sight Gauge	Yes	Yes
Ultrasonic Level Indicator	Yes	Yes
Maximum Ambient Temperature (□F)	100	100
Leak Detection Unit	Yes	Yes
Tank Top Manway	Yes	Yes
External Fill Pipe	Yes	Yes
Internal Down Pipes	Yes	Yes
Vents	Yes	Yes
Tie-Down System	Yes	Yes
Location	Outdoors	Outdoors

¹ Polymer for sludge dewatering operations

- M. The Owner shall provide the chemical fills. The Contractor is responsible for coordinating with the Owner to ensure delivery of chemicals does not delay operation or startup of the system.
- N. The high density linear polyethylene tanks shall be manufactured via the spiral extrusion wound process or approved equal.
- O. The polyethylene tanks shall be designed and constructed in accordance with DVS 2205 standard. The tanks shall be capable of storing the specified chemicals at temperatures up to 140°F.

² Sodium bisulfite for dechlorination operations

P. The sodium hypochlorite tanks shall be constructed using the spiral extrusion wound process.

- Q. The chemical storage tanks shall be designed so that no external bracing, ribs, hoops, or support wires are required.
- R. The entire thickness of the cylindrical shell (inner surface, interior layer, and exterior layer) shall be built up prior to removal of the shell from the mandrel.
- S. The top shall have a minimum thickness of ¼-inch. Flat bottoms shall have a minimum thickness as required by DVS 2205 but not less than ½-inch provided on the shop drawings submitted for approval.
- T. The chemical storage tanks shall be completely fabricated in the shop. No field assembly is permitted.

2.02 Materials and Equipment

A. Size and Capacity

- 1. Each tank shall have a minimum capacity, straight side height, and bottom and top construction as noted above in Article 2.01(L).
- 2. The tank shall be manufactured in accordance with the German DVS 2205 standard.
- 3. The tank wall thickness shall be determined using the RITA tank design program or equivalent. The minimum total wall thickness shall be at least ½-inch thick.

B. Resin

- 1. The resin to be used in the fabrication of the chemical storage tank(s) shall be virgin, polyethylene, or equal, fully formulated, with low warpage and shrinkage.
- 2. The resin shall be as recommended by the resin manufacturer for the conditions of service for maximum chemical resistance and extended service life.
- 3. A UV inhibitor shall be added to the exterior layer for improved weather resistance.
- 4. Pigments added for tank coloring shall not exceed 0.25% (dry blended) of the total weight. The tank color shall be as selected by the Owner (manufacturer's recommendations for the chemicals being stored in said tanks shall be submitted).

5. The chemical storage tank(s) shall be suitable for outdoor chemical storage applications, as noted on the Contract Drawings, and shall be food contact approved.

2.03 Tank Attachments and Accessories

- A. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank manufacturer. The tank will deflect based upon tank loading, chemical temperature, and storage time duration. Tank piping flexible couplers shall be designed to allow at least four percent (4%) design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.
- B. Flexible connections to each chemical storage tank shall be provided by the Contractor in accordance with the manufacturer's recommendations.
- C. A tank sight level gauge, and all associated appurtenance, shall be provided with each tank provided as part of this Project.
- D. The extrusion wound polyethylene tanks shall be equipped with the following accessories:
 - 1. A top access port with bolted lid (24-inch), Viton gasket, and Type 316 stainless steel hardware.
 - 2. Nozzles shall be sized as follows:
 - a. 4-inch welded ANSI flange (vent).
 - b. 2-inch welded ANSI flange (fill-primary tank).
 - c. 3-inch welded ANSI flange (suction-primary tank).
 - d. 3-inch welded ANSI flange (overflow).
 - e. 6-inch welded ANSI flange (level).
 - f. 3-inch welded ANSI flange (drain-secondary tank).
 - g. 3-inch welded ANSI flange (vent-secondary tank).
- E. The area on the back of all flanges around each bolt hole and the diameter of the standard washer shall be flat and parallel to the flange face. This area shall be spot faced if necessary to meet this requirement.

- F. All nozzles shall be flanged. The flange outer diameters and drilling shall be per ANSI 16.5. All flange faces shall be flat and true.
 - 1. Unless otherwise specified, nozzles on top or bottom heads shall have flanged faces perpendicular to the vertical centerline of the tank and nozzles on side walls shall have flanged faces perpendicular to radial centerlines.
 - 2. Nozzles shall be of the flush type installation. Gaskets shall be suitable for the intended chemical use.

G. Ultrasonic Level Indicator

- 1. The ultrasonic level indicator shall consist of a two (2) or three (3) inch, 4 20 mA output PVC sensor and a 3½-inch digit display unit.
- 2. The sensor shall be equipped with male pipe threads and be connected to the tank with a PE bulkhead fitting, or the sensor may be Teflon faced and flange bolted to the tank with encapsulated Type 316 stainless steel bolts. The sensor shall be connected to a display unit that is mounted at a location to be designated by the Engineer and Owner.
- The display unit box shall be NEMA 4 rated and factory pre-wired for 110 VAC power. All connections shall be labeled to prevent errors in field installation. The display unit shall be pre-programmed for each individual the tank required by the Project.
- 4. The display will read directly in *level (to the nearest 0.01 feet) and gallons*.
- 5. The signal and level of chemical in each tank shall be incorporated into the facility's SCADA system.

H. Leak Detector Unit

- 1. A leak detector unit shall be provided with each double-walled chemical storage tank and shall be incorporated into the facility's SCADA system.
- 2. The leak detector unit shall consist of a proximity sensor, a welded 2 inch FPT connection, a two (2) inch bung plug with a ¾-inch strain relief, and an indicator box. The sensor shall be placed in the interstitial space between the primary and secondary tanks approximately one (1) inch above the tank bottom. The indicator box shall be NEMA 4 rated and factory pre-wired for 110 VAC power.
- 3. All connections shall be labeled to prevent errors in field installation. The indicator box will show a green light when the power is "on" and the sensor is not detecting

- a liquid. The light is a push to test light allowing the operator to test for a power outage or malfunction. If the green light goes out there are two possibilities:
- a. The green light does not come on when the button is pushed. This would indicate a lack of power to the unit or the light bulb is burned out.
- b. If the green light comes on when pushed, then a possible leak condition is indicated.

I. Bolted Sealed Top Manway

- 1. Sealed manways shall be provided for each tank to be provided as part of this Project.
- 2. The manways shall be liquid tight for maximum loading condition and suitable for the intended chemical use.
- 3. Manways shall be made the same as for flanged nozzles of the same diameter.
- 4. The cover shall be fume tight furnished with Viton gaskets, and corrosion resistant bolts as recommended by the manufacturer for the chemical to be stored. The tolerance of flatness shall be the same as for the flanges.

J. External Fill Pipes

- 1. All external fill pipes shall be supported at three (3) foot maximum intervals with a support structure independent of the tank (ground supported).
- 2. All external fill pipes shall be constructed of PVC or other material recommended by the manufacturer for the chemical to be stored and shall be corrosion-resistant materials.

K. Internal Down Pipes

- 1. Internal down pipes shall be installed in the locations indicated on the Contract Drawings.
- 2. All internal down pipes shall be supported at five (5) foot maximum intervals with a support structure welded to the inside of the primary tank. The support design may utilize a PVC clamp or other manufacturer recommended material for the intended use, function and chemical stored.
- 3. All internal down pipes shall be constructed of PVC or other material recommended by the manufacturer for the chemical to be stored and shall be corrosion-resistant materials.

L. Vents

- 1. Each tank shall be properly vented to the exterior of the chemical feed facility for the type of material and flow rates expected.
- 2. The vents must comply with OSHA 1910.106 (F) (iii) (2) (IV) (9) normal venting for atmospheric tanks or other accepted standard, or shall be as large as the filling or withdrawal connection, whichever is larger but *in no case less than three (3) inch nominal inside diameter*.
- 3. All vents shall have a "rain-cap" and be screened with a very fine mesh, non-corrosive material to eliminate the possibility of pests, insects, etc. from entering the tank.
- 4. All vents shall be constructed of PVC or other material recommended by the manufacturer for the chemical to be stored.

M. Flange Adapters

- 1. Flange adapters shall be provided as indicated on the Contract Drawings or as required to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components.
- 2. Flange adapters are available in PVC, CPVC or other material recommended by the manufacturer for the chemical to be stored.
- 3. Flange adapter construction shall utilize Schedule 80 components.

N. Tie-Down Systems

- 1. The tie down system shall be designed to withstand 150 MPH wind loads. Tie down systems must meet Seismic Zone 4 requirements per UBC 1993 code.
- 2. Anchor bolts shall be provided by the Contractor per the manufacturer's instructions and the base plates required for the system.
- The tie-down system shall be provided in either Type 316 stainless steel or other
 material recommended by the manufacturer for the chemical to be stored. The
 material shall be compatible and non-corrosive with respect to the material being
 stored within.
- O. Equipment Platforms NOT USED
- P. Cone Bottom Tanks Stands NOT USED

Q. Certification Plates

- A corrosion resistant, non-metallic plate, suitable for use with the stored chemical, shall be installed below the storage tank nameplate. The following data shall be included on the certification plate:
 - a. Name of tank fabricator.
 - b. Date of manufacture.
 - c. Product to be stored.
 - d. Maximum allowable concentration, specific gravity, and temperature of the specified chemical solution that can be stored safely.
 - e. Mechanical properties of the polypropylene.
 - f. Tank characteristics (diameter, height, volume)
 - c. Product to be stored.

R. Fastening Hardware

1. All fastening hardware used to with the tank(s) shall be corrosion resistant and compatible for use with the chemical to be stored.

S. Tank Lifting Lugs

- 1. Bulk tanks shall be provided with a suitable means to lift the tanks during shipping and handling that prevents distortion.
- 2. Any permanent lifting system such as lifting lugs shall be made of corrosion resistant material compatible with the chemical to be stored within.
- T. The Contractor shall be responsible for coordinating all piping and equipment connections to the tank and the tank manufacturer shall provide all adapters, fittings, connectors, etc., necessary.
 - 1. All O-rings, gaskets, etc. for fittings shall be suitable for use with the chemical being stored within the tank(s).

U. Chemical Storage Tank Gasket/Diaphragm

1. The Contractor shall install a non-degradable, non-corrosive gasket, between

the chemical storage tank bottom and elevated housekeeping pad.

- 2. The gasket shall be the same diameter as the chemical storage tank.
- V. The tank manufacturer shall submit a certification that the double wall HDLPE tank is suitable for the chemical being stored. If the HDLPE tank is unacceptable, the tank manufacturer shall submit an alternative tank material that is best suited for the chemical to be stored.

3. EXECUTION

3.01 **Shop Inspection and Quality Control**

- A. The polyethylene tank manufacturer shall have a quality control procedure adequate to ensure that all fabrication complies with the requirements specified herein.
- B. The Manufacturer's Quality Assurance Supervisor shall perform a final inspection of all tanks prior to factory testing. Final inspections shall include checks for dimensions, wall thickness, hydro tests, and visual inspections.
- C. A Quality Control Inspection Report, approved and signed by the Manufacturer's Quality Assurance Supervisor shall be provided for each chemical storage tank. The report shall include all tank inspection records covering the following information:
 - 1. Thickness measurements.
 - 2. Measurements showing compliance with dimensions and tolerances in diameters, lengths, fittings and flanges, and flatness of flanges.
- D. Upon completion of fabrication and inspection, the following factory tests shall be performed for each polyethylene chemical storage tank:
 - 1. A Hydrostatic Leak Test shall be conducted on each chemical storage tank. It shall be filled to the top nozzle and let stand for 24 hours with no leakage, evidence of weeping, or capillary action.
 - 2. A Factory Test Report, approved and signed by the Manufacturer's Quality Assurance Supervisor, shall be submitted to the Engineer for review and approval. The report shall include, at a minimum, the following items:

 - a. Inspection records.b. Results of hydrostatic testing.
- E. An inspection shall be performed for each chemical storage tank and a report shall be made for each tank. Inspection records shall be provided to the Engineer for review.

3.02 Installation

- A. Upon delivery, check the chemical storage tanks closely for defects and damage.
- B. The tanks shall be installed in strict accordance with the manufacturer's instructions, and in the location shown on the Contract Drawings.
- C. The tanks shall be installed on a level, smooth concrete pad designed for load weight. All debris and protrusions shall be removed before setting the tank.
- D. The tanks shall be anchored to the floor or housekeeping pad as directed by the tank manufacturer for this application using materials and hardware that are corrosion resistant and suitable for use with the chemical to be stored. Anchor bolts shall be drilled after arrival and setting of the tank on a concrete pad.
- E. Flexible connections to each chemical storage tank shall be provided by the Contractor in accordance with the manufacturer's recommendations. Flexible connections are required to avoid continuous weight such as pipes, valves, and all accessories. All weight shall be supported by the ground and not supported solely by flanges on the tank.
- F. The chemical storage tanks shall be isolated from any vibration source using adapters such as, but not limited to, expansion joints.
- G. All chemical feed pumping systems drawing chemical from these chemical storage tank(s), installed as a part of this Project, shall be vented into the chemical storage tank(s).

3.03 Inspection and Testing

- A. The tank shall be hydrostatically tested for leaks by filling with water in the presence of the Engineer. The tank shall be checked for leaks after it has been filled for at least forty-eight (48) hours. No leaks, evidence of weeping, or capillary action is permitted.
- B. The Engineer may request that the beginning and end of this test be performed in his presence.
- C. If the tank(s) do not meet the specifications, corrective measures will be taken or the piece of equipment shall be removed and replaced with equipment which satisfies the conditions specified at no additional cost to the Owner.
- D. After testing, the Contractor shall thoroughly clean and dry the tank(s) before use.

3.04 Cleaning

- A. All interior surfaces of the vessel shall be cleaned before shipment. This includes all loose or removable polyethylene accessories.
- B. Each surface to be cleaned shall be cleaned with a mild detergent capable of removing grease, oil, or other residue, no abrasive cleaning agents shall be used. This detergent shall then be thoroughly rinsed off with fresh water through a spray mechanism. Care shall be taken in order to not damage the surface being cleaned.

END OF SECTION

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SECTION 09750 PROTECTIVE FLOOR COATING

1. GENERAL

1.01 Description

A. Scope of Work

- 1. The work included in this Section consists of furnishing and applying a protective floor coating on the concrete floor surfaces and equipment pad surfaces at the Dewatering Building.
- B. All areas identified above shall receive the "<u>high gloss</u>", slip-resistant, protective epoxy floor coating after the floors have been properly cleaned.

1.02 Field Quality Control

- A. The Contractor shall provide the manufacturer's field service consisting of scheduled site visits for inspection of the coating system application.
- B. Inspections shall be scheduled following surface preparation, application of primer, application of intermediate coat and application of finish coat.

1.03 Submittals

- A. Submit the manufacturer's descriptive literature, catalog data, illustrations, specifications, samples and other pertinent data for the entire protective floor coating system in accordance with Section 01300, *Shop Drawings, Submittals and Samples*.
- B. The Contractor shall also **submit the following materials to the Engineer prior to ordering any material** or commencing with any of the work operations:
 - 1. Color chart of manufacturer's standard colors.

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- 2. Test results from a qualified testing laboratory attesting to conformance with all specifications.
- 3. Certification of flooring applicator's qualification to install this product.

1.04 Product Delivery, Storage and Handling

- A. Do not deliver the materials until required in the general sequence of construction for the Project.
- B. All coating containers shall be properly sealed and bear the manufacturer's label, batch number, date of manufacture and shelf life.
- C. The coating containers shall be stored off of the ground, inside, away from direct contact with the elements, in a cool dry area. Normal storage temperature limits shall be between 50 \textsuperscript{F} and 98 \textsuperscript{F}.
- D. All coating containers shall come from the same batch.
- E. Surface preparation and the installation of the seamless epoxy flooring shall not begin until at least thirty (30) days after the concrete has been placed.

2. PRODUCTS

2.01 Materials

- A. The material must be one hundred percent (100%) percent solids, self-leveling polymer/epoxy based blend capable of being applied at a range of 1/8-inch to ½-inch in one (1) coat to a properly prepared concrete surface.
- B. The material must conform to applicable Federal, State and local VOC regulations.
- C. The material must be able to withstand immersion in following chemicals for five (5) days per ANSI N5.12:

Chemical Constituent	Solution Concentration
Nitric Acid	5%
Disodium Phosphate	5%
Sulfuric Acid	50%
Ammonium Hydroxide	5%

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Chemical Constituent	Solution Concentration
Hydrazine	5%
Sodium Fluoride	0.5M
Sodium Hydroxide	50%
Hydrogen Peroxide	0.3 M
Sodium Hypochlorite	20%
Sodium Borate	5%
Citric Acid	5%
Trisodium Phosphate	1.0 lb/gal

D. The material must have the following minimum physical properties as per ASTM:

Parameter	ASTM Standard	Value
Compression	ASTM C-579	14,000 psi
Flammability	ASTM D-635	self-extinguishing
Tensile	ASTM C-190	2,200 psi
Flexural	ASTM C-790	5,500 psi
Elasticity	ASTM C-580	3.0 x 10 ⁶
Water Absorption	ASTM D-570	0.10% maximum
Linear Shrinkage	ASTM C-531	0.01% maximum

- E. Abrasion resistance must not exceed 25 mg lost after being exposed to 1,000 cycles on CS 17 wheels per Taber Abrasion Test, ASTM D4060 CS.
- F. The flame spread shall be 10 or less per Underwriters Laboratory (UL).
- G. Aggregate is to be a suitable silica substitute to resist exposure to sodium hypochlorite, alum, supplemental carbon chemical(s) and hydrofluosilicic acid.
- H. Acceptable Slip-Resistant Flooring System Manufacturer's
 - 1. Sika 700 Novalac Resin.
 - 2. Perma TEC 5000. A Non-Skid roughness of first coat shall be equal to 60 grit sandpaper.

- 3. Sanitile 945, aggregate floor system as manufactured by Carboline, Inc.
- 4. Stonshield, slip resistant flooring system, as manufactured by Stonehard, Inc.
- 5. Or approved equal.
- 1. The color of the "<u>high gloss</u>", slip-resistant, protective epoxy floor coating shall be selected by the Engineer and Owner from the manufacturer's standard color wheel.

3. EXECUTION

3.01 Preparation of the Concrete Surfaces

- A. Any oil and grease deposits shall be cleaned prior to abrasive blasting with a trisodium phosphate solution or Surface Cleaner No. 3. The cleaned area shall be thoroughly rinsed and tested with pH paper to assure that no TSP residue remains.
- B. Abrasive blasting shall be performed using a low pressure sweep of sufficient intensity to remove any laitance layers and reveal a dull matte finish.
- C. Sand, dust, and other contaminants shall be removed from the blasted surface by vacuuming or compressed air blasting. The air used shall be free of oil and/or water.
- D. A matte finish should be achieved similar to 60 80 grit sandpaper.
- E. Mechanical methods can sometimes create deep profiles and create excessive porosity. In such cases, provide a cementitious based repair material such as Chemproof Perma Grout E, to repair all such areas.

F. Other Surface Preparation Methods

- 1. High pressure water blasting (minimum 10,000 psi).
- 2. Acid etching (i.e., muriatic acid, citric acid, phosphoric acid). The Contractor shall be responsible for protecting piping, equipment, and walls and repairing any damages caused by acid etching operations.
- 3. Roto Peen.
- 4. Blast Trac.

- G. If an acid etch methodology is used, the concrete must be flushed with fresh potable water after each etching to obtain a neutral or slightly alkaline pH content (pH 8.0 to 9.0).
- H. Surface profile shall be witnessed by the representative of coating manufacturer before application of the system. Written conformation of this review shall be provided.

3.02 Mixing

- A. All mixing of components for the epoxy flooring system shall be in strict accordance with the flooring system manufacturer's printed instructions.
- B. No thinning of the epoxy flooring system materials shall be allowed unless specifically allowed and approved by the manufacturer.

3.03 Application of Seamless Epoxy Flooring

- A. The material shall be applied at an even thickness of not less than 1/4-inch by an applicator trained and approved by the coating manufacturer. Proper tools must be on hand prior to job start-up. Apply the material when the substrate and ambient temperature is 65 90 F.
- B. Apply the floor topping by one of the methods approved by the manufacturer and to the thickness required by the manufacturer to provide the chemical protection, durability and traffic bearing capacity as specified herein. *The minimum dry film thickness* (*DFT*) *shall be 75 mils, minimum*.
- C. **Apply the floor topping in a wet sequence** such that fresh material is continually being applied to the previously applied wet edge. Do not allow previously applied film to stiffen to avoid creating ridges and/or discoloration.
- D. Applicators shall be equipped with spike shoes to walk onto the applied topping film and backroll with a spike roller. As soon as the applicators have drawn out the first pass, the person on spike shoes shall walk onto the wet surface and begin backrolling.
- E. Applicators shall broad-cast the aggregate onto the wet film surface of the seamless epoxy floor system to provide a uniform non-skid surface.

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3.04 Application of a "High Gloss" Finish Coat

- A. The <u>"high gloss"</u> finish coat material shall be applied at an even film thickness of twenty (20) mils by an applicator trained and approved by the coating manufacturer. Proper tools must be on hand prior to job start-up.
- B. *Minimize traffic on the epoxy flooring coat prior to finish coat*. Thoroughly vacuum or blow down the area.
- C. Pour finish coat onto the work surface in manageable portions. Saturate a ¼-inch mohair roller with material, then begin slowly spreading the coating on the surface. Spread the coating by pulling the finish coat toward you. Minimize the number of passes to avoid entraining air.
- D. Spike roll the finish coat. The applicator conducting the spiking shall use a brush to spread out the coating into any missed areas. Areas where the desired finish coat thickness is not attained shall have a second coat applied.

END OF SECTION

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SECTION 09900 PAINTING

1. GENERAL

1.01 Description

- A. This specification defines the methods of surface preparation, coating systems, and methods of application for painting of surfaces as outlined herein.
- B. The Contractor shall furnish all supervision, materials, labor, tools, equipment, scaffolding or other structures, incidentals required for transportation, unloading, storage and application of paint and protective coating systems and associated products for the surfaces listed herein and not otherwise excluded. All surfaces described shall be included within the scope of this Section. Surface preparation, priming, and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of the work.
- C. "Paint", as used herein, means all coating systems, materials, including primers, emulsions, enamels, epoxies, sealers and fillers, and other applied materials whether used as a prime, intermediate, or finish coats.
- D. The Work includes painting and finishing of interior and exterior exposed items and surfaces such as structural steel, miscellaneous metals, ceilings, walls, floors, doors, frames, transoms, fans, construction signs, guardrails, trenches, posts, pipes, fittings, valves, tanks, equipment, and all other work obviously required to be painted unless otherwise specified herein or on the Contract Drawings. The omission of minor items in the schedule of work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the specifications as stated herein. The following major items of the Project shall be coated:
 - 1. Concrete floor surfaces, equipment pad surfaces, trenches and the chemical containment areas (floor, vertical walls and top of walls) using a protective coating system described in Section 09750, Protective Floor Coating.
 - 2. Exterior and interior of buried concrete surfaces (cast-in-place, precast or block).
 - 3. Interior and exterior of precast concrete surfaces of meter and valve vaults.
 - 4. Exposed ferrous surfaces of any components of equipment, pumps, motors, tanks

and ferrous or galvanized metal fittings and accessories (except stainless steel).

- 5. Submerged surfaces, surfaces exposed to liquids, and surfaces in vaults of any ferrous metal and aluminum components of equipment, piping, fittings and valves (except stainless steel).
- 6. Exposed surfaces of PVC components of piping, fittings, valves, electrical conduit, and equipment.
- 7. Exposed exterior surfaces of all metallic piping, fittings and valves located on the interior and exterior of buildings and structures. This shall include new piping, fittings and valves for the Project.
- 8. Embedded aluminum or aluminum in contact with dissimilar metals or in contact with corrosive atmospheres.
- 9. Traffic stripes on paving are specified in Division 2, Site Work.

E. The following items will not be painted unless otherwise noted:

- 1. Any code-requiring labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.
- 2. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated.
- 3. Stainless steel angles, tube, pipe, etc.
- 4. Aluminum or fiberglass handrails, walkways, kickplates/toeboards, windows, louvers, grating, checker plate, hatches, and stairways unless otherwise indicated.
- 5. Products with polished chrome, aluminum, nickel, or stainless steel finish.
- 6. Stainless steel, brass, bronze, chromium plate, anodized aluminum, and aluminum other than exposed utility tubing.

- 7. Flexible couplings, lubricated bearing surfaces, insulation, and plastic pipe or duct interiors.
- 8. Plastic switch plates and receptacle plates.
- 9. Signs, nameplates, code-required labels, equipment identification, performance rating, name or nomenclature plates.
- 10. Finish hardware.
- 11. Packing glands and other adjustable parts, unless otherwise indicated.
- 12. Pre-finished items including architectural woodwork and casework, toilet enclosures, metal lockers, elevator equipment, light fixtures, and distribution cabinets.
- 13. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in, or in contact with, concrete shall be coated to prevent electrolysis.
- F. The Contractor shall obtain, at his own expense, all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules, and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970."
- G. All work shall be done in strict accordance with this specification, the Contract Drawings, painting package and the manufacturer's printed instructions.

1.02 Related Work Specified Elsewhere

Specification Section	Title
03300	Cast-in-Place Concrete
03400	Precast Concrete Structures
07100	Waterproofing
07900	Joint Sealants
09750	Protective Floor Coating
09820	Cementitious Coating Systems for CMU Wall Surfaces

Specification Section	Title
09905	Piping, Valve and Equipment Identification System
15000	Mechanical - General Requirements
15060	Ductile Iron Pipe and Fittings
15065	Polyvinyl Chloride (PVC) Pressure Pipe
15100	Valves and Appurtenances
Division	Information
5	Metals
11	Equipment
16	Electrical
Contract Drawings and General Provisions of the Contract	

1.03 Definitions

- A. *Field Painting* is the painting of new or rebuilt items at the Project Site. Field painting shall be the responsibility of the Contractor.
- B. **Shop Painting** is the painting of new or rebuilt items in the shop prior to delivery to the Project Site.
- C. **Dry Film Thickness (DFT)** is the thickness of a coat of paint in fully cured state measured in mils ($^{1}/_{1000}$ inch).
- D. Definitions of additional painting terms as defined in ASTM D16, unless otherwise specified.
- E. The abbreviations and definitions listed below, when used in this specification, shall have the following meanings:

1. SSPC: Steel Structures Painting Council

2. Exterior: Outside, exposed to weather

3. Interior Dry: Inside, not subject to immersion service

4. Interior Wet: Inside, subject to immersion service

5. ASTM: American Society of Testing Materials

6. NACE: National Association of Corrosion Engineers

7. NFPA: National Fire Protection Association

8. OSHA: Occupational Safety and Health Administration

9. NSF: National Science Foundation

10. AWWA: American Water Works Association

1.04 Quality Assurance

A. **Provide the best quality grade of the various types of coatings** as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

- B. The Contractor shall be responsible for a satisfactory paint application which will adhere without peeling, flaking, delamination, blistering or discoloration. Before application of any painting materials, the Contractor shall submit a Project specific Letter of Certification from the manufacturer of the materials to be used. The letter shall state that the manufacturer recommends the materials selected for the application proposed.
- C. Painting shall be accomplished by experienced painters specializing in industrial painting familiar with all aspects of surface preparations and applications required for this Project. Work shall be done in a safe and workmanlike manner. Prior to application of coating materials, the approved paint manufacturer shall submit shall submit a Project specific letter certifying that the Contractor or his painting subcontractor are qualified to apply their respective products.
- D. Provide undercoat paint produced by the same manufacturer as the finish coats.

 Undercoat and finish coat paints shall be compatible. Use only thinners approved by the paint manufacturer, and use only within recommended limits.
- E. A five (5) year warranty for the installed painting/coating systems shall be provided, guaranteeing against premature chipping, flaking, fading, cracking, blistering, peeling, delaminating, or any other defects.

F. Reference Standards

1. All work shall conform to applicable provisions of the following standards, except as modified herein:

a. American National Standards Institute (ANSI)

ANSI Standard	Standard Title
ANSI/EIA RS-359-1969	Colors for Identification and Coding (ANSI C83.1)
ANSI Z53.1-1979	Safety Color Code and Marking Physical Hazards
ANSI A13.1-1975	Scheme for the Identification of Piping Systems

b. American Society for Testing and Materials (ASTM)

ASTM Standard	Standard Title
ASTM D 2200-67(1980)	Pictorial Surface Preparation Standards for Painting Steel Structures
ASTM D 3276-80	Recommended Guide for Paint Inspectors

c. Steel Structures Painting Council (SSPC)

SSPC Spec.	Specification Title
SSPC SP-1	Chemical and/or Solvent Cleaning Removal of loose rust, loose mill scale, and loose paint to a clean sound substrate by hand chipping, scraping, sanding, and wire brushing.
SSPC SP-2	Hand Tool Cleaning Removal of loose rust, loose mill scale, and loose paint to a clean sound substrate by hand chipping, scraping, sanding, and wire brushing.
SSPC SP-3	Power Tool Cleaning Removal of loose rust, loose mill scale, and loose paint to a clean sound substrate by power tool chipping, descaling, sanding, wire brushing, and grinding.
SSPC SP-4	Flame Cleaning Dehydrating and removal of rust, loose mill scale, and some light mill scale by use of flame, followed by wire brushing.
SSPC SP-5 (NACE-1)	White Metal Blast Cleaning Complete removal of all mill scale, rust, rust scale, previous coating, etc., leaving the surface a uniform gray-white color.
SSPC SP-6 (NACE-3)	Commercial Blast Cleaning Complete removal of all dirt, rust scale, mill scale, foreign matter, and previous coatings, etc., leaving only shadows and/or streaks caused by rust stain and mill scale oxides. At least 66% of each square inch of surface area is to be free of all visible residues, except slight discoloration.

SSPC Spec.	Specification Title
SSPC SP-7 (NACE-4)	Brush-off Blast Cleaning Removal of rust scale, loose mill scale, loose rust, and loose coatings, leaving tightly-bonded mill scale, rust and previous coatings. On concrete surfaces, brush-off blast cleaning shall remove all laitance, form oils, and solid contaminants. Blasting should be performed sufficiently close to the surface so as to open up surface voids, bug holes, air pockets, and other subsurface irregularities, but so as not to expose underlying aggregate.
SSPC SP-8	Pickling Complete removal of rust and mill scale by acid pickling, duplex pickling or electrolytic pickling (may reduce the resistance of the surface to corrosion, if not to be primed immediately).
SSPC SP-10 (NACE-2)	Near-White Blast Cleaning Removal of all rust scale, mill scale, previous coating, etc., leaving only light stains from rust, mill scale, and small specks of previous coating. At least 95% of each square inch of surface area is to be free of all visible residues and the remainder shall be limited to slight discoloration.
SSPC SP-11-87	Power Tool Cleaning to Bare Metal Complete removal of rust, rust scale, mill scale, foreign matter, and previous coatings, etc., to a standard as specified on a Commercial Grade Blast Cleaning (SSPC-SP6, NACE-3) by means of power tools that will provide the proper degree of cleaning and surface profile.
SSPC PA-1-64	Paint Application Spec's, No. 1: Shop, Field and Maintenance Painting
SSPC PA-2-73T	Paint Application Specifications, No. 2: Measurement of Dry Paint Thickness with Magnetic Gauges

- d. National Association of Corrosion Engineers (NACE)
- e. Occupational Safety and Health Administration (OSHA)
- f. National Science Foundation (NSF)
- g. National Fire Protection Association (NFPA)
- h. American Water Works Association (AWWA)

G. Acceptable Manufacturers

- 1. It is the intent of this specification section that the Contractor *use one paint manufacturer throughout*, unless otherwise approved by the Engineer. Products shall be manufactured by one of the following:
 - a. Tnemec Company, Inc.

- b. Carboline Company
- c. Induron Coatings, Inc.
- d. Devoe, Inc.
- e. Or approved equal.
- 2. No request for substitution will be considered that decreases the dry film thickness and/or number of coats to be applied, or that offers a change from the generic type of coating specified.

1.05 Resolution of Conflicts

- A. It shall be the responsibility of the Contractor to arrange a meeting prior to the start of painting, or flooring installation between the Contractor's, the paint manufacturer (whose products are to be used), and the Engineer.
- B. All aspects of surface preparation, application and coating systems as covered by this specification will be reviewed at this meeting.
- C. Clarification shall be requested promptly from the Engineer when instructions are lacking, conflicts occur in the specification, or the procedure seems improper or inappropriate for any reason.
- D. Copies of all manufacturer's instructions and recommendations shall be furnished to the Engineer by the Painting Contractor a minimum of seven (7) days prior to the meeting.
- E. It shall be the responsibility of the Coating Manufacturer to have their factory representative meet in person with the Contractor and Engineer during the job as a consultant on surface preparation, mil thickness of coating and proper application of coating unless meeting is determined to be unnecessary by the Engineer.

1.06 Submittals

A. Materials and Shop Drawings

1. Submit to the Engineer as provided in the General Conditions, Supplementary Conditions and Section 01300, *Shop Drawings, Submittals and Samples*, shop drawings, manufacturer's specifications and data on the proposed paint systems, including, but not limited to, the following:

- a. Percent solids by volume.
- b. Minimum and maximum recommended dry-film thickness (DFT) per coat for prime, intermediate and finish coats for each application.
- c. Recommended and detailed surface preparation procedures and techniques.
- d. A certificate identifying the type and gradation of abrasives used for surface preparation.
- e. Recommended thinners for each of the proposed painting/coating systems.
- f. A statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
- g. Application procedures and instructions including recommended equipment and temperature limitations.
- h. Curing requirements and instructions.
- i. Safety Data Sheets (SDS) for each painting/coating material.
- j. A certificate identifying the type and gradation of abrasives used for surface preparation.
- 2. Submit a project specific Letter of Certification from the manufacturer of the materials to be used stating that the manufacturer recommends the materials selected for the application proposed.
- 3. Submit a project specific letter certifying that the Contractor or his painting subcontractor are qualified to apply their respective products.
- 4. The Contractor shall submit to the Engineer, immediately upon completion of the job, certification from the manufacturer indicating that the quantity of each coating purchased was sufficient to coat all surfaces, in accordance with the requirements of this Section. Such certification shall make reference to square footage figures provided to the manufacturer by the Contractor.

B. Schedule

 The Contractor shall submit for approval a complete Schedule of Painting Operations, in an electronic format, within thirty (30) days after the Notice to Proceed. This Schedule is imperative so that the various fabricators or suppliers may be notified of the proper ship prime coat to apply. It shall be the Contractor's

responsibility to properly notify and coordinate the fabricators' or suppliers' surface preparation and painting operations with these specifications. This Schedule shall include for each surface to be painted, the brand name, generic type, solids by volume, application method, the coverage and the number of coats in order to achieve the specified dry film thickness, and color charts. When the Schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gauges may be utilized by the Owner or Engineer to verify the proper application while work is in progress.

- 2. It is the intent of this Section that as much as possible all structures, equipment, and piping utilize coating systems specified herein supplied by a single manufacturer. All exceptions must be noted on the Schedule. For each coating system, only one (1) manufacturers' product shall be used.
- 3. Requests for substitutions shall be made within ten (10) calendar days of the Bid and shall include all of the information required in the Schedule plus a signed and notarized statement from the Chief (Manufacturing) Chemist that the products listed are equal to the specified products, test results, and a list of ten (10) municipal treatment facility projects where each product has been used and has provided satisfactory service for at least ten (10) years. No request for substitution shall be considered that would change the generic type of coating, decrease DFT, or decrease the number of coats.
- 4. Test result submittals shall be certified by a qualified testing laboratory. A quality of paint that is measured by analytical written ASTM/Federal test procedures will provide assurances that quality products are utilized.
- 5. The results from the following testing procedures shall be submitted for determining quality:

a. Abrasion: Federal Test Method Std. No. 141, Method 6192, CS-17

Wheel, 1,000 gram load.

b. Adhesion: Elcometer Adhesion Tester (0 to 1,000 psi).

c. Exterior Exposure: Exposed at 45 F facing ocean (South Florida Marine

Exposures).

d. Hardness: ASTM D3363, latest revision.

e. Humidity: ASTM D2247, latest revision.

f. Salt Spray (Fog): ASTM B117, latest revision.

C. Color Samples

1. The manufacturer's standard color charts for color selection by the Engineer and Owner.

D. Painting Samples

- 1. **Paint colors will be selected by the Engineer and Owner**. Compliance with all other requirements is the exclusive responsibility of the Contractor.
- 2. Samples of each finish and color shall be submitted to the Engineer and Owner for approval before any work is started.
- 3. Samples shall be prepared so that an area of each sample indicates the appearance of the various coats. For example, where three (3) coat work is specified, the sample shall be divided into three (3) areas:
 - a. One (1) showing the application of one (1) coat only.
 - b. One (1) showing the application of two (2) coats.
 - c. One (1) showing the application of all three (3) coats.
- 4. Such samples when approved in writing shall constitute a standard, as to color and finish only, for acceptance or rejection of the finish work.
- 5. For piping, valves, equipment and miscellaneous metal work, provide sample chips or color charts of all paint selected showing color, finish, and general characteristics.
- 6. Rejected samples shall be resubmitted until approved.

1.07 Product Delivery, Handling and Storage

- A. Deliver all materials to the job site in "new", "original", "unopened packages and containers bearing the manufacturers' name, trade name and label analysis, in accordance with Section 01600, Materials and Equipment.
- B. Provide labels on each container with the following information:
 - 1. Name or title of material.
 - 2. Federal Specification numbers, if applicable.

- 3. The manufacturer's stock no., date of manufacture and expiration date (shelf life).
- 4. The manufacturer's formula or specification number.
- 5. The manufacturer's batch number.
- 6. The manufacturers' name.
- 7. Generic type.
- 8. Contents by volume, for major pigment and vehicle constituents.
- 9. Application instructions (including ambient conditions, etc.).
- 10. Thinning instructions.
- 11. Color name and number.
- C. Packages shall not be opened until they are inspected by the Engineer and required for use.
- D. Containers shall be clearly marked to indicate any hazards connected with the use of the paint and steps which should be taken to prevent injury to those handling the product.
- E. All containers shall be handled and stored in such a manner as to prevent damage or loss of labels or containers. All containers shall be handled and stored in a steel cabinet raised four (4) inches above the floor to prevent damage from spillage or loss of labels on containers.
- F. The Engineer or Owner shall designate areas for storage and mixing of all painting materials. Store only acceptable product materials on the Project site. Restrict storage to paint materials and related equipment.
- G. All painting materials shall be stored in a clean, dry, well-ventilated place, protected from sparks, flame, direct rays of the sun or from excessive heat. Paint susceptible to damage from low temperatures shall be kept in a heated storage space when necessary. The Contractor shall be solely responsible for the protection of the materials stored by himself at the job site. Empty coating cans shall be required to be neatly stacked in an areas designated by the Engineer and removed from the job site on a schedule determined by the Engineer. Engineer may request a notarized statement from Contractor detailing all materials used on the project.

- H. Storage of paint materials and related equipment shall comply with the requirements or pertinent codes and fire regulations. The Contractor shall take all safety precautions in accordance with Section 7 of AWWA D102, NFPA Bulleting No. 101 and all federal, state and local regulations. In addition, all safety precautions noted on the manufacturer's Material Safety Data Sheets (MSDS) and other literature shall be strictly followed. Proper containers outside of buildings shall be provided by the Contractor and used for painting wastes. No plumbing fixtures shall be used for this purpose.
- I. Used rags shall be removed from the buildings every night and every precaution taken against "spontaneous combustion".

1.08 Job Conditions

- A. Apply water-base paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 \(\sigma F \) and 90 \(\sigma F \) unless otherwise permitted by the paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 and 95 funless otherwise permitted by the paint manufacturer's printed instructions.
- C. Do not apply paint in rain, fog, or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.
- D. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and maintained within the temperature and humidity limits specified by the paint manufacturer during application and drying periods.

1.09 Warranty and Guarantees

- A. For more information on warranties and bonds, the Contractor is directed to Section 01740, *Warranties and Bonds*.
- B. All paint and coatings work performed under these specifications shall be guaranteed by the coating's applicator for one-hundred percent (100%) of the total coated area for both materials and labor against failures for a warranty period of five (5) years from the date of Final Project Acceptance by the Owner.
- C. Failure under this warranty shall include chipping, flaking, fading, cracking, blistering, peeling, delaminating, or any other defects of the coating due to aging, chemical attack,

- or poor workmanship; but it shall not include areas which have been damaged by unusual chemical, thermal, or mechanical abuse.
- D. The Owner will notify the Contractor at least thirty (30) days prior to the one year anniversary of the date of Final Project completion and shall establish a date for coating inspections. <u>Any defects in the coating system shall be repaired by the Contractor at no additional cost to the Owner</u>. Should a failure occur to more than 20% of the painted surface, either interior or exterior, the entire surface shall be cleaned and painted in accordance with these specifications.

1.10 Identification Systems

A. Paint piping and equipment for identification purposes in accordance with Section 09905, *Piping, Valve and Equipment Identification System*.

1.11 Extra Stock

- A. At the conclusion of the Project, the Owner shall be furnished, at no additional cost, unopened containers providing a minimum of two (2) gallons of each type and color of finish paint for touching up.
- B. The paint or coating container shall indicate the applicable painting system as indicated in these Contract Documents.

1.12 Cooperation with Other Trades

- A. This Work shall be scheduled and coordinated with other Work and/or job conditions as required to achieve satisfactory results.
- B. The Contractor shall examine the Contract Documents for the various trades and shall thoroughly familiarize himself with all their provisions regarding painting and coating systems required.

1.13 Painting Conference

A. At the request of the Engineer and/or Owner, the Contractor shall schedule a painting conference. Attendees shall include the Owner, Engineer, Contractor and a technical

- representative of the paint supplier to discuss the painting requirements and finalize color selections before painting is started.
- B. Prior to painting any surface, the Contractor shall schedule a meeting with the painter and Engineer to inspect the surface preparation and verify that the surface is ready for painting. Failure to inspect a surface prior to coating could result in the rejection of the coating.

2. PRODUCTS

2.01 Materials

- A. All paint shall be manufactured by one of the suppliers listed in Article 1.04(G), herein, and shall be their highest grade and quality of paint.
- B. The following coating systems list a product by name to establish a standard of quality; other products of the same generic types may be submitted to the Engineer for approval as described in Article 1.06, herein. When other than the specified coating system is proposed, the Contractor shall submit a list, in an electronic format) giving the proposed coatings, brand, trade name, generic type and catalog number of the proposed system for the Engineer's review and approval, prior to the application of the painting/coating system.
- C. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Shop paint shall be of the same type and manufacture as used for field painting by the Contractor.
- D. Emulsion and alkyd paints shall contain a "mildewcide" and both the paint and "mildewcide" shall conform to OSHA and Federal requirements, including Federal Specification TT-P-19.
- E. **No paint containing lead or chromate shall be allowed on the Project**. Oil shall be pure boiled linseed oil.
- F. Rags shall be clean painter's rags, completely sterilized.
- G. All cleaners, thinners, driers and other additives and surface pretreatment materials shall only be those approved for use by the manufacturer of the coatings.
- H. Do not dilute paints except as recommended by the paint manufacturer.

- Work areas will be designated by the Owner/Engineer for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations.
- J. Proper containers outside of the buildings/structures shall be provided and used for painting wastes.
- K. All recommendations of the paint manufacturer in regard to the health and safety of the workmen shall be followed.
- L. All coatings to be shop applied must meet the requirements for volatile organic compounds (VOC) of not more than 3.5 pounds per gallon after thinning.
- M. Colors, where not specified, shall be as selected by the Engineer and Owner.
- N. All coatings in contact with potable water need to be NSF certified in accordance with ANSI/NSF Standard 61.

2.02 Coating Schedule

- A. The painting manufacturer's current coating system (paint/coating system name or number) shall be used, whether identified in the Painting Systems identified below (Systems 1 29) or not.
- B. The following coating systems table lists the general features of the standard coating systems, by service and generic type, and is provided as a general guideline for this project:

System No.	Generic Type	Surface Material	Finish	Typical Function
1	Epoxy / Polyurethane	Ferrous Metal, Non-galvanized	Gloss	Exterior Metals not subject to immersion or frequent splashing
2	Polyurethane	Ferrous Metal, galvanized	Gloss	Exterior metals not subject to immersion or frequent splashing
3	Ероху	Ferrous Metal, Non-galvanized	Semi-gloss	Interior metals not subject to immersion or frequent splashing or condensation
4	Alkyd	Ferrous Metal, Galvanized	Semi-gloss	Interior metals not subject to immersion or frequent splashing or condensation

System No.	Generic Type	Surface Material	Finish	Typical Function
5	Ероху	Ferrous Metal, Non-galvanized	Semi-gloss	Interior metals subject to condensation
6	Ероху	Ferrous Metal, Galvanized	Semi-gloss	Interior metals subject to condensation
7	Ероху	Ferrous Metal, Non-galvanized	Semi-gloss	Metals subject to immersion or frequent splashing
8	Ероху	Ferrous Metal, Galvanized	Semi-gloss	Metals subject to immersion or frequent splashing
9	Ероху	Concrete	Semi-gloss	Interior
10	Ероху	Concrete	Tile-like gloss	Interior walls of washrooms
11	Acrylic	Concrete	Low sheen	Precast concrete ceilings, beams and columns
12	Elastomeric	Concrete	Tile-like gloss	Exterior concrete
13	Ероху	Masonry	Semi-gloss	Interior masonry
14	Ероху	Masonry	Tile-like gloss	Interior walls of washrooms
15	Elastomeric	Masonry	Low sheen	Exterior masonry
16	Acrylic	Masonry	Low sheen	Interior masonry
17	Acrylic	Drywall, Plaster	Low sheen	Interior drywall, plaster
18	Acrylic	Plaster, Stucco	Low sheen	Exterior plaster, stucco
19	Alkyd	Wood	Gloss	Exterior wood
20	Alkyd	Wood	Semi-gloss	Exterior wood
21	Alkyd	Wood	Gloss	Interior wood
22	Alkyd	Wood	Semi-gloss	Interior wood
23	Acrylic	Wood	Low sheen	Interior wood
24	Acrylic	Canvas wrapped insulation	Semi-gloss	Canvas wrapped insulation piping
25	Coal Tar Epoxy	Ferrous Metal	Semi-gloss	Metals submerged in non-potable water
26	Coal Tar Epoxy	Concrete	Semi-gloss	Submerged concrete in non- potable water or below grade
27	Ероху	Ferrous Metal	Semi-gloss	Metals submerged in potable water
28	Ероху	Concrete	Semi-gloss	Concrete submerged in potable water
29	Sealer, Hardener	Concrete	Semi-gloss	Concrete Floors

2.03 Coating Systems

A. System No. 1

- 1. System No. 1 shall be used for exterior non-galvanized ferrous metals that are not subject to immersion or frequent splashing of water, reclaimed water or wastewater, including but not limited to the following:
 - a. Exposed exterior piping, valves and fittings.
 - b. Steel storage tanks.
 - c. Exterior cranes and hoists.
 - d. Clarifier and sludge thickener bridge, top side and railings.
 - e. Gate operators.
 - f. Exterior mechanical equipment, control panels, miscellaneous metal, etc. without a factory-applied final finish.
- 2. Surface Preparation: SP 6

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series I Omnithane	1	3.0
Carboline	Carbocoat 115	1	2.0
Induron	P-14 Armorguard Primer	1	3.0 - 5.0
Devoe	Devprime 1405	1	2.0

4. Field Touch-Up: Same material as Shop Primer.

5. Intermediate Coat

a. Provide intermediate coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	N 69	1	3.5
Carboline	Carbocoat 45	2	1.5 - 2.0
Induron	Armorguard II	2	2.0 - 3.0
Devoe	Devlac 1431	2	1.5 - 2.0

6. Finish Coat

a. One (1) full coat of High Gloss aliphatic polyurethane:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	1074	1	3.0
Carboline	Carbocoat 45	1	1.5
Induron	Indurethane 6600 Plus Gloss Enamel	1	1.5 - 2.5
Devoe	Devthane 379	1	1.5

B. System No. 2

- System No. 2 shall be used for exterior galvanized ferrous metals that are not subject to immersion or frequent splashing of water, reclaimed water or wastewater, including but not limited to the following:
 - a. Exposed galvanized piping.
 - b. Exposed galvanized conduit, equipment, miscellaneous metal, etc. without a factory-applied final finish.
- 2. Surface Preparation: SSPC SP1 followed by mechanical abrasion to scarify.
- 3. Field Clean-Up: Remove all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC SP1.

4. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	N69	1	2.5 - 3.5
Carboline	Galoseal WB	1	0.5 - 1.0
Induron	Vinyl Primer	1	0.5 - 1.0
Devoe	Devprime 1405	1	2.0

5. Finish Coat

a. Provide finish coats of one of the following or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	1074	1	3.0
Carboline	Carbocrylic 3359	2	1.5 - 2.0
Induron	Indurethane 6600 Plus Gloss Enamel	2	1.5 - 2.5
Devoe	Devlac 1431 Alkyd Devcryl 1449 Acrylic	2	1.5 - 2.0

C. System No. 3

- 1. System No. 3 shall be used for interior, non-galvanized, ferrous metals not subject to immersion, frequent splashing or condensation, including but not limited to, the following:
 - a. Interior piping, valves and fittings, except infrastructure subject to condensation.
 - b. Exposed structural steel.
 - c. Steel doors and frames.
 - d. Interior equipment, control panels, miscellaneous metal, etc. without a factory-applied final finish.
- 2. Surface Preparation: SP 6

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series I Omnithane	1	3.0
Carboline	Carbocoat 115	1	2.0
Induron	P-14 Armorguard Primer	1	3.0 - 5.0
Devoe	Devprime 1405	1	2.0

4. Field Touch-Up

a. The "field touch-up" coating shall be the same material as the shop primer.

5. Finish Coat

a. Provide finish coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 1075	2	3.0
Carboline	Carbocoat 45	2	2.0
Induron	Armorguard II	2	3.0 - 5.0
Devoe	Devcryl 1449	2	1.5 - 2.0

D. System No. 4

- System No. 4 shall be used for interior, galvanized, ferrous metals not subject to immersion, frequent splashing or condensation, including but not limited to, the following:
 - a. Interior galvanized piping, except piping subject to condensation.
 - b. Interior galvanized conduit, mechanical equipment, control panels, miscellaneous metal, etc. without a factory-applied final finish.

2. Surface Preparation: SP M1

3. Field Clean-Up

a. Remove all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC - SP1.

4. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N 69	1	2.5 - 3.5
Carboline	Galoseal WB	1	0.5 - 1.0
Induron	Vinyl Wash Primer	1	0.5 - 1.0
Devoe	DEVPRIME 1405	1	2.0

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N 69	2	1.5 - 2.0
Carboline	Carbocrylic 3359	2	1.5 - 2.0
Induron	Indurethane 6600 Plus Gloss Enamel	2	1.5 - 2.5
Devoe	DEVCRYL 1449	2	1.5 - 2.0

E. System No. 5

- 1. System No. 5 shall be used for interior, non-galvanized ferrous metals subject to condensation, including but not limited to the following:
 - a. Interior liquid process and water piping.
 - b. Chemical piping and air intake piping.
 - c. Pumps.
- 2. Surface Preparation: SP 6

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N 69	1	2.5 - 3.5
Carboline	Carboguard 60	1	4.0
Induron	P-14 Armorguard Primer	1	3.0 - 5.0
Devoe	DevRan 201 Universal Epoxy Primer	1	2.0 - 3.0

4. Field Touch-Up

a. The "field touch-up" coating shall be the same material as the shop primer.

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N 69	2	2.5 - 3.5
Carboline	Carboguard 60	2	3.0
Induron	Amorguard Epoxy	2	3.0 - 5.0
Devoe	Devran 224 HS	2	3.0

F. System No. 6

1. System No. 6 shall be used for interior, galvanized, ferrous metals subject to condensation, including but not limited to, the following:

a. Interior galvanized liquid process and water piping.

2. Surface Preparation: SP M1 or SP 7

3. Field Clean-Up: Remove all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC - SP1.

4. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N69 Epoxoline	1	2.5
Carboline	Carboguard 60	1	3.0
Induron	Vinyl Wash Primer	1	0.5 - 1.0
Devoe	Bar-Rust 235	1	2.0

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N69 Epoxoline	2	1.5 - 2.0
Carboline	Carboguard	2	3.0
Induron	Armorguard II	2	3.0 - 5.0
Devoe	BAR-RUST 235	2	3.0

G. System No. 7

- 1. System No. 7 shall be used for non-galvanized, ferrous metals subject to immersion or frequent splashing, including but not limited to, the following:
 - a. Submerged piping and piping subject to splashing
 - b. Barscreen systems
 - c. Barscreen hoists
 - d. Mechanical Aerators
 - e. Submersible pumps
 - f. Mixers
 - g. Flocculation systems
 - h. Sludge conveyors

- i. Clarifiers, grit collectors, and sludge thickeners
 - 1) Interior mechanisms
 - 2) Steel weirs, troughs, supports
 - 3) Bridge underside
- j. Sluice gates, slide gates, and flap gates.
- k. Submerged miscellaneous metal, equipment, etc. without a factory-applied final finish.
- 2. Surface Preparation: SP 10

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series I Omnithane	1	2.5 - 3.5
Carboline	Carboguard 890	1	4.0
Induron	P-14 Armorguard Primer	1	3.0 - 5.0
Devoe	DevRan No. 201 Universal Epoxy Primer	1	3.0

4. Field Touch-Up

a. The "field touch-up" coating shall be the same material as the shop primer.

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 446 Permashield MCU	2	5.0 - 7.0
Carboline	Carboguard 890	2	5.0
Induron	Armorguard II	2	3.0 - 5.0
Devoe	Devran 224 HS	2	5.0

H. System No. 8

- 1. System No. 8 shall be used for galvanized, ferrous metals subject to immersion or frequent splashing, including but not limited to, the following:
 - a. Submerged galvanized piping and piping subject to splashing.
 - b. Submerged galvanized conduit, miscellaneous metal, equipment, etc. without a factory-applied final finish.
- 2. Surface Preparation: SP M1 and SP 7
- 3. Field Clean-Up: Remove all grease, oil and contaminants with rags soaked in Toluol or Xylol in accordance with SSPC SP1.

4. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N69	1	2.5 - 3.5
Carboline	Carboguard 890	1	4.0
Induron	Vinyl Wash Primer	1	1.0 - 2.0
Devoe	DevRan No. 201 Universal Epoxy Primer	1	3.0

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series N69 Epoxoline	2	2.5 - 3.5
Carboline	Carboguard 890	2	5.0
Induron	Amorguard Epoxy	2	3.0 - 5.0
Devoe	Devran 224 HS	2	5.0

I. System No. 9

- 1. System No. 9 shall be used for concrete submerged in mild to moderate wastewater service, including but not limited to, the following:
 - a. Interior, exterior and submerged concrete.
- 2. Surface Preparation: Abrasive blast to produce anchor profile equal to ICRI CSP 5.

3. Filler

a. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	218 Mortar Clad *	
Carboline	Sanitile 100	72
Induron	Polyfill Epoxy Block Filler	100
Devoe	Tru-Glaze 4015	75 - 100

^{*} Apply to all surfaces at 1/16-inch

b. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 446 Permashield MCU	2	5.0 - 7.0
Carboline	Carboguard 890	2	5.0
Induron	Armorguard SG Epoxy	2	3.0 - 5.0
Devoe	Devran 224 HS	2	5.0

J. System No. 10

1. System No. 10 shall be used for interior concrete requiring a tile-like finish, including but not limited to, interior washroom walls

2. Surface Preparation: SP C2

3. Filler

a. The need for a filler may be deleted if concrete surface has been "rubbed" finish.

b. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft² / gallon)
Tnemec	Series 1254	130
Carboline	Sanitile 100	72
Induron	Polyfill Epoxy Block Filler	100
Devoe	Tru-Glaze 4015	75 - 100

c. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 84 Ceramlon	2	4.0
Carboline	Carboguard 890	2	4.0
Induron	Perma-Clean II	2	4.0 - 6.0
Devoe	Devran 224 HS	2	5.0

K. System No. 11

- 1. System No. 11 shall be used for interior concrete requiring a matte finish, including but not limited to the following:
 - a. Precast concrete ceilings, beams and columns.

2. Surface Preparation: SP C2

3. Filler

- a. The need for a filler may be deleted if concrete surface has been "rubbed" finish.
- b. There is no need for filler for concrete that is to be "submerged.
- c. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	215 Surfacing Epoxy	As needed
Carboline	Sanitile 100	72
Induron	AC 202 Acrylic Block Filler	75
Devoe	Tru-Glaze 4015	75 - 100

d. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	Aquanaut II Acrylic Eggshell	2	2.0
Devoe	Intercryl 520	2	1.5

L. System No. 12

1. System No. 12 shall be used for exterior concrete requiring a matte finish.

2. Surface Preparation: SP C2

3. Filler

a. The need for a filler may be deleted if concrete surface has been "rubbed" finish.

b. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	Series 218	As needed
Carboline	Sanitile 100	72
Induron	Not Needed	
Devoe	Tru-Glaze 4015	75 - 100

c. Remove excess filler from the concrete surface.

4. Finish Coat

- a. Two (2) coats of one of the following, or approved equal:
- a. Tnemec Series 6 Tneme-Cryl at 2.5 mils dry thickness per coat.
- b. ICI Dulux Paints Ultra Hide Durus Exterior Acrylic Flat Masonry Finish No. 2220. Apply at 1.5 2.0 mils dry thickness per coat.

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	AC 403 Acrylic Elastomeric	2	6.0
Devoe	Intercryl 520	2	1.5

M. System No. 13

- 1. System No. 13 shall be used for interior masonry, including but not limited to the following:
 - a. Masonry walls, except washroom walls.

2. Surface Preparation: SP C1

3. Filler

a. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	Series 1254	130
Carboline	Sanitile 100	72
Induron	Polyfill Epoxy Block Filler	100
Devoe	Tru-Glaze 4015	75 - 100

b. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 66 Epoxoline	2	5.0
Carboline	Carboguard 60	2	5.0
Induron	Armorguard II	2	4.0
Devoe	Devran 224 HS	2	5.0

N. System No. 14

- 1. System No. 14 shall be used for masonry wall requiring a tile-like epoxy finish, including but not limited to the following:
 - a. Interior washroom walls.

2. Surface Preparation: SP C1

3. Filler

a. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	Series 1254	130
Carboline	Sanitile 100	72
Induron	Polyfill Epoxy Block Filler	100
Devoe	Tru-Glaze 4015	75 - 100

b. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 84 Ceramlon	2	4.0
Carboline	Carboguard 890	2	4.0
Induron	Perma-Clean II	2	4.0 - 6.0
Devoe	Devran 224 HS	2	5.0

O. System No. 15

1. System No. 15 shall be used for exterior masonry requiring a matte finish.

2. Surface Preparation: SP C2

3. Filler

a. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers listed below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	Series 1254	130
Carboline	Sanitile 100	72
Induron	Not Needed	
Devoe	Tru-Glaze 4015	75 - 100

b. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	AC 403 Acrylic Elastomeric	2	6.0
Devoe	Intercryl 520	2	1.5 - 2.0

P. System No. 16

1. System No. 16 shall be used for interior masonry requiring a matte finish.

2. Surface Preparation: SP C2

3. Filler

a. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers listed below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	Series 54 Modified Epoxy Masonry Filler	80
Carboline	Sanitile 100	72
Induron	AC 202 Acrylic Block Filler	75
Devoe	Tru-Glaze 4015	75 - 100

b. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	Aquanaut II Acrylic Eggshell	2	2.0
Devoe	Intercryl 520	2	1.5 - 2.0

Q. System No. 17

- 1. System No. 17 shall be used for the following interior surfaces:
 - a. Drywall.
 - b. Stucco.
 - c. Plaster.
- 2. Surface Preparation: SP P1 (Drywall) or SP P2 (Plaster and Stucco).

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 51 PVA Sealer	1	1.5
Carboline	Sanitile 120	1	1.0 - 2.0
Induron	AC 402 Acrylic Masonry Sealer	1	1.0
Devoe	Intercryl 520	1	1.5

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	Aquanaut II Acrylic Eggshell	2	2.0
Devoe	Intercryl 520	2	1.5 - 2.0

R. System No. 18

1. System No. 18 shall be used for the following exterior surfaces:

a. Concrete columns and beams.

b. Plaster and stucco.

2. Surface Preparation: SP P2

3. Primer

a. Filler shall be applied until the surface is "pin-hole" free using the product of one of the manufacturers below (or approved equal), except as indicated above:

Manufacturer	Coating System	Coating Application (ft ² / gallon)
Tnemec	Series 218	As needed
Carboline	Sanitile 100	72
Induron	Not Needed	
Devoe	Tru-Glaze 4015	75 - 100

b. Remove excess filler from the concrete surface.

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	AC 403 Acrylic Elastomeric	2	6.0
Devoe	Professional Velvet Matte Interior Flat Wall and Trim Finish No. 1200	2	1.5 - 2.0

S. System No. 19

1. System No. 19 shall be used for exterior wood surfaces requiring a gloss finish.

2. Surface Preparation: SP W1

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	10-99W	1	2.0 - 3.0
Carboline	Sanitile 120	1	1.0 - 2.0
Devoe	Intercryl 520	1	2.0

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 1028	2	1.5 - 2.5
Carboline	Carbocoat 45	2	2.0
Devoe	Intercryl 530	2	2.0 - 3.0

T. System No. 20

1. System No. 20 shall be used for exterior wood surfaces requiring a semi-gloss finish.

2. Surface Preparation: SP W1

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	10-99 W	1	2.0 - 3.0
Carboline	Sanitile 120	1	1.0 - 2.0
Induron	AC 301 Wood Primer	1	1.5
Devoe	Intercryl 520	1	1.5 - 2.0

4. <u>Finish Coat</u>

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 1029	2	2.0 - 3.0
Carboline	Carbocoat 45	2	2.0
Induron	Armorlux 2500	2	1.5
Devoe	Intercryl 530	2	1.5 - 2.0

U. System No. 21

1. System No. 21 shall be used for interior wood surfaces requiring a gloss finish.

2. Surface Preparation: SP W1

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	10-99 W	1	2.0 - 3.0
Carboline	Sanitile 120	1	1.0 - 2.0
Induron	AC 301 Wood Primer	1	1.5
Devoe	Intercryl 520	1	1.5

4. <u>Finish Coat</u>

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	1028 Enduratone	2	2.0 - 3.0
Carboline	Carbocoat 45	2	2.0
Induron	Armorlux 2500	2	1.5
Devoe	DEVLAC 1431	2	2.0

V. System No. 22

- 1. System No. 22 shall be used for interior wood surfaces requiring a semi-gloss finish.
- 2. Surface Preparation: SP W1

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	10-99 W	1	2.0 - 3.0
Carboline	Sanitile 120	1	1.0 - 2.0
Induron	AC 301 Wood Primer	1	1.5
Devoe	Intercryl 520	1	1.5

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 1029 Enduratone	2	2.0 - 3.0
Carboline	Carbocoat 45	2	2.0
Induron	AC-240 Acrylic Semi-Gloss	2	2.0
Devoe	Devcryl 1449	2	1.5

W. System No. 23

1. System No. 23 shall be used for interior wood surfaces requiring a low-sheen finish.

2. Surface Preparation: SP W1

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	10-99 W	1	2.0 - 3.0
Carboline	Sanitile 120	1	1.0 - 2.0
Induron	AC 301 Wood Primer	1	1.5
Devoe	Intercryl 520	1	1.5

4. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6 Tneme-Cryl	2	2.5
Carboline	Sanitile 155	2	2.0
Induron	Aquanaut II Acrylic Eggshell	2	2.0
Devoe	Devcryl 1449	2	1.5 - 2.0

X. System No. 24

1. System No. 24 shall be used for insulated and canvas-wrapped piping.

2. Surface Preparation: General Cleaning

3. Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6	1	2.0 - 3.0
Carboline	Sanitile 120	1	1.0 - 2.0
Induron	AC 210 Acrylic Primer	1	1.5
Devoe	None		

4. Finish Cover

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 6	2	1.0 - 2.0
Carboline	Carbocoat 45	2	2.0
Induron	Aquanaut II Acrylic Eggshell	2	1.5
Devoe	Devcryl 1449	2	2.0

Y. System No. 25

1. System No. 25 shall be used for metal surfaces, including but not limited to the following:

a. Submerged piping

2. Surface Preparation: SP 10

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 1	1	2.5 - 3.5
Carboline	Carboguard 60	1	3.0
Induron	PE-70 Primer	1	3.0 - 5.0
Devoe	DevRan No. 201 Universal Epoxy Primer	1	3.0

4. Field Touch-Up

a. The "field touch-up" coating to be applied, as required, shall be from one of the following manufacturers, or approved equal:

Manufacturer	Coating System
Tnemec	Series I
Carboline	Bitumastic 300M
Induron	Ruff Stuff 2100 Coal Tar Epoxy
Devoe	DevRan No. 201 Universal Epoxy Primer

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	446 Permashield MCU **	2	6.0 - 8.0
Carboline	Bitumastic 300M	2	8.0
Induron	Ruff Stuff 2100 Coat Tar Epoxy *	2	8.0
Devoe	DevTar 5A, No. 221 Epoxy High Build Coating **	2	8.0

^{*} Apply the second coat within 90 hours of the first coat.

^{**} Apply the second coat within 7 days of the first coat.

Z. System No. 26

- 1. System No. 26 shall be used for concrete surfaces, including but not limited to the following:
 - a. Submerged concrete.
 - b. All precast structures or cast-in-place concrete below grade (interior and exterior).
- 2. Surface Preparation: SSPC -SP 13 - Abrasive blast to provide an anchor profile equal to ICRI CSP 5 or greater.

3. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Tnemec 46-413 Tneme-Tar *	2	9.0
Carboline	Bitumastic 300M	2	8.0
Induron	Ruff Stuff 2100 Coat Tar Epoxy *	2	8.0
Devoe	DevTar 5A, No. 221 Epoxy High Build Coating ***	2	8.0

AA.System No. 27

1. System No. 27 shall be used for steel surfaces in potable water immersion.

2. Surface Preparation: **SP 10**

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

 ^{*} Apply the second coat within 90 hours of the first coat.
 * Apply the second coat within 24 hours of the first coat.
 *** Apply the second coat within 7 days of the first coat.

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series I Omnithane	1	2.5 - 3.5
Carboline	Carboguard 61	1	5.0
Induron	PE-70 Primer	1	3.0 - 5.0
Devoe	BAR-RUST 233 H	1	3.0 - 5.0

4. Field Touch-Up

a. The "field touch-up" coating to be applied, as required, shall be from one of the following manufacturers, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series I Omnithane	1	2.5 - 3.5
Carboline	Carboguard 61	1	3.0 - 5.0
Induron	PE-70 Primer	1	3.0 - 5.0
Devoe	Bar-Rust 233 H	1	3.0 - 5.0

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	141 Epoxoline	2	6.0 - 8.0
Carboline	Carboguard 61	2	5.0
Induron	PE-70 Int./Finish	2	3.0 - 5.0
Devoe	Bar-Rust 233 H	2	3.0 - 5.0

BB. System No. 28

1. System No. 28 shall be used for concrete surfaces in potable water immersion.

2. Surface Preparation: SSPC - SP13 Abrasive Blast to produce an anchor profile equal to ICRI CSP 5

3. Shop Primer

a. One (1) coat of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 218 *	1	
Carboline	Carboguard 61	1	5.0
Induron	PE-70 Primer	1	3.0 - 5.0
Devoe	Bar-Rust 233 H	1	3.0 - 5.0

^{*} Apply ¹/₁₆-inch to all surfaces

4. Field Touch-Up

a. The "field touch-up" coating to be applied, as required, shall be from one of the following manufacturers, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 218 *	1	As needed
Carboline	Carboguard 61	1	3.0 - 5.0
Induron	PE-70 Primer	1	3.0 - 5.0
Devoe	Bar-Rust 233 H	1	3.0 - 5.0

5. Finish Coat

a. Two (2) coats of one of the following, or approved equal:

Manufacturer	Coating System	No. of Coats	DFT per Coat (mils)
Tnemec	Series 141	2	6.0 - 8.0
Carboline	Carboguard 61	2	5.0
Induron	PE-70 Int./Finish	2	3.0 - 5.0
Devoe	Bar-Rust 233 H	2	3.0 - 5.0

CC. System No. 29

- 1. System No. 29 shall be used for all non-painted, exposed concrete flooring surfaces.
- 2. Surface Preparation: SP C1
- 3. System 29 shall consist of the application of three (3) coats of one of the following:
 - a. Tnemec Series 629 CT Densifyer
 - b. Sonneborn "Kure-N-Seal"
 - c. Euclid Chemical Company "Surfhard"
 - d. Lambert Corporation "Solidus"
 - e. Approved Equal.

2.04 Wet Striping

A. After primer coat is applied, the same primer in a different color shall be applied to nuts, bolts, corners and sharp edges.

2.05 Extra Paint

A. Furnish two (2) unopened gallon cans of each type and each color of paint used, properly marked for future use by the Owner.

3. EXECUTION

3.01 General

A. Inspection of Surfaces

Before application of the prime coat and each succeeding coat, *inspect all surfaces*, adjoining work and conditions under which coating systems are to be applied and report to the Engineer, in writing, any existing unsatisfactory conditions.

- Any defects or deficiencies shall be corrected by the Contractor before application of any subsequent coating. Commencement of surface preparation and painting shall constitute the acceptance of existing conditions and any defects appearing in the painting work thereafter shall be by the Contractor at no additional cost to the Owner.
- 3. When any appreciable time has elapsed between coatings, previously coated areas shall be carefully inspected by the Engineer, and where, in his opinion, surfaces are damaged or contaminated, they shall be cleaned and recoated at the Contractor's expense. Recoating times of the manufacturer's printed instructions shall be adhered to.
- 4. Coating thickness shall be determined by the use of a properly calibrated inspection gauge for non-ferrous and cementitious surfaces. Coating thickness minimums shall be adhered to. If a surface fails the DFT test, the entire surface shall be recoated at no additional cost to the Owner.

B. Equipment

- Effective oil and water separators shall be used in all compressed air lines serving spray painting and sandblasting operations to remove oil or moisture from the air before it is used. Separators shall be placed as far as practical from the compressor.
- 2. All equipment for application of the paint and the completion of the work shall be furnished by the Contractor in "first-class condition" and shall comply with recommendations of the paint manufacturer.
- 3. The Contractor shall provide, free of charge to the Engineer, a "Nordson-Mikrotest" or "Positest" dry film thickness gauge for ferrous metal and an OG232 "Tooke" gauge, or equal, for nonferrous and cementitious surface, to be used to inspect coatings by the Engineer and Contractor. The gauges may be used by the Contractor and returned each day to the Engineer. The Engineer will return gauges to the Contractor at completion of job.

3.02 Protection of Surfaces Not Scheduled to be Coated

- A. **Protect surrounding areas and surfaces** not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

- C. Provide temporary closures as required to prevent circulation of dust from adjacent areas where other work is in progress. Where it is necessary to remove existing protection of work of others, such protection shall be fully replaced.
- D. Locate and protect all existing utilities, structures and appurtenances.

3.03 Shop Painting

A. Surface Preparation

- All ferrous metal to be primed in the shop shall have all rust, dust and scale, as well as all other foreign substances, removed by sandblasting or pickling in accordance with SSPC-SP5 or SP8, respectively. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Under no circumstances will cleaned metal be allowed to sit overnight before priming, or pretreatment and priming.
- 2. All non-ferrous metals shall be solvent cleaned prior to the application of primer.
- 3. In addition, galvanized surfaces which are to be top-coated shall first be degreased then primed.
- 4. All non-ferrous metal surfaces shall also be scarified prior to top-coating.

B. Materials Preparation

- 1. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt and other foreign materials.
- 2. No thinners shall be used except those specifically mentioned and only in such quantity as directed by the manufacturer in his instructions. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or cleanup solvent shall be used for all clean-up.
- 3. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.

C. Applications

1. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Coating systems shall be as specified herein.

- 2. **Apply paint in accordance with the manufacturer's directions**. Use applicators and techniques best suited for the type of material being applied.
- All paint and coatings materials shall be stored under cover and at a temperature within 10□F of the anticipated application temperature and at least 5□F above te dew point.
- 4. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color, and appearance.
- 5. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness.
- 6. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.
- 7. The equipment manufacturer or supplier shall provide touch-up paint for items with shop applied finish coats.
- 8. Where specified in the individual sections, primer coat(s) shall be applied in the shop by the equipment manufacturer. The shop coats shall be as specified and shall be compatible with the field coat or coats.

D. Certification

1. The Contractor shall obtain from the equipment manufacturer or supplier, prior to shipment of equipment, a *written certification that surface preparation, coating brand, material, DFT, and application method complied with this Section*.

3.04 Surface Preparation

- A. Prepare all surfaces in accordance with the coating manufacturer's instructions and as specified. Surfaces shall be uniform texture, dry, and free from all dust, rust, scale, splinters, loose particles, disintegrated paint, grit, oil, grease, or deleterious substances that will adversely affect adhesion or appearance of the coating. Rough edges of metal, weld seams and sharp edges from scaffold lugs shall be ground to a curve.
- B. Exposed nails and other ferrous metals on surfaces to be coated shall be spot- primed with a metal primer compatible with the finish.
- C. Surfaces that have been cleaned, pre-treated, and/or otherwise prepared for painting shall be given a coat of the first-coat material as soon as practicable prior to any deterioration of the prepared surface.

- D. Hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items and surfaces not to be painted which are in contact with or nearby surfaces to be painted shall be removed, masked, or otherwise protected prior to surface preparation and painting operations.
- E. Before commencing work, the painter must make certain that surfaces to be covered are in "perfect" condition and must obtain Engineer's approval to proceed. Should the painter find such surfaces not in "perfect" condition, he shall report such fact(s) to the Engineer prior to covering. The application of paint shall be held as an acceptance of the surfaces and working conditions and the painter will be held responsible for the results reasonably expected from the materials and processes specified.
- F. Program the cleaning and painting so contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.
- G. Do not sandblast or prepare more surface area in one (1) day than can be coated in one (1) day. Prepare surfaces and apply coatings the same day.
- H. Do not sandblast PVC, CPVC or FRP piping or equipment. Do not sandblast epoxyor enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.
- I. The surface shall be cleaned as specified for the paint system being used. All cleaning shall be as outlined in the Steel Structures Painting Council's (SSPC) Surface Preparation Specification unless otherwise noted. If surfaces are subject to contamination, other than mill scale or normal atmospheric rusting, the surfaces shall be pressure washed, and acid or caustic pH residues neutralized, in addition to the specified surface preparation.
- J. Visual standards, SSPC-VIS-1 (Swedish SIS OS 5900), "Pictorial Surface Preparation Standards for Painting Steel Surfaces," and the National Association of Corrosion Engineers (NACE), "Blasting Cleaning Visual Standards" TM-01-70 and TM-01-75 shall be considered as standards for proper surface preparation.
- K. Standards for Surface Preparation

SSPC Spec.	Specification Title and General Description
SSPC - SP1	Solvent Cleaning Removal of all visible oil, grease, soil drawing and cutting compounds and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process.

SSPC Spec.	Specification Title and General Description				
SSPC - SP2	Hand Tool Cleaning Hand Tool Cleaning removes all loose mill scale, loose rust and other detrimental foreign matter. It is not intended that adherent mill scale, rust and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before hand tool cleaning, remove visible oil, grease, soluble welding residues and salts by the methods outlined in SSPC-SP1.				
SSPC - SP5 (NACE 1)	White Metal Blast Cleaning A White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.				
SSPC - SP6 (NACE 3)	Commercial Blast Cleaning A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter, except for staining. Staining shall be limited to no more than 33% of each square inch of surface area and may consist of light shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.				
SSPC - SP7 (NACE 4)	Brush-off Blast Cleaning A Brush-Off Blast Cleaned surface, when viewed without magnification, shall I free of all visible oil, grease, dirt, dust, loose mill scale, loose rust and loose pair Tightly adherent mill scale, rust and paint may remain on the surface. Mill scal rust and coating are considered adherent if they cannot be removed by lifting will a dull putty knife after abrasive blast cleaning has been performed. Before blat cleaning, visible deposits of oil or grease shall be removed by any of the method specified in SSPC-SP1 or other agreed upon methods.				
SSPC - SP10 (NACE 2)	Near-White Blast Cleaning A Near-White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter, except for staining. Staining shall be limited to no more than 5% of each square inch of surface area and may consist of light shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods. The blasted clean surface shall be primed the same day and before any rusting of the surface occurs.				
SSPC - SP11	Power Tool Cleaning to Bare Metal Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. The profile shall not be less than 1 mil. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1, "Solvent Cleaning", or other agreed upon methods.				

SSPC Spec.	Specification Title and General Description				
SSPC - SP12 (NACE 5)	High and Ultra-High Pressure Water Jetting for Steel and Other Hard Metals This standard provides requirements for the use of high and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only, without the addition of solid particles in the stream.				
SSPC - SP13 (NACE 6)	Concrete This standard gives requirements for surface preparation of concrete by mechanical, chemical or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete and dust, and should provide a dry, sound, uniform substrate suitable for the application of protective coating or lining systems (Depending upon the desired finish and system, a block filler may be required).				

- L. Oil, grease, soil, dust, etc., deposited on the surface preparation that has been completed shall be removed prior to painting according to SSPC - SP1 Solvent Cleaning.
- M. Weld flux, weld spatter and excessive rust scale shall be removed by Power Tool Cleaning as per SSPC SP 11.
- N. All weld seams, sharp protrusions, and edges shall be ground smooth prior to surface preparation or application of any coatings.
- O. All areas requiring field welding shall be masked off prior to shop coating, unless waived by the Engineer.
- P. All areas which require field touch-up after erection, such as welds, burnbacks, and mechanically damaged areas, shall be cleaned by thorough Power Tool as specified in SSPC SP11.
- Q. Touch-up systems will be same as original specification except that approved manufacturer's organic zinc-rich shall be used in lieu of inorganic zinc where this system was originally used. Also strict adherence to manufacturer's complete touch-up recommendations shall be followed. Any questions relative to compatibility of products shall be brought to the Engineer's attention; otherwise, the Contractor assumes full responsibility.
- R. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structures Painting Council, Surface Preparation Specifications, ANSI A159.1) specifications listed above.

S. When specified, the surface shall be pre-treated in accordance with the specified treatment prior to application of the prime coat of paint.

T. Ferrous Metal Surfaces

- Remove any oil or grease from surfaces to be coated with clean rags soaked in a solvent recommended by the coating manufacturer in accordance with SSPC specifications. Any chemical contamination shall be eliminated by means of neutralization or flushing or both prior to additional surface preparation. Clean rags shall be changed each 100 ft².
- 2. For immersion service, all sharp edges and welds shall be ground smooth to a rounder contour, all weld splatter shall be removed, and all pits and dents shall be filled, and all imperfections shall be corrected prior to sandblasting.
- 3. For non-immersion service, all sharp edges and welds shall be ground, all weld splatter shall be removed, all pits and dents shall be filled, and all imperfections shall be corrected prior to sandblasting.
- 4. For immersion service, all surfaces to be coated shall be sandblasted to white metal in accordance with Steel Structures Painting Council Specification SSPC SP10 of the National Association of Corrosion Engineers Specification NACE 2. A white metal blast is defined as removing all rust, scale, paint, etc., to a clean white metal which has a uniform gray-white appearance. No streaks or stains or rust or any other contaminants are allowed. The proper abrasive to obtain the specified surface profile (anchor pattern) designated in the coating manufacturer's most recent printed application instructions shall be used. After sandblasting, dust and spent sand shall be removed from the surfaces by brushing or vacuum cleaning. The prime coat shall be applied as soon as possible after the blasting preparation is finished and always before the surface starts to rust. No sandblasted surface shall stand overnight before coating.
- 5. For non-immersion service, or wherever specified in the coating manufacturer's most recent printed application instructions for other services, all surfaces to be coated shall be sandblasted to near white metal in accordance with Steel Structures Painting Council Specification SSPC SP10 or the National Association of Corrosion Engineers Specification NACE 2. A near white metal blast is defined as removing all rust, scale, paint, etc., except for very light shadows, very slight streaks or slight discolorations caused by rust stain, mill scale oxides, or slight, tight residues of paint or coatings that may remain. The proper abrasive to obtain the specified surface profile (anchor pattern) designated in the coating manufacturer's most recent printed Application Instructions shall be used. After sandblasting, dust and spent sand shall be removed from the surfaces by brushing or vacuum cleaning. The prime coat shall be applied as soon as possible after the blasting preparation is finished and always before the surface starts to rust. No sandblasted

- surface shall stand overnight before coating. (This is 95 percent of any given surface area blasted to white metal).
- 6. For non-immersion service surfaces to be coated shall be sandblasted where specified to a commercial sandblast in accordance with Steel Structures Painting Council Specification SSPC SP 6 or National Association of Corrosion Engineers Specification NACE 3. A commercial sandblast is defined as removing all rust, scale, paint, etc., except for slight shadows, streaks or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain, if the surface is pitted, slight residues or paint or rust, may be found in the bottom of pits. The proper abrasive to obtain the specified surface profile (anchor pattern) designated in the coating manufacturer's most recent printed Application Instructions shall be used. After sandblasting, dust and spent sand shall be removed from the surfaces by brushing or vacuum cleaning. The prime coat shall be applied as soon a possible after the blasting preparation is finished and always before the surface starts to rust. no sandblasted surface shall stand overnight before coating (this is bof any given surface area blasted to white metal).
- 7. Ferrous metal surfaces previously exposed to sulfides shall be sandblasted, flame cleaned, and sandblasted again in accordance with the recommended surface preparation for the particular service in question.
- 8. Where blast cleaning is done in the field, only "virgin" sand, grit, or abrasive will be used.
- 9. Inaccessible areas, such as behind tank rafters or skip-welded lap joints, or in between back-to-back angle iron bracing, shall be coated before assembly to prevent corrosive action from taking place in these inaccessible areas. All surface voids shall be sealed-welded and back-to-back bracing and tank rafters either coated before assembly or eliminated from the design and construction. Sharp corners and edges shall be ground to a smooth contour and welds prepared as described above.

U. Concrete Surfaces

1. All efflorescence, laitance, chalk, dust, dirt, oils, grease, concrete curing agents, form release agents, sealers, old coatings and other chemical contaminants shall be removed either by steam cleaning with detergent, by scrubbing with a hot trisodium phosphate solution consisting of two (2) pounds of trisodium phosphate to each gallon of hot water (160□F), or by high pressure water blasting (3,000 psi or higher). Multiple cleaning operations may be required to remove all contaminants. Repeat the cleaning operation until the contamination is removed and flush the area with clean water to remove residual cleaning solution. Allow to dry thoroughly before coating.

- 2. All concrete surfaces to be coated shall be clean and dry. "Dry" is defined for new concrete as free of moisture and fully cured which is a minimum of 30 days at 75 □ F and fifty percent (50%) Relative Humidity or some equivalent cure time at other conditions (7 days minimum for stucco). The moisture content of the concrete shall be determined by using both of the following methods.
 - a. The presence of moisture shall be checked by taping a one-foot square piece of 20 mil thick minimum plastic film on the surface. Pieces of test plastic film should be placed at various locations that are likely to be slow drying out, such as below grade, low spots in floors, inside corners and lower wall areas. The plastic film should be carefully sealed with tape to prevent the escape of any moisture or vapor that would be trapped behind the film. The film should be left in place over night or longer to allow sufficient time for moisture migration. After a minimum of sixteen (16) hours, remove and examine the backside for moisture condensation and inspect the concrete surface for darkened areas. The source of the moisture, if present, shall be located, and the cause corrected prior to coating.
 - b. The presence of moisture shall also be determined with a moisture detection device such as a Delmhorst Model DLM2E, or equal. Moisture determined by this method shall be less than fourteen (14) percent moisture content before coating operations shall be allowed to proceed.
- 3. Do not use form oils incompatible with the coating, concrete curing agents, or concrete hardeners on concrete surfaces to be coated.
- 4. Old paint and unremoved tar stains shall be solvent cleaned with naphtha, trichloroethylene, or perchloroethylene. Proper safety precautions shall be observed if this step is necessary. The surface shall be flushed with fresh water and dried.
- Concrete and/or cinder block walls to receive a coating shall be air-blasted with 100 psi clean, dry, oil-free air to remove dust, etc., and wire brushed to remove all loose and/or weak mortar. See the requirements for sumps, tanks and other water-bearing structures below.
- 6. Concrete floors shall be thoroughly swept clean and then acid etched. Acid etching consists of first dampening the entire surface with clean water (avoid and excess of water that will for puddles). Acid etch the damp floor with a 10 to 15 percent solution of hydrochloric (muriatic) or phosphoric acid. Allow the acid to stand on the floor until the bubbling stops. For best results, while the acid is bubbling scrub the floor with a stiff bristled brush. Do not allow the "spent" acid to dry on the floor. Rinse the surface thoroughly with fresh water. If the surface does not appear as rough as medium grit sandpaper, repeat the above steps. Neutralize the surface with a five percent (5%) solution of soda ash, tri-sodium phosphate, or ammonium

hydroxide in clean water. Let the solution stand for ten (10) minutes on the surface. Rinse thoroughly with water. The surface must be slightly alkaline (pH of 9.0) prior to coating.

7. The floors or concrete sumps, tanks or other water-bearing structures should be acid etched as described above or they may be sandblasted. The walls of concrete sumps and tanks must be sandblasted. Roughen the surface to a texture equivalent to that of medium grit sandpaper. Use a compressed air blast nozzle with oil-free air. The abrasive used should be dry silica sand with the maximum particle size that will pass through a sixteen (16) mesh screen and minimum particle size retained on a thirty (30) mesh screen. After the blast cleaning is completed, sand, dust and loose particles should be removed from the surface by vacuuming or blowing off with high pressure oil-free air. Examine the surface for texture and uniformity, as well as the removal of dust, efflorescence and laitance. Patch voids and cracks that will cause discontinuities in the coating or unsightly appearance using a patching compound compatible with the coating system.

V. Wood Surfaces

- 1. Wood should be clean and dry.
- 2. Remove surface deposits of sap or pitch by scraping and wiping clean with rags dampened with mineral spirits or VM & P Naphtha.
- Seal knots and pitch pockets with shellac reduced with equal parts of shellac thinner (denatured alcohol) before sandpaper and finishing with fine grit and remove sanding dust.
- 4. After the prime coat is dry, fill cracks and holes with putty or spackling compound.
- 5. When the filler is hard, sand flush the surface using fine grit sandpaper. Sand lightly between coats with fine grit, open-coated sandpaper.

W. Galvanized Steel and Non-Ferrous Metal

- 1. Galvanized steel and aluminum will only be coated when so specified.
- Surfaces shall be clean and dry. Remove dust and dirt by blowing off the surface
 with high pressure air or wiping clean with dry rags. Oil, grease and protective mill
 coatings should be removed by solvent cleaning in accordance with SSPC-SP1.
- 3. White mst should be removed from galvanized steel or aluminum by hand or power brushing. Care should be taken not to damage or remove the galvanizing. Rust should be removed from old galvanized steel by Hand or Power Tool Cleaning in accordance with SSPC SP2 or SSPC SP11.

- 4. All surfaces shall be scarified by brush blasting for immersion service or hand sanding for non-immersion service.
- 5. Other surface preparation, as outlined in the coating manufacturer's latest written Application Instructions, shall be observed for more demanding exposures.

X. Stainless Steel

- 1. Stainless steel will only be coated when so specified, or when it is adjacent to areas to be coated such as piping supports, anchor bolts or flange bolts.
- 2. Stainless steel requires only solvent cleaning prior to coating using any one of the methods in SSPC SP1. Only solvents and cleaning solutions containing less than 200 ppm of halogens should be used to prevent stress corrosion cracking.
- 3. Stainless steel may be whip-blasted to provide a surface profile to increase the mechanical bond of the coating system. The height of the profile and the texture required should be defined for the operator and as a standard for the acceptance of the work. Pictorial standards for the surface cleanliness of carbon steel are not applicable to stainless steel, since there are no corrosion products or mill scale to remove from the surface.
- 4. Abrasive blast cleaning procedures outlined by the Steel Structures Painting Council for carbon steel may also be used for stainless steel. Only very hard silica sand or other abrasive media should be used for a fast cutting action and to obtain a sharp angular profile.

Y. Gypsum Drywall

- 1. Sand joint compound with fine grit, open-coated sandpaper to provide a smooth flat surface. Avoid heavy sanding of the adjacent wall board surfaces, which will raise the nap of the paper covering. Remove dust from the surface by wiping with clean rags or other means. If additional joint finishing is required to provide a smooth surface, the same joint compound of a ready-mixed spackling compound should be used. Putty, patching pencils, caulking, or masking tape should not be applied to dry wall surfaces to be painted.
- 2. Lightly scuff-sand tape joints after priming to remove raised paper nap. Take care not to sand through the prime coat and remove dust by wiping with clean rags.

Z. PVC or Other Plastic Piping or Ductwork

1. Solvent clean.

2. If recommended by the manufacturer, lightly abrade surface with medium grade sandpaper. Remove dust by wiping with clean rags.

AA. Previously-Painted Surfaces (Except Ferrous Metal, Non-immersion)

- Careful examination of the old coating is necessary in order to determine the
 condition of the coating prior to recommending the degree of surface preparation
 that will be needed. The old coating shall be shaved with a knife to ascertain its
 present adhesion to the substrate, as well as the flexibility of the film. If the old
 coating has a tendency to powder or shatter easily under the knife, or disbonds
 freely from the substrate or underfilms, it would indicate total removal is necessary.
 - a. When up to ten percent (10%) of the total area has failed, spot blasting back to at least one (1) inch into sound film, feathering of edges and spot priming is required.
 - b. When the coating system has deteriorated to approximately twenty-five percent (25%) of the total area, or if the coating is brittle, eroded or underfilm rusting is present, completely remove the original coating system by sandblasting as specified.
- 2. Tank linings, immersion-service coatings, and some other types of high performance coatings generally require total removal before recoating. Consult the manufacturer's recommendations for which of the other types of high performance coatings require total removal.
- 3. In instances where the film has been eroded due to weathering or worn thin due to abrasion or impingement with no rusting, the surface contaminants may be removed through high pressure water blasting (approximately 2,000 to 3,000 psi, over 4 gallons per minute) with emulsifying agents or cleaners, rinsed and dried. Roughening of the surface shall be used to improve the adhesion of subsequent coats. Recoat with the recommended finish coat(s).

3.05 Materials Preparation

- A. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt, and other foreign materials. Colors shall be thoroughly mixed with no streaks or separation of color.
- B. Mechanical mixers, capable of thoroughly mixing the pigment and vehicle together, shall mix the paint prior to use where required by manufacturer's instructions; thorough hand mixing will be allowed for small amounts up to one (1) gallon.

- C. Pressure pots shall be equipped with mechanical mixers to keep the pigment in suspension, when required by manufacturer's instructions. Otherwise, intermittent hand mixing shall be done to assure that no separation occurs.
- D. All mixing shall be done in accordance with SSPC Vol. 1, Chapter 4, "Practical Aspects, Use and Application of Paints" and/or with manufacturer's recommendations.
- E. Except where otherwise specified, thinning shall be done only if necessary for the workability of the coating material and then, only in accordance with the coating manufacturer's most recent printed application instructions. Use only the thinner provided by the coating manufacturer. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or cleanup solvent shall be used for all cleanup. Do not incorporate in the coating any thinners or solvents used for cleaning brushes or equipment.
- F. Exercise care to keep fire hazards to a minimum. Provide an approved hand fire extinguisher near each paint storage and mixing area. No oily waste, rags, or painting equipment shall be left scattered throughout the premises.
- G. Protect all adjacent areas against damage and leave storage and mixing areas clean at the completion of painting.
- H. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.

3.06 Application

- A. Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather, unless otherwise allowed by the paint manufacturer.
 - 1. Except as provided below or where the manufacturer allows, painting shall not be permitted when the atmospheric temperature is below 50°F, or when freshly painted surfaces may be damaged by rain, fog, dust, or condensation, and/or when it can be anticipated that these conditions will prevail during the drying period.
 - 2. No exterior painting shall be done during inclement weather when relative humidity exceeds 85%, or under conditions identified by the manufacturer as unsuitable.
- B. No coatings shall be applied unless surface temperature is a minimum of 5°F above the dew point; the temperature must be maintained during curing.

	DEW POINT* CALCULATION CHART "Surface Temperature at which Condensation begins"										
	Ambient Air Temperature (□F)										
RH	20	30	40	50	60	70	80	90	100	110	120
90%	18	28	37	47	57	67	77	87	97	107	117
85%	17	26	36	45	55	65	76	84	95	103	113
80%	16	25	34	44	54	63	73	82	93	102	110
75%	15	24	33	42	52	62	71	80	91	100	108
70%	13	22	31	40	50	60	68	78	88	96	105
65%	12	20	29	38	47	57	66	76	85	93	103
60%	11	19	27	36	45	55	64	73	83	92	101
55%	9	17	25	34	43	53	61	70	80	89	98
50%	6	5	23	31	40	50	59	67	77	86	94
45%	4	13	21	29	37	47	56	64	73	82	91
40%	1	11	18	26	35	43	52	61	69	78	87
35%	-2	8	16	23	31	40	48	57	65	74	83
30%	-6	4	13	20	28	36	44	52	61	69	77

^{* &}lt;u>Dew Point</u>: Temperature at which moisture will condense on a surface. No coating shall be applied unless the surface temperature is a minimum of 5□F above this point. The temperature must be maintained during curing.

<u>Example</u>: If the air temperature is 70□F and the relative humidity is 65%, then the dew point is 57□F. No coating shall be applied unless the surface temperature is 62□F.

C. Paint all exposed surfaces in rooms scheduled for painting whether or not colors are designated in schedules, except where the natural finish of material is obviously intended and specifically noted as a surface not be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If the color of the finishes are not designated, the Engineer will select them from the standard colors available for the materials systems as specified.

D. Ventilation

1. Provide adequate ventilation for safe application and for proper drying of coatings on interior surfaces.

- 2. Ensure solvent vapors are released during and after application of coatings. Remove vapors by exhausting air from the lowest portions of tanks and enclosed spaces and keep tops open and clear.
- 3. During coating application in enclosed areas, the capacity of ventilating fans shall be at least 300 cfm per gallon of coating applied per hour.
- 4. Provide continuous forced ventilation at a rate of at least one complete air change per four (4) hours for at least five (5) days after the coating application is completed.
- E. The average rate of application shall not exceed the theoretical rate of coverage recommended by the coating manufacturer for the type of surface involved, less an allowance for losses. Average dry film thickness shall not be less than thickness set forth under Painting Systems. Not more than 10-20% of points inspected may be less than 90% of the specified thickness. Deficiencies shall be corrected by application of additional coating.
- F. Each coat shall be uniform in coverage and color. Successive coats shall perceptibly vary in color. Each coat shall be carefully examined and faulty material, poor workmanship, holidays, damaged areas and other imperfections shall be touched up prior to applying succeeding coats. Comply with coating manufacturers' recommendations for drying time between coats.
- G. Bottoms, sides and edges of doors shall receive same finish as faces of doors. If refitting of wood doors is done prior to final acceptance, refinish at no extra cost.
- H. Incidental niches, recesses, passages, closets, etc., shall be finished to match similar or adjacent spaces.
- Access doors, panels, convectors, grilles and similar items shall be coated the same color as adjacent work, except for non-ferrous metal or where otherwise directed by the Engineer.
- J. Primed hardware shall be coated to match adjacent work to which they are attached.
 - K. In the event that the finished surfaces are not acceptable, completely refinish entire unit areas and sections as necessary to eliminate visible laps or other indications of repairs.

L. Color Selection

- 1. Colors for Multi-Coat Systems
 - a. Each coat shall be applied in a different color or shade from the preceding coat to aid in determining the uniformity and coverage of the coating.
 - b. The finish coat color shall be selected by the Engineer and Owner.

c. When a white finish coat is specified, the last two (2) coats shall be white.

2. Color Coding Piping

- a. All exposed piping shall be identified as specified in Section 09905, "Piping and Equipment Identification System".
- b. The pipe identification system shall include color coding or banding, legends, and arrows.

3. Color Coding Conduit

- a. All exposed electrical conduit with conductors over 120 volts shall be color banded as specified in Division 16, "Electrical" and Section 09905, "Piping and Equipment Identification System" (color code, if provided, takes precedence).
- M. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship.
- N. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied. All equipment shall be maintained in good working order and shall be comparable to that described in the coating manufacturer's most recent application instructions. It shall be thoroughly cleaned and inspected daily. Worn spray nozzles, tips, etc., shall be replaced regularly. Effective oil and water separators shall be used and serviced on all air lines.
- O. All paints and coating materials shall be stored under cover and at a temperature within 10 F of the anticipated application temperature and at least 5 F above the dew point.
- P. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color, and appearance.
- Q. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps, and brush marks. Edges of paint adjoining other colors or materials shall be sharp and true. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness. Allow each coat to dry thoroughly before applying the next coat, follow manufacturer's recommendations taking into account temperature and relative humidity as indicated in Article 3.06(B) of this specification section.
- R. All interior surfaces of structures shall be finish coated prior to installation of equipment, conduit, and other exposed items by mechanical, electrical, or instrumentation.
 - 1. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.

- S. Finish exterior doors on tops, bottoms, and side edges the same as the exterior faces, unless otherwise indicated.
- T. Sand lightly between each succeeding enamel or varnish coat.
- U. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise specified.

V. Retouching Existing Painted Surfaces

- Existing painted surfaces damaged by the modification work or other operations
 of the Contractor shall be retouched to conform to the above coating systems
 and blend in with the new and existing work.
- 2. Damaged surfaces shall be repainted with not less that two (2) coats, and other existing surfaces that are listed shall be repainted with the coating system specified.
- W. The prime and intermediate coats as specified for the various coating systems may be applied in the shop by the manufacturer. The shop coats shall be of the type specified and shall be compatible with the field coat or coats. Such items as pumps, motors, equipment, electrical panels, etc shall be given at least one touch-up coat with the intermediate coat material and one complete finish coat in the field.
- X. Field Painting in the immediate vicinity of, or on, energized electrical and rotating equipment, and equipment and/or pipes in service shall not be performed without the approval of the Engineer.
- Y. Extreme care shall be exercised in the painting of all operable equipment, such as valves, electric motors, etc., so that the proper functioning of the equipment will not be affected.
- Z. The Contractor's scaffolding shall be erected, maintained, and dismantled without damage to structures, machinery, equipment or pipe. Drop cloths shall be used where required to protect buildings and equipment. All surfaces required to be clear for visual observations shall be cleaned immediately after paint application.
- AA. Painting shall not be performed on insulated pipe within three (3) feet of insulation operations or, on insulation whose covering and surface coat have not had time to set and dry. Painting shall not be performed on uninsulated pipe within one (1) foot of any type of connection until the connection has been made, except as directed by the Engineer.

- BB. The prime coat shall be applied immediately following surface preparation and in no case later than the same working day. All paint shall be applied by brushing, paint mitt and roller, conventional spraying, or airless spraying, using equipment approved by the paint manufacturer.
- CC. Each coat of paint shall be recoated as per manufacturer's instructions. Paint shall be considered recoatable when an additional coat can be applied without any detrimental film irregularities such as lifting or loss of adhesion.
- DD. Surfaces that will be inaccessible after assembly shall receive either the full specified paint system or three shop coats of the specified primer before assembly.
- EE. Finish colors shall be in accordance with the Painting and Color Schedule and shall be factory mixed (i.e., there shall be no tinting by the Contractor, unless authorized by the Engineer).
- FF. All edges and weld seams in immersion service shall receive a "stripe coat" (applied by brush) of the first coat prior to application of the full first coat.
- GG. All open seams in the roof area of tanks shall be filled after application of the topcoat with a flexible caulking such as Sika Flex 1A, or approved equal.

HH. Unsatisfactory Application

- If the item has an improper finish, color or insufficient dry film thickness, the surface shall be cleaned and top coated with the specified material to obtain the specified color and coverage. Specific surface preparation information is to be secured from the coatings manufacturer.
- 2. All visible areas of chipped, peeled or abraded paint shall be hand or powersanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications.
- 3. Work shall be free of runs, bridges, shiners, laps or other imperfections. Evidence of these conditions shall be cause for rejection.
- 4. Any defects in the coating system shall be repaired by the Contractor per written recommendations of the coating manufacturer.
- 5. Any repairs made on steel surfaces for immersion service shall be holiday detected in accordance with ASTM G62 Low Voltage Holiday Detection.
 - a. Areas found to have holidays shall be marked and repaired in accordance with the paint manufacturer's instructions.

b. The Engineer shall be notified of the holiday testing time so that he may be present during the testing.

3.07 Application Restrictions

A. Environmental Requirements

- 1. Comply with the manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.
 - a. The conditions below shall be adhered to even if the manufacturer's recommendations are less stringent. If the manufacturer's recommendations are more stringent, they shall apply.
 - b. No coatings shall be applied when the air, surface, and material temperature is below 55□F or above 95□F for 24 hours prior to and 24 hours after coating application. Surface temperature shall be at least 5□F above the dew point for 24 hours prior to and 24 hours after coating application. The dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Weather Bureau psychometric tables. Do not apply coatings when the relative humidity exceeds 85% percent or to damp or wet surfaces, unless otherwise permitted by the coating manufacturer's printed instructions. The Contractor is referred to Article 3.06(B) of this specification section for additional information.
 - c. No painting shall be done when the surfaces may become damaged by rain, fog or condensation or when it is anticipated that these conditions will prevail during the drying period, unless suitable enclosures to protect the surface are used. Provisions shall be made, at the Contractor's expense, to control atmospheric conditions artificially inside the enclosure, within the limits suitable for painting throughout the painting operations. Where heat is necessary, it shall be supplied by the painting applicator and shall be of such type that it will maintain an air and coated surface temperature of 55 F minimum prior to and after the coating application as described above, and 90 F minimum during the cure stage if hot air forced curing is recommended by the coating manufacturer for special coatings. Further, this heater shall be of such type as not to contaminate the surface area to be or being coated with combustion products. The Contractor shall supply utilities to run electric or gas heaters. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Engineer or Owner.
- 2. Do not apply finish in areas where dust is being or will be generated during application through full cure.

- 3. All exterior painting shall be done only in dry weather.
- 4. Spray application shall occur only when wind velocities, including gusts, are less than ten (10) miles per hour. All materials, equipment, etc. in the vicinity of spray application shall be protected from overspray.

B. Weather Conditions

- 1. Do not paint in the rain, wind, snow, mist and fog or when the steel or metal surface temperatures are less than 5□F above the dew point.
- 2. No coatings shall be applied unless the relative humidity is below 85%.
- 3. Do not paint when the temperature of the metal to be painted is above 120 F.
- 4. Do not apply alkyd, chlorinated rubber, inorganic zinc, silicone aluminum, or silicone acrylic paints if the air or surface temperature is below 40□F or expected to be below 40□F within twenty-four (24) hours.
- 5. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if the air or surface temperature is below 60□F or is expected to drop below 55□F within twenty-four (24) hours.
- C. Application of materials shall be done only on properly prepared surfaces as herein specified. Between any two (2) coats of material, unless specifically cover in the coating manufacturer's most recent printed application instructions, if more than one (1) week passes between subsequent coats, the coating manufacturer will be contacted for his recommended preparation of the surface *prior* to application of the next coat. This preparation might include brush-off blasting, steam cleaning, or solvent wiping (with an indicated solvent) and shall be specified in writing by the material supplier and followed by the applicator. Any surface coating damaged by moisture or rain shall be removed and redone as directed by the Engineer or Owner.
- D. In no case shall paint be applied to surfaces which show a moisture content greater that fourteen percent (14%). The presence of moisture shall be determined prior to coating by testing with a moisture detection device such as a Delmhorst Model DLM2E, or equal.

3.08 Minimum Coating Thickness

A. Coating thickness shall meet or exceed the specified minimum dry film thickness (DFT) in all areas. The average coating thickness as determined by multiple representative

DFT measurements shall meet or exceed the mid-point of DFT range. If below this DFT value, the surface shall be recoated with at least the minimum DFT until the total DFT meets or exceeds the mid-point DFT.

- B. Coverage rates are theoretical as calculated by the coating manufacturer and are, therefore, the maximum allowable.
- C. Apply a prime coat to material which is required to be painted or finished, and which has not been prime coated by others.
- D. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, is shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.
- E. Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

3.09 Finishes

A. Pigmented (Opaque) Finishes

- 1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- 2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

B. Complete Work

- 1. Match approved samples for color, texture, and coverage.
- 2. Remove, refinish, or repaint work not in compliance with specific requirements.

3.10 Workmanship

- A. The Contractor must show proof that all employees associated with this project shall have been employed by the Contractor for a period of not less than six (6) months.
- B. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship.

C. Painting shall be performed by experienced painters in accordance with the recommendations of the paint manufacturer. All paint shall be uniformly applied without sags, runs, spots, or other blemishes. Work which shows carelessness, lack of skill, or is defective in the opinion of the Engineer, shall be corrected at the expense of the Contractor.

3.11 Field Quality Control

- A. The Contractor shall request acceptance of each coat by the Owner's representative before applying the next coat; and the Contractor shall provide the necessary properly calibrated gauges.
- B. All non-ferrous surfaces shall be checked for the number of coats and thickness by use of a Tooke gauge, or equal.
- C. *All ferrous surfaces shall be checked for film thickness* by use of an Elcometer or Micro-Test magnetic dry film gauge, or equal, properly calibrated.
- D. Submerged tank linings and metals shall be tested for freedom from holidays and pinholes by use of a Tinker-Rasor, K-D Bird Dog Holiday Detector, or equal.
- E. All defects shall be corrected to the satisfaction of the Engineer and Owner.

3.12 Protection

- A. All other surfaces shall be protected while painting.
- B. Protection of furniture and other movable objects, equipment, fittings, and accessories shall be provided throughout the painting operation. Remove all electric plates, surface hardware, etc., before painting; protect and replace when completed.
- C. **Mask all machinery nameplates and all machined parts not to receive paint**. Lay drop cloths in all area where painting is being done to adequately protect flooring and other work from all damage.

3.13 Cleaning

A. The Contractor shall perform the work under this Section while keeping the premises free from accumulation of dust, debris, and rubbish and shall remove all scaffolding, paint cloths, paint, empty paint containers, and brushes from buildings and the project site when completed.

- B. All paint brushed, splattered, spilled, or splashed on any surface not specified to be painted shall be removed.
- C. The Contractor shall insure that all glass throughout that portion of the facility in which he worked is cleaned of dirt and paint before he leaves the job site. Further, the Contractor shall insure that all glass in this area is thoroughly washed and polished.
- D. All cloths and waste that might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work, all staging, scaffolding and containers shall be removed from the Project Site and/or destroyed in an approved and legal manner.
- E. Upon completion of the Project, remove from the premises all rubbish and accumulated material and leave the work in a neat and clean condition, acceptable to the Engineer and Owner.

3.14 Extra Stock

- A. Upon completion of painting work, the Owner shall be furnished, at no additional cost, unopened containers providing a minimum of two (2) gallons of each type and color of finish paint for touching up.
- B. Multi-component coatings shall have each component supplied in separate containers boxed together. Paint container labels shall be complete with manufacturer's name, generic type, number, color, and location where used.

END OF SECTION

SECTION 09901

SURFACE PREPARATION AND SHOP PRIME PAINTING

1. GENERAL

1.01 Description

- A. Furnish all labor, materials, equipment and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.
- B. Related Work Specified Elsewhere

Specification Section	Title		
09900	Painting		
Division	Information		
5	Metals		
11	Equipment		
Contract Drawings and General Provisions of the Contract			

1.02 Quality Assurance

- A. Provide the **best quality grade** of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.
- B. The **equipment manufacturer shall be responsible for a satisfactory paint application** which will adhere without peeling, flaking, delamination, blistering or discoloration. Before application of any painting materials, the manufacturer shall submit a Project specific Letter of Certification identifying the materials to be used. The letter shall state that the manufacturer recommends the materials selected for the application proposed.

- C. Painting shall be accomplished by experienced painters specializing in industrial painting familiar with all aspects of surface preparations and applications required for this Project. Work shall be done in a safe and workmanlike manner.
- D. Provide undercoat paint produced by the same manufacturer as the finish coats. *Undercoat and finish coat paints shall be compatible*. Use only thinners approved by the paint manufacturer, and use only within recommended limits.
- E. **A five (5) year warranty** for the installed painting/coating systems shall be provided, guaranteeing against premature chipping, flaking, fading, cracking, blistering, peeling, delaminating, or any other defects.

F. Standards

- 1. ASTM
- 2. OSHA
- 3. NFPA
- 4. SSPC
- 5. AWWA
- 6. NSF
- 7. NACE

G. Acceptable Manufacturers

- 1. Tnemec Company, Inc.
- 2. Carboline Company
- 3. ICI Devoe, Inc.
- 4. Or approved equal.

1.03 Submittals

A. Submit, in accordance with Section 01300, *Shop Drawings, Submittals and Samples*, manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures, number of coats applied and dry mil thicknesses. All submittals shall be in an electronic format (PDF).

B. Submit a certification of the compatibility of the finished coat with the factory-applied primer.

- C. The Contractor shall submit a listing of equipment/materials that are to be field painted and the type of primer, intermediate and finish coats to be used and applied.
- D. Submittals shall include representative physical samples of the proposed primers, if required by the Engineer.

2. PRODUCTS

2.01 Materials

A. Submerged Surfaces

- 1. Shop primer for ferrous metals which will be submerged or which are subject to splash action or which are specified to be considered submerged service shall be sprayed with one (1) of Kop-Coat 340 Gold Primer, Tnemec Series 20 Potapox Primer, or equal, at a minimum dry film thickness of 5.0 mils.
- Primers to be used for submergence in potable water shall be NSF certified.
 This certification to be submitted to the Engineer during the shop drawing review process.

B. Non-Submerged Surfaces

- Non-submerged metals shall be sprayed with one coat of Tnemec 90-91 H₂O Hydro-Zinc 2000 (NSF Standard 61 certified), dry film thickness 2.5 to 3.5 mils by Tnemec Co., or approved equal NSF certified coating.
- 2. The coating shall be Class B, Slip Critical certified for steel construction. Use for structural steel, steel joists and miscellaneous carbon steel items.
- 3. For pipe and associated items and not over open tanks, spray apply one (1) coat of Tnemec 66-1211 Epoxoline Primer dry film thickness 3.0 to 4.0 mils by Tnemec Co., equal by Ameron (VyGuard), DuPont or approved equal.

C. Non-Primed Surfaces

 Non-primed surfaces such as gears, bearings surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. 2. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

D. Compatibility of Coating Systems

 Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09900, *Painting*, for use in the field and which are recommended for use together.

3. EXECUTION

3.01 Application

A. Surface Preparation and Priming

- 1. Non-submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP-6, immediately prior to priming. Submerged components scheduled for priming, as defined above, shall be blast cleaned in accordance with SSPC-SP-10, immediately prior to priming.
- 2. Surfaces shall be dry and free of dust, oil, grease, dirt, rust, loose mill scale and other foreign material before priming.
- 3. Shop prime in accordance with approved paint manufacturer's recommendations.
- 4. Priming shall immediately follow sandblasting before any evidence of corrosion has occurred. If over twenty-four (24) hours have passed, the manufacturer/contractor shall repeat the surface preparation procedures.

B. Non-Primed Surfaces

1. Apply an approved coating per the manufacturer's recommendations.

3.02 Fabricated Items

A. All items to be shop primed shall be blast cleaned as specified for applicable service prior to priming. If, in the opinion of the Engineer, any prime coating that has been

improperly applied or if material contrary to this Section has been used, that coating shall be removed by abrasive blasting to white metal and re-primed in accordance with this Section.

- B. All shop prime coats shall be of the correct materials and applied in accordance with this Section. Remove any prime coats not in accordance with this Section by blast cleaning and apply the specified prime coat at no additional cost to the Owner.
- C. Shop primed surfaces shall be cleaned thoroughly and damaged or bare spots prepared as approved and retouched with the specified primer before the application of successive paint coats in the field.
- D. Shop finish coats, if proposed and allowed, shall be equal in appearance and protection quality to a field applied finish coat. If, in the opinion of the Engineer, a shop finish coat system does not give the appearance and protection quality of other work of similar nature, prepare the surfaces and apply the coat or coats of paint as directed by the Engineer to accomplish the desired appearance and protection quality. Submit to the Engineer substantial evidence that the standard finish is compatible with the specified finish coat.
- E. Properly protect the shop prime and finish coats against damage from weather or any other cause.
- F. Wherever fabricated equipment is required to be blast cleaned, protect all motors, drives, bearings, gears, etc, from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned.

END OF SECTION



SECTION 09905

PIPING, VALVE AND EQUIPMENT IDENTIFICATION SYSTEM

1. GENERAL

1.01 Description

A. Scope of Work

1. The work included under this Section consists of providing an identification system for piping systems and related equipment.

B. Related Work Specified Elsewhere

Specification Section	Title		
09900	Painting		
15060 Ductile Iron Pipe and Fittings			
15065	Polyvinyl Chloride (PVC) Pressure Pipe and Fittings		
15100	Valves and Appurtenances		
Contract Drawings and General Provisions of the Contract			

1.02 Quality Assurance

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standard(s):

STANDARD	DESCRIPTION		
American National Standard Institute (ANSI)			
ANSI A13.1	Scheme for the Identification of Piping Systems		

1.03 Submittals

A. The Contractor shall submit shop drawings, manufacturer's descriptive literature, illustrations, specifications, and other pertinent data in accordance with Section 01300, *Shop Drawings, Submittals and Samples.* All submittals shall be in an electronic format (PDF).

B. Schedules

- 1. Provide a typewritten list of all tagged valves giving tag color, shape, letter code and number, the valve size, type, use, and general location.
- 2. Provide a complete list of materials to be furnished and surfaces on which they will be used.

C. Samples

- 1. Provide a sample of each type of valve tag supplied.
- 2. Provide a sample of each type of identification tape and marker balls supplied.
- 3. Provide manufacturer's color charts for color selection by the Engineer.

1.04 Product Delivery, Storage and Handling

A. Delivery of Materials

 Except for locally mixed custom colors, deliver sealed containers with labels legible and intact.

B. Storage of Materials

- 1. Store only acceptable project materials on project site.
- 2. Store in a suitable location.
- 3. Restrict storage to paint materials and related equipment.
- 4. Comply with all health and fire regulations.

1.05 Job Conditions

A. Environmental Requirements

- 1. Comply with manufacturer's recommendations as to the environmental conditions under which coatings and coating systems can be applied.
- 2. Do not apply finish in areas where dust is being generated.

B. Protection

1. Cover or otherwise protect all finished work of other trades and surfaces not to be painted.

2. PRODUCTS

2.01 Materials

- A. Materials for painting shall conform to requirements of Section 09900, *Painting*.
- B. Materials selected for coating systems for each type surface shall be the product of a **single manufacturer**.
- C. Aboveground piping shall be identified by painting the name of the material flowing through the pipe as well as flow arrows (text and arrow type to be provided by the Engineer).
 - 1. Markers shall be of wording and color as shown in Table 09905-1.
 - 2. Lettering shall be as follows:
 - a. 21/4-inches high for pipes 3 inches in diameter and larger.
 - b. 1c-inches high for pipes less than 3 inches in diameter.
 - 3. Flow arrows shall be as follows:
 - a. 2½-inches by six (6) inches for pipes three (3) inches in diameter and larger.
 - b. 1c-inches by three (3) inches for pipes less than three (3) inches in diameter.

D. Buried piping shall be identified by "identification tape" installed over the centerline of the pipelines.

1. Identification Tape for Steel or Iron Pipe and Conduit

- a. Identification tape shall be manufactured of inert polyethylene film so as to be highly resistant to alkalies, acids, or other destructive agents found in the soil, and shall have a minimum thickness of four (4) mils.
- b. The tape width shall be six (6) inches and shall have the background color specified below, imprinted with black letters. The imprint shall be as specified below and shall repeat itself a minimum of once every two (2) feet for the entire length of the tape.
- c. The tape shall be Terra Tape Standard 250, or approved equal.

2. Identification Tape for Plastic or Non-Magnetic Pipe and Conduit

- a. Identification tape shall be manufactured of reinforced polyethylene film with a minimum overall thickness of 9.7 mils and shall have a 0.5 mil thick magnetic metallic foil core.
- b. The tape shall be highly resistant to alkalies, acids, and other destructive agents found in the soil.
- c. The tape width shall be three (3) inches and shall have the background color specified below, imprinted with black letters. The imprint shall be as specified below and shall repeat itself a minimum of once every two (2) feet for the entire length of the tape.
- d. The tape shall be Terra Tape Sentry Line 1350, or approved equal.
- 3. Tape background colors and imprints shall be as follows:

Imprint	Pipe Service	Background Color
"Caution: Wastewater Line Buried Below"	RWW	Green
"Caution: Electrical Line Buried Below"	ELECT	Red
"Caution: Water Line Buried Below"	RW, FW, PW	Blue
"Caution: Telephone Line Buried Below"	TELE	Orange
"Caution: Gas Line Buried Below"	GAS	Yellow
"Caution: Reuse Line Buried Below"	REUSE	Purple

4. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX; Allen Systems, Inc., Wheaton, IL; or approved equal.

E. Electronic Marker Ball System

- 1. Buried piping on the facility site and on all off-site areas shall be marked with marker balls.
- 2. Electronic marker balls shall consist of a passive device capable of reflecting a specifically designated repulse frequency tuned to the utility being installed.
- 3. Electronic marker balls shall be four (4) inches in diameter with a high density polyethylene shell. Marker balls shall be color coded in accordance with the American Public Works Association's (APWA) Utility Location and Coordinating Council Standards.
- 4. Electronic marker balls and marker locator and probe shall be the "ScotchMark™ Electronic Marker System" as manufactured by 3M.
- 5. Electronic marker balls, for each utility type (water, wastewater, reclaimed water), shall be furnished and installed so that a *marker ball will be located at fifty (50)* foot intervals along the pipeline length. Marker balls shall also be placed at each change in direction, tees, other points of connection, and as directed by the Engineer.
- 6. Place markers directly above the pipe and hand backfill one (1) foot above the marker to prevent damage or movement during subsequent backfilling. Depth of burial shall be between eighteen (18) and twenty-four (24) inches.
- 7. The four-inch (4") diameter marker balls shall be colored as follows, as applicable to this project:

Utility Type	Marker Ball Color	Marker Ball Model No.
Water	Blue	1403 - XR
Wastewater	Green	1404 - XR
Gas	Yellow	1405 - XR
Reclaimed Water	Purple	1408 - XR

8. Electronic Marker Locator and Probe

- a. The Contractor shall provide one (1) ScotchMark™ EMS II Electronic Marker Locator and Probe as manufactured by the 3M Corporation, or latest version.
- b. The Electronic Marker Locator and Probe shall be capable of operating between 0∏F and 130∏F.
- c. The Electronic Marker Locator and Probe Package shall contain the following:

1) Electronics Package: 9" x 10" x 3"

2) Probe: 81/4-inch diameter and 13/4-inch thick

3) <u>Telescoping Handle</u>: 22-inches (collapsed); 32-inches (extended)

d. The Contractor shall provide twenty-four (24), Duracell alkaline batteries, of the size required to operate the Electronic Marker Locator and Probe."

F. Aboveground Valve Identification

1. A coded and numbered tag attached with a stainless steel chain and/or stainless steel "S" hooks (Type 316) shall be provided on all valves.

2. Tag Types

- a. Tags for valves on pipe shall be stainless steel, or anodized aluminum, 19 gauge thick.
- b. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which it is installed.
- c. Square tags shall be used to indicate "normally closed" valves and round tags shall indicate "normally open" valves.

3. Coding

- a. In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the information presented in Article 2.01(G)(1)(a-g).
- b. All color and letter coding shall be approved by the Engineer.

- c. Above ground valve tags shall be furnished with stainless steel (Type 316) wire for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.
- d. Valve service shall either be as listed in Table 09905-1, or by equipment abbreviation if associated with a particular piece of equipment. *Valve numbering shall be as approved by the Engineer and/or Owner*.

G. Belowground Valve Identification

- Buried valves shall have valve boxes protected by a concrete pad as identified on the Contract Drawings. The concrete pad for the valve box cover shall have a 3-inch diameter, 19 gauge thick, bronze disc embedded in the surface as shown on the Contract Drawings. The bronze disc shall have the following information neatly stamped on it:
 - a. Size of valve (inches)
 - b. Valve Tag ID: To be provided by the Engineer and Owner and shall include:
 - 1) Type of Valve
 - a) GV: Gate Valve
 - b) BfV: Butterfly Valve
 - c) PV: Plug Valve
 - d) Other valve abbreviations shall be provided by the Engineer.
 - 2) Additional Valve Identifiers
 - c. Year of Installation
 - d. Direction to open the valve
 - e. Number of turns to fully open the valve
- 2. Submit to the Engineer for approval, within thirty (30) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work.
- 3. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- 4. The information contained in the valve schedules shall be coded on the tags in a system provided by the Engineer and Owner.

- H. Submit to the Engineer for review, two (2) samples of each type of tag proposed and the manufacturer's standard color chart and letter styles. Tags shall have stamped or engraved on them the information shown on the Contract Drawings and the data described herein. Submit to the Engineer for approval, within thirty (30) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work. The schedule shall contain all of the information required by Articles 2.01(F) and 2.01(G) of this specification section.
- 1. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- J. The information contained in the valve schedules shall be coded on the tags in a system provided by the Owner.
- K. Above ground valve tags shall be furnished with stainless steel chain and/or stainless steel "S" hooks (Type 316) for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.

3. EXECUTION

3.01 Color Coding for Pipes and Equipment

A. Piping color codes, and code labels for pipe identification on this project shall conform to Table 09905-1.

B. General Notes and Guidelines

- 1. Pipelines, equipment, or other items which are not listed here shall be assigned a color by the Owner and Engineer and shall be treated as an integral part of the contract, with no additional cost to the Owner.
- 2. Color coding shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, or semiliquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit systems.
- 3. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be "Safety Orange".
- 4. All safety equipment shall be painted in accordance with OSHA standards.

- 5. All in-line equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to, but not including, the flanges attached to pumps and mechanical equipment assigned another color.
- 6. All pipe hangers and pipe support floor stands shall be painted, unless specified otherwise due to material of construction.
- C. All hangers and pipe support floor and accessories stands shall be painted to match their piping. The system shall be painted up to, but not including, the face of flanges or the flexible conduit connected to electrical equipment. Structural members used solely for pipe hangers or supports shall be painted to match their piping. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be coated in accordance with Section 09900, Painting.
- D. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to, but not including, the face of flanges or connections on the equipment.
- E. All insulated surfaces, unless otherwise specified, shall be given one (1) coat of glue sizing, one (1) prime coat and one (1) finish coat.
- F. System code lettering and arrows shall conform to the requirements of ANSI A13.1 marked on piping as follows:
 - 1. Legends shall be of the following color for the respective pipe color.

Key to Clas Predominant C	Color of Letters, if not otherwise specified	
(F) Fire Protection	Red	White
(D) Dengerate	Yellow	Black
(D) Dangerous	Orange	Black
	Green	Black
	White	Black
(C) C-f-	Black	White
(S) Safe	Light Grey	Black
	Dark Grey	White
	Aluminum	Black
(P) Protective	Blue	White

- 2. All piping containing or transporting corrosive or hazardous chemicals shall be identified with labels every ten (10) feet and with at least two (2) labels in each room. Otherwise, markers shall be placed no more than twenty (20) feet apart with at least one (1) marker on every straight run and additional markers at turns and where pipe passes through walls.
- 3. An arrow indicating direction of flow shall be placed adjacent to each marker.

3.02 Fabricated Equipment

- A. Unless otherwise indicated or specifically approved, all fabricated equipment shall be shop primed and finished. See Section 09900, *Painting*.
- B. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- C. Where specified in other Sections of these specifications for mechanical equipment, the Contractor shall apply field coat or coats of paint in accordance with Section 09900, *Painting*. If the shop finish coat is unsatisfactory due to poor adhesion or other problems with primer or finish coats, the coatings shall be removed and replaced by sandblasting, priming and finishing in accordance with Section 09900, *Painting* and this Section.
- D. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned. Equipment contaminated by grit in critical areas, such as bearings, gears, seals, etc., shall be replaced at no cost to the Owner.

3.03 Installation of Identification Tape

- A. Identification tape shall be installed for all buried pipelines, as applicable to the Project, in accordance with the manufacturer's installation instructions and as specified herein.
- B. Identification tape for piping shall be installed at two (2) locations:
 - 1. One (1) foot below finished grade along centerline of pipe, and;
 - 2. Directly on top of the pipe.

3.04 Buried Valves

- A. In paved or concrete areas, the tops of valve box covers shall be set flush with the pavement or top of the concrete. In concrete areas, valve boxes shall be embedded.
- B. Following paving operations, a twenty-four (24) inch square shall be neatly cut in the pavement around the box and the paving removed. The top of the box shall then be adjusted to the proper elevation and a twenty-four (24) inch square by six (6) inch thick concrete pad (with #5 rebar installed) poured around the box cover. Concrete pads in traffic areas shall be reinforced with No. 4 reinforcement bars as shown on the Contract Drawings. Concrete for the pad shall be Class B, with a compressive strength of 3,000 psi.
- C. In unpaved areas, the tops of valve box covers shall be set 0.10-foot above finished grade. After the top of the box is set to the proper elevation, a twenty-four (24) inch square by six (6) inch thick concrete pad (with #5 rebar installed) shall be poured around the box cover. Concrete for the pad shall be Class B, with a compressive strength of 3,000 psi.
- D. The bronze valve identification disc shall be embedded in the concrete pad.

END OF SECTION

TABLE 09905-1

FLAGER BEACH WWTF SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Acetylene	C ₂ H ₂	Orange w/yellow band	White
Acid	Acid Name	Orange w/black 3-inch bands spaced 5 foot, on center	White
Alum Solution	ALUM	Orange	Black
Anti-Scalant Solution	ASC	Green	Black
Argon	AR	Yellow w/black band	White
Argon-Methane Mix	AR / CH ₂	Orange w/black band	White
Backwash Water - Clean	BWC	Light Green	Black
Backwash Water - Dirty	BWD	Dark Green	White
Blowers		White	
Caustic Soda	Na₂CO₃	Orange w/white 3-inch bands spaced 5 foot, on center	Black
Chlorine Gas	CG	OSHA Yellow	Green
Chlorine Solution	CS	OSHA Yellow w/brown 3-inch bands spaced 5 foot, on center	Brown
Compressed Air	AIR	Light Grey	Black
Compressors		Battleship Grey	
Dewatered Sludge	DWS	Dark Brown w/dual white 3-inch bands spaced 5 foot, on center	White
Diesel Fuel	DF	OSHA Red	White
Digested Sludge	DS	Medium Brown w/white 3-inch bands spaced 5 foot, on center	White
Electrical Conduit with Conductors over 120 V		Black w/yellow 3-inch bands spaced 5 foot, on center	
Electrical Conduit with Conductors under 120 V		Interior - Match adjacent wall or equipment color Exterior - Grey	

TABLE 09905-1

SANFORD NORTH WRF: TERTIARY FILTRATION SYSTEM IMPROVEMENTS COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Filter Influent	FI	Medium Green	White
Filtered Effluent	FE	Light Green	Black
Fire Hydrant		Red	
Finished Water	FW	Dark Blue	White
Fire Sprinkler Piping	FS	Blue	White
Force Main	FM	Brown	Black
Fuel Oil Return	FOR	Red	White
Fuel Oil Supply	FOS	Red w/white 3-inch bands spaced 5 foot, on center	White
Fuel Oil Vent	FOV	Red w/dual white 3-inch bands spaced 5 foot, on center	White
Gas Line	GAS	Orange w/red band	White
Gravity Drain	DRAIN	Dark Grey	Black
Helium	He	Red w/yellow band	White
Hydrogen	H ₂	Red w/black band	White
Hydrogen Peroxide	H ₂ O ₂	Orange w/green 3-inch bands spaced 5 foot, on center	Black
Lime Solution	LS	Light Green	Black
LP Gas	LPG	Red	Black
Mixed Liquor	ML	Brown	Black
Motors		White	
Nitrogen	N_2	Yellow w/red band	White
Nitrous Oxide	N ₂ O	Yellow w/orange band	White
Non-potable Water	NPW	Green w/black 3-inch bands spaced 5 foot, on center	Black
Polymer Solution	PS	Orange w/silver 3-inch bands spaced 5 foot, on center	Black

TABLE 09905-1

SANFORD NORTH WRF: TERTIARY FILTRATION SYSTEM IMPROVEMENTS COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Potable Water	PW	Dark Blue	White
Pumps		Battleship Grey	
Raw Water	RW	Light Blue	Black
Raw Wastewater	RWW	Dark Green	Black
Reclaimed Water Hydrant		Purple	
Return Activated Sludge	RAS	Medium Brown	Black
Reuse Water	REUSE	Purple	Black
Scum	SCUM	Dark Brown	Black
Secondary Effluent	SEFF	Dark Green	Black
Sodium Hydroxide	NaOH	Green	White
Sodium Hypochlorite	NaOCI	OSHA Yellow w/black 3-inch bands spaced 5 foot, on center	Black
Substandard Effluent	SSE	Brown	Black
Sump Pump Discharge	SPD	Grey w/black 3-inch bands spaced 5 foot, on center	
Thickened Sludge	TS	Light Brown	Black
Vacuum Line	VAC	Light Olive Green	White
Vent	V	White	Black
Waste Activated Sludge	WAS	Light Brown	Black

Note: All pipe hangers shall be painted to match the color of the piping.

SECTION 09905

PIPING, VALVE AND EQUIPMENT IDENTIFICATION SYSTEM

1. GENERAL

1.01 Description

A. Scope of Work

1. The work included under this Section consists of providing an identification system for piping systems and related equipment.

B. Related Work Specified Elsewhere

Specification Section	Title		
09900	Painting		
15060	Ductile Iron Pipe and Fittings		
15065	Polyvinyl Chloride (PVC) Pressure Pipe and Fittings		
15100	Valves and Appurtenances		
Contract	Contract Drawings and General Provisions of the Contract		

1.02 Quality Assurance

A. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standard(s):

STANDARD	DESCRIPTION		
American National Standard Institute (ANSI)			
ANSI A13.1	Scheme for the Identification of Piping Systems		

1.03 Submittals

A. The Contractor shall submit shop drawings, manufacturer's descriptive literature, illustrations, specifications, and other pertinent data in accordance with Section 01300, *Shop Drawings, Submittals and Samples*.

B. Schedules

- 1. Provide a typewritten list of all tagged valves giving tag color, shape, letter code and number, the valve size, type, use, and general location.
- 2. Provide a complete list of materials to be furnished and surfaces on which they will be used.

C. Samples

- 1. Provide a sample of each type of valve tag supplied.
- 2. Provide a sample of each type of identification tape and marker balls supplied.
- 3. Provide manufacturer's color charts for color selection by the Engineer.

1.04 Product Delivery, Storage and Handling

A. Delivery of Materials

1. Except for locally mixed custom colors, deliver sealed containers with labels legible and intact.

B. Storage of Materials

- 1. Store only acceptable project materials on project site.
- 2. Store in a suitable location.
- 3. Restrict storage to paint materials and related equipment.
- 4. Comply with all health and fire regulations.

1.05 Job Conditions

A. Environmental Requirements

- 1. Comply with manufacturer's recommendations as to the environmental conditions under which coatings and coating systems can be applied.
- 2. Do not apply finish in areas where dust is being generated.

B. Protection

1. Cover or otherwise protect all finished work of other trades and surfaces not to be painted.

2. PRODUCTS

2.01 Materials

- A. Materials for painting shall conform to requirements of Section 09900, Painting.
- B. Materials selected for coating systems for each type surface shall be the product of a **single manufacturer**.
- C. Aboveground piping shall be identified by "painting" the name of the material flowing through the pipe as well as flow arrows (text and arrow type to be provided by the Engineer).
 - 1. Markers shall be of wording and color as shown in Table 09905-1.
 - 2. Lettering shall be as follows:
 - a. 21/4-inches high for pipes 3 inches in diameter and larger.
 - b. 1 1/8-inches high for pipes less than 3 inches in diameter.
 - 3. Flow arrows shall be as follows:
 - a. 2½-inches by six (6) inches for pipes three (3) inches in diameter and larger.
 - b. 1 1/8-inches by three (3) inches for pipes less than three (3) inches in diameter.

D. Buried piping shall be identified by "identification tape" installed over the centerline of the pipelines.

1. Identification Tape for Steel or Iron Pipe and Conduit

- a. Identification tape shall be manufactured of inert polyethylene film so as to be highly resistant to alkalies, acids, or other destructive agents found in the soil, and shall have a minimum thickness of four (4) mils.
- b. The tape width shall be six (6) inches and shall have the background color specified below, imprinted with black letters. The imprint shall be as specified below and shall repeat itself a minimum of once every two (2) feet for the entire length of the tape.
- c. The tape shall be Terra Tape Standard 250, or approved equal.

2. Identification Tape for Plastic or Non-Magnetic Pipe and Conduit

- a. Identification tape shall be manufactured of reinforced polyethylene film with a minimum overall thickness of 9.7 mils and shall have a 0.5 mil thick magnetic metallic foil core.
- b. The tape shall be highly resistant to alkalies, acids, and other destructive agents found in the soil.
- c. The tape width shall be three (3) inches and shall have the background color specified below, imprinted with black letters. The imprint shall be as specified below and shall repeat itself a minimum of once every two (2) feet for the entire length of the tape.
- d. The tape shall be Terra Tape Sentry Line 1350, or approved equal.
- 3. Tape background colors and imprints shall be as follows:

Imprint	Pipe Service	Background Color
"Caution: Wastewater Line Buried Below"	RWW	Green
"Caution: Electrical Line Buried Below"	ELECT	Red
"Caution: Water Line Buried Below"	RW, FW, PW	Blue
"Caution: Telephone Line Buried Below"	TELE	Orange
"Caution: Gas Line Buried Below"	GAS	Yellow
"Caution: Reuse Line Buried Below"	REUSE	Purple

4. Identification tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, TX; Allen Systems, Inc., Wheaton, IL; or approved equal.

E. Electronic Marker Ball System

- 1. Buried piping on the facility site and on all off-site areas shall be marked with marker balls.
- 2. Electronic marker balls shall consist of a passive device capable of reflecting a specifically designated repulse frequency tuned to the utility being installed.
- 3. Electronic marker balls shall be four (4) inches in diameter with a high density polyethylene shell. Marker balls shall be color coded in accordance with the American Public Works Association's (APWA) Utility Location and Coordinating Council Standards.
- 4. Electronic marker balls and marker locator and probe shall be the "ScotchMark™ Electronic Marker System" as manufactured by 3M.
- 5. Electronic marker balls, for each utility type (water, wastewater, reclaimed water), shall be furnished and installed so that a *marker ball will be located at fifty (50)* foot intervals along the pipeline length. Marker balls shall also be placed at each change in direction, tees, other points of connection, and as directed by the Engineer.
- 6. Place markers directly above the pipe and hand backfill one (1) foot above the marker to prevent damage or movement during subsequent backfilling. Depth of burial shall be between eighteen (18) and twenty-four (24) inches.
- 7. The four-inch (4") diameter marker balls shall be colored as follows, as applicable to this project:

Utility Type	Marker Ball Color	Marker Ball Model No.
Water	Blue	1403 - XR
Wastewater	Green	1404 - XR
Gas	Yellow	1405 - XR
Reclaimed Water	Purple	1408 - XR

8. Electronic Marker Locator and Probe

- a. The Contractor shall provide one (1) ScotchMark™ EMS II Electronic Marker Locator and Probe as manufactured by the 3M Corporation.
- b. The Electronic Marker Locator and Probe shall be capable of operating between 0□F and 130□F.
- c. The Electronic Marker Locator and Probe Package shall contain the following:

1) Electronics Package: 9" x 10" x 3"

2) Probe: 8½-inch diameter and 1¾-inch thick

3) <u>Telescoping Handle</u>: 22-inches (collapsed); 32-inches (extended)

d. The Contractor shall provide twenty-four (24), Duracell alkaline batteries, of the size required to operate the Electronic Marker Locator and Probe."

F. Aboveground Valve Identification

1. A coded and numbered tag attached with a stainless steel chain and/or stainless steel "S" hooks (Type 316) shall be provided on all valves.

2. Tag Types

- a. Tags for valves on pipe shall be stainless steel, or anodized aluminum, 19 gauge thick.
- b. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which it is installed.
- c. Square tags shall be used to indicate "normally closed" valves and round tags shall indicate "normally open" valves.

3. Coding

- a. In addition to the color coding, each tag shall be stamped or engraved with wording or abbreviations to indicate the information presented in Article 2.01(G)(1)(a-g).
- b. All color and letter coding shall be approved by the Engineer.

- c. Above ground valve tags shall be furnished with stainless steel (Type 316) wire for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.
- d. Valve service shall either be as listed in Table 09905-1, or by equipment abbreviation if associated with a particular piece of equipment. *Valve numbering shall be as approved by the Engineer and/or Owner*.

G. Belowground Valve Identification

- Buried valves shall have valve boxes protected by a concrete pad as identified on the Contract Drawings. The concrete pad for the valve box cover shall have a 3-inch diameter, 19 gauge thick, bronze disc embedded in the surface as shown on the Contract Drawings. The bronze disc shall have the following information neatly stamped on it:
 - a. Size of valve (inches)
 - b. Valve Tag ID: To be provided by the Engineer and Owner and shall include:
 - 1) Type of Valve
 - a) GV: Gate Valve
 - b) BfV: Butterfly Valve
 - c) PV: Plug Valve
 - d) Other valve abbreviations shall be provided by the Engineer.
 - 2) Additional Valve Identifiers
 - c. Year of Installation
 - d. Direction to open the valve
 - e. Number of turns to fully open the valve
- 2. Submit to the Engineer for approval, within thirty (30) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work.
- 3. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- 4. The information contained in the valve schedules shall be coded on the tags in a system provided by the Engineer and Owner.

- H. Submit to the Engineer for review, two (2) samples of each type of tag proposed and the manufacturer's standard color chart and letter styles. Tags shall have stamped or engraved on them the information shown on the Contract Drawings and the data described herein. Submit to the Engineer for approval, within thirty (30) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work. The schedule shall contain all of the information required by Articles 2.01(F) and 2.01(G) of this specification section.
- 1. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- J. The information contained in the valve schedules shall be coded on the tags in a system provided by the Owner.
- K. Above ground valve tags shall be furnished with stainless steel chain and/or stainless steel "S" hooks (Type 316) for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.

3. EXECUTION

3.01 Color Coding for Pipes and Equipment

A. Piping color codes, and code labels for pipe identification on this project shall conform to Table 09905-1.

B. General Notes and Guidelines

- 1. Pipelines, equipment, or other items which are not listed here shall be assigned a color by the Owner and Engineer and shall be treated as an integral part of the contract, with no additional cost to the Owner.
- 2. Color coding shall consist of color code painting and identification of all exposed conduits, through lines and pipelines for the transport of gases, liquids, or semiliquids including all accessories such as valves, insulated pipe coverings, fittings, junction boxes, bus bars, connectors and any operating accessories which are integral to a whole functional mechanical pipe and electrical conduit systems.
- 3. All moving parts, drive assemblies, and covers for moving parts which are potential hazards shall be "Safety Orange".
- 4. All safety equipment shall be painted in accordance with OSHA standards.

- 5. All in-line equipment and appurtenances not assigned another color shall be painted the same base color as the piping. The pipe system shall be painted with the pipe color up to, but not including, the flanges attached to pumps and mechanical equipment assigned another color.
- 6. All pipe hangers and pipe support floor stands shall be painted, unless specified otherwise due to material of construction.
- C. All hangers and pipe support floor and accessories stands shall be painted to match their piping. The system shall be painted up to, but not including, the face of flanges or the flexible conduit connected to electrical equipment. Structural members used solely for pipe hangers or supports shall be painted to match their piping. Where the contact of dissimilar metals may cause electrolysis and where aluminum will contact concrete, mortar or plaster, the contact surface of the metals shall be coated in accordance with Section 09900, Painting.
- D. All systems which are an integral part of the equipment, that is originating from the equipment and returning to the same piece of equipment, shall be painted between and up to, but not including, the face of flanges or connections on the equipment.
- E. All insulated surfaces, unless otherwise specified, shall be given one (1) coat of glue sizing, one (1) prime coat and one (1) finish coat.
- F. System code lettering and arrows shall conform to the requirements of ANSI A13.1 marked on piping as follows:
 - 1. Legends shall be of the following color for the respective pipe color.

Key to Clas Predominant C	Color of Letters, if not otherwise specified	
(F) Fire Protection	Red	White
(D) December 1	Yellow	Black
(D) Dangerous	Orange	Black
	Green	Black
	White	Black
(C) Cofo	Black	White
(S) Safe	Light Grey	Black
	Dark Grey	White
	Aluminum	Black
(P) Protective	Blue	White

- 2. All piping containing or transporting corrosive or hazardous chemicals shall be identified with labels every ten (10) feet and with at least two (2) labels in each room. Otherwise, markers shall be placed no more than twenty (20) feet apart with at least one (1) marker on every straight run and additional markers at turns and where pipe passes through walls.
- 3. An arrow indicating direction of flow shall be placed adjacent to each marker.

3.02 Fabricated Equipment

- A. Unless otherwise indicated or specifically approved, all fabricated equipment shall be shop primed and finished. See Section 09900, *Painting*.
- B. The Contractor shall be responsible for and take whatever steps are necessary to properly protect the shop prime and finish coats against damage from weather or any other cause.
- C. Where specified in other Sections of these specifications for mechanical equipment, the Contractor shall apply field coat or coats of paint in accordance with Section 09900, Painting. If the shop finish coat is unsatisfactory due to poor adhesion or other problems with primer or finish coats, the coatings shall be removed and replaced by sandblasting, priming and finishing in accordance with Section 09900, Painting and this Section.
- D. Wherever fabricated equipment is required to be sandblasted, the Contractor shall protect all motors, drives, bearings, gears, etc., from the entry of grit. Any equipment found to contain grit shall be promptly and thoroughly cleaned. Equipment contaminated by grit in critical areas, such as bearings, gears, seals, etc., shall be replaced at no cost to the Owner.

3.03 Installation of Identification Tape

- A. Identification tape shall be installed for all buried pipelines, as applicable to the Project, in accordance with the manufacturer's installation instructions and as specified herein.
- B. Identification tape for piping shall be installed at two (2) locations:
 - 1. One (1) foot below finished grade along centerline of pipe, and;
 - 2. Directly on top of the pipe.

3.04 Buried Valves

- A. In paved or concrete areas, the tops of valve box covers shall be set flush with the pavement or top of the concrete. In concrete areas, valve boxes shall be embedded.
- B. Following paving operations, a twenty-four (24) inch square shall be neatly cut in the pavement around the box and the paving removed. The top of the box shall then be adjusted to the proper elevation and a twenty-four (24) inch square by six (6) inch thick concrete pad (with #5 rebar installed) poured around the box cover. Concrete pads in traffic areas shall be reinforced with No. 4 reinforcement bars as shown on the Contract Drawings. Concrete for the pad shall be Class B, with a compressive strength of 3,000 psi.
- C. In unpaved areas, the tops of valve box covers shall be set 0.10-foot above finished grade. After the top of the box is set to the proper elevation, a twenty-four (24) inch square by six (6) inch thick concrete pad (with #5 rebar installed) shall be poured around the box cover. Concrete for the pad shall be Class B, with a compressive strength of 3,000 psi.
- D. The bronze valve identification disc shall be embedded in the concrete pad.

END OF SECTION

TABLE 09905-1

FLAGLER BEACH WWTF SLUDGE

MANAGEMENT SYSTEM IMPROVEMENTS

COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Acetylene	C ₂ H ₂	Orange w/yellow band	White
Acid	Acid Name	Orange w/black 3-inch bands spaced 5 foot, on center	White
Alum Solution	ALUM	Orange	Black
Anti-Scalant Solution	ASC	Green	Black
Argon	AR	Yellow w/black band	White
Argon-Methane Mix	AR / CH ₂	Orange w/black band	White
Backwash Water - Clean	BWC	Light Green	Black
Backwash Water - DIrty	BWD	Dark Green	White
Blowers		White	
Caustic Soda	Na ₂ CO ₃	Orange w/white 3-inch bands spaced 5 foot, on center	Black
Chlorine Gas	CG	OSHA Yellow	Green
Chlorine Solution	CS	OSHA Yellow w/brown 3-inch bands spaced 5 foot, on center	Brown
Compressed Air	AIR	Light Grey	Black
Compressors		Battleship Grey	
Dewatered Sludge	DWS	Dark Brown w/dual white 3-inch bands spaced 5 foot, on center	White
Diesel Fuel	DF	OSHA Red	White
Digested Sludge	DS	Medium Brown w/white 3-inch bands spaced 5 foot, on center	White
Electrical Conduit with Conductors over 120 V		Black w/yellow 3-inch bands spaced 5 foot, on center	
Electrical Conduit with Conductors under 120 V		Interior - Match adjacent wall or equipment color Exterior - Grey	

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Piping, Valve and Equipment Identification System

TABLE 09905-1 FLAGER BEACH WWTF SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Filter Influent	FI	Medium Green	White
Filtered Effluent	FE	Light Green	Black
Fire Hydrant		Red	
Finished Water	FW	Dark Blue	White
Fire Sprinkler Piping	FS	Blue	White
Force Main	FM	Brown	Black
Fuel Oil Return	FOR	Red	White
Fuel Oil Supply	FOS	Red w/white 3-inch bands spaced 5 foot, on center	White
Fuel Oil Vent	FOV	Red w/dual white 3-inch bands spaced 5 foot, on center	White
Gas Line	GAS	Orange w/red band	White
Gravity Drain	DRAIN	Dark Grey	Black
Helium	He	Red w/yellow band	White
Hydrogen	H_2	Red w/black band	White
Hydrogen Peroxide	H ₂ O ₂	Orange w/green 3-inch bands spaced 5 foot, on center	Black
Lime Solution	LS	Light Green	Black
LP Gas	LPG	Red	Black
Mixed Liquor	ML	Brown	Black
Motors		White	
Nitrogen	N_2	Yellow w/red band	White
Nitrous Oxide	N ₂ O	Yellow w/orange band	White
Non-potable Water	NPW	Green w/black 3-inch bands spaced 5 foot, on center	Black
Polymer Solution	PS	Orange w/silver 3-inch bands spaced 5 foot, on center	Black

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Piping, Valve and Equipment Identification System

TABLE 09905-1 FLAGLER BEACH WWTF SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS COLOR CODES AND ABBREVIATIONS

Service	Mark	Conduit, Pipe, and Valve Color Code	Letter and Flow Arrow Color
Potable Water	PW	Dark Blue	White
Pumps		Battleship Grey	
Raw Water	RW	Light Blue	Black
Raw Wastewater	RWW	Dark Green	Black
Reclaimed Water Hydrant		Purple	
Return Activated Sludge	RAS	Medium Brown	Black
Reuse Water	REUSE	Purple	Black
Scum	SCUM	Dark Brown	Black
Secondary Effluent	SEFF	Dark Green	Black
Sodium Hydroxide	NaOH	Green	White
Sodium Hypochlorite	NaOCI	OSHA Yellow w/black 3-inch bands spaced 5 foot, on center	Black
Substandard Effluent	SSE	Brown	Black
Sump Pump Discharge	SPD	Grey w/black 3-inch bands spaced 5 foot, on center	
Thickened Sludge	TS	Light Brown	Black
Vacuum Line	VAC	Light Olive Green	White
Vent	V	White	Black
Waste Activated Sludge	WAS	Light Brown	Black

Note: All pipe hangers shall be painted to match the color of the piping.

SECTION 10400 SIGNAGE SYSTEMS

1. GENERAL

1.01 Description

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install signage, fire and safety and ADA signage, as specified herein. Complete signage for all Contract improvements shall include, but is not limited to, that indicated in Table 10400-1. A complete list of all signage required shall be developed by the Engineer during the course of the Project and shall be installed as specified herein.

B. Related Work Specified Elsewhere

1. Related work specified elsewhere includes:

Specification Section	Title
00700	General Conditions
01500	Temporary Facilities
10450	Cast Bronze Plaque (NOT IN CONTRACT)
10550	Fire Extinguishers, Cabinets and Accessories
Division	Information
1	General Requirements
16	Lighting Systems

1.02 Quality Assurance

A. Each type of product specified under this Section shall be *furnished by a single manufacturer* who is an experienced specialist in the production of these materials, with a minimum of five (5) years of documented experience.

B. Standards

1. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

Standard	Description		
Federal Specifications			
QQ-A-200/8D	6063 aluminum alloy bar, rod, shapes, tube and wire.		
QQ-A-250/2D	3003 aluminum alloy plate and sheet		
Code of Federal Regulations (CFR)			
36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition		
Americans with	Americans with Disabilities Act (ADA)		
	Americans with Disabilities Act (ADA) Standards for Accessible Design		
International Co	International Code Council (ICC)		
ICC A117.1	Accessible and Usable Buildings and Facilities		
Other Standards and Building Codes			
	Florida Building Code		

C. Tolerances

1. The dimensional tolerance shall be $\pm^{1}/_{16}$ -inch.

1.03 Submittals

- A. Submit manufacturer's descriptive literature, catalog data, illustrations, specifications, and other pertinent data in accordance with Section 01300, *Shop Drawings, Submittals and Samples*.
- B. Shop drawings for signage shall be submitted to the Engineer for approval prior to fabrication
 - 1. <u>Product Data</u>: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, and overall dimensions of each sign.

- 2. <u>Signage Schedule</u>: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - **2.01** When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - **2.02** When content of signs is indicated to be determined later, request such information from the Engineer within two (2) weeks of the preconstruction meeting. After receiving this information, the Contractor shall submit a preliminary building sign schedule.
 - **2.03** Submit for approval by the Engineer prior to fabrication of building signage.
- 3. <u>Samples</u>: Submit two (2) samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- 4. Submit scaled sign layouts for each sign required.
- 5. <u>Selection Samples</u>: Where colors are not specified, submit two sets of color selection charts or chips.
- 6. <u>Manufacturer's Installation Instructions</u>: Include installation templates and attachment devices.
- C. Sample charts and catalog information of materials, colors and a finished corner of interior and exterior sign construction complete with lettering shall also be submitted for approval.
- D. Submit cleaning and maintenance instructions for all signage components.

1.04 Product Delivery, Storage and Handling

- A. The manufacturer shall package signs, as required, to prevent damage before installation.
- B. Do not deliver the materials until required in the general sequence of construction for the Project.
- C. Deliver the materials in the manufacturer's unopened containers or bundles fully identified with name, brand, type, and grade.
- D. Store all materials off of the ground, inside a dry ventilated space, and in a manner acceptable to the manufacturer. Prevent metal studs from rust and damage.

E. If any of the materials are damaged, they shall not be used in the construction and shall be *replaced at no additional cost to the Owner*.

2. PRODUCTS

2.01 General

- A. Each door shall have signs that indicates the door number and room name/function.
- B. The Engineer and Owner shall develop a room sign numbering and naming system during the construction of the proposed improvements.
- 2.02 Employee Office Identification Signs (EOIS) NOT USED
- 2.03 Raised Image Laminated Signs (RILS) NOT USED
- 2.04 Equipment/Miscellaneous Signs (EMS)
 - A. Fixed plaque signs consisting of ¹/₁₆-inch thick, clear matte acrylic that is sub-surface printed with the sign message prior to being laminated to a ¹/₈-inch thick baseplate of red opaque acrylic, or color to be selected by the Engineer and Owner. Plaques shall have one-inch radius rounded corners and shall be suitable for outdoor use.

B. Lettering

- 1. Minimum two (2) inch high, unless otherwise indicated by the Engineer, upper case Helvetica Medium, die-cut pressure sensitive vinyl letters and symbols.
- 2. Lettering shall be in all capital letters.

C. Mounting

- 1. <u>Door or Equipment Mounted Signs:</u> Mechanical fastening with stainless steel countersunk screws 5'-0" above the finished floor, exterior side.
- 2. <u>Wall Mounted</u>: 0.125-inch aluminum shim plate with pre-drilled counter sunk holes and stainless steel screws. Plaque affixed to shim plate with vinyl foam tape or silastic adhesive, approximately 5'-6" above the finished floor, unless otherwise noted.

- D. Signage shall be as manufactured by Nelson-Harkins Industries, Andco Industries Corporation, Vomar Products, Cooper Architectural Signs, or approved equal
- 2.05 Building/Structure Identification Signs (BSIS) NOT USED
- 2.06 Cast Aluminum City Seal/Logo NOT USED
- 2.07 Site Entrance Sign (SES) NOT USED

2.08 Safety and Restrictive Signs (SRS)

A. Fixed plaque signs consisting of ¹/₁₆-inch thick, clear matte acrylic that is sub-surface printed with the sign message prior to being laminated to a 1/8-inch thick baseplate of opaque acrylic (or color selected by the Engineer). Plaques shall have one (1) inch radius rounded corners and shall be suitable for outdoor use.

B. Lettering

1. A minimum of two (2) inches high, upper case Helvetica Medium, die-cut pressure sensitive vinyl letters and symbols. Lettering shall be in all capital letters.

C. Mounting

- 1. Wall mounted with 0.125-inch aluminum shim plate with pre-drilled, countersunk holes and stainless steel screws.
- 2. Plaque shall be affixed to shim plate with vinyl foam tape or silastic adhesive at the locations to be identified by the Engineer.
- 3. Door or equipment mounted signs shall be mounted with mechanical fastenings with stainless steel countersunk screws at the locations identified by the Engineer
- D. Signage shall be as manufactured by Nelson-Harkins Industries, Andco Industries Corporation (Series 800), Vomar Products, Cooper Architectural Signs, or approved equal

2.09 Traffic Signage (TS) - NOT USED

3. EXECUTION

3.01 Examination

A. Verify that substrate surfaces are ready to receive the signage work.

3.02 Installation

- A. Signage shall be installed at the locations as directed in accordance with the manufacturer's recommendations and approved Shop Drawings.
- B. Do not install signs until the final coat of paint on the mounting surface is dry.
- C. Signage shall be installed at the locations as directed by the Engineer and Owner and in accordance with the approved Shop Drawings.
 - 1. Room Signs: Locate on the wall at the latch side of the door with the centerline of the sign at sixty (60) inches above finished floor.
 - 2. Door signs: Locate on the door frame as directed by Engineer and Owner.
- D. Do not install signs until the final coat of paint on the mounting surface is dry.
- E. Signage shall be installed at the locations as directed by the Engineer and Owner and in accordance with the approved Shop Drawings.
 - 1. Room Signs: Locate on the wall at the latch side of the door with the centerline of the sign at sixty (60) inches above finished floor.
 - 2. Door signs: Locate on the door frame as directed by Engineer and Owner.
- F. Install neatly, with horizontal edges level.
- G. Damaged units or components shall be removed and replaced at no additional cost to the Owner.
- H. Signage shall be cleaned to the satisfaction of the Engineer, using the approved methods, upon completion of the installation, and again just prior to acceptance of the project.
- I. Protect all signage from damage until Substantial Completion; repair or replace any damaged items.

END OF SECTION

TABLE 10400 - 1

FLAGLER BEACH WWTF SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS - SIGNAGE SYSTEM

Sign Location	Mounting Location	No. of Signs Required	Background / Letter Colors	Inscription	
Equipment / Miscellaneous Signs (EMS)					
Biosolids Dewatering Building and Cher	nical Feed System Area				
Sodium Bisulfite Storage Tank	Mount on east side of tank (centered)	1	Black / White	SODIUM BISULFITE STORAGE TANK (500 Gallons)	
Polymer Storage Tank	Mount on east side of tank (centered)	1	Black / White	POLYMER STORAGE TANK (500 Gallons)	
Dewatering Polymer Feed Pumps	Location to be determined by the Engineer and Owner	2	Black / White	DEWATERING POLYMER PUMP No. 1 and No. 2	
Sodium Bisulfite Feed Pumps	Location to be determined by the Engineer and Owner	2	Black / White	SODIUM BISULFITE PUMP No. 1 and No. 2	
Dewatering Screw Press	Location to be determined by the Engineer and Owner	1	Black / White	DEWATERING SCREW PRESS No. 1	

TABLE 10400 - 1

FLAGLER BEACH WWTF: SLUDGE MANAGEMENT SYSTEM IMPROVEMENTS - SIGNAGE SYSTEM

Sign Location	Mounting Location	No. of Signs Required	Background / Letter Colors	Inscription
General Location Signage				
As Directed by the Owner	As Directed by Owner (2 locations)	2	Yellow / Black	CAUTION
	As Directed by Owner (2 locations)	2	Red / White	AUTHORIZED PERSONNEL ONLY
At All Wash Stations	Adjacent to ALL Hose Bibbs		Yellow / Black	NON-POTABLE WATER DO NOT DRINK AGUA NO POTABLE NO APTA PARA BEBER

In addition to the above signs, provide safety and danger signs throughout the facility, type and number as required by the Engineer/Owner.

This Schedule of Signage is by no way complete. It is presented for the Contractors convenience in estimating the signage required for Project.

SECTION 11314

PROGRESSIVE CAVITY SLUDGE PUMPS

1. GENERAL

1.01 Scope of Work

- A. The work specified in this Section shall include, but is not limited to, furnishing all labor, materials, equipment, tools, services, and all incidental items and work required for construction, installation, field testing and placing into acceptable operation the following positive displacement, eccentric screw, PC sludge pumps:
 - 1. One (1) VFD controlled sludge cake pump to convey dewatered sludge from the biosolids dewatering screw press(s) to the storage container/dumpster for proper disposal off-site.
 - 2. One (1) VFD controlled thickened sludge feed pumps to convey Class "B" biosolids from the BNR Process Digester(s) to the biosolids dewatering screw press(s).

The pumping systems identified above, complete with electric motors, couplings, bases, direct coupled drives, controls, meters and appurtenant equipment, shall be mounted on a common baseplate and all items shown or inferred on the Contract Drawings or reasonably specified herein. If any items for a complete job are omitted or not shown, the Contractor shall furnish and install the same without additional cost to the Owner. The pumps shall be suitable for outside installation and service, with hydrogen sulfide gas present.

- B. These specifications are intended to give a general description of what is required, but do not cover all details, which will vary in accordance with the requirements of the equipment offered. It is, however, intended to cover the furnishing, shop testing, delivery, complete installation, and field testing, start-up, and debugging of all materials, equipment, and appurtenances for the complete installation of the pumping units as herein specified, whether specifically mentioned in these Specifications or not.
- C. All components of the sludge pumping system shall be engineered for long, continuous, and uninterrupted service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts.

- D. All equipment shall be constructed of non-corrosive materials of the grade specified herein.
- E. For all units there shall be furnished and installed all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not.
- F. This installation shall incorporate the highest standards for the type of service shown on the Contract Drawings, including field testing of the entire installation and instruction of the regular operating personnel in the care, operation and maintenance of all equipment.
- G. The proper operation of the progressive cavity sludge pumping systems, as required by this Project, shall be the responsibility of the manufacturer of the pumping system.
- H. Equipment furnished and installed under this Section shall be fabricated, assembled, erected and placed in proper operating condition in full conformance with detail drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer as approved by the Engineer.

1.2 Related Work Specified Elsewhere

A. Related work specified elsewhere includes:

Specification Section	Title
01300	Shop Drawings, Submittals and Samples
01600	Materials and Equipment
01650	Systems Start-up and Demonstration
01720	Project Record Documents
01730	Operation and Maintenance Data
01740	Warranties and Bonds
Division	Information
5	Metals
9	Finishes
13	Process Instrumentation and control System PICS
15	Mechanical
16	Electrical

1.3 Description

- A. Pumps shall be positive displacement progressing cavity eccentric screw and shall be of the design and type specified for pumping thickened sludge (2-5% solids) and dewatered sludge (15 20% dry solids).
- B. The pumps shall be designed to allow the suction port to rotate in 90° increments perpendicular to the pump centerline.
- C. Pump castings shall be grey cast iron as specified for the intended service.
- D. Pump clean out ports are 180° opposed tapped and plugged. Drain plugs will be located in the suction casting, gland housing and clean out ports.
- E. Suction and discharge flanges shall be raised face 150 lb. flanges meeting ANSI B 16.5 standards. Discharge flanges shall be tapped for gages and plugged.
- F. The pump bearings shall be designed for a L-10 life of 50,000 hrs.
- G. The pump design will allow for complete rotating assembly removal from the pump discharge without dismantling the pump wet end, bearing frame, suction piping or driver.
- H. The rotating assembly includes rotor, universal joints, shaft and coupling rod.

I. Dewatered Sludge Conveyance Pumping System

- The sludge cake pump shall be used to convey dewatered sludge from the discharge
 of the dewatering screw press via the pump discharge piping into the holding
 container/dumpster, at a distributed and regulated rate, for legal off-site disposal by a thirdparty vendor, separately contracted by the owner.
- 2. The one (1) VFD controlled sludge cake pump shall be controlled by the Cake Pump Conveying Control Panel. The pump supplier shall coordinate with the Cake Pump Conveying Control Panel supplier for proper integration.
- 3. Each progressive cavity sludge cake pump shall be equipped with a "dry run protection device" with the dry run relay supplied to the Cake Pump Conveying Control Panel manufacturer to be installed within the Cake Pump Control Panel.

J. Digested Sludge Transfer Pump Station

- 1. The thickened sludge feed pumps shall be used to automatically pump digested, Class "B" biosolids from the digested sludge transfer pump station directly to the dewatering screw presses.
- 2. The one (1) VFD controlled digested sludge transfer pumps shall be automatically

operated and controlled by Dewatering Screw Press Control Panel..

3. Each progressive cavity pump shall be equipped with a "dry run protection device". The associated run dry relay shall be supplied to contractor for installation within the <u>Digested Sludge Transfer Pump</u> VFD control panel furnished by the contractor.

K. Environmental Conditions

- 1. The pumping systems provided under this Section will be installed outdoors as indicated on the Contract Drawings.
- 2. The manufacturer shall provide all of the required accessories necessary for complete and fully functional pumping systems that will be exposed to the elements (weatherproof systems).

1.4 Patents and Licenses

- A. The pumping equipment manufacturer shall be responsible, in all respects, for all matters related to patents or licenses pertaining to the equipment that may be provided.
- B. The manufacturer shall assume all costs of patent fees or licenses for the equipment or process and shall safeguard and save harmless the Owner from all damages, judgments, claims and expenses arising from license fees, or claimed infringement of any letters, patent or patent rights, or fees for the use of any equipment or process structural feature or arrangement of any of the component parts of the installation, and the bid price shall be deemed to, and shall, include payment of all such patent fees, licenses or other costs pertaining thereto.

1.5 Quality Assurance

- A. The pumps covered by these specifications are intended to be standard pumping equipment of proven ability as manufactured by a reputable manufacturer having long experience in the production of such pumps. The pumps furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. Pumps shall be manufactured in accordance with the standards of the Hydraulic Institute.
- B. **The equipment specified under this specification section shall be new and unused** and provided by manufacturers who are fully experienced, reputable, qualified, and regularly engaged in the manufacture of the components and equipment to be furnished for a minimum of five (5) years. All equipment and manufacturers shall be approved by the Engineer and Owner.

C. The pumps, motors and all related equipment shall be suitably constructed of materials to withstand the operating conditions that will be experienced during the pumping systems performance and outdoor environment.

D. <u>Unit Responsibility</u>

1. In cooperation with the Contractor, the manufacturer/supplier shall assume complete responsibility for the satisfactory installation and operation of the dewatering sludge and digested sludge transfer pump station systems.

E. Standards and References

Unless otherwise indicated, all materials, workmanship and practices shall conform
to the following standards. They shall be part of this Section as specified and
modified. In case of conflict between the requirements of this Section and those of
the listed documents, the requirements of this Section shall prevail:

STANDARD	DESCRIPTION	
American Gear Manufacturers Association (AGMA)		
AGMA 6010-E-88	Spur, Helical, Herringbone, and Bevel Enclosed Drive	
AGMA 6019-E-89	Gear Motors using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears	
AGMA 6023-A-88	Design Manual for Enclosed Epicyclic Gear Drives	
Other Standards		
	ANSI, ASTM, NEC, NEMA	

F. Minor Changes and Equipment Drawings

- The structures shown on the Contract Drawings for the various items of equipment are the result of the best obtainable information from various sources. Due to the variances in equipment details between equipment manufacturers, the Contractor may find it necessary to make minor changes to accommodate the piping and the equipment furnished.
- 2. The Contractor shall not undertake to construct any structure containing equipment until he has obtained approved, certified dimension prints of the equipment involved. Any structural changes necessary to accommodate the equipment furnished shall be approved by the Engineer and shall be made at no additional cost to the Owner.
- The equipment suppliers for the various items of equipment shall assume all
 responsibility in informing the Contractor of any changes that may be required in the
 structures, mechanical system, electrical or controls systems to accommodate their
 equipment. Where details of equipment vary considerably from that shown, the

equipment supplier shall prepare complete installation drawings, following the form of the Contract Drawings and such other drawings as may be required by the Engineer to provide complete installation drawings. Where changes require such drawings, the equipment supplier shall furnish to the Engineer AutoCAD drawings (latest version) in addition to approval prints.

- G. All pump manufacturers shall have a minimum of five (5) years service and a minimum fifty (50) similar installations for the design and type of pumping system and accessories specified and must be providing proven, reliable service.
- H. The City is in the process of standardizing equipment between both of their water reclamation facility's for operations and maintenance purposes. Therefore, the progressive cavity pumping systems for conveying thickened and digested sludge shall be Seepex, Inc., no equal.

1.6 Submittals

A. Shop Drawings and Manufacturer's Literature

- 1. For all pumps to be furnished under this Section, the Contractor shall submit shop drawings, including at least the following, to the Engineer for approval in accordance with the provisions of Section 01300, "Shop Drawings, Submittals and Samples":
 - a. Manufacturer's descriptive literature, illustrations and specification data. Show the pump type and model number.
 - b. Certified shop, dimensional and erection drawings showing all important details of construction, dimensions and anchor bolt locations and dimensions. Show details of construction and materials by ASTM reference and grade and indicate all coatings. Show outline dimensions and weights of pumps, bases and motors. Indicate all structural and operating features, space required, clearances, type of finish or shop coat, and other pertinent data.
 - c. Manufacturer's certified performance curves developed for the specific application. Performance curves shall plot speed, discharge capacity, head, brake horsepower, NPSH required, and efficiency from 0 - 110% of the design capacity of the pump.
 - d. Details of all pump accessories.
 - e. Dimensions of major components.
 - f. The following data shall be submitted for each motor:
 - 1) Materials of construction.
 - 2) Dimensions.

- 3) Manufacturers designation.
- 4) Number of phases.
- 5) Horsepower output.
- 6) Efficiency.
- 7) Voltage and Time rating.
- 8) Full load current and Temperature rise.
- 9) Code and designation letter.
- 10) RPM at full load.
- 11) Design letter.
- 12) Frequency and Service factor.
- 13) Manufacturer's recommended lubrication requirements.
- g. A copy of the control diagrams and process and instrumentation diagrams.
- h. Layout drawings shall show exact installation, piping, and foundation details for the pumping units and air compressor system being submitted, openings, connections, construction details of the equipment, wiring diagrams, and weights of major components.
- i. A complete bill of materials of all equipment, including materials of construction.
- j. The total weight of the equipment including the weight of the single largest item.
- k. A copy of the Contract Document control diagrams and process and instrumentation diagrams that apply to the equipment in this Section marked to show specific changes necessary for the supplied equipment. The submittal shall be accompanied by a detailed, written justification for each deviation/change. If no changes are required, the drawings shall be marked "no changes required".
- A copy of this specification section and all referenced sections that apply to the equipment in this Section, with each Article check marked to show specific compliance or marked to show deviations with proper written, detailed justification.
- m. Manufacturer's guarantee/warranty.
- n. Provide a notarized statement by the pump supplier which shall certify that the pump supplier shall always maintain in stock at least one (1) set of spare parts for each model of pump furnished, and that if any of the parts are not in stock when ordered by the Owner, the pump supplier shall either provide a pump or reimburse the Owner for rental of a pump to maintain the pumping systems in operation until the ordered part(s) are delivered.

o. Submit a listing of all manufacturer's recommended spare parts and special tools to be provided for each pumping system along with the manufacturer's SKU number and the current price for each item.

B. Operating and Maintenance (O&M) Instructions

- 1. O&M Manuals shall be furnished for this Project in accordance with Section 01730, "Operation and Maintenance Data" and shall be submitted in accordance with Section 01300, "Shop Drawings, Submittals and Samples".
- 2. The O&M Manuals shall be prepared specifically for this installation and shall include all detailed operating and maintenance instructions and specifications relative to the assembly, alignment, checking, lubrication, placing in operation, adjustment, and maintenance of equipment and auxiliaries furnished under this Contract; operating instructions (normal startup and shutdown procedures, normal operating conditions and emergency situations); assembly, wiring and controls diagrams; a troubleshooting guide; a complete parts lists with catalog numbers and predicted life of parts subject to wear, and normal delivery times of such parts; performance curves from identical units; coating systems applied; copies of shop drawings, certified dimensions drawings and design calculations; and required cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.
- 3. All such material shall be in addition to any instructions or parts lists packaged with or attached to the equipment when delivered.
- 4. The "final" O&M Manuals shall contain "plastic laminated pull-out lubrication and maintenance cards" detailing all lubrication points, lubricant type, and frequency of lubrications and all additional required maintenance and frequency intervals.
- 5. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Supplier, as defined in Section 13300, "PICS System Supplier", for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (System Integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically to the Engineer in both PDF and JPEG formats, no exceptions.
- 6. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "on-line" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the PICS at the treatment facility.

1.7 Product Delivery, Storage and Handling

- A. The progressive cavity sludge pumps and related equipment and accessories shall be factory assembled and tested, and shall be delivered to the site for installation. Deliver a complete system ready to install as the job progress requires.
- B. All parts and equipment shall be properly protected via storage in a weathertight building/structure so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation. Protect the equipment from being contaminated by dust, vibration and moisture. Each box, crate or package shall be properly marked to show its net weight in addition to its contents.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. All instrumentation equipment and appurtenances shall be stored in a clean, dry weathertight building or enclosure.
- E. Finished surfaces of all exposed pump openings shall be protected by wooded planks, strongly built and securely bolted thereto.
- F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- G. Each box or package shall be properly marked to show its net and tare weight in addition to its contents.
- H. After hydrostatic or other tests, all entrapped water and solids shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- I. Deliver equipment to the project job site at the appropriate time for installation. Delivery, storage and handling shall comply with Section 01600, "Materials and Equipment".
- J. Store mechanical and electrical components off of the ground in weathertight enclosures and keep dry at all times.

1.8 Warranty

- A. Warranties shall be provided for all equipment in accordance with the Project General Conditions and Section 1740, "Warranties and Bonds", unless specified otherwise.
- B. The pump manufacturer shall guarantee and warrant that the equipment furnished is free from defects in design, material and workmanship.
- C. The pumping system, ancillaries and incidentals shall be warranted by the pump manufacturer. The warranty period shall be for a period of two (2) years from the date of Final Project Acceptance by the Owner.
- D. The pump manufacturer shall provide the Owner with an *annual preventive maintenance contract (renewable)* for the Owner's consideration sixty (60) calendar days prior to Final Project Acceptance. This cost *shall not* be included in the Bid Amount.
- E. If any equipment fails to perform as specified herein, the equipment manufacturer shall promptly repair or replace the defective equipment *at no additional cost to the Owner*. Normal wear and tear shall be excluded.
- F. This warranty is in addition to any other warranty required by the Contract Documents.

1.9 Manufacturer's Services

- A. A factory representative of all major component manufacturers, who has complete knowledge of proper operation and maintenance, shall be provided for *two (2) eight hour days to inspect, certify, calibrate, start-up, and optimize* the pumping systems and provide operation and maintenance training to representatives of the Owner and the Engineer.
- B. The field factory engineer shall be available to inspect the installed equipment and supervise the start-up demonstration and testing as specified in Section 01650, "Systems Start-up and Demonstration".
- C. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional services shall be provided at no additional cost to the Owner.

D. Certifications

- 1. The Contractor shall furnish the Engineer with a written certification signed by and from the manufacturer's representative that the equipment:
 - a. Has been properly installed per the manufacturer's requirements.

- b. Has been properly lubricated per the manufacturer's instructions.
- c. Has been accurately aligned and proper running clearances have been set.
- d. Is free from undue stress imposed by piping or mounting bolts.
- e. All suction piping has been flushed and all debris removed prior to start-up.
- f. Is free from any known defects.
- g. Is ready to be operated on a continuous basis.

E. Operation and Maintenance Training

- 1. A factory field engineer who has complete knowledge of the proper operation and maintenance (O&M) of the pumping system, shall be provided for one (1) eight-hour day of Operation and Maintenance training to the Owner and Engineer prior to the initial start-up of the respective system/equipment. Classroom training (with organized handouts and professional presentations) along with training at the treatment facility site with the process/equipment shall be provided. Training materials shall be provided to the Engineer for review and approval at least thirty (30) calendar days prior to the training sessions. Training will only be considered valid for approval by the Engineer if it takes place after the successful Start-up and Demonstration Test of the pumping system.
- 2. At six (6) months after the completion of the first training session, a second training/maintenance session is to be scheduled. In addition to a classroom-style training refresher for the Owner and Engineer, the training instructor shall also perform any necessary maintenance or repairs required to the equipment, at no additional cost to the Owner.
- 3. Operation and Maintenance Manuals shall be submitted and approved in accordance with Section 01300, "Shop Drawings, Submittals and Samples", and Section 01730, "Operation and Maintenance Data", in accordance with the time schedule contained therein.

F. Field Testing

- 1. The services of a factory representative shall be furnished to check the installation of the system and supervise any field adjustments necessary to insure proper mechanical operation.
- 2. If there are difficulties in the operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner.

- G. The costs associated with the manufacturer's services stated herein shall be incorporated into the Contractor's Bid Price for this Project.
- H. The Contractor shall film all training and maintenance sessions with a high-definition video camera (1080p resolution) as part of the Contract. Three (3) copies of each training/maintenance session shall be provided electronically within three (3) calendar days after the filming.

1.10 Special Tools and Spare Parts

- A. Furnish one (1) complete set of all special tools, including lubricating devices, required for normal operation, adjustment and maintenance of the equipment supplied. All such tools shall be furnished with the appropriate number of heavy duty, thermoplastic tool chests complete with padlocks, identification plate for tools and duplicate keys.
- B. Furnish all lubricants required for operation and maintenance of the progressive cavity pumping system equipment for a period of two (2) years from the date of Final Project Acceptance, as specified in Section 01600, "Materials and Equipment".
- C. Replacement parts required for normal operation during the first two (2) years of the progressive cavity pumping system equipment shall be provided by the pump manufacturer to assure uninterrupted operation of the pumping systems.
- D. The Process Equipment Supplier shall furnish a complete set of recommended spare parts necessary for the first two (2) years of operation of each of the pumping systems. A list of the spare parts shall be submitted to the Engineer for approval during the shop drawing review process. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long-term storage.
- E. The spare parts and tools shall be carefully packed in moisture proof containers, properly labeled with indelible markings with complete ordering information including the manufacturer's name, local representative's name, address and telephone number, part number, part name, and equipment for which the part is to be used, and shall be properly treated and protected for a long period of storage.
- F. At a minimum, the following spare parts shall be provided for **each** pumping system:
 - 1. One (1) set of packing tools.
 - 2. One (1) packing set.
 - 3. One (1) set of gaskets, O-rings, seals and joints.

- 4. One (1) rotor.
- 5. One (1) stator.

2. PRODUCTS

2.01 Materials and Equipment

- A. The pumping systems required under this specification section shall be complete with proper alignment and balancing of the individual units. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially adapted for the intended use. Ample room shall be provided for inspection, repairs and adjustment. The pump design shall allow the suction port to be rotated in 90° increments perpendicular to the pump centerline.
- B. The support systems for pump and drives shall be rigidly and accurately anchored into position. Foundation bolts, plates, nuts and washers shall be furnished by the Contractor.
- C. Stainless steel nameplates giving the name of the manufacturer, the rated capacity, head, speed and all other pertinent pump and motor data shall be attached to each pump and motor.

2.2 Pumps

A. General

- 1. The Contractor shall furnish, install, field-test and start-up the positive displacement, eccentric screw, progressing cavity pumps as shown on the Contract Drawings and shall conform to all requirements stipulated herein.
- 2. The pumps shall be of standard dimensions, built to limit gauges or formed to templates, such that parts will be interchangeable between like units.
- 3. The pumps shall be of the self-priming, positive displacement, progressing cavity type, designed for pumping thickened wastewater sludge and digested Class "B" biosolids (2 8 % dry solids).
- 4. The pumps shall incorporate the required number of stages to pump the fluid effectively and efficiently.

B. <u>Performance Requirements</u>

1. The sludge handling pump hydraulic performance conditions and design data are as follows:

Parameter	Dewatered Sludge Conveyance Pumping Station	Digested Sludge Transfer Pump Station
No. of Pumps (Drive Type)	1	2
Fluid Pumped	Dewatered Sludge	Thickened, Digested Sludge
Feed Solids (%)	15-20	2-5
Specific Gravity		
Solids Size (mm)		< 2
рН	5 - 9	5 - 9
Temperature °F	32-113	32-113
Minimum No. of Stages		
Seal Lubrication		
Max. Rated Capacity (gpm)	10	80
Maximum Pump Speed at Max. Rated Capacity (rpm)	56	223
Min. Rated Capacity (gpm)	2	20
Suction Head	Flooded	Flooded
Pressure Head (psig)	250	30
Differential Pressure at Maximum Capacity (psi)		
Pump Drive Type	VFD	VFD
Soft Start Provided for Motor	Yes	Yes
Minimum Motor Size (hp)	15	7.5
Motor Speed (rpm)	1800	1800
Suction Piping (in)	4	5
Discharge Piping (in)	4	4
Pump Manufacturer / Model No.	Seepex, Inc., BTVE 17-24	Seepex, Inc. BN 35-6LS

- 2. The pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of one hundred fifty percent (150%) of the actual thrust load.
- 3. The pumps, along with associated appurtenances, shall be mounted on common fabricated steel baseplates.

C. Materials

1. Materials of construction shall be as follows:

Component	Material - Sludge Pumps	
Rotor	C45 Alloy Steel Duktil Coated	
Stator	Buna N (NBR 73 ± 3 Shore A Hardness) with TSE Run-Dry Protection	
Joint Seal	Buna N (NBR 73 ± 3 Shore A Hardness)	
Pump Body	Grey cast iron with tapped and plugged clean out ports (ASTM A-48 or ASTM A-126)	
Plug-in Shaft	420 Stainless Steel (AISI-420 or 440C hardened to 450 Brinell)	
Coupling Rod	420 Stainless Steel (AISI-420 or 440C hardened to 450 Brinell)	
Universal Joint	Tool Steel (D-6)	
Metal Parts of Mechanical Seals	Type 316 Stainless Steel or Hastelloy C with Viton O-rings (UNS S31600, N10276 or N60455; seal rotating and stationary parts shall be tungsten carbide or silicon carbide)	
Shaft Sealing	Single acting mechanical seal, Burgmann, MG1-QIQ1VGG with Viton Bellows, silicar faces, Type 316 SS wetted parts	
Base Plate	Steel (ASTM A-36)	

D. Rotor and Stator

- 1. Each pump shall be of the *staged-design type* employing a convoluted rotor operating in a similarly convoluted stator.
- 2. The convolutions shall be configured to form a cavity between the rotor and stator progressing from the pump's inlet to discharge port with the operation of the rotor. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pump chamber (suction).

- 3. The stator shall be vulcanized in a metal tube and have a Shore A hardness of 73 ± 3. The stator shall be Buna N/Nitrile and shall be bonded to the stator sleeve ends forming a collar to prevent any liquid or sludge from contacting the metal stator sleeve providing a seal between the stator, suction casing and discharge flange. Gaskets or "O" rings may not be used to form this seal.
- 4. The stator tube shall be drilled for TSE. The TSE controller shall be mounted in the VFD or Cake Pump Conveying control panel.
- 5. The sludge pump rotors shall be constructed of highly polished, high chrome content (11 13%), C45 alloy steel Duktil coated and hardened to 64 hRc and treated to prevent corrosion. An additional surface coating diffusing into the base metal providing a minimum surface hardness of 1250 1650 Vickers and a minimum thickness of 0.0108-inches shall be provided. The coating shall be a chromium nitride coating (Duktil coated 316 TiSS). Hard chrome plating or ceramic coatings shall not be acceptable. Tungsten Carbide is an acceptable alternative coating for non- corrosive environments.

E. Rotor and Drive Train

- 1. The rotor drive train shall be warranted to be free from defects in materials and/or workmanship for a period of two (2) years from date of Final Project Acceptance by the Owner and shall consist of the following:
 - a. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod.
 - b. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc.
 - c. A Type 316 stainless steel shell shall cover the universal joint assembly to protect the elastomer sleeve from being damaged.
 - d. The universal joint and all components shall be totally enclosed and completely isolated from the fluid being pumped. The wearing parts shall be hardened using hardened bolts and replaceable bushings, 62 and 65 HRc, respectively. These components shall be manufactured of L-5.
 - e. The universal joint shall be so designed that only bolt and bushing replacement is required for repair. The "U" joint shall be covered by an elastomeric (Buna N or Hypalon) sleeve similar to the stator and secured by Type 316 stainless steel bands packed with high quality, high temperature (450° F), PTFE base synthetic grease.

- f. The positive banded U-joint shall be rated for 150 psig to prevent ingress of liquid. The universal joint shall be further equipped with a Type 316 stainless steel two-piece cover which shall encompass the sealed joint. This cover shall be secured by Type 316 stainless steel hex machine bolts, covered by elastomer bands two times the diameter of the connection. A second set of Type 316 stainless steel mechanical bands will secure the elastomer.
- g. All sludge pumps shall have an "unconditional" 10,000-hour universal joint performance guarantee at 100% replacement, with regard to damage or wear. The "U" joint service factor shall exceed the maximum torque at the maximum speed and maximum pressure rating of the pump by 1.50.

F. Casing

- 1. Pump castings shall be grey cast iron with tapped clean out ports 180° opposed. The castings shall be free of sand holes and other defects. At least three (3) drain plugs shall be located in the suction castings.
- 2. The suction and discharge casings shall each be provided with a ½-inch (or larger) tap to permit installation of pressure instruments.

G. Flanges

- 1. Suction and discharge flanges shall be raised 150-pound flanged connections meeting ANSI B16.5 standards.
- 2. Flanged connections shall be provided at both the inlet and discharge ports.
- 3. Discharge flanges shall be tapped and plugged to accept gauges.

H. Shaft, Seals and Bearings

- The pump shaft shall be manufactured of solid Type 420 stainless steel bar stock and shall be of the split design for easy disassembly of the entire rotating assembly from the pump discharge. The shaft coating will diffuse into the base metal providing a minimum surface hardness of 1250 - 1650 Vickers when packing is provided.
- The stuffing box shall be removable should modification be required and of sufficient size to incorporate packing or mechanical seals. The pump shall be supplied with single mechanical seals having sil car vs sil car faces, Type 316 stainless steel wetted parts and Viton elastomers. The seals do not require an external flush.

- 3. Pump anti-friction bearings shall have a minimum AFBMA L-10 rating of 100,000 hours. Bearings shall be oil lubricated and housings shall be designed for all loads imposed and so removal can be made without dismantling the pump wet end or the suction piping.
- I. Anti-Reversal Holdback Device NOT USED
- J. Fiber Deflector NOT USED

K. Noise and Vibration

 All equipment containing moving parts shall be installed level and plumb, unless otherwise indicated, and shall be anchored securely in order that noise be suppressed to a minimum and that vibrations do not cause damage while in operation.

L. Inspection Ports

- 1. Provide two (2) inspection ports, at least four (4) inches square on each side of the universal joints.
- 2. Provide cover plates, screwed or bolted to the pump body.

M. Hardware

1. All anchor bolts, nuts and washers shall be Type 316 stainless steel. All brackets and the hardware items shall be Type 316 stainless steel.

N. Accessories

1. Run-Dry Protection

- a. To prevent the pump from "running dry", each pumping system shall be equipped with "run-dry" protection integral to the stator.
- b. The stator shall be fitted with a sensor sleeve and thermistor sensor. The thermal sensor shall measure the temperature between the rotor and stator and automatically "shut-down" the driver when loss of liquid occurs and activate an "alarm" sequence.
- Extra contacts shall be provided in the TSE controller and shall be provided and installed by the Contractor in the VFD Control Panel, and to the Cake Pump Conveying Control Panel supplier

- d. The controller shall include a manual local and remote reset function. Input to the controller shall be 1 x 115 VAC, 60 Hz.
- e. The manufacturer shall provide documentation that verifies at least fifteen (15) installations in service for five (5) years each, in order to verify reliability.

2. Over-Pressure Protection

- a. To prevent inadmissible overpressure, each pumping system shall be fitted with a diaphragm contact pressure transmitter in connection with the pump drive. The pump/pumping system will be switched off and protected against damage when the maximum preset pressure (90% of the pump maximum) is reached.
- b. The unit shall be of the Onyx/Ashcroft valve annular type, six (6) inch diameter minimum with glycol filled 4-inch gauge, NBR sleeve, steel body and acetyl end plates.

3. TSE

a. Temperature sensors shall be 110 VAC and shall be installed per the recommendation of the Engineer (wired to the VFD control panel and Cake Pump Conveying control panel as shown on the Contract Drawings).

4. Panel Enclosure

- a. The TSE "run-dry" protection controller is to be wired to the VFD control panel and Cake Pump Conveying control panel for each pumping system, that meet the requirements of Section 13315, "Process Instrumentation and Control System - Control Panels".
- b. The VFD's are to be mounted in the VFD control panel and Cake Pump Conveying control panel for each pumping system
- c. The AS panel shall interface with the PICS.
- d. These items are in addition to the requirements of Section 13315, "Process Instrumentation and Control System Control Panels".

5. Hopper Extension with Laser Mounting Brackets

- a. Each cake pump shall be supplied with a Type 316 stainless steel hopper extension that is flange mounted to the pump inlet. The hopper extension shall include, at a minimum, the following:
 - 1. An open hopper flange (Type 316 stainless steel) for the integration of

- the cake pump with a Type 316 stainless steel transition extension that will extend from the dewatering equipment discharge chutes to the extension flange.
- 2. The integral flanged hopper extension (Type 316 SS) shall integrate a window on the drive end of the hopper extension. This window will be used for level measurement and presence/absence detection of cake.
- 3. The integral hopper extension shall include a metal fabricated sloped canopy internal to the hopper extension and covering the window. This canopy will eliminate any cake from falling out of the hopper and obstructing the level measurement and presence/absence detectors.
- 4. The hopper extension shall incorporate a flexible polycarbonate shield that will divert falling cake away from the level measurement equipment signal. This shield will be clear polycarbonate and will be ½ ½ thick. It will be flexible in order to prevent cake build up and eliminate possibility of bridging.
- 5. The hopper extension shall include all adjustable brackets to mount all of the presence/absence and level control transmitters and receivers.

6. Laser Level Transmitters - Dewatered Cake System

- a. Each cake pump will be supplied/installed with three (3) pre-programmed laser measurement devices that incorporate the following characteristics:
 - 1. Each laser shall be self-contained and have an IP67 rating for being capable of being fully submersed.
 - 2. Must be able to measure distances ranging from 8 390 inches with an overall accuracy of not more ¾-inch where extraneous light is less than 40klx.
 - 3. The laser level transmitter shall project a dot no larger than %-inch diameter at the maximum measuring length.
 - 4. The laser measurement system shall be able to operate in environmental temperatures ranging from 15-140° F.
 - 5. Each laser transmitter shall utilize sealed M12 connections to prevent any contamination, but easy period maintenance or removal and replacement.
 - 6. Each laser transmitter shall incorporate a discrete output to represent the laser line being broke by falling cake. Additionally, the laser transmitter shall include an analog process signal indicating the proximity of cake from the sensor.
 - 7. Each of the three laser transmitters shall be programmed identically in order to permit them to measure level or indicate presence of sludge

- cake. The operator shall be able to switch the function of each transmitter only by swapping the M12 quick connector.
- 8. In addition to the cake level monitoring provided at the Cake Pump Conveying System Control Panel, monitoring of the hopper sludge level, for each dewatered sludge pump, shall be integrated into the Master Dewatering Control Panel and facility SCADA by the System Integrator.

7. Level Control

a. The Cake Pump Conveying System Control Panel shall receive and analyze all of the level signals to determine proper operation and speed of the pump to keep the process operating in a continuous manner.

2.3 Motors

A. General

- 1. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards, where applicable.
- 2. Motors shall also meet the requirements of Section 16150, "Motors".
- 3. The motors for the VFD controlled pumps shall be of the TEFC design, premium efficiency, inverter duty rated, with thermostats in the motor windings, Class F insulation, a service factor of 1.15 and suitable for corrosive duty. The VFD's shall conform to the requirements of Section 16370, "Variable Frequency Drives".
- 4. Gear motors or gear reducers shall be designed in accordance with AGMA 6019-E, Class II, with a minimum safety factor of 1.50, shall be splash lubricated, and suitable for twenty-four (24) hour/day operation.
- 5. Motors shall be as manufactured by U.S. Motors, SEW, NORD or approved equal product meeting the requirements of these Specifications.
- 6. Refer to specification section 16150 for additional requirements.

B. Performance Requirements

- 1. Motors shall be rated for operation on 230/460 V, three phase, 60 Hz power supply, 1760 rpm maximum. Each motor shall have a 1.15 service factor and insulation class F.
- 2. Motors shall have the horsepower and full load output speed ratings as listed.
- 3. Motors shall have a minimum full load efficiency as indicated in Section 16150, "Motors".

- 4. Motors shall be free of objectionable noise and vibration. Motor sound pressure level shall not exceed sound pressure levels of 75 to 80 dBA at five (5) feet under free field, no load conditions in accordance with IEEE Standard 85. Vibration level measured on the bearing housing shall be in accordance with values shown in NEMA and Hydraulic Institute standards.
- 5. Maximum temperature rise of the motor windings shall not exceed 80°C as measured by resistance, when motor is operated continuously at 115% of rated horsepower, rated voltage and frequency in ambient air temperature of 40°C.

2.4 Shop Painting

- A. Before exposure to weather and prior to shop painting, all surfaces shall be thoroughly cleaned, dry and free from all mill/scale, rust, grease, dirt and other foreign matter.
- B. All pumps, motors and bases shall be shop primed, with a primer compatible with field painting as specified herein. Shop prime coat shall be in accordance with the specifications.
- C. Gears, bearing surfaces and other similar surfaces obviously not to be painted, shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during periods of storage and erection and shall be satisfactory to the Owner up to the time of the Final Project Acceptance Test.

3. EXECUTION

3.01 Installation

- A. Install the pumps where indicated, in strict accordance with the manufacturer's published installation instructions, with recommended clearances provided for service and maintenance. The installation and initial operation of all components shall be certified in writing by the manufacturer.
- B. Install base-mounted pumps and steel foundation plates on a concrete base. Anchor bolts used to secure the pumps and plates to the concrete base shall be poured in place as indicated on the Contract Drawings. Set and level the pumps and grout under the pump base with non-shrink grout.
- C. Provide piping, accessories, hangers, supports and anchors, valves, meters and gauges, vibration isolation and equipment supports as indicated and/or required for a complete and fully functional installation.
- D. Check the alignment, and where necessary, realign shafts of motors and pumps within

the recommended tolerances of the manufacturer, and in presence of the manufacturer's service representative.

- E. Provide the manufacturer's recommended lubricants in the pumps, bearings and other mechanical equipment. Lubricate the pumps before start-up. Start-up shall be in strict accordance with the manufacturer's instructions and these Technical Specifications.
- F. Have the manufacturer's representative on-site to inspect the installation and provide the Engineer with a written report as to any installation or start-up problems. Should any problems be noted the manufacturer's representative will describe procedures to resolve them and, upon approval by the Engineer, the Contractor/manufacturer shall resolve all problems to the satisfaction of the Engineer and Owner.
- G. Ensure that pumping units are properly wired, with rotation in the correct direction, and that pump and motor grounding have been provided.

3.2 Miscellaneous

- A. Nameplates and other data plates shall be Type 316 stainless steel, suitably secured to the pump.
- B. All machine bolts, Type 316 stainless steel stud nuts, and capscrews shall be of the hex head type.

C. Parts

- 1. Parts shall be completely identified with a numerical system (no alphabet letters) to facilitate parts inventory control.
- 2. Each part shall be properly identified by a separate number, and those parts which are identical shall have the same number to effect minimum spare parts inventory.

3.3 Cleaning

A. Clean grease, oil, or any other debris from the exterior surfaces of the equipment and adjacent surfaces.

3.4 Field Painting

A. Coat the pump, motor, drive system and base shall be painted with the highest/best grade paint suitable for the particular application and in accordance with Section 09900, "Painting".

- B. Field painting shall be provided by the Contractor. The field paint shall be products of the same manufacturer as the primer paint used in the shop to assure compatibility. Acceptable paint manufacturer's include Tnemec, Koppers Company or approved equal. The finish coat color shall match the color of the adjacent piping.
- C. Colors shall be selected by the Engineer and Owner from a color chart submitted during the shop drawing review process.
- D. All nameplates shall be properly protected during painting.

3.5 Inspection and Testing

A. Factory Hydrostatic Testing - NOT USED

B. General

- 1. The Engineer and Owner shall have the right to inspect and test all materials or equipment to be furnished under these Specifications prior to their shipment from the point of manufacture.
- 2. The Engineer and Owner shall be notified, in writing, five (5) calendar days prior to initial shipment to make arrangements for inspection.
- 3. Operation and Maintenance Manuals shall be provided in accordance with Section 01730, "Operation and Maintenance Data".
- 4. A factory representative of all major component manufacturers, who has complete knowledge of proper operation and maintenance, shall be provided for two (2) eight hour days to inspect, certify, calibrate, start-up, and optimize the pumping systems and provide operation and maintenance training to representatives of the Owner and the Engineer in accordance with the requirements of Article 1.09, "Manufacturer's Services". The factory representative shall provide, in addition to the previously described services, complete instructions to the operating and maintenance personnel. The instructions given shall be based upon the operating and maintenance manual. The Contractor shall make a high-definition recording of the training session and provide two (2) copies to the Engineer for distribution.
- 5. The Contractor shall advise the Engineer not less than one (1) week in advance of each trip.
- 6. A written report covering the technician's findings and installation approval shall be submitted to the Engineer prior to placing the system in operation. The installation and testing inspection report shall cover inspections performed, outline in detail any deficiencies noted, and outline in detail corrective measures taken. The technician shall remain on the Project Site until all deficiencies are corrected, or shall make as many additional trips as required to ensure that the installation is proper, in accordance with the Contract Documents, and acceptable to the Owner and

Engineer.

- 7. A written report covering the pumping system start-up shall be submitted to the Engineer not more than two (2) weeks after start-up procedures, outlining in detail any discrepancies, deficiencies, or failures occurring during start-up, and outlining in detail corrective measures taken or to be taken. The technician shall remain on the Project Site until the pumping systems equipment are operating properly, in accordance with the Contract Documents, or shall make as many additional trips as required until the system is operating properly.
- 8. Field tests shall not be conducted until the entire installation is complete and ready for testing.

C. Pumps and Motors

- After all pumps and pumping systems have been completely installed and are properly working under the direction of the manufacturer, conduct in the presence of the Engineer and Owner, all tests necessary to indicate that pumping operations conform to these Specifications.
- 2. Field tests shall include all pumping systems described under this Section. The Owner shall supply all water, wastewater, sludge and biosolids required to complete the field tests.
- The supplier shall check all motors for correct clearances and alignment and for correct lubrication in accordance with the manufacturer's instructions. The supplier shall check the direction of rotation of all motors and reverse connections, if necessary.
- 4. Bump the motor(s) to ensure that the motor has been connected for proper rotation.
- 5. With the Owner and Engineer present, the Contractor shall megger each motor winding before energizing the motor and, if insulation resistance is found to be low, shall notify the Supplier and shall not energize the motor. Thereafter, the motor shall be replaced with a new motor that meets these Specifications.
- 6. Operate each pump one at a time. Manually adjust the speed of each pump (one at a time) via the respective speed control unit such that each pump output is 10%, 20%, 30%, 40%, 50%, 60%, 80%, 90% and 100% of the maximum capacity specified. The duration of each flow rate shall be at least one (1) hour.
- 7. Assure that in the automatic mode each pump responds to its control signal(s). Assure that each pump operates at a steady rate (±5% of the set point) at each given level/rate for 10%, 20%, 30%, 40%, 50%, 60%, 80%, 90% and 100% of the maximum capacity specified.
- 8. Demonstrate that the pumping systems, units, motors and control system meet the requirements of the specifications and the following:

- a. That the pumping systems can deliver the specified pressure and discharge rate at the rated efficiency.
- b. The pumping systems and units operate as specified without excessive noise, cavitation, vibration and without overheating of the bearings.
- c. All automatic and manual controls function in accordance with the specified requirements.
- d. All drive equipment operates without being overloaded.
- 9. Measure the motor amperage. Assure that each pump operates without exceeding the motor nameplate rating.
- 10. Verify that the pump speeds can be altered over the specified range by use of the VFD on the pumping systems.
- 11. Operate each pumping system for thirty (30) consecutive days, during which time no repairs or adjustments shall be required. Repair or replace defective equipment as required; however, the test shall start anew. Demonstrate that the pumps turn "on" and "off" in response to their automatic sequencing and control system and these specifications.
- D. If the pumping systems performance do not meet the specifications, corrective measures shall be taken by the Contractor, or the pumping system shall be removed and replaced with a pumping system that satisfies the conditions specified, at no additional cost to the Owner.

END OF SECTION

SECTION 11340

CHEMICAL METERING PUMPS AND ACCESSORIES

1. GENERAL

1.01 Scope of Work

A. This Section covers the furnishing of a skid-mounted chemical metering/pumping system for the following application(s) at the Flagler Beach WWTF as specified under this Section and as shown on the Contract Drawings:

Skid No.	No. Of Pumps	Description
1	2	De-chlorination of the effluent intended for surface water discharge using bulk sodium bisulfite.

- B. The skid fabricator's Work includes furnishing all equipment and related services and systems, and providing labor, materials, and appurtenances to properly place all equipment, chemical metering pumps, drive motors, all piping, valves, etc. into service, including interface, coordination, installation, instrumentation and controls, start-up, testing, calibration, operating, training, troubleshooting and warranty repair. The skid manufacturing, mounting of the pumps, mounting of the accessories and service shall be supplied by Guardian Equipment, Inc., no equal.
- C. These specifications provide a general description of the requirements of each chemical feed system, but do not cover all details which will vary according to the details of each individual application. Each Chemical Feed System shall be provided as a complete system and shall include all the necessary components and accessories required to form a system which is practical and functional in its operation, appropriate from the point of view of generally accepted safety standards, correctly designed for the type of chemical used, well ordered and complete in every way.

D. Related Work Specified Elsewhere

1. General and Supplementary Conditions: County Contract Documents

2. General and Project Requirements: Division 1

3. Double Wall Chemical Storage Tanks (HDLPE): Section 06702

4. Polyvinyl Chloride (PVC) Pipe and Fittings: Section 15065

Valves and Appurtenances: Section 15100
 Pipe Hangers and Supports: Section 15125
 Instrumentation and Control Systems: Division 13
 Mechanical: Division 15
 Electrical: Division 16

1.2 Description of Work

- A. The Project Work includes furnishing, installing, and testing sodium bisulfite chemical metering systems consisting of chemical metering pumps, drive motors, pumping system skids, chemical piping, valves, appurtenances, digital control interfaces, flow control components, pump controls and instrumentation, chemicals, and all associated work to make complete and fully operational the chemical feed systems as follows:
 - 1. Skid No. 1 (Duplex): De-chlorination of the surface discharged effluent
 - a. For the application of bulk sodium bisulfite to the effluent De-chlorination Basin for effluent intended for surface water discharge.
 - b. A duplex sodium bisulfite skid-mounted chemical pumping system shall be provided and shall include two (2) chemical feed pumps (1 duty, 1 standby), motors, controls, piping, valving, appurtenances for the addition of sodium bisulfite furnished on a non-corrosive skid system with a drip lip.
 - c. Skid No. 1 shall be an "**automatically**" controlled pumping system, flow paced with the effluent discharge meter and include a manual override.
 - d. The chemical feed pumping skid shall be located along the south wall of the adjacent dewatering facility. The chemical feed pumping skid shall pull sodium bisulfite from the bulk storage tank co-located within the dewatering facility.
- B. All chemical metering pumping systems are to be supplied by a single manufacturer with the responsibility for:
 - Designing and providing the appropriate piping, valving, pressure relief valves, antisiphoning systems, wiring, controls, instrumentation and all appurtenances necessary to ensure an efficient and fully operational and functional pumping system.
 - 2. Providing construction oversight and final certification.
- C. The manufacturer shall review the chemical feed systems, chemical(s) being applied, hydraulic and head conditions, suction and discharge conditions, chemical storage tank

elevations, control systems and controls, application points and **ensure and certify that the appropriate chemical feed system** (pump size, discharge pressure, materials, piping, valving, pressure relief valves, anti-siphoning systems, etc.) **is supplied and will function as required**.

1.3 Quality Assurance

- A. All work under this specification shall be the responsibility of the Contractor.
- B. The products of this section shall be provided by a single supplier who shall demonstrate previous experience in the manufacturer of skid-mounted chemical metering systems. The manufacturer must have a service center with trained technicians authorized to make repairs to all components of the chemical feed system. This supplier shall be responsible for providing all equipment, accessories, spare parts, documentation and installation supervision required for a complete and operational chemical feed system. *All equipment shall be "new" and "unused"*.
- C. The manufacturer shall *supply five (5) separate references*, with contact names and phone numbers, where substantially similar installations for the chemical and equipment as specified have been in *satisfactory operation for a minimum of two (2) years.*
- D. The pump skids shall be a regularly marketed product of the manufacturer who must have a physical plant, technical and design staff, and production personnel to complete the work as specified. Systems assembled by second party fabricators, integrators or contractors shall not be acceptable. The chemical metering skids shall be assembled and tested by the manufacturer prior to delivery.
- E. The products of this section shall be manufactured by Guardian Equipment, Inc. or approved equal.

1.4 Chemicals to be Delivered

A. The following chemicals and volumes shall be delivered and installed in each of the chemical storage tanks to be provided as part of this Project:

Chemical	Volume (gallons)	Storage Tank Location
Sodium Bisulfite	500	Dewatering Facility
(NaHSO3)		Sodium Bisulfite Chemical Storage Tank

B. The Contractor shall be responsible for receipt, protection and storage in accordance with manufacturer's recommendations of all items shipped to the site from the time of delivery until installation is completed and the units and equipment are ready for operation.

- C. All materials and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- D. Each box, crate or package shall be properly marked to show its net weight in addition to its contents.
- E. All instrumentation equipment and appurtenances shall be stored in a clean, dry weathertight building or enclosure.
- F. **Deliver equipment to the job site at the appropriate time for installation**. Exercise care to prevent damage from handling. Delivery, storage and handling shall comply with Section 01600, "Materials and Equipment".
- G. Store mechanical and electrical components off of the ground in weathertight enclosures and keep dry at all times.

1.5 Submittals

- A. The Contractor shall submit all shop drawings for the equipment and appurtenances, identified herein in accordance with Section 01300, "Shop Drawings, Submittals and Samples", for approval by the Engineer prior to ordering any material or commencing any work operations.
- B. Submit operation and maintenance data as specified in Section 01730, "Operation and Maintenance Data". Submit the equipment supplier's certificate that the installation is in accordance with suppliers recommendations.
- C. Submit data on the characteristics and performance of the pumps which show that they meet the specified requirements. Data shall include the following items at a minimum:
 - 1. Manufacturer's literature and illustrations.
 - 2. Specifications and engineering data including dimensions, materials, size, weight, performance data, required net inlet pressure, flow rate, motor hp and speed.
 - Certified performance curves based on actual shop tests of similar units showing pump characteristics of capacity, head, power, and metering accuracy. Curves shall be plotted of the full permissible operating range of the pumps.
 - 4. Submit *performance affidavits* from the manufacturer certifying to the Contractor and Owner jointly that the equipment meets in every way the required performance.
- D. Submit information on the high pressure injection quill system for application of each chemical at the delivery point(s).

- E. A list of the manufacturer's recommended spare parts to be supplied, with the manufacturer's part number (SKU #) and current price for each item. See Article 1.10 of this specification section.
- F. Detailed layout and dimensional drawings of each proposed chemical metering skid showing plan and profile views. Exact dimensions of construction shall be identified. Equipment and part specifications shall also be included.
- G. **Detailed information, drawings, cut-sheets, etc.** on all components, including, but not limited to the following:
 - 1. Motor specifications.
 - 2. Calibration columns.
 - 3. Valves and strainers.
 - 4. Pressure gauges and guards.
 - 5. High pressure injection quills/diffusers and accessories.
 - 6. Cables and wiring.
 - 7. Flow through assemblies.
 - 8. Piping.
 - 9. Coatings.

1.6 Operation and Maintenance Data

- A. O&M Manuals shall be furnished for this Project in accordance with Section 01730, "Operation and Maintenance Data" and shall be submitted in accordance with Section 01300, "Shop Drawings, Submittals and Samples".
- B. The O&M Manuals shall be prepared specifically for this installation and shall include all detailed operating and maintenance instructions and specifications relative to the assembly, alignment, checking, lubrication, placing in operation, adjustment, and maintenance of equipment and auxiliaries furnished under this Contract, together with its complete parts lists therefore, and copies of shop drawings, certified dimensions drawings and design calculations, required cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.
- C. All such material shall be in addition to any instructions or parts lists packaged with or attached to the equipment when delivered.
- D. The "final" O&M Manuals shall contain *plastic laminated pull-out lubrication and maintenance cards* detailing all lubrication points, lubricant type, and frequency of lubrications and all additional required maintenance and frequency intervals.

E. SCADA System O&M Manuals

- 1. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the Process Contractor for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF and JPEG formats, no exceptions.
- 2. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "online" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the SCADA System at the Flagler Beach WWTF.

1.7 Documentation and Training

- A. The Chemical Feed System Supplier shall provide full documentation for all hardware, components, and equipment, including complete manuals for installation, operation, calibration, troubleshooting. *All documentation shall be neatly organized, readable and complete*.
- B. Complete hardware installation, operation, maintenance and troubleshooting manuals shall be provided in accordance with Section 01730, "Operation and Maintenance Data".
- C. Operation and maintenance manuals shall be prepared specifically for this **Project**, and shall include all required cut sheets, drawings, equipment lists, descriptions, safety requirements, special handling practices, etc., which are required to instruct operators and maintenance personnel on the proper operation and maintenance of these systems.
- D. A factory representative of the chemical feed system manufacturer, who has complete knowledge of the proper operation and maintenance requirements for that specific chemical feed system, shall be provided for four (4) hours to instruct representatives of the Owner and the Engineer on proper operation and maintenance of each system. Training shall be organized, well structured and executed, so that the treatment facility staff is well qualified and confident to operate these systems. This four (4) hour training allowance is in addition to the four (4) hours required for system start-up.
- E. If there are difficulties in the operation of the equipment, due to the inadequate level of training or the manufacturer's design or fabrication, additional training and/or services shall be provided to resolve the difficulties, *at no additional cost to the Owner*.
- F. Training sessions shall be scheduled at the convenience of the Owner, so that the appropriate personnel can be available. *All training shall be video-taped, in HD*

(1080p), by the Contractor and BD/DVD's shall be turned over to the Engineer for future use.

1.8 Tools and Spare Parts

A. **All special tools required** for normal operation, adjustment, or maintenance of the equipment shall be **furnished with the equipment by the manufacturer**.

B. Spare Parts

- 1. As a minimum the following spare parts shall be furnished for each chemical feed system:
 - a. Sufficient inventory of lubricants to provide two (2) complete changes of oil or other required lubrication, as indicated in the manufacturer's recommendations.
 - b. One (1) maintenance kit for each chemical metering pump, to include, but is not limited to a diaphragm, check valve seats, gaskets and O-rings.
 - c. One (1) spare valve, of each type, that is installed on each chemical feed skid.
 - d. One (1) spare gauge, of each type, that is installed on each chemical feed skid.
 - e. Parts list for all serviceable parts including SKU number and cost of each item.
- C. The chemical feed system manufacturer shall *provide one* (1) *spare feed pump and motor of each size* (complete) for the each pumping application.
- D. The manufacturer shall provide a recommendation and <u>supply all parts and</u> <u>accessories expected to be required for normal operation for the first two (2) years of operation</u>, in addition to the spare parts outlined in Article 1.10(B).
- E. All tools and spare parts shall be furnished in containers clearly marked with indelible markings as to their contents. This inventory shall be provided in a manner that is well ordered and complete.

1.9 Start-up Services

- A. The Contractor shall furnish the services of a factory-trained service engineer for startup of each system.
- B. The minimum required time to be provided as part of this Contract is eight (8) hours.
- C. A factory representative of the chemical feed system manufacturer, who has complete knowledge of the proper operation and maintenance requirements for the chemical feed systems, shall be provided as required in Section 1.09(D) of this Section.
- D. Start-up shall include confirmation that the equipment has been installed in accordance with the requirements recommended by the manufacturer, testing, coordination with the System Integrator, installation certification, and start-up report.

E. The Contractor is referred to Section 01600, "Materials and Equipment" and Section 01650, "Systems Start-Up and Demonstration".

1.10 Warranty

- A. The Contractor shall obtain a *manufacturer's two (2) year warranty* from the chemical feed systems manufacturer and furnish it to the Owner in accordance with Section 01740, "Warranties and Bonds". *The guarantee period shall commence from the date of Final Project Acceptance by the Owner*.
- B. The guarantee shall cover all necessary labor, equipment and replacement parts resulting from faulty or inadequate equipment, improper assembly or erection, defective workmanship and materials, leakage, breakage or other failure of all equipment and components furnished by the manufacturer. The Owner shall incur no labor or equipment cost associated with work under warranty during the guarantee period.

2. PRODUCTS

2.1 General

A. Manufacture, install, test and certify sodium bisulfite chemical feed systems, including metering pumps, drive motors, controls and instrumentation, piping, valves, cabling, chemical feed skid and appurtenances as indicated on the Contract Drawings and specified herein at the Flagler Beach Wastewater Treatment Facility Sludge Management System Improvements.

2.2 Chemical Feed Metering Systems

A. <u>Basis for Design: Sodium Bisulfite (NaHSO3) Addition to Effluent for De-Chlorination</u>

1. Skid No. 1 (Duplex)

Parameter	Value	
No. of Pumps	2 (One duty, one stand-by)
No. of Skids		1
Chemical Service	40% Sodium Bisulfite Solution	
Minimum Capacity (US gallons per hour)	2	
Maximum Capacity (US gallons per hour)	100	50:1 turndown capability
Rated maximum discharge pressure (psig)		100 psi

Standard Motor Capacity	< 1 hp
Motor Speed (rpm)	< 1,800
Controls	Manual Control
Pump Head, Diaphragm and Valve Ball Material	Manufacturer selection based on chemical

B. As indicated in Section 1.10(C), the chemical feed system manufacturer shall provide one (1) spare feed pump and motor of each size (complete) for each pumping application.

2.3 Chemical Metering Pumps

- A. The pumps shall be Simplex positive displacement mechanical actuated diaphragm spring return metering pumps. Pumps are controlled-volume reciprocating pumps that utilize a crank gear driven by an electric motor and an integral, oil-splash-lubricated, endless screw/wormwheel reduction gear to control the strokes per minute of the diaphragm to displace a measured quantity of chemical through the metering head. Materials of construction shall be suitable for the intended chemical use. Pump shall be ± 2% accuracy within 10 100% of the nominal flow rate."
- B. The gearbox shall be cast aluminum black anodized completely with external powder coating. Gearbox shall have an easy to service oil lubrication system including a fill port with removable cap on top of the pump, oil level site glass on the side of the pump and oil drain with removable cap on the bottom of the pump.
- C. The metering pump shall not create gas in the chemical pumped nor require a degasifying system in order to operate reliably.
- D. The diaphragm shall be completely flat without any protrusions into the process chemical and shall be removed and replaced in the pump for service by hand on a threaded connection to the actuation slide piston. The diaphragm shall be a multilayered, Teflon coated, nylon reinforced rubber diaphragm bonded to a metallic disc surrounded by a PVC support ring."
- E. Single ball check valves shall be provided on pump suction and discharge ports and shall be removable by hand without disconnecting any process piping.
- F. The stroke shall be manually adjustable from 0 to 100 percent flow capacity while the pump is operating. The stroke adjuster mechanism shall be repeatable within ± 1% accuracy over a 10:1 range for stroke length and over a 5:1 range for stroke speed. Pump linearity shall be within two percent (2%). Stroke adjuster shall incorporate integral self-locking ratchet mechanism.
- G. Motor frame size on pump shall accommodate 56C frame motors. Motor horsepower shall be as recommended by the pump manufacturer for the intended chemical use.

- H. Maximum speed of the chemical metering pumps shall be 103 strokes per minute. A VFD shall be supplied for each pump and shall be mounted on the skid and prewired to the motor. The drive shall be housed in a NEMA 4 enclosure and accept a 120 VAC single phase input to power the drive. The drive shall have a digital display of the speed and accept a 4-20 mA DC input.
- I. The chemical metering pumps shall be manufactured by TKM, as provided by Guardian Equipment, Inc.

2.4 Miscellaneous Items

- A. A relay shall be installed for fault indication.
- B. Other accessories required to ensure a complete, operational and fully functional system that meet the requirements and conditions for disinfection (sodium hypochlorite), chemical precipitation (alum) and denitrification (supplemental carbon). All appurtenances shall be protected or compatible with the process chemicals to be used.

C. SCADA Interface

- 1. The chemical feed, storage and pumping systems shall be integrated into the proposed Flagler Beach WWTF SCADA system.
- 2. The following conditions shall be monitored on each "automatically controlled" pumping system outputs:
 - a. Pump Run Status. 120VAC rated dry contact.
 - b. Pump Fail. 120VAC rated dry contact.
 - c. In Remote Status. 120VAC rated dry contact.
 - d. A 4 20 mA signal for pump speed reference.
- Pump (inputs) shall accept 120VAC rated dry contact input for start/stop from the SCADA system and an analog 4 - 20 mA signal for remote speed/stroke adjustment.

D. Appurtenances

- Any appurtenances shown on the Contract Drawing or which are otherwise necessary to establish a properly functioning chemical feed system shall be furnished and installed by the Contractor. All appurtenances shall be protected or compatible with the process chemicals.
- 2. Strainers, as required, shall be PVC Thermoplastic sediment strainers, approved for use with the chemical to be conveyed, by Hayward, or equal.

E. A UL listed NEMA 4X fiberglass reinforced local control panel shall be furnished and cantilevered mounted on the side of the chemical skid for all power and control interface wiring. Pumps or chemical piping will not be permitted above or below the local control panel. The local control panel shall be side mounted as shown on the electrical drawings for the required NEC clearances. All skid mounted devices shall be prewired to the local control panel. Shop drawings shall be submitted identifying all wiring furnished by the chemical skid supplier and all wiring to be provided by the Contractor.

2.5 Skid Mounted System

- A. The "skid mounted" chemical metering system shall be complete with the skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical, controls, instrumentation, accessories, as specified herein.
- B. The skid system shall be as designed and manufactured by chemical feed pump manufacturer. All vendors that require pre-approval are also required to supply a spare pump, motor and variable speed drive (VSD). Additionally, they shall also extend a five (5) year warranty for the equipment in lieu of the two (2) year warranty specified herein.
- C. The chemical metering skids shall be constructed from solid white rigid polypropylene sheet with a minimum thickness of ½-inch. The skid shall be self-supporting and all components of the chemical metering system shall be contained within the skid. Pump shelf, the entire width of the skid, shall be provided with supports under each pump and shall be 14" above grade. The skid shall have containment built into the base equal to twenty-five (25) gallons per pump and a drain valve to empty any spills. The containment basin should be sloped to one corner to allow for complete evacuation of liquid. A true union vented ball shall be provided on the outside of the skid to drain any liquid. The skids shall be manufactured using thermal welding technology, bolted construction is not acceptable.
- D. For each chemical metering pump the piping system shall include (1) pressure relief valve; (1) pulsation dampener; (1) diaphragm protected pressure gauge; (1) back pressure valve; (1) re-prime valve; (1) flushing inlet; (1) flushing outlet; and all required piping, valves, and supports to provide efficient and functional chemical delivery. Piping shall include isolation valves and unions for all serviceable components. The chemical supply piping shall allow for chemical inlets with a bulkhead fitting through the containment. Y-strainers shall be in the suction line outside of the skid. One calibration column shall be provided and designed for use with any of the metering pumps. The piping shall allow for the any of the pumps to remain in operation while any one pump or piping component on the pumping skid is isolated for maintenance or repair. The discharge piping shall allow for each pump to serve individual loads.
- E. All piping shall be Schedule 80 PVC bearing the NSF potable water logo with assembly performed in a controlled shop environment by the skid manufacturer. *All pipe shall be "squarely" cut on precision equipment with the ends chamfered*

and deburred. All socket-welded connections shall follow the guidelines set by the pipe/fitting manufacturer for proper cleaning, priming and gluing procedures. A heavy bodied solvent suitable for use with sodium bisulfite shall be used. All threaded connections will utilize Teflon tape, a suitable thread sealant or a combination of both. Threaded connections shall utilize Type 316 stainless steel reinforcement rings where applicable to reduce the risk of cracking.

- F. The piping shall be attached to the chemical metering skid with a non-metallic corrosion resistant support system. The straps shall be removable and reusable to allow for servicing of the system. All inlet/outlet connections, valves and pump accessories shall be clearly labeled on the skid.
- G. A power receptacle with weatherproof cover shall be provided for the metering pump power cords and shall be pre-wired to the terminal junction box.
- H. The chemical metering skids shall be completely assembled and tested by the manufacturer prior to delivery to the job site. Each skid shall be supplied with Type 316 Stainless Steel mounting tabs.
- I. All piping, valves, gaskets, supports, hardware, wiring, junction boxes, and accessories necessary for fully functioning skids.
- J. Piping shall be terminated within two (2) inches from the edge of the skid. Electrical cables shall terminate in the control panel.
- K. The skid shall be specially designed, constructed, and installed for the service intended and shall comply with the conditions identified within the Contract Documents. The chemical pump manufacturer/supplier shall submit compatibility data to confirm the materials used to construct the skid and compatibility with the chemical being fed.
- L. The chemical feed systems shall be completely assembled, mounted, calibrated, tested, and each delivered to the site on a single skid. Components to be mounted on the skid are as indicated herein and shall include the metering pumps, calibration column, piping valves, piping accessories (pulsation dampeners, strainers, etc.), and wiring integral to the skid. The chemical feed system supplier shall be responsible for providing all equipment, valves, and piping within the skid boundary.

M. Accessories

- 1. Lifting Lugs shall be supplied for all equipment weighing over one hundred (100) pounds.
- 2. An Equipment Identification Plate manufactured of sixteen (16) gauge Type 316 stainless steel with ¼-inch die-stamped equipment tag number securely shall be mounted in a readily visible location.
- 3. Anchor bolts shall be Type 316 stainless steel, ½-inch minimum diameter.
- 4. Calibration Columns

- a. A clear PVC calibration column shall be provided in the chemical supply piping.
- b. The piping shall be designed for the calibration column to be used with any of the metering pumps.
- c. The top of the calibration column shall be vented back to the chemical storage tank by the Contractor.

5. Pressure Relief Valves

a. Pressure relief valves shall be provided to eliminate excess pressure in the system. The pressure relief valves shall be fully adjustable with PVC bodies, Teflon diaphragm and shall have no metal parts in contact with the chemical.

6. Pulsation Dampeners

a. Gas charged pulsation dampeners shall be provided and sized for a minimum of 90% dampening. Pulsation dampeners shall be CPVC with a Sanaprene bladder and include gas charge fitting and pressure gauge. The dampeners shall be installed as close to the chemical metering pump discharge as possible. Pulsation dampeners shall be provided with an isolation valve.

7. <u>Diaphragm Protected Pressure Gauges</u>

- a. Pressure gauges of the diaphragm-protected type shall be provided for indication of system pressure. Industrial quality liquid filled, Type 316 Stainless Steel gauges shall be utilized and the isolators shall have CPVC housings with a Teflon diaphragm and suitable liquid fill.
- b. Pressure gauges shall be provided with isolation valves.

8. Back Pressure Valves

- a. Back pressure valves shall be provided to provide a constant back pressure at the chemical metering pump discharge.
- b. The back pressure valves shall be fully adjustable with PVC bodies, Teflon diaphragm and shall have no metal parts in contact with the chemical.

9. Piping and Valves

- All piping shall be solvent welded schedule 80 PVC and shall bear the NSF potable water logo.
- b. All valves and unions shall be Schedule 80 PVC with Viton O-rings. Valves shall be true union type and include built-in handle locking mechanisms. Ball valves for use with chemical prone to gassing shall be vented. Valves shall be Asahi vented true union, Type 21.
- c. Suction header piping shall be two (2) pipe sizes larger than the discharge piping and shall have a vent pipe inside the skid which will be piped back to the bulk chemical storage tank.

N. The chemical feed skids shall each have a blowoff that is vented into a pipe and conveyed to the appropriate bulk chemical storage tank.

3. EXECUTION

3.1 Installation of Chemical Feed Systems

A. The Contractor shall provide all labor, materials, equipment, and expertise required to carry out the installation, calibration, testing, operator training, and start-up of all equipment in a manner in keeping with the best standard practices available and in accordance with the manufacturer's recommendations for each piece of equipment supplied.

3.2 Equipment Calibration

- A. Every analog instrument, control or related device shall be properly calibrated, tuned, adjusted and commissioned so that the accuracy and operation of the device equals the highest level of performance which that device can achieve.
- B. Accurate and appropriate test equipment and industry standard test procedures shall be used to demonstrate that the equipment operates within it's expected tolerance of accuracy at various points throughout it's operating range.
- C. Whenever calibration adjustments are being made, the technician shall notify the members of the treatment facility staff, so that they may witness the procedure as an educational process. The technicians shall assist the Operator in any way possible in becoming well-versed in the start-up, operation, calibration, maintenance and calibration of the equipment provided. The technician shall be fully familiar, trained and qualified to service and support the items which are being serviced.

3.3 Calibration and Service Reports

A. A written, dated report shall be prepared by the chemical metering system supplier technician, for each chemical feed skid, for the start-up, calibration, troubleshooting or maintenance event which identifies the equipment serviced, defines procedures, describes the results of the testing, identifies witnesses, and

provides conclusions. This shall include every instrument or system provided in this Project, and shall also apply to every visit by equipment suppliers and system subcontractors. The report(s) shall also document every wiring modification, warranty repair and problem analysis.

B. All reports shall be distributed to the Engineer and Contractor in both a paper and PDF format. A copy of each report shall be kept in a permanent file "on-site" for future reference.

3.4 Coordination with the System Supplier

A. Work closely with the division 13 System Supplier to ensure the chemical feed systems are fully compatible with and monitored and controlled, as required, by the facility-wide SCADA system.

END OF SECTION

SECTION 11553

BIOSOLIDS DEWATERING SCREW PRESS

1. GENERAL

1.01 Description

- A. Furnish all labor, materials, equipment and incidentals required to install, place into operation, and field test one (1) triple drum biosolids volute dewatering (screw) press together with associated sludge conditioning tank, control panel, polymer system, flow meter, integration with the digested sludge transfer pump station pumps, and all appurtenances as specified in the Contract Documents and as required to meet the specified performance requirements and to provide a full and properly functioning sludge dewatering system.
- B. These specifications are intended to give a general description of what is required, but do not cover all details, which will vary in accordance with the requirements of the equipment offered. It is, however, intended to cover the furnishing, shop testing, delivery, complete installation, and field testing of all materials, equipment, and appurtenances for the complete installation of the biosolids volute dewatering (screw) press and all associated equipment and appurtenances.
- C. All components of the biosolids dewater screw press equipment shall be engineered for long, continuous, and uninterrupted service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts.
- D. All equipment furnished under this section shall be the responsibility of a single manufacturer, the Process Control Supplier (PCS), to fabricate or procure, integrate, factory test, and deliver to the project site. It shall be the responsibility of the PCS to coordinate all details and components required for a properly functioning system. All equipment shall be constructed of non-corrosive materials of the grade specified herein. The PCS shall coordinate the operation of the screw presses with the operation of the Sludge Transfer Pumping System.
- E. The PCS shall meet Division 13 specifications for Process Instrumentation and Controls System (PICS) requirements.
- F. The PCS shall coordinate with the System Supplier and Control System Engineer (CSE) throughout all development and implementation phases of the project.
- G. PLC/HMI Software and Hardware development shall be coordinated with the System

Supplier, CSE, Engineer and Owner for proper integration.

- H. The PCS shall provide a five (5) year parts and labor guarantee as specified herein.
- I. Related Work Specified Elsewhere
 - 1. Related work specified elsewhere includes

Title	Title
01300	Shop Drawings, Submittals and Samples
01430	Manufacturer's Services
01650	Systems Start-up and Demonstration
01720	Project Record Documents
01730	Operation and Maintenance Data
01740	Warranties and Bonds
11314	Progressive Cavity Sludge Pumps
13	Process Instrumentation and Control System - PICS
15	Mechanical
16	Electrical

1.2 System Description

- A. The biosolids dewatering system shall consist of one (1) triple drum screw volute dewatering (screw) press, and all associated equipment, and shall be designed to adequately condition and dewater the biosolids generated from the BNR Process so that the dewatered sludge cake that is produced easily discharges from the screw press dewatering unit, without blinding or plugging, into the dewatered cake conveyance pumping system for discharging into the collection container/dumpster.
- B. The biosolids screw press system 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. The dewatering screw press unit shall operate with no requirement for operator attention other than periodic inspection and chemical replenishment.
- C. The polymer system shall be capable of providing a continuous polymer solution for efficient polymer utilization.
- D. The volute dewatering screw press system shall be a *complete*, *prefabricated* system consisting, at a minimum, of the following components:
 - 1. One (1) triple drum volute dewatering screw press system.

- 2. A biosolids conditioning system consisting of two-stage flocculation tanks with a mixing tank with gear motor and mixing impeller to allow efficient mixing of polymer in the biosolids and a flocculation tank including gear motor and large cross-sectional area agitator.
- 3. Three (3) x 300 series "dewatering drums" including spray wash down system and gear drives per unit.
- 4. The support structure for the dewatering drums including filtrate collection pan and outlet plumbing. All required mounting holes and brackets will be in place, drilled and tapped.
- 5. A self-contained electrical and control panel including control for ancillary equipment such as feed pumps and solids conveying.

E. Appurtenances

- 1. Polymer dilution and dosing equipment and all ancillary items and appurtenances shall be provided as part of this Project.
- 2. Sludge influent magnetic flow meter.
- F. The one (1) triple drum volute dewatering screw press unit Model ES-303 shall be as manufactured by Process Water Technologies (PWTech), LLC, Rosedale, MD, or approved equal.
- G. The triple drum volute dewatering screw press shall be designed with a maximum capacity of 100 GPM (<1% solids) or 1050 dry pound per hour for thicker sludge (>3% solids). The dewatering screw press shall be designed for dewatering the sludge as generated by the BNR process.
- H. 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.

1.3 Quality Assurance

- A. Consideration will be given only to products of manufacturers who can demonstrate that their equipment fully complies with all requirements of the Contract Documents. Any changes to the specified equipment and Contract Drawings shall be brought to the attention of the Engineer no later than ten (10) calendar days prior to the Bid Date. The review, as well as any site changes shall be paid for by the Contractor.
- B. The latest version of all applicable standards for the fabrication, assembly, and installation of the systems shall apply.

- C. Each component and ancillary equipment item furnished under this specification shall be "new" and "unused", of the type, size, design, and efficiency installed on previous projects and the product of a single manufacturer.
- D. The Contractor and Volute Dewatering Screw Press manufacturer shall assume responsibility for the satisfactory installation and operation of the "entire" biosolids dewatering system, polymer feed system, controls, instrumentation and all associated equipment.
- E. The equipment shall be products of manufacturers who are fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.
- F. All components of the biosolids volute dewatering equipment shall be engineered for long, continuous, and uninterrupted service with minimal operator intervention. Provisions shall be made for easy maintenance, adjustment, or replacement of all parts.
- G. To ensure unity of responsibility, the biosolids dewatering screw press, supporting frames, polymer mixing and feeding blend unit, and control systems shall be furnished and coordinated by a single supplier. The Contractor shall assume full responsibility for the satisfactory installation and operation of the entire biosolids dewatering screw press system package.
- H. Prior to shipment, the volute dewatering screw press and control panel shall be factory tested at the place of assembly. Factory test each pre-assembled, pre-wired, volute dewatering press and its associated control panel to be supplied to the job site. Prior to shipment, verify through a one (1) hour continuous operating test that the volute dewatering screw press and associated equipment operate smoothly, noiselessly, vibration free, and without overheating of any bearing or motor.
- I. 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 one (1) weeks' notice prior to testing.
- J. The equipment shall be supplied by a firm which has been regularly engaged in the design, fabrication, assembly, testing, start-up and service of full-scale volute dewatering screw press systems and shall have at least ten (10) full-scale systems utilizing the exact technology proposed for this Project operating successfully for at least five (5) years in North America at municipal wastewater treatment plants that were furnished under the manufacturer's own name.

1.4 Patents

- A. The manufacturer shall warrant the use of his system and its equipment, in the process for which the system has been expressly designed, and that it will not infringe upon any U.S. or foreign patents or patents pending.
- B. In the event of any claim of infringement the manufacturer shall defend and indemnify the Owner and Engineer free from any liabilities associated with the use of the patented equipment or process.
- C. The manufacturer shall grant 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 sub-licenses.

1.5 Submittals

- A. Copies of all materials required to establish compliance with the Contract Documents shall be submitted in accordance with the provisions of Section 00700, "General Conditions, Section 00800, "Supplementary Conditions", Section 00805, "FDEP Supplementary Conditions", and Section 01300, "Shop Drawings, Submittals and Samples".
- B. Submittals shall include, at a minimum, the following:
 - Certified shop and erection drawings, showing all important details of construction dimensions, physical characteristics, dimensions, water and power connections, and anchor bolt locations. Show materials of construction by ASTM reference and grade. Identify all coatings to be applied and show the thicknesses of all plates, channels and panels.
 - 2. The manufacturer's installation instructions.
 - 3. Descriptive literature, bulletins, and/or catalog cut sheets of each item of equipment.
 - 4. The total weight of the equipment including the weight of the single largest item or component.
 - 5. A complete total bill of materials of all equipment.
 - 6. Structural calculations demonstrating compliance with the structural frame design specifications. All calculations shall be verified by a stamp of a Professional Engineer in the State of equipment manufacture.

- 7. Details of the polymer feed/flocculation system.
- 8. Elevation of the local control panel and operator control station showing panel mounted devices. Provide details of power distribution and full load current draw of the panel. Provide a list of all terminations required to receive inputs or transmit inputs from the local control panel.
- 9. A list of manufacturer's recommended spare parts to be supplied in addition to those specified in Article 1.08 with the manufacturer's SKU number and current price for each item.
- 10. Manufacturer's warranties and guarantees for all equipment.
- 11. Separate AWS certificates (certification required within the last year) for all fabrication shop and field welders performing welds on the equipment.
- 12. Complete motor and gear reducer data to be provided with the volute dewatering screw press system package.
- 13. List of ten (10) reference installations with location, size, contact person, and phone number for each reference.
- 14. Manufacturer's recommended procedures for jobsite storage and handling of equipment.
- 15. Material certification sheets.
- 16. The required summer and winter grades of lubricants shall be specified together with alternative references to equal products of other manufacturers.
- 17. Statement verifying that the structural design by the Engineer, for support of the volute dewatering screw press unit, is satisfactory and will support the unit over its design period.
- 18. Performance data and operating experience for the volute dewatering screw press system indicating the equipment proposed for this Project will comply with the specified dewatering requirements.
- 19. Operation and maintenance data as specified in Section 01730, "Operation and Maintenance Data".
- 20. Complete control schematic diagrams and schematics of all power and control systems showing wiring requirements between the system and connection to work of other sections.
- 21. Complete electrical drawings showing wiring, controls, interlocks, terminals and disconnects. Label each terminal, showing which control or electrical power wire connects to each terminal.

- 22. Complete details of electrical components including enclosures and machinemounted components.
- 23. Complete details of control strategy and programming approach, including P&ID and process control testing procedure.
- 24. A manufacturer's certification that the volute dewatering screw press system and all associated equipment, components and ancillaries conform to the requirements specified herein for this Project, and are capable of operating within the parameters stated in this specification section and ensures a complete and functional system.

C. Submittals for Supervisory Control and Data Acquisition (SCADA) System

1. Instrumentation and Controls submittals shall include, at a minimum, the following, each of which is further defined in Division 13

Information	Specification Section
System Integration Plan - SIP	13300
Other System submittals	13300
Field Instrumentation	13310
Control Panels	13315
PLC Hardware	13325
Application Programming Description	13326
Fiber Optic	13360

D. In the event that it is impossible to conform to certain details of the specifications, due to different manufacturing techniques, describe all non-conforming aspects.

1.6 Conditions of Service and Performance Requirements

A. Conditions of Service

- 1. The volute dewatering screw press equipment shall be designed to adequately condition and dewater the biosolids so that a dewatered Class "B" cake is produced that easily discharges from the unit without blinding or plugging, into the dewatered cake screw conveyance system for discharge into a container/dumpster.
- 2. The biosolids volute dewatering screw press unit(s) 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 biosolids beyond the nominal machine envelope.

3. The description of the sludge to be fed to the volute dewatering screw press system is as follows:

Parameter	Value
Type of Biosolids to be Dewatered	Class "B"
Digestion System	Extended Aeration
Feed Solids (% dry solids)	0.6 – 2.0%
рН	6.0 – 8.0
Volatile Suspended Solids Content	25 – 30%

B. Project Performance Requirements

1. The volute dewatering screw press unit shall be capable of meeting the following minimum performance criteria provided the above conditions of service are furnished:

Performance Parameters	Value
Biosolids Throughput - feed solids of 1.6% or greater (lb dry solids/hr/unit)	540
Hydraulic Capacity/unit - feed solids of 1% or less (gpm)	80
Power Use (hp)	3.9
Washwater Use	16 gpm (intermittent) 48 gph (total)
Neat Polymer Metering Pump Capacity (gph)	5
Dilution Water (gph) Minimum	60 - 600
Performance Requirements	Value
Dewatered Sludge Concentration (% dry solids), minimum	16
Minimum Solids Capture (%)	90

C. Performance Testing

- 1. Perform preliminary testing in order to select a liquid polymer that provides the best performance. Test a minimum of five (5) liquid polymers prior to selection. *Dry polymer systems will not be acceptable.*
- 2. Perform a complete start-up and shut-down of the volute dewatering screw press system using both local and SCADA control systems. Verify every component start and stop selector functions properly.
- 3. Verify the input and output signals to and from the control panel are transmitted and received.
- 4. The Performance Tests shall consist of two (2) tests, of each dewatering unit, that shall last eight (8) hours each, during which no repairs or adjustments shall be allowed. Assure that all interconnects function properly. Test each function specified herein ("Controls") and verify that each function is performed. Test interlocks and verify that each interlock functions.
- 5. Feed sludge to the unit shall contain 0.6 2% dry solids, by weight. Demonstrate that the volute dewatering screw press units can produce a biosolids cake with at least 16% dry solids, by weight.
- 6. During the Performance Tests, the Manufacturer and Owner shall measure the solids concentration in the dewatered biosolids and filtrate. One biosolids sample and one filtrate sample shall be collected each hour of the test and split for the following testing:
 - a. One of the split biosolids samples shall be tested for dry solids content.
 - b. One of the split filtrate samples shall be tested for dry solids content.
 - c. Dewatered biosolids collected shall be composited for each eight (8) hour shift.
 - d. Filtrate samples shall be collected composited for each eight (8) hour shift.

The average of the composited biosolids samples shall ensure that the dewatered solids concentration exceeds the Performance Test requirement. The average of the composited filtrate samples shall ensure that the solids capture rate exceeds the Performance Test requirement.

- 7. Sampling and analysis shall be performed by an independent laboratory, approved by the Engineer and Owner. This cost shall be included in the Contractor's Bid.
- 8. If the volute dewatering screw press unit fails to meet the specified Project Performance Requirements (Article 1.06(B)(1)), the Contractor and manufacturer

shall make adjustments or replace the unit as necessary. Two additional eight (8) hour Project Performance Tests shall then be carried out after adjustments have been made. If the volute dewatering screw press units fail these additional tests, the Contractor shall replace the volute dewatering screw press unit(s) with equipment that meets the Project Performance Requirements. *All modifications or replacement shall be at no cost to the Owner*.

9. The equipment manufacturer shall guarantee the above performance criteria, backed by a performance bond in the full amount of the equipment price, presented with the submission of engineering submittals. The manufacturer shall be allowed two (2) opportunities to demonstrate compliance with the performance criteria. Should the equipment fail to meet the performance criteria after the second test, the manufacturer shall forfeit the bond or irrevocable letter of credit and remove the equipment.

1.7 Manufacturer's Services

A. Mechanical Start-Up Services

1. Provide two (2) eight-hour days of mechanical start-up services and system optimization to the Owner and Engineer on the day of system/equipment start-up and online operation.

B. Polymer Selection and Optimization Services

- A factory representative who has complete knowledge of proper operation and polymer selection/optimization shall be provided for one (1) eight-hour day of polymer selection/optimization associated with the new volute dewatering screw press units.
- 2. The selected polymer shall maximize the dry solids content of the biosolids cake and minimize the dry solids content of the filtrate.

C. Operation and Maintenance Training

- A factory representative who has complete knowledge of proper operation and maintenance shall be provided for one (1) eight-hour day of O&M training to the Owner and Engineer prior to the initial start-up of the respective system/equipment
- 2. O&M Manuals shall be submitted and approved at least thirty (30) days prior to the training session in accordance with Section 01300, "Shop Drawings, Submittals and Samples" and Section 01730, "Operation and Maintenance Data".

D. Project Performance Testing

- A factory representative who has complete knowledge of proper operation and maintenance and system optimization shall be provided for a minimum of two (2) eight-hour days to perform the Project Performance Tests identified in Article 1.06© of this specification section.
- 2) If there are difficulties in the operation and optimization of the equipment due to the manufacturer's design or fabrication, additional manufacturer services and modifications to the volute dewatering screw press unit(s) shall be provided at no additional cost to the Owner.

1.8 Special Tools and Spare Parts

- A. Furnish one (1) complete set of all special tools, including lubricating devices, required for normal operation, adjustment and maintenance of the equipment supplied. All such tools shall be furnished with a heavy duty, thermoplastic tool chest complete with a padlock and duplicate keys.
- B. Furnish all required lubricants required for operation and maintenance of the volute dewatering screw press units for a period of one (1) year as specified in Section 01600, "Materials and Equipment".
- C. The manufacturer shall recommend and supply all spare parts for the volute dewatering screw press units to assure normal running and maintenance for a period of one (1) year, from the date of Final Project Acceptance by the Owner. At a minimum, the following spare parts shall be provided: (1) two (2) wash water solenoid valves; and (2) one (1) full set of spray nozzles for each dewatering unit.
- D. Spare parts shall be furnished in containers properly labeled and identified with indelible markings as to their contents. Each container shall be suitably protected for long-term indoor storage.
- E. Replacement parts required for normal operation, other than routine maintenance items, shall be provided by the manufacturer to assure uninterrupted operation of the volute dewatering screw press units.

1.9 Operation and Maintenance Manuals and Instructions

A. O&M Manuals shall be furnished for this Project in accordance with Section 01730, "Operation and Maintenance Data" and shall be submitted in accordance with Section 01300, "Shop Drawings, Submittals and Samples".

- B. The O&M Manuals shall be *prepared specifically for this installation* and shall include all detailed operating and maintenance instructions and specifications relative to the assembly, alignment, checking, lubrication, placing in operation, adjustment, and maintenance of equipment and auxiliaries furnished under this Contract, together with its complete parts lists therefore, and copies of shop drawings, certified dimensions drawings and design calculations, required cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.
- C. All such material shall be in addition to any instructions or parts lists packaged with or attached to the equipment when delivered.
- D. The "final" O&M Manuals shall contain "plastic laminated pull-out lubrication and maintenance cards" detailing all lubrication points, lubricant type, and frequency of lubrications and all additional required maintenance and frequency intervals.
- E. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Supplier for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (System Integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF and JPEG formats, no exceptions.
- F. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "on-line" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the SCADA/PICS System at the treatment facility.

1.10 Product Delivery, Storage and Handling

- A. The volute dewatering screw press and all ancillary equipment shall be factory assembled and tested, and shall be delivered to the site for installation.
- B. All equipment and parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay form the time of shipment until installation is completed and the units and equipment are ready for operation.
- C. The Contractor shall store and temporarily support the equipment prior to installation in strict accordance with the manufacturer's recommendations and instructions. Protect

- all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested and finally accepted.
- D. Protect the equipment from being contaminated by dust, vibration and moisture. The equipment storage area shall be well ventilated to prevent excessive heat buildup.
- G. Exposed openings for connection to piping shall be properly plugged or protected by wooded planks, etc., strongly built and securely bolted to the flanged surfaces.
- H. The Contractor shall handle the equipment during delivery, storage and installation in a manner to prevent damage of any nature in accordance with the manufacturer's approved written instructions and in accordance with instructions given on-site by the manufacturer's representative. Each box, crate or package shall be properly marked to show its net and tare weight in addition to its contents.
- I. Store mechanical, electrical and instrumentation equipment, components and appurtenances off of the ground in weathertight enclosures and keep dry at all times.
- J. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- K. Deliver equipment to the job site at the appropriate time for installation. Exercise care to prevent damage from handling. Delivery, storage and handling shall comply with Section 01600, "Materials and Equipment".

1.11 Warranty

- A. The equipment shall be warranted, in writing, to be free from defects in workmanship, design and materials for a period of two (2) years from the date of Final Project Acceptance by the Owner.
- B. The process equipment supplier shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship.
- C. If any part of the equipment should fail during the warranty period, it shall be replaced at no additional cost to the Owner. The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.
- D. The equipment manufacturers shall each provide the Owner with an annual preventive maintenance contract (renewable) for his consideration prior to Final Project Acceptance. *This cost shall not* be included in the Bid Amount.

- E. Refer to the General Conditions and Section 01740, "Warranties and Bonds" for additional guarantee and warranty requirements.
- F. This warranty is in addition to any other warranty required by the Contract Documents.

1.12 Polymer Selection and Optimization Services

- A. The volute dewatering screw press system manufacturer shall provide the services of an independent polymer consultant once the equipment has been tested and placed into operation. The polymer consultant and screw press manufacturer shall be responsible for selecting and optimizing the appropriate liquid polymer specific to the Owner's Class "B" biosolids product. The polymer consultant and screw press manufacturer shall coordinate all testing activities with the Contractor and shall work directly with the Owner's personnel during the performance testing period. The polymer consultant and screw press manufacturer shall test a minimum of five (5) liquid polymers prior to selection.
- B. Once a polymer has been selected, the Contractor shall be responsible for providing the first six (6) months supply of liquid polymer. *All polymer costs associated during Performance Testing and for a period of six (6) months thereafter shall be borne by the General Contractor*.
- C. Following liquid polymer screening and selection, the independent polymer consultant and screw press system manufacturer shall submit three (3) copies of submit a complete report to the Engineer offering a complete assessment and cost-effectiveness analysis as to the liquid polymer selected.

2.0 PRODUCTS

2.1 Materials and Coatings

- A. All materials used in the construction of the biosolids volute dewatering screw press system shall be of the best quality and entirely suitable in every respect for the service required. All stainless steel shall conform to the appropriate ASTM Standard Specifications. 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.
- B. No carbon steel will be used for any part of the screw press unit

- C. All electrical components shall be U.L. listed where such listing exists and all electrical control panels shall be assembled in U.L. approved facilities.
- D. All materials utilized in the construction of the biosolids volute dewatering screw press equipment shall be entirely suitable in every respect for the service required. All metals in contact with polyelectrolyte or biosolids, and all other metal components other than those specified in the table below shall be Type 304 or 316 stainless steel.

The following table indicates the materials and coatings that shall be provided for the volute dewatering screw press and related components unless specified otherwise herein:

ITEM	MATERIAL / COATING
Tanks	Type 304 Stainless Steel
Plumbing	Type 304 Stainless Steel
Dewatering Drums	Type 304 Stainless Steel
Dewatering Drum Screw	Type 304 Stainless Steel with Flame Coating 10Co-4Cr
Gear Motors	Die-Cast Aluminum and Type 304 Stainless Steel
Gear Motor Coating	Acrylic Paint
Spray Bars and Water	Type 304 Stainless Steel
Spray Nozzles	Polypropylene
Electrical Enclosure	NEMA 4X Type 304 Stainless Steel
Electrical Wiring Housing	Non-metallic flexible liquid-tight conduit and fittings
Frame/Skid Mounting	Type 304 Stainless Steel
Valves - Wetted Sections	Stainless Steel, EPDM seating

2.2 Structural Components

A. The structural support frame shall be fabricated of Type 304 stainless steel members conforming to the latest ASTM Standard Specifications for Structural Steel, Designation A36. It shall be a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection.

- B. The framework shall be of welded and/or bolted construction. All welding shall conform with the American Welding Society (AWS) Structural Welding Code.
- C. The structure shall be designed for installation on a prepared concrete foundation, suitable flat concrete slab, or fabricated platform and secured with anchor bolts.
- D. The construction shall allow easy access and visual inspection of all internal components.

2.3 Mixing and Flocculation Tanks

- A. Each biosolids volute dewatering screw press unit shall have an integrated two-stage mixing system comprising of a flash/rapid mix tank and flocculation tank, each with mixers and drive motors. Tank sizing and design shall ensure adequate residence times and mixing conditions to ensure complete flocculation and satisfactory dewatering performance. The tank design shall minimize the possibility of any short circuiting of flow.
- B. The design and manufacture of tanks and spill trays shall ensure that no leakage or spillage of fluids under normal working conditions.
- C. Mixing and flocculation tanks shall be manufactured from Type 304 stainless steel and shall be a minimum of 11 gauge (0.12-inch). Tanks and spill containment trays shall be fully welded internally and externally.

D. Mixing and Tank Drive Motors

- 1. The mixer and flocculation tank drive motors shall be a one piece gear motor. Gear motors shall be of the *hollow-shaft design* and be designed to drive the mixing impeller shafts with no additional couplings or joints.
- 2. Motors shall be filled with grease on assembly and sealed for life. Mixer rotational speed shall be obtained through a hypoid reduction gear.
- 3. The input power to the dewatering drum drive shall be supplied through an AC VFD unit allowing variable mixing energy to be input to the system.

4. Flash Mixing Drive Motor Data

Parameter	Value
Maximum Horsepower (hp)	0.5
Power Requirements	480 VAC, 3-phase, 60 Hz
No Load Motor Speed (rpm)	1720

Parameter	Value
Gear Reduction	10 :1
Output Shaft Speed	180 rpm at 60 Hz
Insulation Class	IP65
Enclosure	TEFC
Enclosure Material	Die Cast Aluminum
Service Factor	1.15

5. Flocculation Tank Drive Motor Data

Parameter	Value
Maximum Horsepower (hp)	2
Power Requirements	480 VAC, 3-phase, 60 Hz
No Load Motor Speed (rpm)	1760
Gear Reduction	60:1
Output Shaft Speed	30 rpm at 60 Hz
Insulation Class	IP65
Enclosure	TEFC
Enclosure Material	Die Cast Aluminum
Service Factor	1.15

E. The polymer mixing system shall be designed specifically for its intended use with the Class "B" biosolids to be generated at the treatment facility from the BNR Process.

2.4 Dewatering Drums

- A. The dewatering drums will be constructed of ASTM Type 304 Stainless Steel except for the rings in the thickening section of the drum that will be manufactured in a polycarbonate resin. All circular components will be laser cut to ensure maximum evenness of wear and therefore operating life.
- B. Assembly shall be undertaken in such a way that all fixed rings are concentric and parallel. All fixed rings shall be equally spaced apart for each section of the dewatering

- drum. When mounted on the retaining rods and installed, all moving rings shall move freely between the fixed rings.
- C. Each dewatering drum shall be equipped with individual spray bars. Each spray bar shall consist of a spray pipe fitted with spray nozzles, located above the dewatering drum. The spray pipe and spray nozzle assembly shall be readily removable. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another on the dewatering drum surface. The sprays shall operate periodically and shall remove solids built up externally on the drum such that over time no significant buildup of solids occurs on the drum.

D. Dewatering Drum Drive Motor

1. The mixer and flocculation tank drive motors shall be a one-piece gearmotor. Gearmotors shall be of the hollow-shaft design and be designed to drive the mixing impeller shafts with no additional couplings or joints. Motors shall be filled with grease on assembly and sealed for life. Mixer rotational speed shall be obtained through a hypoid reduction gear. The input power to the dewatering drum drive shall be supplied through an AC VFD unit allowing variable mixing energy to be input to the system.

2. Dewatering Drum Drive Motor Data

Parameter	Value
Maximum Horsepower (hp)	1
Power Requirements	480 VAC, 3-phase, 60 Hz
No Load Motor Speed (rpm)	1750
Gear Reduction	450:1
Output Shaft Speed	4 rpm at 60 Hz
Insulation Class	IP65
Enclosure	TEFC
Enclosure Material	Die Cast Aluminum
Service Factor	1.15

2.5 Liquid Polymer Blending System

A. Furnish one (1) Polymer Blending Unit (PBU) with progressive cavity pump, motors and controls, including all integral piping, valves, fitting, pipe supports, special equipment and appurtenances in accordance with these specifications, including all incidental work

necessary to make it complete, satisfactory and ready for operation.

B. The polymer dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1% to 1.0% concentration of emulsion polymers with active contents up to 75%.

C. Design Criteria

Parameter	Value
Polymer	Emulsion
Polymer Activity (percent active)	30 - 75
Polymer Concentration Range	0.1 - 1.0%
Neat Polymer Flow Range (gph)	0.25 - 5.0
Dilution Water Range (gph)	60 - 600

D. Quality Assurance

- 1. Prior to shipment the system shall be inspected for quality of construction verifying all fasteners and fittings are tight, all wires are secure and connections whisker-free.
- 2. The system shall be tested under pressure for a minimum of one (1) hour at 100 psi. If leaks are found they shall be fixed and a new test shall be conducted for one a. hour at 100 psi until the plumbing system is verified to be leak free.
- 3. The liquid polymer blending system equipment shall be shipped in a new, high quality completely enclosed weather proof wooden crate constructed of 2" x 4" studs and 3/8-inch thick ply wood. Access to the crate shall be by a front panel removable by lag bolts. A skid shall be constructed of 4" x 4" or two 2" x 4" each, allowing fork-lifting. The crate shall include a shock sensor to warn of equipment mishandling during shipment.
- 4. The equipment shall be warranted, in writing, to be free from defects in workmanship, design and materials for a period of two (2) years from the date of Final Project Acceptance by the Owner. The mixing chamber shall be warranted for the life of the system against failure for plugging for any reason.
- E. Provide a name plate securely affixed to the liquid polymer blending system unit providing the manufacturer's phone number, model number, serial number (minimum).

F. The following material requirements shall be strictly adhered to:

Parameter	Value
System Skid	Type 304 Stainless Steel
Hardware	Type 18-8 Stainless Steel
Piping and Pipe Fittings	Schedule 80 PVC
Tubing and Tube Fittings	Polyethylene, polypropylene, stainless steel and viton
Water Solenoid Valve	Brass
Pressure Gauges	Stainless Steel, liquid-filled
Pressure Switches	NEMA 4, brass connection
Flow Meter	Acrylic or stainless steel
Water Control Valve	Stainless Steel with Stainless Steel seat
Mixing Chamber Body/Flanges	Stainless Steel
Mixing Chamber Cover/Chamber	Clear polycarbonate
Impeller	Type 304 Stainless Steel
Impeller Shaft Seal	Viton, stainless steel, ceramic
Mixing Chamber Pressure Relief Valve	Stainless Steel
Metering Pump Wetted Parts	Stainless Steel and Viton
Seals	Ceramic or Teflon
Control Enclosure	FRP

G. Polymer Activation and Blending Chamber

 To provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, the system shall be a multistage, multi-zone, hydro-mechanical polymer activation and blending technology. The system shall be provided with both a non-mechanical and mechanical mixing stage:

a. Non-Mechanical Stage

- 1) To optimize reliability, the device shall be capable of activating and blending polymer based on plant water pressure alone at 30 psi or greater.
- 2) Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is no way diminished prior to polymer and water contact.
- 3) The non-mechanical zone shall be designed such that the velocity of the

mixing energy-producing water jet is maintained or increases as flow decreases.

b. Hydro-Mechanical Mixing Stage

- To provide optimal polymer performance under all operating conditions and to provide total control over mixing energy, in addition to the non-mechanical mixing stage the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer.
- 2) The mixing impeller shall be fully controllable and capable of inducing ultra high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller.
- 3) The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range.
- c. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.
- 2. To prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber. At no time shall there be low velocity within any portion of the mixing chamber.
- 3. The mixing impeller shall be controlled by an VFD motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.
- 4. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.
- Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement.

- 6. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.
- 7. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be ³/₁₆-inch without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

H. Dilution Water Assembly

- 1. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range as specified under section 2.5C herein. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.
- 2. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.
- 3. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 9 and 60 psi. Static working pressure, 500 psi. Proof pressure shall be 2000 psi minimum. The pressure switch shall be as manufactured by Ashcroft.
- 4. Provide a 2½-inch stainless steel, liquid-filled, pressure gauge to monitor the dilution water inlet pressure.

I. Progressive Cavity Neat Polymer Metering Pump

- 1. The unit shall have one (1) neat polymer metering pump integrally mounted on the systems skid. The metering pump(s) shall have a range as specified under section 2.5C herein. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be packing type, mechanical seals shall not be used. A 230/480 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 1750 RPM. The motor shall be controlled by an VFD motor controller located in the system control panel.
- Provide a calibration column with two (2) full-port PVC ball valves having Viton Orings. The column shall be calibrated for a one (1) minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly

mounted to the systems frame with a minimum of two heavy duty brackets.

- 3. A brass pressure relief on the discharge of the metering pump adjustable between 25 and 100 psi shall be provided.
- 4. A loss of polymer flow sensor shall be provided with the system.

B. Solution Discharge Assembly

1. Provide a 2½-inch stainless steel, liquid-filled, pressure gauge to monitor system discharge pressure.

C. Controls

- 1. A junction box integral to the systems frame shall be provided.
- 2. The enclosure shall be rated NEMA 4X and constructed of FRP.

D. System Skid

- 1. The system's frame shall be constructed of rugged Type 304 stainless steel.
- 2. All piping shall be rigidly supported.
- Under no circumstance shall the pump suction exceed 5-inches from the bottom of the skid for progressive cavity pumps and 12-inches from the bottom of the skid for diaphragm pumps.
- 4. The overall system dimensions shall not exceed 34" (W) x 24" (D) X 42" (H).

2.6 Control Panels

- A. Each biosolids volute dewatering screw press shall have an integrated electrical and control system that will allow for safe, simple and automated operation of the unit. All electrical work, motors and drives will comply with any relevant NEMA standards.
- B. The volute dewatering screw press supplier hereunder shall furnish the following control panels:
 - 1. A volute dewatering screw press mounted NEMA 4X 316 Stainless Steel control panel with AC unit on each screw press unit.
- C. The Control Panels shall be furnished in full compliance with the requirements of Division 13, "Process Instrumentation and Control System (PICS)" and shall be

powered by a 3-phase 480 VAC source.

D. External Enclosure Features

- 1. The external door of the panel will have the following switches and indicators:
 - a. Main Isolating Switch (Circuit Breaker).
 - b. An emergency stop button which shall be a mushroom head style pushbutton that when depressed shall immediately de energize all moving equipment in the system.
- 2. Within a windowed enclosure mounted on the panel door:
 - a. HMI Touch Screen.
 - b. An H-O-A system switch to switch the system from AUTO to OFF to MANUAL modes.
 - c. Power on Light (white).
 - d. An Operating Light to illuminate when the unit is actually in operation (green).
- 3. In addition to items located on the main enclosure door, provide the following:
 - a. An Alarm Light a flashing light located on the top of the panel (red).

2.7 Programmable Logic Controller (PLC)

A. Each of the Control Panels shall be provided with an Allen Bradley CompactLogix 5380 Series PLC, VTSCADA (VGT) Operator Interface Terminal (OIT), fiber optic interface as defined in Division 13, installed, wired and programmed to perform the following functions:

1. Operational Control

a. Control of all components of the biosolids volute dewatering screw press and the dewatered sludge conveyance system including the ability to set times and operating speeds for any of the digested sludge transfer pump station feed pumps, solids conveyance system, dewatering drums, mixers, polymer dosing system and wash-down sprays.

2. System Tuning

a. The PLC shall allow the Operator to adjust operating parameters such as delay

timers for fault alarms and system calibration constants.

3. Monitoring Operation

- a. The PLC shall allow the Operator to inspect the operation of all the components including indicators such as output frequency, current draw, thermal condition, elapsed operating times, and any faults present.
- b. The Operator shall be able to view approximated readouts of all operational speeds and flow rates relevant to the operation of the system.

4. Manual Operation of Components

a. The Operator shall be able to manually operate each item of equipment from the PLC interface for inspection and maintenance reasons.

5. Time Clocks

a. The Operator shall be able to set the unit to operate at a specific time or on specific days with no Operators present.

2.8 Electrical Hardware

A. Electrical hardware shall be as follows:

B.

Electrical Hardware	Description
Power Wiring	All power and wiring shall be 600 volt, Type SIS insulation stranded copper and shall be sized for the required load, 14 AWG minimum.
Control Wiring	Control wiring shall be 250 volt, Type SIS insulation stranded copper and shall be sized for the required load, 18 AWG minimum.
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 or approved equal.
Motor Starters	Motor starters shall be full voltage, non-reversing, IEC style across the line units. Coils shall be 120 VAC. Siemens Type Sirius 3RT10 or approved equal.
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.
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 or approved equal.

	Terminal Blocks	Terminal blocks shall be high density, solderless box lug style, with 600-volt rating. Terminal blocks shall be Allen Bradley Type 1492 or approved equal.
	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 or approved equal.
	Variable Frequency Drives (VFDs)	The VFDs shall be UL listed and shall be manufactured by Square D (Altivar Series) or approved equal. See VFD requirements in Specification Section 16370, "Variable Frequency Drives"

2.9 Functional Specification

A. The control panel shall undertake the functional operations described below.

B. Auto-Manual Operation

- 1. The biosolids volute dewatering screw press system may be set to either Auto/Manual/Off on the Control Panel via a 3-position switch. This shall be the "main switch" for the facility.
- 2. When set to "Manual", all items may be switched "On" and "Off" at the Control Panel by the switches on the HMI unit.
- 3. When set to "Off", no items will work whether switched "On" or "Off" either at the control panel or anywhere else.
- 4. When set to "Auto", all items of equipment will work, as further described below.

C. Clock Operation

- 1. The clock function will be controlled by the PLC in the Control Panel. Two clock functions will be allowed for in the program. The clock may be set to either "On" or "Auto/Timer" via the PLC. If the clock is set to "On" the facility will run for as long as the main switch is set to "Auto". When the clock is set to "Auto/Timer" the facility shall will operate in accordance with the clock settings.
- 2. Clock function settings shall allow the Operator to set the volute dewatering screw press and all associated equipment to switch "On" and "Off", at pre-designated times on pre-designated days with no Operators being present. A minimum of two (2) different "clock programs" shall be allowed for in the PLC program.

D. Polymer Feed

1. Polymer feed to the plant is achieved by the integral polymer preparation system connected to the plant. This system is controlled and powered by the control panel.

- Outputs from the control panel to the polymer preparation system will include power, start and stop signals, and variable speed control for the polymer feed pump.
- 2. Manual adjustment of the speed control for the polymer dilution mixing chamber will be make from the Control Panel. The Control Panel shall also monitor the polymer preparation system for faults due to low water pressure, or no polymer flow and shut the system down with an alarm should this occur.

E. Flocculation Tank Agitation

- 1. Whenever the plant is operating, two (2) motorized agitators will operate continuously, stirring the contents of the flocculation tank. These are geared motors and will be controlled by a VFD in the Control Panel. The VFD shall be adjustable from 5 72 Hz.
- 2. A high level sensor will detect any high fluid level in the flocculation tank and will shut the plant down and cause an alarm should this occur.

F. Dewatering Drums

- 1. The dewatering drums shall operate whenever the plant is operating. The motor is controlled by a single VFD. The "range of adjustment" for this will be 15 72 Hz. When the plant shuts down the dewatering drum shall continue to operate for a pre-set time before they shut down.
- 2. Sprays will periodically switch on while the dewatering drum is operating. The frequency and duration of the spray are adjustable in the PLC.

G. <u>Dewatered Sludge Conveyance pumping System (Discharging into the Container/Dumpster)</u>

- 1. The dewatered biosolids conveyance pumping system shall operate whenever the dewatering drums are operating and will shut down following a pre-set delay following the shut down of the dewatering drums. The sludge cake pump motor is controlled by a VFD in the Dewatering Screw Press Control Panel. The "range of adjustment" for this will be 15 72 Hz.
- 2. The Sludge cake pump speed shall be set to user adjustable speed values (Four).
- 3. E-stop and Dry-Run protection relay for the conveyance pumping system and located in the Dewatering Screw Press Control Panel, shall shut down the system and cause an alarm in the event they are activated.
- H. Sludge Feed pumping System (Discharging from Digester to Dewatering Press)
 - 1. The sludge feed pumping system shall operate whenever the dewatering drums are

operating and will shut down following a shut down of the dewatering press. The sludge feed pump motor is controlled by a VFD in the Electrical Building. The "range of adjustment" for this will be 15 - 72 Hz.

- 2. Assign the sludge feed pumps to a DUTY/STANDBY sequence that can be manually overridden by the operator. If any pump is not controllable (i.e H/O/A is OFF, pump is failed), omit it from the sequence. Automatically switch assignments every time sludge pumping stops.
- 3. In Manual control mode, The Sludge feed pump speed shall be set to a user adjustable speed value.
- 4. In Automatic flow control mode:
 - a. Provide the following operator adjustable values:
 - 1) FS Target discharge flow
 - 2) FD Percent allowable differential from target discharge flow.
 - b. Provide a PID control loop to adjust the pump speed to maintain a discharge flow of FS. Freeze the PID when the flow reaches FS.
 - c. If the flow falls to FS-FD for an operator adjustable time, restart the PID until the flow starts to increase then freeze the PID again.
 - d. If the flow rises to FS+FD for an operator adjustable time, restart the PID until the flow starts to decrease then freeze the PID again.
 - e. When the DSPCP calls for pumping, run the DUTY pump.
 - f. If a pump fails to start or fails while running, automatically call for the STANDBY pump.
- 5. E-stop and Dry-Run protection relay for the Sludge feed pump shall shut down the pump and cause an alarm in the event they are activated.

3.0 EXECUTION

3.1 Installation

- A. The biosolids volute dewatering screw press system shall be shop assembled prior to shipment and test run to assure proper operation of components, and then delivered to the site for installation.
- B. Installation of the biosolids volute dewatering screw press system shall be in strict accordance with the manufacturer's instructions and recommendations in the location shown on the Contract Drawings. Installation shall include furnishing the

manufacturer's recommended grades of oil and grease furnished for operation.

- C. Anchor bolts of Type 316 stainless steel shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and approved shop drawings. The manufacturer shall review the structure layout and verify in writing that the equipment will operate and fit in the structure as designed or as modified per the manufacturer's recommendations.
- D. The biosolids volute dewatering screw press system manufacturer shall have responsibility for the screw presses, polymer feed system, operation/control of the biosolids feed pumps and operation/control of the dewatered sludge conveyance system as part of this Project to ensure a complete and functional system. The Contractor and biosolids volute dewatering screw press system manufacturer shall coordinate with the digested biosolids transfer pump station pump manufacturer, BNR Process System supplier and dewatered biosolids conveyance system manufacturer to ensure that all components are integrated properly, function properly and in the proper operational sequence (start, stop, emergency shutdown, interconnects, interlocks, etc.).
- E. The Contractor shall provide all necessary anchor bolts, temporary lifting equipment, power, water, labor and all other material and requirements for a complete and satisfactory installation.

3.2 Start-up, Training and Manufacturer's Services

- A. The services of a 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 the biosolids volute dewatering screw press system and all associated equipment and ancillaries by the Contractor, including placing of the equipment, setting and leveling the equipment, piping and electrical connections to all of the equipment, the manufacturer's representative shall approve the installation and begin start-up and training.
- B. The manufacturer shall provide a letter to the Engineer approving the:
 - 1. Installation of all components of the biosolids dewatering system and that the system is ready to operate and that the performance testing is to proceed.
 - 2. Integration of the controls for the biosolids volute dewatering screw press system, dewatering biosolids conveyance system, the BNR Process and the digested biosolids transfer pump station pumps and that the controls and overall system is ready to operate as intended (functionally and sequentially).
- C. Upon approval of the installation, the manufacturer's factory trained representative shall be provide equipment start-up and calibration services (the Contractor and manufacturer are referred to Article 1.07, "Manufacturer Services"). During the start-up and calibration phase, the manufacturer's representative shall inspect all system

components for proper connection and alignment and assist the Contractor in placing the equipment in a proper operating condition.

- D. Upon satisfactory completion of the start-up and calibration of the systems, a representative of the manufacturer shall be provided to instruct the Owner's personnel in the proper operation and maintenance of the "new" equipment. The manufacturer's representative who will be providing the instruction shall have prior operation, maintenance and instructing experience acceptable to the Engineer. The Contractor shall submit the individual's name and qualifications to the Engineer for approval at least ten (10) calendar days prior to the scheduled operating and maintenance instruction sessions. The number of days listed in Article 1.07, "Manufacturer Services", for services of the manufacturer's factory trained representative shall be provided when requested by the Owner and Engineer during the Project.
- E. The manufacturer's representative shall complete all of the above sessions in a total of two (2) trips to the jobsite. The equipment manufacturer will request, in writing, that all installation of the biosolids volute dewatering screw press system, all associated equipment and ancillaries and electrical and control systems are complete andready, prior to arriving at the jobsite. If the equipment manufacturer arrives at the jobsite and the equipment installation is not complete, *the Owner will not be responsible for any additional costs associated with the time delays*. The equipment manufacturer shall bill the Contractor, at the manufacturer's standard service rates, or as agreed, at the time of the service request.
- F. The Contractor is referred to Section 1.07, "Manufacturer Services" of this specification section for additional Manufacturers Services requirements.

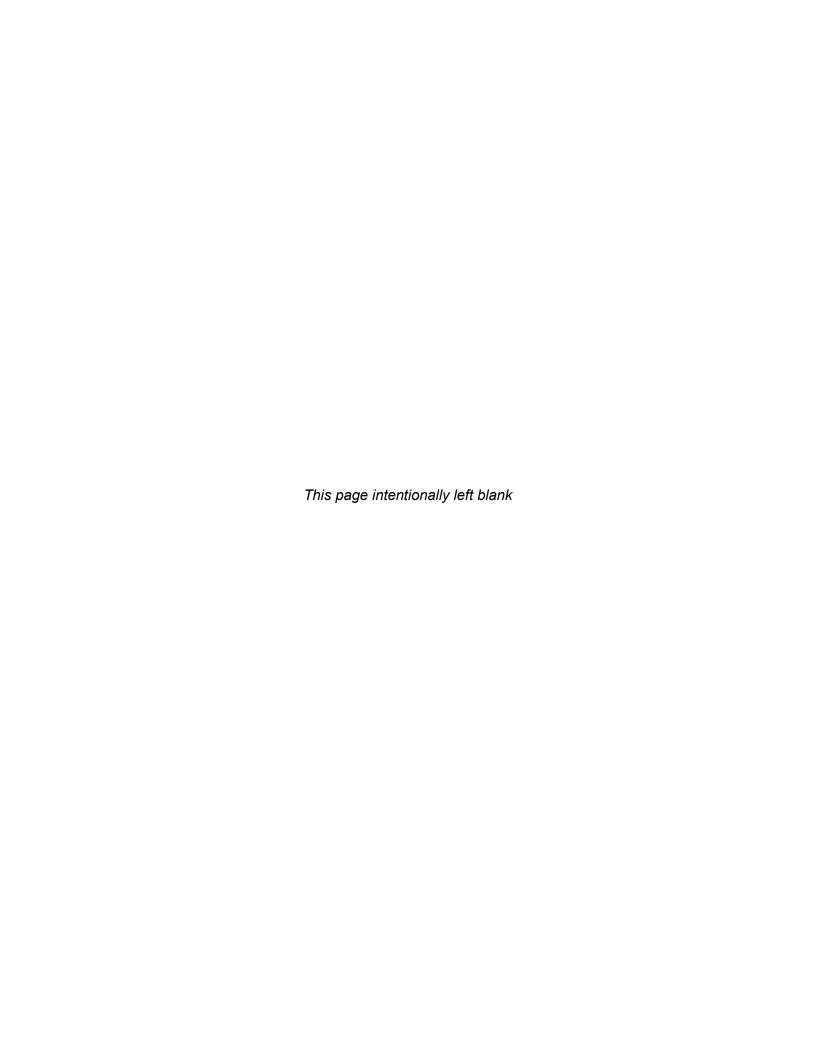
3.3 Polymer Selection and Optimization Services

A. Polymer Selection and Optimization Services shall be performed as described in Articles 1.06(C)(1), 1.07(B) and 1.12 of this specification section.

3.4 Project Performance Testing

A. Project Performance testing is covered under Section 1.06, "Conditions of Service and Performance Requirements" of this specification section.

END OF SECTION



SECTION 13300

PROCESS INSTRUMENTATION AND CONTROL SYSTEM GENERAL REQUIREMENTS

1. GENERAL

1.01 Scope of Work

- A. The overall system general requirements are given in this section. These requirements apply to each additional section of these specifications as noted herein and as specified in the associated sections.
- B. Work includes engineering, furnishing, installing, testing, documenting and placing in operation the complete Process Instrumentation and Control System (PICS) for City of Flagler (Owner) Flagler Wastewater Treatment Facility (WWTF) Biosolids Improvements. Training of the Owner's personnel is also included. The work is specified in this Section and as further specified in the following sections:
 - 1. Specification Section 13310: Field Instruments.
 - 2. Specification Section 13315: Control Panels.
 - Specification Section 13325: Programmable Logic Controller (PLC) System.
 - 4. Specification Section 13326: Programmable Logic Controller (PLC) System Programming.
 - 5. Specification Section 13330: Supervisory Control and Data Acquisition (SCADA) System.
 - 6. Specification Section 13360: Fiber Optic System.
 - 7. Specification Section 16370: Variable Frequency Drives
- C. Three entities are defined in this specification.
 - 1. Biosolids Process Control Supplier (PCS):
 - a. PWTECH Inc.

- b. Approved Equal.
- 2. SYSTEM SUPPLIER:
 - a. Controls Instruments Inc.
 - b. Rocha Controls
 - c. Southern Flow
- 3. The CONTROL SYSTEM ENGINEER (CSE):
 - a. Smart Energy Solutions LLC.
 - b. Approved Equal
- D. The SYSTEM SUPPLIER scope of work shall include the following:
 - 1. Include the services of the CONTROL SYSTEMS ENGINEER (CSE) in the SYSTEM SUPPLIER scope of work.
 - 2. Coordinate with the Contractor, PCS and CSE during hardware and software development and implementation for proper integration of the PICS.
 - 3. Provide Process Control Panel (PCP-1) in the Biosolids treatment area. PCP-1 shall be NEMA 4X stainless steel panel with AC unit and contain CompactLogix Programmable Logic Controller (PLC-1), mixed media ethernet switch and input output modules, UPS and network interface (copper and fiber optic).
 - 4. PLC-1 shall monitor and Control equipment associated with Biosolids treatment system, sludge feed pumping, and Dechlorination process.
 - 5. Provide programming and configuration for PLC, OIT and Network to reflect all process and equipment monitoring and control.
 - 6. Provide copper and fiber optic network cabling and terminations, as shown on contract drawings and further detailed in Section 13360.
 - 7. Provide all field instruments except those specifically identified in Contract Drawings as being furnished under other Divisions.
- E. The CONTROL SYSTEM ENGINEER (CSE) shall work with the SYSTEM SUPPLIER through all phases of the design development, PLC and SCADA programming, network configuration, construction, Installation, testing, and certification. The following outlines the CSE scope of work:
 - The CSE shall work with the SYSTEM SUPPLIER and Process Control Supplier during shop drawing development to ensure that the components of the PICS submitted for use are coordinated, compatible and that all requirements of the project are being implemented.

- 2. The CSE is responsible for review and approval of PLC and OIT development prior to submittal to the EOR for review.
- 3. The CSE is responsible for reviewing and approval of the PICS Hardware and Software Startup training materials prior to submittal to the EOR for review.
- 4. The CSE is responsible for review and approval of the Network and communication protocol coordination prior to submittal to the EOR for review.
- 5. The CSE is responsible for observing the factory testing of the PICs.
- 6. The CSE is responsible for observing the field testing and commissioning of the PICS performed by the SYSTEM SUPPLIER.
- 7. The CSE shall have the following qualifications:
 - a. Licensed PE in the state of Florida for "Control Systems".
 - b. Florida based office located within 100 miles of the project site.
 - c. 10 years controls engineering experience with minimum 5 years in the Water and Wastewater industry.
- 8. At the conclusion of the project the CSE shall certify to the Engineer of Record (EOR) that the PICS has been implemented in accordance with project specifications requirements. This includes the PLC, MCC, VFD and Network Hardware and Software systems. As applicable to this project.
- F. Instrumentation and control systems for this project are intended to be supplied completely under this section. All control panels shall be supplied through the System Supplier; however, some special control panels and devices specifically called out in Division 11 specifications are to be part of those sections, furnished with that equipment. The instruments and controls shall, however, be furnished in conformance to and in coordination with Division 13.
- G. The CONTRACTOR shall furnish all labor, materials, equipment, programming, services and incidentals required to install and place into operation a digital computer-based PICS configured as shown on the Contract Drawings, and as specified herein.
- H. The CONTRACTOR shall furnish all labor, materials, equipment, programming, services and incidentals required to install and place into operation a digital computer-based PICS configured as shown on the Contract Drawings, and as specified herein.

- The CONTRACTOR shall provide all equipment, materials, programming, software, modifications to existing equipment, calibrations and services that are required to successfully interface and interconnect the PICS and any other control systems and associated equipment that are specified or designated in any drawings or provisions of these specifications for the purpose of providing a fully integrated and functional control system.
- J. It is the intent of these Contract Documents that the CONTRACTOR shall have overall responsibility for the PICS.
- K. Division of Work. It is the ultimate responsibility of the CONTRACTOR to furnish a complete and fully operable PICS that reliably performs the specified functions. The CONTRACTOR is to assume full responsibility for additional costs which may result from unauthorized deviations from the specifications. The CONTRACTOR is to establish the actual division of work with the minimum requirements as specified herein.
- L. The CONTRACTOR shall be responsible for:
 - 1. Furnishing and terminating the fiber optic cables.
 - 2. All hardware and software submittals.
 - 3. The final system operation and reliability.
 - 4. Obtaining the required information on all field elements, equipment starters, valve actuators, chemical feed equipment, local control panels, and other control equipment or devices that are required to be interfaced with, but that are not provided with the PICS in order to provide full system coordination regarding interface, function, testing, and adjustment requirements.
 - 5. Providing accessory devices including furnishing and installation of networking interface cards, interposing relays, control switches and signal converters necessary to perform the intent as described by the control strategies and services necessary to achieve a fully integrated and operational system as shown on the Contract Drawings and defined in the Specifications.
 - 6. Coordinating all interface requirements with mechanical and electrical system suppliers and furnishing any signal isolation devices that might be required in order to insure compatibility between all equipment.
 - 7. Providing any special manufacturer's cables required.
 - 8. Defining the final installation and connection requirements of the PICS at the jobsite through development of interconnection diagrams.
 - 9. Final connection of fiber patch cables between Fiber Patch Panels furnished by others and PICS panels.
 - 10. Verifying correctness of all final power and signal connections to the PICS. The

SYSTEM SUPPLIER shall make final adjustments to and calibrate all field elements provided with the PICS.

11. Verifying that:

- a. All components provided under this section are properly installed.
- b. The proper type, size and number of control wires with their conduits and junction boxes are provided and installed.
- c. Proper electric power circuits are provided for all components and systems.
- d. Provision, installation and termination of field and power wiring to PICS supplied control panels and field elements. Termination shall be made in accordance with final accepted interconnection diagrams developed by the SYSTEM SUPPLIER. The electrical subcontractor shall mark on the interconnect diagram the field wire numbers used for each termination point. The SYSTEM SUPPLIER shall finalize the interconnect diagrams by including these field wire numbers in the final as built version.
- e. Installation and termination of all specialty cables, including fiber optic cables, furnished by the SYSTEM SUPPLIER.
- f. Requiring the SYSTEM SUPPLIER to observe and advise on the installation of equipment furnished by SYSTEM SUPPLIER and installed by CONTRACTOR to the extent required to certify, with the operational check-out tests, that the equipment will perform as required.
- g. Ensuring that information on equipment provided under other Divisions and needed by the SYSTEM SUPPLIER to coordinate the PICS is provided in a timely manner.
- M. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.
- N. In the bid price, the CONTRACTOR shall provide for obtaining the services of authorized field personnel from the manufacturers of specialty instruments and from the suppliers of application software packages as necessary. Should these personnel be required during installation, start-up and checkout of the respective portions of the PICS, such services shall be provided at no additional cost to the OWNER.

1.02 Related Work

A. Division 15 – Mechanical. Installation of all mechanical piping and fittings, as well as in-line instruments supplied with and/or supplied for the PICS.

- B. Division 16 Electrical. All conduits are provided and installed under Division 16, Electrical. With the exception of certain specified special manufacturer's cables, all wiring and cables are provided and installed under Division 16, Electrical.
- C. Field devices such as motorized valves, pump motors, solenoid valves, etc. and local control panels for specialized subsystems such as chemical feed systems, etc. are supplied and installed under other Divisions of these Specifications.

1.03 System Integration Plan

- A. Prior to any other shop drawing submittals the System Supplier shall submit a System Integration Plan (SIP). Other submittals received before this submittal will be returned without review.
- B. The SIP shall identify, and provide details of, all new and modified PICS functions. This shall include the following elements:
 - 1. Field.
 - 2. PLC.
 - 3. System Inputs and Outputs.
 - 4. Network/communications.
- C. Field. Provide an Excel spreadsheet that covers all field instruments. For each instrument define the following:
 - 1. Tag Number.
 - 2. Instrument Type.
 - 3. Specification Section supplied under.
 - 4. Signal Type.
 - 5. Range or On/Off states as applicable.
- D. PLC. Provide an Excel spreadsheet that covers all new or modified PLC. For each, define the following:
 - 1. PLC Designation Number.
 - 2. Location.
 - 3. New or modified.
 - 4. A list of I/O modules (existing and new individually identified) that will exist at project completion.

- E. System Inputs and Outputs (I/O). Provide an Excel spreadsheet that lists all system I/O for the complete PICS. For each point, the list shall include the following:
 - 1. PICS database tag number.
 - 2. Signal Description.
 - 3. I/O Type.
 - 4. Range or On/Off state as applicable.
- F. Network/communications. This shall provide a tabular listing identifying the following:
 - 1. Ethernet switches listed by port and including spares.
 - 2. Connected equipment to each port.
 - Spreadsheet listing all network connected components, including any existing PICS equipment. For each, identify the network connection point and proposed or existing IP address.
- G. Following PLC programming, revise the system I/O spreadsheet to include all pseudo points (differentiated from physical I/O) that are used by the OIT/HMI.
- H. Provide a fully updated SIP as part of the final system documentation.

1.04 Submittals

- A. Furnish, as prescribed under the General Requirements, all required submittals covering the items included under this section and its associated sections of the work.
- B. Submit complete, neat, orderly, and indexed submittal packages. Handwritten diagrams are not acceptable and all documentation submittals shall be made using CADD generated utilities.
- C. Partial submittals or submittals that do not contain sufficient information for complete review or are unclear will not be reviewed and will be returned by the Engineer as not approved.
- D. All submitted component data sheets shall be marked to specifically identify the model/part numbers to be furnished.
- E. Provide all shop drawing submittals on thumb drive in PDF format.
- F. In addition to the shop drawing submittals required in the related specification sections, submit the submittals defined below covering the complete system.
 - 1. System Performance. This submittal shall be a written description of how the operator will control the system and the system's subsequent response. Every

piece of controllable equipment shall be separately described and the following information included:

- a. Use of local manual controls.
- b. Use of OIT/HMI software controls.
- c. Use of automatic controls.
- 2. Each functional description shall specifically identify any interlocks (hardware and software) and OIT/HMI alarms generated.
- 3. Operator Screens. This submittal shall include color copies of all proposed OIT/HMI operator screens.
- 4. Field Acceptance Test Plan. This submittal shall define the steps to be conducted during the required witnessed acceptance testing. The test shall be conducted in accordance with the general requirements set forth in Part 3 hereof. The submitted plan shall meet the following requirements:
 - a. Each of the equipment covered in the system performance submittal shall be tested.
 - b. For each equipment test, the required operator control actions and system response shall be demonstrated on the complete system, including each operator action, the response and appropriate OIT/HMI display/alarm updates.
- G. The Contractor and System Supplier are hereby specifically advised that the above submittals shall be Approved or Approved As Noted prior to any witnessed performance testing.
- H. Loop Diagram Submittal. This submittal may be made in conjunction with the submittals required under related specification sections. Loop diagrams, consisting of complete wiring and/or plumbing diagrams for each control loop showing all terminal numbers, the location of the dc power supply, the location of any booster relays or common dropping resistors, surge arrestors, etc. The loop diagrams shall be divided into four areas for identification of element locations: PICS I/O point(s), panel face, back-of-panel, and field, respectively.
- I. Test Procedures: Submit the procedures proposed to be followed during all required testing. Procedures shall include test descriptions, forms, and check lists to be used to control and document the required tests.
- J. Test Reports: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures to the Engineer.

1.05 Final Documentation

- A. After the demonstration tests have been completed and as a part of the final acceptance requirements, submit the PICS record drawings. Record drawings shall include, corrected for any changes that may have been made up through Substantial Completion:
 - 1. System block diagram.
 - 2. Network architecture diagram.
 - 3. Instrument loop wiring diagrams.
 - 4. Panel wiring diagrams.
 - Panel elevations.
 - 6. Interconnection diagrams showing terminal numbers at each wiring termination.
- B. Record drawings shall be developed or converted to latest version of AutoCAD. Provide electronic copies of all AutoCAD files.
- C. Operating and Maintenance (O&M) Manuals: Provide the specified number of complete sets of three-ring bound O&M manuals in accordance with Division 1. Provide separate manuals for each Specification Section, clearly marked. Include descriptive material, drawings, and figures bound in appropriate places. Include:
 - 1. Cross references to 3rd party O&M manuals.
 - 2. Additional operating and maintenance instructions in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration and maintenance of each component provided with the PICS.
 - 3. Internal wiring diagrams (not already shown on the panel wiring diagram record drawings) for all components provided in the PICS that clearly show all terminal block number designations and wire numbers.
 - 4. Bill of Materials identifying the manufacturer and complete part number of all components.
 - 5. All the submittal data for each component from the approved shop drawing submittals with corrections made on approved as noted items.
 - 6. A USB containing the shop drawing data in PDF format in the binder sleeve.
- D. Provide a final System Integration Plan.
- E. Refer to the individual specification sections of the PICS for final documentation requirements that are in addition to the above.

1.06 Quality Control

- A. Base bids for the System Supplier shall be as listed in the Contract Proposal. System Suppliers seeking Engineer approval shall have extensive experience in systems of similar size and complexity. Panel fabrication shop shall be a UL listed panel shop. Acceptance of alternates shall be made based on price, location of the fabrication shop, accessibility of personnel, PLC programming knowledge, and Owner confidence. The System Supplier shall be subcontracted by and paid by the Contractor.
- B. The System Supplier shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.
- C. All equipment furnished by the System Supplier shall be of the latest and most recent design and shall have overall accuracy as guaranteed by the manufacturer.
- D. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
- E. Component equipment shall be as supplied by one of the manufacturers named in the individual specification sections or approved equal. The design of the PICS is based on the first-named manufacturer's equipment if there is a difference.
- F. To facilitate the Owner's operation and maintenance, products shall be of the same major manufacturer, with panel mounted devices of the same type and model as far as possible.
- G. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained.
- H. The System Supplier shall designate a single point of contact for interface with the Engineer on this project. The Engineer reserves the sole right to approve or reject this point of contact.
- I. The System Supplier's selected project personnel shall meet the following requirements:
 - 1. Project engineer shall have at least 10 years' experience in installing similar systems and shall have a minimum of secondary education in the field of electronics or similar technical discipline.
 - 2. Project technician assisting the project engineer for field element calibration and check out shall have at least five years experience in installing similar systems.
 - 3. Key staff resumes shall be submitted for Engineer's approval with the Project Plan as further detailed under submittals.

- J. Service Facility: The System Supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time from the jobsite.
- K. The System Supplier shall provide experienced personnel on-site to coordinate and/or perform installation, termination, and adjustment; on-site testing; Owner training; and startup assistance for the PICS.
- L. The System Supplier shall provide, on-site, an experienced project engineer to supervise and coordinate all of the on-site PICS activities. An experienced technician may be provided to assist the project engineer in field element installation, field calibration, and checkout tests. The System Supplier's project engineer shall be onsite during the period required to effect all of the critical on-site activities related to the PICS, particularly the software debugging, PICS training, and witnessed testing activities.

1.07 Standards

- A. The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.
- B. Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that the equipment famished has been manufactured in accordance with the National Electric Code and OSHA requirements.
- C. Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the Owner.
- D. International Society of Automation (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the PICS.
- E. All equipment used on this project to test and calibrate the installed equipment shall be in calibration at the time of use. Calibration shall be traceable to National Institute of Standards (NIS formally NBS) calibration standards.
- F. For the purposes of uniformity and conformance to industry standard, provide analog signal transmission modes of electronic 4-20 ma DC. No other signal characteristics are acceptable.
- G. Discrete signals are two-state logic signals. Use 120V ac sources on all discrete signals unless otherwise noted or shown.

H. Provide appropriately sized electrical transient protection devices for all electrical elements of the system as further defined in the individual specification sections. For field mounted devices, provide protector enclosures to the electrical Subcontractor for mounting and installation.

1.08 Warranty and Guarantees

- A. In accordance with Division 1, the System Supplier shall furnish to the Owner a written two year guarantee commencing with final acceptance, that all equipment and parts thereof, material and/or workmanship for the field elements, instruments, and control panels are of top quality and free from defects.
- B. The System Supplier shall guarantee all equipment whether or not of his own manufacture.

1.09 Spares and Expendables

- A. Obtain from the manufacturer(s) and provide the recommended critical spare parts as part of the work. Refer to the individual requirements listed in the associated specification sections for the PICS for specific parts to be provided as a minimum. The spare parts are the property of the Owner.
- B. Obtain from the manufacturer(s) and furnish any special tools, calibration equipment and testing apparatus required for the proper adjustment and maintenance of the material provided.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.01 Sequence of Work

- A. Coordination Meetings: In order to ensure timely performance of the Contract and the system's conformance with these specifications, coordination meetings shall be held. The first meeting will be held 30 days after award of the Contract to the Contractor. The Contractor and System Supplier shall provide for their attendance at this meeting in their quotation. A schedule for additional coordination meetings (approximately one each month) will be derived at this initial meeting for periodic update, coordination, and conflict resolution during the project duration.
- B. Prerequisite Activities and Lead Times: Do not start the following key project activities until the listed prerequisite activities have been completed and lead times have been satisfied:

- 1. Hardware Purchasing, Fabrication, and Assembly: Associated design related submittals completed (no exceptions, or approved as noted).
- 2. Shipment: Completion and approval of all design related submittals.
- 3. Startup: Operational Checkout Tests.
- 4. Owner Training: Owner training completed and O&M manuals delivered.
- 5. Demonstration Tests: Operational Check-out Tests, Startup, Owner Training, and Demonstration Test Procedures must be complete. Give 4 weeks' notice prior to the planned test start date.
- C. Consoles, Panels, and Panel Mounted Equipment: Consoles, panels, and panel mounted equipment shall be assembled as far as possible at the System Supplier's shop. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the jobsite.

3.02 Payments

- A. General: All work provided under this Section and its associated Sections for the PICS shall be paid for in accordance with the approved payment Schedule of Values submitted by the Contractor. The approved Schedule of Values will be the basis for partial payment for work provided for the PICS.
- B. Partial Payment for Work Completed: The breakdown in the Schedule of Values allows for the partial payment of work completed for the PICS. Before partial payment is considered for approval, each specific activity must be completed.
- C. Substantial Completion: Substantial Completion for the project is as defined in the General Conditions. However, the following requirements must be fulfilled before consideration will be given for Substantial Completion of the PICS:
 - 1. All PICS submittals have been completed.
 - 2. The PICS has successfully completed the Demonstration Tests.
 - 3. The required Owner training has been implemented.
 - 4. All spares, expendables, and test equipment have been received by Owner.
- D. Final Acceptance: PICS final acceptance is defined as the date when the Engineer issues a written notice of final acceptance. For this Section, the following must have been completed before consideration will be given to the issuance of notice of final acceptance:
 - 1. All punch-list items have been checked off.

- 2. Revisions to the PICS O&M Manuals have been made (that may have resulted from the Demonstration Tests).
- E. Partial Payment Limits: The partial payments for work provided for the PICS shall satisfy the following limiting maximum criteria (percentages of the lump sum pay item for the PICS):

1.	Submittals (not including O&M Manuals)	15%
2.	Training	5%
3.	O&M Manuals	5%
4	Demonstration Tests	10%

3.03 Product Handling

- A. Store and protect equipment until installation following the storage and handling instructions recommended by the equipment manufacturers. Place special emphasis on proper anti-static protection of sensitive equipment.
- B. Protection During Construction: Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the System Supplier's recommendations.
- C. Corrosion Protection: Protect all consoles, panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, include capsules in the shipping containers, and equipment as recommended by the capsule manufacturer. During the construction period, periodically replace the capsules in accordance with the capsule manufacturer's recommendations. Replace all capsules just prior to Final Acceptance.
- D. ESD Protection: Provide for the proper handling, storage, and environmental conditions required for the PICS components deemed static sensitive by the equipment manufacturer. Utilize anti-stat wrist straps and matting during installation of these items to prevent component degradation. Flooring used in control areas shall be reviewed and approved by the System Supplier.
- E. Adequately pack manufactured material to prevent damage during shipping, handling, storage and erection. Pack all material shipped to the project site in a container properly marked for identification. Use blocks and padding to prevent movement.
- F. Ship materials that must be handled with the aid of mechanical tools in wood-framed crates.

- G. Ship all materials to the project site with at least one layer of plastic wrapping or other approved means to make it weatherproof. Anti-stat protection shall be provided for all sensitive equipment.
- H. Inspect the material prior to removing it from the carrier. Do not unwrap equipment until it is ready to be installed. If any damage is observed, immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition, and any subsequent damage that is discovered shall be repaired and replaced at no additional expense to the Owner.
- I. The Contractor shall be responsible for any damage charges resulting from the handling of the materials.

3.04 Installation

- A. Material and Equipment Installation: Install the PICS in locations indicated on the Drawings and follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instruction and these Contract Documents, follow Engineer's decision, at no additional cost. Keep copy of manufacturers' instructions on the jobsite available for review at all times.
- B. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Coordinate I&C work with the Owner and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.
- C. Provide finish on instruments and accessories that protects against corrosion by the elements in the environment in which they are to be installed. Finish both the interior and exterior of enclosures. Provide extra paint of each color used in the material from the manufacturer for touch-up purposes.
- D. Equipment Finish: Provide materials and equipment with manufacturer's standard finish system. Provide manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.
- E. Cleaning and Touch-up Painting: Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.
- F. Control Valves: Verify correctness of installation. Verify calibration and adjustment of all positioners and I/P transducers and verify correct control action. Verify position switch settings. Verify opening and closing speeds and travel stops.

3.05 System Operating Criteria

- A. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two (2) cycles per minute or a magnitude of movement of 0.5 percent full travel.
- B. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
- C. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 2 percent of full scale over a 6:1 operating range.
- D. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.
- E. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.
- F. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

3.06 Training

- A. The cost of training programs to be conducted with Owner's personnel shall be included in the Contract price. The training and instruction, insofar as practicable, shall be directly related to the System being supplied.
- B. The System Supplier shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- C. The System Supplier shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
- D. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- E. All training schedules shall be coordinated with, and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.
- F. Specific details of the nature and duration of training to be provided are defined in the individual specification sections.

3.07 Testing - General

- A. All elements of the PICS, both hardware and software, shall be tested to demonstrate that the total system satisfies all of the requirements of the Contract Documents
- B. As a minimum, the testing shall include shop tests, operational check-out tests, and Demonstration Tests.
- C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system producing the correct result (effect), the specific test requirements will have been satisfied.
- D. All tests shall be conducted in accordance with, and documented on, prior approved procedures, forms, and checklists. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.
- E. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.
- F. The System Supplier shall coordinate all of their testing with the Contractor, the Engineer, all affected suppliers, and the Owner.
- G. The Engineer reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

3.08 Factory Test

- A. Prior to shipment, perform a factory demonstration test on the fully assembled and functioning system as further defined below.
- B. Successfully perform a full dry run of the test prior to certifying to the Engineer that the system is ready for discretionary Owner and/or Engineer witness of a formal test.
- C. The intent of this test is to demonstrate to the Engineer's satisfaction that the system is fully operational and debugged prior to shipment and installation. It is recognized that loop tuning, final drive parameter settings, etc. can only be performed in the field. However, subsequent to shipment it should only be necessary to confirm correct wiring and installation and proper control loop operation. The factory demonstration test shall therefore be structured to confirm the functional operation of the complete system.
- D. The test system shall, as a minimum, include the following equipment:
 - 1. All stand-alone VFD and SSS cabinets networked to the appropriate Process Control Panel.

- 2. Test motors connected to its representative VFD.
- 3. Simulated I/O for each PCP including each type of signal.
- E. Before starting the test, prepare a system inspection log. In the log, record the serial numbers of all major components and document that all portions of the system have been inspected by quality assurance personnel. Include the log in the required test report.
- F. Start-up the system from a fully powered down condition demonstrating that the various system elements can be brought on line without adverse consequences. Throughout subsequent testing, use system diagnostics to demonstrate system status under the various fault scenarios.
- G. Demonstrate normal operations including the following:
 - 1. Functioning of all control strategies using the operator process graphics.
 - 2. The ability to modify the system including:
 - a. Add points to the system database
 - b. Develop a new process graphic using the newly added points
 - c. Modify a test report to include the new points
 - d. Build a trend using one of the new points
 - 3. Message logging and alarm handling
 - 4. Historical data collection and access from the administrative network
 - 5. Correct operation of protective interlock relay logic within the Process Control Panels and MCCs.
- H. Demonstrate the ability, from an Operator Workstation, to review, modify, and adjust the following:
 - PLC programs.
 - 2. VFD drive parameters.
 - 3. SSS parameters.
 - 4. Radio subsystem parameters
- I. Demonstrate the system can automatically fully recover (i.e. no loss of data) from failure of an application server.

- J. Demonstrate the required UPS back-up duration. This may be performed concurrently with other portions of the test.
- K. Demonstrate the system can detect the following failures and that other system functions remain unaffected:
 - 1. Failure of a PLC.
 - 2. Failure of an Operator Work Station
 - 3. Failure of a drive
 - 4. Loss of communications with a VFD.
- L. Provide for up to two hours per day of Owner/Engineer additional tests.

3.09 Operational Readiness Test (ORT)

- A. Prior to startup and demonstration testing, certify that the entire installed PICS (inspected, tested and documented) is ready for operation. These inspections and tests shall include Loop/Component inspections and tests. Toward the end of these checkout tests, down load the OIT/HMI software and test the system loop by loop to complete the PICS checkout tests. The System Supplier shall fully debug problems in the system as a whole. Final approval of control software will not be based on written descriptions of software functions alone, but on actual performance in the field.
- B. Check the entire PICS for proper installation, calibration and adjustment on a loop-byloop and component-by-component basis to ensure that it is in conformance with related submittals and the PICS Specifications.
- C. The Loop/Component Inspections and Tests shall be implemented using approved forms and checklists. Example sheets are provided at the end of this Specification Section. These shall be developed by the System Supplier and submitted for approval.
- D. Maintain the Loop Status Reports and Component Calibration Sheets at the jobsite and make them available to the Engineer at any time.
- E. Witnessing: These inspections and tests do not require witnessing. However, the Engineer will review the Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Checkout Tests. Correct any deficiencies found.
- F. Final Documentation: The completed reports and sheets shall be assembled in one document and submitted together with a completed Manufacturer's Check-Out Certification.

3.10 Field Acceptance Test (FAT)

- A. Once the PICS has passed the ORT, the System Supplier shall perform a witnessed Field Acceptance Test (FAT) on the complete PICS. The FAT shall demonstrate that the PICS is operating and in compliance with the Contract requirements. Each specified function shall be demonstrated on a paragraph-by-paragraph, and site-by-site basis.
- B. Prior to the FAT, the entire installed PICS shall be certified in writing by the Contractor that it is ready for operation.
- C. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.
- D. The FAT shall cover the entire PICS, including control functions, alarms, and status monitoring. Test procedures used for factory tests may be adopted for these tests if modified as required.

3.11 30-Day System Acceptance Test (SAT)

- A. After completion of the Field Acceptance Tests, the entire system shall operate for a period of 30 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction.
- B. Provide complete O&M Manuals for the PICS at the jobsite at least two weeks prior to the SAT.
- C. During this test, plant operating and System Supplier personnel shall be present as required. The System Supplier is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system.
- D. While this test is proceeding, the Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.
- E. Any malfunction during the tests shall be analyzed and corrections made by the System Supplier. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
- F. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence by the System Supplier's personnel, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
- G. Upon completion of repairs, by the System Supplier, the test shall be repeated as specified herein.
- H. In the event of rejection of any part or function, the System Supplier shall perform repairs or replacement within 90 days.

- I. All data base errors must be corrected prior to the start of each test period. The 30-day test will not be considered successful until all databases are correct.
- J. The total availability of the system shall be greater than 99.5 percent during this test period.
 - 1. Availability is given by "(Total Time-Down Time)□ / Total Time".
 - 2. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided, shall not contribute to the availability test times above.
- K. Upon successful completion of the 30-day Site Acceptance Test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.

Project	Owner's Project No. (if applicable): Page of
Project	Regulatory Agency Project No. (if
HDR Project	Date:

	FIELD		CONTROL CAB TERM/CONT CHECK ₍₂₎				
DESCRIPTION	LEAK CHECK ₍₁₎				TERM/CONT CHECK ₍₂₎		
	Device Process Signal Tag No. Conn. Tube		Device Tag No.	Terminatio n Ident.	Device Tag No.	Termination Ident.	

Leak check for pneumatic signal tubing to be per ISA-PR7.1.

2. Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT

MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.					
PROCESS VAR						
EQUIP STATUS						
ALARM POINT						

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATIO N	TAG NO.	LOCATIO N	TAG NO.	LOCATION

AS LEFT SETTINGS

TAG NO.	SWITCH ALARM SP	&	CONTROLLERS				
			Gain	Reset, rpm	Deriv. min	(rate),	PV Set Point
TC .1	.1 . 11		1 .1 •	1 1 1 1 .	1 1 1	1 1 (•

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by:	Date:

Project Name:	Owner's Project No. (if
Project Owner:	Regulatory Agency Project No. (if
HDR Project	Date:
Control Loop	
Instrument Tag	Transmitter/gauge
Manufacturer:	Switch set-point:
Model No.	Switch dead band:
Serial No.	Switch range:
TRANSMITTERS AND INDICATIONS	·

TRANSMITTERS AND INDICATORS

	INCREASI	ING INPUT DECREASING INPUT			DECREASING INPUT			
% OF SPAN	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)		
0%								
25%								
50%								
75%								
100%								
Other (if applicable)								
Other (if applicable)								

SWITCHES

	INCREASING INPUT DECREASING INPUT						
ACTUATION POINT	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% range)	of

Flagler Beach WWTF: Sludge Management System Improvements - Project Manual 13300-25									
High (Increasing input)									
Low (Decreasing input)									
Maximum allowable error (per Contract Documents):									
Remarks:									
CALIBRATION E	QUIPMENT I	JTILIZED							
DEVICE TYPE	MFR/MODI	EL NO.	ACCURACY		NIST TRAC	EABILITY?			
Certified by: Date Certified:									

END OF SECTION

SECTION 13310

PROCESS INSTRUMENTATION AND CONTROL SYSTEM FIELD INSTRUMENTS

1. GENERAL

1.01 Scope of Work

- A. This Specification Section covers work related to the various field instruments to be supplied with the Process Instrumentation and Control System (PICS).
- B. Field instrumentation, as specified herein, shall be furnished by the same SYSTEM SUPPLIER furnishing services and equipment as outlined in 13300.

1.02 Related Work

- A. Specification Section 13300 defines work associated with the overall PICS.
- B. Specification Section 13315 defines work associated with control panels and enclosures housing the various elements of the PICS.
- C. Specification Section 13325 defines work associated with the Programmable Logic Controllers (PLCs) that will interface the system with the field instruments defined hereunder.
- D. Physical Installation of field instruments is performed under Division 15, Mechanical.
- E. Provision of all field and power wiring except manufacturer-supplied cables and installation of all such wiring is performed under Division 16, Electrical.

1.03 Submittals

- A. Submit the following Field Instrumentation Shop Drawings in a single package:
 - 1. Catalog information, descriptive literature, wiring diagrams, and shop drawings on all components of the field instruments, including all miscellaneous electrical and mechanical devices furnished under this section.

- 2. Individual data sheets for all components of the field instruments to supplement the above information by citing all specific features for each specific component (e.g. scale range, materials of construction, special options included, etc.). Each component data sheet shall bear the component name and instrument tag number designation shown in the Drawings and Specifications.
- 3. Installation details for all field mounted devices to show conformance with the Contract Documents.
- 4. Configuration documentation for all programmable devices to indicate actual settings used to set the device scale, range, trip points, and other control parameters.
- 5. Proposed tag numbers for each specific instrument.

2. PRODUCTS

2.01 General Requirements

- A. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.
- B. All instruments requiring plumbing shall utilize stainless steel components as follows:
 - 1. Test Tap: Shall consist of Crawford Fitting Co. Swagelock quick connects Series QC4-DE, or equal.
 - Tubing, Stainless Steel: Shall be ASTM A 312, TP 316, seamless, soft annealed with 0.065 inch wall. Fittings shall be ASTM A 276, TP 316 compression or socket weld type.
 - 3. Valve, Ball: Shall be stainless steel ball valves, Whitey Series 40, Hoke Flamite Series 7100, or equal.
- C. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks.
- D. Instruments with remote transmitters shall be provided with power and signal surge protection and sunshields (NEMA 3R Aluminum with rubber front face cover).
- E. Instrument cable lengths shall be determined by the SYSTEM SUPPLIER based on actual field installation requirements.
- F. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent. Indicator readouts shall be linear in process units.

G. Electronic equipment shall utilize printed circuitry suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

2.02 Lightning/Surge Protection

- A. Surge suppressors and arrestors meeting the requirements of IEEE/ANSI Standard C-62.41 (latest revision) shall be provided on all electronic field instruments.
- B. AC Powered Instruments. Lightning and surge protection shall be provided on both the AC power supply and signal lines. The protectors and the associated instrument/transmitter and power disconnect shall be mounted in a NEMA 3R Stainless Steel, vented enclosure powder-coat painted white with three point latch. The protectors shall meet the following criteria:
 - 1. NEMA 4X small case, conduit mounted enclosure.
 - 2. Response time of less than five nanoseconds.
 - 3. AC Power protection: IEEE/ANSI Std. C-62.41 rated C3 at 330 Volts clamping level.
 - 4. Signal line protection: 10,000 Amp 8 x 20 microsecond surge, clamped at 36 Volts clamping level.
 - 5. Test jacks for low level signal monitoring.
 - 6. Manufacturer/model: ASCO Model 265.
- C. Loop Powered Instruments. Lightning and surge protection shall be provided on the 4-20 mA DC signal line. The protectors shall meet the following criteria:
 - 1. Encapsulated in Stainless Steel Pipe nipples for in-line conduit mounting.
 - 2. Response time of less than one nanosecond.
 - 3. Capable of withstanding up to 400 occurrences of 500 Amps at 10 x 1 millisecond.
 - 4. Series resistance of 5 ohms per line.
 - 5. Protection of both lines plus shield.
 - 6. Manufacturer/model: ASCO model 157.

2.03 Field Instruments

A. Electro-magnetic Flow Metering System. The magnetic flow metering system shall comprise a flow through spool piece with sensing electrodes (Flow Element, FE) and an electronics unit (Flow Indicating Transmitter, FIT). The spool piece shall contain a coil energized by d.c. pulses from the electronics unit. The voltage induced in the process fluid shall be sensed by the electrodes and converted, by the electronics unit, into a derived flow signal.

1. System Performance:

- a. Systems shall be wet calibrated at the factory using NIST traceable equipment.
- b. Overall system accuracy shall be plus or minus 0.5 percent of rate between 1 and 30 feet per second.
- c. It shall be possible to verify system calibration in the field. Methods which require removal of the spool piece or a second flow measurement (i.e. another meter or known volume) will not be acceptable.

2. Materials:

- a. Tube Carbon Steel
- b. Liner Neoprene rubber for clean water applications. All other applications shall be Teflon.
- c. Flange -316 Stainless Steel ANSI 150#
- d. Electrodes 316 Stainless Steel.

3. Ratings:

- a. Rated for continual submergence to 10 feet. This shall include potting of the able between the spool piece and electronics unit.
- b. Electronics Unit Remote mount NEMA 4X.

4. Electrical:

- a. Power Requirement 120 VAC plus or minimum 10 percent, 60 Hertz.
- b. Maximum Power Consumption 20 Watts.

5. Functional:

a. Programmable low flow cut-out

- b. Empty pipe detection
- c. Electronic unit display: minimum of 2 x 16 character, backlit LCD.

6. Options

- a. Provide grounding rings as required to establish potential matching.
- b. Provide ultrasonic cleaning where necessary for coating sensitive systems
- c. Provide special tools and software necessary to effect field calibration
- d. Provide certificate of factory calibration
- 7. Manufacturer, Model series:
 - a. Endress and Hauser, ProMag 400
 - b. Approved equal
- B. Flow Element Ultrasonic Doppler
 - 1. Type:
 - a. Strap-on single head sensor
 - b. Stainless steel mounting clamp

2. Operation:

- a. Purpose To produce a 4-20 mA signal proportional to flow rate.
- b. Operating Principle Transmitted ultrasonic signal is reflected back by suspended solids. The received frequency differs from the transmitted frequency because of the Doppler effect. The difference is proportional to flow rate in the pipe.

3. Functional:

- a. Power Requirement 120 VAC plus or minus 10 percent, 60 Hertz.
- b. Maximum Power Consumption 12 VA
- c. Transmitter Back lit LCD display

4. Physical:

- a. Transmitter NEMA 4X fiberglass enclosure with stainless steel hardware
- b. Transducer Epoxy encapsulated.

5. Performance

- Accuracy Plus or minus 2 percent of full scale between 0.2 and 30 feet per second
- b. Capable of operation down to 100 ppm of minimum 100 micron suspended solids.

6. Manufacturers:

- a. Dynasonics DDFXD series
- b. Approved equal
- C. Ultrasonic Level Element and Transmitter. The system shall consist of a sensor (Level Element, LE) that uses a non-contact ultrasonic measurement technique to measure the liquid level in a vessel, tank or basin, interconnecting cable, and electronics unit that produces an analog signal proportional to level (Level Indicating Transmitter, LIT) or, in the case of weir applications, flow (Flow Indicating Transmitter, FIT).

1. System Performance:

- a. Overall system accuracy shall be plus or minus 0.25 percent of span or 0.1 inches, whichever is greater, automatically compensated for temperature.
- b. The electronics unit shall contain preset algorithms containing the necessary factors to convert a weir level into a flow value.
- c. The system shall be field calibratable without the use of external calibrators.

2. Sensor Materials:

- a. Chemical tank locations All Teflon.
- b. Other locations PVC and Teflon.

3. Ratings:

a. Electronics Unit - NEMA 4X.

4. Electrical:

- a. Power Requirement 120 VAC plus or minimum 10 percent, 60 Hertz.
- b. Maximum Power Consumption 10 Watts.

- 5. Functional:
 - a. Span, output, linearization and digital output scaling shall be adjustable at the transmitter.
 - b. Echo status and loss indication shall be provided at the transmitter.
 - c. Electronic unit display: 16 character, backlit LCD.
- 6. Manufacturer, Model series:
 - a. Endress and Hauser, Prosonic.
 - b. Approved equal.
- D. Chlorine Analyzer. The analyzer shall comprise of a panel equipped with two amperometric sensors (Analysis Element, AE), flow switch, and flow cells and a separate analysis indicating transmitter (AIT). The AE shall measure Total Chlorine Residual and pH. The AIT shall then indicate and transmit analog signals proportional to each parameter.
 - 1. Transmitter Performance:
 - a. Provide signal conditioning and conversion for up to two analysis sensors.
 - b. Dual, isolated analog outputs configurable for linear or logarithmic proportionality.
 - c. Built-in self-diagnostics.
 - d. Three individually programmable alarm contacts (two process level, one system fault).
 - e. Operating temperature range: -20 to 60 degrees C.
 - 2. Chlorine Sensor Performance:
 - a. Measurement Range: 0-20 ppm.
 - b. Response time: 100 seconds for 90% step change.
 - 3. pH Sensor Performance:
 - a. Equipped with Pt 1000 ohm RTD for temperature compensation.
 - b. Measurement Range: 0-14.
 - c. Accuracy: +/- 0.1% of span.

- 4. Ratings:
 - a. NEMA 4X transmitter enclosure
- 5. Electrical:
 - a. 120 V AC, 60 Hz supply
 - Alarm contacts: SPDT dry contacts rated for 5A resistive at 24 V DC and 120 V AC.
 - c. Graphic dot matrix LCD display with LED backlighting and with a 240 x 160 pixel resolution
 - d. Analog outputs: 4-20 mA DC
- 6. Sample Line. Provide a pressure reducing valve and flow control valve on the sample influent line.
- 7. Hach no equal
- E. Multi-Function Analyzer/Transmitter. The analysis indicating transmitter (AIT) shall be capable of interfacing with multiple types of sensors (Analysis Element, AE) and then indicating and transmitting signals proportional to each particular parameter.
 - 1. Application:
 - a. The AIT shall be used to monitor analysis sensors where shown on the Contract Drawings.
 - 2. Transmitter Performance:
 - a. Provide signal conditioning and conversion for up to two analysis sensors.
 - b. Built-in self-diagnostics.
 - c. Pipe or panel mount.
 - d. Operating temperature range: -20 to 55 degrees C.
 - 3. Ratings:
 - a. IP65 transmitter enclosure.
 - 4. Electrical:
 - a. 120 V AC, 60 Hz supply.
 - b. Display: 4.5" x 3.4" TFT touch screen with backlighting and 320 x 240 pixel resolution.

- c. Dual 4-20 mA outputs.
- Manufacturer/Model:
 - a. Hach model sc4500.
 - b. Approved equal.

2.04 Discrete Instruments

- A. Level Switch, Float. The level switch shall be a direct acting, weighted float suspended on its own cable. As the liquid level rises the float tilts and actuates a hermetically sealed switch inside the float. The cable shall be terminated within a junction box located outside the tank or basin. For multiple float applications, all cables shall terminate in a single junction box.
 - 1. Materials:
 - a. Float wetted part Polypropylene
 - b. Cable PVC jacketed
 - c. Junction box 316 SS
 - 2. Ratings:
 - a. Junction box NEMA 4X
 - b. NSF approved for potable water.
 - 3. Electrical:
 - a. Dry contact rated to 4.5 Amps at 120 VAC
 - b. Normally open or normally closed as required for the application
 - 4. Options
 - a. Provide stainless steel hanging bar. Attach the float cables to the bar using Kellum grips.
 - b. Provide other supports/mounting accessories as required.
 - 5. Manufacturer, model:
 - a. Anchor Scientific, Eco-float type G
 - b. Approved equal.

B. Flow Switch. The flow switch shall use thermal dispersion and be capable of monitoring low flow rates in viscous fluids. The sensor head employs two temperature sensors with a constant low power heating source attached to one. The other temperature sensor compensates for process temperature changes. The difference in temperature between the two sensors varies with flow. Alternate flow switches to those specified that employ physical deflection to detect flow will not be acceptable except for clean water applications.

1. Performance:

- a. Operating Temperature 0 to 65 degrees C
- b. Operating pressure Up to 500 psig
- c. Response time less than 5 seconds
- d. Adjustable setpoint down to 0.01 feet/second in liquid and 0.1 feet/second in air

2. Physical:

- a. Spherical tip suitable for wastewater applications.
- b. Insertion length suitable for monitored pipe's diameter. Specifically identify proposed insertion lengths in shop drawing submittal.

3. Materials:

a. Sensor Head – 316L stainless steel.

4. Ratings:

- a. Electrical Class UL approved explosion proof
- b. Electronic enclosure NEMA 4X.

5. Electrical:

- a. Power Requirement 120 VAC plus or minimum 10 percent, 60 Hertz.
- b. Maximum Power Consumption 5 Watts
- c. Output DPDT relay contact rated 10 Amps resistive at 120 VAC.

6. Manufacturer, model:

- a. Magnetrol, model TD2
- b. Approved equal

2.05 Test Equipment And Special Tools

A. Provide a hand held programmer suitable for calibrating the pressure transmitters.

2.06 Spares And Expendables

- A. Provide the following spare parts:
 - 1. One spare analysis sensor of each type used.
 - 2. Ten percent spare fuses (minimum of 10) of each type and rating supplied.
 - 3. Five percent (minimum of 2) spare surge protection devices of each type used.
- B. Provide the following expendables:
 - 1. One year's (or shelf life worth if less than one year) supply of buffer and reagents used for analyzers

3. EXECUTION

3.01 INSTALLATION

- A. Install the PICS field instruments in strict accordance with the respective manufacturer's instructions and recommendations, in locations as shown on the Drawings, and as indicated on the installation details of the Drawings.
- B. Fully calibrate each instrument.
- C. Provide surge protection enclosures to the electrical sub-contractor for mounting and installation. The enclosures shall be fully wired internally. Coordinate grounding requirements with Division 16, Electrical.

3.02 TRAINING

- A. On-site (field) training shall be conducted at the OWNER's plant site and shall provide detailed hands-on instruction to OWNER's personnel covering all supplied field instruments.
- B. Training shall include:
 - 1. calibration procedures.
 - 2. preventive maintenance methods and timing.

- 3. fault-finding techniques.
- C. The training shall run at times chosen by the OWNER over a period of two (2) months as follows:

END OF SECTION

SECTION 13315

PROCESS INSTRUMENTATION AND CONTROL SYSTEM CONTROL PANELS

1. GENERAL

1.01 Scope Of Work

- A. This Specification Section covers work related to the control panels and enclosures to be supplied with the Process Instrumentation and Control System (PICS).
- B. The control panels, as specified herein, shall be furnished by the same SYSTEM SUPPLIER furnishing services and equipment as defined under Specification Section 13300.
- C. The SYSTEM SUPPLIER shall design, furnish and install all interior wiring within the control panels and furnish complete wiring diagrams showing the electrical circuits inside the panel and interconnections between the panel and the external instruments and components.
- D. Size control panel(s) to adequately dissipate heat generated by equipment mounted inside or on the panel front face.

1.02 Related Work

- A. Specification Section 13300 defines work associated with the overall PICS.
- B. Programmable Logic Controllers (PLC) are to be mounted in control panels hereunder. PLC are defined in Specification Section 13325.
- C. The panels defined hereunder are installed under Division 15, Mechanical.

1.03 Submittals

- A. Submit the following control panel shop drawings in a single package:
 - 1. Layout diagrams for all control panels and enclosures. Include panel elevations

(front, side, interior), and sizing. Panel front elevations shall be of sufficient scale to allow all engraved nameplates and inscriptions to be legible without the use of schedules.

- 2. A complete Bill of Materials for each panel cross-referenced to the panel layout drawings and identifying the manufacturer and complete part number of all components.
- 3. Wiring diagrams for all control panels. Diagrams shall be complete electrical wiring diagrams showing all components and all auxiliary devices such as relays, alarms, fuses, lights, fans, heaters, etc. All wires and terminals shall be numbered on the diagrams, and line cross-references shall be labeled. Include wiring interface to the PLCs where applicable. Include on these drawings a tag number to identify each component and referenced to a component identification list.
- 4. Data sheets for all components. The data sheets shall be marked to indicate those portions applicable to the components to be furnished.
- Power requirements and heat dissipation summary for all control panels. Power requirements shall state required voltages, currents, and phase(s). Heat dissipations shall be maximums and shall be given in Btu/hr. The summary shall be supplemented with calculations.

2. PRODUCTS

2.01 General Requirements

- A. Equipment to be installed in a hazardous area shall meet Class, Group, and Division classification as shown on the Contract Electrical Drawings, or comply with the local or National Electrical Code, whichever is the most stringent requirement.
- B. Electronic equipment shall utilize printed circuitry suitably coated to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for their purpose, to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.
- C. All equipment shall be designed to operate on a 60-Hertz alternating current power source at a normal 120 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

- D. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single MANUFACTURER, insofar as possible, and shall consist of equipment models which are currently in production.
- E. The equipment furnished shall be designed to operate satisfactorily between 0 degrees C and 40 degrees C for indoor panels and 50 degrees C for outdoor panels at up to 95 percent Relative Humidity (non condensing).
- F. Except where specifically noted otherwise, all outdoor panels and enclosures containing electronic or electrical components shall be equipped with sunshields on both sides, the front, the back and the top with a minimum separation of one inch and a maximum separation of one and one-half inches. Sun shields shall be 14 gauge Stainless Steel or 12 gauge Anodized Aluminum or thicker. Finish with reflective white, two part epoxy coating or reflective, white, polyester powder deposited coating.
- G. All outdoor control panels and enclosures shall be equipped with 3 ½" stainless steel mounting uni-struts across the width of the back. For free-standing panels the struts shall be located half-way up the panel and six inches from the top. For other panels they shall be located 3" from the top and 3" from the bottom.
- H. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 volts-amperes (VA), unless specifically noted otherwise.
- I. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.
- J. All discrete inputs entering the panel shall be wetted by 120 VAC. Provide isolation relays if necessary to accommodate this requirement.
- K. All discrete output signals shall be equipped with interposing relays to electrically isolate them from the control system I/O.
- L. Provide signal isolators for analog signals leaving the building.

2.02 Lightning/Surge Suppression

- A. Surge suppressors and arrestors meeting the requirements of ANSI Standard C-62.41 (latest revision) shall be provided as further detailed below.
- B. DC Signals. Lightning and surge protection shall be provided on all DC signal wires entering or leaving the panel. The protectors shall meet the following criteria:
 - 1. 35 mm DIN rail mounted with spring terminals.
 - 2. Response time of less than one nanosecond.
 - 3. Operating signal current: up to 0.5 A

- 4. Capable of withstanding 5,000 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.
- 5. Nominal series resistance of less than 2 ohms each leg
- 6. Manufacturer/model:
 - a. Dehn DCO RK ME
 - b. Approved equal.
- C. AC Signals. Lightning and surge protectors for all incoming 120 VAC discrete signals lines shall meet the following criteria:
 - 1. Serial protection.
 - 2. Nominal operating voltage: 120 VAC 47/63 Hz.
 - 3. Response time of less than 0.25 nanoseconds.
 - 4. Capable of withstanding up to 40,000 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.
 - Manufacturer/model:
 - a. Phoenix Contact 2906840
 - b. Approved equal.
- D. Single phase AC Power. Lightning and surge protectors for AC power supply lines up to 15 Amps service shall meet the following criteria:
 - 1. Serial protection with replaceable fuse.
 - 2. Failure indicator.
 - 3. Response time of less than five nanoseconds.
 - 4. Capable of withstanding up to 10,000 Amps at IEEE/ANSI C-62.41 8 by 20 microseconds combination wave.
 - 5. Manufacturer/model:
 - a. EDCO HSP121BT
 - b. Approved equal.
- E. Single phase AC Power (over 15Amps). Lightning and surge protectors for AC power supply lines over 15 Amps service shall meet the following criteria:
 - 1. Parallel protection using MOVs and thermal fusing technology.

- 2. Failure indicator
- Response time of less than five nanoseconds.
- 4. Capable of withstanding up to 6,500 Amps at IEEE/ANSI C-62.41 8 x 20 microseconds combination wave.
- 5. Manufacturer/model:
 - a. EDCO FAS-120AC
 - b. Approved equal.
- F. Three phase AC Power. Lightning and surge protectors for 480 VAC power supply lines shall meet the following criteria:
 - 1. Designed specifically for three phase 480/277 VAC wye connected power supply lines.
 - 2. Wall mountable IP66/NEMA 4x stainless steel enclosure.
 - 3. Failure indicators.
 - 4. Response time of less than twenty-five nanoseconds.
 - 5. Capable of withstanding up to 50,000 amp surge current per phase.
 - 6. Manufacturer/model:
 - a. Phoenix Contact SYSTEMTRAB 2800718.
 - b. Approved equal.

2.03 Control Panels

- A. Dewatering Screw Press Control Panel (DSPCP) by the PCS:
 - 1. Enclosure shall be NEMA 4X Stainless Steel with AC unit, containing PLC equipment defined in Specification Section 13325.
 - 2. DSPCP shall include an integral UPS and battery with 30 minutes minimum full load capacity.
 - 3. DSPCP shall be 3 phase 480 VAC with circuit breakers, VFDs, Starters, power and signal surge protection.
 - 4. DSPCP shall include fiber optic network interface.
- B. Dewatered Sludge Cake Pump Conveying Control Panel (CCCP) by Division 11 supplier:

- 1. Enclosure shall be NEMA 4X Stainless Steel with AC unit, containing PLC equipment defined in Specification Section 13325.
- 2. CCCP shall include an integral UPS and battery with 30 minutes minimum full load capacity.
- 3. CCCCP shall be 3 phase 480 VAC with circuit breakers, VFDs, Starters, power and signal surge protection.
- 4. CCCP shall include fiber optic network interface.

C. Control Panels by SYSTEM SUPPLIER:

- 1. Process Control Panel PCP-1. The following components are required:
 - a. Enclosure shall be NEMA 4X Stainless Steel with AC unit, containing PLC equipment defined in Specification Section 13325.
 - b. PCP-1 shall include an integral UPS and battery with 30 minutes minimum full load capacity.
 - c. PCP-1 shall be single phase 120VAC with circuit breakers, power and signal isolators and surge protection.
 - d. PCP-1 shall include fiber optic network interface.

2.04 Control Panels and Enclosures

A. Finish:

- 1. All front panel openings for panel-mounted equipment shall be cut with counterboring and provided with trim strips as required to give a neat finished appearance.
- 2. With the exception of stainless steel panels, all steel panel surfaces shall be treated with phosphatized treatment inside and out, and then finished on the exterior with two coats of baked enamel of the approved color. Interiors of panels shall be white, ANSI No. 51.
- 3. Stainless steel panels shall be No. 7 polished, 316 stainless steel.

B. Doors:

- 1. All control panels shall have a continuous piano hinge door for ease of access. A minimum of 80% of the panel interior shall be exposed by doors.
- 2. NEMA 4X rated panel door openings shall be sealed and fully gasketed.
- 3. The inside of each door shall be equipped with a print pocket. Provide individually laminated 11x17 sheets for all wiring diagrams.

- 4. Two-door enclosures shall have a removable center post.
- 5. Sealed panel doors shall be equipped with quick-release latches.
- 6. NEMA 1 rated panel doors shall be equipped with a three-point latching mechanism.
- 7. Where noted or shown on the drawings, doors shall be equipped with a fully gasketed glass window to allow viewing of internally mounted devices without opening the door.
- C. All components and terminals shall be accessible without removing other components except for covers.
- D. All conduit entry shall be from the bottom only.
- E. No components shall be mounted on the interior sides of any panel.
- F. All panels shall be provided with an isolated copper grounding bus to ground all signal shield connections.
- G. Control Panels containing PICS control system equipment shall each be equipped with an internal, hand-switch controlled, LED light and 120V, 15 amp, duplex utility receptacle.
- H. All panels shall be provided with laminated as built electrical wiring diagrams in each panel.
- I. Nameplates:
 - All front-face panel mounted controls and indicators shall be equipped with 10-year outdoor-rated adhesive laminated plastic nameplates to completely define their use. Provide Brady Type BBP31 or BBP33 as applicable or approved equal.
 - 2. All internal components shall be equipped with identification tags
 - 3. Each wire shall be uniquely identified and shall be labeled.
- J. Power Supplies.
 - 1. Uninterruptible power supplies (UPS) shall be provided in all control panels as follows:
 - a. Size the supplies for all internal equipment plus an additional 20% spare capacity.
 - b. Provide 15 minutes battery back-up capability at full load.
 - c. Provide relay option card for indication of "On UPS Power" and "Low Battery Level".

- d. For outdoor panels provide an UPS and battery rated for operation at up to 50 degrees C.
- 2. Provide two diode-auctioneered DC power supplies for analog signal use.
- 3. Provide individually fused DC power for field transmitters.

K. Electrical:

- 1. Main circuit breaker and branch circuit breaker for each branch circuit as required to distribute power from the main power feed.
- 2. All breakers accessible when the panel door is open.
- 3. No more than 20 devices on any single circuit.
- 4. No more than 12 amps for any branch circuit.
- 5. Panel (or site) lighting, receptacles, heaters, controls, telemetry and fans on separate branch circuits.

L. Wiring:

- 1. Power wiring shall be 300 volt, type MTW stranded copper, No. 14 AWG size, for 120V service.
- 2. Discrete wiring shall be 300-volt type MTW stranded copper, sized for the current carried, but not smaller than No. 16 AWG.
- 3. Analog signal wiring shall be 300 volt, stranded copper in twisted shield pairs, no smaller than No. 16 AWG.
- 4. Panel wiring shall be routed within wire troughs or panduits.
- 5. Hinge wiring shall be secured at each end with the bend portion protected by a plastic sleeve.
- 6. Analog or dc wiring shall be separated from any ac power or control wiring by at least six inches.
- 7. Terminal blocks shall be provided for all field wiring entering the panel. The greater of 4 or 15% spare terminal blocks shall be provided.
- 8. No more than one wire per screw and yoke termination.

M. Construction:

- 1. Minimum metal thickness: 14-gauge.
- 2. Stiffeners as required to prevent deflection under instrument loading and permit

lifting without racking or distortion.

3. When required, removable lifting rings and fill plugs to replace rings after installation.

N. Miscellaneous Equipment:

- All panels shall be protected from internal corrosion by the use of corrosion inhibiting vapor capsules, Northern Instruments Model Zerust VC, Hoffman, model A-HCI, or equal.
- 2. All sealed panels shall be equipped with combination drain/breathers, Crouse-Hinds model ECD18; or equal.
- 3. When noted on drawings, panels shall be equipped with thermostatically controlled space heaters to maintain internal temperatures above dew point.
- O. All panels shall be manufactured items, Hoffman Engineering, or equal.

2.05 Front Panel Devices

- A. Potentiometer. Units shall meet the following:
 - 1. Three-terminal potentiometers with a total resistance of 1000 ohms and a power dissipation rating of 2 watts
 - 2. Oil-tight construction, rated NEMA 13
 - 3. Resolution of 1 percent, and linearity of plus or minus 5 percent.
 - 4. Panel mounting accommodating panel thickness between 1/16 to ¼ inch.
 - 5. Legend plates with marking as noted.
 - 6. Allen-Bradley, type 800T, or equal.
- B. Selector Switch. Units shall meet the following:
 - Heavy-duty, oil-tight, industrial type selector switches rated for NEMA 4 service.
 - 2. Contacts rated for 120-volt ac service at 10 amperes continuous.
 - 3. Number of positions and contact arrangements as required.
 - 4. Factory-engraved legend plate indicating position definition.
 - 5. Panel mounting accommodating panel thickness between 1/16 to ¼ inch.
 - 6. Black knob type operator.

- 7. Square D Class 9001, Type K; Allen-Bradley type 800T, or equal.
- C. Pushbutton. Units shall meet the following:
 - 1. Heavy-duty, oil-tight, industrial type push buttons rated for NEMA 4 service.
 - 2. Contacts rated for 120-volt ac service at 10 amperes continuous.
 - 3. Number of positions and contact arrangements as required.
 - 4. Factory-engraved legend plate indicating function.
 - 5. Panel mounting accommodating panel thickness between 1/16 to ¼ inch.
 - 6. Operator: Red extended head for STOP, green flush head for START, black flush head for other functions.
 - 7. Square D Class 9001, Type K; Allen-Bradley type 800T, or equal.
- D. Indicating Light. Units shall meet the following:
 - 1. Heavy-duty, oil-tight, push-to-test industrial type with integral transformer for 120V AC application.
 - 2. Rated for NEMA 4 service.
 - 3. Screwed on flat-faced lenses in colors shown on the drawings.
 - 4. Factory-engraved legend plates.
 - 5. Square D type K, Allen-Bradley Type 800T, or approved equal.

2.06 Internal Panel Components

- A. Control/Interposing Relays: All relays shall meet the following:
 - 1. Compact, general-purpose, plug-in type.
 - 2. Socket mounted.
 - 3. Contacts rated for not less than 10 amperes at 120V.
 - 4. Equipped with neon status lights and test buttons.
 - 5. Permanent, legible identification
 - 6. Potter & Brumfield series KRPA or approved equal.
- B. Time Delay Relay. Time delay relays shall meet the following:

- 1. Available functions: On delay, Off delay, or one shot.
- 2. Socket mounted.
- 3. Knob adjustment.
- 4. Contacts rated for not less than 10 amperes at 120V.
- 5. Timing range as appropriate for the application.
- 6. Magnecraft series W211 or approved equal.
- C. Terminal Blocks. Terminal blocks shall meet the following requirements:
 - 1. Terminals capable of accepting 10-26 AWG wire.
 - 2. DIN-rail mounting.
 - 3. Connectors shall be either copper or steel. Use of aluminum connectors shall not be permitted without prior approval of the Engineer
 - 4. Phoenix Contact or approved equal.

2.07 Spares and Expendables

- A. Provide the following spare parts:
 - 1. One spare d.c. power supply of each type provided.
 - 2. Five spare relays of each type provided.
 - 3. Two spare surge protection devices of each type provided
- B. Provide the following expendables:
 - 1. Two year supply of corrosion inhibitor capsules
 - 2. Ten spare fuses of each type and rating supplied.
 - 3. Ten spare indicator light bulbs of each type and color supplied.

3. EXECUTION

3.01 Installation

- A. Control Panels shall be installed at the locations indicated on the Contract Drawings.
- B. Control panels shall be provided to the mechanical subcontractor for installation.
- C. Verify the correct installation of all panels supplied under this Specification Section.

END OF SECTION



SECTION 13325

PROCESS INSTRUMENTATION AND CONTROL SYSTEM PLC SUBSYSTEM HARDWARE

1. GENERAL

1.01 Scope of Work

- A. This Specification Section covers work related to the PLC subsystem hardware for the Process and Instrument and Control System (PICS).
- B. The work specified herein shall be furnished by the same SYSTEM SUPPLIER furnishing services and equipment as defined in 13300.

1.02 Related Work

- A. Related work specified elsewhere includes:
 - 1. Specification Section 13300 defines work associated with the overall PICS.
 - 2. The PLCs will be mounted in control panels under Specification Section 13315.
 - 3. Specification Section 13326 defines programming requirements for the equipment specified herein.

1.03 Submittals

- A. Provide the following submittals specific to the work defined herein:
- B. A PLC hardware shop drawing package that includes the following:
 - 1. Block Diagram: A detailed system block diagram showing all major components. Identify components by model number. Show interconnecting cables diagrammatically (by type and size).
 - 2. Bill of Materials: A list of all components, including all software. Group components by type and include component model number and part number,

- component description, quantity supplied, and reference to component catalog information.
- 3. Descriptive Information: Catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, power consumption, and heat dissipation of all elements. Clearly mark all options and features proposed for this project.
- 4. Installation Details. Equipment installation drawings showing external dimensions, enclosure material and spacing, mounting connections, and installation requirements.

2. PRODUCTS

2.01 General Requirements

- A. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single MANUFACTURER, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.
- B. The equipment furnished shall be designed to operate satisfactorily between 0 degrees C and 40 degrees C at up to 95 percent Relative Humidity (non-condensing).
- C. All equipment furnished shall be designed and constructed so that in the event of power interruption, or temperatures outside the operational range, the equipment specified hereunder shall go through an orderly shutdown with no loss of memory, and resume normal operation without manual resetting when power is restored.

2.02 Programmable Logic Controller (PLC)

- A. PLC shall be implemented using Allen Bradley CompactLogix modules. No other PLC series will be considered. Modules shall be selected from the following list:
 - 1. Central Processor Unit (CPU). Each CPU shall be Allen-Bradley CompactLogix 5069-L320ER or approved equal. A minimum of 2 Mbytes of RAM memory shall be installed. However, the actual amount of memory supplied shall be sufficient to provide 20% unused capacity when the entire PLC program, as provided, is loaded and running. Provide battery back-up sufficient to maintain memory integrity for a minimum of 24 hours to eliminate the need for down-loading system programs from the host computer following temporary (short-term) power failures.

- 2. Each PLC (CPU) shall include bus power supply for CPU and IO modules (MOD) and another bus power supply for field devices (SA). AC and DC devices should be on isolated SA power buses. Provide 5069-FPD Compact I/O Field Potential Distributor Module and terminal kits.
- 3. End Cap. Each PLC (CPU) bank shall expanded within the PCP, when required by manufacturer's design, to additional local (I/O) banks by use of CompactLogix additional power supplies. 5069-FPD Compact I/O Field Potential Distributor Module shall be use as required for IO module power supply. Terminate last I/O bank with appropriate 5069 end cap: 5069-ECR(right side).
- 4. Process interface modules. All I/O modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All terminals shall be provided with unique identification in accordance with approved loop interconnection diagrams. Furnish input/output modules sufficient to accommodate the inputs/outputs shown on the Process and Instrumentation Diagrams contained in the Contract Drawings plus an additional 15% spares of each type. The spares shall be supplied fully wired such that it is only necessary to add field wiring and update the PLC database in order to activate them. The requirements for each type of module are:
- 5. 120VAC Discrete input modules. The module inputs shall be isolated from the PLC and designed to withstand transients and surges without damage. Light emitting diodes, (LED's), one for each input, shall be provided to indicate a closed contact condition. Provide Allen Bradley model 5069-IA16 or approved equal
- 6. Analog input modules. Analog input modules shall include isolated analog inputs and accept differential and/or single ended 4-20 mA dc inputs from field mounted transmitters. Common mode input protection of 30 V. DC minimum shall be provided. Input signal A/D conversion shall be a minimum of 16-bits, with an accuracy of one bit. Provide Allen Bradley model 5069-IF8 series B or approved equal.
- 7. Discrete output modules. Isolation resistance shall be 1,000 ohms minimum at 300 V. DC between any set of field terminals and any other set or earth ground. Isolation voltage shall be 500 V. AC rms minimum between any set of field terminals and any other set or earth ground. Light-emitting diode status indication shall be provided adjacent to each contact output to indicate a closed contact condition. Provide Allen Bradley Relay output modules 5069-OW16 or approved equal.
- 8. Analog output Modules. Analog output modules shall provide isolated 4-20 mA dc signals to adjust set points of local process control stations, pump speed, valve positions, etc. Output load drive capability shall be 750 ohms minimum for each output. There shall be separate D/A conversion circuits for each output which shall convert 16-bit data words into output signals with an accuracy of +/- 1 bit over the full scale output span. Response to station or communication system failure shall be selectable such that upon failure the output would either remain at the last

- value, or go to zero (4mA), as required by the process. Provide Allen Bradley model 5069-OF8 or approved equal.
- 9. All I/O modules shall be provided with manufactured terminal blocks and cables to interconnect with field termination points.
- 10. All analog IO signals leaving the building shall be provided with analog signal isolators.

B. Communication Module:

- 1. Protocol Converter. Converts Ethernet/IP to Modbus TCP/IP protocols. Prosoft Technology, Anybus, Red Lion or approved equal.
- 2. Media Converter. Converts copper Ethernet media to fiber optic media. Moxa or approved equal.
- C. Ethernet Switch. The switch shall be an industrialized, hardened metal DIN-rail mountable enclosure meeting the following requirements:
 - 1. Sufficient fiber and copper ports to support all necessary connections (including future) together with at least two spare ports of each type. Additional Ethernet Switches if needed.
 - 2. Operating Temperature: Up to 80 degrees C.
 - 3. Power Supply Dual redundant 10-49 Volts DC.
 - 4. Appropriate SFP transceivers installed.
 - 5. Surge protection on power inputs and ports leaving the building.
 - 6. Manufacturer:
 - a. Allen Bradley (Stratix 5400)
- D. Operator Interface Terminal. (OIT). The OIT shall be a front panel mounted PC. It shall be connected to its associated PLC and combatable with its hardware, software and communication protocol. It shall provide operator interface for monitoring and controlling all equipment connected to the associated PLC. It shall meet the following requirements:
 - 1. 15 inch, full color resistive touch screen graphical display.
 - 2. Ethernet/IP communication.
 - 3. VTSCADA Graphic Terminal (VGT)
- E. Software: Provide Rockwell Studio 5000 Designer programming software.

2.03 Spares and Expendables

- A. Provide the following spare parts:
 - 1. One of each PLC module including CPU.
 - 2. One of each I/O module
 - 3. One of each communication module
 - 4. One of each power supply type

3. EXECUTION

3.01 Training

- A. Hardware Maintenance: Provide a minimum of one day of hardware training for up to three of the OWNER's personnel in the maintenance of the PICS hardware which shall include:
 - 1. Training in standard hardware maintenance for the equipment provided.
 - 2. Specific training for the actual hardware configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up.
 - 3. Test, adjustment, and calibration procedures.
 - 4. Troubleshooting and diagnosis.
 - 5. Component removal and replacement.
 - 6. Periodic maintenance.
- B. Software Maintenance: Provide a minimum of one day of software training for up to four of the OWNER's personnel in the maintenance and use of the PICS software.
- C. Operator Training. Provide a minimum of one day of training for up to six of the OWNER's personnel in the operation and use of the operator screens.

END OF SECTION

SECTION 13326

PROCESS INSTRUMENTATION AND CONTROL SYSTEM PROGRAMMING

1. GENERAL

1.01 Scope of Work

- A. This Specification Section covers work related to programming the PLC and OIT equipment furnished under other sections of these specifications.
- B. The Work specified herein associated with PCP-1 shall be performed by the SYSTEM SUPPLIER defined in Specification Section 13300.

1.02 Related Work

- A. Specification Section 13300: General Requirements.
- B. Specification Section 13325 defines requirements applicable to the equipment to be programmed hereunder.

1.03 Submittals

- A. Provide an application programming design package that illustrates each individual control strategy using a program flow chart or written description. The descriptions shall also include details of all formulae to be used (e.g. chemical feed, flow paced, etc.). This submittal shall be Approved or Approved As Noted prior to any PLC programming Work. Simply repeating the descriptions provided herein shall not be acceptable.
- B. Provide an OIT programming submittal with copies of all proposed operator graphic screens accompanied by descriptions of the method of operator interaction.
- C. Provide a final documentation package that includes:
 - 1. Licenses in the Owner's name for PLC and, where applicable, OIT programming software.

- 2. Final copies of all programming files on Compact Disk
- 3. A complete printout of all "Annotated" PLC program logic.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.01 PLC Programming – General Monitoring

- A. Provide the following general monitoring functions for analog inputs:
 - 1. For all analog inputs (pseudo and real):
 - a. Provide out of range alarms if the input signal goes outside the instrument's range
 - b. Provide individually operator adjustable emergency high and low alarms when the value goes outside the allowable process range.
 - c. Provide individually operator adjustable high and low alarms when the value goes outside the normal process operating range.
 - d. Provide a dead-band on all alarm settings.
 - e. Issue Return-to Normal alarms whenever the signal returns to within limits.
 - 2. For all flow related analog inputs:
 - a. Monitor for and record minimum and maximum daily 5-minute average values. Record the date and time of occurrence for each.
 - b. Accumulate a running daily total flow. At midnight, transfer the total to yesterday's total and restart from zero.
 - c. Calculate a running daily average flow. At midnight, transfer the value to yesterday's average and restart the averaging.
 - 3. For all level and pressure related analog inputs:
 - a. Monitor for and record minimum and maximum daily values. Record the date and time of occurrence for each.
 - 4. For all analysis analog inputs:
 - a. Monitor for and record minimum and maximum daily values. Record the date and time of occurrence for each.

- b. Calculate a running daily average reading. At midnight, transfer the value to yesterday's average and restart the averaging.
- B. Provide the following general monitoring functions for discrete inputs:
 - 1. For all discrete inputs:
 - 2. Indicate but do not alarm when a discrete signal changes, as expected, as a result of a control command.
 - 3. Alarm whenever an un-commanded change of state occurs
 - 4. For all local control switch position feedback discrete inputs:
 - 5. Issue an advisory alarm to the operator whenever a position change is detected
 - 6. Exclude from any control strategy any equipment whose local switch position precludes control. If an operator attempts to control the device through the system, issue a message indicating that the control cannot be accomplished together with the reason.
 - 7. For all motorized equipment:
 - 8. Accumulate equipment run times based on the running status feedback discrete input.
 - 9. Reset the run time value to zero only on operator command via the OIT.
 - 10. For all device failure discrete inputs:
 - 11. Issue an alarm when the input indicates a device fault
 - 12. Set a software fault for the controlled device that can only be reset by operator action after the fail signal has been removed.
- C. Special Level Monitoring. Based on the level and tank dimensions, continuously calculate the volume of liquid in each storage tank and display on the associated graphic screen.

3.02 OIT Programming

- A. Graphic Standards
 - 1. Owner graphic standards shall supersede others. Refer to 1.01 C for owner standards.

- All operator graphic screens shall include an alarm list at the bottom indicating the most recent alarms colored as defined below under color standards and, at the top, tabs to allow the user to switch to key graphics including the process overview and the alarm list.
- 3. All graphic screens shall, as closely as possible, depict the actual process equipment in three dimensional symbols with fill color depicting current status in accordance with the graphic standards defined below.
- 4. For detailed process graphics where the process is continued on or continued from another graphic, software pushbuttons shall be provided to lead to the appropriate other graphic.
- 5. The owner standard colors shall be used.
- 6. Operator Actions. Operator control of equipment (e.g. start, stop, change of OIT H/O/A switch, set point adjustment, etc.) shall be accomplished by right-clicking on the appropriate graphic symbol which shall cause a pop-up window to appear providing the operator with the available options.
- 7. All adjustable values shall be changeable by the operator via the graphic screens.
- 8. Provide the following general monitoring functions for analog inputs:
 - a. For all analog inputs:
 - 1) Indicate in black text the current value adjacent to the symbol on the graphic.
 - 2) Provide individually adjustable emergency high and low alarms when the value goes outside the allowable process range.
 - 3) Provide individually adjustable high and low alarms when the value goes outside the normal process operating range.
 - 4) Provide a dead-band on all alarm settings.
 - b. For all level signals:
 - 1) Color fill the symbol for the tank or vessel proportionally to indicate the amount contained.
 - 2) Indicate in text the volume contained.
- 9. Equipment Status. Color the symbol for each piece of equipment to reflect its current status (e.g. running, stopped, failed, etc.) in accordance with the graphic standards.
- 10. Equipment Control Status. Adjacent to each piece of equipment indicate its control status, where such is available, as follows:

- a. Local Hardware Hand/Off/Auto switch position in context sensitive text: Hand red, Off black, Auto green.
- b. HMI software Hand/Off/Auto switch position in context sensitive text labeled "HMI": Hand red, Off black, Auto green.
- 11. Set points. Indicate the current value of all set points adjacent to the associated process value. All set points shall be operator adjustable via the process graphics.

B. Graphics

- 1. Provide the following graphic screens, as further detailed below:
 - a. Dechlorination Chamber and Mixers
 - b. Sodium Bisulfate Feed Pumps
 - c. Chemical Tanks (Polymer and Sodium Bisulfate)
 - d. Sludge feed Pumps
 - e. Biosolids Process
- 2. Plant Overview. No control shall be provided directly from this screen (though popup windows are acceptable).
- 3. Control System. Provide a single system block diagram for the system. Indicate the status of each communication link and, via a separate screen or pop-up window, the status of each PLC module.

C. Other OIT Programming

- 1. Alarm Log. Provide a log of all alarms issued by the system. The log shall include the date and time of detection. Provide the operator with the ability to sort the displayed log by any combination of the following:
 - a. Specific equipment.
 - b. Alarm description
 - c. Date and time.
- 2. Trends. Provide trending of all process parameters. Provide the following additional trends:
 - a. Up to eight comparative trends, each with up to four parameters. The parameters in each shall be as OWNER selected.

3.03 PLC Programming – General Control

- A. General Requirements applicable to the control strategies are:
 - 1. All software fault conditions that are set can only be cleared by operator acknowledgement.
 - 2. Wherever in the descriptions the control strategy refers to the operator, it is intended to mean via the Operator Interface Terminal (OIT).
 - 3. All control strategies shall run within the PLC. Data manipulation (calculated analog values, elapsed time functions, event determination) shall be performed by the PLC for the associated equipment it is monitoring. Any resulting values from these manipulations shall be reported as individual registers. The intent is to avoid utilizing the OIT software for this purpose.
 - 4. The control functions described herein are not intended to be complete comprehensive programming logic descriptions. They describe only the general intended control operation required. Provide complete program logic to completely fulfill the functional requirements indicated.
 - Provide all programming necessary to support the functional requirements of the operator graphic screens.
 - 6. Provide complete debugging services to address issues identified by the OWNER or ENGINEER during and after startup until final acceptance.
- B. Common Constant Speed Motor Operator Control. For all constant speed equipment, provide an operator controllable software HAND/OFF/AUTO switch and proceed as follows:
 - 1. While the switch is in HAND run the equipment.
 - 2. While the switch is in OFF, stop the equipment and prevent any start commands.
 - 3. While the switch is in AUTO, take start and stop signals from the appropriate automatic control strategy defined herein.
- C. Common Variable Speed Motor Operator Control. For all variable speed equipment, provide an operator controllable software HAND/OFF/AUTO switch and SPEED potentiometer and proceed as follows:
 - 1. While the switch is in HAND run the equipment at the speed set by the potentiometer.
 - 2. While the switch is in OFF, stop the equipment and prevent any start commands.
 - 3. While the switch is in AUTO, take start, stop, and speed signals from the appropriate automatic control strategy defined herein.

- D. Common Motorized Valve Operator Control. For all valves, provide an operator controllable software OPEN/CLOSE/AUTO switch and POSITION potentiometer where applicable. Proceed as follows:
 - 1. While the switch is in OPEN, open the valve to the position set by the potentiometer.
 - 2. While the switch is in CLOSE, close the valve and prevent any other commands.
 - 3. While the switch is in AUTO, take open, close and position signals from the appropriate automatic control strategy defined herein.
- E. Common PLC Fault Logic for VFD/RVSS/OLR Driven Motors:
 - 1. Low Flow:
 - a. Flow Switch/Limit Switch In the event the flow switch fails to open when the pump is called to run, the alarm signal to the VFD/RVSS/OLR shall stop the VFD/RVSS/OLR from running.
 - b. Flow Meter If the flow rate remains below a minimum setpoint entered by the operator on the OIT or HMI, stop VFD/RVSS/OLR from running.
 - 2. High Temp In the event the motor temperature switch is triggered, the alarm signal to the VFD/RVSS/OLR shall stop the VFD/RVSS/OLR from running.
 - 3. High Discharge Pressure:
 - a. Pressure Switch In the event the high discharge pressure switch is triggered, the alarm signal to the VFD/RVSS/OLR shall stop the VFD/RVSS/OLR from running.
 - b. Pressure Indicating Transmitter If the discharge pressure remains below a minimum setpoint entered by the operator on the OIT or HMI, stop VFD/RVSS/OLR from running.
 - 4. Seal Fail In the event the motor seal fail switch is triggered, the alarm signal to the VFD shall stop the VFD from running.
 - 5. Fault Lockout In the event the lockout relay is triggered due to any failure above, the alarm signal to the VFD/RVSS/OLR shall stop the VFD/RVSS/OLR from running.
 - 6. Fault Reset In failure mode, the pump shall remain in latched alarm state until the failure is no longer active, and lockout relay is reset. If PLC fails to reset the lockout relay after three (3) attempts via OIT, operator shall inspect drives locally to fix fault signals and reset the fault lockout. Operator shall manually restore to normal condition after alarms have been cleared at the VFD/RVSS/OLR.

- 7. Time Relay Relay should be set to an operator adjustable time 0-60 sec before system returns online in the event of a failure.
- F. Common Motorized Equipment Flow Monitoring. For all motorized equipment provided with a dedicated discharge flow meter, issue an alarm and stop the equipment if the flow fails to reach an operator controllable minimum value within an operator adjustable time of being called to start.

3.04 Specific PLC Automatic Control Strategies

- A. Solids and Dewatering Process. Automatic control will be provided by the Process Control Supplier.
- B. Sludge Feed Pumps and Valves Control. Automatic control will be provided by the Process Control Supplier.
- C. Sludge Feed pumping System (Discharging from Digester to Dewatering Press)
 - 1. The sludge feed pumping system shall operate whenever the dewatering drums are operating and will shut down following a shut down of the dewatering press. The sludge feed pumps motor are controlled by VFDs in the Electrical Building supplied by the contractor. The "range of adjustment" for this will be 15 72 Hz.
 - 2. Assign the two sludge feed pumps, one existing and one new, to a DUTY/STANDBY sequence that can be manually overridden by the operator. If any pump is not controllable (i.e H/O/A is OFF, pump is failed), omit it from the sequence. Automatically switch assignments every time sludge pumping stops.
 - 3. In Manual control mode, The Sludge feed pump speed shall be set to a user adjustable speed value.
 - 4. In Automatic flow control mode:
 - a. Provide the following operator adjustable values:
 - 1) FS Target discharge flow
 - 2) FD Percent allowable differential from target discharge flow.
 - b. Provide a PID control loop to adjust the pump speed to maintain a discharge flow of FS. Disable the PID when the flow reaches FS.
 - c. If the flow falls to FS-FD for an operator adjustable time, enable the PID until the flow starts to increase (slope positive) then disable the PID again.
 - d. If the flow rises to FS+FD for an operator adjustable time, enable the PID until the flow starts to decrease (slope negative) then disable the PID again.

- e. When the dewatering system calls for pumping, run the DUTY pump after a user adjustable time delay.
- f. If a pump fails to start or fails while running, automatically call for the STANDBY pump.
- 2. E-stop and Dry-Run protection relay for the Sludge feed pumps shall shut down the pump and cause an alarm in the event they are activated.
- D. Sludge Feed Transfer valves:
 - 1. The Sludge Feed Transfer valves shall open whenever the sludge feed pump is called to run and close following a stop or shutdown of the sludge feed pump plus a user adjustable time delay.
- E. Pump Out Connection Valve. OIT manual control only.
- F. Digester Sludge Transfer PS Valve. OIT manual control only.
- G. Dechlorination Chamber Mixers. OIT manual control only.
- H. Sodium Bisulfate Feed (Dechlorination). This control strategy shall run to eliminate chlorine residual at the Dechlorination Chamber. Establish a DUTY/STANDBY sequence for the pumps that can be manually modified by the operator. Switch the DUTY/STANDBY pump assignment every 24 hours at midnight. Provide an operator controllable software TOTAL TRIM OFF/AUTO switch. Proceed as follows:
 - 1. Provide the following operator adjustable parameters:
 - a. D post CCC residual chlorine.
 - b. T Trim value.
 - c. K scaling factor.
 - d. P percentage of effective chemical in the feed solution.
 - e. AS Target free chlorine residual level (set to zero).
 - f. ASH maximum Dechlorination chamber effluent chlorine residual.
 - g. ASL minimum Dechlorination chamber effluent chlorine residual.
 - 2. Run the LEAD pump at a speed given by the following formula:

Speed% =
$$(D \times T \times K \times F \times 100) / (24 \times P \times Q)$$

Where Q = maximum feed capacity of the pump in g.p.h. and F = plant discharge flow in m.g.d.

- 3. Periodically based on an operator adjustable time, check the Dechlorination chamber effluent free chlorine level (AIT-5540). If it is outside an operator adjustable dead band of AS, issue an advisory alarm and increase (chlorine residual too low) or decrease (chlorine residual too high), as appropriate, the dosage, D, by an operator adjustable percentage.
- 4. When the TOTAL TRIM OFF/AUTO is set to AUTO, check the Dechlorination chamber effluent chlorine residual value every operator adjustable duration (Range: 10-90 minutes, Initial Setting: 15 minutes). If it above ASH or below ASL, issue an advisory alarm and increase (chlorine residual too low) or decrease (chlorine residual too high), as appropriate, T , by an operator adjustable percentage.
- 5. If the DUTY pump fails to start or fails while running automatically call for the STANDBY pump.

3.05 Programming Acceptance

- A. Regardless of any submittal approvals, final acceptance of the system programming will occur during the final Demonstration Test.
- B. The ENGINEER/OWNER reserves the right to require minor changes in the graphics and programming during the test.

END OF SECTION

SECTION 13360

PROCESS INSTRUMENTATION AND CONTROL SYSTEM FIBER OPTIC SYSTEM

1. GENERAL

1.01 Scope of Work

- A. Work includes furnishing, installing, and testing, fiber optic cable links as defined in the Contract Drawings.
- B. The System Supplier defined in Specification Section 13300 shall be responsible for coordinating all aspects of the fiber optic system.
- C. All duct bank installation work covered by this specification shall be performed by a SUB-Contractor experienced in fiber optic cable installation.
- D. It is the ultimate responsibility of the Contractor to furnish a complete and fully operable system that supports the required functions specified elsewhere. The Contractor is to assume full responsibility for additional costs which may result from unauthorized deviations from the specifications.
- E. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the Owner.

1.02 Submittals

- A. Shop Drawings: Submit, in a single package, catalog information, descriptive literature and drawings for all components of the fiber optic system.
- B. Test Procedure: Submit the procedure proposed to be followed during duct bank cable pulls. The procedure shall include data sheets to be used to record cable pull lengths and the attenuation readings before and after installation as defined in Part 3 herein.

1.03 Final Documentation

- A. Provide a complete wiring diagram of the entire fiber optic system including termination numbers at all fiber patch panels.
- B. Distances and installed attenuation of all fiber runs within the duct bank system.
- C. Provide a hard copy of all final documentation and also in electronic format on a Compact Disk.

2. PRODUCTS

2.01 Fiber Optic Cable

- A. Provide fiber optic cable for implementing the fiber links required within the system.
- B. Duct Bank Cable. The fiber optic cable within the duct bank system shall also meet the following requirements:
 - 1. Six pair (12 strand), or as shown on drawings.
 - 2. OS2 single mode fiber.
 - 3. Number of fibers as defined in the Contract Drawings.
 - 4. Indoor/outdoor rated for underground duct bank installation.
 - 5. All dielectric loose tube.
 - 6. Gel-filled.
 - 7. PE outer jacket.
 - 8. Manufacturer: Belden, Corning or approved equal.
- C. Fiber optic cable within buildings shall also meet the following requirements:
- D. Non-conductive, plenum rated
 - 1. Type OFNP
 - 2. PVDF outer jacket
 - 3. Manufacturer: Belden, Corning or approved equal.
- E. Fiber patch cables shall be manufacturer's pre-fabricated two fiber cables with length as required for the application.

2.02 Fiber Patch Panels

- A. Fiber patch panels (FPP) shall be provided at all locations where fiber optic cable enters a building.
- B. FPP located outside shall be NEMA 4X 316 Stainless Steel lockable enclosures.
- C. FPP located indoors shall be NEMA 12 steel lockable enclosures.
- D. FPP shall contain one or more housings with sufficient quantities of ST compatible adaptor panels to accommodate all fibers terminating within the FPP. This requirement includes all dark fibers.
- E. The housing shall be equipped with strain relief for the cables and shall have a lockable access door.
- F. Provide Siecor WCH housing with CCH connector panels or approved equal

3. EXECUTION

3.01 Installation

- A. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Coordinate the work with the Owner and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.
- B. Install suitably sized innerduct in all duct bank conduits. Exposed innerduct shall be labeled with fiber optic warning labels where they enter the duct bank and every three feet in between.
- C. All conduit within buildings shall be labeled every six feet with fiber optic warning labels
- D. All cables within fiber patch panels shall be clearly labeled with destination.
- E. Install all duct bank fiber cable runs in accordance with the manufacturers recommendations and including:
 - 1. Use manufacturer approved cable lubricant.
 - 2. Use a pulling winch that continuously monitors and records the pull tension.
 - 3. Note from the distance markers on the cable the exact length of each installed run and record the information.
- F. All pulling equipment and hardware that will contact the cable shall be sized to maintain the cable's minimum bend radius.

G. Do not utilize a figure-of-eight machine for installation without prior written confirmation of compatibility from both the machine and cable manufacturer.

3.02 Testing

- A. Measure the attenuation of the fiber optic cable prior to installation and determine the average attenuation per foot.
- B. Following installation, measure the attenuation of each run and compare the attenuation per foot readings with those taken prior to installation. Replace any runs whose attenuation per foot reading is more than 10% higher than the pre-installation value.
- C. Provide all special testing materials and equipment.
- D. Coordinate all testing with the Contractor, the Engineer, all affected suppliers, and the Owner.
- E. The Engineer reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.

END OF SECTION

SECTION 15000

MECHANICAL - GENERAL REQUIREMENTS

1. GENERAL

1.01 Description

A. Scope of Work

- 1. Furnish all labor, materials, services, supplies, tools, equipment, transportation and facilities necessary to install complete and operable all mechanical equipment as shown on the Contract Drawings and specified in this Division.
- 2. The Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible.
- The Contractor shall be responsible for all structural and other alternations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Technical Specifications.
- 4. The Work includes, but is not necessarily limited to, the following:
 - a. All treatment facility process equipment.
 - b. Plumbing fixtures, trim, fittings, and equipment.
 - c. Air filtration equipment and accessories.
 - d. All electrical devices required for proper operations of equipment, including motors, starters, control devices, contactors, etc.
 - e. Vibration isolation equipment, devices and accessories.
 - f. Start-up and adjusting.
 - g. Piping, valve and equipment identification.
 - h. Manuals, charts and instructions, guarantees and warranties.

B. Contract Drawings and Specifications

- The Contract Drawings and Specifications shall be considered as complementary, one to the other, so that materials and work indicated, called for, or implied by the one and not by the other shall be supplied and installed as though specifically called for by both.
- 2. The Contract Drawings are to be considered diagrammatic, not necessarily showing in detail or to scale, all of the equipment or minor items.
- 3. In the event of discrepancies between the Contract Drawings and the Specifications, or between either of these and any regulations or ordinances governing work of this Division, the Bidder shall notify the Engineer in ample time to permit clarification and correction before submitting a Bid.
- 4. It is the intent of the Contract Drawings and Specifications to obtain a complete and satisfactory installation. The mechanical and electrical drawings are diagrammatic (not necessarily showing in detail or to scale, all of the equipment or minor items), but are not to be followed as closely as the actual construction of the building and the work of other trades will permit.
- 5. The Contractor shall carefully examine the civil, structural and mechanical drawings and specifications in addition to the electrical and other related trades and sections.
- 6. The structural drawings shall take precedence over the mechanical and electrical drawings with reference structure construction and dimensions. The mechanical and electrical drawings are diagrammatic but are to be followed as closely as the actual construction of the structures and the work of other trades will permit.
- 7. All changes from the Contract Drawings necessary to make the work conform with the structures constructed and to fit the work of other trades or to the rules of the bodies having jurisdiction shall be made by the Contractor at his own expense. The Contractor shall provide shop, installation and detail drawings where necessary to supplement the Contract Drawings.
- 8. The Drawings indicate in diagrammatic form, the arrangements desired for the equipment fixtures, principal apparatus, equipment, etc., and shall be followed as closely as possible. However, the Contractor shall include any additional conduit, boxes and wiring due to structural or other obstructions at no additional cost to the Owner.

C. Safety Requirements

1. In addition to the components specified and shown on the Contract Drawings and necessary for the specified performance, the Contractor shall incorporate in the

design and show on the shop drawings all the safety features required by the current codes and regulations, including, but not limiting to, those of the Occupational Safety and Health Act of 1970, and Amendments thereto.

D. Related Work Specified Elsewhere

Specification Section	Title
01300	Shop Drawings, Submittals and Samples
01650	System Start-up and Demonstration
Division	Description
2	Site Work
11	Equipment
15	Mechanical
16	Electrical
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

- A. All equipment and materials used in this installation shall be new, unused, and undamaged when installed or otherwise incorporated in the Work and shall be standard catalog items of the various manufacturers. No such material or equipment shall be used by the Contractor for any purpose other than that intended or specified, unless such use is specifically authorized in writing by the Owner. No material shall be delivered to the work site workout prior acceptance of shop drawings and data by the Engineer.
- B. Equipment and appurtenances shall be designed in conformity with ANSI, ASME, IEEE, NEMA, OSHA, AGMA, and other generally acceptable applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions or operations. All bearings and moving parts shall be adequately protected against wear by bushings or other approved means. Provisions shall be made for adequate lubrication with readily accessible devices.
- C. Machinery parts shall conform to the dimensions shown on the working drawings within allowable tolerances. The corresponding parts of identical machines shall be made interchangeable. Protruding members such as joints, corners and gear covers shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

- D. **Provide materials and equipment that are standard products of manufacturers** regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship.
- E. Facilities and labor for handling and inspection of all materials and equipment shall be furnished by the Contractor. If the Engineer requires, either prior to the beginning, or during the progress of the Work, the Contractor shall submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the Contract Specifications. Such samples shall be furnished, stored, packed, and shipped as directed at the Contractor's expense.
- F. The Contractor shall submit data and samples sufficiently early in the Project to permit consideration and acceptance before materials are necessary for incorporation into the Work.

G. Service Support

- 1. The equipment items shall be supported by service organizations. **Submit a** certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications.
- 2. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

H. Tolerances

- 1. Machinery parts shall conform to the dimensions indicated on the Drawings within allowable tolerances. Protruding members such as joints, corners, and gear covers shall be finished in appearance.
- 2. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

I. Clearances and Access

- 1. Ample clearance shall be provided for inspection and adjustment. All equipment shall fit the allotted space and shall leave reasonable access room for servicing and repairs.
- 2. Greater space and room required by substituted equipment shall be provided by the Contractor and at his expense.
- 3. **Provide access panels** for access to valves, equipment or any part requiring maintenance or service.

4. Provide minimum sizes of twelve (12) inches by twelve (12) inches for hand access or twenty-four (24) inches by twenty-four (24) inches for personnel access.

J. Safety Requirements

- 1. In addition to the components shown and specified, all machinery and equipment shall be safeguarded in accordance with the safety features required by the current safety codes and regulations of ANSI, OSHA, and local industrial codes.
- The Contractor shall provide for each V-belt drive or rotating shaft a protective guard which shall be securely bolted to the floor or apparatus. The guard shall completely enclose drives and pulleys and be constructed to comply with all safety requirements.
- 3. For fans, the belt guard shall be arranged so as not to restrict the air flow into the fan inlet. Guards shall not interfere with lubrication of equipment.
- 4. Points of operation, ingoing nip points, and machinery producing flying chips and sparks shall be guarded in accordance with the applicable portions of 29 CFR 1910 Subpart 0. Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures.
- 5. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified.
- 6. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters, tools, etc.

1.03 Project Conditions

- A. *Prior to commencement of the Work, the Contractor shall verify conditions, locations, dimensions, and counts at building the Project site*. Submit discrepancies and differences, within thirty (30) calendar days of the Notice to Proceed, to the Engineer for consideration and decision before proceeding.
- B. Obtain full information regarding peculiarities and limitations of space available for installation of all materials under Contract.
- C. Butt all openings, chases and trenches required for introduction of work and equipment and do all backfilling of floors and walls damaged by such cutting. All work completed under this heading must conform in every respect to the finished quality of workmanship and materials used in this construction project.

D. Provide accurate layout, grades and elevations; set sleeves and openings in ample time and take proper precautions to protect all work and equipment from damage. Provide all necessary supports required for the safe and proper installation of electrical equipment.

E. Discrepancies

- 1. All obvious discrepancies in the above mentioned documents shall be called to the attention of the Engineer prior to commencing the Work.
- 2. No extras to the original drawings and specifications will be authorized.
- 3. Questions arising from this inspection and/or from the drawings and specifications shall be submitted, in writing, to the Engineer for clarification and revisions.

F. Contingencies

- 1. In order to obtain a firm price on the cost of the Project, the Contractor shall include in this Bid sufficient contingencies to complete the Work as designed.
- 2. The Contract Drawings reflect the finished required results and any changes necessary to accomplish these results because of field conditions or codes in effect at the time of the Bidding shall not result in any change in cost.

1.04 Error and Omissions

A. Site conditions, budget considerations and code interpretations may change. Therefore, all errors and/or omissions or required clarifications in the above mentioned documents that are discovered by the Contractor and/or subcontractor shall be called to the attention of the Engineer at least seven (7) calendar days prior to the Bid Date.

1.05 Connection to Work of Others

- A. The mechanical subcontractor shall be responsible for the connection of all equipment included in Division 15, *Mechanical*, even when furnished by others. Control wiring shall be under the supervision of the subcontractor furnishing the equipment.
- B. Termination of power wiring shall be performed by the electrical contractor under the supervision of the mechanical contractor. Termination of the low voltage and control wiring shall be performed by the mechanical contractor or designated subcontractor.

1.06 Permits and Inspections

- A. Provide all special permits required for Work under the various Sections of this Division.

 All permits shall be paid for by the Contractor. Reinspection fees, if any, shall be paid for by the Contractor at no additional cost to the Owner.
- B. The Work will be observed by the Engineer during the course of the construction. Provide for inspection by others having jurisdiction during the proper phases. Furnish a certificate of final approval at the completion of final inspection.

1.07 Codes and Standards

- A. The latest edition and revision of the following codes and standards are considered minimum requirements for materials, workmanship and safety where not covered elsewhere in these specifications:
 - 1. Florida Building Code (FBC).
 - 2. National Electric Code (NEC).
 - 3. Where materials and equipment are available under the continuing inspection and laboring service of Underwriter's Laboratories, Inc., furnish materials and equipment bearing such labels.
 - 4. Law 91-596, Occupational Safety and Health Act.
 - 5. Ordinances of the Local Authority having jurisdiction.
 - 6. NFPA, Life Safety Code.
 - 7. ANSI B-31.0 1987 (with addenda, power piping).

1.08 Shop Drawings

- A. The Contractor shall submit in conformance with Section 00700, *General Conditions* and Section 00800, *Supplementary Conditions*, for review by the Engineer, complete sets of detailed and dimensioned working shop drawings showing the construction of the proposed facility and installation of all equipment complete in every respect.
- B. Shop drawings shall be submitted in accordance with the provisions of the Section 01300, Shop Drawings, Submittals and Samples. All shop drawing submittals shall be in an electronic (PDF) form.

- C. Each drawing shall be indexed and/or referenced to the Contract Drawings and Specifications.
- D. No work upon the manufacture or fabrication of any equipment shall be performed until the Engineer's review has been completed.
- E. The review of Shop Drawings by the Engineer will not relieve the Contractor of his responsibility to furnish all necessary material and equipment, and to perform all work required by the Contract Documents.
- F. Certified performance data/curves shall indicate actual test performance of units furnished. The Contractor shall submit, with the shop drawings, layout drawings showing exact installation, piping and foundation details for the units being submitted.
- G. The various Sections in this Division specify additional requirements for shop drawings with which the Contractor shall comply.
- H. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry and technical society reference standards, years of satisfactory service, and other information necessary to establish contract compliance of each item the Contractor proposes to be provided.

I. Drawings

- Drawings shall include/site plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, piping, control panels, accessories, and other items that must be shown to ensure a coordinated installation.
- Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment.
- 3. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

J. Manufacturer's Instructions

- 1. Where installation procedures or part of the installation procedures are required to be in accordance with the manufacturer's instructions, submit printed copies of those instructions prior to installation.
- 2. Installation of the item shall not proceed until the manufacturer's instructions are received. Failure to submit can be cause for rejection of the equipment or material.

K. Certificate of Compliance

 Submit a certificate of compliance from the manufacturer for approval for products, finishes, and equipment as specified in the technical sections whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of the products, equipment, or materials and the referenced standard and shall simply state that the manufacturer certifies that the product conforms to the requirements specified.

a. Reference Standards Compliance

- 1) Where equipment or materials are specified to conform to industry and technical society reference standards of organizations such as, but not limited to, the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters Laboratories (UL), submit proof of such conformance.
- 2) If an organization uses a label or listing to indicate compliance with a particular reference standard, the labor or listing will be acceptable evidence, unless otherwise specified in the individual sections.

b. Independent Testing Organization Certificate

- 1) In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing and approved by the Engineer.
- 2) The certificate shall state that the item has been tested in accordance with the specified organization's test methods, and that the item complies with the specified organization's reference standard.

L. Operation and Maintenance Manuals

- 1. The O&M Manuals shall be compiled and submitted to the Engineer in accordance with Section 01300, Shop Drawings, Submittals and Samples, and 01730, Operation and Maintenance Data.
- 2. O&M Manuals shall be provided for each piece of equipment including individual components and subsystems of complete assemblies. The section of the manual on operation shall describe the function of each component and its relationship to the system of which it is a part. Where several models, options, or styles are described, the manual shall identify the items actually provided.

- 3. All data furnished shall conform to the installation as constructed. Cuts showing other equipment and data not applicable to the installation shall be crossed out and where practical shall be omitted from the manual. The assembly of the manual shall be in a logical manner and each section shall be indexed in the Table of Contents.
- 4. Each manufacturer shall outline a maintenance procedure for his equipment installed and the Contractor shall then compile these procedures in a logical manner to provide a procedure for the operating personnel of the Owner to follow in their day to day operation of the facility.
- 5. Operation and maintenance manuals specified herein are in addition to any operation, maintenance, or installation instructions by the Contractor to install, test, and start up equipment.
- 6. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.
- 7. Additional requirements for Operation and Maintenance Data
 - a. The Contractor shall refer to the respective Sections of the Specifications.
 - b. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Integrator for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF and JPEG formats, no exceptions.
 - c. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "online" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the SCADA System at the treatment facility.

M. Delivery, Storage and Handling

- 1. Handle, store and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Engineer.
- 2. Replace damaged or defective items at no additional cost to the Owner.

N. Posted Operating Instructions

1. Posted operating instructions shall be provided for each system and principal item of equipment as specified in the technical sections for the use of the operation and maintenance personnel. The operating instructions shall include the following:

a. System Descriptive Information

- 1) Wiring diagrams, control diagrams, piping diagrams, control sequence and operating points for each principal system and item of equipment.
- 2) Post instructions where directed.

b. Equipment Instructions

- 1) Attach to or post adjacent to each principal item of equipment and include directions for Start-up, proper adjustment, operating, lubrication, and shutdown procedures; safety precautions, procedure in the event of equipment failure; and other areas as recommended by the manufacturer or each system or item of equipment.
- Print or engrave, and frame under glass or in approved laminated plastic.
 Operating instructions exposed to the weather shall be made of weatherproof materials or enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

O. Electrical Requirements

- Provide electrical components of mechanical equipment and systems such as motors, controllers, contactors and disconnects under Division 11, *Equipment* or Division 15, *Mechanical*, except that controllers indicated as part of motor control centers shall be provided under Division 16, *Electrical*; these components shall meet the minimum requirements as specified in Division 16, *Electrical*, and all additional requirements specified in the section covering the associated mechanical equipment.
- 2. Extended voltage range motors will not be permitted. Provide interconnecting wiring for components of packaged equipment as an integral part of the equipment. Interconnecting power wiring and conduit for field erected equipment and control wiring rated at 100 V or higher and conduit shall be as specified in Division 16.
- 3. Control wiring rated at one hundred (100) volts or less and conduit shall be as specified in Division 13, *Special Construction*, Division 15, *Mechanical*, and Division 16, *Electrical*.

P. Instructions to Operating Personnel

- 1. When specified in other sections, furnish the services of a competent instructor to give full instruction to the Owner's operating personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system.
- 2. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.
- 3. Instruction shall be given during the first regular work week after the equipment or system that has been accepted and turned over to the Owner for regular operation.
- 4. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than four (4) man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.
- 5. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.09 Protective Coatings

- A. All machined surfaces and shafting shall be cleaned and protected from corrosion by the proper type and amount of coating necessary to assure protection during shipment and prior to installation.
- B. Oil lubricated gearing, bearings, etc. are to be shipped with an oil soluble protective coating as recommended by the equipment manufacturer.
- C. Motors, reducers and electric controls shall have the standard factory finish prior to delivery.
- D. Refer to Section 09905, *Piping, Valve and Equipment Identification System*, for painting of equipment and piping and Section 09900, *Painting*, for general painting.

1.10 Product Delivery, Storage and Handling

A. Packaging

1. All equipment to be provided shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed,

- crated, or otherwise completely enclosed and protected during shipment, handling, and storage.
- 2. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times.

B. Protection

- 1. All machined surfaces and shafting shall be cleaned and protected from corrosion by the proper type and amount of coating necessary to assure protection during shipment and prior to installation. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage as specified in Section 09900, *Painting* and Section 09905, *Piping*, *Valve and Equipment Identification System*.
- 2. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

C. Lubrication

1. Grease and lubricating oil shall be applied to all bearings and similar items as necessary to prevent damage during shipment and storage.

D. Marking

- 1. **Each item of equipment shall be tagged or marked** as identified in the delivery schedule or on the Shop Drawings.
- 2. Complete packing lists and bills of material shall be included with each shipment.

E. Fabricated Assemblies

 Fabricated sub-assemblies, if any, shall be shipped in convenient sections as permitted by carrier regulations and shall be properly match-marked for ease of field erection.

F. Responsibility

 The Contractor shall be responsible for all material, equipment, and supplies sold and delivered to the site under this Contract, or directly purchased by the Owner, until Final Project Acceptance by the Owner. In the event any such material, equipment, and supplies are lost, stolen, damaged, or destroyed prior to Final Project Acceptance, the Contractor shall replace same without additional cost to the Owner.

- 2. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract, or ODP equipment, within seven (7) days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract.
- 3. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

G. Delivery

- 1. The Contractor shall arrange deliveries of products in accordance with construction schedules and coordinate to avoid conflict with work and conditions at the site.
 - a. **The Contractor shall deliver products in an undamaged condition**, in the manufacturer's original containers or packaging, with identifying labels intact and legible.
 - b. Immediately on delivery, the Contractor shall inspect all shipments to assure compliance with requirements of Contract Documents and accepted submittals, and that products are properly protected and undamaged.
 - c. Under no circumstances shall the Contractor deliver equipment to the site more than one (1) month prior to installation without written authorization from the Engineer. Operation and maintenance data shall be submitted to the Engineer for review prior to shipment of equipment as described in Section 01730, Operation and Maintenance Data.

H. Storage and Protection of Products

- The Contractor shall furnish a covered, weather-protected storage structure providing a clean, dry non-corrosive environment for all mechanical equipment, valves, electrical and instrumentation equipment, and special equipment to be incorporated into this Project.
- 2. Storage of equipment shall be in strict accordance with the "Instructions for Storage" of each equipment supplier and manufacturer including connection of space heaters, and placing of storage lubricants in equipment. Corroded, damaged, or deteriorated equipment and parts shall be replaced before acceptance of the Project. Equipment and materials not properly stored will not be included in a payment application.
- 3. The Contractor shall store products subject to damage by the elements in weathertight enclosures.

- 4. The Contractor shall maintain temperature and humidity within the ranges required by manufacturer's instructions.
- 5. The Contractor shall store fabricated products above the ground, on blocking or skids, to prevent soiling or staining. The Contractor shall cover products which are subject to deterioration with impervious sheet coverings and provide adequate ventilation to avoid condensation.
- 6. The Contractor shall store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
- 7. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during, and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind whatsoever to the material or equipment.
- 8. Cement, sand, and lime shall be stored under a roof and off the ground, and shall be kept completely dry at all times. All structural and miscellaneous steel and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease, and in a position to prevent accumulations of standing water, staining, chipping, or cracking.
- All materials which, in the opinion of the Engineer, have become damaged and are unfit for the use intended or specified shall be promptly removed from the site of the Work and the Contractor shall receive no compensation for the damaged material or its removal.
- 10. The Contractor shall arrange storage in a manner to provide easy access for inspection. The Contractor shall make periodic inspections of stored products to assure products are maintained under specified conditions, and free from damage or deterioration.

11. Protection After Installation

- a. The Contractor shall provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
- b. The Contractor shall remove covering when no longer needed.

I. Extended Storage Requirements for Equipment

1. Because of the long period allowed for construction, special attention shall be given to extended storage and handling of equipment onsite. As a minimum, the procedure specified herein shall be followed:

- a. If equipment will be stored onsite for more than one (1) month prior to incorporation into the Work, the Contractor shall submit a written request to the Engineer outlining any special provision to be made to protect and maintain the equipment while it is being stored. All such provisions shall be acceptable to the Owner. No equipment shall be stored on-site for more than one (1) month without prior written authorization from the Engineer.
- b. All equipment having moving parts including gears, electric motors, and/or instruments shall be stored in a temperature and humidity controlled building accepted by the Engineer, until such time as the equipment is to be installed.
- c. All equipment shall be stored fully lubricated with oil and grease unless otherwise instructed by the manufacturer.
- d. Manufacturer's storage instructions shall be carefully studied by the Contractor and reviewed by him with the Engineer. These instructions shall be carefully followed and a written record of this review kept by the Contractor.
- e. Moving parts shall be rotated <u>a minimum of once weekly</u> to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment the Contractor shall start the equipment and operate, loaded when possible, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
- f. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. Mechanical equipment to be used in the Work, if stored for longer than ninety (90) days, shall have the bearings cleaned, flushed, and lubricated prior to testing and startup, at no extra cost to the Owner.
- g. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment, equally in both instances. If such a certification is not given, the equipment shall be judged to be defective, and it shall be removed and replaced at the Contractor's expense.
- h. A maintenance log shall be maintained by the Contractor outlining the schedule of maintenance required for each piece of equipment as well as the date on which the maintenance was actually performed and the initials of the individual performing the work. The Contractor shall submit a copy of the maintenance log monthly with his application for payment.

1.11 Pipe and Valve Identification

A. Pipe Identification

- 1. All exposed pipe shall have code letters and flow arrows painted per Section 09905, *Piping, Valve and Equipment Identification System.* The mechanical contractor shall ensure that the pipes are properly marked.
- 2. All underground pipe shall be located by laying plastic warning tape continuously along the run of pipe per Section 09905, *Piping, Valve and Equipment Identification System*.

B. Valve identification

1. The Contractor shall provide a coded and numbered identification tag on all valves, per Section 09905, *Piping, Valve and Equipment Identification System*.

1.12 Nameplates

- A. Provide identification nameplates for all equipment, controls, and apparatus where nameplates and/or data plates are not specified elsewhere.
 - 1. Equipment and apparatus nameplates shall be fabricated from 1½-inch high corrosion resistant metal with one (1) inch high cut-in black letters, permanently secured with stainless steel screws.
 - 2. Controls and switches shall be labeled with one (1) inch high black laminated plastic with $\frac{1}{2}$ -inch white letters to designate functions.
 - 3. The Contractor shall submit a nameplate schedule (proper names and designations) and sample to the Engineer for approval prior to fabrication of the nameplates.
- B. Each piece of equipment shall be provided with a stainless steel data plate securely fastened in a conspicuous place and clearly inscribed with the equipment manufacturer's name, year of manufacture, serial number and principal rating data. These data plates shall not be painted.

1.13 Equipment Cleaning

A. All equipment, piping, duct work, insulation and other work provided under this Division and to receive finish painting by the Contractor shall be thoroughly cleaned and ready for finish painting.

B. Thoroughly inspect all items of equipment and any items dented, scratched or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and approval.

1.14 System Cleaning

- A. Each system of piping shall be blown through, washed out and/or flushed after completion to remove grit, dirt, sand, etc., from coils and piping for as long a time as required to thoroughly clean the apparatus.
- B. All elements within the system that may be damaged by the cleaning operation shall be removed or otherwise protected during the operation.
- C. Repair or replace any control valves or other system components which do not function properly due to damage during the cleaning operation or because of imperfect cleaning of any piping system.
- D. All strainers shall be inspected and cleaned as often as required and left in a clean condition at project completion.

1.15 Protection of Piping, Duct Work and Appurtenances

- A. All duct work, piping, appurtenances, and openings furnished and installed under this Division shall be protected from dirt, foreign objects, and damage during the construction period. Damaged piping, duct work or other appurtenances shall be replaced without additional cost to the Owner, should the damage occur prior to final acceptance of the work by the Owner. As soon as installed, all metal plated or polished fixture trimmings shall be thoroughly covered with non-corrosive grease which shall be maintained until all construction work is completed.
- B. Suitable precautions against freezing shall be taken during cold weather.
- C. All open ends of piping shall be closed by suitable cap or plug fitting to prevent obstruction and damage.
- D. The Contractor shall also be responsible for the work of other trades that may be damaged or disturbed in the course of this work and he shall restore it to the condition existing prior to damage without additional cost to the Owner.

1.16 Field Instructions

- A. Upon completion and start-up of the work and at a time designated, the Contractor shall provide the services of one or more project engineers to work in conjunction with the service engineers and suppliers' representative in instructing the Owner's personnel in the proper operation and maintenance of the equipment.
- B. The project engineer(s) shall also be required to start-up and operate under normal working conditions the entire installation as a unit. These field instructions shall cover all the items contained in the bound instructions.
- C. The instruction period shall be given at the time the facility is operating under normal conditions.
- D. In addition to these requirements, the Contractor shall provide field instructions as specified under the various Sections of the Specifications.

1.17 Framed Instructions

- A. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves and control sequence, framed in laminated plastic, shall be posted within the associated control panels or where directed by the Owner.
- B. In addition, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safety operation and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams.
- C. **Proposed diagrams, instructions and other sheets shall be submitted for approval prior to posting**. The framed instructions shall be posted before acceptance testing of the systems.

1.18 Project Record Drawings

- A. Project Record Drawings shall be submitted to the Engineer before Final Project Acceptance, in accordance with the requirements of Section 01720, *Project Record Documents*. In addition to the details included in Section 01720, submit the following:
 - 1. Exact vertical and horizontal locations of all buried pipes and conduits, giving dimensions from fixed reference points.

- 2. A survey shall show any deviations from contract drawings and such changes shall be reviewed prior to approval, for all tanks and structures.
- 3. Drawings shall show routing of piping indicating valves, cleanouts, and access panels.

1.19 Guarantee and Warranties

- A. The Contractor shall guarantee all work, materials, equipment, etc. against defects for a period of two (2) years from the date of the Final Project Acceptance by the Owner, unless specified otherwise in the Contract Documents, that all the equipment has the capacity specified and that it will operate without excess noise or vibration caused by improper installation.
- B. In addition to the guarantee, the Contractor shall provide the performance warranties as specified for the equipment in the various sections.
- C. The manufacturer's written warranty shall be submitted for all major pieces of equipment, as specified in Section 01740, *Warranties and Bonds*.

1.20 Spare Parts and Special Tools

- A. Spare parts and Special Tools for certain equipment provided under Division 11, *Equipment*, Division 13, *Special Construction*, Division 15, *Mechanical*, and Division 16, *Electrical* have been specified in the pertinent sections of the specifications.
- B. The Contractor shall collect and store all spare parts in an area to be designated by the Engineer. In addition, the Contractor shall furnish to the Engineer an inventory listing of all spare parts and special tools, the equipment they are associated with, and the name, address, telephone and FAX numbers, e-mail address and website of the supplier.

2. MATERIALS

2.01 General Product Compliance

A. General

1. The compliance requirements, for individual products as indicated in the Contract Documents, are multiple in nature and may include generic, descriptive, proprietary,

- performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.
- 2. Also "allowances" and similar provisions of the Contract Documents will have a bearing on the selection process.

B. <u>Procedures for Selecting Products</u>

- The Contractor's options in selecting products are limited by the requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects.
- 2. Required procedures include, but are not limited to, the following for various indicated methods of specifying.

C. Single Product/Manufacturer Name as Basis of Design

- 1. Provide the product indicated, unless "equivalent" products with listed salient features for equivalency are permitted.
- 2. Advise the Engineer before proceeding, where known that the named product is not a feasible or acceptable selection.

D. Two or More Product/Manufacturer Names as Basis of Design

- 1. Provide one of the named products at the Contractor's option; but excluding products that do not comply with the requirements.
- 2. Do not provide or offer to provide an unnamed product, except where none of the named products comply with the requirements or are a feasible selection; advise the Engineer before proceeding.
- E. "Named", except as otherwise indicated, is defined to mean the manufacturer's name for a product, as recorded in published product literature, of the latest issue as of the date of the Contract Documents. Refer requests to use products of a later (or earlier) model to the Engineer for acceptance before proceeding.
- F. Where only compliance with an imposed standard, code or regulation is required, selection from among products which comply with the requirements including those standards, codes and regulations, is the Contractor's option.

G. Performance Requirements

- 1. Provide products which comply with the specific performances indicated, and that are recommended by the manufacturer for the application indicated.
- 2. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance.
- 3. General overall performance of a product is implied where the product is specified for specific performances.

H. Descriptive Specification Requirements

1. Provide products that have been produced in accordance with descriptive requirements, using specified ingredients and components, and complying with specified requirements for mixing, fabricating, curing, finishing, testing and similar operations in the manufacturing process.

I. Visual Matching

- Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Engineer.
- 2. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of the Contract Documents concerning "Change Orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.

J. Visual Selection

- 1. Except as otherwise noted, where specified product requirement include the phrase "... as selected from the manufacturer's standard colors, patterns, textures" or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements.
- 2. The Engineer is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.

2.02 Fabrication and Manufacture

A. Workmanship and Materials

- The Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage or other failure. Materials shall be suitable for all service conditions.
- 2. All equipment shall be designed, fabricated and assembled in accordance with recognized and acceptable engineering and shop practice.
- 3. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable.
- 4. **Equipment shall not have been in service at any time prior to delivery**, except as required by tests.
- 5. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4-inch thick.

B. Lubrication

- 1. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
- Lubricants of the type recommended by the equipment manufacturer shall be furnished by the Contractor in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.
- 3. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform.
- 4. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

C. <u>Drive Units</u>

 Unless otherwise specified, drive units furnished with equipment shall meet the following requirements. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for twenty-four (24) hour continuous service.

2. Gear Reducers

- a. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated anti-friction, rolling element bearings throughout.
- b. Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class 11. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall bear an AGMA nameplate.
- c. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.
- d. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.
- e. Gear reducers which require the removal of parts or periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.
- f. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

D. Safety Guards

1. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a "safety guard". Safety guards shall be

- fabricated form 16 USS gauge or heavier galvanized aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal or Type 316 stainless steel mesh.
- 2. Each guard shall be designed for easy installation and removal.
- All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

2.03 Equipment Foundation and Support

- A. All foundations, platforms and hangers required for the proper installation of equipment shall be furnished and installed by the Contractor.
- B. All floor mounted equipment shall be mounted on a reinforced concrete pad of four (4) inches in height, as a minimum, or as required by the Contract Drawings.
- C. Concrete for pads shall be Class B concrete (3,000 psi) and shall conform to the requirements of Section 03300, Cast-in-Place Concrete.
- D. Reinforcement shall be as shown on the Contract Drawings or as specified in Section 03200, *Concrete Reinforcement*, and all edges shall be chamfered.
- E. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in Section 03600, *Grout*. All open equipment bases shall be filled with non-shrinking grout sloped to drain to the perimeter of the base.
- F. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.
- G. **Equipment suppliers shall furnish suitable anchor bolts for each item of equipment**. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall, unless otherwise specified, have a minimum diameter of ¾-inch. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1½-inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

- H. Anchor bolts required or indicated by the Contract Drawings shall be furnished and built into the concrete foundations.
- Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division shall be provided and installed by Contractor.
- J. All foundations, anchor pads, piers, inertia blocks, pipe supports, and structural steel supports shall be built to template and reinforced as required for loads imposed on them.
- K. The Contractor shall assume all responsibility for sizes, locations and design of all foundations, anchor pads, piers, inertia blocks, pipe supports, curbs and structural steel supports.

2.04 Vibration Isolation

- A. All rotating or reciprocating equipment unless otherwise directed shall be mounted on vibration isolators and provided with flexible connections to isolate the equipment from the structure and/or installation.
- B. Isolators shall produce uniform loading and deflections, regardless of equipment weight distribution, and shall be the product of a manufacturer regularly engaged in the production of such items and who publishes engineering and selection data.

2.05 Shop Painting

- A. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished smooth, thoroughly cleaned and filled as necessary to provide a smooth uniform base for painting.
- B. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade oil-resistant enamel suitable for coating in the field with an alkyd enamel.
- C. All coatings shall be suitable for the environment where the equipment is installed.
- D. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or

- more coats of the specified primer. Unless otherwise specified, the shop primer for steel and iron surfaces shall be Cook "391-167 Barrier Coat", Koppers "No. 10 Inhibitive Primer", or equal.
- E. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound, Houghton "Rust Veto 344", Rust-Oleum "R-9", or equal.

2.06 Noise Attenuation and Control

- A. Unless otherwise specified, the maximum permissible noise level for a complete installed piece of equipment located within or outside a structure **shall not exceed seventy-five** (75) **dB at three** (3) **feet**. A complete piece of equipment includes the driver and driven equipment, plus any intermediate couplings, gears, and auxiliaries.
- B. All equipment provided herein that is specified to be factory and field tested shall be tested as specified herein for noise generation at the equipment manufacturer's expense.
- C. Maximum permissible noise (sound pressure) levels shall be in decibels as read on the "A" weighting scale of a standard sound level meter (dB). All measurements shall be made in relation to a reference pressure of 0.0002 microbar.
- D. Measurements of emitted noise levels shall be made on a sound level meter meeting at least the Type 2 requirements set forth in ANSI S 1.4 Specification for Sound Level Meters. The sound level meter shall be set on the "A" scale and to slow response. Unless otherwise specified for a particular piece of equipment, the point of measurement of sound level shall be made at the specified distance from any major surface along the entire perimeter and at mid-height of the piece of equipment, or at the specified distance from an outer major surface encompassing the sound source including inlets or outlets.

2.07 Fire Hazard Rating

A. All piping, duct work, and equipment insulation, fasteners, and jacketing materials shall have a fire hazard rating not to exceed 25 for flame spread, 50 for fuel contributed, and 50 for smoke developed. Rating shall be determined by ASTM Designation E84, Surface Burning Characteristics of Building Materials. Corresponding ratings determined by Underwriters' Laboratories, Inc., UL-723, Test Method for Fire Hazard Classification of Building Materials, will also be acceptable.

- B. Fire hazard ratings for materials proposed for use shall be substantiated by test results from the National Bureau of Standards, a certified report from an approved testing laboratory, or a UL label or listing.
- C. Flame-proofing treatments will not be accepted.

2.08 Accessories

A. Special Tools and Accessories

 Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

B. Fasteners

1. All nuts, bolts, anchors, washers, and other fastening devices shall be a minimum of Type 304 stainless steel unless otherwise specified.

C. Hardware

- All hardware and accessory fittings shall be of a type designed, intended or appropriate for the use, and complement the items with which they are used, and shall have corrosion protection suitable for the atmosphere in which they are installed.
- 2. All such hardware shall be U.S. Standard Size.

3. EXECUTION

3.01 Field Supervision

- A. The Contractor shall be responsible for compliance with all laws and ordinances governing his work.
- B. The Contractor shall have, at all times, a competent, English speaking superintendent on the Project site.

3.02 Operation and Maintenance

A. Repairs and Replacement - Performance

- 1. Repair and replacements required shall be accomplished as promptly as possible.
- 2. This includes overtime work required to make emergency repairs as promptly as possible.

B. Repairs and Replacement - Expense

 Any repair or replacement required because of established vandalism, fire, windstorm, or other Acts of God, shall be accomplished by the Contractor at his cost prior to Final Project Acceptance and by the Owner and at the Owner's expense after Final Project Acceptance by the Owner.

C. Owner's Inspection

- 1. Periodic inspections and year-end inspections to determine if the maintenance services have been properly performed will be made by the Engineer.
- 2. Evidence of improper performance of service will result in the prompt notification of the Contractor's bonding company.

3.03 Equipment and Materials

- A. Equipment and materials used in this installation shall be "new", "unused" and of the best quality, and unless otherwise noted, shall be the standard catalog items of the various manufacturer's and shall be the manufacturer's latest design.
- B. Equipment and materials shall be installed to fit the allotted space with reasonable access room for servicing and repairs.
- C. Pipe openings shall be kept closed with approved caps or plugs prior to installation. Plumbing fixtures, valves and equipment shall be adequately kept covered and protected against weather, dust, and/or chemical or mechanical injury, and delivered and installed in a condition acceptable to the Engineer. All such items not acceptable shall be replaced at no additional cost to the Owner.
- D. Equipment of similar nature shall be identical. For example, all unit ventilators must be of the same manufacture and of the same style.

3.04 Access

- A. The Contractor shall inform himself fully regarding the peculiarities and limitations of the space available for the installation of materials under this Contract. All devices such as valves, traps, strainers, cleanouts, controls (manual, electric, pneumatic), and other such apparatus, which are concealed above the ceilings or in furred spaces, shall be readily accessible.
- B. Access panels shall be painted to match the adjacent surfaces, unless provided in stainless steel or aluminum.

3.05 Interferences

A. Where interferences occur, and departures from the indicated arrangement are required, the Contractor shall consult with the other trades involved and come to an agreement as to changed locations and elevations of the ductwork and/or piping and shall obtain approval from the Engineer prior to implementing the proposed changes.

3.06 Excavation

- A. The Contractor shall do all excavating and backfilling necessary for installation of the Work. The Contractor shall provide the required compacting.
- B. Pipe trenches shall be sufficiently straight between designated angle points to permit the pipe to be laid true to line in the approximate center of the trench.
- C. All excavations outside the fenced "limit of construction" area shall be backfilled at the end of each work day and adequately marked with barricades, barriers, flashing lights, etc., appropriate to protect public life and safety.

3.07 Installation of Equipment

- A. The Contractor's attention is called to the fact that the project area will be open to public viewing. Therefore, it is the intention of these specifications that all finished work be suitable for such purpose.
- B. The equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary for proper results. When so specified, or when employees of the Contractor or his subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.

- C. The Contractor shall have on-site sufficient proper construction equipment and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled when practical.
- D. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Contract Drawings, unless otherwise directed by the Engineer during installation.
- E. All equipment shall be installed in such a manner as to provide access for routine maintenance including lubrication.
- F. **All rotating equipment shall be statically and dynamically balanced**. Unless otherwise specified, the vibration allowance in the units shall not exceed the upper limits as established by the manufacturer.
- G. Equipment of a portable nature which requires no installation shall be delivered to a location designated by the Owner.
- H. All valves and operators shall be installed in the position shown on the Contract Drawings or as directed by the Engineer if not shown.

I. Tolerances

- 1. **Precision gauges and levels shall be used in setting all equipment**. All piping and equipment shall be perfectly aligned, horizontally and vertically.
- 2. Tolerances for piping and equipment installation shall be 1/8-inch in 50 feet horizontal and vertically.

J. Alignment and Level

1. The equipment shall be brought to proper level by shims (¼-inch maximum). After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bind the machine firmly into place against the wedges or shims. Grout shall be as specified in Section 03600, *Grout*.

K. Contact of Dissimilar Metals

- 1. Where the contact of dissimilar metal may cause electrolysis and where aluminum will contact concrete, mortar, or plaster, the contact surface of the metals shall be separated using not less than one (1) coat of zinc chromate primer and one (1) heavy coat of aluminum pigmented asphalt paint on each surface.
- 2. The Contractor is referred to Section 09900, Painting.

L. Grouting

1. The grout shall be tamped into position with a board, steel bar or other tool. Tamping should not be so hard as to raise or otherwise displace the plate.

M. Cutting and Patching

- All cutting and patching necessary for the work shall be performed by the Contractor. Where interferences occur, and departures from indicated arrangements are required, the Contractor shall coordinate the mechanical work with the other trades involved and make a determination as to changed locations and elevations of ductwork and/or piping and shall obtain approval from the Engineer for the proposed changes.
- 2. The Contractor shall furnish and set pipe sleeves and other accessories and frame other necessary openings.

N. Operation

- All equipment installed under this Contract, including that furnished by Owner or others under separate contract, shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative.
- 2. All required adjustments, tests, operation checks, and other startup activity shall be provided as part of this Project.

3.08 Coordination with Other Trades

- A. The Contractor shall clean all pipe surfaces and hanger rods free of grease, scale, rust and other foreign matter and prepare those materials that need to be painted. Touch-up all factory finishes marred in construction with factory touch-up kits.
- B. Provide motor starters when required for motors specified in the Contract Documents. Provide all control items and wiring diagrams required for this equipment. Electrical items furnished must conform in all respects to the requirements of Division 16, "Electrical".
- C. Where there is a combination of air conditioning ductwork, plumbing, piping, and electrical conduits in the ceilings, walls, piping spaces, and equipment rooms, special care must be exercised to avoid conflict.

- 1. Where elevations of piping are specified on the Contract Drawings, the installation shall be made with extra care after studying the air conditioning and electrical drawings.
- 2. Wherever a crossing is indicated, the installation of the plumbing lines shall be coordinated with the electrical and air conditioning subcontractors prior to the installation of any work.
- 3. Provide the necessary pipe, valves and fittings where required to off-set or re-route piping to clear electrical piping, ducts or conduits.
- D. Coordinate the work with other trades to avoid interferences and obtain the proper fit with related work specified in other Divisions of these Contract Documents.

3.09 Lubrication

- A. The Contractor shall thoroughly lubricate all equipment in accordance with the equipment manufacturer's instructions. Lubricating oils and greases shall be of type and viscosity as recommended by the equipment manufacturer.
- B. All lubricants shall be furnished by the Contractor.
- C. All systems requiring oil lubrication for gearing, bearings, etc., are to be flushed with flushing oils as recommended by the equipment manufacturer. This includes all gearings, bearings, etc., regardless of whether they have been shipped with or without oil soluble protective coatings.
- D. Following flushing, oil lubricated systems shall be filled with "run-in" oil as recommended by the equipment manufacturer. The equipment will be "run-in" at the no-load condition for a minimum period of two (2) hours. Following "run-in" and inspection, the equipment is to be drained and flushed again with flushing oil as recommended by the equipment manufacturer.
- E. The schedule for the above procedures is to be submitted for review by the Engineer at least two (2) weeks prior to the selected procedure starting date. At this time inspection details can be worked out.
- F. The Contractor shall provide a one (1) year supply of all types of lubricants required for the various types of equipment furnished and installed under this Contract. Lubricants shall be in metal containers suitably labeled.

3.10 Cleaning and Adjustment

- A. The Contractor shall keep the premises free from accumulation of waste materials or rubbish caused by his employees on the job, and at the completion of the same, he shall leave the site of his work broom clean.
- B. Enamelware and plated piping shall be left clean and bright. The Contractor shall take proper precautions to protect his work and equipment from damage and disfigurement.
- C. Upon completion of the Work, the Contractor shall clean, oil and grease fans, motors, compressors, pumps, and other running equipment and apparatus and mechanisms as instructed in other sections of this specification.

3.11 Pressure Tests

- A. After installation, all piping shall be pressure tested. Piping shall be tested in accordance with Section 15044, *Pressure Testing of Piping*.
- B. All tests shall be made in the presence of and to the satisfaction of the Engineer and Owner's representative and also, to the satisfaction of any local or state inspector having jurisdiction.
 - 1. **Provide not less than seventy-two (72) hours written notice to the Engineer** and the authority having jurisdiction when it is proposed to make the tests.
 - 2. Any piping or equipment that has been left unprotected and subject to mechanical or other injury in the opinion of the Engineer shall be retested in part or in whole as directed by the Engineer.
 - 3. The piping systems may be tested in sections as the work progresses but no joint or portion of the system shall be left untested.
- C. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
- D. All defects and leaks observed during the tests shall be corrected and made tight in an approved manner and the tests repeated until the system is proven tight.
- E. Repair all damage done to existing or adjacent work or materials due to or on account of the tests.
- F. Provide test pumps, gauges, and other instruments and equipment required for the performance of all tests. Provide all temporary bracing, test plugs, and additional restraint which may be required for test pressures above normal working pressures.

G. All tests shall be maintained for as long a time as required to detect all defects and leaks but not less than the duration specified for each type of pipe or piping system in this Division.

3.12 Observation of Performance Tests

A. Where the specifications require observation of performance tests by the Engineer or Resident Project Representative, such tests shall comply with Article 1.02, *Quality Assurance* in this specification section.

3.13 Test Operation

- A. When equipment is required to be factory tested, *the results of the tests shall be submitted to the Engineer and approval* of the test results shall be obtained before shipment of the equipment.
- B. When an item of equipment, including controls and instrumentation, has been completely erected, the Contractor shall notify the Engineer, who will designate a time to make such tests as required, and operate the item to the satisfaction of the Engineer.

 All testing shall be done in the presence of the Engineer or Resident Project Representative (RPR). "Completely erected" shall mean that the installation is erected, all necessary adjustments have been made, all required utility connections have been made, required lubricants and hydraulic fluid have been added and the unit has been cleaned up and painted (as required).
- C. The Contractor shall furnish labor, lubricants, and all other materials, equipment and instruments necessary for all tests.

3.14 Failure of Tests

A. <u>Defects</u>

- Any defects in the equipment, or deviations from the guarantees or requirements of the specifications, shall be promptly corrected by the Contractor by replacements or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligations under the Contract shall be final and conclusive.
- 2. If the Contractor fails to correct any defects or deviations, or if the replaced equipment, when tested, shall fail again to meet the guarantees or specified

requirements, the Owner, notwithstanding his having made partial payment for such equipment, may reject that equipment and order the Contractor to remove it from the premises at the Contractor's expense.

B. Rejection of Equipment

- 1. In case the Owner rejects a particular item of equipment, then the Contractor hereby agrees to repay the Owner all sums of money paid to him and the Owner agrees to deliver to the Contractor a bill of sale of all his rights, title, and interest in and to the rejected equipment provided, however, that the equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- 2. The bill of sale shall not abrogate the Owner's right to recover damages for delays, losses or other conditions arising out of the basic Contract.
- The Owner hereby agrees to obtain the alternate equipment within a reasonable time and the Contractor agrees that the Owner may use the original equipment furnished by him without rental or other charge until the other equipment is obtained.

3.15 Responsibility During Tests

A. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

3.16 Equipment Manufacturer's Service Representative

- A. An experienced, competent, and authorized representative of the manufacturer of each item of equipment shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer and Owner.
- B. All costs relative to services by equipment manufacturer's service representatives shall be borne by the Contractor and be included in the contract amount.

C. A letter of certification and Check-Out Memo, shall be submitted to the Engineer from the manufacturer's representative, upon completion of a facility visit indicating that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; that the facility personnel have been instructed in the proper use of the equipment; and has been operated under full load conditions and that it operated satisfactorily.

END OF SECTION

SECTION 15041

DISINFECTION OF PIPING AND STRUCTURES

1. GENERAL

1.01 Description

A. Scope of Work

- 1. Furnish all labor, materials, equipment, incidentals and procedures for disinfection of potable water mains and systems by the continuous feed method and by the slug method. The tablet method to disinfect pipelines is unacceptable.
- 2. Disinfection of piping in accordance with AWWA C-651 except as modified below.

B. Related Work Specified Elsewhere

Specification Section	Title
15044	Pressure Testing of Piping
15100	Valves and Appurtenances
Division	Description
15	Piping

1.02 Quality Assurance

- A. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility.
- B. The Contractor shall schedule the rate of flow and locations of discharges in advance to permit review and coordination with the Owner, Engineer and responsible regulatory authorities.

- C. Potable water shall be used for chlorination of structures and pipelines.
- D. The Contractor shall submit a written request for use of water from waterlines of the Owner at least seventy-two (72) hours in advance.

1.03 Submittals

A. The Contractor shall submit shop drawings of pipe and fittings in accordance with Section 01300, *Shop Drawings, Submittals and Samples*. All submittals shall be in an electronic format (PDF).

B. The following items shall be submitted:

- 1. Procedures for disinfection of pipelines and/or structures.
- 2. Materials to be used in the disinfection process.
- 3. Description and literature on the disinfectant to be used including SDS sheets.

2. PRODUCTS

2.01 Liquid Chlorine

- A. Inject with a solution feed chlorination and a water booster pump.
- B. Use an experienced operator and follow the instructions of the chlorination manufacturer.

2.02 Sodium Hypochlorite (Solution)

A. Further dilute in water to the desired concentration and pump into the pipeline or structure at a metered rate.

2.03 Calcium Hypochlorite

A. Dissolve in water to a known concentration in a drum and pump into the pipeline or structure at a metered rate.

3. EXECUTION

3.01 Cleaning and Flushing

A. Prior to the disinfection process, all pipelines and structures to be disinfected under this Contract shall be *cleaned and flushed* to remove sand, loose dirt, and other debris.

B. Pipelines

- 1. The minimum flushing velocity shall be 2.5 feet per second. Flushing shall continue until clean water flows from the main. The Contractor shall endeavor to use the minimum amount of flushing water required to complete the work.
- 2. Temporary blowoffs may be required for the purpose of flushing mains. Temporary blowoffs shall be installed as close as possible to the ends of the main being flushed. Blowoffs installed on the main shall be the same diameter as the main. Temporary blowoffs shall be removed and plugged after the main is flushed. All costs for installing and removing temporary blowoffs shall be at no additional cost to the Owner.
- Blowoffs and temporary drainage piping used for flushing shall not be discharged into any gravity sewer or pumping station wetwell. The Contractor shall obtain prior approvals from the Engineer and the Owner as to the methods and locations of flushing water discharge.

C. Structures

- 1. All structures to be disinfected shall have the interiors pressure washed and cleaned.
- 2. All cleaning water, flushing water and debris shall be removed from the structure.
- D. The Owner shall be notified, in writing, at least seventy-two (72) hours prior to flushing water lines.

3.02 Disinfection of Potable Water Lines

A. Before any portion of the potable water piping system is to be placed in service, it shall be disinfected; and its disinfection shall be demonstrated by bacteriological tests conducted in accordance with <u>Standard Methods for Examination of Water and Wastewater</u>, latest edition, for the coli-aerogenes group, by an approved laboratory, acceptable to the Engineer, County Health Department and FDEP.

- B. All pipe, fittings, valves, and all other appurtenances installed for potable water lines shall be disinfected prior to being placed in service. Disinfection procedures shall be approved by the Engineer and shall be in conformance with ANSI/AWWA C-651, latest revision.
- C. Pipe subjected to contaminating materials shall be treated in a manner approved by the Engineer. Should such treatment fail to remove the contaminants from the pipe, the contaminated sections of pipe shall be replaced with new uncontaminated pipe at no additional cost to the Owner.
- D. Disinfection of a completed line shall be accomplished using the following procedure:
 - All potable water piping, fittings, valves, and appurtenances shall be disinfected with a chlorine solution with a sufficient concentration such that the *initial chlorine* concentration in the potable water line shall be a minimum of 100 mg/L available chlorine, at any point in the line.
 - 2. Chlorine used for the purpose of disinfection shall be sodium hypochlorite (liquid) or high test granular calcium hypochlorite which contains approximately 65 to 70 percent available chlorine by weight. The calcium hypochlorite shall be stored in a cool, dry, and dark environment, prior to its use, to minimize deterioration. The dry calcium hypochlorite will be used to makeup a high concentration chlorine solution which will be used for disinfection. Under no circumstances will undiluted, dry calcium hypochlorite be placed in the pipeline to be disinfected. Upon approval by the Engineer, the Contractor may substitute gaseous chlorine for the above referenced disinfectants. However, the same minimum initial available chlorine residual shall be 100 mg/L.
 - 3. Water from the existing, in-service water line shall be made to flow at a constant, slow rate into the line to be disinfected. Chlorine solution shall be injected or pumped at a regulated rate into the new main, at a point not more than ten (10) feet downstream from the beginning of the new water main. The method of tapping the water main for the chlorine injection point and the location of the tap shall be approved by the Engineer.
 - 4. **The chlorine solution shall be circulated** in the water main by opening the water control valve and systematically manipulating hydrants, valves and blowoffs.
 - 5. Water service lines shall be disinfected in a similar manner as that for water mains, including corrective measures, by methods acceptable to the Engineer.
 - 6. The chlorine solution shall remain in the water lines for no less than twenty-four (24) hours, but longer than twenty-four (24) hours if directed by the Engineer.
 - 7. Extreme care shall be exercised at all times to prevent concentrated chlorine solution from entering existing water mains.

- E. After twenty-four (24) hours, the free residual chlorine concentration in the water line at the pipe extremities shall be at least 20 mg/L; if not, the water lines shall be re-disinfected as described above.
- F. Final flushing of lines may proceed after twenty-four (24) hours, provided the free residual chlorine analysis is satisfactory. Flushing shall be continued until a chlorine residual test shows that lines contain only the normal chlorine residual. Prior to flushing water with high chlorine concentrations, obtain approvals from the Engineer and the Owner as to the methods and locations of discharge.
- G. Following disinfection and thorough flushing of the water lines, as specified herein, the Contractor shall furnish all labor and materials required to obtain samples of water from established points of the water line, in accordance with AWWA C-651, in suitable sterilized containers obtained from the County Health Department or approved analytical laboratory. Two (2) series of successive samples shall be obtained at each established sampling point. Each test series will require two (2) samples at each sampling point. The period between each series of samples shall be a minimum of twenty-four (24) hours. Samples shall be delivered by the Contractor to the County Health Department or approved analytical laboratory for bacteriological examination within six (6) hours after sample collection. Samples shall be collected in conformance with the County Health Department standards and lab testing schedule. Prior to collecting samples, the Contractor shall notify the Engineer and the Owner who will have representatives present during sample collection.
- H. At a minimum, the following number and location of samples shall be collected:
 - 1. One (1) sample for every 1,000 feet of new potable water line.
 - 2. One (1) sample from the end of the line.
 - 3. One (1) sample from each branch.
 - 4. One (1) sample from each point of connection to an existing potable water main.
 - 5. One (1) sample from each occupied building on the treatment facility site.
- I. Bacteriological test results will be available approximately forty-eight (48) to seventy-two (72) hours after samples are submitted. If tests results are unsatisfactory, the Contractor shall immediately re-chlorinate and retest the water lines and proceed with such corrective measures as are necessary to secure disinfected lines. All services shall be re-chlorinated if the lines are re-chlorinated. The water lines shall be re-disinfected and retested, at the Contractor's expense, until approved by the Engineer, Owner, Health Department and Florida Department of Environmental Protection (FDEP).

- J. At satisfactory completion of the bacteriological test requirements, potable water lines shall be placed in service only after receiving official written approval from FDEP through a "Letter of Clearance". Lines shall be placed in service in a manner approved by the Engineer and the Owner. The Contractor shall notify the Engineer and the Owner, in writing, seventy-two (72) hours prior to placing lines in service.
- K. Following the chlorination period, all treated water shall be flushed from the lines at their extremities and replaced with water from the distribution system. All treated water flushed from the lines shall be disposed of by discharging to the nearest sanitary sewer or by other approved means. No discharge to any storm sewer or natural water course will be allowed.

3.03 Disinfection of Structures

- A. Before any structure identified herein is to be placed in service, it shall be disinfected; and its *disinfection shall be demonstrated by bacteriological tests conducted* in accordance with <u>Standard Methods for Examination of Water and Wastewater</u>, latest edition, for the coli-aerogenes group, by an approved laboratory, acceptable to the Engineer, County Health Department and FDEP.
- B. Disinfection of a completed line shall be accomplished using the following procedure:
 - Structures shall be disinfected immediately prior to facility start-up. The
 Contractor and Engineer shall develop a disinfection schedule following substantial
 completion and prior to facility start-up so that the following procedures do not have
 to be repeated.
 - 2. All structures and associated piping, fittings, valves, and appurtenances shall be disinfected with a chlorine solution with a sufficient concentration such that the initial chlorine concentration shall be a minimum of 10 mg/L available chlorine, at any point.
 - 3. Chlorine used for the purpose of disinfection shall be sodium hypochlorite (liquid) or high test granular calcium hypochlorite which contains approximately 65 to 70 percent available chlorine by weight. The calcium hypochlorite shall be stored in a cool, dry, and dark environment, prior to its use, to minimize deterioration. The dry calcium hypochlorite will be used to makeup a high concentration chlorine solution which will be used for disinfection. Under no circumstances will undiluted, dry calcium hypochlorite be placed in the pipeline to be disinfected. Upon approval by the Engineer, the Contractor may substitute gaseous chlorine for the above referenced disinfectants. However, the same minimum initial available chlorine residual shall be 100 mg/L.

- 4. Water from the existing, in-service water line shall be made to flow at a constant, slow rate into the structure to be disinfected. Chlorine solution shall be injected or pumped at a regulated rate into the line feeding the structure. The method of tapping the water main for the chlorine injection point and the location of the tap shall be approved by the Engineer.
- 5. The chlorine solution shall remain in the structures for no less than twenty-four (24) hours, but longer than twenty-four (24) hours if directed by the Engineer.
- C. After twenty-four (24) hours, the free residual chlorine concentration in the water line at the pipe extremities shall be at least 2.0 mg/L; if not, the structure shall be redisinfected as described above.
- D. Following disinfection. as specified herein, the Contractor shall furnish all labor and materials required to obtain samples of water from established points with the structures in suitable sterilized containers obtained from the County Health Department or approved analytical laboratory. Two (2) series of successive samples shall be obtained at each established sampling point. Each test series will require two (2) samples at each sampling point. The period between each series of samples shall be a minimum of twenty-four (24) hours. Samples shall be delivered by the Contractor to the County Health Department or approved analytical laboratory for bacteriological examination within six (6) hours after sample collection. Samples shall be collected in conformance with the County Health Department standards and lab testing schedule. Prior to collecting samples, the Contractor shall notify the Engineer and the Owner who will have representatives present during sample collection.
- E. Bacteriological test results will be available approximately forty-eight (48) to seventy-two (72) hours after samples are submitted. If tests results are unsatisfactory, the Contractor shall immediately re-chlorinate and retest the structures and proceed with such corrective measures as are necessary to secure said structures. The structures failing the bacteriological tests shall be re-disinfected and retested, at the Contractor's expense, until approved by the Engineer, Owner, and Florida Department of Environmental Protection (FDEP).
- F. At satisfactory completion of the bacteriological test requirements, structures shall be placed in service only after receiving official written approval from FDEP.

END OF SECTION

SECTION 15044 PRESSURE TESTING OF PIPING

1. GENERAL

1.01 Description

A. Scope of Work

1. This Section specifies the general requirements for testing (pneumatic, hydrostatic, and leakage) the various piping systems shown on the Contract Drawings and specified elsewhere in these Specifications.

B. <u>Test Pressures</u>

- 1. Test pressures for the various services and types of piping are shown in Table 15044-1, at the end of this specification section.
- 2. Testing of piping shall be at a minimum of 150% of the working pressure.

C. Related Work Specified Elsewhere

Specification Section	Title
15000	Mechanical - General Requirements
15060	Ductile Iron Pipe and Fittings
15065	Polyvinyl Chloride (PVC) Pressure Pipe and Fittings
15100	Valves and Appurtenances

1.02 Submittals

A. Submittals shall be submitted in accordance with Section 01300, Shop Drawings, Submittals and Samples, for the Engineer's review. All shop drawings shall be in an electronic (PDF) format.

B. Testing Plan

- 1. **Submit a testing plan (in a PDF format) prior to testing** and include at least the information that follows:
 - a. Testing dates.
 - b. Piping systems and section(s) to be tested.
 - c. Test type.
 - d. Method of isolation.
 - e. Calculation of maximum allowable leakage for piping section(s) to be tested.
- C. Certifications of Calibration of all testing equipment.
- D. Certified Test Report.

E. Testing Records

- 1. Provide a record of each piping installation during the testing (in a PDF format). These records shall include, but not be limited to, the following:
 - a. Date of the test.
 - b. Identification of the pipeline tested or retested.
 - c. Identification of the pipeline material.
 - d. Identification of the pipe specification.
 - e. The test fluid.
 - f. The test pressure.
 - g. Remarks
 - 1) Leaks identified (type and location).
 - 2) Types of repairs.
 - 3) Corrections made.

- h. Certification by the Contractor that the leakage rate measured conformed to the Specifications.
- i. Signature of the Engineer's or Owner's representative witnessing the pipe test.
- 2. Submit the test records in an electronic (PDF) format to the Engineer's representative upon completion of the testing.

1.03 Reference Standards

- A. American Waterworks Association (AWWA)
 - 1. AWWA C600
 - 2. AWWA M23

1.04 Quality Assurance

- A. Hydrostatic tests consisting of pressure tests and leakage tests shall be conducted on all newly-installed pressure pipes and appurtenances.
- B. The tests shall be in accordance with the provisions listed in this specification and with the provisions of AWWA C600 or M23 as applicable.

2. PRODUCTS

2.01 Tests

A. <u>Hydrostatic Tests</u>

- 1. The testing fluid shall be water for all hydrostatic tests whenever possible.
- 2. In those systems where water cannot be used the test fluid may be either the one to be used in the system or one agreed upon by the Engineer and the Contractor.

B. Service Pressure Tests

1. The fluid for which the system is designed shall be the test fluid.

C. <u>Pneumatic Test</u>

- 1. Compressed air shall normally be used. Other gases may be used when specified or directed by the Engineer.
- 2. Test pressures shall be one hundred ten percent (110%) of the anticipated maximum operating pressure, but not exceeding 100 psig, and not less than 5 psig at the highest point in the system.

2.02 Testing Equipment

A. The Contractor shall provide pressure gauges, pipes, bulkheads, pumps, test plugs, all necessary bracing and restraint, meters and all other ancillary equipment to perform the hydrostatic and/or pneumatic testing.

B. Hydrostatic Testing

- 1. Water: Of sufficient capacity to deliver the required test pressure.
- 2. <u>Strainer</u>: On inlet side of the pump to prevent foreign matter from entering the system.
- 3. Valves: Shall be provided on the suction and discharge side of the pump.
- 4. <u>Heater</u>: To allow heating of the test fluid when elevated temperatures are required for test.
- 5. Relief Valve: Set at a pressure to relieve at 20 to 25 percent above the required test pressure.
- 6. <u>Pressure Gauge(s)</u>: Capable of reaching 50 percent over the test pressure.

 These should be located at the pump discharge and any other place deemed convenient by the Contractor. The pressure gauges shall be marked in one (1) psi increments.
- 7. Pressure gauges and relief valves shall be checked for accuracy before use in all test procedures.

C. Service Testing

1. A pressure gauge capable of registering 25 psi (minimum) over the design pressure shall be installed down-stream from the supply shut-off valve if one is not included in the system. The pressure gauge shall be marked in one (1) psi increments.

D. Pneumatic Testing

- 1. Building supply air to deliver the required test pressure if available, or provide a compressor capable of the required test pressure.
- 2. Valves shall be provided on the discharge side of the pump.
- 3. A relief valve shall be provided to relieve at 10 15 percent over the test pressure.
- 4. **Pressure gauge(s) capable of reaching fifty percent (50%) over the test pressure shall be provided**. A gauge shall be located on the pump discharge and other location as required by the Engineer. The pressure gauges shall be marked in one (1) psi increments.

3. EXECUTION

3.01 Preparation

- A. Pipes shall be in place and anchored before commencing pressure testing.
- B. Conduct the hydrostatic and/or pneumatic tests on exposed and aboveground piping *after* the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. Before conducting the hydrostatic tests, flush all pipes with water to remove dirt and debris. For pneumatic tests, blow air through all of the pipes.
- D. Test new pipelines which are to be connected to existing pipelines by isolating the new line from the existing line by means of pipe caps, special flanges, or blind flanges. After the new pipeline has been successfully tested, remove all caps or flanges and connect to the existing piping.
- E. Conduct hydrostatic tests on buried pipe after the trench has been completely backfilled. The pipe may be partially backfilled and the joints left exposed for inspection for an initial leakage test. Perform the final leakage test, however, after completely backfilling and compacting the trench.
- F. The Contractor shall provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove all temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid is obtained.

- G. The Contractor shall provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Drain the pipes after they have been tested.
- H. The Contractor shall notify the Engineer, in writing, a minimum of seventy-two (72) hours prior to conducting the pressure testing.

I. Chlorine Piping

1. Chlorine piping shall be tested, dried and cleaned in accordance with the requirements of the Chlorine Institute, Pamphlet 6.

J. New Piping Connected to Existing Piping

1. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges or as acceptable to the Engineer.

K. Items that do not require Testing

- 1. Piping between wet wells and wetwell isolation valves.
- 2. Equipment seal drains.
- 3. Tank overflows to atmospheric vented drains.
- 4. Tank atmospheric vents.

L. Cleaning

- 1. Before conducting hydrostatic tests, flush all pipes with water to remove dirt and debris. For pneumatic test, blow air through the pipes.
- 2. Maintain a flushing velocity of at least 2.5 feet per second for water testing and at least 2,000 feet per minute for pneumatic testing. Flushing shall continue until clean water flows from the pipeline. The minimum amount of flushing time shall be as follows:

$$T = 0.667 L$$

Where: T = Flushing Time (seconds)

L = Pipe Length (feet)

M. Performed all required disinfection after hydrostatic testing is complete and acceptable, in accordance with these specifications.

N. Length of Test Section for Buried Piping

1. The maximum length of the test section for buried pipe shall be as follows:

Pipe Diameter (inches)	Maximum Allowable Test Section Length (feet)
≤ 12	3,500
> 12	5,280

2. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

O. Initial Pipeline Filling for Hydrostatic Testing

1. The maximum rate of filling shall not cause the water velocity in the pipeline to exceed one-half $(\frac{1}{2})$ foot per second.

P. Gravity Piping

- 1. Perform testing after service connections, manholes and backfilling have been completed between stations to be tested.
- 2. Determine the groundwater level at the time of testing by excavating exploratory holes or other methods acceptable to the Engineer.

Q. Pressure Test

- 1. All tests shall be made in the presence of and to the satisfaction of the Engineer and/or Owner and also, to the satisfaction of any local or state inspector having jurisdiction.
 - a. **Provide not less than seventy-two (72) hours written notice to the Engineer, Owner**, and the authority having jurisdiction when it is proposed to make the tests.
 - b. Any piping or equipment that has been left unprotected and subject to mechanical or other injury, in the opinion of the Engineer, shall be retested in part or in whole as directed by the Engineer.

- c. The piping systems may be tested in sections as the work progresses, but no joint or portion of the system shall be left untested.
- 2. All elements within the system that may be damaged by the testing operation shall be removed or otherwise protected during the operation.
- 3. Repair all damage done to any existing or adjacent work or materials due to or on account of the tests.

3.02 Inspection and Testing

- A. Hydrostatic Testing of Above Ground or Exposed Piping
 - 1. **The maximum filling velocity shall be 0.50 feet per second**, applied over the full area of the pipe.
 - 2. Open vents at high points of the piping system to purge air while the pipe is being filled.
 - 3. Subject the piping system to the test pressure indicated.
 - 4. Maintain the test pressure for a minimum of four (4) hours.
 - 5. Examine all joints, fittings, valves, and connections for leaks.
 - 6. The piping system shall show no leakage or weeping.
 - 7. Correct leaks and retest until no leakage is obtained.

B. Hydrostatic Testing of Buried Piping

- 1. Testing shall begin after backfilling operations have been completed. Expel air from the piping system during filling.
- 2. Where any section of the piping contains concrete encasement, do not make the pressure test until at least ten (10) days after the concrete has been poured. When testing mortar-lined piping, fill the pipe to be tested with water and allow it to soak for at least forty-eight (48) hours to absorb water before conducting the pressure test.
- 3. Apply and maintain the test pressure by means of a hydraulic force pump.

 **Maintain the test pressure for a minimum duration of four (4) hours. After the

test pressure is reached, use a meter to measure the additional water added to maintain the pressure during the four (4) hours. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the following formula:

a. AWWA C-600 Ductile Iron Mains

$$V = \underbrace{\begin{array}{c} S \times D \times 7P \times T \\ 133,200 \end{array}}$$

b. AWWA Manual No. M-23 PVC Mains

$$V = \underbrace{0.90 \times S \times D \times 7P \times T}_{133,200}$$

c. Where: V = Allowable Leakage (gallons)

S = Length of Pipe Tested (feet)

D = Diameter of the Pipe Tested (inches)

P = Specified Test Pressure (psig)

T = Pressure Test Time (hours)

d. Repair and retest any and all pipes showing leakage rates greater than that allowed.

C. Pneumatic Testing

- This procedure for a pneumatic test of piping systems shall be used when directed by the Engineer when water, or other liquid, cannot be introduced into the line, or as a supplement to a hydrostatic test. It shall not be used to test non-metallic (plastic) pipe, including, but not limited to, PVC, CPVC, E-CTFE, etc.
- 2. All pneumatic tests shall be done under the supervision of Contractor and in the presence of the Engineer and/or Owner's representative.
- 3. The Engineer and the Owner must be informed, in writing, at least seventy-two (72) hours prior to the proposed pressure test.

- 4. Only those people actively participating in the test shall be allowed in the test area. Protect test personnel and the Owner's/Engineer's operating personnel.
- 5. Safety glasses and hard-hats must be worn.
- 6. Perform tests only after the piping has been completely installed including supports, hangers and anchors. Secure piping to be tested to prevent the pipe from moving and to prevent damage to adjacent piping and equipment. Remove or isolate from the pipe any appurtenant instruments or devices that could be damaged by the test, prior to applying the test.
- 7. Fluid: Oil-free, dry air.

8. Procedure

- a. The test pressure shall be 150% of the working pressure.
- b. Apply an initial pneumatic test pressure of 25 psig maximum to the piping system prior to final leak testing, to locate visible leaks. Apply a soap bubble mixture to joints and connections, and examine the system for leakage.
- Correct visible leaks and repeat the preliminary test until all visible leaks are corrected.
- d. **Gradually increase the pressure in the system to one-half (50%) of the test pressure**. Thereafter, increase the pressure in steps of approximately one-tenth of the specified test pressure until the required test pressure has been reached.
- e. Maintain the pneumatic test pressure continuously for a minimum time of four (4) hours and for such additional time as may be necessary to conduct a soap bubble examination for leakage.
- f. The piping system shall show no leakage. Correct any visible leakage and retest. All leaks shall be noted on the Pressure Test Record Form.
- g. After satisfactory completion of the test, vent the line and allow it to return to atmospheric pressure. Connection can then be made to the supply line as necessary.

D. Hydrostatic Test for Gravity Piping

1. The testing equipment accuracy shall be ± 0.5 gallons of water leakage under the specified conditions.

2. The maximum allowable leakage shall be 0.10 gallons per hour per inch diameter per 100 feet. Include service connection footage in the test section, subjected to the minimum head specified.

3. Gravity Sanitary and Roof Drain Piping

- a. Test with fifteen (15) feet of water to include the highest horizontal vent in filled piping.
- b. Where vertical drain and vent systems exceed fifteen (15) feet in height, test systems in fifteen (15) foot vertical sections as piping is installed.

4. Exfiltration Test

a. Hydrostatic Head

- 1) At least six (6) feet above the maximum estimated groundwater level in the section being tested.
- 2) No less than six (6) feet above the inside top of the highest section of pipe in the test section, including service connections.

Infiltration Test

a. Groundwater Level

- 1) At least six (6) feet above the inside top of the highest section of pipe in the test section, including service connections.
- Piping with a groundwater infiltration rate greater than the allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.

7. Defective Piping Sections

a. Replace or test and seal individual joints, and retest as specified.

E. Pressure Testing of Double-Walled Containment Piping

1. Test the primary pipe as described for buried and aboveground or exposed piping.

2. Test the secondary containment piping by performing a pneumatic test as described above of the annual space between the primary and secondary pipes at a pressure of 5 psi.

F. Repetition of Test

- 1. If the actual leakage exceeds the allowable leakage, locate and correct the faulty work and repeat the test.
- 2. Restore the work and all damage resulting from the leak and its repair. Eliminate visual leakage.

G. Test Pressure

1. All pipe shall be tested at the pressures shown in Table 15044-1 and at a minimum of 150% of the normal working pressure of the pipe.

END OF SECTION

TABLE 15044-1

PIPING PRESSURE TEST SCHEDULE

Service	Pipe Designation	Test Pressure (psig)
Chemical Vacuum Pipe	CG	See note 3
Chemical Solution Lines		150
Domestic Water Pipe	DW	150
Gravity Flow Pipe	DR	See notes 2 and 3
Irrigation Pipe	IW	150
Non-Potable Water	NPW	150
Potable Water	PW	150
Pressure Process Pipe	RW, PW, FW	150
Reuse Water	RW	150

NOTES

- 1. Piping not listed and sections of piping in gross conflict with the listed pressure, with the prior approval of the Engineer, shall be tested at a minimum of 150% of the working pressure.
- 2. Non pressure process piping shall be tested at 150% of the maximum head pressure on the pipe.
- 3. Gravity drain lines within buildings shall be hydrostatically tested by capping or plugging drain lines and system ends and filling the system through the vent lines to the top of the vents. Leaking shall be calculated from this static head pressure and amount of water required to refill the vent pipe after the test duration.

SECTION 15060 DUCTILE IRON PIPE AND FITTINGS

1. GENERAL

1.01 Scope of Work

- A. Furnish all labor, materials, equipment, gaskets, accessories and incidentals required to install, disinfect, and test ductile iron pipe, fittings and appurtenances of the sizes and in the locations shown on the Contract Drawings and as specified herein.
- B. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes, or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- C. All wastewater ductile iron piping shall have an interior lining of Protecto 401 Ceramic Epoxy. All buried ductile iron pipe and fittings shall have a bituminous exterior coating.

1.02 Related Work

A. The Contract Documents include, but are not limited to, the following related sections:

Specification Section	Title
01600	Materials and Equipment
02200	Earthwork
02220	Excavation, Backfill and Compaction
09900	Painting
09905	Piping, Valve and Equipment Identification System
15000	Mechanical - General Requirements
15041	Disinfection of Piping and Structures

Specification Section	Title
15044	Pressure Testing of Piping
15100	Valves and Appurtenances
15125	Pipe Hangers and Supports
Contract Drawings and General Provisions of the Contract	

1.03 Reference Standards

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION	
American Society for Testing and Materials (ASTM)		
ASTM A-307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength	
ASTM C-150	Standard Specification for Portland Cement	
ASTM D-1248	Standard Specification for Fusion-bonded Polyethylene Lining for Water	
American National Standards Institute (ANSI) / American Water Works Association (AWWA)		
.ANSI/AWWA C104/A21.4	American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.	
ANSI/AWWA C105/A21.5	American National Standard for Polyethylene Encasement for Ductile- Iron Piping for Water and Other Liquids	
ANSI/AWWA C110/A21.10	American National Standard for Ductile-Iron and Gray Iron Fittings, 3-inch through 48-inch (75mm Through 1200mm) for Water and Other Liquids	
ANSI/AWWA C111/A21.11	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings	
AWWA C115	Standard for Flanged Ductile-Iron Pipe	
ANSI/AWWA C150/A21.50	American National Standard for the Thickness Design of Ductile-Iron Pipe	
ANSI/AWWA C151/A21.51	American National Standard for Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids	
ANSI/AWWA C153/A21.53	American National Standard for Ductile- Iron Compact Fittings, 3-inch through 60-in, for Water and Other Liquids	
ANSI B16.1	American National Standard for Cast Iron Pipe Flanges and Fittings	

STANDARD	DESCRIPTION	
American Water Works Association (AWWA)		
AWWA C600	AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances	
AWWA C651	AWWA Standard for Disinfecting Water Mains	
American National Standards Institute (ANSI)		
ANSI B 16.1	Cast Iron Pipe Flanges and Flanged Fittings	
National Science Foundation (NSF)		
NSF No. 60	Drinking Water Treatment Chemicals - Health Effects	
NSF No. 61	Drinking Water System Components - Health Effects	
Miscellaneous		
CIPRA Standard	Standard for Threaded Flanges	

B. Where reference is made to one of the above standards, the revision in effect at the time of the Bid Opening shall apply.

1.04 Quality Assurance

- A. All ductile iron pipe and fittings shall be from a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. All ductile iron pipe and fittings to be installed under this Project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish, in duplicate, to the Engineer, sworn certificates of such tests and their results prior to the shipment of the pipe.
- B. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.
- C. Inspection of the pipe and fittings will also be made by the Engineer or representative of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the Project site.

- D. All ductile iron pipe and fittings shall be permanently marked with the following information:
 - 1. Manufacturer, date.
 - 2. Size, type, class, or wall thickness, length dimension.
 - 3. Standard produced to (ANSI/AWWA, ASTM, etc).

E. Construction Requirements

- 1. All pipelines shall be installed with at least three (3) feet of cover, unless otherwise shown or indicated on the Contract Drawings.
- 2. For underground utilities, changes in horizontal alignment of less than 11¼□ may be achieved through the use of allowable pipe deflection in lieu of fittings shown on the Contract Drawings at the Contractor's option, but subject to approval of the Engineer as to layout. Said deflection shall not exceed seventy-five percent (75%) of the maximum allowable deflection as stated in the pipe manufacturer's installation instructions.
- 3. All piping installed underneath structures or concrete slabs shall be ductile iron Pressure Class 250 for 14-inch pipe and larger and Pressure Class 350 for 12-inch pipe and smaller and shall be concrete-encased.

F. Supplier / Manufacturer

1. All pipe shall be as manufactured by the American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, McWane Cast Iron Pipe Co., or approved equal.

1.05 Submittals

- A. All shop drawings shall be submitted to the Engineer for approval in accordance with Section 01300, *Shop Drawings, Submittals and Samples*, prior to construction. *All shop drawing submittals shall be in an electronic (PDF) format*.
- B. Submit to the Engineer, within fifteen (15) days of the Effective Date of the Agreement, the name of the pipe and fitting suppliers, their addresses, phone numbers, FAX numbers, e-mail addresses, and a list of materials to be furnished.
- C. The Contractor shall submit shop drawings, including layouts within, and under buildings and structures, to the Engineer for approval.

D. **Shop drawing submittals shall include, at a minimum**, the following:

- A laying schedule and marking diagrams which indicate the specific number of each pipe and fitting, the location and direction of lay of each pipe and fitting in the completed line shall be submitted to the Engineer. In addition, the laying schedules shall include, but not limited to, the following:
 - a. Order of installation and closures.
 - b. Pipe invert elevation and station at each change of grade and alignment.
 - c. The station and invert elevation to which the bell end of each pipe will be laid.
 - d. Elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.
 - e. The limits of each reach of pipe thickness class and of restrained joints.
 - f. The limits of each reach of concrete encasement or encasement in casing.
 - g. Locations of closures for length adjustment and for construction convenience.
 - h. Locations of manholes and other points of access for placement of mortar lining, field joints and removal of test bulkheads.
 - i. Locations of valves and other mechanical equipment.
 - j. Methods and locations of supports.
- 2. Details of special elbows and fittings.
- 3. Calculations and test data demonstrating that the proposed restrained joint arrangement can transmit the required forces with a minimum safety factor of 1.50.
- 4. Copy of the manufacturer's quality control check of pipe material and production. Include hydrostatic test records and acceptance test records. For each acceptance test, submit a stress-strain diagram showing yield strength, yield point, tensile strength, elongations, and reduction in area. Provide specimen test section dimensions and speed and method used to determine speed of testing, method used for rounding of test results, and reasons for replacement specimens, if any. Submit ring bending test of pipe of the same diameter and pressure class as the pipe required for this Project to prove ring bending stress at 48 ksi results in a factor of safety of 2.0.

- 5. Provide an affidavit of compliance with AWWA standards referenced in this specification section.
- 6. Coatings and linings applied, materials and thicknesses (dft).
- 7. Details of restrained and flexible joints.
- 8. Couplings.
- 9. Flexible expansion joints, tie-rods, and flange coupling adapters.
- Joint lubricant.
- 11. Temporary plug and anchorage systems for hydrostatic pressure tests.
- 12. A test report on the physical properties of the rubber compound used in the gaskets.
- 13. Drawings or manufacturer's data sheet showing flange facing, including design of facing serrations.
- E. Submit the anticipated production and delivery schedule for the Project materials.

1.06 Delivery, Storage and Handling

- A. All pipe and fittings shall be shipped and stored at the Project Site in accordance with DIPRA's *Guide for the Installation of Ductile Iron Pipe* and the pipe manufacturer's recommendations.
- B. The Contractor shall exercise care in loading, transporting, and unloading to prevent injury to the pipe. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be used in pipe handling.
- C. *Materials, if stored, shall be kept safe from damage*. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times.
- D. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Wood lagging shall be required between pipes such that pipes do not make contact with one another. Stacking shall conform to manufacturer's recommendations.

- E. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.
- F. The Contractor shall exercise extra care when handling epoxy, cement and polyethylene lined pipe and fittings. Damage to the lining will render it unfit for use and shall require replacement, unless repair to the lining can be made in accordance with AWWA C104.

1.07 Job Conditions

A. Water in Excavation

- 1. Water shall not be allowed in the trenches while underground pipes, fittings, valves and/or accessories are being laid and/or tested.
- 2. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the Engineer. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.
- 3. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately plugged during construction by the use of approved stoppers and not by improvised equipment.
- 4. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such materials has entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

1.08 Warranties and Guarantees

- A. The manufacturer shall guarantee that the equipment and materials furnished is suitable for the purpose intended and free from defects of design, material and workmanship.
- B. The ductile iron piping and fittings shall be unconditionally warranted by the manufacturer for a period of five (5) years from the date of Final Project Acceptance by the Owner.
- C. Warranties shall be provided for all equipment in accordance with the Project General Conditions and Section 1740, *Warranties and Bonds*, unless specified otherwise.

- D. In the event that any equipment or material fails to perform as specified herein, the equipment manufacturer shall promptly repair or replace the defective equipment at no additional cost to the Owner.
- E. This warranty is in addition to any other warranty required by the Contract Documents.

2. PRODUCTS

2.01 Materials

A. General

- 1. Pipe shall have a minimum rated water working pressure of 250 psi and shall be furnished in laying lengths of twenty (20) feet or less, unless specifically shown otherwise on the Contract Drawings.
- 2. All ductile iron pipe shall conform to ANSI A-21.51 and AWWA C-151.
- 3. If not otherwise specified, provide the following:
 - a. Flanged joints for exposed piping.
 - b. Standard mechanical joints, restrained joints, or rubber-ring type push-on joints for buried piping.

B. Pipe Markings

- Plainly mark each length of straight pipe and each fitting at the bell end to identify
 the design pressure class, the ductile-iron wall thickness, and the date of
 manufacture, and the proper location of the pipe item by reference to the layout
 schedule.
- 2. Mark the spigot end of restrained joint pipe to show clearly the required depth of insertion into the bell.

C. Ductile Iron Pipe (DIP)

1. Exposed (Flanged) Pipe

a. Fabricated in accordance with requirements of AWWA C 151, Thickness Class 53 (Special Class).

2. Buried (Non-Flanged) Pipe

- a. Non-flanged pipe shall conform to AWWA C150/C151 and ANSI A21.51 for material, pressure, thickness, dimensions, tolerances, tests, markings, and other requirements. The pipe shall be supplied in standard lengths as much as possible.
- b. Thickness design shall be a minimum Class 350 for diameters up to twelve (12) inches and minimum Class 250 for piping diameters fourteen (14) inches and larger.
- 3. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
- 4. Pipe for use with split type couplings shall have ends with cast or machined shoulders or grooves that meet the requirements of the coupling manufacturer.
- 5. Pipe supplied shall be supplied in lengths not in excess of twenty (20) feet having rubber-ring push-on joints, standard mechanical joints or restrained joints where required for underground piping and flanged joint piping, for all above grade piping as shown on the Contract Drawings.

D. Coatings and Linings

1. Exterior Coating for Buried Pipe

- a. Ductile iron pipe, fittings, and specials to be installed underground shall be coated on the exterior at the factory with two coats, 1 mil DFT per coat, of bituminous coating (ANSI A21.4), minimum.
- b. All clamps, bolts, nuts, studs, and other uncoated parts of joints for underground installation shall be coated with a bituminous coating prior to backfilling. The bituminous coating shall meet ANSI A21.4 and shall be 2 mils, DFT, minimum.

2. Exterior Coating for Exposed Pipe

- a. Ductile iron pipe, fittings, and specials to be installed aboveground shall be furnished with a shop applied primer on the exterior. The shop primer shall be as specified in Section 09900, *Painting*.
- b. Exposed piping shall be painted in accordance with Sections 09900, *Painting*, and 09905, *Piping*, *Valve and Equipment Identification System*.

3. Cement-Mortar Interior Lining

- a. Cement mortar linings are to be used, where indicated on the piping schedule for potable water applications.
- b. All cement mortar linings shall be in accordance with ANSI 21.4.
- 4. <u>Ceramic Epoxy Interior Lining Wastewater, Sludge/Biosolids, Reclaimed Water and Reject Water</u>
 - a. **Ductile iron pipe, fittings, and specials shall be lined with Protecto 401 Ceramic Epoxy**, a high build multi-component amine cured Novalac epoxy lining, containing at least twenty percent (20%) by volume of ceramic quartz pigment, manufactured by Indurall Coatings, Inc., Birmingham, AL, or approved equal.
 - b. The interiors of the ductile iron pipe, fittings, and specials shall receive forty (40) mils dry film thickness (DFT) of the ceramic epoxy protective lining. Storage, surface preparation, application, and safety precautions shall strictly follow manufacturer's instructions.
 - c. **Test the lining thickness using a magnetic film thickness gauge**. Conduct testing in accordance with SSPC-PA-2, Film Thickness Rating. Test for pinholes with a non-destructive 2,500 V test. Repair all defects prior to shipment.
- 5. The pipe manufacturer shall label, in large legible lettering on the exterior of the pipe, the type of pipe interior lining.
- 6. Air service piping shall be unlined.

E. Fittings

- 1. Fittings for ductile iron pipe shall be either mechanical joint, restrained joint, flanged joint, or grooved-end coupling as indicated on the Contract Drawings and shall have a *minimum working pressure of 250 psi*.
- Fittings shall be ductile iron and shall conform to ANSI/AWWA C110, ANSI/AWWA C111 and ANSI/AWWA C153, latest revisions, for flanged and mechanical joint pipe, and grooved-end fittings shall conform to AWWA C110 and ANSI B16.1 with grooved ends conforming to AWWA C606, radius cut rigid joints.
- 3. Fitting material shall conform to ASTM A-48, Class 30, or ASTM A-126, Class B.
- 4. All flanged fittings shall be Class 125 (ANSI B-16.1) unless otherwise specifically noted.

- 5. Fittings shall be coated and lined as specified above in Article 2.01(D).
- 6. The rubber gaskets for flanged, mechanical, and push-on joints shall be as described in herein.
- 7. Fittings and couplings shall be furnished by the same manufacturer.

F. Joints

1. General

- a. Joints in "*runs*" of aboveground (exposed) piping or piping located in vaults and structures shall be flanged or rigid radius grooved end.
- b. Joints in "runs" of buried piping shall be of the push-on, mechanical, restrained joint type per AWWA C-111, except where flanged joints are required to connect to valves, meters and other equipment.

2. Flanged Joints

- a. Flanges shall be Class 125 per ANSI B-16.1, unless otherwise specifically noted to be Class 250.
- b. Flanges shall be of the long-hub type screwed tightly on the pipe by a machine at the foundry prior to facing and drilling.
- c. Flange faces shall be coated with a rust inhibitor immediately after facing and drilling. Field assembled screwed on flanges are prohibited.
- d. Provide specifically drilled flanges when required for connection to existing piping or special equipment.

e. Gaskets

1) Gaskets shall be fullface, c-inch thick, cloth-inserted rubber and shall be suitable for a *water pressure of 350 psi at a temperature of 180*°F.

2) Air Service

a) Gaskets for air service shall be manufactured of materials suitable for high temperature service (> 250°F).

3) All Other Services

 Gaskets for all other services shall be manufactured of Buna-N rubber suitable for wastewater, biosolids/sludge, reclaimed water and water service.

f. Bolts and Nuts for Flanges

- Bolts and nuts for flanges located indoors, in enclosed vaults and structures, buried and submerged and located outdoors above ground or in open vaults or structures shall Type 316 stainless steel conforming to ASTM A-193, Grade B8M for bolts and ASTM A-194, Grade M for nuts.
- 2) Provide washers for each nut. Washers shall be of the same material as the nuts.

3. Grooved-End Couplings

- a. Grooved-end couplings shall be malleable iron, ASTM A-47 (Grade 32510) or ductile iron, ASTM A-536 (Grade 65-45-12).
- b. Bolts shall be ASTM A-193, Grade B8, Class 2.
- Gaskets shall be halogenated butyl rubber or EPDM for water service and Buna-N for wastewater and reclaimed water service, conforming to ASTM D-2000.

d. Couplings

- 1) AWWA C-606 for rigid radius ductile iron pipe. Couplings shall be Victaulic Style 31, Gustin-Bacon No. 500, or equal.
- e. Grooved-end adapter flanges for piping having an operating pressure of 150 psi and less shall be Victaulic Style 341, or equal. Flange dimensions shall conform to ANSI B-16.1, Class 125.
- f. Grooved-end transition couplings for connecting ductile iron pipe to steel pipe shall be Victaulic Style 307, or approved equal.

4. Push-on and Mechanical Joints

a. Pipe using push-on and mechanical joints shall be in strict accordance with AWWA C111 and ANSI A21.11, latest revision and shall be as manufactured

by American Cast Iron Pipe Company (Fastite Joint), U.S. Pipe Company (Tyton Joint), or Clow Corporation (Super Bell Tite Joint), or approved equal.

b. Gaskets

1) Gaskets shall be full-face, c-inch thick, EPDM and shall be suitable for a water pressure of 350 psi at a temperature of 180°F.

2) Air Service

a) Gaskets for air service shall be manufactured of materials suitable for high temperature service (> 250°F).

3) All Other Services

- Gaskets for all other services shall be manufactured of Buna-N rubber suitable for wastewater, biosolids/sludge, reclaimed water and water service.
- c. Each joint shall be complete with gasket, cast iron gland and all required bolts and nuts.
- d. Jointing materials shall be provided by the pipe manufacturer and installation shall be in strict accordance with the manufacturer's recommended practice.

5. Restrained Joints and Fittings

- a. Restrained joints shall be provided for all buried piping systems at the location required to restrain system thrust.
- b. Pipe joints and fittings shall be restrained in accordance with the Contract Drawings and the requirements of this specification section.
- c. It is intended that all buried joints and all fittings be restrained.
- d. In cases where the calculated required length of restrained pipe is not evenly divisible by nominal laying lengths of pipe, the total required length of restrained pipe shall be rounded up to the next closest nominal length that is evenly divisible by the standard laying length.
- e. Pipe joints and fittings shall be restrained as follows:

- 1) Manufactured restrained joints shall be "Flex-Ring", "Lok-Ring", or "Lok-Fast" manufactured by the American Cast Iron Pipe Company; "Lok-Tyte" or "Tr-Flex" Type manufactured by the United States Pipe Company; or an equal approved by the Engineer. Joints shall be the manufacturer's standard specifically modified push-on type joints with joint restraint provided by ductile iron retainer rings joined together by corrosion-resistant, high strength steel tee head bolts and nuts or with joint restraint provided by a welded-on retainer ring and a split flexible ring or locking ring assembled behind the retainer ring.
- 2) Restrained joint pipe and fittings shall be ductile iron only and shall comply with applicable portions of this specification. Manufactured restrained joints shall be capable of deflection during assembly. Deflection shall not exceed seventy-five percent (75%) of the manufacturer's recommendations.
- 3) Tee head bolts and nuts for restrained joints shall be manufactured of CORTEN, high strength, low alloy, corrosion resistant steel as manufactured by NSS Industries, Plymouth, Michigan, or an equal approved by the Engineer.
- 4) Restrained joints utilizing tie-rods, or retainer glands and set screws will not be allowed.
- 5) Field-Lok by U.S. Pipe Company and "Fast-Grip" by American Cast Iron Pipe Company are acceptable for push-on joint pipe.

f. Alternate Restrained Joints

- 1) When prior approval is obtained from the Engineer, ductile iron pipe and fittings with mechanical joints may be restrained using a follower gland which includes a restraining mechanism. When actuated during installation, the restraining device shall impart a multiple wedging action against the pipe wall which increases resistance as internal pressure in the pipeline increases.
- 2) The joint shall maintain flexibility after installation.
- 3) Glands shall be manufactured of ductile iron conforming to ASTM A-536 and restraining devices shall be of heat treated ductile iron with a minimum hardness of 370 BHN. The gland shall have standard dimension and bolting patterns for mechanical joints conforming to ANSI/AWWA C111 and C153, latest revisions.
- 4) Tee head bolts and nuts shall be manufactured of corrosion-resistant, high strength, low alloy CORTEN steel in accordance with ASTM A-242.

- 5) The restraining wedges shall have twist-off nuts to insure proper torquing. The mechanical joint restraint device shall have a minimum working pressure rating of 250 psi with a minimum safety factor of 2 to 1 and shall be MEGALUG® as manufactured by EBBA Iron, Inc. No other retainer gland type device will be acceptable.
- 6) After installation prior to backfilling, all parts of the joint restraint system shall be coated with bituminous epoxy.

6. Compression Sleeve Couplings

- a. The Contractor shall furnish and install, where required or where shown on the Drawings, manufactured compression couplings equal to Style 38 or Style 39, as manufactured by the Dresser Manufacturing Division of Dresser Industries or an approved equal.
- b. The compression couplings shall consist of two (2) steel follower flanges, one (1) steel middle ring with pipe stops removed, and sufficient rolled thread trackhead bolts to properly compress the gaskets. After fabrication, the middle and follower rings shall be cold expanded to size and dimension. The thickness of the middle rings shall be suitable for the pressures specified, and the application, and in no case be less than 3/8-inch thick for pipes ten (10) inch through thirty-six (36) inch or 1/4-inch thick for pipes less than ten (10) inches in diameter.
- c. All parts of the compression coupling shall be galvanized or heavily cadmium plated at the point of manufacture and shall be epoxy coated in accordance with AWWA C-210 or AWWA C-203.
- d. The entire compression sleeve coupling unit shall be rated for working pressure plus surge pressure as a minimum.
- e. The Contractor shall provide field coating for buried couplings in accordance with AWWA C-203.

f. Deflections

- Small deflections in the pipe alignment may be made at compression type coupling joints, but such deflections shall not exceed 3□ between any two (2) adjacent pipe sections.
- 2) Where changes in line and/or grade in excess of 3□ are required the deflections shall be made by deflecting multiple joints or by using fittings approved by the Engineer.

3) Joint deflection shall be limited to seventy-five percent (75%) of the manufacturer's recommended maximum.

2.02 Polyethylene Encasement

- A. Polyethylene encasement, where shown on the Contract Drawings, shall be cross laminated, high density polyethylene sleeves as specified in and conforming to AWWA C-105. The minimum polyethylene thickness shall be four (4) mils.
- B. Polyethylene sleeves shall be white in color, manufactured with ultraviolet (UV) light inhibitors and installed by Method A specified in AWWA C-105. Exposure of the polyethylene sleeves to weather shall be kept to a minimum, and in no case shall it exceed five (5) days.

2.03 Accessories

A. Outlets

- 1. For outlets larger than two (2) inches, where required or indicated on the Contract Drawings, provide a tee with a flanged outlet.
- 2. Provide outlets two (2) inches and smaller, where required or indicated on the Contract Drawings, by tapping and attaching a service clamp.

2.04 Quality Control

A. The Contractor shall follow the manufacturer's and supplier's recommended product quality control specifications as required for the Project.

3 EXECUTION

3.01 General

A. Inspection and Testing

1. All pipe, fittings and specials shall be inspected and tested at the foundry.

- 2. The Owner shall have the right to have any or all piping, fittings or special castings inspected and tested by an independent testing agency at the foundry or elsewhere. Such inspection and testing will be at the Owner's expense.
- 3. The Contractor shall mark as rejected and immediately remove from the Project site, all pipe lengths showing cracks in pipe or damaged lining, which cannot be repaired per AWWA C-104, or received a severe blow that may cause an incipient fracture, even though no such fracture can be seen. Damaged lining shall be defined as lining that appears to be separated from the pipe wall over extensive areas, excessive hair line fractures, or lifted edges or separated segments visible to the naked eye.
- 4. Any pipe showing a distinct crack, but no incipient fracture beyond the limits of the visible crack, may be cut off and the sound portion installed. Cut the pipe at least twelve (12) inches from the visible limits of the crack. Cutting of pipe shall be done by skilled workmen, and in such a manner as to not damage the pipe. Every cut shall be square and smooth, with no damage to the pipe lining. Cut surfaces shall be recoated as specified for the pipe. Cutting and installing cracked pipe shall only be performed when approved by the Engineer, and shall be at the expense of the Contractor.
- B. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, coatings and linings. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before laying, and no piece shall be installed that is found to be defective. Any damage to the pipe coatings shall be repaired in accordance with the manufacturer's instructions.
- C. All connections to existing piping systems shall be made as shown or indicated on the Contract Drawings after consultation and cooperation with authorities of the Owner. Some such connections may have to be made during off-peak hours (late night or early morning).
- D. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner, by the Contractor, at his/her own expense.
- E. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and, when installed or laid, shall conform to the lines and grades required.

F. Pipe Joint Deflection

1. Whenever it is desirable to deflect pipe joints to avoid obstructions or to maintain required alignment, the amount of the joint deflection shall not exceed seventy-five percent (75%) of the maximum limits allowed by the pipe manufacturer.

G. Pipe, fittings, valves, and accessories shall be installed as shown or indicated on the Contract Drawings.

3.02 Installation

A. Handling and Cutting Pipe

- 1. Care shall be taken in handling, cutting, and laying ductile iron pipe and fittings to avoid damaging the pipe and interior lining, scratching or marring machined surfaces, and abrasion of the pipe coating.
- 2. All cracked pipe and fittings shall be removed at once from the Work at no additional cost to the Owner.
- 3. Pipe cutting shall be done in a neat workmanlike manner without creating damage to the pipe and interior linings.
- 4. Ductile iron pipe may be cut using an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw or oxyacetylene torch. Cut ends and rough edges of ductile iron pipe shall be ground smooth.
- 5. For push-on joint connections, the cut end shall be beveled to prevent gasket damage during joint assembly.
- 6. The interior lining shall be repaired at cut ends per the manufacturer's instructions prior to joint assembly.

B. Installing Buried Pipe and Fittings

- Inspect each piece of pipe or fitting before lowering it into the trench. Inspect the
 interior and exterior protective coatings. Clean the ends of the pipe or fitting
 thoroughly. Remove any foreign matter or dirt from inside the pipe or fitting and
 keep clean during and after laying.
- 2. Excavation, backfill and compaction shall conform to the provisions of Section 02220, Excavation, Backfilling and Compaction. Upon satisfactory installation of the pipe bedding material as specified in Section 02220, Excavation, Backfilling and Compaction a continuous trough for the pipe barrel and recesses for the pipe bells or couplings shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.

- In preparation for pipe installation, placement (stringing) of pipe should be as close to the trench as practical on the opposite side of the trench from the excavated material. The bell ends of the pipe should point in the direction of the work progress.
- 4. **Pipe and fittings shall be laid accurately to the lines and grades indicated** on the Contract Drawings or required. Where grades for the pipeline are not indicated on the Contract Drawings, maintain a uniform depth of cover with respect to finish grade. Care shall be taken to insure a good alignment both horizontally and vertically and to give the pipe a firm bearing along its entire length. Any pipe which has its grade or joint disturbed after laying shall be taken up and relayed.
- 5. All pipe and fittings shall be cleared of sand, dirt, and debris before laying. All precautions shall be taken to prevent sand, dirt, or other foreign material from entering the pipe during installation. If necessary, a heavy, tightly woven canvas bag of suitable size shall be placed over each end of the pipe before lowering into the trench and left there until the connection is made to the adjacent pipe. Any sand, dirt, or other foreign material that enters the pipe shall be removed from the pipe immediately. The interior of all pipe and fittings shall be kept clean, by the Contractor, after installation until Final Project Acceptance by the Owner.
- 6. The Contractor shall keep the trench in a dewatered condition during pipelaying in accordance with Section 02220, *Excavation, Backfilling and Compaction*.
- 7. Any time that pipe installation is not in progress, the open ends of pipe shall be closed by a watertight plug or other method approved by the Engineer. Plugs shall remain in pipe ends until all water is removed from the trench. No pipe shall be installed when trench conditions are unsuitable for such work, including standing water, excess mud, or rain.
- 8. After pipe has been laid, inspected, and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place while conducting the preliminary hydrostatic test. No backfill shall be placed over the joints until the preliminary test is satisfactorily completed, leaving them exposed to view for the detection of visible leaks.
- 9. Cover for underground piping shall not be less than that indicated on the Contract Drawings. *The minimum cover for pipe shall be thirty-six (36) inches*. In areas where other piping conflicts preclude the maximum cover desired, the piping shall be laid to provide the maximum cover obtainable.
- 10. Upon satisfactory completion of the hydrostatic test, backfilling of the trench shall be completed.

11. The Contractor shall provide and install all required piping and accessories in strict accordance with the Contract Documents and manufacturer's recommendations.

C. Installing Interior Pipe and Fittings

- 1. All piping and fittings shall be installed true to alignment and rigidly supported thrust anchors shall be provided where required. Any damage to linings shall be repaired to the satisfaction of the Owner and Engineer before the pipe is installed. Each length of pipe shall be cleaned out before erection.
- 2. Any sand, dirt, or other foreign material that enters the pipe shall be removed from the pipe immediately. The interior of all pipe and fittings shall be kept clean, by the Contractor, after installation until Final Project Acceptance by the Owner.
- 3. Sleeves shall be installed of the proper size for all pipes passing through floors and walls as shown on the Contract Drawings. Where indicated on the Contract Drawings, or required for liquid or gas-tightness, the pipe shall be sealed with a mechanical seal equal to Link-Seal as manufactured by the Thunderline Corporation, Wayne, Michigan.
- 4. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be, in accordance with the requirements of the piping layout and jointing method and their locations shall be verified from approved layout drawings and the structural drawings.
- 5. Except as otherwise shown on the Contract Drawings, either flange joints or split type couplings may be used. Prior to approval of jointing, method layouts for hangers and supports shall be submitted to the Engineer for approval.
- 6. Flanged joints shall be made with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped.
- 7. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain from being imposed on the equipment. When manufacturer's have indicated requirements that piping loads shall not be transferred to their equipment, a certification shall be submitted stating that such requirements have been complied with.
- 8. The Contractor shall provide and install all required piping and accessories in strict accordance with the Contract Documents and manufacturer's recommendations.
- 9. Upon satisfactory completion of the piping, fitting and appurtenance installation, hydrostatic testing of the system shall be performed.

D. <u>Ductile Iron Pipe Joints</u>

- 1. The joints of all pipelines shall be made absolutely "water-tight".
- 2. The particular joint used shall be approved by the Engineer prior to installation.
- 3. Where shown on the Contract Drawings or where, in the opinion of the Engineer, settlement or vibration is likely to occur, all pipe joints shall be of the bolted mechanical type or restrained joint as specified above, or as indicated on the Contract Drawings.

4. Push-on Joints

- a. Push-on joints shall be made in strict accordance with the manufacturer's recommendations and AWWA C-600.
- b. Manufacturer's installation recommendations shall be submitted to the Engineer for review and approval before commencing work.
- c. Insert the gasket into the groove of the ball.
- d. Uniformly apply a thin film of special lubricant over the inner surface of the gasket the will contact the spigot end of the pipe. The lubricant shall be an inert, non-toxic, water soluble compound incapable of harboring, supporting, or culturing bacterial life.
- e. The bell of the pipe shall be cleaned of excess materials or other obstructions and wiped out before the cleaned and prepared spigot of the next pipe is inserted.
- f. Insert the chamfered end of the plain end pipe into the gasket and push until firmly into place until properly seated and held securely.

5. Bolted Joints

- a. Remove rust preventative coatings from machined surfaces prior to assembly.
- b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings and gaskets.

6. Grooved End Joints

a. Install grooved end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following:

- Clean loose scale, rust, oil, grease and dirt from the pipe or fitting groove before installing the coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior, including lips, pipe ends and housing interiors.
- 2) Fasten coupling alternately and evenly until the coupling halves are seated. Use torques as recommended by the coupling manufacturer.

7. Flanged Joints

- a. Flanged joints shall be made up by inserting the gasket between the flanges. The threads of the bolts and the faces of the gaskets shall be coated with a suitable lubricant immediately before installation. The lubricant shall be an inert, non-toxic, water soluble compound incapable of harboring, supporting, or culturing bacterial life.
- b. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. The Contractor shall clean flanges by wire brushing them before installing flanged fittings. The Contractor shall clean flange bolts and nuts by wire brushing them and lubricate bolts with oil and graphite.
- c. The Contractor shall insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- d. The Contractor shall execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
- e. If flanges leak under pressure testing, the Contractor shall loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. All joints shall be "water-tight".

8. Mechanical Joints

- a. All types of mechanical joint pipes shall be laid and jointed in full conformance with manufacturer's recommendations and AWWA C-600, which shall be submitted to the Engineer for review and approval before work is begun.
- b. Only specially skilled workmen shall be permitted to makeup mechanical joints. Torque wrenches, set as specified in AWWA Standard C-111, shall be used; or spanner type wrenches not longer than specified therein may be used with the permission of the Engineer.

- c. Thoroughly clean, with a wire brush, surfaces that will be in contact with the gaskets.
- d. Lubricate the gasket, bell and spigot by washing with soapy water.
- e. Slip the gland and gasket, in that order, over the spigot and insert the spigot into the bell until properly sealed. Evenly seat the gasket in the bell at all points, center the spigot, and firmly press the gland against the gasket.
- f. Insert the bolts, install the nuts finger tight, and progressively tighten diametrically opposite nuts uniformly around the joints to the proper tension with a torque wrench.

9. Bell and Spigot Joints

- a. Thoroughly clean the bell and spigots and remove excess tar and other obstructions.
- b. Insert the spigot firmly into place and hold securely until the joint has been properly completed.

10. Restrained Joints

- a. Restrained joints shall be made in strict, complete compliance with the manufacturer's recommendations.
- b. Restrained joints shall be provided where indicated on the Contract Drawings and at all connections to existing piping systems.
- c. Joint assembly shall be made in strict accordance with the manufacturer's instructions, which shall be submitted to the Engineer for review and approval before commencing work.

E. <u>Fabrication</u>

1. Tapped Connections

- a. The Contractor shall make all tapped connections as shown on the Contract Drawings or as directed by the Engineer.
- b. The Contractor shall make all connections watertight and of adequate strength to prevent pullout.

- c. The Contractor shall drill and tap normal to the longitudinal axis of the pipe.
- d. The maximum size of taps in pipes and fittings without bosses shall not exceed the sizes listed in the Appendix of ANSI A21.51 based on two full threads.

2. Cutting

- a. The Contractor shall perform all cutting with machines having rolling wheel cutters or knives designed to cut ductile iron. The use of a hammer and chisel to cut pipe is prohibited.
- b. The Contractor shall after cutting, examine all cut ends for possible cracks and advise the Engineer for observation.
- c. The Contractor shall adequately chamber all cut ends to be used with push-on joints to prevent damage to gaskets when pipe is installed.

3.03 Polyethylene Encasement

A. The polyethylene encasement, where shown on the Contract Drawings, shall be installed in accordance with either method specified in AWWA C-105.

3.04 Separation of Non-Potable Water Mains and Potable Water Mains

A. Horizontal Separation

- 1. Existing and proposed water and wastewater or non-potable force mains shall be separated at least six (6) feet horizontally.
- Horizontal separation between water mains and wastewater or non-potable force mains must always be a minimum of six (6) feet unless a closer than separation has been specifically detailed on the Contract Drawings that have been approved under the FDEP Permit.

B. Vertical Separation

1. Parallel Lines

a. Whenever potable water and non-potable water lines (reclaimed, sanitary, stormwater, force mains) run parallel and do not meet the horizontal separation

requirements, then the lines shall be vertically separated with the potable water line at least eighteen (18) inches above the top of the non-potable lines.

2. Crossings

- a. Force mains crossing water mains shall be installed to provide a minimum vertical distance of eighteen (18) inches measured from the outside of the potable water line to the outside of the non-potable line. The potable water line may be either above or below the non-potable line at crossings. The constructed pipeline shall be installed so that the pipeline joints are as far from the crossing as possible.
- b. When the eighteen (18) inch maximum vertical separation distance cannot be maintained, the potable water main shall be encased in concrete. Concrete encasement of the potable water main shall be ten (10) feet each way of the crossing.

3.05 Concrete Pipe Encasement

- A. Concrete for concrete pipe encasement shall have a minimum strength of 3,000 psi at 28 days and encasement shall be constructed in accordance with details shown on the Contract Drawings. Encasement shall be constructed where:
 - 1. Indicated on the Contract Drawings.
 - 2. Piping is laid under buildings, structures and structure pads.
 - 3. Potable water mains do not meet the eighteen (18) inch vertical separation.
 - 4. The Engineer shall order the pipeline encased.
- B. The points of beginning and ending of concrete pipe encasement shall not be more than six (6) inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the erects of superimposed live loads.
- C. Pipe encasement shall provide a minimum coverage of twelve (12) inches all around the pipe including pipe bells.

3.06 Connection to Existing Water, Wastewater, Biosolids/Sludge and Reuse Systems

A. The Contractor shall coordinate making connection of the new mains to mains which are in service at the time of construction with the Owner.

- B. The Contractor shall not connect to existing facilities unless the Engineer and a representative of the Owner are present. The Engineer and the Owner shall be notified, in writing, at least seventy-two (72) hours prior to the time connection is desired.
- C. Operation of all system valves shall be the responsibility of the Owner's personnel only. At no time shall the Contractor operate any system valves. System valves shall be defined as any valve which has main pressure against either side of the valve. The Contractor shall notify the Owner to request that a valve be operated, in writing, at least seventy-two (72) hours prior to the time operation is required.

3.07 Cleaning and Flushing of Pipelines

- A. Following the hydrostatic and leakage tests, all the mains constructed under this Contract shall be cleaned and flushed to remove sand, loose dirt, and other debris. The *minimum flushing velocity shall be 2.5 feet per second*. Flushing shall continue until clean water flows from the main. However, the Contractor shall endeavor to use the minimum amount of flushing water required to complete the work.
- B. Upon completion of testing for the gravity drain line system, drain lines shall be flushed to remove dirt, sand, stones, and other debris which may have entered the lines during construction and settled out in the lines and/or manholes. Materials and debris flushed from the drain lines shall be removed from a downstream manhole, basin or lift station and disposed of at an approved disposal area.
- C. Temporary blowoffs may be required for the purpose of flushing mains. Temporary blowoffs shall be installed as close as possible to the ends of the main being flushed. Blowoffs installed on the main shall be the same diameter as the main. Temporary blowoffs shall be removed and plugged after the main is flushed. All costs for installing and removing temporary blowoffs shall be at no additional cost to the Owner.
- D. The Owner shall be notified, in writing, at least seventy-two (72) hours prior to flushing mains.
- E. Blowoffs and temporary drainage piping used for flushing shall not be discharged into any gravity sewer or pumping station wetwell. The Contractor shall obtain prior approvals from the Engineer and the Owner as to the methods and locations of flushing water discharge.

3.08 Disinfection of Potable Water Pipelines

- A. Before any portion of the potable water piping systems is to be placed in service, it shall be disinfected; and its disinfection shall be demonstrated by bacteriological tests conducted in accordance with Standard Methods for Examination of Water and Wastewater, latest edition, for the coli-aerogenes group, by an approved laboratory, acceptable to the Engineer and the County Health Department.
- B. Disinfection of potable water pipelines shall be in accordance with Section 15041, *Disinfection of Piping and Structures*.

3.09 Pressure Testing of Pipe

- A. After installation, the pipe shall be tested for compliance with the specifications. The Contractor shall furnish all necessary equipment and labor for the pressure test and leakage test on the pipelines.
- B. Pressure testing of pipeline shall be in accordance with Section 15044, *Pressure Testing of Piping*.

END OF SECTION

SECTION 15065

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

1. GENERAL

1.01 Scope of Work

- A. Furnish all labor, materials, equipment and incidentals required and install, disinfect and test polyvinyl chloride (PVC) pipe, fittings and appurtenances of the sizes and in the locations shown on the Contract Drawings and as specified herein.
- B. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes, or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- C. Pipe/piping refers to all pipe, fittings, material and appurtenances required to construct PVC pressure piping systems throughout the Project, as specified, complete and in place.

1.02 Related Work Specified Elsewhere

A. The Contract Documents include, but are not limited to, the following related sections:

Specification Section	Title
01600	Materials and Equipment
02200	Earthwork
02220	Excavation, Backfilling and Compaction
09905	Piping, Valve and Equipment Identification System
15000	Mechanical - General Requirements
15041	Disinfection of Piping and Structures
15044	Pressure Testing of Piping

Specification Section	Title
15100	Valves and Appurtenances
15129	Couplings and Connectors
Division	Description
15	Piping
Contract Drawings and General Provisions of the Contract	

1.03 Reference Standards

A. Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:

STANDARD	DESCRIPTION		
American Soc	American Society for Testing and Materials (ASTM))		
ASTM A-242	Standard Specification for High-Strength Low-Alloy Structural Steel		
ASTM A-320	Std Specification for Alloy-Steel Bolting Materials for Low-Temperature Service		
ASTM A-536	Standard Specification for Ductile Iron Castings		
ASTM D-1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds		
ASTM D-1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120		
ASTM D-2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80		
ASTM D-2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Sch 80		
ASTM D-2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems		
ASTM D-2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping		
ASTM D-2855	Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings		
ASTM D-3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals		
ASTM F-437	Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80		
ASTM F-477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe		

STANDARD	DESCRIPTION		
American Wat	American Water Works Association (AWWA)		
AWWA C-110	Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids		
AWWA C-111	Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings		
AWWA C-651	Disinfecting Water Mains		
AWWA C-900	Polyvinyl Chloride (PVC) Pressure Pipe, 4-in Through 12-in for Water Distribution		
AWWA C-905	Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-in Through 36-in.		
AWWA M-23	PVC Pressure Pipe and Fittings		
National Sanitation Foundation (NSF)			
Std No. 14	Plastic Piping Components and Related Materials		
Std No. 61	Drinking Water System Components - Health Effects		

B. Where reference is made to one of the above standards, the revision in effect at the time of Bid Opening shall apply.

1.04 Quality Assurance

- A. All PVC pipe and fittings shall be from a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these specifications.
- B. *Pipe for use with domestic potable water shall have an NSF seal of approval*. The Supplier shall be responsible for the provisions of all test requirements specified in NSF Standard No. 14 as applicable.
- C. Acceptable Manufacturers of PVC shall include Certain-Teed Products, Corporation; Johns-Manville (J-M), or approved equal.

1.05 Submittals

A. Submit to the Engineer, in accordance with Section 00700, *General Conditions*, and Section 01300, *Shop Drawings, Submittals and Samples*, within thirty (30) days of the

Effective Date of the Agreement, the name of the pipe and fitting manufacturers and a list of materials to be furnished by each manufacturer. The submittal shall include information on the local representative for each manufacturer, if the product is sold through a distributor, descriptive literature, illustrations, specifications, installation instructions and related information.

- B. Shop Drawings including piping layouts and schedules shall include dimensioning, fittings, types and locations of valves and appurtenances, joint details, methods and location of supports, anchorage, gasket material, grade of material and all other pertinent technical information for all items to be furnished.
- C. Prior to each shipment of pipe, certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and AWWA Standards specified herein shall be submitted.
- D. All shop drawings shall be submitted in an electronic (PDF) format.

1.06 System Description

- A. The equipment and materials specified herein are intended to be of standard types for use in transporting water, wastewater and reclaimed water. Note information in the pipe schedule on Contract Drawings, if any, and in this Section, especially concerning pressures, minimum thickness, etc.
- B. The Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

1.07 Product Delivery, Storage and Handling

- A. PVC pipe shall be delivered to the Project Site in unbroken bundles packaged in such a manner as to provide protection against damage. When possible pipe should be stored at the Project Site in unit packages ready for use. Package units shall be handled using a forklift or a spreader bar with fabric straps. Packaged units shall not be stacked higher than two (2) units high at the Project Site. Any pipe damaged in shipment shall be replaced as directed by the Engineer, at no additional cost to the Owner.
- B. When it is necessary to store PVC pipe and fittings for more than thirty (30) days, exposure to direct sunlight shall be prevented by covering the pipe with an opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. PVC pipe shall not be stored close

to heat sources or hot objects such as heaters, fires, boilers or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The interior and all sealing surfaces of pipe, fittings and other appurtenances shall be kept clean and free of dirt and foreign matter.

C. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

D. Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged or defective pipe and fittings, or any length of pipe having a gouge, scratch or other permanent indentation of more than ten percent (10%) of the wall thickness in depth, shall be rejected and removed at once from the work and replaced with new acceptable pipe at no additional cost to the Owner.

1.08 Job Conditions

A. Water in Excavation

- 1. Water shall not be allowed in the trenches while underground pipes, fittings, valves and/or accessories are being laid and/or tested.
- 2. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the Engineer. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.
- 3. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately plugged during construction by the use of approved stoppers and not by improvised equipment.
- 4. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such materials has entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

1.09 Warranties and Guarantees

A. Provide an equipment warranty in accordance with Section 01740, *Warranties and Bonds*.

2. PRODUCTS

2.01 General

A. All materials that come into contact with potable water shall be on either the EPA or NSF lists of products approved for use in contact with potable water. Manufacturers shall submit an affidavit with the shop drawings indicating approval by the EPA or NSF for the materials used in products that come into contact with potable water, in accordance with Rule 62-555.320(3), Florida Administrative Code.

2.02 Polyvinyl Chloride (PVC) Pipe and Fittings

- A. Small Diameter Gravity Drainage Piping (< 4-inches)
 - 1. PVC pipe smaller than four (4) inches nominal diameter used for gravity drainage piping shall be Schedule 40 pipe in accordance with ASTM D-1785.
 - 2. Schedule 40 PVC pipe shall have solvent welded joints as specified for PVC pressure pipe.
- B. Large Diameter Gravity Drainage Piping (≥ 4-inches)
 - 1. Unless otherwise noted, large gravity drainage piping shall conform to the requirements and shall have gasketed integral bell ends:

Pipe Size (inches)	Pipe Requirements
4 - 12	AWWA C900, DR25
> 12	AWWA C905, DR25

- 2. Pipe shall be designed for a maximum working pressure at not less than 100 psi and with not less than a 4 to 1 sustained hydrostatic pressure safety factor.
- 3. Fitting shall be ductile iron fittings with restrained mechanical joints and as specified in Section 15060, Ductile Iron Pipe and Fittings.
- 4. Pipe shall be made of ductile iron pipe O.D.'s instead of IPS.

C. Small PVC Pressure Piping (< 4-inches)

1. Unless otherwise specified, PVC pressure pipe smaller than four (4) inches nominal diameter shall conform to the following requirements, as shown on the Contract Drawings or specified in other Sections.

Pipe Size (inches)	Pipe Requirements
< 4	Schedule 80, ASTM D-1785

- 2. Schedule 80 pipe shall have solvent welded joints unless otherwise shown on the Contract Drawings or specified in other Divisions.
- 3. PVC pressure pipe shall bear the approved seal of the National Sanitation Foundation (NSF).
- 4. PVC pipe that is exposed to sunlight shall be manufactured with UV additives to provide resistance to ultraviolet light deterioration.

5. Fittings

- a. Socket type, solvent welded fittings for Schedule 80 PVC pipe, less than three (3) inches in diameter, shall be in conformance with ASTM D-2467. Socket type, solvent welded fittings for Schedule 80 CPVC pipe, less than three (3) inches in diameter, shall be in conformance with ASTM F-439.
- b. Threaded type fittings for Schedule 80 PVC pipe, less than three (3) inches in diameter, shall be in conformance with ASTM D-2464. Threaded type fittings for Schedule 80 CPVC pipe, less than three (3) inches in diameter, shall be in conformance with ASTM F-437.
- c. Solvent weld solvent welded or threaded joints shall be "water-tight".
- d. All fittings for PVC pipelines greater than or equal to three (3) inches shall be ductile iron. All adapters, fittings and transition gaskets necessary to connect PVC fittings shall be furnished.

6. Flanges

a. Flanges for Schedule 80 PVC pipe shall be rated for a 150 psi working pressure with ANSI B-16.1 dimensions and bolting pattern.

- b. Flanges shall be connected to PVC piping with either solvent welded or threaded joints in accordance with ASTM D-2467 or ASTM D-2464, respectively. Gaskets shall be neoprene, full faced type with a minimum thickness of 1/8inch.
- c. Nuts and bolts shall be hexagonal with machine threads, manufactured of Type 316 stainless steel in accordance with ASTM A-320, Class 2.
- d. Type 316 stainless steel flat washers with lock washers shall be used against PVC flanges.
- e. The nuts shall have a hardness that is lower than that of the bolts and washers by a difference of 50 Brinnell hardness to prevent galling during installation.
- 7. PVC solvent cement shall be in compliance with ASTM D-2564 and in accordance with the pipe manufacturer's recommendations. The Contractor shall use a cleaner recommended by the manufacturer for cleaning the pipe/fittings prior to solvent welding. Lubricant for Schedule 80 threaded joints shall be Teflon tape only.
- 8. Provide suitable adapters for connections to equipment and other piping systems.

D. Large PVC Pressure Piping (≥ 4-inches)

1. Unless otherwise noted, PVC pressure pipe for the nominal diameters shown shall conform to the following requirements, have gasketed integral bell ends, and be manufactured to ductile iron O.D.'s instead of IPS.

Pipe Size (inches)	Pipe Requirements	Max. Working Pressure (psi)
4 - 12	AWWA C900, DR-18	150
> 12	AWWA C905, DR-18	235

- 2. PVC pipe shall bear the NSF marking of approval when used for potable water applications.
- 3. PVC Pipe shall be designed for maximum working pressure as indicated above and with not less than a 4 to 1 sustained hydrostatic pressure safety factor.
- 4. Fittings shall be ductile iron fittings with restrained mechanical joint ends as specified in Section 15060, Ductile Iron Pipe and Fittings. All adapters, fittings and transition gaskets necessary shall be furnished.

5. PVC pipe that is exposed to sunlight shall be manufactured with UV additives to provide resistance to ultraviolet light deterioration.

6. Bell and Spigot

- a. Pipe joints shall be made with integral bell and spigot pipe ends meeting ASTM D-3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals. The bell shall consist of an integral thickened wall section designed to be at least as strong as the pipe wall.
- b. The bell shall be supplied with factory glued rubber ring gasket which conforms to the manufacturer's standard dimensions and tolerances.
- c. The gasket shall meet the requirements of ASTM F-477, *Elastomeric Seals* (*Gaskets*) for Joining Plastic Pipe.
- d. PVC joints shall be "Ring-Tite" as manufactured by Johns-Manville Manufacturing Company, Inc. or an equal approved by the Engineer.

7. Fittings

- a. All fittings for use with PVC pipe three (3) inches and larger in size shall be ductile iron with a minimum working pressure of 250 psi and shall conform to ANSI/AWWA A21.10/C-110, latest revision except as shown on the Contract Documents.
- b. Fittings shall have mechanical joint bell ends manufactured in accordance with ANSI/AWWA A21.11/C-111, latest revision. Jointing materials for mechanical joints shall be provided by the fitting manufacturer. Materials, assembly and bolting shall be in accordance with ANSI/AWWA A21.11/C-111, latest revision.
- c. Tee head nuts and bolts for mechanical joints shall be manufactured of corrosion resistant high strength, low alloy COR-TEN steel meeting the requirements of ASTM A-242.
- d. All cast iron and ductile iron fittings for use with PVC pipe shall be coated and lined, as specified for ductile iron pipe in Section 15060, Ductile Iron Pipe and Fittings, intended for similar service, as noted on the Contract Drawings.

8. Restrained Joints

a. In accordance with the Contract Drawings, to prevent pipe joints and fittings from separating under pressure, pipe joints and fittings shall be restrained as follows:

- 1) PVC pipe bell and spigot joints shall be restrained with the EBBA Iron MEGALUG® Series 1500 Restrainer or an equal approved by the Engineer. The restraining device and tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536, Grade 65-45-12. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy COR-TEN steel meeting the requirements of ASTM A-242.
- 2) Mechanical joint fittings used with PVC pipe shall be restrained with the EBBA Iron MEGALUG® Series 2000 PV Restrainer or an equal approved by the Engineer. The restraining device and tee head bolts shall be manufactured of high strength ductile iron meeting ASTM A-536, Grade 65-45-12. Clamping bolts and nuts shall be manufactured of corrosion resistant high strength, low alloy COR-TEN steel meeting the requirements of ASTM A-242.

E. Clear PVC Reinforced Tubing

- 1. Clear PVC tubing, for chemical applications shown on the Contract Drawings, shall be nylon reinforced, PVC clear tubing.
- 2. The inside diameter shall be as shown on the Contract Drawings or as specified in Sections of this Project Manual.
- 3. Tubing shall be able to withstand a working pressure of 150 psi.
- 4. Tubing shall be Amaclear "R" as manufactured by Amazon Hose Rubber Company, or approved equal.
- F. All ductile iron fittings and accessories for pipelines (above grade flanged; below grade mechanical joint) shall be compatible with the pipe.
- G. PVC fittings shall meet the requirements of AWWA C-900/C-905 and be of the same, or higher, pressure rating as the pipeline.
- H. PVC color shall be in accordance with the Contract Documents and as required by the Engineer and Owner.

3. EXECUTION

3.01 Storage and Handling of PVC Pipe

A. Delivery, Storage and Handling of PVC pipe shall follow the requirements of Article 1.07 of this Section.

3.02 Installation of PVC Pipe and Fittings

- A. **No single piece of pipe shall be laid unless it is straight**. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than $^{1}/_{16}$ -inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the pipe manufacturer shall be explicitly followed.
- B. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner.
- C. All PVC pipe and fittings and cast or ductile iron fittings shall be laid in accordance with the pipe manufacturer's published installation guide, the AWWA Manual of Practice No. M23, *PVC Pipe Design and Installation* and the Uni-Bell Plastic Pipe Association installation recommendations.
- D. In preparation of pipe installation, placement (stringing) of pipe should be as close to the trench as practical on the opposite side of the trench from the excavated material. The bell ends of the pipe should point in the direction of the work progress.
- E. **Pipe and fittings shall be laid accurately to the lines and grades indicated** on the Contract Drawings or as indicated by the Engineer. Care shall be taken to insure a good alignment both horizontally and vertically and to give the pipe a firm bearing along its entire length. Any pipe that has its grade or joint disturbed after laying shall be taken up and re-laid.
- F. All pipe and fittings shall be cleared of sand, dirt and debris before laying. All precautions shall be taken to prevent sand, dirt or other foreign material from entering the pipe during installation. If necessary, a heavy, tightly woven canvas bag of suitable size shall be placed over each end of the pipe before lowering into the trench and left there until the connection is made to the adjacent pipe. Any sand, dirt or other foreign material that enters the pipe shall be removed fro the pipe immediately. The interior of all pipe and fittings shall be kept clean after installation until accepted in the complete work.
- G. Any time that pipe installation is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other method approved by the Engineer. Plugs shall remain in the pipe ends until all water is removed from the trench. No pipe shall be installed when trench conditions are unsuitable for such work, including standing water, excess mud, rain or snow.
- H. Good alignment shall be preserved during installation. *The deflection at joints shall not exceed that recommended by pipe manufacturer*. Fittings, in addition to those shown on the Contract Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.

I. As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Contract Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid-diameter, and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Bedding for pipe shall be as specified in Section 02220, Excavation, Backfilling and Compaction. Generally the compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial three (3) feet of backfill shall be approved by the pipe manufacturer's representative prior to use.

J. Field Cutting of PVC Pipe

- 1. Field cutting of pipe shall be done in a neat workmanlike manner without creating damage to the pipe. The pipe shall be cut square with a fine-toothed hand or power saw or other cutter or knife designed for use with plastic pipe.
- 2. Prior to cutting, the pipe shall be marked around its entire circumference or a square-in vise shall be used to ensure the pipe end is cut smooth at right angles to the axis of the pipe.
- 3. Remove burrs by smoothing edges with a knife, file, or sandpaper.
- 4. **Bevel the cut end of the pipe** with a pipe beveling tool, wood rasp or portable sander to prevent damage to the gasket during joint assembly. A factory finished beveled end should be used as a guide to ensure a proper beveling angle and correct depth of bevel. **Round off any sharp edges on the leading edge of the bevel with a knife or file.**
- K. Any pipe having defective joint surfaces shall be rejected, marked as such and immediately removed from the job site.
- L. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place.
- M. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- N. Precautions shall be taken to prevent flotation of the pipe in the trench.

O. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.

3.03 Jointing PVC Pipe (Push-On Type)

- A. Pipe shall be laid with bell ends looking ahead.
- B. The PVC bell and spigot joint shall be assembled in accordance with the pipe manufacturer's installation instructions, ASTM D-2774, and AWWA Manual M-23. Clean the interior of the bell, the gasket, and the spigot of the pipe to be jointed with a rag to remove any dirt or foreign material before assembling. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation.
- C. Lubricate the spigot end of the pipe with a lubricant supplied or specified by the pipe manufacturer for use with gasketed PVC pipe in the application being installed (potable water, wastewater, effluent, or reclaimed water). The lubricant should be applied as specified by the pipe manufacturer. After the spigot end is lubricated, it must be kept clean and free of dirt and sand. If dirt and sand adhere to the lubricated end, the spigot must be wiped clean and relubricated.
- D. *Insert the spigot into the bell so that it contacts the gasket uniformly*. Align the pipe sections and push the spigot end into the bell until the manufacturer's reference mark on the spigot is flush with the end of the bell. The pipe should be pushed into the bell using a bar and block. The joint shall not be assembled by "stabbing" or swinging the pipe into the bell, nor shall construction machinery be used to push the pipe into the bell.
- E. If undue resistance to insertion of the spigot end is encountered or if the reference mark does not reach the flush position, disassemble the joint and check the position of the gasket. If the gasket is twisted or pushed out of its seat, inspect the components, repair or replace damaged items, clean the components, and repeat the assembly steps. Be sure the pipe is in proper alignment during assembly. If the gasket was not out of position, check the distance between the spigot end and the reference mark and relocate the mark if it is out of position.
- F. The weight of valves and fittings shall not be carried by the PVC pipe. The valve or fitting shall be supported by a concrete cradle as shown on the standard details. Concrete for the cradle shall be poured against undisturbed soil.

3.04 Jointing Mechanical Joint Fittings

- A. Mechanical joints at valves, fittings and where designated shall be in accordance with the AWWA C-111 and the instructions of the pipe manufacturer. Suitable PVC to cast iron adapters shall be installed prior to installing fittings. PVC beveled spigots shall be cut flush prior to insertion in mechanical joint pipe. To assemble the joints in the field, thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts.
- B. **Bolts shall be tightened to the specified torques**. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

3.05 PVC Joint Assembly for Threaded and Solvent Welded Pipe

- A. All threaded and solvent welded joints shall be made watertight in accordance with ASTM D-2855, ASTM D-2564, and AWWA Manual M-23. All pipe cutting, threading, and jointing procedures for threaded and solvent welded PVC pipe joints shall be in strict accordance with the pipe and fitting manufacturer's printed installation instructions. Thread lubricant for threaded joints shall be teflon tape only.
- B. At threaded joints between PVC and metal pipes, the metal side shall contain the socket end and the PVC side the spigot. A metal spigot shall not, under any circumstances, be screwed into a PVC socket.
- C. The Contractor shall make sure that the proper cement is used with the proper pipe and fittings. Never use CPVC cement on Type I PVC pipe or, conversely, never use PVC cement on CPVC pipe and fittings.

3.06 Restrained Joints

- A. Restrained joints shall be made in strict, complete accordance with the manufacturer's recommendations.
- B. All piping shall be restrained as indicated on the Contract Drawings.
- C. All fittings shall be restrained.
- D. In cases where the calculated required length of restrained pipe is not evenly divisible by nominal laying lengths of pipe, the total required length of restrained pipe shall be rounded up to the next closest nominal length that is evenly divisible by the standard laying length.

3.07 Field Painting

A. *Pipe normally exposed to view shall be painted and marked* as specified in Section 09900, *Painting* and Section 09905, *Piping, Valve and Equipment Identification System*.

3.08 Separation of Non-Potable Water Mains and Potable Water Mains

A. Horizontal Separation

- 1. Existing and proposed water and wastewater or non-potable force mains shall be **separated at least six (6) feet horizontally**.
- Horizontal separation between water mains and wastewater or non-potable force mains must always be a minimum of six (6) feet unless a closer than separation has been specifically detailed on the Contract Drawings that have been approved under the FDEP Permit.

B. Vertical Separation

1. Parallel Lines

a. Whenever potable water and non-potable water lines (reclaimed, sanitary, stormwater, force mains) run parallel and do not meet the horizontal separation requirements, then the lines shall be vertically separated with the potable water line at least eighteen (18) inches above the top of the non-potable lines.

2. Crossings

- a. Force mains crossing water mains shall be installed to *provide a minimum* vertical distance of eighteen (18) inches measured from the outside of the potable water line to the outside of the non-potable line. The potable water line may be either above or below the non-potable line at crossings. The constructed pipeline shall be installed so that the pipeline joints are as far from the crossing as possible.
- b. When the eighteen (18) inch maximum vertical separation distance cannot be maintained, the potable water main shall be encased in concrete. Concrete encasement of the potable water main shall be ten (10) feet each way of the crossing.

3.09 Concrete Pipe Encasement

- A. Concrete for concrete pipe encasement shall have a minimum strength of 3,000 psi at twenty-eight (28) days and encasement shall be constructed in accordance with details shown on the Contract Drawings. Encasement shall be constructed where:
 - 1. Indicated on the Contract Drawings.
 - 2. Piping is laid under buildings, structures and structure pads.
 - 3. Potable water mains do not meet the eighteen (18) inch vertical separation.
 - 4. The Engineer shall order the pipeline encased.
- B. The points of beginning and ending of concrete pipe encasement shall not be more than six (6) inches from a pipe joint to protect the pipe from cracking due to uneven settlement of its foundation or the erects of superimposed live loads.
- C. Pipe encasement shall provide a minimum coverage of twelve (12) inches all around the pipe including pipe bells.

3.10 Connection to Existing Water, Biosolids/Sludge, Wastewater and Reuse Systems

- A. The Contractor shall coordinate making connection of the new mains to mains which are in service at the time of construction with the Owner.
- B. The Contractor shall not connect to existing facilities unless the Engineer and a representative of the Owner are present. The Engineer shall be notified, in writing, at least seventy-two (72) hours prior to the time connection is desired.
- C. Operation of all system valves shall be the responsibility of the Owner's personnel only. At no time shall the Contractor operate any system valves. System valves shall be defined as any valve which has main pressure against either side of the valve. The Contractor shall notify the Owner to request that a valve be operated, in writing, at least seventy-two (72) hours prior to the time operation is required.

3.11 Cleaning and Flushing of Pipelines

A. Following the hydrostatic and leakage tests, all the mains constructed under this Contract shall be cleaned and flushed to remove sand, loose dirt, and other

debris. The minimum flushing velocity shall be 2.5 feet per second. Flushing shall continue until clean water flows from the main. However, the Contractor shall endeavor to use the minimum amount of flushing water required to complete the work.

- B. **Upon completion of testing for the gravity drain line system, drain lines shall be flushed** to remove dirt, sand, stones, and other debris which may have entered the lines during construction and settled out in the lines and/or manholes. Materials and debris flushed from the drain lines shall be removed from a downstream manhole, basin or lift station and disposed of at an approved disposal area.
- C. Temporary blowoffs may be required for the purpose of flushing mains. Temporary blowoffs shall be installed as close as possible to the ends of the main being flushed. Blowoffs installed on the main shall be the same diameter as the main. Temporary blowoffs shall be removed and plugged after the main is flushed. All costs for installing and removing temporary blowoffs shall be at no additional cost to the Owner.
- D. The Owner shall be notified, in writing, at least seventy-two (72) hours prior to flushing mains.
- E. Blowoffs and temporary drainage piping used for flushing shall not be discharged into any gravity sewer or pumping station wetwell. The Contractor shall obtain prior approvals from the Engineer and the Owner as to the methods and locations of flushing water discharge.

3.12 Disinfection of Potable Water Pipelines

- A. Before any portion of the potable water piping systems is to be placed in service, it shall be disinfected; and its disinfection shall be demonstrated by bacteriological tests conducted in accordance with <u>Standard Methods for Examination of Water and Wastewater</u>, latest edition, for the coli-aerogenes group, by an approved laboratory, acceptable to the Engineer and the County Health Department.
- B. Disinfection of potable water pipelines shall be in accordance with Section 15041, *Disinfection of Piping and Structures*.

3.13 Pressure Testing of Pipe

A. After installation, the pipe shall be tested for compliance with the specifications. The Contractor shall furnish all necessary equipment and labor for the pressure test and leakage test on the pipelines.

SECTION 15076

PVC DOUBLE WALL CONTAINMENT PIPING

1. GENERAL

1.01 Scope of Work

- A. Furnish all labor, materials, equipment and incidentals required and install, disinfect and test double wall containment piping, fittings and appurtenances of the sizes and in the locations shown on the Contract Drawings and as specified herein.
- B. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes, or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- C. All plastic pipe and fittings shall conform to this specification section whether provided as a part of an equipment "package" or purchased separately by the Contractor.
- D. Double wall containment piping systems are required for all underground pipe, risers and chemical feed lines. The double wall containment piping shall be used when the piping is in contact with the ground, located in the trenches or any other location indicated on the Contract Drawings.

E. Related Work Specified Elsewhere

1.	Painting:	Section 09900
2.	Piping, Valve and Equipment Identification System:	Section 09905
3.	Mechanical - General Requirements:	Section 15000
4.	Disinfection of Piping and Structures:	Section 15041
5.	Pressure Testing of Piping:	Section 15044
6.	Valves and Appurtenances:	Section 15100

7. Pipe Hangers and Supports: Section 15125

8. Couplings and Connectors: Section 15129

1.02 Quality Assurance

- A. All double wall containment piping, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications.
- B. The solvent welder shall be qualified in accordance with Chapter VII of the ASME B31.3-93 Code, Part 9, Paragraph A328.
- C. Double wall containment pipe shall be as manufactured by Asahi, Guardian, R.G. Sloane, or approved equal. The manufacturer shall have at least ten (10) years experience and proven product reliability.

1.03 Submittals

- A. Submit shop drawings to the Engineer, in accordance with Section 00700, *General Conditions*, and Section 01300, *Shop Drawings, Submittals and Samples*.
- B. Shop Drawings shall include complete piping layouts and schedules shall include dimensioning, fittings, types and locations of valves and appurtenances, joint details, methods and location of supports, anchorage, gasket material, grade of material, installation instructions and all other pertinent technical information (specifications, detail, literature, etc.) for all items to be furnished.
- C. Prior to each shipment of pipe, certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and AWWA Standards specified herein shall be submitted.

1.04 Product Delivery, Storage and Handling

A. Double wall containment piping, fittings and accessories shall be delivered to the Project site in unbroken bundles packaged in such a manner as to provide protection against damage.

- B. Any piping, fittings or accessories damaged in shipment shall be replaced as directed by the Engineer, at no additional cost to the Owner.
- C. Pipe and fittings shall be handled and stored in a manner which will ensure installation in a sound, undamaged condition. Handling methods and equipment used shall prevent damage to the pipe. Bare cables, chains, or metal bars shall not be used. Pipe shall be stored off the ground on wide padded skids.
- D. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.
- E. Any pipe or fitting showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected, removed at once from the work, and replaced at no additional cost.
- F. While stored, pipe shall be adequately supported from below at not more than three (3) foot intervals to prevent deformation.
- G. When it is necessary to store double wall containment pipe and fittings for more than thirty (30) days, exposure to direct sunlight shall be prevented by covering the pipe with an opaque material. Adequate air circulation above and around the pipe shall be provided as required to prevent excessive heat accumulation. Double wall containment pipe and fittings shall not be stored close to heat sources or hot objects such as heaters, fires, boilers or engine exhaust. Pipe gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. The interior and all sealing surfaces of pipe, fittings and other appurtenances shall be kept clean and free of dirt and foreign matter.
- H. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.
- I. Care shall be taken in handling and laying pipe and fittings to avoid severe impact blows, crushing, abrasion damage, gouging or cutting. Pipe shall be lowered, not dropped, from trucks or into trenches. All cracked, damaged or defective pipe and fittings, or any length of pipe having a gouge, scratch or other permanent indentation of more than ten percent (10%) of the wall thickness in depth, shall be rejected and removed at once from the work and replaced with new acceptable pipe at no additional cost to the Owner.

1.05 Job Conditions

A. Water in Excavation

- 1. Water shall not be allowed in the trenches while underground pipes, fittings, valves and/or accessories are being laid and/or tested.
- 2. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the Engineer. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.
- 3. In no case shall the pipelines being installed be used as drains for such water, and the ends of the pipe shall be kept properly and adequately plugged during construction by the use of approved stoppers and not by improvised equipment.
- 4. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the pipelines. If on completion of the work any such materials has entered the pipelines, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

1.06 Warranties and Guarantees

A. Provide an equipment warranty in accordance with Section 01740, *Warranties and Bonds*.

2. PRODUCTS

2.01 General

A. All double wall containment piping system components shall be pre-engineered, factory fabricated, tested and assembled such that field assembly is minimized to primarily that of straight joints.

2.02 Materials and Equipment

A. Carrier Pipe

1. Unless specified otherwise, pipe shall be made of polyvinyl chloride (PVC), Schedule 80 pipe, conforming to ASTM D1784-92.

- 2. Schedule 80 pipe shall have solvent welded socket type joints.
- 3. Laying lengths of twenty (20) feet or as shown on the Drawings shall be used.

B. Containment Pipe

1. Pipe shall be made of polyvinyl chloride (PVC) or chlorinated polyvinyl chloride (CPVC), Schedule 80 pipe, conforming to ASTM D1784-92 and the material being conveyed; chemical and pipeline capatability is required.

C. Fittings

- 1. Fittings for Schedule 80 pipe shall be of the socket type, solvent welded in conformance with ASTM D-2467.
- 2. Solvent welded joints shall be watertight.

D. Solvent Cement

1. PVC solvent cement shall be in compliance with ASTM D-2564.

2.03 Accessories

A. Leak Detection System

- Install in strict accordance with the system manufacturer's instructions and recommendations. Leak detection shall be installed with a sensor located at the lowest point in the piping, with all piping sloping to the location of the leak detection sensor. The leak detection system shall sound a local alarm and an alarm signal shall be sent to the facility SCADA system when a leak occurs.
- 2. Signal wires from the low point sensor shall be connected to the local output panel. Contact with any aqueous chemical shall result in an audible alarm and an LED signal. The local output panel shall be housed in a NEMA 4X enclosure. The leak detection output panel shall be located outside the chemical feed facilities where the piping first penetrates the ground or is located within the trench. For any miscellaneous control component data, the Contractor is referred to Division 11, *Equipment*, Division 13, *Special Construction* or Division 16, *Electrical*. The output relays shall be capable of interfacing with the facility SCADA system.
- 3. The leak detection system shall be manufactured by Asahi or approved equal.

2.04 Spare Parts

A. All special tools, solvents, lubricants, and cements required for normal installation shall be furnished with the pipe.

2.05 Quality Control

A. The Contractor shall follow the manufacturer's and supplier's recommended product quality control specifics as required for this project.

3. EXECUTION

3.01 Installation

- A. Install double wall containment pipe where shown on the Contract Drawings and in strict accordance with the manufacturer's technical data and printed instructions.
- B. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than ¹/₁₆-inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the pipe manufacturer shall be explicitly followed.
- C. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. Double wall containment pipe and fittings shall be installed in accordance with requirements of the manufacturer, ASTM and AWWA standards or as otherwise provided herein.
- D. All pipe shall be sound and clean before installation. When installation is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by pipe manufacturer. Fittings, in addition to those shown on the Contract Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.
- E. All valves and equipment shall be supported independently from the pipe. Anchor valves such that the turning moment resulting from their operation will not be transmitted to the pipe.

- F. Joints for double wall containment pipe and fittings shall be solvent welded. *All joints* shall be made watertight. All pipe cutting, threading and jointing procedures for solvent welded pipe joints shall be in strict accordance with the pipe and fitting manufacturer's printed installation instructions. In making solvent welded connections, clean dirt and moisture from pipe and fittings, bevel pipe ends slightly with emery cloth, if necessary and apply solvent cement of proper grade.
- G. Installation of valves and fittings shall be strictly in accordance with the manufacturer's instructions. Particular care shall be taken not to over-stress threaded connections at sleeves. In making solvent weld connections the solvent shall not be spilled on valves or allowed to run from joints.
- H. All piping shall have sufficient number of unions to allow convenient removal and shall be as approved by the Engineer.
- I. Where plastic passes through wall sleeves, joints shall be scaled with a mechanical seal. Mechanical seals shall be Link-seal, or approved equal.
- J. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify their locations from approved piping layout Drawings and the structural Drawings. Pipe hangers and supports are specified in Section 15125, Pipe Hangers and Supports.

K. Field Painting

1. Pipe normally exposed to view shall be painted and marked as specified in Section 09905, *Piping, Valve and Equipment Identification System*.

3.02 Cleaning, Flushing and Testing of Pipelines

- A. The Contractor shall clean and flush all double wall containment lines to remove sand, loose dirt, and other debris. The minimum flushing velocity shall be 2.5 feet per second. Flushing shall continue until clean water flows from the main. However, the Contractor shall endeavor to use the minimum amount of flushing water required to complete the work.
- B. All double wall containment piping shall be hydrostatically pressure tested in accordance with Section 15044, *Pressure Testing of Piping*.
- C. Following installation and testing:
 - 1. Flush clean the carrier and containment piping system.

2. Purge the annular space of moisture with clean, dry air.

3.03 Start-up and Instruction

- A. Provide a manufacturer's representative to assist with the unloading of the double wall containment piping system, system tests, containment pipe joint closure, installation and testing of the leak detection system, and training of the Owner's personnel in the operation and maintenance of the leak detection system.
- B. The manufacturer's representative shall complete a Certificate of Completed Demonstration Form (Section 00866) for the double wall containment piping system and present a letter to the Engineer that the system has been installed, tested and calibrated and is ready for operation in accordance with the manufacturer's instructions and recommendations. Inspection and examination practices shall be according to ASME B31.3-93 for normal fluid service.

END OF SECTION

SECTION 15100 VALVES AND APPURTENANCES

1. GENERAL

1.01 Description

- A. The Work included in this Section consists of furnishing all labor, equipment, materials, and incidentals required to install and test, complete and ready for operation, all valves and appurtenances as shown on the Contract Drawings and as specified herein.
- B. The equipment shall include, but is not limited to, the following:

1.	Gate Valves	11.	Hose Bibbs
2.	Ball Valves	12.	Washdown Hoses
3.	Diaphragm Valves	13.	Expansion Joints
4.	Check Valves	14.	Strainers
5.	Pressure Relief Valves	15.	Unions
6.	Solenoid Valves	16.	Pressure Gauges
7.	Valve Operators	17.	Diaphragm Seals
8.	Air Release Valves	18.	Valve Boxes
a	Evewsches and Showers		

- 9. Eyewashes and Showers
- 10. Sediment Strainers
- 11. Service Saddles and Corporation Stops

C. Related Work Described Elsewhere

Specification Section	Title	
09900	Painting	
09905	Piping, Valve and Equipment Identification System	
15000	Mechanical - General Requirements	
15044	Pressure Testing of Piping	
15129	Couplings and Connectors	

Division	Description
15	Piping
16	Electrical
Contract Drawings and General Provisions of the Contract	

D. General Design

1. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water, air, chemicals, etc., depending on the application.

1.02 Quality Assurance

A. All types of valves and appurtenances shall be the products of well established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

B. Compliance with Standards

- 1. Valves and appurtenances shall meet the requirements of the following applicable standards that shall be made a part of the Contract Documents by reference:
 - a. American Water Works Association (AWWA).
 - b. American Society for Testing and Methods (ASTM)
 - c. American National Standard Institute (ANSI)
 - d. American Society of Mechanical Engineers (ASME)
 - 1) ASME B31.9 for building services piping valves
 - 2) ASME B16.10 and B16.34 compliance for ferrous valves (dimension and design criteria).
 - e. National Sanitation Foundation (NSF)
 - 1) NSF 61 for valve materials for potable water use.

C. Valving and Appurtenance Inspection

- 1. The Contractor shall obtain from the valve and appurtenance manufacturer's, a certificate of inspection to the effect that the equipment supplied for this Contract have been inspected at the plant and that they meet the requirements of these specifications.
- All valving and appurtenances shall be subject to visual inspection at the time of delivery by rail or truck and also just before they are installed. Equipment that does not conform to these specifications will be rejected and must be removed immediately by the Contractor and shall be replaced at no additional cost to the Owner.
- 3. The entire product of any plant may be rejected when, in the opinion of the Engineer, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce valves or appurtenances.

1.03 Submittals

- A. All shop drawings shall be submitted to the Engineer for approval in accordance with Section 01300, Shop Drawings, Submittals and Samples, prior to construction. All shop drawings shall be submitted in an electronic (PDF) format.
- B. Submit within fifteen (15) calendar days after the Project Notice to Proceed a list of materials to be furnished, the names of suppliers and the date of delivery of materials to the Project Site.
- C. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer for approval prior to ordering of materials. The valve manufacturers shall certify, in writing, that the valve design and materials of construction are suitable for the intended service.
- D. Shop drawings for valves and appurtenances shall include, at a minimum, the following:
 - 1. Certified Dimensional Drawings of all piping, fittings, valves and appurtenances.
 - 2. A laying schedule and marking diagrams which indicate the specific number of each pipe, fitting, valve and appurtenance, the location and direction of lay of each pipe, fitting, valve and appurtenance in the completed line. In addition, the laying schedules shall include, but not limited to, the following:
 - a. Invert station and elevation of each valve and appurtenance.
 - b. Locations of valves, appurtenances and other mechanical equipment.

- 1) Methods and locations of supports.
- 2) Details of special elbows and fittings.
- c. Details of restrained and flexible joints.
- d. All valves, including gate, plug, ball, check, air release, solenoid, telescoping valves, etc.
- e. Valve operators.
- f. Valve boxes.
- g. Valve and meter vaults.
- h. Fire hydrants, backflow preventers and emergency eyewashes/showers.
- i. Hose bibbs and washdown hoses
- j. Couplings, connectors and unions.
- k. Service saddles.
- I. Pressure gauges.
- m. Flexible expansion joints, tie rods, and flanged coupling adapters.
- n. Joint lubricant.
- o. Sediment strainers.
- p. Diaphragm seals.
- q. Service saddles and corporation stops.
- 3. A separate shop drawing submittal will be required for each major item listed above and for each different type of an item within a major item. For example, separate submittals will be required for butterfly, plug, ball, solenoid, check, and automatic air release valves. All submittals shall be in accordance with the General and Supplementary Conditions and Section 01300, Shop Drawings, Submittals and Samples.

E. Quality Control Submittals

1. Certificate of Compliance for:

a. Electric Operators: Full compliance with AWWA C-540

b. <u>Butterfly Valves</u>: *Full compliance with AWWA C-504*

- 2. Test and inspection data.
- 3. Manufacturer's certificate of proper installation and check-out.
- 4. Operation and Maintenance Manuals.
- F. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, CDA, etc.), and grade and type. Identify each valve by tag number to which the catalog data and detail sheets pertain.
- G. Show valve dimensions including layout lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valve. Show the location of internal stops for gear actuators. State differential pressure and fluid velocity used to size the actuators. For worm gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.
- H. **Show valve linings and coatings** and submit the manufacturer's catalog data and descriptive literature.
- Submit three (3) copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to the Project Site until the reports have been returned by the Engineer and marked either "Approved" or "Approved as Noted".
- J. For butterfly and eccentric plug valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.
- K. Acceptance of Material and Certifications
 - The Contractor shall furnish a certified Affidavit of Compliance for all valves, appurtenances and other products or materials furnished under this Contract complies with all applicable provisions of current AWWA, ASTM, NSF and ANSI standards, and these specifications.

- 2. No valves and/or appurtenances will be accepted for use in the Work on this project until the Affidavit has been submitted and approved by the Engineer.
- L. Submit O&M Manuals for valves, appurtenances and other products and materials requiring periodic maintenance and/or explanation of operation.

1.04 Delivery, Storage and Handling

- A. All valves and appurtenances shall be handled in such manner as to ensure a sound undamaged condition during shipping, delivering, and installing. The Contractor shall also refer to the requirements of Section 01600, *Materials and Equipment*.
- B. Care shall be taken not to injure the valve and/or appurtenance coating and/or lining.
- C. The Contractor shall exercise care when handling lined valves and appurtenances. Damage to the lining will render it unfit for use and shall require replacement at no additional cost to the Owner.
- D. The insides of valves and appurtenances shall be kept free of dirt and debris.

1.05 Operation and Maintenance Manuals

- A. O&M Manuals shall be furnished for this Project in accordance with Section 01730, Operation and Maintenance Data and shall be submitted in accordance with Section 01300, Shop Drawings, Submittals and Samples.
- B. The O&M Manuals shall be prepared specifically for this installation and shall include all detailed operating and maintenance instructions and specifications relative to the assembly, alignment, checking, lubrication, placing in operation, adjustment, and maintenance of equipment and auxiliaries furnished under this Contract, together with its complete parts lists therefore, and copies of shop drawings, certified dimensions drawings and design calculations, required cut sheets, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.
- C. All such material shall be in addition to any instructions or parts lists packaged with or attached to the equipment when delivered.
- D. The "final" O&M Manuals shall contain *plastic laminated pull-out lubrication and maintenance cards* detailing all lubrication points, lubricant type, and frequency of lubrications and all additional required maintenance and frequency intervals.

- E. In addition to standard O&M Manuals, all manufacturers supplying equipment and products specified herein shall also submit their operation and maintenance manuals and data to the System Integrator for this Project on CD/DVD/BD's in Corel WordPerfect (latest version), Microsoft Word (latest version), or text, "txt", formats. All graphic files shall be in BMP, PCX, CDR, JPEG, DWG or DXF formats (integrators preference for the system shall be required). All O&M Manual files shall also be submitted electronically on CD/DVD/BD's to the Engineer in both PDF and JPEG formats, no exceptions.
- F. The System Integrator shall be responsible to configure and compile the O&M Manuals into "hypertext" window help files for use as computer "on-line" help screens for equipment operation and maintenance. The System Integrator shall return all hypertext files to the equipment and product manufacturer's for review and approval prior to introducing them into the SCADA System at the treatment facility.

1.06 Job Conditions

A. Water in Excavation

- 1. Water shall not be allowed in the trenches while underground valves and/or appurtenances are being laid and/or tested.
- 2. The Contractor shall not open more trench than the available pumping facilities are able to dewater to the satisfaction of the Engineer. The Contractor shall assume responsibility for disposing of all water so as not to injure or interfere with the normal drainage of the territory in which he is working.
- 3. All necessary precautions shall be taken to prevent the entrance of mud, sand, or other obstructing matter into the valves and appurtenances. If on completion of the work any such materials has entered either valves or appurtenances, it must be cleaned as directed by the Engineer so that the entire system will be left clean and unobstructed.

1.07 Warranties and Guarantees

A. Provide equipment warranty in accordance with Section 01740, Warranties and Bonds. Provide a minimum three (3) year warranty from the date of Final Project Acceptance by the Owner.

2. PRODUCTS

2.01 General

- A. Install valves complete with operating handwheels or actuators, levers, chain wheels, extension stems, floor stands, gear operators, operating nuts, chains, wrenches and accessories required for operation.
- B. All valves and appurtenances shall be of the size shown on the Contract Drawings and all equipment of the same type shall be from a single manufacturer.
- C. All valves and appurtenances shall have the name of the manufacturer, size of the valve and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- D. All bolts, washers and nuts shall be Type 304 stainless steel.

2.02 Finishes

A. Potable Water

1. Epoxy Lining and Coating

- a. An epoxy lining and coating shall be applied to all potable water valves and appurtenances in accordance with AWWA C-550, unless otherwise specified and NSF approved.
- b. Either two-part liquid material or heat-activated (fusion) material shall be used, except only heat-activated material shall be used if the specifications call for "fusion" or "fusion bonded" epoxy.
- c. A minimum seven (7) mil dry film thickness shall be provided except where limited by valve operating tolerances.

2. Exposed Valves

- a. Exposed valves shall be coated in accordance with Section 09900, *Painting*.
- b. Safety isolation valves and lockout valves with handles, handwheels or chain wheels shall be painted "safety yellow".

B. Raw Wastewater, Biosolids/Sludge, Secondary Effluent and Reclaimed Water

1. Exterior Coating for Buried Valves and Appurtenances

- a. All exterior surfaces of valves and appurtenances shall be clean, dry and free from rust and grease before coating.
- b. Valves and appurtenances to be installed underground shall be coated on the exterior at the factory with a two (2) coat bituminous epoxy system with a minimum total finish dry film thickness of twenty (20) mils.
- c. Prior to back filling, all uncoated nuts, bolts, glands, rods, and other parts of joints for underground installation shall be coated in the field with bituminous epoxy.

2. Exterior Coating for Exposed Valves and Appurtenances

- a. All exterior surfaces of valves and appurtenances shall be clean, dry and free from rust and grease before coating.
- b. For valves and appurtenances installed above-ground, the exterior ferrous parts of all valves shall be shop primed at the factory with **one** (1) **coat**, **minimum dry film thickness of four** (4) **mils**, of a lead/chromate free, rust-inhibitive universal epoxy primer. The primer shall be suitable for the finish paint specified.
- c. Following installation, all above-ground valves shall be finish painted in accordance with Section 09900, *Painting*.
- d. Exposed piping shall be painted in accordance with Sections 09900, *Painting*, and 09905, *Piping*, *Valve and Equipment Identification System*.

3. Interior Valve and Appurtenance Lining

- a. The interior of the valve body and valve disc shall be coated with a two-coat fusion bonded or thermosetting epoxy coating in accordance with AWWA C-550, latest revision and NSF 61.
- b. The coating shall be holiday-free, NSF approved, with a minimum thickness of sixteen (16) mils.
- c. Surfaces shall be clean, dry, and free from rust and grease before coating.

2.03 Gate Valves (GV)

A. General

- 1. Gate valves shall have a clear waterway equal to the nominal diameter of the pipe when fully open.
- 2. The opening nut or wheel shall have an arrow cast in the metal indicating the direction of the opening. Each valve shall have the manufacturer's distinctive markings, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by applying to it a hydrostatic pressure equal to twice the specified working pressure.
- 3. Hydrostatic and leakage testing shall be conducted in strict accordance with ANSI/AWWA C-500, latest revision or ANSI/AWWA C-509, latest revision whichever is applicable.
- 4. All gate valves which are installed on pipe sizes larger than three (3) inches shall have mechanical joint or flanged ends to fit the pipe run in which they are to be used. Flanged valves shall be faced and drilled to the ANSI 125/150 pound standard. Mechanical joint ends shall be to the AWWA Standard C111-72. Gate valves installed on pipes three (3) inches and smaller shall have slip on joints or screwed ends. Screwed ends shall be to the NPT Standard.
- 5. Gate valves shall open left or counter-clockwise when viewed from the stem.
- 6. Buried gate valves shall be furnished with two (2) inch square AWWA standard nut operators with a valve box and cover. Gate valves located above ground or inside structures shall be furnished with handwheel operators and shall have a suitable indicator arrow to give the valve position from fully open to fully closed.

B. Gate Valves for Tapping Valves and Sleeves

1. Tapping Valves

- a. Tapping valves shall conform to ANSI/AWWA C-500 or C-509, latest revision, and shall be designed for a minimum working pressure of 150 psi.
- b. Tapping valves three (3) inches to twelve (12) inches shall be resilient seat type gate valves as specified in Article 2.03. Resilient seat type tapping valves shall be furnished with a raised guide ring cast integrally on the flanged end which is designed to match the groove in the tapping sleeve. The purpose of this guide ring shall be to ensure true alignment of the valve with the tapping sleeve.

- c. Tapping sleeves larger than twelve (12) inches shall be iron body, bronze mounted gate valves, with double disc, parallel seat and non-rising stem. The stem shall be bronze and sealed by two "O" rings. The stem nut shall be bronze and cast integrally into the top wedge. The valve disc seating mechanism shall be bottom wedging, hook and wedge type, with disc hooks and wedges as separate interacting parts. The valve shall be designed for vertical mounting in approximately level setting on buried water lines. The valve ends shall be flanged American Standard Class 125 pound steam pressure ratings on one side of the valve and mechanical joint on the other side for use with the class and type of pipe to be installed from the tapping sleeve. Tapping sleeves twelve (12) inches and larger shall be furnished with a raised guide ring cast integrally on the flanged end as specified above for resilient seat type tapping valves.
- d. The valve shall open left or counter-clockwise when viewed from the stem. The valve shall be furnished with a 2-inch square AWWA standard nut operator with a valve box and cover as specified herein.

2. Tapping Sleeves

- a. Tapping sleeves shall be of the cast iron, mechanical joint type, with a working pressure rating of 200 psi for sizes four (4) inches through twelve (12) inches and 150 psi for sizes fourteen (14) inches and larger, and shall conform to the applicable sections of AWWA Standard C-110, latest revision.
- b. Sleeve and glands shall be of the split-type for assembly on the pipe, and the sleeve and mechanical joint glands and gaskets shall be sized for use with the class and type of pipe being tapped. Sleeve and glands shall be standard bituminous coated, and shall be furnished complete with all accessories. The outlet flange shall be Class 125 Standard. The Contractor shall obtain approval from the Engineer for drilling machine used prior to tapping connections.

3. Operator

- a. Two (2) inch square nut or other operator specified on the Contract Drawings or by the Engineer.
- 4. Gate valves shall be manufactured by Mueller Company, Dresser Industries, Inc., American Valve and Hydrant Valve Company, Kennedy Valve Manufacturing Company, or equal.
- 5. Interior and Exterior coatings shall be in accordance with Article 2.02.

C. Knife Gate Valves (KGV) - Stainless Steel

- 1. Provide electric operated knife gate valves, in sizes and quantities as indicated on the Drawings for the dewatered solids discharge system.
- 2. Monitoring and control of the electric actuated knife gate valves to be integrated into the Master Dewatering Control Panel and facility SCADA.
- 3. The Master Dewatering Control Panel PLC programming shall allow for operator adjustable periodic cycling through all or any selected combination of possible cake discharge points at desired preset time intervals while the dewatering system is in operation. The programming shall allow for the use of only one drop point, cycling among any two adjacent drop points, or cycling between three drop points.
- 4. Knife gate valves shall be resilient seated, full, round port design for high flow capacity and minimal pressure drop. The valve body port area shall not be less than eighty percent (100%) of the nominal pipe diameter. Valves shall be designed for positive drip-tight shutoff at 150 psi. All materials of construction shall be as specified herein and shall be suitable for use with dewatered biosolids. The valves shall be equipped with automatic actuators and secondary chainwheel operators and extensions or floor stand operator with handwheel and extensions as shown on the Contract Drawings. Provide bevel gear actuators for valves fourteen (14) inches and larger.

5. Body and Gate

- a. The body material shall be Type 316 stainless steel.
- b. The body shall have a lugged design drilled tapped in accordance with ANSI 150 standards.
- c. The gate shall be constructed of Type 316 stainless steel in accordance with ASTM A-240, finish ground on each side to prevent packing or seat damage.

6. Packing and Gland Material

- a. The packing gland shall be Type 316 stainless steel in accordance with ASTM A-240.
- b. Valve packing shall be square braided PTFE impregnated synthetic fiber. Removal or replacement of the packing shall be accomplished without necessitating the removal of the valve from the pipeline.

7. Yoke Sleeve

a. The yoke super structure shall be constructed of ASTM A-36. The yoke sleeve shall be aluminum bronze in accordance with ASTM B-30, Alloy C84400.

b. The bonnet shall be Type 316 stainless steel.

8. Seat Ring and Seat

- a. The seat ring shall be Type 316 stainless steel in accordance with ASTM A-240.
- b. The resilient seat material shall be EPDM or Neoprene and shall be bonded to the seat ring.
- 9. The stem and gate shall be manufactured of Type 316 stainless steel in accordance with ASTM A-240.
- 10. Interior and Exterior coatings shall be in accordance with Article 2.02.
- 11. The valve shall be cast of stainless steel and shall be manufactured by DeZurik, or approved equal.

2.04 Butterfly Valves

A. General

- Butterfly valves for shall meet or exceed the design standards of ANSI/AWWA C-504-150B, latest revision and designed for a *minimum working pressure of 150* psi.
- 2. Valves shall be bubble tight in either direction at the rated pressure and shall be suitable for throttling and/or operation after long periods of inactivity.
- 3. The manufacturer shall provide the Engineer with a letter of compliance, within twenty (20) calendar days of the Notice to Proceed indicating that the valve and all materials are compatible with the liquid to flow through it and applicable for the intended use.
- 4. All valves shall be furnished with position indication.
- 5. Valve discs shall rotate 90° from the fully open position to the fully closed position.

6. Thrust Bearings

- a. Provide thrust bearings to hold the valve disc in the center of the valve seat. No bearings shall be mounted inside the valve body within the waterway.
- b. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

7. Bronze Components

a. Bronze components in contact with water shall comply with the following requirements:

Constituent	Maximum Content (%)
Zinc	7
Aluminum	2
Lead	8
Copper + Nickel + Silicon	83

8. Port Sizes

- a. For valves twenty-four (24) inches and smaller, the actual port diameter shall be at least ninety-three percent (93%) of the nominal valve size. For valves larger than twenty-four (24) inches, the port diameter shall not be more than 1.25-inches smaller than the nominal valve size.
- b. The dimension of the port diameter shall be the clear waterway diameter plus the thickness of the seat.
- 9. Butterfly valves shall be as manufactured by DeZurik, Dresser Industries, Inc., Kennedy Valve Manufacturing Company, Clow Valve Company, Mueller Company, Henry Pratt Company, or equal.

B. Valve Bodies

- 1. Valve bodies shall be constructed of high-strength cast iron or ductile iron conforming to ASTM A126, Class B.
- 2. Buried valves shall have integrally cast mechanical joint ends as specified for ductile iron pipe and above-ground valves shall have cast iron flanges.
- 3. End flanges shall conform in dimensions and drilling to ANSI B 16.1, Class 125.
- 4. Two trunnions for shaft bearings shall be integral with each valve body.
- 5. Valve body thickness shall be in strict accordance with ANSI/AWWA C-504, latest revision, for Class 150B valves.

C. Valve Seat Ring

1. The valve seat ring shall be constructed of Type 316 stainless steel. The seating

edges of the seat ring shall be smooth and polished.

2. The seat ring shall be capable of compensating for changes in direction of flow to assure a bubble tight seal in either direction.

D. Valve Discs

- 1. Valve discs shall be solid (no cores) for 24-inch and smaller valves, and shall be either solid or hollow core for valves greater than 24-inch. Valve discs shall be constructed of ductile iron in conformance with AWWA C-504.
- 2. The valve disc shall be of the offset type design to provide 360° uninterrupted seating.

E. Valve Shafts

- 1. Valve shafts may consist of a one piece unit extending completely through the valve disc bearings and into the operating mechanism or may be of the "stub shaft" type, which comprises two separate shafts inserted into the valve disc hubs. If used, stub shafts shall extend a minimum of 1½ shaft diameters into the valve disc hubs.
- 2. Valve shafts shall be constructed of Type 316 stainless steel or a stainless steel with greater overall corrosion and oxidation resistance.
- 3. The minimum shaft diameter shall conform to ANSI/AWWA C-504, latest revision, for Class 150B valves.
- 4. The valve disc shall be attached to the shaft by means of "O" ring sealed taper pins.
- 5. The valve shaft seal shall consist of "O" rings in bronze cartridge or self adjusting nitrile Vee-type ring seals.

F. Valve Seats

- 1. Valve seats shall be of a corrosion and chlorine resistant synthetic rubber compound bonded to a high grade stainless steel retaining ring and secured to the valve disc by Type 316 stainless steel set screws or shall be molded in, vulcanized, and bonded to the body.
- 2. Seats bonded to the body shall withstand a 75-pound pull tested in accordance with ASTM D429, Method B.
- 3. The valve seat shall be adjustable and replaceable in the field without dismantling operator, disc, or shaft.

G. Valve Bearings

- 1. Valve shafts shall be fitted with sleeve-type bearings.
- 2. Bearings shall be corrosion resistant and self-lubricating (Nylon or Teflon).
- 3. Bearings shall be designed for a pressure not exceeding the published design load for the bearing material, or ¹/₅ of the compressive strength of the bearing or shaft material.

H. Valve Operators

- All butterfly valves shall open left or counter-clockwise (CCW) when viewed from the stem. Automatic valve operators shall have motorized valve actuators as specified hereinafter. Manual valve operators shall be of the worm gear or traveling nut type and shall be fully enclosed suitable for buried or submerged service.
- 2. All operators shall have adjustable mechanical stop limiting devices to prevent over travel of the disc. Should an adjustment of the disc be required to maintain a bubble tight seal, this adjustment shall be made externally without removing the operator housing cover. The operator shall be designed such that all adjustments can be made under pressure and without the possibility of dirt getting into the operator lubricant. Any adjustments through the lower shaft will not be acceptable.
- 3. Units furnished for buried service shall be fully gasketed and grease packed.
- 4. Manual valves located above ground and above grating shall be equipped with handwheel or chainwheel operators and shall have a suitable indicator arrow to give valve position from "fully open" to "fully closed".
- 5. Buried butterfly valves and valves below grating shall be furnished with a two (2) inch square AWWA nut operator with valve box and cover. The stems shall be "pinned" and shall bring the 2-inch square nut to approximately six (6) inches from the finished valve pad elevation. Operator components shall, at the extreme operator positions, withstand without damage a pull of 200 lbs. for handwheel or chainwheel operators or an input torque of 300 ft-lbs. for operating nuts.
- I. Interior and Exterior coatings shall be in accordance with Article 2.02.

J. Valve Testing

 Prior to shipment from the factory, hydrostatic and leakage tests shall be conducted on each butterfly valve. Hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C-504, latest revision, and results shall be submitted to the Engineer.

2.05 Ball Valves

A. PVC Ball Valves

1. General

- a. All PVC ball valves ½-inch through 4-inch in size shall be of one piece capsule type manufactured of Type I, Grade 1 PVC.
- b. All ball valves shall be true union design with two-way blocking capability and shall have solvent welded socket or NPT threaded ends.
- c. All ball valves shall be designed for a 150 psi water working pressure at 120°F.
- d. Manually operated ball valves shall be supplied with an ABS lever operating handle. Motorized ball valves shall be equipped with an electric actuator as specified hereinafter.
- 2. <u>PVC Ball Valves for Anti-Scalant, Sodium Hydroxide, Hydrofluosilicic Acid,</u> Phosphate Inhibitor and Ammonia - NOT USED
- 3. PVC Ball Valves Used with Halar (ECTFE) Sulfuric Acid Piping Systems NOT USED
- 4. <u>PVC Ball Valves Used with Teflon-Lined Carbon Steel Sulfuric Acid Piping Systems</u>
 NOT USED
- 5. PVC Ball Valves for Bulk Sodium Hypochlorite NOT USED
- 6. Standard PVC Ball Valves for Water and Reclaimed Water Service
 - a. All PVC ball valves ½-inch through 4-inch in size shall be of one piece capsule type manufactured of Type 1, Grade 1 PVC.
 - b. Ball valves shall be true union design with two-way blocking capability and shall have solvent welded socket or NPT threaded ends.
 - c. Ball valves shall have Teflon seats with Viton backing cushions and Viton O-ring seals, and shall be designed for a 150 psi water working pressure at 120°F.
 - d. Manually operated valves shall be supplied with ABS lever operating handles. Motorized ball valves shall be equipped with an electric actuator as specified hereinafter.

e. PVC ball valves shall be manufactured by Plast-O-Matic, Asahi/America, Hayward, or an equal approved by the Engineer.

B. Stainless Steel Ball Valves

- 1. Stainless steel ball valves shall be of the standard port type with flanged connections for the sizes indicated on the Contract Drawings or specified herein.
- 2. Stainless Steel ball valves shall be designed for a working pressure of 200 psi with positive shut off when in the closed position.
- 3. The valve shall be a one (1) piece, Grade CF-8M, Type 316 stainless steel body, ANSI B16 with a solid Type 316 stainless steel ball and stem.
- 4. The seats and seals shall be Teflon.
- 5. The ball shall have a full bore port design machined from a solid metal piece with highly polished surfaces.
- 6. Manually operated ball valves shall be furnished with level operators manufactured of forged Type 316 stainless steel with a molded vinyl sleeve.
- 7. Stainless steel ball valves shall be manufactured by KTM, DeZurik, Neles-Jamesbury, or an equal approved by the Engineer.

C. Electric Actuator for PVC Ball Valves

- 1. Where indicated on the Contract Drawings, PVC ball valves shall be provided with an electric actuator. The actuator shall be matched to the valve and shall have sufficient operating torque to operate the valve for its maximum expected breakaway torque.
- 2. The actuator shall be capable of full 90° actuation within ten (10) seconds. The actuator shall be UL listed and suitable for 120 volt AC, 60 Hz, one-phase electric power, and shall be provided with a corrosion-resistant, NEMA 4 enclosure.
- The valve actuator shall be provided with a manual operator override which is disengageable such that the valve cannot be operated electrically while the manual override is engaged.
- 4. The actuator shall be furnished with a high torque, reversible, brushless, capacitor run, heavy duty motor with built-in motor overload protection, and gears and shafts shall be heat treated, high allow steel.
- 5. The unit shall be permanently lubricated and travel limit switches shall be independently adjustable. The actuator shall be provided with an integral electrical

- terminal strip, position indicator, over-torque protection, and travel limit switches for position light operation.
- 6. The valve actuator enclosure shall be provided with a combination heater and thermostat to maintain the case interior above 40°F.
- 7. Two additional limit switches shall be provided to energize and de-energize a pump interlocked with the valve.
- 8. The electric actuator shall be a Model 92 Electric Valve Actuator as manufactured by Asahi/America, or an equal approved by the Engineer.

2.06 Diaphragm Valves

A. Bronze Angle Hose Valves

- 1. Angle-type hose valves, less than two (2) inches in size, shall have a brass or bronze body (ASTM B-62 or ASTM B-584, Alloy C83600) with rising or non-rising stem, composition disc, and bronze or malleable iron handwheel.
- 2. The stem shall be bronze, ASTM B-62, ASTM B-584 (Alloy 83600), or ASTM B-198 (Alloy 87600).
- 3. The valve shall have a cold water service pressure rating of 150 psi.
- 4. Provide a cap and chain with the valve.
- 5. Threads on the valve outlet shall be American National Standard fire hose coupling screw thread.
- 6. Valves shall be Nibco T-301-HC, Powell Figure 151 with Figure 527 nipple adapter, Crane 17TF with hose nipple adapter, or approved equal.

B. Bronze Hose Bibbs

- 1. Hose bibbs of size ½-inch, ¾-inch and 1-inch shall be all bronze (ASTM B-62 or ASTM B-584, Alloy C83600) with rising or non-rising stem, composition disc, and bronze or malleable iron handwheel.
- 2. The stem shall be bronze, ASTM B-99, Alloy 651; ASTM B-371, Alloy C69400; or ASTM B-584, Alloy 87600. The packing shall be Teflon or graphite.
- 3. The valve shall have a cold water service pressure rating of 150 psi.
- 4. Provide a cap and chain with the valve.

- 5. Threads on the valve outlet shall be American National Standard fire hose coupling screw thread (ANSI B1.20.7).
- 6. Provide a vacuum breaker approved by the State of Florida Health Department on each hose bibb.
- 7. Valves shall be Jenkins Figure 112, 113 or 372; Nibco T-113-HC; Powell Figure 503H, or approved equal.

C. <u>Electric Actuator for Diaphragm Valves</u>

- 1. Where indicated on the Contract Drawings, diaphragm valves shall be provided with an electric actuator. The actuator shall be matched to the valve and shall have sufficient operating torque to operate the valve for its maximum expected breakaway torque.
- 2. The actuator shall be capable of full 90° actuation within ten (10) seconds. The actuator shall be UL listed and suitable for 120 volt AC, 60 Hz, one-phase electric power, and shall be provided with a corrosion-resistant, NEMA 4 enclosure.
- The valve actuator shall be provided with a manual operator override which is disengageable such that the valve cannot be operated electrically while the manual override is engaged.
- 4. The actuator shall be furnished with a high torque, reversible, brushless, capacitor run, heavy duty motor with built-in motor overload protection, and gears and shafts shall be heat treated, high allow steel.
- 5. The unit shall be permanently lubricated and travel limit switches shall be independently adjustable. The actuator shall be provided with an integral electrical terminal strip, position indicator, over-torque protection, and travel limit switches for position light operation.
- 6. The valve actuator enclosure shall be provided with a combination heater and thermostat to maintain the case interior above 40°F.
- 7. Two additional limit switches shall be provided to energize and de-energize a pump interlocked with the valve.
- 8. The electric actuator shall be a Model 92 Electric Valve Actuator as manufactured by Asahi/America, or approved equal.

2.07 Plug Valves

A. General

- 1. Plug valves shall be of the non-lubricated eccentric type for use in wastewater service with flanged or mechanical joint ends as specified herein. Valves shall open by turning to the left (counter-clockwise), when viewed from the stem. The port area of the valves shall be a minimum of eighty percent (80%) of the full pipe area. The valves shall be capable of providing a drip-tight shutoff to the full valve rating with the pressure in either direction.
- 2. Plug valves shall be tested in accordance with AWWA C-504-80, Section 5. Each valve shall be performance tested in accordance with Section 5.2 and shall be given a leakage test and hydrostatic test as described in Articles 5.3 and 5.4. The leakage test shall be applied to the face of the plug tending to unseat the valve. The leakage test shall be performed at the valve rating pressure as specified herein. The manufacturer shall furnish certified copies of the reports covering proof of design testing as described in Section 5.5.
- 3. All interior ferrous surfaces of the valve that will come into contact with the wastewater shall be coated with a factory applied, thermally bonded epoxy coating in accordance with AWWA C-550, latest revision. Surfaces shall be clean, dry and free from rust, oil and grease before coating. Exterior surfaces shall be coated as specified hereinafter.

4. Valve Joints

- a. All plug valves installed above-ground, in valve vaults or on flange piping shall have flanged ends. Flanges shall comply with facing, drilling and thickness requirements of the ANSI Standards for Class 125 dimensions.
- b. Nuts and bolts for flanged connections in valve vaults or corrosive environments shall be Type 304 stainless steel in accordance with ASTM A-320, Class 2.
- c. Nuts and bolts for above-ground installations or non-corrosive atmospheres shall be carbon steel in accordance with ASTM A-307. Grade B.
- d. All buried plug valves shall have mechanical joint ends with dimensions, bolting patterns and assembly in strict accordance with ANSI/AWWA C-111, latest revision.
- e. Tee head bolts and nuts for mechanical joints shall be manufactured of CORTEN-A, high strength, low alloy, corrosion resistant steel as manufactured by NSS Industries, or an equal approved by the Engineer.
- f. Plug valves four (4) inch in size and larger buried underground, and all plug valves six (6) inch in size and larger installed above-ground, buried or in valve vaults shall be furnished with mechanical gear actuators. Gear actuators shall be furnished with AWWA Standard 2-inch square operating nuts for buried valves, or handwheel, chainwheel or 2-inch square nut operators for above-ground or valve vault installation, as shown on the Contract Drawings. The gear actuator shall be sized for the maximum pressure differential across the valve,

equal to the pressure rating of the valve. All gearing shall be enclosed in a high strength cast iron housing, suitable for running in a lubricant.

- B. Prior to shipment from the factory, each valve shall be hydrostatically tested as follows. Valve seats shall be tested to provide leak tight shut off to 175 psi for valves through 12-inch and 150 psi for valves 14 inches and larger, with pressure in either direction. In addition, a hydrostatic shell test shall be performed with the plug open to a pressure twice that of rating specified above to demonstrate overall pressure integrity of the valve body.
- C. Plug valves shall be eccentric plug valves as manufactured by DeZurik, Henry-Pratt Co., or approved equal.

D. <u>Eccentric Plug Valves</u>

- Valve bodies shall be constructed of high strength cast iron conforming to ASTM A126, Class B and AWWA C504, latest revisions. Valve bodies shall be cast with raised eccentric seats which have a corrosion-resistant welded-in overlay of not less than ninety percent (90%) pure nickel on all surfaces contacting the plug face or valve seats shall be replaceable 316 stainless steel seats. Valve seats shall be in accordance with AWWA C504 and AWWA C507, latest revisions.
- Valves shall be furnished with resilient faced plugs with neoprene facing, suitable
 for use with wastewater or sludge. Valves shall be furnished with replaceable,
 permanently lubricated, stainless steel sleeve-type bearings in the upper and lower
 plug stem journals. Plug stem bearings shall comply with AWWA C504 and C507,
 latest revisions.
- 3. The valves shall be of the bolted bonnet design with shaft seals designed so that they can be repackaged without removing the bonnet and the packing shall be adjustable. Packing material shall be Buna-Vee type packing. Valve shaft seals shall be in accordance with AWWA C504 and AWWA C507, latest revisions.
- 4. All exposed valve nuts, bolts, springs, washers, and the like shall be Type 316 stainless steel.
- 5. Eccentric plug valves shall be as manufactured by DeZurik, Henry-Pratt Co., or equal.
- E. Interior and Exterior coatings shall be in accordance with Article 2.02.
- F. Pressure Rating for the valves shall be in accordance with ANSI B16.1-1967 and shall be as follows:

Pipe Size (inches)	Pressure Rating (psi)
≤ 12	175
> 14	150

2.08 Check Valves - NOT USED

2.09 Pressure Relief Valves (PRV's) - NOT USED

2.10 Backpressure Sustaining Valves - NOT USED

2.11 Isolation Valves

- A. Isolation valves shall be provided for water and reclaimed water services.
- B. The isolation valves shall be of the ball type. Materials of construction of the valve body shall be compatible with the type of service, as indicated above, and as shown on the Contract Drawings.
- C. Valves shall be of the threaded, flanged, socket, plain, union or grooved ends as required by the Contractor.
- D. The operator shall be of the "handle" type compatible with the type of service.
- E. The valve shall be rated for an operating pressure of 150 psi.
- F. The isolation valves shall be as manufactured by ASAHI/America, Simtech, or approved equal.

2.12 Solenoid Valves

A. Potable Water Service

- 1. The solenoid valve shall be normally closed and shall be equipped with a manual override operator.
- 2. The valve shall be of the general purpose type and shall be fabricated with a body and trim of stainless steel.
- 3. The operator shall be of the solenoid type rated for 120 V service.
- 4. The valve shall be rated for an operating pressure of 150 psi.
- 5. The solenoid valve shall be as manufactured by ASCO Red-Hat or approved equal.

2.13 Pinch Valves - NOT USED

2.14 Electric Motor Operated Pinch Valves - NOT USED

2.15 Telescoping Valves - NOT USED

2.16 Air Release Valves

A. Wastewater and Reclaimed Water Air Release Valves

- 1. Air release valves for wastewater service shall be of the long stem and body type designed to keep the valve operating mechanism as free from contact with the wastewater as possible.
- 2. Valves shall have a two (2) inch threaded inlet, with a one (1) inch blow-off connection with a one (1) inch blow-off valve (gate valve), ½-inch back-flushing attachments with a ½-inch outlet. The outlet and back flushing connections shall be quick couplings. The valve shall have a minimum orifice diameter of 5/16-inch.
- Valves shall be shall be properly sized for the proposed application and of the proper materials of construction for the intended service (wastewater, reclaimed water, etc.) and shall be a product manufactured by APCO, Valmatic, Valve and Primer Co., or approved equal.
- 4. Valves shall be constructed of cast iron, ASTM A48, Class 35 with Type 316 stainless steel trim, lever pins and float.
- 5. Valves shall have a working pressure rating of at least 150 psi.

B. Air and Vacuum Wastewater/Reclaimed Water Valves

- 1. Air and vacuum valves for wastewater service shall be of the long stem and body type designed to keep the valve operating mechanism as free from contact with the wastewater as possible.
- 2. Valves shall have a two (2) inch threaded inlet, with a one (1) inch blow-off connection with a one (1) inch blow-off valve (gate valve), ½-inch back-flushing attachments with a ½-inch outlet. The outlet and back flushing connections shall be quick couplings. The valve shall have a minimum orifice diameter of one (1) inch. The valves on the discharge piping of pumping stations shall have the orifice sized as required to expel air on pump starting.

- 3. Valves shall be shall be properly sized for the proposed application and of the proper materials of construction for the intended service (wastewater, reclaimed water, etc.) and shall be a product manufactured by APCO, Valmatic, Valve and Primer Co., or approved equal.
- 4. The valve body shall be constructed of cast iron, ASTM A48, Class 35. The valve and float shall be Type 316 stainless steel. Valves shall have a working pressure rating of at least 150 psi.

C. Valve End Connections

- 1. Valves smaller than three (3) inches shall have threaded ends. Valves four (4) inches and larger shall have flanged ends.
- 2. Flanges for Class 150 valves shall comply with ANSI B 16.1, Class 125.
- 3. Flanges for Class 300 valves shall comply with ANSI B16.1, Class 250.
- 4. Threaded ends shall comply with ANSI B2.1.
- D. All air release and vacuum relief valves shall be isolated from the service line with a Type 316 stainless steel gate valve for valves up to 3-inches, and a flanged body butterfly valve for valves greater than three (3) inches (provide a spacer plate if required to clear the rotation of the butterfly disc).

2.17 Surge Anticipating Control Valve - NOT USED

2.18 Reduced Pressure Backflow Preventors (RPBP)

A. Potable Water Service

1. Reduced pressure backflow preventers for potable water service shall meet the requirements of AWWA C-511.

2.19 Valve Operators

A. General

1. All operators shall be sized to operate the valve at the valve's full-rated pressure. Gear actuator shall be sized for the maximum pressure differential across the valve, equal to the pressure rating of the valve. All gearing shall be enclosed in a high-

strength cast iron housing, suitable for running in a lubricant. Housing shall be provided with seals on all shafts to prevent the entry of dirt and water into the actuator. The actuator shaft and quadrant shall be supported on permanently lubricated bronze bearings. The actuator shall clearly indicate valve position for above-ground and valve vault installations and an adjustable stop shall be provided to set closing torque. The actuator shall be capable of withstanding an over-torque without damage up to 450 foot-pounds for two (2) inch square nut operators and to 300 foot-pounds for handwheel or chainwheel operators.

- 2. Valve operators, handwheels or levers shall open by turning counter-clockwise (CCW) and shall be constructed of non-corrosive materials.
- 3. Four (4) inch and smaller aboveground valves shall be furnished with manual actuators, one-quarter turn to open. The actuator shall be supplied with an AWWA Standard two (2) inch operating nut with a standard valve operating lever.
- 4. Exposed operators shall be furnished with chainwheel operators, geared operators, extension stems, floor stands, and other elements to permit operation from the normal operating level.
- 5. All valve stem extensions for buried valves shall be "pinned".

B. Manual Operators

1. Manual operators include handwheel, chainwheel, lever and handle type operators. When the maximum force to operate a valve under full operating head exceeds forty (40) pounds, gear reduction operators shall be provided.

2. Lever Operator

- a. Levers shall be fabricated of non-corrosive materials. They shall include a set screw and be grease lubricated.
- b. The operator shall be capable of being locked in any position and shall be provided with an adjustable memory stop.

3. Handwheel

a. Gate/valve operators shall be selected so that no more than forty (40) pounds effort on the operator will be required to open or close a gate/valve. Gate/valve operators shall be located at a maximum height of forty-two (42) inches above the structure. When the normal yoke elevation is above 42-inches above structure, the geared lift shall be coupled to a ninety degree (90°) bevel gear box by means of a floating shaft and lovejoy couplings. This gearbox shall be mounted on the edge of the self-contained yoke. All shafts and couplings

shall be Type 304 stainless steel and aligned to acceptable coupling tolerance. All cast iron gearbox housings shall be epoxy coated in accordance with Section 09900, *Painting*, for corrosion protection.

- b. All operators shall be geared and shall have a weatherproof cast iron housing or pedestal with a bronze operating nut. An effective gear ratio of at least 2:1 is required.
- c. The operator shall include a position indicator and self-locking feature to prevent the disc or plug from creeping.
- d. Gear operators shall be totally enclosed and lubricated. Operators shall be grease lubricated and provided with grease fittings.
- e. Handwheel operators supplied with floorstands and benchstands shall be self-locking at any position of stem travel. *Cranks and handwheels shall be cast iron and hot dip galvanized after fabrication or as specified on the Contract Drawings*. Cranks shall be no less than twelve (12) inches long and shall be keyed to the operating nut. Handwheels shall not have a diameter greater than thirty (30) inches.
- f. Self-locking gear shall be a one-piece design of gear bronze material (ASTM B 427), accurately machine cut. The sector gear shall be hardened alloy steel (ASTM A-322), grade G41500 or ASTM A-148, Grade 105-85, with thread ground and polished. The reduction gearing shall run in a proper lubricant.

4. Buried Operators

- a. Buried service operators on valves larger than 2½ inches shall have a 2-inch AWWA operating nut (extended to within 6 inches of the finished valve pad elevation).
- b. Buried operators on valves 2-inches and smaller shall have cross handle for operation for forked key. All moving parts of the valve and operators shall be enclosed in a housing to prevent contact with the soil.
- c. Buried service operators for quarter-turn valves shall be designed to withstand 450 foot-pounds of input torque at the fully open or fully closed positions without damage to the valve or operator and shall be grease packed and gasketed to withstand a submersion in water to 10 psi.
- d. Valves shall be installed with "pinned" extension stems, as required, valve boxes, concrete valve pad and valve identification tag.

C. <u>Electric Motor Operated Valve Actuators</u>

1. General

- a. The actuators shall be suitable for use on a nominal 460 volt three-phase 60 Hertz power supply and are to incorporate motor, integral reversing starter, local control facilities, and terminals for remote control and indication connections.
- b. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator.
- c. It shall be possible to carry out the setting of the torque, turns, and configuration of the indication contacts without the necessity to remove any electrical compartment covers.

2. Actuator Sizing

- a. The actuator shall be sized to guarantee valve closure at the specified differential pressure.
- b. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage ten percent (10%) below nominal.
- c. The operating speed shall be such as to give valve closing and opening at approximately 10 12 inches per minute.

3. Ambient Temperature

a. The actuator shall be capable of functioning in an ambient temperature ranging from -22 °F (-30°C) to +158°F (+70°C).

4. Motor

- a. The electric motor shall be Class F insulated with a time rating of at least fifteen (15) minutes at 104°F (40°C) or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of the maximum valve torque.
- b. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case. Plugs and sockets are not acceptable as a means of electrical connection for the motor.

5. Motor Protection

a. Protection shall be provided for the motor as follows:

- 1) The motor shall be de-energized in the event of stall when attempting to unseat a jammed valve.
- 2) Motor temperature shall be sensed by a thermostat to protect against overheating.
- 3) Single phasing protection.

6. Gearing

- a. The actuator gearing shall be totally enclosed in an oil-filled gear case suitable for operation at any angle. All main drive gearing must be of metal construction.
- b. Where the actuator operates gate valves or large diameter ball or plug valves, the drive shall incorporate a lost-motion hammerblow feature.
- c. For rising spindle valves, the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator, and the design should be such as to permit the gear case to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service.
- d. Standard SAE80EP gear oil shall be used to lubricate the gear case. Special or exotic lubricants shall not be used as they may be difficult to source in remote locations.

7. Hand Operation

- a. A handwheel (**non-corrosive material**) shall be provided for emergency operation engaged when the motor is declutched by a lever or similar means; the drive being restored to power automatically by starting the motor.
- b. The hand/auto selection lever should be padlockable in both the "Hand" and "Auto" positions. It should be possible to select "Hand" operation while the actuator is running or start the actuator motor while the "Hand/Auto" selection lever is locked in "Hand" without damage to the drive train.
- c. The handwheel drive must be mechanically independent of the motor drive, and any gearing should be such as to permit emergency manual operation in a reasonable time.
- d. Clockwise (CW) operation of the handwheel shall give closing movement of the valve.

8. Drive Bushing

- a. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bushing shall be positioned in a detachable base of the actuator.
- b. Thrust bearings, when housed in a separate thrust base, should be of the "sealed for life" type.

9. Torque and Turns Limitations

a. Torque and turns limitation to be adjustable as follows

1) Position setting range: 2.5 to 100,000 turns, with resolution to 7.5°

of actuator output.

2) Torque setting: 40% to 100% rated torque.

- 3) Torque sensing must be affected directly electrically or electronically. Extrapolating torque from mechanically measured motor speed is not acceptable due to response time. Torque measurement shall be independent of variations in frequency, voltage or temperature.
- 4) "Latching" shall be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads.
- b. The electric circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit. An inexpensive setting tool is required for non-intrusive calibration and interrogation of the actuator. This setting tool will provide speedy interrogation capabilities as well as security in a non-intrusive intrinsically safe watertight casing.

10. Remote Valve Position/Actuator Status Indication

- a. In the event of a (main) power (supply) loss or failure, the position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities. If batteries are required to maintain contact functionality the actuator vendor shall provide a supply sufficient for thirty (30) continuous days of unpowered operation with one (1) complete valve cycle every hour.
- b. A backup power source must be provided in the actuator to ensure correct remote indication should the actuator be moved manually when the power supply is interrupted.

- c. The position of the actuator and valve must be updated contemporaneously, even when the power supply is not present.
- d. Four (4) contacts shall be provided which can be selected to indicate any position of the valve with each contact externally selectable as normally open or normally closed. The contacts shall be rated at 5A, 250V AC, 30V DC.
- e. As an alternative to providing valve position, any of the four (4) above contacts shall be selectable to signal one of the following:
 - 1) Valve Opening or Closing
 - 2) Valve Moving (Continuous or Pulsing)
 - 3) Local Stop Selected
 - 4) Local Selected
 - 5) Remote Selected
 - 6) Open or Close Interlock Active
 - 7) ESD Active
 - 8) Motor Tripped on Torque in Mid-Travel
 - 9) Motor Tripped on Torque Going Open
 - 10) Motor Tripped on Torque Going Closed
 - 11) Pre-Set Torque Exceeded
 - 12) Valve Jammed
 - 13) Actuator Being Operated by Handwheel
 - 14) Lost Main Power Phase
 - 15) Customer 24V DC or 120V AC Supply Lost
 - 16) Battery Low
 - 17) Internal Failure Detected
 - 18) Thermostat Tripped

f. Provision shall be made in the design for the addition of a contact less transmitter to give a 4-20 mA analog signal corresponding to valve travel for remote indication when required.

11. Local Position Indication

- a. The actuator must provide a local display of the position of the valve, even when the power supply is not present. The display shall be able to be rotated in 90° increments so as to provide easy viewing regardless of mounting position.
- b. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the power to the actuator is isolated.
- c. The local display should be large enough to be viewed from a distance of six (6) feet when the actuator is powered up.

12. Integral Starter and Transformer

- a. The reversing starter, control transformer, and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup.
- b. For ON/OFF service, this starter shall be an electromechanical type suitable for 60 starts per hour and of a rating appropriate to the motor size.
- c. For modulating duty, the starter shall be suitable for up to a maximum of 1,200 starts per hour. The controls supply transformer shall be fed from two of the incoming three phases. It shall have the necessary tapings and be adequately rated to provide power for the following functions:
 - 1) 120V AC energization of the contactor coils
 - 2) 24V DC output where required for remote controls
 - 3) Supply for all the internal electrical circuits
 - 4) The primary and secondary windings shall be protected by easily replaceable fuses.

13. <u>Integral Push Buttons and Selector</u>

- a. Integral to the actuator shall be local controls for Open, Close, and Stop, and a local/remote selector Switch, padlockable in any one of the following three positions:
 - 1) Local Control Only
 - 2) Off (No Electrical Operation)
 - 3) Remote Control plus Local Stop Only
- b. It shall be possible to select maintained or non-maintained local control.
- c. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

14. Control Facilities

- a. The necessary wiring and terminals shall be provided in the actuator for the following control functions described herein.
- b. Removable links for substitution by external interlocks to inhibit valve opening and/or closing.
- c. Connections for external remote controls fed from an internal 24V DC supply and/or from an external supply of (min. 12V, max. 120V) to be suitable for any one or more of the following methods of control:
 - 1) Open, Close, and Stop.
 - 2) Open and Close.
 - Overriding Emergency, Shutdown to Close (or Open) Valve from a "Make" Contact.
 - 4) Two-Wire Control, Energize to Close (or Open), De-Energize to Open (or Close).
- d. Selection of maintained or push-to-run control for modes (1) and (2) above shall be provided and it shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of approximately 300 ms.

- e. Provision shall be made for connectivity with field bus control systems via a plug-in card. The following interfaces shall be available:
 - 1) Modbus
- 2) Approved equal.
- f. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2.0 kV.

15. Monitoring and Diagnostics Facilities

- a. Facilities shall be provided for monitoring actuator operation and availability as defined herein.
- b. Monitor (availability) relay, having one change-over contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the "Remote" position to indicate that the actuator is available for remote (Operations Building) operation.
- c. Where required, it shall be possible to provide indication of thermostat trip and "Remote" selected as discreet signals.
- d. A non-intrusive hand-held computer must be available, capable of duplex communication for uploading and downloading all variables for the actuator as well as performing detailed diagnostics.
- e. Actuators shall include a diagnostic module, which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. A software tool shall be provided to allow configuration and diagnostic information to be reviewed and analyzed and reconfigured.
- f. Diagnostic status screens must be provided to show multiple functions simultaneously so troubleshooting can be affected rapidly and efficiently. All diagnostic information should be contained on no more than eight (8) screens so multiple functions can be checked simultaneously.
- g. Provision shall be made to display valve torque demand as a percent of rated actuator torque and position simultaneously, so as to facilitate valve troubleshooting and diagnostics.

16. Wiring and Terminals

a. Internal wiring shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and three phase power. Each wire shall be clearly identified at each end.

- b. The terminals shall be embedded in a terminal block of high tracking resistance compound.
- c. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal.
- d. The terminal compartment of the actuator shall be provided with a minimum of three (3) threaded cable entries. When required, a forth cable entry shall be provided.
- e. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.
- f. Control logic circuit boards mid relay boards must be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.
- g. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
 - 1) Serial Number.
 - 2) External Voltage Values.
 - 3) Wiring Diagram Number.
 - 4) Terminal Layout.
- h. This must be suitable for the contractor to inscribe cable core identification beside terminal numbers.

17. <u>Enclosure</u>

- a. Actuators shall be 'O' ring sealed, watertight to NEMA 6, and shall at the same time have an inner watertight and dustproof "O" ring seal between the terminal compartment and the internal electrical elements of the actuator fully protecting the motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.
- b. The enclosure must allow for temporary site storage without the need for electrical supply connection.
- c. All external fasteners should be of Type 316 stainless steel.

d. Actuators for explosion hazardous applications shall in addition be certified flameproof for Zones 1 and 2 (Divisions 1 and 2) Group gases.

18. Startup Kit

a. Each actuator shall be supplied with a startup kit comprising installation instruction, electrical wiring diagram, and sufficient spare cover screws and seals to make good any site losses during the commissioning period.

19. Performance Test Certificate

- a. Each actuator must be performance tested and individual test certificates shall be supplied free-of-charge. The test equipment should simulate a typical valve load and the following parameters should be recorded:
 - 1) Current at maximum torque setting.
 - 2) Torque at maximum torque setting.
 - 3) Flash Test Voltage.
 - 4) Actuator Output Speed or Operating Time.
- b. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

20. Warranty

a. Each actuator shall be warranted for a *three (3) years from the date of Final Project Acceptance by the Owner*.

21. Experience

- a. All technologies and devices used in the actuator must have a minimum of five (5) years' of commercial operating experience for that specific manufacturer, including torque and position sensing, lubrication, and electrical compartment design. The manufacturer must provide ten (10) Florida municipal site references of similar applications.
- b. Electric motor valve actuators shall be as manufactured by Limitorque, Auma Actuators, Inc., or approved equal.

2.20 Valve Boxes

- A. Furnish, assemble, and place a valve box over the operating nut for each buried valve. The valve box shall be designed so as to prevent the transmission of surface loads directly to the valve or piping.
- B. Valve boxes shall be of the adjustable slide-type of suitable length with an interior diameter of not less than five (5) inches. The valve boxes shall be manufactured of cast iron and shall be of the two piece design including a bottom section and top section with cover. The cast iron cover shall be cast with the applicable service, "WATER," "WASTEWATER," "REUSE," etc., markings. The top section shall be adjustable for elevation and shall be set to allow equal movement above and below finished grade.
- C. The castings shall be manufactured of clean, even grain, gray cast iron conforming to ASTM A48, Class 30B for Gray Iron Castings; and shall be smooth, true to pattern, free from blow holes, sand holes, projections, and other harmful defects. The seating surfaces of both the cover and the top section shall be machined so that the cover will not rock after it has been seated.
- D. The valve boxes shall be coated inside and outside with an asphaltic coating prior to machining, so that the machined seating surfaces will be free of any coating. Cast iron valve box assemblies shall be Clow Corp. No. F-2452, Tyler Corp. Series 6855 or 6865 or an approved equal.
- E. Valve extension stems shall be provided for all buried valves when the operating nut is deeper than three (3) feet below finished grade. The stems shall be "pinned" and shall bring the 2-inch square nut to approximately six (6) inches from the finished valve pad elevation.

2.21 Tie Rods

- A. When prior approval is obtained from the Engineer, ductile iron pipe, fittings, and valves may be restrained using a "tie bolt joint restraint".
- B. Joint restraint materials for this method of restraint shall be the Super-Star SST Series Joint Restraint System as manufactured by Star National Products, a Division of Star Industries, Inc. Columbus, Ohio, or an equal approved by the Engineer.
- C. All bolts, nuts, washers, tie rods, and other fasteners for the joint restraint system shall be manufactured of CORTEN high strength, low alloy, corrosion-resistant steel in conformance with ASTM A242. Tie bolts shall be manufactured of heat treated CORTEN steel. Tie rods and all fasteners f or the system shall be galvanized in conformance with the requirements of ASTM A123. Tie rods shall have a minimum diameter of ¾-inch. The number of tie rods required per joint shall be as recommended by the manufacturer.

D. **Prior to backfilling after installation, all parts of the joint restraint system shall be coated with bituminous epoxy** equal to Kop-Coat Bitumastic No. 300-M, for a minimum dry film thickness of twenty (20) mils.

2.22 Valve Identification

A. Aboveground Valve Identification

1. A coded and numbered tag attached with a stainless steel chain and/or stainless steel "S" hooks shall be provided on all valves.

2. Tag Types

- a. Tags for valves on pipe shall be stainless steel, or anodized aluminum, 19 gauge thick. Colors for aluminum tags shall, where possible, match the color code of the pipe line on which it is installed.
- b. Square tags shall be used to indicate "normally closed" valves and round tags shall indicate "normally open" valves.

3. Coding

- a. In addition to the color coding, each tag shall be stamped or engraved with "wording" or abbreviations to indicate the information presented in Article 2.01(G)(1)(a-g) of Specification Section 09905, *Pipe, Valve and Equipment Identification System*.
- b. All color and letter coding shall be approved by the Engineer.
- c. Above ground valve tags shall be furnished with stainless steel (Type 316) wire for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.
- d. Valve service shall either be as listed in Table 09905-1 (Section 09905), or by equipment abbreviation if associated with a particular piece of equipment. Valve numbering shall be as approved by the Engineer and/or Owner.

B. Belowground Valve Identification

1. Buried valves shall have valve boxes protected by a concrete pad as identified on the Contract Drawings. The concrete pad for the valve box cover shall have a 3inch diameter, 19 gauge thick, bronze disc embedded in the surface as shown on the Contract Drawings. The bronze disc shall have the following information neatly stamped on it:

a. Valve Service: See Table 09905-1 for the abbreviations to be used

b. Valve Identification No.: To be provided by the Engineer and Owner

c. Size of valve, inches

d. Type of valve

1) GV: Gate Valve
2) BfV: Butterfly Valve

3) PV: Plug Valve

- 4) Other valve abbreviations shall be provided by the Engineer.
- e. Number of turns to fully open the valve
- f. Direction to open the valve
- g. Year of Installation
- 2. Submit to the Engineer for approval, within thirty (30) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work.
- 3. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- 4. The information contained in the valve schedules shall be coded on the tags in a system provided by the Engineer and Owner.
- C. Submit to the Engineer for review, two (2) samples of each type of tag proposed and the manufacturer's standard color chart and letter styles. Tags shall have stamped or engraved on them the information shown on the Contract Drawings and the data described herein. Submit to the Engineer for approval, within thirty (30) days from the Notice to Proceed, a valve schedule containing all valves required for his/her work. The schedule shall contain all of the information required by Articles 2.22(A) and 2.22(B) of this Specification Section.
- D. The valve schedule, abbreviations, words, identification, etc. shall be approved by the Engineer and Owner prior to submission for casting.
- E. The information contained in the valve schedules shall be coded on the tags in a system provided by the Owner.

F. Above ground valve tags shall be furnished with stainless steel chain and/or stainless steel "S" hooks (Type 316) for attachment thereof. The tag shall not be attached to the handwheel or crank operators or any part of the valve which would inhibit operation of the valve.

2.23 Expansion Joints

A. Water Service

- 1. Expansion joints shall be manufactured of molded EPDM with a single wide arch. Expansion joints shall be suitable for buried service or above ground service. Flanges shall be drilled to ANSI 125 lb.
- 2. Working pressures are as follows:

Size (inches)	Pressure (psi)
2 - 12	150
14	130
16 - 20	110
24 - 30	100
36	90

- 3. The maximum temperature shall be 250°F.
- 4. Expansion joints shall be Model 100 HT/711 as manufactured by Metraflex or approved equal.
- 5. Expansion joints shall be furnished with 304 stainless steel split, bevelled retaining rings and control rod assemblies to limit over expansion or compression. A minimum of two control units shall be furnished with each expansion joint and shall be suitable for working pressures as specified above.
- B. Chemical Solution Service NOT USED

2.24 Sediment Strainers

A. Sediment strainers shall be Y-type manufactured of transparent Type 1, Grade 1 PVC with threaded or solvent welded socket ends.

- B. The screen for the strainers shall be 20 mesh, Type 316 stainless steel. The screen shall be easily removed for cleaning or replacement from the filter body without removing the body from the pipeline. The bonnet seal shall be EPDM "O" rings.
- C. The sediment strainers shall have a pressure rating as follows:

Strainer Size	Water Non-Shock Pressure Rating
½-inch to 1-inch	150 psi at 70°F
1½-inch to 2-inch	90 psi at 70°F
3-inch to 4-inch	60 psi at 70°F

D. Sediment strainers shall be manufactured by Asahi/America, or an equal approved by the Engineer.

2.25 Unions

- A. Unions on ferrous pipe 2 inches in diameter and smaller shall be 150 pounds malleable iron, zinc-coated.
- B. Unions on water piping 2½ inches in diameter and larger shall be of the flange pattern, 125-pound class, zinc-coated.
- C. Gaskets for flanged unions shall be of the best quality fiber, plastic, or leather.
- D. Unions shall not be concealed in walls, ceilings, or partitions.

2.26 Pressure Gauge Assemblies - NOT USED

2.27 T-Handled Operating Wrench

- A. Provide two (2) galvanized operating wrenches, 4 feet long.
- B. The operating wrenches shall be Mueller; No. A-224610, Clow No.; F-2520, or approved equal.

2.28 Floor Box and Stem - NOT USED

2.29 Emergency Shower/Eye Wash (ES/EW) - NOT USED

2.30 Spare Parts

A. Special tools, if required for normal operation and maintenance, shall be supplied with the equipment.

2.31 Quality Control

A. The Contractor shall follow the Manufacturer's and Supplier's recommended product quality control specifics as required for the Project.

2.32 Hose Bibb/Wash Station

- A. Provide the number, type and materials as shown on the Contract Drawings.
- B. Hose racks shall be fabricated from Type 304 stainless steel.

2.33 Washdown Hose

- A. Hoses shall be fifty (50) feet long, or the length specified on the Contract Drawings, 1-inch diameter abrasion and weather resistant and "kink-proof", industrial grade hose with a 1/4-turn industrial grade stainless steel ball valve, with a 1-inch stainless steel male x female (NPT) QF series quick connect coupling on the supply end.
- B. An industrial grade Type 304 stainless steel spray nozzle shall be provided on each hose.
- C. All components shall be manufactured by Amazon Hose & Rubber Company or approved equal.

2.34 Miscellaneous Items

A. Other items necessary for the complete installation and not specified herein shall conform to the details and notes shown on the Contract Drawings.

B. All minor items implied, usually included, or required for the construction of a complete operating system shall be installed whether shown on the Contract Drawings or not.

3. EXECUTION

3.01 Inspection

- A. All valves and other material shall be subject to inspection and approval by the Engineer after delivery, and no broken, cracked, imperfectly coated, or otherwise damaged or unsatisfactory material shall be used.
- B. When a defect or crack is discovered, the damaged item shall not be installed and shall be replaced at no additional cost to the Owner.

3.02 Preparation

- A. All exterior surfaces of iron body valves shall be clean, dry and free from rust and grease before coating.
- B. For valves installed underground or in valve vaults, all exterior ferrous parts or valve and actuator shall be coated at the factory with a thermally bonded epoxy coating in accordance with AWWA C-550, latest revision, or with a bituminous epoxy (Engineer approval required). Bituminous epoxy shall be applied in two (2) 8-mil dry film thickness coats for a minimum total finish dry film thickness of sixteen (16) mils. Prior to backfilling, all uncoated nuts, bolts, glands, rods and other part of joints shall be coated in the field with bituminous epoxy.
- C. For above-ground service, the exterior ferrous parts of all valves shall be coated as follows:
 - Prior to shipment from the factory, valves shall be coated with a thermally bonded epoxy coating in accordance with AWWA C-550, latest revision, or shall be shop painted with one (1) coat, 1.5 mils dry film thickness, of a combination lead and chromate primer with rust-inhibitive pigments and synthetic resins (Engineer approved method).
 - 2. Following installation in the field, valves shall be painted with one (1) coat, 1.5 mils dry film thickness, of a combination lead and chromate primer with rust-inhibitive pigments and synthetic resins. Valves shall be finish painted with two (2) coats, 1.5 mils dry film thickness each coat, of a medium to long oil alkyd resin coating. Field applied coatings shall be as manufactured by the Carboline Co. or an equal approved by the Engineer. The color of the finish coats shall be in accordance with the piping color code in the painting schedule.

3.03 Installation

- A. Excavation, backfill and compaction shall conform to the provisions of Section 02220, *Excavation*. *Backfill and Compaction*.
- B. Cover for buried valves shall not be less than that indicated on the Contract Drawings. The minimum cover for pipe shall be thirty-six (36) inches.
- C. Valves of the size and type shown on the Contract Drawings shall be set plumb and installed at the locations indicated on the Contract Drawings. Valves shall be installed in accordance with manufacturer's installation instructions and with the details shown on the Contract Drawing and shall be rigidly supported.
- D. Valves shall be installed such that they are supported properly in their respective positions, free from distortion and strain. Valves shall be installed such that their weight is not borne by pumps and equipment that are not designed to support the weight of the valve.
- E. Valves shall be carefully inspected during installation; they shall be opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat. *Check and adjust all valves for smooth operation*.
- F. Install valves with the operating stem in either horizontal or vertical position.
- G. Allow sufficient clearance around the valve operator for proper operation.
- H. Clean iron flanges by wire brushing before installing flanged valves. Clean carbon steel flange bolts and nuts by wire brushing, lubricate threads with oil or graphite, and tighten nuts uniformly and progressively. Clean threaded joints by wire brushing or swabbing. Apply teflon joint compound or teflon tape to pipe threads before installing threaded valves. All joints shall be watertight.
- Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Contract Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms areerected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structures.
- J. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections in Division 15, *Mechanical*.
- K. Flanged joints shall be made with Type 304 stainless steel bolts, nuts and washers. Mechanical joints shall be made with mild corrosion resistant alloy steel bolts

and nuts. All exposed bolts shall be painted the same color as the pipe. All buried bolts and nuts shall be heavily coated with two (2) coats of bituminous paint.

- L. **Pressure gauges** shall not be installed until after the substantial completion date unless otherwise requested by the Owner.
- M. For buried valves, a valve box shall be centered accurately over the operating nut and the entire assembly shall be plumb. *The tops of all valve boxes shall be adjusted to the proper elevation* as specified below and as shown on the Contract Drawings.
 - 1. In paved areas, the tops of valve box covers shall be flush with the pavement. Following paving operations, a twenty-four (24) inch square shall be neatly cut in the pavement around the box and the paving removed. The top of the box shall then be adjusted to the proper elevation and a twenty-four (24) inch square by six (6) inch thick concrete pad poured around the box cover. Concrete pads in traffic areas shall be reinforced with No. 4 reinforcement bars as shown on the Contract Drawings. Concrete for the pad shall be 3,000 psi compressive strength at 28 days.
 - 2. In unpaved areas, tops of valve box covers shall be set one (1) inch above finished grade. After the top of the box is set to the proper elevation, a twenty-four (24) inch square by six (6) inch thick concrete pad shall be poured around the box cover. Concrete for the pad shall be 3,000 psi compressive strength at 28 days.
 - 3. The concrete pad for the valve box cover shall have a three (3) inch diameter, identification disc embedded in the concrete surface as shown on the Contract Drawings. The bronze identification disc shall be as specified in Section 09905, Piping, Valve and Equipment Identification System and shall have the information as shown on the Contract Drawings neatly stamped on it.

N. Valve Orientation

- 1. Install operating stem vertical when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 ft or less above finished floor, unless otherwise shown.
- 2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown.
- 3. If no plug valve seat position is shown, locate as follows:
 - a. <u>Horizontal Flow</u>: The flow shall produce an "unseating" pressure, and the plug shall open into the top half of valve.

- b. Vertical Flow: Install seat in the highest portion of the valve.
- O. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or the in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.
- P. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and ceilings for valve access.
- Q. *All valves and appurtenances shall be tested hydrostatically for a minimum of four (4) hours*, concurrently with the pipeline in which they are installed at the working pressure corresponding to the class of pipe, unless a different test pressure is specified. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure used for the pressure test(s). If valve joints leak during pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and hydrostatically retest the joints.
- R. Following installation, all above-ground valves shall be painted in accordance with the painting system specified in Section 09900, *Painting*. Following installation of buried valves or valves installed in valve vaults, repair any scratches, marks and other types of surface damage, etc., with a coating equal to the original coating supplied by the manufacturer.

3.04 Installation of Air Release and Air and Vacuum Valves

- A. Piping, fittings, and the air release and air and vacuum valves shall be installed as shown on the Contract Drawings. Air Release/Air and Vacuum valves shall be installed on the discharge side of all "non-submersible" type pumping stations.
- B. The air release valve assemblies shall be installed so that they are properly supported and such that they will function properly and freely and no parts shall be strained.
- C. Air release/air and vacuum valve testing shall be performed during the testing of pipeline which air release is attached.

3.05 Installation of Tie Rods

A. Tie rods shall be installed in strict accordance with the manufacturer's written installation requirements.

- B. Unless otherwise indicated on the Contract Drawings, the size and number of tie rods for a joint or installation shall be as recommended by the manufacturer's design chart for a working pressure of 150 psi.
- C. Following installation and prior to backfilling, all parts of the buried tie rod joint restraint system, including tie rods, tie bolts, nuts, washers, and other fasteners, shall be coated with two (2) coats, ten (10) mils DFT per coat, of bituminous epoxy.

3.06 Inspection and Hydrostatic Pressure and Leakage Testing

- A. Completed pipe shall be subjected to hydrostatic pressure test for four (4) hours at full working pressure. All leaks shall be repaired and lines retested as approved by the Engineer. Prior to testing, the gravity pipelines shall be supported in an approved manner to prevent movement during tests.
- B. Hydrostatic pressure and leakage testing shall be performed in accordance with Section 15044, *Pressure Testing of Piping*.

END OF SECTION

SECTION 15125 PIPE HANGERS AND SUPPORTS

1. GENERAL

1.01 Description

A. Scope of Work

 Furnish all labor, materials, equipment, accessary items (bolts, screws, nuts, neoprene isolation pads, drip guards, etc.) services, and incidentals required and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices required for supporting all piping as indicated and as specified herein.

B. Number and Location

- 1. The Contract Drawings depict only "minimum" pipe support locations.
- 2. Adequate pipe supports shall be supplied for all piping systems to provide a "rigid overall" installation and additional support for pipe ends when equipment is disconnected. Non-rigid installation shall be replaced at the Contractor's cost.

C. Related Work Specified Elsewhere:

Specification Section	Title
05500	Metal Fabrications
09900	Painting
15000	Mechanical - General Requirements
Division	Description
3	Concrete
15	Piping and Fittings
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

- A. Hangers and supports shall be of an approved standard design where possible and shall be adequate to maintain the supported load in the proper position under all operating conditions. The minimum working safety factor for pipe supports shall be five (5) times the material ultimate strength of the material, assuming ten (10) feet of water filled pipe being supported.
- B. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment.
- C. When manufacturer's have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit a certification stating that such requirements have been complied with.

1.03 Submittals

- A. Shop drawing submittals shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01300, Shop Drawings, Submittals, and Samples and shall be submitted to the Engineer for approval. All submittals shall be in an electronic format (PDF).
- B. Submit to the Engineer, for approval, the *manufacturer's descriptive literature for all pipe support devices* and materials demonstrating compliance with this Specification and the support details shown on the Contract Drawings and samples of all materials specified herein.
- C. **Submit line drawings of each piping system** to the scale shown on the Contract Drawings, or larger, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.
- D. Submit installation drawings and manufacturer's information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

1.04 Product Delivery, Storage and Handling

A. The equipment provided under this specification section shall be shipped, handled and stored in accordance with the manufacturer's written instructions and in accordance with Section 01600, *Materials and Equipment*.

1.05 Warranty and Guarantees

- A. The Contractor shall furnish the Owner with a five (5) year service/parts warranty as specified in Section 01740. Warranties and Bonds.
- B. The equipment manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship.
- C. In the event that any equipment fails to perform as specified herein, the equipment manufacturer shall promptly repair or replace the defective equipment at no additional cost to the Owner.
- D. This warranty is in addition to any other warranty required by the Contract Documents.

2. PRODUCTS

2.01 General

- A. All piping and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and cure the pipe in the intended position and alignment. Support piping by piping support where it connects to pumps or other mechanical equipment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe and personnel contact. All pipe supports shall be approved prior to installation.
- B. The Contractor shall select and design all piping support systems within the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves, all filled with water, plus valve actuators and any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of five (5) based on material ultimate strength.
- C. No attempt has been made to show all required pipe supports in all locations, either on the Contract Drawings or in the details. The absence of pipe supports and details on any Drawings shall not relieve the Contractor of the responsibility for providing them throughout the facility.
- D. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

- E. All materials used in the manufacturing of hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.
- F. Hangers and supports shall be spaced in accordance with ANSI B31.1.0 except that the maximum unsupported span shall not exceed ten (10) feet unless otherwise specified herein.
- G. Unless otherwise specified herein, pipe hangers and supports shall be as manufactured by ITT Grinnel Co., Inc, Carpenter and Patterson, Inc., or approved equal. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product, and shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.

2.02 Piping Hangers and Supports for Metal Pipe

A. Furnish and install supports necessary to hold the piping and appurtenances in a firm, substantial manner at the lines and grades indicated on the Contract Drawings or as specified. Piping supports and hangers shall conform to Federal Specification WW-H-171 or shall be as specifically shown or indicated on the Contract Drawings. Piping within structures shall be adequately supported from floors, walls, ceilings or beams. Supports from the floor shall be approved flange supports, saddle stands or suitable concrete piers as indicated or approved. Pipe saddles shall be shaped to fit the pipe with which they will be used and shall be capable of screw adjustment.

B. Suspended Single Pipes

1. Suspended single pipes shall be supported by hangers suspended by steel rods from galvanized concrete inserts, beam clips or ceiling mounting bolts as follows:

2. Hangers

Pipe Size (inches)	Grinnel Figure No.
< ½	138R
½ - 1	97C
11/4 - 4	104
6 - 12	590
14 - 30	171

3. Hanger rods shall be rolled steel machine threaded with load ratings conforming to ASTM specifications and the strength of the rod shall be based on the root diameter. Hanger rods shall have the following minimum diameters:

Pipe Size (inches)	Minimum Rod Diameter (inches)
< 2½	³ / ₈
2½ - 3	1/2
4	⁵ / ₈
6	³ /4
8 - 12	7/8
14 - 30	1

- 4. Where applicable, structural attachments shall be beam clamps. Beam clamps, for rod sizes ½-inch through ¾-inch shall be equal to Grinnel Figure No. 229, and for rod sizes **f**-inch through 1¼-inches shall be equal to Grinnel Figure No. 228, or approved equal.
- 5. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls or floors, spot inserts for individual pipe hangers, or ceiling mounting bolts for individual pipe hangers and shall be manufactured by Unistrut Corp., Wayne, Michigan; Carpenter and Patterson, Inc., Laconia, New Hampshire; Richmond or approved equal and shall be as follows:
 - a. Continuous concrete inserts shall be used where applicable and/or as shown on the Contract Drawings and shall be used for hanger rod sizes up to and including ¾-inch diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be Series P3200 by Unistrut Corporation; Figure 1480, Type 2 by Carpenter and Patterson, Inc., or approved equal. Inserts to be used where supports are perpendicular to the main slab reinforcement shall be Series P3300 by Unistrut Corporation; Figure 1480, Type 1 by Carpenter and Patterson, Inc., or approved equal.
 - b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including finch diameter. Inserts shall be Figure 650 by Carpenter and Patterson, Inc. for hanger rod sizes ½-inch through and including ¾-inch, and Figure 266 by Carpenter and Patterson Inc., for finch hanger rods, or approved equal.
 - c. Ceiling mounting bolts shall be used where applicable and be for hanger rod sizes 1-inch through 1¼-inches and shall be Figure 104M as manufactured by Carpenter and Patterson, Inc., or approved equal.

d. All pipe hangers shall be capable of vertical adjustment under load and after erection. Turnbuckles, as required and where applied, shall be equal to Grinnel Figure No. 230.

C. Wall or Column Supported Pipes

- 1. Wall or column supported pipes shall be supported by welded steel brackets equal to Grinnel Figure 194, 195 and 199 as required, for pipe sizes up to and including 20-inch diameter. Additional wall bearing plates shall be provided where required.
- 2. Where the pipe is located above the bracket, the pipe shall be supported by an anchor chair and U-bolt assembly supported by the bracket for pipes four (4) inches and larger and by a U-bolt for pipes smaller than four (4) inches. Anchor chairs shall be equal to Carpenter and Patterson Figure No. 127. U-bolts shall be equal to Grinnel Figure No. 120 and 137.
- Where the pipe is located below the bracket, the pipes shall be supported by pipe hangers suspended by steel rods from the bracket. Hangers and steel rods shall be as specified above.

D. Floor Supported Pipes

- Floor supported pipes three (3) inches and larger in diameter shall be supported by either cast-in-place concrete inserts or adjustable pipe saddle supports as directed by the Engineer. In general, concrete supports shall be used when lateral displacement of the pipes is probable (unless lateral support is provided), and adjustable pipe saddle type supports shall be used where later displacement of pipes is not probable.
- 2. Each concrete support shall conform to the details shown on the Contract Drawings. Concrete shall be poured after the pipe is in place with temporary supports. Concrete piers shall conform accurately to the bottom one-third (a) to one-half (½) of the pipe. Top edges and vertical corners of each concrete support shall have one (1) inch bevels. Each pipe shall be secured on each concrete support by a wrought iron or steel anchor strap anchored to the concrete with cast-in-place bolts or with expansion bolts. Where directed by the Engineer, vertical reinforcement bars shall be grouted into drilled holes in the concrete floor to prevent overturning or lateral displacement of the concrete support. Unless otherwise approved by the Engineer, maximum support height shall be five (5) feet.
- 3. Concrete piers used to support base elbows and tees shall be similar to that specified above. Piers may be square or rectangular.

4. Each adjustable pipe saddle support shall be screwed or welded to the corresponding size 150 lb. companion flange or slip-on welding flange, respectively. The supporting pipe shall be of schedule 40 steel pipe construction. Each flange shall be secured to the concrete floor by a minimum of two (2) expansion bolts per flange. Adjustable saddle supports shall be equal to Grinnel Figure No. 264, or approved equal. Where used under base fittings, a suitable flange shall be substituted for the saddle.

E. Vertical Piping

- 1. Where pipes change from horizontal to vertical, the pipes shall be supported on the horizontal runs within two (2) feet of the change in direction by pipe supports as previously specified herein.
- 2. For vertical runs exceeding ten (10) feet, pipes shall be supported by approved pipe collars, clamps, brackets, or wall rests at all points required to insure a rigid installation.
- 3. Where vertical piping passes through a steel floor sleeve, the pipe shall be supported by a friction type pipe clamp which is supported by the pipe sleeve. Pipe clamps shall be equal to Grinnel Figure No. 262.
- F. Anchor bolts shall be equal to Kwik-Bolt as manufactured by the McCullock Industries, Wej-it as manufactured by Wej-it Expansion Products, Inc., or approved equal.
- G. All fabricated steel or cast iron pipe supports, saddles, rolls, brackets, clevises, and the like shall be hot dip galvanized after fabrication and/or machining in accordance with ASTM A123.
- H. All nuts, bolts, clips and other hardware, and all hanger rods used for pipe supports, shall be Type 316 stainless steel. All nuts, bolts and threaded rods shall be in accordance with ASTM A-320, Class 2.

2.03 Pipe Hangers and Supports for Plastic Pipe and Rubber Hose

- A. Single plastic pipes shall be supported by pipe supports as previously specified herein.
- B. Multiple, suspended, horizontal plastic pipe runs, where possible, and rubber hose shall be supported by ladder type cable trays such as the Electray Ladder by Husky-Burndy, the Globetray by the Metal Products Division of United States Gypsum, or approved equal. The ladder shall of mild steel construction. Rung spacing shall be approximately eighteen (18) inches for plastic pipe and twelve (12) inches for rubber hose. The tray

width shall be approximately six (6) inches for single runs of rubber hose and twelve (12) inches for double runs of rubber hose. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners equal to Globe Model M-CAC, Husky-Burndy Model SCR or approved equal. The spacing between the clamps shall not exceed nine (9) feet. The cable trays shall provide continuous support along the length of the pipe.

C. Individual clamps, hangers and supports in contact with plastic pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

2.04 Pipe Supports for Small Diameter PVC, Copper and Steel Pipe

- A. Small diameter PVC piping, three (3) inches in diameter and smaller, and steel or copper piping two (2) inches in diameter or smaller shall be supported with "SUSPORT" system arrangements as manufactured by Universal Suspension Systems Inc., Gillette, New Jersey, or approved equal. Clamping halves for the pipe support shall be manufactured of molded polypropylene and shall support and fit closely for 360 around the pipe. To support piping carrying non-corrosive fluids or gases located in non-corrosive, indoor environments, all hardware for the "SUSPORT" system shall be nickel chrome plated carbon steel. To support piping carrying corrosive fluids or gases located in corrosive environments or piping located outdoors, all hardware for the "SUSPORT" system shall be manufactured of Type 316 stainless steel.
- B. In some cases, to adequately support small diameter PVC or steel piping, a metal frame support structure may be required for support of the "SUSPORT" system specified above. Where required, metal frame support structures shall be constructed using channels, fittings, brackets, hardware and other accessories as manufactured by B-Line Systems, Inc. of Highland, Illinois, or an equal approved by the Engineer. If located in indoor, non-corrosive environments, the materials for the frame structure shall be carbon steel with an epoxy coating applied by a cathodic, electro-deposition process which is equal to "Dura-a-Green" by B-Line Systems, Inc. For corrosive or outdoor systems, the materials for the frame structure shall be Type 316 stainless steel unless otherwise noted on the Contract Drawings. Hardware used to construct the frame support structure shall be Type 316 stainless steel.
- C. Pipe supports for small diameter PVC shall be located wherever necessary in the opinion of the Engineer to adequately support the pipe; however, they shall have a maximum spacing as specified below for straight pipe runs. Adequate supports shall especially be used adjacent to valves and fittings in pipelines. The following table is based on spacing requirements for Schedule 80 PVC or Standard Weight (Schedule 40) steel pipe and hard drawn copper tube carrying a fluid with a specific gravity of 1.0

at a temperature not exceeding 120 F. Support spacing for PVC or steel piping carrying fluids with specific gravities or temperatures exceeding those stated above shall be approved by the Engineer.

Nominal	Support Spacing (feet)		
Pipe Diameter (inches)	PVC Pipe	Steel Pipe	Copper
1/2	3.5	4.5	4.0
3/4	4.0	5.0	4.0
1	4.5	5.5	4.0
11⁄4	5.0	6.5	6.0
1 ½	5.0	7.5	6.0
2	5.5	8.0	6.0
2 ½	5.5		
3	6.0		

2.05 Waffle Isolation Pads

- A. Waffle isolation pads shall be a minimum ¼-inch thick.
- B. Waffle isolation pads shall be Mason Type "W"; Machinery Installation Systems "Unisorb", Type S, SB, F or FB; or approved equal.

2.06 Neoprene Isolating Sleeves

A. Neoprene isolating sleeves for metal pipe six (6) inches and smaller shall be Unistrut P2600, B-Line "Vibrocushion", or approved equal.

2.07 Quality Control

A. The Contractor shall follow the manufacturer's and supplier's recommended product quality control specifics as required for this Project.

3. EXECUTION

3.01 Preparation

- A. Prior to prime coating, all pipe hangers and supports shall be thoroughly clean, dry and free from all mill-scale, rust, grease, dirt, paint and other foreign substances to the satisfaction of the Engineer.
- B. All submerged pipe supports shall be prime coated with Koppers 654 Epoxy Primer or approved equal. All other pipe supports shall be prime coated with Rustinhibitive Primer No. 621 as manufactured by Koppers Company, Inc., or equal.
- C. Finish coating shall be compatible with the prime coating used and shall be applied as specified in Section 09900, Painting and 09905, Piping, Valve and Equipment Identification System.

3.02 Installation

- A. All pipes, horizontal and vertical, shall be rigidly supported from the building or structure by approved supports. Supports shall be provided at changes in direction and elsewhere as shown on the Contract Drawings or specified herein. No piping shall be supported from other piping or from metal stairs, ladders and walkways, unless it is so indicated on the Contract Drawings, or specifically directed or authorized by the Engineer.
- B. All piping supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations and all probable externally applied forces. Prior to installation, all pipe supports shall be approved by the Engineer.
- C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings, and sleeve type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting piping.
- D. *Install separate hangers or supports at each valve*. Provide one (1) hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset actuators.
- E. Install separate hangers or supports at each pipe elbow, tee or fitting. Provide separate hangers or supports on both sides of each non-rigid joint or flexible pipe coupling.

- F. Install hangers and supports at sufficiently close intervals to maintain proper alignment and prevent sagging.
- G. Piping support systems and accessories shall be installed in accordance with the manufacturer's installation instructions.
- H. Pipe supports shall be provided as follows:
 - 1. Cast iron and ductile iron shall be supported at a maximum support spacing of ten (10) feet with a minimum of one (1) support per pipe section at the joints.
 - 2. All vertical pipes shall be supported at each floor or at intervals of at least ten (10) feet by approved pipe collars, clamps, brackets or wall rests, and at all points necessary to insure rigid construction.

I. Supporting PVC

- 1. Support the piping in strict accordance with the manufacturer's instructions and recommendations for the conditions of operation, temperature, and size of pipe.
- 2. Support the piping in a manner that will prevent subsequent visible sagging of the pipe between supports due to plastic deformation.
- J. Support drain, waste and vent piping by adjustable hangers.
- K. Effects of thermal expansion and contraction of the pipe shall be accounted for in pipe support selection and installation.
- L. Inserts for pipe hangers and supports shall be installed on forms before the concrete is poured. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. The Contractor shall be responsible for the proper location of all pipe supports to be installed as part of this Project.
- M. Continuous metal inserts shall be embedded flush with the concrete surface.
- N. Standard Pipe Supports
 - 1. Horizontal Suspended Piping
 - a. Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.
 - b. Grouped Pipes: Trapeze hanger systems.

- c. Furnish a galvanized steel protection shield and oversized hangers for all insulated pipe.
- d. Furnish pre-cut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.

2. Horizontal Piping Supported from Walls

a. <u>Single Pipes</u>: Wall brackets or wall clips attached to the wall with anchors. Clips attached to wall mounted framing shall also be acceptable.

b. Stacked Piping

- 1) Wall mounted framing systems and clips are acceptable for piping smaller than three (3) inches in diameter.
- 2) Piping clamps which resist axial movement of the pipe through the support shall not be acceptable.
- c. Wall mounted piping clips shall not be acceptable for insulated piping.

3. Horizontal Piping Supported from Floors

a. Stanchion Type

- 1) Pedestal type, adjustable with stanchion, saddle and anchoring flange.
- 2) Use yoke saddles for piping whose centerline elevation is eighteen (18) inches or greater above the floor and for all exterior installations.
- 3) Provide neoprene waffle isolation pads under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.

b. Floor Mounted Channel Supports

- 1) Use for piping smaller than three (3) inches nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal type supports.
- 2) Attach the channel framing to the floors with anchor bolts.
- 3) Attach the pipe to the channel with clips or pipe clamps.

c. Concrete Cradles

1) Use for piping larger than three (3) inches along the floor and in trenches at piping elevations lower than can be accommodated using stanchion type supports.

4. Vertical Pipe

a. Support with wall brackets and base elbow or riser clamps on floor penetrations.

5. <u>Standard Attachments</u>

Attachment To	Standard Attachment(s)
Concrete Ceilings	Concrete inserts
Steel Beams	I-beam clamp or welded attachments
Wooden Beams	Lag screws and angle clips to members not less than 2½ inches thick
Concrete Walls	Concrete inserts or brackets or clip angles with anchor bolts

O. Temporary Pipe Supports

- 1. Layout each section of pipeline and make connections while the pipe is held in temporary supports.
- 2. After the completion of connections in each section of pipeline, hold the section in place with temporary clamps.
- 3. Do not remove the temporary clamps until the piping is correctly installed on the permanent supports.

3.03 Painting

A. All fabricated steel or cast iron pipe supports, saddles, brackets, rolls, clevises and the like shall be painted, after installation, as specified in Sections 09900, *Painting* and 09905, *Piping, Valve and Equipment Identification System*.

END OF SECTION

SECTION 15129 COUPLINGS AND CONNECTORS

1. GENERAL

1.01 Description

- A. Furnish all labor, materials, equipment, devices, services, ancillary items, accessories and incidentals and perform all operations required, for the correct installation of couplings and connectors of the type(s) and size(s) in the location(s) shown on the Contract Drawings, as specified herein and as required to ensure proper engineering construction methods.
- B. Pipe supports shall be placed where shown on the Contract Drawings or as required by Section 15125, *Pipe Hangers and Supports*.
- C. The Contractor may install additional pipe supports and flexible couplings to facilitate piping installation, provided that complete details describing their location, the pipe supports and hydraulic thrust protection are submitted. Thrust protection shall be adequate to sustain the force developed by one hundred fifty percent (150%) of the design operating pressures specified.

D. Related Work Specified Elsewhere

Specification Section	Title
15000	Mechanical - General Requirements
15044	Pressure Testing of Piping
15125	Pipe Hangers and Supports
Division	Description
15	Piping
Contract Drawings and General Provisions of the Contract	

1.02 Quality Assurance

- A. The minimum pressure rating shall be equal to that of the pipeline in which they are to be installed.
- B. Couplings and connectors, other than those specified herein, are subject to the Engineer's approval.

1.03 Submittals

- A. Shop drawing submittals shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01300, Shop Drawings, Submittals, and Samples. All submittal shall be in an electronic format (PDF).
- B. Submit shop drawings to the Engineer for approval, including, but not limited to, manufacturer's catalog data on all couplings and connectors. Show the manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings are used.
- C. Submit the manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe coupling.
- D. Show materials of construction by ASTM reference and grade. Show all dimensions.
- E. Show the number, size and materials of construction of the rods and lugs for each thrust harness on the Project.

1.04 Product Delivery, Storage and Handling

A. All of the couplings and connectors and all accessories covered by this specification section shall be *delivered to the job site and stored in a safe, dry place* with appropriate labels and/or other product identification and in accordance with Section 01600, *Materials and Equipment*.

1.05 Warranty and Guarantees

- A. The Contractor shall furnish the Owner with a *five (5) year service/parts warranty* as specified in Section 01740, *Warranties and Bonds*.
- B. This warranty is in addition to any other warranty required by the Contract Documents.

- C. The equipment manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended and free from defects of design, material and workmanship.
- D. In the event that any equipment fails to perform as specified herein, the equipment manufacturer shall promptly repair or replace the defective equipment at no additional cost to the Owner.

2. MATERIALS

2.01 Material and Equipment

A. All Couplings and Connectors

- 1. <u>Gasket Materials</u>: Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
- 2. Diameters to properly fit the specified type of pipes on which couplings and connectors are to be installed.

B. Sleeve-Type Couplings (When Applicable)

- 1. Exposed Couplings (When Applicable)
 - a. Steel middle ring.
 - b. Two (2) steel follower rings.
 - c. Two (2) wedge-section gaskets.
 - d. Sufficient steel bolts to properly compress the gaskets.
 - e. Acceptable Manufacturers

1) Dresser Manufacturing Co.: Style 38

2) Smith-Blair, Inc.: Style 411

3) Or approved equal.

2. Buried Couplings (When Applicable)

a. Cast iron middle rings with pipe stops removed.

- b. Two (2) malleable iron follower rings with ribbed construction.
- c. Two (2) wedge-section gaskets.
- d. Bolts and Nuts for buried couplings, shall be Type 316 stainless steel conforming to ASTM A-193, Grade B8 for bolts, and ASTM A-194, Grade 8 for nuts. Bolts and nuts greater than 1c inches shall be carbon steel, ASTM A-307, Grade B, with cadmium plating, ASTM A-165, Type NS.

e. Acceptable Manufacturers

1) Dresser Manufacturing Co.: Style 53

2) Smith-Blair, Inc.: Style 411

3) Or approved equal.

C. Split-Type (Grooved End) Couplings (When Applicable)

- 1. Constructed from malleable or ductile iron.
- 2. For use with grooved or shouldered end pipe with a minimum wall thickness as required so as not to weaken the pipe.
- 3. Cast in two (2) segments for ¾-inch through 14-inch pipe sizes; four (4) segments for fifteen (15) inch through twenty-four (24)inch pipe sizes; and six (6) segments for pipe sizes over twenty-four (24) inches.
- 4. Coating: Enamel
- 5. Bolts: Carbon Steel
- 6. Acceptable Manufacturers
 - a. Victaulic Company of America: Style 77
 - b. Gustin-Bacon Co.
 - c. Or approved equal.

D. Flanged Adapters (When Applicable)

1. For joining plain end of grooved end pipe to flanged pipes and fittings.

 Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150 pound standard unless otherwise required for connections.

3. Exposed Sleeve Type

- a. Constructed from steel.
- b. Coating: Enamel
- c. Bolts: Carbon Steel
- d. Acceptable Manufacturers
 - 1) Dresser Manufacturing Co.: Style 128 for CI, DIP and steel pipes with diameters of two (2) inches through ninety-six (96) inches.
 - 2) Or approved equal.

4. Buried Sleeve Type

- a. Construction from cast iron.
- b. Bolts and Nuts for buried sleeves, shall be Type 316 stainless steel conforming to ASTM A-193, Grade B8 for bolts, and ASTM A-194, Grade 8 for nuts and washers. Bolts and nuts greater than 1c inches shall be carbon steel, ASTM A-307, Grade B, with cadmium plating, ASTM A-165, Type NS.
- c. Acceptable Manufacturers
 - 1) Dresser Manufacturing Co.: Style 127 locking type for CI, DIP, AC and steel pipes with diameters of three (3) inches through twelve (12) inches.
 - 2) Or approved equal.

5. Split Type

- a. Constructed from malleable or ductile iron.
- b. For use with grooved or shouldered end pipe.
- c. Coating: Enamel

d. Acceptable Manufacturers

1) Victaulic Company of America: Style 741 for pipe diameters of two (2)

inches through twelve (12) inches

Victaulic Company of America: Style 742 for pipe diameters of

fourteen (14) inches through sixteen

(16) inches

3) Or approved equal.

E. Deflection Joints

2)

- 1. Joints designed to permit a nominal maximum deflection of 15□ in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under 15□.
- 2. Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
- 3. Supplied with control rods as required.

F. Transition Couplings

1. Transition couplings for connecting different types of pipe having different outside diameters shall be steel.

2. Acceptable Manufacturers

a. Dresser Manufacturing Co: Style 62 or 162

b. Rockwell: Series 413

c. Baker: Series 212 or 240

d. Or approved equal

2.02 Accessories

A. Joint Harnesses

1. Tie bolts or studs shall be as shown in the Table 15129 - 1.

- 2. Bolt or stud material shall conform to ASTM B-193, Grade B7.
- 3. Nuts shall conform to ASTM A-194, Grade 2H.
- 4. Lug material shall conform to ASTM A-36, ASTM A-283 (Grade B, C or D) or ASTM A-285 (Grade C). Lug dimensions shall be as shown in AWWA Manual M-11, Table 19.7.

TABLE 15129 - 1 Tie Bolts or Stud Requirements for Flexible Pipe Couplings Tie Bolt or Stud Minimum Requirements 150 psi 300 psi Nominal Pipe Size No. of Bolts Size No. of Bolts Size (Inches) or Studs (inches) or Studs (inches) 2 2 2 е е 3 2 2 2 2 4 е е 6 2 е е 8 2 2 е е 2 2 10 е 2 2 3/4 f 12 14 2 3/4 2 1 f 16 2 2 11/4 2 2 1 1d 18 2 2 20 1 11/2 1 4 4 11/2 24 30 4 1c 4 11/2 36 4 11/4 4 $1\frac{3}{4}$ 42 4 11/2 6 1e 6 48 6 11/2 1**f** 54 6 11/2 6 21/4

21/4

TABLE 15129 - 1 Tie Bolts or Stud Requirements for Flexible Pipe Couplings Tie Bolt or Stud Minimum Requirements 300 psi 150 psi Nominal Pipe Size Size No. of Bolts Size No. of Bolts (Inches) or Studs or Studs (inches) (inches) 60 6 1e 8 21/4 66 6 13/4 8 21/4 72 6 1**-F** 10 21/4 21/4 84 6 21/4 12

5. Select number and size of the bolts based on the test pressure shown in Section 15044, *Pressure Testing of Piping*. For test pressures less than or equal to 150 psi, use the 150 psi design in Table 15129-1. For test pressures between 150 and 300 psi, use the 300 psi design in Table 15129-1.

21/4

14

6. Provide a washer for each lug. The washer material shall be the same as the nut material. The minimum washer thickness shall be 1/8-inch.

2.03 Quality Control

96

8

A. The Contractor shall follow the manufacturer's and supplier's recommended product quality control specifics as required for this Project.

3. EXECUTION

3.01 Installation

- A. Sleeve Type Couplings (When Applicable)
 - 1. Thoroughly clean pipe ends for a distance of eight (8) inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.

- 2. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
- 3. Insert the other length into the middle ring the proper distance.
- 4. Press the gaskets and followers evenly and firmly into the middle ring flares.
- 5. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
- 6. Insert and tighten the tapered threaded lock pins.
- 7. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flanges to the torque recommended by the manufacturer.

B. Split Type Flange Adapters (When Applicable)

- 1. Install in the same manner as the Split Type Couplings.
- C. Buried Couplings, Adapters and Connectors (When Applicable)
 - 1. Thoroughly coat all exterior surfaces, including nuts and bolts, after assembly and inspection by the Engineer with a heavy-bodied bituminous mastic as approved by the Engineer.
- D. Install thrust rods, supports, and other provisions to properly support the pipe weight and axial equipment loads.

3.02 Inspection and Testing

- A. Upon completion of all coupling and connector work covered by this specification section, visually inspect the work and verify that it has been correctly installed.
- B. Hydrostatically test flexible pipe coupling and joints in place with the pipe being tested. Tests shall be in accordance with Section 15044, *Pressure Testing of Piping*.

END OF SECTION

SECTION 15421 FLOOR DRAINS

1. GENERAL

1.01 Description

- A. Furnish all labor, materials, equipment, services, and incidentals required and install a complete floor drain plumbing system as shown on the Contract Drawings and as specified herein.
- B. All work of this Section shall be governed by all provisions of the General and Supplementary Conditions, Division 3, *Concrete* and Division 15, *Mechanical*, and the Contract Drawings.

1.02 Submittals

- A. Shop drawing submittals shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01300, Shop Drawings, Submittals, and Samples.
- B. Submit catalog information on each device to show compliance with the specifications.

2. MATERIALS

2.01 Floor Drains (FD)

- A. For the purpose of explanation and description only, plate numbers have been given in the following schedule; such numbers, unless otherwise noted, are taken from the catalogs of Zurn Industries Inc. or approved equal. All drains shall be of sizes and types shown on the Drawings.
- B. Provide floor drains as shown on the Contract Drawings.

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- C. Refer to the Contract Drawings, which indicate the floor finish in each room or area where floor drains are to be installed.
- D. All floor drains as required shall be fitted with a deep seal cast iron "P" type trap to suit drain outlet.
- E. All floor drains shall have cast iron drainage flanges, seepage control, clamping collar and inside caulk outlet unless noted otherwise to be IPS outlet.
- F. Provide trap primers for floor drains where indicated on the Contract Drawings and where required by Code.
- G. Provide all necessary bolts, clamping rings and incidentals for a complete system.

3. EXECUTION

3.01 Floor Drains

- A. Install floor and area drains in accordance with the manufacturer's written procedures and in locations indicated.
- B. The Contractor shall coordinate flashing work with work of waterproofing and adjoining substrate work.
- C. Install drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with the finished floor.
- D. Install drain flashing collar or flange so that no leakage occurs between the drain and the adjoining flooring. Maintain the integrity of waterproof membranes, where penetrated.
- E. **Position drains so that they are accessible and easy to maintain**. Relief valves and equipment seal water shall be piped to drain over the floor drains.
- F. Protect drains during the remainder of the construction period, to avoid clogging with construction materials and debris, and to prevent damage from traffic and construction work.
- G. Install trap primers as indicated on the Contract Drawings, and in accordance with the manufacturer's installation instructions. Pitch piping towards the drain trap, a minimum of 1/8-inch per foot (1%). Adjust the trap primer for proper flow.

END OF SECTION

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SECTION 16050

ELECTRICAL – GENERAL PROVISIONS

1. GENERAL

1.01 Scope of Work

- A. Furnish all labor, materials, equipment and incidentals required for a complete electrical system at the Flagler Beach Wastewater Treatment Facility (WWTF) Sludge Management System Improvements, hereinafter specified and shown on the Drawings.
- B. The work, apparatus and materials which shall be furnished under these Specifications and accompanying Drawings shall include all items listed hereinafter and/or shown on the Drawings. Certain equipment will be furnished as specified in other sections of these Specifications which will require wiring thereto and/or complete installation as indicated. All materials necessary for the complete installation shall be furnished and installed by the Contractor to provide complete power, lighting, communication systems, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein.
- C. The Contractor shall furnish and install the necessary main circuit breakers, cables, transformers, motor control centers, protective devices, panelboards, exterior electrical system, etc., to serve motor loads, lighting loads and miscellaneous electrical loads as indicated on the Drawings and/or as specified hereinafter.
- D. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; sub-standard work will be rejected.
- E. It is the intent of the Contract Documents that the Contractor will have the ultimate responsibility for the coordination of the Division 11, 13, 15 and Division 16 systems.
- F. Mount and wire speed indicators, variable frequency drives, reduced voltage soft starters, and process instruments furnished under other Divisions of these Specifications.
- G. Mount and wire isolation transformers, operator's stations, and power conversion equipment for all variable speed drive systems furnished under other Divisions of these specifications.

- H. Make all field connections to process instrument panels and other control panels furnished under other Divisions of these Specifications.
- I. For process instrumentation, furnish and install all conduit, wire and interconnections between primary elements, transmitters, local indicators and receivers.
- J. Furnish necessary devices and make connections to provide power to drinking fountains and other equipment. This will require appropriate receptacles in some cases and direct wiring in other cases, depending upon equipment furnished.
- K. Install and wire all thermostats and other devices furnished under other Divisions of this Specification directly controlling heating equipment or fan motors.
- L. Mount and wire electric heaters furnished under other Divisions of this Specification.
- M. Wire all ventilation equipment furnished under other Divisions of this Specification.
- N. Each bidder or his authorized representatives shall, before preparing his proposal, visit all areas of the site in which work under this division is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that he or his representative has visited the proposed site and noted the locations and conditions under which the work will be performed and that he takes full responsibility for a complete knowledge of all factors governing his work.
- O. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work which may be reasonably implied as being incidental to the work of this Section shall be furnished at no extra cost.
- P. Related Work Specified Elsewhere

7. Concrete:

Submittals: Section 01300
 Manufacturer's Field Services: Section 01460
 Materials and Equipment: Section 01600
 Equipment Testing and Facilities Startup: Section 01465
 Operations and Maintenance Data: Section 01730
 Sitework: Division 2

Division 3

1.02 Service and Metering

A. Permanent electrical power is existing provided by the Florida Power & Light (FPL) at the voltages indicated on the drawings.

1.03 Codes, Inspection and Fees

- A. All material and installation shall be in accordance with the 2020 edition of the National Electrical Code and all applicable national, local and state codes.
- B. Pay all fees required for permits and inspections.

1.04 Tests

- A. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct the Owner's personnel in the proper operation of the systems.
- B. The following minimum tests and checks shall be made prior to the energizing of electrical equipment. Test shall be by an independent NETA certified testing firm, and a certified test report shall be submitted stating that the equipment meets and operates in accordance with the Manufacturer's and job specifications, and that equipment and installation conforms to all applicable Standards and Specifications:
 - 1. Testing and setting of protective relays for calibration and proper operation.
 - 2. Mechanical inspection of all circuit breakers 100 amps and larger to assure proper operation.
 - 3. Motors: Megger to ground each motor winding. Record date, motor temperature, terminal, reading and operator and have Owner representative sign off on each reading.
 - 4. Conductors: Megger to ground prior to termination all 600 volt conductors not used for service conductors. Record the date, conductor, reading and operator and have Owner representative sign off on each reading.
 - 5. Service Conductors: Megger to ground prior to termination in the presence of the Engineer or his representative all 600 volt service conductors. Record date, conductor, reading, operator, and have the Owner representative sign off on each reading.
 - 6. 480 Volt Main Breakers and Power Panels: After installing, with circuit breakers closed, but prior to terminating any conductors or bus to the motor control center, megger each phase to phase and phase to ground. Record the date, test (i.e. A/B or A/G), reading and operator and have Owner representative sign off on each reading.

7. Connections & Terminations:

- a. Main Breakers and Power panels: Torque to Manufacturer's values in the presence of the Engineer or his representative. Record the date, conductor, torque, operator and have the Engineer sign off on each reading.
- 8. Data Base: After equipment suppliers test, calibrations, and inspection, megger all circuits leaving all switchgear and power panels. Record the date, conductor, circuit condition (i.e. load connected or unconnected), reading and operator and have Owner representative sign off on each reading.
- 9. Hot Spot Testing: Perform infrared hot spot inspection of the main breaker, ATS, motor control centers and associated equipment as soon as determined by the engineer that representative loads are present. Record the date, gear conditions found, operator and have the owner's representative who must be present for the inspection sign off in each instance.

10. Miscellaneous

- a. Meggering must be done at 1000 VDC for one minute. The ground plane used must be the one established at the main source of energy for conductors, switchboards and control centers. The motor frame may be used for the ground plane for motors.
- b. In the course of construction, it will become necessary to temporarily energize some systems for testing. Confirm that any motor has been meggered prior to connection and testing. Do not leave any motor or system unattended and energized without written authorization.
- c. An unsuccessful test will be one in which any one of the three megger readings differs from another by more than 25%. Engineer shall determine if cables and/or equipment bussing shall be replaced.

1.05 Sleeves And Forms For Opening

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

1.06 Cutting And Patching

A. All cutting and patching shall be done in a thoroughly workmanlike manner.

1.07 Interpretation Of Drawings

A. The Drawings are not intended to show exact locations of conduit runs.

- B. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.
- C. Unless otherwise approved by the Engineer conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.
- D. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.
- E. The Contractor shall harmonize the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished so as to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Owner's authorized representative is to decide which equipment, piping, etc., must be relocated, regardless which was installed first.
- F. Verify with the Engineer the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- G. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- H. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.
- I. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.
- J. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can determined in advance of the purchase of equipment.
- K. All connections to equipment shall be made as shown, specified, and directed and in accordance with the Manufacturer's approved shop drawings, regardless of the number of conductors shown on the Drawings.

1.08 Size of Equipment

- A. Investigate each space in the building where equipment must pass to reach its final location. If necessary, the Manufacturer shall be required to ship his material in sections, sized to permit passing through such restricted areas in the building.
- B. The equipment shall be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer shall be required to brace the equipment suitably, to insure that the tilting does not impair the functional integrity of the equipment.

1.09 Record Drawings

- A. Provide red lined record drawings at appropriate intervals of work on site not to exceed every three months. Red lined drawings shall depict as exact, as-built information.
- B. See specification 01720 for additional requirements.

1.10 Component Interconnections

- A. Component equipment furnished under this Specification will not be furnished as integrated systems. Contractor shall field install and wire completely all components.
- B. Contractor shall analyze all systems components and their shop drawings, identify all terminals and prepare shop drawings and wiring tables necessary for component interconnection. Contractor shall provide crimp on wire numbers on both ends of all control wiring installed between all panels furnished under this contract. These numbers shall directly relate to the interconnect wiring drawing furnished by the Contractor and be reflected in the record drawings submitted.

1.11 Shop Drawings

- A. As specified under other sections shop drawings shall be submitted for approval of all materials, equipment, apparatus, and other items as required by the Engineer.
- B. Shop drawings shall be submitted for the following equipment as a minimum:
 - 1. Panelboards
 - 2. Main Breakers (MB)
 - 3. Variable Frequency Drives (VFDs)
 - 4. Dry Type Transformers
 - 5. Lighting Contactor Panels
 - 6. Component Interconnect Drawings

- 7. Process Control Panel (PCP)
- 8. Lighting Fixtures with Structural Engineering Certification
- 9. Disconnect Switches
- 10. Enclosed Circuit Breakers
- 11. Motor Starters
- 12. Lighting Contactors
- 13. Emergency Battery Units
- 14. Wire and Cable
- 15. Conduit Layout Drawings
- 16. Equipment Racks with Structural Engineering Certification
- 17. Lightning Protection and Grounding System
- 18. Field Instrument Transmitters and enclosures
- 19. Coordination, Short Circuit and Arc Flash Study
- C. The Manufacturer name and product designation and catalog data sheet shall be submitted for the following material:
 - 1. Conduit
 - 2. Receptacles
 - 3. Boxes and fittings
 - 4. Switches
 - 5. Lamps
 - 6. Control Relays
- D. Prior to submittal by the Contractor, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.

- E. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.
- F. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.
- G. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

1.12 Manufacturer Services

- A. Provide Manufacturer services for testing and start-up of the following equipment:
 - 1. 480 Volt Panelboards
 - 2. Variable Frequency Drives
 - 3. Other items as required by appropriate specification sections.
- B. The Manufacturer of the above listed equipment shall provide experienced Field Service Engineer to accomplish the following tasks:
 - 1. The equipment shall be visually inspected upon completion of installation and prior to energization to assure that wiring is correct, interconnection complete and the installation is in compliance with the manufacturer's criteria. Documentation shall be reviewed to assure that all Drawings, operation and maintenance manuals, parts list and other data required to check out and sustain equipment operation is available on site. Documentation shall be red-lined to reflect any changes or modifications made during the installation so that the "As-built" equipment configuration will be correctly defined. Spare parts shall be inventoried to assure correct type and quantity. The Manufacturer shall provide written approval that equipment supplied is approved for energization
 - 2. The Field Service Engineers shall provide engineering support during the energization and check out of each major equipment assembly. They shall perform any calibration or adjustment required for the equipment to meet the Manufacturer's performance specifications.
 - 3. Upon satisfactory completion of equipment test, they shall provide engineering support of system tests to be performed in accordance with Manufacturer's test specifications.
 - 4. Two (2) 4-hour training sessions on operation, and two (2) 4-hour training sessions (one for each system) on maintenance and trouble-shooting procedures shall be provided for the Owner's maintenance personnel. All training shall be

- conducted at a facility provided by the Owner. The maintenance and troubleshooting sessions shall be conducted with record "As-built" electrical drawings sufficient for a class of eight personnel.
- 5. A final report shall be written and submitted to the Contractor within fourteen days from completion of final system testing. The report shall document the inspection and test activity, define any open problems and recommend remedial action. The Contractor shall forward a copy of this report to the Engineer for approval.

1.13 Materials

- A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials where not specified shall be of the very best of their respective kinds. Samples of materials or Manufacturer's specifications shall be submitted for approval as required by the Engineer.
- B. Materials and equipment used shall be Underwriters Laboratories, Inc. listed.
- C. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out-of-doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired by the Contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the expense of the Contractor, or shall be replaced by the Contractor at his own expense.

1.14 Coordination, Short Circuit And Arc Flash Hazard Study

A. General

- 1. The Contractor shall provide a complete project wide Power System Study and Arc Flash Study for the electrical power distribution and motor control equipment. The studies shall be a totally independent effort to verify adequacy of all of the existing equipment as well as new additions being implemented under these Specifications. The studies shall be prepared by a professional Engineer, registered in the State of Florida, with demonstrated experience in the performance of industrial power system and fault arc hazard analysis. All work shall be submitted both hard copy and thumb drive. The studies shall be prepared using SKM Power Tools, latest edition. The following firms are approved to perform the study:
 - a. Judson Walker P.E., RCDD (904) 219-0885
 - b. Industry Electric Design (Mr. Don Trawick, P.E. (678) 617-7507
- 2. The Contractor shall provide data necessary to perform the study. This includes

feeder cable sizes, approximate feeder length motor data, generator data, existing protective relay settings and any other information relevant to the study.

- 3. A summary of the short circuit analysis shall be provided to the Contractor at the time shop drawings for all of the new equipment is submitted for approval.
- 4. The Contractor shall provide complete sets of motor control center and emergency generator shop drawings for use in the studies.

B. Scope

- 1. The short circuit study shall be in accordance with ANSI Standard C37.010 and C37.13, shall be performed to check the adequacy, and to verify the correct application of circuit protective devices and other system components specified. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating facilities. Minimum as well as maximum possible fault conditions shall be adequately covered in the study.
- Fault contribution of all motors shall be considered. The Contractor shall be responsible for obtaining all required data of equipment. All back-up calculations shall become part of the final report. The calculations shall be in sufficient detail to allow easy review.
- 3. The arc flash analysis study shall include the calculations of flash protection boundary limits and the incident energy exposure for the maximum arc producing flash expected from the electrical equipment. The study will determine incident energy exposure level and flash arc protection boundaries for the electrical equipment, based on IEEE-1584 and NFPA-70E. The study shall be based on the protective device settings and interrupting device clearing time.

C. Contents

- 1. The study shall include representation of the power company's system, the base quantities selected, impedance source-data, calculation methods and tabulations, one-line and impedance diagrams, conclusions and recommendations. Short-circuit momentary duties, shall be calculated on the basis of an assumed bolted three-phase short circuit at the main breaker, ATS, 480 volt motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the systems. The short circuit tabulations shall include significant X to R ratios, asymmetry factors, KVA, and symmetrical fault current.
- 2. A protective device time current coordination study shall be included with coordination plots of key and/or limiting devices, tabulated data, rating, and/or settings selected. The study shall present an Engineering balance between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.

- Separate plots shall be provided for each mode, "normal," and, "standby," operation. Maximum fault values shall be shown in each case. Both power sources shown in one plot will not be accepted.
- Generator short circuit decrement curves and thermal limit curves shall be included.
- 5. Required settings for breakers and relays shall be maximized to provide the most effective protection possible whether the system is fed from the normal or emergency source.
- 6. Tabulations indicating recommended set points for all protective devices shall be provided. This shall include the normal as well as the emergency source.
- 7. Arc Flash study shall include representation of the calculation methods and tabulations, and a one-line drawing of all identifying equipment included in this study. The complete study shall be turned over to the Owner. As part of the study, the Contractor shall affix permanent adhesive non-fading labeling indicating the equipment ID number and required information as required by NFPA 70E. Two Arc Flash labels shall be provided for each equipment: The first label shall provide arc flash information based on generator power (generator running). The second label shall provide arc flash information based on utility power (normal power).
- 8. Samples of arc flash warning labels are presented below:

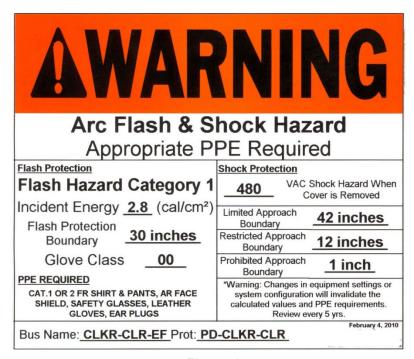


Figure 1

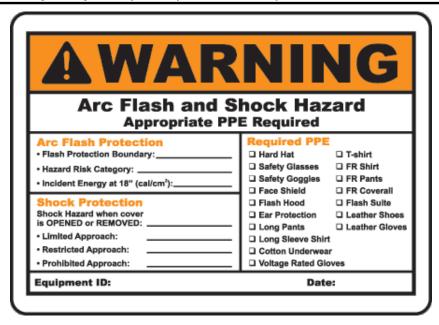


Figure 2

D. Motor Current-Time Characteristic Curves

- 1. A complete independent set of current-time characteristic curves for all 480 volt motor drives indicating coordination between the protective relays and the thermal characteristics of the motor shall be provided.
- 2. The Contractor shall obtain from the motor supplier, the necessary information to perform the study. Certified curves for, "Safe time vs. current at 100 percent voltage," and "Accelerating time vs. current at 100 percent voltage," shall become part of the final report.

E. Motor Starting Study

 A motor starting study for all large electric drives to determine voltage dip or power inrush limitations at selected locations due to starting of motors shall be provided. This applies to both the normal and the emergency mode.

F. Generator Protective Devices

- 1. The study shall address all of the protective devices provided for generator protection.
- 2. Protective relays requiring settings shall include, but not necessarily limited to:
 - a. Differential
 - b. Overcurrent with voltage restraint
 - c. Ground

- d. Undervoltage
- e. Reverse power
- f. Unbalanced loading and open phase
- g. Loss of excitation

G. General Information for Time-Current Curves Presentation

- The coordination plots shall include complete titles, representative one-line diagrams, legends, associated power company's relay or system characteristics, significant motor starting characteristics, complete parameters for power, and substation transformers, and complete operating bands for low-voltage circuit breaker trip devices.
- 2. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pickup settings required.
- 3. The short-time region shall indicate the medium voltage relay instantaneous elements, the magnetizing in-rush, and ANSI withstand transformer parameters, the low-voltage circuit breaker instantaneous trip devices, fuse manufacturing to tolerance bands, and significant symmetrical and asymmetrical fault currents.
- 4. Each primary protective device required for a delta-to-wye connected transformer shall be selected so that the characteristic or operating band is within the transformer parameters; which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.
- Low-voltage power circuit breakers shall be separated from each other and the
 associated primary protective device, where feasible, by a 16 percent current
 margin for coordination and protection in the event of secondary line-to-line
 faults.
- 6. Protective relays shall be separated, where feasible, by a 0.3 second time margin when the maximum three-phase fault flows, to assure proper selectivity.

1.15 Conduit Layout Drawings

- A. In addition to the manufacturer's equipment shop drawings, the Contractor shall submit for the approval, electrical installation working drawings for the overall site work, existing electrical buildings and all process structures. The layout drawings shall contain the following:
 - Concealed and buried conduit layouts shown on floor plans drawn at not less than 1/4-inch = 1-foot-0-inch scale. The layouts shall include locations of process equipment, motor control centers, transformers, panelboards, control

panels and equipment, motors, switches, motor starters, large junction or pull boxes, instruments, and any other electrical devices connected to concealed or buried conduits.

- 2. Plans shall be drawn with ACAD 2021, size 34-inch x 22-inch, and shall be presented in a neat, professional manner. Drawing files shall be provided for review.
- 3. Concrete floors and/or walls containing concealed conduits shall not be poured until conduit layouts are approved.
- 4. Site plan conduit layout drawings shall be at 1" = 30'-0".
- 5. Note: ACAD drawing files are available from the Engineer.

1.16 Operation and Maintenance Data

A. Submit complete operations and maintenance data for all equipment furnished under this Division in accordance with Section 01730. The manuals shall be prepared specifically for this installation and shall include all required cutsheets, Drawings, equipment lists, descriptions, complete part lists, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.17 Warranty

- A. A one year warranty shall be provided for all electrical equipment. Commencement date shall be after substantial completion.
- 2. PRODUCTS (NOT USED)
- 3. EXECUTION (NOT USED)

END OF SECTION

SECTION 16108

MISCELLANEOUS EQUIPMENT

1. GENERAL

1.01 Scope of Work

A. Furnish and install all miscellaneous equipment as hereinafter specified and as shown on the Drawings.

2. PRODUCTS

2.01 Materials

A. Disconnect Switches

- 1. Fusible and non-fusible disconnect switches shall be heavy-duty, NEMA type H, quick-make, quick-break, visible blades, 600 volt, 3 pole with full cover interlock. All current carrying parts shall be copper.
- 2. Enclosure type shall be NEMA 4X 316 stainless steel unless otherwise noted.
- 3. Furnish with copper lugs except as otherwise shown on the Drawings.
- 4. Provide a single dry contact with each disconnect to provide position indication of the switch.
- 5. Switches shall be horsepower rated as manufactured by Schneider Electric or Eaton.
- 6. Control wiring shall not pass through any disconnect enclosure. A junction box shall be provided, constructed of the same material as the disconnect switch, and utilized to separate power and control wiring prior to the disconnect enclosure.
- 7. Each disconnect shall be provided with a plastic nameplate, affixed to the enclosure without screws, identifying the equipment served.

B. Manual Motor Starters

Manual motor starters shall be furnished and installed for single-phase motors.
 Manual starters shall be non-reversing, reversing or two speed type as shown on
 the Drawings. Built-in control stations shall be furnished where shown on the

Drawings.

- 2. Enclosure type shall be NEMA 1 except as shown on the Drawings.
- 3. All outdoor enclosures shall be NEMA 4X 316 stainless steel.
- 4. Manual motor starters shall be manufactured by the Schneider Electric or approved equal.

C. Magnetic Motor Starters

- Motor starters shall be 2 or 3 pole, 1 or 3-phase as required, 60 Hz, 600 volt, magnetically operated, full voltage non-reversing except as shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings.
- 2. Two speed starters shall be for single or two winding motors as shown on the Drawings.
- 3. Each motor starter shall have a 120 volt operating coil, and control power transformer. Three phase starters shall have 3 overload relays. Auxiliary contacts shall be provided as shown on the Drawings or required.
- 4. Overload relays shall be non-adjustable, ambient compensated and manually reset.
- 5. Control power transformers shall be sized for additional load where required. Transformer secondaries shall be equipped with time-delay fuses.
- 6. Built-in control stations and indicating lights shall be furnished where shown on the Drawings.
- 7. Enclosure type shall be NEMA 1 except as shown on the Drawings.
- 8. All outdoor enclosures shall be NEMA 4X 316 stainless steel.
- 9. Magnetic motor starter shall be as manufactured by Schneider Electric or Eaton.

D. Control Stations

- Control stations shall be NEMA 4X 304 stainless steel heavy-duty type, with full size operators when located outdoors, in "NEMA 4" locations or in "Corrosive" areas.
- 2. Control stations shall be Class 9001, manufactured by the Schneider Electric or Eaton.
- 3. Pilot lights shall be complete with glass jewels and 150 volt lamps.

E. Dry Type Step Down Transformers

- 1. Transformers shall be dry type, two-winding with KVA and voltage ratings as shown on the Drawings.
- 2. Four full capacity taps shall be furnished, two 2-1/2% above and two 2-1/2% below rated primary voltage.
- 3. Transformers shall be built in accordance with ANSI C89 and NEMA ST1-4 with a maximum insulation temperature rise of 115° C.
- 4. Transformers shall be manufactured by Schneider Electric or Eaton.
- F. Unless otherwise noted, all outdoor enclosures shall be NEMA 4X 316 stainless steel. NEMA 4X push buttons and pilot lights shall be provided in all weatherproof control panels.
- G. All Enclosures installed in "Corrosive" areas shall be non-metallic fiberglass reinforced polyester.
- H. Electrical Switchboard Matting
 - 1. Electrical Switchboard matting shall be provided in the electrical rooms and control rooms around all electrical gear including Switchgear, Switchboard, MCC's, distribution/lighting panels, transformers and PLC's.
 - 2. The rubber matting shall provide a floor covering to prevent shock around high voltage electrical apparatus, fuse boxes, switchgear, control panels and heavy machinery.
 - 3. The matting shall meet current ASTM and ANSI (plus IEC Division of ANSI, Tech Committee-78) specifications for this material.
 - 4. The matting shall be 1/4-inch thick, Class 2 as manufactured by The Mat King, or approved equal.
 - 5. Provide floor sealant, suitable for electrical/control rooms.
- I. Break-Glass Emergency (Shunt Trip) Stations
 - 1. Break-Glass Emergency Station shall be of the break glass design with a weatherproof cast metal outer case finished in fire red and have an attached chain hung "Hammer". A glass panel shall be mounted in front of the push button operator. Switch contacts shall be 1-open, 1-closed, rated 10 amps, 600 Volts.
 - 2. Emergency stations shall be NEMA 4X stainless steel heavy-duty type.

3. EXECUTION (NOT USED)

END OF SECTION

SECTION 16110

RACEWAYS AND FITTINGS

1. GENERAL

1.01 Scope of Work

A. Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.02 Applications

- A. Except where otherwise shown on the Drawings, or hereinafter specified. The following describes the conduit requirements of the project:
 - 1. All exposed raceways shall be in aluminum conduit except as noted below in 2 and 3 below.
 - 2. Exposed raceways in chemically "Corrosive" areas shall be in PVC schedule 80 conduit. Mounting hardware shall be 316 stainless steel
 - 3. Underground raceways shall be PVC schedule 80.
 - 4. Underground raceways containing shielded cable shall be provided with a #10 ground wire.
- B. Transition from concrete reinforced or underslab to exposed shall be PVC coated rigid aluminum. All elbows above grade shall be suitably grounded. Conduit spaces shall be provided for underground conduit installation.
- C. All conduits entering or leaving Corrosive Areas shall have Crouse Hinds EYS conduit seals installed and filled with Chico Cement.
- D. All conduit of a given type shall be the product of one manufacturer.
- E. All switch, outlet and control station boxes and fittings shall be cast aluminum FS boxes with aluminum covers.
- F. Concealed switch, outlet and control station boxes in NEMA 1 areas shall be aluminum.

- G. Terminal boxes, junction boxes, pull boxes, etc.; installed outdoors shall be NEMA 4X 316 stainless steel. All boxes installed indoors (except in corrosive areas) shall be aluminum. Boxes in corrosive areas shall be PVC.
- H. Combination expansion-deflection fittings shall be used where exposed or embedded conduits cross structure expansion joints.

2. PRODUCTS

2.01 Materials

- A. Rigid Metal Conduit:
 - 1. Rigid metal conduit shall be for use under the provisions of NEC Article 346.
 - 2. Rigid aluminum conduit shall be 6063 alloy and shall be as manufactured by New Jersey Aluminum Corp., AFC Co., VAW of America, Inc., or approved equal.
 - 3. PVC coated aluminum conduit shall have a 1/50-in thick, polyvinyl chloride coating permanently bonded to the aluminum conduit and an internal phenolic coating, and shall be plasti-bond 2" as manufactured by Robroy Industries, Triangle PWC Inc., Perma-Cote Industries, or approved equal.
- B. Rigid Nonmetallic Conduit:
 - 1. Rigid nonmetallic conduit shall be for use under the provisions of NEC Article 347.
 - 2. PVC conduit shall be rigid polyvinyl chloride schedule 80 as manufactured by Carlon, An Indian Head Co., Kraloy Products Co., Inc., Highland Plastics Inc., or approved equal.
- C. Liquidtight Flexible Conduit, Couplings and Fittings:
 - 1. Liquidtight flexible conduit shall be for use under the provisions of NEC Article 351A.
 - 2. All flexible connections shall be made with liquidtight flexible metal conduit (LFMC) shall be for use under the provisions of NEC Article 351A.
 - 3. Fittings used with LFMC shall be grounded.
- D. Construction shall be aluminumFlexible Couplings, Non-metallic:
 - 1. Flexible non-metallic couplings shall be as manufactured by the Crouse-Hinds Co., Appleton Electric Co., Killark Electric Manufacturing Co., or approved equal.

E. Boxes and Fittings:

- 1. PVC, aluminum and stainless steel switch and outlet boxes shall be manufactured by Carlon, Appleton, or approved equal.
- NEMA 1 terminal boxes, junction boxes, pull boxes etc., may be fiberglass (FRP) or stainless steel. Boxes shall be as manufactured by Hoffman Engineering Co., Stahlin, or approved equal. NEMA 4 boxes located outdoors shall be 316 stainless steel.
- 3. Cast aluminum boxes and fittings shall be copper-free aluminum with cast aluminum covers and corrosion-proof screws as manufactured by the Killark Electric Co., Crouse-Hinds Co., Appleton Electric Co., or approved equal.
- 4. Conduit hubs shall be as manufactured by Meyers Electric Products, Inc., Raco Div., Appleton Electric Co., or approved equal. Conduit hubs shall be provided for all outdoor conduit terminations.
- 5. Conduit wall seals shall be Type WSK as manufactured by the O.Z. Electrical Mfg. Co., or approved equal.
- 6. Combination expansion-deflection fittings shall be Type XD as manufactured by the Crouse-Hinds Co., or approved equal.
- 7. Conduit wall seals for new concrete walls below grade shall be O.Z./Gedney Co., Type WSK, Spring City Electrical Manufacturing Co., Type WDP, or approved equal.
- 8. Conduit wall seals for cored holes shall be Type CSML as manufactured by the O.Z./Gedney Co., or approved equal.
- 9. Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co., or approved equal.
- 10. Conduit sealing bushings shall be O.Z./Gedney Type CSB or approved equal.

F. Conduit Mounting Equipment:

- 1. 316 Stainless steel channel and stainless steel hardware shall be used in all areas indoors or outdoors unless otherwise noted.
- 2. In "Corrosive" areas all mounting equipment shall be "non-metallic" or 316 stainless steel.

3. EXECUTION

3.01 Installation

- A. No conduit smaller than 3/4-inch electrical trade size shall be used, nor shall any have more than four 90 degree bends in any one run. Pull boxes shall be provided as required or directed. Minimum size in floor slabs shall be 3/4-inch.
- B. All empty raceways shall be installed with a pull cord.
- C. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.
- D. The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.
- E. Conduit supports shall be spaced at intervals as required to obtain rigid construction, but in no case less as required by the NEC.
- F. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-inch diameter. Material type shall be as specified in Section 2.
- G. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.
- H. All conduits on exposed work shall be run at right angles to and parallel with the surrounding walls and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run perfectly straight and true. Conduits not installed in this fashion shall be replaced entirely at the Contractor's expense with no cost to the Owner.
- I. No unbroken run shall exceed 300 feet in length. This length shall be reduced by 75 feet for each 90 degree elbow.
- J. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.
- K. Conduit terminating in gasketed enclosures shall be terminated with conduit hubs.
- L. Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.
- M. Liquidtight flexible metal conduit shall be used for all motor terminations and other equipment where vibration is present.

- N. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.
- O. Conduit stub outs for future construction shall be provided with threaded PVC end caps at each end.
- P. Metallic conduit entering manholes and below grade pull boxes shall be terminated with grounding type bushings and connected to a 5/8" x 10" copperweld rod with a #6 bare copper wire.
- Q. Underground 120 volt circuits (Schedule 80 PVC) shall be installed directly to the respective motor control centers, lighting panels, etc. Stainless steel pull boxes shall be wall mounted on structures to eliminate excessive bends. With prior approval, below grade pull boxes, equal to Brooks #2424 (minimum), with hot dip galvanized covers and frames may be used. Splices shall not be made in above or below grade pull boxes without prior approval.
- R. All exposed conduits coming up through the ground or slab shall have concrete curbs surrounding conduit, extending 3-inch up from floor level or grade and 3-inch horizontally from conduit. This applies to ALL exposed conduits installed indoors or outdoors.

3.02 Conduit Identification

- A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, condulets, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:
 - 1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 - 2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word "TO:" and the text in the 'TO' column of the conduit and wire schedule (e.g. TO: MCC-1A). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word "FROM:" and the text in the 'FROM' column of the conduit and wire schedule (e.g. FROM: EEB-SWGR-1). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.
 - 3. For conduits 3/4" through 11/2" in size, the text shall be a minimum 18 point font. For conduits 2" and larger, the text shall be a minimum 24 point font.
 - 4. Label height shall be ¾" minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.

- Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.
- 6. Labels shall be made of permanent vinyl with adhesive backing as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal. Labels made of any other material are not acceptable.
- B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:
 - 1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 - 2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.
 - 3. Tags shall be White Tyvek as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.

END OF SECTION

SECTION 16120

LOW VOLTAGE WIRE AND CABLE

1. GENERAL

1.01 Scope of Work

A. Furnish, install and test all wire, cable, and appurtenances as shown on the Drawings and as hereinafter specified.

1.02 Submittals

- A. Approved samples will be sent to the project location for comparison by the Resident Engineer with the wire actually installed.
- B. Installed, unapproved wire shall be removed and replaced at no additional cost to the Owner.

1.03 Applications

- A. Wire for lighting and receptacle circuits above grade shall be type THWN-2.
- B. Wire for all power motor circuits and below grade lighting and receptacle circuits shall be type XHHW-2, stranded.
- C. All cables between the VFD and the motor shall be VFD rated cable.
- D. Single conductor wire for control, indication and metering shall be type MTW No. 14 AWG, 19 strand or type XHHW No. 14 AWG stranded.
- E. Multi-conductor control cable shall be No. 14 AWG, 19 strand.
- F. Wire for process instrumentation or shielded control cable shall be No. 16 AWG, shielded and stranded. All shielded cables shall be provided with a #16 shielded ground.
- G. Ethernet shielded Twisted Pair (STP), 600V rated. Cable shall be Cat-6, yellow, Belden 7953A or approved equal.

1.04 Minimum Sizes

A. Except for control and instrumentation wiring, no conductor smaller than No. 12 AWG shall be used.

2. PRODUCTS

2.01 Material

A. All wires and cables shall be of annealed, 98 percent conductivity, soft drawn stranded copper conductors.

2.02 600 Volt Wire and Cable

- A. Type XHHW-2 shall be cross-linked polyethylene (XLP); as manufactured by General Cable, Southwire Co., Collyer Insulated Wire Co., Rome Cable or approved equal.
- B. Type THWN-2 shall be as manufactured by General Cable, Southwire Co., Collyer Insulated Wire Co., Rome Cable or approved equal.

2.03 Instrumentation And Control Cable

- A. Process instrumentation wire shall be twisted pair, 600V, cross-linked polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed, type "XLP" as manufactured by General Cable, American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal. Multi-conductor cables shall be supplied with individually shielded twisted pairs.
- B. Multi-conductor control cable shall be stranded, 600V, cross-linked polyethylene insulated with PVC jacket, type "XLP" as manufactured by General Cable, American Insulated Wire Co., Eaton Corp. "Polyset," or approved equal.

2.04 Variable Frequency Drive (VFD) Output Power Cable

- A. Section applies to power cables routed between the output of VFD's and motor terminals.
- B. Cable shall be rated for 2000 volts and shall meet the requirements below:
 - 1. Conductors shall be stranded Class B bare copper.
 - 2. All wire shall be brought to the job in unbroken packages and shall bear the data of manufacturing; not older than 12 months.

- 3. Type of wire shall be XLPE RHH/RHW-2 rated 90 degrees C suitable for wet locations.
- 4. Provide overall 5 millimeter metallic shield (copper tape shield) overlapped 50%.
- 5. No wire smaller than No. 12 gauge shall be used unless specifically indicated.
- 6. Cable construction shall consist of three insulated current-carrying phase conductors and three bare ground conductors, symmetrically placed between the phase conductors, and twisted beneath a continuous overall PVC polymeric jacket.
- C. Each ground conductor size (circular mil area) shall be one-third (1/3) of the NEC required size (circular mil area) for a single ground conductor. If one third of the required circular mil area does not correspond to a standard size (circular mil area) of construction, the next largest size of standard construction shall be used. All conductors shall be megger tested after installation and insulation must be in compliance with the Insulated Power Cable Engineers Association Minimum Values of Insulation Resistance.
- D. Manufacturers
 - 1. Belden
 - 2. Flex
 - 3. Lutze

2.05 CAT 6E Ethernet Cable

- A. All Cat 6 Cable shall be suitable for harsh environment and suitable for underground installation in wet areas. Cables shall meet the following requirements:
 - 1. 600 volt rated with shielding.
 - 2. UV-resistant PVC jacket.
 - 3. Suitable for WET installations
 - 4. Operating Temperature Range: -45 to +80 degrees C.
 - 5. Beldon 7953A or approved equal.
- B. Surge protection shall be provided at both ends of all ethernet cables installed.

2.06 Terminations and Splices

- A. Power Conductors: Terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling.
- B. Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors per termination. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors. Heat shrink boots shall be utilized for all outdoor splices.
- C. Instrumentation Signal Conductors (including graphic panel, alarm, low and high level signals): Terminations permitted shall be typical of control conductors. Splices are allowed at instrumentation terminal boxes only.
- D. Except where otherwise approved by the Engineer no splices will be allowed in manholes, handholes or other below grade located boxes.
- E. Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc.), conduit bodies, etc.

3. EXECUTION

3.01 Installation

- A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
- B. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. listed for use with the insulation specified.
- C. Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.
- D. Shielded instrumentation wire shall be installed in rigid steel conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from control cables in manholes.
- E. Shielding on instrumentation wire shall be grounded at one end only, as directed by supplier of the instrumentation equipment.
- F. Wire and cable connections to terminals and taps shall be made with compression connectors. Connections of insulated conductors shall be insulated and covered. All connections shall be made using materials and installation methods in accordance with instructions and recommendations of the manufacturer of the particular item of wire and cable. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

- G. All wire and cable shall be continuous and without splices between points of connection to equipment terminals, except a splice will be permitted by the Engineer if the length required between the points of connection exceeds the greatest standard shipping length available from the manufacturer specified or approved by the Engineer as the manufacturer of the particular item of wire and cable.
- H. Steel fish tapes and/or steel pulling cables shall not be used in PVC conduit runs.
- I. All control and instrumentation circuits and wiring shall be clearly and permanently numbered and labeled at each end so as to identify the location of the opposite end and the function of the circuit. Individual wires in a multi-wire circuit shall be identified with wire numbers. Labeling shall be in place prior to turnover of any equipment, system or sub-system to Owner.

3.02 Tests

- A. All 600-volt wire insulation shall be tested with a meg-ohmmeter after installation. Tests shall be made at not less than 1,000 VDC. See section 16050 Electrical General Provisions, for additional testing requirements.
- B. All service conductors shall be tested as in paragraph A above. These tests shall be witnessed by the Engineer. A written report shall be submitted to the engineer for review.

END OF SECTION

SECTION 16150 MOTORS

1. GENERAL

1.01 Scope of Work

A. Furnish and install the motors as hereinafter specified and as called for in other sections of these Specifications.

1.02 Qualifications

A. Motor shall be sufficient size for the duty to be performed and shall not exceed their full-rated load when the driven equipment is operating at specified capacity. Unless otherwise noted, motors driving pumps shall not be overloaded at any head or discharge condition of the pump.

1.03 Submittals

- A. The motor manufacturer shall submit to the Engineer certified dimension prints showing nameplate data and outline dimensions within three weeks of the date they receive the order.
- B. Guarantee: All equipment furnished and installed under this Section shall be guaranteed against defects of workmanship, materials and improper installation for the period of time specified Section 16050 Electrical General Provisions. All such equipment or parts proven defective, due to the above noted causes, shall be replaced in the machines by the Contractor at no expense to the Owner.

2. PRODUCTS

2.01 Ratings

A. Unless otherwise noted, all motors shall be of the low voltage type. All motors 1/2 through 100 horsepower shall be rated 230/460 volt, 3 phase, 60 Hertz A.C.; motors 125 horsepower through 500 horsepower shall be rated 460 volt, 3-phase, 60 Hertz, and motors below 1/2 horsepower shall be rated 115/230 volt, 1 phase, 60 Hertz A.C.

2.02 Three Phase Induction Motors

- A. Unless otherwise indicated, Motors 15 HP and larger shall have a 120-volt space heater for moisture control.
- B. Unless specifically noted in other sections of these Specifications, all motors shall have a minimum as indicated in the table below. All motors shall be "premium efficiency" type.

TABLE 1								
Motor HP	Min. Eff.	Max. dba	Motor HP	Min. Eff	Max. dba			
1-2	0.84	74	25-30	0.92	92			
3-5	0.865	79	40-50	0.93	97			
7.5-10	0.902	84	60-75	0.94	100			
15-20	0.91	89	100	0.941	102			

- C. Motors operating with variable frequency drives shall state that they are suitable for their intended applications. Motor nameplate shall read "Inverter Duty Rated".
- D. Motors larger than 1 HP shall have imbedded winding temperature switch in each phase.
- E. Motors operating with variable frequency drives (VFD's) shall meet the requirements of NEMA MG1, Part 31.

2.03 Construction

A. General

- All dripproof and weather protected Type I motors shall have epoxy encapsulated windings. Totally enclosed motors shall not be encapsulated. Motors not readily available with encapsulated windings may be standard type. Motors exposed to the outside atmosphere shall be totally enclosed fan cooled (TEFC) unless otherwise specified.
- 2. Squirrel-cage rotors shall be made from high-grade steel laminations adequately fastened together and to the shaft, or shall be cast aluminum or bar-type construction with brazed end rings.
- B. Low Voltage, Three Phase Motors
 - Motors shall be of the squirrel-cage or wound rotor induction type as noted. Horizontal, vertical solid shaft, vertical hollow shaft, normal thrust and high thrust types shall be furnished as specified herein. All motors shall be built in accordance with current NEMA, IEEE, ANSI and AFBMA standards where applicable. Motors shall be of the type and quality described by these specifications, fully capable of performing in accordance with manufacturer's

standard rating, and free from defective material and workmanship.

- 2. Motors shall have normal or high starting torque (as required), low starting current (not to exceed 600 percent full load current), and low slip.
- 3. Motors shall be totally enclosed fan-cooled construction with 1.15 service factor unless otherwise noted. Indoor motors shall be WPI unless otherwise noted.
- 4. Motors shall be suitable for operation in moist air with hydrogen sulphide gas present.
- 5. The output shaft shall be suitable for direct connection or belt drive as required.
- 6. Motors shall have a Class B nonhygroscopic insulation system. Class F insulation shall be used and shall be limited to Class B temperature rise.
- 7. All motors shall have a final coating of chemical resistant corrosion and fungus protective epoxy fortified enamel finish sprayed over red primer over all interior and exterior surfaces. Stator bore and rotor of all motors shall be epoxy coated.
- 8. All fittings, bolts, nuts, and screws shall be 316 stainless steel. Bolts and nuts shall have hex heads.
- 9. All machine surfaces shall be coated with rust inhibiter for easy disassembly.
- 10. Conduit boxes shall be gasketed. Lead wires between motor frame and conduit box shall be gasketed.
- 11. Totally enclosed motors shall be provided with condensate drain hole and epoxy coated motor windings to protect against moisture.
- 12. Nameplates shall be stainless steel. Lifting lugs or "O" type bolts shall be supplied on all frames 254T and larger. Enclosures will have stainless steel screen and motors shall be protected for corrosion, fungus and insects.
- 13. Low voltage, three phase motors shall be manufactured by General Electric, Siemens, U.S. Motors, Westinghouse or approved equal.

C. Fractional Horsepower

- Fractional horsepower motors shall be rigid, welded-steel, designed to maintain accurate alignment of motor components and provide adequate protection. End shields shall be reinforced, lightweight die-cast aluminum. Windings shall be of varnish-insulated wire with slot insulation of polyester film, baked-on bonding treatment to make the stator winding strongly resistant to heat, aging, moisture, electrical stresses and other hazards.
- Motor shaft shall be made from high-grade, cold-rolled shaft steel with drive-shaft extensions carefully machined to standard NEMA dimensions for the particular drive connection.

- For light to moderate loading, bearings shall be quiet all-angle sleeve type with large oil reservoir that prevents leakage and permits motor operation in any position.
- 4. For heavy loading, bearings shall be carefully selected precision ball bearings with extra quality, long-life grease, and large reservoir providing 10 years' normal operation without relubrication.

D. Integral Horsepower

- Motor frames and end shields shall be cast iron or heavy fabricated steel of such design and proportions as to hold all motor components rigidly in proper position and provide adequate protection for the type of enclosure employed.
- 2. Windings shall be adequately insulated and securely braced to resist failure due to electrical stresses and vibrations.
- 3. The shaft shall be made of high-grade machine steel or steel forging of size and design adequate to withstand the load stresses normally encountered in motors of the particular rating. Bearing journals shall be gound and polished.
- 4. Rotors shall be made from high-grade steel laminations adequately fastened together, and to the shaft. Rotor squirrel-cage windings may be cast-aluminum or bar-type construction with brazed end rings.
- 5. Motors shall be equipped with vacuum-degassed antifriction bearings made to AFBMA Standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent lubrication, but facilities shall be provided for adding new lubricant and draining out old lubricant without motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of lubricant out of the bearing cavity.
- 6. Bearings of high thrust motors will be locked for momentary upthrust of 30% downthrust. All bearings shall have a minimum B10 life rating of 100,000 hours in accordance with AFBMA life and thrust values.
- 7. Vertical hollow-shaft motors will have nonreverse ratchets to prevent backspin.

E. Low Voltage, Single Phase Motors

- Single phase motors shall be split-phase and capacitor-start induction types rated for continuous horsepower at the rpm called for on the Drawings. Motors shall be rated 115/230 volts, 60 Hertz, single phase, open dripproof, or totally enclosed fan cooled as called for on the Drawings or driven equipment specifications, with temperature rise in accordance with NEMA Standards for Class B insulation.
- 2. Totally enclosed fan cooled motors shall be designed for severe-duty.

- 3. Motors shall have corrosion and fungus protective finish on internal and external surfaces. All fittings shall have a corrosion protective plating.
- 4. Mechanical characteristics shall be the same as specified for polyphase fractional horsepower motors.

3. EXECUTION

3.01 Installation

A. Motor Connections: All motors shall be connected to the conduit system by means of a short section 18-inch minimum of flexible conduit unless otherwise indicated. For all motor connections, the Contractor shall install a grounding conductor in the conduit and terminate at the motor control center with an approved grounding clamp.

3.02 Tests and Checks

- A. The following tests shall be performed on all motors after installation but before putting motors into service.
 - The Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor. The following table gives minimum acceptable insulation resistance in megohms at various temperatures and for various voltages with readings being taken after one minute of megger test run.

TABLE 2								
Degree Winding Temperature		Voltage						
°F	°C	115V	230V	460V	4,160V			
37	3.9	60	108	210	1700			
50	10	32	60	120	1000			
68	20	13	26	50	460			
86	30	5.6	11	21	195			
104	45	2.4	4.5	8.8	84			
122	50	1	2	3.7	35			
140	60	0.5	0.85	1.6	15			

2. The Contractor shall check all motors for correct clearances and alignment and for correct lubrication, and shall lubricate if required in accordance with manufacturer's instructions. The Contractor shall check direction of rotation of all motors and reverse connections if necessary.

3.03 Shaft Grounding Rings (All Motors With Variable Frequency Drives)

- A. Shaft grounding rings (SGR) shall be factory installed inside the motors by the manufacturer wherever possible. SGR's may be field installed by installing contractor subject to Engineer's approval. Provide AEGIS SGR Colloidal Silver Shaft Coating, or approved equal, on shafts prior to rings installation, per SGR manufacturer's recommendations, after first cleaning shafts.
- B. Install and test SGR's in accordance with manufacturer's recommendations. Install the SGR so that the aluminum frame maintains an even clearance around the shaft. Conductive microfibers shall be in full circumferential contact with conductive metal surface of the shaft. Do not use thread lock to secure the mounting screws as it may compromise the conductive path to ground. If thread lock is required, use a small amount of EP2400 AEGIS Conductive Epoxy, or approved equal, to secure the screws in place.
- C. Shafts shall be clean and free of any coatings, paint, or other nonconductive material (clean to bare metal). Depending upon the condition of the shaft, it may require using emery cloth or Scotch-Brite. If the shaft is visibly clean, a non petroleum based solvent may be used to remove any residue. Check the conductivity of the shaft using an ohm meter. Ohms test: Place the positive and negative meter leads on the shaft at a place where the microfibers will contact the shaft. Each motor will have a different reading but in general one should have a maximum reading of less than 2 ohms. If the reading is higher, clean the shaft again and retest.
- D. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Place one probe on metal frame of SGR and one probe on motor frame. Motor must be grounded to common earth ground with variable frequency drive according to applicable standards. Verify that SGR installations and test readings comply with SGR manufacturer's requirements. Shaft voltage testing and verification of the proper installation of the AEGIS Bearing Protection Ring and its effectiveness can be accomplished by testing the motors for shaft voltages using a digital oscilloscope that is 100-Mhz or faster. An AEGIS Shaft Voltage Test Probe is attached to the oscilloscope probe end which is then placed on the machine's shaft allowing for the "real time" measurement of machines as they are operating under PWM IGBT VFD control.

3.04 High-Frequency Bonding (All Motors With Variable Frequency Drives)

A. All motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high-frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection. Provide AEGIS HF Ground Straps, or equal. After motors with SGR are fully installed in the field (in equipment, assemblies, or individually), for both factory-installed-SGR and field-installed-SGR cases, test for a conductive path to ground using an Ohm meter. Ground resistance must be 2 Ohms or less.

END OF SECTION

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SECTION 16160 PANELBOARDS

1. GENERAL

1.01 Scope of Work

A. Furnish all labor, materials, equipment and incidentals required and install all panelboards as hereinafter specified and as shown on Drawings.

2. PRODUCTS

2.01 Rating

A. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2.02 Standards

A. Panelboards shall be in accordance with the Underwriter Laboratories, Inc. "Standard for Panelboards" and "Standard for Cabinets and Boxes" and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

2.03 Construction

A. Interiors

- All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the antiturn solderless type and all shall be suitable for copper wire of the sizes indicated.
- Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.
- 3. Branch circuits shall be arranged using double row construction except when

narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing panel type, number of circuit breakers and ratings.

B. Buses

- 1. Bus bars for the mains shall be of copper. Full size neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.
- 2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
- 3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.
- Buses for 480V panelboards shall be rated for 65,000 amperes RMS symmetrical. Buses for 120/208V panelboards shall be rated 10,000 amperes RMS symmetrical.

C. Boxes

- 1. Recessed boxes shall be made from galvanized code gauge steel without multiple knockouts. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4-inches on all sides.
- 2. Surface mounted boxes shall have an internal and external finish as hereinafter specified in paragraph D4.
- 3. At least four (4) interior mounting studs shall be provided.
- 4. All conduit entrances shall be field punched.

D. Trim

- 1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
- 2. Doors shall have semi flush type cylinder lock and catch, except that doors over 48-inches in height shall have a vault handle and 3-point catch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

- 3. The trims shall be fabricated from code gauge sheet steel.
- 4. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
- 5. Trims for flush panels shall overlap the box by at least 3/4-inch all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

E. Manufacturer

- 1. 120/240V, single phase, 3-wire, and 120/208V 3-phase, 4-wire panelboards shall be manufactured by Schneider Electric, Eaton, Allen Bradley or approved equal.
- 2. 480V, 3-phase, 3-wire panelboards shall be manufactured by Schneider Electric, Eaton, Allen Bradley or approved equal.

2.04 Construction (NEMA 4X)

- A. Interiors and buses:
 - 1. Interiors and buses shall be as herein before specified for NEMA 1 construction.
- B. Boxes and Covers:
 - 1. Boxes and covers shall be made from stainless-steel with natural finish.
 - 2. Boxes and covers shall be bolted together and gasketed.
 - 3. Conduit openings shall be tapped.

C. Manufacturers:

1. All panelboards shall be NEMA 4X 304 stainless steel as required by voltage application.

2.05 Circuit Breakers

- A. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
- B. Circuit breakers shall be molded case, bolt-in type. Plug in circuit breakers not accepted.
- C. Circuit breakers used in 120/240V and 120/208V panelboards shall have and interrupting capacity of not less than 10,000 amperes, RMS symmetrical.

- D. Three pole breakers used in 480V panelboards shall have an interrupting capacity of not less than 65,000 amperes RMS symmetrical.
- E. GFCI (ground fault circuit interrupter) shall be provided for circuits where indicated on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be U.L. listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time), and an interrupting capacity of 10,000 amperes RMS.

2.06 Surge Suppressors

A. All panelboards shall be equipped with surge protection devices.

3. EXECUTION

3.01 Installation

- A. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2-inch air space between the box and the wall.
- B. Unless otherwise noted on the Drawings, top of cabinets shall be mounted 6-feet 6-inches above the floor, properly aligned and adequately supported independently of the connecting raceways.
- C. All wiring in panelboards shall be neatly formed, grouped, laced, and identified to provide a neat and orderly appearance. A typewritten directory card identifying all circuits shall be placed in the card holder inside the front cover.

3.02 Warranty

A. The warranty provided shall comply with Section 01740, "Warranties and Bonds".

END OF SECTION

SECTION 16370

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.01 Scope of Work

- A. Furnish all labor, materials, equipment and incidentals required to furnish and install variable frequency drives as shown on the Drawings and as specified herein.
- B. These specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all materials, equipment and appurtenances for the variable frequency drives herein specified.

1.02 Description of System

- A. The variable frequency drives shall be furnished by the Division 16 CONTRACTOR and integrated into the control system by the SYSTEM SUPPLIER specified in Division 13. These VFDs shall be furnished by the designated equipment manufacturer. The CONTRACTOR is responsible for complete system operation and necessary coordination.
- B. The variable frequency drives will operate motors as specified in Division 11, 15 and Division 16. The drives furnished herein under shall be totally compatible and adequately sized with the Motors to be supplied.
- C. 6-pulse variable frequency drives shall be provided with integrally mounted line reactors. Drives 30 hp and larger shall be furnished with a DC choke. All variable frequency drives shall be provided with integrally mounted dV/dT output filters.
- D. Drives shall be sized at a minimum of 125% larger than the full load ampacity of the motor, unless otherwise shown on the single line diagrams.

1.03 Qualifications

A. Variable speed drives shall be of sufficient size for the duty to be performed and shall not exceed their full rated capacity when the driven equipment is operating as

- specified. To assure unity of responsibility, all equipment specified in this Section of the specifications shall be furnished and coordinated by the Contractor.
- B. The drives covered by these Specifications are intended to be equipment of proven ability as manufactured by reputable manufacturers having long experience in the production of identical units. The equipment furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.
- C. The variable frequency control shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10% total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other variable frequency drives are operated from the same bus.
- D. Individual or simultaneous operation of the variable frequency drives shall not add more than 5% total harmonic voltage distortion to the normal bus, nor more than 10% while operating from standby generator (if applicable) per IEEE 519, latest edition. The load side of the main breaker shall be the point of common coupling (PCC). The short circuit current at point of common coupling under utility operation is approximately 25,000 Amps. A preliminary harmonic (voltage and current) analysis must be submitted by the variable frequency drive manufacturer withing 30 days after the notice to proceed, this must include all calculations, simply a statement of compliance is not acceptable. Compliance shall be verified by the variable frequency drive manufacturer with field measurements of the harmonic distortion difference at the point of common coupling with and without variable frequency drives operating. See testing requirements.
- E. The variable frequency drive manufacturer shall maintain and staff engineering service and repair shops through the United States, including the State of Florida, trained to do start up service, emergency service calls, repair work, service contracts and training of customer personnel.
- F. Approved Manufacturers:
 - 1. Schneider Electric
 - 2. Eaton
 - 3. Yaskawa

1.04 Submittals

- A. Copies of all materials required to establish compliance with the specifications shall be submitted. Submittals shall include at least the following:
 - 1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

- 2. Descriptive literature, bulletins and/or catalogs of the equipment.
- 3. Data on the characteristics and performance of the variable frequency drives. Data shall include certification that the variable frequency drives are warranted for use with the motors specified in Division 13, 15, and Division 16.
- 4. Complete drawings shall be furnished for approval before proceeding with manufacture and shall consists of master wiring diagrams, elementary or control schematics including coordination with other electrical control devices operating in conjunction with the variable frequency drive, and suitable outline drawings with sufficient details for locating conduit stub-ups and field wiring. Generic schematics not specific to this project shall not be acceptable.
- 5. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List bearings by the bearing manufacturer's numbers only.

1.05 Operating Instructions

A. See Section 01730: Operation And Maintenance Data.

1.06 Tools and Spare Parts

- A. One (1) set of all special tools required for normal operation and maintenance shall be provided. If no special tools are required, then a statement to this effect shall be provided.
- B. The Manufacturer shall furnish a complete list of recommended spare parts.

1.07 Product Handling

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. All equipment and spare parts must be properly protected against any damage during a prolonged period at the site.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.08 Warranty

A. The warranty provided shall comply with Section 01740, "Warranties and Bonds".

2. PRODUCTS

2.01 General

- A. The Contractor shall furnish and install complete variable frequency drives as described in this specification and as detailed on the applicable Drawings.
- B. The Contractor shall be responsible for the erection, installation, and start up of the equipment covered by this specification.
- C. The variable frequency drive shall be furnished by a VFD manufacturer who has actively been manufacturing variable frequency drives for a period of at least five (5) years.
- D. The variable frequency drive shall be comply with the latest applicable standards of ANSI, NEMA, IEEE, and the National Electric Code.
- E. Variable frequency drive shall operate as specified on standby generators or normal power sources.
- F. The Contractor shall provide a listing of all programmable parameters that are different from the factory default values. For each indicate:
 - The factory default and meaning
 - 2. The revised value and meaning
- G. The Contractor shall provide hardwired interface to all VFDs specified.
- H. The Contractor shall provide a copy of PC compatible remote programming/diagnostic software to the supplier of the control system. Refer to Section 13300.

2.02. Construction

- A. Each variable frequency drive shall consist of a 460V, 3 phase rectifier, DC link and variable frequency inverter with features, functions and options as specified. The inverter shall be voltage source design using pulse width modulation (PWM) techniques.
- B. The variable frequency drives shall be rated for the HP, full load current and rpm of the motor. The variable frequency drives shall be designed to provide continuous speed adjustment of three-phase motors. The variable frequency output voltage shall provide constant volts-per-Hertz excitation to the motor terminals up to 60 Hertz.

- C. Inverters shall be capable of converting incoming three phase, 460V (+10 to -5%) and 60 Hertz (+/-2) Hertz power to DC bus levels. The DC voltage shall be inverted to a variable frequency drive output.
- D. Controllers shall be rated for an ambient temperature of 0°C to 40°C, an altitude of up to 3,300 feet above sea level and humidity of 0 to 95% non-condensing.
- E. VFDs shall have complete front accessibility.
- F. The following standard basic control features shall be provided on the inverter:
 - 1. Start, Stop, and indicating lights as shown on the drawings. Terminations for remote mounted operator control devices shall be furnished.
 - 2. Unidirectional operation, coast to rest upon stop.
 - 3. Variable linear independent timed acceleration.
 - 4. Variable torque performance from 4 to 60 Hertz.
 - 5. Frequency stability of 0.5% for 24 hours with voltage regulation of +2% of maximum rated output voltage.
 - 6. LED status indication for Power On, Run, Inverter Enable, Overcurrent, Overvoltage, Overtemperature, Low Supply, and Phase Loss.
 - 7. 115V AC control power for operator devices.
 - 8. Phase insensitive to input power.
 - 9. Automatic restart upon return of power following a utility outage. Drive shall require manual reset after three (3) attempts in a 60 second period.
- G. The following protective features shall be provided on the drive:
 - Input AC circuit breaker with an interlocked, pad lockable handle mechanism and AC input line current limiting fuses for fault current protection of AC to DC converter section and circuit breaker. Minimum short circuit rating of 65,000 AIC shall be provided.
 - 2. Electronic overcurrent trip for instantaneous overload protection.
 - 3. Undervoltage and phase loss protection of output.
 - 4. Over-frequency protection.
 - 5. Over-temperature protection.
 - 6. Surge protection from input AC line transients.

- 7. Electrical isolation between the power and logic circuits, as well as between the 115V AC control power and the static digital sequencing.
- 8. Drive to be capable of withstanding output terminal line short or open circuits without component failure.
- 9. Output filters with di/dt and dv/dt protection for converter semiconductors.
- 10. Units shall have an English language (no codes) alphanumeric diagnostic display. LED indication of overfrequency, instantaneous overcurrent, DC overvoltage, AC undervoltage/loss-of-phase, emergency stop, overload overtemperature, inverter pole trip and standby modes shall be provided and door mounted. Additional door mounted status indicating LEDs for self-diagnostic including run, phase loss, micro-processor fault, as well as board mounted LEDs including one for each inverter pole gating signal, each inverter pole status and each logic level VDC used. A comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions is also approved.
- 11. Input Line Reactors
- 12. Input Filters as required by the required IEEE study to be performed by the Contractor.
- H. The following standard independent adjustments shall be provided on the inverter:
 - 1. Minimum speed (1 to 60 HZ).
 - 2. Maximum speed (1 to 60 HZ).
 - 3. Acceleration time 1 to 60 Sec.
 - 4. Deceleration time 1 to 60 Sec.
 - 5. Volts per Hertz.
 - 6. Stability adjustment, if required.
 - 7. Voltage boost (100 to 600 percent of nominal V/HZ ratio at 1 HZ tapering to 100 percent at 20 HZ).
- I. Additional control circuitry as shown on the drawings.

3. EXECUTION

3.01 Execution

A. The Contractor shall ensure that all VFDs shall be furnished in a timely fashion.

3.02 Installation

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Field wiring shall be in accordance with manufacturer's recommendations. Anchor bolts shall be stainless steel and set in accordance with the manufacturer's recommendations.

3.03 Shop Painting

- A. Prior to shop painting, all surfaces shall be thoroughly cleaned, dry, and free from all mill/scale, rust, grease, dirt, and other foreign matter.
- B. Drives shall be shop painted.

3.04 Testing

A. Tests and Check

- The drive manufacturer shall test the drive controller with a motor load prior to shipment. The motor shall have equal or greater full load current than the specified motor.
- 2. A certified copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the Owner.
- B. The Contractor shall provide the services of a competent and experienced equipment manufacturer's factory field engineer to supervise start-up and provide training to the Owner's personnel. The factory field engineer shall be available for one (1) eight (8) hour day to inspect the installed equipment and supervise the start-up demonstration and testing as specified in Section 01465 Equipment Testing and Facilities Startup, and additional testing and training as specified herein. The factory field engineer shall be available for two (2) additional eight (8) hour days (a total of three (3) eight (8) hour days) to provide factory and on-site training to the Owner's personnel as specified herein. Training of the Owner's personnel will only be considered valid for approval by the Engineer if it takes place after the successful start-up and demonstration test.

3.05 Training

- A. The training and instruction shall be directly related to the System being supplied.
- B. The Supplier shall provide classroom training detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

- C. The Supplier shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to Owner.
- D. The training program shall represent a comprehensive program covering all aspects of the variable frequency drive and maintenance of the system.
- E. All training schedules shall be coordinated with, and at the convenience of the Owner. Shift training may be required to correspond to the Owner's working schedule.
- F. Factory Training: Factory training shall be conducted before the System is commissioned, and subsequent to final manual submittals. Two days of factory training shall be provided and consist of schooling and hands on experience for two people covering the following:
 - 1. Theory of Operation
 - 2. Use of Software
 - 3. Troubleshooting
- G. On-site Training: On-site (field) training shall be conducted at the Owner's Plant Site and shall provide detailed hands-on instruction to Owner's personnel covering: system debugging, program modification, trouble-shooting, maintenance procedures, calibration procedures, and system operation.

END OF SECTION

SECTION 16402 UNDERGROUND SYSTEM

1. GENERAL

1.01 Scope of Work

- A. Furnish and install a complete underground system of ducts, manholes and handholes all as hereinafter specified and shown on the Drawings.
- B. Provide a minimum of one (1) spare conduit of each size in each duct bank from distribution gear to nearest manhole or handhole.

1.02 Related Work

- A. Excavation and backfilling is included in Division 2.
- B. All concrete and reinforcing steel shall be included under Division 3.
- C. Conduit for ducts shall be as specified under Section 16110 Raceways and Fittings.
- D. Ground rods and other grounding materials and methods shall be as specified under other Sections of Division 16.

2. PRODUCTS

2.01 Material

- A. Ducts shall be PVC Schedule 40 DB encased in concrete. Direct buried conduits shall not be allowed.
- B. Cable racks, supports, pulling-in irons, manhole steps, and hardware shall be stainless steel manufactured by Cope or approved equal. All hardware shall be 304 stainless steel.
- C. Precast manholes and handholes shall be heavy duty type, designed for a Class H20 wheel load. Precast manholes and handholes shall be as manufactured by Oldcastle, or approved equal.

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D. Class H20 traffic rated handhole covers and frames shall be provided as required.

3. EXECUTION

3.01 Installation

- A. Ducts shall be installed to drain away from buildings; ducts between manholes or handholes shall drain toward the manholes or handholes. Duct slopes shall not be less than 3 inches per 100 feet.
- B. Duct banks shall be fiber reinforced concrete.
- C. Duct lines shall be laid in trenches on a clean backfill bedding not less than 6 inches thick and well graded.
- D. Plastic spacers shall be used to hold ducts in place whether concrete encased or not. Spacers shall provide not less than 2-inch clearance between ducts.
- E. The minimum cover for duct lines shall be 24 inches unless otherwise permitted by the Engineer.
- F. Duct entrances to buildings and structures shall be made with PVC coated rigid aluminum.
- G. PVC duct terminations at manholes shall be with PVC end bells. Steel conduits shall be terminated with insulated, grounding-type bushings.
- H. Where bends in ducts are required, standard radius elbows, sweeps and offsets shall be used.
- I. All ducts shall be rodded and a mandrel drawn through followed by a swab to clean out any obstructions which may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter 1/2 inch less than the inside diameter of the duct.
- J. Spare ducts shall be plugged and sealed watertight at all manholes, buildings and structures.
- K. Ducts in use shall be sealed watertight at all manholes, buildings and structures.
- L. Pulling-in irons shall be installed opposite all duct entrances to manholes, equal to Cope Cat. No. 311-9.
- M. Cable racks shall be cut to length for one, two, three or four vertical tiers of cables. Racks shall be mounted with 1/2 inch by 4 inch expansion bolts on manhole walls. Arms similar and equal to Cope Cat. No. 325-T4, 325-T75 and/or 325-T10 for one, two and/or three cables respectively shall be furnished and installed with Cat. No. 326-T22 porcelain insulators for support of cables. Lock clips shall be furnished and installed to secure hooks in position.

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- N. Cables shall be trained in manholes and supported on racks and hooks at intervals not greater than 3 feet-0 inches and supports shall be installed on each side of all splices. Furnish inserts on all manhole walls for mounting future racks as well as racks required for present installation.
- O. PVC coated rigid steel conduit shall be used for risers. For fiber runs, a fiber to PVC coated rigid steel conduit adapter shall be used at the lower end of the elbow and the elbow and all exposed conduit shall be PVC coated.
- P. All risers from underground shall be given a heavy coat of bitumastic paint from a point 1 foot-0-inch below grade to a point not less than 6 inches above grade or surface of slab.
- Q. All joints shall be made so as to prevent the passage of concrete inside the conduit to form obstructions or cause cable abrasions.
- R. Manhole covers in streets shall finish flush with finished paving and in other areas shall finish 3 inches above crown of adjacent roadway. Floor elevations of manholes shall be so set that the center line of the lowest conduit entering will be not less than 1-foot above the floor and center line of the highest conduit entering will be not less than 1 foot below the roof slab.
- S. Concrete monuments shall be provided at each stubbed conduit location. Monuments shall be as shown on the Drawings and shall be installed in the same manner outlined for manhole covers.
- T. A 5/8-inch by 20-foot copperclad ground rod shall be driven in the bottom of each manhole. After installation, the ground rod opening shall be filled in with non-shrink grout to form a watertight plug. All bond wires and galvanized steel conduits shall be bonded to the ground rod.

END OF SECTION

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SECTION 16450 GROUNDING SYSTEM

1. GENERAL

1.01 Scope of Work

- A. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.
- B. Furnish and install a grounding system for facilities shown on the plans. Grounding grid shall consist of copper ground rod, bare copper ground conductor, ground test well and copper to copper exothermic weld, as indicated. All handrails, walkways, equipment racks, pole mounted lighting fixtures, air pipes and pipe supports shall be bonded to the grounding system.

1.02 Related Work

- A. Wire shall be as specified under Section 16120-Low Voltage Wire and Cable.
- B. Conduit shall be as specified under Section 16110–Raceway and Fittings.

2. PRODUCTS

2.01 Materials

A. Ground rods: Ground rods shall be copperclad steel 5/8-inch x 20 foot. Ground rods shall be Copperweld or be an approved equal product.

3. EXECUTION

3.01 General

- A. As a minimum, the service entrance equipment ground bus shall be grounded to the ground grid, equipment pad structural rebar, electrical equipment racks, and the steel frame of the building. The Contractor shall not allow water pipe connections to be painted. If the connections are painted, they shall be disassembled and remade with new fittings.
- B. Ground bus in all switchboards and unit substations shall be connected to the service entrance equipment ground bus with using copper conductors, sized as shown on the single line diagrams.
- C. All steel building columns shall be bonded together and connected to the building ground grid and to the service entrance ground with a No. 3/0 copper conductor. The bond wire for all motors shall be connected to the motor casing via Cadweld.
- D. Conduits stubbed-up below a motor control center shall be fitted with insulated grounding bushings and connected to the motor control center ground bus. Boxes mounted below motor control centers shall be bonded to the switchboard ground bus. The grounding wire shall, unless otherwise indicated on the drawings, be sized in accordance with Table 250-122 of the National Electrical Code, except that a minimum No. 12 AWG shall be used.
- E. Motors shall be grounded as specified in Section 16150-Motors.
- F. Step down Transformer neutrals shall be grounded to a grounding electrode and the service entrance ground.
- G. Grounding electrodes shall be driven as required. Where rock is encountered, copper grounding plates may be used in lieu of grounding rods.
- H. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.
- I. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A or approved equal. All buried connections shall be made by welding process equal to Cadweld.
- J. The plant grounding grid conductors shall be embedded in backfill material around the structures.
- K. All underground conductors shall be laid slack and where exposed to mechanical injury shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard.
- L. The Contractor shall exercise care to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

3.02 Tests

A. The Contractor shall test the ground resistance of the system using the 3 point fall of potential method. All test equipment shall be provided by the Contractor and approved by the Engineer. Dry season resistance of the system shall not exceed 5 ohms. If such resistance cannot be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional payment. The Contractor shall submit all grounding system test results to the Engineer for review.

END OF SECTION

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SECTION 16500 LIGHTING SYSTEM

1. GENERAL

1.01 Scope of Work

A. Furnish and install complete lighting systems including panelboards, transformers, lighting fixtures, receptacles, switches, contactors, clocks and all necessary accessories and appurtenances required as hereinafter specified.

1.02 Standards

A. All lighting fixtures shall be in accordance with the National Electrical Code and shall be constructed in accordance with the latest edition of the Underwriters Laboratories "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be Underwriters Laboratories labeled.

1.03 Related Work

- A. Panelboards shall be as specified under Section 16160.
- B. Conduit shall be as specified under Section 16110.
- C. Wire shall be as specified under Section 16120.
- D. Transformers shall be specified under Section 16050.

2. PRODUCTS

2.01 Materials

A. Switches

- 1. Wall switches shall be of the indicating, toggle action, flush mounting quiet type. All switches shall conform to Federal Specification W-S-896-D.
- 2. Wall switches shall be of the following types and manufacturer or approved equal.

- a. Single pole Arrow-Hart No. 1991 or Leviton No. 1221-2.
- b. Double pole Arrow-Hart No. 1992 or Leviton No. 1222-2.
- c. Three way Arrow -Hart No. 1993 or Leviton No. 1223-2.
- d. Four way Arrow-Hart No. 1994 or Leviton No. 1224-2.
- e. Single pole, key operated Arrow-Hart No. 1991-L or Leviton No. 1221-2L.
- f. Momentary contact, 2 circuit, center off Arrow-Hart No. 1895 or Leviton No. 1256.
- g. Weatherproof cover for Arrow-Hart 2900 series tap action switches Arrow-Hart Catalog No. 2881-G.

B. Receptacles

- 1. Wall receptacles shall be of the following types and manufacturer or approved equal.
 - a. Single, 20A, 125V, 1P, 3W; Arrow-Hart No. 5361 or Leviton No. 5361.
 - b. Duplex, 20A, 125V, 2P, 3W; Arrow-Hart No. 5362 or Leviton No. 5362.
 - c. Weatherproof, 20A, 125V, 2P, 3W; Arrow-Hart No. 5362 or Leviton No. 5361 and Crouse-Hinds WLRD-1 cover or Leviton No. 4926.
 - d. Corrosion-resistant, duplex, 20A, 125V, 2P, 3W; Arrow-Hart No. 5739-CR or Leviton No. 5362CR and Crouse-Hinds WLRD-1 cover.
 - e. Ground fault interrupter, duplex, 20A, 125V, 3P, 2W; Arrow-Hart No. GF5362 or Leviton No. 6899.
 - f. Stainless steel indoor mounting plate for G.F.I. receptacle; Arrow-Hart Catalog No. S-26.
 - g. Weatherproof cover for G.F.I. receptacle in FS box; Arrow-Hart No. 4501-FS or Leviton No. 6196.
 - h. Clock hanger, 15A, 125V, 2P, 3W; Arrow-Hart No. 452 or Leviton No. 628.
 - i. Single, 20A, 250V, 2P, 3W; Arrow-Hart No. 5461 or Leviton No. 5461.
 - Single, 30A, 125V, 2P, 3W; Arrow-Hart No. 5716N; cap: Arrow-Hart No. 5717N or Leviton No. 5371.
 - k. Clothes dryer, 30A, 125/250V, 3P, 3W; Arrow-Hart No. 9344N. Cap: Arrow-Hart No. 9352AN or Leviton No. 5209 and No. 9382-P.

- 2. Special wiring devices shall be provided as noted of the drawings.
 - a. Tamper resistant duplex receptacle Leviton No. 5262-SG or approved equal.
 - b. Scene select microprocessor dimmer Leviton No. 17765 or approved equal.
 - c. Surge protective duplex receptacle Leviton No. 5380 or approved equal.

C. Device Plates

- 1. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.
- 2. Plates for surface mounted device boxes shall be of the same material as the box.

D. Lighting Fixtures

 Lighting fixture types shall be as shown on the "Lighting Fixture Schedule" on the Drawings. The catalog numbers listed are given as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be reviewed. Photometric and minimum in order for Engineer to consider equivalency.

E. Lamps

- 1. All lamps shall be LED type.
- 2. All lamps shall be of one manufacturer and shall be as manufactured by Lithonia, Kenall, Hubble Beghelli, Columbia or approved equal.

F. Flexible Fixture Hangers

- Flexible fixture hangers used in nonhazardous areas shall be Type ARB and flexible fixture supports used in hazardous areas shall be Type ECHF as manufactured by the Crouse-Hinds Company or approved equal.
- Stainless steel channel, roll formed into U-shape, shall be sued to span between building steel for mounting of fixtures where required by fixture location or as indicated on the Drawings. Channel shall be as manufactured by Unistrut Corporation or approved equal.

G. Lighting Contactor

1. Lighting contactor shall be of the electrically operated, mechanically held type in NEMA 1 steel enclosures of the number of poles as called for on the Drawings.

2. Contactors shall be rated for 20A-600 volt contacts and be equal to Automatic Switch Company bulletin 1255-166 RC.

H. Photocell

1. Intermatic K4400 series or equal.

3. EXECUTION

3.01 Installation

- A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.
- B. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.
- C. Flexible fixture hangers shall be used for all pendant mounted fixtures.
- D. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.
- E. Receptacles in process areas and shops shall be mounted 36 inches above the floor unless otherwise noted on the Drawings.
- F. Receptacles in office and other like areas shall be mounted 18 inches above the floor unless otherwise noted on the Drawings.

3.02 Cleaning Up

A. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

END OF SECTION

SECTION 16670

LIGHTNING PROTECTION SYSTEM

1. GENERAL

1.01 Scope of Work

- A. A Lightning Protection System shall be furnished and installed for the following facilities:
 - 1. Electrical building No. 1.
 - 2. Chemical Facility.
 - 3. Operations/Maintenance Building
- B. The system shall be furnished and installed in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Lightning Protection Institute. All equipment to that result shall be included whether or not specifically called for herein or shown on the plans. Installers shall be LPI (Lightning Protection Institute) certified, master and Journeyman in accordance with LPI standards or of equal qualifications as approved by Engineer. A LPI label for the system shall be required.
- C. Material shall comply in weight, size and composition with the requirements of the Lightning Protection Institute and the National Fire Protection Code relating to this type of installation, and shall be LPI labeled.
 - 1. All materials, where available by any one manufacturer, shall be cast. All bolts shall have hexagonal heads, no screw heads will be permitted.
 - 2. Lightning protection cable shall be Class I copper. Grounding counterpoise shall be as shown. Fittings and straps shall be cast copper.

1.02 Submittals

A. Shop Drawings: Shop drawings shall be submitted before work is done. Drawings shall include full layout of cabling and points, and connections.

B. Product Data: Product Data shall be submitted on all equipment to show compliance with this section of the specifications and shall include manufacturer's written recommendations for installation.

2. PRODUCTS

2.01 Air Terminals

A. Air terminals shall be copper as required to match roof conductors, and shall have proper base support for surface on which they are attached, and shall be securely anchored to surface. Terminals shall project a minimum of 10" above top of object to which attached.

2.02 Conductors

A. Roof conductors shall consist of copper complying with the weight and construction requirements of the Code, and shall be coursed to interconnect with air terminals, and in general, provide a two-way minimum path to ground. The angle of any turn shall not exceed 90 degrees, and shall provide an approximately horizontal or downward course. Down conductors shall be copper, concealed within the structure. Radius of bends shall not be less than 8 inches. Roof conductors material shall match and/or be compatible with roof flashing material.

2.03 Fastener

A. Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

2.04 Ground Connections

- A. Ground connections shall be made in accordance with requirements of all applicable codes. Ground rods shall be placed in a minimum of two (2) feet from building foundations. In addition to above artificial grounds, one down conductor of each twopath system shall be connected to water piping system with approved water pipe type strap connector.
- B. All ground rods shall be 5/8" diameter, with a minimum length of 20' copperweld type. Each installed ground rod shall be checked for resistance to ground. If a 0 to 5 ohm reading is not obtained, extend 10' rod lengths and continue driving rods until the required reading is obtained.
- C. No rod can be connected to the bonding cable without the required ohm reading.

3. EXECUTION

3.01 Installation

A. Installation shall be made in an inconspicuous manner with conductors coursed to conceal equipment as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" schedule 80 PVC conduit. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor. System shall also be tied to the main service electrical ground.

3.02 Equipment

A. Equipment shall be as manufactured by Lightning Masters Corp or approved equal.

END OF SECTION