

**SECTION 11101
GENERAL PROCESS MECHANICAL REQUIREMENTS**

PART 1 - GENERAL

1.01 DESCRIPTION

The provisions of this entire section of the specifications are intended to govern the quality of design, fabrication, workmanship, operation, etc., of all materials, equipment and appurtenances to be furnished and installed under the various sections of the process mechanical specifications and all other sections that include process mechanical equipment as part of the specified items.

1.02 SUBMITTALS

A. Shop Drawings and Product Data

Shop drawings, including dimensioned drawings, descriptive literature, performance data, electrical characteristics, and in general all information necessary to provide compliance with the specifications, shall be submitted as required in Section 01300.

B. Maintenance Data and Operating Instructions

Submit an Operation and Maintenance Manual for the equipment furnished including a detailed description of the function of each principal component, procedures for operation, instructions for overhaul and maintenance in accordance with Section 01300. Include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

1.03 GUARANTEE

All materials, equipment, workmanship and performance shall be guaranteed for the period and [in accordance with the provisions of Section 00800](#).

1.04 MANUFACTURER'S OPERATION AND MAINTENANCE MANUALS

The Contractor shall provide manufacturer's operation and maintenance manuals as required in Section 01300.

1.05 STANDARDS

Where standards, codes or specifications are referred to, the reference is to particular standards, codes or specifications together with all the latest amendments and errata applicable at the time the bids are taken. These are listed below:

I.E.E.E.	Institute of Electrical & Electronics Engineers
A.S.T.M.	American Society for Testing Materials
A.S.M.E.	American Society of Mechanical Engineers

A.N.S.I.	American National Standards Institute
A.W.S.	American Welding Society
A.W.W.A.	American Water Works Association
N.F.P.A.	National Fire Protection Association
N.E.M.A.	National Electrical Manufacturer's Association
Federal	Federal Government Specifications
O.S.H.A.	Occupational Safety and Health Act
U.L.	Underwriters Laboratories
A.A.B.C.	Associated Air Balance Council
A.D.C.	Air Diffusion Council
A.G.A.	American Gas Association
A.R.I.	Air Conditioning and Refrigeration Institute
C.S.	Commercial Standard
I.B.R.	Institute of Boiler and Radiator Manufacturers
M.S.S.P.	Manufacturers Standards Society of the Valve and Fitting Industry
S.M.A.C.N.A.	Sheet Metal and Air Conditioning Contractors National Association
N.E.C.	National Electrical Code

1.06 GENERAL DESIGN OF EQUIPMENT AND MACHINERY

- A. All equipment and machinery furnished under this contract shall be of the latest and most improved design suitable for the service of which it is to be used. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of labor, power, maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum noise, wear and vibration (maximum amplitude of 3.0 mils unless otherwise specified) when properly installed.
- B. Ample room for erecting, repairs, inspecting and adjusting all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.
- C. The design and construction of the several units shall be such that they shall present a uniform appearance and the arrangement shall be such that their operation shall be in harmony in every respect. Whenever possible, fittings and fixtures of the same make and model shall be used for the several units and their connections. All equipment of identical type and service shall be the product of the same manufacturer.
- D. All equipment selected shall be of such size and general arrangement to suit the space in which it is to be installed.
- E. The various parts of the equipment and machinery shall be of plain shape and good lines, especially designed and constructed for strength and durability. Casting shall be designed and constructed to cool uniformly without shrinking strains and shall have good-sized fillets at all re-entrant corners. Sudden change of section shall be avoided.

- F. Whenever possible, part of each unit shall be made to gauge and be a duplicate of and interchangeable with the same parts of other machines of the same size and kind.
- G. The workmanship shall be of the highest class throughout.
- H. All assemblies shall be completely shop fabricated and structural steel parts shall be shop erected. Assemblies and structural steel parts shall be matchmarked before being disassembled for shipment. Parts shall be shipped assembled in as large unit as possible to minimize field reassembly. All parts shall be amply proportioned for all stresses, which may occur during operation, and for any additional stresses, which may occur during fabrication and erection.
- I. Unless otherwise specified, welding shall be in accordance with the latest standard specifications for "Gas Tight Welding" of the American Welding Society.
- J. Unless otherwise specified, galvanizing shall be hot-dipped in accordance with the latest standard specifications for "Zinc Coating" of the ASTM, Serial Designation A-123.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified, materials shall be in accordance with the following latest Standard Specifications of the ASTM:

Structural Steel	A-36
Welding Steel Pipe	A-53
Iron Castings	A-48
Babbitt	B-23
Bronze Castings	B-30
Bronze (Manganese)	B-138
Bronze (Silicone)	B-98
Steel Bolts	A-307
Hot Dip Zinc Coating	A-123
Stainless Steel Bolts	A-193, Grade B, Type 2
- B. All materials shall, if required, be tested and shall fulfill all requirements specified. Physical tests may be made by the Owner. The Contractor at his own expense shall furnish test pieces and samples in the number, shape, size and finish required by the Engineer. All broken material shall become the property of the Owner. The failure of test specimens to fully conform to the requirements of the specifications shall be sufficient cause for rejection of the whole melt or stock from which samples were obtained.
- C. Iron castings shall be smooth, clean and free from scale, lumps, blisters and other defects. No plugging, welding or filling will be allowed.

- D. The alloy grade number of all babbitt shall be that bearing alloy of a composition recommended by the manufacturer of the equipment or machinery for the service required, subject to the approval of the Engineer.
- E. All bronze shall be made of new material and shall be free from objectionable imperfections. If the materials show signs of improper mixing when being machined, the castings will be rejected.

2.02 JOURNALS, BEARINGS AND KEYS

- A. Journals and bearing surfaces shall be of sufficient size and properly proportioned for the least wear and to avoid heating under all conditions, and where necessary, provisions shall be made for each removal and for proper adjustments. Journals shall be suitable boxes, which, where necessary, shall be lined with babbitt metal hammered into grooves and bored in place. If bearings are of the ball bearing type, both inner and outer races as well as the balls shall be heat-treated steel to resist wear. The balls shall be of ample size to carry the maximum loads with a large factor of safety to prevent flaking, spalling, or crushing. The balls shall be properly spaced and held in position by rugged continuous spacing or retainer rings.
- B. Pins and keys shall be properly proportioned. Keys, nuts and all other parts, which might otherwise work loose shall be secured with approved locking devices.

2.03 LUBRICATION

- A. All bearings, except those specifically requiring oil or water lubrication shall be pressure grease lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the Alemite type as made by the Stewart Warner Corporation, or equal. The pattern of the fitting shall be selected for accessibility in lubricating and shall meet the approval of the Engineer. Housings of grease-lubricated bearings shall be automatically exhausted to atmosphere to prevent excessive greasing. The Contractor shall furnish three Alemite Hydraulic guns, or equal.
- B. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point of lubrication, the type of lubricant to be applied and the frequency of lubrication. Charts and schedules shall be submitted to the Engineer in quadruplicate, bound in folios, with each chart or schedule protected by a transparent plastic envelope.
- C. The Contractor shall furnish one (1) year's supply of each type of lubricant. A typewritten list shall be furnished with the lubricants, designating the specific lubricant to be used for each piece of equipment. This is in addition to the required operating and maintenance manuals, which will also contain lubrication requirements.

2.04 MOTORS AND CONTROLS - GENERAL

- A. Motors and controls shall conform to the latest requirements of IEEE and NEMA, and where applicable, shall be UL listed. Minimum sizes are specified with the

driven equipment. Motor starting and control equipment is specified either with the motor, which is controlled, or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

- B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.
- C. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.
 - 1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplate.
 - 2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overload, without exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the driven equipment to operating speed.
 - 3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.
 - 4. Motors shall be designed for operation on 60-hertz power service. Unless otherwise specified or shown, motors less than ½ horsepower shall be single phase, and motors ½ horsepower and larger shall be 3 phase.
 - 5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.
- D. Single phase motors smaller than 1/20 horsepower shall be ball or sleeve bearing, drip-proof, totally enclosed or explosion proof, as specified, 115 volts, permanent split capacitor or shaded pole type. These motors shall not be used for general power purposes and shall only be provided as built-in components of such mechanical equipment as fans, unit heaters, humidifiers and damper controllers.
- E. Single phase motors 1/20 horsepower and larger shall be ball bearing, drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115, 115/230, 200 or 230 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type.
- F. Except as otherwise specified in the various specification sections, 3 phase motors shall meet the requirements of this paragraph. Motors shall be NEMA design B squirrel cage induction type. Insulation shall be Class F and motor shall be rated at

no greater than 50 degrees C rise for open motors and 65 degrees C rise for closed motors both above an ambient temperature of 45 degrees C. At 40 degrees C ambient temperature explosion proof and totally enclosed motors shall have a 1.00 service factor and drip proof motors shall have a service factor of 1.15 or higher. Motors specified for operation at 480 volts shall be name plated 460 volts.

- G. Minimum three phase motor efficiencies at full load for motors having nominal rated speeds of 1200 RPM and higher shall be as follows:

<u>Horsepower</u>	<u>Minimum Efficiency</u>
1	80.0
1-1/2	81.5
2	82.5
3	84.0
4	85.5
5	87.5
7-1/2	87.5
10	87.5
15	88.5
20	90.2
25	91.0
30	91.0
40	91.7
50	92.4
60	93.0
75	93.0
100	93.6
125	93.6
150	94.1
200	94.5
250	95.0

Three phase motors shall be E-plus Energy Efficient Standard Duty Motor of the Electric Motor Division of Goulds, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corporation, the equivalent product of Baldor Company, or equal.

- H. Motors seventy-five (75) horsepower and larger shall be as specified with the driven equipment in these specifications.
- I. Belt-connected motors shall have adjustable bases and setscrews to maintain proper belt tension. All fan motors shall have adjustable sheaves for speed adjustment.

2.05 FLANGES AND BOLTS

- A. Flanges, except as otherwise specified, shall be cast solid, and boltholes shall be drilled and spot-faced on the back. Stud holes shall not be drilled through. Flanges shall be uniform in thickness and shall come fair and, if required, shall be turned or chipped in a neat and workmanlike manner.

- B. Jacking screws shall be provided for covers, etc. where required, and also suitable eye bolts for lifting. Bolts and nuts shall be of the best quality of open hearth, free machining steel. Bolts shall have good, sound well-fitting threads; nuts shall be cold pressed. All heads, nuts and threads shall be of the American Standard regular sizes. All ferrous bolts and nuts shall be galvanized by the hot dipped process.
- C. Bolts and nuts connecting pumps, valves and meters (as in flange connections) shall be Stainless Steel- Grade 316.

2.06 COUPLINGS

- A. Except where otherwise specified for a particular item of equipment, all equipment where flexible couplings are specified or are required for the purpose, a standard self-aligning forged steel coupling with sealed lubrication, as manufactured by Thomas, Koppers, Falk, Sier-Bath, or equal shall be provided between each motor and its driven equipment. One hub of the coupling shall be firmly fixed and keyed to the equipment shaft with the other hub similarly secured to the abutting drive shaft. Couplings shall be placed as close as possible to the driven equipment and the motor bearings to make compactly arranged units. Couplings shall be of all metal construction and shall be moisture proof and dustproof. Arrangement of couplings shall be such that there is sufficient room to place a dial indicator for alignment checking of shafts of the motor driven equipment. Each coupling shall be provided with an easily removable guard meeting all OSHA requirements.
- B. All equipment and motors/drives shall be field aligned using a dial indicator in accordance with the procedures established by the latest revision of the Hydraulic Institute Standards. Parallel and angular misalignment shall not exceed the limits recommended by both the equipment and the coupling manufacturer.

2.07 EQUIPMENT BEDPLATES

The various items of motor driven equipment, such as pumps, shall be mounted on structural steel bedplates. The bedplates shall be adequate size to accommodate the equipment and its motor, to form an integral rigid mounting platform. Steel or brass shims shall be used to level equipment bedplates mounted in contact with concrete pads or floors. Jacking bolts or jacking (leveling) nuts on mounting studs shall not be used in lieu of shims. Bedplates shall be grouted to the concrete base and shall be filled with grout in all instances where the manufacturer has made provision for introducing grouting mixture into bedplate cavities. It shall be the contractor's complete responsibility to determine the proper method, to provide all materials and components required, and to coordinate the work, to set, couple, align and install all equipment in a satisfactory manner.

PART 3 - EXECUTION

3.01 MANNER OF INSTALLATION

- A. The general arrangement of pipe and equipment shall be as shown on the drawings. Detailed drawings of proposed departures due to actual field conditions or other causes shall be submitted to the Engineer for approval. The Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of materials and equipment as indicated, without substantial alteration. Because of the small scale of the drawings, it is not possible to indicate the exact location of piping, all offsets, fittings and accessories, which may be required. The Contractor shall carefully investigate the space requirements for proper clearances and the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such offsets, fittings, valves and accessories as may be required to meet such conditions.
- B. Each trade shall determine the location, size, etc. of all chases and openings required for the proper installation of its work, and shall see that such are provided. Where it is necessary to run pipes or ductwork through walls or fittings, the trade performing the work shall notify the Contractor so that proper provisions can be made for same. Each trade shall furnish and set all inserts, sleeves, hanger supports, etc. required for its work and shall be responsible for their proper and permanent location.
- C. All piping and ductwork exposed to view shall be run generally parallel with the lines of the building and as close to walls and column as may be practical and consistent with proper grade and the maintenance of proper clearances for access to all parts requiring servicing.
- D. The Contractor, in the prosecution of the work, shall do no cutting of woodwork, masonry, concrete or other materials after same have been installed, without the written permission of the Engineer. No waterproofing shall be cut for any purpose except on written approval of the Engineer.

3.02 TESTING

- A. After erection, the Contractor shall adjust and balance all equipment and systems, and shall demonstrate that all equipment is operating in a satisfactory manner. All rotating equipment shall be lubricated according to recommendations of the manufacturer and all adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly, without vibration, overheating, or sign of distress at full-specified capacity. Adjustments shall be made as necessary. All defective parts on machinery shall be replaced.
- B. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction.

3.03 MISCELLANEOUS

- A. Finished parts shall be well protected in the shop, during transportation and before and after erection to prevent injury of any kind. Injured parts which in the opinion of the Engineer are damaged or which cannot be refitted, shall be promptly replaced by the Contractor without expense to the Owner. All exposed finished parts of machinery shall be greased or oiled before shipment.
- B. The Contractor shall furnish all tools of special nature, which are required for making adjustments (by the Owner after the work has been turned over to him) to equipment, but will not be required to furnish standard tools.
- C. All exposed belts, gears, and drives shall be protected with guards. Guards may be of the equipment manufacturer's standard design, but must meet all the OSHA Standards.

3.04 PAINTING AND LABELING

- A. All fabricated or assembled surfaces normally painted shall be thoroughly dry and free from all rust, grease, dirt or scale. The Contractor is reminded to correlate the selection of shop prime coats to be compatible with subsequent field applied coats of paint. The Contractor shall touch up paint any item damaged during shipping or installation.
- B. Each piece of equipment (including mechanical operators, and electrical switches for the equipment) shall be identified by hand painting or stenciled, two-inch letters and numbers, to indicate the service or function. Unless specified otherwise in the mechanical and electrical sections of these specifications, each motor and motor controller shall be similarly numbered (or lettered) to correspond to the number (or letter) of the driven unit.

3.05 ADJUSTMENTS TO RELATED WORK

The final work shall include any adjustment that may be required by the approved equipment furnished, with modifications made to concrete shapes and to dimensions shown on the contract drawings as may be required to suit the details of the approved equipment furnished, all at no additional cost to the Owner.

END OF SECTION 11101

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**SECTION 11170
LIQUID CHEMICAL METERING PUMP SYSTEMS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install chemical metering pumps at the locations shown on the Drawings and as specified herein.
- B. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- C. For chemical applications, the pump supplier shall be responsible for the supply of tubing, piping, fittings, adapters, appurtenances, and accessories starting from the chemical drum, through the metering pump, and ending at the injection quill, inclusive. These shall include, but not be limited to, the pump table, couplings, controls, pressure gauges, calibration columns, isolation valves, Y-strainers, flow indicators, check valves, backpressure/anti-siphon valves, pressure relief valves, and pulsation dampeners as indicated on the Drawings, or as otherwise required. The supplier is responsible for ensuring the chemical compatibility of the materials provided. The supplier shall certify all of the above equipment as a coordinated system with an Equipment Guarantee and Certification Form. The pump supplier's scope of responsibility does not include rigid vent piping connected to calibration columns.
- D. Equipment shall be provided in accordance with the requirements of Section 11100, General Process Mechanical Requirements.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15060 – Pipe and Pipe Fittings
- B. Section 15080 – Valves and Piping Specialties

1.03 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- a. Pump Performance and Design Requirements

Parameter	Polyaluminum Chloride (PACl)
Application Points	Raw Water Pipe in Prop. Clarifier Building
Pump Type	Peristaltic
No. of Pumps (including 1 spare)	2

Parameter	Polyaluminum Chloride (PACl)
Normal Operating Range, gpd	1.0 - 10
Capacity shall not exceed: gph	18.0
Pump Speed shall not exceed:	150 rpm
Normal Discharge Pressure	<10 psig
Working Pressure Rating (capability)	100 psig
Motor Horsepower shall not exceed:	1/8 hp
Drive Type	Variable Speed DC

1.04 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to, the submittal requirements specified in Section 01300 - Submittals; and Section 11100 - General Process Mechanical Requirements:
1. The Contractor shall obtain and submit to the Engineer certification from the chemical pump Manufacturer and equipment Supplier that the equipment meets the requirements of the Contract Drawings and Specifications. This certification form is included at the end of this Section.
 2. Pump dimensions, general cutaway section, and performance data (discharge pressure, strokes per minute, etc.). Also provide the manufacturer's estimated relationship of pump speed versus flow rate for the particular pump and tube submitted, noting the pressures used for the estimation.
 3. Submit the pump flow rate versus pump speed shop test results for approval before shipment of pumps.
 4. Catalog cut sheets and brochures of all equipment.
 5. Assembly Drawings of the pump table and arrangement of chemical feed equipment on the pump table.
 6. Details on materials of construction of all components including applicable ASTM designations.
 7. Chemical resistance data for all wetted pump parts and accessories including, but not limited to; pump housing, pump liquid end material, pump diaphragms, pump tubes, isolation valves, check valves, check valve balls and o-rings.
 8. Sizing calculations for pulsation dampeners.
 9. Equipment shop coating systems, interior and exterior.
 10. Details of sealing system.
 11. The total uncrated weight of the equipment plus the approximate weight of shipped materials.
 10. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at $\frac{1}{2}$, $\frac{3}{4}$, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.

11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
 12. Complete wiring diagrams
 13. Complete control descriptions for pump operation
 14. Complete erection, installation, and adjustment instructions and recommendations.
 15. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues. Such warranty shall be submitted for pumps and all other equipment and accessories.
- B. Submit all installation and start up test results to the Engineer for review.
- C. Operation and Maintenance Manuals for the chemical metering pump systems shall be submitted in accordance with Section 01300 - Submittals, and 11101 - General Process Mechanical Requirements. The manufacturer shall provide estimates of pump tube life based on installation conditions.
- D. The Contractor shall be responsible for coordinating all interfaces with related mechanical, structural, electrical and instrumentation and control work. The Contractor shall be responsible for all work associated with installation of the equipment.
- E. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.

1.05 WARRANTY AND GUARANTEE

- A. The pump manufacturer shall warrant the pump for materials and workmanship for a period of three (3) years after the Substantial Completion of the project. Warranty shall be submitted with the Shop Drawings. The pump manufacturer shall replace or repair the defective or unsatisfactory drive train during the warranty period at no cost to the Owner.
- B. All equipment and accessories shall be warranted for materials and workmanship for a period of one (1) year after Substantial Completion of the project.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The Manufacturer shall be a company specializing in manufacture, assembly, and field performance of mechanical metering pumps with a minimum of five years experience.

- B. The chemical peristaltic metering pumps shall be ProSeries Flex-Pro M-224 manufactured by Blue-White Ind., Qdos manufactured by Watson Marlow Pumps, or approved equal.

2.02 GENERAL

- A. All parts of the equipment furnished shall be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.
- D. All equipment which contacts the liquid chemicals or raw water shall be NSF 61 approved.

2.03 MATERIALS: CHEMICAL PERISTALTIC PUMPS

- A. METERING PUMPS shall be a positive displacement, peristaltic type tubing pump with a variable speed DC motor, non-spring loaded roller assembly located in the pumphead, integral tube failure detection system, and peristaltic pump tubing assembly with attached connection fittings.
 - 1. Within the pumphead, there shall be no valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact the pump tubing assembly and connection fittings only.
 - 2. Capable of self-priming at the maximum rated pressure of up to 100 PSI (8.6 bar).
 - 3. Capable of running dry without damage.
 - 4. Pump rollers shall be capable of operating in either direction at the maximum rated pump pressure.
 - 5. Pump rollers shall be capable of operating in either direction without output variation.
 - 6. Suction lift shall be 30 feet of water.
- B. PUMPHEAD shall be a single, unbroken track with a clear removable cover.
 - 1. Tube failure detection sensors shall be wholly located in the pumphead and be capable of sending an alarm signal to the control system. Tube failure detection system shall not trigger with water contact. Float switch type switches alone shall not be used. Process fluid waste ports or leak drains alone shall not be provided as the sole means of protection.

2. Squeeze rollers with encapsulated ball bearings shall be directly coupled to a one piece thermoplastic rotor. The roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression; field adjustment shall not be required.
3. Rotor assembly shall be installed on a D-shaped motor shaft and removable without tools.
4. For tubing installation and removal, rotor assembly shall be rotated by the motor drive at 6 RPM maximum when the pumphead cover is removed. Hand cranking of the rotor assembly shall not be required.
5. Pump head and tubing compression surface shall be corrosion resistant thermoplastic.
6. The pump head cover shall be clear, annealed acrylic thermoplastic with an integral ball bearing fitted to support the overhung load on the motor shaft. Cover shall include an imbedded magnetic safety interlock which will limit the motor rotation speed to 6 RPM when removed.

C. PUMP TUBE ASSEMBLY

1. To ensure pump performance and accuracy, only tubing provided by the manufacturer is acceptable.
2. Connection fittings shall be permanently attached to the tubing at the factory. To prevent tubing misalignment and ensure accuracy, fittings shall insert into keyed slots located in the pump head and secured in place by the pump head cover.
3. Tube maintenance should be limited to replacement of the tube assembly only. Replacement of the entire pump head assembly shall not be acceptable.

2.04 ELECTRICAL AND CONTROLS REQUIREMENTS FOR CHEMICAL PUMPS

- A. DRIVE SYSTEM shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on 110/130VAC 50/60 Hz, or 208/250VAC 50/60 Hz, single phase supply, user configurable via a selection switch located in the junction box.
1. Motor
 - a. Reversible, DC gear motor rated for continuous duty.
 - b. Motor shall include overload protection.
 2. Enclosure
 - a. Rated NEMA 4X (IP66).

- b. Provide extended height brackets for mounting pump 4 to 6 inches above surface level.
- c. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads to un-pluggable type terminal block connectors. Terminal board shall be positively secured to the rear of the pump housing by two polymeric screws and fully enclosed by the wiring compartment cover. The terminal board shall not be disturbed by the removal of the wiring compartment cover. Ribbon cables shall not be used in the wiring compartment. Conduit hubs, liquid-tight connectors, connector through holes and tapped holes shall be sized in U.S. inches.

3. Control Circuitry

- a. Control circuitry shall be integral to the pump and capable of adjusting the pump motor speed from 0.5 % to 100.00% in 0.1% increments.
- b. The pump output shall be capable of being placed in MANUAL control using the front control panel touchpad. While in manual control, the pump motor speed shall be adjustable from 1.0 % to 100.00% in 0.1% increments using the front control panel touchpad.
- c. The pump output shall be capable of being placed in REMOTE 4-20mA control using the front control panel touchpad. While in remote control via 4-20mA analog input, the input resolution shall be 0.1 of input value and capable of adjusting the pump motor speed from 0% to 100.0% motor speed in 0.1% increments. Four values shall be user configurable to define the low and high points on the output slope; a low input value, the required pump percentage of motor speed at the low input value, a high input value, the required pump percentage of motor speed at the high input value.
- d. The pump output shall be capable of being placed in REMOTE high-speed pulse input control using the front control panel touchpad. While in remote control via high-speed TTL/Cmos type digital pulse inputs or AC Sine wave type input pulses, the frequency resolution shall be 1 Hz and capable of adjusting the pump motor speed from 0% to 100.0% motor speed in 0.1% increments. Four values shall be user configurable to define the low and high points on the output slope; a low input value, the required pump percentage of motor speed at the low input value, a high input value, the required pump percentage of motor speed at the high input value.
- e. The pump output shall be capable of being placed in REMOTE pulse triggered batch input control using the front control panel

touchpad. While in remote control via pulse triggered batch input, the pump shall accept a TTL/Cmos digital pulse type input or a contact closure type pulse input in the range of 1 to 9999 pulses per batch. The batch time shall be adjustable from 1 to 999.9 seconds or minutes. The pump motor speed during the batch shall be adjustable from 0% to 100.0% motor speed in 0.1% increments.

- f. The pump shall be capable of being remotely controlled via any of the following optional communications modules, Profibus DPV1, Modbus RTU, Modbus-TCP, EtherNet/IP, or Profinet RT I/O. The optional communications module hardware shall install into the junction box of the pump. The pump shall be field upgradable at any time with any of the communications protocols.
- g. The pump operating firmware shall be field upgradable. New firmware shall be downloadable via the Internet. A serial communications port shall be provided on the pump terminal board, which when connected to the user's computer, will permit the uploading of the new firmware into the pump.
- h. Provide a 9-button front panel user touchpad control for stop/start, configuration menu access and navigation, operating mode selection, motor reverse, tube life hour display, and auto priming.
- i. Provide a back-lit LCD display for menu configuration settings, current pump operating mode, pump output volume, tube timer hour counter, tube failure detection (TFD) system and flow verification system (FVS) alarms status, motor direction and remote input signal values.
- j. The pump output volume display shall be programmable to indicate the volume in ml/min, L/hr, Oz/min or Gal/hr units of measure.
- k. Provide for remote stop/start pump via 6-30 VDC powered loop or non-powered contact closure loop.
- l. Provide a 4-20mA output signal which is scalable and proportional to pump output volume.
- m. Provide a contact closure alarm output rated at 3A-250VAC (3A-30VDC) that will energize when the TFD (Tube Failure Detection) or FVS (Flow Verification system) is triggered.
- n. Provide an auto-prime function that will run the pump at 100% motor speed for 60 seconds maximum when the PRIME button is pressed.

B. SAFETY

1. The pump shall be listed to UL standard 778 as a motor operated pump and CSA standard C22.2 as process control equipment.
2. Tube Failure Detection (TFD) system sensors shall be wholly located in the pumphead. TFD system will stop the pump within three seconds of leak detection. To prevent false alarms due to rain, wash-down, condensation, etc., sensors shall be wholly located in the pumphead. The tube failure detection system shall not trigger with water contact. Float switch type switches alone shall not be used. Process fluid waste ports or leak drains alone shall not be provided as the sole means of protection.
3. Pumphead cover shall include an imbedded magnetic safety interlock which will stop the pump when removed. Pump rotor speed shall be limited to 6 RPM when cover is removed.

C. RAW WATER PUMP

1. Raw water sample pump shall have adjustable flow rate. If variable frequency drive and panel are not integral to the pump assembly, the manufacturer shall supply them and they shall be installed on the same pump table with the pump.

2.05 METERING PUMP ACCESSORIES

- A. The metering pump supplier shall furnish accessory equipment as specified herein, as specified in Section 15080 – Valves and Piping Specialties, and as shown on the Drawings, including but not limited to the following below.
- B. **PRESSURE:** All supplied components on both the suction and discharge side of the chemical feed pumps, including tubing and fittings, shall be pressure rated at least to the same “Working Pressure Rating (Capability)” listed in Tables 1.02.B of this Section.
 1. Tubing and Fittings.
 2. PVC Piping – Not all solvent cements are suitable for the chemical applications. Use a specially formulated solvent cement suitable for sodium hypochlorite for solvent welded joints for ALL chemicals. Use IPS Weld-On 724, or approved equal for ALL chemicals, not just sodium hypochlorite. Use IPS’s recommended primer, P-70, or approved equal.
 3. Pump Table – Pump manufacturer shall supply pump skid platform system with a back wall which can hold equipment mounted to it. If the pump supplier’s skid platform does not have legs, the Contractor may submit a design for Engineer’s approval which provides four (4) galvanized steel strut channel legs to raise the skid platform to operator level. The table surface shall be 29 to 36 inches high above the floor level. Table shall be bolted to floor with concrete anchors. Support pump

on raised mounting feet secured to table surface. Table material shall be FRP, PE, or PP, or metal with protective coating.

4. Pressure Gauges - Gauges with diaphragm seals shall be provided on the discharge of metering pumps. Gauges shall be the product of one manufacturer.
 5. Pressure Relief Valves.
 6. Anti-Siphon/Back Pressure Valves. Each of these valves shall function to provide both back pressure and prevention of siphoning.
 7. Ball Valves
 8. Diaphragm valves
 9. Y-Strainers
 10. Flow Indicators – Shall be visual ball type.
 11. Check Valves.
 12. Pulsation Dampeners - Each dampener shall be equipped with a charging valve and gas pad pressure gauge. Sizing of the pulsation dampeners shall be the responsibility of the manufacturer, and calculations shall be submitted with Shop Drawings.
 13. Calibration Column – Calibration columns shall be constructed of transparent material. Graduations shall be in mL. Each calibration column shall be sized such that at 50% pump capacity, the calibration column will be emptied in 1.5 to 2.5 minutes.
 14. Injection Quill – Shall be retractable and the injection pipe passes through a valve which is connected to the process pipe saddle. This valve can be closed when the injection pipe is removed for maintenance. Select injection pipe length which dispenses chemical as close to center of process pipe as possible without voiding warranty. End tip shall be cut slanted at 45°. Shall be Saf-T-Flo or approved equal.
- B. All of the above valves shall have internal components that cause tight sealing to prevent unintentional internal leakage.

2.06 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The equipment manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.
- B. Spare parts shall be provided in accordance with Section 11101, General Process Mechanical Requirements and shall include the following:

1. One (1) spare pump for each chemical and pump type, per pump quantity requirements described in this Section.
 2. Two (2) complete sets of gaskets and O-ring seals for each size and material combination offered.
 3. One (1) spare valve for each valve type and chemical.
 4. Three (3) peristaltic pump tubes for each peristaltic pump supplied (not including spare pumps).
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the Owner in a group prior to substantial completion. All of these materials shall be properly packed, labeled (including by chemical), and stored where directed by the Owner and Engineer.

2.07 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
1. Perform shop tests with water on all chemical feed pumps (except duplicate spares) which confirm pump capacity while the suction pressure is 0 psi and the discharge pressure is equal to the "Normal Discharge Pressure" listed in Tables 1.02.B in this Section.
 2. Test all pressure relief valves and backpressure valves to ensure that they are set as shown in the Drawings.
- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. Three (3) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. Shop testing of electric motors shall be in accordance with applicable requirements of Section 16050 - Basic Materials and Methods.

PART 3 - EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided as follows:

Service	Number of Trips	Number of Days/Trip
Startup and Training	1	1

- B. The Contractor shall be fully informed and shall be responsible to ensure that all Contractor's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.
- C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out with the Owner on each day he is at the project.
- D. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies noted.
- E. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. Contractor shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.
- B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense to the Owner. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.

3.03 INSTALLATION

- A. The Contractor shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 11101 - General Process Mechanical Requirements.
- B. The Contractor shall have on hand sufficient personnel, 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 insofar as practical.

- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. The Contractor shall support piping adjacent to pumps such that no weight is carried on pump casings.

3.04 TESTING, CLEANING, AND START-UP

- A. The Contractor shall demonstrate to the Engineer that the completed systems meet the functional requirements intended and that all components of the system are properly calibrated.
- B. After installation of piping and accessories but before connection of chemical piping to the storage tank, pumps, and process piping, the Contractor shall completely flush the system to clean and remove all foreign matter from the piping system.
- C. Complete system hydrostatic tests and operational tests shall be completed with potable water. The Contractor shall check the functioning of all pump accessories, valves, and feed points and shall repair or replace all malfunctioning or unsatisfactory components. The Contractor shall repair all leaking joints and components identified during the test and through the guarantee period.
- D. Before connection of the chemical tubing/piping to the storage tank, pumps, and process piping, perform hydrostatic pressure tests for all assembled tubing, piping, and valving systems, including on the suction side of the pump, at a pressure of 25 psi for 24 hours. Then drain the piping and tubing of all test water before placing into chemical service.
- E. After pressure testing the chemical tubing/piping system, but before placing the chemical feed system into service of injection into the process pipes, test the flow rate of the installed pumps with chemical (not water) within the completely assembled system as follows:
 - 1. Ensure that chemical storage tank is at least half full of chemical.
 - 2. Ensure that the chemical feed piping and valving system is completely assembled and connected to the storage/day tanks per design and ready for normal operation, with the exception that the injection point is disconnected so that chemical will not enter the ultimate process piping. Disconnect the piping/tubing immediately prior to the injection quill, which usually will be at a portion of flexible tubing which can be disconnected. If there is no flexible tubing near the injection quill, use a capped rigid test port near the quill and shut off the valve to the process pipe. During testing, chemical will flow out at these points (not into process pipe) and the Contractor shall be responsible for capturing, disposing of or reusing the pumped chemical flows during testing. Ensure sufficient ventilation of

- the area and minimize fumes. Use personal protective equipment as needed.
3. Run the chemical feed pumps to fill the feed piping system. Remove trapped air in the lines.
 4. Perform flow rate tests with the chemical to determine the pump flow rate as a function of pump speed (rpm) and percentage (%). Test at least at approximately 25%, 50%, 75%, and 100% of the upper limit of the Normal Operating Range as shown in Tables 1.02.B of this Section. Provide charts of this data and a linear regression equation relating the variables. The flow rate may be measured using the calibration column or by precisely measuring the waste chemical leaving the piping system.
- F. Final acceptance tests shall demonstrate the following:
1. The pumps have been properly installed and are in proper alignment.
 2. The pumps operate without overheating or overloading of any parts and without objectionable vibration. Vibration shall be within the Hydraulic Institute limits, or manufacturer's limits if more stringent.
 3. The pump motors can meet the specified operating conditions. All pumps shall be checked at maximum speed for amperage. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing.

3.05 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

END OF SECTION 11170

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**SECTION 11220
IN-LINE STATIC MIXING EQUIPMENT**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish, pressure test, install and place in satisfactory operation, in-line static mixers as shown in the Drawings and described herein: complete with mixing elements and housing pipe.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Mixer Schedule

Application:	Alum Rapid Mix Coagulation
Quantity of mixers	1
Main Process Fluid	"Raw" untreated water from reservoir, pH = 6-9
Main Pipe Diameter	6"
Main Process Flow Rate Range, gpm	50 – 300
Mixer Pressure Rating (also test pressure), psi	150
Chemical Added	Polyaluminum Chloride solution
Chemical Flow Rate Range, gpd	3 - 10
Mixing performance Requirement within Flow Rate Ranges described above	At least 95% mixing completion at the end of the mixer outlet, as defined by Coefficient of Variation
Pressure (Head) Loss at Maximum Flow Rate shall not exceed:	4 psi
Length Requirements	None
Minimum Liquid Temperature	40°F

1.03 SUBMITTALS

- A. The Contractor shall submit the following in accordance with Section 01300 - Submittals:
1. Detailed manufacturer's design data, including all materials and coatings.
 2. Dimensional drawings.
 3. Performance data. Provide chart of flow vs. mixing performance and head loss. List pressure rating.

4. Cutsheets and/or brochures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Static mixers shall be manufactured by Koflo, Komax, or Statiflo.

2.02 DESIGN

- A. The mixer shall be the static in-line type with no moving parts. The mixer shall contain fixed static mixing elements inside of a circular pipe spool piece.
- B. Mixing shall be by stationary, rigid elements arranged to split and recombine streams to provide a near-homogeneous stream at the mixer outlet.
- C. The mixer shall be flanged on both sides, compatible with surrounding piping.
- D. Mixer shall be structurally sound and suitable to withstand typical stresses associated with the intended installation arrangement.
- E. Materials of construction, inside and outside, shall be stainless steel, epoxy-coated carbon steel, or epoxy-coated ductile iron. All materials in contact with process liquid shall be NSF 61 approved.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The mixers shall be installed and supported as indicated on the Drawings and as recommended by the manufacturer.

3.02 EXTERIOR COATINGS

- A. The exterior of the static mixer housing shall be epoxy coated (unnecessary for stainless steel) and shall have a different color than the surrounding piping, but the color shall still be a tint of blue, green, or olive. Stencil "Static Mixer" label onto the mixer body.

END OF SECTION 11220

**SECTION 11340
CHEMICAL SCALES**

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish, test, install and place in satisfactory operation a chemical drum scale for coagulant (Polyaluminum Chloride), complete with all spare parts, accessories, and appurtenances as specified or shown in the Contract Documents.
- B. Equipment shall be provided in accordance with the requirements of Section 11100, General Process Mechanical Requirements.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

Digital Drum Scale(s) shall be provided for weighing chemical drums and cylinders. Scale shall be of the digital readout/electronic load cell type with a net capacity of 1000 lbs. (kg). Scale shall be of the single load cell design.

1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to, the submittal requirements specified in Section 01300, Submittals, and Section 11101, General Process Mechanical Requirements:

1.04 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11101, General Process Mechanical Requirements, with the exception that the warranty period shall be for five (5) years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Drum scales shall be as manufactured by Scaleton Industries, LTD, or equal.
- B. Digital indicators shall be model 4040-26 as manufactured by Scaleton Industries, LTD, or equal.

2.02 GENERAL REQUIREMENTS

- A. All equipment shall be suitable for the intended chemical service specified in 1.02A.
- B. Scales

1. Day tank scales shall be used to measure the weight of the coagulant chemical tank.

2.03 DAY TANK SCALE DESIGN REQUIREMENTS

- A. Tank scales shall be of the digital readout/electronic load cell, dual cylinder type. Full-scale accuracy of the scales shall be equal to or better than ¼ of 1%.
- B. The single, NTEP approved load cell shall be of the shear beam strain gauge type. A minimum of 20 feet of flexible cable shall be provided to connect the load cell to the digital indicator.
- C. Scale platform shall be sized to accept up to an 26” diameter drum or cylinder. Scale must have a rugged, steel frame that is protected by a corrosion resistant coating. Coating system shall consist of a zinc oxide primer and dry powder epoxy that is resistant to chemicals, moisture and UV light. The decking shall be solid, 1/4" thick PVC to protect scale base from abrasion. All hardware shall be stainless steel. The platform height shall not exceed 1.81" (46 mm) so as not to require a pit or ramp. A stainless steel leveling foot shall be supplied with the load cell. A heavy-duty adjustable shall be provided to facilitate centering of drums and cylinders on the platform. There must be a provision for securing weigh frame to floor.
- D.

2.04 DIGITAL INDICATOR DESIGN REQUIREMENTS

- A. Each scale shall be provided with a digital indicator which shall be used to display tote or day tank weight.
- B. Digital indicators shall be designed to withstand exposure to the chemicals being stored in the respective totes and day tanks.
- C. Display & Operation: Indicator must be electronic with a 6 digit, 1 line LED display with characters at least 0.56" high for weight value, plus a 2 line, 16 characters per line, alphanumeric LCD display for status and features. The indicator shall give operator the ability to monitor chemical by weight or volume in pounds, kilograms, gallons or liters. Indicator shall have 10 numeric and 10 function keypad with audible, tactile and visual confirmation for programming and setting tare weights, while all operations shall be menu prompted for ease of use. Indicator shall have a redundant memory back-up so that it does not need to be reprogrammed in the event of a power loss.

2.05 ELECTRICAL AND CONTROL REQUIREMENTS

- B. Electrical Requirements

Parameter	Tote Bin-Scales	Day Tank Scales
Power Requirements	N/A	110/240VAC, 1 ph, 60 Hz

Indicator Enclosure	N/A	NEMA 4X
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PART 3 - EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. Startup and training shall be coordinated with the Owner, and the Owner shall have final approval authority for the scheduled date(s).

END OF SECTION 11340

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SECTION 11500
DISSOLVED AIR FLOTATION CLARIFICATION EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Dissolved Air Flotation equipment
 - 1. This section specifies the furnishing and commissioning of a dissolved air flotation (DAF) system complete with pressurization system, recirculation pumps, pneumatic panel, continuously stirred tank reactor (CSTR) with mixer, equipment control panel, special equipment and appurtenances including, but not limited to, skimming device, sludge collector mechanisms, and factory wiring as specified herein to provide a complete and operable system for algae removal, in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Submit three (3) copies of the following descriptive information with the Bid:
 - 1. Proposed equipment supply list with electrical characteristics of motor driven equipment.
 - 2. Make, model number and catalog information of all process equipment, including, but not limited to, recirculation pumps, sludge pumps, instrument and sensors, and appurtenances
- B. Submit Shop Drawings and descriptive literature in accordance with Section 013300. Submit the following within seven (7) calendar days of receipt of purchase order:
 - 1. Layout drawings including all proposed system components with dimensions, clearances required and sizes indicated and total weights of the equipment with off-loading instructions.
 - 2. Detailed specifications and data describing the materials of construction.
 - 3. Complete information on electric motors furnished including make and type of motor, brake horsepower and locked rotor current at full voltage.
 - 4. Complete electrical wiring diagrams and data on controls to be furnished.
 - 5. Pump performance curves.
 - 6. Complete installation instructions, with dimensional drawings, points of electrical and plumbing connection requirements clearly shown in Field Installation Assembly drawings.
- C. Submit Operation and Maintenance Data in accordance with Section 013300 within forty-five (45) calendar days of receipt of purchase order.

1.03 QUALITY ASSURANCE

- A. The manufacturer shall have dissolved air flotation units of the type specified herein successfully operating on algae removal applications for a minimum of five (5) years in the USA.
- B. In lieu of the specific experience requirement listed in 1.3 A, furnish a performance bond in the name of the Owner in the amount of 150% of the dissolved air flotation equipment cost to provide for replacement of the equipment if necessary within the first five (5) years of operation.
- C. Compliance with the performance requirements of the specifications shall not relieve the vendor of his responsibilities of supplying equipment having the specified structural, mechanical, corrosion resistance and operational features.
- D. All electrical equipment and materials specified herein shall be approved by Underwriters Laboratories (UL) for the purpose for which they are used and shall bear the UL label. Labels from other electrical testing laboratories will be acceptable if approved by the local electrical inspection authority.

1.04 WARRANTY

- A. Guarantee the equipment against defects in material and workmanship under normal use and service for a period of one (1) year after start up not to exceed eighteen (18) months after shipment during which time repairs or replacements are to be made without charge.
- B. Further, provide an additional four (4) year warranty (total of five (5) years) for the dissolved air flotation vessels and their coatings, the CSTRs and their coatings and the aeration systems and their coatings.

1.05 COORDINATION

- A. Provide at least one (1) calendar weeks' notice prior to equipment installation to the Owner and Engineer.
- B. Provide at least two (2) calendar weeks' notice prior to manufacturer training.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Protect all equipment during delivery and during storage on site. Store equipment on suitable blocking to maintain parts clear of the ground and cover to insure drainage of all rainwater

PART 2 - PRODUCTS

2.01 DISSOLVED AIR FLOATATION

- A. Manufacturers:
1. Sulzer Chemtech USA Inc. dba as FRC Systems International
 2. Or approved equal
- a. Specifications and equipment arrangements for DAF system are based on Sulzer Chemtech USA Inc. dba as FRC Systems International. Changes to the arrangement indicated in the specifications and in the plan set or any redesign required from the Engineer shall be at the expense of the installing Contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.
- B. Schedule
1. DAF16001
 2. DAF26001
- C. General
1. The manufacturer shall supply two (2) complete working dissolved air floatation systems including all integral piping, wiring, instrumentation, controls and related accessories for the process specified herein and identified in the plans.
 2. Air compressor shall be provided by the DAF manufacturer with air quality adequate for the use as required. Type and grade: S (single component) and P (pourable).
- D. Performance and Design Requirements
1. The dissolved air floatation (DAF) system shall be a high-rate separator system with plate packs for dissolved air assisted separation of free and/or flocculated solids.
 2. Design Requirements:
 - a. Maximum flow rate (per unit): 150 gpm
 - b. Maximum influent Turbidity concentration: 100 NTU
 - c. Hydraulic loading rate shall not exceed 1 gpm/ft² of effective separation area. The recycle flow rate shall be included in the total loading rate of 1 gpm/ft².
 - d. Effective separation area: ≥ 250 ft²
 - e. Solids loading rate: 2.5 lb/ft² /hr (max)
 - f. Recycle flow rate (min): 44 gpm

- g. Compressed air requirement for each DAF: Approx. 1 SCFM at 100 psi
- 3. The system package shall include the DAF unit, the CSTR, instrumentation, pneumatic control panels, control system and spare parts with ancillary equipment and features as specified in the following paragraphs.

E. Dissolved Air Floatation Unit

- 1. Each vessel shall be constructed of 304 stainless steel, with approximate overall dimensions of 10 ft long by 8 ft wide by 12 ft high. Units having other dimensions will be considered but may not fit within the available space.
- 2. Vessel shall be constructed in accordance with the following:
 - a. Minimum 30 ft² of free surface area.
 - b. Full surface skimming system with skimmer blades.
 - c. Bottom settled solids removal system.
 - d. Manually adjustable effluent weirs.
 - e. Stainless steel plate pack system
- 3. An aeration system shall be provided for each DAF system. The aeration system shall recycle water from the effluent compartment of the DAF unit to the inclined air dissolving tube.
- 4. Furnish with a pneumatic control panel for each DAF unit with pressure switches, air flow solenoid valves and pressure gauges for monitoring and control of air to the system.
- 5. Provide a dedicated equipment control panel for each DAF with operator interface terminal (OIT)

F. Aeration System

- 1. Each aeration system shall be a complete functioning system with two (2) ANSI type centrifugal recirculation pumps with flexible-coupled motors, air dissolving mechanism, aeration header, valves and appurtenances. Pumps shall be furnished as one (1) operating and one (1) standby for each aeration system. No narrow tolerance pumps shall be allowed nor aspirating pumps with air dissolving capability. The recirculation pumps shall increase the water pressure to approximately 90 psig.
- 2. Each recycle pump shall be 10 hp (max).
- 3. Compressed air shall be introduced into the recycle water stream in the air dissolving tube and the air saturated recycle water shall be distributed to various points within the DAF unit. The air pressure shall be 7-10 psig greater than the pressure of the water in the recycle stream.
 - a. Air shall dissolve into the recycle water stream over the entire length of the air dissolving tube.

- b. Air flow meters and adjusting valves shall be provided in the pneumatic panel for each DAF unit to allow for regulation of the air volume metered into the air dissolving tube.
- c. The recycle water, saturated with air, shall be dosed through the aeration header to strategic points within the DAF unit, including the wastewater inlet to the unit and the final bays near the skim ramp. The recycle water dosing system shall be designed to provide sufficient air bubbles to provide buoyancy to the floc and to create an air cushion below the float mat.
- d. Depressurization shall occur through specifically designed inlet devices resulting in fine air bubbles to adhere and carry very small to large particulate contaminants upward to the float mat.

G. Skimming And Grit/Sludge Collection and Removal System

- 1. Each DAF unit shall have a float dewatering/skimming system (SC16005, SC26005) with adjustable outlet weirs for regulating the solids content of the skimmed material.
 - a. The adjustable outlet weirs shall be located downstream of a retention baffle which holds the float mat within the dewatering zone.
 - b. A grid thickening system shall be provided above the inclined plate pack to allow for thickening or partial dewatering of the scum mat before it is taken off by the skimmer blades.
 - c. A scraper system consisting of skimmer blades on a chain assembly shall be provided to continuously or intermittently remove the thickened float. An adjustable timer shall be provided to allow the float mat to build and thicken or dewater between scraping cycles if continuous operation does not provide a satisfactory solids concentration.
 - d. Skimmer drive shall be rated 1 HP and TEFC 460V/60Hz/3-Phase.
- 2. Each DAF unit shall be provided with a bottom and grit collection/removal system. The grit collection/removal system shall be located at the base of the influent compartment.

H. CSTR

- 1. Materials of construction shall be stainless steel.
- 2. CSTR tank to be dual-chambered with each chamber having a minimum volume of 3,000 gallons.
- 3. Furnish CSTR complete with inlet flange, outlet flange, drain, and two (2) reactor tank mixers rated at 2 HP.

I. Accessories

- 1. The DAF system shall include all required accessories necessary for operation including but not limited to the following:

- a. Pneumatic panels, valves and related appurtenances for integral air service
 - b. Aeration system plumbing
 - c. Applicable pressure indicators
 - d. E-stops
- J. Local Control Panel
- 1. Provide a single equipment control panel for automatic or manual operation of both DAFs. Control panel shall be designed for mounting near the DAFs.
 - 2. Each control panel shall be a NEMA 4 painted steel enclosure complete with the following components:
 - a. Main panel electrical disconnect rated per the NEC.
 - b. Terminal blocks for all field wiring to instrumentation, control devices and pressurization system.
 - c. Wire management system for internal panel wiring.
 - d. Audible alarm horn (piezo type).
 - e. Control transformer and circuit breakers as required.
 - f. Programmable logic controller to control the flight speed, operational cycle times, equipment control valves, pressurization pumps, chemical feed pumps, etc. PLC shall be an Allen Bradley / Rockwell Compactlogix with Ethernet communication capability.
 - g. Each PLC output including pilot lights must be individually fused if not individually fused on the output card of module.
 - h. Operator Interface Terminal (OIT) in the face of control panel door – Allen Bradley Panelview with Ethernet communication capability (10" screen, 128MB of memory minimum).
 - i. Provide Ethernet switch in the panel to allow for remote Ethernet communications to main SCADA PLC and to allow access via laptop to locally modify program as required.
 - j. Provide, as required, control transformer(s), properly sized for the application.
 - 3. The local electrical control panel OIT shall be set to provide graphical screens depicting the following information, alarms, control functions:
 - a. Main Operations Screen for DAFs:
 - i. Start/stop control of DAFs & Pressurization System
 - ii. Adjustment of time cycle for skimmer
 - iii. Chemical feed rate into each DAF
 - iv. Run indication status of skimmers, chemical feed pumps, and other ancillary equipment for each DAF
 - v. General system alarm indication for each DAF.
 - b. Alarm Screen
 - i. Alarm and horn acknowledge/reset
 - ii. Recirculation water pressure low
 - iii. Low air pressure
 - iv. Skimmer stopped fault for each

4. Scope of supply shall include any and all components, accessory devices, valves and controls required for a complete and functional installation.
- K. Surface Protection
1. Provide completely corrosion resistant materials of construction (stainless steel) and protective coatings and coverings such that shop or field applied paint coating is not required.
 2. Provide completely corrosion resistant miscellaneous parts such as brackets, spacers, guards, etc. fabricated from type 304 stainless steel.
 3. Provide items such as motors, gear reducers, pumps, air compressors, etc. with standard manufacturer's finish coatings

PART 3 - EXECUTION

3.01 FACTORY ACCEPTANCE TEST

- A. The factory acceptance test shall include tank and piping leakage tests, motor voltage and rotation checks and complete testing of control function.

3.02 INSTALLATION

- A. Installation to be performed according to manufacturer instructions.
- B. Install the dissolved air flotation system in accordance with the contract drawings, shop drawings and the manufacturers' field service and installation manual.
- C. Include the recommended oil and grease for the first twelve (12) months of operation.
- D. Nameplates, plant equipment identification and maintenance direction signs must be clearly visible after finish painting. Apply manufacture supplied warning and maintenance instructions in conspicuous locations.

3.03 DEMONSTRATION AND START-UP

- A. The services of a factory trained engineer/technician shall be provided to supervise the installation of the equipment, test the equipment, supervise the initial operation of the treatment system, demonstrate the performance of the equipment, and to instruct the Owner's personnel in the operation of the equipment. Factory services shall include three (3) 8 hour days on-site during installation, start-up and performance demonstration.
- B. Prior to plant startup, all installed equipment shall be inspected for proper alignment, proper connection and satisfactory performance.

- C. The equipment manufacturer shall make all initial adjustments to the equipment and shall operate the equipment continuously for seventy-two (72) hours, to demonstrate that the system performs its intended functions. During this performance period, no less than four (4) representative samples per day shall be tested for effluent solids concentration. Solids feed rates and chemical consumption shall be recorded.

3.04 OPERATOR TRAINING

- A. At least one (1) training session of six (6) hours in length shall be arranged to instruct the Owner's personnel in the operation and maintenance of the system. Training of the Owner's personnel shall be done by an experienced factory engineer. Training shall include a hands-on demonstration of all aspects of the operation and a simulation of all control and alarm functions.
- B. Owner can request additional training as needed.

3.05 CLEANING

- A. Remove all dirt and markings from equipment.

END OF SECTION 11500