UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2017
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SECTION 43 32 69

CHEMICAL FEED SYSTEMS

04/06

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USACE / NAVFAC / AFCEC / NASA | **UFGS-43 32 69 (April 2006)**

Preparing Activity: USACE | **Superseding UFGS-43 32 69 (April 2005)**

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SECTION 43 32 69

CHEMICAL FEED SYSTEMS
04/06

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NOTE: This guide specification covers the requirements for chemicals and controlled volume pumps and appurtenances.

Adhere to UFC 1-300-02 **Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.**

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR)**.**

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1/Z129.1	(2010) Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B201	(2013) Soda Ash
AWWA B300	(2010; Addenda 2011) Hypochlorites
AWWA B302	(2016) Ammonium Sulfate
AWWA B303	(2010) Sodium Chlorite
AWWA B402	(2012) Ferrous Sulfate
AWWA B403	(2016) Aluminum Sulfate - Liquid, Ground, or Lump
AWWA B404	(2014) Liquid Sodium Silicate
AWWA B405	(2016) Sodium Aluminate
AWWA B406	(2014) Ferric Sulfate
AWWA B407	(2012) Liquid Ferric Chloride
AWWA B408	(2010) Liquid Polyaluminum Chloride
AWWA B451	(2016) Poly(Diallyldimethylammonium Chloride)
AWWA B452	(2014) EPI-DMA Polyamines
AWWA B453	(2013) Polyacrylomide
AWWA B501	(2013) Sodium Hydroxide (Caustic Soda)
AWWA B502	(2011) Sodium Polyphosphate, Glassy (Sodium Hexametaphosphate)
AWWA B503	(2011) Sodium Tripolyphosphate
AWWA B504	(2012) Monosodium Phosphate, Anhydrous
AWWA B505	(2012) Disodium Phosphate, Anhydrous
AWWA B511	(2010) Standard for Potassium Hydroxide

AWWA B550	(2010) Standard for Calcium Chloride
AWWA B600	(2016) Powdered Activated Carbon
AWWA B601	(2011) Sodium Metabisulfite
AWWA B602	(2008) Copper Sulfate
AWWA B603	(2016) Permanganates
AWWA B701	(2011) Sodium Fluoride
AWWA B702	(2011) Sodium Fluorosilicate
AWWA B703	(2011) Fluorosilicic Acid

ASME INTERNATIONAL (ASME)

ASME A13.1	(2015) Scheme for the Identification of Piping Systems
ASME B16.1	(2015) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.11	(2011) Forged Fittings, Socket-Welding and Threaded
ASME B16.5	(2013) Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard

ASTM INTERNATIONAL (ASTM)

ASTM D1785	(2012) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D1998	(2013) Polyethylene Upright Storage Tanks
ASTM D3299	(2010) Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM D5421	(2015) Contact Molded "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
ASTM E1067/E1067M	(2011) Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels
ASTM F441/F441M	(2013; E 2013) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

HYDRAULIC INSTITUTE (HI)

HI 7.1-7.5	(2006) Controlled Volume Metering Pumps

HI 9.1-9.5	(2000) Pumps - General Guidelines for Types, Applications, Definitions, Sound Measurements and Documentation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 37	(2015) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(2017) National Electrical Code

NSF INTERNATIONAL (NSF)

NSF/ANSI 60	(2016) Drinking Water Treatment Chemicals - Health Effects

PLUMBING-HEATING-COOLING CONTRACTORS ASSOCIATION (PHCC)

NAPHCC NSPC	(2009) National Standard Plumbing Code

UNDERWRITERS LABORATORIES (UL)

UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations

1.2 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G"

designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Use the "S" classification only in SD-11 Closeout Submittals. The "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G[, [_____]]

SD-03 Product Data

Chemical Feed System; G[, [_____]]

Material Safety Data Sheets

Framed Instructions

Auxiliary Equipment and Spare Parts

SD-06 Test Reports

Factory Test Report

Field Testing

SD-07 Certificates

Chemicals

SD-10 Operation and Maintenance Data

Operating Instructions; G[, [_____]]

Maintenance Instructions; G[, [_____]]

1.3 DELIVERY, STORAGE, AND HANDLING

Protect material and equipment delivered and placed in storage from the weather, excessive humidity and excessive temperature variation, dirt, dust, or other contaminants.

1.4 EXTRA MATERIALS

****

NOTE: Include items needed for future maintenance and repair, items that might be difficult to obtain because of color or pattern match, or spare parts needed to ensure continued operation of critical equipment.

****

Concurrent with delivery and installation of the specified equipment, furnish auxiliary equipment and spare parts as follows:

a. Spare parts for each different item of material and equipment specified including all of the parts recommended by the manufacturer to be replaced after [1] [and] [3] [year] [years] service.

b. For each machine: one extra of each part used that is made from glass, hard rubber, or clear plastic; one extra set of solution-hose connections; one extra set of diaphragms, two filler plug seal washers; two ball checks; two seats; two complete sets of all gaskets; one spare diaphragm for each back pressure regulator; one hydraulic plunger assembly for each different size metering pump; one of each type of material back pressure regulator, with three spare springs and fluorocarbon resin diaphragms for each; one spare diaphragm and air valve for pulsation dampener.

c. For each different size of direct current motor one SCR circuit board with 12 drive motor fuses and 12 SCR controller fuses; overload replacement elements for each size and type of motor.

d. One set of special tools for each type of equipment including calibration devices, and instruments required for adjustment, calibration, disassembly, operation, and maintenance of the equipment.

e. One residual-chlorine comparator employing permanent color standards and 13- or 26-millimeter viewing depth sample tubes, with corrosion-resistant case, color disk reading from 0.0 to 1 part per million, and sufficient DPD tablets for 100 tests.

f. Two pairs of safety goggles and/or face shields, two chemical resistant aprons, and two pairs of chemical resistant gloves in one or more wall mounted steel cases.

g. One assembly tool for tubular diaphragm.

h. One lever type grease gun or other lubricating device for each type of grease required.

i. One or more steel tool cases mounted on the wall in a convenient location complete with flat key locks, two keys, and clips or hooks to

hold each special tool.[

j. [_____].]

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a chemical feed system consisting of a chemical supply storage tank from which the chemical solution is pumped through piping or tubing, as appropriate, to the point of application. Include with each chemical feed system controlled volume pumps, tanks, mixers, gauges, back pressure regulators, strainers, pressure relief valves, sight glasses and flow metering devices, check valves, and hand valves.

2.1.1 Design Requirements

Design and fabrication the pumps in accordance with HI 7.1-7.5 and HI 9.1-9.5 except as modified herein. Provide pump stands and platforms adequate to support the pumping system.

2.1.2 Performance Requirements

Capacity and design of the chemical feed systems and accessories must be suitable for 24-hour full load service in ambient, non-freezing conditions.

2.1.3 Submittal Data

Submit manufacturer's performance charts, and pump curves. List of materials, list of equipment, including a complete list of parts and supplies with current unit prices and source of supply. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.

2.2 MATERIALS AND EQUIPMENT

****
NOTE: Review the materials recommendations of EM 1110-1-4008 Liquid Process Piping, Appendix B.
****

2.2.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment must be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2.2 Nameplates

Each major item of equipment must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.3 CHEMICALS

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NOTE: Consider the environmental consequences of each chemical, including disposal of precipitated solids and other wastes. Chemicals need not be required to meet AWWA or NSF specifications for waste water applications, use other available industrial/commercial standards.

****

Submit Material Safety Data Sheets in conformance with ANSI Z400.1/Z129.1 for each chemical. Provide a [30] [90] [_____] day supply at the maximum pumping rate for each feeder or pair of duplexed feeders. Submit [two] [_____] copies of certification stating that each chemical supplied meets the following requirements.

2.3.1 Acids

Hydrochloric (muratic acid), sulphuric (sulfuric acid).

2.3.2 Adsorption Agents

AWWA B600 powdered activated carbon.

2.3.3 Bases

AWWA B501 caustic soda, AWWA B511 potassium hydroxide, AWWA B201 soda ash (sodium carbonate).

2.3.4 Biocides

Glutaraldehyde; Tolcide(R); AWWA B602 copper sulfate.

2.3.5 Coagulant Aids

Anionic polyelectrolytes, cationic polyelectrolytes.

2.3.6 Disinfecting Agents

AWWA B302 ammonium sulfate, AWWA B300 hypochlorites.

2.3.7 Miscellaneous

AWWA B451 poly(diallyldimethylammonium chloride), AWWA B452 EPI-DMA polyamines, AWWA B453 polyacrylamide, AWWA B550 calcium chloride, AWWA B405 sodium aluminate, AWWA B601 sodium metabisulfite (Sodium Pyrosulfite), AWWA B303 sodium chlorite, AWWA B404 liquid sodium silicate, AWWA B504 monosodium phosphate, anhydrous, AWWA B408 polyaluminum chloride, AWWA B505 disodium phosphate, anhydrous.

2.3.8 Oxidants

[50] [35] [_____] percent NSF/ANSI 60 hydrogen peroxide solution, AWWA B603 potassium permanganate [potassium permanganate may be supplied in powder form for onsite preparation] at the discretion of the Contracting Officer.

2.3.9 Precipitants

[_____].

2.3.10 Primary Coagulants

AWWA B403 aluminum sulfate, AWWA B407 liquid ferric chloride, AWWA B406 ferric sulfate, AWWA B402 ferrous sulfate.

2.3.11 Prophylaxis

AWWA B703 hydrofluosilicic acid, AWWA B701 sodium fluoride, AWWA B702 sodium silicofluoride.

2.3.12 Sequestrants

AWWA B502 sodium polyphosphate, glassy (sodium hexametaphosphate), AWWA B503 sodium tripolyphosphate.

2.4 CONTROLLED VOLUME PUMPS

****

NOTE: See HI 7.1-7.5 to determine the optimum type of metering pumps with capacities between 0.04 liters per hour 0.011 gph and 10,000 liters per hour 2500 gph. Materials for each pump shall be as recommended in Table 9.3 of HI 9.1-9.5 for the material to be pumped. If the system backpressure is not at least 5 psi 0.35 bar greater than the suction pressure, a backpressure valve must be installed in the discharge piping to prevent flowthrough (downhill pumping) which contributes to pump failure and undesired flow at pump shutdown. System backpressure must not exceed the rated discharge pressure of the pump.

****

Provide controlled volume pumps as defined by HI 7.1-7.5. Each pump must be capable of delivering chemical solution at any rate from the minimum flow rate to the maximum flow rate and must be capable of continuous operation at rated capacity. Accuracy must be plus or minus 2 percent over a 100 to 1 range from the required maximum capacity to the minimum pumping rate. Net positive suction head required cannot exceed 90 percent of the net positive suction head available, as installed. Provide in a configuration as simple as practicable to provide equipment isolation, bypass and reliable service and to be readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

2.4.1 Acid Feed System

Provide the following for [hydrochloric] [sulfuric] [_____] acid solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.2 Adsorption Agent Feed Systems

Provide the following for [powdered activated carbon] [_____] slurry delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.3 Base Feed System

Provide the following for [sodium carbonate (soda ash)] [sodium hydroxide (caustic soda)] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.4 Biocide Feed System

Provide the following for [copper sulfate] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.5 Coagulant Aid Feed System

Provide the following for [polyelectrolyte] [_____] [solution] [slurry] delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.6 Disinfecting Agent Feed Systems

Provide the following for [ammonium sulfate] [hypochlorite] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.7 Miscellaneous Feed System

Provide the following for [poly(diallyldimethylammonium chloride)] [calcium chloride] [sodium aluminate] [sodium metabisulfite (sodium pyrosulfite)] [sodium chlorite] [sodium silicate] [monosodium phosphate] [disodium phosphate] [_____] [solution] [slurry] delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.8 Oxidant Feed System

Provide the following for [potassium permanganate] [hydrogen peroxide] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.9 Precipitant Feed System

Provide the following for [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.10 Primary Coagulant Feed System

Provide the following for [aluminum sulfate] [ferric chloride] [ferric sulfate] [ferrous sulfate] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl

chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.11 Prophylaxis Feed System

Provide the following for [hydrofluosilicic acid] [sodium fluoride] [sodium silicofluoride] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.4.12 Sequestrant Feed Systems

Provide the following for [sodium polyphosphate, glassy (sodium hexametaphosphate)] [sodium tripolyphosphate] [_____] solution delivery.

a. Concentration: Minimum [_____] percent; maximum [_____] percent.

b. Number of pumps: [_____].

c. Type of pump: [Packed plunger] [Packed piston] [Mechanically or hydraulically coupled diaphragm].

d. Configuration: [Simplex] [Duplex] [Multiplex].

e. Controls: [Automatic] [Semiautomatic] [Manual] rate adjustment.

f. Feed/flow rate: Minimum [_____] L/hour gph; maximum [_____] L/hour gph.

g. Back pressure at point of injection: [_____] kPa psig. Install back pressure regulating valve on the pump discharge and factory adjust to crack open at [_____] kPa psig. Regulators must be of [polyvinyl chloride] [or] [_____] construction with [fluorocarbon resin] [or] [chlorosulphonated polyethylene] diaphragms.

h. Suction valve cartridge: [Single] [Double] [Slurry type] ball check.

i. Discharge valve cartridge: [Single] [Double] [Slurry type] ball check.

j. Materials of construction allowed for wetted parts: [Type [304L] [316] [316L] stainless steel,] [PVC,] [hypalon] [nylon,] [fluorocarbon resin,] [chlorosulfonated polyethylene,] [hard rubber,] [_____].

2.5 CONTROLS

****
NOTE: Proportional control is appropriate for variable flow systems. Batch systems should have manual, pH, ORP, or timer control. Constant pumping rate systems should respond to pump operation or a flow switch, if the pumps are remote from the feed system.
****

Provide the chemical metering equipment with the appurtenances and accessories, as required, for flow capacity adjustment. Provide manual range adjustment on all systems.

2.5.1 Automatic Control

Automatic control must have the capability to vary feed rate based on signals from a [flow], [oxidation-reduction potential (ORP)], [or] [pH] meter or controller.

2.5.1.1 Flow meter and Controller

Vary the chemical dosage in proportion to the measured flow with the dosage per flow unit manually adjustable.

2.5.1.2 Oxidation-Reduction Potential Probe

Locate the oxidation-reduction potential probe where indicated. Chemical feed rate must be variable in response to the deviation from set point.

2.5.1.3 pH Probe

Locate the pH probe where indicated. Chemical feed rate must be variable in response to the deviation from set point.

2.5.2 Semiautomatic Control

Semiautomatic control must have the capability to automatically start and stop the chemical metering equipments. The pump start and stop must respond to [flow switch] [or] [pump operation] [or] [timer] status. Install flow switch for semiautomatic operation in the pipe line upstream of chemical injectors.

2.5.3 Manual Control

Nonautomatic control must have the capability for starting or stopping the chemical metering equipment and adjustment of the solution feed rate by the operator. Provide semicontinuous operation for where intermittent dosages may be desired (for example control of biocide addition where periodic (shock) treatment is sufficient or preferred).

2.6 DRIVES FOR CONTROLLED VOLUME PUMPS

****
NOTE: Alternating current motors are preferred where a reliable power supply is accessible. Water power drives are feasible only when the take off can be located at a point with significantly higher pressure than the injection pressure.
****

Provide with and drive the metering pumps by [water pressure] [alternating current electric motor] [direct current electric motor] [plant air] [gasoline engine] drives.

2.6.1 Water Pressure Drive

Provide appropriate pressure regulation devices for water pressure drives operated off system water pressures.

2.6.2 Electric Motor Drive

Electric motor must be of sufficient capacity to operate the chemical metering equipment under all operating conditions without exceeding their rated nameplate current or power, or their specified temperature limits. Provide motors having starting characteristics and ruggedness necessary under the actual conditions of operations or clean-up procedures used in the areas where they will be located. Alternating current motors with power rating of 248.6 W 1/3 hp or less must be 115 volts, single-phase, 60-Hz service; motors with power rating in excess of 248.6 W 1/3 hp must be 460 volts, three-phase, 60-Hz service. Electrical features of direct current motors, including the ratings of the motors, must be compatible with the capabilities and ratings of the rectifier controllers with which they are used.

2.6.3 Gasoline Engine Drive

Gasoline engines must develop sufficient horsepower to operate the chemical metering equipment continuously under the maximum operation conditions without overheating or overloading when operating at a speed not to exceed [_____] rpm. Provide 4-cycle, vertical, single cylinder, high tension magneto, air cooled type engines. Connect the engine to the pump or mechanical device by V-belts that are fully guarded.

2.7 CALIBRATION STANDPIPES

Provide chemical metering equipment with a calibration standpipe for measuring pump output. The standpipe must allow convenient observation of the change of fluid level for at least 1/2 minute at full stroke and maximum speed settings, and of Schedule 80, clear PVC pipe conforming to ASTM D1785 with Schedule 80 fittings equipped with a flanged connection to

the pump manifold and an end cap fitted with a PVC vacuum breaker and ball valve for air venting. The standpipe mustl have a clear, observable length of at least [300 mm 12 inches] [_____] and be permanently calibrated in liters gallons and fractions thereof, to allow reading of the fluid contents with an accuracy of [1] [_____] percent.

2.8 VALVES

2.8.1 Metering Pump Valves

Equip the metering pump with adjustable internal vacuum and pressure relief valve, hydraulic oil refill valve, and automatic air bleed valve. The relief valve must be adjustable over the full pressure range of the pump and preset at the factory.

2.8.2 Suction and Discharge Valves

Fit suction and discharge valve cartridges with ball checks that open to full pipe diameter.

2.8.3 Back Pressure Valve

Install back pressure regulating valve on the pump discharge and factory adjust to crack open at the indicated pressure. Diaphragms must be spring opposed with loading pressures adjustable by means of a screw in the top works.

2.8.4 Pulsation Dampeners

****

NOTE: The pulsation dampener should always be installed as close to the pumps as possible in order to reduce the length of pipe in which pulsating flow occurs. A pulsation dampener is a pneumatically charged diaphragm within a chamber that stores energy carried in the acceleration of the pumped fluid. On the discharge side it will protect sensitive equipment from pulsating flow spikes, and will translate pulsating flow to near linear flow by reducing the peak flow and pressure generated by the metering pump. When a pulsating dampener is used on the suction side of a metering pump, it will improve suction pressure conditions by reducing pressure losses associated with the acceleration of the fluid.

****

Size pulsation dampeners for the displacement of each pump. Pulsation dampeners must have a diaphragm separating the upper chamber from the lower chamber. Charge the upper chamber with compressed air to 50 percent of the expected line pressure. The diaphragm must be of molded construction and prevent the air charge from being dissolved in the process fluid. The lower chamber must be [plastic] [or] [lined with inert plastic material] to prevent corrosion by the process fluid. Equip the upper chamber with a tire valve type charging valve and air pressure gauge. Provide an air line and air hose with pressure regulator and hand-operated, lever-type valve suitable for charging the pulsation dampers.

2.9 SOLUTION TANKS

Tanks must be fully resistant to the effects of the full-strength and fully diluted solution concentrations, and be pressure rated for 1.5 times the weight of solution at full capacity. Each tank must have the capacity listed and be equipped with a fill nozzle, vent, discharge, level instrument, drain, and two spare connections. Tanks must be reinforced to withstand all forces when full of solution. Tanks must be completely shop fabricated with no field assembly permitted. Drain connections must provide complete drainage of the tank. All gaskets must be fluorocarbon elastomer; nuts and bolts Type 316 stainless steel; and steel supports either stainless or epoxy coated. Furnish each tank with a calibrated side wall strip to indicate volume. Attach a permanent plastic sign indicating the tank contents to the front of each tank. Fit tanks smaller than 900 mm 36 inches in diameter with removable lids. Fit tanks larger than 900 mm 36 inches in diameter with 600 mm 24 inch manways. Manufacture polyethylene tanks in accordance with ASTM D1998. Manufacture fiberglass tanks in accordance with ASTM D3299 with flanged openings in accordance with ASTM D5421. Line steel tanks with [ceramic], [rubber] or [plastic], as indicated herein. Tanks designated to be double walled or provided with secondary containment must be provided with containment separate from the containment provided for other tanks to prevent reaction within the contained area. Provide dissolving baskets and tank mixers as indicated and size to provide initial mixing and maintain suspensions. Provide floating seals as indicated.

2.9.1 Acid Tank

Tank must be [hydrochloric] [sulfuric] acid solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: "DANGER - [HYDROCHLORIC] [SULFURIC] ACID SOLUTION."

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.2 Adsorption Agent Tank

Tank must be [powdered activated carbon] [_____] slurry resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.3 Base Tank

Tank must be [sodium hydroxide (caustic soda)] [_____] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: "DANGER - ALKALI (SODIUM HYDROXIDE) SOLUTION."

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.4 Biocide Tank

Tank must be [copper sulfate] [Tolcide(R)] [Glutaraldehyde] [_____] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.5 Coagulant Aid Tank

****
NOTE: Polyelectrolytes degrade with storage.
****

Tank must be [polyelectrolyte] [_____] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: "CAUTION - [POLYELECTROLYTE SOLUTION - SLIP HAZARD] [_____]."

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.6 Disinfecting Agent Tank

Tank must be [ammonium sulfate] [hypochlorite] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: "[_____]."

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.7 Miscellaneous Tanks

Tanks must be [poly(diallyldimethylammonium chloride)] [calcium chloride] [sodium aluminate] [sodium metabisulfite (sodium pyrosulfite)] [sodium chlorite] [sodium silicate] [monosodium phosphate] [disodium phosphate] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.8 Oxidant Tank

Tank must be [hydrogen peroxide] [potassium permanganate] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: ["DANGER - STRONG OXIDIZER"] [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.9 Precipitant Tank

Tank must be [_____] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.10 Primary Coagulant Tank

Tank must be [aluminum sulfate] [ferric chloride] [ferric sulfate] [ferrous sulfate] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.11 Prophylaxis Tank

Tank must be [hydrofluosilicic acid] [sodium fluoride] [sodium silicofluoride] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: [_____].

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.9.12 Sequestrant Tank

****
NOTE: Polyelectrolytes degrade with storage.
****

Tank must be [sodium polyphosphate, glassy (sodium hexametaphosphate)] [sodium tripolyphosphate] solution resistant and comply with the following:

a. Number of tanks: [_____].

b. Minimum tank capacity: [_____] liters gal.

c. Sign shall read: "CAUTION - [SODIUM HEXAMETAPHOSPHATE] [SODIUM TRIPOLYPHOSPHATE] SOLUTION - SLIP HAZARD."

d. Mixer: [Constant] [Variable] speed [_____] rpm, maximum.

e. Dissolving basket: [_____].

f. Floating seal: [_____].

g. Containment: Double wall/secondary containment.

2.10 PRESSURE GAUGES

Gauges must be diaphragm type with Bourdon tube and diaphragm compartments filled completely with oil, and made of materials suitable for the application. Install diaphragm seals at each gauge connection to isolate gauges from corrosion, sludge or other hazards of the process fluid. Seal material must be compatible with the oil in the gauge and the process fluid.

2.11 INJECTORS

Introduce injectors for chemical solution into the pipeline mains by means of a [hard rubber] [or] [plastic] injection nozzle, or by means of a suitable diffuser tube inserted through a corporation cock. Construct the device for introducing the solution into a pressure main in such a way that accidental breakage of discharge hose or tubing will not cause water to escape from the pipeline, and allows disassembling of the unit without leakage.

2.12 PIPING

2.12.1 Backflow Preventer

Provide backflow prevention devices or air gaps on tank fill lines in accordance with NAPHCC NSPC.

2.12.2 Chemical Solution Piping

****
NOTE: Select materials in accordance with EM 1110-1-4008 Liquid Process Piping.

****

Incorporate provisions to allow solution piping to be conveniently and safely bled of trapped air and minimize infiltration of air bubbles. Chemical solution piping must be in accordance with Section 40 05 13 PIPELINES, LIQUID PROCESS PIPING.

2.12.2.1 Smaller than 40 mm 1-1/2 inch Diameter

Chemical solution piping smaller than 40 mm 1-1/2 inch diameter must be [PVC pipe conforming to ASTM D1785 or CPVC pipe conforming to ASTM F441/F441M] [[_____] tubing] [or] [rubber hose]. Fittings for plastic pipe must be of plastic with [flanged] [or] [threaded] joints. Joints for rubber hose must be made using a clamp-type mechanical coupling.

2.12.2.2 Piping 40 mm 1-1/2 inch Diameter or Greater

Chemical solution piping of 40 mm 1-1/2 inch diameter or larger must be [rubber-lined] [or] [plastic-lined] steel pipe. Steel pipe must have [threads] [or] [flanges integral with the pipe] [or] [forged-steel flanges screwed to the pipe barrel].

2.12.3 Pipe Lining

Linings for steel pipe smaller than 150 mm 6 inches must be not less than 4.8 mm 3/16 inch thick. Linings must be continuous and free of holidays.

2.12.4 Pipe Fittings

Pipe fittings for steel pipe must be [flanged conforming to ASME B16.1or ASME B16.5] [or] [forged-steel threaded conforming to ASME B16.11].

2.12.5 Plumbing

Provide water piping, drain, waste and vent piping in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.13 ELECTRICAL WORK

****

NOTE: Coordinate hazard areas with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and the drawings.

****

Provide electric motor-driven equipment complete with motor, motor starter, and controls. Provide electrical equipment and wiring in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Implement hazard classifications in accordance with NFPA 70.

2.13.1 Motor Starters

Provide motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

2.13.2 Control and Protective Devices

Provide manual or automatic control and protective or signal devices required for the operation and any control wiring required for controls and devices. Motor controls must conform to NEMA ICS 1 or NEMA ICS 2. Prewire

equipment to the maximum practicable extent. Control cabinets must conform to the requirements of UL 50, NEMA 250, [Type 4,] [Type 7,] [or] [Type 12].

2.14 EQUIPMENT APPURTENANCES

Bolts, nuts, anchors, washers and all other types of supports necessary for the installation of the equipment must be galvanized steel, cadmium plated or Type 316 stainless steel.

2.15 FACTORY PAINTING

Factory painting must conform to manufacturer's standard factory finish, provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Coating must be not less than 0.05 mm 1.75 mils thick.

2.16 FACTORY TEST REPORT

Factory examine fiberglass tanks in accordance with ASTM E1067/E1067M prior to shipping. Furnish a copy of the corresponding test report with each tank.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Submit detail drawings containing complete piping, wiring, schematic, flow diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings must show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for installation, maintenance and operation.

3.2.1 Chemical Feeding Equipment

Install controlled volume pumps, equipment, and appurtenances to provide a complete and integrated system in accordance with the instruction of the manufacturer and under the direct supervision of the manufacturer's representative.

3.2.2 Gasoline Engines

Install gasoline engines in accordance with NFPA 37.

3.2.3 Pipe, Tubing, Hangers and Supports

Install pipes and tubes in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.3 FIELD PAINTING

Thoroughly clean, prime and top-coat factory painted items requiring

touching up in the field with the manufacturer's standard factory finish provided it does not discolor in the presence of hydrogen sulfide fumes, high water vapor atmosphere, alkaline water vapor, and concentrated chlorine (oxidizing) conditions. Paint equipment which did not receive a factory finish as specified in Section 09 90 00 PAINTS AND COATINGS. Coating must be not less than 0.05 mm 1.75 mils thick. Provide piping identification as specified in [ASME A13.1] [Section 09 90 00 PAINTS AND COATINGS. Mark pipe carrying materials not listed in Section 09 90 00 PAINTS AND COATINGS in accordance with ASME A13.1.]

3.4 FRAMED INSTRUCTIONS

Post framed instructions, containing wiring and control diagrams, where directed. Post condensed operating instructions as specified above. Post the framed instructions before acceptance testing of the systems.

3.5 FIELD TESTING

After installation of each controlled volume pump, carry out operating tests to assure that the chemical metering installation operates properly. If any deficiencies are revealed during any tests, correct such deficiencies and reconduct the tests. Submit reports of all tests in booklet form prior to final acceptance of the installation. Show all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

3.5.1 Tanks

Clean tanks of loose debris and dry prior to testing. Field test tanks for leaks or damage in shipment. Hydrostatically test tanks to [_____] kPa psig or 1.5 times the system operating pressure, whichever is greater, to detect large leaks and then with the specified chemical to detect small leaks. Test tanks with each solution for a period of 24 hours at which time no visible leakage is evident. Supply all pipes, hoses, pumps, water, power and other equipment required to convey the test liquids and to carry out the tests. Repair damage or leaks in tanks or replace tanks. Replace damaged ceramic tanks.

3.5.2 Controlled Volume Pumps

Test pumps to demonstrate that the pumps are capable of operating without vibration or leakage. Perform testing at the maximum design flow rate and at half the design flow rate. Demonstrate testing while controlled and operated in all feasible modes with the pumps operated singly and in unison. Plot the response of each pump on curves for the various operating pressures encountered and the results compare to the curves shown on the manufacturer's published pump data. If control characteristic curves are not available at the time of testing, the pump manufacturer's service engineer must generate such curves for each pump. Pump curves must graphically depict the pump displacement at 25, 50, 75, and 100 percent of motor speed for SCR equipped pumps, and at 25, 50, 75, and 100 percent of maximum stroke position for all pumps. Generate curves only for the specified back pressure.

3.5.3 Time, Volume and Pumping Pressure

Test pumps by filling [the standpipe] [a portable calibrated standpipe

furnished by the Contractor] with chemical and measuring the outage, with all other equipment valved off. Record the time, volume and pumping pressures.

3.5.4 Test Pressure

****
NOTE: To establish that full service can be provided, fill in the blank with the numerical value of the pressures that can be expected during normal operation of the system.
****

Carry out tests at [_____] and [_____] kPa psig. Back pressure valves must be manually controlled for this testing, and must be reset as necessary after testing. The time to deliver a given quantity of chemical at a given stroke and speed setting must be the same at all pressures.

3.5.5 Flow

Test pumps to demonstrate zero L/second gpm flow at a zero stroke or speed setting. Failure to meet this test is cause for rejection.

3.5.6 Synchronization

Operate the pumps for a period of 4 hours to demonstrate that the double diaphragm systems do not lose their synchronization. Loss of synchronization is also cause for rejection and the pump must be repaired or replaced as necessary. Fully retest repaired or replaced equipment.

3.5.7 Chemical Waste

****
NOTE: In selection of chemicals, consider the environmental consequences, including disposal of precipitated solids and other wastes. Select the most appropriate options and edit to fit the situation for drinking water or waste water treatment systems.
****

Neutralize chemicals wasted during testing procedures to achieve a pH value between 6.5 and 9.5 and a chlorine concentration of not more than 1 percent (10,000 mg/L). Route all chemicals wasted during testing procedures [to the sanitary sewer] [through the treatment process] at a rate that the process can assimilate without upset.

3.6 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, and testing of the equipment.

3.7 FIELD TRAINING

Conduct a field training course for designated operating, maintenance and supervisory staff members. Provide training for a total period of [_____] hours of normal working time and start after the system is functionally

complete but prior to final acceptance tests. Field training must cover all of the items contained in the Operating and Maintenance Instructions.

3.8 CLOSEOUT ACTIVITIES

3.8.1 Operating Instructions

Submit complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include in the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Also include in the instructions as-built drawings of the piping layout, equipment layout, simplified wiring and control diagrams of the system as installed, and flow diagrams.

3.8.2 Maintenance Instructions

Submit complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble-shooting guides.

-- End of Section --