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USACE / NAVFAC / AFCESA / NASA **UFGS-46 07 53.16 (February 2011)**

Preparing Activity: USACE **Superseding UFGS-44 41 13 (October 2007)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2012
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DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

SECTION 46 07 53.16

PACKAGED WASTEWATER TREATMENT EQUIPMENT, BIOCHEMICAL

02/11

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SECTION 46 07 53.16

PACKAGED WASTEWATER TREATMENT EQUIPMENT, BIOCHEMICAL
02/11

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NOTE: This guide specification covers the requirements for prefabricated biochemical wastewater treatment plants up to 380,000 L per day (100,000 gpd) capacity.

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 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 PETROLEUM INSTITUTE (API)

API Spec 6D	(2008; Errata 1 2008; Errata 2 2008; Errata 3 2009; Addendum 1 2009; Errata 4 2010; Errata 5 2010; Errata 6 2011; Addendum 2 2011) Specification for Pipeline Valves

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2011) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2009) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C200	(2005) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C206	(2011) Field Welding of Steel Water Pipe
AWWA C207	(2007) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.
AWWA C208	(2007; Errata 2009) Standard for Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C900	(2007; Errata 2008) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2010; Errata 2010) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2006) Pipe Threads, General Purpose (Inch)
ASME B1.20.2M	(2006; R 2011) Pipe Threads, 60 Deg. General Purpose (Metric)
ASME B16.1	(2010) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2011) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B31.1	(2010) Power Piping
ASME B40.100	(2005; R 2010) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2010) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D1785	(2012) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2009) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2564	(2004; R 2009e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3139	(1998; R 2011) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3308	(2006) PTFE Resin Skived Tape
ASTM E164	(2008) Ultrasonic Contact Examination of Weldments
ASTM E390	(2011) Radiographs Steel Fusion Welds

ASTM E94	(2004; R 2010) Radiographic Examination
ASTM F477	(2010) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2009) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2011) Motors and Generators

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 2009-132	(2008) Attention Emergency Responders - Guidance on Emergency Responder - Personal Protective Equipment (PPE) for Response to Chemical, Biological, Radiological, and Nuclear (CBRN) Terrorism Incidents

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10/NACE No. 2	(2007) Near-White Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

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.

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

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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.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Equipment Installation[; G][; G, [_____]]

SD-03 Product Data

Treatment Plant Construction
Spare Parts
Framed Instructions
Manufacturer's Written Instructions

SD-06 Test Reports

Testing

SD-10 Operation and Maintenance Data

Treatment Plant Installation[; G][; G, [_____]]

1.3 QUALIFICATIONS

Procedures and welders shall be qualified in accordance with the code under which the welding is specified to be accomplished.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 EXTRA MATERIALS

Submit spare parts data for each different item of equipment and material specified, after approval of the related submittals and not later than [_____] months prior to the date of beneficial occupancy. Include with the data a complete list of parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

****
NOTE: Delete either paragraph Extended Aeration Plant Design or Contact Stabilization Plant Design.
****

2.1.1 Extended Aeration Plant Design

****
NOTE: If effluent standards require a 5-day B.O.D. of less than 10 mg/L, then effluent filters are recommended. The filtration unit shall be [one] [two] [single] [dual] media filter cell(s), with backwash and backwash holding tanks, and related pumps, blowers, valves, piping, and control devices.

Insert design and peak flow rates. Comply with UFC 3-240-09FA for design flow rates. Peak flow rate should be 3 times design flow for plants up to 57,000 L per day (15,000 gpd) design flow. Peak flow should be 2.5 times design flow for plants between 57,000 L per day (15,000 gpd) and 380,000 L per day (100,000 gpd) design flow. Short term peak flow rate should be 4 times the design flow expressed as an hourly rate which does not necessarily correspond with the peak daily flow expressed in L per day (gpd). Verify percent suspended solids and BOD removal.

Provide seismic details, if a Government designer (either Corps office or A/E) is the Engineer of Record, and show on the drawings. Delete the bracketed phrase, in the last sentence, if no seismic details are provided. Pertinent portions of UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL

EQUIPMENT, properly edited, must be included in the contract documents.

****

Treatment of wastewater shall be accomplished through intimate contact with activated sludge for a minimum of 18 hours followed by gravity clarification and chemical disinfection. The treatment plant shall be sized for a design flow of [_____] L/day gpd and a peak daily flow of [_____] L/day gpd. The treatment plant shall remove a minimum of [90] [_____] percent of the suspended solids and biochemical oxygen demand (5-Day BOD) for domestic wastewater with a 5-day BOD and suspended solids concentration between [200] [_____] and [400] [_____] mg/L at a short term peak flow rate of [_____] L/hour gph. Plant design shall conform to UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown on the drawings].

2.1.1.1 Aeration Zone

The aeration zone shall be sized for a detention time of between 18 and 36 hours at the design range of flows. Minimum waste-water depth shall be [3] [_____] m [10] [_____] feet and freeboard shall be 450 mm 18 inch. Provide a [_____] mm -inch diameter influent opening, reinforced with a pipe flange or steel plate and with suitable connection for the [inlet sewer] [raw sewage pump discharge pipe]. The influent shall enter the tank slightly above the wastewater surface and as far as practicable from the effluent opening. Air diffusers shall be provided in accordance with paragraph AIR-DIFFUSION EQUIPMENT. Fillets shall be provided at the base of both long walls. A froth control spray system shall be provided in accordance with paragraph FROTH CONTROL SYSTEM. For rectangular tank air diffusers mounted [along one side] [in center of tank] the depth to width ratio shall be between 1.0:1.0 to 1.0:2.2 for good spiral roll mixing. Peripheral tanks in circular plants shall utilize diffuser mounted [along one side] [in radial pattern from inside tank wall].

2.1.1.2 Sludge-Settling Zone

The sludge-settling zone size shall be based upon a surface loading rate of not more than [12,225] [_____] L per day per square meter [300] [_____] gpd per square foot of water surface area at the average daily flow rate, and not more than [20,375] [_____] L per day per square meter [500] [_____] gpd per square foot of water surface area at the peak hourly flow rate. Minimum water depth shall be [3] [_____] m [10] [_____] feet and freeboard shall be 450 mm 18 inches. The tank bottom shall consist of one or more hoppers having side slopes of not less than 1.70 vertically to 1 horizontally. In lieu of the above, a flat bottom may be provided with a mechanical sludge scraper in accordance with paragraph SLUDGE AND SCUM RECIRCULATION EQUIPMENT. The tank influent shall be below the water surface and shall have a stilling baffle extending at least 150 mm 6 inch above and below the inlet opening. A scum baffle shall be provided at the effluent opening and extending at least 75 mm 3 inch above and 300 mm 12 inch below the water surface. Air lift sludge and scum pumps shall be provided in accordance with paragraph SLUDGE AND SCUM RECIRCULATION EQUIPMENT.

2.1.1.3 Sludge-Holding Zone

****

NOTE: Insert capacity, generally all waste sludge

produced in one week of operation.

****

The sludge-holding zone shall have a minimum capacity of [_____] cubic meters cubic feet. A supernatant draw-off connection shall be provided between the sludge-holding zone and the aeration zone. The supernatant draw-off connection shall be located above the aeration zone water level. Air diffusers shall be provided in the sludge-holding zone in accordance with paragraph AIR-DIFFUSION EQUIPMENT.

2.1.1.4 Chlorination Zone

The chlorination zone shall be designed for quiescent plug flow through the tank and to provide at least 30 minutes contact time at peak flow rate. A turbulent zone shall be provided at the tank inlet for proper chlorine solution mixing. The tank shall be baffled to promote plug flow and reduce short circuiting. Chlorination equipment shall be provided in accordance with paragraph GAS CHLORINATION SYSTEM or CALCIUM HYPOCHLORITE CHLORINATION SYSTEM. Effluent from the chlorination zone shall flow over a weir and exit the plant through a [_____] mm -inch diameter flanged pipe.

2.1.2 Contact Stabilization Plant Design

****

NOTE: If effluent standards require a 5-day B.O.D. of less than 10 mg/L, then effluent filters are recommended. The filtration unit shall be [one] [two] [single] [dual] media filter cell(s), with backwash and backwash holding tanks, and related pumps, blowers, valves, piping, and control devices.

Insert design and peak flow rates. Comply with UFC 3-240-09FA for design flow rates. If the ratio of peak flow to design flow is expected to exceed 2:1, the peak flow may not be able to meet the 20 to 40 minute detention time requirement for all flows. If the detention time is not met, provide flow equalization prior to the treatment plant. Verify percent suspended solids and BOD removal.

Equalization tank should be sized to handle flow in excess of plant design flow rate for period of time that the peak flow is calculated to last. A dedicated blower system or motor operated valve as well as an aerating mixer are alternatives which will be used to aerate the equalization tank. The air should be shut off before the contents of the equalization tank are drained back to lift station or pumped by airlift or grinder pump during low flow periods. Air overflow weir in the equalization tank should allow flow to go back to aeration tank or back to lift station.

Provide seismic details, if a Government designer (either Corps office or A/E) is the Engineer of Record, and show on the drawings. Delete the bracketed phrase, in the last sentence, if no seismic details are provided. Pertinent portions of UFC 3-310-04 and Sections 13 48 00 SEISMIC

PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, properly edited, must be included in the contract documents.

****

Treatment of wastewater shall be accomplished through absorption of the suspended solids and biochemical oxygen demand (5-Day BOD) by contact with stabilized activated sludge for a short time duration followed by gravity clarification and chemical disinfection. The treatment plant shall be sized for a design flow of [_____] L/day gpd and a peak flow of [_____] L/day gpd. The treatment plant shall remove [80] [_____] percent of the suspended solids and 5-day BOD for domestic wastewater with 5-Day BOD and suspended solids concentration between [200] [_____] and [400] [_____] mg/L. Plant design shall conform to UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown on the drawings].

2.1.2.1 Contact Zone

The contact zone shall receive plant influent and bring it into contact with stabilized activated sludge for a minimum of [30] [_____] minutes and a maximum of [2] [_____] hours. Minimum wastewater depth shall be [3] [_____] m [10] [_____] feet and freeboard shall be 450 mm 18 inch. A [_____] mm -inch diameter influent opening, reinforced with a pipe flange or steel plate and with suitable connection for the [inlet sewer] [raw sewage pump discharge pipe] shall be provided. The influent shall enter the tank slightly above the wastewater surface and as far as practicable from the effluent opening. Air diffusers shall be provided in accordance with paragraph AIR DIFFUSION EQUIPMENT. Fillets shall be provided at the base of both long walls. A froth control spray system shall be provided in accordance with paragraph FROTH CONTROL SYSTEM. For rectangular tank air diffusers mounted [along one side] [in center of tank] depth to width ratio shall be between 1.0:1.0 to 1.0:2.2 for good spiral roll mixing. Peripheral tanks in circular plants shall utilize diffusers mounted [along one side] [in radial pattern from inside tank wall].

2.1.2.2 Sludge-Settling Zone

The sludge-settling zone size shall be based upon a surface loading rate of not more than [12,225] [_____] L per day per square meter [300] [_____] gpd per square foot of water surface area at the average daily flow rate, and not more than [20,375] [_____] L per day per square meter [500] [_____] gpd per square foot of water surface area at the peak hourly flow rate. Minimum water depth shall be [3] [_____] m [10] [_____] feet and freeboard shall be 450 mm 18 inches. The tank bottom shall consist of one or more hoppers having side slopes of not less than 1.70 vertically to 1 horizontally. In lieu of the above, a flat bottom may be provided with a mechanical sludge scraper in accordance with paragraph SLUDGE AND SCUM RECIRCULATION EQUIPMENT. The tank influent shall be below the water surface and shall have a stilling baffle extending at least 150 mm 6 inch above and below the inlet opening. A scum baffle shall be provided at the effluent opening and extending at least 75 mm 3 inch above and 300 mm 12 inch below the water surface. Air lift sludge and scum pumps shall be provided in accordance with paragraph SLUDGE AND SCUM RECIRCULATION EQUIPMENT.

2.1.2.3 Reaeration Zone

The reaeration zone shall be sized to provide [3 to 6] [_____] hours of reaeration of sludge pumped from the bottom of the sludge-settling zone. Minimum sludge depth shall be [3] [_____] m [10] [_____] feet and freeboard shall be 450 mm 18 inches. Effluent from the reaeration zone shall discharge to the contact zone. Air diffusers shall be provided in accordance with paragraph AIR-DIFFUSION EQUIPMENT. Fillets shall be provided at the base of both long walls. A froth control spray system shall be provided in accordance with paragraph FROTH CONTROL SYSTEM.

2.1.2.4 Sludge-Holding Zone

****
NOTE: Insert capacity, generally all waste sludge produced in one week of operation.
****

The sludge-holding zone shall have a minimum capacity of [_____] cubic meters cubic feet. A supernatant draw-off connection shall be provided between the sludge-holding zone and the aeration zone. The supernatant draw-off connection shall be located above the aeration zone water level. Air diffusers shall be provided in the sludge-holding zone in accordance with paragraph AIR-DIFFUSION EQUIPMENT.

2.1.2.5 Chlorination Zone

The chlorination zone shall be designed for quiescent plug flow through the tank and to provide at least 30 minutes contact time at peak flow rate. A turbulent zone shall be provided at the tank inlet for proper chlorine solution mixing. The tank shall be baffled to promote plug flow and reduce short circuiting. Chlorination equipment shall be provided in accordance with paragraph GAS CHLORINATION SYSTEM or CALCIUM HYPOCHLORITE CHLORINATION SYSTEM. Effluent from the chlorination zone shall flow over a weir and exit the plant through a [_____] mm -inch diameter flanged pipe.

2.2 MATERIALS AND EQUIPMENT REQUIREMENTS

2.2.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and which essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall 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 shall 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.

2.2.3 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

2.3 MATERIALS

Materials shall conform to the following requirements:

2.3.1 Steel Plates, Shapes, and Bars

Steel plates, shapes, and bars shall conform to ASTM A36/A36M.

2.3.2 Ductile Iron Pipe

Ductile iron pipe shall conform to AWWA C151/A21.51.

2.3.2.1 Flanged Ductile Iron Pipe

Flanged pipe shall conform to AWWA C115/A21.15 with ASME B16.1, Class 125 flanges.

2.3.2.2 Joints

Joints for ductile iron pipe shall conform to AWWA C111/A21.11.

2.3.2.3 Fittings for Ductile Iron Pipe

Fittings shall conform to AWWA C110/A21.10.

2.3.3 Steel Pipe

Steel pipe shall conform to AWWA C200.

2.3.3.1 Flanged Joints

Flanged joints shall conform to AWWA C207, Class B Ring Type.

2.3.3.2 Slip Joints

Slip joints shall conform to AWWA C200.

2.3.3.3 Mechanical Joints

Mechanical joints shall conform to AWWA C200.

2.3.3.4 Welded Joints

Welded joints shall conform to AWWA C206.

2.3.3.5 Fittings for Steel Pipe

Fittings shall conform to AWWA C200 and be fabricated in compliance with AWWA C208.

2.3.4 Galvanized Steel Pipe and Fittings

Pipe shall conform to ASTM A53/A53M, standard weight, galvanized. Pipe smaller than 100 mm 4-inch diameter shall have screwed joints in accordance with ASME B1.20.2MASME B1.20.1. Fittings shall be galvanized malleable iron in accordance with ASME B16.3. Pipe 100 mm 4-inch diameter and larger shall have flanged joints and fittings in accordance with AWWA C207.

2.3.5 Polyvinyl Chloride (PVC) Pipe and Fittings

PVC pipe and fittings less than 100 mm 4-inch diameter shall be in accordance with ASTM D1785 or ASTM D2241. PVC pipe and fittings 100 mm 4 inch in diameter and larger shall be in accordance with ASTM D2241 or AWWA C900 and shall have push-on joints.

2.3.5.1 Push-On Joints

Push-on joints shall conform to ASTM D3139 or ASTM F477.

2.3.5.2 Solvent Cement

Solvent cement shall conform to ASTM D2564.

2.3.6 Pipe Hangers and Supports

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

2.3.7 Valves

2.3.7.1 Angle, Check, and Globe Valves

Angle, check and globe valves shall conform to MSS SP-80, Type 3 Globe and Angle, Types 3 and 4 Check.

2.3.7.2 Gate Valves

Gate valves shall conform to MSS SP-80, Type 1, Class 150 or MSS SP-70, Type I, Class 125 Bronze Trim.

2.3.7.3 Plug Valves

Bronze plug valves shall conform to MSS SP-78. Iron plug valves shall conform to API Spec 6D.

2.3.8 Joint Compound

Joint compound for screwed joints shall be a stiff mixture of graphite and oil, inert filler and oil, or a graphite compound.

2.3.9 Joint Tape

Joint tape for screw joints shall conform to ASTM D3308.

2.3.10 Bolts and Nuts

Bolts and nuts shall conform to ASTM A307, Grade B.

2.4 EQUIPMENT

Equipment shall conform to the following requirements:

2.4.1 Electric Motors

Electric motors shall conform to NEMA MG 1.

2.4.2 Motor Controls

Motor Controls shall conform to NEMA ICS 1.

2.4.3 Protection from Moving Parts

All belts, chains, couplings, and other moving parts shall be completely enclosed by guards to prevent accidental personal injury. Guards shall be removable or so arranged as to allow access to the equipment for maintenance. If equipment is housed in a lockable enclosure, this shall be sufficient protection and no additional guards are necessary.

2.5 SEWAGE SHREDDER

****
NOTE: Retain "aeration" for extended aeration type plants. Retain "contact" for contact stabilization type plants.
****

A sewage shredder shall be provided in the influent line immediately upstream of the [aeration] [contact] zone.

2.5.1 Performance and Design Requirements

The sewage shredder shall be capable of cutting all sewage solids including sticks, rags, and stringy material without clogging the screen or binding, jamming or stalling the moving parts under normal load conditions. The unit shall be designed to clear jams by repeatedly reversing and restarting. The shredder shall be designed to operate continuously and shall have a hydraulic capacity at least equal to the treatment plant peak flow rate.

2.5.2 Screening and Cutting Mechanism

****
NOTE: Alternate shredder (comminutor) design utilizes two vertical cutter shafts with hardened 4130 steel alloy cutters of 42 to 48 Rc hardness.
****

Screen configuration shall be such that all wastewater must pass through it before entering the treatment plant. Screen bars shall be spaced not greater than 6 mm 1/4 inch apart. Cutters shall be constructed of tool steel with a surface hardness of at least 35 on Rockwell C scale. Cutters shall be removable to facilitate replacement.

2.5.3 Motor and Mounting

The drive motor shall be in accordance with NEMA MG 1 and shall be suitable for outdoor service in a high moisture atmosphere. Motor shall be suitable for [_____] volts ac [3] [_____] phase, 60 Hz power supply and shall be equipped with a thermal overload protector with manual reset. The motor shall be direct-coupled to a gear reducer unit which shall be coupled to the cutting mechanism. The shredder shall be mounted on a suitable cast [iron] [or] [aluminum] support.

2.5.4 Controls

A control unit shall conform to NEMA ICS 1 and shall be provided for operation of the shredder. The control unit shall contain a hand-off-automatic selector switch; forward start, stop, and reverse start pushbuttons for manual operation; automatic controls; dual magnetic starters, one forward and one reverse; and other equipment required for proper operation. If a jam occurs when in the automatic mode of operation, the automatic controls shall alternately reverse and restart the shredder until the jam is cleared or the thermal overload in the motor is tripped. The control unit shall contain a pushbutton to manually reset the controls after a thermal overload. The controls shall be housed in a NEMA 250, Type 4 enclosure.

2.5.5 By-Pass Bar Screen

A by-pass bar screen shall be provided for stand-by service during shredder clogging or maintenance. Screen shall have no greater than 10 mm 3/8-inch spacing between bars and shall be sized for treatment plant peak flow. The by-pass bar screen shall be located such that flow passes through it only when the shredder is clogged.

2.6 BLOWERS

Two electric motor driven positive displacement blowers with all necessary accessories and appurtenances shall be provided.

2.6.1 Performance and Design Requirements

Each blower shall meet the following performance and design requirements:

2.6.1.1 Capacity

Each blower shall have sufficient capacity to supply the entire plant demand, including air for the specified air diffusion equipment and air lift pumps. Air pressure shall be as required for proper operation of the treatment plant. Blowers shall be designed for continuous operation. Certified blower capacity shall equal [_____] standard cubic meters/second SCFM at [_____] kPa psig.

2.6.1.2 Impellers

Impellers shall be accurately machined from cast iron. Impeller shaft shall be either a common casting with the impeller or permanently fastened to the impeller. The blower casing shall be heavily ribbed cast iron. Headplates shall be cast iron. Timing gears shall be machined from alloy steel. Bearings shall be anti-friction. Drive end bearings shall be grease lubricated. Timing gears and gear end bearings shall be splash oil lubricated. Positive oil seals shall be provided to prevent lubricant from entering the air stream. Suction and discharge connections for sizes under 150 mm 6-inch nominal diameter shall be threaded and for sizes 150 mm 6-inch nominal diameter and larger shall be ASME B16.1 Class 125 flanged.

2.6.1.3 Discharge

Each blower shall be provided with a filter-silencer on the suction side and a check valve, gate valve, pressure relief valve, and pressure gauge on the discharge side.

2.6.2 Drive

The blower drive shall consist of an electric motor, V-belts, and sheaves. V-belts shall be sized for the horsepower required to drive the blowers. Sheaves shall be provided for full capacity operation. Extra sheaves and V-belts shall be provided to permit operation of blowers at 2/3 rated capacity. Blower speed shall not exceed [_____] revolutions per minute. Blower motor shall operate on [_____] volts ac [_____] phase, 60 Hz. Blower motor shall produce [_____] kW hp. Blower motor shall be weatherproof conforming to NEMA MG 1.

2.6.3 Controls

A circuit breaker, magnetic starter, and manual-off-automatic selector switch for each blower motor, and timers required for automatic operation shall be provided. When in the automatic mode of operation, the blowers shall operate alternately for 1-hour periods. Controls shall conform to NEMA ICS 1. All controls shall be housed in a NEMA 250, Type 4 enclosure.

2.6.4 Air Pressure Gauges

An air pressure gauge shall be provided on the discharge line from each blower. The gauge shall comply with ASME B40.100 and shall have a scale range to include the full range of expected operation and up to 125 percent, but not more than 150 percent of maximum. The gauges shall be mounted in the blower enclosure and shall be easily read with the enclosure open.

2.6.5 Pressure Relief Valve

A pressure relief valve shall be provided in the discharge piping from each blower. The valve shall vent pressure to the atmosphere when system pressure exceeds [_____] kPa psi and shall reset automatically when pressure drops below [_____] kPa psi. Volumetric release rate shall be 1.5 times the rated capacity of the blower. Relief valves shall have threaded connections and shall be constructed and installed in compliance with ASME BPVC SEC IV.

2.6.6 Air Filter-Silencer

Filter-silencers shall be used on blowers of 0.094 cubic meters/second 200 cfm or less. Provide separate silencer and air filter as well as a discharge silencer on blowers over 0.094 cubic meters/second 200 cfm. Filters shall be of the cleanable element type. Collection efficiency shall be at least 90 percent of particulates 5 micrometers microns in diameter and larger. Pressure drop through a clean unit shall not exceed 50.8 Pa 0.2 inches of water at rated capacity of blower. If filters are mounted outside, provide weatherproof enclosures. Silencers shall be heavy-duty, all welded chamber absorption types with double wall construction to prevent high frequency ringing.

2.6.7 Mounting

Blowers and motors shall be rigidly mounted on a steel baseplate or framework. Motor mount shall provide for adjustment of V-belt tension.

2.6.8 Enclosure

Blowers and motors shall be housed in a weatherproof enclosure constructed

of a corrosion-resistant material such as aluminum or galvanized steel, or shall be factory painted with one prime coat and two finish coats of baked enamel. The enclosure shall have wall louvers adequate to provide air for cooling and, if the intake is in the enclosure, for blower supply. Construction of the enclosure shall allow access to the blowers and motors for maintenance.

2.7 AIR-DIFFUSION EQUIPMENT

****
NOTE: Retain "aeration zone" for extended aeration type treatment plants. Retain "contact zone" and "reaeration zone" for contact stabilization type treatment plants.
****

Air supply piping, valves, and diffusers for aeration in the [aeration zone] [contact zone, reaeration zone] and sludge-holding zone shall be provided.

2.7.1 Performance and Design Requirements

Aeration equipment shall be provided as required to supply a minimum of 3 cubic meters of air per minute per 100 cubic meters of tank volume 30 cubic feet of air per minute per 1000 cubic feet of tank volume (cfm/1000 cu. ft.) to the [aeration zone] [contact zone, reaeration zone] and the sludge-holding zone. System design and diffuser placement shall be such that a rolling motion is imparted to the tank contents.

2.7.2 Piping and Valves

****
NOTE: Aboveground PVC and galvanized steel pipe 50 mm (2 inches) or less in diameter should be covered by weather resistant foam thermal covering to protect pipe from freezing.
****

[Piping shall be Schedule 80 PVC.] [Piping shall be galvanized steel.] Isolation-control valves shall be gate valves. A minimum of [three] [_____] separate air-diffusion headers per tank shall be provided. Headers shall be independently valved and supported and shall be capable of being independently removed from service without the use of a crane or hoist and without dewatering of the tank.

2.7.3 Diffusers

Diffusers shall be of the coarse bubble, fixed-nozzle type individually attached to the headers by screwed connections, U-bolts, or stainless steel straps and springs. Welded or other nonremovable connections are not acceptable. Diffusers shall have an oxygen transfer efficiency of at least 6 percent and a pressure drop not greater than 3.5 kPa 0.5 psi at the design flow rate. The diffusers shall be manufactured of plastic, stainless steel, rubber, or other corrosion resistant material and shall be designed to seal under no-flow conditions to prevent wastewater from entering the piping system.

2.8 SLUDGE AND SCUM RECIRCULATION EQUIPMENT

****
NOTE: Retain "aeration" for extended aeration type plants. Retain "reaeration" for contact stabilization type plants.
****

Equipment shall be provided to collect sludge from the bottom of the sludge-settling zone and pump the sludge to the [aeration] [reaeration] zone and the sludge holding zone. Sludge collection shall be accomplished either through the use of a hopper bottom settling tank or a flat bottom settling tank with a mechanical collector. The equipment shall also collect scum from the top of the sludge-settling zone and pump it to the [aeration] [reaeration] zone. Pumping shall be accomplished by air lift pumps.

2.8.1 Piping and Valves

Piping and valves shall be provided as required to pump sludge to either the [aeration] [reaeration] zone or the sludge holding zone or both simultaneously. Piping and valves shall be provided as required to pump scum to the [aeration] [reaeration] zone. Piping shall be galvanized steel pipe or PVC pipe with solvent weld or push-on joints. Valves shall be gate valves.

2.8.2 Air Lift Pumps

If the sludge settling zone is the hopper bottom type, at least one air lift pump shall be provided in each hopper. If the sludge settling zone contains a mechanical sludge collector, an air lift pump shall be provided at the collector discharge. Each air lift pump shall consist of a foot piece located at the bottom of a vertical eductor tube and air supply piping and control valves. The foot piece shall provide maximum practicable lift through the formation of small air bubbles. Eductor tubes and foot pieces shall be constructed of PVC plastic, galvanized steel, or stainless steel. Air control valves shall be globe valves. Sludge recirculation air lifts shall be sized based on pumping a sludge volume of [100] [_____] percent of the treatment plant design flow.

2.8.3 Mechanical Sludge Collector

If the sludge settling zone does not have a hopper bottom, a mechanical sludge collector shall be provided to scrape the entire tank bottom. Mechanical sludge collectors shall be either the rotating arm or conveyor type. The collector shall be driven by an electric motor through an appropriate gear or chain drive. Motors and drives shall be positioned above the plant high water level or shall be suitable for submerged service. Motors shall be totally enclosed conforming to NEMA MG 1. Each motor shall be furnished with magnetic starter with thermal overload protection and control devices conforming to NEMA ICS 1. Enclosure shall be NEMA 250, Type 3R. The tip speed of rotating arm collectors shall not exceed 1500 mm/minute 5 feet/minute. Linear speed of conveyor type collectors shall not exceed 300 mm/minute 1 foot/minute. Collector speed shall be fast enough to avoid sludge-residence time exceeding 3 hours. Scraper blades shall be replaceable. Collector drive shall have overload protection.

2.9 FROTH CONTROL SYSTEM

****
NOTE: Retain "aeration zone" for extended aeration type treatment plants. Retain "contact zone" and "reaeration zone" for contact stabilization type treatment plants.
****

A system shall be provided to control froth in the [aeration] [contact and reaeration] zones. The system shall consist of a pump, piping, valves, and spray nozzles.

2.9.1 Froth Spray Pump

The pump shall be an electric motor operated, self-contained, submersible pump of a design acceptable for the required service. Pump capacity shall be such that not less than 0.1 L/second 1-1/2 gpm will be supplied to each froth spray nozzle when operating at the design head loss and pressure requirements. The pump shall be mounted in the sludge settling tank with the suction no less than 150 mm 6 inch below the water surface but not so deep that the pump will pick up settled solids. An intake screen shall be provided around the pump suction. Screen openings shall be no larger than the pump nozzle opening. Motor shall be watertight and shall be in accordance with NEMA MG 1. Required controls, including a magnetic starter with start and stop buttons and a circuit breaker with reset button in conformance with NEMA ICS 1shall be provided, all enclosed in a NEMA 250, Type 4 enclosure.

2.9.2 Piping and Valves

The froth spray header shall be at least 25 mm 1-inch diameter galvanized steel or PVC pipe and shall be mounted above the water surface along the tank wall opposite the air diffusers. The header shall be connected to the froth spray pump through a gate valve and appropriate piping. Provide a hose bib in the sludge settling zone and arranged such that the entire froth spray pump flow can be directed through the hose bib by closing the header gate valve.

2.9.3 Froth Spray Nozzles

Froth spray nozzles shall be constructed of bronze, stainless steel, or plastic. Spray pattern may be either flat or conical and shall have sufficient force at a flow rate of 0.1 L/second 1-1/2 gpm per nozzle to effectively break down accumulated froth. Nozzles shall be mounted equally spaced along the header to provide a slightly overlapping spray pattern at the water surface.

2.10 GAS CHLORINATION SYSTEM

****
NOTE: For small wastewater treatment plants of 75,000 to 150,000 L per day (20,000 to 40,000 gpd) that do not require flow proportional chlorination, tablet chlorinator offers a safe and effective means of chlorination.
****

A system shall be provided for the disinfection of the treatment plant

effluent using chlorine gas. The system shall include a gas chlorinator, booster pump diffusers, pipe, valves, and controls. The system shall automatically regulate the chlorine feed rate in proportion to the wastewater flow.

2.10.1 Gas Chlorinator

The chlorinator shall be of the flow proportioning continuous solution feed type. The gas system shall operate under vacuum. The chlorinator shall include a vacuum regulator, flow meter, flow proportioning valve, proportioner, and ejector.

2.10.1.1 Vacuum Regulator

The vacuum regulator shall mount directly on the chlorine supply cylinder and shall regulate the flow of gas from the cylinder into the system. If vacuum is lost, the regulator shall seal off the gas supply from the cylinder. A vent valve shall be provided on the regulator to release any gas in the system that is under positive pressure to the outdoors through a vent line.

2.10.1.2 Flow Meter

The flow meter shall be of the rotometer type and shall indicate flow rate in kg pounds of gas per 24 hours. The meter range shall be from 0 to [_____] kg pounds per 24 hours.

2.10.1.3 Flow Proportioning Valve

The flow proportioning valve shall meter the chlorine gas as it passes the ejector. The position of the valve, as set by the proportioner, shall determine the chlorine flow rate. The unit shall allow for manual adjustment of chlorine dosage between 1 and 8 mg/L. The dosage shall remain constant from low wastewater flows to peak flow conditions through the action of the flow proportioning valve.

2.10.1.4 Proportioner

The proportioner shall position the flow proportioning valve in response to electric signals received from a wastewater flow measuring device specified in paragraph FLOW METERING AND CONTROL. Control devices shall conform to NEMA ICS 1. The proportioner shall move the proportioning valve by way of a bidirectional electric motor/actuator NEMA Type 4X conforming to NEMA MG 1. Enclosures shall be NEMA 250 [Type 12] [_____]. Feedback signals from the valve shall indicate to the proportioner when it is in the proper position relative to the wastewater flow signal.

2.10.1.5 Ejector

The ejector shall create a vacuum on the chlorine gas system and shall mix the gas with the water flowing through the ejector. A check valve shall be incorporated with the ejector to prevent water from flowing into the gas system. The ejector shall be constructed of PVC plastic or other material suitable for service in the highly corrosive wet chlorine atmosphere. The ejector shall be sized to provide sufficient vacuum for operating the system over its full range. The ejector shall be mounted in the piping which connects the booster pump to the diffuser and shall be located as close to the diffuser as practicable.

2.10.2 Booster Pump

An electric motor driven, close-coupled, centrifugal pump shall be provided to supply water to the chlorinator ejector assembly. The pump shall be designed for continuous duty and shall be sized as required for proper operation of the ejector. The pump and motor shall be suitable for outdoor service or shall be enclosed in a weatherproof housing. A magnetic starter with start and stop push buttons and a circuit breaker with manual reset pushbutton in accordance with NEMA ICS 1 shall be provided, all enclosed within a NEMA 250, Type 4 enclosure. The pump motor shall be totally enclosed fan cooled conforming to NEMA MG 1 and shall be [_____] volts ac [_____] phase, 60 Hz.

2.10.3 Diffuser

A diffuser shall be provided to effectively disperse the chlorine solution into the wastewater flow. The diffuser shall be constructed of PVC plastic or other material resistant to the highly corrosive wet chlorine atmosphere. The diffuser shall be installed at a point of local turbulence, such as the outfall from a weir, to achieve rapid and thorough mixing with the plant effluent.

2.10.4 Chlorinator Enclosure

An insulated weatherproof enclosure with a thermostatically controlled heater shall be provided to house the chlorinator. The enclosure shall have lockable access doors and shall be louvered for ventilation. The enclosure shall be aluminum, galvanized steel, or mild steel with a factory-applied finish.

2.10.5 Piping and Valves

Piping in the chlorination system shall be Schedule 80 PVC with solvent weld joints. Gas valves shall be bronze or plastic construction. Valves in contact with chlorine solution shall be PVC or rubber-lined steel.

2.10.6 Cylinder Scale

A cylinder scale shall be provided for determining the amount of chlorine remaining in the supply cylinder. Capacity of the scale shall be [_____] kg pounds with an accuracy of 2 percent of full scale. The scale shall be located within the chlorinator enclosure.

2.10.7 Gas Mask

A gas mask shall be provided to protect against chlorine gas inhalation. The gas mask shall be NIOSH 2009-132 certified for use chlorine gas environments. The mask shall be stored in a weatherproof enclosure outside the building immediately adjacent to the entrance.

2.11 CALCIUM HYPOCHLORITE CHLORINATION SYSTEM

A system shall be provided for the disinfection of the treatment plant effluent using calcium hypochlorite solution. The system shall include a chemical solution tank with mixer and liquid-level switch, a metering pump, diffusers, pipe, valves, and controls. The system shall automatically regulate the chlorine feed rate in proportion to the wastewater flow.

2.11.1 Chemical Solution Tank

The tank shall be polyethylene and shall have a capacity of [115] [190] L [30] [50] gallons. The cover shall be fiberglass reinforced plastic of sufficient strength to support the mixer. The mixer shall be electric motor driven impeller type mixer capable of mixing and maintaining the solution. The mixer shaft shall be plastic covered. The mixer impeller shall be plastic. A liquid level switch shall be provided to prevent the metering pump from operating without adequate liquid in the tank.

2.11.2 Metering Pump

The metering pump shall be a [single] [dual] head, diaphragm type metering pump and shall have a capacity of [_____] L/day gpd of calcium hypochlorite solution. All parts in contact with the calcium hypochlorite solution shall be resistant to the corrosive attack of the solution. The metering pump shall have an electric stroke length positioner to proportion solution flow in response to a signal received from a wastewater flow measuring device specified in paragraph FLOW METERING AND CONTROL. Control devices shall conform to NEMA ICS 1. Motor frame shall be [_____] [totally enclosed] [explosionproof] conforming to NEMA MG 1. The pump motor shall be [_____] volts ac [_____] phase, 60 Hz.

2.11.3 Diffuser

A diffuser shall be provided to effectively disperse the chlorine solution into the wastewater flow. The diffuser shall be constructed of PVC plastic or other material resistant to the highly corrosive wet chlorine atmosphere. The diffuser shall be installed at a point of local turbulence, such as the outfall from a weir, to achieve rapid and thorough mixing with the plant effluent.

2.11.4 Chlorinator Enclosure

An insulated weatherproof enclosure with a thermostatically controlled heater shall be provided to house the chlorinator. The enclosure shall have lockable access doors and shall be louvered for ventilation. The enclosure shall be aluminum, galvanized steel, or mild steel with a factory-applied finish.

2.11.5 Piping and Valves

Piping in the chlorination system shall be Schedule 80 PVC with solvent weld joints. Gas valves shall be bronze or plastic construction. Valves in contact with chlorine solution shall be PVC or rubber-lined steel.

2.12 SEWAGE PUMPS

Sewage pumps shall be provided for pumping [raw sewage to] [final effluent from] the treatment plant.

2.12.1 Pumps

Duplex pumps shall be provided in compliance with Section 22 13 29 SANITARY SEWERAGE PUMPS. Motor frame shall be [_____] [totally enclosed] [explosionproof] type and shall conform to NEMA MG 1.

2.12.2 Controls

Pumps shall be automatically controlled by float-type level switches. The controls shall automatically alternate the pumps upon completion of each operation. All switches, relays, and auxiliary equipment required for pump operation shall be provided. A magnetic starter and a combination manual on-off control and circuit breaker shall be provided for each pump. All controls shall be in conformance with NEMA ICS 1. All parts in contact with sewage shall be constructed of corrosion resistant material. Enclosure for controls shall be NEMA 250 Type 4.

2.12.3 Pumping Structures

Wetwells [and drywells] shall be sized to permit access to pumps and other equipment for maintenance. [Drywells shall be provided with sump pumps and dehumidifiers to protect the equipment against corrosion.] [Pump houses shall be weatherproof and shall be louvered for ventilation.] Wetwells shall be sized to handle part or all of short term peak flows and shall provide for minimum pump run times.

2.13 FLOW METERING AND CONTROL

Provide means for flow metering and control.

2.13.1 Flow Metering

****
NOTE: Delete inapplicable flow metering paragraph.
****

2.13.1.1 Float Operation

Measurement of wastewater flow shall be accomplished by an outfall weir and a float operated recorder. The recorder shall be of the electrically operated circular or strip chart type and shall continuously record the flow through the plant in L/second gpm. The recorder shall also produce an electrical signal in proportion to the flow for control of the chlorinator. A weatherproof enclosure shall be provided for the recorder.

2.13.1.2 Ultrasonic Measuring

Measurement of wastewater flow shall be accomplished by an outfall weir and an ultrasonic flow meter with digital recorder. Measurement shall be noncontact, echo-time measuring-type for use with V-notch weir. Unit shall have reference receivers providing instant compensation in gas medium for temperature, atmospheric pressure and humidity changes. Enclosure for transmitter shall be NEMA Class 250, Type 4X and shall include indicator and recorder. Transmitter shall provide a flow proportional signal if required.

2.13.2 Flow Control

Adjustable weirs shall be provided at the inlet and outlet of the chlorination tank for control of wastewater depth in the plant.

2.14 ACCESS WALKWAYS, PLATFORMS, AND HANDRAILS

****
NOTE: Include handrails around plant perimeter if

plant is installed with tank walls at or near grade.
****

Access walkways and platforms shall be provided for access to all equipment for operation and maintenance. Walkways and platforms shall be nonslip open grating fabricated from galvanized steel, factory painted mild steel, aluminum, or fiberglass. Rigid handrails shall be provided along the sides of walkways and platforms [and around the perimeter of the entire plant]. Handrails shall be fabricated from aluminum, galvanized steel or painted steel, shall be 1075 mm 42 inch high, and shall have two horizontal rails. Gates shall be provided as required for access to equipment. Access walkways, platforms, and handrails shall conform to Section 05 12 00 STRUCTURAL STEEL.

2.15 LUBRICATION

An adequate means of lubrication shall be provided for all moving parts subject to wear. Except as otherwise approved, lubrication shall be by grease or oil. Grease fittings shall be provided for all grease-type bearings. If bearings are not easily accessible, grease tubing shall be provided to a convenient location. Bearings shall be provided with relief ports to prevent build-up of pressures which might damage the bearings or seals. Oil reservoirs shall be liberal in size and shall be provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, and a drain opening at the lowest point. Reservoirs shall be properly vented to prevent pressure build-up.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 TREATMENT PLANT CONSTRUCTION

All work not absolutely required to be performed in the field shall be performed in a factory under controlled conditions. The treatment plant shall be fabricated from not less than 6 mm 1/4-inch steel plate with welded joints and shall be reinforced as necessary with steel angles, tees, or other structural members. The units shall be designed and constructed for transportation, installation, and operation without detrimental buckling, distortion, or other defects. Tanks shall not leak when filled with water or sewage.

3.2.1 Pipe and Valve Installation

Piping shall be installed in a neat manner with all joints tight and with no undue marring of finishes. Installed piping, valves, and fittings shall be free from strain and excessive stresses caused by weight or misalignment.

3.2.1.1 Flanged Joints

Bolts shall be tightened uniformly to prevent overstressing flanges and misalignment.

3.2.1.2 Screw Joints

Screw joints shall be made tight with joint compound, applied to the male threads only, or joint tape.

3.2.1.3 Push-On Joints for PVC Pipe

Pipe ends shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. Lubricate gasket to prevent displacement. Exercise care to ensure that the gasket remains in proper position in the bell or coupling while making joint.

3.2.1.4 Solvent-Weld Joints for PVC Pipe

Joints shall be made in accordance with the manufacturer's written instructions.

3.2.1.5 Valves

Valves shall be installed with the stem vertical and located for easy access for operation.

3.2.2 Equipment Installation

Equipment shall be installed in compliance with the manufacturer's written instructions. Submit drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the Drawings proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

3.2.3 Electrical Work

****
NOTE: Select the applicable exterior electrical section.
****

Electrical work shall be in accordance with the applicable requirements of Section [33 70 02.00 10 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND][33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION][33 71 01.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION][33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION].

3.3 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall include, in typed form, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system. The framed instructions shall be posted before acceptance testing of the system.

3.4 TREATMENT PLANT INSTALLATION

The plant shall be installed such that proper wastewater flow through the

plant will be achieved.

3.4.1 Preparation

Excavation, filling, and backfilling shall be in accordance with Section 31 00 00 EARTHWORK. A reinforced concrete foundation pad, of the size and design recommended by the treatment plant manufacturer, shall be installed in accordance with Section [03 30 00.00 10 CAST-IN-PLACE CONCRETE][03 30 00 CAST-IN-PLACE CONCRETE].

3.4.2 Installation

The treatment plant and equipment shall be installed in accordance with the manufacturer's written instructions.

3.4.3 Testing and Adjusting

3.4.3.1 Pretesting Activities

Prior to backfilling, all tanks, wet-wells, piping, valves, and appurtenances shall be filled and inspected for leaks in accordance with manufacturer's specifications. All leaks shall be repaired by removal of defective materials or rewelding. Use of caulking compounds is not permitted. Testing and repairs shall be repeated until tanks, wetwells, piping, valves, and appurtenances are free from leaks.

3.4.3.2 Demonstration

As soon as practicable after completion, an operating test of the treatment plant and all equipment shall be performed to demonstrate that the plant functions properly. After completion of all tests, the plant shall be adjusted for proper operation while on-line with the wastewater source in accordance with the manufacturer's written instructions. For final acceptance plant must perform as specified.

3.4.3.3 Reporting

Provide performance test reports in booklet form showing 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. Each test report shall indicate the final position of controls.

3.5 WELDING

3.5.1 Procedures

****
NOTE: If the need exists for more stringent pipe welding requirements, delete the sentences in the first set of brackets.
****

[Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the

tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with AWS D1.1/D1.1M.] [Welding and nondestructive testing procedures for piping shall be as specified in Section 40 05 13.96 WELDING PROCESS PIPING.]

3.5.2 Testing

3.5.2.1 Non-Destructive Testing

Weld testing of [_____] percentage of welds shall be performed by testing agency.

a. Radiographic Testing

(1) Test method shall be in accordance with ASTM E94.

(2) Make identification of defects by comparing radiographs to reference radiographs in ASTM E390.

(3) Film shall positively and properly identify as to member being inspected, location of weld, and location of film on weld.

(4) Stamp identification on steel so film may be easily identified and matched to identification mark.

b. Ultrasonic Testing of Welds

(1) Inspection methods shall be in accordance with ASTM E164.

(2) Size of defects will be determined by relating amplitude of oscilloscope traces to hole in ASTM reference weldment.

(3) Diameter of reference holes shall be 2.4 mm 3/32-inch.

(4) Weld defects which are cause for rejection include cracks, lack of fusion, incomplete penetration, porosity, or slag inclusions which produce reflections equal to or greater than 80 percent of reference hole reflection and have linear dimensions as indicated by transducer movement exceeding following:

(a) 6 mm 1/4-inch for material thickness up to and including 19 mm 3/4-inch.

(b) 8 mm 1/3-inch for material thickness over 19 mm 3/4-inch up to and including 57 mm 2-1/4 inch.

(c) 19 mm 3/4-inch for thickness over 57 mm 2-1/4 inch.

3.5.2.2 Correction of Defective Welds

Repair weld areas containing defects; additional tests of repaired areas shall be made at Contractor's expense. If 20 percent or more of welds made by a given welder contain defects requiring repair, 100 percent nondestructive inspection of that welder's work will be required at Contractor's expense.

3.6 PAINTING

****
NOTE: Modular prefabricated concrete plants should be considered in locations where corrosion is a significant problem.
****

All metal surfaces, except aluminum, bronze, brass, galvanized steel, and stainless steel shall be painted. Unless otherwise specified, surface preparation and painting may be performed in the shop or in the field. Manufactured items, such as motors and switchboards, shall be finished with the manufacturer's standard finish.

3.6.1 Preparation and Application

Ferrous metal surfaces shall be prepared in accordance with SSPC SP 10/NACE No. 2. Nonsubmersed surfaces shall receive 0.10 to 0.13 mm 4 to 5 mils dry film thickness (dft) of epoxy metal primer, finished with coat of epoxy enamel (0.10 to 0.15 mm 4.0 to 6.0 mils dft) plus coat of polyurethane enamel (0.02 to 0.05 mm 1.0 to 2.0 mils dft). Submerged surfaces shall use 2 coats of coal tar bitumastic of 0.20 to 0.25 mm 8 mils to 10 mils dft each or 2 coats of amine-cured coal tar epoxy to 0.36 to 0.51 mm 14.0 to 20.0 mils total dft.

3.6.2 Coating Testing

Coatings shall be examined for flaws and tested for thickness and holidays. Thickness of coatings shall be measured by a commercial film thickness gauge. Coatings shall be tested for pinholes, holidays, and other defects with an electric flaw detector equipped with an audible signal that operates when a pinhole is detected. The detector shall be a 90-volt wet sponge pinhole detector.

3.6.3 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair shall consist of preparing the affected area in compliance with SSPC SP 10/NACE No. 2 and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, the surface shall be prepared and additional coats applied in the affected area in compliance with the manufacturer's instructions.

3.7 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, and testing of the equipment in accordance with the manufacturer's written instructions.

3.8 CLOSEOUT ACTIVITIES

3.8.1 Operation and Maintenance Manuals

Submit copies of operation and copies of maintenance manuals for the treatment plant equipment furnished. One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and

shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed. Manuals shall be approved prior to the field training course.

3.8.2 Field Training

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of [_____] hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals.

-- End of Section --