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USACE / NAVFAC / AFCEC / NASA | UFGS-46 07 53 (February 2020)
Change 1 - August 2022

Preparing Activity: NAVFAC | Superseding
UFGS-46 07 53.13 (February 2011)
UFGS-46 07 53.16 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

SECTION 46 07 53

PACKAGED WASTEWATER TREATMENT EQUIPMENT

02/20, CHG 1: 08/22

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SECTION 46 07 53

PACKAGED WASTEWATER TREATMENT EQUIPMENT
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****
NOTE: This guide specification covers the requirements for prefabricated package wastewater treatment biochemical and aeration systems, including extended aeration, contact stabilization, step aeration, and complete mixing. These facilities are intended for treatment of domestic wastewater only. Special consideration must be given to wastewater containing industrial wastes.

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 item(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).
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NOTE: On the project drawings, show:

1. Type of plant: (Extended Aeration, Contact Stabilization, Step Aeration, or Complete Mixing).

2. Design flow.

3. 5-day BOD loading.

4. Suspended solids loading.

5. Whether a comminutor is needed for facilities 1.09 L/s 25,000 GPD or less in size.

6. Whether mechanical aerator is allowed.

7. Whether plant should be concrete , steel, composite, or a combination.

8. Whether piling is required for foundations.

9. Whether hypochlorinator or whether chlorinator will used for facilities in 4.38 to 6.57 L/s 100,000 to 150,000 GPD range.

10. Whether raw wastewater recirculation box (recirculation to pumping station) is needed.

11. Whether plant is to be of aboveground or belowground construction.

12. Seismic loading (if necessary).

13. Electric power characteristics for motors.

14. Whether automatic operation of air lift pumps are required.

15. Wind load and ice load for rotating sludge collector.

16. Organic loading (5-day BOD).

17. Total suspended solids.

18. Size of hypochlorite mixing chamber if larger capacity than 113.4 L 30 gallons is needed.

19. Size of hypochlorite solution chamber if larger capacity than 208 L 55 gallons is needed.

20. Whether, for extended aeration type plant, eventual conversion to step aeration type is anticipated.

****

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 BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 908	(1989B; R 1999) Information Sheet: Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth
AGMA 2011	(2014B) Cylindrical Wormgearing Tolerance and Inspection Methods
AGMA ISO 10064-6	(2010A) Code of Inspection Practice - Part 6: Bevel Gear Measurement Methods
AGMA ISO 17485	(2008A; Supplement 2008) Bevel Gears - ISO System of Accuracy (Including Supplement - Tolerance Tables 2008)
ANSI/AGMA 2001	(2004D; R 2010) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
ANSI/AGMA 2004	(2008C; R 2014) Gear Materials, Heat Treatment and Processing Manual
ANSI/AGMA 6013	(2006A; R 2016) Standard for Industrial Enclosed Gear Drives
ANSI/AGMA 6034	(1992B; R 2010) Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors
ANSI/AGMA 6113	(2016B) Standard for Industrial Enclosed Gear Drives (Metric Edition)

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for

Pipeline and Piping Valves

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B1.20.2M	(2006; R 2011) Pipe Threads, 60 Deg. General Purpose (Metric)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2021) Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110/A21.10	(2021) Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C200	(2012) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C206	(2017) Field Welding of Steel Water Pipe
AWWA C207	(2018) Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)
AWWA C504	(2015) Standard for Rubber-Seated Butterfly Valves
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon

	Structural Steel
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A240/A240M	(2023) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B209M	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

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

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
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	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2021) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification

and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Package Wastewater Treatment Plant Layout

Package Wastewater Treatment Plant Component

Diffuser Layout

Mechanical Aerator Drawings

Special Concrete Work

Walkways

Access

Handrails

SD-03 Product Data

Air Blower Assembly; G[, [_____]]

Air Diffusers; G[, [_____]]

Mechanical Aerator; G[, [_____]]

Piping System; G[, [_____]]

Spray Nozzles; G[, [_____]]

Comminutor; G[, [_____]]

Mechanical Sludge Collection Equipment; G[, [_____]]

Scum Collection and Transfer Equipment; G[, [_____]]

Electrical Control System Components; G[, [_____]]

Program timer; G[, [_____]]

Air Blower Accessories; G[, [_____]]

Flow Measuring Equipment; G[, [_____]]

[Hypochlorinator Assembly; G[, [_____]]

][Chlorinator Assembly; G[, [_____]]

] SD-06 Test Reports

Package Wastewater Treatment Plant Performance Test Reports; G[, [_____]]

Chamber Tests; G[, [_____]]

Comminutor Tests; G[, [_____]]

Mechanical Aerator Tests; G[, [_____]]

Blower-driven Assembly Operation Tests; G[, [_____]]

Chlorinator Tests; G[, [_____]]

Discharge Capacity Test for Air Lift Pump; G[, [_____]]

Flow Measuring Equipment; G[, [_____]]

Electrical Control System Tests; G[, [_____]]

Hypochlorinator Tests; G[, [_____]]

System Startup; G[, [_____]]

SD-07 Certificates

Warranty

Electrical Control System

Mechanical Aerators

Materials Not Labeled or Certified

SD-08 Manufacturer's Instructions

Aeration Equipment

Air Blower Assembly

Sludge Transfer Pumps

Mechanical Sludge Collection Equipment

Comminutor

Froth Control System Pump

Flow Measuring Equipment

Corrosion Protection

Utilities Service Connections

Electrical Wiring

Excavation and Backfilling

[Hypochlorinator Assembly

] SD-10 Operation and Maintenance Data

Package Wastewater Treatment Plant Acceptance Test Results, Data Package 3; G[, [_____]]

Package Wastewater Treatment Plant Operation and Maintenance Data, Data Package 3; G[, [_____]]

Aeration System, Data Package 3; G[, [_____]]

Air Blower Assembly, Data Package 3; G[, [_____]]

Froth control System, Data Package 3; G[, [_____]]

Comminutor, Data Package 3; G[, [_____]]

[Hypochlorinator Assembly, Data Package 3; G[, [_____]]

]1.3 MAINTENANCE MATERIAL SUBMITTALS

1.3.1 Spare Parts

Provide manufacturer recommended spare parts that are identical and interchangeable with original parts. Protect spare parts from corrosion and furnish in clearly marked containers. Spare parts must meet standards recommended by the manufacturer in the manufacturer's operation, maintenance, or instruction manual.

1.4 QUALITY CONTROL

Unless otherwise specified, all materials and equipment must be new and be standard commercial products in regular production by the manufacturer, and suitable for the required service.

1.4.1 Manufacturer's Representative

Procure the services of an engineer representative of the manufacturer of the major portion of the treatment plant who is also familiar with the other equipment furnished. The representative inspects the equipment after erection, make adjustments in placing the equipment in operation, and is present during final inspection, start-up, and acceptance test.

1.4.2 Regulatory Requirements

****
NOTE: Ensure compliance with NPDES permits.
****

Conduct a regulatory review to determine impact of new and existing permit conditions and regulations. Notify the Contracting Officer of any discrepancies.

1.4.3 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.

1.4.4 List of Prior Installations

Submit a list of installations where plants of similar type as specified have been constructed, including the date of construction and capacity of the plant. Certify that the plant furnished and installed is the latest model and that spare parts are available.

1.4.5 Welding

Weld in accordance with AWS D1.1/D1.1M.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with a minimum of handling. Store materials in enclosures or under protective covering. Rubber gaskets which are not to be installed immediately must be stored under cover, out of direct sunlight. Do not store materials directly on the ground. Keep interior of pipes, valves and fittings free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery in sound, undamaged condition. Avoid damage to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged.

1.6 PROJECT AND SITE CONDITIONS

1.6.1 Environmental Requirements

Comply with applicable local, state, and Federal environmental requirements as directed by the Contracting Officer.

1.7 WARRANTY

Provide a system with a minimum [5] [_____] year warranty. Submit the manufacturer's warranty for each piece of equipment.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements

****

NOTE: Insert values for 5 day BOD loading, total suspended solids (TSS), and design and peak flow

rates; values should be based on tests of the wastewater to be treated. A typical influent value for BOD is 200 mg/L.

If effluent standards require a 5-day B.O.D. of less than 10 mg/L, effluent filters are recommended. Tertiary treatment may be required.

****

Provide a Package Wastewater Treatment Plant capable of treating wastewater with the following flow and removal requirements:

a. Average daily design flow of [_____] L/s gallons per day of domestic wastewater

b. Total Suspended Solids removal; [80] [90] [_____] percent

c. 5-day BOD removal; [80] [90] [_____] percent

The influent domestic wastewater has a 5-Day BOD and Total Suspended Solids (TSS) concentration between [200] [400] [_____] mg/L

2.1.2 Package Wastewater Treatment Plant

****

Plant material selection includes steel, concrete, composite. Among the factors to be considered are initial cost, maintenance costs, life expectancy, and possible need for relocation during period of useful life.

****

The Package Wastewater Treatment Plant includes a [comminutor,] aeration chamber, [flow equalization chamber,] clarifier chamber, sludge holding chamber, disinfection chamber, aeration equipment, and other related equipment. Duplicate facilities of equal size having a combined capacity equal to the average design flow specified when one unit is out of service are acceptable.

2.1.3 Components and Systems

****

NOTE: Delete reference to mechanical sludge collection equipment for extended aeration type below 0.66 L/s 15,000 GPD capacity. For facilities below 0.66 L/s 15,000 GPD capacity, hopper bottom only should be specified for settling chambers. For facilities above 4.38 L/s 100,000 GPD capacity, mechanical sludge collectors only should be used in clarifier chambers. For plants between 0.66 L/s and 4.38 L/s 15,000 and 100,000 GPD capacity, either hopper bottom or mechanical sludge collector should be allowed as a Contractor's option.

Delete reference disinfection equipment not used. Hypochlorinator may be specified for facilities 4.38 L/s 100,000 GPD capacity and below. Chlorinator may be specified for facilities 6.57 L/s 150,000 GPD capacity and above. Between 4.38 L/s and 6.57 L/s

100,000 GPD and 150,000 GPD capacity either is suitable. Selection should be made on basis of existing station or base practices, local availability, and comparative costs.

Delete reference to mechanical sludge collector for extended aeration of 4.38 L/s 100,000 GPD capacity and less and for step aeration of 3.0 L/s 67,500 GPD capacity and less.

****

The Package Wastewater Treatment Plant includes the following equipment: A diffused air aeration system [or mechanical aerator(s)] for the aeration chamber and the sludge holding chamber; [mechanical sludge collection equipment for the clarifier chamber;][froth control system for the aeration chamber;] sludge pumps in the clarifier chamber and the sludge holding chamber for sludge transfer; scum removal system for the clarifier chamber; [a comminutor at the plant inlet;] a disinfection system, and all necessary piping.

[2.1.4 Concrete Work

****

NOTE: The applicable requirements for cast-in-place concrete as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE and Section 03 45 33 PRECAST [PRESTRESSED] STRUCTURAL CONCRETE should be incorporated into the appropriate section of the project specification.

****

Concrete work includes [concrete plant walls, partitions, and bottom;] [support slab for all-steel plant or concrete bottom for steel wall plant;] and concrete pad for equipment support.

]2.2 MANUFACTURED UNITS

2.2.1 Process Chambers

****

NOTE: Use appropriate wording depending on whether plant is to be installed above ground (hydrostatic pressures...liquid level) or below ground (soil pressures...operating level).

Delete reference to comminutor and screening basket when not required for the plant. For facilities of 1.09 L/s 25,000 GPD capacity and below, the comminutor and bar screen unit may be omitted, and in lieu thereof, a screening basket provided in the aeration chamber. For installations in which all wastewater has passed through a comminutor and bar screen upstream of the plant, a comminutor and bar screen unit need not be provided as a part of the plant equipment.

Delete reference to influent distribution channel for extended aeration type.

For a detention time in the aeration chamber, insert values of 18 to 24 hours for extended aeration, 5.0 to 7.5 hours for step aeration, and 30 minutes to 2 hours for contact stabilization systems.

For organic loading in aeration chamber, insert 5.67 kg 12.5 pounds, 5 day BOD for extended aeration, 13.6 to 22.1 kg 30 to 50 pounds, 5-day BOD for step aeration, and 52.16 kg 115 pounds, 5-day BOD for complete mixing systems. Organic loadings used in this specification are those for wastewater strength of 200 mg/L. Organic loadings for higher strength wastewater would be proportional.

Delete the requirement for clarifier chamber detention time when the complete mixing process is specified.

For detention time in the clarifier chamber for extended aeration, insert 4.0 hours for plants of less then 2.19 L/s 50,000 GPD, 3.6 hours for plants from 2.19 L/s 50,000 GPD to 6.57 L/s 150,000 GPD capacity, and 3.0 hours for facilities of 6.57 L/s 150,000 GPD capacity and above. For step aeration, insert 3.0 hours.

Delete reference to mechanical aeration when step aeration or complete mixing is specified, or when not allowed for extended aeration. Mechanical aerator may not be suitable for use in areas having prolonged periods of sub-freezing temperatures when spray may form accumulation of ice. Consideration should be given to temperature and detention time of the liquid and freeboard in the chamber in determining temperatures that may be tolerated. Mechanical aerator is not suitable for extended aeration where eventual conversion to step aeration is contemplated.

For extended aeration, insert 0.013 L/s 300 GPD for 6.57 L/s 150,000 GPD capacity and less; and 0.026 L/s 600 GPD for facilities of more than 6.60 L/s 150,000 GPD capacity. For step aeration, insert 0.026 L/s 600 GPD. For complete mixing, insert 0.02 L/s 50 GPD.

Delete reference to mixing with aeration chamber contents for extended aeration and step aeration.

Delete references to and requirements for seismic loading when unnecessary to consider seismic loading. For specific environmental loads (wind, seismic) see UFC 3-301-01.

****

Pass the raw wastewater through a [comminutor] [screening basket] [and an influent distribution channel], aeration chamber of adequate capacity to provide [not less than [_____] hours detention time and] a maximum organic loading not to exceed [_____] kg per 1000 cubic meter [_____] pounds 5-day

BOD per 1,000 cubic feet of aeration chamber volume at average design flow rate. A clarifier chamber of adequate capacity to provide [not less than [_____] hours detention time and] a surface settling rate not to exceed [_____] L/s per square meter GPD per square foot at average design flow rate. The settled sludge is [collected by a mechanical sludge collector and] recirculated back to the aeration chamber [where it is rapidly and thoroughly mixed in with the aeration chamber contents,] or wasted to the sludge holding chamber. Size a disinfection chamber to provide a detention time of at least 15 minutes at peak flow and then to an outfall. The sludge holding chamber has a capacity of not less than 0.057 cubic meter 2 cubic feet per capita. Aeration is by [diffused air] [mechanical aeration].

Plant includes an aeration chamber, [equalization chamber,] clarifier chamber, sludge holding chamber, and disinfection chamber. Chambers may be separate or contiguous with a common partition between. Ensure the plant structure and separate chamber structures withstand [hydrostatic pressures [and seismic loading] when installed above grade and filled to normal operating liquid level] [soil pressures (as indicated by Government-furnished soil borings) when installed below grade, backfilled, and dewatered] [; and seismic loading when installed below grade, backfilled, and filled to normal liquid operating level]. The plant and foundation must have sufficient mass to overcome flotation forces when the entire plant is dewatered. Provide for dewatering of individual chambers or compartments and the entire plant.

The Package Wastewater treatment Plant is constructed of [steel] [composite] [concrete] [_____]. It must be complete and self-sufficient except for electric power, water supply, and disinfection agent. All structural steel must conform to ASTM A36/A36M. All submerged steel members must have minimum thickness of 6 mm 1/4 inch. Perform cast-in-place concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. Precast concrete must be in accordance with [_____]. Results of Government-made soil bearing tests will be furnished to the Contractor.

2.2.1.1 Aeration Chamber

****

NOTE: A mechanical aerator may not be suitable for use in areas having prolonged periods of sub-freezing temperatures when spray may form accumulation of ice. Consider temperature and detention time of the liquid and freeboard in the tank in determining temperatures that may be tolerated. A mechanical aerator is not suitable for extended aeration type where eventual conversion to step aeration is contemplated.

****

The aeration chamber will have capacity to provide [a minimum of [24][_____] hours retention of the average daily flow] [a volume of [_____] L gallons]. Ensure that the interior configuration of the aeration chamber provides thorough mixing and efficient air dispersion, precludes short-circuiting of the liquid flow, and inhibits solids deposition. Provide a [_____] mm inch diameter influent opening, reinforced with a pipe flange or steel plate and with a suitable connection for the [inlet sewer] [raw wastewater pump discharge pipe]. Provide air diffusers in accordance with paragraph DIFFUSED AIR AERATION EQUIPMENT.

2.2.1.2 Clarifier Chamber

****

NOTE: Delete the first and fourth sentences for extended aeration type facilities above 4.38 L/s 100,000 GPD capacity, step aeration type facilities above 3.0 L/s 67,500 GPD capacity, and for all complete mixing type facilities.

Delete reference to mechanical sludge collection equipment for extended aeration type below 0.66 L/s 15,000 GPD capacity. For facilities below 0.66 L/s 15,000 GPD capacity, hopper bottom only should be specified for clarifiers. For facilities above 4.38 L/s 100,000 GPD capacity, consider mechanical sludge collectors clarifier chambers. For facilities between 0.66 L/s and 4.38 L/s 15,000 and 100,000 GPD capacity, either hopper bottom or mechanical sludge collector may be allowed as a Contractor's option.

In all facilities (except circular facilities with concentric inner clarifier) where the design flow exceeds 4.38 L/s 100,000 GPD, the clarifier chamber should be in multiple units each capable of independent operation and whose combined capacity equals the design flow rate when one unit is out of operation. In fourth sentence, delete first and third optional wordings when design flow is 4.38 L/s 100,000 GPD and below; delete second optional wording when design flow exceeds 4.38 L/s 100,000 GPD.

****

[Provide clarifier chamber with a minimum of 4 hours retention time and a hopper bottom[when mechanical sludge collection equipment is not provided].]The clarifier chamber[, except in circular facilities with a concentric inner tank,] is [in a single unit][or][in multiple units] [each of which is capable of independent operation and] whose combined capacity equals the design flow when one unit is out of operation.[The hopper bottom of the clarifier cannot have slide slopes of less than 1.05 rad 60 degrees from the horizontal; horizontal area of hopper bottom is commensurate with the capability of the sludge pump for efficient sludge withdrawal. In lieu of the above, a flat bottom may be provided with a mechanical sludge scraper in accordance with paragraph SLUDGE AND SCUM COLLECTION AND TRANSFER EQUIPMENT.] Provide means of velocity control at the clarifier chamber inlet. Provide a scum baffle, weir, or other means to prevent scum from passing out with effluent. Provide air lift sludge and scum pumps in accordance with paragraph SLUDGE AND SCUM COLLECTION AND TRANSFER EQUIPMENT.

2.2.1.3 Sludge Holding Chamber

****

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

****

Provide a sludge holding chamber with a minimum capacity of [_____] cubic meters cubic feet. Provide a supernatant draw-off connection between the

sludge-holding chamber and the aeration chamber. Provide an inlet pipe connection or sludge weir for transfer of sludge from the clarifier chamber to the sludge holding chamber. Provide pipe connection(s) in this chamber for waste sludge draw-off. Provide air diffusers in accordance with paragraph DIFFUSED AIR AERATION EQUIPMENT.

2.2.1.4 Disinfection Chamber

Provide a disinfection chamber as an integral part of the plant or an adjacent detached tank. Ensure at least 15 minutes contact time at peak flow rate. Provide baffles to eliminate short-circuiting and ensure complete mixing. Provide disinfection equipment in accordance with paragraph DISINFECTION EQUIPMENT. Provide a flange on the outlet of the tank.

2.2.1.5 Structural Requirements for Steel Tanks

Provide tanks suitable for support by and anchorage to a concrete base. Steel tank walls and bottom are structural steel plate. Use minimum 6 mm 1/4 inchstructural steel shapes for reinforcing and bracing are in the thinnest section. Placement of reinforcing and bracing cannot adversely affect the performance characteristics with the aeration tank. All sides, compartment partitions, tank bottoms, braces, and corners are continuously welded inside and out and ground smooth before priming. Ensure that water tightness is provided by means of welding. Ensure that the common partitions are reinforced to withstand pressures resulting from liquid level differentials that would occur when any individual compartment(s) is dewatered while contiguous compartments remain at normal operating liquid level.

2.3 EQUIPMENT

2.3.1 Aeration Equipment

****
NOTE: Delete reference to mechanical aerator when step aeration type or complete mixing type is specified, or when not allowed.
****

Aeration will take place by [diffused air] [fixed mechanical aeration]. Ensure that the aeration system supplies 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.). The aeration equipment will completely mix the contents of the aeration tank and maintain a minimum velocity of 0.18 m/s 0.6 fps.

2.3.1.1 Diffused Air Aeration Equipment

****
NOTE: Delete reference to coarse bubble type when not allowed. For facilities of 2.19 L/s 50,000 GPD capacity and below, fine bubble diffusers or coarse bubble diffusers are allowed as Contractor's option. For facilities of more than 2.19 L/s 50,000 GPD, use fine bubble diffusers.
****

Aeration equipment includes diffusers, diffuser holder assembly, air

blower assembly, and piping. Provide [fine bubble] [coarse bubble] diffusers. Ensure that the oxygen transfer capacity of the diffuser system is capable of furnishing an adequate supply of oxygen in the aeration tank to meet treatment requirements at the design wastewater load.

2.3.1.1.1 Air Diffusers

Ensure that the diffuser layout provides sufficient mixing capacity to thoroughly mix the waste water throughout the tank depth. Use fixed-nozzle diffusers, individually attached to the headers by screwed connections, U-bolts, or stainless steel straps and springs. Welded or other nonremovable connections are not acceptable. Ensure 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. Provide diffusers of plastic, stainless steel, rubber, or other corrosion resistant material and seal under no-flow conditions to prevent wastewater from entering the piping system.

2.3.1.1.2 Diffuser Holder Assembly

****
NOTE: Delete reference to swing-out type when steel plant only is required.
****

The assembly includes an air control and shut-off valve and all the air piping downstream from this valve. Select a butterfly valve, plug valve, or globe valve suitable for air control with indicator markings for throttling and complete shut-off. The diffuser holder assembly is the [fixed type] [or swing-out type]. Ensure that the spacing of diffuser assemblies in the tank and diffusers on the header is as recommended by the diffuser manufacturer. Provide independently valved and supported headers capable of being independently removed from service without the use of a crane or hoist and without dewatering of the tank.

2.3.1.1.3 Air Diffusers

Provide a drop-pipe with air diffusers in the chamber with placement of diffusers near the bottom. Ensure that the amount of air supplied to the tank is sufficient to allow aerobic stabilization of solids and in no case less than 0.25 cubic meter per second of air per 1,000 cubic meters 15 CFM of air per 1,000 cubic feet of tank volume.

2.3.1.2 Mechanical Aeration Equipment

****
NOTE: Delete paragraph and subparagraph when step aeration type or complete mixing type is specified, or when mechanical aerator is not allowed.
****

Provide a fixed type mechanical aerator. Include a drive assembly, impeller shaft, impeller, and shroud. Provide all accessories necessary for proper operation and to generate the necessary required oxygenation capacity, including flow straightening surge rings or tank baffles.

2.3.1.2.1 Drive Assembly

Provide a fully enclosed for outdoor installation drive assembly including

an electric motor, gear reduction unit, and bearings.

a. Motor: Motor is constant speed, totally enclosed, fan-cooled, horizontal type, with solid shaft, suitable for outdoor service, and conforming to NEMA MG 1. Ensure that the motor is of adequate wattage horsepower to drive the equipment continuously at the maximum load encountered under any operating condition without overloading or exceeding the nameplate rating of the motor. Motor must be suitable for operation with the voltage characteristics indicated. Motor must be protected against overload, low voltage, and unbalanced voltage. Connect vertical motor directly to the gear reduction unit or else connect by a flexible coupling. Connect horizontal to the gear reduction unit by a flexible coupling only. In lieu of a constant speed motor with a gear reduction unit, a two-speed motor may be provided as a means of speed reduction.

b. Gear Reduction Unit: Ensure a minimum AGMA service factor when the unit is operating at full load motor wattage horsepower, 24 hours a day continuous running under moderate shock loads, of 1.5 for speed reducers and 2.0 for gear motors. Ensure a life expectancy of 100,000 hours with the probability of no more than 10 percent failures prior to its expected life. Gearing may be spur, helical, spiral bevel, or a combination. If helical, the helical angle must not exceed 0.314 rad 18 degrees. Worm gearing will not be acceptable. All gears must be AGMA Quality 10 or higher as outlined in AGMA ISO 10064-6, AGMA ISO 17485 or AGMA 2011. Provide a lubrication system for the gears.

c. Bearings must have a minimum rated life expectancy (L-10) of 100,000 hours based on ABMA 11 Standards when operating continuously at the rated full-load motor wattage horsepower and speed under the specified loading conditions. Internal bearings may be either oil or grease lubricated. All grease lubrication pressure lines must be fed from fittings accessibly located above the platform supporting the mechanism.Underwater bearings are not acceptable.

2.3.1.2.2 Impeller Shaft

Ensure that the shaft is of sufficient diameter to withstand the loading imposed by the impeller, using a safety factor of 1.5. The shaft must be removable from the speed reducer.

2.3.1.2.3 Impeller

The aeration blades must be designed to achieve the maximum aeration and pumping effect. The impeller must be readily removable from the shaft.

2.3.1.2.4 Shroud

Equip the aerator with a shroud to prevent the mixed liquor from splashing and spraying the underside of the supporting platform, walkway, railings, and walls of the aeration tank.

2.3.1.2.5 Mechanical Aerator Supports, Walkways and Rails

Place supports for mechanical aerator mounting plate on the bottom of the chamber or extended from structural steel beams on tank walls. Provide a service walkway to the mechanical aerator and handrails on each side.

2.3.1.3 Screening

****
NOTE: Delete comminutor and subparagraphs when comminutor is not required. For facilities of 1.09 L/s 25,000 GPD capacity and below, the comminutor may be omitted, and a screening basket provided. For installations in which all wastewater has passed through a comminutor and bar screen upstream, a comminutor is not required.
****

Provide a [comminutor] [screening basket] [bar screen] in the influent line immediately upstream of the aeration chamber.

[2.3.1.3.1 Comminutor

Provide a rotating type comminutor capable of cutting all wastewater solids including sticks, rags, and stringy material without clogging the screen or binding, jamming or stalling the moving parts under normal load conditions. Ensure that the comminutor is capable of continuous operation and have a hydraulic capacity at least equal to the treatment facility peak flow rate and at zero flow conditions. Ensure that the screen configuration is such that all wastewater must pass through it before entering the treatment facility. Space screen bars not greater than 6 mm 1/4 inch apart. Provide cutters constructed of tool steel with a surface hardness of at least 35 on Rockwell C scale. Ensure cutters are removable for replacement. Ensure free discharge where the discharge is located above the liquid level in the aeration chamber or controlled discharge when partially submerged.

2.3.1.3.1.1 Comminutor Drive

Provide a comminutor driven by an electric motor, constant speed, totally enclosed, horizontal or vertical type, suitable for outdoor service, and conforming to NEMA MG 1. The motor must be of adequate wattage horsepower to drive the comminutor continuously at the maximum load encountered under any operating condition without overloading or exceeding the nameplate rating of the motor. Motor must be suitable for operation with the voltage characteristics as indicated. Motor must be protected against overload, low voltage, and unbalanced voltage.

][2.3.1.3.2 Screening Basket

Provide at the plant influent, a readily removable, fabricated steel screening basket, sized for maximum flow, located so that the total volume of incoming raw wastewater is screened before it enters the plant. Fabricate the basket from 5 mm 3/16 inch diameter 302 stainless steel wire or 10 mm 3/8 inch hot-rolled steel bars with 25 mm one inch space between bars.

][2.3.1.3.3 Bar Screen

Provide an inlet bar screen to remove large solids from the incoming raw wastewater. Fabricate the bars from 13 mm 1/2 inch diameter bars spaced 25 mm one inch apart and arranged as shown in the drawings. The bars will be sloped to permit easy cleaning of debris. Furnish a drying deck for the debris.

]2.3.2 Sludge and Scum Collection and Transfer Equipment

****

NOTE: For facilities below 0.66 L/s 15,000 GPD capacity, hopper bottom only should be specified for clarifier chambers. For facilities above 4.38 L/s 100,000 GPD capacity, mechanical sludge collectors should be used in clarifier chambers. For facilities between 0.66 L/s and 4.38 L/s 15,000 and 100,000 GPD capacity, either hopper bottom or mechanical sludge collector should be allowed.

Delete reference to mechanical sludge collection equipment for extended aeration facilities below 0.66 L/s 15,000 GPD capacity.

****

Provide equipment to collect sludge from the bottom of the clarifier chamber. Collect sludge through the use of a hopper bottom clarifier chamber or a flat bottom clarifier chamber with a mechanical collector. The equipment will also collect scum from the top of the clarifier. Sludge and scum collection and transfer equipment includes sludge transfer pump(s), [mechanical sludge collection equipment [(if used)],] scum collection and transfer system, and supernatant transfer.

2.3.2.1 Sludge Transfer Pumps

Provide a positive sludge recirculation system. If the sludge clarifier is the hopper bottom type, provide at least one air lift pump in each hopper. If the clarifier contains a mechanical sludge collector, provide an air lift pump at the collector discharge. Each air lift includes a foot piece, eductor, air and vent piping, and control valves. Sludge recirculation air lifts will have recirculation capacity of 0 percent to 150 percent of the design flow. Support pump and equip with a clean-out plug for cleaning and maintenance.

2.3.2.2 Mechanical Sludge Collection Equipment

If the clarifier does not have a hopper bottom, provide a mechanical sludge collector to scrape the entire tank bottom. Mechanical sludge collectors may be either the rotating arm or conveyor type. Drive the collector by an electric motor through an appropriate gear or chain drive. Position motors and drives above the plant high water level or use equipment suitable for submerged service. Ensure motors are totally enclosed and conform to NEMA MG 1. Furnish each motor with a magnetic starter with thermal overload protection and control devices conforming to NEMA ICS 1. Avoid sludge-residence time exceeding 3 hours. Scraper blades will be replaceable. Provide collector drive with overload protection.

2.3.2.3 Scum Collection and Transfer Equipment

2.3.2.3.1 Scum Collection in Hopper Bottom Settling Tanks

Scum collection is accomplished by means of a suction skimmer. Suction skimmer is a 50 mm 2 inch diameter drop pipe supported by a structural steel member and so mounted that it can be raised or lowered with respect to the liquid surface by means of stainless steel adjusting screws with hand knobs or by corrosion-resisting turnbuckles located above the liquid surface. Attach the lower end of drop pipe to a 50 mm 2 inch air lift by

means of a flexible hose of chloroprene or other material suitable for use in sewage.

2.3.2.3.2 Scum Collection in Circular Settling Tanks

Scum Collection in Circular Setting Tanks With Mechanical Sludge Collectors: Scum collector assembly includes a blade skimmer and a scum trough. Assembly is continuously move surface scum to the scum trough. The assembly discharges scum with a minimum discharge of water. Blade skimmer includes an arm fabricated of structural steel shapes and attached to a steel blade skimmer or floating redwood skimmer, with an adjustable chloroprene wiper. Scum skimmer is supported by the center shaft and one scraper arm. Scum trough is welded structural steel, minimum thickness 6 mm 1/4 inch, has a connection to the scum airlift pump, and supported from the tank wall or scum baffles. Shape the inclined approach ramp leading to the scum trough to contain the scum as it is moved up the incline to the trough by the scum skimmer.

2.3.2.3.3 Scum Collection in Rectangular Settling Tanks

Scum Collection in Rectangular Setting Tanks With Mechanical Sludge Collectors: Accomplish the scum collection by means of traveling blade or paddle skimmer or by suction skimmer. Attach the traveling blade or paddle skimmer to the traveling sludge collector at surface level and designed to sweep the surface of the settling tank in one direction only with each pass of the sludge collector. Collected scum is discharged into a trough, collector pipe or suction skimmer. Scum trough is steel, 6 mm 1/4 inch minimum thickness, with approach ramp and have a connection to the scum air lift pipe and supported from the tank wall. The collector pipe is steel pipe with a 1.05 rad 60 degree wide slot cut symmetrically above the vertical axis. At maximum intervals of 750 mm 30 inches, a 50 mm 2 inch wide band of full circumference is left for stiffness. End supports includes a rolled steel collar welded to an adjustable steel end plate. Provide a readily renewable grease-resistant, watertight seal and so constructed that it will allow smooth action of the revolving pipe. Ensure that the seal is readily renewable without removing pipe. Secure the end supports to the concrete walls by stainless steel anchor bolts having a minimum diameter of 16 mm 5/8 inch. Collector pipe operator is a manual, lever type, mounted on the collector pipe. Operator is steel pipe having a minimum diameter of 31 mm 1 1/4 inches and secured to the collector pipe with a bolted connection. The operator extends at least 900 mm 3 feet above the top of tank and permits rotation of the collector pipe to at least 0.52 rad 30 degrees of each side of the vertical axis. Ensure that the collector pipe has a suitable means of discharge to the scum airlift pump.

2.3.2.3.4 Scum Recirculation System

Scum transfer is accomplished by means of an airlift pump. Airlift pump consists of a 50 mm 2 inch airlift skimming device. The skimming device will skim and return floating material to the aeration chamber. Equip the supply airline with a valve to regulate the rate of return. Ensure the scum intake is adjustable providing exact positioning of the skimmer at water level.

2.3.2.4 Supernatant Transfer

When a pump is used for supernatant transfer, provide a positive means of flow regulation. Provide all necessary piping.

[2.3.3 Froth Control System

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NOTE: Froth removal may be required where nicardia foaming is a potential problem.
****

Provide a froth control system including: pump, piping, manifold, spray nozzles, and valves.

2.3.3.1 Froth Control System Pump

Provide an electric motor operated, self-contained, submersible pump suitable for the required service. Mount the pump with the suction no less than 50 mm 2 inches below the water surface but not so deep that the pump will pick up settled solids. Provide an intake screen around the pump suction. Ensure that the screen openings are no larger than the pump nozzle opening. Provide a watertight motor in accordance with NEMA MG 1. Provide controls, including a magnetic starter with start and stop buttons and a circuit breaker with reset button in conformance with NEMA ICS 1.

2.3.3.2 Spray Nozzles

Provide self-cleaning spray nozzles, that will produce a sharp flat or conical spray at normal pumping rates. Use spray nozzles of corrosion-resisting materials to provide sufficient force at a flow rate of 0.1 L/second 1-1/2 gpm per nozzle to effectively break down accumulated froth. Mount spray nozzles to provide uniform coverage of the chamber.

2.3.3.3 Piping and Valves

Provide a froth spray header of at least 25 mm one inch diameter galvanized steel or PVC pipe and mount above the water surface opposite the air diffusers. Provide for a garden hose connection for wash-down purposes.

]2.3.4 Air Blower Assembly

Provide an air blower assembly including: air blowers, blower driver, V-belt drive (for positive displacement blower), housing and accessories. Provide each blower with [a filter-silencer on the suction side,] a check valve, pressure relief valve, and pressure gauge.

2.3.4.1 Air Blower

Provide at least two air blowers with the capacity to produce the plant air requirement at the necessary operating pressure including allowance for pressure drop in air piping, fittings, and accessories. The unit will deliver [_____] cubic meters/second cfm when operating at [_____] kPag psig. Ensure blowers are suitable for continuous operation. Each blower must have the capacity to provide the total plant air requirement.

2.3.4.2 Blower Driver

The blower drive consists of an electric motor, V-belts, and sheaves. Motor must be suitable for operation with the voltage characteristics as indicated. Blower motor will be weatherproof conforming to NEMA MG 1. Provide a constant speed, totally enclosed, fan-cooled motor, suitable for

outdoor service, and conforming to NEMA MG 1. Ensure that the motor is of adequate wattage horsepower to drive the equipment continuously at the maximum load encountered under any operating condition without overloading or exceeding the nameplate rating of the motor. Ensure that the motor is suitable for operation with the voltage characteristics as indicated. Protect the motor against overload, low voltage, and unbalanced voltage. Provide any silencing or dampening required.

2.3.4.3 Air Blower and Blower Driver Housing

Mount the blower-driver on a base plate with vibration dampening in a weatherproof, corrosion resistant enclosure. Ensure that the base plate has provisions for adjustment of V-belt tension, and provides the necessary anchoring. Provide louvers or ventilation adequate to provide air for cooling and, if the intake is in the enclosure, for blower supply. Allow access to the blowers and motors for maintenance.

2.3.4.4 Air Blower Accessories

[2.3.4.4.1 Air Filter Silencer

****

NOTE: Optional, consider use of filter-silencers on blowers of 0.094 cubic meters/second 200 cfm or less or separate silencer and air filter as well as a discharge silencer on blowers over 0.094 cubic meters/second 200 cfm.

****

Provide filter-silencer type, cleanable, air filters. If filters are mounted outside, provide weatherproof enclosures. Provide filters having a maximum pressure loss of 25 mm 1.0 inch water gage mm In.W.G. at the maximum capacity of blower when clean. Ensure that the silencing chamber has a peak attenuation in the frequency range 300-1, 1,200 cycles per second.

]2.3.4.4.2 Pressure Relief Valve

Provide a pressure relief valve for each blower on the discharge side. Furnish a valve for a pressure setting of not more than 90 percent of the maximum operating pressure.

2.3.4.4.3 Check Valve

Provide a check valve on the discharge side of each blower.

2.3.4.4.4 Pressure Gage

Provide an air pressure gage on the discharge line from each blower. Gauge scale range to include the full range of expected operation and up to 125 percent, but not more than 150 percent of maximum. Mount the gages in an easy to read location within the enclosure.

2.3.5 Disinfection Equipment

****

NOTE: Delete the reference to a heater for plants in areas where freezing temperatures are not encountered.

For small facilities of that do not require flow proportional chlorination, a tablet chlorinator offers a safe and effective means of disinfection.

Delete unused disinfection system paragraphs below. Hypochlorinator may be specified for plants 4.38 L/s 100,000 GPD capacity and below. Chlorinator may be specified for all plants 6.57 L/s 150,000 GPD capacity and above. Make a selection on basis of existing station or base practices, local availability, and comparative costs.
****

Provide the manufacturer's standard disinfection system [Chlorine Tablet Feed] [Chlorinator Assembly] [Hypochlorinator Assembly] [UV Disinfection].

[2.3.5.1 UV Disinfection

Ultra-violet system includes lamps, ballasts, and controls.[Provide heater.]

][2.3.5.2 Chlorine Tablet Feed

Provide a tablet chlorinator feeder[, provide heater if required].

][2.3.5.3 Hypochlorinator Assembly

Provide hypochlorite assembly in accordance with Section 46 31 11 CHLORINE GAS FEED EQUIPMENT. Provide an adjustable capacity system of between 2 to 8 mg/L of chlorine equivalent, with fully automatic and manually adjustable operation[, provide heater if required].

][2.3.5.4 Chlorinator Assembly

Chlorinator assembly includes chlorinator, scale, chlorine gas manifold, flexible connector, water piping, chlorine solution piping, vent tubing, vacuum signal tubing, diffuser, and housing. Provide chlorinator assembly in accordance with Section 46 31 11 CHLORINE GAS FEED EQUIPMENT. Ensure that the chlorinator has proportional-automatic control. Ensure that the chlorinator receives chlorine gas from chlorine cylinders and water from the water supply system[, provide heater if required]. Discharge the chlorine solution through piping to the diffuser located in the chlorine contact chamber.

]2.3.6 Flow Measuring Equipment

2.3.6.1 V-notch weir

Use a V-notch weir that can measure flow to plus or minus 2 percent of the actual rate over a five-to-one range.

2.3.6.2 Float Operation

Provide flow measurement of wastewater by an effluent weir and a recorder. The recorder will be of the electrically operated circular or strip chart type and continuously record the flow through the plant in L/second gpm. The recorder will also produce an electrical signal in proportion to the flow for control of the chlorinator. Provide a

weatherproof enclosure for the recorder.

2.3.6.3 Ultrasonic Measuring

Measure wastewater flow by an effluent weir and an ultrasonic flow meter with digital recorder. Measurement is noncontact, echo-time measuring-type for use with V-notch weir. Provide reference receivers for instant compensation in gas medium for temperature, atmospheric pressure and humidity changes. Provide a NEMA 4X enclosure for the transmitter and include an indicator and recorder. Ensure the transmitter provides a flow proportional signal if required.

2.3.6.4 Flow Control

Provide adjustable weirs at the inlet and outlet of the disinfection chamber for control of wastewater depth in the plant.

2.4 COMPONENTS

2.4.1 Piping System

2.4.1.1 Air Piping

Air piping includes all piping from the blowers to the diffusers and air lift pumps. Provide gate valves in air piping branches from air main when serving two or more air diffuser drop pipes; provide gate valves as blow-off valves for air mains.

2.4.1.2 Sludge Return, Waste Sludge and Scum Return Piping

Provide valves on air lift discharge piping between the air lift discharge riser and the air separator. Provide gate valves, globe valves, or plug valves in branch piping for return sludge and waste sludge lines when separate return sludge and waste sludge pumps are not used.

[2.4.1.3 Froth Control System Piping

Provide valves in suction and discharge piping to froth control pump and in the froth control main line piping.

]2.4.1.4 Miscellaneous Piping

Provide a flanged connection to incoming wastewater line. [Provide inlet piping for concrete aeration tanks in sleeve in wall and connected to incoming sewer by means of a grout ring.]Provide gate valves or shear gates for a tank drain or dewatering piping.

2.4.2 Electrical Control System Components

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NOTE: Specify outdoor type enclosure except when enclosure will be located in a building.

****

The system includes enclosure; main and branch circuit breakers; starters, contactors, and reset buttons; selector switches, push buttons, and pilot lights; circuit control items for electrical control of the various plant components; and all necessary wiring and tubing. Provide an electrical control system in accordance with NEMA ICS 1. Ensure that all electrical

components are in accordance with the requirements of NFPA 70.

Mount electrical controls in [outdoor weatherproof enclosure, NEMA [3R][4X]] [indoor enclosure, NEMA 1 OR NEMA 12]. Wire electrical controls so that the various items of plant equipment can be operated either manually or automatically. Completely wire all electrical control system components and mount in the enclosure at the manufacturer's facility and test prior to shipment from the factory. The electric service available is [_____] volt, [_____] phase, [_____] Hertz, [_____] wire. [Install all push buttons, selector switches, and indicating lights on the outside of the door(s), properly identified with name plates.]Identify all components on the [outside of enclosure and on the] internal panel.

2.4.2.1 Sequence of Operation

Ensure the electrical control system and its components perform the following automatic functions:

****
NOTE: Delete reference to comminutor when not required.
****

a. The 7-day program timer automatically starts and stops the blowers [comminutor,] [and froth control system pump]. A percentage timer automatically starts and stops blower motors.

b. If operating lead blower should stop, standby blower, acting in response to setting of failure transfer timer, automatically starts and stays in operation until such time as lead blower returns to service. Range of failure transfer timer is such as to prevent the transfer to the standby system from such causes as momentary interruptions of power, loss of power and similar malfunctions. Provide a selector switch to allow manual change in the lead-standby system. Arrange pressure switches in the motor control circuit to cause the system failure transfer circuit to operate when there is a lack of or loss of pressure due to belt slippage or breakage, or air loss, until such time as the fault is corrected. Horn and warning light alarm circuits are energized to indicate that the standby system has replaced the selected lead blower in operation.

c. [Chlorinator is controlled by the flow meter and starts, stops, and proportionally regulates the dosage in response to the received signals.][[Hypochlorinator][Tablet feeder] starts and stops in response to signals from liquid level sensing probes.]

d. Thermostat automatically places into operation equipment automatically taken out of service by the 7-day timer when the outside air temperature drops below 0 degrees C 32 degrees F or any other predetermined temperature setting.

e. A percentage timer automatically controls the sludge transfer pump, scum transfer pump, and supernatant return pump.

[f. Ensure that the froth control system pump is suitably interlocked with blowers so as to automatically start and stop in parallel with the blowers.

]2.4.2.2 Circuit Breakers

All circuit breakers must be thermal magnetic type and meet the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.4.2.2.1 Main Circuit Breaker

Ensure that the main circuit breaker has a maximum capacity of 150 percent of the electrical load. The main circuit breaker has an external handle mechanism mounted outside the enclosure to permit operation of this breaker from outside the enclosure. Provide the main circuit breaker with positive locking device to permit locking the operating handle.

2.4.2.2.2 Branch Circuit Breakers

****
NOTE: Delete references to unused components.
****

Provide an E-frame bolt-on type branch circuit breakers mounted on an interior bus bar. Provide branch circuit breakers for each blower, [comminutor,] [mechanical aerator(s),] froth control system pump, [sludge collector drive motor,] [hypochlorinator,] control circuit, [control circuit transformer,] flow meter, [chlorinator housing heater,] [hypochlorinator housing heating device,] drive motor, lighting circuit(s), and receptacle. Ensure that the panel includes spaces for four additional circuit breakers.

2.4.2.3 Starters, Contactors, and Reset Buttons

Provide magnetic starters for each blower motor, [(each) mechanical aerator motor,] [comminutor motor,] and froth control system pump motor, [sludge collector drive motor]. Mount reset buttons for magnetic starters on enclosure doors.

[2.4.2.4 Selector Switches, Pushbuttons, and Pilot Lights

Mount selector switches, pushbuttons, and pilot lights on the outside of the enclosure. Provide One Hand-Off-Automatic (H-O-A) selector switch for each motor starter. Provide one selector switch for changing lead blower in the lead-standby system. Provide push buttons for manual (Hand) operation of motors. Provide pilot lights for each H-O-A selector switch: red to indicated motor is running and amber to indicate automatic operation. Connections to the selector switch are such that only the normal automatic regulating control devices will be by-passed when the switch is in the "Hand" position. Connect all safety control devices such as motor overload protection devices in the motor control circuit in both the "Hand" and "Automatic" positions.

]2.4.2.5 Circuit Controls

****
NOTE: Delete last sentence when not necessary.
****

Circuit controls include the following: Program timer, 30-minute percentage timer, thermostat, control circuit transformer, and all necessary relays and pressure switches to carry out the sequence of operation as specified above. Program timer is the 7-day type, electric

motor driven, with each hour of the day shown. Ensure that the time intervals are adjustable with a minimum switching interval of 4 hours. Percentage timer is 30-minute type.[Provide a transformer to step down incoming service voltage to 120 volts.]

[2.4.2.6 Alarm

****
NOTE: Delete requirements for alarm circuit auxiliary contacts where transmission of alarm to remote 24-hour manned station is impractical or not desired. Transmission is preferred where necessary to expedite investigation of alarm condition. Insert identity of remote location. Provision should be made in the appropriate section of the project specification to extend alarm circuit wiring from auxiliary contacts to the remote location.
****

Provide a horn or 150 mm 6 inch bell alarm, battery and necessary circuits to sound alarm:

a. when standby blower(s) has replaced lead blower

b. when power to plant has been interrupted

[Include an alarm circuit with auxiliary contacts for transmission of signal indicative of either alarm condition to [_____].

]]2.4.2.7 Electrical Wiring

Wire all control circuits in accordance with the Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.5 MATERIALS

2.5.1 Treatment and Painting

Except as otherwise specified, treat and paint equipment in accordance with the manufacturer's standard practice.

2.5.2 Lubrication

For equipment requiring lubrication, provide means for lubrication of all moving parts and lubricate prior to delivery.

2.5.3 Steel Plates, Shapes, and Bars

For steel plates, shapes, and bars, conform to ASTM A36/A36M or ASTM A276/A276M.

2.5.4 Ductile Iron Pipe and Fittings

For ductile iron pipe, conform to AWWA C151/A21.51, ASME B16.4 and ASME B16.5.

2.5.4.1 Flanged Ductile Iron Pipe

For flanged pipe, conform to AWWA C115/A21.15 with ASME B16.1, Class 125

flanges.

2.5.4.2 Joints

For joints for ductile iron pipe, conform to AWWA C111/A21.11.

2.5.4.3 Fittings for Ductile Iron Pipe

For fittings for ductile iron pipe, conform to AWWA C110/A21.10.

2.5.5 Steel Pipe

For steel pipe, conform to AWWA C200.

2.5.5.1 Flanged Joints

For flanged joints, conform to AWWA C207, Class B Ring Type.

2.5.5.2 Slip Joints

For slip joints, conform to AWWA C200.

2.5.5.3 Mechanical Joints

For mechanical joints, conform to AWWA C200.

2.5.5.4 Welded Joints

For welded joints, conform to AWWA C206.

2.5.5.5 Fittings for Steel Pipe

For steel pipe fittings, conform to AWWA C200.

2.5.6 Galvanized Steel Pipe and Fittings

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

2.5.7 Polyvinyl Chloride (PVC) Pipe and Fittings

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

2.5.7.1 Push-On Joints

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

2.5.7.2 Solvent Cement

Solvent cement will conform to ASTM D2564.

2.5.8 Pipe Hangers and Supports

Pipe hangers and supports will conform to MSS SP-58.

2.5.9 Valves

2.5.9.1 Angle, Check, and Globe Valves

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

2.5.9.2 Gate Valves

Gate valves will conform to MSS SP-80 or MSS SP-70.

2.5.9.3 Plug Valves

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

2.5.10 Butterfly Valves

Provide butterfly valves conforming to AWWA C504.

2.5.11 Joint Compound

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

2.5.12 Joint Tape

Joint tape for screw joints will conform to ASTM D3308.

2.5.13 Bolts and Nuts

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

2.5.14 Gears

Conform to the following for AGMA standards for surface durability, strength and materials: Spur gearing and helical gearing: AGMA 908, ANSI/AGMA 2001, ANSI/AGMA 2004, ANSI/AGMA 6113 ANSI/AGMA 6013, and ANSI/AGMA 6034

2.6 ACCESSORIES

[2.6.1 Chlorine Gas Manifold

Ensure that the chlorine gas manifold is a material resistant to chlorine and suitable for the working pressure involved.

2.6.2 Flexible Connector

Ensure that the flexible connector between the chlorine gas manifold and the chlorinator is extra-heavy Type K seamless copper tube conforming to ASTM B88M ASTM B88.

2.6.3 Water Piping

Water piping is schedule 80 PVC piping with solvent welded joints. Provide a gate valve and check valve conforming to MSS SP-80 and a Y-pattern brass or stainless steel strainer.

2.6.4 Solution Piping

Ensure that the solution piping from chlorinator to diffuser is flexible polyethylene pipe, chlorine solution hose, rigid polyvinylchloride (PVC) pipe, or rigid acrylonitrile-butadiene-styrene (ABS) pipe.

2.6.5 Vent Tubing

Vent tubing is any elastomer or plastic tubing resistant to chlorine or chlorine solutions. Any other material having qualities acceptable for such use may be substituted in place of the elastomer or plastic tubing. Slope the vent line continuously downward to outside of housing without dips or sags. Provide an insect screen at end of line.

2.6.6 Signal Tubing

Signal tubing is Type K soft copper tubing.

2.6.7 Diffuser

Provide a diffuser of rigid PVC or ABS pipe, resistant to chlorine solution. Provide an open channel type diffuser that is perforated and fastened at each end to the tank wall near the bottom in the flow stream of the influent to the chlorine contact tank.

2.6.8 Housing

Enclose the chlorinator scale, piping, and controls in a weatherproof housing constructed of 0.9 mm 20 gage metal with minimum 25 mm one inch insulation. Provide a full access door for easy access to equipment. Mount the housing on top of treatment plant or on a concrete pad adjacent to the chlorine contact tank that projects not less than 150 mm 6 inches beyond outside face of housing. Provide a thermostatically controlled space heater within the housing to maintain a temperature of 21 degrees C 70 degrees F.

]2.6.9 Appurtenances and Accessories

2.6.9.1 Walkways, Platforms, and Bridges

****
NOTE: Include handrails around plant perimeter if plant is installed with tank walls at or near grade.
****

Provide access walkways and platforms for access to all equipment for operation and maintenance. Make walkways and platforms nonslip open grating fabricated from galvanized steel, factory painted mild steel, aluminum, or fiberglass. Provide rigid handrails along the sides of walkways and platforms [and around the perimeter of the entire plant]. Fabricate handrails from aluminum, galvanized steel or painted steel, be 1075 mm 42 inch high, and have two horizontal rails. Provide gates as required for access to equipment. Provide access walkways, platforms, and

handrails conforming to Section 05 12 00 STRUCTURAL STEEL.

[2.6.9.2 [Access Stairway] [Access Ladder]

****

NOTE: Delete references and requirements for access ladder as Contractor's option unless it can be justified on an economic and technical basis. Although more expensive, a stairway is preferable in that it provides safer and easier access to platforms and walkways.

Delete "raised platform floor plate" or "grating" as necessary. Delete references and requirements for raised platform floor plate or for grating as necessary. Grating is recommended where snow or ice accumulation may be anticipated; otherwise, use floor plate.

****

When top of plant is more than 600 mm 24 inches above surrounding ground level, provide an access [stairway] [ladder]. Fabricate stairway of structural steel members. Steps are [raised-pattern floor plate] [grating].[Provide access ladder(s) of steel or aluminum and be 450 mm 18 inches wide minimum, with step bars spaced 300 mm 12 inches on center. Provide ladders anchored at the bottom, top, and intermediate points with brackets 1.8 m 6 feet apart. Ensure that the brackets are the same size as side bars and of such length as to hold ladder 150 mm 6 inch away from walls. Provide curved returns at top of ladder. Aluminum side bars and step bars conform to ASTM B221M ASTM B221.]

]2.6.9.3 Handrails

Provide handrails on stairways, platforms, bridges, and other points of personnel access for operation and inspection. Provide a handrail around the perimeter of the tank if the top of the exposed side wall is less than 1.07 m 3 feet 6 inches above grade. Construct handrails of structural steel section or of standard 38 mm 1 1/2 inch pipe conforming to ASTM A53/A53M.

[2.6.9.4 Raw Wastewater Recirculation Box

****

NOTE: Delete this paragraph when raw wastewater recirculation box is considered unnecessary. When wastewater is pumped to the treatment plant, the use of a raw wastewater recirculation box (which recirculates a portion of incoming wastewater back to the pumping station) should be considered to provide uniform flow and avoid surges through the plant. Base decision on undesirability of surge effects on the plant vs. economics of the recirculation system.

****

Fabricate a raw wastewater recirculation box from 6 mm 1/4 inch steel plate and have suitable sized connections for incoming raw wastewater line, plant influent line, and recirculation line. Provide box with a fixed weir and an adjustable weir or other suitable means of flow

regulation so that a portion of the incoming raw wastewater may be recirculated. Provide a removable or hinged cover. Continuously weld the joints inside walls, bottom, and partitions inside and out. After welding, remove weld spatter and extreme roughness. Inlet cannot be less than 200 mm 8 inch size.

]2.6.9.5 Influent Flow Division Box

****

NOTE: Delete this paragraph when not used. Delete for extended aeration type 0.66 L/s 15,000 GPD and below and for all step aeration type and complete mixing type facilities and extended aeration type when complete mixing type facilities and extended aeration type when eventual conversion to step aeration type is contemplated.

****

With two or more aeration tanks, provide a plant influent flow division box. Fabricate the box of 6 mm 1/4 inch steel plate and have suitably sized connections for incoming raw wastewater line and influent lines to each aeration tank. Ensure that the box for dividing flow between two tanks has a hinged divider plate that will permit adjustment of from zero to 100 percent to either outlet. Divider plate has locking nut and handle. Ensure that the box has a hinged cover with provisions for padlocking. Provide a continuous weld for all inside walls, bottom, and partitions, inside and out. After welding, remove all weld spatter and extreme roughness. Flow division boxes for more than two tanks are as specified herein, except that method of flow division is as recommended by the manufacturer of the plant.

2.6.9.6 Influent Distribution Channel

****

NOTE: Delete this paragraph for extended aeration type except when eventual conversion to step aeration type is contemplated.

Use first optional wording in fifth sentence for step aeration type and second optional wording for complete missing type.

****

Continuously weld the aeration tank influent distribution channel to the side of the tank wall. Ensure that the bottom of the channel is at the same elevation as the liquid surface of the aeration tank. The inlet to the channel is at one point and not less than 200 mm 8 inches in diameter. Fabricate the channel from steel plate of not less than 6 mm 1/4 inch thickness. Provide the channel with [adjustable weirs or stop gates, not less than three in number, spaced the full length of the channel] [multiple discharge openings] for uniform distribution to the aeration tank. Provide weir or stop gates of stainless steel or aluminum. Ensure that the gates have gaskets on the bottom, with wedges or other means to insure a close fit. Guides for the gates are of the same material as the gates. Ensure that the channel is of such size as to accommodate the peak flow to the plant.

2.6.9.7 Sludge Division Box

Provide a sludge division box to divide return sludge and waste sludge when this method of sludge transfer is used, as specified in paragraph SLUDGE TRANSFER SYSTEM. Fabricate the box of 6 mm 1/4 inch steel plate and have a suitably sized connection for incoming sludge and outlets for return sludge and waste sludge. Provide the box with a hinged plate or adjustable gate that will permit adjustment of flow from zero to 100 percent to either outlet. Plate or gate to have a locking nut and handle. Provide a weir on each outlet. Ensure that the box is adequately [covered] [and baffled] to prevent splashing of the sludge. Continuously weld all joints between walls, bottom, and partitions inside and out. After welding, remove all weld spatter and extreme roughness.

2.6.9.8 Clarifier Effluent Weir and Scum Baffle

Provide weir and scum baffles of stainless steel, ASTM A240/A240M, ASTM A36/A36M, or aluminum ASTM B209M ASTM B209 or ASTM B221M ASTM B221, alloy 6061, temper T6. Provide weirs, of a size and section for structural stability to handle peak flows through the plant. The upstream face of the weir plate is flat and smooth. Ensure that the weir plates and baffle supports permit horizontal and vertical adjustment of the weir and baffle. Mount weir plates to fill any voids between the tank and the weir plate.

2.6.9.9 Mixer for Return Sludge Mixing

****

NOTE: Delete this paragraph and subparagraphs thereto except for complete mixing type.

****

2.6.9.9.1 General

Provide a vertical mixer and include a drive assembly, impeller shaft and impeller, and support. The mixer will continuously mix raw wastewater with return sludge so that the mixture is homogeneous.

2.6.9.9.2 Drive Assembly

Mixer driver assembly includes an electric motor connected to a gear reduction unit whose output shaft is directly connected to the mixer impeller shaft. Motor is constant speed, totally enclosed, fan-cooled horizontal type, suitable for outdoor service, and conforming to NEMA MG 1.

Ensure that the motor is of adequate wattage horsepower to drive the equipment continuously at the maximum load encountered under any operating condition without overloading or exceeding the nameplate rating of the motor. Ensure that the motor is suitable for operation with the voltage characteristics indicated. Protect the motor against overload, low voltage, and unbalanced voltage. Power transmission from motor to impeller shaft is by means of a vertical or a right angle gear reduction unit. Ensure that the reduction ratio is such as to produce the proper operating speed for the mixer.

Ensure that the gear reduction unit will withstand any loadings produced by thrust, out-of-balance, and vibration resulting from operating conditions and operate from zero rpm to a speed compatible with the impeller speed. All components must continuously withstand the full load

wattage horsepower. All gears are wrought or alloy steel except that worm gears shall be bronze. The gear teeth may be through-hardened, contour-induction-hardened, nitrided, or carburized. Flame-hardened gears will not be acceptable. Provide a lubrication system for the gears.

Ensure that the housing is of high quality, close-grained cast iron or fabricated steel. Bearings may be lubricated with oil or grease. Base plate or mounting lugs are of steel or integrally cast with the gear reduction unit and furnished with leveling anchor bolts with lock nuts.

2.6.9.10 Anchorage

Materials necessary for anchorage of the plant to the concrete support slab are as recommended by the manufacturer of the facility.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

2.7.1 Factory Inspection

****
NOTE: Delete the paragraph when concrete plant only is required.
****

Factory inspection includes soundness of welds and water tightness for tanks fabricated at the factory. Inspect the primary and finish shop painting for pin holes or voids.

2.7.2 Quality Assurance

2.7.2.1 Package Wastewater Treatment Plant Layout Drawings

Show the complete assembly of the plant with all components, equipment, and parts, each with an assigned number corresponding to the plant manufacturer's parts list.

2.7.2.2 Package Wastewater Treatment Plant Component Drawings

Show construction details for each component and piece of equipment, including aeration chamber, clarifier chamber, sludge holding chamber, disinfection chamber, blower assembly, diffuser layout, pump assemblies, [comminutor assembly,] [,mechanical aerator assembly,] support slab, [disinfection assembly,] appurtenances, and all piping and wiring.

2.7.2.3 Diffuser Layout Drawings

Show construction details for the diffuser layout including diffusers, diffuser holders and diffuser holder assemblies, blower assembly, and air piping layouts.

[2.7.2.4 Mechanical Aerator Drawings

****
NOTE: Delete the bracketed phrase when step aeration type of complete mixing type is specified or when mechanical aerator is not allowed for extended aeration type.
****

Show manufacturer's suggested geometry in sufficient detail for construction.[Show construction details for the mechanical aerator assembly, including shroud and draft tube (if used).]

]2.7.2.5 Excavation and Backfilling

Include specific instructions for excavation and backfilling as interrelated to plant installation and any special concrete work necessary.

2.7.2.6 Package Wastewater Treatment Plant Performance Test Reports

Submit reports of plant performance evaluation tests by the National Sanitation Foundation (NSF). These tests are performed in conformance with the criteria based on the use of the Standard Performance Evaluation Method of the NSF report. [Base the test on the subdivision flow pattern.]For all units not tested by NSF, reports of independent performance tests are required on the type of plant submitted for the project. These tests are in accordance with the Standard Performance Evaluation Method based on the subdivision flow pattern as established by the NSF.

2.7.2.7 Chamber Tests

****
NOTE: Delete paragraph sentence when concrete plant only is required.
****

Submit a test report stating that all chambers of the prefabricated steel plant have been tested (1) as watertight, (2) welds are sound, (3) the finish is smooth, and (4) are shop painted before shipment to the site.

2.7.2.8 Electrical Control System

Ensure that the electrical control system and its components are wired and tested, including motors and controls in accordance with specification requirements for manual and automatic operation of wastewater treatment plant equipment.

[2.7.2.9 Mechanical Aerators

****
NOTE: Delete paragraph when step aeration type or complete mixing type is specified or when mechanical aerator is not allowed.
****

Submit certification that the aerator has an oxygenation capacity of 1.36 kg 3.0 lb of oxygen per electrical input watt per hour horsepower per hour, when tested under standard conditions in clear tap water at 20 degrees C 68 degrees F and zero D.O. Certification includes description of test procedure, test data, and calculations of oxygenated capacity. Also furnish data to substantiate that the manufacturer's aerator can achieve mixing and adequate velocities for the geometry of the basin as indicated.

]2.7.2.10 Materials Not Labeled or Certified

For materials whose compliance with organizational standards or specifications is not regulated by an organization using their own

listings or labels as proof of compliance, submit a certificate stating that the material complies with the applicable referenced standard or specification. This statement is in addition to any proof required.

2.7.3 Source Quality Control

****

NOTE: When two or more 22.0 L/s 0.5 MGD or four or more 11 L/s 0.25 MGD Package Wastewater Treatment Plants are contracted for at one time, select the alternative to witness the factory tests.

****

Conduct all factory tests by the manufacturer of the package Package Wastewater Treatment Plant in the presence of the Contracting Officer.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Protection from Moving Parts

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

3.2 PREPARATION

All work not absolutely required to be performed in the field is performed in a factory under controlled conditions. Fabricate the treatment facility from not less than 6 mm 1/4-inch steel plate with welded joints and reinforced as necessary with steel angles, tees, or other structural members. Construct the units for transportation, installation, and operation without detrimental buckling, distortion, or other defects. Tanks cannot leak when filled with water or wastewater. Excavation, filling, and backfilling is in accordance with Section 31 00 00 EARTHWORK. Install a reinforced concrete foundation pad, of the size and design recommended by the treatment facility manufacturer, in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.1 Corrosion Protection

****

NOTE: Specify corrosion protection for metal plants in contact with soil. If other than steel is specified, specify an appropriate protective coating system for the plant material.

Cathodic protection is only recommended in severely corrosive soils or environments.

Identify site specific atmospheric conditions that would produce a corrosive environment for plant materials so that the proper protective coatings or corrosion resistant materials can be provided.

****

For [below ground] [partially above and partially below ground] [above ground] metal plants, provide corrosion protection. Provide an exterior [75 mil polyurethane coating] [_____] [[_____]mil coating and cathodic protection] that protects the plant from the in situ soil conditions.

3.2.2 Electrical Work

****
NOTE: This paragraph contains a NASA tailoring option.
****

Electrical work is in accordance with the applicable requirements of Section [33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION][33 71 01.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION][33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION].

3.3 INSTALLATION

Install the treatment facility and equipment 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 the proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

3.3.1 Sequence of Operations

Sequence of operations follows the recommendations of the facility manufacturer. Installation of facility cannot begin until the concrete support slab has achieved not less than fifty percent of its maximum strength. Modify backfilling operations as recommended by the instructions of the plant manufacturer. Complete, inspect and receive approval for all welding, corrosion protection, alignment, water tightness testing, painting, and anchoring before any backfilling is done.

3.3.2 Matchmarking

Ensure that all parts and components of the plant are clearly match marked, corresponding to assembly drawings furnished by the manufacturer of the facility.

3.3.3 Piping and Valve Installation

Install piping in a neat manner with all joints tight and with no undue marring of finishes. Ensure that installed piping, valves, and fittings are free from strain and excessive stresses caused by weight or misalignment.

[3.3.4 Clarifier Floor

****
NOTE: Delete requirements for signal transmission to the chlorinator when not used.
****

When a rotating sludge collector is used, work is as hereinbefore

specified through placing of tank floor except for sludge cone, which shall be in accordance with recommendations of the facility manufacturer. The tank floor is then given a screed finish, after which the floor is roughened by scoring with a rake or similar tool. Following installation of the rotating sludge collector mechanism, bring the tank floor to finish grade by means of a cement-mortar grout surfacing swept into place by use of the sludge collector arms, as hereinafter specified. When the collector mechanism has been erected and inspected by the engineer representative of the manufacturer and the arms and blades have been adjusted to give the required clearance above final floor grade, fasten a 50 by 150 mm 2 by 6 inch wooden straight-edge with metal-clad edge to each sweeping arm approximately 6 mm 1/4 inch below the sweeping blades to provide a suitable squeegee.

Cement-mortar grout is composed of one part cement, three parts sand, with sufficient water as required for conditions of placement, and with one teaspoon of powdered aluminum added per bag of cement. Before the cement-mortar grout is placed, thoroughly clean the floor of dirt, soil, or other substances that would prevent the proper bonding of the surfacing to the concrete subfloor. Bring the grout surfacing to finish grade as nearly as possible by hand. Rotate the collector arms with straightedges attached manually to complete the operation. Use of the drive unit for sweeping in the grout surfacing will not be permitted. Make provision to prevent grout from entering the sludge cone; remove immediately any grout which falls in the sludge cone or on the tank walls.

]3.3.5 Utilities Service Connections

[3.3.5.1 Water Service

****

NOTE: Specify in the appropriate section of project specification the nearest point of connection to the facility, and also type of connection available.

Delete reference to "frost-proof" for facilities in areas where freezing temperatures are not encountered.

Delete reference either to chlorinator or to hypochlorinator.

Delete reference either to chlorinator or to hypochlorinator.

****

The water line is a[25 mm one inch] [_____] copper water line extending from a point not less than[1.52 m 5 feet] [_____] from the treatment facility to the [hypochlorinator housing] [chlorinator]. Provide a 25 mm one inch valve in a[frost-proof] valve box below grade.[Provide a 19 mm 3/4 inch hose bibb in the [hypochlorinator] [chlorinator] housing.]

]3.3.5.2 Electrical Service

Provide electric service from a point not less than 1.52 m 5 feet from the treatment plant to the electrical control system enclosure.

3.4 FIELD QUALITY CONTROL

Conduct field inspections and witness field tests specified in this specification. Perform field tests and provide all labor, equipment and materials required for testing, except that the Government will provide water, fuel, and electric power required for field test, when available. Correct all defective equipment, materials, or workmanship disclosed as a result of the tests given herein at no cost to the Government.

3.4.1 Tests

Before allowing any liquid to discharge into the tanks, ensure that all tanks, chambers, channels, launders, piping and pieces of equipment are clean and free of any debris such as pieces of wood, concrete or leaves. Test all mechanical and electrical units as specified herein. Remedy any defects that occur before or during the tests, make changes or replacement equipment as necessary and retest.

3.4.1.1 Coating Testing

Examine coatings for flaws and test for thickness and holidays. Measure thickness of coatings by a commercial film thickness gauge. Test coatings 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 is a 90-volt wet sponge pinhole detector.

3.4.1.2 Comminutor Tests

****

NOTE: Delete the paragraph when comminutor is not required for facility.

****

Operate the comminutor with liquid flowing through the comminutor. After two hours of operation, check for overheating, noise, vibration, and speed of the motor and comminutor. Check the automatic reversing of the comminutor when an object is lodged in the cutting stream.

3.4.1.3 Mechanical Aerator Tests

****

NOTE: Delete paragraph when step aeration type or complete mixing type is specified or when mechanical aerator is not allowed for extended aeration type.

****

Test the mechanical aerator(s) as soon as practicable after installation, and the aeration tank is ready for use. Operate the aerator under the varying submergence conditions specified in the factory test. During these tests, operate the unit(s) without overheating or excessive vibration and ensure satisfactory operation. Conduct the field tests under the supervision of the facility manufacturer. Supply labor and materials necessary to properly perform the tests. During the tests, take operating data at regular intervals and incorporate in a report. Base data readings on facility meters, gages, and instruments, and include the following: motor amperes, motor kilowatts, bearing temperatures, and lubricating oil pressures and temperatures.

3.4.1.4 Blower-Driven Assembly Operation Tests

Test the blower-driven assembly as soon as practicable after installation. Operate the blower under varying capacities and discharge pressures covering the range of conditions specified. During these tests, ensure that the units operate without overheating or excessive vibration. Conduct the initial operation of the blower driver and the the field tests under the supervision of the facility manufacturer. Supply such labor and materials as may be necessary to properly perform the tests. During the tests, take operating data at regular intervals and incorporate in a report. Base the data readings on facility meters, gages and instruments, and include the following:

a. Air volume

b. Air inlet and discharge pressure and temperature

c. Motor amperes

d. Motor kilowatts

e. Bearing temperatures

f. Stator temperatures

g. Lubricating oil pressures and temperatures

h. Lubricating oil cooling water temperatures

3.4.1.5 Diffusers

Conduct performance capacity and mixing tests on the diffusers in the field according to the manufacturer's instructions.

3.4.1.6 Hypochlorinator Tests

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NOTE: Delete this paragraph when hypochlorinator is not required.

****

Inspect and adjust the pulley and belt drive for the average flow of feed solution desired. Test the capacity of the feeder for a period of not less than 2 hours nor more than 6 hours. Make the following tests:

a. Check the unit for leaks.

b. Determine the amount of chemical solution used during the test run to ascertain if the unit is functioning within the prescribed limits of the feed rate indication plus 15 percent.

c. Ensure the unit shuts off automatically when the liquid elevation in the chlorine contact tank drops below the contact sensing probes and start when the water rises. The unit starts and stops 10 times out of 10 consecutive starts.

3.4.1.7 Chlorinator Tests

****

NOTE: Delete this paragraph when chlorinator is not required.
****

Operate the unit for a period of not less than 2 hours nor more than 6 hours. Perform the following tests:

a. Check the unit for leaks by using an aqueous ammonia solution on a cotton or cloth swab on a wooden stick held close to all connections of the chlorinator.

b. Determine the amount of chlorine used during the test run to ascertain if the unit is functioning within the prescribed limits of 4 percent of the set feed rate.

c. Stop the chlorinator when the water supply is interrupted or shut off.

d. When the gas supply is exhausted or shut off, there is no back-flow of water into the unit.

3.4.1.8 Air Lift Pump

Test the air lift pump for discharge capacity in liters per second gallons per minute of clean water. Base this on percentage of submergence of the eductor pipe to the total height of the eductor pipe. Test and adjust the air throttling valve to provide the desired discharge rate. Test all joints in the airline for leaks at 689.4 kPa 100 psi pressure.

3.4.1.9 Electrical Control System Tests

The plant manufacturer's representative inspects the installation of the electrical control system with the Contracting Officer and checks circuits and connections to all motors and electrical controls. The manufacturer's representative, upon satisfactory operation of all circuits and controls to the Contracting Officer, submits [three] [_____] copies of a letter certifying that the wiring is complete and in accordance with the intent of the specifications for both manual and automatic operation and proper functioning of the Package Wastewater Treatment Plant.

3.4.2 Inspection

3.4.2.1 Alignment and Leveling

Make inspections to assure that the facility is level within tolerances recommended by the facility manufacturer. Check all facility components and equipment to ensure that they are properly aligned and level.

3.5 SYSTEM STARTUP

A manufacturer's representative will be present at facility start-up. Follow the manufacturer's manual on operation and maintenance step by step, so that as each piece of equipment is put into operation, the manufacturer's representative will explain in detail its function. Once the facility is filled with water or wastewater the follow the furnished flow diagram and check out the on-site inspection.

Adjust equipment as required. Examine the plant to determine if it is structurally sound. Report and correct all defects, submit findings.

3.6 ADJUSTING AND CLEANING

3.6.1 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair consists of preparing the affected area in compliance with manufacturer's recommendations and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, prepare the surface and apply additional coats in the affected area in compliance with the manufacturer's instructions.

3.6.2 Adjustments

For items of equipment involving V-belt drives, adjustment of sheave alignment and belt tension is carried out in accordance with product manufacturer's instructions.

3.7 CLOSEOUT ACTIVITIES

3.7.1 Operation and Maintenance Manuals

Post framed instructions containing wiring and control diagrams under glass or in laminated plastic where directed. The instructions show wiring and control diagrams and complete layout of the entire system. The instructions 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. Post the framed instructions before acceptance testing of the system.

Submit [_____] copies of operation and maintenance manuals for the treatment facility equipment furnished. [One][_____] complete set prior to performance testing and the remainder upon acceptance. Operation manuals detail the step-by-step procedures required for system startup, operation, and shutdown. Operation manuals include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

Submit Package Wastewater Treatment Plant Operation and Maintenance Data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.7.2 Demonstration

As soon as practicable after completion, perform an operating test of the treatment facility and all equipment to demonstrate that the facility functions properly. After completion of all tests, adjust the facility for proper operation while on-line with the wastewater source in accordance with the manufacturer's written instructions. For the final acceptance, the facility must perform as specified, submit Package Wastewater Treatment Plant acceptance test results.

-- End of Section --