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USACE / NAVFAC / AFCEC **UFGS-46 71 16 (February 2011)**

Preparing Activity: USACE **Superseding**
UFGS-44 46 13 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025
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SECTION 46 71 16

GRAVITY BELT THICKENERS

02/11

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SECTION 46 71 16

GRAVITY BELT THICKENERS
02/11

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NOTE: This guide specification covers the requirements for sludge collecting equipment.

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).

****

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.

ALUMINUM ASSOCIATION (AA)

AA ANSI H35.2M	(2024) Dimensional Tolerances for Aluminum Mill Products
AA H35.1/35.1M	(2024) American National Standard Alloy and Temper Designation Systems for Aluminum

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

ANSI/AGMA 2001	(2004D; R 2010) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
ANSI/AGMA 6034	(1992B; R 2010) Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(2024) Power Piping
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2022) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2024) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,

	Welded and Seamless
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2024) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A354	(2017; E 2017; E 2018) Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM B632/B632M	(2024) Standard Specification for Aluminum-Alloy Rolled Tread Plate
ASTM D256	(2010; R 2018) Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
ASTM D570	(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D790	(2017) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2047	(2017) Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2017) Metal Bar Grating Manual
NAAMM MBG 532	(2019) Heavy Duty Metal Bar Grating Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2021) Motors and Generators

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2023) Rules for the Measurement & Inspection of Hardwood & Cypress

REDWOOD INSPECTION SERVICE (RIS) OF THE WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

RIS Grade Use	(2019) California Redwood Lumber Grades and Uses

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 and Air Force 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.

****

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. Submittals not having a "G" or "S" classification are 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

Installation

SD-03 Product Data

Sludge Collectors for Rectangular Tanks

Collectors for Circular and Square Tanks

Spare Parts

Framed Instructions

Qualifications

SD-06 Test Reports

Testing

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals; G, [_____]

[Six] [_____] [hard] [optical disc] copies of operation and [six] [_____] copies of maintenance manuals for the equipment furnished. One complete set prior to performance testing and the remainder upon acceptance.

1.3 QUALIFICATIONS

Qualify procedures and welders in accordance with the code under which the welding is specified to be accomplished. Submit qualified procedures and list of names and identification symbols of qualified welders and welding operators, prior to welding operations.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

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

reasonably convenient to the site.

2.1.2 Nameplates

Provide each major item of equipment with the manufacturer's name, address, type or style, model or serial number, and catalog number if applicable on a plate secured to the item of equipment.

2.1.3 Special Tools

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

2.1.4 Spare Parts

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

2.2 MATERIALS

****
NOTE: Steel components are often specified galvanized where not submerged or intermittently wetted to minimize painting and paint maintenance.
****

2.2.1 Steel Plates, Shapes, and Bars

Provide steel plates, shapes, and bars that are ASTM A36/A36M, minimum 6 mm 1/4 inch thickness unless otherwise specified.

2.2.2 Malleable Iron

Provide malleable iron conforming to ASTM A47/A47M.

2.2.3 Iron Castings

Provide iron castings conforming to ASTM A48/A48M.

2.2.4 Aluminum for Structural and Rolled Shapes

Provide aluminum for structural and rolled shapes conforming to AA H35.1/35.1M, alloy 6061-T6, and AA ANSI H35.2M.

2.2.5 Aluminum for Extruded Shapes

Provide aluminum for extruded shapes conforming to AA H35.1/35.1M, alloy 6063-T6.

2.2.6 High Strength Bolts

Provide high strength bolts conforming to ASTM A325M ASTM A325 with suitable nuts and washers conforming to ASTM A354; galvanized, ASTM A153/A153M.

2.2.7 Anchor Bolts

Provide anchor bolts conforming to ASTM A307; galvanized, ASTM A153/A153M.

2.2.8 Fiberglass Reinforced Polyester Plastic (FRP)

2.2.8.1 Molded FRP

Fiberglass reinforced polyester plastic must be 6 mm 1/4 inch thick and molded by the matched die method to produce uniform, smooth surfaces. Through the use of "low profile" resin systems, ensure all surfaces are smooth, resin rich, free of voids and porosity, without dry spots, crazes, or unreinforced areas, and provide for increased corrosion resistance and weathering.

2.2.8.2 FRP Laminate

Provide laminate with a glass content of 30 plus or minus 2 percent using Type "E" glass with chrome or silane finish. Provide powdered reinforcements consisting of 47.5 plus or minus 1 percent of resin mixture. Use resin mixture of the "low profile" type. Ensure final laminate thickness is within plus or minus 10 percent of the specified thickness.

2.2.8.3 Physical Properties

Physical properties of fiberglass reinforced polyester plastic are as follows:

a. Minimum Tensile Strength: 96.5 MPa 14,000 psiconforming to ASTM D638.

b. Minimum Flexural Strength: 172.4 MPa 25,000 psiconforming to ASTM D790.

c. Minimum Flexural Modulus: 0.9 by 10 to the sixth power conforming to ASTM D790.

d. Minimum Impact, Notches, Izod: 720 Joules/meter 13.5 ft-lb per inch conforming to ASTM D256, Method A.

e. Maximum Average Coefficient of Thermal Expansion: 29 by 10 to the negative sixth power mm per mm, per degree K 16 by 10 to the negative sixth power inch per inch, per degree F.

f. Maximum Water Absorption: 0.02 percent in 24 hours conforming to ASTM D570.

2.2.8.4 Resin Sealing

Where plates of nonstandard length or mounting hole configuration are required, resin seal machined or cut edges.

2.3 HANDRAILS

****

NOTE: Handrails specified are the utilitarian type. Drawings will show design requirements, locations, and general configuration of railing. Where railing is to be fabricated of material other than pipe, this paragraph must be rewritten for type

chosen and the drawings must show configuration and design requirement for type of railing selected.

****

Provide handrails that are 1065 mm 42 inches high with two horizontal rails. Fabricate handrails of Schedule 40 [galvanized] steel pipe conforming to ASTM A53/A53M or Schedule 40 [mill finished] [anodized] aluminum pipe conforming to ASTM B429/B429M. Provide pipe size of [40] [50] mm [1-1/2] [2] inch NPS. To maximize extent practicable, shop fabricate railing. Provide rigid joints consisting of flush-finished welded assembly. Reinforce joints with tight fitting interior sleeves and assemble by welding rails and posts to flush-type fittings, or by mitering and welding joining rails to posts. Locate expansion joints at lengths of rails as recommended by the manufacturer. Provide inner-sleeved slip joint type expansion joints with one end of the sleeve secured to the railing. Locate expansion joints and splices near the intersection of rails and posts. Make bends in railing smooth and in a manner that will not crush or deform the railing. Grind all welds smooth and ensure railings are free of burrs and sharp corners and edges. Removable sections must be as indicated.

2.4 FLOOR GRATING AND FRAMES

Design [carbon steel] [aluminum] [stainless steel] grating in accordance with [NAAMM MBG 531] [NAAMM MBG 532] to meet the indicated load requirements. Band edges with bars 6 mm 1/4 inch less in height than bearing bars for grating sizes above 19 mm 3/4 inch. Make banding bars flush with the top of bearing grating. Provide frames of welded steel construction finished to match the grating. [Galvanize floor gratings and frames after fabrication.]

2.5 FLOOR PLATES

****

NOTE: Specific pattern should not be indicated unless required for matching purposes or to meet design requirements.

****

Provide aluminum floor plates in conformance with ASTM B632/B632M. Provide other aluminum floor plates consisting of 6 mm 1/4 inch thick, [raised thread steel] [pattern indicated] [galvanized] [slip-resistant, carbon steel conforming with ASTM A283/A283M having a minimum static coefficient of friction of 0.50 when tested in accordance with ASTM D2047. Ensure wearing surface is aluminum oxide or silicon carbide].

2.6 LUMBER

Provide Red Cypress conforming to NHLA Rules, clear, S4S finish. Provide Redwood conforming to RIS Grade Use, clear all heart, S4S finish.

2.7 MOTORS

Provide motors conforming to NEMA MG 1.

2.8 COLLECTORS FOR CIRCULAR AND SQUARE TANKS

2.8.1 Drive Unit

Provide drive unit consisting of a gear reducer and motor, direct or flexible coupled. Provide drive unit with a [cast iron housing] [or] [fabricated steel housing with integral hardened steel raceway] and designed in compliance with ABMA 9 and ABMA 11, ANSI/AGMA 2001 and ANSI/AGMA 6034. Base the continuous torque rating of the spur gear assembly upon the smaller of the values developed by ANSI/AGMA 2001 and consider as the rated torque capacity the entire gear will develop continuously over a 20-year period. Rate drive unit as follows:

Approximate Rotational Speed	[_____] rpm
Continuous Operating Torque	[_____] N-m ft-lb
Alarm Torque	[_____] N-m ft-lb
Shut-off Torque	[_____] N-m ft-lb
Momentary Peak Torque	[_____] N-m ft-lb

2.8.2 Bridge Supported Drive

The reduction unit must be one of the following types:

2.8.2.1 Primary Worm Gear Type

A unit consisting of a primary worm gear speed reducer coupled with a final reduction gear. Mount the final gear on a ball bearing assembly with the balls running in replaceable hardened alloy steel races. Ensure all bearings for this type of unit are antifriction type and run in an oil bath. Ensure reduction unit has housings effectively sealed against contaminants. Provide an oil filling and level check pipe.

2.8.2.2 Chain and Sprocket Drive Type

A unit consisting of a chain and sprocket drive, connected to a worm and worm gear final reduction unit. All bearings for this type unit must be tapered roller type.

2.8.3 Bridge Supported Drive Torque Tube

Bolt a steel torque tube to the final reduction gear to support and rotate the sludge collection arms.

2.8.4 Center Pier-Supported Drive Reduction Unit

Provide the helical or worm gear type primary speed reducer, coupled to the intermediate speed reducer directly or by a standard steel roller chain and steel sprockets. Protect chain and sprockets by chain guards. The intermediate speed reducer consists of a worm and worm gear or planetary gear, keyed to a shaft which drives the internal spur gear. Ensure the final speed reducer is a spur gear designed to withstand the maximum torque loads imposed on the clarifier mechanism. Provide

antifriction type bearings. Run bearings in cast iron units in replaceable hardened alloy steel races. Run all gears in an oil bath. Provide oil seals and oil fill, drain, and level check systems. Lubricate chains as recommended by the manufacturer. Provide a drive cage, with provision to connect to the final reduction unit. Fabricate drive cage from structural steel members and design to withstand the momentary peak torque of the collector without permanent deformation of the members. The drive cage must have provision for attachment of sludge removal arms.

2.8.5 Electric Motor

Provide motor that operates on [_____] volts ac, [_____] phase, 60 Hz and is totally enclosed fan cooled with a minimum [1.15] [_____] service factor. Equipment vendor must size motor to be of sufficient size for duty to be performed and do not exceed full load rating under the most severe conditions expected. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed. Furnish each motor with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter must be in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

2.8.6 Overload Protection

Provide drive unit with an overload protection system, enclosed in a weatherproof housing. The system must consist of two micro-switches actuated by the movement of the worm shaft in the worm gear housing. Adjust switches to sound an alarm when the torque reaches [120] [_____] percent of the continuous operating torque and to stop the drive motor when the torque load reaches [140] [_____] percent of the continuous operating torque. Visually indicate overload points. Provide a shear pin assembly to serve as back-up overload protection and set to fail at [160 to 180] [_____] percent of continuous operating torque.

2.8.7 Influent

2.8.7.1 Siphon Feed Influent/Support Column

****
NOTE: Siphon feed influent is most commonly associated with center pier supported mechanisms.
****

Provide a combination influent and support column to support the drive, collector mechanism, and access bridge and to serve as the center influent pipe. Fabricate column from steel plate and anchor to the concrete. The column must be a minimum of [_____] mm feet-inches in diameter and have a series of openings near the upper end to direct flow into the influent feedwell at low velocity.

2.8.7.2 Siphon Feed Influent Feedwell

****
NOTE: Use 76 mm per second 0.25 fps for primary collectors and 46 mm per second 0.15 fps for secondary collectors.
****

Fabricate the influent feedwell from steel plate sections with bolted connections and support from the center cage. Ensure the feedwell is of adequate size and design to diffuse the flow into the tank. Design feedwell such that the flow-through velocity does not exceed [46] [76] mm/second [0.15] [0.25] fps at maximum flow. Provide baffled ports at the water surface in the feedwell to permit the escape of scum.

2.8.7.3 Side Feed Influent Feedwell

****
NOTE: Side feed influent is most commonly associated with bridge supported mechanisms.
****

Fabricate the influent feedwell from steel plate with necessary stiffening members. Support the feedwell by structural steel members which span the tank and are attached to brackets mounted on the tank wall above design water level. Design feedwell to diffuse the flow into the tank and with baffled ports at the water surface to permit the escape of scum. Provide a flanged pipe connection and an influent pipe from the tank side.

2.8.7.4 Influent Feedwell for Thickeners

****
NOTE: Energy dissipating feedwells may not be required for all thickeners.
****

Faricate the influent feedwell from steel plate with necessary stiffening members. Ensure feedwell is of energy dissipating design having 3 internal peripheral horizontal shelves with tangential inlet ducts to provide counterflows of influent which shear on each other as they are displaced inward beyond the shelves. Support the feedwell by structural steel members which span the tank and are attached to brackets mounted on the tank wall. Provide a flanged pipe nozzle and influent pipe from the tank side. Provide a cleanout at the point where the flow splits prior to entering the influent feedwell.

2.8.7.5 Peripheral Feed Influent

Provide peripheral feed system consisting of an influent channel and either an orifice and baffle system or a downcomer pipe system. Construct influent channel of [concrete] [steel plate] at the periphery of the tank and in conjunction with the effluent channel. Design influent and effluent channels for proper flow distribution and collection. The orifice and baffle system must consist of orifice openings in the floor of the influent channel, a steel plate orifice baffle for each orifice, and a steel plate influent skirt to prevent short circuiting. Use orifice dimensions and spacing as determined by the manufacturer for even flow distribution. The orifice baffles must contain no restriction less than the diameter of the orifice or greater than the orifice diameter plus 25 mm 1 inch. Extend the influent skirt 1.5 m 5 feet below the water surface or 300 mm 1 foot below the influent channel bottom, whichever is greater. Provide sufficient clearance between the bottom of the influent skirt and the tank floor to permit operation of the collector mechanism. Provide downcomer pipe system consisting of steel drop pipes spaced evenly around the influent channel. The bottom of the drop pipe must have a fiberglass 90 degree bend and flared discharge nozzle oriented toward the center of the tank.

2.8.8 Scraper Sludge Removal

Provide unit consisting of [one] [two] [_____] structural steel scraper arms, equipped with blades or scrapers designed to move settled sludge to a hopper at the center of the tank. Provide adjustable [spring brass] [PVC] [galvanized steel] squeegees for each scraper blade. Ensure squeegees project 40 mm 1-1/2 inches below the scraper blade and are adjustably secured by [brass] [or] [stainless steel] bolts and nuts.

2.8.9 Hydraulic Sludge Removal

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NOTE: Hydraulic sludge removal is most commonly associated with activated sludge systems.

****

Accomplish hydraulic sludge removal by the use of the header and manifold system or the uptake pipe system.

2.8.9.1 Header

Design header to continuously remove the required proportional settled solids volume to effect uniform withdrawal over the entire tank diameter, collecting larger volumes of sludge at greater distances from the tank center. Collect the sludge from the tank bottom and transmit it through the header to the manifold, removal being accomplished by hydrostatic pressure. Maximum peripheral speed of the header is not allowed to exceed [0.061] [_____] meters/second [12] [_____] fpm and maximum allowable head loss from the clarifier water level to the sludge pipe connection at the pier bottom is [_____] mm feet. Provide header that is fabricated from steel plate, rectangular, and varies in size from a minimum at the outer end to a maximum at the center of the tank. Stepped and constant cross sectional area type headers are not acceptable. The header must be parallel to the tank bottom, and mount the longitudinal cross sectional axis at an angle of 45 degrees to provide a peaked top. Extend the leading edge of the header downward 50 mm 2 inches to provide an equalizing vane as an integral part of the header and to direct the sludge into the area of influence of the orifice. Provide a 3.175 mm 10 gauge steel scraper with a neoprene blade to clean the tank bottom around the manifold and direct the sludge to the first orifice. Space inlet orifices along the length of the header such that in a single revolution the header will clean the entire tank bottom. Maximum orifice spacing is [775] [_____] mm [30] [_____] inches. Drill orifices accurately in the header. Support the header from the center cage by steel tie-bars with turnbuckles, clevises, and locknuts. The support system must hold the header in alignment both horizontally and vertically. Provide a suitable counterweight to counterbalance the header.

2.8.9.2 Manifold

Fabricate the sludge collection manifold from steel plate. Provide two seals to ensure that the sludge enters the manifold only through the headers. Anchor the bottom plate to the tank bottom, align, and grout in place.

2.8.10 Uptake Pipe System

****

NOTE: Provide sufficient quantity of nozzles for a maximum of 1 to 1.5 meter 3 to 5 foot spacing.
****

Provide system consisting of a sludge discharge column within the influent column; [two] [_____] truss-type sludge collection arms, supported from and driven by the drive cage; V-plow blades and squeegees attached to the sludge collection arms; a minimum of [_____] suction nozzles per arm, supported by the sludge collection arms, and piping to a sitewell; and either sludge control boxes or variable orifice slip tubes inside the sitewell.

a. Fabricate sludge discharge column from steel plate and extend from the sludge sitewell to the bottom of the stationary influent column where it connects to the sludge discharge pipe under the tank bottom.

b. Provide sludge collection arms of welded truss construction requiring no tie rods for support. Provide V-plow blades with [spring brass] [_____] squeegees with [brass] [_____] fasteners. Ensure the blades completely rake the bottom [twice] [_____] per revolution.

c. Provide suction nozzles that are a minimum of [_____] mm inches in diameter. Provide Schedule 80 PVC suction piping sized for a flow velocity no less than 0.16 meters/second 0.5 fps at minimum flow to prohibit solids settling in the piping. Provide Type 304 stainless steel or Schedule 80 PVC fittings with bell-type ends with O-ring seals.

d. Provide sitewell approximately [_____] mm feet square by [_____] mm feet deep, fabricated from steel plate, and containing either sludge control boxes or variable orifice slip tubes. Provide a neoprene seal between the sitewell and influent column. Ensure sludge control boxes are integral with the sitewell. Control sludge being withdrawn from each section of the arm by a submerged orifice sludge control box to allow pacing of the recycled rate. Each box must have a manually controlled PVC gate valve with positioning stem and position indicator. Provide variable orifice slip tubes of steel or PVC pipe construction that permit throttling of individual sludge lines by rotating the slip tubes.

e. Induce sludge flow by means of hydraulic head differential between the tank water level and the sludge control boxes or variable orifice slip tubes at a head of [_____] mm feet. The total sludge drawoff must be dependent on and controlled solely by the pumping rate from outside the mechanism.

2.8.11 Corner Scrapers for Square Tanks

Provide a corner blade on [one] [each] sludge scraper arm. Corner scraper blades consist of a straight blade attached to two horizontal members mounted on the main scraper arm. Pivot the scraper mechanism on special underwater bearings and actuate by a counterweight or spring to keep the end of the arm in contact with the side of the tank. Provide steel guide plates for the tank corners to direct the path of the corner blades. Provide a carrier wheel on the outer end of each corner blade. Provide springs, cable, and chain composed of stainless steel, galvanized steel, or other corrosion-resistant material.

2.8.12 Scum Removal for Tank Water Surface

****
NOTE: Use of dual skimmer arms and wide scum beach/box improves scum removal performance.
****

Scum removal consists of a [single] [dual] skimming device, a scum baffle, and [one] [two] skimmer blade ramp(s) and scum box(es).

a. Sweep the water surface of the tank and automatically move the scum up the skimmer blade ramp and into the scum box. Support skimming devices by structural steel members attached to the [sludge collection arms and counterweight] [torque tube]. Do not rely on the scum baffle for support. Provide neoprene scum scraper blade.

b. Fabricate scum baffle from [steel plate] [or] [fiberglass reinforced polyester plastic]. [Provide fiberglass scum baffle plates in standard lengths not to exceed 3600 mm 12 feet]. Construct connections between baffle sections in a manner that will not interfere with smooth contact of the skimmer. Provide all supports and connectors required for a complete installation.

c. Provide scum boxes of the dimensions indicated and fabricated from steel plate. Provide assembly with a scum sump, vertical steel sides, and a sloping skimmer blade ramp. Provide a flexible connector between the scum outlet piping and the tank wall. [Provide an automatic flushing device, which will open as the scraper passes.]

2.8.13 Influent Channel Scum Removal

****
NOTE: Influent channel scum removal is required only on peripheral feed collectors. Delete the inapplicable system.
****

In addition to the tank water surface scum removal, provide a system for removal of scum from the influent channel. The system consists of [an additional scraper blade attached to the main tank skimmer,] [or] [an influent channel spray nozzle system designed to move the scum to the scum box,] a scum box, and a motorized telescopic scum control valve. Provide all controls required for the system.

2.8.14 Bridge

2.8.14.1 Bridge Design and Construction

Provide bridge fabricated from structural steel and all-welded construction. Use either truss or beam type bridge design. Maximum allowable deflection of the bridge is 1/360 of the span length under a live load of 2.9 kPa 60 psf. Provide bridge walkway composed of [floor plate] [grating]. Provide handrail with a 100 mm 4 inch high toe plate on both sides of the walkway. If truss-type bridge construction is used, the truss members may be used as handrail.

2.8.14.2 Bridge for Bridge-Supported Drives

The bridge must span the entire tank diameter and be supported by and

anchored to the tank wall. The bridge must support the drive and collector mechanism and provide access for maintenance. Ensure access walkway is at least 900 mm 3 feet wide. Provide at least 775 mm 2 feet 6 inches clearance between the drive unit and the handrails on all sides where maintenance is required.

2.8.14.3 Bridge for Center Pier-Supported Drives

Support bridge on one end by the tank wall and on the other end by the drive unit. Ensure access walkway is at least 900 mm 3 feet wide and extends to a point 775 mm 2 feet 6 inches beyond the drive assembly. Provide at least 775 mm 2 feet 6 inches clearance between the drive unit and the handrails on all sides where maintenance is required.

2.8.15 Effluent

2.8.15.1 Weir Plates

****

NOTE: Sludge collectors which require additional linear footage of weir, beyond weir trough circumference length can utilize finger weir or weir pans to increase length up to two and one-half times length of single circumferential weir. Manufacturer of this type should be required to have at least five years experience in furnishing weir pan systems.

****

Weir plates must be [fabricated from steel plate][or][fiberglass reinforced polyester plastic]. Provide weir plates of the dimensions indicated. Mold vee notches in fiberglass weir plates in the plate; cut edges are not acceptable. Mount weir plates in a manner to be watertight and to provide a minimum of 50 mm 2 inches vertical adjustment.

2.8.15.2 Effluent Trough and Drop Box

****

NOTE: The effluent trough and drop box may be cast of concrete with the tank wall and deleted from this specification.

****

Fabricate the effluent trough and drop box from [steel plate] [or] [fiberglass reinforced polyester plastic]. Trough and drop box dimensions are as indicated. Ensure joints between sections are watertight. Provide support assemblies of adequate strength to prevent trough or box distortion through filling and draining of the tank.

2.9 SLUDGE COLLECTORS FOR RECTANGULAR TANKS

2.9.1 Chain and Flight Scraper Type Collectors

Provide sludge collector including chain, flight and wear shoes, sprockets, shafts, wall bearings, return tracks with support brackets, tee rails, drive unit complete with reducer, motor and overload device, and all associated attachment and anchor bolts. Allow chain for primary tank collectors to run over four sets of sprocket wheels at a design speed of [_____] fpm, so that the flights will clean the sludge from the tank bottom and skim the surface on the return run, concentrating scum in front

of the scum pipe. Allow chains for intermediate tank collectors to run over three sets of sprocket wheels at a design speed of [_____] fpm, so that the flights will clean the sludge from the tank bottom and route it to the sludge collection trough. Ensure cross collectors run at twice the speed of the longitudinal collectors. Select collector components based upon the following criteria: operation under dry tank conditions; friction factor for dry steel on dry steel of 0.33; friction factor for polyurethane on dry steel of 0.25; bearing friction of 5 percent of shaft assembly.

2.9.1.1 Metallic Chains

Manfacture metallic chains of corrosion-resistant processed metal having an average tensile strength of [551.6] [_____] MPa [80,000] [_____] psi and a hardness range of 179-229 Brinell. Provide 7205 heavy pintle type chains with 150 mm 6 inch [_____] pitch, weighing [7.6] [_____] kg/m [5.1] [_____] lb/ft, and with plain and attachment links assembled with 19 mm 3/4 inch diameter hardened steel pins and rivets. The chain must have an allowable working load of [15.7] [_____] kN [3,540] [_____] pounds and proof test each assembled strand at a minimum of [83.6] [_____] kN [18,800] [_____] pounds to detect and remove defective castings. Provide rigid attachments for full depth of the flight and attach with four 10 mm 3/8 inch diameter bolts. Match chain sections within 5 mm in 3 meters 3/16 inch in 10 feet, tag, and wire together in pairs.

2.9.1.2 Nonmetallic Chains

Provide nonmetallic chains with 152 mm 6 inch [_____] pitch links manufactured of acetal resin and connected with pins manufactured of reinforced nylon resin. Provide pins of T-head or T-end construction to prevent rotation and hold in place without the use of pinlocks or cotters. Provide chain with a working load of [8.0] [_____] kN [1,800] [_____] pounds. Provide rigid attachments full depth of the flights and attach with four 10 mm 3/8 inch diameter bolts.

2.9.1.3 Drive Chains

Provide H-78 mill type drive chains manufactured of a corrosion resistant processed metal, consisting of[66.27 mm 2.609 inch] [_____] pitch links, and with an allowable working load of [10.4] [_____] kN [2,350] [_____] pounds. Proof test each assembled strand at a minimum of [44.5] [_____] kN [10,000] [_____] pounds to detect and remove defective castings. Provide a hot-dip galvanized chain tightener to take up unnecessary slack in the drive chain.

2.9.1.4 Wood Flights

Provide wood flights os[50 by 150 mm 2 by 6 inch][75 by 200 mm 3 by 8 inch] nominal size and space approximately [3000] [_____] mm [10] [_____] feet on centers. Use redwood or red cypress flights. Drill all flights accurately and notch at the factory to ensure proper alignment.

2.9.1.5 Fiberglass Flights

Provide fiberglass flights of[50 by 150 mm 2 by 6 inch][75 by 200 mm 3 by 8 inch] nominal size, especially designed for sludge collector service. Provide scraper with continuous fiberglass filaments running the full length of the member and include a scraper lip on the leading edge to ensure cleaning of the tank floor. Include filler blocks for bolting the

member to the chain attachment links. Ensure flight spacing is approximately [3] [_____] m [10] [_____] feet. Buoyant flight design will not be acceptable.

2.9.1.6 Wearing Shoes

Provide each flight with 13 mm 1/2 inch thick polyurethane wearing shoes to run on the floor rails and return tracks. Ensure wearing shoes are reversible, providing two usable wearing surfaces.

2.9.1.7 Rails

Furnish two 11 kg 25 pound ASCE tee rails and install in the tank floor in accordance with manufacturer's written recommendations.

2.9.1.8 Return Tracks

Provide return tracks composed of[76.2 by 50.8 by 9.5 mm 3 by 2 by 3/8 inch] [_____] thick steel angles with 6 mm 1/4 inch thick steel support brackets. Design each bracket to cantilever the return track off the tank wall. Space support brackets approximately 3000 mm 10 feet apart and fasten to the tank wall by a minimum of two anchors.

2.9.1.9 Sprockets

Provide sprockets consisting of chilled tooth bearing surfaces with a hardness of no less than 360 Brinell and chill depth of at least 4.8 mm 3/16 inch. Key driving sprockets firmly to the headshaft. Provide corner shafts with one sprocket setscrewed and one running loose on the shaft. Provide double-life type collector chain sprockets composed of split construction. Ensure headshaft sprockets are no less than [_____] mm inch pitch diameter and have no less than [_____] teeth. Ensure all other collector chain sprockets are no less than [_____] mm inch pitch diameter and have no less than [_____] teeth. Traction wheels, idler wheels, or other substitutions for sprockets will not be acceptable. Fit the drive sprocket with a bronze bushing and provide with a shear pin device to provide for full protection of equipment in case of excessive loading. Ensure the driving sprocket on the reducer shaft is not less than [_____] mm inch pitch diameter and has no less than [_____] teeth. Provide driven sprocket on the collector headshaft composed of split construction, no less than [_____] mm inch pitch diameter, and no less than [_____] teeth.

2.9.1.10 Shafts

Ensure shaft sizing is compatible with the tank dimensions and sprocket location. Maximum shaft deflection is 4 mm/meter 3/64 in/ft of shaft length. Shafting must be straight and true, solid, cold-finished steel and held in alignment with set collars. Shafting must contain keyways with fitted keys where necessary and must be of sufficient size to transmit the power required. Extend shafting the full width of the tank and turn in bearings mounted on the tank walls. Ship shafting to the project site as complete subassemblies with sprockets, bearings, and set collars in place.

2.9.1.11 Bearings

Provide underwater bearings consisting of cast iron construction, babbitted, and of the water-lubricated, ball and socket, self-aligning type designed to prevent the accumulation of settled solids on their

surfaces. Bolt bearings directly to the tank wall in a manner to permit easy adjustment. Ensure take-up bearings provide no less than 250 mm 10 inches of horizontal travel. Take-up bearings must be of cantilevered design, with a fabricated steel support base, and have cadmium plated take-up screws. Design take-up bearings so that no recesses in the concrete are required to maintain clearances.

2.9.1.12 Drive Unit

Provide drive unit consisting of a motor, speed reducer, and electrical control equipment to power the sludge collector. Where a drive unit operates two separate collectors, provide suitable clutches to permit independent operation of each collector. Ensure drive unit for primary collectors is rated for [_____] N-m ft-lb torque, based on dry tank conditions. Ensure drive unit for intermediate collectors is rated for [_____] N-m ft-lb torque, based on dry tank conditions. Base torque rating of the gear assembly on the smaller of the values developed by ANSI/AGMA 2001 and consider as the rated torque capacity the entire gear will develop continuously over a 20-year period. Design drive unit in accordance with ABMA 9 and ABMA 11 and ANSI/AGMA 2001 and ANSI/AGMA 6034.

a. The motor must be totally-enclosed, fan-cooled; ball bearing, constant speed; and of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Connect the motor directly to the speed reducer by a flexible coupling. V-belt drives are not acceptable. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. The drive unit speed reducer must be of the [helical] [worm] gear type, fully housed, running in oil, with antifriction bearings throughout.

c. Furnish each motor with a magnetic full-voltage starter conforming to NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure. [If motors have reversing starters, provide a jog type switch such that mechanism is activated in the reverse direction only as long as button is pushed down. Ensure multiple collectors operated by same drive unit have jaw type disengaging clutches.] [Provide sludge-collector motors with nonreversing starters and 2-button start-stop pushbutton stations.]

2.9.1.13 Overload Protection System

Provide a shear pin assembly to serve as overload protection and set to fully protect the equipment.

2.9.1.14 Cross Collector

Provide cross collector of either the helical coil or the conveyor type and designed to scrape and convey the collected sludge from the sludge channel to a sludge sump. Use materials in the construction of the cross collector of the same type and quality as those used in the main sludge collector. Helical coil consists of a helical steel blade mounted on a steel shaft, driven by a sprocket-connected drive. Conveyor must be

similar in operation to the conveyor used in the main sludge collector.

2.9.2 Traveling Bridge Type Collectors

Provide traveling bridge collector composed of a complete bridge assembly supported on ASCE type rails. Provide bridge assembly consisting of a traveling bridge with walkway, bridge drive, sludge removal system, support rail and anchorage parts, and electrical control panel with necessary controls for the operation of the mechanism. Design drive train to withstand maximum horizontal loads placed on the bridge and sludge removal system. Ensure all parts of each mechanism are proportioned for stresses that may occur during fabrication, erection, and operation. Provide bridge with a travel speed of [_____] meters/second fpm and a reverse speed of [_____] meters/second fpm.

2.9.2.1 Bridge Construction

****
NOTE: Beam bridges are normally provided for tank widths between 4.5 and 13.75 m 15 and 45 feet. Truss bridges are normally provided for widths greater than 13.75 m 45 feet.
****

Design bridge to span the entire width of the tank and to withstand all dead loads required for the proper operation of the mechanism, a [_____] N pound sludge load per foot of blade length, and a 2394 Pa 50 psf live load on the walkway. Maximum deflection under all loads not allowed to exceed 1/360 of the span length. Provide walkway that is a minimum of 750 mm 30 inches wide and cover itwith [floor plate] [grating]. [Construct bridge of parallel beams with lateral bracing as required.] [Construct bridge of two parallel trusses fabricated from structural steel and diagonal supports welded to the upper and lower chords.]

2.9.2.2 Bridge Drive

****
NOTE: Gear and rack drivers are desirable in climates that have freezing rain and snow.
****

Provide bridge drive consisting of a drive assembly, wheels, rails, drive shaft, [rack and pinion,] and controls.

a. Provide drive assembly consisting of a [single speed] [dual speed] [variable speed] drive, gear reducer, drive chain, and drive and driven sprockets. Fully enclose all gearing in an oil-tight housing with the gears running in oil. Use anti-friction type bearings. Provide roller chain type drive chain. Ensure motor is totally-enclosed, fan-cooled; ball bearing; and of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. V-belt drives are not acceptable. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Furnish each motor with a magnetic full-voltage starter conforming to

NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

c. Provide drive shaft of sufficient size to adequately and safely withstand all bending and torsional loads of starting and operating. Support drive shaft by multiple, grease lubricated bearings. Provide two load-bearing wheels, one flanged and one flangeless, running on roller bearings mounted on idler shafts at each end of the bridge. Provide running rails that are 18 kg 40 pound [_____] ASCE with standard rail splices and anchor to the tank wall. Provide four rail stops; locate at travel extremes. Drive bridge by gears with a 75 mm 3 inch pitch, keyed to the ends of the drive shaft. Mesh gears with a steel rack anchored to the top of the tank wall.

2.9.2.3 Scraper Sludge Removal, Blades, and Supports

****
NOTE: Scraper type traveling bridge collectors are normally used for primary basins where the volume of sludge is low and the main requirement is to increase the sludge concentration.
****

Provide scraper blades consisting of a minimum 300 12 inch deep structural steel channel, polyurethane wear shoes, and neoprene strips acting as squeegees on the tank bottom. Position and guide scraper blade assembly by two or more rigid structural steel support assemblies attached to the bridge. Attach scraper blade assemblies through pivot joints and bearings to the support assemblies. Ensure scraper assembly retracts above the water surface for maintenance and inspection.

2.9.2.4 Scraper Sludge Removal Cross Collector

****
NOTE: Cross collectors are normally desirable on long basins. Spacing of cross collectors is dependent upon the type of sludge encountered.
****

Provide a screw cross collector consisting of a drive unit with an overload alarm, vertical drive torque shaft, underwater gear box, helical screw, bearings, and anchors. Provide drive unit consisting of a motor and gear reducer connected to a vertical drive shaft through a flexible coupling. Provide totally-enclosed, fan-cooled, ball bearing, constant speed motor of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Vendor must size motor of sufficient size for duty to be performed without exceeding full load under most severe conditions expected. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

a. The gear reducer must be of the worm gear type with anti-friction bearings and completely immersed in oil in a sealed housing.

b. Provide a replaceable switch, with normally open and normally closed

contacts to be actuated upon shear pin failure. Design drive unit to rotate the screw at a speed of [_____] rpm. Provide pressure lubricated underwater gear box with bearings and seals designed for submerged operation. Provide grease lubrication lines from each submerged bearing to an accessible location. Provide helical screw with [_____] mm inch diameter blades of 4.8 mm 3/16 inch thick steel plate welded to a hollow steel core. Support screw by end bearings [and intermediate bearings].

c. Furnish each motor with a magnetic full-voltage starter conforming to NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

d. Provide an automatic control system for operation of the collector, enclosed in a NEMA 250, Type 3R control panel and mounted on the bridge. Prewire and factory test all electrical components. Provide an electric overload system, consisting of suitable relays and an indicating meter plainly showing the overload points. The overload system must sound an alarm when the load reaches full load torque capacity of the drive motor and de-energize the motor. Provide a torque sensing and indicating device to indicate percentage of maximum torque being developed.

2.9.2.5 Vacuum Sludge Removal

****

NOTE: Vacuum and siphon sludge removal systems are normally used for secondary basins in activated sludge systems where large volumes of sludge are to be removed.

****

Provide traveling bridge with [_____] sludge pick-up heads, each [_____] mm feet, inches long, suspended from the bridge. Provide pick-up heads with continuous slot orifices or include neoprene sludge guides covering all settling areas to divert the sludge to large diameter inlet ports. Power vacuum system by [_____] self-priming centrifugal solids handling pumps mounted on the bridge. Provide pumps capable of pumping [_____] L/second gpm per pump at a static head of [_____] mmfeet.

a. Provide totally-enclosed, fan-cooled, ball bearing, constant speed pump motor of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Connect motor directly to the speed reducer by a flexible coupling. V-belt drives are not acceptable. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Furnish each motor with a magnetic full-voltage starter conforming to NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

c. Provide a manual control system for operation of the collector,

enclosed in a NEMA 250, Type 3R control panel and mounted on the bridge. Prewire and factory test all electrical components. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor.

2.9.2.6 Siphon Sludge Removal

2.9.2.6.1 Sludge Removal Siphons

Provide traveling bridges with [_____] sludge removal siphons, [each consisting of a horizontal pipe header with uniformly spaced inlet ports] [each having one large diameter pick-up port and neoprene sludge guides covering all settling areas to divert sludge to the inlet ports]. Submerge siphon discharge in the sludge trough.

2.9.2.6.2 Vacuum Priming System

[Provide a portable vacuum pump for siphon priming. Connect pump manually to a male hose cock on the siphon pipe. Manually turn connection between the pump and siphon pipe to "OFF" as the pipe is primed.] [Provide a bridge mounted vacuum pump for siphon priming. Pipe pump to a vacuum header through a vacuum canister. Terminate vacuum header by hand-operated valve to allow vacuum header purging after the priming operation. Manually turn each connection between the vacuum header and siphon pipes to "OFF" as the pipe is primed.]

2.9.2.6.3 Siphon Flow Control

[Control sludge removal rate of each siphon pipe by an eccentric plug valve, manually operated from the bridge by a handwheel.] [Control sludge removal rate of each siphon pipe by a pneumatically controlled variable orifice pinch valve. Size valve to provide no restriction or change of shape in the siphon pipe when in the full open position. Adjust throttling status of each valve manually and independently maintain by a pneumatic control circuit. Automatically allow the siphon pipes to purge daily at maximum velocity and then return flows to the preset quantities.] [Control sludge removal rate of the siphons by a control box at the discharge end of the traveling bridge. Provide control box of sufficient depth to allow filling the box to the water level in the tank. Regulate discharge from the control box by a [manually] [pneumatically] [hydraulically] [electromechanically] operated sluice gate.]

2.9.2.7 Airlift Pump Sludge Removal

Provide traveling bridge with [_____] sludge pick-up heads, each [_____] mm feet, inches long, suspended from the bridge. Provide pick-up heads including neoprene sludge guides covering all settling areas to divert the sludge to large diameter inlet ports. Size drop pipes for a maximum sludge removal rate of 100 percent of the average daily flow. Use airlift to provide a pumping rate of [_____] L/second gpm per pump at a static head of [_____] mm feet. Power airlift system by a positive displacement blower or centrifugal compressor, depending on air volume required. Mount compressor on the bridge.

a. Provide totally-enclosed, fan-cooled, ball bearing, constant speed compressor motor of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____]

phase, 60 Hz with [1.15] [_____] service factor. Connect motor directly to the speed reducer by a flexible coupling or V-belt drive. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Furnish each motor with a magnetic full-voltage starter conforming to NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

c. Provide a manual control system for operation of the collector, enclosed in a NEMA 250 l Type 3R control panel and mounted on the bridge. Prewire and factory test all electrical components. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor.

2.9.2.8 Power Supply Stretch Cable System

Provide a stretch cable system, consisting of a stainless steel cable stretched between two anchor posts. Provide cable with a number of pulleys which support the electrical cable used to power the collector. Loop electrical cable in coils with each coil being attached to a separate pulley. Upon traveling to the end of the basin, extend the coils to form a draped electrical cable supported by the pulleys, and as the cable returns, retract the loops by the action of the bridge.

2.9.2.9 Power Supply Trolley Track System

Provide a trolley track system, which allows the electrical cable to uncoil and retract as the bridge moves.

2.9.2.10 Power Supply Cable Reel System

Provide a cable reel system capable of unwinding and rewinding the power cable while maintaining a constant tension on the cable. Provide a strain relief device to protect the fixed end of the cable.

2.9.2.11 Control System for Bridge Drive

****

NOTE: NEMA Class 250, Type 4X is recommended where corrosive gases, dust, or water hosedown are environmental factors. NEMA 4X type is not ventilated.

****

Provide an automatic control system for operation of the collector, enclosed in a NEMA 250, Type 3R control panel and mounted on the bridge. Prewire and factory test all electrical components. Provide an electric overload system, consisting of suitable relays and an indicating meter plainly showing the overload points. The overload system must sound an alarm when the load reaches full load torque capacity of the drive motor and de-energize the motor. Provide a torque sensing and indicating device, mounted on the bridge, to indicate percentage of maximum torque being developed.

2.9.3 Center Track Airlift Pump Type Collectors

****

NOTE: Center track airlift pump type collectors are normally limited to basins no larger than 12 m 40 feet long and 6 m 20 feet wide.

****

Provide collector consisting of a support beam and track assembly, carriage assembly, motor and gear reducer, drive chain and sprockets, sludge pick-up assembly, and compressor. Ensure all moving parts are above the water level. Ensure lubrication and adjustment points are readily accessible. Design system to handle a horizontal load (drag) of [438] [_____] N [30] [_____] pounds per lineal meter foot on the scraper blade and all stresses which may occur in fabrication, shipping, erection, and operation. Provide unit with a traverse speed of [_____] mm/second fpm in both directions.

2.9.3.1 Support Beam and Track Assembly

The support beam and integral track must constitute a single box structure spanning the length of the basin. Locate track inside the support beam for weather protection. Provide assembly of sufficient rigidity to withstand both horizontal and vertical loads without supplemental stiffening members. Provide a mounting assembly for attaching the beam and track to the basin wall at the correct height.

2.9.3.2 Carriage Assembly

Provide a carriage assembly to traverse the track assembly. Provide assembly with four flanged support wheels to travel along the track. Ensure assembly has four additional wheels to oppose moment resulting from drag on the scraper blade.

2.9.3.3 Drive Assembly

Provide drive assembly consisting of a motor and gear reducer driving a continuous chain through a shear pin protected drive sprocket. Provide single speed, [_____] volts ac, [_____] phase, 60 Hz motor. Mount motor and gear reducer directly on the support beam. Totally enclose drive sprocket, chain, and driven sprocket in the support beam assembly. Provide a means for adjusting chain tension at the driven sprocket. Direct linkage between the drive chain and the carriage is prohibited. Allow chain to run continuously in one direction with reciprocating motion of the carriage imparted by a fitting on the chain which will engage the carriage at two different points. Allow a brief dwell time at each end of the travel. Engagement of the carriage must not produce eccentric loads on the chain.

a. Provide totally-enclosed, fan-cooled, ball bearing, constant speed motor of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Furnish each motor with a magnetic full-voltage starter conforming to

NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

2.9.3.4 Airlift Pump

****
NOTE: Airlift pumps are made of noncorrosive materials. Air lines are removable with multiorifice diffuser discharge end. Airlift pump must be properly reinforced to handle structural and dynamic loads. Capacity, submergence, and air requirements should be calculated for each airlift pump. Priming pump vacuum is heavy-duty industrial vacuum with minimum liquid volume of 23 liters 6 gallons, double filtration system, and automatic water level shutoff float.
****

Provide each collector with a sludge pick-up head [_____] mm feet, inches long, suspended from the carriage. Provide pick-up head including neoprene sludge guides covering all settling areas to divert the sludge to large diameter inlet ports. Size drop pipe for a maximum sludge removal rate of 100 percent of the average daily flow. Use airlift to provide a pumping rate of [_____] L/second gpm per pump at a static head of [_____] mm feet. Power airlift system by positive displacement blowers or centrifugal compressors, depending on air volume required. Provide a pair of compressors to feed a common air manifold to provide air supply for [_____] collectors as shown. Provide required check valves, shut-off valves, and regulating valves for isolation, regulation, and balancing.

a. Provide totally-enclosed, fan-cooled, ball bearing, constant speed compressor motor of ample power for starting and continuously operating the mechanism under most severe expected operating conditions without overloading. Provide motor conforming to NEMA standards and suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Connect motor directly to the blower by a flexible coupling or V-belt drive. Make necessary adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Furnish each motor with a magnetic full-voltage starter conforming to NEMA ICS 1. Provide starter in weatherproof cast metal enclosure. Provide a separate pole with manually reset thermal-overload protection in each ungrounded conductor. Mount controls in starter cover or in separate weatherproof cast metal enclosure.

2.9.3.5 Controls

****
NOTE: NEMA Class 250, Type 4X is recommended where corrosive gases, dust, or water hosedown are environmental factors. NEMA 4X type is not ventilated.
****

Provide an automatic control system for operation of the collector. Enclose controls in a NEMA 250, Type 3R control panel and mount on the

support beam. Ensure all electrical components are prewired and factory tested.

2.9.4 Floating Bridge Siphon-Type Collectors

Provide collector consisting of a floating bridge, bridge drive and idler stand, siphons and sludge removal system, float system, control system, and necessary support structures and anchorage. Ensure collector is capable of removing settled solids from the tank floor and discharging them into a sludge trough. Control flow rate of the mechanism over a range of [_____] L/second gpm to [_____] L/second gpm per collector bridge assembly by individually adjustable siphon pipes.

2.9.4.1 Floating Bridge

Design and contruct floating assembly to comply with the hydraulic conditions of the system. Provide bridge consisting of rigidly interlaced aluminum beams, stainless siphon pipes, and fiberglass floats, all designed to support the entire mechanism and maintain a minimum floating clearance of 50 mm 2 inches from the floor of the collector basin. Furnish beams of sufficient size to support the floats and the siphon pipes. Furnish stainless steel brackets and pipe clamps to securely mount all of the siphon pipes in the proper position to the support beams. Mount floats securely to the siphon pipes to provide uniform travel of the bridge in both directions, the full length of the collector basin. Design floats for the general hydraulic conditions and consisting of closed cell polyurethane foam encased in a fiberglass enclosure and support by structural aluminum angle. Ensure recyclable materials conform to EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Secure aluminum tow brackets to the siphon pipes and furnish with stainless steel mounting hardware of adequate quantity and size to withstand the loading and tension applied to the towing cable when the collector reverses direction. Secure inboard and outboard end trucks and guide wheel assemblies to the floats or support beams and design to allow for thermal expansion and contraction of the floating bridge. Provide wheels composed of noncorrosive material.

2.9.4.2 Bridge Drive Assembly and Idler Stand

Tow each floating bridge along the longitudinal length of the basin by a stainless steel, stranded wire cable. Use cable of adequate size to tow the entire structure and span the length of the tank with a minimum of catenary. Affix drive cable to floating bridge assembly through tow bridle assembly. Provide bridge drive consisting of a reducer driven by a constant torque, variable speed dc electric motor, [single] [_____] phase, 60 Hz, [120] [_____] volts, totally enclosed, suitable for continuous duty. House reducer in an oil- and dust-tight casing, equip with anti-friction bearings, and design for splash-type lubrication. Provide switches permitting directional change of the unit on the drive base assembly. Provide an idler stand complete with adjustable base and sheave at the opposite end of the tank. Provide a complete corrosion-resistant enclosure for each drive and idler assembly.

2.9.4.3 Sludge Removal System

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NOTE: Assemblies, parts, and connectors in submerged service should be made of 304/316 stainless steel or fiberglass, rather than aluminum.

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Provide total sludge removal capacity range of the vacuum sludge removal system which is adjustable from [_____] L/second gpm to [_____] L/second gpm. Construct all siphon piping and headers of stainless steel with vacuum tight welded joints. Design piping assembly structure to adequately support itself on the tank floor with the basin dewatered. Provide orifices of adequate size and spacing in each header pipe. Design entrance velocity at each orifice to create an angular zone in influence, to permit all sludge on the basin floor to be cleaned at the end of each cycle. Each siphon pipe must be independent from the others and independently controlled. Terminate and discharge each siphon pipe into a sludge control device. The submerged siphon piping must be stainless steel on the exterior surface in accordance with collector manufacturer's recommendations to protect the pipe from oxygen cell corrosion. Furnish individual sludge control for each siphon as an integral part of the siphon collector. Ensure control is corrosion resistant and adequately supported. Suspend control device from the floating structure and secured to the siphon piping. Manually adjust flow rate by setting the adjustable discharge opening using a rising stem operator. Construct sludge control device to prevent air from breaking the siphon during priming. Design siphon collector to permit priming of each suction header. Furnish a priming device consisting of a portable, wet-dry vacuum pump with handle and wheels. Provide valves for each siphon pipe that are capable of holding 635 mm 25 inches of mercury with zero leakage. Provide flexible single ply rubber priming hose and quick disconnect couplings with each unit. The vacuum pump must be industrial wet/dry type, [single] [_____] phase, 60 Hz, [120] [_____] volts ac. Provide one priming pump per pair of siphon collector mechanisms.

2.9.4.4 Control Panel

Furnish a control panel by the collector manufacturer containing all controls necessary for the operation of the collector. Ensure all of the components are factory installed in a NEMA 250, Type 4 [4X] [3R] enclosure, factory prewired to numbered terminal strips within the enclosure and factory tested. Include manual override controls for collector travel in addition to the automatic operations. Furnish areversing mechanism with time delay relays to change the collector direction of travel automatically. Provide a SCR controller to vary the speed of the collector at between [1.2] [_____] m/minute [4] [_____] fpm and [3.7] [_____] m/minute [12] [_____] fpm for both directions of the bridge travel. Furnish limit switches with internal heaters and stainless steel limit switch actuators to reverse the movement of the collector. Mount one limit switch securely to the bridge drive, and mount the other limit switch securely to the idler stand. Affix microswitch to overclutch clutch to activate alarm and shut down.

2.9.4.5 Automatic Programmer

Provide a programmer in the control panel to automatically adjust rate of collector travel. Upon reversing direction of the collector, allow collector rate of travel to increase automatically for manually preset distance and then return to preset normal rate of travel. Ensure programmer has a manual override. Provide a single phase, 60 Hz, [120] [_____] volts ac solid state, encapsulated, proximity switch as an integral part of the programming control.

2.9.5 Scum Removal

Provide a retracting surface skimmer to remove scum from the tank. Attach mechanism with a blade extending the width of the tank, or as required, to the bridge. Allow skimmer to operate while the bridge is traveling in one direction only and retract for the return trip of the bridge. Provide a beaching type scum trough across one end of the basin. Construct trough of [steel plate] [or] [fiberglass] to the dimensions indicated. Provide all hardware required for trough installation.

2.9.6 Effluent Removal

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NOTE: Coordinate with paragraph WEIR PLATES.
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Provide weir plates composed of [fabricated steel plate] [or] [fiberglass reinforced polyester plastic] of the dimensions indicated. Mold vee notches in fiberglass weir plates in the plate; cut edges are not acceptable. Mount weir plates in a manner to be watertight and to provide a minimum of 50 mm 2 inches vertical adjustment. Fabricate effluent trough from [steel plate] [or] [fiberglass reinforced polyester plastic] to the dimensions indicated. Ensure joints between sections are watertight. Provide support assemblies of adequate strength to prevent trough distortion through filling and draining of the tank.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 FACTORY PAINTING

Ensure all ferrous metal equipment, except stainless steel and galvanized steel, is cleaned, primed, and given two coats of machinery enamel at the factory. Field paint in accordance with Section 09 90 00 PAINTS AND COATINGS.

3.3 FRAMED INSTRUCTIONS

Post framed instructions, containing wiring and control diagrams under glass or in laminated plastic, where directed. Show wiring and control diagrams and complete layout of the entire system. 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. Submit a copy of the posted instructions proposed to be used. Post framed instructions before acceptance testing of the system.

3.4 EQUIPMENT INSTALLATION

3.4.1 Installation

Install equipment as indicated and in accordance 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 proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

Furnish grease and oil, of grades recommended by the manufacturer, as part of the installation and as required for initial operation.

3.4.2 Adjusting

Make field adjustments as required for proper operation of the equipment.

3.4.3 Testing

3.4.3.1 Operational Test

Subject each mechanism to an operational test, under the observation of the Contracting Officer. Demonstrate that the equipment is not defective and is in safe and satisfactory operating condition. Submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

3.4.3.2 Torque Test

Conduct a torque test on one mechanism selected by the Contracting Officer. Conduct test under the supervision of a factory serviceman and observation of the Contracting Officer. The purpose of the test is to verify the structural integrity and adequacy of the mechanism and drive. Perform torque test consisting of securing all rake arms at multiple points by cables to anchor bolts installed in the tank floor at locations recommended by the manufacturer. Apply a torque load to the drive by hand if possible. Measure the magnitude of the applied load by a calibrated pressure reading, the plunger and rod area, and the distance of the line of action of each cylinder from the centerline of the mechanism. Take readings at 100, 120, and 140 percent of continuous operating torque. Apply test loads such that the torque overload device can be used to indicate the alarm and motor shut-off torque values of the drive.

3.4.3.3 Retesting

If any deficiencies are revealed during any test, correct such deficiencies and reconduct the tests.

3.4.4 Tank Bottom

Finish the tank bottom in such a manner that full contact will be obtained between the [sludge scrapers] [flights] [manifold] and the surface.

3.5 WELDING

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NOTE: If the need exists for more stringent pipe welding requirements, delete the sentences in the first set of brackets.
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[Weld piping in accordance with qualified procedures using performance qualified welders and welding operators. Use qualified procedures and welders in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. Notify the Contracting Officer 24 hours in advance of tests and perform the tests at the work site if practical. The welder or welding operator must apply his assigned symbol near each weld he makes as a permanent record. Weld structural members in accordance with Section 05 05 23.16 STRUCTURAL WELDING.] [Use welding and nondestructive testing procedures for piping as specified in Section 40 05 13.96 WELDING PROCESS PIPING.]

3.6 MANUFACTURER'S SERVICES

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

3.7 CLOSEOUT ACTIVITIES

3.7.1 Field Training

Provide a field training course for designated operating and maintenance staff members. Provide training for a total period of [_____] hours of normal working time and start after the system is functionally complete but prior to final acceptance tests. Cover all of the items contained in the Operating and Maintenance Manuals.

3.7.2 Operating and Maintenance Manuals

Detail in the Operation manuals the step-by-step procedures required for system startup, operation, and shutdown. Include in the Operation manuals the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. List in the Maintenance manuals routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Include in the Maintenance manuals piping and equipment layout and simplified wiring and control diagrams of the system as installed. Obtain approval of manuals prior to the field training course.

-- End of Section --