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USACE / NAVFAC / AFCEC / NASA | **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 2021

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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	(2017) Dimensional Tolerances for Aluminum Mill Products
AA H35.1/35.1M	(2017) 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	(2020) 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 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	(2003; R 2016) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2014; E 2017) 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	(2008) 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	(2009) Heavy Duty Metal Bar Grating Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2018) Motors and Generators

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2015) Rules for the Measurement & Inspection of Hardwood & Cypress

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use	(1998) 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, 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

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. Equipment shall be supported by a

service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each major item of equipment shall have 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

Steel plates, shapes, and bars shall be ASTM A36/A36M, minimum 6 mm 1/4 inch thickness unless otherwise specified.

2.2.2 Malleable Iron

Malleable iron shall conform to ASTM A47/A47M.

2.2.3 Iron Castings

Iron castings shall conform to ASTM A48/A48M.

2.2.4 Aluminum for Structural and Rolled Shapes

Aluminum for structural and rolled shapes shall conform to AA H35.1/35.1M, alloy 6061-T6, and AA ANSI H35.2M.

2.2.5 Aluminum for Extruded Shapes

Aluminum for extruded shapes shall conform to AA H35.1/35.1M, alloy 6063-T6.

2.2.6 High Strength Bolts

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

2.2.7 Anchor Bolts

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

2.2.8.2 FRP Laminate

Laminate shall have a glass content of 30 plus or minus 2 percent using Type "E" glass with chrome or silane finish. Powdered reinforcements shall consist of 47.5 plus or minus 1 percent of resin mixture. Resin mixture shall be of the "low profile" type. Final laminate thickness shall be within plus or minus 10 percent of the specified thickness.

2.2.8.3 Physical Properties

Physical properties of fiberglass reinforced polyester plastic shall be 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, machined or cut edges shall be resin sealed.

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.
****

Handrails shall be 1065 mm 42 inches high with two horizontal rails. Handrails shall be fabricated of Schedule 40 [galvanized] steel pipe conforming to ASTM A53/A53M or Schedule 40 [mill finished] [anodized] aluminum pipe conforming to ASTM B429/B429M. Pipe size shall be [40] [50] mm [1-1/2] [2] inch NPS. To maximize extent practicable, railing shall be shop fabricated. Rigid joints shall be flush-finished welded assembly. Joints shall be reinforced with tight fitting interior sleeves and shall be assembled by welding rails and posts to flush-type fittings, or by mitering and welding joining rails to posts. Expansion joints shall be located at lengths of rails as recommended by the manufacturer. Expansion joints shall be the inner-sleeved slip joint type with one end of the sleeve secured to the railing. Expansion joints and splices shall be located near the intersection of rails and posts. Bends in railing shall be smooth and made in a manner that will not crush or deform the railing. All welds shall be ground smooth and railings shall be free of burrs and sharp corners and edges. Removable sections shall be as indicated.

2.4 FLOOR GRATING AND FRAMES

[Carbon Steel] [Aluminum] [Stainless Steel] grating shall be designed in accordance with [NAAMM MBG 531] [NAAMM MBG 532] to meet the indicated load requirements. Edges shall be banded with bars 6 mm 1/4 inch less in height than bearing bars for grating sizes above 19 mm 3/4 inch. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. [Floor gratings and frames shall be galvanized after fabrication.]

2.5 FLOOR PLATES

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

Aluminum floor plates shall conform with ASTM B632/B632M, other aluminum floor plates shall be 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. Wearing surface shall be aluminum oxide or silicon carbide].

2.6 LUMBER

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

2.7 MOTORS

Motors shall conform to NEMA MG 1.

2.8 COLLECTORS FOR CIRCULAR AND SQUARE TANKS

2.8.1 Drive Unit

Drive unit shall consist of a gear reducer and motor, direct or flexible

coupled. Drive unit shall have a [cast iron housing] [or] [fabricated steel housing with integral hardened steel raceway] and shall be designed in compliance with ABMA 9 and ABMA 11, ANSI/AGMA 2001 and ANSI/AGMA 6034. The continuous torque rating of the spur gear assembly shall be based upon the smaller of the values developed by ANSI/AGMA 2001 and considered as the rated torque capacity the entire gear will develop continuously over a 20-year period. Drive unit shall be rated 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 shall 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. The final gear shall be mounted on a ball bearing assembly with the balls running in replaceable hardened alloy steel races. All bearings for this type of unit shall be antifriction type and shall run in an oil bath. The reduction unit shall have housings effectively sealed against contaminants. An oil filling and level check pipe shall be provided.

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 shall be tapered roller type.

2.8.3 Bridge Supported Drive Torque Tube

A steel torque tube shall be bolted to the final reduction gear and shall support and rotate the sludge collection arms.

2.8.4 Center Pier-Supported Drive Reduction Unit

The primary speed reducer shall be of the helical or worm gear type, coupled to the intermediate speed reducer directly or by a standard steel roller chain and steel sprockets. Chain and sprockets shall be protected by chain guards. The intermediate speed reducer shall consist of a worm and worm gear or planetary gear, keyed to a shaft which drives the internal spur gear. The final speed reducer shall be a spur gear designed to withstand the maximum torque loads imposed on the clarifier mechanism. Bearings shall be antifriction type. Bearings in cast iron units shall run in replaceable hardened alloy steel races. All gears shall run in an oil bath. Oil seals and oil fill, drain, and level check systems shall be provided. Chains shall be lubricated as recommended by the manufacturer. A drive cage, with provision to connect to the final reduction unit, shall

be provided. The drive cage shall be fabricated from structural steel members and shall be designed to withstand the momentary peak torque of the collector without permanent deformation of the members. The drive cage shall have provision for attachment of sludge removal arms.

2.8.5 Electric Motor

Motor shall operate on [_____] volts ac, [_____] phase, 60 Hz and shall be totally enclosed fan cooled with a minimum [1.15] [_____] service factor. Equipment vendor shall size motor to be of sufficient size for duty to be performed and shall not exceed full load rating under the most severe conditions expected. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

2.8.6 Overload Protection

The drive unit shall be provided with an overload protection system, enclosed in a weatherproof housing. The system shall consist of two micro-switches actuated by the movement of the worm shaft in the worm gear housing. The switches shall be adjusted 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. The system shall visually indicate overload points. A shear pin assembly shall be provided 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.
****

A combination influent and support column shall support the drive, collector mechanism, and access bridge and shall serve as the center influent pipe. The column shall be fabricated from steel plate and shall be anchored to the concrete. The column shall be a minimum of [_____] mm feet-inches in diameter and shall 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.
****

The influent feedwell shall be fabricated from steel plate sections with bolted connections and shall be supported from the center cage. The

feedwell shall be of adequate size and design to diffuse the flow into the tank. Feedwell design shall be such that the flow-through velocity does not exceed [46] [76] mm/second [0.15] [0.25] fps at maximum flow. Baffled ports shall be provided 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.

****

The influent feedwell shall be fabricated from steel plate with necessary stiffening members. The feedwell shall be supported by structural steel members which span the tank and are attached to brackets mounted on the tank wall above design water level. Feedwell shall be designed to diffuse the flow into the tank and shall have baffled ports at the water surface to permit the escape of scum. A flanged pipe connection and an influent pipe from the tank side shall be provided.

2.8.7.4 Influent Feedwell for Thickeners

****

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

****

The influent feedwell shall be fabricated from steel plate with necessary stiffening members. The feedwell shall be 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. The feedwell shall be supported by structural steel members which span the tank and are attached to brackets mounted on the tank wall. A flanged pipe nozzle and influent pipe from the tank side shall be provided. A cleanout shall be provided at the point where the flow splits prior to entering the influent feedwell.

2.8.7.5 Peripheral Feed Influent

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

2.8.8 Scraper Sludge Removal

Unit shall be [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, shall be provided. Adjustable [spring brass] [PVC] [galvanized steel] squeegees shall be provided for each scraper blade. The squeegees shall project 40 mm 1-1/2 inches below the scraper blade and shall be 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.
****

Hydraulic sludge removal shall be accomplished by the use of the header and manifold system or the uptake pipe system.

2.8.9.1 Header

The header shall be designed 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. The mechanism shall 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 shall not 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 shall be [_____] mm feet. The header shall be fabricated from steel plate, shall be rectangular, and shall vary 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 shall be parallel to the tank bottom, and the longitudinal cross sectional axis shall be mounted at an angle of 45 degrees to provide a peaked top. The leading edge of the header shall extend 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. A 3.175 mm 10 gauge steel scraper with a neoprene blade shall be provided to clean the tank bottom around the manifold and direct the sludge to the first orifice. Inlet orifices shall be spaced along the length of the header such that in a single revolution the header will clean the entire tank bottom. Maximum orifice spacing shall be [775] [_____] mm [30] [_____] inches. Orifices shall be accurately drilled in the header. The header shall be supported from the center cage by steel tie-bars with turnbuckles, clevises, and locknuts. The support system shall hold the header in alignment both horizontally and vertically. A suitable counterweight shall be provided to counterbalance the header.

2.8.9.2 Manifold

The sludge collection manifold shall be fabricated from steel plate. Two seals shall be provided to ensure that the sludge enters the manifold only through the headers. The bottom plate shall be anchored to the tank bottom, aligned, and grouted 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.
****

The system shall consist 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. The sludge discharge column shall be fabricated from steel plate and shall extend from the sludge sitewell to the bottom of the stationary influent column where it shall connect to the sludge discharge pipe under the tank bottom.

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

c. The suction nozzles shall be a minimum of [_____] mm inches in diameter. Suction piping shall be Schedule 80 PVC and shall be sized for a flow velocity not less than 0.16 meters/second 0.5 fps at minimum flow to prohibit solids settling in the piping. Fittings shall be Type 304 stainless steel or Schedule 80 PVC and shall have bell-type ends with O-ring seals.

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

e. Sludge flow shall be induced 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 shall be dependent on and controlled solely by the pumping rate from outside the mechanism.

2.8.11 Corner Scrapers for Square Tanks

A corner blade shall be provided on [one] [each] sludge scraper arm. Corner scraper blades shall consist of a straight blade attached to two horizontal members mounted on the main scraper arm. The scraper mechanism shall be pivoted on special underwater bearings and shall be actuated by a counterweight or spring to keep the end of the arm in contact with the side of the tank. Steel guide plates for the tank corners shall be provided to direct the path of the corner blades. A carrier wheel shall

be provided on the outer end of each corner blade. Springs, cable, and chain shall be 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 shall consist of a [single] [dual] skimming device, a scum baffle, and [one] [two] skimmer blade ramp(s) and scum box(es).

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

b. The scum baffle shall be fabricated from [steel plate] [or] [fiberglass reinforced polyester plastic]. [Fiberglass scum baffle plates shall be in standard lengths not to exceed 3600 mm 12 feet] Connections between baffle sections shall be constructed in a manner that will not interfere with smooth contact of the skimmer. All supports and connectors required for a complete installation shall be provided.

c. Scum boxes shall be of the dimensions indicated and shall be fabricated from steel plate. The assembly shall have a scum sump, vertical steel sides, and a sloping skimmer blade ramp. A flexible connector shall be provided between the scum outlet piping and the tank wall. [An automatic flushing device, which will open as the scraper passes shall be provided.]

2.8.13 Influent Channel Scum Removal

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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, a system shall be provided for removal of scum from the influent channel. The system shall consist 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. All controls required for the system shall be provided.

2.8.14 Bridge

2.8.14.1 Bridge Design and Construction

The bridge shall be fabricated from structural steel and shall be all-welded construction. The bridge shall be either truss or beam type design. Maximum allowable deflection of the bridge shall be 1/360 of the span length under a live load of 2.9 kPa 60 psf. The bridge walkway shall

be [floor plate] [grating]. Handrail with a 100 mm 4 inch high toe plate, shall be provided 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 shall span the entire tank diameter and shall be supported by and anchored to the tank wall. The bridge shall support the drive and collector mechanism and provide access for maintenance. The access walkway shall be at least 900 mm 3 feet wide. At least 775 mm 2 feet 6 inches clearance shall be provided between the drive unit and the handrails on all sides where maintenance is required.

2.8.14.3 Bridge for Center Pier-Supported Drives

The bridge shall be supported on one end by the tank wall and on the other end by the drive unit. The access walkway shall be at least 900 mm 3 feet wide and shall extend to a point 775 mm 2 feet 6 inches beyond the drive assembly. At least 775 mm 2 feet 6 inches clearance shall be provided 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 shall be [fabricated from steel plate][or][fiberglass reinforced polyester plastic]. Weir plates shall be of the dimensions indicated. Vee notches in fiberglass weir plates shall be molded in the plate; cut edges are not acceptable. Weir plates shall be mounted 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

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

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The effluent trough and drop box shall be fabricated from [steel plate] [or] [fiberglass reinforced polyester plastic]. Trough and drop box dimensions shall be as indicated. Joints between sections shall be watertight. Support assemblies of adequate strength to prevent trough or box distortion through filling and draining of the tank shall be provided.

2.9 SLUDGE COLLECTORS FOR RECTANGULAR TANKS

2.9.1 Chain and Flight Scraper Type Collectors

The sludge collector shall include 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. Chains for primary tank collectors shall 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. Chains for intermediate tank collectors shall 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. Cross collectors shall run at twice the speed of the longitudinal collectors. Collector components shall be selected based upon the following criteria: operation under dry tank conditions; friction factor for dry steel on dry steel shall be 0.33; friction factor for polyurethane on dry steel shall be 0.25; bearing friction shall be 5 percent of shaft assembly.

2.9.1.1 Metallic Chains

Metallic chains shall be manufactured 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. The chains shall be 7205 heavy pintle type 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 shall have an allowable working load of [15.7] [_____] kN [3,540] [_____] pounds and each assembled strand shall be proof tested at a minimum of [83.6] [_____] kN [18,800] [_____] pounds to detect and remove defective castings. Rigid attachments shall be provided for full depth of the flight and attached with four 10 mm 3/8 inch diameter bolts. Chain sections shall be matched within 5 mm in 3 meters 3/16 inch in 10 feet, tagged, and wired together in pairs.

2.9.1.2 Nonmetallic Chains

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

2.9.1.3 Drive Chains

Drive chains shall be H-78 mill type manufactured of a corrosion resistant processed metal, shall consist of[66.27 mm 2.609 inch] [_____] pitch links, and shall have an allowable working load of [10.4] [_____] kN [2,350] [_____] pounds. Each assembled strand shall be proof tested at a minimum of [44.5] [_____] kN [10,000] [_____] pounds to detect and remove defective castings. A hot-dip galvanized chain tightener shall be provided to take up unnecessary slack in the drive chain.

2.9.1.4 Wood Flights

Wood flights shall be[50 by 150 mm 2 by 6 inch][75 by 200 mm 3 by 8 inch] nominal size and spaced approximately [3000] [_____] mm [10] [_____] feet on centers. Flights shall be redwood or red cypress. All flights shall be accurately drilled and notched at the factory to ensure proper alignment.

2.9.1.5 Fiberglass Flights

Fiberglass flights shall be[50 by 150 mm 2 by 6 inch][75 by 200 mm 3 by 8 inch] nominal size, especially designed for sludge collector service. The scraper shall have continuous fiberglass filaments running the full length of the member and shall include a scraper lip on the leading edge to ensure cleaning of the tank floor. The scraper shall include filler blocks for bolting the member to the chain attachment links. Flight spacing shall be approximately [3] [_____] m [10] [_____] feet. Buoyant flight design will not be acceptable.

2.9.1.6 Wearing Shoes

Each flight shall be provided with 13 mm 1/2 inch thick polyurethane wearing shoes to run on the floor rails and return tracks. Wearing shoes shall be reversible, providing two usable wearing surfaces.

2.9.1.7 Rails

Two 11 kg 25 pound ASCE tee rails shall be furnished and installed in the tank floor in accordance with manufacturer's written recommendations.

2.9.1.8 Return Tracks

Return tracks shall be[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. Each bracket shall be designed to cantilever the return track off the tank wall. Support brackets shall be spaced approximately 3000 mm 10 feet apart and fastened to the tank wall by a minimum of two anchors.

2.9.1.9 Sprockets

Sprockets shall have chilled tooth bearing surfaces with a hardness of not less than 360 Brinell and chill depth of at least 4.8 mm 3/16 inch. Driving sprockets shall be keyed firmly to the headshaft. Corner shafts shall have one sprocket setscrewed and one running loose on the shaft. Collector chain sprockets shall be of the double-life type and of split construction. Headshaft sprockets shall be not less than [_____] mm inch pitch diameter and shall have not less than [_____] teeth. All other collector chain sprockets shall be not less than [_____] mm inch pitch diameter and have not less than [_____] teeth. Traction wheels, idler wheels, or other substitutions for sprockets will not be acceptable. The drive sprocket shall be fitted with a bronze bushing and shall be provided with a shear pin device to provide for full protection of equipment in case of excessive loading. The driving sprocket on the reducer shaft shall be not less than [_____] mm inch pitch diameter and shall have not less than [_____] teeth. The driven sprocket on the collector headshaft shall be split construction, shall not be less than [_____] mm inch pitch diameter, and shall have not less than [_____] teeth.

2.9.1.10 Shafts

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

2.9.1.11 Bearings

Underwater bearings shall be 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. The bearings shall be bolted directly to the tank wall in a manner to permit easy adjustment. Take-up bearings shall provide not less than 250 mm 10 inches of horizontal travel. Take-up bearings shall be of cantilevered design, with a fabricated steel support base, and shall have cadmium plated take-up screws. Take-up bearings shall be designed so that no recesses in the concrete are required to maintain clearances.

2.9.1.12 Drive Unit

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

a. The motor shall 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. The motor shall be directly connected to the speed reducer by a flexible coupling. V-belt drives shall not be acceptable. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

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

c. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast

metal enclosure. [If motors have reversing starters, a jog type switch shall be provided such that mechanism is activated in the reverse direction only as long as button is pushed down. Multiple collectors operated by same drive unit shall have jaw type disengaging clutches.] [Sludge-collector motors shall be provided with nonreversing starters and 2-button start-stop pushbutton stations.]

2.9.1.13 Overload Protection System

A shear pin assembly shall be provided to serve as overload protection and set to fully protect the equipment.

2.9.1.14 Cross Collector

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

2.9.2 Traveling Bridge Type Collectors

Traveling bridge collector shall be a complete bridge assembly supported on ASCE type rails. The bridge assembly shall consist 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. The drive train shall be designed to withstand maximum horizontal loads placed on the bridge and sludge removal system. All parts of each mechanism shall be proportioned for stresses that may occur during fabrication, erection, and operation. The bridge shall have 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.
****

The bridge shall be designed 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 shall not exceed 1/360 of the span length. The walkway shall be covered with [floor plate] [grating] and shall be a minimum of 750 mm 30 inches wide. [The bridge shall be constructed of parallel beams with lateral bracing as required.] [The bridge shall be constructed of 2 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.
****

The bridge drive shall consist of a drive assembly, wheels, rails, drive shaft, [rack and pinion,] and controls.

a. The drive assembly shall consist of a [single speed] [dual speed] [variable speed] drive, gear reducer, drive chain, and drive and driven sprockets. All gearing shall be fully enclosed in an oil-tight housing with the gears running in oil. Bearings shall be anti-friction type. Drive chain shall be roller chain type. The motor shall be 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. V-belt drives shall not be acceptable. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

c. The drive shaft shall be of sufficient size to adequately and safely withstand all bending and torsional loads of starting and operating. The drive shaft shall be supported by multiple, grease lubricated bearings. Two load-bearing wheels shall be provided, one flanged and one flangeless, running on roller bearings mounted on idler shafts at each end of the bridge. Running rails shall be 18 kg 40 pound [_____] ASCE with standard rail splices and shall be anchored to the tank wall. Four rail stops shall be provided, located at travel extremes. The bridge shall be driven by gears with a 75 mm 3 inch pitch, keyed to the ends of the drive shaft. The gears shall mesh with a steel rack anchored to the top of the tank wall.

2.9.2.3 Scraper Sludge Removal, Blades, and Supports

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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.
****

Scraper blades shall consist of a minimum 300 12 inch deep structural steel channel, polyurethane wear shoes, and neoprene strips acting as squeegees on the tank bottom. The scraper blade assembly shall be positioned and guided by two or more rigid structural steel support assemblies attached to the bridge. The scraper blade assemblies shall attach through pivot joints and bearings to the support assemblies. The scraper assembly shall retract 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.

****

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 shall be provided. The drive unit shall consist of a motor and gear reducer connected to a vertical drive shaft through a flexible coupling. The motor shall 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Vendor shall size motor of sufficient size for duty to be performed without exceeding full load under most severe conditions expected. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

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

b. A replaceable switch, with normally open and normally closed contacts to be actuated upon shear pin failure shall be provided. The drive unit shall be designed to rotate the screw at a speed of [_____] rpm. The underwater gear box shall be pressure lubricated and shall have bearings and seals designed for submerged operation. Grease lubrication lines shall be provided from each submerged bearing to an accessible location. The helical screw shall have [_____] mm inch diameter blades of 4.8 mm 3/16 inch thick steel plate welded to a hollow steel core. The screw shall be supported by end bearings [and intermediate bearings].

c. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

d. An automatic control system shall be provided for operation of the collector, enclosed in a NEMA 250, Type 3R control panel and mounted on the bridge. All electrical components shall be prewired and factory tested. An electric overload system, consisting of suitable relays and an indicating meter plainly showing the overload points, shall be provided. The overload system shall sound an alarm when the load reaches full load torque capacity of the drive motor and shall de-energize the motor. A torque sensing and indicating device shall be provided 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.
****

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

a. The pump motor shall 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. The motor shall be directly connected to the speed reducer by a flexible coupling. V-belt drives shall not be acceptable. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

c. A manual control system shall be provided for operation of the collector, enclosed in a NEMA 250, Type 3R control panel and mounted on the bridge. All electrical components shall be prewired and factory tested. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor.

2.9.2.6 Siphon Sludge Removal

2.9.2.6.1 Sludge Removal Siphons

The traveling bridges shall be provided 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]. The siphon discharge shall be submerged in the sludge trough.

2.9.2.6.2 Vacuum Priming System

[A portable vacuum pump shall be provided for siphon priming. The pump shall be manually connected to a male hose cock on the siphon pipe. The connection between the pump and siphon pipe shall be manually turned to "OFF" as the pipe is primed.] [A bridge mounted vacuum pump shall be provided for siphon priming. The pump shall be piped to a vacuum header through a vacuum canister. The vacuum header shall be terminated by hand-operated valve to allow vacuum header purging after the priming operation. Each connection between the vacuum header and siphon pipes shall be manually turned to "OFF" as the pipe is primed.]

2.9.2.6.3 Siphon Flow Control

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

2.9.2.7 Airlift Pump Sludge Removal

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

a. The compressor motor shall 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. The motor shall be directly connected to the speed reducer by a flexible coupling or V-belt drive. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

c. A manual control system shall be provided for operation of the collector, enclosed in a NEMA 250 l Type 3R control panel and mounted on the bridge. All electrical components shall be prewired and factory tested. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor.

2.9.2.8 Power Supply Stretch Cable System

A stretch cable system, consisting of a stainless steel cable stretched between two anchor posts, shall be provided. The cable shall be provided

with a number of pulleys which support the electrical cable used to power the collector. The electrical cable shall be looped in coils with each coil being attached to a separate pulley. Upon traveling to the end of the basin, the coils shall be extended to form a draped electrical cable supported by the pulleys, and as the cable returns, the loops shall be retracted by the action of the bridge.

2.9.2.9 Power Supply Trolley Track System

A trolley track system, which allows the electrical cable to uncoil and retract as the bridge moves, shall be provided.

2.9.2.10 Power Supply Cable Reel System

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

2.9.2.11 Control System for Bridge Drive

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

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

2.9.3 Center Track Airlift Pump Type Collectors

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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.

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The collector shall consist of a support beam and track assembly, carriage assembly, motor and gear reducer, drive chain and sprockets, sludge pick-up assembly, and compressor. All moving parts shall be above the water level. Lubrication and adjustment points shall be readily accessible. The system shall be designed 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. The unit shall have 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 shall constitute a single box

structure spanning the length of the basin. The track shall be located inside the support beam for weather protection. The assembly shall be of sufficient rigidity to withstand both horizontal and vertical loads without supplemental stiffening members. A mounting assembly shall be provided for attaching the beam and track to the basin wall at the correct height.

2.9.3.2 Carriage Assembly

A carriage assembly shall be provided to traverse the track assembly. The assembly shall have four flanged support wheels to travel along the track. The assembly shall also have four additional wheels to oppose moment resulting from drag on the scraper blade.

2.9.3.3 Drive Assembly

The drive assembly shall consist of a motor and gear reducer driving a continuous chain through a shear pin protected drive sprocket. The motor shall be single speed, [_____] volts ac, [_____] phase, 60 Hz. The motor and gear reducer shall be mounted directly on the support beam. The drive sprocket, chain, and driven sprocket shall be totally enclosed in the support beam assembly. A means shall be provided for adjusting chain tension at the driven sprocket. There shall be no direct linkage between the drive chain and the carriage. The chain shall 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. There shall be a brief dwell time at each end of the travel. Engagement of the carriage shall not produce eccentric loads on the chain.

a. The motor shall 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

2.9.3.4 Airlift Pump

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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.

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

a. The compressor motor shall 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. The motor shall conform to NEMA standards and be suitable for operation on [_____] volts ac [_____] phase, 60 Hz with [1.15] [_____] service factor. The motor shall be directly connected to the blower by a flexible coupling or V-belt drive. Necessary adjustments shall be made to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually installed.

b. Each motor shall be furnished with a magnetic full-voltage starter conforming to NEMA ICS 1. The starter shall be in weatherproof cast metal enclosure. A separate pole with manually reset thermal-overload protection shall be provided in each ungrounded conductor. Controls shall be mounted in starter cover or in separate weatherproof cast metal enclosure.

2.9.3.5 Controls

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

****

An automatic control system shall be provided for operation of the collector. Controls shall be enclosed in a NEMA 250, Type 3R control panel and shall be mounted on the support beam. All electrical components shall be prewired and factory tested.

2.9.4 Floating Bridge Siphon-Type Collectors

The collector shall consist of a floating bridge, bridge drive and idler stand, siphons and sludge removal system, float system, control system, and necessary support structures and anchorage. The collector shall be capable of removing settled solids from the tank floor and discharging them into a sludge trough. The flow rate of the mechanism shall be controlled 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

The floating assembly shall be designed and constructed to comply with the

hydraulic conditions of the system. The bridge shall consist 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. The beams shall be furnished of sufficient size to support the floats and the siphon pipes. Stainless steel brackets and pipe clamps shall be furnished to securely mount all of the siphon pipes in the proper position to the support beams. The floats shall be securely mounted to the siphon pipes to provide uniform travel of the bridge in both directions, the full length of the collector basin. The floats shall be designed for the general hydraulic conditions and shall each consist of closed cell polyurethane foam encased in a fiberglass enclosure and supported by structural aluminum angle. Recyclable materials shall conform to EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Aluminum tow brackets shall be secured to the siphon pipes and furnished 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. Inboard and outboard end trucks and guide wheel assemblies shall be secured to the floats or support beams and designed to allow for thermal expansion and contraction of the floating bridge. Wheels shall be noncorrosive material.

2.9.4.2 Bridge Drive Assembly and Idler Stand

Each floating bridge shall be towed along the longitudinal length of the basin by a stainless steel, stranded wire cable. The cable shall be of adequate size to tow the entire structure and span the length of the tank with a minimum of catenary. Drive cable shall be affixed to floating bridge assembly through tow bridle assembly. The bridge drive shall consist 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. The reducer shall be housed in an oil- and dust-tight casing, equipped with anti-friction bearings, and designed for splash-type lubrication. Switches permitting directional change of the unit shall be provided on the drive base assembly. An idler stand complete with adjustable base and sheave shall be provided at the opposite end of the tank. A complete corrosion-resistant enclosure shall be provided 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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The total sludge removal capacity range of the vacuum sludge removal system shall be adjustable from [_____] L/second gpm to [_____] L/second gpm. All siphon piping and headers shall be constructed of stainless steel with vacuum tight welded joints. The piping assembly structure shall be designed to adequately support itself on the tank floor with the basin dewatered. Orifices of adequate size and spacing shall be provided in each header pipe. The entrance velocity at each orifice shall be designed 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 shall be independent from the others and independently controlled. Each

siphon pipe shall terminate and discharge into a sludge control device. The submerged siphon piping shall be stainless steel on the exterior surface in accordance with collector manufacturer's recommendations to protect the pipe from oxygen cell corrosion. Individual sludge control for each siphon shall be furnished as an integral part of the siphon collector. The control shall be corrosion resistant and adequately supported. The control device shall be suspended from the floating structure and secured to the siphon piping. The flow rate shall be adjustable by manually setting the adjustable discharge opening using a rising stem operator. The sludge control device shall be constructed to prevent air from breaking the siphon during priming. The siphon collector shall be designed to permit priming of each suction header. A priming device consisting of a portable, wet-dry vacuum pump with handle and wheels shall be furnished. Valves shall be provided for each siphon pipe and shall be capable of holding 635 mm 25 inches of mercury with zero leakage. Flexible single ply rubber priming hose and quick disconnect couplings shall be provided with each unit. The vacuum pump shall be industrial wet/dry type, [single] [_____] phase, 60 Hz, [120] [_____] volts ac. One priming pump shall be provided per pair of siphon collector mechanisms.

2.9.4.4 Control Panel

A control panel shall be furnished by the collector manufacturer, and shall contain all controls necessary for the operation of the collector. All of the components shall be factory installed in a NEMA 250, Type 4 [4X] [3R] enclosure, factory prewired to numbered terminal strips within the enclosure and factory tested. Manual override controls for collector travel shall be included, in addition to the automatic operations. A reversing mechanism shall be furnished, with time delay relays to change the collector direction of travel automatically. A SCR controller shall be provided 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. Limit switches with internal heaters and stainless steel limit switch actuators shall be furnished to reverse the movement of the collector. One limit switch shall be securely mounted to the bridge drive, and the other limit switch shall be securely mounted to the idler stand. Microswitch shall be affixed to overclutch clutch to activate alarm and shut down.

2.9.4.5 Automatic Programmer

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

2.9.5 Scum Removal

A retracting surface skimmer shall be provided to remove scum from the tank. The mechanism shall be attached to the bridge and shall have a blade extending the width of the tank or as required. The skimmer shall operate while the bridge is traveling in one direction only and shall retract for the return trip of the bridge. A beaching type scum trough shall be provided across one end of the basin. The trough shall be

constructed of [steel plate] [or] [fiberglass] to the dimensions indicated. All hardware required for trough installation shall be provided.

2.9.6 Effluent Removal

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NOTE: Coordinate with paragraph WEIR PLATES.
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Weir plates shall be [fabricated steel plate] [or] [fiberglass reinforced polyester plastic] of the dimensions indicated. Vee notches in fiberglass weir plates shall be molded in the plate; cut edges are not acceptable. Weir plates shall be mounted in a manner to be watertight and to provide a minimum of 50 mm 2 inches vertical adjustment. The effluent trough shall be fabricated from [steel plate] [or] [fiberglass reinforced polyester plastic] to the dimensions indicated. Joints between sections shall be watertight. Support assemblies of adequate strength shall be provided 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

All ferrous metal equipment, except stainless steel and galvanized steel, shall be cleaned, primed, and given two coats of machinery enamel at the factory. Field painting shall be 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. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall also 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. The framed instructions shall be posted 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. Drawings shall 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

Each mechanism shall be subjected to an operational test, under the observation of the Contracting Officer. The test shall 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

A torque test shall be conducted on one mechanism selected by the Contracting Officer. The test shall be conducted under the supervision of a factory serviceman and shall be observed by the Contracting Officer. The purpose of the test is to verify the structural integrity and adequacy of the mechanism and drive. The torque test shall consist of securing all rake arms at multiple points by cables to anchor bolts installed in the tank floor at locations recommended by the manufacturer. A torque load shall be applied to the drive by hand if possible. The magnitude of the applied load shall be measured 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. Reading shall be taken at 100, 120, and 140 percent of continuous operating torque. The test loads shall be applied 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, such deficiencies shall be corrected and the tests shall be reconducted.

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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[Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators

qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING.] [Welding and nondestructive testing procedures for piping shall be 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. The representative shall supervise the installation, adjustment, and testing of the equipment.

3.7 CLOSEOUT ACTIVITIES

3.7.1 Field Training

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

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. Manuals shall be approved prior to the field training course.

-- End of Section --