UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2019
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DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

SECTION 46 23 00

GRIT REMOVAL AND HANDLING EQUIPMENT

02/11

-- End of Section Table of Contents --

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USACE / NAVFAC / AFCEC / NASA | **UFGS-46 23 00 (February 2011) Change 1 - 08/13**

Preparing Activity: NAVFAC | **Replacing without change UFGS-44 42 39 (November 2009)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2019

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SECTION 46 23 00

GRIT REMOVAL AND HANDLING EQUIPMENT
02/11

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NOTE: This guide specification covers the requirements for equipment used for treatment of domestic sewage only.

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

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

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

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****

NOTE: This guide specification is for treatment of domestic sewage only. Special consideration must be given to sewage containing industrial wastes.

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NOTE: The following information shall be shown on the project drawings or provided by the project designer. Design Grit Removal System in accordance with Unified Facilities Criteria (UFC) 3-240-02, "Domestic Wastewater Treatment."

1. Size, depth and general configuration of grit separation, chamber, final discharge point, collection, removal, and classifying facilities. Give space limitations which may affect optional choices;

2. Grit size and percentage removal of grit required;

3. Electrical characteristics and wattage horsepower of motor for grit separation, collection, removal and classifying equipment;

4. Flow range in cubic meter per second mgd plant is designed to serve;

5. Type to diffuser holder assembly, whether fixed or swing out type;

6. Supply of external air quantity in cubic meter per second cfm and pressure in kPa psi;

7. Type of diffuser, whether non-porous nozzle or valve orifice type is used;

8. Type of power for hoist, whether electric or gasoline engine;

9. Type of velocity control, whether regulator or weir;

10. Applicable wind and ice loadings;

11. Type of grit pump configuration, whether vertical or horizontal;

12. Removal capacity of screw conveyor in cubic meter per second cubic feet per hour;

13. Pitch diameter of flights and liner plate diameter for screw conveyors;

14. Type of wastewater from which grit is to be removed, whether raw sewage or settled primary sludge;

15. Capacity in cubic meter per second gpm and pressure in kPa psi for the cyclone;

16. Cyclone pressure switch range in kPag psig;

17. Type of walkway, whether raised pattern floor plate or grating, on shallow tank separator; and

18. Whether corrosive conditions exist in sewage or in atmosphere at installation.

****

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.

****

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 DAF45	(2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 11	(2005; R 2013) Standard Method of Test for Materials Finer Than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T 27	(2014) Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

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

AMERICAN GAS ASSOCIATION (AGA)

AGA GMC	Gas Measurement Committee Report No. 3

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)

AGMA 908	(1989B; R 1999) Information Sheet: Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth
ANSI/AGMA 6034	(1992B; R 2005) Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C207	(2018) Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 in. through 144 in. (100 mm through 3600 mm)
AWWA C504	(2015) Standard for Rubber-Seated Butterfly Valves
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B16.4	(2011) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B17.1	(1967; R 2017) Keys and Keyseats
ASME B17.2	(1967; R 2017) Woodruff Keys and Keyseats
ASME B29.400	(2001; (R 2008) (R 2013) (R 2018)) Combination, "H" Type Mill Chains, and Sprockets

ASSOCIATION FOR IRON AND STEEL TECHNOLOGY (AIST)

AIST PB-229	(2008) Stainless Steels: A Steel Products Manual

ASTM INTERNATIONAL (ASTM)

ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A27/A27M	(2017) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A312/A312M	(2017) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A36/A36M	(2014) Standard Specification for Carbon

Structural Steel

ASTM A48/A48M (2003; R 2012) Standard Specification for Gray Iron Castings

ASTM A53/A53M (2018) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A536 (1984; R 2014) Standard Specification for Ductile Iron Castings

ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B209M (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B221 (2014) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM B221M (2013) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM B26/B26M (2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings

ASTM B30 (2016) Standard Specification for Copper Alloys in Ingot Form

ASTM D1785 (2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D2467 (2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

ASTM D2564 (2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

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

MSS SP-72 (2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (2013) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2016; SUPP 2016) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 10.01	(1982; E 2004) Hot-Applied Coal Tar Enamel Painting System
SSPC Paint 16	(2006; R 2015; E 2015) Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-DTL-24441	(2009; Rev D) Paint, Epoxy-Polyamide, General Specification for
MIL-DTL-24441/29	(2009; Rev B) Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type IV
MIL-DTL-24441/31	(2009; Rev B) Paint, Epoxy-Polyamide, White, Formula 152, Type IV
MIL-P-21035	(1991; Rev B; Notice 2 2003) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)
MIL-PRF-24635	(2009; Rev E) Coating Systems, Weather Resistant, Exterior Use

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-3120	(Rev A) Paint: For Swimming Pools
FS TT-P-645	(Rev C) Primer, Paint, Zinc-Molybdate, Alkyd Type

1.2 DEFINITIONS

1.2.1 Grit

The settleable solids load present in wastewater such as sand, gravel, cinders, metal fragments not ameliorated by secondary treatment and/or sludge removal techniques and capable of producing excessive wear on mechanical equipment.

1.2.2 Grit Separation

****

NOTE: Delete "aeration" when an aerated grit system is not required, delete "the tank configuration"

when an aerated grit system is required.
****

The process of separating grit from wastewater by controlling the velocity of the wastewater with aeration to suspend organics and/or by tank configuration to separate the grit from the organic solids by differential sedimentation and scour.

1.2.3 Grit Collection

****
NOTE: Delete the first option when an aerated grit chamber with an inclined bottom is required, delete the second option when an aerated grit chamber with an inclined bottom is not required.
****

The process of gathering the separated grit in a hopper or other point of collection [by mechanical equipment designed for the purpose] [by means of hydraulic flow over an inclined chamber floor].

1.2.4 Grit Removal

****
NOTE: Delete the first option when classifying equipment is not required, delete the second option when classifying equipment is required.
****

The process of conveying grit out of the chamber from the point of collection in the chamber to [classifying equipment for further processing] [the indicated point of discharge]. Grit removal equipment may accomplish some dewatering.

1.2.5 Grit Classifying

****
NOTE: Delete all references to classifying when classifying is not included in the grit removal system.
****

The process of further separation of grit by washing putrescible matter from the removed grit by means of sprays or washing the tanks and dewatering with screw conveyors or cyclones. These screw conveyors or cyclones also convey the grit to the indicated point of discharge.

1.3 DESIGN REQUIREMENTS

****
NOTE: Delete all references to classifying when classifying is not included in the grit removal system. The use of any combination of grit removal system for any wastewater treatment plant will be the responsibility of the project engineer. The combinations of equipment for the following systems are several:

1. Aerated grit system.

2. Aerated grit system (inclined bottom chamber).

3. Longitudinal grit system.

4. Vortex type grit system.

The following are some of the factors involved in the selection of grit removal system:

1. Site area availability;

2. Amount of grit anticipated;

3. Type of sewer system, separate or combined;

4. Other selected process i.e., air available if diffused air activated sludge processes; incineration disposal for grit; primary sedimentation process; and

****

Grit removal system shall be designed to separate, collect, remove, [classify] and deposit grit at the indicated point of its discharge, within the area and at the elevations indicated. Equipment shall duplicate units that have been manufactured, installed and operated for a minimum of 2 years.

[1.3.1 Aerated Grit Removal System

****

NOTE: Choose this paragraph or one of the paragraphs below, entitled "Inclined Bottom Grit Removal System," "Longitudinal Grit Removal System," and "Vortex Type Grit Removal System."

****

****

NOTE: The project designer shall determine which grit removal system is suitable for the project. Paragraphs which describe systems which are not included in the project should be deleted. Delete those options of collection and removal equipment which are not appropriate to the project. When it is anticipated that the bottom of a chamber will be utilized for grit storage, a screw conveyor should be used for collecting grit when the depth of the stored grit is expected to exceed the height of a rake or bucket collector. A grit pump must be used for removal when a cyclone is included with the classifying equipment. Space limitations may preclude the use of inclined removal equipment. Delete all references to cyclone when a cyclone is not included in the classifying equipment. Delete reference to screw-type classifiers when a cyclone is the only classifier required. Delete all references to classifying when classifying is not included in the grit removal system. Delete screw conveyor when space limitations prohibit an inclined

screw, delete screw conveyor and bucket elevator when cyclone is included in classifying equipment.

****

Grit shall be separated in an aerated grit chamber. Collection and removal of grit shall be by [horizontal screw conveyor and bucket elevator,] [horizontal screw conveyor and inclined screw conveyor,] [horizontal screw conveyor and grit pump,] [chain and bucket equipment,] [and] [airlift pump]. Classifying equipment shall be a [cyclone] [and] [screw-type classifier].

][1.3.2 Inclined Bottom Grit Removal System

****

NOTE: Choose this paragraph or the paragraph above, entitled "Aerated Grit Removal System," or one of the paragraphs below, entitled "Longitudinal Grit Removal System," and "Vortex Type Grit Removal System."

****

Grit shall be separated in an inclined bottom aerated grit chamber. Chamber bottom shall be inclined to move grit to the point of removal. Removal of grit shall be by [screw conveyor] [airlift pump] [bucket elevator] [grit pump]. Classifying equipment shall be a [cyclone] [and] [screw-type classifier].

][1.3.3 Longitudinal Grit Removal System

****

NOTE: Choose this paragraph or one of the paragraphs above, entitled "Aerated Grit Removal System," and "Inclined Bottom Grit Removal System," or the paragraph below, entitled "Vortex Type Grit Removal System."

****

Grit shall be separated in a longitudinal grit chamber. Collection and removal of grit shall be by [horizontal screw conveyor and bucket elevator,] [horizontal screw conveyor and inclined screw,] [horizontal screw conveyor and grit pump,] [and] [chain and bucket equipment]. Classifying equipment shall be a [cyclone] [and] [screw-type classifier].

][1.3.4 Vortex Type Grit Removal System

****

NOTE: Choose this paragraph or one of the paragraphs above, entitled "Aerated Grit Removal System," "Inclined Bottom Grit Removal System," and "Vortex Type Grit Removal System."

****

Grit shall be separated in a vortex type grit removal system. Removal of grit shall be by [grit pump] [airlift pump]. Classifying equipment shall be [cyclone] [and] [screw-type classifiers].

]1.3.5 System Requirements

System shall be capable of separating and removing [_____] percent of

[_____] mesh grit having a specific gravity of [2.65] [_____] from a flow ranging from [_____] to [_____] cubic meter per second million gallons per day.

1.4 SUBMITTALS

****

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

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

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. Locate the "S" submittal under the SD number that best describes the submittal item.

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

****

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

****

NOTE: Delete all references to classifying when classifying is not included in the grit removal

system.

****

SD-02 Shop Drawings

Grit handling equipment layout

Reinforced concrete

SD-05 Design Data

Reinforced concrete design calculations

SD-06 Test Reports

****

NOTE: Delete all references to classifying when classifying is not included in the grit removal system. The use of any combination of grit removal system for any wastewater treatment plant will be the responsibility of the project engineer. The combinations of equipment for the following systems are several:

1. Aerated grit system.

2. Aerated grit system (inclined bottom chamber).

3. Longitudinal grit system.

4. Vortex type grit system.

The following are some of the factors involved in the selection of grit removal system:

1. Site area availability;

2. Amount of grit anticipated;

3. Type of sewer system, separate or combined;

4. Other selected process i.e., air available if diffused air activated sludge processes; incineration disposal for grit; primary sedimentation process; and

****

Performance tests

Grit pump tests

[Grit classifying equipment tests

] For grit pumps, submit sufficient data, including manufacturer's rating curves showing pump characteristics of head, wattage brake horsepower, and speed to show that the pump meets all requirements of the specifications.

SD-10 Operation and Maintenance Data

Grit handling equipment, Data Package 3; G[, [_____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit operation and maintenance data for each item of the grit separation, collection, removal and classifying system.

SD-11 Closeout Submittals

Posted operating instructions

Submit text of posted operating instructions for each component of the grit separation, collection, removal, and classifying system.

1.5 QUALITY ASSURANCE

Welders shall be qualified in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.5.1 Layout Drawings

Submit drawings showing layout of all equipment. Include construction and erection details for all components of the complete grit separation, collection removal [and classifying] system and also show associated piping to connection with plant piping.

1.5.2 Reinforced Concrete Drawings

Submit reinforced concrete drawings when the equipment requires any change in structural concrete, whether chamber configuration or otherwise, from that indicated.

1.5.3 Data Requirements

When the equipment submitted requires any change in structural concrete, whether chamber configuration or otherwise, from that indicated, submit reinforced concrete design calculations [to the Contracting Officer].

1.6 DELIVERY, STORAGE, AND HANDLING

Equipment and parts shall be packaged for shipment to prevent breakage, damage or cause out-of-adjustment calibration, readings or controls. Materials delivered to the site shall be inspected for damage and shall be unloaded and stored with a minimum of handling. Equipment and materials shall be stored indoors, off the floor. Area shall be dry with adequate ventilation, free from dust or water, and shall permit easy access for inspection and handling.

1.7 SPARE PARTS

****
NOTE: Delete spare parts listed for any equipment not allowed on the project.
****

Spare parts for the equipment specified above shall be furnished in the quantities listed below. The spare parts shall be identical and interchangeable with the original parts. The parts shall be furnished in wooden containers clearly marked with contents on two sides and top. Where the number of spare part units required by the schedule results in a fractional number of units, the number furnished shall be rounded off to the next highest.

Description of Spare Part Unit	Number of Spare Units Required as Percentage of Part Units Installed
a. Screw [Collector] [and] [Conveyor]:	
Drive chains	25 percent
Drive sprocket with shear pin hub	25 percent
b. Chain and Bucket Collectors:	
Drive chains	25 percent
Collector chain lengths	5 percent
Buckets, complete with attachments	55 percent
Drive sprocket with shear pin hub	25 percent
c. Aerated Grit System:	
Diffusers	5 percent
d. Grit Pump:	
One set of pump gland packing	
One complete set of gaskets	
One complete set of bearings, bushings, sleeves and seals	
e. Cyclone:	
One complete rubber lining	
f. In addition, one dozen shear pins of each size used shall also be furnished.	

1.8 POSTED OPERATING INSTRUCTIONS

Provide posted operating instructions conforming to the requirements of Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, including wiring and control diagrams showing the layout of the entire system, posted where directed. Provide 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 in typed form, framed as specified above for wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Unless otherwise specified, materials and equipment shall be standard commercial products in regular production by the manufacturers and suitable for the required service. Unless otherwise specified, structural steel shall conform to ASTM A36/A36M hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M. Submerged steel shall have a minimum thickness of 6 mm 1/4 inch. Unless otherwise specified, cast iron shall conform toASTM A48/A48M, Grade 30. Bronze castings not otherwise specified shall conform to ASTM B30. Drives, lubrication, and bearings shall be accessible from walkways at or above ground level.

2.1.1 [Aerated Grit Separation Equipment

****
NOTE: Choose this paragraph and its subparagraphs or one of the paragraphs below, entitled "Longitudinal Grit Separation Equipment" and "Vortex Type Grit Separation," and its subparagraphs.
****

Grit separation equipment shall include air piping and valves, swing diffuser holder assembly, header pipes, hoist, and diffusers. Baffles shall be structural steel plate, 50 mm 2 inch thick redwood, or manufacturer's standard. System shall receive air from an external supply at a maximum rate of [_____] cubic meter per second cfm at [_____] kPa psi.

]2.1.1.1 Air Piping

****
NOTE: Stainless steel or plastic pipe should be specified in lieu of cast iron or steel when corrosion is considered a problem. Delete inapplicable materials.
****

Includes piping from air main to diffusers. Air header piping shall be steel or stainless steel. Drop and diffuser header piping shall be [galvanized steel] [stainless steel] [or plastic].

a. Steel pipe for sizes 100 mm 4 inch diameter and smaller shall be standard-weight zinc-coated steel pipe conforming to ASTM A53/A53M with fittings of cast iron conforming to ASME B16.4, Type II. Steel pipe for sizes 125 mm 5 inch diameter and larger shall be seamless or electric-resistance welded, standard weight, black steel pipe conforming to ASTM A53/A53M, Grade B. Joints for pipe sizes 100 mm 4 inch diameter and smaller shall be screwed joints. Joints for pipe sizes 125 mm 5 inch diameter and larger shall be flanged with flanges conforming to ASME B16.5 or AWWA C207. Bolts and nuts for flanged connections shall conform to the requirements specified in AWWA C207. Gaskets shall be plain rubber gaskets 3 mm 1/8 inch thick.

b. Stainless steel piping shall conform to ASTM A312/A312M, Type 304 or Type 316, Schedule 10.

c. Plastic piping shall conform to ASTM D1785, Class PVC 1220, Schedule 80. Fittings shall be the same type and grade as the pipe and conform to ASTM D2467.

2.1.1.2 Swing-Out Type Diffuser Holder Assembly

Assembly shall include an upper pivot joint with air control and shut-off valve, a drop pipe with intermediate pivot joint, and a diffuser header. Upper pivot joint shall be of cast iron or cast steel and shall have a trunnion type support for the rotary joint. Unit shall have a base flange for mounting to a wall anchorage elbow, and joint shall rotate on two bronze sleeve bearings, either permanently lubricated or with suitable grease fittings for lubrication. Chloroprene or Buna N rubber O-ring gaskets shall be included at each pivot bearing to ensure air and water tightness. Valve shall be butterfly type and be suitable for air control with indicator markings for throttling and complete shut-off. Butterfly valve shall conform to AWWA C504, shall have cast-iron or bronze body and chloroprene rubber seat, and shall be lever or hand wheel operated. Intermediate pivot joint shall be as specified for the upper joint, except that it shall not have the integral valve and base flange. Threaded or flanged connections shall be provided for the upper and lower hanger pipes. Bearings with O-ring seals shall be as specified for the upper pivot joint. The intermediate pivot joint shall have a locking device to allow positive locking in any position. Spacing of diffuser assemblies in the basin and diffusers on the header shall be as recommended by the diffuser manufacturer. Drilling and tapping of diffuser header pipe shall be such as to make the diffuser level in the horizontal plane. Diffuser header shall incorporate an adjustable stop on the wall side to prevent the diffuser from coming into contact with the wall. A portable hoist shall be provided to raise and lower the diffuser assembly. Hoist shall be expressly designed to be compatible with the diffuser holder assembly and shall be provided by the same manufacturer. Hoist shall be hydraulically operated, powered by [an electric motor] [a gasoline engine] with quick clamping arrangement to engage upper hanger pipe. The hoist shall be adequately powered to raise the assembly from the tank. The hoist shall provide means of locking the diffuser header in a raised position over the tank or the walkway.

2.1.1.3 Diffusers

Diffusers shall be of the non-porous nozzle or valve orifice type. Nozzle devices shall be saddle mounted with stainless steel spring fasteners or thread mounted on the diffuser header as recommended by the diffuser manufacturer. Nozzle orifice shall be sized for the particular application to assure the proper range of exit velocity and back pressure. [Units shall be cast iron, plastic, or stainless steel.]

2.1.2 [Longitudinal Grit Separation Equipment

****

NOTE: Choose this paragraph and its subparagraphs or the paragraph above, entitled "Aerated Grit Separation Equipment," and its subparagraphs, or the paragraph below, entitled "Vortex Type Grit Separation" and its subparagraphs.

****

****

NOTE: Delete all requirements and references pertaining to velocity control regulator when a proportional weir is required, delete all requirements and references pertaining to proportional weir when a velocity control regulator is required.

****

Velocity control device in the grit chamber shall be a [velocity control regulator] [proportional weir].

][2.1.2.1 Velocity Control Regulator

****

NOTE: Choose this paragraph or the paragraph below, entitled "Proportional Weir."

****

****

NOTE: Where corrosive environment is not present, specify structural steel. Where corrosion can occur and cost is not a factor, specify stainless steel, otherwise specify aluminum.

****

Regulator shall maintain the velocity of flow at a selected rate through a channel of cross sections indicated. Regulator shall be fabricated from [AIST PB-229, Type 304 stainless steel] [structural steel] [aluminum conforming to ASTM B209M ASTM B209 or ASTM B221M ASTM B221, Alloy 6061, Temper T6]. Regulator opening shall be adjustable by means of hand wheel operated racks and pinions to provide a range of flows from zero to [_____] cubic meter per second mgd.

][2.1.2.2 Proportional Weir

****

NOTE: Choose this paragraph or the paragraph above, entitled "Velocity Control Regulator."

****

****

NOTE: Where corrosive environment is not present, specify structural steel. Where corrosion can occur and cost is not a factor, specify stainless steel, otherwise specify aluminum.

****

Velocity shall be controlled by a [AIST PB-229, Type 304 stainless steel] [aluminum conforming to ASTM B209M ASTM B209 or ASTM B221M ASTM B221, Alloy 6061, Temper T6] [structural steel] proportional weir. Weir shall be provided as indicated and shall be suitable for providing a constant velocity through the grit chamber for a range of flows from [_____] to [_____] cubic meter per second mgd.

]2.1.2.3 Framework and Control Sections

****
NOTE: Specify material compatible with material specified in the paragraph entitled "Velocity Control Regulator" or "Proportional Weir."
****

[AIST PB-229, Type 304 stainless steel] [Aluminum conforming to ASTM B209M ASTM B209 or ASTM B221M ASTM B221, Alloy 6061, Temper T6 and shall be reinforced to provide rigidity]. Provide anchor bolts required for anchoring or bolting the control device to the concrete work. The bolts shall be AIST PB-229, Type 304 stainless steel.

2.1.3 [Vortex Type Grit Separation

****
NOTE: Choose this paragraph and its subparagraphs or one of the paragraphs above, entitled "Aerated Grit Separation" and "Longitudinal Grit Separation Equipment," and its subparagraphs.
****

Separation and collection equipment shall be installed in a concrete chamber. Equipment shall include motor drive assembly, paddle drive tube; air [lift pump,] piping and valves; and control box. System shall receive air from an external supply at a maximum rate of [_____] cubic meter per second CFM at [_____] kPa psi.

]2.1.3.1 Design

Removal device shall have less than 6 mm 1/4 inch head loss through the chamber. Influent baffles, if required, shall be stainless steel installed according to equipment manufacturer's recommendations. Grit shall be hydraulically scoured to remove organics before it is [airlifted] [pumped] to the separation equipment. Paddle agitator assembly shall be geared to provide a rotational velocity of no greater than [28] [_____] RPM.

2.1.3.2 Mechanical Drive

Grit removal unit shall have variable pitch and depth paddles mounted onto a drive torque tube bolted to the slewing bearing with integral gearing driven by the gear head. Design of drive assembly shall be such as to permit sustained operation at the continuous output torque rating without excessive wear and to develop twice the continuous output torque rating without damage to or failure of the drive assembly components.

a. Grit removal mechanism shall be powered by a helical gear motor no larger than [_____] watts hp with a minimum service factor of 2.0. The motor shall be a totally enclosed fan-cooled (TEFC) type, suitable for outside installations with normal starting torque and low starting current, suitable for [_____] volt, [_____] Hz, [_____] phase service, enclosed in an anti-corrosion aluminum housing. Gear motor shall be in accordance with AGMA, not be overloaded under any normal operating conditions encountered and be designed for long life at 24 hours per day service. Helical gearing shall be oil lubricated.

b. Reducer shall include anti-friction bearings and double lip high temperature oil seals riding on precision ground shafts. Gears shall

be made of hardened and heat treated forged steel. Gear motor shall drive a gear head consisting of a pinion driving a slewing bearing with integral gearing. Both pinion and slewing bearing shall have a service factor of 5.0 or greater. Pinion shall be heat treated and machined on all surfaces. Slewing bearing shall be no less than 475 mm 19 inches in diameter and shall have precision-ground, deep induction-hardened raceway, chrome alloy steel balls separated by spacers and protected by seals. Gears on the external ring and bearing shall be grease-packed in a heavy cast iron-gear case. Slewing bearings and pinion shall be wear-resistant to withstand 24 hours per day continuous service. The gear box shall have an appropriately sized opening for the drive torque tube to the propeller. Bottom opening shall have an air bell around the drive torque tube to prevent water from entering the gear box. [Top of gear box shall have a bolted flanged connection for the airlift pipe.]

2.1.4 [Screw Collector/Bucket Elevator

****
NOTE: Choose this paragraph, and its subparagraphs, or one of the paragraphs below, entitled "Screw (Collector) (and) (Conveyor)" and "Chain and Bucket Elevator Collector," and its subparagraphs.
****

****
NOTE: At least two manufacturers combine a screw collector and a bucket elevator utilizing the bucket chain to drive the screw and using only one drive assembly. This unit may be used in either an aerated grit removal system or a longitudinal grit removal system when the screw conveyor is not more than 15 m 50 feet long or when the amount of grit to be removed does not exceed 0.06 cubic meter per second 120 cubic feet per hour. Delete this paragraph and all subparagraphs when this unit is not allowed as an alternate to the separate units or when the above physical limits will be exceeded.
****

A unit utilizing the bucket chain of the elevator as a drive chain for the screw collector shall be provided. Unit shall include screw shafts and bearings, liner plate, chain, sprockets, grit buckets, drive assembly, housing and overload protection.

]2.1.4.1 Design

Screw collector with bucket elevator unit shall be designed for continuous and intermittent operation and shall have a removal capacity both of not less than [_____] cubic meter per second cubic feet per hour of dry grit weighing [1922] [_____] kg per cubic meter [120] [_____] pounds per cubic feet.

2.1.4.2 Screw Collector Assembly for Combination Unit

****
NOTE: The following table lists the requirements for selecting a screw.

Grit Cap. Cu. m/sec	Dia. MM	Screw Conveyor Pipe Size MM	Watts	Shaft Dia. MM
0.03	300	100	746	50 or 61
0.05	400	100	1,119	75
0.08	500	125	1,492	75 or 86

Grit Cap. Cu. Ft/Hr.	Dia. Inch	Screw Conveyor Pipe Size Inches	H.P.	Shaft Dia. Inches
55	12	4" Std.	1.0	2 or 2 7/16"
100	16	4" X-Hvy	1.5	3"
163	20	5" Std.	2.0	3 or 3 7/16"

Alternate screw type can be helicoid with short shafts.

****

a. Screw shall be [_____] mm inch diameter, half pitch with 10 mm 3/8 inch flights butt welded or fillet welded on both sides and mounted on [_____] mm inch steel pipe conforming to ASTM A53/A53M and bushed for [_____] mm inch shaft. As an alternate, a helicoid type screw conveyor section with 10 mm 3/8 inch steel flights may be provided with renewable short shafts of solid cold rolled steel conforming to ASTM A108. Screw shall be made in the manufacturer's standard lengths with a coupling flight connection for ease of installation and removal. Outer leading edges of the flighting shall be protected with a coating of weldment, a minimum of 25 mm one inch wide and 3 mm 1/8 inch thick. If a carbon steel flighting is provided with a minimum 10 mm 3/8 inch thickness, it will be acceptable without coating provided that it has a minimum Brinell hardness of 500 or other abrasion-resistant material.

b. Shafts shall be cold rolled steel conforming to ASTM A108. Coupling bolts shall be AIST PB-229, Type 316 stainless steel. Driven end shall be coupled to the foot shaft of the bucket elevator. Tail shaft bearings shall be grease lubricated bearings provided with cast iron, high carbon or heat treated alloy steel bushings. Bearings shall be rated for a minimum of five years on a continuous service basis.

c. A curved 10 mm by [_____] mm 3/8 by [_____] inch I.D. steel liner plate shall be provided with edges drilled for plug welding to 13 by 150 mm 1/2 by 6 inch steel straps embedded in the concrete. Plate shall have a Brinell hardness of 300 to 350.

2.1.4.3 Bucket Elevator Assembly for Combination Unit

a. Bucket chain shall be ASME B29.400 combination "H" Type Mill C102 having an average ultimate strength of 160 kN 36,000 pounds and shall weigh no less than 15 kg per meter 9.7 pounds per foot. Chain links

shall be of corrosion resisting malleable iron having an average tensile strength of at least 483 MPa 70,000 psi and an average Brinell hardness between 170 and 190.

b. Sprockets shall be high-test cast iron, having a minimum tensile strength of 138 MPa 20,000 psi cast in a chill, and shall have a Brinell hardness of not less than 360 with a chill depth of at least 5 mm 3/16 inch. Sprockets shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit chain. Sprockets shall be split construction assembled with cadmium plated nuts and bolts. Driven sprocket and the sprockets on the head shaft and screw shaft shall be keyseated. Keys and keyseats shall conform to ASME B17.1 or ASME B17.2.

c. Shafting shall be solid, cold-finished steel conforming to ASTM A108, straight and continuous for full width of tank. Shafting shall be of sufficient size to transmit the maximum force developed by the drive assembly. Keyways shall be provided where necessary to attach or locate sprockets on shafting. Keys and keyseats shall conform to ASME B17.1 and ASME B17.2. Shafting shall be polished in areas of contact with bearings.

d. Bearings shall be babbitt-lined, ductile-iron type, self-aligning ball-and-socket type or heat treated ductile-iron self-aligning type. Bearings shall be designed to allow minimum field variations without shimming. Bearings above water shall be provided with flush ball-check grease-lubrication fittings. Underwater bearings shall be water lubricated with tops designed to prevent solids accumulation. Underwater bearings shall be equipped with flush ball-check grease-lubrication fittings. All bearings shall be rated for a minimum of 5 years on a continuous service basis.

e. Grit buckets shall be fabricated structural steel or malleable iron with hardened lip designed to drain off free water. Buckets shall be attached to chains at not more than 1.5 m 5 foot intervals with heat treated carbon steel pins and rivets having a minimum diameter of 17 mm 11/16 inch.

2.1.4.4 Drive Assembly for Combination Unit

Motor drive assembly shall include a motor; speed reducer; drive sprocket on output shaft of speed reducer; drive chain from drive sprocket to driven sprocket; shear pin; and chain guard. Unit shall be fully enclosed and designed for mounting outside and exposed to the weather.

a. Motor shall be suitable for operation on [_____] volt, [_____] phase, [_____] Hz service.

b. Chain and belt drives incorporated in the drive assembly shall be designed with a minimum factor of safety of 4 as applied to ultimate breaking or transmission strength of the chain or belt with respect to the loads transmitted at normal continuous operating load.

2.1.4.5 Housing

****
NOTE: Specify galvanized steel unless corrosion is considered a problem.
****

1.8 mm 14 gage [galvanized steel] [AIST PB-229, Type 302 or AIST PB-229, Type 304 stainless steel] mounted on the structural supports and securely fastened to the structural frame with bolts or sheet metal screws of the same material as the housing. Suitable openings for chain installation and inspection shall be provided at convenient locations in the housing.

2.1.5 Screw [Collector] [and] [Conveyor]

****
NOTE: Choose this paragraph and its subparagraphs or the paragraph above, entitled "Screw Collector/Bucket Elevator," and its subparagraphs, or the paragraph below, entitled "Chain and Bucket Elevator Collector" and its subparagraphs.
****

****
NOTE: Screw mechanisms may be used as collectors, conveyors, or both together. Delete "collector and" when screw type collector is not allowed; delete "and conveyor" when screw type conveyor is not allowed; use all optional wording and appropriate pluralizations when both screw collector and conveyor are not allowed.
****

[Collector] [and] [conveyor] shall include screw assembly, motor drive assembly, [liner plates] [and] [trough] and appurtenances. Liner plates and troughs may be fiber reinforced plastic instead of steel.

2.1.5.1 Design

Screw [collector] [and] [conveyor] shall be designed for continuous and/or intermittent operation and shall have a removal capacity of not less than [_____] cubic meter per second cubic feet per hour of dry grit weighing [1922] [_____] kg per cubic meter [120] [_____] pounds per cubic foot.

2.1.5.2 Screw Assembly

****
NOTE: The following table lists the requirements for selecting a screw.

Grit Cap. Cu. m/sec	Dia. MM	Screw Conveyor Pipe Size MM	Watts	Shaft Dia. MM
0.03	300	100	746	50 or 61
0.05	400	100	1,119	75
0.08	500	125	1,492	75 or 86

Grit Cap. Cu. Ft/Hr.	Dia. Inch	Screw Conveyor Pipe Size Inches	H.P.	Shaft Dia. Inches
55	12	4" Std.	1.0	2 or 2 7/16"
100	16	4" X-Hvy	1.5	3"
163	20	5" Std.	2.0	3 or 3 7/16"

Alternate screw type can be helicoid with short shafts.

****

a. Screw: Screw shall be [horizontal] [inclined]. Screw shall be [_____] mm inch diameter, half pitch with 10 mm 3/8 inch flights butt welded or fillet welded both sides and mounted on [_____] mm inch Schedule 80 steel pipe conforming to ASTM A53/A53M and bushed for [_____] mm inch shaft. As an alternate, a helicoid type screw conveyor section with 10 mm 3/8 inch steel flights may be provided with short shafts of solid cold rolled steel conforming to ASTM A108. Screw shall be made in manufacturer's standard lengths with a coupling flight connection for ease of installation and removal. Outer leading edges of the flighting shall be protected with a coating of weldment, a minimum of 25 mm one inch wide and 3 mm 1/8 inch thick. If carbon steel flighting is provided with a minimum 10 mm 3/8 inch thickness, it will be acceptable without coating provided that it has a minimum Brinell hardness of 500.

b. Shafting shall be cold rolled steel conforming to ASTM A108. Coupling bolts shall be AIST PB-229, Type 316 stainless steel. A keyway shall be provided to attach driven sprockets. Keys and keyseats shall conform to ASME B17.1 or ASME B17.2.

c. Driven sprocket shall be high-test cast iron having a minimum tensile strength of 138 MPa 20,000 psi cast in a chill, and shall have a Brinell hardness of not less than 360 with a chill depth at least 5 mm 3/16 inch. Sprocket shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit chain. Sprocket shall be split construction assembled with cadmium-plated nuts and bolts. Sprocket shall be key seated on the screw drive shaft.

d. Tail shaft bearings shall be grease lubricated bearings provided with cast iron, high carbon or heat treated alloy steel bushings. Bearings shall be rated for a minimum of 5 years on a continuous service basis.

****

NOTE: Delete first optional paragraph below when horizontal screw collector is not allowed: Delete second optional paragraph when inclined screw conveyor is not allowed.

****

[e. Drive end bearings for horizontal screw shall be grease lubricated bearings provided with high carbon or heat-treated alloy steel bushings. Thrust shall be taken by the drive end bearing. Bearings shall be provided with lubrication fittings brought to an accessible location. Bearings shall be rated for a minimum of 5 years on a continuous service basis.

][f. Drive and bearings for inclined screw shall be extra heavy roller bearing pillow blocks. Thrust shall be taken by the drive end bearing. Grease lubricated ball bearings will be allowed. Bearings shall have a minimum rated life expectancy (L-10) of 40,000 hours based on American Bearing Manufacturers Association Standards on a continuous service basis.

]2.1.5.3 Motor Drive Assembly

Drive assembly shall include an electric-motor-driven speed reducer; drive sprocket on output shaft of speed reducer; drive chain from drive sprocket to driven sprocket; shear pin; and chain guard.

a. Motor shall be suitable for operation on [_____] volt, [_____] phase, [_____] Hz service.

b. Chain and belt drives incorporated in the drive assembly shall be designed with a minimum factor of safety of 4 as applied to the ultimate breaking or transmission strength of the chain or belt with respect to the loads transmitted at normal continuous operating load.

2.1.5.4 Liner Plate

****
NOTE: Specify liner plate for horizontal grit collector and trough for inclined grit conveyor.
****

Curved 10 by [_____] mm 3/8 by [_____] inch I.D. abrasion-resistant steel liner plate shall be provided with edges drilled for plug welding to 50 by 150 mm 1/2 by 6 inch steel straps embedded in the concrete for the horizontal screw. Plate shall have a Brinell hardness of 300 to 350.

2.1.5.5 Steel Trough

****
NOTE: Specify liner plate for horizontal grit collector and trough for inclined grit conveyor.
****

Steel trough shall be abrasion-resistant steel, 10 mm 3/8 inch thick. Trough shall be fitted with a gasket at the inspection opening and clean-out plate on the lower end and a discharge spout on the upper end. Thrust shall be taken by the upper (drive end) bearing for inclined screw. Trough shall have a Brinell hardness of 300 to 350.

2.1.5.6 Structural Supports

****
NOTE: Delete this paragraph when inclined screw conveyor is not allowed. Specify galvanized steel unless corrosion is considered a problem.
****

No steel member shall be less than 6 mm 1/4 inch thick. Assembly and anchor bolts shall be [AIST PB-229, Type 302 or AIST PB-229, Type 304 stainless steel] [galvanized steel]. [Supports shall be designed with a factor of safety of 4.0 against vertical loads and torque.]

2.1.6 [Chain and Bucket Elevator Collector

****
NOTE: Choose this paragraph and its subparagraphs or one of the paragraphs above, entitled "Screw Collector/Bucket Elevator" and "Screw (Collector) (and) (Conveyor)," and its subparagraphs.
****

****
NOTE: Chain and bucket mechanisms may be used as an elevator or as a combination collector and elevator.
****

Chain and bucket equipment shall include housing, motor drive assembly, chain, shafting, sprockets, grit buckets, and overload protection.

]2.1.6.1 Design

Chain and bucket collection and removal assembly shall be designed for continuous and/or intermittent operation and shall have a removal capacity of not less than [_____] cubic meter per second cubic feet per hour of dry grit weighing [1922] [_____] kg per cubic meter [120] [_____] pounds per cubic foot. Chain and bucket equipment shall operate at a speed of from 0.04 to 0.05 meter per second 8 to 10 feet per minute.

2.1.6.2 Chain and Bucket Assembly

a. Bucket chains shall be ASME B29.400 combination "H" Type Mill C110 having an average ultimate strength of 134 kN 30,000 pounds and shall weigh no less than 7.8 kg per m 5.2 pounds per foot. Chain links shall be of corrosion resisting malleable iron having an average tensile strength of 483 MPa 70,000 psi and an average Brinell hardness between 170 and 190.

****
NOTE: At the text below, delete all references to idler sprockets when chain and bucket elevator is not allowed for the project.
****

b. Sprockets shall be high-test cast iron, having a minimum tensile strength of 138 MPa 20,000 psi cast in a chill, and shall have a Brinell hardness of not less than 360 with a chill depth of at least 5 mm 3/16 inch. Sprockets shall be stress relieved before machining. Sprocket teeth shall be accurately ground to fit chain. Sprockets shall be split construction assembled with cadmium-plated nuts and bolts. Driven sprocket on the head shaft shall be of the offset type. Sprockets on the head shaft shall be keyseated. Keys and keyseats shall conform to ASME B17.1 or ASME B17.2. [Idler wheel and chain take-up shaft sprocket shall not be keyseated but, except for number of teeth, shall be identical in other respects to the head shaft sprockets. Idler wheel and take-up shaft sprocket shall be set-screwed to the shaft.]

c. Bearings shall be babbitt-lined, self-aligning ball-and-socket type or heat treated ductile-iron, self-aligning type. Bearings, except those for bracket-supported driven sprockets, shall be bolted to the tank

walls. Bearings shall be designed to allow minimum field variations without shimming. Bracket supports, except on head shaft driven sprocket, will not be allowed. Bearings above water shall be provided with flush ball-check grease-lubrication fittings. Underwater bearings shall be water lubricated with tops designed to prevent solids accumulation. Underwater bearings shall have flush ball-check grease-lubrication fittings. Take-up bearings shall be provided on take-up shaft. Take-up bearings shall be self-aligning and shall be arranged to slide between or to be steadied by two cast iron, mild steel or silicon bronze guides. Take-up bearings shall have a minimum range of travel of 250 mm 10 inches and shall be positioned by a stainless steel or silicon bronze threaded power bolt, which shall be arranged for locking at any position of the bearing. Bearings shall be rated for a minimum of 5 years continuous service condition.

****
NOTE: At the text below, delete references to stirring flights when only bucket elevator is to be specified.
****

d. The grit buckets shall be fabricated structural steel or malleable iron with hardened lip [and stirring flights shall be fabricated from structural steel angles and plates]. Buckets shall be designed to drain off free water. Buckets [and stirring flights] shall have replaceable alloy cast iron or malleable iron wearing shoes that can be rotated to distribute the wear. Buckets [and stirring flights] shall be attached to the chains at not more than 1.5 m 5 foot intervals with heat treated carbon steel pins and rivets having a minimum diameter of 17 mm 11/16 inch.

****
NOTE: Delete the paragraph below when only bucket elevator is allowed.
****

e. One [two] industrial type steel rail(s), minimum weight 8 kg per m 16 pounds per yard each, shall be provided for each collector mechanism. Necessary splice bars, rail clips, and appurtenances shall be included. Return tracks shall be structural steel shapes having a minimum thickness of 10 mm 3/8 inch and shall be supported by steel cross members supported from chamber walls.

2.1.6.3 Motor Drive Assembly

Motor drive assembly shall include a motor; speed reducer; drive sprocket on output shaft of speed reducer; drive chain from drive sprocket to driven sprocket; shear pin; and chain guard. Unit shall be fully enclosed and designed for mounting outside and exposed to the weather.

a. Motor shall be suitable for operation on [_____] volt, [_____] phase, [_____] Hz service.

b. Chain and belt drives incorporated in the drive assembly shall be designed with a minimum factor of safety of 4 as applied to the ultimate breaking or transmission strength of the chain or belt with respect to the loads transmitted at normal continuous operating load.

2.1.6.4 Housing

****
NOTE: Specify galvanized steel unless corrosion is considered a problem.
****

1.8 mm 14 gage [galvanized steel] [AIST PB-229, Type 302 or AIST PB-229, Type 304 stainless steel] above the operating floor and 5 mm 3/16 inch below the floor, mounted on the structural supports and securely fastened to the structural steel frame with bolts or sheet metal screws of the same material as the housing. The drive unit and head shaft assembly shall be as indicated on the shop drawings. Suitable openings for chain installation and inspection shall be provided at convenient locations in the housing.

2.1.7 Grit Pump

The grit pump shall be heavy-duty [[vertical] [horizontal], torque flow vortex pump with mechanical variable speed drive] [vertical close-coupled, vacuum primed pump]. Pump suction and discharge shall be positioned as indicated. Pump shall be designed for pumping grit under the following conditions of services:

Design Capacity: [_____] cubic meter per second gpm
Horsepower of Driver: [_____] watts HP
Maximum Solid Size: [_____] mm inches
Range of Head Conditions: [_____] m feet
Amount of Grit in Water: [_____] percent

Final selection of pump operating conditions will depend upon actual cyclone selected. The equipment shall include casing, impeller shaft, bearings, motor, drive unit, 6.28 rad 360 degree pressure sensors, and anchor bolts.

2.1.7.1 Pump Casing

Cast iron alloy (28-percent chromium) having a Brinell hardness of 500 to 550 with end-type suction and [horizontal] [vertical-up] discharge, and shall be open from suction to discharge without wearing rings or impeller face plates. Internal case clearances shall be essentially equal to the discharge diameter so that materials will not be impinged by the impeller. An inspection cover shall be provided in the casting. Suction and discharge shall be equipped with flanges to receive 57 kg 125 pound ANSI standard bolting.

2.1.7.2 Impeller

Recessed design, constructed of cast iron alloy (28-percent chromium) having a Brinell hardness of 500 to 550 mounted substantially out of the flow path between the pump inlet and the discharge connections so that the solids pumped are not impinged by the impeller.

2.1.7.3 Shaft

AIST PB-229, Type C1141 or AIST PB-229, Type C1144 steel, or rolled forged steel, and protected throughout the packing area by a removable chrome-plated or stainless steel shaft sleeve. The stuffing box shall contain graphite impregnated packing rings and bronze lantern ring arranged

for grease lubrication.

2.1.7.4 Radial and Thrust Bearings

Provide a minimum rated life expectancy (L-10) of 40,000 hours based on ABMA 11 when operating continuously at the rated full-load motor wattage horsepower and speed under the specified loading conditions. Internal bearings may be either oil or grease lubricated.

2.1.7.5 Pump and Motor Base

Fabricate of steel or cast iron and designed to support the full weight of pump, drive and motor, and provided with grout holes, undersurface mounting pads and lifting brackets.

2.1.7.6 Motor

Motor shall be suitable for operation on [_____] volt, [_____] phase, [_____] Hz service.

2.1.7.7 Drive Unit

Drive unit shall be a mechanical variable speed drive with a [_____] to 1 ratio, and shall be manually adjustable in infinite steps over the entire range.

2.1.7.8 Pressure Switch

Provide a bellows type pressure switch in the piping to the cyclone to monitor the pressure buildup. Switch shall be wired to an alarm which will actuate when pressure exceeds a preset value. Alarm shall be of the industrial type and include rotating beacon, 90-decibel horn, and spare contact for remote signal. Switch shall be furnished for a pressure range of from [_____] to [_____] kPag psig with an adjustable alarm contact.

2.1.8 Airlift Pump

Airlift type pump shall include an air pipe, educator, foot piece, tail pipe, air separator and a vent pipe. The air pipe to the educator shall be of zinc-coated steel Schedule 40 of adequate size to discharge the required amount of liquid without excessive pressure drop. An air control valve shall be provided on the air pipe to provide accurate adjustment of the airlift discharge rate. Air control valve shall be a MSS SP-80 globe valve, MSS SP-72 ball valve, or MSS SP-78 plug valve. Tail pipe below the foot piece, the educator pipe, air separator and vent from it shall be of zinc-coated steel. Fittings shall be of zinc-coated malleable iron or cast iron. Educator shall be provided with a clean-out above the water level. Airlift pump shall be installed so as to permit easy removal for maintenance.

2.1.9 Cyclone

Cyclone shall be a cylindrical-conical unit having a replaceable, high-density, gum rubber lining, or synthetic rubber lining, with a hardness of 79 durometers, a minimum 16 mm 5/8 inch thickness. The cyclone shall have a capacity of [_____] cubic meter per second gpm at a maximum feed pressure of [_____] kPa psi and shall be capable of making a separation at approximately [_____] mesh predicated on a feed solids concentration of not more than one percent solids for grit pumped from the

point of removal of the grit chamber. Components shall have flanged ANSI Standard 57 kg 125 pound feed connections, and transition fittings shall have flanges to adapt to both the feed and overflow connections.

2.1.9.1 Feed Chamber

Cast steel or cast iron. Feed chamber shall be rubber lined steel as specified above or unlined cast iron alloy, 28-percent chromium, having a Brinell hardness of 550 to 600.

2.1.9.2 Inlet Head Casing

Cast steel conforming to ASTM A27/A27M or cast aluminum conforming to ASTM B26/B26M.

2.1.9.3 Cylindrical Sections

Fabricated from structural steel plate or cast aluminum conforming to ASTM B26/B26M.

2.1.9.4 Apex Valve

Provide cast aluminum housing with pivoted, quick opening, toggle-clamp operator or a four-bolt flange with cast iron alloy (28-percent chromium) apex section.

2.1.10 Screw Type Classifying Equipment

Equipment shall include washing tank, steel screw conveyor mounted in a housing, drive unit, and supporting substructures.

2.1.10.1 Mechanism

****

NOTE: The following table lists the requirements for selecting a screw.

Grit Cap. Cu. m/sec	Dia. MM	Screw Conveyor Pipe Size MM	Watts	Shaft Dia. MM
0.03	300	100	746	50 or 61
0.05	400	100	1,119	75
0.08	500	125	1,492	75 or 86

Grit Cap. Cu. Ft/Hr.	Dia. Inch	Screw Conveyor Pipe Size Inches	H.P.	Shaft Dia. Inches
55	12	4" Std.	1.0	2 or 2 7/16"
100	16	4" X-Hvy	1.5	3"

Grit Cap. Cu. Ft/Hr.	Dia. Inch	Screw Conveyor Pipe Size Inches	H.P.	Shaft Dia. Inches
163	20	5" Std.	2.0	3 or 3 7/16"

Alternate screw type can be helicoid with short shafts.

****

Grit shall be conveyed from classifier settling compartment and discharged by means of a helicoid screw conveyor. Inclined screw shall be [_____] mm inch diameter, half pitch with 10 mm 3/8 inch flights butt welded and mounted on [_____] mm inch Schedule 80 steel pipe conforming to ASTM A53/A53M and bushed for [_____]<MET inch shaft. As an alternate, a helicoid type screw conveyor section with 10 mm 3/8 inch steel flights shall be provided with short shafts of solid cold-rolled steel conforming to ASTM A108. Screw shall be made in standard lengths with a coupling flight connection for ease of installation and removal. Outer leading edges of the flighting shall be protected with a coating of weldment, a minimum of 25 mm one inch wide and 3 mm 1/8 inch thick. If a carbon steel flighting is provided with a minimum 10 mm 3/8 inch thickness, it will be acceptable without a coating provided that it has a minimum Brinell hardness of 500. Carbon steel flighting provided with abrasion resistant wearing shoes will also be acceptable. Wearing shoes shall be attached with counter sunk AIST PB-229, Type 304 stainless steel bolts.

a. Tail shaft bearings shall be grease lubricated bearings provided with high carbon or heat treated alloy steel bushings. Bearings shall be rated for a minimum of 5 years on a continuous service basis.

b. Drive end bearings shall be extra heavy roller bearing pillow blocks. Thrust shall be taken by the drive and bearing. Grease lubricated ball bearings will be allowed. Bearings shall have a minimum rated-life expectancy (L-10) of 40,000 hours based on ABMA 11 on a continuous service basis.

2.1.10.2 Housing

The classifier tank shall be constructed of 6 mm 1/4 inch steel plate, suitably reinforced and mounted on steel supports. The tank shall be designed to provide a settling compartment where grit separation may take place. Suitable anchor bolts shall be provided. The substructure shall be designed and arranged to support the classifier tank and cyclone and necessary mounting brackets shall be included as a component part of the classifier.

2.1.10.3 Drive Unit

The drive unit shall be a mechanical variable speed drive with a [_____] to 1 ratio, and shall be manually adjustable in infinite steps over the entire range.

2.1.10.4 Motor

Motor shall be suitable for operation on [_____] volt, [_____] phase, [_____] Hz service.

2.1.10.5 Overflow Weir

Depth of liquid in the settling compartment shall be regulated by an adjustable weir fitted at the end of the settling tank. Regulation of weir shall provide pool depth of a minimum of 150 percent of the spiral diameter. The weir shall be fabricated of structural steel or aluminum conforming to ASTM B209M ASTM B209, or ASTM B221M ASTM B221, Alloy 6061, Temper T6.

2.2 ELECTRICAL REQUIREMENTS

****

NOTE: Insert appropriate Section number and title in blank below using format per UFC 1-300-02, "Unified Facilities Guide Specifications (Ufgs) Format Standard".

****

Unless indicated or specified otherwise, electrical components of mechanical equipment, such as motors, motor starters, control (pushbutton) stations, electrical disconnecting (isolating) means, and other devices functioning to control associated mechanical equipment, are included under this section. The work shall be complete and operable, and shall be in accordance with NFPA 70. Installation shall be made with rigid metal conduit and fittings. Liquid tight flexible steel conduit shall be used for short connections to motors and their controllers. Wiring and equipment in hazardous locations as defined by the NFPA 70 shall conform to Class [_____], Group [_____], Division [_____] requirements. The interconnecting conduit and wire (except when included in factory-assembled equipment), in the motor-control equipment forming a part of motor control centers or switchgear assemblies, and the electrical connection of the mechanical equipment to the electrical power circuit are specified in [_____].

2.3 FABRICATION AND MANUFACTURE OF MECHANICAL COMPONENTS

2.3.1 Motor

Motor shall be constant speed, totally enclosed, thermal protected horizontal type, suitable for outdoor service, and conforming to NEMA MG 1. Motor shall be of adequate wattage horsepower to drive the equipment continuously at the maximum load encountered under any operating condition without overloading or exceeding the nameplate rating of the motor. Motor shall be protected against overload, low voltage, and unbalanced voltage. Motor shall be directly connected to speed reducer or drive unit through a flexible coupling.

2.3.2 Speed Reduction Unit

Speed reducer shall be either a helical gear reduction unit or a worm gear reduction unit fully enclosed in a cast iron or fabricated steel case provided with dust and oil seals with all gears running in oil and with anti-friction bearings throughout. Gears used in speed reducer shall conform to applicable requirements of the following standards. Speed reducer shall be designed with a minimum AGMA service factor of 2.0 and shall also have an AGMA Service Classification II.

a. Helical Gearing: AGMA 908, ANSI/AGMA 6034,ASTM A48/A48M, and ASTM A536.

b. Work Gearing: ANSI/AGMA 6034 and ASTM A536.

Speed reducer case shall be equipped with oil fill port, oil drain line, and an oil level indicator pipe.

2.3.3 Bearings

Bearings incorporated within drive assemblies shall be of the anti-friction type and conform to the following minimum schedule of rated-life expectancy (L-10) based on the American Bearing Manufacturers Association Standards when operating at the normal continuous torque rating of the mechanism.

a. Worm and wheel gear box bearings: L10-100,000 hours

b. Geared motor (direct drive): L10-100,000 hours

c. Intermediate helical and spur gear box bearings: L10- 17,000 hours

d. Geared motor (indirect drive): L10- 17,000 hours

2.3.4 Chain and Belt Drives

Chain and sprockets or V-belt and pulleys connecting motor and speed reducer shall be enclosed in a weatherproofed fabricated steel or fiberglass guard. Chain connecting motor and speed reducer shall be steel roller type. Sprockets shall be hardened ground alloy steel or high-test cast iron, having a minimum tensile strength of 276 MPa 40,000 psi cast in a chill, and shall have Brinell hardness of not less than 360 with a chill depth of not less than 5 mm 3/16 inch. Sprocket teeth shall be accurately ground to fit the chain. V-belts shall be rayon corded with heat- and oil-resisting rubber covering. Motor position of V-belt drives shall be adjustable to increase or decrease belt tension. Drive sprocket shall be keyed on the output shaft of the speed reducer and shall be bronze bushed with a grease-lubricated bronze bushing and provided with shear pin overload protection. A drive chain tightener shall be provided to adjust and tighten the chain.

2.3.5 Drive Unit

Drive unit shall be mechanical variable speed drive with ratio indicated, and shall be manually adjustable in infinite steps over the entire range. The drive unit shall be suitable for mounting with motor provided. The unit shall include a motor sheave, speed reduction sheave and V-belt. Multiple belts shall be used to transmit the required power. The drive unit shall be designed to have a minimum service factor of 1.5.

a. Sheaves shall be cast iron or cast steel conforming to ASTM A27/A27M and shall be keyed to the shafts. Keys and key seat shall conform to ASME B17.1 or ASME B17.2.

b. Shafts shall be solid, cold finished steel conforming to ASTM A108. Shafts shall be of sufficient size to transmit maximum force developed by the drive assembly. Shafting shall be polished in areas in contact with bearings.

c. V-belts shall be heavy-duty type, rayon corded, with oil- and heat-resistant and heat-dissipating rubber cover.

d. Bearings in the drive unit shall be of the anti-friction type, shall run in oil, and shall have a minimum rated life expectancy (L-10) of 50,000 hours based on ABMA 11 when operating under normal continuous operating load.

2.3.6 Overload Protection and Alarm

Overload alarm system shall be a waterproof torque actuated overload unit or indicating ammeter overload unit designed to indicate the load on the mechanism at all times, to sound an alarm in case of impending excessive load, and to stop the mechanism when such load is reached. Overload alarm shall include an industrial Type 90-decibel horn, rotating beacon, relay and reset button in a weatherproof metal housing with a removable gasketed cover. Horn shall be constructed of corrosion-resisting material and shall be suitable for remote mounting. Shut-off switch, NEMA Type 2, shall be provided for horn and beacon.

2.4 WELDING

Perform welding, welding inspection, and corrective welding in accordance with AWS D1.1/D1.1M. Weld in a manner to prevent permanent distortion of the connected parts. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation.

2.5 REPAIR OF ZINC-COATED SURFACES

Repair surfaces damaged by welding or other means with galvanizing repair paint conforming to MIL-P-21035 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved. Clean areas to be repaired and remove the slag from the welds. Surfaces to which stick or paste material is applied, shall be heated with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

2.6 TREATMENT AND PAINTING

Except as otherwise specified, equipment shall be treated and painted in accordance with the manufacturer's standard practice. Exposed surfaces of ferrous metals, other than piping, including those to be submerged, shall be sandblasted in accordance with SSPC SP 6/NACE No.3 and shop coated with two coats of epoxy polyamide conforming to SSPC Paint 16 applied to a minimum dry film thickness of 0.20 mm 8 mils per coat. The maximum time between coats shall be 72 hours. The following items shall be finished in accordance with manufacturer's standard practice suitable for end use environment: motors, gear motors, motor-driven speed, reducers, shafts, and pushbutton stations. Aluminum shall have an AA DAF45 finish. Stainless steel, stellite, and nonferrous metals shall not be coated. Exposed surfaces of concrete tanks shall be provided with two coats of rubber-base paint, gloss or semi-gloss, conforming to CID A-A-3120. Surfaces of housings and enclosures shall be coated with zinc-molybdate primer conforming to FS TT-P-645, and finish coat conforming to MIL-PRF-24635or an epoxy polyamide system in accordance with MIL-DTL-24441, with a primer coat conforming to MIL-DTL-24441/29, intermediate coat conforming to MIL-DTL-24441/31, and a topcoat conforming to MIL-DTL-24441/31. Exterior surfaces of piping which are not subject to submersion or which are buried shall be given a coal tar coating system in accordance with SSPC PS 10.01.

PART 3 EXECUTION

3.1 INSTALLATION

Install grit handling equipment and accessories specified herein in accordance with approved shop drawings and manufacturer's recommendations. Includes providing all lubricants for initial operation.

3.1.1 Air Piping

Piping shall be installed in alignment and supported with pipe hangers and supports. Mechanical joints shall be made in accordance with the requirements of AWWA C600. Flanged joints shall be made up tight, care being taken to avoid undue strain on flanges, valves, fittings, and other equipment and accessories. Screwed joints shall be made up tight with polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil, applied to the male threads only. Threads shall be full cut; not more than three threads on the pipe shall remain exposed. Provide exposed ferrous pipe threads with one coat of FS TT-P-645 applied to a minimum dry film thickness of 0.025 mm one mil. Joints for PVC pipe shall be made with solvent cement conforming to ASTM D2564 and shall be joined in accordance with the Appendix thereto.

3.1.2 Grit Pump

The pump complete with driver and motor shall be mounted on a heavy duty base. The base shall be complete with machined undersurface mounting pads and lifting brackets. The complete unit shall be installed in accordance with the recommendations of the manufacturer. Installation shall include providing oil and grease for initial operation in accordance with the manufacturer's recommendations.

3.1.3 Cyclone

Installed in accordance with the manufacturer's instructions to ensure self-regulation and produce a low moisture grit.

3.2 FIELD QUALITY CONTROL

3.2.1 Grit Separation, Collection, Removal and Classifying Equipment

Test in operation to demonstrate correct alignment, smooth operation, freedom from vibration and freedom from noise and overheating of moving machinery. Correct all defects.

3.2.2 Aerated Grit Equipment

3.2.2.1 Air Diffusers

Test for uniformity. Each diffuser shall have uniform distribution along the entire header as determined by the method of testing specified.

a. The uniformity testing apparatus shall consist of a large easily read scale for measuring the flow of air to the header system and pressure gauges for measuring pressure at the third point of the header. The header and diffusers shall be tested in the aerated grit tank. The meter shall be of the orifice type, of proper size, and installed in accordance with the recommendation of AGA GMC. Before tests are started, the calibration of the orifice meter shall be checked with a

standard displacement type gas meter of not less than [_____] cubic meter per second cubic feet per hour capacity which has been accurately calibrated volumetrically in a manner satisfactory to the Contracting Officer.

b. Diffusers to be tested for uniformity shall be submerged with tap water to a depth of 0.30 m one foot. Air shall then be diffused through the diffusers at a rate of [_____] cubic meter per second cubic feet per minute per diffuser for one minute. The rate of air flow shall then be reduced to [_____] cubic meter per second</MET cubic feet per minute per diffuser, the uniformity of diffusion shall be observed. Nozzles having unsatisfactory distribution shall be replaced.

3.2.3 Grit Pump

After pump has been installed, conduct such tests as are necessary to indicate that the pump conforms to the specifications. A 24-hour operating period of the pump will be required before acceptance.

3.2.4 Cyclone

Upon installation, operate equipment for 24 continuous hours at the design flow specified. During this period, sample cyclone overflow periodically as directed by the Contracting Officer, but not less than once every four hours. Dry and test samples as specified by AASHTO T 27 and AASHTO T 11. If particles average more than 5 percent larger in size than [_____] mesh, adjust the equipment to meet these specifications.

3.2.5 Performance Tests

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NOTE: Performance tests consist of determining the amount of grit entering the chamber and the amount of grit in the effluent from the chamber and comparing the two values as a percentage. One test procedure is presented in an article in the April 1984 issue of the Water Pollution Control Foundation Journal entitled "Evaluation of Full Scale Aerated Grit Chambers" and may be of use in approving Contractor's submittal of test procedure verifying efficiency.

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Provide field test data from full scale units of comparable design capacity demonstrating the performance of grit removal efficiencies as specified. Grit removal efficiency shall be determined by averaging the results obtained from at least 20 sample performance test runs on similar installations. If such data is not available, the manufacturer shall run these tests at start-up. Specified performance shall be met before equipment will be accepted. Testing costs shall be borne by the Contractor. Should start-up tests be required, an acceptable grit removal efficiency test procedure shall be submitted to and approved by the Contracting Officer prior to actual testing.

3.2.6 Manufacturer's Representative

Equipment manufacturer shall provide the services of an engineer representative to supervise the field installation of the equipment and accessories, in accordance with the manufacturer's specifications. In

addition, manufacturer of the equipment shall provide the services of an engineer representative for [_____] man days to instruct operating personnel during the initial operating period.

-- End of Section --