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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
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DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

SECTION 46 23 00

GRIT REMOVAL AND HANDLING EQUIPMENT

02/20

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SECTION 46 23 00

GRIT REMOVAL AND HANDLING EQUIPMENT
02/20

****
This guide covers the requirements for grit removal and handling equipment to remove, collect, pump, and wash grit from wastewater. This guide is for treatment of domestic wastewater 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 wastewater only. Special consideration must be given to wastewater containing industrial wastes.

Show the following information on the project drawings.

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

2. Percentage of removal of grit required;

3. Electrical characteristics of motor(s) for grit

separation, collection, removal, pumping and washing equipment;

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

5. Type of diffuser holder assembly;

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. Source of power for hoist.;

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 wastewater 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 wastewater 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.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN 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 2010) Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

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 (2020) Structural Welding Code - Steel

ASSOCIATION FOR IRON AND STEEL TECHNOLOGY (AIST)

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

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon Structural Steel

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 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 (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A536 (1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings

ASTM B30 (2020) Standard Specification for Copper Alloys in Ingot Form

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 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	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

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 or sludge removal techniques and capable of producing excessive wear on mechanical equipment.

1.2.2 Grit Separation

The process of separating grit from wastewater by controlling the velocity of the wastewater with aeration to suspend organics 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 washing equipment is not required, delete the second option when washing equipment is required.

****

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

1.2.5 Grit Washing

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 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

Grit Handling Equipment

SD-06 Test Reports

Performance Tests

Grit Pump tests

[Grit Washing Equipment tests

] SD-07 Certificates

Warranty

SD-10 Operation and Maintenance Data

Grit Handling System, Data Package 3; G[, [_____]]

1.4 SPARE PARTS

Furnish spare parts for the equipment specified above in the quantities listed below. The spare parts must be identical and interchangeable with the original parts. Furnish the parts 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, round off the number furnished 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, also furnish one dozen shear pins of each size used.	

1.5 QUALITY CONTROL

1.5.1 Regulatory Requirements

****
NOTE: Design Grit Removal System in accordance with UFC 3-240-01, "Wastewater Treatment and Collection." Ensure compliance with permits.
****

Conduct regulatory review to determine impact of new and existing permit conditions and regulations, communicate with federal, state, local and DOD agencies.

1.5.2 Qualifications

Ensure welds are in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.5.3 Shop Drawings

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

1.6 DELIVERY, STORAGE, AND HANDLING

Package equipment and parts for shipment to prevent breakage, damage or problems with calibration, readings or controls. Inspect materials delivered to the site for damage and unload and store with a minimum of handling. Store equipment and materials indoors, off the floor. Area must be dry with adequate ventilation, free from dust or water, and permit easy access for inspection and handling.

1.7 WARRANTY

Provide grit separation equipment with minimum [_____] [5] year warranty. Submit the manufacturer's warranty.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a grit removal system to separate, collect, remove, wash and deposit grit at the indicated point of its discharge, within the area and at the elevations indicated.

2.1.1 Design Requirements

****

NOTE: Delete all references to washing when washing is not included in the grit removal system. The use of any combination of grit removal system for any wastewater treatment facility 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.

5. Detritor grit removal.

Select the grit removal system based on the following factors:

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

****

2.1.2 Grit Removal System Type

****

NOTE: Choose one of the paragraphs below, AERATED GRIT REMOVAL SYSTEM, INCLINED BOTTOM GRIT REMOVAL SYSTEM, LONGITUDINAL GRIT REMOVAL SYSTEM, VORTEX TYPE GRIT REMOVAL SYSTEM, and DETRITOR GRIT REMOVAL SYSTEM.

Determine which grit removal system is suitable for the project. Delete paragraphs which describe systems and options which are not included in 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. Use a grit pump for removal when a cyclone is included with the washing equipment. Space limitations may preclude the use of inclined removal equipment. Delete reference to screw-type washers when a cyclone is the only washer required. Delete screw conveyor when space limitations prohibit an inclined screw, delete screw conveyor and bucket elevator when cyclone is included in washing equipment.
****

[2.1.2.1 Aerated Grit Removal System

Separate grit in an aerated grit chamber. Collect and remove grit 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]. Use a [cyclone] [and] [screw-type washer].

][2.1.2.2 Inclined Bottom Grit Removal System

Separate grit in an inclined bottom aerated grit chamber. Chamber bottom must be inclined to move grit to the point of removal. Remove grit by [screw conveyor] [airlift pump] [bucket elevator] [grit pump]. Use a [cyclone] [and] [screw-type washer].

][2.1.2.3 Longitudinal Grit Removal System

Separate grit in a longitudinal grit chamber. Collect and remove grit by [horizontal screw conveyor and bucket elevator,] [horizontal screw conveyor and inclined screw,] [horizontal screw conveyor and grit pump,] [and] [chain and bucket equipment]. Use a [cyclone] [and] [screw-type washer].

][2.1.2.4 Vortex Type Grit Removal System

Separate grit in a vortex type grit removal system. Remove grit by a [grit pump] [airlift pump]. Use [cyclone] [and] [screw-type washers].

][2.1.2.5 Detritor Grit Removal System

Separate grit in a detritor grit removal system, including a rotating grit-collecting mechanism and a reciprocating grit-washing mechanism. Collect and remove grit by [grit auger and grit pump,] [horizontal screw conveyor and bucket elevator,] [horizontal screw conveyor and inclined screw,] [horizontal screw conveyor and grit pump,] or [chain and bucket equipment]. Use a [cyclone] [and] [screw-type washer].

]2.1.3 Performance Requirements

Provide a system 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.

2.1.4 Electrical Requirements

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 must be complete and operable, and in accordance with NFPA 70 and the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 ASSEMBLY [OR] FABRICATION

2.3 EQUIPMENT

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

2.3.1 Materials and Equipment

****

NOTE: Choose this paragraph and its subparagraphs or one of the paragraphs below, LONGITUDINAL GRIT SEPARATION EQUIPMENT, VORTEX TYPE GRIT SEPARATION, and DETRITOR GRIT REMOVAL EQUIPMENT, and its subparagraphs.

****

[2.3.1.1 Aerated Grit Separation Equipment

Include air piping and valves, swing diffuser holder assembly, header pipes, hoist, and diffusers. Provide baffles of structural steel plate 50 mm 2 in, or manufacturer's standard. Provide system with air from an external supply at a maximum rate of [_____] cubic meter per second cfm at [_____] kPa psi.

2.3.1.1.1 Air Piping

Provide manufacturer's recommended piping from air main to diffusers.

2.3.1.1.2 Diffuser Holder Assembly

Provide an upper pivot joint with air control and shut-off valve, a drop pipe with intermediate pivot joint, and a diffuser header. Provide unit with mounting to wall anchorage and a rotating joint, either permanently lubricated or with grease fittings for lubrication. Include gaskets at each pivot bearing to ensure air and water tightness. Provide valve for air control with indicator markings for throttling and complete shut-off, conforming to AWWA C504. Provide connections for the upper and lower hanger pipes. Provide locking device to allow positive locking in any position. Ensure spacing of diffuser assemblies in the basin and diffusers on the header is as recommended by the diffuser manufacturer. Ensure the diffuser is level. Provide a portable hoist to raise and lower the diffuser assembly. Use hoist by the same manufacturer, and compatible with, the diffuser holder assembly. Hoist must be hydraulically operated and adequately powered to raise the assembly from the tank. Provide means

of locking the diffuser header in a raised position over the tank or the walkway.

2.3.1.1.3 Diffusers

Provide saddle mounted or thread mounted diffusers as recommended by the manufacturer. Ensure diffusers are sized for the particular application for the range of exit velocity and back pressure.

][2.3.1.2 Longitudinal Grit Separation Equipment

****
NOTE: Choose one of the following paragraphs VELOCITY CONTROL REGULATOR or PROPORTIONAL WEIR.

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, or manufacturer standard.
****

Control velocity with a [velocity control regulator] [proportional weir].

[2.3.1.2.1 Velocity Control Regulator

Maintain the velocity of flow through a channel of cross sections indicated. Provide regulator conforming to [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 must be adjustable and provide a range of flows from zero to [_____] cubic meter per second mgd.

][2.3.1.2.2 Proportional Weir

Control velocity with 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 will provide a constant velocity through the grit chamber for a range of flows from [_____] to [_____] cubic meter per second mgd.

]2.3.1.2.3 Framework and Control Sections

****
NOTE: Specify material compatible with material specified in paragraph VELOCITY CONTROL REGULATOR or PROPORTIONAL WEIR.
****

Provide compatible fasteners for anchoring or bolting the control device.

][2.3.1.3 Vortex Type Grit Separation

[2.3.1.3.1 Forced Vortex

Include motor drive assembly, paddle drive tube; [air [lift pump,] piping and valves,] [vacuum pump] [suction pump]; and control box.[Provide system air from an external supply at a maximum rate of [_____] cubic meter per second CFM at [_____] kPa psi.]

2.3.1.3.1.1 Mechanical Drive

Ensure 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.

][2.3.1.3.2 Induced Vortex

Include [air [lift pump,] piping and valves,] [vacuum pump] [suction pump].[Provide system air from an external supply at a maximum rate of [_____] cubic meter per second CFM at [_____] kPa psi.].

][2.3.1.3.3 Multi-Tray Vortex

Provide manufacturer standard trays and distribution system.

]][2.3.1.4 Detritor Grit Removal Equipment

Provide manufacturer's standard system.

]2.3.1.5 Collector Systems

****

NOTE: Choose one paragraph, and its subparagraphs, of the following: SCREW COLLECTOR AND BUCKET ELEVATOR, SCREW [COLLECTOR] [AND] [CONVEYOR] or CHAIN AND BUCKET ELEVATOR COLLECTOR.

Some 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.

****

2.3.1.5.1 Screw Collector and Bucket Elevator

Provide a unit utilizing the bucket chain of the elevator as a drive chain for the screw collector. Include screw shafts and bearings, liner plate, chain, sprockets, grit buckets, drive assembly, housing and overload protection. Ensure unit is capable of continuous and intermittent operation with 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 feet.

2.3.1.5.1.1 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. Provide [_____] mm inch diameter screw, half pitch with 10 mm 3/8 inch flights and mounted on [_____] mm inch steel pipe conforming to ASTM A53/A53M and bushed for [_____] mm inch shaft. As an alternate, provide a helicoid type screw conveyor section with 10 mm 3/8 inch steel flights. Screw must be made in the manufacturer's standard lengths.

b. Ensure shafts are cold rolled steel conforming to ASTM A108 and coupling bolts are AIST PB-229, Type 316 stainless steel. Couple driven end to the foot shaft of the bucket elevator. Grease lubricate tail shaft bearings; provide with cast iron, high carbon or heat treated alloy steel bushings. Ensure bearings are rated for a minimum of five years on a continuous service basis.

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

2.3.1.5.1.2 Bucket Elevator Assembly for Combination Unit

a. Provide bucket chain of ASME B29.400 combination "H" Type Mill C102 having an average ultimate strength of 160 kN 36,000 pounds and weighing no less than 15 kg per meter 9.7 pounds per foot, with chain links 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. Ensure sprockets are high-test cast iron, having a minimum tensile strength of 138 MPa 20,000 psi cast in a chill, with a Brinell hardness of not less than 360 with a chill depth of at least 5 mm 3/16

inch, stress relieved before machining. Sprocket teeth must be accurately ground to fit chain. Sprockets must be split construction assembled with cadmium plated nuts and bolts. Driven sprocket and the sprockets on the head shaft and screw shaft must be keyseated with keys and keyseats conforming to ASME B17.1 or ASME B17.2.

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

d. Ensure bearings are babbitt-lined, ductile-iron type, self-aligning ball-and-socket type or heat treated ductile-iron self-aligning type, designed to allow minimum field variations without shimming. Provide bearings above water with flush ball-check grease-lubrication fittings. Water lubricate underwater bearings with tops designed to prevent solids accumulation. Equip underwater bearings with flush ball-check grease-lubrication fittings. Ensure all bearings are rated for a minimum of 5 years on a continuous service basis.

e. Fabricate grit buckets of structural steel or malleable iron with hardened lip designed to drain off free water; 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.

2.3.1.5.1.3 Drive Assembly for Combination Unit

Include motor; speed reducer; drive sprocket on output shaft of speed reducer; drive chain from drive sprocket to driven sprocket; shear pin; and chain guard. Fully enclose unit and ensure suitability for mounting outside and exposed to the weather.

a. Motor must be suitable for operation with the voltage characteristics as indicated.

b. Ensure chain and belt drives incorporated in the drive assembly have 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.

2.3.1.5.1.4 Housing

****

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

****

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

2.3.1.5.2 Screw [Collector] [and] [Conveyor]

****

NOTE: Choose this paragraph and its subparagraphs,

the paragraph above, SCREW COLLECTOR AND BUCKET ELEVATOR, and its subparagraphs, or the paragraph below, 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.

****

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

Provide screw [collector] [and] [conveyor] suitable for continuous or intermittent operation and with 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.

2.3.1.5.2.1 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. Provide [horizontal] [inclined] screw of [_____] 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 must be made in manufacturer's standard lengths with a coupling flight connection for ease of installation and removal. Protect outer leading edges of the flighting 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. Ensure shafting is cold rolled steel conforming to ASTM A108 and coupling bolts are AIST PB-229, Type 316 stainless steel. Provide keyway to attach driven sprockets. Keys and keyseats must conform to ASME B17.1 or ASME B17.2.

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

d. Grease lubricate tail shaft bearings; provide with cast iron, high carbon or heat treated alloy steel bushings. Ensure bearings are rated for a minimum of 5 years of continuous service.

****

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. Grease lubricate drive end bearings for horizontal screw; provide bearings with high carbon or heat-treated alloy steel bushings. Ensure bearings are suitable for taking thrust. Provide bearings with lubrication fittings brought to an accessible location. Ensure bearings are rated for a minimum of 5 years of continuous service.

f. Ensure drive end bearings for inclined screw are extra heavy roller bearing pillow blocks, suitable for taking thrust. Grease lubricated ball bearings will be allowed. Ensure bearings have a minimum rated life expectancy (L-10) of 40,000 hours based on American Bearing Manufacturers Association Standards on a continuous service basis.

2.3.1.5.2.2 Motor Drive Assembly

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 must be suitable for operation with the voltage characteristics as indicated.

b. Ensure chain and belt drives incorporated in the drive assembly have 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.

2.3.1.5.2.3 Liner Plate

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

Provide curved 10 by [_____] mm 3/8 by [_____] inch I.D. abrasion-resistant steel liner plate 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, and a Brinell hardness of 300 to 350.

2.3.1.5.2.4 Steel Trough

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

Fit abrasion-resistant stainless steel 10 mm 3/8 inch thick trough with a gasket at the inspection opening, a clean-out plate on the lower end and a discharge spout on the upper end. Ensure the upper (drive end) bearings are suitable to take thrust for inclined screw. Ensure trough has a Brinell hardness of 300 to 350.

2.3.1.5.2.5 Structural Supports

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

Construct structural supports using minimum 6 mm 1/4 inch thick material[and based on a safety factor of 4.0 against vertical load and torque]. Use [AIST PB-229, Type 302 or AIST PB-229, Type 304 stainless steel] [galvanized steel] assembly and anchor bolts.

2.3.1.5.3 Chain and Bucket Elevator Collector

****
NOTE: Choose this paragraph and its subparagraphs or one of the paragraphs above, SCREW COLLECTOR AND 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.
****

Provide chain and bucket collection and removal assembly suitable for continuous or intermittent operation with 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 which operates at a speed of from 0.04 to 0.05 meter per second 8 to 10 feet per minute. Include housing, motor drive assembly, chain, shafting, sprockets, grit buckets, and overload protection.

2.3.1.5.3.1 Chain and Bucket Assembly

a. Ensure bucket chains are ASME B29.400 combination "H" Type Mill C110 having an average ultimate strength of 134 kN 30,000 pounds and must weigh no less than 7.8 kg per m 5.2 pounds per foot with links 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. Ensure sprockets are high-test cast iron, having a minimum tensile strength of 138 MPa 20,000 psi cast in a chill, and a Brinell hardness of not less than 360 with a chill depth of at least 5 mm 3/16 inch and stress relieved before machining. Sprocket teeth must be accurately ground to fit chain. Sprockets must be split construction assembled with cadmium-plated nuts and bolts. Driven sprocket on the head shaft must be of the offset type. Keyseat sprockets on the head shaft. Keys and keyseats must conform to ASME B17.1 or ASME B17.2.[Do not keyseat idler wheel and chain take-up shaft sprocket but, except for number of teeth, must be identical in other respects to the head shaft sprockets. Set-screw idler wheel and take-up shaft sprocket to the shaft.]

c. Ensure bearings babbitt-lined, self-aligning ball-and-socket type or heat treated ductile-iron, self-aligning type. Bolt bearings, except those for bracket-supported driven sprockets, to the tank walls. Ensure bearings are designed to allow minimum field variations without shimming. Bracket supports, except on head shaft driven sprocket, are not be allowed. Provide bearings above water with flush ball-check grease-lubrication fittings. Provide water lubrication to underwater bearings, with tops designed to prevent solids accumulation, and flush ball-check grease-lubrication fittings. Provide self-aligning take-up bearings on take-up shaft arranged to slide between or to be steadied by two cast iron, mild steel or silicon bronze guides, with a minimum range of travel of 250 mm 10 inches and positioned by a stainless steel or silicon bronze threaded power bolt, which must be arranged for locking at any position of the bearing. Ensure bearings are rated for a minimum of 5 years of continuous service.

****

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

****

d. Fabricate grit buckets of structural steel or malleable iron with hardened lip[and stirring flights fabricated from structural steel angles and plates]. Ensure buckets are designed to drain off free water. Buckets[and stirring flights] must have replaceable alloy cast iron or malleable iron wearing shoes that can be rotated to distribute the wear. Attach buckets[and stirring flights] 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. For each collector mechanism, provide [one] [two] industrial type steel rail(s), minimum weight 8 kg per m 16 pounds per yard. Include necessary splice bars, rail clips, and appurtenances. Ensure structural steel return tracks have a minimum thickness of 10 mm 3/8 inch. Support return tracks by steel cross members supported from chamber walls.

2.3.1.5.3.2 Motor Drive Assembly

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. Ensure unit is fully enclosed and suitable for mounting outside and exposed to the weather.

a. Motor must be suitable for operation with the voltage characteristics as indicated.

b. Ensure chain and belt drives incorporated in the drive assembly have 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.

2.3.1.5.3.3 Housing

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

Mount 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, on structural supports and securely fastened to the structural steel frame with bolts or sheet metal screws of the same material as the housing. Ensure the drive unit and head shaft assembly are as indicated on the shop drawings. Provide suitable openings for chain installation and inspection at convenient locations in the housing.

2.3.1.6 Grit Pump

Provide heavy-duty [[vertical] [horizontal], torque flow vortex pump with mechanical variable speed drive] [vertical close-coupled, vacuum primed pump]. Position pump suction and discharge as indicated. Ensure pump is suitable for pumping grit under the following conditions of services:

Capacity: [_____] cubic meter per second gpm

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. Include casing, impeller shaft, bearings, motor, drive unit, 6.28 rad 360 degree pressure sensors, and anchor bolts.

2.3.1.6.1 Pump Casing

Provide manufacturer standard pump casing. Equip suction and discharge with flanges.

2.3.1.6.2 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.

2.3.1.6.3 Pump and Motor Base

Provide manufacturer's standard base.

2.3.1.6.4 Motor

Motor must be suitable for operation with the voltage characteristics as indicated.

2.3.1.6.5 Drive Unit

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

[2.3.1.6.6 Pressure Switch

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

]2.3.1.7 Airlift Pump

Include an air pipe, educator, foot piece, tail pipe, air separator and a vent pipe. Provide zinc-coated Schedule 40 steel pipe to the educator of adequate size to discharge the required amount of liquid without excessive pressure drop. Provide a MSS SP-80 globe valve, MSS SP-72 ball valve, or MSS SP-78 plug air control valve on the air pipe for accurate adjustment of the airlift discharge rate. Ensure tail pipe below the foot piece, the educator pipe, air separator and vent from it are of zinc-coated steel. Fittings must be of zinc-coated malleable iron or cast iron. Provide educator with a clean-out above the water level. Install airlift pump so as to permit easy removal for maintenance.

2.3.1.8 Cyclone

Provide cylindrical-conical cyclone unit with a replaceable, high-density, lining, with a capacity of [_____] cubic meter per second gpm at a maximum feed pressure of [_____] kPa psi and 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. Provide flanged components for feed connections, and transition fittings to adapt to both the feed and overflow connections.

2.3.1.9 Screw Type Washing Equipment

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

Provide heavy-duty stainless steel vessel grit washer suitable to capture grit slurry and separate the grit from the organics. The Grit Washer must be suitable for the following conditions of services:

Design Flow of Grit Slurry per unit: [_____] cubic meter per second gpm

Grit Processing Capacity per unit: [_____] kg per hr ton per hr

Maximum water content in washed grit: [_____] percent at design flow

Maximum volatile solids in washed grit: [_____] percent at design flow

Minimum capture rate of [_____] size grit: [_____] percent at design flow

Surface overflow rate: [_____] cubic meter per second per squared meter gpm per square foot

Horsepower of Driver: [_____] watts HP

2.3.1.9.1 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.

****

Convey grit from washer settling compartment and discharge by means of a screw conveyor. Mount [_____] mm inch diameter, [half pitch] with 10 mm 3/8 inch flights, incline screw on [_____] mm inch pipe. Provide manufacture's standard screw, ensuring ease of installation and removal.

a. Grease lubricate tail shaft bearings; provide with high carbon or heat treated alloy steel bushings. Ensure bearings are rated for a minimum of 5 years of continuous service.

b. Ensure drive end bearings are extra heavy roller bearing pillow blocks suitable for taking thrust. Grease lubricated ball bearings are acceptable. Ensure bearings have a minimum rated-life expectancy (L-10) of 40,000 hours based on ABMA 11 on a continuous service basis.

2.3.1.9.2 Housing

Construct the washing tank of 6 mm 1/4 inch steel plate, suitably reinforced and mounted on steel supports. Ensure tank provides a settling compartment for grit separation. Provide suitable anchor bolts. Arrange the substructure to support the washing tank and cyclone, include necessary mounting brackets as a component part of the washer.

2.3.1.9.3 Drive Unit

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

2.3.1.9.4 Motor

Motor must be suitable for operation with the voltage characteristics indicated.

2.3.1.9.5 Overflow Weir

Regulate depth of liquid in the settling compartment by an adjustable weir fitted at the end of the settling tank. Regulate pool depth to a minimum of 150 percent of the spiral diameter.

2.4 COMPONENTS

2.4.1 Motor

Provide motor that is constant speed, totally enclosed, thermally protected horizontal type, suitable for outdoor service, and conforming to NEMA MG 1. Motor must 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 must be suitable for operation with the voltage characteristics as indicated. Protect motor against overload, low voltage, and unbalanced voltage. Connect motor directly to speed reducer or drive unit through a flexible coupling.

2.4.2 Speed Reduction Unit

Provide speed reducer with a fully enclosed gear reduction unit. Ensure gears used in speed reducer conform to applicable requirements of the following standards. Ensure speed reducer is designed with a minimum AGMA service factor of 2.0 and has an AGMA Service Classification II.

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

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

2.4.3 Bearings

Provide anti-friction drive bearings conforming to the following minimum schedule of rated-life expectancy (L-10) based on the ABMA 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

2.4.4 Chain and Belt Drives

Enclose chain and sprockets or V-belt and pulleys connecting motor and speed reducer in a weatherproofed guard. Chain connecting motor and speed reducer must be steel roller type. Sprockets must 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 must have Brinell hardness of not less than 360 with a chill depth of not less than 5 mm 3/16 inch. Sprocket teeth must be accurately ground to fit the chain. V-belt drives must be adjustable to increase or decrease belt tension. Drive sprocket must be keyed on the output shaft of the speed reducer and provided with shear pin overload protection. Provide a drive chain tightener to adjust and tighten the chain.

2.4.5 Drive Unit

Provide drive unit that is mechanical variable speed drive with ratio indicated, and is manually adjustable over the entire range. The drive unit must be suitable for mounting with motor provided. Include a motor sheave, speed reduction sheave and V-belt. Transmit the required power with multiple belts. Ensure a minimum service factor of 1.5.

[2.4.6 Overload Protection and Alarm

Provide waterproof torque actuated overload alarm system, 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. Include an industrial Type 90-decibel horn, rotating beacon, relay and reset button in a weatherproof

metal housing with a removable gasketed cover. Construct horn of corrosion-resisting material and ensure that it is suitable for remote mounting. Provide shut-off switch, for horn and beacon.

]2.5 MATERIALS

2.5.1 Finishes

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

PART 3 EXECUTION

3.1 INSTALLATION

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

3.1.1 Air Piping

Install piping in alignment and support with pipe hangers and supports. Make mechanical joints in accordance with the requirements of AWWA C600. Make flanged joints tight, avoid undue strain on flanges, valves, fittings, and other equipment and accessories. Make screwed joints tight with pipe thread tape, pipe cement and oil, or PTFE powder and oil, applied to the male threads only. Leave no more than 3 threads exposed, ensure threads are full cut. Make up joints for PVC pipe with solvent cement conforming to ASTM D2564 and join in accordance with the Appendix thereto.

3.1.2 Grit Pump

Mount the pump complete with driver and motor on a heavy duty base. Ensure the base is complete with machined undersurface mounting pads and lifting brackets. Install the complete unit in accordance with the recommendations of the manufacturer. Provide oil and grease for initial operation in accordance with the manufacturer's recommendations.

3.1.3 Cyclone

Install 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 Tests

3.2.1.1 Grit Separation, Collection, Removal and Washing Equipment

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

3.2.1.2 Aerated Grit Equipment

3.2.1.2.1 Air Diffusers

Test for uniformity. Each diffuser must have uniform distribution along

the entire header as determined by the method of testing specified.

a. Test using 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. Test the header and diffusers in the aerated grit tank. Use orifice type meter, of proper size, and installed in accordance with the recommendation of AGA GMC. Before tests are started, check the calibration of the orifice meter 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. For uniformity testing, submerge diffusers in tap water to a depth of 0.30 m one foot. Diffuse air at a rate of [_____] cubic meter per second cubic feet per minute per diffuser for one minute. Then reduce the airflow to [_____] cubic meter per second cubic feet per minute per diffuser, observe uniformity. Replace nozzle having unsatisfactory distribution.

3.2.1.3 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 is required before acceptance. 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.

3.2.1.4 Performance Tests

****
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.
****

Provide field test data demonstrating the performance of grit removal efficiencies as specified. Specified performance must be met before equipment will be accepted. The contractor is responsible for testing costs. Submit an acceptable grit removal efficiency test procedure prior to actual testing.

3.2.1.5 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.

3.2.2 Manufacturer Field Service

3.2.2.1 Manufacturer's Representative

Provide the services of an engineer representative to supervise the field installation and start-up of the equipment and accessories, in accordance

with the manufacturer's specifications.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Grit Handling System

Submit grit handling equipment information, including operation and maintenance manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, for each item of the grit separation, collection, removal and washing system.

-- End of Section --