Preparing Activity: USACE Superseding
UFGS-46 20 20 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION TABLE OF CONTENTS

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

SECTION 46 20 20

SEWAGE BAR SCREEN AND MECHANICAL SHREDDER

05/21

PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 MAINTENANCE MATERIAL SUBMITTALS
1.3.1 Extra Materials
1.4 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT
2.1.1 Bearings
2.1.2 Iron, Steel, and Miscellaneous Metal
2.1.2.1 Miscellaneous Metal
2.1.2.2 Malleable Iron
2.1.2.3 Structural Steel
2.1.3 Motors, Electric
2.1.4 Motor Controls
2.1.5 Switches, Enclosed
2.2 COMPONENTS
2.2.1 Electrical Work
2.2.1.1 Electric Motors
2.2.1.2 Motor Controls
2.2.2 Hydraulic Work
2.2.2.1 Fluid Motors
2.2.2.2 Hydraulic Controls
2.2.2.3 Fluid Power Valves
2.2.2.4 Fluid Tubing
2.2.2.5 Hydraulic Fluid
2.3 MANUFACTURED UNITS
2.3.1 Mechanically-Cleaned Bar Screen
2.3.1.1 Bar Screen
2.3.1.2 Screen Rake
2.3.1.2.1 Rake Mechanism

2.3.1.2.2 Revolving-Frame-Type
2.3.1.2.3 Automatic-Hoist-Type
2.3.1.2.4 Endless-Chain-Type
2.3.1.2.5 Screw-Drive Type
2.3.1.2.6 Rake Mechanism Control Equipment
2.3.2 Mechanical Shredder, Cutter, or Grinder
2.3.2.1 Operation Requirements
2.3.2.2 Control Equipment
2.3.2.3 Cutter Mechanism
2.3.2.4 Bearings
2.3.2.5 Stuffing Boxes
2.3.2.6 Lubrication
2.4 PAINTING

PART 3 EXECUTION

3.1 EXAMINATION
3.2 INSTALLATION
3.2.1 Installation of Concrete Foundations
3.2.2 Installation of Equipment
3.2.3 Field Painting
3.3 FIELD QUALITY CONTROL
3.3.1 Tests
3.3.2 Manufacturer's Field Services
3.4 CLOSEOUT ACTIVITIES
3.4.1 Framed Instructions
3.4.2 Operating and Maintenance Instructions
3.4.3 Training

-- End of Section Table of Contents --

Preparing Activity: USACE

Superseding
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References are in agreement with UMRL dated July 2023

SECTION 46 20 20

SEWAGE BAR SCREEN AND MECHANICAL SHREDDER
05/21

NOTE: This guide specification covers the requirements for sewage bar screen and mechanical shredder for use in sewage treatment plants normally handling domestic sewage.

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

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

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

PART 1 GENERAL

NOTE: Refer to UFC 3-240-02 for design requirements. This guide specification is written for one bar screen and mechanical shredder.

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date,

and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

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

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A47/A47M	(1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 3	(2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and

Systems: Enclosures

NEMA MG 1 (2021) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2023) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1677 (2022) Tests and Procedures for Carbon Steel and High Strength Low Alloy Steel Tubing

UNDERWRITERS LABORATORIES (UL)

UL 98 (2016; Reprint Jan 2022) UL Standard for Safety Enclosed and Dead-Front Switches

1.2 SUBMITTALS

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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.

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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

Materials And Equipment; G[, [_____]]

SD-03 Product Data

Spare Parts

Framed Instructions

SD-06 Test Reports

Tests

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G[, [_____]]

1.3 MAINTENANCE MATERIAL SUBMITTALS

1.3.1 Extra Materials

Furnish a complete set of manufacturer's recommended spare parts, including cutting teeth and combs or other cutting elements, fasteners, screens, seals or bearings, etc. Furnish special tools for the proper operation and maintenance of equipment, installed in a wall-mounted hardwood or metal container.

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings, and not later than [_____] months prior to the date of beneficial occupancy. Include in the data package a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after [1][and][3] year(s) of service.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products, that conform to the respective publications and other requirements specified and that essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening. Ensure all equipment is supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

b. To each major item of equipment, securely attach a plate to the item

that includes the manufacturer's name, address, and catalog or model number. In lieu of adding a nameplate on the shredder and bar screen, integrally cast the adding a manufacturer's name or trademark onto the shredder, or stamp, or otherwise permanently mark the shredder.

c. Fully enclose moving parts of the equipment, such as drive chains and sprockets, in removable guards. Fully enclose equipment above the level of the sewage-carrying channel in a cast iron or 1.897 mm (14 gauge) 14 gauge sheet steel or wrought-iron housing. Ensure housing is provided with a sufficient number of doors or removable panels to ensure ready access to any part of equipment for repairs, replacements, or cleaning. The joint between the housing and the concrete foundation is required to be leakproof.

d. Submit detail drawings consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Ensure detail drawings contain complete wiring and schematic diagrams, equipment layout and anchorage, and any other details required to demonstrate that the system has been coordinated and is fully functional as a unit.

2.1.1 Bearings

ABMA 9 and ABMA 11.

2.1.2 Iron, Steel, and Miscellaneous Metal

2.1.2.1 Miscellaneous Metal

Provide bolts, nuts, anchors, washers, and other types of supports necessary for the installation of equipment made of steel or wrought iron, galvanized according to the requirements of ASTM A153/A153M.

2.1.2.2 Malleable Iron

ASTM A47/A47M, grade No. 32510, minimum.

2.1.2.3 Structural Steel

ASTM A36/A36M.

2.1.3 Motors, Electric

NEMA 250, NEMA ICS 1, NEMA ICS 3, NEMA ICS 4, NEMA ICS 6 and NEMA MG 1.

2.1.4 Motor Controls

NEMA ICS 2.

2.1.5 Switches, Enclosed

UL 98.

2.2 COMPONENTS

2.2.1 Electrical Work

Provide electrical equipment and wiring in accordance with Section 26 20 00

INTERIOR DISTRIBUTION SYSTEM. Electrical work must comply with NFPA 70, latest edition. Supply with electrical characteristics as indicated. Provide automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices but not shown on electrical plans, under this section of the specification.

2.2.1.1 Electric Motors

Provide equipment complete with motors of the [open] [totally enclosed] ball-bearing squirrel-cage induction type, with a maximum speed not to exceed 1800 rpm. Provide motors of sufficient capacity to drive equipment at the specified capacity without exceeding rating shown on nameplate attached to the motor.

2.2.1.2 Motor Controls

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NOTE: For complex automatic controls, the Designer is to review UFGC Section 40 60 00 PROCESS CONTROL and reference it in this paragraph if required.
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Provide motor controls required to control the motor in the manner indicated or specified with the associated motor and ensure they contain properly sized thermal-overload protective elements. Except where otherwise indicated, provide starters in [general-purpose] [weatherproof] enclosures. Where manual control is specified, provide starter with a start-stop pushbutton in the cover. Where automatic control is specified, provide starter with a hand-off-automatic selector switch in the cover. Provide each starter with an appropriate nameplate or stencil identifying the equipment controlled. [Provide controls in accordance with Section 40 60 00 PROCESS CONTROL.]

2.2.2 Hydraulic Work

Provide hydraulic equipment and application in accordance with [Section 41 24 26 HYDRAULIC POWER SYSTEMS] [and] [Section 35 05 40.14 10 HYDRAULIC POWER SYSTEMS FOR CIVIL WORKS STRUCTURES]. Provide manual or automatic control and protective or signal devices required for the operation specified, and any control wiring or hydraulic connections required for controls and devices but not shown on electrical or hydraulic plans, under this section of the specification.

2.2.2.1 Fluid Motors

Provide equipment complete with fluid motors of the [vane] [piston] type. Ensure motors are of sufficient capacity to drive equipment at the specified rating without exceeding rating shown on the nameplate attached to the motor.

2.2.2.2 Hydraulic Controls

Provide controls in the manner indicated or specified, coordinated with the associated equipment, and having properly sized overload protective elements.

2.2.2.3 Fluid Power Valves

SAE J1677.

2.2.2.4 Fluid Tubing

SAE J1677.

2.2.2.5 Hydraulic Fluid

Provide hydraulic fluid in accordance with Section 41 24 26 HYDRAULIC POWER SYSTEMS.

2.3 MANUFACTURED UNITS

2.3.1 Mechanically-Cleaned Bar Screen

A bar screen consists of a stationary bar screen, a screen rake, a rake mechanism operated by [an electric] [a hydraulic] drive unit, and a dead plate and rake-cleaning device, where required. Install equipment so as not to obstruct the flow of sewage to bar screen. Unless otherwise specified, ensure all metal that is submerged in the sewage-carrying channel or that comes in contact with sewage consists of wrought iron, steel, cast iron, or other equally corrosion-resistant metal.

2.3.1.1 Bar Screen

Ensure each bar screen is suitable for installation in a rectangular channel [_____] m [_____]-feet [_____]-inches wide by [_____] m [_____]-feet [_____]-inches deep, and is designed for handling sewage flows as follows:

a. Minimum, [_____] cubic meters/day MGD.

b. Average, [_____] cubic meters/day MGD.

c. Maximum, [_____] cubic meters/day MGD.

2.3.1.2 Screen Rake

Ensure rake is designed to rake up screenings collected on the bar screen and in the openings between bars, and to convey screenings to a [drain platform] [collection trough] [grinder]. Provide rake made of cast iron, steel, or other suitable material not less than [_____] mm inch thick. Space rake teeth to pass between bars of the screen. Ensure rake teeth plate is easily removable and replaceable.

2.3.1.2.1 Rake Mechanism

Provide a revolving-frame, automatic-hoist, endless-chain type mechanism, or screw-drive type mechanism that includes parts and accessories necessary for a complete operating unit. Ensure parts for the mechanism are amply proportioned for stresses that may occur during fabrication, erection, and operation. Provide interchangeable individual parts that are alike in each. Provide shearing pins or an overload-release mechanism for overload protection. Ensure rake speed ranges from [____] to [____] m/second feet per minute. Provide rake mechanism with a complete and adequate system of lubrication to moving parts subject to wear. Provide grease- or oil-lubricated bearings except submerged bearings which are

required to be fabricated from alloy-bearing metal designed to operate without any lubrication and to prevent accumulation of deposits.

2.3.1.2.2 Revolving-Frame-Type

A revolving-frame-type rake mechanism consists of two pairs of structural-steel-angle rake arms mounted on a horizontal shaft. Screen rakes are attached to steel crossbars mounted on the outer end of each pair of rake arms. The entire rake mechanism is required to revolve about the horizontal shaft.

2.3.1.2.3 Automatic-Hoist-Type

An automatic-hoist-type rake mechanism consists of a reciprocating rake mounted on a horizontal shaft or frame and guided by steel channels or angles at each end of the frame. The rake and frame are pulled up the slope of the guide rails by two or more cables operating over motor-propelled grooved drums. After screenings are discharged, the rake frame is required to automatically tilt and lower to the bottom of screen.

2.3.1.2.4 Endless-Chain-Type

An automatic-chain-type rake mechanism consists of a drive chain, drive sprockets, and sprocket wheels mounted on a drive shaft, and an idler shaft where required, operating two endless chains with rakes securely attached.

a. Fabricate the drive chain connecting motor sprocket with the drive shaft and the endless chain of malleable iron with heat-treated-steel pins or rivets. Provide a chain tightener or takeup bracket for drive chain. Ensure chains are of suitable size and design to withstand strains imposed.

b. Fabricate the sprockets for the drive and endless chains of semi-steel or cast iron with chilled teeth and rims. Grind the rims and teeth of the sprockets to fit chains. Provide sprockets of the size recommended by the equipment manufacturer. Fabricate shafts of cold-rolled steel, straight and true, and of ample diameter to transmit the power required without undue deflection. Accurately cut the keyways where required. Provide malleable iron or bronze safety collars where required to keep shafting and sprockets in alignment.

2.3.1.2.5 Screw-Drive Type

A screw-drive type rake mechanism consists of a reversing threaded screw-drive and bearing nut attached to rake. Provide all rakes with reciprocating action.

2.3.1.2.6 Rake Mechanism Control Equipment

Start motors by means of [automatic time switch for intermittent operation, adjustable to give 3 to 60 minutes between cycles] [float switch for automatic operation at predetermined levels] [float switch for automatic operation at predetermined rise in head of sewage on the upstream side of the screen bar]. [Provide floats constructed of corrosion-resistant metal.]

a. Endless-Chain-Type-Rake Mechanism: Provide a motor-reversing switch so that direction of travel of the rake mechanism is reversible in the

event of jamming. Provide a motor-reversing switch consisting of a double-throw externally operable switch enclosed in a [raintight] [watertight] enclosure. Mark the switch as follows: "Forward," "Off," "Reverse."

b. Automatic Hoist-Type Rake Mechanism: Provide starters for this type of rake mechanism that are the reversing type. Arrange control devices so that on completion of upward travel of the rake mechanism, motor stops and then reverses, and rake travels to the lower position, at which point motor again stops and automatically adjusts for the next automatic operation.

c. Revolving Frame-Type Rake Mechanism: Provide an emergency stop push-button and a rake limit switch in a weatherproof enclosure, to always stop the rake out of water after discharge of screenings.

d. Bearing Type Rake Mechanism: Control the travel of the rake in a downward or upward direction by proximity switches. Provide for adjustable frequency. Provide rake delay on the [top] [bottom]. Provide [electric][hydraulic] rake drive. Provide overload protection for down and up stroke. Provide drive with a control panel (minimum NEMA ICS 2) mounted.

e. Rake Wiper: Where required to remove screenings from rake, provide a rake wiping or scraping device at the discharge point of rake. Fabricate device to include either a plate attached to swinging hinged arms or a continuous hinged plate actuated by motion of the rake. Design wiper so that after cleaning of the rake is completed, wiper falls into the proper place ready for the next scraping operation. Control the fall of wiper either mechanically or hydraulically to absorb any shock.

f. Dead Plate or Apron: Provide a wrought iron or steel dead plate where required to prevent any deposited screenings from falling into the downstream side of rake. Ensure provided dead plate is not less than 2.657 mm 12 gauge metal if required by the design and type of rake mechanism installed, and is rigidly braced if required.

2.3.2 Mechanical Shredder, Cutter, or Grinder

2.3.2.1 Operation Requirements

Provide shedder, cutter, or grinder unit suitable to receive screenings from screening unit specified and to discharge resulting pulp into the sewage flow. Operate machine by means of an electric drive unit designed to cut sewage solids, including sticks, rags, and stringy material without clogging, jamming, or stalling moving parts. Direct connect grinder and drive unit by a flexible or friction-type coupling integrally mounted on a structural steel or cast iron base. Provide grinder with a water-flushing system where required to flush ground solids through the machine. Ensure machine provided has a capacity of grinding [_____] kg pounds of sewage screening per hour.

2.3.2.2 Control Equipment

Arrange control so that shredder motor automatically start when the rake-mechanism motor starts. Provide a relay to allow the shredder to continue to run for a predetermined time after rake mechanism has stopped, and to automatically stop the shredder motor.

2.3.2.3 Cutter Mechanism

The cutter consists of cutting blades or impellers mounted on a revolving shaft or drum in contact with a stationary cutter screen or blade. Provide cutting devices made of tool steel or other material equally suitable for cutting tools. Ensure devices are accurately cut and ground to size to provide sharp cutting edges having extreme resistance to wear.

2.3.2.4 Bearings

Provide bearings of the self-aligning ball or roller type. Design bearings and bearing supports to safely carry and withstand the stresses imposed by the disintegrating action of the grinder.

2.3.2.5 Stuffing Boxes

Wherever the drum shaft passes through the machine housing, provide stuffing boxes of proper depth and construction.

2.3.2.6 Lubrication

Ensure bearings and moving parts, subject to wear, are provided with adequate devices for grease or oil lubrication.

2.4 PAINTING

Thoroughly clean, prime, and give all equipment two finish coats of paint at the factory in accordance with the recommendations of the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

3.2.1 Installation of Concrete Foundations

Use concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Concrete foundations are required to be integral with, and of same strength as the building floor, unless otherwise specified. For concrete used in foundations that are entirely separated from the surrounding floor, use 17 MPa 2500 psi. When new foundations are constructed on existing concrete, bond new concrete to old as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Furnish foundation bolts, as required, for proper positioning during placement of concrete.

3.2.2 Installation of Equipment

Install all materials and equipment as shown and in accordance with the approved written recommendations of the equipment manufacturer.

3.2.3 Field Painting

Field painting is specified in Section 09 90 00 PAINTS AND COATINGS.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

After installation of the sewage bar screen and mechanical shredder is complete, conduct operational tests required to demonstrate that the sewage bar screen and mechanical shredder and controls operate in accordance with the requirements of this section of the specifications. At a minimum, operate the rake through [5][10][__] cycles to ensure the system is operating correctly. Conduct a minimum of [2][5][__] tests with the rake loaded with debris to simulate actual field conditions. Indicate the final position of controls in each test report.

3.3.2 Manufacturer's Field Services

Obtain the services of the manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified. Ensure the representative supervises the installation, adjustment, and testing of the equipment.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Framed Instructions

Provide framed instructions, including wiring and control diagrams, showing the complete layout of the entire system, posted where directed. Pot the framed instructions before acceptance testing of the systems. Prepare 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 the wiring and control diagrams and posted beside the diagrams. Submit proposed diagrams, instructions, and other sheets, prior to posting.

3.4.2 Operating and Maintenance Instructions

Submit operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include within the instructions the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Submit maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Include simplified diagrams for the system as installed.

3.4.3 Training

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

-- End of Section --