Preparing Activity: USACE Superseding
UFGS-46 61 00 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 46 61 00

FILTRATION EQUIPMENT
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NOTE: This guide specification covers the requirements for filtration systems with capacity less than 750 liters 200 gallons per minute.

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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PART 1 GENERAL

1.1 REFERENCES

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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.

AMERICAN LADDER INSTITUTE (ALI)

ALI A14.3	(2008; R 2018) Ladders - Fixed - Safety Requirements

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A1264.1	(2017) Safety Requirements for Workplace Walking/Working Surfaces and Their Access; Workplace, Floor, Wall and Roof Openings; Stairs and Guardrail/Handrail Systems

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B100	(2016; Errata 2017; Addenda 2018) Granular Filter Material
AWWA C110/A21.10	(2021) Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2020) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA D100	(2021) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A126	(2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A193/A193M	(2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A216/A216M	(2021) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2022a) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A420/A420M	(2020) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service

ASTM A707/A707M	(2019) Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2022) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C582	(2023) Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
ASTM C1147	(2014; R 2022) Standard Practice for Determining the Short Term Tensile Weld Strength of Chemical-Resistant Thermoplastics
ASTM D1330	(2004; R 2010) Rubber Sheet Gaskets
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3299	(2010) Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape
ASTM D4097	(2001; R 2010) Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM F477	(2014; R 2021) Standard Specification for

	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ANSI/ISA 5.1	(2022) Instrumentation Symbols and Identification

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

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2022) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
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-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2022) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2021) Motors and Generators

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2023) Structural Engineering

1.2 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's

Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Filtration System; G[, [_____]]

Include complete wiring and schematic diagrams; equipment layout and anchorage; and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

SD-03 Product Data

Posting Framed Instructions

Qualifications

Media

Materials and Equipment

Control System

Spare Parts

Submit after approval of the shop drawings, and not later than [_____] days prior to the start of operation.

SD-06 Test Reports

Acceptance Testing

Factory Tests

SD-07 Certificates

Materials and Equipment

SD-10 Operation and Maintenance Data

Field Training

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

1.3 MAINTENANCE MATERIAL SUBMITTALS

1.3.1 Extra Materials

Provide standard spare parts as recommended in the manufacturer's instruction manuals for each component of the equipment. Submit spare parts data for each different item of material and equipment specified. Include in the data a complete list of parts and supplies, with current unit prices and source of supply.

1.4 QUALIFICATIONS

Submit qualifications of the installer, and the manufacturer's and media supplier's representatives.

1.4.1 Installer

Installers are required to have a minimum of [_____] years' experience in the installation of a minimum of [_____] similar filtration systems and are required to show evidence of satisfactory operation for each installation.

1.4.2 Manufacturer's Representative

Ensure a representative of the filtration system manufacturer, who is familiar with the design and experienced in the installation, adjustment, and operation of the equipment specified is present at the jobsite during installation of the filtration system.

1.4.3 Media Supplier Representative

Ensure a representative of the media supplier who is experienced in the installation of the specified filtration media is present at the jobsite during media installation.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a [pressure] [continuous backwash] [traveling bridge] [cartridge] [bag] filtration system. Design, construct and install the filtration system to comply with the following design conditions. Supply auxiliary systems and equipment required to maintain complete and workable filter systems including, but not limited to, required piping between units, auxiliary equipment for plumbing and power, and controls and interfaces between auxiliary equipment and the filter. Chemical additives [are] [are not] allowed to enhance the filtration system. Construct the installation [indoors] [outdoors]. [_____] volts of electricity, [_____] Pa psi air pressure, and [_____] Pa psi water pressure is available for installation.

2.1.1 Influent Flow Characteristics

****
NOTE: This paragraph describes influent flow characteristics for continuous backwash, traveling bridge, and pressure filtration systems.
****

Design Flow	[_____]L gallons per minute
Maximum Flow Rate	[_____]L gallons per minute
Minimum Available Head	[_____]m feet
Design Influent Temperature	[_____]degrees C degrees F
Maximum Influent Temperature	[_____]degrees C degrees F
Minimum Influent Temperature	[_____]degrees C degrees F
Flow Conditions	[intermittent] [continuous] [batch]
Design Influent, Suspended Solids	[_____] mg/L
Design Influent, Particle Size	[_____] micron
Maximum pH	[_____]
Minimum pH	[_____]
Maximum BOD	[_____] mg/L
Minimum BOD	[_____] mg/L
Source of Process Water	[metals precipitation] [biological treatment] [surface water] [landfill leachate] [_____]

Chemical Pretreatment	[alum] [polymer] [_____]
Alkalinity	[_____] mg CaCO3/L
Calcium Concentration	[_____] mg/L
Hardness	[_____] mg/L
[_____]	[_____]

2.1.2 Design Criteria

****
NOTE: This paragraph specifies minimum design requirements for continuous backwash, traveling bridge, and pressure filtration systems.
****

Number of Filters	[_____]
Maximum Effluent, Suspended Solids	[_____] mg/L
Maximum Effluent, Particle Size	[_____] micron
Maximum BOD	[_____] mg/L
Backwash Type	[_____]
Maximum Filtration Rate	[_____] L/second/square meter[_____] gal/second/square foot
Maximum Influent, Pipe Velocity	[_____] m/s[_____] ft/s
Maximum Effluent, Pipe Velocity	[_____] m/s[_____] ft/s
Clean Bed Maximum Headloss (at design flow and temperature)	[_____] meters[_____] feet

2.1.3 Cartridge and Bag Influent

****
NOTE: This paragraph describes influent flow characteristics for cartridge and bag filtration systems. In addition to the information listed below, concentrations of Target Compound List (TCL) and Target Analyte List (TAL) compounds in the waste

stream should be included in the influent stream characteristics paragraph. This information will help ensure that the bag or cartridge filtration materials are compatible with the waste stream.
****

Design Flow	[_____] L/minute[_____] gal/minute
Maximum Flow Rate	[_____] L/25 cm filter[_____] gal/25 cm filter equivalent
Design Inlet Pressure	[_____] Pa[_____] psi
Design Influent Temperature	[_____] degrees C[_____] degrees F
Maximum Influent Temperature	[_____] degrees C[_____] degrees F
Minimum Influent Temperature	[_____] degrees C[_____] degrees F
Fluid Viscosity	[_____] cP[_____] lb/ft-s
Flow Conditions	[intermittent] [continuous] [batch]
Design Influent, Suspended Solids	[_____] mg/L
Design Influent, Particle Size	[_____] micron
Maximum pH	[_____]
Minimum pH	[_____]
Source of Process Water	[metals precipitation] [biological treatment] [surface water] [landfill leachate] [_____]
Chemical Pretreatment	[alum] [polymer] [_____]
Alkalinity	[_____] mg CaCO3/L
Calcium Concentration	[_____] mg/L
Hardness	[_____] mg/L
[_____]	[_____]

2.1.4 Cartridge and Bag Design Criteria

****
NOTE: This paragraph specifies minimum design requirements for cartridge and bag filtration systems.
****

Total Number Operating Units	[_____]
Number of On-line Units	[_____]
Number of Stand-by Units	[_____]
Number of Elements per Unit	[_____]
Design Effluent, Suspended Solids	[_____] mg/L
Design Effluent, Particle Size	[_____] micron
Maximum Differential Pressure	[_____] Pa[_____] psi at design temperature
	[_____] Pa[_____] psi at maximum temperature

2.2 EQUIPMENT

2.2.1 Materials and Equipment

****

NOTE: Pipes, valves, pumps, and appurtenances are generally supplied as part of the package filtration system, but the designer must specify those sites requiring special materials of construction, sizing, etc., based on the influent stream characteristics.

****

Ensure all recyclable materials conform to EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

2.2.1.1 Standard Products

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

2.2.1.2 Nameplates

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

2.2.1.3 Protection of Moving Parts

Completely enclose by guards belts, chains, couplings, and other moving parts to prevent accidental personal injury. Fabricate guards to be removable or arranged in a way to allow access to the equipment for maintenance. If equipment is housed in a lockable housing, ensure the housing provides sufficient protection and no additional guards are necessary.

2.2.1.4 Special Tools

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

2.2.1.5 Steel Plates, Shapes and Bars

ASTM A36/A36M.

2.2.1.6 Pipe and Fittings

Provide pipe and fittings that conform to the standards specified below.

2.2.1.6.1 Steel Pipe

ASTM A53/A53M.

a. Flanged Joints: ASTM A707/A707M.

b. Welded Joints: AWS D1.1/D1.1M.

c. Bolts: ASTM A307, Grade B.

d. Fittings: ASTM A420/A420M.

2.2.1.6.2 Ductile Iron Pipe

AWWA C115/A21.15.

a. Flanged Pipe: AWWA C115/A21.15 with ASME B16.1, Class 125 flanges.

b. Rubber-Gasket Joints: AWWA C111/A21.11.

c. Fittings: AWWA C110/A21.10.

d. Push-on Joints: AWWA C151/A21.51.

e. Bolts and Nuts: ASTM A307, Grade B.

2.2.1.6.3 Stainless Steel Pipe

ASTM A312/A312M, Schedule 40, Type 316 or Type 304.

a. Flanged Pipe: ASME B16.5, Class 150.

b. Rubber-Gasket Joints: ASTM D1330.

c. Fittings: ASME B16.3.

d. Bolts: ASTM A193/A193M, Class 1, Grade B8.

e. Nuts: ASTM A194/A194M, Grade 8.

2.2.1.6.4 Polyvinyl Chloride (PVC) Pipe

Provide PVC pipe and fittings less the 100 mm 4 inch diameter in accordance with ASTM D1785 or ASTM D2241. Provide PVC pipe and fittings 100 mm 4 inch in diameter or larger in accordance with ASTM D2241 with push-on joints.

a. Push-on Joints: ASTM D3139 or ASTM F477.

b. Solvent Cement: ASTM D2564.

2.2.1.7 Pipe Hangers and Supports

MSS SP-58.

2.2.1.8 Valves

2.2.1.8.1 Steel Valves

ASTM A216/A216M, Grade WCB.

2.2.1.8.2 Cast Iron Valves

ASTM A126, Class B.

a. Globe and Angle Valves: MSS SP-85.

b. Gate Valves: MSS SP-70.

c. Plug Valves: MSS SP-78.

d. Butterfly Valves: MSS SP-67.

e. Ball Valves: MSS SP-72.

f. Check Valves: MSS SP-71.

2.2.1.8.3 PVC Valves

ASTM D1784, Class 12454-B (formerly designated Type I, Grade 1).

2.2.1.9 Other Materials

2.2.1.9.1 Polypropylene Support Material

****

NOTE: The polypropylene requirements are applicable to use for support materials for bag and cartridge filters.

****

ASTM C1147.

2.2.1.9.2 Joint Compound

Use joint compound for threaded joints made from a stiff mixture of graphite and oil, inert filler and oil, or a graphite compound.

2.2.1.9.3 Joint Tape

Provide joint tape for threaded joints that complies with ASTM D3308.

2.2.2 Electrical Equipment

2.2.2.1 Electrical Work

[Provide electrical motor-driven equipment specified complete with [motors] [motors and motor starters] and controls.] [Motor starters complete with properly sized thermal overload protection and other appurtenances necessary for the motor specified.] Perform electrical work as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices.

2.2.2.2 Electric Motors

Provide motors that conform to NEMA MG 1. Provide motors with nameplate horsepower equal or greater than 380 watts 1/2 hp that are suitable for 480 volt, 3 phase operating service, unless otherwise specified. Provide motors of greater than 760 watts 1 hp that are high efficiency type as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2.2.3 Motor Controls

Provide controls that conform to NEMA ICS 1.

2.2.2.4 Electrical Power Control

****

NOTE: Generally, the filter manufacturer will supply a standard control system with the package unit. To allow maximum flexibility, the control system should be specified only to the extent necessary to achieve project needs. The following sub paragraphs provide specification for several control system components the designer may require the manufacturer to incorporate into the package system. Delete paragraphs not required.

****

2.2.2.4.1 General Requirements

Provide a [manual] [semi-automatic] [automatic] [_____] complete electrical power, control, and instrumentation system as specified or recommended by the equipment manufacturer for the safe operation and supervision of the filter units and related equipment, except those items specified to be furnished under other sections. Provide schematics and interconnection wiring diagrams for power, control, and instrumentation circuits to equipment specified. Provide terminal blocks (plus 25 percent spare terminals) in panels to terminate field and interconnection wiring.

2.2.2.4.2 Control System

Provide control power transformers, relays, adjustable timers, auxiliary contacts, switches, or additional equipment as required to interconnect the filter equipment to a remote plant monitoring system, and control circuits as shown on schematic or instrument control system drawings. Furnish conduit wiring between control panels and control devices as part of this specification. Submit a description of the control system including, but not be limited to, the following items:

a. Product information for sensors/transducers and field instruments.

b. Programmable Controller System Information

(1) System Description

(2) Hardware Description

(3) Software Description

c. Panels, Consoles, and Cabinets Information

(1) Layout Drawings

(2) Panel schematic and internal point-to-point wiring interconnect and/or piping diagrams

(3) Electrical control schematics in accordance with NFPA standards for all circuits indicated in the specifications or on the Contract Drawings. "Typical" wiring diagrams are acceptable but the use of tables or charts to describe wire numbers is not acceptable. Label wires and shown on the submittal drawings.

(4) Plan showing equipment layout.

(5) Stock lists or Bill of Materials for each panel including tag number, functional name, manufacturer's name, manufacturer's model number, and quantity for components mounted in and on the panel, console, or cabinet.

d. Field wiring and piping diagrams and point-to-point wiring diagrams including interconnections between field devices, panels, control stations, lighting panels, and motor starters.

e. Instrument loop diagrams for analog display, control and I/O loops prepared using ISA standard symbols.

f. System Software Documentation to include the following as a minimum:

(1) Complete hard copies of ladder diagram programming.

(2) Complete listing of external and internal I/O address assignments, register assignments, and preset constant values along with functional point descriptions. Also list unused/undefined I/O and data table registers available.

(3) Complete hard copies of program documentation for all types of programs.

(4) Detailed system memory map defining memory segments used and spare memory segments available for system memory, I/O tables, Data Tables, and control program.

(5) Complete database listing.

(6) User's manual describing procedures and providing examples for use of programming terminal, accessories, and system utility routines to perform control, program modification, program verification,

diagnostics, program documentation, loading and backup, and other required system support functions.

2.2.2.5 Remote Alarm and Process Variable Monitoring

****
NOTE: Coordination with remote systems, such as Supervisory Control and Data Acquisition (SCADA) System and annunciators, must be specified in this paragraph and must include the method of transmission to remote locations for the process variables to be monitored for each unique application. If remote alarm and process variable monitoring is not used, this paragraph must be deleted.
****

2.2.2.6 Bolts, Nuts, Anchors, and Washers

Provide steel bolts, nuts, anchors, and washers, galvanized in accordance with ASTM A153/A153M.

2.2.2.7 Valves

Transfer water to and from the filtration unit by a means of [ball valve] [butterfly valve] [globe valve] [air solenoid] [_____] for [automatic] [semiautomatic] [manual] operation. Design the valve mechanisms such that gradually increasing flows are attained as ports are opened and initial surges and sudden inrushes of water are avoided. Include a dial pointer to indicate each step of the operation.

2.2.2.8 Pumps

Supply air compressors where insufficient head is available to move the [influent] [effluent] [backwash] [wash] water. Ensure the pump complies with the requirements of Section 23 21 23 HYDRONIC PUMPS.

2.2.2.9 Air Compressors

Supply pump in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.2.2.10 Pressure Gauges

Show or schedule gauge sizes and scale ranges on the Contract Drawings. Provide gauges that comply with ASME B40.100 Type 2A, as a minimum. Provide compound gauges on the suction side of pumps and standard pressure gauge on the discharge side of pumps. Use gauges with clear acrylic or shatterproof glass windows and shock-resistant cases. Set the design operations to fall at the midpoint of the graduated scale. Equally space major divisions and show in whole integers. Engrave scale units on the scale face. Limit pointer travel to not less than 200 degrees nor more than 270 degrees arc. Provide gauge accuracy of plus or minus 0.5 percent of span. Provide each gauge, except those for hydraulic systems, with a process shutoff valve.

2.2.2.11 Gauge Panel

Provide a gauge panel on which [1] [2] [_____] nominal pressure gauges to sense unit inlet and outlet pressures and [1] [2] [_____] pressure switch

are mounted. Wire the pressure sensor switch to a control panel which sounds an alarm when the differential pressure exceeds the [maximum differential pressure specified in Paragraphs Design Criteria or Cartridge and Bag Design Criteria (as applicable)] [maximum differential pressure specified by the manufacturer].

2.2.2.12 Tank Requirements

****
NOTE: Further requirements for tanks specific to each filtration process are presented in the applicable paragraph.
****

2.2.2.12.1 Parameters

Provide specified tanks in accordance with the following general requirements, unless otherwise indicated. Provide each tank with flanged fittings for inlet, outlet, overflow and drain. Provide the size, elevation and orientation in accordance with construction drawings. Provide hold down lugs to anchor the tank to the base.

2.2.2.12.2 Tank Construction Materials

****
NOTE: Tank construction materials must be compatible with the materials to be handled. This requirement is applicable for all tanks (e.g., filter tanks, backwash tanks, chemical feed, polymer supply, etc.).
****

Provide tank construction material compatible with the material to be handled. Provide tanks constructed of polyethylene, polypropylene, and fiberglass reinforced plastic (FRP) that conform to applicable material and construction provisions of ASTM C582, ASTM D3299, and ASTM D4097. Provide tanks constructed of steel that conform with applicable material and construction provisions of AWWA D100. Fabricate carbon steel tanks with ASTM A283/A283M carbon steel Grade C or D and protected with [an appropriate interior coating system for the intended service] [vinyl ester epoxy] [_____] in accordance with applicable requirements in Section 09 90 00 PAINTS AND COATINGS. Fabricate stainless steel tanks of Type 304 stainless steel conforming to ASTM A167 with structural support conforming to ASTM A276/A276M. Provide exterior painting or coating in accordance with Paragraph PAINTING.

2.2.2.12.3 Site Glasses

Provide a [_____] mm inch diameter observation port in the tank wall. Locate the observation port [at the surface of the filter media] [at the media interface] [_____].

2.2.3 Media

Provide filter materials that conform to the requirements of AWWA B100. Perform a sieve analysis in accordance with ASTM C136/C136M and AWWA B100. Determine specific gravity in accordance with ASTM C127 for support media and ASTM C128 for [silica sand] [anthracite coal] [high-density media]. Submit characteristics of each filter media material.

2.2.3.1 High-Density Sand

Provide high-density sand composed from [garnet] [ilmenite] [_____] with a specific gravity of [3.6] [4.0] [4.2] [_____], uniformity coefficient less than or equal to [_____], and an effective size between [_____] and [_____]. Ensure ninety-five percent of the material is larger than or equal to [_____].

2.2.3.2 Silica Sand

Provide silica sand with an effective size between [_____] and [_____], uniformity coefficient less than or equal to [_____], and a specific gravity of [2.55] [2.60] [2.65] [_____]. Ensure ninety-five percent of the material is larger than or equal to [_____].

2.2.3.3 Anthracite Coal

Provide anthracite coal with a specific gravity of [1.45] [1.50] [1.55] [1.73] [_____], uniformity coefficient of [_____], and an effective size between [_____] and [_____]. Ensure ninety-five percent of the material is larger than or equal to [_____]. The anthracite media is required to be clean and free from thin or scaly pieces, with a calcium carbonate and magnesium carbonate hardness of [_____].

2.2.3.4 Support Media

Provide support gravel consisting of hard, rounded stones with an average specific gravity of not less than [_____]. Ensure not more than [_____] percent by weight has a specific gravity of [_____] or less. Ensure gravel contains not more than [_____] percent by weight of thin, flat, or elongated pieces (pieces in which the largest dimension exceeds three times the smallest dimension), and is free from shale, mica, clay, sand, loam, and organic impurities of any kind.

2.2.4 Continuous Backwash Filtration System

2.2.4.1 Equipment Capacity

Provide each unit with a moving bed, continuous backwash [upflow] [downflow] granular media filter, having a capacity to filter [_____] L/minute gpm of water at the operating conditions identified in Paragraph Design Criteria.

2.2.4.2 Filter Tank

****

NOTE: Provide seismic details if a Government designer (either Government Agency Office or A/E) is the engineer of record, and show on the drawings. Delete the bracketed phrase, in the last sentence, if seismic details are not provided. Pertinent portions of UFC 3-301-01 and Sections 13 48 73 and 23 05 48.19, properly edited, must be included in the contract documents.

****

Provide a cylindrical, sloped-bottom filter tank with the dimensions shown and constructed of [epoxy coated carbon steel] [type 304 stainless steel]

[fiberglass reinforced plastic] [_____] construction, free from physical imperfections. Construct the tank with a minimum number of pieces and a minimum thickness of metal parts exposed to the water of [_____]. Fit the tank with lifting lugs to facilitate handling and placement. Provide the filter tank with sufficient support to withstand wind speed in excess of [_____] km/hour mph and design for seismic forces in accordance with UFC 3-301-01 and Sections 13 48 73 SEISMIC CONTROL FOR MISCELLANEOUS EQUIPMENT and 23 05 48.19 [SEISMIC] BRACING FOR HVAC [as shown on the drawings].

2.2.4.3 Filter Media

Provide silica sand filter media at a total depth of [_____] m feet. Ensure all media conforms to the requirements of AWWA B100.

2.2.4.4 Influent Dosing System

****
NOTE: Each continuous backwash filter manufacturer has a particular influent dosing system. The influent dosing system should be specified only to the extent necessary to achieve the project objectives.
****

Provide an influent dosing system capable of delivering the influent stream uniformly over the entire media bed. Introduce the influent water to the [bottom] [top] of the filter tank. Construct all components of the dosing system of [stainless steel] [fiberglass reinforced plastic] [_____].

2.2.4.5 Effluent Collection System

Collect effluent by [discharge of filtrate overflow over an effluent weir constructed of [stainless steel] [fiberglass reinforced plastic] [_____] and placed and sized dimensionally as shown on the Construction Drawings.] [a filtrate line connected to a filtrate chamber consisting of a cylinder with a wedgewire screen periphery and hood. Construct the screen of stainless steel trapezoidal bars having an opening smaller than the finest media grain. Configure and size dimensionally the effluent collection system as shown on the Construction Drawings.] [_____] discharge effluent through a [_____] mm inch diameter [stainless steel] [fiberglass reinforced] [_____] pipe.

2.2.4.6 Media Cleaning System

The media cleaning system consists of a sand lift, sand washer, sand distribution equipment and reject collection system.

2.2.4.6.1 Sand Lift

The sand lift consists of [Type 304] [Type 304L] stainless steel eductor pipe. The pipe mounts [externally] [internally] and fixed [by welding] [by means of a [_____] ANSI gasketed flange] [_____] to the filter vessel. Supply compressed air at [_____] to [_____] cubic meters cubic feet per minute at [_____] Pa psig to the eductor pipe. Provide a suction rate that is sufficient to result in internal recycling of the media once every [_____] hours.

2.2.4.6.2 Sand Washer

****
NOTE: Delete cross-sectional area sizing requirements if the sand washer unit is external to the filter tank.
****

The sand washer consists of a chamber constructed of [Type 304 stainless steel] [acrylic] [fiberglass reinforced plastic] [_____]. Provide a sloped floor to clear the sand from the bottom of the chamber. Equip the chamber with [_____] baffles attached to its walls with a slope sufficient to cause the descending sand to strike the opposing chamber wall before dropping to the next level. Size the cross-sectional area to assure sufficient velocity of upflowing water to transport separated solids into the wash chamber and out the reject pipe.

2.2.4.6.3 Sand Distribution Equipment

Return the cleaned sand to the bed via a [sand distribution cylinder] [sand distribution cone] [return pipe] [washbox skirt] [_____], constructed of [fiberglass reinforced plastic] [Type 304 stainless steel] [_____] placed and sized as shown. Return the sand so that the media distributes evenly in a cone on top of the media bed.

2.2.4.6.4 Reject Collection System

The reject collection system consists of a stainless steel reject weir and a [_____] diameter reject nozzle. Position the reject weir to achieve the desired differential head between the effluent water and the reject water. Design the reject collection system to allow no more than [2] [10] [20] [_____] percent reject water.

2.2.4.7 Effluent Rate Control

Control filter operation by the liquid level in the filter tank using a proportional, displacer-type liquid level sensor. Provide an automatic effluent control [globe] [ball] [_____] valve with a pneumatic positioner to regulate the degree of opening in response to a [_____] to [_____] pneumatic signal. Ensure that an increase in signal air pressure increases the degree of valve opening. Ensure the flow control system is self-contained and does not require manual adjustments.

2.2.4.7.1 Pneumatic Controls

The pneumatic controls consist of a pressure gauge and a flowmeter. Mount the pressure gauge on the panel with a [_____] to [_____] Pa psi range and a [_____] mm inch face. Provide a flowmeter of the variable area type with a stainless steel indicator. Provide the meter with a metering valve, [_____] mm inch scale, and a range of [_____] to [_____] cubic meters cubic feet per minute. Mount both devices on a hinged panel visible through a window in the control enclosure.

2.2.4.7.2 Headloss Switch

Supply a headloss switch to signal when the media bed is beginning to foul. Rate the switch contacts at [_____] amps and connect to [an alarm] [process controls] [purge valve] [_____].

2.2.4.8 Equipment Control Panel

The equipment manufacturer is required to furnish a control panel containing all necessary timers, contact switches, internal wiring, completely assembled and mounted in a NEMA [4] [4X] [12] [_____] enclosure. The control panel provides for [automatically starting and stopping pumps] [manual operation of the control valves] [_____]. Mount the control panel on the filter unit and provide electrical wiring and connections external to the unit.

2.2.4.9 Flowmeters

Equip influent and effluent lines with [kennison nozzle] [parshall flume] [shuntflo stream] [sonic] [_____] flowmeters.

2.2.5 Traveling Bridge Filter

2.2.5.1 Tank

Provide a tank [_____] wide by [_____] long by [_____] deep constructed of [_____] thick [mild steel] [carbon steel] [_____]. Construct the assembled tank to allow loading and unloading as a unit and equip with lifting lugs. Furnish integral supports so that the body of the tank, when installed, are [_____] mm inches above the concrete slab. Place the supports to allow for full inspection of the underside of the tank. Construct tank in accordance with Paragraph Tank Requirements and prepared in accordance with the requirements of Paragraph PAINTING and Paragraph MATERIALS PROTECTION.

2.2.5.2 Filter Bed

2.2.5.2.1 Cell Dividers

Provide a filter bed [_____] wide by [_____] long and consisting of a series of self-supporting lateral partitions (cell dividers) which divide the filter into a multitude of [_____] wide compartments. Arrange each compartment for connection to a separate backwash port. Fabricate the divider sheets of [glass fiber reinforced plastic binder] [Type 304 stainless steel] [_____] with a finished thickness of [_____]. Ensure all divider sheets are without voids and/or air pockets. Cell sheets are not allowed to twist, curve or bend.

2.2.5.2.2 Porous Plate

Provide a porous plate supporting underdrain constructed of [fused aluminum oxide] [polyethylene] [_____] to a thickness of [_____] that is factory installed. Provide for a maximum pore diameter of [_____] microns. Provide sheets with a porosity between [_____] and [_____] and a minimum flexural strength of [_____] Pa psi. The plate allows a flow of [_____] L gallons per minute per [_____] mm inch water column pressure. Seal the porous plate completely with a [polyurethane] [silicone] [_____] sealant during installation. Provide a sealant with, at a minimum, [_____] hardness and [_____] tensile strength that does not contain asbestos fibers.

2.2.5.3 Voids Distribution

Provide media with uniform voids distribution from coarse to fine in the direction of flow. Ensure all filter materials conform to the

requirements of AWWA B100.

2.2.5.4 Rails

Provide [_____] kg lb ASCE rails with stainless steel splice plates and hardware mounted on the two main filter walls. Provide Type 304 stainless steel caps factory installed on each rail. Install and have a factory service engineer field adjust carriage rail stops fabricated from 300 Series stainless steel.

2.2.5.5 Carriage Mechanism

2.2.5.5.1 Carriage Frame

Traveling carriage or bridge systems contain and support the [positive drive mechanism] [pumps] [automatic backwash system] [washwater removal system] [motors] [limit switches] [_____]. Fabricate the carriage frame of welded steel construction. Provide a separate maintenance platform.

2.2.5.5.2 Carriage Drive

The carriage drive unit consists of a gear reducer, sprockets, stainless steel drive shaft, a NEMA B design single speed [_____] watt TCFC motor for three phase, [_____] hertz, [_____] volt power supply, provided with a sealed conduit box. Design the drive unit so that a torque limiting device is not required and has a strength of [_____]. Ensure all gear reducers are AGRA approved. Provide the drive shaft of sufficient size to adequately and safely withstand bending and torsional loads of starting and operating. Fully enclose all gearing in an oil-tight cast iron housing with the gears running in oil and anti-friction type bearings.

2.2.5.5.3 Carriage Wheels

Provide double flanged wheels of hardened Type 304 stainless steel. Provide self-aligning bearings with lubrication fittings. Provide wheels capable of compensating for minor misalignment of rails by sliding on the shaft. Do not use horizontally mounted wheels within the tank to align the carriage. Do not use caster-type wheels.

2.2.5.6 Automatic Backwash System

****

NOTE: If adjustable compression springs are not required, delete the second sentence.

****

Attach a fabricated backwash support frame to the traveling carriage on the effluent chamber side. Furnish adjustable stainless steel compression springs mounted between the carriage weldment and the backwash frame to allow adjustment of the backwash valve from outside the tank while the filter is in use. Mount a backwash shoe on the frame that can independently follow any irregularities of the matching backwash surface along the effluent ports. Construct the shoe of a material softer than the mating backwash surface (strip). Control the shoe flexible movement by using 300 series stainless steel springs. Attach the shoe to the piping by means of a flexible hose. Connect the piping to the backwash pump and include a throttle valve to achieve the correct pumping rate. Factory bolt the backwash surface (strip) to the effluent header by means of countersunk Type 304 stainless steel fasteners.

2.2.5.7 Washwater Removal System

Fabricate the washwater hood from [[304] [316L] stainless steel] [fiberglass reinforced plastic] [_____]. Ensure the hood permits the uniform expansion of the filter media. Fabricate the hood width to be [_____] times the cell width. Install a [stainless steel] [PVC] [_____] manifold in the upper portion of the washwater hood and connect to the washwater pump. Provide the washwater hood with a [high density polyethylene] [304 stainless steel] [_____] raking device and a minimum of two vent pipes extending to [_____] above the overflow weir.

2.2.5.8 Washwater Launders

Construct the washwater launders from [_____] mm inch [A36 steel] [fiberglass reinforced plastic] [_____] with a [_____] mm inch depth and [_____] mm inch width as an integral part of the filter tank wall. Ensure both backwash and washwater pumping systems are capable of discharging into the launder. Provide a "V" notch weir plate to calibrate and balance the flow of the washwater pumping system.

2.2.5.9 Equipment Control

2.2.5.9.1 Automatic Controls

Furnish automatic controls for the filter operation as an integral part of the carriage mechanism. Mount the automatic controls on the end of the filter tank. Factory assemble the carriage mechanism and attaching components and test for mechanical and electrical operation prior to shipment.

2.2.5.9.2 Control Panel

Provide the control panel with a hinged door for access to the control equipment. Mount "Hand-off-auto" selector switches with indicating lights for each pump motor and the carriage motor on the front of the panel door. Provide a main disconnect switch to de-energize the control panel with a pendulum handle operator extending through the control panel door. Provide a ground fault protected convenience outlet. Fabricate the enclosure from NEMA [3R] [4X] [_____], [painted steel] [Type 300 series stainless steel] construction, factory wired and tested. The pump and carriage motor controls consisting of magnetic contactors with thermal overcurrent protective devices.

2.2.5.9.3 Motors

Include controls, a timing device, relays and magnetic motor starters for each pump motor and carriage motor in the panel. Actuate these motors automatically by a predetermined increase in hydraulic head, or by the timing device to control the interval between each cleaning cycle. [Terminate the cleaning cycle by a signal from the low water sensing electrode. Control the "off time" of the cleaning cycle by a reset timer with a range of 1 minute to 60 hours. When the timer times out, actuate the motors. During the "on time", de-energize the timer and reset for starting "off time" at the end of the cycle. Should high water occur "off time", start the motors by a relay actuated from the high water electrode signal, with a corresponding resetting of the timer.] [Continue the washing cycle, when activated, for one complete pass of the filter bed. Under normal operation, ensure the carriage does not come to rest other

than at either end of the filter.]

2.2.5.9.4 Backwash Mechanism

Wire the control sequence for the backwash mechanism so the backwash mechanism stops at either end of the filter upon termination of the backwash cycle, which is also at the low operating probe signal. Install a low water shutoff probe to prevent pumping the filter tank below the minimum water level point. Furnish additional electrodes to protect the submersible pumps by giving a signal prior to reaching the overflow point.

2.2.5.9.5 Electrification System

Provide a stretch cable electrification system. Construct the cable of [_____] diameter stainless steel. Provide a stainless steel turnbuckle at one end for cable tension adjustment. Equip the electrification system with a number of non-friction nylon trolley carriers which support the electrical flat cable used to power the carriage. Connect the electrification system to a NEMA [4X] [3R] [_____] [Type 300 series stainless steel] [fiberglass reinforced plastic] equivalent junction box.

2.2.5.9.6 Factory Tests

Submit test reports of all factory tests specified in the above paragraphs and throughout this specification.

2.2.5.10 Auxiliary Equipment

2.2.5.10.1 Pumps

Power the backwash and washwater systems by a submersible pump suspended from the filter carriage. Any pumps other than dual submersible pumps are not acceptable. Furnish each pump capable of providing a minimum pumping rate of [_____] at a head of [_____]. Equip the pumps with stainless steel shafts, and abrasive-resistant impellers. Supply pumps in accordance with the requirements of Section 23 21 23 HYDRONIC PUMPS.

2.2.5.10.2 Weirs

Construct the influent and effluent weirs of sufficient length so that the flow does not exceed [_____] L cubic feet per minute per weir length at the average daily flow. Install the influent weir [_____] mm inch above the effluent weir. Install the effluent weir [_____] mm inch above the top of the cell dividers. Fabricate the weirs of Type 304 stainless steel to be [_____] deep with [_____] mm inch adjustment. Mount the weirs on [_____] mm inch mild steel plate with Type 304 stainless steel hardware on [_____] mm inch centers sealed with a neoprene rubber gasket. Install the overflow weir a minimum of [_____] mm inch above the effluent weir. Fabricate the weir to be the full width of the filter. Do not allow the overflow to discharge into the backwash channel.

2.2.5.10.3 Backwash Channel and Washwater Trough

Fabricate the bottom surface of the washwater trough to be at least [_____] m feet above the overflow weir. Construct the backwash channel of [stainless steel] [fiberglass reinforced plastic] [_____]. Provide a tank drain in the backwash channel.

2.2.6 Pressure Filters

2.2.6.1 Pressure Filter Tank

****
NOTE: Delete the partition wall requirement if the vessel will not be divided into multiple filter cells.
****

Construct the pressure filter tank to have a diameter of [_____] m feet, a height of [_____] m feet, straight shell length of [_____] m feet and oriented [horizontally] [vertically]. Provide each vessel with [_____] partition wall to divide the vessel into [_____] filter cells. Construct the filter vessels of welded steel and test to withstand a hydrostatic pressure of [_____] Pa psi in excess of the working pressure of [_____] Pa psi. Design and fabricate the vessel in accordance with the ASME BPVC SEC VIII D1 and stamp and certify as such. Provide lifting lugs, supports, connections and appurtenances as detailed on the drawings. Construct the filter tank in accordance with Paragraph Tank Requirements and prepared in accordance with the requirements of Paragraph PAINTING and Paragraph MATERIALS PROTECTION.

2.2.6.2 Underdrain System

Furnish each filter with [pipe laterals with nozzles] [pipe laterals with orifices] [a porous plate] [_____] underdrain system. Provide underdrain of standard manufacturer's design particular to the supplied filter unit and furnished with the constructed package unit. Design the underdrain system to withstand all loads due to design pressures, design loading rates, and loads from the media to be installed in the filter tank.

2.2.6.3 Pressure Filters Media

Ensure the media provides uniform voids distribution from coarse to fine in the direction of flow. Ensure filter materials conform to the requirements of AWWA B100.

2.2.6.4 Distributor/Collector

Provide each filter with an influent distributor/backwash collector of the [central manifold] [lateral arm] [_____] type. Fabricate the influent distributor and waste water collector as an integral part of the filter tank. Construct the system from [steel] [aluminum] [fiberglass] [_____] of the manufacturer's standard design.

2.2.6.5 Surface Wash Agitators

****
NOTE: Since surface wash systems vary greatly, additional information regarding the strength, construction, method of connection and nozzle size and type may be required to adequately specify surface wash agitators. The designer is required to add this information and any other additional information necessary for adequate specification.
****

Provide each filter with a [straight line] [S-shaped] [_____], [single]

[double] arm [rotary] [fixed] agitator constructed of [stainless steel] [brass-bronze] [_____] components. Design the agitator to create the most efficient degree of agitation to all portions of the filter. Ensure each agitator is capable of discharging [_____] L cubic feet per minute of water at an operating pressure of [_____] Pa psi. Maximum increase in bed expansion from surface wash is [_____] percent.

2.2.6.6 Air Scour System

2.2.6.6.1 Air Wash Distribution

Provide each tank with a separate air wash distributor. The distributor consists of a [brass] [red brass] [_____], [_____] mm inch air header with [_____] mm inch slotted [brass] [red brass] laterals on approximately [_____] mm inch center. [Introduce air to the media bed through the underdrain system.] [Introduce air at the top of the [gravel support layer] [underdrain].] A headloss up the wall of the filter of [_____] L per minute per square meter cubic feet per minute per square foot at [_____] mm inch of water column is acceptable.

2.2.6.6.2 Air Blower

Supply a positive displacement air blower for supplemental air wash. Provide the blower with a minimum capacity of [_____] L cubic feet per minute at [_____] Pa psi discharge pressure and supply in accordance with the requirements of Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.2.6.7 Equipment Control

2.2.6.7.1 Control Valves

Ensure the filter influent, backwash, waste, rinse, and surface wash valves allow for automatic operation of each filter unit.

2.2.6.7.2 Effluent Rate Controllers

Provide each filter with an effluent rate of flow controller consisting of a [flanged venturi tube] [butterfly valve] [electronic differential pressure transmitter] [_____].

2.2.6.7.3 Backwash Controller

Provide one backwash rate of flow controller consisting of a [flanged venturi tube] [butterfly valve] [electronic differential pressure transmitter] [_____].

2.2.6.8 Equipment Control Panel

Supply a control panel with a NEMA [4X] [12] [_____] enclosure to contain all necessary timers, lights, contact switches, internal wiring, etc. and associated equipment to allow for the completely automatic operation of the system. Provide the control panel for [automatically starting and stopping pumps] [manual operation of the control valves] [[manual] [automatic] [_____] backwash initiation] [_____]. Initiate backwash by [elapsed time] [high head loss] [high turbidity] [manual initiation] [_____]. Furnish the panel completely assembled, wired, and tested at the factory prior to shipment. Provide the panel with required switches for manual operation as required.

2.2.6.9 Backwash Tank

****
NOTE: The designer should consider the size of the facility in determining whether a separate specification section for the backwash tank is warranted or if the following paragraph is adequate.
****

Furnish the backwash tank with a capacity of [_____] to backwash the system at the manufacturer's recommended rate, pressure and frequency. Construct the tank in accordance with the requirements of Paragraph Tank Requirements.

2.2.7 Cartridge Filter

2.2.7.1 Equipment Capacity

Supply [_____] filtration units. [_____] units are required to be on-line, [_____] units are required to be on standby. On-line and standby units are required to have the capacity to treat the entire waste stream as specified in Paragraph Cartridge and Bag Design Criteria.

2.2.7.2 Filter Material

Filter material consists of [acetate] [acrylic] [glass] [nylon] [polyester] [polypropylene] [rayon] [saran] [cotton] [fluorocarbon] [teflon] [polyethylene] [_____] construction.

2.2.7.3 Cartridge Style

Cartridge style are to be [double open end industrial] [single open ended (SOE) flat closed end to fit housings with 020 O-ring posts] [SOE flat closed end with external 222 O-rings] [double open end with internal O-rings] [SOE flat closed end with external 226 O-rings] [SOE fin end with external 226 O-rings] [SOE fin end with external 222 O-rings] [double open end with internal O-rings] [SOE flat closed end with internal 120 O-rings].

2.2.7.4 Gasket or O-Ring Material

Provide the gaskets or O-rings fabricated from [silicone] [buna-n] [white silicone] [white buna-n] [viton-a] [EPDM] [teflon].

2.2.7.5 Pore Size/Rating

Provide filter pore sizes of [0.1] [0.2] [0.45] [1] [3] [10] [30] [50] [75] [100] [200] [_____] microns.

2.2.7.6 Filter Cartridge Dimensions

The filter cartridge is required to be the standard length of 250 mm 10 inch. Provide the cartridge inside diameter of [_____]. Provide the cartridge outside diameter of [_____].

2.2.7.7 Core Material

Provide cartridge core material made of [tinned steel] [polypropylene] [304 stainless steel] [316 stainless steel] [_____].

2.2.7.8 Filter Housing

2.2.7.8.1 Material of Construction

****
NOTE: Where flange options are specified, the designer must account for clearance of flanged fittings during installation.
****

Construct the filter housing head, shell, and associated internal and external connections and internal and external hardware of [304 stainless steel] [316 stainless steel] [carbon steel] [teflon] [polypropylene] [fiberglass reinforced plastic] [acrylic]. Prefabricate the housing and deliver to the site in such a condition that the unit can be fastened in the location designated on the design drawings. Provide the filter housing with the following dimensions and inlet, outlet, and system control connections:

Diameter	[_____]
Overall Height	[_____]
Inlet/Outlet	[_____] [NPT] [Flange] [ANSI 150 lb] raised face, [threaded flanges] [_____]
Body/Sump Drain	[_____] [NPT] [Flange] [_____]
Vent	[_____] [NPT] [Flange] [_____]
Gauge	[_____] [NPT] [Flange] [_____]

2.2.7.8.2 Shell O-Ring Material

Provide filter housing shell O-ring material composed of [buna-n] [silicon] [neoprene] [viton-a] [ethylene] [propylene] [_____] material.

2.2.8 Bag Filter

2.2.8.1 Equipment Capacity

Supply [_____] filtration units. [_____] units are set to be on-line, [_____] are set to be standby. Each on-line and standby unit is required to have the capacity to treat the entire waste stream as specified in Paragraph Cartridge and Bag Design Criteria.

2.2.8.2 Filter Material

Provide filter material consisting of [acetate] [acrylic] [glass] [nylon] [polyester] [polypropylene] [rayon] [saran] [cotton] [fluorocarbon] [teflon] [polyethylene] [_____] construction.

2.2.8.3 Gasket Material

Provide a single gasket cover seal for each bag element. Provide [silicone] [buna-n] [white silicone] [white buna-n] [viton-a] [EPDM]

[teflon]as material of construction.

2.2.8.4 Pore Size/Rating

Provide bag pore size of [0.1] [0.2] [0.45] [1] [3] [10] [30] [50] [75] [100] [200] [_____] microns.

2.2.8.5 Bag Surface Area

Provide bag surface area of [_____].

2.2.8.6 Bag Support

Support material fabricated from [tinned steel] [polypropylene] [304 stainless steel] [316 stainless steel] [_____].

2.2.8.7 Filter Housing

2.2.8.7.1 Material of Construction

****

NOTE: Where flange options are specified, the designer must account for clearance of flanged fittings during installation.

****

Construct the filter housing head, shell, and associated internal and external connections and internal and external hardware of [304 stainless steel] [316 stainless steel] [carbon steel] [teflon] [polypropylene] [fiberglass reinforced plastic] [acrylic]. Prefabricate the housing and deliver to the site in such a condition that the unit can be fastened in the location designated on the design drawings. Provide filter housing having the following dimensions and inlet, outlet, and system control connections:

Diameter	[_____]
Overall Height	[_____]
Inlet/Outlet	[_____] [NPT] [Flange] [ANSI 150 lb] raised face, [threaded flanges] [_____]
Body/Sump Drain	[_____] [NPT] [Flange] [_____]
Vent	[_____] [NPT] [Flange] [_____]
Gauge	[_____] [NPT] [Flange] [_____]

2.2.8.7.2 Shell O-Ring Material

Provide filter housing shell O-ring material made of [buna-n] [silicon] [neoprene] [viton-a] [ethylene] [propylene] [_____] material.

2.2.9 Sample Ports

Locate two sample ports, at a minimum, on each unit; one to sample the

influent and one to sample the effluent. Fabricate so the sample ports are readily accessible and of the manufacturer's standard design and placement.

2.2.10 Turbidimeter

****
NOTE: Delete the interface screening requirement if turbidity monitoring will not be performed at the media interface and for bag and cartridge filters.
****

Install a turbidimeter for automatically testing the turbidity of the water in the [influent line] [effluent line] [media interface] for each filter unit. Obtain [influent] [effluent] samples directly from the piping. Collect interface samples from a screen located within the media bed [_____] mm inch above the media interface. House the turbidimeter in a NEMA [4x] [12] [_____] enclosure located within [_____] from the sensor. Turbidimeter is required to be programmable to read in NTU, FTU, and engineering units and provide a measurement range from [_____] NTU to [_____] NTU.

2.2.11 Drain Line

Locate a drain line to facilitate the removal of water from the filter tank. Ensure the drain line is readily accessible and of the manufacturer's standard design and placement.

2.2.12 Chemical Feed

Provide chemical feed systems in accordance with the requirements of Section 46 30 00 WATER AND WASTEWATER CHEMICAL FEED SYSTEMS.

2.2.13 Materials Protection

Treat the interior and exterior of fabricated ferrous metal components after fabrication to prevent corrosion. Sandblast the surfaces of the filter tanks and completely factory finish paint prior to shipment. Use insulating components such as gaskets, couplings, or bushing or dielectric-type which prevent corrosion of bimetallic-type contacts, at connections between dissimilar metals.

2.2.14 Access Walkways, Platforms, Ladders And Handrails

****
NOTE: Drawings should provide for the location of access walkways, platforms, ladders and handrails.
****

Provide walkways, platforms and ladders for access to equipment for operation and maintenance in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS. Walkways and platforms are required to be nonslip open grating fabricated from [galvanized steel] [aluminum] [fiberglass] [_____]. Provide rigid handrails and kick-plates along the sides of walkways and platforms. Fabricate handrails from [galvanized steel] [aluminum] [_____], to be [_____] high, and to have two horizontal rails. Provide gates as required for access to equipment. Set the last rung of the ladder on top at the same level as the top of the tank. Ensure construction conforms to ASSP A1264.1 and ALI A14.3.

PART 3 EXECUTION

3.1 EXAMINATION

Verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

3.2.1 Fabrication

Any work not required to be performed in the field is to be performed in a factory under controlled conditions.

3.2.2 System Installation

Install the system such that proper wastewater flow through the unit and required effluent conditions as specified in Paragraphs Design Criteria or Cartridge and Bag Design Criteria (as applicable) is achieved and maintained. Perform all electrical work in accordance with the applicable requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2.3 Painting

Perform painting in accordance with applicable requirements provided in Section 09 90 00 PAINTS AND COATINGS, and additional requirements provided herein.

3.2.3.1 Metal surfaces

Paint all metal surfaces except aluminum, bronze, brass, galvanized steel, and stainless steel. Surface prepare and paint in the shop or in the field as indicated. Finish manufactured items, such as motors and switchboards, with the manufacturer's standard finish.

3.2.3.2 Preparation and Application

Prepare ferrous metal surfaces in accordance with SSPC SP 6/NACE No.3 and paint with two or three coats of MIL-DTL-24441 epoxy paint to achieve a total dry film thickness of 150 microns (6 mils). Master Painter's Institute (MPI) #120 Epoxy, High Build, Self-Priming, Low Gloss, is an acceptable replacement to MIL-DTL-24441.

3.2.3.3 Coating Testing

Examine coating for flaws and tested for thickness. Measure the thickness of coatings wet and dry using a commercial film thickness gauge. Notify the Contracting Officer in advance of any painting. Do not apply additional coats until the previous coat has been approved. Repair or add additional coats at no additional cost to the government.

3.2.3.4 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, prepare the affected area in compliance with SSPC SP 6/NACE No.3 and reapply the coating to that area. If holidays are detected or film thickness is insufficient, prepare the surface and apply additional coats in the affected area in compliance with the

manufacturer's instructions.

3.2.4 Valve And Pipe Installation

3.2.4.1 Valves

Install valves as nearly as possible in the position shown in the Contractor provided Shop Drawing. Install and support valves in their respective position free from distortion and strain on appurtenances during handling and installation. Inspect material for defects in workmanship and material. Debris and foreign material Clean out debris and foreign material from valve openings and seats; operate operating mechanisms to check their proper functioning, and check nuts and bolts for tightness. Valves and other equipment which do not operate easily or are otherwise defective are to be repaired or replaced at no additional cost.

3.2.4.2 Piping

Install piping to accurate lines and grades. Use temporary supports that are sufficiently rigid to prevent shifting or distortion of the pipe. Make provision for expansion where necessary. Pitch piping toward low points, and provide for draining at these low points. Use a sufficient number of unions or flanges allow for the dismantling of all water pipe, valves, and equipment. Install piping including cleaning, cutting, threading and jointing, in accordance with [Section 22 00 00 PLUMBING, GENERAL PURPOSE] [_____].

3.2.5 Filter Tank

3.2.5.1 Installation

Install the filter tank in accordance with the recommendations of the manufacturer and by workers experienced in the installation of this type of equipment. Check Components with corrosion protective coating and restore any damaged or abraded areas to the original or an equivalent coating.

3.2.5.2 Erection of Equipment

Properly align equipment. Turn unit to a vertical position and set in place. Set the anchor bolts in place and tighten the nuts against the shims. After the foundation alignments have been approved, bolt the stationary assembly securely in place. Check the alignment of equipment after securing to the foundations. Remove bracing and shipping from the bottom and/or interior of the tank. Connect piping as indicated. Close valves.

3.2.6 Underdrain

****

NOTE: Prefabricated package systems may have the underdrain installed. This paragraph should only be included where the underdrain is to be installed in the field.

****

Install the underdrain in accordance with approved shop drawings and requirements of the manufacturer, including instructions of the manufacturer's representative. Clean and wash the filter tank prior to

installation of the underdrain. Replace broken or defective components. Do not modify the manufacturer-supplied underdrain. Following installation, completely clean the underdrain system and wash free of loose materials and debris. Restore any damaged surfaces to the original or equivalent coating. Do not subject to internal water pressure or testing of the system for a minimum of [_____] days after completion of installation. Maintain the underdrain system in clean condition until installation of filter media.

3.2.7 Support Media

****

NOTE: The need for a supporting layer of gravel will depend on the selected underdrain. If the underdrain does not require a gravel layer, delete this paragraph. Also, delete this paragraph for traveling bridge, continuous backwash, cartridge and bag filters.

****

Provide gravel size and layer thickness as follows:

Gravel Layer	Layer Thickness	Size Limits
Bottom	[_____]	[_____]
Second	[_____]	[_____]
Third	[_____]	[_____]
[_____]	[_____]	[_____]
Top layer	[_____]	[_____]

Place the gravel by hand to avoid movement to the underdrain system and to ensure free passage of water from the underdrain. Complete each gravel layer before the next layer above is started. Remove gravel that becomes mixed and replace in layers as specified. Obtain the correct thickness of each layer as follows: Before the gravel is placed, mark the top of each layer on the side of the filter. Then level the top of each layer against a water surface held at the appropriate mark. No particles are allowed to be less than half submerged, and nowhere are places to be left where additional gravel can be placed without the particles extending more than 1/2 their volume above the water surface. Blackwash the support gravel after it has been placed, in accordance with AWWA B100.

3.2.8 Filter Media Installation

****

NOTE: Media installation may be performed by the manufacturer supplying the filter system for package treatment systems. This paragraph should be used only when the media will be installed in the field. Delete the freeboard requirement for filtration systems which do not require bed expansion during backwashing.

****

Install media under the supervision of the filter equipment supplier. Before installing the filter media, check all piping connections and ensure filter components are in good condition and proper position. Place media to the depths [required by the manufacturer] [as follows:

Media Type	Layer Thickness
Sand	[_____]
Anthracite	[_____]
[_____]	[_____]

]

Leave a minimum freeboard of [_____] between the top of the media and the top of the tank.

3.2.8.1 Media Layers

Complete each layer of media before the next layer above is started. Deposit each layer of media so as not to disturb the level surface of the layer below. Remove and replace media which is made dirty before or after placement.

3.2.8.2 Cleaning of Media

Backwash, scrape, and skim the filter media in accordance with AWWA B100 to remove excess fine material upon completion of placement of each layer. Perform the number of washes, the wash rate and duration of wash to achieve the specified gradation for each layer in accordance with the recommendations of the filter media supplier.

3.2.9 Identification Systems

3.2.9.1 Identification Tags

****

NOTE: Delete when identification tags are not considered necessary on small projects.

****

Install identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number on valves, except those valves installed on supplies at plumbing fixtures. Size tags to be 35 mm 1-3/8 inch minimum diameter, and stamp and engrave all markings. Provide black indentations, for reading clarity. Attach tags to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.2.9.2 Color Coding

****

NOTE: Color coding for piping identification as required by using agency will be developed and inserted in the Color Code Schedule in Section 09 90 00 PAINTS AND COATINGS.

****

Color code piping identification as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2.10 Vent Line Installation

****
NOTE: This paragraph only applies to cartridge and bag filters.
****

Install the vent line according to the manufacturer's standard design and placement. Locate the vent line in position to reduce system operating pressure prior to replacement of filter elements.

3.3 FIELD QUALITY CONTROL

****
NOTE: If the Contractor will be responsible for obtaining water for filter acceptance testing, such requirement should be indicated in the following paragraph.
****

Perform field tests in the presence of the Contracting Officer and provide labor, equipment, and incidentals required for the tests. Provide for disposal of all waste residuals resulting from the tests. Notify the Contracting Officer [_____] days prior to the date and time for the acceptance tests. Rectify any deficiencies found and retest any work affected by such deficiencies.

3.3.1 Initial Operation

Following completion of installation of the treatment systems and after the Contractor and manufacturer's representative agree the system is ready for operation, operate the system over an initial operating period not to exceed [_____] days. Demonstrate proper operation of the equipment, including, but not limited to, the ability of the system to produce the minimum specified effluent requirements detailed in Paragraphs Design Criteria or Cartridge and Bag Design Criteria (as applicable), proper operation of the media cleaning equipment, and the control system ability to provide the correct operational logic to optimize the filtration process.

3.3.2 Acceptance Testing

Commence acceptance testing not sooner than [_____] days and not later than [_____] days following approval of the initial operation. Demonstrate within the acceptance the ability of the filtration system to meet the specified effluent requirements when operating at the design flow rate and demonstrate the ability of the control system to provide the correct operational logic to optimize the filtration process. Conduct the tests over [_____] days of continuous operation. Collect [_____] effluent samples during each [_____] hour period. Do not take samples less than [_____] hours nor more than [_____] hours apart. Analyze the samples for [turbidity] [total suspended solids] [effluent particle size] [_____] by standard methods as described in [_____]. For the filtration system to qualify for process acceptance, the average value of each of the filtered water effluent parameters monitored during the continuous testing is required to not exceed the values of the specified parameters. In the

event that the specified filtered water quality requirements are not met during the period that acceptance testing is conducted, the defective equipment or operation must be modified or replaced and the testing repeated. The schedule for retesting is subject to approval by the Contracting Officer.

Submit test reports in booklet form showing field tests performed to adjust each component and to prove compliance with the specified performance criteria. Indicate the final position of controls in each test report.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Posting Framed Instructions

Post frame instructions containing wiring and control diagrams under glass or in laminated plastic where directed. Frame condensed operating instructions, prepared in typed form, as specified above and post beside the diagrams. Submit proposed diagrams and instruction prior to posting. Post the framed instructions before acceptance testing of the system.

3.4.2 Field Training

Provide a field training course for designated operating and maintenance staff members. Provide training for a total period of [_____] hours of normal working time and start after the system is functionally complete but prior to final acceptance test. Cover all of the items contained in the Operating and Maintenance Instructions in the field training. Ensure the instructions include, but are not necessarily limited to the following:

a. System layout showing piping, valves and controls and installation requirements.

b. Approved wiring, logic, and control diagrams prepared in accordance with ANSI/ISA 5.1 including a drawing index, legend and symbols list, and abbreviations and identifiers.

c. A control sequence describing startup, operation, and shutdown; including the functional and operational description of the control system covering the procedures for programming, operation, startup, shut-down, and calibration.

d. Operating and maintenance instructions for each piece of equipment, including checkout, troubleshooting, and servicing.

e. Manufacturer's bulletins, cut sheets and descriptive data, parts list, and recommended spare parts.

3.4.3 Operating And Maintenance Instructions

Provide operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. Include the manufacturer's name, model number, service manual, parts list, and brief description of equipment and their basic operating features in the instructions. Also, provide maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guides. Include simplified diagrams for the system as installed. Show valves numbered and tagged in the manual and provide a schematic indicating the number of each valve. Permanently bind each set

and provide with a hard cover. Inscribe the following identification on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the facility, name of the Contractor, and contract number.

-- End of Section --