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USACE / NAVFAC / AFCEC / NASA | **UFGS-46 61 00 (February 2011)**
Change 1 - 08/14

Preparing Activity: USACE | **Superseding**
UFGS-44 43 00 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

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DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

SECTION 46 61 00

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02/11, CHG 1: 08/14

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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).

****

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	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B40.100	(2013) 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	(2012) Ductile-Iron and Gray-Iron Fittings for Water
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	(2011) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

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

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2020) 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	(2016a) 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	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2020a) 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	(2016) 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	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2019) 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	(2015) 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	(2009) Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
ASTM C1147	(2014) 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	(2012) 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) Standard Specification for Elastomeric Seals (Gaskets) for Joining

Plastic Pipe

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ANSI/ISA 5.1	(2009) 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	(2017; Errata 1 2017) 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	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA MG 1	(2018) 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	(2019) Structural Engineering

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.
****

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 QUALIFICATIONS

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

1.3.1 Installer

The installer shall have a minimum of [_____] years experience in the installation of a minimum of [_____] similar filtration systems and shall show evidence of satisfactory operation for each installation.

1.3.2 Manufacturer's Representative

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 shall be present at the jobsite during installation of the filtration system.

1.3.3 Media Supplier Representative

A representative of the media supplier who is experienced in the installation of the specified filtration media shall be present at the jobsite during media installation.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 EXTRA MATERIALS

Standard spare parts shall be provided 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.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a [pressure] [continuous backwash] [traveling bridge] [cartridge]

[bag] filtration system. The filtration system shall be designed, constructed, and installed 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 [will] [will not] be allowed to enhance the filtration system. The installation shall be constructed [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 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.

****

Recyclable materials shall conform to EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

2.2.1 Standard Products

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

2.2.2 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.

2.2.3 Protection of Moving Parts

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

2.2.4 Special Tools

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

2.2.5 Steel Plates, Shapes and Bars

ASTM A36/A36M.

2.2.6 Pipe and Fittings

Pipe and fittings shall conform to the standards specified below.

2.2.6.1 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.

2.2.6.2 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.

2.2.6.3 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.

2.2.6.4 Polyvinyl Chloride (PVC) Pipe

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

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

b. Solvent Cement: ASTM D2564.

2.2.7 Pipe Hangers and Supports

MSS SP-58.

2.2.8 Valves

2.2.8.1 Steel Valves

ASTM A216/A216M, Grade WCB.

2.2.8.2 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.

2.2.8.3 PVC Valves

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

2.2.9 Other Materials

2.2.9.1 Polypropylene Support Material

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

ASTM C1147.

2.2.9.2 Joint Compound

Joint compound for threaded joints shall be a stiff mixture of graphite and oil, inert filler and oil, or a graphite compound.

2.2.9.3 Joint Tape

Joint tape for threaded joints shall comply with ASTM D3308.

2.3 ELECTRICAL EQUIPMENT

2.3.1 Electrical Work

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

2.3.2 Electric Motors

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

2.3.3 Motor Controls

Controls shall conform to NEMA ICS 1.

2.3.4 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.
****

2.3.4.1 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. Schematics and interconnection wiring diagrams for power, control, and instrumentation circuits shall be provided to equipment specified. Terminal blocks (plus 25 percent spare terminals) shall be provided in panels to terminate field and interconnection wiring.

2.3.4.2 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. Conduit wiring between control panels and control devices shall be furnished 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. No "typical" wiring diagrams will be acceptable and no tables or charts to describe wire numbers will be acceptable. Wires shall be labeled 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 shall 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.

2.3.5 Remote Alarm and Process Variable Monitoring

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NOTE: Coordination with remote systems, such as Supervisory Control and Data Acquisition (SCADA) System and annunciators, shall be specified in this paragraph and shall 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 shall be deleted.

****

2.3.6 Bolts, Nuts, Anchors, and Washers

Bolts, nuts, anchors, and washers shall be steel, galvanized in accordance with ASTM A153/A153M.

2.3.7 Valves

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

2.3.8 Pumps

Pump shall be supplied where insufficient head is available to move the [influent] [effluent] [backwash] [wash] water. The pump shall comply with the requirements of Section 23 21 23 HYDRONIC PUMPS.

2.3.9 Air Compressors

Air compressors shall be supplied in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.3.10 Pressure Gauges

Gauge sizes and scale ranges shall be as shown or scheduled on the Contract Drawings. Gauges shall comply with ASME B40.100 Type 2A, as a minimum. Compound gauges shall be provided on the suction side of pumps and standard pressure gauge on the discharge side of pumps. Gauges shall have clear acrylic or shatterproof glass windows and shock-resistant cases. The design operations should be at the midpoint of the graduated scale. Major divisions shall be equally spaced and shall be in whole integers. Scale units shall be engraved on the scale face. Pointer travel shall not be less than 200 degrees nor more than 270 degrees arc. Gauge accuracy shall be plus or minus 0.5 percent of span. Each gauge, except those for hydraulic systems, shall have a process shutoff valve.

2.3.11 Gauge Panel

A gauge panel shall be provided on which [1] [2] [_____] nominal pressure gauges to sense unit inlet and outlet pressures and [1] [2] [_____] pressure switch shall be mounted. The pressure sensor switch shall be wired 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].

2.3.12 Tank Requirements

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

****

2.3.12.1 Parameters

Tanks specified shall be provided in accordance with the following general requirements, unless otherwise indicated. Each tank shall include flanged fittings for inlet, outlet, overflow and drain. The size, elevation and orientation shall be provided in accordance with construction drawings. Hold down lugs shall be provided to anchor the tank to the base.

2.3.12.2 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.).

****

The tank construction material shall be compatible with the material to be handled. Tanks constructed of polyethylene, polypropylene, and fiberglass reinforced plastic (FRP) shall conform to applicable material and

construction provisions of ASTM C582, ASTM D3299, and ASTM D4097. Tanks constructed of steel shall conform with applicable material and construction provisions of AWWA D100. Carbon steel tanks shall be fabricated 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. Stainless steel tanks shall be fabricated of Type 304 stainless steel conforming to ASTM A167 with structural support conforming to ASTM A276/A276M. Exterior painting or coating shall be provided in accordance with Paragraph PAINTING.

2.3.12.3 Site Glasses

A [_____] mm inch diameter observation port shall be provided in the tank wall. The observation port shall be located [at the surface of the filter media] [at the media interface] [_____].

2.4 MEDIA

Filter materials shall conform to the requirements of AWWA B100. Sieve analysis shall be performed in accordance with ASTM C136/C136M and AWWA B100. Specific gravity shall be determined 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.

2.4.1 High-Density Sand

The high-density sand shall be [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 [_____]. Ninety-five percent shall be larger than or equal to [_____].

2.4.2 Silica Sand

The silica sand shall have an effective size between [_____] and [_____], uniformity coefficient less than or equal to [_____], and a specific gravity of [2.55] [2.60] [2.65] [_____]. Ninety-five percent shall be larger than or equal to [_____].

2.4.3 Anthracite Coal

The anthracite coal shall have a specific gravity of [1.45] [1.50] [1.55] [1.73] [_____], uniformity coefficient of [_____], and an effective size between [_____] and [_____]. Ninety-five percent shall be larger than or equal to [_____]. The anthracite media shall be clean and free from thin or scaly pieces, and shall have a calcium carbonate and magnesium carbonate hardness of [_____].

2.4.4 Support Media

The support gravel shall consist of hard, rounded stones with an average specific gravity of not less than [_____]. Not more than [_____] percent by weight shall have a specific gravity of [_____] or less. The gravel shall contain 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 shall be free from shale, mica, clay, sand, loam, and organic impurities of any kind.

2.5 CONTINUOUS BACKWASH FILTRATION SYSTEM

2.5.1 Equipment Capacity

Each unit shall be 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.

2.5.2 Filter Tank

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NOTE: Provide seismic details if a Government designer (either Corps 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.

****

The filter tank shall be a cylindrical, sloped-bottom tank with the dimensions shown and shall be of [epoxy coated carbon steel] [type 304 stainless steel] [fiberglass reinforced plastic] [_____] construction, free from physical imperfections. The tank shall be constructed with a minimum number of pieces. Minimum thickness of metal parts exposed to the water shall be [_____]. The tank shall be fitted with lifting lugs to facilitate handling and placement. The filter tank shall have sufficient support to withstand wind speed in excess of [_____] km/hour mph and designed for seismic forces in accordance with UFC 3-301-01 and Sections 13 48 73 SEISMIC CONTROL FOR MECHANICAL EQUIPMENT and 23 05 48.19 [SEISMIC] BRACING FOR HVAC [as shown on the drawings]..

2.5.3 Filter Media

Filter media shall be silica sand. Total depth of filtration media shall be [_____] m feet. All media shall conform to the requirements of AWWA B100.

2.5.4 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.

****

The influent dosing system shall deliver the influent stream uniformly over the entire media bed. The influent water shall be introduced to the [bottom] [top] of the filter tank. All components of the dosing system shall be constructed of [stainless steel] [fiberglass reinforced plastic] [_____].

2.5.5 Effluent Collection System

The effluent shall be collected by [discharge of filtrate overflow over an effluent weir constructed of [stainless steel] [fiberglass reinforced

plastic] [_____] and being placed and having dimensions 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. The screen shall be constructed of stainless steel trapezoidal bars having an opening smaller than the finest media grain. The effluent collection system shall be configured and have the dimensions as shown on the Construction Drawings.] [_____] effluent shall be discharged through a [_____] mm inch diameter [stainless steel] [fiberglass reinforced] [_____] pipe.

2.5.6 Media Cleaning System

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

2.5.6.1 Sand Lift

The sand lift shall consist of [Type 304] [Type 304L] stainless steel eductor pipe. The pipe shall be [externally] [internally] mounted and fixed [by welding] [by means of a [_____] ANSI gasketed flange] [_____] to the filter vessel. Compressed air shall be supplied at [_____] to [_____] cubic meters cubic feet per minute at [_____] Pa psig to the eductor pipe. The suction rate shall be sufficient to result in internal recycling of the media once every [_____] hours.

2.5.6.2 Sand Washer

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

****

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

2.5.6.3 Sand Distribution Equipment

The cleaned sand shall be returned 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. The sand shall be returned so that the media will distribute evenly in a cone on top of the media bed.

2.5.6.4 Reject Collection System

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

2.5.7 Effluent Rate Control

Filter operation shall be controlled by the liquid level in the filter tank using a proportional, displacer-type liquid level sensor. An automatic effluent control [globe] [ball] [_____] valve shall be provided with a pneumatic positioner which shall regulate the degree of opening in response to a [_____] to [_____] pneumatic signal. An increase in signal air pressure shall increase the degree of valve opening. Flow control system shall be self-contained and shall not require manual adjustments.

2.5.7.1 Pneumatic Controls

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

2.5.7.2 Headloss Switch

A headloss switch shall be supplied to signal when the media bed is beginning to foul. The switch contacts shall be rated at [_____] amps and shall be connected to [an alarm] [process controls] [purge valve] [_____].

2.5.8 Equipment Control Panel

The equipment manufacturer shall 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 shall provide 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.

2.5.9 Flowmeters

Influent and effluent lines shall be equipped with [kennison nozzle] [parshall flume] [shuntflo steam] [sonic] [_____] flowmeters.

2.6 TRAVELING BRIDGE FILTER

2.6.1 Tank

The tank shall be [_____] wide by [_____] long by [_____] deep and be constructed of [_____] thick [mild steel] [carbon steel] [_____]. The assembled tank shall be constructed to allow loading and unloading as a unit and shall be equipped with lifting lugs. Integral supports shall be furnished so that the body of the tank, when installed, will be [_____] mm inches above the concrete slab. The placement of the supports shall allow for full inspection of the underside of the tank. Tank shall be constructed in accordance with Paragraph Tank Requirements and prepared in accordance with the requirements of Paragraph PAINTING and Paragraph MATERIALS PROTECTION.

2.6.2 Filter Bed

2.6.2.1 Cell Dividers

The filter bed shall be [_____] wide by [_____] long and shall consist of a series of self-supporting lateral partitions (cell dividers) which shall divide the filter into a multitude of [_____] wide compartments. Each compartment shall be arranged for connection to a separate backwash port. The divider sheets shall be fabricated of [glass fiber reinforced plastic binder] [Type 304 stainless steel] [_____] with a finished thickness of [_____]. The divider sheets shall be without voids and/or air pockets. Cell sheets shall not twist, curve or bend.

2.6.2.2 Porous Plate

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

2.6.3 Voids Distribution

The media shall provide uniform voids distribution from coarse to fine in the direction of flow. All filter materials shall conform to the requirements of AWWA B100.

2.6.4 Rails

[_____] kg lb ASCE rails with stainless steel splice plates and hardware shall be mounted on the two main filter walls. Type 304 stainless steel caps shall be factory installed on each rail. Carriage rail stops of 300 Series stainless steel shall be installed and field adjusted by a factory service engineer.

2.6.5 Carriage Mechanism

2.6.5.1 Carriage Frame

The traveling carriage or bridge system shall contain and support the [positive drive mechanism] [pumps] [automatic backwash system] [washwater removal system] [motors] [limit switches] [_____]. The carriage frame shall be of welded steel construction. A separate maintenance platform shall be provided.

2.6.5.2 Carriage Drive

The carriage drive unit shall consist 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. The drive unit shall be designed so that a torque limiting device is not required and shall have a strength of [_____]. The gear reducers shall be AGRA approved. The drive shaft shall be of sufficient size to adequately and safely withstand bending and

torsional loads of starting and operating. Gearing shall be fully enclosed in an oil-tight cast iron housing with the gears running in oil and bearings of anti-friction type.

2.6.5.3 Carriage Wheels

The wheels shall be double flanged, hardened Type 304 stainless steel. Bearings shall be self aligning and shall have lubrication fittings. Wheels shall be capable of compensating for minor misalignment of rails by sliding on the shaft. Horizontally mounted wheels within the tank shall not be used to align the carriage; caster-type wheels shall not be used.

2.6.6 Automatic Backwash System

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

A fabricated backwash support frame shall be attached to the traveling carriage on the effluent chamber side. Adjustable stainless steel compression springs mounted between the carriage weldment and the backwash frame shall be furnished to allow adjustment of the backwash valve from outside the tank while the filter is in use. A backwash shoe shall be mounted on the frame that can independently follow any irregularities of the matching backwash surface along the effluent ports. The shoe shall be constructed of a material softer than the mating backwash surface (strip). The shoe flexible movement shall be controlled by 300 series stainless steel springs. The shoe shall attach to the piping by means of a flexible hose. The piping shall connect to the backwash pump and shall include a throttle valve to achieve the correct pumping rate. The backwash surface (strip) shall be factory bolted to the effluent header by means of countersunk Type 304 stainless steel fasteners.

2.6.7 Washwater Removal System

The washwater hood shall be fabricated from [[304] [316L] stainless steel] [fiberglass reinforced plastic] [_____]. The hood shall permit the uniform expansion of the filter media. The hood width shall be [_____] times the cell width. A [stainless steel] [PVC] [_____] manifold shall be installed in the upper portion of the washwater hood and shall connect to the washwater pump. The washwater hood shall contain a [high density polyethylene] [304 stainless steel] [_____] raking device and a minimum of two vent pipes extending to [_____] above the overflow weir.

2.6.8 Washwater Launders

The washwater launders shall be constructed from [_____] mm inch [A36 steel] [fiberglass reinforced plastic] [_____] with a [_____] mm inch depth and [_____] mm inch width and be an integral part of the filter tank wall. Both backwash and washwater pumping systems shall be capable of discharging into the launder. A "V" notch weir plate shall be provided to calibrate and balance the flow of the washwater pumping system.

2.6.9 Equipment Control

2.6.9.1 Automatic Controls

The automatic controls for the filter operation shall be furnished as an

integral part of the carriage mechanism. The automatic controls shall be mounted on the end of the filter tank. The carriage mechanism and attaching components shall be factory assembled and tested for mechanical and electrical operation prior to shipment.

2.6.9.2 Control Panel

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

2.6.9.3 Motors

Controls, a timing device, relays and magnetic motor starters for each pump motor and carriage motor shall be included in the panel. These motors may be actuated automatically by a predetermined increase in hydraulic head, or by the timing device to control the interval between each cleaning cycle. [The cleaning cycle shall be terminated by a signal from the low water sensing electrode. The "off time" of the cleaning cycle shall be controlled by a reset timer with a range of 1 minute to 60 hours. When the timer times out, the motors shall be actuated. During the "on time", the timer shall be de-energized and reset for starting "off time" at the end of the cycle. Should high water occur "off time", the motors shall be started by a relay actuated from the high water electrode signal, with a corresponding resetting of the timer.] [The washing cycle, when activated, shall continue for one complete pass of the filter bed. Under normal operation, the carriage shall not come to rest other than at either end of the filter.]

2.6.9.4 Backwash Mechanism

The control sequence for the backwash mechanism shall be wired so the backwash mechanism stops at either end of the filter upon termination of the backwash cycle, which will be at the low operating probe signal. A low water shutoff probe shall prevent pumping the filter tank below the minimum water level point. Additional electrodes shall be furnished to protect the submersible pumps by giving a signal prior to reaching the overflow point.

2.6.9.5 Electrification System

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

2.6.9.6 Factory Tests

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

2.6.10 Auxiliary Equipment

2.6.10.1 Pumps

The backwash and washwater systems shall each be powered by a submersible pump suspended from the filter carriage. Only dual submersible pumps will be acceptable. Each pump shall provide a minimum pumping rate of [_____] at a head of [_____]. The pumps shall be equipped with stainless steel shafts, and abrasive-resistant impellers. Pumps shall be supplied in accordance with the requirements of Section 23 21 23 HYDRONIC PUMPS.

2.6.10.2 Weirs

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

2.6.10.3 Backwash Channel and Washwater Trough

The bottom surface of the washwater trough shall be at least [_____] m feet above the overflow weir. The backwash channel shall be constructed of [stainless steel] [fiberglass reinforced plastic] [_____]. A tank drain shall be provided in the backwash channel.

2.7 PRESSURE FILTERS

2.7.1 Pressure Filter Tank

****

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

****

The pressure filter tank shall have a diameter of [_____] m feet, a height of [_____] m feet, straight shell length of [_____] m feet and shall be oriented [horizontally] [vertically]. Each vessel shall be provided with [_____] partition wall to divide the vessel into [_____] filter cells. The filter vessels shall be of welded steel construction and shall be tested to withstand a hydrostatic pressure of [_____] Pa psi in excess of the working pressure of [_____] Pa psi. The vessel shall be designed and fabricated in accordance with the ASME BPVC SEC VIII D1 and shall be so stamped and certified. Lifting lugs, supports, connections and appurtenances shall be as detailed on the drawings. The filter tank construction shall be in accordance with Paragraph Tank Requirements and

prepared in accordance with the requirements of Paragraph PAINTING and Paragraph MATERIALS PROTECTION.

2.7.2 Underdrain System

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

2.7.3 Pressure Filters Media

The media shall provide uniform voids distribution from coarse to fine in the direction of flow. Filter materials shall conform to the requirements of AWWA B100.

2.7.4 Distributor/Collector

Each filter shall be provided with an influent distributor/backwash collector of the [central manifold] [lateral arm] [_____] type. The influent distributor and waste water collector shall be fabricated as an integral part of the filter tank. The system shall be constructed from [steel] [aluminum] [fiberglass] [_____] of the manufacturer's standard design.

2.7.5 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.

****

Each filter shall be provided with a [straight line] [S-shaped] [_____], [single] [double] arm [rotary] [fixed] agitator constructed of [stainless steel] [brass-bronze] [_____] components. Design of the agitator shall create the most efficient degree of agitation to all portions of the filter. Each agitator shall be 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.

2.7.6 Air Scour System

2.7.6.1 Air Wash Distribution

Each tank shall be provided with a separate air wash distributor. The distributor shall consist of a [brass] [red brass] [_____], [_____] mm inch air header with [_____] mm inch slotted [brass] [red brass] laterals on approximately [_____] mm inch center. [Air shall be introduced to the media bed through the underdrain system.] [Air shall be introduced at the top of the [gravel support layer] [underdrain].] Allowable headloss up the wall of the filter shall be [_____] L per minute per square meter cubic

feet per minute per square foot at [_____] mm inch of water column.

2.7.6.2 Air Blower

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

2.7.7 Equipment Control

2.7.7.1 Control Valves

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

2.7.7.2 Effluent Rate Controllers

Each filter shall be provided with an effluent rate of flow controller consisting of a [flanged venturi tube] [butterfly valve] [electronic differential pressure transmitter] [_____].

2.7.7.3 Backwash Controller

One backwash rate of flow controller shall be provided. The backwash rate of flow controller shall consist of a [flanged venturi tube] [butterfly valve] [electronic differential pressure transmitter] [_____].

2.7.8 Equipment Control Panel

A control panel with a NEMA [4X] [12] [_____] enclosure shall be supplied to contain all necessary timers, lights, contact switches, internal wiring, etc. and associated equipment to allow for the completely automatic operation of the system. The control panel shall provide for [automatically starting and stopping pumps] [manual operation of the control valves] [[manual] [automatic] [_____] backwash initiation] [_____]. Backwash initiation shall be triggered by [elapsed time] [high head loss] [high turbidity] [manual initiation] [_____]. The panel shall be completely assembled, wired, and tested at the factory prior to shipment. The panel shall be provided with required switches for manual operation should it be required.

2.7.9 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.

****

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

2.8 CARTRIDGE FILTER

2.8.1 Equipment Capacity

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

2.8.2 Filter Material

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

2.8.3 Cartridge Style

The cartridge style shall be of [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].

2.8.4 Gasket or O-Ring Material

The gasket or O-ring material shall be [silicone] [buna-n] [white silicone] [white buna-n] [viton-a] [EPDM] [teflon].

2.8.5 Pore Size/Rating

The filter pore size shall be [0.1] [0.2] [0.45] [1] [3] [10] [30] [50] [75] [100] [200] [_____] microns.

2.8.6 Filter Cartridge Dimensions

The filter cartridge shall be the standard length of 250 mm 10 inch. The cartridge inside diameter shall be [_____]. The cartridge outside diameter shall be [_____].

2.8.7 Core Material

Cartridge core material shall be [tinned steel] [polypropylene] [304 stainless steel] [316 stainless steel] [_____].

2.8.8 Filter Housing

2.8.8.1 Material of Construction

****

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

****

The filter housing head, shell, and associated internal and external connections and internal and external hardware shall be constructed of [304 stainless steel] [316 stainless steel] [carbon steel] [teflon] [polypropylene] [fiberglass reinforced plastic] [acrylic]. The housing

shall be prefabricated and delivered to the site in such a condition that the unit can be fastened in the location designated on the design drawings. The filter housing shall have 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] [_____]

2.8.8.2 Shell O-Ring Material

The filter housing shell O-ring material shall be [buna-n] [silicon] [neoprene] [viton-a] [ethylene] [propylene] [_____].

2.9 BAG FILTER

2.9.1 Equipment Capacity

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

2.9.2 Filter Material

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

2.9.3 Gasket Material

A single gasket cover seal for each bag element shall be provided. The material of construction shall be [silicone] [buna-n] [white silicone] [white buna-n] [viton-a] [EPDM] [teflon].

2.9.4 Pore Size/Rating

The bag pore size shall be [0.1] [0.2] [0.45] [1] [3] [10] [30] [50] [75] [100] [200] [_____] microns.

2.9.5 Bag Surface Area

The bag surface area shall be [_____].

2.9.6 Bag Support

Support material shall be [tinned steel] [polypropylene] [304 stainless

steel] [316 stainless steel] [_____].

2.9.7 Filter Housing

2.9.7.1 Material of Construction

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

The filter housing head, shell, and associated internal and external connections and internal and external hardware shall be constructed of [304 stainless steel] [316 stainless steel] [carbon steel] [teflon] [polypropylene] [fiberglass reinforced plastic] [acrylic]. The housing shall be prefabricated and delivered to the site in such a condition that the unit can be fastened in the location designated on the design drawings. The filter housing shall have 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] [_____]

2.9.7.2 Shell O-Ring Material

The filter housing shell O-ring material shall be [buna-n] [silicon] [neoprene] [viton-a] [ethylene] [propylene] [_____].

2.10 SAMPLE PORTS

Two sample ports, at a minimum, shall be located on each unit; one to sample the influent and one to sample the effluent. The sample ports shall be readily accessible and shall be of the manufacturer's standard design and placement.

2.11 TURBIDIMETER

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

A turbidimeter for automatically testing the turbidity of the water shall be installed in the [influent line] [effluent line] [media interface] for

each filter unit. The [influent] [effluent] sample shall be obtained directly from the piping. The interface sample shall be collected from a screen located within the media bed [_____] mm inch above the media interface. The turbidimeter shall be housed in a NEMA [4x] [12] [_____] enclosure and located within [_____] from the sensor. It shall be programmable to read in NTU, FTU, and engineering units. The measurement range shall be from [_____] NTU to [_____] NTU.

2.12 DRAIN LINE

A drain line shall be located to facilitate the removal of water from the filter tank. The drain line shall be readily accessible and shall be of the manufacturer's standard design and placement.

2.13 CHEMICAL FEED

Chemical feed systems shall be in accordance with the requirements of Section 46 30 00 WATER AND WASTEWATER CHEMICAL FEED SYSTEMS.

2.14 MATERIALS PROTECTION

The interior and exterior of fabricated ferrous metal components shall be treated after fabrication to prevent corrosion. The surfaces of the filter tanks shall be sandblasted and completely factory finish painted prior to shipment. Insulating components such as gaskets, couplings, or bushing or dielectric-type which will prevent corrosion of bimetallic-type contacts, shall be used at connections between dissimilar metals.

2.15 ACCESS WALKWAYS, PLATFORMS, LADDERS AND HANDRAILS

****

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

****

Walkways, platforms and ladders shall be provided for access to equipment for operation and maintenance in accordance with Section 08 31 00 ACCESS DOORS AND PANELS. Walkways and platforms shall be nonslip open grating fabricated from [galvanized steel] [aluminum] [fiberglass] [_____]. Rigid handrails and kick-plates shall be provided along the sides of walkways and platforms. Handrails shall be fabricated from [galvanized steel] [aluminum] [_____], shall be [_____] high, and shall have two horizontal rails. Gates shall be provided as required for access to equipment. The last rung of the ladder on top shall be at the same level as the top of the tank. Construction shall conform 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 PREPARATION

3.2.1 Fabrication

Work not required to be performed in the field shall be performed in a factory under controlled conditions.

3.2.2 System Installation

The system shall be installed 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) will be achieved and maintained. Electrical work shall be in accordance with the applicable requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.3 PAINTING

Painting shall be performed in accordance with applicable requirements provided in Section 09 90 00 PAINTS AND COATINGS, and additional requirements provided herein.

3.3.1 Metal surfaces

Me, except aluminum, bronze, brass, galvanized steel, and stainless steel shall be painted. Surface preparation and painting shall be performed in the shop or in the field as indicated. Manufactured items, such as motors and switchboards, shall be finished with the manufacturer's standard finish.

3.3.2 Preparation and Application

Ferrous metal surfaces shall be prepared in accordance with SSPC SP 6/NACE No.3 and painted 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.

3.3.3 Coating Testing

Coating shall be examined for flaws and tested for thickness. Thickness of coatings shall be measured wet and dry using a commercial film thickness gauge. The Contracting Officer shall be notified in advance of any painting. Additional coats shall not be applied until the previous coat has been approved. Repair or additional coats shall be accomplished at no additional cost to the government.

3.3.4 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair shall consist of preparing the affected area in compliance with SSPC SP 6/NACE No.3 and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, the surface shall be prepared and additional coats applied in the affected area in compliance with the manufacturer's instructions.

3.4 VALVE AND PIPE INSTALLATION

3.4.1 Valves

Valves shall be installed as nearly as possible in the position shown. Valves shall be erected and supported in their respective position free from distortion and strain on appurtenances during handling and installation. Material shall be inspected for defects in workmanship and material. Debris and foreign material shall be cleaned out of valve openings and seats; operating mechanisms shall be operated to check their

proper functioning, and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced.

3.4.2 Piping

Piping shall be installed to accurate lines and grades. Where temporary supports are used they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Provision shall be made for expansion where necessary. Piping shall pitch toward low points, and provision shall be made for draining these low points. A sufficient number of unions or flanges shall be used to allow for the dismantling of all water pipe, valves, and equipments. Installation of piping including cleaning, cutting, threading and jointing, shall be in accordance with [Section 22 00 00 PLUMBING, GENERAL PURPOSE] [_____].

3.5 FILTER TANK

3.5.1 Installation

The filter tank shall be installed in accordance with the recommendations of the manufacturer and by workers experienced in the installation of this type of equipment. Components with corrosion protective coating shall be checked and any damaged or abraded areas shall be restored to the original or an equivalent coating.

3.5.2 Erection of Equipment

Equipment shall be properly aligned. The unit shall be turned to a vertical position and set in place. The anchor bolts shall be set in place and the nuts tightened against the shims. After the foundation alignments have been approved, the stationary assembly shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations. Bracing and shipping support shall be removed from the bottom and/or interior of the tank. Piping shall be connected as indicated. Valves shall be closed.

3.6 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.

****

The underdrain shall be installed in accordance with approved shop drawings and requirements of the manufacturer, including instructions of the manufacturer's representative. The filter tank shall be cleaned and washed prior to installation of the underdrain. Broken or defective components shall be replaced. The manufacturer-supplied underdrain shall not be modified. Following installation, the underdrain system shall be completely cleaned and washed free of loose materials and debris. Any damaged surfaces shall be restored to the original or equivalent coating. Internal water pressure or testing of the system shall not be performed for a minimum of [_____] days after completion of installation. The underdrain system shall be maintained in clean condition until installation of filter media.

3.7 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.

****

Gravel size and layer thickness shall be as follows:

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

The gravel shall be placed by hand to avoid movement to the underdrain system and to ensure free passage of water from the underdrain. Each gravel layer shall be completed before the next layer above is started. Gravel that becomes mixed shall be removed and shall be replaced in layers as specified. The correct thickness of each layer shall be obtained as follows: Before the gravel is placed, the top of each layer shall be marked on the side of the filter. Then the top of each layer shall be leveled against a water surface held at the appropriate mark. None of the particles shall be less than half submerged, and there shall be no places where additional gravel can be placed without the particles extending more than 1/2 their volume above the water surface. The support gravel shall be backwashed after it has been placed, in accordance with AWWA B100.

3.8 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.

****

Media shall be installed 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. Media shall be placed to the depths [required by the manufacturer] [as follows:

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

]

A minimum freeboard of [_____] shall be left between the top of the media and the top of the tank.

3.8.1 Media Layers

Each layer of media shall be completed before the next layer above is started. Each layer of media shall be deposited so as not to disturb the level surface of the layer below. Any media which is made dirty before or after placement shall be removed and replaced.

3.8.2 Cleaning of Media

The filter media shall be backwashed, scraped, and skimmed in accordance with AWWA B100 to remove excess fine material upon completion of placement of each layer. The number of washes, the wash rate and duration of wash required to achieve the specified gradation for each layer shall be in accordance with the recommendations of the filter media supplier.

3.9 IDENTIFICATION SYSTEMS

3.9.1 Identification Tags

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

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.9.2 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 coding for piping identification shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.10 VENT LINE INSTALLATION

****

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

The vent line shall be installed according to the manufacturer's standard design and placement. The vent line shall be located in position to reduce system operating pressure prior to replacement of filter elements.

3.11 POSTING FRAMED INSTRUCTIONS

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

3.12 FIELD TESTS AND INSPECTIONS

****
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. Any deficiencies found shall be rectified and work affected by such deficiencies shall be retested.

3.12.1 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, the system shall be operated 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.

3.12.2 Acceptance Testing

Acceptance testing shall commence not sooner then [_____] days and not later than [_____] days following approval of the initial operation. The acceptance tests shall demonstrate the ability of the filtration system to meet the effluent specified requirements when operating at the design flow rate and to demonstrate the control system ability to provide the correct operational logic to optimize the filtration process. The tests shall be conducted over [_____] days of continuous operation. [_____] effluent samples shall be collected during each [_____] hour period. Samples shall be taken not less than [_____] hours nor more than [_____] hours apart. The samples shall be analyzed 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 shall 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 shall 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. Each test report shall indicate the final position of controls.

3.13 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of [_____] hours of normal working time and shall start after the system is functionally complete but prior to final acceptance test. Field training shall cover all of the items contained in the Operating and Maintenance Instructions. The instructions shall include, but shall not be 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.

3.14 OPERATING AND MAINTENANCE INSTRUCTIONS

Provide operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of equipment and their basic operating features. Also, provide maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guides. The instructions shall include simplified diagrams for the system as installed. The manual shall require valves be numbered and tagged and shall provide a schematic indicating the number of each valve. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed 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 --