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USACE / NAVFAC / AFCEA / NASA UFGS-23 22 23 (August 2008)  
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Preparing Activity: NASA Superseding  
UFGS-23 22 00.00 40 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2008

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08/08

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### SECTION 23 22 23

#### STEAM CONDENSATE PUMPS 08/08

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NOTE: This specification covers the requirements for condensate return pump units and condensate steam pumps. Delete, select or rewrite any of the following paragraphs as required by project conditions.

This specification includes units to indicated equivalent direct radiation (edr) with discharge pressures of up to 60 pounds per square inch, gage 450 kilopascal.

Motors are covered in Section 26 60 13.00 40 LOW-VOLTAGE MOTORS.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS 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 RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

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

ASME INTERNATIONAL (ASME)

ASME BPVC SEC VIII D1 (2007; Addenda 2008) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

HYDRAULIC INSTITUTE (HI)

HI M100 (2005) Complete Set of Centrifugal, Reciprocating, Rotary and Vertical Centrifugal/Vertical Pump Standards

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1 (2003; Corrigendum 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerance - International Restrictions

ISO 2858 (1975) End Suction Centrifugal Pump (Rating 16 Bar) Designation Nominal Duty Point and Dimensions - International Restrictions

ISO 5199 (2002) Technical Specifications for Centrifugal Pumps, Class II

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2007) Standard for Motors and Generators

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 to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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

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

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

#### SD-02 Shop Drawings

Submit the following in accordance with paragraph entitled, "General Requirements," of this section.

Connection Diagrams  
Control Diagrams  
Fabrication Drawings  
Installation Drawings

#### SD-03 Product Data

Submit Manufacturer's catalog data for condensate pumps showing equipment foundation data and equipment and performance data including performance curves and indicating brake power, head (liter per minute) (gpm), and NPSH.

#### SD-06 Test Reports

Ensure test reports for condensate pumps consist of pump flow capacity tests in accordance with the paragraph entitled,

"Testing," of this section.

Pump Flow Capacity Tests  
Efficiency Tests  
Vibration Tests

#### SD-07 Certificates

Listing of product installations for the following items shall include identification of five installed units similar to those proposed for use, that have been in successful service for a minimum period of five years. Include within list, purchaser, address of installation, service organization, and date of installation.

Condensate Return Pump Units  
Condensate Receiver  
Reciprocating Steam Pumps

Submit certificates for the following items showing conformance with the referenced standards contained in this section.

Condensate Return Pump Units  
Condensate Receiver  
Reciprocating Steam Pumps

### 1.3 GENERAL REQUIREMENTS

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NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted. If Section 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT is not included in the project specification, applicable requirements therefrom should be inserted and the second paragraph deleted. If Section 26 60 13.00 40 LOW-VOLTAGE MOTORS is not included in the project specification, applicable requirements therefrom should be inserted and the third paragraph deleted.  
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[Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.]

[Section 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT applies to work specified in this section.]

[Section 26 60 13.00 40 LOW-VOLTAGE MOTORS applies to this section.]

Connection Diagrams for condensate pumps shall show details of cable and motor connections.

Submit Control Diagrams for condensate pumps showing motor starters, relays, or any other component necessary for safe operation.

Fabrication Drawings for condensate pumps shall indicate size, type, and

efficiency rating.

Ensure [Installation Drawings](#) for condensate pumps are in accordance with the manufacturer's recommended instructions.

Submit Manufacturer's catalog data for condensate pumps showing equipment foundation data and equipment and performance data including performance curves and indicating brake power, head ([liter per minute](#)) ([gpm](#)), and NPSH.

#### 1.3.1 Factory Tests

The manufacturer shall test the pump and submit prior to shipment of the finished pump the following test data:

[Pump Flow Capacity Tests](#) - Pump flow shall conform to requirements listed in accordance with paragraph entitled, "CONDENSATE-RETURN PUMP UNITS," of this section.

[Efficiency Tests](#) - Pump efficiency shall conform to the approved design documents.

[Vibration Tests](#) - Vibration tests shall conform to requirements listed in accordance with paragraph entitled, "TESTING," of this section.

### PART 2 PRODUCTS

#### 2.1 [CONDENSATE RETURN PUMP UNITS](#)

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NOTE: Revise part title as necessary to include pump number series.

Drawing schedules should indicate data selected from the following to completely define the grimp (grp) low-pressure systems:

<a href="#">Nominal Equivalent Direct Radiation Square Feet</a>	<a href="#">Pump Capacity GPM</a>	<a href="#">Approximate Gallons Stored Between Start/Stop</a>	<a href="#">Storage Capacity Gal</a>
1,000	1.5	1.0	10
2,000	3.0	1.5	10
4,000	6.0	4.5	14
6,000	9.0	4.5	14
8,000	12.0	6.5	16
10,000	15.0	7.5	25
15,000	22.5	11.25	30
20,000	30.0	15.0	35

25,000	37.5	18.75	40
30,000	45.0	22.5	45
40,000	60.0	30.0	50
50,000	75.0	37.5	60
75,000	112.5	56.25	80
100,000	150.0	75.0	150

**Nominal  
Equivalent**

<b>Direct Radiation Square Metre</b>	<b>Pump Capacity Litres Per Minute</b>	<b>Approximate Gallons Stored Between Start/Stop</b>	<b>Storage Capacity Litres</b>
93	5.7	3.79	38
186	11.4	5.68	38
372	22.7	17.03	53
557	34.1	17.03	53
744	45.4	24.61	61
930	56.8	28.39	95
1394	85.2	42.59	114
1858	113.6	56.78	133
2322	41.9	70.98	151
2787	170.3	85.17	170
3716	227.1	113.56	189
4645	283.9	141.95	227
6968	425.8	212.93	303
9300	567.8	283.91	568

Units should be selected to handle a minimum of three times the normal condensate from the system. Normal condensate means, for the purposes of this specification, 1/4 pound per hour per square foot 6 kilogram per square meter per hour equivalent direct radiation (edr) or 0.5 Gallon per minute per 1,000 square feet 2 liter per minute per 100 square meter edr except when small boilers are involved. Discharge pressures and pump revolutions per minute should be indicated.

Receiver capacity should be indicated as nominal.

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NOTE: Pump and Motor balance shall conform to ISO Std. 1940/1 - (1986) Balance Quality Requirements of Rigid Rotors - Determination of Permissible Residual Unbalance unless otherwise noted. Motor vibration levels shall conform to NEMA Specification MG-1, Motors and Generators, Part 7 unless otherwise noted.

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Factory assemble condensate-return pump units and include condensate receivers, motor-driven pump(s), manual and automatic liquid-level controls, and other accessories as specified herein or which may be necessary for complete and satisfactorily operating units(s).

Pump(s) and all accessories mounted on the receiver and unit(s) shall be complete with all intercomponent piping and wiring. Receiver and unit(s) shall be complete with all intercomponent piping and wiring. Receiver shall have integral cast lugs for securing to mounting surface. Pump suction piping shall contain a shutoff valve for pump servicing.

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NOTE: When more than one unit is involved, rewrite to include unit identification or indicate on the drawing schedule.

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Condensate-return pump units shall be [simplex] [duplex] type.

Condensate-return pump unit shall be factory tested for capacity and pressure.

#### 2.1.1 Pumps

Pumps shall be close coupled or flexible coupled with guard centrifugal volute vertically or horizontally mounted on or next to receiver. Pumps shall conform to applicable requirements of ISO 2858 and ISO 5199 HI M100 standards and shall be bronze mounted. Casing shall be close-grained cast iron with renewable wearing ring. Provide tapped openings for automatic venting, draining, and pressure-gage connection. Pump shaft shall be AISI Type 300 series corrosion-resistant steel. Pump seal shall be manufacturer's standard for continuous service at 121 degrees C 250 degrees F, minimum, at seal rotating and stationary members interface and 98 degrees C 209-degree F pumped fluid. Compensate impeller for hydraulic thrust, balance rotating assembly, and ensure strength of shafting such that when pump is operating at its worst hydraulic condition, vibration readings conform to ISO 1940-1, [G6.3] [G2.5] [G1.0] [\_\_\_\_]. Pumps shall be capable of handling 98 degrees C 209-degree F condensate without cavitation or vapor binding while delivering specified capacity.

#### 2.1.2 Motor Requirements

Motors shall be vertical or horizontal and conform to NEMA MG 1, requirements specified under the electrical sections of the specifications and to the following additional requirements.

Motor insulation shall be Class H or manufacturer's standard and be



suitable for satisfactory operation under the following conditions:

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**NOTE: Rewrite following temperatures to suit project.**  
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Still air at 65 percent relative humidity, with service-location temperatures to 50 degrees C 122 degrees F

Thermal conduction along motor shaft immersed in 98 degrees C 209-degree F water

Proximity of motor to receiver surfaces at 98 degrees C 209 degrees F

Lubricants shall be specifically suitable for high-temperature service.

#### 2.1.3 Receiver

Condensate receiver shall be a single tank constructed of close-grained cast iron with a minimum receiver wall thickness of 8 millimeter 5/16 inch or steel with a rust-resistant interior coating.

Fit each receiver with:

Redline borosilicate gage glass and nonferrous shutoff valve assembly for use in case of glass breakage.

External inlet strainer with removable basket for pump protection.

Thermometer with separable well conforming to requirements specified elsewhere in this section.

Receiver top-vent connection and drain at lowest point. Assemble drain closures with tetrafluoroethylene tape.

#### 2.1.4 Controls

Simplex-unit control shall consist of a float-operated switch UL rated for the load imposed and wired to the motor. Float and float arm shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

Duplex-unit control shall consist of a float-operated automatic mechanical alternator controlling at two levels with double-pole alternating switches and operated by a single float. Control shall automatically alternate operation of two pumps to deliver total capacity of two pumps under peak-load conditions, and automatically operate second pump should on-line pump fail. Switch shall be UL rated for the load imposed and be wired to motors. Float and float arm shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

Duplex unit control shall consist of an automatic electric sequence controller used in conjunction with two motor controllers, two selector switches, and two float switches, complete with intercomponent wiring, installed in a NEMA Type 1 enclosure mounted on the receiver. Provide selector switches with automatic OFF positions. Provide a momentary-contact test pushbutton. One float switch shall control the alternator to provide automatic alternation of the two pumps. Second float

switch shall provide simultaneous operation of two pumps to deliver total capacity of two pumps under peak-load conditions and automatically operate second pump should on-line pump fail. Switches shall be UL rated for the load imposed. Floats and float arms shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

## 2.2 CONDENSATE RECEIVER

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NOTE: Select for built-up units where crp series capacities are inadequate.

Built-up units may utilize reciprocating steam pumps or centrifugal pumps with respective pumping-equipment specifications supplemented to suit project requirements.

If an ASME vessel is required, choose the first paragraph; if a manufacturer's standard vessel is sufficient, choose the second paragraph.

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Design and construct receiver in accordance with ASME BPVC SEC VIII D1 for operation under atmospheric conditions but certified as hydrostatically tested at 690 kilopascal 100 pounds per square inch, gage.

Receiver shall be manufacturer's standard vessel.

### 2.2.1 Materials and Construction

Construct receiver of either cast iron or galvanized steel [and be a standard item of the manufacturer] with dished heads, indicated openings including those for vent, inlets, discharge, drain, gage-glass connections, and level-control devices. Minimum tank opening shall be 25 millimeter 1-inch iron pipe size. Couplings shall be forged carbon steel. Nozzle-piping weight shall be Schedule 80. Piping, flanges, and fittings shall conform to specifications for connecting condensate piping system.

Mount receiver as indicated.

Provide one 280 by 380 millimeter 11- by 15-inch gasketed manhole at a point in the head or shell for access when receiver is in place.

Sandblast receiver internal surfaces, including nozzles, to white metal, to a profile required by the coating manufacturer. Coat internal surfaces with a multiple-coat baked or air-dry phenolic system to produce, in not less than three coats, a dry-film thickness of not less than 0.175 millimeter 7 mils. Ensure coating is certified as suitable for continuous service when immersed in condensate at a temperature not less than 149 degrees C 300 degrees F.

### 2.2.2 Accessories

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NOTE: Supplement following text with specifications for control devices to suit pumps selected.

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Provide receiver with a shutoff-valve-equipped gage-glass assembly to

indicate liquid level over not less than 80 percent of receiver diameter from the bottom. Gage glass shall be red-lined borosilicate glass and fitted with wire or sheet-metal guards.

## 2.3 RECIPROCATING STEAM PUMPS (RSP)

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NOTE: Select for remote-location condensate pumping applications, where no electrical power is available. Coordinate with specification of condensate receiver. Weighted or pilot float-operated steam control valve, piped-cylinder end drains, and traps for continuous condensate removal, steam pressure-reducing or speed-governor valve as necessary, and discharge line-relief valves.

Show size or capacity on drawings.

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Pump shall be horizontal duplex double-acting reciprocating type.

Pump speed, capacity, materials construction, and installation shall conform to applicable requirements of ISO 2858 and ISO 5199 HI M100 Standards, as modified and supplemented herein.

Ensure steam end is rated at not less than 1725 kilopascal 250 pounds per square inch (psi) working steam pressure.

Ensure liquid end is rated at not less than 860 kilopascal at 100 degrees C 125 psi at 212 degrees F.

### 2.3.1 Construction

Pump shall be fully bronze-fitted, except that piston rods shall be AISI Type 304 corrosion-resistant steel alumina-ceramic-coated in the packing box area where optionally available.

Steam-end cylinders shall have sufficient thickness to permit up to 4 millimeter 1/8-inch reboring.

Insulate steam end cylinders and lag with sheet-metal.

Liquid end shall be valve-plate type.

Fit liquid-end cylinder with a replaceable bronze liner.

Cylinder openings shall be manufacturer's standard, flanged whenever optionally available.

### 2.3.2 Tools and Accessories

Provide one set of special tools.

Provide one set of nonmetallic rings and packing for steam- and liquid-end cylinders and one set of steam-end cylinder rings.

Provide pump-actuated mechanical lubricator with sufficient lubricant feed points and lubricant storage capacity to permit once-per-week lubrication.

### 2.3.3 Steam-Cylinder Drainage

Provide all cylinder end drains with check valves and Type TOD steam traps.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Based on the motor nominal operating speed, align the Pump and driver to the following specifications:

Speed(RPM)	angle(mils)	offset(mils/inch)
600	6.0	2.0
900	5.0	1.5
1200	4.0	1.0
1800	3.0	0.5
3600	1.5	0.4
7200	1.0	.03

### 3.2 TESTING

#### 3.2.1 Vibration Analyzer

Use an FFT analyzer to measure vibration levels. It shall have the following characteristics: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

An accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk(or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

#### 3.2.2 Acceptance Testing

Prior to pump final acceptance, use vibration analysis to demonstrate that pump and motor are aligned as specified, and ensure misalignment does not impart more than .04 inches per second vibration level at 2 times run speed.

Vibration analysis shall also verify pump conformance to specifications. Vibration levels shall not be more than .075 in/sec at 1 times run speed and at pump frequency, and .04 in/sec at other multiples of run speed.

Demonstration that the pump is non-overloading at any operating point and that the flow capacity is as specified.

Provide final test reports to the Contracting Officer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the

words "Final Test Reports - Forward to the Systems Engineer/Condition  
Monitoring Office/Predictive Testing Group for inclusion in the Maintenance  
Database."

-- End of Section --