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**USACE / NAVFAC / AFCEC / NASA** **UFGS-23 22 23.00 40 (February 2023)**

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**Preparing Activity: NASA** **Superseding**
**UFGS-23 22 23.00 40 (August 2015)**
**UFGS-23 22 23 (August 2008)**

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
**********

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 22 23.00 40

STEAM CONDENSATE PUMPS

**02/23**


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SECTION 23 22 23.00 40

STEAM CONDENSATE PUMPS
**02/23**

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**NOTE: This guide 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 450 kilopascal 60 pounds per square inch, gage.**

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

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

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

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

**********

PART 1 GENERAL

**********

**NOTE: If Section 23 30 00 HVAC AIR DISTRIBUTION is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted. If Section**

**23 05 48.00 40 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.**
**********

[ Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

][Section 23 05 48.00 40 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.

]1.1 REFERENCES

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

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

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

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 SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME BPVC SEC VIII D1 | (2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1 |

HYDRAULIC INSTITUTE (HI)

| | |
|---|---|
| HI M100 | (2009) HI Pump Standards Set |

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| 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 |
| ISO 21940-11 | (2016) Mechanical vibration -- Rotor balancing -- Part 11: Procedures and Tolerances for Rotors with Rigid Behavior |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2021) Motors and Generators |

1.2 SUBMITTALS

**********

**NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.**

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

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

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

**********

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

SD-02 Shop Drawings

Connection Diagrams[; G[, [____]]]

Control Diagrams[; G[, [____]]]

Fabrication Drawings[; G[, [____]]]

Installation Drawings[; G[, [____]]]

SD-03 Product Data

Condensate Pumps[; G[, [____]]]

SD-06 Test Reports

Pump Flow Capacity Tests[; G[, [____]]]

Efficiency Tests[; G[, [____]]]

Vibration Tests[; G[, [____]]]

Final Test Reports[; G[, [____]]]

SD-07 Certificates

Product Installations[; G[, [____]]]

## 1.3 QUALITY ASSURANCE

### 1.3.1 Product Installation

Submit a listing of product installations for the following items:

1. Condensate Return Pump Units

2. Condensate Receiver

3. Pressure Powered Condensate Pumps

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.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

Submit connection diagrams for condensate pumps showing details of cable and motor connections.

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

Submit fabrication drawings for condensate pumps indicating size, type, and efficiency rating.

## 2.2 COMPONENTS

### 2.2.1 Condensate Return Pump Units

**********

**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:**

| Nominal Equivalent Direct Radiation Square Metre | Pump Capacity Litre Per Minute | Approximate Gallons Stored Between Start/Stop | Storage Capacity Litre |
|---|---|---|---|
| 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 |

| Nominal Equivalent Direct Radiation Square Feet | Pump Capacity GPM | Approximate Gallons Stored Between Start/Stop | Storage Capacity Gal |
|---|---|---|---|
| 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 |

**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, 6 kilogram per square meter per hour 1/4 pound per hour per square footequivalent direct radiation (edr) or 2 liter per minute per 100 square meter 0.5 Gallon per minute per 1,000 square feet edr except when small boilers are involved. Discharge pressures and pump revolutions per minute should be indicated.**

**Receiver capacity should be indicated as nominal.**

**********

**********

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

**********

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).

Ensure pump(s) and all accessories mounted on the receiver and unit(s) are complete with all intercomponent piping and wiring. Ensure receiver and unit(s) are complete with all intercomponent piping and wiring. Provide receiver with integral cast lugs for securing to mounting surface. Ensure pump suction piping contains a shutoff valve for pump servicing.

**********

**NOTE: When more than one unit is involved, rewrite**

**to include unit identification or indicate on the drawing schedule.**
**********

Provide [simplex] [duplex] condensate-return pump units.

Factory test condensate-return pump unit for capacity and pressure.

2.2.1.1 Pumps

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 gallons per minute, and NPSH.

Provide close coupled or flexible coupled pumps with guard centrifugal volute, vertically or horizontally mounted on or next to receiver. Ensure pumps conform to applicable requirements of ISO 2858 and ISO 5199 HI M100 standards and are bronze mounted. Casing is close-grained cast iron with renewable wearing ring. Provide tapped openings for automatic venting, draining, and pressure-gage connection. Pump shaft meets AISI Type 300 series corrosion-resistant steel. Pump seal is 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 21940-11,[G6.3] [G2.5] [G1.0][_____]. Select pumps capable of handling 98 degrees C 209-degree F condensate without cavitation or vapor binding while delivering specified capacity.

2.2.1.2 Motor Requirements

Motors are 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 is Class H or manufacturer's standard and be suitable for satisfactory operation under the following conditions:

**********
**NOTE: Rewrite following temperatures to suit project.**
**********

a. Still air at 65 percent relative humidity, with service-location temperatures to 50[_____] degrees C 122[_____] degrees F

b. Thermal conduction along motor shaft immersed in 98[_____] degrees C 209[_____]-degree F water

c. Proximity of motor to receiver surfaces at 98[_____] degrees C 209[_____] degrees F

Ensure lubricants are specifically suitable for high-temperature service.

2.2.1.3 Receiver

Condensate receiver is 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:

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

b. External inlet strainer with removable basket for pump protection.

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

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

2.2.1.4 Controls

2.2.1.4.1 Simplex-unit control

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

2.2.1.4.2 Duplex-unit control

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

Consists of an automatic electric sequence controller used in conjunction with two motor controllers, two selector switches, and two float switches, complete with intercomponent wiring. Install 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 controls the alternator to provide automatic alternation of the two pumps. Second float switch provides 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. Use UL rated switches for the load imposed. Floats and float arms are AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

2.2.2 Condensate Receiver

**********

**NOTE: Select for built-up units where condensate receiver pump capacities are inadequate.**

**Built-up units may utilize pressure powered condensate 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.**
**********

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 is manufacturer's standard vessel.

2.2.2.1 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 is 25 millimeter 1-inch iron pipe size. Couplings are forged carbon steel. Use Schedule 80 pipe for nozzle piping. Ensure piping, flanges, and fittings 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.

2.2.2.2 Accessories

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

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. Use red-lined borosilicate gage glass and fitted with wire or sheet-metal guards.

2.2.3 Pressure Powered Condensate Pumps

**********
**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.**
**********

Pump is pressure motive float operated type.

Operate pumps by[ [_____] kilopascal [_____] pounds per square inch (psi) pressure steam][ [_____] kilopascal [_____] psi compressed air].

Ensure pump is rated at not less than 860 kilopascal 125 psi.

2.2.3.1 Construction

Pump construction must be ductile iron or steel body with stainless steel trim and internals. Incorporate echanism Inconel X-750 springs.

Provide pumps containing float operated snap-acting mechanism with no external seals or packing.

Provide pumps with inlet and outlet stainless steel disc check valves installed at factory.

2.2.3.2 Accessories

Provide gauge glasses with brass shut-off cocks for trap and receiver.

Where scheduled, provide unit with vented steel receiver with duplex pressure powered pumps.

Provide duplex units with isolation valves on inlet and discharge of each pump.

[ Provide pumps with battery powered cycle counter.
]

Pumps may be furnished with factory supplied removable insulation blankets in lieu of field insulation. Factory supplied insulation comply's with applicable performance requirements of 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Factory Tests

Ensure the manufacturer tests the pump. Submit prior to shipment of the finished pump the following test data:

2.3.1.1 Pump flow capacity tests

Conform pump flow to requirements listed in accordance with paragraph CONDENSATE RETURN PUMP UNITS.

2.3.1.2 Efficiency tests

Conform pump efficiency to the approved design documents.

2.3.1.3 Vibration tests

Conform vibration tests to requirements listed in accordance with paragraph TESTING.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Submit installation drawings for condensate pumps in accordance with the manufacturer's recommended instructions.

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 | 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 | 0.3 |

### 3.2 FIELD QUALITY CONTROL

#### 3.2.1 Testing

##### 3.2.1.1 Vibration Analyzer

Use an FFT(Fast Fourier Transform) analyzer to measure vibration levels with 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.

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

##### 3.2.1.2 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 two times run speed.

Use vibration analysis to also verify pump conformance to specifications. Ensure vibration levels are not more than .075 in/sec at one 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. Provide reports with 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 --