	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: HVAC Standards	Section: 23 22 23 00 Steam Condensate Pumps
		Date: 6/15/16
		Author: Office of Facilities
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PART 1 - INTRODUCTION

1.1 PURPOSE

- A. This section is intended to define the general installation and minimum product requirements for Steam, Condensate Pumps, and Flash Tanks, for both Building and Utility Systems.


PART 2 - GENERAL DESIGN REQUIREMENTS

2.1 CONDENSATE RETURN UNITS AND FLASH TANKS

A. GENERAL

1. Installation Requirements

- a. Condensate return units shall be located in all building mechanical rooms and at all low points in the system where pressure in a dedicated return line cannot push the condensate back to a condensate receiver. Locating a condensate return package in a steam manhole must receive approval from Yale Utilities.
- b. Ensure that the vent of a condensate receiver goes to atmosphere and to a safe location. Do not pipe the vent into the mechanical room – a blown steam trap could cause major humidity and temperature issues.
- c. Note that all condensate receivers for electric powered systems have overflow pipes. Ensure that there is a floor drain or sump pump that is rated for the temperature that could come out of an overflowing condensate receiver. Ensure that the vent line for the condensate receiver is sized accurately and that the overflow line is piped correctly so that the overflow line does not act like a vent and cause humidity and high temperature to go into the mechanical room.
- d. Steam powered condensate return units (also known as liquid movers) are preferred in tunnels and mechanical rooms of buildings where adequate steam pressure is available. They must have a back-up air compressor that has 40 PSIG air supply so that condensate can be returned during start-up of the steam


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system when the steam pressure is not available for the motive force for condensate return.

- e. The designer shall ensure that condensate receivers are not over pressurized, especially by the pressure from the flash steam. Typical receiver packages that are not the steam powered type are not rated as pressure vessels. A flash tank may be required upstream of the receiver package depending on the design and the flash tank must have a safety relief valve with a set pressure to protect the vessel. The electric powered pump package is specified to have the condensate pumps rated for 250 degrees F service. If this does not occur, a flash tank must be installed on condensate return lines ahead of the condensate receiver to reduce the condensate temperature to a specified pumping temperature of 200 degrees F. Some steam powered packages require steam to be flashed upstream of the unit so provide one when required.
- f. All condensate return pumps and liquid movers shall have spring loaded check valves at the discharge as specified in Part 7.

B. Electric Powered Pump Condensate Return Package.

1. Acceptable Manufacturers include Shipco, Skidmore, and Spirax Sarco.
2. Description: Factory-fabricated, packaged, electric-drive pump units of capacity indicated. Include receiver, pumps, float switches, controls, control panel, and accessories suitable for operation with specified conditions. Receiver shall be able to receive and flash high pressure condensate.
3. Configuration: Floor-mounting, duplex unit with receiver, 2 centrifugal water pumps, 2 float switches, and connecting piping.
4. Receiver: Typically 21 Gallon (total capacity) but tank size to allow a full discharge flow rate for 1-1/2 to 3 minutes to prevent short-cycling of the pump. Material shall be cast iron – ensure flash tank upstream since tank will not be rated for pressure. Include externally adjustable float switches, water-level gage, one loose pressure gage (for Contractor installation on common discharge header downstream of all isolation valves), dial thermometer, and 2 lifting eyebolts. Shall be full vented to operate at atmospheric pressure. ASME Code stamp not required.

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5. Performance: Each pump shall be provided with the following design values:
 - a. Fluid: Condensate
 - b. Temp (deg F.): 212
 - c. Design Flow (gpm): Per the design. Size electric driven condensate pumps for 2-1/2 to 3 times the amount of condensate returned in one minute.
 - d. Pump Head (PSIG): Per the design. Ensure that the pump can satisfy the static lift requirements back to the next condensate receiver it is pumping to.
 - e. Pump Minimum Net Positive Suction Head, NPSH (FT): 2.0
 - f. Maximum Speed (RPM): 3500

6. Inlet Valves: Shall be provided for each pump, pre-assembled. Shall be butterfly style to reduce head drop.

7. Inlet Strainer: Provide basket style strainers for each pump.\


8. Water Pumps: Centrifugal, enclosed vane and precision balanced cast bronze impeller, close coupled, permanently aligned, base mounted. Provide straightening vanes for the axial flow impeller to provide low NPSH. Include enclosed renewable bronze case rings, stainless-steel shafts, and mechanical seals. Flange mount centrifugal water pump on receiver. Provide close-coupled pump, vertical design, permanently aligned, bronze fitted, equipped with stainless steel shaft, enclosed bronze impeller, renewable bronze case ring, mechanical shaft seal, and suction butterfly valve. Seals must be rated for 250°F. Provide open drip proof motor close coupled to pump. Pump shall be rated for maximum 2' net positive suction head (NPSH) @ 210°F (sea level). (If pumps are not rated for 2' NPSH, the tank must be elevated on legs to a level where the pumps will not cavitate.)

9. Motor shall be heavy duty ball bearing design, open drip proof and shall be 460VAC, 3-phase, 60 hertz. Provide water safety slingers to prevent the water from entering the motor.

10. Pressure Gage: Provide at discharge of each pump.


11. Overflow: Pipe end shall be located near bottom of receiver with water loop to prevent overflow from acting as a vent. Provide separate vacuum breaker piping external to the tank to prevent the overflow line to act as a siphon.

12. Duplex Pump Control Panel: The condensate return unit manufacturer shall provide a factory-assembled, and UL listed and labeled duplex pump control panel for each pair

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of pumps. The control panel shall be located in a position that an operator does not require a ladder to access the panel. Where the pump package is in a pit, the control panel shall be located above, outside, and adjacent to the pit. Factory wired for single external electrical connection. The control panel shall be supplied with the following components:

- a. NEMA 4X stainless steel enclosure with ANSI 61 light gray exterior and white interior.
- b. Three-pole molded case thermal magnetic circuit breaker sized for motor load, with external flange mounted disconnect switch handle. External disconnect switch handle shall be capable of being padlocked in the open position.
- c. NEMA rated motor starters with three-pole motor circuit protectors to provide individual motor starter short circuit protection, three-pole magnetic contactors, and Class 10 ambient compensated bimetal overload relays.
- d. Control power transformer with primary and secondary fuses, line voltage primary and 120V grounded secondary, with minimum of 50VA additional capacity.
- e. Door-mounted HAND-OFF-AUTO selector switch, START pushbutton, STOP pushbutton, RESET pushbuttons for overload relays, red LED MOTOR STOPPED, and green LED MOTOR RUNNING pilot lights for each pump motor.
- f. Solid state lead-lag pump alternator with float status lights.
- g. Lag pump delay start relay.
- h. Alternator shall be suitable for four sump float operation (low level – pumps off, lead pump on, lag pump on, high level alarm). Dry contact shall be provided for remote high level alarm notification.
- i. Alternator selector switch to override the lead-lag alternator and allow operation of pump 1 or pump 2 only.
- j. 115V anti-condensation heater connected to 120V control transformer. Heater shall be provided with adjustable thermostat and over-temperature control.
- k. Local external high level alarm light and horn.
- l. 115VAC service light to provide internal panel illumination during service work.
- m. Internal 115VAC duplex convenience receptacle.
- n. Terminal blocks shall be provided for connection of level controls and other control wiring as required for proper pump installation.
- o. Motor starters, relays, and other internally mounted components shall be DIN rail mounted


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- p. Internal wiring shall be type THHN/THWN/MTW 600 V insulated stranded copper wire
- q. Wire between devices shall be neatly routed inside plastic wireway with slots for wiring and snap-on plastic covers
- r. Field wiring shall be terminated at insulated tubular barrel terminal strips with compression plates. No more than two wires shall be installed at each terminal
- s. Tank float switches shall be mounted from top to bottom in the following order:
 - 1) High Level Alarm
 - 2) Lag Pump On
 - 3) Lead Pump On
 - 4) Low Level
- t. Pump sequence of operation shall be as follows:
 - 1) Tank empty: Pumps off.
 - 2) Tank level rises to lead pump float switch: Start lead pump.
 - 3) Tank level rises to lag pump float switch: Start lag pump.
 - 4) Tank level rises to high level alarm float switch: Transmit high level alarm to one of the Yale Controls and Alarm Call Center. Contact Yale Utilities Distribution Systems (UDS) for direction and location of alarm termination points.
 - 5) Shut off pumps when level falls below low level float switch.
 - 6) Pumps alternate lead and lag for next pump out cycle.


13. Manual Lead-Lag Control: Shall override electric alternator when active pump is manually selected and allow both pumps to operate on receiver high level.

C. Steam Powered Condensate Return Unit (Liquid Mover)

- 1. Acceptable Manufacturer is Gestra, Product FPS 14, Steam-Powered Condensate-Return Unit or approved as equal by Yale Utilities Distribution Project Representative.
- 2. Description: Factory-fabricated, packaged, steam powered unit of capacity indicated. Unit shall use steam pressure (and compressed air as a back-up) to move condensate to the next condensate receiver downstream. Include receiver and accessories suitable for operation with specified conditions. Receiver shall be able to receive and flash high pressure condensate.

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3. Configuration: Floor-mounted. For each location, provide two units so that one serves as a back-up for a lead-lag type configuration. Provide all external piping to allow isolation of one unit to keep the other unit in service.
4. Package: Size of body is dictated by the capacity of the unit. Body shall be cast steel, shall be provided with ASME Sec VIII Code stamp, and the external shall be painted. The package shall include all necessary items for complete operation including steam inlet control valve, float valve of chromium or stainless steel, and check valves for inlet, outlet, and vent – all of these items shall be steel or stainless steel. Include water-level gage with isolation valves and one loose pressure gage and dial thermometer for Contractor installation on common discharge header downstream of all isolation valves. Include drain plug. Float and steam inlet and vent valves shall be accessible through a flanged connection on top of the unit.
5. Performance: Each liquid mover shall be provided with the following design values:
 - a. Fluid: Condensate
 - b. Temp (deg F.): 212
 - c. Design Flow (gpm): Per the design.
 - d. Pump Head (PSIG): Per the design. Ensure that the pump can satisfy the static lift requirements back to the next condensate receiver it is pumping to.
 - e. Pump shall use no more than 3 pounds of steam per 1000 pounds of liquid condensate moved.
 - f. Note that flow and head ability of the equipment are highly dependent on available motive pressure (steam or compressed air). Designers must verify conditions with the manufacturer before specifying.
6. Pressure Switch: Provide a pressure switch and connect to each liquid mover. The switch shall be rated for steam service to 150 PSIG and shall have a field adjustable range from 5 to 100 PSIG. When the pressure is below the set point and the switch is open, it is assumed that the liquid mover is collecting condensate. When the pressure goes above the set point and the switch closes, it is assumed that the liquid mover is in the pumping stage. Connect each switch to Yale Customer Service Control Center and commissioning the operation of the switch to be per the described logic. This pressure switch will be monitored by Yale Systems Engineering – if the switch does not close after a period of time, it will be assumed that there is something wrong with the liquid mover. Also, the switch can be used by Yale Systems Engineering as a back-up and/or a verification of the condensate return meter.

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D. Flash Tanks

1. General

- a. Refer to Detail, Flash Tank.
- b. Provide flash tanks for reducing high and medium pressure to low pressure and draining condensate down to a receiver.
- c. Flash steam velocity shall be low enough to permit moisture-free steam exiting the tank. Tank diameter shall be minimum of 12 inches.

2. Type and Construction: The flash tank shall be designed and constructed in accordance with the ASME Unfired Pressure Vessel Code and bear the appropriate code symbol. The design pressure shall be 20 PSIG or greater. Flash tank shall be constructed of SA516 Grade 70 Carbon Steel. Hydrostatically test vessel at 1-1/2 times design pressure. New gaskets shall be furnished with the vessel after the test. Equip tank with required wear plates to insure maximum moisture-solids removal and long life. The wear plate shall extend 270 degrees around the internal circumference of the tank.

3. Accessories

- a. Safety Relief Valve: Shall have ASME UV stamp for Section VIII vessel. Shall be set for 20 PSIG.
- b. Gage Glass: Length shall cover normal operating level plus/minus 6 inches. Provide automatic gage valves which stop the flow if a glass is broken. Provide a drain lock on lower gage valve.
- c. Nameplate: Attach to bracket projecting beyond field-applied insulation. This nameplate must include all ASME pressure vessel nameplate information as required by the Code.
- d. Support: Steel legs welded to the flash tank. Coordinate location with structural design of building. Support shall facilitate bottom piping connections.
- e. Cleaning and Painting: Remove all foreign material to bare metal. Coat exterior of tank with rust-preventative primer. . Do not coat interior of tank.
- f. Insulation: Field-applied. Refer to detail.
- g. Steam Trap Station: Provide and mount per detail to keep water level in tank.