BESTOBELL STEAM TRAPS

Pressure-Operated

Condensate Return Pumps

BESTOBELL STEAM
Steam Traps and Steam Specialties

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Reclaim energy from discharged condensate with Bestobell Steam's Pressure-Operated Pumps.

... how much money are you pouring down the drain?

Making the most out of the BTU's in your steam system is the key to efficient operation. Yet, you may be pouring up to 20% of your heat energy down your drains with the condensate that is being discharged from your steam traps. It's not enough to simply remove the condensate from your system ... the true benefits come from adopting a simple condensate recovery program.

Condensate Recovery

A condensate recovery program will enable you to reclaim the condensate that is routinely discharged from your steam traps by recirculating it to your boiler for use in producing additional steam. By doing this, you'll find savings in a number of areas:

Recapture lost heat energy — instead of losing the usable BTU's in the condensate, recirculate them to the return main and boiler feedwater system for use in producing additional steam.

Lower make-up costs — returning hot condensate to the return main not only conserves energy, it also lowers your costs for preheating boiler make-up water.

Reduced operating costs — instead of sending treated water down the drain, a condensate recovery system will return it to the boiler where it will be re-used without requiring additional treatment chemicals.

Savings can be significant

Using a pressure-operated pump will pay for itself many times in just a short period. Conservative figures have been used in this example. To calculate your actual savings, substitute your own figures.

Application Data & Unit Costs:

Condensate load:	7500 lbs/hr.
Annual usage (80%):	7008 hours
Cost of water: *(includes water/sewage/treatment)*	$0.005/gallon
Discharged condensate temp:	180°F
Cold make-up water temp:	55°F
Temperature difference (rise)	125°F
Cost of fuel oil	$0.75/gallon
Heat from oil	127,500 BTU/gallon
Cost of steam	$6 per 1000 lbs.

■ **Water & Treatment Savings *(calculated at 85% to allow for 15% flash steam loss in open type system)***

Annual Savings= (85% x condensate load x yearly hours use x cost of gallon of water) ÷ wt. of gallon of water

$$\text{Annual Water Savings} = \frac{.85 \times 7500 \times 7008 \times .005}{8.34 \text{ lbs.}} = \$26{,}784.17$$

■ **Fuel Oil Savings from Reduction in Pre-Heating Make-up (@ 85% to allow for flash steam loss)**

Annual Savings= (85% x condensate load x yearly hours use x temperature rise x oil cost) ÷ heat from gallon oil

$$\text{Oil Savings} = \frac{.85 \times 7500 \times 7008 \times 125°F \times .75}{127{,}500} = \$32{,}850.00$$

Total Yearly Savings = Water Savings + Oil Savings =

$26,784.17 + $32,850.00 = $59,634.17 Annual Savings

Return condensate without the use of electricity.

Bestobell Steam's Pressure-Operated Pump Systems (POPS) are designed to move condensate without the use of electricity, and return condensate at temperatures above the 200°F limit typical of conventional electric pumps. Since they are pressure-operated, they require no electrical panels, starters or accessories. They operate with minimal maintenance with no rotating seals to leak or motors to burn out.

How a pressure-operated pump works...

In its normal position prior to start-up, the float is at its lowest position with the motive pressure inlet valve closed, and the exhaust outlet valve open.

When liquid flows by gravity through the inlet check valve into the pump body, the float becomes buoyant and begins to rise.

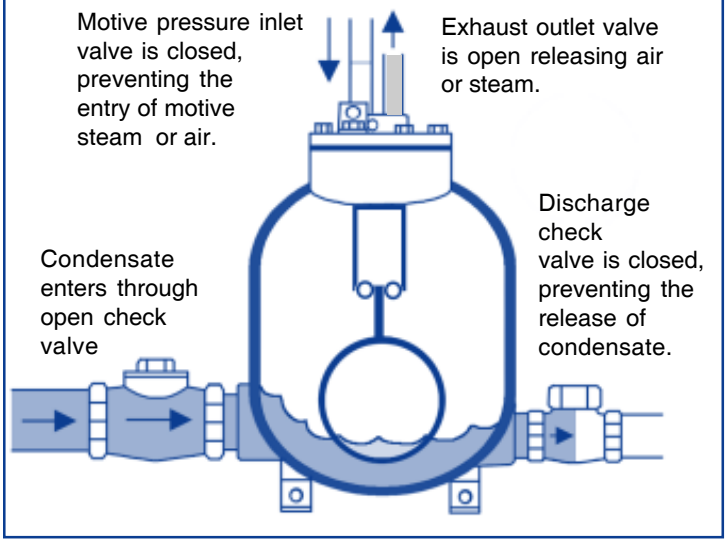
As the float continues to rise, the linkage mechanism is engaged and increases the spring tension. When the float has risen to the upper tripping position, the energy in the springs is instantaneously released, causing the linkage to simultaneously open the inlet motive force valve while closing the exhaust outlet valve.

Steam, air or inert gas will now flow through the inlet valve, developing a pressure within the pump body and forcing the liquid out through the discharge check valve. The inlet check valve will be closed during this discharge cycle.

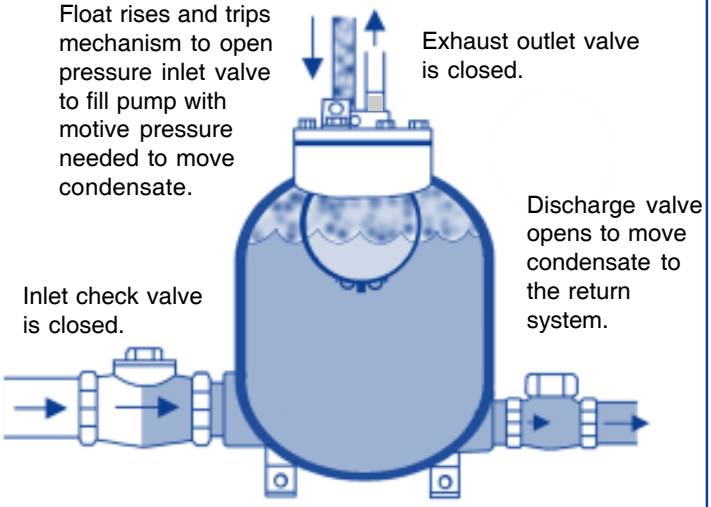
As the liquid level within the pump body decreases, the float falls. Before it reaches its lowest position, the linkage mechanism engages and increases the tension on the springs. When the float reaches its lower tripping position, the energy in the springs is released causing the linkage to simultaneously close the inlet motive force valve and open the exhaust valve.

Liquid will again flow through the inlet check valve, filling the pump body until the cycle repeats itself to recirculate more condensate.

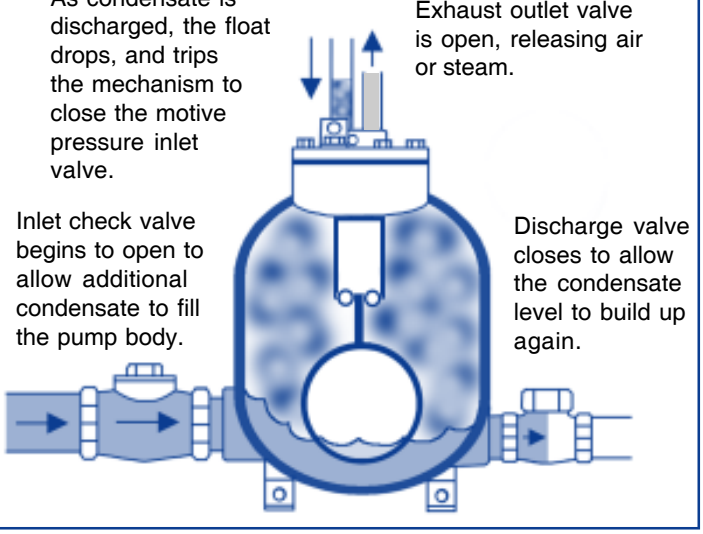
Operation on Start-Up



Operation During Pumping



Operation After Pumping



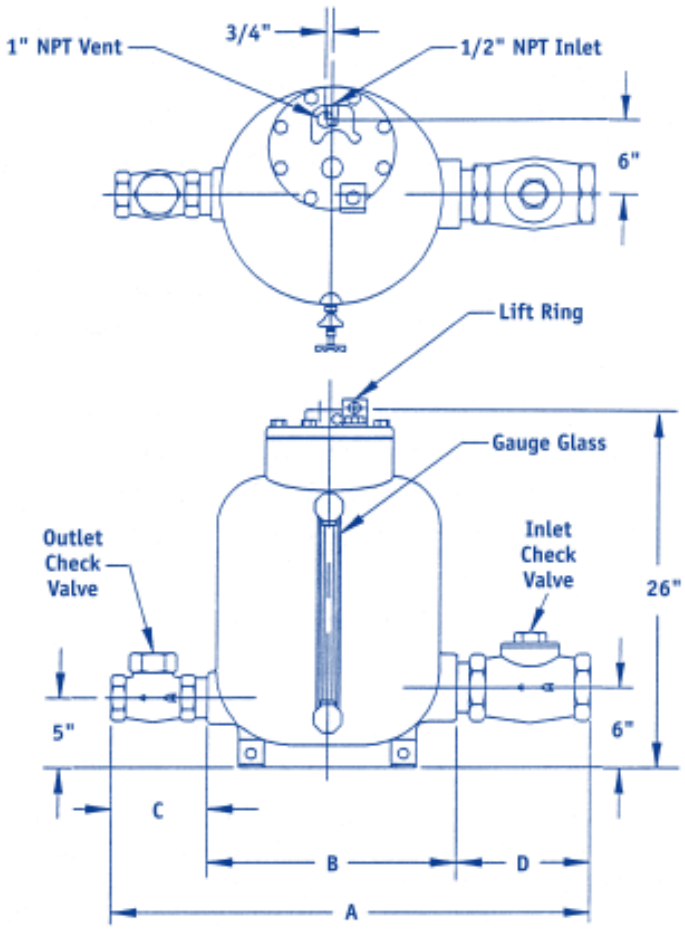
"POPS" Pressure Operated Pump System

Bestobell Steam's original high flow condensate return pump that saves energy, steam, water, and costly water treatment chemicals by transferring high temperature condensate to the return main. Features a cast iron tank (other alloys available) with 316SS internal parts. Produced in 1" x 1", 1.5" x 1.5", 2" x 2", and 3" x 2" sizes.

- Totally self-operated: no electric power source is required; connects to existing steam, air, or gas supply.
- Ideal for use in hazardous or wet environments; suitable for NEMA 4, 7 & 9 locations.
- Avoids cavitation and pump seal problems: transfers high temperature (200°F+) condensate or other liquids from a low point, low pressure or vacuum space to an area of higher pressure or elevation with no cavitation or pump seal problems.
- Virtually maintenance-free: requires no lubrication; no rotating seals that can leak or motors that can burn out.

Dimensions					
Size	A*	B	C	D	Wt.
1" x 1"	30-1/8"	17-5/8"	6-1/4"	6-1/4"	267#
1.5" x 1.5"	32-3/8"	17-5/8"	7-3/8"	7-3/8"	269#
2" x 2"	31-3/8"	17-5/8"	6-7/8"	6-7/8"	271#
3" x 2"	34-3/8"	17-5/8"	6-7/8"	9-7/8"	274#

* Check valves are standard equipment, but require installation by customer. This dimension is for check valves installed with close nipples approximately 2" long. To achieve rated capacity, pump must be installed with check valves as supplied by Bestobell Steam; the use of other check valves can affect capacities. Capacity data can be found later in this booklet.



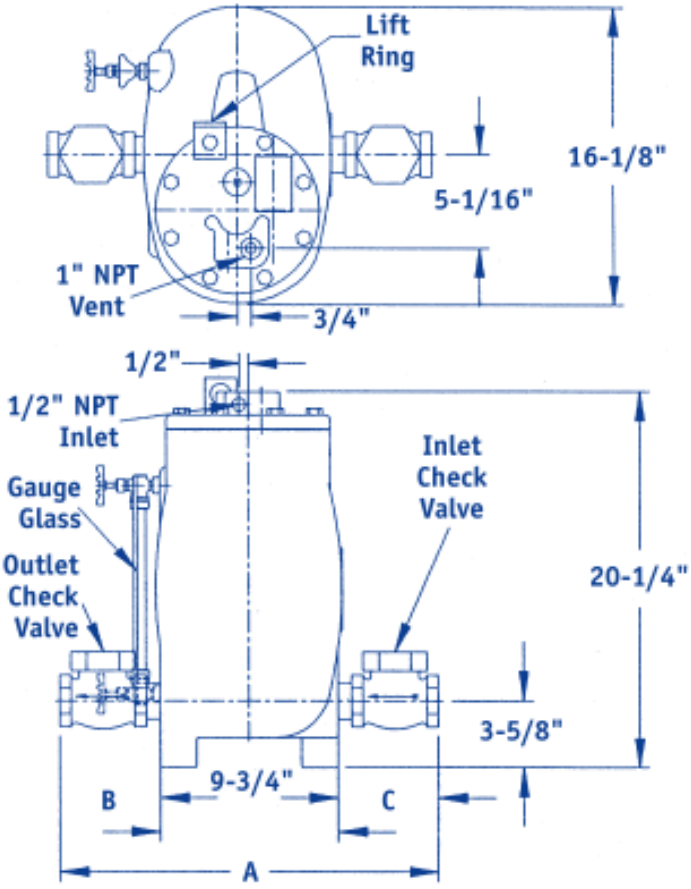
"POPS, Jr." Compact Condensate Return Pump

Similar to the *POPS* unit, *POPS Jr.* features a compact design for small condensate loads such as those found on individual heat exchangers.

- Streamlined dimensions makes *"POPS, Jr."* ideal for tight spaces.
- Constructed of quality materials for effective operation in hazardous locations and in the handling of corrosive liquids; suitable for NEMA 4, 7 & 9 locations.
- All stainless steel internal parts resist damage and corrosion; investment cast actuator plate and float lever eliminate binding points.
- Reduced downtime & maintenance: no impellers, seals or motors that require maintenance; needs no lubrication.

Dimensions					
Size	A*	B	C	D	Wt.
1" x 1"	22-1/4"	6-1/4"	6-1/4"	6-1/4"	145#
1.5" x 1.5"	24-1/2"	7-3/8"	7-3/8"	7-3/8"	145#

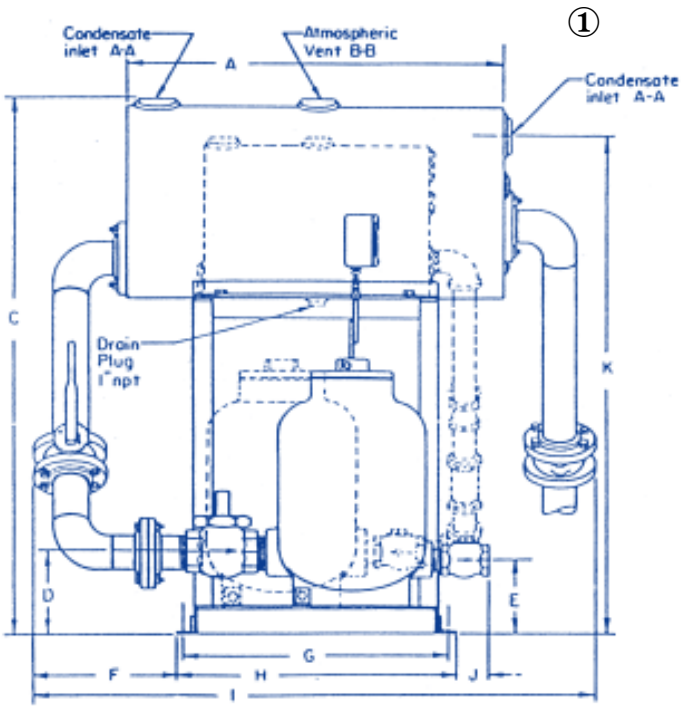
* Check valves are standard equipment, but require installation by customer. This dimension is for check valves installed with close nipples approximately 2" long. To achieve rated capacity, pump must be installed with check valves as supplied by Bestobell Steam; the use of other check valves can affect capacities. Capacity data can be found later in this booklet.

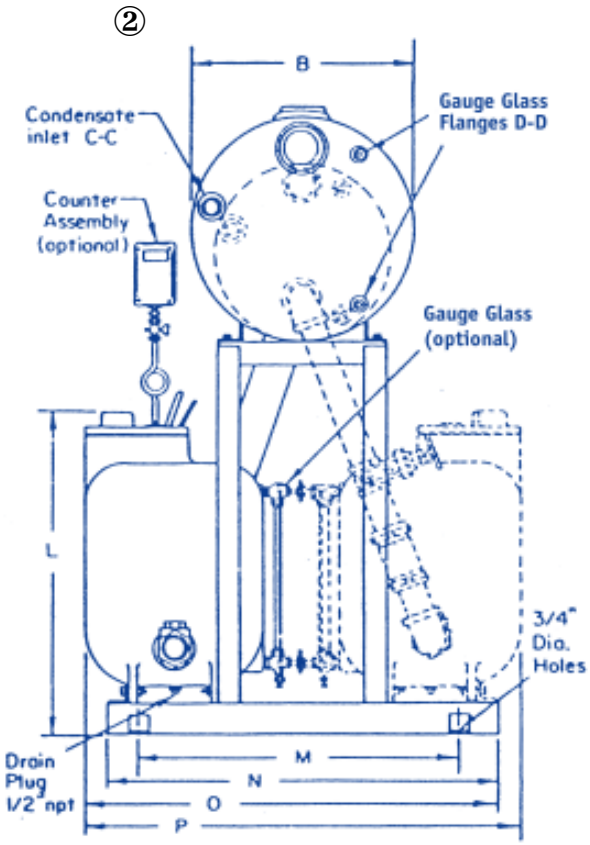


Simplex & Duplex Condensate Recovery Systems

Prepackaged condensate recovery systems are available that include the pressure operated pump in a simplex arrangement, or two pumps in duplex systems, along with all interconnecting piping, isolating valves, base, and receiver tank completely installed and ready for operation.

- Dashed lines in drawing ① represent 21 gallon tank and piping used on most 2" x 2" or smaller Pump Stations.
- Solid lines in drawing ② represent Simplex Configured 3" x 2" Pump Station and piping with 54 gallon tank.
- Dashed lines in drawing ② show placement of a second POPS unit for Duplex Configuration Pump Station.





Dimensions					
Inlet x Outlet	1" x 1"	1-1/2" x 1-1/2"	2" x 2"	3" x 2"	3" x 2" duplex
A	24"	24"	24"	24"	40"
B	16"	16"	16"	16"	20"
Gal.	21	21	21	21"	54
C	52"	52"	52"	52"	56"
D	8.5"	8.5"	8.5"	8.5"	8.5"
E	8"	8"	8"	8"	8"
F	2"	2"	2"	14.5"	14.5"
G	28.25"	28.25"	28.25"	28.25"	28.25"
H	30"	30"	30"	30"	30"
I	37"	37"	37"	48"	59"
J	3.5"	3.5"	3.5"	3.5"	3.5"
K	49"	49"	49"	49"	51.63"
L	28.75"	28.75"	28.75"	28.75"	28.75"
M	28"	28"	28"	28"	28"
N	34.5"	34.5"	34.5"	34.5"	34.5"
O	34.5"	34.5"	34.5"	34.5"	—
P	—	—	—	—	36.5"
A-A	2"	2"	2"	2"	3"
B-B	2"	2"	2"	2"	3"
C-C	1"	1"	1"	1"	1"
D-D	3/8"	3/8"	3/8"	3/8"	3/8"
Wt	461	468	475	543	969

Consult factory for other variations.

Engineering Specifications

The following text can be used to write Engineering Specifications for Bestobell Steam's "POPS" Pressure Operated Pump System.

Non-electric condensate pumps and sump pumps shall be Pressure Operated Pump System (POPS) type, sized for the actual maximum capacity of the system being drained. A float-operating, snap-acting mechanism controls the direction of condensate flow without using external seals or packing. The mechanism utilizes a lift check valve for direction of flow. The POPS Pressure-Operated Pump System shall be of non-cavitating design operating up to 125 psig motive steam, air or inert gas, capable of handling water at up to 350°F when pumping from a closed loop, equalized system. Steam is the required pumping medium in an equalized application.

The pump shall incorporate either a flash receiver and reservoir pipe, or a factory assembled tank package to allow for flash steam venting in an atmospheric system. A package system installation includes all interconnecting piping, isolating valves, base, pump(s), and tank completely installed and ready for operation.

On equipment with modulated steam supply, elevated, or otherwise pressurized condensate return lines, a pressure operated pump system (POPS)/F&T trap combination is necessary. When the load changes, back pressure due to elevation, flash or deaerator pressure will at times be above trap inlet pressure. At this point, positive pressure differential is maintained across the F&T trap by the *POPS* pump.

For sump drainage, the inlet check valve shall be a swing type and be protected by a full size strainer. Air is the preferred pumping medium for sump applications.

Pump body shall be of cast iron construction for maximum corrosion resistance where permissible and all moving parts shall be stainless steel for durability. A guarded gauge glass is standard for all applications, but it should be removed for sump and pit drainage applications.

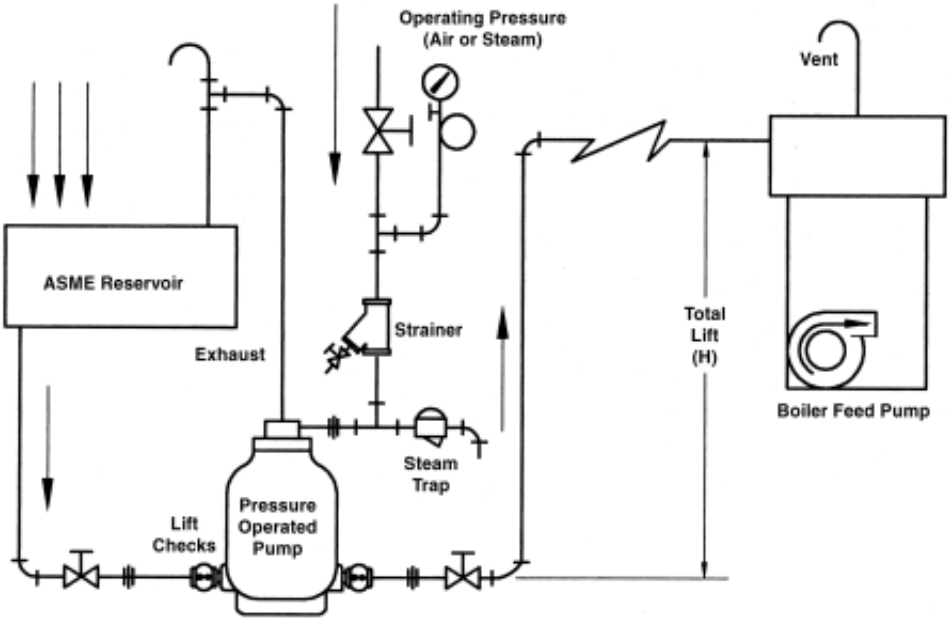
Applications include vented condensate return systems, closed-loop equalized systems on heat exchangers and air coils which allow the omission of flash vessel, vents, and vacuum breakers. Other draining applications include pressurized flash recovery systems, vacuum condensing turbines and reboilers, sumps, manholes, and steam absorption chillers.

Available accessories include bronze check valve sets, steel check valve sets with SST discs, gauge glass assemblies, cycle counters, pump station assemblies, pressure reducing valves for the motive operating supply system, dripleg traps for steam operating supply line and float & thermostatic traps for modulated steam draining applications.

Return System Applications

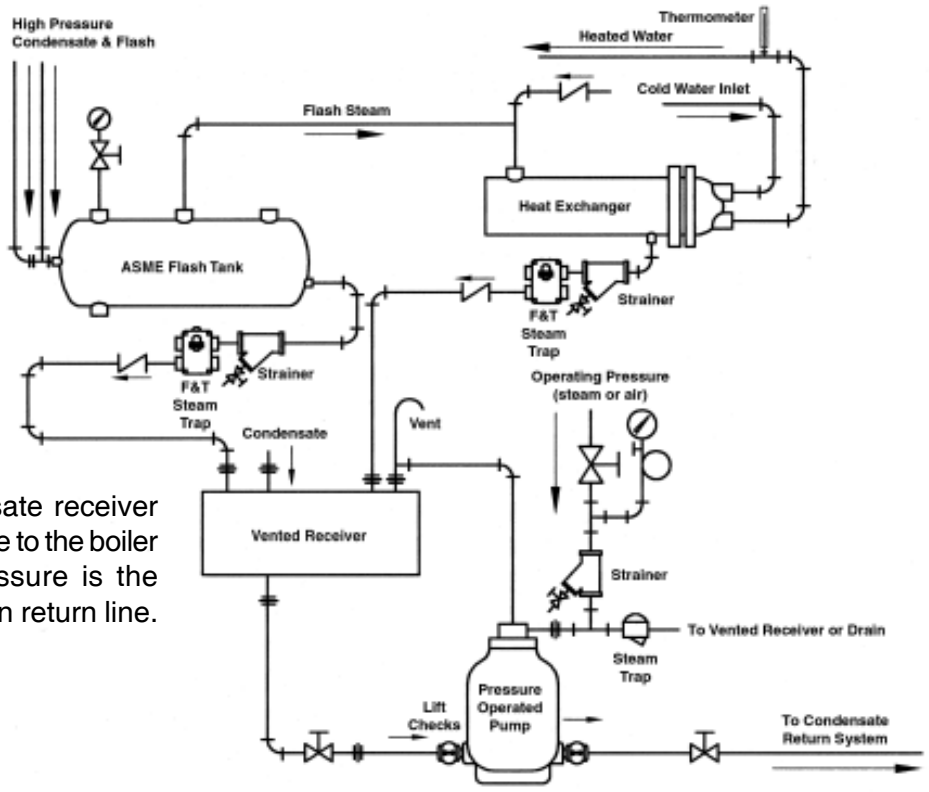
■ Vented Return Systems

This figure illustrates the draining of condensate to a vented condensate receiver tank and then returning the condensate to the boiler feed pump. (Total lift or back pressure is the [height (H) in feet] x [0.433] + PSIG in return line.



■ High Pressure/High Temperature Return Systems

The figure illustrates receiving condensate above 200°F transferred from a high pressure steam source and moving it into a flash tank. Steam and condensate separate with the condensate draining to a vented receiver. The flash steam returns to the heat exchanger. Condensate from the heat exchanger also drains to the vented receiver. In turn, it fills the “POPS” Pressure Operated Pump System.

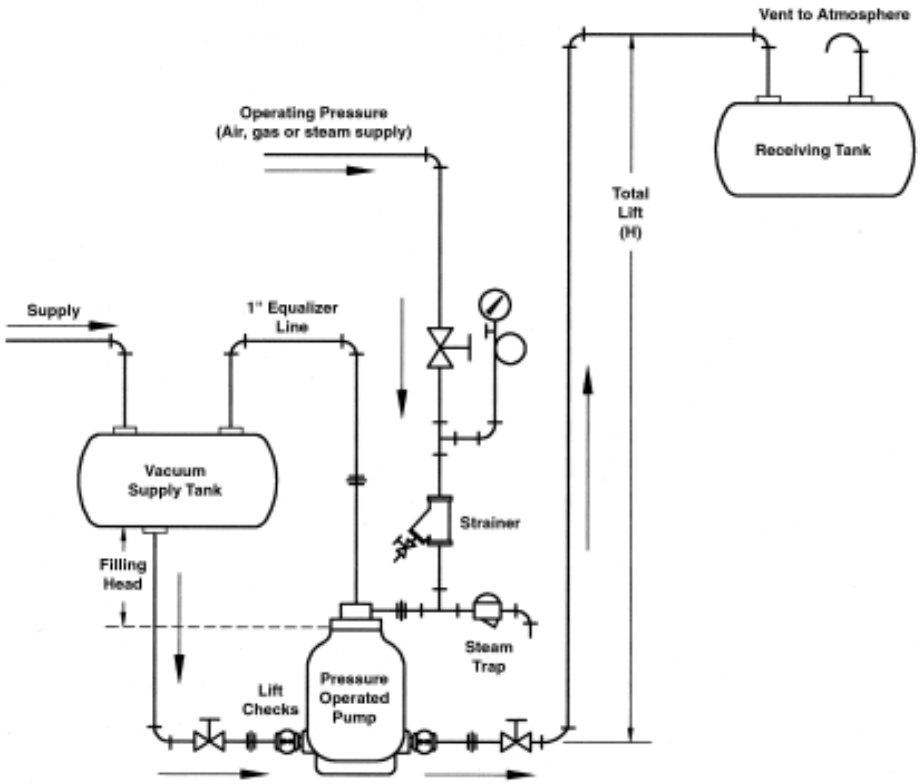


This figure illustrates the draining of condensate to a vented condensate receiver tank and then returning the condensate to the boiler feed pump. (Total lift or back pressure is the [height (H) in feet] x [0.433] + PSIG in return line.

Return System Applications

■ Vacuum Return Systems

When draining equipment under a vacuum, a pressure equalizer line that allows the pump to fill is required. (Total lift or back pressure is the [height (H) in feet] x [0.433] + PSIG in the return line.

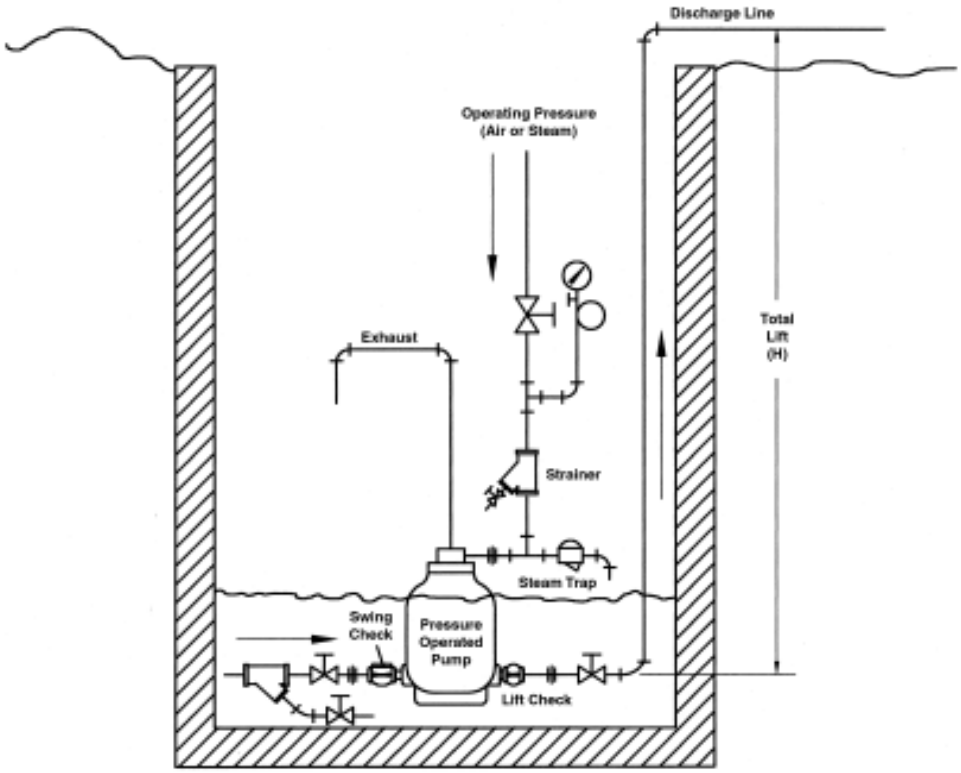


■ Sump or Pit Drainage

Bestobell's Pressure-Operated Pump System can be used to drain water from a sump pit. (Total lift or back pressure is the [height (H) in feet] x [0.433] + PSIG in return line.

Note: do not use gauge glass assembly in this application. Remove and plug 3/8" ports. Air is the preferred operating medium in this application.

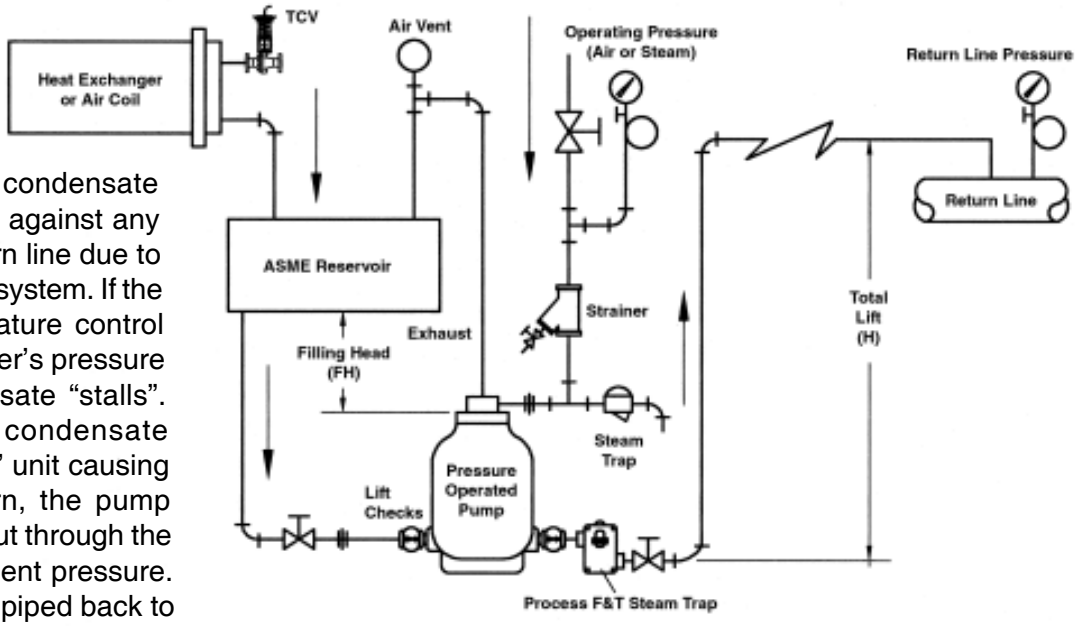
Use a swing check valve and strainer on inlet.



Applications

Draining Applications with Modulated Steam

Pressure Operated Pumps assist in draining a system where a stall condition can occur. Normally the steam pressure in the heat exchanger or coil is high enough to push condensate through the process trap, against any back pressure in the return line due to lift or a pressurized return system. If the regulation of the temperature control valve lowers the exchanger's pressure significantly, the condensate "stalls". When this occurs, the condensate backs up into the "POPS" unit causing it to activate and, in turn, the pump pushes the condensate out through the process trap under sufficient pressure. "POPS" exhaust must be piped back to the ASME rated reservoir, and the process trap must be sized for the maximum load of the coil at stall conditions and/or the maximum "POPS" capacity per given conditions.



Inlet Reservoir Piping

When draining a single piece of equipment and a receiver is not supplied ahead of the pump, install with sufficient piping as shown in the table and use a 12" minimum filling head. This will prevent any flooding of the equipment while the pump is discharging.

Note: The reservoir is not a flash tank. Sizes shown are adequate to accept condensate reaching the pump during discharge stroke. In an "open" system draining condensate from pressure(s) in excess of 30 psi, the reservoir and vent pipe must be sized to handle the flash steam at a velocity of 400 FPM or less ***OR*** a Packaged Pressure Operated Pump System should be used.

Liquid Load lbs/hr	Reservoir Pipe Size				
	1-1/2"	2"	3"	4"	6"
500 or less	2'				
1,000	3'	2'			
1,500	5'	3'			
2,000	6'	4'	2'		
3,000		6'	3'		
4,000		8'	3.5'	2'	
5,000		10'	4.5'	2.5'	
6,000			5.5'	3'	
7,000			6'	3.5'	
8,000			7'	4'	
9,000			8'	4.5'	2'
10,000			9'	5'	2.2'
11,000			10'	5.5'	2.4'

Table shows feet of reservoir piping above top of pump when pressure operated pump is installed without a receiver; table shown is for pump sizes 1-1/2", 2" and 3" x 2".

Sizing Information

Capacity Data

To size the system, you must know:

1) Condensate load, lbs/hr
2) Steam, air, or gas pressure available for operating the pump, psig
3) Vertical lift (back pressure), ft.
4) Pressure in the return piping
5) Filling head available, inches

Example:

1) Condensate load: 4500 lbs/hr
2) Steam available (motive pressure): 50 psig
3) Vertical lift (back pressure): 55 ft.
4) Pressure in return piping: 15 psig
5) Filling head available: 12”

To size, calculate “H” back pressure:
H= (55 x 0.433) + 15 psig = 39 psig
From capacity table, with 50 psig inlet and 40 psig back pressure, you would choose a 2” x 2” POPS, which has a capacity of 4800 lbs/hr.

.Operating Inlet Pressure		Total Lift or Back Pressure		POPS				POPS, Jr.	
				Check Valve & Pipe Sizing					
PSIG	bar	PSIG	bar	1" x 1"	1.5" x 1.5"	2" x 2"	3" in, 2" out	1" x 1"	1.5" x 1.5"
125	8.6	15	1.0	2600	4700	6700	11,300	2200	4000
125	8.6	40	2.8	2400	4500	6300	10,600	2050	3850
125	8.6	60	4.1	2300	3900	6000	10,200	1600	2700
100	6.9	15	1.0	2600	4600	6600	11,200	2150	3800
100	6.9	40	2.8	2400	4200	6100	10,400	1700	3000
100	6.9	60	4.1	2200	3600	5800	9,900	1150	1900
75	5.2	15	1.0	2500	4200	6600	11,200	1900	3200
75	5.2	40	2.8	2400	3800	5800	9,800	1400	2200
75	5.2	60	4.1	2000	3400	5000	8,500	1250	2100
50	3.4	10	.69	2400	4000	6400	10,800	1800	3000
50	3.4	25	1.7	2300	3700	5800	9,800	1350	2200
50	3.4	40	2.8	2000	3200	4800	8,200	1250	2000
25	1.7	5	.34	2300	4200	6100	10,400	1500	2700
25	1.7	10	.69	2100	3900	5600	9,600	1250	2300
25	1.7	15	1.0	2000	3300	5100	8,700	1050	1700
10	.69	2	.14	2000	3300	5100	8,700	1000	1650
10	.69	5	.34	1800	2900	4100	7,000	900	1450
5	.34	2	.14	1600	2700	3800	6,200	850	1400

Based on steam service with standard POPS installed with 12” filling head; POPS Jr. with 6” filling head. Use multiplying factors for other filling heads. Steam motive force with liquid Sg between 0.9 and 1.0; other services, see lower chart.

Capacity Multiplying Factors for Other Filling Heads

Filing Head	Check Valve & Piping Size				
	POPS, Jr.	Standard POPS			
	1" or 1.5"	1"	1.5"	2"	3 x 2"
6"	1.0	0.7	0.7	0.7	0.84
12"	1.15	1.0	1.0	1.0	1.0
24"	1.35	1.2	1.2	1.2	1.08
36"	1.50	1.35	1.35	1.35	1.20

Capacity Multiplying Factors for Other Than Steam

1" through 3" x 2" Pressure Operated Pump Systems									
% Back Pressure vs. Motive Pressure (BP/MP)	10%	20%	30%	40%	50%	60%	70%	80%	90%
Mult. Factor	1.04	1.06	1.08	1.10	1.12	1.15	1.18	1.23	1.28

Note: Bestobell Steam reserves the right to modify specifications as necessary for product development and improvement.

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