Thermaflo Inc.
2880 Fair Avenue
Newberry, South Carolina 29108
www.thermafloengineering.com

SERIES POP
Pressure Operated Pump
INSTALLATION & MAINTENANCE

Applications

The Pressure Operated POP Pump is recommended when liquids must be moved to a higher elevation, higher pressure, or greater distances. Typical applications are:

- Condensate from Vacuum or Low Pressure Systems.
- Condensate Systems with High Back Pressure.
- Any Steam Condensing Equipment (i.e., some underground steam distribution systems, tank farms, etc.)
- Remote Installation (i.e. Tank Farms)
- Where Electricity is Prohibited (i.e., some underground steam distribution systems, tank farms, etc.)
- Submersible, Hard-To-Get-At Areas.

How It Works

The Pressure Operated Pump uses a spring-loaded mechanism inside a pump body to control liquid removal. When the pump is starting to fill through the inlet check valve the float is in the low level position which opens the vent valve at the top and closes the motive gas (steam or air) supply valve.

When the single spring-loaded mechanism reaches the trip point and snaps over the center, the vent valve closes and the gas supply valve opens simultaneously. As the liquid in the body is pumped out through the outlet check valve, the float starts to drop. When the float reaches the switch point, the mechanism snaps over the center, the gas supply valve closes, and the vent valve opens, allowing the filling process to repeat.

POP DUPLEX CONDENSATE SYSTEM

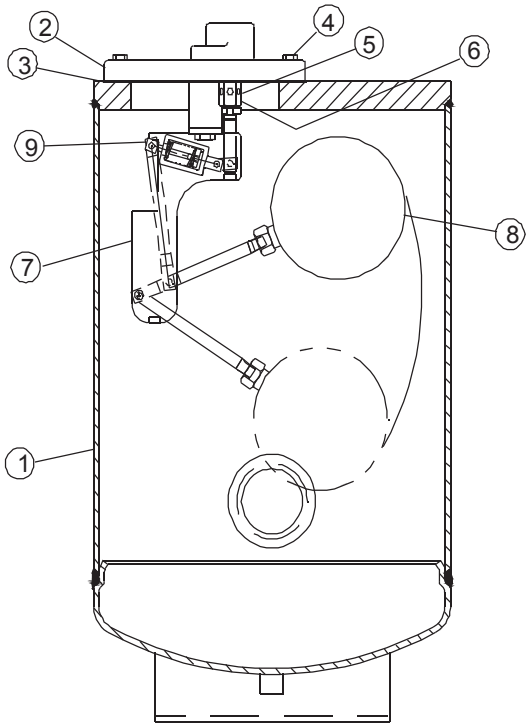
SPECIFICATIONS

AVAILABLE OPTIONS

- Check Valve Sizes for pump inlet and outlet (Sizes 1", 1 1/2", 2", 3" all with screwed ends) Standard Check Valves are Wafer Type.
- Gauge Glass Assembly
- Cycle Counter Assembly
- Insulation Cover
- Freeze Protection Drain Line
- Pressure Regulator for Motive Steam or Air
- Supply-1/2" Type O for each pump. For skid-mounted units, consult factory.
- Complete Skid-mounted Unit (including receiver, pump(s) check valves, etc.) all fully piped and ready to use.

MAX. OPERATING CONDITIONS

POP Series
PMO 150 PSIG
TMO 400°F
Custom pumps or special application pumps can be rated diffrently.



MATERIALS

1)Body . . . . . Carbon Steel

2)Cover . . . . . Machined Steel

3) Cover Gasket . . . . . Non Asbestos

4) Cover Bolts . . . . . Steel

5) Inlet Valve . . . . . 17-4 PH S.ST.

6) Vent Valve . . . . . 17-4 PH S.ST.

7) Mechanism . . . . . 304 S.ST.

8) Ball Float . . . . . 304 S.ST.

9)Compression Spring . . . . . Inconel

10) Other Internal Comp. . . . . S.ST.

11) Check Valves . . . . . S.ST. or Bronze

INSTALLATION

- The pump must be installed standing in the vertical position and located directly under the equipment to be drained. It is important that the preferred minimum filling head of 12"be established from the top of the pump body to the underside of the receiver (vented system) or reservoir for closed loop system.

- Vented Receiver: A vented receiver should be installed before and above the pressure mo tive pump. If you will be using and existing tank or fabricated one, be sure to verify that the vessel is properly sized and vented for the application. Please consult our sizing guide.

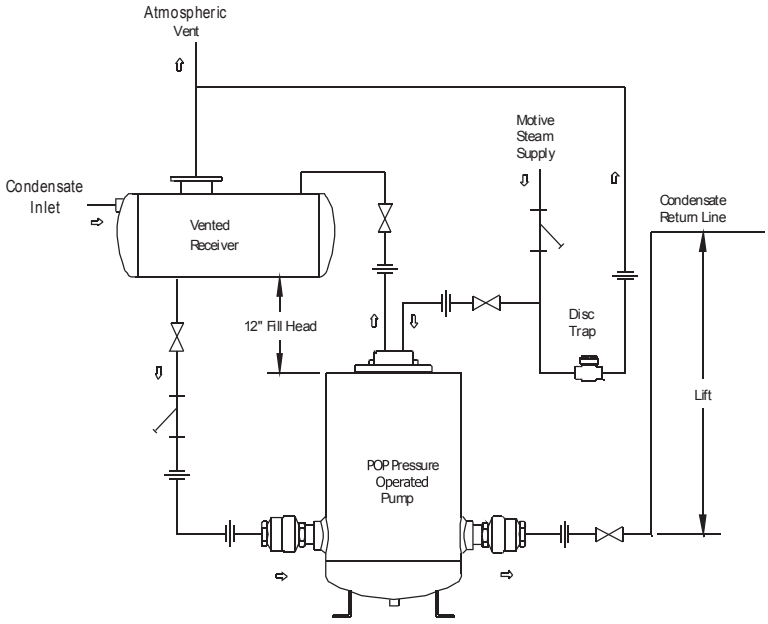
- Closed Loop Reservoir: A reservoir should be installed before and above the pressure mo tive pump. If you will be using and existing tank of fabricated one, be sure to verify that the vessel is properly sized for the application. Please consult our sizing guide on Page 25d of this instruction.

- Connect the inlet and outlet check valves to thepump. **Caution:** Make sure that the flow arrows on the check valves are oriented in the proper direction. For optimum pe rformance, horizontal pipe runs immediately before and after the check valves should be kept as short as possible. Pipe up the pump inlet check valve to the receiver or reservoir and outlet check to the discharge line. Recommend the use of matching line size, full port isolation valves for the pump.

- Connect the operating supply pressure to the motive inlet connection (1/2" FNPT) at the to p of the pump head. Motive pressure line sh ould always be equipped with an isolation val ve, strainer and a steam trap, if steam is used and a liquid drainer if air/gas supply is used. The trap condensate discharge should be piped to receiver, reservoir or outlet side of pump.

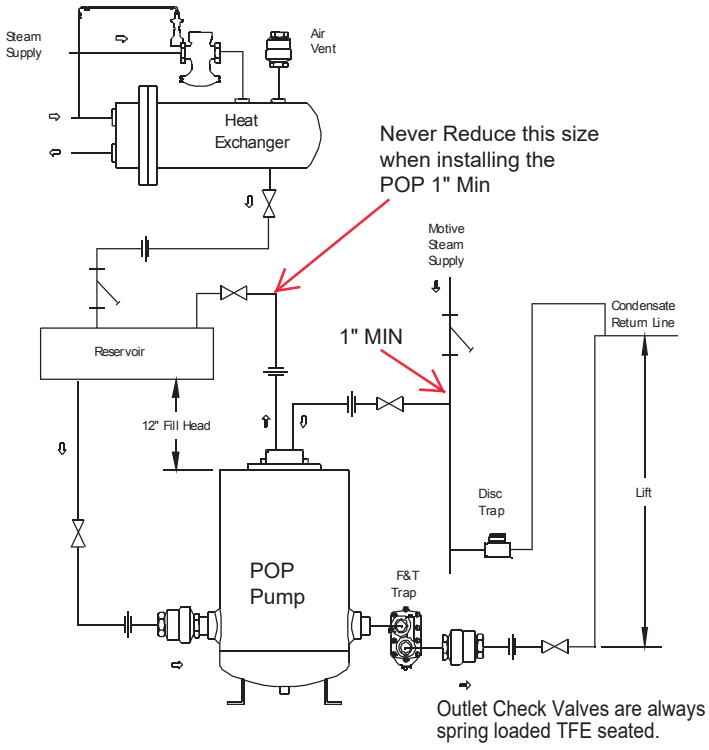
- Install a pipe line from the vent connection (1" FNPT) at the top of the pump head to rec eiver or reservoir.

Steam Motive supply piping should never be less than 1" in size and reduced to 1/2" directly at the steam inlet with drip trap located as close as possible.



Vented Receiver POP Pump System

Filling Heads 6" and Lower are furnished with TFE seated swing check valves.



Closed Loop POP Pump/Trap System

SIZING VENTED RECEIVER

Vented Receiver Sizing			
Flash Steam up to --	Receiver		Vent Line Dia.
	Dia.	Length	
75 pph	4”	36”	1.5”
150 pph	6”	36”	2”
300 pph	8”	36”	3”
600 pph	10”	36”	4”
900 pph	12”	36”	6”
1200 pph	16”	36”	6”
Below figures are approximate for 4” X 4” POP4HC Packages			
2000 pph	20”	60”	8”
3000 pph	24”	60”	8”
4000 pph	26”	60”	10”
5000 pph	28”	60”	10”
6000 pph	30”	72”	12”
7000 pph	32”	72”	12”
8000 pph	36”	72”	14”

When sizing a Pressure Operated Pump for an atmospheric return system, the amount of flash steam to be vented through the receiver must be calculated . Vent sizing is critical to maintain zero psig in the receiver tank to allow free drainage of low pressure systems. Undersized vents will cause gradual pressure increase in the receiver. This impedes drainage from the condensate source, and can cause waterlogging of the system.

To Size Receiver & Vent:
Usually the condensate load to be pumped comes from multiple sources. For each source determine the pressure and load. Then go into the "Percent Flash" table with the condensate pressure and move right until under the appropriate tank pressure to read the percentage of condensate that will flash into steam. Now take that source load and multiply it by the decimal value of the percentage to calculate the amount (lbs/hr) of flash steam. Repeat this for all condensate sources and total the flash steam. Enter the "Vented Receiver Sizing" table with the total flash steam load to determine the correct sizes for receiver and vent.

Percent Flash Steam
Produced when condensate is discharged to atmosphere or into flash tank controlled at various pressures.

Condensate Pressure (psig)	Flash Tank Pressure (psig)										
	0	2	5	10	15	20	30	40	60	80	100
5	1.6	0.9	0.0								
10	2.9	2.2	1.3	0.0							
15	3.9	3.3	2.4	1.1	0.0						
20	4.9	4.2	3.3	2.1	1.0	0.0					
30	6.5	5.8	5.0	3.7	2.6	1.7	0.0				
40	7.8	7.2	6.3	5.1	4.0	3.0	1.4	0.0			
60	10.0	9.4	8.5	7.3	6.2	5.3	3.7	2.3	0.0		
80	11.8	11.2	10.3	9.1	8.1	7.1	5.5	4.2	1.9	0.0	
100	13.3	12.7	11.8	10.6	9.6	8.7	7.1	5.8	3.5	1.6	0.0
125	14.9	14.3	13.5	12.3	11.3	10.4	8.8	7.5	5.3	3.4	1.8
150	16.3	15.7	14.9	13.7	12.7	11.8	10.3	9.0	6.8	4.9	3.3
200	18.7	18.1	17.3	16.2	15.2	14.3	12.8	11.5	9.4	7.6	6.0
250	20.8	20.2	19.4	18.2	17.3	16.4	14.9	13.7	11.5	9.8	8.2
300	22.5	21.9	21.2	20.0	19.1	18.2	16.8	15.5	13.4	11.7	10.2
350	24.1	23.5	22.8	21.7	20.7	19.9	18.4	17.2	15.1	13.4	11.9
400	25.6	25.0	24.2	23.1	22.2	21.4	19.9	18.7	16.7	15.0	13.5

Sizing POP-FT Closed Loop Resevoir

Reservoir Pipe Sizing Closed Loop System									
Condensate Load (lbs/hr)	Reservoir Pipe Size (NPS)								
	3"	4"	6"	8"	10"	12"	16"	20"	24"
Up to 500	2'								
1000	2'								
1500	3'	2'							
2000	3.5'	2'	1'						
3000		3'	2'						
4000		4'	2'	1'					
5000		6'	3'	2'					
6000			3'	2'					
7000			3'	2'					
8000			4'	2'					
9000			4.5'	3'	2'				
10000			5'	3'	2'	5'	3'	2'	
20000						10'	7'	4'	
30000							9'	6'	4'
40000							12'	7.5'	6'
50000								9'	6'

* When BP/MP is less than 50% these reservoir lengths can be reduced by half.

Lbs/hr x .002 = GPM Example 6000lbs/hr x .002= 12 GPM

When sizing Pressure Operated Pumps for closed loop return systems a condensate reservoir should be installed on the inlet side of the pump and below the equipment to be drained. This will enable the condensate to collect while the pump is in the discharge cycle, thus preventing liquid backup into the equipment. The Reservoir Sizing Table gives the minimum pipe size & length to produce the required reservoir volume to accommodate the condensate load.

How to select: Determine the total condensate load to be pumped . Find that load value or greater in the table and move right to read the pipe lengths in feet with the diameters indicated above.

Customized reservoirs can be designed to accommodate specific space, and dimensional requirements. It is critical for these designs to have adequate vapor space for condensate to collect. When the volume required is known, from the previous selection table, optional pipe diameters and lengths can be selected to provide the same or greater volume. This table will allow you to convert required volumes to customized sizes needed. Thermaflo can furnish customized Pressure Operated Pump Packages to fit your needs.

Pipe Sizing Data

NPS	Outside Dia. (in)	Schedule 40				Schedule 80			
		Inside Dia. (in)	Wall Thick. (in)	Flow Area		Inside Dia. (in.)	Wall Thick. (in.)	Flow Area	
				(in^2)	(ft^2)			(in^2)	(ft^2)
1/2	.0840	.622	.109	.3039	.00211	.546	.147	.2341	.00162
3/4	1.050	.824	.113	.5333	.00370	.742	.154	.4324	.00300
1	1.315	1.049	.133	.8640	.00600	.957	.179	.719	.00499
1 1/4	1.660	1.380	.140	1.496	.01039	1.278	.191	1.283	.00891
1 1/2	1.900	1.610	.145	2.036	.01414	1.500	.200	1.767	.01227
2	2.375	2.067	.154	3.356	.02330	1.939	.218	2.953	.02051
2 1/2	2.875	2.469	.203	4.780	.03325	2.323	.276	4.238	.02943
3	3.500	3.068	.216	7.393	.05134	2.900	.300	6.605	.04587
3 1/2	4.000	3.548	.226	9.887	.06866	3.364	.318	8.888	.06172
4	4.500	4.026	.237	12.73	.08884	3.826	.337	11.50	.07984
5	5.563	5.047	.258	20.01	.1389	4.813	.375	18.19	.1263
6	6.625	6.065	.280	28.89	.2006	5.761	.432	26.07	.1810
8	8.625	7.981	.322	50.03	.3474	7.625	.500	45.66	.3171
10	10.750	10.020	.365	78.85	.5476	9.564	.593	71.84	.4989
12	12.750	11.938	.406	111.9	.7773	11.376	.687	101.6	.7058
14	14.000	13.124	.438	135.3	.9394	12.500	.750	122.7	.8522
16	16.000	15.000	.500	176.7	1.227	14.314	.843	160.9	1.118
18	18.000	16.876	.562	223.7	1.553	16.126	.937	204.2	1.418
20	20.000	18.814	.593	278.0	1.931	17.938	1.031	252.7	1.755
22	22.000	21.250	.375	354.7	2.463	19.750	1.125	306.4	2.127
24	24.000	22.626	.687	402.1	2.792	21.564	1.218	365.2	2.536

START-UP PROCEDURE (ALL PUMP PACKAGES)

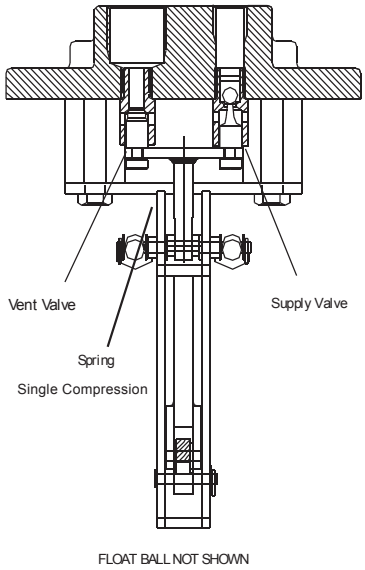
Gradually open supply (steam, air, or gas) to provide pressure at the pump motive inlet. Make sure the motive trap is operational.

Completely open the full port isolation valves in the pump inlet and outlet lines.

Open gate valve ahead of the pump receiver or reservoir allowing condensate to enter the vessel and begin to fill the pump body below it. Pump will discharge when full.

Carefully observe the POP unit. The pump(s) should cycle periodically with an audible sound at the end of each pumping cycle. If any irregularities are observed, recheck installation instructions for proper installation, or call the applications engineering department for assistance.

If overflow piping has been provided, check that a water seal has been established to prevent any steam from being vented in normal operation. Prime piping if necessary.



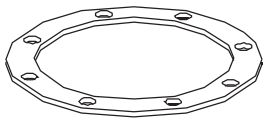
REPAIR & MAINTENANCE

Close all pump isolation valves. Make certain no pressure is trapped in the system. Remove bolts from top cover and lift complete mechanism out of pump body.

Inspect for:

- Wear, dirt and scale on vent, supply, and check valve seat.
- Worn linkage.
- Condition of springs.
- Waterlogged or damaged float.
- Always use a new cover gasket when reassembling.

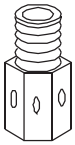
COVER GASKET



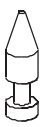
Individual check valves: order by size & material.

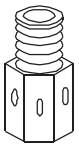
SPARE PARTS

Never substitute a different check valve when you are replacing these. This will effect the speed of the filling and overall capacity of the pump. The picture shown here is a wafer swing that is used on the inlet. These do not have gaskets but O Rings. If the O rings leak over time a 1/16" Garlock 5500 can be installed Consult factory. Only use 6800 series TFE seated spring loaded on the outlet or backflow and hammer will occur.



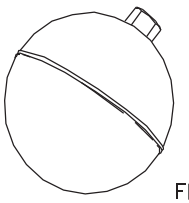
SUPPLY VALVE & SEAT ASSEMBLY





VENT VALVE & SEAT ASSEMBLY

Note: POP-T Pumps have an inner coupling float please specify when ordering



FLOAT

TROUBLESHOOTING:

PROBLEM	CAUSE	ACTION POINT
1. Pump fails to operate on startup.	a. Motive pressure line closed.	a. Open valves to supply motive pressure to pump.
	b. Motive pressure insufficient to overcome backpressure.	b. Check motive pressure and backpressure. Adjust motive pressure to 10 psi higher than the backpressure.
	c. Liquid inlet line closed.	c. Open all valves to supply liquid to the pump.
	d. Liquid discharge line closed.	d. Open all valves on the discharge side of the pump.
	e. Pump air-locked	e. Open System: Make sure that vent line is unrestricted to atmosphere and self draining. Closed System: Isolate the pump from the pressurized space being drained. (Exhaust tie-back line closed). Break vent connection at pump cover. Stand clear of vent connection. If pump begins to cycle, air locking has occurred. Recheck that exhaust tie-back line is self draining.
	f. Check valves installed in wrong direction	f. Reverse the check valve(s) to
2. Liquid backup and equipment flooded, but pump appears to cycle normally.	a. Motive pressure is too low to achieve required capacity.	a. Check motive pressure setting and maximum backpressure during operation. Check against sizing table. Increase motive pressure as required.
	b. Insufficient filling head.	b. Verify required filling head. Lower pump to achieve required filling head.
	c. Valve Closed in Outlet Piping	c. Check that only full ported fittings are used. Clean the strainer. Verify that all valves are fully open.
	d. Restriction in liquid inlet line.	d. Isolate inlet check valve and relieve pressure. Remove cap and visually inspect for debris. Clean seating surfaces and reinstall or replace, if necessary.
	e. Inlet check valve stuck open.	
	e. Pump undersized.	e. Verify rated capacity in the sizing capacity table. Increase check valve size or install additional pump as required.

TROUBLESHOOTING:

PROBLEM	CAUSE	ACTION POINT
3. Liquid backup and equipment flooded, and pump has stopped cycling.	a. Motive pressure low	a. If motive pressure is below backpressure, increase motive pressure setting to 10 psig above backpressure. Do not exceed rated pressure limits of equipment.
	b. Discharge line closed via valve blocked with debris	b. Compare motive pressure and backpressure. If equal, a closed or blocked discharge line is possible. Check valves downstream of pump.
	c. Outlet check valve stuck closed	c. After checking per step 3(b), isolate discharge check valve and relieve line pressure. Remove cap and visually inspect. Clean seating surfaces and reinstall or replace, if necessary.
	d. Inlet check valve stuck closed	d. If mechanism is not heard to trip and fluid is not running from the vent connection, it is suspected that the fault lies in the condensate inlet piping. Be sure that all valves leading to the pump have been opened. If so, this indicates that the inlet check valve is stuck closed. Isolate the pump and check valve and relieve line pressure. Remove the cap and visually inspect. Clean seating surfaces and reinstall or replace, if necessary. Reinstall exhaust/tie-back connection and open line.
SAFETY NOTE TO PREVENT INJURY: For steps (d) through (g), it is necessary to disconnect the vent line at the pump head. On closed loop systems, be sure that the pump is completely isolated, and pressure is relieved prior to breaking this connection to avoid injury to personnel. Also, it is possible that hot condensate may run out of the vent connection when broken for both closed loop and vented systems.	e. Motive inlet valve leaking and/or worn	e. Gradually open motive supply line, leaving the condensate inlet and discharge lines closed. Observe the vent connection for steam or air leakage. If observed, inlet valve is damaged. With pump isolated, remove cover and visually inspect. Replace inlet valve and seat assembly.
	f. Mechanism failure 1. Ruptured float. 2. Mechanism binding+	f. Keeping motive line open, slowly open condensate inlet line to the pump, allowing pump to fill and observe vent connection. If condensate runs out of vent connection, a mechanism problem is apparent. Isolate pump by shutting off motive supply and condensate inlet, remove cover and visually inspect. Examine float for defects. Stroke mechanism and check for any binding or increased friction. Repair or replace.

TROUBLESHOOTING:

PROBLEM	CAUSE	ACTION POINT
3. (cont'd) Liquid backup and equipment flooded, and pump has stopped cycling.	g. Exhaust/tie-back causing vapor lock (vented or closed loop).	g. If mechanism is heard to trip and no fluid is observed running out of the vent connection, slowly open the discharge line from the pump and observe operation. Keep personnel clear of exhaust connection! If pump cycles normally, a fault in the exhaust/tie-back line is suspected. Recheck the vent/tie-back piping layout for compliance with the installation instructions. Exhaust/tie-back line must be self-draining to prevent vapor locking the pump.
4. Chattering or banging in return main after pump discharges.	a. When a pump discharges a significant volume of liquid into a long horizontal return line with rises and drops, the sudden changes in velocity can develop a vacuum.	a. Install a vacuum breaker at high point in return line. For pressurized return systems, an air eliminator may be required down-stream of the vacuum breaker.
	b. Pump is blowing by.	b. Compare inlet and outlet pump pressure. If the inlet pressure equals or exceeds the backpressure, a "blow through" problem is possible. Open Systems: If trap is leaking steam into inlet piping to the pump, the increased pressure could push the liquid in the pump out the discharge side. Replace bad traps. Closed Systems: If, under normal operating conditions, the inlet pressure is greater than the return line pressure, and F&T trap should be added to the outlet of pump just before the check valve. The trap will pass the liquid through at the normal higher inlet pressures and allow the pump to normally pressures and allow the pump to normally cycle when low load pump pressures are present.
5. Vent line discharging excessive flash steam (vented applications only).	a. Faulty steam traps discharging live steam into condensate inlet line. See also 4(b), Pump is blowing-by.	a. Check for leaking traps discharging into condensate return. Repair or replace faulty traps. (See also 4(b), pump is blowing-by).
	b. Excessive flash steam being vented through pump.	b. Vent receiver or reservoir piping ahead of pump.
	c. Vent valve stuck or worn.	c. Isolate pump and remove cover and mechanism assembly. Remove exhaust head and seat assembly. Visually inspect seating surface. Clean and reinstall or replace if worn.

Blank Notes Pages