Series PMPT & PMPTS
Pressure Motive Pump

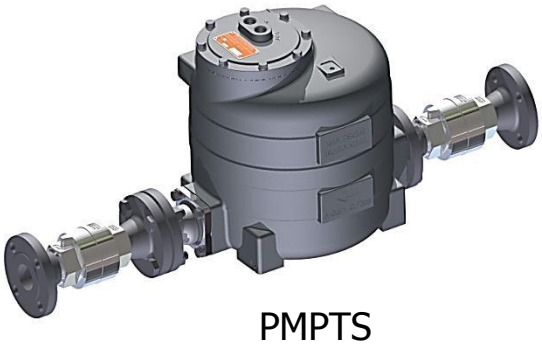
Installation

Operation &

Maintenance

Manual

PMPT



PMPTS

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Safety Considerations

Follow installation guidelines to ensure the product functions properly and as intended.
Improper installation and use may result in such hazards as damage to the product or malfunctions that may lead to injuries or damage. Failure of the product to function may result in problems occurring in the system, such as equipment flooding with condensate or improper drainage.

See page 9 & 10 for System Troubleshooting.

When disassembling or removing the product, wait until the internal pressure is relieved and the product has cooled to room temperature.
Disassembling or removing the product when it is hot or under pressure may lead to injuries or damage.

Do not excessively over tighten or torque when connecting piping to the product.
Over-tightening may cause cracks and damage to the product which may lead to fluid discharge, which may cause injuries.

PMPT Specifications

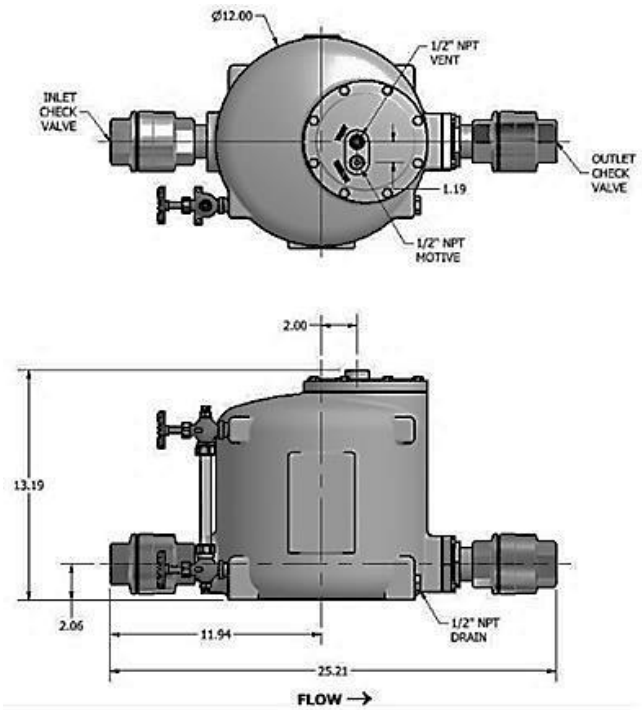

Figure 1: PMPT Pump

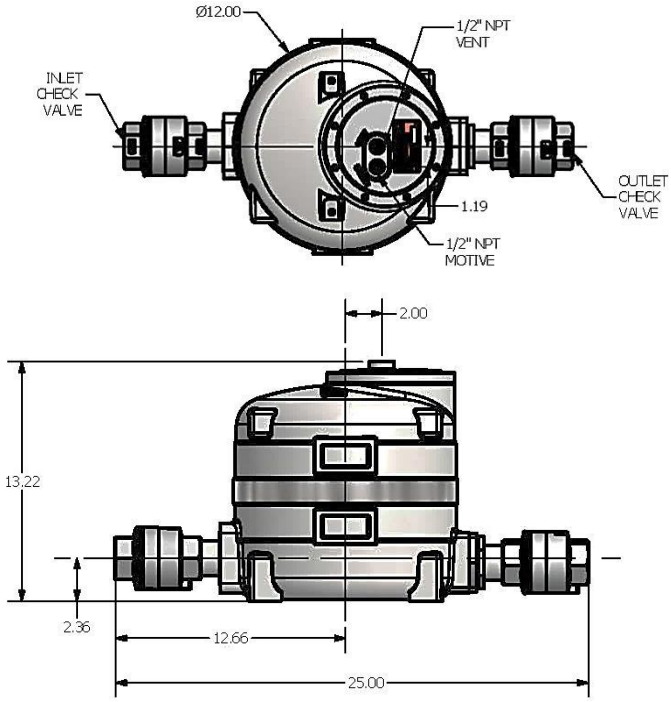

Figure 2: PMPTS

Note: Pump overall length dimensions shown with 1½" check valves.
For 1" check valve overall length, subtract 2.86".

Operating Specifications	
Average instantaneous discharge rate	16.1 gpm
Average pump discharge per cycle	1.9 gal
Average steam consumption	3 lbs. per 1000 lbs. liquid pumped
Average air consumption	100 SCF per 1000 lbs. liquid pumped

PMPT/S Pressure-Temperature Ratings	
PMO Max. Operating Pressure	125 psig
TMO Max Operating Temperature	336°F
PMA Max Allowable Pressure	150 psig
TMA Max Allowable Temperature	450°F

Weight	
1"	85 lb
1 ½"	95 lb
1 ½"	98 lb

Pump **Serial Number** and **Date Code** can be located on the tag mounted to the top of the pump cover.

Figure 3: PMPT Cutaway View

Principle of Operation

The PMPT Pressure Motive Pump-Trap replaces a stand-alone steam trap, typically when draining process equipment that uses a modulating control or regulating valve. The PMPT allows condensate discharge under all operating conditions of modulating equipment, including vacuum. The PMPT is for applications requiring compact design due to spatial constraints and is used when liquids must be moved to higher elevation, higher pressure, or extended distances. The PMPT is intended to work in a closed loop (pressurized) system, for drainage of a single source of steam heating equipment.

A PMPT consists of a pump tank, float with internal operating mechanism, internal steam trap, and a set of inlet and outlet check valves. The positions of the vent and motive valves control the filling and discharge of the pump. The vent valve must be open during the filling cycle to allow air or steam in the pump to be displaced as water enters the pump. Since condensate flows into the pump by gravity, the pump tank pressure must be neutralized for the pump tank to fill. The PMPT uses pressurized gas such as steam or air to motivate and pump the condensate.

1. When the pump is in the normal start up position, the float mechanism will be at its lowest point with the vent valve open and the motive pressure valve closed. At this point the internal steam trap will be in the closed position. The steam trap will not open until enough condensate fills the pump to lift the float mechanism.

2. When steam pressure to the heat transfer equipment is sufficient to overcome system backpressure, the condensate passes through the steam trap into the return line. Since there is enough pressure to allow for the condensate to pass through the steam trap into the return line, condensate will not build up in the tank, therefore the pump will not cycle. The integral steam trap ensures condensate drainage while preventing the loss of live steam.

3. When the modulating steam valve begins to close, steam pressure will eventually fall below system backpressure and condensate will begin to accumulate in the pump body. As condensate fills the pump, the float mechanism begins to rise.

4. The float mechanism will continue to rise until it reaches the upper trip point. When the spring loaded mechanism reaches the trip point, it snaps over the center and the motive pressure valve opens and the vent valve closes.

5. When the motive valve opens, the pump becomes pressurized, opening the outlet check valves and discharging condensate out of the tank. A check valve placed at the condensate inlet will stop the condensate from being pumped back into the receiver. As the condensate flows out of the pump under the motive pressure, the float begins to drop.

6. When the float reaches the low trip point, the mechanism snaps over the center and the motive pressure valve closes and the vent valve opens. The pressure in the pump is released and the condensate is able to once again flow from the receiver down into the pump.

Installation – Closed Loop (Pressurized) System

1. The pump must be installed standing in the vertical position and located below the equipment to be drained. It is important that the preferred operating filling head be established from the top of the pump body to the underside of the reservoir for the closed system. **Note:** Additional filling head can increase pump capacity.

2. **Closed Loop Reservoir:** A reservoir should be installed before and above the pressure motive pump-trap. This allows a vessel for condensate to collect while the pump is pumping condensate, so that the process equipment does not become flooded. If an existing tank or fabricated one is to be used, be sure to verify that the vessel is properly sized for the application. Please consult our sizing guide on Page 10 of this instruction.

3. Connect the inlet and outlet check valves to the pump. **Caution:** Make sure that the flow arrows on the check valves are oriented in the proper direction. For optimum performance, 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 reservoir and outlet check to the discharge line. It is recommended that full port isolation valves be used for the pump, matching the line size.

4. Connect the operating steam supply pressure to the motive inlet connection (1/2" FNPT) at the top of the pump cover. Motive pressure line should always be equipped with a pressure gauge, an isolation valve, strainer and a steam trap. The motive steam drip trap condensate discharge may be piped to the top of the reservoir or pump discharging line. A gauge glass may be installed on the pump to aid as a visual guide for pump operation.

5. **Pump Vent (Equalization) Line:** Install a pipe line from the pump vent connection (1/2" FNPT) to the top of the receiver. This piping is extremely important to ensure proper operation of the pump and system. Since water flows into the pump by gravity, the pump tank pressure must be neutralized for the pump tank to fill.

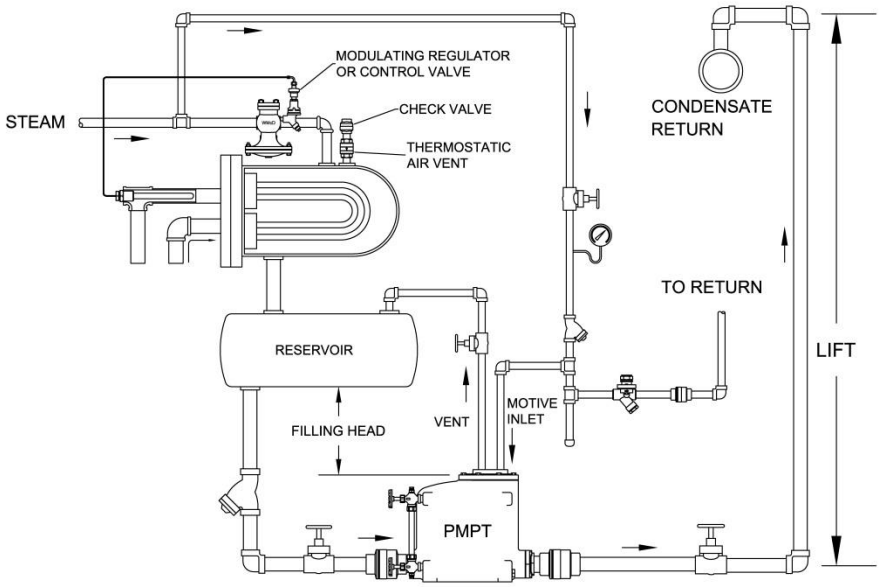

Figure 4: Closed Loop Pump System

Start up

1. Gradually open steam supply to provide pressure at the pump motive inlet. Make sure the drip trap on the motive line is operational.

2. Completely open the full port isolation valves on the pump vent/exhaust lines, the pump outlet lines and lastly the condensate inlet line.

3. Open the isolation valve(s) ahead of the pump receiver allowing condensate to enter the vessel and begin to fill the pump body below it. Pump will discharge when full. Gauge glass installed on pump will show level of condensate fill.

4. Carefully observe the PMP unit. The pump(s) should cycle periodically (exception, see Note) with an audible sound (if the surrounding areas conditions make it permissible) at the end of each pumping cycle. If any irregularities are observed, recheck installation and start-up instructions for proper procedure, or call the applications engineering department for assistance.

Note: PMPT may not trip/cycle under <u>normal operation</u> if there is sufficient pressure to push condensate through the pump against the back pressure.

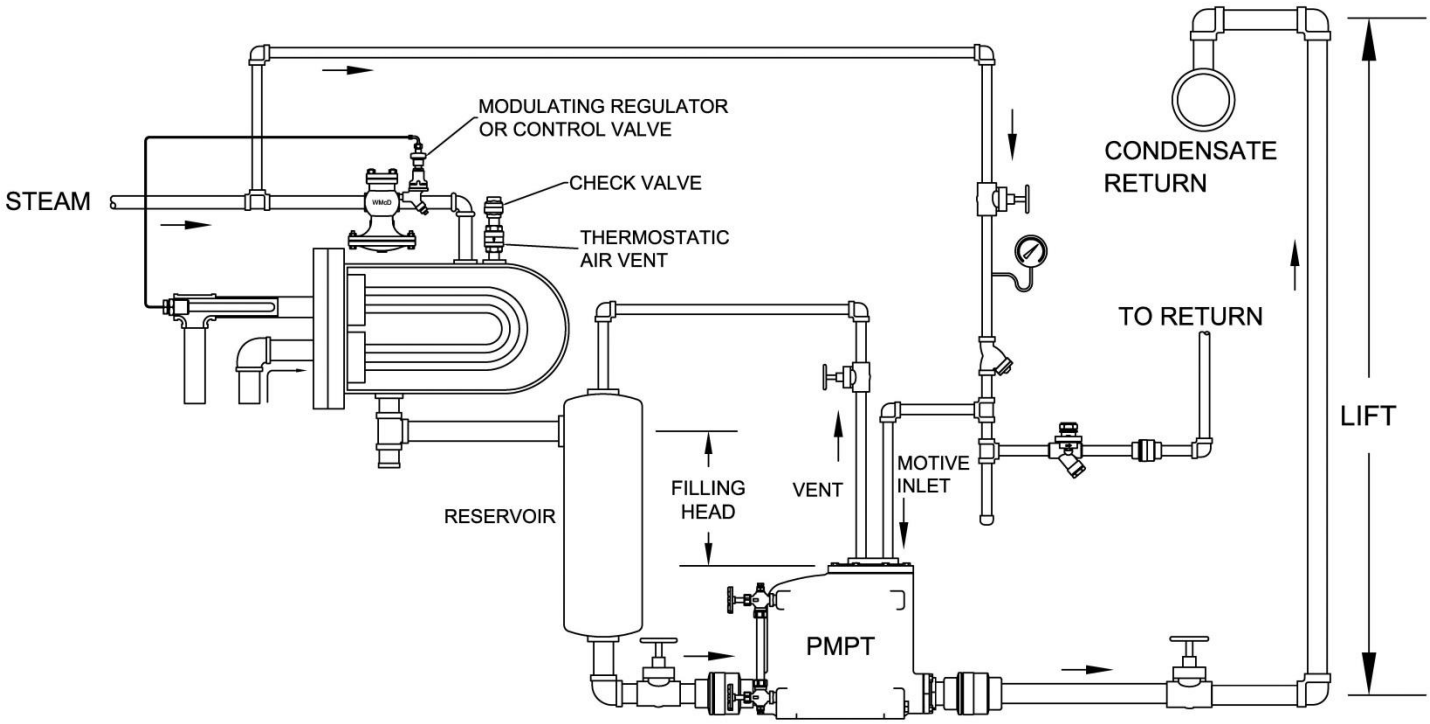

Figure 5: Closed Loop Pump System with Vertical Reservoir when Fill Head is Restricted

Maintenance

If problem with pump operation arises and before any maintenance on the pump is performed, review troubleshooting section on page 9. If deemed necessary to inspect pump internals, follow procedure below.

Close all pump isolation valves. Make certain no pressure is trapped in the system. Allow unit and piping to cool to room temperature.

1. Remove the motive pressure and vent piping connections. Remove bolts from top cover and lift complete mechanism out of pump body.

2. Inspect mechanism for wear, dirt, and scale. Make sure the mechanism moves as intended. Remove check valves and inspect for any dirt or debris that could be obstructing the valve. Clean seating surfaces then reinstall or replace if necessary.

3. Check the (2) springs and pins. If either is defective, remove and replace with new springs and pins.

4. Inspect motive pressure inlet and vent valves. Clean the valve and seats, and replace if necessary. If pump is not cycling during stall conditions, check motive pressure and adjust to 5 psi min. above the backpressure. If the motive pressure valve is leaking, the inlet valve may be obstructed or damaged. With the pump isolated, remove the cover and inspect. Replace the inlet valve and seat assembly, if necessary.

Note: PMPT may not trip/cycle under normal operation if there is sufficient pressure to push condensate through the pump against the back pressure.

5. Confirm that the pump mechanism is in the proper orientation when reassembling. Replace cover gasket with new gasket. Make sure that the seating surface is clean of any dirt or debris. When placing mechanism cover assembly into the pump body, ensure that the plunger rod sets into the steam trap mechanism. See Figure 7 & 8 for plunger rod and plunger rod insert on the trap mechanism. If inserted correctly, cover will sit slightly above the cover gasket. You will be able to feel a springing when pressed down on the cover. See figure 6. The cover bolts should be torqued to approx. 20 ft.-lbs. Reconnect the motive and vent lines to the pump, refer to the installation instructions. After the pump is reinstalled, follow the start-up procedures to bring the pump into operation.

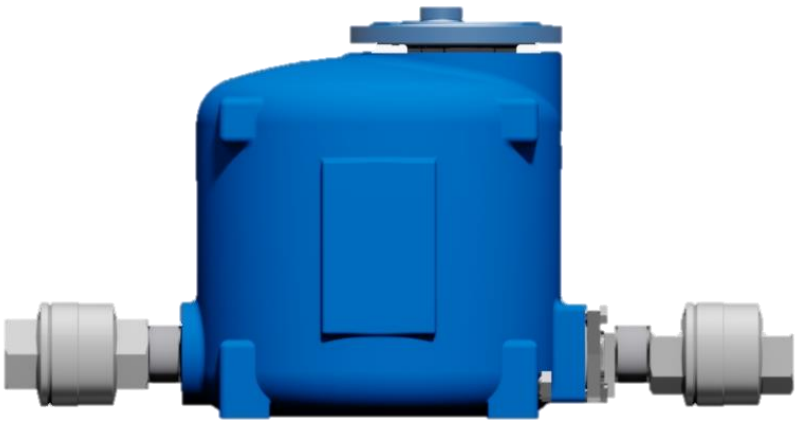

Figure 6: Cover Assembly Installation

Maintenance cont.

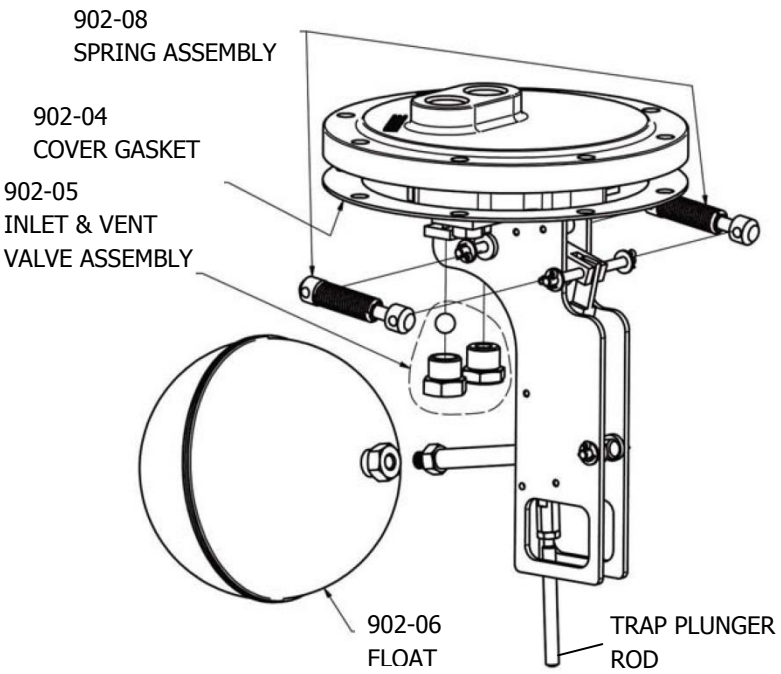

Figure 7: 912-03 Complete Pump Mechanism for PMPT

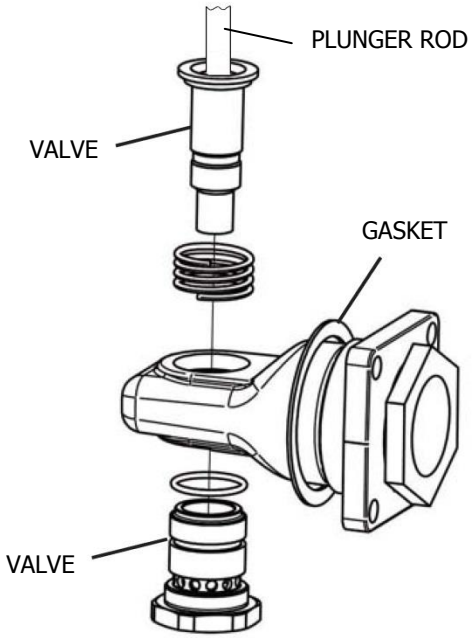

Figure 8: 917-03 Internal Trap Assembly Mechanism for PMPT

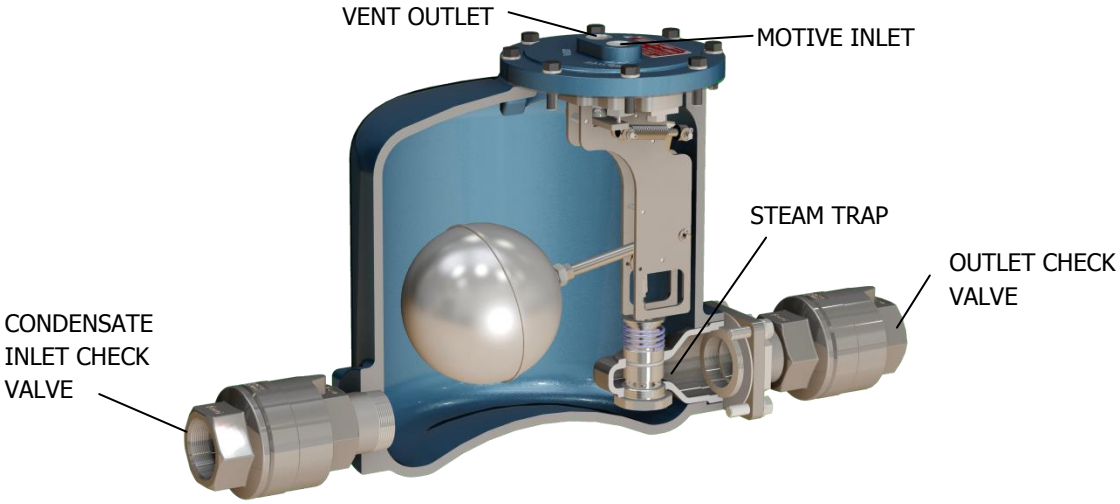

Figure 9: PMPT Cutaway View

Ordering Spare Parts

Model	Kit Order #	Description
PMPT & PMPTS	**W-KIT-902-04**	Cover Gasket
	W-KIT-902-05	Inlet & Vent Valve Assembly
	W-KIT-902-06	Float & Cover Gasket
	W-KIT-902-08	Spring Assembly
	W-KIT-912-03	Complete Pump Mechanism Assembly & Gasket PMPT
	W-KIT-912-03-SS	Complete Pump Mechanism Assembly & Gasket PMPTS
	W-KIT-917-03	Internal Trap Assembly Mechanism & Gasket

System Troubleshooting

PROBLEM	POSSIBLE CAUSE	CAUSE CORRECTION
1. Pump fails to operate on startup.	a) Condensate pressure higher than back pressure. Therefore pump is not required to move condensate and will operate without cycling.	a) If condensate pressure is greater than system back pressure, condensate will flow through pump and into condensate return line. Pump will only fill once beck pressure exceeds condensate pressure.
	b) Motive pressure line closed	b) Open valve to supply motive pressure to pump.
	c) Motive pressure insufficient to overcome backpressure	c) Check motive pressure and backpressure. Adjust motive pressure to 5 psi (min.) higher than the backpressure.
	d) Condensate inlet line closed	d) Open all valves to supply liquid to the pump.
	e) Condensate discharge line closed	e) Open all valves on the discharge side of the pump
	f) Pump vapor-locked	f) Break vent connection at pump cover. Stand clear of vent connection. If pump begins to cycle, vapor locking has occurred. Re-check that the exhaust tie-back line is unobstructed and completely self-draining (no low points for condensate to collect) to a lower pressure area with sufficient vapor space. Check that reservoir is not flooded and preventing pump from venting off.
	g) Insufficient filling head to allow pump to trip	g) Verify required filling head is large enough for condensate to drain freely by gravity into the pump properly. Raise condensate source or lower pump to achieve required filling head.
2. Condensate 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 to achieve required capacity	b) Verify required filling head is large enough for condensate to drain freely by gravity into the pump properly. Raise condensate source or lower pump to achieve required filling head.
	c) No reservoir (see sizing and installation guidelines)	c) Install reservoir to allow condensate to drain from equipment while pump is in pumping mode.
	d) Restriction in liquid inlet line	d) Check that only full ported fittings are used. Clean the strainer. Verify that all valves are fully open
	e) Inlet check valve stuck open	e) Isolate inlet check valve and relieve pressure. Remove cap and visually inspect for debris. Clean seating surfaces and reinstall or replace, if necessary
	f) Pump undersized	f) Verify rated capacity in the sizing capacity table. Increase check valve size, increase motive pressure, and/or increase filling head. Install additional pump as required.
3. Condensate 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 5 psi (min.) above backpressure. Do not exceed rated pressure limits of equipment

PROBLEM	POSSIBLE CAUSE	CAUSE CORRECTION
3. (continued) Condensate backup and equipment flooded, and pump has stopped cycling **SAFETY NOTE TO PREVENT INJURY: For steps (d) through (g), it is necessary to disconnect the vent line at the pump head. It is possible that hot condensate may run out of the vent connection when broken.**	b) Discharge line closed via valve blocked with debris	b) Compare motive pressure and backpressure. If backpressure is higher or equal, a closed or blocked discharge.
	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 is a possible indication that the inlet check valve is stuck closed. Isolate the pump and check valve and relieve line pressure. Remove the check valve and visually inspect. Clean seating surfaces and reinstall or replace, if necessary. Reinstall exhaust/tie-back connection and open line
	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 obstructed or 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 as needed
	g) Exhaust/tie-back causing vapor lock	g) Recheck the vent/tie-back piping layout for compliance with the installation instructions. Check that the exhaust tie-back line is unobstructed and completely self-draining (no low points for condensate to collect) to a lower pressure area with sufficient vapor space. Check that reservoir is not flooded and preventing pump from venting off.
4. Pump is blowing by	a) Motive inlet valve leaking and/or worn	a) Gradually open motive supply line, leaving the condensate inlet and discharge lines closed. Observe the vent connection for steam or air leakage. If observed, motive inlet valve is obstructed or damaged. With pump isolated, remove cover and visually inspect. Replace inlet valve and seat assembly
	b) Trap assembly leaking	b) Isolate pump and relieve pressure. Visually inspect assembly for debris, clean seating surfaces and reinstall or replace, if necessary

PMPT Check Valve Capacities

Operating Check Valve - Capacities

CAPACITIES - Condensate (lbs/hr) Using steam as a motive pressure			
Motive Pressure (PSIG)	Total Back Pressure (PSIG)	Check Valve Size	
		1" x 1"	1-1/2" x 1-1/2"
		6" Head	6" Head
5	2	150	258
10	5	302	523
10	2	409	704
25	15	791	1380
25	10	1020	1780
25	5	1224	2110
50	40	839	1470
50	25	1012	1770
50	10	1318	2280
75	60	810	1420
75	40	1122	1970
75	15	1241	2150
100	80	490	859
100	60	969	1700
100	40	1209	2100
100	15	1318	2260
125	115	146	256
125	100	371	649
125	80	634	1110
125	60	961	1680
125	40	1054	1830
125	15	1046	1780

TRAP CAPACITIES	
Differential Pressure (PSIG)	Capacity - Condensate (lbs/hr)
5	3470
10	4126
20	4907
30	5430
40	5835
50	6170
65	6588
75	6828
100	7337
125	7758

Capacity Correction Factor for Alternate Fill Heads				
Inlet Size	Filling Head			
	0"	6"	12"	18"
1"	0.70	1.00	1.16	1.28
1-1/2"	0.70	1.00	1.16	1.28

Sizing Closed Loop Reservoir

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.

When sizing Pressure Motive Pump-Traps 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, optional pipe diameters and lengths can be selected to provide the same or greater volume. Watson McDaniel can furnish customized Pressure Motive Pump Trap 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	0.084	0.622	0.109	0.3039	0.00211	0.546	0.147	0.2341	0.00162
3/4	1.05	0.824	0.113	0.5333	0.0037	0.742	0.154	0.4324	0.003
1	1.315	1.049	0.133	0.864	0.006	0.957	0.179	0.719	0.00499
1 1/4	1.66	1.38	0.14	1.496	0.01039	1.278	0.191	1.283	0.00891
1 1/2	1.9	1.61	0.145	2.036	0.01414	1.5	0.2	1.767	0.01227
2	2.375	2.067	0.154	3.356	0.0233	1.939	0.218	2.953	0.02051
2 1/2	2.875	2.469	0.203	4.78	0.03325	2.323	0.276	4.238	0.02943
3	3.5	3.068	0.216	7.393	0.05134	2.9	0.3	6.605	0.04587
3 1/2	4	3.548	0.226	9.887	0.06866	3.364	0.318	8.888	0.06172
4	4.5	4.026	0.237	12.73	0.08884	3.826	0.337	11.5	0.07984
5	5.563	5.047	0.258	20.01	0.1389	4.813	0.375	18.19	0.1263
6	6.625	6.065	0.28	28.89	0.2006	5.761	0.432	26.07	0.181
8	8.625	7.981	0.322	50.03	0.3474	7.625	0.5	45.66	0.3171
10	10.75	10.02	0.365	78.85	0.5476	9.564	0.593	71.84	0.4989
12	12.75	11.938	0.406	111.9	0.7773	11.376	0.687	101.6	0.7058
14	14	13.124	0.438	135.3	0.9394	12.5	0.75	122.7	0.8522
16	16	15	0.5	176.7	1.227	14.314	0.843	160.9	1.118
18	18	16.876	0.562	223.7	1.553	16.126	0.937	204.2	1.418
20	20	18.814	0.593	278	1.931	17.938	1.031	252.7	1.755
22	22	21.25	0.375	354.7	2.463	19.75	1.125	306.4	2.127
24	24	22.626	0.687	402.1	2.792	21.564	1.218	365.2	2.536