

PRESSURE MOTIVE PUMPS

SERIES PMPC, PMP, PMPSS, PMPLS, PMPHP, PMPBP & PMPM

INSTALLATION & MAINTENANCE INSTRUCTIONS

Applications

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

- Condensate from Vacuum or Low Pressure Systems
- Condensate Systems with High Back Pressure
- Any Steam Condensing Equipment (*i.e.*, Heat Exchangers, Condensers, Turbines)
- 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 Motive 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 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.



PMPC



PMP & PMPSS



PMPLS



PMPHP



PMPBP



PMPM



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Manufacturers of:

**PRESSURE & TEMPERATURE REGULATORS - RELIEF VALVES - STEAM TRAPS - CLEAN STEAM PRODUCTS
 LIQUID DRAINERS - PRESSURE PUMPS - EJECTORS - SPECIALTY PRODUCTS**



ASME Sect VIII Div I

PRESSURE MOTIVE PUMPS SPECIFICATIONS

Available Options

- Check Valve Sizes for pump inlet and outlet (Sizes 1", 1 1/2", 2", 3" all with screwed ends)
- 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.

Design Pressure/Temperature Ratings

PMPC, PMP, PMPSS, PMPLS, PMPBP & PMPM:

Bronze Checks125 psig (PMA) @ 400° F (TMA)

SST Checks150 psig (PMA) @ 470° F (TMA)

PMPHP:

SST Checks210 psig (PMA) @ 650° F (TMA)

Maximum Operating Conditions

PMPC, PMP, PMPSS, PMPLS, PMPBP & PMPM:

Bronze Checks125 psig (PMO) @ 352° F (TMO)

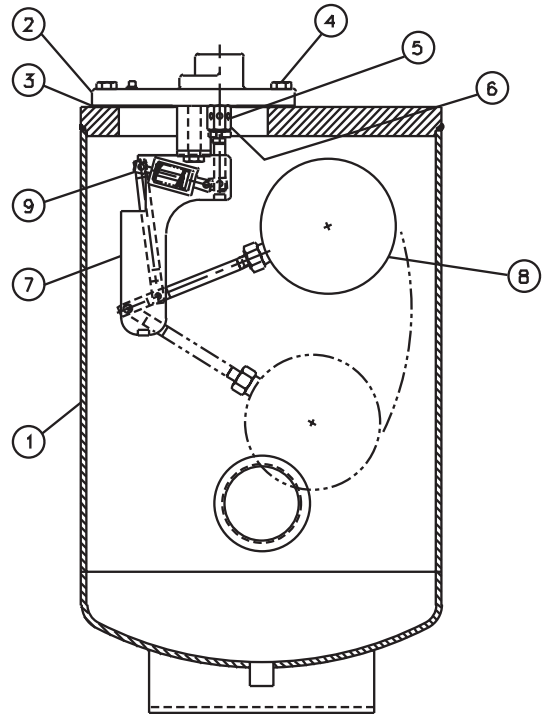
SST Checks150 psig (PMO) @ 366° F (TMO)

PMPHP:

SST Checks200 psig (PMO) @ 600° F (TMO)

Weights

Pump Series	(lbs)
PMPC	385
PMP	240
PMPSS	240
PMPLS	205
PMPHP	270
PMPBP	1050
PMPM	125



Materials

- 1) BodyDuctile Iron, PMPC
Cast Iron, PMPM
304L SST, PMPSS
Carbon Steel, all other Series
- 2) CoverDuctile Iron, PMPC
Cast Iron, PMPM
Carbon Steel, all other Series
- 3) Cover Gasket.....Non Asbestos
- 4) Cover BoltsSteel
- 5) Inlet Valve17-4 PH SST
- 6) Vent Valve17-4 PH SST
- 7) Mechanism Yoke304 SST
- 8) Ball Float.....304 SST
- 9) SpringsInconel
- 10) Other Internal Comp...SST
- 11) Check ValvesSST or Bronze

Product Warranty

Lifetime Warranty on Springs

One Year Warranty on Complete Pump

PRESSURE MOTIVE PUMPS INSTALLATION

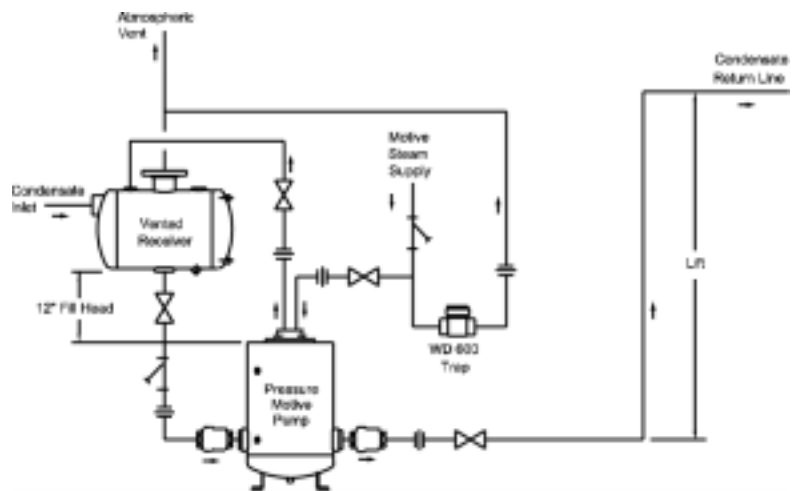
- The pump must be installed standing in the vertical position and located directly under the equipment to be drained. It is important that the preferred minimum filling head of 12" be established from the top of the pump body to the underside of the receiver (vented system) or reservoir for closed loop system.
- Vented Receiver: A vented receiver should be installed before and above the pressure motive pump. If you will be using an existing tank or fabricating one, be sure to verify that the vessel is properly sized and vented for the application. Please consult our sizing guide on page 21c of this manual.
- Closed Loop Reservoir: A reservoir should be installed before and above the pressure motive pump. If you will be using an existing tank or fabricating one, be sure to verify that the vessel is properly sized for the application. Please consult our sizing guide on page 21d of this manual.

- 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 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.

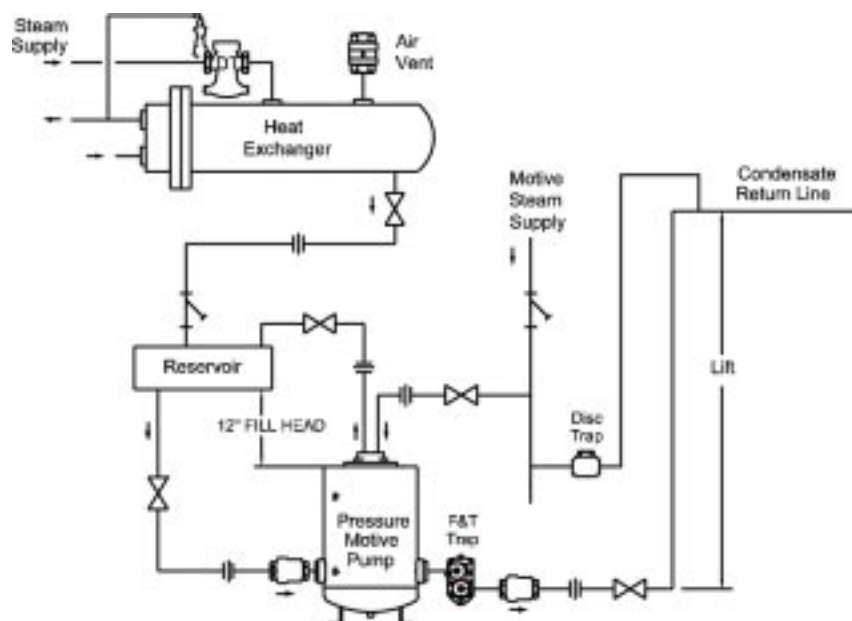
- Connect the operating supply pressure to the motive inlet connection (1/2" FNPT) at the top of the pump head. Motive pressure line should always be equipped with an isolation valve, strainer and a steam trap, if steam supply, or a liquid drainer, if air/gas supply. The trap condensate discharge should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

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

Vented Receiver Pump System



Closed Loop Pump/Trap System



PRESSURE MOTIVE PUMPS

SIZING VENTED RECEIVER

Vented Receiver Sizing			
Flash Steam up to —	Receiver		Vent Line Diameter
	Diameter	Length	
75 pph	4"	36"	1"
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 APPROPRIATE FOR 4" X 4" PUMP 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 Motive 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 a 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

PRESSURE MOTIVE PUMPS

SIZING CLOSED LOOP RESERVOIR

Reservoir Pipe Sizing Closed Loop System									
Condensate Load (lb/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 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. Watson McDaniel can furnish customized Pressure Motive Pump Packages to fit your needs.

Pipe Sizing Data

NPS	Outside Diameter (in)	Schedule 40				Schedule 80			
		Inside Diameter (in)	Wall Thickness (in)	Flow Area		Inside Diameter (in)	Wall Thickness (in)	Flow Area	
				(in ²)	(ft ²)			(in ²)	(ft ²)
1/2	0.840	0.622	0.109	0.3039	0.002110	0.546	0.147	0.2341	0.001626
3/4	1.050	0.824	0.113	0.5333	0.003703	0.742	0.154	0.4324	0.003003
1	1.315	1.049	0.133	0.8640	0.006002	0.957	0.179	0.719	0.004995
1 1/4	1.660	1.380	0.140	1.496	0.01039	1.278	0.191	1.283	0.00891
1 1/2	1.900	1.610	0.145	2.036	0.01414	1.500	0.200	1.767	0.01227
2	2.375	2.067	0.154	3.356	0.02330	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	3.500	3.068	0.216	7.393	0.05134	2.900	0.300	6.605	0.04587
3 1/2	4.000	3.548	0.226	9.887	0.06866	3.364	0.318	8.888	0.06172
4	4.500	4.026	0.237	12.73	0.08840	3.826	0.337	11.50	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	0.280	28.89	0.2006	5.761	0.432	26.07	0.1810
8	8.625	7.981	0.322	50.03	0.3474	7.625	0.500	45.66	0.3171
10	10.750	10.020	0.365	78.85	0.5476	9.564	0.593	71.84	0.4989
12	12.750	11.938	0.406	111.9	0.7773	11.376	0.687	101.6	0.7058
14	14.000	13.124	0.438	135.3	0.9394	12.500	0.750	122.7	0.8522
16	16.000	15.000	0.500	176.7	1.227	14.314	0.843	160.9	1.118
18	18.000	16.876	0.562	223.7	1.553	16.126	0.937	204.2	1.418
20	20.000	18.814	0.593	278.0	1.931	17.938	1.031	252.7	1.755
22	22.000	21.250	0.375	354.7	2.463	19.750	1.125	306.4	2.127
24	24.000	22.626	0.687	402.1	2.792	21.564	1.218	365.2	2.536

PRESSURE MOTIVE PUMPS

Start-Up Procedure for 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 PMP 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 application 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 spring
- Waterlogged or damaged float
- Always use a new cover gasket when reassembling

Spare Parts

Kit # 900-5 Supply & Vent valve assembly for PMPC, PMP, PMPSS, PMPLS, PMPHP & PMPM

Kit # 900-15 for PMPBP

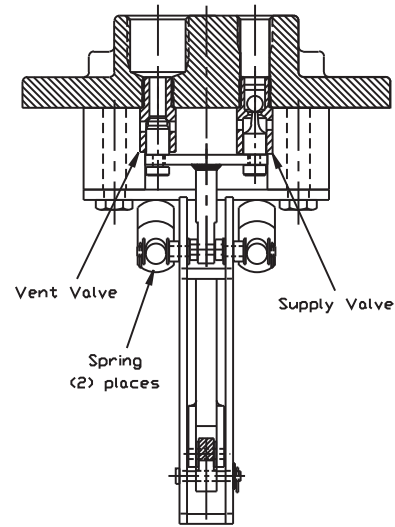


SUPPLY VALVE & SEAT ASSEMBLY



VENT VALVE & SEAT ASSEMBLY

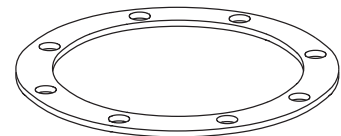
Kit # 910-3 Complete Pump Mechanism for PMPC & PMPLS / Kit # 900-3 for PMP & PMPHP



FLOAT BALL NOT SHOWN

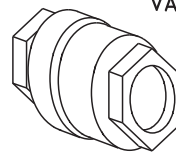
Kit # 900-4 Cover Gasket for PMPC, PMP, PMPSS, PMPLS & PMPHP. Kit # 900-14 for PMPBP.

COVER GASKET

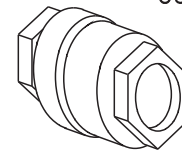


Individual check valves: order by size & material

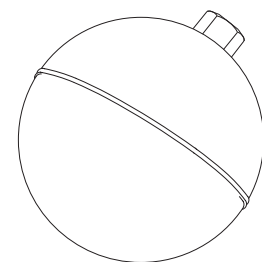
INLET CHECK VALVE



OUTLET CHECK VALVE



Kit # 900-6 Float w/ cover gasket for all except PMPBP
Kit # 900-16 for PMPBP



FLOAT

PRESSURE MOTIVE PUMPS

TROUBLESHOOTING

Problem	Cause	Action Point
1. Pump fails to operate on startup.	1. a. Motive pressure line closed. b. Motive pressure insufficient to overcome backpressure. c. Liquid inlet line closed. d. Liquid discharge line closed. e. Pump air-locked.	1. a. Open valves to supply motive pressure to pump. b. Check motive pressure and backpressure. Adjust motive pressure to 10 psi higher than the backpressure. c. Open all valves to supply liquid to the pump. d. Open all valves on the discharge side of the pump. e. Open System: Make sure that vent line is unrestricted to atmosphere and self-draining.
2. Liquid backup and equipment flooded, but pump appears to cycle normally.	f. Check valve(s) installed in wrong direction. 2. a. Motive pressure is too low to achieve required capacity. b. Insufficient filling head. c. Restriction in liquid inlet line. d. Inlet check valve stuck open. e. Pump undersized.	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 is in accordance with the installation instructions. Install a thermostatic air vent at a high point in the exhaust line. Ensure that the tie-back line is self-draining. f. Reverse the check valve(s) to follow flow direction of system. 2. a. Check motive pressure setting and maximum backpressure during operation. Check against sizing table. Increase motive pressure as required. b. Verify required filling head. Lower pump to achieve required filling head. c. Check that only full ported fittings are used. Clean the strainer. Verify that all valves are fully open. 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. Verify rated capacity in the sizing capacity table. Increase check valve size or install additional pump as required.

PRESSURE MOTIVE PUMPS**TROUBLESHOOTING (cont'd.)****Problem**

3. (cont'd)
Liquid 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. 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.

Cause

3. a. Motive pressure too low.
- b. Discharge line closed via valve blocked with debris.
- c. Outlet check valve stuck closed.
- d. Inlet check valve stuck closed.
- e. Motive inlet valve leaking and/or worn.
- f. Mechanism Failure
 1. Ruptured float
 2. Mechanism binding

Action Point

3. 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. Compare motive pressure and backpressure. If equal, a closed or blocked discharge line is possible. Check valves downstream of pump.
- 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. 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.
- e. Gradually open motive supply line, leaving the condensate inlet and discharge lines closed. Observe the vent connection for steam or air leakage. If leakage is observed, inlet valve is damaged. With pump isolated, remove cover and visually inspect. Replace inlet valve and seat assembly.
- 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 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.

PRESSURE MOTIVE PUMPS TROUBLESHOOTING (cont'd.)

Problem	Cause	Action Point
3. (cont'd) Liquid backup and equipment flooded, and pump has stopped cycling.	3. a. Exhaust/tie-back causing vapor lock (vented or closed loop).	3. g. If mechanism is heard to trip and no fluid is observed running out 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.	4. 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. b. Pump is blowing-by.	4. a. Install a vacuum breaker at high point in return line. For pressurized return systems, an air eliminator may be required downstream of the vacuum breaker. 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, an 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 cycle when low load pump pressures are present.
5. Vent line discharging excessive flash steam (vented applications only).	5. a. Faulty steam traps discharging live steam into condensate inlet line. (See also 4(b), Pump is blowing-by). b. Excessive flash steam being vented through pump. c. Vent valve stuck or worn.	5. a. Check for leaking traps discharging into condensate return. Repair or replace faulty traps. (See also 4(b), pump is blowing-by). b. Vent receiver or reservoir piping ahead of pump. 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.

PRESSURE MOTIVE PUMPS

SIZING AND SELECTION — Bronze Check Valves

Liquid Capacity - in lbs/hr using steam as motive media at indicated Filling Head

Inlet Press (psig)	Total Lift (psig)	1"x1" 6" Head	1½"x1" 12" Head	1½"x1½" 12" Head	2"x1" 12" Head	2"x1½" 12" Head	2"x2" 12" Head	3"x2" 12" Head	4"x4" 24" Head	3"x2" Duplex	3"x2" Triplex	3"x2" Quadraplex
5	2	1600	2558	2750	3668	4031	4430	5560	-	11,120	16,680	22,240
10	5	1700	2781	2990	4844	5324	5850	6800	-	13,600	20,400	27,200
10	2	2000	3134	3370	6227	6843	7520	8960	-	17,920	26,880	35,840
25	15	1500	3236	3480	4604	5060	5560	6280	-	12,560	18,840	25,120
25	10	1800	3376	3630	5631	6188	6800	7930	-	15,860	23,790	31,720
25	5	2100	4064	4370	6476	7116	7820	9470	-	18,940	28,410	37,880
50	40	1500	3060	3290	3925	4313	4740	5250	-	10,050	15,750	21,000
50	25	1800	3674	3950	5615	6170	6780	8030	-	16,060	24,090	32,120
50	10	2100	4064	4370	6227	6843	7520	8960	-	17,920	26,880	35,840
75	60	1400	3255	3500	4182	4596	5050	5660	-	11,320	16,980	22,640
75	40	1800	3543	3810	5010	5506	6050	7000	-	14,000	21,000	28,000
75	15	2200	4018	4320	6227	6843	7520	8960	-	17,920	26,880	35,840
100	80	1500	3162	3400	4265	4687	5150	5770	-	11,540	17,310	23,080
100	60	1700	3543	3810	4944	5433	5970	6900	-	13,800	20,700	27,600
100	40	1900	4111	4420	5548	6097	6700	7830	-	15,660	23,490	31,320
100	15	2200	4334	4660	6484	7125	7830	9370	-	18,740	28,110	37,480
125	115	1300	2957	3180	3495	3840	4220	4430	-	8860	13,290	17,720
125	100	1400	3162	3400	4008	4404	4840	5150	-	10,300	15,450	20,600
125	80	1500	3441	3700	4604	5060	5560	6280	-	12,560	18,840	25,120
125	60	1700	3729	4010	5200	5715	6280	7310	-	14,620	21,930	29,240
125	40	1900	4287	4610	5797	6370	7000	8340	-	16,680	25,020	33,360
125	15	2200	4520	4860	6567	7216	7930	9680	-	19,360	29,040	38,720

Capacity correction factors for different filling heads

Pump Inlet size	Filling Head						
	6"	12"	18"	24"	36"	48"	60"
1"	1.0	1.1	1.2	1.3	1.5		
1½"-2"	0.7	1.0	1.1	1.2	1.35		
3"	0.84	1.0	1.04	1.08	1.2		
4"			0.8	1.0	1.1	1.15	1.2

Capacity correction factors for Gas motive supply

Pump Size	% backpressure vs. Motive pressure								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
1"	1.10	1.13	1.16	1.20	1.25	1.30	1.35	1.40	1.45
1½"-3"	1.04	1.06	1.08	1.10	1.12	1.15	1.18	1.23	1.28
4"	No capacity change								

PRESSURE MOTIVE PUMPS

SIZING AND SELECTION — Stainless Steel Check Valves

Liquid Capacity - in lbs/hr using steam as motive media at indicated Filling Head

Inlet Press (psig)	Total Lift (psig)	1"x1" 6" Head PMPLS	1½"x1" 12" Head	1½"x1½" 12" Head	2"x1" 12" Head	2"x1½" 12" Head	2"x2" 12" Head	3"x2" 12" Head	4"x4" 24" Head	3"x2" Duplex	3"x2" Triplex	3"x2" Quadraplex
5	2	1760	1860	1920	2860	3180	3540	5000	16,600	10,000	15,000	20,000
10	5	1870	2200	2450	4350	4840	5380	7210	19,000	14,420	21,630	28,840
10	2	2200	3030	3370	6880	7650	8500	11110	22,600	22,220	33,330	44,440
25	15	1650	3130	3480	4990	5550	6170	8230	33,200	16,460	24,690	32,920
25	10	1980	3600	3990	6560	7290	8100	10780	40,300	21,560	32,340	43,120
25	5	2300	4700	5200	7970	8860	9850	13350	46,200	26,700	40,050	53,400
50	40	1650	2280	2530	3370	3750	4170	5670	33,300	11,340	17,010	22,680
50	25	1980	4050	4500	6800	7560	8400	11550	40,100	23,100	34,650	46,200
50	10	2300	4700	5240	7970	8860	9850	13440	47,000	26,880	40,320	53,760
75	60	1540	2400	2660	3600	4000	4440	6340	32,900	12,680	19,020	25,360
75	40	1980	3780	4190	5920	6580	7320	9870	39,400	19,740	29,610	39,480
75	15	2420	5130	5700	8580	9540	10600	14330	47,200	28,660	42,990	57,320
100	80	1650	2750	3060	4160	4630	5150	6860	27,200	13,720	20,580	27,440
100	60	1870	3600	4000	5560	6180	6870	9100	35,100	18,200	27,300	36,400
100	40	2090	4700	5210	6880	7650	8500	11270	42,100	22,540	33,810	45,080
100	15	2420	5400	6010	8740	9720	10800	14330	48,000	28,660	42,990	57,320
125	115	1430	2380	2640	3270	3640	4050	4960	19,500	9920	14,880	19,840
125	100	1540	2980	3300	4140	4600	5130	6390	25,300	12,780	19,170	25,560
125	80	1760	3430	4100	5400	6000	6670	8540	32,200	17,080	25,620	34,160
125	60	1980	4170	4850	6600	7340	8160	10530	38,500	21,060	31,590	42,120
125	40	2200	5100	5950	7760	8630	9590	12500	44,000	25,000	37,500	50,000
125	15	2420	5850	6660	9240	10270	11420	15100	49,200	30,200	45,300	60,400
150	120	1590	2650	2940	3400	3780	4200	5690	21,600	11,380	17,070	22,760
150	100	1640	3150	3490	4320	4800	5350	7000	29,000	14,000	21,000	28,000
150	80	1860	3800	4230	5490	6100	6770	9100	34,500	18,200	27,300	36,400
150	60	2080	4500	5000	6660	7400	8240	11120	40,300	22,240	33,360	44,480
150	40	2300	5290	5870	7920	8800	9780	13220	44,700	26,440	39,660	52,880
150	15	2520	6100	6820	9450	10500	11680	15500	49,500	31,000	46,500	62,000
175	120	1680	2870	3150	3580	4000	4450	5960	-	11,920	17,880	23,840
175	100	1770	3370	3720	4500	5000	5590	7700	-	15,400	23,100	30,800
175	80	1980	3960	4470	5680	6350	6920	9440	-	19,880	28,320	37,760
175	60	2210	4740	5240	6900	7580	8350	11480	-	22,960	34,440	45,920
175	40	2420	5600	6040	8150	8920	9880	13550	-	27,100	40,650	54,200
175	15	2630	6260	6970	9750	10520	11680	15780	-	31,560	47,340	63,120
200	120	1800	3090	3350	3720	4190	4680	6270	-	12,540	18,810	25,080
200	100	1810	3600	3940	4680	5190	5800	8020	-	16,040	24,060	32,080
200	80	2100	4160	4660	5820	6520	7080	9720	-	19,440	29,160	38,880
200	60	2330	4950	5450	7080	7720	8480	11800	-	23,600	35,400	47,200
200	40	2530	5790	6220	8400	8900	10040	13900	-	27,800	41,700	55,600
200	15	2740	6440	7080	1000	10700	11880	16080	-	32,160	48,240	64,320

See fill head correction factors on page 21i.

Founded in 1878 Watson McDaniel has been providing a wide range of products and service to industry that have served to make the operation of steam, compressed air, heat transfer, and fluid systems more effective and efficient. The company's goal through the years, and at the heart of its success, is a strong tradition of service and response to customer needs.

An ongoing product development and enhancement program assures Watson McDaniel customers unequaled dependability and long service life. These efforts and improvements in product dependability are to be expected by the one steam specialty supplier with over 120 years experience serving the needs of industry with pride and dedication.

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With a strong commitment to manufacturing Watson McDaniel has invested heavily in the infrastructure of its machining, assembly, inspection, and shipping operations. Its state of the art machine shop, considered one of the most modern in the industry, offers the capability to quickly respond to needs in the marketplace.

Watson McDaniel serves the global marketplace with a network of Manufacturer's Representatives and Distributors. This local and regional level of service and support assures immediate response to steam and systems questions and service requirements.

Watson McDaniel provides service, through its network of Manufacturer's Representatives and Distributors, systems knowledge with over 120 years of field service, and a range of products designed from the users perspective.

Watson McDaniel. Precision manufactured products for business and industry, since 1878.



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