The Pivotrol[®] Pressure Powered Pump

Featuring Reliable PowerPivot[®] Technology for the effective removal of condensate from steam systems



Effective condensate system management is

Efficient handling of condensate is essential if overall plant efficiency, energy conservation and product quality are to be maintained.

Spirax Sarco offers solutions for maintaining efficiency in all areas of condensate pumping systems by providing equipment in various materials of construction and technical assistance for proper installation.

Condensate management

When condensate leaves the steam trap, it contains approximately 20% of the heat energy transferred in the boiler to generate steam.

Total condensate management prevents:

- Excessive blowdown
- Loss of expensive heat energy
- Waste of water treatment chemicals
- High make-up water costs
- Added costs to preheat feedwater

All too often these problems are just accepted simply because no readily available solution exists.

Condensate removal

Condensate removal is necessary on all temperature-controlled heat exchange and process equipment to provide stable operating conditions.

Efficient condensate removal prevents:

- Unstable product temperatures
- Product quality problems
- Excessive corrosion
- Equipment damage and noise caused by waterhammer

The total system solution

The Spirax Sarco Pivotrol[®] (Patent Pending) Pressure Powered Pump[®] is specifically designed to remove condensate under all operating conditions and provides the unique opportunity to solve all condensate handling problems.

The pump is a self-contained unit using steam or other pressurized gas as its motive power. There are no electric motors or level switches, simplifying installation and making it ideal for wet or hazardous areas.

One pump design covers all applications from vacuum systems to highly efficient heat exchangers, including general condensate return.

The Pivotrol[®] Pump featuring reliable PowerPivot[®] technology, outperforms more complicated and expensive condensate handling systems. An added benefit is the ability to effectively pump high temperature fluids.

Plant maintenance problems caused by leaking mechanical seals and cavitation are eliminated.

User benefits

- Removes condensate under all load conditions, even vacuum, ensuring maximum process efficiency.
- No mechanical seals or packing glands to leak, reducing maintenance costs.
- Requires no electrical power. Single trade for installation and repair.
- Cavitation problems eliminated, reducing maintenance costs.
- Suitable for hazardous and demanding environments.
- Zero emissions. No motive steam loss when installed in a closed system, reducing operating costs.
- Minimal Steam Consumption.
- Six-month payback or less. Call your local sales representative for payback analysis.
- 3 Million Cycle x 3 Year Standard Warranty.
- 5 Million Cycle x 5 Year Extended Warranty available.
- Featuring Reliable PowerPivot[®] Technology, designed for reliable trouble free service.
- Cycle Counter included for pump & system monitoring.
- High cycle life check valves specifically designed for pump use.

an essential part of any steam-using plant

How it works

The Pivotrol® Pump operates on a pressure displacement principle.

Liquid enters the pump body through the inlet check valve causing the float to rise. As the chamber fills, the valve changeover linkage is engaged opening the steam inlet valve and closing the exhaust valve. This snap action linkage ensures a rapid change from filling to pumping stroke.

As pressure inside the pump increases above the total back pressure, condensate is forced out through the outlet check valve into the return system.

The liquid level falls within the pump, the float re-engages the valve changeover linkage causing the steam inlet valve to close and the exhaust valve to open.

As the pressure inside the pump body falls, condensate re-enters through the inlet check valve and the cycle is repeated.





Typical applications



Condensate removal from process vessels and heat exchangers & air heaters (pump/trap combination, closed system)

Removal of condensate under all pressure conditions ensures stable temperatures. It also prevents bottom end tube corrosion and potential damage due to waterhammer and freezing.



Drainage of condensate from temperature controlled equipment

Temperature controls, by their operation, create in all heat exchange applications a "stall" condition where condensate cannot flow through the steam trap because of insufficient pressure differential.

Under the stall condition, partial or complete flooding may occur leading to:

- Unstable temperature control
- Leakage of heat transfer equipment due to corrosion
- Damage to equipment caused by waterhammer

The use of the "stall" chart allows the point at which flooding occurs to be determined by plotting the information below:

 T_1 = Inlet product temperature (°F)

- T_2 = Outlet product temperature (°F)
- P_1 = Design steam pressure from the control valve (psig)

P₂ = System back pressure on steam trap (psig)





Plotting the points

- 1. Plot T₁ on left side of chart. Plot T₂ on right side of chart. Draw line connecting these two points.
- 2. Plot P₂ on right side of chart. Draw horizontal line across chart.
- 3. Mark P1 on left side of chart.

- Next 1, other side of chart.
 Plot T_{mean} on line T₁ T₂. Draw a horizontal dotted line to right side of chart.
 Connect P₁ and T_{mean} with the diagonal line.
 At the intersection of line P₁ T_{mean} and P₂, draw line R₁ down to bottom of chart (% load).
- 7. At the intersection of R_1 and line T_1T_2 , draw line horizontally to left and label R_2 .

How to read chart points

- 1. Line R1 intersects the % load axis at the "stall" condensate load. The % load to the right of R1 must be pumped, the% load to the left of R1 will be removed by the trap.
- 2. Line R₂ intersects the temperature axis at the inlet product temperature that will cause stall to occur.

Heat

The Solution

The Spirax Sarco Pressure Powered Pump®/Steam Trap Combination provides the total solution to the stall condition by removing condensate under all pressure conditions.

When steam space pressure is sufficient to overcome back pressure, the trap operates normally.

When pressure falls and before flooding occurs, the Pressure Powered Pump® operates and removes all the condensate by pumping through the steam trap, preventing all the problems associated with the stall condition.

Pressure Powered Pump®/Steam Trap Combinations

When selecting a steam trap for this application on temperature controlled equipment, the Spirax Sarco Float and Thermostatic Steam Trap is recommended. Trap should be sized based on the maximum pressures and flowrates and must be capable of passing the maximum instantaneous discharge rate of the pump.

Vented Receiver*

To drain condensate from a single or multiple source "open" system, a vented receiver should be installed in a horizontal plane above and ahead of the pump. Sufficient receiver volume is needed above the filling head level to accept the condensate reaching the receiver during the pump discharge stroke. More important, the receiver must be sized to allow sufficient area for complete flash steam separation from the condensate. The chart below shows proper vented receiver sizing (per criteria set forth in the A.S.H.R.A.E. Handbook) based on the amount of flash steam present. If the receiver is sized as shown below, there will be sufficient volume for condensate storage and sufficient area for flash steam separation. The receiver can be a length of large diameter pipe or a tank.

Inlet Reservoir Piping**

To drain condensate from a single piece of equipment in a "closed" system, a reservoir should be installed in a horizontal plane above and ahead of the pump. Sufficient reservoir volume is needed above the filling head level to accept the condensate reaching the reservoir during the pump discharge stroke. The chart below shows minimum reservoir sizing, based on condensate load, needed to prevent equipment flooding during the pump discharge stroke. The reservoir can be a length of large diameter pipe or a tank. A Float and Thermostatic steam trap may be required in a closed system (details shown on page 5).



Typical installation

Pressure Powered Pump® sizing and selection

From the inlet pressure, back pressure and filling head conditions given below, select the pump size and check valve package which meets the capacity requirement of the application.

- Specify pump body, type PTC, PTF, or other model. Select optional extras as required.
- For GPM, multiply the capacities below by 0.002.
- For kg/h, multiply the capacities below by 0.454.
- For liquid specific gravities from 0.9 to 0.65, consult Spirax Sarco.
- * Back pressure is the lift height (H) in feet x 0.433 plus psig in return line, plus downstream piping friction pressure drop in psi calculated based on the maximum instantaneous discharge rate of the respective pump selected, see TI sheets.
- Note: To achieve rated capacity, pump must be installed with check valves supplied by Spirax Sarco.

Filling Head		Check valve and piping size, pump type			
Inches	mm	2" x 2" PTC/PTF	3" x 2" PTC/PTF		
-3.0	-76	0.47	-		
-1.0	-25	0.66	0.40		
0.0	0	0.76	0.43		
6.0	152	0.90	0.69		
12.0	305	1.00	1.00		
18.0	457	1.08	1.02		
24.0	610	1.16	1.04		
36.0	914	1.38	1.17		
48.0	1219	1.48	1.25		

Capacity Multiplying Factors for other Filling Heads

Capacity Multiplying Factors for Motive Gas Supply

(other than steam) 2" and 3" x 2" PTC / PTF									
10%	20%	30%	40%	50%	60%	70%	80%	90%	% Back Pressure VS. Motive Pressure (bp / MP)
1.04	1.06	1.08	1.10	1.12	1.15	1.18	1.23	1.28	Capacity Multiplying Factors



Example:

Condensate Load	7,000 lb/h
Steam pressure available for operating pump	80 psig
Vertical lift from pump to the return piping	30 feet
Pressure in the return piping (piping friction negligible)	25 psig
Filling head on the pump available	12 inches

Solution:

- 1. Calculate "H", the total lift or back pressure, against which the condensate must be pumped. H = $(30 \times 0.433) + 25 = 38 \text{ psig}$
- 2. From sizing table with 80 psig inlet pressure and 40 psig back pressure, choose a 2" x 2" pump with stainless steel check valves, which has a capacity of 6,935 lb/h.

Notes from capacity multiplying factor charts (shown below):

- A. Pump capacity if filling head is 24 in.: 1.16 x 6,935 = 8,045 lb/h
- B. Pump capacity using compressed air: $1.12 \times 6,935 = 7,767 \text{ lb/h}$ (% back pressure is $40 \div 80 = 50\%$).



The Pivotrol Pump[®] Patent Pending Selection and Sizing

Motive Pressure	Back Pressure	2" x 2" PTC/PTF	3" x 2" PTC/PTF	3" x 2" PTF-HTF
psig	psig	12" Filling Head Ib/hr	12" Filling Head Ib/hr	12" Filling Head Ib/hr
200	190			
200	160	-	5250	3518
200	140	6375	7375	4941
200	120	7375	9440	6325
200	80	9000	12565	8419
200	60	9685	14260	9554
200	50	10000	14875	9966
200	40	10310	15690	10512
200	20	10950	17000	11390
200	10	11195	17640	11819
180	160		3750	2513
180	140	5425 6685	6335	4244
180	100	7760	10375	6951
180	80	8600	11980	8027
180	60	9450	13625	9129
180	50	9830	14375	9631
180	40 30	10230	15150	10151
180	20	10895	16665	11166
180	10	11195	17505	11728
160	140	4250	4860	3256
160	120	5750	7500	5025
160	80	7040 8065	9375	0281 7460
160	60	9105	12940	8670
160	50	9565	13750	9213
160	40	9990	14565	9759
160	30	10440	15400	10318
160	20 10	11195	17315	11601
140	120	4625	6085	4077
140	100	6120	8145	5457
140	80	7420	10065	6744
140	60 50	8625	12120	8120
140	40	9690	13940	9340
140	30	10245	14875	9966
140	20	10760	15840	10613
140	10	11195	17045	11420
120	80	6475	8625	5779
120	60	7845	10970	7350
120	50	8530	12100	8107
120	40	9240	13160	8817
120	30 20	9865	14250	9546
120	10	11065	16655	11159
100	80	4995	6260	4194
100	60	6620	9255	6201
100	50 40	/500 8370	10680	/156 8067
100	30	9145	13310	8918
100	20	9900	14460	9688
100	10	10630	16100	10787
80	60 50	5010	0485 8435	4345
80	40	6935	10185	6824
80	30	7970	11750	7873
80	20	8870	13250	8878
<u> </u>	10	10000	15190	101//
60	40	5315	7485	5015
60	30	6360	9625	6449
60	20	7460	11580	7759
60	10	9190	13750	9213
50	40 30	5625	8125	5444
50	20	6730	10315	6911
50	10	8690	12755	8546
40	30	4630	5750	3853
40 40	20 10	5850 7930	8700 11470	5829 7685
30	20	4810	5810	3893
30	15	5475	8000	5360
30	10	6820	9690	6492
20	15	4375	5375 7450	3601
<u> </u>	10	J2 IU 4375	6000	4920

Selection and Sizing

2" x 2" Pivotrol Pump



3" x 2" Pivotrol Pump



NEW PIVOTROL® PRESSURE POWERED PUMP DESIGNED FOR LONG CYCLE LIFE

The all-new Pivotrol[®] Pressure Powered Pump is engineered for dependable steam system condensate recovery in rapid cycling environments. Featuring reliable PowerPivot[®] technology and backed by a 3 million cycle x 3-year warranty. The Pivotrol[®] Pump addresses pump maintenance, high-energy consumption, heat exchanger stall, waterhammer and erratic steam system performance. An extended 5 million cycles x 5-year warranty option is also available.

PowerPivot® Technology, What is it?

In all types of Pressure Powered Pump internal components wear, the result of constant mechanical use. Spirax Sarco's new PowerPivot[®] Technology extends the service life of its Pivotrol[®] Pump by drastically limiting the possibility of wear.

Until now, every mechanically driven Pressure Powered Pump has relied on a float to actuate pins and linkages of a spring mechanism, which, in turn, opens a steam valve. Internal mechanisms utilize a number of pins and linkages to transfer the motion and energy required to open and close the inlet and exhaust valves.



Repetitive pin and linkage movement of every cycle continually rub, create friction and, in turn, wear each component. It is the pins and linkages that wear, elongate holes, gall pins and prevent the free movement of the mechanism causing the pump to stick and fail.

PowerPivot[®] Technology virtually eliminates the friction and wear surfaces by replacing the bearing surfaces with pivots. Friction within the mechanism has been reduced to a negligible amount, thus extending the service life of each mechanism. The pivots are manufactured from an exceptionally hard carbide material, which, during operation are virtually wear free.

PowerPivot[®] Technology utilizes a hydraulic paddle to reduce the shock and impact induced from the aggressive snap action of spring linkage mechanisms. As the spring actuates the mechanism, all the energy from the spring is instantaneously transferred to the inlet and exhaust valves. The impact forces imposed by this change over can reduce the life of the inlet and exhaust valves and wear each each of the linkages. The hydraulic paddle acts as a shock absorber eliminating high impact forces thus extending the service life of the Pivotrol[®] Pump mechanism.

The Pivotrol[®] Pump alone exclusively utilizes patent pending PowerPivot[®] Technology to eliminate the high surface contact areas that create friction and wear surfaces. The hydraulic paddle minimizes spring induced impact forces. PowerPivot[®] Technology provides point contact only, virtually eliminating frictional forces that absorb so much of the

float and springs energy. *No bearings, no bushings, no pins, no friction, no sticking, no galling, no wear and no premature failure!*



Spiraxsarco[®] Is the world's leading provider of steam system solutions, dedicated to providing knowledge, service and products for the control and efficient use of steam and other industrial fluids. With over 90 years of experience, Spirax Sarco has both the resources and capabilities to meet customers' total system needs.



For more information on Spirax Sarco, contact your Regional Hub Office below, or call 1-800-883-4411 and you will be connected to the location nearest you.

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