

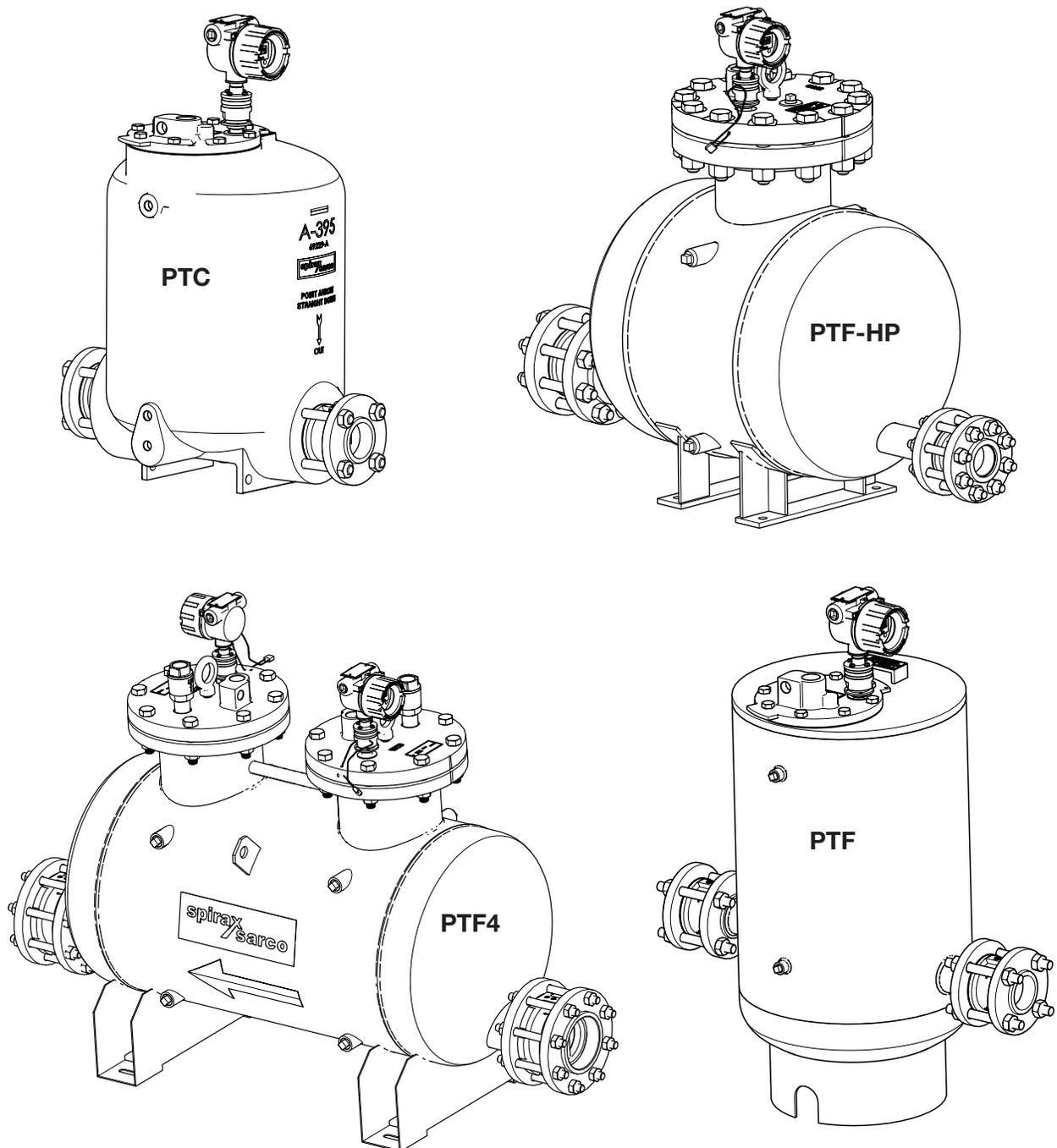


## INSTALLATION AND MAINTENANCE INSTRUCTIONS

IM-5-201-US

September 2017

# THE PIVOTROL PUMP<sup>®</sup> (Patented) Featuring Reliable PowerPivot<sup>®</sup> Technology



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# 1.0 Safety Information

Safe operation of these products can be guaranteed only if they are properly installed, commissioned, used and maintained by qualified personnel (see section 1.11) in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment, must also be compiled with.

## 1.1 Intended Use

Referring to the Installation and Maintenance Instructions, name-plate, and Technical Information sheet, check that the product is suitable for the intended use / application.

- i) The product has been specifically designed for use on steam or water/condensate. The products' use on other fluids may be possible but, if this is contemplated, Spirax Sarco, Inc. should be contacted to confirm suitability for the application being considered.
- ii) For design compliance see chart below. When specifying and ordering a Pivotrol Pump, ensure the correct compliance approval options have been selected.

Regulatory Compliance Options		
	PTC Range	PTF Range
Designed in accordance with ASME VIII, Div. 1	X	X
ASME code stamped to ASME VIII, Div. 1		X
CE	X	X

- iii) The product complies with the requirements of the Pressure Equipment Directive, 2014/68/EU and carries the CE mark when so required. See chart below for further details.

Group 2 Gases			
Product	PED Category		
	Ductile Iron	Steel	Stainless Steel
PTC Range	II	n/a	n/a
PTF, PTF-HP, PTF4	n/a	III	III

- iv) Check material suitability, pressure and temperature and their maximum and minimum values. If the maximum operating limits of the product are lower than those of the system in which it is being fitted, or if malfunction of the product could result in a dangerous over pressure or over temperature occurrence, ensure a safety device is included in the system to prevent such over-limit situations.
- v) Determine the correct installation situation and direction of fluid flow.
- vi) Spirax Sarco, Inc. products are not intended to withstand external stresses, including pipe stresses, which may be induced by any system to which they are installed. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimize them.
- vii) Remove all protective covers from all connections before installation.

## 1.2 Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

## 1.3 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

## 1.4 Hazardous liquids or gases in the pipeline

Consider what is in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extremes of temperature.

## 1.5 Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

## 1.6 The system

Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolation valves, electrical isolation) put any other part of the system or any personnel at risk? Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

## 1.7 Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking or labelling of closed valves. Do not assume that the system has depressurised even when the pressure gauge indicates zero.

## 1.8 Temperature

Allow time for temperature to normalise after isolation to avoid danger of burns.

## 1.9 Tools and consumables

Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spirax Sarco replacement parts.

## 1.10 Protective clothing

Consider whether you and/or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high/low temperature, radiation, noise, falling objects, and dangers to eyes and face.

## 1.11 Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions.

Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety.

Post 'warning notices' if necessary.

## 1.12 Handling

Manual handling of large and/or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

## 1.13 Residual hazards

In normal use the external surface of the product may be very hot. If used at the maximum permitted operating conditions the surface temperature of some products may reach temperatures in excess of 572°F (300°C).

Many products are not self-draining. Take due care when dismantling or removing the product from an installation (refer to 'Maintenance instructions').

### 1.14 Freezing

Provision must be made to protect products which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

### 1.15 Disposal

Unless otherwise stated in the Installation and Maintenance Instructions, this product is recyclable and no ecological hazard is anticipated with its disposal providing due care is taken.

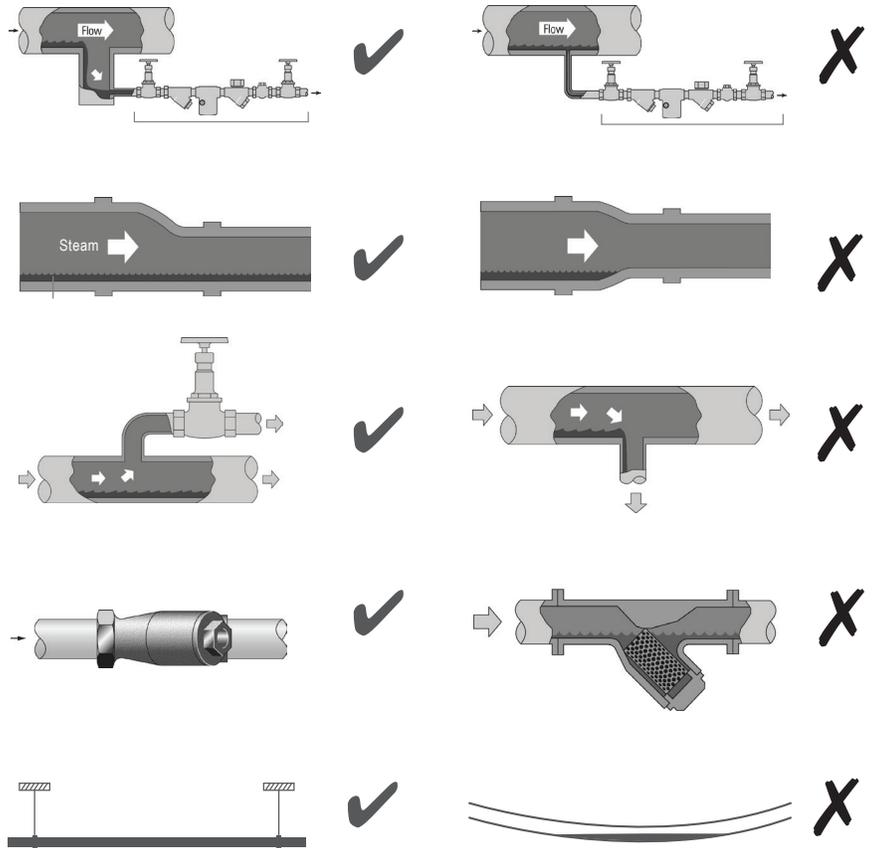
### 1.16 Returning products

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

### 1.17 Working safely with cast iron products on steam

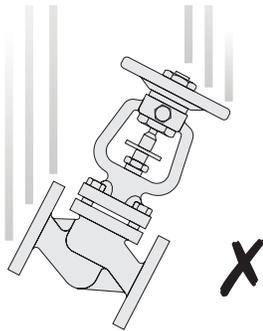
Cast iron products are commonly found on steam and condensate systems. If installed correctly using good steam engineering practices, it is perfectly safe. However, because of its mechanical properties, it is less forgiving compared to other materials such as SG iron or carbon steel. The following are the good engineering practices required to prevent waterhammer and ensure safe working conditions on a steam system.

### Steam Mains - Do's and Don't's:



### Safe Handling

Cast Iron is a brittle material. If the product is dropped during installation and there is any risk of damage the product should not be used unless it is fully inspected and pressure tested by the manufacturer.



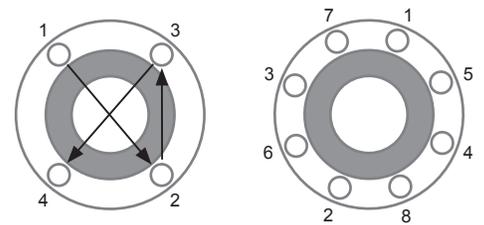
### Prevention of tensile stressing

Pipe misalignment:

Installing products or re-assembling after maintenance:



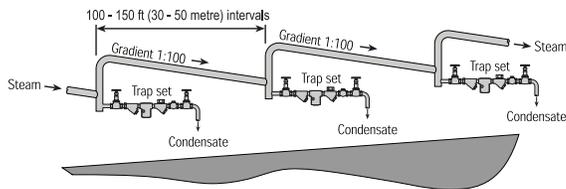
Do not over tighten.  
Use correct torque figures.



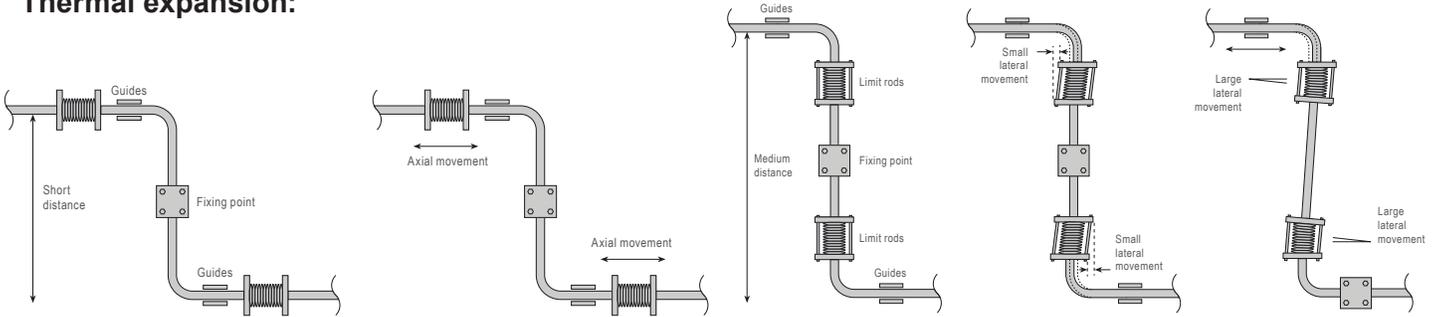
Flange bolts should be gradually tightened across diameters to ensure even load and alignment.

### Prevention of water hammer

Steam trapping on steam mains:



## Thermal expansion:



## 2.0 General Product Information

### 2.1 Description

The Pivotrol Pump® (patented) is a non electric pump which transfers high temperature condensate, or other liquids from a low point, low pressure or vacuum space to an area of higher pressure or elevation. This self-contained unit including PowerPivot® technology (patented) uses steam, compressed air or any other suitable pressurized gas as the pumping (motive) force.

### 2.2 Options

- Digital Cycle counter with auxiliary output.
- Specific Gravity Options include: 0.65–0.79, 0.80–0.89, 0.9–1.0

**Note: PTF4 and PTF-HP only offered with specific gravity option of 0.88–1.0**

### 2.3 Accessories

- Gauge glass
- Reflex type gauge glass
- Insulation cover

### 2.4 Sizes and Connections

Product	Inlet / Outlet Size	Inlet / Outlet Flange	Flange Rating*	Motive / Exhaust
PTC	2x2 (DN50 x DN50)	NPT or SW	ANSI 150	NPT
	3x2 (DN80 x DN50)			
PTC T-Bone	3x3			
PTF	2x2 (DN50 x DN50)		ANSI 150 or ANSI 300	NPT or SW
	3x2 (DN80 x DN50)			
PTF T-Bone	3x3			
PTF Top	3x3			
PTF-HTF	3x2	RF	ANSI 300	SW
PTF-HP	3x2	NPT or SW	ANSI 150 or ANSI 300	NPT or SW
PTF4	4x4 (DN100 x DN100)			

\*Limited to pressure rating of pump.

### 2.5 Limiting Operating Conditions

Product	PMO	PMA	TMA
PTC	200 psig (13.8 barg)	200 psig @ 400°F (13.8 barg @ 204°C)	650°F @ 125 psig (343°C @ 8.6 barg)
PTC T-Bone			
PTF			
PTF T-Bone			
PTF Top			
PTF-HTF	200 psig @ 750°F	750°F @ 200 psig	
PTF-HP	300 psig (20.7 barg)	300 psig @ 650°F (20.7 barg @ 343°C)	650°F @ 300 psig (343°C @ 20.7 barg)
PTF-HP*	300 psig (20.7 barg)	300 psig @ 650°F (20.7 barg @ 343°C)	600°F @ 300 psig (343°C @ 20.7 barg)
PTF4	200 psig (13.8 barg)	200 psig @ 400°F (13.8 barg @ 204°C)	650°F @ 125 psig (343°C @ 8.6 barg)

\* When fitted with Reflex Gauge Glass

- Max number of cycles per minute = 6
- For complete sizing and selecting data, including capacities, see TI-5-030-US
- PTF-HTF pumps are not supplied with check valves but require two. Spirax Sarco recommends the Velan Model F00-1114C-02AA ANSI 300 RF Flanged cast steel swing type check valve. Capacities in TI-5-030-US for the PTF-HTF were achieved using these check valves.
- See Technical Information sheet for design conditions.

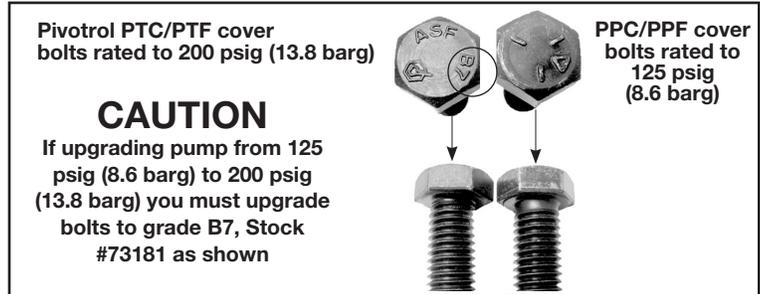
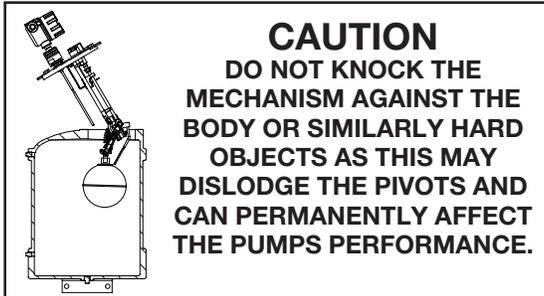


## 3.0 Installation

**Caution—**Before installation or any maintenance is performed, ensure that all condensate, steam, air or gas lines are closed to prevent personal injury. Proper lock-out / tag-out procedures must be followed. Ensure all pressurized lines are dissipated and cooled before starting work.

### 3.1 Upgrading mechanism

When upgrading the mechanism from the old PPC/PPF style to the new Pivotrol® mechanism, it is necessary to replace the cover bolts. Also take caution when upgrading such that the mechanism does not get damaged as the pivots may become dislodged. See below.



### 3.2 Open (vented) systems suitable for ASME and PED compliant pumps only

In an open system, flash steam must be vented or condensed ahead of pump inlet. Application details will dictate which of the following options will be necessary to accomplish this.

The condensate receiver must have an adequately sized over-flow connection and vent pipe. Discharge from both the over-flow and vent pipe(s) MUST be piped to a safe location, such that there is no risk to personnel. In the event of pump or system malfunction or overload, very hot condensate may be discharged from the over-flow, or the vent pipe, or both. Where the vent pipe is not piped to a pit, or similar safe location, the use of a vent head to reduce the chance of entrained hot condensate spraying out of the vent is recommended.

**Over-flow Connection —** Over-flow piping must be used on a vented system. Over-flow connections are required to ensure that in the event of pump or system malfunction, condensate will run in a controlled manner, from the condensate receiver to a safe location, such as a drain (subject to temperature and local regulations) or to an alternative safe location. The over-flow piping can be a 'U' bend water seal which has a 12" (305 mm) minimum depth. The preferred over-flow would use a float and thermostatic steam trap sized to handle full load of the pump system. The trap, unlike the "U" bend, will prevent any steam from flowing out of the over-flow pipe should the tank become slightly pressurized and is the preferred method.

Piping for the trap would be to direct flow from the over-flow connection and elbow directly down to the lowest point that the trap can fit and still drain by gravity. The "U" bend must be primed before starting the system to ensure no vapor escapes. The addition of the over-flow provides a safety mechanism ensuring the pressure within the receiver does not increase. The over-flow is also a tool to diagnose system problems. In the event of the over-flow spilling fluid the operator is immediately made aware of a system problem. This could include failed traps feeding the package failed pump and changes in system loads and overloaded receiver.

Pump or system malfunction which could cause the receiver to over-flow, can occur for many reasons. These include, loss of motive gas due to blockage or incorrect operation, mechanical failure of the pump mechanism or associated check valves, blockage of the condensate inlet strainer or closure of the pumped return line and system shutdowns.

Over-flows will normally be a minimum of 1 1/2" (40 mm) in diameter, but may need to be larger for high capacity units such as packaged PTF4, or

where the length of over-flow pipe run, between receiver and discharge point, is more than 6 ft (1.8 m). A general "rule of thumb" (based on a 6 ft (1.8 m) pipe run and a head of 2 ft (0.6 m)):

- Condensate loads from zero to 11000 lb/hr (4990 kg/hr) use 1½" (DN40)
- Condensate loads from 11000 (4990 kg/hr) to 22000 lb/hr (9982 kg/hr) use 2" (DN50)
- Condensate loads from 22000 (9982 kg/hr) to 39600 lb/hr (17,962 kg/hr) use 3" (DN80)

The over-flow must be fitted with a "loop seal" arrangement or a suitably sized float trap (preferred), to prevent steam escaping via the over-flow connection.

### Vented Receivers

To drain condensate from single or multiple sources in an open system, a vented receiver should be installed in a horizontal plane ahead of the pump. Sufficient volume is needed above the filling head level to accept the condensate reaching the receiver during the pump discharge stroke. More importantly, the receiver must be sized to allow sufficient area for complete flash steam separation from the condensate. By sizing the receiver appropriately, 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. A receiver overflow piping should be installed as shown in Figures 3 or 4 and piped to a suitable drain. The piping must form a loop type water seal at least 12" (305 mm) deep immediately after the receiver.

**Note: To achieve rated capacity and maintain the pumps warranty, each pump must be installed with the check valves as supplied by Spirax Sarco Inc, except at the inlet on a sump pit application as shown in Figure 13.**

#### Installation Procedure:

1. Install the pump physically below the receiver to be drained with the exhaust connection vertically upwards. Pump should be installed with the recommended filling head (the vertical distance between the top of the pump and the bottom of the receiver) as shown in Figures 3 or 4. For other filling head variations, see the capacity table on TI-5-030- US.
2. To prevent equipment flooding during the pump discharge stroke, a vented receiver should be installed in a horizontal plane ahead of the pump as shown in Figures 3 or 4. All inlet line fittings must be fully ported.
3. Connect the vented receiver to the inlet check valve on the pump.

Connect the discharge to the return main or other installation point. For best performance, horizontal runs immediately ahead of the inlet check valve should be kept to a minimum. Connect the discharge to the return main or other installation point. Where the return line rises to a high level directly after leaving the pump a second check valve should be fitted at the highest point, either in the horizontal or vertical run, to prevent water from falling back on the outlet check valve of the pump and reducing its service life. This prevents water-hammer in the condensate return line.

4. Connect the operating medium (motive gas) to the motive inlet in the cover. Supply main should have a strainer and steam trap (steam service) or drain trap (air or gas service) installed upstream of the supply inlet. The steam discharge should be piped into the receiver. Drain Trap on air service should be piped to drain. For increased service life, operate the pump with motive pressures between 15 to 20 psig (1.0 to 1.4 barg) above the pump back pressure, while ensuring the maximum required pump capacity is still achieved.

**Note:** When available operating medium pressure exceeds 200 psig (13.8 barg), a Spirax Sarco pressure reducing valve (PRV) is required to reduce pressure to the pump. The PRV should be located as far from the pump as possible. For best operation, motive pressure should be reduced to the minimum required to overcome pump back pressure and achieve the desired capacity. A safety relief valve should be installed at the connection provided in the motive supply piping.

5. Any horizontal runs in the exhaust line should be pitched so that the line is self-draining. The exhaust line should be piped, unrestricted, to atmosphere as shown in Figures 3 or 4.

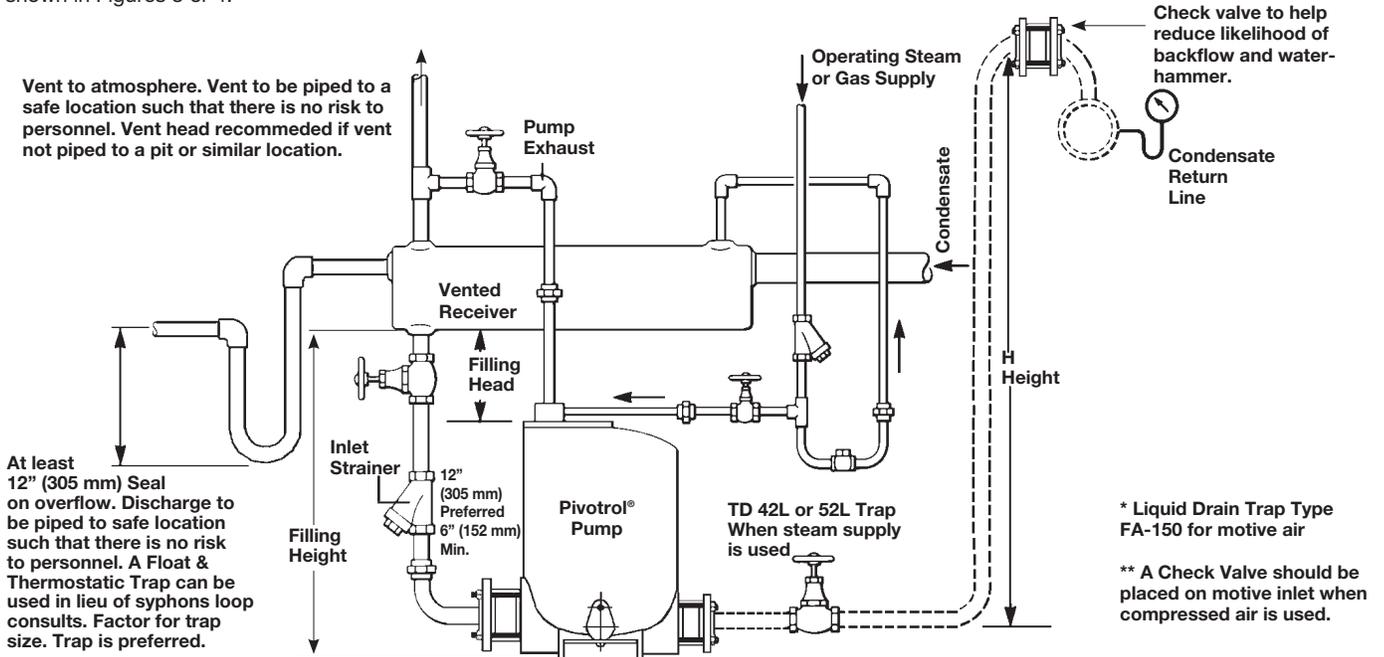


Figure 3

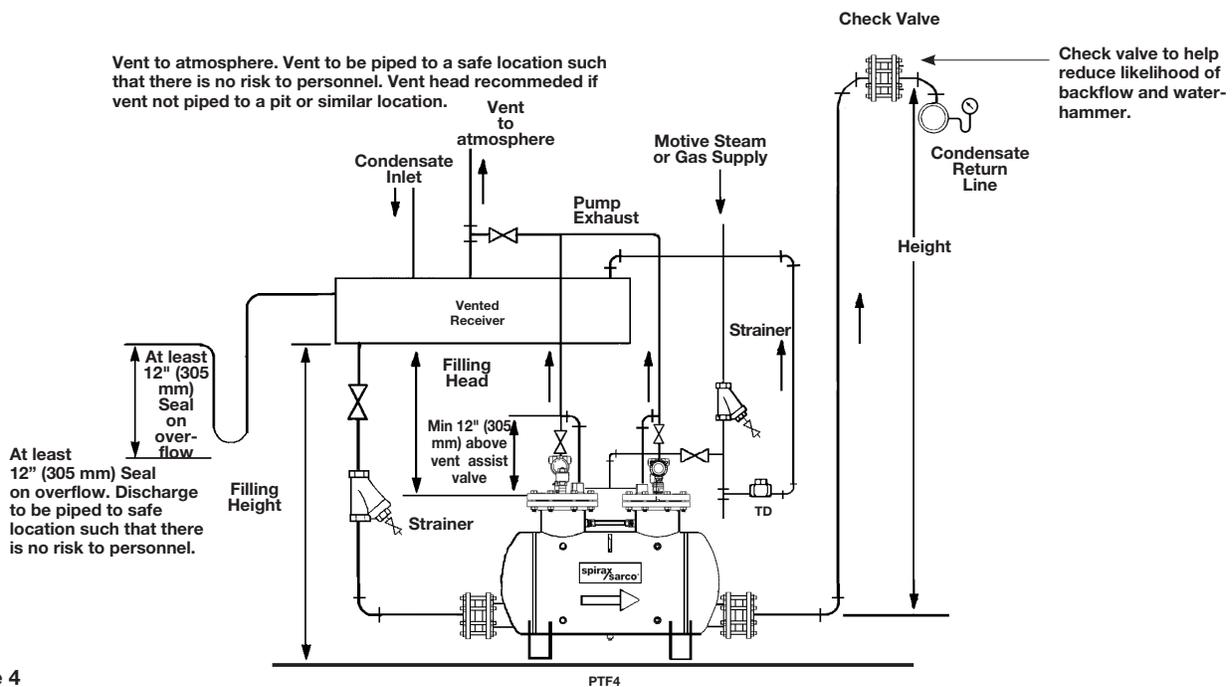


Figure 4

### 3.3 Closed (non-vented) systems suitable for ASME and PED compliant pumps only

A closed-loop installation is one in which the exhaust line of the pump is piped back (pressure equalized) to the reservoir or equipment being drained.

#### Installation Procedure:

1. Install the pump physically below the equipment being drained with the exhaust connection vertically upwards. Pump should be installed with the recommended filling head (the vertical distance between the top of the pump and the bottom of the reservoir) as shown in Figures 5 or 6. For other filling head variations, see Capacity Table on TI-5-030-US.
2. To prevent equipment flooding during the pump discharge stroke, a reservoir should be installed in a horizontal plane ahead of the pump as shown in Figures 5 or 6. For proper reservoir sizing, refer to TI-5-030-US. All inlet line fittings must be fully ported. If desired, overflow piping can be installed using a properly sized float and thermostatic trap. The trap inlet should be located at the maximum allowable water level, at or near the top of the reservoir, and it should discharge to a suitable drain.
3. For best performance, horizontal piping runs immediately ahead of the inlet check valve should be kept to a minimum. Connect the discharge to the return main or other installation point. Where the return line rises to a high level directly after leaving the pump a second check valve should be fitted at the highest point, either in the horizontal or vertical run, to prevent water from falling back on the outlet check valve of the pump and reducing its service life. This prevents water-hammer in the condensate return line.
4. Connect the operating medium (motive gas) to the motive inlet in the cover. Supply main should have a strainer and steam trap (steam

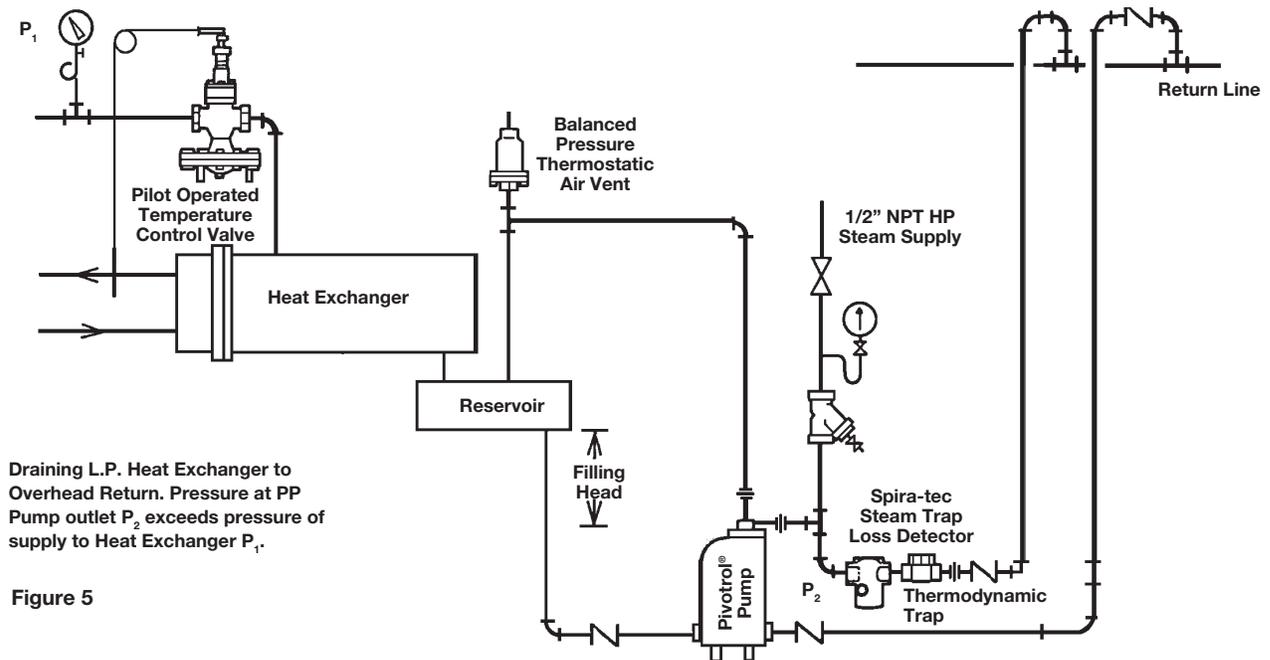
service) or drain trap (air or gas service) installed upstream of the supply inlet. The steam / drain trap discharge should be piped into the receiver. For increased service life, operate the pump with motive pressures between 15 to 20 psig above the pump back pressure, while ensuring the maximum required pump capacity is still achieved.

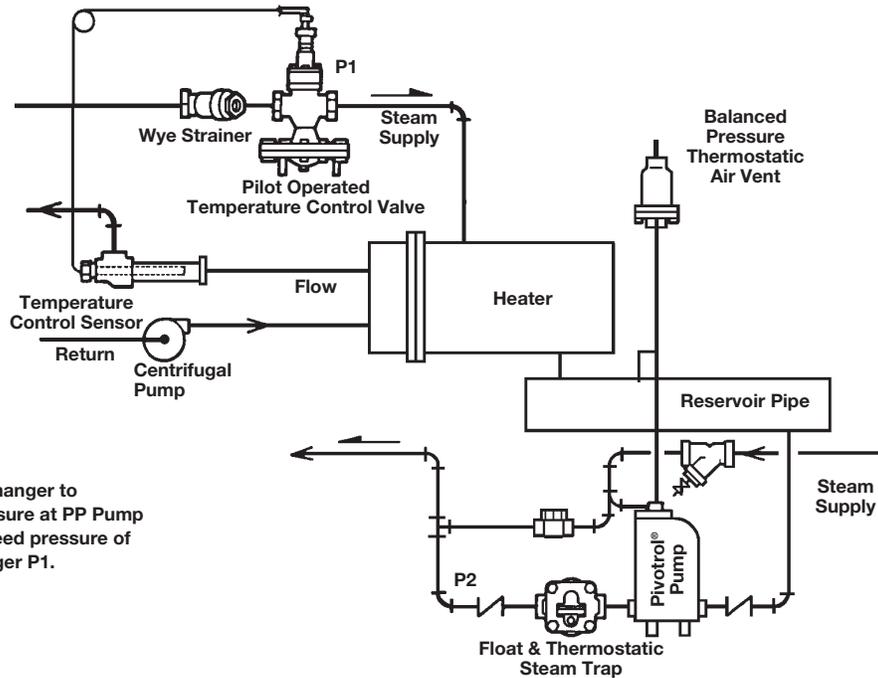
**Note: When available operating medium pressure exceeds 200 psig, a Spirax Sarco pressure reducing valve (PRV) is required to reduce pressure to the pump. The PRV should be located as far from the pump as possible. For best operation, motive pressure should be reduced to the minimum required to overcome backpressure and achieve desired capacity. A safety relief valve must be installed to prevent over pressurizing the mechanism / pump / system.**

5. Exhaust line must be piped, unrestricted, to the top of the reservoir in order to equalize all pressures and ensure condensate drains by gravity. On vacuum systems the exhaust line may be connected to the steam space being drained. A thermostatic air vent should be installed at the highest point of the exhaust line to vent all non-condensable gases during start-up. Any horizontal runs in the exhaust line should be pitched so that the line is self-draining.
6. If at any time the backpressure against the pump is less than the pressure in the equipment being drained, a properly sized float and thermostatic trap must be installed between the pump and discharge check valve as shown in Figure 6. Consult Spirax Sarco for trap sizing.

#### 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 ahead of the pump. Sufficient reservoir volume is needed above the filling head level to accept condensate reaching the pump during the discharge stroke. See TI-5-030-US for minimum reservoir sizing, based on condensate load, needed to prevent equipment flooding during the pump discharge stroke.





Draining L.P. Heat Exchanger to Overhead Return. Pressure at PP Pump outlet P2 does not exceed pressure of supply to Heat Exchanger P1.

Figure 6

### Closed System Considerations for PTF4

The pump will not satisfactorily operate below a motive pressure of 30 psig (2 barg).

The steam inlet pipework must allow for an equal quantity of steam to be fed into each of the two mechanisms. For this to happen the steam inlet pipework must be of equal pipe size and length when split into two lines from the main steam inlet pipework. For the customer's convenience and to ensure correct steam inlet hook-up the option has been made available to purchase an inlet piping assembly.

At a minimum, the inlet piping should be at least 2" (DN50) pipe from the supply header dropping to the pump. Only when the motive inlet pipework is close to 2 ft (.7 m) to the pump should the motive line piping be reduced and split equally into two separate lines. These should be of equal diameter and length to be fed into each mechanism's motive inlet. This will ensure the motive gas is supplied uniformly to each of the PTF4 pump mechanisms and will provide synchronous operation of both mechanisms.

When the PTF4 is placed in a Closed System the exhaust line from the exhaust valve must be piped into the exhaust line from the Vent Assist Valve. To ensure no back pressure is placed on the Vent Assist Valve the exhaust line from the exhaust valve must be tied in at least 12 (305 mm) inches above the Vent Assist Valve. See Figure 7 below.

#### To size the PTF4 in a closed system:

- Establish available motive pressure. Establish static back pressure on Pump.
- Place established pressures in formulae below:
- Pump Motive Pressure (psig/barg) – min. VAV delta P (psig/barg) > Back Pressure (psig/barg)
- Capacity charts to be read as normal, i.e. at pump motive and back pressure.
- If, Pump Motive Pressure (psig/barg) – min. VAV delta P (psig/barg) < Back Pressure (psig/barg), then isolate or remove VAV and multiply capacity by 0.77 to find reduced capacity without VAV.

VAV = Vent Assist Valve

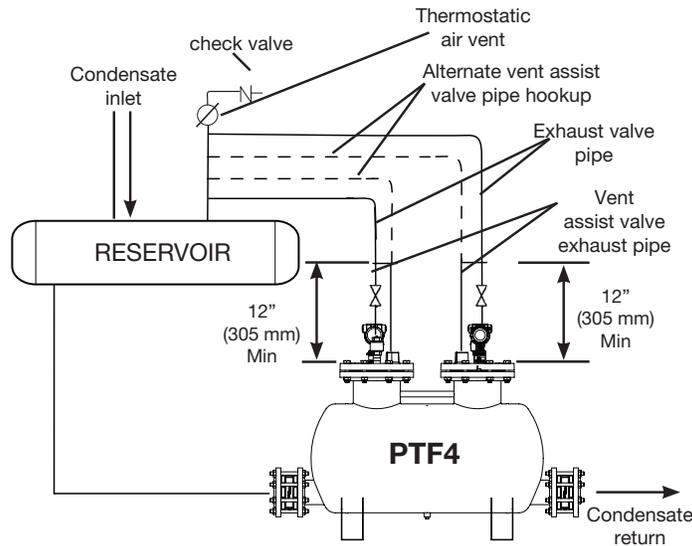


Figure 7

Typical PTF4 exhaust and vent assist valve pipe hookup for closed system.

### 3.4 Closed (non-vented) systems suitable for low specific gravity and volatile fluid application with ASME compliant pump

The Pivotrol® Pump is not ATEX approved and hence is not suitable for use in such applications in the European Community.

**SPECIAL SAFETY NOTE:** When using the PTF4 to pump hazardous fluids and/or in hazardous locations it is essential the Vent Assist Valves are removed and plugged prior to installation and commissioning. A PTF4 pump must never be placed in service in hazardous duty with a Vent Assist Valve attached. Reference TI-5-030-US for PTF4 capacities without vent assist valve.

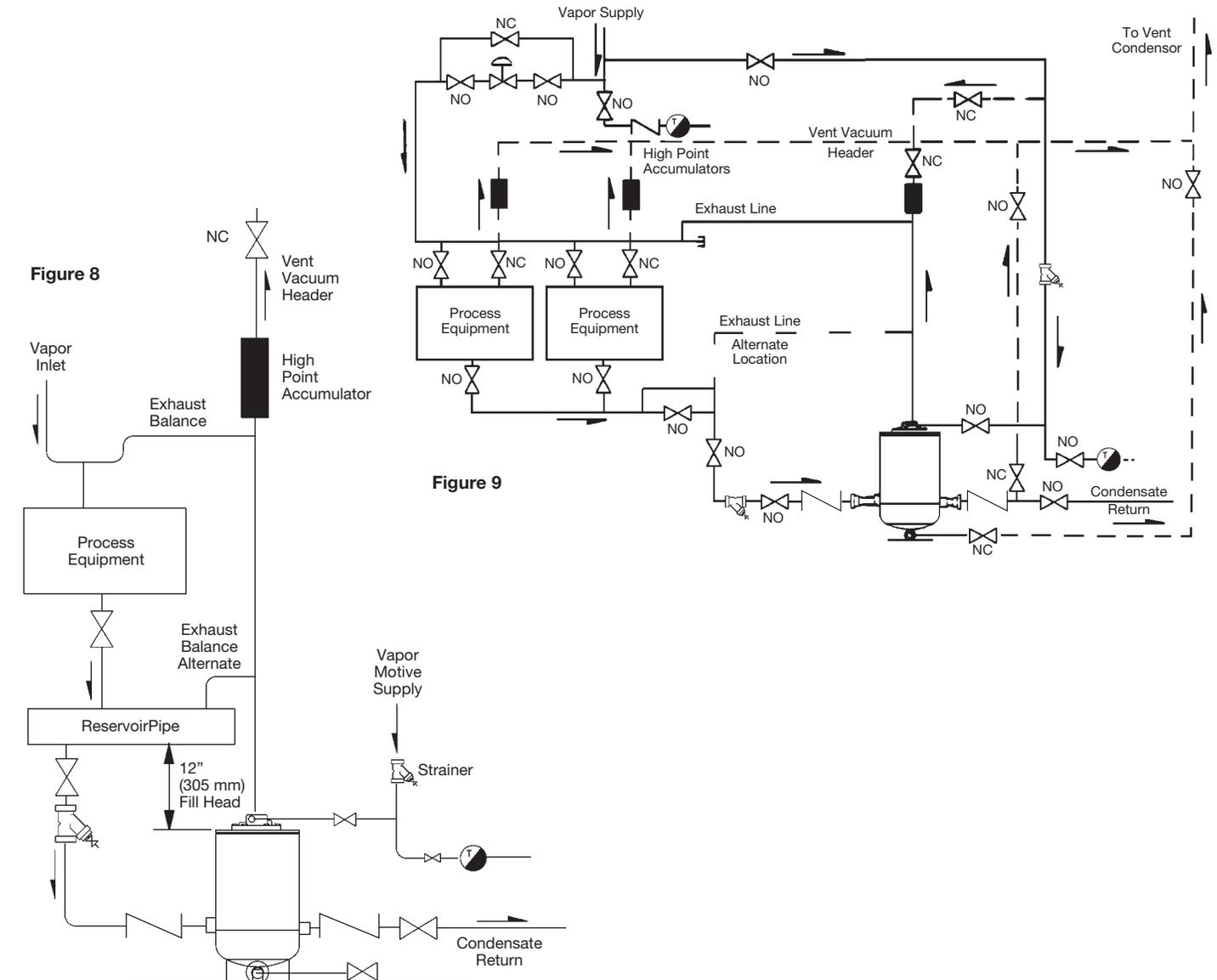
Although the Pivotrol® pump is suitable for pumping hazardous fluids and pumping in hazardous locations the enduser must always perform a full risk-assessment of the environment into which the Pivotrol® pump is being placed and must ensure there is no possibility of spark creation and that every possibility is taken to ensure a safe working environment. Prior to installation and commissioning of a Pivotrol® pump on low specific gravity and volatile fluid applications always gain approval from the local Safety Officer.

Awareness of flash point of gases must be considered, either those surrounding the pump (environment) or those from the pumping fluid at the set operating pressure. Pumping velocity of the fluid must remain below 3.3 ft/s (1.0 m/s) to ensure no static build up of componentry or fluid will occur. Only inert gases can be used in closed loop systems and

purging the system of all oxygen components must be performed with great emphasis. The pump must be grounded to the system in which it is installed.

When maintaining or working on Pivotrol® pumps in hazardous environments or pumping hazardous liquids, or using hazardous gases as pumping motives, it is essential extra precautions must be taken to ensure safe handling of liquids and gases to prevent burns, asphyxiation and other personnel injury which may occur in locations in and around the pump. Be aware of the flash point of gases in the environment surrounding the pump. Be aware of the flash point of fluid's vapor at the operating pressure set for the pump. All precautions must be taken to prevent the possibility of spark initiation.

When pumping low specific gravity and volatile fluids or operating in a hazardous location, the motive gas and liquid being pumped must be an inert mixture. Always contact Spirax Sarco Inc technical support department for advice and recommendations when pumping low specific gravity fluids, such as hydrocarbons, which may be classed as volatile in nature. See Figures 8 and 9 for typical hook-up sketches.



### 3.5 Open (vented) systems suitable for low specific gravity and volatile fluid application with ASME compliant pump

**SPECIAL SAFETY NOTE:** When using the PTF4 to pump hazardous fluids and/or in hazardous locations it is essential the Vent Assist Valves are removed and plugged prior to installation and commissioning. A PTF4 pump must never be placed in service in hazardous duty with a Vent Assist Valve attached. Reference TI-5-030-US for PTF4 capacities without vent assist valve.

For low specific gravity and volatile fluid pumping applications see product hook-up recommendations in Section 3.2 (Figures 3 and 4), however closed systems as described in Section 3.4 are strongly recommended by Spirax Sarco for volatile fluid applications rather than open (vented) systems as an added safety precaution.

Although the Pivotrol® pump is suitable for pumping hazardous fluids and pumping in hazardous locations the enduser must always perform a full risk-assessment of the environment into which the Pivotrol® pump is being placed and must ensure there is no possibility of spark creation and that every possibility is taken to ensure a safe working environment. Prior to installation and commissioning of a Pivotrol® pumps on low specific gravity and volatile fluids applications always gain approval from the local Safety Officer.

Awareness of flash point of gases must be considered, either those surrounding the pump (environment) or those from the pumping fluid at the set operating pressure. Pumping velocity of the fluid must remain below 3.3 ft/s (1.0 m/s) to ensure no static build up of componentry will occur. Only inert gases can be used in closed loop systems and purging the system must be performed with great emphasis. The pump must be grounded to the system in which it is installed.

When maintaining or working on Pivotrol® pumps in hazardous environments or pumping hazardous liquids, or using hazardous gases as pumping motives, it is essential extra precautions must be taken to ensure safe handling of liquids and gases to prevent burns, asphyxiation and other personnel injury which may occur in locations in and around the pump. All precautions must be taken to prevent the possibility of spark initiation.

When pumping low specific gravity and volatile fluids or operating in a hazardous location, the motive gas and liquid being pumped must be an inert mixture. Always contact Spirax Sarco Inc technical support department for advice and recommendations when pumping low specific gravity fluids, such as hydrocarbons, which may be classed as volatile in nature.

### 3.6 Multiple Pivotrol® Pumps

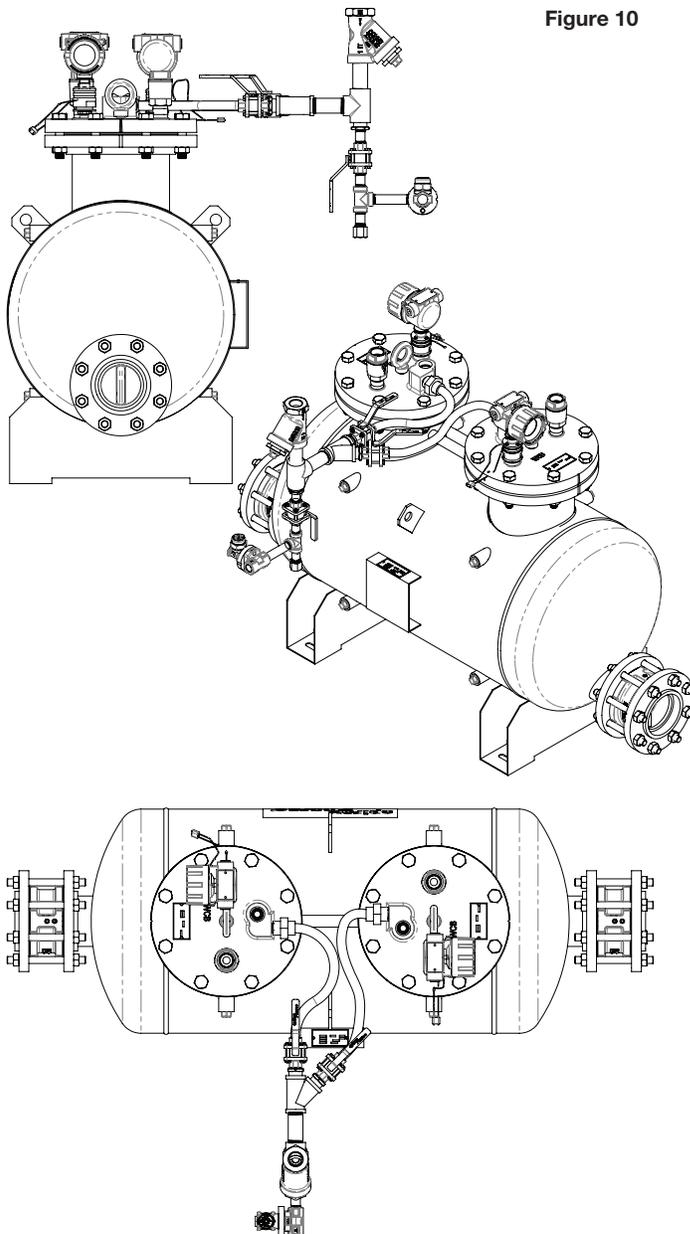
To ensure even wear and extended service life of each of the pumps in a multiple pump set the pumps should not be staged so that a primary pump operates continuously and the secondary pump seldom operates. Each pump should be piped to ensure even operation of each pump. When piping multiple pumps into a single return line an additional check valve should be fitted in the single return line to reduce the likelihood of water-hammer in the return line due to high flow rates and velocities induced during multiple pump discharge cycles.

### 3.7 Recommended PTF4 Steam Inlet / Exhaust Piping Hook Up

The PTF4 motive supply line should be sized correctly to ensure sufficient motive capacity during the pumping stroke. A correctly sized inlet pipe will prevent pressure spikes and dips during the pumping stroke and ensure smooth operation and published capacities are met.

At a minimum, the inlet piping should be at least 2" (DN50) pipe from the supply header dropping to the pump. Only when the motive inlet pipework is close to 2 ft (.6 m) to the pump should the motive line piping be reduced and split equally into two separate lines. These should be of equal diameter and length to be fed into each mechanism's motive inlet. This will ensure the motive gas is supplied uniformly to each of the PTF4 pump mechanisms and will provide synchronous operation of both mechanisms. Hook up of the exhaust lines running from the pump must be clear and free to atmosphere when piped in an open system, and clear and free when piped into the reservoir in a closed system. The Vent Assist Valves must be piped directly into either the pump's receiver or, the pump's vent line. In this latter case the Vent Assist Valve exhaust line must be piped into the vent line at least 12" (305 mm) away from the pump exhaust connection. Traps discharge pipelines must not be piped into any of the pumps vent lines. See Figure 10 below.

Figure 10



## 4.0 Start-up Procedures

### 4.1 Open and Closed systems suitable for ASME and PED compliant pumps only (Reference Sections 3.2 & 3.3)

1. Slowly open supply medium (motive gas) to provide pressure at the Pivotrol® Pump motive inlet valve. Check that trap/drain on supply line is operational.
2. Open gate valves in the Pivotrol® Pump inlet and discharge lines.
3. Open valve(s) ahead of pump allowing fluid to enter from the receiver/reservoir and fill the Pivotrol® Pump body. Pump will discharge when full.
4. Observe operation for any abnormalities. Pivotrol® Pump(s) should cycle periodically with an audible exhaust at the end of the pumping cycle. If exhaust line is tied back to receiver / reservoir or piped away, and audible “click” will occur. If any irregularities are observed, recheck installation instructions for proper hookup. Consult Spirax Sarco if necessary.
5. If over-flow piping has been provided, check that a water seal has been established. Prime over-flow piping if necessary.

### 4.2 Closed systems suitable for low specific gravity and volatile fluid application with ASME compliant pump (Reference Section 3.4)

1. Energize all steam tracing and ensure the piping and equipment is hot, and condensate drains properly from the tracing system.
2. Evacuate all air components from the system piping and equipment.  
**NOTE: use of a vacuum system is mandatory to evacuate all oxygen components. A vacuum is normally sequenced in stages to ensure complete air removal and maintenance of the vacuum in each section of piping prior to charging the system with heat transfer fluid / vapor / volatile fluid. Ensure vacuum is maintained throughout the entire startup procedure.**
3. Open the Pivotrol® pump discharge outlet valve(s).
4. Slowly open the supply at the main header to supply pressure to the vapor pressure control stations and the Pivotrol® pump motive inlet. Open the vapor supply valve very slowly to prevent hammer and raise the pressure/temperature very slowly. Hot bolting/torquing may be required during the system heat-up procedure.
5. Open the Pivotrol® pump motive vapor valve(s).
6. Open the Pivotrol® pump liquid inlet valve(s).
7. Verify fluid flows to the Pivotrol® Pump(s) and that it is discharged. Observe operation for any abnormalities. The Pivotrol® Pump(s) will cycle periodically with an audible exhaust at the end of the pumping cycle. If any irregularities are observed, shutdown the system, recheck installation instructions for proper hook-up. Consult Spirax Sarco, if necessary.

### 4.3 Open systems suitable for low specific gravity and volatile fluid application with ASME compliant pump ( Reference Section 3.5)

**The Pivotrol® Pump is not ATEX approved and hence is not suitable for use in such applications in the European Community.**

Reference Section 4.1 for start-up procedure. All vent lines must be terminated in a safe area with no ignition sources present and away from personnel.

## 5.0 Maintenance

**CAUTION:** Before removing the cover and mechanism assembly, be sure the pump is completely isolated and relieved of any internal pressure to prevent personal injury. Motive supply, exhaust / tie-back, fluid inlet and discharge lines should all be closed prior to performing any work on the pump. Also ensure any hot parts have cooled to prevent risk of injury from burns. Use caution when removing cover and gasket. Gasket contains thin stainless steel reinforcement that may cause cuts to the skin. Care should be taken to prevent personal injury from the strong snapping action of the spring. When venting hazardous vapors, suitable personal protection equipment (PPE) should be worn.

### 5.1 Inspection

Inspections should be performed on a regular basis to ensure the Pivotrol Pump mechanism is functioning properly. This is especially important when installed in a hazardous pumping application to ensure no potential ignition sources or sparks can occur.

**NOTE: Each mechanism assembly is factory set and tested. No adjustment to the mechanism should be made. If the mechanism assembly does not function correctly the entire mechanism should be returned to the factory for replacement under the warranty terms.**

#### Procedure:

1. Break and disconnect all connections to the cover. Remove cover bolts and lift the cover and mechanism assembly from the body, noting the cover orientation.
2. Visually inspect the mechanism to verify that it is free of dirt and scale and that the float and mechanism moves freely.
3. To re-assemble, reverse the above procedure noting the following points.
  - a. When installing the cover and mechanism in tight spaces the mechanism should be held horizontally as shown in Figure 11-A/G. Ensure gasket surfaces are clean and free of old gasket material before installing a new gasket.
  - b. The float should be inserted into the pump body first, carefully ensuring the cycle counter probe and paddle do not clash with the body per Figure 11-B/H. Special attention must be made when fitting the cover and mechanism assembly. Do not knock the mechanism against the body or similarly hard object as this may dislodge the pivots and can permanently affect the pumps performance.
  - c. As the mechanism is inserted into the pump body the mechanism should be held vertically and gently lowered to its final resting position as shown in Figure 11-C/J. The cover must be orientated so the “V” cast in to the pump cover lines up with the body casting “part line” as shown in Figure 11-D/K/L
4. Assemble cover bolts and torque to 46-50 ft-lbs (62-68N.M) (155-165 ft-lbs (210-224 N.M) for PTF4 & 300-320 ft-lbs (407-434 N.M) for PTF-HP) in a cross pattern as shown in Figure 11-E / K / L.
5. When replacing / inspecting a check valve, clean off gasket surface before installing new gasket. Torque check valve nuts to 105-115 ft-lbs (142-165 N.M).

### 5.2 Replacement

**NOTE: Each mechanism assembly is factory set and tested. No adjustment to the mechanism should be made. If the mechanism assembly does not function correctly the entire mechanism should be returned to the factory for replacement under the warranty terms.**

**For a replacements under warranty please contact Spirax Sarco Inc. at 1-800-883-4411, for all other replacements or for spare items please contact your local sales representative.**

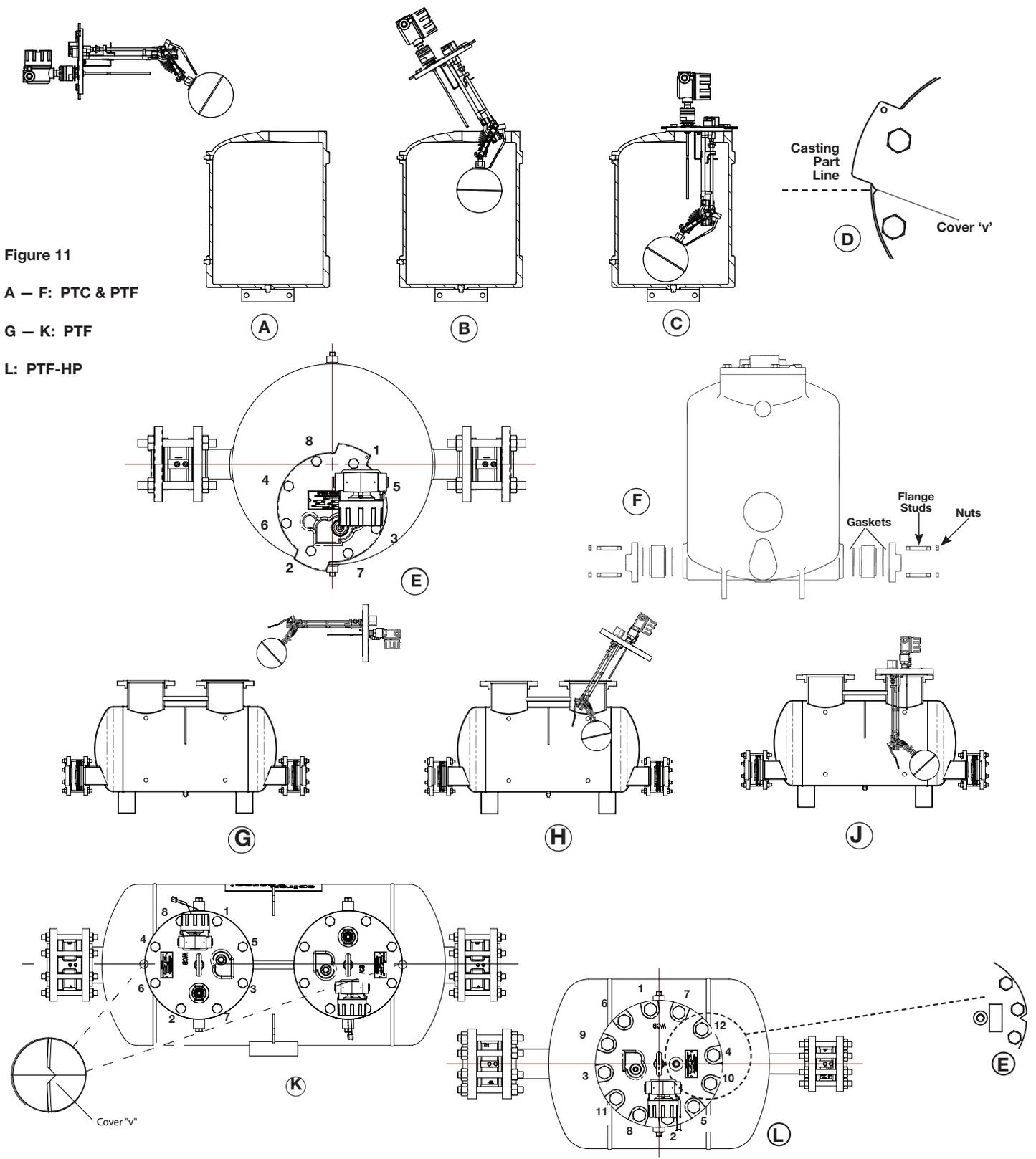


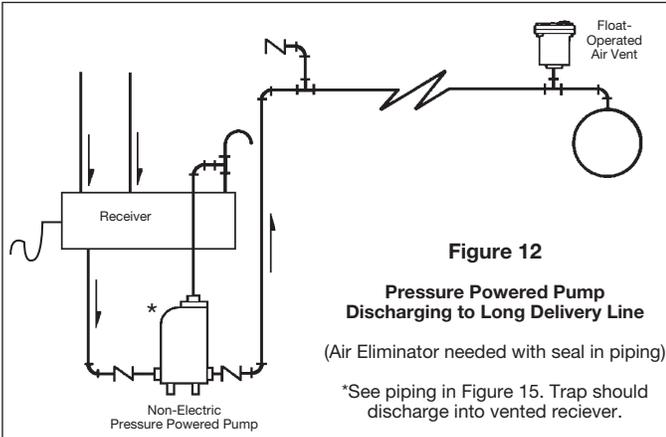
Figure 11

A – F: PTC & PTF

G – K: PTF

L: PTF-HP

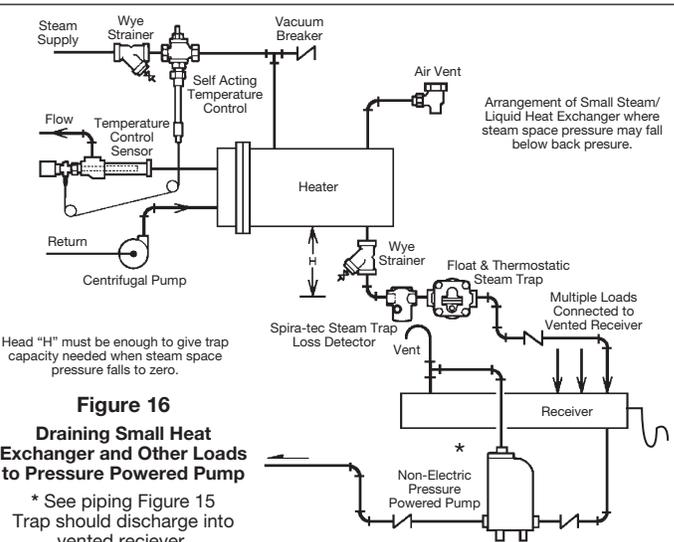
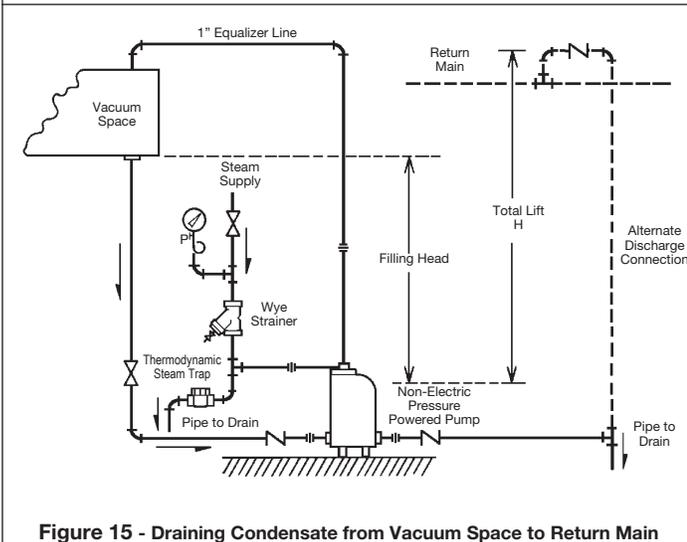
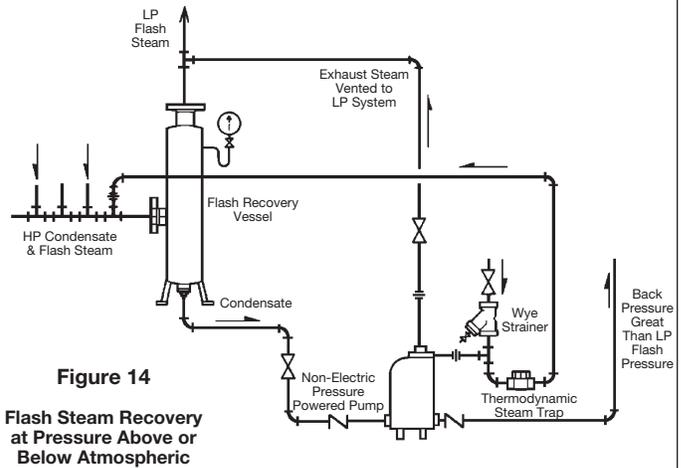
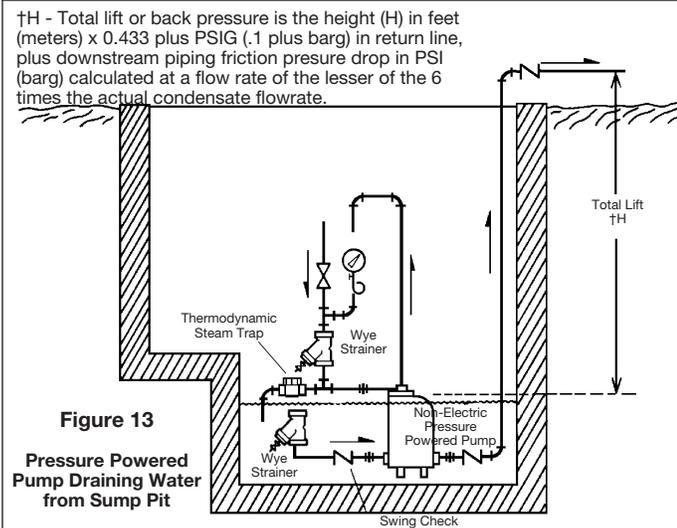
## 6.0 Other Hook-up Sketches



The hook-up sketches shown do not necessarily represent recommended arrangements for specific service conditions; but rather serve only to illustrate the variety of applications where the pressure-powered pump can be utilized. Design requirements for each application should be evaluated for the best condensate recovery arrangement tailored to your specific needs.

For use of the pressure powered pump in hook-ups other than those described previously, and for any additional information you may require, contact Spirax Sarco Applications Engineering Department, toll free:

1-800-883-4411



## 7.0 Troubleshooting

If a correctly sized Pressure Powered Pump does not operate properly, an incorrect hookup is suspect in new installations. For existing installations where the pump operates occasionally or not at all, the cause is often a change in the system supply or back pressure conditions beyond the original design parameters. With the system conditions and problem symptoms determined, check the following in turn and correct as necessary.

### Caution:

Symptom	Cause	Check and Cure
1. Pump fails to operate on startup.	1. a) Motive supply closed. b) Condensate inlet line closed. c) Condensate discharge line closed. d) Motive pressure insufficient to overcome backpressure. e) Check valves(s) installed in wrong direction. f) Pump air-locked.	1. a) Open valve(s) to supply motive pressure to pump. b) Open all valves to allow condensate to reach pump. c) Open all valves to allow free discharge from pump to destination. d) Check motive pressure and static backpressure. Adjust motive pressure to 15 - 20 psig (1.0-1.4 barg) higher than static backpressure. e) Verify proper flow direction and correct, if required. f) On vented system, assure that vent line is unrestricted to atmosphere and self-draining to the pump or receiver. On a closed system, isolate the pump from the pressurized space being drained. (Exhaust tie-back line closed.) Break exhaust connection at pump cover. Keep personnel clear of exhaust 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. Assure that the equalizer line is self-draining.
2. Supply line/equipment flooded, but pump appears to cycle normally (periodic audible exhaust observed).  Remove check valve & visually inspect, body and plate faces, hinge and spring.	2. a) Pump undersized. b) Insufficient filling head. c) Insufficient motive pressure to achieve rated capacity. d) Restriction in condensate inlet line. e) Inlet check valve stuck open (debris).	2. a) Verify rate capacity per TI-5-030-US capacity table. Increase check valve size or install additional pump as required. b) Verify required filling head per TI-5-030-US. Lower pump to achieve required filling head. c) Check motive pressure setting and maximum backpressure during operation. Compare to capacity table of TI-5-030-US. Increase motive pressure as required to meet load conditions. d) Verify that fully ported fittings are used. Blowdown the strainer, if fitted. Check that all valves are fully open. e) Isolate inlet check valve and relieve line pressure. Clean seating surfaces and reinstall or replace, if necessary.
3. Supply line/equipment flooded, and pump has stopped cycling (audible periodic exhaust not observed).	3. a) Discharge line closed or blocked. b) Discharge check valve stuck closed. c) Insufficient motive pressure.	3. a) Check motive pressure and static back-pressure (at pump discharge). If equal, a closed or blocked discharge line is suspected. Check all valves downstream of pump to assure an unobstructed discharge. b) After checking per 3(a), isolate discharge check valve and relieve line pressure. Remove check valve & visually inspect body and plate faces, hinge and spring. Clean seating surfaces and reinstall or replace, if necessary. c) If motive pressure is below static backpressure, increase motive pressure setting to 15 - 20 psig (1.0 -1.4 barg) above static backpressure. Do not exceed rated pressure limits of equipment. For steps 3(d) through 3(g) —With exhaust/tie-back line isolated from the equipment being drained (close-loop systems), break the exhaust/tie-back connection at the pump cover and—

Symptom	Cause	Check and Cure
<p><b>Important Safety Note:</b> For steps (d) through (g) it is necessary to break the exhaust/tie-back line at the pump exhaust connection. On closed loop systems, care should be exercised to assure that the pump is isolated (motive supply, condensate inlet and discharge, and exhaust/tie-back line all closed) and that case pressure is relieved prior to breaking this connection to avoid injury to personnel. Also, under fault conditions, it is possible that hot condensate may run out of the exhaust connection when broken for both closed loop and vented systems. This possibility should be taken into consideration when performing these steps to avoid scalding of personnel or water damage to nearby equipment.</p>	d) Motive inlet valve leaking and/or worn.	d) Slowly open motive supply line, leaving the condensate inlet and discharge lines closed. Observe the exhaust connection for steam or air leakage. If leakage is observed, an inlet valve problem is indicated. Isolate pump, remove cover and mechanism assembly and visually inspect. Replace inlet valve and seat assembly.
	e) Mechanism Faults i) Broken spring ii) Ruptured float	e) With motive line open, slowly open condensate inlet line to the pump, allowing pump to fill and observe exhaust connection. <b>Keep personnel clear of exhaust!</b> If condensate runs out exhaust connection, a mechanism fault is clearly indicated. Isolate pump by shutting off motive supply and condensate inlet, remove cover and mechanism assembly, and visually inspect. Examine springs and float for obvious defects. Stroke mechanism and check for any source of binding or increased friction. Repair and/or replace all defects observed.
	f) Exhaust/tie-back causing vapor lock (vented or closed loop).	f) If mechanism is heard to trip and no fluid is observed running out the exhaust connection, slowly open the discharge line from the pump and observe operation. <b>Keep personnel clear of exhaust connection!</b> If pump cycles normally, a fault in the exhaust/tie-back line is suspected. Recheck the exhaust/tie-back piping layout for compliance with the installation instructions. Exhaust/tie-back line must be self-draining to prevent vapor locking the pump.
	g) Inlet check valve stuck closed.	g) If mechanism is not heard to trip and fluid is not observed running from the exhaust connection, it is suspected that the fault lies in the condensate inlet piping. Assure that all valves leading to the pump have been opened. If so, this indicates that the inlet valve is stuck closed. Isolate the pump and check valve and relieve line pressure. Visually inspect the head, seat and stem. Clean seating surfaces and reinstall or replace, if necessary. Reinstall exhaust/tie-back connection and open line.
4. Chattering or banging in return main after pump discharges.	4. a) Vacuum created at pump outlet after discharge because of acceleration/deceleration of large water slug in return main (usually results from long horizontal run with multiple rises and drops).	4. a) Install a vacuum breaker at the top of the lift (at high point in return line). For pressurized return systems and air eliminator may be required downstream of the vacuum breaker. (See Fig. 12).
	b) Pump "blow-by".	b) Check condensate inlet pressure and static backpressure at the pump discharge. If the inlet pressure equals or exceeds the static backpressure, a "blow through" problem is suspected. On vented systems, check for leaking traps discharging into the condensate inlet line which would increase inlet line pressure. Replace any faulty traps. On closed loop systems, if condensate inlet pressure can exceed static backpressure under normal operation (i.e. boost in equipment operating pressure via a modulating control valve or significant decrease in static return main pressure), a pump trap combination is required. The pump trap combination will prevent passage of steam into the return main and allow the pump to cycle normally when condensate is present (See Fig. 6)
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 "Blow-By").	5. a) Check for leaking traps discharging into condensate return. Repair or replace faulty traps. (See also 4(b), Pump "Blow-By").
	b) Excessive (over 50 lb/hr, 22.7 kg/hr) flash steam being vented through pump.	b) Vent receiver ahead of pump.
	c) Exhaust 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.

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