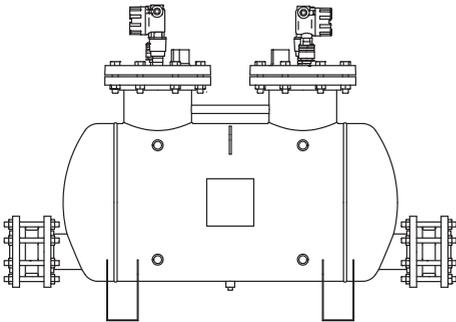


PTF4 Pivotrol® Pump (patented) (€ version) Dual Mechanism - Pressure Powered Pump Installation and Maintenance Instructions



1. Safety information
2. General product information
3. Installation
4. Commissioning
5. Operation
6. Maintenance
7. Fault finding

1. Safety information

Safe operation of these products can only be guaranteed 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 complied 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.

The product complies with the requirements of the European Pressure Equipment Directive 2014/68/EU, Group 2 gases to Category 3 and carries the  mark when so required.

- 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 should be contacted to confirm the suitability of the product for the application being considered.
- ii) 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 overpressure or overtemperature occurrence, ensure a safety device is included in the system to prevent such over-limit situations.
- iii) Determine the correct installation situation and direction of fluid flow.
- iv) Spirax Sarco products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimise them.
- v) Remove protective covers from all connections and protective film from all name-plates, where appropriate, before installation on a steam or other high temperature applications.

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 204.5 °C (400 °F).

Take due care when dismantling or removing the product from an installation (refer to Section 6 'Maintenance instructions').

1.14 Freezing

Provision must be made to protect systems 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.

Please visit the Spirax Sarco product compliance web pages

<https://www.spiraxsarco.com/product-compliance>

for up to date information on any substances of concern that may be contained within this product. Where no additional information is provided on the Spirax Sarco product compliance web page, this product may be safely recycled and/or disposed providing due care is taken. Always check your local recycling and disposal regulations.

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.

2. General product information

2.1 Description

The Spirax Sarco 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 pressurised gas as the pumping force.

The standard Pivotrol® PTF4 Pump will handle liquids from 0.88 to 1.0 specific gravity.

Warranty

1 year.

Accessories:

- Reflex type gauge glass.
- Insulation cover.

Standard

This product fully complies with the requirements of the European Pressure Equipment Directive 2014/68/EU.

Certification

This product is available with certification to EN 10204 3.1.

Note: All certification / inspection requirements must be stated at the time of order placement.

Note: For further product data see the following Technical Information Sheet, TI-P135-13.

2.2 Sizes and pipe connections

Inlet and Outlet:	4" x 4" (DN100 x DN100) ASME Class 150 threaded flange (NPT) or Socket weld
Motive:	½" Screwed NPT or Socket weld
Exhaust:	1" Screwed NPT or Socket weld

Please note that pressure gauges may be fitted into any of the top gauge glass connectors.

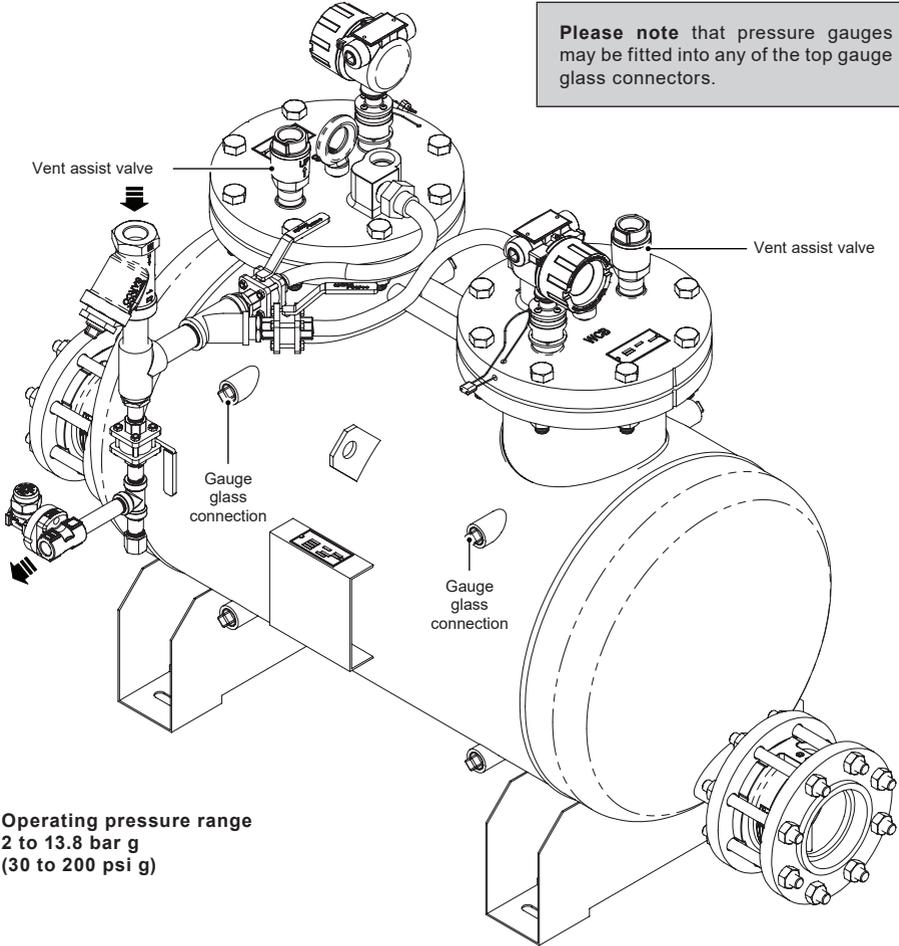
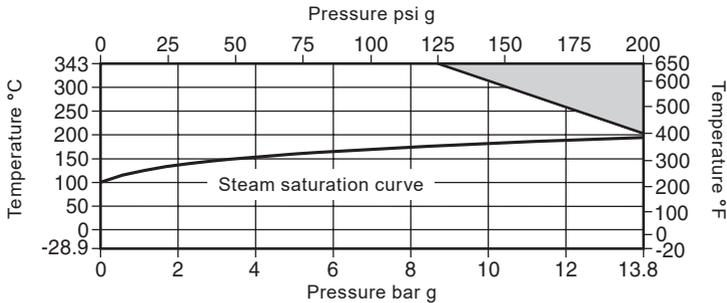


Fig. 1

2.3 Pressure / temperature limits (ISO 6552)



The product **must not** be used in this region.

Body design condition		ASME Section VIII, Division 1	
PMA	Maximum allowable pressure	13.8 bar g @ 204 °C	(200 psi g @ 400 °F)
TMA	Maximum allowable temperature	343 °C @ 8.6 bar g	(650 °F @ 125 psi g)
	Minimum allowable temperature	-28.9 °C	(-20 °F)
PMO	Maximum operating pressure	13.8 bar g	(200 psi g)
TMO	Maximum operating temperature for saturated steam service	198 °C	(388 °F)
	Minimum operating temperature	-28.9 °C	(-20 °F)
Note: For lower operating temperatures consult Spirax Sarco			
	Minimum motive differential required:	0.5 bar g	(7 psi g)
	Maximum backpressure:	75% of motive pressure	
	Designed for a maximum cold hydraulic test pressure of:	20.7 bar g	(300 psi g)
	Note: With internals fitted, test pressure must not exceed:	20.7 bar g	(300 psi g)

Specific gravity of pumped liquid 0.88 to 1.0

Please contact: Spirax Sarco for the product specific Technical Information sheet for the cycle counter.

Filling head requirements

	Filling head above pump cover	Filling height from base of pump
Standard recommended	305 mm (12")	1125 mm (44.3")
Maximum filling head	1524 mm (60")	2337 mm (92.0")
Minimum filling head	-76 mm (-3")	744 mm (29.3")

Maximum number of cycles per minute = 6

3. Installation

Note: Before actioning any installation observe the 'Safety information' in Section 1.

Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended installation:

- 3.1** Check materials, pressure and temperature and their maximum values. If the maximum operating limit of the product is lower than that of the system in which it is being fitted, ensure that a safety device is included in the system to prevent overpressurisation.
- 3.2** Determine the correct installation situation and the direction of fluid flow.
- 3.3** Remove protective covers from all connections and protective film from all name-plates, where appropriate, before installation on a steam or other high temperature applications.
- 3.4** Recommended installation of the PTF4 Pivotrol® Pump when fitted with a reservoir or vented receiver. In an 'open' system flash steam must be vented or condensed ahead of the pump inlet. Application details will dictate which of the following options will be necessary to accomplish this.

It is highly recommended by Spirax Sarco that an adequately sized overflow is fitted to all condensate receivers. This should be considered best practice and overflows should only be excluded from installations in exceptional circumstances. Discharge from both overflows and vent pipes 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 overflow, 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.

Overview connection - The overflow piping must be used on a vented system. Overflow 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 overflow piping must be a 'U' bend water seal which has a 304 mm (12") minimum depth. Once primed on start-up the water seal is self-filling and should be piped to a suitable drain. The addition of the overflow provides a safety mechanism ensuring the pressure within the receiver does not increase. The overflow is also a tool to diagnose system problems. In the event of the overflow 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 overflow, can occur for many reasons. These include; loss of motive steam 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.

Overflows will normally be a minimum of 40 mm (1½") in diameter, but may need to be larger for high capacity units such as packaged PTF4, or where the length of overflow pipe run, between receiver and discharge point, is more than 6 ft (2 metres). A general 'rule of thumb' based on a 2 m (6 ft) pipe run and a head of 0.6 m (2 ft):

Condensate loads from:	0 to 4889 kg/h	(0 to 11 000 lb/h)	use a DN40 (1½")
Condensate loads from:	4 889 to 9977 kg/h	(11 000 to 22 000 lb/h)	use a DN50 (2")
Condensate loads from:	9977 to 17959 kg/h	(22 000 to 39 600 lb/h)	use a DN80 (3")

Normally overflow connections will be fitted with a 'loop seal' arrangement or a suitably sized float trap, to prevent steam escaping via the overflow connection.

3.5 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. Table 1, illustrates 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. By sizing the receiver as shown in Table 1 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 Figure 2 and piped to a suitable drain. The piping must form a loop type water seal at least 304 mm (12") deep immediately after the receiver.

- 3.5.1** Install the pump physically below the receiver to be drained with the exhaust connection vertically upwards. The 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 Figure 2. For other filling head variations, see the Capacity Table on TI-P135-13.
- 3.5.2** 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 Figure 2. For the correct receiver sizing, refer to Table 1. All inlet line fittings must be fully ported.
- 3.5.3** 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 waterhammer in the condensate return line.**

Note: To achieve rated capacity and maintain the pumps warranty, each pump must be installed with the check valves as supplied by Spirax Sarco, except at the inlet on a sump pit application as shown in Figure 9.

- 3.5.4** Connect the operating medium (steam, air or gas) supply 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 trap / drain discharge should be piped into the receiver ahead of the pump for steam systems. **For increased service life operate the pump with motive pressures of 1 to 1.3 bar g (15 to 20 psi g) above the pump backpressure, while ensuring the maximum required pump capacity is still achieved.**

Note: When available motive pressure exceeds 13.8 bar g (200 psi g), a Spirax Sarco pressure reducing valve 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 backpressure and achieve the desired capacity. A safety relief valve should be installed at the connection provided in the pump cover or in the motive supply piping.

- 3.5.5** 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 Figure 2.

Vent to atmosphere. The vent should be piped to a safe location such that there is no risk to personnel. The use of a VHT vent head is recommended if the vent is not piped to a pit or similar location.

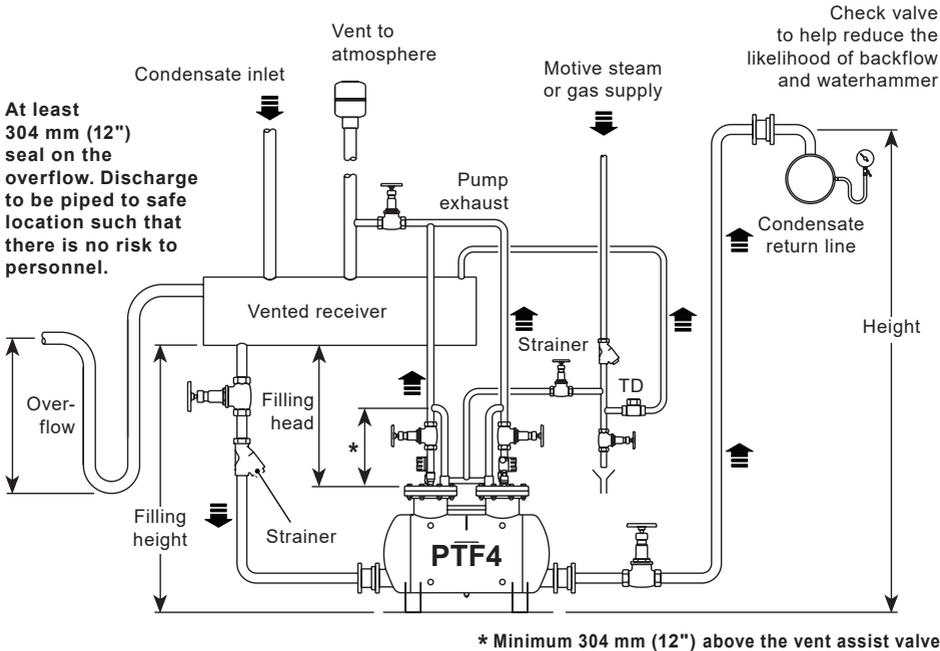


Fig. 2 Typical installation - Vented pump system

Table 1 Vented receiver sizing for the PTF4 in mm and (inches)

Flash steam up to:	Pipe size		Vent line diameter
	Diameter *	Length	
454 kg/h (1000 lb/h)	400 mm (16")	1524 mm (60")	150 mm (6")
907 kg/h (2000 lb/h)	500 mm (20")	1524 mm (60")	200 mm (8")
1361 kg/h (3000 lb/h)	600 mm (24")	1524 mm (60")	200 mm (8")
1814 kg/h (4000 lb/h)	650 mm (26")	1524 mm (60")	250 mm (10")
2268 kg/h (5000 lb/h)	700 mm (28")	1524 mm (60")	250 mm (10")
2722 kg/h (6000 lb/h)	750 mm (30")	1829 mm (72")	300 mm (12")
3175 kg/h (7000 lb/h)	800 mm (32")	1829 mm (72")	300 mm (12")
3629 kg/h (8000 lb/h)	900 mm (36")	1829 mm (72")	350 mm (14")

* Note:
The receiver can be made from pipe as shown or be a fabricated tank.

3.6 Open system considerations

The pump will not satisfactorily operate below a motive pressure of 2 bar g (30 psi g). 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, when using steam, the inlet piping should be at least 50 mm (2") NB pipe from the steam header dropping to the pump. Only when the steam (motive) inlet pipework is close to 0.6 m (2 ft) 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 steam (air or 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 an 'open / vented system' the vent assist valve must be piped to atmospheric pressure without restriction to ensure correct operation. Any backpressure acting on the vent assist valve will reduce its ability to open and function correctly.

When the PTF4 is placed in an 'open / vented system' the vent line from the exhaust valve must be piped into the vent line from the vent assist valve. To ensure no backpressure is placed on the vent assist valve the vent line from the exhaust valve must be tied in at least 304 mm (12") above the vent assist valve.

3.7 Installation - Closed loop systems (Figure 3)

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

Before breaking any connections on the pump or piping system every effort should be made to ensure all internal pressure has been relieved and the motive supply line is shut off to prevent inadvertent discharge of the pump.

When breaking any connection, piping/bolts should be removed slowly so that if the line is under any internal pressure, this fact will be apparent before completely removing the pipe or component. Always relieve pressure before breaking any joint.

- 3.7.1 Install the pump physically below the equipment being drained with the exhaust connection vertically upwards. The 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 Figure 3. For other filling head variations, see the Capacity Table on TI-P135-13.
- 3.7.2 To prevent equipment flooding during the pump discharge stroke, a reservoir pipe should be installed in a horizontal plane ahead of the pump as shown in Figure 3. For the correct reservoir sizing, refer to Table 2 'Inlet reservoir piping'. 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.
- 3.7.3 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 waterhammer in the condensate return line.**

Note: To achieve rated capacity, and maintain the pumps warranty, the pump must be installed with check valves as supplied by Spirax Sarco.

To size the PTF4 in a closed system:

Establish the available motive pressure.

Establish the static backpressure on the pump-trap combination.

Place established pressures (bar g or psi g) into the formulae below:

Pump motive pressure – Minimum vent assist valve* delta P > Backpressure

Capacity charts to be read as normal, i.e. at the pump motive and backpressure.

If, the Pump motive pressure – Minimum vent assist valve* delta P < Backpressure, then isolate or remove the vent assist valve and multiply the capacity by 0.77 to find the reduced capacity without the vent assist valve.

* Please note that the vent assist valve is clearly identified in Figure 1.

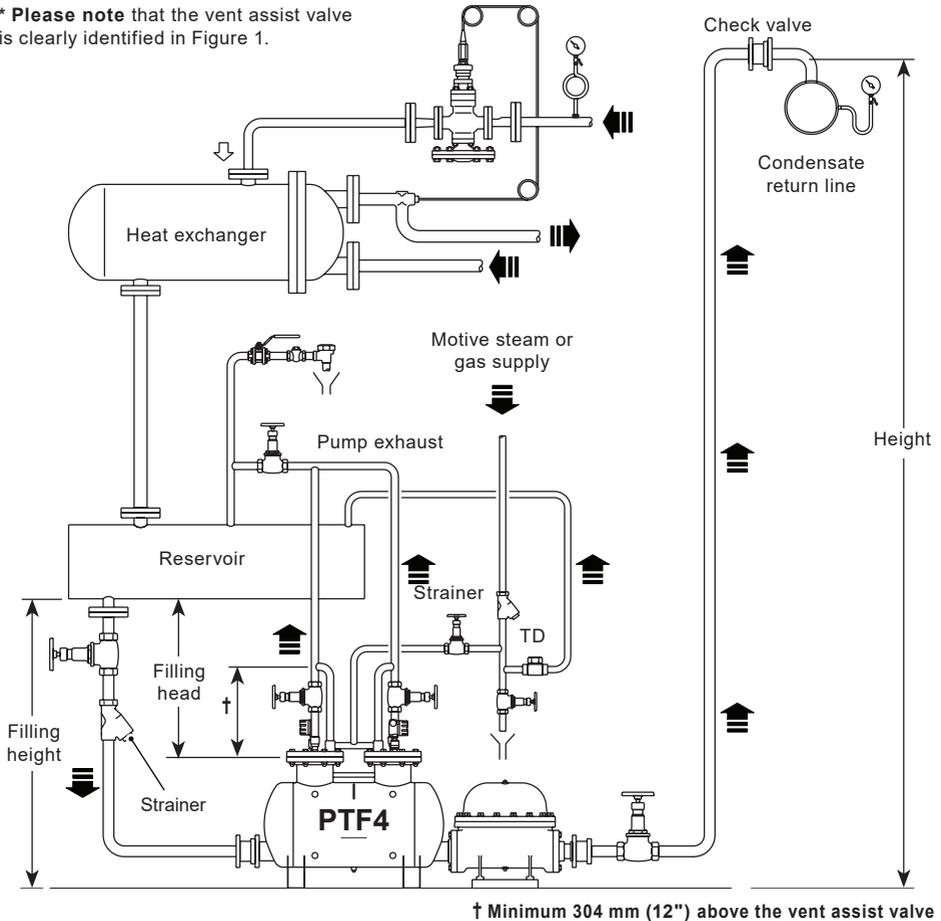


Fig. 3 Closed loop system with trap

- 3.7.4 Inlet reservoir piping** - To drain condensate from a single piece of equipment in a 'closed loop 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. Table 2, illustrates the 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 see Table 2.
- 3.7.5** Connect the operating medium supply to the motive supply inlet in the cover. The supply main should have a strainer and steam trap installed upstream of the supply inlet. The steam trap discharge should be piped to the downstream piping (Non-flooded).
Note: When the available motive pressure exceeds 13.8 bar g (200 psi g), a Spirax Sarco pressure reducing valve 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 the desired capacity. A safety relief valve should be installed at the connection provided in the pump cover or in the motive steam supply piping.
- 3.7.6** The exhaust line must be piped, unrestricted, to the top of the reservoir in order to equalize all pressures and ensure that the 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-condensibles during start-up. Any horizontal runs in the exhaust line should be pitched so that the line is self-draining.
- 3.7.7** 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 3.

3.8 Closed system considerations

- 3.8.1** The pump will not satisfactorily operate below a motive pressure of 2 bar g (30 psi g).
- 3.8.2** 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.
- 3.8.3** At a minimum, when using steam, the inlet piping should be at least 50 mm (2") NB pipe from the steam header dropping to the pump. Only when the steam (motive) inlet pipework is close to 0.6 m (2 ft) 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 steam (air or motive gas) is supplied uniformly to each of the PTF4 pump mechanisms and will provide synchronous operation of both mechanisms.
- 3.8.3** 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 backpressure is placed on the vent assist valve the exhaust line from the exhaust valve must be tied in at least 304 mm (12") above the vent assist valve:
- In an open system, the backpressure acting on the exhaust side of the vent assist valve (VAV) will be atmospheric pressure.
 - When the pump is fitted in a closed system, the backpressure acting on the exhaust side of the vent assist valve (VAV) is the closed system pressure.
 - The maximum possible closed system pressure acting on the exhaust side of the vent assist valve will be the static backpressure acting on the pump-trap combination. If the closed system pressure were higher than the static backpressure on the pump-trap combination the condensate would flow through both the pump and trap. The pump would not operate.

* Minimum 304 mm (12")
above the vent assist valve

Fig. 4
Closed loop system with trap

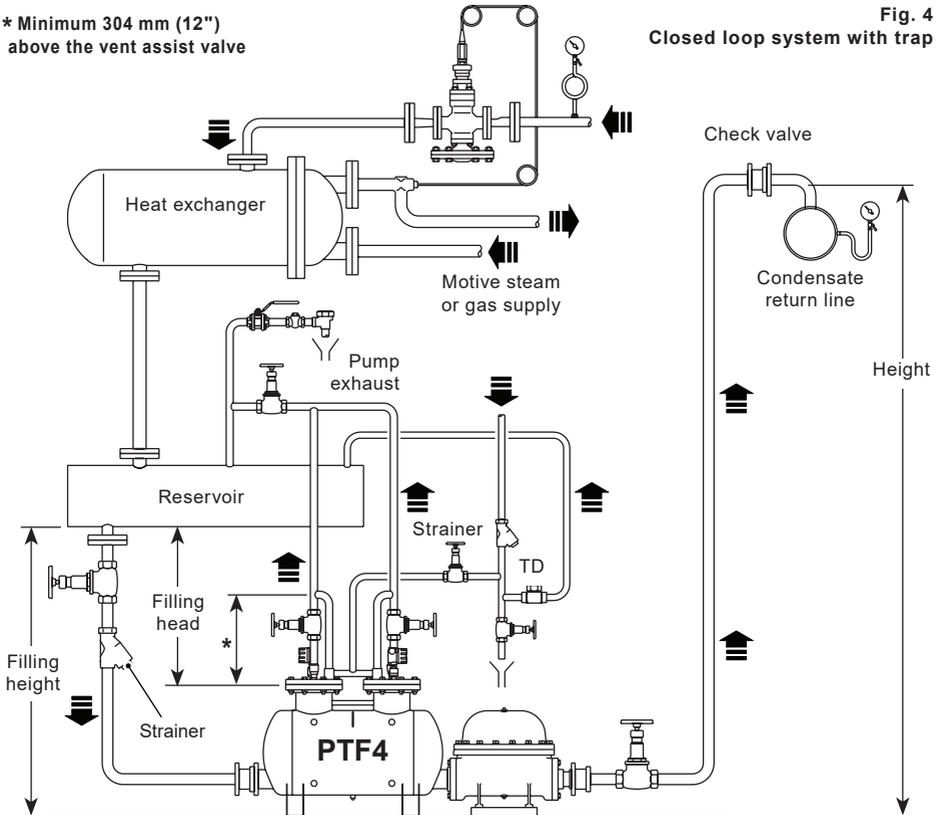


Table 2 Inlet reservoir piping for the PTF4 in mm and (inches or feet)

Liquid load kg/h (lb/h)	Reservoir pipe size			
	300 mm (12")	400 mm (16")	500 mm (20")	600 mm (24")
4535 kg/h (10000 lb/h)	1524 mm (5 ft)	914 mm (3 ft)	610 mm (2 ft)	
9070 kg/h (20000 lb/h)	3048 mm (10 ft)	2133 mm (7 ft)	1219 mm (4 ft)	
13605 kg/h (30000 lb/h)		2743 mm (9 ft)	1828 mm (6 ft)	1219 mm (4 ft)
18141 kg/h (40000 lb/h)		3658 mm (12 ft)	2286 mm (7.5 ft)	1828 mm (6 ft)
22676 kg/h (50000 lb/h)			2743 mm (9 ft)	1828 mm (6 ft)
27211 kg/h (60000 lb/h)			2743 mm (9 ft)	1828 mm (6 ft)

3.9 Installation - Multiple pressure powered 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 waterhammer in the return line due to high flowrates and velocities induced during multiple pump discharge cycles.

3.10 PTF4 steam inlet / exhaust pipe - 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, when using steam, the inlet piping should be at least 50 mm (2") NB pipe from the steam header dropping to the pump. Only when the steam (motive) inlet pipework is close to 0.6 m (2 ft) to the pump should the motive line piping be reduced and split equal into two separate lines. These should be of equal diameter and length to be fed into each mechanism's motive inlet. This will ensure steam (air or motive gas) is supplied uniformly to each of the PTF4 pump mechanisms and will provide synchronous operation of both - See Figures 5, 6 and 7.

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 the case of the latter the vent assist valve exhaust line must be piped into the vent line at least 304 mm (12") away from the pump exhaust connection. Trap discharge pipelines must not be piped into any of the pumps vent lines - See Figures 8 and 9.

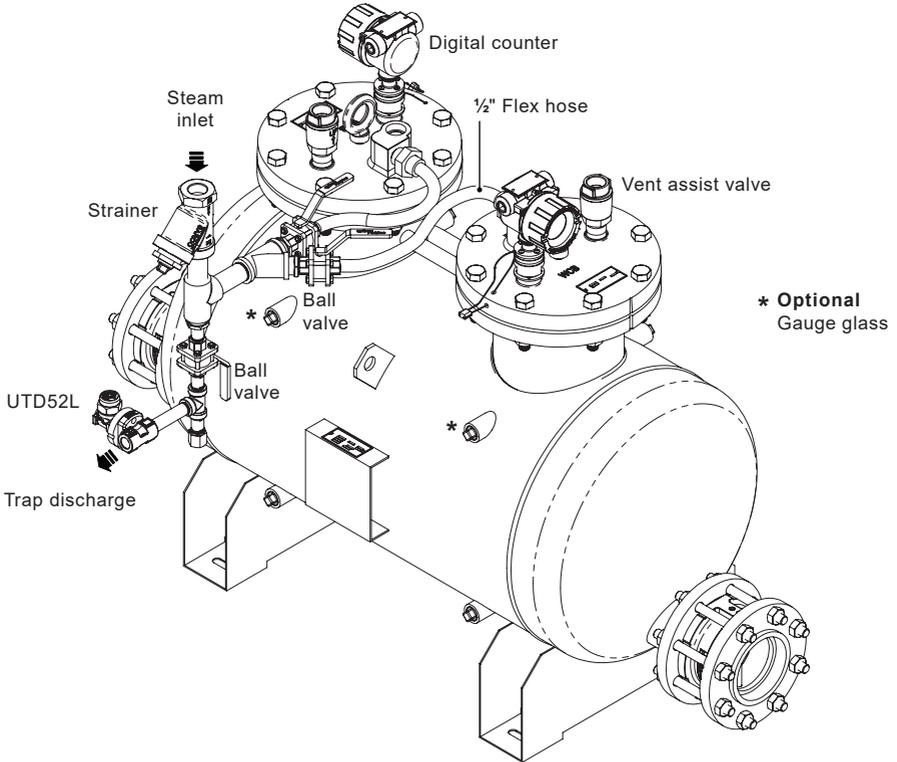


Fig. 5 Recommended steam inlet piping hook-up

For pressure / temperature limits see Section 2.3

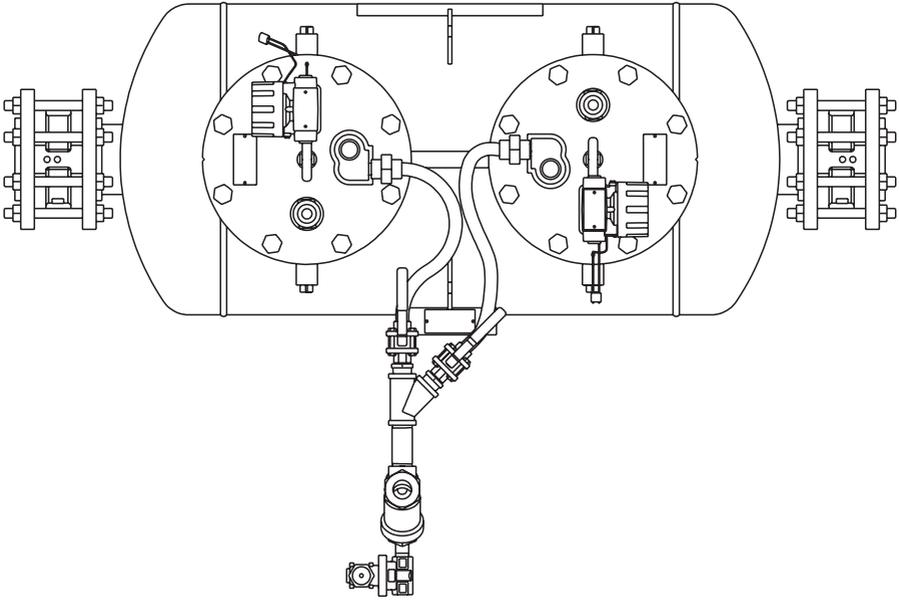


Fig. 6 Recommended steam inlet piping hook-up

For pressure / temperature limits see Section 2.3

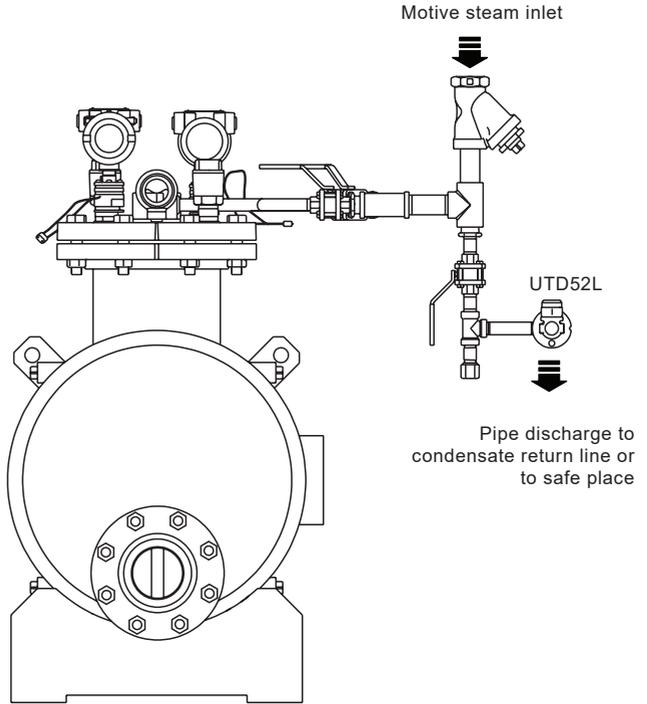


Fig. 7 Recommended steam inlet piping hook-up

For pressure / temperature limits see Section 2.3

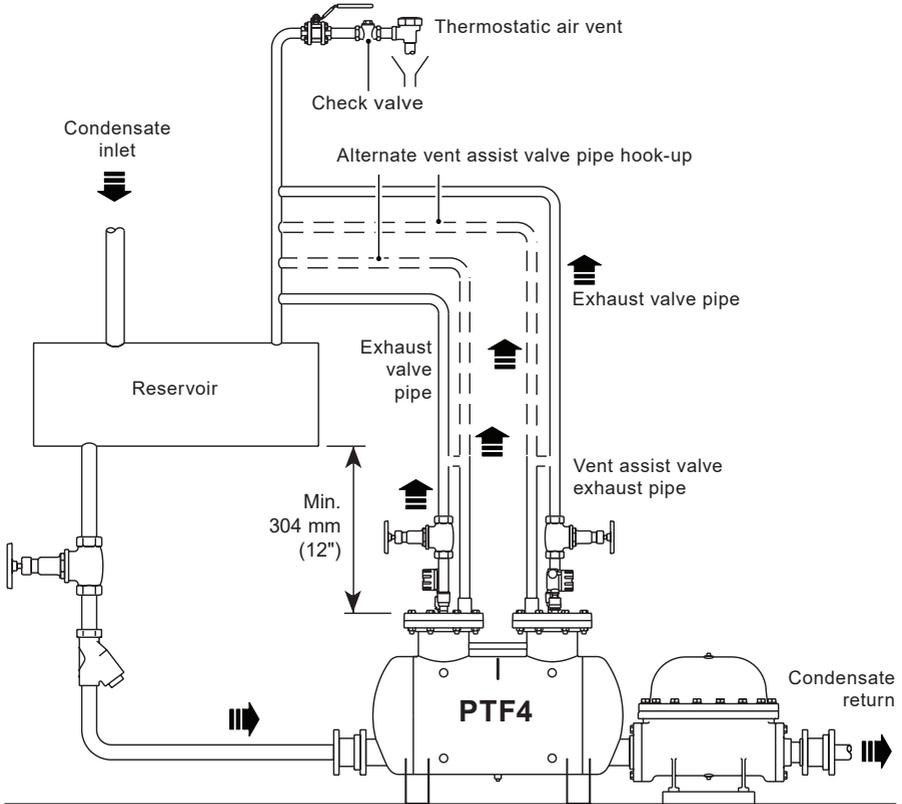
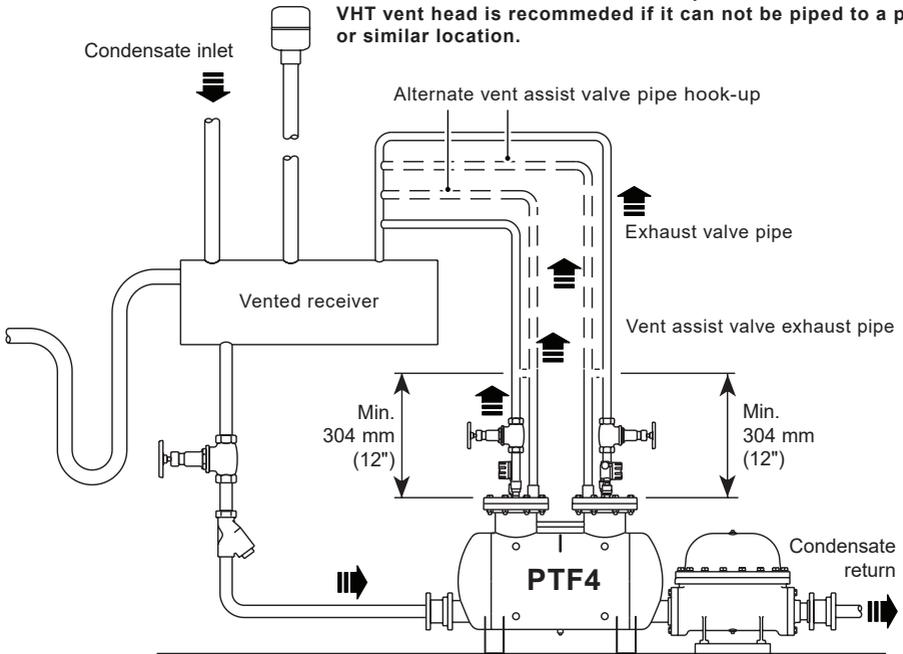


Fig. 8 Typical PTF4 exhaust and vent assist valve pipe hook-up for closed system

3.11 Start-up procedure

- 3.11.1 Slowly open the supply (steam, air or gas) to provide pressure at the pressure power pump inlet valve. Check that trap/drain on motive line is operational.
- 3.11.2 Open the gate valves in the pressure power pump inlet and discharge lines.
- 3.11.3 Open valve(s) ahead of the unit allowing condensate to enter the receiver/reservoir and fill the pressure power pump body. The pump will discharge when full.
- 3.11.4 Observe operation for any abnormalities. Pressure power pump(s) will cycle periodically with an audible exhaust at the end of the pumping cycle. If any irregularities are observed, recheck the installation instructions for correct hook-up (See following pages). Consult Spirax Sarco if necessary.
- 3.11.5 If the overflow piping has been provided, check that a water seal has been established to prevent any steam from being vented during normal operation. Prime the overflow piping if necessary.

Vent to atmosphere. The vent must be piped to a safe location such that there is no risk to personnel. The use of a VHT vent head is recommended if it can not be piped to a pit or similar location.



At least 304 mm (12") seal on the overflow.
 Discharge to be piped to a safe location such that there is no risk to personnel.

Fig. 9 Typical PTF4 exhaust and vent assist valve pipe hook-up for open (vented) system

4. Commissioning

After installation or maintenance ensure that the system is fully functioning. Carry out tests on any alarms or protective devices.

Note: As with all steam systems it is very important that the pressure is built up slowly to avoid possible damage to any sensitive equipment.

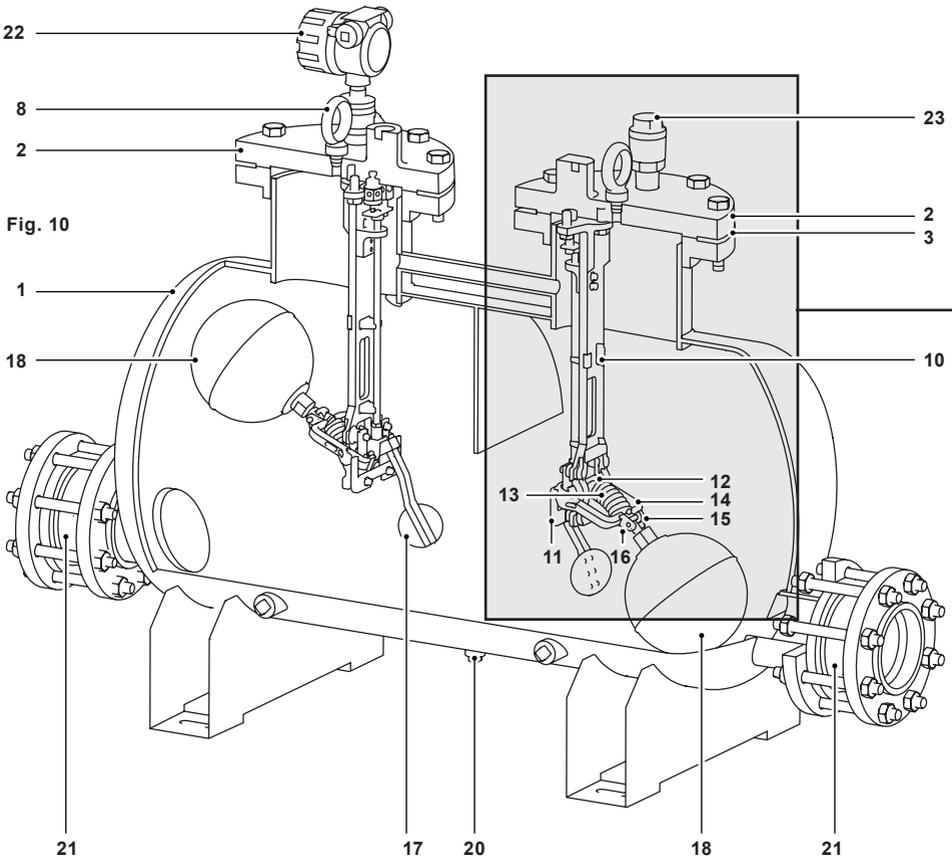
5. Operation

How the Pivotrol Pump® operates

- 5.1.1** In the normal position before start-up the float (18) is at its lowest position with the steam inlet valve (4) closed, the exhaust valve (6) is open.
- 5.1.2** When liquid flows, by gravity, through the inlet check valve (21) into the pump body, the float (18) will become buoyant and rise.

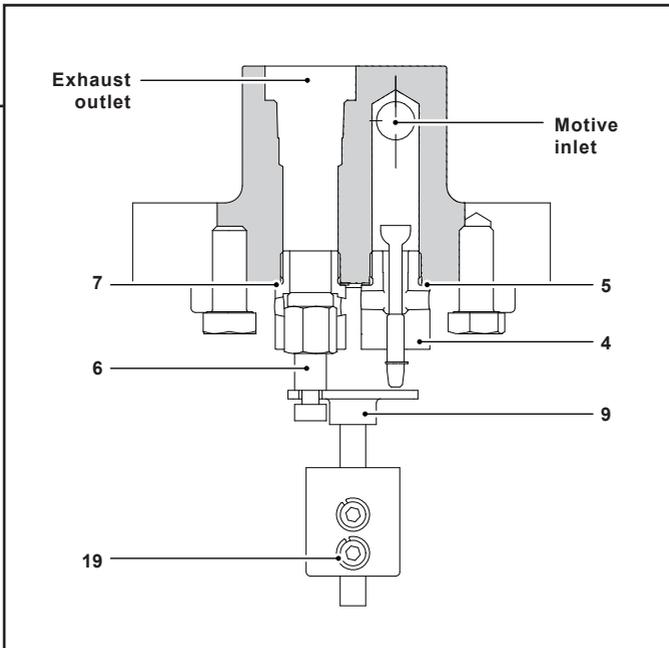
Operating pressure range
2 to 13.8 bar g (30 to 200 psi g)

Please note that pressure gauges may be fitted into any of the top gauge glass connectors.



- 5.1.3 As the float (18) continues to rise the float arm assembly (14) is engaged which increases the compression in the spring (13). When the float (18) has risen to its upper tripping position the energy in the spring is released instantaneously causing the float arm assembly (14) to snap upwards over center moving the pushrod (9) upwards to simultaneously open the steam inlet valve (4) and close the exhaust valve (6).
- 5.1.4 Steam will now flow through the steam inlet valve (4) and develop a pressure within the body forcing the liquid out through the discharge check valve (21). The inlet check valve (21) will be closed during the discharge cycle.
- 5.1.5 As the liquid level in the pump body lowers so does the float's (18) position. Before the float (18) reaches its lowest position the float arm assembly (14) is engaged increasing the compression in the spring (13). When the float (18) is at its lower tripping position in the body the energy in the spring (13) is released instantaneously causing the float arm assembly (14) to snap over center downward moving the pushrod (9) down causing the steam inlet valve (4) to close and exhaust valve (6) to open simultaneously.
- 5.1.6 Liquid will again flow through the inlet check valve (21) to fill the pump body and the cycle will be repeated.

Cross sectional view



6. Maintenance

Note: Before actioning any maintenance programme observe the 'Safety information' in Section 1.

6.1 Maintenance

CAUTION: Use caution when removing the cover and gasket. The 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.

- 6.1.1** Break and disconnect all connections to the cover. Remove the cover bolts and lift the cover and mechanism assembly from the body, noting the cover orientation ('V' notch) - Reference Figs 12 - 14 to visually see how to remove the cover and mechanism assembly.
- 6.1.2** Visually inspect the mechanism to verify that it is free of dirt and scale and that the float and mechanism moves freely. **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 Spirax Sarco for replacement under the warranty terms.
- 6.1.3** 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 12.
 - 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 13. **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. The cover must be orientated so that the 'V' cast into the pump cover lines up with the body vertical line on the outside diameter of the mating flange located on Figure 11. This ensures correct float orientation - See Figure 14.
- 6.1.4** Assemble the cover bolts and torque to 210 to 238 N m (155 to 175 lbf ft) in a cross pattern as shown in Figure 11.

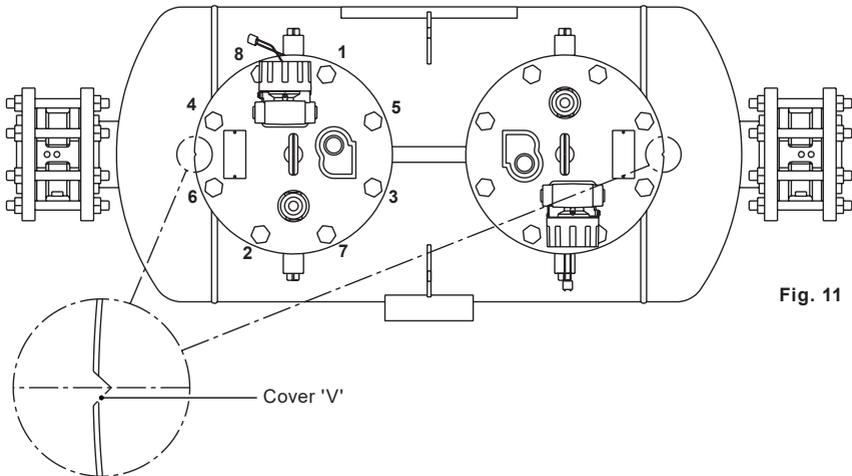


Fig. 12

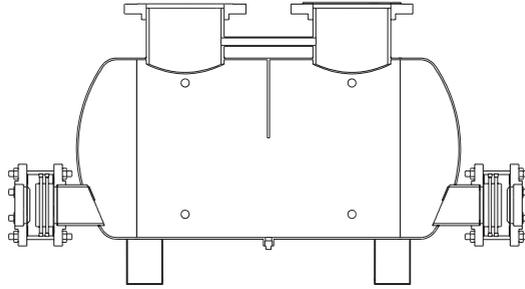
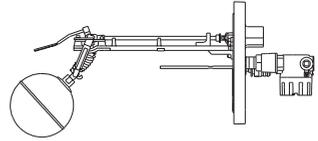


Fig. 13

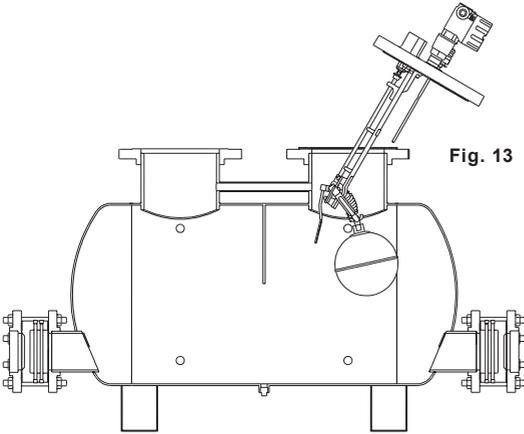
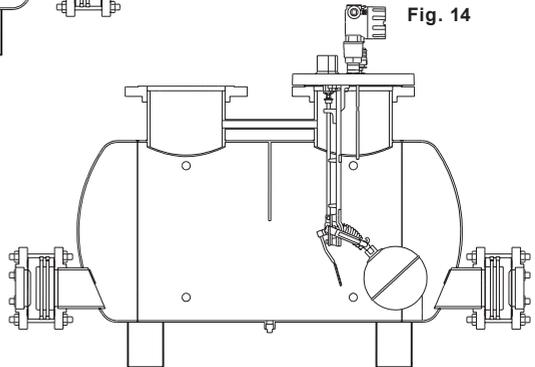


Fig. 14



7. Fault finding

Note: Before actioning any maintenance programme observe the 'Safety information' in Section 1.

If a correctly sized PTF4 pressure powered pump does not operate properly, an incorrect hook-up 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 backpressure conditions beyond the original design parameters. With the system conditions and problem symptoms determined, check the following in turn and correct as necessary.

Symptom	Cause
<p style="text-align: center;">1</p> <p>Pump fails to operate on start-up.</p>	<ul style="list-style-type: none"> 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. g) Vent assist valve not closing on start-up.
<p style="text-align: center;">2</p> <p>Supply line /equipment flooded, but the pump appears to cycle normally (periodic audible exhaust observed).</p> <p>Remove the check valve and visually inspect, body and plate faces, hinge and spring.</p>	<ul style="list-style-type: none"> 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).

Check and Cure

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 1 to 1.3 bar g (15 - 20 psi g) higher than static backpressure.
 - e) Verify proper flow direction is correct.
 - f) On a vented system, ensure that the vent line is unrestricted to atmosphere and self-draining to the pump or receiver. On a closed system, isolate the pump from the pressurised space being drained. (Exhaust tie-back line closed.) Break the exhaust connection at the pump cover. Keep personnel clear of the exhaust connection. If the pump begins to cycle, air locking has occurred. Recheck that the 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 equalizer line is self-draining.
 - g) Close the isolation valve fitted in the exhaust line above the vent assist valve, closing the vent assist valve discharge but still allowing the exhaust valve to discharge fully. Allow hot condensate to reach the pump and then re-open the isolation valve above the vent assist valve.
2.
 - a) Verify capacity rate - See TI-P135-13. Increase the check valve size or install an additional pump as required.
 - b) Verify filling head - See Section 2.3. Lower the pump to achieve the required filling head.
 - c) Check motive pressure setting and maximum backpressure during operation. Compare with the capacity table - See TI-P135-13. Increase the 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 the inlet check valve and relieve line pressure. Clean seating surfaces and reinstall or replace, if necessary.

Symptom	Cause
<p style="text-align: center;">3</p> <p>Supply line/equipment flooded, and the pump has stopped cycling (audible periodic exhaust not observed).</p> <p>Important safety note: 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 ensure 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>	<p>3. a) Discharge line closed or blocked.</p> <p>b) Discharge check valve stuck closed.</p> <p>c) Insufficient motive pressure.</p> <p>d) Motive inlet valve leaking and/or worn.</p> <p>e) Mechanism faults: i) Broken spring. ii) Ruptured float.</p> <p>f) Exhaust/tie-back causing vapour lock (vented or closed loop).</p> <p>g) Inlet check valve stuck closed.</p>
<p style="text-align: center;">4</p> <p>Chattering or banging in the return main after the pump discharges.</p>	<p>4. a) Vacuum created at the pump outlet after discharge because of acceleration/deceleration of large water slug(s) in the return main (usually results from long horizontal run with multiple rises and drops).</p> <p>b) Pump 'blow-by'.</p>

Check and Cure

3. a) Check the motive pressure and static backpressure (at pump discharge). If equal, a closed or blocked discharge line is suspected. Check all valves downstream of the pump to ensure that the discharge is not obstructed.
- b) After checking per 3(a), isolate the discharge check valve and safely relieve line pressure. Remove the check valve and visually inspect the body and plate faces, hinge and spring. Clean the seating surfaces and reinstall or replace, if necessary.
- c) If the motive pressure is below the static backpressure, increase the motive pressure setting to 1 to 1.3 bar g (15 - 20 psi g) above the static backpressure. Do not exceed the rated pressure limits of the equipment.
- d) Slowly open the 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 the pump, and safely relieve pressure, remove the cover and mechanism assembly and visually inspect. Replace inlet valve and seat assembly.
- e) With the motive line open, slowly open the condensate inlet line to the pump, allowing the pump to fill and observe the exhaust connection. **Keep personnel clear of exhaust!** If condensate runs out of the exhaust connection, a mechanism fault is clearly indicated. Isolate the pump by shutting off the motive supply and condensate inlet, and safely relieve the pressure, remove the cover and mechanism assembly, and visually inspect. Examine the springs and float for obvious defects. Also check the stroke mechanism for any source of binding or increased friction. Repair and/or replace all defects observed.
- f) If the 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. **Keep personnel clear of exhaust connection!** If the 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 vapour locking the pump.
- g) If the 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. Ensure 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 the 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 the line.
4. a) Install a vacuum breaker at the top of the lift (at a high point in the return line). For pressurised return systems an air eliminator may be required downstream of the vacuum breaker - See Figure 15.
- b) Check the 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 Figures 5, 6 and 7.

Symptom	Cause
<p style="text-align: center;">5</p> <p>Vent line discharging excessive flash steam (vented applications only).</p>	<p>5. a) Faulty steam traps are discharging live steam into the condensate inlet line (See also 4(b), Pump 'blow-by').</p> <p>b) Excessive (over 110 kg/h, 50 lb/h) flash steam is being vented through the pump.</p> <p>c) Exhaust valve stuck or worn.</p> <p>d) Vent assist valve not closing.</p>

Check and Cure

5. a) Check for leaking traps discharging into the condensate return. Repair or replace faulty traps (See also 4(b), Pump 'blow-by').
- b) Vent the receiver ahead of the pump.
- c) Isolate the pump and safely relieve the pressure, and remove the cover and mechanism assembly. Remove the exhaust head and seat assembly. Visually inspect the seating surface. Clean and reinstall or replace, if worn.
- d) Close the isolation valve fitted in the exhaust line above the vent assist valve, closing the vent assist valve discharge but still allowing the exhaust valve to discharge fully. If the discharge stops and the pumping capacity is still acceptable leave as is. If by closing the vent assist valve the capacity is no longer acceptable replace the vent assist valve.

Other typical hook-up drawings

The hook-up drawings illustrated on the following pages, 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.

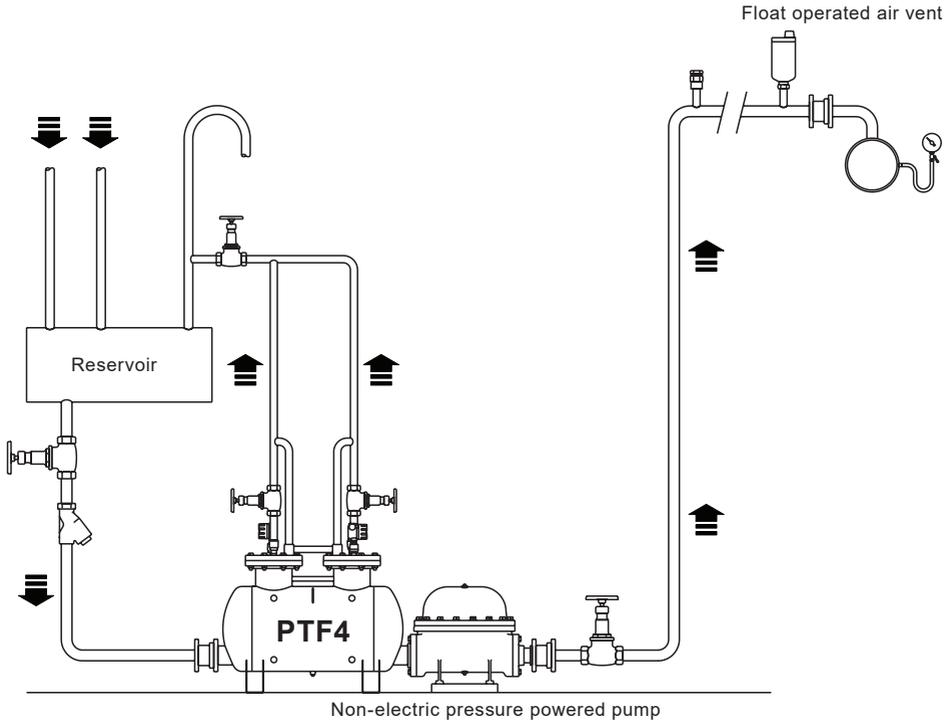


Fig. 15 Pressure-powered pump discharging to a long delivery line
 (An air eliminator is needed with a seal in the piping)

*H - Total lift or backpressure is the height (H) in feet x 0.433 plus psi g in the return line, plus downstream piping friction pressure drop in psil calculated at a flowrate of the lesser of the 6 times the actual condensate flowrate.

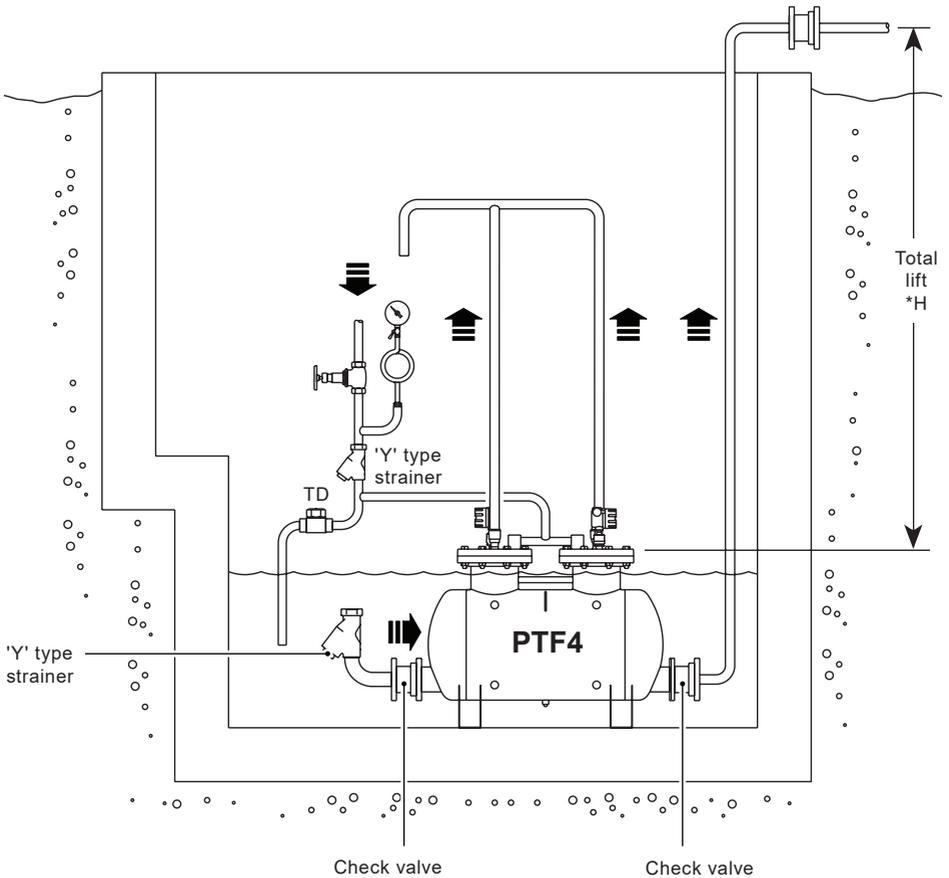


Fig. 16 Pressure-powered pump draining water from a sump pit

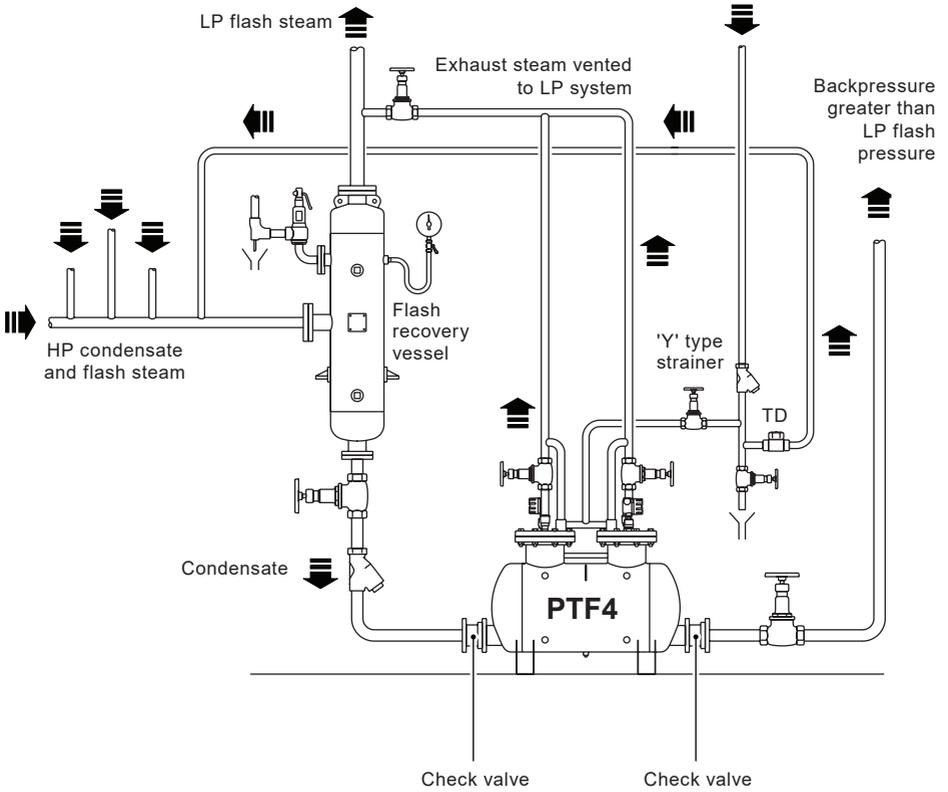


Fig. 17 Flash steam recovery at pressure above or below atmospheric

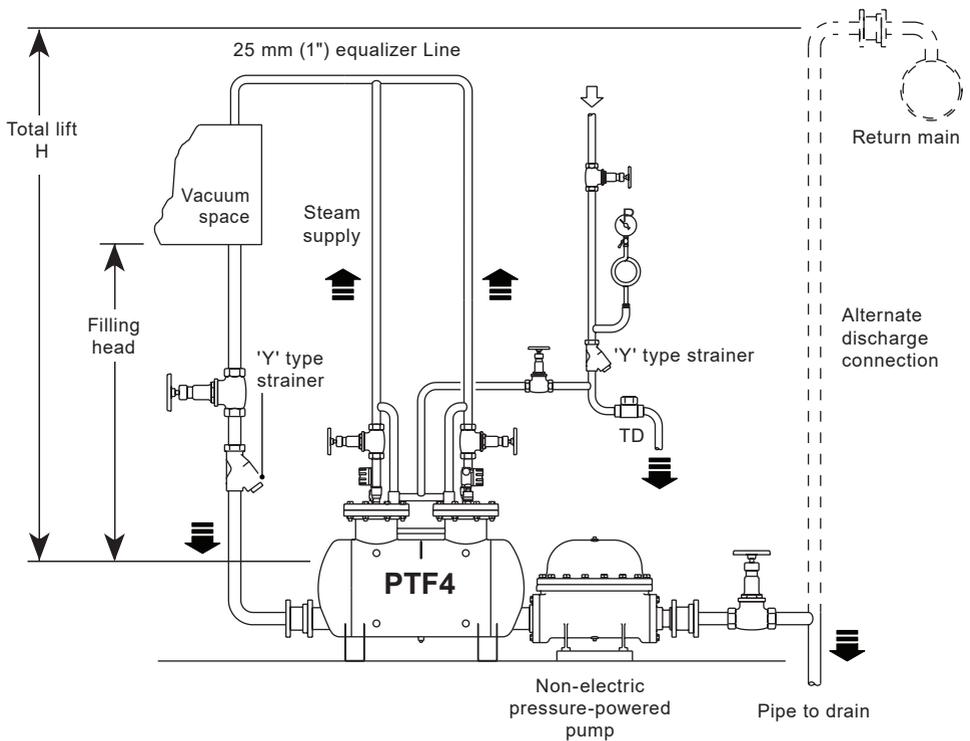


Fig. 18 Draining condensate from a vacuum space to return main

Arrangement of small steam/liquid heat exchanger where steam space pressure may fall below the backpressure.

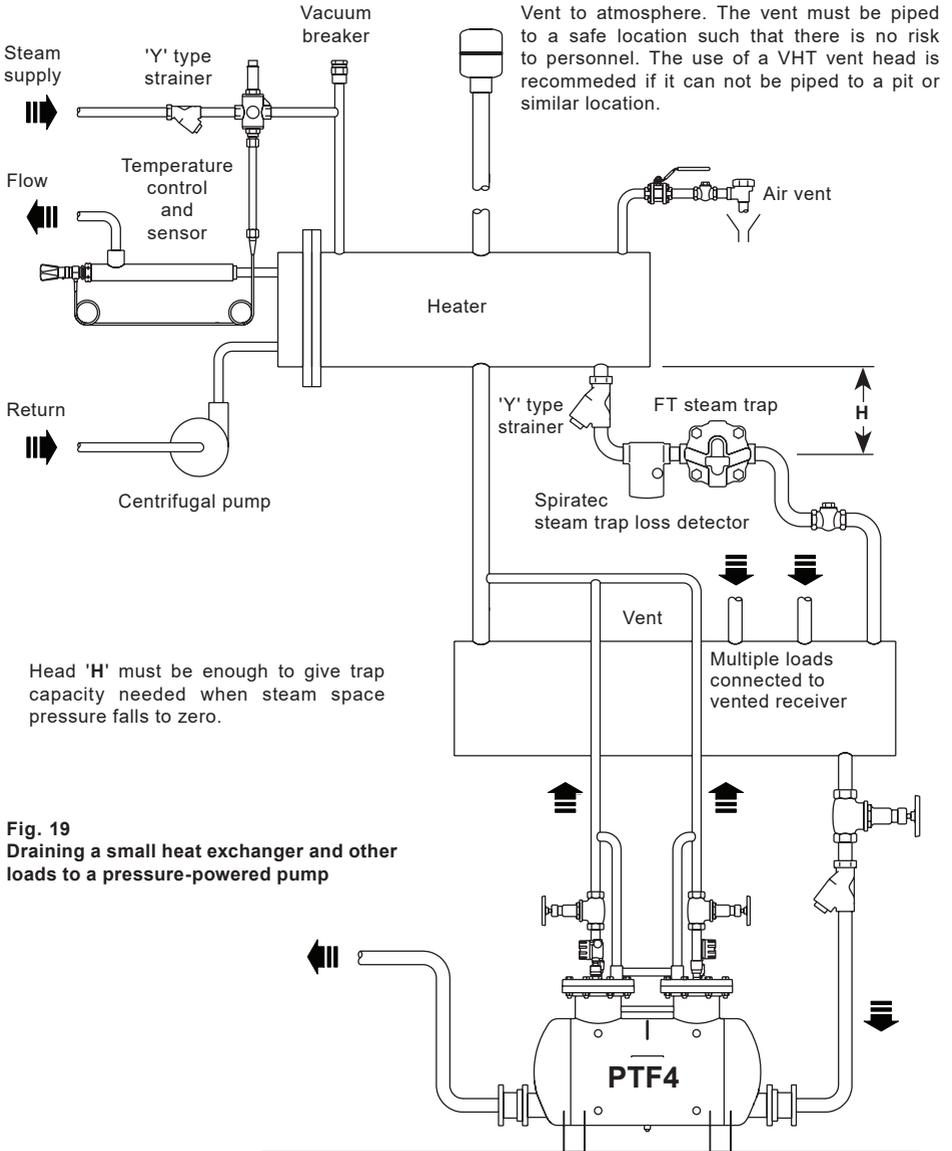


Fig. 19
Draining a small heat exchanger and other loads to a pressure-powered pump

