Pumping Traps

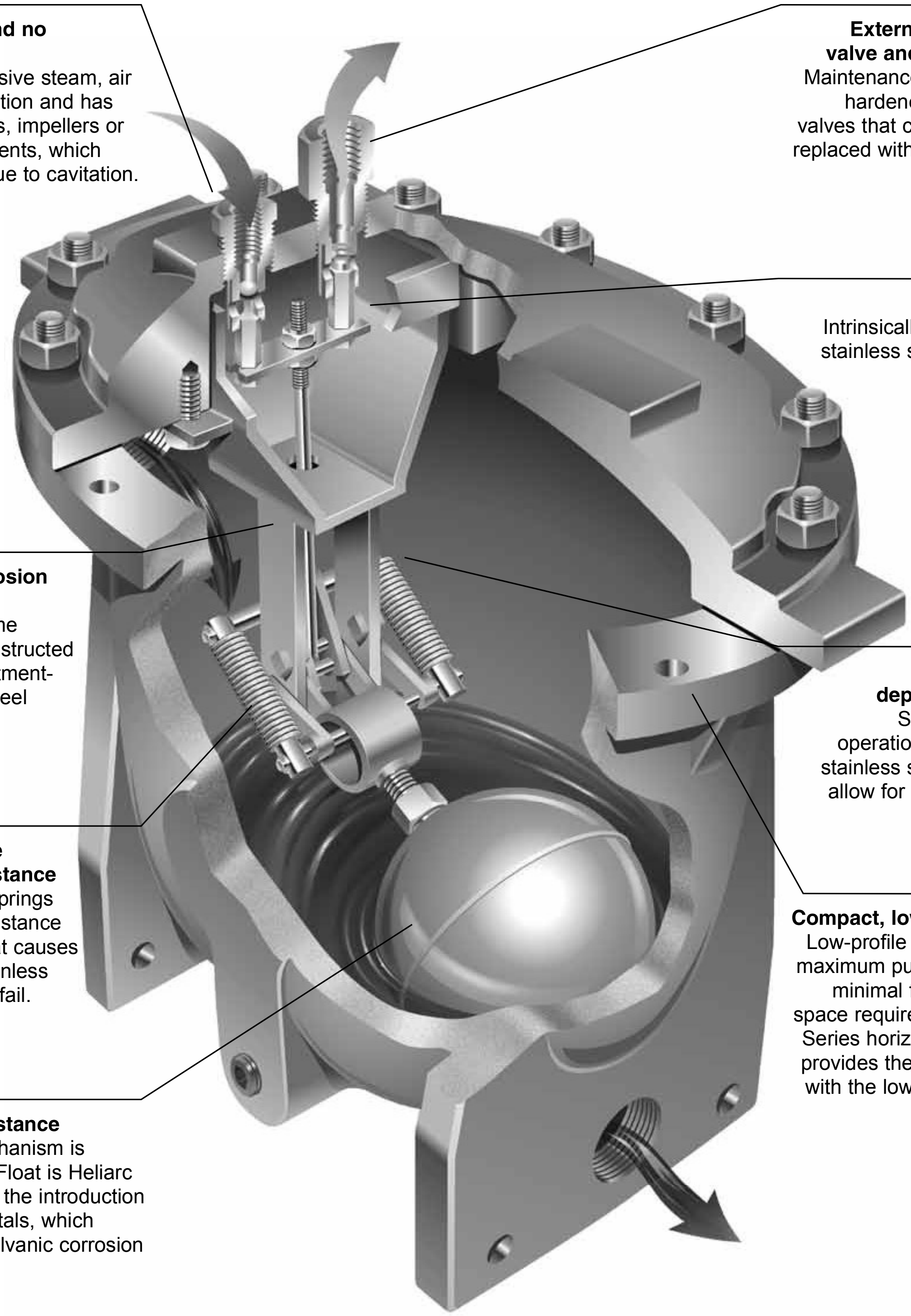
Inside Advantages

Mechanical condensate pumps operate with a spring-assisted float mechanism, which means the springs themselves are a major wear point. Armstrong pumping traps have large-diameter Inconel X-750 springs, which provide superior corrosion resistance and longer service life than those in competitive models. For other inside advantages, see below.

Notice the difference in spring design from the industry standard spring set (left) and the Armstrong Inconel spring set.

Non-electric and no cavitation
Utilizes inexpensive steam, air or gas for operation and has no seals, motors, impellers or electric components, which frequently fail due to cavitation.

Externally replaceable valve and seat assembly
Maintenance is a “snap” with hardened stainless steel valves that can be cleaned or replaced without cap removal.



Explosion proof
Intrinsically safe due to all-stainless steel construction of mechanism.

Wear and corrosion resistance
Mechanism frame assembly is constructed of rugged investment-cast stainless steel components.

Long life and dependable service
Simple float/spring operation and rugged all-stainless steel construction allow for long, trouble-free service life.

Stress chloride corrosion resistance
Inconel X-750 springs have higher resistance to the stress that causes lower-grade stainless steel springs to fail.

Compact, low-profile design
Low-profile design allows for maximum pump capacity with minimal fill head and floor space requirements. EPT-300 Series horizontal tank design provides the highest capacity with the lowest profile on the market.

Corrosion resistance
Entire float mechanism is stainless steel. Float is Heliarc welded to avoid the introduction of dissimilar metals, which could lead to galvanic corrosion and float failure.

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Effective Condensate Management = Energy Savings

The most basic part of energy management is utilizing all valuable kJ within the steam system. Depending on the pressure, condensate exiting a trap contains approximately 20% of the heat energy transferred at the boiler in the form of sensible heat. Effective recovery of condensate reduces four tangible costs of producing steam:

- Fuel/energy costs and CO_2 emissions associated with producing steam
- Boiler water make-up and sewage treatment
- Boiler water chemical treatment
- Boiler blow-down rate

These savings can be calculated using the attached savings form. Returning condensate saves money, energy and the environment. Pour money and energy savings back into your plant – not down the drain.

Condensate Recovery Savings Analysis   Location ______________________ Building ______________________

Energy costs will vary from plant to plant and regions of the world. Values shown are conservative. Complete this form using your facilities' numbers to determine annual savings in your plant by returning condensate. If some costs are not known, use the figures below for conservative estimates.

A) Condensate Load .... = 2 m³/h

B) Annual Hours of Operation................... = 5 000 h/year

C) Total Water and Sewage Cost .... = 1,0 € per m³
   c1) Untreated water and sewage .... = 0,5 € per m³
   c2) Water treatment chemicals.............. = 0,5 € per m³

D) Make-Up Water Preheating Requirements. = 314 kJ/kg
   d1) Condensate Return Temperature....... = 90°C
   d2) Make-Up Water Temperature........... = 15°C

E) Steam Cost .... = 15 € per ton
   e1) Steam Pressure.......................... = 3 bar
   e2) Enthalpy at 3 bar .... = 2 738 kJ/kg

F) Annual Water Savings....................... = 10 000 €
   (A)2 x (B)5 000 x (C)1,0

G) Savings for Preheating Make-Up Water.... = 17 606 €

$$\frac{\text{(A)2 x (B)5 000 x (D)314 x (E)15}}{\text{(e2)2 738 - ((d2)15 x 4,186)}}$$

H) Cost of Steam to Operate†
   Armstrong Pump Trap .... = 450 €

$$\frac{\text{3 kg steam/m³ x (A)2 x (B)5 000 x (E)15}}{\text{1 000}}$$

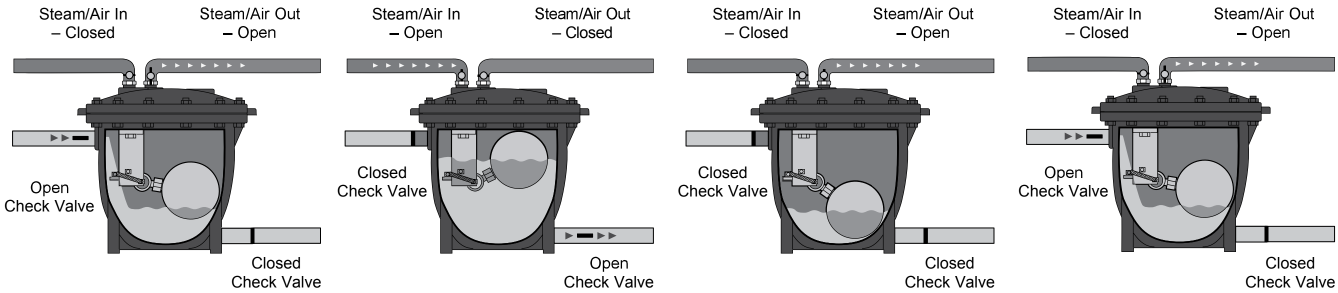
I) Total Euro Saved Annually (F + G - H).... = 27 156 €

J) Payback Period in Years .... = 67 Days

$$\frac{\text{**(cost of equipment/installation)5 000 €}}{\text{(I)27 156}}$$

** Estimated equipment and installation cost
† Cost to operate in example assumes an "open" vented system. If pump trap is used in "closed loop" application, energy of motive steam is completely used in the system.

Pumping Trap Operation



Filling
1. During filling, the steam or air inlet and check valve on pumping trap outlet are closed. The vent and check valve on the inlet are open.

Begin Pumping
2. Float rises with level of condensate until it passes trip point, and then snap action reverses the positions shown in step one.

End Pumping
3. Float is lowered as level of condensate falls until snap action again reverses positions.

Repeat Filling
4. Steam or air inlet and trap outlet are again closed while vent and condensate inlet are open. Cycle begins anew.

Condensate Recovery Equipment ID Charts

Table CRE-214-1. Armstrong Condensate Recovery Equipment

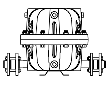
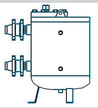
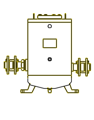
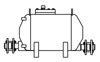
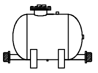
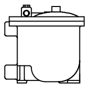
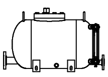
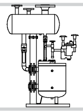
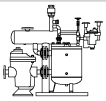
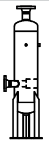
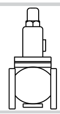
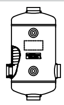
Illustration	Type	Connection Type	Max. Allow. Press. barg	TMA °C	Body Material	Mechanism Material	Model	Max. Oper. Press. barg	Capacity Range (condensate) kg/h	Connection Size				Located on Page
										1"	1 1/2"	2"	3" x 2"	
	**Model EPT-104** Pumping Trap	PN40 Flanged	10	232	ASTM A48 Class 30 Cast Iron	Stainless Steel Inconel X-750 Spring	**EPT-104**	6	900	●				CRE-220
	**Series EPT-200** Pumping Trap	PN40 Flanged	10	250	Fabricated Carbon Steel	Stainless Steel Inconel X-750 Spring	**EPT-204** **EPT-206**	9	1 716 2 620	●	●			CRE-222
	**Series EPT-400** Pumping Trap	PN40 Flanged	10	250	Fabricated Carbon Steel	Stainless Steel Inconel X-750 Spring	**EPT-404** **EPT-406** **EPT-408** **EPT-412**	9	2 520 3 705 5 000 7 310	●	●	●		CRE-224
	PT-400LL	150# ANSI Flanged											●	CRE-232
	**Series EPT-300** Pumping Trap	PN40 Flanged	10	250	Fabricated Carbon Steel	Stainless Steel Inconel X-750 Spring	**EPT-308**	9	9 040			●		CRE-226
	PT-300LL	300# ANSI Flanged		260			**PT-312**		7 530				●	CRE-232
	**Model EPT-516** Pumping Trap	150# ANSI Flanged	10	250	Fabricated Carbon Steel	Stainless Steel with Stainless Steel Springs	**EPT-516**	10	35 920	4" x 4"				CRE-228
	**Double Duty® 4**	Screwed	5	160	Ductile Iron	Stainless Steel	**EDD-4**	5	Pumping Capacities **159 kg/h** Trapping Capacities **10 206 kg/h**	●	●			CRE-234
	**Double Duty® 6**	Flanged	14	204	Carbon Steel	Stainless Steel Inconel X-750 Spring	**EDD-6**	14	Pumping Capacities **2 177 kg/h** Trapping Capacities **10 206 kg/h**	1 1/2" x 1"				CRE-236
	Open System Packages	PN40 Flanged 150# ANSI Flanged	10	250	Fabricated Carbon Steel	Stainless Steel Inconel X-750 Spring	**Open System Packages**	9	1 470 18 880		●		●	CRE-238
	Closed System Packages	PN40 Flanged 150# ANSI Flanged	10	250	Fabricated Carbon Steel	Stainless Steel Inconel X-750 Spring	**Closed System Packages**	9	1 470 12 240		●		●	CRE-240
	**Series EAFT** Flash Tanks	PN40 Flanged	10	260	Fabricated Steel P265GH / P275H Merkblätter		**EAFT-6** **EAFT-8** **EAFT-12** **EAFT-16**	10	900 2 270 4 540 9 070	Inlet: 50 - Vent: 65 Inlet: 80 - Vent: 100 Inlet: 100 - Vent: 150 Inlet: 150 - Vent: 150				CRE-242

Table CRE-214-2. Posi-Pressure Draining System & MTS - Thermosiphon Mixer

Illustration	Type	Fluid	Connection Type	Max. Allow. Press. barg	TMA °C	Body Material	Model	Maximum Operating Pressure barg	Connection Size	Located on Page
	**GD-22** Posi-Pressure Regulator	Air	Screwed	10	80	Cast Iron	**GD-22**	10	1/2"	CRE-244
	**MTS** Thermosiphon Mixer	–	–	20	250	Stainless Steel or P265GH A106B	**MTS-300** **MTS-500**	20	3/4" x 1"	CRE-246

All models comply with the Pressure Equipment Directive PED 97/23/EC. For details, see specific product page or Armstrong PED Certificate.

Sizing and Selection – EPT-100/200/300/500/400 Series

The Armstrong non-electric pump trap is sized based on actual condensate load (kg/h) being pumped. The following steps are used to size the pump.

1. Determine the total condensate load to be pumped in kg/h. See conversion factors tables on specific product page.
2. Determine the total back pressure the pump will operate against. Total back pressure is the sum of the following:
   - Vertical lift expressed in barg (10 m lift = 1 barg).
   - Existing pressure in condensate return line or condensate collecting tank.
   - Frictional loss from pipe, valves and fittings
3. Determine type of motive gas to be used (steam, air or other inert gas) and pressure available.

Example:
- Condensate load = 1 100 kg/h.
- Total back pressure = 1,5 barg
  (5 m vertical lift = 0,5 barg, 1 barg in condensate return line).
- Motive pressure is steam at 3,5 barg.

Solution: Model EPT-206
Find 1,5 barg total lift or back pressure in column two of EPT-200 Pumping Trap Capacities table on page CRE-223. Then find 3,5 barg motive pressure in column one. Move across the capacity table until you reach a model number with the correct capacity. An EPT-206 has been highlighted above for this example.

Either a closed reservoir pipe or a vented receiver is required for proper condensate storage during the pump-down cycle of the pumping trap.

For vented / open system receiver sizing:
- Determine the pressure from where the condensate is being discharged.
- Determine condensate load.

Reference Percentage of Flash Steam chart on page CRE-230 to find the pressure that corresponds with the discharge condensate pressure. For this example, use 1,0 barg.

Follow 1,0 barg on the horizontal axis where it intersects the curve. Move left from the intersecting lines to the vertical axis for the percentage of flash steam that is created. For this example it will be 3% (see shaded area on Percentage of Flash Steam chart).

Multiply 3% by the condensate load. Using example above:
1 100 kg/h x 0,03 = 33 kg/h flash steam

Using the Vented Receiver Sizing table CRE-230-2 on page CRE-230, find the amount of flash steam in column one. Follow the table across to determine the size of the vented receiver. (See shaded area on Vented Receiver Sizing table CRE-230-2 for this example.)

For closed reservoir piping:
- Determine condensate load (using example above 1 100 kg/h).

Reference the inlet reservoir pipe sizing table CRE-230-1 for closed systems on page CRE-230. Find 1 100 kg/h in column one. Move horizontally across to find proper pipe size. (Note length or diameter may be slightly enlarged when capacity falls between given condensate loads in column one.) Selection is shaded.

Accessories

Use of external check valves required for operation of pumping trap.

Insulation Jacket

Features
- Lower risk of injury
- Higher energy efficiency
- Delays potential freezing

Gauge Glass Assembly

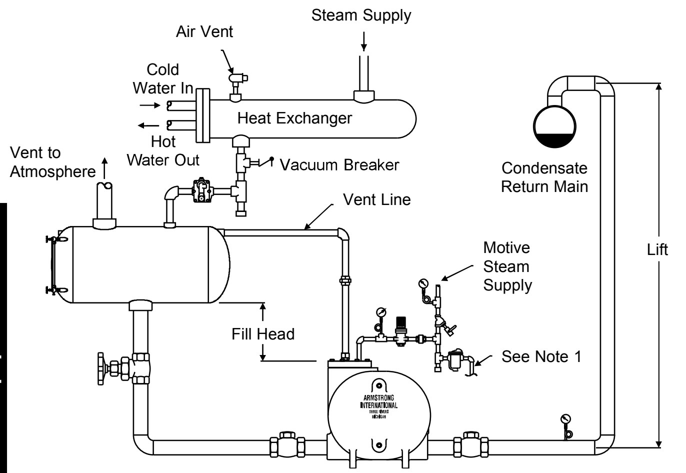
Features:
- Condensate load monitoring
- Allows troubleshooting not only of the pump, but also of the installation upward

Note: The above applies to all models.

Digital Cycle Counter

Features
- Totalizer is UL recognized, CSA certified
- 5-year lithium battery life
- Eight-digit counter readout
- Both totalizer and housing are Nema 4 rated, for protection against dust particles and water
- Easily installed on pumping traps
- Optional auxiliary contacts available upon request
- Push-button reset on face or key lock reset for security
- Rated for temperatures up to 178°C
- Closed loop option available

Reference Bulletin No. AFH-237.

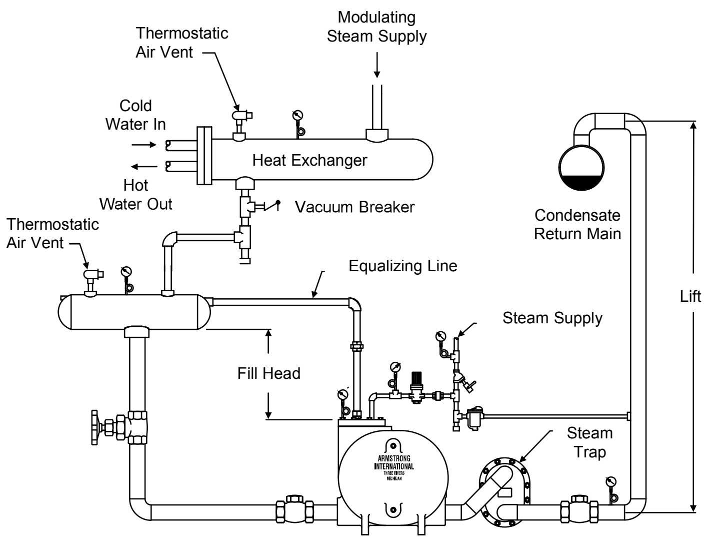


Multiple or single traps discharging to vented receiver.

OPEN SYSTEMS

For the majority of applications, a steam trap is recommended on each piece of heat exchange equipment. The steam trap, or traps, discharge to a vented receiver where flash steam will be vented to the atmosphere. The pump trap is located downstream and below the vented receiver, allowing for proper fill head height. See table CRE-230-2 for vented receiver and vent sizing for an open system.

Note: Drip trap on pump motive line may be discharged into the receiver, the return line or to the drain.



Draining steam coil or heat exchanger when pressure is lower than return line pressure. Note that a steam trap is not required in this application, as differential pressure is always negative. For more details, see installation and operation manuals.

CLOSED SYSTEMS

Applications exist where it is desirable to tie the vent line back into the heat exchange space, equalizing the pressure in the heat exchanger, reservoir/piping and the pump trap. This allows water to flow by gravity down to the pump where it can be returned. Valuable kJ remain within the system due to no flash steam loss to the atmosphere through the vent. Closed system applications can also be used to drain liquid from the equipment under a vacuum. See table CRE-230-2 for reservoir pipe sizing.

Note 1: If steam motive is used, the drip trap may be discharged into the return line or to the drain.

Note 2: Vent piping from the pump trap can be connected to the inlet side of the equipment being drained if the pressure drop across the equipment is less than 0,03 bar and there is a minimum of 600 mm of fill head present.

Note 3: A vacuum breaker might be installed to protect the heat exchanger if the vent piping from the pump trap is connected to the receiver. If the equipment modulated down to a sub-atmospheric condition, the vacuum breaker will open to equalize the system and provide adequate drainage.

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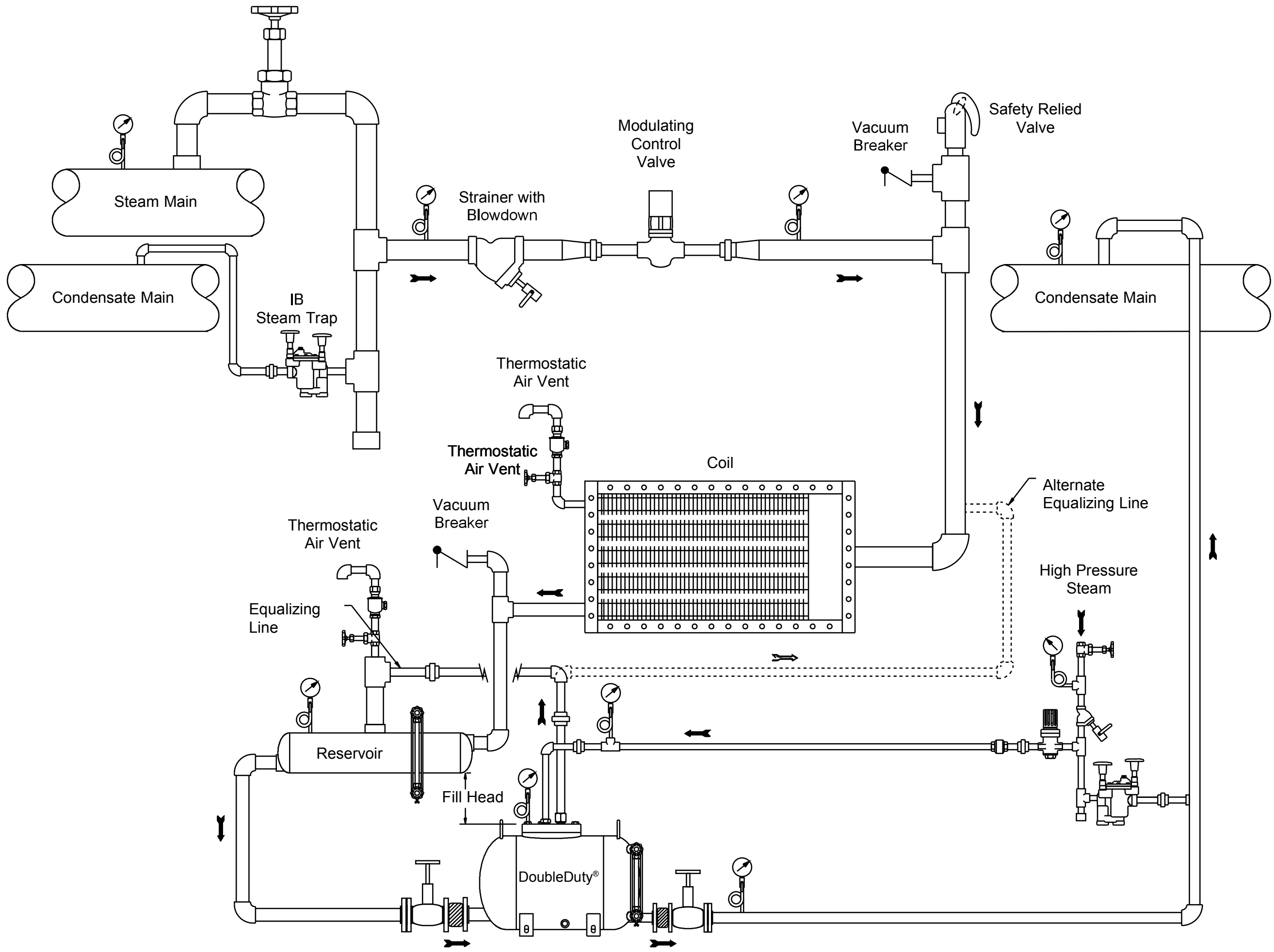
Double Duty® Typical Application

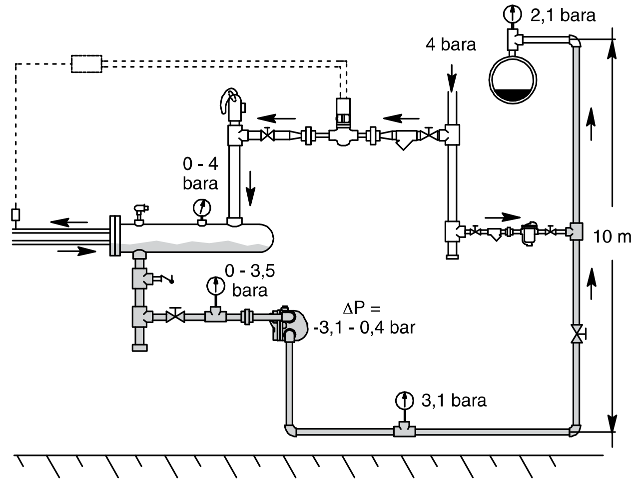


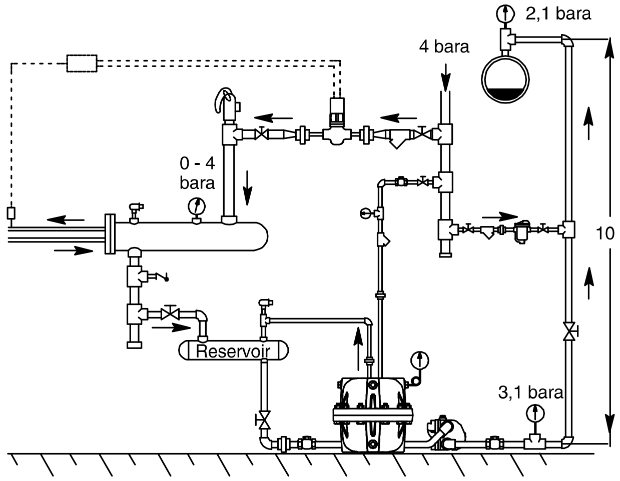
Common Applications for Condensate Armstrong Pump Traps

- Air Heating Coils
- Plate and Frame Heaters
- Jacketed Kettles
- Vacuum Space
- Flash Tanks
- Shell and Tube Heat Exchangers
- Absorption Chillers
- Low Pressure Applications

Any application using modulated control.

Condensate Drainage From Temperature Controlled Equipment





Problem: "Stall" Condition on Modulated Steam Control

Modulated steam controls are required to change steam pressure in the heat exchanger to control accurate product output temperature. Due to these varying steam pressure changes, a stall condition exists in all heat exchangers where condensate cannot flow through the steam trap due to insufficient or even negative pressure differential. Under the stall condition, partial or complete flooding will occur. Reference figure above noting the stall conditions and problems that can occur.

Armstrong Solution

The combination of Armstrong pump trap and Armstrong steam trap is the total solution to the stall condition by removing condensate under all system conditions. When the steam system pressure is sufficient to overcome the back pressure, the steam trap operates normally. When the system pressure falls to the stall condition, the pump trap operates and pumps condensate through the steam trap. Temperature control and condensate drainage are assured under all system conditions.

Note: The pump trap is sized for the stall conditions.

Problems

1. Stall condition – no condensate drainage due to insufficient pressure to move condensate through the steam trap
2. Heat exchange equipment floods causing equipment damage from:
   - Water hammer due to steam and condensate occupying the same space
   - Corrosion due to carbonic acid forming from sub-cooled condensate reabsorbing trapped carbon dioxide and non-condensable gases
3. Inaccurate temperature control

Stall Calculation

Use of the stall chart on right will determine the point where flooding will occur.

Application information required:	**Example**
Ps = Max. Steam Pressure in heat exchanger	1 barg
ts = Maximum Steam Temperature	120°C
Qs = Maximum Steam Flow	1 000 kg/h
or	
Qs = Total Power of Heat Exchanger (kW)	
Pb = Back Pressure	0,3 barg
tb = Corresponding temperature	107°C
t1 = Inlet Product Temperature	15°C
t2 = Outlet Product Temperature	60°C
Qcr= Critical (Stall) Load	

Stall Calculation:

$$Q_{cr} = \frac{t_b - \Delta t}{t_s - \Delta t} \times Q_s$$

$$= \frac{107°C - 37{,}5°C}{120°C - 37{,}5°C} \times 1000 \text{ kg/h}$$

$$= \frac{62°C}{75°C} \times 1000 \text{ kg/h}$$

$$= 826 \text{ kg/h}$$

Stall Information:

- When the control valve allows more than 826 kg/h of steam to enter into the heat exchanger, **differential pressure will be positive**. Steam trap should be able to discharge 826 kg/h at 0,1 bar differential pressure.

- When the control valve allows less than 826 kg/h of steam to enter into the heat exchanger, **differential pressure will be negative**. Condensate pump should be able to discharge 826 kg/h with 1 barg motive pressure and 0,3 barg back pressure.

- If the heat exchanger is oversized by 20%, it would be able to handle up to 1 200 kg of steam per hour. The stall will appear at 84,25%, which means 1 011 kg/h. As only 1 000 kg/h are needed to heat the maximum product load at the maximum differential temperature, the **pressure differential will always be negative**. In that case, the steam trap is not needed (see closed systems on page CRE-216).