Overview of Steam Traps

An Online Continuing Education Course for Engineers

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Steam traps are automatic valves used in every steam system to remove condensate, air, and other non-condensable gases while preventing or minimizing the passing of steam. If condensate is allowed to collect, it reduces the flow capacity of steam lines and the thermal capacity of heat transfer equipment. In addition, excess condensate can lead to “water hammer,” with potentially destructive and dangerous results. Air that remains after system startup reduces steam pressure and temperature and may also reduce the thermal capacity of heat transfer equipment. Non-condensable gases, such as oxygen and carbon dioxide, cause corrosion. Finally, steam that passes through the trap provides no heating service. This effectively reduces the heating capacity of the steam system or increases the amount of steam that must be generated to meet the heating demand.

No single steam trap is suitable for all steam distribution applications since the condensate pressures and flow rates vary significantly at various points. As a result, many different types of steam traps have been developed. The three major categories of steam traps are 1) mechanical, 2) thermostatic, and 3) thermodynamic. In addition, some steam traps combine characteristics of more than one of these basic categories.

Types of Steam Traps

There are three basic types of steam trap into which all variations fall; all three are classified by International Standard ISO 6704:1984.

Group	Principle	Sub-group

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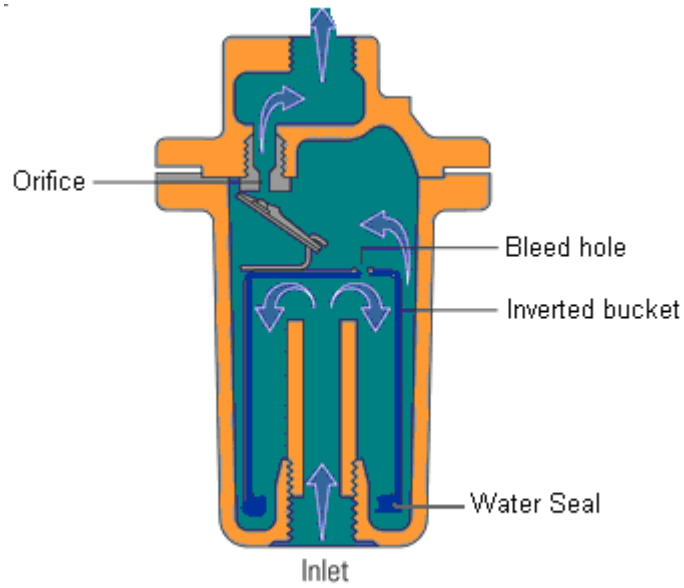
Mechanical Trap	This range of steam traps operates by sensing the difference in density between steam and condensate.	Bucket type • Open bucket • Inverted bucket with lever, without lever Float type • Float with lever • Free float
Thermodynamic Trap	This range of steam traps operate by sensing difference in thermodynamic properties between steam and condensate. Thermodynamic steam traps rely on the fact that hot condensate, released under dynamic pressure, will flash-off to give a mixture of steam and water.	Disc type Impulse type Labyrinth type Orifice type
Thermostatic Trap	This range of steam traps operate by sensing difference in temperature between steam and condensate.	Bimetallic type Metal expansion type

Some of the important traps in industrial use are discussed below

Inverted Bucket Steam Trap

The inverted bucket trap is a mechanically actuated model that uses an upside down bucket as a float. The bucket, connected to an outlet valve through a mechanical linkage, sinks when condensate fills the steam trap, opening the outlet valve. The bucket floats when steam enters the trap, closing the valve.



Inverted bucket trap

Advantages of the inverted bucket steam trap

1) The inverted bucket trap can be a very economical solution for low-to-medium pressures applications such as plant heating and light-duty processes. When handling high pressures and capacities, these traps become large and expensive.
2) Like a float-thermostatic steam trap, it has a good tolerance to water hammer conditions
3) Can be used on superheated steam lines with the addition of a check valve on the inlet
4) Failure mode is usually open, so it's safer on those applications that require this feature, for example turbine drains

Disadvantages of the inverted bucket steam trap

1) The small size of the hole in the top of the bucket means that this type of trap can only discharge air very slowly. The hole cannot be enlarged, as steam would pass through too quickly during normal operation.

2) Inverted bucket traps, as a group, are capable of handling a wide range of steam pressures and condensate capacities. However, each specific steam trap handles a very narrow range. An inverted bucket trap designed for 8.5 Kg/cm^2 service operates at pressures below this; however, its capacity is so diminished that it may “back up" a system with unwanted condensate.

3) There should always be enough water in the trap body to act as a seal around the lip of the bucket. If the trap loses this water seal, steam can be wasted through the outlet valve. This can often happen on applications where there is a sudden drop in steam pressure, causing some of the condensate in the trap body to 'flash' into steam. The bucket loses its buoyancy and sinks, allowing live steam to pass through the trap orifice. Only if sufficient condensate reaches the trap will the water seal form again, and prevent steam wastage.

Important Guidelines for Inverted Bucket Traps

1) If an inverted bucket trap is used on an application where pressure fluctuation of the plant can be expected, a check valve should be fitted on the inlet line in front of the trap. Steam and water are free to flow in the direction indicated, while reverse flow is impossible as the check valve would be forced onto its seat.

2) The higher temperature of superheated steam is likely to cause an inverted bucket trap to lose its water seal. A check valve in front of the trap should be regarded as essential under such conditions. Some inverted bucket traps are manufactured with an integral check valve as standard.

3) The inverted bucket trap is likely to suffer damage from freezing, if installed in an exposed position with sub-zero ambient conditions. Suitable insulation lagging can overcome this problem, if conditions are not too severe. If ambient conditions well

below zero are to be expected, then it may be prudent to consider a more robust type of trap to do the job. In the case of mains drainage, a thermodynamic trap would be the first choice.

4) It is important to correlate the pressure rating and size with a specific application. For example, an inverted bucket trap designed for up to [illegible] ails to operate at pressures [illegible]

F[illegible]

Th[illegible] steam and cor[illegible] collects, it lifts [illegible]ment purg[illegible] the trap. This [illegible]

Float trap

Advantages of the float-thermostatic steam trap