Energy Efficiency Opportunities with Thermostatic Steam Traps

Abstract

The purpose of this document is to educate the reader about the energy efficiency of the Thermostatic steam trap. Each trap type has different energy efficiency, and recognizing this can lead to massive energy savings. This document demonstrates that the thermostatic trap design is the most energy efficient trap available, and asserts that it should be part of a consumer's consideration while trying to make energy efficiency changes.

Steam traps have the potential to play a huge role in a steam system's energy efficiency. The proper trap can make the difference between steam loss, and huge savings in energy costs. However, there is little available information to help a consumer pick the correct, energy efficient trap. Presently, the main recommendation for maintaining energy efficiency with steam traps is to do one of two things:

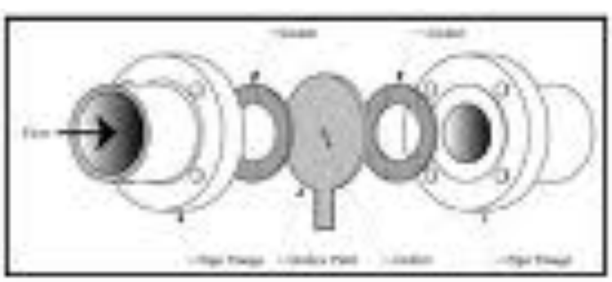
1. Replace failed traps
2. Buy and learn to operate steam trap monitoring equipment.

There can be no argument that a fully functioning steam system is an asset. And monitoring steam traps is always a good efficiency practice. But replacing traps and monitoring steam systems is not the whole answer, nor does it completely address the problem. There are energy efficient steam traps currently on the market. The thermostatic trap stands apart from its competitors by being a highly engineered product that is energy efficient, low in maintenance cost, and gives long service life.

Steam Trap Types

According to C. B. Oland, the basic function of the trap is to keep steam from escaping, remove condensate, and remove air. Because of this need for multi-functionality, many different kinds of traps have been developed.[1] The orifice trap is a simple trap. Conventional traps, such as the thermodynamic, mechanical, and thermostatic traps, are more complex.

Orifice Trap[2]



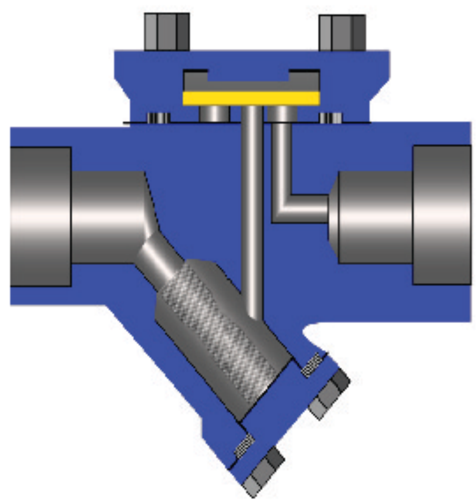
The orifice trap is a non-complex system that "contains a set orifice in the trap body and continually discharges condensate."[3] This trap is recommended for situations where the steam load is constant. Any kind of deviation or fluctuation can unseat the trap and cause steam loss. It differs from its

[1] Oland, "Trap Classification" pg 5
[2] Visual, Orifice Trap, Oland, pg 2
[3] USDOE-FEMP "Steam Trap Types" pg 3

conventional trap counterparts by having no moving part and relatively small mechanical need. However, conventional traps have a much wider application.

The advantages of orifice traps include its ability to handle a high pressure system, its lack of design complexity, its versatility in mounting positions and its relative maintainability. The disadvantages include susceptibility to failure or blockage from debris in the system, a loss of live steam after minimal wear, and an inability to accommodate varying condensate loads.[4]

Thermodynamic Trap[5]



The thermodynamic trap is a popular conventional trap design. This trap is "driven by the difference in the pressure applied by steam and condensate with the presence of steam or condensate within the trap being affected by the design of the trap and its impact on local flow velocity and pressure."[6] It's an advantageous design, because it can handle a wide variety of pressures, and it is widely viewed as an affordable and versatility trap. However, this trap relies highly on that cycle which causes the disk to open and close. Often this cycle rate is inefficient, wastes a great deal of live steam and can be extremely loud. According to an in-house laboratory study conducted by the James D Acers Company, the average thermodynamic trap looses .032 pounds of steam per cycle.[7] They also have a great deal of difficulty discharging air and other noncondensable gas from the trap, contributing to overall inefficiency.[8]

Mechanical Traps

Mechanical traps come in several varieties, but the most notable types of mechanical traps are the inverted bucket trap and the float and thermostatic trap.

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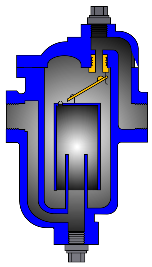
[4] Oland "Advantages and Disadvantages" pg 11
[5] Visual, Picut and Foszcz, pg 103
[6] USDOE-FEMP "Steam Trap Types" pg 2
[7] James D. Acers, pg 7
[8] Picut and Foszcz, pg 103

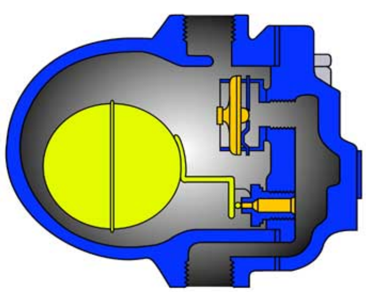
Inverted Bucket Traps[9]



The mechanical trap is also called the inverted bucket trap as it is a "mechanically activated model that uses an upside-down bucket as a float."[10] The operating principal of a trap like this "is driven by the difference in density between condensate and steam."[11] The bucket rises under the force of the non-condensable gas entering the trap, causing the valve to seal. However, since the trap relies on fluid density to close and open the valve, "it cannot distinguish between air and steam and must purge air (and some steam) through a small hole."[12] The traps cannot function properly without this live steam release. Armstrong International published a graph that acknowledged that a high functioning inverted bucket steam trap looses around three pounds of live steam per hour[13]. This trap is advantageous to a buyer because its various failings are easy to diagnose, and it is primed for superheated systems. However, its inherent lack of energy efficiency and its inability to handle high pressures and capacities is a disadvantage.[14]

Float and Thermostatic Traps[15]

Not to be confused with a thermostatic trap, a float and thermostatic trap is a form of



mechanical hybrid. The trap opens and closes "as condensate collects, and it lifts a float which opens a valve as much as required."[16] This trap's most useful application is process and space heating of minimal pressures. It must be installed horizontally (as shown in the visual). This trap is viewed as

9 Visual, Picut and Foszcz, pg 102
10 Picut and Foszcz, pg 103
11 USDOE-FEMP "Steam Trap Types" pg 1
12 USDOE-FEMP "Steam Trap Types" pg 2
13 Armstrong International, pg 3
14 Picut and Foszcz, pg 102
15 Visual, Picut and Foszcz, pg 103
16 Picut and Foszcz, pg 102

advantageous because it is seen as an "economical solution for light-to-medium condensate loads and lower pressures."[17] However, it is an extremely sensitive system that can accommodate very little pressure fluctuation. It is also very susceptible to both freezing and water hammer.

Thermostatic Traps

Thermostatic traps are widely viewed as the most efficient traps on the market. Thermostatic traps are "Driven by the difference in temperature between steam and sub-cooled condensate."[18] The trap opens and closes by "expansion and contraction of a bimetallic element or a liquid filled bellows."[19] There is no mechanical need for live steam to be lost in order for the trap to close or open. And it has a multiplicity of uses. Picut and Foszcz refer to it as "a universal steam trap," saying "thermostatic traps offer advantages in terms of initial cost, long-term energy conservation, reduced inventory, and ease in application and maintenance." [20] Some disadvantages to this design include changes in performance over the traps lifetime due to wear in the bimetal stack.[21]

When considering trap selection it is important to remember that the cost of a trap is determined by the lifetime of that traps usage and the cost of maintenance and required additional parts, not its purchase price. According to S.P Frank, there are several design features that a potential buyer might consider when thinking about which of these traps would work best with the plants system. These suggested things are "no live steam loss under all operating conditions, rugged construction with low maintenance costs, self-draining design to prevent damage from freezing during plant shutdown, reduced valve seat wear and an open fail"[22] amongst other things. Frank also mentions a common selection pitfall, "many plant engineers are making the selection based only on the purchase price of the actual trap, not the overall cost."[23]

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[17] Picut and Foszcz, pg 103
[18] USDOE-FEMP "Steam Trap Types" pg 1
[19] USDOE-FEMP "Steam Trap Types" pg 1
[20] Picut and Foszcz, pg 104
[21] Frank, "Selecting the right steam trap" pg 81
[22] Frank, "Selecting the right steam trap" pg 79
[23] Frank, "Selecting the right steam trap" pg 79

Advantages of Trap Type

It is our wholehearted hope that some discussion can be given to the advantages of steam trap type within your facility. It makes a difference what kind of trap a consumer uses. An inverted bucket trap *needs* to loose steam to function properly. The thermodynamic trap requires live steam to close, which can cause huge energy costs to the consumer. The fail stature of many of these traps can be dangerous, resulting in high back-pressure or a water hammer, which as the case study "Safety Precautions"[24] observed, can be dangerous for workers, if not out right deadly. The kind of trap that a consumer uses matters, and which type they choose can affect the entire system, their overhead cost, their energy expenses, and their worker's wellbeing.

We hope that this challenges you to make a thorough and detailed evaluation of the steam traps your establishment is currently using**.** Currently, there are thermostatic steam traps on the market that are energy conserving and efficient. Even when viewing a steam system holistically, the proper trap can save a plant tons of steam and millions of dollars. Please consider the energy saving power of thermostatic traps, and make the most efficient choice.

[24] USDOE and FEMP, "Steam Trap Case Studies/ Safety Precautions"

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