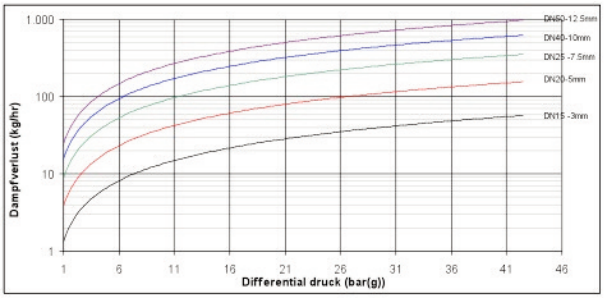
Mechanical steam trap failure

Condensate traps are commonly employed to remove condensed water from steam utilizing plant and equipment. In this context they are normally referred to as steam traps. There are many different designs of steam traps to suit a variety of circumstances. The majority of traps involve a self-actuating mechanism which detects the presence of condensate in the trap, and when necessary opens to allow the condensate to drain.

An alternative form of steam trap is a Venturi Orifice steam trap. These are reliable, as they have no moving parts, and comprise of a venturi and an orifice through which condensate is discharged. Flash steam, produced as the pressure drops during flow through the venturi, acts to reduce the amount of condensate that escapes through the orifice.

Typical losses through Mechanical traps

Mechanical traps open when condensate is present and close to prevent steam escaping. The mechanical mechanism is activated by various methods, such as internal floats, buckets, bimetallic bellows or discs. On continuous applications, mechanical traps open and close several times a minute, which results in wear and leakage. Mechanical trap manufacturers estimate that the typical lifecycle is about three to five years. The graph shows the relationship between steam pressure and steam losses. As mechanical trap sizes increase, the inherent steam losses from fully open traps do not increase in a linear fashion but logarithmically.



Caption for graph ???????? ??????? ???????

How the Venturi Orifice trap works

A plate or simple orifice trap has a limited operating range on varying loads. It will work if the loads are relatively constant e.g. distribution systems. The Venturi Orifice trap works by combing venturi technology with the orifice. The capacity of the Venturi Orifice trap is related to the size of the orifice and also to the backpressure generated inside the venturi. It is a combination of these two factors that gives the venturi orifice trap its overall capacity.

As the condensate passes through the orifice there is a pressure loss. On the upstream side of the orifice (the heat exchanger or steam line side) the condensate has the same pressure and temperature as the steam and therefore contains a lot of energy (it's hot). As it drops pressure across the orifice, the temperature and pressure of the condensate reduces, resulting in it containing less energy. However, energy cannot disappear. So the difference in energy between the high pressure/temperature upstream side and the low pressure/temperature downstream side (i.e. the condensate return system) is converted into steam.

The higher the pressure difference across a trap (and it is the same for all traps) the more condensate has to be converted into 'flash' steam. Venturi Orifice technology uses this flash steam to create a backpressure inside the venturi.

As the condensate is forced through the orifice of the steam trap by the upstream pressure, the resultant pressure drop generates flash steam. This flash steam is 1000 times the volume of the condensate, so the sudden expansion results in the condensate being accelerated in the venturi part of the trap. This sudden acceleration creates an opposite and equal force or backpressure inside the venturi, which acts to restrict the flow of condensate through the orifice.

How the Venturi Orifice trap works *continued*

Because the amount of flash steam changes, depending upon the operating conditions, the resultant backpressure also changes. This then becomes a self-regulating flow of condensate through the trap that gives variable capacity characteristics.

Figure 1. Shows the start-up condition in a typical heat exchanger when the difference between the steam temperature and the product temperature is at maximum.

Figure 2. Shows the running condition when the temperature differential is stabilised. Here the condensate volume is a minimum value and its temperature is close to the steam temperature. At this point the condensate has maximum energetic value.

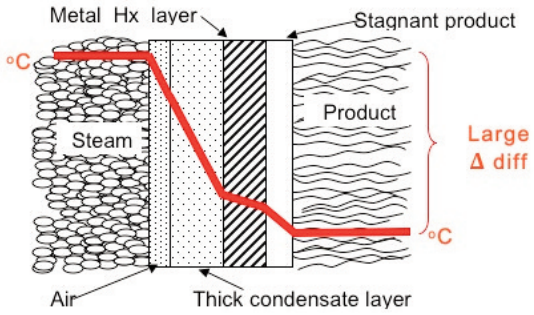
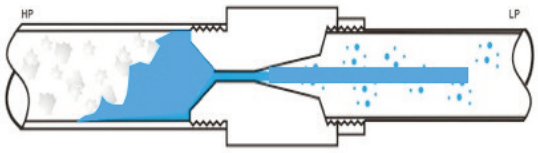


Figure 1. Heat exchanger start-up condition



Start up and intermittent load condition

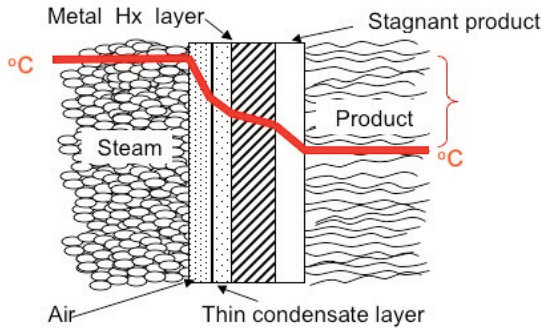
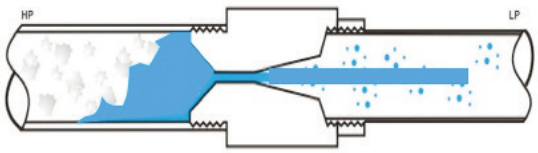


Figure 2. Heat exchanger running condition



Running load condition

Practical effects of the difference between mechanical and Venturi Orifice technology

University studies* have shown that new Venturi orifice steam traps are typically 10% more efficient than a range of new mechanical steam traps. This is due to the completely different operating principle of the two traps. As the Venturi orifice does not close against steam but uses the physical properties of the steam condensate interface, there is no steam leakage. This results in user energy savings that can be significant.

Volker Genkes Vietmetall's Production Manager has been impressed with the results, saying: "Since the installation of the Venturi Orifice traps we have seen a large reduction in the amount of salt and additives we have been using to treat the boiler feed water. We have used less make up water and the large steam plume from the condensate receiver has also virtually disappeared".

Most impressive of all has been the sites average gas consumption. According to Mr Genkes: "Following the installation of the Venturi Orifice traps we closely monitored our gas usage and noted that it was between 20% and 30% less than the previous year. Due to the lack of moving parts within the Venturi Orifice traps supplied by EBE Engineering Ltd, maintenance has been greatly reduced and the traps also carry a full ten year performance guarantee".

*** See Performance Analysis of Venturi Orifice Steam Traps A Post Graduate Thesis** - Dissertation from Shada Abu-Halimeh, February 2004; Supervisor: Dr. Gavin Walker, Queen's University Belfast, Faculty of Engineering, Chemical Engineering Department.

About EBE Engineering

EBE Engineering is an independent company delivering energy saving solutions to industry. Specializing in the European market, EBE supplies steam traps that are based on a completely new concept. Losses from traditional steam systems substantially contribute to a company's waste gas emissions and increased energy costs. By replacing the traditional mechanical components with solid-state venturi orifice technology, EBE's energy surveys have shown customers that paybacks of less than 12 months are possible.

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