Steam Pressure and Trap Capacity

We know that for a steam trap to operate, there must be a higher pressure at its inlet than there is at its outlet. The actual amount of condensate which the trap can discharge is governed by the following three factors:

1. The differential pressure
2. The size of the trap discharge orifice.
3. The temperature of the condensate.

We must now examine these factors in more detail.

1. Differential Pressure
The maximum amount of condensate the trap will discharge will increase as the differential pressure (the difference in pressure between the inlet and outlet of the trap) increases. In other words, the capacity of a trap discharging to atmosphere with steam at 5 bar g or 75 psig will be greater than that of the same trap with steam at 2 bar g or 30 psig. The capacity does not, however, increase in proportion to the pressure.

It is not wise to assume that the pressure at which steam is supplied to a piece of equipment will be the pressure on the inlet to its steam trap. Pressure losses often mean that the steam pressure at the trap will be considerably less than the steam supply pressure.

If a steam trap is discharging condensate to atmosphere, the outlet pressure will be atmospheric and, therefore, the differential pressure will be the same as the gauge pressure at the trap inlet. However, if the trap discharges into a main which is under pressure, the differential pressure will be reduced by an amount which can be determined by subtracting the outlet pressure from the trap inlet pressure. The quantity of condensate which the trap is capable of passing in a given time will be reduced accordingly.

2. Size of Discharge Orifice
The size of the discharge orifice not only helps to determine the capacity of the trap but also often fixes the maximum pressure at which the trap will operate. Reference to the steam trap section reveals that the vast majority of the traps described have the valve on the pressure side (the inlet side) of the valve seat. The only notable exception to this arrangement occurs in the bimetallic type of traps where the valve is on the outlet side of the valve seat. In the case of traps with the valve on the pressure side of the valve seat, the valve, when closed, will be held on its seat by the steam pressure. According to the type of trap in question, the thermostatic element, ball float or bucket must have enough force to pull the valve away from its seat against this pressure.

In any given trap, the force is a fixed amount.

Force Required = pressure x area.

The maximum pressure at which the valve of the trap can open is the pressure at which this operating force is just greater than the valve seat area multiplied by the pressure in the trap body.
In the case of traps with the valve at the outlet side of the valve seat, the situation is different. In this type, the steam pressure tends to open the valve, so the maximum pressure at which the trap can close is when the operating force is just greater than the steam pressure multiplied by the valve seat area.

3. The Temperature Of The Condensate.

The capacity of a trap should never be based on the amount of cold water the trap will pass at any given differential pressure. Condensate in a steam trap is usually at a temperature above atmospheric boiling point. When the condensate is passing through the valve seat of the trap, its pressure is quickly reduced and a certain amount of flash steam is generated. This flash steam tends to choke the discharge orifice, reducing its effective area. As the condensate temperature rises, the amount of flash steam generated will increase and the discharge capacity of the trap will decrease. The extent of which condensate temperature affects the trap’s discharge capacity is relative to its temperature below saturation temperature -- lower temperatures, lower flashing rates.