

Steam Traps: Critical Engineered Devices for Optimal Performance of Steam Systems

Steam systems are large, sophisticated process or plant investments. Proper design, application, and installation of these systems and their components are essential in order to maximize performance and efficiency. Engineers and others responsible for steam systems now recognize the critical role played by one component in particular, the steam trap.

Due to their nature and size relative to larger pieces of steam equipment, it is tempting to overlook these highly engineered devices; however, the function of traps to properly drain condensate while preventing wasteful discharge of steam has a direct effect not only on overall system efficiency, but on the productivity and reliability of other system components, as well. According to the U. S. Department of Energy, “Steam trap performance can have a wide range of effects on the steam system, including improved end-use equipment performance, better steam quality, and decreased risk of water hammer. Although system efficiency increases when the number of failed traps in the system is reduced, there are other benefits as well.”*

Steam traps are specially designed to perform in a wide variety of demanding environments with extreme temperatures, corrosive substances, and high pressures. To meet the wide variety of challenges faced by traps, designers use many different principles of operation, methods of construction, and materials. A trap that is perfect for one application may be ill-suited for another. The growing awareness of the importance of selecting the proper trap for a specific application is reflected in the U.S. Department of Energy’s Oak Ridge National Laboratory proclamation that proper “...trap selection is critical for efficient steam system performance.”**

The following applications demonstrate some of the considerations that must go into selecting the proper steam trap:

- ◆ **Steam Main and Header Pipe Drainage (commonly referred to as “Drip” applications):**
Traps used to drain condensate at frequent intervals in steam distribution piping must operate over long periods under constant pressure and varying load conditions. They must also be able to adapt to system startup, where air and water drainage is critical in achieving operating pressures and temperatures. Drip applications benefit from using the smallest steam traps having sufficient characteristics to meet operating conditions, to help extend service life and prevent live steam loss should the trap fail open. This can help reduce inventory, as well as reduce the risk of improper steam trap selection. The use of larger steam traps on Drip applications should only be considered after proper evaluation of start-up conditions, piping and installation practices, and steam quality, with the

* *Steam System Opportunity Assessment for the Pulp and Paper, Chemical Manufacturing, and Petroleum Refining Industries*, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, page 71

** *Review of Orifice Plate Traps*, ORNL Publication TM-2000/353/R1, page 6.

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notable exception of boiler headers where the traps are required to handle carryover loads. For additional information, refer to FCI 13-1, Determining Condensate Loads to Size Steam Traps.

- ◆ Heat Exchanger and General Process Heating Applications (commonly referred to as “Process” Applications): Steam traps enable the efficient operation of heat exchangers by effectively containing steam to allow full transfer of heat energy, as well as enabling the removal of condensate immediately as it forms in the heat transfer space. They perform this function well across a wide range of modulating pressures and at various condensing rates, provided that the differential pressure across the trap (from inlet to outlet) is positive. Steam traps in this service must be carefully sized so as to have the ability to drain the full condensate load at very low pressure differentials. They must also be sized on their ability to remove air.

In some cases, the differential pressure across the steam trap may be negative. This usually occurs because of reduced modulated pressure on the trap inlet, the need to lift condensate after the steam trap, and/or an oversized heat exchanger but may also occur should the heat balance require the steam pressure to reduce to a vacuum condition. This negative pressure differential is commonly referred to as heat exchanger “stall”, whereby condensate backs up into the steam space reducing heat transfer efficiency, increasing the potential for water hammer, and possibly damaging the heat exchanger. The drain solution for negative differential pressure will generally require a vacuum breaker if draining to an atmosphere back pressure, or that steam trap mechanism is used in conjunction with a pumping system if draining to elevated back pressure. This combination of pump and trap can either be separately assembled, or contained within one body. For additional information, refer to FCI 13-1, Determining Condensate Loads to Size Steam Traps.

- ◆ Tracing: Steam tracing is used to protect pipe work and equipment in environments where freezing is possible. Tracing is also used to improve the flow of some fluids. The sizing and application of traps in this service must take into account the condensate flow and relative impact of sub-cooling.

Protect and enhance the investment you have made in your steam system by using properly engineered, sized, and selected steam traps that meet industry standards. The members of the FCI Steam Trap Section are committed to providing designers, engineers, and steam system operators with the tools to make steam system design and operation safe, efficient, and productive.

To view the current list of FCI members, visit the FCI website: fluidcontrolsinstitute.org.