No. 12 Best Practices for Installing Steam System Heat Transfer Components

Summary

There are twelve primary factors that impact the performance, longevity, and on-going maintenance requirements for steam heat transfer components. Generally, a steam component should be evaluated in terms of a ten (10) year operational life cycle.

Proper selection of a component first requires a full understanding of the operational characteristics where the steam component will function. A thorough review should be conducted of the steam system's operating parameters and documentation. Failing to understand the context of the application commonly results in improperly sized and applied steam heat transfer components.

In addition to the understanding the application, all pertinent codes and design specifications must be understood TEMA, ASME and B31.1, are some of the codes and standards the should be reviewed to insure safety and proper documentation.

Adhering to appropriate installation recommendations for steam components will eliminate premature failures and greatly enhance likelihood of proper performance and longevity of the heat transfer units and the associated components.

Overview of Heat Transfer

Failure to employ basic fundamentals and establishing appropriate specifications for selecting the correct steam heat transfer components are just some of the factors that lead to premature failure or underperforming heat transfer results.

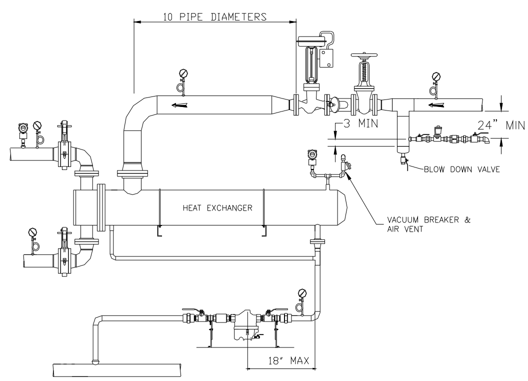
Numerous industrial heat transfer applications in various locations and industries were reviewed. Following is a summary of the most common problems caused by incorrect component selection or improper installation practices:

- Unacceptable product quality
- Premature failure of components
- Poor temperature control
- Waterhammer
- Low process temperatures
- Fouling of the heat transfer equipment
- Code violations

Best Practice Guidelines.

The common problems listed above may be avoided by following some simple rules and field proven techniques. The “Best Practices” items listed below should be reviewed and implemented into the steam system design, maintenance and specification program for each facility.

1. *Steam control valves and the Condensate Drip leg*



   A steam control valve is a modulating component. Low or no flow will result in the build-up of condensate prior to the inlet of the control valve. Condensate accumulation before valve can cause waterhammer or condensate passing through the steam control valve will cause premature failure of the control valve The buildup of condensate can simple be eliminated by installing a drip leg prior to the valve. This allows the condensate to fall into the drip pocket and be evacuated with the assistance of a steam trap.

2. *Lockout Ball valves*

   Ball valves provide a tight shut off (Class 4 or higher) in steam service. All ball valves should be purchased or outfitted with locking handles for all valves 2” or smaller. This provides the best safety procedure for lock out – tag out. Be sure to check with your safety officer to ensure compliance with any company, local, state, or federal regulations concerning lock out – tag out procedures.

3. *Install a strainer ahead of the control valve.*
    a. Foreign particles may become prevalent in a steam line. A common cause of the foreign material is corrosion and its byproducts. . The foreign material can lodge in the control valve trim causing premature failure of the steam control valve. A strainer will act as a filter and prevent any foreign material from entering the steam valve.
    b. When installing the strainer; always install a blow off valve with locking kit on the strainer and pipe the discharge from the valve to a safe location.
    c. Always installed the strainer with the strainer section in the horizontal position as detailed in the drawing. Never install the strainer with the strainer section vertical.
4. *Turndown and Control valves*

    Several factors are relevant when selecting control valves and a primary factor is the turndown capability or working range of the valve. Following are some guidelines for control valves. Heat transfer components require properly sized control valves for proper process temperature control (heat sink principle).

    a. Cage control = 40 : 1 turndown ratio provides the highest degree of controllability
    b. Globe control valve = 30 : 1 turndown ratio
    c. Regulating valve = 20 : 1 turndown ratio
5. *Install pressure gauges before and after the control valve.*

    Pressure gauges provide the information needed to understand the conditions inside the pipe and components. It is always a good practice to install a pressure gauge before and after a control valve. This provides accurate data to assist in understanding the flow characteristics of the medium while passing through the valves. Additionally, all pressure gauges should be installed with a siphon pipe (pig tail) and isolation valve.
6. *Air vents*
    a. The existence of air in a steam system has several detrimental effects on heat transfer. Air in the system can form thin films on heat transfer surfaces. Air is a very efficient insulator (Thermal conductivity 0.2). A film of air of only 1/1000 of an inch has the same effect as a thickness of 13” of copper or 3” of cast iron.
    b. Air not only insulates but also reduces the heat transfer rate by lowering the temperature of the steam. The saturation temperature of steam is reduced when mixed with air in accordance with the law of partial pressures. Air contributes to the pressure of the mixture but does not contribute to the available heat content.

7. *Saturated Steam versus Superheated Steam*

   Typical steam applications require a steam quality of 100% at saturated steam conditions. This level of quality refers to steam containing no minute droplets of condensate entrained in the vapor. The addition of any superheated steam to a heat transfer process can cause performance problems if the original design did not anticipate any superheat. Furthermore, superheated steam may require material changes in order to handle difference in pressure and temperature of the steam.

8. *Condensate Removal*

   a. When designing heat transfer units, condensate drainage is accomplished by either gravity or pressure differential. Heat transfer equipment should be installed to promote gravity drainage with no vertical lift before or after steam traps if possible. This is very crucial in any application that has a modulating steam control valve.
   b. Other applications do not permit gravity drainage and therefore, care should be taken to insure no undo backpressure is placed on the drain devices (steam trap or control valve). Numerous premature failures and performance problems are due to unanticipated backpressure on the drain devices which causes condensate to accumulate in the heat transfer unit. This will result in water hammer and inadequate temperature control. Poor condensate drainage can also result in corrosion problems for the heat transfer unit.
   c. If the heat transfer unit has a steam supply modulating control valve, all condensate drains must flow by gravity to a collection tank or pumping system which will then pump the condensate back to the boiler area. To ensure proper control of any of the heat transfer, it is essential to have zero backpressure or vertical lifts in the condensate piping.
   d. The horizontal distance from the vertical drop leg (condensate outlet of heat exchanger) to the steam trap; should never be more than 8 inches. Any length of greater than 8” can lead to steam locking.
   e. Install a test valve or a visual sight glass after the steam trap for visual indication of performance.

9. *Insulation*

   All exposed surface areas in a heat transfer application should be insulated. Please refer to the DOE Best Practices Steam Tip Sheet on insulation for further details on pay back and material selection.

10. *Control valve piping*
    a. The sizing and length of pipe from the control valve outlet to the inlet nozzle on the heat transfer unit is critical. Control valve outlet piping must be increased to be equal to or larger than the inlet connection to the heat transfer unit.
    b. The control valve should be located at least 10 pipe diameters away from the heat transfer unit with the expanded pipe.
11. *Vacuum Breakers*

    All heat transfer components, whether shell-and-tube, plate-and-frame, or any other device, requires vacuum breakers. Vacuum breakers protect heat exchanging equipment when a system is shut down by preventing a vacuum to occur. Additionally, the vacuum breaker maintains the condensate in the heat transfer equipment. It is generally recommended that all heat transfer devices have an air vent and vacuum breaker installed at points designated by the heat transfer manufacturer. The normal locations are close to the steam inlet or on the top portion of the heat transfer unit.
12. *Codes and Standards.*

    As mentioned earlier, all relative jurisdictional codes must be known and followed.