DELTA T HEAT EXCHANGERS
Phone: (519)471-2800
Fax: (519)471-8494
E-mail: sales@deltathx.com
1674 Hyde Park Rd., Suite 206, London, ON, Canada N6H 5L7

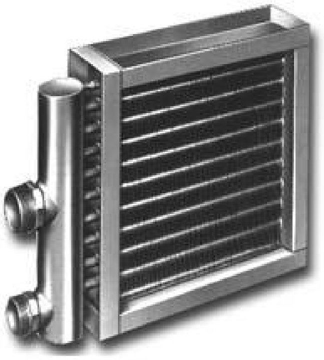
Industrial Heat Exchangers
www.deltathx.com

Steam Coil Selection and Installation

In facilities where steam is available a Steam Coil can be a cost effective way to heat air. However they are designed to operate with steam, not condensate, inside the tubes. Costly failures can occur due to freezing or water hammer resulting from condensate build-up in the steam coil.

The cause of condensate trapping can typically be attributed to one or more of the following:

- Inappropriate coil selection for the application.
- Improper coil installation.
- Inadequate venting of non-condensables.
- Vacuum formation.
- Inadequate or incorrect steam trapping.



Coil selection

Some coil designs promote short circuiting in certain applications. Short circuiting can occur when tubes in the same row or in adjacent rows of a multi-row coil have dissimilar condensing rates causing a higher pressure drop in some of the tubes. The tubes with the higher condensing rate tend to “plug” with condensate often resulting in water hammer or freezing problems.

Dissimilar condensing rates between adjacent tubes is most commonly caused by an uneven air flow or temperature profile across the coil face. If certain tubes see either a higher airflow or colder air than other tubes they will condense the steam at a faster rate than the tubes that see either less air flow or warmer temperature air.

In multiple row coils, there is a dissimilar condensing rate between in each row as the second row of tubes will see warmer air than the first row, and so on. Factors such as; steam pressure, air temperature, piping system and coil size and orientation, influence whether condensate build up will be a problem.

There are several different coil designs that have been developed for specific operating conditions. Aside from an unsuitable condensate handling, condensate short circuiting can be addressed by selecting the correct coil type for the installation.

Coil installation

One of the most often overlooked causes of poor coil drainage is the mechanical installation of the coil itself. It may have been positioned correctly when it was first piped up, but a settling building or weakened support may have caused it to pitch up. Improperly supported tubes may sag. Regardless of the cause, no coil can drain uphill. If you have an installation in which freezing recurs, examine the coil to make sure that all the tubes are provided gravity drainage.

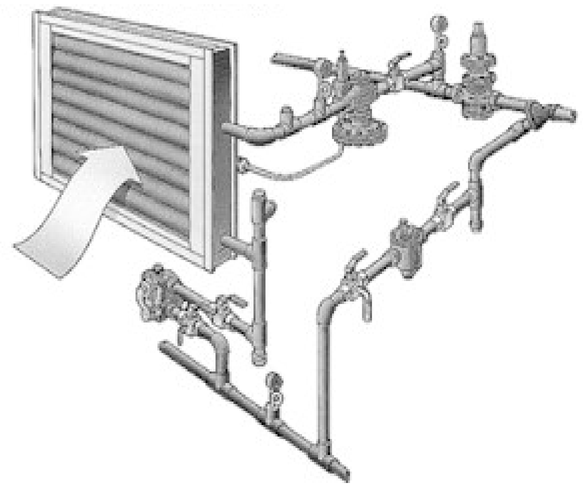
The coil installation also includes the design of the condensate handling system. The coil might be installed and oriented correctly but if a back pressure is created in the condensate line due to the piping or condensate storage, condensate could back up into the coil. In addition to the coil installation, consideration should be give to the piping installation.

Even when the proper coils are correctly installed, condensate can be retained and freeze if the system is not designed around the special circumstances that occur in modulated steam heating systems. The venting of non-condensable gases, vacuum elimination, and condensate removal are three major areas of concern.

Venting non-condensables

Air and other non-condensable gases are also fluids that must keep flowing. If they are not constantly removed from the system, they can cause a number of problems. These gases steal space from the steam, insulate heat exchange surfaces, lower the temperature inside the coil, accelerate corrosion, and bind up the system, preventing drainage.

Because of the nature of modulating systems, non-condensables are often found in heating coils, especially at start-up. To evacuate the occasional large amounts of air encountered in these systems, one should use an auxiliary air vent. This is in addition to the vent in the float and thermostatic trap.



Vacuum breakers

Vacuum formation in the steam coil is another major cause of poor coil drainage and subsequent freeze-ups. In a system that modulates steam pressure to control outlet air temperature, any heating temperature requirement below 212° F results in sub-atmospheric pressure inside the coil.

For example, in a system designed to heat air from 0 to 85° F using 15 psig steam, the temperature control valve will modulate to 0 psig steam when the outside air temperature is slightly less than 20° F. At any entering air temperature above 20° F, the system will be in a vacuum unless it is relieved. The most amazing fact is that in this example, we will still be condensing 75 percent of the full load of steam at the 20° F air temperature specified. With the pressure lower in the coil than in the return line, the trap cannot operate, the coil cannot drain, and in the presence of 20° F air, the coil will freeze.

To alleviate the vacuum as it forms, a vacuum breaker should be installed on the outlet of the coil before the trap or use a trap with a built-in vacuum breaker. A vacuum breaker opens whenever the upstream pressure drops below atmospheric. This introduces air into the coil, breaking the vacuum.

Steam traps

Sometimes coil flooding is due to incorrect or inadequate trapping. A few simple rules make this problem one of the easiest to cure, provided there is a gravity return system:

- Every individual coil should be drained vertically. Master trapping is *never* appropriate as it produces the same short-circuiting problems discussed previously.
- Always trap steam coils with continuously draining traps. These traps continue to drain the coil between discharge cycles. The preferred trap for modulating heating systems is a float and thermostatic trap because it provides air venting as well as continuous condensate drainage.

- The trap must be adequately sized to handle the condensate load generated by the coil under all conditions. On 0 to 15 psig steam, a 2:1 safety factor at 1/2 psi pressure differential should be used. On 16 to 30 psig steam, a safety factor of 2:1 at 2 psi differential should be used. Above 30 psig steam, one should use a 3:1 safety factor at half the maximum pressure differential across the trap. Remember to size the traps that drain these systems carefully. In some instances, the trap must discharge a majority of its full load capacity with only a small water head providing the differential pressure.

- Always use good piping practices: supply the coil with clean, dry steam; install the trap below the liquid level of the coil; make trap inlet piping as short as possible; use a minimum number of elbows and other restrictions in the inlet and outlet piping; install a dirt pocket ahead of the trap; install a full-ported valve on each side of the trap for maintenance; and to maximize service life, install a strainer ahead of the control valve supplying the coil.

Although everyone knows that pressurized and elevated return lines should be avoided, sometimes they are a necessity. When they are encountered, special precautions must be taken to avoid flooding when the coil pressure falls below that of the return line:

- Install check valves after the trap and air vent outlets to prevent backflow into the system.
- Provide for the removal of condensate from the system when there is insufficient differential pressure to elevate it. This can be done in one of two ways: 1) install a vented receiver and pump or pumping trap to return the condensate under pressure, or (2) install a safety drain, which is a second steam trap, before and above the primary trap. The safety drain trap should discharge to an open drain.

Summary

The design of a condensate handling system is an involved procedure that is specific to each system and installation. For this reason, we have not provided “a generic” steam and condensate piping diagram for steam coils. Although the above guidelines are given, it is recommended that, after the coil is selected, the condensate handling system be designed by an expert in condensate piping. By design, a steam coil will generate condensate and if the condensate is not removed from the coil, operational problems will result.