

## SINGLE PHASE FLUID COILS

A single phase *fluid* is one that **does not** change state (i.e. from a liquid phase to a gaseous phase, or a vapor phase to a condensate phase) during heating or cooling. For example, water that remains a liquid from the point it enters a heat exchanger to the point it exits the heat exchanger, is a single phase fluid\*. A single phase fluid acts as a heat source or heat sink reservoir by lowering or raising the temperature of a mass of the fluid. This is different from steam and refrigerants that release or absorb heat during the fluids phase change (enthalpy), with a minor change in the fluid's temperature.

The major factor that makes heat want to transfer from one fluid to another is the temperature difference between the two fluids. The greater the temperature difference, the more heat that will be transferred in the same amount of time. If the heat load is kept the same, the temperature difference between the fluids can be increased by:

- (1) Raising the temperature of the heat source fluid, and/or lowering the temperature of the heat sink fluid
- (2) Increasing the flow rate of one (or, ideally both) fluids

The design of a single phase fluid *coil* takes advantage of the way **single phase fluids** transfer, release and absorb heat. A single phase fluid coil has at least one single phase fluid entering and leaving it. Usually a liquid is flowing inside the tubes, since a liquid is a better thermal conductor than a gas, requiring less heat transfer surface area. To ensure that the maximum possible temperature difference is maintained between the fluids as they move through the coil, the fluid flow path (circuiting) is specifically laid out to create a particular thermal counterflow heat pattern between the air and the liquid. Exceptions are one and two row deep coils, and coils with a single tube in/out connections. For these the coil performance is designed around a crossflow thermal pattern.

As the fluids move faster over the fins and through the tubes of the coil, the fluids increased velocity creates more turbulence. This fluid turbulence lowers resistance to heat transfer. The result is a more thermal efficient conduit (coil), allowing more heat from the heat source fluid to be transferred to the heat sink fluid. To ensure that an optimum fluid velocity is created in the coil, though a fixed fluid flow rate is supplied to the coil, the coil face area and the number of coil circuits fed by the coil supply header are properly selected.

Finally, to ensure that thermal counterflow is maintained, that any air inside the tubes gets automatically purged, and that the liquid in the tubes will drain by gravity and/or prime a pump, the single phase fluid coil's circuiting must be designed for a specific mounted orientation of the coil. A coil mounted in the wrong orientation will reduce coil thermal performance and/or shorten the coil's service life.

Most single phase fluid coils are not designed to be used as steam (phase change) coils or boilers (cooling hot gases at temperatures above the boiling point of the liquid when at atmospheric pressure). Doing so can cause coil failure, resulting in possible bodily injury and equipment damage. For such conditions contact SRC.

\*Other commonly used single phase liquids in heat exchangers are; a glycol/water mix, and thermal oils. Any time water is blended, it's heat transfer *properties* are diminished, requiring a coil with more heat transfer *area* to compensate. For oils it is critical that the viscosity of the oil be low, so that a turbulent flow can be established inside the tubes at an acceptable fluid pressure drop.

