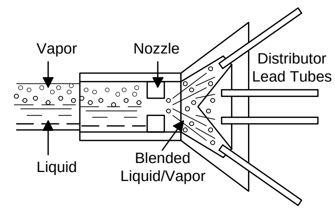
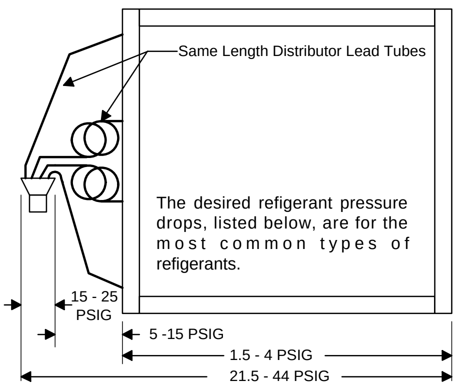
REFRIGERANT EVAPORATOR (DX) COIL

An evaporator or direct expansion (DX) coil works on the “refrigeration effect”. Cooling occurs when a fluid under pressure and at a temperature above its normal boiling point, has the pressure reduced. This makes the fluid want to boil or “flash” to a gas. For it to boil (“flash”), the liquid must absorb heat from its surrounding environment, thus cooling the surroundings. Refrigerants are a mix of chemicals that boil at low temperatures, some down to –100 F. By controlling how much pressure the refrigerant is under, the “flash” point temperature of the liquid refrigerant is controlled. Most refrigeration systems use a refrigerant expansion control valve at the evaporator coil to senses the temperature of the gaseous refrigerant *leaving* the coil, so as to regulate the amount of liquid refrigerant *entering* the coil.

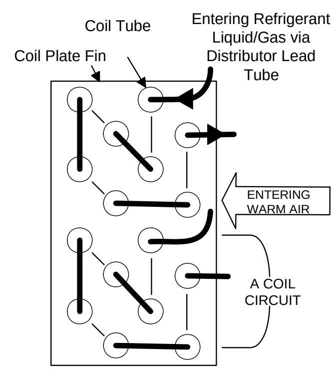


As liquid refrigerant passes through the refrigerant expansion control valve, part of the liquid flashes to a gas. Upon exiting, the refrigerant stream is mostly liquid, but the vapor occupies more space. This causes the two fluids to travel at different rates and separate, with the gas at the top and the liquid at the bottom of the stream. If this gas/liquid stream is not properly mixed and distributed, then some coil circuits receive mostly gas, and other circuits, the liquid. This degrades the heat transfer capabilities of the evaporator coil.



To avoid this, evaporator coils come with distributors. The distributor is ideally mounted pointing up or down to minimize this liquid/gas separation, it blends these two fluids, and evenly distributes this stream to the individual coil circuits. To maintain the same proportion of liquid/gas as the stream travels from the distributor to coil tubes at different locations, distributor lead tubes are used. These lead tubes are the same length, ensuring a nearly identical pressure drop between the distributor and each coil circuit.

Also inside the distributor is a nozzle or orifice. As the refrigerant flows through the nozzle, its speed increases, helping to blend and create the proper pressure drop, so the “flashing” process can occur inside the coil tubes. It is important that the distributor, nozzle opening size, diameter and length of the distributor lead tubes be properly sized. They all affect the amount of pressure drop in the refrigerant stream and the resulting “flash” temperature in the coil. If not properly sized for the type refrigerant and system operating conditions, then the temperature of the leaving hot gas will be different. The expansion control valve responses accordingly, and can starve or flood the compressor with refrigerant. The compressor then shuts down to avoid damage from a low or high head pressure.



Some evaporator coils do not have a distributor. On this type coil proper sizing of headers, lead tubes, and the coil circuiting, size, fin surface type and FPI are even MORE critical. Once built, the pressure drop through this coil can not be adjusted, unlike a coil with a distributor where the nozzle can be changed to balance the desired overall pressure drop (to a point).

Ideally the tube circuiting in an evaporator coil are designed to be identical to each other for consistent pressure drop and “flash” temperature, with the first and last tube of the circuit on, or near, the warmest air side of the coil. This quickly heats the liquid refrigerant *entering* the coil to the flash point, and boils off any residual liquid refrigerant *leaving* the coil, so it does not go to the compressor. It is common for most refrigeration systems to circulate a small amount of compatible oil with the refrigerant to lubricate moving parts inside the system compressor. If the refrigerant velocity through the coil tubes is sufficiently high, the oil is pushed through and out of the coil, thus not usually a concern. But if the “flash” temperature gets extremely low, the oil thickens and is harder to move, causing it to “log up” in the coil tubes. For such applications the coil circuit has to be designed for drainablity of the oil.

Attention to fin spacing is required where an evaporator “flash” temperature is below 32 ^{o}F. Moisture in the air stream can build significant frost on the cold fin surface, blocking air flow and compromising system temperature settings that can lead to coil/system failure. A proper coil design can help minimize these issues. As with water type coils, knowing the coil hand and if the air flow is vertical or horizontal, are critical to designing the coil circuits for proper and efficient operation. Also information on the distributor, nozzle and distributor lead tube sizes, or the coil thermal performance criteria so they can be sized, is needed. Contact any SRC facility near you for additional assistance in locating or providing this information.

