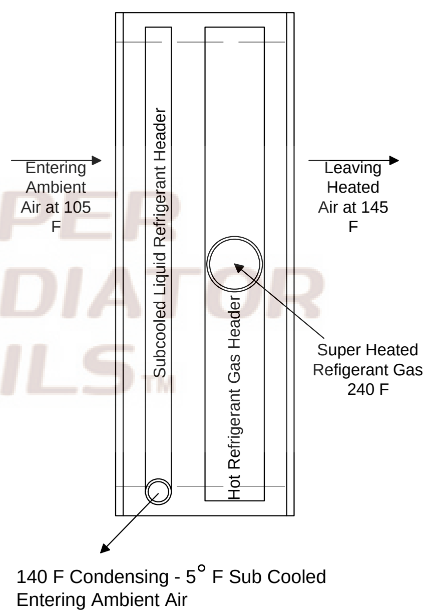
CONDENSER COIL PRIMER

STANDARD CONDENSER COILS

Standard condenser coils incorporate several refrigerant cooling stages: desuperheating, condensing, and sub-cooling. Before the hot refrigerant gas enters the condenser coil, it gets compressed, which heats the refrigerant. Additional heat is picked up as the refrigerant passes through the compressor (to help cool the compressor). So a small portion of the condenser coil first cools this superheated gaseous refrigerant to its saturation point.

The refrigerant gas is then cooled to condense it into a liquid. It's during this refrigerant condensing stage ("phase change" of a gas to a liquid) that the majority of the heat is released. The heat from de-superheating and sub-cooling the refrigerant are small in comparison.

Finally the liquid is further cooled, by an additional 5 °F. Sub-cooling the liquid refrigerant keeps a portion of it from flashing back to a gas, as it travels to the thermal expansion valve at the evaporator coil.



To exchange the heat efficiently, the cool ambient air enters the side of the coil where the liquid is sub-cooled and leaves the coil. The heated air then exits the side of the coil where the hot refrigerant gas from the compressor is entering the coil. Since de-superheating contributes a small amount to the total exchanged heat (usually less than 5%), the temperature of the leaving hot air ideally needs to be the same or less than the desired refrigerant condensing temperature.

The wider the temperature difference is between the air and the refrigerant condensing temperature, the smaller, thus less expensive, the condenser coil has to be to reject the same amount of heat. This temperature difference can be widened by lowering the entering air temperature, and/or increasing the CFM of air, and/or increasing the refrigerant condensing temperature.

Most refrigeration systems also circulate a small amount of "miscible" oil with the refrigerant, to lubricate the sealed compressor. The number of condenser coil circuits are selected to provide an optimum refrigerant velocity in the tubes, for good heat transfer at a reasonable pressure loss, and to push the oil through and out of the coil. The tube passes are laid out in a pattern to minimize pushing the oil "uphill", and to have a near identical temperature gradients/pressure losses in each circuit.

An improper coil circuiting pattern, and/or mounted orientation of the coil, can cause velocity/pressure drop variations and/or oil particles to coalesce together to flood a coil tube(s). This degrades coil performance by the oil insulating valuable heat transfer surface inside the tubes. Also it reduces the amount of oil that is circulated for proper lubrication of the compressor. Trapped oil can build to a point where a large volume is pushed out of the condenser at once, flooding the evaporator coil and compressor.

Ideally the hot gas connection on the condenser coil is located in the center of the hot gas supply header to help ensure even gas distribution to tubes connected at the extreme ends of the header. The liquid return header is usually smaller in size, as the liquid refrigerant occupies less volume, and the connection is located at the lowest point to prevent the miscible oil and condensed refrigerant from getting backed up into the coil circuits. Knowing how the coil/headers are to be oriented in reference to the air stream, and the ground, is imperative for proper condenser coil and cooling system operation.