Don't mix & Match

Install Matching Condensing Units and Evaporator Coils to Avoid Trouble Down the Road

Selling mismatched sets may be fine for mattresses, but it can spell disaster for contractors who try to cut corners by not installing condensing units and evaporator coils as a manufacturer matched system. In reality, installing a new condensing unit on an old evaporator coil is about the worst thing you could ever do for your customer.

The hard, cold fact is that most HVAC contractors who say they are trying to save the customer money are simply trying to be the low bidder and undercut the competition.

The evaporator coil looks brand new and doesn't have any leaks, so why change it? Older evaporator coils operate at lower temperatures and pressures than modern evaporator coils. Study a charging chart from any new air conditioning system using R22 refrigerant and you'll see that at 95°F outdoor air temperature, most of the systems will require an operating suction pressure of around 84 PSIG. Fully loaded, these systems have a saturation temperature at the evaporator that averages between 48-50°F.

Study a charging chart from an old system that is using R22 refrigerant and it is likely the suction pressure requirement at 95°F outdoor air temperature is anywhere from about 70 PSIG to 75 PSIG. Fully loaded, these old evaporator coils have a saturation temperature that averages 40-45°F.

The two sample charging performance charts (on the next page) illustrate this point. Figure 1 reflects the pressure requirements under proper charge of an older system manufactured in the 1980's. Figure 2 reflects the pressure requirements of a new modern air conditioning system. The 95°F outdoor air temperature is highlighted on both charts. A return air wet bulb temperature of 67°F is also highlighted. Note the older system operates at a pressure of around 75 PSIG and the new system operates at 83 PSIG. From the charts, it is obvious that older evaporator coils do not operate at suction pressure levels of modern coils.

The basics of the compression cycle: It is all about moving pounds. Suction pressure is one of the most important factors that control heat transfer in compression systems. Refrigerants have a property called suction vapor density, rated in pounds per cubic feet. At higher suction pressures, the vapor density increases. In other words, the refrigerant vapor gets heavier as the suction pressure goes up. Compressors are rated in size by how many cubic feet of vapor per minute they can move. The compressor displacement does not change, but the suction pressure does. As the suction pressure goes up, the compressor moves more pounds of refrigerant. When the suction pressure falls, the compressor moves less pounds. At 85 PSIG suction pressure, a compressor will move more pounds of refrigerant vapor than at a suction pressure of 75 PSIG.

Refrigerant vapor has another property called vapor enthalpy, which is a rating of how many BTU's are in every pound of vapor. The higher the suction pressure, the more heat the refrigerant carries. At a saturation temperature of 50°F, which occurs at a suction pressure of 85 PSIG, R22 carries about 109 BTU's per pound saturated.

Heat flowing in the system is highest when the suction pressure is high. The high capacity is a result of high pounds of refrigerant flowing in the system. The higher the suction pressure, the heavier the vapor and the greater the flow. Reduce the suction pressure and the vapor gets lighter, thereby reducing flow. Remember, each pound of refrigerant/vapor flowing carries heat. Reduce the pounds and the flow of heat is reduced.

Air conditioning systems operating with R22 refrigerant lose about 1% of their cooling capacity for every one pound of pressure drop in the suction vapor. This capacity loss is due to the reduced weight of the vapor entering the compressor.

How important is suction pressure to a manufacturer of air conditioners? Manufacturers recommend a maximum pressure drop in suction lines of 3 PSIG from the evaporator to the compressor (R22). The 3 PSIG drop limits the capacity loss due to suction line piping pressure loss to 3%. Add this piping to a system that is already operating 10 PSIG low because it is running on an old evaporator and the loss of capacity is 13% if the refrigerant piping is actually designed properly.

Bottom line: keep the suction pressure up and maximize the weight of the vapor entering the compressor. An old evaporator coil will lower the suction pressure. The low pressure reduces the capacity of the system.

Today's systems use modern evaporator engineering to reduce compressor displacement by operating at higher suction pressures. By increasing evaporator coil size and heat transfer, the suction pressure rises. At higher suction pressure, the suction vapor is heavy. Heavier vapor allows manufacturers to reduce the displacement size of the compressor. Older systems operating at lower suction pressure had to have a larger compressor because the vapor weight was lower.

Put a new condensing unit on an old evaporator coil and the compressor in the new outdoor unit is too small for the old evaporator coil. A common complaint from homeowners who were talked into saving money is that on a hot day their new unit cannot cool the house down to a temperature as low as the old unit could.

Reliability of mismatched systems is questionable at best. They have a greater chance of operating with liquid flooding back to the compressor. When metering device mismatches occur, the suction vapor superheat level may be too high, causing elevated compressor temperature. When excess charge is added to the system in an attempt to get the suction pressure up, the head pressure elevates. The elevated head pressure reduces the volumetric efficiency of the compressor.

Cutting corners ends up costing more. The only reason for not changing out the evaporator coil is to be the low bidder. With a mismatched system, the consumer never gets the efficiency or capacity they think they are buying. The consumer wants cooling at an efficient cost. A mismatched system delivers none of that. The consumer will only become unhappy when the system does not deliver their expectations. That moment will occur when the outdoor air temperature is high and their system cannot cool their home as well as the old one did. Their next moment of displeasure will occur when they get their energy bill.

Finally, a word of advice to owners of heating and air conditioning companies: If your company is using any type of computer-based payback software that calculates energy savings, don't give the homeowner a copy of what you are promising unless the system is a rated match.

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Prokup Media is a leading source of books, educational software and diagnostic software for use in the HVAC/R industry. For more information, visit www.prokupmedia.com.

Figure 1

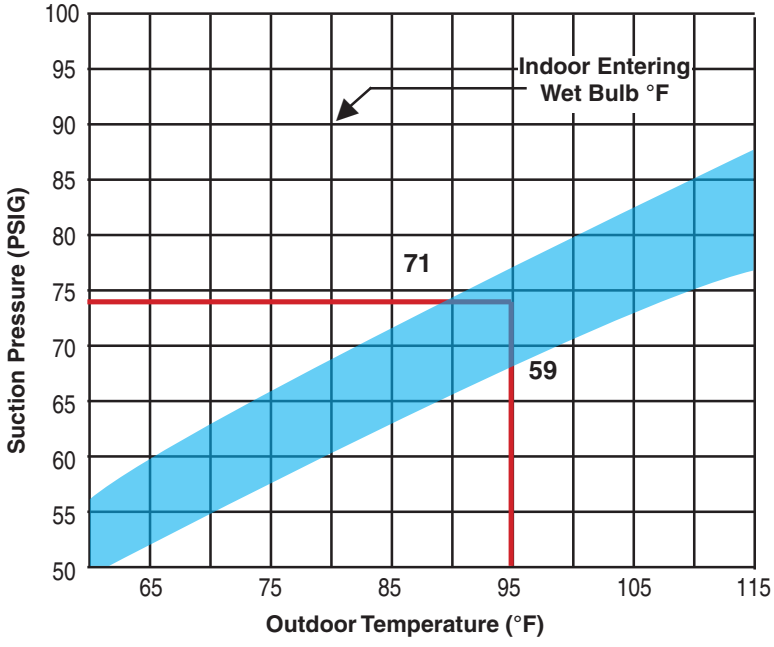

Figure 2