The Game Changer in the Design and Manufacture of Residential and Commercial Air Conditioner Products

The Technology

A game changer for the design and manufacture of residential and commercial air conditioners would reduce cost and increase energy efficiency. The solution is now available. Demands for reduced raw materials costs and the use of environmentally friendlier refrigerants have been the impetus for heat exchanger designs that are based on smaller diameter copper tubes. Reducing the tube diameter achieves weight and cost reductions, increases compatibility with new refrigerants, and increases energy efficiency, all without compromising quality. In addition, all the advantages of using copper are maintained, such as recyclability, sustainability, resistance to corrosion, and familiar factory footprints and handling.

Why Less Is More

The small tube advantage has to do with scaling. Stated in the simplest terms, smaller bodies are easier to cool than larger bodies.

Smaller diameter tubes allow for higher heat-transfer efficiency because the refrigerant flow is closer to the tube wall as the tube diameter decreases.

Because a coil made with smaller diameter tubes can be designed with a higher "heat-transfer coefficient," smaller tubes can achieve the same performance as larger diameter tubes with less tube and fin.

Copper Micro-Grooves

The surface area of smaller diameter tubes is further increased by rifling or grooving the inside surface of the tube. This surface enhancement helps to mix the refrigerant and homogenize the refrigerant temperature across any tube section, resulting in more efficient convective heat transfer. Typically, such surface enhancement can significantly increase overall performance.

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Higher Pressure Requirements

Small diameter copper tubes are more desirable as operating pressures increase. Higher pressures typically are required to condense new refrigerants (e.g., R410a or R744) compared to refrigerants that are being phased out (e.g., R22). Working pressure is directly proportional to wall thickness and inversely proportional to diameter. In other words, for tubes with the same thickness, smaller diameter tubes can withstand higher pressures than larger diameter tubes.

There are some tradeoffs involved in reducing tube diameters. The refrigerant "pressure drop" increases for smaller diameter tubes. More work is required to circulate the refrigerant through a given length of tube when the pressure drop is high. This pressure drop can be offset by designing coils with shorter tube lengths.

Overall Benefits of Smaller Diameter Tubes

Energy efficiency and reduced overall system size can be achieved at a lower material cost with smaller diameter tubes. Smaller tubes result in reduced usage of tube materials, fin materials and refrigerants, contributing to overall reduction in system cost. Also, as mentioned, smaller diameter tubes can operate at higher pressures.

Copper tube offers other advantages, such as corrosion resistance, durability, superior properties and familiar manufacturing methods.

Ready When You Are

The migration to smaller diameter copper tubes is increasing because of their inherent advantages. The copper industry has co-sponsored research into the design and manufacture of coils made with smaller diameter copper tubes. This project involves manufacturers who together account for more than 80 percent of HVAC production. Currently, several OEMs in North America and China — and shortly in Europe as well — are marketing residential air conditioner products with smaller diameter copper tubes.

Proven product designs and manufacturing technologies are available to tube fabricators, coil makers and OEM air conditioner manufacturers. ■

ECONOMICAL, ECO-FRIENDLY COPPER TUBES

Smaller, grooved tubes make possible smaller, more efficient heat exchanger coils ... and hence air conditioners with high energy-efficiency.

Coils made with this new technology weigh less and take up less space. They use less refrigerant and operate at higher pressures. The cost effective copper fabrication processes and assembly techniques are proven and familiar to suppliers and manufacturers. Corrosion resistant, durable and dependable, copper tubes provide long life, reliable performance and recyclability.

New commercial and residential air-conditioner products based on small diameter copper tubing are already changing the game.

Available from a range of suppliers.

For more information visit www.copper.org/hvac

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