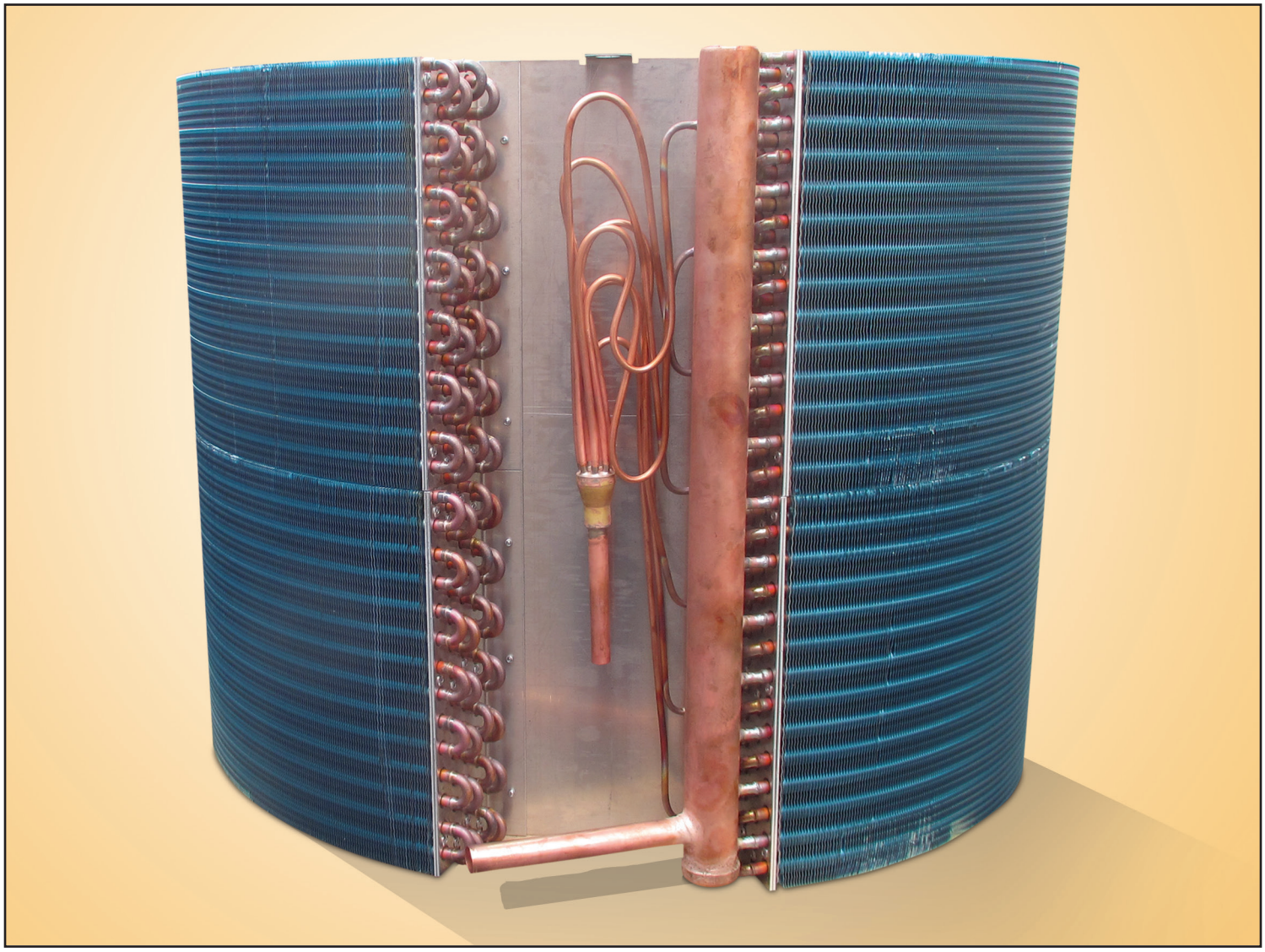
microgroove™ Technology for Heat Pumps

Q&A



New designs of heat pumps promise better management of temperature and thermal energy in homes as well as commercial and industrial applications. Ecologically friendly refrigerants, high-technology compressors and smart expansion valves provide unprecedented control over the refrigeration cycle.

Additional advantages can be obtained using MicroGroove™ smaller-diameter, inner-grooved copper tubes to build highly efficient round-tube plate fin (RTPF) coils for use in refrigerant-to-air heat exchangers, including evaporators, condensers and gas coolers.

MicroGroove evaporators efficiently gather energy from indoor spaces, waste heat or outdoor heat sources. On the other side of the refrigeration cycle, MicroGroove condensers and gas coolers offer outstanding performance for heating indoor spaces and hot water.

THE FOLLOWING Q&A EXAMINES THE USE OF MICROGROOVE TECHNOLOGY IN THE DESIGN OF HEAT PUMPS.

Q1. What exactly is MicroGroove Technology?

The International Copper Association and the Copper Alliance refer to the technologies associated with smaller diameter, inner-grooved copper tubes as MicroGroove™ technology. This trademark is suggestive of "micro" (small diameter) tubes with "grooves" (i.e., surface enhancements or "microfins") on the inside surfaces of the tubes. The term can also be applied to coils, meaning such coils contain MicroGroove copper tubes.

Q2. What are the diameters of MicroGroove tubes?

The term refers to any copper tube with an outer diameter smaller than 3/8 inches, or 9.52 mm, which is currently a commonly specified tube diameter for air conditioning, refrigeration and heat pumps. MicroGroove outer diameters include 7 mm, 1/4 inch (6.35 mm), 5 mm and even smaller diameters.

Q3. Why are there grooves in MicroGroove tubes?

The "inner-fins" in MicroGroove tubes disrupt insulating boundary layers in condensers or speed up nucleation of vapor bubbles in evaporators. The exact patterns of the inside-the-tube enhancement remain a subject of intense research. Tube supplier members of the ICA have developed proprietary enhancements. The most effective patterns are application specific. The most common patterns are helical and crosshatch with varying angle.

Q4. What is the current status of MicroGroove Technology in the marketplace?

MicroGroove is a proven technology for high-volume, residential air-conditioners, including window units as well as split systems. Major ACR manufacturing giants such as Chigo, Gree, Haier, Kelon and Midea are producing air-conditioners with MicroGroove Technology for sale on global markets. The Lu-Ve Group and Goodman-Daikin are also marketing smaller diameter copper tubes in condensers under their respective trademarks, SmartCoil™ and Minichannel™. Several other coil makers now build many types of coils from smaller diameter tubes, including coils for refrigeration and heat pump applications. Work is also underway in transportation and display-case applications.

Q5. What are the advantages of MicroGroove technology for air conditioning and refrigeration?

The higher heat-transfer coefficients of smaller-diameter tubes compared to larger-diameter tubes allow for one or more of the following advantages: smaller overall size, higher system performance, less copper tube and/or less refrigerant.

Q6. How do these advantages differ for heat pumps compared to air conditioners?

For air-to-air units for space heating and space cooling, the condenser and evaporator both benefit from the known MicroGroove advantages, including the ability to easily shed the condensate from the evaporator. In a combined AC/HP system, this advantage exists in both heat exchangers since their functions change as the operating mode changes from air conditioner to heat pump. For the air-conditioner mode, the evaporator is indoors. For the heat pump mode, the evaporator is outdoors. In the case of a heat pump water heater (HPWH), these same advantages apply to the evaporator coil.

Q7. What types of heat pumps currently use copper tubes in their coils?

In air-to-air units, both condensers and evaporators typically use round tube plate fin (RTPF) heat exchanger technology. A HPWH typically uses a RTPF heat exchanger for the evaporator and either a submersed coil inside the water tank or a wound coil on the outside of the water tank as condenser. The condenser provides the heat to the water.

Q8. Which heat-pump heat exchanger applications are possible candidates for adopting MicroGroove technology?

- Residential HP for space heating and cooling
- Residential HPWHs
- Commercial HPWHs, if the demand is not too high (e.g., less than eight gallons per hour).
- HP with eco-friendly refrigerants
- HP with natural or chemical-free refrigerants
- HP with phase-change materials

Q9. What are the strengths of MicroGroove in the following types of coils?

Outdoor evaporator: High efficiency and the ability to easily shed condensate

Outdoor condenser: Same advantages as in an AC

Indoor evaporator: Same advantages as in an AC plus the ability to easily shed condensate

Indoor condenser, air-to-air: Same advantages as in an AC

Indoor condenser, HPWH: No advantage for designs with tube wrapped around water tank

Q10. How can MicroGroove increase the COP of heat pumps?

In the case of an air-to-air HP, the advantages are the same as for AC unit. In the case of HPWH, the unit will benefit from a MicroGroove evaporator. In both cases, MicroGroove heat exchangers offer high heat-transfer coefficients, more compact coils, and lower power requirements for fans. All of these factors contribute to a higher system COP

Q11. Is MicroGroove competitive with MicroChannel in heat pump applications?

Yes. A heat pump with a MicroGroove condenser and evaporator will have no problem shedding condensate in either AC or HP mode of operation, unlike a MicroChannel heat exchanger.

Q12. Are there any design considerations that make MicroGroove unsuitable for use in certain types of heat pump applications?

In most HPWH applications, the condenser is a tube wrapped around the outside of the water tank. Smaller diameter tubes make sense only if multiple tubes are used in parallel, to alleviate the higher pressure drop of smaller diameter tubes in long lengths.

Q13. What are the major trends in the heat pump marketplace?

- The improvement of the coefficient of performance.
- Heat pumps for combined space heating and water heating. This innovation requires a high compressor exit temperature, which is currently available only with R744 or R32.

Q14. Where can I find more information about MicroGroove technology?

The website www.microgroove.net includes additional Q&A's relating to MicroGroove technology. It also includes links to the MicroGroove series of webinars. A technical literature section provides links to technical papers relating to laboratory experiments, tube circuitry optimization, fin design and manufacturing equipment. These technical papers were written by members of an international research consortium that was established to advance the technology of smaller-diameter copper tubes.

You can also find a Supplier Directory, with detailed contact information of ICA member companies who supply copper tubes for use in the manufacture of air-conditioners as well as refrigeration products and heat pumps.

ABOUT ICA

The International Copper Association, Ltd. (ICA) is the leading organization for promoting the use of copper worldwide. ICA's mission is to promote the use of copper by communicating the unique attributes that make this sustainable element an essential contributor to the formation of life, to advances in science and technology, and to a higher standard of living worldwide. Visit www.microgroove.net for more information about ICA.

For more information, visit
www.microgroove.net

the microgroove™ advantage

IT'S A GAME CHANGER

MicroGroove™ technology is changing the game of OEM product design.

OEMs are going back to their drawing boards. They are designing products with high energy-efficiency, while minimizing materials usage and reducing refrigerant volume.

The resulting products are smaller and lighter yet can be produced using familiar manufacturing methods.

It's a whole new game!

For more information, or to join a free webinar, visit

www.microgroove.net.

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Welcome to Montreal! Visit us at IEA HPC.

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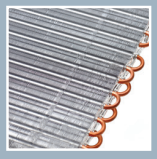


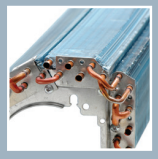

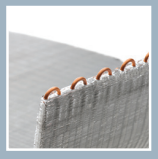

Available from a range of suppliers.
For more information visit:
www.microgroove.net