**Smaller-Diameter Copper Tubing Is Well Suited for Propane and Carbon Dioxide Refrigerants, Says International Copper Association**

*High Thermal Conductivity, High Strength and Low Tube Volume Are Key Advantages of Smaller Diameter Copper Tubes for Use with Natural Refrigerants*

**New York, NY (November 22, 2011)** — The International Copper Association today announced that copper tubes are well suited for use with natural refrigerants such as propane (R290) and carbon dioxide (R744). According the ICA, the advantages of copper tubes, and especially small diameter copper tubes, in these applications are multifold. These advantages include high thermal conductivity, high burst strength and low tube volume.

**R744 Goes Mainstream**

In the transcritical refrigeration cycle pioneered by Gustav Lorentzen in the late eighties, the thermodynamic process after the compressor does not condense the gas into a liquid but merely cools the gas. Hence, the heat exchangers for this step are called “gas coolers” rather than condensers. Technological improvements with respect to high-pressure compressors and high-pressure expansion valves (HPEVs) have contributed to the feasibility of R744 as an eco-friendly refrigerant in many applications ranging from vending machines to ice-skating rinks.

For R744 as a refrigerant, gas cooler pressure is very high, typically in the range of 120 bar and burst pressure ratings may be several times higher. Maximum working pressures for the evaporation step in the transcritical cycle are less, typically in the 45 to 60 bar range. Traditional heat exchanger coil technology with copper tubes is well suited for both the gas cooler and the evaporator in R744 applications. The main requirement is that the thickness of the tube wall and header should be sufficient to withstand the high pressures. Interestingly, burst pressure increases as tube diameter decreases, so smaller diameter tubes would be especially appropriate for R744 applications. (Note: one bar equals 14.5037 psi; so 120 bar = 1450 psi. By comparison, typical diesel engines reach pressures of 40 bar; but newer “common rail” diesel engines reach extremely high pressures of 2500 bar.)

In a paper presented at the recent International Congress of Refrigeration in Prague (Paper 295) by LU-VE S.p.A. in Uboldo, Italy, a major manufacturer of air conditioning and refrigeration products, the gas cooler tubes were made of a special copper alloy hardened by small percentages of iron. The evaporator coil was an off-the-shelf design also made with copper tubes. Typically, tubes for R744 do not require inner grooving because the heat transfer coefficient is high for R744.

**Small Tubes for Propane**

Propane is another natural refrigerant under consideration for use in air conditioner systems. Known in ACR circles as R290, propane is an eco-friendly hydrocarbon (chemical formula C3H8) with outstanding thermodynamic properties that make it well suited as a refrigerant for residential air conditioners. Perhaps the only drawback is its flammability, so the volume of refrigerant needs to be minimized compared to the room air volume to be cooled; and certain safety features must be included in the product designs.

In a recent study supported by ICA, a three-dimensional distributed parameter model was used for simulation and a knowledge-based evolution method (KBEM) optimizer was applied to optimize air conditioner heat exchangers with smaller diameter tube. Refrigerant charge was dramatically reduced using smaller diameter tubes. The experimental results confirmed the simulation results, demonstrating that smaller diameter copper tubes are suitable for developing safe room air conditioners with R290.

“Key technologies are maturing for bringing products with eco-friendly refrigerants to the marketplace,” says Nigel Cotton, Global OEM Team Leader for ICA. “Smaller diameter copper tubes are an excellent match for many of these new refrigerants.”

MicroGroove uses simple and familiar techniques well-known to manufacturers. The process is flexible and versatile because it does not require investment in complex brazing furnaces, and yet it results in superior products. For more information on this study or MicroGroove technology, visit [www.microgroove.net](http://www.microgroove.net).

**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.copperinfo.com](http://www.copperinfo.com) for more information about ICA.

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