Marketing News

M-183-2007

Date: August 7, 2007

To: All Branch Managers, Branch Sales and Service Managers, Distributor Principals, Distributor Sales and Service Managers, Regional Sales Managers and Regional Sales Vice Presidents

Subject: **York Microchannel Technology White Paper**

As our industry has migrated to the 13 SEER standards, the physical dimensions and weights of the traditional tube and fin condensing units have drastically increased. The larger sizes have resulted in added costs that extend beyond the unit itself. A few of these include increased freight, additional refrigerant requirements, larger trucks and more manpower to handle the equipment. Additionally, in some cases, the traditional units have become a challenge to incorporate into apartment and town house projects due to the minimal space available.

In response to the desire for a smaller unit, we launched our highly anticipated TCGD line of condensing units in April. Thanks to our innovative microchannel coil technology, they boast the smallest 13 SEER footprints in the industry! Not only do they require less real estate, but they also weigh significantly less due to the robust aluminum coil technology. Additional benefits of microchannel aluminum coil technology include improved heat transfer properties, improved durability and serviceability, improved corrosion protection and reduced refrigerant charge of up to fifty percent.

The excitement generated by our industry-leading microchannel coil technology has resulted in many questions from the field. In order to answer your questions and to assist your sales efforts, we are pleased to announce the availability of the microchannel coil technology white paper. This is an excellent piece that can be used to educate your sales professionals, service technicians, and engineers about the benefits of microchannel coil technology. A copy of the white paper is attached to this M-Letter.

With the introduction of the microchannel product line of condensers, Johnson Controls has once again raised the bar and set the standard for the HVAC industry. With its superior corrosion protection, enhanced durability and serviceability, smaller size and lighter weight, microchannel is clearly the technology of the future and Johnson Controls is leading the way!

If you have any questions, please feel free to contact me at (405)419-6230 or via email at brian.k.michael@jci.com.

Good Selling!

Brian Michael

Brian Michael
Residential Product Marketing Manager

MICROCHANNEL TECHNOLOGY

Benefits of Microchannel Technology
In HVAC Applications

UNITARY PRODUCTS DIVISION

August 6, 2007

MICROCHANNEL TECHNOLOGY

History

Microchannel technology was first introduced as a viable heat exchanger option in the late 1980's. During that time, the automotive industry was in a state of transition with regard to refrigeration systems. The industry had traditionally used R-12 refrigerant, a CFC-based refrigerant that was being replaced by the more environmentally friendly R-134a option. With the change to R-134a, new challenges surfaced that required advanced technology. Enter microchannel.

The change in refrigerant type introduced new thermo-physical properties that could no longer be addressed by traditional copper tube and aluminum fin (TF) designs. The combination R-134a and TF coils resulted in insufficient cooling performance due to the inferior heat transfer characteristics of R134a as compared to R-12. One option for the automotive industry was to increase the size of the TF coil, a common practice used to improve performance. However, in an industry restricted by size, weight and cost, this option was discarded in light of a better option.

What the industry required was a coil with heat transfer properties equal to or better than the oversized TF coils being evaluated – but with a reduced size, reduced weight and increased leak protection. Microchannel coils brazed in a controlled environment offered the solution.

Since that time, microchannel technology has taken over the automotive industry and is now being applied in 4 out of every 5 vehicles being produced today worldwide. With its proven performance and reliability, it was inevitable that other applications would soon be taking advantage of the superior technology found in microchannel.

Coil Construction

The TF coil traditionally used in the HVAC industry is constructed with copper tubes and aluminum fins that are bonded to one another by mechanical expansion. The TF coil has evolved in many ways over the years with improvements in construction methods, tube properties and aluminum fin enhancements. However, the basic design of TF coils is fundamentally the same as it was when it was introduced in the early 1900's.

Variations to the traditional copper tube/aluminum fin coil include the use of aluminum round tubes, while still using the multiple return bend brazing concept (FIGURE 1).

This design offered the benefit of reduced weight and cost but experienced a higher joint leak rate as a result of using copper tube manufacturing processes that are not conducive to producing a robust aluminum tube design.

FIGURE 1 – Aluminum Tube/ Fin Coil

FIGURE 2 – Spiny Fin Coil

One method to better control the manufacturing process when using aluminum tubes is to eliminate the use of traditional stamped aluminum fins and expansion, and move toward an alternate fin design and assembly process: spiny fins tightly wrapped around an aluminum tube (FIGURE 2).

This aluminum fin geometry provides an increase in the amount of fin surface directly in the air stream, while eliminating many of the production/leak issues associated with conventional aluminum tube/aluminum fin coils. However, the improved leak rate and improved heat transfer consistency come with a price: spiny fins are much more susceptible to damage and are difficult to maintain and clean after installation. Failure to properly and regularly clean HVAC units with the spiny fin coil surface will result in reduced heat transfer properties and a loss of capacity and efficiency, thereby yielding higher energy consumption. In addition, spiny fin coils are limited to single-row designs and are therefore considerably larger than other coil types.

The JCI microchannel coils are taking the HVAC industry to a new level. The microchannel coil is constructed of parallel flow aluminum tubes that are mechanically brazed to enhanced aluminum fins (FIGURE 3). This combination of materials and construction methods results in a superior coil capable of meeting/exceeding the requirements of the HVAC industry.

Three basic components are used in the manufacture of microchannel coils:

- Parallel Flow Aluminum Tubes
- Enhanced Aluminum Fins
- Header Manifolds

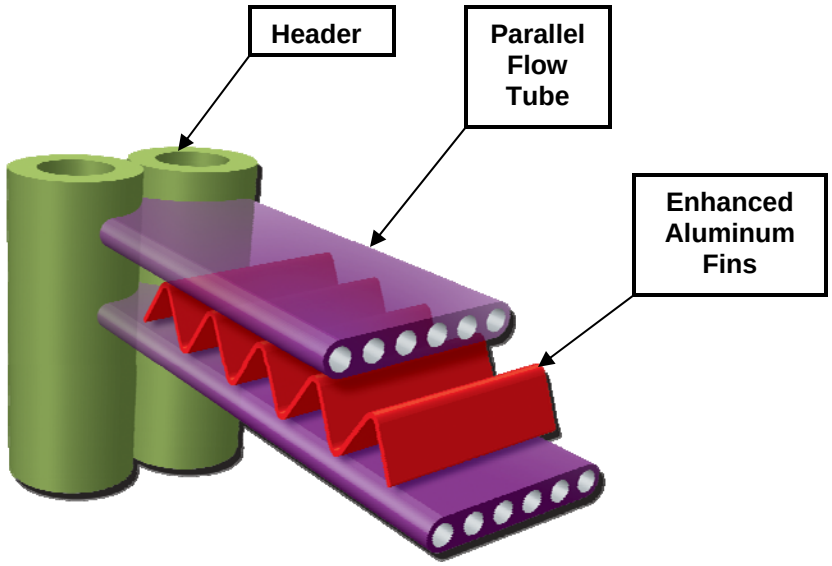

FIGURE 3 – Basic Microchannel Coil Construction

These components are combined by alternating tube and fin sections - a layer of tube atop a layer of fin atop a layer of tube, etc. This combination of fins and tubes is captured at both ends by the header manifolds. Separator plates are located within the header manifolds to segment the coil assembly into two distinct sections; a de-superheating section where the refrigerant gas transitions from gas to liquid and a sub-cooling section where the liquid refrigerant is further cooled below its saturated temperature. FIGURE 4 shows the typical microchannel coil refrigerant flow path.

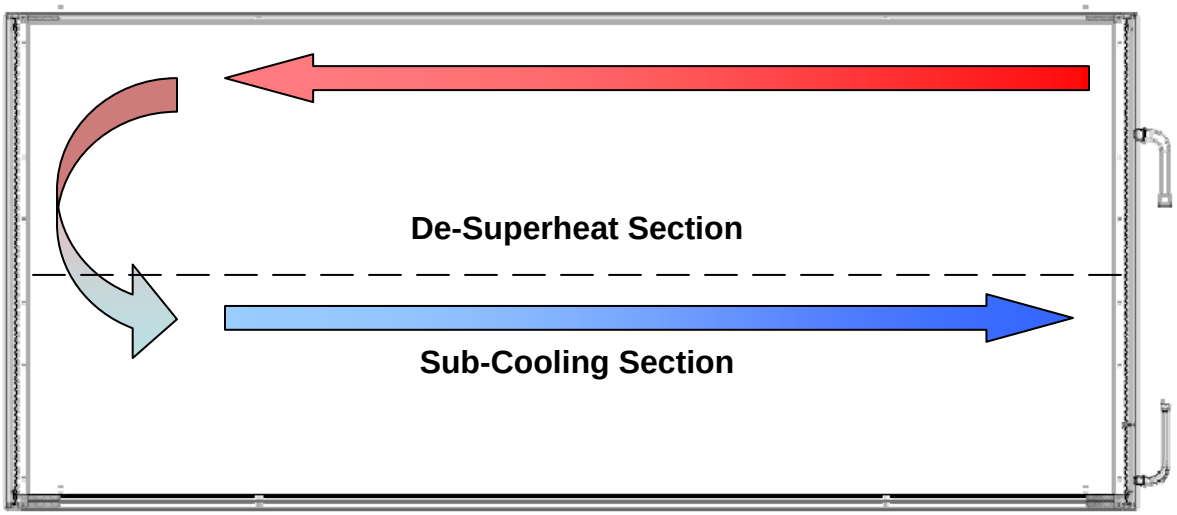

FIGURE 4 – Typical Microchannel Refrigerant Flow

CAB Furnace Manufacturing Process

Controlled Atmosphere Brazing (CAB) furnaces are commonly used to manufacture all-aluminum microchannel coils. This process utilizes several sections within the furnace which are precisely controlled. As described in the name, CAB, the furnace atmosphere is tightly controlled (enriched with Nitrogen) to minimize oxidation on the coil surface and promote clean, consistent braze joints. By maintaining a near oxygen-free environment, braze joints within the MC coil are superior to those found in traditional TF coils that are often brazed by hand in normal atmosphere conditions.

Technology Benefits

Microchannel offers several advantages when compared to traditional TF coils.

- Improved Heat Transfer Properties
- Smaller Size and Weight
- Improved Durability and Serviceability
- Improved Corrosion Protection
- Reduced refrigerant charge up to 50%

These benefits have become necessary in light of recent and future changes imposed on the HVAC industry over the past few years. Starting in January 2006, the minimum residential cooling product efficiency was increased from 10 SEER to 13 SEER. Units with traditional round tube coils increased in size up to 60%, which significantly impacted everyone from the manufacturer, the distributor, the dealer and the homeowner.

Looking towards the future, January 2010, one of the current refrigerant options, R-22, can no longer be used in the manufacture of HVAC equipment and will be entirely replaced with R-410A, a more environmentally-friendly refrigerant. Microchannel addresses all of the current and foreseeable future challenges in the HVAC industry.

Improved Heat Transfer Properties

Today's refrigeration coils are evaluated by examining the coil's ability to efficiently transfer heat between the refrigerant passing through the coil tubes and the air moving across the coil fins. Microchannel coils offer improvements in heat transfer by enhancing the three basic components in the overall heat transfer equation: air-side heat transfer (between the fins and the ambient air), heat conduction (between the fins and tubes) and refrigerant-side heat transfer (between the tubes and the refrigerant).

- Air is essentially an insulator; thereby limiting the overall heat transfer on the air-side portion of the equation. Fin geometry has evolved to incorporate enhancements which provided some improvements in system efficiency. This limitation is common to both TF and Microchannel heat exchangers. However, the flat tubes found in Microchannel coils result in reduced aerodynamic drag which in turn decreases air-side pressure drop. Reduced pressure drop means reduced power input to the fan system and improved overall energy efficiency.

- The heat conduction portion of the equation depends heavily on the mechanical bond between the fin and tube. In TF coils, that bond is created by mechanical interference (expansion of copper tubes to "tightly" fit inside punched hole aluminum fins). If the fins are loose on the tube (either from under-expanded tubes or splits in the fin collars due to over-expanded tubes), air gaps between the two materials are created, reducing the heat transfer. Microchannel coils are bonded by brazing the fins directly to the tubes, eliminating the possibility for air gaps and significantly improving heat conduction.
- The refrigerant-side heat transfer occurs at the boundary between the refrigerant and the internal surface area of the hairpin — typically known as the "wetted perimeter." Copper tube internal geometry has evolved over the years from smooth to rifled to cross-hatched in an effort to increase the internal surface area and improve the heat transfer. Microchannel coils take this enhancement to a whole new level by segmenting each tube into multiple parallel-flow sections as opposed to one large round tube with minor tube enhancements (seen in TF coils).

Smaller Size and Weight

As a result of the improved thermal performance found in the microchannel heat exchanger, coil size and weight can be significantly reduced. When compared to TF coils used in similar applications, coil face area can be reduced by as much as 40% and weight reduced by as much as 30%. This results in smaller overall product size and weight and greater flexibility in product application and handling.

Reduced Refrigerant Charge

With an advantage in size, the smaller Microchannel coil refrigerant charge is reduced up to 50% when compared to an equivalent TF residential split system design. This reduction in refrigerant charge reduces the possibility of liquid refrigerant "flooding" the compressor and causing premature failure. In addition, the rising cost of R-410A (mandatory in 2010) makes reduced refrigerant usage attractive for both the dealer and homeowner by providing both lower installation and service costs.

Improved Durability and Serviceability

Microchannel coil construction, with mechanically bonded tubes and fins, yields superior durability when compared to TF coils. In typical TF construction, the very thin (as low as .0039 inches thick) aluminum fins protrude past the edge of copper/aluminum round tubes, making these coils susceptible to damage as a result of handling, cleaning, and during the course of normal installation and maintenance.

This durability in MC construction allows for coil cleaning methods not available with other types of HVAC coils. Medium-pressure water (garden hose with spray nozzle) can be used in cleaning MC coils resulting in an easier to clean coil and faster cleaning time. This type of cleaning would result in damage to traditional TF coils, but is completely harmless for MC coils. In addition, cleaning solutions used with TF coils can be safely used with Microchannel.

In the unlikely event that a leak does occur, repair is accomplished by the use of a hand-held MAPP gas torch as opposed to the typical oxy-acetylene torch used to repair copper tubes. The ability to utilize a light-weight, off-the-shelf gas torch results in improved serviceability. JCI has developed a very simple repair procedure – clean, heat, apply special braze material. A service kit is available in Source 1.

All of the other interconnecting joints that could be encountered by the dealer are standard copper to copper joints and current brazing practices apply.

Improved Corrosion Protection

Conventional copper tube/aluminum fin coils are predisposed to galvanic corrosion by the very nature of their construction. Galvanic corrosion requires three fundamental elements, all of which must be present, in order to occur. These elements include an anode (the material that "dissolves" away), a cathode and an electrolyte. Depending on the properties of the cathode and anode, as well as environmental conditions, rate of corrosion can vary significantly from one application to the next.

In a traditional TF coil, two dissimilar materials, typically copper tubes and aluminum fins, act as the anode (aluminum) and the cathode (copper). As seen in seacoast applications, these materials, in the presence of salt-water air (electrolyte), combine to create galvanic corrosion resulting in the loss of aluminum fins.
Microchannel coils reduce the rate of galvanic corrosion by utilizing tube and fin material with similar properties, thus helping to minimize the anode/cathode relationship. Testing with microchannel coils has resulted in corrosion resistance that is seven times greater than that found in TF coils (FIGURES 5 and 6).

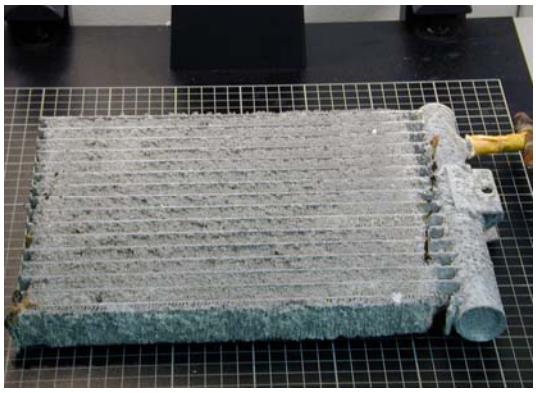

FIGURE 5 – Microchannel coil at 7000 hrs

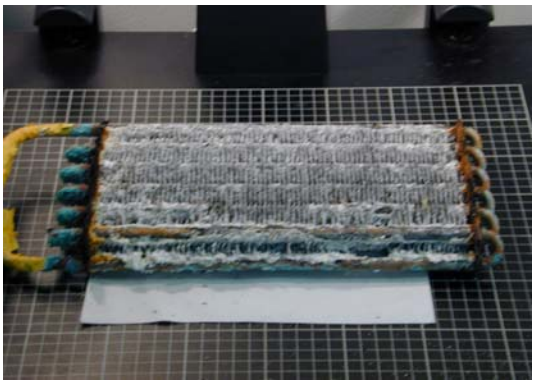

FIGURE 6 – TF coil at 1000 hrs

As a result of improved corrosion resistance, microchannel condensers are particularly desirable in seacoast applications where traditional TF condensers can corrode to point of failure in just a few short years. JCI has been testing Microchannel coils in coastal applications for over four years with excellent results.

JOHNSON CONTROLS – THE TECHNOLOGY LEADER

With the introduction of the microchannel product line of condensers, Johnson Controls has once again raised the bar and set the standard for the HVAC industry. With its superior corrosion protection, enhanced durability and serviceability, smaller size and lighter weight, microchannel is clearly the technology of the future and Johnson Controls is leading the way!