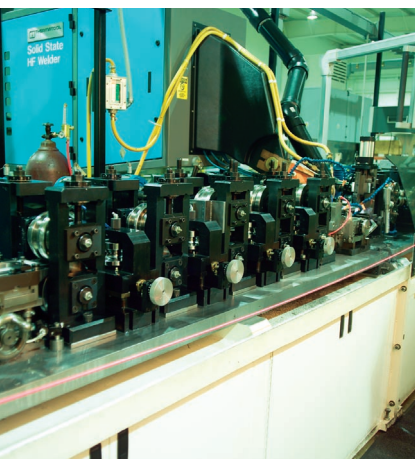


EXECUTIVE *Report*

Special Machinery Boosts Production

A CuproBraze® heat exchanger is a marvel of design and manufacturing. In the manufacturing process, coils of copper strip and coils of brass strip are transformed into the most efficient air-to-air and liquid-to-air heat exchangers that are available today for the automotive and truck industries.



This tube mill uses high frequency welding to make tubes from brass strip. Photograph is courtesy of Mill Masters.

Machinery is essential for converting brass strip into tubes and copper strip into fins. Beyond that, although it is possible to hand-assemble tubes and fins into heat-exchanger cores, the use of specialized machinery greatly increases the throughput, reliability and yield.

Fortunately, many equipment makers offer a range of automated and semi-automated equipment for heat-exchanger production. A modest investment in some or all of these types of equipment greatly increases the manufacturing capacity of a CuproBraze production line.

The following synopsis gives a brief description of the specialized equipment that can be employed on a CuproBraze production line. Table 1 lists a sampling of companies that build special machinery.

Fin Mills

In the beginning, there are coils of copper strip, which must be converted into fins on a corrugated fin machine. Scores of companies make tools and dies for processing metal strip and the high-speed machinery that folds, cuts and stamps copper strip into a wide variety of shapes, for external and internal fins.

Fins can be folded into serpentine or square wave patterns, which are preferred for trucks in off-road applications, for strength and easy cleaning. Fins can also be made with various cuts (e.g., splitter-fin design) to break up the boundary layer that affects the transfer of heat from the fin to the air passing by the fin. The splitter fin design is a candidate for use in advanced radiators for passenger cars and is also being adapted for use in high performance heavy-duty truck radiators and CAC designs.

The design of internal and external fins is an area of on-going research. Copper is a strong-yet-ductile metal that is well suited for these processes. The fin alloy used in the CuproBraze process becomes more conductive during the brazing process. Many fin

designs can be realized with copper that would be impractical using aluminum.

Tube Mills

An optimized heat exchanger uses flat wide tubes. A tube mill starts with large coils of brass strip. These mills gradually fold the strip at high speed and then carefully line up the edges, which are typically joined by high frequency (induction) welding. The tubes are then cut to length and passed on to the next step in the manufacturing process.

Tube Spray

Tubes can be sprayed with the CuproBraze brazing paste, which must be allowed to dry before the assembly step. Tube spraying is a simple step, and several companies have developed the necessary equipment, including special nozzles that spray a uniform coat of brazing material on the tubes. These companies often have close ties with the manufacturers of brazing paste.

Fin-tip Coating

Special machinery also exists for fin-tip coating with the brazing paste. Tubes do not have to be coated if the brazing paste is applied to the tips of the fins, typically by passing serpentine fins between two rollers, which coat both the top and bottom tips. Spraying tubes or coating fin-tips both result in an effective tube-to-fin joint. Only one method needs to be applied.

In-house vs. Out-sourced

Some heat exchanger manufacturers prefer to buy tubes from another manufacturer and concentrate on the assembly steps of heat exchanger production. Volume manufacturers typically find it cost effective to invest in their own fin and tube mills. However, a niche manufacturer could purchase made-to-order fins and tubes from an outside source and focus on the assembly and brazing of heat exchanger cores.

The International Copper Association, Ltd. (ICA)

is the leading organization for the promotion of the use of copper worldwide. The Association's twenty-nine members represent about 80 percent of the world's refined copper output, and its six associate members are among the world's largest copper and copper alloy fabricators. ICA is responsible for guiding policy, strategy and funding of international initiatives and promotional activities. With headquarters in New York City, ICA operates in 28 worldwide locations through a network of regional offices and copper development associations.

For general mailing information about the CuproBrazing process or ICA's CuproBrazing consulting services, please contact International Copper Association at mrosario@copper.org. For technical information contact cuprobrazing@copper.org. For European inquiries contact ndc@eurocopper.org.

Assembly of Cores

Regardless of the source, tubes and fins are eventually transported to an assembly area, where they are interleaved into a heat exchanger core. Simple tools can be used to facilitate the assembly of a variety of products or a high degree of automation can be used to maximize throughput of a high volume of identical products.

Header Plate Attachment

Once the tubes and fins are assembled into the core, the header plates are fitted to the tube ends, holding the entire assembly together. Special machinery is often used to apply the right amount of pressure to force the holes in the header plate around the tubes.

Header Slurry Machine

The next step requires the application of brazing slurry around each tube where the tube passes through the holes in the header plate. This critical process is best done by a machine, which is called a header slurry machine. This machinery is unique to the CuproBrazing process. However, several equipment makers globally are capable of making production-worthy header slurry machines.

Materials Handling Equipment

Materials handling equipment also becomes more sophisticated with high volume production, where it is important to avoid bottlenecks by keeping a large number of heat exchangers moving between the various

assembly and processing steps in the manufacturing operation.

A wide variety of materials handling equipment can be used to transport coils of metal strip, racks of fins, racks of tubes and individual heat exchanger cores through the production line.

This equipment is widely available and readily adapted to the CuproBrazing production line.

Versatile Process

In addition to the above equipment, a manufacturer would need to also choose an appropriate brazing furnace. It can be seen that the CuproBrazing manufacturing process is simple, flexible and versatile, yet it can also be adopted for high volume production.

An astonishing variety of heat exchangers can be fabricated using the CuproBrazing process.

CuproBrazing heat-exchanger cores can be used for radiators, charge air coolers, oil coolers, climate control systems and other applications. These products are suitable for heavy-duty trucks, off-road diesel engines, stationary generators, spark injection and diesel light trucks and SUVs, and passenger cars.

CuproBrazing heat exchangers represent the most efficient and most advanced heat exchangers available today.

Table 1 lists just a few of the companies globally who can assist manufacturers in building production facilities that suit their needs, whether for a high volume production facility for passenger car radiators; or a flexible, small volume facility, making large heat exchangers for niche applications. ■

Ahaus Tool & Engineering	200 Industrial Pkwy, P.O. Box 280, Richmond, Indiana 47375	+1 (765) 962-3571	www.ahaus.com
Bondmet	PO Box 136, FI 03101 Nummela, Finland	+358 400 415 079	www.bonairsystems.fi
Brouwers Machine and Tool	446 Harrop Drive, Milton, ON L9T3H2, Canada	+1 (905) 876-4617	call for info
Ecko Tool and Die	Lakewood, NY 14750	+1 (716) 763-1031	www.eckotool.com
Emerson & Renwick	4906 IDA Park Drive, Lockport, NY 14094	+1 (716) 438-0747	www.eandr.com
The Fin Machine Company	Salter's Lane Industrial Estate, Sedgfield, Stockton-on-Tees, TS21 3EB	+44 (0)1740 626100	www.fin-machine.co.uk
FinTool International	2919 Union Road, Suite C, Paso Robles, CA 93446	+1 (805) 238-3711	www.fintool.com
Livernois	25315 Kean Street, Dearborn, MI 48124	+1 (313) 278-0200	www.livernois.com
Mill Masters	39 Mill Master Drive, Jackson, TN 38305	+1 (731) 668-5558	www.millmasters.com
Outokumpu Fabrication Technologies	Trefasgatan 1 PO Box 594, SE 721 10 Västerås, Sweden	+46 21 198359	www.outokumpu.com
Robinson Fin Machine	13670 Highway 68 South, Kenton, OH 43326	+1 (419) 674-4152	www.robfin.com
Schoeler	Frankfurter Strasse 4-6, 23689 Pansdorf, Germany	+49 4504 6010	www.schoeler.de
Sterling Tool Company	2570 E Miraloma Way, Anaheim, CA 92806	+1 (714) 630-8830	call for info
Voss Manufacturing	2345 Lockport Road, Sanborn, NY 14132	+1 (716) 731-5062	www.vossmfg.com