

World Headquarters: 1160 White Street, Sturgis, MI 49091 - Telephone 800.686.3201 - Facsimile 269.503.7795 Texas Facility: 1720 N. Quevado Street, Jacksonville, TX 75766 - Telephone 903.589.3933 - Facsimile 903.589.3924

Brazing All-Aluminum Coils Without Cleaning the Coil Slab

Stanley Pickens

s.pickens@metalloidcorp.com

Metalloid Corporation

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Introduction

Aluminum alloys are being widely used in the HVAC industry due to their thermal conductivity and low cost. However, there are some difficulties associated with them at the brazing process because of the strong oxide layer on the surface of Al alloy. In addition, the melting point of the alloy is similar to that of the brazing filler metal resulting in thermal damage to the Al alloys.

Definition: A **Coil Slab** as defined here, is a fin pack that has the tubes installed along with the corresponding tube sheets (end plates) and has been processed through the expansion operation to the point it is ready for the brazing operation.

With the increased use of aluminum tubing to build heat exchangers (coils) many facilities are using some form of cleaning prior to their brazing operation. This is done to increase the first past yield and is deemed necessary because of the increase in difficulty when brazing aluminum return bends to aluminum tubing as compared to copper-to-copper joints. This difficulty increases the need for a clean joint free of contaminants and a fin pack that is free of volatile lubricants. There are three major contamination concerns with aluminum coil slabs that negatively impact brazing.

- 1. Contamination of the joint area by handling and at previous processes: glove fibers, metal shavings, dust are all possible contaminants that can cause leaks
- 2. Process lubricants and tramp oils burning in the joint area during brazing and depositing carbon that will prevent flow of solder from completing the seal.
- 3. Process lubricants and tramp oils volatizing from the fin pack, burning and creating air flow across the joint area that reduces the critical temperature at the joint resulting in an incomplete melting of the solder ring.

This paper will discuss how the use of the proper fin stock and tube bending/forming lubricants can eliminate the need to clean the coil slab before brazing and still achieve an acceptable first past yield at the brazing operation.

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At The Fin Line

Low VOC Products:

Finworks 150, a non-evaporative, low VOC fluid, is formulated to be applied at a rate of 50mg or less per side. An even coating applied at this rate will allow the fin stock material to be drawn and formed; it will also provide the critical protection for the forming plates and tooling of the fin die.

The residue on the fin of the coil slab when using Finworks 150 applied at the rate of 50mg per square foot per side of material will be minimal and should not interfere with brazing, eliminating the need to clean the fin before brazing.

Using the FW-150 in conjunction with one of Metalloid's brazer friendly fluids to bend cut and form the tubing used, will maximize the opportunity for a leak free joint.

High VOC Products:

Finworks 100, an evaporative, high VOC fluid, is formulated to be applied at a rate required to form the desired fin surface and collar height. This rate may vary from 75mg per sq ft per side up to over 200mg per sq ft per side. It will depend on the condition of the die, the application method, the fin being stamped, and the fin stock being used. With a solvent content of about 90%, even when ran at the highest rate, will result in a final deposition of 20mg per sq ft per side. To reach this point it will be necessary to expose the coil slab to air flow that traverses through the fin pack.

If solvent is still present when brazing it is highly likely that any remaining solvent in the upper 4 to 6 inches of fin will volatize and burn as the coil passes through the heat zone. This can be mitigated by adding a station before the heat zone to introduce air flow across the fins.

At Metalloid we have a complete line of fin stamping lubricants to handle any type of fin stock in any type of fin stamping die. Finworks 150 and Finworks 100 are our most versatile but may not be suited to your situation.

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At The Hairpin Bender (and all other tube fabrication operations)

Both non-evaporative and low VOC options are available. The fluid selection will be done based on the tubing size diameter, wall thickness, the alloy used, and the customer's preference.

Low VOC Products:

The non-evaporative, low VOC options are designed to be compatible with the compressor oil and miscible in the refrigerant. Their chemistry allows them to have excellent thermal stability, and they will not interfere with the flow of solder during the brazing operations.

These products are:

Miscible in the refrigerant used. They will not fall out and clog the filter.

Compatible with the compressor oil being used. They have a similar chemistry as the compressor oil and will be absorbed into the compressor oil.

Thermally stable and will not create carbon that will negatively affect the flow and seal at the brazed joint.

Evaporative Products:

The evaporative options are designed to disperse into the atmosphere at room temperature. The small amount of remaining components will be picked up and suspended in the compressor oil.

These products are:

Evaporative at room ambient temperatures and will disperse to as low as 10% of the original volume applied.

Miscible in the refrigerant used. The remaining chemistry left after evaporation of the solvent will not fall out and clog the filter.

Compatible with the compressor oil being used. After evaporation of the solvent the compressor oil will absorb the remaining chemistry and continue to function properly.

Thermally stable after the solvent has had a chance to evaporate. It may be desirable to add a heated blow off ahead of the brazing station to be sure any remaining solvent is off-gassed.

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CONCLUSION

Using either Metalloid's low VOC Finworks 150 or the evaporative Finworks 100 as the fin stock lubrication and utilizing a brazer friendly fluid on the tubing are only two of the necessary steps. When combined with a program to mitigate contamination and prevent introduction of foreign particles to the area of the braze joint an acceptable first pass yield is achievable without the cost, time, and floor space needed to install and operate a standalone cleaning system.

Key Take Aways

Use of the proper processing lubricants and an effective program to prevent contamination can eliminate the need to clean coil slabs made with aluminum fin and tube before they are brazed.

Metalloid has both evaporative (high VOC) and non-evaporative (low VOC) stamping and bending lubricants that will not interfere with the brazing operation when applied at the proper rate.

When brazing coil slabs made with aluminum tube and fin an acceptable first pass yield can be achieved by using the proper processing lubricants and following the best practices to assure the joint to be brazed is free of contaminates that will interfere with flow and seal of the fill material.

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