RSES Journal

HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION

OCTOBER 2009 • rsesjournal.com • $5.95

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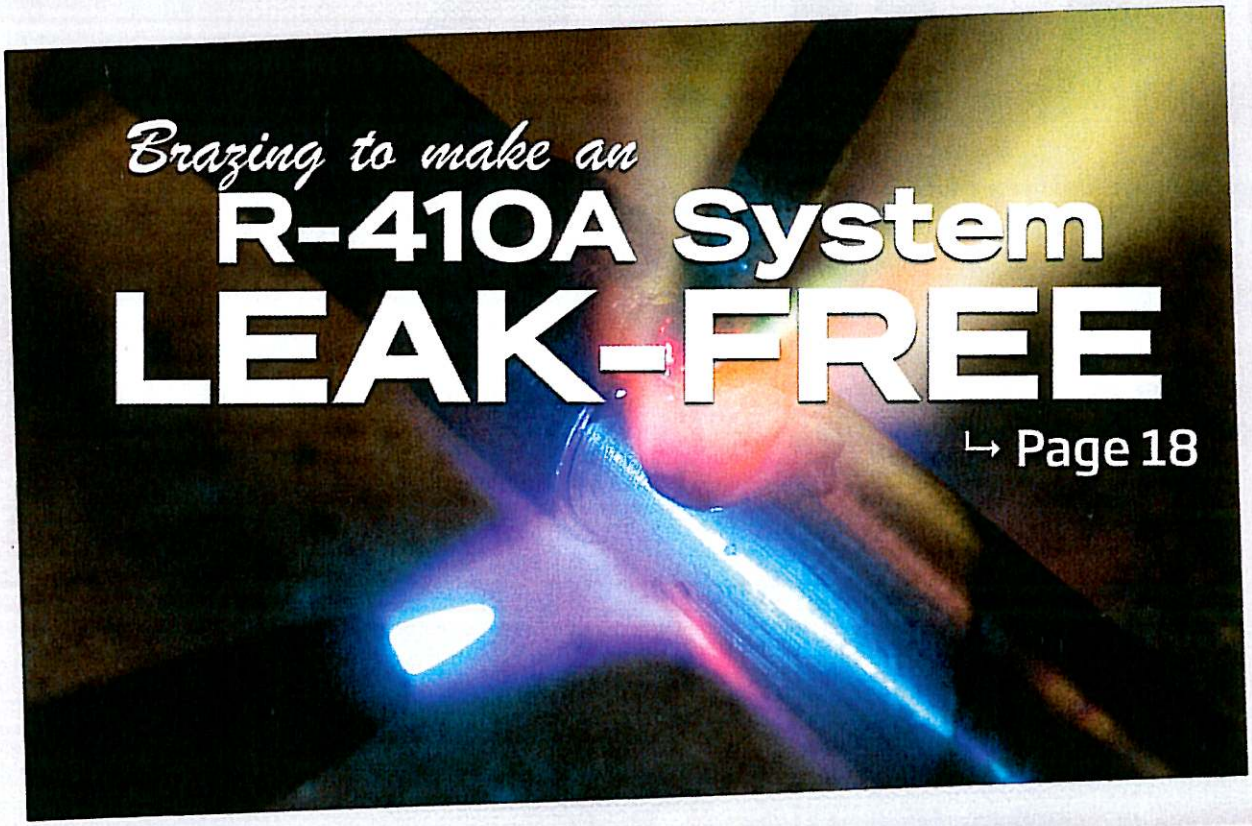

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Brazing to make an R-410A System LEAK-FREE

BY ROBERT HENSON

The higher working pressures and hydroscopic nature of lubricants associated with R-410A systems means keeping moisture out is a must.

On Jan. 1, 2010, air-conditioning manufacturers will cease production of new equipment that uses R-22 refrigerant, eliminating the use of HCFCs from newly-manufactured systems. The most obvious replacement for R-22 is R-410A; equipment manufacturers have been producing systems utilizing this refrigerant for years, and R-410A is readily available on the market.

The enemy: moisture

While this change will help accelerate a trend that sees the HVACR industry moving away from using chemical blends suspected of harming the environment, it also poses some new potential hiccups for the HVACR service professional. For example, R-410A's operating pressure is significantly higher than R-22. In addition, the POE lubricants found in R-410A systems are more hydroscopic—they readily absorb water. The potential problem is moisture can cause the breakdown of POE oils into organic acids. [*Editor's Note: For more on this topic, read the feature "Keep It Clean!" on pg. 32 of this issue*]. For these reasons—and numerous others—making sound brazed connections while keeping the system clean and moisture-free, is important.

Because there has been a gradual conversion away from R-22 for some time, many contractors and technicians have some experience brazing R-410A system connections. But since all new manufactured units will change, now is a good time to review best practices and discuss why brazing may take on increased significance.

Leak-free, step-by-step

Many HVACR professionals have their own "best practices" or preferred methods for performing different tasks, and brazing line connections is no different. Still, following these simple steps can ensure leak-free connections and cut out time-consuming callbacks.

Step 1. Clean—Remove oil from tubes, fittings and connections. Next, use a cleaning pad—such as 3M's Scotch Brite—or a stainless-steel wire brush to remove oxide from the tube ends and the interior diameter of the fitting. For tube cuts, use a de-burring tool to ream the tube ends.

Step 2. Flux—Most manufacturers' installation guides recommend using "no flux" on copper. To meet this requirement a phosphorus/copper/silver braze rod is used. The phosphorus content makes these alloys "self-fluxing" on copper.

When brazing copper to brass or to steel, a flux is always required. Brazing fluxes contain 15%–35% water—and moisture is the enemy of the system—so it is imperative to keep excess flux from inside the lines. As a suggestion to help prevent this, always use a brush to apply a thin coating of flux and do not apply flux to the end of the tube (as shown in Image 1). Do not apply flux to the fitting socket. When heated, flux liquefies and capillary action will draw it to the fitting.

<< Image 1. Since flux contains moisture—the enemy of an HVACR system—techs should keep excess flux from inside the lines using a brush to apply a thin coating of the substance to copper tubing.

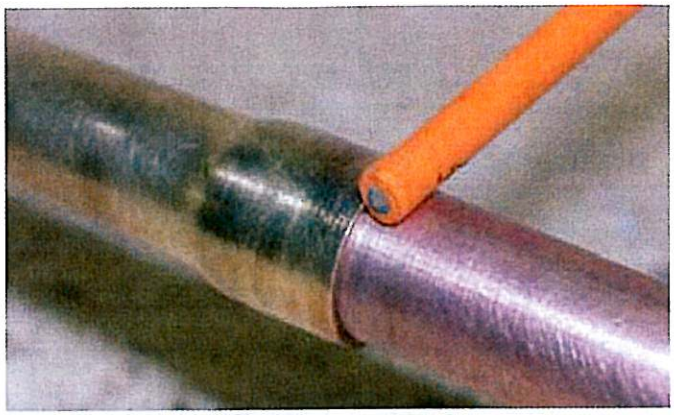


Image 2. Flux-coated braze rods are uniformly covered, allowing the service technician to take the rods to the jobsite without the need for carrying flux separately.

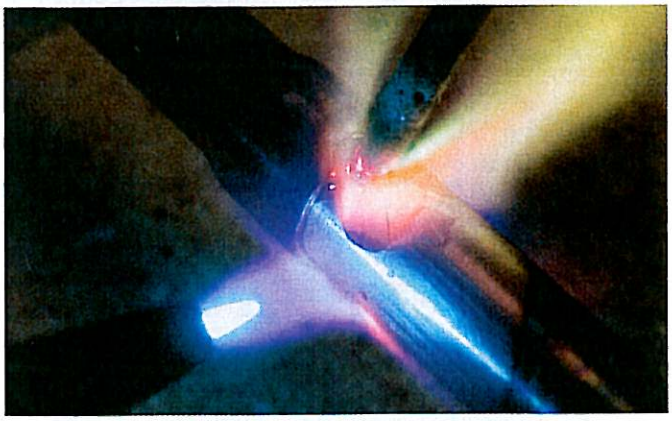


Image 3. When heated, the coating on flux-coated rods will liquefy and move into the joint before the braze alloy melts and follows. This makes for a tight connection with minimal flux inside the joint.

Image 4. Brazing can cause copper to oxidize, forming flakes of "scale" metal like the ones shown from this 5/8-in. outside-diameter fitting braze job. A nitrogen purge can help prevent this problem.

A low-pressure stream of nitrogen injected through the tube by the contractor/technician during part heating and cooling will ensure there are no internal scale problems.

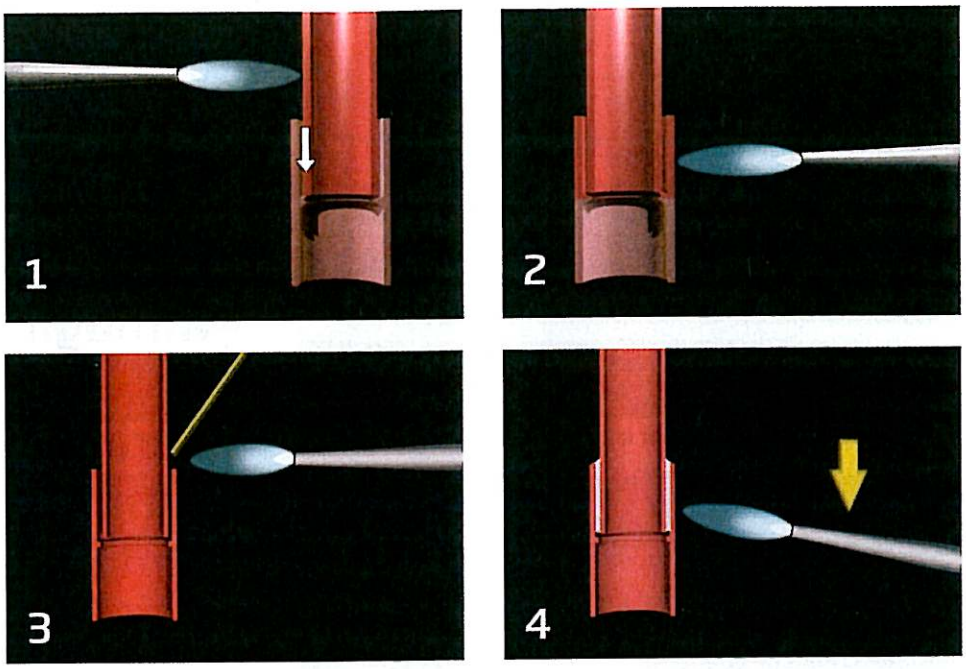
Braze rods also are available flux coated (as shown in Image 2). These braze alloys have a uniform covering of flux on the outside of the rod. While offered primarily as a convenience—the contractor or technician does not have to carry a separate flux jar—there is another benefit: the coating melts during heating and flows into the joint ahead of the melting braze alloy (as shown in Image 3). This action and the uniform coating thickness minimize unwanted flux inside the connection.

After the brazing process is complete, remove flux residue from the parts by washing them with a wet rag. If parts are overheated and flux is difficult to remove, mechanical cleaning may be required.

Step 3. Purge—Brazing heat causes the copper tubing to oxidize. As the tube cools, the oxidation flakes off in tiny pieces called "scale" (shown at left in Image 4).

While unsightly on the outside, scale presents a larger problem on the tube interior. POE lubricant will remove the copper oxide more effectively than the mineral oils that were previously used with systems using R-22 refrigerant. R-410A refrigerant can carry this oxide scale through the system to block TXVs and other metering devices.

To prevent scale formation, a nitrogen purge is recommended by nearly all component manufacturers. Nitrogen is essentially inert—chemically non-reactive—and displaces oxygen inside the tube. A low-pressure stream of nitrogen injected through the tube by the contractor/technician during part heating and cooling will ensure there are no internal scale problems.



›› **Figure 1.** Follow these steps to properly braze a connection. 1. Heat the tube to conduct heat inside the coupling. 2. Move heat to the coupling exterior to evenly heat both parts. 3. Apply filler metal. 4. Move the flame towards the coupling base to draw alloy into the joint.

Step 3. Heat—The most frequent cause of poorly brazed joints is incorrect heating. The goal is simple: heat both tube and fitting to evenly bring them to brazing temperature, and do so before you apply the braze rod. Here is a suggested approach to accomplish that goal (see the illustrations in Figure 1):

1. Heat the tube to conduct heat inside the coupling;
2. Move heat to the coupling exterior to evenly heat both parts;
3. Apply the filler metal; and
4. Move the flame towards the coupling base to draw alloy into the joint.

If flux is used, the flux will turn transparent when it nears the brazing temperature. This is a visual indication that shows the tecnician when to apply the brazing rod. The flux should be the same consistency on both parts. If there is an obvious difference one side may require additional heat.

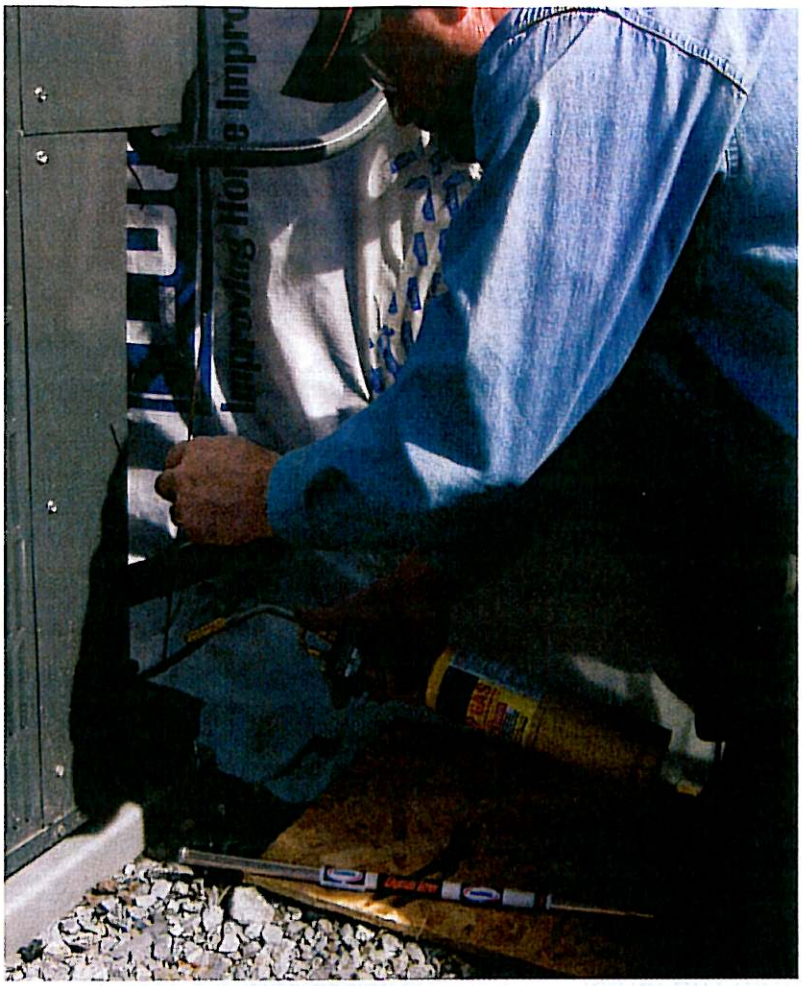
Choosing the correct braze filler metal is a key factor in brazing successful joints. For copper-to-copper assemblies, HVACR professionals should use a phosphorus-copper-silver braze rod, as they are self-fluxing on copper; however, they are not recommended for steel because these connections may have low ductility.

Take care when brazing copper-coated steel, such as a compressor stub. The technician may abrade the thin copper coating during cleaning or melt it if the part is overheated. When this occurs, the tech will find they are brazing the underlying steel surface instead of the copper on the surface.

» Choosing the right braze filler is critical, and should be based on the types of materials being joined. Technicians should also be sure to match the filler with the proper brazing flux or flux-coated rod to ensure a tight, leak-free joint.

For copper-to-brass or -steel connections, common choices are silver/copper/zinc braze wires. These alloys melt at low temperatures and form excellent bonds on nearly all metals except aluminum. Technicians should pair these with a white brazing flux, or select a flux-coated braze rod.

These steps are the key to successful brazed connections, whether it comes to installing residential split systems or per-



<< From residential units to those found in industrial/commercial applications, properly brazed connections eliminate moisture from systems and help ensure efficient, effective equipment operation.

forming work on a multi-ton chiller. By effectively and properly brazing connections, HVACR pros will keep moisture and unwanted contaminants out—and their customers' systems up and running efficiently.

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