Exploring Different Brazing and Soldering Methods

Here's a look at various ways — using furnace, dip, resistance, and torch techniques — to complete a job

BY JERRY ARNOLD, EARL MILLER, AND GREG MITCHELL

Brazing and soldering processes offer professionals strong, long-lasting joints, but when it comes to performing the action, different applications can utilize different methods. Some of the most common methods of heating include furnace, dip, resistance, and torch. So the question is, which method should you use on your next job?

Furnace

In both brazing and soldering, the furnace method of heating can be profitable for processing many parts at a time or for making many joints at once in a large and complex part. For instance, this method is used to make dental equipment as well as tools used in the aerospace industry.

This method comes in handy when the brazing material can be in contact with the joint, and the part can survive uniform heating. However, there are several disadvantages to using furnace methods. Furnace heating can be costly using high power consumption and requiring a significant amount of maintenance. Typically, furnaces are heated by electric elements, gas, or flame — provided the flame does not impinge directly on the work load.

Dip

The most effective way to apply heat uniformly and rapidly by direct contact is the dip method. Used especially for aluminum parts, the filler metal may be provided as a thin layer clad on the brazing sheet from which parts are formed. Dip consists of applying heat through the immersion of the solid parts either in a molten flux or metal. A metallic bath, covered with a flux, provides the molten filler metal. The cleaned parts should be covered with flux at the joint locations.

A critical advantage of using the dip method is that an entire unit comprised of any number of joints can be brazed and/or soldered in one operation, thus increasing production volume at a minimum cost of equipment. On the other hand, only alloys containing high-melting metals can be used in this method. There is a chance low-melting metals may vaporize from the bath. In addition, this method lacks portability to on-site applications. Likewise, safety should always take first priority during the dipping process due to the risk of explosion when wet parts are dipped into the bath.

Resistance

Resistance brazing and soldering is a process using resistance heating to heat a workpiece while melting a braze or solder filler alloy. Contact tips or horns clamp onto the part and pass a current through at a point adjacent to the joint causing internal and contact resistance heating. The molten alloy wets and flows across the heated work surface. Temperatures are normally high so that a metallurgical bond can be formed, but fusion of the workpiece does not normally occur.

Resistance brazing is normally used for low-volume production, where heat is localized at the area to be brazed. According to brazing experts, this method is essential to the electromechanical equipment production industry, which relies on resistance brazing to join dispersion-strengthened, ceramic composites to metals with high electrical conductivity. Both resistance brazing and soldering are commonly used in the automotive, electronic, and plumbing industries. Used for soldering various joints, resistance soldering can fuse everything from components on a circuit board to copper tubing.

Although the resistance method has many advantages, it still has its limitations. One problem with this method is its distortion of joints. Additionally, brazing and soldering cannot be done simultaneously, resulting in less efficiency.

Torch

One of the most versatile methods of heating is torch brazing and soldering. Due to its practicality, the torch method is used in almost every industry from fabrication to repair work. This method joins relatively small assemblies made from materials that do not oxidize or can be protected from oxidation with a flux. The most commonly used filler metals include aluminum-silicon alloys, silver-base alloys, and copper-zinc alloys. Flux is required with these fillers unless protective atmosphere is used. Self-fluxing copper-phosphorus alloys are also available.

Torch brazing and soldering are accomplished with hand-held oxyfuel gas torches using various fuels; and both processes are similar in the fact that the source of oxygen used can be from bottled/pressurized oxygen cylinders or oxygen from atmospheric air.

Historically, the preferred method of heating was the use of a torch that used an oxygen acetylene mixture to create the flame and heat. The oxygen and acetylene

JERRY ARNOLD (Jerry_Arnold@thermadyne.com) *is the western regional manager, EARL MILLER is the eastern regional manager, and GREG MITCHELL is the central regional manager for Thermadyne Specialty Markets, St. Louis, Mo.*

Tips for Proper Torch Usage

Torch brazing and soldering utilize the most common method of heating, and it is crucial to practice proper torch usage when using those processes. According to Thermadyne, following the correct procedures in soldering and brazing can be the determining factor between a durable joint and failure.

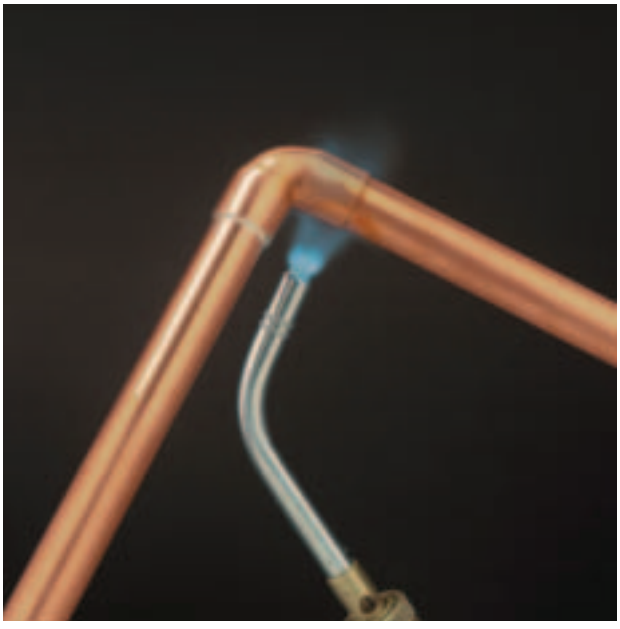
Don'ts

- Don't reduce the flame, which could overheat the tip, ruin the tip end, or loosen the helical rotor.
- Don't use partial flame with self-lighting tips, which could cause ignition wire to burn as well as loosen the rotor.
- Don't rotate the torch flame.

Dos

- Remember the acetylene regulator should always be turned full on.
- Always run torch with a full flame.
- Keep the flame on copper with as little movement as possible; instead move the filler.
- Bear in mind that the regulators on hand torches are adjustable for MAPP®. Replace with MAP//PRO™ or propane.

A worker demonstrates the correct flame using a TurboTorch® TX540.



Another example of a correct flame during a torch brazing operation.

were provided from pressurized cylinders each containing one of these gases. With the invention of TurboTorch® "swirl" technology, it became possible to create enough temperature and heat energy by combining a fuel gas with oxygen taken from the atmosphere through a venturi and then using a mixer to facilitate a flame, which allows you to complete a solder or braze connection. The most common fuel gases used for this process are MAP//PRO™, propane, and acetylene. Each offers its own unique combination of temperature and energy (BTUs). It is important that you choose the right combination of these along with the proper tip size selection in order to complete your solder or braze connection properly.

Using a TurboTorch, the following applies:

- Oxyacetylene, 5800°F, 1470 BTU/ft^3
- Swirl air acetylene, 2800°F, 1470 BTU/ft^3
- Swirl air propylene (called MAP//PRO), 2200°F, 2200 BTU/ft^3
- Swirl air propane, 1700°F, 1700 BTU/ft^3

Swirl technology continues to be developed through continuous engineering improvements. It is easy to make a swirl torch, but it is the right combination of regulator flow, venturi, flame tube, and mixer that allows the professional to make a safe and effective connection.

Conclusion

While there are many methods of heating for brazing and soldering purposes, the deciding factor in a professional's application will depend on the technical, production, and economical means and requirements. Selecting the most appropriate heating methods will provide the best possible connections in brazing and soldering. The fact is the welding industry is continually advancing and changing technology while simultaneously promoting the safety and superior welding capabilities of our industry.◆