BRAZING

Brazing is a process which differs from braze welding in one very important way: In brazing, the filler metal is drawn into the joint by capillary attraction, rather than deposited in the joint as in oxy-acetylene fusion welding. What do we mean by ”capillary attraction”? It is the ability of a liquid to rise into a narrow gap or passage against the force of gravity.

By American Welding Society definition, brazing is a welding process in which the filler metal has a melting point higher than 800^0F (425^0C) but lower than that of the metal of metals being joined, and in which the filler metal is drawn into the joint by capillary attraction.

The process known as soldering is generally similar to brazing except that the filler metals used melt at temperatures below 427^0C (800^0F). In actual practice, most brazing alloys melt at temperatures well above 427^0C, most solders melt at temperatures well below 427^0C. Many of the brazing alloys based on silver (all of which melt above 600^0C) were formerly termed ”silver solders”. Avoid that term, and its relative, ”silver soldering”. Even the term ”silver brazing” is sometimes misleading, since some brazing applications for which silver alloys are generally used can also be handled with alloys which contain no silver.

In virtually all brazing applications, heat is applied directly to the parts that are to be brazed, not directly to the brazing alloy. Many different heat sources can be used; flames, furnaces, electricity (through resistance or induction heating), radiant (infrared) sources, even molten salt baths. When gas flames are used, the process is termed torch brazing.

What metals can be brazed? Almost every metal, and some combinations of metals that cannot be successfully fusion-welded together. While the silver-based brazing alloys are the most widely used, there are also families of brazing alloys based on aluminum and magnesium (for use with those metals), on copper and phosphorus, on copper alone or copper and zinc, on nickel, and even on gold. Brazing alloys are designated by the American Welding Society with the letter ”B” followed by the chemical symbol or symbols of the major element or elements. ”BAg-1, BAg-2”, etc. are alloys based on silver (usually about 50%). The copper-phosphorus alloys are designated ”BCuP-1, BCuP-2”, etc., nickel-base alloys ”BNi-1”, etc. In the ”BAg” group there are no less than 19 different compositions, all of which contain copper as well as silver; some also contain zinc, some cadmium, and a few contain tin or nickel.

The key to successful brazing is joint design. Because the process depends on capillary attraction, the spacing between the parts to be joined must be small and accurately controlled. While it is possible to make a square-butt joint, the two edges must be very carefully prepared, and spaced precisely, if the joint is to be successful. Such butt joints are occasionally employed, but are exceptions. Almost all brazed joints can be classified as lap joints. The joint between a piece of copper tube and a socket-type fitting is a kind of lap joint. In such a joint, the separation between the two parts should usually be between 0.050 mm (.002 in.) and 0.150 mm (0.006 in.) While clearances greater than 0.150 mm can usually be filled with brazing alloy, the joint will lose some of its strength when subject to tensile forces.

In brazing operations, a flux is required. The purpose of the flux is to remove from the surfaces of the parts any oxides which may remain after thorough mechanical cleaning, or which form as the parts are being heated to brazing temperature. The fluxes used with silver- or copper- based brazing alloys are all based on boric acid and other boron or flourine compounds. The active ingredients are dry powders, which are then mixed with a vehicle to form a paste or thick liquid, which can be readily applied to the joint surfaces. When the joint is heated, the vehicle evaporates, and the flux then liquefies to do its work of dissolving oxides.