CHAPTER 3

BRAZING FILLER METALS

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INTRODUCTION

Brazing filler metals are metals that are used to produce a braze. These metals have a liquidus that is above 840°F (450°C) but below the solidus of the base metals. With respect to brazing, the term solidus denotes the highest temperature under equilibrium conditions at which the metal is completely solid, that is, the temperature above which melting starts. The term liquidus refers to the lowest temperature under equilibrium conditions at which a metal is completely liquid, that is, the temperature below which freezing starts.

It should be noted that the term brazing filler metal has replaced the terms formerly used to refer to this material, including hard solder, silver solder, gold solder, braze filler metal, and brazing alloy.

For satisfactory use as a brazing filler metal, a metal or alloy should possess the following characteristics:

1. The ability to spread and adhere to the base materials on which it is used. This is referred to as wetting;
2. Suitable melting point or melting range and fluidity to permit its distribution by capillary action into properly prepared joints;
3. A composition of sufficient homogeneity and stability to minimize the separation of constituents by liquation under the brazing conditions to be encountered;
4. The ability to form brazed joints possessing suitable mechanical and physical properties for the intended service application; and
5. Depending on requirements and specifications, the ability to produce or avoid certain interactions between the base metal and brazing filler metal. Brittle intermetallic compounds or excessive erosion may be undesirable, while a higher joint remelt temperature—the temperature to which a completed brazed joint must be raised to separate the joint—might be an attribute (see Chapter 17, “Diffusion Brazing”).

MELTING OF BRAZING FILLER METALS

Pure metals melt at a single temperature and are generally very fluid. For example, pure silver melts at 1761°F (961°C), and pure copper melts at 1981°F (1083°C). Combinations of copper and silver have very different melting characteristics, depending on the ratio of the two metals.

Figure 3.1 presents the phase diagram for the silver-copper binary system. The solidus temperature line, ADCEB, represents the start of melting for all alloy combinations of silver and copper in the system. The liquidus temperature line, ACB, represents the temperatures above which each of these alloys in the system is completely liquid. At Point C, the liquidus and solidus temperature lines meet, indicating that a particular alloy melts at a constant temperature instead of melting over a range of temperatures. This point is known as the eutectic point. The composition of the alloy at this point—in this case, 72% silver and 28% copper—is known as the eutectic composition. This composition is essentially as fluid as pure metal.

For temperatures between the solidus and liquidus temperatures, some constituents of noneutectic alloy compositions are in the liquid phase while others are in the solid phase. In general, alloys with melting