PIPE AND TUBING
It is unknown exactly when human beings first made use of metal tubular goods to convey materials from one location to another. Remnants of copper pipe show that metal was used to convey water as early as 3000 B.C. in the great Egyptian pyramid built for the Pharaoh Cheops.\(^1\) By the time of the Roman Empire, the use of metals to convey water and other materials was certainly well established. At this time, too, tubular members were probably first joined to various alloys.

Basic joining methods have changed little since then, and for the most part, they are still manual operations. However, the demands and service conditions of today's technology have created the need for a wide variety of materials, the development of new alloy filler metals, as well as advanced joining techniques.

Brazed joints are economical and can easily be made by skilled personnel with the proper equipment and materials. Brazed joints can readily be made in aluminum alloys, copper and copper alloys, steel, stainless steel, and most other metals. Most pipe and tubing materials that can be soldered can also be brazed, and when service conditions are too severe for soldered joints, brazed joints can very often be used satisfactorily.

A wide variety of brazing filler metals and fluxes are available, and most are readily applicable to pipe and tubing. A brazing filler metal for use with tubing or piping material should be chosen from the tables presented in the chapters addressing the various metals. In situations in which joint clearances cannot be held to close tolerance, the brazing filler metal should have a melting range wide enough to be easily workable and be fluid enough to flow readily into the capillary space with good wetting action.

Copper tube is used extensively in heating, cooling, plumbing, and other applications, as can be observed in Table 35.1. Copper tube is durable, economical, lightweight, corrosion resistant, safe, readily formable, and easy to join. Leak-tight joints can be produced in copper tube with brazing filler metals having liquidus temperatures of 1100°F (593.3°C) to 1500°F (815.6°C). The brazing filler metals most commonly used are the BCuP series and the BAg series. The fluxes most commonly used are AWS FB-3A or AWS FB3-C.\(^2\), \(^3\), \(^4\)

Most brazed joints in pipe and tubing do not need as much depth of socket insertion (overlap) as do soldered joints. A depth of tube insertion three times the thickness of the tube ordinarily results in a joint that is as strong as or stronger than the base metal. This is illustrated by the test results shown in Figure 35.1. It should be noted that attempts to draw brazing filler metal to the base of a socket designed for soldering often result in serious overheating.

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4. At the time of the preparation of this chapter, the referenced standards were valid. If a standard is cited without a date of publication, it is understood that the latest edition of the document referred to applies. If a standard is cited with the date of publication, the citation refers to that edition only, and it is understood that any future revisions or amendments to the code or standard are not included; however, as standards undergo frequent revision, the reader is encouraged to consult the most recent edition.