CHAPTER 25

COPPER AND COPPER ALLOYS

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COPPER AND COPPER ALLOYS

INTRODUCTION

Copper and its alloys are selected for many brazing applications because of their wide range of properties. This entire family of wrought metals normally has excellent corrosion resistance and formability. Brazing can readily be performed on most copper alloys with the proper precautions. Electrical and thermal conductivities vary widely depending on the composition of the base metal and the brazing filler metal.

BASE METALS

The classes of wrought and cast copper alloys are shown in Tables 25.1 and 25.2. In comparison with steels, copper and its alloys have a higher thermal expansion. This is important when brazing dissimilar metals.

If the proper precautions are not taken when copper and copper alloys are brazed, then cracking, distortion, and unacceptable softening may occur. However, these potential problems should not discourage the use of these alloys in brazed assemblies. Knowledge of the factors that cause such problems makes it possible to predict the properties of the resulting brazement.

Residual stresses arising from cold working, casting, or machining operations can cause the cracking of some copper alloys during brazing. Heating and cooling can induce additional stress as a result of uneven expansion or contraction. Relatively low stresses from all these factors may be sufficient to cause cracking at elevated temperatures in the presence of liquid brazing filler metal.

Uniform and controlled heating is very important, especially with brasses, cold-worked phosphor bronzes, and cold-worked silicon bronzes. These materials are especially susceptible to cracking as a result of intergranular penetration when subject to tensile stress in areas exposed to liquid brazing filler metal.

Softening of the base metal occurs frequently during brazing because many copper base alloys derive their properties from low temperature heat treatment or cold work, or both. The degree of softening increases with temperature and the length of exposure to high temperatures. The softening of areas close to the braze can be minimized by (1) cooling the assembly, except for the area to be brazed, (2) immersion in water, (3) packing with wet rags, or (4) providing a heat sink to keep the overall temperature of the assembly as low as possible. Brazing with low-melting brazing filler metal for a minimum time also minimizes softening.

OXYGEN-BEARING COPPERS

This group includes the fire-refined and electrolytic tough-pitch grades of copper and silver-bearing copper [10 ounce (oz)/ton to 20 oz/ton; 300 grams (g) per metric ton to 600 g/metric ton]. Fire-refined copper contains very small percentages of impurities as well as from 0.02% to 0.05% oxygen in the form of copper oxide, which constitutes part of a copper-copper oxide eutectic. The latter is scattered as globules throughout the wrought metal and appears as an interdendritic structure in cast products. The copper-copper oxide eutectic has no serious effects on mechanical properties or electrical conductivity. However, it makes the copper susceptible to embrittlement when it is heated in a hydrogen atmosphere.