CHAPTER 13

INDUCTION BRAZING

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Photograph courtesy of Induction Atmospheres
INTRODUCTION

Many designs specify that metal components be joined by induction brazing to fabricate weldments. In the induction brazing process, the components at the joint area, including the surfaces of the components to be joined and the brazing filler metal, are heated selectively to the brazing temperature. This is accomplished by means of induced electrical energy in the joint using an induction coil or inductor. By heating only the joint area, significant energy savings result. Induction brazing can be implemented in manual, mechanized, semiautomated, and automated production modes.

Induction brazing is particularly well suited to mass production applications that require selective joint heating. In automated induction brazing operations involving large production runs, the processing time amounts to a matter of seconds. This brazing process finds extensive use in the aerospace, automotive, electronic, and electrical industries, among others, for the fabrication of industrial and consumer products.

This chapter describes the induction brazing process, its fundamentals, required equipment, materials and consumables, process considerations, applications, uses, and safety considerations.

PROCESS FUNDAMENTALS

The heat required for induction brazing is generated primarily as result of resistance to the flow of the induced current (referred to as I²R losses), as shown in Figure 13.1. Resistance occurs in each subassembly, provided it is an electrical conductor, when it is placed in an electromagnetic field established by rapid alternating-current (ac) flow in the induction coil. The response to the electromagnetic field depends on various factors, including the frequency of the current, the type of materials being heated, the shape of the subassemblies, and the design of the coil.

Magnetic materials with high electrical resistivity (e.g., steel) are heated more efficiently than nonmagnetic materials with a low electrical resistance (e.g., copper and brass). This is due to the magnetic dipole hysteresis heating that occurs below the Curie point of the material. This heating is directly proportional to the frequency of the induction power supply. The higher the frequency is, the faster the heating of magnetic materials.

The induced current is greatest at the surface of the assembly, decreasing exponentially toward the interior, as shown in Figure 13.2. Therefore, surface heat is possible with a high power density (kilowatts...