CHAPTER 34

HONEYCOMB STRUCTURES

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Honeycomb structures are remarkable high-strength-to-weight assemblies finding broad use today in a wide range of industries as diverse as aerospace, automotive, shipbuilding, commercial equipment, and general packaging. Many honeycomb structures are made from metal, and brazing is used to create a wide variety of light-weight structures that are very strong, leak tight, and able to handle high-temperature service very well.

As can be seen in Figure 34.1, metallic honeycomb typically consists of rows of corrugated metal strips that are spot-welded together at their nodes. When honeycomb structures are made using brazing as the joining technique, it is important that the facing (contacting) surfaces inside each of the nodes are brazed and that the bottom edges of each of the honeycomb cells are well brazed to their backing materials. Metallic honeycomb structures can take many sizes and shapes, as will be discussed in this chapter.

Cylindrical honeycomb assemblies for high-temperature heat transfer (as in automotive engine exhaust applications), or “open-faced” honeycomb structures for high-temperature abradable wear surfaces (as in aircraft engine or ground-power turbine applications) are important forms of honeycomb brazements finding increasing use in this new century. But probably the most widely used form of honeycomb brazement is the sandwiched honeycomb structure, in which a honeycomb material is brazed to sheets of metal placed on each side of the honeycomb.

Consider the sandwiched panel assembly shown in Figure 34.2. It is comprised of a central honeycomb core and top and bottom closure panels or face sheets. The central core consists of a plurality of cells that have four- or six-sided polygonal cross sections that are brazed to the face sheets using one of the many brazing filler metals described later in this chapter.

The face sheets are the prime load-bearing members. The complete stabilization of the facing surfaces by means of the proper honeycomb core design permits the desired panel strength to be attained, even when the face sheets and the honeycomb core use thin-gauge materials. The core performs the vital function of providing essentially continuous support to the face sheets by preventing buckling while at the same time transmitting shear forces. Furthermore, excellent stiffness, vibration dampening, thermal, acoustic, and insulation properties are inherent. The favorable properties of the brazed sandwich, when manufactured properly, can be maintained even at elevated temperatures.

Depending on their end-use applications, brazed honeycomb structures may be constructed of aluminum, copper, titanium, stainless steel, or high-temperature nickel-based or cobalt-based superalloys. Even coated ceramic honeycomb cylinders are finding use in automotive exhaust applications, and brazing technology will be pushed to its limits to remain involved in that technology. As of the early 21st century, honeycomb brazing is still primarily limited to metal structures, as this chapter will show.

Specific guidelines for brazing each particular type of base metal as well as recommended brazing filler metals can be found in the chapters of this book that specifically relate to each particular type of base metal. This chapter on honeycomb brazing will deal with specific manufacturing/brazing needs not covered in those other chapters.