CHAPTER 32

STAINLESS STEELS

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INTRODUCTION

The term *stainless steels* describes a wide variety of iron-based alloys containing chromium in excess of 10%. These alloys are used primarily in applications demanding heat or corrosion resistance. This class of materials is brazeable by all processes, though tighter process controls are needed than those required to braze carbon steels.

The most rigorous requirements are imposed by the inherent chemical characteristics of stainless steels and the generally more arduous service environments. Chromium has a high affinity for oxygen, resulting in the formation of a tenacious chromium oxide layer that reduces the brazability of stainless steels in an oxygen-containing atmosphere. Thus, stainless steels are brazed under protective atmospheres such as dry hydrogen, vacuum, and other inert gases.

Success in the brazing of stainless steel components depends on knowledge of the properties of stainless steels and rigid adherence to the appropriate process controls.

CATEGORIZATION OF STAINLESS STEELS

Stainless steels are grouped into the following five categories:

1. Austenitic (nonhardenable) steels,
2. Ferritic (nonhardenable) steels,
3. Martensitic (hardenable) steels,
4. Precipitation hardening steels, and
5. Duplex stainless steels.

All these alloys are iron based and contain at least 10% chromium, the basic element that imparts corrosion resistance in the form of a tenacious and transparent chromium oxide layer. The corrosion resistance of stainless steels varies from one alloy to another, and for any given alloy, it varies from one corrosive medium to another. If any doubt exists regarding the proper stainless steel to use in a given environment, standard reference works\(^1,2,3\) or manufacturers’ representatives should be consulted for further information.

AUSTENITIC (NONHARDENABLE) STAINLESS STEELS

Austenitic (nonhardenable) stainless steels contain sufficient nickel or nickel plus manganese additions to (1) stabilize austenite down to room temperature and (2) cause these alloys to become nonmagnetic and nonhardenable by heat treatment. Stainless steels of this class possess the highest heat and corrosion resistance.

The chromium-nickel steels are designated by an American Iron and Steel Institute (AISI) type number in the 300 Series, while the chromium-nickel-magnesium steels are designated by a 200-Series number. One commonly used alloy is Type 304, which contains nominally 18% (by weight) chromium and 8% nickel.

In the 200-Series stainless steels, some of the nickel is replaced with manganese on a ratio of approximately 2% of manganese for each percent of replaced nickel. Type 202, the parallel to Type 302, contains 18% chromium, 5% nickel, and 9% manganese.

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