

AWS G2.1M/G2.1:2002
An American National Standard

Guide for the Joining of Wrought Nickel-Based Alloys



American Welding Society



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Guide for the Joining of Wrought Nickel-Based Alloys

Prepared by
AWS G2 Committee on Joining Metals and Alloys

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AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This document describes the welding of different wrought nickel-based alloys, including solid solution and precipitation hardening alloys. A safety section is included.



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Guide for the Joining of Wrought Nickel-Based Alloys

1. Scope

This guide presents a description of wrought nickel-based alloys and the processes and procedures that can be used to join these materials. This guide stresses the process basics, parameters, applications, and safety considerations. Practical information has been included in the form of figures, tables, and graphs which should prove useful in determining capabilities and limitations in the joining of these materials. Readers who desire additional information about the joining of nickel-based alloys should consult the references in 2.1 Reference Documents.

This standard makes use of both the International System of Units (SI) and U.S. Customary Units. The measurements may not be exact equivalents; therefore, each system must be used independently of the other without combining in any way. The standard with the designation G2.1M:2002 uses SI Units. The standard designation G2.1:2002 uses U.S. Customary Units. The latter are shown within parentheses () or in appropriate columns in tables and figures.

2. Background

The family of wrought nickel-based alloys can be divided into two categories and numerous classes according to composition. The categories include solid solution strengthened alloys and precipitation hardenable alloys. The classes of solid solution nickel-based alloys are: nickel, nickel-copper, nickel-molybdenum, nickel-chromium and nickel-chromium-iron, nickel-iron-chromium, nickel-iron, and nickel-chromium-molybdenum. These classes are listed in Table 1. The classes of precipitation hardenable nickel-based alloys are: nickel, nickel-copper, nickel-chromium and nickel-chromium-iron, nickel-iron-chromium, nickel-iron. These classes are listed in Table 2. There are no precipitation hardenable nickel-molybdenum alloys. In general, the nickel-based alloys can be welded with practices and procedures similar to the austenitic series (300) stainless steels.

This standard addresses these two categories of wrought nickel-based alloys. The first category addresses solid solution nickel alloys hardened only by cold working. The second category addresses precipitation hardening alloys hardened by heat treating in addition to cold working. Additionally, Annex A addresses safety and health issues associated with welding nickel-based alloys.

2.1 Reference Documents

- (1) AWS A5.8, *Specification for Filler Metals for Brazing and Braze Welding*¹
- (2) AWS A5.11/A5.11M, *Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding*
- (3) AWS A5.12/A5.12M, *Specification for Tungsten and Tungsten Alloy Electrodes for Arc Welding and Cutting*
- (4) AWS A5.14/A5.14M, *Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods*
- (5) AWS A5.30, *Specification for Consumable Inserts*
- (6) AWS A5.31, *Specification for Fluxes for Brazing and Braze Welding*
- (7) AWS A5.32/A5.32M, *Specification for Welding Shielding Gases*
- (8) AWS *Brazing Handbook*
- (9) AWS B1.11, *Guide for the Visual Examination of Welds*
- (10) AWS B2.1, *Specification for Welding Procedure and Performance Qualification*
- (11) AWS B2.2, *Specification for Brazing Procedure and Performance Qualification*
- (12) AWS C1.1, *Recommended Practices for Resistance Welding*
- (13) AWS C3.2, *Standard Method for Evaluating Strength of Braze Joints in Shear*

1. For ordering AWS and ANSI Z49.1 standards information, contact Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112-5776. Telephones: (800) 854-7179, (303) 397-2740; fax (303) 397-2740; Internet: www.global.ihs.com.