

AWS G2.4/G2.4M:2021
An American National Standard

Guide for the Fusion Welding of Titanium and Titanium Alloys



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An American National Standard

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Guide for the Fusion Welding of Titanium and Titanium Alloys

3rd Edition

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Prepared by the
American Welding Society (AWS) G2 Committee on Joining Metals and Alloys

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

The standard *Guide for the Fusion Welding of Titanium and Titanium Alloys* provides instructional guidance for the welding of titanium and titanium alloys. This guide explains processes, equipment, materials, workshop practices, joint preparation, welding technique, tests, and the repair of discontinuities.



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This standard is subject to revision at any time by the AWS G2 Committee on Joining Metals and Alloys. It must be reviewed every five years, and if not revised, it must be either reaffirmed or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are requested and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS G2 Committee on Joining Metals and Alloys and the author of the comments will be informed of the Committee's response to the comments. Guests are invited to attend all meetings of the AWS G2 Committee on Joining Metals and Alloys to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

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Foreword

This foreword is not part of this standard but is included for informational purposes only.

The American Welding Society formed the G2 Committee on the Joining of Metals and Alloys in 1992 in response to an industry demand for information on welding the metals and alloys that have not been covered by other documents and committees. This document is written by the G2 Committee on the Joining of Metals and Alloys.

This guide makes use of both U.S. Customary Units and the International System of Units (SI). The measurements are not exact equivalents; therefore, each system must be used independently of the other, without combining values in any way. In selecting rational metric units, the AWS A1.1, *Metric Practice Guide for the Welding Industry*, and the International Standard ISO 544, *Welding consumables — Technical delivery conditions for welding filler metals — Type of product, dimensions, tolerances and markings*, are used where suitable. Tables and figures make use of both U.S. Customary and SI Units, which, with the application of the specified tolerances, provide for interchangeability of products in both the U.S. Customary and SI Units.

The evolution of AWS G2.4/G2.4M, *Guide for the Fusion Welding of Titanium and Titanium Alloys*, is shown below:

AWS G2.4/G2.4M:2007	<i>Guide for the Fusion Welding of Titanium and Titanium Alloys;</i>
AWS G2.4/G2.4M:2014	<i>Guide for the Fusion Welding of Titanium and Titanium Alloys;</i>
AWS G2.4/G2.4M:2021	<i>Guide for the Fusion Welding of Titanium and Titanium Alloys</i>

A vertical line in the margin or underlined text in clauses, tables, or figures indicates an editorial or technical change from the 2014 edition.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS G2 Committee on Joining Metals and Alloys, American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

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Guide for the Fusion Welding of Titanium and Titanium Alloys

1. General Requirements

1.1 Scope. This guide provides information on welding processes and procedures that are recommended for use in titanium fabrication. The document presents detailed and up-to-date technical information on the best practices to allow first time fabricators of titanium as well as established fabricators to join titanium parts into high quality components.

Although this guide is not written with mandatory requirements, mandatory language, such as the use of “shall,” will be found in those portions of the document where failure to follow the instructions or procedures could produce inferior, misleading, or unsafe results.

1.2 Units of Measure. This standard makes use of both the U.S. Customary Units and the International System of Units (SI). The latter are shown within brackets ([]) or in appropriate columns in tables and figures. The measurements may not be exact equivalents; therefore, each system must be used independently.

1.3 Safety. Safety and health issues and concerns are beyond the scope of this standard and therefore are not fully addressed herein. Safety and health information is available from the following sources:

American Welding Society:

- (1) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*
- (2) AWS Safety and Health Fact Sheets
- (3) Other safety and health information on the AWS website

Material or Equipment Manufacturers:

- (1) Safety Data Sheets supplied by materials manufacturers
- (2) Operating Manuals supplied by equipment manufacturers

Applicable Regulatory Agencies

Work performed in accordance with this standard may involve the use of materials that have been deemed hazardous and may involve operations or equipment that may cause injury or death. This standard does not purport to address all safety and health risks that may be encountered. The user of this standard should establish an appropriate safety program to address such risks as well as to meet applicable regulatory requirements. ANSI Z49.1 should be considered when developing the safety program.

2. Normative References

The documents listed below are referenced within this publication and are mandatory to the extent specified herein. For undated references, the latest edition of the referenced standard shall apply. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. (Informative standards and specifications for titanium fabrication are available in Annexes C and D.)

American Welding Society (AWS) documents:

AWS A3.0M/A3.0, *Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*;