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An American National Standard



Recommended Practices for Gas Tungsten Arc Welding of Titanium Piping and Tubing



American Welding Society



Key Words— Joint design, filler metals, preweld cleaning, gas shielding weld quality tests, preheat and postweld heat treatment, arc welding, recommended practice, titanium pipe, gas tungsten arc welding

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Prepared by
AWS D10 Committee on Piping and Tubing

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard summarizes information on the welding of titanium. It explains the special precautions necessary to shield the molten and hot metal from atmospheric contamination. Various methods of checking weld quality are also presented.



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Recommended Practices for Gas Tungsten Arc Welding of Titanium Piping and Tubing

1. Scope

This document summarizes information on the welding of titanium pipe.¹ The information has been collected from the welding literature and from various company shops and laboratories. The document is intended to serve as a welding guide.

This standard makes use of both U.S. Customary Units and the International System of Units (SI). 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 D10.6:2000 uses U.S. Customary Units. The standard designation D10.6M:2000 uses SI units. The latter are shown within parenthesis () or in appropriate columns in tables and figures.

2. Reference Documents

- (1) AWS A3.0, *Standard Welding Terms and Definitions*
- (2) AWS A5.12, *Specification for Tungsten and Tungsten Alloy Electrodes for Arc Welding and Cutting*
- (3) AWS A5.16, *Specification for Titanium and Titanium Alloy Welding Rods and Electrodes*
- (4) AWS A5.32/A5.32M, *Specification for Welding Shielding Gases*
- (5) AWS B1.10, *Guide for the Nondestructive Examination of Welds*
- (6) AWS B4.0, *Standard Methods for Mechanical Testing of Welds*
- (7) AWS C5.5, *Recommended Practices for Gas Tungsten Arc Welding*

1. Where *pipe* is used in this document, it refers to both piping and tubing.

(8) ANSI Z49.1, *Safety in Welding, Cutting and Allied Processes* (available from the American Welding Society)

(9) AWS *Safety and Health Fact Sheets*

(10) AWS *Welding Handbook*, 8th Edition, Volume 1, Chapter 16, "Safe Practices"

(11) AWS *Welding Handbook*, 8th Edition, Volume 4, Chapter 9, "Titanium and Titanium Alloys"

(12) AWS *Fumes and Gases in the Welding Environment*

(13) American Conference of Governmental Industrial Hygienists (ACGIH), *Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment*²

(14) ANSI Z41.1, *Safety-Toe Footwear*²

(15) ANSI Z87.1, *Practice for Occupational and Educational Eye and Face Protection*³

(16) NFPA No. 70, *National Electrical Code*⁴

(17) Occupational Safety and Health Administration (OSHA), *Code of Federal Regulations*, Title 29 Labor, Chapter XVII, Part 1901.1 to 1910.1450⁵

3. Basic Information

In general, titanium pipe can be welded using Gas Tungsten Arc Welding (GTAW) techniques similar to those used for welding stainless steel pipe. However, the following paragraphs describe two fundamental differences

2. ACGIH documents are available from the American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Suite 600, Cincinnati, OH 45240-1634.

3. ANSI standards may be obtained from the American National Standards Institute, 11 W. 42nd Street, 13th Floor, New York, NY 10036.

4. Available from National Fire Protection Association, Battery March Park, Quincy, MA 02269-9101.

5. OSHA standards may be obtained from the U.S. Government Printing Office, Washington, DC 20402.