



AEROSPACE MATERIAL SPECIFICATION

AMS4951™**REV. L**

Issued 1958-03
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Superseding AMS4951K

Titanium Welding Wire,
Commercially Pure,
Environment Controlled Packaging
(Composition similar to UNS R50120)

RATIONALE

AMS4951L results from a Five-Year Review and update of this specification with changes to update wording related to exceptions (see 4.4.1), relocate Definitions (see 2.3), and update Applicable Documents (see Section 2), Fabrication (see 3.4), Sampling and Testing (see 4.3), Tolerances (see Table 3B), and Ordering Information (see 8.5).

1. SCOPE

1.1 Form

This specification covers one grade of commercially pure titanium in the form of wire for welding filler metal (see 8.5).

1.2 Application

This wire has been used typically as filler metal for gas-metal-arc and gas-tungsten-arc welding with chemistry matched to unalloyed titanium UNS R50400, but usage is not limited to such applications.

1.3 Classification

Product covered by this specification is classified by melting practice as follows:

Type I: Multiple melted with vacuum arc remelting as the last melting cycle.

Type II: Single melted using either the electron beam cold hearth or plasma arc cold hearth method.

1.3.1 Unless a specific type is ordered, either type may be supplied (see 8.5).

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

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Documents

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2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), www.sae.org.

AMS2249	Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS2814	Packaging and Marking of Packages of Welding Wire, Premium Quality
AMS2816	Identification, Welding Wire, Tab Marking Method
AMS2819	Identification, Welding Wire, Direct Color Code System
ARP1876	Weldability Test for Weld Filler Metal Wire
ARP4926	Alloy Verification and Chemical Composition Inspection of Welding Wire
AS7766	Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E8/E8M	Tension Testing of Metallic Materials
ASTM E539	Analysis of Titanium Alloys by Wavelength Dispersive X-Ray Fluorescence Spectrometry
ASTM E1409	Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by Inert Gas Fusion
ASTM E1447	Determination of Hydrogen in Reactive Metals and Reactive Metal Alloys by Inert Gas Fusion with Detection by Thermal Conductivity or Infrared Spectrometry
ASTM E1941	Determination of Carbon in Refractory and Reactive Metals and Their Alloys by Combustion Analysis
ASTM E2371	Analysis of Titanium and Titanium Alloys by Direct Current Plasma and Inductively Coupled Plasma Atomic Emission Spectrometry (Performance-Based Test Methodology)
ASTM E2994	Analysis of Titanium and Titanium Alloys by Spark Atomic Emission Spectrometry and Glow Discharge Atomic Emission Spectrometry (Performance-Based Method)

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Wire Composition

Shall conform to the percentages by weight shown in Table 1; carbon shall be determined in accordance with ASTM E1941, hydrogen in accordance with ASTM E1447, oxygen and nitrogen in accordance with ASTM E1409, and other elements in accordance with ASTM E539, ASTM E2371, or ASTM E2994. Other analytical methods may be used if acceptable to the purchaser.

Table 1 - Composition

Element	Min	Max
Iron	--	0.12
Oxygen (see 3.1.1.1)	0.08	0.16
Carbon (see 3.1.1.1)	--	0.03
Nitrogen (see 3.1.1.1)	--	0.015
Hydrogen (see 3.1.1.1)	--	0.005 (50 ppm)
Yttrium (see 3.1.1.2)	--	0.005 (50 ppm)
Other Elements, each (see 3.1.1.2)	--	0.05
Other Elements, total (see 3.1.1.2)	--	0.20
Titanium	remainder	

3.1.1 Except for carbon, oxygen, nitrogen, and hydrogen, chemical analysis of initial ingot, bar, or rod stock before drawing is acceptable provided the processes used for drawing or rolling, annealing, and cleaning are controlled to ensure continued conformance to composition requirements.

3.1.1.1 Carbon, oxygen, nitrogen, and hydrogen shall also be determined on each lot of finished wire.

3.1.1.2 Determination not required for routine acceptance.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2249.

3.2 Melting Practice

Type I shall be multiple melted with the last melting cycle under vacuum. When multiple melted, melting cycle(s) prior to the final melting cycle shall be made using vacuum consumable electrode, nonconsumable electrode, electron beam cold hearth, or plasma arc cold hearth melting practice(s). The final melting cycle shall be made using vacuum arc remelting (VAR) practice with no alloy additions permitted.

Type II shall be single melted using electron beam cold hearth or plasma arc cold hearth melting practice.

3.2.1 The atmosphere for nonconsumable electrode melting shall be vacuum or shall be inert gas at a pressure not higher than 1000 mm of mercury (Hg).

3.2.2 The electrode tip for nonconsumable electrode melting shall be water-cooled copper.

3.3 Condition

As drawn, having tensile strength not higher than 130 ksi (896 MPa), determined in accordance with ASTM E8/E8M, and descaled.

3.4 Fabrication

3.4.1 Finished wire shall be formed from rod, bar, or wire descaled by a process that does not affect the composition of the wire. Surface irregularities without alpha case consistent with normal forming processes are acceptable provided the wire conforms to the tolerances of 3.7.

3.4.2 In-process annealing, if required between rolling or drawing operations, shall be performed after cleaning the material and in a vacuum or in protective inert atmosphere to avoid surface oxidation and adsorption of other extraneous elements unless the contaminated surface is removed mechanically or chemically.

3.4.3 Butt welding is permissible provided both ends to be joined are either alloy verified using a method or methods capable of distinguishing the alloy from all other alloys processed within the facility or to join an in-process break at the wire processing station. The butt weld shall not interfere with uniform, uninterrupted feeding of the wire in machine welding equipment.