NOTICE OF ADOPTION

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Title of Document: Titanium Alloy Welding Wire
6Al - 4V, Extra Low Interstitial
Environment Controlled Packaging

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# AEROSPACE MATERIAL SPECIFICATION

SAE AMS-4956 REV C

Issued 1969-05-01
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Superseding AMS-4956B

An American National Standard

## TITANIUM ALLOY WELDING WIRE
## 6Al - 4V, Extra Low Interstitial
## Environment Controlled Packaging

UNS R56402

1. SCOPE:

1.1 Form: This specification covers a titanium alloy in the form of welding wire.

1.2 Application: Primarily for use as filler metal for gas-tungsten-arc welding of base metal of similar composition intended for cryogenic or elevated temperature applications, particularly for use with equipment providing continuous inert gas shielding of the wire as it passes from the dispenser to the welding arc, where high reliability of joints is required.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS-2249 - Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS-2814 - Packaging of Welding Wire, Premium Quality
AMS-2815 - Identification, Welding Wire, Line Code System
AMS-2816 - Identification, Welding Wire, Color Code System

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 120 - Chemical Analysis of Titanium and Titanium Alloys

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E 120, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

| | min | max | |
|---|---|---|---|
| Aluminum | 5.50 | 6.75 | |
| Vanadium | 3.50 | 4.50 | |
| Iron | -- | 0.15 | |
| Oxygen | -- | 0.08 | |
| Carbon | -- | 0.03 | |
| Nitrogen | -- | 0.012 | (120 ppm) |
| Hydrogen | -- | 0.005 | ( 50 ppm) |
| Yttrium (3.1.1) | -- | 0.005 | ( 50 ppm) |
| Residual Elements, each (3.1.1) | -- | 0.03 | |
| Residual Elements, total (3.1.1) | -- | 0.10 | |
| Titanium | remainder | | |

3.1.1 Determination not required for routine acceptance,

3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS-2249.

3.2 Condition: Vacuum annealed.

3.2.1 Wire shall be formed from bar descaled by a process which does not affect the composition of the alloy. Surface irregularities inherent with a forming process which does not tear the wire surface are acceptable provided the wire conforms to the tolerances of 3.5 and the irregularities are free from contaminants.

3.2.2 Wire shall be furnished on disposable spools for machine welding or in cut lengths for manual welding, as ordered.

3.2.3 Drawing compounds, oxides, dirt, and oil shall be removed by cleaning processes which will neither result in pitting nor cause gas absorption by the wire or deposition of substances harmful to welding operations.

3.2.4 Wire shall be vacuum degassed after cleaning as in 3.2.3.

3.3 Properties: Wire shall conform to the following requirements:

3.3.1 Weldability: Melted wire shall flow smoothly and evenly during welding and shall produce acceptable welds, determined by a procedure agreed upon by purchaser and vendor.

3.3.2 Spooled Wire: Shall conform to 3.3.2.1 and 3.3.2.2.

3.3.2.1 Cast: Wire, wound on standard 12-inch (305-mm) diameter spools, shall have imparted to it a curvature such that a specimen sufficient in length, 4 - 8 feet (1.2 - 2.4 m), to form one loop, when cut from the spool and laid on a flat surface, shall form a circle 15 - 30 inches (381 - 762 mm) in diameter.

3.3.2.2 Helix: The specimen on which cast was determined, when laid on a flat surface and measured between adjacent turns, shall show a vertical separation not greater than 1 inch (25 mm).

3.4 Quality:

3.4.1 Alloy shall be multiple melted; at least one of the melting cycles shall be under vacuum. The first melt shall be made by consumable electrode, nonconsumable electrode, electron beam, or plasma arc melting practice. The subsequent melt or melts shall be made using consumable electrode practice with no additions permitted in the final melt.

3.4.1.1 The atmosphere for nonconsumable electrode melting shall be vacuum or shall be inert gas at a pressure not higher than 250 mm of mercury.

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

3.4.2 Wire, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to welding operations, operation of welding equipment, or properties of the deposited weld metal,

3.5 Sizes and Tolerances: Wire shall be supplied in the sizes and to the tolerances shown in 3.5.1 and 3.5.2.

3.5.1 Diameter:

TABLE I

| Form | Nominal Diameter Inch | | | | Tolerance, Inch Plus | Tolerance, Inch Minus |
|---|---|---|---|---|---|---|
| Cut Lengths | 0.030, | 0.045, | 0.062, | 0.078 | 0.002 | 0.002 |
| Cut Lengths | 0,094, | 0.125, | 0.156, | 0.188 | 0.003 | 0.003 |
| Spools | 0.007, | 0.010, | 0.015, | 0.020 | 0.0005 | 0.0005 |
| Spools | 0.030, | 0.035, | 0.045 | | 0.001 | 0.002 |
| Spools | 0.062, | 0.078, | 0.094 | | 0.002 | 0.002 |

TABLE I (SI)

| Form | Nominal Diameter Millimetres | Tolerance, Millimetre Plus | Minus |
|---|---|---|---|
| Cut Lengths | 0.76, 1.14, 1.57, 1.98 | 0.05 | 0.05 |
| Cut Lengths | 2.39, 3.18, 3.96, 4.78 | 0.08 | 0.08 |
| Spools | 0.18, 0.25, 0.38, 0.51 | 0.013 | 0.013 |
| Spools | 0.76, 0.89, 1.14 | 0.03 | 0.05 |
| Spools | 1.57, 1.98, 2.39 | 0.05 | 0.05 |

3.5.2 Length: Cut lengths shall be furnished in 12, 18, 27, or 36 inch (305, 457, 686, or 914 mm) lengths, as ordered, and shall not vary more than +0, l/2 inch (-13 mm) from the length ordered.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of wire shall supply all samples Ø for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1) and sizes and tolerances (3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests for weldability (3.3.1), cast (3.3.2.1), and helix (3.3.2.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of wire to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required,

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing: Shall be as follows; a lot shall be all wire of the Ø same nominal size from the same heat processed at the same time: