Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 4951C
Superseding AMS 4951B
Issued 3-1-58
Revised 5-15-72

TITANIUM WIRE, WELDING

1. SCOPE:

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

1.2 Application: Primarily for inert gas arc welding.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2249 - Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2350 - Standards and Test Methods
AMS 2814 - Packaging of Welding Wire, Premium Quality
AMS 2815 - Identification, Welding Wire, Line Code System

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM E8 - Tension Testing of Metallic Materials
ASTM E120 - Chemical Analysis of Titanium and Titanium-Base Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E120, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods.

	min	max
Iron	--	0.20
Oxygen	--	0.18
Carbon	--	0.08
Nitrogen	--	0.05
Hydrogen	--	0.005 (50 ppm)
Other Elements, each (3.1.1)	--	0.10
Other Elements, total (3.1.1)	--	0.60
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: As drawn, having tensile strength, determined in accordance with ASTM E8, not higher than 130,000 psi (896 MPa), and descaled.

3.3 Properties:

3.3.1 Tensile Properties After Annealing: Wire shall be capable of showing tensile strength, determined in accordance with ASTM E8, of 50,000 - 80,000 psi (345 - 552 MPa) when annealed by heating to 1300 F ± 15 (704.4 C ± 8.3) in an inert atmosphere, holding at heat for approximately 30 min., and cooling in air and then descaled.

3.3.2 Weldability: Melted wire shall flow smoothly and evenly during welding and shall be capable of producing acceptable welds.

3.3.3 Spooled Wire: Shall conform to the following, unless otherwise agreed upon by purchaser and vendor:

3.3.3.1 Cast: Wire shall have imparted to it a curvature such that a specimen sufficient in length to form one loop, when cut from the spool and laid on a flat surface, shall form a circle not less than 15 in. (381 mm) and not greater than 30 in. (762 mm) in diameter.

3.3.3.2 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 in. (25 mm).

3.4 Quality: Unless otherwise specified, material shall be produced by multiple melting using consumable electrode practice; at least one of the melting cycles shall be under vacuum. Wire shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to welding operations, operation of welding equipment, or properties of the deposited weld metal.

3.5 Sizes and Tolerances: Unless otherwise specified, wire shall be supplied in sizes and to the tolerances shown in Table I:

3.5.1 Diameter:

TABLE I

Form	Nominal Diameter Inch	Tolerance, Inch plus and minus
Cut Lengths	0.030, 0.045, 0.062, 0.093, 0.125 in.	0.003
Spools	0.030, 0.035, 0.045, 0.062, 0.093 in.	0.002

TABLE I (SI)

Form	Nominal Diameter Millimeters	Tolerance, mm plus and minus
Cut Lengths	0.762, 1.143, 1.575, 2.362, 3.175	0.08
Spools	0.762, 0.889, 1.143, 1.575, 2.362	0.05

3.5.2 Length: Cut lengths shall be furnished in 12, 18, 27, or 36 in. (304, 457, 686, or 914 mm) lengths, as ordered, and shall not vary more than +0, -1/2 (+0, -13 mm) from the length ordered.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that material conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), condition (3.2), and tolerance (3.5) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to tensile properties after annealing (3.3.1), weldability (3.3.2), cast (3.3.3.1), and helix (3.3.3.2) requirements are classified as qualification or periodic control tests.

4.3 Sampling: Shall be in accordance with the following; when sampling is on a lot basis, a lot shall be all material of the same nominal size from the same heat processed at the same time.

4.3.1 Routine Control Tests:

4.3.1.1 Composition: One sample from each heat except that for hydrogen determinations one sample from each lot.

4.3.1.2 Other Requirements: As agreed upon by purchaser and vendor.

4.3.2 Periodic Control Tests: As agreed upon by purchaser and vendor.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment and the results of tests on each lot to determine conformance to the hydrogen and tensile strength requirements of this specification. This report shall include the purchase order number, heat number, material specification number and its revision letter, nominal size, and quantity from each heat.

4.4.2 When parts made of this wire or assemblies requiring use of this welding wire are supplied, the part or assembly manufacturer shall inspect each lot of material to determine conformance to this specification and shall furnish with each shipment three copies of a report stating that the material conforms to the requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, part or assembly number, and quantity.

4.5 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the testing of three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Layer Winding: Wire shall be closely wound in layers but adjacent turns within a layer need not necessarily be touching; shall be wound so as to avoid producing kinks, waves, and sharp bends; and shall be free to unwind without restriction caused by overlapping or wedging. The outside end of the spooled wire shall be so treated that it may be readily located.

5.2 Heat: Wire on each spool shall be one continuous length from the same heat of material. Cut lengths in any one package shall be from the same heat of material.