AEROSPACE MATERIAL SPECIFICATION

AMS6533™	REV. C

Issued	1991-04
Revised	2002-03
Noncurrent	2005-04
Reaf. Noncur.	2015-12
Reaffirmed	2020-09

Superseding AMS6533B

Steel, Welding Wire
2.0Cr - 10Ni - 14Co - 1.0Mo - (0.13 - 0.17C)
Vacuum Melted, Environment Controlled Packaging
(Composition similar to UNS K92571)

RATIONALE

AMS6533C has been reaffirmed to comply with the SAE five-year review policy.

NONCURRENT NOTICE

This specification has been declared “NONCURRENT” by the Aerospace Materials Division, SAE, as of April, 2005. It is recommended, therefore, that this specification not be specified for new designs.

“NONCURRENT” refers to those specifications which have previously been widely used and which may be required for production or processing of existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. “NONCURRENT” specifications are available from SAE upon request.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS6533C

1. SCOPE:

1.1 Form:

This specification covers a premium aircraft-quality alloy steel in the form of welding wire.

1.2 Application:

This wire has been used typically as filler metal for gas-metal-arc or gas-tungsten-arc welding of steels of similar composition requiring joints with high strength and fracture toughness, but usage is not limited to such applications.

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure
MAM 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2813	Packaging and Marking of Packages of Welding Wire, Standard Method
AMS 2814	Packaging and Marking of Packages of Welding Wire, Premium Quality
AMS 2816	Identification, Welding Wire, Tab Marking Method
AMS 2819	Identification, Welding Wire, Direct Color Code System
AMS 6522	Steel Plate, 2.0Cr - 10Ni - 14Co - 1.0Mo, (0.13 - 0.17C) Vacuum Melted, Normalized, and Overaged
ARP1876	Weldability Test for Weld Filler Metal Wire
ARP4926	Alloy Verification and Chemical Composition Inspection of Welding Wire

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E 399	Plane-Strain Fracture Toughness of Metallic Materials

3. TECHNICAL REQUIREMENTS:

3.1 Wire Composition:

Wire shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon (3.1.1.1)	0.13	0.17
Manganese	--	0.10
Silicon	--	0.10
Phosphorus	--	0.008
Sulfur	--	0.005
Phosphorus + Sulfur	--	0.010
Chromium	1.80	2.20
Nickel	9.50	10.50
Cobalt	13.50	14.50
Molybdenum	0.90	1.10
Titanium	--	0.015
Copper	--	0.10
Oxygen (3.1.1.1)	--	0.010 (100 ppm)
Nitrogen (3.1.1.1)	--	0.0015 (15 ppm)
Hydrogen (3.1.1.1)	--	0.0005 (5 ppm)

3.1.1 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 periodically on finished wire (Refer to 4.2.2).

3.1.2 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248. No variation over maximum is permitted for oxygen, nitrogen, and hydrogen (See 8.2).

3.2 Melting Practice:

Steel shall be multiple melted using vacuum induction melting practice followed by vacuum arc remelting.

3.3 Condition:

Cold worked, bright finish, in a temper and with a surface finish which will provide proper feeding of the wire in machine welding equipment.

3.4 Fabrication:

3.4.1 Wire shall be formed from rod or bar descaled by a process that does not affect the composition of the wire.

3.4.2 In-process annealing between cold rolling or drawing operations shall be performed in a protective atmosphere to avoid surface oxidation and adsorption of other extraneous elements.

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

3.4.4 Drawing compounds, oxides, dirt, oil, and other foreign materials 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.

3.4.5 Residual elements and dissolved gases deposited on, or absorbed by, the wire as a result of cleaning or cold working operations shall be removed by vacuum degassing.

3.5 Properties:

Wire shall conform to the following requirements:

3.5.1 Weldability: Melted wire shall flow smoothly and evenly during welding and shall produce acceptable welds. ARP1876 may be used to resolve weldability disputes.

3.5.2 Spooled Wire: Shall conform to 3.5.2.1 and 3.5.2.2.

3.5.2.1 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 to form one loop with a 1-inch (25-mm) overlap, when cut from the spool and laid on a flat surface, shall form a circle 15 to 50 inches (381 to 1270 mm) in diameter.

3.5.2.2 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).

3.5.3 Fracture Toughness: When specified, test specimens prepared in accordance with 4.3.1, shall be subjected to fracture toughness testing in accordance with ASTM E 399. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5.4 Tensile Properties: When specified, specimens taken in the weld metal from a coupon prepared as in 4.3.1 shall be subjected to tensile testing in accordance with ASTM E 8 or ASTM E 8M. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 Quality:

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.

3.6.1 Steel shall be premium aircraft quality conforming to AMS 2300 or MAM 2300.

3.7 Sizes and Tolerances:

Wire shall be supplied in the sizes and to the tolerances shown in 3.7.1 and 3.7.2.

3.7.1 Diameter: Shall be as shown in Table 2.

TABLE 2A - Sizes and Diameter Tolerances, Inch/Pound Units

Form	Nominal Diameter Inch	Tolerance Inch Plus and Minus
Cut Lengths	0.030, 0.035, 0.045	0.001
Cut Lengths	0.062, 0.094, 0.125	0.002
Spools	0.007, 0.010, 0.015, 0.020	0.0005
Spools	0.030, 0.035, 0.045	0.001
Spools	0.062, 0.094	0.002

TABLE 2B - Sizes and Diameter Tolerances, SI Units

Form	Nominal Diameter Millimeters	Tolerance Millimeter Plus and Minus
Cut Lengths	0.76, 0.89, 1.14	0.025
Cut Lengths	1.57, 2.39, 3.18	0.05
Spools	0.18, 0.25, 0.38, 0.51	0.013
Spools	0.76, 0.89, 1.14,	0.025
Spools	1.57, 2.39	0.05

3.7.2 Length: Cut lengths shall be furnished in 18, 27, or 36 inch (457, 686, or 914 mm) lengths, as ordered, and shall not vary more than +0, -0.5 inch (-13 mm) from the length ordered.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of wire shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1.1), fracture toughness (3.5.3) when specified, tensile properties (3.5.4) when specified, sizes and tolerances (3.7), and alloy verification (5.2) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Determination of carbon, oxygen, nitrogen, and hydrogen on finished wire (3.1.1.1), weldability (3.5.1), cast (3.5.2.1), and helix (3.5.2.2), are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2371 and the following:

4.3.1 Specimens for fracture toughness testing and tensile tests, when specified, shall be prepared from a double-vee-groove, butt joint weld made between two pieces of AMS 6522 steel plate, 1.50 inches (38.1 mm) minimum thickness, which have been chamfered full depth to a 60-degree included angle; the weld shall be perpendicular to the longitudinal grain direction of the test pieces. Specimens, after welding, shall be normalized, hardened, sub-zero cooled, and aged in accordance with AMS 6522.

4.4 Reports:

The vendor of wire shall furnish with each shipment a report showing the results of tests for chemical composition and, when specified, for fracture toughness and/or tensile properties of each heat, and stating that the wire conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 6533B, nominal size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2371.