AEROSPACE MATERIAL SPECIFICATION

AMS5568™	REV. J

Issued 1954-05
Reaffirmed 2006-04
Revised 2023-02

Superseding AMS5568H

(R) Steel, Corrosion- and Heat-Resistant, Welded Tubing
17Cr - 7.1Ni - 1.1Al
Solution Heat Treated, Precipitation-Hardenable
(Composition similar to UNS S17700)

RATIONALE

AMS5568J is the result of a Five-Year Review and update of the specification. The revision provides new definitions (2.3), includes composition and reporting updates (3.1, 3.1.1), revises requirements for condition and fabrication, including passivation requirements (3.2, 3.3), adds pyrometry control (3.4), adds strain rate control (3.5.1), updates response to heat treatment to AMS2750 (3.5.3), clarifies requirements (3.7, 5.2), adds yield strength exceptions (Tables 2 and 3), updates cleanliness and NDT requirements consistent with other tubing specs (3.6, 4.2.1, 4.2.1.1, 4.4), revises UT method (3.6.4), updates exceptions requirements (3.8, 8.5), and allows prior revisions (8.4).

1. SCOPE

1.1 Form

This specification covers a corrosion- and heat-resistant steel in the form of welded tubing.

1.2 Application

This tubing has been used typically for parts requiring corrosion resistance and high strength up to 600 °F (316 °C) after precipitation heat treatment, but usage is not limited to such applications.

1.2.1 Certain design and processing procedures may cause this tubing to become susceptible to stress-corrosion cracking after precipitation heat treatment; ARP1110 recommends practices to minimize such conditions.

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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
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SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS5568J/

2.1 SAE Publications

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

AMS2243 Tolerances, Corrosion- and Heat-Resistant Steel Tubing

AMS2248 Chemical Check Analysis Limits, Corrosion- and Heat-Resistant Steels and Alloys, Maraging and Other Highly Alloyed Steels, and Iron Alloys

AMS2371 Quality Assurance Sampling and Testing, Corrosion- and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock

AMS2634 Inspection, Ultrasonic, of Thin Wall Tubing

AMS2750 Pyrometry

AMS2807 Identification, Carbon and Low-Alloy Steels, Corrosion- and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing

ARP1110 Minimizing Stress Corrosion Cracking in Wrought Forms of Steels and Corrosion-Resistant Steels and Alloys

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 A370 Mechanical Testing of Steel Products

ASTM A751 Chemical Analysis of Steel Products

ASTM A1016/1016M General Requirements for, Ferritic Alloy, Austenitic Alloy, Steel and Stainless Steel Tubes

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E426 Electromagnetic (Eddy Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys

ASTM E1417/E1417M Liquid Penetrant Testing

2.3 Definitions

Terms used in AMS are defined in AS7766 and the following:

BORE CONDITIONING: Any mechanical method that is used in the bore of tubing to improve the final surface appearance, with no resultant change in tubing size beyond the allowable tolerances.

SOLUTION HEAT TREATMENT: Heating of an alloy to a suitable temperature, holding it at that temperature long enough to cause one or more constituents to enter into a solid solution and then cooling it rapidly enough to keep these constituents in solution. AMS2761 provides guidance but refers to this process as annealing with a quenching treatment.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.09
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	16.00	18.00
Nickel	6.50	7.75
Aluminum	0.75	1.50

3.1.1 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection, unless limits of acceptability are specified by the purchaser.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248.

3.2 Condition

3.2.1 Solution Heat Treated

Solution heat treatment shall be performed in an atmosphere yielding a bright finish. Alternately, product shall be passivated in accordance with AMS2700 to produce a uniform finish. It is permissible to pickle prior to passivation. Passivation shall be performed after final finishing (see 3.3.2). Tubing shall have been cold worked sufficiently to ensure proper weld reinforcement height and roundness in the weld reinforcement area.

3.3 Fabrication

Tubing shall be produced by a welded and drawn process. Any finishing operation applied to remove objectionable pits and surface blemishes shall be performed prior to final solution heat treatment. A light polish to improve external surface appearance may be employed after solution heat treatment and, and if performed, the product shall be subsequently passivated.

3.3.1 Bore conditioning is permitted after final heat treatment provided the tubing is not sized by metal removal methods beyond the allowable tolerances. If bore conditioning is used, 100% visual inspection of each tube shall be performed. The tube ID shall be uniformly shiny with no evidence of remnant material, neither metallic nor nonmetallic in nature.

3.3.2 Tubing shall be passivated in accordance with AMS2700 after any ID or OD finishing that occurs after solution heat treatment.

3.4 Solution Heat Treatment

Tubing shall be solution heat treated by heating to 1950 °F ± 25 °F (1066 °C ± 14 °C), holding at heat for a time commensurate with wall thickness and heating equipment and procedure used, and cooling in air or quenching in water. Pyrometry shall be in accordance with AMS2750.

3.5 Properties

Tubing shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.5.1 Unless otherwise specified, the strain rate for all tensile testing shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.5.2 As Solution Heat Treated

3.5.2.1 Tensile Properties

Shall be as shown in Table 2.

Table 2 - Tensile properties

Property	Value
Tensile Strength, Maximum	150 ksi (1034 MPa)
Yield Strength at 0.2% Offset, Maximum[1]	55 ksi (379 MPa)
Elongation in 2 Inches (50 mm), Minimum	20%

[1] Yield strength is not required to be determined for OD sizes less than 0.125 inch (3.2 mm) or for wall thicknesses less than 0.015 inch (0.38 mm).

3.5.2.2 Hardness

Shall be not higher than 92 HRB, or equivalent (see 8.2).

3.5.2.3 Flarability

Specimens as in 4.3.1 shall withstand, without formation of cracks or other visible defects, flaring at room temperature by being forced axially with steady pressure over a hardened and polished tapered steel pin having a 74 degree included angle to produce a flare having a permanent expanded OD as agreed upon by purchaser and producer (see 8.6).

3.5.3 Response to Heat Treatment - After Austenite Conditioning and Precipitation Heat Treating

Samples of tubing shall have the properties shown in 3.5.3.1 and 3.5.3.2 after being austenite conditioned by heating to 1400 °F ± 25 °F (760 °C ± 14 °C), holding at heat for 90 minutes ± 5 minutes, cooling to 60 °F (16 °C) or colder within 1 hour, holding at that temperature for not less than 30 minutes, and precipitation heat treated by heating to 1050 °F ± 10 °F (566 °C ± 6 °C), holding at heat for 90 minutes ± 5 minutes, and cooling to room temperature. Pyrometry shall be in accordance with AMS2750.

3.5.3.1 Tensile Properties

Shall be as shown in Table 3.

Table 3 - Minimum tensile properties

Property	Value
Tensile Strength	180 ksi (1241 MPa)
Yield Strength at 0.2% Offset[1]	150 ksi (1034 MPa)
Elongation in 2 Inches (50 mm)	6%

[1] Yield strength is not required to be determined for OD sizes less than 0.125 inch (3.2 mm) or for wall thicknesses less than 0.015 inch (0.38 mm).

3.5.3.2 Hardness

Shall be not lower than 38 HRC, or equivalent (see 8.2).

3.6 Quality

Tubing, as received by purchaser, shall be uniform in quality and condition and shall have a finish conforming to the best practice for high quality aircraft tubing. It shall be smooth and free from grease, oil and other foreign matter, heavy scale or oxide, burrs, seams, tears, cracks, grooves, laminations, slivers, pits, and other imperfections detrimental to usage of the tubing. Surface imperfections, such as handling marks, straightening marks, light mandrel and die marks, and scale pattern, will not be considered injurious if the imperfections are removable within the tolerances specified for wall thickness, but removal of such imperfections is not required.

3.6.1 If weld reinforcement is present at the welds on the inner surface of the tubing, such weld reinforcement shall be no thicker than 0.010 inch (0.25 mm). The outer surface of the tubing shall be free from weld reinforcement.

3.6.2 A clean white cloth or plug drawn or blown through the length of the bore of a test sample at least 12 inches (30 cm) in length, shall show no visual evidence of metallic flakes or particles. Discoloration of the cloth or plug, without the presence of flakes or particles, is acceptable. Alternate methods for evaluating tube cleanliness may be used for tubing 0.500 inch (12.7 mm) and under ID.

3.6.3 When no inspection is specified by the purchaser, tubing shall be subjected to either ultrasonic or eddy current inspection in accordance with ASTM A1016/A1016M except that suspect indications shall not be accepted based on visual observation, i.e., indications must be either rejected or reconditioned and retested to pass the test. Alternate methods of inspection may be used when approved by the cognizant engineering organization for tube 0.25 inch (0.64 cm) and under in nominal diameter.

3.6.4 When specified by purchaser, tubing shall be subjected to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M, to ultrasonic inspection in accordance with AMS2634, to electromagnetic (eddy-current) testing in accordance with ASTM E426, or to any combination thereof. Standards for such inspections shall be as agreed upon between purchaser and producer (see 8.6).

3.7 Tolerances

Shall conform to all applicable requirements of AMS2243 for hydraulic tubing.

3.8 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of tubing shall supply all samples for producer'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 tubing conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile properties (3.5.2.1 and 3.5.3.1), quality and cleanliness (3.6), and tolerances (3.7) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Nondestructive testing (3.6.3 or 3.6.4 when specified) shall be performed on each finished tube. Inspection per 3.6.3 shall become effective one year after the publication of this document.