



AEROSPACE MATERIAL SPECIFICATION

AMS5571™**REV. K**

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Superseding AMS5571J

(R) Steel, Corrosion- and Heat-Resistant, Seamless Tubing
18Cr - 10.5Ni - 0.70Cb (Nb) (347)
Solution Heat Treated
(Composition similar to UNS S34700)

RATIONALE

AMS5571K is the result of a Five-Year Review and update of the specification. The revision includes updates in composition testing and reporting (3.1, 3.1.1), adds passivation requirements and clarifies other finishing operations (3.2, 3.3), adds tensile test requirements (Table 2, 3.4.1.1), updates intergranular testing requirements to align with other similar standards (3.4.3, 4.2), adds inspection requirements consistent with other similar standards (3.5.1, 3.5.2, 4.2.1, and 4.4), clarifies applicable requirements (3.6, 5.2), requires reporting of country of origin (4.4), prohibits unauthorized exceptions (3.7, 4.4.1, 6.2.1, and 8.4), and allows the use of prior revisions (8.3).

1. SCOPE

1.1 Form

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

1.2 Application

This tubing has been used typically for parts requiring both corrosion and heat resistance, especially when such parts are welded during fabrication, but usage is not limited to such applications. Also for parts requiring oxidation resistance up to 1500 °F (816 °C), but useful at that temperature only when stresses are low.

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.

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

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For more information on this standard, visit
<https://www.sae.org/standards/content/AMS5571K/>

AMS2371	Quality Assurance Sampling and Testing, Corrosion- and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS2634	Ultrasonic Inspection, Thin Wall Metal Tubing
AMS2645	Fluorescent Penetrant Inspection
AMS2700	Passivation of Corrosion Resistant Steels
AMS2761	Heat Treatment of Steel Raw Materials
AMS2807	Identification, Carbon and Low-Alloy Steels, Corrosion- and Heat-Resistant Steels and Alloys Sheet, Strip, Plate, and Aircraft Tubing
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 A262	Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A370	Mechanical Testing of Steel Products
ASTM A632	Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A751	Chemical Analysis of Steel Products
ASTM A1016/A1016M	General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
ASTM E426	Electromagnetic (Eddy-Current) Testing 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:

2.3.1 "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.

2.3.2 "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 the purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.08
Manganese	--	2.00
Silicon	0.30	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	17.00	19.00
Nickel	9.00	12.00
Columbium (Niobium)	10xC	1.10
Molybdenum	--	0.75
Tantalum	--	0.05
Copper	--	0.75

3.1.1 The 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

Solution heat treated (see 2.3). 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 may take place after any final finishing (see 3.3.3).

3.3 Fabrication

3.3.1 Tubing shall be produced by a seamless process. Finishing operations for removal of 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 if performed, the product shall be subsequently passivated.

3.3.2 Bore conditioning (see 2.3) is permitted after final anneal 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.

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

3.4 Properties

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

3.4.1 Tensile Properties

Shall be as shown in Table 2.

Table 2A - Tensile properties, inch/pound units

Nominal OD Inches	Wall Thickness Inches	Tensile Strength ksi, Max	Tensile Strength, ksi, Min ¹	Yield Strength at 0.2% Offset, Min ²	Elongation in 2 Inches , Min Strip	Elongation in 2 Inches , Min Full Tube
Up to 0.188, incl	Up to 0.016, incl	120	75	30	--	33
	Over 0.016	105	75	30	--	35
Over 0.188 to 0.500, incl	Up to 0.010, incl	115	75	30	30	35
	Over 0.010	105	75	30	30	35
Over 0.500	Up to 0.010, incl	120	75	30	25	30
	Over 0.010	105	75	30	30	35

¹ Minimum tensile properties for tubing have been taken directly from ASTM A511 and are not based on AMS Statistical methods.

² Yield strength is not required to be determined for OD sizes less than 0.125 inch or for wall thicknesses less than 0.015 inch.

Table 2B - Tensile properties, SI units

Nominal OD Millimeters	Wall Thickness Millimeters	Tensile Strength MPa, Max	Tensile Strength, Mpa, Min ¹	Yield Strength, at 0.2% Offset, Min ¹	Elongation in 50 mm , Min Strip	Elongation in 50 mm , Min Full Tube
Up to 4.78, incl	Up to 0.41, incl	827	515	210	--	33
	Over 0.41	724	515	210	--	35
Over 4.78 to 12.70, incl	Up to 0.25, incl	793	515	210	30	35
	Over 0.25	724	515	210	30	35
Over 12.70	Up to 0.25, incl	827	515	210	25	30
	Over 0.25	724	515	210	30	35

¹ Minimum tensile properties for tubing have been taken directly from ASTM A511 and are not based on AMS Statistical methods.

² Yield strength is not required to be determined for OD sizes less than 3.2 mm or for wall thicknesses less than 0.38mm.

3.4.1.1 Unless otherwise specified, the strain rate 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/min 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.

3.4.2 Flarability

Specimens as in 4.3.1 shall withstand flaring at room temperature, without formation of cracks or other visible defects, 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 not less than specified in Table 3.

Table 3A - Flarability, inch/pound units

Nominal OD Inches	Expanded OD Inches	Nominal OD Inches	Expanded OD Inches
0.125	0.200	0.750	0.937
0.188	0.302	1.000	1.187
0.250	0.359	1.250	1.500
0.312	0.421	1.500	1.721
0.375	0.484	1.750	2.106
0.500	0.656	2.000	2.356
0.625	0.781		

Table 3B - Flarability, SI units

Nominal OD Millimeters	Expanded OD Millimeters	Nominal OD Millimeters	Expanded OD Millimeters
3.18	5.08	19.05	23.80
4.78	7.67	25.40	30.15
6.35	9.12	31.75	38.10
7.92	10.69	38.10	43.71
9.52	12.29	44.45	53.49
12.70	16.66	50.80	59.84
15.88	19.84		

3.4.2.1 Tubing with nominal OD between any two standard sizes given in 3.4.2 shall take the same percentage flare as shown for the larger of the two sizes.

3.4.2.2 Flarability requirements for tubing over 2.000 inches (50.80 mm) or under 0.125 inch (3.18 mm) in nominal OD shall be as agreed upon by the purchaser and producer.

3.4.3 Susceptibility to Intergranular Attack

Specimens from tubing, after sensitizing treatment, shall pass the intergranular corrosion test performed in accordance with ASTM A262, Practice E. After immersion, tubing shall not exhibit intergranular attack or cracks when tested in accordance with the following:

3.4.3.1 Examination of OD Surface

Shall be performed after flattening a 1-inch (25-mm) long specimen to a total thickness under load of three times the wall thickness.

3.4.3.2 Examination of ID Surface

Shall be performed after splitting a 1-inch (25-mm) long specimen and folding the split specimen, with ID surfaces on the outside of fold, around a mandrel having a diameter equal the nominal wall thickness of the tube.

3.4.3.2.1 Tubing Over 0.625 Inch (15.88 mm) in OD

The axis of the fold shall be parallel to the axis of the tube.

3.4.3.2.2 Tubing 0.625 Inch (15.88 mm) and Under in OD

The axis of the fold shall be either parallel or transverse to the axis of the tube.

3.5 Quality

Tubing, as received by the 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 heavy scale or oxide, burrs, seams, tears, 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; removal of such imperfections is not required.

3.5.1 Tubing shall be free from grease or other foreign matter. Metallic flakes or particles shall not be collected by a clean white cloth or plug drawn or blown through the bore of a 12-inches (30-cm) length of sample tube. Discoloration of the cloth, without the presence of flakes or particles, is acceptable. Alternate methods, as agreed with the purchaser, for evaluating tube cleanliness may be used for tubing 0.500 inch (12.7mm) and under ID.

3.5.2 When no inspection is specified by the purchaser, tubing shall be subjected to either ultrasonic or eddy current inspection in accordance with ASTM A1016, 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 performed when approved by the cognizant engineering organization for tube 0.25 inch (0.64 cm) and under in nominal diameter.

3.5.3 When specified by the 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 acceptance shall be as agreed upon by the purchaser and producer.

3.6 Tolerances

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

3.7 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 the producer's tests and shall be responsible for the performance of all required tests. The 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 (3.4.1), cleanliness of tubing (3.5.1), nondestructive inspection when specified (3.5.3), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Nondestructive inspection (3.5.2) shall be performed on each finished length of tube or as specified (3.5.3). Inspection per 3.5.2 shall become effective 1 year after publication of this document.

4.2.2 Periodic Tests

Flarability (3.4.2) and susceptibility to intergranular attack (3.4.3) is a periodic test and shall be performed at a frequency selected by the producer unless frequency of testing is specified by the purchaser.

4.3 Sampling and Testing

Shall be in accordance with AMS2371 and the following:

4.3.1 Specimens for flarability test (3.4.2) shall be full tubes or sections cut from a tube. The end of the specimen to be flared shall be cut square, with the cut end smooth and free from burrs, but not rounded.

4.4 Reports

The producer of tubing shall furnish with each shipment a report showing the producer's name and the country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), and the results of tests for composition of each heat and for tensile properties, susceptibility to intergranular attack, cleanliness, nondestructive inspection, and tolerances of each lot and stating that the tubing conforms to the other technical requirements, including NDT method and acceptance standard used. This report shall include the purchase order number, heat and lot numbers, AMS5571K, size, and quantity.