AEROSPACE MATERIAL SPECIFICATION

AMS5570™	REV. R
Issued 1939-12 Revised 2022-06 Superseding AMS5570Q	

Steel, Corrosion- and Heat-Resistant, Seamless Tubing
18Cr - 11Ni - 0.40Ti (321)
Solution Heat Treated
(Composition similar to UNS S32100)

RATIONALE

AMS5570R is the result of a Five-Year Review and update of the specification. The revision prohibits unauthorized exceptions (3.7, 4.4.1, 5.2.1, 8.4), updates composition testing and reporting (3.1, 3.1.1), updates condition and fabrication requirements (3.2, 3.3) updates tensile testing (3.4.1.1), provides notes and size limits for Table 2, updates inspection (3.5), adds NDT acceptance testing (4.2.1, 4.4), clarifies tolerances and identification (3.6, 5.2), and allows 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, and also for parts requiring oxidation resistance up to 1500 °F (816 °C), but useful at that temperature only when stresses are low, but usage is not limited to such applications.

2. REFERENCES

2.1 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 producer 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.

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS5570R/

2.1.1 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

AMS2700 Passivation of Corrosion-Resistant Steels

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

2.1.2 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

2.2 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 by wet chemical methods in accordance with ASTM A751 or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.08
Manganese	--	2.00
Silicon	0.25	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	17.00	19.00
Nickel	9.00	13.00
Titanium	5x(C+N)	0.70
Molybdenum	--	0.75
Copper	--	0.75
Nitrogen	--	0.10

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

Solution heat treated (see 2.2). 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 2.2) 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 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	Nominal Wall Thickness Inches	Tensile Strength ksi[1]	Yield Strength at 0.2% Offset[2] ksi, Min	Elongation in 2 Inches %, Min Strip	Elongation in 2 Inches %, Min Full Tube
Up to 0.188, incl	Up to 0.016, incl	75-120	30	--	33
	Over 0.016	75-105	30	--	35
Over 0.188 to 0.500, incl	Up to 0.010, incl	75-115	30	30	35
	Over 0.010	75-105	30	30	35
Over 0.500	Up to 0.010, incl	75-120	30	25	30
	Over 0.010	75-105	30	30	35

[1] Minimum tensile properties have been taken from ASTM A632. The above properties are not based on AMS statistical guidelines.
[2] 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).

Table 2B - Tensile properties, SI units

Nominal OD Millimeters	Nominal Wall Thickness Millimeters	Tensile Strength MPa[1]	Yield Strength at 0.2% Offset[2] MPa, Min	Elongation in 50 mm %, Min Strip	Elongation in 50 mm %, Min Full Tube
Up to 4.78, incl	Up to 0.41, incl	517-827	207	--	33
	Over 0.41	517-724	207	--	35
Over 4.78 to 12.70, incl	Up to 0.25, incl	517-793	207	30	35
	Over 0.25	517-724	207	30	35
Over 12.70	Up to 0.25, incl	517-827	207	25	30
	Over 0.25	517-724	207	30	35

[1] Minimum tensile properties have been taken from ASTM A632. The above properties are not based on AMS statistical guidelines.
[2] 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).

3.4.1.1 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. The strain rate after yield may be increased to any value up to 0.5 in/in/min (or mm/mm/min) or equivalent crosshead speed as a function of gage length. This 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 - Minimum 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 - Minimum 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 Table 3 shall take the same percentage flare as that for the larger of the two sizes.

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 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, but 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 on a clean white cloth or plug drawn or blown through the bore of a 12 inch (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 (12.7 mm) and under ID.

3.5.2 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 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 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 (3.4.1), cleanliness of tubing (3.5.1) and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Nondestructive testing (3.5.2) shall be performed on each finished length of tube. Inspection per 3.5.2 shall become effective one year after the publication of this document.

4.2.2 Periodic Tests

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