AEROSPACE MATERIAL SPECIFICATION

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

AMS 5567A
Superseding AMS 5567

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STEEL TUBING, SEAMLESS AND WELDED, CORROSION RESISTANT
19Cr - 10Ni (SAE 30304)
Hydraulic, Solution Treated

1. SCOPE:

1.1 Form: This specification covers two types of a corrosion resistant steel in the form of tubing.

1.2 Application: Primarily for parts and assemblies, such as fluid lines subject to medium high pressures, requiring corrosion resistance. Welding, brazing, or other exposure to temperatures over 800 F (427 C) during fabrication may impair corrosion resistance.

1.3 Classification: The tubing covered by this specification is classified as follows:

Type 1 - Seamless
Type 2 - Welded and drawn

1.3.1 Unless a specific type is specified, either Type 1 or Type 2 may be supplied.

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 2243 - Tolerances, Corrosion and Heat Resistant Steel Tubing
AMS 2248 - Chemical Check Analysis Limits, Wrought Heat and Corrosion Resistant Steels and Alloys
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings

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

ASTM A262 - Detecting Susceptibility to Intergranular Attack in Stainless Steels
ASTM A370 - Mechanical Testing of Steel Products
ASTM A393 - Conducting Acidified Copper Sulfate Test for Intergranular Attack in Austenitic Stainless Steel
ASTM E112 - Estimating Average Grain Size of Metals
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron 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 E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods.

	min	max
Carbon	--	0.08
Manganese	--	2.00
Silicon	--	0.75
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	18.00	20.00
Nickel	8.00	12.00
Molybdenum	--	0.75
Copper	--	0.75

3.1.1 Check Analysis: Composition variations shall conform to the requirements of AMS 2248.

3.2 Condition: Solution heat treated and descaled.

3.3 Fabrication: Tubing shall be produced by a seamless or a welded and drawn process. The external and internal surface finishes may be produced by pickling, bright annealing, or any method which will provide the required surface condition and which will not affect limits of wall thickness or corrosion resistance, with the exception that centerless ground finish is not acceptable. A light polish to improve surface appearance may be employed. Passivation treatment shall follow any surface treatment used.

3.3.1 Welded (Type 2) tubing shall be processed to remove completely the bead and any dimensional indication of the presence of welds.

3.4 Properties:

3.4.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM A370, except that yield strength requirements do not apply to tubing 0.188 in. (4.775 mm) and under in OD with wall thickness 0.010 in. (0.254 mm) and under.

TABLE I

Nominal OD Inches	Nominal Wall Thickness Inch	Tensile Strength psi, max	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. %, min	
				Strip	Full Tube
Up to 0.188, incl	Up to 0.016, incl	115,000	30,000	--	35
	Over 0.016	100,000	30,000	--	40
Over 0.188 to 0.500, incl	Up to 0.010, incl	110,000		--	37
	Over 0.010	100,000	30,000	--	40
Over 0.500	Over 0.010	100,000	30,000	35	40

TABLE I (SI)

Nominal OD Millimeters	Nominal Wall Thickness Millimeters	Tensile Strength MN/m^2, max	Yield Strength at 0.2% Offset MN/m^2, min	Elongation in 50.8 mm %, min	
				Strip	Full Tube
Up to 4.775, incl	Up to 0.406, incl	793	207	--	35
	Over 0.406	690	207	--	40
Over 4.775 to 12.700, incl	Up to 0.254, incl	758		--	37
	Over 0.254	690	207	--	40
Over 12.700	Over 0.254	690	207	35	40

3.4.2 Flarability: Tubing shall be capable of being flared without formation of cracks or other visible defects. The specimen shall, at room temperature, be forced axially with steady pressure over a hardened and polished tapered steel pin having a 74 deg (1.29 rad.) included angle, to produce a flare having the permanent expanded OD specified in Table II.

TABLE II

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	2.500	2.856
		3.000	3.356

TABLE II (SI)

Nominal OD Millimeters	Expanded OD Millimeters	Nominal OD Millimeters	Expanded OD Millimeters
3.175	5.080	19.050	23.800
4.775	7.376	25.400	30.150
6.350	9.119	31.750	38.100
7.925	10.693	38.100	43.713
9.545	12.294	44.450	53.492
12.700	16.662	50.800	59.842
15.875	19.837	63.500	72.542
		76.200	85.242

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 Tubing with nominal OD greater than 3.000 in. (76.2 mm) or less than 0.125 in. (3.175 mm) shall have flarability as agreed upon by purchaser and vendor.

3.4.3 Pressure Test: The tubing shall show no bulges, leaks, pinholes, cracks, or other defects when subjected to an internal hydrostatic pressure (P), except that a diametric permanent set of 0.002 in. per in. (0.002 mm/mm) of diameter is acceptable. The hydrostatic pressure (P) shall be determined from the formula:

$$P = S \frac{D^2 - d^2}{D^2 + d^2}$$

where S = Yield strength from Table I
D = Nominal OD
d = Nominal ID

3.4.4 Embrittlement: Tubing, as received, shall be capable of being exposed to acidified copper sulfate in accordance with ASTM A393 without evidence of intercrystalline surface attack. After exposure, full cross-sectional specimens of tubing 0.625 in. (15.875 mm) or less in diameter shall be flattened to a total thickness under load of three times the wall thickness of the tubing, and 1 in. (25.4 mm) long specimens of tubing over 0.625 in. (15.875 mm) in nominal diameter shall be split and bend 180 deg (3.14 rad), with outside surface of tube on inside of bend, around a diameter equal to four times the wall thickness without showing cracks or other defects. In either flattening or bending, the fold shall be made parallel to the axis of the tube and shall coincide with the weld in welded (Type 2) tubing if the weld is visible.

3.4.4.1 Care should be exercised in differentiating between cracks caused by intergranular corrosion and cracks resulting from superficial yielding or rupturing of the surface of the specimens. Cases where there is doubt as to whether superficial cracking is caused by intergranular corrosion should be resolved by metallographic examination.

3.4.5 Corrosion Rate: The general corrosion rate of the tubing shall be less than 0.0015 in. (0.0381 mm) penetration per month as determined from a boiling nitric acid test conducted in accordance with ASTM A262, Practice C. This test is normally not required. It shall be performed on tubing showing questionable results when embrittlement tested as in 3.4.4.

3.4.6 Grain Size: Shall be 5 or finer determined by comparison of a specimen polished and then electrolytically etched in 10% oxalic acid solution with the chart in ASTM E112, using 100 diameters magnification.

3.5 Quality:

3.5.1 Tubing shall be uniform in quality and condition and shall have a workmanlike finish conforming to the best practice for high quality tubing. It shall be smooth, clean, and free from heavy scale or oxide, burrs, seams, tears, grooves, laminations, slivers, pits, and other injurious conditions. Surface imperfections such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale pattern will not be considered injurious if the imperfections are removable within the tolerances specified for wall thickness. The removal of surface imperfections is not required.

3.5.2 Cleanliness of Tubing: Tubing shall be free from grease or other foreign matter. No metallic flakes or particles shall be collected by a clean white cloth when it is drawn through the length of the bore of a test sample. The presence of metallic flakes or particles on the cloth will be cause for rejection. Discoloration of the cloth, without the presence of flakes or grit, will not be cause for rejection.

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, tubing will be acceptable in mill lengths of 6 - 20 ft (1.8 - 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 ft (3 m).

3.7 Tolerances: Unless otherwise specified, tolerances shall conform to all appplicable requirements of AMS 2243.