



AEROSPACE MATERIAL SPECIFICATION

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

AMS 5562

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STEEL TUBING, SEAMLESS, CORROSION AND HEAT RESISTANT 9.0Mn - 20Cr - 6.5Ni - 0.28N

1. SCOPE:

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

1.2 Application: Primarily for fluid-conducting lines requiring both corrosion and heat resistance, especially when such parts and assemblies are welded or brazed during fabrication, and having higher strength than that of the 18-8 types. Parts and assemblies requiring oxidation resistance up to approximately 1100° F (593°C).

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 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:

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	min	max
Carbon	--	0.04
Manganese	8.00 - 10.00	
Silicon	--	1.00
Phosphorus	--	0.060
Sulfur	--	0.030
Chromium	19.00 - 21.50	
Nickel	5.50 - 7.50	
Nitrogen	0.15 - 0.40	
Molybdenum	--	0.75
Copper	--	0.50

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

3.2 Condition: Solution heat treated and descaled.

3.3 Fabrication: Tubing shall be produced by a seamless 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.

3.4 Properties:

3.4.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM A370:

Tensile Strength, min	100,000 psi (690 MPa)
Yield Strength at 0.2% Offset, min	60,000 psi (414 MPa)
Elongation in 2 in. (50.8 mm), min	
Strip Specimens	40%
Full Tube Specimens	45%

3.4.2 Flareability: 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 I.

TABLE I

Nominal OD Inches	Expanded OD Inches, min	Nominal OD Inches	Expanded OD Inches, min
0.125	0.200	0.750	0.937
0.188	0.290	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 I (SI)

Nominal OD Millimetres	Expanded OD Millimetres	Nominal OD Millimetres	Expanded OD Millimetres
3.18	5.08	19.05	23.80
4.78	7.37	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 Tubing with nominal OD greater than 2.000 in. (50.80 mm) or less than 0.125 in. (3.18 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, P = Test Pressure in psi (MPa)

S = Yield Strength from 3.4.1

D = Nominal OD

d = Nominal ID

- 3.4.4 Embrittlement: Tubing, after being sensitized by heating to 1250° F ± 25 (676.7° C ± 14) in air, holding at heat for 60 min. ± 5, and cooling in air, shall be capable of being exposed to copper-copper sulfate-sulphuric acid solution in accordance with ASTM A262, Practice E, without evidence of intercrystalline surface attack. After exposure, full cross-sectional specimens of tubing 0.625 in. (15.88 mm) or less in OD shall be flattened to a total thickness under load of three times the wall thickness of the tubing and 1 in. (25 mm) long specimens of tubing over 0.625 in. (15.88 mm) in nominal OD shall be split and bent 180 deg (3.14 rad) with outside surface of tube on inside of bend, around a diameter equal to the nominal 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.

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 applicable requirements of AMS 2243.
4. QUALITY ASSURANCE PROVISIONS:
- 4.1 Responsibility for Inspection: The vendor of tubing shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that the tubing conforms to the requirements of this specification.
- 4.2 Classification of Tests:
- 4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), tensile property (3.4.1), pressure test (3.4.3), and tolerance (3.7) requirements are classified as acceptance or routine control tests.
- 4.2.2 Qualification Tests: Tests to determine conformance to flarability (3.4.2) and embrittlement (3.4.4) requirements are classified as qualification or periodic control tests.
- 4.3 Sampling: Shall be in accordance with AMS 2371 and the following:
- 4.3.1 Specimens for flarability test may be cut from any portion of a tube or an entire tube may be used as a specimen. 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:
- 4.4.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment, for tensile properties of each size from each heat, and the results of tests to determine conformance to the pressure test and tolerance requirements of this specification. This report shall include the purchase order number, heat number, material specification number, size, and quantity from each heat.
- 4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.
- 4.5 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the tubing may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the tubing represented and no additional testing shall be permitted. Results of all tests shall be reported.