Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 5558C
Superseding AMS 5558B
Issued 1-15-58
Revised 1-15-79

UNS S34700

STEEL TUBING, WELDED, CORROSION AND HEAT RESISTANT
18Cr - 10.5Ni - 0.70 (Cb + Ta) (SAE 30347)
Thin Wall

1. SCOPE:

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

1.2 Application: Primarily for high-pressure air ducting requiring both corrosion and heat resistance, especially when such ducting is welded during fabrication, wherein the wall thickness is approximately 2% of the OD or less.

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., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

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
AMS 2635 - Radiographic Inspection

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 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, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

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 analytical methods approved by purchaser:

	min	max
Carbon	--	0.08
Manganese	--	2.00
Silicon	0.50	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	17.00	19.00
Nickel	9.00	12.00
Columbium + Tantalum	10 x C	1.10
Molybdenum	--	0.75
Copper	--	0.50

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

3.2 Condition: Descaled and passivated. Tubing shall have been rolled only enough to ensure weld bead height and roundness in the weld bead area.

3.3 Fabrication: Tubing shall be machine fusion welded by gas-metal-arc process, shall contain no more than one longitudinal weld, and shall contain no circumferential welds. Tube ends shall be cut square and deburred. Tubing, except for the weld bead, shall have a surface appearance comparable to a commercial corrosion-resistant steel No. 2D Sheet Finish.

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

3.4.1 Tensile Properties: Shall be as follows:

Tensile Strength	75,000 - 105,000 psi (517 - 724 MPa)
Yield Strength at 0.2% Offset, min	35,000 psi (241 MPa)
Elongation in 2 in. (50 mm), min	
Strip Specimen (See 4.3.1)	35%
Full Section	40%

3.4.2 Bending: A specimen as in 4.3.2 shall withstand, without showing cracks or other imperfections when examined at 10X magnification, bending at room temperature flat on itself with axis of bend perpendicular to axis of weld and with inside of tube on either inside or outside of bend.

3.4.3 Weld Crack Susceptibility: A specimen as in 4.3.3 shall withstand, without evidence of cracks occurring on, or adjacent to, the weld bead when examined at 10X magnification, being pulled parallel to the direction of the weld bead until rupture occurs.

3.4.4 Embrittlement: Specimens of tubing taken to include the weld, after sensitization treatment, shall pass the copper/copper sulfate/sulfuric acid test performed in accordance with ASTM A262, Practice E, without evidence of intercrystalline surface attack. After exposure, specimens shall withstand, without cracking, bending at room temperature through an angle of 180 deg around a diameter equal to the nominal thickness of the specimen with axes of bends both perpendicular and parallel to the axis of the tubing.

3.4.5 Pressure Test: After all fabricating and sizing operations, each length of tubing shall withstand for 1 min., without leaking or developing bulges, permanent set, or other imperfections which exceed the allowable tolerances for the finished product, a gradually applied internal hydrostatic pressure (P), calculated from the following equation:

$$P = \frac{2St}{D}$$

where, P = Test pressure in psi (MPa)
S = 20,000 psi (138 MPa) tensile stress
t = Minimum wall thickness
D = Nominal OD

3.4.6 Weld Strength: Shall be as follows, determined in accordance with 3.4.6.1 or 3.4.6.2.

3.4.6.1 Hydrostatic Pressure Test: A test specimen as in 4.3.4 shall withstand an internal hydrostatic pressure of 75,000 psi (517 MPa) for not less than 60 sec without rupture. Hydrostatic pressure (P) shall be calculated from the equation in 3.4.5 and shall be applied gradually in 30 - 60 sec at a temperature not lower than 60°F (16°C).

3.4.6.2 Tensile Strength: Shall be not lower than 75,000 psi (517 MPa), determined on specimens as in 4.3.5.

3.5 Quality:

3.5.1 Tubing, as received by purchaser, shall be uniform in contour, quality, and condition and shall have a finish conforming to the best practice for high quality tubing. It shall be sound and free from grease, oil, and other foreign matter. It shall be free from burrs, cracks, tears, grooves, seams, laminations, dents, crimps, and other imperfections detrimental to usage of the tubing.

3.5.2 The weld in each length of tubing shall, unless otherwise specified, by subjected to radiographic inspection in accordance with AMS 2635, prior to rolling, and shall conform to acceptance standards agreed upon by purchaser and vendor to guarantee against the shipment of tubing with any of the following imperfections in or adjacent to the weld: porosity, pinholes, entrapped slag, cracks, mismatches, lack of fusion, undercutting, or other imperfections which cause sharp notches or a reduction of thickness greater than 10% of parent metal wall thickness.

3.5.2.1 Metal thinning in, or adjacent to, the weld shall be permissible if not greater than 10% of parent metal wall thickness, provided also that it presents only gradual transitions.

3.5.2.2 Individual lengths of tubing which contain no weld imperfections other than metal thinning in excess of 10% of parent metal wall thickness may be reinspected radiographically after rolling. If rolling has reduced the metal thinning to less than 10%, the thinning indicated by the first radiograph will not be cause for rejection.

3.5.2.3 Each length of tubing in a shipment shall be accompanied by its radiographs.

3.5.3 Mechanical imperfections, such as light handling marks and light tool marks, are acceptable provided they have not dented the wall of the tube and are gradual in contour to a maximum depth of 10% of parent metal wall thickness.

3.5.4 The weld flash shall not extend in height beyond the contour of the adjacent metal more than 0.0025 in. (0.064 mm) on either outside or inside of the tubing, and the sum of both outside and inside weld flash heights shall not exceed 0.004 in. (0.10 mm).

3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, straight tubes 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, the following tolerances shall apply:

3.7.1 Diameter:

TABLE I

Nominal OD Inches	Tolerance, Inch Minus Only
1.000 to 2.500, incl	0.005
Over 2.500 to 3.500, incl	0.007
Over 3.500 to 4.500, incl	0.009
Over 4.500 to 7.000, incl	0.012

TABLE I (SI)

Nominal OD Millimetres	Tolerances, Millimetre Minus Only
25.40 to 63.50, incl	0.13
Over 63.50 to 88.90, incl	0.18
Over 88.90 to 114.30, incl	0.23
Over 114.30 to 177.80, incl	0.30

3.7.1.1 Outside diameter shall be measured using a periphery or Pi tape.

3.7.2 Wall Thickness:

TABLE II

Nominal Wall Thickness Inch	Tolerance, Inch plus and minus
0.010 to 0.016, incl	0.002
Over 0.016 to 0.026, incl	0.003
Over 0.026 to 0.040, incl	0.004
Over 0.040 to 0.058, incl	0.005
Over 0.058 to 0.072, incl	0.006

TABLE II (SI)

Nominal Wall Thickness Millimetres	Tolerance, Millimetres plus and minus
0.25 to 0.41, incl	0.05
Over 0.41 to 0.66, incl	0.08
Over 0.66 to 1.02, incl	0.10
Over 1.02 to 1.47, incl	0.13
Over 1.47 to 1.83, incl	0.15

3.7.3 Ovality: For tubing having nominal wall thickness of 0.040 in. (1.02 mm) or less, ovality shall not exceed 6% of the nominal OD. For tubing having nominal wall thickness greater than 0.040 in. (1.02 mm), the tolerances in Table III shall apply:

TABLE III

Nominal OD Inches	Tolerance % of OD
1.000 to 1.250, incl	5.0
Over 1.250 to 1.500, incl	4.0
Over 1.500 to 1.750, incl	3.5
Over 1.750 to 2.000, incl	3.0
Over 2.000 to 2.500, incl	2.5
Over 2.500 to 7.000, incl	2.0

TABLE III (SI)

Nominal OD Millimetres	Tolerance % of OD
25.40 to 31.75, incl	5.0
Over 31.75 to 38.10, incl	4.0
Over 38.10 to 44.45, incl	3.5
Over 44.45 to 50.80, incl	3.0
Over 50.80 to 63.50, incl	2.5
Over 63.50 to 177.80, incl	2.0

3.7.3.1 Ovality is obtained by dividing the difference between the maximum and minimum OD of any one station along the tube by the nominal OD and multiplying by 100.

3.7.4 Length: Cut-to-length tubing shall not vary from the length ordered by more than +1/8 in. (+3.2 mm), -0.

3.7.5 Straightness: When measured using a 3-ft (914-mm) straight-edge touching the tube at two points, the perpendicular distance from the straight-edge to the tube at any point between the two points of contact, shall not exceed 0.030 x L/3 in., where "L" is the distance in feet between points of contact or shall not exceed 0.83 x L mm, where "L" is the distance in metres between points of contact.

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 ensure 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 requirements for composition (3.1), tensile properties (3.4.1), bending (3.4.2), weld crack susceptibility (3.4.3), pressure test (3.4.5), weld strength (3.4.6), quality (3.5) and tolerances (3.7) are classified as acceptance tests and shall be performed on each lot.