SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS5581 | REV. F

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Superseding AMS5581E

Nickel Alloy, Corrosion and Heat-Resistant, Seamless or Welded Tubing
62Ni - 21.5Cr - 9.0Mo - 3.7Cb (Nb)
Annealed

(Composition similar to UNS N06625)

RATIONALE

AMS5581F corrects an error in Table 3A.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat-resistant nickel alloy in the form of two types of tubing.

1.2 Application

This tubing has been used typically for fluid lines requiring high strength and corrosion resistance at temperatures from cryogenic to 1800 °F (982 °C), but usage is not limited to such applications.

1.3 Classification

The tubing covered by this specification is classified as follows:

Type 1 - Seamless and drawn

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 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.

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http://www.sae.org/technical/standards/AMS5581F

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), or www.sae.org.

AMS2263 Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Tubing

AMS2269 Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys

AMS2371 Quality Assurance Sampling and Testing, Corrosion and-Heat Resistant Steels and Alloys, Wrought Products and Forging Stock

AMS2807 Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing

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, or www.astm.org.

ASTM A 370 Mechanical Testing of Steel Products

ASTM E 112 Determining Average Grain Size

ASTM E 354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

ASTM E 407 Microetching Metals and Alloys

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 E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

Element	min	max
Carbon	--	0.10
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	20.00	23.00
Molybdenum	8.00	10.00
Columbium (Niobium)	3.15	4.15
Titanium (3.1.1)	--	0.40
Aluminum (3.1.1)	--	0.40
Cobalt (3.1.2)	--	1.00
Iron	--	5.00
Nickel	remainder	

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3.1.1 Shall be present but not in excess of specified maximum.

3.1.2 Determination not required for routine acceptance.

3.1.3 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Condition

Solution heat treated, and unless solution heat treatment is performed in an atmosphere yielding a bright finish, pickled as required.

3.3 Fabrication

Tubing shall be produced by a seamless and drawn or a welded and drawn process. A light polish to improve external surface appearance may be employed after cold drawing.

3.3.1 Welded (Type 2) tubing shall be cold reduced after welding to remove the bead and any dimensional indication of the presence of welds.

3.4 Properties

Tubing shall conform to the following requirements:

3.4.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM A 370.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	120 ksi (827 MPa)
Yield Strength at 0.2% Offset	60 ksi (414 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, min	35%

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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 Inch	Expanded OD Inch	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 Table 3 shall take the same percentage flare as shown for the larger of the two sizes.

3.4.3 Pressure Test

Tubing, when subjected to an internal hydrostatic pressure (P) as determined from Equation 1, shall show no bulges, leaks, pinholes, cracks, or other defects, except that a diametric permanent set of 0.002 inch per inch (0.002 mm/mm) of diameter is acceptable.

$$P = S \frac{D^2 - d^2}{D^2 + d^2} \quad \text{(Eq. 1)}$$

where, P = Test pressure in ksi (MPa)
S = 60.0 ksi (414 MPa)
D = Nominal OD in inches (mm) (nominal OD plus tolerance)
d = Nominal ID in inches (mm) (nominal OD minus twice the minimum wall thickness)

3.4.4 Microstructure

Tubing shall reveal no continuous intergranular carbide precipitation when suitably etched and examined microscopically at 500X magnification. The presence of some discontinuous intergranular carbide precipitation shall not be considered detrimental if the other technical requirements are met. Standards for acceptance may be as agreed upon by purchaser and vendor.

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