SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5583D

Issued JUL 1977
Revised MAR 2002
Reaffirmed OCT 2006

Superseding AMS 5583C

Nickel Alloy, Corrosion and Heat-Resistant, Seamless Tubing
72Ni - 15.5Cr - 0.95Cb - 2.5Ti - 0.70Al - 7.0Fe
Vacuum Melted
Solution Heat Treated, Precipitation Hardenable to 170 ksi (1172 MPa) Tensile Strength

(Composition similar to UNS N07750)

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

1.1 Form:

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

1.2 Application:

This tubing has been used typically for fluid lines requiring high strength up to 1300 °F (704 °C) and oxidation resistance up to 1800 °F (982 °C), but usage is not limited to such applications. Parts may be formed and then heat treated to improve strength at elevated temperatures.

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2263	Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Tubing
MAM 2263	Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt Alloy Tubing
AMS 2269	Chemical Check Analysis Limits, Nickel, Nickel Alloys and Cobalt Alloys
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2634	Ultrasonic Testing, Thin Wall Metal Tubing

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1 (Continued):

AMS 2750	Pyrometry
AMS 2807	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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
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 426	Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys
ASTM E 1417	Liquid Penetrant Examination

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	--	0.08
Manganese	--	0.35
Silicon	--	0.35
Phosphorus	--	0.015
Sulfur	--	0.010
Chromium	14.00	17.00
Nickel	70.00	--
Columbium	0.70	1.20
Titanium	2.25	2.75
Aluminum	0.40	1.00
Iron	5.00	9.00
Cobalt (3.1.1)	--	1.00
Tantalum	--	0.05
Copper	--	0.50

3.1.1 Determination not required for routine acceptance.

3.1.2 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2269.

3.2 Melting Practice:

Alloy shall be multiple melted using consumable electrode practice in the remelt cycle. If consumable electrode remelting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used for remelting.

3.3 Condition:

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

3.4 Heat Treatment:

Tubing shall be solution heat treated by heating to a temperature not lower than 1800 °F (982 °C), holding at the selected temperature within ±25 °F (±14 °C) for a time commensurate with cross-sectional thickness, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS 2750.

3.5 Fabrication:

Tubing shall be produced by a seamless and drawn process. Any surface finishing operation applied to remove objectionable pits and surface blemishes shall be performed prior to solution heat treatment. A light polish to improve external surface appearance may be employed after solution heat treatment.

3.6 Properties:

Tubing shall conform to the following requirements:

3.6.1 As Solution Heat Treated:

3.6.1.1 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.

TABLE 2 - Solution Heat Treated Tensile Properties

Property	Value
Tensile Strength, maximum	140 ksi (965 MPa)
Yield Strength at 0.2% Offset, maximum	80 ksi (552 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, minimum	
Strip Specimen	30%
Full Tube	35%

3.6.1.2 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.6.1.3 Flarability: Specimens as in 4.3.1 from tubing 0.188 to 2.000 inches (4.78 to 50.80 mm), inclusive, in nominal OD 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 1.20 times the original nominal OD.

3.6.2 After Precipitation Heat Treatment: Tubing shall have the following properties after being precipitation heat treated by heating to 1350 °F ± 25 (732 °C ± 14), holding at heat for not less than 8 hours, cooling at a rate of 100 F (56 C) degrees per hour to 1150 °F ± 25 (621 °C ± 14), holding at 1150 °F ± 25 (621 °C ± 14) for 8 hours ± 0.5, and cooling at a rate equivalent to cooling in air. Instead of the 100 F (56 C) degrees per hour cooling rate to 1150 °F ± 25 (621 °C ± 14), tubing may be furnace cooled at any rate provided the time at 1150 °F ± 25 (621 °C ± 14) is adjusted to give a total precipitation heat treatment time of not less than 18 hours.

3.6.2.1 Tensile Properties: Shall be as shown in Table 3, determined in accordance with ASTM E 8 or ASTM E 8M.

TABLE 3 - Minimum Tensile Properties After Precipitation Heat Treatment

Property	Value
Tensile Strength	170 ksi (1172 MPa)
Yield Strength at 0.2% Offset	115 ksi (793 MPa)
Elongation in 2 Inches (50.8 mm) or 4D	
Strip Specimen	12%
Full Tube	15%

3.6.2.2 Hardness: Should be not lower than 30 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18. Tubing shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.2.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.7 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 grease, oil and other foreign matter, 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, shallow pits, 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.

3.7.1 When specified by purchaser, tubing shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417, to ultrasonic inspection in accordance with AMS 2634, to electromagnetic (eddy-current) inspection in accordance with ASTM E 426, or to any combination thereof. Tubing shall meet the requirements of acceptance criteria established by the cognizant engineering organization.

3.8 Tolerances:

Shall conform to all applicable requirements of AMS 2263 or MAM 2263.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of tubing shall supply all samples for vendor'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 (3.6.1.1 and 3.6.2.1), average grain size (3.6.1.2), hardness (3.6.2.2), nondestructive inspection when specified (3.7.1), and tolerances (3.8) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Flarability (3.6.1.3) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2371 and the following:

4.3.1 Specimens for flarability test (3.6.1.3) 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.