AEROSPACE MATERIAL SPECIFICATION

AMS5590™	REV. G

Issued 1966-09
Revised 2018-07
Reaffirmed 2023-05

Superseding AMS5590F

Nickel Alloy, Corrosion- and Heat-Resistant, Seamless Tubing
52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe
Consumable Electrode or Vacuum Induction Melted
1950 °F (1066 °C) Solution Heat Treated
(Composition similar to UNS N07718)

RATIONALE

AMS5590G introduces exceptions (3.8), revises fabrication (3.4), properties (3.5.3), quality (3.6.1), reports (4.4), and identification (5.2.1), and is a Five-Year Review and update of this specification.

AMS5590G has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat-resistant nickel alloy in the form of seamless tubing having nominal OD of 0.125 inch (3.18 mm) and over with nominal wall thickness of 0.015 inch (0.38 mm) and over (see 8.5).

1.2 Application

This tubing has been used typically for fluid lines and structural components requiring high strength at cryogenic temperatures and for short-time service up to 1200 °F (649 °C) and oxidation resistance up to 1800 °F (982 °C), particularly those parts which are formed or welded and then heat treated to develop desired properties, but usage is not limited to such applications.

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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

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

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

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS5590G/

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

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

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, www.astm.org.

ASTM A1016 General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E18 Rockwell Hardness of Metallic Materials

ASTM E112 Determining Average Grain Size

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt 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 E354, 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	--	0.015
Chromium	17.00	21.00
Nickel	50.00	55.00
Molybdenum	2.80	3.30
Columbium (Niobium)	4.75	5.50
Titanium	0.65	1.15
Aluminum	0.20	0.80
Cobalt	--	1.00
Tantalum	--	0.05
Boron	--	0.006
Copper	--	0.30
Iron	remainder	

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.2 Melting Practice

Alloy shall be produced by multiple melting using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum. 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

Cold drawn, solution heat treated, and unless solution heat treatment is performed in an atmosphere yielding a bright finish, pickled as required. No specific solution heat treating instructions are specified but it is recommended that the tubing be solution heat treated by heating in a suitable protective atmosphere to 1950 °F ± 25 °F (1066 °C ± 14 °C), holding at heat for not more than 30 minutes, and cooling at a rate equivalent to an air cool or faster.

3.4 Fabrication

Tubing shall be produced by a seamless process. 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 a centerless ground finish is not acceptable. A light polish to improve external surface appearance may be employed. Bore conditioning is permitted after final anneal providing the tubing is not sized by metal removal methods and the tubing is passivated after any such conditioning (see 8.3.1).

3.5 Properties

Tubing shall conform to the following requirements:

3.5.1 As Solution Heat Treated

3.5.1.1 Tensile Properties

Tubing having nominal OD of 0.125 inch (3.18 mm) and over with nominal wall thickness of 0.015 inch (0.38 mm) and over shall have the properties shown in Table 2, determined in accordance with ASTM E8/E8M.

Table 2 - Tensile properties

Property	Value
Tensile Strength, max	145 ksi (1000 MPa)
Yield Strength at 0.2% Offset, max	85 ksi (586 MPa)
Elongation in 2 Inches (50.8 mm), min	30%

3.5.1.2 Average Grain Size

Shall be ASTM No. 3 or finer, determined in accordance with ASTM E112.

3.5.1.3 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 1.25 times the original nominal outside diameter.

3.5.2 After Precipitation Heat Treatment

Tubing shall meet the requirements of 3.5.2.1 and 3.5.2.2 after being precipitation heat treated by heating to 1400 °F ± 15 °F (760 °C ± 8 °C), holding at heat for 10 hours ± 0.5 hour, furnace cooling to 1200 °F ± 15 °F (649 °C ± 8 °C), holding at 1200 °F ± 15 °F (649 °C ± 8 °C) until a total precipitation time of 20 hours has been reached, and cooling at a rate equivalent to an air cool or faster.

3.5.2.1 Tensile Properties

Shall be as shown in Table 3 for tubing 0.125 inch (3.18 mm) and over in nominal OD with nominal wall thickness of 0.015 inch (0.38 mm) and over, determined in accordance with ASTM E8/E8M.

Table 3 - Minimum tensile properties

Property	Value
Tensile Strength	170 ksi (1172 MPa)
Yield Strength at 0.2% Offset	145 ksi (1000 MPa)
Elongation in 2 Inches (50.8 mm)	15%

3.5.2.2 Hardness

Shall be not lower than 36 HRC, or equivalent, (see 8.2) determined in accordance with ASTM E18.

3.5.3 Properties for product outside the ranges shown in 1.1 shall be agreed upon between purchaser and producer.

3.6 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 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.

3.6.1 Tubing shall be subjected to either ultrasonic inspection or to electromagnetic (eddy-current) testing in accordance with ASTM A1016 except that suspect indications shall not be accepted based on visual observation, i.e., indications must be either rejected or reconditioned and retested to pass the test.

3.6.2 Tubing shall be free from grease, oil or other foreign materials. Metallic flakes or particles shall not be collected on a clean white cloth drawn through the length of the bore of a test sample. Discoloration of the cloth, without the presence of flakes or particles, is acceptable.

3.7 Tolerances

Shall conform to all applicable requirements of AMS2263.

3.8 Exceptions

Any exceptions shall be authorized by purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of tubing shall supply all samples for producer'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.