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SAE-AMS5587, "NICKEL ALLOY, CORROSION AND HEAT RESISTANT, SEAMLESS TUBING 47.5NI - 22CO - 9.0MO - 0.60W - 18.5FE, SOLUTION HEAT TREATED", was adopted on 04-MAR-88 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: ASC/ENOI, Building 560, 2530 Loop Road West, Wright-Patterson AFB, OH 45433-7101. Copies of this document may be purchased from the Society of Automotive Engineers 400 Commonwealth Drive Warrendale, Pennsylvania, United States, 15096-0001. http://www.sae.org/

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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5587D

Issued FEB 1965
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Reaffirmed SEP 2000

Superseding AMS 5587C

Nickel Alloy, Corrosion and Heat Resistant, Seamless Tubing
47.5Ni - 22Cr - 1.5Co - 9.0Mo - 0.60W - 18.5Fe
Solution Heat Treated

UNS N06002

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 operating in service under appreciable stresses at elevated temperatures, but usage is not limited to such applications. Alloy has good strength up to 1800 °F (982 °C) and oxidation resistance up to 2200 °F (1204 °C).

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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, Wrought 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 2632	Ultrasonic Inspection of Thin Materials, 0.5 Inch (13 mm) and Thinner
AMS 2645	Fluorescent Penetrant Inspection
AMS 2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
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SAE WEB ADDRESS: http://www.sae.org

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
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) Testing of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

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	0.05	0.15
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	20.50	23.00
Cobalt	0.50	2.50
Molybdenum	8.00	10.00
Tungsten	0.20	1.00
Iron	17.00	20.00
Boron	--	0.010
Copper	--	0.30
Nickel	remainder	

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

3.2 Condition:

Cold drawn, solution heat treated, and descaled. 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 2150 °F ± 25 (1177 °C ± 14), holding at heat for not more than 30 minutes, and cooling rapidly. In no case shall the solution heat treatment temperature be lower than 2100 °F (1149 °C).

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 a centerless-ground finish is not acceptable. A light polish to improve surface appearance may be employed.

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 E 8 or ASTM E 8M on 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.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	100.0 ksi (689 MPa)
Yield Strength at 0.2% Offset	45.0 ksi (310 MPa)
Elongation in 2 Inches (50.8 mm)	
Strip Specimens	20%
Full-Section Specimens	25%

3.4.1.1 Tensile property requirements for tubing under 0.125 inch (3.18 mm) in nominal OD or under 0.015 inch (0.38 mm) in nominal wall thickness shall be as agreed upon by purchaser and vendor.

3.4.2 Grain Size: Tubing 0.125 inch (3.18 mm) and under in nominal wall thickness shall have an average grain size of four or finer, determined in accordance with ASTM E 112. Grain size requirements for tubing over 0.125 inch (3.18 mm) in nominal wall thickness shall be as agreed upon by purchaser and vendor.

3.4.3 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 1.2 times the original nominal OD.

3.4.4 Pressure Test: Tubing shall shown 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 inch per inch (0.002 mm/mm) of diameter is acceptable. The hydrostatic pressure (P) shall be determined from Equation 1.

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

Where S = 40.0 ksi (276 MPa)

D = Nominal OD

d = Nominal ID

3.5 Quality:

3.5.1 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.

3.5.2 When specified, tubing shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645, to ultrasonic inspection in accordance with AMS 2632, to electromagnetic (eddy-current) inspection in accordance with ASTM E 426, or to any combination thereof. Acceptance standards shall be as established by purchaser.

3.6 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 performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1), tensile properties (3.4.1), grain size (3.4.2), quality (3.5.1), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests for flarability (3.4.3) and pressure test (3.4.4) are periodic tests 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 (3.4.3) 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.

4.3.2 When nondestructive inspection (3.5.2) is required, each length of tubing shall be inspected.

4.4 Reports:

The vendor of tubing shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and the results of tests of each lot to determine conformance to the other acceptance tests requirements and, when performed, to the periodic test requirements. This report shall include the purchase order number, lot number, AMS 5587D, size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2371.

5. PREPARATION FOR DELIVERY:

5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight tubing will be acceptable in mill lengths of 6 to 24 feet (1.8 to 7.3 m) but not more than 25% of any shipment shall be supplied in lengths of 6 to 9 feet (1.8 to 2.7 m).

5.2 Identification:

Shall be in accordance with AMS 2807.