AEROSPACE MATERIAL SPECIFICATION

AMS5587™	REV. G

Issued 1965-02
Reaffirmed 2006-04
Revised 2021-11

Superseding AMS5587F

Nickel Alloy, Corrosion and Heat Resistant, Seamless Tubing
47.5Ni - 22Cr - 1.5Co - 9.0Mo - 0.60W - 18.5Fe
Solution Heat Treated
(Composition similar to UNS N06002)

RATIONALE

AMS5587G is the result of a Five-Year Review and update of the specification. The revision prohibits unauthorized exceptions (3.7. 4.4.1, 5.2.1, 8.5), revises condition and fabrication (3.2, 3.3), updates tensile tests (3.4.1, 8.6), standardizes hydrostatic test requirements (3.4.4), updates quality (3.5, 4.2.1.1, 4.4), adds country of origin (4.4), clarifies identification (5.2), adds definitions (8.2.1), and allows prior revisions (8.4).

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. This alloy has good strength up to 1800 °F (982 °C) and oxidation resistance up to 2200 °F (1204 °C).

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/AMS5587G/

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

AMS2632 Inspection, Ultrasonic, of Thin Materials, 0.50 Inch (12.7 mm) and Under in Cross-Sectional Thickness

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, www.astm.org.

ASTM B829 General Requirements for Nickel and Nickel Alloys Seamless Pipe and Tube

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E112 Determining Average Grain Size

ASTM E354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

ASTM E426 Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys

ASTM E1417E1417M Liquid Penetrant Testing

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM E354 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 applicable requirements of AMS2269.

3.2 Condition

Cold drawn and solution heat treated. Solution heat treatment shall be performed in an atmosphere yielding a bright finish. Alternately, finished product shall be passivated to produce a uniform finish. It is permissible to pickle prior to passivation. Passivation may take place after any final finishing (see 3.3.2). 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 °F (1177 °C ± 14 °C), 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

3.3.1 Tubing shall be produced by a seamless and cold drawn process.

3.3.2 Finishing operations shall be performed prior to final solution heat treatment. Tubing shall not be centerless ground. A light polish to improve external surface appearance or meet surface finish requirements may be employed after solution heat treatment and, if performed, the product shall be subsequently passivated.

3.3.3 Bore conditioning is permitted after final anneal provided the tubing is not sized by metal removal methods beyond the allowable tolerances (see 8.2.1). If bore conditioning is used, 100% visual inspection of each tube shall be performed. The tube ID shall be uniformly shiny with no evidence of remnant material, neither metallic nor nonmetallic in nature.

3.3.4 Tubing shall be passivated after any ID or OD finishing that occurs after solution heat treatment.

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 E8/E8M

Table 2 - Minimum tensile properties

Property	Value
Tensile Strength	100 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 Unless otherwise specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. The strain rate after yield may be increased to any value up to 0.5 in/in/min (or 0.5 mm/mm/min) or equivalent crosshead speed as a function of gage length.

3.4.1.2 For tubing with an OD less than 1/8 inch (3.2 mm) or wall thickness under 0.015 inch (0.38 mm), alternate testing and acceptance methods may be agreed between the purchaser and the supplier (see 8.6).

3.4.2 Average Grain Size

Shall be ASTM No. 4 or finer, determined in accordance with ASTM E112, for tubing 0.125 inch (3.18 mm) and under in nominal wall thickness.

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 Hydrostatic Test

Tubing shall withstand an internal hydrostatic pressure (P), based on Equation 1, without developing leaks, local bulges, or cracks and without an increase in mean diameter of more than 0.2%.

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

where:

P = test pressure in ksi (MPa)

S = minimum yield strength from 3.4.1

D = maximum OD in inches (mm) (defined as nominal (i.e., order or specified) OD plus tolerance)

d = maximum ID in inches (mm) (maximum OD (D) minus twice the minimum wall thickness)

Mean diameter is the average of two diameters at right angles to each other in the same transverse plane; measurements before and after testing should be taken at substantially the same location.

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 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, 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 A clean white cloth or plug drawn or blown through the length of the bore of a test sample at least 12 inches (30 cm) in length, shall show no visual evidence of metallic flakes or particles. Discoloration of the cloth or plug, without the presence of flakes or particles, is acceptable. Alternate methods for evaluating tube cleanliness may be used for tubing 0.500 inch (12.7 mm) and under ID.

3.5.3 When no nondestructive inspection is specified by the purchaser, tubing shall be subjected to either ultrasonic or eddy current inspection in accordance with ASTM B829, 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. Alternate methods of inspection may be performed when approved by the cognizant engineering organization for tube 0.25 inch (0.64 cm) and under in nominal diameter.

3.5.4 When specified, tubing shall be subjected to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M, to ultrasonic inspection in accordance with AMS2632, to electromagnetic (eddy-current) inspection in accordance with ASTM E426, or to any combination thereof. Standards for such inspections shall be as agreed upon between purchaser and producer (see 8.6).

3.6 Tolerances

Shall conform to AMS2263.

3.7 Exceptions

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