AEROSPACE MATERIAL SPECIFICATION

AMS5597™ REV. H

Issued 1965-09
Reaffirmed 2015-04
Revised 2022-04

Superseding AMS5597G

Nickel Alloy, Corrosion and Heat Resistant, Sheet, Strip, and Plate
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

AMS5597H is the result of a Five-Year Review and update of the specification. The revision incorporates size limits (1.1, 3.5.3), updates heat treatment requirement 3.4, adds strain rate for tensile tests (3.5.1.1, 3.5.2.1), prohibits unauthorized exceptions (3.9, 4.4.1, 5.1.1, 8.6), and allows prior revisions (8.7).

1. SCOPE

1.1 Form

This specification covers a corrosion and heat resistant nickel alloy in the form of sheet, strip, and plate from 0.010 to 1.000 inch (0.25 to 25.40 mm) in thickness.

1.2 Application

These products have been used typically for parts, such as cases and ducts, requiring high strength at cryogenic temperatures and for short-time use up to 1000 °F (538 °C), particularly those parts which are formed or welded and then heat treated to develop required 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.

AMS2262 Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Sheet, Strip, and Plate

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/AMS5597H/

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

AMS2750 Pyrometry

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

AS4194 Sheet and Strip Surface Finish Nomenclature

AS6279 Industry Standard Practice for Production, Distribution, and Procurement of Metal Stock

AS7766 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 A480/A480M Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

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 E290 Bend Testing of Material for Ductility

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 multiple melted 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

The product shall be supplied in the following condition:

3.3.1 Sheet and Strip

Hot or cold rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled having a surface appearance as described in ASTM A480/A480M or AS4194, and 3.3.1.1 or 3.3.1.2 as applicable.

3.3.1.1 Sheet

No. 2D finish.

3.3.1.2 Strip

No. 1 strip finish.

3.3.2 Plate

Hot rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled.

3.4 Solution Heat Treatment

No specific heat treating instructions are specified but it is recommended that the product be solution heat treated by heating in a suitable protective atmosphere to 1950 °F ± 25 °F (1066 °C ± 14 °C), but in no case lower than 1850 °F (1010 °C), holding at heat for a time commensurate with product thickness, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS2750.

3.4.1 Continuous Heat Treatment

When continuous heat treating is used process parameters (e.g., furnace temperature set points, heat input, travel rate, etc.) for continuous heat treating lines shall be established by the material producer and validated by testing of product to the requirements of 3.5.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 As Solution Heat Treated

3.5.1.1 Tensile Properties

Shall be shown in Table 2, determined in accordance with ASTM E8/E8M.

3.5.1.1.1 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. The requirement for compliance becomes effective for material produced 1 year after the publication date of this document.

Table 2 - Tensile properties

Property	Value
Tensile Strength, max	140 ksi (965 MPa)
Yield Strength at 0.2% Offset, max	75.0 ksi (517 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, min	30%

3.5.1.2 Hardness

Should be not higher than 25 HRC, or equivalent (see 8.2), determined in accordance with ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile properties of 3.5.1.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.5.1.3 Bending

Product shall be tested in accordance with ASTM E290 using a sample prepared nominally 0.75 inch (19.0 mm) in width with its axis of bending parallel to the direction of rolling and shall withstand without cracking when bending at room temperature through an angle of 180 degrees around a diameter equal to the bend factor shown in Table 3 times the nominal thickness of the product. In case of dispute, the results of tests using the guided bend test of ASTM E290 shall govern.

Table 3 - Bending parameters

Nominal Thickness Inches	Nominal Thickness Millimeters	Bend Factor
Up to 0.050, incl	Up to 1.27, incl	1
Over 0.050 to 0.1874, incl	Over 1.27 to 4.760, incl	2

3.5.1.4 Average Grain Size

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

3.5.1.5 Microstructure

Metallographic examination shall disclose no significant alloy depleted layer (see 8.3) or other undesirable surface condition. Standards for acceptance shall be as agreed upon by purchaser and producer.

3.5.2 After Precipitation Heat Treatment

The product shall have the following properties 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 heat treatment time of 20 hours has been reached, and cooling at a rate equivalent to air or faster. The product shall also meet the requirements of 3.5.2.1 and 3.5.2.2 after being re-solution heat treated by heating to 1950 °F ± 25 °F (1066 °C ± 14 °C) in a suitable protective atmosphere, holding at heat for 60 minutes ± 5 minutes, and cooling at a rate equivalent to an air cool or faster and precipitation heat treated as above.

3.5.2.1 Tensile Properties

Shall be as shown in Table 4 for product 0.010 to 1.000 inch (0.25 to 25.40 mm), inclusive, in nominal thickness, determined in accordance with ASTM E8/E8M and 3.5.1.1.1.

Table 4 - Minimum tensile properties

Property	Value
Tensile Strength	180 ksi (1241 MPa)
Yield Strength at 0.2% Offset	150 ksi (1034 MPa)
Elongation in 2 Inches (50 mm) or 4D	15%

3.5.2.2 Hardness

Should be not lower than 38 HRC, or equivalent (see 8.2), determined in accordance with ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile properties 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.

3.5.3 Mechanical property requirements for product outside the size range covered by Table 4 shall be agreed upon between purchaser and producer and reported per 4.4.1.

3.6 Quality

The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.7 Tolerances

Shall conform to all applicable requirements of AMS2262.

3.8 Production, distribution, and procurement of metal stock shall comply with AS6279.

3.9 Exceptions

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product 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 product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are acceptance tests and shall be performed on each heat or lot as applicable: