



AEROSPACE MATERIAL SPECIFICATION

AMS5598™**REV. G**

Issued 1965-09
Reaffirmed 2012-10
Revised 2024-07

Superseding AMS5598F

(R) Nickel Alloy, Corrosion- and Heat-Resistant, Sheet, Strip, and Plate
72Ni - 15.5Cr - 0.95 (Cb [Nb] + Ta) - 2.5Ti - 0.70Al - 7.0Fe (X750)
Consumable Electrode, Remelted or Vacuum Induction Melted,
Solution Heat Treated, Precipitation-Hardenable
(Composition similar to UNS N07750)

RATIONALE

AMS5598G is the result of a Five-Year Review and update of the specification. The revision updates the composition testing specification and reporting requirements (see 3.1 and 3.1.1), revises the finish requirements (see 3.3.1), adds strain rate controls (see 3.5.1.1.3 and 3.5.2.2), updates bending requirements (see 3.5.1.2), adds pyrometry controls and clarifies heat-treatment time (see 3.5.2), updates tensile and hardness requirements (see 3.5.1.1, 3.5.2.1, and 8.2) and updates the exception requirements (see 8.5).

1. SCOPE

1.1 Form

This specification covers a corrosion- and heat-resistant nickel alloy in the form of sheet and strip up to 0.187 inch (4.75 mm) thick, inclusive, and plate up to 4.000 inches (101.6 mm) thick, inclusive.

1.2 Application

These products have been used typically for parts requiring high strength up to 1500 °F (816 °C) and oxidation resistance up to 1800 °F (982 °C) and for bellows and flat springs requiring optimum resistance to relaxation up to 1000 °F (538 °C) with moderate or relatively low stresses, particularly where welding is involved, but usage is not limited to such applications. Parts may be formed, welded if required, 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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2024 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, or used for text and data mining, AI training, or similar technologies, without the prior written permission of SAE.

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
http://www.sae.org

SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS5598G>

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
AMS2283	Composition Testing Methods for Nickel- and Cobalt-Based Alloys
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
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 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

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Composition shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2283, or by other analytical methods acceptable to the 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 (Niobium)	0.70	1.20
Tantalum	--	0.05
Titanium	2.25	2.75
Aluminum	0.40	1.00
Iron	5.00	9.00
Copper	--	0.50

3.1.1 The producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection unless limits of acceptability are specified by the purchaser.

3.1.2 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 that 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

Sheet and strip shall be hot or cold rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled having a uniform finish.

3.3.2 Plate

Plate shall be 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 1800 °F ± 25 °F (982 °C ± 15 °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 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 the 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

As solution heat-treated properties for product 0.005 inch (0.12 mm) and over shall be as shown in Tables 2 and 3, determined in accordance with ASTM E8/E8M.

3.5.1.1.1 Strip

Table 2A - Strip tensile properties, inch/pound units

Nominal Thickness Inches	Tensile Strength ksi, Max	Elongation in 2 Inches or 4D %, Min
Up to 0.010, excl	140	--
0.010 to 0.187, incl	135	18

Table 2B - Strip tensile properties, SI units

Nominal Thickness Millimeters	Tensile Strength MPa, Max	Elongation in 50 mm or 4D %, Min
Up to 0.25, excl	965	--
0.25 to 4.75, incl	931	18

3.5.1.1.2 Sheet

Table 3A - Sheet tensile properties, inch/pound units

Nominal Thickness Inches	Tensile Strength ksi, Max	Yield Strength at 0.2% Offset ksi, Max	Elongation in 2 Inches or 4D %, Min
0.010 to 0.024, incl	135	75	30
Over 0.024 to 0.187, incl	135	75	35

Table 3B - Sheet tensile properties, SI units

Nominal Thickness Millimeters	Tensile Strength MPa, Max	Yield Strength at 0.2% offset MPa, Max	Elongation 50 mm or 4D %, Min
0.25 to 0.61, incl	931	517	30
Over 0.61 to 4.75, incl	931	517	35

3.5.1.1.3 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. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.5.1.2 Bending

Product 0.187 inch (4.75 mm) and under in nominal thickness shall be tested in accordance with ASTM E290. Testing shall be performed at room temperature. Bend requirements shall be in accordance with Table 4. When visually examined, the specimen shall exhibit no cracking. In case of dispute, the results of tests using the guided bend test of ASTM E290 shall govern.

Table 4A - Bending parameters, inch/pound units

Nominal Thickness Inch	Angle Degrees	Bend Radius ^(1, 2)
Up to 0.050, incl	180	0.5t
Over 0.050 to 0.187, incl	180	1t

(1) Bend radius is defined as a bend factor multiplied by the nominal thickness (t).

(2) Prior versions of this specification may have specified a bend factor and a bend diameter in lieu of bend radius.

Table 4B - Bending parameters, SI units

Nominal Thickness Millimeters	Angle Degrees	Bend Radius ^(1, 2)
Up to 1.27, incl	180	0.5t
Over 1.27 to 4.75, incl	180	1t

(1) Bend radius is defined as a bend factor multiplied by the nominal thickness (t).

(2) Prior versions of this specification may have specified a bend factor and a bend diameter in lieu of bend radius.

3.5.1.3 Average Grain Size

Sheet and strip 0.010 to 0.187 inch, inclusive, in nominal thickness shall have an average grain size of ASTM No. 5 or finer, determined in accordance with ASTM E112.

3.5.1.4 Properties for plate, if specified, shall be as agreed upon by the purchaser and producer.

3.5.2 Response to Precipitation Heat Treatment

Samples from product shall have the following properties after being precipitation heat treated by heating to 1350 °F ± 15 °F (732 °C ± 8 °C), holding at heat for 8 hours ± 0.5 hour, cooling at a rate of 100 °F ± 15 °F (56 °C ± 8 °C) per hour to 1150 °F ± 15 °F (621 °C ± 8 °C), holding at 1150 °F ± 15 °F (621 °C ± 8 °C) for 8 hours ± 0.5 hour, and cooling in air. Instead of the 100 °F ± 15 °F (56 °C ± 8 °C) per hour cooling rate to 1150 °F ± 15 °F (621 °C ± 8 °C), product may be furnace cooled at any rate provided the time at 1150 °F ± 15 °F (621 °C ± 8 °C) is adjusted to give a total precipitation heat-treatment time of 18 hours minimum. Pyrometry shall be in accordance with AMS2750.

3.5.2.1 Tensile Properties - Response to Heat Treatment

Tensile properties from response to heat-treatment samples shall be as shown in Table 5, determined in accordance with ASTM E8/E8M for product 0.005 inch (0.13 mm) and over in thickness.

Table 5A - Minimum tensile properties - response to heat treatment, inch/pound units

Product	Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Strip	Up to 0.010, excl	155.0	--	--
	0.010 to 0.187, incl	160.0	--	12
Sheet	0.010 to 0.187, incl	170.0	115.0	18
Plate	Over 0.187 to 4.000, incl	160.0	105.0	18

Table 5B - Minimum tensile properties - response to heat treatment, SI units

Product	Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50 mm or 4D %
Strip	Up to 0.25, excl	1069	--	--
	0.25 to 4.75, incl	1103	--	12
Sheet	0.25 to 4.75, incl	1172	793	18
Plate	Over 4.75 to 101.6, incl	1103	724	18

3.5.2.2 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. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.5.2.3 Hardness

Hardness from response to heat-treatment samples shall not be lower than shown in Table 6, or equivalent (see 8.2), determined in accordance with ASTM E18. Product shall not be rejected on the basis of hardness if tensile properties of 3.5.2.1 are acceptable, determined on a specimen taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

Table 6 - Minimum hardness

Product	Hardness
Strip 0.005 to 0.187 inch (0.12 to 4.75 mm), inclusive, in nominal thickness	30 HRC
Sheet	32 HRC
Plate	30 HRC

3.5.3 Mechanical properties for product outside the range specified in 1.1 shall be agreed upon between the purchaser and producer.

3.6 Quality

The product, as received by the 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

Sheet 44 inches (1118 mm) and under in width and 0.010 inch (0.25 mm) and over in nominal thickness; strip, other than for thickness; and plate shall conform to all applicable requirements of AMS2262. Thickness tolerances for strip shall be $\pm 10\%$ of the nominal thickness.