AEROSPACE MATERIAL SPECIFICATION

AMS5608™	REV. H

Issued 1971-05
Reaffirmed 2006-04
Revised 2022-07

Superseding AMS5608G

Cobalt Alloy, Corrosion- and Heat-Resistant, Sheet, Strip, and Plate
40Co - 22Cr - 22Ni - 14.5W - 0.07La
Solution Heat Treated
(Composition similar to UNS R30188)

RATIONALE

AMS5608H is the result of a Five-Year Review and update of the specification. The revision prohibits unauthorized exceptions (3.6, 4.4.1, 5.1.1, 8.4), updates composition testing and reporting (3.1, 3.1.1), updates surface finish and continuous heat treatment requirements (3.2.1, 3.3.1), controls strain rate during tensile tests (3.4.1.3), and allows prior revisions (8.3).

1. SCOPE

1.1 Form

This specification covers a corrosion- and heat-resistant cobalt alloy in the form of sheet, strip, and plate.

1.2 Application

These products have been used typically for formed and drawn parts requiring high strength up to 1800 °F (982 °C) and oxidation resistance up to 2000 °F (1093 °C), 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

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

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/AMS5608H/

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

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E21 Elevated Temperature Tension Tests of Metallic Materials

ASTM E112 Determining Average Grain Size

ASTM E139 Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

ASTM E290 Bend Testing Material for Ductility

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

2.3 Definitions

Terms used in AMS are defined in AS7766.

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	--	1.25
Silicon	0.20	0.50
Phosphorus	--	0.020
Sulfur	--	0.015
Chromium	20.00	24.00
Nickel	20.00	24.00
Tungsten	13.00	16.00
Lanthanum	0.02	0.12
Boron	--	0.015
Iron	--	3.00
Cobalt	remainder	

3.1.1 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 Condition

The product shall be supplied in the following condition:

3.2.1 Sheet and Strip

Hot rolled 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 in accordance with ASTM A480/A480M, AS4194, and 3.2.1.1 or 3.2.1.2 as applicable.

3.2.1.1 Sheet

No. 2D or better finish.

3.2.1.2 Strip

No. 1 or better strip finish.

3.2.2 Plate

Hot rolled, solution heat treated, and descaled.

3.3 Heat Treatment

The product shall be solution heat treated by heating to a temperature within the range 2125 to 2250 °F (1163 to 1232 °C), holding at the selected temperature within ±25 °F (±14 °C) for a time commensurate with section thickness, and cooling at a rate equivalent to air cooling or faster, except as specified in 3.3.1. Pyrometry shall be in accordance with AMS2750.

3.3.1 Continuous Heat Treating

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 other requirements of 3.4.

3.3.2 Any thermal treatment following solution heat treatment as in 3.3 shall not involve use of temperatures higher than 2050 °F ± 25 °F (1121 °C ± 14 °C).

3.4 Properties

The product shall conform to the following requirements:

3.4.1 Tensile Properties

3.4.1.1 At Room Temperature

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

3.4.1.1.1 For product 0.010 inch (0.25 mm) and under in nominal thickness, properties may be established using a sample up to 0.025 inch (0.64 mm) in nominal thickness from the same master coil and heat. The supplier's certification of test shall indicate the thickness at which the tensile test was performed.

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

Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.010, incl	125	55	Report
Over 0.010. to 0.020, incl	125	55	40
Over 0.020	125	55	45

Table 2B - Minimum tensile properties, SI units

Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50 mm or 4D %
Up to 0.25, incl	862	379	Report
Over 0.25 to 0.51, incl	862	379	40
Over 0.51	862	379	45

3.4.1.2 At 1200 °F (649 °C)

Shall be as shown in Table 3, determined in accordance with ASTM E21 on specimens heated to 1200 °F ± 5 °F (649 °C ± 3 °C), held at heat for not less than 20 minutes before testing, and tested at 1200 °F ± 5 °F (649 °C ± 3 °C).

3.4.1.2.1 For product 0.010 inch (0.25 mm) and under in nominal thickness, properties may be established using a sample up to 0.025 inch (0.64 mm) in nominal thickness from the same master coil and heat. The supplier's certification of test shall indicate the thickness at which the tensile test was performed.

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

Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.010, incl	90	36.0	Report
Over 0.010 to 0.020, incl	90	36.0	40
Over 0.020	90	36.0	50

Table 3B - Minimum tensile properties, SI units

Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50 mm or 4D %
Up to 0.25, incl	621	248	Report
Over 0.25 to 0.51, incl	621	248	40
Over 0.51	621	248	50

3.4.1.3 Unless otherwise specified, the strain rate for both room temperature and elevated temperature tensile testing 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 specification.

3.4.2 Bending

Product 0.1874 inch (4.760 mm) and under in nominal thickness 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 4 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 4 - Bending parameters

Nominal Thickness Inches	Nominal Thickness Millimeters	Bend Factor
Up to 0.050, incl	Up to 1.27, incl	1.5
Over 0.050 to 0.1874, incl	Over 1.27 to 4.760, incl	2

3.4.3 Average Grain Size

Shall be ASTM No. 4 or finer, determined in accordance with ASTM E112.

3.4.4 Stress-Rupture Properties at 1700 °F (927 °C)

A tensile specimen, maintained at 1700 °F ± 3 °F (927 °C ± 2 °C) while the load required to produce the initial axial stress shown in Table 5 or higher stress is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be as specified in Table 5. Tests shall be conducted in accordance with ASTM E139.

Table 5A - Stress-rupture properties, inch/pound units

Nominal Thickness Inches	Stress ksi	Elongation in 2 Inches or 4D %, Min
Up to 0.020, incl	9.0	8
Over 0.020	11.0	15

Table 5B - Stress-rupture properties, SI units

Nominal Thickness Millimeters	Stress MPa	Elongation in 50 mm or 4D %, Min
Up to 0.51, incl	62.1	8
Over 0.51	75.8	15

3.4.4.1 The test of 3.4.4 may be conducted using incremental loading. In such case, the load required to produce the applicable initial axial stress specified in Table 5 or higher stress shall be used to rupture or for 23 hours, whichever occurs first. After the 23 hours and at intervals of 8 hours minimum, thereafter, the stress shall be increased in increments of 2.0 ksi (13.8 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.4.

3.4.4.2 For product 0.010 inch (0.25 mm) and under in nominal thickness, stress rupture properties may be established using a sample up to 0.025 inch (0.64 mm) in nominal thickness from the same master coil and heat. The supplier's certification of test shall indicate the thickness at which the stress rupture test was performed.

3.4.5 Oxidation Resistance

A specimen representing each heat shall be prepared in accordance with 3.4.5.1, tested in accordance with 3.4.5.2, and meet the requirements of 3.4.5.3.

3.4.5.1 Specimens shall have not less than 1.5 square inches (9.7 cm^2) test surface in excess of material required for fixturing. Test surfaces shall be hand polished, using 120 grit or finer silicon carbide paper, and degreased. Specimens may be fixtured during test by insertion into inert ceramic brick or by suspension from inert ceramic rods. Specimens shall not be placed in crucibles.

3.4.5.2 Specimens shall be subjected to four cycles; each cycle shall consist of heating to a temperature within the range 2000 to 2100 °F (1093 to 1149 °C), holding at the selected temperature within ±25 °F (±14 °C) for 25 hours ± 1 hour, and air cooling to 300 °F (149 °C) or lower between cycles. Heating shall be performed in a furnace which provides natural convection air flow such that test surfaces are equally exposed.