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Superseding AMS5598D

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

RATIONALE

AMS5598E has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat-resistant nickel alloy in the form of sheet, strip, and plate procured in inch/pound units.

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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS 2262	Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Sheet, Strip, and Plate
AMS 2269	Chemical Check Analysis Limits, Nickel, 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 2807	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

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<http://www.sae.org/technical/standards/AMS5598E>**

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 A 480/A 480M	Flat-Rolled Stainless and Heat-Resistant Steel Plate, Sheet and Strip
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 290	Bend Test for Ductility of Metallic Materials
ASTM E 354	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 E 354, 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	--	0.010
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 Check Analysis

Composition variations shall meet the applicable requirements of AMS 2269.

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 in accordance with ASTM A 480/A480M and AS 4194, and conforming to 3.3.1.1 and 3.3.1.2 as applicable, except that product 0.010 inch (0.25 mm) and under in nominal thickness shall have a surface appearance comparable to a No. 2B finish.

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 $1800^{\circ}\text{F} \pm 25$ ($982^{\circ}\text{C} \pm 15$), holding at heat for a time commensurate with product thickness, and cooling at a rate equivalent to an air cool or faster.

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 as shown in Table 2 and Table 3, determined in accordance with ASTM E 8.

3.5.1.1.1 Strip

TABLE 2A - STRIP TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Thickness Inch	Tensile Strength ksi, max	Elongation in 2 Inches or 4D %, min
Up to 0.010, excl	140.0	--
0.010 to 0.187, incl	135.0	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 Inch	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	135.0	75.0	30
Over 0.024 to 0.187, incl	135.0	75.0	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

3.5.1.2 Bending

Product 0.187 inch (4.75 mm) and under in nominal thickness shall be tested in accordance with ASTM E 290 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 with axis of bend parallel to the direction of rolling. In case of dispute, the results of tests using the guided bend test of ASTM E 290 shall govern.

TABLE 4A - BENDING PARAMETERS, INCH/POUND UNITS

Nominal Thickness Inch	Bend Factor
Up to 0.050, incl	1
Over 0.050 to 0.187, incl	2

TABLE 4B - BENDING PARAMETERS, SI UNITS

Nominal Thickness Millimeters	Bend Factor
Up to 1.27, incl	1
Over 1.27 to 4.75, incl	2

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 E 112.

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

3.5.2 After Precipitation Heat Treatment

The product shall have the following properties after being precipitation heat treated by heating to $1350^{\circ}\text{F} \pm 15$ ($732^{\circ}\text{C} \pm 8$), holding at heat for $8 \text{ hours} \pm 0.5$, cooling at a rate of $100^{\circ}\text{F} \pm 15$ ($56^{\circ}\text{C} \pm 8$) degrees per hour to $1150^{\circ}\text{F} \pm 15$ ($621^{\circ}\text{C} \pm 8$), holding at $1150^{\circ}\text{F} \pm 15$ ($621^{\circ}\text{C} \pm 8$), for $8 \text{ hours} \pm 0.5$, and cooling in air. Instead of the $100^{\circ}\text{F} \pm 15$ ($56^{\circ}\text{C} \pm 8$) degrees per hour cooling rate to $1150^{\circ}\text{F} \pm 15$ ($621^{\circ}\text{C} \pm 8$), product may be furnace cooled at any rate provided the time at $1150^{\circ}\text{F} \pm 15$ ($621^{\circ}\text{C} \pm 8$), is adjusted to give a total precipitation heat treatment time of 18 hours.

3.5.2.1 Tensile Properties

Shall be as shown in Table 5, determined in accordance with ASTM E 8.

TABLE 5A - MINIMUM TENSILE PROPERTIES, 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