AEROSPACE MATERIAL SPECIFICATION

AMS5699	REV. G

Issued 1953-06
Revised 2003-01
Reaffirmed 2013-12

Superseding AMS5699F

Nickel Alloy, Corrosion and Heat-Resistant, Wire
72Ni - 15.5Cr - 0.95Cb - 2.5Ti - 0.70Al - 7.0Fe
Spring Temper, Precipitation Hardenable
(Composition similar to UNS N07750)

RATIONALE

AMS5699G 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 round, square, and flat wire 0.625 inch (15.88 mm) and under in nominal diameter or thickness.

1.2 Application:

This wire has been used typically for helical springs for service at elevated temperatures (See 8.2 and 8.3), 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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

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**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5699G

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 8 Tension Testing of Metallic Materials
ASTM E 8M Tension Testing of Metallic Materials (Metric)
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	--	1.00
Silicon	--	0.50
Sulfur	--	0.010
Chromium	14.00	17.00
Nickel	70.00	--
Columbium	0.70	1.20
Titanium	2.25	2.75
Aluminum	0.40	1.00
Iron	5.00	9.00
Cobalt	--	1.00
Tantalum	--	0.05
Copper	--	0.50

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2269.

3.2 Condition:

Cold drawn from hot finished wire or rod which has had suitable surface preparation for removal of scale, seams, or other injurious surface imperfections. Wire shall be solution heat treated by heating within the range 2000 to 2200 °F (1093 to 1204 °C) before reducing to the size ordered.

3.2.1 Wire 0.250 inch (6.35 mm) and under in nominal diameter or thickness shall be cold reduced between 50% and 65% following solution heat treatment.

3.2.2 Wire over 0.250 to 0.625 inch (6.35 to 15.88 mm) in nominal diameter or thickness shall be cold reduced not less than 30% following solution heat treatment.

3.2.3 All traces of lubricant shall be removed after cold reduction.

3.3 Properties:

Wire shall conform to the following requirements; tensile testing shall be performed in accordance with ASTM E 8 or ASTM E 8M:

3.3.1 As Received:

3.3.1.1 Tensile Properties: Shall be as shown in Table 2.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Nominal Diameter or Thickness Inch	Tensile Strength ksi Round Wire	Tensile Strength ksi Square or Flat Wire
Up to 0.250, incl	190	175
Over 0.250 to 0.625, incl	160	160

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal Diameter or Thickness Millimeters	Tensile Strength MPa Round Wire	Tensile Strength MPa Square or Flat Wire
Up to 6.35, incl	1310	1207
Over 6.35 to 15.88, incl	1103	1103

3.3.1.2 Wrapping: Wire shall withstand, without cracking, wrapping at room temperature five full, closely-spaced turns around a diameter as shown in Table 3.

TABLE 3 - Wrapping Parameters

Wire Shape	Wrapping Diameter
Round	4X Nominal Diameter of Wire
Square	4X Nominal Diagonal of Wire
Flat	4X Nominal Width of Wire

3.3.2 After Precipitation Heat Treatment (See 8.2):

3.3.2.1 Tensile Properties: Shall be as shown in Table 4, determined on wire precipitation heat treated by heating to 1200 °F ± 25 (649 °C ± 14), holding at heat for 4 hours ± 0.25, and cooling at a rate equivalent to air cooling.

TABLE 4A - Minimum Tensile Strength, Inch/Pound Units

Nominal Diameter or Thickness Inch	Tensile Strength ksi
0.012 to 0.250, incl	220
Over 0.250 to 0.418, incl	200
Over 0.418 to 0.625, incl	180

TABLE 4B - Minimum Tensile Strength, SI Units

Nominal Diameter or Thickness Millimeters	Tensile Strength MPa
0.30 to 6.35, incl	1517
Over 6.35 to 10.62, incl	1379
Over 10.62 to 15.88, incl	1241

3.3.3 After Solution and Precipitation Heat Treatment (See 8.3):

3.3.3.1 Tensile Properties: Shall be as shown in Table 5, determined on wire solution heat treated by heating to 2100 °F ± 25 (1149 °C ± 14), holding at heat for 2 hours ± 0.25, and cooling at a rate equivalent to air cooling, and precipitation heat treated by heating to 1550 °F ± 25 (843 °C ± 14), holding at heat for 24 hours ± 0.5, cooling at a rate equivalent to air cooling, reheating to 1300 °F ± 25 (704 °C ± 14), holding at heat for 20 hours ± 0.5, and cooling at a rate equivalent to air cooling.

TABLE 5A - Minimum Tensile Strength, Inch/Pound Units

Nominal Diameter or Thickness Inch	Tensile Strength ksi
0.012 to 0.250, incl	150
Over 0.250 to 0.625, incl	145

TABLE 5B - Minimum Tensile Strength, SI Units

Nominal Diameter or Thickness Millimeters	Tensile Strength MPa
0.30 to 6.35, incl	1034
Over 6.35 to 15.88, incl	1000

3.4 Quality:

Wire, as received by purchaser, shall be uniform in quality and condition and free from kinks, twists, scrapes, splits, cold shuts, and other imperfections detrimental to usage of the wire. The surface of the wire shall be free from lubricant and have a bright, smooth finish free from pits, abrasions, and other defects.

3.5 Tolerances:

Shall be as follows:

3.5.1 Round and Square Wire: Shall be as shown in Table 6.

TABLE 6A - Round and Square Wire Tolerance, Inch/Pound Units

Nominal Diameter or Thickness Inch	Tolerance, Inch Plus and Minus
0.003 to 0.005, excl	0.0001
0.005 to 0.008, excl	0.0002
0.008 to 0.012, excl	0.0003
0.012 to 0.024, excl	0.0004
0.024 to 0.033, excl	0.0005
0.033 to 0.044, excl	0.0008
0.044 to 0.312, excl	0.0010
0.312 to 0.500, excl	0.0015
0.500 to 0.625, incl	0.0020

TABLE 6B - Round and Square Wire Tolerance, SI Units

Nominal Diameter or Thickness Millimeters	Tolerance Millimeter Plus and Minus
0.08 to 0.13, excl	0.003
0.13 to 0.20, excl	0.005
0.20 to 0.30, excl	0.008
0.30 to 0.61, excl	0.010
0.61 to 0.84, excl	0.013
0.84 to 1.12, excl	0.020
1.12 to 7.92, excl	0.025
7.92 to 12.70, excl	0.038
12.79 to 15.88, incl	0.051

3.5.2 Out-of-Roundness: Round wire shall not be out-of round by more than one-half the total permissible tolerance in 3.5.1.

3.5.3 Flat Wire 0.062 to 0.375 Inch (1.57 to 9.52 mm), Inclusive, in Nominal Width: Shall be as shown in Table 7:

TABLE 7A - Flat Wire Tolerances, Inch/Pound Units

Nominal Thickness Inch	Tolerance, Inch Plus and Minus Thickness	Tolerance, Inch Plus and Minus Width
Up to 0.029, excl	0.0010	0.005
0.029 to 0.035, excl	0.0015	0.005
0.035 to 0.3125, incl	0.0020	0.005

TABLE 7B - Flat Wire Tolerances, SI Units

Nominal Thickness Millimeters	Tolerance, Millimeter Plus and Minus Thickness	Tolerance, Millimeter Plus and Minus Width
Up to 0.74, excl	0.025	0.13
0.74 to 0.89, excl	0.038	0.13
0.89 to 7.937, incl	0.051	0.13

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of wire shall supply all samples for vendor'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 wire conforms to specified requirements.

4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2371.

4.4 Reports:

The vendor of wire shall furnish with each shipment a report showing the results of tests for composition of each heat and for tensile properties and wrapping as supplied, tensile properties after precipitation heat treatment, tensile properties after solution and precipitation heat treatment of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot number, AMS 5699G, size, and quantity.