AEROSPACE MATERIAL SPECIFICATION

AMS5772™	REV. F

Issued 1971-05
Reaffirmed 2009-06
Revised 2021-09

Superseding AMS5772E

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

RATIONALE

AMS5772F updated composition tests (3.1), adds bar conditions (3.2.1), adds strain rate control (3.4.1.1.1), allows tensile tests to accept product in lieu of hardness (3.4.1.2), prohibits unauthorized exceptions (3.7, 4.5.8, 5.2.1.1, 8.6), allows prior revisions (8.5), updates ordering information (8.7), and is the result of a Five-Year Review and update of the specification.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat-resistant cobalt alloy in the form of bars, forgings, flash welded rings, and stock for forging or flash welded rings.

1.2 Application

These products have been used typically for 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.

AMS2261 Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire

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/AMS5772F

AMS2374 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings

AMS2750 Pyrometry

AMS2806 Identification Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys

AMS2808 Identification Forgings

AMS7490 Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels, Austenitic-Type Iron, Nickel or Cobalt Alloys, or Precipitation-Hardenable Alloys

ARP1917 Clarification of 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 E10 Brinell Hardness of Metallic Materials

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

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 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 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 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 Bars

3.2.1.1 Bars shall be hot finished or cold finished and solution heat treated; round bars shall be ground or turned.

3.2.1.2 Bars shall not be cut from plate (also see 4.5.5).

3.2.2 Forgings and Flash Welded Rings

Solution heat treated. Surface finish shall be as agreed upon by purchaser and the forging or flash welded ring manufacturer.

3.2.2.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, rings shall be manufactured in accordance with AMS7490.

3.2.3 Stock for Forging or Flash Welded Rings

As ordered by the forging or flash welded ring manufacturer.

3.3 Solution Heat Treatment

Bars, forgings, and flash welded rings shall be solution heat treated by heating to 2150 °F ± 25 °F (1177 °C ± 14 °C), holding at heat for a time commensurate with cross-sectional thickness, and cooling at a rate which will produce product meeting the requirements of 3.4.1.1, 3.4.1.2, and 3.4.1.3. Pyrometry shall be in accordance with AMS2750.

3.3.1 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 Bars, Forgings, and Flash Welded Rings

3.4.1.1 Tensile Properties

Specimens, taken in the longitudinal direction from bars, in the circumferential direction from parent metal of flash welded rings, and from forgings in locations agreed upon by purchaser and producer, shall have the properties shown in Table 2, determined in accordance with ASTM E8/E8M.

Table 2 - Minimum tensile properties

Property	Value
Tensile Strength	125 ksi (862 MPa)
Yield Strength at 0.2% Offset	55 ksi (379 MPa)
Elongation in 4D	45%

3.4.1.1.1 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.

3.4.1.2 Hardness

Shall be as follows, determined in accordance with ASTM E10. 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.

3.4.1.2.1 Bars

Not higher than 302 HB, or equivalent (see 8.2), determined approximately midway between center and surface.

3.4.1.2.2 Forgings and Flash Welded Rings

Not higher than 293 HB, or equivalent (see 8.2).

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

A tensile specimen, maintained at 1700 °F ± 3 °F (927 °C ± 2 °C) while a load sufficient to produce an initial axial stress of 13.0 ksi (90 MPa) or higher is applied continuously to specimens from bars and flash welded rings and of 12.0 ksi (83 MPa) or higher is similarly applied to specimens from forgings, 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 not less than 15% in 4D. Test shall be conducted in accordance with ASTM E139.

3.4.1.3.1 The test of 3.4.1.3 may be conducted using incremental loading. In such case, the load required to produce the applicable initial axial stress specified in 3.4.1.3 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 (14 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.3.

3.4.1.4 Oxidation Resistance

Shall be as follows, determined in accordance with 4.4.1:

3.4.1.4.1 Metal converted to oxide scale plus any continuous intergranular oxidation shall not exceed an average of 0.0015 inch (0.038 mm) on each side or 0.003 inch (0.08 mm) on each specimen.

3.4.1.4.2 Specimens displaying localized areas greater than 0.062 inch (1.57 mm) in diameter with excessive oxidation attack, unless such attack can be attributed to contact with ceramic supports, shall be considered invalid and the test repeated. If the condition is duplicated, the product is not acceptable.

3.4.2 Forging Stock

When a sample of stock is forged to a test coupon and solution heat treated as in 3.3, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.1, 3.4.1.2.2, 3.4.1.3, and 3.4.1.4. If specimens taken from the stock after heat treatment as in 3.3 conform to the requirements of 3.4.1.1, 3.4.1.2.2, 3.4.1.3, and 3.4.1.4, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4.3 Stock for Flash Welded Rings

Specimens taken from the stock after solution heat treatment as in 3.3 shall conform to the requirements of 3.4.1.1, 3.4.1.2.2, 3.4.1.3, and 3.4.1.4.

3.5 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.

3.5.1 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.6 Tolerances

Bars shall conform to all applicable requirements of AMS2261.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.5.8.

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

Composition (3.1), tensile properties (3.4.1.1), hardness (3.4.1.2), stress-rupture properties (3.4.1.3), and oxidation resistance (3.4.1.4) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests

Tests of forging stock (3.4.2) and of stock for flash welded rings (3.4.3) to demonstrate ability to develop required properties and grain flow of die forgings (3.5.1) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

Shall be as follows:

4.3.1 Bars, Flash Welded Rings, and Stock for Forging or Flash Welded Rings

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.

4.4 Test Methods

4.4.1 Oxidation Resistance

4.4.1.1 Specimen Preparation

Specimens shall have surface area not less than 1.5 square inches (9.7 cm^2) available for exposure in excess of material required for fixturing. Both sides of the specimen shall have a 120 grit surface finish. Specimens' dimensions shall be measured within ±0.0003 inch (±0.008 mm). Specimens shall be degreased.

4.4.1.2 Testing

Specimens shall be subjected to four cycles, each cycle consisting of heating to 2000 to 2100 °F (1093 to 1149 °C), holding at the selected temperature within ±25 °F (±14 °C) for 25 hours ± 1 hour, and cooling in air to 300 °F (149 °C) or lower between each cycle for a total of 100 hours ± 4 hours at heat. Specimens may be partially inserted into inert ceramic bricks or suspended from inert ceramic rods or suitable metallic rods, but shall not be placed in crucibles. The specimens may be tested in a muffle or comparable furnace providing air flow is such that the required surface areas are equally exposed to the flowing air and temperature.

4.4.1.3 Examination

Test specimens shall be cross sectioned and examined metallographically in the as-polished condition at not lower than 500X magnification. Not less than eight randomly selected surface areas, 0.008 inch (0.20 mm) in length, shall be measured and the values averaged to determine compliance with 3.4.1.4.

4.5 Reports

The producer of the product shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the following results of tests and relevant information:

4.5.1 For each heat:

Composition

4.5.2 For each lot of bars, forgings, and flash welded rings:

Tensile properties
Hardness
Stress-rupture properties
Oxidation resistance

4.5.3 A statement that the product conforms to the other technical requirements.

4.5.4 Purchase order number
Heat and lot numbers
AMS5772F
Size
Quantity

4.5.5 If the ship size/shape is cut from a larger cross section, report the nominal metallurgically worked size (also see 3.2.1.1).

4.5.6 If forgings are supplied, the size and melt source of stock used to make the forgings.

4.5.7 The producer of stock for forging or flash welded rings shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the results of tests for composition of each heat. This report shall include the purchase order number, AMS5772F, size, and quantity.

4.5.8 When material produced to this specification has exceptions taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS5772F(EXC) because of the following exceptions:" and the specific exceptions shall be listed (also see 5.2.1.1).

4.6 Resampling and Retesting

Shall be as follows: