



# AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.  
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

**AMS 5759F**  
Superseding AMS 5759E

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ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT  
52Co - 20Cr - 10Ni - 15W

## 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: Primarily for parts and assemblies requiring high strength up to 1500° F (815° C) and oxidation resistance up to 2000° F (1095° C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

### 2.1.1 Aerospace Material Specifications:

AMS 2261 - Tolerances, Nickel, Nickel Base, and Cobalt Base Alloy Bars and Forging Stock

AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys

AMS 2350 - Standards and Test Methods

AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock

AMS 2374 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Forgings and Forging Stock

AMS 2375 - Control of Forgings Requiring First Article Approval

AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys

AMS 2808 - Identification, Forgings

AMS 7490 - Rings, Flash Welded, Corrosion and Heat Resistant, Austenitic Steels and Austenitic-Type Alloys

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, 19103.

ASTM E8 - Tension Testing of Metallic Materials

ASTM E10 - Brinell Hardness of Metallic Materials

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

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

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	0.05 -	0.15
Manganese	1.00 -	2.00
Silicon	--	0.40
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	19.00 -	21.00
Nickel	9.00 -	11.00
Tungsten	14.00 -	16.00
Iron	--	3.00
Cobalt	remainder	

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

- 3.2 Condition: The product shall be supplied in the following condition:

- 3.2.1 Bars: Hot rolled and solution heat treated.

- 3.2.2 Forgings and Flash Welded Rings: Solution heat treated.

- 3.2.2.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, they shall be manufactured in accordance with AMS 7490.

- 3.2.3 Stock for Forging or Flash Welded Rings: As ordered by the forging or flash welded ring manufacturer.

- 3.3 Heat Treatment: Bars, forgings, and flash welded rings shall be solution heat treated by heating to a temperature within the range 2150° - 2250° F (1175 - 1230° C), holding at the selected temperature within  $\pm 25^\circ$  F ( $\pm 15^\circ$  C) for not less than 15 min., and either quenching in water or cooling rapidly in air.

- 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: Shall be as follows, determined in accordance with ASTM E8:

Tensile Strength, min	125,000 psi (862 MPa)
Yield Strength at 0.2% Offset, min	45,000 psi (310 MPa)
Elongation in 4D, min	30%

- 3.4.1.2 Hardness: Should be as follows, determined in accordance with ASTM E10, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.
- 3.4.1.2.1 Bars: Not higher than 275 HB or equivalent, taken approximately midway between surface and center.
- 3.4.1.2.2 Forgings: Not higher than 248 HB or equivalent.
- 3.4.1.2.3 Flash Welded Rings: Not higher than 302 HB or equivalent.
- 3.4.1.3 Stress-Rupture Properties at 1500° F (816° C): A tensile specimen, maintained at 1500° F  $\pm$  3 (816° C  $\pm$  2) while a load sufficient to produce an initial axial stress of 24,000 psi (165 MPa) is applied continuously, shall not rupture in less than 24 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 10% in 4D. Tests shall be conducted in accordance with ASTM E139.
- 3.4.1.3.1 The test of 3.4.1.3 may be conducted using a load higher than required to produce an initial axial stress of 24,000 psi (165 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.1.3.
- 3.4.1.3.2 When permitted by purchaser, the test of 3.4.1.3 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 24,000 psi (165 MPa) shall be used to rupture or for 24 hr, whichever occurs first. After the 24 hr and at intervals of 8 - 16 hr, preferably 8 - 10 hr, thereafter, the stress shall be increased in increments of 5000 psi (34.5 MPa). Elongation requirement shall be as specified in 3.4.1.3.
- 3.4.2 Forging Stock: When a sample of stock is forged to a test coupon and 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, and 3.4.1.3. 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, and 3.4.1.3, 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 heat treatment as in 3.3 shall conform to the requirements of 3.4.1.1, 3.4.1.2, and 3.4.1.3.
- 3.5 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.
- 3.6 Tolerances: Unless otherwise specified, tolerances for bars and forging stock shall conform to all applicable requirements of AMS 2261.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of the product shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.
- 4.2 Classification of Tests:
- 4.2.1 Acceptance Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

- 4.2.2 Preproduction Tests: Tests of forgings to determine conformance to all technical requirements of this specification when AMS 2375 is specified are classified as preproduction tests and shall be performed on the first-article shipment of a forging to a purchaser, when a change in material or processing requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.
- 4.2.2.1 For direct U.S. Military procurement of forgings, substantiating test data and, when requested, preproduction forgings shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.
- 4.3 Sampling: Shall be in accordance with the following:
- 4.3.1 Bars, Flash Welded Rings, and Stock for Flash Welded Rings: AMS 2371 and as follows:
- 4.3.1.1 Specimens from flash welded rings shall be cut from parent metal not including the weld heat affected zone.
- 4.3.2 Forgings and Forging Stock: AMS 2374.
- 4.4 Approval: When specified, approval and control of forgings shall be in accordance with AMS 2375.
- 4.5 Reports:
- 4.5.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and the results of tests for tensile properties, hardness, and stress-rupture properties of each size from each heat and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number and its revision letter, specific solution heat treat temperature used, size, and quantity from each heat. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.
- 4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.
- 4.6 Resampling and Retesting: Shall be in accordance with the following:
- 4.6.1 Bars, Flash Welded Rings, and Stock for Flash Welded Rings: AMS 2371.
- 4.6.2 Forgings and Forging Stock: AMS 2374.
5. PREPARATION FOR DELIVERY:
- 5.1 Identification: The product shall be identified as follows:
- 5.1.1 Bars: In accordance with AMS 2806.
- 5.1.2 Forgings: In accordance with AMS 2808.
- 5.1.3 Flash Welded Rings and Stock for Forging or Flash Welded Rings: As agreed upon by purchaser and vendor.
- 5.2 Packaging: