



<b>78AEROSPACE MATERIAL SPECIFICATION</b>	<b>AMS5754™</b>	<b>REV. P</b>
	Issued 1954-05 Reaffirmed 2012-10 Revised 2024-09	
Superseding AMS5754N		
Nickel Alloy, Corrosion- and Heat-Resistant, Bars, Forgings, Rings, and Forging, Ring, and Heading Stock 47.5Ni - 22Cr - 1.5Co - 9.0Mo - 0.60W - 18.5Fe (Alloy X) Solution Heat Treated (Composition similar to UNS N06002)		

### RATIONALE

AMS5754P is the result of a Five-Year Review and update of the specification. The revision revises the Title to match the Scope, updates composition testing and reporting (see 3.1 and 3.1.1), adds option for larger bar sizes (see 3.2.1.2), adds pyrometry controls and option for continuous heat treatment (see 3.3.1 and 3.3.2), adds an option for additional forging stock properties (see 4.4.2 and 8.6), and updates the exceptions requirements (see 8.5).

#### 1. SCOPE

##### 1.1 Form

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

##### 1.2 Application

These products have been used typically for parts, such as turbine rotors, shafts, flanges, blades, and bolts, requiring oxidation resistance up to 2200 °F (1204 °C) and relatively high strength above 1500 °F (816 °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](http://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

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AMS2283	Composition Testing Methods for Nickel- and Cobalt-Based Alloys
AMS2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS2374	Quality Assurance Sampling and Testing, Corrosion- and Heat-Resistant Steel and Alloy Forgings
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
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](http://www.astm.org).

ASTM E10	Brinell Hardness of Metallic Materials
ASTM E139	Conducting 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

## 2.3 Definitions

Terms used in AMS are defined in AS7766.

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Composition shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2283 or by other analytical methods acceptable to the purchaser.

**Table 1 - Composition**

Element	Min	Max
Carbon	0.05	0.15
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	20.50	23.00
Cobalt	0.50	2.50
Molybdenum	8.00	10.00
Tungsten	0.20	1.00
Iron	17.00	20.00
Boron <sup>1</sup>	--	0.010
Aluminum <sup>1</sup>	--	0.50
Titanium	--	0.15
Copper	--	0.50
Nickel	remainder	

<sup>1</sup>Shall be present but not in excess of value specified

3.1.1 The 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 Bars

3.2.1.1 Bars shall be hot finished, solution heat treated, and descaled, except round bars shall be ground or turned.

3.2.1.2 Bars, other than hexagons, over 2.75 inches (69.8 mm) in nominal diameter or least distance between parallel sides, shall be hot finished or cold finished.

3.2.1.3 Bars shall not be cut from plate (see 4.4.1.2).

#### 3.2.2 Forgings and Flash-welded Rings

Forgings and flash-welded rings shall be solution heat treated and descaled.

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

#### 3.2.3 Stock for Forging or Flash-welded Rings

Stock for forging or flash-welded rings shall be as ordered by the forging or flash-welded ring manufacturer.

#### 3.2.4 Stock for Heading

Stock for heading shall be solution heat treated, cold reduced, and centerless ground.

### 3.3 Heat Treatment

3.3.1 Bars, forgings, flash-welded rings and stock for heading shall be solution heat treated by heating within the range 2100 to 2150 °F (1149 to 1177 °C), holding at the selected temperature within  $\pm 25$  °F ( $\pm 14$  °C) for a time commensurate with cross-sectional thickness but not less than 20 minutes, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS2750.

#### 3.3.2 Continuous Heat Treatment

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 requirements of 3.4

### 3.4 Properties

The product shall conform to the following requirements:

#### 3.4.1 Bars, Forgings, and Flash-welded Rings

##### 3.4.1.1 Hardness

Hardness shall be as follows, determined in accordance with ASTM E10:

##### 3.4.1.1.1 Bars and Forgings

Hardness for bars and forgings shall not be higher than 241 HBW, or equivalent (see 8.2). Hardness of bars shall be determined at approximately mid-radius of rounds and at approximately T/4 of other shapes.

##### 3.4.1.1.2 Flash-welded Rings

Hardness for flash-welded rings shall not be higher than 277 HBW, or equivalent (see 8.2), after sizing.

##### 3.4.1.2 Stress-Rupture Properties at 1500 °F (816 °C)

A tensile specimen, maintained at 1500 °F  $\pm$  3 °F (816 °C  $\pm$  2 °C) while a load sufficient to produce an initial axial stress of 15.0 ksi (103 MPa) or higher 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.

3.4.1.2.1 The test of 3.4.1.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 15.0 ksi (103 MPa) or higher shall be used to rupture or for 24 hours, whichever occurs first. After the 24 hours and at intervals of 8 hours minimum thereafter, the stress shall be increased in increments of 5.0 ksi (34.5 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.2.

#### 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 and 3.4.1.2. If specimens taken from the stock after heat treatment as in 3.3 conform to the requirements of 3.4.1.1 and 3.4.1.2, the tests shall be accepted as equivalent to tests of a forged coupon.

#### 3.4.3 Stock for Flash-welded Rings or Heading

Specimens taken from the stock after heat treatment as in 3.3 shall conform to the requirements of 3.4.1.1 and 3.4.1.2.

### 3.5 Quality

The product, as received by the 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 4.4.1.1.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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

The following requirements are acceptance tests and shall be performed on each heat or lot as applicable:

Composition (see 3.1) of each heat.

Hardness (see 3.4.1.1) and stress-rupture properties (see 3.4.1.2) of each lot of bars, forgings, and flash-welded rings.

Tolerances (see 3.6) of bars.

#### 4.2.2 Periodic Tests

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

### 4.3 Sampling and Testing

Sampling shall be as follows:

4.3.1 Bars, flash-welded rings, and stock for forging, flash-welded rings, or heading shall be sampled in accordance with AMS2371.

4.3.2 Forgings shall be sampled in accordance with AMS2374 and as follows:

4.3.2.1 Specimens for stress-rupture tests of forgings shall be taken from any plane perpendicular to the axis of the forging with axis of specimen in the selected plane perpendicular to a radius. When size and shape permit, additional specimens shall be taken with the axis of specimen approximately parallel to the axis of the forging. Size, location, and number of specimens shall be as agreed upon by the purchaser and producer (see 8.6).

### 4.4 Reports

4.4.1 The producer of bars, forgings, and flash-welded rings shall furnish with each shipment a report showing the producer's name; country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations); the results of tests for composition of each heat; the results of tests for hardness and stress-rupture properties 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 numbers, AMS5754P, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.1.1 When material produced to this specification has exceptions taken to the technical requirements listed in Section 3 (see 5.2.1.1), the report shall contain a statement "This material is certified as AMS5754P(EXC) because of the following exceptions:" and the specific exceptions shall be listed.

4.4.1.2 Report the nominal metallurgically worked cross-sectional size and the cut size, if different (see 3.2.1.3).

4.4.2 The producer of stock for forging, flash-welded rings, or heading shall furnish with each shipment a report showing the producer's name; country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations); the results of tests for composition of each heat; and the results of any additional property requirements imposed by 8.6. This report shall include the purchase order number, heat and lot numbers, AMS5754P, product form, size or part number, and quantity.