



AEROSPACE MATERIAL SPECIFICATION	AMS5665™	REV. R
	Issued 1940-10 Reaffirmed 2006-10 Revised 2023-05	
Superseding AMS5665P		
Nickel Alloy, Corrosion- and Heat-Resistant, Bars, Forgings, and Rings and Stock for Forgings and Rings 74Ni - 15.5Cr - 8.0Fe (Composition similar to UNS N06600)		

RATIONALE

AMS5665R is the result of a Five-Year Review and update of the specification. The revision removes the size limits (1.1), updates the Title to match the Scope, updates composition and reporting (3.1, 3.1.1), adds strain rate control (3.3.1.1.1), adds note on mechanical properties (Table 2), adds requirements for selling (EXC) marked product (8.5), authorizes additional testing on forging stock (4.4.2, 8.6), and adds ordering information to address alternate conditions (8.6).

1. SCOPE

1.1 Form

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

1.2 Application

These products have been used typically for parts requiring both corrosion and oxidation resistance, where such parts may require welding during fabrication, and for parts requiring oxidation resistance up to 2000 °F (1093 °C) but is useful at the higher temperatures only when stresses are low, but usage is not limited to such applications. Strength at elevated temperatures is similar to that of the 18-8 type steels.

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

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2023 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

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
<http://www.sae.org>

SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS5665R>

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.

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E10 Brinell Hardness of Metallic Materials

ASTM E18 Rockwell Hardness 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

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	--	0.15
Manganese	--	1.00
Silicon	--	0.50
Sulfur	--	0.015
Chromium	14.00	17.00
Nickel	72.00	--
Iron	6.00	10.00
Cobalt	--	1.00
Columbium (Niobium)	--	1.00
Titanium	--	0.50
Aluminum	--	0.35
Copper	--	0.50

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 requirements of AMS2269.

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Bars

3.2.1.1 Rounds 2.50 Inches (63.5 mm) and Under in Nominal Diameter

Cold drawn unless ordered hot finished or annealed and turned or ground.

3.2.1.2 Rounds Over 2.50 Inches (63.5 mm) in Nominal Diameter

Hot finished and annealed or hot finished and turned or ground.

3.2.1.3 Squares, Hexagons, and Rectangles

Hot finished.

3.2.1.4 Bars shall not be cut from plate (see 4.4.1.1).

3.2.2 Forgings and Flash Welded Rings

Annealed.

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

As ordered by the forging or flash welded ring manufacturer.

3.3 Properties

The product shall conform to the following requirements:

3.3.1 Bars, Forgings, and Flash Welded Rings

3.3.1.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M on specimens taken from round bars over 2.50 to 4.50 inches (over 63.5 to 114.3 mm), inclusive, in nominal diameter and from forgings over 2.50 inches (63.5 mm) in nominal thickness.

Table 2 - Minimum tensile properties¹

Properties	Bars	Forgings
Tensile Strength	85 ksi (586 MPa)	80 ksi (552 MPa)
Yield Strength at 0.2% Offset	35 ksi (241 MPa)	30 ksi (207 MPa)
Elongation in 4D	30%	35%

¹ Minimum properties are based on ASTM B166 and ASTM B564 and are not based on AMS statistical guidelines.

3.3.1.1.1 Unless otherwise specified, the strain rate for all room and elevated temperature tensile tests, 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. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.3.1.1.2 Tensile property requirements for square, hexagonal, and rectangular bars, for round bars 2.50 inches (63.5 mm) and under in nominal diameter, for forgings 2.50 inches (63.5 mm) and under in nominal thickness, and for flash welded rings, when required, shall be as agreed upon by the purchaser and producer (8.6).

3.3.1.2 Hardness

Shall be as follows, or equivalent (see 8.2), determined in accordance with ASTM E10 or ASTM E18.

3.3.1.2.1 Bars

As shown in Table 3.

Table 3 - Hardness

Properties	Thickness Inches	Thickness Millimeters	Hardness
Cold Drawn (only)	Up to 1.00, incl	Up to 25.4, incl	229 - 311 HB
	Over 1.00 to 2.50, incl	Over 25.4 to 63.5, incl	207 - 285 HB
Hot Finished (only)	Up to 0.50, incl	Up to 12.7, incl	134 - 241 HB
	Over 0.50	Over 12.7	134 - 217 HB

3.3.1.2.2 Forgings

Not higher than 187 HB, or equivalent (see 8.2).

3.3.1.2.3 Flash Welded Rings

Not higher than 217 HB, or equivalent (see 8.2).

3.3.2 Stock for Forging or Flash Welded Rings

Shall have properties as agreed upon by the purchaser and producer.

3.4 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.

3.4.1 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.

3.5 Tolerances

Bars shall conform to all applicable requirements of AMS2261.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.4.

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

Composition (3.1), tensile properties (3.3.1.1), hardness (3.3.1.2), and tolerances (3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests

Grain flow of die forgings (3.4.1) is a periodic test 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

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 Reports

4.4.1 The producer of product shall furnish with each shipment a report of 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 chemical composition of each heat and the condition, hardness, and tensile properties, when applicable, 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, AMS5665R, 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 Report the nominal metallurgically worked size and cut size if different (see 3.2.1.4).

4.4.1.2 When material produced to this specification has exceptions authorized by the purchaser 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 AMS5665R(EXC) because of the following exceptions:" and the specific exceptions shall be listed.

4.4.2 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 and any additional requirements imposed by 8.6. This report shall include the purchase order number, heat number, AMS5665R, size, and quantity.

4.5 Resampling and Retesting

Shall be as follows:

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

In accordance with AMS2371.