AEROSPACE MATERIAL SPECIFICATION

AMS5654™	REV. H

Issued 1967-11
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Superseding AMS5654G

(R) Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Mechanical Tubing, Rings and Forging Stock
18Cr - 11Ni - 0.60Cb (Nb) (347)
Premium Aircraft Quality, Consumable Electrode Melted
Solution Heat Treated

(Composition similar to UNS S34700)

RATIONALE

AMS5654H is the result of a Five-Year Review and update of the specification. The revision updates the Title to match the Scope, adds properties for small diameter bars, removing the associated original size limitations (see 3.4.1.1, Table 2, and 1.1), updates composition reporting (see 3.1.1), adds hot finish and cold finished properties (see Table 3), adds strain rate control during tensile testing (see 3.4.1.3), revises micro-inclusion rating method (see 3.4.4), adds quality requirements and associated guidance (see 3.5.2 and 8.5), and prohibits exceptions based on the new product sizes covered (see 4.4.2, 5.2.1.1, and 8.6).

1. SCOPE

1.1 Form

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

1.2 Application

These products have been used typically for parts requiring corrosion and heat resistance and subject to very rigid inspection standards, especially when such parts are welded during fabrication, for parts requiring oxidation resistance up to 1500 °F (816 °C) but useful at that temperature only when stresses are low, 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.

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/AMS5654H

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.

AMS2241 Tolerances, Corrosion- and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire

AMS2243 Tolerances, Corrosion and Heat-Resistant Steel Tubing

AMS2248 Chemical Check Analysis Limits, Corrosion- and Heat-Resistant Steels and Alloys, Maraging and Other Highly Alloyed Steels, and Iron 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 A262 Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

ASTM A276 Stainless Steel Bars and Shapes

ASTM A370 Mechanical Testing of Steel Products

ASTM A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

ASTM E45 Determining the Inclusion Content of Steel

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 ASTM A751 or by other analytical methods acceptable to the purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.08
Manganese	--	2.00
Silicon	--	1.00
Phosphorus	--	0.020
Sulfur	--	0.020
Chromium	17.00	19.00
Nickel	9.00	13.00
Columbium (Niobium)	10xC	1.10
Molybdenum	--	0.75
Copper	--	0.75

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 AMS2248.

3.2 Melting Practice

Product shall be multiple melted using consumable electrode practice in the remelt cycle.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars, Wire, Forgings, Mechanical Tubing, and Flash Welded Rings

Solution heat treated.

3.3.1.1 Bars and Wire

3.3.1.1.1 All hexagons, other bars 2.75 inches (69.8 mm) and under in nominal diameter or least distance between parallel sides, and wire shall be cold finished.

3.3.1.1.2 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.

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

3.3.1.2 Mechanical Tubing

Shall be cold finished.

3.3.1.3 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.

3.3.2 Stock for Forging or Flash Welded Rings

As ordered by the forging or flash welded ring manufacturer.

3.4 Properties

The product shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.4.1 Tensile Properties

3.4.1.1 Properties for bars 0.50 inch (12.7 mm) and under in nominal diameter or least distance between parallel sides shall be as shown in Table 2.

Table 2 - Minimum tensile properties- bar up to 0.5 inch (12.7mm) inclusive

Property	Value
Tensile Strength	90.0 ksi (620 MPa)
Yield Strength at 0.2% Offset	45 ksi (310 MPa)
Elongation in 4D or 2 inch (50 mm)	30%
Reduction of Area	40%

Note: Minimum tensile properties for bars and forgings have been taken directly from ASTM A276 and ASTM A473 and are not based on AMS Statistical Guidelines

3.4.1.2 Properties for bars over 0.50 inch (12.7 mm) in nominal diameter or least distance between parallel sides and all forgings shall be as shown in Table 3.

Table 3 - Minimum tensile properties-bars over 0.50 inch (12.7 mm) and all forgings

Property	Value
Tensile Strength	75.0 ksi (517 MPa)
Yield Strength at 0.2% Offset	30 ksi (206.8 MPa)
Elongation in 4D or 2 inches (50 mm)	
Hot Finished	40%
Cold Finished	30%
Reduction of Area	
Hot Finished	50%
Cold Finished	40%

Note: Minimum tensile properties for bars and forgings have been taken directly from ASTM A276 and are not based on AMS Statistical Guidelines

3.4.1.3 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. 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 parallel 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.

3.4.1.4 Wire shall have tensile strength not higher than 125 ksi (862 MPa).

3.4.2 Hardness

3.4.2.1 Bars

Shall be as shown in Table 4, or equivalent (see 8.2), determined approximately at mid-radius or quarter thickness.

Table 4 - Hardness, HBW

Nominal Diameter or Least Distance Between Parallel Sides Inches	Nominal Diameter or Least Distance Between Parallel Sides Millimeters	Min	Max
Up to 2.00, incl	Up to 50.8, incl	140	255
Over 2.00	Over 50.8	--	255

3.4.2.2 Mechanical Tubing

Shall be not higher than 90 HRB, or equivalent (see 8.2), determined approximately midway between outer and inner surfaces.

3.4.2.3 Forgings and Flash Welded Rings

Shall be not higher than 187 HBW, or equivalent (see 8.2).

3.4.3 Susceptibility to Intergranular Attack

The product, after sensitizing treatment, shall pass the intergranular corrosion test performed in accordance with ASTM A262, Practice E.

3.4.4 Micro-Inclusion Rating

No specimen shall exceed the limits shown in Table 5, determined in accordance with ASTM E45, Method A, except that the length of any inclusion shall be not greater than 0.015 inch (0.38 mm).

Table 5 - Micro-inclusion rating limits

Type	A	B	C	D
Thin	2.0	1.5	1.5	1.5
Heavy	1.0	1.0	1.0	1.5

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 re-entrant grain flow.

3.5.2 Bars and mechanical tubing shall be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182.

3.6 Tolerances

Shall be as follows:

3.6.1 Bars and Wire

In accordance with AMS2241.

3.6.2 Mechanical Tubing

In accordance with AMS2243.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.2.

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:

4.2.1.1 Composition (see 3.1) and micro-inclusion rating (see 3.4.4) of each heat.

4.2.1.2 Tensile properties (see 3.4.1) of each lot of bars and wire.

4.2.1.3 Hardness (see 3.4.2) of each lot of bars, mechanical tubing, forgings, and flash welded rings.

4.2.1.4 Tolerances (see 3.6) of bars, wire, and mechanical tubing.

4.2.2 Periodic Tests

Susceptibility to intergranular attack (see 3.4.3) 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

Shall be as follows:

4.3.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Forging or Flash Welded Rings

In accordance with AMS2371.

4.3.2 Forgings

In accordance with AMS2374.