# AEROSPACE MATERIAL SPECIFICATION

| AMS5651™ | REV. L |
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Superseding AMS5651K

# Steel, Corrosion- and Heat-Resistant, Bars, Wire, Forgings, Mechanical Tubing, Rings, and Stock for Forging and Rings, 25Cr - 20Ni (310), Solution Heat Treated

(Composition similar to UNS S31008)



RATIONALE

AMS5651L is the result of a Five-Year Review and update of the specification. The revision revises composition testing and reporting (see 3.1 and 3.1.1), adds finish/quality requirements for bar and tubing (see 3.4.2 and 8.5), and updates the exceptions requirements (see 4.4.4, 4.4.6, 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 oxidation resistance up to 2000 °F (1093 °C) and good corrosion resistance, for parts that will be subjected to elevated temperatures during fabrication or in service, and especially where such parts may require welding during fabrication, 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.

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

AMS2243 Tolerances, Corrosion and Heat-Resistant Steel Tubing



**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/AMS5651L/

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

AS1182 Standard Stock Removal Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel, Bars and Mechanical Tubing

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 A370 Mechanical Testing of Steel Products

ASTM A751 Chemical Analysis of Steel Products

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

***Table 1 - Composition***

| Element | Min | Max |
|---|---|---|
| Carbon | -- | 0.08 |
| Manganese | -- | 2.00 |
| Silicon | 0.30 | 0.80 |
| Phosphorus | -- | 0.040 |
| Sulfur | -- | 0.030 |
| Chromium | 24.00 | 26.00 |
| Nickel | 19.00 | 22.00 |
| 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 applicable requirements of AMS2248.

3.2 Condition

The product shall be supplied in the following condition:

3.2.1 Bars, wire, forgings, mechanical tubing, and flash-welded rings shall be solution heat treated.

3.2.1.1 Bars shall not be cut from plate (see 4.4.6).

3.2.1.2 Bars and Wire

3.2.1.2.1 All hexagons, regardless of size, 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.

3.2.1.2.2 Bars over 2.75 inches (69.8 mm) in nominal diameter or least distance between parallel sides shall be hot finished and descaled or cold finished.

3.2.1.3 Mechanical Tubing

Mechanical tubing shall be cold finished.

3.2.1.4 Flash-Welded Rings

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.

3.2.2 Stock for Forging or Flash-Welded Rings

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

3.3 Properties

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

3.3.1 Tensile Properties

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

3.3.2 Hardness

3.3.2.1 Bars

Bar hardness shall not be higher than 187 HBW, or equivalent (see 8.2), except that, if supplied cold finished, hardness may be as high as 229 HBW, or equivalent (see 8.2), determined at approximately mid-radius or quarter-thickness.

3.3.2.2 Forgings and Flash-Welded Rings

Forging and flash-welded ring hardness shall not be higher than 187 HBW, or equivalent (see 8.2).

3.3.2.3 Mechanical Tubing

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

3.3.3 Susceptibility to Intergranular Attack

Specimens from the product shall pass the intergranular corrosion test performed in accordance with ASTM A262, Practice E.

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 that contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.4.2 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.

3.5 Tolerances

Tolerances shall be as follows:

3.5.1 Bars and wire shall be in accordance with AMS2241.

3.5.2 Mechanical tubing shall be in accordance with AMS2243.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.4.

## 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 (see 3.1), tensile strength of wire (see 3.3.1), hardness (see 3.3.2), and tolerances (see 3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

#### 4.2.2 Periodic Tests

Susceptibility to intergranular attack (see 3.3.2.4) and grain flow of die forgings (see 3.4.1) 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, wire, mechanical tubing, flash-welded rings, and stock for forging or flash-welded rings shall be sampled and tested in accordance with AMS2371.

4.3.2 Forgings shall be sampled and tested in accordance with AMS2374.

### 4.4 Reports

The producer of the product 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), and the following results of tests and relevant information:

#### 4.4.1 For Each Heat

Composition.

#### 4.4.2 For Each Lot of Bars, Wire, Forgings, Mechanical Tubing, and Flash-Welded Rings

Tensile strength, if wire.
Hardness.

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

4.4.4 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 AMS5651L(EXC) because of the following exceptions:" and the specific exceptions shall be listed.