AEROSPACE MATERIAL SPECIFICATION

AMS5931™	REV. B

Issued 1995-05
Reaffirmed 2018-10
Revised 2023-10

Superseding AMS5931A

Steel, Wear, Galling, and Corrosion-Resistant Bars, Wire, Forgings, Extrusions, Mechanical Tubing, Rings, and Stock for Forgings, Rings, and Extruding 5.0Mn - 3.5Si - 16.5Cr - 5.0Ni - 0.14N Solution Heat Treated

(Composition similar to UNS S20161)

RATIONALE

AMS5931B is the result of a Five-Year Review and update of the specification. The revision updates the Title to match the Scope, revises composition testing and reporting (see 3.1 and 3.1.1), prohibits bar being cut from plate (see 3.2.1.1.3 and 4.4.2), adds strain rate control during tensile testing (see 3.4.1.1.1), adds country of origin requirement to reporting (see 4.4), addresses option for additional forging stock properties (see 4.4.3 and 8.7), updates bar and tubing quality requirements (see 3.5.1 and 8.4), prohibits unauthorized exceptions (see 3.7, 4.4.4, 5.2.1.1, and 8.5), and allows the use of prior revisions (see 8.6).

1. SCOPE

1.1 Form

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

1.2 Application

These products have been used typically for parts requiring wear, galling, and corrosion resistance up to 950 °F (510 °C), but usage is not limited to such applications.

1.2.1 Welding, brazing, or other exposure to temperatures over 950 °F (510 °C) during fabrication may impair corrosion resistance.

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/AMS5931B

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

AMS2750 Pyrometry

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 Publication

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.

Table1 - Composition

Element	Min	Max
Carbon	--	0.15
Manganese	4.00	6.00
Silicon	3.00	4.00
Phosphorus	--	0.040
Sulfur	--	0.040
Chromium	15.00	18.00
Nickel	4.00	6.00
Nitrogen	0.08	0.20
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, extrusions, mechanical tubing, and flash-welded rings shall be solution heat treated.

3.2.1.1 Bars and Wire

3.2.1.1.1 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.

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

3.2.1.1.3 Bars shall not be cut from plate (see 4.4.2).

3.2.1.2 Mechanical tubing shall be cold finished.

3.2.1.3 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.

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

3.3 Heat Treatment

Bars, wire, forgings, extrusions, mechanical tubing, and flash-welded rings shall be solution heat treated by heating to 1950 °F ± 25 °F (1066 °C ± 14 °C), holding at heat for a time commensurate with section thickness, and cooling at a rate equivalent to an air cool. Pyrometry shall be in accordance with AMS2750.

3.4 Properties

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

3.4.1 Bars, Wire, Forgings, Extrusions, Mechanical Tubing, and Flash-Welded Rings

3.4.1.1 Tensile Properties shall be as shown in Table 2.

Table 2 - Minimum tensile properties

Property	Value
Tensile Strength	110 ksi (758 MPa)
Yield Strength at 0.2% Offset	50 ksi (345 MPa)
Elongation in 4D or 2 inches (50 mm)	45%
Reduction of Area	55%

3.4.1.1.1 Unless otherwise specified, the strain rate used for all tensile testing 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.

3.4.1.2 Hardness shall be as follows, or equivalent (see 8.2).

3.4.1.2.1 Bars shall be 187 to 255 HBW, determined at approximate mid-radius or quarter-thickness.

3.4.1.2.2 Forgings, extrusions, and flash-welded rings shall be 197 to 248 HBW.

3.4.1.2.3 Mechanical tubing shall not be higher than 100 HRB, determined approximately midway between outer and inner surfaces.

3.4.1.3 Susceptibility to Integranular Attack

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

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 acceptable as equivalent to tests of a forged coupon.

3.4.3 Stock for Extruding or 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 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 Bars and mechanical tubing be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182.

3.5.2 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

3.6.1 Tolerances for bar and wire shall be in accordance with AMS2241.

3.6.2 Tolerances for mechanical tubing shall be in accordance with AMS2243.

3.7 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

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

- Composition (see 3.1) of each heat
- Tensile properties (see 3.4.1.1) of each lot of bars, wire, forgings, extrusions, mechanical tubing, and flash-welded rings
- Hardness (see 3.4.1.2) of each lot of bars, forgings, extrusions, mechanical tubing, and flash-welded rings
- Tolerances (see 3.6) of bars, wire, and mechanical tubing

4.2.2 Periodic Tests

Susceptibility to intergranular attack (see 3.4.1.3), tests of forging stock (see 3.4.2) and stock for extruding or flash-welded rings (see 3.4.3) to demonstrate ability to develop required properties, and grain flow of die forgings (see 3.5.2) 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

4.3.1 Sampling and testing of bar, wire, extrusions, mechanical tubing, flash-welded rings, and stock for forging, extruding, or flash-welded rings shall be in accordance with AMS2371.

4.3.2 Sampling and testing of forgings shall be in accordance with AMS2374.