

# AEROSPACE MATERIAL SPECIFICATION

**SAE** AMS5931

REV. A

Issued 1995-05  
Revised 2005-08  
Reaffirmed 2012-04

Superseding AMS5931

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

(Composition similar to UNS S20161)

## RATIONALE

AMS5931A has been reaffirmed to comply with the SAE five-year review policy.

### 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.

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SAE WEB ADDRESS:

## 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://www.sae.org).

AMS 2241	Tolerances, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2243	Tolerances, Corrosion and Heat-Resistant Steel Tubing
AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2374	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings
AMS 2750	Pyrometry
AMS 2806	Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS 2808	Identification, Forgings
AMS 7490	Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels, Austenitic-Type Iron, Nickel, or Cobalt Alloys or Precipitation-Hardenable Alloys
AS1182	Standard Machining Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical Tubing

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM A 262	Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A 370	Mechanical Testing of Steel Products
ASTM E 353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

## 3. TECHNICAL REQUIREMENTS:

### 3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - 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 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248.

### 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: 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.

3.2.1.2 Mechanical Tubing: Shall be cold finished.

3.2.1.3 Flash Welded Rings: Shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, rings shall be manufactured in accordance with AMS 7490.

3.2.2 Stock for Forging, Extruding, or Flash Welded Rings: 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  $1950^{\circ}\text{F} \pm 25$  ( $1066^{\circ}\text{C} \pm 14$ ), 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 AMS 2750.

### 3.4 Properties:

The product shall conform to the following requirements; tensile and hardness testing shall be performed in accordance with ASTM A 370:

#### 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	45%
Reduction of Area	55%

##### 3.4.1.2 Hardness: Shall be as follows, or equivalent (See 8.2).

###### 3.4.1.2.1 Bars: 187 to 255 HB, determined at approximate mid-radius or quarter-thickness.

###### 3.4.1.2.2 Forgings, Extrusions, and Flash Welded Rings: 197 to 248 HB.

###### 3.4.1.2.3 Mechanical Tubing: Not higher than 100 HRB, determined approximately midway between outer and inner surfaces.

##### 3.4.1.3 Susceptibility to Intergranular Attack: Specimens from the product shall pass the intergranular corrosion test performed in accordance with ASTM A 262, 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 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 tubing ordered hot rolled or cold drawn, or ground, turned, or polished, shall, after removal of the standard machining allowance in accordance with AS1182, be free from seams, laps, tears, and cracks open to the ground, turned, or polished surface.

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:

Shall be as follows:

3.6.1 Bars and Wire: In accordance with AMS 2241.

3.6.2 Mechanical Tubing: In accordance with AMS 2243.

#### 4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. 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 (3.1) of each heat.

4.2.1.2 Tensile properties (3.4.1.1), of each lot of bars, wire, forgings, extrusions, mechanical tubing, and flash welded rings.

4.2.1.3 Hardness (3.4.1.2) of each lot of bars, forgings, extrusions, mechanical tubing, and flash welded rings.

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

4.2.2 Periodic Tests: Susceptibility to intergranular attack (3.4.1.3), tests of forging stock (3.4.2) and stock for extruding or flash welded rings (3.4.3) to demonstrate ability to develop required properties, and grain flow of die forgings (3.5.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 Bars, Wire, Extrusions, Mechanical Tubing, Flash Welded Rings, and Stock for Forging, Extruding, or Flash Welded Rings: In accordance with AMS 2371.



4.3.2 Forgings: In accordance with AMS 2374.

4.4 Reports:

The vendor of the product shall furnish with each shipment a report showing the results of tests for composition of each heat and for tensile properties and hardness 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, AMS 5931A, 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 The vendor of stock for forging, extruding, or flash welded rings shall furnish with each shipment a report showing the results of tests for composition of each heat. This report shall include the purchase order number, heat number, AMS 5931A, size, and quantity.

4.5 Resampling and Retesting:

Shall be as follows:

4.5.1 Bars, Wire, Extrusions, Mechanical Tubing, Flash Welded Rings, and Stock for Forging, Extruding, or Flash Welded Rings: In accordance with AMS 2371.

4.5.2 Forgings: In accordance with AMS 2374.

5. PREPARATION FOR DELIVERY:

5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight bars, wire, and tubing will be acceptable in mill lengths of 6 to 20 feet (1.8 to 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).

5.2 Identification:

Shall be as follows:

5.2.1 Bars, Wire, Extrusions, and Mechanical Tubing: In accordance with AMS 2806.

5.2.2 Forgings: In accordance with AMS 2808.

5.2.3 Flash Welded Rings and Stock for Forging, Extruding, or Flash Welded Rings: As agreed upon by purchaser and vendor.