

# AEROSPACE MATERIAL SPECIFICATION

**SAE**® **AMS 5653E**

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Superseding AMS 5653D

Submitted for recognition as an American National Standard

STEEL, CORROSION AND HEAT RESISTANT, BARS, WIRE, FORGINGS, TUBING, AND RINGS  
17Cr - 12Ni - 2SMo  
Solution Heat Treated

UNS S31603

## 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 both corrosion and heat resistance up to 1600 °F (871 °C), but usage is not limited to such applications.

- 1.2.1 At comparable elevated temperatures, strength of this steel is slightly higher than, and oxidation resistance is similar to, that of 18-8 type steels.

## 2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

### 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2241	Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
MAM 2241	Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2243	Tolerances, Corrosion and Heat Resistant Steel Tubing
MAM 2243	Tolerances, Metric, Corrosion and Heat Resistant Steel Tubing

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## 2.1 (Continued)

- 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 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 and Austenitic-Type Alloys, or Precipitation Hardenable Alloys

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

- 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

## 2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

## 3. TECHNICAL REQUIREMENTS:

## 3.1 Composition:

(R)

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	--	0.030
Manganese	1.25	2.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	16.00	18.00
Nickel	10.00	14.00
Molybdenum	2.00	3.00
Copper	--	1.00

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

### 3.2 Condition:

The product shall be supplied in the following condition:

3.2.1 Bars, Wire, Forgings, Mechanical Tubing, and Flash Welded Rings: Solution heat treated free from continuous carbide network.

#### 3.2.1.1 Bars and Wire:

3.2.1.1.1 All hexagons, other bars 2.75 inches (69.8 mm) and under in nominal diameter or distance between parallel sides, and wire shall be cold finished after solution heat treatment.

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

3.2.1.2 Mechanical Tubing: Shall be cold finished after solution heat treatment.

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 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; hardness and tensile testing shall be performed in accordance with ASTM A 370:

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: Shall be as shown in Table 2, or equivalent (See 8.2), determined at approximately mid-radius or quarter-thickness.

TABLE 2 - Brinell Hardness

Nominal Diameter or Distance Between Parallel Sides Inches	Nominal Diameter or Distance Between Parallel Sides Millimeters	Hardness min	Hardness max
Up to 2.000, incl	Up to 50.80, incl	140	255
Over 2.000	Over 50.80	--	255

- 3.3.2.2 Mechanical Tubing: Shall be not higher than 90 HRB, or equivalent (See 8.2), determined approximately midway between outer and inner surfaces.
- 3.3.2.3 Forgings and Flash Welded Rings: Shall be not higher than 187 HB, or equivalent (See 8.2).
- 3.3.3 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 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.

- 3.4.1 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 re-entrant grain flow.

#### 3.5 Tolerances:

Shall be as follows:

- 3.5.1 Bars and Wire: In accordance with AMS 2241 or MAM 2241.
- 3.5.2 Mechanical Tubing: In accordance with AMS 2243 or MAM 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: Composition (3.1), tensile properties (3.3.1), hardness (3.3.2), susceptibility to intergranular attack (3.3.3), 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 vendor unless frequency of testing is specified by 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 AMS 2371.
- 4.3.2 Forgings: In accordance with AMS 2374.

#### 4.4 Reports:

- 4.4.1 The vendor of bars, wire, forgings, mechanical tubing, and flash welded rings shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and for tensile properties or hardness, as applicable, of each lot. This report shall include the purchase order number, heat and lot number, AMS5653E, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings, shall also be included.
- 4.4.2 The vendor of stock for forging or flash welded rings shall furnish with each shipment a report showing the results of tests for chemical composition of each heat. This report shall include the purchase order number, heat number, AMS5653E, size, and quantity.

#### 4.5 Resampling and Retesting:

Shall be as follows:

- 4.5.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Forging 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 mechanical 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).