

Steel Bars, Forgings, and Rings  
0.50Cr - 0.55Ni - 0.20Mo (0.28 - 0.33C) (SAE 8630)  
(Composition similar to UNS G86300)

1. SCOPE:

1.1 Form:

This specification covers an aircraft-quality, low-alloy steel in the form of bars, forgings, flash welded rings, and stock for forging or flash welded rings.

1.2 Application:

These products have been used typically for parts, with sections 0.500 inch (12.70 mm) and under in thickness at time of heat treatment, requiring a through-hardening steel capable of developing hardness as high as 35 HRC when properly hardened and tempered and also for parts of greater thickness but requiring proportionately lower hardness, 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://www.sae.org).

AMS 2251	Tolerances, Low-Alloy Steel Bars
MAM 2251	Tolerances, Metric, Low Alloy Steel Bars
AMS 2259	Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2301	Steel Cleanliness, Aircraft-Quality, Magnetic Particle Inspection Procedure

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**TO PLACE A DOCUMENT ORDER:**

Tel: 877-606-7323 (inside USA and Canada)  
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Fax: 724-776-0790  
Email: [custsvc@sae.org](mailto:custsvc@sae.org)  
<http://www.sae.org>

**SAE WEB ADDRESS:**

## 2.1 (Continued):

AMS 2370	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock
AMS 2372	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel 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 7496	Rings, Flash Welded, Carbon and Low Alloy Steels
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, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM A 255	Determining the Hardenability of Steel
ASTM A 370	Mechanical Testing of Steel Products
ASTM E 112	Determining Average Grain Size
ASTM E 350	Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E 381	Macroetch Testing, Steel Bars, Billets, Blooms, and Forgings
ASTM E 384	Microindentation Hardness of Materials

## 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 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

TABLE 1 - Composition

Element	min	max
Carbon	0.28	0.33
Manganese	0.70	0.90
Silicon	0.15	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.40	0.60
Nickel	0.40	0.70
Molybdenum	0.15	0.25
Copper	--	0.35

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259.

3.2 Condition:

The product shall be supplied in the following condition; hardness and tensile strength shall be determined in accordance with ASTM A 370:

3.2.1 Bars:

3.2.1.1 Bars 0.500 Inch (12.70 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides: Cold finished having tensile strength not higher than 125 ksi (862 MPa) or hardness not higher than 27 HRC.

3.2.1.2 Bars Over 0.500 Inch (12.70 mm) in Nominal Diameter or Least Distance Between Parallel Sides: Hot finished and annealed, unless otherwise ordered, having hardness not higher than 229 HB, or equivalent (See 8.2). Bars ordered cold finished may have hardness as high as 248 HB, or equivalent (See 8.2).

3.2.2 Forgings and Flash Welded Rings: As ordered.

3.2.2.1 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 7496.

3.2.3 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 testing shall be performed in accordance with ASTM A 370:

3.3.1 Macrostructure: Visual examination of transverse full cross sections from bars, billets, and stock for forging or flash welded rings, etched in hot hydrochloric acid in accordance with ASTM E 381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM E 381 shown in Table 2:

TABLE 2 - Macrostructure Limits

Section Size			Macrographs
Square Inches	Square Centimeters		
Up to 36, incl	Up to 232, incl		S2-R1-C2
Over 36 to 100 incl	Over 232 to 645 incl		S2-R2-C3

3.3.2 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112 (See 8.3).

3.3.3 Hardenability: Shall be J5/16 inch (7.9 mm) = 35 HRC minimum and J8/16 inch (12.7 mm) = 28 HRC minimum, determined on the standard end-quench test specimen in accordance with ASTM A 255 except that the steel shall be normalized at 1700 °F ± 10 (927 °C ± 6) and the test specimen austenitized at 1525 °F ± 10 (829 °C ± 6) (See 8.4).

3.3.4 Decarburization:

3.3.4.1 Bars and flash welded rings ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.

3.3.4.2 Allowable decarburization of bars and billets ordered for redrawing or forging or to specified microstructural requirements shall be as agreed upon by purchaser and vendor.

3.3.4.3 Decarburization of bars and flash welded rings to which 3.3.4.1 or 3.3.4.2 is not applicable shall be not greater than shown in Table 3:

TABLE 3A - Maximum Decarburization Limits, Inch/Pound Units

Nominal Diameter or Distance Between Parallel Sides Inches	Total Depth of Decarburization, Inch
Up to 0.375, incl	0.010
Over 0.375 to 0.500, incl	0.012
Over 0.500 to 0.625, incl	0.014
Over 0.625 to 1.000, incl	0.017
Over 1.000 to 1.500, incl	0.020
Over 1.500 to 2.000, incl	0.025
Over 2.000 to 2.500, incl	0.030
Over 2.500 to 3.000, incl	0.035
Over 3.000 to 4.000, incl	0.045

TABLE 3B - Maximum Decarburization Limits, SI Units

Nominal Diameter or Distance Between Parallel Sides Millimeters	Total Depth of Decarburization, Millimeters
Up to 9.52, incl	0.25
Over 9.52 to 12.70, incl	0.30
Over 12.70 to 15.88, incl	0.36
Over 15.88 to 25.40, incl	0.43
Over 25.40 to 38.10, incl	0.51
Over 38.10 to 50.80, incl	0.64
Over 50.80 to 63.50, incl	0.76
Over 63.50 to 76.20, incl	0.89
Over 76.20 to 101.60, incl	1.14

- 3.3.4.3.1 When permitted by purchaser, flash welded rings, to be machined all over by purchaser, may have decarburization greater than shown in Table 3 provided such decarburization is removable within the machining allowance for the part.
- 3.3.4.4 Decarburization shall be measured by the metallographic method, by the HR30N scale hardness testing method, or by a traverse method using microhardness testing in accordance with ASTM E 384. The hardness method(s) shall be conducted on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization, when measured by a hardness method, is defined as the perpendicular distance from the surface to the depth under that surface below which there is no further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.
- 3.3.4.5 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the above limits by more than 0.005 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.

#### 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 Steel shall be aircraft quality conforming to AMS 2301.
- 3.4.2 Bars ordered hot rolled or cold drawn and bars and flash welded rings ordered 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 surfaces.
- 3.4.3 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.

#### 3.5 Tolerances:

Bars shall conform to all applicable requirements of AMS 2251 or MAM 2251.

### 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), hardness (3.2.1), macrostructure (3.3.1), average grain size (3.3.2), hardenability (3.3.3), decarburization (3.3.4), frequency-severity cleanliness ratings (3.4.1), 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 is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by the purchaser.

#### 4.3 Sampling and Testing:

Shall be as follows:

- 4.3.1 Bars, Flash Welded Rings, Forging Stock, and Stock for Flash Welded Rings: In accordance with AMS 2370.
- 4.3.2 Forgings: In accordance with AMS 2372.

#### 4.4 Reports:

The vendor of the product shall furnish with each shipment a report showing the results of composition, macrostructure, hardenability, and frequency-severity cleanliness rating for each heat and for average grain size of each lot, and stating that the product conforms to other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 6280J, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

#### 4.5 Resampling and Retesting:

Shall be as follows:

- 4.5.1 Bars, Flash Welded Rings, Forging Stock, and Stock for Flash Welded Rings: In accordance with AMS 2370.
- 4.5.2 Forgings: In accordance with AMS 2372.

### 5. PREPARATION FOR DELIVERY:

#### 5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight bars 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).