SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 5930A

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Superseding AMS 5930

Steel, Corrosion-Resistant, Bars and Forgings
13.0Cr - 2.5Ni - 5.5Co - 2.0Mo - 0.60V (0.05 - 0.09C)
Vacuum Induction Plus Vacuum Consumable Electrode Melted

(Composition similar to UNS S42670)

1. SCOPE:

1.1 Form:

This specification covers a premium aircraft-quality, alloy steel in the form of bars, forgings, and forging stock.

1.2 Application:

These products have been used typically for carburized parts requiring high minimum case hardness and corrosion resistance equivalent to AISI Type 440C, but usage is not limited to such applications. These products are suitable for service up to 675 °F (357 °C).

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.

AMS 2241	Tolerances, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure

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**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5930A

2.1 (Continued):

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
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.

ASTM A 370	Mechanical Testing of Steel Products
ASTM A 604	Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E 45	Determining the Inclusion Content of Steel
ASTM E 112	Determining Average Grain Size
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	0.05	0.09
Manganese	0.50	1.00
Silicon	0.10	0.70
Phosphorus	--	0.015
Sulfur	--	0.010
Chromium	12.00	14.00
Nickel	2.00	3.00
Cobalt	4.00	7.00
Molybdenum	1.50	2.50
Vanadium	0.40	0.80

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

3.2 Melting Practice:

Steel shall be multiple melted using vacuum induction melting practice followed by vacuum consumable electrode remelting.

3.3 Condition:

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

3.3.1 Bars:

3.3.1.1 Bars 0.500-Inch (12.70-mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides: Annealed and cold-finished having tensile strength not higher than 150 ksi (1034 MPa) or equivalent hardness (See 8.2).

3.3.1.2 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 302 HB, or equivalent (See 8.3). Bars ordered annealed and cold finished may have hardness as high as 311 HB, or equivalent (See 8.3).

3.3.2 Forgings: Annealed.

3.3.3 Forging Stock: As ordered by the forging manufacturer.

3.4 Properties:

The product shall conform to the following requirements:

3.4.1 Macrostructure: Visual examination of transverse full cross-sections from bars, billets, and forging stock, etched in hot hydrochloric acid in accordance with ASTM A 604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections for product 36 square inches (232 cm^2) and under in nominal cross-sectional area shall be no worse than the macrographs of ASTM A 604 shown in Table 2.

TABLE 2 - Macrostructure Limits

Class	Condition	Severity
1	Freckles	A
2	White Spots	A
3	Radial Segregation	B
4	Ring Pattern	B

3.4.2 Micro-Inclusion Rating: No specimen shall exceed the limits of Table 3, determined in accordance with ASTM E 45, Method D.

TABLE 3 - Micro-Inclusion Rating Limits

	A Thin	A Heavy	B Thin	B Heavy	C Thin	C Heavy	D Thin	D Heavy
Worst Field Severity	2.0	1.0	1.5	1.0	1.5	1.0	1.5	1.0
Worst Field Frequency maximum	a	1	a	1	a	1	5	1
Total Rateable Fields, Frequency, maximum	b	1	b	1	b	1	c	1

a Combined A+B+C, not more than three fields of No. 2.0 A Type or No. 1.5 B and C Types
b Combined A+B+C, not more than eight fields
c Any number of lower rateable fields is permitted

3.4.2.1 A rateable field is defined as one which has a Type A, B, C, or D inclusion rating of at least No. 1.0 thin or heavy in accordance with the Jernkontoret Chart, Plate I-r, ASTM E 45 (See 8.7).

3.4.3 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.4.4 Response to Heat Treatment: Product 4.0 inches (102 mm) and under in nominal cross-section and specimens 4.0 inches (102 mm) and under in nominal cross-section extracted from larger product shall have hardness not lower than 38 HRC or equivalent (See 8.3), determined in accordance with ASTM A 370, at any location after being heated to 1900 °F ± 25 (1038 °C ± 14), held at heat for 15 to 30 minutes, and quenched in oil.

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 Steel shall be premium aircraft-quality conforming to AMS 2300.

3.5.2 Bars 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 of decarburization and from seams, laps, tears, and cracks open to the ground, turned, or polished surface.

3.5.3 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.

3.6 Tolerances:

Bars shall conform to all applicable requirements of AMS 2241.

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), condition (3.3), macrostructure (3.4.1), micro-including rating (3.4.2), average grain size (3.4.3), response to heat treatment (3.4.4), and tolerancees (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Frequency-severity cleanliness rating of each heat and grain flow of die forgings (3.5.3) 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 and Forging Stock: In accordance with AMS 2371.

4.3.2 Forgings: In accordance with AMS 2374.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment a report showing the results of tests for composition, macrostructure, micro-inclusion rating, grain size, and when performed, the frequency-severity cleanliness rating of each heat and for response to heat treatment 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 5930A, size, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.2 The vendor of forging stock shall furnish with each shipment a report showing the results of tests for composition and frequency-severity cleanliness rating of each heat. This report shall include the purchase order number, heat number, AMS 5930A, size, and quantity.

4.5 Resampling and Retesting:

Shall be as follows:

4.5.1 Bars and Forging Stock: 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 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: In accordance with AMS 2806.

5.2.2 Forgings: In accordance with AMS 2808.

5.2.3 Forging Stock: As agreed upon by purchaser and vendor.

5.3 Packaging:

5.3.1 Product ordered cold drawn, cold rolled, ground, turned, or polished shall be protected from corrosion prior to shipment.

5.3.2 The product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT:

A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS:

Product not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.