



# AEROSPACE MATERIAL SPECIFICATIONS

## AMS 5735F

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

485 Lexington Ave., New York, N. Y. 10017

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### STEEL, CORROSION AND HEAT RESISTANT 15Cr - 26Ni - 1.3Mo - 2.1Ti - 0.3V

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. FORM: Bars, forgings, mechanical tubing, flash welded rings, and stock for forgings, flash welded rings, or heading.
3. APPLICATION: Primarily for parts, such as turbine rotors, shafts, buckets or blades, bolts, dowels, and fittings, requiring high strength up to 1300 F (704 C) and oxidation resistance up to 1500 F (816 C).
4. COMPOSITION:

	min	max
Carbon	--	0.08
Manganese	1.00	- 2.00
Silicon	0.40	- 1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	13.50	- 16.00
Nickel	24.00	- 27.00
Molybdenum	1.00	- 1.50
Titanium	1.90	- 2.30
Boron	0.0010	- 0.010
Vanadium	0.10	- 0.50
Aluminum	--	0.35

- 4.1 Check Analysis: Composition variations shall meet the requirements of the latest issue of AMS 2248.

5. CONDITION:

- 5.1 Bars and Flash Welded Rings: Solution and precipitation heat treated. Bars 2.75 in. and less in diameter or distance between parallel sides shall be cold finished.

- 5.1.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, they shall be manufactured in accordance with the latest issue of AMS 7490, unless otherwise specified.

- 5.2 Tubing: Cold finished and solution and precipitation heat treated.

- 5.3 Forgings: Solution and precipitation heat treated and descaled, unless otherwise specified.

- 5.4 Stock for Forging, Flash Welded Rings, or Headings: As ordered by the forging, flash welded ring, or heading manufacturer.

6. TECHNICAL REQUIREMENTS:

- 6.1 Bars, Forgings, Tubing, and Flash Welded Rings:

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standards or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

6.1.1 **Heat Treatment:** The product shall be solution heat treated by heating to  $1800\text{ F} \pm 25$  ( $982.2\text{ C} \pm 14$ ), holding at heat for 1 hr, and quenching in oil or water, and shall then be precipitation heat treated by heating to not lower than  $1300\text{ F}$  ( $704\text{ C}$ ) but not higher than  $1400\text{ F}$  ( $760\text{ C}$ ), holding at heat for 16 hr, and air cooling.

6.1.2 **Tensile Properties:** Tensile test specimens taken from bars, forgings, and tubing and from parent metal of flash welded rings and tested at room temperature shall conform to the following requirements.

Tensile Strength, psi	130,000 min
Yield Strength at 0.2% Offset or at 0.0098 in. in 2 in. Extension Under Load ( $E = 29,100,000$ ), psi	85,000 min
Elongation, % in 4D	15 min
Reduction of Area, %	18 min

6.1.2.1 When tensile test specimens are machined, tangentially, from approximately the center of large disc forgings (over 50 sq in. cross sectional area), the elongation may be as low as 10% and the reduction of area as low as 12%. Specimens machined in other directions from this location are not required.

6.1.2.2 Reduction of area requirement does not apply to tubing from which a solid round test specimen cannot be cut.

6.1.2.3 When a dispute occurs between purchaser and vendor over the yield strength values, yield strength determined by the offset method shall apply.

6.1.3 **Hardness:** Shall be Brinell 248 - 341 or equivalent.

6.1.4 **Stress-Rupture Test at  $1200\text{ F}$  ( $648.9\text{ C}$ ):** A combination smooth and notched test specimen machined from bars, forgings, and tubing and from parent metal of flash welded rings to the dimensions shown in Fig. 1 and Table I, maintained at  $1200\text{ F} \pm 3$  ( $648.9\text{ C} \pm 1.7$ ) while an axial stress of 65,000 psi is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture, either maintaining the same stress or increasing the stress in 5000 psi increments after 48 hr and at intervals of not less than 8 hr thereafter. Rupture shall occur in the smooth section and elongation of this section after rupture, measured at room temperature, shall be not less than 5% in 4D if the specimen ruptures in 48 hr or less and not less than 3% in 4D if the specimen ruptures in more than 48 hours. Tests shall be conducted in accordance with the issue of ASTM E139 specified in the latest issue of AMS 2350.

6.1.4.1 As an alternate procedure, separate smooth and notched test specimens, machined from adjacent sections of the same piece, with gage sections conforming to the respective dimensions of Table I may be tested individually under the above conditions, including increase of stress after 48 hours. The smooth specimen shall not rupture in less than 23 hr and elongation after rupture, measured at room temperature, shall be as specified above. The notched specimen need not be tested to rupture but shall not rupture in less time than the companion smooth specimen.

6.1.4.2 For tubing from which a solid round test specimen cannot be cut, a full section of tubing shall be tested and shall meet the smooth bar requirements of 6.1.4.1.

6.2 **Stock for Forging, Flash Welded Rings, or Heading:** When a sample of stock is forged to a test coupon and heat treated as in 6.1.1, specimens taken from the heat treated coupon shall conform to the requirements of 6.1.2, 6.1.3, and 6.1.4. If specimens taken from the stock after heat treatment as in 6.1.1 conform to the requirements of 6.1.2, 6.1.3, and 6.1.4, the tests shall be accepted as equivalent to tests of the forged coupon.

7. QUALITY: Material shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.
8. TOLERANCES: Unless otherwise specified, tolerances shall conform to all applicable requirements of the following:
  - 8.1 Bars: The latest issue of AMS 2241.
  - 8.2 Tubing: The latest issue of AMS 2243.
9. REPORTS:
  - 9.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment and the results of tests on each size from each heat to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number, size, quantity from each heat, and a statement of record of specific heat treating temperatures and cycles used to provide reported properties. If forgings are supplied, the part number and size of stock used to make the forgings shall also be included.
  - 9.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.
10. IDENTIFICATION:
  - 10.1 Bars and Tubing: Individual pieces or bundles shall have attached a metal tag stamped with the purchase order number, AMS 5735F, nominal size, and heat number, or shall be boxed and the box marked with the same information. In addition to the above identification, flats 2 x 1 in. and larger and other bars 1 in. and over in diameter or distance between parallel sides shall be stamped with the heat number within 2 in. of one end.
  - 10.2 Forgings: Shall be identified in accordance with the latest issue of AMS 2808.
  - 10.3 Flash Welded Rings: Shall be identified as agreed upon by purchaser and vendor.
  - 10.4 Stock for Forging, Flash Welded Rings, or Heading: Shall be identified as agreed upon by purchaser and vendor.
11. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection.