AEROSPACE MATERIAL SPECIFICATION

AMS5737™	REV. R

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Revised 2023-09

Superseding AMS5737P

(R) Steel, Corrosion- and Heat-Resistant, Bars, Wire, Forgings, Mechanical Tubing, and Stock for Forging and Heading
15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V (A286)
Consumable Electrode Remelted
1650 °F (899 °C) Solution and Precipitation Heat Treated
(Composition similar to UNS S66286)

RATIONALE

AMS5737R is the result of a Five-Year Review and update of the specification. The revision revises the Title to match the Scope, clarifies size limits and prohibits exceptions (see 1.1, 3.5.4, 3.8, 4.4.2, 5.2.1, and 8.6), updates composition testing and reporting (see 3.1 and 3.1.1), limits cutting bar from larger products (see 3.3.1.1.3 and 4.4.3), adds option for continuous heat treatment (see 3.4.3), updates tensile test requirements including strain rate control during testing (see 3.5.1.1), adds quality requirements (see 3.6.1 and 8.4), provides for forging stock properties (see 4.4.4 and 8.7), requires reporting of country of origin (see 4.4), and allows the use of prior revisions (see 8.5).

1. SCOPE

1.1 Form

This specification covers a corrosion- and heat-resistant steel in the form of bars, wire, forgings, mechanical tubing, up to 5.00 inches (127 mm), inclusive, in nominal diameter or least distance between parallel sides (thickness), and stock for forging or heading of any size.

1.2 Application

These products have been used typically for parts, such as turbine rotors, shafts, blades, vanes, dowels, flanges, and fittings, requiring moderate strength up to 1300 °F (704 °C) and oxidation resistance up to 1500 °F (816 °C), 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.

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**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS5737R/

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2241 Tolerances, Corrosion- and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire

AMS2243 Tolerances, Corrosion and Heat-Resistant Steel Tubing

AMS2248 Chemical Check Analysis Limits, Corrosion- and Heat-Resistant Steels and Alloys, Maraging and Other Highly Alloyed Steels, and Iron Alloys

AMS2371 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock

AMS2374 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings

AMS2750 Pyrometry

AMS2806 Identification Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels, and Corrosion and Heat-Resistant Steels and Alloys

AMS2808 Identification, Forgings

AS1182 Standard Stock Removal Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel, Bars and Mechanical Tubing

AS7766 Terms used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A370 Mechanical Testing of Steel Products

ASTM A751 Chemical Analysis of Steel Products

ASTM E112 Determining Average Grain Size

ASTM E139 Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

ASTM E292 Conducting Time-for-Rupture Notch Tension Tests of Materials

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to the purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.08
Manganese	--	2.00
Silicon	--	1.00
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	13.50	16.00
Nickel	24.00	27.00
Molybdenum	1.00	1.50
Titanium	1.90	2.35
Boron	0.003	0.010
Vanadium	0.10	0.50
Cobalt	--	1.00
Aluminum	--	0.35
Copper	--	0.50

3.1.1 The producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection unless limits of acceptability are specified by the purchaser

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248.

3.2 Melting Practice

Steel shall be produced by multiple melting using consumable electrode practice in the remelt cycle.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars, Wire, Forgings, and Mechanical Tubing

Bars, wire, forgings, and mechanical tubing shall be solution and precipitation heat treated.

3.3.1.1 Bars and Wire

3.3.1.1.1 All hexagons, regardless of size, and other bars 2.750 inches (69.85 mm) and under in nominal diameter or least distance between parallel sides, and wire shall be cold finished.

3.3.1.1.2 Bars, other than hexagons, over 2.750 inches (69.85 mm) in nominal diameter or least distance between parallel sides shall be hot finished and descaled or cold finished.

3.3.1.1.3 Bars shall not be cut from plate (see 4.4.3).

3.3.1.2 Forgings

Forgings shall be descaled.

3.3.1.3 Mechanical Tubing

Mechanical tubing shall be cold finished.

3.3.2 Stock for Forging or Heading

Stock shall be as ordered by the forging or heading manufacturer.

3.4 Heat Treatment

Bars, wire, forgings, and mechanical tubing shall be heat treated as follows; pyrometry shall be in accordance with AMS2750:

3.4.1 Solution Heat Treatment

Heat to 1650 °F ± 25 °F (899 °C ± 14 °C), hold at heat for a time commensurate with cross-sectional thickness, and quench in oil, water, or other medium acceptable to the purchaser, except that product 0.250 inch (6.35 mm) and under in nominal diameter or least distance between parallel sides may be air cooled from the solution heat-treating temperature.

3.4.2 Precipitation Heat Treatment

Heat to a temperature within the range 1300 to 1400 °F (704 to 760 °C), hold at heat for not less than 16 hours, and cool in air.

3.4.3 Continuous Heat Treating of Wire

Process parameters (e.g., furnace temperature set points, heat input, travel rate, etc.) for continuous heat-treating lines shall be established by the material producer and validated by testing of product to the other requirements of this specification.

3.5 Properties

The product shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.5.1 Bars, Wire, Forgings, and Mechanical Tubing

3.5.1.1 Tensile Properties

Tensile properties shall be as shown in Table 2, except as permitted by 3.5.1.1.3, for product 5.00 inches (127.0 mm) and under in nominal diameter or least distance between parallel sides.

Table 2 - Minimum room temperature tensile properties

Property	Value
Tensile Strength	140 ksi (965 MPa)
Yield Strength at 0.2% Offset	95 ksi (655 MPa)
Elongation in 4D	12%
Reduction of Area	15%

3.5.1.1.1 Tensile properties shall be taken in the short transverse direction, except as noted below.

3.5.1.1.1.1 If the product cross section does not allow a 2-1/2-inch (63.5-mm) long specimen to be taken in the short transverse direction, then tensile properties shall be determined in the long transverse direction.

3.5.1.1.1.2 If the product cross section does not allow a 2-1/2-inch (63.5-mm) long specimen to be taken in the short or the long transverse direction, then tensile properties shall be determined in the longitudinal direction.

3.5.1.1.2 Products tested in the transverse direction need not be tested in the longitudinal direction.

3.5.1.1.3 When tensile specimens are machined from the center area of disk and hub forgings and this area lies within a 4-inches (102-mm) radius or 25% of the forging radius, whichever is the smaller dimension, elongation may be as low as 10% and reduction of area as low as 12%.

3.5.1.1.4 Unless otherwise specified, the strain rate used for all tensile testing shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (±0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.5.1.2 Hardness

Hardness shall be 277 to 363 HBW, or equivalent (see 8.2). Product shall not be rejected on the basis of hardness if the tensile properties of 3.5.1.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.5.1.3 Stress-Rupture Properties at 1200 °F (649 °C)

Stress-rupture properties at 1200 °F (649 °C) shall be as follows; testing of notched specimens and of combination smooth-and-notched specimens shall be performed in accordance with ASTM E292 and of smooth specimens in accordance with ASTM E139:

3.5.1.3.1 A standard cylindrical combination smooth-and-notched specimen conforming to ASTM E292, maintained at 1200 °F ± 3 °F (649 °C ± 2 °C) while a load sufficient to produce an initial axial stress of 65.0 ksi (448 MPa) or higher is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. 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 hours or less and not less than 3% in 4D if the specimen ruptures in more than 48 hours.

3.5.1.3.2 As an alternate procedure, separate smooth and notched specimens, machined from adjacent sections of the same piece, with gage sections conforming to the respective dimensions shown in ASTM E292, may be tested individually under the conditions of 3.5.1.3.1. The smooth specimen shall not rupture in less than 23 hours and elongation after rupture, measured at room temperature, shall be as specified in 3.5.1.3.1. The notched specimen shall not rupture in less time than the companion smooth specimen but need not be tested to rupture.

3.5.1.3.3 The tests of 3.5.1.3.1 and 3.5.1.3.2 may be conducted using incremental loading. In such cases, the load required to produce an initial axial stress of 65.0 ksi (448 MPa) or higher shall be used to rupture or for 48 hours, whichever occurs first. After the 48 hours and at intervals of 8 hours, minimum, thereafter, the stress shall be increased in increments of 5.0 ksi (34.5 MPa). Time to rupture, rupture location, and elongation requirements shall be as specified in 3.5.1.3.1 and 3.5.1.3.2.

3.5.1.3.4 For tubing from which a solid round specimen cannot be cut, a full section of tubing shall be tested and shall meet the smooth bar requirements of 3.5.1.3.1.

3.5.1.4 Average Grain Size

Shall be ASTM No. 1 or finer, determined in accordance with ASTM E112. Transition from coarse to fine grains shall be gradual without sharp lines of demarcation.

3.5.2 Forging Stock

When a sample of stock is forged to a test coupon and heat treated as in 3.4, specimens taken from the heat-treated coupon shall conform to the requirements of 3.5.1.1, 3.5.1.2, and 3.5.1.3. If specimens taken from the stock after heat treatment as in 3.4 conform to the requirements of 3.5.1.1, 3.5.1.2, and 3.5.1.3, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5.3 Heading Stock

Specimens taken from the stock after heat treatment as in 3.4 shall conform to the requirements of 3.5.1.1, 3.5.1.2, and 3.5.1.3.

3.5.4 Mechanical property requirements for product outside of the range covered by 1.1 shall be agreed upon between the producer and purchaser and reported in 4.4.2.

3.6 Quality

The product, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.6.1 Bars and mechanical tubing shall be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182.

3.6.2 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.

3.7 Tolerances

3.7.1 Bars and Wire

Tolerances for bars and wire shall be in accordance with AMS2241.

3.7.2 Mechanical Tubing

Tolerances for mechanical tubing shall be in accordance with AMS2243.

3.8 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.2

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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:

Composition (see 3.1) of each heat.

Tensile properties (see 3.5.1.1), hardness (see 3.5.1.2), stress-rupture properties (see 3.5.1.3), and average grain size (see 3.5.1.4) of each lot of bars, wire, forgings, and mechanical tubing.

Tolerances (3.7) of bars, wire, and mechanical tubing.

4.2.2 Periodic Tests

Tests of forging stock (see 3.5.2) and of heading stock (see 3.5.3) to demonstrate ability to develop required properties, and grain flow of die forgings (see 3.6.1) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by the purchaser.

4.3 Sampling and Testing

4.3.1 Bars, Wire, Mechanical Tubing, and Stock for Forging or Heading

Sampling and testing shall be in accordance with AMS2371.

4.3.2 Forgings

Sampling and testing shall be in accordance with AMS2374.

4.4 Reports

4.4.1 The producer of the product shall furnish with each shipment a report showing the producer's name and the country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the results of tests for composition of each heat, and for tensile properties, hardness, average grain size, and stress-rupture properties 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, AMS5737R, size, quantity, and the specific precipitation heat-treatment temperature used. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.2 When material produced to this specification is beyond the sizes allowed in the scope or other exceptions are taken to the technical requirements listed in Section 3 (see 5.2.1), the report shall contain a statement "This material is certified as AMS5737R(EXC) because of the following exceptions:" and the specific exceptions shall be listed.

4.4.3 Report the nominal metallurgically worked cross-sectional size and the cut size, if different (see 3.3.1.1.3).

4.4.4 The producer of stock for forging or flash welded rings shall furnish with each shipment a report showing the producer's name and country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), and the results of tests for the composition of each heat and the results of any additional property requirements imposed by the purchase order (see 8.7). This report shall include the purchase order number, heat and lot number, AMS5737R, size, and quantity.

4.5 Resampling and Retesting

4.5.1 Bars, Wire, Mechanical Tubing, and Stock for Forging or Heading

Resampling and retesting shall be in accordance with AMS2371.

4.5.2 Forgings

Resampling and retesting shall be in accordance with AMS2374.

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).

5.2 Identification

5.2.1 Bars, Wire, and Mechanical Tubing

Bars, wire and mechanical tubing shall be identified in accordance with AMS2806. When technical exceptions are taken (see 4.4.2), the material shall be marked with AMS5737R(EXC).

5.2.2 Forgings

Forgings shall be identified in accordance with AMS2808.

5.2.3 Stock for Forging or Heading

Stock shall be identified as as agreed upon by the purchaser and producer.

5.3 Packaging

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 producer 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 the purchaser, will be subject to rejection.

8. NOTES

8.1 Revision Indicator

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 Hardness conversion tables for metals are presented in ASTM E140.

8.3 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.4 Purchasers should consider stock removal requirements of 3.6.1 when selecting the appropriate size and condition including surface finish to specify in ordering information.

8.5 Unless otherwise specified, the material producer shall work to the revision of this specification (AMS5737) in effect on the date of order placement. Unless otherwise specified, material manufactured and certified to the immediately previous revision of this specification (AMS5737) may be procured and used until inventory is depleted.

8.6 It is the purchaser’s obligation to ensure that product they procure or resell as AMS5737R has any exceptions approved by their subsequent purchaser.

8.7 Purchase documents should specify not less than the following:

AMS5737R
Form and size or part number of product desired
If forging stock, specify any additional property requirements beyond those reported in 4.4.4 and provide details of how to obtain the desired samples
Quantity of product desired