



AEROSPACE MATERIAL SPECIFICATION

AMS5773™**REV. G**

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Superseding AMS5773F

(R) Steel, Corrosion-Resistant, Bars, Wire, Forgings, Mechanical Tubing, Rings, and
Stock for Forgings or Rings
15Cr - 6.5Ni - 0.75Mo - 0.30Cb (Nb) - 1.5Cu
Consumable Electrode Remelted, Solution Heat Treated,
Precipitation Hardenable
(Composition similar to UNS S45000)

RATIONALE

AMS5773G is the result of a Five-Year Review and update of the specification. The revision updates the Title to match the Scope, restates the heat-treat condition (see 1.1), updates the melting terminology (see 1.3 and 3.2), updates composition reporting (see 3.1.1), adds finish categories (see 3.3), prohibits bar being cut from plate (see 3.3.1.1.3 and 4.4.3), revises the heat-treatment specification (see 3.4), adds tensile strain rate requirements except for wire (see 3.5.1 and 3.5.3.1.1.2), updates hardness requirements (see 3.5.3.2 and Table 6), updates response to heat-treatment requirements (see 3.5.3.2 and Table 4), updates transverse testing (see 3.5.4.1.1), adds quality requirements and guidance (see 3.6.3 and 8.4), and prohibits unauthorized exceptions (see 3.8, 4.4.2, and 8.6).

1. SCOPE

1.1 Form

This specification covers a premium aircraft-quality, corrosion-resistant steel in the form of bars, wire, forgings, mechanical tubing, and flash welded rings in the solution heat-treated condition, 12 inches (305 mm) and under in nominal diameter, thickness or, for hexagons, least distance between parallel sides (thickness), and stock of any size for forging or flash welded rings.

1.2 Application

Primarily for parts requiring corrosion resistance approximating that of 18Cr-8Ni type steels and high strength exceeding that of 12Cr martensitic type steels up to 700 °F (371 °C), but usage is not limited to such applications. This steel can be used in the solution heat-treated condition and is capable of being precipitation heat treated to tensile strengths as high as 180 ksi (1241 MPa) with good ductility and strength in the transverse directions in large section sizes.

1.2.1 Although this steel is relatively immune to stress-corrosion cracking, reference should be made to ARP1110 for recommended practices to minimize such conditions.

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1.3 Classification

Products covered by this specification are classified as follows:

Type 1 - Multiple melted using electroslag remelting.

Type 2 - Multiple melted using consumable electrode vacuum remelting.

1.3.1 Type 1 shall be supplied unless Type 2 is permitted by the purchaser.

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 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
AMS2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure
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
AMS2761	Heat Treatment of Steel Raw Materials
AMS2806	Identification Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels, and Corrosion and Heat-Resistant Steels and Alloys
AMS2808	Identification, Forgings
AMS7490	Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels, Austenitic-Type Iron, Nickel or Cobalt Alloys, or Precipitation-Hardenable Alloys
ARP1110	Minimizing Stress Corrosion Cracking in Wrought Forms of Steels, and Corrosion Resistant Steels and Alloys
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 A604 Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets

ASTM A751 Chemical Analysis of Steel Products

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	--	0.05
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.020
Sulfur	--	0.015
Chromium	14.00	16.00
Nickel	6.00	7.00
Molybdenum	0.50	1.00
Columbium (Niobium)	8xC	--
Copper	1.25	1.75

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

Product shall be multiple melted using either electroslog remelting for Type 1 or using consumable electrode vacuum remelting for Type 2 (see 1.3).

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars, Wire, Mechanical Tubing, Forgings, and Flash Welded Rings

3.3.1.1 Round Bars

Solution heat treated and descaled, to hot finished or cold finished tolerances (see 3.7).

3.3.1.2 Squares, Hexagons, and Flat Bars

Hot finished, solution heat treated, and descaled, or cold drawn after solution heat treatment or descaling, as ordered.

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

3.3.1.4 Wire

Cold drawn after solution heat treatment.

3.3.1.5 Mechanical Tubing

Cold finished and solution heat treated.

3.3.1.6 Forgings

Solution heat treated and descaled.

3.3.1.7 Flash Welded Rings

Solution heat treated and descaled. Flash welded rings shall not be supplied unless specified or permitted on the purchaser's part drawing. When supplied, rings shall be manufactured in accordance with AMS7490.

3.3.2 Stock for Forging or Flash Welded Rings

As ordered by the forging or flash welded ring manufacturer.

3.4 Solution Heat Treatment

Bars, wire over 0.187 inch (4.75 mm) in nominal diameter, forgings, mechanical tubing, and flash welded rings shall be solution heat treated in accordance with AMS2761 by heating to 1900 °F $\pm$ 25 °F (1038 °C $\pm$ 14 °C), holding at heat for not less than 1 hour, and cooling rapidly.

3.4.1 Except as in 3.4.1.1, wire 0.187 inch (4.8 mm) and under in nominal diameter shall be solution heat treated by heating to 1900 °F $\pm$ 25 °F (1038 °C $\pm$ 14 °C), holding at heat for a time commensurate with the wire size, and cooling rapidly.

3.4.1.1 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 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.

3.5.2 Macrostructure

Visual examination of transverse sections from bars, billets, and stock for forging or flash welded rings, etched in hot hydrochloric acid in accordance with ASTM A604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections for product 80 square inches (516 cm²) and under in nominal cross-sectional area shall be no worse than the macrographs of ASTM A604 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

3.5.3 As Solution Treated

3.5.3.1 Tensile Properties

3.5.3.1.1 Bars, Forgings, Mechanical Tubing, and Flash Welded Rings

Tensile properties in the as solution treated condition shall be as shown in Table 3.

Table 3 - Minimum tensile properties

Property	Value
Tensile Strength	125 ksi (862 MPa)
Yield Strength at 0.2% Offset	95 ksi (655 MPa)
Elongation in 4D or 2 inches (50 mm)	10%
Reduction of Area	40%

3.5.3.1.2 Wire

Not higher than 165 ksi (1138 MPa), or equivalent hardness (see 8.2). The strain rate limitations of 3.5.1 do not apply.

3.5.3.2 Hardness

Hardness testing shall be in accordance with ASTM A370. Acceptance shall be determined using one of the hardness test methods listed. Material shall not be rejected if acceptable test results are obtained by either of the hardness test methods listed.

3.5.3.2.1 Bars

Not higher than 321 HBW or 32 RC, or equivalent determined at mid-radius or quarter thickness.

3.5.3.2.2 Mechanical Tubing, Flash Welded Rings, and Forgings

Not higher than 321 HBW or 32 RC, or equivalent.

3.5.4 Response to Precipitation Heat Treatment

Samples from the solution heat-treated product, 12 inches (305 mm) and under in nominal diameter, thickness, or, for hexagons, least distance between parallel sides, precipitation heat treated to a particular condition in accordance with the corresponding temperatures and times shown in Table 4 and cooled in air, shall have the mechanical properties shown in Tables 5 and 6 for that particular condition. Tensile and hardness tests shall be performed in the H900 precipitation heat-treated condition, unless the purchaser specifies another heat-treated condition.

Table 4 - Precipitation heat treatment

Condition	Temperature	Time (Min)
H900	900 °F ± 15 °F (482 °C ± 8 °C)	4 hours
H950	950 °F ± 15 °F (510 °C ± 8 °C)	4 hours
H1000	1000 °F ± 15 °F (538 °C ± 8 °C)	4 hours
H1050	1050 °F ± 15 °F (566 °C ± 8 °C)	4 hours
H1100	1100 °F ± 15 °F (593 °C ± 8 °C)	4 hours
H1150	1150 °F ± 15 °F (621 °C ± 8 °C)	4 hours

3.5.4.1 Tensile Properties – Response to Heat Treatment

Shall be as shown in Table 5.

Table 5A - Minimum tensile properties - response to heat treatment, inch/pound units

Condition	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D or 2 inches %	Reduction of Area %
H 900	Longitudinal	180	170	10	40
	Transverse	180	170	6	20
H 950	Longitudinal	170	160	10	40
	Transverse	170	160	7	22
H1000	Longitudinal	160	150	12	45
	Transverse	160	150	8	27
H1050	Longitudinal	145	135	12	45
	Transverse	145	135	9	30
H1100	Longitudinal	130	105	16	50
	Transverse	130	105	11	30
H1150	Longitudinal	125	75	18	55
	Transverse	125	75	12	35

Table 5B - Minimum tensile properties - response to heat treatment, SI units

Condition	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D or 50 mm %	Reduction of Area %
H900	Longitudinal	1241	1172	10	40
	Transverse	1241	1172	6	20
H950	Longitudinal	1172	1103	10	40
	Transverse	1172	1103	7	22
H1000	Longitudinal	1103	1034	12	45
	Transverse	1103	1034	8	27
H1050	Longitudinal	1000	931	12	45
	Transverse	1000	931	9	30
H1100	Longitudinal	896	724	16	50
	Transverse	896	724	11	30
H1150	Longitudinal	862	517	18	55
	Transverse	862	517	12	35

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

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

3.5.4.1.1.2 If the product cross section does not allow a 2-1/2-inches (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.

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

3.5.4.1.3 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.

3.5.4.2 Hardness – Response to Heat Treatment

Should be not lower than shown in Table 6 for the corresponding precipitation heat-treatment condition. The product shall not be rejected on the basis of hardness if the tensile property requirements of Table 5 for that condition are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness, or from another sample with similar nonconforming hardness.

Table 6 - Minimum hardness - response to heat treatment

Condition	Hardness, HBW	Hardness, RC
H900	363	39
H950	341	37
H1000	331	36
H1050	321	34
H1100	285	30
H1150	262	26

3.5.5 Forging Stock

When a sample of stock is forged to a test coupon and heat treated as in 3.4 and 3.5.4, specimens taken from the heat-treated coupon shall conform to the requirements of 3.5.4.1 and 3.5.4.2. If specimens taken from the stock after heat treatment as in 3.4 and 3.5.4 conform to the requirements of 3.5.4.1 and 3.5.4.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5.6 Stock for Flash Welded Rings

Specimens taken from the stock after heat treatment as in 3.4 and 3.5.4 shall conform to the requirements of 3.5.4.1 and 3.5.4.2.

3.6 Quality

3.6.1 Steel shall be premium aircraft-quality conforming to AMS2300.

3.6.2 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.

3.6.3 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.

3.6.4 Grain flow of die forgings, except in areas which contain flash-line and grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.7 Tolerances

Shall be as follows:

3.7.1 Bars and Wire

In accordance with AMS2241.

3.7.2 Mechanical Tubing

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:

4.2.1.1 Composition (see 3.1) and macrostructure (see 3.5.2) of each heat.

4.2.1.2 Tensile properties (see 3.5.3.1) and hardness (see 3.5.3.2) of each lot of bars, wire, forgings, mechanical tubing, and flash welded rings as solution treated.