Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 7819A
Superseding AMS 7819

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MOLYBDENUM ALLOY BARS
0.48Ti - 0.09Zr - 0.02C
Arc Cast, Stress Relieved

1. SCOPE:

1.1 Form: This specification covers an arc-cast molybdenum alloy in the form of round bars.

1.2 Application: Primarily for parts requiring high modulus and uniform strength up to 2300° F (1260° C). This alloy is not recommended for use in oxidizing atmospheres above 1000° F (540° C) unless protected by a suitable coating.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E8 - Tension Testing of Metallic Materials
ASTM E92 - Vickers Hardness of Metallic Materials
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

2.4 ANSI Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight; carbon shall be determined in accordance with ASTM E350, molybdenum by difference, gaseous elements by vacuum fusion, and other metallic elements by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max	Check Analysis Under Min	Check Analysis Over Max
Molybdenum	99.25	--	--	--
Titanium	0.40	0.55	0.05	0.05
Zirconium	0.06	0.12	0.02	0.02
Carbon	0.010	0.030	0.005	0.005
Iron	--	0.020	--	0.002
Silicon	--	0.010	--	0.002
Nickel	--	0.010	--	0.001
Oxygen	--	0.0030 (30 ppm)	--	--
Nitrogen	--	0.0010 (10 ppm)	--	0.0005 (5 ppm)
Hydrogen	--	0.0005 (5 ppm)	--	--

3.2 Condition: Hot-cold worked, descaled, and stress-relieved; when so specified, bars shall be centerless ground before being stress-relieved. The surface texture of centerless ground bars shall be 90 microin. (2.3 µm) or smoother, determined in accordance with ANSI B46.1.

3.3 Properties: Bars 0.125 to 4.500 in. (3.18 to 114.30 mm), incl, in nominal diameter shall conform to the following requirements; bars under 0.125 in. (3.18 mm) or over 4.500 in. (114.30 mm) in nominal diameter shall have tensile properties and hardness as agreed upon by purchaser and vendor:

3.3.1 As-Received:

3.3.1.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM E8 with the rate of strain maintained at 0.002 - 0.005 in. per in. per min. (0.002 - 0.005 (mm/mm)/min.) through the 0.6% offset and 0.002 - 0.05 in. per in. per min. (0.02 - 0.05 (mm/mm)/ min.) above the 0.6% offset to fracture.

TABLE I

Nominal Diameter Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 4D %, min
0.125 to 0.875, incl	115,000	100,000	18
Over 0.875 to 1.875, incl	100,000	85,000	10
Over 1.875 to 2.875, incl	90,000	80,000	10
Over 2.875 to 3.500, incl	85,000	75,000	5
Over 3.500 to 4.500, incl	80,000	70,000	5

TABLE I (SI)

Nominal Diameter Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D %, min
3.18 to 22.22, incl	793	690	18
Over 22.22 to 47.62, incl	690	586	10
Over 47.62 to 73.02, incl	621	552	10
Over 73.02 to 88.90, incl	586	517	5
Over 88.90 to 114.30, incl	552	483	5

3.3.1.2 Hardness: Shall be as follows, determined in accordance with ASTM E92:

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Nominal Diameter Inches	Nominal Diameter (Millimetres)	Maximum Hardness HV/10
0.125 to 0.875, incl	(3.18 to 22.22, incl)	320
Over 0.875 to 1.125, incl	(Over 22.22 to 28.58, incl)	310
Over 1.125 to 1.875, incl	(Over 28.58 to 47.62, incl)	300
Over 1.875 to 2.875, incl	(Over 47.62 to 73.02, incl)	290
Over 2.875 to 3.500, incl	(Over 73.02 to 88.90, incl)	285
Over 3.500 to 4.500, incl	(Over 88.90 to 114.30, incl)	280

3.3.2 After High-Temperature Exposure: Bars shall meet the tensile property (3.3.1.1) and hardness (3.3.1.2) requirements after being heated in a suitable protective atmosphere to 2100° F ± 25 (1150° C ± 15), held at heat for 30 min. ± 3, and cooled rapidly.

3.4 Quality:

Ø 3.4.1 Alloy shall be carbon deoxidized and vacuum arc melted using consumable electrode practice.

3.4.2 Bars, as received by purchaser, shall be uniform in quality and condition, sound, smooth, and Ø free from foreign materials and from internal and external imperfections detrimental to usage of the bars.

3.5 Tolerances: Unless otherwise specified, tolerances shall be as follows:

3.5.1 Hot-Cold Worked and Descaled: Shall be as shown in Table II.

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TABLE II

Nominal Diameter Inches	Tolerance, Inch plus	Tolerance, Inch minus	Out of Round Inch
0.125 to 0.281, incl	0.002	0.002	0.004
Over 0.281 to 0.406, incl	0.003	0.003	0.006
Over 0.406 to 0.625, incl	0.010	0.005	0.012
Over 0.625 to 0.875, incl	0.015	0.005	0.015
Over 0.875 to 1.000, incl	0.020	0.005	0.015
Over 1.000 to 1.375, incl	0.020	0.010	0.018
Over 1.375 to 1.500, incl	0.020	0.015	0.020
Over 1.500 to 1.625, incl	0.025	0.015	0.020
Over 1.625 to 2.000, incl	0.030	0.020	0.025
Over 2.000 to 2.500, incl	0.032	0.032	0.025
Over 2.500 to 3.250, incl	0.032	0.032	0.027
Over 3.250 to 3.500, incl	0.045	0.045	0.040
Over 3.500 to 4.500, incl	0.062	0.062	0.050

TABLE II (SI)

Nominal Diameter (Millimetres)	Tolerance, Millimetres plus	Tolerance, Millimetres minus	Out of Round Millimetres
3.18 to 7.14, incl	0.05	0.05	0.10
Over 7.14 to 10.31, incl	0.08	0.08	0.15
Over 10.31 to 15.88, incl	0.25	0.13	0.30
Over 15.88 to 22.22, incl	0.38	0.13	0.38
Over 22.22 to 25.40, incl	0.51	0.13	0.38
Over 25.40 to 34.92, incl	0.51	0.25	0.46
Over 34.92 to 38.10, incl	0.51	0.38	0.51
Over 38.10 to 41.28, incl	0.64	0.38	0.51
Over 41.28 to 50.80, incl	0.76	0.51	0.64
Over 50.80 to 63.50, incl	0.81	0.81	0.64
Over 63.50 to 82.55, incl	0.81	0.81	0.69
Over 82.55 to 88.90, incl	1.14	1.14	1.02
Over 88.90 to 114.30, incl	1.57	1.57	1.27

3.5.2 Centerless Ground:

Nominal Diameter Inches	Nominal Diameter (Millimetres)	Tolerance, Plus and Minus Inch	Tolerance, Plus and Minus (Millimetre)
0.0625 to 2.000, incl	(1.588 to 50.80, incl)	0.002	(0.05)
Over 2.000	(Over 50.80)	0.003	(0.08)

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of bars shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the bars conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties (3.3.1.1), hardness (3.3.1.2), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for tensile properties and hardness after high-temperature exposure (3.3.2) requirements are classified as periodic tests and shall be performed at a frequency selected by vendor unless frequency of testing is specified by purchaser.

4.3 Sampling: Shall be as follows:

4.3.1 Acceptance Tests:

4.3.1.1 Composition: One specimen from each heat.

4.3.1.2 Tensile and Hardness Tests: One specimen from each size from each heat.