

Issued	1992-07
Revised	2003-12
Reaffirmed	2012-02
Superseding AMS4633	

Bronze, Aluminum Silicon, Rods, Bars, and Forgings
90Cu - 7.0Al - 1.8Si
Drawn and Stress Relieved (HR50)

(Composition similar to UNS C64200)

RATIONALE

AMS4633A has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Form:

This specification covers one type of aluminum silicon bronze in the form of rods, bars, forgings, and forging stock.

1.2 Application:

This product has been used typically for parts requiring strength and wear resistance at moderate temperatures, 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 canceled 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 2221	Tolerances, Copper and Copper Alloy Bars and Rods
AMS 2808	Identification, Forgings

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM B 154	Mercurous Nitrate Test for Copper and Copper Alloys
ASTM B 249	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings
ASTM B 249M	General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes, and Forgings (Metric)
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 858	Standard Test Method for Ammonia Vapor Test for Determination Susceptibility to Stress Corrosion Cracking in Copper Alloys
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 10	Brinell Hardness of Metallic Materials
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 478	Chemical Analysis of Copper 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 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element (3.1.1)	min	max
Aluminum	6.3	7.6
Silicon	1.5	2.2
Zinc	--	0.50
Iron	--	0.30
Nickel, including Cobalt	--	0.25
Tin	--	0.20
Arsenic	--	0.15
Manganese	--	0.10
Lead	--	0.05
Copper (3.1.2)	remainder	
Sum of Named Elements (See 3.1.3)	99.5	--

- 3.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer or supplier and purchaser.
- 3.1.2 Copper may be reported as “remainder”, or as the difference between the sum of results for all elements and 100%, or as the result of direct analysis.
- 3.1.3 When all the elements in the table are analyzed, the sum shall be 99.5%, minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition:

The product shall be supplied in the following condition:

- 3.2.1 Bars and Rods: Drawn and stress relieved (HR50) temper. (See 8.1).
- 3.2.2 Forgings: Stress relieved.
- 3.2.3 Forging Stock: As ordered by the forging manufacturer.

3.3 Properties:

The product shall conform to the following requirements:

3.3.1 Bars, Rods, and Forgings:

3.3.1.1 Longitudinal Tensile Properties:

- 3.3.1.1.1 Bars and Rods: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Nominal Diameter Distance Between Parallel Sides Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
Up to 0.5, incl	90.0	45.0	9
Over 0.5 to 1.0, incl	85.0	45.0	12
Over 1.0 to 2.0, incl	80.0	42.0	12
Over 2.0 to 3.0, incl	75.0	35.0	15

TABLE 2B - Minimum Tensile Properties, SI Units

Nominal Diameter Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 4D %
Up to 12.7, incl	621	310	9
Over 12.7 to 25.4, incl	586	310	12
Over 25.4 to 50.8, incl	552	290	12
Over 50.8 to 76.2, incl	517	241	15

3.3.1.1.2 Forgings: Shall be as agreed upon by purchaser and vendor.

3.3.1.2 Hardness: Shall be as follows:

3.3.1.2.1 Surface: Not lower than 130 HB/10/1000, determined in accordance with ASTM E 10 or not lower than 72 HRB, determined in accordance with ASTM E 18; on rounds, a flat, as necessary for accuracy, may be made.

3.3.1.2.2 Internal: Not lower than 80 HRB, or equivalent, determined in accordance with ASTM E 18 at mid-radius or quarter thickness.

3.3.1.3 Embrittlement: Specimens as in 4.3.1.2 and 4.3.2.1 shall withstand, without cracking, immersion in mercurous nitrate solution in accordance with ASTM B 154, Procedure A, or the ammonia vapor test in accordance with ASTM B 858.

3.3.2 Forging Stock: Shall be as agreed upon by purchaser and vendor.

3.4 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 Tolerances:

Bars and rods shall conform to AMS 2221 as applicable to refractory alloys.

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: The following requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Tensile properties (3.3.1.1.1) of each lot of bars and rods and of each lot of forgings when specified (3.3.1.1.2).

4.2.1.3 Hardness (3.3.1.2) of each lot of bars, rods, and forgings.

4.2.1.4 Tolerances (3.5) of bars and rods.

4.2.2 Periodic Tests: Tests of bars, rods, and forgings for embrittlement (3.3.1.3) and forging stock (3.3.2) for properties when specified 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 in accordance with the following:

4.3.1 Bars and Rods: ASTM B 249 or ASTM B 249M and the following:

4.3.1.1 Longitudinal tensile specimens shall be located midway between the two surfaces of bar and rod under 1.5 inches (38.1 mm) in nominal diameter or distance between parallel sides and midway between the center and surface of bar and rod 1.5 inches (38.1 mm) and over in nominal diameter or distance between parallel sides.

4.3.1.2 Specimens for embrittlement test shall be the full cross-section of the product and shall have length of approximately 6 inches (152 mm) or twice the diameter or least distance between parallel sides, whichever is greater.

4.3.2 Forgings: Two forgings from each lot; a lot shall be all forgings of one part number processed consecutively and presented for vendor's inspection at one time.

4.3.2.1 Specimens for embrittlement test shall be an entire forging. Acceptance standards shall be established by purchaser.

4.4 Reports:

4.4.1 The vendor of bar, rods, and forgings shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and for tensile properties and hardness of each lot and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 4633A, size or part number, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.