SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4880 | REV. D

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Superseding AMS 4880C

Aluminum Bronze Alloy, Centrifugal and Continuous-Cast Castings
81.5Cu - 10.3Al - 5.0Ni - 2.8Fe
Quench Hardened and Temper Annealed (TQ50)
(Composition similar to UNS C95510)

RATIONALE

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

1. SCOPE:

1.1 Form:

This specification covers an aluminum bronze alloy in the form of centrifugal and continuous-cast castings.

1.2 Application:

These castings have been used typically for bearings requiring abrasion resistance, good ductility, and good retention of hardness 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 cancelled 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 2360	Room Temperature Tensile Properties of Castings
AMS 2694	Repair Welding of Aerospace Castings
AMS 2750	Pyrometry
AMS 2804	Identification, Castings

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

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS4880D

2.2 ASTM Publications:

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

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 478	Chemical Analysis of Copper Alloys
ASTM E 1417	Liquid Penetrant Examination
ASTM E 1742	Radiographic Examination

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	min	max
Copper (3.1.1)	78.0	--
Aluminum	9.7	10.9
Nickel (including Cobalt)	4.5	5.5
Iron	2.0	3.5
Manganese	--	1.5
Zinc	--	0.30
Tin	--	0.20
Sum of named elements (3.1.3)	99.8	--

3.1.1 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.

3.1.2 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.

3.1.3 When all the elements in Table 1 are analyzed, the sum shall be 99.8% minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition:

Quench hardened and temper annealed (TQ50). (See 8.2).

3.3 Casting:

Castings shall be produced in lots from metal conforming to 3.1. Metal remelted from previously analyzed ingot may be poured directly into castings. Molten metal taken from alloying furnaces, with or without additions of foundry operating scrap (gates, sprues, risers, and rejected castings), shall not be poured into castings unless first converted to ingot, analyzed, and remelted or unless the composition of a sample taken after the last addition to the melt conforms to 3.1.

3.3.1 A melt shall be the metal withdrawn from a batch-furnace charge of 2000 pounds (907 kg) or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 pounds (1814 kg) or less of metal withdrawn from a continuous furnace in not more than eight consecutive hours.

3.3.2 A lot shall be all castings poured from a single melt in not more than eight consecutive hours and quench hardened and temper annealed in the same heat treatment batch.

3.4 Test Specimens:

Chemical analysis specimens and tensile coupons shall be cast as follows:

3.4.1 Chemical Analysis Specimens: Shall be cast from each melt and shall be of any convenient size, shape, and form.

3.4.2 Tensile Coupons: Coupons shall be of such size as to allow machining tensile specimens conforming to ASTM E 8 or ASTM E 8M with 0.500 inch (12.70 mm) diameter at the reduced parallel gage section.

3.4.2.1 For centrifugal castings, the coupons shall be cast in permanent molds from each melt of metal used for pouring castings. Metal for the coupons shall be part of the melt which is used for castings and shall be poured at a temperature not lower than the temperature of the metal during pouring of the castings.

3.4.2.2 For continuous castings, the coupons shall be taken from the cast product

3.5 Heat Treatment:

Castings and representative tensile coupons shall be heat treated as in 3.5.1 and 3.5.2; at least one set of tensile coupons shall, during each stage of heat treatment, be put into a batch-type furnace with each load of castings or into a continuous furnace at intervals of not longer than three hours. Pyrometry shall be in accordance with AMS 2750.

3.5.1 Quench Hardening: Heat to a temperature within the range 1600 to 1700 °F (871 to 927 °C), hold at the selected temperature within ±25 °F (±14 °C) for not less than two hours, and quench in water.

3.5.2 Temper Annealing: Heat to a temperature within the range 1100 to 1200 °F (593 to 649 °C), hold at the selected temperature within ±15 °F (±8 °C) for not less than two hours, and cool in air to room temperature.

3.6 Properties:

Castings and representative tensile coupons produced in accordance with 3.4.2 shall conform to the following requirements:

3.6.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E 8 or ASTM E 8M; conformance to the requirements of 3.6.1.1 shall be used as the basis for acceptance of centrifugal castings except when purchaser specifies that the requirements of 3.6.1.2 apply. Conformance to the requirements of 3.6.1.3 shall be used as the basis for acceptance of continuous castings.

3.6.1.1 Separately-Cast Coupons: Shall be as specified in Table 2.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	105.0 ksi (724 MPa)
Yield Strength at 0.2% Offset	62.5 ksi (431 MPa)
Elongation in 4D	9%

3.6.1.2 Specimens Cut From Centrifugal Castings: Test specimens as in 4.3.4 cut from any area of a casting shall meet the requirements shown in Table 3 or Table 4 as applicable.

3.6.1.2.1 Castings 1.0 Inch (25 mm) and Under in Nominal Cross-Section shall be as shown in Table 3:

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	105.0 ksi (724 MPa)
Yield Strength at 0.2% Offset	62.5 ksi (431 MPa)
Elongation in 4D	9%

3.6.1.2.2 Castings Over 1.0 inch (25 mm) in Nominal Cross-Section shall be as shown in Table 4:

TABLE 4 - Minimum Tensile Properties

Property	Value
Tensile Strength	95.0 ksi (655 MPa)
Yield Strength at 0.2% Offset	50.0 ksi (345 MPa)
Elongation in 4D	8%

3.6.1.2.3 When tensile properties other than those of 3.6.1.2.1 or 3.6.1.2.2 are required, tensile specimens as in 4.3.4 machined from locations indicated on the drawing, from a casting or castings chosen at random to represent a lot, shall have the properties indicated on the drawing for such specimens. Property requirements may be designated in accordance with AMS 2360.

3.6.1.3 Specimens Cut from Continuous Castings: Test specimens cut from any area of a casting shall meet the requirements shown in Table 5 or Table 6 as applicable.

3.6.1.3.1 Castings Under 4.0 Inches (102 mm) in Nominal Cross-Section shall be as shown in Table 5:

TABLE 5 - Minimum Tensile Properties

Property	Value
Tensile Strength	105.0 ksi (724 MPa)
Yield Strength at 0.2% Offset	62.5 ksi (431 MPa)
Elongation in 4D	9%

3.6.1.3.2 Castings 4.0 Inches (102 mm) and Over in Nominal Cross-Section shall be as shown in Table 6:

TABLE 6 - Minimum Tensile Properties

Property	Value
Tensile Strength	95.0 ksi (655 MPa)
Yield Strength at 0.2% Offset	56.0 ksi (386 MPa)
Elongation in 4D	9%

3.7 Quality:

Castings, 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 castings.

3.7.1 Castings shall have smooth surfaces and shall be sufficiently cleaned to permit fluorescent penetrant inspection.

3.7.2 Castings, when specified, shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with ASTM E 1742 until proper foundry technique, which will produce castings free from harmful internal imperfections, is established for each part number and of production castings as necessary to ensure maintenance of satisfactory quality.

3.7.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417 or other inspection procedure designated by purchaser.

3.7.3.1 Radiographic, fluorescent penetrant, and other quality acceptance standards shall be acceptable to purchaser.

3.7.4 Castings shall not be reworked by peening, plugging, welding, or other methods without written permission from purchaser.

3.7.4.1 When permitted in writing by purchaser, defects in castings may be removed and the castings reworked by welding in accordance with AMS 2694.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of castings 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 castings conform to specified requirements.

4.2 Classification of Tests:

All technical requirements, except as specified in 4.2.1, are acceptance tests and preproduction tests and shall be performed prior to or on the initial shipment of a casting to a purchaser, on each melt or lot as applicable, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.1 Tensile properties of specimens cut from centrifugal castings shall be determined only when specified by purchaser or when separately-cast specimens are not available. Tensile properties of separately-cast centrifugal specimens need not be determined when tensile properties of specimens cut from centrifugal castings are determined.

4.3 Sampling and Testing:

Shall be in accordance with the following:

4.3.1 One chemical analysis specimen in accordance with 3.4.1 from each melt or a casting from each lot.

4.3.2 One or more tensile specimens in accordance with 3.4.2 from each lot except when purchaser requires properties of specimens machined from centrifugal castings.

4.3.3 Sufficient preproduction castings of each part number in accordance with 4.4.1 as required to satisfy dimensional, mechanical property, and quality evaluations.

4.3.4 One or more castings from each lot when properties of specimens machined from centrifugal castings are required. Specimens shall conform to ASTM E 8 or ASTM E 8M and shall be either 0.500 inch (12.70 mm) diameter at the reduced parallel gage section, subsize specimens proportional to the standard, or standard sheet-type specimens. For determining conformance to the requirements of 3.6.1.2, if specimen locations are not shown on the drawing, not less than two tensile specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting or castings from each lot.

4.3.5 For continuous castings under 0.500 inch (12.70 mm) in wall section, subsize specimens proportional to the standard is permitted.

4.4 Approval:

4.4.1 Sample castings from new or reworked patterns or molds and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived by purchaser.

4.4.2 Vendor shall establish, for production of sample castings of each part number, parameters for the process control factors which will produce acceptable castings; these shall constitute the approved casting procedure and shall be used for producing production castings. If necessary to make any change in parameters for the process control factors, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, test specimens, sample castings, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

4.4.2.1 Control factors for producing castings include, but are not limited to, the following:

Type of furnace
Furnace atmosphere
Fluxing or deoxidation procedure
Mold set-up, parting agent, and rotational speed for centrifugal castings
Metal pouring temperature; variation of ±50 °F (±28 °C) from the established limit is permissible
Solidification and cooling procedures
Quench hardening and temper annealing heat treatment cycles
Cleaning operations
Methods of inspection

4.4.2.1.1 Any of the above process control factors for which parameters are considered proprietary by the vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.