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AEROSPACE MATERIAL SPECIFICATION

AMS 4880A
Superseding 4880

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ALUMINUM BRONZE CASTINGS, CENTRIFUGAL
81.5Cu - 10.3Al - 5.0Ni - 2.8Fe
Solution Heat Treated and Tempered

1. SCOPE:

1.1 Form: This specification covers one type of aluminum bronze in the form of centrifugal castings.

1.2 Application: Primarily for bearings requiring abrasion resistance, good ductility, and good retention of hardness at moderate temperatures.

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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2360 - Room Temperature Tensile Properties of Castings
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2646 - Contrast Dye Penetrant Inspection
AMS 2694 - Repair Welding of Aerospace Castings
AMS 2804 - Identification, Castings

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 E10 - Brinell Hardness of Metallic Materials
ASTM E478 - Chemical Analysis of Copper Alloys

2.3 U.S. 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-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, Ø determined by wet chemical methods in accordance with ASTM E478, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Copper	78.0	--
Aluminum	9.7	10.9
Nickel	4.5	5.5
Iron	2.0	3.5
Manganese	--	1.5
Zinc	--	0.30
Tin	--	0.20
Total Named Elements	99.8	--

3.1.1 If composition is determined by instrumental methods, such as Ø spectrographic, X-ray, or atomic absorption, copper may be reported as "remainder".

3.2 Condition: Solution heat treated and tempered.

3.3 Casting: Castings shall be produced in lots from metal conforming to 3.1. Ø Metal remelted from previously analyzed ingot may be poured directly into castings. Unless otherwise agreed upon by purchaser and vendor, 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 lb (900 kg) or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 lb (1800 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.

3.4 Test Specimens: Chemical analysis specimens and tensile coupons shall be cast as follows and, when requested, shall be supplied with the castings:

3.4.1 Chemical Analysis Specimens: Shall be cast from each melt and shall be of any convenient size, shape, and form for vendor's tests; when chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and vendor.

3.4.2 Tensile Coupons: Shall be cast in permanent molds from each melt of metal used for pouring castings. Coupons shall be of such size as to allow machining tensile specimens conforming to ASTM E8 with 0.500 in. (12.50 mm) diameter at the reduced parallel gage section. 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.

3.5 Heat Treatment: Castings and representative tensile coupons shall be heat treated as follows; 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 3 hours:

3.5.1 Solution Heat Treatment: Heat to a temperature within the range 1600° - 1700°F (870° - 925°C), hold at the selected temperature within ±25°F (±15°C) for not less than 2 hr, and quench in water.

3.5.2 Tempering: Heat to a temperature within the range 1100° - 1200°F (595° - 650°C), hold at the selected temperature within ±15°F (±8°C) for not less than 2 hr, 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 E8; conformance to the requirements of 3.6.1.1 shall be used as the basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.1.2 apply:

3.6.1.1 Separately-Cast Coupons:

Tensile Strength, min	105,000 psi (725 MPa)
Yield Strength at 0.2% Offset, min	62,500 psi (430 MPa)
Elongation in 4D, min	9%

3.6.1.2 Specimens Cut From Castings: Test specimens as in 4.3.4 cut from any area of a casting shall meet the following requirements:

3.6.1.2.1 Castings 1.0 In. (25 mm) and Under in Nominal Cross-Section:

Tensile Strength, min	105,000 psi (725 MPa)
Yield Strength at 0.2% Offset, min	62,500 psi (430 MPa)
Elongation in 4D, min	9%

3.6.1.2.2 Castings Over 1.0 In. (25 mm) in Nominal Cross-Section:

Tensile Strength, min	95,000 psi (655 MPa)
Yield Strength at 0.2% Offset, min	50,000 psi (345 MPa)
Elongation in 4D, min	8%

3.6.1.2.3 Ø 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 the lot, shall have the properties indicated on the drawing for such specimens. Property requirements may be designated in accordance with AMS 2360.

3.6.2 Hardness of Castings: Ø Should be 192 - 248 HB determined in accordance with ASTM E10, or equivalent, but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.2 are met.

3.7 Quality:

3.7.1 Ø Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the castings.

3.7.1.1 Castings shall have smooth surfaces and shall be well cleaned.

3.7.2 Ø Castings, when specified, shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with AMS 2635 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 Ø Castings, when specified, shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645 or to contrast dye penetrant inspection in accordance with AMS 2646.

3.7.4 Radiographic, fluorescent penetrant, contrast dye penetrant, and other quality standards shall be as agreed upon by purchaser and vendor.

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

3.7.5.1 When permitted in writing by purchaser, defects in castings may be Ø repaired by welding in accordance with AMS 2694.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of castings shall supply all Ø samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the castings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Except as specified in 4.2.1.1, tests to determine Ø conformance to requirements for composition (3.1) tensile properties of separately-cast specimens (3.6.1.1) or, when specified, tensile properties of specimens machined from castings (3.6.1.2), and quality (3.7) are classified as acceptance tests and shall be performed on each melt or lot as applicable.

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

4.2.2 Periodic Tests: Tests to determine conformance to requirements for hardness Ø of castings (3.6.2) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical Ø requirements of this specification are classified as preproduction tests and shall be performed prior to or on the first-article shipment of a casting to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when Ø requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Two chemical analysis specimens in accordance with 3.4.1 from each melt or Ø a casting from each lot.

4.3.2 Three tensile test coupons in accordance with 3.4.2 from each lot except Ø when purchaser requires properties of specimens machined from castings.

4.3.3 Two preproduction castings in accordance with 4.4.1 of each part number. Ø

4.3.4 One or more castings from each lot when properties of specimens machined Ø from castings are required. Specimens shall conform to ASTM E8 and shall be either 0.500 in. (12.50 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.

4.4 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 Ø 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, Ø the following:

Type of furnace and its capacity
Type and size of furnace charge
Furnace atmosphere
Fluxing or deoxidation procedure
Mold set-up, parting agent, and rotational speed
Metal pouring temperature (variation of ±50°F (±30°C) from the established limit is permissible)
Solidification and cooling procedures
Solution and tempering heat treatment cycles
Cleaning operations
Methods of inspection