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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4871D

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Superseding AMS 4871C

ALUMINUM BRONZE CASTINGS, CENTRIFUGAL AND CHILL
85Cu - 11Al - 3.6Fe
Solution Heat Treated and Tempered

UNS C95420

1. SCOPE:

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

1.2 Application: Primarily for parts requiring high strength 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 Specification 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 2630 - Ultrasonic Inspection
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 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 E54 or by spectrochemical or other analytical methods approved by purchaser:

	min	max
Copper	83.5	--
Aluminum	10.3	11.5
Iron	3.0	4.3
Manganese	--	0.50
Nickel + Cobalt	--	0.50
Copper plus Sum of Named Elements	99.5	--

3.1.1 Limits may be established and analysis required for elements not listed in 3.1 when agreed upon by purchaser and vendor.

3.2 Condition: Solution heat treated and tempered.

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 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 one continuous furnace is not more than eight consecutive hours.

3.3.2 A lot shall be all castings poured from a single melt in not more than Ø eight consecutive hours and solution heat treated and tempered in the same heat treatment batch.

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.

3.4.2 Tensile Coupons: Shall be cast in permanent molds from each melt of metal Ø 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 the 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 three 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	90,000 psi (620 MPa)
Yield Strength at 0.2% Offset, min	45,000 psi (310 MPa)
Elongation in 4D, min	5%

3.6.1.2 Specimens Cut From Castings: Shall be as follows, determined on not Ø less than four, and preferably 10, specimens cut from thick and thin sections of a casting or castings.

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

Tensile Strength, min	90,000 psi (620 MPa)
Yield Strength at 0.2% Offset, min	40,000 psi (275 MPa)
Elongation in 4D, min	5%

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

Tensile Strength, min	72,000 psi (495 MPa)
Yield Strength at 0.2% Offset, min	36,000 psi (250 MPa)
Elongation in 4D, min	5%

3.6.1.2.3 When properties other than those specified in 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 each lot, shall have the properties indicated on the drawing for such specimens. Tensile property requirements may be designated in accordance with AMS 2360.

3.6.2 Hardness of Castings: Should be 200 - 235 HB/10/3000/15, or equivalent, determined in accordance with ASTM E10, but the 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 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.

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

3.7.2 Castings 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 When specified, castings shall be subjected to ultrasonic inspection in accordance with AMS 2630, to fluorescent penetrant inspection in accordance with AMS 2645, to contrast dye penetrant inspection in accordance with AMS 2646, or to any combination thereof.

3.7.4 Radiographic, ultrasonic, 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 removed and the castings repaired 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 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 (3.5.1.1) or, when specified, tensile properties of specimens cut from castings (3.5.1.2), and quality (3.6) are classified as acceptance tests and shall be performed to represent 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 Ø tensile properties of specimens cut from castings (3.6.1.2) and hardness (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, 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 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 At least one chemical analysis specimens in accordance with 3.4.1 from Ø each melt or a casting from each lot.

4.3.2 Three separately-cast tensile coupons in accordance with 3.4.2 from each Ø lot except when purchaser requires tensile properties of specimens cut from castings.

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

4.3.4 One or more castings from each lot when properties of specimens machined 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 3.6.1.2.3 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 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 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:

Ø Type of furnace
Ø Furnace atmosphere
Ø Mold set-up, parting agent, and rotational speed for centrifugal castings
Ø Fluxing or deoxidation procedure
Ø Metal pouring temperature; variation of ±50°F (±30°C) from the established limit is permissible
Ø Solidification and cooling procedures
Ø Solution and tempering heat treatment cycles
Ø Cleaning operations
Ø 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.

4.5 Reports:

4.5.1 The vendor of castings shall furnish with each shipment a report showing the results of tests for chemical composition of at least one casting or of separately-cast specimens from each melt and the results of tests for tensile properties of separately-cast coupons representing each lot or of specimens cut from castings from each lot. This report shall include the purchase order number, lot number, AMS 4871D, part number, and quantity.

4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4871D, contractor or other direct supplier of castings, part number, and quantity. When castings for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of castings to determine conformance to the requirements of this specification and shall include in the report either a statement that the castings conform or copies of laboratory reports showing the results of tests to determine conformance.