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

AEROSPACE MATERIAL SPECIFICATION

AMS 4881

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Revised

NICKEL-ALUMINUM-BRONZE CASTINGS, MARTENSITIC
Sand and Centrifugal
78Cu - 11Al - 5.1Ni - 4.8Fe

1. SCOPE:

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

1.2 Application: Primarily for parts requiring a combination of high strength and hardness with some ductility and toughness.

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
AMS 2630 - Ultrasonic Inspection
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2646 - Contrast Dye Penetrant Inspection
AMS 2804 - Identification, Castings

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

ASTM B208 - Preparing Tension Test Specimens for Copper-Base Alloys for Sand Castings
ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E478 - Chemical Analysis of Copper-Base Alloys

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-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

Printed in U.S.A.

3.1 Composition: Shall conform to the following percentages by weight, 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 approved analytical methods:

	min	max
Copper	74.5	--
Aluminum	10.5	11.5
Nickel	4.2	6.0
Iron	4.0	5.5
Manganese	--	1.5
Zinc	--	0.30
Tin	--	0.25
Cobalt	--	0.20
Silicon	--	0.15
Chromium	--	0.05
Lead	--	0.03

3.2 Condition: Solution heat treated and annealed.

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. 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 compostion of a sample taken after the last addition to the melt has been found to conform to 3.1.

3.3.1 A melt shall be the metal withdrawn from a batch furnace charge of 2000 lb (908 kg) or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 lb (1816 kg) or less of metal withdrawn from one continuous furnace in not more than 8 consecutive hours.

3.3.2 A lot shall be all castings poured from a single melt in not more than 8 consecutive hours.

3.4 Separately-Cast Test Specimens: Chemical analysis specimens and tensile test specimens 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 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 Test Specimens: Shall be cast with each lot of castings and as follows:

3.4.2.1 Sand Cast: Coupons from which specimens are produced shall be standard keel blocks in accordance with ASTM B208 cast in molds made with the regular foundry mix of green sand, without using chills, or in baked core sand molds. Metal for the coupons shall be part of the melt which is used for the castings. If the metal for castings is given any treatment such as fluxing or cooling and reheating, the metal for the coupons shall be a portion of the metal so treated, and during such treatment shall be heated to the same maximum temperature and held for approximately the same length of time as the molten metal for the castings. Coupons shall be heat treated with the castings in accordance with 3.5 and machined to standard tensile test specimens conforming to ASTM E8, with 0.505 in. (12.83 mm) diameter at the reduced parallel gage section.

3.4.2.2 Centrifugally Cast: Coupons from which specimens are produced shall be cylindrical bars of such size to allow machining specimens conforming to ASTM E8 with 0.505 in. (12.83 mm) diameter at the reduced parallel gage section. Metal for the coupons shall be part of the melt which is used for the castings. If the metal for castings is given any treatment in the furnace as described in 3.4.2.1, the metal for the coupons shall be given the same treatment.

3.5 Heat Treatment: All castings and representative coupons for tensile test specimens shall be solution heat treated by heating to a temperature within the range 1600° - 1700°F (871.1° - 926.7°C), holding at the selected temperature within ±25°F (±14°C) for not less than 2 hr, and quenching in water and tempered by heating to a temperature within the range 925° - 1000°F (496.1° - 537.8°C), holding at the selected temperature within ±15°F (±8.3°C) for not less than 2 hr, and cooling in air to room temperature.

3.6 Properties: Castings and representative test specimens produced in accordance with 3.4.2 and heat treated as in 3.5 shall conform to the following requirements:

3.6.1 Tensile Properties: Shall be as specified in 3.6.1.1 or 3.6.1.2, as applicable, determined in accordance with ASTM E8:

3.6.1.1 Separately-Cast Test Specimens:

3.6.1.1.1 Sand Cast:

Tensile Strength, min	125,000 psi (862 MPa)
Yield Strength at 0.2% Offset, min	95,000 psi (655 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	2%

3.6.1.1.2 Centrifugally Cast:

Tensile Strength, min	130,000 psi (896 MPa)
Yield Strength at 0.2% Offset, min	95,000 psi (655 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	3%

3.6.1.2 Specimens Cut from Castings: Test specimens cut from any area of the casting shall meet the following requirements:

3.6.1.2.1 Specimens Cut from Castings 1.00 In. (25.4 mm) and Under in Nominal Section Thickness:

3.6.1.2.1.1 Sand Castings: Shall meet the requirements of 3.6.1.1.1.

3.6.1.2.1.2 Centrifugal Castings: Shall meet the requirements of 3.6.1.1.2.

3.6.1.2.2 Specimens Cut from Castings Over 1.00 In. (25.4 mm) in Nominal Section Thickness:

3.6.1.2.2.1 Sand Castings:

Tensile Strength, min	120,000 psi (827 MPa)
Yield Strength at 0.2% Offset, min	85,000 psi (586 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	1.5%

3.6.1.2.2.2 Centrifugal Castings:

Tensile Strength, min	125,000 psi (862 MPa)
Yield Strength at 0.2% Offset, min	90,000 psi (621 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	2%

3.6.2 Hardness: Shall be not lower than the following, determined in accordance with ASTM E18:

3.6.2.1 Sand Castings and Sand-Cast Test Specimens: 25 HRC or equivalent.

3.6.2.2 Centrifugal Castings and Centrifugally-Cast Test Specimens: 28 HRC or equivalent.

3.7 Quality:

3.7.1 Castings, as received by the 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. Castings shall have smooth surfaces and shall be well cleaned.

3.7.2 Castings shall be produced under radiographic control, unless otherwise specified. 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 subject to ultrasonic inspection in accordance with AMS 2630, to fluorescent penetrant inspection in accordance with AMS 2645, and/or to contrast dye penetrant inspection in accordance with AMS 2646.

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 provided the weld repair area has properties comparable to those of the parent metal. Repair welds shall be subjected to the same inspection procedures and acceptance standards required of the casting. Weld repair areas shall be suitably marked to facilitate inspection. The repair welding shall be performed prior to any heat treatment and nondestructive testing specified herein.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of castings 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 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the castings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), tensile properties of separately-cast specimens (3.6.1.1), hardness (3.6.2), and quality (3.7) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance to tensile properties of specimens cut from castings (3.6.1.2) requirements are classified as periodic tests.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests.

4.2.2.1 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: