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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4881B

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An American National Standard

Superseding AMS 4881A

NICKEL-ALUMINUM-BRONZE, MARTENSITIC, SAND AND CENTRIFUGAL CASTINGS
78Cu - 11Al - 5.1Ni - 4.8Fe
Quench Hardened and Temper Annealed

UNS C95520

1. SCOPE:

1.1 Form:

This specification covers a nickel-aluminum bronze alloy in the form of sand or centrifugal castings.

1.2 Application:

These castings have been used typically for parts requiring a combination of high strength and hardness with some ductility and toughness, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2360 Room Temperature Tensile Properties of Castings
AMS 2630 Ultrasonic Inspection
AMS 2635 Radiographic Inspection
AMS 2645 Fluorescent Penetrant Inspection
AMS 2694 Welding, Repair of Aerospace Castings
AMS 2750 Pyrometry
AMS 2804 Identification, Castings

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 208 Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings
ASTM E 8 Tension Testing of Metallic Materials
ASTM E 8M Tension Testing of Metallic Materials, Metric
ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 478 Chemical Analysis of Copper Alloys

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DoD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

(R) 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	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
Copper plus Sum of Named Elements (3.1.1)	99.8	--

3.1.1 If composition is determined by instrumental methods, such as spectrochemical, x-ray, or atomic absorption, copper may be reported as remainder.

3.2 Condition:

(R)

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 one 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:

(R)

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

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

3.4.2 Tensile Coupons: 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 B 208 cast in molds made with the regular foundry mix of 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 and shall be poured at a temperature not lower than the temperature of the metal during pouring of 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 specimens conforming to ASTM E 8 or ASTM E 8M with 0.500 inch (12.70 mm) diameter at the reduced parallel gage section.

3.4.2.2 Centrifugally Cast: Coupons from which specimens are produced shall be cylindrical bars of such size to allow machining specimens conforming to ASTM E 8 or ASTM E 8M with 0.500 inch (12.70 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. 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:

(R)

All castings and representative coupons for tensile specimens shall be solution heat treated by heating to a temperature within the range 1600 to 1700 °F (871 to 927 °C), holding at the selected temperature within ±25 °F (±14 °C) for not less than two hours, and quenching in water and tempered by heating to a temperature within the range 925 to 1000 °F (496 to 538 °C), holding at the selected temperature within ±15 °F (±8 °C) for not less than two hours, and cooling in air to room temperature. Pyrometry shall be in accordance with AMS 2750.

3.6 Properties:

Castings and representative tensile coupons 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 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 castings except when purchaser specifies that requirements of 3.6.1.2 apply:

3.6.1.1 Separately-Cast Specimens:

3.6.1.1.1 Sand Cast: Shall conform to Table 2.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	125 ksi (862 MPa)
Yield Strength at 0.2% Offset	95.0 ksi (655 MPa)
Elongation in 4D	2%

3.6.1.1.2 Centrifugally Cast: Shall conform to Table 3.

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	130 ksi (896 MPa)
Yield Strength at 0.2% Offset	95.0 ksi (655 MPa)
Elongation in 4D	3%

3.6.1.2 Specimens Cut From Any Area of a Casting:

3.6.1.2.1 Castings 1.00 Inch (25.4 mm) and Under in Nominal Section Thickness:

3.6.1.2.1.1 Sand Cast: Shall meet the requirements of Table 2.

3.6.1.2.1.2 Centrifugal Cast: Shall meet the requirements of Table 3.

3.6.1.2.2 Castings Over 1.00 Inch (25.4 mm) in Nominal Section Thickness:

3.6.1.2.2.1 Sand Cast: Shall conform to Table 4.

TABLE 4 - Minimum Tensile Properties

Property	Value
Tensile Strength	120 ksi (827 MPa)
Yield Strength at 0.2% Offset	85.0 ksi (586 MPa)
Elongation in 4D	1.5%

3.6.1.2.2.2 Centrifugal Cast: Shall conform to Table 5.

TABLE 5 - Minimum Tensile Properties

Property	Value
Tensile Strength	125 ksi (860 MPa)
Yield Strength at 0.2% Offset	90.0 ksi (621 MPa)
Elongation in 4D	2%

3.6.1.2.3 When 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 taken from locations indicated on the drawing, from a casting or castings chosen at random to represent the lot, shall have the properties specified on the drawing for such specimens. Property requirements for such specimens may be designated in accordance with AMS 2360.

3.6.2 (R) Hardness: Shall be not lower than the following, determined in accordance with ASTM E 18.

3.6.2.1 Sand Castings: 25 HRC, or equivalent.

3.6.2.2 Centrifugal Castings: 28 HRC, or equivalent.

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 (R) Castings shall have smooth surfaces and shall be sufficiently cleaned to permit fluorescent penetrant inspection.

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 (R) When specified, castings shall be subjected to ultrasonic inspection in accordance with AMS 2630, to fluorescent penetrant inspection in accordance with AMS 2645, or to both.

3.7.4 (R) Radiographic, ultrasonic, fluorescent penetrant, and other quality acceptance standards may be agreed upon by purchaser and vendor.

3.7.5 Castings shall not be reworked 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:

(R)

The vendor of castings shall supply all samples for vendor's tests and shall be responsible for performing all required tests. 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 for composition
(R) (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), hardness (3.6.2), and quality (3.7) are 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 only when specified by purchaser or when separately-cast specimens are not available. Tensile properties of separately-cast specimens need not be determined when properties of specimens cut from castings are determined.

4.2.2 Preproduction Tests: Tests for all technical requirements are 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 and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

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, contracting officer, or request for procurement.

4.3 Sampling and Testing:

(R)

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 Two separately-cast tensile specimens in accordance with 3.4.2 from each
(R) lot except when properties of specimens cut from castings are required.

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

4.3.4 (R) One or more castings from each lot when properties of specimens machined from castings are required. Size, location, and number of specimens machined from castings shall be as specified on the drawing or as agreed upon by purchaser and vendor. When size, location, and number of specimens are not specified, 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 (R) One or more castings from each lot for hardness testing.

4.4 Approval:

4.4.1 Sample castings from new or reworked master 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
Gating and risering practices (sand castings), mold set-up, parting agent, and rotational speed (centrifugal castings)
Metal pouring temperature; variation of ±50 °F (±28 °C) 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.