

AEROSPACE MATERIAL SPECIFICATION



AMS 4890B

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Superseding AMS 4890A

Copper-Beryllium Alloy Castings
97Cu - 2.1Be - 0.52Co - 0.28Si
Solution Heat Treated (TB00)

UNS C82500

1. SCOPE:

1.1 Form:

This specification covers a copper-beryllium alloy in the form of sand, investment, or centrifugal castings.

- 1.1.1 Castings shall be made by the investment casting process unless another casting process is agreed upon by purchaser.

1.2 Application:

These castings have been used typically for small parts of intricate design requiring good corrosion resistance and high strength, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

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.

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2.1 SAE Publications:

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

AMS 2360	Room Temperature Tensile Properties of Castings
AMS 2635	Radiographic Inspection
AMS 2645	Fluorescent Penetrant Inspection
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 Castings
ASTM B 770	Copper-Beryllium Alloy Sand Castings for General Application
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 106	Chemical Analysis of Copper-Beryllium Alloys
ASTM E 272	Reference Radiographs for High-Strength Copper-Base and Nickel-Copper Alloy Castings
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:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 106 or ASTM E 478, by spectro-chemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Beryllium	1.90	2.25
Cobalt	0.35	0.7
Silicon	0.20	0.35
Iron	--	0.25
Nickel	--	0.20
Aluminum	--	0.15
Chromium	--	0.10
Tin	--	0.10
Zinc	--	0.10
Lead	--	0.02
Copper + Sum of named elements (3.1.2)	99.5	--
Copper (3.1.1)	remainder	

3.1.1 Applicable when copper is not determined by analysis. The reported (certified) value is the difference between the sum of all other specified elements and 100%; and will therefore include unnamed elements. Limits for unnamed elements may be established by agreement between purchaser and manufacturer or supplier.

3.1.2 Applicable only when copper is determined by direct analysis.

3.2 Condition:

Solution heat treated, (TB00) (See 8.2).

3.3 Casting:

Castings shall be made by the investment casting process unless another process is agreed to by purchaser. Castings shall be poured from a single furnace charge of not more than 2000 pounds (907 kg). The furnace charge may consist of virgin material, gates, sprues, risers, or other recycled material.

3.4 Heat Qualification:

Each heat shall be qualified by chemical analysis and tensile specimens conforming to 3.4.1 and 3.4.2 respectively. Heat identity of all specimens and parts shall be maintained through all operations.

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

3.4.2 Tensile Specimens: Specimens shall be prepared from locations shown on the part drawing from at least one casting from each lot. If specimen location is not designated, specimens shall be taken from the most representative location or integrally-cast area. Specimens shall be of standard proportions in accordance with ASTM E 8 or ASTM E 8M with 0.250 inch (6.35 mm) diameter at the reduced parallel gage section or shall be prepared in accordance with ASTM B 208, whichever is most representative of the casting.

3.5 Heat Treatment:

All castings and representative tensile specimens shall be solution heat treated in accordance with 3.5.1. Pyrometry shall be in accordance with AMS 2750.

3.5.1 All castings, and integrally-cast coupons when permitted, shall be solution heat treated by heating to $1475^{\circ}\text{F} \pm 10$ ($802^{\circ}\text{C} \pm 6$), holding at heat for one hour per inch (25 mm) of nominal cross-section but not less than 15 minutes, and quenching in cold water or suitable oil.

3.5.2 Unless otherwise specified, representative specimens shall be precipitation heat treated by heating within the range 650 to 750°F (343 to 399°C), holding at heat for not less than one hour to demonstrate heat treat response (See 8.3).

3.6 Properties:

Castings, and integrally-cast coupons when permitted, shall conform to the following requirements:

3.6.1 As Solution Heat Treated:

3.6.1.1 Tensile Properties: When specified, shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M on specimens cut from a casting or integrally-cast coupon.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	60.0 ksi (414 MPa)
Yield Strength at 0.2% Offset	20.0 ksi (138 MPa)
Elongation in 4D	30%

3.6.1.1.1 When properties other than those of 3.6.1.1 are required, the engineering drawing or purchase order shall specify tensile property limits. Property requirements may be designated in accordance with AMS 2360.

3.6.1.2 Hardness: Shall be not higher than 80 HRB, or equivalent, determined in accordance with ASTM E 18.

3.6.1.3 Microstructure: When specified, microstructure and grain size shall conform to standards agreed upon between purchaser and vendor.

3.6.2 After Precipitation Heat Treatment: Unless otherwise specified, specimens cut from castings or from representative separately-cast tensile specimens, precipitation heat treated in accordance with 3.5.2 to demonstrate response to heat treatment, shall have the following properties:

3.6.2.1 Tensile Properties: Shall be as shown in Table 3, determined in accordance with ASTM E 8 or ASTM E 8M on separately-cast specimens, specimens cut from castings, or from integrally-cast specimens.

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	150 ksi (1034 MPa)
Yield Strength at 0.2% Offset	120 ksi (827 MPa)
Elongation in 4D	2%

3.6.2.1.1 When properties other than those of 3.6.2.1 are required, the engineering drawing or purchase order shall specify tensile property limits. Property requirements may be designated in accordance with AMS 2360.

3.6.2.2 Hardness: Shall be not lower than 35 HRC, or equivalent, determined in accordance with ASTM E 18.

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 sufficiently cleaned to permit fluorescent penetrant inspection. Metallic shot or grit shall not be used for final cleaning.

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 satisfactory quality. ASTM E 272 may be used to define radiographic acceptance standards.

3.7.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645. Standards for acceptance shall be as agreed upon between purchaser and vendor.

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

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. 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 (3.1), tensile properties (3.6.1.1, and, when specified 3.6.2.1), and hardness (3.6.1.2) are acceptance tests and shall be performed to represent each heat and lot of castings.

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

Shall be in accordance with ASTM B 770 for all castings and the following; a lot shall be all castings of the same form and size from the same heat processed at the same time.

4.3.1 One chemical analysis specimen from each heat.

4.3.2 At least two castings from each lot for hardness testing in accordance with 3.6.1.2.

4.3.3 Sufficient castings of each part number shall be supplied in accordance with 4.4.1 to ensure that all requirements of the drawing and this specification can be tested.

4.3.4 Unless otherwise specified, one tensile specimen cut from a casting, one integrally-cast coupon, or one separately-cast specimen representing each lot for testing as in 3.6.1.1 or 3.6.2.1.

- 4.3.5 When specified, to demonstrate response to precipitation heat treatment, at least one tensile specimen for testing in accordance with 3.6.2.1.
- 4.3.6 When specified, to demonstrate response to precipitation heat treatment, at least one specimen for hardness testing in accordance with 3.6.2.2.
- 4.4 Approval:
- 4.4.1 Sample castings from new or reworked master patterns 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 procedures 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 and its capacity
 - Type and size of furnace charge
 - Time molten metal is in furnace
 - Furnace atmosphere
 - Fluxing or deoxidation procedure
 - Number of ladles used in pour
 - Mold refractory formulation
 - Mold back-up material
 - Gating practices
 - Mold preheat and metal pouring temperatures; variations of ± 25 °F (± 14 °C) are permissible
 - Solidification and cooling procedures
 - Solution heat treatment cycle
 - 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.