



AEROSPACE MATERIAL SPECIFICATION

AMS4860™**REV. F**

Issued 1939-12
Revised 2009-07
Reaffirmed 2015-09

Superseding AMS4860E

Manganese Bronze, Sand and Centrifugal Castings

58Cu – 39Zn – 1.2Fe – 1.0Al – 0.80Mn

As Cast

(Composition similar to UNS C86500)

RATIONALE

AMS4860F has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers a manganese bronze alloy in the form of sand and centrifugal castings.

1.2 Application

These castings have been used typically for parts requiring strength, toughness, and corrosion resistance, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply:

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2694 In-Process Welding of Castings
AMS2804 Identification, Castings

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2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 208	Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings
ASTM E 8/E 8M	Tension Testing of Metallic Materials
ASTM E 478	Chemical Analysis of Copper Alloys
ASTM E 1417	Liquid Penetrant Testing
ASTM E 1742	Radiographic Examination

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 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

Element (3.1.1)	min	max
Copper (3.1.4)	55.0	60.0
Zinc (3.1.2)	36.0	42.0
Iron	0.40	2.0
Aluminum	0.50	1.5
Manganese	0.10	1.5
Tin	--	1.0
Nickel (plus Cobalt)	--	1.0
Lead	--	0.40
Sum of Named Elements (3.1.3)	99.0	--

- 3.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer or supplier and purchaser.
- 3.1.2 Zinc may be reported as "remainder", or as the difference between the sum of results for all elements and 100%, or as the result of direct analysis.
- 3.1.3 When all the elements in Table 1 are analyzed, the sum shall be 99.0% minimum, but such determination is not required for routine acceptance of each lot.
- 3.1.4 In determining copper minimum, copper may be calculated as copper plus nickel.

3.2 Condition

As cast. MO₁ (as sand cast) or MO₂ (as centrifugally cast) (See 8.2).

3.3 Casting

Castings shall be produced in lots from metal conforming to 3.1.

- 3.3.1 A lot shall be all castings produced from one furnace melt or crucible melt. When two or more furnace melts or crucible melts or combination thereof are used to charge a ladle for pouring, the castings therefrom shall constitute a lot. A lot shall be not more than 1000 pounds (454 kg) of castings.

3.4 Test Specimens

Chemical analysis specimens and tensile coupons 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 in accordance with 3.4.2.1 and 3.4.2.2. 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 time as the molten metal for the castings. The temperature of the metal during pouring of the coupons shall be not lower than that during pouring of the castings.

3.4.2.1 Sand Cast

Coupons from which specimens are machined shall be standard keel blocks conforming to ASTM B 208 cast in molds made with the regular foundry mix of sand without using chills or baked sand core molds. Coupons shall be machined to standard tensile specimens conforming to ASTM E 8/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 machined shall be cylindrical bars of such size to allow machining of standard tensile specimens conforming to ASTM E 8/E 8M with 0.500 inch (12.70 mm) diameter at the reduced parallel gage section.

3.5 Properties

Castings and representative tensile specimens produced in accordance with 3.4.2 shall conform to the following requirements:

3.5.1 Tensile Properties

Separately-cast specimens or specimens as in 4.3.4 cut from any area of a casting shall meet the requirements shown in Table 2, determined in accordance with ASTM E 8/E 8M.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	65.0 ksi (448 MPa)
Yield Strength at 0.2% Offset	25.0 ksi (172 MPa)
Elongation in 4D	20%

3.5.1.1 Tensile properties of separately-cast specimens shall be used for acceptance of castings except when purchaser specifies that tensile properties of specimens cut from any area of a castings apply.

3.6 Quality

3.6.1 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.

3.6.1.1 Castings shall have smooth surfaces and shall be cleaned sufficiently to permit nondestructive testing.

- 3.6.2 Castings shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with ASTM E 1742 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.
- 3.6.3 When specified, castings shall be subjected to fluorescent penetrant testing in accordance with ASTM E 1417.
- 3.6.4 Radiographic, fluorescent penetrant, and other quality acceptance standards may be agreed upon by purchaser and vendor.
- 3.6.5 Castings shall not be repaired by peening, plugging, welding, or other methods without written permission from purchaser.
- 3.6.5.1 When permitted in writing by purchaser, defects in castings may be removed and the castings reworked by welding in accordance with AMS2694.

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 the performance of 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 specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Except as specified in 4.2.1.1, composition (3.1), tensile properties (3.5.1), and quality (3.6) 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 coupons are not available. Tensile properties of separately-cast coupons need not be determined when tensile properties of specimens cut from castings are determined.

4.2.2 Preproduction Tests

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.

4.3 Sampling and Testing

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 lot except when properties of specimens cut from castings are required.
- 4.3.3 Sufficient castings of each part number in accordance with 4.4.1 as required to satisfy dimensional, mechanical property, and quality evaluation.