

**MIL-B-16540B**

26 MARCH 1969

SUPERSEDING

MIL-B-16540A(Wep)

24 May 1961 and

NOTICE 1 (OS)

20 August 1968

## MILITARY SPECIFICATION

### BRONZE, PHOSPHOR: CASTINGS

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope - This specification prescribes the requirements for phosphor bronze sand castings containing a controlled lead content.

1.2 Classification - Phosphor bronze castings shall be of the composition shown in Table I and grade as shown in Table II (see 6.2).

1.3 Condition - Phosphor bronze castings shall be furnished in the "as cast" condition.

#### 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

#### SPECIFICATIONS

##### Federal

|           |                                     |
|-----------|-------------------------------------|
| PPP-B-585 | Boxes, Wood, Wirebound              |
| PPP-B-601 | Boxes, Wood, Cleated-Plywood        |
| PPP-B-621 | Boxes, Wood, Nailed and Lock-Corner |
| PPP-C-650 | Crate, Wood, Open and Covered       |

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STANDARDS

Federal

Fed. Test Method      Metals, Test Methods  
Std. No. 151

Military

MIL-STD-105      Sampling Procedures and Tables for Inspection by  
Attributes

MIL-STD-129      Marking for Shipment and Storage

MIL-STD-271      Nondestructive Testing Requirements for Metals

PUBLICATION

Naval Ship Systems Command

NAVSHIPS-250-537-1 Radiographic Standards for Bronze Castings  
or 2

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2      Other publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Trucking Associations, Inc.

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., 1616 P Street, N. W., Washington, D. C. 20036.)

Uniform Classification Committee

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, Chicago, Ill. 60606.)

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American Welding Society

AWS A2.2-58

Nondestructive Testing Symbols

(Application for copies should be addressed to the American Welding Society, United Engineering Center, 345 East 47th Street, New York, New York 10017.)

American Society for Testing and Materials

Standard E8-66

Tension Testing of Metallic Materials

(Copies of the document are stocked by DOD Single Stock Point, Naval Publications and Forms Center, Philadelphia, Pennsylvania, for issue to Military Activities only.)

## 3. REQUIREMENTS

3.1 Chemical requirements - Castings shall conform to the chemical composition requirements of Table I.

TABLE I

## CHEMICAL REQUIREMENTS

| Grade | Copper         | Tin          | Zinc         | Lead       | Iron<br>(max.) | Nickel<br>(max.) | Phos-<br>phorus<br>(max.) | Other<br>(max.) |
|-------|----------------|--------------|--------------|------------|----------------|------------------|---------------------------|-----------------|
| A     | %<br>85.0-89.0 | %<br>7.5-9.0 | %<br>3.0-5.0 | %<br>0-1.0 | %<br>0.25      | %<br>1.00        | %<br>0.50                 | %<br>0.50       |

3.1.1 The contractor shall furnish an analysis of each melt of castings showing the percentage of each of the elements specified in Table I.

3.2 Mechanical properties - Mechanical properties of these coupons for tension tests (see 4.4.2.3) shall conform to those specified in Table II.

TABLE II

## MECHANICAL PROPERTIES

| Grade | Tensile strength<br>(min.)          | Elongation<br>in 2 inches<br>(min.) |
|-------|-------------------------------------|-------------------------------------|
| A     | Pounds per<br>square inch<br>35,000 | Percent<br>18                       |

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### 3.3 Production control and soundness -

3.3.1 Foundry control - When specified (see 6.2), castings shall be produced under foundry control approved by the procuring activity. Foundry control shall consist of the examination of castings by radiographic or other methods specified by the procuring activity until the gating, pouring and other foundry practices have been established to produce castings meeting the quality standards agreed upon by the procuring activity and the contractor. When the foundry practices have been so established, the practices shall not be changed without demonstrating to the satisfaction of the procuring activity that the change does not adversely affect the quality of the castings.

3.3.2 Soundness - When specified (see 6.2), the soundness of the castings shall meet standards agreed upon by the procuring activity and the manufacturer. The areas of the castings subject to the soundness requirements shall be as specified (see 6.2) and the number and extent of sponginess, blowholes and other defects in such areas shall not be greater than indicated by the standard.

3.3.3 Nondestructive testing - Radiographic and other nondestructive tests used for foundry control methods and determinations of soundness shall conform to MIL-STD-271. Radiographic examination of production castings will not be required unless specified in the contract or order (see 6.2), on the drawings, or in the applicable specifications listed in the contract or order.

3.4 Pressure - Castings shall meet such pressure requirements as may be specified in the contract or order (see 6.2).

### 3.5 Dimensions -

3.5.1 The responsibility for furnishing castings that can be laid out and machined to the finished dimensions, within the specified tolerances, as shown on the blueprints or drawings, and that will conform to such gages as may be specified in individual cases, shall rest with the contractor. Sufficient stock shall be allowed for shrinkage and, where required, for finishing, but castings of excessive size or weight shall not be furnished.

3.5.2 Cast-to-size parts shall conform to dimensions and tolerances specified, and shall not be warped or distorted in such a manner as to adversely affect the appearance or serviceability.

### 3.6 Repairing of defective castings -

3.6.1 Castings shall not be welded, impregnated, plugged, burned in or otherwise repaired without permission from the procuring activity. Such permission will be given only when the defects are small and do not adversely affect the strength, use, or machinability of the castings.

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3.6.2 Each repair shall be encircled with a ring of white paint prior to submission for inspection or shipment.

3.7 Cleaning - Castings shall be smooth and well cleaned before inspection by sand-blasting, tumbling, chipping, or other process approved by the procuring activity.

3.8 Identification marking - When castings are of sufficient size, each casting shall be marked with the following data:

Manufacturer's name or trade mark

Heat, melt or lot number

Pattern or drawing number

3.8.1 When castings are so small that individual marking is impracticable, castings of the same lot or melt and pattern, shall be wired together or placed in a container, or otherwise segregated and a metal tag containing the data required in 3.8 attached thereto.

3.8.2 Impression stamping - When impression stamping is used for identification marking, the markings shall be located in areas of low stress as referred to in the blueprint or drawing. Markings should be in locations which will not be machined off.

3.9 Workmanship - Castings shall be free of injurious blowholes, porosity, hard spots, cracks, and other defects. The contractor may be required to replace castings in which injurious defects are revealed by manufacturing operations performed after acceptance, without expense to the Government. Castings shall be of the highest grade of workmanship and shall be of uniform quality and condition.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot - A lot shall consist of all the castings of one grade of material produced from the same melt or the same pouring of a furnace, a crucible, or a ladle. When two or more furnace or crucible melts are used to charge a ladle for pouring, the castings produced therefrom shall comprise the lot for sampling purposes.

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4.3 Quality conformance inspection - Quality conformance inspection shall consist of:

- (a) Visual examination
- (b) Quality conformance tests

4.4 Sampling -

4.4.1 Sampling for visual examination - A random sample of castings shall be selected from each lot in accordance with MIL-STD-105, Inspection Level III, Acceptable Quality Level (AQL) 1.5 percent defective, and shall be surface inspected to determine conformance with the cleaning and workmanship requirements of this specification. Lots exceeding the allowable sample defective shall be rejected.

4.4.2 Sampling for quality conformance testing -

4.4.2.1 Dimensional inspection - A sample shall be selected at random from each inspection lot in accordance with MIL-STD-105, Inspection Level I, Acceptable Quality Level (AQL) 4.0 percent defective, and inspected for dimensional requirements of this specification to show that they can be properly machined to the required finished dimensions specified.

4.4.2.2 Chemical analysis - A sample for chemical analysis shall be taken from the first and the last casting of each lot made from the same patterns. The sample for analysis shall consist of not less than five (5) ounces of drillings taken from sound metal below the surface and shall be fine, clean, free from oil, dirt, grit, and foreign matter.

4.4.2.3 Coupons for tension tests -

4.4.2.3.1 Separately cast coupons (test bars) - Unless otherwise specified, two separately cast test coupons shall be poured from each lot. One shall be cast at the beginning of pouring, and the other at the end of pouring the castings of a lot. Test coupons shall be cast in the form and dimensions illustrated by Figures 1, 2, and 3. Separately cast test coupons shall be drawn from the sand, and properly marked for identification. Unless specifically provided for in the contract or order, the chilling of test coupons shall cause the rejection of the material which the coupons represent.

4.4.2.3.2 Attached coupons - When specified in the contract or order (see 6.2), or if the manufacturer desires and the procedure is satisfactory to the Government, test coupons shall be attached to the individual castings as follows:

- (a) Each casting weighing 250 pounds or more shall have at least one test coupon cast with it, and attached thereto.

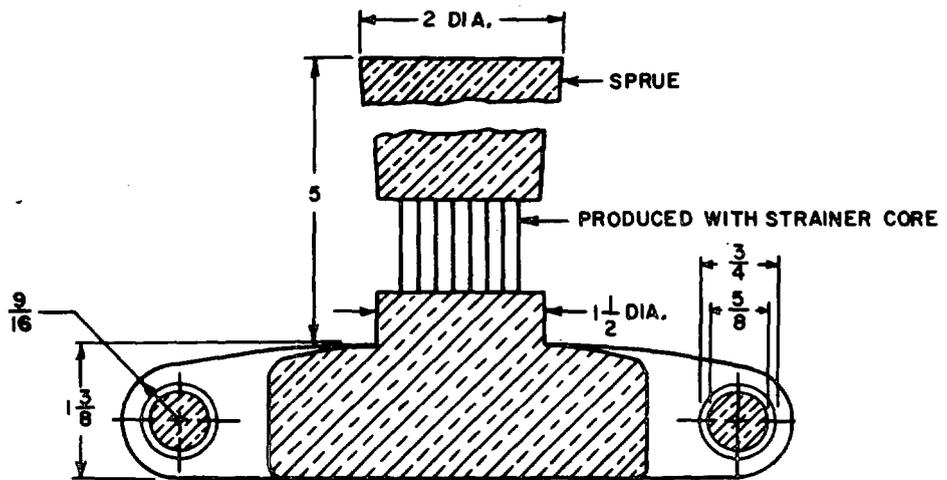
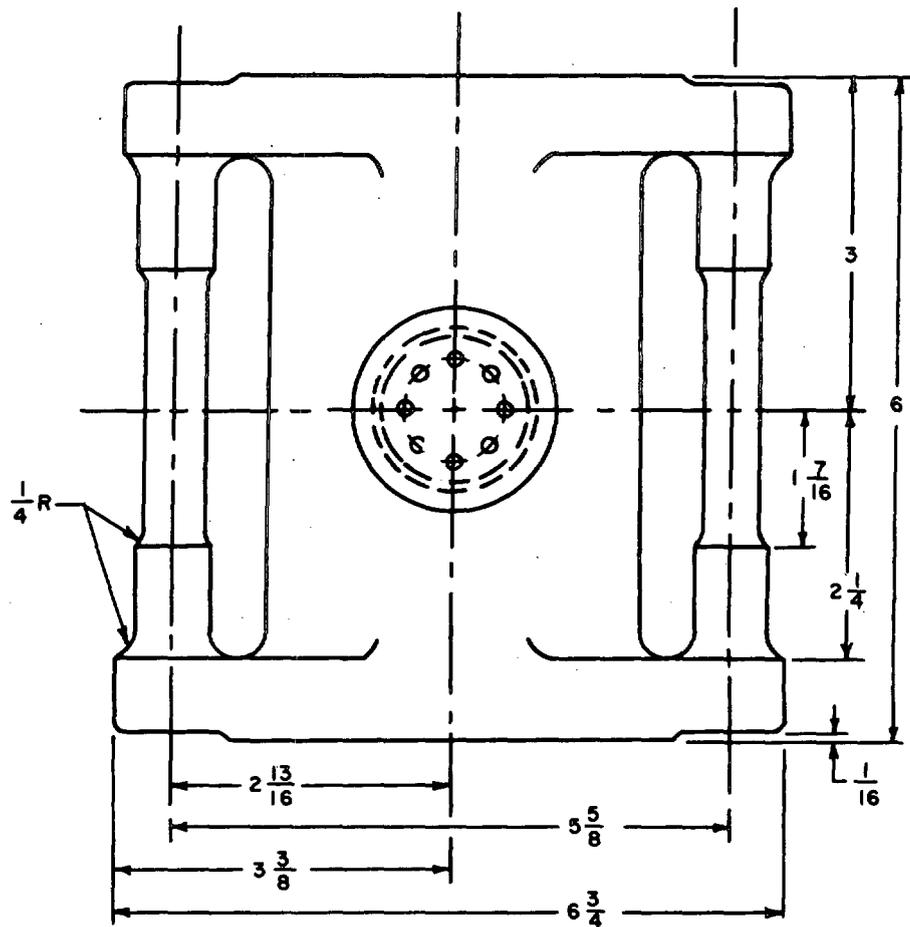


Figure 1. Test-bar casting for tin bronzes and silicon bronzes (dimensions in inches)



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- (b) If the castings weigh less than 250 pounds, at least one cast test coupon shall be attached to the first and last castings poured in each lot.

4.4.2.3.3 Sample castings - When the manufacturer so desires, a casting in the lot may be submitted as the test coupon in lieu of test bars or attached cast coupons.

4.4.2.4 Sampling for examination of packing and marking requirements - Sampling castings shall be selected at random from each lot in accordance with MIL-STD-105, Inspection Level III, Acceptable Quality Level (AQL) 2.5 percent defective, and examined for conformance to the requirements of Section 5.

4.4.2.5 Sampling for non-destructive testing - When a soundness requirement is specified, sampling shall be accomplished as specified by the procuring activity (see 6.2).

#### 4.5 Tests -

4.5.1 Chemical analysis - The samples, obtained in accordance with 4.4.2.2, shall be analyzed by Method 111 of Fed. Test Method Std. No. 151 for conformance with the chemical composition requirements for the specified grade of material. If a sample fails to conform to the requirements of this specification the lot shall be rejected.

#### 4.5.2 Tension test -

4.5.2.1 Preparation of tensile specimens - Specimen I (Figure 9) tensile specimens shall be prepared from test coupons obtained in accordance with 4.4.2.3, in conformance to ASTM Designation E8-66.

4.5.2.2 Test procedure - Tension tests shall be performed in accordance with ASTM Designation E8-66, for compliance with the mechanical property requirements of this specification. If any specimen, prepared from a cast test coupon or a casting, fails to pass the test, the casting or lot represented shall be rejected.

4.5.2.3 Replacement of test specimens - Test specimens may be discarded and replaced in accordance with the general section of Fed. Test Method Std. No. 151.

4.5.3 Radiographic examination - When radiographic examination is required (see 6.2), it shall be conducted in accordance with MIL-STD-271, and the radiographic quality classification which is assigned in accordance with NAVSHIPS-250-537-1 or 2, shall be specified in the applicable specifications, contract or order, or drawings approved by the procuring activity.

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4.5.3.1 The procuring activity may require radiographic examination of additional areas to investigate the extent of defects revealed by original radiographic examination, by surface inspection, by machining, or by pressure or other tests.

4.5.3.2 Marking of drawings- When radiographic examination is required, all drawings detailing radiographic examination of castings shall be submitted to the contracting agency for approval. Contractors are required to submit drawings showing the proper radiographic markings, in accordance with AWS A2.2-58, including the extent, location, and classification assigned. Other pertinent information, such as section thickness, design pressures and temperatures, should be included on the drawings submitted. The type or format of the drawings shall conform to the applicable specification or master drawing system as specified in the contract or order.

## 5. PREPARATION FOR DELIVERY

### 5.1 Packing -

5.1.1 All castings shall be separated by pattern when packed for shipment. Where practicable, shipping containers shall be of uniform size, minimum cube and weight, and shall contain the identical number of castings of the same pattern. Containers shall be designed to fit the contents in a compact manner. Castings shall be adequately blocked, braced, or otherwise secured to prevent their movement within the shipping containers.

5.1.1.1 Finished or polished castings - Finished or polished castings shall be so packed as to afford adequate protection to the finished surfaces. Where practicable, the castings shall be boxed. Large polished or finished castings, when boxing is not practicable, shall have finished or polished surfaces protected with batten strips.

5.1.1.2 Rough castings - Unless otherwise specified in the contract or order, rough castings not susceptible to damage in shipment may be shipped unpacked or bundled.

5.1.1.3 Castings having projections - Castings having projections that may be damaged in handling or transit shall be boxed or crated or the projections adequately protected by wood batten strips.

### 5.1.2 Level A -

5.1.2.1 Small castings weighing up to 250 pounds each shall be packed in wood cleated plywood (overseas type), nailed wood (Class 2) wirebound wood (Style 3 for Type 2 load) boxes or open crates conforming to PPP-B-601, PPP-B-621, PPP-B-585 and PPP-C-650, respectively, at the option of the contractor. Finished or polished castings shall be adequately protected from mechanical damage. Box

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closures and strapping shall be as specified in the applicable box specification or appendix thereto.

5.1.2.2 Large rough castings weighing more than 250 pounds each require no packing except that, when specified for convenience in handling due to size and shape, the items shall be secured on skids or pallets. Large finished or polished castings having projections or surfaces that may be damaged shall be packed in crates conforming to PPP-C-650 or secured by skids or pallets with the projections adequately protected by wood batten strips.

5.1.3 Level B -

5.1.3.1 Castings shall be packed as specified for Level A, except boxes shall be of the domestic type or class.

5.1.4 Level C -

5.1.4.1 Castings shall be so prepared and shipping containers so constructed as to insure safe delivery by common or other carrier to the point of delivery at the lowest rate, and shall afford maximum protection from the normal hazards of transportation. Containers shall comply with the Uniform Freight Classification rules or National Motor Freight Classification rules.

5.2 Marking -

5.2.1 Unless otherwise specified in the contract or order, each bundle, shipping container, and unpacked casting shall be marked with the name of the material; pattern or mold number as specified on the drawings; this specification number and grade; the gross weight and quantity; the name of the contractor, the number of the contract or order.

5.2.2 In addition to the marking specified in 5.2.1 and special markings required in the contract or order, marking of the shipping containers shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use -

6.1.1 Grade A bronze (1.2) is a leaded phosphor bronze or leaded gun metal which may be used for expansion joints, special pipe fittings, gears, valves, pump pistons and casings, bushings, bearings, and similar applications requiring good strength and resistance to sea-water corrosion.

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6.2  
following:

Ordering data - Procurement documents should specify the

- (a) Title, number and date of this specification.
- (b) The grade of phosphor bronze required (see 1.2).
- (c) Whether foundry control is required (see 3.3.1).
- (d) Whether nondestructive tests are required (see 3.3.2 and 3.3.3).
- (e) Whether pressure tests are required (see 3.4).
- (f) Pattern and drawing number.
- (g) Whether pattern is to be furnished.
- (h) Whether attached test coupons are required (see 4.4.2.3.2).
- (i) Level of packing required (see 5.1).
- (j) Quantity of castings required.

6.3 Radiographic standards for bronze castings are available at the Department of Commerce, Office of Technical Services.

Custodians:

Army - MR  
Navy - AS  
Air Force - 11

Preparing activity:

Navy - AS  
(Project No. MECA-0041)

Review activities:

Army - ME  
Navy - YD  
Air Force - 84

User activities:

Navy - OS, MC

| SPECIFICATION ANALYSIS SHEET   |                            | Form Approved<br>Budget Bureau No. 119-R004 |
|--|----------------------------|---|
| INSTRUCTIONS   |                            |   |
| This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof). |                            |   |
| SPECIFICATION  |                            |   |
| MIL-B-16540B   |                            | BRONZE, PHOSPHOR: CASTINGS                  |
| ORGANIZATION (Of submitter)  |                            | CITY AND STATE                              |
| CONTRACT NO.   | QUANTITY OF ITEMS PROCURED | DOLLAR AMOUNT                               |
| MATERIAL PROCURED UNDER A  |                            |   |
| <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT   |                            |   |
| 1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?   |                            |   |
| A. GIVE PARAGRAPH NUMBER AND WORDING.  |                            |   |
| B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.  |                            |   |
| 2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID  |                            |   |
| 3. IS THE SPECIFICATION RESTRICTIVE?   |                            |   |
| <input type="checkbox"/> YES <input type="checkbox"/> NO         IF "YES", IN WHAT WAY?  |                            |   |
| 4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)   |                            |   |
| SUBMITTED (Printed or typed name and activity)   |                            | DATE  |