



# Standard Specification for Gear Bronze Alloy Castings<sup>1</sup>

This standard is issued under the fixed designation B 427; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope \*

1.1 This specification<sup>2</sup> establishes requirements for alloys whose copper alloy numbers and nominal compositions are shown in Table 1. The castings may be furnished as one of three types: static chill, centrifugal chill, or sand cast.

1.2 The values stated in inch-pound units are to be regarded as the standard. Metric values given in parentheses are for information purposes only.

## 2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.1 *ASTM Standards:*

B 208 Practice for Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings<sup>3</sup>

B 824 Specification for General Requirements for Copper Alloy Castings<sup>3</sup>

E 8 Test Methods of Tension Testing of Metallic Materials<sup>4</sup>

E 10 Test Method for Brinell Hardness of Metallic Materials<sup>4</sup>

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>5</sup>

## 3. Ordering Information

3.1 Orders for material to this specification shall include the following information:

3.1.1 Quantity of castings required,

3.1.2 Copper Alloy UNS No. (Table 1),

3.1.3 Specification title, number, and year of issue,

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.05 on Castings and Ingots for Remelting.

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<sup>2</sup> The UNS system for copper and copper alloys (see Practice E 527) is a simple expansion of the former standard designation system accomplished by the addition of a prefix “C” and a suffix “00.” The suffix can be used to accommodate composition variations of the base alloy.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 02.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 01.01.

TABLE 1 Nominal Composition

| Copper Alloy UNS No. | Previously Used Designation | Composition, % |      |        |      |            |
|----------------------|-----------------------------|----------------|------|--------|------|------------|
|                      |                             | Copper         | Tin  | Nickel | Lead | Phosphorus |
| C90800               | A                           | 87.8           | 12.0 | ...    | 0    | 0.2        |
| C91700               | B                           | 86.3           | 12.0 | 1.5    | 0    | 0.2        |
| C90700               | ...                         | 87.8           | 11.0 | ...    | 0    | 0.2        |
| C91600               | C                           | 88.0           | 10.3 | 1.5    | 0    | 0.2        |
| C92900               | D                           | 83.5           | 10.0 | 3.5    | 2.8  | 0.2        |

3.1.4 Pattern or drawing number and casting type (Section 1),

3.1.5 Repair of castings (Section 7),

3.1.6 Certification, if specified in the purchase order (Specification B 824),

3.1.7 Foundry test report, if specified in the purchase order (Specification B 824), and

3.1.8 Witness inspection, if specified in the purchase order (Specification B 824).

3.2 When material is purchased for agencies of the U.S. Government, the Supplementary Requirements of Specification B 824 may be specified.

## 4. Chemical Composition

4.1 The castings shall conform to the requirements as to chemical composition prescribed in Table 2.

4.2 These specification limits do not preclude the presence of other elements. Limits may be established by agreement between manufacturer or supplier and purchaser for these unnamed elements. Copper may be given as remainder and may be taken as the difference between the sum of all elements analyzed and 100 %. When all the named elements in Table 2 are analyzed, their sum shall be as specified in Table 3.

## 5. Mechanical Properties

5.1 Mechanical properties shall be determined from separately cast test bar castings and shall meet the requirements shown in Table 4.

## 6. Dimensions, Weights, and Permissible Variations

6.1 Variations in dimensions and weights shall be as agreed upon between the producer and the consumer but shall not be more than 3 % in the as-cast condition.

\*A Summary of Changes section appears at the end of this standard.

**TABLE 2 Chemical Requirements**

| Element    | Composition, max % (Unless Shown as a Range or Minimum) Copper Alloy UNS No. |                     |                     |                     |                     |
|------------|--|---------------------|---------------------|---------------------|---------------------|
|            | C90800 <sup>A</sup>  | C91700 <sup>A</sup> | C90700 <sup>A</sup> | C91600 <sup>A</sup> | C92900 <sup>A</sup> |
| Copper     | remainder  | remainder           | remainder           | remainder           | remainder           |
| Tin        | 11.0–13.0  | 11.3–12.5           | 10.0–12.0           | 9.7–10.8            | 9.0–11.0            |
| Lead       | 0.25   | 0.25                | 0.50                | 0.25                | 2.0–3.2             |
| Zinc       | 0.25   | 0.25                | 0.50                | 0.25                | 0.25                |
| Iron       | 0.15   | 0.20                | 0.15                | 0.20                | 0.20                |
| Antimony   | 0.20   | 0.20                | 0.20                | 0.20                | 0.25                |
| Nickel     | 0.50   | 1.2–2.0             | 0.50                | 1.2–2.0             | 2.8–4.0             |
| Sulfur     | 0.05   | 0.05                | 0.05                | 0.05                | 0.05                |
| Phosphorus | 0.30   | 0.30                | 0.30                | 0.30                | 0.50                |
| Aluminum   | 0.005  | 0.005               | 0.005               | 0.005               | 0.005               |
| Silicon    | 0.005  | 0.005               | 0.005               | 0.005               | 0.005               |

<sup>A</sup> Ingot for remelting specifications vary from the ranges shown.

**TABLE 3 Copper Plus Sum of All Named Elements Analyzed**

| Copper Alloy UNS No. | Copper Plus Named Elements, % min |
|----------------------|-----------------------------------|
| C90800               | 99.4                              |
| C91700               | 99.4                              |
| C90700               | 99.4                              |
| C91600               | 99.4                              |
| C92900               | 99.3                              |

6.2 The manufacturer shall not be responsible for the dimensional accuracy of patterns or molds furnished by the purchaser.

### 7. Casting Repair

7.1 The castings shall not be repaired, plugged, welded, or burned-in without the written approval of the purchaser.

### 8. General Requirements

8.1 Material furnished under this specification shall conform to the applicable requirements of Specification B 824.

### 9. Sampling

9.1 Test bar casting representing sand castings in the Copper Alloy UNS Nos. under this specification shall be cast to the form and dimensions shown in Figs. 2, Figs. 3, or Figs. 4 of Practice B 208.

9.2 Test bar castings representing castings produced in chill molds of metal or graphite may be cast in open keel-block molds of the same material as the molds used for the castings.

9.3 Separate centrifugally cast test bars shall be made in accordance with Practice B 208.

9.4 At the manufacturer's option test bar specimens may be removed from centrifugal castings instead of separate centrifugally cast test coupons (9.3).

### 10. Number of Tests

10.1 One Brinell hardness reading shall be made for each lot of castings.

### 11. Test Methods

11.1 Brinell readings shall be taken on the grip end of the tension test bar, at or within 1 in. (25.4 mm) of the casting outside diameter, or as indicated on the purchaser's drawing and shall be made in accordance with Test Method E 10.

### 12. Certification

12.1 In the case of a product manufactured in advance and supplied for sale from stock by the manufacturer, jobber or other dealer, the product may upon request of the purchaser be certified by the manufacturer as conforming to this specification subject to the following procedure. Not less than two tension tests, and two hardness tests, from different heats, and not less than one chemical analysis shall be made by the manufacturer from each day's melt. Records of the tension test results, hardness, and chemical analysis shall be systematically made and maintained and shall be the basis for certification. In lieu of the manufacturer's certification and upon written request by the purchaser, these records may be examined on the manufacturer's premises by the purchaser or his accredited representative.

### 13. Keywords

13.1 bronze castings; copper-base castings; gear castings

**TABLE 4 Mechanical Requirements<sup>A</sup>**

NOTE 1—The properties of a separate cast test specimen shall meet the following *minimum* values:

|   | Copper Alloy UNS Nos. C90700, C90800, C91700                            | Copper Alloy UNS No. C91600   | Copper Alloy UNS Nos. C90700, C90800, C91600, C91700 | Copper Alloy UNS No. C92900                             |
|---|---|---|--|---|
|   | Static or Centrifugally Chill Cast, ksi <sup>B</sup> (MPa) <sup>C</sup> | Static or Centrifugally Chill Cast, ksi <sup>B</sup> (MPa) <sup>C</sup> | Sand Cast, ksi <sup>B</sup> (MPa) <sup>C</sup>       | Sand or Chill Cast, ksi <sup>B</sup> (MPa) <sup>C</sup> |
| Tensile strength, min                   | 50 (345)  | 45 (310)  | 35 (241)   | 45 (310)  |
| Yield strength, at 0.5 % extension, min | 28 (193)  | 25 (172)  | 17 (117)   | 25 (172)  |
| Elongation in 2 in. (50.8 mm), min, %   | 12  | 10  | 10   | 8   |
| Brinell-500 kg on bar or casting, min   | 95  | 85  | 65   | 75  |

<sup>A</sup> Test taken in accordance with Test Methods E 8.

<sup>B</sup> ksi = 1000 psi.

<sup>C</sup> See Appendix X1.

## APPENDIX

### (Nonmandatory Information)

#### X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ( $N = \text{kg}\cdot\text{m}/\text{s}^2$ ). The derived SI unit for pressure or

stress is the newton per square metre ( $\text{N}/\text{m}^2$ ), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since  $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$  the metric equivalents are expressed as megapascal (MPa), which is the same as  $\text{MN}/\text{m}^2$  and  $\text{N}/\text{mm}^2$ .

#### SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue that may impact the use of this standard.

- (1) Paragraph 1.1 was rewritten.
- (2) The entire specification was revised to comply with Specification B 824.

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