



Designation: B427 – 21

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

This standard is issued under the fixed designation B427; 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 U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification<sup>2</sup> establishes requirements for alloys whose copper alloy numbers and 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 standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>3</sup>

**B208 Practice for Preparing Tension Test Specimens for Copper Alloy Sand, Permanent Mold, Centrifugal, and Continuous Castings**

**B824 Specification for General Requirements for Copper Alloy Castings**

**B846 Terminology for Copper and Copper Alloys**

<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 E527) 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> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

**B950 Guide for Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys**

**E8/E8M Test Methods for Tension Testing of Metallic Materials**

**E10 Test Method for Brinell Hardness of Metallic Materials**  
**E255 Practice for Sampling Copper and Copper Alloys for the Determination of Chemical Composition**

**E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)**

## 3. General Requirements

3.1 The following sections of Specification **B824** constitute a part of this specification.

3.1.1 Terminology (Section 4)

3.1.2 Materials and Manufacture

3.1.3 Sampling

3.1.4 Number of Tests and Retests

3.1.5 Specimen Preparation

3.1.6 Certification

3.1.7 Test Reports

3.2 In addition, when a section with a title identical to that referenced in 3.1, above, appears in this specification, it contains additional requirements which supplement those appearing in Terminology **B846**.

## 4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology **B846**.

## 5. Ordering Information

5.1 Include the following information in orders for product:

5.1.1 ASTM designation and year of issue (for example, B427 – 09);

5.1.2 Copper Alloy UNS No. (for example, C90800);

5.1.3 Dimensions: inside diameter, outside diameter, thickness, and width;

5.1.4 Form: cross-section, such as tube, round, hexagon, octagon, square, or rectangle;

5.1.5 Tolerances, agreed upon with producer and consumer (Section 8);

5.1.6 Length (including length tolerance if other than mill lengths);

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

**TABLE 1 Chemical Requirements**

Element	Composition, max % (Unless Shown as a Range or Minimum) Copper Alloy UNS No.				
	C90700 <sup>A</sup>	C90800 <sup>A</sup>	C91600 <sup>A</sup>	C91700 <sup>A</sup>	C92900 <sup>A</sup>
Copper	88.0–90.0 <sup>B</sup>	85.0–89.0 <sup>B</sup>	86.0–89.0 <sup>B</sup>	84.0–87.0 <sup>B</sup>	82.0–86.0 <sup>B</sup>
Tin	10.0–12.0	11.0–13.0	9.7–10.8	11.3–12.5	9.0–11.0
Lead	0.50	0.25	0.25	0.25	2.0–3.2
Zinc	0.50	0.25	0.25	0.25	0.25
Iron	0.15	0.15	0.20	0.20	0.20
Antimony	0.20	0.20	0.20	0.20	0.25
Nickel (incl. cobalt)	0.50 <sup>C</sup>	0.50 <sup>C</sup>	1.2–2.0 <sup>C</sup>	1.2–2.0 <sup>C</sup>	2.8–4.0 <sup>C</sup>
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.

<sup>B</sup> In determining Cu min., Cu may be calculated as Cu + Ni.

<sup>C</sup> Ni value includes Co.

5.1.7 Number of castings or total weight for each size and form; and

5.1.8 When castings are purchased for agencies of the U.S. government, the Supplementary Requirements of Specification **B824** may be specified.

5.2 The following requirements are optional and should be specified in the purchase order, when required:

5.2.1 Chemical analysis of residual elements (Section 6 and Specification **B824**),

5.2.2 Mechanical requirements (Section 7 and Test Methods **E8/E8M**),

5.2.3 Witness inspection (Specification **B824**).

5.2.4 Certification (Specification **B824**),

5.2.5 Foundry test report (Specification **B824**),

5.2.6 Product marking (Specification **B824**), and

5.2.7 Approval of weld repair and records of repair (Section 9).

## 6. Chemical Composition

6.1 The castings shall conform to the requirements as to chemical composition requirements in **Table 1** for the copper [alloy] UNS No. specified in the ordering information.

6.2 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and purchaser, limits may be established and analysis required for 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 1** are analyzed, their sum shall be as specified in **Table 2**.

## 7. Mechanical Property Requirements

7.1 Mechanical properties shall be determined from separately cast test bar castings.

7.1.1 When specified in the contract or purchase order, the product shall conform to the tensile, yield, and elongation requirements prescribed in **Table 3**, when tested in accordance with Test Methods **E8/E8M**.

7.1.2 When specified in the contract or purchase order, the product shall conform to the Brinell hardness requirement prescribed in **Table 3**, when tested in accordance with Test Method **E10**.

## 8. Dimensions, Mass, and Permissible Variations

8.1 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.

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

## 9. Casting Repair

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

## 10. Sampling

10.1 Sampling shall be in accordance with requirements of Practice **E255**.

10.2 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 **B208**.

10.3 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.

**TABLE 2 Copper Plus Sum of All Named Elements Analyzed**

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

**TABLE 3 Mechanical Requirements<sup>A</sup>**

	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 **E8/E8M**.

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

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

10.4 Separate centrifugally cast test bars shall be made in accordance with Practice **B208**.

10.5 At the manufacturer's option, test bar specimens may be removed from centrifugal castings instead of separate centrifugally cast test coupons (**10.4**).

### 11. Number of Tests

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

### 12. Test Methods

12.1 Analytic chemical methods are given in Specification **B824** (Section 13).

12.2 Tensile strength, yield strength, and elongation properties shall be determined from separately cast test bar castings in accordance with Test Methods **E8/E8M**.

12.3 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 **E10**.

### 13. Certification

13.1 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.

### 14. Keywords

14.1 bronze castings; copper-base castings; gear bronze; gear castings

<https://standards.iteh.ai/catalog/standards/sist/91ca29c4-9c39-4155-805c-98b40c88906c/astm-b427-21>

## 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  $\text{N}/\text{mm}^2$ .