



Designation: **B770—15 B770 – 21**

# Standard Specification for Copper-Beryllium Alloy Sand Castings for General Applications<sup>1</sup>

This standard is issued under the fixed designation B770; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

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

## 1. Scope\*

1.1 This specification establishes requirements for copper-beryllium alloy sand castings for general applications and nominal compositions alloys defined by this specification are shown sand castings produced from copper-beryllium alloys. The following alloys are covered:

| Copper Alloy<br>UNS No. | Designation              | Copper | Nickel | Beryllium |
|-------------------------|--------------------------|--------|--------|-----------|
| C81400                  | 70C                      | 99.1   | ...    | 0.06      |
| C82000                  | 10C                      | 97     | ...    | 0.5       |
| C82200                  | 3C, 14C                  | 98     | 2.0    | 0.5       |
| C82400 <sup>A</sup>     | 165C, 165CT <sup>A</sup> | 97.8   | ...    | 1.7       |
| C82500 <sup>A</sup>     | 20C, 20CT <sup>A</sup>   | 97.2   | ...    | 2.0       |
| C82510                  | 21C                      | 96.6   | ...    | 2.0       |
| C82600 <sup>A</sup>     | 245C, 245CT <sup>A</sup> | 96.8   | ...    | 2.4       |
| C82800 <sup>A</sup>     | 275C, 275CT <sup>A</sup> | 96.6   | ...    | 2.6       |
| C96700                  | 72C                      | 67.2   | 31.0   | 1.2       |

<sup>A</sup> When fine-grained castings are specified, 0.02 to 0.12 titanium is added for grain refinement, usually in the remelt ingot. See Specification B30. in Table 1.

1.2 *Units*—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 The following safety hazard caveat pertains only to the test methods described in this specification: *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 requirements 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 The following documents in the current issue of the *Annual Book of ASTM Standards* form a part of this specification to the extent referenced herein:

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

2.2 *ASTM Standards:*<sup>2</sup>

- [B30 Specification for Copper Alloys in Ingot and Other Remelt Forms](#)
- [B208 Practice for Preparing Tension Test Specimens for Copper Alloy Sand, Permanent Mold, Centrifugal, and Continuous Castings](#)
- [B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast](#)
- [B824 Specification for General Requirements for Copper Alloy Castings](#)
- [B846 Terminology for Copper and Copper Alloys](#)
- [E527B950 Practice Guide for Numbering Metals and Alloys in the Unified Numbering System \(UNS\) Editorial Procedures and Form of Product Specifications for Copper and Copper Alloys](#)
- [E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

**3. General Requirements**

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

- 3.1.1 ~~Terminology~~, Terminology
- 3.1.2 Material and ~~Manufacture~~, Manufacture
- 3.1.3 Chemical Composition,
- 3.1.4 Dimensions and Permissible ~~Variations~~, Variations
- 3.1.5 Workmanship, Finish, and ~~Appearance~~, Appearance
- 3.1.6 ~~Sampling~~, Sampling
- 3.1.7 Number of Tests and ~~Retests~~, Retests
- 3.1.8 Specimen ~~Preparation~~, Preparation
- 3.1.9 Test ~~Methods~~, Methods
- 3.1.10 Significance of Numerical ~~Limits~~, Limits
- 3.1.11 ~~Inspection~~, Inspection
- 3.1.12 Rejection and ~~Rehearing~~, Rehearing
- 3.1.13 Certification,
- 3.1.14 ~~Mill Test Report~~, and Reports
- 3.1.15 Packaging and Package ~~Marking~~, Marking

3.2 In addition, when a section with a title identical to that referenced in 3.1 appears in this specification, it contains additional requirements ~~which~~ that supplement those appearing in Specification **B824**.

**4. Terminology**

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

<sup>2</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.

## 5. Ordering Information

5.1 ~~Include the following information for orders for product:~~ specified choices when placing orders for product under this specification, as applicable:

5.1.1 ~~ASTM designation number, title, and year of issue;~~ issue

5.1.2 ~~Copper Alloy UNS Number designation;~~ No.

5.1.3 ~~Temper;~~ Temper (Section 8)

5.1.4 ~~Quantity of castings required;~~ total number of pieces

5.1.5 ~~Pattern or drawing number;~~ number and condition (cast, machined, and so forth); forth

5.1.6 ~~When material is purchased for agencies of the U.S. government, the Supplementary Requirements of Specification B824 may be specified.~~

5.2 ~~The following options are available and should and, when required, shall be specified in the contract or purchase order when required at the time of placing the order:~~

5.2.1 ~~Mechanical requirements, if specified in the purchase order requirements (Section 10);~~

5.2.2 ~~Pressure test requirements, if specified in the purchase order Hydrostatic test (Specification B824);~~

5.2.3 ~~Soundness requirements, if specified in the purchase order (Specification B824);~~

5.2.4 ~~Repair of castings (Section Certification 12);~~

5.2.5 ~~Certification, if specified in the purchase order (Specification Test report B824);~~

5.2.6 ~~Foundry test report, if specified in the purchase order (Specification B824);~~

5.2.6 ~~Witness inspection, if specified in the purchase order (Specification inspection B824); and~~

5.2.7 Product marking

5.2.8 ~~Product marking, if specified in the purchase order (Specification If product is purchased for agencies of the U.S. government, see the Supplementary Requirements of Specification B824);~~ for additional requirements, if specified.

## 6. Materials and Manufacture

6.1 ~~Material—Materials:~~ Materials: ~~The material of manufacture shall be castings of the copper alloys listed in Table 1, as specified in the purchase order or contract, and of such purity and soundness as to be suitable for the products prescribed herein.~~

6.1.1 The materials of manufacture shall be castings of Copper Alloy UNS Nos. C81400, C82000, C82200, C82400, C82500, C82510, C82600, C82800, or C96700 as specified in the purchase order or contract, and of such purity and soundness as to be suitable for the products prescribed herein.

6.2 ~~Manufacture—Manufacture:~~

6.2.1 The product shall be manufactured by casting and thermal treatment to meet the properties specified.

## 7. Chemical Composition

7.1 ~~The castings shall conform to the chemical composition requirements prescribed in Table 21 for the Copper Alloy UNS Number designations~~ copper alloy UNS number designation ~~specified in the ordering information.~~

**TABLE 21 Chemical Requirements<sup>A</sup>**

Composition, % max, except as indicated

| Copper Alloy UNS No. | Copper, <sup>B</sup> min | Beryllium | Cobalt                 | Nickel                 | Silicon   | Zirconium | Titanium  | Manganese | Iron     | Zinc | Chromium | Lead | Aluminum | Tin  |
|----------------------|--------------------------|-----------|------------------------|------------------------|-----------|-----------|-----------|-----------|----------|------|----------|------|----------|------|
| C81400               | remainder                | 0.02–0.10 | ...                    | ...                    | ...       | ...       | ...       | ...       | ...      | ...  | 0.6–1.0  | ...  | ...      | ...  |
| C82000               | remainder                | 0.45–0.8  | 2.40–2.70 <sup>C</sup> | 0.20 <sup>C</sup>      | 0.15      | ...       | ...       | ...       | 0.10     | 0.10 | 0.09     | 0.02 | 0.10     | 0.10 |
| C82200               | remainder                | 0.35–0.8  | 0.30                   | 1.0–3.0                | 0.15      | ...       | ...       | ...       | ...      | ...  | ...      | ...  | ...      | ...  |
| C82400 <sup>B</sup>  | remainder                | 1.60–1.85 | 0.20–0.65              | 0.20                   | ...       | ...       | ...       | ...       | 0.20     | 0.10 | 0.09     | 0.02 | 0.15     | 0.10 |
| C82500 <sup>B</sup>  | remainder                | 1.90–2.25 | 0.35–0.70 <sup>C</sup> | 0.20 <sup>C</sup>      | ...       | ...       | ...       | ...       | 0.25     | 0.10 | 0.09     | 0.02 | 0.15     | 0.10 |
| C82510               | remainder                | 1.90–2.15 | 1.0–1.2                | 0.20                   | 0.20–0.35 | ...       | ...       | ...       | 0.25     | 0.10 | 0.09     | 0.02 | 0.15     | 0.10 |
| C82600 <sup>B</sup>  | remainder                | 2.25–2.55 | 0.35–0.65              | 0.20                   | 0.20–0.35 | ...       | ...       | ...       | 0.25     | 0.10 | 0.09     | 0.02 | 0.15     | 0.10 |
| C82800 <sup>B</sup>  | remainder                | 2.50–2.85 | 0.35–0.70 <sup>C</sup> | 0.20 <sup>C</sup>      | 0.20–0.35 | ...       | ...       | ...       | 0.25     | 0.10 | 0.09     | 0.02 | 0.15     | 0.10 |
| C96700               | remainder                | 1.10–1.20 | ...                    | 29.0–33.0 <sup>C</sup> | 0.15      | 0.15–0.35 | 0.15–0.35 | 0.40–1.0  | 0.25     | 0.10 | 0.09     | 0.02 | 0.15     | 0.10 |
| C96700               | remainder                | 1.10–1.20 | ...                    | 29.0–33.0 <sup>A</sup> | 0.15      | 0.15–0.35 | 0.15–0.35 | 0.40–1.0  | 0.40–1.0 | ...  | ...      | 0.01 | ...      | ...  |

<sup>A</sup> Analysis shall regularly be made only for the major elements. All others are considered residual elements, and if above the noted maximums, may influence performance of the casting, particularly in conductivity, magnetic permeability, and machinability.

<sup>B</sup> In reporting chemical analyses obtained by use of instruments such as spectrograph, X-ray, and atomic absorption, copper may be indicated as “remainder,” and taken by difference.

<sup>A</sup> Nickel + cobalt.

<sup>B</sup> When fine-grained fine-grained castings are specified, 0.02–0.12 titanium is added for grain refinement, usually in the remelt ingot. See Specification B30.

7.2 These composition limits do not preclude the presence of other elements. ~~Limits—By agreement between manufacturer and purchaser, limits may be established for unnamed elements by agreement between manufacturer or supplier and purchaser; and analysis required for unnamed elements.~~

7.3 ~~Copper is customarily given as remainder but may be taken as~~For alloys in which copper is listed as “remainder,” copper is the difference between the sum of results of all elements analyzed~~determined~~ and 100 %.

7.4 When all elements in Table 2 are analyzed, ~~their sum~~determined, the sum of results shall be 99.5 % minimum.

## 8. Temper

8.1 The standard tempers ~~are listed as~~for products described in this specification are given in Table 2~~follows~~. See Classification B601.

8.1.1 ~~TF00—Cast, solution heat treated, and precipitation heat treated~~treated temper TF00.

8.1.2 ~~M01—As sand cast~~As sand cast temper M01.

**TABLE 3 Mechanical Requirements**

NOTE 1—“TF00” property values denote product in the standard solution heat treated and precipitation heat treated condition.

NOTE 2—“M01” property values denote product in the as sand cast condition.

| Copper Alloy<br>UNS No. | Temper<br>Designation | Tensile Strength, min |                  | Yield Strength 0.2 % Offset |                  | Elongation % min in<br>4xD <sup>C</sup> |
|-------------------------|-----------------------|-----------------------|------------------|-----------------------------|------------------|---|
|                         |                       | ksi <sup>A</sup>      | MPa <sup>B</sup> | ksi <sup>A</sup>            | MPa <sup>B</sup> |   |
| C81400                  | TF00                  | 53                    | 366              | 36                          | 248              | 11                                      |
| C81400                  | M01                   | 45                    | 311              | 15                          | 104              | 15                                      |
| C82000                  | TF00                  | 90                    | 621              | 70                          | 483              | 3                                       |
| C82000                  | M01                   | 45                    | 311              | 15                          | 104              | 15                                      |
| C82200                  | TF00                  | 90                    | 621              | 70                          | 483              | 5                                       |
| C82200                  | M01                   | 55                    | 380              | 25                          | 173              | 15                                      |
| C82400                  | TF00                  | 145                   | 1001             | 135                         | 932              | 1                                       |
| C82400                  | M01                   | 70                    | 483              | 35                          | 242              | 15                                      |
| C82500                  | TF00                  | 150                   | 1035             | 120                         | 828              | 1                                       |
| C82500                  | M01                   | 75                    | 518              | 40                          | 276              | 15                                      |
| C82510                  | TF00                  | 160                   | 1104             | 150                         | 1035             | 1                                       |
| C82510                  | M01                   | 80                    | 552              | 45                          | 311              | 10                                      |
| C82600                  | TF00                  | 165                   | 1139             | 155                         | 1070             | 1                                       |
| C82600                  | M01                   | 80                    | 552              | 45                          | 311              | 10                                      |
| C82800                  | TF00                  | 165                   | 1139             | 155                         | 1070             | 1/2                                     |
| C96700                  | TF00                  | 125                   | 863              | 80                          | 552              | 10                                      |

**TABLE 2 Mechanical Requirements**

| Copper Alloy<br>UNS No. | Temper<br>Designation | Tensile Strength, min |                  | Yield Strength 0.2 % Offset |                  | Elongation % min in<br>4xD <sup>C</sup> |
|-------------------------|-----------------------|-----------------------|------------------|-----------------------------|------------------|---|
|                         |                       | ksi <sup>A</sup>      | MPa <sup>B</sup> | ksi <sup>A</sup>            | MPa <sup>B</sup> |   |
| C81400                  | TF00                  | 53                    | 365              | 36                          | 250              | 11                                      |
| C81400                  | M01                   | 45                    | 310              | 15                          | 105              | 15                                      |
| C82000                  | TF00                  | 90                    | 620              | 70                          | 485              | 3                                       |
| C82000                  | M01                   | 45                    | 310              | 15                          | 105              | 15                                      |
| C82200                  | TF00                  | 90                    | 620              | 70                          | 485              | 5                                       |
| C82200                  | M01                   | 55                    | 380              | 25                          | 175              | 15                                      |
| C82400                  | TF00                  | 145                   | 1000             | 135                         | 930              | 1                                       |
| C82400                  | M01                   | 70                    | 485              | 35                          | 240              | 15                                      |
| C82500                  | TF00                  | 150                   | 1035             | 120                         | 830              | 1                                       |
| C82500                  | M01                   | 75                    | 520              | 40                          | 275              | 15                                      |
| C82510                  | TF00                  | 160                   | 1105             | 150                         | 1035             | 1                                       |
| C82510                  | M01                   | 80                    | 5520             | 45                          | 310              | 10                                      |
| C82600                  | TF00                  | 165                   | 1140             | 155                         | 1070             | 1                                       |
| C82600                  | M01                   | 80                    | 550              | 45                          | 310              | 10                                      |
| C82800                  | TF00                  | 165                   | 1140             | 155                         | 1070             | 1/2                                     |
| C96700                  | TF00                  | 125                   | 865              | 80                          | 550              | 10                                      |

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

<sup>B</sup> See Appendix.

<sup>C</sup> 4xD = 4 × diameter.