Designation: B22/B22M – 17

Standard Specification for Bronze Castings for Bridges and Turntables[1]

This standard is issued under the fixed designation B22/B22M; 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 (ε) 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 establishes requirements for bronze castings for turntables, movable bridges and bridge parts, and bronze castings suitable for use in bridges and other structures for fixed and expansion bearings in which motion is slow and intermittent. The following Copper Alloys are specified: UNS No. C86300, C90500, C91100, C91300, and C93700.

NOTE 1—Historically, the alloys in this specification have been used in the applications listed in Appendix X1. Actual practice may vary.[2]

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 The following safety hazard caveat pertains only to the test method(s) described in this specification:

1.3.1 *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 and health 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 The following documents in the current issue of the Book of Standards form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[3]

B824 Specification for General Requirements for Copper Alloy Castings

B846 Terminology for Copper and Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E9 Test Methods of Compression Testing of Metallic Materials at Room Temperature

E10 Test Method for Brinell Hardness of Metallic Materials

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

3. General Requirements

3.1 The following sections of Specification B824 form a part of this specification. In the event of a conflict between this specification and Specification B824, the requirements of this specification shall take precedence.

3.1.1 Terminology,
3.1.2 Other Requirements,
3.1.3 Dimensions, Mass, and Permissible Variations,
3.1.4 Workmanship, Finish, and Appearance,
3.1.5 Sampling,
3.1.6 Number of Tests and Retests,
3.1.7 Specimen Preparation,
3.1.8 Test Methods,
3.1.9 Significance of Numerical Limits,
3.1.10 Inspection,
3.1.11 Rejection and Rehearing,
3.1.12 Certification,
3.1.13 Test Report,
3.1.14 Product Marking,
3.1.15 Packaging and Package Marking,
3.1.16 Keywords, and

[1] 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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This specification was prepared in cooperation with representatives of the American Association of State Highway Officials and the American Railway Engineering Association.

[2] 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.

[3] 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.

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

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Composition, % max, except as indicated											
	Copper	Tin	Lead	Zinc	Iron	Nickel Including Cobalt	Aluminum	Manganese	Antimony	Sulfur	Phosphorus	Silicon
C86300	60.0–66.0	0.20	0.20	22.0–28.0	2.0–4.0	1.0[A]	5.0–7.5	2.5–5.0	...	...	...	...
C90500	86.0–89.0	9.0–11.0	0.30	1.0–3.0	0.20	1.0[A]	0.005	...	0.20	0.05	0.05[B]	0.005
C91100	82.0–85.0	15.0–17.0	0.25	0.25	0.25	0.50[A]	0.005	...	0.20	0.05	1.0[B]	0.005
C91300	79.0–82.0	18.0–20.0	0.25	0.25	0.25	0.50[A]	0.005	...	0.20	0.05	1.0[B]	0.005
C93700	78.0–82.0	9.0–11.0	8.0–11.0	0.8	0.7[C]	0.50[A]	0.005	...	0.50	0.08	0.10[B]	0.005

[A] In determining copper minimum, copper may be calculated as copper plus nickel.
[B] For continuous castings, phosphorus shall be 1.5 % max.
[C] Iron shall be 0.35 % max. when used for steel-backed.

3.1.17 Supplementary Requirements.

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 specified choices when placing orders for products covered under this specification, as applicable:

5.1.1 ASTM designation and year of issue (for example, B22/B22M-14),

5.1.2 Number of castings or total weight, for each size and form,

5.1.3 Copper Alloy UNS No. designation (see Table 1),

5.1.4 Temper,

5.1.5 Pattern or drawing number and condition (as-cast, machined, and so forth).

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

5.2 The following options are available but may not be included unless specified at the time of placing of the order when required:

5.2.1 Soundness requirements (Specification B824),

5.2.2 Certification (Specification B824),

5.2.3 Test Report (Specification B824),

5.2.4 Inspection (Specification B824),

5.2.5 Product marking (Specification B824), and

5.2.6 Heat identification or traceability details.

6. Materials and Manufacture

6.1 *Material(s):*

6.1.1 The material of manufacture shall be a casting of Copper Alloy UNS No.(s) C86300, C90500, C91100, C91300, or C93700 of such purity and soundness as to be suitable for processing in to the products prescribed herein.

6.1.2 When specified in the contract or purchase order, that heat identification or traceability is required, the purchaser shall specify the details desired.

6.2 *Manufacture:*

6.2.1 The product shall be manufactured by such casting methods to produce a uniform finished product.

7. Chemical Composition

7.1 The material shall conform to the chemical composition requirements in Table 1 for the copper alloy UNS No. designation specified in the ordering information.

7.2 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.

7.3 For UNS No. C86300 copper or zinc may be taken as the difference between the sum of the results of all other elements determined and 100 %.

7.4 For UNS No. C90500, C91100, C91300, and C93700 copper may be taken as the difference between the sum of the results of all elements determined and 100 %.

7.5 When all named elements in Table 1 are determined, the sum of the results shall be as shown in Table 2.

8. Temper

8.1 The standard tempers for products described in this specification are given in Table 3A, Table 3B, and Table 3C.

8.1.1 As Sand Cast M01.

8.1.2 As Centrifugal Cast M02.

8.1.3 As Continuous Cast M07.

9. Mechanical Property Requirements

9.1 *Tensile Strength Requirement:*

9.1.1 For Copper Alloy UNS Nos. C86300, C90500, and C93700 furnished under this specification shall conform to the tensile strength requirements, yield strength at 0.5 % extension requirements, and elongation percent in a gage length of 2 in. [50 mm] requirements in Table 3, when tested in accordance with Test Methods E8/E8M.

TABLE 2 Sum of All Named Elements Analyzed

Copper Alloy UNS No. Copper Plus Named	Elements, % min
C86300	99.0
C90500	99.7
C91100	99.4
C91300	99.4
C93700	99.0

TABLE 3 A Mechanical Requirements (As Sand Cast)

Temper	Copper Alloy UNS No.	Tensile Strength, min.		Yield Strength, at 0.5 % Extension Under Load, min		Elongation in 2 in. [50 mm], %	Brinell Hardness, min	Compression Deformation Limit, min	
		ksi[A]	[MPa][B]	ksi[A]	[MPa][B]			ksi[A]	[MPa][B]
M01	C86300	110	[760]	60	[415]	12	223 (3000 kg)	55	[380]
M01	C90500	40	[275]	18	[125]	20	...	...	...
M01	C91100	...	...	...	...	...	135	18	[125]
M01	C91300	...	...	...	...	...	170	24	[165]
M01	C93700	30	[205]	12	[85]	15	...	...	...

TABLE 3 B Mechanical Requirements (As Centrifugal Cast)

Temper	Copper Alloy UNS No.	Tensile Strength, min.		Yield Strength, at 0.5 % Extension Under Load, min		Elongation in 2 in. [50 mm], %	Brinell Hardness, min	Compression Deformation Limit, min	
		ksi[A]	[MPa][B]	ksi[A]	[MPa][B]			ksi[A]	[MPa][B]
M02	C86300	110	[760]	60	[415]	12	223 (3000 kg)	55	[380]
M02	C90500	40	[275]	18	[125]	20	...	...	...
M02	C91100	...	...	...	...	...	...	18	[125]
M02	C91300	...	...	...	...	...	...	24	[165]
M02	C93700	30	[205]	12	[85]	15	...	...	...

TABLE 3 C Mechanical Requirements (As Continuous Cast)

Temper	Copper Alloy UNS No.	Tensile Strength, min.		Yield Strength, at 0.5 % Extension Under Load, min		Elongation in 2 in. [50 mm], %	Brinell Hardness, min	Compression Deformation Limit, min	
		ksi[A]	[MPa][B]	ksi[A]	[MPa][B]			ksi[A]	[MPa][B]
M07	C86300	110	[760]	62	[425]	14	223 (3000 kg)	55	[380]
M07	C90500	44	[305]	25	[170]	10	...	...	...
M07	C91100	...	...	...	...	...	...	18	[125]
M07	C91300	...	...	...	...	...	...	24	[165]
M07	C93700	35	[240]	20	[140]	6	...	...	...

[A] 1 ksi = 1000 psi.
[B] MPa (Mega Pascal) See Appendix X1.

9.1.2 Acceptance or rejection based upon mechanical properties shall depend on tensile strength, yield strength at 0.5 % extension, and an elongation percent in a gage length of 2 in. [50 mm].

9.2 *Compression Deformation Requirement:*

9.2.1 For Copper Alloy UNS Nos. C86300, C91100, and C91300 furnished under this specification shall conform to the compression deformation requirements in Table 3A, Table 3B, and Table 3C. The deformation limit in compression shall be determined as the load which produces a permanent set of 0.001 in. [0.025 mm] in the compression test specimen described in 12.2.2.

9.2.2 Acceptance or rejection based upon mechanical properties shall depend on the compression deformation.

9.3 *Brinell Hardness Requirement:*

9.3.1 For Copper Alloy UNS No. C86300 furnished under this specification shall conform to the Brinell hardness requirement prescribed in Table 3, when tested in accordance with Test Method E10 on the finished casting.

10. Sampling

10.1 Refer to sampling section in Specification B824.

10.2 For Copper Alloy UNS No. C86300 castings, one tensile sample, one compression test sample, and two hardness tests samples shall be made for each four castings from the same lot and the same pattern.

10.3 For Copper Alloy UNS No. C91100 and C91300 one compression sample shall be made from each lot and the same pattern.

10.4 For Copper Alloy UNS Nos. C90500 and C93700 one tensile sample shall be made from each lot and the same pattern.

10.5 For castings of any grade weighing over 100 lb [45 kg] finished, the specified tests shall be made for each casting.

11. Number of Tests and Retests

11.1 *Tests:*

11.1.1 *Chemical Analysis*—Refer to the Number of Tests and Retests in Specification B824.

11.2 *Other Tests:*

11.2.1 For Copper Alloy UNS No. C86300 castings, one tensile strength test, one yield strength test, one compression test, and two hardness tests shall be performed for each four castings from the same lot and the same pattern.

11.2.2 For Copper Alloy UNS Nos. C91100 and C91300 one compression test shall be performed from each lot and the same pattern.

11.2.3 For Copper Alloy UNS No. C90500 and C93700 one tensile strength test, one yield strength test, shall be performed from each lot and the same pattern.

11.3 *Retests:*

11.3.1 Refer to the Number of Tests and Retests in Specification B824.

12. Test Methods

12.1 *Chemical Composition:*

12.1.1 Refer to the Test Methods in Specification B824.

12.2 *Mechanical Tests:*

12.2.1 The tensile strength requirements, yield strength at 0.5 % extension requirements, and elongation percent in a gage length of 2 in. [50 mm] requirements are to be tested in accordance with Test Methods E8/E8M.

12.2.2 The compression deformation requirements are to be tested in accordance with Test Methods E9.

12.2.3 The Brinell hardness testing of Copper Alloy UNS No. C86300 castings shall be performed in accordance with Test Method E10 with the exception that the load shall be 3000 kg and shall be applied for 30 s to a finished plane surface.

13. Casting Repair

13.1 The castings shall not be repaired without approval of the purchaser.

14. Keywords

14.1 bridge plates; bronze castings; copper-alloy castings; copper-base alloy castings; expansion bearings; UNS No. C86300; UNS No. C90500; UNS No. C91100; UNS No. C91300; UNS No. C93700

APPENDIXES

(Nonmandatory Information)

X1. APPLICATIONS FOR ALLOYS IN THIS STANDARD

X1.1 The alloys in this specification have historically been used in the following applications. This information is provided for "information only" and should not be considered as recommendations.

X1.1.1 *Copper Alloy UNS No. C91300 (Formerly Alloy A)*—For contact with hardened steel disks at low speeds under pressures not over 3 ksi [20 MPa], for example, disk-bearing metals used in center-bearing swing bridges.

X1.1.2 *Copper Alloy UNS No. C91100 (Formerly Alloy B)*—For contact with hardened steel disks at low speeds under pressures not over 2.5 ksi [17 MPa], for example, disk-bearing metals used in turntable and center-bearing swing bridges; for contact with steel (tensile strength 60 ksi [415 MPa], min) at low speeds under pressures not over 1.5 ksi [10 MPa], for example, trunnions of movable bridges; and for bearing and expansion plates under pressures not to exceed 2.5 ksi.

X1.1.3 *Copper Alloy UNS No. C90500 (Formerly Alloy D)*—For gears, worm wheels, nuts, and similar parts that are subjected to other than compressive stresses.

X1.1.4 *Copper Alloy UNS No. C86300 (Formerly Alloy E)*—For bushings for bridge pins and similar applications in which angular movement is slight and compressive stresses may attain 8 ksi [55 MPa].

X1.1.5 *Copper Alloy UNS No. C93700 (Formerly Alloy C)*—For ordinary machinery bearings and for bearing and expansion plates under pressures not to exceed 1 ksi [6.9 MPa].

X2. METRIC EQUIVALENTS

X2.1 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 1 kg, gives it an acceleration of 1 m/s^2 ($N = kg \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa, the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2.

SUMMARY OF CHANGES

Committee B05 has identified the location of selected changes to this standard since the last issue (B22/B22M–15) that may impact the use of this standard. (Approved April 1, 2017.)

(1) Revised 9.2.1.