Designation: B138/B138M – 11 (Reapproved 2017)

Standard Specification for Manganese Bronze Rod, Bar, and Shapes[1]

This standard is issued under the fixed designation B138/B138M; 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.

1. Scope*

1.1 This specification establishes the requirements for manganese bronze rod, bar and shapes produced in Copper Alloy UNS Nos. C67000, C67500, or C67600.

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

1.3 **Warning—**Mercury has been designated by many regulatory agencies as a hazardous material that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Safety Data Sheet (SDS) for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.

NOTE 1—Product suitable for hot forging applications is available under Specification B124/B124M.

1.4 The following safety hazard caveat pertains only to the Performance Requirements section of this specification.

1.4.1 *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.*

1.5 *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:*[2]

B124/B124M Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes

B154 Test Method for Mercurous Nitrate Test for Copper Alloys

B249/B249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings

B858 Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys

E8/E8M Test Methods for Tension Testing of Metallic Materials

E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]

E478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B249/B249M constitute a part of this specification:

3.1.1 Terminology,
3.1.2 Materials and Manufacture,
3.1.3 Workmanship, Finish and Appearance,
3.1.4 Sampling,
3.1.5 Number of Tests and Retests,
3.1.6 Specimen Preparation,
3.1.7 Test Methods,
3.1.8 Significance of Numerical Limits,
3.1.9 Inspection,
3.1.10 Rejection and Rehearing,
3.1.11 Certification,
3.1.12 Test Report,
3.1.13 Packaging and Package Marking, and
3.1.14 Supplementary Requirements.

[1] This specification is under the jurisdiction of ASTM Committee B05 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.02 on Rod, Bar, Wire, Shapes and Forgings.

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[2] 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

3.2 In addition, when a section with a title identical to one of those referenced in 3.1 above, appears in this specification, it contains additional requirements which supplement those appearing in Specification B249/B249M.

4. Ordering Information

4.1 Include the following when placing orders for product under this specification, as applicable:

4.1.1 ASTM designation and year of issue,

4.1.2 Copper Alloy UNS No. designation (for example, C67000),

4.1.3 Temper,

4.1.4 Form of product (for example, round, hexagonal),

4.1.5 Dimensions (for example, diameter, distance between parallel surfaces, width, thickness),

4.1.6 Tolerances for shapes,

4.1.7 Edge contours,

4.1.8 Length,

4.1.9 Quantity (total weight, footage or number of pieces),

4.2 The following options are available and should be specified at the time of placing the order when required:

4.2.1 Piston finish (Performance Requirements section),

4.2.2 Residual stress test (Performance Requirements section),

4.2.2.1 Ammonia Vapor Test or Mercurous Nitrate Test,

4.2.2.2 For Ammonia Vapor Test, pH value other than 10.

4.2.3 Certification (Specification B249/B249M),

4.2.4 Mill Test Report (Specification B249/B249M), and

4.2.5 If product is purchased for agencies of the U.S. Government (see Other Requirements section).

5. Material and Manufacture

5.1 *Material*—The material of manufacture shall be cast billets of Copper Alloy UNS No. C67000, C67500, or C67600 as specified in the ordering information, and shall be of such purity and soundness as to be suitable for hot working.

5.2 *Manufacture:*

5.2.1 The product shall be manufactured by hot working (extrusion, forging, or rolling) to produce a uniform wrought structure in the finished product.

5.2.2 The product shall be finished by such cold working, annealing, and straightening as may be necessary to achieve the temper properties specified.

6. Chemical Composition

6.1 The material shall conform to the chemical composition requirements in Table 1 for the Copper Alloy UNS No. specified in the ordering information.

6.1.1 These composition limits do not preclude the presence of other elements. By agreement between the manufacturer and the purchaser, limits may be established and analysis required for unnamed elements.

6.2 For copper alloys in which zinc is specified as the "remainder," either copper or zinc may to be taken as the difference between the sum of results for all other elements determined and 100 %. When copper is so determined, that difference value shall conform to the requirements given in Table 1.

TABLE 1 Chemical Requirements

Element, %	Copper Alloy UNS No.		
	C67000	C67500	C67600
Copper[A]	63.0–68.0	57.0–60.0	57.0–60.0
Tin	0.50 max	0.50–1.5	0.50–1.5
Lead	0.20 max	0.20 max	0.50–1.0
Zinc	remainder	remainder	remainder
Iron	2.0–4.0	0.8–2.0	0.40–1.3
Aluminum	3.0–6.0	0.25 max	. . .
Manganese	2.5–5.0	0.05–0.50	0.05–0.50

[A] Includes silver.

6.2.1 When all elements in Table 1 are determined, the sum of results shall be 99.5 % min.

7. Temper

7.1 The standard tempers for products described in this specification are given in Tables 2 and 3.

7.1.1 Soft Anneal Temper (O60),

7.1.2 As Hot Rolled Temper (M20),

7.1.3 As Hot Extruded Temper (M30),

7.1.4 Half-Hard Temper (H02), and

7.1.5 Hard Temper (H04).

8. Mechanical Property Requirements

8.1 *Tensile Requirements:*

8.1.1 Product furnished under this specification shall conform to the tensile requirements prescribed in Table 2 or Table 3 when tested in accordance with Test Methods E8/E8M.

9. Performance Requirements

9.1 *Residual Stress Test:*

9.1.1 When specified in the contract or purchase order, the product shall be tested for residual stress according to the requirements of Test Method B154 or Test Method B858 and show no signs of cracking. (**Warning—**Mercury is a definite health hazard. With the mercurous nitrate test, equipment for the detection and removal of mercury vapor produced in volatilization is recommended. The use of protective gloves for this test is recommended.)

9.1.2 When the ammonia vapor test is used, the test pH value appropriate for the intended application shall be 10 unless otherwise specified by the purchaser.

NOTE 2—A residual stress test provides information about the adequacy of the stress relief of the material. Bar straightening is a method of mechanical stress relief. Stress relief annealing is a method of thermal stress relief.

10. Other Requirements

10.1 *Purchases for U.S. Government:*

10.1.1 When specified in the contract or purchase order, product purchased for agencies of the U.S. government shall conform to the additional requirements prescribed in the Supplementary Requirements section of Specification B249/B249M.

10.2 *Piston Finish*—When specified in the contract or purchase order, round rod over 0.500 in. [13 mm] in diameter shall be furnished piston finish.

TABLE 2 Tensile Requirements, in./lb

Form	Temper Designation		Diameter or Distance Between Parallel Surface,[A] in.	Tensile Strength, min, ksi	Yield Strength at 0.5 % Extension Under Load, min, ksi	Elongation min, %[B]
	Code	Name				
			Copper Alloy UNS No. C67000			
Rod and bar	O60	soft-anneal	all sizes	85	45	10
	H02	half-hard	all sizes	105	60	7
	H04	hard	all sizes	115	68	5
	M10	as hot forged	all sizes	[C]	[C]	[C]
	M20	as hot rolled				
	M30	as hot extruded				
			Copper Alloy UNS Nos. C67500 and C67600			
Rod	O60	soft anneal	all sizes	55	22	20
	H02	half-hard	1 and under	72	36	13
			over 1 to 2½ incl	70	35	15
			over 2½	65	32	17
	H04	hard	1 and under	80	56	8
			over 1 to 1½ incl	76	52	10
			over 1½ to 2½ incl	73	48	12
			over 2½	68	45	16
Bar	O60	soft anneal	all sizes	55	22	20
	H02	half-hard	1 and under	72	36	13
			over 1 to 2½ incl	70	35	15
			over 2½	65	32	17
	H04	hard	1 and under	76	52	8
			over 1 to 2½ incl	72	47	12
			over 2½	68	45	16
Shapes[D]	O60	soft anneal	all sizes	55	22	20

[A] For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.
[B] Elongation in 4× diameter or thickness of specimen. In any case, a minimum gage length of 1 in. shall be used.
[C] See Note 3. The tensile properties of as-hot-forged (M10), as-hot-rolled (M20), and as-hot-extruded (M30) are essentially the same as those shown for rod and bar, but have not been finalized for publication.
[D] Tensile requirements for drawn shapes shall be as agreed upon between the manufacturer and the purchaser at the time of the order.

TABLE 3 Tensile Requirements, SI

Form	Temper Designation		Diameter or Distance Between Parallel Surface,[A] mm	Tensile Strength, min, [MPa]	Yield Strength at 0.5 % Extension Under Load, min, MPa	Elongation min, %[B]
	Code	Name				
			Copper Alloy UNS No. C67000			
Rod and bar	O60	soft-anneal	all sizes	585	310	10
	H02	half-hard	all sizes	725	415	7
	H04	hard	all sizes	790	470	5
	M10	as hot forged	all sizes	[C]	[C]	[C]
	M20	as hot rolled				
	M30	as hot extruded				
			Copper Alloy UNS Nos. C67500 and C67600			
Rod	O60	soft anneal	all sizes	380	150	20
	H02	half-hard	25 and under	500	250	13
			over 25 to 65 incl	480	240	15
			over 65	450	220	17
	H04	hard	25 and under	550	385	8
			over 25 to 38 incl	525	360	10
			over 38 to 65 incl	505	330	12
			over 65	470	310	16
Bar	O60	soft anneal	all sizes	380	150	20
	H02	half-hard	25 and under	500	250	13
			over 25 to 65 incl	480	240	15
			over 65	450	220	17
	H04	hard	25 and under	525	360	8
			over 25 to 65 incl	500	325	12
			over 65	470	310	16
Shapes[D]	O60	soft anneal	all sizes	380	150	20

[A] For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.
[B] Elongation in 4× diameter or thickness of specimen. In any case, a minimum gage length of 25 mm shall be used.
[C] See Note 3. The tensile properties of as-hot-forged (M10), as-hot-rolled (M20), and as-hot-extruded (M30) are essentially the same as those shown for rod and bar, but have not been finalized for publication.
[D] Tensile requirements for drawn shapes shall be as agreed upon between the manufacturer and the purchaser at the time of the order.

11. Dimensions and Permissible Variations

11.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B249/B249M with particular reference to the following tables and related paragraphs:

11.2 *Diameter or Distance Between Parallel Surfaces:*

11.2.1 *Rod: Round, Hexagonal, Octagonal*, drawn—Refer to Table 2.

11.2.2 *Rod, M30 Temper,*—Refer to Table 5 for UNS Alloy No. C67000 and Table 4 for UNS Alloy Nos. C67500 and C67600.

11.2.3 *Rod, Round, M20 Temper*—Refer to Table 6.

11.2.4 *Rod, Piston Finish*—Refer to Table 3.

11.2.5 *Rod, M10 Temper*—Refer to Table 12.

11.3 *Width and Thickness:*

11.3.1 *Bar, Rectangular and Square*, drawn—Refer to Tables 9 and 11.

11.3.2 *Bar in M10 Temper*—Refer to Table 12.

NOTE 3—M10 as-hot-forged rod and bar are generally produced in sizes over 3½ in. [88 mm] in diameter and should not be confused with M30 as-hot-extruded or M20 as-hot-rolled rod and bar.

11.3.3 *Bar, Rectangular and Square in M30 Temper*—Refer to Table 4 for thickness and width for UNS Alloy Nos. C67500 and C67600, and to Table 5 for UNS Alloy No. C67000.

11.4 *Shapes*—The dimensional tolerances for shapes shall be agreed upon between the manufacturer and the purchaser.

11.5 *Lengths:*

11.5.1 *Rod, Bar, and Shapes*—Refer to Table 13 for tolerances.

11.5.2 *Schedule of Lengths*—Refer to Table 14 for specific and stock with ends for UNS Alloy Nos. C67500 and C67600 and to Table 15 for UNS Alloy No. C67000.

11.6 *Straightness:*

11.6.1 *Rod, Bar, and Shapes*, drawn—Refer to Table 16.

11.6.2 *Shafting Rod*—Refer to Table 17.

11.6.3 *Rod, Bar and Shapes in M20, M30 or M10*—Tempers shall have straightness requirements as agreed upon between the manufacturer and the purchaser.

11.7 *Edge Contours:*

11.7.1 For a description of edge contours, refer to the section entitled, “Edge Contours” and Figs. 1, 2, and 3 in Specification B249/B249M.

12. Test Methods

12.1 *Chemical Analysis:*

12.1.1 In cases of disagreement, test methods for chemical analysis shall be subject to agreement between the manufacturer or supplier and the purchaser. Methods in the following table may be considered:

Element	Test Methods
Aluminum	E54
Copper	E478
Iron	E54
Lead	E478 (atomic absorption)
Manganese	E62
Tin	E478 (titrimetric)
Zinc	E478 (titrimetric)

12.1.2 Test method(s) to be followed for the determination of element(s) resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and the purchaser.

13. Keywords

13.1 manganese bronze bar; manganese bronze rod; manganese bronze shape; UNS No. C67000; UNS No. C67500; UNS No. C67600

SUMMARY OF CHANGES

Committee B05 has identified the principal changes to this specification that have been incorporated since the 2006 issue as follows:

(1) Various sections were editorially revised to conform with B950.

(2) Several metric conversions were corrected in Table 3.