



Standard Specification for Manganese Bronze Rod, Bar, and Shapes¹

This standard is issued under the fixed designation B 138/B 138M; 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 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 given in brackets. The values stated in each system of units are not exact equivalents; each system is independent of the other. Combining values from the two systems may result in nonconformance with the specification.

1.3 The following safety hazard caveat pertains only to the Performance Requirements section of 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 and health practices and determine the applicability of regulatory limitations prior to use.*

1.4 **Warning**—Mercury is a definite health hazard in use and disposal.

NOTE 1—Product suitable for hot forging applications is available under Specification B 124/B 124M.

2. Referenced Documents

2.1 ASTM Standards:²

B 124/B 124M Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes

B 154 Test Method for Mercurous Nitrate Test for Copper Alloys

B 249/B 249M Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, Shapes and Forgings

B 858 Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys

E 8 Test Methods for Tension Testing of Metallic Materials

E 8M Test Methods for Tension Testing of Metallic Materials [Metric]³

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes³

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)

E 478 Test Methods for Chemical Analysis of Copper Alloys

3. General Requirements

3.1 The following sections of Specification B 249/B 249M 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.

3.2 In addition, when a section with a title identical to one of those referenced in 3.1 appears in this specification, it contains additional requirements which supplement those appearing in Specification B 249/B 249M.

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,

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.

Current edition approved Feb. 1, 2006. Published February 2006. Originally approved in 1941. Last previous edition approved in 2001 as B 138/B 138M – 01.

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 Withdrawn.

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

- 4.1.7 Edge contours,
- 4.1.8 Length,
- 4.1.9 Quantity (total weight, footage or number of pieces),
- 4.1.10 If product is purchased for agencies of the U.S. government (see Supplementary Requirements section of Specification **B 249/B 249M**).

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

- 4.2.1 Heat identification or traceability details (Specification **B 249/B 249M**),
- 4.2.2 Piston finish (Performance Requirements section),
- 4.2.3 Residual stress test (Performance Requirements section),
- 4.2.3.1 Ammonia Vapor Test or Mercurous Nitrate Test,
- 4.2.3.2 For Ammonia Vapor Test, pH value other than 10.
- 4.2.4 Certification (Specification **B 249/B 249M**), and
- 4.2.5 Mill Test Report (Specification **B 249/B 249M**).

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 required properties.

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 compositional 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 be taken as the difference between the sum of results for all elements determined and 100 %. When copper is so determined, that difference value shall conform to the requirements given in **Table 1**.

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

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.

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 The 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 **E 8** or **E 8M**.

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 **B 154** or Test Method **B 858** 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.

9.2 *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.

10. Purchases for U.S. Government

10.1 Product purchased for agencies of the U.S. government shall conform to the additional requirements prescribed in the Supplementary Requirements section of Specification **B 249/B 249M**.

11. Dimensions and Permissible Variations

11.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification **B 249/B 249M** 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*:



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
			1 and under	80	56	8
			over 1 to 1½ incl	76	52	10
	H04	hard	over 1½ to 2½ incl	73	48	12
			over 2½	68	45	16
			all sizes	55	22	20
			1 and under	72	36	13
			over 1 to 2½ incl	70	35	15
over 2½			65	32	17	
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
			1 and under	76	52	8
			over 1 to 2½ incl	72	47	12
	H04	hard	over 2½	68	45	16
			all sizes	55	22	20
			Shapes ^D			

^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	720	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	450	240	15
			over 65	450	220	17
			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	510	330	12
			over 65	470	310	16
			over 65	470	310	16
			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	450	240	15
			over 65	450	220	17
			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
			over 65	470	310	16
			over 65	470	310	16
			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.

11.3.1 *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 **B 249/B 249M**.

12. Test Methods

12.1 *Chemical Analysis*:

12.1.1 In cases of disagreement, determine the composition using the following methods:

Element	Test Methods
Aluminum	E 54
Copper	E 478
Iron	E 54
Lead	E 478 (atomic absorption)
Manganese	E 62
Tin	E 478 (titrimetric)
Zinc	E 478 (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 location of selected changes to this standard since the last issue (B 138/B 138M – 01) that may impact the use of this standard. (Approved Feb. 1, 2006.)

(1) Section 11 was revised to clarify and coordinate with Specification **B 249/B 249M**.

(2) Various sections were editorially revised to conform with the latest changes to B05 *Outline of Form*.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone); 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).