Designation: B21/B21M – 14

Standard Specification for Naval Brass Rod, Bar, and Shapes[1]

This standard is issued under the fixed designation B21/B21M; 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 the requirements for naval brass rod, bar, and shapes produced from Copper Alloy UNS Nos. C46200, C46400, C46750, C47940, C48200, or C48500.

1.1.1 For piston-finish rod or shafting refer to the Other Requirements Section.

1.1.2 For hot forging material, refer to Specification B124/B124M.

1.2 *Units*—The values stated in inch-pound units or SI 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 nonconformance with the specification.

1.3 **Warning—**Mercury is a definite health hazard in use and disposal (see Performance Requirements).

1.4 *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.*

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

B601 Classification for Temper Designations for Copper and Copper Alloys—Wrought and Cast

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

E18 Test Methods for Rockwell Hardness of Metallic Materials

E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]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 Mill Test Report,
3.1.13 Packaging and Product Marking, and
3.1.14 Supplementary Requirements.

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 Specification B249/B249M.

4. Ordering Information

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

4.1.1 ASTM designation and year of issue,

[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**

4.1.2 Copper Alloy UNS No. designation (Scope),

4.1.3 Temper (Temper Section and related Tables),

4.1.4 Form—cross-section such as round, hexagonal, square, and so forth,

4.1.5 Diameter or distance between parallel surfaces, width and thickness (Dimensions and Permissible Variations),

4.1.6 Length (Dimensions and Permissible Variations),

4.1.7 Edge contours (Dimensions and Permissible Variations),

4.1.8 Quantity—number of pieces or total weight, for each size and form, and

4.1.9 Intended application.

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

4.2.1 Tensile test for product ½ in. [12 mm] and over, for the alloys and tempers listed in Table 4.

4.2.2 Residual stress test (Performance Requirements section),

4.2.3 Piston finish rod or shafting (Other Requirements section),

4.2.4 Certification (Specification B249/B249M),

4.2.5 Mill test report (Specification B249/B249M),

4.2.6 Heat identification or traceability details (Specification B249/B249M), and

4.2.7 If product is purchased for agencies of the U.S. government (Other Requirements—Purchases for U.S. Government).

5. Chemical Composition

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

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

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

5.4 When all the elements listed in Table 1 for the Copper Alloy No. are determined, the sum of the results shall be 99.6 % minimum except for C46750, which shall be 99.5 % minimum.

6. Temper

6.1 The standard tempers for products described in this specification, as defined in Classification B601, are shown in Tables 2 and 3.

7. Mechanical Property Requirements

7.1 Product furnished under this specification shall conform to the mechanical property requirements prescribed in Tables 2-4.

7.1.1 *Rockwell Hardness Requirements*—For the alloys and tempers listed, the product ½ in. [12 mm] and over in diameter or distance between parallel surfaces should conform with the requirements prescribed in Table 4, when tested in accordance with Test Methods E18.

7.1.1.1 For the alloys, tempers, and sizes listed in Table 4, Rockwell hardness may be used as the basis of acceptance or rejection for mechanical properties except when the tensile test is specified in the contract or purchase order.

7.1.1.2 Hardness test results outside the ranges of Table 4 shall not be cause for rejection if the tensile property requirements of Tables 2 and 3 are met.

7.1.2 *Tensile Strength Requirements*—The product shall conform with the requirements of Tables 2 and 3, when tested in accordance with Test Methods E8/E8M. Whenever tensile test results are obtained from both full-size and from machined test specimens and they differ, the results obtained from full-size test specimens shall be used to determine conformance to the requirements of this specification.

8. Performance Requirements

8.1 *Residual Stress Test:*

8.1.1 When specified in the contract or purchase order, product in drawn tempers shall be tested for residual stress according to the requirements of Test Method B154 or Test Method B858 and show no signs of cracking.

8.1.2 Unless otherwise agreed upon between the manufacturer, or supplier, and the purchaser, the manufacturer shall have the option of using either the Mercurous Nitrate Test or the Ammonia Vapor Test. When the Ammonia Vapor Test is

TABLE 1 Chemical Requirements

Element, %	Copper Alloy UNS No.					
	C46200	C46400	C46750	C47940	C48200	C48500
Copper	62.0–65.0	59.0–62.0	59.2–62.5	63.0–66.0	59.0–62.0	59.0–62.0
Tin	0.50–1.0	0.50–1.0	1.00–1.80	1.2–2.0	0.50–1.0	0.50–1.0
Lead	0.20 max	0.20 max	0.25 max	1.0–2.0	0.40–1.0	1.3–2.2
Zinc	remainder	remainder	remainder	remainder	remainder	remainder
Iron	0.10 max	0.10 max	0.10 max	0.10–1.0	0.10 max	0.10 max
Nickel[A]	...	...	0.50 max	0.10–0.50	...	...
Antimony	...	...	0.05–0.15	...	...	...
Phosphorus	...	...	0.05–0.15	...	...	...

[A] Including cobalt.

TABLE 2 Tensile Requirements, Inch-pound

Temper Designation		Diameter or Distance Between Parallel[A] Surfaces, in.	Tensile Strength, min, ksi	Yield Strength at 0.5 % Extension Under Load, min, ksi	Elongation in 4 × Diameter or Thickness of Specimen, min, %[B]
Code	Name				
		Copper Alloy UNS No. C46200			
M30	as-hot extruded	all forms, all sizes	50	20	30
O60	soft anneal	rods and bars, all sizes	48	16	30
O50	light anneal	rods and bars:			
		0.500 and under	58	27	22
		over 0.500 to 1.000, incl	56	27	25
		over 1.000 to 2.000, incl	54	26	25
		over 2.000 to 3.000, incl	52	25	27
		over 3.000 to 4.000, incl	50	22	30
		over 4.000	50	20	30
H60	cold heading, forming	rods, all sizes	48	18	22
H02	half-hard	rods and bars:			
		0.500 and under	58	27	22
		over 0.500 to 1.000, incl	56	27	25
		over 1.000 to 2.000, incl	54	26	25
		over 2.000 to 3.000, incl	52	25	27
		over 3.000 to 4.000, incl	50	22	30
		over 4.000	50	20	30
H04	hard	rods and bars:			
		0.500 and under	64	40	13
		over 0.500 to 1.000, incl	62	38	13
		over 1.000 to 2.000, incl	58	34	18
		Copper Alloy UNS No. C46400			
M30	as-hot extruded	all forms, all sizes	52	20	30
O60	soft anneal	rods and bars:			
		1.000 and under	54	20	30
		over 1.000 to 2.000, incl	52	20	30
		over 2.000	50	20	30
		shapes, all sizes	52	20	30
O50	light anneal	rods and bars:			
		0.500 and under	60	27	22
		over 0.500 to 1.000, incl	60	27	25
		over 1.000 to 2.000, incl	58	26	25
		over 2.000 to 3.000, incl	54	25	25
		over 3.000 to 4.000, incl	54	22	27
		over 4.000	54	22	30
H50[C]	extruded and drawn[C]	shapes, all sizes	58	25	20
H02	half-hard	rods and bars:			
		0.500 and under	60	27	22
		over 0.500 to 1.000, incl	60	27	25
		over 1.000 to 2.000, incl	58	26	25
		over 2.000 to 3.000, incl	54	25	25
		over 3.000 to 4.000, incl	54	22	27
		over 4.000	54	22	30
H04	hard	rods and bars:			
		1.000 and under	67	45	13
		over 1.000 to 2.000, incl	62	37	18
		Copper Alloy UNS No. C46750			
M30	as hot extruded	all forms, all sizes	48	20	15
O60	soft annealed	rod and bar, all sizes	49	20	15
O61	annealed	rod and bar, all sizes	49	20	15
H50	hot extruded and drawn	rod and bar:			
		over 0.300 to .500	48	20	5
		over 0.500 to 1.000	48	20	10
		over 1.000	48	20	15
		Copper Alloy UNS No. C47940			
M30	as-hot extruded	all forms, all sizes	50	20	30
O60	soft anneal	rods and bars, all sizes	48	20	30
O50	light anneal	rods and bars:			
		0.500 and under	58	30	18
		over 0.500 to 1.000, incl	56	30	20
		over 1.000 to 2.0, incl	54	25	22
		over 2.000	50	25	25
H50[C]	extruded and drawn[C]	shapes, all sizes	56	25	20
H02	half-hard	rods and bars:			
		0.500 and under	58	30	18
		over 0.500 to 1.000, incl	56	30	20
		over 1.000 to 2.000, incl	54	25	22
		over 2.000	50	25	25
H04	hard	rods and bars:			
		0.500 and under	70	55	10
		over 0.500 to 1.000, incl	65	52	13
		over 1.000 to 2.000, incl	62	45	15

TABLE 2 *Continued*

Temper Designation		Diameter or Distance Between Parallel[A] Surfaces, in.	Tensile Strength, min, ksi	Yield Strength at 0.5 % Extension Under Load, min, ksi	Elongation in 4 × Diameter or Thickness of Specimen, min, %[B]
Code	Name				
		Copper Alloy UNS No. C48200			
M30	as-hot extruded	all forms, all sizes	52	20	25
O60	soft anneal	rods and bars:			
		1.000 and under	54	20	25
		over 1.000 to 2.000, incl	52	20	25
		over 2.000	50	20	25
		shapes, all sizes	52	20	25
O50	light anneal	rods and bars:			
		1.000 and under	60	27	18
		over 1.000 to 2.000, incl	58	26	20
		over 2.000 to 3.000, incl	54	25	20
		over 3.000 to 4.000, incl	54	22	20
		over 4.000	54	22	25
H50[C]	extruded and drawn[C]	shapes, all sizes	58	25	15
H02	half-hard	rods and bars:			
		1.000 and under	60	27	18
		over 1.000 to 2.000, incl	58	26	20
		over 2.000 to 3.000, incl	54	25	20
		over 3.000 to 4.000, incl	54	22	20
		over 4.000	54	22	25
H04	hard	rods and bars:			
		1.000 and under	67	45	11
		over 1.000 to 2.000, incl	62	37	15
		Copper Alloy UNS No. C48500			
M30	as-hot extruded	all forms, all sizes	52	20	20
O60	soft anneal	rods and bars:			
		1.000 and under	54	20	20
		over 1.000 to 2.000, incl	52	20	20
		over 2.000	50	20	20
		shapes, all sizes	52	20	20
O50	light anneal	rods and bars:			
		1.000 and under	60	27	12
		over 1.000 to 2.000, incl	58	26	20
		over 2.000 to 3.000, incl	54	25	20
		over 3.000 to 4.000, incl	54	22	20
		over 4.000	54	22	20
H50[C]	extruded and drawn[C]	shapes, all sizes	58	25	15
H02	half-hard	rods and bars:			
		1.000 and under	60	27	12
		over 1.000 to 2.000, incl	58	26	20
		over 2.000 to 3.000, incl	54	25	20
		over 3.000 to 4.000, incl	54	22	20
		over 4.000	54	22	20
H04	hard	rods and bars:			
		1.000 and under	67	45	10
		over 1.000 to 2.000, incl	62	37	13

[A] For rectangular bar, the Distance Between Parallel Surfaces refers to thickness.
[B] In any case, a minimum gage length of 1 in. shall be used.
[C] This temper does not apply to hollow shapes.

used, the test pH value appropriate for the intended application shall be 10 unless otherwise specified by the purchaser. (**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—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. Other Requirements

9.1 *Piston-Finish Rod and Shafting:*

9.1.1 When so specified in the contract or order, round rods over ½-in. [12 mm] diameter shall be furnished as piston-finish rods or shafting.

9.1.2 Piston-finish rods shall have a special surface produced by turning or grinding and shall comply with the special diameter tolerances specified in Piston-Finish Rod Section under Dimensions and Permissible Variations.

9.1.3 The straightness tolerances for piston-finish rod are subject to agreement between the manufacturer or supplier and the purchaser.

9.2 *Purchases for U.S. Government:*