



Standard Specification for Brass Wire¹

This standard is issued under the fixed designation B 134/B 134M; 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 Department of Defense.

1. Scope *

1.1 This specification establishes requirements for round, hexagonal, octagonal, rectangular and square brass wire of UNS Alloys C21000, C22000, C22600, C23000, C23400, C24000, C26000, C27000, and C27400.

1.2 *Units*—The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text and tables, the 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 standard.

2. Referenced Documents

2.1 ASTM Standards:

B 250 Specification for General Requirements for Wrought Copper-Alloy Wire²

B 250M Specification for General Requirements for Wrought Copper-Alloy Wire (Metric)²

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast²

E 8 Test Methods for Tension Testing of Metallic Materials³

E 8M Test Methods for Tension Testing of Metallic Materials (Metric)³

E 112 Test Methods for Determining the Average Grain Size³

E 478 Test Methods for Chemical Analysis of Copper Alloys⁴

3. General Requirements

3.1 The following sections of Specification B 250 or B 250M 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 Reports,

3.1.13 Product Marking,

3.1.14 Packaging and Package Marking,

3.1.15 Supplementary Requirements.

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 that supplement those that appear in Specification B 250 or B 250M.

4. Ordering Information

4.1 Include the following information in orders for product:

4.1.1 ASTM Designation and year of issue,

4.1.2 Copper Alloy UNS No. designation,

4.1.3 Temper,

4.1.4 Cross section (round, hexagonal, octagonal, rectangular, or square),

4.1.5 Quantity; total weight, footage, or number of pieces of each temper, cross section, or alloy,

4.1.6 Dimensions; diameter or distance between parallel surfaces, width and thickness, length,

4.1.7 Type of edge; square corners, rounded edge, full-rounded edge,

4.1.8 How furnished; coil, spool, or reel, specific lengths with or without ends, and

4.1.9 When material is purchased for agencies of the U.S. Government (Specification B 250 or B 250M).

4.2 The following options are available to this specification and should be specified in the contract or purchase order when required:

4.2.1 Certification (Specification B 250 or B 250M), and

4.2.2 Mill Test Report (Specification B 250 or B 250M).

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 *Annual Book of ASTM Standards*, Vol 02.01.

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.06.

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

5. Materials and Manufacture

5.1 Material:

5.1.1 The material shall be made from cast billets, logs, or rods of Copper Alloy UNS Numbers C21000, C22000, C22600, C23000, C23400, C24000, C26000, C27000, or C27400, of such purity, soundness, and structure to be suitable for processing into the desired product.

5.2 Manufacture:

5.2.1 The products shall be manufactured by such hot working, cold working, and annealing processing as to produce a uniform wrought structure in the finished product.

6. Chemical Composition

6.1 The material shall conform to the chemical compositional requirements specified in Table 1 for the copper alloy specified in the ordering information.

6.1.1 When all elements specified for a given alloy in Table 1 are determined, their sum of results shall be as follows:

Alloy UNS Nos.	Sum of Results, Percent, Minimum
C21000, C22000, C22600, C23000, C23400, C24000	99.8
C26000, C27000, C27400	99.7

6.2 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 the purchaser.

6.3 Zinc, listed as the “remainder,” is the difference between the sum of results for all elements determined and 100 %.

7. Temper

7.1 The product in drawn or rolled wire of UNS Alloy Nos. C21000, C22000, C22600, C23000, C23400, C24000, C26000, C27000, and C27400 shall be available in H00, H01, H02, H03, H04, H06, H08, and H10 tempers as defined in Practice B 601.

7.1.1 Product made in H04 temper is not generally available in sizes over ½ in. [13 mm] in diameter.

7.1.2 Product made in H06 temper is not generally available in sizes over ⅜ in. [10 mm] in diameter.

7.1.3 Product made in H08 temper is not generally available in sizes over ¼ in. [6 mm] in diameter.

7.1.4 Square product is not generally available in H06 or H08 tempers.

7.1.5 The tension test shall be the standard temper test for all H temper wire.

7.1.6 The product in annealed form of UNS Alloys Nos. C21000 and C22000 shall be available in OS050, OS035, OS025, and OS015 tempers as defined in Practice B 601.

7.1.7 The product in annealed form of UNS Alloy Nos. C22600, C23000, C23400, and C24000 shall be available in OS070, OS050, OS035, OS025, OS015, and OS010 tempers as defined in Practice B 601.

7.1.8 The product in annealed form of UNS Alloy Nos. C26000, C27000, and C27400 shall be available in OS120, OS070, OS050, OS035, OS025, and OS015 tempers as defined in Practice B 601.

8. Grain Size for Annealed Wire

8.1 Grain size shall be the standard requirement for all product in the annealed tempers.

8.2 Acceptance or rejection based on grain size shall depend only on the average grain size of test specimens taken from each of two sample portions and each specimen shall be within the limits prescribed in Table 2 when determined in accordance with Test Methods E 112.

9. Mechanical Property Requirements

9.1 Tensile Strength Requirements:

9.1.1 Drawn or rolled product shall conform to the requirements specified in Tables 3-6, by alloy and temper, for wire 0.020 in. [0.5 mm] and over in diameter or distance between parallel surfaces.

9.1.1.1 The temper of wire under 0.020 in. [0.5 mm] in diameter or distance between parallel surfaces shall be subject to agreement between the manufacturer, or supplier, and the purchaser.

9.1.2 Rectangular product, furnished in the “H” tempers shall conform to the requirements in Tables 5 and 6 for the temper and Copper Alloy UNS No. designation specified in the ordering information when tested in accordance with Test Methods E 8 or E 8M.

9.1.3 Acceptance or rejection based upon mechanical property shall depend on the tensile strength values obtained when tested in accordance with Test Methods E 8 or E 8M.

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Composition, %			
	Copper	Lead, max	Iron, max	Zinc
C21000	94.0–96.0	0.05	0.05	remainder
C22000	89.0–91.0	0.05	0.05	remainder
C22600	86.0–89.0	0.05	0.05	remainder
C23000	84.0–86.0	0.05	0.05	remainder
C23400	81.0–84.0	0.05	0.05	remainder
C24000	78.5–81.5	0.05	0.05	remainder
C26000	68.5–71.5	0.07	0.05	remainder
C27000	63.0–68.5	0.10	0.07	remainder
C27400	61.0–64.0	0.10	0.05	remainder

TABLE 2 Grain Size Requirements and Approximate Rockwell Hardness Values for Annealed Wire

Temper Designation		Grain Size, mm		Approximate Rockwell Hardness for Rectangular Wire ^A			
				F Scale		30-T Scale	
Standard (B 601)	Nominal	Min	Max	Min	Max	Min	Max
Copper Alloy UNS No. C21000							
OS050	0.050	0.035	0.090	40 ^B	52 ^B	...	4
OS035	0.035 ^C	0.025	0.050	47 ^B	54 ^B	...	7
OS025	0.025	0.015	0.035	50 ^B	61 ^B	1	17
OS015	0.015 ^C	^D	0.025	54 ^B	65 ^B	7	23
Copper Alloy UNS No. C22000							
OS050	0.050	0.035	0.090	50	60	1	16
OS035	0.035 ^C	0.025	0.050	54	64	7	21
OS025	0.025	0.015	0.035	58	70	13	31
OS015	0.015 ^C	^D	0.025	62	75	19	39
Copper Alloy UNS Nos. C22600, C23000, and C23400							
OS070	0.070	0.050	0.100	53	60	6	16
OS050	0.050 ^C	0.035	0.070	56	63	10	20
OS035	0.035 ^C	0.025	0.050	58	66	13	24
OS025	0.025 ^C	0.015	0.035	60	72	16	34
OS015	0.015 ^C	^D	0.025	62	79	19	48
OS010	0.010 ^C	^D	0.015	66	83	25	50
Copper Alloy UNS No. C24000							
OS070	0.070	0.050	0.120	53	64	2	21
OS050	0.050 ^C	0.035	0.070	57	67	8	27
OS035	0.035 ^C	0.025	0.050	61	72	16	35
OS025	0.025 ^C	0.015	0.035	63	77	20	42
OS015	0.015 ^C	^D	0.025	66	83	25	50
Copper Alloy UNS Nos. C26000, C27000, and C27400							
OS120	0.120	0.070	...	50	62	...	21
OS070	0.070	0.050	0.120	52	67	3	27
OS050	0.050	0.035	0.070	61	73	20	35
OS035	0.035	0.025	0.050	65	76	25	38
OS025	0.025	0.015	0.035	67	79	27	42
OS015	0.015	^D	0.025	72	85	33	50

^A Rockwell hardness values apply as follows: The F scale applies to metal 0.020 in. [0.5 mm] in thickness and over; the 30-T scale applies to metal 0.015 in. [0.4 mm] in thickness and over.

^B Copper Alloy UNS No. C21000 in these several OS (annealed) tempers is too soft for Rockwell F hardness tests below 0.030 in. [0.75 mm] in thickness.

^C The nominal grain sizes are those in which wire other than rectangular are normally available. Rectangular wire is normally available in any of the nominal grain sizes listed.

^D Although no minimum grain size is required, the material must be fully recrystallized.

TABLE 3 Tensile Strength Requirements for Round, Hexagonal, Octagonal, and Square Wire 0.020 in. and Over in Diameter or Distance Between Parallel Surfaces

Temper Designation		Tensile Strength, ksi ^A									
Code	Name	Copper Alloy UNS No. C21000		Copper Alloy UNS No. C22000		Copper Alloy UNS Nos. C22600 and C23000		Copper Alloy UNS Nos. C23400 and C24000		Copper Alloy UNS Nos. C26000, C27000, and C27400	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
H00	eighth-hard	35	45	38	50	43	57	50	65	50	65
H01	quarter-hard	41	51	45	57	53	65	62	75	62	77
H02	half-hard	49	58	56	67	66	77	78	90	79	94
H03	three-quarter hard	57	64	64	74	76	86	90	101	92	107
H04 ^B	hard	61	68	70	79	83	92	100	110	102	117
H06 ^{C,D}	extra-hard	66	73	78	86	94	102	112	121	115	129
H08 ^{E,D}	spring	72	...	84	...	100	...	116	...	120	...

^A ksi = 1000 psi.

^B H04 (hard) temper wire is not generally available in sizes over 1/2 in. in diameter.

^C H06 (extra-hard) temper is not generally available in sizes over 3/8 in. in diameter.

^D Square wire is not generally available in extra hard or spring tempers.

^E H08 (spring) temper is not generally available in sizes over 1/4 in. in diameter.

9.2 Rockwell Hardness:

9.2.1 The approximate Rockwell hardness values for rectangular other than square wire given in Table 2, Table 5, and

Table 6 are for general information and assistance in testing and shall not be used as a basis for product rejection.

TABLE 4 Tensile Strength Requirements for Round, Hexagonal, Octagonal, and Square Wire 0.5 mm and Over in Diameter or Distance Between Parallel Surfaces

Temper Designation		Tensile Strength, MPa ^A									
Code	Name	Copper Alloy UNS No. C21000		Copper Alloy UNS No. C22000		Copper Alloy UNS Nos. C22600 and C23000		Copper Alloy UNS Nos. C23400 and C24000		Copper Alloy UNS Nos. C26000, C27000, and C27400	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
H00	Eighth-hard	240	310	260	345	295	395	345	450	345	450
H01	Quarter-hard	285	350	310	395	365	450	425	515	425	530
H02	Half-hard	340	400	385	460	455	530	540	620	545	650
H03	Three-quarter hard	395	440	440	510	525	595	620	700	635	740
H04 ^B	Hard	420	470	485	545	570	635	690	760	700	810
H06 ^{C,D}	Extra-hard	455	505	540	595	650	700	770	830	790	890
H08 ^{E,D}	Spring	495	...	580	...	690	...	800	...	830	...

^A See Appendix X1.

^B H04 (hard) temper wire is not generally available in sizes over 13 mm in diameter.

^C H06 (extra-hard) temper is not generally available in sizes over 10 mm in diameter.

^D Square wire is not generally available in extra hard or spring tempers.

^E H08 (spring) temper is not generally available in sizes over 6 mm in diameter.

NOTE 1—The Rockwell hardness test offers a quick and convenient method of checking for general compliance with properties for temper condition.

10. Dimensions, Mass, and Permissible Variations

10.1 The dimensions and tolerances for product described by this specification shall be as specified in Specifications B 250 or B 250M with particular reference to the following tables and related paragraphs in those specifications:

10.1.1 *Diameter or Distance Between Parallel Surfaces*—Table 1 in Specifications B 250 or B 250M.

10.1.2 *Thickness*—Table 3 in Specifications B 250 or B 250M.

10.1.3 *Width*—Table 5 in Specification B 250 or Table 4 in Specification B 250M.

10.1.4 *Length*—Tables 7 and 8 in Specification B 250 or Tables 5 and 6 in Specification B 250M.

10.1.5 *Straightness*—Table 9 in Specification B 250 or Table 7 in Specification B 250M.

10.1.5.1 This requirement is applicable to rectangular and square product only when ordered in lengths.

10.1.6 *Edge Contour*—Refer to the section on edge contour.

11. Test Methods

11.1 Chemical Analysis

11.1.1 Composition shall be determined, in case of disagreement, as follows:

Element	Test Method
Copper	E 478
Lead	E 478 (AA)
Iron	E 478
Zinc	E 478 (Titrametric)

11.1.2 Test methods to be followed for the determination of elements resulting from contractual or purchase order agreement shall be as agreed upon between the manufacturer or supplier and the purchaser.

12. Keywords

12.1 brass wire; C21000; C22000; C22600; C23000; C23400; C24000; C26000; C27000; C27400; copper-alloy wire; copper-zinc alloy wire; general purpose wire; hexagonal wire; high strength wire; nonelectrical wire; octagonal wire; ornamental wire; rectangular wire; round wire; spring wire; square wire; wire

TABLE 5 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Rectangular Wire

Temper Designation		Tensile Strength, ksi		Approximate Rockwell Hardness ^A			
				B Scale		Superficial 30-T	
Standard (B 601)	Former	Min	Max	0.020 to 0.036 in. incl	Over 0.036 in.	0.012 to 0.028 in. incl	Over 0.028 in.
Copper Alloy UNS No. C21000							
H01	quarter-hard	37	47	20-48	24-52	34-51	37-54
H02	half-hard	42	52	40-56	44-60	46-57	48-59
H03	three-quarter-hard	46	56	50-61	53-64	52-60	54-62
H04	hard	50	59	57-64	60-67	57-62	59-64
H06	extra hard	56	64	64-70	66-72	62-66	63-67
H08	spring	60	68	68-73	70-75	64-68	65-69
H10	extra spring	61	69	69-74	71-76	65-69	66-70
Copper Alloy UNS No. C22000							
H01	quarter-hard	40	50	27-52	31-56	38-53	41-56
H02	half-hard	47	57	50-63	53-66	52-61	54-63
H03	three-quarter-hard	52	62	59-68	62-71	58-64	60-66
H04	hard	57	66	65-72	68-75	62-66	64-68
H06	extra hard	64	72	72-77	74-79	67-71	68-72
H08	spring	69	77	76-79	78-81	70-72	71-73
H10	extra spring	72	80	78-81	80-83	71-73	72-74
Copper Alloy UNS Nos. C22600 and C23000							
H01	quarter-hard	44	54	33-58	37-62	42-57	45-60
H02	half-hard	51	61	56-68	59-71	56-64	58-66
H03	three-quarter-hard	57	67	66-73	69-76	63-68	65-70
H04	hard	63	72	72-78	74-80	67-71	68-72
H06	extra hard	72	80	78-83	80-85	70-74	71-75
H08	spring	78	86	82-85	84-87	74-76	75-77
H10	extra spring	82	90	84-87	86-89	75-77	76-78
Copper Alloy UNS Nos. C23400 and C24000							
H01	quarter-hard	48	58	38-61	42-65	42-57	45-60
H02	half-hard	55	65	59-70	62-73	56-64	58-66
H03	three-quarter-hard	61	71	69-76	72-79	63-68	65-70
H04	hard	68	77	76-82	78-84	68-72	69-73
H06	extra hard	78	87	83-87	85-89	72-75	73-76
H08	spring	85	93	87-90	89-92	75-77	76-78
H10	extra spring	89	97	88-91	90-93	76-78	77-79
Copper Alloy UNS No. C26000							
H01	quarter-hard	49	59	40-61	44-65	43-57	46-60
H02	half-hard	57	67	60-74	63-77	56-66	58-68
H03	three-quarter-hard	64	74	72-79	75-82	65-70	67-72
H04	hard	71	81	79-84	81-86	70-73	71-74
H06	extra hard	83	92	85-89	87-91	74-76	75-77
H08	spring	91	100	89-92	90-93	76-78	76-78
H10	extra spring	95	104	91-94	92-95	77-79	77-79
Copper Alloy UNS Nos. C27000 and C27400							
H01	quarter-hard	49	59	40-61	44-65	43-57	46-60
H02	half-hard	55	65	57-71	60-74	54-64	56-66
H03	three-quarter-hard	62	72	70-77	73-80	65-69	67-71
H04	hard	68	78	76-82	78-84	68-72	69-73
H06	extra hard	79	89	83-87	85-89	73-75	74-76
H08	spring	86	95	87-90	89-92	75-77	76-78
H10	extra spring	90	99	88-91	90-93	76-78	77-79

^A Rockwell hardness values apply as follows: the B scale values apply to metal 0.020 in. and over in thickness, and the 30-T scale values apply to metal 0.012 in. and over in thickness.

**B 134/B 134M – 01****TABLE 6 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Rectangular Wire**

Temper Designation		Tensile Strength, MPa ^A	Approximate Rockwell Hardness ^B				
			B Scale		Superficial 30-T		
Standard (B 601)	Former	Min	Max	0.5 to 0.9 mm incl	Over 0.9 mm	0.3 to 0.7 mm incl	Over 0.7 mm
Copper Alloy UNS No. C21000							
H01	quarter-hard	255	325	20-48	24-52	34-51	37-54
H02	half-hard	290	360	40-56	44-60	46-57	48-59
H03	three-quarter-hard	315	385	50-61	53-64	52-60	54-62
H04	hard	345	405	57-64	60-67	57-62	59-64
H06	extra hard	385	440	64-70	66-72	62-66	63-67
H08	spring	415	470	68-73	70-75	64-68	65-69
H10	extra spring	420	475	69-74	71-76	65-69	66-70
Copper Alloy UNS No. C22000							
H01	quarter-hard	275	345	27-52	31-56	38-53	41-56
H02	half-hard	325	395	50-63	53-66	52-61	54-63
H03	three-quarter-hard	360	425	59-68	62-71	58-64	60-66
H04	hard	395	455	65-72	68-75	62-66	64-68
H06	extra hard	440	495	72-77	74-79	67-71	68-72
H08	spring	475	530	76-79	78-81	70-72	71-73
H10	extra spring	495	550	78-81	80-83	71-73	72-74
Copper Alloy UNS Nos. C22600 and C23000							
H01	quarter-hard	305	370	33-58	37-62	42-57	45-60
H02	half-hard	350	420	56-68	59-71	56-64	58-66
H03	three-quarter-hard	395	460	66-73	69-76	63-68	65-70
H04	hard	435	495	72-78	74-80	67-71	68-72
H06	extra hard	495	550	78-83	80-85	70-74	71-75
H08	spring	540	595	82-85	84-87	74-76	75-77
H10	extra spring	565	620	84-87	86-89	75-77	76-78
Copper Alloy UNS Nos. C23400 and C24000							
H01	quarter-hard	330	400	38-61	42-65	42-57	45-60
H02	half-hard	380	450	59-70	62-73	56-64	58-66
H03	three-quarter-hard	420	490	69-76	72-79	63-68	65-70
H04	hard	470	530	76-82	78-84	68-72	69-73
H06	extra hard	540	600	83-87	85-89	72-75	73-76
H08	spring	585	640	87-90	89-92	75-77	76-78
H10	extra spring	615	670	88-91	90-93	76-78	77-79
Copper Alloy UNS No. C26000							
H01	quarter-hard	340	405	40-61	44-65	43-57	46-60
H02	half-hard	395	460	60-74	63-77	56-66	58-68
H03	three-quarter-hard	440	510	72-79	75-82	65-70	67-72
H04	hard	490	560	79-84	81-86	70-73	71-74
H06	extra hard	570	635	85-89	87-91	74-76	75-77
H08	spring	625	690	89-92	90-93	76-78	76-78
H10	extra spring	655	720	91-94	92-95	77-79	77-79
Copper Alloy UNS Nos. C27000 and C27400							
H01	quarter-hard	340	405	40-61	44-65	43-57	46-60
H02	half-hard	380	450	57-71	60-74	54-64	56-66
H03	three-quarter-hard	425	495	70-77	73-80	65-69	67-71
H04	hard	470	540	76-82	78-84	68-72	69-73
H06	extra hard	545	615	83-87	85-89	73-75	74-76
H08	spring	595	655	87-90	89-92	75-77	76-78
H10	extra spring	620	685	88-91	90-93	76-78	77-79

^A See Appendix X1.^B Rockwell hardness values apply as follows: the B scale values apply to metal 0.5 mm and over in thickness, and the 30-T scale values apply to metal 0.3 mm and over in thickness.

APPENDIX**(Nonmandatory Information)****X1. METRIC EQUIVALENTS**

X1.1 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 one kilogram gives it an acceleration of one metre per second squared ($N = \text{kg}\cdot\text{m}/\text{s}^2$). 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 $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$, 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 (B 134-96) that may impact the use of this standard.

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|--|--|
| (1) Added alloys C22600 and C23400 to the standard. | (3) Revised the standard as a combined specification with both inch-pound and metric requirements. |
| (2) Generally revised document to conform to ASTM form and style requirements. | |

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