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Standard Specification for Brass Plate, Sheet, Strip, And Rolled Bar[1]

This standard is issued under the fixed designation B 36/B 36M; 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 covers brass plate, sheet, strip, and rolled bar of the following alloys:[2]

Copper Alloy UNS No.[3]	Previously Used Designation	Nominal Composition Copper, %	Zinc, %
C21000	1	95	5
C22000	2	90	10
C22600	...	87.5	12.5
C23000	3	85	15
C24000	4	80	20
C26000	6	70	30
C26800	8	66	34
C27200	9	63	37
C28000	...	60	40

1.2 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not 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.[3]

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar[4]

B 248M Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar [Metric][4]

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast[4]

E 8 Test Methods of Tension Testing of Metallic Materials[5]

E 8M Test Methods of Tension Testing of Metallic Materials [Metric][5]

E 527 Practice for Numbering Metals and Alloys (UNS)[6]

3. Ordering Information

3.1 Orders for material under this specification should include the following information:

3.1.1 Quantity,

3.1.2 Name of material: brass,

3.1.3 Form of material: plate, sheet, strip, or rolled bar,

3.1.4 Alloy number (see 1.1),

3.1.5 Temper (see Section 5),

3.1.6 Dimensions: thickness and width, and length if applicable.

3.1.7 How furnished: rolls, stock lengths with or without ends, specific lengths with or without ends (see 8.4),

3.1.8 Type of edge, if required: slit, sheared, sawed, square corners, rounded corners, rounded edges, or full-rounded edges (see 8.6),

3.1.9 Type of width and straightness tolerances, if required: slit-metal tolerances, square-sheared-metal tolerances, sawed-metal tolerances, straightened or edge-rolled metal tolerances (see 8.3 and 8.5).

3.1.10 ASTM Specification B 36/B 36M, year of issue, and whether inch-pound or SI units are applicable (see 1.2).

3.1.11 Special tests or exceptions, if any.

3.2 In addition, when material is purchased for agencies of the U. S. Government, it shall conform to the Supplementary Requirements as defined in Specification B 248 when specified in the contract or purchase order.

4. Chemical Composition

4.1 The materials shall conform to the compositions prescribed in Table 1.

4.2 These specification limits do not preclude the presence of other elements. Limits for unnamed elements may be

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[1] This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.01 on Plate, Sheet, and Strip.

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[2] SAE Specifications CA210, CA220, CA230, CA240, CA260, CA268 and CA272 conform to the requirements for Copper Alloy UNS Nos. C21000, C22000, C23000, C24000, C26000, C26800, and C27200, respectively.

[3] The UNS system for copper and copper alloys (see Practice E 527) 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.

[4] *Annual Book of ASTM Standards*, Vol 02.01.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

[6] *Annual Book of ASTM Standards*, Vol 01.01.

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Copper, %	Lead, max, %	Iron, max, %	Zinc
C21000 (95 Cu, 5 Zn)	94.0 to 96.0	0.03	0.05	remainder
C22000 (90 Cu, 10 Zn)	89.0 to 91.0	0.05	0.05	remainder
C22600 (87.5 Cu, 12.5 Zn)	86.0 to 89.0	0.05	0.05	remainder
C23000 (85 Cu, 15 Zn)	84.0 to 86.0	0.05	0.05	remainder
C24000 (80 Cu, 20 Zn)	78.5 to 81.5	0.05	0.05	remainder
C26000 (70 Cu, 30 Zn)	68.5 to 71.5	0.07	0.05	remainder
C26800[A] (66 Cu, 34 Zn)	64.0 to 68.5	0.15	0.05	remainder
C27200[B] (63 Cu, 37 Zn)	62.0 to 65.0	0.07	0.07	remainder
C28000[C] (60 Cu, 40 Zn)	59.0 to 63.0	0.30	0.07	remainder

[A] Material shall be free from beta constituent when examined at a magnification of 75 diameters.
[B] Small amounts of beta constituent, if present, may interfere in some instances with severe forming or drawing; therefore, suitability for forming or drawing should be established between manufacturer and purchaser.
[C] It is anticipated that this material will contain the beta constituent that may interfere with severe forming or drawing operations.

established by agreement between manufacturer or supplier and purchaser.

4.3 Either copper or zinc may be taken as the difference between the sum of all elements analyzed and 100 %. When all elements in Table 1 are analyzed, their sum shall be as shown in the table as follows:

Copper Alloy UNS No.	Copper Plus Named Elements, % min
C21000	99.8
C22000	99.8
C22600	99.8
C23000	99.8
C24000	99.8
C26000	99.7
C26800	99.7
C27200	99.7
C28000	99.7

5. Temper

5.1 *As Hot-Rolled (M20) Material*—The standard temper of sheet and plate produced by hot rolling is as designated in Table 2.

TABLE 2 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Rolled Tempers

NOTE 1—Plate is generally available in only the as hot-rolled (M20) temper. Required properties for other tempers shall be agreed upon between the manufacturer and the purchaser at the time of placing the order.

Rolled Temper		Tensile Strength, ksi[A]		Tensile Strength, MPa[B]		Approximate Rockwell Hardness[C]							
Temper Designation						B Scale				Superficial 30-T			
Standard	Former	Min	Max	Min	Max	0.020 (0.508) to 0.036 in. (0.914 mm) incl		Over 0.036 in. (0.914 mm)		0.012 (0.305) to 0.028 in. (0.711 mm) incl		Over 0.028 in. (0.711 mm)	
						Min	Max	Min	Max	Min	Max	Min	Max
Copper Alloy UNS No. C21000													
M20	As hot-rolled	32	42	220	290	...	...	...	...	...	...	...	...
H01	Quarter hard	37	47	255	325	20	48	24	52	34	51	37	54
H02	Half-hard	42	52	290	355	40	56	44	60	46	57	48	59
H03	Three-quarter-hard	46	56	315	385	50	61	53	64	52	60	54	62
H04	Hard	50	59	345	405	57	64	60	67	57	62	59	64
H06	Extra hard	56	64	385	440	64	70	66	72	62	66	63	67
H08	Spring	60	68	415	470	68	73	70	75	64	68	65	69
H10	Extra spring	61	69	420	475	69	74	71	76	65	69	66	70
Copper Alloy UNS No. C22000													
M20	As hot-rolled	33	43	230	295	...	...	...	...	...	...	...	...
H01	Quarter-hard	40	50	275	345	27	52	31	56	34	51	37	54
H02	Half-hard	47	57	325	395	50	63	53	66	50	59	52	61
H03	Three-quarter-hard	52	62	355	425	59	68	62	71	55	62	58	64
H04	Hard	57	66	395	455	65	72	68	75	60	65	62	67
H06	Extra hard	64	72	440	495	72	77	74	79	64	68	66	69
H08	Spring	69	77	475	530	76	79	78	81	67	69	68	70
H10	Extra spring	72	80	495	550	78	81	80	83	68	70	69	71
Copper Alloy UNS No. C22600													
H01	Quarter-hard	42	52	290	355	29	58	29	58	39	58	39	58
H02	Half-hard	48	58	330	400	52	68	52	68	54	64	54	64
H03	Three-quarter-hard	53	63	365	435	61	73	61	73	59	68	59	68
H04	Hard	58	67	400	460	67	77	67	77	64	70	64	70

TABLE 2 *Continued*

Rolled Temper		Tensile Strength, ksi[A]		Tensile Strength, MPa[B]		Approximate Rockwell Hardness[C]							
Temper Designation						B Scale				Superficial 30-T			
Standard	Former	Min	Max	Min	Max	0.020 (0.508) to 0.036 in. (0.914 mm) incl		Over 0.036 in. (0.914 mm)		0.012 (0.305) to 0.028 in. (0.711 mm) incl		Over 0.028 in. (0.711 mm)	
						Min	Max	Min	Max	Min	Max	Min	Max
H06	Extra hard	65	73	450	505	74	81	74	81	68	73	68	73
H08	Spring	70	78	485	540	78	83	78	83	71	74	71	74
H10	Extra spring	74	82	510	565	81	86	81	86	73	76	73	76
Copper Alloy UNS No. C23000													
M20	As hot-rolled	37	47	255	325	...	...	...	...	...	...	...	...
H01	Quarter-hard	44	54	305	370	33	58	37	62	42	57	45	60
H02	Half-hard	51	61	350	420	56	68	59	71	56	64	58	66
H03	Three-quarter-hard	57	67	395	460	66	73	69	76	63	68	65	70
H04	Hard	63	72	435	495	72	78	74	80	67	71	68	72
H06	Extra hard	72	80	495	550	78	83	80	85	70	74	71	75
H08	Spring	78	86	540	595	82	85	84	87	74	76	75	77
H10	Extra spring	82	90	565	620	84	87	86	89	75	77	76	78
Copper Alloy UNS No. C24000													
M20	As hot-rolled	41	51	285	350	...	...	...	...	...	...	...	...
H01	Quarter-hard	48	58	330	400	38	61	42	65	42	57	45	60
H02	Half-hard	55	65	380	450	59	70	62	73	56	64	58	66
H03	Three-quarter-hard	61	71	420	490	69	76	72	79	63	68	65	70
H04	Hard	68	77	470	530	76	82	78	84	68	72	69	73
H06	Extra hard	78	87	540	600	83	87	85	89	72	75	73	76
H08	Spring	85	93	585	640	87	90	89	92	75	77	76	78
H10	Extra spring	89	97	615	670	88	91	90	93	76	78	77	79
Copper Alloy UNS No. C26000													
M20	As hot-rolled	41	51	285	350	...	...	...	...	...	...	...	...
H01	Quarter-hard	49	59	340	405	40	61	44	65	43	57	46	60
H02	Half-hard	57	67	395	460	60	74	63	77	56	66	58	68
H03	Three-quarter-hard	64	74	440	510	72	79	75	82	65	70	67	72
H04	Hard	71	81	490	560	79	84	81	86	70	73	71	74
H06	Extra hard	83	92	570	635	85	89	87	91	74	76	75	77
H08	Spring	91	100	625	690	89	92	90	93	76	78	76	78
H10	Extra spring	95	104	655	715	91	94	92	95	77	79	77	79
Copper Alloy UNS No. C26800													
M20	As hot-rolled	40	50	275	345	...	...	...	...	...	...	...	
H01	Quarter-hard	49	59	340	405	40	61	44	65	43	57	46	60
H02	Half-hard	55	65	380	450	57	71	60	74	54	64	56	66
H03	Three-quarter-hard	62	72	425	495	70	77	73	80	65	69	67	71
H04	Hard	68	78	470	540	76	82	78	84	68	72	69	73
H06	Extra hard	79	89	545	615	83	87	85	89	73	75	74	76
H08	Spring	86	95	595	655	87	90	89	92	75	77	76	78
H10	Extra spring	90	99	620	685	88	91	90	93	76	78	77	79
Copper Alloy UNS No. C27200													
M20	As hot-rolled	41	51	285	350	...	...	...	...	...	...	...	...
H01	Quarter-hard	49	59	340	405	40	61	44	65	43	57	46	60
H02	Half-hard	56	66	385	455	57	74	60	76	54	67	56	68
H03	Three-quarter-hard	63	73	435	505	71	78	74	81	64	70	66	71
H04	Hard	70	80	485	550	76	82	78	84	67	72	68	73
H06	Extra hard	81	91	560	625	82	87	85	89	71	75	72	76
Copper Alloy UNS No. C28000													
M20	As hot-rolled	40	55	275	380	...	...	...	...	...	...	...	...
H01	Quarter-hard	50	62	345	425	40	65	45	70	45	65	45	70
H02	Half-hard	58	70	400	485	50	75	52	80	50	70	50	75
H03	Three-quarter-hard	60	75	415	515	55	80	55	82	52	78	55	80
H04	Hard	70	85	485	585	60	85	60	87	55	80	55	82
H06	Extra hard	82	95	565	655	65	92	65	90	60	85	60	85

[A] ksi = 1000 psi.
[B] MPa (Mega Pascals) See Appendix X1.
[C] Rockwell hardness values apply as follows: the B scale values apply to metal 0.020 in. (0.508 mm) and over in thickness, and the 30-T scale values apply to metal 0.012 in. (0.305 mm) and over in thickness.

5.2 *Rolled (H) Material*—The standard tempers of rolled material are as designated in Table 2 with the prefix "H". Former designations and the standard designations as defined in Practice B 601 are shown. Special or nonstandard tempers are subject to negotiation between the manufacturer and the purchaser (See 3.1.5).

5.3 *Annealed (OS) Material*—The standard tempers of annealed material are as designated in Table 3 and Table 4. Nominal grain size and the standard designations as defined in Practice B 601 are shown. Special or nonstandard tempers are subject to negotiation between the manufacturer and the purchaser (see 3.1.5).

5.4 *Annealed-To-Temper (O) Material*—The standard tempers of annealed-to-temper material are as designated in Table 5 with the prefix "O". Former designations and the standard designations as defined in Practice B 601 are shown. Special or nonstandard tempers are subject to negotiation between the manufacturer and the purchaser (See 3.1.5).

6. Mechanical Properties

6.1 *Tensile Strength of Rolled Tempers*:

TABLE 3 Grain Size Requirements for Annealed Material

Copper Alloy UNS No.	Standard Temper Designation (B 601)	Grain Size		
		Nominal	Min	Max
C21000	OS050	0.050	0.035	0.090
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C22000	OS050	0.050	0.035	0.090
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C22600	OS050	0.050	0.035	0.090
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C23000	OS070	0.070	0.050	0.100
	OS050	0.050	0.035	0.070
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C24000	OS070	0.070	0.050	0.120
	OS050	0.050	0.035	0.070
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C26000 and C26800	OS120	0.120	0.070	...
	OS070	0.070	0.050	0.120
	OS050	0.050	0.035	0.070
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C27200	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025
C28000	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
	OS015	0.015	[A]	0.025

[A] Although no minimum grain size is required, this material must be fully recrystallized.

TABLE 4 Approximate Rockwell Hardness of Annealed Material

Anneal Temper, Nominal Grain Size	Standard Temper Designation (B 601)	Approximate Rockwell Hardness[A]			
		F Scale		Superficial 30-T	
		Min	Max	Min	Max
UNS No. C21000					
0.050-mm	OS050	40[B]	52[B]	...	4
0.035-mm	OS035	47[B]	54[B]	...	7
0.025-mm	OS025	50[B]	61[B]	1	17
0.015-mm	OS015	54[B]	65[B]	7	23
UNS No. C22000					
0.050-mm	OS050	50	60	1	16
0.035-mm	OS035	54	64	7	21
0.025-mm	OS025	58	70	13	31
0.015-mm	OS015	62	75	19	39
UNS No. C22600					
0.050-mm	OS050	48	58	6	18
0.035-mm	OS035	52	62	10	23
0.025-mm	OS025	55	67	14	29
0.015-mm	OS015	58	76	18	40
UNS No. C23000					
0.070-mm	OS070	53	60	6	...
0.050-mm	OS050	56	63	10	...
0.035-mm	OS035	58	76	13	24
0.025-mm	OS025	60	72	16	34
0.015-mm	OS015	62	79	19	48
UNS No. 24000					
0.070-mm	OS070	53	64	2	21
0.050-mm	OS050	57	67	8	27
0.035-mm	OS035	61	72	16	35
0.025-mm	OS025	63	77	20	42
0.015-mm	OS015	66	83	25	50
UNS Nos. C26000 and C26800					
0.120-mm	OS120	50	62	...	21
0.070-mm	OS070	52	67	3	27
0.050-mm	OS050	61	73	20	35
0.035-mm	OS035	65	76	25	38
0.025-mm	OS025	67	79	27	42
0.015-mm	OS015	72	85	33	50
UNS No. C27200					
0.035-mm	OS035	65	76	25	38
0.025-mm	OS025	67	79	27	42
0.015-mm	OS015	72	85	33	50
UNS No. C28000					
0.035-mm	OS035	65	80	26	44
0.025-mm	OS025	68	83	28	48
0.015-mm	OS015	72	90	30	55

[A] Rockwell hardness values apply as follows: The F scale applies to metal 0.020 in. (0.508 mm) in thickness and over; the 30-T scale applies tometal 0.015 in. (0.381 mm) in thickness and over.

[B] This alloy in these several annealed tempers is too soft for Rockwell F hardness tests below 0.030 in. (0.762 mm) in thickness.

6.1.1 Products ordered to this specification in inch-pound units shall be tested in accordance with Test Methods E 8, and shall conform to tensile strength requirements prescribed in ksi units in Table 2.

6.1.2 Products ordered to this specification in SI units shall be tested in accordance with Test Methods E 8M, and shall conform to tensile strength requirements prescribed in MPa units in Table 2.

6.1.3 Acceptance or rejection based on mechanical properties shall depend only on the tensile strength.

6.1.4 Tension test specimens shall be taken so the longitudinal axis of the specimen is parallel to the direction of rolling.

TABLE 5 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Annealed-to-Tempers

NOTE 1—Required properties for other tempers shall be agreed upon between the manufacturer and the purchaser at the time of placing the order.

Annealed-to-Temper		Tensile Strength, ksi[A]		Tensile Strength, MPa[B]		Approximate Rockwell Hardness[C]			
Temper Designation		Min	Max	Min	Max	B Scale		Superficial 30-T	
Standard	Former					Min	Max	Min	Max
Copper Alloy UNS No. C22000									
O81	Quarter-hard	40	50	275	345	...	45	28	52
Copper Alloy UNS No. C22600									
O81	Quarter-hard	42	52	290	355	20	50	30	54
Copper Alloy UNS No. C23000									
O81	Quarter-hard	44	54	305	370	30	53	35	54
Copper Alloy UNS No. C24000									
O81	Quarter-hard	48	58	330	400	33	53	38	54
Copper Alloy UNS No. C26000									
O81	Quarter-hard	49	59	340	405	32	55	36	53
O82	Half-hard	57	67	395	460	52	72	50	66
Copper Alloy UNS No. C26800									
O81	Quarter-hard	49	59	340	405	33	55	37	55
O82	Half-hard	55	65	380	450	52	72	51	67

[A] ksi = 1000 psi.
[B] MPa (Mega Pascals) See Appendix X1
[C] Rockwell hardness values apply as follows: The B scale applies to metal 0.020 (0.058 mm) in thickness and over; the 30T applies to metal 0.015 in. (0.381 mm) in thickness and over.

6.2 *Tensile Strength of Annealed-to-Tempers*:

6.2.1 Products ordered to this specification in inch-pound units shall be tested in accordance with Test Methods E 8, and shall conform to tensile strength requirements prescribed in ksi units in Table 5.

6.2.2 Products ordered to this specification in SI units shall be tested in accordance with Test Methods E 8M, and shall conform to tensile strength requirements prescribed in MPa units in Table 5.

6.2.3 Acceptance or rejection based on mechanical properties shall depend only on the tensile strength.

6.2.4 Tension test specimens shall be taken so the longitudinal axis of the specimen is parallel to the direction of rolling.

6.3 *Rockwell Hardness*—Since Rockwell hardness tests offer a quick and convenient method of checking brass of any temper for general conformity to the requirements for tensile strength or grain size, the approximate Rockwell hardness values for each temper are given in Table 2, Table 4, and Table 5 for general information and assistance in testing.

7. Grain Size of Annealed Tempers

7.1 Grain size shall be the standard test for material of all thicknesses in annealed tempers, and acceptance or rejection shall depend on the grain sizes. The average grain size of each of two samples of annealed material as determined on a plane parallel to the surface of the material shall be within the limits prescribed in Table 3.

8. Dimensions and Permissible Variations

8.1 The inch-pound dimensions and tolerances for products covered by this specification shall be as prescribed in the current edition of Specification B 248, and the SI dimensions and tolerances covered by this specification shall be as prescribed in the current edition of Specification B 248M, with particular reference to Section 5 and the following tables of those specifications:

8.2 *Thickness*—See 4.2, Table 1.

8.3 *Width*:

8.3.1 *Slit Metal and Slit Metal With Rolled Edges*—See 4.3, Table 4.

8.3.2 *Square-Sheared Metal*—See 5.3, Table 5.

8.3.3 *Sawed Metal*—See 5.3, Table 6.

8.4 *Length*:

8.4.1 *Specific and Stock Lengths With and Without Ends*—See 5.4, Table 7.

8.4.2 *Schedule of Lengths (Specific and Stock) With Ends*—See 5.4, Table 8.

8.4.3 *Length Tolerances for Square-Sheared Metal*—See 5.4, Table 9.

8.4.4 *Length Tolerances for Sawed Metal*—See 5.4, Table 10.

8.5 *Straightness*:

8.5.1 *Slit Metal or Slit Metal Either Straightened or Edge-Rolled*—See 5.5, Table 11.

8.5.2 *Square-Sheared Metal*—See 5.5, Table 12.

8.5.3 *Sawed Metal*—See 5.5, Table 13.

8.6 *Edges*—See 5.6.

8.6.1 *Square Edges*—See 5.6.1, Table 14.

8.6.2 *Rounded Corners*—See 5.6.2, Table 15.

8.6.3 *Rounded Edges*—See 5.6.3, Table 16.

8.6.4 *Full-Rounded Edges*—See 5.6.4, Table 17.

9. General Requirements

9.1 Products furnished under this specification in inch-pound units shall conform to the applicable requirements of the current edition of Specification B 248.

9.2 Products furnished under this specification in the SI units shall conform to the applicable requirements of the current edition of Specification B 248M.

10. Keywords

10.1 brass plate; brass rolled bar; brass sheet; brass strip

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 ($N = kg \cdot m/s^2$). 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.