

Standard Specification for Brass Plate, Sheet, Strip, And Rolled Bar¹

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 establishes the requirements for brass plate, sheet, strip, and rolled bar of the following alloys:²

Copper Alloy UNS No.	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. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from two systems may result in nonconformance with the standard.

2. Referenced Documents

2.1 The following documents in the current issue of Book of Standards form a part of this specification to the extent referenced herein:

2.2 ASTM Standards:

B 248 Specification for Requirements for Wrought Copper and Copper Alloy Plate, Sheet, Strip, and Rolled Bar³

B 248M Specification for Requirements for Wrought Copper and Copper Alloy Plate, Sheet, Strip, and Rolled Bar [Metric]³

B 601 Practice for Temper Designations for Copper and Copper Alloys-Wrought and Cast³

B 846 Standard Terminology for Copper and Copper Alloys³

E 8 Test Methods for Tension Testing of Metallic Materials⁴

E 8M Test Methods for Tension Testing of Metallic Materials [Metric]⁴

E 112 Test Methods for Determining Grain Size⁴

E 478 Test Methods for Chemical Analysis of Copper Alloys⁵

3. General Requirements

3.1 The following sections of Specification B 248 [B 248M] constitute a part of this specification:

3.1.1 Terminology

3.1.2 Materials and Manufacture

3.1.3 Dimensions, Mass, and permissible Variations

3.1.4 Workmanship, Finish, and Appearance

3.1.5 Sampling

3.1.6 Number of tests and Retests

3.1.7 Specimen Preparation

3.1.8 Test Methods

3.1.9 Significance of Numerical Limits

3.1.10 Inspection

3.1.11 Rejection and Rehearing

3.1.12 Certification

3.1.13 Test Reports

3.1.14 Packaging and Package Marking

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 which supplement those appearing in Specification B 248 [B 248M].

4. Terminology

4.1 For definitions of terms related to copper and copper alloys, refer to Terminology B 846.

5. Ordering Information

5.1 Orders for products should include the following information:

5.1.1 ASTM designation and year of issue,

5.1.2 Copper alloy UNS No. designation,

5.1.3 Quantity,

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

¹ This specification is under the jurisdiction of ASTM Committee B05 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 Annual Book of ASTM Standards, Vol 02.01.

⁴ Annual Book of ASTM Standards, Vol 03.01.

⁵ Annual Book of ASTM Standards, Vol 03.06.

- 5.1.5 Temper (Section 7),
- 5.1.6 Dimensions: thickness, width, and length if applicable,
- 5.1.7 Tolerances (Section 10),
- 5.1.8 How furnished: rolls, stock lengths with or without ends, specific lengths with or without ends (Section 10),
- 5.1.9 Type of edge, if required (Section 10),
- 5.1.10 When the product is purchased for agencies of the U.S. Government.
- 5.2 The following options are available and should be specified at the time of placing the order when required:
 - 5.2.1 Heat identification or traceability details,
 - 5.2.2 Certification,
 - 5.2.3 Mill test report,
 - 5.2.4 Special tests or exceptions, if any.
 - 5.2.5 Supplemental requirements for agencies of the U.S. Government as given in Specification B 248 [B 248M].

6. Chemical Composition

- 6.1 The material shall conform to the chemical compositional requirements in Table 1 for the copper alloy UNS No. designation specified in the ordering information.
- 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 and purchaser.
- 6.3 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, the sum of the results 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

7. Temper

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

7.2 *Rolled (H)*—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.

7.3 *Annealed (OS)*—The standard tempers of annealed material are as designated in Tables 3 and 4. Nominal grain size and the standard designations are defined in Practice B 601 are shown.

7.4 *Annealed-To-Temper (O)*—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.

7.5 Special or nonstandard tempers are subject to negotiation between the manufacturer and purchaser (See 5.1.5).

8. Grain Size

8.1 Grain size shall be standard requirement for all products of the annealed (OS) tempers.

8.2 Acceptance or rejection based upon grain size shall depend only on the average grain size of the test specimens and shall be within the limits prescribed in Table 3 when determined in accordance with Test Methods E 112.

8.3 The average grain size shall be determined on a plane parallel to the surface of the product.

9. Mechanical Properties

9.1 Tensile Strength Requirements of Rolled Tempers

9.1.1 Product furnished under this specification shall conform to the tensile strength requirements prescribed in Table 2 when tested in accordance with Test Methods E 8 [E 8M]. The test specimens shall be taken so the longitudinal axis of the specimen is parallel to the direction of rolling.

9.1.2 Acceptance or rejection based upon mechanical properties shall depend only on tensile strength.

9.2 Tensile Strength Requirements of Annealed-to-Temper

9.2.1 Product furnished under this specification shall conform to the tensile strength requirements prescribed in Table 5 when tested in accordance with Test Methods E 8 [E 8M]. The test specimens shall be taken so the longitudinal axis of the specimen is parallel to the direction of rolling.

9.2.2 Acceptance or rejection based upon mechanical properties shall depend only on tensile strength.

9.3 Rockwell Hardness

TABLE 1 Chemical Requirements

Copper Alloy UNS No.	Copper, %	Lead, max, %	Iron, max, %	Zinc
C21000	94.0 to 96.0	0.03	0.05	remainder
C22000	89.0 to 91.0	0.05	0.05	remainder
C22600	86.0 to 89.0	0.05	0.05	remainder
C23000	84.0 to 86.0	0.05	0.05	remainder
C24000	78.5 to 81.5	0.05	0.05	remainder
C26000	68.5 to 71.5	0.07	0.05	remainder
0.26800 ^A	64.0 to 68.5	0.15	0.05	remainder
C27200 ^B	62.0 to 65.0	0.07	0.07	remainder
C28000 ^C	59.0 to 63.0	0.30	0.07	remainder

^AMaterial shall be free from beta constituent when examined at a magnification of 75 diameters.

^BSmall 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.

^CIt is anticipated that this material will contain the beta constituent that may interfere with severe forming or drawing operations.

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TABLE 2 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Rolled Temper (H) Product

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 [MPa ^A]		Approximate Rockwell Hardness ^B							
Temper Designation		Min	Max	B Scale				Superficial 30-T			
Standard	Former			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 [220]	42 [290]	...	...	...	...	...	...	...	...
H01	Quarter hard	37 [255]	47 [325]	20	48	24	52	34	51	37	54
H02	Half-hard	42 [290]	52 [355]	40	56	44	60	46	57	48	59
H03	Three-quarter-hard	46 [315]	56 [385]	50	61	53	64	52	60	54	62
H04	Hard	50 [345]	59 [405]	57	64	60	67	57	62	59	64
H06	Extra hard	56 [385]	64 [440]	64	70	66	72	62	66	63	67
H08	Spring	60 [415]	68 [470]	68	73	70	75	64	68	65	69
H10	Extra spring	61 [420]	69 [475]	69	74	71	76	65	69	66	70
Copper Alloy UNS No. C22000											
M20	As hot-rolled	33 [230]	43 [295]	...	...	...	...	...	...	...	...
H01	Quarter-hard	40 [275]	50 [345]	27	52	31	56	34	51	37	54
H02	Half-hard	47 [325]	57 [395]	50	63	53	66	50	59	52	61
H03	Three-quarter-hard	52 [355]	62 [425]	59	68	62	71	55	62	58	64
H04	Hard	57 [395]	66 [455]	65	72	68	75	60	65	62	67
H06	Extra hard	64 [440]	72 [495]	72	77	74	79	64	68	66	69
H08	Spring	69 [475]	77 [530]	76	79	78	81	67	69	68	70
H10	Extra spring	72 [495]	80 [550]	78	81	80	83	68	70	69	71
Copper Alloy UNS No. C22600											
H01	Quarter-hard	42 [290]	52 [355]	29	58	29	58	39	58	39	58
H02	Half-hard	48 [330]	58 [400]	52	68	52	68	54	64	54	64
H03	Three-quarter-hard	53 [365]	63 [435]	61	73	61	73	59	68	59	68
H04	Hard	58 [400]	67 [460]	67	77	67	77	64	70	64	70
H06	Extra hard	65 [450]	73 [505]	74	81	74	81	68	73	68	73
H08	Spring	70 [485]	78 [540]	78	83	78	83	71	74	71	74
H10	Extra spring	74 [510]	82 [565]	81	86	81	86	73	76	73	76
Copper Alloy UNS No. C23000											
M20	As hot-rolled	37 [255]	47 [325]	...	...	...	...	...	...	...	...
H01	Quarter-hard	44 [305]	54 [370]	33	58	37	62	42	57	45	60
H02	Half-hard	51 [350]	61 [420]	56	68	59	71	56	64	58	66
H03	Three-quarter-hard	57 [395]	67 [460]	66	73	69	76	63	68	65	70
H04	Hard	63 [435]	72 [495]	72	78	74	80	67	71	68	72
H06	Extra hard	72 [495]	80 [550]	78	83	80	85	70	74	71	75
H08	Spring	78 [540]	86 [595]	82	85	84	87	74	76	75	77
H10	Extra spring	82 [565]	90 [620]	84	87	86	89	75	77	76	78
Copper Alloy UNS No. C24000											
M20	As hot-rolled	41 [285]	51 [350]	...	...	...	...	...	...	...	...
H01	Quarter-hard	48 [330]	58 [400]	38	61	42	65	42	57	45	60
H02	Half-hard	55 [380]	65 [450]	59	70	62	73	56	64	58	66
H03	Three-quarter-hard	61 [420]	71 [490]	69	76	72	79	63	68	65	70
H04	Hard	68 [470]	77 [530]	76	82	78	84	68	72	69	73
H06	Extra hard	78 [540]	87 [600]	83	87	85	89	72	75	73	76
H08	Spring	85 [585]	93 [640]	87	90	89	92	75	77	76	78
H10	Extra spring	89 [615]	97 [670]	88	91	90	93	76	78	77	79
Copper Alloy UNS No. C26000											
M20	As hot-rolled	41 [285]	51 [350]	...	...	...	...	...	...	...	...
H01	Quarter-hard	49 [340]	59 [405]	40	61	44	65	43	57	46	60
H02	Half-hard	57 [395]	67 [460]	60	74	63	77	56	66	58	68
H03	Three-quarter-hard	64 [440]	74 [510]	72	79	75	82	65	70	67	72
H04	Hard	71 [490]	81 [560]	79	84	81	86	70	73	71	74
H06	Extra hard	83 [570]	92 [635]	85	89	87	91	74	76	75	77
H08	Spring	91 [625]	100 [690]	89	92	90	93	76	78	76	78
H10	Extra spring	95 [655]	104 [715]	91	94	92	95	77	79	77	79
Copper Alloy UNS No. C26800											
M20	As hot-rolled	40 [275]	50 [345]	...	...	...	...	...	...	...	...
H01	Quarter-hard	49 [340]	59 [405]	40	61	44	65	43	57	46	60
H02	Half-hard	55 [380]	65 [450]	57	71	60	74	54	64	56	66

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TABLE 2 *Continued*

Rolled Temper		Tensile Strength, ksi [MPa ^A]		Approximate Rockwell Hardness ^B							
Temper Designation		Min	Max	B Scale				Superficial 30-T			
Standard	Former			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
H03	Three-quarter-hard	62 [425]	72 [495]	70	77	73	80	65	69	67	71
H04	Hard	68 [470]	78 [540]	76	82	78	84	68	72	69	73
H06	Extra-hard	79 [545]	89 [615]	83	87	85	89	73	75	74	76
H08	Spring	86 [595]	95 [655]	87	90	89	92	75	77	76	78
H10	Extra spring	90 [620]	99 [685]	88	91	90	93	76	78	77	79
Copper Alloy UNS No. C27200											
M20	As hot-rolled	41 [285]	51 [350]	...	...	...	...	...	...	...	...
H01	Quarter-hard	49 [340]	59 [405]	40	61	44	65	43	57	46	60
H02	Half-hard	56 [385]	66 [455]	57	74	60	76	54	67	56	68
H03	Three-quarter-hard	63 [435]	73 [505]	71	78	74	81	64	70	66	71
H04	Hard	70 [485]	80 [550]	76	82	78	84	67	72	68	73
H06	Extra hard	81 [560]	91 [625]	82	87	85	89	71	75	72	76
Copper Alloy UNS No. C28000											
M20	As hot-rolled	40 [275]	55 [380]	...	...	...	...	...	...	...	...
H01	Quarter-hard	50 [345]	62 [425]	40	65	45	70	45	65	45	70
H02	Half-hard	58 [400]	70 [485]	50	75	52	80	50	70	50	75
H03	Three-quarter-hard	60 [415]	75 [515]	55	80	55	82	52	78	55	80
H04	Hard	70 [485]	85 [585]	60	85	60	87	55	80	55	82
H06	Extra hard	82 [565]	95 [655]	65	92	65	90	60	85	60	85

^AMPa (Mega Pascals) See Appendix X1.

^BRockwell 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.

9.3.1 The approximate Rockwell hardness values given in Table 2, Table 4, and Table 5 are for general information and assistance in testing and shall not be used as a basis for product rejection.

NOTE 1—The Rockwell hardness test offers a quick and convenient method of checking for general conformity to the specification requirements for temper, tensile strength and grain size.

10. Dimensions and Permissible Variations

10.1 The dimensions and tolerances for product described by this specification shall be as specified in Specification B 248 [B 248M] with particular reference to the following related paragraphs in that specification.

10.1.1 *Thickness.*

10.1.2 *Width:*

10.1.2.1 *Slit Metal and Slit Metal With Rolled Edges.*

10.1.2.2 *Squared-Sheared Metal.*

10.1.2.3 *Sawed Metal.*

10.1.3 *Length:*

10.1.3.1 *Specific and Stock Lengths With and Without Ends.*

10.1.3.2 *Schedule of Lengths (Specific and Stock) With Ends.*

10.1.3.3 *Length Tolerances for Square-Sheared Metal.*

10.1.3.4 *Length Tolerances for Sawed Metal.*

10.1.4 *Straightness:*

10.1.4.1 *Slit Metal or Slit Metal Either Straightened or Edge-Rolled.*

10.1.4.2 *Squared-sheared Metal.*

10.1.4.3 *Sawed metal.*

10.1.5 *Edges:*

10.1.5.1 *Square Edges.*

10.1.5.2 *Rounded Corners.*

10.1.5.3 *Rounded Edges.*

10.1.5.4 *Full-Rounded Edges.*

11. Test Methods

11.1 *Chemical Analysis:*

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

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

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

12. Keywords

12.1 brass plate; brass rolled bar; brass sheet; brass strip

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TABLE 3 Grain Size Requirements for Annealed (OS) Product

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
C27200	OS015	0.015	^A	0.025
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035
C28000	OS015	0.015	^A	0.025
	OS035	0.035	0.025	0.050
	OS025	0.025	0.015	0.035

^AAlthough no minimum grain size is required, this material must be fully recrystallized.

TABLE 4 Approximate Rockwell Hardness of Annealed (OS) Product

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

^ARockwell 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 to metal 0.015 in. (0.382 mm) in thickness and over.

^BThis alloy in these several annealed tempers is too soft for Rockwell F hardness tests below 0.030 in. (0.762 mm) in thickness.

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TABLE 5 Tensile Strength Requirements and Approximate Rockwell Hardness Values for Annealed-to-Temper (O) Product

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

^AMPa (Mega Pascals) See Appendix X1

^BRockwell 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.

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 $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$ the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2 .