

WROUGHT COPPER AND COPPER ALLOYS

1. Scope—This standard¹ describes the chemical, mechanical, and dimensional requirements for a wide range of wrought copper and copper alloys used in the automotive and related industries.

1.1 Wrought forms covered by this standard include sheet, strip, bar, plate, rod, wire, tube, and shapes; however, form required must be specified by purchaser.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein.

2.1.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B248—Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar

ASTM B249—Specification for General Requirements for Wrought Copper and Copper-Alloy Rod, Bar, and Shapes

ASTM B250—Specification for General Requirements for Wrought Copper-Alloy Wire

ASTM B251—Specification for General Requirements for Wrought Copper-Alloy Wire

3. Chemical and Mechanical Properties—The chemical composition of products identified by the UNS designations shall conform to the limits shown in Table 1. Mechanical properties shall conform to limits shown in Table 2A (metric(si) units) or 2B (customary units).

3.1 Products shall be of uniform quality and free from defects (such as desegregation, pipes, nonmetallic inclusions, cracks, seams, laps, buckles, and die or roll marks) detrimental to their appearance, fabrication and/or performance in service.

3.2 Both inside and outside surfaces of tubing shall be clean and smooth.

3.3 Forgings shall not be brazed, soldered, welded, or ground to hide defects or to salvage defective products, unless specifically approved by the purchaser.

1. If none of the alloys listed herein include the characteristics required for a particular application, users are encouraged to consider alloy specifications listed in CDA Publication "Standards Handbook for Copper Alloy Wrought Mill Products," published by the Copper Development Association, 405 Lexington Avenue, New York, NY 10017, before creating specifications of their own.

- 3.4 Necessary brazes in soft annealed copper wire shall be in accordance with best commercial practice.
4. **Testing**—Unless otherwise specified all properties stated herein are based on latest methods of test published in the ASTM Standards.
5. **Dimensional Tolerances**—Standard forms of products identified by the UNS designations shall conform to the dimensions specified by the purchaser, within the tolerance limits shown in Tables 4 - 11, the “key” for which is Table 3, “Index to Standard Product Tolerance Tables.” Specified dimensions not covered by these tables shall be within the tolerance limits shown in ASTM B248 (plate, sheet, strip, and rolled bar), ATM B249 (rod, bar, and shapes), ASTM B250 (wire), and ASTM B251 (pipe and tube). (Note: the terms “refractory” and “nonrefractory” used in Table 3 are common in the copper industry, the first applying to alloys which, because of their hardness on abrasiveness, require dimensional tolerances greater than those established for nonrefractory alloys.)

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TABLE 1—CHEMICAL COMPOSITIONS OF WROUGHT COPPER ALLOYS^a

Copper Alloy UNS No. ^b	% by Weight, Maximum (Except where otherwise noted)											Other Named Elements
	Cu	Fe	Zn	Pb	Sn	Mn	Ni	Al	Si	P	Be	
C10200 ^c	99.9 min	—	—	—	—	—	—	—	—	—	—	—
C11000 ^c	99.9 min	—	—	—	—	—	—	—	—	—	—	—
C11100 ^c	99.9 min	—	—	—	—	—	—	—	—	—	—	See Note d
C11300 ^{c,e}	99.9 min ^f	—	—	—	—	—	—	—	—	—	—	Ag, .027 min (8) ^g
C11400 ^{c,e}	99.9 min ^f	—	—	—	—	—	—	—	—	—	—	Ag, .034 min (10) ^g
C11500 ^{c,e}	99.9 min ^f	—	—	—	—	—	—	—	—	—	—	Ag, .054 min (16) ^g
C11600 ^{c,e}	99.9 min ^f	—	—	—	—	—	—	—	—	—	—	Ag, .085 min (25) ^g
C12000	99.9 min	—	—	—	—	—	—	—	—	.004–.012	—	—
C12200 ^h	99.9 min	—	—	—	—	—	—	—	—	.015–.040	—	—
C14500 ⁱ	99.9 min ^j	—	—	—	—	—	—	—	—	.004–.012 ^k	—	Te, .40–.60
C14700	99.9 min ^j	—	—	—	—	—	—	—	—	—	—	S, .2–.5
C15000	99.8 min	—	—	—	—	—	—	—	—	—	—	Zr, .10–.20
C16200	99.8 min	.02	—	—	—	—	—	—	—	—	—	Cd, .7–1.2
C17000	99.5 min ^m	Note n	—	—	—	—	Note n	—	—	—	1.6–1.8	Co ⁿ
C17200	99.5 min ^m	Note n	—	—	—	—	Note n	—	—	—	1.8–2.0	Co ⁿ
C17500	99.5 min ^m	.10	—	—	—	—	—	—	—	—	.40–.70	Co, 2.4–2.7
C17600	99.5 min ^m	—	—	—	—	—	—	—	—	—	.25–.50	Co, 1.4–1.7 Ag, .9–1.1
C18400	99.8 min ^o	.15	.70	—	—	—	—	—	.10	.05	—	As, .005 Cr, .40–1.2 U, .05 Ca, .005
C18700	99.9 min ^o	—	—	.8–1.5	—	—	—	—	—	—	—	—
C19200	98.7 min	.8–1.2	—	—	—	—	—	—	—	.01–.04	—	—
C21000	94.0–96.0	.05	rem	.05	—	—	—	—	—	—	—	—
C22000	89.0–91.0	.05	rem	.05	—	—	—	—	—	—	—	—
C23000	84.0–86.0 ^p	.05	rem	.05 ^p	—	—	—	—	—	—	—	—
C24000	78.5–81.5	.05	rem	.05	—	—	—	—	—	—	—	—
C26000	68.5–71.5	.05	rem	.07	—	—	—	—	—	—	—	—
C26800	64.0–68.5	.05	rem	.15	—	—	—	—	—	—	—	—
C27000	63.0–68.5	.07	rem	.10	—	—	—	—	—	—	—	—
C33000	65.0–68.0	.07	rem	.20–.8 ^q	—	—	—	—	—	—	—	—
C33100	65.0–68.0	.06	rem	.70–1.2	—	—	—	—	—	—	—	—
C34200	62.5–66.5	.10	rem	1.5–2.5	—	—	—	—	—	—	—	—
C34500	62.0–64.0	.10	rem	1.5–2.8	—	—	—	—	—	—	—	—
C35000	59.0–64.0 ^r	.10	rem	.8–1.4	—	—	—	—	—	—	—	—
C36000	60.0–63.0	.35	rem	2.5–3.7	—	—	—	—	—	—	—	—
C37700	58.0–62.0	.30	rem	1.5–2.5	—	—	—	—	—	—	—	—
C46400	59.0–62.0	.10	rem	.20	.50–1.0	—	—	—	—	—	—	—
C46500	59.0–62.0	.10	rem	.20	.50–1.0	—	—	—	—	—	—	As, .02–.10

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ed. TABLE 1—CHEMICAL COMPOSITIONS OF WROUGHT COPPER ALLOYS^a (CONTINUED)

Copper Alloy UNS No. ^b	% by Weight, Maximum (Except where otherwise noted)											
	Cu	Fe	Zn	Pb	Sn	Mn	Ni (incl. Co)	Al	Si	P	Be	Other Named Elements
C46600	59.0–62.0	.10	rem	.20	.50–1.0	—	—	—	—	—	—	Sb, .02–.10
C46700	59.0–62.0	.10	rem	.20	.50–1.0	—	—	—	—	0.2–.10	—	—
C51000	99.5 min ^a	.10	.30	.05	4.2–5.8	—	—	—	—	.03–.35	—	—
C51100	99.5 min ^a	.10	.30	.05	3.5–4.9	—	—	—	—	.03–.35	—	—
C52100	99.5 min ^a	.10	.20	.05	7.0–9.0	—	—	—	—	.03–.35	—	—
C52400	99.5 min ^a	.10	.20	.05	9.0–11.0	—	—	—	—	.03–.35	—	—
C54400	99.5 min ^a	.10	1.5–4.5	3.5–4.5	3.5–4.5	—	—	—	—	.01–.50	—	—
C60800	88.8–92.5 ^f	.10	—	.10	—	—	—	5.0–6.5	—	—	—	As, .2–.35
C61300	88.5–91.5 ^f	2.0–3.0	.05	.01	—	.15	—	6.0–7.5	—	.015	—	See Note v
C61400	88.0–92.5 ^f	1.5–3.5	.20	.10	—	1.0	—	6.0–8.0	—	.015	—	—
C61800	86.9–91.0 ^f	.50–1.5	.02	.02	—	—	—	8.5–11.0	.10	—	—	—
C62300	82.2–89.5 ^f	2.0–4.0	—	—	.60	.50	1.0	8.5–11.0	.25	—	—	—
C62400	82.8–88.0 ^f	2.0–4.5	—	—	.20	.30	—	10.0–11.5	.25	—	—	—
C63000	78.0–85.0 ^f	2.0–4.0	.30	—	.20	1.5	4.0–5.5	9.0–11.0	.25	—	—	—
C64200	88.2–92.2 ^f	.30	.50	.05	.20	.10	.25	6.3–7.6	1.5–2.2	—	—	As, .15
C65500	rem ^f	.8	1.5	.05	—	.50–1.3	.60	—	2.8–3.8	—	—	—
C67000	63.0–68.0	2.0–4.0	rem	.20	.50	2.5–5.0	—	3.0–6.0	—	—	—	—
C67300	58.0–63.0	.50	rem	.4–3.0	.30	2.0–3.5	.25	.25	.50–1.5	—	—	—
C67400	57.0–60.0	.35	rem	.50	.30	2.0–3.5	.25	.50–2.0	.50–1.5	—	—	—
C67500	57.0–60.0	.8–2.0	rem	.20	.50–1.5	.05–.50	—	.25	—	—	—	—
C70600	99.5 min ^a	1.0–1.8	1.0 ^a	.05 ^a	—	1.0	9.0–11.0	—	—	—	—	See Note u
C71000	99.5 min ^a	1.0	1.0	.05	—	1.0	19.0–23.0	—	—	—	—	—
C71500	99.5 min ^a	.40–.70	1.0 ^a	.05 ^a	—	1.0	29.0–33.0	—	—	—	—	See Note u
C75200	63.0–68.5	.25	rem	.10	—	.50	16.5–19.5	—	—	—	—	—
C77000	53.5–56.5	.25	rem	.10	—	.50	16.5–19.5	—	—	—	—	—

^a These specification limits do not preclude the possible presence of other unnamed elements. However, analysis shall regularly be made only for the minor elements listed in the table, plus all major elements except one. The major element which is not analyzed shall be determined by difference between the sum of those elements analyzed and 100%. By agreement between manufacturer and purchaser, analysis may be required and limits established for elements not specified.

^b Unified Numbering System. For cross reference to SAE, Former SAE, ASTM, and Former Trade Names, see SAE J461.

^c These are high conductivity coppers which have in the annealed condition a minimum conductivity of 100% IACS.

^d Small amounts of Cd or other elements may be added by agreement to improve resistance to softening at elevated temperatures.

^e This includes Low Resistance Lake Copper and Electrolytic Copper.

^f This includes Cu + Ag.

^g Figures in parentheses are troy ounces per avoirdupois ton.

^h This includes Oxygen-Free Copper which contains P in an amount agreed upon.

ⁱ This includes Oxygen-Free Tellurium Bearing Copper which contains P in an amount agreed upon.

^j This includes Cu + Ag + Te.

^k Other deoxidizers may be used as agreed upon, in which case P need not be present.

^l This includes Cu + Ag + S.

^m The value of Cu is exclusive of Ag.

ⁿ Ni + Co, 0.20% min.

^o Ni + Fe, + Co, 0.6% max.

^p This includes copper plus elements with specified limits. Copper alloy UNS Nos. C70600 ed. (CA706), Cu + Ag, 86.5% min and C71500 (CA715), Cu + Ag, 65% min. Specific limits are defined as any numerical values, whether maximum only, minimum only or ranges.

^q For pipe and tube, the Cu limit may be 83.0% minimum and the Pb 0.06% max.

^r For tube over 5 in O.D., the Pb may be less than 0.20%.

^s Copper 61.0% min for rod.

^t This includes Cu + Sn + P.

^u This includes Cu + Sn + P + Pb + Zn.

^v When the product is for welding applications and so specified by the purchaser, Zn shall be 0.50% max, Pb 0.02% max, P 0.02% max, S 0.02% max, and C 0.05% max.

^w When the product is for welding applications and so specified by the purchaser, Cr, Cd, ed. and Zr shall each be 0.05% max.

ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS

Metric (SI) Units														
Copper or Copper Alloy UNS No. ^{1,2}	Form	Temper	Size Section, mm		Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ³	Hardness				Grain Size, mm	
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max	
C10200 C11000 C11100 C11300 C11400 C11500 C11600 C12000 C12200	Plate, Sheet, Strip, and Rolled Bar	Soft Anneal	—	—	—	—	—	—	RF ^b		R30T ^b		Note a	—
		—	—	65	—	—	—	—	—					
		Deep-Draw- ing Anneal	—	—	—	—	—	30	75	—	—	Note a	0.050	
		Light Cold Rolled	—	220	275	—	—	40	82	—	49	—	—	
		1/2 Hard ⁴ Hard ⁴	—	225 285	315 360	—	—	77 86	80 93	43 54	57 62	—	—	
		Spring ⁴ Extra Spring ⁴	—	345 360	400 —	—	—	91 92	97 —	60 61	66 —	—	—	
		Hot Rolled Hot Rolled and Annealed	—	205 205	260 260	—	—	—	75 65	—	41 31	—	—	
C10200 C11000 C12000 C12200	Rod, Bar and Shapes	Soft Anneal	All Sizes ¹¹		Type B Mat ^{1a}		—	Type B ^{6a}	Type A ^{7a}		—	—	—	—
		—	—	255	—	25	—	65	—	—	—	—		
		Hard	—/6.5 ⁸	345	—	—	—	68	95	—	—	—	—	
			6.5/9.5 ⁸	310	—	—	—	68	95	—	—	—	—	
			9.5/25 ⁸	275	—	—	—	68	95	—	—	—	—	
			25/50 ⁸	240	—	—	—	68	95	—	—	—	—	
			50/75 ⁸	230	—	—	—	68	95	—	—	—	—	
			4.8/9.5 ⁸	290	—	—	—	68	95	—	—	—	—	
			9.5/13 ⁸	275	—	—	—	68	95	—	—	—	—	
			13/50 ⁸	230	—	—	—	68	95	—	—	—	—	
			50/100 ⁸	220	—	—	—	68	95	—	—	—	—	
			All Sizes ⁹	220	—	—	—	—	—	—	—	—	—	
		C10200 C12000 C12200	Tube	Soft Anneal	OD	Wall	—	—	In 50 mm	—	—	R15T ^d		0.040 0.040
All Sizes	0.4/0.9			—	—	40 ^a	—	50 ^d	—	60				
Light Anneal	All Sizes			0.4/0.9	—	—	—	—	55 ^d	—	65	—	0.040 0.040	
Light Drawn Drawn Hard Drawn	All Sizes			All Sizes	250	325	—	—	—	—	R30T ^d		—	—
	All Sizes	All Sizes	250	—	—	—	—	—	30	60				
	—/25	0.5/3.0	310	—	—	—	—	—	55	—				
	25/50	0.4/4.5	310	—	—	—	—	—	55	—				
	50/100	1.5/6.5	310	—	—	—	—	—	55	—				
C10200 C11000	Wire	Annealed	Size Section, mm		—	—	—	In 250 mm	RF ^b	R30T ^b		—	—	
			Over/Thru							—	—			
0.08/0.25	—	—	—	15	—	—	—	—	—					
0.25/0.50	—	—	—	20	—	—	—	—	—					
0.50/2.5	—	—	—	25	—	—	—	—	—					
2.5/7.5	—	—	—	30	—	—	—	—	—					
7.5/12	—	—	—	35	—	—	—	—	—					
C14500	Rod	1/2 Hard ⁴	1.6/6.5	260	—	205	—	In 4 × Dia	—	—	—	—	—	
		6.5/65	260	—	205	—	8	—	—	—	—	—		
		—	—	—	—	—	12	—	—	—	—	—		
C14700	Rod	Hard	1.6/6.5	330	—	275	—	4	—	—	—	—	—	
		6.5/30	305	—	260	—	8	—	—	—	—	—		
		30/50	275	—	240	—	8	—	—	—	—	—		
C14700	Rod	1/2 Hard ⁴	1.6/6.5	—	—	205	—	8	—	—	—	—	—	
		6.5/65	—	—	205	—	12	—	—	—	—	—	—	
C15000	Round Rod	Hard ⁴	1.6/6.5	—	—	275	—	4	—	—	—	—	—	
		6.5/30	—	—	260	—	8	—	—	—	—	—	—	
		30/50	—	—	240	—	8	—	—	—	—	—	—	

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TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units													
Copper or Copper Alloy JNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm	
				Min	Max			0.5% Ext Under Load	in 50 mm	Min	Max	Min	Max
			Over/Thru	Type B Matl ^a		Min	Max			Min	Max	Min	Max
C16200	Round Rod	Drawn	—/25 25/50 50/75	Type B Matl ^a		— — —	20 25 25	RB ^b		R30T ^b		— — —	— — —
				415 380 345	— — —			65 60 55	— — —	— — —	— — —		
				—/25 25/—	415 345			— —	— —	20 20	55 50		
	Square, Rectangular and Hex Rod and Bar	Drawn	—/25 25/—	415 345	— —	— —	20 20	55 50	— —	— —	— —	— —	— —
Forging	As Forged	—/25 25/—	415 345	— —	— —	20 25	55 55	— —	— —	— —	— —	— —	
C17000	Strip	A Soft ¹	All Sizes	415	540	— — —	35	RB ^b		R30T ^b		17	—
				—	35			45	78	46	67		
				—	35			45	78	46	67		
		1/4 Hard ¹ 1/2 Hard ¹ Hard ¹	All Sizes All Sizes All Sizes	515 585 690	605 690 825	— — —	10 5 2	68 88 96	90 96 102	62 74 79	75 79 83	16 15 15	— — —
				—	—			—	—	—	—		
				—	—			—	—	—	—		
		AT ² 1/4 HT ² 1/2 HT ² HT ²	All Sizes All Sizes All Sizes All Sizes	1035 1100 1170 1240	— — — —	885 930 1000 1070	3 2.5 1 1	RC ^b		R30N ^b		22 22 22 22	3 2 2 2
				33 35 37 39	— — — —			53 55 56 59	— — — —				
				—	—			—	—	—	—		
		AM ³	All Sizes	690	795	485 min 655 max	18	18	23	37	44	23	—
		1/4 HM ⁴	All Sizes	760	860	550 min 725 max	15	21	26	42	47	23	—
		1/2 HM ⁴	All Sizes	830	930	655 min 795 max	12	25	30	46	50	24	—
		HM ⁴	All Sizes	930	1030	760 min 930 max	9	30	35	50	55	25	—
XHM ⁴	All Sizes	1100	1200	930 min 1100 max	2	32	36	52	56	24	—		
C17200	Strip	A (Soft) ¹	All Sizes	415	535	—	35	RB ^b		R30T ^b		17	—
				—	35			45	78	46	67		
				—	35			45	78	46	67		
		1/4 Hard ¹ 1/2 Hard ¹ Hard ¹	All Sizes All Sizes All Sizes	515 585 690	605 690 825	— — —	10 5 2	68 88 96	90 96 102	62 74 79	75 79 83	16 15 15	— — —
				—	—			—	—	—	—		
				—	—			—	—	—	—		
		AT ²	All Sizes	1140	1350	—	—	RC ^b		R30N ^b		22	3
				36	—			56	—				
				—	—			—	—	—	—		
		1/4 Hard ² 1/2 Hard ² HT ²	All Sizes All Sizes All Sizes	1200 1770 1310	1410 1480 1520	— — —	— — —	38 39 40	— — —	58 59 60	— — —	22 22 22	2 2 2
				—	—			—	—	—	—		
				—	—			—	—	—	—		
		Rod and Bar	A (Soft) ¹	All Sizes	415	585	—	—	RB ^b		R30T ^b		17
—	—				45	85			—	—			
—	—				—	—			—	—			
—	—				—	—			—	—			
—	—				—	—			—	—			
Hard ¹	—/9.5 9.5/25 25/—	655 620 585	895 825 795	— — —	— — —	92 91 88	103 102 104	— — —	— — —	15 15 15	— — —		
		—	—			—	—	—	—				
		—	—			—	—	—	—				
		—	—			—	—	—	—				
AT ²	All Sizes	1140	1310	—	—	RC ^b		R30N ^b		22	3		
		36	40			—	—						
		—	—			—	—	—	—				
HT ²	—/9.5 9.5/25 25/—	1280 1240 1200	1480 1450 1410	— — —	— — —	39 38 37	45 44 43	— — —	— — —	22 22 22	3 2 2		
		—	—			—	—	—	—				
		—	—			—	—	—	—				

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units													
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Elec Cond, %IACS Min	Heat Treat h at 315°C ^d
				Over/Thru	Min	Max		0.2% Offset	In 50 mm	Min	Max		
C17500	Strip and Plate	A (Soft) ^f	All Sizes	—	380	140 min 205 max	20	RB ^{e,g}		R30T ^{e,g}		20	—
		1/2 Hard ^f	All Sizes	415	515	345 min 485 max	5	65	76	60	67	25	—
		Hard ^f	All Sizes	485	585	415 min 550 max	2	78	88	69	75	25	—
		AT ^g	All Sizes	690	825	550 min 690 max	8	92	100	77	82	45	—
		1/2 HT ^g HT ^g	All Sizes	760	895	655 min 825 max	5	95	102	79	83	48	—
	Hot Worked Sizes, Forgings	A (Soft) ^f	All Sizes	—	380	140 min 205 max	20	20	45	—	—	20	—
		AT ^g	All Sizes	690	825	550 min 690 max	10	92	100	—	—	45	—
C17500 C17600	Rod, Bar Shapes and Tubing	A (Soft) ^f	All Sizes	240	380	140 min 205 max	20	25	45	—	—	20	—
		1/2 Hard	All Sizes	450	585	380 min 515 max	10	60	75	—	—	20	—
		AT ^g	All Sizes	690	825	550 min 690 max	10	92	100	—	—	45	—
		1/2 HT ^g	All Sizes	760	895	690 min 825 max	8	92	102	—	—	48	—
C18400	Rod (Round Only)	Drawn	—/25 25/50 50/75	450	—	—	15	75	—	—	—	—	—
				415	—	—	15	70	—	—	—	—	—
	380			—	—	15	65	—	—	—	—	—	
	Rod (Hexagonal) and Bar	Drawn	—/25 25/—	450	—	—	15	70	—	—	—	—	—
				380	—	—	15	65	—	—	—	—	—
	Forgings	As Forged	—/25 25/50 50/—	450 380 380	— — —	— — —	15 15 15	72 70 65	— — —	— — —	— — —	— — —	— — —
C18700	Rod	1/2 Hard ^f	1.6/6.5 6.5/65	260 260	— —	205 205	8 12	— —	— —	— —	— —	— —	— —
		Hard	1.6/6.5 6.5/30 30/50	330 305 275	— — —	275 260 240	4 8 8	— — —	— — —	— — —	— — —	— — —	
C19200	Tube	A (Soft) Light Drawn	All Sizes All Sizes	260 275	— —	80 240	— —	— —	— —	— —	— —	— —	— —
C21000	Plate, Sheet, Strip and Rolled Bar ¹	Annealed	0.050 mm 0.035 mm 0.025 mm 0.015 mm	—	—	—	—	RF ^b		—	—	—	—
				—	—	—	—	40	52	—	4	0.035	0.090
				—	—	—	—	47	54	—	7	0.025	0.050
				—	—	—	—	50	61	1	17	0.015	0.035
		1/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	255	325	—	—	—	—	—	—	—	—

(Table continued on next page)

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units													
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm	
			Over/Thru	Min	Max	0.5% Ext Under Load	In 50 mm	Min	Max	Min	Max	Min	Max
C21000	Plate, Sheet, Strip and Rolled Bar ^d	1/2 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	290	360	—	—	RB ^b		R30T ^b		—	—
								.40 44 —	56 60 —	— 46 48	— 57 59	— — —	
		3/4 Hard	0.50/0.90 0.90/—	315	385	—	—	50 53	61 64	— —	— —	— —	
		3/4 Hard	0.30/0.70 0.70/—	315	385	—	In 4 × Dia or Thickness of Specimen	—	—	52 54	60 62	— —	
		Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	345	405	—	—	57 60 —	64 67 —	— 57 59	— 62 64	— — —	
		Extra Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	385	440	—	—	64 66 —	70 72 —	— 62 63	— 66 67	— — —	
		Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—	415	470	—	—	68 70 —	73 75 —	— 64 65	— 68 69	— — —	
		Extra Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—	420	475	—	—	69 71 —	74 76 —	— 65 66	— 69 70	— — —	
C22000	Plate, Sheet, Strip and Rolled Bar ^d	Annealed	—	—	—	—	—	RB ^b				0.035	0.090
		0.050 mm	—	—	—	—	—	50	60	1	16	0.025	0.050
		0.035 mm	—	—	—	—	—	54	64	7	21	0.015	0.035
		0.025 mm	—	—	—	—	—	58	70	13	31	Note 1	0.025
		0.015 mm	—	—	—	—	—	62	75	19	39		
		1/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	275	345	—	—	RB ^b				—	—
								27 31 —	52 56 —	— 38 41	— 53 56	— — —	
		1/2 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	325	395	—	—	50 53 —	63 66 —	— 52 54	— 61 63	— — —	
		3/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	360	425	—	—	59 62 —	68 71 —	— 58 60	— 64 66	— — —	
		Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	395	455	—	—	65 68 —	72 75 —	— 62 64	— 66 68	— — —	
		Extra Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	440	495	—	—	72 74 —	77 79 —	— 67 68	— 71 72	— — —	
		Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—	475	530	—	—	76 78 —	79 81 —	— 70 71	— 72 73	— — —	
		Extra Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—	495	550	—	—	78 80 —	81 83 —	— 71 72	— 73 74	— — —	

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units															
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm		Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm		
			Over/Thru		Min	Max		0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max
			C22000	Tube	Soft Anneal	Wall Thickness				—	—	—	—	RF ^b	
—/1.1 1.1/—		—				70	—	30							
Light Anneal	—/1.1 1.1/—				—	—	—	—	78	—	37	Note a Note a	0.035 0.035		
Drawn (Gen- eral Purpose)	All Sizes				275	—	—	—	—	38	—	—	—		
Hard Drawn	OD	Wall			—/100	0.5/6.5	360	—	—	—	55	—	—	—	
C23000	Sheet and Strip	Annealed	Size Section, mm		—	—	—	—	53 56 58 60 62	60 63 66 72 79	6 10 13 16 19	16 20 24 34 48	0.050 0.035 0.025 0.015 Note a	0.100 0.070 0.050 0.035 0.025	
			Over/Thru												
			—												
			—												
			—												
		1/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—		305	370	—	—	RB ^b		33 37 — —	58 62 — —	— — 42 45	— — 57 60	— — — —
			—												
			—												
		1/2 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—		350	420	—	—	56 59 —	68 71 —	— — 56 58	— — 64 66	— — — —	— — — —	
			—												
			—												
		3/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—		395	460	—	—	66 69 —	73 76 —	— — 63 65	— — 68 70	— — — —	— — — —	
			—												
			—												
		Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—		435	495	—	—	72 74 —	78 80 —	— — 67 68	— — 71 72	— — — —	— — — —	
			—												
			—												
		Extra Hard	0.50/0.90		495	550	—	—	78	83	—	—	—	—	
		Extra Hard	0.90/— 0.30/0.70 0.70/—		495	550	—	—	80 — —	85 — —	70 71 75	— 74 75	— — —	— — —	
			—												
			—												
		Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—		540	595	—	—	82 84 —	85 87 —	74 75 77	76 77 77	— — —	— — —	
			—												
			—												
		Extra Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—		565	620	—	—	84 86 —	87 89 —	75 76 78	77 78 78	— — —	— — —	
			—												
			—												
C23000	Tube	Soft Anneal	Wall Thickness		—	—	—	—	RF ^d		R30T ^d		0.025 0.025	0.060 0.060	
			—/1.1 1.1/—						—	75	—	36			
		Light Anneal	—/1.1 1.1/—		—	—	—	—	85	—	39	Note a Note a	0.035 0.035		
		Light Drawn ^e	All Sizes		305	400	—	—	—	—	43	75	—	—	
		Drawn (Gen- eral Purpose)	All Sizes		305	—	—	—	—	—	43	—	—	—	

ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units															
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm		Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm		
			Over/Thru		Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max	
C23000	Tube	Hard Drawn	OD	Wall						RF ^b		R30T ^d			
			—/109	0.5/6.5	395	—	—	—	—	—	—	65	—	—	
C24000	Sheet and Strip	Annealed	Size Section, mm							53	64	2	21	0.050	0.120
			Over/Thru												
		0.070 mm	—	—	—	—	—	—	—	57	67	8	27	0.035	0.070
		0.050 mm	—	—	—	—	—	—	—	61	72	16	35	0.025	0.050
		0.035 mm	—	—	—	—	—	—	—	63	77	20	42	0.015	0.035
		0.025 mm	—	—	—	—	—	—	—	66	83	25	50	Note a	0.025
		0.015 mm	—	—	—	—	—	—	—	—	—	—	—	—	—
		1/4 Hard	0.50/0.90		330	400	—	—	38	61	—	—	—	—	
			0.90/—												
			0.30/0.70												
		1/2 Hard	0.50/0.90		380	450	—	—	59	70	—	—	—	—	
			0.90/—												
			0.30/0.70												
		3/4 Hard	0.50/0.90		420	490	—	—	69	76	—	—	—	—	
			0.90/—												
			0.30/0.70												
		Hard	0.50/0.90		470	530	—	—	76	82	—	—	—	—	
			0.90/—												
			0.30/0.70												
		Extra Hard	0.50/0.90		540	600	—	—	83	87	—	—	—	—	
			0.90/—												
			0.30/0.70												
		Spring	0.50/0.90		565	640	—	—	87	90	—	—	—	—	
			0.90/—												
			0.30/0.70												
		Extra Spring	0.50/0.90		615	670	—	—	88	91	—	—	—	—	
			0.90/—												
			0.30/0.70												
C26000	Plate ¹ , Sheet, Strip, Rolled Bar and Wire	Annealed	—							50	62	—	21	0.070	—
			—												
			—												
		0.120 mm	—	—	—	—	—	—	—	52	67	3	27	0.050	0.120
		0.070 mm	—	—	—	—	—	—	—	61	73	20	35	0.035	0.070
		0.050 mm	—	—	—	—	—	—	—	65	76	25	38	0.025	0.050
		0.035 mm	—	—	—	—	—	—	—	67	79	27	42	0.015	0.035
		0.025 mm	—	—	—	—	—	—	—	72	85	33	50	Note 1	0.025
		0.015 mm	—	—	—	—	—	—	—	—	—	—	—	—	—
		1/4 Hard	0.50/0.90		340	405	—	—	40	61	—	—	—	—	
			0.90/—												
			0.30/0.70												
		1/2 Hard	0.50/0.90		395	460	—	—	60	74	—	—	—	—	
			0.90/—												
			0.30/0.70												
		3/4 Hard	0.50/0.90		440	510	—	—	72	70	—	—	—	—	
			0.90/—												
			0.30/0.70												

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units																			
Copper or Copper Alloy UNS No. ^{ee}	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm							
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max						
C26000	Plate ¹ , Sheet, Strip, Rolled Bar and Wire	Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	490	560	—	—	RB ^b		R30T ^d		—	—						
								70 81	84 86	— —	— —								
								— —	— —	70 71	73 74								
		Extra Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	570	635	—	—	—	—	85 87	89 91	— —	— —	— —					
	— —									— —	74 75	76 77							
	Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—	625	690	—	—	—	—	89 90	92 93	— —	— —	— —						
									— —	— —	76 76	78 78							
	Extra Spring	0.50/0.90 0.90/— 0.30/0.70 0.70/—	655	715	—	—	—	—	91 92	94 95	— —	— —	— —						
									— —	— —	77 77	79 79							
	Tube	Soft Anneal	Wall Thickness		—	—	—	—	RF ^b		—	40	0.025 0.025	0.060 0.060					
			—/0.75 0.75/—						— —	80									
		Light Anneal	—/0.75 0.75/—		—	—	—	—	—	90	—	60	Note a Note a	0.035 0.035					
		Drawn (General Purpose)	All Sizes		370	—	—	—	—	—	53	—	—	—					
		Hard Drawn	OD	Wall	455	—	—	—	—	—	70	—	—	—					
—/100			0.5/6.5																
C26800	Plate ¹ , Sheet, Strip and Rolled Bar	Annealed	Size Section, mm		—	—	—	—	—	RF ^d		R30T ^b		0.070 0.050 0.035 0.025 0.015 Note a	— 0.120 0.070 0.050 0.035 0.025				
			Over/Thru																
			—							—	—	—	—			50	62	—	21
			—							—	—	—	52			67	3	27	
			—							—	—	—	61			73	20	35	
			—							—	—	—	65			76	25	38	
			—							—	—	—	67			79	27	42	
			—							—	—	—	72			85	33	50	
		1/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	340	405	—	—	—	RB ^b		—	—	—	—					
									40 44	61 65									
									— —	43 46					57 60				
		1/2 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	380	450	—	—	—	57 60	71 74	— —	— —	— —	— —					
									— —	— —	54 56	64 66							
									3/4 Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	425	495	—	—	—	70 73	77 80	— —	— —
		— —	— —	65 67	69 71														
		Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	470	540	—	—	—								76 78	82 84	— —	— —
									— —	— —	68 69	72 73							
									Extra Hard	0.50/0.90 0.90/— 0.30/0.70 0.70/—	545	615	—	—	—	RF ^b		—	—
		83 85	87 90																
		— —	— —	73 74	75 76														

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units															
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm			
			Over/Thru	Min	Max			0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max
C26800	Plate ¹ , Sheet, Strip and Rolled Bar	Spring	0.50/0.90	595	655	—	—	R ^B		R30T ^b		—	—		
			0.90/—					87	90	—	—				
		0.30/0.70	89	92	75	77	—	—							
		0.70/—	—	—	76	78	—	—							
C27000	Wire	Annealed	0.100 mm	—	—	—	—	—	—	—	—	0.070	—		
			0.070 mm	—	—	—	—	—	—	—	—	0.050	0.100		
			0.050 mm	—	—	—	—	—	—	—	—	0.035	0.070		
			0.035 mm	—	—	—	—	—	—	—	—	0.025	0.050		
0.025 mm	—		—	—	—	—	—	—	—	0.015	0.035				
0.015 mm	—		—	—	—	—	—	—	—	Note a	0.025				
C27000	Wire	1/8 Hard	—	345	450	—	—	—	—	—	—	—	—		
			1/4 Hard	—	425	530	—	—	—	—	—	—	—		
			1/2 Hard	—	545	650	—	—	—	—	—	—	—		
			3/4 Hard	—	635	740	—	—	—	—	—	—	—		
Hard ^h	—		705	805	—	—	—	—	—	—	—				
Extra Hard ⁱ	—		795	890	—	—	—	—	—	—	—				
C27000	Wire	Spring ^j	—	825	—	—	—	—	—	—	—	—	—		
			—	—	—	—	—	—	—	—	—	—			
		C33000	Tube	Soft Anneal	—/0.75	—	—	—	—	—	80	—	40	0.025	0.060
					0.75/—	—	—	—	—	—	—	—	0.025	0.060	
Light Anneal	—/0.75			—	—	—	—	—	90	—	60	Note a	0.035		
	0.70/—			—	—	—	—	—	—	—	Note a	0.035			
C33000	Tube	Drawn (General Purpose)	All Sizes	370	—	—	—	—	—	53	—	—	—		
			—	—	—	—	—	—	—	—	—	—			
		Hard Drawn ^f	OD	Wall	—	—	—	—	—	—	—	—	—		
			—/100	0.50/6.5	455	—	—	—	—	—	70	—	—	—	
C33100	Tube	Soft Anneal	—/0.75	—	—	—	—	—	—	80	—	40	0.025	0.060	
			0.75/—	—	—	—	—	—	—	—	0.025	0.060			
		Light Anneal	—/0.75	—	—	—	—	—	—	90	—	60	Note a	0.035	
			0.75/—	—	—	—	—	—	—	—	Note a	0.035			
C33100	Tube	Drawn (General Purpose)	All Sizes	370	—	—	—	—	—	53	—	—	—		
			—	—	—	—	—	—	—	—	—	—			
		Hard Drawn	OD	Wall	—	—	—	—	—	—	—	—	—		
			—/100	0.50/6.5	455	—	—	—	—	—	70	—	—	—	
C34200 C35000	Plate, Sheet, Strip and Rolled Bar	Annealed	Over/Thru	—	—	—	—	—	—	—	—	—	—		
			All Sizes	—	—	—	—	—	—	—	—	—			
		1/4 Hard	All Sizes	340	405	—	—	—	—	—	—	—	—		
			1/2 Hard	All Sizes	380	450	—	—	—	—	—	—	—		
C34500 C35000	Rod	Soft	12.5/25	315	—	110	20	—	—	—	—	—	—		
			25/50	305	—	105	25	—	—	—	—	—			
		Extra Hard	All Sizes	470	540	—	—	—	—	—	—	—	—		
			—	545	615	—	—	—	—	—	—	—	—		

ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units													
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm	
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max
C34500 C35000	Rod	1/4 Hard	—/12.5	360	—	170	10	RB ^b		R30T ^b			—
			12.5/25	345	—	140	15	50	75	—	—	—	—
		25/50	290	—	105	20	40	70	—	—	—	—	
		1/2 Hard	—/12.5	395	—	170	7	60	80	—	—	—	—
			12.5/25	380	—	170	10	55	75	—	—	—	—
			25/50	345	—	140	15	40	70	—	—	—	—
C36000	Rod	Soft	—/25	330	—	140	15	—	—	—	—	—	—
			25/50	305	—	125	20	—	—	—	—	—	—
			50/—	275	—	105	25	—	—	—	—	—	—
		1/2 Hard	—/12.5	395	—	170	7	—	—	—	—	—	—
			12.5/25	380	—	170	10	—	—	—	—	—	—
			25/50	345	—	140	15	—	—	—	—	—	—
	Hard	50/100	310	—	105	20	—	—	—	—	—	—	
		100/—	275	—	105	20	—	—	—	—	—	—	
		1.5/5.0	550	—	310	—	—	—	—	—	—	—	
		5.0/12.5	480	—	240	4	—	—	—	—	—	—	
		12.5/20	450	—	205	6	—	—	—	—	—	—	
	Flat Products	Soft	Thickness	Width									
			—/25	—/150	305	—	125	20	—	—	—	—	—
			25/—	—/150	275	—	105	25	—	—	—	—	—
		1/2 Hard	—/12.5	—/25	345	—	170	10	—	—	—	—	—
			—/12.5	25/150	310	—	115	15	—	—	—	—	—
12.5/50			—/50	310	—	115	20	—	—	—	—	—	
C37700	Die Forgings	As Forged	Over/Thru										
			—/38	345	—	125	25	—	—	—	—	—	
			38/—	315	—	105	50	—	—	—	—	—	
C46400 C46500 C46600 C46700	Rod and Bar	Soft	—/25	370	—	140	30	—	—	—	—	—	—
			25/50	360	—	140	30	—	—	—	—	—	—
			50/—	345	—	140	30	—	—	—	—	—	—
		1/4 Hard or Light Annealed	—/12.5	415	—	185	22	—	—	—	—	—	—
			12.5/25	415	—	185	25	—	—	—	—	—	—
			25/50	400	—	180	25	—	—	—	—	—	—
	Shapes	As Extruded	50/75	270	—	170	25	—	—	—	—	—	—
			75/100	270	—	150	27	—	—	—	—	—	—
			100/—	270	—	150	30	—	—	—	—	—	
C51000	Sheet and Strip	Soft	1.0/—					16	64	—	—	—	—
			0.75/—	295	400	—	—	12	60	32	59	—	—
			0.50/1.0					—	—	24	53	—	—
		1/2 Hard	0.25/0.75										
			1.0/—					64	85	—	—	—	—
			0.75/—	400	505	—	—	—	—	59	73	—	—
		Hard	0.50/1.0					60	82	—	—	—	—
			0.25/0.75					—	—	53	69	—	—
			1.0/—	525	625	—	—	86	93	—	—	—	—
		Extra Hard	0.75/—					84	91	73	78	—	—
			0.50/1.0					—	—	71	75	—	—
			0.25/0.75					92	96	—	—	—	—
Spring	1.0/—					89	95	77	81	—	—		
	0.75/—	605	710	—	—	—	—	74	78	—	—		
	0.50/1.0					94	98	79	82	—	—		
					92	97	76	80	—	—			

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units															
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm			
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max		
C51000	Sheet and Strip	Extra Spring	1.0/— 0.75/— 0.50/1.0 0.25/0.75	690	785	—	—	RB ^b		R30T ^b					
			95 94 ⁺ —	99 98 —	80 77 —	83 81 —	—	—							
			—	—	—	—	—	—							
	Rod	Soft	—/6.5	275	400	—	—	—	—	—	—	—	—		
		Hard	—/6.5 6.5/12.5 12.5/25 25/— 6.5/9.5 9.5/—	550 485 415 380 415 380	885 — — — — —	— — — — — —	— 13 15 18 10 15	— — — — — —	— — — — — —	— — — — — —	— — — — — —	— — — — — —			
			Spring	—/0.65 ^{aa}	860	—	—	—	—	—	—	—	—		
			Spring	0.65/1.6 ^{aa} 1.6/3.2 ^{aa} 3.2/6.5 ^{aa} 6.5/9.5 ^{aa} 9.5/12.5 ^{aa}	795 760 725 690 620	— — — — —	— — — — —	— — 3.5 5.0 9.0	— — — — —	— — — — —	— — — — —	— — — — —			
				Wire for General Purposes	Soft	—	295	400	—	—	—	—	—	—	—
					1/4 Hard 1/2 Hard 3/4 Hard Hard	— — — —	415 550 660 745	525 670 795 885	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	
		Wire for Spring Purposes	— — — — —		—/0.65 0.65/1.6 1.6/3.2	1000 930 845	— — —	— — —	In 50 mm — — —	— — —	— — —	— — —	— — —	— — —	
	—/0.65 0.65/9.5 9.5/12.5			860 825 720	— — —	— — —	— 5.0 9.0	— — —	— — —	— — —	— — —				
	C51100 C54400			Sheet and Strip	Soft	1.0/— 0.75/— 0.50/1.0 0.25/0.75	275	380	—	—	7 0 —	50 45 —	— 24 16	— 50 46	— — —
						—	—	—	—	—	—	—	—	—	—
—						—	—	—	—	—	—	—	—	—	
1/2 Hard		1.0/— 0.75/— 0.50/1.0 0.25/0.75	380		485	—	—	60 53 —	81 78 —	— 57 52	— 73 71	— — —			
		—	—		—	—	—	—	—	—	—	—			
Hard		1.0/— 0.75/— 0.50/1.0 0.25/0.75	495		600	—	—	82 80 —	90 88 —	— 71 69	— 77 75	— — —			
		—	—		—	—	—	—	—	—	—	—			
Extra Hard		1.0/— 0.75/— 0.50/1.0 0.25/0.75	580		685	—	—	88 86 —	94 92 —	— 75 73	— 80 78	— — —			
		—	—		—	—	—	—	—	—	—	—			
Spring		1.0/— 0.75/— 0.50/1.0 0.25/0.75	625		725	—	—	90 88 —	96 94 —	— 77 75	— 81 79	— — —			
	—	—	—	—	—	—	—	—	—	—					
	—	—	—	—	—	—	—	—	—	—					
Extra Spring	1.0/— 0.75/— 0.50/1.0 0.25/0.75	660	750	—	—	92 89 —	97 94 —	— 78 76	— 82 80	— — —					
	—	—	—	—	—	—	—	—	—	—					
	—	—	—	—	—	—	—	—	—	—					
C52100	Sheet and Strip	Soft	1.0/— 0.75/—	365	460	—	—	29 —	70 —	— 38	— 68	— —			
		—	—	—	—	—	—	—	—	—	—				
		Soft	0.50/1.0 0.25/0.75	365	460	—	In 4 × Dia or Thickness of Specimen —	20 —	66 —	— 27	— 62	— —			

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units														
Copper or Copper Alloy UNS No. ^{ac}	Form	Temper	Size Section, mm		Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm	
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max	
C52100	Sheet and Strip	1/2 Hard	1.0/— 0.75/— 0.50/1.0 0.25/0.75	475	580	—	—	RB ^b		R30T ^b		—	—	
			76 — 69 —					91 — 88 —	— 67 63 75	— 78 — —				
		Hard	1.0/— 0.75/— 0.50/1.0 0.25/0.75	585	690	—	—	91 — 89 —	97 — 95 —	— 76 73 80	— 81 — 80	—	—	
		Extra Hard	1.0/— 0.75/— 0.50/1.0 0.25/0.75	670	770	—	—	95 — 93 —	100 — 98 —	— 78 77 82	— 83 — 82	—	—	
		Spring	1.0/— 0.75/— 0.50/1.0 0.25/0.75	725	820	—	—	97 — 95 —	102 — 100 —	— 79 78 83	— 84 — 83	—	—	
		Extra Spring	1.0/— 0.75/— 0.50/1.0 0.25/0.75	760	840	—	—	98 — 96 —	103 — 101 —	— 80 79 83	— 84 — 83	—	—	
C52400	Sheet and Strip	Soft	1.0/— 0.75/— 0.50/1.0 0.25/0.75	400	505	—	—	35 — 25 —	75 — — —	— 40 71 29	— 78 — 84	—	—	
		1/2 Hard	1.0/— 0.75/— 0.50/1.0 0.25/0.75	525	625	—	—	78 — 74 —	95 — 93 —	— 67 63 77	— 80 — 77	—	—	
		Hard	1.0/— 0.75/— 0.50/1.0 0.25/0.75	650	750	—	—	94 — 92 —	101 — 100 —	— 78 75 81	— 82 — 81	—	—	
		Extra Hard	1.0/— 0.75/— 0.50/1.0 0.25/0.75	740	840	—	—	93 — 97 —	103 — 102 —	— 80 79 83	— 84 — 83	—	—	
		Spring	1.0/— 0.75/— 0.50/1.0 0.25/0.75	795	890	—	—	99 — 98 —	104 — 103 —	— 81 80 84	— 85 — 84	—	—	
		Extra Spring	1.0/— 0.75/—	825	915	—	—	100 —	105 —	— 82	— 86	—	—	
		Extra Spring	0.50/1.0 0.25/0.75	825	915	—	—	99 —	104 —	— 81	— 85	—	—	
C54400	Sheet and Strip	See C51100												
	Rod	Hard	1.5/6.5 ^{bb} 6.5/12.5 ^{bb} 12.5/25 ^{bb} 25/— ^{bb}	450 415 380 345	— — — —	— — — —	8 10 12 15	— — — —	— — — —	— — — —	— — — —	— — — —		
Flat Products	Hard	6.5/9.5 ^{cc} 9.5/— ^{cc}	380 345	— —	— —	10 15	— —	— —	— —	— —	— —			
C60800	Tube	Annealed	All Sizes	345	—	130	—	—	—	—	—	0.010	0.045	
C61300	Plate ^a , Sheet, Strip and Rolled Bar	Soft	Thickness	Width			In 50 mm			BHN 1000 kg				
			—/12.5	All	515	—	255	35	—	—	—	—	—	—
			12.5/50	All	495	—	210	35	—	—	—	—	—	—
			50/125	All	450	—	195	35	—	—	—	—	—	—

ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units															
Copper or Copper Alloy UNS No. ^{1c}	Form	Temper	Size Section, mm		Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm		
			Over/Thru		Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max	
			Thickness	Width				In 50 mm	Min	Max	BHN 1000 kg				
C61400	Plate ¹ , Sheet, Strip and Rolled Bar	Soft	—/12.5	All	495	—	220	35	—	—	—	—	—	—	
			12.5/50	All	485	—	205	35	—	—	—	—	—		
			50/125	All	450	—	195	35	—	—	—	—	—		
		Hard	—/12.5	All	550	—	310	25	—	—	—	—	—		
			12.5/25	All	485	—	275	30	—	—	—	—	—		
C61300	Rod and Bar	—	—/12.5		550	—	345	30	—	—	—	—	—	—	
			12.5/25		515	—	310	30	—	—	—	—	—		
			25/50		495	—	275	30	—	—	—	—	—		
			50/75		485	—	240	30	—	—	—	—	—		
C61400	Rod and Bar	—	—/12.5		550	—	275	30	—	—	—	—	—	—	
			12.5/25		515	—	240	30	—	—	—	—	—		
			25/50		485	—	220	30	—	—	—	—	—		
			50/75		485	—	205	30	—	—	—	—	—		
C61800	Rod	1/2 Hard	—/75		—	—	—	—	—	—	—	—	—		
C62300	Rod and Bar	Drawn	—/12.5		620	—	310	12	90	—	155	—	—	—	
			12.5/25		605	—	305	15	—	—	—	—	—		
			25/—		580	—	275	15	—	—	—	—	—		
			50/25		525	—	255	20	—	—	—	—	—		
			75/—		515	—	205	20	—	—	—	—	—		
	Shapes	—	All Sizes	—	—	205	20	—	—	—	—	—	—		
		Forgings	As Forged	—/38		515	—	205	20	—	—	3000 kg		—	—
38/—					495	—	195	25	—	—	—	—	—		
C62400	Rod	As Extruded	All Sizes	550	—	310	7.0	—	—	175	—	—	—	—	
	Forgings	As Forged	—	550	—	310	7.0	—	—	175	—	—	—	—	
		Hardened and H ₂ O Quenched	—	—	—	—	—	—	—	240	—	—	—	—	
		Hardened, H ₂ O Quenched and Tempered	—	600	—	—	8.0	—	—	179	—	—	—	—	
C63000	Rod and Bar	Annealed	12.5/25		690	—	345	5	—	—	R30T ^b		—	—	
			25/50		620	—	310	6	—	—	—	—			—
			50/100		585	—	295	10	—	—	—	—			—
			Shapes	As Extruded	All Sizes	585	—	295	10	—	—	—			—
C64200	Rod and Bar	Drawn	—/12.5		620	—	310	9	—	—	—	—	—	—	
			12.5/25		585	—	310	12	—	—	—	—	—	—	
			25/50		550	—	290	12	—	—	—	—	—	—	
			50/75		515	—	240	15	—	—	—	—	—	—	
C65500	Plate ¹ , Sheet, Strip and Rolled Bar	Annealed	0.070 mm	—	360	400	—	—	—	—	70	82	0.050	0.110	
			0.040 mm	—	380	440	—	—	—	—	76	93	Note 1	0.055	
		1/4 Hard	—	—	425	495	—	—	65	60	—	—	—	—	
			1/2 Hard ^k	—	—	490	560	—	—	79	91	—	—	—	—
		Hard ^k	—	—	600	670	—	—	88	96	—	—	—	—	
			Extra Hard ^k	—	—	685	745	—	—	93	98	—	—	—	—
	Spring ^k	—	—	725	780	—	—	94	99	—	—	—	—		

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units														
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm		
				Over/Thru	Min			Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max
			C65500	Plate ^b , Sheet, Strip and Rolled Bar	Hot Rolled	—	380	495	—		—	RB ^b		RF ^b
Hot Rolled and Cold Rolled Finish	—	400			495	—	—	60	80	—	—	—	—	
Rod, Bar and Shapes	Soft	All Forms and Sizes		360	—	105	35	—	—	R30T ^b				
	1/4 Hard	All Forms and Sizes		380	—	165	25	—	—	—	—	—	—	
	1/2 Hard	—/50 ^d		485	—	260	17	—	—	—	—	—	—	
	Hard	—/6.5 ^d 6.5/38 ^d		585 585	—	345 345	8 13	—	—	—	—	—	—	
	Extra Hard	—/12.5 ^e		690	—	380	7	—	—	—	—	—	—	
Rod	Soft	All Sizes		360	—	105	35	—	—	—	—	—	—	
	Hard	—/25 25/38 38/75		450 415 380	— — —	265 205 165	20 25 27	— — —	— — —	— — —	— — —	— — —	— — —	
C67000	Rod and Bar	Soft		All Sizes	585	—	310	10 ^e	—	—	—	—	—	—
		1/2 Hard	All Sizes	725 795	— —	415 470	7 ^e 5 ^e	— —	— —	— —	— —	— —		
	Forgings	Soft	—	585	—	310	10	—	—	—	—	—	—	
		1/2 Hard	—	675 690	— —	345 380	7 5	— —	— —	— —	— —	— —	— —	
C67300	Rod and Bar	As Extruded	All Sizes	360	—	170	20	60	—	—	—	—	—	
		Soft	All Sizes	360	—	170	20	50	—	—	—	—	—	
		1/2 Hard ^g	—/25 25/75 75/—	450 400 360	— — —	275 240 205	12 15 18	70 70 65	— — —	— — —	— — —	— — —		
		1/2 Hard ^h	All Sizes	415	—	205	20	70	—	—	—	—	—	
		Hard ^g	—/25 25/50	485 425	— —	345 290	10 15	70 70	— —	— —	— —	— —	— —	
	Shapes	As Extruded	All Sizes	360	—	170	20	60	—	—	—	—	—	
		Forgings	As Forged	—	360	—	170	20	60	—	—	—	—	—
			Forged and Heat Treated	—	475	—	240	12	70	—	—	—	—	—
C67400	Rod and Bar	As Extruded	All Sizes	485	—	235	12	75	—	—	—	—	—	
		Extruded and Drawn	—/25 25/50 50/75	540 515 485	— — —	275 275 250	8 10 12	84 80 78	— — —	— — —	— — —	— — —		
	Shapes	As Extruded	All Sizes	485	—	235	12	75	—	—	—	—	—	
	Forgings	As Forged	—	450	—	205	15	75	—	—	—	—	—	
C67500	Rod	Soft	All Sizes	380	—	150	20	—	—	—	—	—	—	
		1/2 Hard	—/25 25/65 65/—	495 485 450	— — —	250 240 220	13 15 17	— — —	— — —	— — —	— — —	— — —		
		Hard	—/25 25/38 38/65 65/—	550 525 505 470	— — — —	385 360 330 310	8 10 12 16	— — — —	— — — —	— — — —	— — — —	— — — —		

SAE 463 Revised SEP81

ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units																										
Copper or Copper Alloy UNS No. ^{a,c}	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Elongation, Min % ^c	Hardness				Grain Size, mm														
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max													
C67500	Bar	Soft	All Sizes	380	—	150	20	RB ^b		R30T ^b		—	—													
		1/2 Hard	—/25	495	—	250	13	—	—	—	—	—	—													
			25/65	485	—	240	15	—	—	—	—	—	—													
			65/—	450	—	220	17	—	—	—	—	—	—													
	Hard	—/25	550	—	385	8	—	—	—	—	—	—														
		25/65	525	—	360	12	—	—	—	—	—	—														
65/—		505	—	330	16	—	—	—	—	—	—															
Shapes	Soft	All Sizes	470	—	310	20	—	—	—	—	—	—														
C70600	Condenser Tube Plate	—	—/65	275	—	105	In 50 mm	—	—	—	—	—	—													
							30																			
	Tube	Annealed Light Drawn	—	—	275 310	—	105 240	—	—	—	—	—	—	—												
C71000	Tube	Annealed	—	310	—	110	Hardness		—	—	—	—	—													
							Min	Max																		
							RF ^b																			
	Plate ^d , Sheet, Strip and Rolled Bar	Annealed 0.035 mm 0.015 mm	—	—	—	—	—	67 76	76 90	18 35	35 58	28 40	40 55	0.025 Note a	0.050 0.020											
																1/4 Hard 1/2 Hard Hard Extra Hard	—	325 385 460 495	435 485 545 580	—	—	—	45 64 76 79	72 78 84 87	46 59 67 69	65 69 73 75
	Spring	—	525	600	—	—	—	82	88	71	75	—	—													
	C71500	Condenser Tube Plate	—	—/65 65/125	345 310	—	140 125	Elongation, Min %	—	—	—	—	—	—	—											
In 50 mm																										
35 35																										
Tube		Annealed	—	360	—	125	—	—	—	—	—	—	—													
														Drawn and Stress Relieved	—/1.2 Wall 1.2/— Wall	495 495	— —	345 345	12 15	— —	— —	— —	— —			
Plate ^d , Sheet, Strip and Rolled Bar		Annealed 0.035 mm 0.015 mm	—	—	—	—	—	Hardness		23 37	45 63	31 40	46 58	0.025 Note a	0.050 0.025											
								Min	Max																	
								RF ^b																		
								70 74	85 93																	
								67 76	81 85																	
								61 67	71 74																	
1/4 Hard 1/2 Hard Hard Extra Hard		—	400 455 515 550	485 550 605 635	— — — —	— — — —	— — — —	83 85	89 91	72 73	76 77	— — — —														
Spring	—	580	650	—	—	—	87	91	74	77	—	—														

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ed. TABLE 2A—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Metric (SI) Units														
Copper or Copper Alloy UNS No. ^{a,c}	Form	Temper	Size Section, mm	Tensile Strength, MPa		Yield Strength, Min MPa	Hardness						Grain Size, mm	
				Over/Thru	Min		Max	0.5% Ext Under Load	Min	Max	Min	Max	Min	Max
			Min			Max								
C75200	Plate ¹ , Sheet, Strip and Rolled Bar	Annealed	—	—	—	—	RF ^b		RB ^b		R30T ^b		0.050 0.025 Note a	0.100 0.050 0.025
		0.070 mm	—	—	—	70	80	25	40	32	43			
		0.035 mm	—	—	—	75	88	35	55	40	53			
		0.015 mm	—	—	—	83	93	45	70	46	64			
		1/4 Hard	—	400	495	—	—	—	50	75	49	67	—	—
		1/2 Hard	—	455	550	—	—	—	68	82	62	72	—	—
		Hard	—	540	625	—	—	—	80	90	70	76	—	—
		Extra Hard	—	595	675	—	—	—	87	94	74	79	—	—
	Spring	—	620	695	—	—	—	89	96	75	80	—	—	
	Rod and Bar	Annealed	—	—	—	—	—	—	—	—	—	—	0.050 0.025	0.100 0.050 0.030
		0.070 mm	—	—	—	—	—	—	—	—	—	—	—	—
		0.035 mm	—	—	—	—	—	—	—	—	—	—	—	—
		0.015 mm	—	—	—	—	—	—	—	—	—	—	—	—
1/4 Hard		0.50/12.5 ^y	415	550	—	—	—	—	—	—	—	—	—	
Hard		0.5/6.5 ^w 6.5/12.5 ^w 12.5/25 ^w 25/— ^w	550 480 450 415	690 620 555 550	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —		
C77000	Plate ¹ , Sheet, Strip and Rolled Bar	Annealed	—	—	—	—	72	83	29	45	35	46	0.050 0.025 Note a	0.100 0.050 0.025
		0.070 mm	—	—	—	—	76	91	37	60	41	57	—	—
		0.035 mm	—	—	—	—	84	98	47	73	47	65	—	—
		0.015 mm	—	—	—	—	—	—	—	—	—	—	—	—
		1/4 Hard	—	475	600	—	23	62	70	88	63	75	—	—
		1/2 Hard	—	540	655	—	51	69	81	92	71	78	—	—
		Hard	—	635	740	—	67	76	90	96	76	80	—	—
		Extra Hard	—	705	795	—	73	80	95	99	79	82	—	—
	Spring	—	745	825	—	77	83	97	100	80	—	—	—	
	Rod and Bar	Annealed	—	—	—	—	—	—	—	—	—	—	0.050 0.025	0.100 0.050 0.030
		0.070 mm	—	—	—	—	—	—	—	—	—	—	—	—
		0.035 mm	—	—	—	—	—	—	—	—	—	—	—	—
		0.015 mm	—	—	—	—	—	—	—	—	—	—	—	—
1/4 Hard		0.50/12.5 ^y	515	655	—	—	—	—	—	—	—	—	—	
Hard		0.50/6.5 ^w 0.50/6.5 ^w 12.5/25 ^w 25/— ^w	620 550 515 485	700 690 655 620	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —		

^a Although no minimum grain size is required, this material must be fully recrystallized.
^b Values are approximate. ¹ and ⁸ scales for metal 0.50 mm and over in thickness. 30T scale for metal 0.30 mm and over in thickness. (0.40 mm for annealed material to ASTM B36 and B122).
^c In any case, a minimum gage length of 25 mm shall be used.
^d Hardness values shall apply only to tubes having a wall thickness of 0.40 mm or over for annealed temper and 0.50 mm or over for drawn temper (0.30 mm for drawn temper to ASTM B135), to round tubes having an inside diameter of 8.0 mm or over, and to rectangular, including square, tubes having an inside major distance between parallel surfaces of 4.8 mm or over. For all other tubes, no Rockwell values shall apply. Hardness tests shall be made on the inside surface of the tube. When suitable equipment is not available for determining the specified hardness, other Rockwell scales and values may be specified, subject to agreement between purchaser and supplier.
^e 3.2 to 22.0 mm outside diameter 0.75 to 1.1 mm wall.
^f Generally available in round, hexagonal, and octagonal.
^g Normally available in round only.
^h Not generally available in sizes over 12.5 mm in diameter.
ⁱ Not generally available in sizes over 9.5 mm in diameter. Square and rectangular wire not generally available.
^j Not generally available in sizes over 6.5 mm in diameter. Square and rectangular wire not generally available.
^k Commercially supplied only as strip. Manufacturer should be consulted for sheet or plate.

^l Capable of being hardened by further heat treatment.
^m Rods and bars.
ⁿ Applicable to material 0.10 mm and over.
^o Applicable to material 0.80 mm and over.
^p Applicable to material 0.40 mm and over.
^q When stated on contract or order, tension test shall be waived provided the strip meets the hardness requirement. In case of dispute, tension test shall be the basis for acceptance.
^r Commonly supplied only as strip.
^s 6.5 mm and over.
^t Plate generally available only in annealed, quarter hard, and half hard.
^u Type A material to listed hardness limits supplied unless otherwise specified.
^v Cold finished.
^w Rods only.
^x Bars only.
^y After heat treatment.
^z After mill heat treatment.
^{aa} Rounds only.
^{bb} Rounds and hexagons.
^{cc} Squares and rectangles.
^{dd} Rods and square bars.
^{ee} Unified Number System. For cross reference to SAE, former SAE, ASTM and former trade names, see SAE J461.

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units													
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, In Over/Thru	Tensile Strength, ksi		Yield Strength, Min ksi 0.5% Ext Under Load	Elongation, Min % ^c In 2 in	Hardness				Grain Size, mm	
				Min	Max			Min	Max	Min	Max	Min	Max
C16200	Rod (Round Only)	Drawn	—/1.0 1.0/2.0 2.0/3.0	Type B Mat ¹⁰		—	20 25 25	RB		R30T ⁹		—	—
				60 55 50	— — —			65 60 55	— — —	— — —	— — —		
	Bar (Square and Rectangular) and Rod (Hexagonal)	Drawn	—/1.0 Thick 1.0/— Thick	60 50	— —	— —	20 25	55 50	— —	— —	— —	— —	— —
	Forging	As Forged	—/1.0 Thick 1.0/— Thick	60 50	— —	— —	20 25	55 50	— —	— —	— —	— —	— —
C17000	Strip	A (Soft) ¹	All Sizes	60 85 100	78 100 120	— — —	35 10 5 2	RB ^{9,10}		R30T ^{9,10}		Elec Cond, % IACS Min	Heat Treat h at 600°F
								45	78	46	67		
								68 88 96	90 96 102	62 74 79	75 79 83		
		AT ⁷	All Sizes	150	—	130 min	3	RC ^{9,10}		R30N ^{9,10}		22	3
								33	—	53	—		
								35	—	55	—		
		1/4 HT ⁷ 1/2 HT ⁷ HT ⁷	All Sizes All Sizes All Sizes	160 170 180	— — —	135 mm 145 mm 155 mm	2.5 1 1	37	—	56	—	22	2
								39	—	59	—	22	2
								39	—	59	—	22	2
		AM ⁸	All Sizes	100	115	70 min 95 max	18	18	23	37	44	23	—
								21	26	42	47	23	—
								25	30	46	50	24	—
C17200	Strip	A (Soft) ¹	All Sizes	60 85 100	78 100 120	— — —	35 10 5 5	RB ^{9,10}		R30T ^{9,10}		17	—
								45	78	46	67		
								68 88 96	90 96 102	62 74 79	75 79 83		
		AT ⁷	All Sizes	165	195	—	—	RC ^{9,10}		R30N ^{9,10}		22	3
								36	—	56	—		
								38 39 40	— — —	58 59 60	— — —	22 22 22	2 2 2
		1/4 HT ⁷ 1/2 HT ⁷ HT ⁷	All Sizes All Sizes All Sizes	175 185 195	205 215 220	— — —	— — —	38	—	58	—	22	2
								39	—	59	—	22	2
								40	—	60	—	22	2
		A (Soft) ¹	All Sizes	60 95 90 85	85 130 120 115	— — — —	— — — —	RB ^{9,10}		R30T ^{9,10}		17	—
								45	85	—	—		
								92 91 88	103 102 104	— — —	— — —	15 15 15	— — —
C17200	Rod and Bar	Hard ¹	—/.375 .375/1.0 1.0/—	95 90 85	130 120 115	— — —	— — —	RC ^{9,10}		R30N ^{9,10}		22	3
								36	40	—	—		

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TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units													
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Elec Cond, % IACS Min	Heat Treat h at 600°F
				Over/Thru	Min	Max		Min	Max	Min	Max		
C17200	Rod and Bar	HT ^g	—/.375 .375/1.0 1.0/—	Type B Mat ^h		— — —	— — —	RC ^{a,g}		R30N ^{a,g}		22 22 22	3 2 2
				185 180 175	215 210 205			39 38 37	45 44 43	— — —	— — —		
				—	—			—	—	—	—		
C17500	Strip and Plate	A (Soft) ⁱ	All Sizes	—	55	20 min 30 max	20	20	45	29	45	20	—
		1/2 Hard ⁱ	All Sizes	60	75	50 min 70 max	5	65	76	60	67	25	—
		Hard ⁱ	All Sizes	70	85	60 min 80 max	2	78	88	69	75	25	—
		AT ^g	All Sizes	100	120	80 min 100 max	8	92	100	77	82	45	—
		1/2 HT ^g	All Sizes	110	130	95 min 120 max	5	95	102	79	83	48	—
		HT ^g	All Sizes	110	130	95 min 120 max	5	95	102	79	83	48	—
	Hot Worked Sizes, Forgings	A (Soft) ⁱ	All Sizes	—	55	20 min 30 max	20	20	45	—	—	20	—
		AT ^g	All Sizes	100	120	80 min 100 max	10	92	100	—	—	45	—
C17500 C17600	Rod, Bar Shapes and Tubing	A (Soft) ⁱ	All Sizes	35	55	20 min 30 max	20	25	45	—	—	20	—
		1/2 Hard	All Sizes	65	85	55 min 75 max	10	60	75	—	—	20	—
		AT ^g	All Sizes	100	120	80 min 100 max	10	92	100	—	—	45	—
		1/2 HT ^g	All Sizes	110	130	100 min 120 max	8	92	102	—	—	48	—
C18400	Round Rod	Drawn	—/1.0 1.0/2.0 2.0/3.0	65	—	—	15	75	—	—	—	—	—
				60	—	—	15	70	—	—	—	—	—
				55	—	—	15	65	—	—	—	—	—
	Rod (Hexagonal) and Bars	Drawn	—/1.0 Thick 1.0/— Thick	65	—	—	15	70	—	—	—	—	—
				55	—	—	15	65	—	—	—	—	—
	Forgings	As Forged	—/1.0 1.0/2.0 2.0/—	65 55 55	— — —	— — —	15 15 15	72 70 65	— — —	— — —	— — —	— — —	— — —
C18700	Rod	1/2 Hard ⁱ	.062/.250 .250/2.625	38 38	— —	30 30	8 12	— —	— —	— —	— —	— —	— —
		Hard	.062/.250 .250/1.250 1.250/2.000	48 44 40	— — —	40 38 35	4 8 8	— — —	— — —	— — —	— — —	— — —	— — —
C19200	Tube	A (Soft) Light Drawn	All Sizes All Sizes	38 40	— —	12 35	— —	— —	— —	— —	— —	— —	— —

ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units													
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, In	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm	
				Over/Thru	Min			Max	0.5% Ext Under Load	In 2 in	Min	Max	Min
C21000	Plate, Sheet, Strip and Rolled Bar ^d	Annealed 0.050 mm 0.035 mm 0.025 mm 0.015 mm	— — — —	— — — —	— — — —	— — — —	— — — —	RF ^b		R30T ^b		0.035 0.025 0.015 Note a	0.090 0.050 0.035 0.025
								40 47 50 54	52 54 61 65	— — 1 7	4 7 17 23		
								RB ^b					
								20 24 — —	48 52 — —	— — 34 37	— — 51 54		
		1/4 Hard	.019/.036 .036/— .011/.028 .028/—	37 — — —	47 — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —		
		1/2 Hard	.019/.036 .036/— .011/.028 .028/—	42 — — —	52 — — —	— — — —	— — — —	40 44 — —	56 60 — —	— — 46 48	— — 57 59	— — — —	— — — —
		3/4 Hard	.019/.036 .036/—	46 —	56 —	— —	— —	50 53	61 64	— —	— —	— —	— —
		3/4 Hard	.011/.028 .028/—	46 —	56 —	— —	In 4 × Dia or Thickness of Specimen	— —	— —	52 54	60 62	— —	— —
		Hard	.019/.036 .036/— .011/.028 .028/—	50 — — —	59 — — —	— — — —	— — — —	57 60 — —	64 67 — —	— — 57 59	— — 62 64	— — — —	— — — —
		Extra Hard	.019/.036 .036/— .011/.028 .028/—	56 — — —	64 — — —	— — — —	— — — —	64 66 — —	70 72 — —	— — 62 63	— — 66 67	— — — —	— — — —
		Spring	.019/.036 .036/— .011/.028 .028/—	60 — — —	68 — — —	— — — —	— — — —	68 70 — —	73 75 — —	— — 64 65	— — 68 69	— — — —	— — — —
		Extra Spring	.019/.036 .036/— .011/.028 .028/—	61 — — —	69 — — —	— — — —	— — — —	69 71 — —	74 76 — —	— — 65 66	— — 69 70	— — — —	— — — —
C22000	Plate, Sheet, Strip and Rolled Bar ^d	Annealed 0.050 mm 0.035 mm 0.025 mm 0.015 mm	— — — —	— — — —	— — — —	— — — —	— — — —	RF ^b				0.035 0.025 0.015 Note a	0.090 0.050 0.035 0.025
								50 54 58 62	60 64 70 75	1 7 13 19	16 21 31 39		
								RB ^b					
								27 31 — —	52 56 — —	— — 38 41	— — 53 56		
		1/4 Hard	.019/.036 .036/— .011/.028 .028/—	40 — — —	50 — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	
		1/2 Hard	.019/.036 .036/— .011/.028 .028/—	47 — — —	57 — — —	— — — —	— — — —	50 53 — —	63 66 — —	— — 52 54	— — 61 63	— — — —	— — — —
		3/4 Hard	.019/.036 .036/— .011/.028 .028/—	52 — — —	62 — — —	— — — —	— — — —	59 62 — —	68 71 — —	— — 58 60	— — 64 66	— — — —	— — — —
		Hard	.019/.036 .036/— .011/.028 .028/—	57 — — —	66 — — —	— — — —	— — — —	65 68 — —	72 75 — —	— — 62 64	— — 66 68	— — — —	— — — —

ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units														
Copper or Copper Alloy UNS No. ^{1a}	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm		
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max	
C10200 C11000 C11300 C11400 C11500 C11600 C12000 C12200	Plate, Sheet, Strip and Rolled Bar	Soft Anneal	—	—	—	—	—	RF ^b		R30T ^b		Note a	—	
		Deep-Drawing Anneal	—	—	—	—	—	30	75	—	—	Note a	0.050	
		Light Cold Rolled	—	32	40	—	—	40	82	—	49	—	—	
		1/2 Hard ^f	—	37	46	—	—	77	89	43	57	—	—	
		Hard ^f	—	43	52	—	—	86	93	54	62	—	—	
		Spring ^g Extra Spring ^g	—	50	58	—	—	91	97	60	66	—	—	
		Hot Rolled Hot Rolled and Annealed	—	30	38	—	—	—	75	—	41	—	—	
		—	30	38	—	—	—	65	—	31	—	—		
C10200 C11000 C12000 C12200	Rod, Bar and Shapes	Soft Anneal	All Sizes ^m	Type B Mat ^h		—	Type B ^d	Type A ^{e,u}		—	—	—	—	
			—	37	—	25	—	65	—	—	—	—		
		Hard	—/1.250 ^w	50	—	—	68	95	—	—	—	—		
			.250/.375 ^w	45	—	—	10	68	95	—	—	—		
			.375/1.0 ^w	40	—	—	12	68	95	—	—	—		
			1.0/2.0 ^w	35	—	—	15	68	95	—	—	—		
			2.0/3.0 ^w	33	—	—	15	68	95	—	—	—		
			.188/.375 ^x	42	—	—	12	68	95	—	—	—		
			.375/.500 ^x	40	—	—	12	68	95	—	—	—		
			.500/2.0 ^x	33	—	—	15	68	95	—	—	—		
2.0/4.0 ^x	32	—	—	15	68	95	—	—	—					
All Sizes ^y	32	—	—	15	—	—	—	—	—	—				
C10200 C12000 C12200	Tube		OD	Wall	—	—	In 2 in	—	—	R15T ^d		—	—	
		Soft Anneal	All Sizes	.014/.034	30	—	—	40 ^e	—	50 ^d	—	60	0.040	0.040
			All Sizes	.034/—	—	—	—	—	—	—	—	—	—	
		Light Anneal	All Sizes	.014/.034	—	—	—	—	—	—	65	—	0.040	0.040
			All Sizes	.034/—	—	—	—	—	—	—	—	—	—	—
		Light Drawn Drawn Hard Drawn	All Sizes	All Sizes	36	47	—	—	—	—	R30T ^d		—	—
			All Sizes	All Sizes	36	—	—	—	—	—	30	60	—	—
—/1.0	.019/.120		45	—	—	—	—	—	30	—	—	—		
C10200 C11000	Wire	Annealed	Size Section, in	—	—	—	In 10 in	—	—	—	—	—	—	
			.0029/.0100 dia	—	—	—	15	—	—	—	—	—	—	
			.0100/.0201 dia	—	—	—	20	—	—	—	—	—	—	
			.0201/.1019 dia	—	—	—	25	—	—	—	—	—	—	
			.1019/.2893 dia	—	—	—	30	—	—	—	—	—	—	
			.2893/.4600 dia	—	—	—	35	—	—	—	—	—	—	
			C14500	Rod	1/2 Hard ^f	.062/.250	38	—	30	In 4 × Dia	—	—	—	—
.250/2.625	38	—				30	8	12	—		—	—	—	
Hard	.062/.250	48			—	40	4	—	—	—	—	—	—	
	.250/1.250	44			—	38	8	—	—	—	—	—	—	
C14700	Rod	1/2 Hard ^f	.062/.250	38	—	30	In 4 × Dia	—	—	—	—	—	—	
			.250/2.625	38	—	30		8	12	—	—	—	—	—
		Hard ^g	.062/.250	48	—	40	4	—	—	—	—	—	—	
			.250/1.250	44	—	38	8	—	—	—	—	—	—	
C15000	Round Rod	1/2 Hard ^f	.062/.250	38	—	30	In 4 × Dia	—	—	—	—	—	—	
			.250/2.625	38	—	30		8	12	—	—	—	—	—
		Hard ^g	.062/.250	48	—	40	4	—	—	—	—	—	—	
			.250/1.250	44	—	38	8	—	—	—	—	—	—	
C15000	Round Rod	1/2 Hard ^f	.062/.250	38	—	30	In 4 × Dia	—	—	—	—	—	—	
			.250/2.625	38	—	30		8	12	—	—	—	—	—
		Hard ^g	.062/.250	48	—	40	4	—	—	—	—	—	—	
			.250/1.250	44	—	38	8	—	—	—	—	—	—	

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units														
Copper or Copper Alloy UNS No. ^{1a}	Form	Temper	Size Section, in		Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm	
			Over/Thru	Min	Max	0.5% Ext Under Load			In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min
C22000	Plate, Sheet, Strip and Rolled Bars ¹	Extra Hard	.019/.036 .036/— .011/.028 .028/—		64	72	—	—	RB ^b		R30T ^b		—	—
			72 74	77 79					—	—				
			—	—					67 68	71 72				
		Spring	.019/.036 .036/— .011/.028 .028/—		69	77	—	—	76 78	79 81	—	—	—	—
			—	—					70 71	72 73	—	—		
			—	—					—	—	—	—		
		Extra Spring	.019/.036 .036/— .011/.028 .028/—		72	80	—	—	78 80	81 83	—	—	—	—
			—	—					71 72	73 74	—	—		
			—	—					—	—	—	—		
	Tube	Soft Anneal	Wall Thickness		—	—	—	—	RB ^b		—	30	0.025	0.060
			—/.045 .045/—						—	70				
		Light Anneal	—/.045 .045/—		—	—	—	—	—	78	—	37	Note a	0.035
			.045/—						—	—	—	Note a	0.035	
		Drawn (General Purpose)	All Sizes		40	—	—	—	—	—	38	—	—	—
		Hard Drawn	OD	Wall	52	—	—	—	—	—	55	—	—	—
			—/4.0	.019/.250										
		C23000	Sheet and Strip	Annealed	Size Section, in		—	—	—	—	53	60	6	16
—														
—														
—														
—														
1/4 Hard	.019/.036 .036/— .011/.028 .028/—			44	54	—	—	RB ^b		—	—	—	—	
	33 37							58 62						
	—							—						
1/2 Hard	.019/.036 .036/— .011/.028 .028/—			51	61	—	—	56 59	68 71	—	—	—	—	
	—							—	56 58	64 66	—	—		
	—							—	—	—	—	—		
3/4 Hard	.019/.036 .036/— .011/.028 .028/—			57	67	—	—	66 69	73 76	—	—	—	—	
	—							—	63 65	68 70	—	—		
	—							—	—	—	—	—		
Hard	.019/.036 .036/— .011/.028 .028/—			63	72	—	—	72 74	78 80	—	—	—	—	
	—							—	67 68	71 72	—	—		
	—							—	—	—	—	—		
Extra Hard	.019/.036 .036/—			72	80	—	—	78 80	83 85	—	—	—	—	
Extra Hard	.011/.028 .028/—			72	80	—	—	—	—	70 71	74 75	—	—	
Spring	.019/.036 .036/— .011/.028 .028/—			78	86	—	—	82 84	85 87	—	—	—	—	
	—							—	74 75	76 77	—	—		
	—							—	—	—	—	—		
Extra Spring	.019/.036 .036/— .011/.028 .028/—			82	90	—	—	84 86	87 89	—	—	—	—	
	—							—	75 76	77 78	—	—		
	—							—	—	—	—	—		

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units																	
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm					
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max				
C23000	Tube	Soft Anneal	Wall Thickness					RF ^d		R30T ^e							
			—/.045 .045/—	—	—	—	—	—	75	—	36	0.025 0.025	0.060 0.060				
		Light Anneal	—/.045 .045/—	—	—	—	—	—	85	—	39	Note a Note a	0.035 0.035				
		Light Drawn ^f	All Sizes	44	58	—	—	—	—	43	75	—	—				
		Drawn (General Purpose)	All Sizes	44	—	—	—	—	—	43	—	—	—				
		Hard Drawn	OD	Wall					RF ^d								
—/1.0	.019/.120		57	—	—	—	—	—	65	—	—	—					
1.0/2.0	.034/.180																
2.0/4.0	.059/.250																
C24000	Sheet and Strip	Annealed	Size Section, in														
			—	—	—	—	—	53	64	2	21	0.050	0.120				
			0.070 mm	—	—	—	—	—	57	67	8	27	0.035	0.070			
			0.050 mm	—	—	—	—	—	61	72	16	35	0.025	0.050			
			0.035 mm	—	—	—	—	—	63	77	20	42	0.015	0.035			
		0.025 mm	—	—	—	—	—	66	83	25	50	Note a	0.025				
		1/4 Hard	.019/.036	48	58	—	—	—	—	RB ^b		—	—	—	—		
			.036/—							38	61						
			.011/.028							42	65						
			.028/—							—	—						
			1/2 Hard	.019/.036	55	65	—	—	—	—	59	70	—	—	—	—	
		.036/—		62													73
		.011/.028		—													—
		.028/—		—													56
		3/4 Hard		.019/.036	61	71	—	—	—	—	69	76	—	—	—	—	
			.036/—	72													79
			.011/.028	—													—
			.028/—	—													63
			Hard	.019/.036	68	77	—	—	—	—	76	82	—	—	—	—	
		.036/—		78													84
.011/.028	—	—															
.028/—	—	68															
Extra Hard	.019/.036	78		87	—	—	—	—	83	87	—	—	—	—			
	.036/—		85												89		
	.011/.028		—												—		
	.028/—		—												72		
	Spring	.019/.036	85	93	—	—	—	—	87	90	—	—	—	—			
.036/—		89													92		
.011/.028		—													—		
.028/—		—													75		
Extra Spring		.019/.036	89	97	—	—	—	—	88	91	—	—	—	—			
	.036/—	90													93		
	.011/.028	—													—		
	.028/—	—													76		
	C26000	Plate, ¹ Sheet, Strip, Rolled Bar and Wire	Annealed	—	—	—	—	—	RF ^d								
0.120 mm				—	—	—	—	50	62	—	21	0.070	—				
0.070 mm				—	—	—	—	52	67	3	27	0.050	0.120				
0.050 mm				—	—	—	—	61	73	20	35	0.035	0.070				
0.035 mm				—	—	—	—	65	76	25	38	0.025	0.050				
0.025 mm				—	—	—	—	67	79	27	42	0.015	0.035				
0.015 mm				—	—	—	—	72	85	33	50	Note a	0.025				
—				—	—	—	—	—	—	—	—	—	—				

(Table continued on next page)

SAE 463 Revised SEP81

ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units																			
Copper or Copper Alloy UNS No. ^{ee}	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm							
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max						
C26000	Plate, ^f Sheet, Strip, Rolled Bar and Wire	1/4 Hard	.019/.036 .036/— .011/.028 .028/—	49	59	—	—	RB ^b		R30T ^d		—	—						
								40 44 —	61 65 —	— 43 46	— 57 60								
		1/2 Hard	.019/.036 .036/— .011/.028 .028/—	57	67	—	—	60 63 —	74 77 —	— 56 58	— 66 68	—	—						
		3/4 Hard	.019/.036 .036/— .011/.028 .028/—	64	74	—	—	72 75 —	79 82 —	— 65 67	— 70 72	—	—						
		Hard	.019/.036 .036/— .011/.028 .028/—	71	81	—	—	79 81 —	84 86 —	— 70 71	— 73 74	—	—						
	Extra Hard	.019/.036 .036/— .011/.028 .028/—	83	92	—	—	85 87 —	89 91 —	— 74 75	— 76 77	—	—							
	Spring	.019/.036	91	100	—	—	89	92	—	—	—	—							
	Spring	.036/— .011/.028 .028/—	91	100	—	—	90 — —	93 — —	— 76 76	— 78 78	—	—							
	Extra Spring	.019/.036 .036/— .011/.028 .028/—	95	104	—	—	91 92 — —	94 95 — —	— 77 77	— 79 79	—	—							
	Tube	Soft Anneal	Wall Thickness						RF ^b										
			—/.030 .030/—	—	—	—	—	—	80	—	40	0.025 0.025	0.060 0.060						
		Light Anneal	—/.030 .030/—	—	—	—	—	—	90	—	60	Note a Note a	0.035 0.035						
		Drawn (General Purpose)	All Sizes	54	—	—	—	—	—	53	—	—	—						
		OD	Wall																
Hard Drawn		—/4.0 .019/.250	66	—	—	—	—	—	70	—	—	—							
C26800	Plate, ^f Sheet, Strip and Rolled Bar	Annealed	Size Section, in	—	—	—	—	RF ^d		R30T ^b		0.070 0.050 0.035 0.025 0.015 Note a	— 0.120 0.070 0.035 0.025 0.015						
								—	—	—	—			—	—	—	—	—	—
		1/4 Hard	.019/.036 .036/— .011/.028 .028/—	49	59	—	—	RB ^b		—	—	—	—						
								40 44 —	61 65 —					— 43 46	— 57 60				
		1/2 Hard	.019/.036 .036/— .011/.028 .028/—	55	65	—	—	57 60 —	71 74 —	— 54 56	— 64 66	—	—						
		3/4 Hard	.019/.036 .036/— .011/.028 .028/—	62	72	—	—	70 73 —	77 80 —	— 65 67	— 69 71	—	—						

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units																
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm				
				Over/Thru	Min			Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max
			RB ^b			R30T ^b										
C26800	Plate, ¹ Sheet, Strip and Rolled Bar	Hard	.019/.036 .036/— .011/.028 .028/—	68	78	—	—	76 78 —	82 84 —	— — 68	— — 72	— — 73	— — —			
			Extra Hard	.019/.036 .036/—	79	89	—	—	83 85	87 90	— —	— —	— —	— —		
				Extra Hard	.011/.028 .028/—	79	89	—	—	—	—	73 74	75 76	— —	— —	
		Spring	.019/.036 .036/— .011/.028 .028/—	86	95	—	—	87 89	90 92	— —	— —	— 75	— 77	— 78	— —	
			Extra Spring	.019/.036 .036/— .011/.028 .028/—	90	99	—	—	88 90	91 93	— —	— —	76 77	78 79	— —	— —
		C27000		Wire	Annealed	—	—	—	—	—	—	—	—	—	—	0.070 0.050 0.035 0.025 0.015 Note a
0.100 mm	—		—		—	—	—	—	—	—	—	—	—	—		
0.070 mm	—		—		—	—	—	—	—	—	—	—	—	—		
0.050 mm	—		—		—	—	—	—	—	—	—	—	—	—		
0.035 mm	—		—		—	—	—	—	—	—	—	—	—	—		
0.025 mm	—		—		—	—	—	—	—	—	—	—	—	—		
0.015 mm	—		—		—	—	—	—	—	—	—	—	—	—		
1/8 Hard	—		50		65	—	—	—	—	—	—	—	—	—		
1/4 Hard	—		67		77	—	—	—	—	—	—	—	—	—		
1/2 Hard	—		79		94	—	—	—	—	—	—	—	—	—		
3/4 Hard	—	92	107	—	—	—	—	—	—	—	—	—				
Hard ^b	—	102	117	—	—	—	—	—	—	—	—	—				
Extra Hard ^d	—	115	129	—	—	—	—	—	—	—	—	—				
C33000	Tube	Soft Anneal	Wall Thickness		—	—	—	—	—	—	—	—	0.025 0.025	0.060 0.060		
			—/.030 .030/—		—	—	—	—	—	80	—	40	—	—		
		Light Anneal	—/.030 .030/—		—	—	—	—	—	—	90	—	60	Note a Note a	0.035 0.035	
			Drawn (General Purpose)	All Sizes		54	—	—	—	—	—	—	53	—	—	—
		Hard Drawn ^e		OD	Wall	66	—	—	—	—	—	70	—	—	—	
			—/.4.0 .019/.250													
		C33100	Tube	Soft Anneal	Wall Thickness		—	—	—	—	—	—	—	40	0.025 0.025	0.060 0.060
					—/.030 .030/—		—	—	—	—	—	80	—	—	—	—
Light Anneal	—/.030 .030/—			—	—	—	—	—	—	90	—	60	Note a Note a	0.035 0.035		
	Drawn (General Purpose)			All Sizes		54	—	—	—	—	—	—	53	—	—	—
Hard Drawn				OD	Wall	66	—	—	—	—	—	70	—	—	—	
	—/.4.0 .019/.250															
C34200 C35000	Plate, Sheet, Strip and Rolled Bar	Annealed	All Sizes All Sizes All Sizes All Sizes	—	—	—	—	54 61 65 67	67 73 76 79	12 20 25 27	27 35 38 42	0.050 0.035 0.025 0.015	0.100 0.070 0.050 0.035			

(Table continued on next page)

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units																									
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm													
				Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max											
C34200 C35000	Plate, Sheet, Strip and Rolled Bar	1/4 Hard	All Sizes	49	59	—	—																		
		1/2 Hard	All Sizes	55	65	—	—	40	65	43	60	—	—												
		Hard Extra Hard	All Sizes	68	78	—	—	76	84	68	73	—	—												
C34500 C35000	Rod	Soft	—/.50 .50/1.0 1.0/2.0	46 44 40	— — —	16 15 15	20 25 30	— — —	— 45 45	— — —	— — —	— — —	— — —												
		1/4 Hard	—/.50 .50/1.0 1.0/2.0	52 50 42	— — —	25 20 15	10 15 20	50 40 35	75 70 65	— — —	— — —	— — —													
		1/2 Hard	—/.50 .50/1.0 1.0/2.0	57 55 50	— — —	25 25 20	7 10 15	60 55 40	80 75 70	— — —	— — —	— — —													
		Flat Products	Soft	Thickness —/1.0 1.0/—	Width —/6.0 6.0/—	44 40 —	18 15 —	20 25 —	— — —	— — —	— — —	— — —	— — —												
														1/2 Hard	—/.50 —/.50 .50/2.0 .50/2.0 2.0/—	—/1.0 1.0/6.0 —/2.0 2.0/6.0 2.0/4.0	50 45 45 40 40	— — — — —	25 17 15 20 20	10 15 20 20 20	— — — — —	— — — — —	— — — — —		
																								Hard	.061/.088 .088/.500 .500/.750
C37700	Die Forgings	As Forged	Over/Thru —/1.50 1.50/—	50 46 —	— — —	18 15 —	25 20 —	— — —	— — —	— — —	— — —														
												C46400 C46500 C46600 C46700	Rod and Bar	Soft	—/1.0 1.0/2.0 2.0/—	54 52 50	— — —	20 20 20	30 30 30	— — —	— — —	— — —	— — —		
																								1/2 Hard or Light Annealed	—/.50 .50/1.0 1.0/2.0 2.0/3.0 3.0/4.0 4.0/—
Hard	—/1.0 1.0/2.0	67 62 —	— — —	45 37 —	13 18 —	— — —	— — —	— — —	— — —																
										Shapes	As Extruded	All Sizes	52 — —	— — —	20 — —	30 — —	— — —	— — —	— — —	— — —					
																					C51000	Sheet and Strip	Soft	.039/— .029/— .019/.039 .009/.029	43 — —
1/2 Hard	.039/— .029/— .019/.039 .009/.029	58 — —	73 — —	— — —	— — —	64 60 —	85 82 —	— 59 53	73 69 —																
										Hard	.039/— .029/— .019/.039 .009/.029	76 — —	91 — —	— — —	— — —	86 84 —	93 91 —	— 73 71	78 75 —	— — —					

SAE 463 Revised SEP81

ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units														
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm		
				Over/Thru	Min			Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min		Max	
			Min			Max	Min				Max			
C51000	Sheet and Strip	Extra Hard	.039/—	88	103	—	—	RB ^b		R30T ^b		—	—	
			.029/—					92	96	—	—			
			.019/.039					89	95	77	81			
			.009/.029					—	—	74	78			
		Spring	.039/—	95	110	—	—	94	98	—	—	—	—	
			.029/—					92	97	79	82			
			.019/.039					—	—	76	80			
		Extra Spring	.039/—	100	114	—	—	95	99	—	—	—	—	
			.029/—					94	98	80	83			
	.019/.039		—					—	77	81				
	Rod	Soft	—/.249 ^{aa}	40	58	—	—	—	—	—	—	—	—	
			Hard	—/.249 ^{bb}	80	128	—	—	—	—	—	—	—	—
				.249/.500 ^{bb}	70	—	—	—	13	—	—	—	—	—
				.500/1.00 ^{bb}	60	—	—	—	15	—	—	—	—	—
		Spring		1.00/— ^{bb}	55	—	—	—	18	—	—	—	—	—
			.249/.375 ^{cc}	60	—	—	—	19	—	—	—	—	—	
			.375/— ^{cc}	55	—	—	—	15	—	—	—	—	—	
			—/.025 ^a	125	—	—	—	—	—	—	—	—	—	
		Spring	.025/.062 ^{aa}	115	—	—	—	—	—	—	—	—	—	
			.062/.125 ^{aa}	110	—	—	—	—	—	—	—	—	—	
			.125/.250 ^{aa}	105	—	—	3.5	—	—	—	—	—	—	
			.250/.375 ^{aa}	100	—	—	5.0	—	—	—	—	—	—	
			.375/.500 ^{aa}	90	—	—	9.0	—	—	—	—	—	—	
		Wire for General Purposes	Soft	—	43	58	—	—	—	—	—	—	—	
			1/4 Hard	—	60	76	—	—	—	—	—	—	—	
	1/2 Hard		—	80	97	—	—	—	—	—	—	—		
	3/4 Hard		—	96	115	—	—	—	—	—	—	—		
	Wire for Spring Purposes	—	—/.025	145	—	—	—	—	—	—	—	—		
			.025/.062	135	—	—	—	—	—	—	—	—		
			.062/.125	130	—	—	—	—	—	—	—	—		
		—	.125/.250	125	—	—	—	—	—	—	—	—		
			.250/.375	120	—	—	5.0	—	—	—	—	—		
			.375/.500	105	—	—	9.0	—	—	—	—	—		
	C51100 C54400	Sheet and Strip	Soft	.039/—	40	50	—	—	7	50	—	—	—	—
				.029/—					0	45	24	50		
				.019/.039					—	—	16	46		
1/2 Hard			.009/.029	55	70	—	—	60	81	—	—	—	—	
			.029/—					53	78	57	73			
			.019/.039					—	—	52	71			
Hard			.039/—	72	87	—	—	82	90	—	—	—	—	
			.029/—					80	88	71	77			
			.019/.039					—	—	69	75			
Extra Hard			.039/—	84	99	—	—	88	94	—	—	—	—	
			.029/—					86	92	75	80			
			.019/.039					—	—	73	78			
Spring			.039/—	91	105	—	—	90	96	—	—	—	—	
			.029/—					88	94	77	81			
			.019/.039					—	—	75	79			
Extra Spring			.039/—	96	109	—	—	92	97	—	—	—	—	
			.029/—					89	94	78	82			
			.019/.039					—	—	76	80			

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units													
Copper or Copper Alloy UNS No. ^{ee}	Form	Temper	Size Section, in Over/Thru	Tensile Strength, ksi		Yield Strength, Min ksi 0.5% Ext Under Load	Elongation, Min % ^c In 2 in	Hardness				Grain Size, mm	
				Min	Max			Min	Max	Min	Max	Min	Max
C52100	Sheet and Strip	Soft	.039/— .029/—	53	67	—	—	RB ^b		R30T ^b		—	—
		Soft	.019/.039 .009/.029	53	67	—	—	29	70	38	68	—	—
		1/2 Hard	.039/— .029/— .019/.039 .009/.029	69	84	—	—	76	91	—	—	—	—
		Hard	.039/— .029/— .019/.039 .009/.029	85	100	—	—	91	97	76	81	—	—
		Extra Hard	.039/— .029/— .019/.039 .009/.029	97	112	—	—	95	100	78	83	—	—
		Spring	.039/— .029/— .019/.039 .009/.029	105	119	—	—	97	102	79	84	—	—
		Extra Spring	.039/— .029/— .019/.039 .009/.029	110	122	—	—	98	103	80	84	—	—
C52400	Sheet and Strip	Soft	.039/— .029/— .019/.039 .009/.029	58	73	—	—	35	75	40	78	—	—
		1/2 Hard	.039/— .029/— .019/.039 .009/.029	76	91	—	—	78	95	67	80	—	—
		Hard	.039/— .029/— .019/.039 .009/.029	94	109	—	—	94	101	78	82	—	—
		Extra Hard	.039/— .029/— .019/.039 .009/.029	107	122	—	—	93	103	80	84	—	—
		Spring	.039/— .029/— .019/.039 .009/.029	115	129	—	—	99	104	81	85	—	—
		Extra Spring	.039/— .029/—	120	133	—	—	100	105	82	86	—	—
		Extra Spring	.019/.039 .009/.029	120	133	—	—	99	104	81	85	—	—
C54400	Sheet and Strip	See C51100											
	Rod	Hard	.061/.250 ^{bb} .249/.500 ^{bb} .500/1.0 ^{bb} 1.0/— ^{bb}	65	—	—	In 4 × Dia or Thickness of Specimen	—	—	—	—	—	—
				60	—	—		—	—	—	—	—	—
				55	—	—		—	—	—	—	—	—
				50	—	—		—	—	—	—	—	—
C60800	Tube	Annealed	All Sizes	50	—	19	—	—	—	—	—	0.010	0.045

SAE 463 Revised SEP81

ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units															
Copper or Copper Alloy UNS No. ^a	Form	Temper	Size Section, in		Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm		
			Over/Thru		Min	Max	0.5% Ext Under Load		In 2 in	Min	Max	Min	Max	Min	Max
			Thickness	Width											
C61300	Plate, ¹ Sheet, Strip and Rolled Bar	Soft													
			—/.500 All Widths		75	—	36	35	—	—	—	—	—	—	
			.500/2.0 All Widths		72	—	32	35	—	—	—	—	—	—	
			2.0/5.0 All Widths		65	—	28	35	—	—	—	—	—	—	
C61400	Plate, ¹ Sheet, Strip and Rolled Bar	Soft													
			—/.500 All Widths		72	—	32	35	—	—	—	—	—	—	
			.500/2.0 All Widths		70	—	30	35	—	—	—	—	—	—	
			2.0/5.0 All Widths		65	—	28	35	—	—	—	—	—	—	
	Hard	—/.500 All Widths		80	—	45	25	—	—	—	—	—	—		
		.500/1.0 All Widths		70	—	40	30	—	—	—	—	—	—		
	Rod and Bar	—	Size Section, in					In 4 × Dia							
			—/.500		80	—	40	30	—	—	—	—	—	—	
			.500/1.0		75	—	35	30	—	—	—	—	—	—	
			1.0/2.0		70	—	32	30	—	—	—	—	—	—	
C61800	Rod	1/2 Hard	—/3.0		—	—	—	—	—	—	—	—	—		
					—	—	—	—	—	—	—	—	—		
C62300	Rod and Bar	Drawn	—/.500		90	—	45	12	90	—	155	—	—	—	
			.500/1.0		88	—	44	15	—	—	—	—	—	—	
			1.0/2.0		84	—	40	15	—	—	—	—	—	—	
			2.0/3.0		76	—	37	20	—	—	—	—	—	—	
C62400	Rod and Bar	Drawn	3.0/—		75	—	30	20	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
C62300	Shapes	—	All Sizes		75	—	30	20	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
C62300	Forgings	As Forged	—/1.5		75	—	30	20	—	—	—	—	—	—	
			1.5/—		72	—	28	25	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
C62400	Rod	As Extruded	All Sizes		80	—	45	7.0	—	—	175	—	—	—	
			—		80	—	45	7.0	—	—	175	—	—	—	
		Forgings	Hardened and H ₂ O Quenched	—		—	—	—	—	—	—	240	—	—	—
			Hardened, H ₂ O Quenched and Tempered	—		87	—	—	8.0	—	—	179	—	—	—
C63000	Rod and Bar	Annealed	.499/1.0		100	—	50	5	—	—	RF ^b		—	—	
			1.0/2.0		90	—	45	6	—	—	—	—	—	—	
			2.0/4.0		85	—	42.5	10	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
C64200	Shapes	As Extruded	All Sizes		85	—	42.5	10	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
					—	—	—	—	—	—	—	—	—	—	
C64200	Rod and Bar	Drawn	—/.500		90	—	45	9	—	—	—	—	—	—	
			.500/1.0		85	—	45	12	—	—	—	—	—	—	
			1.0/2.0		80	—	42	12	—	—	—	—	—	—	
			2.0/3.0		75	—	35	15	—	—	—	—	—	—	
C65500	Plate, ¹ Sheet, Strip and Rolled Bar	Annealed	0.070 mm		52	58	—	—	—	—	70	82	0.050	0.110	
			0.040 mm		55	64	—	—	—	—	76	93	Note a	0.055	
		1/4 Hard	—		62	72	—	—	65	80	—	—	—	—	—
			—		71	81	—	—	79	91	—	—	—	—	
			—		87	97	—	—	88	96	—	—	—	—	
			—		99	108	—	—	93	98	—	—	—	—	
		Spring ^k	—		105	113	—	—	94	99	—	—	—	—	—
			—		—	—	—	—	—	—	—	—	—	—	—
			—		—	—	—	—	—	—	—	—	—	—	—
			—		—	—	—	—	—	—	—	—	—	—	—
Hot Rolled	—		55	72	—	—	—	—	72	—	—	—	—		
	—		—	—	—	—	—	—	—	—	—	—	—		
Hot Rolled and Cold Rolled Finish	—		58	72	—	—	—	—	60	80	—	—	—	—	
	—		—	—	—	—	—	—	—	—	—	—	—		

ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units														
Copper or Copper Alloy UNS No. ^{1a}	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c In 4 × Dia or Thickness of Specimen	Hardness				Grain Size, mm		
				Over/Thru	Min			Max	0.5% Ext Under Load	Min	Max	Min	Max	Min
			Min			Max	Min							
C65500	Rod, Bar and Shapes	Soft	All Forms and Sizes	52	—	15	35	RB ^b		RF ^b		—	—	
		1/4 Hard	All Forms and Sizes	55	—	24	25	—	—	—	—	—	—	
		1/2 Hard	—/.20 ^{dd}	70	—	38	17	—	—	—	—	—	—	
		Hard	—/.250 ^{dd} .250/.500 ^{dd}	85 85	—	50 50	8 13	—	—	—	—	—	—	
		Extra Hard	—/.500 ^{ee}	100	—	55	7	—	—	—	—	—	—	
	Bar	Soft	All Sizes	52	—	15	35	—	—	—	—	—	—	
		Hard	—/1.0 1.0/1.5 1.5/3.0	65 60 55	—	38 30 24	20 25 27	—	—	—	—	—	—	
	C67000	Rod and Bar	Soft	All Sizes	85	—	45	10 ^e	—	—	—	—	—	—
			1/2 Hard Hard	All Sizes All Sizes	105 115	—	60 68	7 ^e 5 ^e	—	—	—	—	—	—
Forgings		Soft	—	85	—	45	10	—	—	—	—	—	—	
		1/2 Hard Hard	— —	93 100	—	50 55	7 5	—	—	—	—	—	—	
C67300	Rod and Bar	As Extruded	All Sizes	55	—	25	20	60	—	—	—	—	—	
		Soft	All Sizes	55	—	25	20	50	—	—	—	—	—	
		1/2 Hard ^{ff}	—/1.0	65	—	40	12	70	—	—	—	—	—	
		1/2 Hard ^{gg}	1.0/3.0 3.0/—	58 55	—	35 30	15 18	70 65	—	R30T ^b		—	—	
		1/2 Hard ^{hh}	All Sizes	60	—	30	20	70	—	—	—	—	—	
		Hard ⁱⁱ	—/1.0 1.0/2.0	70 62	—	50 42	10 15	70 70	—	—	—	—	—	
	Shapes	As Extruded	All Sizes	55	—	25	20	60	—	—	—	—	—	
	Forgings	As Forged	—	55	—	25	20	60	—	—	—	—	—	
		Forged and Heat Treated	—	69	—	35	12	70	—	—	—	—	—	
	C67400	Rod and Bar	As Extruded	All Sizes	70	—	34	12	75	—	—	—	—	—
Extruded and Drawn			—/1.0 1.0/2.0 2.0/3.0	78 75 70	—	40 40 36	8 10 12	84 80 78	—	—	—	—	—	
Shapes		As Extruded	All Sizes	70	—	34	12	75	—	—	—	—	—	
Forgings		As Forged	—	65	—	30	15	75	—	—	—	—	—	
C67500	Rod	Soft	All Sizes	55	—	22	20	—	—	—	—	—	—	
		1/2 Hard	—/1.0 1.0/2.5 2.5/—	72 70 65	—	36 35 32	13 15 17	—	—	—	—	—	—	
		Hard	—/1.0 1.0/1.5 1.5/2.5 2.5/—	80 76 73 68	—	56 52 48 45	8 10 12 16	—	—	—	—	—	—	

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ed. TABLE 2B—MINIMUM MECHANICAL PROPERTIES OF WROUGHT COPPER ALLOYS (CONTINUED)

Customary Units														
Copper or Copper Alloy UNS No. ^{a,c}	Form	Temper	Size Section, in	Tensile Strength, ksi		Yield Strength, Min ksi	Elongation, Min % ^c	Hardness				Grain Size, mm		
			Over/Thru	Min	Max	0.5% Ext Under Load	In 4 × Dia or Thickness of Specimen	Min	Max	Min	Max	Min	Max	
C67500	Bar	Soft	All Sizes	55	—	22	20	RB ^b		R30T ^b		—	—	
		1/2 Hard	—/1.0	72	—	36	13	—	—	—	—	—	—	
			1.0/2.5	70	—	35	15	—	—	—	—	—	—	
			2.5/—	65	—	32	17	—	—	—	—	—	—	
	Hard	—/1.0	76	—	52	8	—	—	—	—	—	—		
1.0/2.5		72	—	47	12	—	—	—	—	—	—			
2.5/—		68	—	45	16	—	—	—	—	—	—			
	Shapes	Soft	All Sizes	55	—	22	20	—	—	—	—	—	—	
C70600	Condenser Tube Plate	—	—/2.5	40	—	15	In 2 in 30	—	—	—	—	—	—	
	Tube	Annealed	—	40	—	15	—	—	—	—	—	—	—	
		Light Drawn	—	45	—	35	—	—	—	—	—	—	—	
C71000	Tube	Annealed	—	45	—	16	—	—	—	—	—	—	—	
		Plate, ^t Sheet, Strip and Rolled Bar	Annealed 0.035 mm 0.015 mm	— —	— —	— —	67 76	76 90	18 35	35 58	28 40	40 55	0.025 Note a	0.050 0.020
			1/4 Hard	—	47	63	—	—	45	72	46	65	—	—
	1/2 Hard		—	56	70	—	—	64	78	59	69	—	—	
	Hard		—	67	79	—	—	76	84	67	73	—	—	
	Extra Hard	—	72	84	—	—	79	87	69	75	—	—		
	Spring	—	76	87	—	—	82	88	71	75	—	—		
	C71500	Condenser Tube Plate	—	—/2.5 2.5/5.0	50	—	20	Elongation, Min % ^c In 2 in						
45					—	18	35 35	—	—	—	—	—	—	
Tube		Annealed	—	52	—	18	—	—	—	—	—	—	—	
		Drawn and Stress Relieved	—/.048 Wall .048/— Wall	72 72	— —	50 50	12 15	— —	— —	— —	— —	— —	— —	
Plate, ^t Sheet, Strip and Rolled Bar		Annealed	— — — —	— — — —	— — — —	— — — —	Hardness							
							Min	Max						
							RF ^b							
							70 74	85 93	23 37	45 63	31 40	46 58	0.025 Note a	0.050 0.025
		1/4 Hard	—	58	72	—	—	67	81	61	71	—	—	
		1/2 Hard	—	66	80	—	—	76	85	67	74	—	—	
		Hard	—	75	88	—	—	83	89	72	76	—	—	
		Extra Hard	—	80	92	—	—	85	91	73	77	—	—	
Spring	—	84	94	—	—	87	91	74	77	—	—			