

COPPER Nos. C12200 and C12210 (PHOSPHORUS DEOXIDIZED, HIGH RESIDUAL PHOSPHORUS)

Composition — percent

	Nominal	Minimum	Maximum
Copper No. C12200	....	99.9*	....
Copper (incl. Silver)	.02	.015	.040
Phosphorus	....	....	....
Copper No. C12210	....	99.90	....
Copper (incl. Silver)	.02	.015	.025
Phosphorus	....	....	....

*This includes oxygen-free copper which contains phosphorus in an amount agreed upon

Nearest Applicable A S T M Specifications

Flat Products	B101, B124, B133 B152, B370, B432, B506
Fittings	ANSI B16.22, ANSI B16.29
Nipples	B687
Pipe	B42, B302
Rod	B124, B133
Shapes	B124, B133
Tube	B68, B75, B88, B111, B280, B306, B359, B360, B395, B447, B543
Wire	B260

**Refer to Specific ASTM Specifications for alloys covered

Physical Properties

	English Units	C. G. S. Units
Melting Point (Liquidus)	1981 F	1083 C
Melting Point (Solidus)	F	C
Density	.323 lb/cu in @ 68 F	8.94 gm/cu cm @ 20 C.
Specific Gravity	8.94	8.94
Coefficient of Thermal Expansion	.0000094 per °F from 68 F to 212 F	.0000170 per °C from 20 C to 100 C
Coefficient of Thermal Expansion	.0000095 per °F from 68 F to 392 F	.0000173 per °C from 20 C to 200 C
Coefficient of Thermal Expansion	.0000098 per °F from 68 F to 572 F	.0000177 per °C from 20 C to 300 C
Thermal Conductivity	196 Btu/sq ft/ft/°F @ 68 F	.81 cal/sq cm/cm/sec/°C @ 20 C
Electrical Resistivity (Annealed)	12.2 Ohms (circ mil/ft) @ 68 F	2.03 Microhm-cm @ 20 C
Electrical Conductivity* (Annealed)	85 % IACS @ 68 F	4.93 Meghm-cm @ 20 C
Thermal Capacity (Specific Heat)	.092 Btu/lb °F @ 68 F	.092 cal/gm °C @ 20 C
Modulus of Elasticity (Tension)	17,000 ksi	12,000 Kg/sq mm
Modulus of Rigidity	6,400 ksi	4,500 Kg/sq mm

* Volume and Weight Basis

Typical Uses

HOUSEHOLD:	air conditioners, gas lines, heater lines and units, oil burner tubes, plumbing pipe and tube, refrigerators
INDUSTRIAL:	air conditioners, brewery tubes, condenser, evaporator and heat exchanger tubes, dairy tubes, distiller tubes, kettles, pulp and paper lines, steam and water lines, tanks
TRANSPORTATION:	(Air, Land and Sea): air, gasoline, hydraulic and oil lines, oil coolers
MISCELLANEOUS:	gauge lines, rotating bands

Common Fabrication Processes

Blanking, coining, coppersmithing, drawing, etching, forming and bending, heading and upsetting, hot forging and pressing, piercing and punching, roll threading and knurling, shearing, spinning, squeezing and swaging, stamping

Fabrication Properties

Capacity for Being Cold Worked	Excellent
Capacity for Being Hot Formed	Excellent
Hot Forgeability Rating (Forging Brass = 100)	65
Hot Working Temperature	1400-1600 F or 750-875 C
Annealing Temperature	700-1200 F or 375-650 C
Machinability Rating (Free Cutting Brass = 100)	20

Suitability for being joined by:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Good
Gas Shielded Arc Welding	Excellent
Coated Metal Arc Welding	Not Recommended
Resistance Welding	Spot Not Recommended
	Seam Not Recommended
	Butt Good

Forms and Tempers Most Commonly Used

FLAT PRODUCTS	Nominal Grain Size mm	Annealed Tempers				Rolled or Drawn Tempers						Hot Finished Tempers											
		.100 (OS100)	.070 (OS070)	.050 (OS050)	.035 (OS035)	Soft Anneal (O60)	Light Anneal (O50)	Eight Hard (H00)	Quarter Hard (H01)	Half Hard (H02)	Three Quarter Hard (H03)	Hard (H04)	Extra Hard (H05)	Spring (H08)	Extra Spring (H10)	Drawn - General Purpose (H58)	Hard Drawn (H80)	Light Draw - Bending (H55)	As Hot Rolled (M20)	As Extruded (M30)	Special Tempers		
Strip, Rolled		•																					
Strip, Drawn																							
Flat Wire, Rolled																							
Flat Wire, Drawn																							
Bar, Rolled																							
Bar, Drawn																							
Sheet																							
Plate																							
ROD																							
WIRE																							
TUBE																							
PIPE																							
SHAPES																							

DRAWN-GENERAL PURPOSE (H58) temper is used for general purpose tube only, usually where there is no real requirement for high strength or hardness on the one hand or for bending qualities on the other.

HARD DRAWN (H80) temper is used only where there is need for a tube as hard or as strong as is commercially feasible for the size in question.

LIGHT DRAW-BENDING (H55) temper is used only where a tube of some stiffness, but yet capable of readily being bent (or otherwise moderately cold worked) is needed.

Mechanical Properties

Form	Size Section in.	Temper	Tensile Strength ksi	Yield Strength		Elongation in 2 in. %	Rockwell Hardness		Shear Strength ksi	Fatigue Strength		
				(.5% Ext. under Load) ksi	(.2% Offset) ksi		F	B | 30T		ksi	Million Cycles	
FLAT PRODUCTS	.040 in.	.050 mm	32.0	10.0	....	45	40	-	22.0	....	....
		.025 mm	34.0	11.0	....	45	45	-	23.0	11.0	100	
		Eight Hard	36.0	28.0	....	30	60	10	25	25.0	....	....
		Quarter Hard	38.0	30.0	....	25	70	25	36	25.0	....	....
		Half Hard	42.0	36.0	....	14	84	40	50	26.0	13.0	100
		Hard	50.0	45.0	....	6	90	50	57	28.0	13.0	100
	.250 in.	Spring	55.0	50.0	....	4	94	60	63	29.0	14.0	100
		Extra Spring	57.0	53.0	....	4	95	62	64	29.0	....	....
		As Hot Rolled	34.0	10.0	....	45	45	-	23.0	....	....	....
		.050 mm	32.0	10.0	....	50	40	-	22.0	....	....	....
		Eight Hard	36.0	28.0	....	40	60	10	25.0	....	....	....
		Quarter Hard	38.0	30.0	....	35	70	25	25.0	....	....	....
1.0 in.	Hard	50.0	45.0	....	12	90	50	28.0	....	....	....
	As Hot Rolled	32.0	10.0	....	50	40	-	22.0	....	....	....
TUBE	1.0 in. OD	Hard	45.0	40.0	....	20	85	45	26.0	....	....
		.050 mm	32.0	10.0	....	45	40	-	22.0	11.0*	20	
	X .065 in.	.025 mm	34.0	11.0	....	45	45	-	23.0	....	....
		Light Drawn (15%)	40.0	32.0	....	25	77	35	45	26.0	14.0*	20
PIPE	¾ in. SPS	Hard Drawn (40%)	55.0	50.0	....	8	95	60	63	29.0	19.0*	20
		Hard (30%)	50.0	45.0	....	10	90	50	-	28.0	....	....

* Rotating beam test on rod

The values listed above represent reasonable approximations suitable for general engineering use. Due to commercial variations in composition and to manufacturing limitations, they should not be used for specification purposes. See applicable A.S.T.M. specification references.