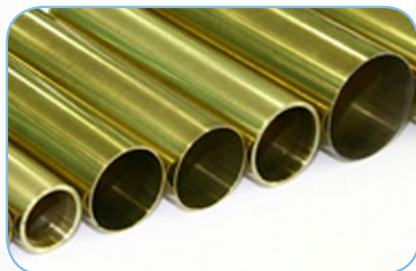
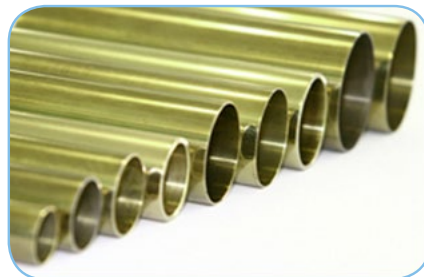
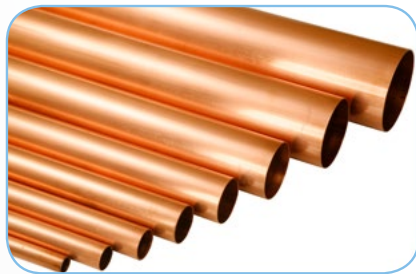




Termomecanica
São Paulo S.A.

Portfolio - Tube Alloys



Typical Applications:

Electrical: Numerous specialized applications such as: radar components and other electrical and electronic equipment, valve anodes, glass-metal seals in electronic equipment, thermostat components, rotor windings for generators and large motors, waveguides and flexible cables, components of electrical equipment working at high temperatures in the presence of reducing gases, anodes for electroplating in cyanide baths, cathode tubes, conductors for lamps and valves.

Miscellaneous: Applications requiring high conductivity and in which there is heating in the presence of reducing gases, including in the processes of welding and brazing.

Processes Used in Transformation: Shearing, minting, stamping, drawing, extrusion, hot forging, hammering, punching, folding, hot forging, knurling and threading with rollers, drawing.

Chemical Composition:

Copper	99,95% minimum
Oxygen	10 ppm maximum

Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ °C)	Electrical Volumetric Conductivity at 20°C (%I.A.C.S.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed at 20°C		
8,94	1083	17,7	101	0,93	0,09	0,0171	115000	44000

Technological Features:

Annealing Temperature Range	375-650°C
Temperature Range for Hot Work	750-875°C
Hot Conformability	Good
Cold Conformability	Excellent
Relative Machining (CLA Brass = 100%)	20%

Junction Methods:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Fair
Carbon Arc Welding	Not Recommended
Arc Welding with Protective Atmosphere	Good
Arc Welding with Coated Electrode	Not Recommended
Resistance Welding:	
Spot and Wheels	Not Recommended
Flash Butt Welding	Not Recommended

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B188):

Cross Section	Temper	Tensile Strength (MPa)		Elongation (%), min. C	Hardness Range	Gauges related to the indicated properties (mm)
		Minimum	Maximum		Rockwell F (HRF)	
Tubes in General	Annealed	-	255	25	50 max.	All
Rectangular and Square Tubes	Hard (1/2 hard)	240	-	8	75 min.	External Width up to 152.40 Wall thickness up to 4.76 incl.
	Hard (1/2 hard)	230	-	15	65 min.	External Width up to 152.40 Wall thickness above 4.76
	Hard (1/2 hard)	220	-	20	65 min.	External Width above 152.40
Round Tubes	Hard (1/2 hard)	275	-	3	80 min.	External diameter up to 101.60 incl.
	Hard (1/2 hard)	260	-	6	75 min.	External diameter above 101.60

C The gauge length is 50 mm.

Manufactured Measures Round Tubes (Straight Lengths):

	Pol.	1/4"	5/16"	3/8"	1/2"	9/16"	5/8"	3/4"	7/8"	1"	1. 1/4"	2"	2.1/8"	2.1/2"	2.5/8"	3.1/8"	3.1/2"	4.1/8"	8"								
		In	0,220	0,250	0,313	0,375	0,500	0,562	0,750	0,875	1,000	1,250	1,575	2,000	2,125	2,500	2,625	3,125	3,500		4,125	6,299	8,000				
DIAMETER																											
	mm	5,60	6,35	7,94	9,52	12,70	14,28	15,87	19,05	22,22	25,40	31,75	40,00	50,80	53,97	63,50	66,67	79,37	88,90	104,77	160,00	203,20	mm				
in.																								in.			
0,014	0,35																							0,014	0,35		
0,016	0,40																								0,016	0,40	
0,019	0,47																									0,019	0,47
0,020	0,50																									0,020	0,50
0,028	0,70																									0,028	0,70
0,031	0,79																									0,031	0,79
0,039	1,00																									0,039	1,00
0,049	1,25																									0,049	1,25
0,062	1,58																									0,062	1,58
0,065	1,65																									0,065	1,65
0,079	2,00																									0,079	2,00
0,125	3,17																									0,125	3,17
0,157	4,00																									0,157	4,00
0,177	4,50																									0,177	4,50
0,276	7,00																									0,276	7,00
0,315	8,00																									0,315	8,00
0,500	12,70																									0,500	12,70
0,630	16,00																									0,630	16,00
0,827	21,00																									0,827	21,00

Any other sizes should be assessed under consultation.

Standard length from 4 to 6 meters. We may provide other lengths upon request.



Typical Applications:

Electrical: Numerous specialized applications such as: radar components and other electrical and electronic equipment, valve anodes, glass-metal seals in electronic equipment, thermostat components, rotor windings for generators and large motors, waveguides and flexible cables, components of electrical equipment working at high temperatures in the presence of reducing gases, anodes for electroplating in cyanide baths, cathode tubes, conductors for lamps and valves.

Miscellaneous: Applications requiring high conductivity and in which there is heating in the presence of reducing gases, including in the processes of welding and brazing.

Processes Used in Transformation: Shearing, minting, stamping, drawing, extrusion, hot forging, hammering, punching, folding, hot forging, knurling and threading with rollers, drawing.

Chemical Composition:

Copper*	99,90% minimum
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* Including Silver.



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ °C)	Electrical Volumetric Conductivity at 20°C (%I.A.C.S.)		Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)		Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed	Cold worked			Annealed for 100-101% I.A.C.S. (100-200°C)	Hard drawn for 97% I.A.C.S. (100-200°C)		
8,89	1083	17,7	100-101,5	97	0,93	0,092	0,017-0,01724	0,00178	115000	44000

Technological Features:

Annealing Temperature Range	475-750°C
Temperature Range for Hot Work	750-875°C
Solidification Temperature	1065°C
Hot Conformability	Excellent
Cold Conformability	Excellent
Relative Machining (CLA Brass = 100%)	20%

Junction Methods:

Soldering	Excellent
Brazing	Good
Oxyacetylene Welding	Not Recommended
Arc Welding with Protective Atmosphere	Fair
Arc Welding with Coated Electrode	Not Recommended
Resistance Welding:	
Spot and Wheels	Not Recommended
Flash Butt Welding	Good

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B188):

Cross Section	Temper	Tensile Strength (MPa)		Elongation (%), min. C	Hardness Range	Gauges related to the indicated properties (mm)
		Minimum	Maximum		Rockwell F (HRF)	
Tubes in General	Annealed	-	255	25	50 max.	All
Rectangular and Square Tubes	Hard (1/2 hard)	240	-	8	75 min.	External Width up to 152.40 Wall thickness up to 4.76 incl.
	Hard (1/2 hard)	230	-	15	65 min.	External Width up to 152.40 Wall thickness above 4.76
	Hard (1/2 hard)	220	-	20	65 min.	External Width above 152.40
Round Tubes	Hard (1/2 hard)	275	-	3	80 min.	External diameter up to 101.60 incl.
	Hard (1/2 hard)	260	-	6	75 min.	External diameter above 101.60

C The gauge length is 50 mm.

Electrolytic Tough Pitch Copper (ETP) | UNS C11000



Manufactured Measures Round Tubes (bar):

		Pol.	1/4"	5/16"	3/8"	1/2"	9/16"	5/8"	3/4"	7/8"	1"	1. 1/4"	2"	2.1/8"	2.1/2"	2.5/8"	3.1/8"	3.1/2"	4.1/8"	8"							
		In	0,220	0,250	0,313	0,375	0,500	0,562	0,625	0,750	0,875	1,000	1,250	1,575	2,000	2,125	2,500	2,625	3,125	3,500	4,125	6,299	8,000				
		DIAMETER																									
		mm	5,60	6,35	7,94	9,52	12,70	14,28	15,87	19,05	22,22	25,40	31,75	40,00	50,80	53,97	63,50	66,67	79,37	88,90	104,77	160,00	203,20	mm			
in.	WALL THICKNESS																						in.	WALL THICKNESS			
0,014	0,35																								0,014	0,35	
0,016	0,40																									0,016	0,40
0,019	0,47																									0,019	0,47
0,020	0,50																									0,020	0,50
0,028	0,70																									0,028	0,70
0,031	0,79																									0,031	0,79
0,039	1,00																									0,039	1,00
0,049	1,25																									0,049	1,25
0,062	1,58																									0,062	1,58
0,065	1,65																									0,065	1,65
0,079	2,00																									0,079	2,00
0,125	3,17																									0,125	3,17
0,157	4,00																									0,157	4,00
0,177	4,50																									0,177	4,50
0,276	7,00																									0,276	7,00
0,315	8,00																									0,315	8,00
0,500	12,70																									0,500	12,70
0,630	16,00																									0,630	16,00
0,827	21,00																									0,827	21,00

Any other sizes should be assessed under consultation.
 Standard length from 4 to 6 meters. We may provide other lengths upon request.

Electrolytic Tough Pitch Copper (ETP) | UNS C11000



Manufactured Measures Rectangular Tubes (bar):

		Pol.	DIMENSIONS											
			In	1,830 x 0,875 x 0,125	2,077 x 1,817 x 0,156	6,000 x 5,000 x 0,250	7,000 x 3,000 x 0,250	1,890 x 1,653 x 0,315			2,756 x 1,653 x 0,374	5,000 x 4,000 x 0,500		
			mm	46,48 x 22,23	52,76 x 46,15	152,00 x 127,00	177,80 x 76,20	48,00 x 42,00	70,00 x 42,00	127,00 x 101,60			mm	
in.											in.			
0,125	WALL THICKNESS	3,17									0,125	3,17		
0,156		3,96									0,156	3,96		
0,250		6,35									0,250	6,35		
0,315		8,00									0,315	8,00		
0,374		9,50									0,374	9,50		
0,500		12,70									0,500	12,70		

Any other sizes should be assessed under consultation.

Manufactured Measures Square Tubes (bar):

			Pol.	2.1/2"	3"	4"				
			In	2,500	3,000	4,000				
DIMENSIONS										
	WALL	mm		63,50 x 63,50	76,20 x 76,20	101,60 x 101,60			mm	
in.										
0,375		9,52							9,52	
0,500		12,70							12,70	

Any other sizes should be assessed under consultation.



Typical Applications:

Architectural and Building: Piping for hot and cold water, for gas and for underground and exposed heating installations, water discharge tubes, reservoirs, tanks, hot water accumulators, air conditioning equipment.

Mechanical: Construction of all equipment that must be heated in a reducing atmosphere for welding or during operation, tubes for evaporators and heat exchangers, tubes for air, water, oil, steam and radiators.

Chemical: Pots, alembics, autoclaves, copper boiler works whose construction requires the use of the welding process, tubes for liquids and gases of reduced aggressiveness and for the refrigeration industry.

Electrical: Anodes for electroplating in acid sulfate baths.

Processes Used in Transformation: Shearing, minting, stamping, drawing, extrusion, hot forging, hammering, punching, folding, hot forging, knurling and threading with rollers, drawing.

Chemical Composition:

Copper	99,90% minimum
Phosphor	0,015 - 0,040%



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ /°C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed at 20°C		
8,9	1083	17,7	80	0,93	0,092	0,0171	117600	44100

Technological Features:

Annealing Temperature Range	375-650°C
Temperature Range for Hot Work	750-875°C
Solidification Temperature	1065°C
Hot Conformability	Good
Cold Conformability	Excellent
Relative Machining (CLA Brass = 100%)	20%

Junction Methods:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Good
Arc Welding with Protective Atmosphere	Not Recommended
Arc Welding with Coated Electrode	Excellent
Resistance Welding:	Spot and Wheels Fair
	Flash Butt Welding Good

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B75):

Cross Section	Temper	External Diameter (mm)	Wall Thickness (mm)	Tensile Strength (MPa)		Yielding Point (MPa), min. A	Grain Size (mm)	Rockwell Hardness Range	
				Min.	Max.			Scale	Value
Bar Tubes Seamless (Extruded)	Light Annealing	All	From 0.381 to 0.889	205		62	0,040mm max.	15 T	65 max.
	Light Annealing	All	0.889 and above	205		62	0,040mm max.	F	55 max.
	1/4 Hard	All	All	250	325	205	-	30 T	30 - 60
	1/2 Hard	All	All	250		205	-	30 T	30 min.
	Hard	Up to 102	From 0.508 to 6.35 incl.	310		275	-	30 T	55 min.
A The indicated value corresponds to the unit load capable of causing a permanent deformation of 0.5%.									

Phosphorus Deoxidized Copper (DHP) | UNS C12200



Manufactured Measures Round Tubes (bar):

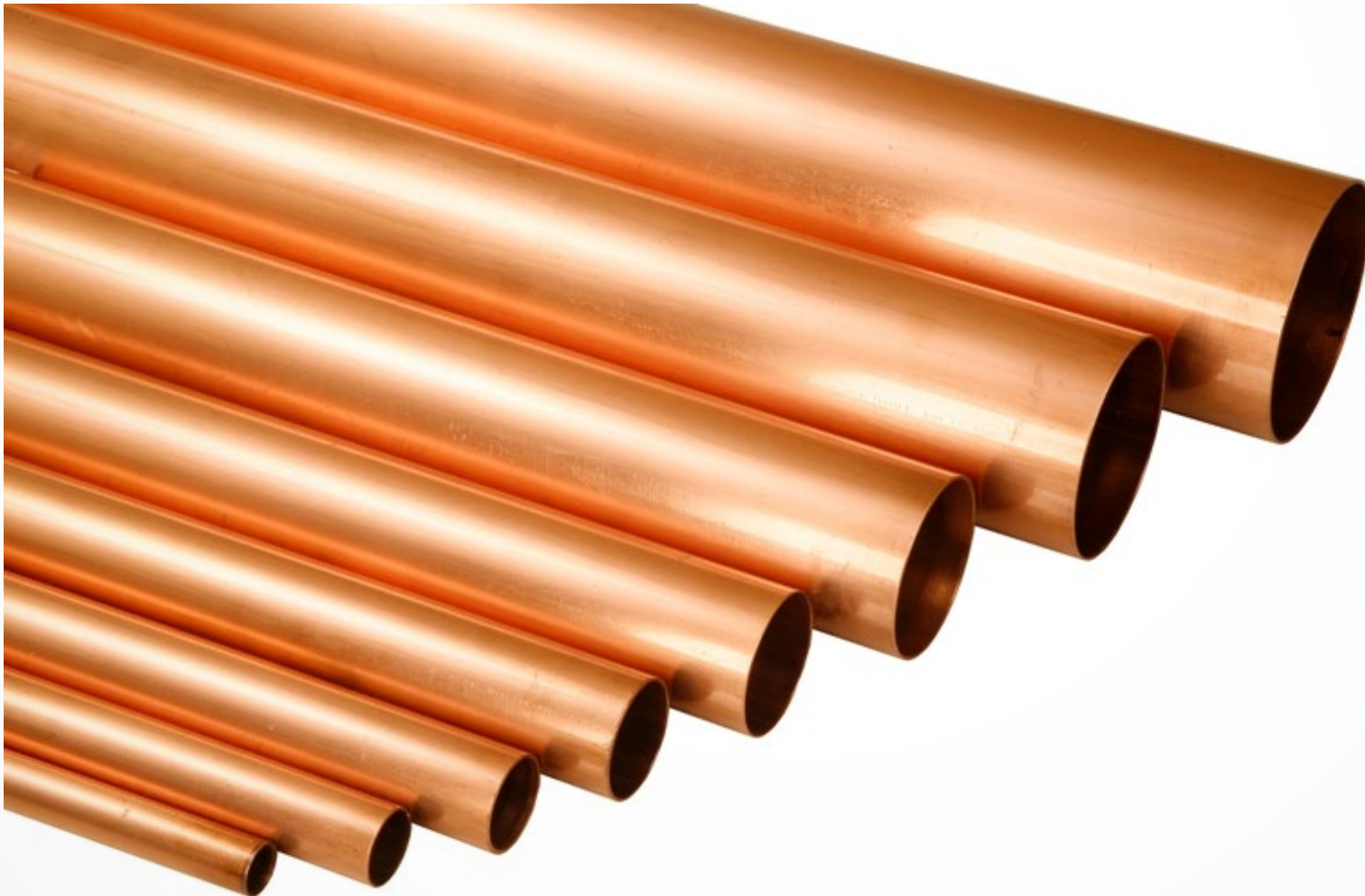
		DIAMETER																		
		Pol.	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	7/8"	2"	2.1/8"	2.5/8"	3.1/8"	3.1/2"	4.1/8"	6.1/8"	8"			
		In	0,250	0,313	0,375	0,500	0,625	0,750	0,875	2,000	2,125	2,625	3,125	3,500	4,125	6,125	8,000			
		mm	6,35	7,94	9,52	12,70	15,87	19,05	22,22	50,80	53,97	66,67	79,37	88,90	104,77	155,57	203,20		mm	
in.	WALL THICKNESS																		in.	
0,014	0,35																		0,014	0,35
0,016	0,40																		0,016	0,40
0,019	0,47																		0,019	0,47
0,020	0,50																		0,020	0,50
0,028	0,70																		0,028	0,70
0,031	0,79																		0,031	0,79
0,031	0,80																		0,031	0,80
0,049	1,25																		0,049	1,25
0,062	1,58																		0,062	1,58
0,065	1,65																		0,065	1,65
0,079	2,00																		0,079	2,00
0,125	3,17																		0,125	3,17
0,157	4,00																		0,157	4,00
0,177	4,50																		0,177	4,50
0,276	7,00																		0,276	7,00
0,315	8,00																		0,315	8,00
0,500	12,70																		0,500	12,70
0,625	15,87																		0,625	15,87
0,827	21,00																		0,827	21,00

Any other sizes should be assessed under consultation.

Standard length from 4 to 6 meters. We may provide other lengths upon request.

Phosphorus Deoxidized Copper (DHP) | UNS C12200

Material images:



Dimensions and Tolerances in Diameter and Wall Thickness for Water Conduction Tube (ASTM-B88):

Nominal Standard (In.)	External Diameter (in.)	External Diameter (mm)	Wall Thickness and Tolerances (mm)					
			Type K		Type L		Type M	
			Thickness (mm)	Tolerance A (mm)	Thickness (mm)	Tolerance A (mm)	Thickness (mm)	Tolerance A (mm)
1/4"	0,375	9,525	0,889	0,089	0,762	0,076	<i>B</i>	<i>B</i>
3/8"	0,500	12,700	1,245	0,127	0,889	0,102	0,635	0,051
1/2"	0,625	15,875	1,245	0,127	1,016	0,102	0,711	0,076
5/8"	0,750	19,050	1,245	0,127	1,067	0,102	<i>B</i>	<i>B</i>
3/4"	0,875	22,225	1,651	0,152	1,143	0,102	0,813	0,076
1"	1,125	28,575	1,651	0,152	1,270	0,127	0,889	0,102
1 1/4"	1,375	34,925	1,651	0,152	1,397	0,152	1,067	0,102
1 1/2"	1,625	41,275	1,829	0,178	1,524	0,152	1,245	0,127
2"	2,125	53,975	2,108	0,203	1,778	0,178	1,473	0,152
2 1/2"	2,625	66,675	2,413	0,254	2,032	0,203	1,651	0,152
3"	3,125	79,375	2,769	0,279	2,286	0,229	1,829	0,178
3 1/2"	3,625	92,075	3,048	0,305	2,540	0,254	2,108	0,203
4"	4,125	104,775	3,404	0,330	2,794	0,279	2,413	0,254
5"	5,125	130,175	4,064	0,406	3,175	0,305	2,769	0,279
6"	6,125	155,575	4,877	0,483	3,556	0,356	3,099	0,305
8"	8,125	206,375	6,883	0,686	5,080	0,508	4,318	0,432
10"	10,125	257,175	8,585	0,864	6,350	0,635	5,385	0,533
12"	12,125	307,975	10,287	1,016	7,112	0,711	6,452	0,635

A Maximum deviation at any point.

B No tolerance was established.

The colors used are: green for Type K, blue for Type L and red for Type M. This color marking is not applicable to the tube supplied in annealed straight lengths.

Typical Applications:

Architectural: Intended for parts to be brazed: friezes, gaskets, angles, cold obtained gutters, engraved plates, emblems.

Chemical: Flexible hoses and piping.

Decorative: Emblems, cosmetic containers, dials for clocks and instruments, costume jewelry, engraved plates.

Mechanical: Parts to be brazed, bellows, flexible tubes, zip locks, eyelets and hooks.

Hydraulic: Water piping and accessories. Material used in the oil refineries when the circulating water is fresh or with low salinity. Good resistance to dezincification and low resistance to sulfur attack.

Processes Used in Transformation: Shearing, minting, stamping, drawing, extrusion, hot forging, hammering, punching, folding, hot forging, knurling and threading with rollers, drawing.

Chemical Composition:

Copper	84,0 - 86,0%
Lead	0,050% maximum
Iron	0,050% maximum
Zinc	Remaining

Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ /°C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed at 20°C		
8,75	1025	18,7	37	0,38	0,09	0,047	115000	44000

Technological Features:

Annealing Temperature Range	425-725°C
Temperature Range for Hot Work	800-900°C
Solidification Temperature	990°C
Hot Conformability	Fair
Cold Conformability	Excellent
Relative Machining (CLA Brass = 100%)	30%

Junction Methods:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Good
Carbon Arc Welding	Not Recommended
Arc Welding with Protective Atmosphere	Good
Arc Welding with Coated Electrode	Not Recommended
Resistance Welding:	
Spot and Wheels	Fair
Flash Butt Welding	Good

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B135):

Cross Section	Hardness Degree	External Diameter (mm)	Wall Thickness (mm)	Tensile Strength (MPa)	Grain Size (mm)	Hardness Range	
						Scale	Value
Tubes	Deep Annealing	All	up to 1.0 incl.	-	0.025 - 0.060	30 T	36 max.
	Deep Annealing	All	above 1.0	-	0.025 - 0.060	F	75 max.
	Light Annealing	All	up to 1.0 incl.	-	0.035 max.	30 T	39 max.
	Light Annealing	All	above 1.0	-	0.035 max.	F	85 max.
	1/4 Hard F	All	All	305 - 400	-	30 T	43 - 75
	1/2 Hard G	All	All	305 min.	-	30 T	43 min.
	Hard F	up to 25.0 incl.	from 0.50 to 3.0 incl.	395 min.	-	30 T	65 min.
	Hard F	from 25.0 to 50.0 incl.	from 0.90 to 5.0 incl.	395 min.	-	30 T	65 min.
	Hard F	Above 50 to 100.0 incl.	from 1.5 to 6.0 incl.	395 min.	-	30 T	65 min.

F The Hardness Degrees 1/4 Hard and Hard are available for round tubes only.
G The Hardness Degree 1/2 Hard is for general use.

Manufactured Measures Round Tubes (Straigth Lengths):

		Pol.	5/8"	3/4"	1"		1.1/4"	1.1/2"	1.3/4"	2.3/4"	3.1/2"	4"	5"			
			In	0,472	0,625	0,750	1,000	1,024	1,250	1,500	1,750	2,750	3,500			4,000
		DIAMETER														
	mm		12,00	15,87	19,05	25,40	26,00	31,75	38,10	44,45	69,85	88,90	101,60	127,00		mm
in.															in.	
0,020	0,50														0,020	0,50
0,031	0,79														0,031	0,79
0,039	1,00														0,039	1,00
0,059	1,50														0,059	1,50
0,094	2,38														0,094	2,38
0,118	3,00														0,118	3,00
0,125	3,17														0,125	3,17

Any other sizes should be assessed under consultation.



Typical Applications:

Chemical: Heat exchangers for fresh and clean water, evaporators and broth heaters in sugar mills, fire extinguisher bodies.

Electrical: Cases for lamps, reflectors, sockets and lamp receptacles.

Miscellaneous: Chains, eyelets, hooks, hinges, wire meshes, wire brushes.

Chemical Composition:

Copper	68,5 - 71,5%
Lead	0,070% maximum
Iron	0,050% maximum
Zinc	Remaining

Mechanical: Parts obtained by deep stamping and drawing, such as: cartridges, musical instruments, tubes and reservoirs for automobile radiators, carburetor components, reinforcement wires for brake linings and clutches, parts obtained by cold sizing, such as rivets and screws, parts obtained by stamping strips.

Processes Used in Transformation: Shearing, minting, stamping, drawing, extrusion, hot forging, hammering, punching, folding, hot forging, knurling and threading with rollers, drawing.



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ /°C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed at 20°C		
8,53	955	19,9	28	0,29	0,09	0,062	110000	40000

Technological Features:

Annealing Temperature Range	425-750°C
Temperature Range for Hot Work	725-850°C
Solidification Temperature	915°C
Hot Conformability	Fair
Cold Conformability	Excellent
Relative Machining (CLA Brass = 100%)	30%

Junction Methods:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Good
Carbon Arc Welding	Not Recommended
Arc Welding with Protective Atmosphere	Fair
Arc Welding with Coated Electrode	Not Recommended
Resistance Welding:	
Spot and Wheels	Good
Flash Butt Welding	Good

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B135):

Cross Section	Temper	External Diameter (mm)	Wall Thickness (mm)	Tensile Strength (MPa)	Grain Size (mm)	Hardness Range	
						Scale	Valor
Tubes	Deep Annealing	All	up to 0.80 incl.	-	0.025 - 0.060	30 T	40 max.
	Deep Annealing	All	above 0.80	-	0.025 - 0.060	F	80 max.
	Light Annealing	All	up to 0.80 incl.	-	0.035 max.	30 T	60 max.
	Light Annealing	All	above 0.80	-	0.035 max.	F	90 max.
	1/2 Hard F	All	All	370 min.	-	30 T	53 min.
	Hard G	up to 25.0 incl.	from 0.50 to 3.0 incl.	455 min.	-	30 T	70 min.
	Hard G	from 25.0 to 50.0 incl.	from 0.90 to 5.0 incl.	455 min.	-	30 T	70 min.
	Hard G	Above 50 to 100.0 incl.	from 1.5 to 6.0 incl.	455 min.	-	30 T	70 min.

F The Hardness Degree 1/2 Hard is for general use.
G The Hardness Degrees Hard is available for round tubes only.

Manufactured Measures Round Tubes (Straight lengths):

		Pol.	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1.1/8"	1.1/4"	1.3/8"	1.1/2"	1.5/8"	1.7/8"	2"	2.1/4"	2.1/2"	2.5/8"	2.3/4"	3"	3.1/2"	4"	5"				
		In	0,250	0,313	0,375	0,500	0,625	0,750	0,875	1,000	1,125	1,250	1,375	1,500	1,625	1,875	2,000	2,250	2,500	2,625	2,750	3,000	3,500	4,000	5,000	5,157	5,236		
		DIAMETER																											
	mm	6,35	7,94	9,52	12,70	15,87	19,05	22,22	25,40	28,57	31,75	34,92	38,10	41,27	47,62	50,80	57,15	63,50	66,67	69,85	76,20	88,90	101,60	127,00	131,00	133,00			
in.																													
WALL THICKNESS	0,020	[Blue shaded area]																											
	0,024	[Blue shaded area]																											
	0,028	[Blue shaded area]																											
	0,031	[Blue shaded area]																											
	0,031	[Blue shaded area]																											
	0,039	[Blue shaded area]																											
	0,062	[Blue shaded area]																											
	0,079	[Blue shaded area]																											
	0,094	[Blue shaded area]																											
	0,125	[Blue shaded area]																											
	0,197	[Blue shaded area]																											
	0,375	[Blue shaded area]																											
		mm																											
in.																													
WALL THICKNESS	0,020	[Blue shaded area]																											
	0,024	[Blue shaded area]																											
	0,028	[Blue shaded area]																											
	0,031	[Blue shaded area]																											
	0,031	[Blue shaded area]																											
	0,039	[Blue shaded area]																											
	0,062	[Blue shaded area]																											
	0,079	[Blue shaded area]																											
	0,094	[Blue shaded area]																											
	0,125	[Blue shaded area]																											
	0,197	[Blue shaded area]																											
	0,375	[Blue shaded area]																											

Any other sizes should be assessed under consultation.

Cartridge Brass | UNS C26000

Material images:



Typical Applications:

Electrical: Cases for beacons, reflectors, sockets and lamp receptacles, switch components.

Hardware: Chains, eyelets, hooks, pins, locks, hinges, wire brushes, base plates, mirrors, artistic metal work.

Mechanical: Products obtained by cold stamping such as: covers, boxes and plates for instruments, wheels, pins, rivets, screws, springs, reservoirs for ballpoint pen ink, reservoirs for car radiators.

Processes Used in Transformation: Shearing, minting, stamping, drawing, extrusion, hot forging, hammering, punching, folding, hot forging, knurling and threading with rollers, drawing.

Chemical Composition:

Copper	62,0 - 65,0%
Lead	0,070% maximum
Iron	0,070% maximum
Zinc	Remaining



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10°C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity at 20°C (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed		
8,45	920	21	27	0,3	0,09	0,064	103000	39000

Technological Features:

Annealing Temperature Range	450-650°C
Temperature Range for Hot Work	720-820°C
Solidification Temperature	905°C
Hot Conformability	Good
Cold Conformability	Good
Relative Machining (CLA Brass = 100%)	35%

Junction Methods:

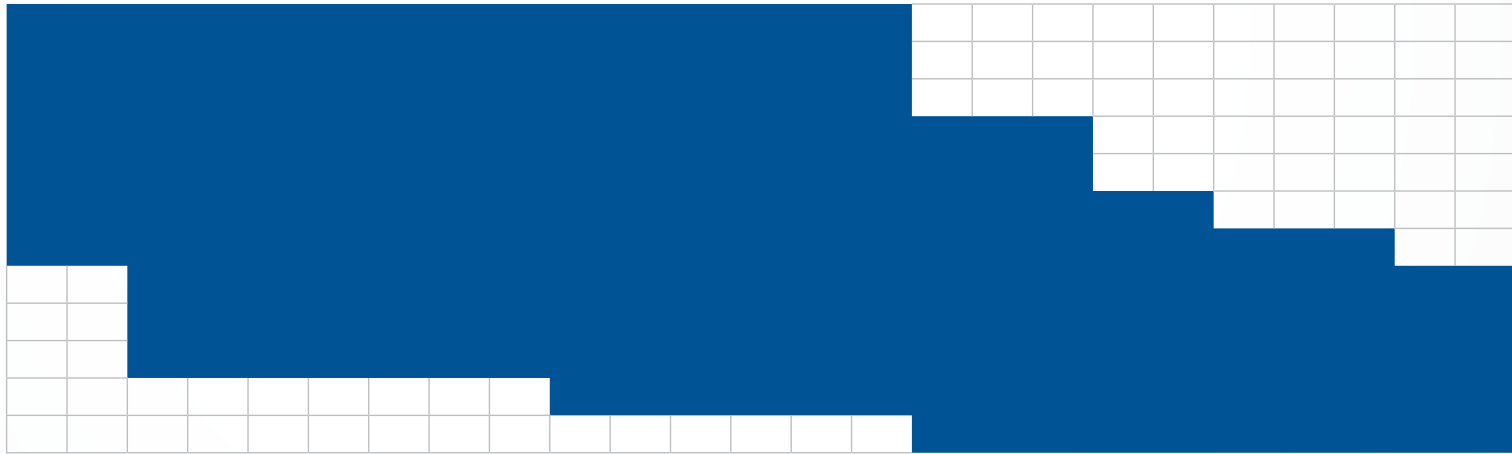
Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Good
Carbon Arc Welding	Not Recommended
Arc Welding with Protective Atmosphere	Fair
Arc Welding with Coated Electrode	Not Recommended
Resistance Welding:	
Spot and Wheels	Fair
Flash Butt Welding	Good

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B135):

Cross Section	Temper	External Diameter (mm)	Wall Thickness (mm)	Yield Strength (MPa), min. A	Grain Size (mm)	Hardness Range	
						Scale	Value
Tubes	Deep Annealing	All	up to 0.80 incl.	-	0.025 - 0.060	30 T	40 max.
	Deep Annealing	All	above 0.80	-	0.025 - 0.060	F	80 max.
	Light Annealing	All	up to 0.80 incl.	-	0.035 max.	30 T	60 max.
	Light Annealing	All	above 0.80	-	0.035 max.	F	90 max.
	1/2 Hard A	All	All	370	-	30 T	53 min.
	Hard B	up to 25.40 incl.	from 0.50 to 3.00 incl.	455	-	30 T	70 min.
	Hard B	from 25.40 to 50.80 incl.	from 0.90 to 5.00 incl.	455	-	30 T	70 min.
	Hard B	from 0.508 to 101.60 incl.	from 1.50 to 6.00 incl.	455	-	30 T	70 min.

A The Hardness Degree 1/2 Hard is for general use.
B The Hardness Degrees Hard is available for round tubes only.

Manufactured Measures Round Tubes (Straight Lengths):

	Pol.	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1.1/8"	1.1/4"	1.3/8"	1.1/2"	1.5/8"	1.7/8"	2"	2.1/4"	2.1/2"	2.5/8"	2.3/4"	3"	3.1/2"	4"	5"					
		In	0,250	0,313	0,375	0,500	0,625	0,750	0,875	1,000	1,125	1,250	1,375	1,500	1,625	1,875	2,000	2,250	2,500	2,625	2,750	3,000	3,500	4,000	5,000	5,157	5,236		
		DIAMETER																											
	mm	6,35	7,94	9,52	12,70	15,87	19,05	22,22	25,40	28,57	31,75	34,92	38,10	41,27	47,62	50,80	57,15	63,50	66,67	69,85	76,20	88,90	101,60	127,00	131,00	133,00			
in.																											in.		
0,020	0,50																										0,020	0,50	
0,024	0,60																										0,024	0,60	
0,028	0,70																										0,028	0,70	
0,031	0,79																										0,031	0,79	
0,031	0,80																										0,031	0,80	
0,039	1,00																										0,039	1,00	
0,062	1,58																										0,062	1,58	
0,079	2,00																										0,079	2,00	
0,094	2,38																										0,094	2,38	
0,125	3,17																										0,125	3,17	
0,197	5,00																										0,197	5,00	
0,375	9,52																										0,375	9,52	

Any other sizes should be assessed under consultation.

Manufactured Measures Square Tubes (Straight Lengths):

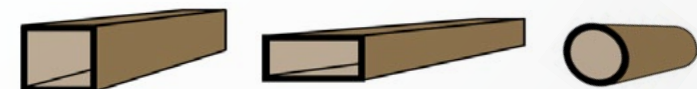
			Pol.	3/4"	1.1/4"				
			In	0,750	1,250				
		DIMENSIONS							
		mm		19,05 x 19,05	31,75 x 31,75	51,80 x 51,80			
in.	THICKNESS						in.		
0,031		0,80					0,031	0,80	
0,039		1,00					0,039	1,00	
0,043		1,10					0,043	1,10	

Any other sizes should be assessed under consultation.

Manufactured Measures Rectangular Tubes (Straight Lengths):

			Pol.	3" x 1.1/2"	
			In	3,000 x 1,500	
		DIMENSIONS			
		mm		76,20 x 38,10	
in.	THICKNESS				
0,125		3,17			

Any other sizes should be assessed under consultation.



Typical Applications:

Tubes and fittings for condensers and heat exchangers, tubes for distillers and evaporators, seawater pipelines used in marine services, in oil refineries.

Processes Used in Transformation: Bending, Flanging.

Chemical Composition:

Copper	70,0 - 73,0%
Tin*	0,80 - 1,20%
Lead	0,070% maximum
Iron	0,060% maximum
Zinc	Remaining
Arsenic	0,020 - 0,060%

* For tubular products the minimum content may be 0.90%



Admiralty Metal Type B Brass | UNS C44300



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ °C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed at 20°C		
8,53	940	11,2	25	0,26	0,09	0,043	110000	41000

Technological Features:

Annealing Temperature Range	430-590°C
Temperature Range for Hot Work	650-760°C
Hot Conformability	Fair
Cold Conformability	Excellent
Relative Machining (CLA Brass = 100%)	30%

Junction Methods:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Good
Arc Welding with Protective Atmosphere	Fair
Resistance Welding: Flash Butt Welding	Good

Admiralty Metal Type B Brass | UNS C44300

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree:

Cross Section	Temper	Tensile Strength (MPa), min.	Yield Strength (MPa), min.	Grain Size (mm)
Tubes	Annealed	310	105	0.010 - 0.045

Corresponding standards:

Country	Material Designation	Standards for Chemical Composition
United States (ASTM)	UNS C44300	B111
	UNS C44300	B135

Manufactured Measures Round Tubes (Straight Lengths):

			Pol.	3/4"	1.1/2"	1.5/8"	1.7/8"		4.1/4"				
			In	0,750	1,500	1,625	1,875	2,313	4,250				
DIAMETER													
	WALL THICKNESS	mm		19,05	38,10	41,27	47,63	58,74	107,95			mm	
in.		in.											
0,065		1,65										0,065	1,65
0,128		3,24										0,128	3,24
0,156		3,96										0,156	3,96
0,187		4,76										0,187	4,76
0,190		4,83										0,190	4,83
0,250		6,35										0,250	6,35

Any other sizes should be assessed under consultation



Silicon Manganese Brass with Lead | UNS C67300

Typical Applications:

Bushings for high and low rotation bearings, rings, fastening components, mechanical wear components, parts for bearings.

Processes Used in Transformation: Hot forging, Machining.

Chemical Composition:

Copper	58,0 - 63,0 %
Silicon	0,50 - 1,50 %
Lead	0,40 - 3,00 %
Manganese	2,00 - 3,50 %
Iron	0,50 % maximum

Zinc	Remaining
Aluminum	0,25% maximum
Tin	0,30% maximum
Nickel*	0,25% maximum

* Including Cobalt.



Silicon Manganese Brass with Lead | UNS C67300



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ °C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Modulus of Rigidity at 20°C (MPa)
			Annealed		Annealed at 20°C	
7,73	870	11,0	22,0	0,23	0,037	117000

Technological Features:

Relative Machining (CLA Brass = 100%) 70%

Silicon Manganese Brass with Lead | UNS C67300

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (SAE J463):

Temper	Tensile Strength (MPa), min.	Yielding Point (MPa), min.	Elongation (%), min.	Hardness Range, min.	Gauges related to the indicated properties (mm)
				Rockwell B (HRB)	
Hot-Extruded	360	170	20	60	All

Silicon Manganese Brass with Lead | UNS C67300

Manufactured Measures Round Tubes (bar):

Any other sizes should be assessed under consultation.



Aluminum Brass, B | UNS C68700

Typical Applications:

Chemical: Evaporators, distillation and heat exchange devices, including desalination and sugar refining plants.

Marine: Tubes, fittings and other components for seawater condensers, coils for heating crude oil in oil tankers.

Processes Used in Transformation: Extrusion, Forging, Wire drawing, Flanging.

Chemical Composition:

Copper	76,0 - 79,0%
Aluminum	1,80 - 2,50%
Lead	0,070% maximum
Iron	0,060% maximum
Zinc	Remaining
Arsenic	0,020 - 0,060%



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10 ⁻⁶ /°C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed at 20°C		
8,35	1010	20,0	23,0	0,24	0,09	0,075	110000	41000

Technological Features:

Annealing Temperature Range	450-650°C
Temperature Range for Hot Work	700-830°C
Hot Conformability	Fair
Cold Conformability	Good
Relative Machining (CLA Brass = 100%)	30%

Junction Methods:

Soldering	Fair
Brazing	Good
Oxyacetylene Welding	Fair
Carbon Arc Welding	Not Recommended
Arc Welding with Protective Atmosphere	Fair
Arc Welding with Coated Electrode	Not Recommended
Resistance Welding:	
Spot and Wheels	Fair
Flash Butt Welding	Good

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B111):

Cross Section	Temper	Tensile Strength (MPa), min.	Yield Strength (MPa), min.
Tubes	Annealed	345	125

Manufactured Measures Round Tubes (Straight Lengths):

		Pol.	3/4"	7/8"	1"			
			In	0,750	0,875			
			DIAMETER					
			mm	19,05	22,22	25,40		mm
in.	WALL THICKNESS						in.	
0,049		1,24				0,049	1,24	
0,065		1,65				0,065	1,65	
0,083		2,11				0,083	2,11	
0,109		2,77				0,109	2,77	

Any other sizes should be assessed under consultation.



90-10 Copper-Nickel | UNS C70600

Typical Applications:

Tubes and fittings for condensers and heat exchangers, tubes for distillers and evaporators, seawater pipelines used in marine services, in oil refineries and power generation companies.

Processes Used in Transformation: Bending, Flanging.

Chemical Composition:

Copper	Remaining
Nickel*	9,00 - 11,00%
Lead	0,050% maximum
Iron	1,00 - 1,80%
Zinc	1,000% maximum
Manganese	1,000% maximum

* Including Cobalt



Physical Properties:

Density at 20°C (g/cm ³)	Melting Point (°C)	Average Coefficient of Thermal Expansion (20-300°C) (10°C)	Electrical Volumetric Conductivity at 20°C (%I.A.S.C.)	Thermal Conductivity at 20°C (cal/cm s °C)	Specific Heat at 20°C (cal/cm s °C)	Electrical Resistivity at 20°C (ohm mm ² /m)	Elasticity Module at 20°C (MPa)	Modulus of Rigidity (Torsion) at 20°C (MPa)
			Annealed			Annealed		
8,94	1150	17,1	9,1	0,10	0,09	0,190	140000	52000

Technological Features:

Annealing Temperature Range	600-825°C
Temperature Range for Hot Work	850-950°C
Solidification Temperature	1100°C
Hot Conformability	Good
Cold Conformability	Good
Relative Machining (CLA Brass = 100%)	20%

Junction Methods:

Soldering	Excellent
Brazing	Excellent
Oxyacetylene Welding	Fair
Carbon Arc Welding	Not Recommended
Arc Welding with Protective Atmosphere	Excellent
Arc Welding with Coated Electrode	Good
Resistance Welding:	
Spot and Wheels	Good
Flash Butt Welding	Excellent

90-10 Copper-Nickel | UNS C70600

Mechanical Properties at Room Temperature Valid for the Indicated Shape and Hardness Degree (ASTM B111):

Cross Section	Temper	Tensile Strength (MPa), min.	Yield Strength (MPa), min.
Tubes	Annealed	275	105
	1/4 Hard	310	240

Manufactured Measures Round Tubes (Straight Lengths):

	Pol.	3/8"	1/2"	5/8"	3/4"	7/8"	2"											
		In	0,375	0,472	0,500	0,625	0,709	0,750	0,787	0,866	0,875	1,654	1,693	2,000	2,244	2,874		
		DIAMETER																
	mm	9,52	12,00	12,70	15,87	18,00	19,05	20,00	22,00	22,22	42,00	43,00	50,80	57,00	73,00		mm	
in.																	in.	
0,024	0,60																0,024	0,60
0,031	0,80																0,031	0,80
0,035	0,90																0,035	0,90
0,039	1,00																0,039	1,00
0,047	1,20																0,047	1,20
0,063	1,59																0,063	1,59
0,083	2,10																0,083	2,10
0,098	2,50																0,098	2,50
0,110	2,80																0,110	2,80
0,118	3,00																0,118	3,00
0,125	3,17																0,125	3,17
0,157	4,00																0,157	4,00

Any other sizes should be assessed under consultation.

