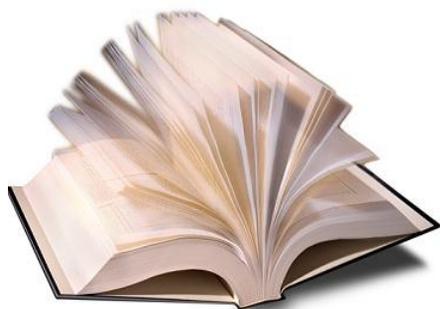


به نام خدا



مرکز دانلود رایگان  
مهندسی متالورژی و مواد

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# COPPER ALLOY TUBES FOR HEAT-EXCHANGER



**SHINKO METAL PRODUCTS CO.,LTD.**

[www.iran-mavad.com](http://www.iran-mavad.com)

مرجع دانشجویان و مهندسين مواد





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## PREFACE

We have been producing copper alloy heat exchanger tubes since 1917, and developed the special aluminum brass tube in 1929. Aluminum brass tubes have been widely used as condenser and heat exchanger tubes.

We have also produced other copper alloy tubes, such as copper-nickel or admiralty brass, which are used as heat exchanger tubes in power plants, desalination plants, oil refineries and petrochemical plants, ships and other industries. In 1995 we received ISO 9001 certification, as the first among Japanese copper and copper alloy tube manufacturers, recognizing our determination to continue meeting stringent customer demands for quality with the finest products.

Features of copper alloy tubes produced by Shinko Metal Products are as follows.

(1) High quality of tubes are produced by through process from melting to final packaging based on ISO 9001, and their quality is guaranteed by eddy current testing in the final step of manufacturing processes. Not only encircling type but also rotating type testing is applied to tubes for power and desalination plants.

(2) Internal surface quality against the crevice corrosion is guaranteed by sand blasting for sensitive alloys such as CN108 in BS2871 or C71640 in ASTM.

(3) Tubes have good workability because chemical composition and quality of the ingot are strictly controlled. Therefore, for example, hard-to-work low fin tubes such as CN108 or C71640 are also able to be provided.

(4) Special aluminum brass, named ALUMIBRASS, is produced as same as plain aluminum brass. It is modified by a small amount of nickel and provides more excellent corrosion resistance.

(5) High grade heat exchanger tubes such as copper alloy tubes with protective film or duplex tubes were developed. Using these tubes, maintenance of heat exchangers would become easier and thermal efficiency would be remarkably improved.

Furthermore, Shinko Metal Products is one of the nondestructive inspectors. According to eddy current testing in the field and investigation of sample tubes, we diagnose the life of heat exchanger tubes and make a suggestion for the improvement.

Shinko Metal Products is an experienced and synthetic company for condenser and heat exchanger tubes.

# NOMINAL COMPOSITIONS, MECHANICAL AND PHYSICAL PROPERTIES OF THE PRINCIPAL ALLOYS

## 1. Chemical Composition

	Cu	Al	As	Ni	Sn	Mn	Mg	P	Fe	Pb	Zn	
<b>Aluminum Brass</b>												
JIS H3300 C6872T	76.0- 79.0	1.8- 2.5	0.02- 0.06	0.20- 1.0					0.05	0.05	Re	
ASTM B111 C68700 ASME SB111 C68700	76.0- 79.0	1.8- 2.5	0.02- 0.06						0.06	0.07	Re	
DIN1785 CuZn20Al2	76.0- 79.0	1.8- 2.3	0.020- 0.035	0.1		0.1	0.005	0.01	0.07	0.07	Re	
BS2871 CZ110	76.0- 78.0	1.8- 2.3	0.02- 0.06						0.06	0.07	Re	
Shinko Metal Products Standard					0.01	0.01	0.005	0.005	0.02	0.02	Re	
<b>Admiralty Brassa</b>												
JIS H3300 C4430T	70.0- 73.0		0.02- 0.06		0.9- 1.2				0.05	0.05	Re	
ASTM B111 C44300 ASME SB111 C44300	70.0- 73.0		0.02- 0.06		0.9- 1.2				0.06	0.07	Re	
DIN1785 CuZn28Sn1	70.0- 72.5		0.020- 0.035	0.1	0.9- 1.3	0.1		0.01	0.07	0.07	Re	
BS2871 CZ111	70.0- 73.0		0.02- 0.06		1.0- 1.5				0.06	0.07	Re	
Shinko Metal Products Standard				0.05				0.005	0.02	0.02	Re	
<b>Copper-Nickel</b>												
JIS H3300 C7060T				9.0- 11.0		0.20- 1.0			1.0- 1.8	0.05	0.50	
ASTM B111 C70600 ASME SB111 C70600	Re			9.0- 11.0		0.1			1.0- 1.8	0.05	1.0	
DIN1785 CuNi10Fe1Mn	Re			9.0- 11.0		0.5- 1.0			1.0- 2.0	0.03	0.5	
BS2871 CN102	Re			10.0- 11.0		0.50- 1.00			1.0- 2.0	0.01		
Shinko Metal Products Standard		0.02	0.005		0.02			0.010		0.01	0.2	
JIS H3300 C7100T				19.0- 23.0		0.20- 1.0			0.50- 1.0	0.05	0.50	
ASTM B111 C71000 ASME SB111 C71000	Re			19.0- 23.0		1.0			0.50- 1.0	0.05	1.0	
Shinko Metal Products Standard		0.10	0.005		0.02			0.010		0.01	0.2	
JIS H3300 C7150T				29.0- 33.0		0.20- 1.0			0.40- 1.0	0.05	0.50	
ASTM B111 C71500 ASME SB111 C71500	Re			29.0- 33.0		1.0			0.40- 1.0	0.05	1.0	
DIN1785 CuNi30Mn1Fe	Re			30.0- 32.0		0.5- 1.5			0.4- 1.0	0.03	0.5	
BS2871 CN107	Re			30.0- 32.0		0.50- 1.50			0.40- 1.00	0.01		
Shinko Metal Products Standard		0.10	0.005		0.02			0.010		0.01	0.2	
JIS H3300 C7164T				29.0- 32.0		1.5- 2.5			1.7- 2.3	0.05	0.50	
ASTM B111 C71640	Re			29.0- 32.0		1.5- 2.5			1.7- 2.3	0.05	1.0	
DIN1785 CuNi30Fe2Mn2	Re			29.0- 32.0		1.5- 2.5			1.5- 2.5	0.02	0.5	
BS2871 CN108	Re			29.0- 32.0		1.5- 2.5			1.7- 2.3			
Shinko Metal Products Standard		0.02	0.005		0.02			0.010		0.01	0.2	

Note : The mark depends on each specification.

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unit : %

C	S	Other Elements	Typical Use
			Condenser and heat exchanger tubes using sea water in power plants, oil refinery plants, petrochemical plants and others.
		As + P 0.035	
		Other total impurities 0.1	
		Total impurities 0.30	
			Condenser and heat exchanger tubes using fresh water.
		As + P 0.035	
		Other total impurities 0.1	
		Total impurities 0.30	
		Cu + Ni + Fe + Mn 99.5	Heat exchanger tubes of evaporators in desalination plants. Piping for sea water in ships.
0.05	0.05	Other total impurities 0.3	
0.05	0.05	Total impurities 0.30	
0.05	0.01		
		Cu + Ni + Fe + Mn 99.5	Heat exchanger tubes of high pressure feed water heaters.
0.05	0.01		
		Cu + Ni + Fe + Mn 99.5	Condenser tubes of air cooling zone in thermal power plants. Heat exchanger tubes in some chemical plants.
0.06	0.05	Other total impurities 0.3	
0.06	0.08	Total impurities 0.30	
0.05	0.01		
		Cu + Ni + Fe + Mn 99.5	Heat exchanger tubes for high temperature zone in desalination plants.
0.05	0.06	Other total impurities 0.3	
		Total impurities 0.30	
0.05	0.01		

## 2. Mechanical Properties

Standard nos. and alloy nos.		Tensile strength N/mm <sup>2</sup> (MPa)	Yield strength N/mm <sup>2</sup> (MPa)	Elongation %	Hardness Hv 5kg	Flattening test	Expansion test	Mercurous nitrate or ammonia vapor test	Grain size mm
<b>Aluminum Brass</b>									
JIS H3300 C6872T-O		375		40					0.010-0.045*
ASTM B111-C68700Ann.		345**	125**						0.010-0.045
ASME SB111-C68700Ann.		345	125						0.010-0.045
DIN 1785	F34	340	120-180	55					0.010-0.050
CuZn20Al2		390	150-230	45					0.010-0.050
BS 2871 CZ110	TA				85-110				0.05
	O				75				
<b>Admiralty Brass</b>									
JIS H3300 C4430T-O		315		30					0.010-0.045*
ASTM B111-C44300Ann.		310**	105**						0.010-0.045
ASME SB111-C44300Ann.		310	105						0.010-0.045
DIN 1785	F32	320	100-170	55					0.010-0.050
CuZn28Sn1		360	140-220	45					0.010-0.050
BS 2871 CZ111	TA				80-105				0.05
	O				75				
<b>Copper-Nickel</b>									
JIS H3300 C7060T-O		275		30					0.010-0.045*
ASTM B111-C70600Ann.		275**	105**						0.010-0.045
ASME SB111-C70600Ann.		275	105						0.010-0.045
DIN 1785	F29	290	90-180	30					0.01-0.05
CuNi10Fe1Mn									
BS 2871 CN102	O				80-110				0.05
JIS H3300 C7150T-O		365		30					0.010-0.045*
ASTM B111-C71500Ann.		360**	125						0.010-0.045
ASME SB111-C71500Ann.		360	125						0.010-0.045
DIN 1785	F37	370	120-220	35					0.01-0.05
CuNi30Mn1Fe									
BS 2871 CN107	O				90-120				0.05
JIS H3300 C7164T-O		430		30					0.010-0.045*
ASTM B111-C71640Ann.		435**	170**						0.010-0.045
DIN 1785	F42	420	150-260	30					0.01-0.05
CuNi30Fe2Mn2									
BS 2871 CN108	O				90-120				0.05

Remarks : \* Only by request, in this case the tensile strength test is not conducted.

\*\* Only by request.  
Tests conducted.

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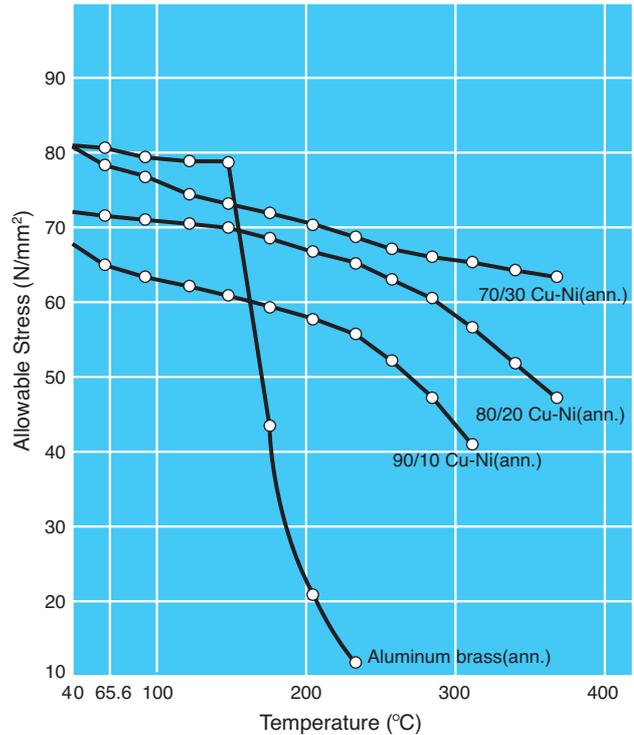
### 3. Mechanical Properties at High Temperature

Test temperatures	0.2% Yield strength N/mm <sup>2</sup>	Tensile strength N/mm <sup>2</sup>	Elongation %	Reduction of area %
Aluminum brass				
R. T.	246	455	39	65
100	234	437	37	63
200	223	410	39	60
300	209	333	26	30
400	129	279	22	23
500	71	157	30	30
90/10 Copper-Nickel (ann.)				
R. T.	106	312	45	78
200	89	268	35	78
300	85	258	32	61
400	86	237	30	60
550	79	150	41	40
80/20 Copper-Nickel (ann.)				
R. T.	121	329	44	81
200	105	284	38	80
300	90	270	35	76
400	92	250	31	56
550	88	160	17	15
70/30 Copper-Nickel (ann.)				
R. T.	144	366	41	75
200	126	318	37	73
300	119	287	35	65
400	104	243	19	15
550	93	175	16	15

## 4. Allowable Stress at Operating Temperature

The maximum allowable stress at each temperature level is shown for Aluminum brass, and 90/10, 80/20 and 70/30 Copper-Nickel tubes. (Based on the ASME Boiler and Pressure Vessel Code of 1989)

**Relationship of allowable stress to operating temperature by heating material**  
(Ref. ASME V111 Table UNF 23)



Using the allowable stress indicated in the figure above, the maximum allowable pressure for a tube with a 1.245 mm thickness and 19 mm outer diameter is calculated. The operating temperature limits of the various heater tube materials are considered to be 180 °C for Aluminum brass, 300 °C for 90/10 Copper-Nickel, and 370 °C for 80/20 and 70/30 Copper-Nickel.

### Maximum Allowable Internal Pressure

Temperature	Aluminum brass	90/10 Cu-Ni	80/20 Cu-Ni	70/30 Cu-Ni
121	11.1MPa	8.8MPa	9.9MPa	10.5MPa
149	11.1	8.5	9.8	10.3
177	6.2	8.2	9.6	10.1
204	3.1	8.1	9.4	9.8
232	1.6	7.8	9.2	9.6
260	-	7.6	8.9	9.4
288	-	6.6	8.5	9.4
316	-	5.7	8.0	9.1
343	-	-	7.4	9.1
371	-	-	6.7	8.9

$$P = \frac{2S \times t}{D - 0.8t}$$

(P = Maximum allowable internal pressure t = Tube thickness D = Outer Diameter S = Maximum allowable stress)

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## 5. Creep Rupture Strength

Test temperature	Rupture strength N/mm <sup>2</sup>			
	100h	1,000h	10,000h	100,000h
<b>Aluminum brass</b>				
100	430	420	-	-
200	280	250	190	160
300	110	80	60	-
<b>90/10 Copper-Nickel (ann.)</b>				
200	-	260	-	-
300	260	250	220	200
400	190	170	160	140
<b>80/20 Copper-Nickel (ann.)</b>				
200	-	-	-	-
300	260	230	210	200
400	170	140	120	110
<b>70/30 Copper-Nickel (ann.)</b>				
200	-	-	-	-
300	260	230	200	180
400	140	120	90	50

## 6. Fatigue Strength

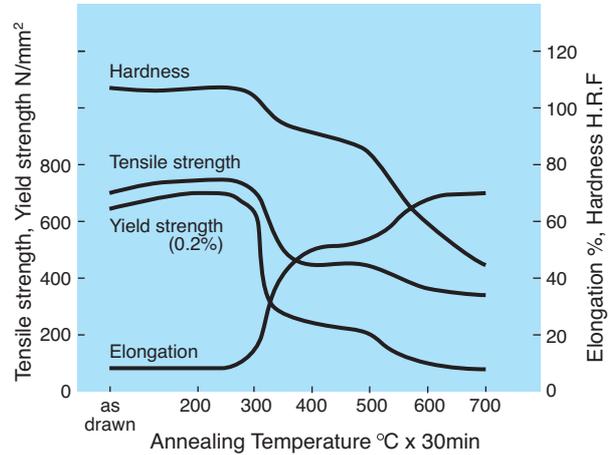
Testing Machine..... Ono Type Rotary Bending Tester

Finish of Sample..... After a 04-emery finish was given, buff finish was applied.

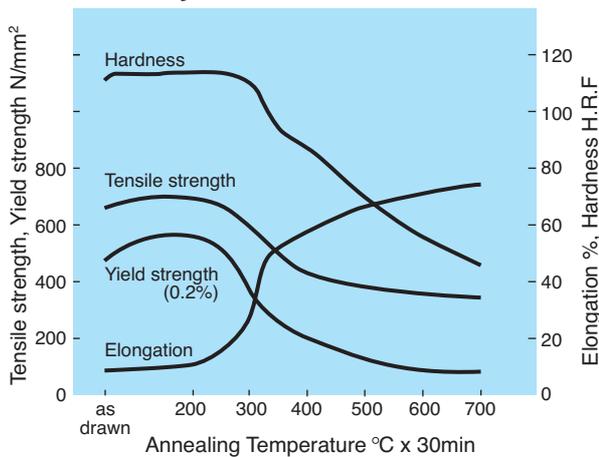
	Tensile Strength	Elongation	Fatigue Strength (10 <sup>7</sup> cycle of reversed stress)
	N/mm <sup>2</sup>	%	N/mm <sup>2</sup>
Aluminum brass	450	46	230
90/10 Copper - Nickel	310	45	150
80/20 Copper - Nickel	340	45	150
70/30 Copper - Nickel	390	45	170

## 7. Mechanical Properties at Normal Temperature

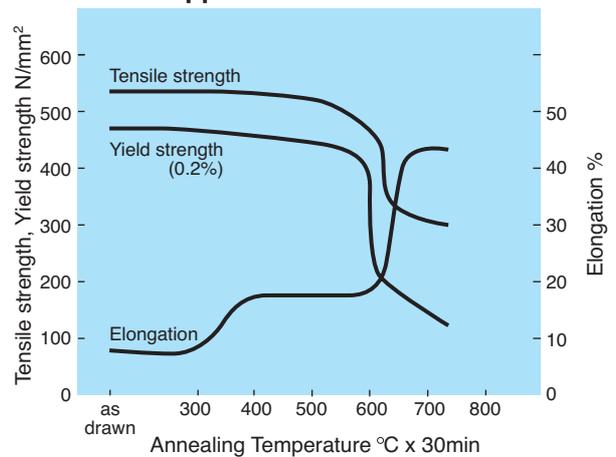
**Aluminum brass**



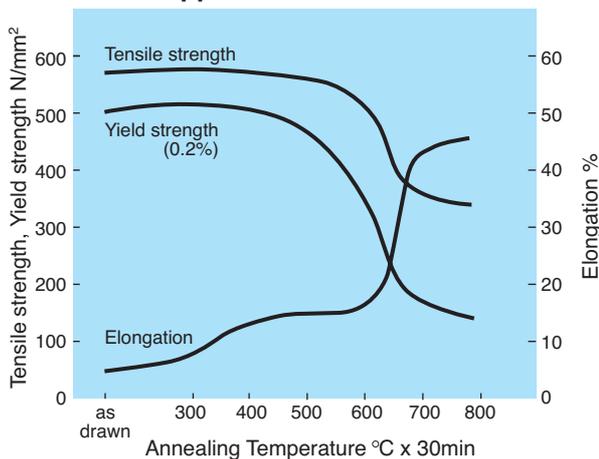
**Admiralty brass**



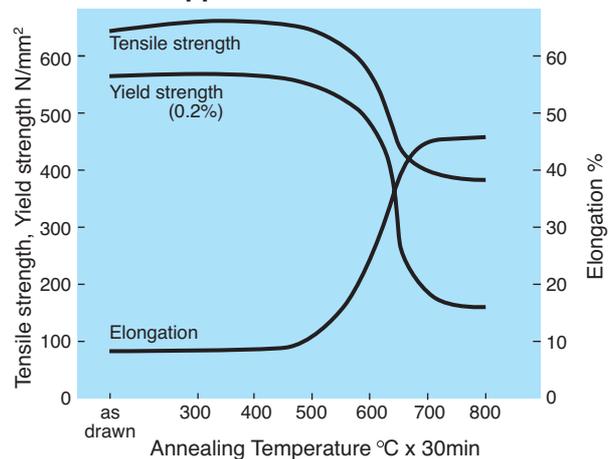
**90/10 Copper-Nickel**



**80/20 Copper-Nickel**



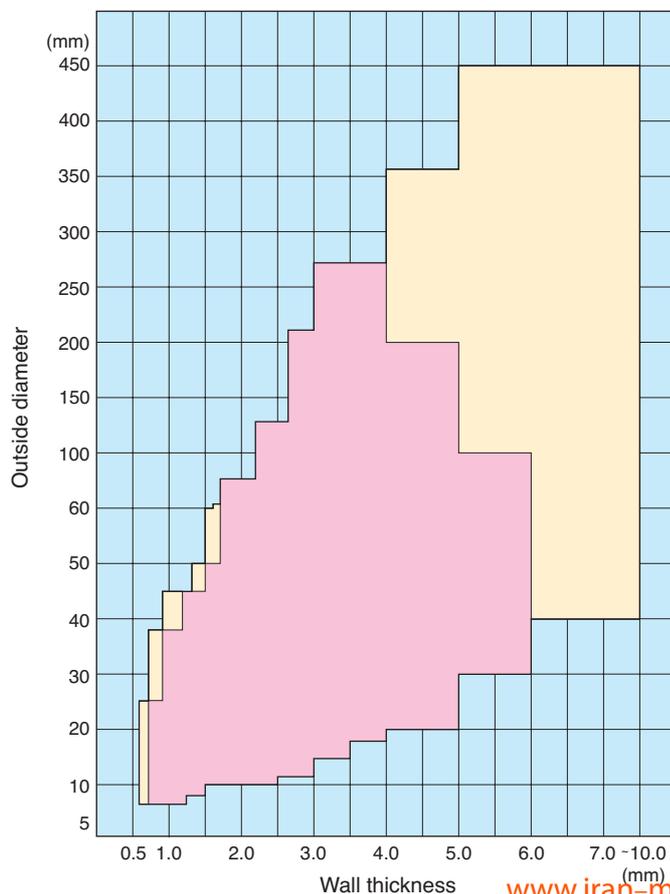
**70/30 Copper-Nickel**



## 8. Physical Properties

	Density g/cm <sup>3</sup> (20 )	Thermal conductivity W/(m·K) (20 )	Thermal expansion 1/K (20-300 )	Specific heat J/(g·K) (20 )	Modulus of elasticity N/mm <sup>2</sup> (R.T.)
Aluminum brass	8.4	1.0 X 10 <sup>2</sup>	18.5 X 10 <sup>-6</sup>	0.38	11 X 10 <sup>4</sup>
Admiralty brass	8.6	1.1 X 10 <sup>2</sup>	20.2 X 10 <sup>-6</sup>	0.38	11 X 10 <sup>4</sup>
90/10 Copper-Nickel	8.9	0.5 X 10 <sup>2</sup>	17.1 X 10 <sup>-6</sup>	0.38	12 X 10 <sup>4</sup>
80/20 Copper-Nickel	8.9	0.3 X 10 <sup>2</sup>	16.8 X 10 <sup>-6</sup>	0.38	14 X 10 <sup>4</sup>
70/30 Copper-Nickel	8.9	0.3 X 10 <sup>2</sup>	16.2 X 10 <sup>-6</sup>	0.38	15 X 10 <sup>4</sup>

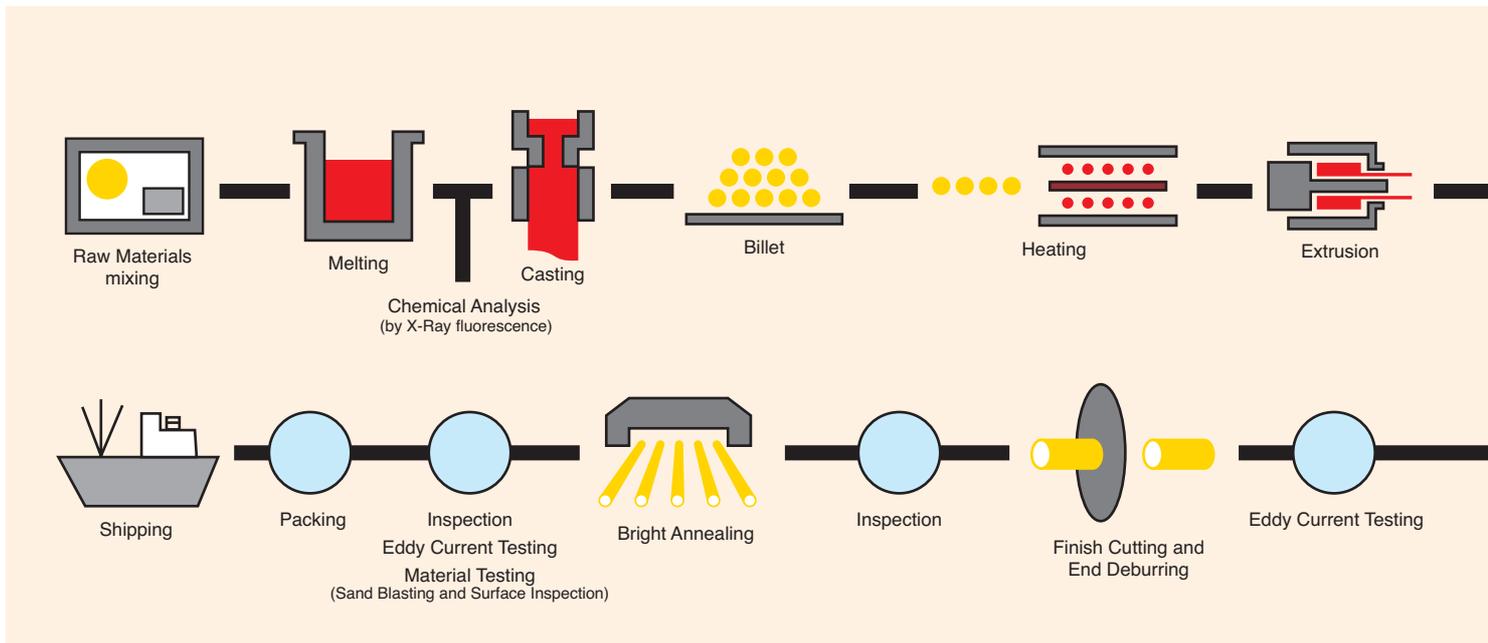
## THE PRODUCTION RANGE OF COPPER ALLOY TUBES



Class	Outside diameter		
	<60	60-90	>90
Length	25m Max.	10m Max.	6m Max.
Mass	60kg Max.	50kg Max.	80kg Max.

 We would like you to contact us before ordering.

# MANUFACTURING PROCESSES AND QUALITY CONTROL



## 1. Materials

In order to supply tubes with excellent qualities including corrosion resistance, materials are blended with virgin cathode copper, virgin cathode nickel, pure zinc, high grade aluminum and process returned scrap.

## 2. Melting and Casting

The melting is carried out in an induction furnace. Because of rapid melting in this furnace, oxidation and gas absorption of molten metal are restrained to a small degree. Further, because of a self-churning action, molten metal is provided with uniform chemical contents. Temperature control is also easy. The refined molten metal is cast into water cooled molds to make an ingot (Semi-continuous casting). An ingot produced in this process has a homogenized structure and no defects such as a blow-hole, shrinkage cavity, segregation or inclusion. Before casting, chemical composition of the molten metal is rapidly analyzed by X-ray fluorescence. So that we can strictly control it.

## 3. Extrusion

The ingot is cut to the required length, heated and extruded to make the mother tube. In order to obtain uniform quality in the mother tube, the cylindrical discarded shell and end of the billet are not used to maintain the soundness of the mother tube. The outer and inner surface is inspected visually and the dimensions are checked.

## 4. Reducing

The mother tube is cold-worked with a tube reducer to the required outside diameter and wall thickness. Exact visual

inspection and dimensional checking are periodically made on the reduced tube in this process.

## 5. Annealing and Drawing

The reduced tubes are annealed in a roller hearth type continuous annealing furnace and drawn with a multi-strand draw bench. A sample from each lot is checked for hardness following heat treatment. Exact dimensional control and visual inspection is also carried out in the drawing process. Through these repeated annealing and drawing processes, the final dimension of the tube is acquired.

## 6. Straightening and Degreasing

The final dimension tube is straightened with a straightener and is degreased.

## 7. Non-destructive Test

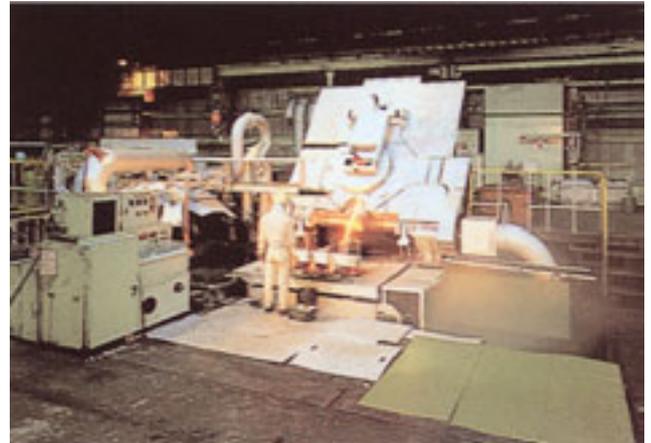
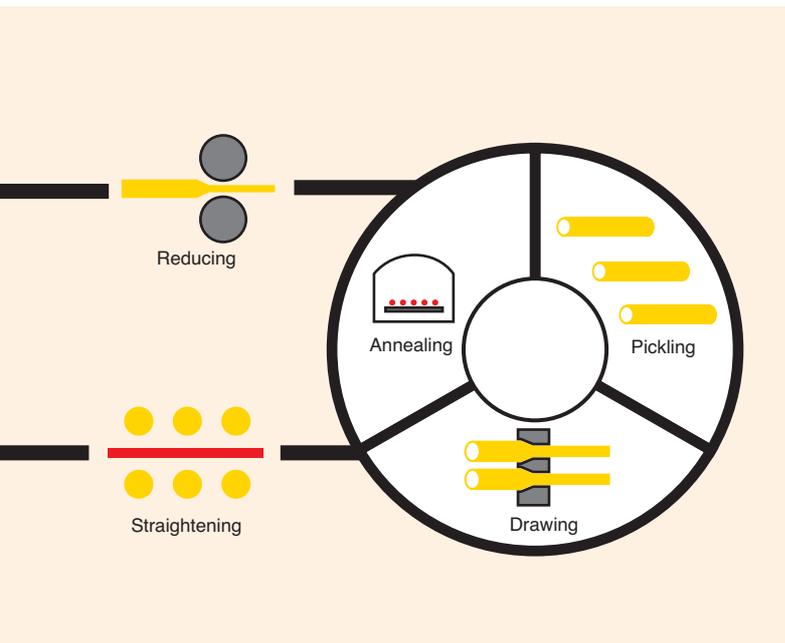
Each tube is eddy current tested with an automatic rejecting device.

## 8. Visual and Dimensional Inspection

After the non-destructive test, the tubes are cut to the required length and deburred with a wire brush. A hydrostatic pressure test or pneumatic test can be applied upon a customer's request. The surface conditions and dimensions of each deburred tube are inspected.

## 9. Bright Annealing

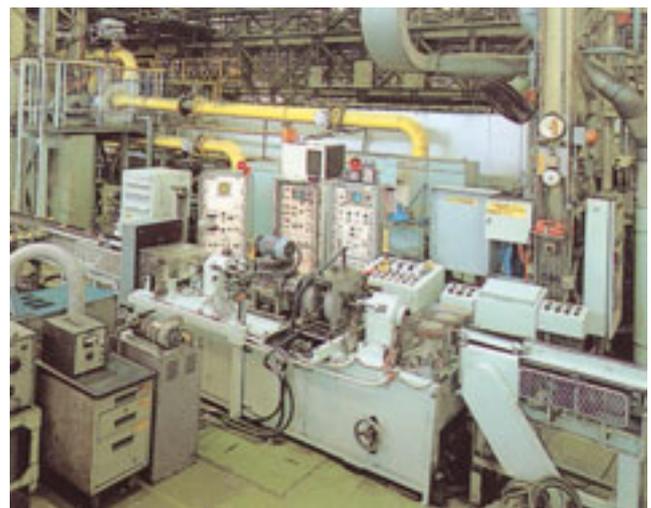
The finished tubes are heat-treated in a roller hearth type continuous bright annealing furnace, where the temperature, tube feeding speed and charging quantity are controlled to



Melting furnace



Bright annealing furnace



Eddy current tester

give the tubes the proper brightness and mechanical properties.

### 10. Surface Treatment

With special alloys and products designed for important use, the tubes are internally sand blasted to remove any surface film. Removing the surface film mechanically is the best way to get optimum conditions for corrosion resistance in the case of CN108 in BS2871 or C71640 in ASTM.

### 11. Material Testing

Material testing is conducted on a random sampling basis according to the specifications. (For tensile strength, hardness, grain size, expanding, flattening and stress corrosion cracking testing.)

### 12. Final Non-destructive Test

The finished tube is given the final non-destructive test again just before packing with the eddy current tester, where both encircling type and rotating type testing is applied, to guarantee high quality. ( Only for power plants and desalination plants)

### 13. Packing

The final inspected tubes are packed in accordance with the specified instructions.

# FEATURES OF SPECIAL ALUMINUM BRASS MODIFIED BY A SMALL AMOUNT OF NICKEL

Aluminum brass tubes are widely used in heat exchangers using sea water. We have developed and supplied a special aluminum brass, named "ALUMIBRASS", which is modified by a small amount of nickel. This alloy is authorized in the JIS (Japan Industrial Standard). ALUMIBRASS has the following features.

## (1) More resistant to erosion-corrosion

The results of a rotating disk test in clean sea water are shown in the figure.

Weight loss of the test piece of ALUMIBRASS was smaller than that of plain aluminum brass.

## (2) More resistant to deposit attack

The results of a vibrating deposit attack test are shown in the figure.

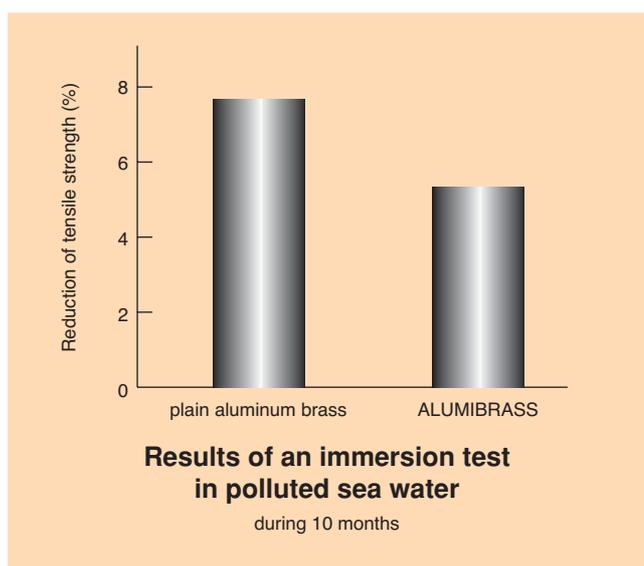
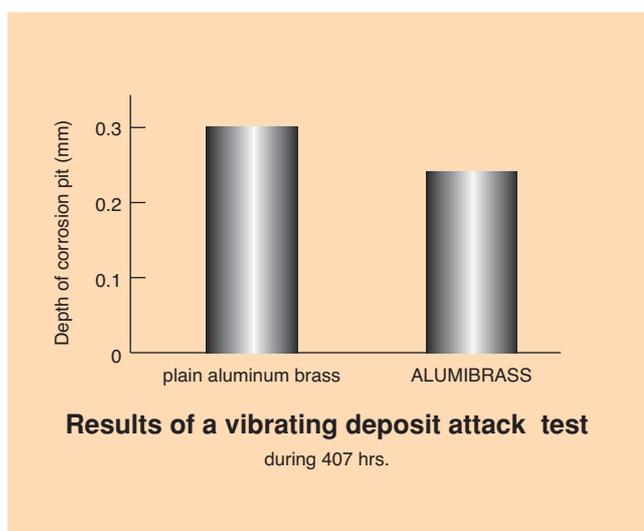
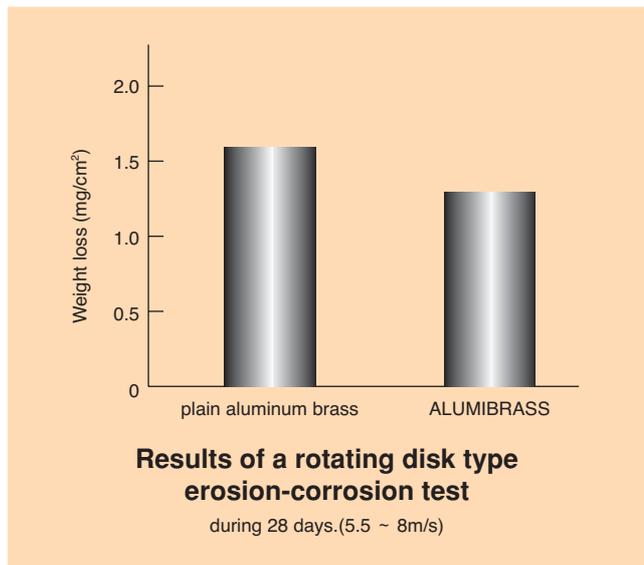
The depth of corrosion pits in ALUMIBRASS were smaller than that found in plain aluminum brass.

## (3) More resistant to corrosion caused by slightly polluted sea water

Corrosion of ALUMIBRASS was less than that of plain aluminum brass in the immersion test using slightly polluted sea water during a 10 month period.

## (4) More resistant to dezincification

Dezincification was never seen in ALUMIBRASS in a model condenser test for polluted sea water, although it was seen in plain aluminum brass.



# OTHER PRODUCTS USED IN CONDENSERS AND HEAT EXCHANGERS

## 1. Ferroco Tube

Formation of a protective film on the inner surface of copper alloy tubes provides excellent corrosion resistance. Ferrous ion injection has been widely employed in order to form a protective film. However, sufficient film is sometimes barely formed by ferrous ion injection, depending upon the condition of the water quality and other factors.

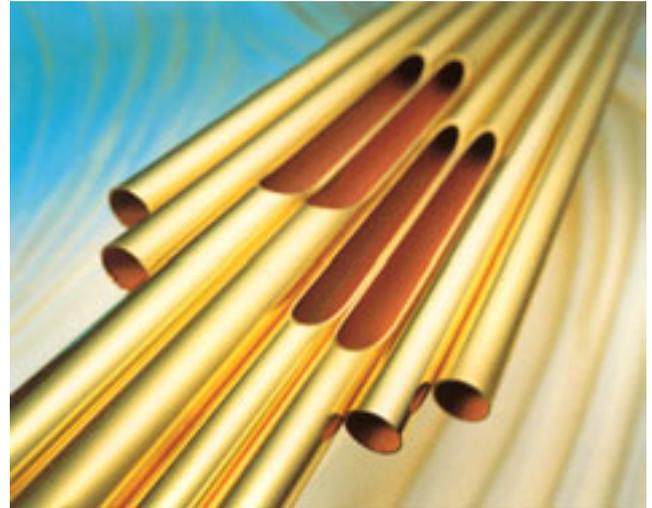
We have developed a technique to form a protective film made of iron oxyhydroxide in the tube manufacturing process, and we can supply copper alloy tubes previously fabricated with a protective film on the inner surface. Ferroco tube is our trade name for a tube with an initial protective film of iron oxyhydroxide. The principal merits of the Ferroco tube are as follows;

(1) The protective film of iron oxyhydroxide, similar to the film made by ferrous ion injection, is formed on the inner surface of the tube, and this exhibits excellent corrosion resistance.

(2) Blistering of the protective film by cathodic protection can never be generated. Therefore, the Ferroco tube can be used under the same conditions of cathodic protection as when using ordinary aluminum brass tubes. This is the most remarkable difference between the Ferroco tube and tubes pre-coated with resin.

(3) Maintenance work, such as tube cleaning and eddy current examination, can also be carried out under the same conditions as when using ordinary aluminum brass tubes.

(4) Ferrous ion of a high concentration need not be injected to form the initial protective film at the start of the operation. Therefore, the whole equipment can exhibit an excellent overall heat transfer coefficient during use.



*Ferroco Tube*

## 2. Duplex Tube for Power Plant Condensers

Although titanium tubes have excellent corrosion resistance, they have limited mechanical properties because of a thin wall thickness. Therefore, they are sometimes unsuitable for retubing in a condenser or heat exchanger using copper alloy tubes.

We have developed duplex tubes, combining an inner tube of titanium with an outer tube of copper-nickel, for use in condensers and heat exchangers using copper alloy tubes. These duplex tubes have the excellent corrosion resistance of titanium tubes and the excellent mechanical properties of copper alloy tubes. Therefore, after retubing with these duplex tubes, an old condenser can be used like a titanium condenser. For example, the condenser may have a high cleanliness factor under suitable conditions of sponge ball cleaning, and the cost of generating power may be reduced.

We used a special copper-nickel tube for the outer tubes. It has better corrosion resistance to stress corrosion cracking and ammonia attack than that found when using an aluminum brass tube as the outer tube. Furthermore, it has an excellent heat transfer coefficient because of its high tightness.

## 3. Duplex Tube for Petrochemical Plants

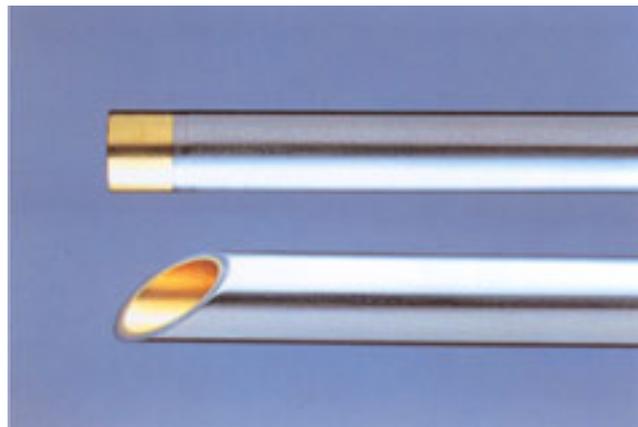
The duplex tubes, a combination of an outer tube of stainless steel or mild steel and inner tube of aluminum brass or copper-nickel, are used primarily for cooling in the oil refining and petrochemical industries. Most of the duplex tubes are attached with sleeves ( the attached length is from 20% to 50% of the wall thickness of the tube plate ) on both ends with the same alloy as the inner tube to prevent galvanic corrosion.

## 4. KC Tube

This is a tube with a protective film of resin on the inner surface. This film serves as an initial protective film. Since resin film is susceptible to damage under over protective conditions of cathodic protection, the KC tube has to be used under strictly controlled conditions of cathodic protection.



*Duplex Tube for Power Plant Condensers*



*Duplex Tube for Petrochemical Plants*



*KC tube*

## 5. Low Fin Tube

When compared with plain tubes, the integrated fin tube increases the surface area of the tubes, and improves heat exchange efficiency. We produce not only aluminum brass and 90/10 copper-nickel, but also 30% copper-nickel containing a large amount of iron and manganese, such as CN108 in BS2871 or C71640 in ASTM, which is known as a material difficult for finning. The low fin tube of this alloy can be produced by peculiar integrated techniques for melting, casting, hot extrusion and cold working.

We also produce mild steel, stainless steel and titanium low fin tubes adding the above copper alloys, and have acquired an admirable reputation with this product for its quality and our production skillfulness.

## 6. Corrugated Tube

The spiral indented corrugation on the surface of the tubes, produces turbulent flow and increases heat transfer efficiency. Production is possible with the same materials as used with low fin tubes.

## 7. U-bend Tube

The production results of U-bend tubes using various raw materials are excellent. The production range of U-bend tubes are as follows;

	Production Range (mm)	
	Minimum	Maximum
Outer Diameter	10	30
Thickness	0.8	5
Radius of bend	1.5D <sup>1)</sup> more than	800R less than
Length of straight part	Less than 10000	

1)Note D = Outer Diameter of tube

## 8. Comprehensive Diagnosis

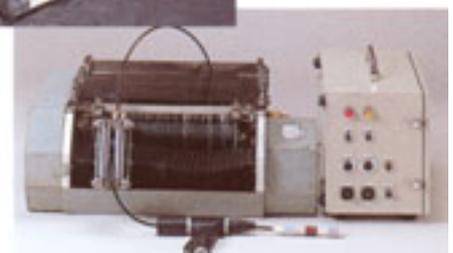
Eddy current testing of tubes is carried out in most condensers and heat exchangers. We are one of the nondestructive inspectors. We have abundant experience and expertise concerning nondestructive examinations and corrosion investigations. Based on the results of an eddy current test, the representative tube would be removed and any problem would be investigated. And we would recommend suitable countermeasures if a heat exchanger has any corrosion problems.

(The ISO 9001 QMS is not approved to comprehensive diagnosis.)



Low-fin tubes and Corrugated tube

Bend radius	Shinko Metal Standard ( ± %)	
	Outer diameter tolerance	Thickness tolerance
2D Less than	15	20
3D Less than	10	18
4D Less than	9	15
6D Less than	8	10
8D Less than	6	9
8D over	5	8



Eddy current equipments

## ENDING

We described the process of manufacturing copper alloys and some properties of these alloys as used in condenser and heat exchanger tubes, and related products and manufacturing techniques.

These tubes would be used in various conditions and during long periods. Therefore, in tube manufacture a high-grade quality product is required and an investigation into the techniques for use, such as corrosion protection technology, is necessary.

We are continuing these investigations in collaboration with other laboratories of our group companies, Kobe Steel and others, concerning the quality control of products, research and development of new products, maintenance techniques for heat exchangers and comprehensive diagnostics.

## OUTLINE OF SHINKO METAL PRODUCTS

### Corporate Outline

Name : Shinko Metal Products Co., Ltd.  
Established : April 1, 1988  
Paid-in-capital : 200 million yen  
Employees : 250  
Address : 2-1, Komorie 2-chome, Moji-ku, Kitakyushu,  
800-0007  
Phone : (093)381-1331 Fax : (093)381-3833  
Site area : 52,000 square meters  
Floor area : 32,400 square meters  
Products : Molds, head exchangers, composite products,  
condenser tubes, copper and copper alloy tubes  
Tokyo office : Kokusaihamamatsucho Bldg.,  
9-18, Kaigan 1-chome, Minato-ku, Tokyo, 105-0022  
Phone : (03)3432-5454 Fax : (03)3432-5456  
Osaka office : Midousuji Mitsui Bldg., 1-3, Bingomachi  
4-chome, Chuo-ku, Osaka, 541-0051  
Phone : (06)6206-6778 Fax : (06)6206-6104

### Corporate Highlights

- 1917 Established as Kobe Steel Moji Plant to handle copper drawing work for the domestic production of vessel boilers and industrial equipment.
- 1929 ALUMIBRASS tube developed.
- 1940 Plant expanded into the coastal area.
- 1959 Condenser tube plant completed.
- 1974 Condenser tube production level raised.
- 1976 Titanium heat exchanger developed.
- 1980 Copper-nickel tube production level raised.
- 1982 Mold mass production stance established.
- 1983 Mass production of isostatic extrusion products begun.
- 1984 Development of double-tube type heat exchangers with groove.
- 1988 Intergrated with Moji Shinkan Kogyo as Shinko Metal Products Co., Ltd.
- 1989 Mass production of Ferroco tubes begun.
- 1991 Mold plant completed.
- 1995 ISO 9001 QMS certification got.
- 1997 500-ton combined drawing machine for large-diameter pipe installed.
- 1999 Additional low-fin rolling machines installed.



# COPPER ALLOY TUBES FOR HEAT-EXCHANGER



## SHINKO METAL PRODUCTS CO.,LTD.

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Some products in this catalogue are restricted to export to avoid military use.  
In such a case, the approval by Japanese government is needed.

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