AIR CONDITIONING AND REFRIGERATION COPPER TUBES

FURUKAWA

FURUKAWA METAL (THAILAND) PUBLIC COMPANY LIMITED

FURUKAWA

Company Policy

FMT is the company that produces only PHD copper tube. It provides all kinds of copper tube required to the manufactures of air conditioners and refrigerators. The followings are the copper tube which FMT can provides ;

FMGT	Inner grooved tube for the heat exchanger
Plain tube LWC	For heat exchanger and piping
Half Hard tube	Radiator tube for refrigerator
Large diameter tube	For Accumulator or Tank
Capillary tube	For air conditioner and refrigerator

FMT's goal is to make the Customers' Satisfaction as the company's supreme priority, and continuing its effort to provide higher quality of the products and services. At present, FMT aims to achieve the certification of ISO 9001. It also will challenge the ISO 14001 to reflect the company's commitment to protect and preserve the global environment.

FMT is proud of high productivity capacity of the low-residual-oil tube developed by the Furukawa Electric Co.,Ltd. FMT is very critical in the selection of the suitable kind of drawing lubricant specially in the production of the low-residual-oil copper tube. FMT also introduced the latest technique to design the annealing furnace for this exclusive use too. FMT's low-residual-oil tube is known by the name of Furukawa Super Clean Tube (FSCT).

FSCT is nearly 100% used for the refrigerator produced in Thailand. The refrigerant for air conditioner is changing from CFC Freon gas to a new refrigerant substitution which is more friendly to the earth environment. Undoubtedly, FSCT will be the indispensable part in the production of new model air conditioners which need the low-residual-oil tube.

We aggressively determine to participate in your new product development.

Factory

Furukawa Metal (Thailand) Public Company Limited

1. Address :

Bangkok Office ; 888/121 12th Floor Mahatun Plaza Building, Ploenchit Road, Lumpini, Patumwan, Bangkok 10330
Tel (02) 253-5020 Fax (02) 253-5021

Saraburi Factory ; Friendship Highway, Km 125th 213 Moo 4, Tab-Kwang, Kaeng Khoi, Saraburi 18260
Tel (036) 329-811-20 Fax (036) 357-342

2. History

Established	June	1988
Started Operation 350 ton/month	July	1990
Started Production of FMGT	June	1991
Started Production of Large Dia Tube	February	1992
Started Production of Capillary Tube	February	1994
Expanded to 700 ton/month	April	1994
Started Production of FSCT	April	1994
Certificated as Public Company	February	1996
Listed Stock to SET	February	1997
Expanded capacity to 1,500 ton/month	March	1997
Started operation of full continuous casting	August	1997
Constructed Fine Tube Factory	October	1998
Received Certification of ISO 9001	January	1999

3. Major Products ; Phosphorized Deoxidized Copper Tube for ACR

1) Furukawa Multi Grooved Tube
2) LWC of Smooth Tube
3) H/2 LWC for Refrigerator
4) Large Diameter Tube for Accumulator & Tank
5) Capillary Tube
6) Others

4. Employees ; Persons

5. Factory Ground Area ; 134,912 sqm.

6. Capital ; 480,000,000 Baht

TÜV CERT

CERTIFICATE

The TÜV CERT Certification Body of Rheinisch-Westfälischer TÜV e.V.

hereby certifies in accordance with TÜV CERT procedure that

FURUKAWA METAL (THAILAND) PUBLIC COMPANY LIMITED
12th Floor, Mahatun Plaza Building,
888/121 Ploenchit Road, Lumpini, Patumwan,
Bangkok 10330, Thailand

has established and applies a quality system for

Production of Copper Tubes for Air Conditioners, Refrigerators and Plumbing. Processing of Copper Tubes

An audit was performed, Report No. [illegible]

Proof has been furnished that the requirements according to

[illegible]

are fulfilled. The certificate is valid until [illegible]

Certificate Registration No. [illegible]

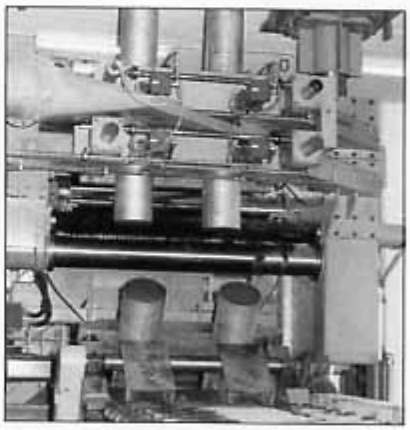
RWTÜV

The Certificate of ISO 9001

ISO 9001 Certificate Awarded Ceremony

Production Process

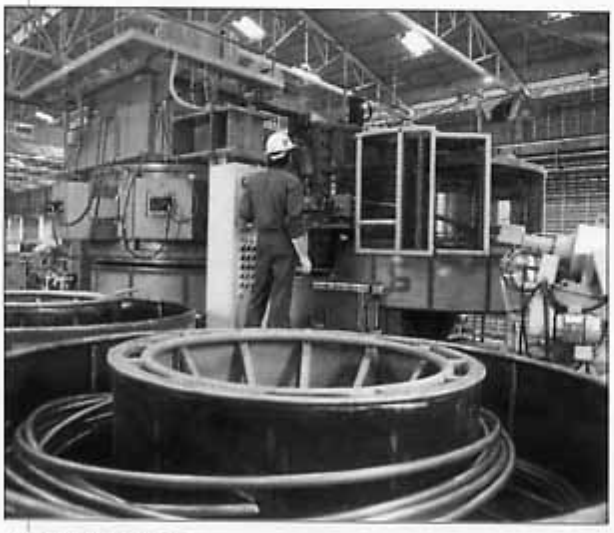
Phosphorus deoxidized copper tubes have superior workability, heat conductivity and resistance to corrosion. It is suitable for air-conditioner, refrigerator, piping and other applications. Furukawa Metal (Thailand) Public Company Limited produces phosphorus deoxidized copper tubes under licensed by Furukawa Electric Company Limited (Japan). It is beautiful in appearance, accurate in dimension and good in quality.



Continuous Casting

Extrusion

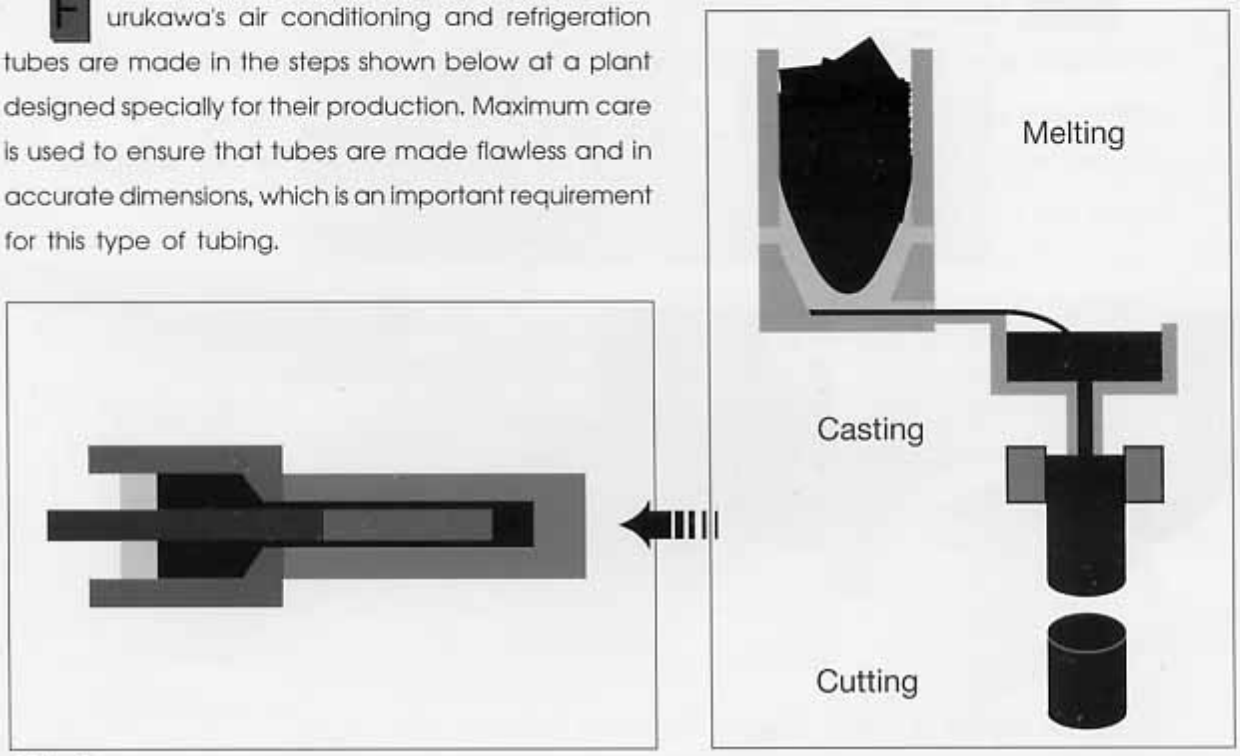
Reducer



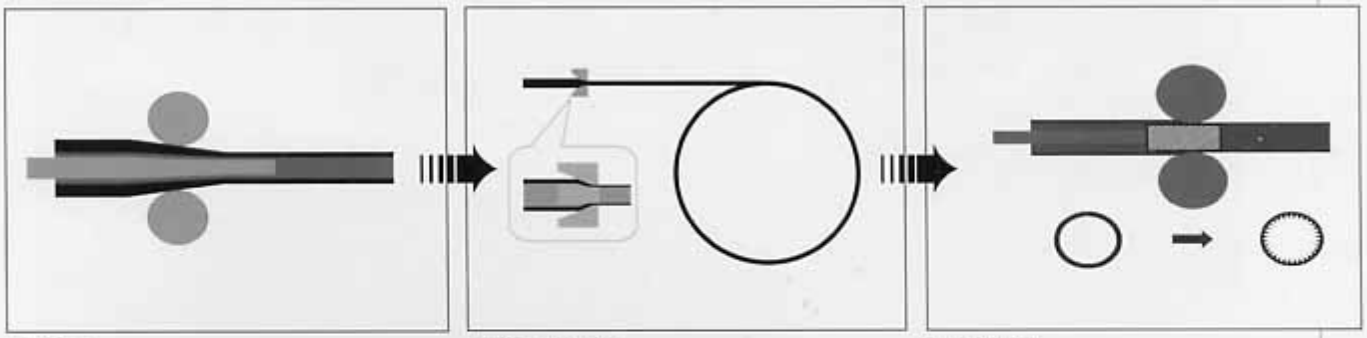
Vertical Bull Block

Level Winder

Furukawa's air conditioning and refrigeration tubes are made in the steps shown below at a plant designed specially for their production. Maximum care is used to ensure that tubes are made flawless and in accurate dimensions, which is an important requirement for this type of tubing.



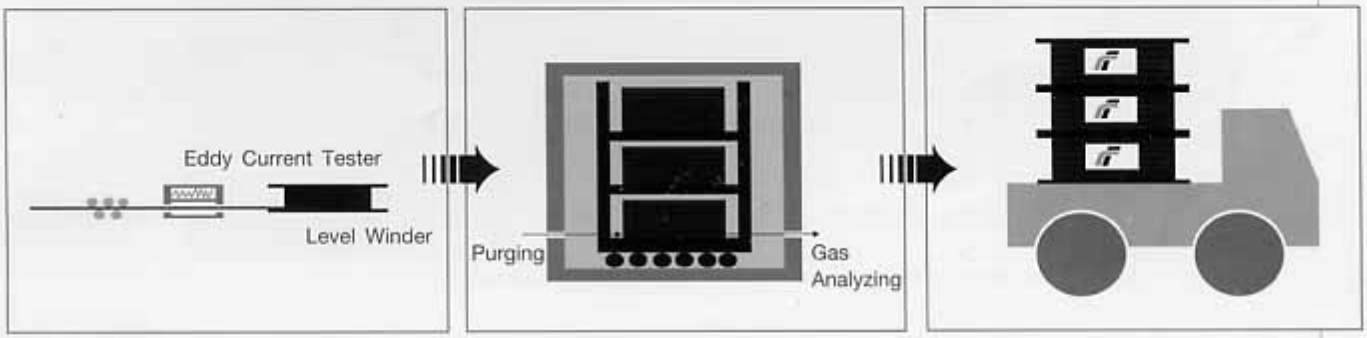
Extruding
Extrusion Press



Rolling
Tube Reducer

Cold Drawing
VBB(Vertical Bull Block)

Grooving
GV (Grooving Machine)



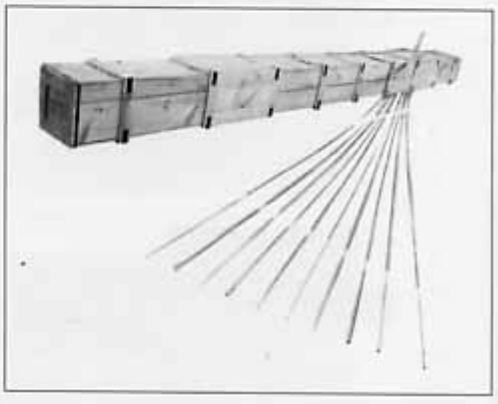
Level Winding
Eddy Current Testing

Bright Annealing
Clean Furnace

Delivery

Smooth Tube

FMT produces various size of smooth tube and supplies as different shape of products such as LWC, Straight Tube or Pancake Coil. Usually we supply the custom size according to the customer's requirement in addition to JIS or ASTM standard size. If you can not find your desirable size in the following size table, please don't hesitate to contact us.



Production Range of LWC. Straight Tube and Pancake Coil

WT \ OD	4.00	4.76	5.00	6.00	6.35	7.00	7.94	9.53	12.70	15.88	19.05
0.30											
0.35											
0.40											
0.45											
0.50											
0.55											
0.60											
0.65											
0.70											
0.75											
0.80											
0.85											
0.90											
0.95											
1.00											
1.10											
1.20											
1.30											

In case of out of range, please contact us. We will consider how to produce it.

FMGT Furukawa Multi Grooved Tube

FMGT can be made various transverse cross sections. Typical transverse cross sections are shown.

Type **A**

Type **B**

Type **G-5**

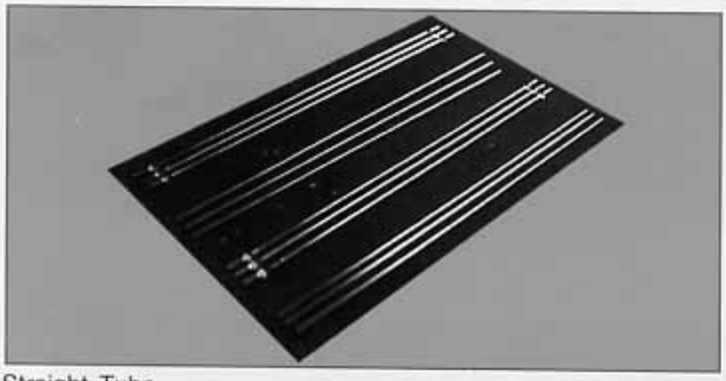
Nominal size	Code	OD Outside Diameter	T Bottom Thickness	N Numder of Groove	Lead Angle	H Groove Dept	W Bottom Width	Inside Surface Area	Unit Weight
		mm	mm		Degree	mm	mm	cm^2/m	g/m
6.35 x 0.25	045-18-15	6.35	0.25	45	18	0.15	0.278	280	49
6.35 x 0.25	055-10-20	6.35	0.25	55	10	0.20	0.147	330	58
7.00 x 0.27	060-18-15	7.00	0.27	60	18	0.15	0.155	320	62
7.00 x 0.25	050-18-18	7.00	0.25	50	18	0.18	0.253	340	58
7.00 x 0.25	050-18-21	7.00	0.25	50	18	0.21	0.231	360	60
7.94 x 0.28	045-18-15	7.94	0.28	50	18	0.15	0.310	340	69
7.94 x 0.28	065-25-15	7.94	0.28	65	25	0.15	0.069	340	75
8.00 x 0.28	050-18-18	8.00	0.28	50	18	0.18	0.316	370	69
8.00 x 0.28	055-18-18	8.00	0.28	55	18	0.18	0.270	380	71
9.52 x 0.28	065-25-15	9.52	0.28	65	25	0.15	0.146	400	95
9.52 x 0.28	060-18-15	9.52	0.28	60	18	0.15	0.270	410	90
9.52 x 0.30	060-18-20	9.52	0.30	60	18	0.20	0.270	450	92
10.00 x 0.34	060-18-20	10.00	0.34	60	18	0.20	0.295	470	110

FMT can produce New Types According to customer requirement

Capillary Tube

FMT supplies various kind of capillary tube for air conditioner and refrigerator. The inside of the capillary tube is very smooth in order to avoid strapping of oil scum. FMT is developing a new degreasing method to avoid residual harmful materials against HFC Freon, such as chlorine, lubricant etc.

Fine Tube Factory



Straight Tube

Capillary Tube

FMT Capillary Tube

Straight Tube (Temper : O, OL)

Size	ID : 0.50 ~ 3.40 mm.
	OD : 1.65 ~ 4.00 mm.
Length	100 ~ 3,150 mm.
Packing	Paper Cylinder

Bunch Coil (Temper : H, OL)

Size	ID : 0.50 ~ 3.40 mm.
	OD : 1.65 ~ 4.00 mm.
Length	100 & 200 Feet
Packing	Card Board Box

Tube End Processing

Deburring

Pinch Seal

Stopper

Half Hard Tube Production Size Table

H/2 LWC (mm)

WT \ OD	4.00	4.76	5.00	6.00	6.35
0.30					
0.40					
0.50					
0.60					
0.70					
0.80					
0.90					
1.00					

H/2 Straight Tube

WT \ OD	4.00	4.76	5.00	6.00	6.35	7.00	7.94	9.53	12.70	15.88	19.05	22.23	25.40
0.30													
0.40													
0.50													
0.60													
0.70													
0.80													
0.90													
1.00													
1.10													
1.20													

Product range of Large Diameter tube (temper : O,OL,H)

WT \ OD	15.88	19.05	22.22	25.40	28.58	30.16	31.75	34.93	41.28	50.80	53.95	55.00	64.00
0.60													
0.70													
0.80													
0.90													
1.00													
1.10													
1.20													
1.30													
1.40													
1.50													
1.60													
1.70													
1.80													
1.90													
2.00													

In case of out of Range, please contact us. We will consider how to produce it

FSCT Furukawa Super Clean Tube

Generally speaking, about 10 mg/m or over of drawing lubricant oil remains inside of copper tube after drawn. The lubricant oil evaporates by heating in annealing furnace and the most of the oil vapor flow out from the each end of long LWC. But, some parts of the vapor still remain inside of LWC, and condense on the inside surface of copper tube partially when cooling in the annealing furnace. The residual oil is harmful as follows ;

It may cause a failure in brazing

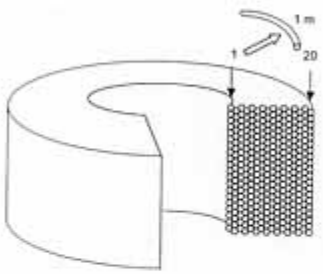
It may cause a blockade accident in refrigerating cycle when using HFC

FMT and its parent company, the Furukawa Electric Co., Ltd., developed a special method to purge out the oil vapor during heating process in annealing furnace. They also designed a new type of annealing furnace which is named as Clean Furnace. Moreover, FMT specifically selected the drawing lubricant which almost completely evaporates at below the annealing temperature.

Clean Furnace

FSCT is recommended for all air conditioner and refrigerator using HFC Freon. It is also recommended for non degreasing assemble process of air conditioner and refrigerator. FSCT's supreme purity inside of copper tube is guaranteed.

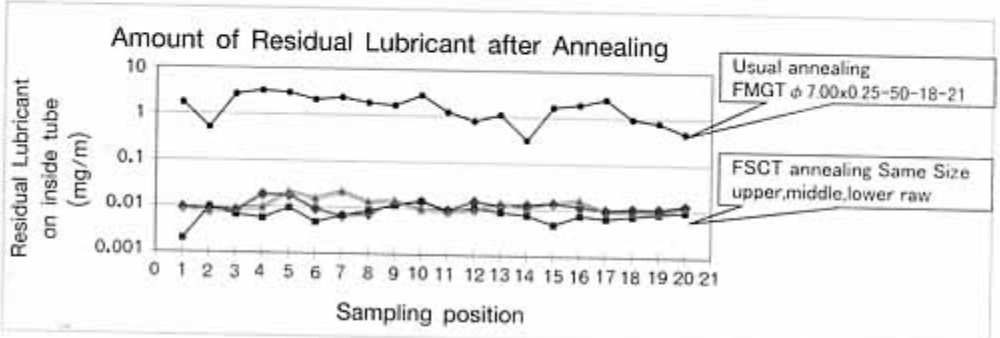
Sample of Analyzing Result



Measuring method

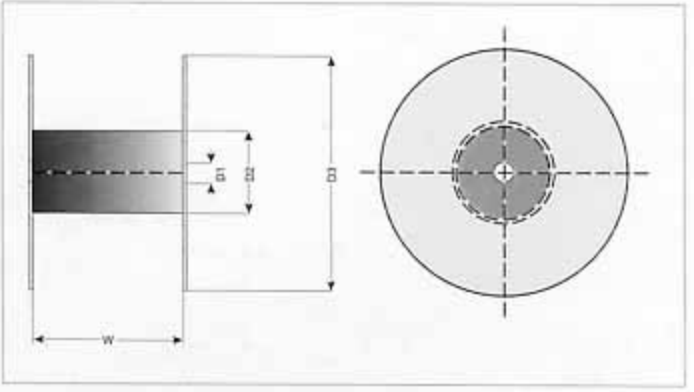
Inner lubricant was abstracted from the tube of 1 sampled at each layer by Freon S-316.

Measuring analyzer : OCMA-300(HORIBA)



Packing Style For LWC

Material	Plywood					Carton			
Flang diameter (D3)	900		1090			1030		1090	
Width (W)	240	300	240	300	360	240	300	240	300
Arbor hole (D1)	130	130	130	130	130	130	130	130	130
Core diameter (D2)	550	550	550	550	550	550	550	550	550



Packing Style For Straight Tube

Wooden Case	Code	Inner Dimension (mm)		
Type		W	H	L
H	H0 to H14	490	345	1,550 ~ 8,550
S	S0 to S14	300	250	1,550 ~ 8,550

Packing Style For Pancake Coil

Packing Box	Tube Diameter mm	Dimension (mm)			Containing Coils
		W	L	H	
Carton Box	4.76	410	410	100	20
	6.00	460	460	100	16
	6.35	460	460	100	16
	7.94	510	510	100	12
	8.00	510	510	100	12
	9.53	560	560	100	10
	10.00	560	560	100	10
	11.11	610	610	100	8
	12.70	610	610	100	8
	15.88	710	710	100	6
	19.05	810	810	100	5

Maximum length is 15.24 m

The level wound coil (L.W.C.) is of continuous length and most popular for use of air conditioners, refrigerators, etc.

The copper tube wound tight on a reel can be used in a long length. L.W.C. has many salient features. With careful attention paid to its dimensional tolerances, and reel, L.W.C. is favorably received by users.

FEATURES OF LEVEL WOUND COIL

- The coil retains a high degree of roundness and therefore permits easy working.
- The tube can be made in a continuous length (maximum 160 kg per coil.)
- The reel comes in carton material and in three sizes to fit the equipment to work the tube.

ขอบเขตการผลิตของท่อแบบเป็นม้วน ท่อตรง และท่อขดลักษณะแพนเค้ก (PRODUCTION RANGE OF LWC, STRAIGHT TUBE & PANCAKE COIL)

Unit: mm (in.)

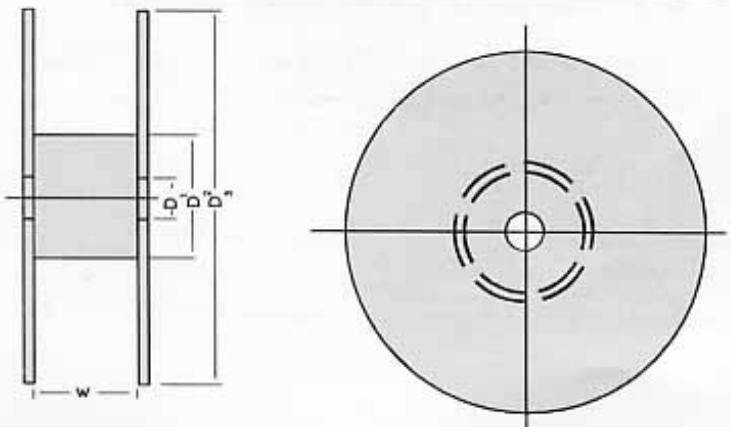
Outside diameter \ Wall thickness	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	1.00 (0.037)
4.76 (0.187)														
6.35 (0.250)														
7.94 (0.312)		F2								E2				
9.52 (0.375)	G2													
12.7 (0.500)			G2					F2						
15.88 (0.625)				F3		G2								
19.05 (0.750)							F3		G2					

ตารางโดยรอบแสดงขอบเขตการผลิต และสีหมายถึงชนิดการใช้งานของท่อแบบเป็นม้วน
Ref. The enclosure shows the production range, and the colour shows the type of the applicable reel for LWC.

ขนาดมาตรฐานของท่อชนิดม้วน (STANDARD REEL SIZE)

Unit: mm (in.)

Reel \ Type	E2	F2	F3	G2
Arbor hole (D_1)	130 (5.1)	130 (5.1)	130 (5.1)	130 (5.1)
Core diameter (D_2)	560 (22)	560 (22)	560 (22)	560 (22)
Flange diameter (D_3)	1,030 (40.6)	1,090 (42.9)	1,090 (42.9)	1,090 (42.9)
Inner width (W)	240 (9.4)	240 (9.4)	240 (9.4)	300 (11.8)



การบรรจุในภาชนะ (CONTENTS IN A CONTAINER)

Type of reel	No. of Coil per container	Weight per container (kg)
E2	70	9,450
F2	70	9,450
F3	70	6,300
G2	60	8,100

Furukawa's air conditioning and refrigeration tubes enhance the performance of air conditioners and refrigerators.

ลักษณะเด่น
(FEATURES)

(1) High quality
The tubes are all given an eddy current test over the entire length, which ensures a flawless, high quality.
(2) High workability
The tubes are made with varied degrees of temper. Therefore one having a desired temper fit for a specific application can be selected.
(3) Excellent brazing
The tubes can be brazed with no fear of hydrogen brittleness.
(4) Fine appearance
The bright-annealed tube surface, inside and outside, persents a fine appearance with metallic luster.
(5) Available in many forms
The tubes are supplied in many forms - straight length, pancake coil, multi - layer coil, bunched coil, and level wound coil. One fit for your tube - working equipment can be selected from among them.

คุณสมบัติทางกายภาพ
(PHYSICAL PROPERTIES)

Melting point	1083 °C
Specific gravity	8.94 (20 °C)
Specific heat	0.092 cal/g °C (20 °C)
Modulus of elasticity	12,000 kgf/mm²
Thermal conductivity	0.81 cal/cm/sec/ °C (20 °C)
Coefficient of thermal expansion	17.7 x 10^{-6}/ °C (20~300 °C)
Electric resistance	2.03 μΩ cm

คุณสมบัติทางเชิงกล
(MECHANICAL PROPERTIES)

The table below shows the mechanical properties of Furukawa's air conditioning and refrigeration tubes. Choose one that fits your tube - working equipment. Hardness and strength increase, but bending and expanding become harder as the temper changes from "O" to "H" in the table.
The temper of "1/16H" is hardening only on the outside surface of the tube. It is suitable for a straight tube for hairpin working.

Temper	Temper designation	Standard	Tensile strength kgf/mm² (MPa)	Elongation %	Yield strength* kgf/mm² (MPa)	Rockwell hardness		Grain size mm
						Scale	Value	
Soft anneal	060	ASTM B75	21 (206) min	-	1) 6.3 (62) min	15T	60 max	0.040 min
	0	JIS H3300	21 (206) min	40 min	-	-	-	0.025 ~ 0.060
	Furukawa typical value		24 (235)	52	2) 5 (49)	15T	47	0.040
Light anneal	050	ASTM B75	21 (206) min	-	1) 6.3 (62)	15T	65 max	0.040 max
	OL	JIS H3300	21 (206) min	40 min	-	-	-	0.040 max
	Furukawa typical value		25 (245)	51	2) 5 (49)	15T	52	0.020
Skin hard	1/16H-1	Furukawa standard	23 (226) min	45 min	2) 5.6 ~ 9.8 (55 ~ 96)	-	-	0.015 ~ 0.040
	Furukawa typical value		25.5 (250)	51	2) 7.5 (74)	15T	55	0.020
Skin hard	1/16H-2	Furukawa standard	23 (226) min	45 min	2) 8 ~ 11 (78 ~ 108)	-	-	0.015 ~ 0.040
	Furukawa typical value		25.5 (250)	50	2) 9.5 (93)	15T	56	0.020
Light drawn	H55	ASTM B75	25.3 ~ 33.0 (250 ~ 325)	-	1) 21 (206) min	30T	30 ~ 60	-
	1/4H	Furukawa Standard	24 ~ 30 (236 ~ 294)	20 min	-	-	-	-
	Furukawa typical value		28 (275)	33	-	15T	70	-
Drawn	H58	ASTM B75	25.3 (250) min	-	1) 21 (206) min	30T	30 min	-
	1/2H	JIS H3300	25 ~ 33 (245 ~ 324)	-	-	-	-	-
	Furukawa typical value		29.5 (289)	28	-	30T	43	-
Hard drawn	H80	ASTM B75	31.6 (310) min	-	1) 28.1 (275) min	30T	55 min	-
	H	JIS H3300	32 (314) min	-	-	-	-	-
	Furukawa typical value		38.5 (378)	-	-	30T	62	-

1) ที่ 0.5% ยืดภายใต้แรงกระทำ (At 0.5% extension under load)
2) ที่ 0.2% ยืดภายใต้แรงกระทำ (At 0.2% extension under load)

ส่วนประกอบ (COMPOSITION)

Furukawa's air conditioning and refrigeration tubes fully meet the requirements of the applicable Japanese Industrial Standard (JIS) and ASTM

ส่วนประกอบทางเคมี (Chemical composition)

Standard	Chemical composition (%)	
	Cu	P
JIS H 3300 C 1220 T (Phosphorus deoxidized copper)	99.90 min.	0.015~0.040
ASTM B75 C 12200 (DHP)	99.9 min.	0.015~0.040

ขนาดของค่าพิกัดความเผื่อ (DIMENSIONAL TOLERANCES)

1. ค่าพิกัดความเผื่อของเส้นผ่าศูนย์กลางภายนอก และความหนา ตามมาตรฐาน ASTM B75
(Tolerances on outside diameter and wall thickness in ASTM B75)

Unit: mm (in)

Standard size, in.	O.d. \ T		Tolerance, plus and minus								
	Nominal	Average tolerance, plus and minus	0.30 (0.012)	0.35 (0.014)	0.41 (0.016)	0.5 (0.020)	0.6 (0.024)	0.7 (0.028)	0.8 (0.031)	0.9 (0.035)	1.0 (0.039)
3/16	4.76 (0.187)	0.051 (0.002)	0.025 (0.001)	0.025 (0.001)	0.025 (0.001)	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.076 (0.003)	0.076 (0.003)
1/4	6.35 (0.250)	0.051 (0.002)	0.025 (0.001)	0.025 (0.001)	0.025 (0.001)	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.076 (0.003)	0.076 (0.003)
5/16	7.94 (0.312)	0.051 (0.002)	0.025 (0.001)	0.025 (0.001)	0.025 (0.001)	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.076 (0.003)	0.076 (0.003)
3/8	9.52 (0.375)	0.051 (0.002)	0.025 (0.001)	0.025 (0.001)	0.025 (0.001)	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.076 (0.003)	0.076 (0.003)
1/2	12.7 (0.500)	0.051 (0.002)	-	0.025 (0.001)	0.025 (0.001)	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.076 (0.003)	0.076 (0.003)
5/8	15.88 (0.625)	0.051 (0.002)	-	-	0.025 (0.001)	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.076 (0.003)	0.076 (0.003)
3/4	19.05 (0.750)	0.064 (0.0025)	-	-	-	0.051 (0.002)	0.051 (0.002)	0.064 (0.0025)	0.064 (0.0025)	0.089 (0.0035)	0.089 (0.0035)

2. ค่าพิกัดความเผื่อของเส้นผ่าศูนย์กลางภายนอก และความหนาเกรดพิเศษ ตามมาตรฐาน JIS H3300
(Tolerances on outside diameter and wall thickness in special grade of JIS H3300)

Unit: mm (in)

Standard size, in.	O.d. \ T		Tolerance, plus and minus								
	Nominal	Average tolerance, plus and minus	0.30 (0.012)	0.35 (0.014)	0.41 (0.016)	0.5 (0.020)	0.6 (0.024)	0.7 (0.028)	0.8 (0.031)	0.9 (0.035)	1.0 (0.039)
3/16	4.76 (0.187)	0.05 (0.002)	0.03 (0.001)	0.03 (0.001)	0.05 (0.002)	0.05 (0.002)	0.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.08 (0.003)	0.08 (0.003)
1/4	6.35 (0.250)	0.05 (0.002)	0.03 (0.001)	0.03 (0.001)	0.05 (0.002)	0.05 (0.002)	0.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.08 (0.003)	0.08 (0.003)
5/16	7.94 (0.312)	0.05 (0.002)	0.03 (0.001)	0.03 (0.001)	0.05 (0.002)	0.05 (0.002)	0.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.08 (0.003)	0.08 (0.003)
3/8	9.52 (0.375)	0.05 (0.002)	0.03 (0.001)	0.03 (0.001)	0.05 (0.002)	0.05 (0.002)	.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.08 (0.003)	0.08 (0.003)
1/2	12.7 (0.500)	0.05 (0.002)	-	0.03 (0.001)	0.05 (0.002)	0.05 (0.002)	0.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.08 (0.003)	0.08 (0.003)
5/8	15.88 (0.625)	0.06 (0.002)	-	-	0.05 (0.002)	0.05 (0.002)	0.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.09 (0.0035)	0.09 (0.0035)
3/4	19.05 (0.750)	0.06 (0.002)	-	-	-	0.05 (0.002)	0.05 (0.002)	0.06 (0.002)	0.06 (0.002)	0.09 (0.0035)	0.09 (0.0035)