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APPLICATION AND ENGINEERING DATA

# Copper Capillary Tubing

For Refrigeration and Air-Conditioning

## DIAMETER AND LENGTH

### FACTORS AFFECTING REFRIGERANT FLOW

The size of the cap tube is fairly critical. Unlike orifices, such as expansion valve seats, capillary tubes depend on their length as well as their diameter to determine their total restriction. The relationship between these two factors are shown in the following charts. A change in diameter on a percentage basis can change the flow more than an equal change in length. To illustrate, changing the diameter by .005" as between .026" I.D. and .031" I.D. can double the flow.

Restriction can also be changed by lengthening or shortening the cap tube. The longer the tube, the slower the flow; the shorter the tube, the faster the flow. The general flow curve graph (right) shows what happens to the flow of refrigerant through a cap tube as the length is changed. This curve is not meant to give specific flows but to simply illustrate what happens with all cap tubes so that the general flow pattern can be understood.

By following the flow curve from left to right it can be seen that for the very longest length the flow is the smallest. Then as the cap tube length is decreased, the flow increases slowly until critical point "L" is reached.

At this point the flow increases more rapidly with each reduction in length until critical point "S" is reached. From this point on, further decrease in

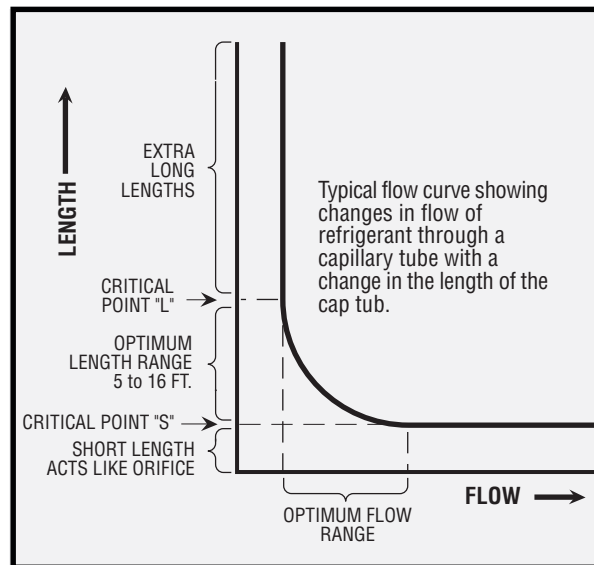
length causes ever increasing flow. From the study of this typical curve, certain pertinent conclusions can be reached that directly affect the field application of capillary tubes.

On the graph, the section above the critical point "L" is marked as extra long lengths. Attempting to increase restriction (i.e. reduce flow) by increasing length into this region is not only uneconomical but frequently hopeless. In addition, tubes in this range may not be responsive enough to changes in head pressures during operation. All in all, tube lengths in this range should be avoided where possible.

Continuing down the graph, the section below critical point "S" should be avoided like the plague. In this range, the tube is so short that even small changes in length will cause very large increases in flow. This is caused by the fact that the length no longer affects the flow and the tube now beings to act more like an orifice than a capillary tube. But, without the other components necessary to control an orifice, such as are present in an expansion valve or high side float, a very short cap tube will give wildly erratic operation under varying ambients and loads.

All of this would be meaningless without some definite way to use this information. Although the critical points will vary depending on the I.D. of the cap tubing being used, a very safe operating rule-of-thumb can be offered. Keep the cap tube no shorter than 5 ft. and no longer than 16 ft.

SHORT COIL	100 FT. COILS	10 COILS	DESCRIPTION
TC-26-16	TC-26-100	TC-26-100-101	.026 ID x .072 OD x 16'
TC-31-12	TC-31-100	TC-31-100-101	.031 ID x .083 OD x 12'
TC-36-12	TC-36-100	TC-36-100-101	.036 ID x .087 OD x 12'
TC-42-12	TC-42-100	TC-42-100-101	.042 ID x .093 OD x 12'
TC-44-12	TC-44-100	TC-44-100-101	.044 ID x .109 OD x 12'
TC-49-11	TC-49-100	TC-49-100-101	.049 ID x .099 OD x 11'
TC-50-11	TC-50-100	TC-50-100-101	.050 ID x .114 OD x 11'
TC-54-11	TC-54-100	TC-54-100-101	.054 ID x .106 OD x 11'
TC-55-11	TC-55-100	TC-55-100-101	.055 ID x .125 OD x 11'
TC-59-10	TC-59-100	TC-59-100-101	.059 ID x .112 OD x 10'
TC-64-10	TC-64-100	TC-64-100-101	.064 ID x .125 OD x 10'
TC-70-12	TC-70-100	TC-70-100-101	.070 ID x .125 OD x 12'
TC-75-9	TC-75-100	TC-75-100-101	.075 ID x .125 OD x 9'
TC-80-10	TC-80-100	TC-80-100-101	.080 ID x .145 OD x 10'
TC-85-9	TC-85-100	TC-85-100-101	.085 ID x .145 OD x 9'
TC-90-7	TC-90-100	TC-90-100-101	.090 ID x .145 OD x 7'
TC-100-10	TC-100-100	TC-100-100-101	.100 ID x .156 OD x 10'





## AIR-CONDITIONING APPLICATION CHART (R-22)

B.T.U./ CIRCUIT	CAP TUBE		B.T.U./ CIRCUIT	CAP TUBE	
	Length	Size		Length	Size
4000	69 in	TC-49	8750	78 in	TC-75
4250	63 in	TC-49	9000	72 in	TC-75
4500	90 in	TC-54	9250	67 in	TC-75
4750	81 in	TC-54	9500	84 in	TC-80
5000	72 in	TC-54	9750	84 in	TC-80
5250	63 in	TC-54	10,000	76 in	TC-80
5500	101 in	TC-64	10,250	72 in	TC-80
5750	94 in	TC-64	10,500	68 in	TC-80
6000	87 in	TC-64	10,750	64 in	TC-80
6250	79 in	TC-64	11,000	60 in	TC-80
6500	72 in	TC-64	11,250	87 in	TC-85
6750	64 in	TC-64	11,500	84 in	TC-85
7000	90 in	TC-70	11,750	78 in	TC-85
7250	84 in	TC-70	12,000	72 in	TC-85
7500	78 in	TC-70	12,500	82 in	TC-90
7750	73 in	TC-70	13,000	72 in	TC-90
8000	69 in	TC-70	13,500	66 in	TC-90
8250	64 in	TC-70	14,000	60 in	TC-90
8500	84 in	TC-75			

R-134a – It is suggested to add 10% to length.

Recommended capillary tube lengths for each circuit in an air conditioner evaporator where R-22 is the refrigerant. All recommendations must be considered approximate and variations may arise in actual field applications.

Window air conditioners normally have 1 circuit and the recommended cap tube can be read directly from the chart. Larger units have 2 or more circuits in the evaporator. Where this is the case, simply divide the total BTU rating of the unit by the number of cap tube circuits to obtain the BTU/CIRCUIT rating of each individual cap tube.

Example:

Air conditioner is rated at 27,000 BTU and has 3 cap tubes connected to the evaporator. Divide 27,000 by 3 = 9,000 BTU/Circuit. From the chart, this would call for .075 I.D. (TC-75) 72 inch long. The length and I.D. of any cap tube may be adjusted to a more readily available size by using the conversion chart.

## REFRIGERATION APPLICATION CHART (R-12 AND R-22)\*

H.P.	REF.	NOTE	NORMAL EVAPORATING TEMPERATURE DEGREES F							
			-10 to +5		+5 to +20		+20 to +35		+35 to +50	
1/20	R12	S-F	16 Ft.	TC-26	10 Ft.	TC-26				
1/12	R12	S-F	12 Ft.	TC-26	12 Ft.	TC-31				
1/9	R12	S	12 Ft.	TC-26	12 Ft.	TC-31				
1/9	R12	S	10 Ft.	TC-26	10 Ft.	TC-31				
1/8	R12	S-F	10 Ft.	TC-26	10 Ft.	TC-31				
1/6	R12	S	12 Ft.	TC-31	12 Ft.	TC-36	8 Ft.	TC-36	10 Ft.	TC-42
1/6	R12	F	10 Ft.	TC-31	10 Ft.	TC-36				
1/5	R12	S	10 Ft.	TC-31	10 Ft.	TC-36	7-1/2 Ft.	TC-42	7-1/2 Ft.	TC-49
1/5	R12	F	8 Ft.	TC-31	8 Ft.	TC-36	10 Ft.	TC-42	6 Ft.	TC-42
1/4	R22	S-F	12 Ft.	TC-36	6 Ft.	TC-36	8-1/2 Ft.	TC-42	6 Ft.	TC-49
1/4	R12	F	10 Ft.	TC-36	6 Ft.	TC-36	8 Ft.	TC-42	6 Ft.	TC-49
1/3	R22	F	10 Ft.	TC-36	6 Ft.	TC-36	11 Ft.	TC-49		
1/3	R12	F	12 Ft.	TC-42	6 Ft.	TC-42	9 Ft.	TC-49	6 Ft.	TC-54
1/2	R22	F	6 Ft.	TC-36	9 Ft.	TC-42	7-1/2 Ft.	TC-54	10 Ft.	TC-64
1/2	R12	F	11 Ft.	TC-54	9 Ft.	TC-49				
3/4	R22	F	11 Ft.	TC-54	9 Ft.	TC-54				
3/4	R12	F	7-1/2 Ft.	TC-54	12 Ft.	TC-70	1 Ft.	TC-80		
1	R22	F	10 Ft.	TC-64	12 Ft.	TC-70				
1	R12	F	10 Ft.	TC-70	11 Ft.	TC-54	7-1/2 Ft.	TC-54 (2 pcs)		
1-1/2	R22	F	7-1/2 Ft.	TC-54 (2 pcs)	7-1/2 Ft.	TC-54 (2 pcs)	8 Ft.	TC-64 (2 pcs)		
1-1/2	R12	F			9 Ft.	TC-64 (2 pcs)	10 Ft.	TC-80 (2 pcs)		
2	R22	F			10 Ft.	TC-70 (2 pcs)	9 Ft.	TC-75 (2 pcs)		
2	R12	F	10 Ft.	TC-70 (2 pcs)	9 Ft.	TC-75 (2 pcs)	10 Ft.	TC-85 (2 pcs)		
3	R22	F			10 Ft.	TC-70 (3 pcs)	9 Ft.	TC-75 (3 pcs)		
3	R12	F	10 Ft.	TC-70 (2 pcs)	8 Ft.	TC-64 (4 pcs)	10 Ft.	TC-80 (4 pcs)		
4	R22	F			10 Ft.	TC-70 (4 pcs)	9 Ft.	TC-75 (4 pcs)		
4	R12	F			10 Ft.	TC-70 (5 pcs)	9 Ft.	TC-75 (5 pcs)		
5	R12	F			10 Ft.	TC-80 (5 pcs)	9 Ft.	TC-85 (5 pcs)		

NOTE: Condenser Type: S = Static, F = FAN

\*R-134a – It is suggested to add 10% to length.

# REFRIGERATION REFERENCE CHART FOR CAPILLARY TUBING

Fan Cooled Units Only. Add 10% to length for Static Cooled

## SINGLE FEED

H.P.	LOW	MED	HIGH
<b>R12 / R416A</b>			
1/8	TC-26 110"	TC-26 84"	TC-26 48"
1/6	TC-26 71"	TC-31 96"	TC-31 72"
1/5	TC-31 54"	TC-31 36"	TC-31 24"
1/4	TC-31 43"	TC-42 90"	TC-42 60"
1/3	TC-42 93"	TC-42 72"	TC-42 36"
1/2	TC-49 96"	TC-49 48"	TC-64 90"
3/4	TC-49 60"	TC-64 92"	TC-64 72"
1	TC-49 36"	TC-64 84"	TC-64 54"
1-1/2	TC-64 84"	TC-64 60"	TC-64 43"
2	TC-64 55"	TC-64 40"	TC-64 26"

<b>R134A / R401A / R401B / R406A, R409A / R500</b>			
1/8	TC-26 121"	TC-26 92"	TC-26 53"
1/6	TC-26 78"	TC-31 106"	TC-31 78"
1/5	TC-31 59"	TC-31 39"	TC-31 26"
1/4	TC-31 47"	TC-42 99"	TC-42 66"
1/3	TC-42 102"	TC-42 79"	TC-42 39"
1/2	TC-49 105"	TC-49 52"	TC-64 99"
3/4	TC-49 66"	TC-64 101"	TC-64 79"
1	TC-49 39"	TC-64 92"	TC-64 59"
1-1/2	TC-64 92"	TC-64 66"	TC-64 47"
2	TC-64 61"	TC-64 44"	TC-64 29"

<b>R22</b>			
1/8	TC-26 132"	TC-26 101"	TC-26 58"
1/6	TC-26 86"	TC-31 116"	TC-31 86"
1/5	TC-31 64"	TC-31 42"	TC-31 28"
1/4	TC-31 51"	TC-42 109"	TC-42 72"
1/3	TC-42 112"	TC-42 87"	TC-42 43"
1/2	TC-49 115"	TC-49 57"	TC-64 109"
3/4	TC-49 72"	TC-64 111"	TC-64 87"
1	TC-49 42"	TC-64 101"	TC-64 65"
1-1/2	TC-64 101"	TC-64 72"	TC-64 51"
2	TC-64 67"	TC-64 48"	TC-64 32"

<b>R402B / R403B, R404A / R407C / R408A / R502</b>			
1/8	TC-26 144"	TC-26 111"	TC-26 63"
1/6	TC-26 95"	TC-26 78"	TC-31 95"
1/5	TC-31 70"	TC-31 46"	TC-31 31"
1/4	TC-31 56"	TC-31 31"	TC-42 79"
1/3	TC-31 30"	TC-42 96"	TC-42 47"
1/2	TC-42 29"	TC-49 63"	TC-49 32"
3/4	TC-49 79"	TC-49 32"	TC-64 96"
1	TC-49 46"	TC-64 111"	TC-64 72"
1-1/2	TC-64 111"	TC-64 79"	TC-64 56"
2	TC-64 74"	TC-64 52"	TC-64 34"

<b>R402A / R407A / R407B / R507</b>			
1/8	N/A	TC-26 122"	TC-26 69"
1/6	TC-26 104"	TC-31 138"	TC-31 105"
1/5	TC-31 77"	TC-31 50"	TC-31 34"
1/4	TC-31 62"	TC-31 34"	TC-42 86"
1/3	TC-31 33"	TC-42 105"	TC-42 52"
1/2	TC-42 31"	TC-49 69"	TC-49 35"
3/4	TC-49 87"	TC-49 37"	TC-64 106"
1	TC-49 52"	TC-49 30"	TC-64 79"
1-1/2	TC-49 32"	TC-64 86"	TC-64 62"
2	TC-64 82"	TC-64 58"	TC-64 37"

<b>R410A</b>			
1/8	N/A	TC-26 144"	TC-26 81"
1/6	TC-26 123"	TC-26 100"	TC-26 78"
1/5	TC-31 90"	TC-31 60"	TC-31 41"
1/4	TC-31 73"	TC-31 40"	TC-42 101"
1/3	TC-31 38"	TC-31 30"	TC-42 62"
1/2	TC-42 37"	TC-49 84"	TC-49 42"
3/4	TC-49 104"	TC-49 44"	TC-49 34"
1	TC-49 62"	TC-49 36"	TC-64 94"
1-1/2	TC-49 38"	TC-64 103"	TC-64 74"
2	TC-64 96"	TC-64 69"	TC-64 45"

## 2 FEED TUBES (Requires 2 lengths of each size listed)

H.P.	LOW	MED	HIGH
<b>R12 / R416A</b>			
1/2	TC-31 43"	TC-42 90"	TC-42 60"
3/4	TC-31 30"	TC-42 63"	TC-42 42"
1	TC-49 96"	TC-49 48"	TC-64 90"
1-1/2	TC-49 60"	TC-64 92"	TC-64 72"
2	TC-49 36"	TC-64 84"	TC-64 54"
2-1/2	TC-64 108"	TC-64 72"	TC-64 49"
3	TC-64 84"	TC-64 60"	TC-64 43"
3-1/2	TC-64 70"	TC-64 54"	TC-64 35"
4	TC-64 55"	TC-64 40"	TC-64 26"

<b>R134A / R401A / R401B / R406A / R409A / R500</b>			
1/2	TC-31 47"	TC-42 99"	TC-42 66"
3/4	TC-31 33"	TC-42 69"	TC-42 46"
1	TC-49 105"	TC-49 52"	TC-64 99"
1-1/2	TC-49 66"	TC-64 101"	TC-64 79"
2	TC-49 40"	TC-64 92"	TC-64 59"
2-1/2	TC-64 119"	TC-64 79"	TC-64 53"
3	TC-64 92"	TC-64 66"	TC-64 47"
3-1/2	TC-64 77"	TC-64 59"	TC-64 38"
4	TC-64 60"	TC-64 44"	TC-64 29"

<b>R22</b>			
1/2	TC-31 52"	TC-42 108"	TC-42 72"
3/4	TC-31 36"	TC-42 77"	TC-42 50"
1	TC-49 115"	TC-49 58"	TC-64 108"
1-1/2	TC-49 72"	TC-64 110"	TC-64 86"
2	TC-49 43"	TC-64 101"	TC-64 65"
2-1/2	TC-49 39"	TC-64 87"	TC-64 58"
3	TC-64 101"	TC-64 72"	TC-64 52"
3 1/2	TC-64 84"	TC-64 64"	TC-64 41"
4	TC-64 66"	TC-64 48"	TC-64 31"

<b>R402B / R403B / R404A / R407C / 408A / R502</b>			
1/2	TC-31 56"	TC-42 119"	TC-42 78"
3/4	TC-31 39"	TC-42 85"	TC-42 55"
1	TC-42 28"	TC-49 63"	TC-64 119"
1-1/2	TC-49 79"	TC-49 32"	TC-64 94"
2	TC-49 47"	TC-64 110"	TC-64 71"
2-1/2	TC-49 43"	TC-64 96"	TC-64 64"
3	TC-64 111"	TC-64 79"	TC-64 57"
3-1/2	TC-64 92"	TC-64 70"	TC-64 46"
4	TC-64 73"	TC-64 53"	TC-64 34"

<b>R402A / R407A, R407B / R507</b>			
1/2	TC-31 52"	TC-31 32"	TC-42 85"
3/4	TC-31 43"	TC-42 92"	TC-42 60"
1	TC-42 31"	TC-49 70"	TC-49 36"
1-1/2	TC-49 87"	TC-49 35"	TC-64 103"
2	TC-49 52"	TC-49 28"	TC-64 78"
2-1/2	TC-49 47"	TC-64 106"	TC-64 70"
3	TC-49 32"	TC-64 86"	TC-64 62"
3-1/2	TC-64 101"	TC-64 77"	TC-64 50"
4	TC-64 80"	TC-64 58"	TC-64 37"

<b>R410A</b>			
1/2	TC-31 72"	TC-31 37"	TC-42 102"
3/4	TC-31 50"	TC-42 116"	TC-42 70"
1	TC-42 37"	TC-49 83"	TC-49 42"
1-1/2	TC-49 102"	TC-49 44"	TC-49 34"
2	TC-49 62"	TC-49 37"	TC-64 93"
2-1/2	TC-49 55"	TC-49 32"	TC-64 81"
3	TC-49 38"	TC-64 101"	TC-64 74"
3-1/2	TC-64 118"	TC-64 90"	TC-64 55"
4	TC-64 92"	TC-64 70"	TC-64 41"

*All recommendations must be considered approximate and variations may arise in actual field applications.*

