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The Copper Connection System Expansion/Contraction Accommodation

Copper tubing, as well as all piping matrials, expands and contracts with temperature changes. Therefore, in a copper tube system, the pipe line can buckle or bend when it expands unless compensation is built into the system. Harmful stresses, buckling and bending are prevented by installing expansion loops.

The following chart provides information on calculating the expansion/contraction of copper tubing due to thermal changes; and the accommodation of this movement with expansion loops constructed of Style 606 couplings and Number 610 Copper 90° Elbows.

| Temperature °F/°C	Copper Inches/millimeters
−40 −40	−0.421 −10,69
−20 −29	−0.210 −5,33
0 −18	0 0
20 −7	0.238 6,05
32 0	0.366 9,30
40 4	0.451 11,46
60 16	0.684 17,37
80 27	0.896 22,76
100 38	1.134 28,80
120 49	1.366 34,70
140 60	1.590 40,39
160 71	1.804 45,82
180 82	2.051 52,10
200 93	2.296 58,32
212 100	2.428 61,67
220 104	2.516 63,91
230 110	2.636 66,95

Expansion Loops for Joining Copper Tubing with Victaulic Copper Connection Products

Expansion loops or "U" bends are frequently used to accommodate the expansion and/or contraction of pipe lines due to thermal changes. Copper tube, as does all piping materials, expands and contracts with these temperature changes. The above table shows the actual expansion of 100' pipe lengths for copper pipe. Calculations for the anticipated expansion/contraction can be obtained from the example shown in 26.02.

The necessary length of the copper tube expansion loop can be calculated from the following formula:

$$L = \sqrt{\frac{3EDe}{S}} \quad (1)$$

L = Loop length, in inches, as shown in the figures below:

2H + W = L
H = 2W
5W = L
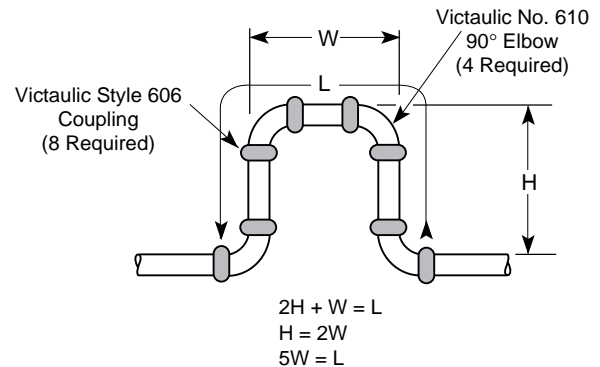
E = modulus of elasticity of copper in PSI = 15,600,000 PSI

S = allowable stress of material in flexure, in PSI = 6000 PSI

D = outside diameter of copper tubing in inches

e = amount of expansion to be absorbed, in inches

Simplifying the formula:

$$L = 88.32\sqrt{De} \quad (2)$$

Calculated Loop lengths for various expansions are shown in the table below:

Expansion Inches mm	Loop Length "L" for Tube Sizes Shown Inches/millimeters					
	2½ 73,0	3 88,9	4 114,3	5 141,3	6 168,3	8 219,1
¹/₂ 12,7	102 2591	111 2819	127 3226	142 3607	155 3937	178 4522
1 25,4	144 3658	157 3988	180 4572	200 5080	219 5563	252 6401
1¹/₂ 38,1	176 4470	192 4877	220 5588	245 6223	268 6807	309 7849
2 50,8	203 5156	221 5613	254 6452	283 7188	310 7874	356 9043
2¹/₂ 63,5	227 5766	247 6274	284 7214	317 8052	346 8788	398 10109
3 76,2	248 6299	271 6883	311 7899	347 8814	379 9627	436 11074

Note: Expansion Loop should be located between two anchors and the pipe should be guided so as to direct the movement into the loop.

References:

(1) Copper/Brass/Bronze Product Handbook, Copper Development Association, Inc.

(2) Source Book on Copper and Copper Alloys. American Society for Metals

The data provided is intended for use as an aid to qualified designers when products are installed in accordance with the latest available Victaulic product data.

Support

The requirements of MSS-SP-69 "Pipe Hangers and Supports – Selection and Application" shall, in general, govern the installation of hangers and supports, in accordance with the following recommendations: Copper tubing joined with grooved type couplings requires support to carry the weight of tubing and equipment. The support or hanging method must be such as to eliminate undue stresses on joints, tubing and other components. Additionally, the method must be such as to allow movement of tubes where required and to provide for other special requirements such as drainage, etc., as may be required by the designer. The support system for mechanical grooved type tubing couplings must consider some of the special requirements of these couplings.

The table shows suggested maximum span between supports for horizontal straight runs of copper tubing carrying water or similar liquids. These DO NOT apply where critical calculations are made or where there are concentrated loads between supports.

SUGGESTED MAXIMUM SPAN BETWEEN SUPPORT FOR COPPER TUBING

TUBE SIZE Nominal Inches Actual mm	Water Service Feet/meters	Gas & Air Service Feet/meters
2 60,3	8 2,44	10 3,05
2¹/₂ 73,0	10 3,05	11 3,35
3 88,9	10 3,05	12 3,66
4 114,3	12 3,66	14 4,27
5 141,3	13 3,96	15 4,57
6 168,3	15 4,57	17 5,18
8 219,1	15 4,57	17 5,18

Spacing corresponds to ANSI B31.9 Building Services Code.