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Cold W·A·R·

Whether it's Air Conditioning or Refrigeration

SPORLAN

Expansion and Contraction

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Refrigerant Piping Expansion and Contraction

All refrigeration piping materials are subject to changes in temperature and will expand and contract with temperature change. Installation techniques must allow for expansion and contraction changes, as this will prevent stresses which may buckle and rupture the copper tube or joints.

The average linear coefficient of expansion of copper is 0.0000104 inch/per inch/per °F. Copper tubing will expand about 1¼ inches per 100 feet per 100°F change in temperature. For example a copper line 75 feet long is used to carry hot discharge refrigerant vapor at 225°F to the system's condenser. The change in temperature could be 155°F, that is 225 - 70 (room ambient). The expected expansion on this application could very well be 75 × 12 × 0.0000104 × 155 = 1.451 or 1½ inches.

There are two common methods of taking care of expansion and contraction in copper lines used in the refrigeration industry. These are the use of "expansion loops" or "pipe offsets." See Figures 1 and 2 for specifics on these two methods.

In the installation of expansion loops, the expansion member should be "cold sprung" approximately one-half the estimated travel expected. In this manner the bend is subject to only about one-half of the stress, when the line is at the highest temperature, than it would be if the loop were installed in its natural position.

Care must be taken during the installation of the lines to maintain perfect alignment, if not, there will be a tendency for the lines to bow, and possibly buckle or rupture, particularly on the smaller sizes.

It is often possible to provide for expansion by offsetting the pipe line rather than to continue in a straight line. This method can be used only where there is plenty of space available. A single offset using two 90° elbows should have a minimum length of not less than three times the radius required in an expansion loop. The legs of the offset should not be spaced less than two times the radius from each other, see Figure 2. This method is just as effective as expansion loops and can be made on the job, see Table 1 for fabrication details. Offsetting by means of long radius allows the installer to vary the length to suit the job. Due to the amount of labor involved in the fabrication of expansion loops they are considered more expensive than offsets made up on the job.

So far we have referred only to main lines in general; these are usually thought of as horizontal. Vertical lines or risers must also be considered in the same manner. Risers should have adequate support at or near the bottom. Where branch lines to fixtures are taken off they should be sufficiently long to take care of any movement in the main.

Rigid fixtures should never be directly connected to risers. One or two turns or elbows in the line will take care of the short branches. Copper tubing may not break as readily, but if continually subjected to strain and bending it will ultimately fail. Designers and contractors must always keep the matter of expansion and contraction in mind.

Refrigerant Piping Expansion and Contraction

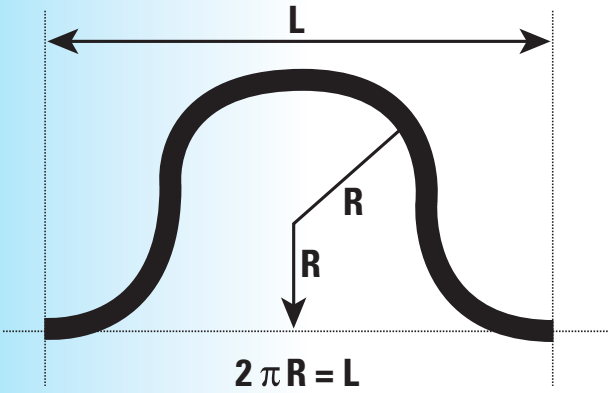
A freezer operating at a SST of minus 30°F and 100ft from the mechanical room which is 70°F, the compressor discharge temperature is 225°F and the condenser 75ft away.

Suction "shrinkage" is **0.0000104 × 12 × 100 × 100 = 1.248** or **1¼ inches**.

Discharge expansion is **0.0000104 × 12 × 75 × 155 = 1.451** or **1½ inches**.

Total expansion and contraction movement in this freezer application would be 1¼ + 1½ = 2¾ inches. The installation and servicing contractor must be aware of the potential problems that could arise if these factors are not taken into consideration in the original installation.

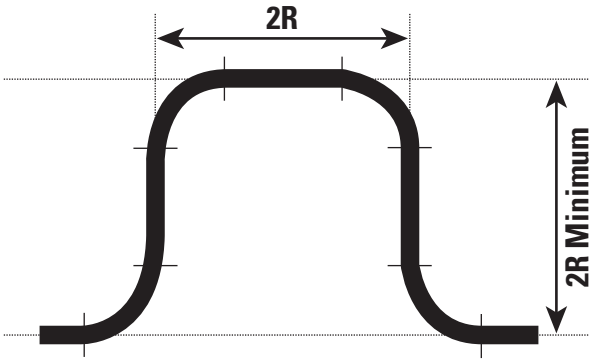
Figure 1: Expansion Loop (U-Bend)



Note:

1. All radii are referenced to the center line of pipe.
2. "L" length of pipe is referenced to the toal length measured along the center line of the bent pipe.

Figure 2: Offset and Return



Offset with four (4) 90° elbows

Note: bracket supports should be within six inches of a change of direction and opposite the source of vibration.

Tube OD (Inch)	Radius - R (Inch)						
	Expansion or Contraction of...						
	½"	1"	1½"	2"	2½"	3"	4"
⅞	10	15	9	22	25	27	30
1⅛	11	16	20	24	27	29	33
1⅜	11	17	21	26	29	32	36
1⅝	12	18	23	28	31	35	-----
2⅛	14	20	25	31	34	-----	-----
2⅝	16	22	27	32	-----	-----	-----
3⅛	18	24	30	34	-----	-----	-----
4⅛	20	28	34	-----	-----	-----	-----

Bends can be made from 20 feet or less of tubing