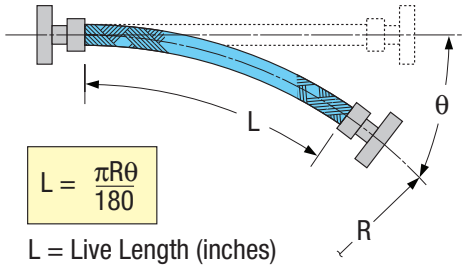
IV. MOTION

Most industrial applications can be reduced to one of five classes of motion: 1) **Angular;** 2) **Axial;** 3) **Offset;** 4) **Radial;** or 5) **Random.**

1. Angular Motion:

Motion that occurs when one end of a hose assembly is deflected in a simple bend with the ends not remaining parallel. Angular motion may be incorporated in an installation to accommodate misalignment and vibration only, but must not be used to accommodate expansion that would result in unloading the braid.

2. Axial Motion:



$$L = \frac{\pi R \theta}{180}$$

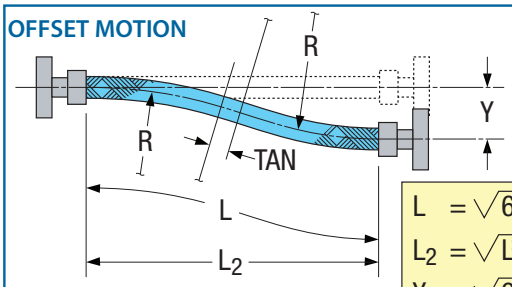
L = Live Length (inches)
R = ℄ Bend Radius (inches)
θ = Angle of Bend (degrees)
π = 3.1416

This type of motion occurs when one end of a hose assembly is deflected along its longitudinal axis. Axial motion is applicable to annular corrugated, unbraided flexible hose only. Neither helical hose nor braided hose should be used in axial motion applications.

3. Offset Motion:

Motion that occurs when one end of the hose assembly is deflected in a plane perpendicular to the longitudinal axis with the end remaining parallel. Offset is measured in inches of displacement of the free end center line from the fixed end center line. In offset motion applications, the offset should never be greater than one-fourth (25%) of the minimum center line bend radius.

OFFSET MOTION



Please refer to chart for live length of hose in offset on page 25

$$L = \sqrt{6YR + Y^2}$$
$$L_2 = \sqrt{L^2 - Y^2}$$
$$Y_M = \sqrt{9R^2 + L^2} - 3R$$

L = Hose Live Length (inches)
L_2 = Projected Linear Length At Offset (inches)
R = ℄ Bend Radius (inches)
Y = ℄ Offset, Motion (inches)
Y_M = ℄ Maximum offset for a given L and R (inches)

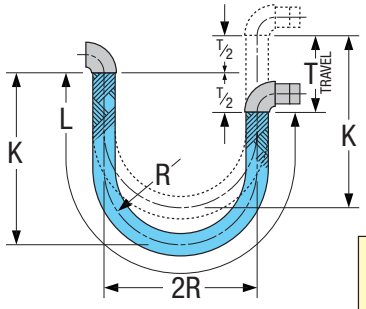
NOTE: Where Offset Motion "Y" occurs both sides of ℄ the Hose Live Length should be based on Total Travel or 2 times Y.

4. Radial Motion:

This type of motion occurs when the center line of a hose assembly is bent in a circular arc. In industrial applications, radial motion is most commonly found in traveling loops.

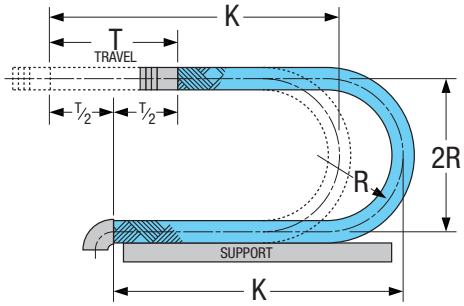
CLASS "A" TRAVELING LOOPS

...For Maximum Vertical Travel



$$L = 4R + T/2$$
$$K = 1.43R + T/2$$

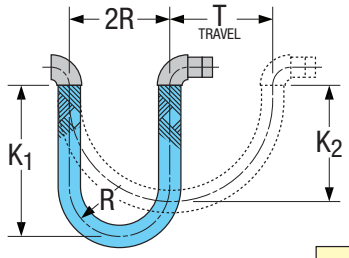
...For Maximum Horizontal Travel



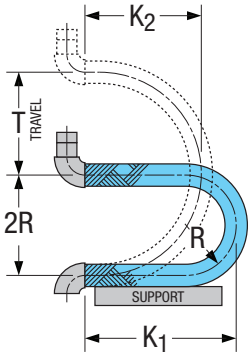
Center line bend radius (in.) K = Loop Length (in.)

CLASS "B" TRAVELING LOOPS

...For Short Horizontal Travel



...For Short Vertical Travel

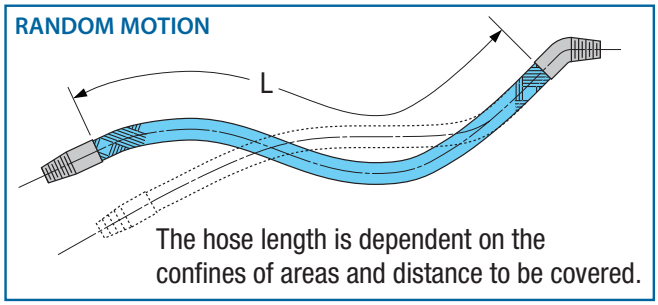


$$L = 4R + 1.57T$$
$$K_1 = 1.43R + .785T$$
$$K_2 = 1.43R + T/2$$

NOTE:
In loop installations both connections and travel should be in same plane as bend.

5. Random Motion:
Non-predictable motion that occurs from manual handling of a assembly. Loading and unloading hose would generally fall into this category. Abusive handling of hose is an important factor to consider in applications involving random motions. The use of an interlocked (RT-6) guard over the corrugated hose is recommended to protect the hose assembly from rough handling and "over-bending" adjacent to the fittings.

V. MOTION FREQUENCY



The frequency of a particular class of motion to which a flexible metal hose may be subjected by repeated flexing or bending. The frequency of motion may be divided into three basic categories: namely vibration, dynamic, and continuous. The minimum live length required for these motion categories may be selected as follows:

1. Vibration:
For the normal vibration encountered in industrial applications, such as pump and compressor discharge lines and engine exhaust installations, the hose live lengths should be taken from the Minimum Live Length For Vibration column on Technical Data Pages.

Normal vibration is shown as the unshaded area of the chart below. If the expected combination of double amplitude (total motion excursion) and frequency falls into the shaded area, consult US Hose Engineering Group.

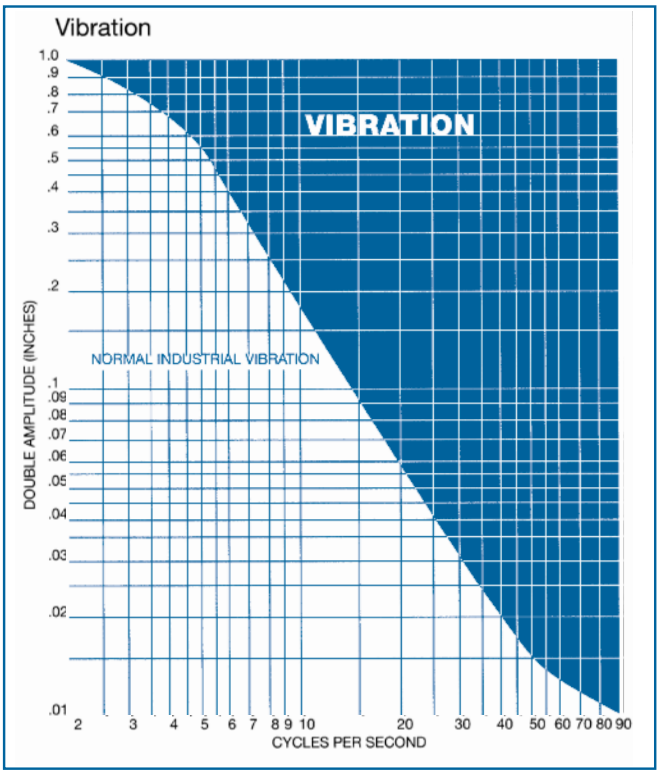
Caution: Avoid hose resonance. If resonance is anticipated, consult US Hose Engineering Group.

2. Dynamic Motion:
Motion that occurs on a regular or irregular basis normally the result of thermal expansion and contraction or other noncontinuous actions.

The dynamic flexing bend radius shown on Hose Technical Data Pages shall be used in the formulas for angular, radial and offset motion when determining hose live length for dynamic motion.

3. Continuous Motion:
Motion that occurs on a regular cyclic basis normally at a slow cyclic rate and constant travel. For Continuous Lateral Offset Motion double the minimum centerline bend radius for Dynamic Flexing shown on Hose Technical Data Pages.

4. Static Bend:
The minimum center line bend radius to which a flexible metal hose may be bent for installation. No further motion is to be imposed other than normal vibration.



VI. CYCLE LIFE

The cycle life expectancy of a metal hose is affected by various factors such as: operating pressure, operating temperature, materials, bend radius (the movement per corrugation due to the flexure), the thickness of the corrugation. Any change in one of these factors will result in a change in the cycle life of a metal hose assembly.

The cycle life of a metal hose assembly is proportional to the sum of the pressure stress range and deflection stress range. The life expectancy can be defined as the total number of competed cycles which can be expected from the metal hose assembly based on S/N curves and data tabulated from tests performed under simulated operating conditions. A cycle is defined as one complete movement from the initial position in the system to some operating point and returning to the original position.

This information should be used as a guide only. We cannot predict every variable which might be encountered in every application nor any misapplication, mechanical damage, and/or any uncontrollable situation.

Chart for Live Length of Hose in Offset

CenterLine
Radius
Inches*Dynamic Offset Motion • Maximum Distance from Centerline • See Sketch, Page 24

	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	5"	6"	8"	10"
2	1 1/4	1 3/4	2 1/4	2 1/2	3 1/4	3 3/4	4 1/4	5 1/4	6 3/4	8	9 1/4	10 1/2	11 3/4	15
4	1 3/4	2 1/2	3	3 1/2	4 1/2	5	6 1/4	7 1/4	9	10 3/4	12	13 1/2	16	18 1/2
6	2 1/4	3 1/4	3 3/4	4 1/4	5 1/4	6 1/4	7 1/2	8 3/4	10 3/4	12 3/4	14 1/4	16	19	21 1/2
8	2 1/2	3 1/2	4 1/4	5	6	7	8 3/4	10	12 1/2	14 1/2	16 1/4	18	21 1/4	24 1/4
10	2 3/4	4	4 3/4	5 1/2	6 3/4	8	9 3/4	11 1/4	13 3/4	16	18	20	23 1/2	26 1/2
12	3	4 1/4	5 1/4	6	7 1/2	8 1/2	10 1/2	12 1/4	15	17 1/2	19 1/2	21 1/2	25 1/2	28 3/4
14	3 1/4	4 3/4	5 3/4	6 1/2	8	9 1/4	11 1/4	13 1/4	16 1/4	18 3/4	21	23 1/2	27 1/4	30 3/4
16	3 1/2	5	6	7	8 1/2	10	12 1/4	14	17 1/4	20	22 1/2	25	29	32 3/4
18	3 3/4	5 1/4	6 1/2	7 1/2	9	10 1/2	13	15	18 1/4	21 1/4	24	26	30 1/2	34
20	4	5 1/2	6 3/4	7 3/4	9 1/2	11	13 1/2	15 3/4	19 1/4	22 1/2	25	27 1/2	32 1/4	36 1/4
25	4 1/2	6 1/4	7 1/2	8 3/4	10 3/4	12 1/4	15	17 1/2	21 1/2	25	28	30 1/2	35 3/4	40
30	4 3/4	6 3/4	8 1/4	9 1/2	11 3/4	13 1/2	16 1/2	19	23 1/2	27 1/4	30 1/2	33 1/2	39	43 3/4
35	5 1/4	7 1/4	9	10 1/4	12 1/2	14 1/2	18	20 3/4	26 1/4	29 1/2	32 3/4	36	42	47
40	5 1/2	7 3/4	9 1/2	11	13 1/2	15 1/2	19	22	27	31 1/4	35	38 1/2	44 3/4	50
45	6	8 1/4	10	11 3/4	14 1/4	16 1/2	20 3/4	23 1/2	28 1/2	33 1/4	37	41	47 1/2	53
50	6 1/4	8 3/4	10 3/4	12 1/4	15	17 1/2	21 1/4	24 1/2	30	35	39	43	50	56
60	6 3/4	9 1/2	11 3/4	13 1/2	16 1/2	19	23 1/4	27	33	38 1/4	43	47	54 1/4	61
70	7 1/4	10 1/4	12 3/4	14 3/4	17 3/4	20 1/2	25 1/4	29	35 1/2	41 1/2	46	51	58 3/4	65 3/4
80	7 3/4	11	13 1/2	15 1/2	19	22	27	31	38	44	49 1/2	54	62 3/4	70
90	8 1/4	11 3/4	14 1/4	16 1/2	20 1/4	23 1/2	28 1/2	33	40 1/2	46 3/4	52	57 1/4	66 1/4	74 1/4
100	8 3/4	12 1/4	15	17 1/2	21 1/4	24 1/2	30	35	42 1/2	49 1/4	55	60 1/2	69 3/4	78 1/4
110	9 1/4	13	15 3/4	18 3/4	22 1/2	25 3/4	31 3/4	36 1/2	44 3/4	51 1/2	58	63 1/4	73 1/4	82
120	9 1/2	13 1/2	16 1/2	19	23 1/4	27	33	38 1/4	46 3/4	54	60 1/2	66	76 1/2	85 1/2
130	10	14	17 1/4	20	24 1/4	28	34 3/4	39 3/4	48 1/2	56	62 3/4	68 3/4	79 1/2	89

*Refer to hose technical pages

IMPORTANT NOTE:

The values shown are minimum live lengths for most centerline bend radii and total offset travel combinations. If the exact radius or travel are not shown on the chart, then the next larger value may be used or use the lateral offset formula. The values as shown in the shaded portion are applicable to static bends only. The offset motion should never be greater than 1/4 (25%) of the centerline bend radius.

Assembly Length (Live Length and Over-all Length)

After the hose is selected for the application, the live length and over-all length of the assembly must be determined to complete the design. The live length is the flexible portion of an assembly and can be determined for the class of motion from the diagrams and for vibration.

After the live length has been determined, the overall length is calculated by adding the dimensions for the end fittings. Refer to factory for fitting lengths as standard and special lengths can be offered.