tyco
Flow Control

Flexible Piping Systems

Metal Hose Selection Factors.

1. Pressure

Maximum Working Pressure
Maximum operating pressure to which the hose should be subjected. It is established at 25% of the Nominal Design Burst Pressure. The hose may be deflected within the specified bend radius range.

Maximum Test Pressure
Maximum test pressure to which the hose should be subjected. It is established at 150% of the Maximum Working Pressure at 21°C with the hose installed straight. No harmful deformation shall occur.
Hydrostatic field test of hose assemblies installed in varying degrees of radial bend or parallel offset should be limited to 120% of the maximum rated working pressure at 21°C or 150% of the actual operating pressure, whichever is lower.

Nominal Design Burst Pressure
The pressure at which the hose can be expected to rupture, based on the minimum annealed ultimate tensile strength of the braid wire and corrugated hose alloys at 21°C and the hose installed straight.

Pulsating or Shock Pressure
When pulsating, surge or shock pressure exists, such as occur due to fast closing valves, the peak pressure shall not exceed 50% of the maximum working pressure. Installation shall be such that there is no initial slack in the braid when the pressure pulse, surge or shock occurs.

Pressure Relative To Unbraided Hose
At maximum Working Pressure, 1 to 2½% elastic elongation will occur in unbraided hose assemblies. To avoid squirm, unbraided hose should be unrestrained at one end, or installed in such a manner as to allow free axial expansion due to pressure, as in a 180° loop.

Pressure Relative To Braided Hose
Whenever appreciable internal pressure is applied to a corrugated metal hose, it will elongate unless restrained. Generally this restraint is provided by a wire braid sheath over the hose, The braid has little effect on bending or flexibility of the hose. However, in extremely short lengths of braided and pressurized hose, additional bending forces are required because of braid friction.

Where the strength of the braid sheath is the limiting factor, additional working pressure may be gained by using a heavier than standard single braid, or two or more braids. However, when the hoop rupture strength of corrugated hose is the limiting factor, no additional pressure resistance is gained with additional braids.

Contact Tyco Flexible Piping Systems for braid/hose design assistance to determine maximum pressure ratings.

Pressure Relative To Temperature
For operating temperature in excess of 21°C the tabulated pressures must be decreased in accordance with the "Correction Factors" listed in the Table 1. Since the pressure ratings are based on annealed material properties, no reduction in pressure ratings is necessary for fitting attachment by TIG welding, brazing, silver brazing, or soft solder.

Correction Factors (Table 1)

Apply to pressure rating for elevated temperatures.

Temp	Material				
°C	Stainless Steel	Steel	Monel	Bronze	Inconel
20	1.00	1.00	1.00	1.00	1.00
66	0.97	0.99	0.93	0.92	0.97
93	0.94	0.97	0.90	0.89	0.94
121	0.92	0.96	0.87	0.86	0.92
150	0.88	0.93	0.83	0.83	0.88
177	0.86	0.91	0.82	0.81	0.86
200	0.83	0.87	0.79	0.78	0.83
230	0.81	0.86	0.77	0.75	0.81
260	0.78	0.81	0.73	-	0.78
316	0.74	0.74	0.72	-	0.74
371	0.70	0.66	0.71	-	0.70
427	0.66	0.52	0.70	-	0.66
482	0.62	0.50		-	0.62
538	0.60	-	-	-	-
593	0.58	-	-	-	-
649	0.55	-	-	-	-
704	0.50	-	-	-	-
760	0.44	-	-	-	-
816	0.40	-	-	-	-

Note: *Consult Tyco Flexible Piping Systems whenever service conditions necessitate consideration of the influence of long time exposure at elevated temperature.*

A.B.N. 83 000 922 690

2. Maximum Service Temperature of Materials

Maximum Service Temperature (Table 2)

Alloy	Max. Temp. °C	Alloy	Max. Temp. °C
Inconel 625	982	Brazing (RCuZn or BCuP-2)	
321 S/S	816	Bronze Hose	232
316L S/S	816	Steel Hose	454
304L S/S	816	Silver Brazing (AWS-BAg-2)	316
304 S/S	454	Aluminium 52S-0 (5052-0)	316
302 S/S	454	Galvanizing	232
Mild Steel	454	Soft Solder (Pb:60, Sn:40)	121
Malleable Iron	427	Soft Solder (Pb:95, Sn:5)	177
Monel	427		
Bronze	232		
Brass	232		
Copper	204		

Note: *Consult Tyco Flexible Piping Systems whenever service conditions necessitate consideration of the influence of long time exposure at elevated temperature.*

3. Flow Velocity

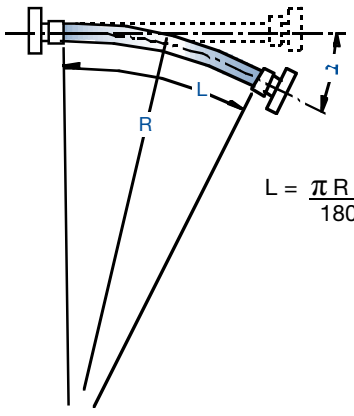
1) Where flow velocity exceeds 30.5m/sec gas (15.25m/sec liquid) in unbraided hose, or in 45.75m/sec gas (22.85m/sec liquid) in braided hose, a flexible metal liner of fully interlocked hose should be used. When the hose is installed in a bent condition, these flow values should be reduced by 50% for a 90° bend, 25% for a 45° bend, and so on, proportional to the angle of bend. In cases where velocity exceeds the above values, the next larger size corrugated hose should be used with the flexible liner size equivalent to the mating pipe size.

2) Where the amount of pressure drop through longer lengths of hose is a significant factor, a larger diameter hose may be required. As a broad rule of thumb, pressure drop through a corrugated metal hose is approximately three times that in comparable size standard steel pipe. For more accurate calculations of pressure drop, consult Tyco Flexible Piping Systems.

4. 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.

4.1 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.



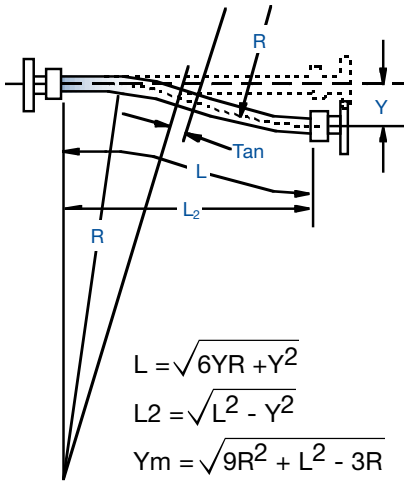
$$L = \frac{\pi R \measuredangle}{180}$$

L = Live Length (mm)
R = ℄ Bend Radius (mm)
∠ = Angle of Bend (degrees)
π = 3.1416

4. Motion (cont.)

4.2 Axial Motion: 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.

4.3 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 centre line from the fixed end centre line. In offset motion applications, the offset should never be greater than one-forth (25%) of the minimum centre line bend radius.



$$L = \sqrt{6YR + Y^2}$$

$$L2 = \sqrt{L^2 - Y^2}$$

$$Ym = \sqrt{9R^2 + L^2} - 3R$$

L = Hose Live Length (mm)
L2 = Projected linear Length at Offset (mm)
R = ℄ Bend Radius (mm)
Y = ℄ Offset, Motion (mm)
Ym = ℄ Maximum offset for a given L and R (mm).

Note: *Where Offset Motion "Y" occurs both sides of ℄, the Hose Live Length should be based on Total Travel or 2 times Y. Please refer to chart for live length of hose in offset, Chart 3.*

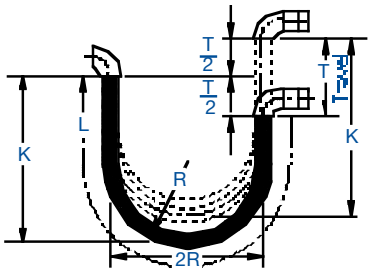
FLEXONICS

4. Motion (cont.)

4.4. Radial Motion: This type of motion occurs when the centre line of a hose assembly is bent in a circular arc. In industrial applications, radial motion is most commonly found in travelling loops.

Class "A" Travelling Loops

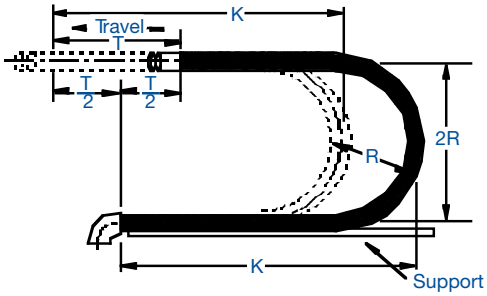
For maximum vertical travel



$$L = 4R + \frac{T}{2}$$

$$K = 1.43R + \frac{T}{2}$$

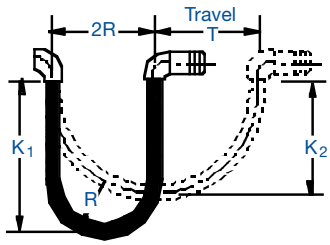
For maximum horizontal travel



T = Total Travel (mm)
R = Centre Line Bend Radius (mm)
L = Hose Live Length (mm)
K = Loop Length (mm)

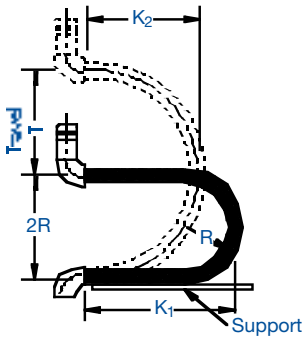
Class "B" Travelling Loops

For short horizontal travel



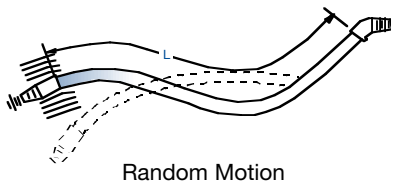
L = 4R + 1.57T
K1 = 1.43R + .785T
K2 = $1.43R + \frac{T}{2}$

For short vertical travel



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

4.5 Random Motion: Non-predictable motion that occurs from manual handling of hose 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 guard over the corrugated hose is recommended to protect the hose from rough handling and "overbending" adjacent to the end fittings.



Random Motion

5. 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, intermittent, and continues. The minimum live length required for these motion categories may be selected as follows:

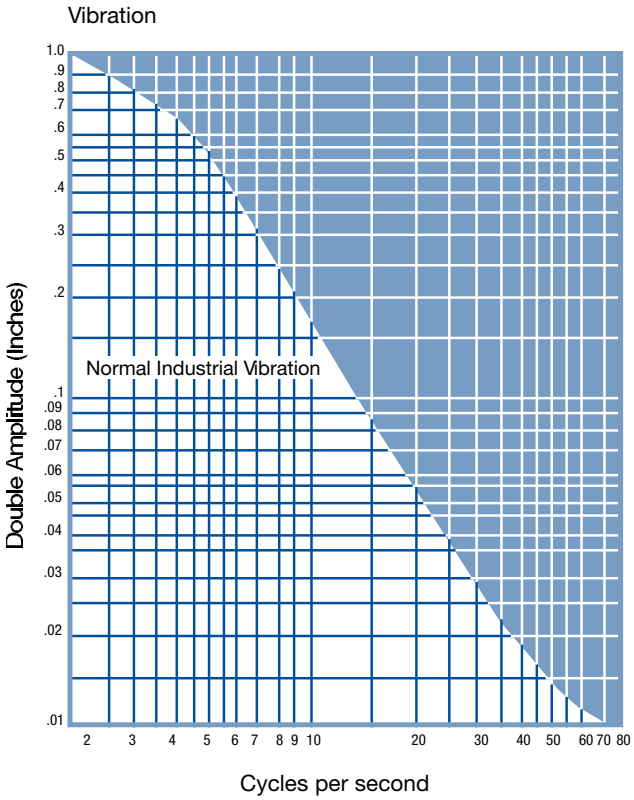
1. Vibration: For the normal vibration encountered in industrial applications, such as pump and compressor discharge lines and engine exhaust installation, consult Tyco Flexible Piping Systems for the Minimum Live Length For Vibration.
Normal vibration is shown as the unshaded area of Chart 2. If the expected combination of double amplitude (total motion excursion) and frequency falls into the shaded area, consult Tyco Flexible Piping Systems.
Caution: Avoid hose resonance. If resonance is anticipated, consult Tyco Flexible Piping Systems.

2. Intermittent Motion: Motion that occurs on a regular or irregular cyclic basis normally the result of thermal expansion and contraction or other non-continuous actions.
The intermittent 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 intermittent 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 centre line bend radius required for Intermittent Flexing shown on Hose Technical Data pages.

4. Static Bend: The minimum centre 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.

Chart 2



6. 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, the corrugation pitch, depth, and shape 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 completed 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 and uncontrollable situation.

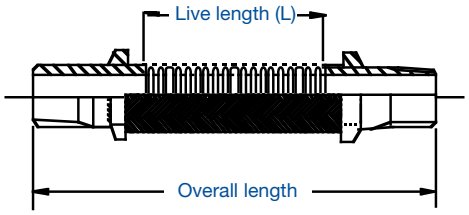
Determination of Minimum Live Hose Length - Chart 3

Centre-Line Radius mm "R"	Intermittent Offset Motion — Maximum Distance From centre Line = "Y" (Refer to 3. Offset Motion Diagram)													
	3	6	10	12	20	25	40	50	80	100	125	150	200	250
50	32	45	56	65	83	95	114	133	171	200	235	267	299	381
100	45	65	75	90	108	125	159	184	229	273	305	343	406	470
150	56	83	95	108	133	159	191	210	273	324	362	406	483	546
200	65	90	108	125	150	178	222	250	317	368	413	457	520	616
250	70	100	120	140	171	200	248	285	349	406	457	508	597	673
300	75	108	133	150	190	216	266	311	381	445	495	546	648	730
350	83	120	146	165	200	235	286	336	413	476	533	597	692	781
400	90	125	150	178	216	250	311	356	438	508	572	635	737	832
450	95	133	165	190	229	267	330	381	463	540	610	660	774	864
500	100	140	171	197	241	279	343	400	489	571	635	698	819	920
635	114	160	190	222	273	311	381	444	546	635	711	775	908	1016
760	120	170	210	241	298	343	419	482	597	692	775	851	990	1111
890	133	185	229	260	318	368	457	527	667	749	832	914	1069	1194
1016	140	200	241	279	343	394	482	559	685	793	889	978	1136	1270
1143	150	210	254	298	368	419	527	597	724	845	939	1033	1206	1346
1270	160	222	273	311	381	445	546	628	762	889	990	1092	1270	1422
1524	171	241	298	343	419	483	590	686	838	971	1092	1194	1384	1549
1778	184	260	324	375	450	521	641	737	901	1054	1168	1295	1492	1670
2032	197	280	343	394	482	559	686	787	965	1117	1257	1372	1594	1778
2286	210	298	362	419	514	597	724	838	1029	1187	1321	1454	1683	1886
2540	222	311	381	445	540	622	762	889	1079	1250	1397	1536	1772	1988
2794	235	330	400	465	572	654	806	927	1136	1308	1473	1606	1873	2083
3048	241	343	420	483	590	686	838	972	1187	1371	1537	1676	1943	2171
3302	254	356	438	508	616	711	883	1010	1232	1422	1594	1746	2019	2261
	Live Length "L"mm													

Note:
The values shown in the shaded portion are applicable to static bends only.
For intermittent flexing, the offset motion should be greater than 1/4 (25%) of the centre line bend radius.

Assembly Length (Live Length and Overall Length)
After the hose is selected for the application, the live length and overall length of the assembly must be determined to complete the design. The live length is the flexible portion of an assembly. After the live length has been determined, the overall length is calculated by adding the dimensions for the end fittings and braid ferrules.

Be sure to add fitting lengths for each end.



FLEXONICS