Franklin Fueling Systems

FLEXIBLE CONNECTORS

INSTALLATION GUIDE

For technical assistance, please contact:

Franklin Fueling Systems
3760 Marsh Rd.
Madison, WI 53718
USA

Web: franklinfueling.com
Tel: +1 608 838 8786 • Fax: +1 608 838 6433
Tel: USA & Canada +1 800 225 9787 • Tel: UK +44 (0) 1473 243300
Tel: Mex 001 800 738 7610 • Tel: DE +49 6571 105 380 • Tel: CN +86 10 8565 4566

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Conventions used in this manual

This manual includes safety precautions and other important information presented in the following format:

NOTE: This provides helpful supplementary information.

IMPORTANT: This provides instructions to avoid damaging hardware or a potential hazard to the environment, for example: fuel leakage from equipment that could harm the environment.

⚠ **CAUTION**: This indicates a potentially hazardous situation that could result in minor or moderate injury if not avoided. This may also be used to alert against unsafe practices.

⚠ **WARNING**: This indicates a potentially hazardous situation that could result in severe injury or death if not avoided.

⚠ **DANGER**: This indicates an imminently hazardous situation that will result in death if not avoided.

Operating precautions

Franklin Fueling Systems (FFS) equipment is designed to be installed in areas where volatile liquids such as gasoline and diesel fuel are present. Working in such a hazardous environment presents a risk of severe injury or death if you do not follow standard industry practices and the instructions in this manual. Before you work with or install the equipment covered in this manual, or any related equipment, read this entire manual, particularly the following precautions:

IMPORTANT: To help prevent spillage from an underground storage tank, make sure the delivery equipment is well-maintained, that there is a proper connection, and that the fill adaptor is tight. Delivery personnel should inspect delivery elbows and hoses for damage and missing parts.

⚠ **CAUTION**: Use only original FFS parts. Substituting non-FFS parts could cause the device to fail, which could create a hazardous condition and/or harm the environment.

⚠ **WARNING**: Follow all codes that govern how you install and service this product and the entire system. Always lock out and tag electrical circuit breakers while installing or servicing this equipment and related equipment. A potentially lethal electrical shock hazard and the possibility of an explosion or fire from a spark can result if the electrical circuit breakers are accidentally turned on while you are installing or servicing this product. Refer to this manual (and documentation for related equipment) for complete installation and safety information.

⚠ **WARNING**: Before you enter a containment sump, check for the presence of hydrocarbon vapors. Inhaling these vapors can make you dizzy or unconscious, and if ignited, they can explode and cause serious injury or death. Containment sumps are designed to trap hazardous liquid spills and prevent environmental contamination, so they can accumulate dangerous amounts of hydrocarbon vapors. Check the atmosphere in the sump regularly while you are working in it. If vapors reach unsafe levels, exit the sump and ventilate it with fresh air before you resume working. Always have another person standing by for assistance.

⚠ **WARNING**: Follow all federal, state, and local laws governing the installation of this product and its associated systems. When no other regulations apply, follow NFPA codes 30, 30A, and 70 from the National Fire Protection Association. Failure to follow these codes could result in severe injury, death, serious property damage, and/or environmental contamination.

⚠ **WARNING**: Always secure the work area from moving vehicles. The equipment in this manual is usually mounted underground, so reduced visibility puts service personnel working on it in danger from moving vehicles that enter the work area. To help prevent this safety hazard, secure the area by using a service truck (or some other vehicle) to block access to the work area.

⚠ **DANGER**: Make sure you check the installation location for potential ignition sources such as flames, sparks, radio waves, ionizing radiation, and ultrasound sonic waves. If you identify any potential ignition sources, you must make sure safety measure are implemented.

Contents

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Flexible Connectors

IMPORTANT INFORMATION-FOLLOW ALL INSTRUCTIONS

The FLEX-ING® line of Franklin Fueling Systems (FFS) flexible connectors offer ease and speed of installation and years of service if installed properly. Flex connectors must be used in a liquid-tight sump with operational leak detection. Below are some guidelines for installing flexible connectors.

NOTE: To be installed only by a certified FFS technician. Installation by a non-qualified person, or any deviations from these recommended procedures, could result in damage or leakage.

NOTE: Take care that brine, saltwater or chlorine do not come in contact with the flex-connectors.

NOTE: Installation Instruction Tags are an integral part of the flex connector. If you receive a flexible connector without an installation tag, contact FFS. The instruction tag must stay with the connector.

Storage and Transport: Flexible connectors are not intended for storage in excessive temperatures or for underground or sump ratings in direct sunlight. Rough handling (drops, impacts, crushing, dragging etc.) during storage and transit may cause damage and result in leaks during use.

Zip Ties: Order a pack of 100 zip ties, model 403963001: 14" long, 120 lb. tensile strength, nylon 6/6 material.

Flexible Connector Ratings and Fuel Compatibilities			
Size	Working Pressure Rating	Suitable locations	Fuel Compatibility
3/4"	50 psig	•Undergound Sumps •Above Ground •Suction Systems (**not** suitable for direct bury in the ground)	Automotive Fuels •Gasoline/Ethanol blends up to 85% •Diesel/Biodiesel Blends up to B20
1"			
1-1/2"			
2"			
3"			
4"			

⚠ **WARNING:** Failure to comply with these instructions could result in hose failure or leakage at a later date and void any warranty.

1. Do not torque the assembly or compress the corrugations of the hose. Watch the Red "LAY-LINE" for any sign of twisting. Install in a single plane of movement. Do not exceed the minimum center line bend radius noted in these instructions. See installation diagrams at the end of these instructions for proper installation orientations.

2. Use standard API practices to connect. Use only thread sealer made for the application in which the assembly is used.

3. Swivels: When using FLEX-ING® swivel, attach the solid side first. Always tighten the swivel connector last.

4. EZ-Fits: Tighten the EZ-Fit clamp wing nut to hand tight plus 1/4 to 1/2 turn (roughly equivalent of 25 in-lbs). Do not exceed one full turn after the wing nut is hand tight.

Important: Be sure to install a zip tie through the wing nut hole and around the plumbing in a manner that keeps tension on the wing nut in the tightening direction to prevent it from loosening up due to vibrations.

Important: Do not reuse EZ-Fit clamp gaskets after disconnecting an EZ-Fit clamp. Replace EZ-Fit gaskets with only FFS- approved gaskets. FFS gaskets are made from a compound that is approved by UL for use with fuel products.

5. Always place a wrench on wrench flats and never on or behind the weld attaching the end fitting to the main hose.

6. For UST applications or UST systems, Flex Connectors must be used in a liquid tight sump that has leak detection.

7. Do not lay the assembly on anything that could puncture it. Do not bury directly in the ground.

8. Do not compress the connector. If the braid is loose or bulging, the connector is installed incorrectly.

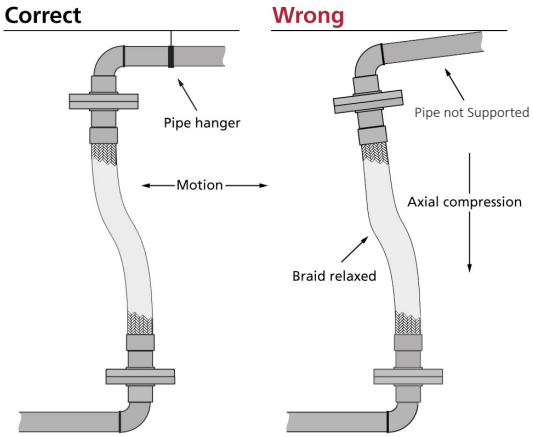
9. Suitable for use in suction systems.

Bend Radius, NPT Fitting Torque, EZ-Fit Torque			
Size	Minimum Centerline Bend Radius	NPT Fitting Torque	EZ-Fit Wing Nut Torque
3/4"	6"	Hand Tight + 3 turns	Hand Tight + 1/4 to 1/2 turn (roughly equivalent to 25 in-lbs) **IMPORTANT:** Do not exceed more than one full turn past hand tight. **NOTE:** Install a zip tie after final tightening.
1"			
1-1/2"			
2"			
3"	9"	Hand Tight + 2 turns	
4"	13"		

Correct EZ-Fit zip tie installation

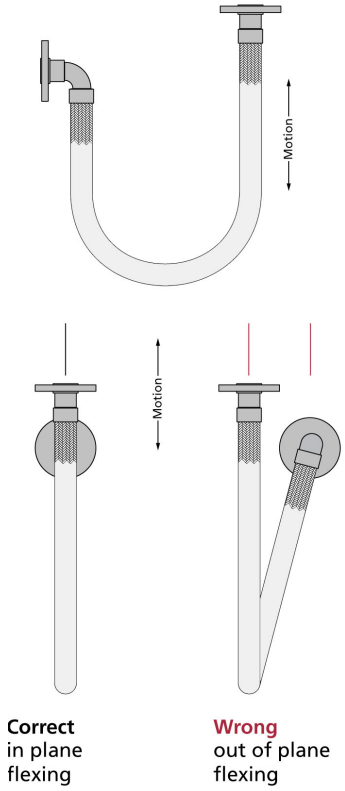
Do not compress or extend axially.

Corrugated metal hose installed in-line with the longitudinal axis of the piping should not have any axial movement.



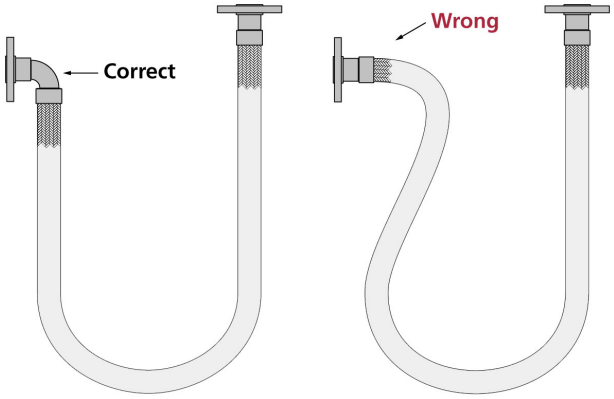
Do not allow movement in multiple planes.

Flexing a metal hose in two separate planes of movement will torque the hose assembly. Always install the metal hose assembly so that flexing occurs in one plane only, the plane in which bending occurs.



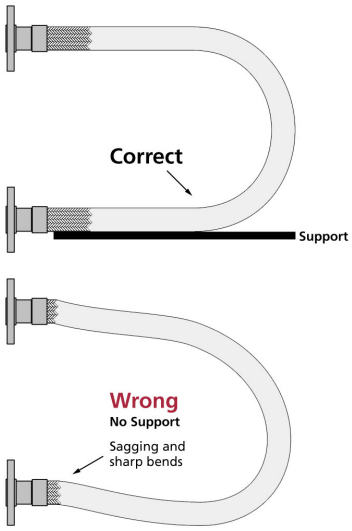
Avoid sharp bends.

Use elbows to avoid sharp bends near the end of the metal hose assembly.



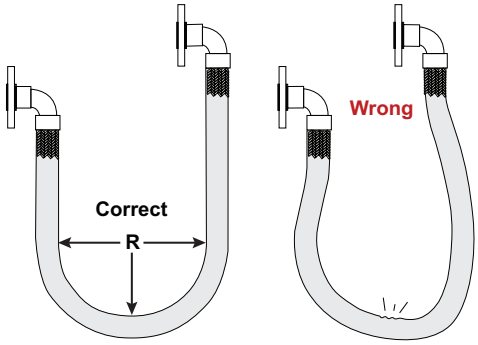
Provide support.

When installing the assembly in a horizontal loop, provide support for the arms to prevent the hose from sagging.



Maintain minimum center-line bend radius.

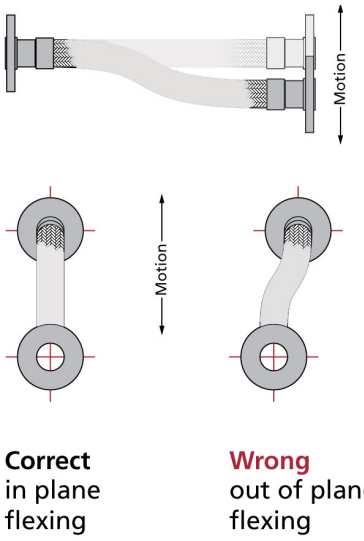
The hose assemblies must not be forced to a bend radius less than specified.



Do not torque during installation.

Metal hose assemblies should not be used to compensate for bolt hole misalignment. Floating flanges will help to minimize twisting of the metal hose.

Pipe unions will help to reduce twisting during connection to the piping. Use two wrenches to help to keep the hose from twisting when tightening the pipe union.



Correct
in plane
flexing

Wrong
out of plane
flexing

Determine the minimum live length of hose required for vibration and oscillating motion applications

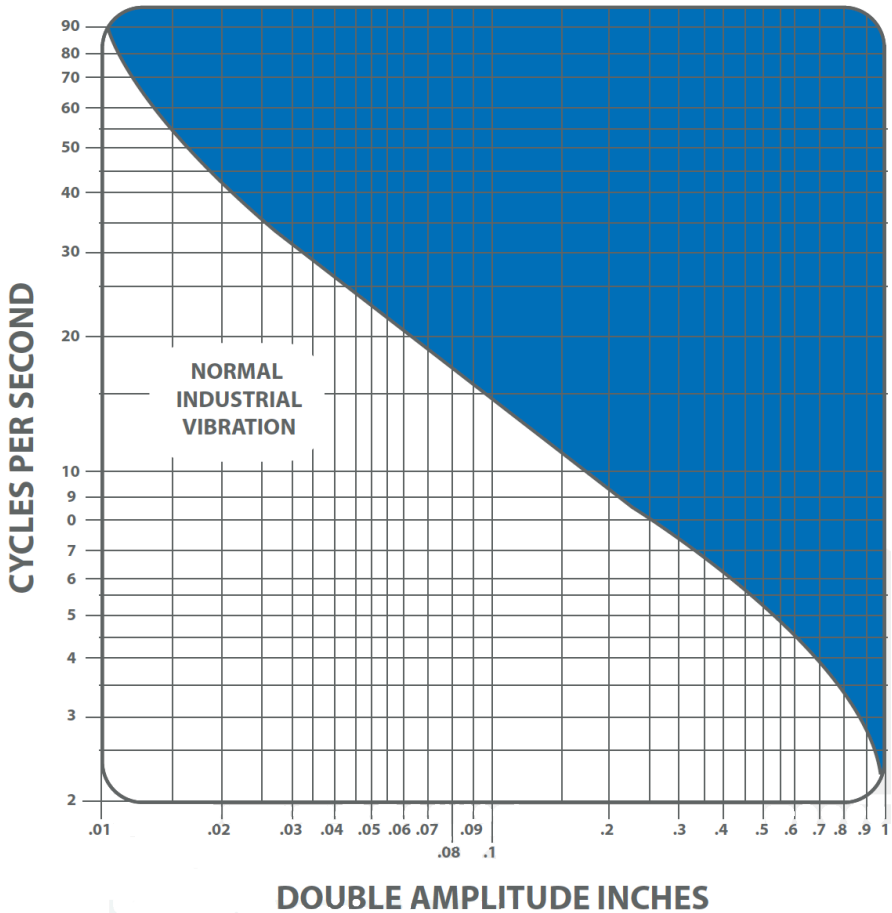
Single braid annular close pitch corrugations

Use the values from this table in the equations on pages 6-8 to calculate application specific minimum live lengths.

Nominal Hose I.D. (inches)	Hose O.D. (inches)	Minimum Centerline Bend Radius		Min. Live Length For Normal Vibration (inches)
		Dynamic Flexing (inches)	Static Bend (inches)	
3/4	1.16	8	6	5 3/4
1	1.46	9	6	7
1 1/2	2.10	11	6	8
2	2.74	13	6	9 1/2
3	3.83	18	9	11
4	4.88	22	13	12

Determination of minimum hose live length for vibration

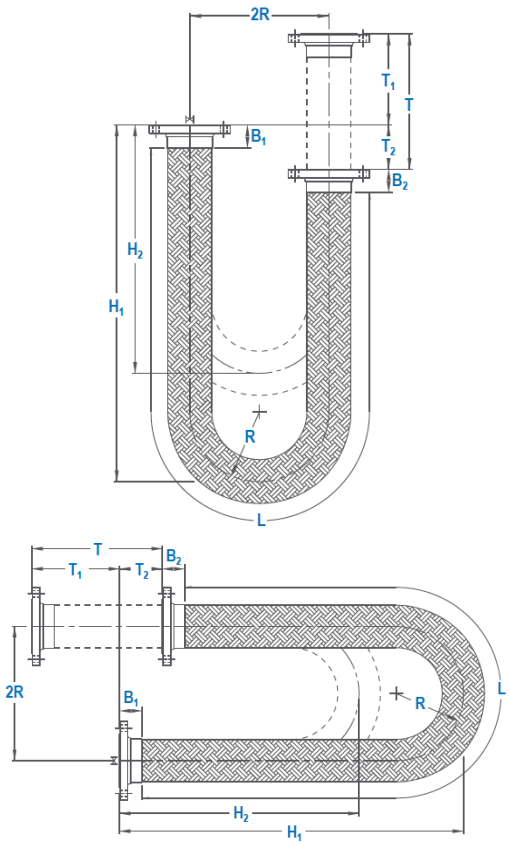
For normal vibrations encountered in industrial applications such as discharge lines on pumps, compressors, and diesel engine exhaust installations, the hose live lengths should be taken from the Minimum Live Length For Vibration Columns on Hose Data Charts. Normal vibration is shown in the unshaded area of the chart to the right.



Constant radius traveling loop

Variables (inches)
L = Minimum Live Length Required For Travel (T)
R = Radius From Dynamic Minimum Center-Line Bend Radius
T = Total Travel
T_1, T_2 = Travel
H_1 = Maximum Drop of 180° Loop
H_2 = Minimum Drop of 180° Loop
B_{12} = Fitting Length (See Hose Fitting Tables)

Equations
$T = T_1 + T_2$
$L = 4R + MAX(T_1, T_2)$
$H_1 = 1.43R + MAX(T/2, T_2) + B_1$
If $T_2 > T_1$ Then: $H_2 = 1.43R + T_2 - T/2 + B_1$
Otherwise: $H_2 = 1.43R = B_1$
Developed Length = $L + B_1 + B_2$

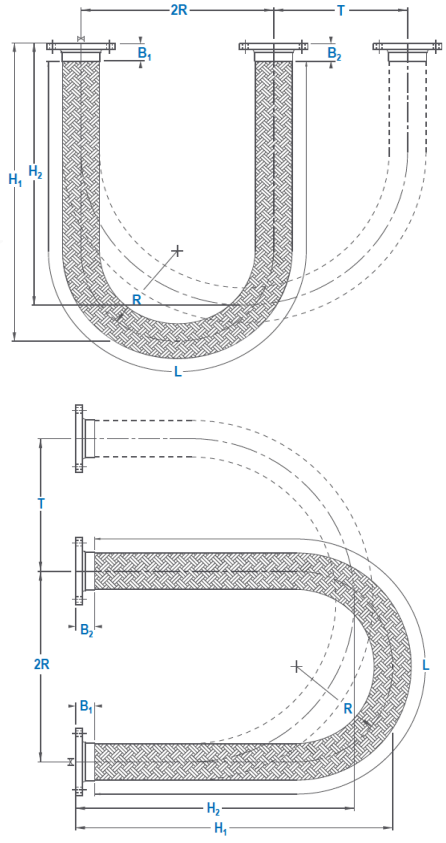


Horizontal Travel: Loop must be properly supported.

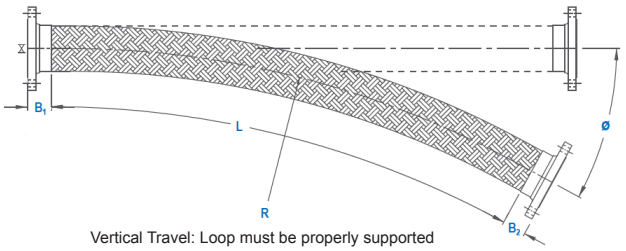
Variable radius traveling loop

Variables (inches)
L = Minimum Live Length Required for Travel (T)
R = Radius from Dynamic Minimum Center-Line Bend Radius
T = Travel
H_1 = Maximum Drop of 180° Loop
H_2 = Minimum Drop of 180° Loop
B_{12} = Fitting Length (See Hose Fitting Table)

Equations
$L=4R + 1.57T$
$H_1 = 1.43R + 0.785T + B_1$
$H_2 = 1.43R + T/2 + B_1$
Developed Length = $L + B_1 + B_2$



Variables (inches)
L = Minimum Live Length Required For Bend
R = Radius From Dynamic Minimum Center-Line Bend Radius
Ø (degrees) = Angle of Bend
B_{12} = Fitting Length (See Hose Fitting Table)

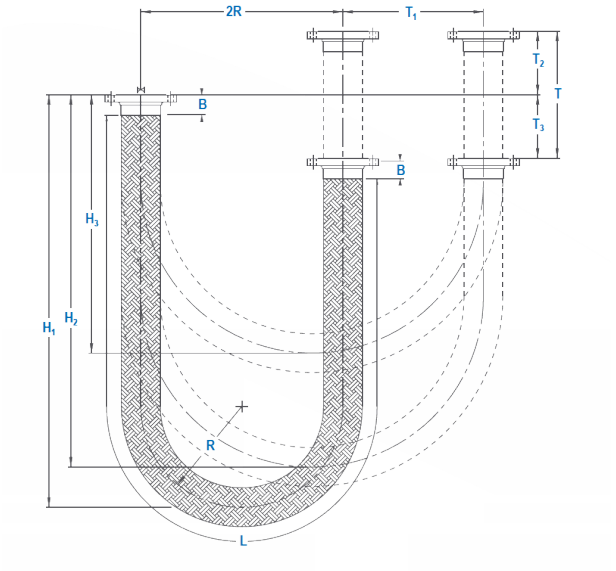


Vertical Travel: Loop must be properly supported

Equations
L = .01745RØ
Developed Length = L = B_1 + B_2

Vertical loop with travel in two directions

Variables (inches)
L = Minimum Live Length Required for Travel
R = Radius from Dynamic Minimum Center-Line Bend Radius
T = Total Vertical Travel
T_1 = Horizontal Travel
T_2 = Upward Vertical Travel
T_3 = Downward Vertical Travel
H_1 = Maximum Drop of 180°
Bend without Horizontal Travel (T_1)
H_2 = Maximum Drop of 180°
Bend with Horizontal Travel (T_1)
H_3 = Minimum Drop of 180°
Bend with Horizontal Travel (T_1)
B = Fitting Length



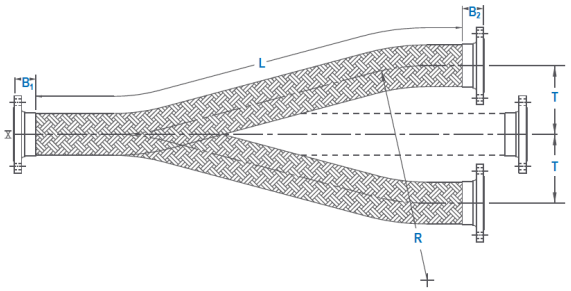
Equations
T= T_2 + T_3
L = πR + 1.57T_1 + T/2
H_1 = R + 0.785T_1 + T/2 + B
H_2 = R + T_1/2 + B
H_3 = R- T_1/2 + B
Developed Length = L+2B
Note: Use the largeset value of T_2 or T_3 if either is greater than T/2.

Determine minimum hose live length for offset motion

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 (B_1, B_2) for the end fittings. Be sure to add fitting lengths for each end.

Variables (inches)

L = Minimum Live Length Required for Travel (T)
R = Radius from Dynamic Minimum Center-Line Bend Radius
T = Travel
B_{12} = Fitting Length



Equations

$L = \sqrt{(T^2 + 6TR)}$
Developed Length = $L + B_1 + B_2$

Intermittent and static flexing loops

Case One

Hose loops must be installed with the proper live length and bend radius (Figure 1). The live length can be determined from the formulas on pages 6-8. The live length distance is based on the distance between two pipes and the proper bend radius. Inadequate hose live length is shown (Figure 2).

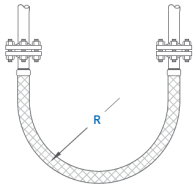


FIGURE 1

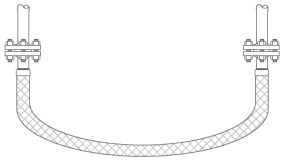


FIGURE 2

Case Two

Avoid bending the hose at the end connections (Figure 4). Install 90° pipe elbows in horizontal pipe runs with hose loops (Figure 3). The proper live length and bend radius must be taken into account as seen in Case One (Figure 1).

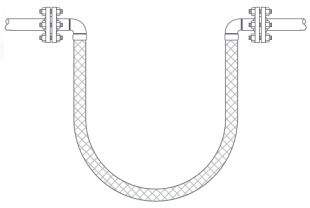


FIGURE 3

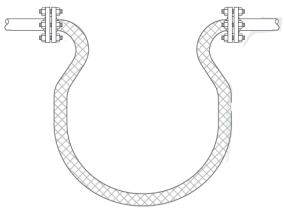


FIGURE 4

Case Three

The horizontal movement of a hose loop (Figure 5) must be directed in the same plane as the loop (Figure 6). Movement out-of-the plane or with the loop offset (Figure 7) will result in unnecessary torsion on the hose. The torsional stress will result in a hose failure.

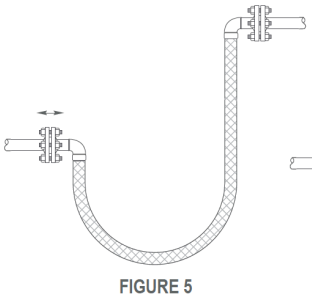


FIGURE 5

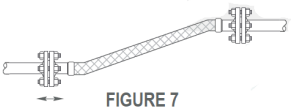


FIGURE 7

FIGURE 6

Case Four
The vertical movement of a hose loop (Figure 8) must be directed in the same plane as the loop (Figure 9). Movement out-of-the-plane or with the loop offset (Figure 10) will result in unnecessary torsion on the hose. The torsional stress will result in a hose failure.

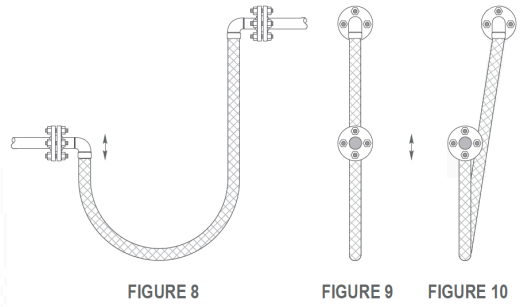


FIGURE 8 FIGURE 9 FIGURE 10

Case Five
A hose loop with elbows (Figure 11) is more suited for vertical movement than a straight hose (Figure 12). The vertical movement will cause bending stresses at the hose ends, resulting in a hose failure.

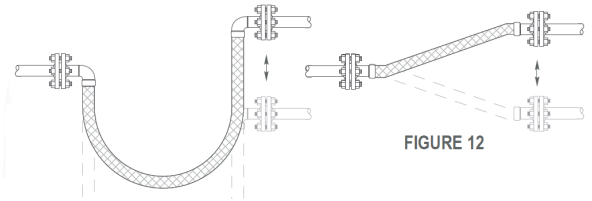


FIGURE 12

Case Six
A hose loop (Figure 13) should be installed to ensure that the hose at full offset is free from interference and all obstacles (Figure 14).

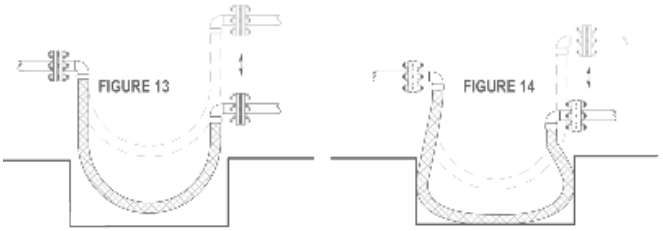


FIGURE 13 FIGURE 14

Case Seven
A horizontally traveling hose loop (Figure 15) should be supported to keep the hose from sagging (Figure 16).

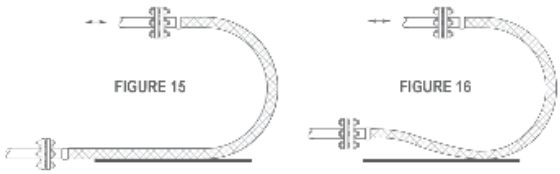


FIGURE 15 FIGURE 16

Vibration

Case Eight
For vibration, the hose should be installed so the movement will be in the plane of the bend (Figure 17). If the hose bend is installed for vibrations so that the movement is out of the plane of the hose bend (Figure 18), a torque will be imposed upon the hose, resulting in a hose failure.

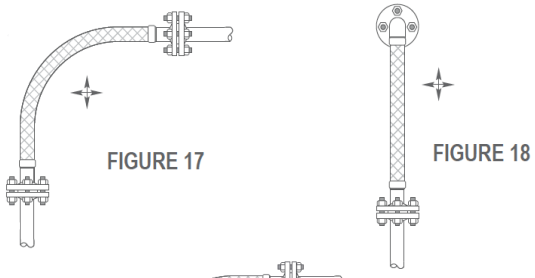


FIGURE 17 FIGURE 18

Case Nine
For vibration, the proper hose live length for intermittent flexing should be determined (Figure 19). If the hose live length is too long (Figure 20) or too short (Figure 21), a hose failure could occur. Also, unnecessary flow restriction could result from an awkward bend.

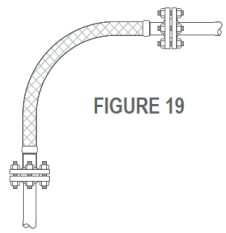


FIGURE 19

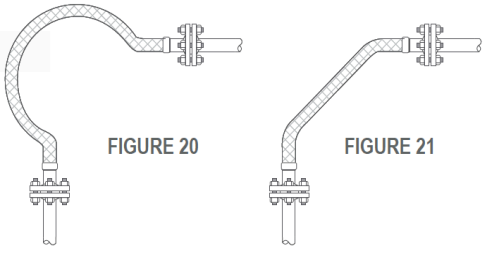


FIGURE 20 FIGURE 21

Case Ten

For vibration in one plane, a straight hose should be used and installed perpendicular to the source of the vibration (Figure 22). Installing the hose parallel to the source of vibration (Figure 23) will cause the hose to be placed in a compression/extension which is not allowed and may cause a hose failure.

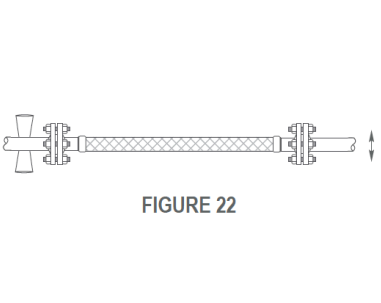


FIGURE 22

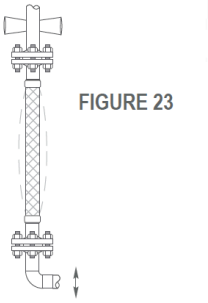


FIGURE 23

Case Eleven

For multi-plane vibration a double hose assembly should be installed (Figure 24). Installing a single hose for multi-plane vibration (Figure 25) will cause the hose to be placed in compression or extension in the axial directions. Compression and/or extension is not allowed and may cause a hose failure.

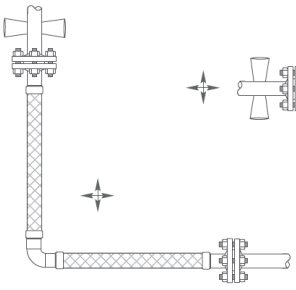


FIGURE 24

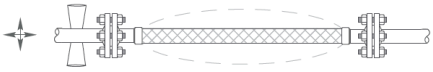


FIGURE 25

Angular Bending

Case Twelve

The hose must have the proper live length to withstand angular bending (Figure 26). Installing a hose that does not have the proper live length for that angular rotation can cause the hose to be permanently bent in the direction of the angular rotation (Figure 27) or can cause hose failure if the bend is severe enough.

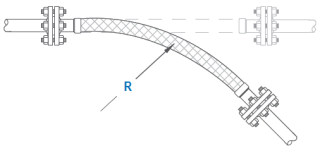


FIGURE 26

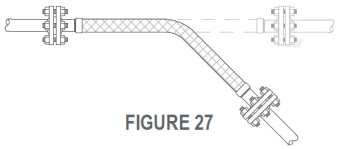


FIGURE 27

Case Thirteen

The direction of the angular rotation must be in the bending plane (Figure 28). Angular movement on a hose that is perpendicular to the bending plane (Figure 29) will cause torsional stress on the hose or hose failure if the hose bend is severe enough.

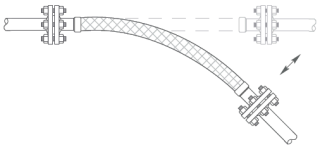


FIGURE 28

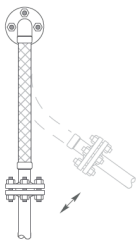


FIGURE 29

Thermal Expansion

Case Fourteen

Thermal expansion of a pipeline should be absorbed by a 90° hose bend (Figure 30 & 31). The movement should be in the directions of the bend plane. A single hose should not be installed in a multi-plane system and then be subjected to thermal expansion (Figure 32). This type of installation will cause a torsion on the hose which could result in hose failure.

Case Fifteen

Lateral movement or intermittent offset is permissible as long as the proper live length of the hose is used (Figure 33). The movement should be 90° to the hose. The hose should not be installed in the same direction as the expansion (Figure 34). This type of installation will place the hose in compression and/or extension, which is not allowed, and could result in a failure of the hose.

Case Sixteen

Considerable magnitudes of lateral movement is better absorbed in a 90° hose bend (Figure 35) than an installation of the hose 90° to the expansion (Figure 36).

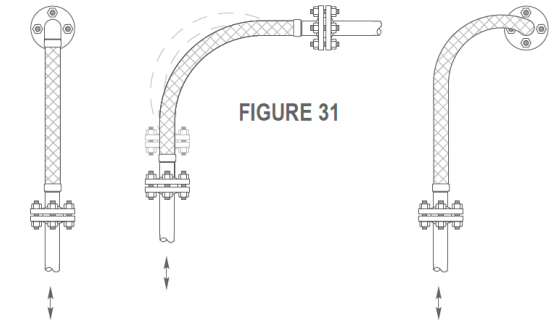


FIGURE 30

FIGURE 31

FIGURE 32

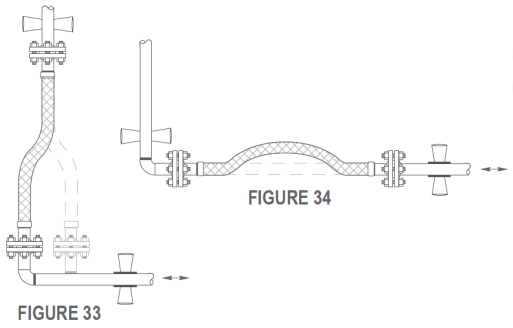


FIGURE 33

FIGURE 34

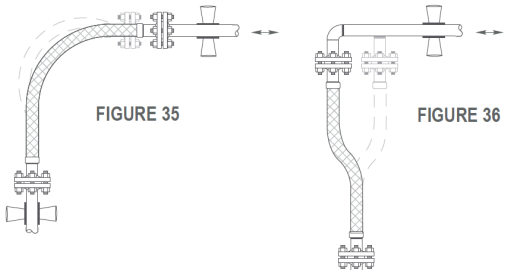


FIGURE 35

FIGURE 36

Other

Case Seventeen
Always use pipe elbows (Figure 37) to avoid bending the hose at a sharp angle (Figure 38). When the hose will be subject to manual connections to other equipment an Interlock bend restrictor can be placed at each end to restrict over bending the hose at the fittings (FIgure 39).

Case Eighteen
Never drag the hose across a surface (Figure 40). The braid could be worn or damaged resulting in a hose failure. If there is a possibility that the hose will be dragged across a surface the hose should be protected with an external interlock guard (Figure 41).

Case Nineteen
To avoid twisting the hose, always use two wrenches when tightening a swivel fitting (Figure 42).

FIGURE 37

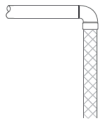
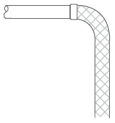


FIGURE 38



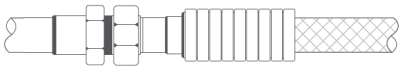


FIGURE 39

FIGURE 40

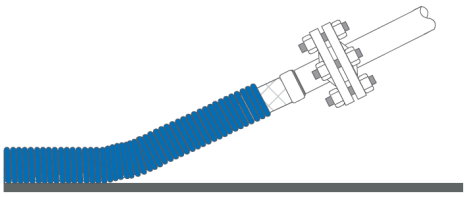


FIGURE 41

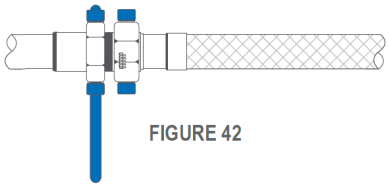


FIGURE 42

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