

Introduction

The Stainless steel corrugated hose is especially designed to achieve several objectives in pipe work design. These include, absorption or vibration, operate under vacuum, handle temperature extremes, suppress rigid pipe noise transmitted, accommodate reciprocating and flexing movement, operate effectively under high pressures and adjust or correct for misalignment.

Stainless steel corrugated hose is a general purpose industrial hose and is available in different grades of stainless steel including 304, 316, 321, Monel & Inconel.

Corrugation Design

The corrugated hose is manufactured from a cylindrical, thin walled tube formed from rolled strip and welded at the seam. Impressed into this tube is a corrugated annular profile. Annular corrugation means each convolution is perpendicular to the centre line of the hose giving a distinct advantage of movement with each corrugation being relatively independent of movement from each other. When the corrugations are closely spaced, the hose is referred to as 'closed pitch' hose. Conversely, when the corrugations are more widely spaced, the hose is referred to as 'open pitch'.



Annular



Convolute Hose

Metallic – Excellence in liquid and gas transfer applications

Temperature

Contingent upon the extremes of temperature; hot or cold metal is a positive choice as it can withstand temperature extremes.

Chemicals

Metal hose is an excellent option as it effectively controls exposure to a wide range of chemicals – both internal and external.

Permeation

Metal hose is not subject to permeation whereas non metal hose can allow permeation through the hose wall material. Pacific Hoseflex has Australian Gas Approved (AGA) certified hose to assure customers of compliance.

Failure

Generally speaking, metal hoses do not disintegrate rapidly causing any major failure. Warning signs are evident that leaks are present and the medium escapes gradually. Non-metallic hoses can be prone to sudden failure.

External Abrasion and Over bending

A range of options exist to prevent these occurrences; including external braid, spring guards, rubber and PVC covers and protective sleeves.

Heat and fire

Our metal hoses maintain form and structure up to 700°C

Vacuum

Where other hose products will collapse, our metal hose will maintain shape under full vacuum.

Fittings / Flanges

We can adapt virtually any fittings and flanges to a metal hose - other hose products require special and significant variances. We specialize in providing flexible options. Certified Welding methods:

- AS4041:2006 Class 1
- ASME B31.3: 2008
- ASME IX:2010
- AS/NZS 3992:1998



Flexibility

The flexibility of the corrugated hose is the result of the bending of the metal corrugations. Service life varies depending upon the severity of the flexing, temperature, corrosive conditions, pressure and vibration to which the hose is subjected.

Unless restrained, corrugated hose will elongate when subjected to increased internal pressure. Restraint is provided by a braided covering, consisting of a tubular sheath of woven metal wires fitted tightly over the corrugated hose and secured at each end. Bending and flexibility of the corrugated hose is not appreciably affected by the wire braid covering.



Tolerances

The nominal length refers to the hose complete with end fittings and indicates the total length. Unless otherwise arranged when ordering, the following length tolerances must be taken into account when checking the nominal length:

Dimensions in mm

Nominal Lengths	up to 500		over 500 up to 1000		over 1000 up to 2000	
Tolerances	Min.	Max.	Min.	Max.	Min.	Max.
ISO 10380:2012	495	515	990	1030	1980	2060

- The "End to End" or "Seat to Seat" length of a hose assembly shall be the length as ordered to a tolerance of +3% / -1
- Smaller length tolerances are possible, but must be specially agreed when ordering.

Braid (ISO 10380)

Unbraided hose (SS0) is satisfactory for vacuum and low pressure applications and for protection against vermin and abrasion.

Stainless steel wire braid (SS1) on the hose assembly provides the hose with a higher internal pressure capability by acting as a restraint against hose elongation, and acts to dampen vibration without significant loss of flexibility.

A second layer of braid (SS2) may be used to increase pressure rating. The test pressure is not to be exceeded or it may incur permanent corrugation deformation.

A third layer of braid (SS3) used to increase pressure rating from SS2.



Flow Velocity Consideration

The flow velocity in corrugated metal hose should never exceed 150 ft/sec for gas, or 75 ft/sec for liquids. When the hose is installed in a bent condition, these flow values should be reduced proportionally to the degree of the bend. Where the flow velocity exceeds these rates, an interlocked metal hose liner is recommended. *Refer to Nomograph Page 364*

Service Life

The Stainless steel corrugated hose is engineered to provide maximum service life when properly installed. Incorrect installation, incorrect flexing or careless handling in an application will reduce the effective service life of the hose and cause premature failure of an assembly. The service life can be affected by many external factors, the environment surrounding the assembly as well as the media being transferred will together determine a general guide to the service life.



Non Destructive Pressure Testing

The nominal pressure rating of a corrugated stainless hose varies according to type, material and size. The pressure can be affected by factors such as temperature, pulsation or shock conditions and bending stresses. To avoid distortion of the convolutions of the hose, the maximum test pressure quoted in the literature must not be exceeded. If requested all hoses can be tested to $1\frac{1}{2}$ times the customers stated working pressure, provided that this does not exceed the stated maximum test pressure.

Applicable Standards

If required your hoses can be manufactured for use with gas and water.



Covers

To protect the stainless steel hose from unusual external abuse you can use different armours and covers such as: stainless steel interlock, heat shrink, lay-flat, scuff guarding, fire sleeve, fibre glass tape, PVC, rubber, wire spring-guard and rope lag cover. **Refer to Cover Section Page 297 for more information**

Silicone Coated Fibreglass Sleeve

Size : 6mm to 130mm

Material : Silicone



PVC Covering

Size : 1.6mm to 125.0mm

Material : Polyolefin



Wire Spring Guard

Size : 20mm to 100mm

Material : 316/304 Stainless Steel, Galvanised



Rope Lag

Size : 6mm to 48mm

Material : Sisal Rope



Wire Bend Restrictor

Size : 20mm to 100mm

Material : 316/304 Stainless Steel, Galvanised



Hose Floats

Size : 10mm - 130mm Hose O.D.

Material : Polyethylene



Pigstail

Size : 7mm to 99mm I.D.

Material : HPDE (High Density Polyethylene)



Bird & Rodent Proofing Briad

Size : 6mm to 150mm

Material : 316/304 Stainless Steel



Whipsock

Size : 14mm to 180mm

Material : 316/304 Stainless Steel, Galvanised



Rawhide

Size : 22.9mm to 93.0mm

Material : Nylon



Stainless Steel Interlock Cover

Size : 3/4" - 12"

Material : 304 Stainless Steel



Ball Joint Armor

Size : 1" - 6"

Material : Stainless Steel, Galvanised



Layflat

Size : 20mm to 200mm I.D.

Material : PVC with low pressure stability



Hose Handling Sling

Size : 4" - 12" Hose Dia.

Material : 100% nylon webbing



Liners

The most common liner used in a corrugated hose is a metal interlock liner. The liner will allow a smooth flow rate whilst maintaining limited flexibility. The interlock will partially reduce the bend radius and inside diameter of the corrugated hose. The smooth liners reduce associated noise. Another alternative liner is braid which doesn't reduce the bend radius of the hose.

Interlock Liner



Braid Liner



Jacketed Hose

A jacketed assembly consists of a "hose within a hose." An inner or primary media conveying hose is enclosed or jacketed by a larger diameter hose. The hoses are joined at each end by specially designed fittings so that there is no media pathway between the two hoses.

Jacketed assemblies are often specified when the primary media must be kept at either an elevated or cryogenic temperature. Steam is often circulated through the jacket hose to keep a viscous material in the inner hose hot and easily conveyed. A vacuum can also be pulled on the jacket hose to insulate cryogenic liquids being conveyed in the inner hose.

The media typically is steam, hot oil or hot water to raise the temperature of the fluid moved in the internal hose. Also cold products such as liquid helium or nitrogen can be used to lower the temperature of the fluid with-in the internal hose.



Following Applications:

- Heated processes
- Rail car and tank truck loading/unloading
- Marine Transfer
- Flexible connections to vibrating equipment
- To relieve pump housing stresses
- Hazardous material piping system using an alarmed vacuum jacket
- Vacuum jacketed hoses for heat insulation or as safety barrier for toxic processes



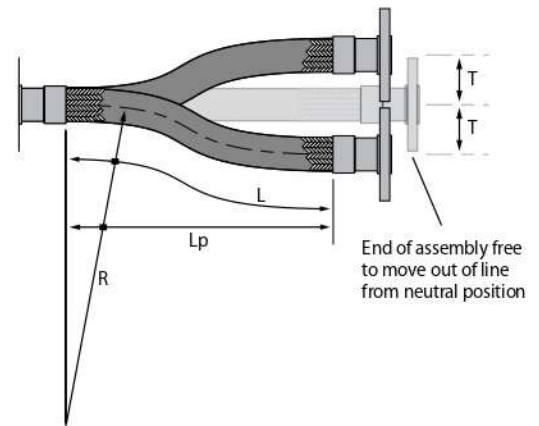
Minimum Bend Radius Occurs at Offset Position

The moving end is free to move "out of line" from neutral position.

To find the live hose length:

$$L = \sqrt{6(RT) + T^2}$$

$$L_p = \sqrt{L^2 - T^2}$$



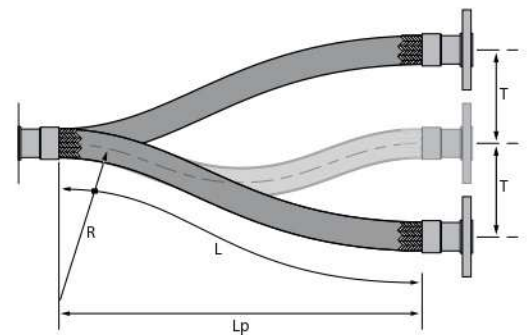
Minimum Bend Radius Occurs at In Line Position

The moving end of the hose is restricted to move only up and down in line as the hose crosses neutral position.

To find the live hose length:

$$L = \sqrt{20(RT)}$$

$$L_p = \sqrt{L^2 - T^2}$$

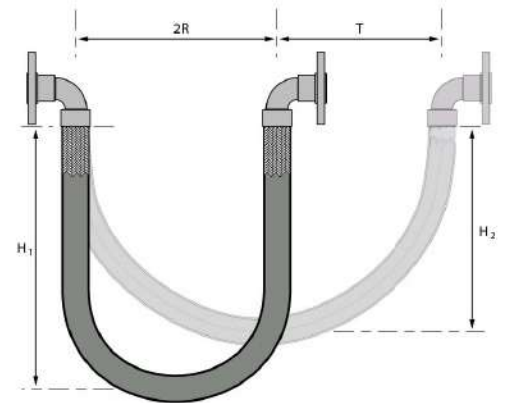


Horizontal Movable Pipe System

$$L = 4R + 1.57T$$

$$H_1 = 1.43R + 0.79T$$

$$H_2 = 1.43R + 0.5T$$



Vertical Movable Pipe System

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

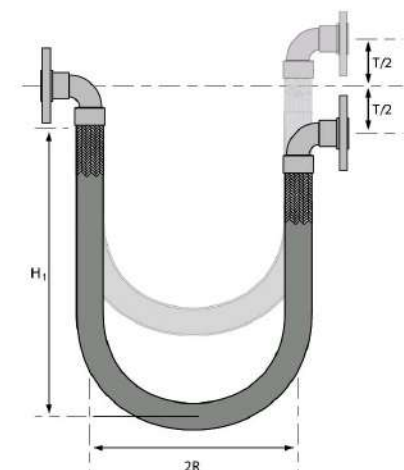
$$H_1 = 1.43R + \frac{T}{2}$$

L = Live Hose Length (mm)

R = Minimum Dynamic Bend Radius for Constant Flexing (mm)

T = Total Travel (mm)

H1 = Hang Length of the Loop (mm)



Prior to Installation

1. Examine the hose for any obvious damage. IF THE HOSE IS DAMAGED, DO NOT USE. Examples of damage may include slices to the cover, kinks, broken braid, and crushing of the hose (can reduce life and pressure rating).

2. Review application to ensure proper selection of hose has been made by examining materials, pressures, chemical compatibility, temperature and environment.

3. Hose movement should be restricted to a SINGLE PLANE (Drawing A) to minimize the resultant twisting (torque). Note: The flexing plane should also be the plane in which the bending occurs. Excessive bending will induce stress fatigue (Drawing B).

4. Axial movement should be eliminated. The hose should not be stretched or compressed along its longitudinal axis when installed in-line (Drawing C).

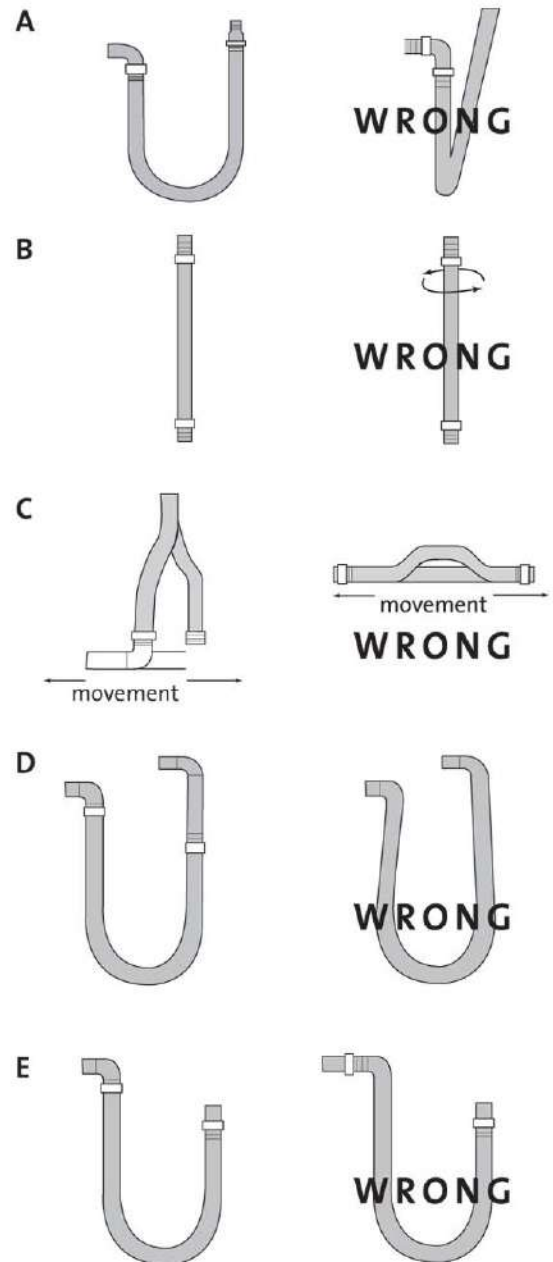
Installation

Never use hose below minimum bend radius (Drawing D). Bend radius (measured to inside radius of fluoropolymer-lined hose and centre line for stainless steel metal hose) are given for individual products and sizes (consult factory for specific data). These values represent the minimum bend radius with which the hose can be properly installed. If these values are not maintained, the hose can fail prematurely.

Note: In some cases, vacuum and pressure ratings are based on not exceeding 2% minimum bend radius (consult factory for specific hose ratings).

Do not allow severe bends (Drawing E). Severe bends can cause kinking in a hose or overstress the assembly/material, resulting in damage and ultimate failure. If severe bends cannot be avoided, use elbows designed to accommodate the direction change.

Do not twist (torque) assembly along centre line during installation. The likelihood of leakage/failure increases for hoses that are twisted (torqued) during assembly. The proper use of floating flanges and swivel-type fittings (i.e., JIC) can eliminate improper twisting.



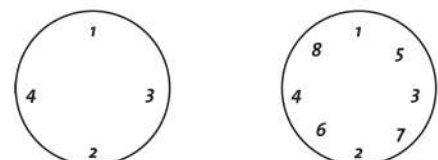
Nominal Hose Size

1/2"	1"	1 1/2"	2"	3"	4"	5"	6"
10	10	15	25	40	30	60	75

Torque (ft.-lbs.)

• For accurate tightening a torque wrench is HIGHLY recommended. If a flange leak occurs on one side of a properly torqued flange, the bolts should not be over-torqued. Instead loosen the bolts on the non-leaking side the same amount you tighten the bolts on the leaking side.

Bolt Torque Sequence



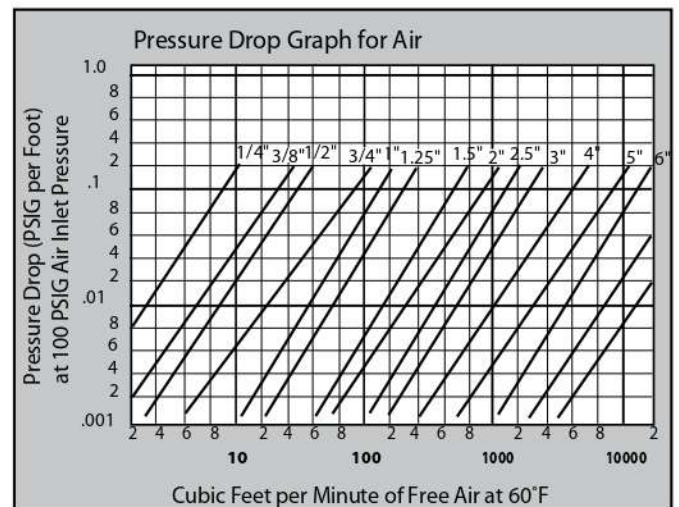
When gas or liquid being conveyed in a corrugated metal hose exceeds certain limits, resonant vibration can occur. Resonance may cause very rapid failure of the assembly. In those applications where product velocities exceed the limits shown in the graph below, a revision of the assembly design might include:

- 1) Addition of an interlocked metal hose liner.
- 2) An increase in the corrugated hose I.D.
- 3) A combination of the above.

Pressure Drop

Pressure drop in a piping system is often a concern of the designer. Compared to rigid pipe, there is always a greater pressure drop in corrugated metal hose. The following graphics are offered as aids in estimating pressure drop in corrugated hose conveying water and air. The values derived are approximate and apply only to straight line installations. Bends and fittings in the hose assembly can increase the pressure drop.

For a rough estimate, it can be assumed that the pressure loss in corrugated hoses in the turbulence zone is around 150% higher than in new welded steel pipes. I.e. the diameter of a corrugated hose would have to be increased by 20% to equal the pressure loss of steel pipe. In the high-velocity zone, corrugated hoses are around 450% higher due to the marked vortex activities; in this case, a diameter increase of 41% would be necessary.



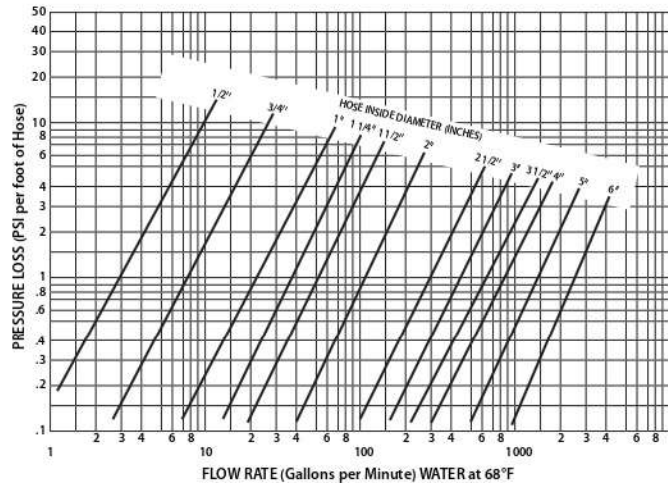
For air inlet pressures other than 100 psig:
 $PD = PD @ 100 \text{ psig} \left(\frac{100 + 14.7}{P + 14.7} \right)$

Water Pressure loss

Corrugated metal hoses are used for conveying of substances of different consistency (gaseous, liquid or solid). One of the important factors to consider in designing systems that implement metal hoses, is the loss of pressure. Due to its profile the pressure loss in corrugated hoses is significantly higher than in steel pipes – almost 100%, and about 20% to 25% higher for the stripwound hoses.

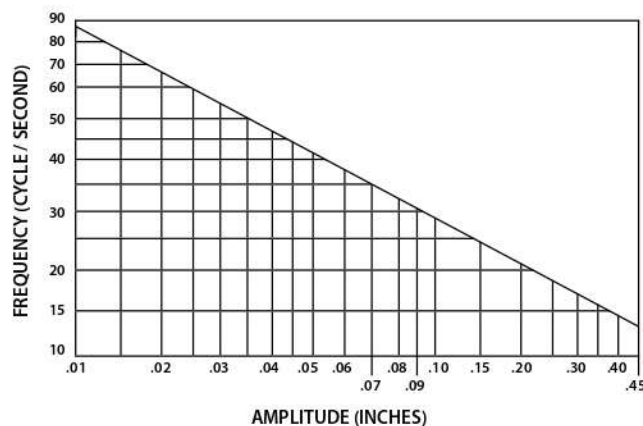
To find out pressure loss over a certain length of hose we can use Pressure Loss graph below – for example: we need to calculate the pressure loss in 85 feet long 2" Corrugated Hose (which transfers water) with Flow Rate been 1400 cubic feet per hour. By using calculator below we find that 1400 ft³/hour. corresponds to 175 gal/min. Then we plot the 175 gpm on the X-axis of the chart below until we "hit" the line for 2" hose ID, then by going over horizontally to the Y-axis, we find that Pressure Loss per foot of hose will be about 3.7 psi. So that the total pressure drop over the hose length will be 314.5 psi (3.7 x 85).

Keep in mind that if you transfer gaseous substance through the hose then you need to find the ratio of the density of gas over the density of water and adjust the pressure drop respectively. For example if you transfer natural gas (density = 0.050 lb/ft³) and knowing that water density = 62.4 lb/ft³ we can find out the pressure drop as the following: $3.7 \times (0.050/62.4) = 0.0030$ psi/ft or 0.255 psi for entire length of hose (85 x 0.003).



Vibration information and graph

The inherent flexibility of corrugated hose plus the dampening effect of the wire braid combine to create the excellent vibration isolation qualities of corrugated metal hose. The graph below defines the combination of amplitudes and frequencies considered to be normal industrial vibration.



COMPOSITE HOSE

COMPOSITE / POLYPROPYLENE HOSE (GC)

FLEXIBLE, LIGHT WEIGHT, COMPOSITE HOSE

- Application** : Composite Hose can handle very wide range of Acids, Chemicals, Petroleum and Refined Oil Products, liquid cargo transfer from barge or ship.
- Construction** : Composite hoses are constructed from polypropylene, polyamide or polyester films & fabrics. Depending on the applications, outer cover could be of PVC coated polyester fabric, which is abrasive, weather & ozone resistant with galvanized steel, polypropylene coated steel & stainless steel 316 internal and galvanized steel, stainless steel external wire.
- Temperature** : (-40°C) to 100°C.
- Specification** : EN 13765 : 2010
- Size** : 1" to 12"
- End Connection** : All types of connections duly crimped as per customer requirement.

PTFE LINED COMPOSITE HOSE (GTC)

- Application** : Corrosive Chemicals / Alkalies.
- Construction** : Same as Composite Hose – Inside Layer shall be PTFE lined.
- Temperature** : (-40°C) to 120°C. [Hoses upto 316°C can be offered]
- Size** : 1" to 12"
- End Connection** : As per customers requirement duly crimped.

For further Information please contact / consult our technical department.



PRESSURE (COMPOSITE / POLYPROPYLENE / PTFE LINED COMPOSITE HOSE)				
	Type 1	Type 2	Type 3	Type 4
Maximum working pressure (bar)	4	10	14	14
Proof pressure (bar)	6	15	21	21
Minimum burst pressure (bar)	16	40	56	56
Vacuum rating (bar)	0.5	0.9	0.9	0.9
Working temperature range (°C)	-20° to +60°	-30° to +80°	-30° to +80°	-30° to +150°