HOSE MASTER

CORRUGATED METAL HOSE & ASSEMBLIES

WHEN TO USE CORRUGATED METAL HOSE

There are many different types of hose available on the market, including metal, rubber, composite, PTFE, and fabric. The decision of which hose type to buy depends on the application for which the hose is being used. Generally, there are eight factors that should alert you to consider using metal hose:

1. TEMPERATURE EXTREMES

   If either the temperature of the media going through the hose or the surrounding atmospheric temperature is very cold or hot, metal may be the only material that can withstand such temperature extremes.

2. CHEMICAL COMPATIBILITY

   Metal hose can handle a wider variety of chemicals than most other hose types. If the hose will be exposed to aggressive chemicals (either internally or externally), metal hose should be considered.

3. PERMEATION CONCERNS

   Non-metal hose is susceptible to gas permeation through the hose wall and into the atmosphere. Metal hose, on the other hand, does not allow permeation. If containing the gases inside the hose is important, metal hose may be required.

4. POTENTIAL FOR CATASTROPHIC FAILURE

   When a metal hose fails, it usually develops small holes or cracks. Other hose types tend to develop larger cracks or come apart completely. If a sudden hose failure is potentially catastrophic, a metal hose may help minimize the effects of a failure by leaking product at a slower rate.

5. ABRASION AND OVERBENDING CONCERNS

   To prevent abrasion and overbending, a metal hose can be used as a protective cover over wires or even other hoses.

6. FIRE SAFETY

   Other hose types will melt when exposed to fire, while metal hose maintains its integrity up to 1300° F. (See NAHAD derating chart on page 33)

7. ACHIEVING FULL VACUUM

   Under full vacuum, metal hose maintains its shape while other hose types may collapse.

8. FLEXIBILITY IN FITTING CONFIGURATION

   Virtually any type of fitting can be attached to metal hose, while other hose types require special shanks and collars.

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ASSEMBLY COMPONENTS

In this section, we will discuss the various components that make up a corrugated metal hose assembly, and what information a metal hose fabricator will need in order to make an assembly for your application. If you need assistance determining this information, we have also included an explanation of how to analyze the application and make the appropriate selections.

In order to produce an assembly, the fabricator will need answers to the following five questions.

1. Hose: (type, alloy, and size): page 4-18
2. Fittings: (type, alloy, and size for each end): pages 19-21
3. Length of the Assembly: (either overall length or live length): page 22-24
4. Fabrication Options: page 25
5. Accessories: page 28

If you have the answers to these questions, a metal hose fabricator will be able to make your custom assembly. If you do not have the answers to all five questions, you will need to obtain them. The next section (S.T.A.M.P.E.D.) is designed to help you obtain the information necessary to determine the answers.

S.T.A.M.P.E.D.

To properly design a metal hose assembly for a particular application, the following design parameters must be determined. To help remember them, they have been arranged to form the acronym "S.T.A.M.P.E.D."

1. SIZE
   The diameter of the connections to which the assembly will be installed is needed to provide a proper fit. This information is required.
2. TEMPERATURE
   As the temperature to which the assembly is exposed (internally and externally) increases, the strength of the assembly's components decreases. Also, the coldest temperature to which the hose will be exposed can affect the assembly procedure and/or fitting materials. If you do not provide this information, it will be assumed that the temperatures are 70° F.
3. APPLICATION
   This refers to the configuration in which the assembly is installed. This includes both the dimensions of the assembly, as well as the details of any movement that the assembly will experience. This information is necessary to determine assembly length and required flexibility.
4. MEDIA
   Identify all chemicals to which the assembly will be exposed, both internally and externally. This is important since you must be sure the assembly's components are chemically compatible with the media going through the hose, as well as the environment in which the hose is to be installed. If no media is given, it will be assumed that both the media and the external environment are compatible with all of the available materials for each component.
5. PRESSURE
   Identify the internal pressure to which the assembly will be exposed. Also, determine if the pressure is constant or if there are cycles or spikes. This information is important to determine if the assembly is strong enough for the application. If no pressure is given it will be assumed that the pressure is low and there are no pressure surges or spikes.
6. END FITTINGS
   Identify the necessary end fittings. This is required since fittings for the assembly must be chosen to properly fit the mating connections.
7. DYNAMICS
   Identify the velocity at which the media will flow through the assembly. Since corrugated metal hose does not have a smooth interior, rapid media flow can create a resonant frequency that will cause the hose to vibrate and prematurely fail. If no velocity is given, it will be assumed that the velocity is not fast enough to affect the assembly's performance.

When selecting a hose, you must consider three variables: pressure-carrying capability, flexibility, and chemical compatibility.

1. PRESSURE-CARRYING CAPABILITY

The hose must be strong enough to handle the pressures to which it will be exposed. To determine hose pressure capability, consult the catalog for the "Maximum Working Pressure" stated for the hose. The Maximum Working Pressure must be reduced for each of the following circumstances:

- Temperature - As temperature increases, hose working pressure decreases. After you have determined the proper alloy (see "Chemical Compatibility" below) go to the "Derating Factor" table on page 33 in Technical Information and match the alloy of the hose and braid with the highest temperature to which they will be exposed (either internally or externally) to obtain the proper derating factors. Then multiply the hose's Maximum Working Pressure by the most-limiting temperature derating factor.

- Dynamic Pressure - Pulsating, surge, or shock pressures, like those encountered with quick opening or closing valves, can inflict severe damage on a hose. If your application entails pulsating pressures, the working pressure should be derated by half. If your application entails shock pressures, derate the stated working pressure to 1/6 of its value.

Example:

1" Annuflex hose - T321 stainless steel hose and T304 stainless steel braid @ 500° F with shock pressures.

Catalog Maximum Working Pressure = 718 psi
Temperature Derating Factor at 500° F. = 0.88; and the
Pressure Derating Factor = 1/6
Maximum Application Working Pressure =
718 psi x 0.88 x 1/6 = 105.31 psi

2. FLEXIBILITY

Confirm that the hose's minimum bend radius is less than the bend radius required for the application. Increasing the installed radius of the hose will reduce fatigue on the corrugations, increasing assembly life. Care should also be taken for applications with vibration. Contact Hose Master's Inside Sales Department if excessive vibration is present. Refer to the Vibration chart on page 35 for additional information.

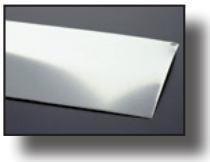
3. CHEMICAL COMPATIBILITY

You must choose a material for the hose and braid that is compatible with the media being conveyed through the hose, as well as the environment in which the hose is to be installed. When determining chemical compatibility, it is important to know the temperature and concentration of the chemical(s). Although there are many resources to confirm chemical compatibility, two of the industry standards that you may use are the National Association of Corrosion Engineers (NACE) and the Compass Corrosion Guides. You may also contact Hose Master's Inside Sales Department, which can check these sources for you.

HOSE MASTER'S PROPRIETARY HOSE FORMING PROCESSES

Annular Profile - Independent corrugations, straight and parallel

The manufacturing process of corrugating annular metal hose starts with a stainless steel strip that is rolled and the edges welded together to form a thin-walled, gas-tight tube. Hose Master offers:

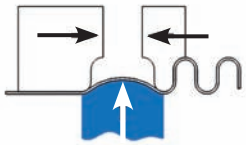


High quality steel strip

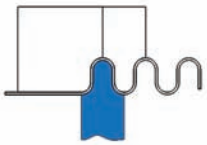
Rolled steel to form a tube with a strong, clean, non-oxidized seam weld

After the tube has been welded, corrugations are formed into the tube to make it flexible. Hose Master uses Hydroforming and Crimp Forming techniques to provide the highest quality annular corrugated metal hose in the industry.

Hydroforming - Hose Master utilizes a proprietary method of hydroforming in which corrugations are formed by expanding a section of stainless steel tube with high pressure water from inside the tube, while simultaneously feeding the tube axially into the process. Hydroforming is a clean, gentle process that enhances flexibility and cycle life, maintains wall thickness, reduces concentrated residual stress, and minimizes work hardening of materials.

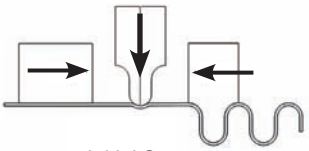


Initial Stage

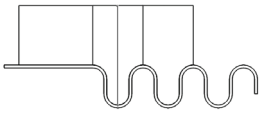


Final Stage

Crimp Forming - Hose Master's proprietary Crimp Forming process is conceptually the inverse of hydroforming, while maintaining the key attributes of product features and benefits. Crimp Forming forms from the exterior by compressing a section of stainless steel tube utilizing a specialized shutter crimp, while simultaneously synchronizing a bi-directional feed of tube axially into the process. This product yields a hose with uniform wall thickness, enhanced flexibility and cycle life, without imparting residual torsional stress common with other manufacturing methods. Starting with 1/4" PressureMax HP, Hose Master uses the Crimp Forming process on items with a relatively large t/d ratio (tube thickness to diameter).



Initial Stage



Final Stage

Helical Profile - One continuous corrugation that spirals around the hose

Helical Seam Weld Process - In addition to our line of annular, corrugated hose, Hose Master offers two helical hoses formed from a manufacturing process specially designed to maximize performance without the drawbacks of traditional, mechanically-formed helical hose.

Helical seam welded hoses are made from a stainless steel strip that is formed before welding. Because it is not mechanically formed from a tube, this hose is extremely flexible and does not contain the residual stresses found in traditional mechanically-formed helical hose.

Single-Walled Helical Profile

Double-Walled Helical Profile

Both single-wall and double-walled helical hoses are made by pre-forming the stainless steel strip, overlapping the material, and continuously resistance-welding the seam together.

The single-walled helical hose is formed from a single stainless steel ply, while the double-walled process features two plies of stainless strip for higher pressure ratings.

FEATURES & BENEFITS

- Feature - Hose Master's proprietary forming methods induce minimal residual stress in the hose wall compared to other methods of manufacturing
  Benefit - Increased resistance to stress minimizes hose failures and significantly increases cycle life

- Feature - A characteristic of Hose Master's forming processes is a very uniform metal thickness throughout the corrugation profile. Other forming methods can result in significant variations in metal gauge
  Benefit - Uniform wall thickness promotes even distribution of strain during flexing, thereby increasing hose longevity

- Feature - Hose Master's proprietary manufacturing methods incorporate three separate tests of the butt-welded hose seam
  Benefit - Ensures highest-quality hose and reduces premature product failure

- Feature - Hose Master's forming processes minimize work hardening of the alloy during the corrugating process
  Benefit - Results in a more flexible hose and maintains proper alloy yield strength

- Feature - Highest technology equipment combined with skilled workmanship allow the use of lighter gauge metals.
  Benefit - Allows for proper wall thickness, maximizing cycle life and flexibility

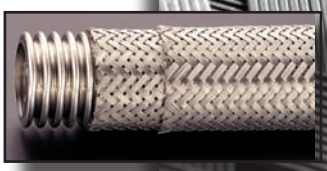
BRAIDING PROCESS

To give corrugated hose the ability to withstand pressure, stainless steel wire is braided over the hose. Hoses may be single braided (one layer of braid) or double braided (two layers of braid) to achieve even greater working pressures. Braided braid is used on large-diameter hose.

Designing the proper braid for each type of corrugated hose requires sophisticated engineering to maintain the proper balance between the braid strength and the hose's flexibility. Hose Master's braid packages offer several advantages:

1. High Percentage Braid Coverage - Hose Master flexible hose has the highest percentage of braid coverage, yielding better cycle life and protection against damage to the hose.

2. Machine Braided Hose - Hose Master weaves the braid directly onto the hose, ensuring that the braid fits tightly against the hose, preventing potential hose deformation or squirm. Machine braided hose also offers repeatable performance and longer cycle life.



HOSE PERFORMANCE CHART

HOSE TYPE	Number of Braids	Inside Diameter (in.)																	
		1/4		5/16		3/8		1/2		5/8		3/4		1		1 1/4		1 1/2	
		Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)
ANNUFLEX Standard Product T321, T316L, T304L See page 9	0 1 2	90 1800 2700	4.5	n/a	n/a	70 1558 2336	5.0	70 1186 1779	5.5	57 1205 1808	7.0	43 898 1347	8.0	43 718 1077	9.0	43 645 968	10.0	28 531 797	11.0
MASTERFLEX Most Flexible T321, T316L, T304L See page 10	0 1 2	90 1800 2700	3.7	n/a	n/a	70 1558 2336	4.0	70 1186 1779	4.4	57 1205 1808	5.6	43 898 1347	6.4	43 718 1077	7.1	43 645 968	7.9	28 531 797	8.7
PRESSUREFLEX HP High Pressure T321 & T316L See page 11	0 1 2	450 3000 4000	5.5	n/a	n/a	400 2400 3300 n/a n/a	8.5	400 2400 3200	10.0	n/a	n/a	220 1100 1650	8.0	190 1000 1400	9.0	200 900 1350	12.0	90 750 1200	13.0
PRESSUREMAX HP® Ultra-High Pressure T321 & T316L See page 12	0 1 2 3 4	500 5000 6000 n/a n/a	4.5	n/a	n/a	400 3500 5000 n/a n/a	7.0	200 2700 4500 n/a n/a	8.0	n/a	n/a	250 2650 3600 n/a n/a	4.5 10.0 10.0 n/a n/a	180 2500 3000 n/a n/a	7.0 11.0 11.0 n/a n/a	190 1775 2600 3000 n/a	9.5 12.5 12.5 14.0 n/a	110 1450 2200 n/a n/a	11.5 13.0 13.0 n/a n/a
CHEMKING® Chemical Resistance 276 See page 13	0 1 2	n/a	n/a	n/a	n/a	n/a	n/a	70 1186 1779	5.5	n/a	n/a	43 898 1347	8.0	43 718 1077	9.0	n/a	n/a	28 531 797	11.0
FORMAFLEX Stay-Put Application T321, T316L See page 15	0 1 2	90 900 n/a	n/a	n/a	n/a	70 800 n/a	n/a	70 665 n/a	n/a	57 500 n/a	n/a	43 380 n/a	n/a	43 355 n/a	n/a	43 280 n/a	n/a	28 264 n/a	n/a
BRONZEFLEX Bronze Alloy See page 16	0 1 2	n/a	n/a	n/a	n/a	60 704 936	6.0	50 566 753	7.0	n/a	n/a	30 468 622	8.0	26 334 444	10.0	16 306 407	12.0	15 297 395	13.5
EXTRAFLEX Helical/Flexible T321 See page 17	0 1 2	71 1778 2489	2.2	43 1422 1991	2.4	36 1138 1707	2.8	28 910 1422	3.1	28 910 1422	3.9	14 711 1138	5.1	11 569 910	6.3	9 455 711	7.9	7 356 569	9.4
HYDRAFLEX Helical/lHigh-Pressure T316L See page 18	0 1 2	n/a 4600 5800	5.0	n/a 4000 4800	5.1	n/a 3800 4000	5.5	n/a 2600 3700	5.7	n/a 2400 2700	6.1	n/a 2000 2200	6.5	n/a 1500 2000	7.9	n/a 1100 1600	9.4	n/a 1000 1500	12.2

Product specifications are subject to change without notice.

HOSE TYPE	Number of Braids	Inside Diameter (in.)																	
		2		2 1/2		3		4		5		6		8		10		12	
		Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)	Working Pressure (psi)	Dynamic Bend Radius (in.)
ANNUFLEX Standard Product T321, T316L, T304L See page 9	0 1 2	14 449 674	13.0	14 417 626	16.0	14 346 519	18.0	14 299 448	22.0	14 275 412	28.0	11 210 315	32.0	3 250 360	29.0	4 175 310	34.0	3 185 325	44.0
MASTERFLEX Most Flexible T321, T316L, T304L See page 10	0 1 2	14 449 674	10.3	14 417 626	12.8	14 346 519	14.5	14 299 448	17.4	14 275 412	21.9	11 210 315	25.0	n/a	n/a	n/a	n/a	n/a	n/a
PRESSUREFLEX HP High Pressure T321 & T316L See page 11	0 1 2	105 800 1150	15.0	46 575 900	17.0	36 550 800	20.0	23 425 575	25.0	28 331 n/a	34.0	23 285 n/a	40.0	n/a	n/a	n/a	n/a	n/a	n/a
PRESSUREMAX HP® Ultra-High Pressure T321& T316L See page 12	0 1 2 3 4	100 1100 1675 n/a n/a	12.0 14.0 14.0 n/a n/a	46 700 1050 n/a n/a	14.5 16.0 16.0 n/a n/a	36 600 900 1200 n/a	16.0 20.0 20.0 75.0 n/a	23 525 875 1200 n/a	19.0 26.0 26.0 n/a 96.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CHEMKING® Chemical Resistance 276 See page 13	0 1 2	14 449 674	13.0	n/a	n/a	14 346 519	18.0	14 299 448	22.0	14 275 412	28.0	11 210 315	32.0	n/a	n/a	n/a	n/a	n/a	n/a
FORMAFLEX Stay-Put Application T321, T316L See page 15	0 1 2	14 221 n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
BRONZEFLEX Bronze Alloy See page 16	0 1 2	10 210 279	17.0	8 194 258	22.0	5 166 221	24.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EXTRAFLEX Helical/Flexible T321 See page 17	0 1 2	6 284 455	11.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
HYDRAFLEX Helical/lHigh-Pressure T316L See page 18	0 1 2	n/a 750 1100	14.6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Product specifications are subject to change without notice.

ANNUFLEX is the foundation of Hose Master's extensive line of annular products. Proprietary manufacturing processes produce a hose with minimal residual stress, uniform wall thickness throughout the corrugations, and minimal work hardening. These processes create a very flexible, long-lasting corrugated metal hose.

Explanation of Annuflex Part Numbers
AF _____ 7 _____
Material Code Braid Code

Material Codes
4 - T321 Stainless Steel
5 - T316L Stainless Steel
7 - T304L Stainless Steel

Braid Codes
00 - Unbraided
50 - T304 Single Braid
55 - T304 Double Braid
T316 Braid available upon request

Example: AF4750 = T321 stainless steel, annular corrugated metal hose with a single T304 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	0 1 2	0.41 0.47 0.53	1.0	4.5	90 1800 2700	n/a 7233 9100	0.04 0.11 0.18
3/8	0 1 2	0.65 0.71 0.77	1.2	5.0	70 1558 2336	n/a 6230 9345	0.10 0.20 0.30
1/2	0 1 2	0.77 0.83 0.89	1.5	5.5	70 1186 1779	n/a 4743 7115	0.11 0.22 0.33
5/8	0 1 2	0.96 1.02 1.08	1.8	7.0	57 1205 1808	n/a 4820 7230	0.17 0.33 0.49
3/4	0 1 2	1.16 1.22 1.28	2.1	8.0	43 898 1347	n/a 3591 5387	0.19 0.37 0.55
1	0 1 2	1.47 1.53 1.59	2.7	9.0	43 718 1077	n/a 2872 4308	0.26 0.50 0.74
1 1/4	0 1 2	1.75 1.83 1.91	3.1	10.0	43 645 968	n/a 2581 3872	0.29 0.61 0.93
1 1/2	0 1 2	2.08 2.16 2.24	3.9	11.0	28 531 797	n/a 2125 3188	0.47 0.85 1.23
2	0 1 2	2.61 2.69 2.77	5.1	13.0	14 449 674	n/a 1797 2696	0.59 1.11 1.63
2 1/2	0 1 2	3.40 3.50 3.60	6.8	16.0	14 417 626	n/a 1669 2504	0.84 1.64 2.44
3	0 1 2	3.88 3.98 4.08	7.8	18.0	14 346 519	n/a 1384 2076	1.18 2.06 2.94
4	0 1 2	4.96 5.06 5.16	9.8	22.0	14 299 448	n/a 1194 1791	1.41 2.69 3.97
5	0 1 2	6.00 6.12 6.24	12.8	28.0	14 275 412	n/a 1099 1649	2.18 3.61 5.04
6	0 1 2	7.01 7.13 7.25	14.8	32.0	11 210 315	n/a 839 1259	2.69 4.44 6.19
8*	0 1 2	9.04 9.32 9.60	18.0	29.0	3 250 360	n/a 1000 1446	4.88 8.21 11.53
10*	0 1 2	11.34 11.56 11.78	21.0	34.0	4 175 310	n/a 700 1247	7.42 11.05 14.67
12*	0 1 2	13.45 13.73 14.00	27.0	44.0	3 185 325	n/a 745 1308	11.04 16.71 22.38

* 8 inch, 10 inch and 12 inch diameter AF4750 are supplied with braided braid

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

MASTERFLEX is manufactured using the same high quality process used to make Annuflex hose, but the number of corrugations per foot is increased to provide for greater flexibility.

Explanation of Masterflex Part Numbers
AF _____ 5 _____
Material Code Braid Code

Material Codes
4 - T321 Stainless Steel
5 - T316L Stainless Steel
7 - T304L Stainless Steel

Braid Codes
00 - Unbraided
50 - T304 Single Braid
55 - T304 Double Braid
T316 Braid available upon request

Example: AF4550 = T321 stainless steel, annular corrugated metal hose with a single T304 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	0 1 2	0.42 0.48 0.54	0.9	3.7	90 1800 2700	n/a 7233 9100	0.07 0.14 0.20
3/8	0 1 2	0.65 0.71 0.77	1.0	4.0	70 1558 2336	n/a 6230 9345	0.15 0.25 0.36
1/2	0 1 2	0.77 0.83 0.89	1.2	4.4	70 1186 1779	n/a 4743 7115	0.18 0.32 0.47
5/8	0 1 2	0.96 1.02 1.08	1.4	5.6	57 1205 1808	n/a 4820 7230	0.19 0.37 0.54
3/4	0 1 2	1.16 1.22 1.28	1.7	6.4	43 898 1347	n/a 3591 5387	0.31 0.53 0.74
1	0 1 2	1.47 1.53 1.63	2.1	7.1	43 718 1077	n/a 2872 4308	0.41 0.76 1.11
1 1/4	0 1 2	1.75 1.83 1.91	2.5	7.9	43 645 968	n/a 2581 3872	0.63 1.00 1.37
1 1/2	0 1 2	2.08 2.16 2.24	3.1	8.7	28 531 797	n/a 2125 3188	0.70 1.16 1.63
2	0 1 2	2.61 2.69 2.77	4.0	10.3	14 449 674	n/a 1797 2696	0.88 1.44 1.99
2 1/2	0 1 2	3.40 3.50 3.60	5.4	12.8	14 417 626	n/a 1669 2504	1.36 2.16 2.96
3	0 1 2	3.88 3.98 4.08	6.3	14.5	14 346 519	n/a 1384 2076	1.63 2.50 3.37
4	0 1 2	4.96 5.06 5.16	7.7	17.4	14 299 448	n/a 1194 1791	2.53 3.90 5.29
5	0 1 2	6.00 6.12 6.24	10.0	21.9	14 275 412	n/a 1099 1649	4.07 5.53 6.99
6	0 1 2	7.01 7.13 7.25	11.6	25.0	11 210 315	n/a 839 1259	4.46 6.34 8.22

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

PRESSUREFLEX HP

PRESSUREFLEX HP® is Hose Master's high-pressure, annular corrugated metal hose. Pressureflex HP® is made from heavy-wall stainless steel, and offers flexibility and dependability when higher pressures are a factor.

Explanation of Pressureflex HP® Part Numbers

AF _____ 7 _____HP

Material Code — Braid Code

Example: AF8750 = T321 stainless steel, annular corrugated metal hose with a single T304 stainless steel braid

Material Codes

8 - T321 Stainless Steel
9 - T316L Stainless Steel

Braid Codes

00 - Unbraided
50 - T304 Single Braid
55 - T304 Double Braid
60 - T316 Single Braid
66 - T316 Double Braid
70 - T321 Single Braid
77 - T321 Double Braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	0 1 2	0.423 0.483 0.543	1.0	5.5	450 3000 4000	n/a 12000 16000	0.08 0.15 0.22
3/8	0 1 2	0.655 0.735 0.815	1.5	8.5	400 2400 3300	n/a 9600 14000	0.12 0.31 0.48
1/2	0 1 2	0.774 0.854 0.934	2.5	10.0	400 2400 3200	n/a 9600 12800	0.24 0.40 0.57
3/4	0 1 2	1.13 1.19 1.25	4.0	8.0	220 1100 1650	n/a 4430 6696	0.41 0.58 0.76
1	0 1 2	1.43 1.49 1.55	5.0	9.0	190 1000 1400	n/a 4187 5837	0.52 0.76 0.99
1 1/4	0 1 2	1.74 1.82 1.90	6.5	12.0	200 900 1350	n/a 3758 5494	0.76 1.13 1.50
1 1/2	0 1 2	2.10 2.18 2.26	7.5	13.0	90 750 1200	n/a 3070 4842	1.13 1.54 1.96
2	0 1 2	2.55 2.68 2.80	9.0	15.0	105 800 1150	n/a 3304 4738	1.10 2.29 3.47
2 1/2	0 1 2	3.35 3.48 3.60	10.5	17.0	46 575 900	n/a 2461 3857	1.75 3.05 4.35
3	0 1 2	3.67 3.79 3.92	12.0	20.0	36 550 800	n/a 2252 3254	1.92 3.18 4.46
4	0 1 2	4.92 5.04 5.16	9.8	25.0	23 425 575	n/a 1754 2350	2.29 4.12 5.98
5*	0 1	5.96 6.13	12.8	34.0	28 331	n/a 1324	3.03 5.14
6*	0 1	6.97 7.22	14.8	40.0	23 285	n/a 1140	3.74 6.44

- Some hose material and braid code combinations may be unavailable. Contact Hose Master Customer Service at 800-221-2319 for available combinations of hose material and braid alloys by hose size
- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

* 5 inch and 6 inch diameters are supplied with braided braid

PRESSUREMAX HP® is Hose Master's annular, heavy-wall corrugated metal hose, specifically designed for ***ULTRA*** high-pressure applications. PressureMax HP® offers superior flexibility and is made from heavy-wall T321 or T316L stainless steel.

Explanation of PressureMax HP® Part Numbers
AF _____ 5 _____HP
Material Code / Braid Code

Material Codes
8 - T321 Stainless Steel
9 - T316L Stainless Steel

Braid Codes
00 - Unbraided
70 - T321 Single Braid
77 - T321 Double Braid
7T - T321 Triple Braid
7Q - T321 Quad Braid

Example: AF8570 = T321 stainless steel, annular corrugated metal hose with a single T321 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	0	0.431	0.5	4.5	500	n/a	0.15
	1	0.556	1.5		5000	20000	0.32
	2	0.681	1.5		6000	24000	0.49
3/8	0	0.670	1.5	7.0	400	n/a	0.18
	1	0.795	2.5		3500	14000	0.46
	2	0.920	2.5		5000	20000	0.77
1/2	0	0.784	2.0	8.0	200	n/a	0.43
	1	0.884	3.0		2700	10800	0.64
	2	0.984	3.0		4500	18000	0.85
3/4	0	1.15	2.5	4.5	250	n/a	0.63
	1	1.28	4.0	10.0	2650	10669	1.09
	2	1.40	4.0	10.0	3600	14521	1.58
1	0	1.45	3.25	7.0	180	n/a	0.84
	1	1.57	5.0	11.0	2500	10000	1.53
	2	1.70	5.0	11.0	3000	12083	2.25
1 1/4	0	1.75	5.0	9.5	190	n/a	1.32
	1	1.88	6.5	12.5	1775	7119	2.09
	2	2.00	6.5	12.5	2600	10400	2.88
	3	2.13	7.0	14.0	3000	12082	3.71
1 1/2	0	2.11	6.0	11.5	110	n/a	1.75
	1	2.23	7.5	13.0	1450	5800	2.64
	2	2.36	7.5	13.0	2200	8892	3.57
2	0	2.57	7.5	12.0	100	n/a	2.04
	1	2.70	9.0	14.0	1100	4415	3.23
	2	2.82	9.0	14.0	1675	6710	4.45
2 1/2	0	3.38	8.0	14.5	46	n/a	2.73
	1	3.51	9.5	16.0	700	2800	4.29
	2	3.63	9.5	16.0	1050	4200	5.59
3	0	3.70	8.5	16.0	36	n/a	3.13
	1	3.83	10.5	20.0	600	2400	4.39
	2	3.95	10.5	20.0	900	3600	5.67
	3	4.08	23.0	75.0	1200	4800	6.99
4	0	4.82	10.0	19.0	23	n/a	5.11
	1	4.94	13.0	26.0	525	2100	6.94
	2	5.07	13.0	26.0	875	3500	8.80
	4	5.32	32.0	96.0	1200	4800	12.62

- Some hose material and braid code combinations may be unavailable. Contact Hose Master Customer Service at 800-221-2319 for available combinations of hose material and braid alloys by hose size
- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

CHEMKING® is Hose Master's chemical-resistant, annular corrugated metal hose. Manufactured with a special 276 alloy, ChemKing® offers excellent flexibility and corrosion resistance for many of the most severe applications found in chemical processing.

Explanation of ChemKing® Part Numbers
AF 67 _____
Braid Code

Braid Codes
00 - Unbraided
60 - T316 Single Braid
66 - T316 Double Braid
20 - C276 Single Braid
22 - C276 Double Braid

Example: AF6760 = 276 annular corrugated metal hose with a single T316 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/2	0 1 2	0.77 0.83 0.89	1.5	5.5	70 1186 1779	n/a 4743 7115	0.11 0.22 0.33
3/4	0 1 2	1.16 1.22 1.28	2.1	8.0	43 898 1347	n/a 3591 5387	0.19 0.37 0.55
1	0 1 2	1.47 1.53 1.59	2.7	9.0	43 718 1077	n/a 2872 4308	0.26 0.50 0.74
1 1/2	0 1 2	2.08 2.16 2.24	3.9	11.0	28 531 797	n/a 2125 3188	0.47 0.85 1.23
2	0 1 2	2.61 2.69 2.77	5.1	13.0	14 449 674	n/a 1797 2696	0.59 1.11 1.63
3	0 1 2	3.88 3.98 4.08	7.8	18.0	14 346 519	n/a 1384 2076	1.18 2.06 2.94
4*	0 1 2	4.96 5.06 5.16	9.8	22.0	14 299 448	n/a 1194 1791	1.41 2.47 3.53
5*	0 1 2	6.00 6.12 6.24	12.8	28.0	14 275 412	n/a 1099 1646	2.18 3.61 5.04
6*	0 1 2	7.01 7.13 7.25	14.8	32.0	11 210 315	n/a 839 1259	2.69 4.44 6.19

* For 4 inch, 5 inch, and 6 inch diameters, consult factory for delivery

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory
- Braid is T316 stainless steel or C276 alloy. Monel™ braid is available upon request. When Monel™ braid is used, stated pressure ratings need to be reduced by 0.75. Part numbers for Monel™ braid are AF6780 (single braid) and AF6788 (double braid)

CHLORSAFE™ is Hose Master's 276 alloy, corrugated chlorine-transfer assemblies, designed specifically to meet the demands of this application. With considerations made for both wet and dry chlorine, these assemblies are the safest available. Hose Master's ChlorSafe™ assemblies are manufactured in compliance with the Chlorine Institute Pamphlet 6, Appendix A, latest edition.

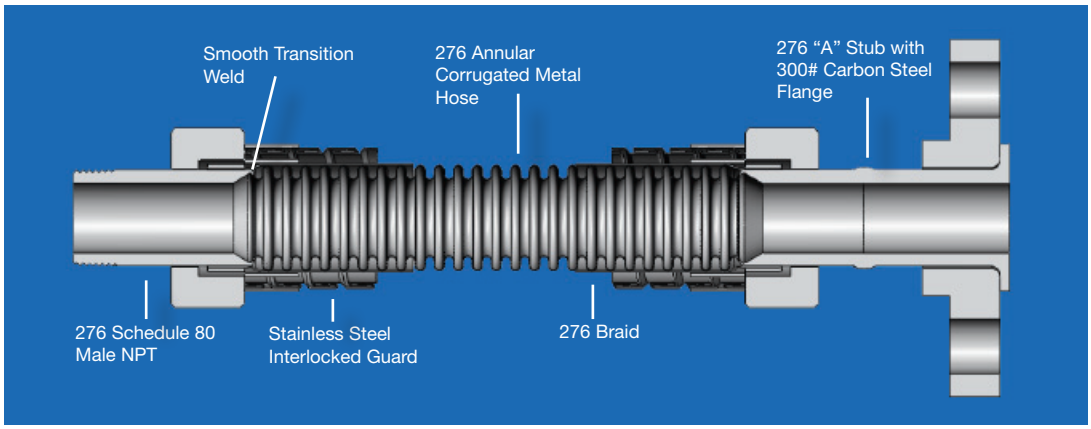
Explanation of ChlorSafe™ Part Numbers
AF 67 _____
Braid Code

Braid Codes
20 - C276 Single Braid
22 - C276 Double Braid

Example: AF6720 = C276 annular corrugated metal hose with a single C276 braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)
1/2	1 2	0.83 0.89	8.0	500	2500
3/4	1 2	1.22 1.28	9.0	375	1875
1	1 2	1.53 1.59	10.0	375	1875
1 1/2	1 2	2.16 2.24	11.0	375	1875
2	1 2	2.69 2.77	13.0	375	1875

- The minimum bend radius is measured from the center-line of the hose
- Per Chlorine Institute specifications, pressure ratings represent a 5:1 safety factor
- For pressures in excess of Chlorine Institute standards, please consult the factory



ChlorSafe™ Features:

- Hose Master's proprietary manufacturing processes reduce residual stress and produce the most flexible chlorine-transfer hose available
- ChlorSafe's™ all-metal construction makes it fire-resistant
- Proprietary welding techniques provide a smooth transition from hose to fitting with no gaps or crevices to entrap contaminants
- All welds are argon-purged to eliminate oxidation

ChlorSafe™ Specifications:

- All wetted surfaces and the braid are made from UNS N10276 (referred to as either C276 or 276 alloy) which has the highest chemical resistance rating for both dry and wet chlorine[1]
- Every assembly is helium mass spectrometer leak tested to at least 5.0 x 10^{-6} std cc/sec
- Each assembly is covered by a stainless steel interlocked metal hose for maximum durability
- All assemblies are strength-tested to twice maximum allowable working pressure

[1] Kenneth M. Pruett, *Chemical Resistance Guide for Metals and Alloys: A Guide to Chemical Resistance of Metals Alloys (Derby: Compass Publications, 1995), 93.*

FORMAFLEX

FORMAFLEX is Hose Master's "stay-put," annular corrugated metal hose. Formaflex is designed to bend and stay in one position, providing a stress-free connection between piping systems.

Explanation of Formaflex Part Numbers

AF _____ 9 _____

Material Code Braid Code

Material Codes
4 - T321 Stainless Steel
5 - T316L Stainless Steel

Braid Codes
00 - Unbraided
50 - T304 Single Braid

Example: AF4950 = T321 stainless steel, annular corrugated metal hose with a single T304 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	0 1	0.41 0.47	1.0	n/a	90 900	n/a 3600	0.04 0.11
3/8	0 1	0.65 0.71	1.2	n/a	70 800	n/a 3200	0.10 0.17
1/2	0 1	0.77 0.83	1.5	n/a	70 665	n/a 2660	0.11 0.19
5/8	0 1	0.96 1.02	1.8	n/a	57 500	n/a 2000	0.17 0.26
3/4	0 1	1.16 1.22	2.1	n/a	43 380	n/a 1520	0.19 0.29
1	0 1	1.47 1.53	2.7	n/a	43 355	n/a 1420	0.26 0.42
1 1/4	0 1	1.75 1.81	3.1	n/a	43 280	n/a 1120	0.29 0.47
1 1/2	0 1	2.08 2.14	3.9	n/a	28 264	n/a 1056	0.47 0.71
2	0 1	2.61 2.69	5.1	n/a	14 221	n/a 884	0.59 0.90

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

BRONZEFLEX is Hose Master's heavy-duty corrugated hose, designed for use in those applications that specifically require a bronze hose.

Explanation of Bronzeflex Part Numbers

BF 11 _____

Braid Code

Braid Codes
00 - Unbraided
10 - Single Bronze Braid
11 - Double Bronze Braid

Example: AF1110 = Bronze corrugated metal hose with a single bronze braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
3/8	0 1 2	0.61 0.67 0.73	2.0	6.0	60 704 936	n/a 2815 3744	0.16 0.29 0.42
1/2	0 1 2	0.76 0.81 0.87	2.3	7.0	50 566 753	n/a 2265 3012	0.23 0.38 0.53
3/4	0 1 2	1.05 1.10 1.16	2.5	8.0	30 468 622	n/a 1870 2487	0.33 0.55 0.77
1	0 1 2	1.34 1.42 1.50	3.0	9.0	26 334 444	n/a 1335 1776	0.41 0.68 0.95
1 1/4	0 1 2	1.66 1.74 1.82	3.5	10.0	16 306 407	n/a 1225 1629	0.71 1.15 1.59
1 1/2	0 1 2	1.89 1.96 2.03	4.0	10.0	15 297 395	n/a 1187 1579	0.93 1.47 2.01
2	0 1 2	2.48 2.57 2.66	6.0	11.0	10 210 279	n/a 840 1117	1.00 1.62 2.24
2 1/2	0 1 2	3.33 3.45 3.57	8.5	16.0	8 194 258	n/a 775 1031	1.70 2.68 3.66
3	0 1 2	3.89 4.01 4.13	10.0	20.0	5 166 221	n/a 665 884	2.10 3.30 4.50

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

EXTRAFLEX

EXTRAFLEX is Hose Master's T321 helical seam welded corrugated metal hose, specifically designed to maximize flexibility while maintaining good pressure ratings. The helical design facilitates draining and reduces in-line turbulence.

Explanation of Extraflex Part Numbers

EF 90 _____

Braid Code

Braid Codes

00 - Unbraided
50 - T304 Single Braid
55 - Double Braid
T316 Braid available upon request

Example: EF9050 = T321 stainless steel, helical corrugated metal hose with a single T304 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	0 1 2	0.39 0.45 0.51	0.4	2.2	71 1778 2489	n/a 7112 9956	0.09 0.13 0.19
5/16	0 1 2	0.47 0.53 0.59	0.6	2.4	43 1422 1991	n/a 5688 7964	0.10 0.18 0.26
3/8	0 1 2	0.55 0.61 0.67	0.6	2.8	36 1138 1707	n/a 4552 6828	0.11 0.19 0.28
1/2	0 1 2	0.67 0.73 0.79	0.8	3.1	28 910 1422	n/a 3640 5688	0.14 0.26 0.39
5/8	0 1 2	0.85 0.91 0.96	1.2	3.9	28 910 1422	n/a 3640 5688	0.19 0.32 0.46
3/4	0 1 2	1.02 1.08 1.18	1.4	5.1	14 711 1138	n/a 2844 4552	0.22 0.38 0.55
1	0 1 2	1.22 1.28 1.34	1.8	6.3	11 569 910	n/a 2276 3640	0.24 0.54 0.83
1 1/4	0 1 2	1.57 1.65 1.73	2.4	7.9	9 455 711	n/a 1820 2844	0.45 0.76 1.09
1 1/2	0 1 2	1.89 1.97 2.05	3.0	9.4	7 356 569	n/a 1424 2276	0.65 1.02 1.40
2	0 1 2	2.36 2.44 2.52	3.5	11.0	6 284 455	n/a 1136 1820	0.71 1.22 1.75

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

HYDRAFLEX is Hose Master's T316, double-walled, helical seam welded corrugated metal hose. Specially designed to maintain extreme pressure and flexibility, Hydraflex is self-draining and generates minimal in-line turbulence.

Explanation of Hydraflex Part Numbers

HF 34 _____

Braid Code

Braid Codes

50 - T304 Single Braid

55 - Double Braid

T316 Braid available upon request

Example: HF3450 = T316 helical corrugated metal hose with a single T304 stainless steel braid

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Minimum Bend Radius (in.)	Dynamic Minimum Bend Radius (in.)	Maximum Working Pressure (psi)	Burst Pressure (psi)	Weight Per Foot (lbs.)
1/4	1 2	0.52 0.62	1.1	5.0	4600 5800	18400 23200	0.21 0.32
5/16	1 2	0.62 0.74	1.2	5.1	4000 4800	16000 19200	0.29 0.45
3/8	1 2	0.70 0.82	1.4	5.5	3800 4000	15200 16000	0.36 0.57
1/2	1 2	0.82 0.94	1.6	5.7	2600 3700	10400 14800	0.43 0.69
5/8	1 2	0.97 1.09	2.2	6.1	2400 2700	9600 10800	0.51 0.82
3/4	1 2	1.19 1.31	2.8	6.5	2000 2200	8000 8800	0.64 1.03
1	1 2	1.39 1.51	3.5	7.9	1500 2000	6000 8000	0.78 1.25
1 1/4	1 2	1.75 1.87	4.1	9.4	1100 1600	4400 6400	1.15 1.70
1 1/2	1 2	2.07 2.19	5.1	12.2	1000 1500	4000 6000	1.45 2.16

- The minimum bend radius is measured from the centerline of the hose
- The working pressure decreases with temperature - obtain derating factor on page 33 in Technical Information
- For rapid pressure fluctuations, consult factory

FITTINGS

Metal hose is more versatile than other hose in that virtually any fitting can be attached to metal hose. Other types of hose require special shanks and collars in order to attach fittings. For metal hose, any fitting made from a weldable material can be attached without needing special features. This versatility also means that multiple fittings can be welded together to make custom solutions for difficult applications.

Selecting the proper fittings for an application is largely determined by the mating fittings to which the hose assembly will be attached. Once the mating fittings have been identified, the hose fittings should complement the mating fittings in type, size, and alloy. Even though the selection of the hose fittings is determined by the mating fittings, it is a good idea to confirm that the fittings used in the application are appropriate for the application. Ensure that the fittings are chemically compatible and are able to withstand the pressure and temperatures of both the media and the surrounding environment.

Male Pipe Nipple

Alloys	T304 & T316 Stainless Steel, Carbon Steel, 276
Size Range	1/8" - 12"
Schedules	40, 80

Hex Male

Alloys	T304 & T316 Stainless Steel, Carbon Steel, Brass
Size Range	1/4” - 4”
Schedules	n/a

Grooved-End Fitting

Alloys	T304 & T316 Stainless Steel, Carbon Steel
Size Range	1" - 12"
Schedules	40

LiveLink® Swivel Fitting

Alloys	T304 Stainless Steel
Size Range	1/4” - 2”
Schedules	Consult factory for pressure rating

Female Union (Threaded/Socket Weld)

Alloys	T304 & T316 Stainless Steel, Carbon Steel, Malleable Iron, Brass
Size Range	1/4” - 4”
Class	125#, 150#, 300, 3000# (depending on alloy)

Female Half Coupling (Threaded/Socket Weld)

Alloys	T304 & T316 Stainless Steel, Carbon Steel
Size Range	1/4” - 4”
Class	150#, 3000#

1, 2, or 3 Piece SAE (JIC)

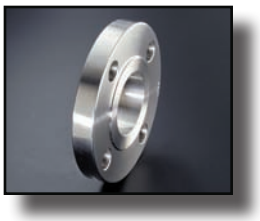
Alloys	T316 Stainless Steel, Carbon Steel, Brass (nut only)
Size Range	1/4” - 2”
Schedules	n/a

45° & 90° SAE (JIC)

Alloys	Stainless Steel, Carbon Steel
Size Range	1/2” - 2”
Schedules	n/a

Sanitary Flange

Alloys	T304 & T316 Stainless Steel
Size Range	1”- 3”
Schedules	n/a

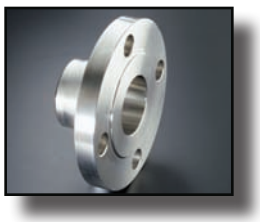


Slip-On Flange

Alloys	T304 & T316 Stainless Steel, Carbon Steel
Size Range	1/2” - 12”
Class	150#, 300#

Plate Flange

Alloys	T304 & T316 Stainless Steel, Carbon Steel
Size Range	1/2” - 12”
Class	150#



Weld Neck Flange

Alloys	T304 & T316 Stainless Steel, Carbon Steel
Size Range	1/2” - 6”
Class	150#, 300#

TTMA Flange

Alloys	T316 Stainless Steel, Carbon Steel
Size Range	2” - 6”
Schedules	n/a

C-Stub with Floating Flange

Alloys	T304 & T316 Stainless Steel
Size Range	1/2” - 10”
Schedules	10

A-Stub with Lap Joint Flange

Alloys	T304 & T316 Stainless Steel, Carbon Steel, 276
Size Range	1/2” - 8”
Schedules	10, 40

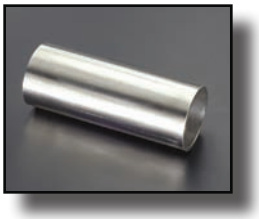
FITTINGS

TTMA C-Stub Swivel

Alloys	T304 & T316 Stainless Steel
Size Range	4” - 6”
Schedules	10

Part A & Part D (Cam-Lock)

Alloys	T316 Stainless Steel, Brass, Aluminum
Size Range	1/2" - 8"
Schedules	n/a



Tube End

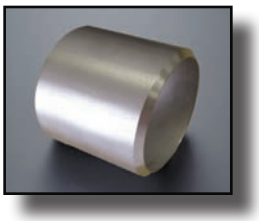
Alloys	T304, T316 & T321 Stainless Steel, Carbon Steel
Size Range	1/8" - 12" (seamless or welded)
Schedules	Various

Short & Long Radius Elbows (45° & 90°)

Alloys	T304 & T316 Stainless Steel, Carbon Steel, 276
Size Range	1/4” - 12”
Schedules	Various

Reducer

Alloys	T304 & T316 Stainless Steel, Carbon Steel
Size Range	3/4” - 12”
Schedules	10, 40 (carbon steel)



Beveled Pipe End

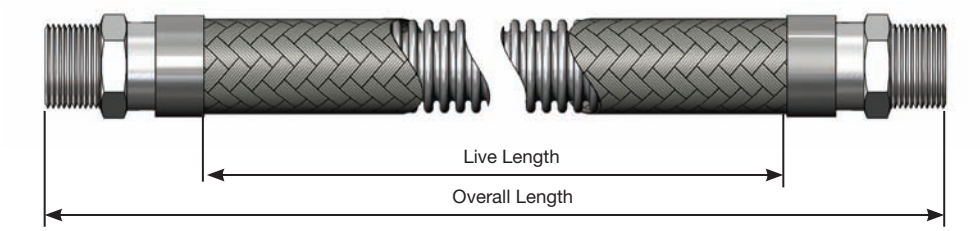
Alloys	T304 & T316 Stainless Steel, Carbon Steel, 276
Size Range	1/8" - 12"
Schedules	Various

Ground Joint Female

Alloys	Carbon Steel
Size Range	1/2” - 4”
Schedules	n/a

Specialty Gas Nuts

Alloys	Brass
Size Range	A, B, C, & D
Schedules	SAE & BSP

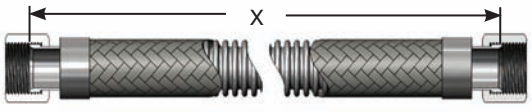


To calculate the proper length of a hose assembly, you need to:

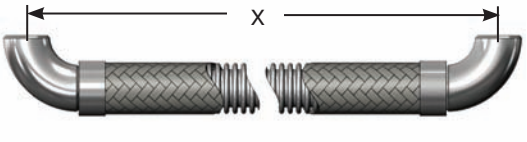
1. Verify that the installation is properly designed (refer to Do's & Don'ts on page 36 in Technical Section)
    - Do not torque the hose
    - Do not overbend the hose
    - Do not compress the hose

2. Calculate the live length of the assembly - The live length of the assembly is the amount of active (flexible) hose in an assembly; that is, the hose between the braid collars (refer to pages 23-24 for formulas to help calculate live length for a variety of common hose installations).

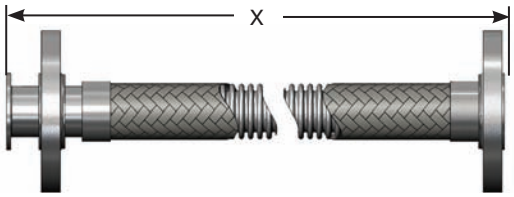
3. Calculate the overall length of the assembly - Overall length is equal to the live length plus the lengths of the braid collars and fittings. When adding fitting lengths, be aware that the points from which measurements should be taken vary for different fitting types. When calculating overall length for assemblies with threaded fittings, remember to account for the length of thread that is lost by threading into the mating connection (refer to Thread Allowance chart on page 36 in the Technical Section).



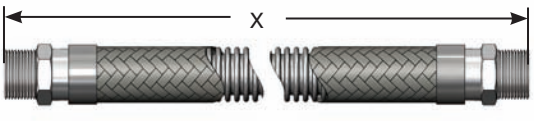
JIC/SAE-type fittings are measured from the seat of the fitting



Elbows and other fittings with a radius are measured from the centerline of the fitting



Flanges are measured from the flange face or from the face of the stub end if one is used



Threaded fittings are measured to the end of the fitting

For assistance in making any calculation or for dimensional information on fittings, please contact Hose Master's Inside Sales Department.

LENGTH CONSIDERATIONS

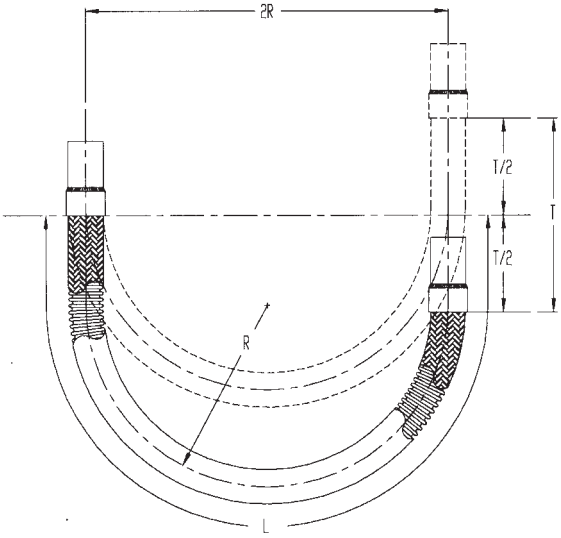
For the following formulas:

L = Live length of hose (inches)
T = Travel (inches)
S = Hose outside diameter (see product data pages 9-18)

Verify that the installed radius is greater than the stated Minimum Bend Radius for the hose at the required working pressure.

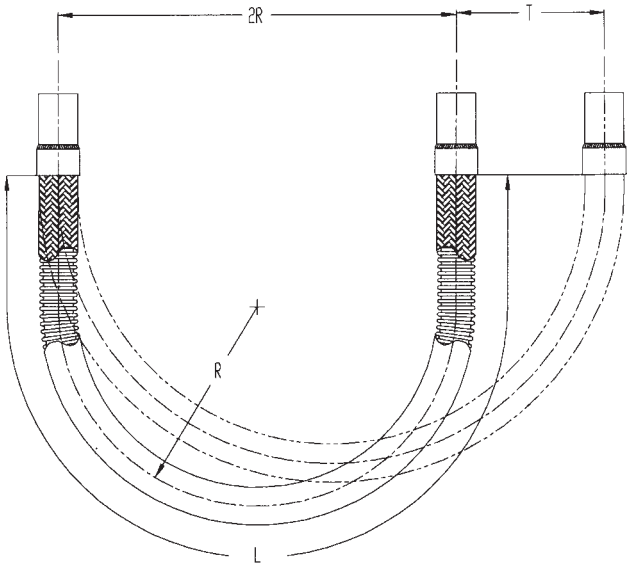
Verify that the centerline of the hose remains in the same plane during cycling to prevent twisting the assembly.

CONSTANT RADIUS TRAVELING LOOP (A-Loop)



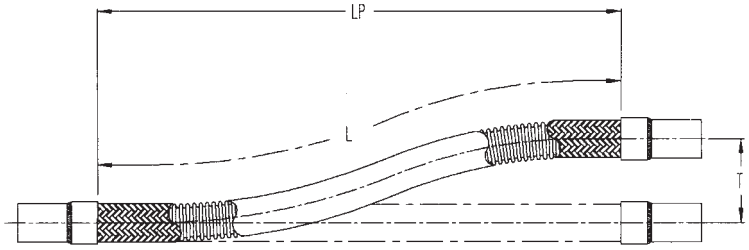
Formula: L = 4R + 1/2T
R = Installation radius in this formula

VARIABLE RADIUS TRAVELING LOOP (B-Loop)



Formula: L = 4R + 1.57T
R = Installation radius in this formula

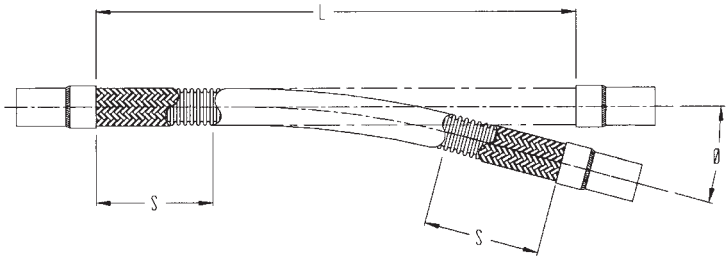
LATERAL OFFSET



Formula: $L = \sqrt{20R \times T}$ $L_p = \sqrt{L^2 - T^2}$

R = Hose minimum bend radius in this formula

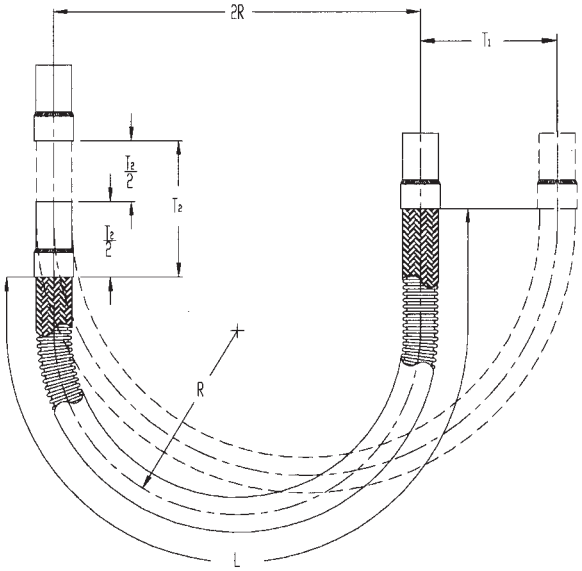
ANGULAR DEFLECTION



Formula: $L = 2S + (\theta/57.3)R$

R = Hose minimum bend radius in this formula

VERTICAL LOOP WITH MOVEMENT IN TWO DIRECTIONS (Combination Loop)



Formula: $L = 4R + 1.57T_1 + (T_2/2)$

R = Hose installation radius in this formula

FABRICATION OPTIONS

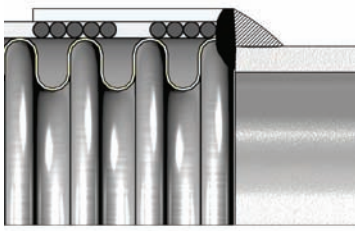
Corrugated metal hose is used in a very broad spectrum of applications. Just as the hose, fittings, and other assembly parts must be tailored to suit the demands of the service, so too must the methods of joining these components. While standard production joining methods work very well for the majority of service demands, the following extremes may dictate special joining or fabrication techniques:

1. Pressures
2. Temperatures
3. Corrosion
4. Other conditions

Hose Master has developed specialized welding, brazing, joining, and fabrication procedures to assure the integrity and serviceability of metal hose assemblies in even the most extreme applications.

The fabrication options and services to be considered are:

1. Specialized attachment techniques
2. Testing options
3. Additional cleaning requirements
4. Packaging

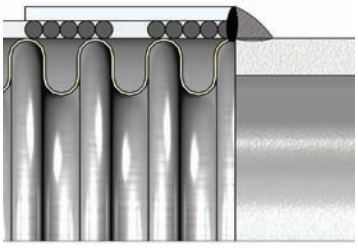


INDUSTRY STANDARD

This method will be used unless another method is specified.

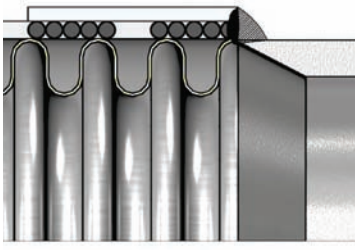
Standard fabrication of an assembly generally consists of:

1. Cutting the hose and braid through a hose corrugation valley
2. Installing a braid collar over each end of the hose
3. Trimming of any excess braid
4. "Cap" welding the hose, braid, and braid collar together
5. Cleaning the cap weld surface
6. Placement and alignment of a fitting on the cap weld
7. "Attachment" welding the fitting to the cap weld
    - Silver brazing is also available, consult factory



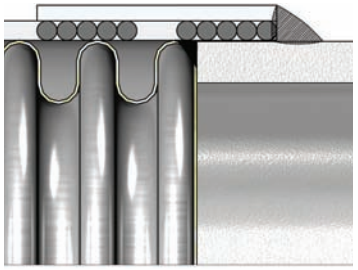
HALF-CORRUGATION

Standard fabrication sometimes leaves a portion of the cut corrugation, or corrugation "lip," just under the base of the fitting. In specialized applications, this residual lip may not be desirable. To prevent any exposed corrugation edges from causing damage, the hose can be specially prepared and welded to remove the lip.



SMOOTH TRANSITION WELD

For applications in which corrosion is a concern, all crevices and fissures must be minimized. Specialized hose and fitting preparation, in conjunction with proprietary welding techniques, is available to provide a full penetration hose-to-fitting weld that is smooth and crevice-free.



BRAID-OVER CONSTRUCTION

Assemblies operating at the upper limits of their rated working pressure, or in severe service, may benefit from a braid-over construction. The fitting is first expanded and then welded to the unbraided hose. Then the braid is drawn over the end of the hose and welded to the side of the fitting. This technique reduces the amount of heat introduced into the braid wires, nearly eliminates the heat-affected zones of the cap and attachment welds, and maximizes the wire strength. Braid-over construction may also be used for specific high-cycle applications.

STANDARD LEAK TESTING

Every corrugated hose assembly is leak tested prior to shipment. Standard testing consists of pressurizing the assembly with air and then submerging the entire assembly under water. This method is reliable and sufficient for the majority of applications.

HYDROSTATIC TESTING

While the standard test is designed to detect leaks, hydrostatic testing is designed to test the assembly's strength. Testing of an assembly to its full permissible test pressure can be economically and accurately accomplished by filling the assembly with liquid while concurrently evacuating all air. The assembly is then hydrostatically pressurized using high-pressure pumps and the test pressure is maintained for a predetermined period of time.

HIGH-PRESSURE GAS

Testing with air under water, at pressures of up to 2500 psi, is available for specialized applications. For a more sensitive test, the use of gases, such as nitrogen or helium, can be requested.

DYE PENETRANT

Dye penetrant testing is available for both leak and weld bead inspection, in accordance with Hose Master procedures or to customer-specified standards.

HELIUM MASS SPECTROMETER

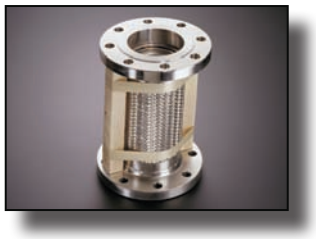
This is the most sensitive leak detection method generally available. The standard test method is to attach the assembly to a mass spectrometer and generate a very high vacuum in the assembly. The exterior of the assembly is then flooded with helium. The relatively tiny helium atoms penetrate even very small openings and are drawn into the mass spectrometer where they are detected and the leak size is quantified. Helium Mass Spetrometer testing can be modified to satisfy customer or regulatory agency requirements.

Note: Always test an assembly with a medium that has a smaller molecular size than the service required.

CLEANING

Hose Master's proprietary methods of manufacturing corrugated hose yields a very clean product. However, specialized cleaning for specific applications such as Clean and Degrease to CGA G-4.1 and Ultrasonic cleaning for BioPharm applications, are available upon request. Contact Hose Master's Inside Sales Department for details.

PACKAGING



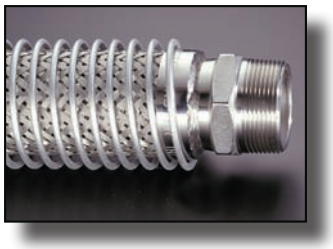
All assemblies are shipped with protectors applied over sealing surfaces, such as threads and flange faces. Spacer bars are installed on all shorter double-flanged assemblies to prevent compression of the assembly during shipping and handling. Special packaging is available to suit customer requirements, including crating, plastic bagging, labeling, and custom fitting protectors.

Metal hose assemblies often require special accessories or components to ensure long service life in severe applications, or to make the assemblies easier to use. There are many accessories that may be specified, including:

- Guards, made from metal and other materials, can be provided to protect an assembly from overbending, abrasion, impact, and thermal damage.
- Jackets and tracer hoses are used with corrugated hose assemblies to keep certain media at elevated or reduced temperatures so that it can be conveyed easily.
- A sacrificial bronze braid can be inserted between the hose and the stainless steel braid to improve cycle life.

One or several accessories can be easily combined with an assembly to more efficiently transport media, protect the assembly, or both.

This is not an exhaustive list of possible accessories, please consult Hose Master's Inside Sales Department for details.



SPRING GUARD

When there is potential for damaging an assembly in service, a guard can be easily installed during fabrication. This type of guard consists of a metal spring that is attached behind the fitting. The style of guard can be tailored to meet the specific application and the type of hose.

PROTECTIVE COVER

If the potential for impact or high-temperature damage is not severe, or if the additional weight and bulk of a full-metal guard is unacceptable, rubber or plastic scuff guards can be installed to protect the corrugated hose and braid.

INSULATING JACKET

If the corrugated hose is to convey high-temperature media, and there is a potential for skin contact, an insulated protective jacket is available. The jacket consists of braided fiberglass insulation, covered and impregnated with silicone rubber that is then installed over the corrugated hose and sealed. The jacket can also be used to insulate the corrugated assembly and either prevent ambient heat from being conveyed to the media or to reduce heat loss.

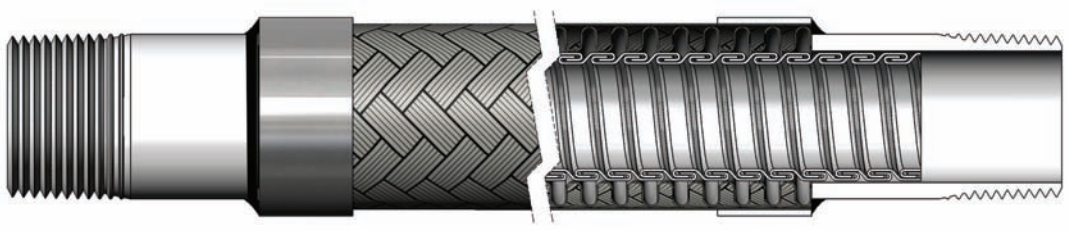
CERTIFICATIONS

Standard written certifications for materials or inspections can be supplied for corrugated hose or assemblies. Certifications of conformance to specific customer requirements, such as military certifications, PMI (Positive Material Identification), and PED are also available upon request.

TAGGING

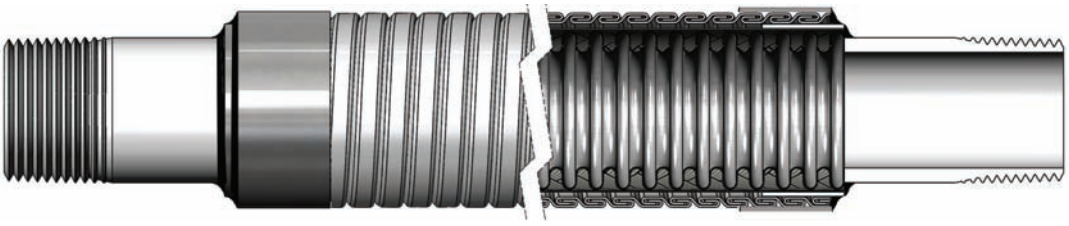
A variety of tags and identifications can be affixed to assemblies. These include cardboard, plastic, and metal tags. Serial numbers, application information, assembly performance capabilities, and other customer-specific information can be provided either on tags or permanently engraved onto one or both braid collars.

LINER



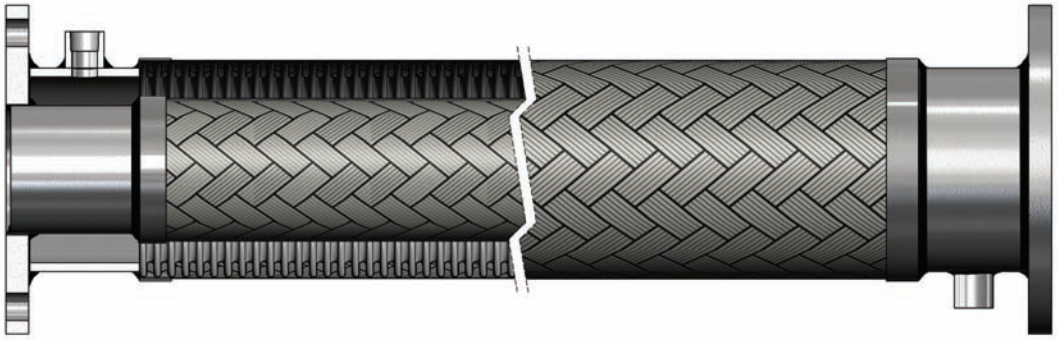
An interlocked hose or liner is often installed inside a corrugated hose assembly. The liner commonly serves two purposes while still maintaining the full working pressure of the corrugated hose. The first is to protect the hose corrugations from excessive media velocities. Media speeds can induce resonant vibrations in the corrugations, causing rapid fatigue and subsequent fracturing of the hose wall. The liner provides a relatively smooth surface for the media and, by avoiding the media impacting on the corrugation valleys, reduces the chances of harmonic resonance. The second purpose for a liner is abrasion resistance. Even slightly abrasive media flowing at medium-to-high speeds can cause premature wear of the interior surfaces of the corrugated hose. The liner provides a smooth flow path, as well as a relatively thick layer of abrasion-resistant metal between the media and the corrugated hose. The liner will also help reduce pressure loss due to friction between the media and corrugated hose. Proper fit between the hoses is essential for good performance. Because Hose Master makes both the corrugated hose and liners, a perfect fit is assured.

ARMOR/BEND RESTRICTER



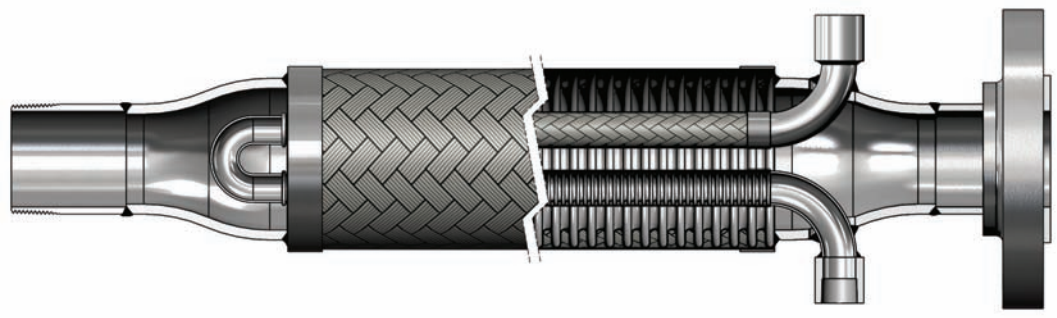
Applications in which the corrugated hose is subjected to external abrasion, molton material splash, or impact damage may require a protective armor or guard along all or a portion of its length. A guard is typically made from interlocked or squarelocked metal hose and is welded to the assembly. Note that the bend restricter has a bend diameter equal-to or greater-than the corrugated hose it is protecting.

JACKET



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.

TRACER



Traced assemblies are similar in concept to jacketed assemblies in that there is an inner, smaller-diameter hose encased by a single, larger-diameter hose. Where jacketed assemblies surround the media with heat or cold, traced assemblies have the media surround the hose containing the heating or cooling element. The tracer, or inner hose, may also be installed in a long “U” shaped loop within the outer hose, with the steam inlet and outlet at the same end of the assembly.

DEFINITIONS

ABRASION
External damage to a hose assembly caused by its being rubbed on a foreign object.

AMBIENT/ATMOSPHERIC CONDITIONS
The surrounding conditions, such as temperature, pressure, and corrosion, to which a hose assembly is exposed.

ANGULAR DEFLECTION
The displacement that occurs when an assembly is bent into a single curve, expressed as an angle.

ANNULAR
Refers to the convolutions on a hose that are a series of complete circles or rings located at right angles to the longitudinal axis of the hose (sometimes referred to as “bellows”).

APPLICATION
The service conditions that determine how a metal hose assembly will be used.

ARMOR GUARD OR CASING
Flexible interlocked or squarelocked tubing placed over the entire length of a hose or in short lengths at the end of a metal hose, to protect it from physical damage and to limit the bending radius.

ATTACHMENT
The method of fixing end fittings to flexible metal hose, i.e., welding, brazing, soldering, swaging, bonding, or mechanical.

AXIAL MOVEMENT
Compression or elongation along the longitudinal axis.

BEAMED BRAID
Braid construction where the strands of wire in each carrier are parallel.

BEND RADIUS
The radius of a bend measured to the hose centerline, as recommended by the manufacturer.

BEND RADIUS, DYNAMIC
The radius at which constant or continuous flexing occurs.

BEND RADIUS, MINIMUM
The smallest radius at which a hose can be used.

BEND RADIUS, STATIC
The smallest fixed radius to which a hose can be subjected.

BRAID
A flexible wire sheath surrounding a metal hose that prevents the hose from elongation due to internal pressure. Braid is composed of a number of wires wrapped helically around the hose while at the same time going under and over each other in a basket weave fashion.

BRAID SLEEVE/RING/FERRULE/COLLAR
A ring made from tube or metal strip placed over the ends of a braided hose to contain the braid wires for attachment of fitting and ferrule, and to immobilize heat-affected corrugations.

BRAID WEAR
Motion between the braid and corrugated hose which normally causes wear on the outside diameter of the corrugation and the inside diameter of the braid.

BRAIDED BRAID
In this braid, the strands of wire on each carrier of the braiding machine are braided together, and then braided in normal fashion, hence the term “braided braid”.

BRAZING
A process of joining metals using a non-ferrous filler metal with a melting point that is lower than the “parent metals” to be joined.

BUTT WELD
A process in which the edges or ends of metal sections are butted together and joined by welding.

CASING (See ARMOR)

CONTROLLED FLEXING
Occurs when the hose is being flexed regularly, as in the case of connections to moving components. Examples: platen presses and thermal growth in pipe work.

CONVOLUTION/CORRUGATION
The annular or helical flexing member in corrugated or stripwound hose.

CORROSION
The chemical or electro-chemical attack of a media upon a hose assembly.

CYCLE LIFE
The number of cycles completed by an assembly before failure.

CYCLE-MOTION
The movement from normal to extreme position and return.

DEVELOPED LENGTH/OVERALL LENGTH
The length of a hose plus fittings required to meet the conditions of a specific application.

DOG-LEG ASSEMBLY
Two hose assemblies joined by a common elbow.

DUPLEX ASSEMBLY
An assembly consisting of two hose assemblies - one inside the other, and connected at the ends. Also known as “jacketed assemblies.”

EROSION
The wearing away of the inside or outside convolutions of a hose caused by the flow of the media conveyed, such as wet steam, abrasive particles, etc.

FATIGUE FAILURE
Failure of the metal structure associated with/due to the flexing of metal hose or bellows.

FERRULE (See BRAID SLEEVE)

FITTING/COUPLING
A loose term applied to the nipple, flange, union, etc., attached to the end of a metal hose.

FLOW RATE
Pertains to a volume of media being conveyed in a given time period, e.g., cubic feet per hour, pounds per second, gallons per minute, etc.

FREQUENCY
The rate of vibration or flexure of a hose in a given time period, e.g. cycles per second (CPS), cycles per minute (CPM), cycles per day (CPD).

HELICAL
Used to describe a type of corrugated hose having one continuous convolution resembling a screw thread.

HELICAL WIRE ARMOR/SPRING GUARD
To provide additional protection against abrasion. Metal hoses can be supplied with an external round or oval section wire spiral.

INSIDE DIAMETER (I.D.)
The diameter inside the hose corrugation.

INTERLOCKED/SQUARELOCKED HOSE
Formed from profiled strip and wound into flexible metal tubing with no subsequent welding, brazing, or soldering. May be made pressure-tight by winding in strands of packing. Refer to Stripwound catalog.

LAP WELD (LW)
Type of weld in which the ends or edges of the metal overlap each other.

LATERAL OFFSET
The perpendicular distance between parallel fitting axes of an assembly.

LINER

Flexible sleeve used to line the inside diameter of hose when conveying a high-velocity media, also prevents erosion.

LIVE LENGTH
The amount of active (flexible) length of hose in an assembly. Does not include the length of fittings and ferrules.

LOOP INSTALLATION
The assembly is installed in a loop or "U" shape and is most often used when frequent and/or large amounts of motion are involved.

MEDIUM, MEDIA
The substance(s) being conveyed through a system.

NOMINAL DIAMETER
Indicates the approximate inside diameter.

OFFSET-LATERAL, PARALLEL
The distance that the ends of a hose assembly are displaced in relation to each other as a result of connecting two misaligned terminations in a system, or intermittent flexure required in a hose application.

OPERATING CONDITIONS
The pressure, temperature, motion, and environment to which a hose assembly is subjected.

OUTSIDE DIAMETER (O.D.)
The external diameter of a metal hose, measured at the top of the corrugation or braiding.

PERCENT OF BRAID COVERAGE
The percent of the surface area of a hose that is covered by braid.

PITCH
The distance between the two peaks of adjacent corrugations or convolutions.

PLY, PLIES
The number of individual thicknesses of metal used in the construction of a wall of the convoluted hose.

PRESSURE
Usually expressed in pounds per square inch (psi).

PRESSURE, BURST
Failure of the hose where the braid fails in tensile, or the hose ruptures, or both, due to the internal pressure applied.

PRESSURE, DEFORMATION
The pressure at which the convolutions of a hose become permanently deformed.

PRESSURE, MAXIMUM ALLOWABLE WORKING
The maximum pressure at which a hose or hose assembly is designed to be used.

PRESSURE, PULSATING
A rapid change in pressure above and below the normal base pressure, usually associated with reciprocating type pumps. This pulsating pressure can cause excessive wear between the braid and the tops of the hose convolutions.

PRESSURE, SHOCK
A sudden increase of pressure in a hydraulic or pneumatic system which produces a shock wave. This shock can cause severe permanent deformation of the hose corrugations, as well as rapid failure due to metal fatigue.

PRESSURE, STATIC
A non-changing, constant pressure.

PRESSURE, WORKING
The pressure, usually internal but sometimes external, imposed on a hose during operating conditions.

RANDOM MOTION
The uncontrolled motion of a metal hose, such as occurs in manual handling.

SAFETY FACTOR
The relationship of working pressure to burst pressure.

SPLICE
A method of joining two sections of hose.

SQUARELOCKED (See INTERLOCKED)
Refer to Stripwound catalog.

SQUIRM
A form of failure in which the hose is deformed into an "S" or "U" bend as the result of excessive internal pressure being applied to unbraided corrugated hose while its ends are restrained, or in a braided corrugated hose which has been axially compressed.

STRESS CORROSION
A form of corrosion in stainless steel normally associated with chlorides.

STRIPWOUND (See INTERLOCKED)
Refer to Stripwound catalog.

TIG WELD/GTAW
The gas tungsten arc welding process sometimes referred to as a "shielded arc" or "heliarc."

TRAVELING LOOP
A general classification of bending wherein the hose is installed in a U-shaped configuration.

TRAVELING LOOP, CLASS A LOOP
An application wherein the radius remains constant and one end of the hose moves parallel to the other end.

TRAVELING LOOP, CLASS B LOOP
A condition wherein a hose is installed in a U-shaped configuration and the ends move perpendicular to each other so as to enlarge or decrease the width of the loop.

TORQUE (TORSION)
A force that produces, or tends to produce, rotation of or torsion about the longitudinal axis of a hose assembly while the other end is fixed.

VACUUM
Negative pressure or suction.

VELOCITY
The speed at which the medium flows through the hose.

VELOCITY RESONANCE
The vibration of convolutions due to the buffeting of a high-velocity gas or liquid flow.

VIBRATION
Low-amplitude motion occurring at high frequency.

WELDING
The process of localized joining of two or more metallic components by means of heating their surfaces to a state of fusion, or by fusion with the use of additional filler material.

TEMPERATURE DERATING

To calculate a working pressure derated for elevated temperature, you must first obtain the derating factors for all of the assembly components (i.e. hose, braid, fittings, etc.) from the following chart. Multiply the hose working pressure shown in the catalog by the lowest rating obtained below to determine the derated working pressure. Note: The working pressure of an assembly at elevated temperatures may be affected by fitting type, material, and method of attachment.

Working Pressure Derating Factor													
Temp. in Degrees F	T304 T301*	T304L	T316	T316L	T321	C276	Monel 400 & C22	Inconel 600	Inconel 625	Carbon Steel**	Alum. 3003 H14	Bronze	Copper
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00
200	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	1.00	1.00	0.89	0.80
300	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	1.00	1.00	0.64	0.83	0.78
400	0.94	0.93	0.97	0.93	1.00	1.00	0.79	1.00	1.00	1.00	0.34	0.78	0.50
500	0.88	0.86	0.90	0.86	0.96	0.99	0.79	1.00	0.97	0.95			0.13
600	0.82	0.81	0.85	0.81	0.91	0.93	0.79	1.00	0.95	0.87			
650	0.81	0.79	0.84	0.79	0.89	0.90	0.79	1.00	0.94	0.85			
700	0.80	0.77	0.82	0.77	0.87	0.88	0.79	1.00	0.93	0.83			
750	0.78	0.75	0.81	0.75	0.86	0.86	0.79	1.00	0.93	0.65			
800	0.76	0.74	0.80	0.74	0.84	0.84	0.79	1.00	0.93	0.54			
850	0.75	0.72	0.79	0.72	0.84	0.83	0.79	0.99	0.93	0.44			
900	0.73	0.71	0.78	0.71	0.83	0.82	0.76	0.95	0.93	0.33			
950	0.72	0.69	0.77	0.69	0.81	0.81	0.71	0.95	0.93	0.23			
1000	0.69	0.67	0.77	0.67	0.81	0.80	0.48	0.42	0.93				
1050	0.61	0.65	0.73	0.65	0.70	0.68		0.27	0.93				
1100	0.49	0.62	0.62	0.61	0.55	0.55		0.20	0.69				
1150	0.39	0.53	0.49	0.52	0.41	0.47			0.57				
1200	0.30	0.38	0.37	0.38	0.32	0.36			0.36				
1250	0.24	0.28	0.28	0.28	0.25	0.29							
1300		0.21	0.21	0.21									

* T301 is not listed in B31.1, but its tensile and yields are identical to T304 per ASM Metals Reference book 3rd Ed. Page 364
**Do not use for temperatures lower than 32°F

VELOCITY

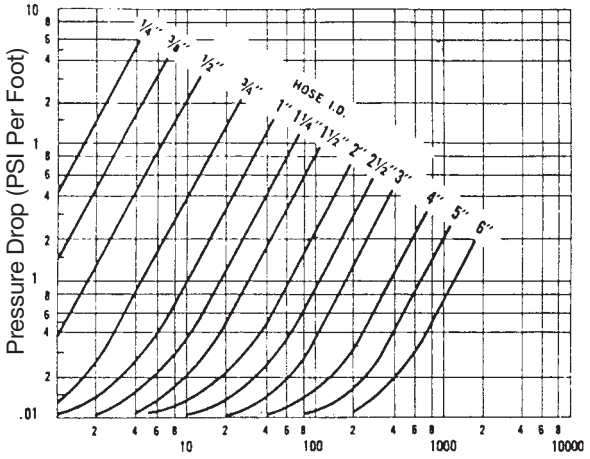
When gas or liquid being conveyed in a corrugated metal hose exceeds certain limits, resonant vibration can occur. Resonance may cause very rapid failure of the assembly. In those applications where product velocities exceed the limits shown in the chart below, a revision of the assembly design might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

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

Velocity in Metal Hose				
Installation Configuration	Maximum Product Velocity (Feet/Second)			
	Unbraided		Braided	
	Dry Gas	Liquid	Dry Gas	Liquid
Straight Run	100	50	150	75
45 Degree Bend	75	40	115	60
90 Degree Bend	50	25	75	40
180 Degree Bend	25	12	38	19

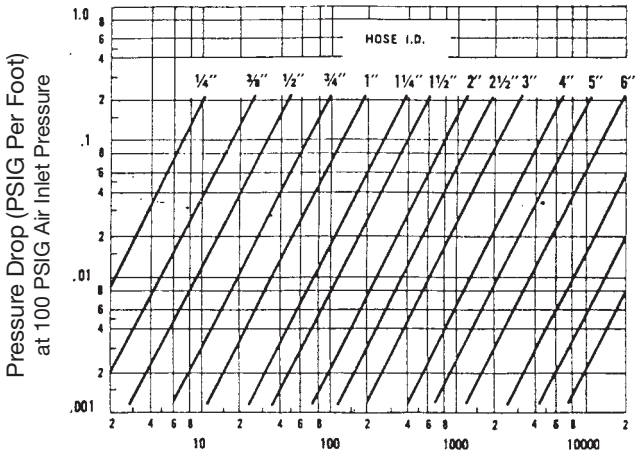
Pressure drop in a piping system is often a concern for the designer. Compared to rigid pipe, there is always a greater pressure drop in corrugated metal hose. The following graphs are offered as aids in estimating pressure drop in corrugated hose conveying water and air. The values derived are approximate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

Pressure Drop Graph for Water



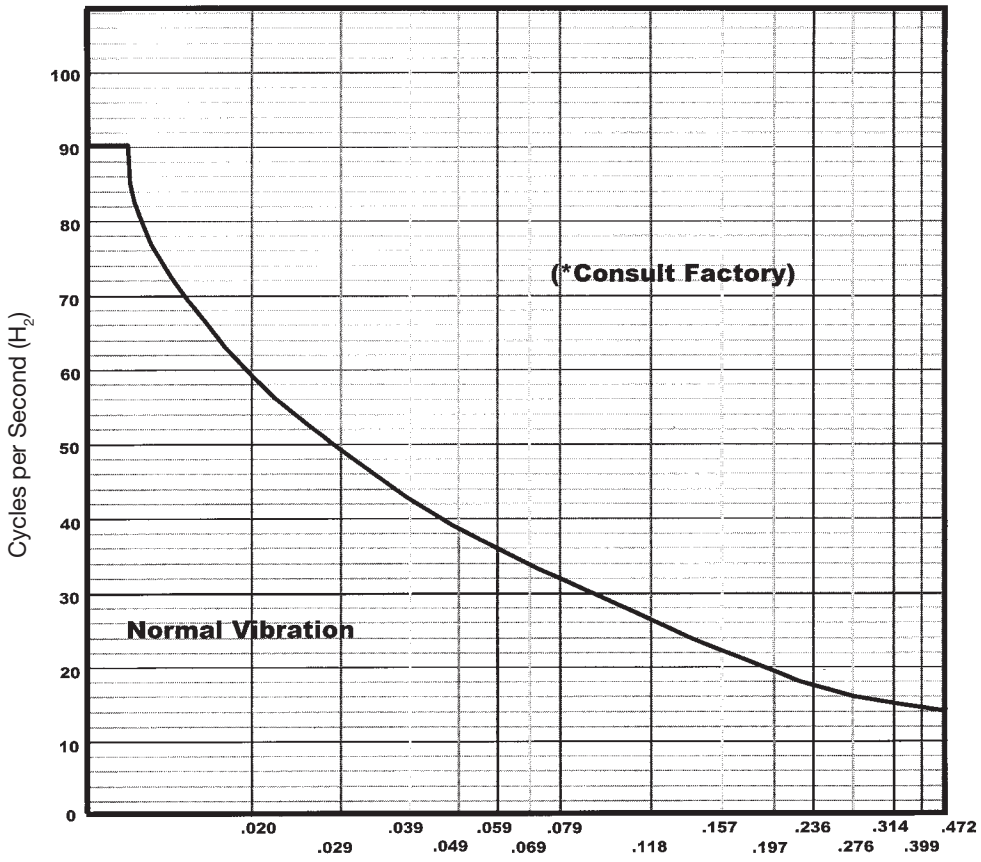
Fluid Velocity (Gals. Per Minute) Water at 70° F.

Pressure Drop Graph for Air



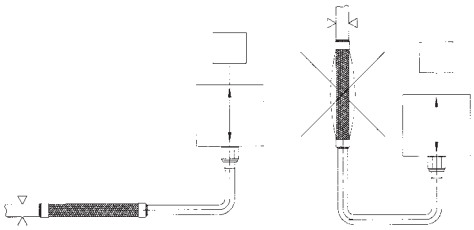
Cubic Feet Per Minute of Free Air at 60° F.

For Air Inlet Pressures Other Than 100 PSIG: P.D. = P.D. @ 100 PSIG $\left(\frac{100 + 14.7}{P + 14.7}\right)$

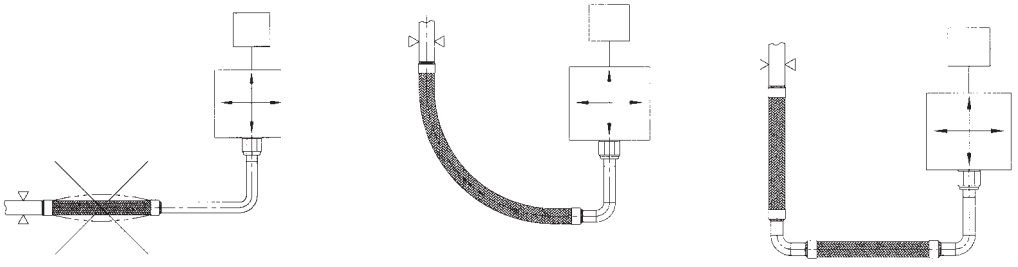


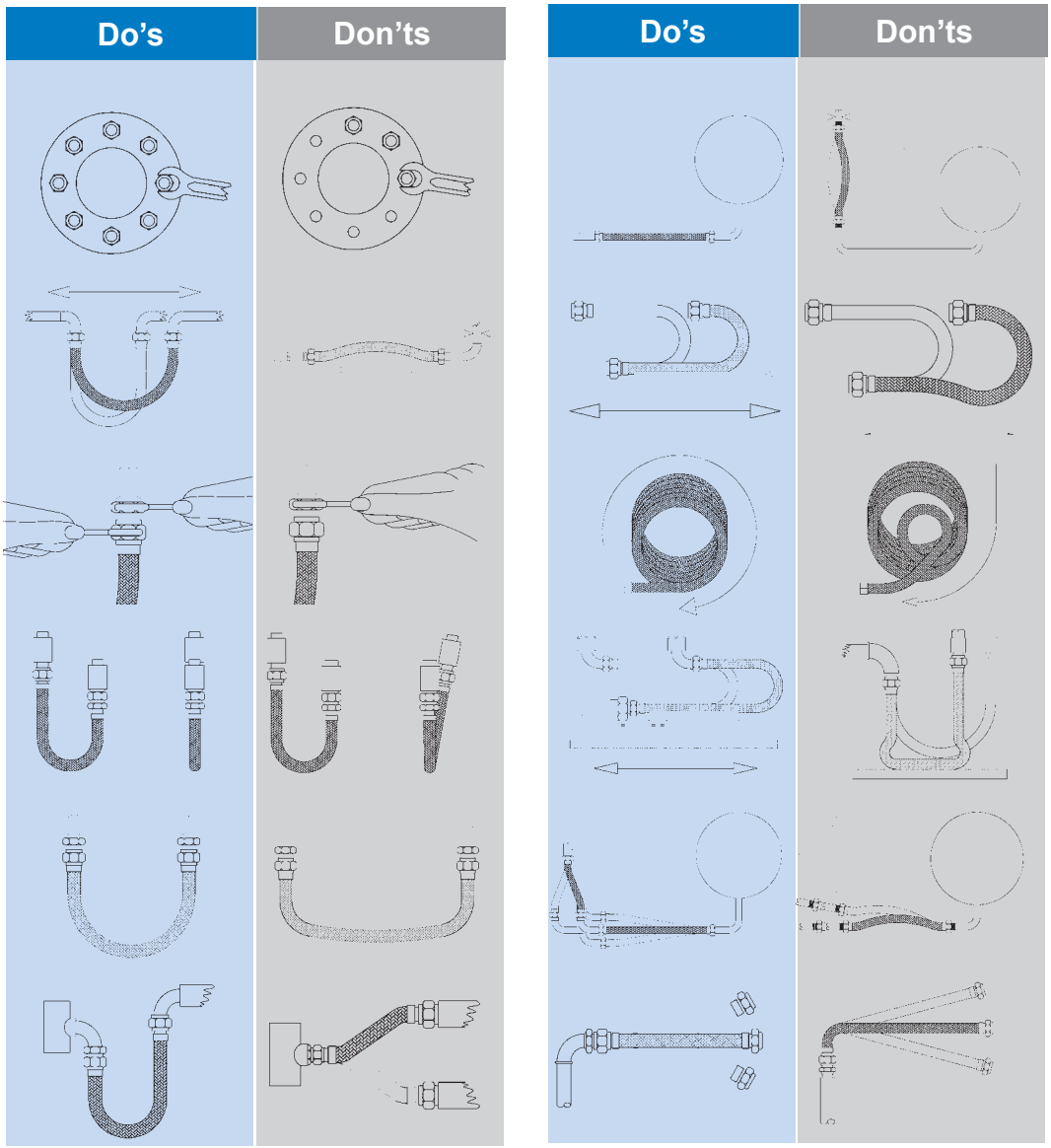
The above graph is representative and should only be used as a guide for estimation purposes. If there are any questions, or your application is near the "Consult Factory" region, please contact Hose Master Inside Sales.

When installing a hose assembly in a vibration application, make sure to install it so the axis of the hose is perpendicular to the direction of the vibration.

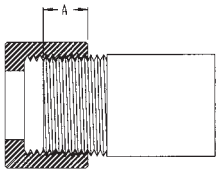


If there is vibration in more than one direction, either install a longer hose bent at 90° or install a "Dog Leg" assembly.





THREAD ALLOWANCE



When calculating the overall length (OAL) of a hose assembly that has a pipe thread as one or both end connection(s), consideration must be given to thread engagement. For example, using the chart below, a hose assembly with a 1" male pipe on one end would have 0.66" added to the OAL to compensate for the length of thread that will be engaged during installation.

Nominal Pipe Size (in.)	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
Thread Allowance (in.) (Dim "A")	0.40	0.41	0.53	0.55	0.66	0.68	0.68	0.70	0.93	1.01	1.09	1.18	1.20

SATURATED STEAM

Absolute Pressure (PSIA)	Gauge Pressure (PSIG)	Temp. Degrees Fahrenheit	Temp. Degrees Centigrade	Specific Volume (cu. ft. per lb.)
15	0.3	213	101	26.3
20	5.3	228	109	20.1
25	10.3	240	116	16.3
30	15.3	250	121	13.7
35	20.3	259	126	11.9
40	25.3	267	130	10.5
45	30.3	274	134	9.4
50	35.3	281	138	8.5
55	40.3	287	142	7.8
60	45.3	293	145	7.2
65	50.3	298	148	6.7
70	55.3	303	151	6.2
75	60.3	308	153	5.8
80	65.3	312	156	5.5
85	70.3	316	158	5.2
90	75.3	320	160	4.9
95	80.3	324	164	4.7
100	85.3	328	164	4.4
105	90.3	331	166	4.2
110	95.3	335	168	4.0
115	100.3	338	170	3.9
120	105.3	341	172	3.7
125	110.3	344	173	3.6
130	115.3	347	175	3.5
135	120.3	350	177	3.3
140	125.3	353	178	3.2
145	130.3	356	180	3.1
150	135.3	358	181	3.0
160	145.3	364	184	2.8
170	155.3	368	187	2.7

Absolute Pressure (PSIA)	Gauge Pressure (PSIG)	Temp. Degrees Fahrenheit	Temp. Degrees Centigrade	Specific Volume (cu. ft. per lb.)
180	165.3	373	189	2.5
190	175.3	378	192	2.4
200	185.3	382	194	2.3
210	195.3	386	197	2.2
220	205.3	390	199	2.1
230	215.3	394	201	2.0
240	225.3	397	203	1.9
250	235.3	401	205	1.8
260	245.3	404	207	1.8
270	255.3	408	209	1,7
280	265.3	411	211	1.7
290	275.3	414	212	1.6
300	285.3	417	214	1.5
350	335.3	432	222	1.3
400	385.3	445	230	1.2
500	485.3	467	242	0.9
550	535.3	477	247	0.8
600	585.3	486	252	0.8
650	635.3	495	257	0.7
700	685.3	503	262	0.7
750	735.3	511	266	0.6
800	785.3	518	270	0.6
850	835.3	525	274	0.5
900	885.3	532	278	0.5
950	935.3	538	281	0.5
1000	985.3	545	285	0.4
1050	1035.3	551	288	0.4
1100	1085.3	556	291	0.4
1150	1135.3	562	294	0.4
1200	1185.3	567	297	0.4

THERMAL EXPANSION OF PIPE

(ANSI B31.1.0-1967)

Material		Temperature range: 70° F. (21° C.) to (select temperature range)													
	F° (C°)	70 (21)	200 (93)	300 (149)	400 (205)	500 (260)	600 (316)	700 (371)	800 (427)	900 (482)	1000 (538)	1100 (593)	1200 (649)	1300 (705)	1400 (760)
Carbon Steel: carbon-moly steel low-chrome steels (through 3% Cr)	A		6.38	6.60	6.82	7.02	7.23	7.44	7.65	7.84	7.97	8.12	8.19	8.28	8.36
	B	0	0.99	1.82	2.70	3.62	4.60	5.63	6.70	7.81	8.89	10.04	11.10	12.22	13.34
Intermediate alloy steels: 5 Cr Mo-9 Cr Mo	A		6.04	6.19	6.34	6.50	6.66	6.80	6.96	7.10	7.22	7.32	7.41	7.49	7.55
	B	0	0.94	1.71	2.50	3.35	4.24	5.14	6.10	7.07	8.06	9.05	10.00	11.06	12.05
Austenitic stainless steels	A		9.34	9.47	9.59	9.70	9.82	9.92	10.05	10.16	10.29	10.39	10.48	10.54	10.60
	B	0	1.46	2.61	3.80	5.01	6.24	7.50	8.80	10.12	11.48	12.84	14.20	15.56	16.92
Straight chromium stainless steels: 12 Cr, 17 Cr, and 27 Cr	A		5.50	5.66	5.81	5.96	6.13	6.26	6.39	6.52	6.63	6.72	6.78	6.85	6.90
	B	0	0.86	1.56	2.30	3.08	3.90	4.73	5.60	6.49	7.40	8.31	9.20	10.11	11.01
25 Cr-20 Ni	A		7.76	7.92	8.08	8.22	8.38	8.52	8.68	8.81	8.02	9.00	9.08	9.12	9.18
	B	0	1.21	2.18	3.20	4.24	5.33	6.44	7.60	8.78	9.95	11.12	12.31	13.46	14.65
Monel 67: Mi-30 Cu	A		7.84	8.02	8.20	8.40	8.58	8.78	8.96	9.16	9.34	9.52	9.70	9.88	10.04
	B	0	1.22	2.21	3.25	4.33	5.46	6.64	7.85	9.12	10.42	11.77	13.15	14.58	16.02
Monel 66: Ni-29 CuAl	A		7.48	7.68	7.90	8.09	8.30	8.50	8.70	8.90	9.10	9.30	9.50	9.70	9.89
	B	0	1.17	2.12	3.13	4,17	5.28	6.43	7.62	8.86	10.16	11.50	13.00	14.32	15.78
Aluminum	A		12.95.	13.28	13.60	13.90	14.20								
	B	0	2.00	3.66	5.39	7.17	9.03								
Gray cast iron	A		5.75	5.93	6.10	6.28	6.47	6.65	6.83	7.00	7.19				
	B	0	0.90	1.64	2.42	3.24	4.11	5.03	5.98	6.97	8.02				
Bronze	A		10.03	10.12	10.23	10/32	10.44	10.52	10.62	10.72	10.80	10.90	11.00		
	B	0	1.56	2.79	4.05	5.33	6.64	7.95	9.30	10.68	12.05	13.47	14.92		
Brass	A		9.76	10.00	10.23	10.47	10.69	10.92	11.16	11.40	11.63	11.85	12.09		
	B	0	1.52	2.76	4.05	5.40	6.80	8.26	9.78	11.35	12.98	14.65	16.39		
Wrought iron	A		7.32	7.48	7.61	7.33	7.88	8.01	8.13	8.29	8.39				
	B	0	1.14	2.06	3.01	3.99	5.01	6.06	7.12	8.26	9.36				
Copper-nickel (70/30)	A		8.54	8.71	8.90										
	B	0	1.33	2.40	3.52										

A = mean coefficient of thermal expansion x 10^6, in/in/°F in going from 70°F. (21° C.) to indicated temperature
B = linear thermal expansion, in/100 ft.. going from 70° F. (21° C.) to indicated temperature
Multiply values of A shown by 1.80 to obtain coefficient of expansions in cm/cm/°C.
Multiply values of B shown by 8.33 to obtain linear expansion in cm per 100 m.

Instructions: To place an order or request a quotation, please complete Section I. If you need assistance in specifying an assembly, complete Section II as well as the "End Fittings" portion of Section I. When completed, fax this form to Hose Master at (216) 481-7557 or email it to insidesales@hosemaster.com.

Customer: _____

Contact: _____ Date: _____

Phone: _____ Fax: _____ Email: _____

Section I Specification Information

Request Quote: _____ (or) Place Order P.O.# _____

Quantity: _____ Date Required: _____

Hose (type and diameter): _____ Length (inches): _____ Live Length / Overall Length
Circle One

End Fittings (type and size for both ends)

End #1 Size: _____ Type: _____ Material: _____

End #2 Size: _____ Type: _____ Material: _____

Liner Required: _____ Yes _____ No If "Yes," Liner Material: _____

Special Fabrication: _____

Accessories: _____

Section II Application Information

Please provide the following information. Be sure that the answers are in the unit of measure stated on the form. If necessary, convert from a different unit of measure. Where appropriate, we have included the assumptions that will be made if an answer is not given.

Application Drawing: (sketch the installation and include all dimensions and motions of hose during application)

Size (inches): _____ (In the event the fittings or hose have different sizes, include all sizes and show on the application drawing)

Temperature: Media: Min. _____°F. Max. _____°F. Environment: Min. _____°F. Max. _____°F. (Assumption is 70° F. for all)

Media: _____ (Assumption is the media is compatible with all available materials)

Max. Pressure (psi): _____ Fluctuations None / Pulsating / Shock (Assumption is nominal pressure, no fluctuations)
Circle One

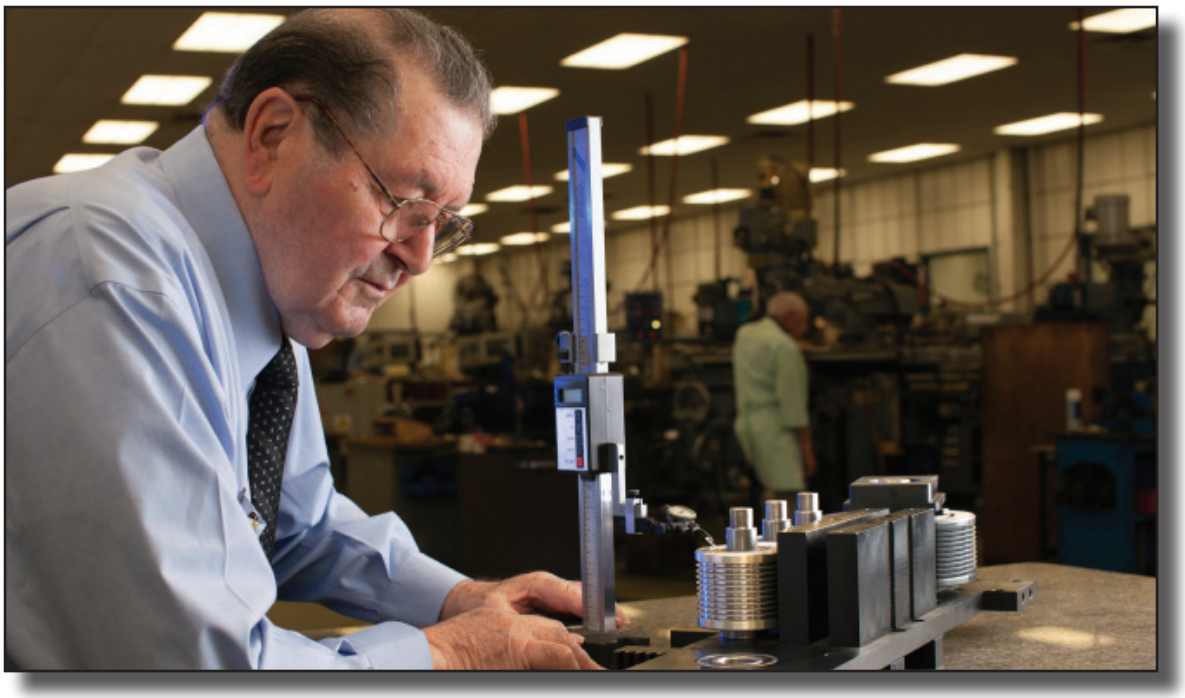
Max. Velocity (feet/second): _____ (Assumption is velocity is too slow to affect performance)

Type of Motion (From drawing above): Static / Constant / Vibration (Assumption is static)
Circle One

Product Engineering

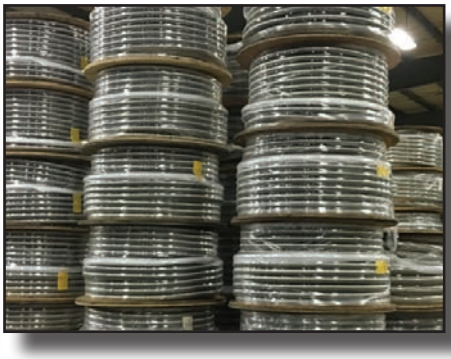
- Our team of engineers is available to answer questions and provide solutions to the most complex applications
- Available on-site assistance
- Quick turnaround from concept to completion

Machine Design



Hose Master designs and manufactures its own products and proprietary production equipment, offering innovative solutions for demanding applications.

Manufacturing, Fabricating, and Stocking Facilities



90+ Welders and large inventories enable us to respond quickly to customer demands

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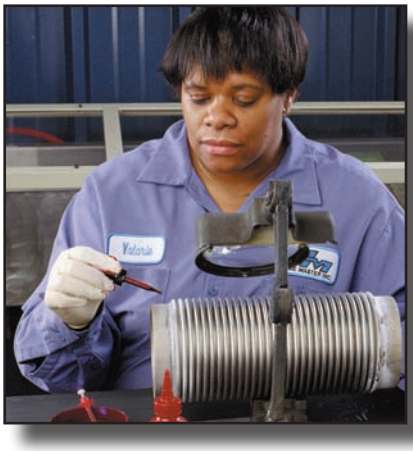

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PEI

PED Pressure Equipment Directive

TÜV ISO 9001

CSA Canadian Registration Number

ASME IX *Certified Welders*

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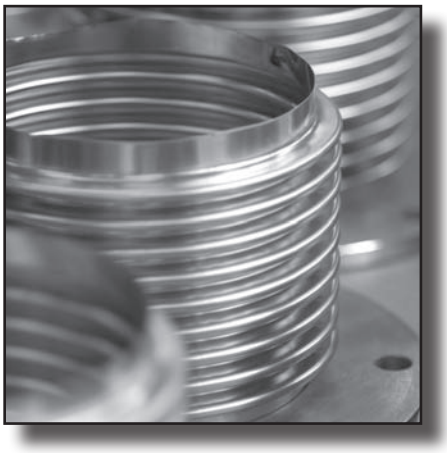
Corrugated Metal Hose and Assemblies



Metal Bellows and Expansion Joints



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