PENFLEX

DEDICATED TO CUSTOMER
SERVICE, SUPPORT & SUCCESS


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About Penflex

Penflex is a leading manufacturer of flexible piping solutions, offering a broad range of metal hose, braid and expansion joint products along with a suite of complementary services. With the company's founding more than 100 years ago, metal hose was—for the first time—being made in America.

Our legacy as an industry pioneer continues to the present day. Through a focus on continuous improvement and customer satisfaction, Penflex has set the standard for durable, corrosion resistant products and, with its global operations, supports hundreds of companies around the world across a range of industries.

Our Mission

Penflex is an ISO certified company with unique manufacturing and production processes that create high quality products that are safe, durable, and economic to use.

Our mission is to be the manufacturer of choice by providing exceptional value through:

- Quality flexible piping solutions
- Competitive pricing
- On-time delivery
- Superior customer service
- Cutting-edge industry expertise

This catalog focuses on Penflex's hose and braid product lines and services. Please visit Penflex.com for the latest product updates and information on other products including:

- Metal Hose Assemblies
- Interlocked Hoses
- Threaded and Flanged Pump Connectors
- Expansion Joints and Raw Bellows

Metal Hose Use Cases

Given the singular capabilities of metal hose to deliver in situations where temperature, pressure, corrosiveness, and motion are problematic for other materials, Penflex products are used in a wide array of applications across a diverse set of markets. This catalog provides information on the types of flexible metal hoses we manufacture.

End fittings are welded to these hoses to create completed assemblies that can be connected into the final installation. We have pulled together a list of common applications to demonstrate various use cases for flexible metal hose assemblies.

Common Applications

In the petroleum industry, our hoses are used as catalytic cracking unit connections, in oil and gas burners, and as water lines on gas engine cooling systems. Steam injection and hydrocarbon drain lines are common applications in refinery turnarounds.

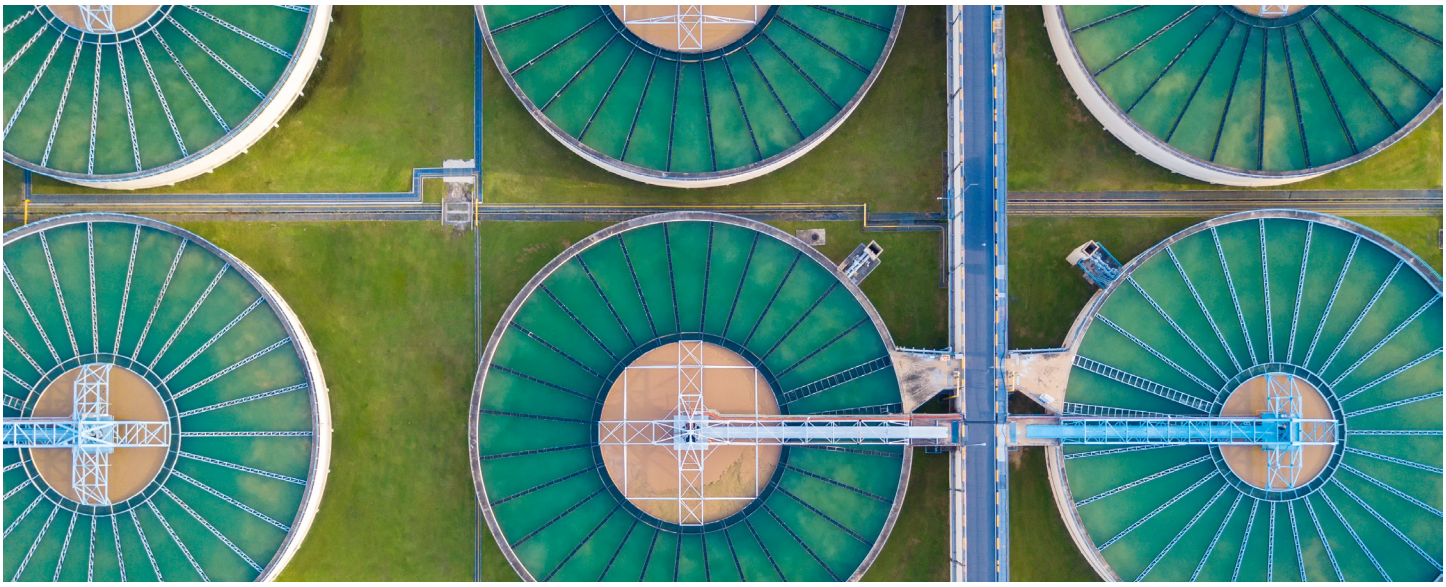
In chemical plants, hoses are used for connections to weigh scales, for loading and unloading tank trucks, for steam lines, and for conveying any highly corrosive media.

Applications in steel mills include water cooling and high temperature lubrication lines and oxygen and water lance hoses. Torches on the continuous casters often require especially flexible hoses.

For use in the transport of frozen foods, manufacture of semiconductors, application of magnetic resonance imaging and beyond, companies rely on Penflex metal hoses to transport media such as nitrogen and helium at cryogenic temperatures.

In the power generation industry, facilities with steam and combustion turbine systems often use our heavy-duty hoses developed specifically for high temperatures. Applications include cooling aids to turbine blades on gas fired units, fuel atomizer lines for oil fired burners, and lines for conveying gas to gas fired burners.

Penflex products can also be found in heating, ventilation and air conditioning systems in both industrial and high-rise buildings. Some examples include pump connections to eliminate vibration on hot and chilled water pumps. These components are also used to accommodate movement caused by expansion and contraction of piping and transitions imposed by seismic or thermal forces. They can also be used as vibration isolators on refrigeration units and air conditioner compressors and cooling towers.



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This catalog is intended to serve as a reference. Please visit Penflex.com for more information. For additional engineering specifications please call the factory at (610) 367-2260. Penflex reserves the right to change specifications without notice.

Hose Product and Service Offerings

Penflex provides a unique breadth and depth of hose products, leading the industry in alloy offerings and wall thicknesses. While capable of forming thinner wall hoses for applications where flexibility is the main requirement, our ability to form heavier wall hoses which offer greater durability and improved resistance to chemical corrosion is unmatched. Such a robust design also offers improved reliability in high pressure applications.

Annular Corrugated Metal Hose

- P3 Series, ¼" - 2" 321/316L Hose/304L Braid
- P4 Series, ¼" - 4" 321/316L Hose/304L Braid
- 700 Series, ¼" - 12" 321/316L Hose/304L Braid
- 800 Series, ¼" - 8" 321/316L Hose/304L Braid
- 900 Series, ¼" - 2" 316L Hose/304L Braid
- 1400 Series, ½" - 4" 316L Hose/304L Braid
- P5 Series, 14" – 24" 304L/316L/321 Hose/304L Braid
- 740 Series, ¼" – 3" Monel 400 Hose/Monel 400 Braid
- 776 Series, ½" – 8" Hastelloy C276 Hose/Hastelloy C276 Braid
- 625 Series, ¼" – 8" Inconel 625 Hose/Inconel 625 Braid
- 794 Series, ¼" – 4" Bronze Hose/Bronze Braid

Helical Corrugated Metal Hose

- 400 Series, ¼" - 1" 304L/316L Hose/304L Braid

Metal Hose Assemblies

Penflex's ASME Section IX certified welders turn out high-quality metal hose assemblies. With our standard line of pre-made assemblies and those built to order, Penflex customers can meet more aggressive lead times without adversely impacting their own production schedules.

We stock a range of fittings and ferrules for quicker delivery and have a greater familiarity and experience with specific assemblies—chlorine transfer hoses, for instance—that are made from more exotic alloys. Pre-made assemblies are generally 316L hose with two layers of 304L braid and are available in ¾" and 1" 50-foot lengths with hex male NPT ends and 2"-12" 10- and 20-foot lengths with 150# 316 SS fixed by floating flanges. Penflex also stocks a range of pump connectors—short assemblies designed to accommodate small amounts of lateral movement—in threaded and flanged ends. Of course, any assembly configuration is available.

Contract Braiding

Penflex offers specialized braiding services across a wide range of hoses sizes, braid configurations and braid materials. While we braid standard or customized metal hoses, we also braid customer-supplied hoses with a wide variety of metallic and synthetic wires or threads. We can even braid without a hose or liner in long continuous lengths, up to a few thousand feet!

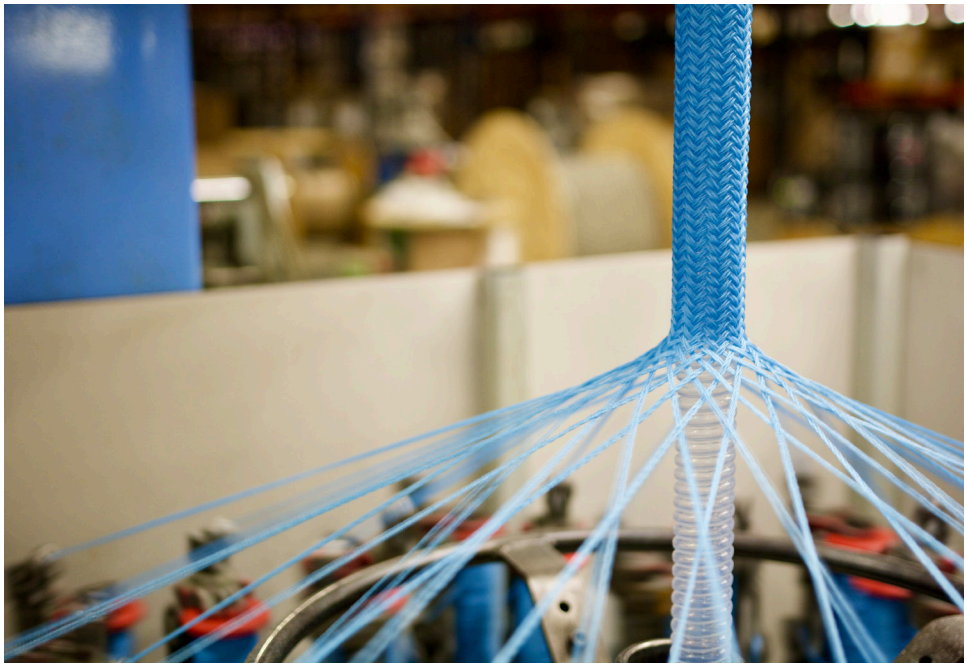
The kinds of hoses supplied to us include PTFE (both smooth bore and convoluted), Rubber, Hydraulic, and EPDM Hoses, Cables and Wiring Bundles.

Metal Wire (Sample List)

- 304L
- 309L
- 316L
- Monel 400
- Inconel 625 and 718
- Hastelloy C276
- Titanium

Non-Metal Wire (Sample List)

- Kevlar ™
- Kynar ™
- Polyethylene
- Polypropylene



Services

Penflex offers a range of services to complement our product line.

- Welder Training Program
- Sales Trainings
- Failure Analysis
- Engineering Support

Online Resources

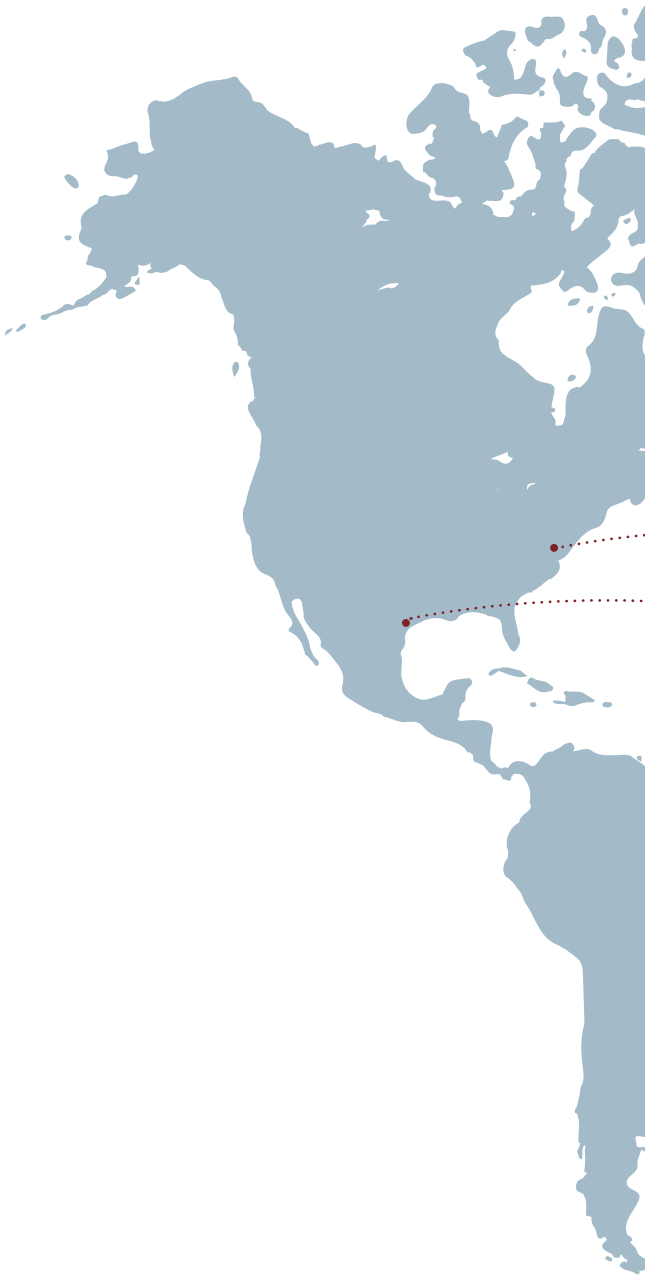
We have developed a set of technical tools to assist customers in the selection and use of flexible metal hose products. These calculators are available in the Technical Tools section of Penflex.com and will allow you to do the following:

- Generate Assembly Drawings
- Determine Hose Assembly Live Length
- Calculate Flow Velocity
- Design Custom Braid Configurations
- Reduce Ratings Based on Temperature Adjustment Factors
- Assess Alloy Chemical Compatibility

To better support and serve the needs of our customers, Penflex also posts Engineering Bulletins on our website. Engineering Bulletins are issued periodically to inform our customers about new products, changes to existing products, and improvements in our manufacturing processes, as well as to provide answers to the most common questions we receive. The Engineering Bulletins archive can be viewed on our website under Industry Resources.

Additional online resources include Penflex's Certifications, a Hose Handling Guide, information about our Non-Destructive Testing Program, Video and Photo Libraries and recorded Sales Trainings.

Our Organization



Locations

In addition to our Gilbertsville, Pennsylvania headquarters and manufacturing plant location, Penflex operates a distribution center in Houston, Texas. Penflex's Vietnam plant serves customers outside North America.

The Penflex Team

From last minute shipments and special requests to end user support and custom orders, Penflex is committed to customer service, satisfaction and success. We handle each customer's needs with a sense of urgency, consideration and professionalism and our customer service professionals are always available to answer questions and provide any assistance you may require.

Quality Management System

Penflex is dedicated to providing superior quality in all that we do, from manufacturing high quality products to providing unsurpassed customer service. Our Quality Management System, which complies with the requirements of ISO 9001:2015, is Penflex's commitment to each customer that quality and customer satisfaction come first. Penflex Quality Management System (Penflex QMS) is made up of the following parts:

- Quality Policy
- Quality Objectives
- Manual
- Procedures
- Forms
- Instructions

Worldwide Locations

Gilbertsville, Pennsylvania

Houston, Texas

Ho Chi Minh City, Vietnam

Penflex Part Numbering System

Specifying Part Numbers for 400 / 700 / 800 / 900 / 1400 / P5 Series Products

7 21 - 004

Hose Type
4 = 400 Series
7 = 700 Series (to 12")
P5 Series (14" – 24")
8 = 800 Series
9 = 900 Series
14 = 1400 Series

Hose Alloy*
04 = 304L
21 = 321
16 = 316L
40 = Monel
76 = Hastelloy
94 = Bronze

Size
See chart at right

*Exception to the rule is 625 Series Inconel Hose. Part numbers for this series begin with 625. For example, 625-008 is ½" Inconel 625 Hose.

Specifying Part Numbers for Braid

1 SB - 6 - 004

Braid Layers
1 = 1 layer
2 = 2 layers

Braid Type
HHB = 400 Series
SB = 700 Series
SHB = 800 Series
HTSB = 900 Series
MB = Monel
SBX = Hastelloy
IB = Inconel
BB = Bronze

Braid Alloy
(only used for 316 braid)
6 = 316L

Size
See chart at right

Specifying Part Numbers for Braided Hose on Reels

7 21 - 1 SB - 6 - 004

Hose/ Braid Type
4 = 400 Series
7 = 700 Series (to 12")
P5 Series (14" – 24")
8 = 800 Series
9 = 900 Series
14 = 1400 Series

Hose Alloy*
04 = 304L
21 = 321
16 = 316L
40 = Monel
76 = Hastelloy
94 = Bronze

Braid Layers
1 = 1 layer
2 = 2 layers

Braid Type
HHB = 400 Series
SB = 700 Series
SHB = 800 Series
HTSB = 900 Series
MB = Monel
SBX = Hastelloy
IB = Inconel
BB = Bronze

Braid Alloy
(only used for 316 braid)
6 = 316L

Size
See chart at right

*Exception to the rule is 625 Series Inconel Hose. Part numbers for this series begin with 625. For example, 625-008 is ½" Inconel 625 Hose.

Specifying Part Numbers for P3 and P4 Products

[ ] 3 0 21 – 004

Pitch
Blank = Standard
C = Compressed

Hose Series
3 = P3
4 = P4

Hose Alloy
16 = 316L
21 = 321

Size
See chart at right

P3 - [ ] H30 21 - [ ] B30 04 - 004

Hose Series
P3 = P3
P4 = P4

Pitch
Blank = Standard
C = Compressed

Hose Alloy
16 = 316L
21 = 321

Braid Layers
Blank = 1 Layer
2 = 2 Layers

Braid Alloy
04 = 304L
16 = 316L

Size
See chart at right

SIZE CODE

004 = 1/4”
005 = 5/16”
006 = 3/8”
008 = 1/2”
010 = 5/8”
012 = 3/4”
016 = 1”
020 = 1-1/4”
024 = 1-1/2”
032 = 2”
040 = 2-1/2”
048 = 3”
056 = 3-1/2”
064 = 4”
080 = 5”
096 = 6”
128 = 8”
160 = 10”
192 = 12”
224 = 14”
256 = 16”
288 = 18”
320 = 20”
352 = 22”
384 = 24”

Chart Terminology

Nominal I.D.
The nominal interior dimension of the hose in inches.

Part Number
The part numbers to be used when ordering.

Braid Layers
The number of wire braid covering(s) required for the indicated pressure rating.

Braid Construction
This term describes how the braid is made. For example, when looking at 36 x 9 x .016:

- 36 = number of carriers
- 9 = number of wires on each carrier
- .016 = diameter of wire in inches

Braid Coverage
The percentage of area covered by wire when referenced to the total cylinder surface area of the hose. 95% coverage means only 5% of the area is not covered by wire.

Nominal O.D.
The nominal exterior dimension of the hose in inches.

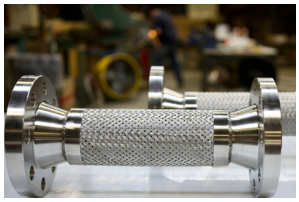
Pressure Ratings
The maximum working and nominal burst pressures for each hose size are shown with welded on fittings. All pressures listed in this catalog have been reduced by 20 percent to account for welding as the method of attachment.

Minimum Centerline Bend Radius – Dynamic
The minimum bend radius, in inches, to which a hose may be bent when installed in conditions of motion that occur on a regular or intermittent basis.

Minimum Centerline Bend Radius – Static
The minimum bend radius, in inches, to which a hose size may be bent when installed in conditions of no movement other than infrequent vibrations.

Weight
Approximate weight per foot in pounds per foot.





P3 Series Stainless Steel Hose

P3 annular corrugated hose features a low profile and a high corrugation count to deliver a very flexible hose with high pressure ratings. Its thinner wall construction makes it a lightweight cost-effective option which, in combination with its working pressures, make P3 an ideal choice in many applications.

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Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	30xx-004	0			0.38	72	----			0.04
1/4"	P3-H30xx-B30xx-004	1	24 x 6 x .010	95	0.43	2,360	9,440	3.15	1.10	0.10
	P3-H30xx-2B30xx-004	2			0.48	2,832	11,328			0.15
	30xx-005	0			0.48	72	----			0.06
5/16"	P3-H30xx-B30xx-005	1	24 x 7 x .010	92	0.53	1,647	6,588	4.85	1.23	0.12
	P3-H30xx-2B30xx-005	2			0.58	1,976	7,904			0.18
	30xx-006	0			0.56	72	----			0.07
3/8"	P3-H30xx-B30xx-006	1	24 x 7 x .012	93	0.62	1,639	6,556	5.08	1.52	0.16
	P3-H30xx-2B30xx-006	2			0.68	1,967	7,868			0.25
	30xx-008	0			0.66	72	----			0.08
1/2"	P3-H30xx-B30xx-008	1	24 x 8 x .012	92	0.72	1,225	4,900	5.47	1.75	0.18
	P3-H30xx-2B30xx-008	2			0.78	1,470	5,880			0.28
	30xx-010	0			0.85	71	----			0.13
5/8"	P3-H30xx-B30xx-010	1	36 x 6 x .014	93	0.92	1,200	4,800	6.28	2.21	0.28
	P3-H30xx-2B30xx-010	2			0.99	1,440	5,760			0.44
	30xx-012	0			1.05	43	----			0.17
3/4"	P3-H30xx-B30xx-012	1	36 x 8 x .014	96	1.12	1,034	4,136	6.58	2.65	0.38
	P3-H30xx-2B30xx-012	2			1.19	1,241	4,964			0.59
	30xx-016	0			1.27	43	----			0.24
1"	P3-H30xx-B30xx-016	1	48 x 7 x .014	95	1.34	796	3,184	7.50	3.33	0.48
	P3-H30xx-2B30xx-016	2			1.41	955	3,820			0.72
	30xx-020	0			1.62	43	----			0.38
1-1/4"	P3-H30xx-B30xx-020	1	48 x 9 x .014	95	1.69	600	2,400	10.20	4.10	0.70
	P3-H30xx-2B30xx-020	2			1.76	720	2,880			1.01
	30xx-024	0			1.95	28	----			0.50
1-1/2"	P3-H30xx-B30xx-024	1	48 x 9 x .016	94	2.03	557	2,228	11.75	5.08	0.90
	P3-H30xx-2B30xx-024	2			2.11	668	2,672			1.31
	30xx-032	0			2.38	28	----			0.61
2"	P3-H30xx-B30xx-032	1	48 x 9 x .020	94	2.48	570	2,280	12.55	6.27	1.25
	P3-H30xx-2B30xx-032	2			2.58	684	2,736			1.88

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

P3 Series Compressed

Compressed P3 closely mimics the geometry of Standard P3 apart from corrugation count. A higher number of corrugations per foot makes Compressed P3 the easiest to bend of all Penflex hoses. It's our most flexible offering.

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Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	C30xx-004	0			0.38	72	----			0.07
1/4"	P3-CH30xx-B30xx-004	1	24 x 6 x .010	95	0.43	2,360	9,440	2.00	1.10	0.12
	P3-CH30xx-2B30xx-004	2			0.48	2,832	11,328			0.17
	C30xx-005	0			0.48	72	----			0.09
5/16"	P3-CH30xx-B30xx-005	1	24 x 7 x .010	92	0.53	1,647	6,588	3.10	1.23	0.15
	P3-CH30xx-2B30xx-005	2			0.58	1,976	7,904			0.21
	C30xx-006	0			0.56	72	----			0.11
3/8"	P3-CH30xx-B30xx-006	1	24 x 7 x .012	93	0.62	1,639	6,556	3.10	1.52	0.20
	P3-CH30xx-2B30xx-006	2			0.68	1,967	7,868			0.29
	C30xx-008	0			0.66	72	----			0.14
1/2"	P3-CH30xx-B30xx-008	1	24 x 8 x .012	92	0.72	1,438	5,750	3.00	1.75	0.24
	P3-CH30xx-2B30xx-008	2			0.78	2,300	9,200			0.34
	C30xx-010	0			0.85	71	----			0.18
5/8"	P3-CH30xx-B30xx-010	1	36 x 6 x .014	93	0.92	1,200	4,800	4.00	2.21	0.34
	P3-CH30xx-2B30xx-010	2			0.99	1,775	7,100			0.50
	C30xx-012	0			1.05	43	----			0.25
3/4"	P3-CH30xx-B30xx-012	1	36 x 8 x .014	96	1.12	1,063	4,250	4.50	2.65	0.46
	P3-CH30xx-2B30xx-012	2			1.19	1,700	6,800			0.66
	C30xx-016	0			1.27	43	----			0.36
1"	P3-CH30xx-B30xx-016	1	48 x 7 x .014	95	1.34	917	3,669	5.30	3.33	0.60
	P3-CH30xx-2B30xx-016	2			1.41	1,467	5,870			0.84
	C30xx-020	0			1.62	43	----			0.56
1-1/4"	P3-CH30xx-B30xx-020	1	48 x 9 x .014	95	1.69	797	3,188	6.90	4.10	0.87
	P3-CH30xx-2B30xx-020	2			1.76	1,275	5,100			1.18
	C30xx-024	0			1.95	28	----			0.91
1-1/2"	P3-CH30xx-B30xx-024	1	48 x 9 x .016	94	2.03	734	2,938	6.90	5.08	1.32
	P3-CH30xx-2B30xx-024	2			2.11	1,175	4,700			1.73
	C30xx-032	0			2.38	28	----			0.97
2"	P3-CH30xx-B30xx-032	1	48 x 9 x .020	94	2.48	594	2,375	8.00	6.27	1.61
	P3-CH30xx-2B30xx-032	2			2.58	950	3,800			2.24

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

CL3 Series Stainless Steel Hose

Clean ID P3 is designed for cryogenic and vacuum applications. Advances in corrugation forming technology leading to the removal of all internal tooling, and thus all lubrication oil, have yielded a hose with a truly clean inside. The hose features the same geometry as P3, delivering the same thin-wall construction with low corrugation profile and high pitch count for a very flexible hose.

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Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	30xx-008-CL	0			0.66	72	----			0.08
1/2"	P3-H30xx-B30xx-008-CL	1	24 x 8 x .012	92	0.72	1,225	4,900	5.47	1.75	0.18
	P3-H30xx-2B30xx-008-CL	2			0.78	1,470	5,880			0.28
	30xx-012-CL	0			1.05	43	----			0.17
3/4"	P3-H30xx-B30xx-012-CL	1	36 x 8 x .014	96	1.12	1,043	4,136	6.58	2.65	0.38
	P3-H30xx-2B30xx-012-CL	2			1.19	1,241	4,964			0.59
	30xx-016-CL	0			1.27	43	----			0.24
1"	P3-H30xx-B30xx-016-CL	1	48 x 7 x .014	95	1.34	796	3,184	7.50	3.33	0.48
	P3-H30xx-2B30xx-016-CL	2			1.41	955	3,820			0.72

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

P4 Series Stainless Steel Hose

The combination of wall thickness and pressure ratings make P4 annular corrugated hose an ideal solution for most applications. Penflex's unique ability to form heavier wall hoses ensures longer hose life when there is corrosive media present or in applications that require periodic replacement for safety.

ISO 10380 QUALIFIED

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	40xx-004	0			0.4	200	----			0.08
1/4"	P4-H40xx-B40xx-004	1	24 x 5 x .014	98	0.48	2,500	10,000	5.00	1.00	0.17
	P4-H40xx-2B40xx-004	2			0.56	3,375	13,500			0.26
	40xx-005	0			0.48	180	----			0.09
5/16"	P4-H40xx-B40xx-005	1	24 x 6 x .014	98	0.57	2,300	9,200	5.00	1.00	0.19
	P4-H40xx-2B40xx-005	2			0.64	3,680	14,720			0.29
	40xx-006	0			0.63	100	----			0.13
3/8"	P4-H40xx-B40xx-006	1	24 x 8 x .014	98	0.7	1,680	6,720	5.50	1.25	0.27
	P4-H40xx-2B40xx-006	2			0.81	2,700	10,742			0.41
	40xx-008	0			0.84	80	----			0.23
1/2"	P4-H40xx-B40xx-008	1	24 x 9 x .014	94	0.91	1,240	4,960	6.00	1.50	0.39
	P4-H40xx-2B40xx-008	2			0.98	1,980	7,920			0.55
	40xx-012	0			1.21	70	----			0.39
3/4"	P4-H40xx-B40xx-012	1	36 x 9 x .014	95	1.28	940	3,760	8.00	2.25	0.62
	P4-H40xx-2B40xx-012	2			1.35	1,500	6,000			0.85
	40xx-016	0			1.51	40	----			0.53
1"	P4-H40xx-B40xx-016	1	36 x 10 x .014	92	1.58	630	2,520	9.00	2.75	0.79
	P4-H40xx-2B40xx-016	2			1.65	1,000	4,000			1.05
	40xx-020	0			1.85	25	----			0.76
1-1/4"	P4-H40xx-B40xx-020	1	48 x 8 x .016	92	1.93	575	2,300	10.50	3.50	1.12
	P4-H40xx-2B40xx-020	2			2.02	920	3,680			1.48
	40xx-024	0			2.19	20	----			0.84
1-1/2"	P4-H40xx-B40xx-024	1	48 x 10 x .016	93	2.28	500	2,000	12.00	4.00	1.29
	P4-H40xx-2B40xx-024	2			2.37	800	3,200			1.74
	40xx-032	0			2.61	15	----			0.9
2"	P4-H40xx-B40xx-032	1	48 x 10 x .020	95	2.73	532	2,128	15.00	5.00	1.61
	P4-H40xx-2B40xx-032	2			2.85	850	3,400			2.33
	40xx-040	0			3.23	12	----			1.16
2-1/2"	P4-H40xx-B40xx-040	1	72 x 8 x .020	94	3.33	500	2,000	20.00	8.00	1.86
	P4-H40xx-2B40xx-040	2			3.43	700	2,800			2.56
	40xx-048	0			3.78	10	----			1.21
3"	P4-H40xx-B40xx-048	1	72 x 9 x .020	93	3.88	400	1,600	22.00	9.00	2.0
	P4-H40xx-2B40xx-048	2			3.98	600	2,400			2.8
	40xx-064	0			4.85	8	----			1.69
4"	P4-H40xx-B40xx-064	1	72 x 11 x .020	91	4.98	300	1,200	27.00	13.00	2.68
	P4-H40xx-2B40xx-064	2			5.08	444	1,776			3.68

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

P4 Series Compressed

Compressed P4 closely mimics the geometry of Standard P4 with the exception of corrugation count. Increasing the number of corrugations per foot yields a more flexible hose.

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Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	C40xx-008	0			0.84	80	----			0.31
1/2"	P4-CH40xx-B40xx-008	1	24 x 9 x .014	94	0.91	1,240	4,960	5.00	1.30	0.47
	P4-CH40xx-2B40xx-008	2			0.98	1,980	7,920			0.63
	C40xx-012	0			1.21	70	----			0.59
3/4"	P4-CH40xx-B40xx-012	1	36 x 9 x .014	95	1.28	940	3,760	6.00	1.70	0.82
	P4-CH40xx-2B40xx-012	2			1.35	1,500	6,000			1.05
	C40xx-016	0			1.51	40	----			0.81
1"	P4-CH40xx-B40xx-016	1	36 x 10 x .014	92	1.58	630	2,520	7.30	2.30	1.07
	P4-CH40xx-2B40xx-016	2			1.65	1,000	4,000			1.33
	C40xx-020	0			1.85	25	----			1.17
1-1/4"	P4-CH40xx-B40xx-020	1	48 x 8 x .016	92	1.93	575	2,300	8.30	2.80	1.53
	P4-CH40xx-2B40xx-020	2			2.02	920	3,680			1.89
	C40xx-024	0			2.19	20	----			1.22
1-1/2"	P4-CH40xx-B40xx-024	1	48 x 10 x .016	93	2.28	500	2,000	8.60	2.90	1.67
	P4-CH40xx-2B40xx-024	2			2.37	800	3,200			2.12
	C40xx-032	0			2.61	15	----			1.24
2"	P4-CH40xx-B40xx-032	1	48 x 10 x .020	95	2.73	532	2,128	12.00	4.10	1.95
	P4-CH40xx-2B40xx-032	2			2.85	850	3,400			2.66
	C40xx-040	0			3.23	12	----			1.45
2-1/2"	P4-CH40xx-B40xx-040	1	72 x 8 x .020	94	3.33	500	2,000	16.30	6.50	2.15
	P4-CH40xx-2B40xx-040	2			3.43	700	2,800			2.85
	C40xx-048	0			3.78	10	----			1.53
3"	P4-CH40xx-B40xx-048	1	72 x 9 x .020	93	3.88	400	1,600	17.30	7.10	2.32
	P4-CH40xx-2B40xx-048	2			3.98	600	2,400			3.11
	C40xx-064	0			4.85	8	----			2.15
4"	P4-CH40xx-B40xx-064	1	72 x 11 x .020	91	4.98	300	1,200	20.50	9.90	3.14
	P4-CH40xx-2B40xx-064	2			5.08	444	1,776			4.14

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

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700 Series Stainless Steel Hose

700 Series is Penflex's oldest product line and one of the most widely used annular corrugated metal hoses in the industry. With an excellent combination of wall thickness and pressure capability, 700 Series is reliable, easily fabricated, and suitable for most applications.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a]		Bend Radius (in.)		Weight per Foot (Lb.)
						Working[b]	Nominal Burst	Dynamic	Static	
	7xx-004	0			0.48	180	----			0.09
1/4"	7xx-1SB-004	1	24 x 5 x .014	89	0.57	2,116	8,464	5.00	1.00	0.17
	7xx-2SB-004	2			0.64	3,125	12,500			0.26
	7xx-006	0			0.63	100	----			0.13
3/8"	7xx-1SB-006	1	24 x 7 x .014	91	0.7	1,501	6,004	5.50	1.25	0.25
	7xx-2SB-006	2			0.81	2,401	9,604			0.36
	7xx-008	0			0.82	80	----			0.23
1/2"	7xx-1SB-008	1	24 x 7 x .014	82	0.89	1,075	4,301	6.00	1.50	0.34
	7xx-2SB-008	2			0.96	1,720	6,880			0.46
	7xx-012	0			1.21	70	----			0.39
3/4"	7xx-1SB-012	1	36 x 8 x .014	90	1.28	792	3,168	8.00	2.25	0.59
	7xx-2SB-012	2			1.35	1,267	5,069			0.79
	7xx-016	0			1.51	40	----			0.53
1"	7xx-1SB-016	1	36 x 9 x .014	85	1.58	571	2,285	9.00	2.75	0.75
	7xx-2SB-016	2			1.65	914	3,654			0.98
	7xx-020	0			1.85	25	----			0.76
1-1/4"	7xx-1SB-020	1	48 x 7 x .016	83	1.93	531	2,125	10.50	3.50	1.07
	7xx-2SB-020	2			2.02	850	3,398			1.37
	7xx-024	0			2.19	20	----			0.84
1-1/2"	7xx-1SB-024	1	48 x 9 x .016	87	2.28	472	1,887	12.00	4.00	1.23
	7xx-2SB-024	2			2.37	755	3,021			1.63
	7xx-032	0			2.6	15	----			0.90
2"	7xx-1SB-032	1	48 x 9 x .020	89	2.72	516	2,064	15.00	5.00	1.52
	7xx-2SB-032	2			2.84	826	3,302			2.14
	7xx-040	0			3.23	12	----			1.16
2-1/2"	7xx-1SB-040	1	72 x 7 x .020	86	3.33	387	1,548	20.00	8.00	1.86
	7xx-2SB-040	2			3.43	619	2,477			2.56
	7xx-048	0			3.78	10	----			1.21
3"	7xx-1SB-048	1	72 x 8 x .020	85	3.88	316	1,264	22.00	9.00	2.00
	7xx-2SB-048	2			3.98	506	2,022			2.80
	7xx-056	0			4.32	9	----			1.62
3-1/2"	7xx-1SB-056	1	72 x 10 x .020	84	4.45	297	1,188	24.00	10.00	2.61
	7xx-2SB-056	2			4.58	475	1,900			3.60
	7xx-064	0			4.85	8	----			1.69
4"	7xx-1SB-064	1	72 x 10 x .020	84	4.98	232	927	27.00	13.00	2.68
	7xx-2SB-064	2			5.1	371	1,485			3.68
	7xx-080	0			5.9	6	----			2.50
5"	7xx-1SB-080	1	72 x 8 x .025	74	6.03	191	764	31.00	18.00	3.75
	7xx-2SB-080	2			6.15	306	1,222			5.00
	7xx-096	0			6.87	5	----			3.47
6"	7xx-1SB-096	1	96 x 12 x .020	90	7.1	165	660	36.00	19.00	4.75
	7xx-2SB-096	2			7.33	264	1,056			6.04
	7xx-128	0			9.12	6	----			5.56
8"	7xx-1SB-128	1	96 x 21 x .024	96	9.22	234	934	40.00	20.00	9.44
	7xx-2SB-128	2			9.31	374	1,495			13.36
	7xx-160	0			11.18	5	----			6.80
10"	7xx-1SB-160	1	96 x 25 x .028	98	11.32	230	918	50.00	25.00	12.90
	7xx-2SB-160	2			11.45	367	1,469			19.00
	7xx-192	0			13.17	3	----			9.02
12"	7xx-1SB-192	1	96 x 25 x .028	97	13.31	161	643	60.00	30.00	14.83
	7xx-2SB-192	2			13.44	257	1,029			20.64

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

800 Series Stainless Steel Hose

800 Series annular corrugated hose has a heavier wall thickness and more corrugations than 700 Series. In combination with heavier braid designs, it is ideal for applications where corrosive media is present or where there are particularly robust handling requirements.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	816-004	0			0.5	180	----			0.09
1/4"	816-1SHB-004	1	24 x 5 x .014	89	0.57	2,562	10,250	5.00	2.50	0.17
	816-2SHB-004	2			0.64	4,099	16,400			0.26
	816-006	0			0.67	100	----			0.13
3/8"	816-1SHB-006	1	24 x 7 x .014	91	0.74	1,501	6,004	5.50	2.75	0.25
	816-2SHB-006	2			0.81	2,401	9,604			0.36
	816-008	0			0.82	80	----			0.39
1/2"	816-1SHB-008	1	24 x 7 x .020	96	0.92	2,194	8,777	8.00	4.00	0.63
	816-2SHB-008	2			1.02	3,510	14,040			0.87
	816-012	0			1.21	70	----			0.48
3/4"	816-1SHB-012	1	36 x 6 x .020	92	1.31	1,311	5,244	8.00	4.00	0.79
	816-2SHB-012	2			1.41	2,098	8,392			1.10
	816-016	0			1.5	40	----			0.79
1"	816-1SHB-016	1	36 x 8 x .020	95	1.6	1,069	4,276	9.00	4.50	1.20
	816-2SHB-016	2			1.7	1,710	6,840			1.61
	816-020	0			1.85	33	----			1.02
1-1/4"	816-1SHB-020	1	48 x 6 x .025	95	1.97	1,110	4,443	10.00	5.00	1.66
	816-2SHB-020	2			2.1	1,776	7,040			2.30
	816-024	0			2.17	20	----			1.36
1-1/2"	816-1SHB-024	1	48 x 7 x .025	95	2.3	868	3,472	10.00	5.00	2.11
	816-2SHB-024	2			2.43	1,388	5,552			2.86
	816-032	0			2.51	15	----			1.60
2"	816-1SHB-032	1	48 x 9 x .025	95	2.64	810	3,240	11.50	5.75	2.56
	816-2SHB-032	2			2.76	1,296	5,184			3.52
	816-040	0			3.23	10	----			2.00
2-1/2"	816-1SHB-040	1	72 x 7 x .025	96	3.36	578	2,312	24.00	12.00	3.12
	816-2SHB-040	2			3.49	925	3,700			3.30
	816-048	0			3.78	10	----			2.97
3"	816-1SHB-048	1	72 x 9 x .025	88	3.91	540	2,160	28.00	14.00	4.42
	816-2SHB-048	2			4.03	864	3,456			5.87
	816-064	0			4.81	8	----			3.1
4"	816-1SHB-064	1	72 x 9 x .025	89	4.93	333	1,332	40.00	20.00	4.55
	816-2SHB-064	2			5.05	533	2,132			6.00
	816-096	0			6.87	5	----			3.85
6"	816-1SHB-096	1	96 x (13 x .025)	89	7.1	266	1,062	48.00	24.00	6.45
	816-2SHB-096	2			7.33	425	1,700			9.05
	FC816-3SHB-096	3			7.56	640	2560			13.19
8"[c]	816-128	0			9.09	6	----	63.00	32.00	6.00
	816-1SB-128	1	96 x (21 x .024)	96	9.19	234	934	63.00	32.00	10.00
	C816-2SB-128	2			9.29	450	1,800	46.00	24.00	18.00
	C816-3SB-128	3			9.39	550	2,200	46.00	24.00	22.00

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.
c. For 8" double and triple braided, use compressed hose.

900 Series Stainless Steel Hose

900 Series annular corrugated hose is another step above 800 for higher pressure applications.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	916-004	0			0.5	180	~~~			0.20
1/4"	916-1HTSB-004	1	24 x 4 x .016	83	0.58	2,754	11,017	12.00	6.00	0.28
	916-2HTSB-004	2			0.64	4,406	17,627			0.36
	916-006	0			0.67	100	~~~			0.31
3/8"	916-1HTSB-006	1	24 x 6 x .016	89	0.75	1921	7,682	12.00	6.00	0.43
	916-2HTSB-006	2			0.83	3,073	12,291			0.55
	916-008	0			0.82	80	~~~			0.40
1/2"	916-1HTSB-008	1	24 x 7 x .020	96	0.92	2194	8,777	14.00	7.00	0.58
	916-2HTSB-008	2			1.02	3,510	14,040			0.76
	916-012	0			1.22	70	~~~			0.65
3/4"	916-1HTSB-012	1	48 x 4 x .024	93	1.34	1994	7,980	15.00	7.50	0.92
	916-2HTSB-012	2			1.46	3192	12,769			1.19
	916-016	0			1.52	40	~~~			1.02
1"	916-1HTSB-016	1	48 x 5 x .024	94	1.65	1599	6,397	16.00	8.00	1.48
	916-2HTSB-016	2			1.77	2558	10,234			1.94
	916-020	0			1.85	25	~~~			1.56
1-1/4"	916-1HTSB-020	1	48 x 6 x .024	93	1.97	1317	5,270	18.00	9.00	2.02
	916-2HTSB-020	2			2.09	2107	8,431			2.48
	916-024	0			2.19	20	~~~			2.01
1-1/2"	916-1HTSB-024	1	48 x 7 x .024	93	2.31	1062	4247	19.00	9.50	2.65
	916-2HTSB-024	2			2.43	1698	6,795			3.30
	916-032	0			2.51	15	~~~			2.43
2"	916-1HTSB-032	1	48 x 8 x .024	93	2.64	842	3,368	24.00	12.00	3.17
	916-2HTSB-032	2			2.77	1346	5,388			3.91

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

1400 Series Stainless Steel Hose

1400 Series annular corrugated hose is designed for extreme pressure applications. Three and four layers of heavy-duty braid deliver the highest working pressures and provide maximum protection to the inner core. An extra heavy wall allows for longer service life in a wide variety of corrosive applications.

Nom. I.D. (in.)	Part Number	Braid Layers	Braid Construction	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a]		Bend Radius (in.)		Weight per Foot (Lb.)
					Working[b]	Nominal Burst	Dynamic	Static	
1/2"	1416-3HTSB-008	3	24 x 7 x .020	1.2	4,000	16,000	14.00	7.00	1.10
3/4"	1416-3HTSB-012	3	48 x 4 x .024	1.65	5,000	20,000	15.00	7.50	2.00
1"	1416-3HTSB-016	3	48 x 5 x .024	1.92	4,200	16,800	16.00	8.00	2.70
1-1/2"	1416-3HTSB-024	3	48 x 7 x .024	2.55	2,750	11,000	24.00	12.00	4.15
2"	1416-3HTSB-032	3	48 x 8 x .024	3.07	2,180	8,720	40.00	20.00	5.00
3"	1416-3SHB-048	3	72 x 9 x .025	4.22	1,250	5,000	84.00	32.00	8.70
4"	1416-4SHB-064	4	72 x 10 x .024	5.27	1,250	5,000	112.00	52.00	10.48

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

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P5 Series Stainless Steel Hose

P5 Series is large diameter annular corrugated hose and braid in sizes 14”- 24.” All braid is braided braid for the highest durability and reliability.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
14”	7xx-224	0	96 x (29x 0.025)	97%	14.7	7.5	~~~~	72.50	38.50	11.50
	7xx-1SB-224	1			15.1	150	600			17.50
16”	7xx-256	0	96 x (29x 0.025)	97%	16.7	5.5	~~~~	81.00	44.00	13.50
	7xx-1SB-256	1			17.1	110	440			19.40
18”	7xx-288	0	96 x (29x 0.025)	93%	18.7	4.3	~~~~	90.00	49.50	15.20
	7xx-1SB-288	1			19.1	85	340			21.20
20”	7xx-320	0	96 x (29x 0.025)	89%	20.7	3.3	~~~~	99.00	55.00	16.90
	7xx-1SB-320	1			21.1	65	260			23.10
22”	7xx-352	0	96 x (29x 0.025)	85%	22.7	2.5	~~~~	107.50	60.50	18.70
	7xx-1SB-352	1			23.1	50	200			25.20
24”	7xx-384	0	96 x (29x 0.025)	81%	24.7	2.3	~~~~	114.50	66.00	20.40
	7xx-1SB-384	1			25.1	45	180			27.30

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

740 Series Monel Hose

740 Series annular corrugated hose made with Monel 400 hose and braid is widely used for applications that require more corrosion resistance than stainless steel offers, such as chlorine transfer hoses. For chlorine transfer hoses, consult factory for additional data.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a]		Bend Radius (in.)		Weight per Foot (Lb.)
						Working[b]	Nominal Burst	Dynamic	Static	
	740-004	0			0.5	144	----			0.09
1/4"	740-1MB-004	1	24 x 4 x .016	84	0.58	1,722	6,888	5.00	2.50	0.19
	740-2MB-004	2			0.66	2,755	11,021			0.29
	740-008	0			0.82	64	----			0.39
1/2"	740-1MB-008	1	24 x 5 x .016	72	0.9	741	2,964	8.00	4.00	0.63
	740-2MB-008	2			0.98	1,186	4,742			0.87
	740-012	0			1.21	156	----			0.48
3/4"	740-1MB-012	1	36 x 6 x .016	82	1.29	629	2,516	8.00	4.00	0.79
	740-2MB-012	2			1.38	1,006	4,026			1.10
	740-016	0			1.5	32	----			0.79
1"	740-1MB-016	1	36 x 8 x .016	86	1.58	517	2,068	9.00	4.50	1.00
	740-2MB-016	2			1.66	827	3,309			1.20
	740-024	0			2.19	16	----			0.84
1-1/2"	740-1MB-024	1	48 x 9 x .016	87	2.27	343	1,372	12.00	6.00	1.28
	740-2MB-024	2			2.35	549	2,195			1.72
	740-032	0			2.60	12	----			1.04
2"	740-1MB-032	1	48 x 14 x .016	97	2.68	376	1,504	15.00	7.50	1.72
	740-2MB-032	2			2.76	602	2,022			2.40
	740-048	0			3.78	8	----			1.21
3"	740-1MB-048	1	72 x 12 x .016	82	3.88	221	884	22.00	11.00	2.04
	740-2MB-048	2			3.98	354	1,414			2.87

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

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776 Series Hastelloy Hose

776 Series is a high-quality industrial hose made from Hastelloy C276 which is among the most corrosion resistant alloys currently available. This annular corrugated hose is commonly used in power generation, steelmaking, chemical manufacturing, and oil & gas.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a]		Bend Radius (in.)		Weight per Foot (Lb.)
						Working[b]	Nominal Burst	Dynamic	Static	
	776-008	0			0.82	80	----			0.25
1/2"	776-1SBX-C276-008	1	24 x 8 x .016	94	0.89	1,075	4,301	5.00	2.50	0.43
	776-2SBX-C276-008	2			0.96	1,720	6,880			0.60
	776-012	0			1.21	70	----			0.43
3/4"	776-1SBX-C276-012	1	36 x 8 x .016	95	1.28	792	3,168	6.00	3.00	0.69
	776-2SBX-C276-012	2			1.35	1,267	5,069			0.96
	776-016	0			1.51	40	----			0.58
1"	776-1SBX-C276-016	1	36 x 10 x .016	95	1.58	571	2,285	7.30	3.65	0.91
	776-2SBX-C276-016	2			1.65	916	3,664			1.24
	776-024	0			2.19	20	----			0.92
1-1/2"	776-1SBX-C276-024	1	48 x 8 x .020	92	2.28	472	1,887	8.60	4.30	1.47
	776-2SBX-C276-024	2			2.37	755	3,021			2.02
	776-032	0			2.60	15	----			1.00
2"	776-1SBX-C276-032	1	48 x 10 x .020	93	2.72	516	2,064	12.00	6.00	1.67
	776-2SBX-C276-032	2			2.84	826	3,302			2.33
	776-048	0			3.78	10	----			1.21
3"	776-1SBX-C276-048	1	72 x 9 x .020	85	3.88	316	1,264	22.00	9.00	2.23
	776-2SBX-C276-048	2			3.98	506	2,022			3.26
	776-064	0			4.85	8	----			1.69
4"	776-1SBX-C276-064	1	72 x 11 x .020	89	4.98	232	927	27.00	13.00	2.94
	776-2SBX-C276-064	2			5.10	371	1,485			4.19
	776-096	0			6.87	5	----			3.47
6"	776-1SBX-C276-096	1	72 x 10 x .025	90	7.10	165	660	36.00	19.00	5.25
	776-2SBX-C276-096	2			7.33	264	1,056			7.03
	776-128	0			9.09	6	----			5.56
8"	776-1SBX-C276-128	1	96 x (21 x .024)	96	9.19	234	934	40.00	20.00	9.44
	776-2SBX-C276-128	2			9.28	374	1,495			13.36

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

625 Series Inconel Hose

625 Series annular corrugated hose is used for corrosive applications and where operating or ambient temperatures are especially high.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	625-004	0			0.48	180	----			0.09
1/4"	625-1IB-004	1	24 x 5 x .014	89	0.57	2,116	8,464	5	1	0.17
	625-2IB-004	2			0.64	3,125	12,500			0.26
	625-006	0			0.63	100	----			0.13
3/8"	625-1IB-006	1	24 x 8 x .014	97	0.70	1,501	6,004	5.5	1.25	0.27
	625-2IB-006	2			0.81	2,401	9,604			0.41
	625-008	0			0.82	80	----			0.23
1/2"	625-1IB-008	1	24 x 9 x .014	94	0.89	1,075	4,301	6	1.5	0.39
	625-2IB-008	2			0.96	1,720	6,880			0.54
	625-012	0			1.21	70	----			0.39
3/4"	625-1IB-012	1	36 x 9 x .014	94	1.28	792	3,168	8	2.25	0.62
	625-2IB-012	2			1.35	1,267	5,069			0.86
	625-016	0			1.51	40	----			0.53
1"	625-1IB-016	1	36 x 10 x .014	91	1.58	571	2,285	9	2.75	0.79
	625-2IB-016	2			1.65	914	3,654			1.05
	625-020	0			1.85	25	----			0.76
1-1/4"	625-1IB-020	1	48 x 7 x .016	83	1.93	531	2,125	10.5	3.5	1.07
	625-2IB-020	2			2.02	850	3,398			1.37
	625-024	0			2.19	20	----			0.84
1-1/2"	625-1IB-024	1	48 x 10 x .016	92	2.28	472	1,887	12	4	1.29
	625-2IB-024	2			2.37	755	3,021			1.74
	625-032	0			2.60	15	----			0.90
2"	625-1IB-032	1	48 x 10 x .020	95	2.72	516	2,064	15	5	1.61
	625-2IB-032	2			2.84	826	3,302			2.31
	625-040	0			3.23	12	----			1.16
2-1/2"	625-1IB-040	1	72 x 8 x .020	93	3.33	387	1,548	20	8	2.01
	625-2IB-040	2			3.43	619	2,477			2.85
	625-048	0			3.78	10	----			1.21
3"	625-1IB-048	1	72 x 9 x .020	93	3.88	316	1,264	22	9	2.16
	625-2IB-048	2			3.98	506	2,022			3.12
	625-064	0			4.85	8	----			1.69
4"	625-1IB-064	1	72 x 11 x .020	89	4.98	232	927	27	13	2.68
	625-2IB-064	2			5.10	371	1,485			4.02
	625-096	0			6.87	5	----			3.47
6"	625-1IB-096	1	96 x 12 x .020	90	7.10	165	660	36	19	5.09
	625-2IB-096	2			7.33	264	1,056			6.71
	625-128	0			9.09	6	----			5.56
8"	625-1IB-128	1	96 x (21 x .024)	96	9.19	234	934	40	20	9.48
	625-2IB-128	2			9.28	374	1,495			13.40

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

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794 Series Bronze Hose

794 Series annular corrugated hose is used often in seismic and water applications and in HVAC piping layouts to connect chillers and for vibration eliminators with copper tube ends.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	794-004	0			0.49	100	----			0.13
1/4"	794-1BB-004	1	24 x 4 x .016	84	0.57	1,035	4,142	5.50	1.00	0.23
	794-2BB-004	2			0.65	1,656	6,627			0.33
	794-006	0			0.67	40	----			0.25
3/8"	794-1BB-006	1	24 x 5 x .016	81	0.75	685	2,738	6.00	1.25	0.36
	794-2BB-006	2			0.83	1,096	4,381			0.47
	794-008	0			0.82	40	----			0.38
1/2"	794-1BB-008	1	24 x 8 x .016	94	0.9	706	2,825	7.00	1.50	0.57
	794-2BB-008	2			0.98	1,130	4,520			0.76
	794-012	0			1.21	30	----			0.5
3/4"	794-1BB-012	1	36 x 6 x .020	92	1.31	577	2,307	8.00	2.25	0.83
	794-2BB-012	2			1.41	923	3,691			1.16
	794-016	0			1.51	20	----			0.68
1"	794-1BB-016	1	36 x 8 x .020	95	1.61	470	1,881	10.00	3.00	1.12
	794-2BB-016	2			1.71	752	3,009			1.56
	794-020	0			1.85	15	----			0.80
1-1/4"	794-1BB-020	1	48 x 7 x .020	93	1.95	361	1,443	12.00	3.50	1.31
	794-2BB-020	2			2.05	577	2,309			1.82
	794-024	0			2.18	10	----			1.03
1-1/2"	794-1BB-024	1	48 x 6 x .025	89	2.31	329	1,317	13.50	4.00	1.73
	794-2BB-024	2			2.43	526	2,107			2.43
	794-032	0			2.5	8	----			1.81
2"	794-1BB-032	1	48 x 8 x .025	92	2.63	317	1,267	17.00	5.00	2.73
	794-2BB-032	2			2.75	507	2,027			3.65
	794-040	0			3.18	8	----			1.39
2-1/2"	794-1BB-040	1	48 x 11 x .025	97	3.31	272	1,090	22.00	8.00	2.66
	794-2BB-040	2			3.43	435	1,744			3.93
	794-048	0			3.65	10	----			1.44
3"	794-1BB-048	1	72 x 12 x .020	92	3.78	211	844	24.00	12.00	2.84
	794-2BB-048	2			3.91	338	1,352			4.11
	794-064	0			4.81	8	----			3.45
4"	794-1BB-064	1	72 x 9 x .025	90	4.94	142	568	26.00	14.00	5.03
	794-2BB-064	2			5.06	227	909			6.61

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

400 Series Stainless Steel Hose

400 Series is Penflex's only helical hose product. While still used in many applications where self-draining is a desired feature, increasingly P3 is used for ease of fabrication.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a] Working[b]	Nominal Burst	Bend Radius (in.) Dynamic	Static	Weight per Foot (Lb.)
	4xx-004	0			0.43	180	----			0.06
1/4"	4xx-1HHB-004	1	24 x 6 x .012	94	0.50	1,987	7,950	5.00	1.00	0.14
	4xx-2HHB-004	2			0.58	3,125	12,500			0.22
	4xx-006	0			0.59	100	----			0.11
3/8"	4xx-1HHB-006	1	24 x 8 x .012	94	0.66	2,000	8,000	5.50	1.00	0.21
	4xx-2HHB-006	2			0.74	2,800	11,200			0.32
	4xx-008	0			0.73	80	----			0.14
1/2"	4xx-1HHB-008	1	24 x 8 x .012	87	0.80	1,500	6,000	6.50	1.50	0.24
	4xx-2HHB-008	2			0.87	1,900	7,600			0.34
	4xx-012	0			1.00	52	----			0.22
3/4"	4xx-1HHB-012	1	36 x 8 x .012	91	1.07	1,000	4,000	8.00	1.50	0.37
	4xx-2HHB-012	2			1.15	1,450	5,800			0.52
	4xx-016	0			1.28	30	----			0.28
1"	4xx-1HHB-016	1	36 x 8 x .016	93	1.37	875	3,500	8.75	1.75	0.54
	4xx-2HHB-016	2			1.46	1,280	5,120			0.81

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

400 Series Compressed

400 Series is Penflex's only helical hose product. While still used in many applications where self-draining is a desired feature, increasingly P3 is used for ease of fabrication.

Nom. I.D (in.)	Part Number	Braid Layers	Braid Construction	Braid Coverage (%)	Nom. O.D. (in.)	Maximum Pressure @ 70°F (PSIG)[a]		Bend Radius (in.)		Weight per Foot (Lb.)
						Working[b]	Nominal Burst	Dynamic	Static	
1/4"	4xx-2HHB-004-CP	2	24 x 6 x .012	94	0.58	4,000	16,000	5.00	1.00	0.22
3/8"	4xx-2HHB-006-CP	2	24 x 8 x .012	94	0.74	3,125	12,500	5.50	1.00	0.35
1/2"	4xx-2HHB-008-CP	2	24 x 8 x .012	87	0.87	2,500	10,000	6.50	1.50	0.43
3/4"	4xx-2HHB-012-CP	2	36 x 8 x .012	91	1.15	1,875	7,500	8.00	1.50	0.65
1"	4xx-2HHB-016-CP	2	36 x 8 x .016	93	1.46	1,600	6,400	8.75	1.75	0.93

a. Pressures listed have been reduced to account for welding as the method of attachment. Other methods such as brazing, neck-down designs or crimping will result in different pressures. Contact the factory for details.
b. Test pressure is 1.5x the Maximum Allowable Working Pressure (MAWP) for single braid layer and 1.1x MAWP for multiple braid layers.

Manufacturing Processes

Transforming a straight tube into a corrugated hose requires a forming process that creates a series of peaks and valleys that then in turn permit the hose to flex.

There are three basic corrugation processes: mechanical forming, hydraulic forming and hydroforming. All three use machines that have many similarities and a few basic differences to create corrugations. Each process has slight advantages and disadvantages that affect the final product. As all are time tested and proven, no one process can claim superiority over another.

To that end, the term “hydroforming” is sometimes used in a manner that can be misleading to suggest a gentle forming process that endows hoses with certain desirable characteristics that are in fact not determined by the manufacturing process. Hydroforming uses liquid or oil to push a straight tube from the inside into a series split dies. Even if water is being used, water under pressure can exert a great amount of force, and to bend metal such force is required. No matter what you call it, hydroforming is still a type of mechanical forming.

Penflex’s mechanically formed hoses in the 700, 800, 900 and 1400 Series also use split dies. However, we do not use internal water pressure. Instead, we rely on an internal rotating die to create an initial indentation which, as the tube moves through the corrugator, is deepened by split dies which close around either side of the indentation and move towards one another, raising the corrugation to its final height. Some of our hoses are also made using an internal urethane ring which—similar to the liquid in hydroforming—pushes the hose into a set of external split dies. Penflex’s P3 and P4 Series hoses are formed using progressive external dies which form corrugations through several gradual steps.

A metal tube will react the same way whether corrugations are formed using pressurized water or expanded rubber. The stresses on the material are the same if the relative change in geometry is the same. Thus, the design of the tooling (the use of smooth curves) and the ability to avoid stress concentrations in the hose geometry are much more important than the medium used to apply the forming force.

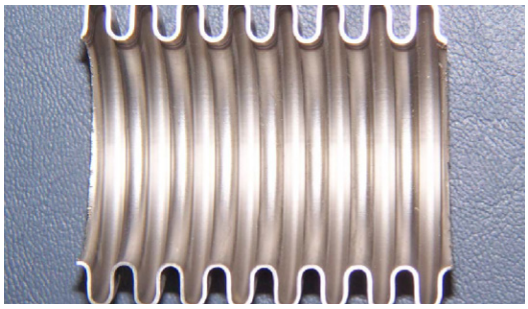
Claims that hydroforming reduce concentrated residual stress and minimize work hardening can be misleading given it's tooling that produces such results. Similarly claims that hydroforming enhances flexibility and cycle life confuse cause and effect. These characteristics are a function of hose geometry—wall thickness, ID, OD, corrugation count, and shape of corrugation—rather than manufacturing method.

Impact on Wall Thickness

Regardless of forming process, all hoses will exhibit variation in wall thickness when measured at various locations of the corrugation. This can be confirmed by measurement using the following procedure.

Basic Measurement Procedure

Each sample should be carefully “clam shelled” using a high-speed band saw to ensure cuts are made in the same manner and to prevent distortion from handling. Pieces should be buffed with a metal wire brush to remove any burrs. One convolution should then be cut from each end of the sample as can be seen in the picture below.



The object is to measure the material thickness at different locations along the tube to determine if the material thickness of the flat, rolled steel is maintained and consistent.

Measurements should be taken in three distinct areas about the convolution: the peak, the valley, and the side wall. Due to the unique shape of the convolution, a point micrometer is the best instrument to use, and should be oriented perpendicular to the material to get an accurate measurement.

In a test carried out by an independent lab on 1” samples of hydroformed and mechanically formed hoses, the results showed that wall thickness varied regardless of

forming process. Which manufacturing process is used will only affect the percentage of variation at different locations. The hydroformed hose saw the greatest amount of thinning at the crest, while the mechanically formed hose saw the greatest amount of thinning within the valley. Overall, the hydroformed hose saw an 8% reduction in wall thickness while the mechanically formed hose saw a 5% reduction in wall thickness.

Claims that hydroformed hose is superior to mechanically formed hose obscure one important issue, and that is the penetration rates of corrosive media and longer life from increased wall thickness. Hydroformed hose is typically made from thin strip. Mechanically formed hose can be manufactured from a wider range of strip thicknesses. Using thicker strip, even with thinning as measured above, still provides a hose that will last longer in a corrosive application than a thinner wall hose, other design components being the same.

Metal Hose Selection Criteria

The selection of flexible metal hose for a particular application is influenced by six primary considerations:

- Temperature
- Pressure
- Media
- Size
- End Fittings
- Motion

Temperature
The physical properties of any material vary with temperature. While many of the 300 series austenitic stainless steels (including 304L, 316L and 321) can be used at temperatures up to 1500°F, operating temperature limits are also affected by end fittings, the method of welding attachment, working pressure, type of media being conveyed, and the nature of the application, i.e., static or dynamic.

The 300 series is also rated for cryogenic service, capable of operating in applications with liquid helium, the coldest material known with a boiling point of -452°F. At such low temperatures, some material physical properties actually improve.

Pressure
The nominal pressure ratings of flexible metal hose vary according to type, material and size. Specific pressure ratings for each type of hose are found in this catalog. Under actual working conditions, pressure is affected by many other factors such as temperature, vibration, and bending stresses.

Media
The type of media being conveyed is an important consideration in the selection process. Metal hose is subject to corrosion by both the material flowing through it and the outside environment. For almost all applications, a metal hose can be selected that is resistant to the intended media.

To assess an alloy's chemical compatibility, refer to the chart posted on our website:
http://www.penflex.com/corrosion

Size
The size of flexible metal hose is specified by the nominal diameter. The existing piping will normally dictate the size of the metal hose for a particular application. However, flow rate, velocity and pressure drop considerations may also influence the selection of the hose size.

End Fittings
The use of flexible metal hose is complimented by an extensive range of end fittings that are available, including male or female pipe threads, unions, flanges, flared tube fittings and other specially designed connectors. Depending on the type of hose and the alloy, end fittings are attached by welding, silver brazing, soldering and occasionally by mechanical means.

Motion
Flexible metal hose is generally used in four types of applications.

- To correct problems of misalignment
- To provide flexibility in manual handling operations
- To compensate for regular or constant movement
- To absorb vibration

In all types, careful hose selection, design of the assembly and installation are important for optimal service life.

Common Alloys Cross Reference

Chart key:

AISI = American Iron and Steel Institute
UNS No. = Unified Numbering System
Werkstoff No. = German “Werkstoff” numbering system (Widely used in Europe)
DIN = Deutsches Institut für Normung (the German Institute for Standardization)

AISI grade	UNS No.	Werkstoff No.	DIN Designation
405	S40500	1.4002	X6CrAl13
410	S41000	1.4006	X12Cr13, X10Cr13
410S	S41008	1.4000	X6Cr13
416	S41600	1.4005	X12CrS13
430	S43000	1.4016	X6Cr17
446	S44600	1.4763	X8Cr24
2205	S31803	1.4462	X2CrNiMoN22-5-3
2207	S32750	1.4410	X2CrNiMoN25-7-4
303	S30300	1.4305	X8CrNiS18-9
304L	S30403	1.4307	X2CrNi18-9
304	S30400	1.4301	X5CrNi18-10
304H	S30409	1.4301	X5CrNi18-10
316	S31600	1.4401	X5CrNiMo17-12-2
316L	S31603	1.4404	X2CrNiMo17-12-2
316Ti	S31635	1.4571	X6CrNiMo17-12-2
317L	S31703	1.4438	X2CrNiMo18-15-4
317	S31703	1.4449	X5CrNiMo18-15-4
321	S32100	1.4541	X6CrNiTi18-10
321H	S32109	1.4541	X6CrNiTi18-10
347	S34700	1.4550	X6CrNiNb18-10
AL6XN	N08367	1.4529	****
309S	S30908	1.4833	X12CrNi24-12
309	S30900	1.4833	X12CrNi24-12
310S	S31008	1.4845	X8CrNi25-21
310H	S31009	1.4845	X8CrNi25-21
310	S31000	1.4845	X12CrNi25-21
314	S31400	1.4841	X15CrNiSi25-20
800	N08800	1.4876	X10NiCrAlTi32-20
800H	N08810	1.4876	X10NiCrAlTi32-20
Alloy 825	N08825	1.4876	NiCr21Mo
Alloy 625	N06625	2.4856	NiCr22Mo9Nb
Alloy 600	N06600	2.4816	NiCr15Fe
Alloy 718	N07718	2.4668	NiCr19NbMo
Monel 400	N04400	2.4360	NiCu30Fe
Monel K-500	N05500	2.4668	NiCu30Al
Alloy C276	N10276	2.4375	NiMo16Cr15W
Alloy 194	C19400	2.1310	****

Temperature Adjustment Factors

In general, the strength and therefore the pressure rating of metal hose decreases as the temperature increases. Thus, as the operating temperature of a metal hose assembly increases, its maximum allowable working pressure decreases. The pressure ratings shown in Penflex catalog specifications charts for corrugated and interlocked hose are valid at 70°F. Elevated service temperatures will decrease these pressure ratings by factors shown in the following chart. **Derating factors are based on braid alloy.** For example, to calculate the maximum working pressure for a 700 Series ¾" 321 stainless steel corrugated hose with one layer of 304L braid that will be operating at 800°F, multiply working pressure (792 PSIG) by appropriate derating factor (.73). The working pressure for the hose at 800°F is 578 PSIG. Keep in mind, the maximum working temperature of the end fittings and method of attachment must also be considered.

Penflex developed its derating factors after gathering raw data on tensile strength at elevated temperatures from major material suppliers and taking the lowest values in each category for the various alloys. For this reason, they may be more conservative than derating factors published by NAHAD or ISO 10380.

Temperature Reduction Factors

Temp (°F)	304L	316L	321	Monel 400	Bronze	Hastelloy C276	Inconel 625	Carbon Steel
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
150	0.95	0.93	0.97	0.93	0.92			0.99
200	0.91	0.89	0.94	0.90	0.89	1.00	0.96	0.97
250	0.88	0.86	0.92	0.87	0.86			0.96
300	0.85	0.83	0.88	0.83	0.83	1.00	0.94	0.93
350	0.81	0.81	0.86	0.82	0.81			0.91
400	0.78	0.78	0.83	0.79	0.78	1.00	0.93	0.87
450	0.77	0.78	0.81	0.77	0.75			0.86
500	0.77	0.77	0.78	0.73		0.99	0.93	0.81
600	0.76	0.76	0.77	0.72		0.92	0.93	0.74
700	0.74	0.76	0.76	0.71		0.88	0.93	0.66
800	0.73	0.75	0.68	0.70		0.85	0.93	0.52
900	0.68	0.74	0.62			0.83	0.93	
1000	0.60	0.73	0.60			0.82	0.93	
1100	0.58	0.67	0.58			0.55	0.90	
1200	0.53	0.61	0.53			0.36	0.84	
1300	0.44	0.55	0.46				0.70	
1400	0.35	0.48	0.42				0.57	
1500	0.26	0.39	0.37				0.50	
1600							0.30	
1800							0.14	

Saturated Steam Pressure to Temperature (PSIG)

Saturated Steam (PSIG)	Temp (°F)
0	212
10	238
20	259
30	274
40	287
50	298
60	307
75	320
80	324
90	331
100	338
125	353
150	366
175	377
200	388
225	397
250	406
275	414
300	422
325	429

Saturated Steam (PSIG)	Temp (°F)
350	436
375	442
400	448
425	454
450	460
475	465
500	470
550	480
600	489
700	505
800	520
900	534
1000	546
1250	574
1500	606
2500	669

Saturated Steam Pressure to Temperature (Hg)

Saturated Steam Vacuum (in. of Hg)	Temp (°F)
-	0
29.84	20
29.74	32
29.67	40
29.39	60
28.89	80
27.99	100
26.48	120
24.04	140
20.27	160
15.20	180
6.46	200

Pressure Loss, Flow Velocity and Hose Flexibility

Pressure Loss

For the same flow characteristics, the pressure loss is higher in metal hoses than rigid piping, due to the profile of the corrugations. As a rough estimation, expect the pressure loss in corrugated hoses to be 150 percent higher than in new, smooth steel pipes.

Flow Velocity Considerations

Velocity is the speed at which the medium flows through the hose. The flow velocity in corrugated metal hose should never exceed 150 ft./sec. for gas or 75 ft./sec. for liquids. When a hose is installed in a bent condition, the flow values should be reduced proportionally to the degree of the bend. Where the flow velocity exceeds these rates, an interlocked metal hose liner or larger hose I.D. is recommended.

To determine your application's flow velocity, visit the Velocity Calculator on penflex.com where you can simply add your inputs and click calculate to find out.

Hose Flexibility: A Complex Calculation

There is a common misperception that the corrugation forming process (i.e., mechanical, hydroforming, etc.) determines how flexible a hose is. Rather, it is the geometry of the hose that dictates just how flexible it will be.

When we say hose geometry, we are referring to these characteristics:

- Inside diameter (ID)
- Outside diameter (OD)
- Wall thickness
- Corrugation width
- Corrugation count

Braid design is an additional variable. When we say braid design, we are referring to its construction which includes the following properties.

- Number of bands of wires or number of carriers
- Number of wires per band
- Diameter of the wires
- Angle of the braid from longitudinal axis

Furthermore, changes in the mechanical properties of the strip or wire used to make braided hose affect the force needed to bend a hose, and thus impact its flexibility. When we talk about these mechanical properties, we are referring to:

- Tensile strength
- Temper
- Elongation

Increases in tensile strength, temper and elongation increase the force required to bend a hose, thereby reducing flexibility.

All of the attributes listed above play a role in the flexibility of a hose or braided hose assembly, and each one is taken into consideration individually as well as collectively when designing the right solution for a particular application.

For instance, if all else remains the same, increasing wall thickness will decrease flexibility. Alternatively, decreasing wall thickness will increase flexibility.

However, increasing wall thickness can be offset by increasing the corrugation count, or increasing the OD—or both—to retain flexibility. Of course, all these characteristics are limited by the ranges within which changes can occur.

If a wider corrugation is desired to reduce the metal content and thus the cost of a hose, a thinner wall hose can be used to retain flexibility and further reduce weight per foot. These changes, however, reduce burst pressures and the hose will fail earlier than a heavier hose when subjected to the predicted penetration of the media.

The important point to keep in mind is that design of a braided hose is always a matter of optimization, and the effects of increasing or decreasing one of the above characteristics can be offset by other changes to the design to achieve the goal set for a particular hose.

Classifications of Motion

Note: Penflex's online Minimum Live Length Calculator will do this number crunching for you. Visit the Technical Tools section of penflex. com, select your type of motion, add inputs and the calculator will determine the minimum live length required for your assembly.

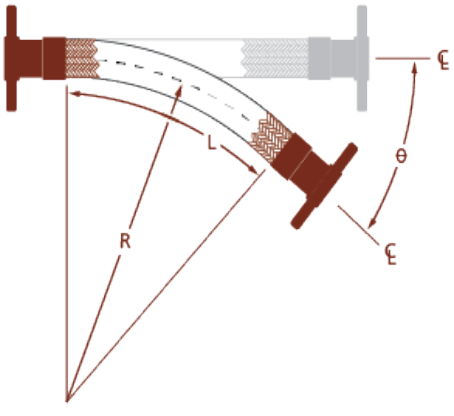
Random Motion
Random motion is non-predictable and occurs during manual handling of the assembly. Care must be taken to prevent over-bending and to avoid external abrasion of the wire braid. An armor covering of interlocked hose is one way to provide protection against these abuses. Proper handling is another.

Axial Motion
This type of motion occurs when there is extension or compression of the hose along its longitudinal axis. A braided hose can accommodate axial motion only in a traveling loop configuration otherwise, if space is a concern, an expansion joint may be a more appropriate option.

Angular Motion
This type of motion occurs when one end of a hose assembly is deflected in a simple bend with the ends not remaining parallel.

L = Live Hose Length (in.)
R = Minimum Centerline Bend Radius, Dynamic (in.)
θ = Angular Deflection (deg.)
s = Outside Diameter (In.)

$$L = \pi R\theta/180 + 2(s)$$



Offset Motion
Offset motion occurs when one end of the hose assembly is deflected in a plane perpendicular to the longitudinal axis with the ends remaining parallel.

This movement can be due to a one-time (static) bend or movement which repeatedly occurs slowly over time such as thermal expansion. The appropriate formula to use to calculate Live Hose Length depends on the condition of the moving end, which Penflex describes as either being "in" or "out" of line.

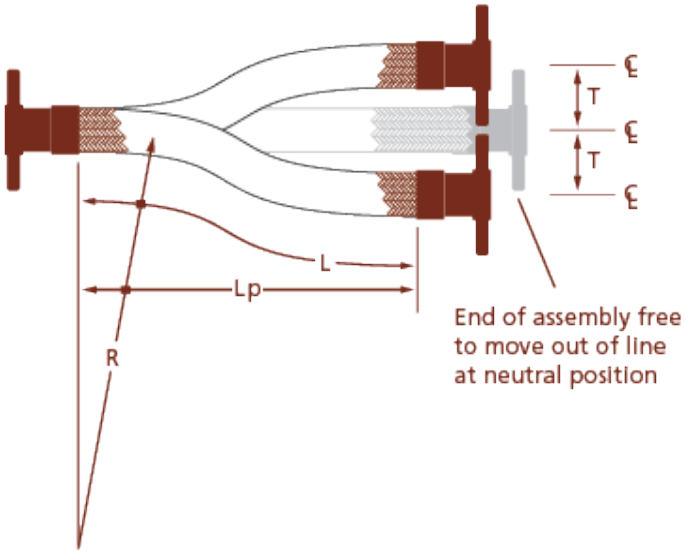
When the offset motion occurs to both sides of the hose centerline, use total travel in the formula; i.e., 2 x "T." The offset distance "T" for constant flexing should never exceed 25 percent of the centerline bend radius "R." If the difference between "L" and "Lp" is significant, exercise care at installation to avoid stress on hose and braid at the maximum offset distance.

L = Live Hose Length (in.)
Lp = Projected Live Hose Length (in.)
R = Minimum Centerline Bend Radius, Dynamic (in.)
T = Offset Motion to One Side of Centerline (in.)

Minimum Bend Radius Occurs at Offset Position
Moving end is free to move "out of line" at neutral position.

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

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

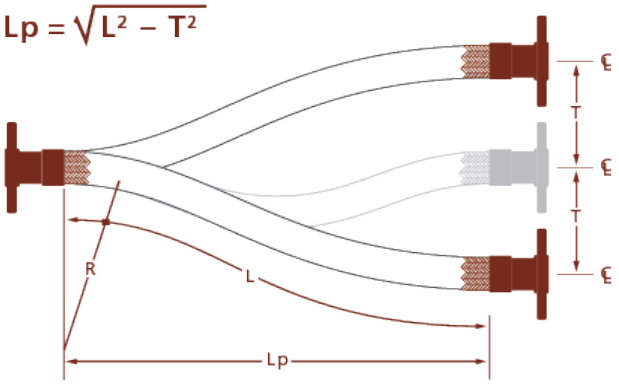


Minimum Bend Radius Occurs at Crowded Position

Moving end is restricted to move only up and down as hose crosses neutral position.

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

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



Traveling Loops

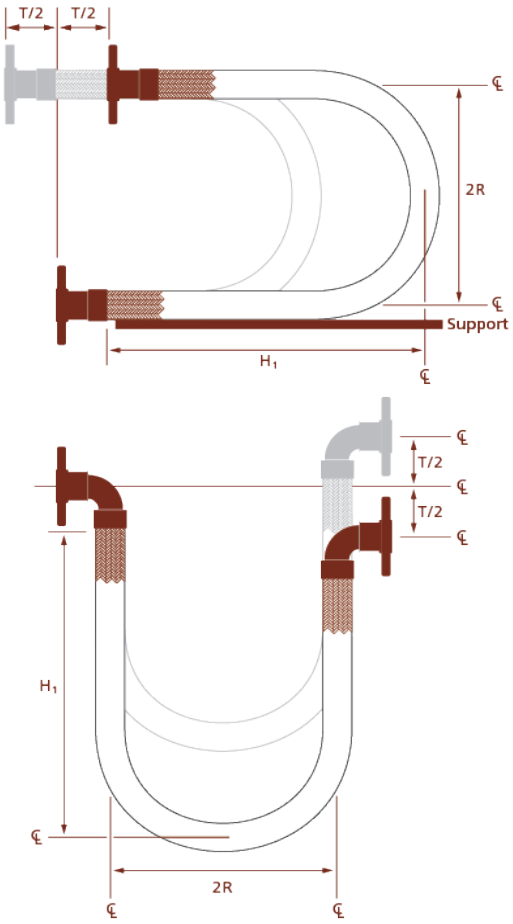
In a piping system where axial movement must be accommodated or where the magnitude of the motion is in excess of the limits of an offset movement, the traveling loop configuration offers an ideal solution.

In traveling loops, the centerline of a hose assembly is bent in a circular arc. Traveling loops accommodate movement in one of two ways. A constant radius traveling loop accommodates motion by varying the length of the arms of the assembly while the radius remains constant. A variable radius traveling loop accommodates motion by varying the bend radius of the hose assembly. Both types of traveling loops can be installed to absorb either horizontal or vertical movement. The constant radius traveling loop provides for greater movement while the variable radius traveling loop requires less installation space.

L = Live Hose Length (in.)
R = Minimum Centerline Bend Radius, Dynamic (in.)
T = Total Travel (in.)
H = Hang Length of Loop (in.)

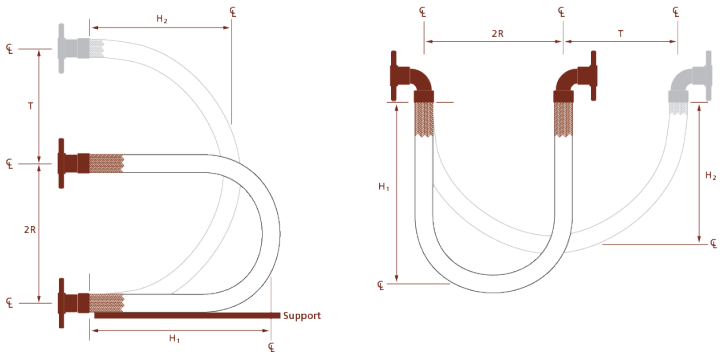
Constant Radius Traveling Loop – Class A

$$L = 4R + T/2$$
$$H1 = 1.43 + T/2$$



Variable Radius Traveling Loop – Class B

$$L = 4R + 1.57T$$
$$H1 = 1.43R + 0.79T$$
$$H2 = 1.43R + 0.5T$$



Assembly Installation

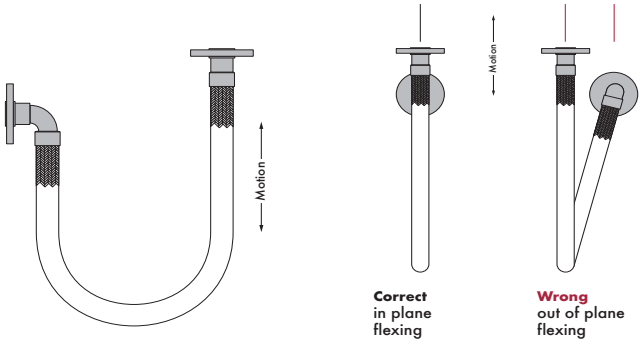
Penflex hose is engineered to provide maximum service life when properly installed. Improper installation, incorrect flexing or careless handling in an application will reduce the effective service life of the hose and cause premature failure of an assembly. The following installation and handling precautions should be observed to achieve optimum performance from hose assemblies.

Avoid torque

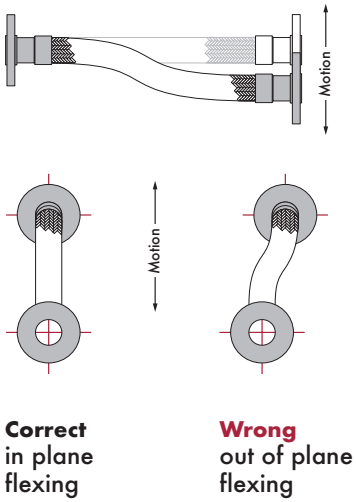
Do not twist the hose assembly during installation when aligning the bolt holes in a flange or in making up pipe threads. The utilization of lap joint flanges or pipe unions will minimize this condition. It is recommended that two wrenches be used in making the union connection; one to prevent the hose from twisting and the other to tighten the coupling.

Prevent Out of Plane Flexing

Prevent out-of-plane flexing in an installation. Always install the hose so that the flexing takes place in only one plane. This plane must be the plane in which the bending occurs.

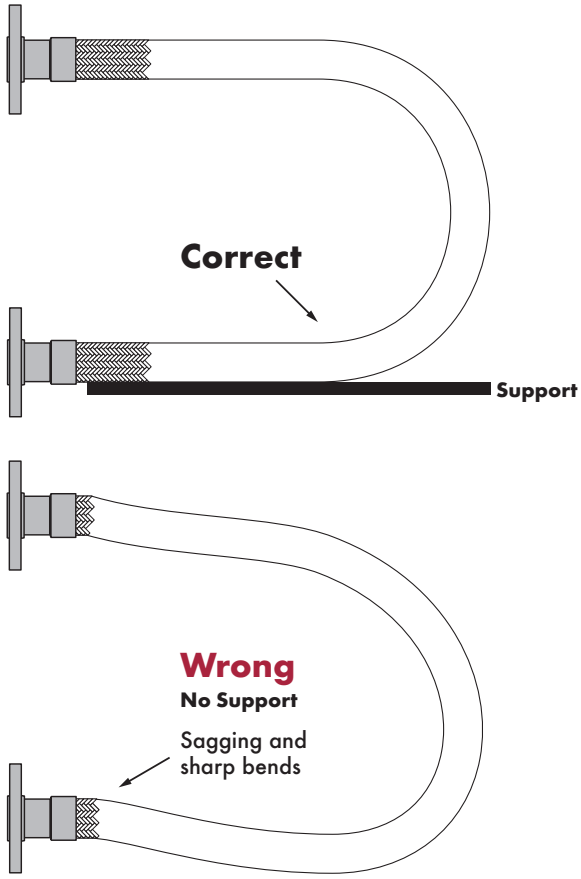


In plane lateral offset installation



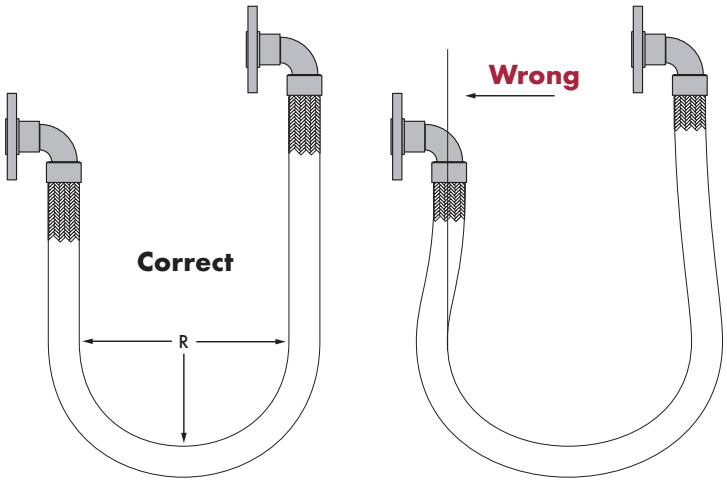
Provide support

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



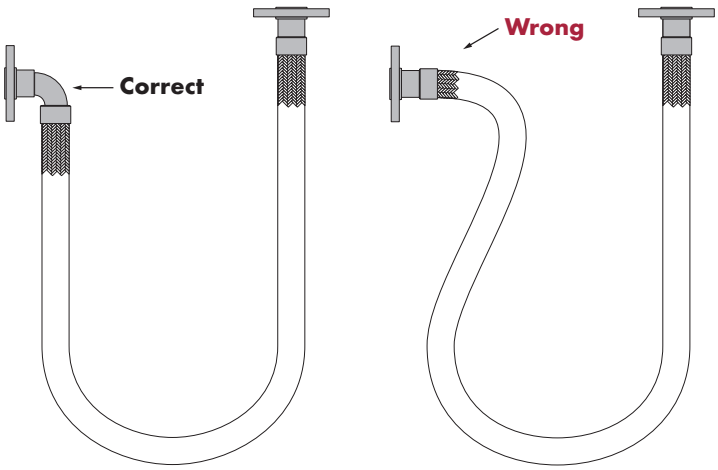
Avoid over bending

The repetitive bending of a hose to a radius smaller than the radius listed in the specification tables will result in premature hose failure. Always provide sufficient length to prevent over bending and to eliminate strain on the hose.



Avoid sharp bends

Utilize sound geometric configurations that avoid sharp bends, especially near the end fittings of the assembly.

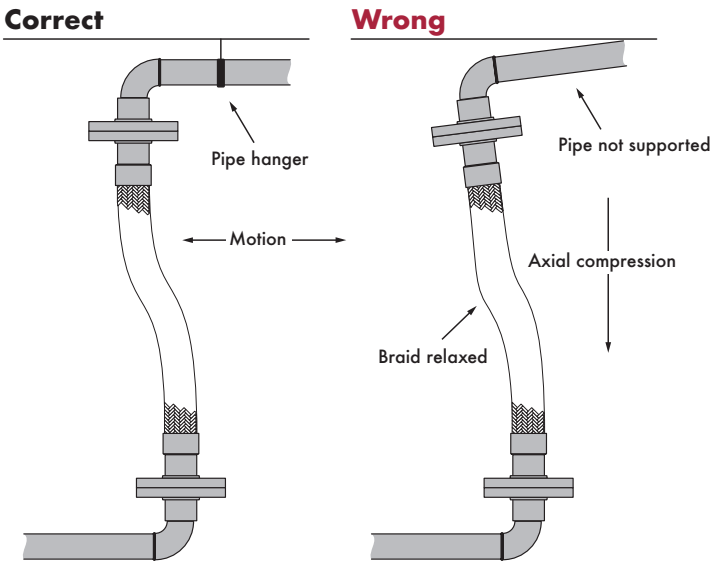


Handle with care

Avoid careless handling of the hose assembly. Always lift or carry assemblies to prevent abrasion damage and store away from areas where they can be subjected to spillage, corrosive fumes or sprays, weld splatter, etc.

Do not extend or compress axially

A piping system which utilizes metal hose to absorb movement must be properly anchored and/or guided. Always support the piping to prevent excessive weight from compressing the hose and relaxing the braid tension.



Maximizing the Safety and Effectiveness of an Assembly

Do...

- design assembly to allow a 2" straight run of hose at each end fitting.
- account for ground movement after installation, such as settling or frost heave.
- handle and store assembly carefully prior to installation.
- install assembly so that the bend is as close to the center of the connector as possible.
- observe minimum bend radius as specified by the manufacturer.
- trial-fit threaded connections by hand, unmake, and then make permanent.
- only wrench on the fitting hex flats as provided.
- use pipe wrenches on both mating hexes to avoid twisting the hose.
- keep hose free from all objects and debris.
- install in such a manner that the connector can be removed.
- check for leaks before covering the installation.

Don't...

- lay the flexible connector on rocks or objects which could puncture it.
- "pre–flex" assembly to limber it up.
- over–bend assembly; a 45°–90° bend should be sufficient for installation.
- twist assembly when aligning the bolt holes in a flange or when making up pipe threads.
- stretch or compress assembly to fit an installation.
- install a flexible connector with bend next to the end fittings.
- apply a wrench to the hose or collar.
- allow other components or equipment to obstruct movement of the hose.
- exceed pressure rating of the assembly.

Glossary

Ambient or Atmospheric Conditions: The surrounding conditions, such as temperature, pressure and corrosion, to which a hose assembly is exposed.
Amplitude of Vibration and/or Lateral Movement: The distance a hose assembly deflects laterally to one side from its normal position when deflection occurs on both sides of the normal hose centerline.
Anchor: A restraint applied to a pipeline to control its motion due to thermal growth.
Annular: Refers to a type of corrugated hose where the corrugations are located at right angles to the longitudinal axis of the hose.
Armor or Casing: Flexible interlocked tubing placed over the entire length or in short lengths at the end of a metal hose to protect it from physical damage and to limit the bending radius.
ASME Section IX: Part of the ASME boiler pressure vessel code that contains the rules for qualifying welding procedures and welders, considered to be the industry's highest standard for welders.
Axial Movement: Compression or elongation of the hose along its longitudinal axis.
Basket Weave: A braid pattern in which the strands of wire alternately cross over and under two braid bands—two over, two under.
Bend Radius: The radius of a bend measured to the hose centerline.
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 around the hose in a basket-weave fashion.
Braid Angle: The acute angle formed by the braid strands and the axis of the hose.
Braid Sleeve, Braid Band or Ferrule: A ring made from tube or metal strip placed over the ends of a braided hose to contain the braid wires for attachment of fittings.
Braid Wear: Motion between the braid and corrugated hose which normally causes wear on the O.D. of hose.
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.
Brazing: A process of joining metals using a non-ferrous filler metal which melts above 800°F but below melting of 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.
Circumferential Cracks: Cracks typically found on the crest of corrugations, but also in the valleys, that are symptomatic of vibration fatigue.
Controlled Flexing: Controlled flexing occurs when the hose is being flexed regularly, as in connections to moving components, i.e., platen presses, thermal growth in pipe work.
Corrosion: The chemical or electro-chemical attack of a media upon a hose assembly.
Corrugation: The annular or helical flexing member in corrugated or strip wound hose.
Corrugation Count: See definition for Pitch.
Cycle-Motion: The movement from normal to extreme position and return.
Developed Length: The length of a hose plus fitting required to meet the conditions of a specific application.
Diamond Weave: A braid pattern in which the strands alternately cross over one and under one of the strands—one under, one over. Also known as plain weave.
Dye Penetrant Inspection or Test: A method for detecting surface irregularities, such as cracks, voids, porosity, etc. The surface to be checked is coated with a red dye that will penetrate existing defects. Dye is removed from surface and a white developer is applied. If there is a defect in the surface being checked, the red dye remaining in it causes the white developer to be stained, thereby locating the defective area.
Displacement: The amount of motion applied to a hose defined as inches for parallel offset and degrees for radial misalignment.
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.
Elastic (Intermittent Flexure): The smallest radius that a given hose can be bent to without permanent deformation of

the metal in its flexing members (convolutions or corrugations).
Elongation: Amount of strain a hose can experience before failure.
Erosion: The wearing away of the inside convolutions of a hose caused by the flow of the media conveyed, such as wet steam, abrasive particles, etc.
Exposed Length: The amount of active (exposed) hose in an assembly. Does not include the length of fittings and errules.
Fatigue: Failure of the metal structure associated with, or due to, the flexing of metal hose or bellows.
Ferrule: (See definition for Braid Sleeve)
Fitting: A loose term applied to the nipple, flange union, etc., attached to the end of a metal hose.
Flat Braid: Has a braid angle greater than 45° (See Braid Angle).
Flow Rate: Pertains to a volume of media being conveyed in a given time period, i.e., cubic feet per hour, pounds per second, gallons per minute, etc.
Fretting Corrosion: A kind of mechanical damage caused by uneven material surfaces in contact with another that can lead to more serious damage caused by chemical attack.
Frequency: The rate of vibration or flexure of a hose in a given time period, i.e., cycles per second (CPS), cycles per minute (CPM), cycles per day (CPD), etc.
Galvanic Corrosion: Corrosion that occurs on the less noble of two dissimilar metals in direct contact with each other in an electrolyte, i.e., water, sodium chloride in solution, sulphuric acid, etc.
Guide (For Piping): A device that supports a pipe radially in all directions but allows free longitudinal movement.
H-Grade: Stainless steel alloys with a higher carbon content than their standard and L grade counterparts which offers increased strength at elevated temperatures.
Helical: Used to describe a type of corrugated hose having one continuous convolution resembling a screw thread.
Helical Wire Armor: To provide additional protection against abrasion under rough operating conditions, metal hoses can be supplied with an external round or oval section wire spiral.
Hydrogen Embrittlement: A form of stress corrosion cracking, hydrogen embrittlement is the loss of a metal's ductility and subsequent inability to maintain its load bearing capacity due to the absorption of hydrogen.
Inside Diameter: This refers to the free cross section of the hose and (in most cases) is identical to the nominal diameter.
Installation: Referring to the installed geometry of a hose assembly.
Interlocked 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.
Intermittent Bend Radius: The designation for a radius used for non-continuous operation. Usually an elastic radius.
Lap Weld (LW): Type of weld in which the ends or edges of the metal overlap each other and are welded together.
Liner: Flexible sleeve that can be used to line the I.D. of a hose in a high velocity application.
Medium (Singular)/Media (Plural): The substance(s) being conveyed through a piping system.
Microbially Influenced Corrosion (MIC): Also called microbiologically induced corrosion, bacterial corrosion, or biocorrosion, MIC is caused by microbes that produce corrosive agents as they metabolize nutrients or change electrochemical conditions at the metal surface by their very presence.
Minimum Bend Radius: The smallest radius to which a hose can be bent without suffering permanent deformation of its convolutions.
Misalignment: A condition in which two points, intended to be connected, will not mate due to their being laterally out of line with each other.
Nominal Diameter: A term used to define the dimensions of a component. It indicates the approximate inside diameter.
Offset – Lateral, Parallel, & Shear: The amount that the ends of a hose assembly are displaced laterally in relation to each other as the result of connecting two misaligned terminations in a piping system or intermittent flexure required in a hose application.
Operating Conditions: The pressure, temperature, motion, media, and environment that a hose assembly is subjected to.

Outside Diameter: This refers to the external diameter of a metal hose, measured from the top of the corrugation or braiding.
Penetration (Weld): The percentage of wall thickness of the two parts to be joined that is fused into the weld pool in making a joint. Our standard for penetration of the weld is 100 percent, in which the weld goes completely through the parent metal of the parts to be joined and is visible on the opposite side from which the weld was made.
Percent Of Braid Coverage: The percent of the surface area of a hose that is covered by braid.
Permanent Bend: A short radius bend in a hose assembly used to compensate for misalignment of rigid piping, or where the hose is used as an elbow. Hose so installed may be subjected to minor and/or infrequent vibration or movement.
Pipe Gap: The open space between adjacent ends of two pipes in which a hose assembly may be installed.
Pitch: Also called corrugation count, the distance between the two peaks of adjacent corrugations.
Pitting Resistance Equivalent Number (PREN): A theoretical way of comparing the pitting corrosion resistance of various types of stainless steels based on the chemical compositions of an alloy.
Positive Material Identification (PMI): Testing to analyze composition of a component by reading quantities of its constituent parts, often delivered in percentages.
Pressure: Usually expressed in pounds per square inch (PSI) and, depending on service conditions, may be applied internally or externally to a hose.
a. Absolute Pressure – A total pressure measurement system in which atmospheric pressure (at sea level) is added to the gage pressure and is expressed as PSIA.
b. Atmospheric Pressure – The pressure of the atmosphere at sea level which is 14.7 PSI, or 29.92 inches of mercury.
c. Burst Pressure (Actual and Rated)
a. Actual – Failure of the hose determined by the laboratory test in which the braid fails in tensile, or the hose ruptures, or both, due to the internal pressure applied. This test is usually conducted at room temperature with the assembly in a straight line, but for special applications, can be conducted at elevated temperatures and various configurations
b. Rated – A burst value which may be theoretical, or a percentage of the actual burst pressure developed by laboratory test. It is expected that an assembly may burst at this pressure but would most often burst at a pressure greater than this.
d. Deformation Pressure (Collapse) – The pressure at which the corrugations of a hose are permanently deformed due to fluid pressure applied internally, or, in special applications, externally.
e. Feet of Water or Head Pressure – Often used to express system pressure in terms of water column height. A column of water 1 ft. high exerts a .434 PSI pressure at its base.
f. Proof Pressure or Test Pressure – The maximum internal pressure which a hose can be subjected to without either deforming the corrugations or exceeding 50 percent of the burst pressure. When a hose assembly is tested above 50 percent of its burst pressure, there often is a permanent change in the overall length of the assembly, which may be undesirable for certain applications.
g. PSIA – Pounds per square inch absolute.
h. PSIG – Pounds per square inch gauge.
i. Pulsating Pressure – 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 corrugations.
j. Shock Pressure – A sudden increase of pressure in hydraulic or pneumatic system, which produces a shock wave. This shock can cause severe permanent deformation of the corrugations in a hose as well as rapid failure of the assembly due to metal fatigue.
k. Static Pressure – A non-changing constant pressure.
l. Working Pressure - The pressure, usually internal, but sometimes external, imposed on a hose during operating conditions.
Profile: Used in reference to the contour rolled into strip during the process of manufacturing stripwound hose, or the finished shape of a corrugation; formed from a tube by either the “bump-out”, “sink” or roll forming processes, used in

making corrugated hose.
Random Motion: The non-cyclic uncontrolled motion of a metal hose, such as occurs in manual handling.
Rates of Corrosion: Rates, or speeds, at which materials deteriorate due to penetration of flow media.
Safety Factor: The relationship of working pressure to burst pressure.
Scale: Generally, refers to the oxide in a hose assembly brought about by surface conditions or welding.
Seamless: Used in reference to a corrugated metal hose made from a base tube that does not have a longitudinal seam as in the case of a butt welded or lap welded tube.
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 or unbraided corrugated hose which has been axially compressed, loosening the braid, while the hose is pressurized. This is particularly true with long lengths of braided hose subjected to manual or mechanical handling.
Steam Hammer: See definition for Water Hammer.
Strand(s): Individual groups of wires in a braid. Each group is supplied from a separate carrier in the braiding machine.
Stress Corrosion: A form of corrosion in stainless steel normally associated with chlorides.
Temper: Delivered though heat treating, temper refers to the toughness of a hose, or its ability to absorb energy without fracturing.
Tensile Strength: A metal's ability to resist tension, or the forces that elongate a hose.
Tig Weld: The tungsten inert gas welding process sometimes referred to as shielded arc. The common trade name is heliarc.
Traveling Loop: A general classification of bending, wherein the hose is installed to a U-shaped configuration, most often used when frequent and/or large amounts of motion are involved.
a. Class A Loop – An application wherein the radius remains constant, and one end of the hose moves parallel to the other end of the hose.
b. 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 through one end of a hose assembly while the other end is fixed.
Velocity Resonance: The sympathetic vibration of convolutions due to buffeting of high velocity gas or air flow.
Vibration: Low amplitude motion occurring at high frequency.
Wall Thickness: Determined by base metal thickness, hose wall thickness is an important design consideration impacting corrosion resistance, pressure rating and flexibility.
Water Hammer: Water hammer most often occurs when some of the steam condenses into water in a horizontal section of the steam piping. Subsequently, steam picks up the water, forms a "slug" and hurls it at high velocity into a pipe fitting, creating a loud hammering noise and greatly stressing the pipe.
Welding: The process of localized join 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 materials.
Weld Purging: A proven process that enhances weld quality by decreasing—or even preventing—oxidation through removal of contaminants in the air around the weld.

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