Parker
FluidConnectors

Parflex®
Metal Hose
Instrumentation Markets

Catalog 4690-MH2/US
February 2002

The World Standard

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Introduction to Parflex Flexible Metal Hoses

Description

Parflex metal hoses are available with no braid, one braid, or two braids, and are constructed with 321, 316, or 316L stainless steel core tube. These hoses provide a wide range of chemical resistances. Operating temperatures range from cryogenic (-380°F) to +1500°F. Many standard and specialized end connections are available. Factory made assemblies only.

Products

- 9A series – standard metal hose
- 9M series – ultra flexible
- 9H series – high pressure

Sizes

1/4" to 6"

Working Pressures

28 in/Hg (vacuum) to 5800 PSI

Why Parflex Metal Hoses Are Superior

A little about Hydroforming…

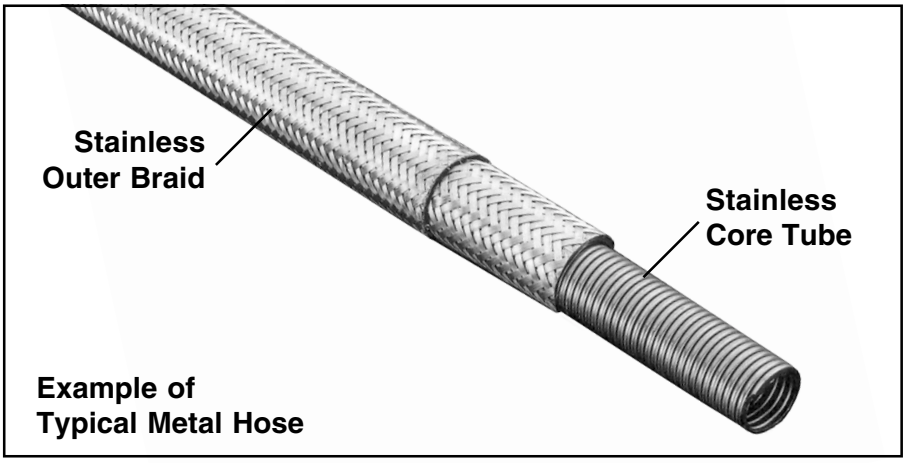
Hydroforming is the use of high pressure water to produce the corrugations in a metal hose core tube. Hydroforming minimizes residual stress to the base metal. The hydroforming process maintains a constant core tube wall thickness, reduces work hardening of the tube material producing a hose which is resistant to mechanical and residual strain during flexing.

A little about Welding…

Poor welding is one of the major causes of hose failure. Parflex Metal Hose assemblies offer the finest welding procedures in metal hose fabrication today. Our proprietary methods of seam and butt welding, and fitting attachment are second to none. Minimum metal annealing, leak free joints, and joints that are actually stronger than the parent metal are a result.

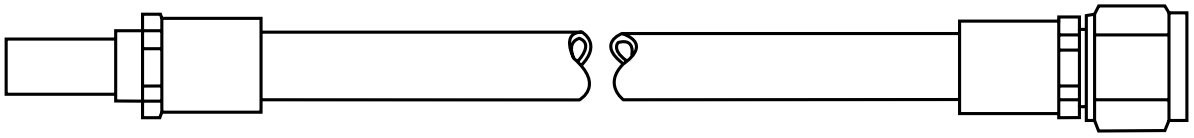
To our customers…

We believe our Parflex Metal Hose to be the strongest, most flexible, longest lasting metal hose on the market today. This catalog offers details on how to order Parflex Metal Hoses. Please review this information carefully before ordering.



**Example of
Typical Metal Hose**

How to Build Parflex Metal Hose Assemblies



9A	1	TU	06	06	06	06	C	–	30

Hose Series
9A = General purpose
9M = Flexible
9H = High pressure

Code #
SS Braid and Tube Material
0 = **No braid**/321 tube
1 = Single braid/321 tube
2 = Double braid/321 tube
3 = **No braid**/316L
4 = Single/316 or 316L
5 = Double braid/316 or 316L
(304SS braid material for all hoses)
(9H is 316 core tube only, 1 or 2 braids required)

***First End Connection**
Consult pages 7 and 8 for fitting style codes.

***Second End Connection**
Consult pages 7 and 8 for fitting style codes.

First End Size
3/8" nominal size

Second End Size
3/8" nominal size

Hose Size
3/8" I.D.

Fitting Material**

Overall length in inches***

This assembly call out is **9A1TU06060606C-30** or a General Purpose Metal Hose constructed with a 321 stainless steel core tube, reinforced with 1 (single) braid 304 stainless steel jacket, welded to a 3/8" tube stub at one end and a female JIC 3/8" swivel at that second end, both 304 stainless steel ends, 30" overall length. *(Other examples shown on following pages).*

* Always Alpha Numeric TU06, *not* 06 TU.
** C = Stainless Steel (304 standard). 316 available upon request. No designation = Steel.
*** Centerline measurements on elbow fittings (seat measurements on Seal-Lok™ fittings) if special ordered.

9A General Purpose Hose
Metal Hose Size and Performance Specifications

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Min. Bend Radius (in.)	* Dynamic Min. Bend Radius (in.)	Working Pressure (psi)	Burst Pressure (psi)	Weight per Foot (lbs.)
	0	0.41			90		0.04
1/4	1	0.47	1.0	4.5	1800	7233	0.11
	2	0.53			2700	9100	0.18
	0	0.65			70		0.10
3/8	1	0.71	1.2	5.0	1558	6230	0.20
	2	0.77			2336	9345	0.30
	0	0.77			70		0.11
1/2	1	0.83	1.5	5.5	1186	4743	0.22
	2	0.89			1779	7115	0.33
	0	0.96			57		0.17
5/8	1	1.02	1.8	7.0	1205	4820	0.33
	2	1.08			1808	7230	0.49
	0	1.16			43		0.19
3/4	1	1.22	2.1	8.0	898	3591	0.37
	2	1.28			1347	5387	0.55
	0	1.47			43		0.26
1	1	1.53	2.7	9.0	718	2872	0.50
	2	1.59			1077	4308	0.74
	0	1.75			43		0.29
1-1/4	1	1.83	3.1	10.0	645	2581	0.61
	2	1.91			968	3872	0.93
	0	2.08			28		0.47
1-1/2	1	2.16	3.9	11.0	531	2125	0.85
	2	2.24			797	3188	1.23
	0	2.61			14		0.59
2	1	2.69	5.1	13.0	449	1797	1.11
	2	2.77			674	2696	1.63
	0	3.40			14		0.84
2-1/2	1	3.50	6.8	16.0	417	1669	1.64
	2	3.60			626	2504	2.44
	0	3.88			14		1.18
3	1	3.98	7.8	18.0	346	1384	2.06
	2	4.08			519	2076	2.94
	0	4.96			14		1.41
4	1	5.06	9.8	22.0	299	1194	2.47
	2	5.16			448	1791	3.53
	0	6.00			14		2.18
5	1	6.13	12.8	28.0	275	1099	3.61
	2	6.25			412	1649	5.04
	0	7.01			11		2.69
6	1	7.14	14.8	32.0	210	839	4.44
	2	7.26			315	1259	6.19

*The radius at which continuous flexing occurs.

Hose Selection

- Determine and locate the size and pressure rating required.
- Note the number of braids required to support the required pressure rating.
- Consult the Fittings on pages 7 and 8 for appropriate end configuration.
- Consult “How to Build Parflex Metal Hose Assemblies” on page 3.

Example

- 1/2" hose (-8) with a 1500 PSI WP rating would begin with **9A2** (2 braids with 321SS core tube).
- If a 316L stainless steel tube is required, the callout would begin with **9A5** (see “How to Build Parflex Metal Hose Assemblies” on page 3).

Temperature derating factors, bend radius derating factors, and other technical information can be found on pages 11-17.

9M Flexible Metal Hose
Metal Hose Size and Performance Specifications

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Min. Bend Radius (in.)	* Dynamic Min. Bend Radius (in.)	Working Pressure (psi)	Burst Pressure (psi)	Weight per Foot (lbs.)
	0	0.42			90		0.07
1/4	1	0.48	0.9	3.7	1800	7233	0.14
	2	0.54			2700	9100	0.21
	0	0.65			70		0.20
3/8	1	0.71	1.0	4.0	1558	6230	0.30
	2	0.77			2336	9345	0.40
	0	0.77			70		0.22
1/2	1	0.83	1.2	4.4	1186	4743	0.33
	2	0.89			1779	7115	0.44
	0	0.96			57		0.31
5/8	1	1.02	1.4	5.6	1205	4820	0.47
	2	1.08			1808	7230	0.63
	0	1.16			43		0.33
3/4	1	1.22	1.7	6.4	898	3591	0.51
	2	1.28			1347	5387	0.69
	0	1.47			43		0.45
1	1	1.53	2.1	7.1	718	2872	0.69
	2	1.59			1077	4308	0.93
	0	1.75			43		0.56
1-1/4	1	1.83	2.5	7.9	645	2581	0.88
	2	1.91			968	3872	1.20
	0	2.08			28		0.82
1-1/2	1	2.16	3.1	8.7	531	2125	1.20
	2	2.24			797	3188	1.58
	0	2.61			14		0.95
2	1	2.69	4.0	10.3	449	1797	1.47
	2	2.77			674	2696	1.99
	0	3.40			14		1.29
2-1/2	1	3.50	5.4	12.8	417	1669	2.09
	2	3.60			626	2504	2.89
	0	3.88			14		1.84
3	1	3.98	6.3	14.5	346	1384	2.72
	2	4.08			519	2076	3.60
	0	4.96			14		2.33
4	1	5.06	7.7	17.4	299	1194	3.39
	2	5.16			448	1791	4.45
	0	6.00			14		3.64
5	1	6.13	10.0	21.9	275	1099	5.07
	2	6.25			412	1649	6.50
	0	7.01			11		4.16
6	1	7.14	11.6	25.0	210	839	5.91
	2	7.26			315	1259	7.66

*The radius at which continuous flexing occurs.

Hose Selection

- Determine and locate the size and pressure rating required.
- Note the number of braids required to support the required pressure rating.
- Consult Fittings on pages 7 and 8 for appropriate end configuration.
- Consult the “How to Build Parflex Metal Hose Assemblies” on page 3.

Example

- 1-1/2" hose (-24) with a 700 PSI rating callout would begin with **9M2** (2 braid with 321SS core tube).
- If a 316L stainless steel tube is required, the callout would begin with **9M5** (see “How to Build Parflex Metal Hose Assemblies” on page 3).

Temperature derating factors, bend radius derating factors, and other technical information can be found on pages 11-17.

9H High Pressure Metal Hose
Metal Hose Size and Performance Specifications

Inside Diameter (in.)	Number of Braids (#)	Outside Diameter (in.)	Static Min. Bend Radius (in.)	* Dynamic Min. Bend Radius (in.)	Working Pressure (psi)	Burst Pressure (psi)	Weight per Foot (lbs.)
1/4	1	0.52	1.1	5.0	4600	18400	0.21
	2	0.62	1.1	5.0	5800	23200	0.32
5/16	1	0.62	1.2	5.1	4000	16000	0.29
	2	0.74	1.2	5.1	4800	19200	0.45
3/8	1	0.70	1.4	5.5	3800	15200	0.36
	2	0.82	1.4	5.5	4000	16000	0.57
1/2	1	0.82	1.6	5.7	2600	10400	0.43
	2	0.94	1.6	5.7	3700	14800	0.69
5/8	1	0.97	2.2	6.1	2400	9600	0.51
	2	1.09	2.2	6.1	2700	10800	0.82
3/4	1	1.19	2.8	6.5	2000	8000	0.64
	2	1.31	2.8	6.5	2200	8800	1.03
1	1	1.39	3.5	7.9	1500	6000	0.78
	2	1.51	3.5	7.9	2000	8000	1.25
1-1/4	1	1.75	4.1	9.4	1100	4400	1.15
	2	1.87	4.1	9.4	1600	6400	1.70
1-1/2	1	2.07	5.1	12.2	1000	4000	1.45
	2	2.19	5.1	12.2	1500	6000	2.16
2	1	2.55	6.7	14.6	750	3000	1.97
	2	2.67	6.7	14.6	1100	4400	2.83

*The radius at which continuous flexing occurs.

Hose Selection

- Determine and locate the size and pressure rating required.
- Note the number of braids required to support the required pressure rating.
- Consult Fittings on pages 7 and 8 for appropriate end connection.
- Consult the “How to Build Parflex Metal Hose Assemblies” on page 3.

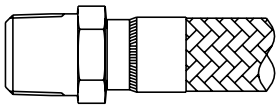
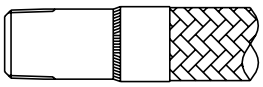
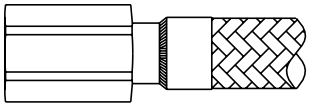
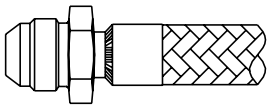
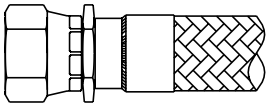
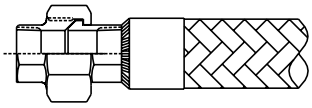
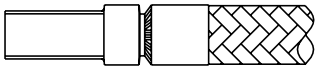
Example

- 1/4" hose (-4) with a 5800 PSI rating callout would begin with **9H5** (2 braids with 316SS core tube).

  9H is available only with 316 core tube and must have 1 or 2 braids.

Temperature derating factors, bend radius derating factors, and other technical information can be found on pages 11-17.

Fittings

Style #	Fitting	Description
01 	Male Taper Pipe	Male Rigid NPTF Pipe with Hex (NPT if stainless)
MT 	Male Taper Pipe	Male Rigid NPTF without Hex (TOE) (NPT if stainless)
02 	Female Taper Pipe Rigid	Female NPT Half Coupling without Hex
03 	Male JIC	Male JIC 37° Flare
06 	Female JIC	Female JIC 37° Flare
07 	Female Pipe Swivel	Female Pipe Union
TU 	Universal Tube Stub	For sizes 5/8 and up, tube stub length and wall thickness must be specified — consult chart below for pressure rating.

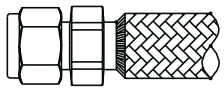
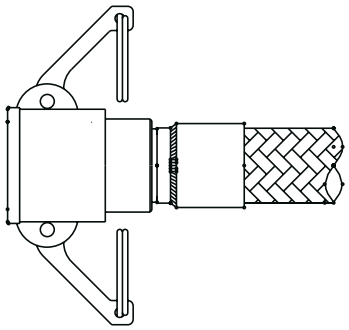
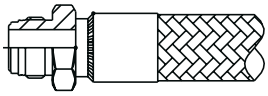
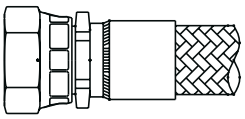
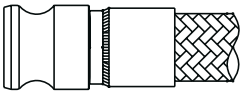
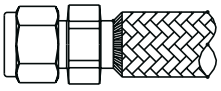
Drawings are for illustration purposes only.
Consult factory for special end connections.

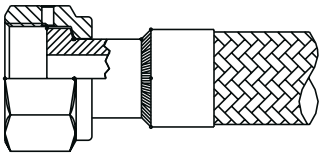
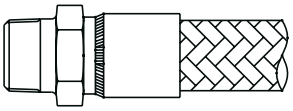
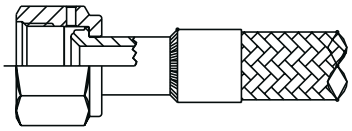
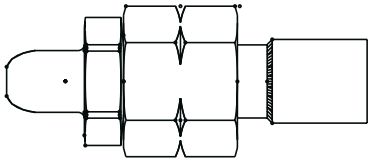
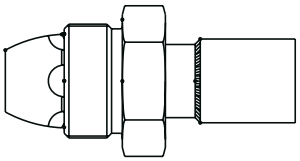
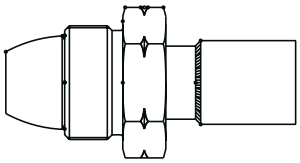
*End user needs to ensure that the selected fittings are chemically compatible with and are able to withstand the pressure and temperatures of both the media and the surrounding environment.

Tube Stubs/Wall Thickness vs. Pressure Ratings (PSI)

316 or 304 Stainless Steel (Seamless)																
Tube O.D. Size	**0.010**	**0.012**	**0.014**	**0.016**	**0.020**	**0.028**	**0.035**	**0.049**	**0.065**	**0.083**	**0.095**	**0.109**	**0.120**	**0.134**	**0.156**	**0.188**
1/16	5600	6900	8200	9500	12100	16800										
1/8						8600	10900									
3/16						5500	7000	10300								
1/4						4000	5100	7500	10300							
5/16							4100	5900	8100							
3/8							3300	4800	6600							
1/2							2500	3500	4800	6300						
5/8								3000	4000	5200	6100					
3/4								2400	3300	4300	5000	5800				
7/8								2100	2800	3600	4200	4900				
1									2400	3200	3700	4200	4700			
1-1/4										2500	2900	3300	3700	4100	4900	
1-1/2											2400	2700	3000	3400	4000	4500
2												2000	2200	2500	2900	3200

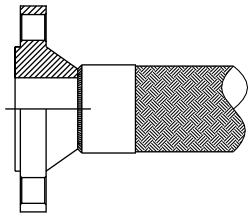
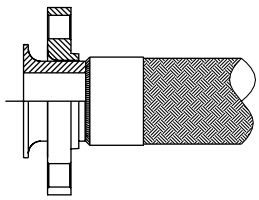
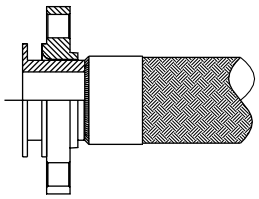
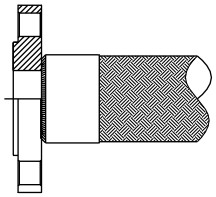
Some tube stubs are non-standard.

Style #	Fitting
AL 	A-LOK® Swivel – Compression Style with Two Ferrules
FC 	Female Cam and Groove with BUNA Basket
HV 	Male VacuSeal™ Rigid
JC 	Female Seal-Lok Swivel Straight
MC 	Male Cam and Groove Rigid
P6 	CPI™ Swivel – Compression Style with one Ferrules

Style #	Fitting
Q1 	UltraSeal™ Swivel
UT 	Metric Male Taper Pipe Rigid
VH 	VacuSeal™ Rigid
CGA350 	Ball Nose Swivel
CGA580 	Ball Nose Swivel
CGA590 	Ball Nose Swivel

- Drawings are for illustration purposes only.
- ***The working pressure of all Parflex Metal Hose assemblies is equal to the pressure rating of the lowest pressure rated component.***
- End user needs to ensure that the selected fittings are chemically compatible with and are able to withstand the pressure and temperatures of both the media and the surrounding environment.
- Please consult Parker Catalog 4200-CPI for more specific fitting information.
- CGA fittings 350, 580 and 590 are standard. Please consult Division for other end connections. Consult Parker Catalog 4010 for other cylinder connections.

Flange

Style #	Flange	Description
	9K 150#	Raised Face Weld Neck 150 lb Flange – Rigid
	9Y 300#	Raised Face Weld Neck 300 lb Flange – Rigid
	4K 150#	Schedule 40 Type A Stub with Slip-on 150 lb Flange – Swivel (Lap Joint)
	1Y 300#	Schedule 40 Type A Stub with Slip-on 300 lb Flange – Swivel (Lap Joint)
	2K 150#	Schedule 10 Type C Stub with Slip-on 150 lb Flange – Swivel
	2Y 300#	Schedule 10 Type C Stub with Slip-on 300 lb Flange – Swivel (Lap Joint)
	8K 150#	Raised Face Slip-on 150 lb Flange – Rigid
	8Y 300#	Raised Face Slip-on 300 lb Flange – Rigid

Drawings are for illustration purposes only.
All flanges meet ANSI B16.5 specifications.

Combinations:

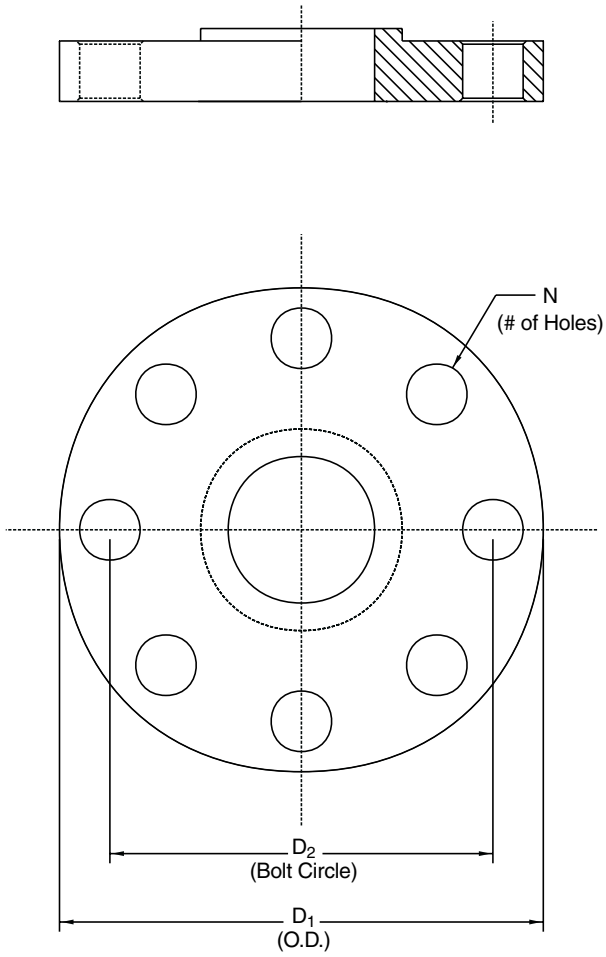
1 Fixed, 1 Floating

2 Floating

(No hose assembly shall contain 2 fixed flanges to eliminate hose twisting)

The working pressure of all Parflex Metal Hose assemblies is equal to the pressure rating of the lowest pressure rated component.
For additional flange identification information, see page 10.

Flange Identification for Parflex Metal Hose Assemblies

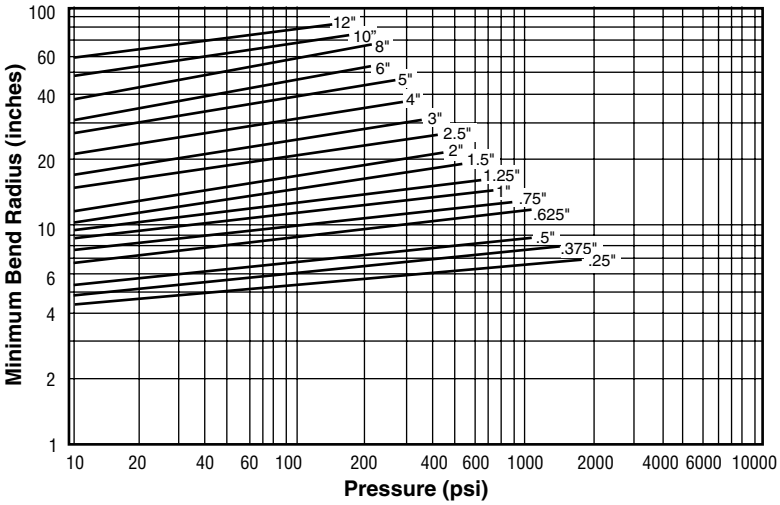


Class	Nominal Size	D_1	D_2	N
150	1/2	3.50	2.38	4
150	3/4	3.88	2.75	4
150	1	4.25	3.12	4
150	1 1/4	4.62	3.50	4
150	1 1/2	5.00	3.88	4
150	2	6.00	4.75	4
150	2 1/2	7.00	5.50	4
150	3	7.50	6.00	4
150	4	9.00	7.50	8
150	5	10.00	8.50	8
150	6	11.00	9.50	8

Class	Nominal Size	D_1	D_2	N
300	1/2	3.75	2.62	4
300	3/4	4.62	3.25	4
300	1	4.88	3.50	4
300	1 1/4	5.25	3.88	4
300	1 1/2	6.12	4.50	4
300	2	6.50	5.00	8
300	2 1/2	7.50	5.88	8
300	3	8.25	6.62	8
300	4	10.00	7.88	8
300	5	11.00	9.25	8
300	6	12.50	10.62	8

Derating Factors

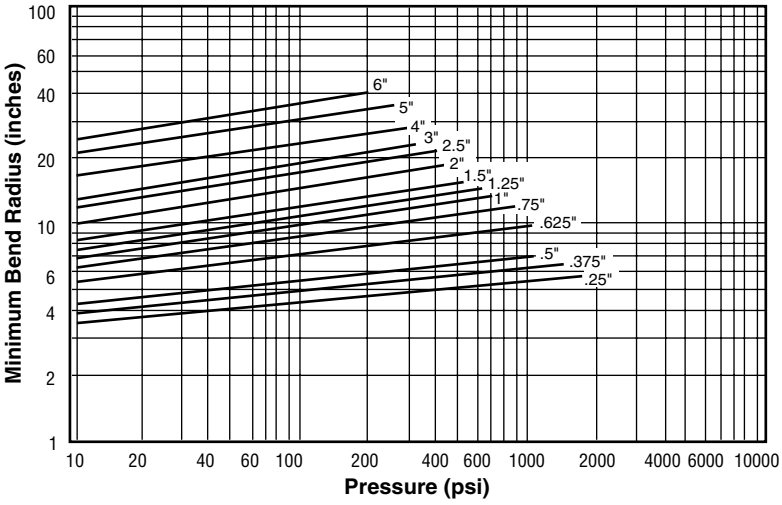
General Purpose Hose 9A



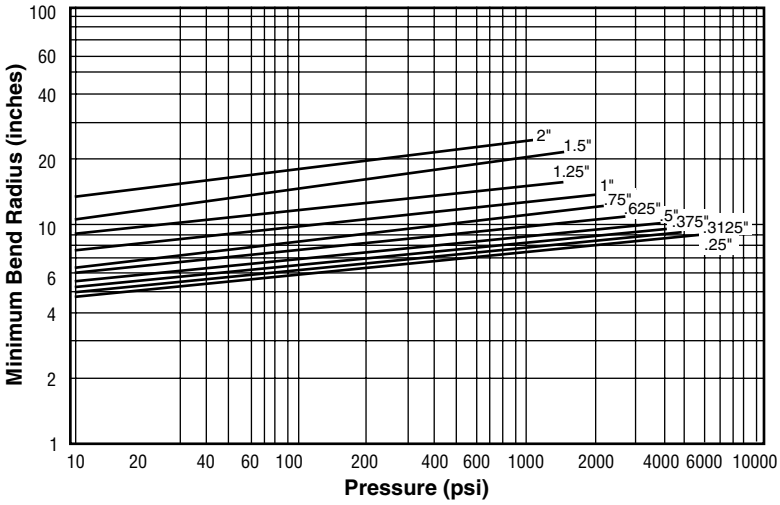
Notes:

- The minimum bend radius is measured from the center line of the hose.
- The minimum bend radius increases with pressure (see graphs).
- Pressure is calculated at 70°F ambient temperature.

Flexible Metal Hose 9M



High Pressure Metal Hose 9H



Velocity in Metal Hose

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

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

Temperature °F	Maximum Product Velocity (Ft./Sec.) Braided	
	Dry Gas	Liquid
Straight Run	150	75
45° Bend	115	60
90° Bend	75	40
180° Bend	38	19

Working Pressure Derating Factor for Elevated Temperatures

Temperature F°	Working Pressure T321/316L	Derating Factor T304
70	1.00	1.00
150	.97	.96
200	.94	.92
250	.92	.91
300	.88	.86
350	.86	.85
400	.83	.82
450	.81	.80
500	.78	.77
600	.74	73
700	.70	.69
800	.66	.64
900	.62	.58
1000	.60	
1100	.58	
1200	.55	
1300	.50	
1400	.44	
1500	.40	

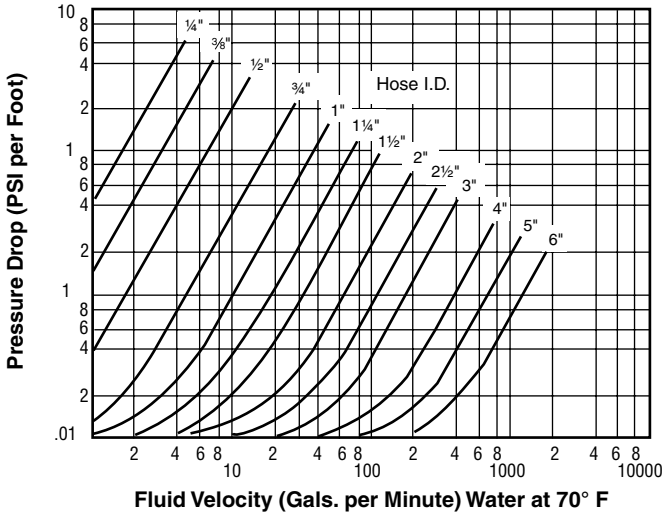
To calculate a working pressure derated for elevated temperature: Multiply the hose working pressure shown in the catalog by the appropriate derating factor from above.

Note: The working pressure of an assembly at elevated temperatures may be affected by fitting type, material and method of attachment.

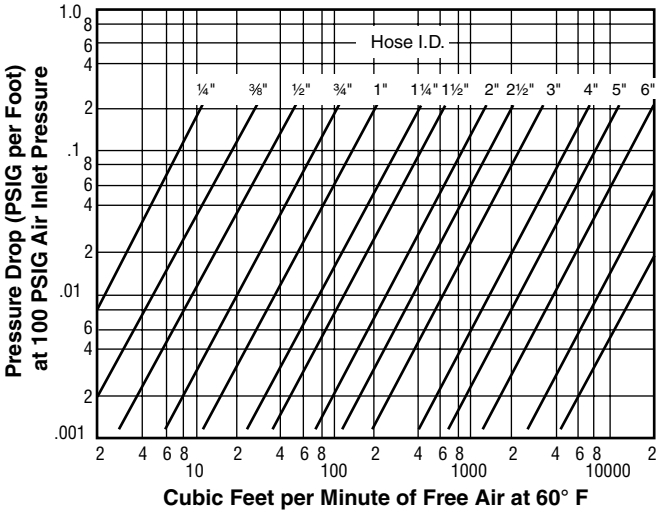
Technical Section

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

Pressure Drop Graph for Water



Pressure Drop Graph for Air



For air inlet pressures other than 100 psig:

$$PD = PD\ @\ 100\ psig \left(\frac{100 + 14.7}{P + 14.7} \right)$$

Parker Hannifin Corporation
Parflex Division
Ravenna, OH

Testing, Cleaning and Packaging of Parflex Metal Hose Assemblies

Code	Testing[2]	Cleaning	Packaging	Fittings/Welds	Typical Where Used[4]
P1	General requirement (low pressure air under water)	General requirement	Bulk packed in cardboard box	As welded	Assemblies using industrial fitting connections
P2	Customer specified	General requirement	Customer specified	As welded	Industrial assemblies with special testing requriements
P3	General requirement (low pressure air under water)	General requirement	Bulk packed in cardboard box	Welds buffed[1], fittings polished (32 Ra)	Industrial assemblies when aesthetics are important
P4	General requirement (low pressure air under water)	Water flushed, hot air dried	Plastic mesh protectors – assemblies sealed in plastic bag	Welds buffed[1], fittings polished (32 Ra)	Industrial assemblies when aesthetics and cleanliness are important
P5	300 psi Helium under water / 5 minutes	General requirement	Plastic mesh protectors – Assemblies sealed in plastic bag	Welds buffed[1], Fittings polished (32 Ra)	A-LOK®, CPI™, VacuSeal™ or UltraSeal™ and general Instrumentation assemblies
P6	300 PSI helium under water / 5 minutes	Oxygen cleaned per CGA G-4.1	Plastic mesh protectors – assemblies sealed in plastic bag	Welds buffed[1], fittings polished (32 Ra)	Oxygen or gas assemblies cleaned per CGA G-4.1 requirements
P7	Customer specified test	Oxygen cleaned per CGA G-4.1	Plastic mesh protectors – assemblies sealed in plastic bag	Welds buffed[1], fittings polished (32 Ra)	Oxygen or gas assemblies when customer has special testing requirements
P8[3]	Helium leak test – leak rate < $1x10^{-5}$ cc/sec	Water flushed, hot air dried	Plastic mesh protectors – assemblies sealed in plastic bag	Welds buffed[1], fittings polished (32 Ra)	High purity assemblies using VacuSeal™, UltraSeal™, CGA fittings
P9[3]	Helium leak test – leak rate < $1x10^{-7}$ cc/sec	Flushed with alcohol, hot air dried	Plastic mesh protectors – assemblies sealed in plastic bag	Welds buffed[1], fittings polished (32 Ra)	High purity assemblies using VacuSeal™, UltraSeal™, CGA fittings
P10[3]	Helium leak test – leak rate < $1x10^{-9}$ cc/sec	Flushed with alcohol, hot air dried	Plastic mesh protectors – assemblies sealed in plastic bag	Welds buffed[1], fittings polished (32 Ra)	High purity assemblies using VacuSeal™, UltraSeal™, CGA fittings
P11	Customer specified	Customer specified	Customer specified	Customer specified	Any

Footnotes:
1. Buffing of welds will remove any heat discoloration due to welding, marker on hose, etc. All welds are argon purged.
2. With any gas under water test, the presence of bubbles would indicate failure.
3. Special care must be taken on these assemblies to insure that the fitting sealing surfaces are not even slightly scratched or dented. Parker assembly standards and components must be used when assembling adapters.
4. The "Where Used" fields are listed for reference only and are not requirements or recommendations.

Corrosion Resistance Chart

Caution: This information is offered only as a guide. Actual service life can only be determined by the end user by testing under all extreme conditions and other analysis. See Parker Safety Guide on pages 20 and 21.

Ratings: 1 – Excellent Resistance
2 – Good Resistance
3 – Fair or Conditional Resistance
X – Not Recommended

Notes: (A) Ratings are based on ambient temperature
(B) No rating indicates no data available

	T321	T316
Acetate Solvents (crude)	1	2
Acetate Solvents (pure)	1	1
Acetic Acid 80%	1	1
Acetic Acid 50%	2	1
Acetic Acid 20%	2	1
Acetic Acid 10%	1	1
Acetic Anhydride	2	2
Acetone	1	1
Acetylene	1	1
ALCOHOLS		
Amyl Alcohol	2	2
Benzyl Alcohol	1	1
Butyl Alcohol	1	1
Diacetone Alcohol	2	2
Ethyl Alcohol	2	2
Hexyl Alcohol	–	–
Isobutyl Alcohol	–	–
Isopropyl Alcohol	2	2
Methyl Alcohol	2	2
Octyl Alcohol	–	–
Propyl Alcohol	1	1
ALUMINUM		
Aluminum Chloride	X	X
Aluminum Fluofide (sat.)	X	2
Aluminum Nitrate (sat.)	2	2
Aluminum Potssium Sulfate	X	2
Aluminum Sulfate (sat.)	2	2
Alum	X	2
AMMONIA		
Ammonia Anhydrous	2	1
Ammonia Gas	1	1
Ammonia Nitrate	–	–
AMMONIUM		
Ammonium Biflouride	–	–
Ammonium Carbonate (sat.)	2	2
Ammonium Casenite	–	–
Ammonium Chloride (sat.)	X	X
Ammonium Hydroxide (sat.)	2	2
Ammonium Nitrate	–	–
Ammonium Phosphate	–	–
Ammonium Sulfate (10%-40%)	X	2
Aniline	1	1
Arsenic Acid	2	2
BARIUM		
Barium Carbonate (sat.)	2	2
Barium Chloride	X	2
Barium Hydroxide	2	2
Barium Sulfate	2	2
Barium Sulfide	2	2

	T321	T316
Beer	1	1
Benzaldehyde	2	2
Benzene, Benzol	2	2
Benzine	–	–
Benzoic Acid	2	2
Black Liquor	2	2
Bleach (12.5% chlorine)	–	X
Borax	2	1
Boric Acid	–	–
Brake Fluid	1	1
Brine Acid	–	–
Bromic Acid	–	–
Bromine Liquid	X	X
Butadeine, Butylene	2	2
Butane	2	2
Butyl Acetate	2	2
Butyric Acid	2	2
CALCIUM		
Calcium Busulfate	X	2
Calcium Bisulfide	–	–
Calcium Bisulfite	2	2
Calcium Carbonate	1	2
Calcium Chloride	–	–
Calcium Hydroxide	2	2
Calcium Hypochlorite (sat.)	X	2
CARBON		
Carbon Bisulfide	2	2
Carbon Dioxide (dry)	2	2
Carbon Dioxide (wet)	2	2
Carbon Disulfide	2	2
Carbon Monoxide	1	1
Carbon Tetrachloride	1	1
Carbonic Acid	2	2
Castor Oil	2	2
Caustic Potash	–	–
Cellosolves	2	2
Chlorine (liquid)	–	–
Chloroform	–	1
Chlorosulfonic Acid	X	X
Chromic Acid 50%	3	2
Citric Acid	–	–
Clorox (bleach) 5.5% CL	–	2
Coke Oven Gas	2	2
COPPER		
Copper Chloride	X	X
Copper Cyanide	2	2
Copper Sulfate (sat.)	–	2
Creysylic Acid	2	2
Cyclohexane	2	2

	T321	T316
Detergents	1	2
Dextrose	–	–
Diesel Fuels	1	1
Diethylamine	2	2
Disodium Phosphate	–	1
Ethers	1	1
ETHYL		
Ethyl Acetate	2	2
Ethyl Chloride	1	1
ETHYLENE		
Ethylene Chloride	–	–
Ethylene Dichloride	2	2
Ethylene Glycol	2	2
Ethylene Oxide	2	2
Fatty Acids	–	1
FERRIC		
Ferric Chloride	X	X
Ferric Hydroxide	1	1
Ferric Nitrate (10%-50%)	2	2
Ferric Sulfate	–	–
FERROUS		
Ferrous Chloride (sat.)	X	X
Ferrous Sulfate	2	2
Fluoboric Acid	–	–
Formaldehyde (50%)	1	1
Formic Acid (Anhyd)	–	–
FREON		
Freon 11	2	2
Freon 12 (wet)	2	2
Freon 22	2	2
Fruit Juice	2	2
Fuel Oils	2	2
Furfural	2	2
GASOLINE		
Refined Gasoline	2	2
Sour Gasoline	2	2
Gelatine	2	2
Glucose	2	2
Glue	2	2
Glycerine	1	1
Glycol	2	2
Green Liquor	–	–
Heptane	2	2
Hexane	1	1
Hydrobromic Acid (50%)	X	X
Hydrobromic Acid (20%)	X	X
Hydrochloric Acid (20%)	X	X
Hydrochloric Acid (37%)	X	X
Hydrocyanic Acid	2	2

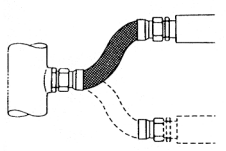
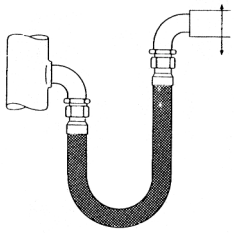
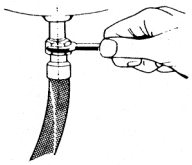
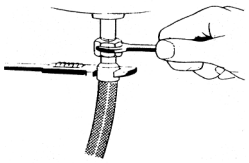
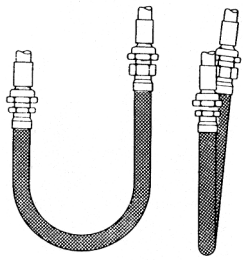
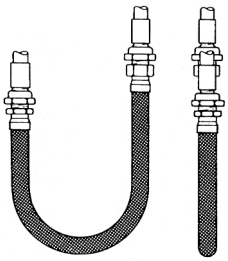
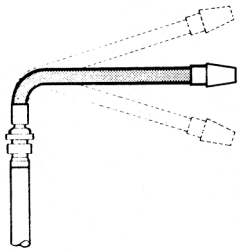
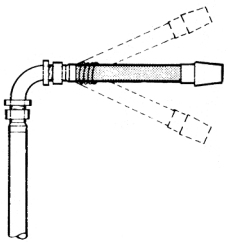
Corrosion Resistance Chart, Continued

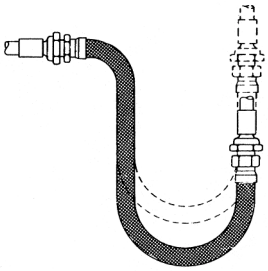
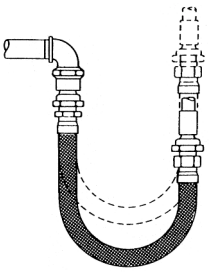
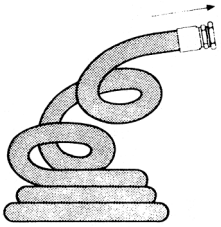
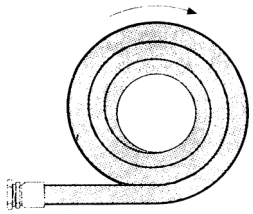
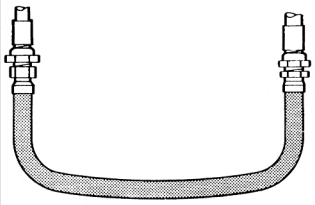
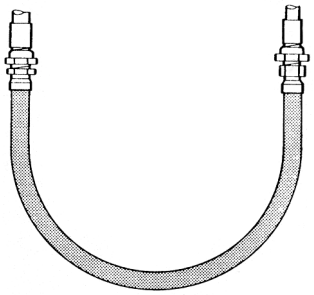
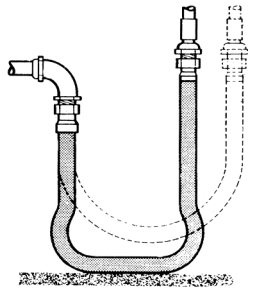
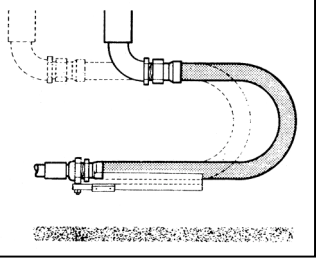
	T321	T316
Hydrofluoric Acid	X	2
Hydrofluosilicic Acid	X	2
HYDROGEN		
Hydrogen Peroxide (50%)	2	–
Hydrogen Sulfide (Aqueous)	X	2
Hydrogen Chloride (Gas, Dry)	–	–
Hydrogen Gas	1	1
Hypochlorous Acid	X	X
Iodine	X	X
Isopropyl Ether	1	2
Jet Fuel (JP3, JP4, JP5)	2	2
Kerosene	2	2
Ketones	2	2
Lactic Acid (25%)	–	–
Lactic Acid (80%)	2	–
Lard Oil	2	2
LEAD		
Lead Acetate	2	2
Lead Chloride	2	2
Lead Sulfate	2	2
Lime Sulphur	2	2
Linoleic Acid	2	2
Linseed Oil	2	2
Lubricants (Oil)	2	2
MAGNESIUM		
Magnesium Carbonate	2	2
Magnesium Chloride	–	–
Magnesium Hydroxide	1	1
Magnesium Nitrate	2	2
Magnesium Oxide	–	–
Magnesium Sulfate	2	2
Maleic Acid	2	2
MERCURIC		
Mercuric Chloride	X	–
Mercuric Cyanide	2	2
Mercury	1	1
Methane	1	1
Methanol	2	2
METHYL		
Methyl Bromide	2	2
Methyl Ethyl Ketone	2	2
Methyl Isobutyl Ketone	2	2
Methyl Methacrylate	2	2
Methylene Chloride	–	–
Milk	1	1
Mineral Oil	1	2
Muriatic Acid	X	X
Naptha	2	2
Napthalene	1	1
NICKEL		
Nickel Chloride	–	–
Nickel Sulfate	2	2
NITRIC		
Nitric Acid (100%)	–	–
Nitric Acid (50%)	1	–
Nitric Acid (30%)	1	–
Nitrobenzene	2	2
OILS		
Castor Oil	2	2
Coconut Oil	2	2

	T321	T316
Corn Oil	–	2
Cotton Seed Oil	3	2
Fuel Oil	2	2
Linseed Oil	2	2
Mineral Oil	1	2
Silicone Oil	2	2
Vegetable Oil	1	1
Oleic Acid	–	1
Oleum	2	2
Oxalic Acid (sat.)	X	X
Oxygen	2	2
Palmitic Acid	2	2
Paraffin	2	2
Perchlorethylene	–	–
Petroletum	2	2
Phenol (Carbolic Acid)	–	1
PHOSPHORIC ACID		
Phosphoric Acid (25%-50%)	–	–
Phosphoric Acid (50%-85%)	1	
Photographic Solutions	1	1
Phthalic Anhydride	1	1
Picric Acid	2	2
PLATING SOLUTIONS		
Brass Plating Solution	–	2
Cadmium Plating Solution	–	2
Chrome 40% Plating Solution	–	2
Copper (Cyanide) Plat. Solution	–	–
Gold Plating Solution	–	1
Iron Plating Solution	–	–
Lead Plating Solution	1	1
Nickel Plating Solution	1	1
Silver Plating Solution	1	1
Tin Plating Solution	X	X
Zinc Plating Solution	–	–
POTASSIUM		
Potassium Acetate	–	–
Potassium Bicarbonate (30%)	1	1
Potassium Carbonate (50%)	1	1
Potassium Chlorate (30%)	2	1
Potassium Chloride (30%)	–	–
Potassium Chromate (30%)	2	2
Potassium Cyanide Sol. (30%)	2	2
Potassium Dichromate (30%)	1	1
Potassium Hydroxide (90%)	X	–
Potassium Nitrate (80%)	2	2
Potassium Permanganate (20%)	2	2
Potassium Sulfate (10%)	–	–
Propane	2	2
Propylene Glycol	2	2
Propylene Oxide	–	–
Pyridine	2	2
Pyrogallic Acid	2	2
Silver Nitrate	2	1
Soap Solutions	2	2
SODIUM		
Sodium Acetate	2	2
Sodium Bicarbonate (20%)	1	1
Sodium Bisulfate	–	–
Sodium Bisulfite	–	–
Sodium Borate	2	2

	T321	T316
Sodium Perborate (10%)	2	2
Sodium Carbonate	–	–
Sodium Chlorate	–	–
Sodium Chloride	–	–
Sodium Cyanide	–	–
Sodium Dichromate	2	2
Sodium Hydroxide (70%)	2	2
Sodium Hydroxide (50%)	1	–
Sodium Hydroxide (30%)	1	1
Sodium Hypochlorite	X	X
Sodium Metaphosphate	2	2
Sodium Nitrate	–	–
Sodium Perborate (10%)	2	2
Sodium Peroxide (10%)	2	2
Sodium Silicate	2	2
Sodium Sulfate	–	1
Sodium Sulfide (50%)	–	2
Sodium Thiosulphate	2	2
Stannic Chloride	X	X
Stannous Chloride	X	–
Steam	–	–
Stearic Acid	2	1
Stoddard Solvent	2	2
Sugar Liquors (cane)	2	2
Sugar Liquors (beet)	1	1
Sulfate Liquors	–	2
Sulfite Liquors	2	2
Sulphur Chloride	–	–
Sulphur Dioxide (dry)	–	2
Sulphur Trioxide	–	2
Sulfuric Acid (to 10%)	X	X
Sulfuric Acid (10%-75%)	–	–
Sulfurous Acid	X	–
Tannic Acid	2	2
Tanning Liquors	1	1
Tartaric Acid	1	1
Titanium Tetrachloride	–	–
Toluene	1	1
Tetrahydrofuran	1	2
Tomato Juice	2	2
Trichloroethylene	–	–
Triethanolamine	2	2
Triethylamine	2	2
Trisodium Phosphate	–	–
Turpentine	1	1
Urea	–	–
Urine	1	1
Vinegar	2	2
Water Acid (mine)	–	–
Water (distilled)	2	2
Water (sea)	2	2
Whiskey	1	1
White Liquor (pulp)	2	2
Wine	1	1
Xylene	2	2
ZINC		
Zinc Chloride	X	2
Zinc Nitrate	2	2
Zinc Sulfate (30%)	1	1

Do's & Don'ts

WRONG	RIGHT
	
	
	
	

WRONG	RIGHT
	
	
	
	

Parker FluidConnectors
Parker Hannifin Corporation
Parflex Division
Ravenna, OH

Length Calculations

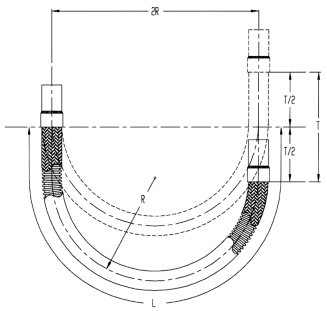
For the following formulas:

L = Live Length of Hose (inches)
T = Travel (inches)
S = House Outside Diameter (see specification sheets)

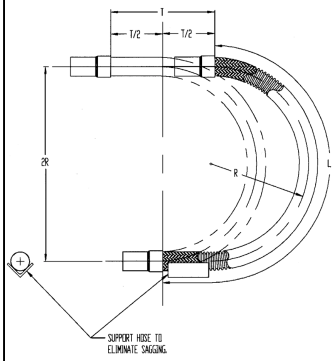
Verify that the installed radius is less than the stated Minimum Bend Radius for the hose at the required working pressure.

Constant Radius Travelling Loop (A-Loop)
Formula: L = 4R + 1/2T

A. Vertical Travel

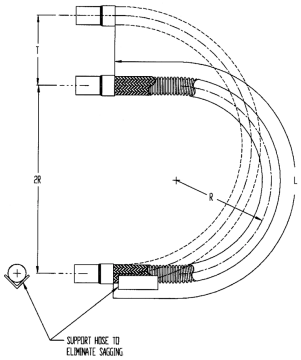


B. Horizontal Travel

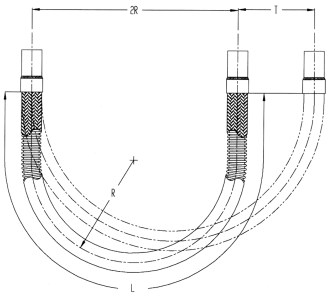


Variable Radius Travelling Loop (B-Loop)
Formula: L = 4R + 1.57T

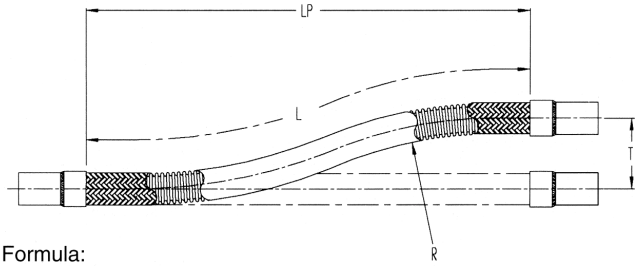
A. Vertical Travel



B. Horizontal Travel



Lateral Offset



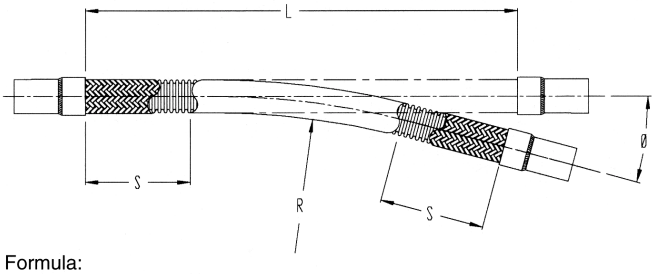
Formula:

$$L = \sqrt{20R \times T}$$

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

Note 1: When the offset motion occurs on both sides of the hose centerline, use total travel in the formula.
Note 2: The offset distance "T" for constant flexing should never exceed 25% of the centerline bend radius.

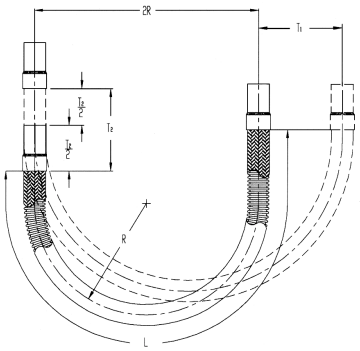
Angular Deflection



Formula:

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

Vertical Loop with Movement in Two Directions (Combination Loop)



Formula:

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

Parker Hannifin Corporation
Parflex Division
Ravenna, OH

Parflex Metal Hose Ordering Checklist

☑	Checklist Item	Page Reference
☐	Specified general purpose, flexible, or high pressure hose (9A, 9M, or 9H).	
☐	Code number identifies appropriate tube material and number of braids (consult chart).	page 3
☐	Specified stainless steel or steel ***ends*** (For stainless, 304 is standard, 316 is available.)	page 3
☐	Special testing, cleaning and packaging specified and called out clearly (refer to chart).	page 13
☐	Consulted Technical Section for working pressure derating factors and maximum fluid velocities.	pages 11 & 12
☐	Flanges identified by style, # rating, bolt pattern and whether they are fixed or floating.	pages 9 & 10
☐	Tube stubs correctly identified pressure ratings (5/8" and above).	page 7
☐	Considered that the working pressure of the hose assembly is equal to the lowest pressure rated component	pages 7 – 10
☐	Reviewed Chemical Compatibility Charts. Consulted Technical Service Department on materials not listed.	
☐	Routing situations considered.	page 16
☐	SPECIAL DELIVERY instructions, if required.	
☐	Reviewed Parker Safety Guidelines	pages 20 & 21

General Markets for Parflex Metal Hose*

Adhesive Manufacturing
Air Conditioning Equipment
Aircraft
Aluminum Manufacturing
Ash Handling
Asphalt Plants
Automobile Manufacturing
Bag Manufacturing
Baking Ovens
Ball Bearing Manufacturing
Barge Lines
Battery Manufacturing
Bottling Machines
Box Factories
Brewery Equipment
Brick Machinery
Brush Manufacturing
Bulk Oil Stations
CNG Installations
Can Manufacturing
Celluloid Products
Cement Manufacturing
Chemical Plants
Chewing Gum Production
City Street Sprinkling Apparatus
Clock Factories
Coal Mining
Cocoa Presses
Compressed Gas Industries
Conduits (moisture proof)
Corn Product Manufacturers
Cork Processing
Diesel Engines & Distribution
Die Castings
Expansion Lines
Fire Extinguishers
Food Processing
Foundries
Gas Cylinder Filling
Gas Lines
Glass Making
Glue Manufacturing
Grain Elevators
Grinding Machines
Hat Manufacturing
High Temperature Air Handling
Hydraulic Lines
Instrument Manufacturing
Laundry Equipment
Light Bulb Manufacturing
LNG Installations
Loading and Unloading Equipment
Lumber Processing
Milk and Egg Drying Machinery
Milk Handling
Mine Pumps
Molding Machines
Mud Guns
OEM Test Cell Pumps
Oil Burners
Oil Lines
Oil Refineries
Ore Thawing
Paint Making
Paper Manufacturing and Processing
Plastic Plants/Pellet Conveying
Platen Presses
Plumbing
Power & Utilities
Quarry Pipes
Radiators
Railroad Cars
Railroad Shops
Railroad Yards
Road Machinery
Rubber Plants
Sewage Treatment
Ship Yards
Shoe Cement Machinery
Soap Manufacturing
Steam Lines
Steel and Mill Furnaces
Sugar Refineries
Testing Boiler Stands
Textile Machinery
Truck Service Centers
Toy Making
Water Cooling
Water Works
Weed Burners
Wood Curing Machinery

*Size, temperature, application criteria, media and pressure must always be considered when ordering Metal Hose. The end user is responsible for final application and should perform tests within those parameters. Reference Parker Safety Guide included in this publication on pages 20 and 21.

Parker Safety Guide for Selecting and Using Hose, Fittings, and Related Accessories

Parker Publication No. 4400-B.1
Revised: April 1997

⚠ **DANGER:** Failure or improper selection or improper use of hose, fittings, or related accessories can cause death, personal injury and property damage. Possible consequences of failure or improper selection or improper use of hose, fittings, or related accessories include but are not limited to:

- Fittings thrown off at high speed.
- High velocity fluid discharge.
- Explosion or burning of the conveyed fluid.
- Electrocution from high voltage electric power lines.
- Sparking or explosion while paint or flammable liquid spraying.
- Dangerously whipping hose.
- Contact with conveyed fluids that may be hot, cold, toxic or otherwise injurious.
- Sparking or explosion caused by static electricity buildup or other sources of electricity.
- Injections by high-pressure fluid discharge.
- Contact with suddenly moving or falling objects that are controlled by the conveyed fluid.

Before selecting or using any Parker hose or fittings or related accessories, it is important that you read and follow the instructions below.

1.0 GENERAL INSTRUCTIONS

1.1 Scope: This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) hose (including all rubber and/or plastic products commonly called "hose" or "tubing"), fittings (including all products commonly called "fittings" or "couplings" for attachment to hose), and related accessories (including crimping and swaging machines and tooling). This safety guide is a supplement to and is to be used with, the specific Parker publications for the specific hose, fittings and related accessories that are being considered for use.

1.2 Fail-Safe: Hose and hose assemblies can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of the hose or hose assembly will not endanger persons or property.

1.3 Distribution: Provide a copy of this safety guide to each person that is responsible for selecting or using hose and fitting products. Do not select or use hose and fittings without thoroughly reading and understanding this safety guide as well as the specific Parker publications for the products considered or selected.

1.4 User Responsibility: Due to the wide variety of operating conditions and uses for hose and fittings, Parker and its distributors do not represent or warrant that any particular hose or fitting is suitable for any specific end use system. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the hose and fitting.
- Assuring that the users requirements are met and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the hose and fittings are used.

1.5 Additional Questions: Call the appropriate Parker technical service department if you have any questions or require any additional information. See the Parker publication for the product being considered or used, for telephone numbers of the appropriate technical service department.

2.0 HOSE AND FITTING SELECTION INSTRUCTIONS

2.1 Electrical Conductivity: Certain applications require that a hose be nonconductive to prevent electrical current flow. Other applications require the hose to be sufficiently conductive to drain off static electricity. Extreme care must be exercised when selecting hose and fittings for these or any other applications in which electrical conductivity or nonconductivity is a factor.

For applications that require hose to be electrically nonconductive, including but not limited to applications near high voltage electric lines, only special nonconductive hose can be used. The manufacturer of the equipment in which the non-conductive hose is to be used must be consulted to be certain that the hose and fittings that are selected are proper for the application. Do not use any Parker hose or fitting for any such application requiring nonconductive hose, including but not limited to applications near high voltage electric lines, unless (i) the application is expressly approved in the Parker technical publication for the product, (ii) the hose is both orange color and marked "nonconductive," and (iii) the manufacturer of the equipment on which the hose is to be used specifically approves the particular Parker hose and fitting for such use.

The electrical conductivity or nonconductivity of hose and fittings is dependent upon many factors and may be susceptible to change. These factors include but are not limited to the various materials used to make the hose and the fittings, manufacturing methods (including moisture control), how the fittings contact the hose, age and amount of deterioration of damage or other changes, moisture content of the hose at any particular time, and other factors.

Parker manufactures a special hose for conveying paint in airless paint spraying applications. This hose is labeled "Electrically Conductive Airless Paint Spray Hose" on its layline and on its packaging. This hose must be properly connected to Parker fittings and properly grounded in order to dissipate dangerous static charge buildup which occurs in all airless paint spraying. Do not use any other hose, even if electrically conductive, for airless paint spraying. Use of any other hose or failure to properly connect the hose can cause a fire or an explosion resulting in death, personal injury, and property damage.

Parker manufactures a special hose for certain compressed natural gas (CNG) applications where static electricity buildup may occur. Parker CNG hose assemblies comply with AGA Requirements 1-93, "Hoses for Natural Gas Vehicles and Fuel Dispensers". This hose is labeled "Electrically Conductive for CNG Use" on its layline and on its packaging. This hose must be properly connected to Parker fittings and properly grounded in order to dissipate dangerous static charge buildup which occurs in, for example, high velocity CNG dispensing or transfer. Do not use any other hose, even if electrically conductive, for CNG transfer where static charge buildup may occur. Use of any other hose in such application or failure to properly connect this hose can cause a fire or an explosion resulting in death, personal injury, and property damage. Care must also be taken to protect against dangerous gas permeation through the hose wall. See section 2.6, Permeation, for more information.

Parker CNG hose is intended for dispenser and vehicle use at maximum temperature of 180°F. Parker CNG hose should not be used in confined spaces or areas exceeding 180°F. Final Assemblies must be tested for leaks.

Caution: Matches, candles, open flame or other sources of ignition shall not be used for this purpose. Leak check solutions should be rinsed off after use. Special care should be taken to ensure the hose is not kinked, twisted, torque, exposed to abusive environmental conditions specified in Section 2.9, or exceed the pressure requirements specified in Section 2.2, "Pressure". Hose assemblies should be tested on at least a monthly basis per Section 4.2 "Visual Inspection Hose/Fitting". Recommended procedures are to pressurize the hose and check for leaks and to visually inspect the hose for damage. Hose assemblies should be tested on a monthly basis for conductivity per AGA 1-93.

2.2 Pressure: Hose selection must be made so that the published maximum recommended working pressure of the hose is equal to or greater than the maximum system pressure. Surge pressures in the system higher than the published maximum recommended working pressure will cause failure or shorten hose life. Do not confuse burst pressure or other pressure values with working pressure and do not use burst pressure or other pressure values for this purpose.

2.3 Suction: Hoses used for suction applications must be selected to insure that the hose will withstand the vacuum and pressure of the system. Improperly selected hose may collapse in suction application.

2.4 Temperature: Be certain that fluid and ambient temperatures, both steady and transient, do not exceed the limitations of the hose. Temperatures below and above the recommended limit can degrade hose to a point where a failure may occur and release fluid. Care must be taken when routing hose near hot objects (e.g. manifolds) to properly insulate and protect the hose.

2.5 Fluid Compatibility: Hose selection must assure compatibility of the hose tube, cover, reinforcement, and fittings with the fluid media used. See the fluid compatibility chart in the Parker publication for the product being considered or used. This information is offered only as a guide. Actual service life can only be determined by the end user by testing under all extreme conditions and other analysis.

2.6 Permeation: Permeation (that is, seepage through the hose) will occur from inside the hose to outside when hose is used with gases, liquid and gas fuels, and refrigerants (including but not limited to such materials as helium, fuel oil, natural gas, or freon). This permeation may result in high concentrations of vapors which are potentially flammable, explosive, or toxic, and in loss of fluid. Dangerous explosions, fires, and other hazards can result when using the wrong hose for such applications. The system designer must take into account the fact that this permeation will take place and must not use hose if this permeation could be hazardous. The system designer must take into account all legal, government, insurance, or any other special regulations which govern the use of fuels and refrigerants. Never use a hose even though the fluid compatibility is acceptable without considering the potential hazardous effects that can result from permeation through the hose assembly.

Permeation of moisture from outside the hose to inside the hose will also occur in hose assemblies, regardless of internal pressure. If this moisture permeation would have detrimental effects (particularly but not limited to refrigeration and air conditioning systems), incorporation of sufficient drying capacity in the system or other appropriate system safeguards should be selected and used.

2.7 Size: Transmission of power by means of pressurized fluid varies with pressure and rate of flow. The size of the components must be adequate to keep pressure losses to a minimum and avoid damage due to heat generation or excessive fluid velocity.

2.8 Routing: Attention must be given to optimum routing to minimize inherent problems (kinking or flow restriction due to hose collapse).

2.9 Environment: Care must be taken to insure that the hose and fittings are either compatible with or protected from the environment (that is, surrounding conditions) to which they are exposed. Environmental conditions including but not limited to ultraviolet radiation, sunlight, heat, ozone, moisture, water, salt water, chemicals, and air pollutants can cause degradation and premature failure.

2.10 Mechanical Loads: External forces can significantly reduce hose life or cause failure. Mechanical loads which must be considered include excessive flexing, twist, kinking, tensile or side loads, bend radius, and vibration. Use of swivel type fittings or adapters may be required to insure no twist is put into the hose. Unusual applications may require special testing prior to hose selection.

2.11 Physical Damage: Care must be taken to protect hose from wear, snagging and cutting, which can cause premature hose failure.

2.12 Proper End Fitting: See instructions 3.2 through 3.5 below. These recommendations may be substantiated by testing to industry standards such as SAE J517.

2.13 Length: When establishing a proper hose length, motion absorption, hose length changes due to pressure, and hose and machine tolerances must be considered.

2.14 Specifications and Standards: When selecting hose and fittings, government, industry, and Parker specifications and recommendations must be reviewed and followed as applicable.

2.15 Hose Cleanliness: Hose components may vary in cleanliness levels. Care must be taken to insure that the assembly selected has an adequate level of cleanliness for the application.

2.16 Fire Resistant Fluids: Some fire resistant fluids require the same hose as petroleum oil. Some use a special hose, while a few fluids will not work with any hose at all. See instructions 2.5 and 1.5. The wrong hose may fail after a very short service. In addition, all liquids but pure water may burn fiercely under certain conditions, and even pure water leakage may be hazardous.

2.17 Radiant Heat: Hose can be heated to destruction without contact by such nearby items as hot manifolds or molten metal. The same heat source may then initiate a fire. This can occur despite the presence of cool air around the hose.

2.18 Welding or Brazing: When using a torch or arc-welder in close proximity to hydraulic lines, the hydraulic lines should be removed or shielded with appropriate fire resistant materials. Flame or weld spatter could burn through the hose and possibly ignite escaping fluid resulting in a catastrophic failure. Heating of plated parts, including hose fittings and adapters, above 450°F (232°C) such as during welding, brazing, or soldering may emit deadly gases.

2.19 Atomic Radiation: Atomic radiation affects all materials used in hose assemblies. Since the long term effects may be unknown, do not expose hose assemblies to atomic radiation.

3.0 HOSE AND FITTING ASSEMBLY AND INSTALLATION INSTRUCTIONS

3.1 Pre-Installation Inspection: Prior to installation, a careful examination of the hose must be performed. All components must be checked for correct style, size, catalog number, and length. In addition, the hose must be examined for cleanliness, obstructions, blisters, cover looseness, or any other visible defects.

3.2 Hose and Fitting Assembly: Do not assemble a Parker fitting on a Parker hose that is not specifically listed by Parker for that fitting unless authorized in writing by the chief engineer of the appropriate Parker division. Do not assemble a Parker fitting on another manufacturers hose or a Parker hose on another manufacturers fitting unless (i) the chief engineer of the appropriate Parker division approves the assembly in writing, and (ii) the user verifies the assembly and the application through analysis and testing. See instruction 1.4 above.

The Parker published instructions must be followed for assembling the fittings on the hose. These instructions are provided in the Parker fitting catalog for the specific Parker fitting being used.

3.3 Related Accessories: Do not crimp or swage any Parker hose or fitting with anything but the proper listed Parker swage or crimp machine and dies and in accordance with Parker published instructions. Do not crimp or swage another manufacturers hose fitting with a Parker crimp or swage die unless authorized in writing by the chief engineer of the appropriate Parker division.

3.4 Parts: Do not use any Parker hose fitting part (including but not limited to socket, shell, nipple, or insert) except with the correct Parker mating parts, in accordance with Parker published instructions, unless authorized in writing by the chief engineer of the appropriate Parker division.

3.5 Reusable/Permanent: Do not reuse any reusable hose product that has blown or pulled off a hose. Do not reuse a Parker permanent (that is, crimped or swaged) hose fitting or any part thereof.

3.6 Minimum Bend Radius: Installation of a hose at less than the minimum listed bend radius may significantly reduce the hose life. Particular attention must be given to preclude sharp bending at the hose/fitting juncture.

3.7 Twist Angle and Orientation: Hose installations must be such that relative motion of machine components does not produce twisting.

3.8 Securement: In many applications, it may be necessary to restrain, protect, or guide the hose to protect it from damage by unnecessary flexing, pressure surges, and contact with other mechanical components. Care must be taken to insure such restraints do not introduce additional stress or wear points.

3.9 Proper Connection of Ports: Proper physical installation of the hose requires a correctly installed port connection insuring that no twist or torque is transferred to the hose.

3.10 External Damage: Proper installation is not complete without insuring that tensile loads, side loads, kinking, flattening, potential abrasion, thread damage, or damage to sealing surfaces are corrected or eliminated. See instruction 2.10.

3.11 System Checkout: All air entrapment must be eliminated and the system pressurized to the maximum system pressure and checked for proper function and freedom from leaks. Personnel must stay out of potential hazardous areas while testing and using.

3.12 Routing: Hose should be routed in such a manner so if a failure does occur, oil mist will not come into contact with hot surfaces, open flame, or sparks, and the chance of personal injury is minimized.

Offer of Sale

1. **Terms and Conditions of Sale:** All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditioned upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

2. **Payment:** Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the rate of 1-1/2% for each month or a portion thereof that Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. **Delivery:** Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. **Warranty:** Seller warrants that the items sold hereunder shall be free from defects in materials or workmanship for a period of 365 days from the date of shipment to Buyer, or 2,000 hours of use, whichever expires first. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**

   NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.

5. **Limitation Of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD, OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.**

6. **Changes, Reschedules and Cancellations:** Buyer may request to modify the designs or specifications for items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of an order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification of cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. **Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges therefor by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer therefor. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. **Buyer's Property:** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished to Seller by Buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. **Taxes:** Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller, or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefor upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, as well as any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. **Indemnity For Infringement of Intellectual Property Rights:** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions, including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation.

    Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

    If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgements resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. **Force Majeure:** Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. **Entire Agreement/Governing Law:** The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

    The items described in this document are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in this document, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

Fluid Connectors Group Regional Sales Offices & Service Centers

Your complete source for quality tube fittings, hose & hose fittings, brass fittings & valves, quick-disconnect couplings, and assembly tools, locally-available from a worldwide network of authorized distributors.

Fittings & Couplings: Available in inch and metric sizes covering SAE, BSP, DIN, GAZ, JIS and ISO thread configurations, manufactured from steel, stainless steel, brass, aluminum, nylon and thermoplastic.

Hose, Tubing and Bundles: Available in a wide variety of sizes and materials including rubber, wire-reinforced thermoplastic, hybrid and custom compounds.

Worldwide Availability: Parker operates Fluid Connectors manufacturing locations and sales offices throughout North America, South America, Europe and Asia-Pacific.

For information, contact the nearest Regional Sales Office listed, or **call toll-free 1-800-C-PARKER** (1-800-272-7537).

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Parker FluidConnectors

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