

Basic Compounds Used in Green Line Hoses...

The following table gives general properties for most common elastomers used in hose today. It is provided as a guide only, and qualities may vary since adjustments and additions to rubber or plastic compounds are often made to suit various applications. For example, an EPDM acid delivery hose may have a different blend of tube compound than an EPDM heater hose.

Common Name	Composition	General Characteristics
EPDM rubber	ethylene propylenediene-terpolymer	excellent ozone, chemical and aging characteristics, poor resistance to petroleum based fluids, very good heat and steam resistance
Hypalon	chloro-sulphonated-polyethylene	good heat and abrasion resistance fair resistance to petroleum based fluids excellent weathering, ozone, and acid resistance
Natural rubber	isoprene natural	excellent physical properties and abrasion resistance, acid-resistant but not oil-resistant
Neoprene rubber	chloroprene	flame retarding, excellent weathering resistance, good oil resistance, good physical properties
Nitrile rubber (Buna-n)	nitrile-butadiene	excellent oil resistance and good physical properties, moderate resistance to aromatics
Nitrile/pvc	nitrile-polyvinyl chloride	excellent oil and weather resistance good abrasion resistance
SBR rubber	styrene-butadiene	good physical properties, good abrasion resistance, poor resistance to petroleum based fluids
Viton rubber	hexafluoro-propylene vinylidene fluoride	excellent high temperature resistance very good chemical resistance very expensive
Cross-linked polyethylene (XLPE)	cross-linked polyethylene	excellent resistance to a very wide range of solvents, chemicals, acids and oils(including aromatics)
PVC	plasticized poly-vinyl chloride	excellent weathering and ozone resistance good chemical and abrasion resistance affected by temperature extremes
Urethane	polyurethane	extremely abrasion resistant, excellent chemical, weathering, petroleum and temperature resistance

Rubber versus Plastic...

With modern compounding technology the line between rubbers and plastics is becoming indistinct. In general, raw rubbers are transformed into finished goods by an irreversible chemical reaction during a heating process called vulcanization. For this reason they are referred to as thermoset elastomers. Plastics must be heated to a soft or liquid state to be formed into tubing or hose, but generally no chemical reaction takes place. If reheated, they will become soft and can be reformed. They are referred to as thermoplastic elastomers. Today many new plastics exhibit rubber-like features, and vice-versa.

Hose selection will depend on the characteristics of the particular elastomer formula that best fit the application.

Temperature Conversion

- **Fahrenheit to Celsius:** subtract 32 and multiply by 0.556.
- **Celsius to Fahrenheit:** multiply by 1.8 and add 32.

Useful information and rules of thumb...

- Each 10 ft of vertical height of water column produces 4.33 psi of pressure.
- 1 Cubic foot of water weighs 62.4 lb.
- 1 Imp Gallon of water weighs 10 lb.
- Each 1 HP on an electric air compressor produces 3.5 to 4 SCFM (standard cubic feet per minute) of air at 100 psi.
- Each 1 HP of drive in a hydraulic system will produce the equivalent of 1 GPM(gallon per minute) at 1500 psi.

Pressure:

1 psi	= 2.307 ft of head (ft of water column)
	= 2.036"Hg
	= 0.06895 Bar
	= 0.006895 MPa (MegaPascals)
	= 0.07031 Kg/sq cm
	= 0.06805 Atmospheres
1 Bar	= 14.5 psi
1 Atmosphere	= 14.7 psi
	= 29.92 Hg (inches of Mercury)
	= 33.9 feet of water
1MegaPascal (Mpa)	= 145 psi
1 Kg/sq cm	= 14.2 psi
Weight :	
1 lb	= 453.59 grams
	= 0.45359 Kg
1 Kg	= 2.2046 lb

Volume:

1 Cubic foot	= 7.48 US Gallons
	= 28.317 liters
1 Imp Gallon	= 1.201 US Gallons
	= 160 Imperial ounces
	= 4.546 liters
	= 4546 milliliters (c.c.'s)
1 US Gallon	= 128 US oz
	= 3.785 liters
1 Barrel oil	= 42 US Gallons
Length:	
1 inch	= 2.54cm
1 meter	= 3.28084 feet
1 Kilometer	= 0.62137 Miles
1 Mile	= 5280 feet
Power:	
1 HP	= 745.7 Watts

Temperature of Saturated

Gauge Pressure (psi)	Temperature	
	°C	°F
25	130	267
30	134	274
40	141	287
50	148	298
60	153	307
80	162	324
100	170	338
120	177	350
140	182	361
160	188	371
180	193	379
200	198	388
225	203	397
250	208	406
275	212	414
300	216	422
325	221	429
350	225	437

Velocity of fluid flow in hose: $V = 0.408 \times \text{GPM} / d^2$

V ...is fluid velocity in feet per second
GPM ...is flow in U.S. gallons per minute
d ...is the hose inside diameter in inches

What size hose should I use?

There are several considerations for determining hose size. Obviously, for a given flow rate, the smaller the hose, the higher the fluid velocity. As velocity increases, friction increases dramatically and much of the energy of the fluid is converted into heat, causing a pressure loss. For example, changing from a 5/8" hose to a 1/2" hose will more than double the pressure drop. For hydraulic systems, rules of thumb for fluid velocity have been developed that provide upper limits of acceptable friction and heat build-up. For industrial hoses, particularly pressure wash hoses, heat build-up is not a concern, rather excessive pressure drop over the length of the hose will make the pressure washer ineffective.

The calculation of actual pressure drop is quite complicated and dependent on many factors including fluid velocity, temperature, and viscosity, as well as tube smoothness. We can only calculate the fluid velocity and use the following guidelines to estimate an acceptable hose size.

Recommended flow velocity:

- Hydraulic suction lines..... 2 - 4 ft/sec.
- Hydraulic pressure lines to 500 psi..... 10 - 15 ft/sec.
- Hydraulic pressure lines (500-3000 psi)..... 15 - 20 ft/sec.
- Hydraulic pressure lines over 3000 psi..... 20 - 25 ft/sec.
- Water suction lines & discharge hoses..... 4 - 7 ft/sec.
- General water service..... 4 - 10 ft/sec.

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A few notes on making hose assemblies:

Permanent Installations: As much as we would like to see hose used everywhere, there are some installations where hose assemblies are not suitable. In general, these are permanent installations where visible inspection of the hose is impossible and where periodic testing is not conducted. The desirable feature of hose – its flexibility – is produced by specialized elastomers which will age and may be adversely affected by temperature, chemicals, ozone and extreme flexing. In general, hose assemblies should not be used as part of permanent piping systems, particularly where routine testing and inspection are not carried out, or where failure will result in property damage.

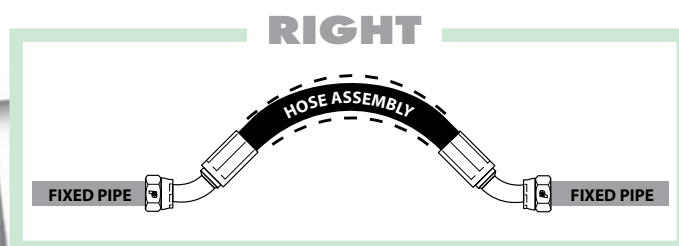
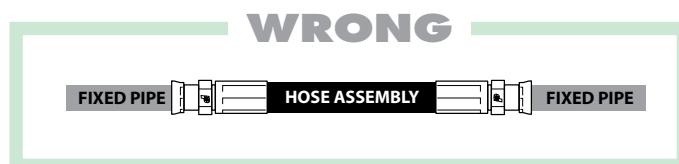
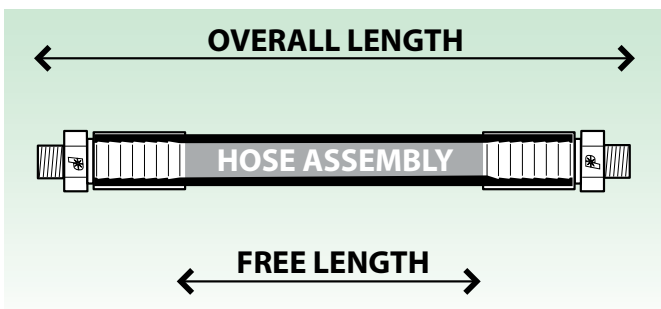
Electrical Grounding: Hoses being used to convey fuels or other flammable chemicals should have the hose electrically grounded to the couplings using the static or helix wire, to allow for dissipation of static electricity that may be built up by the fast flow of the product being carried.

Hydrostatic Testing: Where hose failure may result in environmental damage in the form of a chemical or fuel spill, new hose assemblies should be hydrostatically tested prior to use and periodically for the life of the hose. Typically hoses are tested to U.S. Coast Guard standards published by the Rubber Manufacturers Association. At our Delta location we offer hose testing services complete with test certificates and hose identification tags for your new or used assemblies.

Minimum Bend Radius: The bend radius of a hose is measured from the inside edge of the hose, not from the centerline. Minimum bend radii are typically given at room temperature. Higher temperatures may cause kinking, while low temperatures may make the hose difficult to bend tightly.

Very short rubber or plastic hose assemblies should not be used as flexible joints or expansion joints.

One of the most common hose failures we see is where a very short hose assembly is used between fixed pipes to allow for misalignment or vibration. Failures occur when the free length of the hose (the length of hose between the two fitting stems) is so short that it cannot absorb the flexing and vibration that occurs in the application. Also, when hoses are pressurized, they generally contract in length. If the assembly is in a straight line between two fixed points, something has to give to allow for the contraction. Generally it is the connection to the fittings, causing the fitting to weep.



Pin-pricked Hose Covers

Air and other gases will slowly pass through most elastomers. This is easily shown by balloons and car tires gradually becoming flat even though they are sealed. Some gases (freon, for example) are much more aggressive at moving through certain hose materials and may even require specialized hose to contain them. Since cover compounds may allow gas leakage at different rates than the tube compound used on the same hose, most air, welding, steam and other hoses used for gaseous products have pin-pricked covers. The pin-pricks allow trapped gas to escape rather than having it build up until the pressure

separates the cover from the reinforcement, resulting in cover blisters. However when detectable amounts of gas are noticed leaking from cover pin-pricks, there is a tube failure somewhere in the hose. Often the failure will be at the junction of hose and fitting, where severe sideways pull has caused the tube to be cut by the fitting stem (such as can occur when a portable compressor is dragged along by the hose). Other times, for example in air nailing hose applications, a nail has punctured the hose, and the resulting hole has been repaired with tape rather than with a mender and clamps. This allows air to leak from the perforated tube into the reinforcement and to escape via the cover pinpricks.

Water Hose Flow Rates...

Flow of water through 100 foot lengths hose
(straight with smooth bore)
U.S. Gallons per minute

These are maximum recommended flow rates, and this chart is based on a maximum acceptable pressure drop of 15% per 100 feet of hose. Where pressure drop must be reduced, hose size must be increased.

PSI at Hose Inlet	Nominal Hose Diameters											
	1/2"	5/8"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	6"	8"
20	4	8	12	26	47	76	161	290	468	997	2895	6169
30	5	9	15	32	58	94	200	360	582	1240	3603	7679
40	6	11	18	38	68	110	234	421	680	1449	4209	8970
50	7	12	20	43	77	124	264	475	767	1635	4748	10118
60	8	14	22	47	85	137	291	524	846	1804	5239	11165
75	9	15	25	53	95	154	329	591	955	2035	5910	12595
100	10	18	29	62	112	180	384	690	1115	2377	6904	14712
125	11	20	33	70	126	203	433	779	1258	2681	7788	16595
150	12	22	36	77	139	224	478	859	1388	2958	8593	18313
200	15	26	42	90	162	262	558	1004	1621	3455	10038	21390

Figures are to be used as a guide only, since the type of fittings used, variance of hose I.D., and orifice restriction all influence the actual discharge.

Air Line Sizing

Maximum recommended air flow in standard cubic feet per minute (scfm) as a guide in sizing hose and piping in compressed air systems.

MAXIMUM RECOMMENDED AIR FLOW (SCFM)

System Pressure (psi)	Nominal pipe size or hose i.d.										
	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"
5	0.5	1.2	2.7	4.9	6.6	13	27	40	80	135	240
10	0.8	1.7	3.9	7.7	11	21	44	64	125	200	370
20	1.3	3.0	6.6	13	18	35	75	110	215	350	600
40	2.5	5.5	12	23	34	62	135	200	385	640	1100
60	3.5	8.0	18	34	50	93	195	290	560	900	1600
80	4.7	10	23	44	65	120	255	380	720	1200	2100
100	5.8	13	29	54	80	150	315	470	900	1450	2600
150	8.6	20	41	80	115	220	460	680	1350	2200	3900
200	11	26	58	108	155	290	620	910	1750	2800	5000
250	14	33	73	135	200	370	770	1150	2200	3500	6100

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Air Hose Friction Loss...

Approximate pressure loss in psi through 100 foot hose lengths complete with couplings.

I D. of Hose	Gauge Pressure (psi)	Cubic feet of air per minute (SCFM)															
		40	50	60	70	80	90	100	110	120	130	140	150				
1/2"	50	20.2	36.2														
	60	16.8	29.6	46.8													
	70	14.0	24.8	40.0	56.8												
	80	12.0	21.6	34.8	50.4	69.2											
	90	10.8	19.0	29.6	44.0	61.0	82.0										
	100	9.6	16.8	26.6	38.6	54.4	73.3										
	110	8.6	15.2	24.0	35.2	49.2	66.6	89.0									
3/4"	50	3.0	4.8	7.0	8.8	13.0	17.0	22.8	28.4								
	60	2.4	3.8	5.6	7.6	10.4	13.6	17.2	22.4	28.2							
	70	1.8	3.0	4.6	6.4	8.4	11.0	14.0	17.6	22.0							
	80	1.6	2.6	3.8	5.6	7.2	9.4	11.6	14.4	17.6	21.2						
	90	1.4	2.2	3.2	4.6	6.2	8.0	10.0	12.4	15.0	18.0	21.6					
	100	1.2	2.0	2.8	4.0	5.4	7.0	8.8	10.8	13.2	15.8	18.8	22.2				
	110	1.0	1.8	2.6	3.6	4.8	6.2	7.8	9.8	11.8	14.2	16.8	19.8				
1"	50	0.6	1.0	1.6	2.2	3.0	4.0	5.2	7.0	9.6	14.0						
	60	0.6	0.8	1.2	1.6	2.4	3.0	4.0	5.2	6.6	8.2	11.0	14.4				
	70	0.4	0.8	1.0	1.4	2.0	2.6	3.2	4.0	5.0	6.2	7.6	9.4				
	80	0.4	0.6	1.0	1.4	1.6	2.2	2.8	3.4	4.0	4.8	5.4	7.0				
	90	0.4	0.6	0.8	1.2	1.4	1.8	2.4	2.8	3.4	4.0	4.8	5.6				
	100	0.4	0.4	0.8	1.0	1.2	1.6	2.0	2.4	3.0	3.6	4.2	4.8				
	110	0.4	0.4	0.6	0.8	1.2	1.4	1.8	2.2	2.6	3.0	3.6	4.2				
1 1/4"	50		0.4	0.4	0.6	0.8	1.0	1.4	2.0								
	60		0.2	0.4	0.6	0.6	1.0	1.2	1.6	2.0	2.4	3.0					
	70			0.4	0.4	0.6	0.8	0.8	1.2	1.4	1.6	2.0	2.6				
	80			0.2	0.4	0.4	0.6	0.8	1.0	1.2	1.4	1.6	2.0				
	90				0.4	0.4	0.6	0.6	0.8	1.0	1.2	1.4	1.6				
	100				0.2	0.4	0.4	0.6	0.8	0.8	1.0	1.2	1.4				
	110				0.2	0.4	0.4	0.6	0.6	0.8	1.0	1.0	1.2				
1 1/2"	50					0.4	0.4	0.4	0.6	0.8	0.8	1.0	1.2				
	60					0.2	0.4	0.4	0.4	0.6	0.6	0.8	1.0				
	70						0.2	0.4	0.4	0.6	0.6	0.6	0.8				
	80							0.2	0.4	0.4	0.4	0.6	0.8				
	90								0.2	0.4	0.4	0.4	0.6				
	100									0.4	0.4	0.4	0.4				
	110									0.4	0.4	0.4	0.4				

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Water Hose Friction Loss...

Approximate pressure loss expressed in pounds per square inch (psi) per 100 foot length of straight, smooth bore hose.

Flow of water in U.S. Gal. per min.	Hose Inside Diameter:														
	1/2"	5/8"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	5"	6"	8"	10"	12"
1	1.41														
2	5.09	1.72	0.71												
5	27.7	9.36	3.85	0.95	0.32	0.13									
10	100	33.7	13.9	3.42	1.15	0.47	0.12								
15		71.4	29.4	7.24	2.44	1.00	0.25	0.08							
20		122	50.0	12.3	4.16	1.71	0.42	0.14							
25			75.6	18.6	6.28	2.59	0.64	0.21							
30			106	26.1	8.80	3.62	0.89	0.30	0.12						
35			141	34.7	11.7	4.82	1.19	0.40	0.16						
40				44.4	15.0	6.17	1.52	0.51	0.21						
45				55.3	18.6	7.67	1.89	0.64	0.26						
50				67.1	22.7	9.32	2.30	0.77	0.32						
60				94.1	31.7	13.1	3.22	1.09	0.45						
70				125	42.2	17.4	4.28	1.44	0.59						
80					54.0	22.2	5.48	1.85	0.76						
90					67.2	27.7	6.81	2.30	0.95	0.23					
100					81.7	33.6	8.28	2.79	1.15	0.28					
125					123	50.8	12.5	4.22	1.74	0.43					
150						71.1	17.5	5.91	2.43	0.60	0.20				
175						94.6	23.3	7.86	3.24	0.80	0.27				
200						121	29.8	10.1	4.14	1.02	0.34				
225							37.1	12.5	5.15	1.27	0.43				
250							45.1	15.2	6.26	1.54	0.52				
275							53.8	18.1	7.47	1.84	0.62				
300							63.2	21.3	8.77	2.16	0.73	0.30			
350								84.0	28.3	11.7	2.87	0.97	0.40		
400								108	36.3	14.9	3.68	1.24	0.51		
450									45.1	18.6	4.57	1.54	0.64		
500									54.8	22.6	5.56	1.88	0.77	0.19	
600									76.8	31.6	7.79	2.63	1.08	0.27	
700									102	42.1	10.4	3.49	1.44	0.35	0.12
800									131	53.8	13.3	4.47	1.84	0.45	0.15
1000										81.4	20.0	6.76	2.78	0.69	0.23
1200										114	28.1	9.47	3.90	0.96	0.32
1400										152	37.3	12.6	5.18	1.28	0.43
1600											47.8	16.1	6.64	1.64	0.55
1800											59.5	20.0	8.25	2.03	0.69
2000											72.2	24.4	10.0	2.47	0.83
2500												36.8	15.2	3.73	1.26
3000												51.6	21.2	5.23	1.76

Figures are to be used as a guide only, since factors such as temperature and hose bends can greatly affect friction loss.