

TECHNICAL INFO

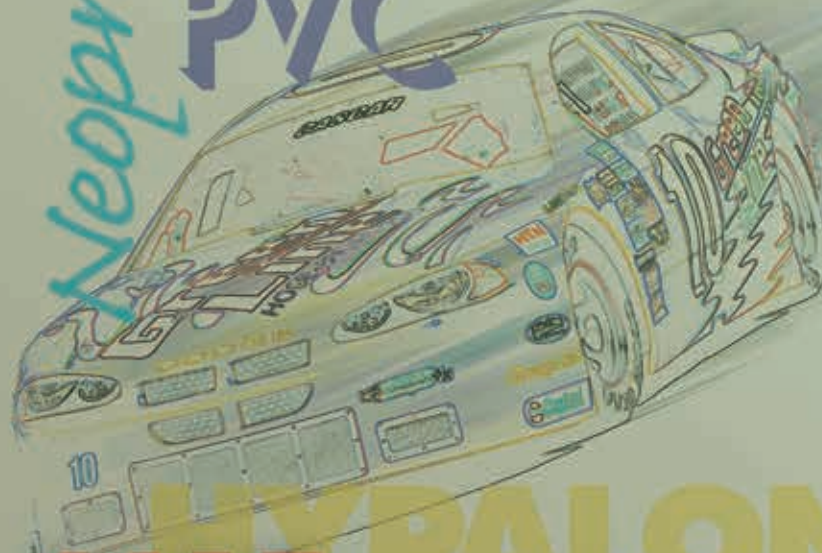
POLYETHYLENE

urethane

PVC

Neoprene

NITRILE



SCFM

HYPALON

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)
	= 2.036Hg
	= 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

Steam:		
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.

TECHNICAL SPECIFICATIONS

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.

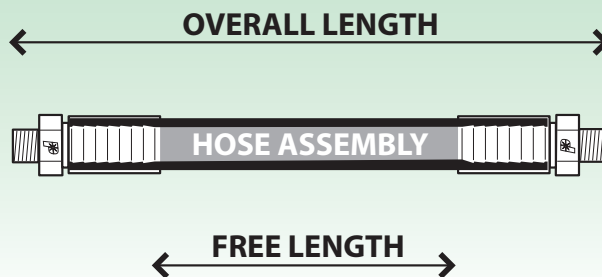
Electrical Grounding: Hoses being used to convey fuels or other flammable chemicals should have the hose electrically grounded to the couplings using the static or helix wire, to allow for dissipation of static electricity that may be built up by the fast flow of the product being carried.

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.



WRONG



RIGHT



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.

		Cubic feet of air per minute (SCFM)											
I D. of Hose	Gauge Pressure (psi)	40	50	60	70	80	90	100	110	120	130	140	150
		Pressure loss in psi											
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

TECHNICAL SPECIFICATIONS

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.



Force (in pounds) acting on end fittings...

The figures in this table demonstrate the importance of good fitting selection and installation. For example, a 4" dia. water discharge hose rated for 150 psi has 1885 lb of force acting on the end fitting when operating at full pressure.

Hose ID	50 psi	100 psi	150 psi	300 psi	500 psi	1000 psi
1/4	2	2	7	15	25	49
3/8	6	11	17	33	55	110
1/2	10	20	29	59	98	196
3/4	22	44	66	133	221	442
1	39	79	118	236	393	785
1 1/4	61	123	184	368	614	1227
1 1/2	88	177	265	530	884	1767
2	157	314	471	942	1571	3142
2 1/2	245	491	726	1473	2454	4909
3	353	707	1060	2121	3534	7070
4	628	1257	1885	3770	6283	12566
5	982	1964	2945	5891	9818	19635
6	1414	2827	4241	8482	14137	28274
8	2513	5027	7540	15080	25133	50274
10	3927	7854	11781	23562	39270	78540
12	5655	11310	16965	33929	56549	113100

Weight of water in one foot of hose...

This table is useful when considering support requirements for hoses during operation. For example, a 10" dia. 30 ft length of G941W-1000 suction hose can contain 1021 lb (over half a ton) of water when filled

Hose I.D.	lb	kg
1/4	0.021	0.010
3/8	0.048	0.022
1/2	0.085	0.039
5/8	0.133	0.060
3/4	0.191	0.087
1	0.340	0.154
1 1/4	0.532	0.241
1 1/2	0.766	0.347
2	1.361	0.618
2 1/2	2.127	0.965
3	3.063	1.389
4	5.445	2.470
5	8.509	3.859
6	12.252	5.558
8	21.782	9.880
10	34.034	15.438
12	49.009	22.230

CHEMICAL RESISTANCE

Due to space limitations, this chart lists more commonly encountered chemicals and hose compounds. For information on other hose or elastomers chemicals such as Hypalon, Viton, Butyl, CPE, Polyethylene and Teflon, please contact us.

Note: This chemical resistance chart gives a general indication of suitability only and recommendations are based on use at room temperature. Conditions of use, such as temperature and pressure, may effect suitability. Other requirements, such as the need for a food grade compound or for agency approval (CGA, ULC, USDA, etc) may affect hose selection.

Chart key:

- E...** recommended; little or no effect on hose compound, suitable for continuous service.
- G...** recommended; minor effect on hose compound, may be suitable for continuous service, suitable for intermittent service.
- C...** conditional or questionable; moderate to severe effect on hose compound, may be suitable for limited applications.
- X...** not recommended.
- I...** no data available.

	EPDM	Natural	Nitrile	Neoprene	SBR	XLPE	PVC	Urethane	UHMWPE
acetaldehyde 50%	G	G	X	C	C	E	X	X	E
acetic acid. glacial	G	G	C	X	G	E	C	X	E
acetic acid 30%	G	G	G	E	G	E	X	X	E
acetic anhydride	C	G	C	G	G	E	X	X	E
acetone	G	C	X	C	C	E	X	X	E
acetyl chloride	X	X	X	X	X	G	C	X	C
acetylene	G	G	E	G	G	E	G	X	E
adipic acid	G	E	E	E	E	I	I	I	E
aluminum acetate	G	E	G	G	G	E	I	X	E
aluminum chloride	G	E	E	E	E	E	E	C	E
aluminum fluoride	G	G	E	E	E	E	E	C	E
aluminum hydroxide	I	E	I	E	C	E	I	I	E
aluminum nitrate	G	E	E	E	E	E	I	C	E
aluminum sulfate	G	E	E	E	E	E	E	X	E
ammonia anhydrous... Use anhydrous ammonia hose only									
ammonia gas (cold)	G	E	E	E	E	E	I	C	I
ammonia gas (hot)	C	X	X	G	X	E	I	X	I
ammonium carbonate	G	E	X	G	X	E	E	X	I
ammonium chloride	G	E	E	E	E	E	E	E	E
ammonium hydroxide	G	X	G	E	X	E	C	X	E
ammonium nitrate	G	C	E	E	G	E	E	X	E
ammonium nitrite	G	E	E	E	E	E	I	I	I
ammonium phosphate	G	E	E	E	E	E	E	I	E
ammonium sulfate	G	E	E	E	E	E	E	E	E
amyl acetate	X	X	X	X	X	E	X	X	E
amyl alcohol	G	G	G	G	G	E	G	X	E
aniline	G	X	X	X	X	E	X	X	E
aniline dyes	G	G	X	G	G	E	I	X	I
aniline hydrochloride	C	G	G	X	X	E	I	X	I
animal fats	C	X	E	G	X	E	E	E	E
arsenic acid	G	G	E	E	E	E	G	C	E
arsenic trichloride	X	X	E	E	I	X	I	I	I
asphalt	I	X	G	G	X	X	C	G	C
barium chloride	G	E	E	E	E	E	E	E	E
barium sulfate	G	E	E	E	E	E	E	E	E
barium sulfide	G	E	E	E	G	E	E	E	E
beer	G	E	E	E	E	I	E	G	E
benzene	X	X	X	X	X	E	X	C	C
benzoic acid	X	X	C	X	X	E	I	I	E
benzyl alcohol	G	X	X	G	X	E	E	X	E
benzyl benzoate	C	X	X	X	X	E	I	I	I
benzyl chloride	X	X	X	X	X	E	I	X	C
boric acid	G	E	E	E	E	E	E	E	E
brine	G	E	E	E	E	E	E	G	E
bromine-anhydrous	X	X	X	X	X	X	I	X	X
bromine trifluoride	X	X	X	X	X	X	I	X	I
bromine water	G	X	X	X	X	X	I	X	I

	EPDM	Natural	Nitrile	Neoprene	SBR	XLPE	PVC	Urethane	UHMWPE
bromotoluene	X	X	X	X	X	C	I	I	I
bunker oil	X	X	E	X	X	E	I	G	E
butadiene	X	X	X	X	X	E	C	X	E
butane	X	X	E	E	X	E	C	E	E
butter	G	X	E	G	X	E	C	E	E
butyl acetate	X	X	X	X	X	E	X	X	E
butyl alcohol	C	E	E	E	E	E	G	X	E
butyl aldehyde	C	X	X	C	X	E	I	I	I
butyl amine	G	X	C	X	X	I	I	X	E
butyl benzoate	C	C	X	X	G	E	I	I	I
butyl cellosolve	G	X	C	C	X	E	I	X	E
butyl stearate	X	X	G	X	X	E	I	I	E
calcium acetate	G	E	G	G	X	E	I	X	E
calcium bisulfite	X	X	X	E	X	E	E	E	E
calcium carbonate	E	E	E	E	E	E	E	I	E
calcium chloride	G	E	E	E	E	E	E	E	E
calcium hydroxide	G	E	E	E	E	E	E	E	E
calcium hypochlorite	G	C	G	C	C	C	G	X	E
calcium nitrate	G	E	E	E	E	E	E	E	E
calcium sulfide	G	G	E	E	G	E	G	E	E
carbitol	C	G	G	G	G	E	I	X	E
carbolic acid (phenol)	C	X	X	C	X	E	C	C	E
carbon bisulfite	X	X	C	X	X	I	I	I	I
carbon dioxide	C	G	E	G	G	E	E	E	E
carbonic acid	G	E	G	E	G	E	E	E	E
carbon monoxide	G	G	E	G	G	E	G	E	I
carbon tetrachloride	X	X	C	X	X	E	X	X	C
carbon tetrafluoride	I	I	I	I	I	I	I	E	E
castor oil	C	E	E	E	E	E	G	E	E
caustic soda (sodium hydroxide)	G	E	G	E	E	E	G	C	E
cellosolve	C	X	X	X	X	E	I	X	E
cellosolve acetate	C	X	X	X	X	E	I	X	E
chlorine (dry)	X	X	X	C	X	C	E	X	C
chlorine (wet)	X	X	X	C	X	C	C	X	G
chlorine dioxide	X	X	X	X	X	I	I	X	I
chloroacetone	G	X	X	C	X	E	I	X	E
chloroacetic acid	G	X	X	X	X	E	I	X	E
chlorobenzene	X	X	X	X	X	E	X	X	E
chlorobutadiene	X	X	X	X	X	E	X	X	I
chloroform	X	X	X	X	X	G	X	X	C
chlorotoluene	X	X	X	X	X	G	X	X	X
chrome plating solutions	C	X	X	X	X	I	G	I	C
chromic acid	G	X	X	C	X	E	E	X	E
citric acid	G	E	E	E	E	E	E	G	E
cobalt	G	E	E	E	E	E	I	I	I
coconut oil	X	X	E	G	X	E	G	G	E
cod liver oil	G	X	E	G	X	E	E	E	E

CHEMICAL RESISTANCE

	EPDM	Natural	Nitrile	Neoprene	SBR	XLPE	PVC	Urethane	UHMWPE
coke oven gas	X	X	X	X	X	E	I	X	E
copper acetate	G	E	G	G	X	E	I	X	I
copper chloride	G	E	E	E	E	E	E	E	E
copper cyanide	G	E	E	E	E	E	E	E	E
copper sulfate	G	G	E	E	G	E	E	E	E
corn oil	X	X	E	C	X	E	E	E	E
cottonseed oil	C	X	E	G	X	E	G	E	E
creosote (coal tar)	X	X	E	G	X	E	X	X	E
cresol	X	X	X	C	X	E	G	X	E
cresylic acid	X	X	X	C	X	E	X	X	E
cumene	X	X	X	X	X	E	I	I	I
cyclohexane	X	X	E	C	X	E	X	G	E
cyclohexanol	X	X	C	E	X	E	X	I	E
cyclohexanone	G	X	X	X	X	E	X	X	E
p-cymene	X	X	X	X	X	E	X	I	I
decalin	X	X	X	X	X	E	I	I	E
denatured alcohol	G	E	E	E	E	E	E	X	E
detergent solution	G	G	E	G	G	E	E	C	E
(non-hydrocarbon) diacetone	G	X	X	X	X	E	I	X	I
diacetone alcohol	G	X	X	G	X	E	X	X	E
dibenzyl ether	C	X	X	C	X	E	I	G	I
dibutyl amine	G	X	X	X	X	E	I	X	I
dibutyl ether	X	X	X	C	X	E	I	G	E
dibutyl phthalate	C	X	X	X	X	E	X	C	E
dibutyl sebecate	C	X	X	X	X	E	I	X	E
dichlorobenzene	X	X	X	X	X	E	X	X	E
dichloroethylene	X	X	X	X	X	C	X	X	C
dichloro-isopropyl ether	X	X	X	X	X	E	I	G	I
diesel oil	X	X	E	C	X	E	C	C	E
diethylamine	G	G	G	G	G	E	E	C	E
diethylamine benzene	X	X	X	X	X	E	I	X	E
diethyl ether	X	X	X	C	X	E	C	G	E
diethylene glycol	G	E	E	E	E	E	E	X	E
diethyl sebecate	C	X	G	X	X	E	I	I	E
diisobutylene	G	X	G	X	X	E	I	I	I
diisopropyl benzene	X	X	X	X	X	E	I	I	I
diisopropyl ketone	G	X	X	X	X	E	I	X	I
dimethyl formamide	G	X	G	C	X	E	I	I	E
dimethyl phthalate	G	X	X	X	X	E	I	I	E
dinitrotoluene	X	X	X	X	X	E	I	I	I
dioctyl phthalate	C	X	C	X	X	E	X	I	E
dioctyl sebecate	C	X	X	X	X	E	I	I	I
dipentene	X	X	G	X	X	E	I	I	I
diphenyl - (phenylbenzene)	X	X	X	X	X	E	I	I	I
dowtherm oil	X	X	X	X	X	E	X	C	E
dry cleaning fluids	X	X	C	X	X	I	I	X	I
ethane	X	X	E	G	X	E	X	C	I
ethanolamine	G	G	G	G	G	E	C	C	E
ethyl acetate	G	X	X	C	X	E	X	X	E
ethyl acetoacetate	G	C	X	C	C	E	I	X	E
ethyl alcohol (ethanol)	G	E	E	E	E	E	G	X	E
ethyl benzene	X	X	X	X	X	E	I	X	E
ethyl benzoate	G	E	X	X	E	G	I	X	I
ethyl cellulose	C	G	G	G	G	E	I	G	E
ethyl chloride	X	X	E	X	X	E	X	C	E
ethyl ether	X	X	C	C	X	E	X	C	E
ethyl formate	C	X	X	G	X	E	I	I	E
ethyl pentachloro-benzene	X	X	X	X	X	X	I	C	I
ethyl silicate	G	G	E	E	G	E	I	I	I
ethylene	C	C	E	C	C	I	I	I	I
ethylene chloride	X	X	X	X	X	E	X	X	I
ethylene chlorohydrin	C	G	X	G	G	E	X	X	E
ethylene diamine	G	E	E	E	G	E	I	X	E
ethylene dichloride	X	X	X	X	X	E	X	X	C
ethylene glycol	G	E	E	E	E	E	E	C	E
ethylene trichloride	X	X	X	X	X	E	I	X	I
fatty acids	X	X	G	G	X	E	E	E	E
ferric chloride	G	E	E	E	E	E	E	E	E

	EPDM	Natural	Nitrile	Neoprene	SBR	XLPE	PVC	Urethane	UHMWPE
ferric nitrate	G	E	E	E	E	E	G	E	E
ferric sulfate	G	E	E	E	E	E	E	E	E
fish oil	X	X	E	X	X	E	I	I	E
fluoroboric acid	G	E	E	E	E	E	E	I	E
fluorobenzene	X	X	X	X	X	E	I	I	I
fluorolube	G	G	E	G	C	I	I	I	I
fluorosilicic acid	C	G	E	G	C	G	I	I	E
formaldehyde	G	G	C	G	G	E	C	X	E
formic acid	G	G	G	E	E	G	G	X	E
freon, all types... Use freon hoses only to prevent permeation into atmosphere									
fuel oil	X	X	E	G	X	E	C	G	E
furfural	G	X	X	C	X	E	X	C	E
gallic acid	G	E	G	G	G	E	E	X	E
gasoline	X	X	E	C	X	E	X	G	E
gelatin	G	E	E	E	E	E	G	C	I
glucose	G	E	E	E	E	E	E	C	E
glycerine	G	E	E	E	E	E	E	E	E
glycols	G	E	E	E	E	E	I	C	E
green sulfate liquor	G	G	G	G	G	E	I	E	E
hexane	X	X	E	G	X	G	C	G	E
hexyl alcohol	X	G	E	G	G	E	I	X	E
hydraulic oil (petroleum)	X	X	E	G	X	E	G	E	E
hydrobromic acid	G	E	X	X	X	E	E	X	E
hydrochloric acid 37%	G	G	C	G	G	E	E	X	E
hydrocyanic acid	G	G	G	G	G	C	G	I	E
hydrofluoric acid-(conc.) cold	G	X	X	X	X	E	E	X	E
hydrofluoric acid-anhydrous	G	X	X	X	X	E	C	X	I
hydrofluosilic acid	C	G	E	G	C	I	E	I	E
hydrogen gas	G	G	E	E	E	E	E	E	E
hydrogen peroxide 10%	I	X	I	I	X	E	I	I	E
hydrogen peroxide >10%	I	X	I	I	X	E	I	I	E
iodine	X	X	X	X	X	E	X	I	E
isobutyl alcohol	G	E	E	E	E	E	G	X	I
isooctane	X	X	E	G	X	E	C	G	E
isopropyl acetate	C	X	X	X	X	E	X	X	E
isopropyl alcohol	G	E	G	G	G	E	G	C	E
isopropyl chloride	X	X	X	X	X	E	I	X	I
isopropyl ether	X	X	G	C	X	E	X	G	E
kerosene	X	X	E	G	X	E	G	G	E
lacquer solvents	X	X	X	X	X	G	X	X	E
lactic acid (cold)	G	E	E	E	E	E	C	I	G
lard	C	X	E	G	X	E	G	E	E
lavender oil	X	X	G	X	X	G	I	X	E
lead acetate	G	E	G	E	X	E	E	X	E
lead nitrate	G	E	E	E	E	E	I	I	I
lead sulfamate	G	G	G	E	G	E	G	I	I
linseed oil	X	X	E	G	X	E	E	G	E
liquefied petroleum gas	X	X	E	G	X	E	I	E	E
lubricating oils - (petroleum)	X	X	E	G	X	E	G	G	E
lye	G	G	G	G	G	I	I	X	I
lye solutions	E	C	I	I	C	E	I	I	E
magnesium chloride	G	E	E	E	E	E	E	E	E
magnesium hydroxide	G	G	G	E	G	E	E	X	E
magnesium sulfate	G	G	E	E	G	E	E	E	E
maleic acid	G	C	X	C	C	G	G	I	E
maleic anhydride	C	C	X	C	C	I	I	I	E
malic acid	G	C	E	C	C	I	E	I	E
mercury	G	E	E	E	E	E	E	G	E
mesityl oxide	C	X	X	X	X	E	X	X	E
methane	X	X	E	G	X	E	I	C	I
methyl acetate	G	C	X	G	C	E	X	X	E
methyl alcohol (methanol)	G	E	E	E	E	E	G	X	E
methyl bromide	X	X	X	X	X	C	X	X	C
methyl butyl ketone (propyl acetone)	G	X	X	X	X	E	X	X	I
methyl cellosolve	C	X	G	G	X	E	C	X	E
methyl chloride	X	X	X	X	X	G	X	X	G
methyl ethyl ketone - (mek)	C	X	X	C	X	E	X	X	E
methyl isobutyl ketone	C	X	X	X	X	E	X	X	E

CHEMICAL RESISTANCE

	EPDM	Natural	Nitrile	Neoprene	SBR	XLPE	PVC	Urethane	UHMWPE
methyl oleate	C	X	X	X	X	E	I	I	I
methylene bromide	X	X	X	X	X	C	I	i	C
methylene chloride	X	X	X	X	X	C	I	i	C
milk	G	E	E	E	E	E	E	X	E
mineral oil	X	X	E	G	X	E	G	E	E
monochlorobenzene	X	X	X	X	X	G	X	X	G
monoethanolamine	G	G	X	X	G	E	I	I	E
monomethylether	X	X	E	C	X	I	I	I	I
monovinyl acetylene	G	G	E	G	G	I	I	I	I
naphtha	X	X	G	C	X	E	X	C	E
naphthalene	X	X	X	X	X	E	C	G	E
naphthenic acid	X	X	G	X	X	E	I	I	E
natural gas	X	G	E	E	G	E	I	G	E
nickel acetate	G	E	G	G	X	E	I	X	E
nickel chloride	G	E	E	E	E	E	E	C	E
nickel sulfate	G	G	E	E	G	E	E	C	E
nitric acid-conc.	G	X	X	X	X	C	X	X	C
nitric acid-dilute	G	X	X	G	X	E	E	C	E
nitrobenzene	G	X	X	X	X	E	X	X	E
nitroethane	C	G	X	C	G	E	I	X	I
nitromethane	C	G	X	G	G	E	I	I	E
nitrogen	G	E	E	E	E	E	E	E	E
nitrous oxide	I	E	E	I	E	E	E	I	E
octachlorotoluene	X	X	X	X	X	I	X	X	I
octyl alcohol	X	G	G	E	G	E	G	X	E
oleic acid	X	X	C	C	X	E	C	G	E
oleum	G	X	G	C	X	I	X	C	X
olive oil	C	X	E	G	X	E	G	E	E
o-dichlorobenzene	X	X	X	X	X	I	I	I	G
oxalic acid	G	G	G	G	G	E	E	I	E
oxygen	G	G	G	E	G	E	E	E	E
ozone	G	X	X	C	X	E	E	E	E
palmitic acid	C	G	E	G	G	G	I	E	E
peanut oil	X	X	E	C	X	E	G	G	E
perchloric acid	C	X	X	G	X	E	I	X	E
perchloroethylene	X	X	G	X	X	E	X	X	E
petroleum	X	X	E	G	X	E	G	G	E
phenol (carbolic acid)	G	X	X	C	I	E	C	C	E
phenylbenzene	X	X	X	X	X	I	X	I	I
phenyl hydrazine	C	E	X	X	G	E	I	I	G
phorone	X	X	X	X	X	E	I	I	I
phosphoric acid-20%	G	G	G	G	G	E	E	E	E
phosphoric acid-80%	G	C	X	G	C	E	E	I	E
phosphorus trichloride	G	X	X	X	X	I	I	I	I
picric acid	G	G	G	E	G	E	X	G	E
pine oil	X	X	E	X	X	E	C	I	E
polyvinyl acetate emulsion	G	G	I	G	X	I	I	I	I
potassium acetate	G	E	G	G	X	E	E	X	E
potassium chloride	G	E	E	E	E	E	E	E	E
potassium cupro cyanide	E	E	E	E	E	E	E	E	E
potassium cyanide	G	E	E	E	E	E	G	E	E
potassium dichromate	G	G	E	E	G	G	E	G	E
potassium hydroxide	G	G	G	G	G	E	E	X	E
potassium nitrate	G	E	E	E	E	E	E	E	E
potassium sulfate	G	G	E	E	E	E	E	E	I
propane	X	X	E	G	X	E	G	C	E
propyl acetate	C	X	X	X	X	E	I	I	E
propyl alcohol (propanol)	G	E	E	E	E	E	G	X	E
propyl nitrate	G	X	X	X	X	E	I	I	I
propylene	X	X	X	X	X	E	I	X	I
pyranol (transformer oil)	X	X	X	E	G	E	I	G	I
pyridine	G	X	X	X	X	E	X	G	I
sal ammoniac	G	E	E	E	E	E	I	E	I
salicylic acid	G	E	G	E	G	E	I	I	I
salt water	G	E	E	E	E	E	E	E	E
sewage	G	G	E	G	G	E	G	X	E
silicone greases	G	E	E	E	E	E	G	E	E

	EPDM	Natural	Nitrile	Neoprene	SBR	XLPE	PVC	Urethane	UHMWPE
silicone oils	G	E	E	E	E	E	G	E	E
silver nitrate	G	E	G	E	E	E	G	E	E
skydrol 500 & 7000	G	X	X	X	X	E	X	X	E
soap solutions	G	G	E	G	E	E	E	C	E
soda ash	G	E	E	E	E	E	E	E	E
sodium acetate	G	E	G	G	X	E	E	X	E
sodium bicarbonate	G	E	E	E	E	E	E	E	E
sodium bisulfite	G	E	E	E	G	E	E	E	E
sodium borate	G	E	E	E	E	E	E	E	E
sodium chloride (brine)	G	E	E	E	E	E	E	E	E
sodium cyanide	G	E	E	E	E	E	E	E	E
sodium hydroxide	G	E	G	E	E	E	G	X	E
sodium hypochlorite	C	X	G	E	X	G	G	X	E
sodium metaphosphate	G	E	E	G	E	E	E	I	E
sodium nitrate	G	G	G	G	E	E	E	E	E
sodium perborate	G	G	G	G	G	E	I	I	E
sodium peroxide	G	G	G	G	G	E	E	X	E
sodium phosphate	G	E	E	G	E	E	E	E	I
sodium silicate	G	E	E	E	E	E	E	E	E
sodium sulfate	G	G	E	E	G	E	E	E	E
sodium thiosulfate	G	G	G	E	G	E	E	E	E
soybean oil	X	X	E	G	X	E	E	G	E
stannic chloride	G	E	E	G	E	E	G	I	E
stearic acid	G	G	G	G	G	E	E	E	E
styrene	X	X	X	X	X	G	X	C	C
sucrose solution	G	E	E	E	G	E	E	X	E
sulfur	G	X	X	E	X	E	I	I	E
sulfur chloride	X	X	C	C	X	E	G	I	I
sulfur dioxide-dry	E	C	X	X	C	G	G	I	I
sulfur dioxide-liquid	G	G	X	G	G	E	X	I	I
sulfur dioxide-wet	E	G	X	G	G	E	X	I	I
sulfuric trioxide	C	G	X	X	G	G	E	I	X
sulfuric acid 10%	G	C	C	G	C	E	E	C	E
sulfuric acid 10-75%	G	X	X	X	X	E	C	X	E
sulfurous acid	G	G	G	G	G	E	G	X	E
tannic acid	G	E	E	E	G	E	E	E	E
tar bituminous	X	X	G	C	X	X	I	I	C
tartaric acid	C	C	E	G	X	E	E	E	E
terpineol	X	X	G	X	X	G	G	G	I
tertiary butyl alcohol	C	G	G	G	G	E	G	X	E
tetrachloroethylene	X	X	X	X	X	E	X	X	E
tetraethyl lead	X	X	G	G	X	I	I	I	I
toluene	X	X	X	X	X	E	X	X	G
toluol	X	X	X	X	X	E	I	I	E
transformer oil	X	X	E	G	X	E	I	E	E
transmission fluid A	X	X	E	G	X	E	I	E	E
trichloroethane	X	X	X	X	X	E	X	X	G
trichloroacetic acid	C	C	G	X	G	E	I	I	E
trichloroethylene	X	X	X	X	X	E	X	X	C
tricsesyl phosphate	X	X	X	X	C	E	X	C	E
triethanol amine	G	G	G	E	G	E	C	X	E
trinitrotoluene	X	X	X	G	X	E	I	I	G
turbine oil	X	X	G	X	X	E	G	E	I
turpentine	X	X	E	X	X	E	G	X	E
vegetable oils	X	X	E	C	X	E	G	G	E
vinegar	G	G	G	G	G	E	E	X	E
vinyl chloride	X	X	X	X	X	E	X	X	E
water	G	E	E	E	E	E	E	G	E
whiskey, wine	G	E	E	E	E	E	C	G	E
white oil	X	X	E	G	X	E	I	E	E
wood oil	X	X	E	G	X	E	E	C	E
xylene	X	X	X	X	X	E	X	X	C
zinc chloride	G	E	E	E	E	E	E	E	E
zinc sulfate	G	G	E	E	G	E	E	I	E

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153 assemblies	37	G212 assemblies	117	G521	164	G91	131
154	37	G212 rack	116	G521 assemblies	165	G910	30
154 assemblies	37	G212L	116	G521CSA assemblies	166	G911	29,96,127
155	37	G221	10,29	G522CSA assemblies	166	G912	30,124
155 assemblies	37	G221 assemblies	5	G571	56	G912 assemblies	24,124,128
157CD	115	G222	10,29	G571 assemblies	58	G922	12
184SC	36	G222 assemblies	5,8	G572	56	G922 assemblies	4
185SC	36	G223	14	G572 assemblies	58	G923	13
186SC	36	G223 assemblies	8	G573	57	G923 assemblies	5
653	72	G224	11	G573 assemblies	58	G924	13
AV	136,152	G232	15,34	G603	60	G924 assemblies	4
AVB	136,152	G232 assemblies	9	G603 assemblies	60	G929	20
CR	118,119	G232G	15,34	G611	106	G929L	20
DF	150	G232G assemblies	9	G611A	123	G929L assemblies	20
DFU	150	G234	11	G621	61	G930	132
DP	154	G242	16	G621 assemblies	61	G940	137,148
G1011	101	G242 assemblies	9	G622	62	G941BG	38
G103	12,108	G242 driller assemblies	51	G622 assemblies	62	G941BLK	38
G1031	31	G242G	16	G623	64	G941BW	39,134
G1033	31	G242G assemblies	9	G625B	64	G941BW assemblies	26
G1033 assemblies	22	G242G driller assemblies	51	G626	63	G941CG	151
G1040	101	G243	17	G626 assemblies	63	G941FT	98
G1041	102	G252	17	G632 assemblies	65	G941GT	151
G1073	102	G261	18	G641BL	67	G941H	38
G105	106	G263	18	G643	66	G941HT	52
G1074	103	G2641	70	G643C	66	G941K	38,133
G1212	115	G2641TC	70	G643L	68	G941K assemblies	26
G1232	19	G2641Y	70	G645	71	G941M	131
G1232 driller assemblies	51	G270	19	G663	73	G941MH	131
G1331 assemblies	22	G2841	88	G665	73	G941MILK	99
G1340C	80	G2847	89	G681A	122	G941MILKLT	99
G1341	42	G300 assemblies	23	G681CE	122	G941PF	52
G1341B	42	G301	28,109,130	G682A	123	G941PS	97
G1341C	80	G302	110	G722	81	G941W	40,77
G1341K	42	G304	110	G724	84	G941WB	132
G1341K assemblies	26	G311	28	G725	82	G941WE	76,100
G1341R	42	G311 assemblies	23	G734	85	G941WOR	71
G1342	43	G312	51	G741	82,103	G941WS	41
G1372	46	G312 assemblies	51	G742	83	G941WT	76,100
G1372 assemblies	27,50,161	G322	28	G743	83	G945	148
G1372Y driller assemblies	51	G322W	33	G772	84	G946	135,149
G1373	46	G324W	33	G774	84	G961	93
G1600BC	69	G329	35	G783	85	G971	45
G1640C	69	G341	43	G783 assemblies	85	G971 assemblies	27
G1641C	69	G341 assemblies	26	G784	85	G972	45
G1700	143	G341C	44	G784 assemblies	85	G972 assemblies	27
G1710 assemblies	7	G341C assemblies	50	G800	144	G974	45
G1712 assemblies	7	G341E	44	G800BL	144	G974 assemblies	27
G1722	14	G341E assemblies	50	G800H	144	G981	93
G1722 assemblies	6	G354	111	G800N	145	HR1722	6
G1740	77,153	G355	111	G800R	144	PAS	70
G1741	78	G372	47	G800T	146	PVW	157
G1741AMPH	78	G373E	48	G800W	144	TPR	155
G1741UBK	79	G373E assemblies	27,50	G800Y	144	TPRW	155
G1745	79	G374	49	G805	145	TPU	156
G1745R	79	G380	130	G822DEF	107		