HOSE CONSTRUCTIONS

14.1.1
Hoses with an external helix

For example all MASTER-CLIP hoses, the hose-types CARFLEX 350 and CARFLEX 570.

Construction

High-tensile connection between hose material and external helix (CLIP) thanks to special clamping procedure.

Advantages

Universal possiblities of processing and combining hose material <u>without</u> using the manufacturing processes of adhesively bonding, vulcanising, welding or sewing.

- external steel helix protects against abrasion
- excellent flexibility
- small bend radius
- extreme compressibility
- easy installation when using CLIP-GRIP hose clamp
- continuously variable production diameters from 1.5" - 36"

14.1.2
Extruded profile hoses

For example all MASTER-PUR and MASTER-PVC hoses.

Construction

Extruded plastic profile helical, lap-welded with immovable cast spring steel wire.

Advantages

Possiblities of producing hose qualities ranging from light and highly flexible to heavy and highly vacuum-proof.

- even, symmetrical bending thanks to the solid bonding between the plastic and spring steel wire.
- smooth inside, for optimum flow characteristics
- possibility of processing the most varied kind of thermo-plastic plastics
- production diameters from 2.0" - 16.00"

14.1.3
Hoses of sheeting or coated fabric strips with set up support spiral

For example: MASTER PUR STEP- and CAR-FLEX SUPER - hose.

Construction

Sheeting or fabric strips, helical, lap-welded, with a plastic spiral.

Advantages

Variable possibility to produce hoses from different materials, films and fabric thickness.

- highly flexible
- small bend radius
- cost-effective storage
- production diameters from 2.0" - 16.00"

14.1.4
Single and multi-layer spiral hoses of vulcanised fabric strips

For example: the hose types MASTER-NEO 1, MASTER-NEO 2, MASTER-SIL 1, MASTER-SIL 2.

Construction

Vulcanised fabric strips wound and overlapping with internal free or embedded spring steel support spiral and additional external fibre string fixing.

1-(layer)

2-(layers)

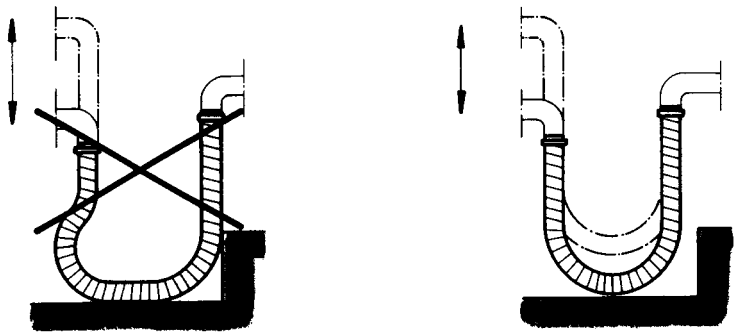
Advantages

- inner hose wall smooth
- extremely flexible
- small bend radius
- good pressure-resistance
- production diameters from 0.52" - 12.20"

14.2 POSITIONING OF MASTERDUCT HOSES

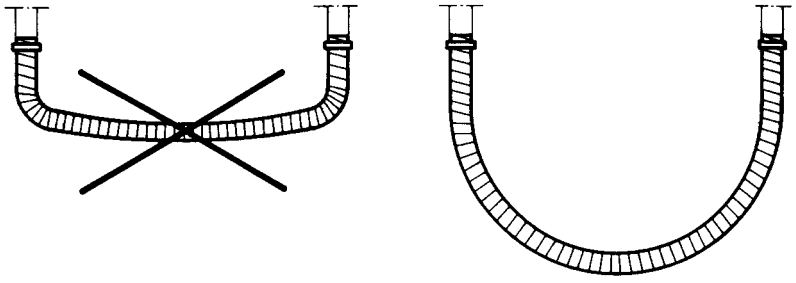
14.2
The length of individual hose types may be changed by the influencing variables of pressure, vacuum, media and ambient temperature. This must be taken into account when laying out flexible hose line in order to prevent mechanical damage occuring.

example 1



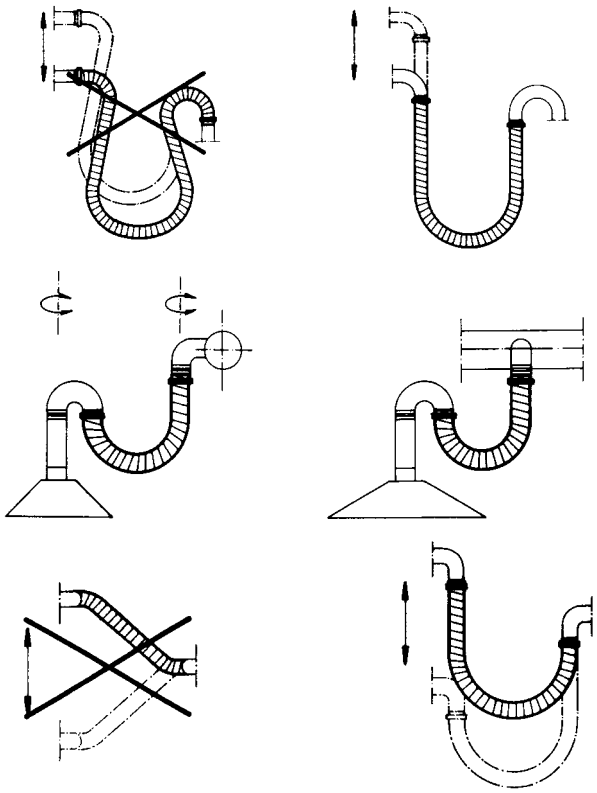
Arrange flexible hose line as freely-suspended bends in such a manner that they do not come in contact with the wall or other objects or with the ground even during extended stroke.

example 2



Install flexible hose line at 180° with sufficiently neutral hose ends. Decide on installation interval in accordance with the required bend radius.

example 3



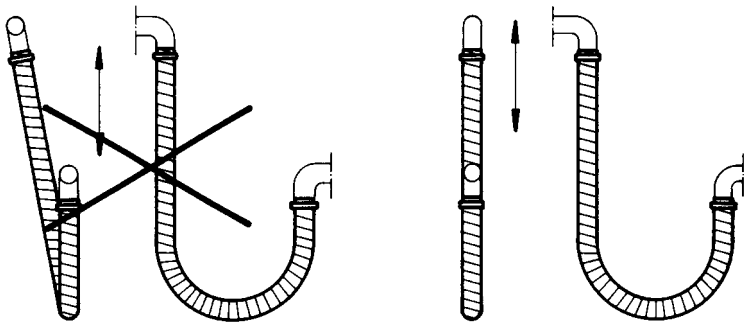
3.1

3.2

Use rigid pipe bends to avoid impermissible bends directly behind the connection fittings. Observe minimum bend radius.

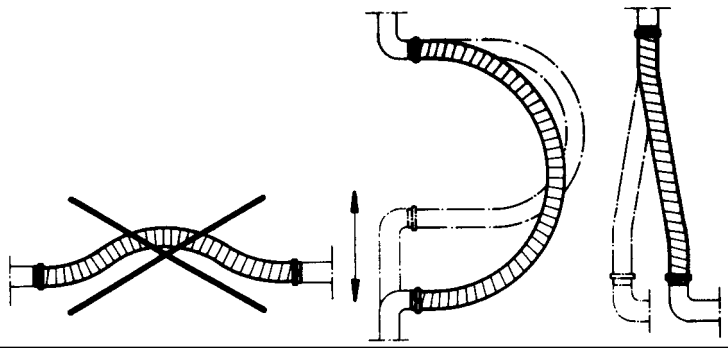
3.3

example 4



Movement direction and hose axis must be level. This prevents harmful torsional strain occurring.

example 5

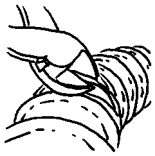


Low lateral movement is permissible.

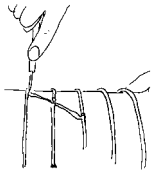
14.3 INSTRUCTION FOR CUTTING LENGTH MASTERDUCT HOSES

14.3.1
How to cut hoses with an external helix
(all MASTER-CLIP , CARFLEX 350 and CARFLEX 570 hoses)

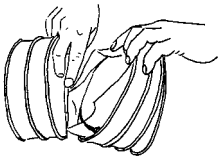
cut the helix at first with a side cutter



using a sharp knife, cut the hose material through to the both neighbouring helix

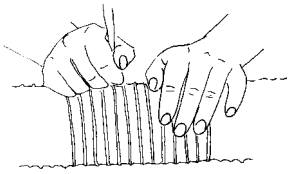


At last cut cleanly the hose material along the helix.

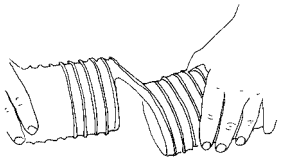


14.3.2
How to cut hoses with integrated reinforce-spiral of spring steel wire or plastic

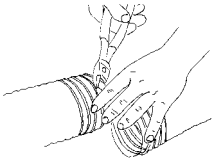
using a sharp knife, cut the hose material through to the reinforce-spiral



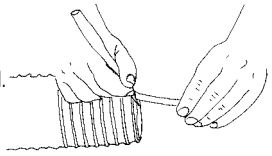
bend the both hose ends to separate the spirals



and cut the reinforce-spiral then with a side cutter



At last cut cleanly the hose material along the reinforce-spiral.



GENERAL TERMS

All catalog specifications are the result of internal tests and trials on internationally recommended standards and refer to a medium and ambient temperature of +68°F. Deviating temperatures can alter the pressure and vacuum specifications. Due to the construction, the length of individual hose types may be affected by the influencing variables of pressure, vacuum, medium and ambient temperature. This alteration in length must be taken into account by the user during operation. (Also see - positioning of MASTERDUCT hoses 14.2)

OPERATING PRESSURE

The operating pressure is the maximum permitted overpressure at which a hose may be used.

TEST PRESSURE

The test pressure is up to 50% above the operating pressure depending on the hose construction. At the test pressure the hose may not present any leaks or lasting deformation.

BURSTING PRESSURE

Bursting pressure refers to the pressure at which the hose is destroyed. The bursting pressure serves to establish the operating pressure with due consideration to the normal safety factors.

VACUUM

Testing the vacuum withstand:
In the vacuum tests the hoses were laid in a 90° bend while maintaining the minimum bending radius and subjected to negative pressure until they showed signs of indentation or collapse. The permissible negative pressure in continuous operation is determined with due regard to the normal safety factors.

14.5 PRESSURE LOSSES OF MASTERDUCT HOSES

14.5.1 Pressure losses in hoses when stretched out

The pressure loss is the resistance to air in a hose or pipeline system. When planning a ventilation system, the air resistance which inevitably occurs must be taken into account. To simplify the determination of pressure loss, there are diagrams showing the specific pressure losses in Masterduct-hoses. The figures are average values for hoses which are stretched out straight and where the temperature is 68°F.

Diagram 1
2.00" - 16.00"
smooth
for following hose types:
MASTER-PUR L
MASTER-PUR H
MASTER-PUR H-EC
FLAMEX L
FLAMEX H
MASTER-PVC L
MASTER-PVC H
MASTER-NEO 2
MASTER-SIL 2

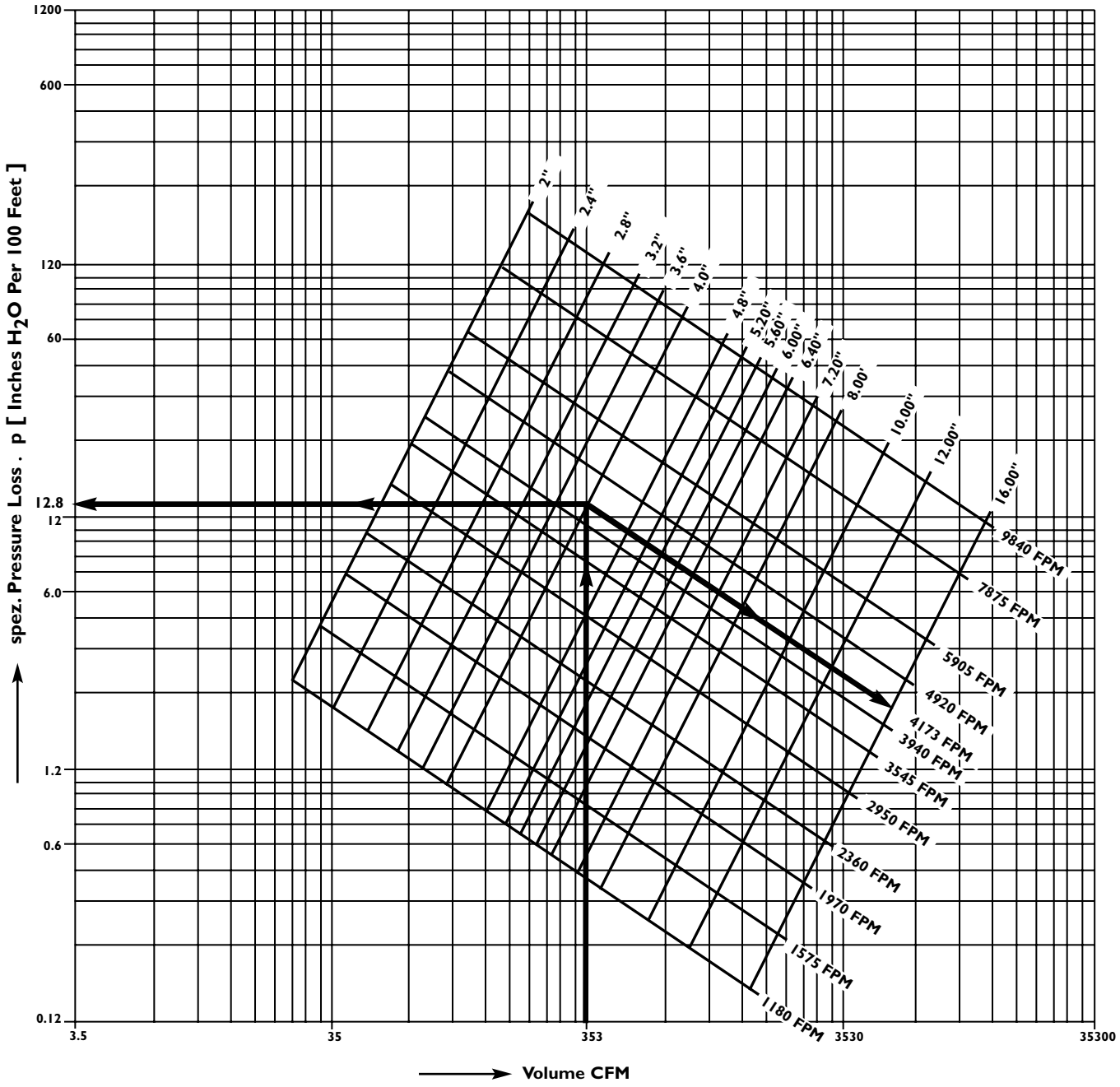
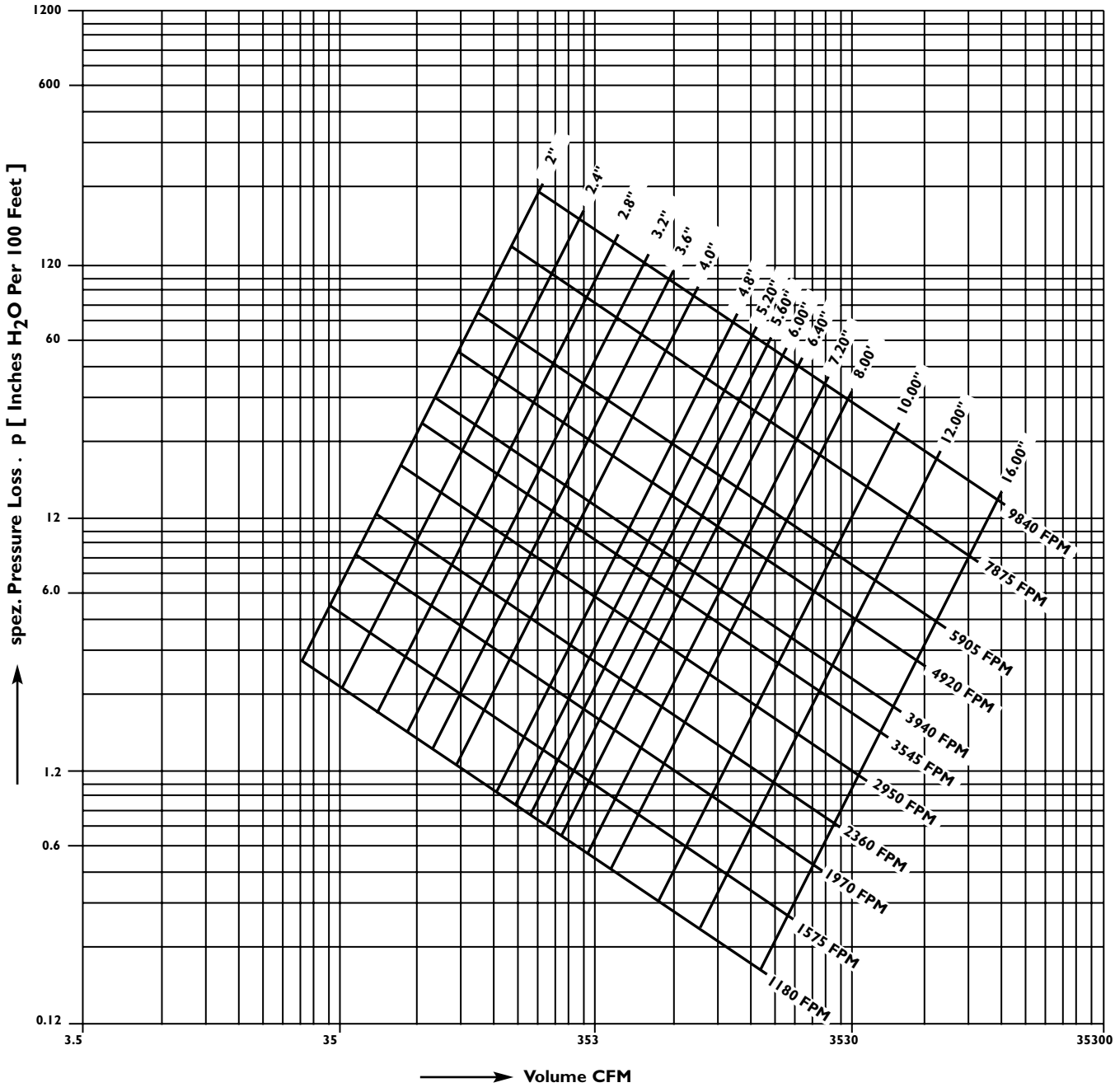
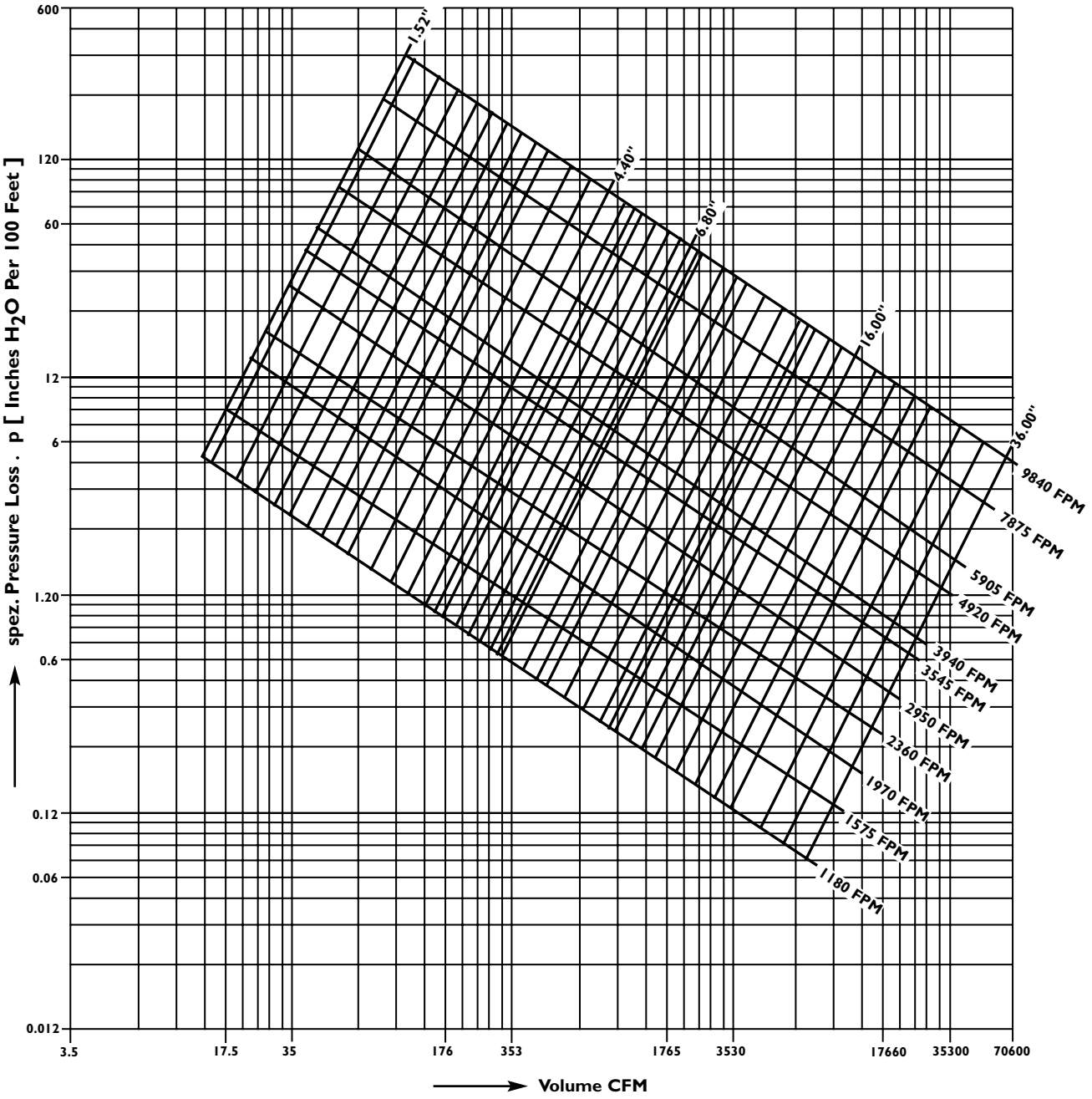


Diagram 2
2.00" - 16.00"
wavy
for following hose types:
MASTER PUR SL
FLAMEX SL
MASTER PVC SL
MASTER-NEO I
MASTER-SIL I
CARFLEX SUPER
MASTER-PUR STEP



14.5.1 PRESSURE LOSSES OF MASTERDUCT HOSES

Diagram 3
1.52" - 36.00"
for following hose types:
CARFLEX 350
CARFLEX 570
all MASTER-CLIP hoses except
hose constructions
loose lined



14.6.1 General points

Flexible hose lines can be a potential source of danger at pneumatic suction and conveying plants due to the building of electrostatic charges. The possibility of discharging is therefore mandatory in many areas of application to ensure safe operation. Hoses are used to transport solids, e.g. in the form of granular material, chips, dust, sand, cement etc. and also liquid and gaseous media. Electrostatic charges arise wherever solids which are non-conductive or of poor conductivity are brought into contact with other materials and separated again. As a result of the separating process one material has less electrons than the other which leads to one being positively and the other negatively charged. In the area of the common boundary surface the so-termed "interfacial potential" is formed which makes spark discharge possible. There are many ways of avoiding such discharge and these are discribed in more detail in the following.

14.6.2 Regulations

There is a series of directives and regulations on evaluating and avoiding the risk of ignition and deciding on the safety precautions to be taken.

14.6.3 Why electrostatic charge occurs

During the transport of solid, liquid or gaseous media, the "interfacial potential" described in the above is built up due to the friction on the insides of the hose lines. Depending on the degree od charge this leads to sparking, to electric breakdown or sometimes the ignition of flammable materials. In addition to the intensity of the contact (friction) between the medium and the inner sides of the hose, the "permittivity" of the hose and the medium flowing through is decisive for the degree of chargeability. This is considered a gauge of the polarisability. Even conductive materials can become charged if not grounded.

14.6.4 Limit determination and definition

In general the following can become electrostatically charged:

- solids with a surface resistance $> 10^{9}$ Ohm
- liquids with a conductivity of $< 10^{-8}$ s/m
- all objects of conductive material which are not grounded

In general the following **cannot** become electrostatically charged:

- all solid and liquid matter which fall short of the above critical resistance values
- all conductive materials which are grounded

14.6 DERIVATION OF ELECTRIC CHARGE AT MASTERDUCT-HOSES

14.6.5 Ways of connecting electrostatic charges

The surface resistance of the materials of the hose sides can be reduced to values between 10^3 - 10^4 Ohm by incorporating conductive additives. These conductive additives form in the plastic a network of conductive particles (volume conductivity) in contact with each other. Another possibility is incorporating antistatic agents. The effect results from the absorption of water from the atmospheric humidity at the surface of the sides of the hose. Surface resistance values of 10^8 Ohm can be attained (surface resistance). Also a risk of danger is not to be expected if the distances between the turns in hoses with metal, grounded support spirals do not exceed .75".

14.6.6 Note

The addition of conductive additives or antistatic agents reduces the mechanical material values (e. g. abrasion and ultimate tensile strength) and accordingly reduces service life. The information summarised under points 1-6 are based on internal and external field research and on the regulations in effect at present. They serve as guidelines for using Masterduct hose types in areas of potential danger but no guarantee is given that they are complete.

The catalogue details with respect to the surface resistance are based to some extent on official test results, details supplied by our raw-material suppliers and internal measurements. In cases of doubt, we recommend testing the hoses under operating conditions or similar circumstances before final installation.

Description of the material polyurethane (TPU)

MASTERDUCT suction and conveying hoses for abrading solids are made of the high-duty material polyurethane.
Polyurethane essentially made of the reaction of three components:

1.) Polyole (long chain diole)
2.) Diisocyanate
3.) short chain diole

The kind of raw materials, the reaction conditions and the initial materials are responsible for the product characteristics.
The using Polyole determine the characteristics of thermoplastic polyurethane quite essentially. Either polyester-polyole or polyether-polyole are used for polyoles.

Thermoplastic polyurethane elastomers, also known as TPU, have the quality and properties to meet the most various requirements, such as:

- flexibility in a wide range of temperatures
- high degree of resistance to wear
- resistance to buckling and breaking (high resistance to nicking and further tearing)
- good resilience
- good dynamic stability under load
- good resistance to hydrolysis and microbes
- good to very good atmospheric corrosion
- resistance to oil, grease and solvents

Color

The inherent color lies between yellowish and white opaque and also translucent, whereby the wall thickness is a factor here. Dying is possible.

14.7.1 Mechanical properties

Resistance to further tearing

The term resistance to further tearing refers to the resistance of a nicked test sample to further tearing. The test is carried out on corner samples, each with a cut on one side. This means that it is much more difficult to tear MASTERDUCT hoses, even when damaged, than other thermoplastic hoses (e. g. PVC hoses).

Resistance to abrasion

Abrasion in rubber and elastomers is tested on samples with a particular contact force is brought to bear on a rotating roller covered with a test emery sheet. The entire length of friction amounts to approx. 130 ft. The material consumption due to abrasive wear is measured with due consideration to the thickness of the test sample and the severity of the attack of the test emery sheet. This is indicated as loss of volume in mm^3. The standard PUR raw material used by MASTERDUCT has an abrasion of approx. 30 mm^3.
Comparative values of raw materials used by MASTERDUCT :

- soft PVC approx. 150 mm^3
- Santoprene approx. 225 mm^3
- PUR-EC approx. 45 mm^3

14.7.2 Thermal properties

Like all materials, TPU is subject to temperature-dependent reversible alterations in length. This is indicated by the coefficient of linear thermal expansion α [1/K] as a function of temperature. Shore hardness is also an influencing variable.
It is therefore advisable in many applications to take account of the dependence on temperature when selecting the MASTER PUR hoses. These hoses can be used in temperatures up to 260°F for short periods but a temperature of 195°F should not be exceeded for longer periods. Soft polyether-based types are flexible in temperatures down to -40°F.

14.7 DESCRIPTION OF THE MATERIAL POLYURETHANE (TPU)

14.7.3 Electrical properties

Surface resistance

The polyurethane raw material processed by MASTERDUCT has a surface resistance of 10^{10} Ohm and can therefore be used as electrically-insulating protective hoses.

Discharging electrostatic charge

We refer here to chapter 14.6.

14.7.4 Resistance to media

The suitability of a synthetic material for a particular application often depends on its resistance to chemicals. The reaction of thermoplastic polyurethane to the effects of chemical substances can vary greatly. The resistance of TPU to certain materials, e.g. cooling and lubricating agents, depends on the additives in these agents. The mechanical properties can change when in contact with such materials.
Swelling in polyurethane material is often due to the effects of the media. (See also chapter 14.8 Technical Terms and Definitions). For TPU resistance to media see our list of resistance properties in chapter 15. For resistance to microbes: see chapter 14.8.

14.7.5 Resistance to atmospheric corrosion

The resistance of TPU to ozone and ultraviolet radiation is good. See also chapter 14.8 for explanations. The resistance of TPU to high-energy radiation, such as α-, ⇓ . -radiation is superior to that of most other plastics. The resistance of these kinds of radiation depends among other things on the dose and dose rate of the radiation, the form and dimensions of the product, and the climate and atmosphere in the location where used. Certain properties such as e. g. resistance to thermoforming and to chemical attack can be positively influenced by purposeful cross-linking as a result of high-energy irradition with the aid of cross-linking agents.

14.7.6 Fire-resisting behaviour

Plastics, like all organic materials, are combustible. The standard TPU we use is also inherently classifiable as such. The fire-resisting behaviour of a material is not a material property however and it is influenced by different criteria. The complexity of the influencing variables makes it impossible to give a comprehensive and generally-applicable description of the fire-resisting behaviour of plastics because the risk of burning depends on, e. g., the thickness of the walling and the form, number and lay-out of the combustible objects and other circumstances of use.
For this reason, the behaviour under fire of plastics should not be described in words or phrases which could be misinterpreted, such as "self-extinguishing" or "non- flammable", but best by code numbers or code letters which refer to a specific method of testing. MASTERDUCT hoses made of special PUR materials are flame retardant as per DIN 4102 B1. (German standard)

Abrasion
Undesirable alteration of the surface due to the detachment of small particles as a result of mechanical strain. This process in synthetics (and in many other materials) is generally referred to as wear. (Also see chapter 14.7 Description of the material polyurethane.)

Additives
All constituents in synthetic mixtures which are not polymers or their primary products or which are only added in relatively low quantities (e. g. conductive soot, flame proofing agents, UV-stabilising agents etc.).

Aging
The entirely of all irreversible chemical and physical processes occuring in a material over the course of time. Usually leads to a deterioration in performance charcteristics. Often caused by: heat, light, high-energy radiation, chemicals, weather, oxygen (ozone).

Bend radius
The bend radius is given in inches. All figures refer to the inside of the hose bend at max. operating pressure.

Elasticity
The ability of a material to reverse alterations in shape or volume caused by outside forces or momentum.

Elastomers
Designation for wide-meshed, cross-linked macromolecular materials which can be extended to at least double of their original length under the influence of a slight force at temperatures of room temperature or higher and can resume their original shape quickly and practically completely once the deforming force has been removed.

Flame proofing agents
Are synthetic additives which reduce the flammability of plastics.

Flexibility
Effectual expenditure of energy to attain the minimum bend radius (the greater the expenditure of force, the less the flexibility).

Gas permeability
See permeability.

Halogens
The elements fluorine (F), chlorine (Cl), bromide (Br) und iodine (J) form the group of halogens.

Hardness
The resistance of one body to the penetration of another. In rubber-type material a needle is pressed with a certain spring tension into the sample. The hardness is measured by the depth of penetration (scale range 0 to 100 in Shore).

Hydrolysis resistance
Hydrolysis = irreversible breaking of the polyester chains in polyester polyurethanes. It occurs after a long period in hot water, saturation steam or a tropical climate (moisture combined with heat). The result of hydrolysis is a decrease in mechanical strength properties. Hardly any hydrolytic decomposition is observed in polyester polyurethanes at room temperatures.

Lamination
Application of a surface coating with particular properties onto foil or plates and the application of foil or sheeting onto fabric web.

Microbial resistance
Polyester-based thermoplastic polyurethanes without additional protection against microbes are at risk of decomposition caused by microbial attack. Moisture combined with heat (e. g. in nutritive surroundings such as grass, foliage, agriculture etc.) can accelerate this process. In such surroundings the microorganisms multiply very rapidly. The enzymes they release split ester compounds and destroy the synthetic part. Attack on individual points is evident first, in contrast to hydrolytic decomposition, which occurs over the entire surface. Polyether based polyurethanes are to a large extent resistant to decomposition by microbial attack but their mechanical properties are not as good as those of comparable polyester polyurethanes.

14.8 TECHNICAL TERMS AND DEFINITIONS

Permeation

Passage of a gas through a test sample; this occurs in three stages:

1. Dissolution of the gas in the test body
2. Diffusion of the dissolved gas through the test sample
3. Evaporation of the gas from the test body

The permeation co-efficient is a material constant which indicates the volume of gas which passes through a test sample of known surface and thickness at a given partial pressure difference at a particular time. It depends on temperature.

Swelling

Absorption of liquid or gaseous matter in solids without a chemical reaction occuring between them. The results are an increase in volume and weight accompanied by a corresponding decrease in mechanical values. Once the infiltrated matter has been exhausted and swelling has decreased accordingly, the original properties of the product are almost completely restored. Swelling is therefor a reversible process.

Crushing strength

Resistance of suction and delivery hoses to compression caused by outside loads on top of them.

Resistance to further tearing

The resistance of nicked test sample to further tearing. The test is carried out on a corner sample with a cut in one side.

UV radiation

Synthetics can be chemically broken down by the effects of UV radiation depending on the duration and intensity (ageing). The resistance of polyurethanes to UV radiation is good in general but over the course of time the material turns yellow and the surface becomes slightly brittle. The results includes a slight lowering of the mechanical properties. Stabilisation against ageing can be attained with the aid of UV stabilisers and/or through colour pigmentation.

Ozone resistance

Ozone is the combination of three oxygen atoms into one molecule (O_3). It is formed by the action of high-energy ultraviolet radiation on the oxygen in the atmosphere. Due to its composition, ozone is very reactive and reacts easily with organic substances. The resistance of polyurethanes to ozone is good in general.

RESISTANCE TABLE 15.1

Chemical Resistance*	Hose wall resp. coating material								
1 = excellent resistance 2 = good resistance 3 = mediocre resistance × = not resistant	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Medium									
Accumulator acid: see Sulphuric acid									
Acetaldehyde	2	1	3	2	×	1	1	3	1
Acetate of copper			2			1	1	2	1
Acetic acid 10%	×	3	1	2	3	1	1	2	1
Acetic acid 25%	×	3	2	2	×	2	1		1
Acetic acid 50%	×	3	2	2	×	3	1	×	1
Acetic acid 100% (concentrate)	×	3	2	×	×	2	1	2	1
Acetic acid anhydride 50%	×	1	1	×	×	3	1	3	1
Acetic acid ethyl ester: see Ethyl acetate									
Acetic ether									
Acetone	×	2	2	×	3	1	1	3	1
Acetylacetone	×	×		×	×	×	1	3	1
Acetylene gas	1	1	1	1	1	1	1	1	1
Acids: see specific designations,									
Applicable in general	3	2	1-3	1	2-3	1-2	1	×	1
Acrylic acid ethylester: see Ethyl acrylate									
Acrylonitrile	×	2	3	2	×	1	1	3	1
Adipic acid			1	1	1	1	1	2	1
Adipic acid diethylester			1	×	×		1		1
Air, atmospheric, oil-free, to + °C	80	175	120	200	70	90	200		200
Air, oil saturated, to + °C	80	175	120	200	70	90	200		200
Alcohols: see specific designations,									
Applicable in general 1)	2	1-2	1	1-2	1-2	1-2	1	2	1
Aliphatic compounds:									
see Gasoline homologues									
Applicable in general	2	×	×	1	3	×	1	×	1
Alkyl chloride									
Alum: see Aluminium potassium sulphate									
Aluminium acetate, aqueous									
(basic aluminium acetate)		×	1		1	1	1	1	1
Aluminium chloride, aqueous	1-2	×	1	1	1	1	1	1	1
Aluminium fluoride	3	1	1	1	1	1	1	1	1
Aluminium hydroxide	2	1		1	1	1	1		1
Aluminium nitrate, aqueous		2	1		1	1	1	1	1
Aluminium phosphate, aqueous									
(aluminium phosphate)		1	1	1	1	1	1	1	1
Aluminium sulphate, aqueous	1	1	2	1	1	1	1	1	1
Amines: see specific designation									
Ammonia gas 20 °C	×	1	2	1	1	1	1	1	1
Ammonia in water (ammonia solution)	×	1	3	1	1	1	1	1	1
Ammonia, liquid	×	3	2	×	3	1	1	1	1
Ammonium carbonate, aqueous	×	2	1	1	1	1	1	1	1
Ammonium chloride, aqueous									
Ammonium diphosphate, aqueous	1	1-2	1	1	1	1	1	1	1
(sal ammoniac)	1	1	2	1	1	1	1	1	1
Ammonium hydroxide, aqueous:									
see Ammonia in water									
Ammonium metaphosphate	1	1	1	1	1	1	1	1	1
Ammonium nitrate, aqueous	1	1	2	1	1	1	1	2	1
Ammonium nitrite		2	1				1	1	1
Ammonium persulphate, aqueous	2	1	1		1	1	1	1	1
Ammonium phosphate, aqueous	1	1	2	1	1	1	1	1	1
Ammonium sulphate	1	1	2	1	1	1	1	1	1
Ammonium thiocyanate	2	1				1	1	1	1
Amyl acetate')	×	3	×	×	×	2	1	3	1
Amyl alcohol	2	1	2	1	1	1	1	1	1
Amyl borate			1	1			1	1	1
Amyl chloride	×	3			×	×	1		1
Aniline (aminobenzene)	×	2	3	1-2	2	1	1	×	1
Aniline dyes	×	2	3	1	1	3	1	2	1
Animal fat: see Oils and greases, animal									
Anol: see Cyclohexanol									
Anon: see Cyclohexanon									
Antifreeze: see precise									
chemical designation									
Antimony chloride 50%	2	×	1	1	1	1	1	1	1
Antimony: see Sodium thiosulphate									
Aqua fortis: see Nitric acid									
Aqua regia	×	3	2	2	2	×	1	3	1
Arctons = ICI freon types: ask for									
our detailed applications									
advisory									
Argon gas	1	1	1	1	1	1	1	1	1
Aromatics: see benzene, toluol,									
xylol and homologues,									
Applicable in general	×	×	3-x	1-2	×	×	1	2	1
Arsenic acid	3	1	1	1	1	1	1	2	1
Asphalt (pitch)	2	2	2	1	2	1	1	2	1
Ate-brake fluid	2	×	3	1	2	2	1	×	1
Bacon')	1	2	3	1		1	1	×	1
Barium chloride, aqueous	1	1	2	1	1	1	1	3	1
Barium hydroxide	1	1	2	1	1	1	1	3	1
Barium suplhate (Barite)	1	1	1	1	1	1	1	2	1
Barium sulphide	2	1	2	1	1	1	1	2	1
Basic aluminium acetate:									
see Aluminium acetate									
Beer')	1	1	1	1	1	1	1	1	1
Benzaldehyde	3	3	×	2	3	×	1	×	1
Benzene									

Chemical Resistance*	Hose wall resp. coating material								
1 = excellent resistance 2 = good resistance 3 = mediocre resistance × = not resistant	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Medium									
Benzene: see Gasoline	×	×	3-x	1-2	×	×	1	×	1
Benzoic acid, aqueous	×	×	×	1	1	1	1		1
Benzyl alcohol	×	1	2	1	3	3	1	3	1
Benzyl benzoate				1					
Benzyl chloride	×	2	×	1	×	2-3	1	×	1
Biphenyl oxide	×	2	×	3			1	×	1
Biphenyl	×	×	×	1	×	2	1	×	1
Biphenyls, polychlorinated (pyranol):									
see Oils, transformer oils									
Bismuth carbonate	1	1		1	1	1	1	1	1
Bisulphite lye, containing SO_2				1	1	1	1	1	1
Bitumen 20 °C (see also Hot bitumen)	2	3	3	1	×	1	1	×	1
Blanc-fixe: see Barium sulphate									
Bleaching lye (eau de Javelle):									
see Potassium hypochlorite									
Borax: see Sodium borate									
Boric acid, aqueous	1	3	1	1	1	1	1	1	1
Brake fluid: see Greases and oils									
Brandy, all kinds[1)]	1	1	1	1	1	1	1	1	1
Brine (tabel salt solution)[1)]	1	1	1	1	1	1	1	2	1
Bromine	×	×	×	1	×	×	1	×	1
Bromine water	×	×	×	1	×	×	1	×	1
Bromobenzene	×	×	×	1	×	×	1	×	1
Butadiene	1-2		2	1	3	1	1	2	1
Butane gas	1	3	1	1	1	×	1	1	1
Butane, liquid	1	3	1	1	2	1	1	1	1
Butanol: see Butyl alcohol									
Butanone: see Methyl ethyl ketone									
Butter milk[1)]	1	1	1	1	1	1	1	2	1
Butter[1)]	2	1	2	1	2	1	1	2	1
Butyl acetate	×	3	3	×	×	×	1	×	1
Butyl alcohol	3	2	1	1	1	×	1	1	1
Butyl amine	×	2	×	×			1	×	1
Butyl benzoate			×	1			1	×	1
Butyl carbitol			2	1			1	3	1
Butyl ether	3	3			1	1	1	2	1
Butyl glycol	3	2		1	×	1	1	×	1
Butyl oleate			×	1			1	3	1
Butyl stearate	1	1		1	1	×	1	×	1
Butylene, liquid			3	1	1	×	1	×	1
Butyraldehyde		3	3	×		1	1	×	1
Butyric acid, aqueous[1)]	×	2	2-3	3	1	×	1	×	1
Calcinated soda: see Sodium carbonate									
Calcium oxide = calcinated lime	1	2	1	1	1	1	1	1	1
Calcium sulphide	1	2	1	1			1	1	1
Calcium acetate			2	×		1	1	3	1
Calcium bisulphite	3	2	1	1	1	1	1	1	1
Calcium bisulphite, aqueous	1	1	1	1	1	1	1	1	1
Calcium carbonate	1	1		1	1	1	1	1	1
Calcium chloride, aqueous	1	1	1	1	1	1	1	1	1
Calcium hydroxide,									
aqueous (slaked lime)	3	2	1	1	1	1	1	1	1
Calcium hypochlorite, aqueous	×	3	2	1	1	1	1	3	1
Calcium nitrate	1	2	1	1	1	1	1	1	1
Calcium sulphate (gypsum), aqueous	1	1		1	1	1	1		1
Carbitol: see Diethyl glycol									
monoethyl ether									
Carbolic acid: see Phenol									
Carbolineum, aqueous	×	×	1	1	3	1	1	1	1
Carbon bisulphide:									
see Bisulphide of carbon									
Carbon dioxide, gaseous,									
as well as wet and dry	1	1	1	1	1	1	1	1	1
Carbon dioxide, solid (dry ice -80 °C)									
but elastomers and plastomers									
become stiff to brittle									
Carbon monoxide	1	1	2	1	1	1	1	2	1
Carbon tetrachloride									
(tetrachloromethane)	3	×	×	1	×	×	1	×	1
Carbonic acid: see Carbon dioxide									
Castor oil[1)]	1	1	1	1		2-3	1	2	1
Caustic potash:									
see Potassium hydroxide									
Caustic soda: see Sodium hydroxide									
Cellulose acetate	1	1				1	1	1	1
Cellulube hydraulic oil: see phosphate									
ester based hydraulic oil									
Chile saltpeter: see Sodium nitrate									
Chloric acid, aqueous			1	×	1	1	1	1	1
Chloric acid gas	2	1	1-2	1	1	1	1	2	1
Chlorinated hydrocarbons:									
see individual designations,									
Applicable in general	×	×	×	2	×	×	1	×	1
Chlorinated lime:									
see Calcium hypochlorite									
Chlorinated water 3%	3	2	3	2	1	2	1	×	1
Chlorine dioxide	×	3	1	1		×	1	1	1
Chlorine, dry	×	×	2	1	×	×	1	×	1
Chlorine, moist	×	×	2	1	×	×	1	×	1

15.1 RESISTANCE TABLE

1 = excellent resistance
2 = good resistance
3 = mediocre resistance
x = not resistant

Chemical Resistance*	Hose wall resp. coating material								
Medium	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Chloroacetic acid: see Monochloracetic acid									
Chlorobenzene: see Monochlorobenzene									
Chlorobiphenyl (Clophene)	x	2	x	1	x	1	1	x	1
Chlorobromomethane	3	x	x	1	x	x	1	x	1
Chlorocalcium: see Calcium chloride									
Chloroethyl: see Ethyl chloride									
Chloroform (trichloromethane)	x	x	x	1	x	x	1	x	1
Chloromethyl: see Methyl chloride									
Chloroprene				1			1	x	1
Chlorosulphonic acid	x	x	x	x	x	x	1	x	1
Chlorothene: see Trichloro-ethane									
Chromic acid 10%	3	3	2	1	1	1	1	3	1
Chromic acid 25%	x	x	2	1	2	1	1	x	1
Chromic acid 50%	x	x	2	1	x	3	1	2	1
Chromium trioxide: see Chromic acid									
Citric acid[1]	1	1	1	1	1	1	1	1	1
Citric acid, aqueous	1	1	1	1	1	1	1	1	1
Clophene: see Chlorobiphenyl									
Coal tar (see also hot tar)	x	1	x	1	2	2	1	x	1
Coconut grease and oil	1	1	2	1	1	x	1	3	1
Compressed air: see Air, oil saturated									
Copper chloride, aqueous	1	1	1	1	1	1	1	1	1
Copper cyanide	2	1	1	1		1	1	1	1
Copper nitrate, aqueous	3	1	1	1	3	1	1	1	1
Copper sulphate, aqueous (blue vitriol)	1	1	1	1	2-3	1	1	1	1
Corn oil	1	1	2	1	2	x	1	3	1
Cottonseed oil[1]	1	1-2	1-2	1	1	1	1	2	1
Creosote	2	2	2-3	1	2-3	x	1	3	1
Cresol: see Cresylic acid									
Cresylic acid	x	2	3	1	x	x	1	3	1
Crude petroleum, strongly aromatic	2	x	2	1	3	3	1	3	1
Cupric hydroxide: see Mountain blue									
Cyankali: see potassium cyanide									
Cyclohexane (hexahydrobenzene)	2	x	x	1	1	1	1	x	1
Cyclohexanol	x	2	1	1	x	1	1	2	1
Cyclohexanon	x	2	x	x	x	1	1	x	1
Decalin (decahydronaphthalene)	1	x	x	1	1	1	1	x	1
Detergent, synthetic, 20 °C	1	1	1	1	1	1	1	1	1
Developer liquids (in general)	2	1	1	1			1	1	1
Dextrose: see Glucose									
Diacetone alcohol	2	1	3	x			1	3	1
Dibenzyl ether	x	2	x	1	x		1	3	1
Dibutyl phthalate	3	2	3-x	2	3	3	1	x	1
Dibutyl sebacate	x	1	x	2	3	1	1	x	1
Dibutylamine		3	x	x			1	x	1
Dichloro-isopropyl ether	2	x	x	3			1	x	1
Dichlorobenzene	x	x	x	1	x	3	1	x	1
Dichloroethylene	x	x	x	2	x	x	1	x	1
Dichloromethane	x	x	x	2	x	x	1	x	1
Diesel oil	2	3	3	1	3	2	1	x	1
Diethanolamine						1	1		1
Diethyl ether: see Ether									
Diethyl sebacate		2	x	2			1	x	1
Diethylamine	3	2	3	x		3	1	x	1
Diethylbenzene	x	x	x		1		1	x	1
Diethylene glycol	3	2	1	1	1	1	1	1	1
Diethylene glycol monoethyl ether (carbitol)	x	2	2	2			1	3	1
Diglycol: see Diethylene glycol									
Dimethyl ether	2		3	3	x	2	1	x	1
Dimethyl formamide	3	2	3	x		1	1	x	1
Dimethyl phthalate			x	2			1	x	1
Dimethylamine			x	x	x	3	1	x	1
Dimethylaniline	x	2	3	1			1	x	1
Dioctyl phthalate	2	3	x	1-2	3	3	1	x	1
Dioctyl sebacate	2	3	x	2			1	x	1
Dioxane	x	x	x	x	x	1	1	x	1
Dipropylene glycol		2	1	1			1	1	1
Distilled oils[1]	2	x	3	1	x	x	1	x	1
Disulphide of carbon	2	x	x	1	2	x	1	x	1
Dodecyl alcohol				1			1	1	1
Drilling oil: determine chemical composition									
Eau de Javelle: see Potassium hypochlorite									
Epichlorohydrin, liquid	x	x	x	x		1	1	x	1
Epsom salt, see Magnesium sulphate									
Esters: see individual designations, Applicable in general	x	x	x	x	x	1-2	1	x	1
Ethanolamine	x	3	2	2		1	1	3	1
Ethane (gas)	1	3	3	1	1	1	1	2	1
Ethanol: see Ethyl alcohol									
Ether (ethyl ether, diethyl ether)	1	x	3	x	3	x	1		1
Ethyl acetate	x	2	x	x	x	2	1	x	1
Ethyl acrylate		2	1	x	x		1	x	1
Ethyl alcohol (denatured = spirits)	2	1	1	1	1	1	1	1	1
Ethyl benzene	x	x	x	2	x	x	1	x	1

Chemical Resistance*	Hose wall resp. coating material								
Medium	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Ethyl bromide	2	x	x	1	x	2	1	x	1
Ethyl chloride	x	x	x	2	3	x	1	3	1
Ethyl dichloride	x	x	x	1	x	x	1		1
Ethyl ether: see Ether									
Ethyl glycol	x			x		1	1		1
Ethyl glycol acetate	x			x		1	1		1
Ethyl mercaptan	x	3	2	x			1	x	1
Ethylene diamine	x	3	2	2	x	1	1	2	1
Ethylene (gas) (ethene)	1	2	x	1	1	1	1		1
Ethylene glycol	2	1	1	1	1	1	1	1	1
Ethylene oxide	x	3-x	x	x	x	x	x	1	x
Ethylene oxide, liquid	x	x	x	x	x	x	1	x	1
Fatty acids in general	1	3	3	1	1	3	1	3	1
Fermented fruit juice[1]	1	1	1	1	1	1	1	1	1
Ferric chloride, aqueous	3	1	1	1	1	1	1	1	1
Fluohydric acid: see Hydrofluoric acid									
Fluoride of boron acid 65%	x	x	2		1	1	1	3	1
Fluorine, liquid				2		x	1	x	1
Fluorobenzene		x	x	1			1	x	1
Formaldehyde	2	1	1-2	1	2	1	1	2	1
Formaline (30-40% aqueous formaldehyde solution with 8-12% methyl alcohol additive)	2	2	2	1	1	1	1	2	1
Formic acid	x	2	1	3	3	2	1	2	1
Freons and frigenes: ask for detailed user advisory									
Fruit juices[1]	1	1	1	1	1	1	1	1	1
Fruit pulp[1]	1	1	1	1	1	1	1	1	1
Fuming sulphuric acid: see Oleum									
Furfural alcohol (furfurol)	x	2	2-3	3	1	x	1	3	1
Gallic acid	3	1	2	1	1	1	1	3	1
Gasoline, aviation	1-2	x	2	1	3	x	1	2	1
Gasoline, high aromatic	2-3	x	x	1	3	x	1	1	1
Gasoline, low aromatic	2	x	x	1	3	x	1	1	1
Gelatins, aqueous	1	1	1	1	1	1	1	1	1
Glacial acetic acid: acetic acid concentrate									
Glauber's salt: see Sodium sulphate									
Glucose[1]	1	1	1	1	1	1	1	1	1
Glue, animal	2	1	1	1	1	1	1	1	1
Glycerine	1	1	1	3	1	1	1	1	1
Glycerol: see Ethylene glycol pure									
Glycols: determine exact designation, Applicable in general	2	1	1	1	1	1	1	1	1
Grape juice: unfermented[1]	1	1	1	1	1	1	1	1	1
Greases: see Oils and greases									
Gypsum: see Calcium sulphate									
Heating oil	2	3	3	1	3	3	1	x	1
Heavy gasoline (white spirit, mineral turpentine): see Gasoline									
Helium	1	1	1	1	1	1	1	2	1
Heptane	2	x	2	1	1	1	1	3	1
Hexahydrobenzene: see Cyclohexane									
Hexaldehyde	3	3				1	1	2	1
Hexaline: see Cyclohexanol									
Hexane	2	x	1	1	1	1	1	1	1
Hexanol = hexyl alcohol	x	3	1	1	3	1	1	2	1
Hot air: see Air									
Hot bitumen to °C	x	x	x	180	x	x	200	x	200
Hot tar to °C	x	x	x	180	x	x	200	x	200
Hydraulic oils and liquids -mineral oil based	1	3	2	1	3	3	1	2	1
-glycol based	1-2	2							
-phosphate ester based	x	2-3	x	1	x	x	1	x	1
Hydrazine	x	x	2	x	1	1	1	3	1
Hydrazine hydrate, aqueous	x	3	1	1	1	1	1	2	1
Hydrobromic acid	3	2	1	1	x	1	1	1	1
Hydrochloric acid 15%	2	1	1-2	1	1	1	1	3	1
Hydrochloric acid 38% (conc.)	x	3	1-2	1	2	1	1	3	1
Hydrocyanic acid: see Prussic acid									
Hydrofluoric acid 10%	2	1	1	1-2	1	2	1	2	1
Hydrofluoric acid 30%	2	1	1-2	1-2	x	2	1	2	1
Hydrofluoric acid 75%	3	1-2	1-2	1-2	x	x	1	2	1
Hydrofluosilic acid, aqueous	x	x	2	x	1	1	1		1
Hydrogen cyanide: see Prussic acid									
Hydrogen (gas)	1	3	1	1	1	1	1	1	1
Hydrogen peroxide 10%	2	1	1	1-2	1	2	1	x	1
Hydrogen peroxide 30%	2	1	1-2	1	x	1	1	2	1
Hydrogen sulphide, dry	3	1	1-2	1	x	1	1	3	1
Hydrogen sulphide, moist	3-x	1	1	1	3	1	1	3	1
Iodine tincture (5-10% alcohol iodine solution)	x	x	2	1	x	3	1	3	1
Iron sulphate, iron vitriol, aqueous	2	1	1	1	1	1	1	1	1
Isobutanol = isobutyl alcohol	x	1	1	1	1	1	1	1	1
Isooctane	2	1	2	1	1	x	1	3	1
Iso octanol = iso octyl alcohol	3	2	2	1	1	1	1	3	1
Isophoron	x	x	x	x			1	x	1
Isopropanol = isopropyl alcohol	3	1	1	1	3	1	1	2	1
Isopropyl acetate	3	2	x	x	2		1	x	1

RESISTANCE TABLE 15.1

1 = excellent resistance
2 = good resistance
3 = mediocre resistance
× = not resistant

Chemical Resistance*	Hose wall resp. coating material								
Medium	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Isopropyl benzene	3-x	×	×	1			1	×	1
Isopropyl chloride				1			1		1
Isopropyl ether	1		3	3	3	3	1	×	1
Javelle lye: see Potassium hypochlorite									
Jet fuel DP1-IPS		×		1	1	×	1	2	1
Kerosene	2	3	2-3	1	1	×	1	1	1
Ketones: see individual designations, Applicable in general	×	2	×	×	×	×	1	×	1
Lacquer: composition must always be determined									
Lactic acid[1)]	2	3	3	1	3	2	1	×	1
Lanolin	1	3	3	1	2	2	1	3	1
Lard: see Oils and greases, animal									
Laughing gas: see Nitrous oxide									
Lauryl alcohol: see Dodecyl alcohol									
Lead acetate, aqueous	1	1			1	1	1		1
Lead arsenate, aqueous	1	1			1	1	1	1	1
Lead nitrate		2	1				1	1	1
Lead sulphate	1	1			1	1	1	1	1
Light gasoline: see Gasoline									
Lighting gas: see Town gas									
Lignite tar oil: See coal tar									
Lime, burned: see Calcium oxide									
Lime, slaked: see Calcium hydroxide									
Limestone: see Calcium carbonate									
Linseed oil[1)]	2	1	1-2	1	3	×	1	2	1
Liquid paraffin	2	2	3	1	1	3	1	×	1
Liquiefied petroleum gas (LPG): see relevant chemical idenfication of the gas									
Liver train (oil)[1)]	1	2	2	1	×	1	1	3	1
LPG: see relevant chemical designation of gas									
Lubricants and greases: see Oils									
Lyes: see exact designations, Applicable in general	2	2	1	2	1	1-2	1	1	1
Machine oils: see Oils, mineral									
Magnesium chloride, aqueous	1	1	1-2	1	1	1	1	2	1
Magnesium hydroxide	1		1	1			1	1	1
Magnesium silicate (talc)	1	1	1	1	1	1	1	1	1
Magnesium sulphate	1	1	1	1	1	1	1	1	1
Magnesium sulphite, aqueous	1	1	1	1	1	1	1	1	1
Maleic acid, aqueous	×		×	1	1	1	1	×	1
Malic acid, aqueous	3	1	1	1	1	1	1	1	1
Manure	1	1	1	1	1	1	1	1	1
Margarine greases and oils[1)]	1	3	1-2	1	2	2-3	1	2	1
Mash[1)] (Potato)	1	1	1	1	1	1	1	1	1
MEK: see Methyl ethyl ketone									
Mercury	1	1	1	1	3	1	1	2	1
Mercury chloride (sublimate)	1	1	1-2	1	3	1	1	2	1
Mercury nitrate	1	1			1	1	1		1
Mesityl oxide		×	×	×			1	×	1
Methane (gas)	3	3	3	1	1	1	1	×	1
Methanol: see methyl alcohol									
Methyl isobutyl ketone	×	3	×	×		1	1	×	1
Methyl acetate	×	×	×	×	×	1	1	×	1
Methyl alcohol	3	1	1	1-2	1	1	1	1	1
Methyl chloride	×	×	×	3	3	×	1	×	1
Methyl ethyl ketone (MEK)	×	×	×	×	3	1	1	3	1
Methyl glycol (methylcellosolve)			2	×	×	1	1	3	1
Methyl glycol acetate	×	×		×			1	×	1
Methyl phthalate: see Dimethyl phthalate									
Methylamine, aqueous			1	1	3	1	1	2	1
Methylated spirit: see Ethyl alcohol, denatured									
Methylene chloride: see Dichloromethane									
Milk of lime (lime water): see Calcium hydroxide, aqueous									
Milk[1)]	2	1	×	1	1	1	1	×	1
Mineral oils: see Oils, mineral									
Mixed acid I (sulphuric acid/nitric acid/water)	×	×	×	×	×	×	1	×	1
Mixed acid II: (sulphuric acid/phosphoric acid/water)			1	1	1	3	1	2	1
Molasses[1)]	1	1	1	1	1	1	1	1	1
Monochloracetic acid	×	×	2	×	×	×	1	3	1
Monochlorobenzene	3	3	×	2	×	×	1	×	1
Monochloromethane: see methyl chloride									
Monostyrol: see Styrol, monomer									
Motor oil: see Oils and greases, clarify mineral additives									
Mountain blue (cupric hydroxide)	1	1				1	1		1
Must, fermented: see Fermented fruit juice									
Must, unfermented[1)]	1	1	1	1	1	1	1	1	1
Myristyl alcohol = myristic alcohol			1	1	1	3	1	2	1
Naphtha	2	2	3	1	3	×	1	3	1
Naphthalene: see Liquid paraffin									

Chemical Resistance*	Hose wall resp. coating material								
Medium	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Natron, also double carbonated N: see sodium bicarbonate									
Natural gas, dry	1	×	1	1	1	1	1	1	1
Natural gas, wet	1-2	×	1	1	1	2	1	1	1
Nickel sulphate, aqueous	2	1	1	1	1	1	1	1	1
Nitrating acid (mixture of nitric acid and conc. sulphuric acid, see latter)									
Nitric acid 10%	×	3	1-2	1-2	1	1	1	3	1
Nitric acid 25%	×	×	1-2	1-2	1	1	1	2	1
Nitric acid 40%	×	×	1-2	1-2	2	×	1	×	1
Nitric acid 60%	×	×	1-2	1-2	3	×	1	2	1
Nitrobenzene	×	×	×	2	×	×	1	×	1
Nitrogen	1	1	1	1	1	1	1	1	1
Nitroluol			×	3	×	1	1	×	1
Nitropropane	×	×	×	×			1	×	1
Nitrous oxide (laughing gas)	1	1	1	1	1	1	1	1	1
Nonyl alcohol (nonanol)	×	2	2	×		1	1	3	1
Octane	1	×	×	1			1	×	1
Octanol = octyl alcohol	×	2	1	1	×	1	1	1	1
Oils and greases									
-mineral, without additives, at 20 °C	1	2-3	2-3	1	2	2	1	×	1
-mineral, without additives, to °C	60	×	150	200	×	30	200		200
-ASTM oil no 1 20 °C	1	2	1	1	2	2	1	1	1
-ASTM oil no 2 20 °C	2	3	2	1	1	3	1	1	1
-ASTM oil no 3 20 °C	2	3	2	2	2	3	1	1	1
-animal[1)]	1	3	1-2	1	2	2-3	1	3	1
-vegetable[1)]	1	3	1-2	1	2	2-3	1	2	1
-transformer oil (pyranol)	2	2	×	1	3	3	1	×	1
-silicon-based	1	×	1	1	1	1	1	1	1
-diesel oil	2	3	3	1	3	2	1	×	1
-heating oil	2	3	3	1	3	2	1	×	1
-hydraulic oils									
-mineral-based	2	3	1-2	1	3	3	1	3	1
-glycol-based (polyalkyl glycols)	1-2	2	2	3		1	1	2	1
-phosphate ester-based	×	2-3	×	1	×	×	1	×	1
Oleic acid	1	×	×	2	1	2	1	×	1
Olein: see Oleic acid									
Oleum (fuming sulphuric acid)	×	×	×	1	×	×	1	×	1
Oleum vapours	×	×	3	3	3	×	1	×	1
Olive oil[1)]	1	2	1-2	1	1	1	1	2	1
Oxalic acid, aqueous	×	1	2	1	2	1	1	2	1
Oxygen, pure to °C	80	175	120	200	70	70	200	200	
Ozone	1	1	1	1	1	×	1	2	1
Palm oil[1)]	2	1	3	1	3	×	1	3	1
Palmitic acid	1	1	1-2	2	×	1	1	3	1
Paraffin	2	3	2-3	1	1	×	1	×	1
Paraformaldehyde	1	1		2		1	1	2	1
Pentachlorophenol	×	3					1		1
Pentane	×	×			1	×	1		1
Perborate: see Sodium borate									
Perchloric acid, aqueous	×	×	1	1	1	1	1	3	1
Perchloroethylene	×	2	×	1	×	×	1	×	1
Perhydrol: see Oxygen superoxide									
Permanganate: see Potassium permanganate									
Petroleum (see also Oils, mineral)	1	2	3	1	×	2-3	1	×	1
Petroleum ether: see Gasoline									
Phenol (carbolic acid), aqueous	×	2	3	1	×	×	1	3	1
Phosphoric acid 50%	2	2	1	1	1	1	1	1	1
Phosphoric acid 85%	×	3	1-2	1	1	1	1	3	1
Phosphoric alumina: see Aluminium phosphate									
Phosphorus oxychloride			1	1	×	3	1	1	1
Phthalic acid anhydride, aqueous (phthalic acid)			1	×	1	1	1	1	1
Picric acid	×	1	2	1-2	1	1	1	3	1
Polychlorinated diphenyls (pyranol): see Oils, transformer oils									
Potash: see Potassium carbonate									
Potassium acetate, aqueous	×	×	×	×	1	1	1	×	1
Potassium aluminium sulphate (alum)	1	2	1	1	1	1	1	1	3
Potassium borate, aqueous	1	1	1	1	1	1	1	1	3
Potassium bromide, aqueous	1	1	1	1	1	1	1	1	3
Potassium bicarbonate	2	1	1	1	1	1	1	1	3
Potassium bichromate: see Potassium dichromate									
Potassium carbonate (potash)	3	1	1	1	1	1	1	1	3
Potassium chlorate, aqueous	2	2	1	1	1	1	1	1	3
Potassium chloride	1	1	1	1	1	1	1	1	3
Potassium cyanide	3	1	1	2	×	1	1	1	3
Potassium dichromate	2	1	1-2	1	1	1	1	2	3
Potassium hydroxide (caustic potash, caustic potash lye)	1	3	1-2	1	1	1	1	1	3
Potassium hypochlorite (eau de Javelle)	×	2	×	1	1	3	1	×	3
Potassium iodide, aqueous			1	1	3	1	1	1	2
Potassium lye: see Potassium hyroxide									
Potassium nitrate, aqueous	1	1	1	1	1	1	1	1	3
Potassium permanganate 10%, aqueous	1	1	1	1	1	1	1	3	2

15.1 RESISTANCE TABLE

Chemical Resistance*	Hose wall resp. coating material								
1 = excellent resistance 2 = good resistance 3 = mediocre resistance × = not resistant	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Medium									
Potassium phosphate (mono and dibasic)	1	×	1	1		1	1	1	3
Potassium sulphate	1	1	1	1	1	1	1	1	3
Potassium sulphite	1	1	1	1	1	1	1	1	3
Propane gas	1	×	2-3	1	1	2	1	1	1
Propane, liquid	1	3	3	1	1	×	1	1	1
Propanol: see Propyl alcohol									
Proprionic acid			3	1	1	1	1	×	1
Propyl acetate			×	×		2	1	×	1
Propyl alcohol	3	2	2	1	3	1	1	3	1
Propylamine	×	×	×	×			1	×	1
Propylene	×	×	×	1			1	×	1
Propylene dichloride		×				×	1		1
Propylene glycol		1	1	1	3	1	1	2	1
Propylene oxide	×	×	×	×			1	×	1
Prussic acid 20%	2	2	2	2	1	1	1	3	1
Prussic acid, 98% (conc.)	2	2	2	2	1	1	1	3	1
Pydrual: see Hydraulic liquids based on phosphate esters									
Pyranol: see Oils, transformer									
Pyridine	×	×	3	3	×	1	1	×	1
Quick lime: see Calcium hydroxide									
Radioactive radiation,									
Applicable in general	3	×	×	×	×	3	×	×	×
Rapeseed oil[1)]	2	×	2	1			1	3	1
Raw sugar sap[1)]	3	1	1	1	1	1	1	2	1
Salicylic acid, aqueous			1	1		1	1	2	1
Salmiac: see Ammonium chloride									
Salt: if table salt see Sodium chloride									
Saltpetre: see Potassium nitrate									
Saltwater: see Brine or see Water, Seawater									
Sangajol = turpentine oil substitute: see Gasoline									
Seawater: see Water									
Silicic acid: see Silicon dioxide									
Silicon dioxide (silicic acid)	1	1	1	1	1	1	1	1	1
Silicon oils and greases	1	2	1	1	×	1	1	1	1
Skydrol: see Hydraulic liquids based on phosphate esters									
Soap solution	2	1	1	1	1	1	1	1	1
Soda, calcinated: see Sodium carbonate, anhydrous									
Soda, crystallised: see Sodium carbonate									
Soda lye: see sodium hydroxide									
Sodium acetate, aqueous	3	1	1	1	1	1	1	1	1
Sodium bicarbonate, aqueous	2	1	1	1	1	1	1	1	2
Sodium bisulphate	×	1	1	1	1	1	1	1	2
Sodium bisulphite, aqueous	×	1	1	1	1	1	1	1	2
Sodium borate (borax)	1	2	2	1	1	1	1	1	2
Sodium carbonate	×	1	1	1	1	1	1	1	2
Sodium chlorate, aqueous	2	1	1	1	1	1	1	1	3
Sodium chloride (table salt)	2	1	1	1	1	1	1	1	3
Sodium cyanide	3	1	1	1	1	1	1	1	3
Sodium dichromate	3	2	1	1		1	1	1	3
Sodium fluoride	2	2		1	1	1	1	1	3
Sodium fluoraluminate 10%	2-3	2		1	1	1	1	1	3
Sodium hydroxide (sod lye) 25%, 20 °C	2	2	1	3	1	1	1	1	2
Sodium hydroxide (sod lye) 25%, 100 °C	×	×	3	×	×	×	1	×	3
Sodium hypochlorite 10%	2	1	1	1	1	1	1	1	1
Sodium hypochlorite 30%	3	3	1	2-3	1	2	1	1	1
Sodium metaphosphate		1	1	1	1	1	1	1	1
Sodium nitrate	1	1	1	1	1	1	1	1	1
Sodium nitrite	1	1	1	1	1	1	1	1	1
Sodium perborate		1	1	1	2	1	1	1	1
Sodium peroxide	3	×	2	2			1	3	1
Sodium phosphate (see also Trisodium phosphate)	2	1	1	1	1	1	1	1	1
Sodium silicate, aqueous	3	1	1	1	1	1	1	1	1
Sodium sulphate, aqueous	1	1	1	1	1	1	1	1	1
Sodium sulphide, aqueous			1	×	1	1	1	1	1
Sodium sulphide, aqueous	1	1	1	1	1	1	1	1	1
Sodium thiosulphate (antichlorine)	2	1	1	1	1	1	1	1	1
Soluble sodium: see sodium silicate									
Solutions: see specific designations									
Soyabean oil[1)]	2	1	2	1	1	×	1	3	1
Spindle oil: see Oils, mineral									
Spirit: see ethyl alcohol, denatured									
Starch, aqueous[1)]	1	1	1	1	1	1	1	2	1
Starch syrup[1)]	1	1	1	1	1	1	1	1	1
Steam to °C	×	120	100	150	×	×	200		200
Stearin (stearic acid)	1	1	2-3	1	1	×	1	×	1
Styrene, monomer	3	×	×	2	×	×	1	×	1
Sublimate: see Mercury chloride									
Sugar, aqueous[1)] (see also Raw sugar juice)	1	1	1	1	1	1	1	1	1
Sulphur, molten, 90 °C	2	1	1	1	×	×	1	2	1
Sulphur dioxide: see Sulphurous acid									
Sulphur trioxide	2	3	2-3	1	1	1	1	×	1
Sulphuric acid, 10%	2	2	1	1	1	1	1	1	1

Chemical Resistance*	Hose wall resp. coating material								
1 = excellent resistance 2 = good resistance 3 = mediocre resistance × = not resistant	polyurethane	silicone	hypalon	viton	Vinyl/PVC	polyethylene	PTFE	neoprene	Kapton
Medium									
Sulphuric acid, 30%	2	×	1	1	1	1	1	1	1
Sulphuric acid, 50%	2	×	1	1	1	1	1	1	1
Sulphuric acid, 75%	×	×	1-2	1	3	3	1	×	1
Sulphuric acid, 90%	×	×	2	1	×	×	1	3	1
Sulphuric acid, conc. (oleum, fuming sulphuric acid)	×	×	×	1	×	×	1	×	1
Sulphuric ether: see Ether									
Sulphurous acid 75%, moist	×	3	2-3	2	×	3	1	3	1
Sulphurous acid 10%, moist	1	2	1-2	1	×	1	1	3	1
Table salt: see Sodium chloride									
Talc: see Magnesium silicate									
Tallow	1	1	1	1	1	1	1	1	1
Tannic acid (tannin)	3	2	1-2	1-2	1	1	1	2	1
Tannin: see Tannic acid									
Tar (see also hot tar)	×	2	×	1	2	2	1	×	1
Test benzene = white spirit: see Gasoline									
Tetrachloroethylene (perchloroethylene)	2	×	×	1	×	×	1	×	1
Tetrahydrofurane			×	×	×	3	1	×	1
Tetraline = tetrahydronaphthalene		×	×	1	1	3	1	×	1
Thinner for paint and lacquer: determine composition									
Tin chloride, aqueous	1	2	1	1	1	1	1	1	1
Toluol	×	×	×	1	×	×	1	×	1
Town gas, lamp gas (for natural gas, see latter)	3	3	3	1	1	1	1	×	1
Train: see Liver train									
Transformer oil: see Oils									
Tributyl phosphate	×		×	×	×	1	1	×	1
Trichloroethane (chloroethane)	×	×	×	1		×	1	×	1
Trichloroethylene	×	×	×	1-2	×	×	1	×	1
Trichloromethane: see Chloroform									
Tricresyl phosphate	×	1	×	2	×	3	1	×	1
Triethanolamine	×	1	3	1	×	1	1	×	1
Triethylamine						1	1		1
Trioctyl phosphate		3	×	×	×	1	1	×	1
Trisodium phosphate	3	1	1		1	1	1	1	1
Turpentine (oil)	×	×	×	1	3	3	1	2	1
Turpentine substitute: see Gasoline									
Urine	1	1	1	1	1	1	1	1	1
Vaseline: see Oils and greases, minerals									
Vegetable oils,applicable in general	1	3	1-2	1	1	1	1	3	1
Vinegar (cooking vinegar)[1)]	3	1	1	3	1	1	1	1	1
Vinyl acetate			1	1	×		1	1	1
Vinyl chloride, monomer	×	×		1	×	×	1	×	1
Vitriol oil: see Oleum									
Vitriol: see Copper sulphate									
Water									
-drinking or mineral water; without additives[1)] to °C	60	120	100	150	70	80	200		200
-distilled, demineralised, desalinated condensed water: does not effect polymers, rather polymers effect water									
-mineral water, CO_2 saturated	1	1	1	1	1	1	1	1	1
-aqua regia: see Aqua Regia									
-seawater	2	1	1	1	1	1	1	1	1
Weathering	1	1	1	1	1	2	1	1	1
White gasoline: see Gasoline									
Wines, red and white[1)] 1	1	1	1	1	1	1	1	2	1
Wood oil	2	3	3	1	3	2	1	×	1
Wool fat: see Lanoline									
Xylene	×	×	×	1-2	×	×	1	×	1
Zinc acetate, aqueous	×	×	×	×		1	1	×	1
Zinc chloride, aqueous	3	1	1	1-2	1	1	1	1	1
Zinc sulphate, aqueous	3	1	1	1	1	1	1	1	1

***** at an ambient temperature of 20 °C

[1)] for food: demand food-permissible quality

The information listed in the table has been collated and compiled on the basis of our own tests, recommendations made by our material suppliers and the experience of our customers. Since individual service conditions further influence the usability of each hose, the information can only serve as a guideline. If no experience of a particular situation is at hand, we advise the user to carry out preliminary tests. This applies in particular when mixed substances are to be conveyed.

TERMS AND CONDITIONS OF SALE

I. CONDITIONS

No terms and conditions contained in any order placed with FLEXMASTER U.S.A., INC. (hereinafter "the Company") other than those stated herein shall be binding on the Company unless hereafter agreed in writing, and all orders shall be subject to the terms and conditions contained herein. If the order acknowledgement of the Company deviates from the order placed, the terms in the Company's acknowledgement shall govern unless opposed by the Purchaser within a period of one (1) week. No orders shall be binding on the Company unless acknowledged in writing by an authorized officer or agent of the Company.

II. PRICES

All prices quoted herein will be subject to the prices in effect at time of shipment. Prices are subject to change without notice. The Company will notify the Purchaser of any change in price before acceptance. All quotations for special products, pricing, and/or conditions are valid for thirty (30) days unless otherwise specified. For special carton markings (one end) by floors, zones, etc., add 2% with a minimum of $10.00 per order. For lengths shorter than maximum lengths shown on price sheets, price as catalogued section plus $1.00 net per joint in reasonable quantities. If only one short length is ordered, it must be priced as a full 25' length.

III. TERMS OF PAYMENT

(a) F.O.B. factory. Unless otherwise specified, freight allowed on shipments of $_____ Net one destination Continental U.S.A. payable in U.S. Funds. Minimum invoice charge of $100.00 Net, Net 30 days. 1% 10th prox., net thirty (30) days.
(b) A master or blanket purchase order must be issued for the total job, and releases made as required below. A blanket purchase order is not allowed for stock shipments. Minimum release against any master order is 500 feet. Releases under 500 feet will be invoiced according to master discount schedule and freight determined accordingly.
(c) All orders subject to approval of credit by the Company.

IV. STANDARD WARRANTY

(a) The Company warrants its products, so far as the same is of its own manufacture, against defects in material and workmanship under normal use and service for which the product was designed for a period of ninety (90) days from date of shipment. The Company will warrant components or parts not manufactured by it only to the same extent that respective manufacturers warrant such goods, equipment, and material and their components or parts. Notwithstanding anything herein to the contrary, only the manufacturer's warranty will be provided to Customer for goods, equipment, components, or parts not manufactured by the Company. ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE GOODS SOLD UNDER THIS AGREEMENT ARE HEREBY EXCLUDED UNLESS EXPRESSLY SET FORTH HEREUNDER.
(b) Products found to be defective in material or workmanship to the extent provided in Paragraph IV(a) will be replaced or repaired, at the option of the Company, if notice of such defect is provided within the above warranty period as required below. If the original product is replaced, the original product must be returned to the Company. THE COMPANY SHALL NOT BE LIABLE TO CUSTOMER OR ANY OTHER PERSONS FOR LOSS OR DAMAGE DIRECTLY OR INDIRECTLY ARISING OUT OF THE USE OF THE GOODS, FROM BREACH OF WARRANTY OR FROM ANY OTHER CAUSE, THE EXCLUSIVE REMEDY OF CUSTOMER UNDER THIS AGREEMENT BEING THE REPLACEMENT OR, AT THE OPTION OF THE COMPANY, REPAIR OF THE DEFECTIVE GOODS. IT IS THE INTENT OF THE PARTIES THAT SAID REMEDY IS THE SOLE REMEDY AVAILABLE TO CUSTOMER AND NOT CUMULATIVE OF ANY OTHER REMEDIES PROVIDED BY STATUTE OR COMMON LAW. IN THE EVENT OF A BREACH OR REPUDIATION OF THIS AGREEMENT BY THE COMPANY OR A DEFECT OR FAILURE OF THE GOODS, CUSTOMER SHALL NOT BE ENTITLED TO ANY SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING BUT NOT LIMITED TO DAMAGES DUE TO DOWN TIME OF GOODS, RENTAL CHARGES WHILE GOODS AND/OR RELATED EQUIPMENT ARE OUT OF COMMISSION, AND INSTALLATION COSTS. Every claim made for defective products or for any other cause shall be deemed waived by Customer unless made in writing to the Company within ten (10) days of the date the defect or other cause arose.
This warranty does not obligate the Company to bear the cost of labor or transportation charges in connection with the replacement or repair of defective parts without written approval by an officer of the Company prior to the time repairs are made. The obligation under this warranty may be limited to the repair or replacement of parts f.o.b. its factory provided that, upon inspection at such point, they shall be determined by the Company to have been defective in material or workmanship.
THE REVISION OR ALTERATION OF THE GOODS BY OTHERS INCLUDING THE PURCHASER, ITS EMPLOYEES, AGENTS, OR REPRESENTATIVES WILL NEGATE ANY WARRANTY PROVIDED IN CONNECTION HEREWITH.
(c) Acceptance of the product from a common or contract carrier constitutes a waiver of any claim against the Company for delay or damages in transit.

V. SHIPMENT

(a) Shipment quoted as being effective as of a particular proposal date will be confirmed upon receipt of order, subject to availability of materials and production space. The Company shall not be held responsible for any delay or failure to deliver due to causes beyond the Company's control such as labor disputes, strikes, riots, war, accident, carrier delays, fire damage to, or destruction in whole or in part of, the equipment or manufacturing facility; lack or inability to obtain raw materials, labor, fuel, parts, or supplies; or storm, fire, flood, or any act of God, or other causes beyond the Company's control.
(b) Should significant manufacturing changes or additions be made by the Purchaser after production has begun, shipping commitments may be extended at the Company's discretion.
(c) The place of delivery of the goods sold hereunder is the Company's place of business unless otherwise agreed in writing signed by both parties.
(d) In the event that Purchaser rejects any of the goods sold by this Agreement, Purchaser must notify the Company of the rejection in writing within forty-eight (48) hours of delivery, and Purchaser agrees not to resell or dispose of the rejected goods in any manner and will hold the equipment without charge to the Company until the time that the Company may reasonably arrange for transportation. Should Purchaser sell the goods, the sale shall be deemed an unequivocal acceptance of the goods.
(e) Purchase should obtain prior written approval for any shipment to be returned to the Company by contacting the Company which will assign a returned goods authorization number. All shipments must be returned freight prepaid, or the shipments will be refused. Freight charges will be credited to the Purchase for any returned goods found to be nonconforming. A minimum restocking charge of 25% of the sales value of the item returned will be applied to each returned item, unless the product is nonconforming. All special products manufactured by the Company are not subject to cancellation or return.
(f) All materials are packed for domestic shipments. For special requirements or export packaging requirements, the Company must be contacted for additional information and pricing.

VI. CANCELLATION

This Contract cannot be canceled without the mutual agreement between the Purchaser and the Company. If such cancellation is agreed upon, Purchaser agrees to pay immediately all cancellation charges. Any order canceled by Purchaser after acceptance by the Company will be subject to a cancellation charge up to an amount equal to 25% of the sales value of the item canceled. All special products manufactured by the Company are not subject to cancellation or return.

VII. TAXES

The Purchaser shall pay to the Company, in addition to the purchase price, the amount of Sales, Use, Privilege, Occupation, Excise or other taxes, Federal, State, local or foreign, which the Company is required to pay in connection with sale of goods. This obligation is in addition to any such taxes which the Purchaser is required to pay in connection with the sale of goods to Purchaser. Prices quoted to Purchaser are exclusive of all such taxes.

VIII. EXCLUSIVE REMEDIES OF PURCHASER

The exclusive remedies of Purchaser are (1) the return of any nonconforming goods to the Company and the reimbursement of the purchase price from the Company or (2) the repair and replacement of nonconforming goods or parts, at the Company's option. Said remedies are the sole remedies available to the Purchaser and are not cumulative of any other remedies provided by law. Under no circumstances shall the Company be liable for incidental or consequential damages.

IX. PRODUCT REQUIREMENTS

Product data listed represents current information available and is subject to change without notice. Technical data concerning dimension, weights, and performance figures along with illustrations, and drawings are only authoritative within the context of usual technical tolerances unless expressly confirmed in writing. The Company reserves the right to introduce technical alterations at any time with no obligation to expressly point out any changes. Any particular product requirement of Purchaser should be communicated to the Company in writing and must be acknowledged in writing by the Company in order to binding on the Company.

X. PLACE OF PERFORMANCE AND JURISDICTION

The Company performs all of its duties under its contracts in the State of Texas, and all payments are due and payable in Houston, Harris County, Texas.