

1.5.1 DETAILS OF THE BLADDERS AND/OR SEALS MATERIAL

The bladders can be made of various types of elastomers. To obtain the thermal and chemical compatibility with the fluid used, you must select the proper elastomer, depending on the fluid used and the working temperature. For more precise information than the specifications outlined below, please contact our technical service.

1.5.2 "P" NITRILE RUBBER (NBR)

Nitrile rubber NBR is the generic name of the acryl-nitrile butadiene compound. The content of nitrile-acrylate is greater than 33%, so you have the right balance between a good compatibility with oils and fuels, while maintaining good flexibility at low temperatures. The NBR rubber is highly resistant to ozone and weathering. Heat resistance up to 80°C and for short periods up to 90°C (at higher temperatures, the aging is accelerated). Resistance to low temperatures down to -20°C, for short periods up to -25°C.

Chemical compatibility:

- aliphatic hydrocarbons (propane, butane, gasoline, oils, mineral greases, diesel fuel, fuel oil, kerosene)
- mineral greases and oils
- HFA, HFB, HFC fluids
- many dilute acids, alkalis, salt solutions
- water
- water glycol

Not compatible with:

- fuels with high aromatic content (i.e. premium gasoline)
- aromatic hydrocarbons (benzene)
- chlorinated hydrocarbons (trichloroethylene)
- polar solvents (ketone, acetone, ethylene esters of acetic acid)
- strong acids
- brake fluids based on glycol
- water glycol
- poor resistance to ozone, weathering and aging.

1.5.3 "F" NITRILE RUBBER FOR LOW TEMPERATURES

The same as with standard nitrile and most types of freon. It has lower content of acrylic nitrile with respect to the standard, so it is best suitable to work at low temperatures but the chemical resistance to various liquids is slightly lower. Working temperature -40°C +70°C.

1.5.4 "H" NITRILE RUBBER FOR HYDROCARBONS

Compatible with normal gasoline, super low-aromatic ones, combined heavy oil and all fluids of standard nitrile. Working temperature -10°C +90°C

1.5.5 "K" HYDROGENATED NITRILE (HNBR)

The hydrogenated nitrile rubber is obtained by adding hydrogen to the compound of the NBR rubber, which imparts superior mechanical properties, outstanding abrasion resistance, high tensile strength, excellent resistance to high temperatures, low gas permeability. Heat resistance up to 130°C, with higher peaks for short periods of up to 150°C. Resistance to low temperatures up to -30°C.

Chemical compatibility greater than the NBR rubber.

1.5.6 "B" BUTYL (IIR)

The butyl rubber has low gas permeability and good electric insulation capacity. Heat resistance up to 100°C, with higher peaks for short periods of up to 120°C. Resistance to low temperatures up to -30°C.

Chemical Compatibility:

- hot water up to 100°C
- brake fluids based on glycol
- many acids and bases
- salt solutions
- polar solvents such as alcohols, ketones and esters
- polyglycol-based hydraulic fluids (HFC fluids) and bases of phosphoric acid esters (HFD-R fluids)
- silicone oils and greases
- Skydrol 500 e 7000
- resistance to ozone, weathering and aging

Not compatible with:

- mineral oils and greases
- fuels
- chlorinated hydrocarbons

1.5.7 "E" ETHYLENE-PROPYLENE (EPDM)

EPDM is a rubber derived from the copolymerization of ethylene with propylene and diene, so it has features particularly suitable to contact with hydraulic fluids based on phosphate esters; it can be also used with fluids of the glycol-based brake systems. Heat resistance up to 100°, with higher peaks for short periods of up to 120°C. Resistance to low temperatures up to -30°C.

Chemical Compatibility:

- hot water up to 100°C
- brake fluids based on glycol
- many organic and inorganic acids
- detergents, sodium and potassium solutions
- hydraulic fluids based on phosphate esters (HFD-R)
- silicone oils and greases
- many polar solvents (alcohol, ketones, esters)
- Skydrol 500 and 7000
- resistance to ozone, weathering and aging

Not compatible with:

- mineral oils and greases
- fuels

1.5.8 "N" CHLOROPRENE (CR)

Trade name NEOPRENE.

Chloroprene rubber is one of the first rubbers created synthetically. Given the high content of chlorine, vulcanizing items have good flammability. They burn under direct action of the flame, but go out when it goes away. The compatibility to the oil is medium, good mechanical properties in the wide temperature range of use. Heat resistance up to 100°C, with higher peaks for short periods of up to 110°C. Resistance to low temperatures up to -30°C.

Chemical Compatibility:

- mineral paraffin oils

- silicone oils and greases
- water and aqueous solutions
- refrigerants (ammonia, carbon dioxide, Freon)
- naphthenic mineral oils
- low molecular aliphatic hydrocarbons (propane, butane, gasoline)
- brake fluids based on glycol
- better resistance to ozone, weathering and aging than in NBR rubber.

Not compatible with:

- aromatic hydrocarbons (benzene)
- chlorinated hydrocarbons (trichloroethylene)
- polar solvents (ketones, esters, ethers, acetone).

1.5.9 "Y" EPICHLOROHYDIN (ECO)

The epichlorohydrin rubber is a copolymer which has good compatibility with mineral oils, fuels and ozone. The high temperature resistance is good; it still has a good elasticity at low temperature, while the gas permeability is not excellent. Heat resistance up to 110°C, with higher peaks for short periods of up to 120°C. Resistance to low temperatures up to -30°C.

Chemical Compatibility:

- mineral oils and greases
- aliphatic hydrocarbons (propane, butane and gasoline)
- silicone oils and greases
- water at ambient temperature
- resistance to ozone, weathering and aging

Not compatible with:

- aromatic hydrocarbons and chlorinated solutions
- ketones and esters
- non-flammable hydraulic fluids of HFD-R and HFD-S groups
- brake fluids based on glycol

1.5.10 "V" FLUOROCARBON (FPM)

The trade name ("DuPont") is VITON®. The fluorocarbon rubber has excellent resistance to high temperatures, ozone, oxygen, mineral oils, synthetic hydraulic fluids, fuels and many chemicals and organic solutions. In the field of low temperatures, its behaviour is not optimal. The permeability to gases is very low, similar to that of butyl. Heat resistance up to 180°C, for short periods of up to 200°C. Resistance to low temperatures up to -10°C.

Chemical Compatibility:

- mineral oils and greases
- non-flammable fluids of HFD group
- silicone oils and greases
- animal and vegetable oils and greases
- aliphatic hydrocarbons (gasoline, butane, propane, natural gas)
- aromatic hydrocarbons (benzene, toluene)
- chlorinated hydrocarbons (tetrachloroethylene, carbon tetrachloride)
- fuels (normal, premium and containing methanol)
- good resistance to ozone, weathering and aging.

Not compatible:

- polar solvents (acetone, methyl ethyl ketone, ethyl acetate, diethyl ether, dioxane)
- Skydrol 500 and 7000

- brake fluids based on glycol
- ammonia gas, amines, alkali
- superheated steam
- low molecular organic acids (formic and acetic acid).

1.5.11 POLYURETHANE (HPU)

The H-PU polyurethane is a copolymer, based on aromatic isocyanate and diols.

Compared to all other elastomers, it has excellent wear resistance, excellent resistance to extrusion and high elasticity. The gas permeability is good compared to that of IIR. Heat resistance: up to approx. +80°C; resistance to low temperatures: up to approx. -20°C.

Chemical Compatibility:

- pure hydrocarbons
- natural oils and greases
- silicone oils and greases
- water up to +50°C
- resistance to ozone and aging

Not compatible with:

- ketones, esters, ethers, alcohols, glycols
- hot water, steam, alkalis, amines, acids

Resistant to:

- oil, petrol, hot water, hot air, ozone, synthetic and native esters

Not resistant to:

- conc. Acids, conc. lyes, conc. alcohols and aromatic solvents.

1.5.12 SILICON-FLUORINE (MFQ)

The rubber MFQ contains in its molecule, as well as methyl groups, even trifluoropropyl groups. The physical and mechanical properties are comparable to those of silicone rubber (MVQ). In comparison to silicone (MVQ), the silicon fluoride (MQF) shows a significantly higher compatibility to fuels and mineral oils, while resistance to the hot air is slightly lower.

Heat resistance: up to approx. 150°C. (max. 180°C)

Resistance to low temperatures: up to approx. +50°C

Chemical Compatibility:

- mineral aromatic oils (i.e. ASTM Oil No. 3)
- fuels
- aromatic low molecular hydrocarbons (i.e. benzene, toluene)
- engine oils and aliphatic type transmissions
- animal and vegetable oils and greases
- brake fluids based on glycol
- non-flammable hydraulic fluids, HFD-R and HFD-S fluids
- chlorinated aromatic hydrocarbons with high molecular content (i.e. Chlophen), chlorinated diphenyl
- water up to +70°C
- dilute salt solutions
- resistance to ozone, aging and weathering

Not compatible with:

- superheated steam over 100°C
- acids and alkalis

- silicone oils and greases
- low molecular chlorinated hydrocarbons (i.e. trichloroethylene)

1.5.12 TEFLON (PTFE)

Normally it is better known by its trade name Teflon®, in which other stabilizers and plasticizers are added to the polymer to improve the characteristics depending on the application. It's a plastic smoother to the touch and resistant to high temperatures (up to 200°C).

The main features are:

- the complete chemical inertia, so it's not attacked by almost all chemical compounds (with the exception of molten alkali metals, fluorine at high pressure and some fluorine compounds under particular conditions of temperature) and especially it does not change the fluids with which is placed in contact, such as high purity fluids for the electronics industry
- the complete insolubility in water and in any organic solvent
- good electric quality (65 kV / mm of dielectric strength)
- excellent resistance to fire: it does not propagate the flame
- Excellent flow properties on the surface: the coefficient of friction is the lowest among the industrial sealing products
- Non-stick: the surface cannot be glued (contact angle is of 127°)

These characteristics take on added importance when you take into account that remain virtually unchanged in a range of temperatures from - 50°C and 150°C (max. 200°C).

Chemical Compatibility:

- Teflon has a high chemical compatibility with most fluids and chemicals used.

Not compatible with:

- hardly compatible with fuel oils in general

1.5.13 THE GAS PERMEABILITY ISSUE SIMPLIFIED

As you gain low temperature capability in a bladder compound, permeability of the bladder increases, and hence greater pre-charge loss due to gas permeation at working temperature.

To show the direct correlation, the potential permeability of each bladder compound was tested to define the relationship between the bladder compound permeability and temperature.

The Gas Permeability Factor was determined by rating the permeability (potential loss of gas pre-charge through the bladder or through the seal) of each compound on a scale of 0 to 50 at 70°F. The higher the Permeability Factor of the faster gas pre-charge would be lost in a low-temperature application using that bladder compound.

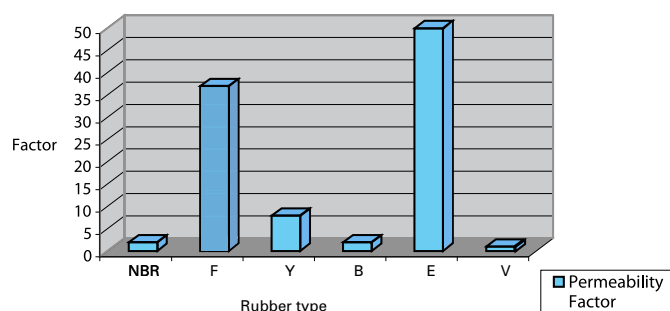
Specifically:

Rubber type	TSmin °C	Permeability Factor
"P" Nitrile (NBR)	- 20	3
"F" Nitrile (NBR-LT)	- 40	30
"Y" Epichlorohydrin ECO)	- 30	8
"B" Butyl (IIR)	- 30	2
"E" Ethylene-propylene(EPDM)	- 30	50
"V" Fluorocarbon (FKM)	- 10	1

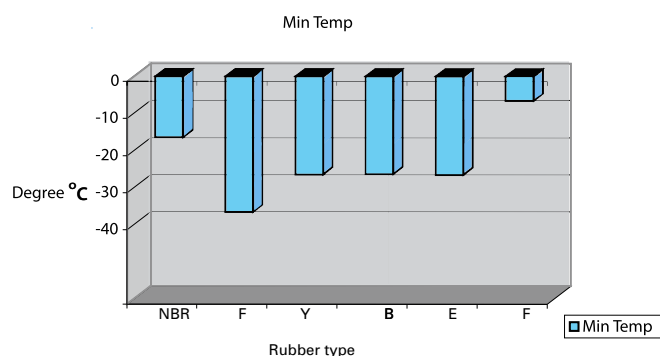
The Permeability Factor increases or decreases with temperature, setting up a trade-off situation for having to use a low temperature bladder compound. If the application requires a - 40°C bladder material because the equipment needs to be left out the cold overnight, the upside is that the bladder won't shatter at low temperature.

The downside is that the pre-charge in the bladder will have to be checked more often because of the higher working temperature when the oil warms up.

The following charts will assist bladder accumulator users when they have a low temperature application. Figure 1.5a Permeability Factor & Bladder Compounds shows the permeability of each compound within a 0 to 50 Permeability Factor scale.



1.5a



1.5b

Figure 1.5b– Minimum Use Temperature & Bladder Compounds shows the lowest temperature at which each bladder compound can be used. With reference to both charts, it is graphically easy to see that the nitrile low temperature compound, for example, has excellent low temperature capability at - 40°C, but the trade-off for that low temperature performance is a relatively high Permeability Factor of 30. This is a solid confirmation that using this bladder compound will require more frequent maintenance checks for the loss of pre-charge due to gas permeation.

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