KLINGER
Sweden

Material selection guide

O-rings, shaft seals, hydraulics, bonded seals etc.









KLINGER Sweden AB

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KLINGER Material selection guide

Aflas®

KLINGER designation: AFLAS
Standard colour: Black
Main applications: Seals for oil field, industrial and chemical applications.
Temperature range: -5°C to 205°C (Dry heat only).
Hardness (Shore A): 60-95

Description: A copolymer of tetrafluoroethylene and propylene, AFLAS exhibits excellent chemical resistance properties, and good to fair high temperature retention of physical properties.

Features: With good resistance to petroleum fluids, steam, a number of acids and alkalies, amines (anti-freeze), phosphate esters and brake fluids, AFLAS has generated considerable interest as a seal material for oil field, industrial and chemical applications.

Laboratory tests have demonstrated a high degree of heat resistance (205°C) with retention of slightly below average (2500 psi) tensile properties. Tests have further shown abrasion resistance to be about the same as Fluorocarbon; cracking to appear after 100 to 200 flexes at 205°C; and no change in material properties after one year of weathering.

Limitations:
Seven day immersion, at room temperature, in solvents indicates such significant volume changes as 50% in Acetone, 58% in MEK, 95% in MIK, 112% in Chloroform, 125% in Methyl Chloroform and 249% in Trichlorotrifluoroethane.

Compression set of 52% after 30 days at 205°C may be considered too high for some sealing applications.

Buna-n (Nitrile)

KLINGER designation: NBR
Standard colour: Black
Main applications: Oil resistant applications of all types. Low temperature military uses. Off-road equipment. Automotive, marine, aircraft fuel systems. Can be compounded for FDA applications.
Temperature range: -40°C to 120°C (Dry heat only).
Hardness (Shore A): 40-90

Description: Presently the seal industry's most widely used elastomer, Nitrile combines excellent resistance to petroleum-based oils and fuels, silicone greases, hydraulic fluids, water and alcohols, with a good balance of such desirable working properties as low compression set, high tensile strength, and high abrasion resistance.

Features: Comprised of the copolymer butadiene and acrylonitrile, by varying the relative proportions of these two base monomers, depending upon the compound, Nitrile performance characteristics may also be varied over a working temperature range of -55°C to 150°C. Increasing acrylonitrile content gives Nitrile its better resistance to petroleum-based oils and hydrocarbon fuels, enhancing resistance to the degrading effects of heat, at a cost of reduced low temperature performance.

Conversely, decreasing acrylonitrile, while increasing butadiene content, provides better low temperature flexibility, a characteristic most often required by Air Force Navy (AN) and Military Standard (MS) o-ring specifications. A carboxylated version of the high-acrylonitrile butadiene copolymer (XNBR) is also available for applications requiring enhanced abrasion resistance.

Limitations: Precautions should be taken to avoid exposure of Nitrile to such highly polar solvents as Acetone, MEK, Chlorinated Hydrocarbons and Nitro Hydrocarbons, which are known to cause rapid and extreme deterioration. Additional limitations on Nitrile use include applications with direct exposure to ozone and sunlight.

Butyl

KLINGER designation: BUTYL
Standard colour: Black
Main applications: Highly effective in vacuum sealing applications. Good seal for hydraulic systems.
Temperature range: -45°C to 120°C (Dry heat only).
Hardness (Shore A): 40-80

Description: A copolymer of isobutylene and isoprene, Butyl has largely been replaced by Ethylene Propylene since its introduction.

Features: With outstanding low permeability to gases, Butyl is especially effective in vacuum sealing applications. It also features good to excellent resistance to ozone and sunlight aging.

Butyl further features excellent shock dampening capabilities. Only slightly affected by oxygenated solvents and other polar liquids, Butyl is often utilized in seals for hydraulic systems using synthetic fluids.

Limitations: Butyl has poor resistance to hydrocarbon solvents and oils, and diester-based lubricants.

EPDM (Ethylene-propylene)

KLINGER designation: EPDM
Standard colour: Black
Main applications: Outdoor weather resistant uses. Hydraulic & automotive brake systems. Automobile cooling systems. Water appliances. Low torque drive belts.
Temperature range: -50°C to 150°C (Dry heat only).
Hardness (Shore A): 40-90

Description: A copolymer of ethylene and propylene (EPM), sometimes combined with a third comonomer (EPDM), Ethylene Propylene has gained wide seal industry acceptance for its excellent ozone and chemical resistance characteristics.

Features: With a working temperature range of -50°C to 150°C, depending upon the compound, EPM/EPDM excels in its resistance to the very same chemical agents that cause rapid and extreme deterioration in Nitrile. In particular, EPM/EPDM features good resistance to such polar solvents as ketones (MEK and Acetone). It is also highly recommended for effective resistance to steam (to 200°C), hot water, silicone oils and greases, dilute acids and alkalies, alcohols and automotive brake fluids.

EPM/EPDM further features excellent resistance to aging by both ozone and sunlight. EPM/EPDM can also be compounded for FDA approved applications.

Limitations: With the exception of resistance to polar solvents, EPM/EPDM is not recommended for its overall solvent resistance.

And, unlike Nitrile, this elastomer performs poorly when exposed to petroleum oils, diester-based lubricants or aromatic fuels.

Fluorocarbon

KLINGER designation: FPM
Standard colour: Black
Main applications: Seals for aircraft engines. Seals for automotive fuel handling systems. High temperature/low compression set applications. Wide chemical exposure situations. Hard vacuum service.
Temperature range: -30°C to 205°C (Dry heat only).
Hardness (Shore A): 50-95

Description: Combining high temperature resistance with outstanding chemical resistance, Fluorocarbon-based compounds approach the ideal for a universal o-ring material.

Features: Featuring excellent resistance to petroleum products and solvents, with good high temperature compression set characteristics, Fluorocarbon o-ring make ideal seals for aircraft, automobile and other mechanical uses.

Fluorocarbons are highly resistant to swelling in gasoline and gasoline/alcohol blends, as well as resistant to the degrading effects of UV-light and ozone. With low gas permeability, they are also well suited for hard vacuum service.

Limitations: Fluorocarbons are not recommended for exposure to ketones, amines, low molecular weight esters and ethers, nitro hydrocarbons, hot hydrofluoric or chlorosulfonic acids, or skydrol fluids. They are also not recommended for situations requiring good low temperature flexibility.

Fluorosilicone

KLINGER designation: FVMQ
Standard colour: Blue
Main applications: Aerospace fuel systems. Auto fuel emission control systems. Primarily for static sealing applications.
Temperature range: -60°C to 205°C (Dry heat only).
Hardness (Shore A): 50-80

Description: Fluorosilicone combines the good high and low temperature stability of silicones with the fuel, oil and solvent resistance of Fluorocarbons.

Features: Fluorosilicone is most often used in aerospace applications for systems requiring fuel and/or diester-based lubricant resistance up to a dry limit of 200°C. Although generally specified for aerospace use, due to its excellent fuel resistance and high temperature stability, Fluorosilicone is becoming an increasingly popular material for a wider range of sealing applications.

Featuring good compression set and resilience properties, Fluorosilicone compounds are suitable for exposure to air, sunlight, ozone, chlorinated and aromatic hydrocarbons.

Limitations: Due to limited physical strength, poor abrasion resistance, and high friction characteristics, Fluorosilicone elastomers are not generally recommended for dynamic sealing. They are predominantly designed for static sealing use.

They are also not recommended for exposure to brake fluids, hydrazine or ketones.

Kalrez®

KLINGER designation: KA
Standard colour: Black
Main applications: Seals for severe chemical axposure and high temperatures. Used extensively in oil exploration and refining. Seals for chemicals processing and transportation. Seals for paint and coatings operations. Seals for analytical and process control instrumentations.
Temperature range: -35°C to 260°C (Dry heat only).
Hardness (Shore A): 65-95

Description: Kalrez parts are made from a perfluoroelastomer possessing exceptional resistance to degradation by aggressive fluids and/or gases.

Features: Kalrez parts combine the high temperature toughness of a fluorocarbon elastomer (such as Viton), with the chemical inertness of Teflon. As a group, Kalrez parts resist attack by nearly all chemical reagents. They provide long term service in virtually all chemical and petrochemical process streams. Compared with Teflon seals, Kalrez parts are much less likely to cold flow ("creep"). Kalrez parts are offered in several compounds, with varying tensile, elongation, hardness, compression set and temperature ranges. For example, tensile strengths vary by compound from low of 13 MPa to a high of 26 MPa, with elongation likewise varying from a low of 12% to a high of 190%.

Limitations: In general, Kalrez compression set properties range from "fair" (32% to 54%) at 100°C to "poor" (66% to 82%) at 204°C, for 70h of test duration. Withstanding degradation by virtually all chemicals, nonetheless Kalrez parts can be made to significantly swell upon exposure to some fluorinated solvents; fully halogenated freons; and uranium hexafluoride. Because a highly exothermic reaction could occur, Kalrez parts should not be exposed to molten or gaseous, alkali metals (such as sodium). As the thermal coefficient of expansion for Kalrez is stated by the manufacturer to be "about 50% greater than for fluoroelastomers", gland volume may have to be increased to allow for this expansion in elevated temperature situations. Despite the desirable characteristics of Kalrez, because of its high cost it is generally used when no other elastomer is appropriate.

Natural Rubber

KLINGER designation: NR
Standard colour: Black
Main applications: Seals in brake systems. Seals in food and beverage applications. Most popular material for non- o-ring-applications.
Temperature range:-50°C to 105°C (Dry heat only).
Hardness (Shore A): 40-90

Description: Natural rubber is the vulcanized product of the juice of the Hevea tree (latex).

Features: Natural rubber features low compression set, high tensile strength, high resilience, high abrasion and high tear resistance properties, with a good friction surface and excellent adhesion to metals. Until the invention of synthetic elastomers in the 1930's, Natural rubber was the only polymer available for o-ring manufacture.

Still used today in FDA applications for food and beverage seals, Natural rubber features good resistance to organic acids, alcohols and automotive brake fluid, with moderate resistance to aldehydes and ketones.

Limitations: The poor resistance of Natural rubber to attack by petroleum oils was primary reason for the research and development of synthetic rubbers beginning in the 1930's.

Also readily deteriorated by exposure to sunlight and ozone, Natural rubber have been predominantly replaced by "use specific" synthetic rubbers in the seal industry of today.

Neoprene

KLINGER designation: CR
Standard colour: Black
Main applications: Numerous component uses in the transportation field. Recommended for exposure to weathering. Preferred sealing material for refrigeration industry. FDA-approved for food and beverage industry use.
Temperature range: -40°C to 120°C (Dry heat only).
Hardness (Shore A): 40-90

Description: One of the earliest of the synthetic materials to be developed as an oil-resistant substitute for Natural rubber, Neoprene is a homopolymer of Chloroprene (Chlorobutadiene).

Features: Neoprene can be used in innumerable sealing applications, due to its broad base of such desirable working properties as: moderate resistance to petroleum oils; good resistance to ozone, sunlight and oxygen aging; relatively low compression se; good resilience and reasonable production cost. Due to its excellent resistance to freon and ammonia, Neoprene is also widely accepted as a preferred material for refrigeration seals.

Limitaions: Neoprene is generally attacked by strong oxidizing acids; ester, ketones, chlorinated, aromatic and nitro hydrocarbons.

Because Nitrile is economically competitive with Neoprene, and generally has superior performace characteristics in most situations, it has largely replaced Neoprene in the o-rings of today.

Nitrile, hydrogenerated

KLINGER designation: HNBR
Standard colour: Black
Main applications: All oil resistant applications, including exposure to such oil additives as detergents, anti-oxidants and anti-wear agents. Exposure to oil soured with metal sludge. Seals for oil well applications. Seals for automotive fuel handling systems. Seals for general industrial usage.
Temperature range: -30°C to 125°C (Dry heat only).
Hardness (Shore A): 75

Description: HNBR is a product of the hydrogenation of Nitrile, resulting in varying degrees of saturation of the polymeric chain, with accompanying varying degrees of enhanced physical strength and chemical resistance properties.

Features: In the areas of heat resistance, tensile strength, abrasion resistance and oil additive resistance, HNBR exhibits improved performance characteristics over non-hydrogenated Nitrile, while showing about five times higher sour gasoline and ozone resistances. Tensile strength at 25°C has been increased from 20 MPa for nitrile to 30 MPa för HNBR.

Various HNBR-compounds have been created with performance characteristics rivaling those of other polymers, such as Fluorocarbon, Polyacrylate, Ethylene Propylene and Neoprene. HNBR's ozone and fuel resistance compares favorably with Fluorocarbon. Its excellent heat and oil resistance rivals that of Polyacrylate. Its resistance to steam (to 175°C) is close to that of Ethylene Propylene. Its high abrasion and heat resistance enables it to replace Neoprene in high temperature belts. In most cases, the tensile strength of HNBR is unsurpassed.

Limitations: Like Nitrile, increasing acrylonitrile content improves oil resistance at a cost of reduced low temperature performance. Also, as the degree of hydrogenation increases, with improved heat resistance comes HNBR tendency to cold flow or "creep". Increased hydrogenation further brings decreased elasticity at low temperatures. Like Nitrile, HNBR is not recommended for exposure to ethers, esters, ketones, or chlorinated hydrocarbons.

Polyacrylate

KLINGER designation: ACM
Standard colour: Black
Main applications: Sealing automatic transmissions and power steering systems. Sealing petroleum oils up to 175°C.
Temperature range:-17°C to 175°C (Dry heat only).
Hardness (Shore A): 40-90

Description: Polyacrylates are copolymers (ethyl) acrylates) possessing outstanding resistance to petroleum fuels and oils.

Features: With excellent resistance to hot oil, automatic transmission and Type A power steering fluids, the greatest use for Polyacrylate is found in automobile manufacture, where o-rings of this material are employed to seal components of automatic transmission and power steering systems.

Highly resistant to sunlight and ozone degradation, Polyacrylate also features an enhanced ability to resist flex cracking.

Limitations: While resistance to hot air aging is superior to Nitrile, Polyacrylate strength, compression set, water resistance properties and low temperature capabilities are inferior to many other polymers. Polyacrylates are also not generally recommended for exposure to alcohol, glycols, alkalies, brake fluids, or to chlorinated or aromatic hydrocarbons.

Polyurethane, cast

KLINGER designation: PU
Standard colour: Amber
Main applications: Seals for high hydraulic pressures. Situations where highly stressed parts are subject to wear.
Temperature range: -50°C to 100°C (Dry heat only).
Hardness (Shore A): 70-90

Description: Cast Polyurethane is outstanding over other o-ring elastomers in abrasion resistance and tensile strength. Additionally, cast Polyurethane surpasses the performance of millable Polyurethane in its higher tensile strength, greater elongation, wider temperature range and lower compression set characteristics.

Features: With tensile strength of up to 41 MPa, elongation of 350% to 650%, compression sets of 10% to 25%, and exceedingly high abrasion resistance, the physical properties of cast Polyurethane are among the best of all o-ring elastomers. The heat resistance of standard compound cast Polyurethanes (100°C) shows a decided improvement over the lesser heat resistance of standard compound millable Polyurethane to 80°C.

Although they swell slightly upon exposure, cast Polyurethane compounds feature excellent resistance to mineral-based oils and petroleum products, aliphatic solvents, alcohols and ether. They are also compatible with hydraulic fluids, weak acids and bases, and mixtures containing less than 80% aromatic constituents.

Limitations: Cast Polyurethane are not recommended for exposure to concentrated acids and bases; ketones, esters, very strong oxidizing agents, pure aromatic compounds and brake fluids. With the exception of special compounds, they are also not recommended for exposure to hot water or steam.

Polyurethane, millable

KLINGER designation: AU
Standard colour: Black
Main applications: Seals for high hydraulic pressures. Situations where highly stressed parts are subject to wear. Wiper seals for axially moving piston rods.
Temperature range: -40°C to 80°C (Dry heat only).
Hardness (Shore A)40-90

Description: Millable Polyurethane is outstanding over most other o-ring elastomers in abrasion resistance and tensile strength.

Features: Millable Polyurethane offers superior seal performance in hydraulic situations, where high pressures, shock loads, or abrasive contamination is anticipated. At temperatures up to approximately 70°C, Millable Polyurethane possesses chemical compatibility similar to that of Nitrile, offering good resistance to petroleum-based oils, hydrocarbon fuels and hydraulic fluids, the oxidizing effects of ozone, and the aging effects of sunlight.

Good low flexibility is also a feature of many Millable Polyurethane elastomer compositions.

Limitations: Unless specially compounded, at elevated temperatures Millable Polyurethane begins to soften, losing its physical strength and chemical resistance advantages over other polymers.

Tending to rapidly deteriorate when exposed to concentrated acids, ketones, esters, chlorinated and nitro hydrocarbons, Millable Polyurethane are also prone to hot water and steam degradation.

Silicone

KLINGER designation: SIL
Standard colour: Red
Main applications: Static seals in extreme temperature situations. Seals for medical devices, compatible with FDA regulations.
Temperature range: -60°C to 230°C (Dry heat only).
Hardness (Shore A): 25-80

Description: A group of elastomers, made from silicone, oxygen, hydrogen and carbon. Silicones are renowned for their retention of flexibility and low compression set characteristics, within one of the widest working temperature ranges for elastomers.

Features: Especially resistant to high, dry heat, in primarily static applications, special Silicone compounds have been manufactured to resist up to 315°C heat for short time durations. Maximum elevated temperature for continuous service, however, remains at 230°C. At the opposite end of the temperature scale, the low limit for Silicone flexibility is -60°C. Silicones are also fungus resistant, odorless, tasteless and non-toxic.

Limitations: Poor tensile and tear strength, low abrasion resistance and high friction characteristics preclude Silicones from effective sealing use in most dynamic situations.

Many Silicone compounds also exhibit higher than normal mold shrinkage, resulting in undersized, molded finished parts (from standard molds).

Unless specially compounded, Silicones swell considerably in aliphatic and aromatic hydrocarbon fuels. They should also be considered NON-resistant to petroleum oils, although they can be used in high anilie point oils.

Silicones are highly permeable to gases, and are generally not recommended for exposure to ketones (MEK: acetone), concentrated acids, or steam.

Styrene butadiene

KLINGER designation: SBR
Standard colour: Black
Main applications: Sealing of hydraulic brake systems.
Temperature range: -45°C to 100°C (Dry heat only).
Hardness (Shore A): 40-90

Descriptions: Also known as Buna S, or GR-S (Government Rubber-Styrene), Styrene Butadiene was the elastomer substituted for Natural Rubber during world war II. Compounded properties are similar to those of Natural Rubber.

Features: Exhibiting excellent resistance to brake fluids, SBR is still used in some brake applications. With good water resistance, and resilience up to 70 durometer, it is also used in plumbing.

The main use for Styrene Butadiene, however, is in the manufacture of automobile tires, a decidedly non o-ring application.

Limitations: SBR is not recommended for exposure to petroleum oils, most hydrocarbons, strong acids, or ozone.

Teflon, virgin

KLINGER designation: PTFE
Standard colour: White
Main applications: Seals for wide chemical exposure situations, with special emphasis on temperature extremes. For static and slow intermittent dynamic situations.
Temperature range: -300°C to 230°C (Dry heat only).
Hardness (Shore A): 98

Descriptions: Teflon is a tough, chemically inert polymer possessing an incredible working temperature range.

Features: Teflon is inert to virtually all industrial chemicals, even at elevated temperatures. Seals fabricated from this material feature outstanding weather resistance, high resistance to ozone, and high resistance to the degrading effects of exposure to such solvents as acetone, MEK, and xylene. Possessing aberage elastomer characteristics of 17 MPa to 24 MPa tensile strength, and 300% elongation, they are tough, impact resistant, low friction, non-twisting performers over an extremely wide temperature range.

Limitations: Teflon is hampered by very poor elastic memory at room, or low temperatures. This presents problems in o-ring installation, requiring extra care to be taken in control over o-ring i.d stretch. Heating Teflon in boiling water, or in a controlled oven, to 95°C is said to enable an o-ring stretch of 10-20% to be achieved, thereby assisting installation, and helping to assure a tight fit.

Because of its poor tear resistance, during o-ring installation particular care should be taken to avoid nicking or scratching Teflon, as imperfections will cause o-ring leakage. Finally, the tendency of virgin Teflon to cold flow over time, under gasketing pressures, may require special material compounding (with fillers) to control such "creep" in critical sealing situations.

Vamac

KLINGER designation:VA
Standard colour:Black
Main applications: Seals for automotive applications, such as automatic transmissions & power steering systems.
Temperature range: -40°C to 150°C (Dry heat only).
Hardness (Shore A): 50-90

Description: A copolymer of ethylene and methyl acrylate, with a small amount of a third monomer added to provide cure active groups in the polymer chain, Vamac exhibits properties similar to those of polyacrylate, but with an extended low temperature limit and better mechanicals.

Features: Ideal for automotive sealing uses, Vamac features excellent heat resistance, outstanding resistance to ozone and sunlight aging, moderate resistance to swelling in oils, and very low permeability to gases.

With a maximum reinforced tensile strength of 17 MPa, Vamac's mechanical properties of adhesion to metals, tear resistance, flex life, abrasion resistance and compression set resistance are all rated as "good".

Resistance to water, engine coolant mixtures (glycols), dilute acids and alkalies is also good.

Limitations: Vamac is not recommended for exposure to concentrated acids, aromatic hydrocarbons, "gasoline", ketones, brake fluids and phosphate esters.

Thermoplastic elastomer

Definition: A relatively new development in o-ring materials, thermoplastic elastomers combine the processing advantages of plastics with the rubber-like perfomance of elastomers. Known as two phase systems, these copolymer are comprised of both hard (plastic) and soft (elastomeric) molecular segments (phases). Each segment contributes advantages and limitations to final material performance. Examples of these materials are Santoprene® and Geolast.

Advantages: In virtually all cases, the substitution of these materials for traditional vulcanized rubbers results in such benefits as:
- the ability to mold more precisely dimensioned parts.
- the ability to reuse clean material scrap.
- the realization of significantly increased production line speeds, due to the use of conventional plastics molding equipment.

Limitations: While in many cases the substitution of these materials for thermosets results in specific property improvements, the blending of two very different base materials also results in performance compromises in such areas as temperature range, flexibility and environmental resistance.

Temperature range: The working temperature range of thermoplastic elastomers is determined by the limits of BOTH material comprising the system. The low temperature limit is defined by the glass transition temperature of the rubber phase, below which the material is brittle. The high temperature limit is defined by the melt point of the plastic phase, above which the material softens and begins to flow. And thermoplastics typically soften BEFORE thermosets, thus lowering the overall heat resistance of the copolymer.

Flexibility: The flexibility of thermoplastic elastomers is directly related to the percentage of hard (plastic) segments in the material. For example, as styrene content is increased in polystyrene elastomer block copolymers, these materials change from weak rubber-like materials; to strong elastomers; to leathery materials; to hard, glass-like products (with styrene content above 75%).

Environmental resistance: The environmental resistance of thermoplastic elastomers is highly dependent upon the resistance characteristics of BOTH segments of the material system.

On the upside, one segment of the material may have poor resistance to certain chemicals, while the other segment compensates with higher resistance, thereby improving overall material performance. On the downside, one segment may have much lower resistance than the other, thereby limiting environmental resistance in situations where this resistance is mandatory.

Order information

Following data have to be defined to ensure the choice of the most suitable material at different performance situations.

- *Dimension and tolerances.*
- *Information about the design.*
- *What kind of metals or additional material will be in contact with the sealing.*
- *What type of motion. Rotating or reciprocating.*
- *What media resistance is needed. Will the sealing be in contact with oils, steam, gases, etc.*
- *The highest, lowest and normal service temperature.*
- *Maximum and normal service pressure.*
















Storage regulations

The storage room must be cool, dry, dust free and the air must not be circulating. The temperature must be lower than +25°C, preferably lower than +15°C. At temperatures higher than +25°C, some degradation processes can speed up and reduce the lifetime of the seals.

Low temperature doesn't make any damage to rubber. Rubber stiffens up at low temperatures and it's wise to let the seals reach room temperature before use. Optimal moisture of air is 65%.

The seals must be protected from light and especially direct sunlight or strongly artificial light with high content of ultraviolet beams.

Most synthetic rubber materials are sensitive to ozone, which speed up the ageing. Seals must not be stored near devices which can produce ozone, e.g. electric motors or other devices, which makes sparks or discharges.

Solvents, gasoline, lubricants, chemicals, acids, etc. must not be stored near the seals.

Don't hang the seals directly on a nail or similar attachment. This can make permanent damages on the sealing surfaces. Store the seals preferably in unopened polyethene bags until assembly.

This is important to do to avoid mix up with dimensions and materials and at the same time protect the seals from outer influence.

Chemical compatibility table

● = *Good*
□ = *Fair (usually ok for static seal)*
◆ = *Questionable*
■ = *Poor*
Blank = No information

	Aflas ®	*Buna-n (nitrile)*	*Butyl*	*EPDM*	*Fluorocarbon*	*Fluorosilicone*	*Kalrez ®*	*Natural rubber*	*Neoprene*	*Nitrile, hydrogenated*	*Polyakrylate*	*Polyurethane, cast*	*Polyurethane, millable*	*Silicone*	*Styrene butadiene*	*Teflon ®, virgin*	*Vamac*
Acetaldehyde		◆	□	□	■	■		□	◆		■		■	□	◆		□
Acetamide	●	●	□	●	◆	●		■	●		■		■	□	■		
Acetic acid	■	□	□	□	■	■	●	□	■		■		■	□	□	●	■
Acetone	■	■	●	●	■	■	●	■	■		■		■	■	■	●	■
Acetylene		●	●	●	●			□	□		■		■	□	□		
Aluminium acetate		□	●	●	■	■		●	□		■		■	■	□		
Aluminium chloride		●	●	●	●	●		●	●		●		◆	□	●	●	●
Ammonia		□	●	●	■	■	●	■	●	●	■		■	□	■	●	
Ammonium chloride		●	●	●	●			●	●				●		●	●	●
Ammonium hydroxide	●	■	●	●	◆	●	●	◆	●		■		■	●	◆		
Amyl acetate		■	◆	◆	■	■		■	■		■		■	■	■		■
Aniline	●	■	□	□	◆	◆	●	■	■		■		■	■	■	●	
ASTM-oil 1	●	●	■	■	●	●		■	●		●		●	●	■		●
ASTM-oil 3	●	●	■	■	●	●		■	■		●		□	◆	■		□
Benzene	◆	■	■	■	●	◆	●	■	■		■		■	■	■		■
Benzoic acid		■	■	■	●	□	●	■	■		■		■	■	■		
Butane		●	■	■	●	□		■	●		●		●	■	◆		
Butyl alcohol	●	●	□	□	●	●		●	●		■		■	□	●		
Calcium chloride	●	●	●	●	●	●		●	●		●		●	●	●	●	
Calcium hydroxide	●	●	●	●	●	●		●	●		■		□	●	●		
Calcium sulfide	●	●	●	●	●	●		□	●		■		●	●	□		
Carbon disulfide	●	■	■	■	●	●		■	■	◆	◆			■	■	●	
Carbon tetrachloride	■	□	■	■	●	□	□	■	■		■		■	■	■		
Castor oil	●	●	□	□	●	●		●	●		●		●	●	●		
Chlorine (wet)		■			□		●	■	■		■			■	■	●	
Chlorine (dry)		■			□		●	■	□		■			■	■	●	
Chloroform	■	■	■	■	●	■	●	■	■		■		■	■	■	●	
Chromic acid	●	■	◆	◆	●	◆			◆		■		■	◆	■	●	
Citric acid	●	●	●	●	●	●		●	●				●	●	●		
Creosote		●	■	■	●	●	●	■	□		●		◆	■	■		
Decalin		■	■	■	●	●		■	■					■	■		
Dibenzyl ether		■	□	□	■			■	■				□		■		
Dibutyl phtalate		■	◆	□	◆	◆		■	■		■		◆	□	■	●	■
Dimethyl formamide		□	□	●	■	■	●	■	◆		■		■	□	■	●	
Ethane		●	■	■	●	◆		■	□		●		◆	■	■		
Ethanol		◆	●	●	◆	●	●	●	●		■		■	□	●		□
Ethyl chloride		●	■	◆	●	●		■	■		◆		□	■	■		■
Ethyl ether		◆	◆	◆	■	◆		■	■	◆	■		□	■	■	●	□
Ethylene chloride		■	■	■	□	□		■	■		■		■	■	■		
Ethylene glycol	●	■	◆	◆	■	■		■	■		■		■	■	■	●	●
Formaldehyde	●	◆	□	□	■	■	●	□	◆		■		■	□	◆	●	
Freon 12		□	◆	◆	●	◆	□	□	●				●	■	●		□
Freon 22		■	◆	◆	■	■		●	●		□		■	■	●		■

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■ = *Poor*
Blank = No information

	Aflas ®	*Buna-n (nitrile)*	*Butyl*	*EPDM*	*Fluorocarbon*	*Fluorosilicone*	*Kalrez ®*	*Natural rubber*	*Neoprene*	*Nitrile, hydrogenated*	*Polyakrylate*	*Polyurethane, cast*	*Polyurethane, millable*	*Silicone*	*Styrene butadiene*	*Teflon ®, virgin*	*Vamac*
Glucose		●	●	●	●	●		●	●				■	●	●		
Glycerine		●	●	●	●	●		●	●		■		■	●	●		
Heptane	◆	●	■	■	●	◆		■	□		●		□	■	■		
Hexane	□	●	■	■	●	◆		■	□		●		□	■	■	●	
Hydraulic oil (petroleum based)		●	■	■	●	●		■	□		●		●	□	■		
Hydrochloric acid	●	◆	●	●	●	□	●		□		■		■	◆	□	●	
Hydrogen gas		●	●	●	●	◆		□	●		□		●	◆	●		
Hydrogen peroxide	●	□	●	●	●	●		□	●		■			●	□	●	
Iso octane	□	●	■	■	●	●		■	□	●	●		□	■	■		
Isopropanol		□	●	●	●	□		●	□		■		■	●	□		
Kerosene	□	●	■	■	●	●	●	■	□		●		●	■	■		□
Methane		●	■	■	●	◆		■	□		●		◆	■	■		
Methanol		●	●	●	■	●	●	●	●		■		■	●	●	●	●
Methyl alcohol	●	●	●	●	■	●		●	●	●	■		■	●	●		●
Methyl chloride		■	◆	◆	●	□		■	■		■		■	■	■		
Methyl ethyl ketone	■	■	●	●	■	■	●	■	■	■	■		■	■	■	●	■
Methylene chloride		■	■	■	□	□	●	■	■		■		■	■	■		■
Naphtha	●	□	■	■	●	□		■	■		□		□	■	■		
Nitric acid	□			■	□		●									●	■
Nitrobenzene	●	■	●	●	□	■	●	■	■		■		■	■	■	●	
Nitrogen		●	●	●	●	●		●	●		●		●	●	●		
Oleum (fuming sulfuric acid)		■	■	■	●			■	■		■		■	■	■		
Oxalic acid		□	●	●	●	●		□	□					□	□		
Oxygen (cold)		□	●	●	●	●		□	●		□		●	●	□		
Oxygen, 93-204 °C		■	■	■	□	■		■	■		■		■	●	■		
Phenol	●	■	■	■	●	□	●	■	■		■		■	■	■	●	
Phosphoric acid		□	●	●	●	◆	●		□		□		■	◆	●	●	
Potassium nitrate	●	●	●	●	●	●		●	●		●		●	●	●		
Propane		●	■	■	●	◆		■	□		●		◆	■	■		
Silicone oil		●	●	●	●	◆		●	●		●		●	◆	●		
Sodium carbonate	●	●	●	●	●	●		●	●					●	●		
Sodium chloride	●	●	●	●	●			●	●	●			●	●	●		●
Sodium hydroxide	●	□	●	●	□	□	●	●	□		■		□	●	□	●	
Steam, below 176 °C	●	■	□	●	■	■	●	■	■	□	■		■	◆	■		●
Stearic acid	●	□	□	□				□	□					□	□		
Sulfuric acid (concentrated)	●	■	■	◆	□	■	●		■		■		■	■	■	●	■
Tetrachlorethane		■	■	■	●	□		■	■		■		■		■		
Tetralin		■	■	■	●	●		■	■					■	■		
Toluene	■	■	■	■	●	□	●	■	■	◆	■		■	■	■		■
Triethanol amine		◆	□	□	■	■		□	□		■		■		□		
Turpentine	◆	●		■	●	●			■		□		□	■	■		◆
Water	●	●	●	●	□	●	●	●	□		■		■	●	●	●	●
Xylene	◆	■	■	■	●	●	●	■	■		■		■	■	■	●	■

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