



TECHNICAL GUIDE

O-Ring & Seal Chemical Compatibility Guide

Chemical resistance and material-selection guidance for NBR, HNBR, EPDM, FKM, Silicone, FFKM and PTFE O-rings, gaskets and sealing components.

NBR / HNBR

Oils & Hydraulics

EPDM

Water / Steam

FKM / FFKM

Fuels / Chemicals

Silicone /

PTFE

Specialist Media

Purpose of this guide

- Screen elastomer families against common oils, fuels, acids, alkalis and hygienic media.
- Understand what the A–D rating system does and does not confirm.
- Compare NBR, HNBR, EPDM, FKM, Silicone, FFKM and PTFE side by side.
- Identify the information needed to select and specify the right compound.

1 HOW TO USE THIS GUIDE

Screening tool, not a final specification

Chemical compatibility charts are screening tools, not final specifications. The resistance of a seal depends on the exact elastomer compound, chemical concentration, temperature, exposure time, pressure, seal geometry and whether the service is static or dynamic.

Important

A material rated suitable at room temperature can become unsuitable when temperature or concentration rises. Mixed chemicals, CIP/SIP cycles and proprietary fluids should be assessed as complete service conditions rather than as isolated ingredients.

Compatibility rating system

Rating	Interpretation
A Excellent	Generally suitable for the stated medium under typical screening conditions.
B Good	Usually suitable; some effect may occur. Confirm for demanding or dynamic service.
C Limited / Conditional	Use only after application-specific review or testing.
D Not Recommended	Significant chemical attack, swelling, hardening or loss of properties is expected.
– No rating	Insufficient generic data; do not assume compatibility.

1 HOW TO USE THIS GUIDE (CONTINUED)

What chemical attack can do to a seal

- **Swelling** — fluid absorption changes dimensions, squeeze and friction.
- **Shrinkage** — extraction of plasticisers or other ingredients can reduce interference and sealing force.
- **Softening** — loss of hardness can reduce extrusion resistance and increase wear.
- **Hardening** — chemical ageing can cause cracking and loss of elastic recovery.
- **Loss of tensile properties** — the seal may remain dimensionally intact but become mechanically weak.
- **Permeation** — small molecules can diffuse through elastomers even where visible chemical attack is limited.

Primary technical references

The generic elastomer ratings in this guide are based primarily on polymer-family screening data published in the Parker O-Ring Handbook (ORD 5700). PTFE resistance guidance is cross-checked against published fluoropolymer chemical-resistance data from Zeus. Trelleborg material literature was used as a secondary reference for material-family behaviour. Ratings have been normalised to the A–D system used throughout this guide.

2 QUICK MATERIAL SELECTOR

Quick material selector

Use this page to narrow the initial material family. Final selection should always be checked against the full media, temperature and application conditions.

Material	Often considered for	Common limitations
NBR (Nitrile)	Petroleum oils, mineral oils, many hydraulic fluids, general industrial service	Ozone/weathering, many ketones and polar solvents, strong oxidisers
HNBR	Oils and fuels with improved heat, ageing and ozone resistance vs NBR	Still not universal; strong solvents and oxidising chemicals require review
EPDM	Water, hot water, steam, dilute acids/alkalis, many polar fluids, outdoor service	Petroleum oils, hydrocarbon fuels and many mineral-oil lubricants
FKM	Hydrocarbon fuels, oils, many solvents and aggressive chemicals at elevated temperature	Hot water/steam, ketones, some amines and polar chemicals – grade dependent
Silicone (VMQ)	Wide temperature range, air, water and many clean/purity applications	Many fuels, oils and aggressive solvents; lower tear/wear capability
FFKM	Very broad chemical resistance and high-temperature capability	High cost; grade selection still matters for specific reactive media
PTFE	Exceptionally broad chemical resistance; aggressive acids, bases and solvents	Low elastic recovery; sealing design differs from conventional elastomers

Six questions to answer before selecting a compound

- Media** — What exact chemical, fluid or mixture contacts the seal?
- Concentration** — Is it dilute, concentrated, proprietary or changing through the process?
- Temperature** — What are the minimum, maximum and cleaning-cycle temperatures?
- Exposure** — Continuous immersion, intermittent contact, splash, vapour or short CIP cycle?
- Application** — Static, reciprocating, rotary, vacuum or pressure service?
- Compliance** — Are FDA, EU 1935/2004, USP Class VI, WRAS, NORSOK or other approvals required?

Selection principle

A polymer family is only the starting point. Once the family is selected, the exact compound grade should be checked for hardness, cure system, temperature range, regulatory status and any application-specific performance requirements.

3 MATERIAL PROFILES: NBR & HNBR

Material profiles: NBR & HNBR

These profiles are preliminary selection guidance. Final suitability depends on the exact compound and media.

NBR

Nitrile / Buna-N

STRENGTHS	petroleum oils, lubricants, many hydraulic fluids, general industrial sealing.
WATCH POINTS	ozone, UV/weathering, ketones, many polar solvents and strongly oxidising media.
COMPOUND EFFECT	acrylonitrile content changes the balance between fuel/oil resistance and low-temperature flexibility.

NBR is one of the most widely used O-ring elastomers because it combines useful mechanical properties, oil resistance and commercial availability. It is a common first choice for petroleum oils, mineral oils, greases and many conventional hydraulic fluids.

HNBR

Hydrogenated Nitrile

STRENGTHS	oils, fuels, lubricants, improved heat and ozone resistance compared with NBR.
TYPICAL SECTORS	automotive, industrial hydraulics, oil and gas, refrigeration and demanding fluid-power systems.
WATCH POINTS	strong solvents, aggressive oxidisers and some polar media still require compound-specific review.

NBR vs HNBR

HNBR should not be treated as simply a higher-temperature NBR. Hydrogenation changes ageing and environmental resistance, but the exact chemical response still depends on the formulation and the fluid being sealed.

3 MATERIAL PROFILES: EPDM & FKM

Material profiles: EPDM & FKM

EPDM

STRENGTHS	water, steam, weathering, ozone, many dilute acids and alkalis, hygienic processing.
TYPICAL SECTORS	food and beverage, dairy, pharmaceutical, water treatment and outdoor equipment.
MAIN LIMITATION	poor resistance to petroleum oils, hydrocarbon fuels and many mineral-oil-based lubricants.
CIP/SIP	peroxide-cured and application-specific EPDM grades are often used where repeated hot cleaning is required.

EPDM is a leading material for water, hot water, steam, outdoor exposure and many hygienic-process applications. It provides excellent resistance to ozone and weathering and performs well with many dilute acids, alkalis and polar chemicals.

FKM

Fluoroelastomer

STRENGTHS	hydrocarbon fuels, petroleum oils, many solvents and elevated-temperature chemical service.
TYPICAL SECTORS	chemical processing, aerospace, automotive, fuel systems and industrial equipment.
WATCH POINTS	standard FKM grades can be unsuitable for ketones, certain amines, hot water/steam and selected polar chemicals.
TRADEMARK NOTE	Viton™ is a Chemours trademark and is not the generic name for all FKM compounds.

3 MATERIAL PROFILES: SILICONE, FFKM & PTFE

Material profiles: Silicone, FFKM & PTFE

Silicone

VMQ

Silicone is valued primarily for its broad temperature capability, low-temperature flexibility and availability in clean or regulated formulations. Chemically, it is less universally resistant than FKM, FFKM or PTFE and should be assessed carefully with fuels, oils and solvents.

FFKM

Perfluoroelastomer

STRENGTHS	aggressive acids, bases, solvents, hydrocarbons and many complex process chemicals – grade dependent.
TYPICAL SECTORS	semiconductor, pharmaceutical, chemical processing, oil and gas and high-value critical equipment.
IMPORTANT	FFKM is a family of compounds, not one universal material. Grade selection remains essential.

PTFE

Fluoropolymer

STRENGTHS	exceptionally broad resistance to acids, bases, solvents and aggressive process chemicals.
DESIGN NOTE	PTFE has little elastic recovery compared with rubber and is not always a direct replacement for an elastomeric O-ring.
KNOWN EXCEPTIONS	certain molten alkali metals and rare highly reactive fluorinated media can attack fluoropolymers under severe conditions.

4 FOOD, BEVERAGE & CIP MEDIA

Food, beverage & CIP media — quick guide

This table highlights common media encountered in hygienic processing. Ratings are screening guidance only; cleaning concentration, time and temperature can change the practical result.

Chemical / Media	NBR	EPDM	FKM	Silicone	FFKM	PTFE
Beer	A	A	A	A	A	A
Citric acid	A	A	A	A	A	A
DI water	B	A	B	B	A	A
Drinking water	A	A	A	A	A	A
Glycerine / glycerol	A	A	A	A	A	A
Hydrogen peroxide	B	A	A	A	A	A
Lactic acid, cold	A	A	A	A	A	A
Milk	A	A	A	A	A	A
Peracetic acid	C	A	C	B	A	A
Sodium hydroxide, 3 molar	B	A	B	A	A	A
Sodium hypochlorite	B	A	A	B	A	A
Steam, below 204°C / 400°F	D	A	D	C	A	A
Water	A	A	B	A	A	A

Hygienic selection note

A compatibility rating does not confirm food-contact compliance. FDA, EU 1935/2004, USP Class VI and other regulatory requirements apply to the specific compound formulation, not merely to the polymer family.

5 OILS, FUELS & SOLVENTS

Oils, fuels & solvents — quick guide

Chemical / Media	NBR	HNBR	EPDM	FKM	FFKM	PTFE
Acetone	D	D	A	D	A	A
Benzene	D	D	D	A	A	A
Diesel oil	A	A	D	A	A	A
Ethyl acetate	D	D	B	D	A	A
Ethanol / ethyl alcohol	C	C	A	C	A	A
Gasoline / petrol	A	A	D	A	A	A
Hydraulic oil, petroleum base	A	A	D	A	A	A
Isopropyl alcohol / IPA	B	B	A	A	A	A
Kerosene	A	A	D	A	A	A
Methanol	D	D	A	D	A	A
Methyl ethyl ketone / MEK	D	D	A	D	A	A
Mineral oils	A	A	C	A	A	A
Toluene	D	D	D	A	A	A
Vegetable oil	A	A	C	A	A	A
Xylene	D	D	D	A	A	A

Fuel-service note

Commercial fuels can contain alcohols, oxygenates, biodiesel components and additives that materially change elastomer compatibility. Treat the exact fuel specification as the media, not the generic word “gasoline” or “diesel”.

6 ACIDS, ALKALIS & OXIDISERS

Acids, alkalis & oxidisers — quick guide

Chemical / Media	NBR	EPDM	FKM	Silicone	FFKM	PTFE
Acetic acid, 5%	B	A	A	A	A	A
Acetic acid, glacial	B	A	B	A	A	A
Ammonia, anhydrous	B	A	D	B	B	A
Chlorine, wet	—	—	—	—	B	A
Hydrogen peroxide, 90%	D	C	A	B	A	A
Hydrochloric acid, 37% cold	D	C	A	—	A	A
Hydrochloric acid, 37% hot	D	C	A	—	A	A
Nitric acid, 0-50%	D	B	A	—	A	A
Peracetic acid	C	A	C	B	A	A
Phosphoric acid, concentrated	B	A	A	C	A	A
Potassium hydroxide, 50%	B	A	D	C	A	A
Sodium hydroxide, 3 molar	B	A	B	A	A	A
Sodium hypochlorite	B	A	A	B	A	A
Sulfuric acid, concentrated	—	C	A	—	A	A

Concentration and temperature matter

Strong acids, caustics and oxidisers can produce very different results at 20°C compared with hot process or cleaning conditions. Use grade-specific data for concentrated or elevated-temperature service.

7 CHEMICAL COMPATIBILITY MATRIX

Chemical compatibility matrix — common media

Generic polymer-family screening ratings. **A** Excellent **B** Good **C** Limited/Conditional **D** Not Recommended — No generic rating. Exact compounds may differ.

Chemical / Media	NBR	HNBR	EPDM	FKM	Silicone	FFKM	PTFE
Acetic acid, 5%	B	B	A	A	A	A	A
Acetic acid, glacial	B	B	A	B	A	A	A
Acetone	D	D	A	D	D	A	A
Ammonia, anhydrous	B	B	A	D	B	B	A
Beer	A	A	A	A	A	A	A
Benzene	D	D	D	A	D	A	A
Brine / seawater	A	A	A	A	—	A	A
Citric acid	A	A	A	A	A	A	A
Chlorine, dry	B	B	D	A	—	A	A
Chlorine, wet	—	—	—	—	—	B	A
Diesel oil	A	A	D	A	D	A	A
DI water	B	—	A	B	B	A	A
Drinking water	A	A	A	A	A	A	A
Ethyl acetate	D	D	B	D	B	A	A
Ethanol / ethyl alcohol	C	C	A	C	B	A	A
Ethylene glycol	A	A	A	A	A	A	A
Formaldehyde	C	C	B	D	B	A	A

7 CHEMICAL COMPATIBILITY MATRIX (CONTINUED)

Chemical compatibility matrix — common media

Chemical / Media	NBR	HNBR	EPDM	FKM	Silicone	FFKM	PTFE
Gasoline / petrol	A	A	D	A	D	A	A
Glycerine / glycerol	A	A	A	A	A	A	A
Hydraulic oil, petroleum base	A	A	D	A	B	A	A
Hydrogen peroxide	B	B	A	A	A	A	A
Hydrogen peroxide, 90%	D	D	C	A	B	A	A
Hydrochloric acid, 37% cold	D	—	C	A	—	A	A
Hydrochloric acid, 37% hot	D	—	C	A	—	A	A
Isopropyl alcohol / IPA	B	B	A	A	A	A	A
Kerosene	A	A	D	A	D	A	A
Lactic acid, cold	A	A	A	A	A	A	A
Lactic acid, hot	D	D	D	A	B	A	A
Methanol	D	D	A	D	A	A	A
Methyl ethyl ketone / MEK	D	D	A	D	D	A	A
Milk	A	A	A	A	A	A	A
Mineral oils	A	A	C	A	B	A	A
Nitric acid, 0-50%	D	—	B	A	—	A	A
Nitric acid, 3 molar to 70°C	D	D	B	C	D	B	A

7 CHEMICAL COMPATIBILITY MATRIX (CONTINUED)

Chemical compatibility matrix — common media

Chemical / Media	NBR	HNBR	EPDM	FKM	Silicone	FFKM	PTFE
Ozone	D	B	A	A	A	A	A
Peracetic acid	C	C	A	C	B	A	A
Phosphoric acid, 20%	—	—	—	—	—	A	A
Phosphoric acid, concentrated	B	B	A	A	C	A	A
Potassium hydroxide, 50%	B	B	A	D	C	A	A
Propylene glycol	C	C	A	C	B	A	A
Sodium carbonate / soda ash	A	A	A	A	A	A	A
Sodium hydroxide, 3 molar	B	B	A	B	A	A	A
Sodium hypochlorite	B	B	A	A	B	A	A
Steam, below 204°C / 400°F	D	D	A	D	C	A	A
Sulfuric acid, 3 molar to 70°C	B	B	A	A	A	A	A
Sulfuric acid, concentrated	—	—	C	A	—	A	A
Toluene	D	D	D	A	D	A	A
Vegetable oil	A	A	C	A	A	A	A
Water	A	B	A	B	A	A	A
Xylene	D	D	D	A	D	A	A

PTFE ratings are general chemical-resistance guidance; PTFE sealing suitability also depends on pressure, creep/cold flow, seal design and temperature.

8 SELECTING THE RIGHT MATERIAL

Selecting the right material for your application

Compatibility data is most useful when combined with a complete application description. The same chemical can produce different results depending on temperature, concentration, pressure, exposure duration and seal movement.

Information to provide for material selection

Seal type and dimensions	O-ring, hygienic gasket, custom moulded part, valve seal, diaphragm or other geometry.
Media	exact chemical name, trade name, mixture or process stream.
Concentration	including concentration changes during cleaning or production.
Temperature	minimum, maximum and intermittent/cleaning-cycle peaks.
Pressure / vacuum	normal and upset conditions.
Service type	static, reciprocating, rotary, oscillating or repeated assembly.
Regulatory requirements	FDA, EU 1935/2004, USP Class VI, WRAS, NORSOK, aerospace or other standards.
Required documentation	material certificates, declarations, traceability or technical data sheets.

When to test

Application testing is strongly recommended where the service involves mixed or proprietary chemicals, elevated temperature, high concentration, dynamic motion, critical containment, long service intervals or a material rating close to the acceptance boundary. Immersion tests can be used to compare volume swell, hardness and physical-property changes, but the final seal should also be evaluated under realistic mechanical conditions where possible.

Need help selecting a compound?

Send International Seal the media, concentration, temperature range, pressure, seal type and required compliance. We can help narrow the material family and identify suitable compound options for technical review.

9 TECHNICAL NOTES & DISCLAIMER

Important technical notes & disclaimer

This guide is intended for preliminary material selection and general technical reference. It does not constitute a guarantee of seal life, a product specification, a certificate of conformity or a substitute for application testing.

- **Compound formulation matters** — fillers, plasticisers, cure systems, fluorine content and other formulation details can materially change chemical resistance.
- **Temperature changes compatibility** — chemical attack generally accelerates as temperature increases.
- **Concentration matters** — dilute and concentrated forms of the same chemical can produce different results.
- **Mixtures can behave differently** — a multi-component process fluid cannot always be predicted from the individual ingredients.
- **Dynamic seals are less forgiving** — swelling, softening and friction changes may become unacceptable sooner than in static service.
- **Regulatory compliance is separate** — chemical resistance does not automatically mean a compound is FDA, EU 1935/2004, USP Class VI or otherwise approved.
- **Oxygen and other hazardous service** — chemical compatibility alone is not sufficient for oxygen, explosive, toxic or other safety-critical media. Cleanliness, ignition risk, decompression and applicable standards must also be considered.

Reference sources

Reference	Use in this guide
Parker O-Ring Handbook, ORD 5700	Compatibility Tables for Gases, Fluids and Solids; polymer-family material guidance.
Trelleborg Sealing Solutions — Chemical Compatibility Guide	Secondary reference for elastomer family behaviour and application limitations.
Zeus — Chemical Resistance Charts	PTFE / fluoropolymer chemical-resistance guidance and known exceptions.

Source data is owned by the respective publishers. International Seal has normalised general screening ratings into a consistent A–D format for easier comparison. Always consult the current technical data for the exact compound being specified.

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