

Seal Material Selection Guide

Twelve compounds, what each one is chosen for and where each one fails.
Written for buyers and design engineers.

How to Choose a Rubber Seal Material in Six Questions

Six questions decide almost every seal material choice. Answer them before you ask for a price, and the quotation you get back will be worth comparing.

What Fluid Does the Seal Actually Touch

The primary medium is usually known. What sinks seals is the secondary exposure nobody mentions: the cleaning agent, the assembly lubricant, the coolant that occasionally overflows. NBR handles oils and fuels well and is the sensible default for hydrocarbon service. EPDM is excellent in water, steam and brake fluid and poor in mineral oil, which is exactly the confusion that produces swollen seals. FKM covers petroleum products, hydraulic fluids and acidic compounds. FFKM goes further, into chemistry that defeats FKM. List every fluid, not just the one on the drawing.

How Hot and How Cold Does It Get

Buyers quote continuous temperature and forget the two extremes that matter. The peak decides whether the compound survives at all, and the cold start decides whether it is still elastic enough to seal when the machine wakes up. HNBR is what we reach for in cold medium sealing, including power steering pipes and automotive oil seals. Silicone and FVMQ hold flexibility across a wide range. Give us continuous, peak and minimum, and the shortlist usually writes itself.

Does the Seal Move

A static face seal and a reciprocating rod seal are different engineering problems that happen to share a material list. Movement brings friction, heat and abrasion, and it usually changes the profile as well as the compound. Y seals and Y O-rings exist because a plain O-ring is not the right answer for every dynamic duty, and they come in hole and shaft variants for a reason.

What Pressure and What Gap

Pressure alone is not the question. Pressure combined with extrusion gap is. A compound that is perfectly adequate at low pressure will extrude into the clearance at high pressure and shear off, and the failure looks like a material fault when it is a design one. Tell us the pressure and the hardware clearance together.

Is the Size Standard

This is a commercial question disguised as a technical one. If the size is in the AS568 series, no new tooling is needed and lead time drops, because we hold the complete AS568 mould set. If it is not, the honest options are to tool it properly or to redesign the groove around a standard size. Substituting the nearest stock size is the option that comes back as a leak.

What Is the Real Cost of Failure

The last question sets the budget for the first five. A seal in an accessible fitting on a bench machine can be a cheap compound replaced often. The same seal inside a process chamber or a sealed gearbox is worth a compound that costs many times more, because the replacement cost is measured in downtime and contamination rather than in the price of the ring. This is why we will sometimes tell a customer that FKM is enough and FFKM is not worth it, and sometimes the reverse.

Quick Answers

- Can I just send you the old seal? Yes, and it helps. We can measure the part, though identifying an unknown compound by eye is not possible, so tell us the application as well.
- Which compounds do you hold formula experience in? FKM, FFKM, SIR, EPDM, NBR, SBR, FVMQ, AEM/ACM, HNBR, CR, NR and CSM.
- Is a harder seal always better? No. Hardness is chosen against pressure, gap and movement. A harder compound resists extrusion but seals less readily at low pressure.

EPDM and NBR Where Each One Belongs and Where It Fails

These two compounds cover an enormous share of industrial sealing between them, and they fail in each other's territory. Getting the boundary right removes most avoidable seal problems.

EPDM Belongs in Water Weather and Heat

EPDM offers good heat, ozone and weather resistance, which is why it is used so widely in automotive, electrical and electronic products, wires and cables, high voltage and ultra high voltage insulation, sports equipment, daily necessities and mechanised industrial equipment. Heating systems, water systems, automotive brake circuits and refrigeration units are its natural home, and food grade EPDM extends it into food processing.

EPDM Fails in Mineral Oil

The single most common EPDM mistake is putting it in contact with mineral oil or fuel. It is not marginal there, it is wrong, and the seal swells. If there is any hydrocarbon in the circuit, EPDM is off the list regardless of how well it suits the temperature.

NBR Belongs Where There Is Oil

NBR is chosen for its resistance to oils, fuels and other hydrocarbons, which makes it the workhorse for automotive, aerospace, wire and cable and home appliance applications. Where a circuit handles oil or fuel at moderate temperature, NBR gives the best balance of cost against performance in our range.

NBR Fails in Weather and Ozone Exposure

Outdoors, in ozone rich environments or under prolonged weather exposure, NBR is the wrong choice and EPDM is the right one. The two failure modes are mirror images, which is why a plant that standardises on one compound for everything eventually sees failures in both directions.

What to Do When You Need Both

Most real machines contain both an oil circuit and a water or weather exposed circuit, which means a mixed seal schedule is normal rather than a sign of poor standardisation. Consolidating that mixed schedule with one supplier who holds both compounds is the practical answer, and it is why buyers bring twelve compound schedules to us on a single purchase order.

Quick Answers

- Can EPDM be used with brake fluid? Yes, EPDM is used in automotive brake systems. It is mineral oil and fuel that rule it out.
- Is NBR suitable for outdoor equipment? Not where weather and ozone exposure are significant. EPDM is the better choice there.
- Do you supply food grade EPDM? Tell us the requirement and the standard you need to meet, and we will confirm what we can supply before you commit.

FFKM or FKM Which One Your Application Actually Needs

FFKM is not simply a better FKM. It is a different commercial decision, and specifying it by reflex wastes money as reliably as under specifying wastes uptime.

What FKM Gives You

FKM is a fluoroelastomer with strong resistance across a wide range of chemicals and temperatures. In practice it covers petroleum products, hydraulic fluids and acidic compounds, which is most of what an industrial hydraulic or fuel system will present. For the large majority of demanding applications, FKM is the correct answer and the conversation should stop there.

What FFKM Adds

FFKM is a perfluoroelastomer, and its resistance is close to universal across aggressive chemicals, solvents and corrosive agents while holding integrity at elevated temperature. It is used where the chemistry defeats FKM outright or where thermal cycling is severe enough to matter. Semiconductor manufacturing, chemical processing, petrochemical service, aerospace, biotechnology and battery and laser plating equipment are the places it earns its cost.

The Question That Decides It

Ask what a failed seal costs. If the seal is accessible and the process tolerates a shutdown, FKM replaced on schedule is usually the cheaper total. If failure contaminates a batch, scraps a wafer lot or stops a plant, the seal price is no longer the relevant number and FFKM is the rational choice. We will say which way we read it, and we have no reason to push the expensive one.

Where They Overlap and How to Test

There is a band of applications where both will work and only service data settles it. The practical approach is to run FKM first where safety allows, record the replacement interval, and move to FFKM only if that interval is unacceptable. Ask for samples of both with the quotation rather than deciding on datasheets.

Sizes and Availability

Both compounds are available in standard AS568 sizes from our existing mould set and in custom cross sections tooled in our own mould workshop. Small quantities of FFKM are normal in the sectors that use it and we quote them rather than turning them away.

Quick Answers

- Is FFKM always better than FKM? No. It resists more chemistry, but for most industrial fluids FKM is adequate and considerably cheaper. Better means better suited, not more expensive.
- Can you supply small FFKM quantities? Yes. Small quantities of high specification compounds are normal for semiconductor and laboratory customers.
- Which industries do you supply FFKM to? Semiconductor, pharmaceutical, chemical, petroleum, automotive, laser plating, battery manufacturing and special equipment production.

Compounds We Mould

- FKM fluoroelastomer
- FFKM perfluoroelastomer
- SIR silicone
- EPDM
- NBR nitrile
- SBR
- FVMQ
- AEM/ACM
- HNBR
- CR
- NR natural rubber
- CSM

How to Ask for a Recommendation

- The medium, including cleaning agents and occasional exposure
- Continuous, peak and minimum temperature
- Pressure and the hardware extrusion gap
- Whether the seal is static or moving
- The size, the AS568 dash number or a drawing
- An annual quantity

Send it to boyce@rubber-tools.com or WhatsApp +86 159 5127 6160. Replies within 1 working day.