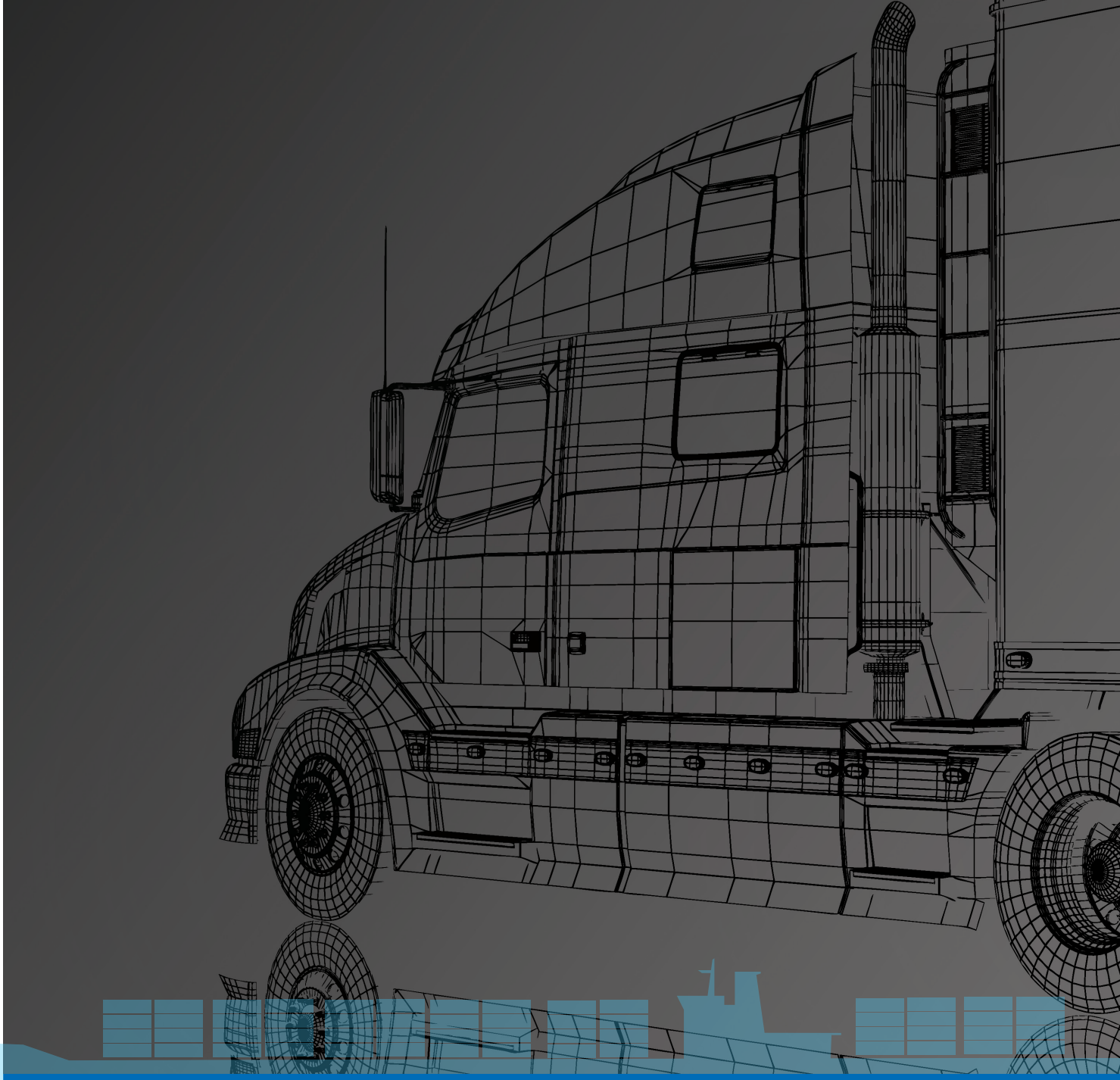


ERIKS Sealing Technology

Polymer Components for Automotive and Transportation

pioneer WESTON

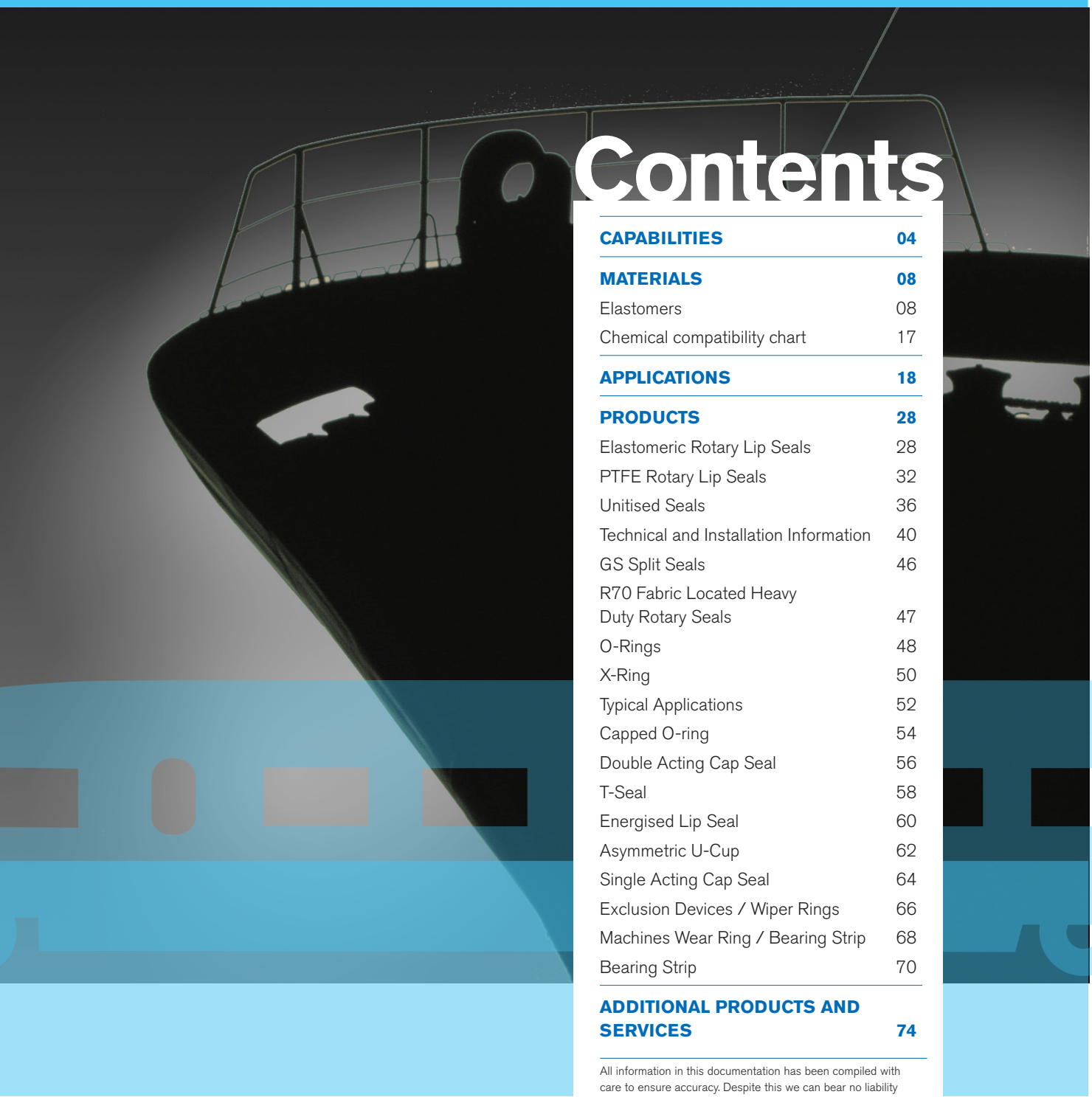
know-how makes the difference

ERIKS

> **Through rigid application of process and quality control we are able to offer our customers the consistent reliable product demanded in safety critical applications.**

Lee Murray
Operations Manager
ERIKS Sealing Technology

Unitised PTFE lip seal for high speed shaft operation and easy installation.



Contents

Leader in Sealing Technology

Quality Control and Assurance are the foundations upon which ERIKS Sealing Technology builds its offering of high-performance products into transportation applications. Pioneer Weston is the premium brand of ERIKS Sealing Technology. After more than 80 years Pioneer Weston remains at the forefront of sealing technology offering continued innovation in both material development and product design.

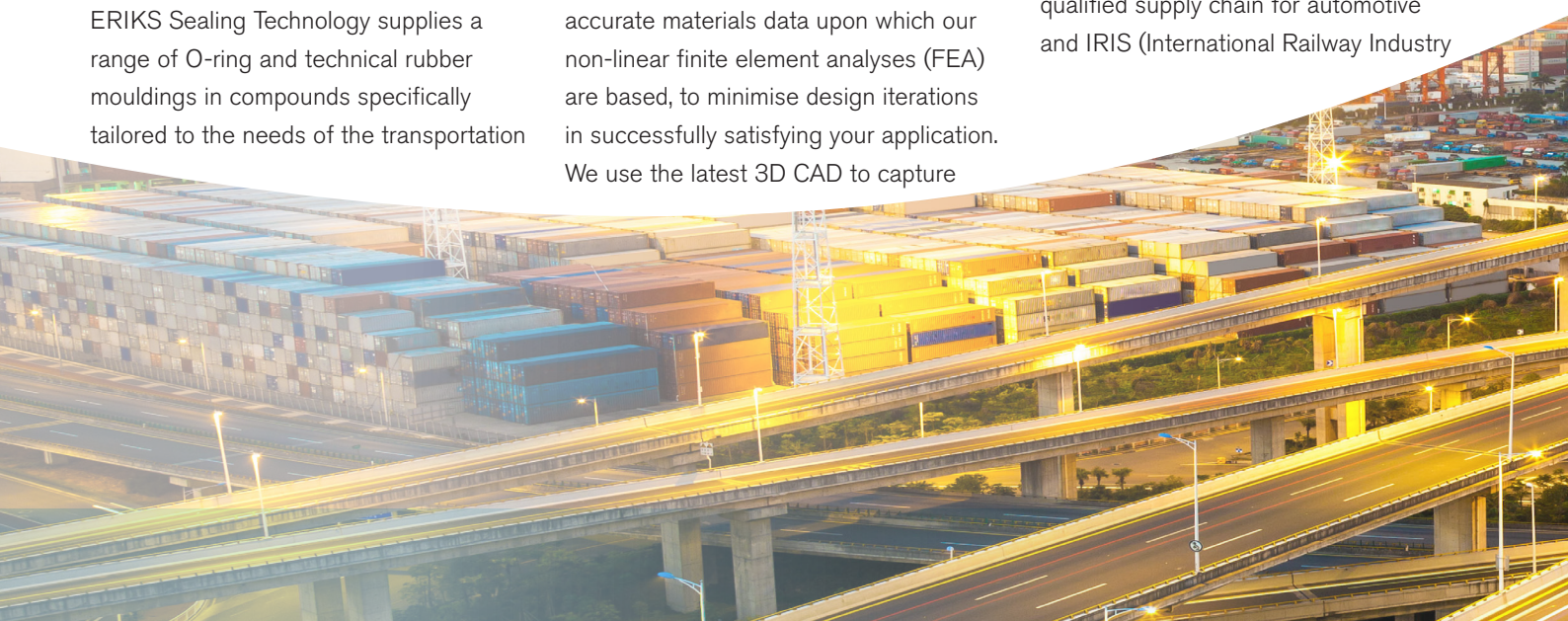
Pioneer Weston originated from the partnership of two British manufacturers, Charles Weston, a supplier of Elastomer and Leather seals into high performance industries, and the prominent Pioneer Oilseals; supplier of Static and Rotary seals into the automotive industry. This strong collaboration helped to make Pioneer Weston a global leader in both the Automotive and General Industrial markets, offering a wide range of sealing products. Whilst the product portfolio has evolved, the core principals of the business remain the same, offering engineered sealing systems that have gained an enviable reputation for quality and performance in some of the world's most demanding applications.

ERIKS Sealing Technology supplies a range of O-ring and technical rubber mouldings in compounds specifically tailored to the needs of the transportation industry. The Pioneer Weston product range consists of Elastomer and PTFE Rotary seals, and bespoke Mechanical seals. The Pioneer Weston Rotary seal style suffixes of R4, R6, R21 and R23 have become a recognised standard to engineers specifying rotary seals - a true testament to the impact the company has made on global industry.

Experienced Application Engineers draw upon in-depth technical knowledge to ensure that the optimal seal is impartially specified for your application; whether this is a standard product from our premium manufacturing facilities, or as a bespoke solution tailored to your needs. ERIKS design teams work closely with our material scientists to produce accurate materials data upon which our non-linear finite element analyses (FEA) are based, to minimise design iterations in successfully satisfying your application. We use the latest 3D CAD to capture design intent, which is verified using our contact and non-contact with coordinate measurement machine (CMM).

These products are supported by advanced technical and logistical services that form the link between our know-how and your delivery.

ERIKS Sealing Technology is a world leader in high-performance O-rings, elastomeric and polymer seals. We hold ISO 9001:2008 certification across both of the UK sealing core competence centres and throughout our distribution network for your peace of mind. Our quality management system embraces the process approach of TS16949 and we are able to draw upon TS16949 qualified supply chain for automotive and IRIS (International Railway Industry



Standard) certified suppliers for rail applications. Our Quality Control Engineers work closely with our supply chain to ensure process control and product consistency through formal PPAP (Production Part Approval Process) methodologies.

Continuity of Supply

As one of the world's largest stockholders of sealing and associated products, you are assured of the highest levels of availability to keep your plant working. We hold extensive stocks of O-rings that may be despatched same-day to meet your requirements. O-rings are available in AS568, BS1806, BS4518 JIS, DIN3771 and ISO 3601, sizes together with Hydraulic Seals, Back-up Rings, Metal Face Seals, Mechanical and Rotary Seals. Customer specific stock holding is our speciality. This maintains continuity of supply, including specific qualified products that we would not otherwise hold. Our advanced logistics software helps us optimise customer specific stock to maximise availability yet minimise your capital exposure.

Support

- Dedicated office based technical support staff and customer service
- Field based Sealing Technology Application Engineers and specialists
- Excellent technical support from skilled Research and Development engineers
- 24-hour UK call out service available

The global ERIKS group of companies are product driven industrial service providers, focussing on five core activities:

- **Sealing technology**
- **Power transmission**
- **Flow technology**
- **Industrial plastics**
- **Tools and maintenance products**

Product Design

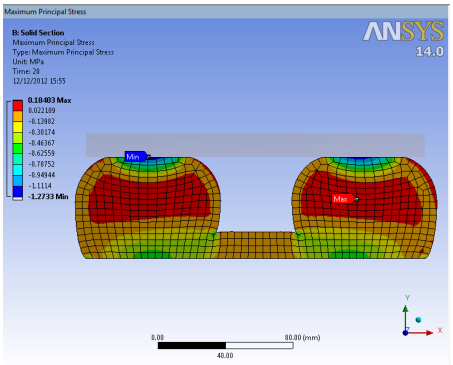
In an environment dedicated to innovation and free thought, our highly talented design team, work with the latest 3D CAD tools to capture design intent with your engineers.

This technology proves an invaluable tool in communicating and developing conceptual solutions involved in co-engineering partnerships; we can share 3D data in many standard formats including IGES and STEP.

Change control and configuration management techniques are used to ensure that the design intent is fully embodied into the finished product; with our combined visual and CMM dimensional measurement system being programmed from the original 3D CAD model.

Finite Element Analysis (FEA)

Using FEA as a mathematical technique to predict deflection strain, stress, reaction force and contact pressure based on dimensional information, physical constraints and material properties improves design integrity and speed. Our Materials Technology Centre can generate temperature specific, validated, hyper-elastic material models on which to base these analyses. FEA allows our engineers to rapidly iterate to optimal design solutions, minimising product development time and cost.

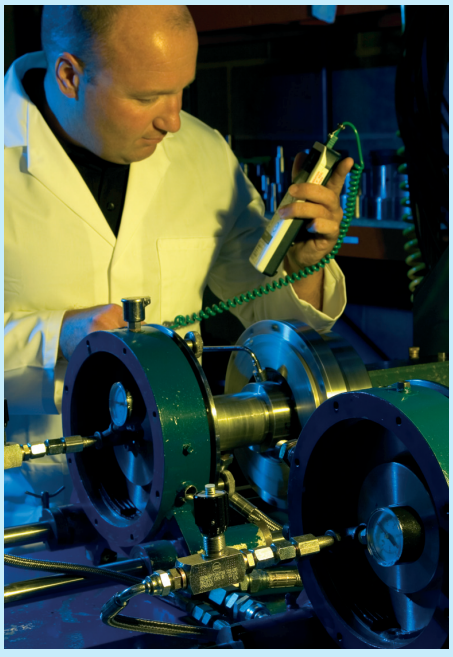


Test and Validation

We run test programmes to SAE standard specifications, our own demanding internal validation standards, customer specific requirements and special test programmes for development projects or competitor benchmarking.

Summary of standard test capability

Maximum Seal OD:	250mm
Speed:	20,000 r.p.m. (max), Cycles up to 7,000 r.p.m. (max)
Rotation:	Clockwise/Anti-clockwise
Orientation:	Shaft or housing rotation
Pressure:	0-10 bar (water, oil, air)
Temperature:	-40°C up to +200°C
Shaft Eccentricity:	Adjustable up to 1 mm
Housing Offset:	Adjustable up to 2 mm
Torque Measurement:	Max 20 Nm
Data Logging:	Speed, temperatures and pressures
Environmental:	Slurry, dust, water



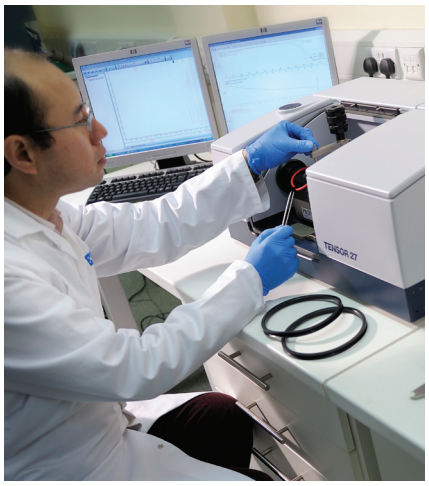
Material Technology Centre

The Material Technology Centre's principal activities are to ensure our high quality standards are maintained and to develop new compounds or technical solutions for your applications.

Situated in Warrington this facility benefits from continuous investment in technology and people and is one of the major factors in ERIKS Sealing Technology's success.

Capabilities:

- Hardness (°IRHD/Shore A)
- Compression-set
- Mechanical property testing
- Chemical and heat ageing
- Ozone resistance
- Material composition
- Dimensional measurements
- Surface defects
- Material properties at temperatures from –70°C to 300°C
- Wet bench analysis
- Extraction testing
- Failure analysis
- Hyper elastic material characterisation
- Immersion testing
- UV resistance
- DMTA – Dynamic Mechanical Thermal Analysis



- Abrasion resistance
- Compression Stress Relaxation
- Internal mixers
- Compression moulding
- 2-Roll mills

Fourier Transform Infra-red Spectroscopy (FTIR)

Molecules have specific frequencies at which they naturally rotate or vibrate.
By exposing a material sample to a spectrum of infra-red frequencies the equipment can identify which molecules are present by detecting which frequencies are absorbed. This technique is used to identify the base polymers material type in quality control and to identify thermo-chemical decomposition.

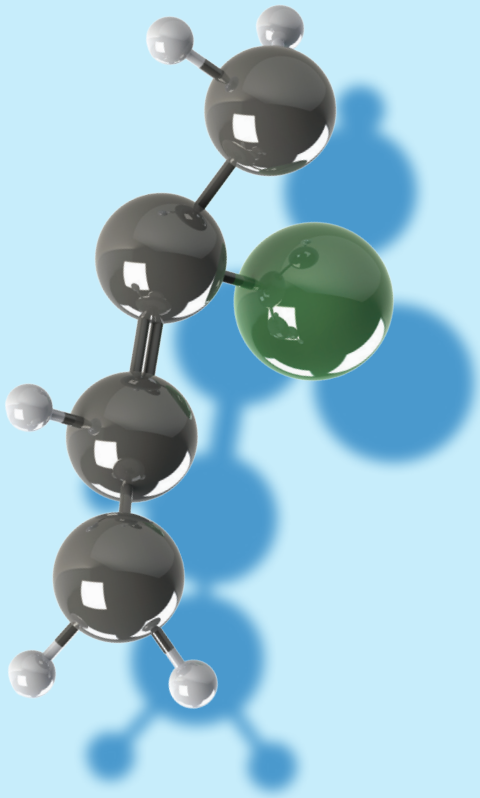
Thermo-Gravimetric Analysis (TGA)

TGA is used to identify weight loss of a compound either isothermally over time or over a ramped temperature range. The relative composition of compounds can be identified, to quantify polymer, organic and inorganic filler contents and types.

Differential Scanning Calorimetry (DSC)

DSC analysis measures changes in enthalpy (exothermic or endothermic energy changes) over time, or, with changes in temperature. DSC analysis can be used as a quality tool (residual cure), an analytical tool (failure analysis), or in development of new materials (glass transition, oxidation etc).

With modulated DSC (MDSC), the samples are subjected to a non-linear heating/cooling regime (i.e. sinusoidal). This non-linear temperature profile allows the measurement of heat-capacity effects simultaneously with the kinetic effect, as well as increasing the sensitivity of the system. With the MDSC, overlapping events can also be separated, i.e. measurement of the Tg and molecular relaxation.



Elastomers

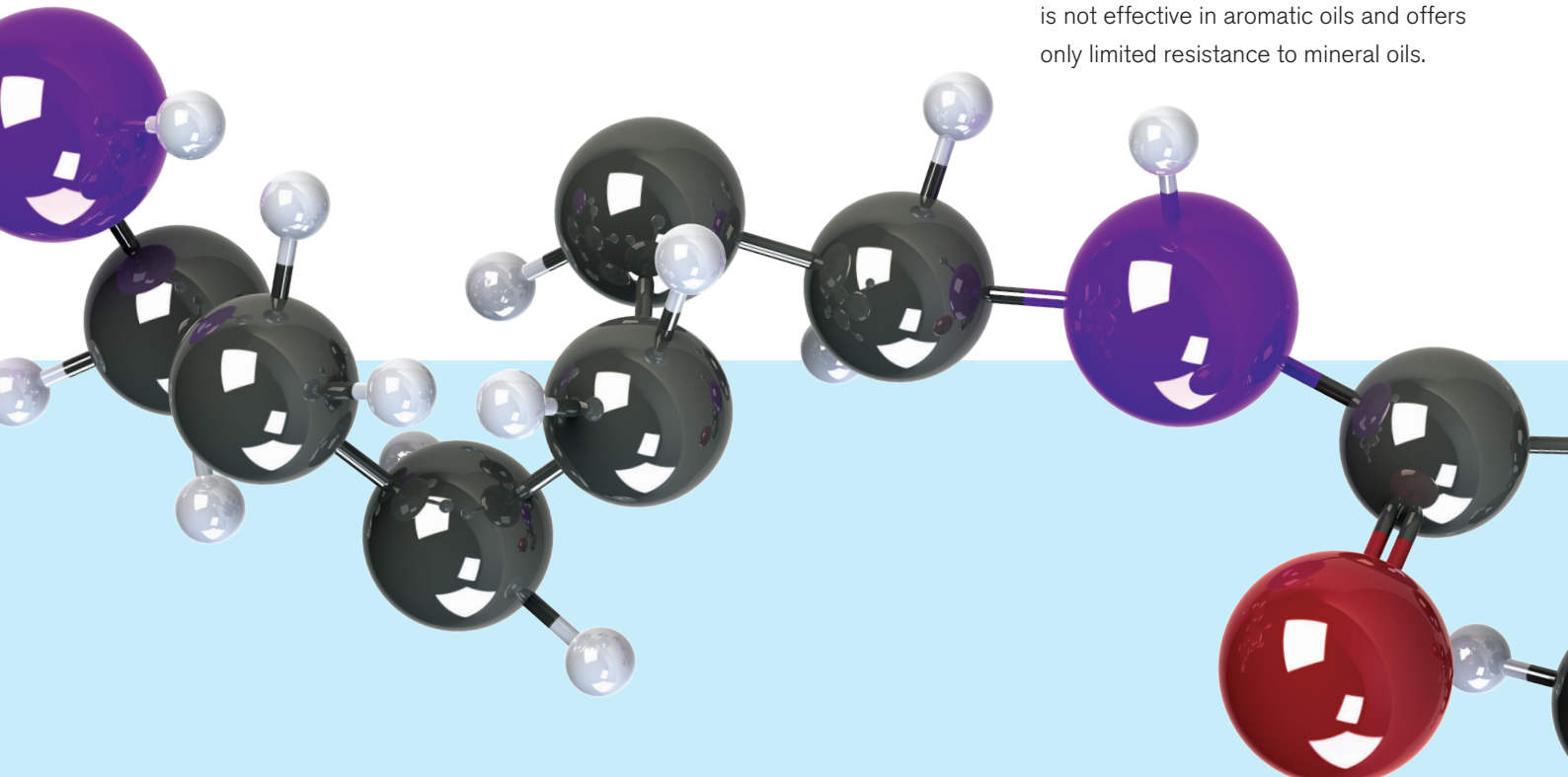
Elastomeric materials are described as having non-linear, viscoelastic behaviour, this means that they exhibit elastic recovery, time dependent behaviour and the relationship between load and deflection is not linear.

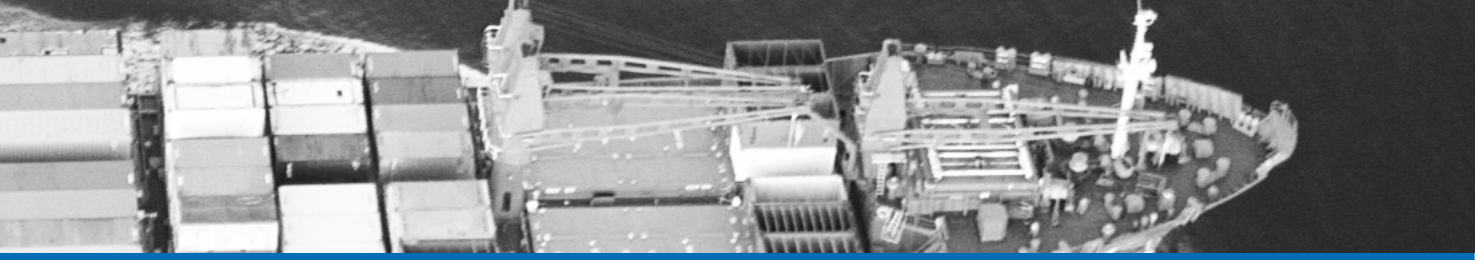
Elastomers used in sealing are often described as compounds, meaning that they are a mixture of ingredients manufactured under specific conditions. A compound typically comprises:

- Polymer backbone – a long chain of molecules made up of one or more monomeric units, this governs the basic thermal, chemical and physical properties of a compound. ISO and ASTM classifications define families of elastomer such as NBR, FKM etc.
- Cross-link – polymer chains are tied together by cross-links; short chains of molecules e.g. sulphur, to prevent chain slippage and create elastic behaviour. Different cross-link systems will fundamentally change thermo-chemical or physical properties.
- Fillers – organic or inorganic solid particles with specific shapes and chemistries that tailor physical properties such as tensile strength, hardness, elongation at break, modulus and compression-set.
- Other ingredients - used to achieve specific manufacturing, application or cost requirements.
- A typical HNBR 70 Shore A compound may have 20 ingredients and may contain only 30% polymer by weight. Therefore it is important not just to specify the family of polymer backbone and hardness, but to specify an individual compound/grade in order to achieve consistent performance.

Polychloroprene (Neoprene Rubber, CR)

Polychloroprene rubbers are homopolymers of chloroprene (chlorobutadiene), and were among the earliest synthetic rubbers used to produce seals. CR has good ageing characteristics in ozone and weather environments, along with abrasion and flex-cracking resistance. Most elastomers are either resistant to deterioration from exposure to petroleum based lubricants, or to oxygen; CR is unusual, in offering a degree of resistance to both. CR also offers resistance to refrigerants, ammonia, Freon®, silicone oils, water, ozone, vegetable oils and alcohols. This, combined with a broad temperature range and moderate cost, accounts for its desirability in many seal applications. CR is not effective in aromatic oils and offers only limited resistance to mineral oils.





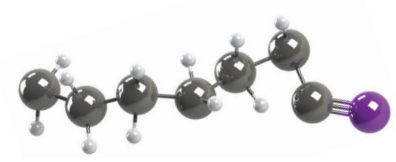
Nitrile (NBR)

Nitrile (often referred to as Buna-N) is the most commonly used elastomer in the seal industry and is a copolymer of two monomers; acrylonitrile (ACN) and butadiene. The properties of this elastomer are ruled by the ACN content which is broken down into three classifications:

High Nitrile:	**>45% ACN content**
Medium Nitrile:	**30 – 45% ACN content**
Low Nitrile:	**<30% ACN content**

The higher the ACN content, the better the elastomers resistance to hydrocarbon oils. With lower ACN content, the material offers better flexibility at low temperatures. Medium nitrile is, therefore, the most widely specified due to its good overall balance in most applications. Typically, nitrile rubber can be compounded to work over a temperature range of -35°C to +120°C and is superior to most other elastomers in regard to compression set, tear and abrasion resistance. Nitrile rubbers posses excellent resistance to oil-based fluids, vegetable oils, greases, water and air.

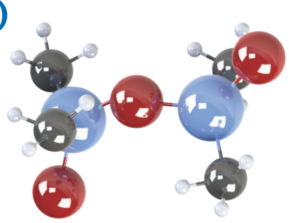
Hydrogenated Nitrile (HNBR)



The properties of Hydrogenated Nitrile Rubber (HNBR) are dependent upon the acrylonitrile content and the degree of hydrogenation of the butadiene copolymer. They have a better oil and chemical resistance than nitrile rubber and can withstand much higher temperatures. HNBR has excellent resistance to glycol based coolants, hot water and ozone. Physical properties (e.g. tensile and tear strength, elongation, abrasion resistance, compression set, etc.) are also excellent and compounds display strong dynamic behaviour at elevated temperatures.

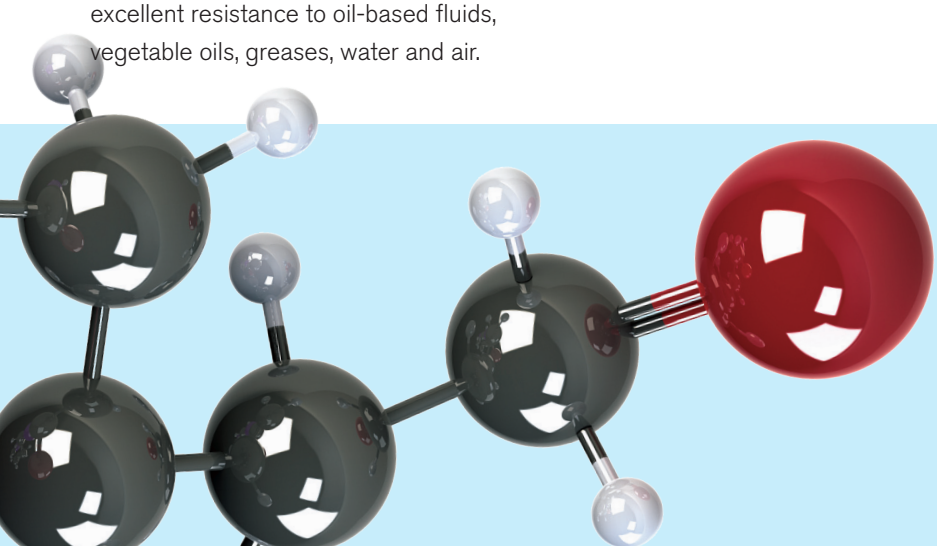
HNBR can either be cured with sulphur or peroxide, depending upon which properties are the most important. Typical applications include accumulator bladders, diaphragms, gaskets and seals. Limitations include poor electrical properties, poor flame resistance and attack by aromatic oils..

Silicone (VMQ)



Silicone elastomers are commonly used for extreme temperature ranges (-90°C to +230°C) and offer good low temperature flexibility. They also offer resistance to ultra violet radiation (UV), oxygen and ozone.

Silicone is best suited to non-dynamic applications, as this elastomer type possess relatively low tear strength and abrasion resistance, although higher strength grades are available. They are also compliant with engine and transmission oils, vegetable oils and some brake fluids.



Fluorocarbon Rubber (FKM, Viton®)

FKMs (sometimes known as FPMs in Europe) are frequently used to resist extreme temperatures and harsh chemicals. The strong carbon-fluorine bonds that make up the polymer structure provide high thermo-chemical resistance, giving excellent ageing characteristics shown by low compression set at elevated temperatures.

FKMs offer excellent resistance to mineral oils and greases, aliphatic, aromatic and some chlorinated hydrocarbons, fuels, silicone oils and greases. However FKMs show poor resistance to bases.

FKMs are available as a copolymer (two monomers), terpolymer (three monomers) or as a tetrapolymer (four monomers).

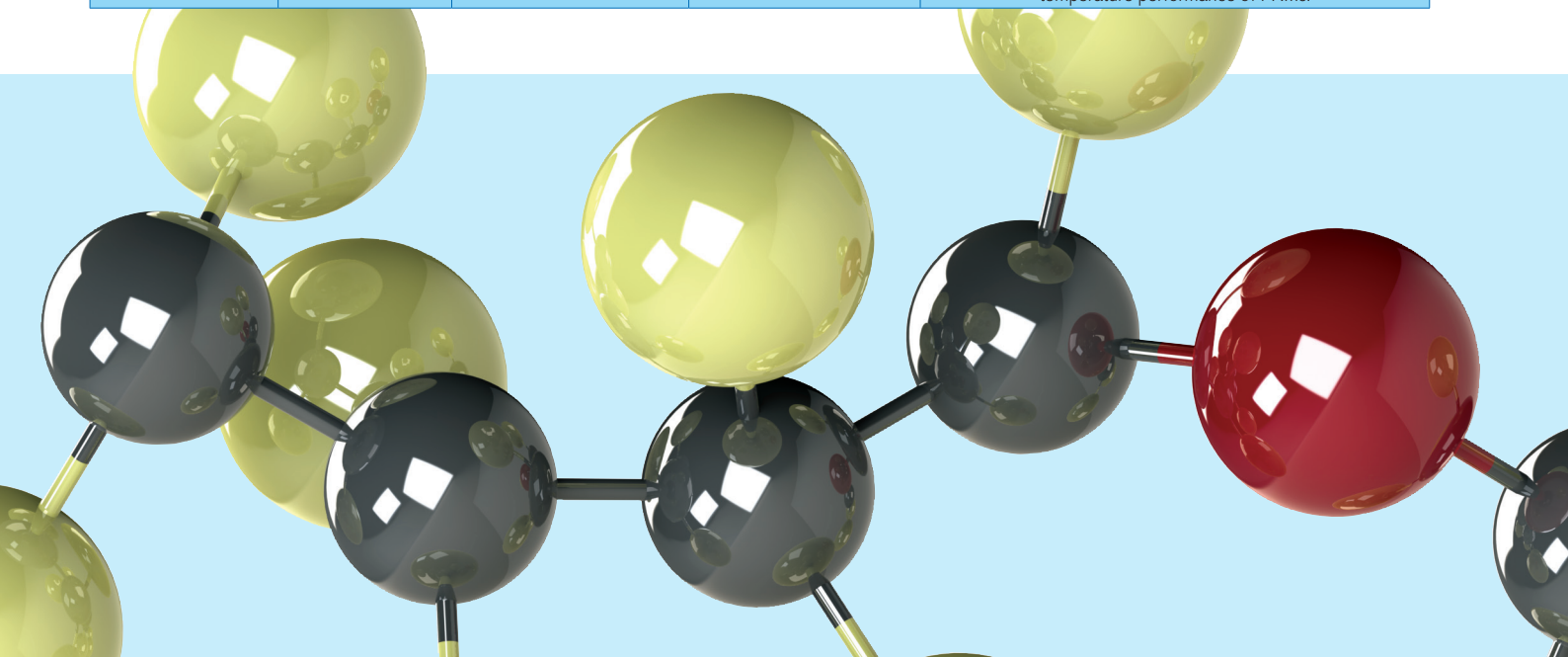
Each type determines both fluorine content and chemical structure which in turn significantly impact the chemical resistance and temperature performance of the polymer.

More recent innovations include the development of FKM materials for use in low temperature applications, where with a glass transition of -40°C, it is possible to use FKMs down to -51°C in service.

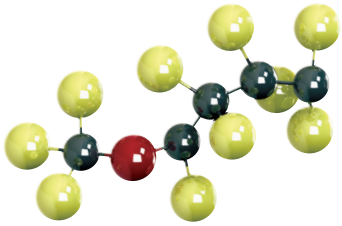
Specific grades are also available for use in biofuels, e.g. ethanol or bio-diesel.

Types of Flourocarbon Rubber

ASTM D1418 Designation	Common Name	Typical Cure system	Typical Fluorine Content	Description
Type 1	Viton® A	Bisphenol or amine	66%	General purpose with excellent mechanical properties
Type 2	Viton® B, F or GF	Bisphenol, amine or peroxide	66 - 70%	Improved fluid and oil/solvent resistance, including improved fuel resistance. Peroxide cured materials offer improvements in coolant and water resistance
Type 3	Viton® GLT	Peroxide	64 - 67%	Improved low temperature resistance but reduced chemical resistance
Type 4	Aflas®	Peroxide	55%	Excellent resistance to lubricating oils, corrosion inhibitors and coolants.
Type 5	Viton® ETP	Peroxide	67%	Speciality grade, excellent chemical resistance, including increased resistance to amines and fuel additives.
Ultra-low temp	Ultra-low temp	Peroxide	66%	Speciality polymers are available that further extend the low temperature performance of FKMs.



Perfluoroelastomers (FFKM)



Perfluoroelastomers (FFKM) have a fully fluorinated polymer backbone resulting in a fluorine content >71%. As the material is free from carbon-hydrogen bonds in the polymer chain, the FFKM materials offer the ultimate thermo-chemical resistance.

This is demonstrated by the good long-term, high-temperature, compression-set resistance. Chemical resistance is second to none, with good performance in a broad variety of harsh environments: performance fuels, MBTE, steam, solvents, hydrocarbons etc.

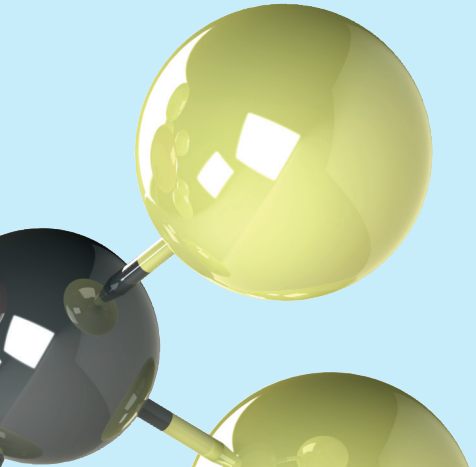
Traditionally, FFKM polymers have offered limited resistance to low temperatures.

New polymer chemistry now offers FFKM grades capable of sealing at temperatures down to -40°C.

Although all FFKM polymer backbones are fully fluorinated, the cross-linking systems used to join the polymer chains together differ significantly, resulting in varied temperature and chemical resistance.

Types of Perfluoroelastomers

Common FFKM Types		
Peroxide	240°C	Broad chemical resistance.
Triazinic	327°C	High temperature, excellent mechanical properties. Reduced chemical and steam resistance.
Modified Triazinic	275°C	Broad chemical resistance, excellent mechanical properties.
Modified Peroxide	325°C	High temperature resistance, excellent mechanical properties, reduced amine and base resistance.

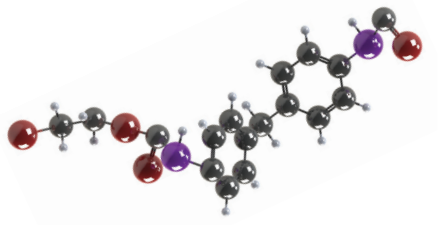


Ethylenepropylene Rubbers (EPM, EPDM)

Ethylenepropylene based rubbers are forms of non-polar synthetic rubbers. EPM (sometimes also known as EP) rubber is based on ethylene and propylene monomers, with no unsaturation (carbon-carbon double bonds) present. EPDM is also based on the same constituent monomers, however as no unsaturation is present in the backbone, it is added as a third monomer, pendent to the main chain. EPDM materials can be cured with either sulphur or peroxide; sulphur offers improved mechanical properties and peroxide enhanced heat stability. EPM rubber can only be cured using free-radicals (peroxide or radiation curing). As the polymer chains of both EPM and EPDM have completely saturated hydrocarbon backbones, excellent ozone resistance and very good resistance to heat and oxidation are achieved.

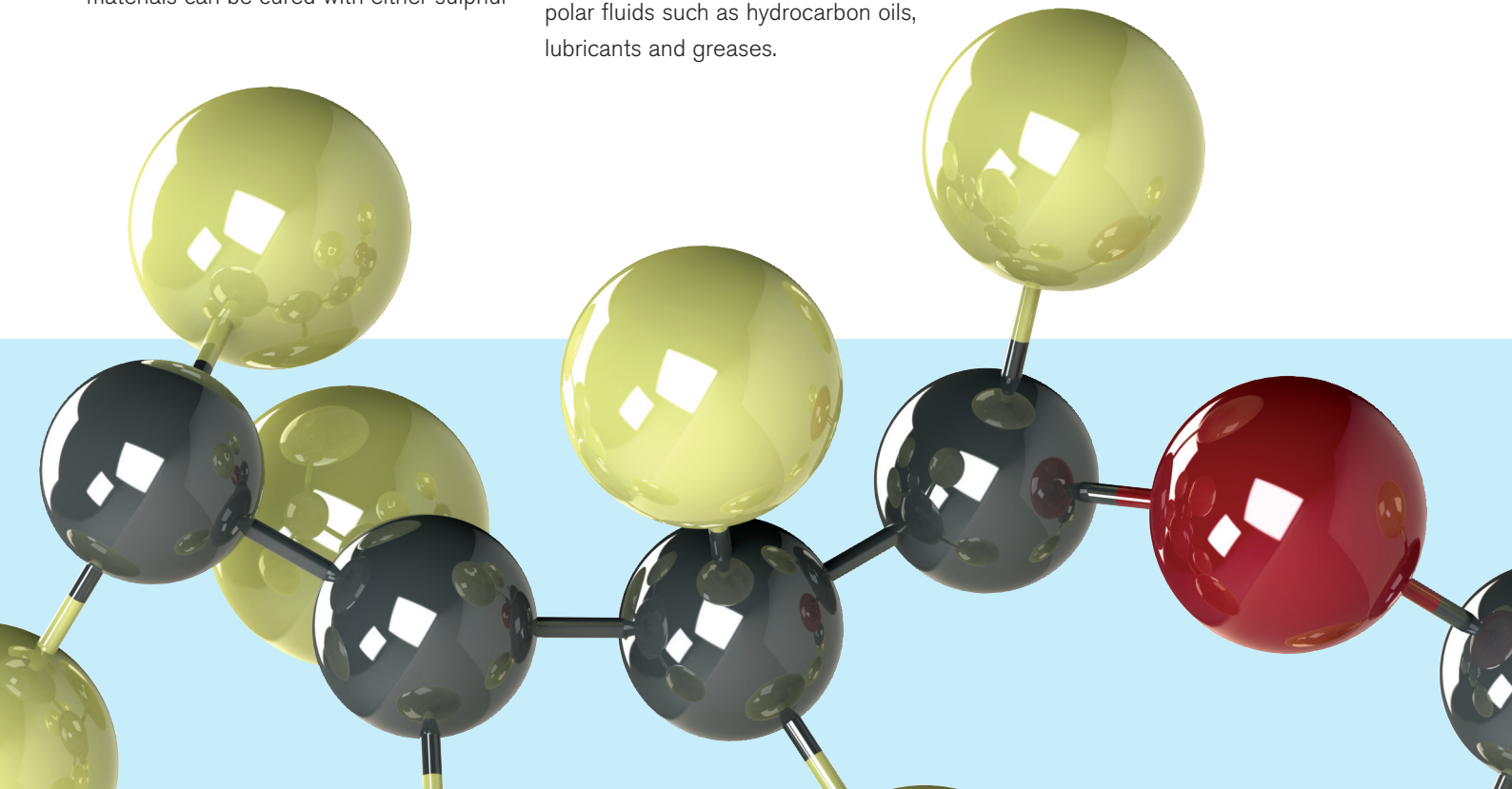
Being non-polar elastomers, EPM and EPDM offer good performance in polar fluids such as alcohols, water, steam, coolants etc., but perform badly in non-polar fluids such as hydrocarbon oils, lubricants and greases.

Polyurethane (AU, EU, PU)

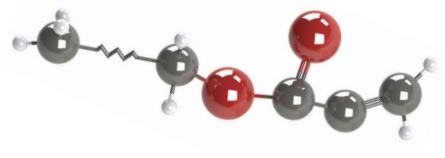


Polyurethane is a polymer formed from a chain of organic units joined by urethane links. Polyurethanes are produced by the addition reaction of a polyisocyanate with a polyalcohol (polyol) in the presence of a catalyst and other additives.

Polyurethane demonstrates excellent resistance to weathering and oxidation. They resist hydrocarbon fuels and mineral oils, however some grades degrade (hydrolyse) in hot water. Polyurethane also offers some of the best resistance to abrasion, and are therefore often specified for use in reciprocating seals.



Acrylic Elastomers (ACM, AEM Vamac®)

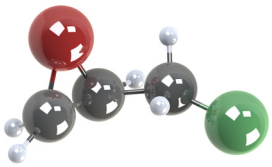


There are generally two forms of acrylic-based elastomer available: Polyacrylates (ACM) and ethylene-acrylates (AEM, Vamac®).

Polyacrylates offer good resistance to lubricating oils and high temperatures, and are commonly used where the two are found in combination. ACM elastomers show excellent resistance to engine oils (semi and fully-synthetic), petroleum based lubricants, transmission fluids, aliphatic hydrocarbons, ozone and ultraviolet radiation.

Ethylene acrylic elastomers (AEM) are terpolymers of ethylene, acrylic and a cure-site monomer, supplied by DuPont™ under the tradename of Vamac®. AEM elastomers exhibit mechanical properties similar to ACM, although they can operate over a wider temperature range than ACM and hydrogenated nitriles (HNBR).

Epichlorohydrin (CO, GCO, ECO, GECO, Hydrin®)



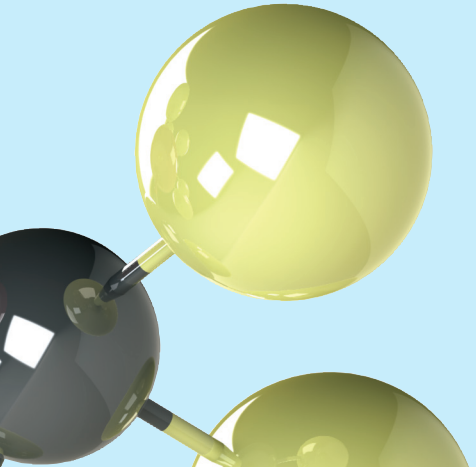
Epichlorohydrin rubber is a synthetic elastomer which The American Society for Testing and Materials (ASTM) has designated as:

- CO - Homopolymer of epichlorohydrin (ECH)
- GCO - Copolymer of epichlorohydrin/ allyl glycidyl ether (ECH/AGE)
- ECO - Copolymer of epichlorohydrin/ ethylene oxide (ECH/EO)
- GECO - Terpolymer of epichlorohydrin/ethylene oxide/allyl glycidyl ether (ECH/EO/AGE)

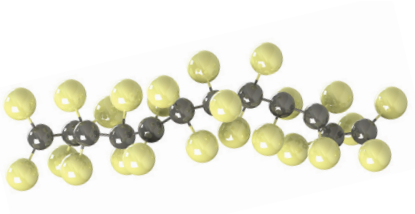
The saturated polymer chain provides excellent ozone resistance. Levels of each of the different monomers can be optimized to improve permeation, fuel and ozone resistance.

In sealing applications, epichlorohydrin rubber compounds are noted for their superior gas impermeability and physical properties over a wide temperature range while maintaining excellent resistance to petroleum oils. It has a stable cycling capability from low to high temperature. Resistance to ozone, oxidation, weathering, and sunlight are other typical ECO qualities. Service temperatures are -51°C to +150°C (-60°F to +300°F).

Epichlorohydrin compounds can also provide vibration dampening comparable to natural rubber (NR). This characteristic makes epichlorohydrin compounds a good technical candidate for suspension mounts and impact absorbers.



Polytetrafluoroethylene (PTFE)



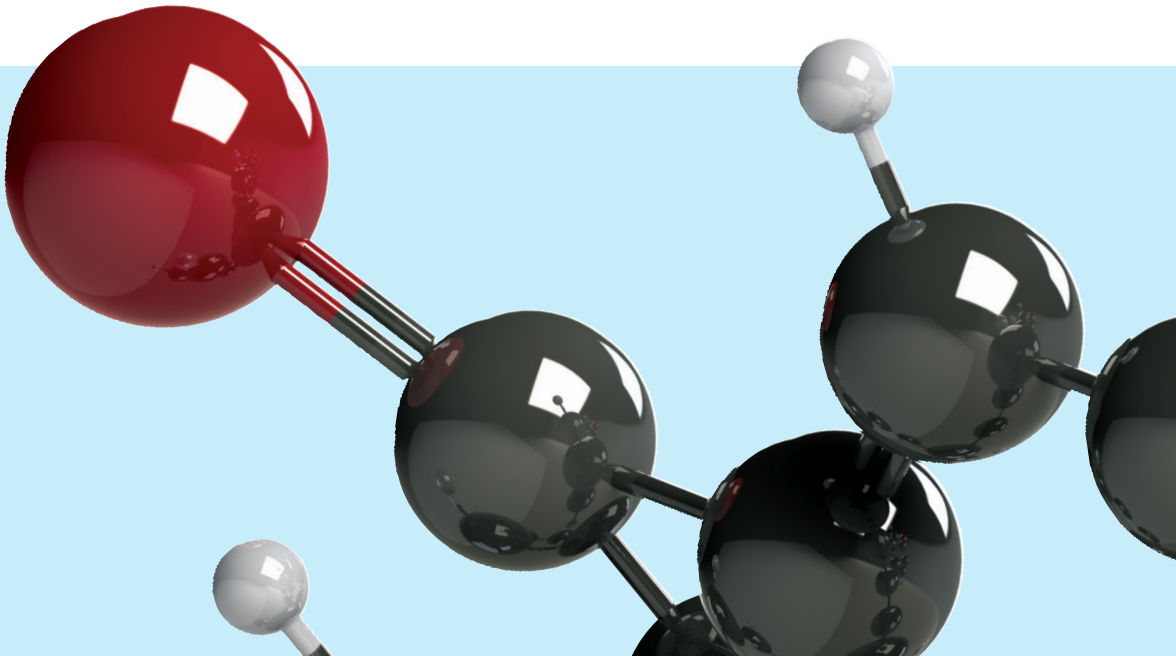
PTFE (polytetrafluoroethylene) is a synthetic, thermoplastic polymer which offers exceptional chemical resistance over a wide range of temperatures and offers extremely low levels of friction.

PTFE lacks elasticity which prevents its use as an elastomeric-type sealing ring, however it is commonly used for anti-extrusion as a back-up ring, and for non-stick requirements. Owing to its low friction and excellent chemical resistance, it is also commonly used for applications such as bearings, gears, rotary seals etc.

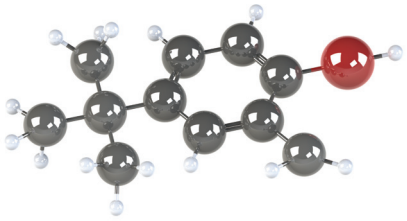
Non-filled (virgin) grades are stable up to +260°C and are quite flexible and resistant to breaking under tensile and compressive stresses. Modified backbone grades of PTFE are available which offer higher temperature (+315°C) and deformation resistance. PTFE is also available with fillers to enhance its physical characteristics.

Typical fillers include:

- Glass fillers for improved deformation and wear.
- Inorganic fillers (e.g. calcium silicate, wollastonite) are used in a similar manner to glass fillers, with reduced abrasiveness.
- Carbon-filled for considerable wear and deformation improvement, and increased thermal conductivity.
- Carbon fibre filled for increased wear resistance and use against non-hardened surfaces.
- Graphite or molybdenum disulphide (MoS_2) filled to lower the coefficient of friction.
- Bronze filled for excellent wear, deformation strength, thermal conductivity (reduced chemical resistance) .
- Polyester filled for improved high temperature and wear resistance, for applications where running surfaces are non-hardened.
- Polyphenylenesulphide (PPS) filled for improved wear extrusion and deformation resistance.
- Polyimide (PI) fillers are used to increase wear and abrasion resistance, being polymeric the abrasion of running surfaces is reduced.
- Combinations of some of the above are also often used to offer optimal performance in service.

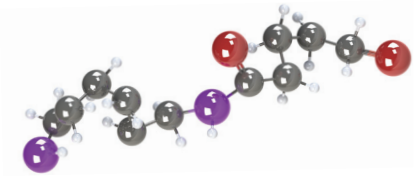


Fabric / Phenolic Resin Composites



Phenolic resins, also known as phenol formaldehyde resins (PF), are synthetic thermosetting resins created by the reaction of phenols with formaldehyde. These thermosets perform well in most engineering applications such as: hydraulic fluids, oils, glycols, phosphate esters, silicone oils and brake fluids etc. Phenolic resins demonstrate high compressive strength, dimensional stability and abrasion resistance, and are commonly used in wear-ring applications as fabric resin composites.

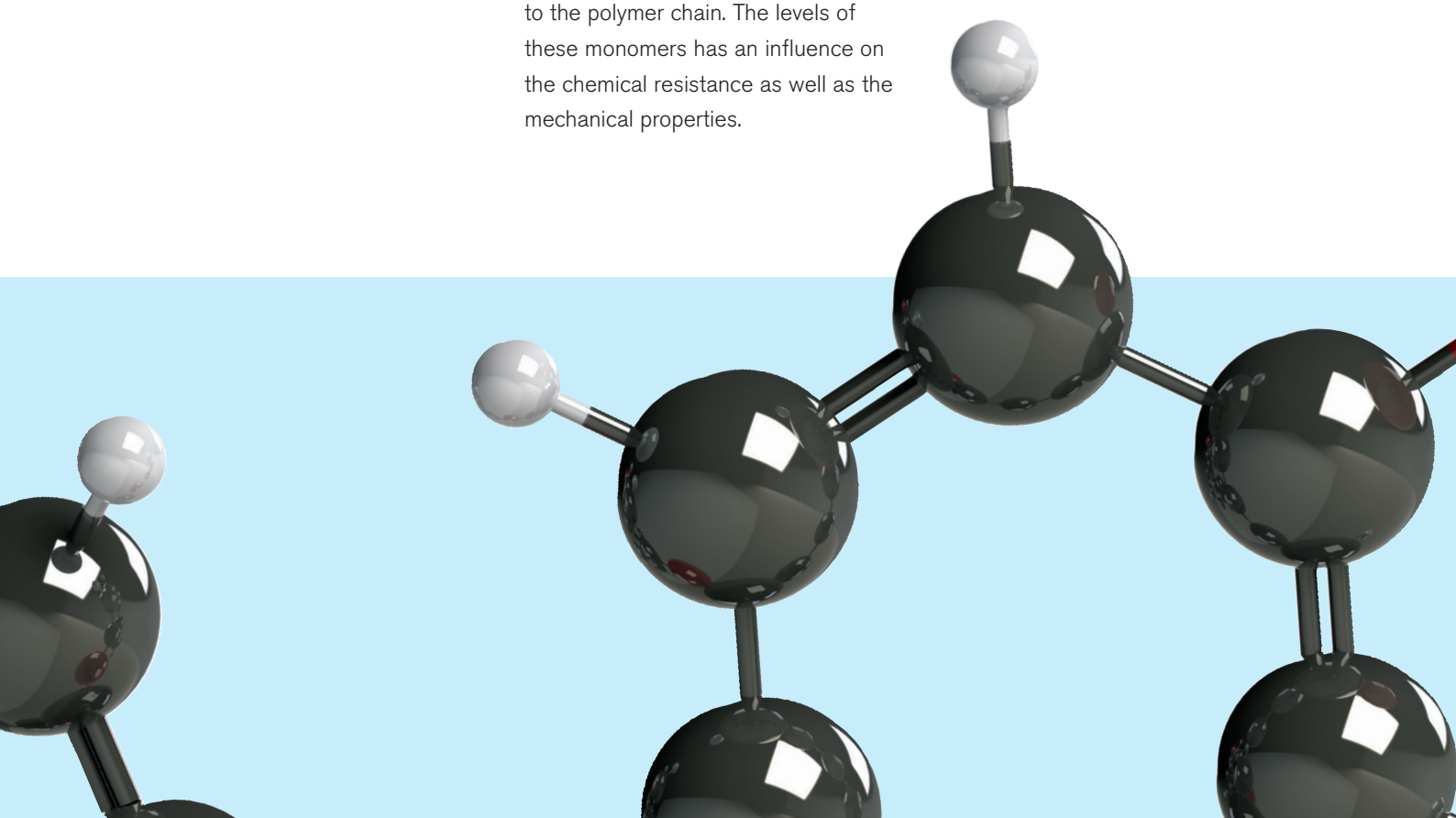
Polyamide (Nylon)



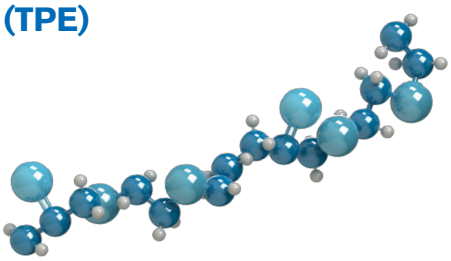
Nylon is a generic designation for a family of synthetic thermoplastic polymers known as polyamides. Nylons are condensation copolymers formed by reacting a diamine and a dicarboxylic acid. Chemical elements included are carbon, hydrogen, nitrogen, and oxygen. The numerical suffix specifies the numbers of carbons donated by the monomers; the diamine first and the diacid second.

The most common variant is Nylon 6-6 which refers to the fact that the diamine and the diacid each donate 6 carbons to the polymer chain. The levels of these monomers has an influence on the chemical resistance as well as the mechanical properties.

Nylon offers excellent mechanical properties in combination with good sheer strength, deformation and wear resistance. Chemical resistance is generally broad, with good resistance to most chemicals, although Nylon can be susceptible to damage when exposed to moisture i.e. it is hydroscopic.



Thermoplastic Elastomers (TPE)



Thermoplastic elastomers (TPE) are a range of co-polymers or a physical mix of polymers (usually a plastic and a rubber). Those based on mixed polymer systems consist of polymers with both plastic and elastic properties. Traditional elastomers are thermosetting materials with covalent crosslinks between the polymer chains (formed during the 'vulcanisation process'), but require processing using different methods to higher-volume thermoplastics, e.g. higher temperatures, longer processing times etc.

The major difference between thermosetting elastomers and TPEs is the type of crosslink utilized. In TPEs, the crosslink is a covalent bond; the crosslinking in TPEs is a weaker dipole, hydrogen bond, or a covalent bond within only one of the phases of the material.

TPEs are advantageous in that they have elastomeric properties, yet can be processed using methods more

common in plastics processing (TPEs can be processed by blow molding, thermoforming, and heat welding). TPEs also have advantages with respect to environmental impact when compared to traditional thermosetting rubbers: TPEs have the potential to be recycled since they can be molded, extruded and re-used like plastics, but also require less energy during processing.

The most common types of commercial TPEs include:

- Elastomeric alloys (TPE-v or TPV)
- Thermoplastic polyurethanes
- Styrenic block copolymers
- Polyolefin blends
- Thermoplastic copolyester
- Thermoplastic polyamides

Due to the variety of materials available, each family will offer different chemical and thermal resistance. Related to the differences in crosslinking, TPEs have relatively poor heat resistance and can show high compression set at elevated temperatures when compared to thermosetting elastomers. Therefore, TPEs are often used in less demanding applications such as door seals, bumpers, extruded profiles etc.

Common Chemical Compatibilities of Materials

Media	NBR	HNBR	CR	ACM	AEM	PU/PE	FKM (A)	FKM (GF)	VMQ	EPDM	TPE	FFKM
AdBlue	2	2	3	2	2	3	1	1	2	1	1	1
Aliphatic Hydrocarbons	1	1	2	1	2	1	1	1	3	4	4	1
Alkanes	1	1	2	1	2	1	1	1	3	4	4	1
Ammonia	2	2	3	4	4	1	4	4	2	1	1	1
Aromatic Hydrocarbons	1	1	4	2	3	3	1	1	3	4	4	1
Bioethanol	2	2	1	4	3	4	3	1	2	1	1	1
Brake fluid - DOT 3, 4 and 5.1 types	3	3	2	4	4	4	4	3	3	1	1	1
Brake fluid - DOT 5 type	1	1	1	1	1	1	1	1	4	1	1	1
Butanol	2	1	1	4	1	3	1	1	3	1	1	1
Corrosion inhibitors	2	1	2	3	3	3	4	4	3	1	1	1
Crude oil	3	3	3	3	3	3	2	1	3	4	4	1
Diesel fuel	1	1	2	1	1	2	2	1	4	4	4	1
Engine lubricating oils	1	1	2	1	2	1	1	1	3	4	4	1
Ester based hydraulic fluids	4	4	4	4	4	4	3	3	3	4	4	1
Ethanol	2	2	1	4	2	4	1	1	1	1	1	1
Fatty acid methyl ester (FAME)	2	2	2	1	1	2	2	1	3	3	3	1
Glycol-based coolants	2	1	1	4	1	3	3	1	3	1	1	1
Glycol-ether based brake fluids	3	3	2	4	4	4	4	3	3	1	1	1
Heavy fuel oil / bunker fuel	3	3	3	3	3	3	2	1	3	4	4	1
Hydraulic oil	1	1	3	1	1	1	1	1	3	4	4	1
IRM 901 fluid (ASTM Oil #1)	1	1	2	1	1	1	1	1	2	4	4	1
IRM 902 fluid (ASTM Oil #2)	1	1	2	1	1	1	1	1	2	4	4	1
IRM 903 fluid (ASTM Oil #3)	2	2	3	3	3	2	1	1	3	4	4	1
Liquidified natural gas (LNG)	1	2	2	3	4	1	1	1	3	4	4	1
Low sulpur diesel fuel	1	1	2	1	1	2	2	1	4	4	4	1
Lubricating oils (API CC-type)	1	1	2	1	2	1	1	1	3	4	4	1
Lubricating oils (API CD-II-type)	3	1	3	2	3	2	1	1	4	4	4	1
Lubricating oils (API CD-type)	1	1	2	1	2	1	1	1	3	4	4	1
Lubricating oils (API CE-type)	1	1	2	1	2	1	1	1	4	4	4	1
Methanol	2	2	1	4	1	4	2	1	2	1	1	1
Methyltertiarybutylether (MTBE)	4	4	4	4	4	4	4	3	4	3	3	1
Mineral oil	1	1	2	1	2	1	1	1	3	4	4	1
Organophosphate ester	4	4	4	4	4	4	3	3	3	3	3	1
Ozone	2	1	2	1	1	2	1	1	1	1	1	1
Petroleum fuels	2	2	2	2	2	2	2	1	3	4	4	1
Polyalkylene glycol (PAG)	2	1	2	4	2	3	3	1	3	2	2	1
Polyalphaolefin	1	1	2	1	2	1	1	1	3	4	4	1
Polyethylene glycol	2	1	1	4	1	3	3	1	3	1	1	1
Polypropylene glycol	2	1	1	4	1	3	3	1	3	1	1	1
Rapeseed (canola) oil	1	1	3	1	1	1	1	1	4	4	4	1
Refridgerant R134a	1	1	2	1	1	1	4	4	2	1	1	2
Silicone oils	1	1	1	1	1	1	1	1	4	1	1	1
Sythetic oil	1	1	2	1	1	1	1	1	3	4	4	1
Universal Transdraulic fluids	3	4	3	2	3	2	1	1	3	4	4	1
Vegetable oils	1	1	3	1	1	1	1	1	4	4	4	1
Water / coolant <100degC	2	1	2	4	1	2	1	1	1	1	2	1
Water / coolant <150degC	4	3	3	4	3	3	3	1	2	1	4	1
Water / coolant <200degC	4	4	4	4	4	4	4	2	4	3	4	1
Weathering	2	1	1	1	1	1	1	1	1	1	1	1

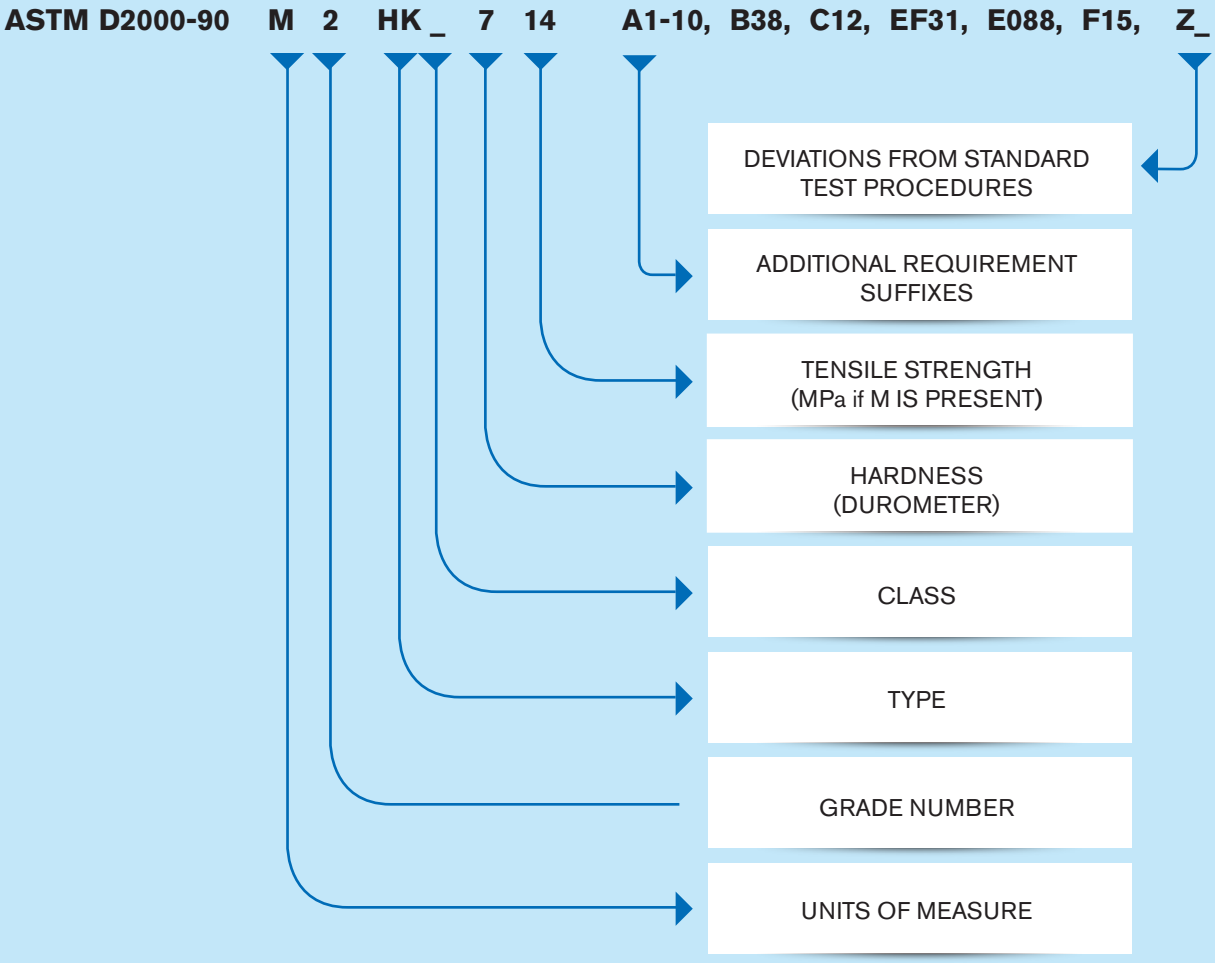
KEY:

1 = Excellent **2 = Good** **3 = Poor** **4 = Not recommended**

Material information can also be found on our Chemical Compatibility tool:

http://oring-groove-wizard.eriks.co.uk/chemicalcompatibility.aspx

American Society for Testing and Materials (ASTM) D-2000 Line call-outs



Units of measure:

If present an “M” denotes that metric units of measure should be used, i.e. MPa for tensile strength, °C for temperature and kN/m for tear strength.

Grade number

1 = Basic Requirements

2 to 6 = Different requirements as detailed in table 6 of ASTM D2000 this specifies minimum basic requirements for tensile strength, elongation, heat aging, oil immersion and compression set by Classification (Type-class). Appropriate additional requirements apply to each classification, with the grade determining the allowable results.

Material information can also be found on our Chemical Compatibility tool:
http://oring-groove-wizard.eriks.co.uk/AstmLookup.aspx

Type

The type classifies materials by temperature resistance. ASTM D2000 limits the change in mechanical properties following 70 hours of heat ageing to: Tensile strength: ±30%, Hardness: -50% max., Hardness: ±15 points.

The test temperature used defines the Type, designated by a letter.

Type	Test Temp, °C
A	70
B	100
C	125
D	150
E	175
F	200
G	225
H	250
J	275
K	300

Class

The Class classifies materials by their resistance to swelling in ASTM Oil Number 3, after 70 hours at the temperature defined by the type, up to 150°C, the temperature limit of the oil. ASTM D2000 limits the maximum allowable volume swell by class.

The allowable volume swell defines the Class, designated by a letter.

Class	Max. Swell, %
A	No Requirement
B	140
C	120
D	100
E	80
F	60
G	40
H	30
J	20
K	10

Material Designation (type and class)	Type of Polymer Most Often Used
AA	Natural, Reclaim, SBR, Butyl, EPDM, Polyisoprene
AK	Polysulfides
BA	EPDM, High Temp SBR and Butyl Components
BC	Chloroprene
BE	Chloroprene
BF	NBR
BG	NBR, Urethanes
BK	NBR
CA	EPDM
CE	Chlorosulfonated Polythylene (Hypalon®)
CH	NBR, Epichlorohydrin
DA	EPDM
DF	Polyacrylic (Butyl Acrylate type)
DH	Polyacrylic
DE	CM, CSM
EE	AEM
EH	ACM
FC	Silicones (high Temp)
FE	Silicones
FK	Fluorosilicones
GE	Silicones
HK	Fluorosilicones
KK	FFKM

With the exception of type/class FC, FE, FK, and GE, all materials are assumed to be black.

Hardness (Durometer)

The hardness of the material, measured in Shore® A is detailed as a single number which is the specified hardness / 10, expressed to 0 decimal places. The limit upon variation in hardness is ±5 points.

Tensile strength

Minimum tensile strength is detailed in MPa, or as psi / 100 to 0 decimal places if using imperial (English) units)

Additional Requirement Suffixes

Each suffix comprises a suffix letter followed by 2 or 3 digits. The first number specifies the duration of the test, and the test method to be used. The second number indicates the test temperature. Three digit numbers should be separated by a hyphen.

Suffix letter	Property	Test Method and Duration	Test Temperature (°C)
A	Heat Resistance	1 = D573 70h 2 = D865 70h 3 = D865 168h 4 = D573 168h 5 = D573 1000h 6 = D865 1000h	1 = 23 2 = 38 3 = 70 4 = 100 5 =125 6 = 150 7 = 175 8 = 200 9 = 225 10 = 250 11 = 275
B	Compression Set	1 = ASTM D395 22h, Method B, Solid 2 = ASTM D395 70h, Method B, Solid 3 = ASTM D395 22h, Method B, Piled 4 = ASTM D395 70h, Method B, Piled 5 = ASTM D395 1000h, Method B, Solid 6 = ASTM D395 1000h, Method B, Piled	
C	Ozone or Weather Resistance	1 = ASTM D1171 Ozone exposure, method A 2 = ASTM D1171 Weather 3 = ASTM D1171 Ozone exposure, method B	
EA	Fluid Resistance (Aqueous)	1 = ASTM D471 Distilled water, 70h 2 = ASTM D471 50% Distilled water & 50% Ethylene Glycol, 70h	
EF	Fluid Resistance (Fuels)	1 = D471, Reference Fluid A, 70h 2 = D471, Reference Fluid B, 70h 3 = D471, Reference Fluid C, 70h 4 = D471, Reference Fluid D, 70h 5 = D471, 85% Reference Fluid D & 15% Denatured Ethanol, 70h 1 = D471, ASTM Oil No. 1, 70h 2 = D471, ASTM Oil No. 2, 70h 3 = D471, ASTM Oil No. 3, 70h 4 = D471, ASTM Oil No. 1, 168h 5 = D471, ASTM Oil No. 2, 168h 6 = D471, ASTM Oil No. 3, 168h 7 = D471, Service Fluid No. 101 70h 8 = D471, Oil specifically designated in ASTM D2000 Table 6	
EO	Fluid Resistance (Oils and Lubricants)	1 = D471, ASTM Oil No. 1, 70h 2 = D471, ASTM Oil No. 2, 70h 3 = D471, ASTM Oil No. 3, 70h 4 = D471, ASTM Oil No. 1, 168h 5 = D471, ASTM Oil No. 2, 168h 6 = D471, ASTM Oil No. 3, 168h 7 = D471, Service Fluid No. 101 70h 8 = D471, Oil specifically designated in ASTM D2000 Table 6	
G	Tear Resistance	1 = D624, die B 2 = D624, die C	
K	Adhesion	1 = D429, Method A 2 = D429, Method B 3 = Bond made after vulcanization	
F	Low Temperature Resistance	1 = D2137, Method A, 9.3.2, 3 min 2 = D1053 5 min, T2, T5, T10, T50 or T100 3 = D2137, Method A, 22h 4 = D1329, 38.1mm die, 50% elongation, retraction 10% min 5 = D1329, 38.1mm die, 50% elongation, retraction 50% min	1 = 23 2 = 0 3 = -10 4 = -18 5 = -25 6 = -35 7 = -40 8 = -50 9 = -55 10 = -65 11 = -75 12 = -80
D	Compression-Deflection Resistance	1 = D575, Method A 2 = D575, Method B	
H	Flex Resistance	1 = D430, Method A 2 = D430, Method B 3 = D430, Method C	
J	Abrasion Resistance	Test method must be specified	
M	Flammability Resistance	Test method must be specified	
N	Impact Resistance	Test method must be specified	
P	Staining Resistance	1 = D925, Method A 2 = D925, Method B Control Panel	
R	Resilience	1 = D945	
Z	Any Special Requirement (Specified in Detail)	Test method and results must be specified in detail.	

Please note: ASTM Oils No.1, 2 and No. 3 are no longer commercially available, they have been replaced by IRM901, IRM902 and IRM903 oils respectively.

United States Environmental Protection Agency (EPA) Federal Emission Standards

The EPA's Office of Transportation and Air Quality (OTAQ) determines the standards controlling mobile source emission in the US through applicable Code of Federal Regulations (CFR) citations.

Standards are grouped by Light Duty, Heavy Duty, Non-road and Fuel Sulphur and govern levels of : Non-Methane Organic Gas (NMOG), Nitrous Oxides (NOx), Carbon monoxide (CO), Total hydrocarbon equivalent (THCE), non-methane hydrocarbon equivalent (NMHCE), Formaldehyde and Particulate Matter (PM). Both exhaust and evaporative emissions are controlled with the vehicle type and model year governing the maximum permissible emissions.

The continuing drive to reduce emissions demands the use of additives in fuels and elevated temperatures which both place increased thermo-chemical demand upon the seals. ERIKS Sealing Technology are able to assist in selection of the correct compounds to resist these challenges, together with controlling fuel permeability to achieve evaporative emissions standards. The permeation of fuels into and through elastomer components is challenging due to the variety of fuels now available in the market place, with some applications requiring resistance to more than one type.

Vehicle Classifications:

Light Duty Vehicles and Trucks	Clean Fuel Fleet
	Clean Vehicle Fuel
	National Low Emission Vehicle
	Tier 0
	Tier 1
	Tier 2
Motor Cycles Driving Cycles	
Heavy-Duty Highway Engines and Vehicles	Clean Fuel Fleet
	Compression Ignition (CI) engines
	Spark-ignition (SI engines)
	Aircraft
	Compression Ignition (CI) Engines
	Spark-ignition (SI Engines)
	Marine (CI) Engines
	Marine (SI) Engines and Vessels
	Recreational Engines and Vehicles
	SI Engines 19KW and below

Fuel use in Transportation

The variety of fuels used in transportation systems is an important factor when optimum sealing solutions are required. Petroleum ("petrol", "gasoline") and diesel fuels are the most common in the automotive market, but recent developments include bio-based alternatives. In marine applications heavy-fuel oils represent a significant challenge. In each case sealing materials need to offer: good chemical resistance, low permeability, and a broad temperature operating range.

With respect to standard fuels, ECO, NBR, HNBR and FKMs are all possible sealing solutions for both petrol and diesel applications. However, where bio-based fuels are used care should be taken, as not all grades are suitable. Breakdown products from such fuels can cause degradation of elastomers, so specialist materials should be sought, especially in the case of FKMs.

Heavy fuel oil contains many species which are problematic for elastomers, and can require elevated temperatures to assist the fuel in flowing. Again, FKMs are common in such systems, with the family of FFKMs also becoming of interest due to the long-term chemical and thermal stability.

For high-performance applications, or those where numerous different fuels are encountered (such as fuel delivery systems), FFKMs are becoming the material of choice. This is again due to the broad chemical resistance offered by FFKMs.

The largest challenge with fuel systems now comes with increasing demands for sealing at temperatures at -40°C and below. Here, standard materials are reaching their limits. New technology with FKMs and FFKMs allows sealing of fuel systems over a broad range of temperatures, from -51°C to > +200°C.

Production Part Approval Process – PPAP

TS16949 requires the use of PPAP to provide the evidence that all customer engineering design records and specification requirements are properly understood by the supplier. Also showing the process has the potential to produce product consistently meeting these requirements during an actual production run, at the quoted production rate.

Typically seals to be used in automotive / transportation applications require the submission of either a Level 2 or Level 3 PPAP report.

- Level 1 - Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer.
- Level 2 - Warrant with product samples and limited supporting data submitted to customer. Typically: initial sample inspection report, drawings, material data-sheets, part submission warrant.
- Level 3 - Warrant with product samples and complete supporting data submitted to customer. Typically: gauge repeatability and reproducibility, process failure mode effect analysis (FMEA), control plan, process flow diagram, process capability report, drawings, material data-sheets, part submission warrant.

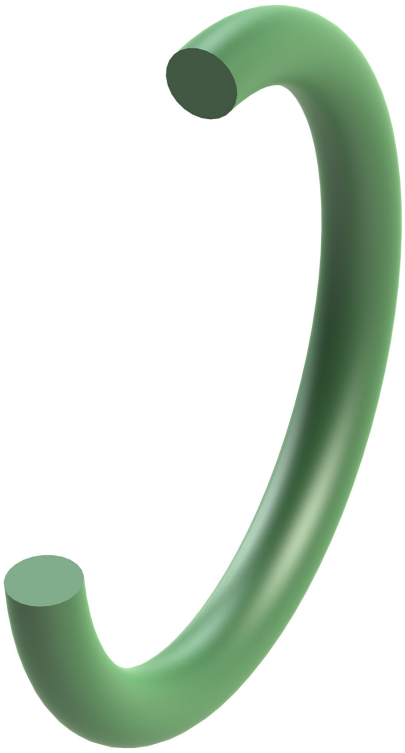
The use of PPAP drives consistency within the supply chain, minimising enterprise risk.

Process Capability Index – C_{pk}

The C_{pk} of a process defines how centred the output of the process is between its lower and upper specification limits and how variable the output is. It is calculated as the ratio of the delta between the actual process mean and the nearest tolerance limit divided by 3 times the standard deviation.

Although many industrial processes require a minimum process C_{pk} of 1.33 it is common for automotive applications to require a C_{pk} of 1.67.

C_{pk}	Parts per million defective
1.00	2,700.0
1.10	967.0
1.20	318.0
1.30	96.0
1.40	26.0
1.50	6.8
1.60	1.6
1.70	0.34
1.80	0.06
2.00	0.0018



Case Study

Summary

Background:

A customer was experiencing leakages when using a low-temperature nitrile (NBR) elastomer in a hydraulic application. The material grade was selected based upon conformance against a customer specification.

Investigation:

The material was re-tested against the full customer specification, with no immediate problems identified (the material met all requirements). Utilizing Fourier-transform infrared analysis (FTIR) and thermogravimetric analysis (TGA) it was determined that the NBR compound in question obtained its low-temperature performance by being compounded using hydrocarbon-based plasticizers. In service in the hydraulic application, these plasticizers were being 'washed out' with the seal then losing volume, leading to a reduction in sealing force and leakage. Although the material met the required specification, it was not actually suitable for the service conditions over a sustained period.

Solution:

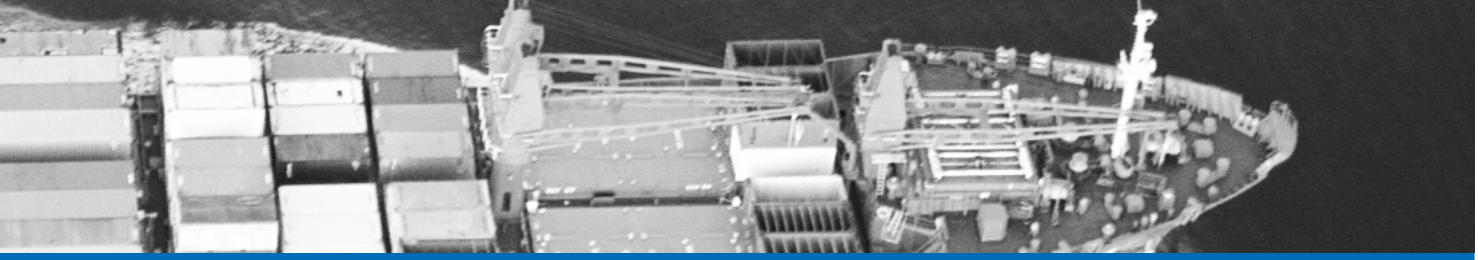
Low temperature performance of NBR compounds can be enhanced by the use of plasticizers and/or selection of a low temperature (low acrylonitrile) polymer. In this application, by switching from a highly plasticized NBR to a low-ACN content NBR, the customer could successfully seal the application. Recommendations were made to the customer as to how their material specification could be updated to prevent similar future occurrences of the same issue.

ERIKS Sealing Technology are happy to assist customers to select appropriate ASTM or custom specifications to help them deliver reliable, consistent product.

Automotive

Automotive applications post a vast array of needs in under-bonnet, drive-train and ancillary applications.

Applications	Requirements	Seal Profiles	Sealing Materials
Steering column	Oil / grease resistance	Rotary Seals O-Rings Washers	NBR HNBR FKM Polyacrylic PTFE
Suspension	Oil / grease resistance Low temperature	Rod seals Rotary seals Piston rings Lip seals Fork seals	NBR HNBR PTFE
Braking systems	Oil / grease resistance Low temperature	Cover seals Diaphragms O-rings Hydraulic seals	CR NBR EPDM PTFE
Turbo charger	Heat resistance Low temperature wear resistance, low friction	O-rings	FKM VMQ
Fuel pump and system	Heat resistance Fuel resistance	Elastomer rotary PTFE Rotary O-rings	FKM PTFE FFKM
Water pump	Coolant resistance Oil Resistance	Elastomer Rotary seals Mechanical seals O-rings	EPDM NBR
Differential / Gearbox Transmission / Drive shaft	Oil / grease resistance Heat resistance	Rotary seals O-rings	NBR HNBR FKM ACM PTFE
Radiators	Coolant resistance Low temperature Steam resistance Corrosion inhibitor resistance	Moulded gaskets O-rings	EPDM
Screen wash systems	Antifreeze resistance Low temperature	O-rings Hydraulic seals Moulded tube	EPDM NBR PTFE
Air conditioning	Chemical compatibility Rapid gas decompression	O-rings	EPDM HNBR
Engine head & block	Heat, oil, coolant, wear resistance, low friction	Rotary seals, valve stem O-rings, moulded components	NBR, FKM, VMQ, ACM, PTFE, FFKM



Truck & Trailer, Bus & Public Service Vehicle

Applications	Requirements	Seal Profiles	Sealing Materials
Hub & Pinion	Abrasion resistance Dirt exclusion Oil / grease resistance	Unitised seals O-rings Bespoke rotary seals	NBR HNBR FKM ACM
Differential / Gearbox Transmission Drive shaft	Abrasion resistance Dirt exclusion Oil / grease resistance	O-rings Rotary seals	NBR HNBR FKM ACM
Engine	Heat resistance Oil resistance	Rotary O-rings Valve stem seals Liner seals	FKM PTFE FFKM EPDM VMQ ACM
Braking Systems	Oil compatibility Low temperature High temperature	Cover seals / Boots Diaphragms / Bellows O-rings Hydraulic / Pneumatic seals	CR NBR EPDM VMQ
Buffers & Bumpers	Mechanical strength Ozone resistance Shock resistance	Rubber mouldings	CR NBR TPE
Suspension systems	Oil / grease resistance Low friction High frequency	Torque arm bushes Rotary seals Piston rings Rod seals	NBR HNBR

Marine / Marine Diesel Engine

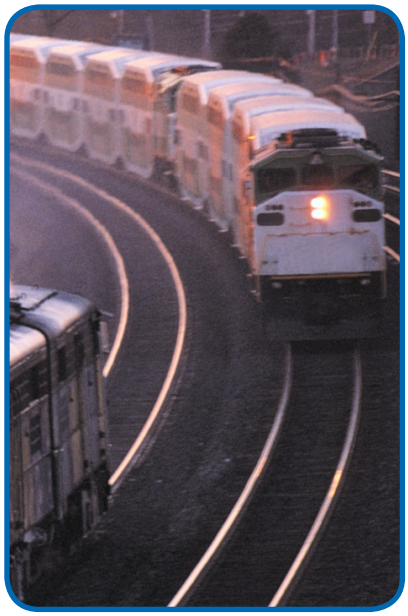
Pioneer Weston has a long history in marine applications, developing products to maximise life and simplifying the installation and replacement processes.

Stringent environmental and efficiency demands upon large diesel engines necessitate the use of elevated temperatures, requiring increased thermal resistance of sealing materials. Specialist FKM and FFKM technologies are frequently used to resist steam, corrosion inhibitors and heavy fuel oils.

Applications	Requirements	Seal Profiles	Sealing Materials
Cylinder liners	Oil resistance Coolant resistance Compression set resistance	O-rings	FKM FKM-F (Special formulations)
Turbo charger	Heat resistance Chemical resistance	O-rings	HNBR FKM FFKM
Fuel systems	Chemical resistance Wide temperature range High pressures Heavy Fuel Oil resistance	O-rings Rotary seals	NBR HNBR FKM FFKM
Valve seats	Heat resistance Oil resistance Fuel resistance Coolant resistance	O-rings Custom profiles	FKM FFKM Aflas®
Gearbox	Oil / grease resistance Submerged operation Simplified installation	O-rings Rotary seals Bespoke mechanical Rotary split seals	NBR HNBR FKM
Cover / hatch seals	Atmospheric conditions Oil splash Sea water Submerged operation	Custom profiles O-rings	NBR EPDM CR
Propeller shaft	Oil / grease resistance Wear /abrasion resistance In-situ replacement	Rotary split seals Rotary seals	NBR HNBR FKM Fabric reinforced
Stern tube	Oil / grease resistance Wear / abrasion resistance In-situ replacement	Rotary split seals Bespoke Rotary seals	NBR HNBR FKM
Dredging	Oil / grease resistance Wear / abrasion resistance	Mechanical seals Bespoke Rotary seals	NBR HNBR FKM

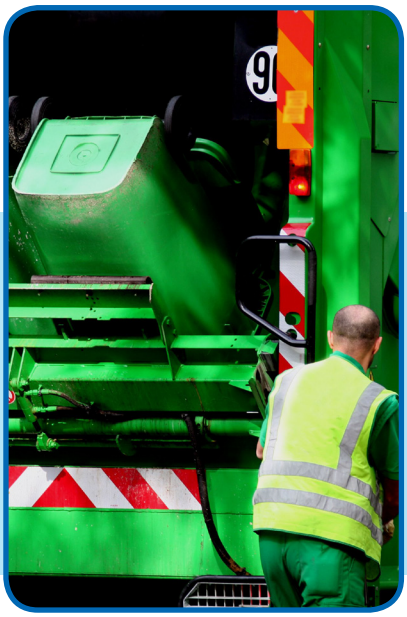
Rail

Applications	Requirements	Seal Profiles	Sealing Materials
Screw compressors	High speed High temperature Low friction	PTFE Lip seals O-rings Moulded gaskets Poppet valve seats	PTFE FKM VMQ
Brake actuation (Pneumatic)	Lubricant compatibility Low temperature	Cover seals Diaphragms O-rings Moulded gaskets U-cups Wipers	CR NBR AU
Valves / Manifolds (Pneumatic)	Lubricant compatibility Low temperature	O-rings Pneumatic seals Poppet valve seals	PU NBR HNBR PTFE
Axle / Bogie	Grease compatibility Abrasion resistance Low friction Dirt / water ingress resistance	Bespoke rotary seals Wear sleeves Poppet valve seats	NBR HNBR
Engine head & block	Heat, oil, coolant Wear resistance Low friction	Rotary seals Valve stem O-rings Moulded components	NBR FKM VMQ ACM PTFE FFKM



Utilities

Applications	Requirements	Seal Profiles	Sealing Materials
Screw compressors	High speed High temperature Low friction	PTFE Lip seals O-rings	PTFE NBR HNBR FKM
Hydraulic actuation	Wear resistance Dirt exclusion Oil / Grease resistance Tight leakage control Low temperature High pressures	O-rings U-cups Cap seals Bearings X-rings Excluders Wipers	NBR FKM PTFE PU Fabric reinforced
Pneumatic actuation	Wear resistance Dirt exclusion Oil / Grease resistance Tight leakage control Low temperature	Cap seals O-rings U-cups X-rings Excluders Wipers	NBR FKM PTFE PU Fabric reinforced Thermoplastics



Elastomeric Rotary Lip Seals

Product Overview

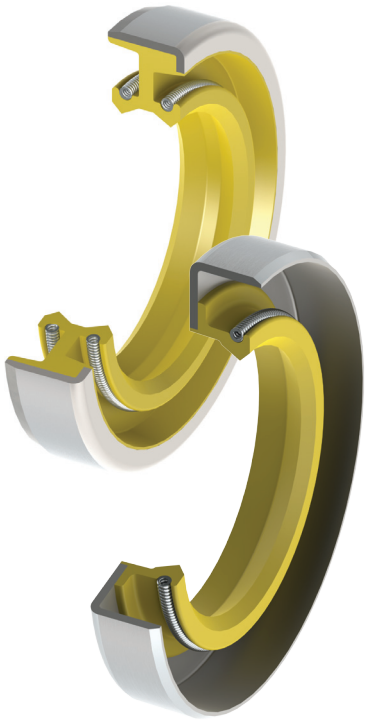
One of the most frequently used types of seal is the rotary lip seal, generally used for sealing lubricating oil or grease in rotary shaft applications. This is achieved by:

- Providing static sealing between the outer diameter of the seal and its housing.
- Sealing between the shaft and the main sealing lip when either static or dynamic. The radial load exerted by the sealing lip must be sufficient to retain the oil or grease, but not so high that excessive friction or wear occurs.

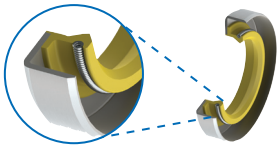
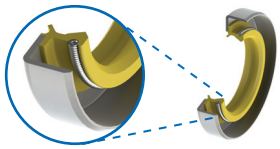
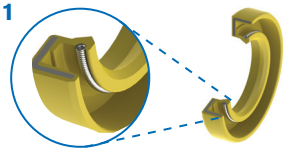
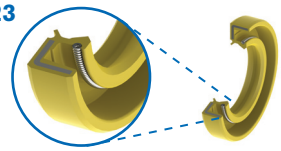
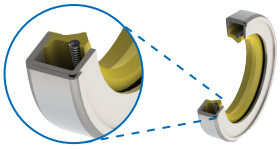
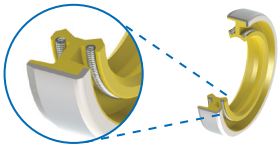
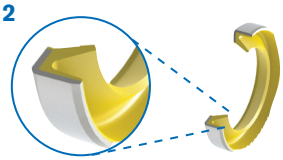
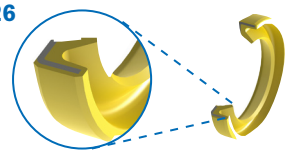
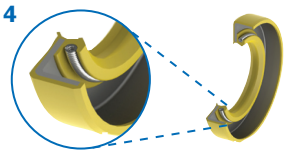
The principal of this can be affected by the following basic parameters and must always be taken into consideration when selecting the correct profile and material to enable the optimum performance.

- Shaft rotational speed and direction
- Operating temperature
- Application hardware details
- Medium being sealed both internally and externally
- Pressure seen within sealed unit

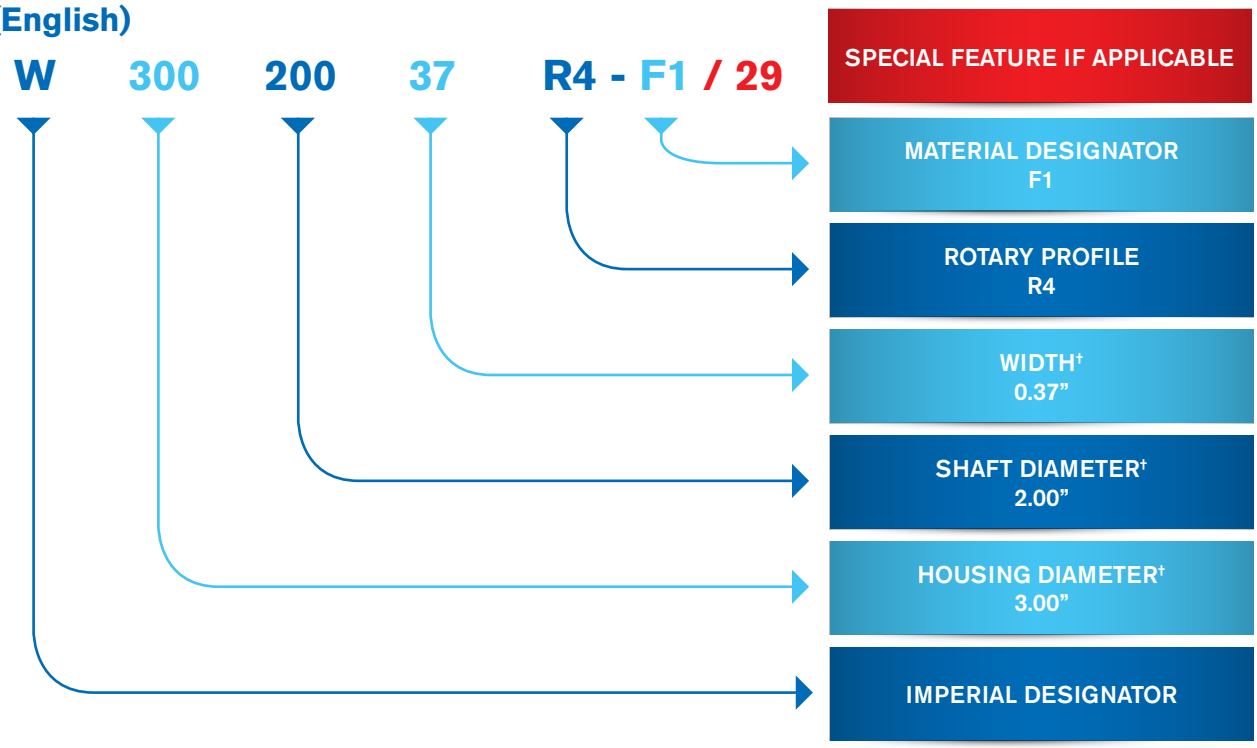
The Pioneer Weston range of rotary lip seals, offered through the ERIKS group, comply with a range of standards including DIN 3760/3761 and ISO 6194. Non-standard designs and materials are available on request.



Elastomeric Rotary Lip Styles

Profile	Profile Features	Profile Advantages	Applications
R4 	– Ground metal outer diameter – Spring-loaded primary seal lip	– Press fit metal OD for precise location in housing – Used in a wide and varied number of applications	– Transmission – Gearbox – Axles
R6 	– Ground metal outer diameter – Spring-loaded primary seal lip – Additional dust lip	– Press fit metal OD for precise location in housing – Used in a wide and varied number of applications – The addition of a dust lip offers protection against low to medium dust and dirt ingress	– Similar to R4 but within environments where contaminants are present
R21 	– Rubber covered outer diameter – Spring-loaded primary seal lip	– Rubber OD sealing allows use in housings of increased roughness or with minor surface defects – Used in a wide and varied number of applications – The addition of a dust lip for R23 style offers protection against low to medium dust and dirt ingress – Can accommodate housing materials with high thermal expansion	– Transmission – Gearbox – Axles – Crankshafts
R23 	– Rubber covered outer diameter – Spring-loaded primary seal lip – Additional dust lip	– Rubber OD sealing allows use in housings of increased roughness or with minor surface defects – Used in a wide and varied number of applications – The addition of a dust lip offers protection against low to medium dust and dirt ingress – Can accommodate housing materials with high thermal expansion	– Similar to R21 but within environments where contaminants are present
R1 	– Ground metal outer diameter – Spring loaded primary seal lip – Additional reinforcing metal insert	– Press fit metal OD for precise location in housing – Metal insert gives seal more rigidity specifically for larger sizes – Can accommodate greater installation errors	– Similar to R4
R5 	– Ground metal outer diameter – Two spring loaded seal lips incorporated in to one design	– Press fit metal OD for precise location in housing – Seal for separation of two media or where liquid or viscous contaminant is present	– Axles – Power take-off units
R12 	– Ground metal outer diameter – Primary sealing lip without spring	– Good solution for grease applications – Can be used as a second seal against low to medium dirt and dust ingress – Press fit metal OD for precise location in housing	– Similar to R4 but in grease filled applications
R26 	– Rubber covered outer diameter – Primary sealing lip without spring	– Good solution for grease applications – Can be used as a second seal against low to medium dirt and dust ingress – Rubber OD sealing allows use in housings of increased roughness or with minor surface defects	– Similar to R21 but in grease filled applications
R14 	– Rubber covered outer diameter – Spring-loaded shorter primary seal lip – Additional dust lip	– For use in pressure rated applications up to 8 bar dependent on rpm – Rubber OD sealing allows use in housings of increased roughness or with minor surface defects – The addition of a dust lip offers protection against low to medium dust and dirt ingress from application environment – Can accommodate housing materials with high thermal expansion	– Hydraulic pumps – Hydraulic motors

Imperial (English)



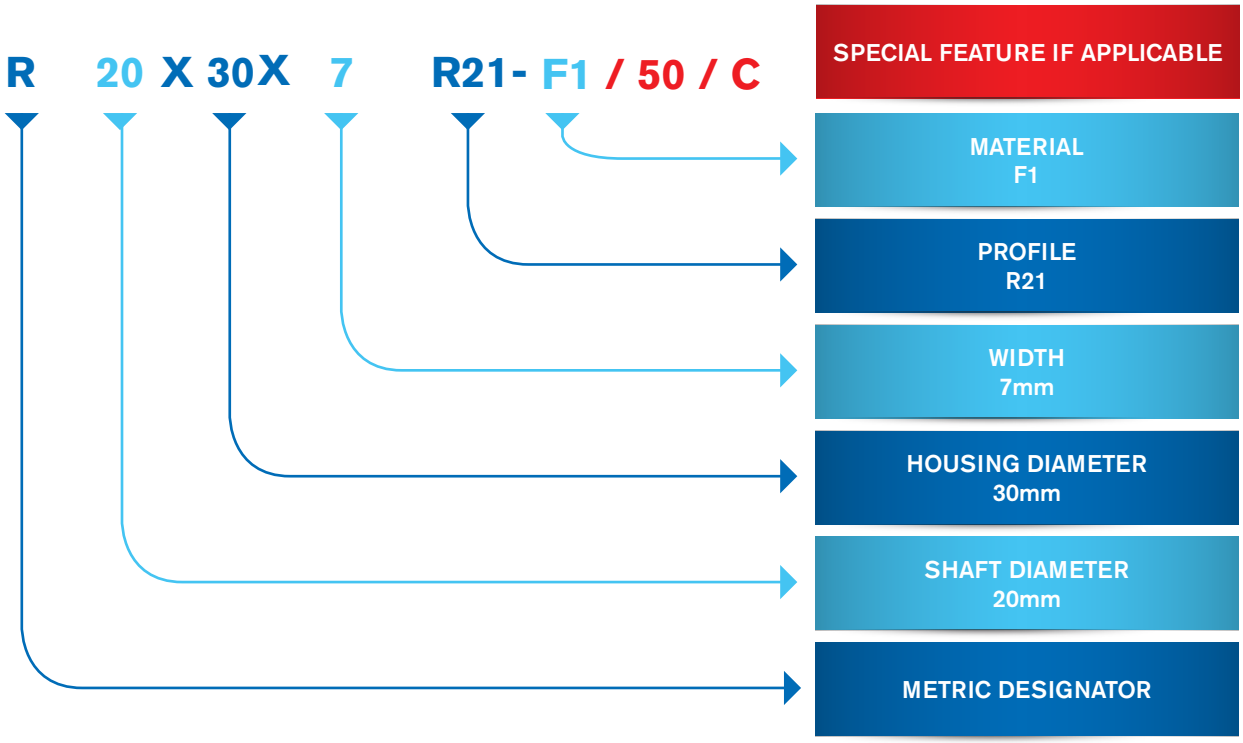
†Dimension rounded down to 2 decimal places then multiplied by 100

Standard Rotary Lip Seal Elastomeric Compound Reference

Polmer Type	Compound Reference	Colour	Hardnes (IRHD)	Temperature Range	Select for..	Material Designator
Nitrile rubber (NBR)	N-70-194	Black	70	-35 to +110°C	General purpose	
Fluorocarbon (FKM, A-type)	V-75-27	Black	75	-20 to +200°C	High temperature performance; high speed applications	F1
	V-85-195	Black	85	-20 to +200°C		F2
	V-75-50	Brown	75	-20 to +200°C		F3
	V-80-271	Black	80	-51 to +200°C	Specialist ultra-low temperature FKM	F4
	V-80-88	Black	80	-15 to +200°C	Specialist FKM terpolymer developed for use with bio-fuels	F5
Silicone (VMQ)	S-80-78	Red	80	-55 to +230°C	High and very low temperature; high eccentricity	S1
Polyacrylate (ACM)	A-70-196	Black	70	-30 to +175°C	High and low temperature capabilities; good compatibility with engine oils	A1
Hydrogenated nitrile (HNBR)	H-80-40	Black	80	-40 to +180°C	Abrasion resistance; high temperatures	H1

Other materials are available on request

Metric



Special Feature Designator

Feature	Function	Selection	Designator
Ribbed outer diameter	Helps to reduce press in force and improves static sealing on outer diameter. This function is primarily used for aftermarket requirements and is available only on seals with elastomeric outer diameters.	As per ag-con	50
Hydrodynamic aid	Helps as a pumping aid to improve functionality of the seal by transferring fluid away from the lip at high speeds to give a positive impact on the life of the seal.	Clockwise Anti-clockwise Bi-directional	C A B
Stainless steel spring	Rust and acid resistant spring	As per ag-con	29
Sealant paint	Only available on metal cased seals, this sealant paint helps to seal against any housing imperfections.	RED BLUE	2 3

If multiple special features are required, these should be expressed using multiple suffixes separated by a “/” sequenced as per the above table. Examples below:

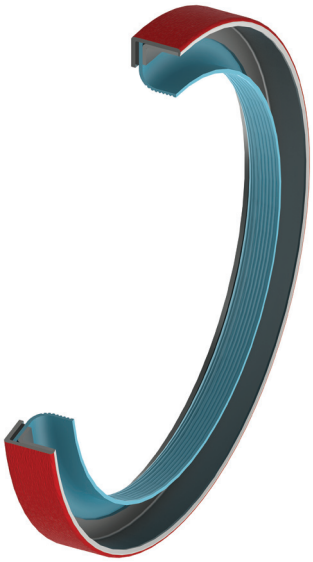
A metric sized fluorocarbon R21 with a ribbed outer diameter and clockwise hydrodynamic aid, would be as follows:

R20X30X7R21-F1/50/C

An imperial sized HNBR R23 with an anti-clockwise hydrodynamic aid and stainless steel spring would be as follows:

W30020037R23-H1/A/29

PTFE Rotary Lip Seals



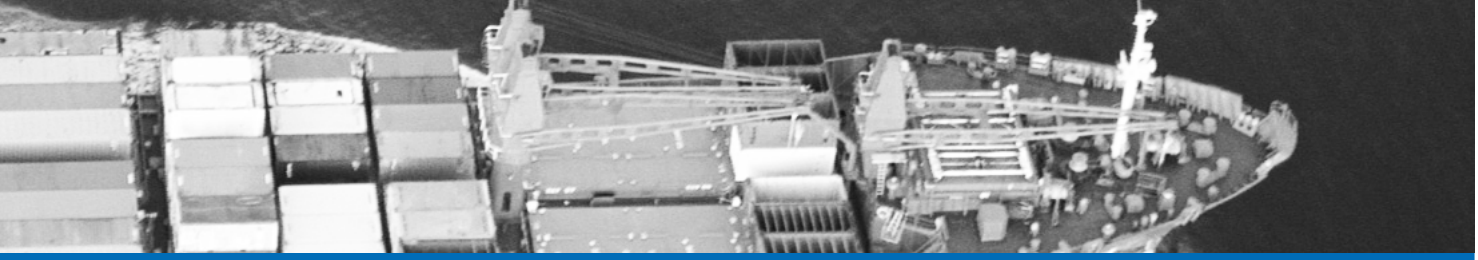
Product Overview

Pioneer Weston's high speed PTFE seal range was first introduced during the 1970s to offer a superior performance to existing rubber seals. This is characterised by the following advantages across this range:

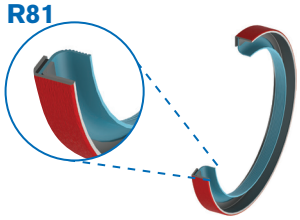
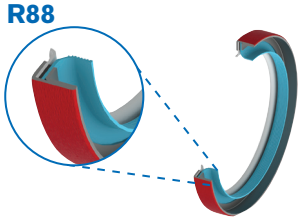
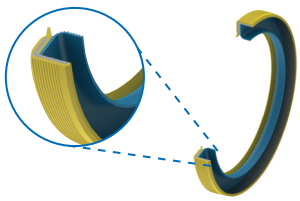
- Low friction
- Aggressive media resistance
- Temperature extremes -100 °C to +250 °C
- Shaft surface speeds up to 30 metres/sec.
- Dry running qualities – reducing breakout friction and stiction
- Low lip wear ensuring prolonged service life
- Extended shelf life – unaffected by ultraviolet & oxidation
- Reduced shaft grooving

Performance can be optimised through the selection of specific PTFE grades, see page 14 for examples of filler packages.

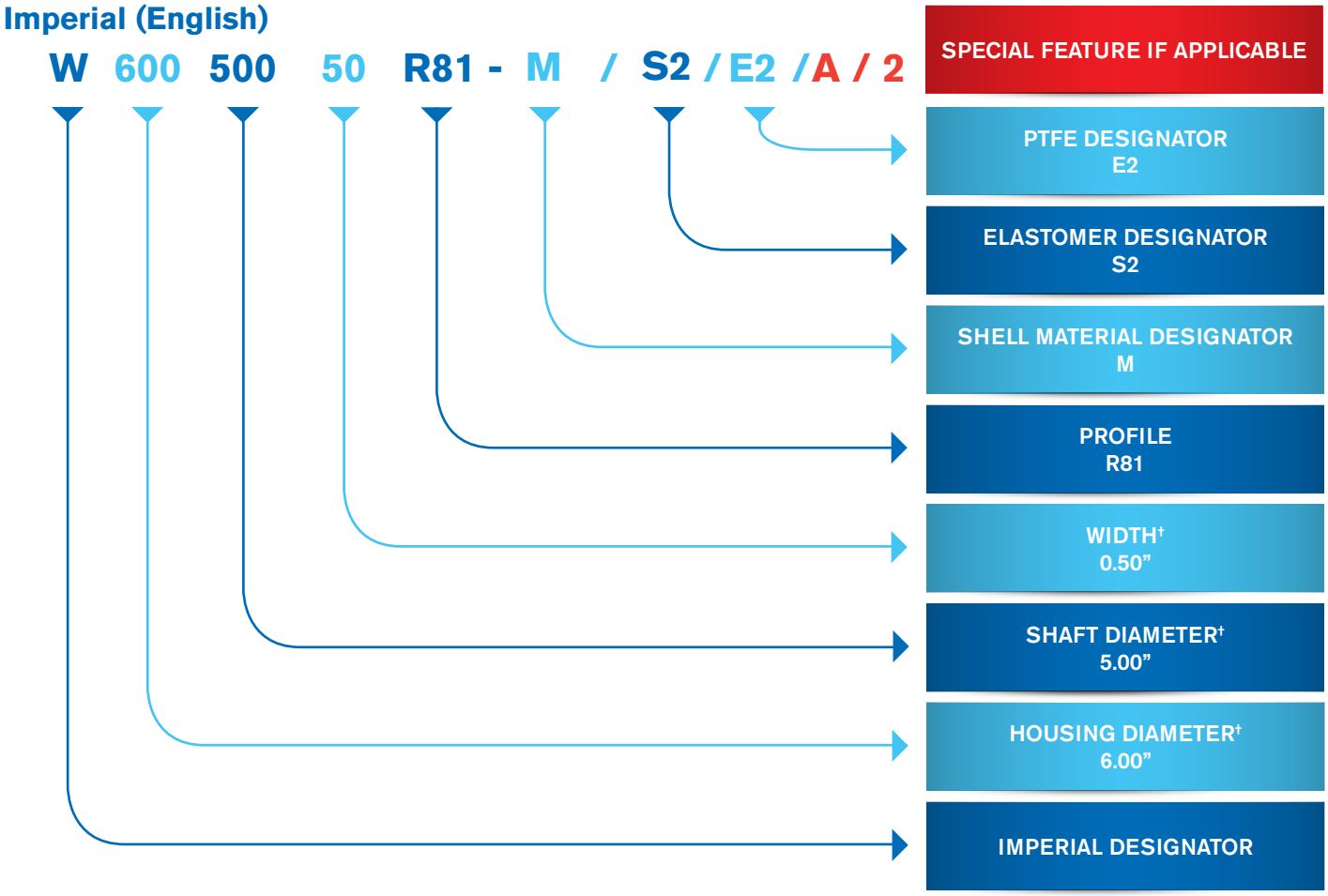
The Pioneer Weston range of PTFE lip seals, offered through the ERIKS group, retro-fit into hardware dimensions as defined in standards including DIN 3760/3761 and ISO 6194. Non-standard designs and materials are available on request.



PTFE Rotary Lip Styles

Profile	Profile Features	Profile Advantages	Applications
R81 	– Ground metal outer diameter with OD sealant paint – Primary PTFE sealing element with hydrodynamic aid – Elastomeric gasket	– Press fit metal OD for precise location in housing – OD sealant paint can help to seal slight housing imperfections – Directional hydrodynamic sealing aid to provide pumping action to increase sealing ability	– Fuel pumps – Compressors
R88 	– Ground metal outer diameter with OD sealant paint – Primary PTFE sealing element with hydrodynamic aid – Additional PTFE wiper lip for R88 style – Elastomeric gasket	– Press fit metal OD for precise location in housing – The addition of wiper lip offers protection against low to medium dust and dirt ingress from application environment – OD sealant paint can help to seal slight housing imperfections – Directional hydrodynamic sealing aid to provide pumping action to increase sealing ability	– Diesel engine crankshafts – Transmissions
R82 	– Ribbed elastomeric covered outer diameter – Primary PTFE sealing element with hydrodynamic aid bonded to inner shell – Elastomer dust lip	– Ribbed elastomer OD sealing allows use in housings of increased roughness or with minor surface defects. – The addition of a dust lip offers protection against low to medium dust and dirt ingress from application environment – Directional hydrodynamic sealing aid to provide pumping action to increase sealing ability	– Diesel engine crankshafts – Gearboxes

Imperial (English)



†Dimension rounded down to 2 decimal places then multiplied by 100

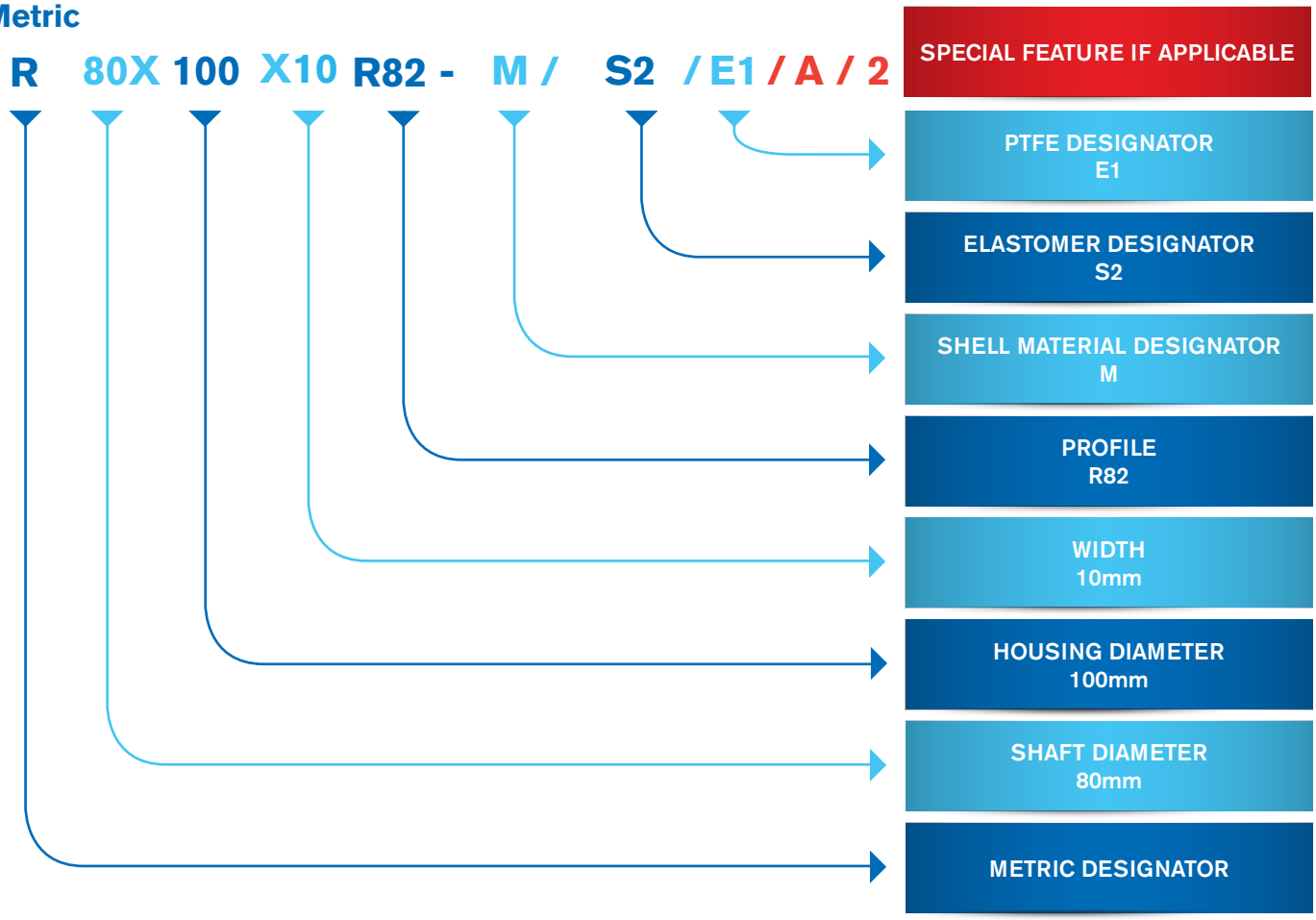
Shell Materials

Metal	Shell Material Designator
Mild Steel	M
Stainless Steel	S
Aluminium	AL

Elastomer Compounds

Polymer Family	Compound Reference	Colour	Hardness (IRHD)	Temperature Range	Select for..	Elastomer Designator
Fluorocarbon (FKM, A-type)	V-75-198	Black	75	-20 to +200°C	High temperature performance; high speed applications	F4
Silicone (VMQ)	S-70-197	Red	70	-55 to +230°C	High and very low temperature; high eccentricity	S2
Polyacrylate (ACM)	A-70-196	Black	70	-30 to +175°C	High and low temperature capabilities; good compatibility with engine oils	A1

Metric



PTFE Grades

Material Composition	Compound Reference	Colour	Coefficient of Friction	Temperature Range	Select for..	PTFE Designator
Glass and MoS_2 reinforced PTFE	PF-200	Grey	0.06 / 0.10	-160 to +290°C	Low wear, high life, reduced friction	E1
Graphite reinforced PTFE	PF-201	Grey / Black	0.06 / 0.10	-200 to +250°C	Soft shafts, reduced friction	E2

Other grades are available on request.

Special Features Designator

Feature	Function	Selection	Designator
Hydrodynamic aid	Helps as a pump aid to improve functionality of the seal by transferring fluid away from the lip at high speeds to give a positive impact on the life of the seal	Clockwise Anti-clockwise	C A
OD sealant paint	Only available on metal cased seals, this sealant paint helps to seal against any housing imperfections	RED BLUE	2 3

If multiple special features are required then these should be expressed using multiple suffixes separated by a "/ " sequenced as per the above table e.g. An R81 profile with a clockwise hydrodynamic aid and red sealant paint would be as follows; W60050050R81-M/S2/E1/C/2

Unitised Seals

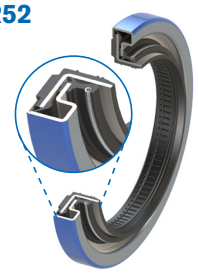
Product overview

Pioneer Weston's Unitised seal range has been specifically designed for use in applications where the exclusion of contaminants such as dirt and dust is required to operate over a prolonged service life.

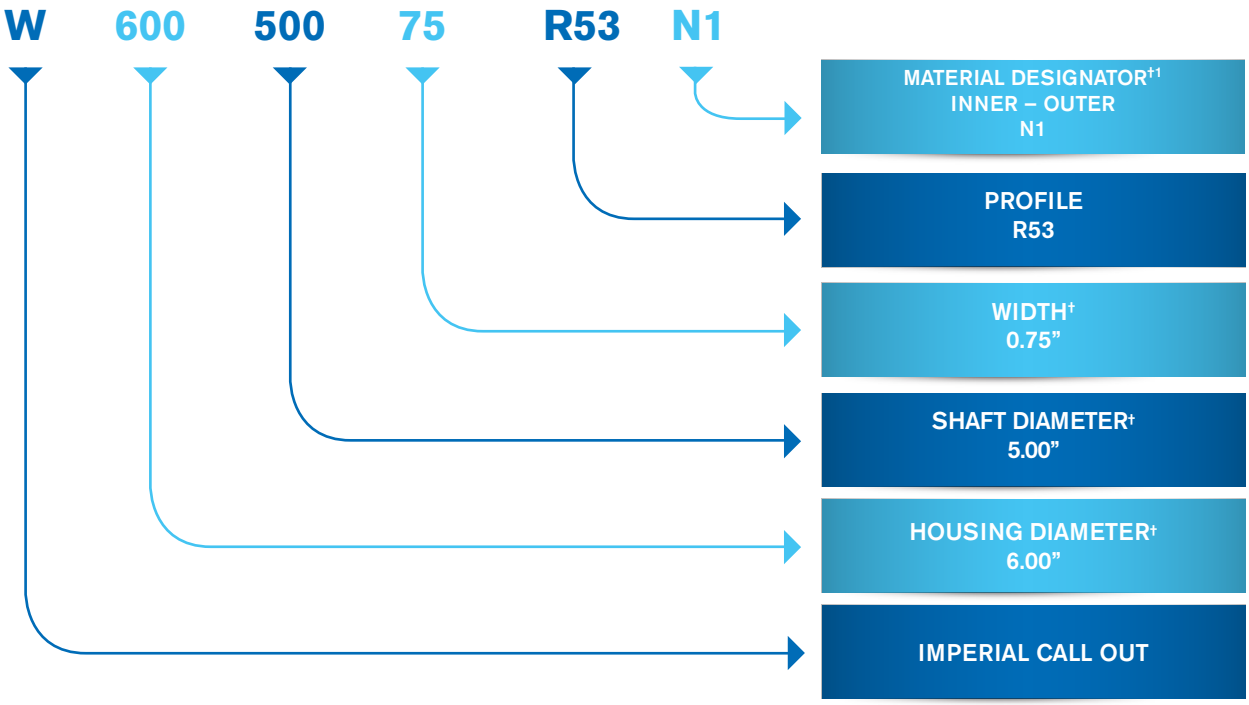
The Unitised seal design incorporates a number of excluder lips in addition to the main sealing lip to achieve this requirement. This is then contained within its own integral housing which features an optimal running surface for the primary seal lip.

Pioneer Weston offers a number of standard profiles in both metric and imperial sizing, but can also provide custom designs to suit a particular application. The operating conditions and service life determine the selection of the most suitable profile and material combination for both the inner and outer components.

Unitised Seal Styles

Seal Profile	Profile Features	Profile Advantages	Applications
R52 	– Two piece construction – Protected radial spring-loaded primary seal lip with hydrodynamic aid – Excluder lips – Ribbed elastomer inner diameter – Ground metal outer diameter with sealant paint – Integral running surface	– Press fit metal OD for precise location in housing, addition of bore sealant paint helps to fill small imperfections in housing. – Ribbed elastomer ID gives effective static sealing on shaft surface as well as aiding installation. – Excluder lips offer contamination protection from the environment. – Integral running surface means no shaft grooving and calls for no special shaft preparation. – A bi-directional hydrodynamic aid helps as a pumping aid to improve functionality of the seal, by transferring fluid away from the lip at high speeds to give a positive impact on the life of the seal. – Primary lip is protected against installation and contamination damage, located remotely from the entry point of any dirt ingress.	– Large wheel hubs – Pinions – Prop shafts
R53 	– Two piece construction – Protected radial spring-loaded primary seal lip – Excluder lips – Ribbed elastomer inner and outer diameter – Integral running surface	– Elastomer OD sealing allows use in housings of increased roughness or with minor surface defects as well as aiding installation. – Ribbed elastomer ID and OD gives effective static sealing on shaft surface as well as aiding installation. – Excluder lips offer contamination protection from the environment. – Integral running surface means no shaft grooving and calls for no special shaft preparation. – Centrifugal lip configuration to allow a constant lip load to be maintained at varying speeds. – A bi-directional hydrodynamic aid helps as a pumping aid to improve functionality of the seal, by transferring fluid away from the lip at high speeds to give a positive impact on the life of the seal. – Primary lip is protected against installation and contamination damage, located remotely from the entry point of any dirt ingress.	– Large wheel hubs – Pinions – Prop shafts
R57 	– Robust 3 piece construction – Protected radial spring-loaded primary seal lip with hydrodynamic aid – Excluder lip with fixed interference – Ribbed elastomer inner and outer diameter – Integral running surface – Increased depth of seal	– Elastomer OD sealing allows use in housings of increased roughness or with minor surface defects as well as aiding installation. – Ribbed elastomer ID and OD gives effective static sealing on shaft surface as well as aiding installation. – Excluder lip offer contamination protection from the environment. – Integral running surface means no shaft grooving and calls for no special shaft preparation. – Centrifugal lip configuration to allow a constant lip load to be maintained at varying speeds. – A bi-directional hydrodynamic aid helps as a pumping aid to improve functionality of the seal, by transferring fluid away from the lip at high speeds to give a positive impact on the life of the seal. – Fixed interference of wiper lip ensures wiper contact at all times. – Suitable for deep bore applications common on American hub units. – Environmentally exposed surfaces rubber covered. – Primary lip is protected against installation and contamination damage, located remotely from the entry point of any dirt ingress.	– Large wheel hubs
R59 	– Two piece construction – Ground metal outer diameter with sealant paint – Ribbed elastomer inner diameter – PTFE primary lip – Excluder lips – Integral running surface	– Press fit metal OD for precise location in housing, addition of bore sealant paint helps to fill small imperfections in housing. – Ribbed elastomer ID gives effective static sealing on shaft surface as well as aiding installation. – PTFE primary lip allows for use at high speeds and helps reduce friction and increase life. – Excluder lips offer contamination protection from the environment. – Integral running surface means no shaft grooving and calls for no special shaft preparation. – Optional hydrodynamic aid helps as a pumping aid to improve functionality of the seal, by transferring fluid away from the lip at high speeds to give a positive impact on the life of the seal. – Primary lip is protected against installation and contamination damage, located remotely from the entry point of any dirt ingress.	– Diesel engine crankshaft – Differential – Transmission – Pinions – Small wheel hubs

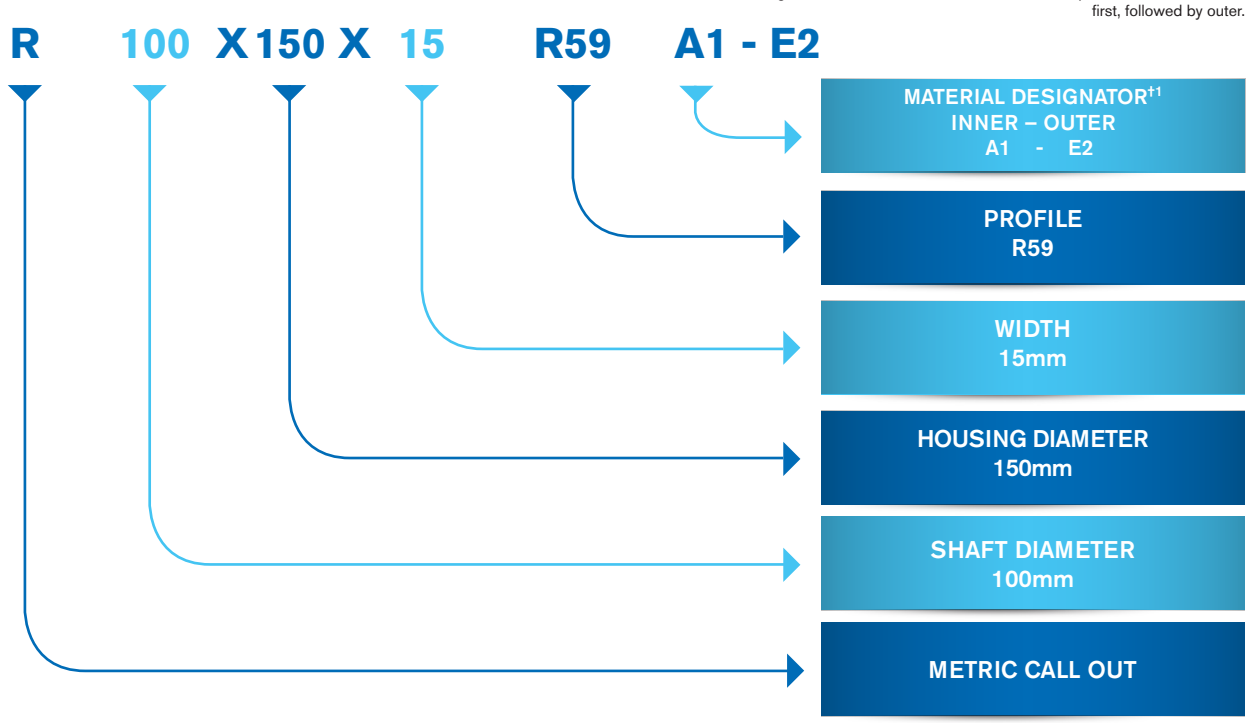
Imperial (English)



†Dimension rounded down to 2 decimal places then multiplied by 100

†1 If inner and outer components are of the same material, one compound designator is used. For two different materials separate with a dash. Inner first, followed by outer.

Metric



†1 If inner and outer components are of the same material, one compound designator is used. For two different materials separate with a dash. Inner first, followed by outer.

Inner and Outer Material Designator

Polymer Types	Compound Reference	Colour	Hardness (IRHD)	Temperature Range	Select for..	Material Designator
Nitrile rubber (NBR)	N-70-194	Black	70	-35 to +110°C	General purpose	N1
Fluorocarbon (FKM, A-type)	V-75-27	Black	75	-20 to +200°C	High temperature performance; high speed applications	F1
	V-85-195	Black	85	-20 to +200°C		F2
	V-75-50	Brown	75	-20 to +200°C		F3
	V-80-271	Black	80	-51 to +200°C	Specialist ultra-low temperature FKM	F4
	V-80-88	Black	80	-15 to +200°C	Specialist FKM terpolymer developed for use with bio-fuels	F5
Silicone (VMQ)	S-80-78	Red	80	-55 to +230°C	High and very low temperature; high eccentricity	S1
Polyacrylate (ACM)	A-70-196	Black	70	-30 to +175°C	High and low temperature capabilities; good compatibility with engine oils	A1
Hydrogenated nitrile (HNBR)	H-80-40	Black	80	-40 to +180°C	Abrasion resistance; high temperatures	H1

Other materials are available on request

PTFE Grades

Material Composition	Compound Reference	Colour	Coefficient of Friction	Temperature Range	Select for..	PTFE Designator
Glass and MoS_2 reinforced PTFE	PF-200	Grey	0.06 / 0.10	-160 to +290°C	Low wear, high life, reduced friction	E1
Graphite reinforced PTFE	PF-201	Grey / Black	0.06 / 0.10	-200 to +250°C	Soft shafts, reduced friction	E2

Other grades are available on request.

Technical and Installation Information

Housings

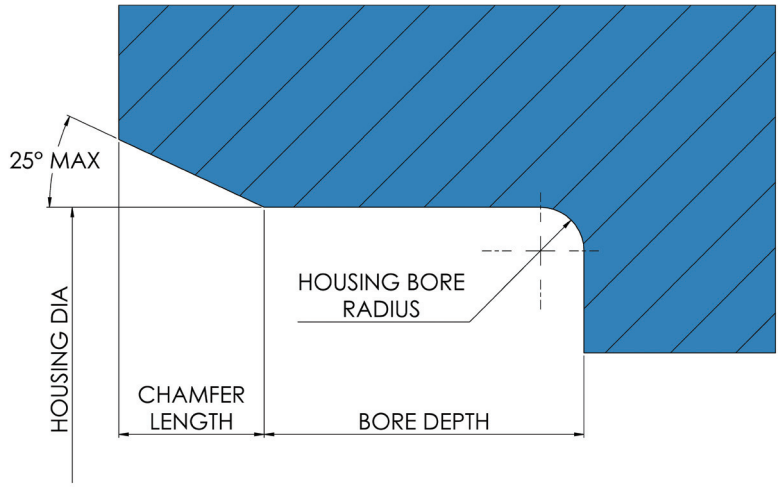
Materials

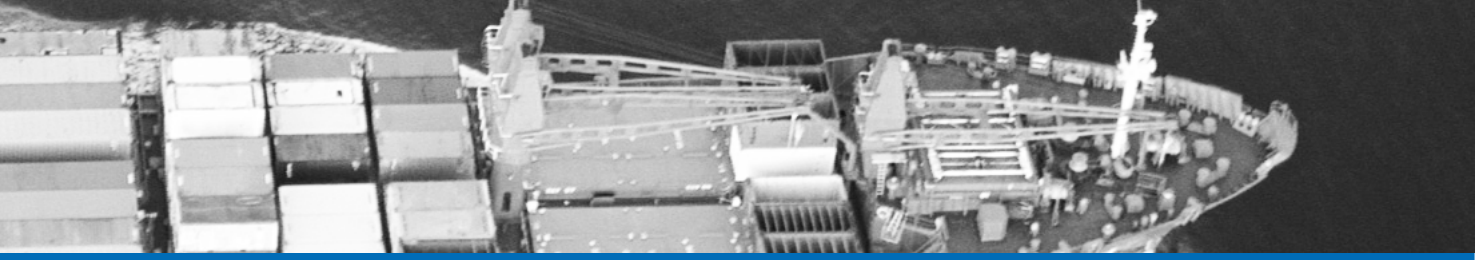
Most engineering materials can accommodate standard rotary lip seals. All steels and cast iron are suitable providing they are machined in accordance with the standards given, and there are no surface imperfections sufficient to provide a leak path. High thermal expansion materials such as light alloys and plastics are best catered for by rubber covered seals of the R21 and R23 types.

Surface Roughness, Dimensions and Tolerances

Parameter	Seals with Metal Outer Diameter	Seals with Rubber Outer Diameter
Surface Roughness (Ra)	0.2 - 0.8 µm	1.6 - 6.3 µm
Tolerance (ISO 286)	H8	H8

Housing Diameter	Length of Chamfer	Housing Bore Radius
Up to and Including 100mm (4.000")	0.70 to 1.00mm 0.028" to 0.040"	0.75mm max 0.030" max
Over 100mm (4.000")	1.20 to 1.50mm 0.047" to 0.059"	1.00mm max 0.040" max





Shafts

Materials

Most machine grades of steel are suitable as shaft material, providing they are free from flaws and surface impurities. Heat treatment is not usually necessary, but it is often recommended as a means of minimising shaft damage, which may cause substantial leakage. Certain grades of cast iron are suitable providing they are of high quality, with minimal porosity. Hard chrome plating may result in variable wear and should be avoided unless dictated by application conditions. Non-ferrous metals also produce variable performance; should corrosion resistance be required, harder grades of stainless steels are recommended.

Hardness

For optimum conditions and maximum lifetime of the seal, a shaft hardness of 45 – 60HRc is recommended (through hardened to a depth of 0.3mm). A minimum hardness of 60HRc is recommended for higher shaft speeds (>10m/s) and where ingress of abrasive contaminants/media are likely.

Method of Manufacture

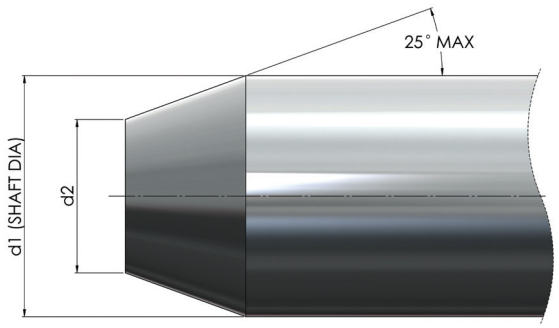
Optimum results are achieved by use of a plunge ground shaft with no lay on the shaft; to prevent oil pumping past the seal.

Surface Roughness, Dimensions and Tolerances

Parameter	Rotary Shaft Seals	PTFE Seals	Unitised Seals
Surface Roughness (Ra)	0.2 - 0.8 µm	0.2 to 0.4 µm	1.6 - 6.3 µm
Tolerance (ISO 286)	h11	h11	h8

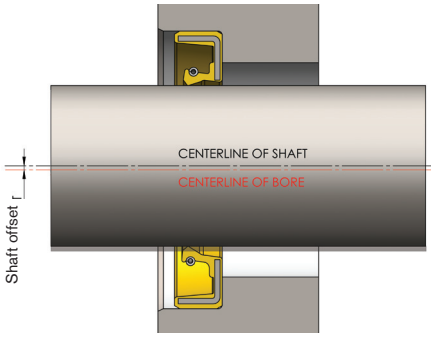
It is important to avoid too smooth and too coarse a surface finish. Too smooth a finish will create insufficient lubrication at the sealing lip, resulting in overheating and eventually cracking of the elastomer. Too coarse a finish and the seal will abrade and wear prematurely.

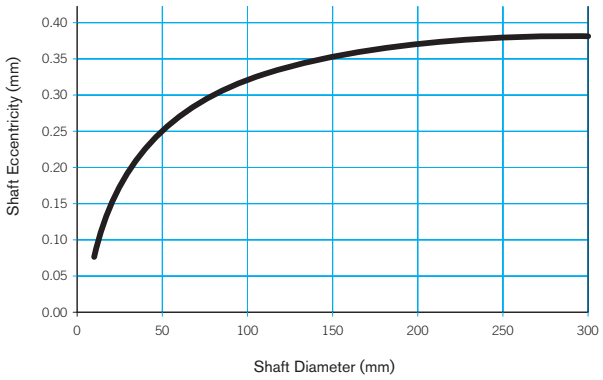
Lead-in Chamfers											
Shaft Diameter (mm)	0-10	10-20	20-30	30-40	40-50	50-70	70-90	90-110	110-130	130-250	250-500
d1 - d2-mm	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	7.0	11.0



Shaft Misalignment

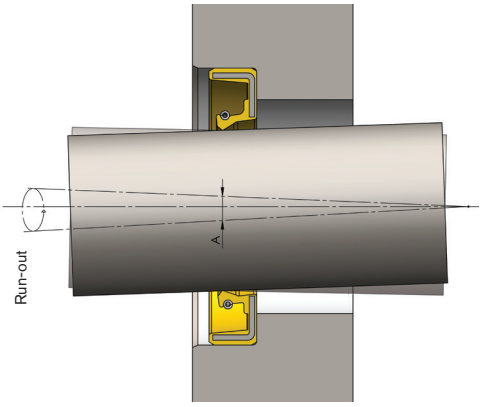
Eccentricity between the centre line of the shaft and the centre line of the housing bore should be kept to a minimum, if there is a large deviation between the two, a unilateral load will be applied to the sealing edge, thus creating heavier wear on one side of the seal. This will in time affect the performance and the life of the seal. For permissible values see graph.

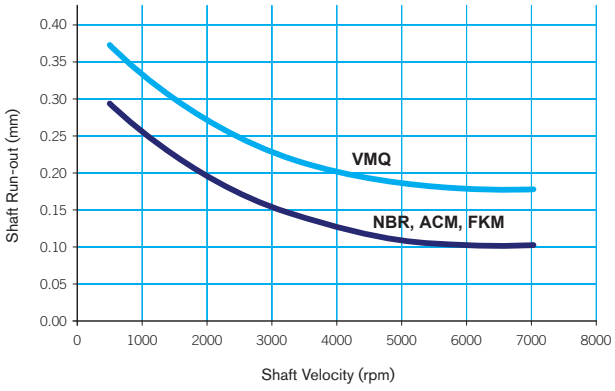




Shaft Run-out (T.I.R.)

Shaft run-out is to be avoided as much as possible, at higher shaft surface speeds it is increasingly difficult (due to its inertia) for the sealing lip to follow the shaft if there is any run-out present. If the lip cannot follow the shaft, the edge will lift from the shaft allowing a leak path through the inside diameter of the seal. This can be kept to a minimum by locating the seal in close proximity to the bearing. Permissible run-out values are shown below.



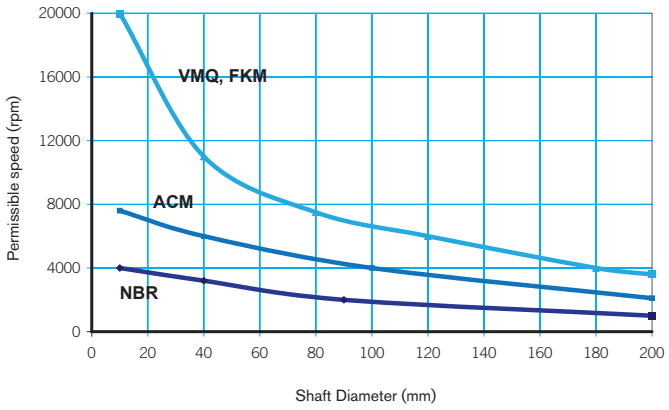


Shaft Surface Speed

The shaft surface speed (V) is defined by the number of revolutions per min (r.p.m.) and the shaft diameter (d1) this is one of the most critical inputs when selecting the type and material of a rotary shaft seal.

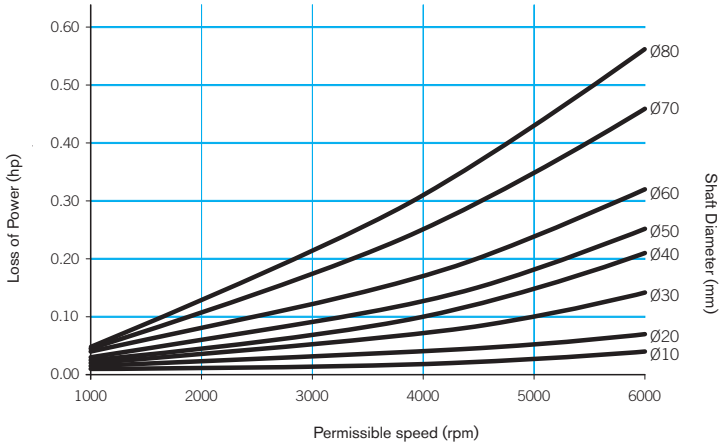
$$V\ (m/s) = \frac{d1\ (mm) \times \pi \times r.p.m.}{60{,}000}$$

Different designs of rotary lip seals allow for different surface speeds. Below is shown approximate permissible surface speeds for R4 & R21 type seals, based on the materials NBR, ACM, FKM (FPM) & VMQ (when provided with adequate lubrication and good heat dissipation by the sealed media under no differential pressure).



Lubrication and Frictional Losses

The graph below approximates friction losses of a rotary lip seal used in standard SAE-30 oil (conducted at 100°C on a correctly prepared shaft, after a short time of running-in). The chart demonstrates the relationships between power loss, shaft diameter and shaft surface speed (V).

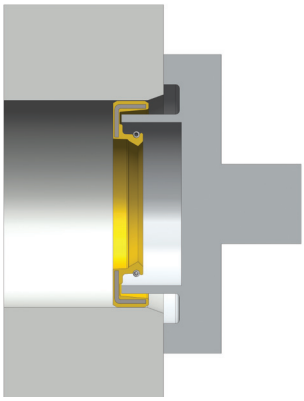


Seal Installation

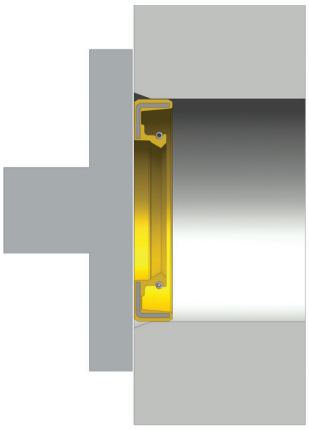
The rotary lip seal, shaft and housing must be clean prior to installation. Contaminants i.e. dirt, grit etc, which may enter the system during assembly can lead to leakage.

The inside diameter of the rotary lip seal has to be stretched during assembly, thus it is necessary that the shaft has a chamfer. The chamfer angle should be between 15 - 25°. If there is a spline present on the shaft there is a danger that the inside diameter of the seal could be damaged, resulting in immediate leakage. Therefore the sealing lip must be protected on installation by the use of a fitting sleeve.

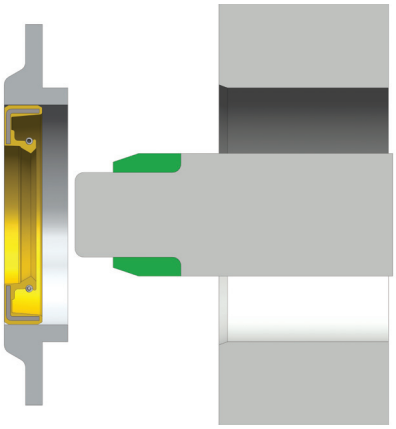
Insertion of the rotary lip seal into the housing must be done evenly; an adapted fitting tool should be used to ensure force is transferred through to the metal part of the rotary lip seal.



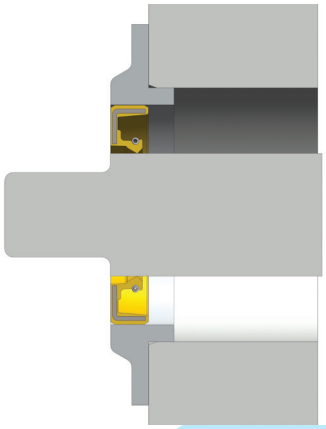
Design of tool to fit a seal partway down a bore.



Tool designed to fit a seal flush with the housing. Plate pressed to face of housing gives square location of seal.



Use of sleeve for assembly over a sharp corner.



Use of spigot to ensure concentricity of seal to shaft.

Non-Standard Elastomeric Rotary Lip Seals

The demands of the Transportation industry often mean that additional profile features are required over that of a standard Rotary Lip Seal to achieve specific requirements. Some of these additional features and benefits are listed below:

- A flanged Rotary lip seal will allow easy installation or replacement, giving additional structural rigidity as well as limiting installation depth into the housing.
- Multiple / extended secondary lip configurations for improved retention of lubricants and to keep out high levels of dirt.
- Pre-greased cavity between primary and secondary lips to combat initial dry running.
- Increased flexible beam section designed for operation at high speeds and in conditions of unusually high shaft deflections.
- Non-standard application hardware or where limited space is available.

Shaft Sleeves

Shaft Sleeves are typically used to repair damaged running surfaces, however they can be used in production to cost-effectively achieve appropriate surface hardness and finish. ERIKS Sealing Technology can provide shaft sleeves manufactured from chromed stainless steel and HVOF-applied wear surfaces. Our manufacturing processes carefully control the average roughness (Ra) and material ratio (Tp) of the surface to maximise life and sealing efficiency.

GS Split

The GS split seal is used in applications where installation and replacement mandates that the surrounding hardware cannot be fully disassembled.

Features and Benefits

- Easy installation and removal
- Suitable for very large diameters
- Robust design
- Flange design allowing accurate positioning
- Short axial length

Applications

- Large Marine Gearbox
- Marine Propulsion Systems

GSFD - double lip flanged

GSF - single lip flanged

Imperial (English)

GSF 475 337 75 - N

MATERIAL	N – NBR F – FKM
WIDTH†	0.750”
SHAFT DIAMETER†	3.375”
HOUSING DIAMETER†	4.75”
TYPE	GSF - SINGLE LIP FLANGED GSFD - DOUBLE LIP FLANGED

†Dimension rounded down to 2 decimal places then multiplied by 100

R70 Fabric Located Heavy Duty Rotary

Our R70 series of heavy duty rotary lip seals are ideal for applications with large diameters, tolerances and eccentricities.

Features and Benefits

- Fabric reinforced outer diameter allows for easy installation and removal
- Can be supplied split
- Primary sealing lip is flexible to accommodate shaft eccentricity
- Low friction and shaft wear

Applications

- Marine Propulsion Systems
- Heavy Duty Gearbox

Metric

R 120 X 160 X 10 R70 - N / S

- R — METRIC DESIGNATOR
- 120 — SHAFT DIAMETER 120mm
- 160 — HOUSING DIAMETER 160mm
- 10 — WIDTH 10MM
- R70 — PROFILE: R70 – SINGLE LIP; R71 – ADDITIONAL DUST LIP
- N — MATERIAL: N – NBR & Fabric; F – FKM & Fabric
- S — S SPLIT - NON-SPLIT

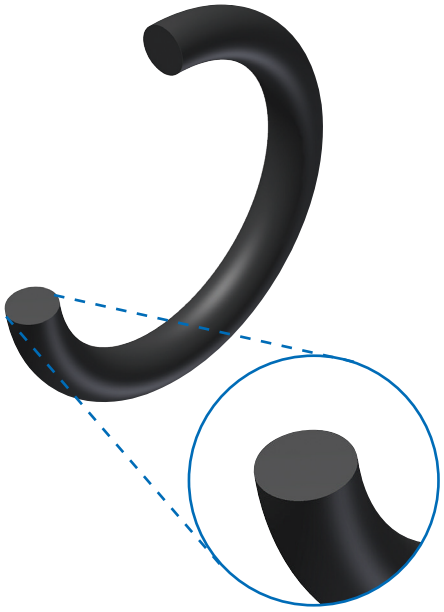
Imperial size range also available, see page 30 for part numbering format.

O-ring

Product Overview

The most common type of static seal is the flexible elastomer O-ring. O-rings provide an affordable seal that in most cases are simple to install and subject to correct material selection, give acceptable life between maintenance checks.

Available in a variety of materials to suit every sealing application, fully moulded O-rings are manufactured to several international size standards, including BS1806, BS4518, AS568 and ISO 3601. Alternatively non-standard custom sizes, up to 2.5m (8ft) diameter can be produced to specific requirements.

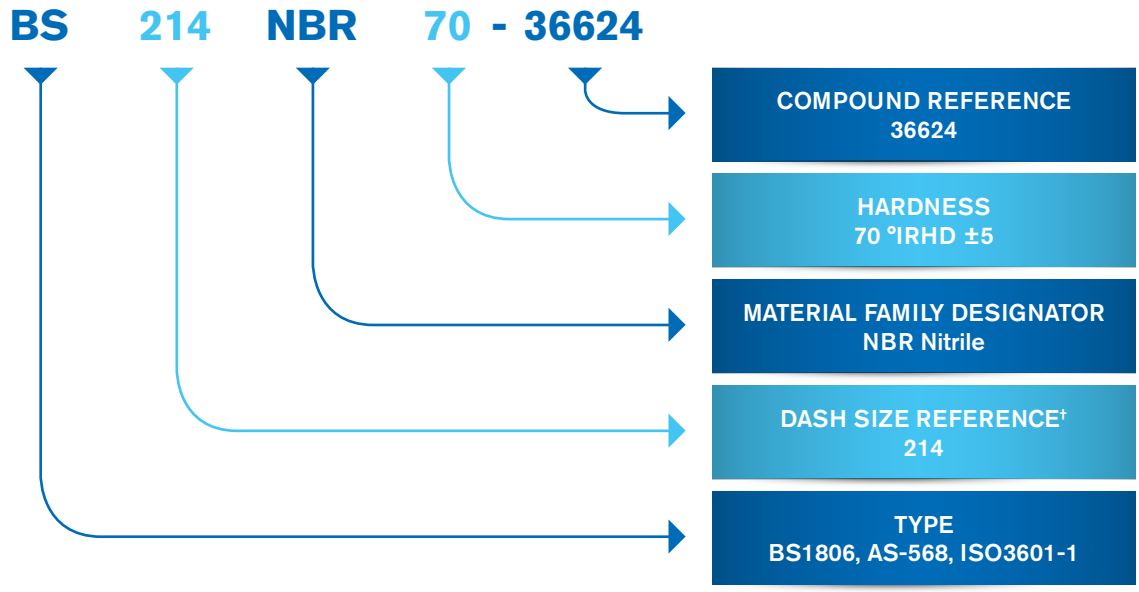


O-ring Standard Compounds

Elastomer	Compound Reference	Colour	Hardness (IRHD)	Temperature Range	Select for..	Material Designator
Nitrile rubber (NBR)	36624	Black	70	-30 to +120°C	Standard compound with good compression set values. Medium acrylonitrile content for use with hydraulic oils, alcohols, water, air, fuels and many other fluids.	NBR
	366513	Green	60	-35 to +120°C	Low temperature NBR elastomer for use in hydraulic applications.	
	366518	Black	60	-50 to +120°C	Low temperature NBR elastomer for use in pneumatic applications.	
	366521	Black	60	-55 to +120°C	Very low temperature NBR elastomer for use in pneumatic systems.	
Fluorocarbon (FKM, A-type)	51414	Black	75	-20 to +200°C	General purpose compound with very low compression set characteristics at high temperatures. Chemically resistant to oils, greases and fuels.	FPM
Fluorocarbon (FKM, GF-type)	514323	Black	75	-20 to +200°C	High fluorine content elastomer offering excellent resistance to fuels and lubricants. Specifically formulated for resistance to bio-fuels and coolants.	
Fluorocarbon (FKM, Ultra-low temp type)	514322	Black	75	-51 to +200°C	Fluoroelastomer with exceptionally low temperature performance. Good resistance to lubricants and fuels.	
Silicone (VMQ)	714177	Red	70	-60 to +220°C	High and very low temperature.	SIL
Polyacrylate (ACM)	335001	Black	70	-10 to +150°C	High and low temperature capabilities; good compatibility with engine oils.	ACM
Polychloroprene (CR, Neoprene)	32906	Black	70	-35 to +110°C	Good ageing characteristics in ozone and weather environments, along with abrasion and flex-cracking resistance. Offers resistance to fluorine-based refrigerants.	CR
Polyurethane (AU)	900270	Black	70	-40 to +95°C	Standard compound offering excellent performance in dynamic applications due to the materials inherent excellent wear resistance.	AU
Hydrogenated nitrile (HNBR)	88625	Black	70	-30 to +180°C	General purpose compound offering improved temperature resistance over NBR grades. Good oil, coolant and hydrocarbon resistance, with excellent abrasion resistance.	HNR

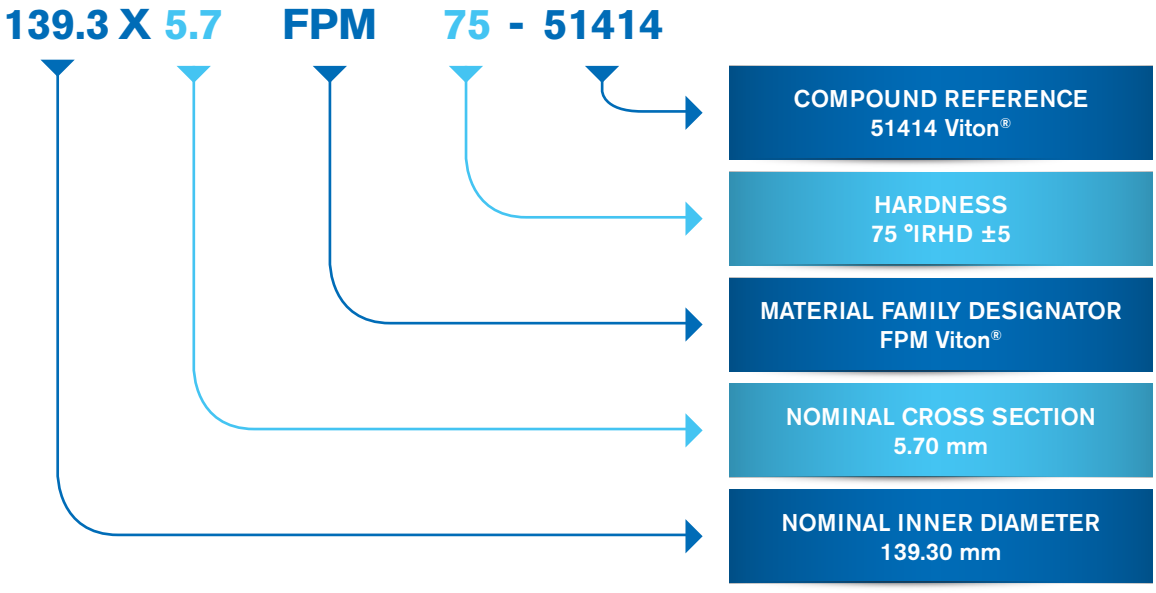
Many more materials available on request.

Imperial O-rings



†O-rings are supplied to ISO3601-1 class 2 tolerances unless otherwise specified.

Metric O-rings



†O-rings are supplied to ISO3601-1 class 2 tolerances unless otherwise specified.

*O-ring and hardware dimensional details are available at:
http://oring-groove-wizard.eriks.co.uk/DiameterGrooves.aspx

X-ring

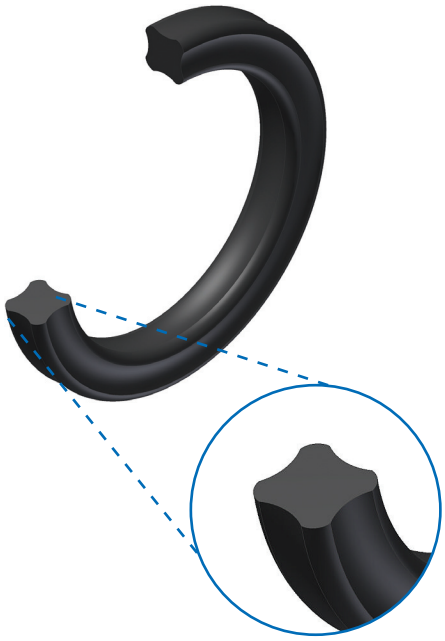
Product Overview

X-rings can be used in a wide variety of static and dynamic sealing applications. They are available in standard O-ring sizes.

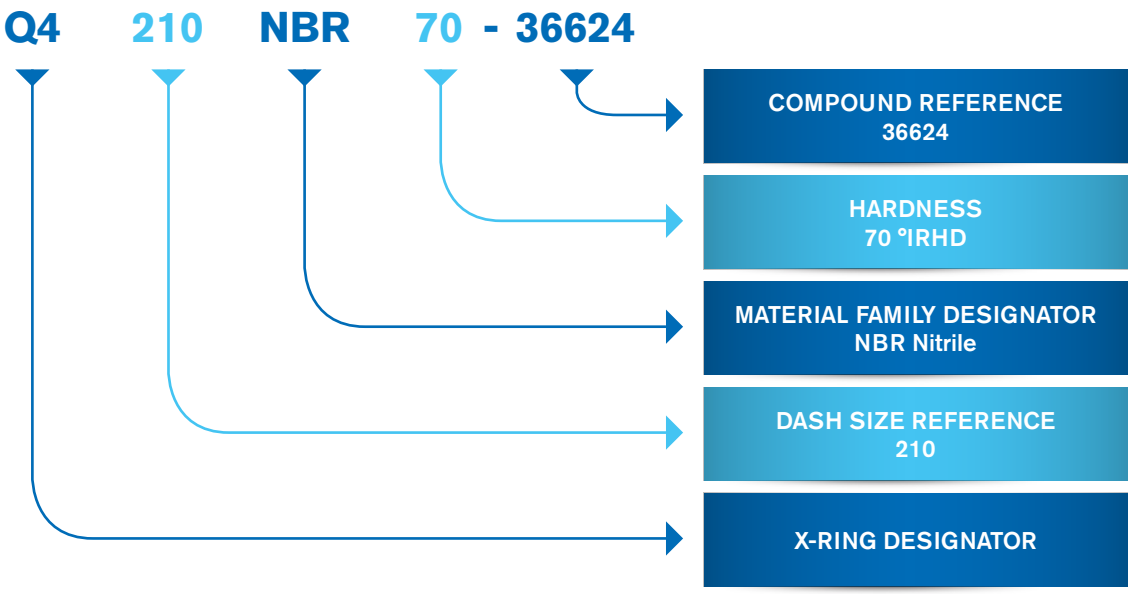
Their four-lobed design provides a larger sealing area in comparison to a standard O-ring. The double seal action requires lower squeeze levels to maintain an effective seal, thus reducing friction level and improving seal life.

X-ring parting lines are between the lobes, away from the sealing surface, therefore eliminating the problems of leakage often resulting from a parting lines irregular surface as found on an O-ring.

X-rings are designed to out perform a standard O-ring in rotary seal applications. The four lobed configuration creates a more stable seal avoiding spiral twisting which can occur in reciprocating applications.



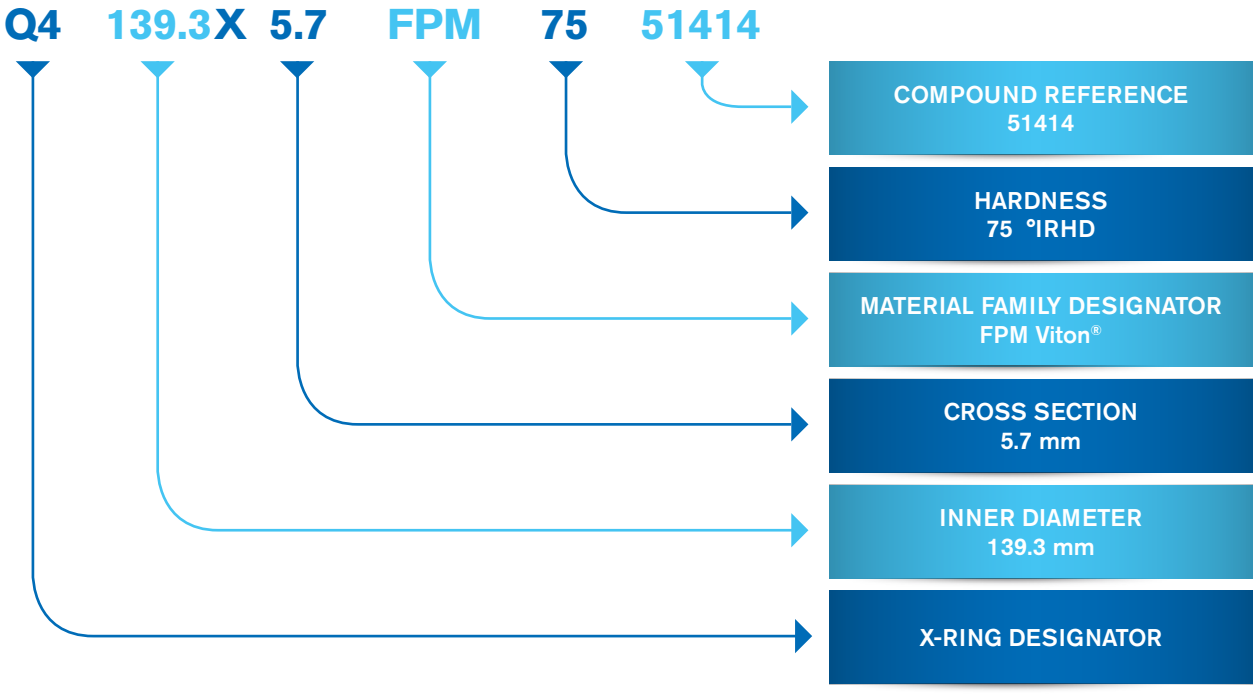
X-Rings



X-ring Materials

Elastomer	Colour	Hardness (IRHD)	Temperature Range	Select for..	Compound Reference	Material Family Designator
Nitrile rubber (NBR)	Black	70	-30 to +120°C	Standard compound with good compression set values. Medium acrylonitrile content for use with hydraulic oils, alcohols, water, air, fuels and many other fluids.	36624	NBR
Fluorocarbon (FKM, A-type)	Black	75	-20 to +200°C	General purpose compound with very low compression set characteristics at high temperatures. Chemical resistant to oils, greases and fuels.	51414	FPM

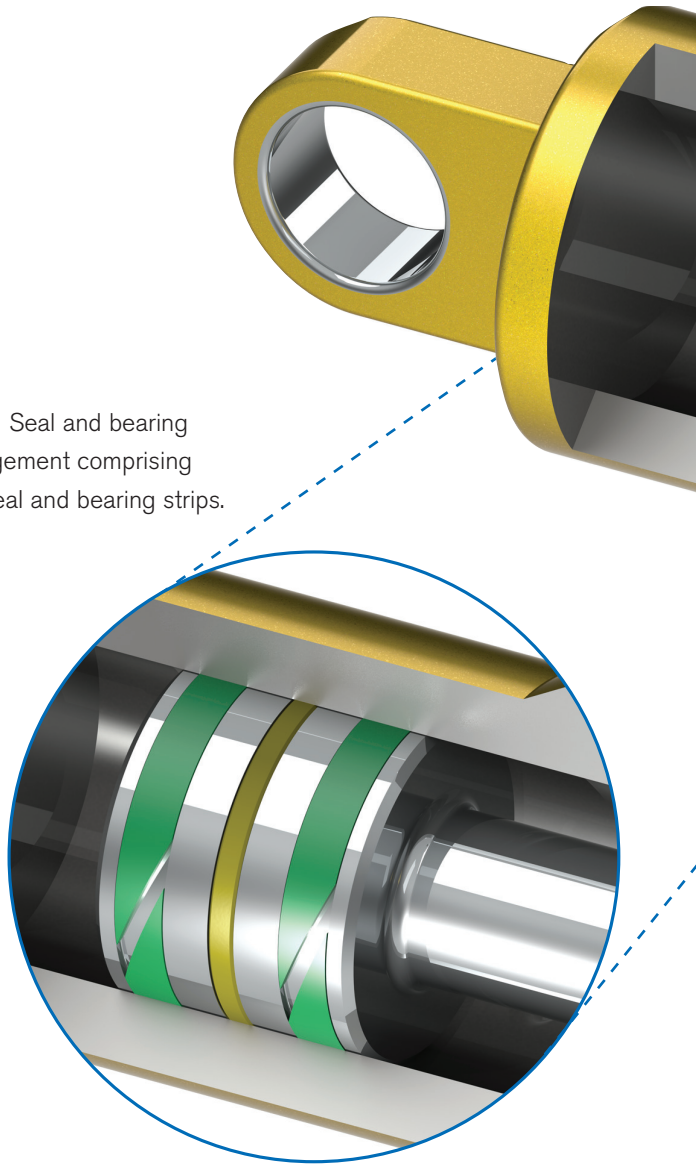
Metric X-Rings



*O-ring and hardware dimensional details are available at:
http://oring-groove-wizard.eriks.co.uk/DiameterGrooves.aspx

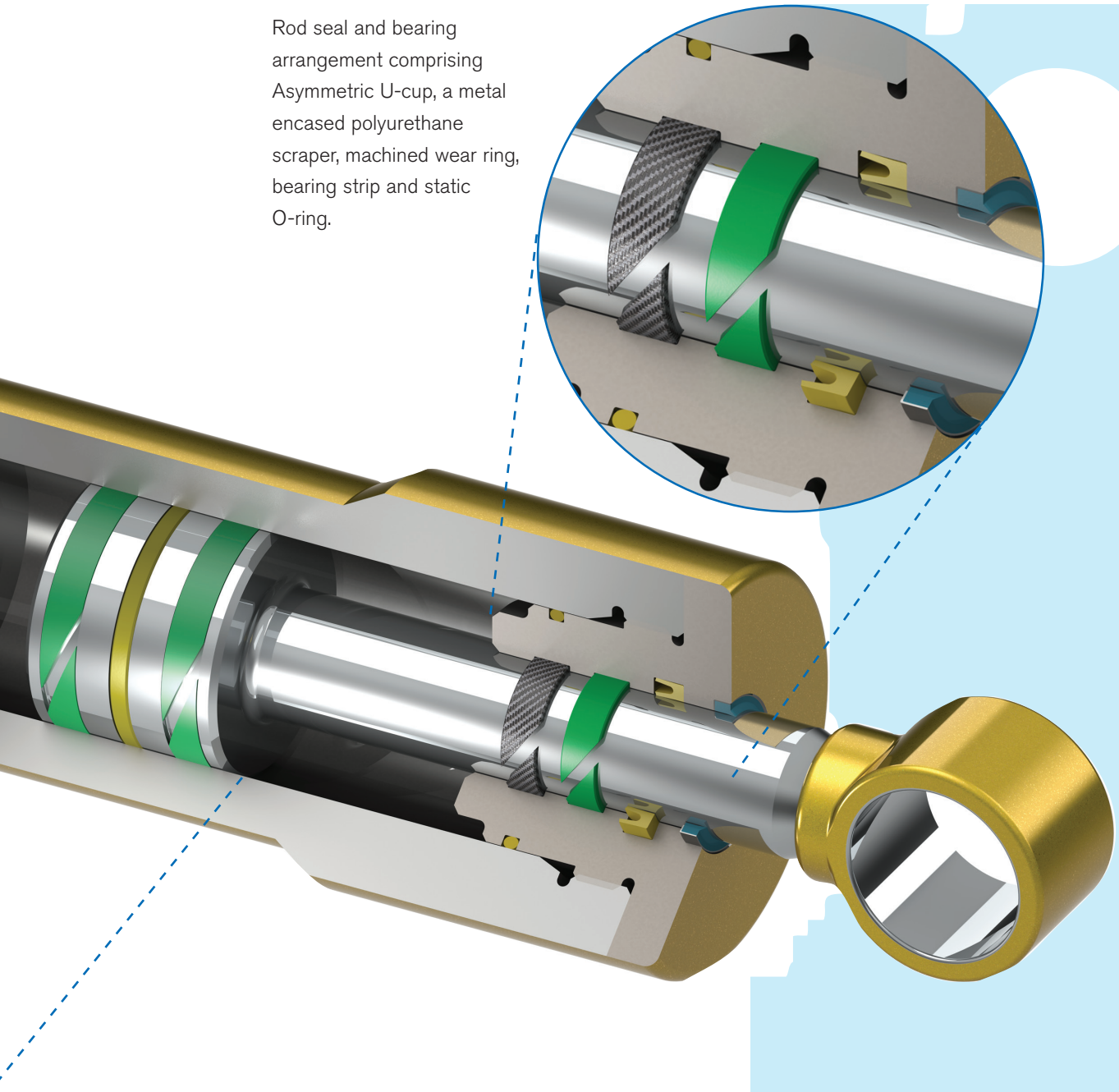
Typical Seal Arrangement for Cylinders

ERIKS Sealing Technology are able to specify and provide complete sealing systems for your application.



Piston Seal and bearing arrangement comprising cap seal and bearing strips.

Rod seal and bearing arrangement comprising Asymmetric U-cup, a metal encased polyurethane scraper, machined wear ring, bearing strip and static O-ring.



*O-ring and hardware dimensional details are available at:
http://oring-groove-wizard.eriks.co.uk/DiameterGrooves.aspx

Capped O-ring

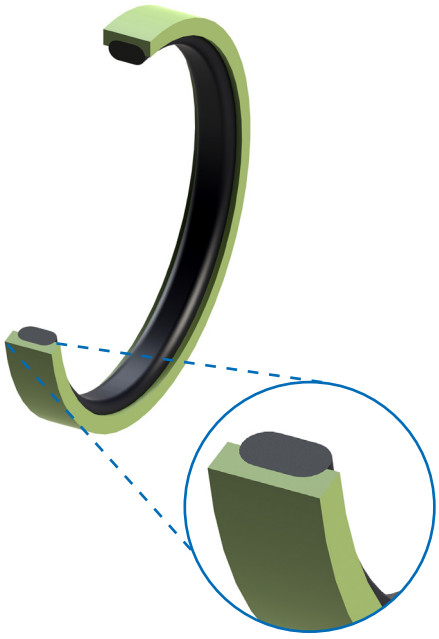
Product Overview

Capped O-rings are a cost-effective solution for providing cap seals for rod and piston seal applications. The seal assembly consists of a cap manufactured from one of ERIKS premier PTFE compounds and an O-ring to act as the seal energiser.

The design of the capped O-ring protects the elastomer from extrusion and nibbling. The specially profiled cap element acts as the seal's dynamic interface and prevents spiral failure and reduces stick slip, commonly associated with O-ring seals.

Our capped O-rings are designed to retrofit existing O-ring grooves, including AS4716 standard housing dimensions. Both metric and imperial sizes are available and can be tailored to fit housing dimensions provided. Our technical team can also advise on how to optimise O-ring squeeze to minimise seal friction.

pioneer WESTON



COP - 10000 - C - 36624 - E491 - PWI

PTFE GRADE CODE E491	- E491
ELASTOMERIC ENERGISER COMPOUND REFERENCE 36624	- 36624
RADIAL SECTION CODE A = 1.78 B = 2.62 C = 3.53 D = 5.33 E = 6.99	- C
BORE/ROD DIAMETER 150.00 mm	- 10000
TYPE COP = PISTON COR = ROD	COP -

Elastomeric Energiser Materials

Elastomer	Colour	Hardness (IRHD)	Temperature Range	Select for..	Compound Reference
Silicone (VMQ)	Red	70	-60 to +220°C	High and very low temperature; high eccentricity	714177
Polyacrylate (ACM)	Black	70	-10 to +150°C	High temperature capabilities; good compatibility with engine oils	335001
Nitrile rubber (NBR)	Black	70	-30 to +120°C	General purpose	36624
Fluorocarbon (FKM, A-type)	Black	75	-20 to +200°C	High temperature performance; high speed applications; 514141 for improved coolant and fuel resistance	51414
	Green	75	-20 to +200°C		51414G
Fluorocarbon (FKM, GF-type)	Black	75	-10 to +200°C		514141
Hydrogenated nitrile (HNBR)	Black	70	-30 to +180°C	High temperatures, moderate fuel resistance	88625

PTFE Grade Codes

Material Composition	Colour	Coefficient of Friction	Temperature Range	Select for..	PTFE Reference
Virgin PTFE	White	0.05 / 0.08	-240 to +200°C	Static or low duty cycles	E400
Glass and MoS_2 reinforced PTFE	Grey / Black	0.06 / 0.10	-160 to +290°C	Dynamic or static, medium duty cycles, hardened metal running surfaces	E431
Graphite reinforced PTFE	Black	0.06 / 0.10	-200 to +250°C	Dynamic, medium duty cycles	E471
Carbon and graphite reinforced PTFE	Black	0.08 / 0.12	-200 to +250°C	Dynamic, medium duty cycles	E462
Polyester reinforced PTFE	Beige	0.08 / 0.12	-130 to +290°C	Dynamic or static, medium to high duty cycles, minimum 45 HRc running surface	E491
Carbon, graphite and PPS reinforced PTFE	Grey/Black	0.08 / 0.12	-130 to +290°C	Dynamic or static, high duty cycles, hardened metal running surfaces	E282Z

*O-ring and hardware dimensional details are available at:
http://oring-groove-wizard.eriks.co.uk/DiameterGrooves.aspx

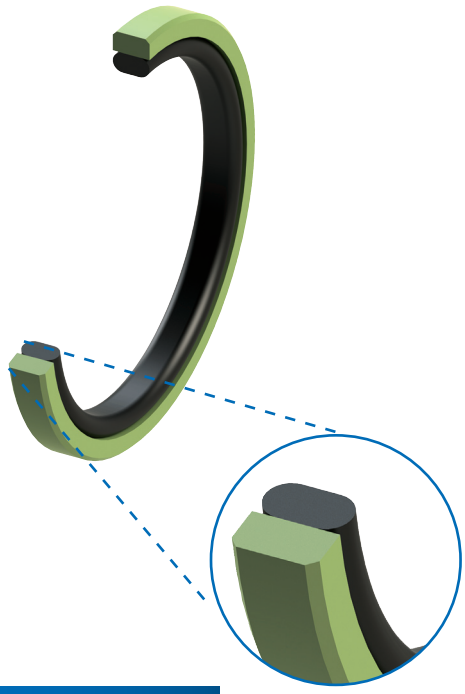
Double Acting Cap Seal

Product Overview

A self-actuating, bi-directional, extrusion resistant seal that combines low breakout and running friction with minimal leakage. The seal is constructed of a premium grade PTFE sealing element and an elastomer energiser.

The Double Acting Cap Seal is a reliable, compact design with a long service life and is available in both rod and piston type geometries to retro-fit into ISO7425-2. Stick-slip is eliminated even after long periods of inactivity whether in a lubricated or non-lubricated environment, giving low breakout friction.

pioneer WESTON

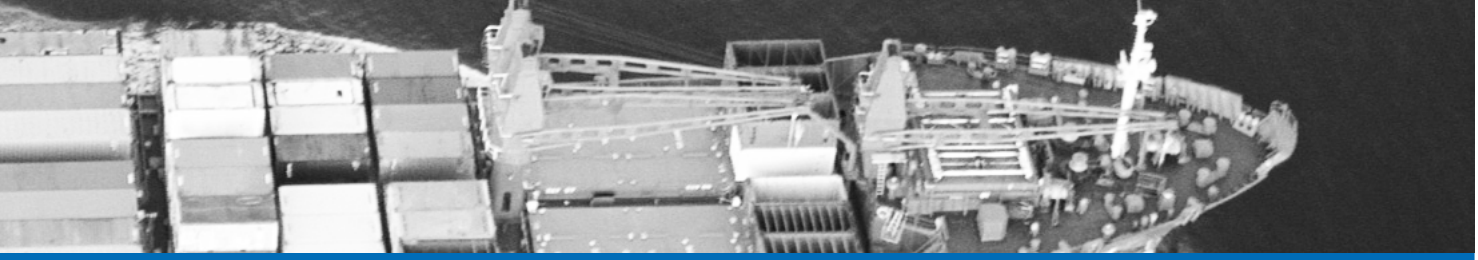


C SP- 15000- D - 36624 - E471 - PWI

- **PTFE GRADE CODE**
  E471
- **ELASTOMERIC ENERGISER COMPOUND REFERENCE**
  36624
- **RADIAL SECTION CODE**
  A = 1.78
  B = 2.62
  C = 3.53
  D = 5.33
  E = 6.99
- **BORE/ROD DIAMETER**
  150.00 mm
- **TYPE**
  SP – Piston Type Single Acting
  DP – Piston Type Double Acting
  SR – Rod Type Single Acting
  DR – Rod Type Double Acting

Standard Radial Sections

Radial Section Code	Standard Bore / Rod diameter (mm)	Piston Groove Diameter (mm)	Rod Groove Diameter (mm)	Groove Width (mm)
A = 1.78	8 – 16.9	Bore Ø – 4.9	Rod Ø + 4.9	2.20
B = 2.62	17 – 26.9	Bore Ø – 7.3	Rod Ø + 7.3	3.20
C = 3.53	27 – 59.9	Bore Ø – 10.7	Rod Ø + 10.7	4.20
D = 5.33	60 – 199.9	Bore Ø – 15.1	Rod Ø + 15.1	6.30
E = 6.99	200 – 255.9	Bore Ø – 20.5	Rod Ø + 20.5	8.10



Elastomeric Energiser Materials

Elastomer	Colour	Hardness (IRHD)	Temperature Range	Select for..	Compound Reference
Silicone (VMQ)	Red	70	-60 to +220°C	High and very low temperature; high eccentricity	714177
Polyacrylate (ACM)	Black	70	-10 to +150°C	High temperature capabilities; good compatibility with engine oils	335001
Nitrile rubber (NBR)	Black	70	-30 to +120°C	General purpose	36624
Fluorocarbon (FKM, A-type)	Black	75	-20 to +200°C	High temperature performance; high speed applications; 514141 for improved coolant and fuel resistance	51414
	Green	75	-20 to +200°C		51414G
Fluorocarbon (FKM, GF-type)	Black	75	-10 to +200°C		514141
Hydrogenated nitrile (HNBR)	Black	70	-30 to +180°C	High temperatures, moderate fuel resistance	88625

PTFE Grade Codes

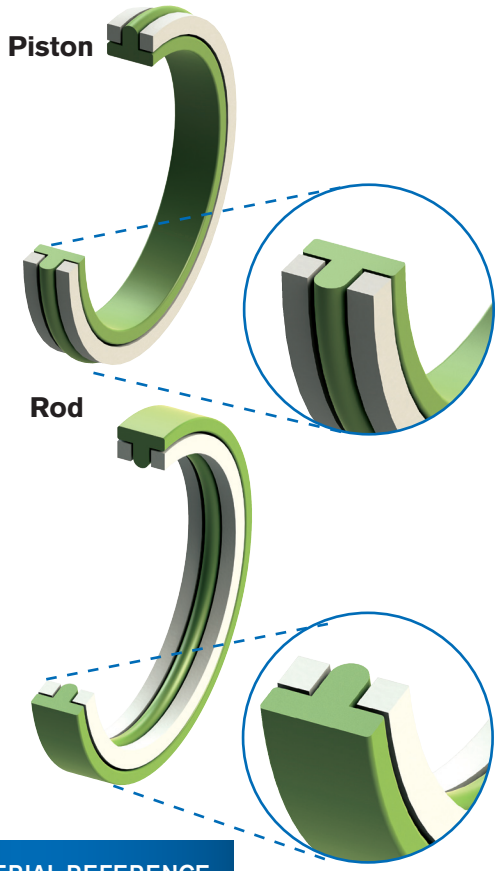
Material Composition	Colour	Coefficient of Friction	Temperature Range	Select for..	PTFE Reference
Virgin PTFE	White	0.05 / 0.08	-240 to +200°C	Static or low duty cycles	E400
Glass and MoS_2 reinforced PTFE	Grey / Black	0.06 / 0.10	-160 to +290°C	Dynamic or static, medium duty cycles, hardened metal running surfaces	E431
Graphite reinforced PTFE	Black	0.06 / 0.10	-200 to +250°C	Dynamic, medium duty cycles	E471
Carbon and graphite reinforced PTFE	Black	0.08 / 0.12	-200 to +250°C	Dynamic, medium duty cycles	E462
Polyester reinforced PTFE	Beige	0.08 / 0.12	-130 to +290°C	Dynamic or static, medium to high duty cycles, minimum 45 HRc running surface	E491
Carbon, graphite and PPS reinforced PTFE	Grey/Black	0.08 / 0.12	-130 to +290°C	Dynamic or static, high duty cycles, hardened metal running surfaces	E282Z

T- Seal

Product Overview

Typically used in reciprocating and high pressure static applications, T-Seals comprise a single T-section elastomeric energiser and two thermoplastic back-up rings. Available in both piston and rod geometries, T-Seals can retro-fit into most standard O-ring grooves designed for widths to accommodate 0, 1 or 2 back-ups.

The shape prevents spiral failure whilst reciprocating. The elastomer component transmits the system pressure under the low pressure back-up ring, forcing it into position, closing the extrusion gap. As an elastomeric contact seal, the T-Seal provides highly efficient sealing and can be used in applications where two fluid types need to be separated e.g. gas, oil separation by an accumulator piston seal.



T1P-BSI-214- - C- 36624 - E471 - PWI

- **BACK-UP MATERIAL REFERENCE**
  E471
- **ELASTOMER ENERGISER COMPOUND REFERENCE**
  36624
- **BACK-UP RING STYLE**
  C=SCARF CUT S = SOLID
- **GROOVE WIDTH**
  0 = Zero back-up ring width (Narrow)
  1 = Single back-up ring width (Inter)
  2 = Double back-up ring width (Wide)
- **SIZE REFERENCE**
  214
- **GROOVE DESIGN STANDARD**
  BSI = BS1806, ASD = AS4716
  ASS = ASS857, ISO = ISO3601
  BSM = BS4518
- **TYPE**
  T1P = PISTON
  T1R = ROD

Elastomeric Energiser Materials

Elastomer	Colour	Hardness (IRHD)	Temperature Range	Select for..	Compound Reference
Nitrile rubber (NBR)	Black	70	-30 to +120°C	General purpose	36624
Fluorocarbon (FKM, A-type)	Black	75	-20 to +200°C	High temperature performance; high speed applications	51414
	Green	75			51414G

Back-Up Material Reference Codes

Material Composition	Colour	Coefficient of Friction	Temperature Range	Select for..	PTFE Reference
Virgin PTFE	White	0.05 / 0.08	-240 to +200°C	Static or low duty cycles	E400
Glass and MoS_2 reinforced PTFE	Grey / Black	0.06 / 0.10	-160 to +290°C	Dynamic or static, medium duty cycles, hardened metal running surfaces	E431
Graphite reinforced PTFE	Black	0.06 / 0.10	-200 to +250°C	Dynamic, medium duty cycles	E471
Carbon and graphite reinforced PTFE	Black	0.08 / 0.12	-200 to +250°C	Dynamic, medium duty cycles	E462
Polyester reinforced PTFE	Beige	0.08 / 0.12	-130 to +290°C	Dynamic or static, medium to high duty cycles, minimum 45 HRc running surface	E491
Carbon, graphite and PPS reinforced PTFE	Grey/Black	0.08 / 0.12	-130 to +290°C	Dynamic or static, high duty cycles, hardened metal running surfaces	E282Z

*O-ring and hardware dimensional details are available at:
http://oring-groove-wizard.eriks.co.uk/DiameterGrooves.aspx

Energised Lip Seals

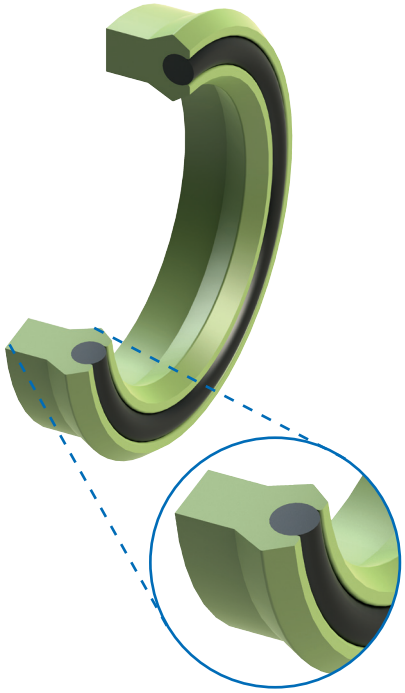
Product overview

Pioneer Weston's Energised Lip Seal is a symmetrical seal optimised for heavy duty reciprocating applications with unidirectional pressure.

The Energised Lip Seal comprises a high modulus, highly durable, wear resistant, elastomeric jacket, energised by a low modulus split O-ring.

The jacket provides superior sealing efficiency and abrasion resistance, whilst the O-ring both transmits system pressure to the contact surfaces and ensures energisation of the seal lips under low pressure or low temperature. The elongated square heal minimises seal roll and improves seal stability.

By separating the sealing and energising functions, optimal materials may be selected for each. A typical application would include actuator rod seals.



Imperial (English) Sizes

ELS - AM1 - 125 - 006000 - 343 - PWI

- **ELS** — ENERGISED LIP SEAL TYPE ELS
- **AM1** — JACKET COMPOUND REFERENCE AM1
- **125** — NOMINAL RADIAL GROOVE CROSS SECTION 0.125" = 125†3
- **006000** — NOMINAL SEAL ID 6.000" = 006000†2
- **343** — NOMINAL AXIAL GROOVE WIDTH 0.125" = 125†1

†1 to 3 decimal places multiplied by 1000

†2 (Rod diameter/Piston groove diameter to 3 decimal places) multiplied by 1000

Compound References

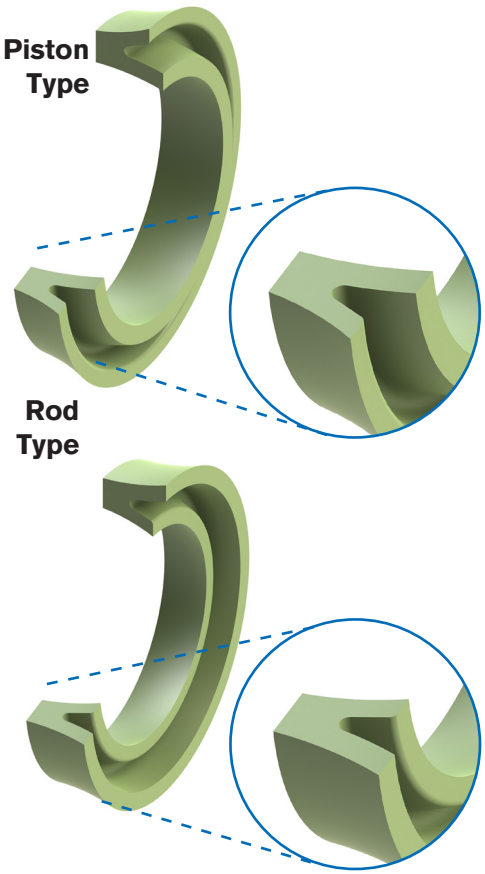
Jacket Material	Compound Reference	Energiser Material	Colour	Hardness (IRHD)	Temperature Range	Select for..	Material Designator
Polyurethane, moulded	PU-90-203	NBR 70	Black	90	-40 to +100°C	Hydraulic ram rod seals for high volume manufacture.	AM1
Polyurethane, machined	PU-90-202	NBR 70	Green	90	-40 to +100°C	Hydraulic ram rod seals for low volume manufacture.	AC1
Polyurethane, hydrolysis resistant	PU-95-166	NBR 70	Red	95	-40 to +100°C	Hydraulic ram rod seals in aqueous environments- low volume manufacture.	AH1
Nitrile rubber (NBR)	N-90-204	NBR 70	Black	90	-35 to +110°C	Piston applications for low – medium pressure	NJ1
Hydrogenated nitrile (HNBR), moulded	H-85-205	HNBR 70	Black	85	-40 to +180°C	Elevated temperatures, high abrasion resistance	HJ1
Hydrogenate nitrile (HNBR), machined	H-85-206	HNBR 70	Black	85	-40 to +180°C	Elevated temperatures, high abrasion resistance, low volume, rapid manufacture	HJ2
Fluorocarbon (FKM, A-type)	V-85-207	FKM 75	Green	85	-20 to +200°C	High temperatures, increased chemical resistance	FJ1

Asymmetric U-Cup

Product Overview

Pioneer Weston's asymmetric U-cup is available in both piston and rod geometries and offers a stand alone, robust solution for both hydraulic and pneumatic reciprocating applications. The asymmetric U-cup may be used as the primary seal in tandem rod arrangements, or back-to-back in piston applications due to the venting lip design. Under low pressure the asymmetric U-cup exerts low friction upon mating hardware requiring low actuation force. Available in a range of high performance materials, the asymmetric U-cup offers exceptional performance and service life, whilst minimising the required space envelope required.

Symmetric U-cup designs are also available.



Imperial (English) Sizes

AUCP - AM1 - 125 - 001000 - 375 - PWI

AUCP	TYPE AUCP = PISTON AUCR = ROD
AM1	MATERIAL DESIGNATOR AM1
125	NOMINAL GROOVE RADIAL PACKING SPACE 0.125" = 125†3
001000	NOMINAL SEAL ID (ROD DIAMETER) 1.000" = 001000†2
375	NOMINAL AXIAL GROOVE WIDTH 0.375" = 375†1

†1 to 3 decimal places multiplied by 1000

Compound References

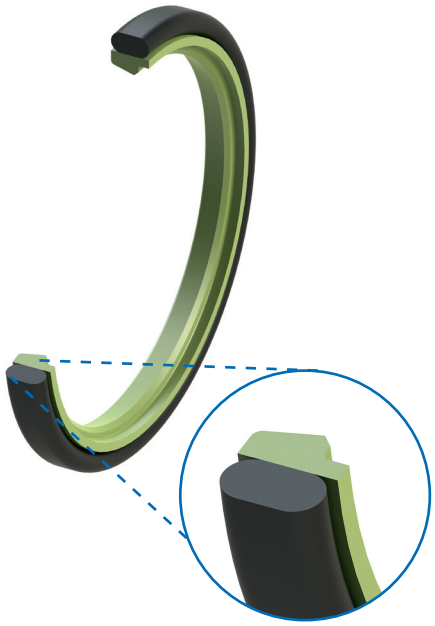
Jacket Material	Compound Reference	Colour	Hardness (IRHD)	Temperature Range	Select for..	Material Designator
Polyurethane, moulded	PU-90-203	Black	90	-40 to +100°C	Hydraulic ram rod seals for high volume manufacture.	AM1
Polyurethane, machined	PU-90-202	Green	90	-40 to +100°C	Hydraulic ram rod seals for low volume manufacture.	AC1
Polyurethane, hydrolysis resistant	PU-95-166	Red	95	-40 to +100°C	Hydraulic ram rod seals in aqueous environments- low volume manufacture.	AH1
Nitrile rubber (NBR)	N-90-204	Black	90	-35 to +110°C	Piston applications for low – medium pressure	NJ1
Hydrogenated nitrile (HNBR), moulded	H-85-205	Black	85	-40 to +180°C	Elevated temperatures, high abrasion resistance	HJ1
Hydrogenate nitrile (HNBR), machined	H-85-206	Black	85	-40 to +180°C	Elevated temperatures, high abrasion resistance, low volume, rapid manufacture	HJ2
Fluorocarbon (FKM, A-type)	V-85-207	Green	85	-20 to +200°C	High temperatures, increased chemical resistance	FJ1

Single Acting Cap Seal

Product Overview

A self-actuating, pressure venting, extrusion resistant seal that combines low breakout and running friction with minimal leakage. The seal is constructed of a premium grade PTFE sealing element and an elastomer energiser.

The Single Acting Cap Seal is a reliable, compact, design with a long service life and is available in both rod and piston type geometries to retro-fit into ISO7425-2. Stick-slip is eliminated even after long periods of inactivity whether in a lubricated or non-lubricated environment, giving low breakout friction.

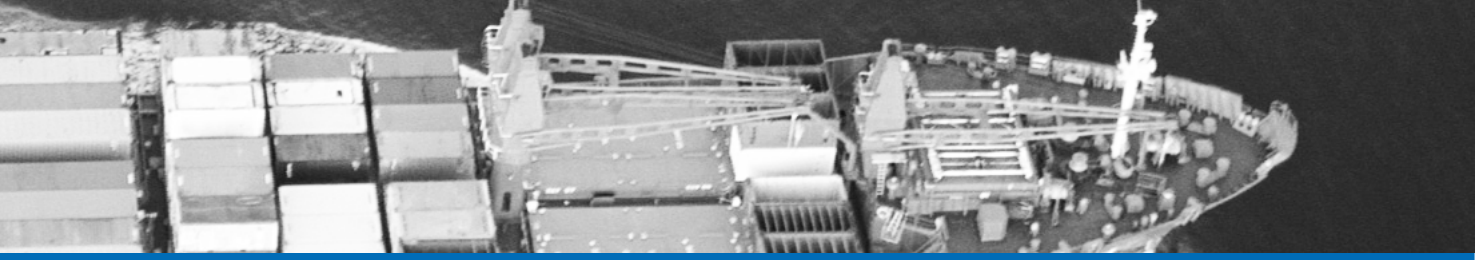


CSP- 15000 - D - 36624 - E471 – PWI

- **PTFE GRADE CODE**
  E471
- **ELASTOMERIC ENERGISER COMPOUND REFERENCE**
  36624
- **RADIAL SECTION CODE**
  A = 1.78
  B = 2.62
  C = 3.53
  D = 5.33
  E = 6.99
- **BORE/ROD DIAMETER**
  150.00mm
- **TYPE**
  CSP – Piston Type Single Acting
  DP – Piston Type Double Acting
  SR – Rod Type Single Acting
  DR – Rod Type Double Acting

Standard Radial Sections

Radial Section Code	Standard Bore / Rod diameter (mm)	Piston Groove Diameter (mm)	Rod Groove Diameter (mm)	Groove Width (mm)
A = 1.78	8 – 16.9	Bore Ø – 4.9	Rod Ø + 4.9	2.20
B = 2.62	17 – 26.9	Bore Ø – 7.3	Rod Ø + 7.3	3.20
C = 3.53	27 – 59.9	Bore Ø – 10.7	Rod Ø + 10.7	4.20
D = 5.33	60 – 199.9	Bore Ø – 15.1	Rod Ø + 15.1	6.30
E = 6.99	200 – 255.9	Bore Ø – 20.5	Rod Ø + 20.5	8.10



Elastomeric Energiser Materials

Elastomer	Colour	Hardness (IRHD)	Temperature Range	Select for..	Compound Reference
Silicone (VMQ)	Red	70	-60 to +220°C	High and very low temperature; high eccentricity	714177
Polyacrylate (ACM)	Black	70	-10 to +150°C	High temperature capabilities; good compatibility with engine oils	335001
Nitrile rubber (NBR)	Black	70	-30 to +120°C	General purpose	36624
Fluorocarbon (FKM, A-type)	Black	75	-20 to +200°C	High temperature performance; high speed applications; 514141 for improved coolant and fuel resistance	51414
	Green	75	-20 to +200°C		51414G
Fluorocarbon (FKM, GF-type)	Black	75	-10 to +200°C		514141
Hydrogenated nitrile (HNBR)	Black	70	-30 to +180°C	High temperatures, moderate fuel resistance	88625

Grade Codes

Material Composition	Colour	Coefficient of Friction	Temperature Range	Select for..	PTFE Reference
Virgin PTFE	White	0.05 / 0.08	-240 to +200°C	Static or low duty cycles	E400
Glass and MoS_2 reinforced PTFE	Grey / Black	0.06 / 0.10	-160 to +290°C	Dynamic or static, medium duty cycles, hardened metal running surfaces	E431
Graphite reinforced PTFE	Black	0.06 / 0.10	-200 to +250°C	Dynamic, medium duty cycles	E471
Carbon and graphite reinforced PTFE	Black	0.08 / 0.12	-200 to +250°C	Dynamic, medium duty cycles	E462
Polyester reinforced PTFE	Beige	0.08 / 0.12	-130 to +290°C	Dynamic or static, medium to high duty cycles, minimum 45 HRc running surface	E491
Carbon, graphite and PPS reinforced PTFE	Grey/Black	0.08 / 0.12	-130 to +290°C	Dynamic or static, high duty cycles, hardened metal running surfaces	E282Z

Exclusion Devices / Wiper Rings

Product Overview

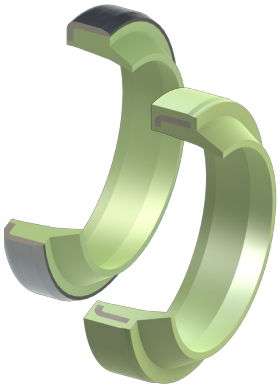
Exclusion devices, also known as Wiper Rings or Scrapers, are installed in sealing configurations to exclude foreign particles such as sand, grit, dirt, water, abrasive media, etc. They are normally installed in the piston rod gland housing and wipe the piston rod during retraction. They prevent contamination of the hydraulic fluid, which could otherwise damage valves, seals, wear rings and other components.

ERIKS Sealing Technology offers a comprehensive range of metallic and polymeric Exclusion Devices. These configurations include combinations of elastomeric, metallic and PTFE based material Exclusion/Wiper lips, which are configured to the application requirements. ERIKS also provide both single-acting and double-acting wiper ring designs.

WR - MET- 050.00-070.00 -10.00- GPN

- **MATERIAL DESIGNATOR**
  GPN
- **GROOVE WIDTH**
  10.00mm
- **GROOVE DIAMETER**
  70.00mm
- **ROD DIAMETER (mm)**
  50.0mm ROD
- **WIPER RING STYLE**
  MET = Metal / Elastomeric
  MEP = Metal Encased Polyeurethane
  ETP = Elastomeric and Thermoplastic Double Acting Wipers
- **WIPER RING CALL OUT**

Different scraper lip material combinations are available upon request.



Elastomeric Scrapers

The ME1 metal encased Elastomeric Scraper and ME2 Elastomeric covered metal insert Scraper profiles can be installed into open grooves. The Elastomeric Scraper element offers highly effective scraping performance and abrasion resistance, giving proven protection to hydraulic and pneumatic cylinders by excluding dust, dirt, water, etc. The standard elastomeric material for these profiles would be Nitrile (NBR).

Metal Encased Polyurethane Scraper

The MEP profile as like the Elastomeric Scraper seals can be installed into open grooves. The profile comprises of a polyurethane (AU) scraper element housed in a ground metal casing. The Metal Encased Polyurethane scraper element offers improved scraping performance and abrasion resistance over the elastomeric profiles in more demanding environments.

Elastomeric and Thermoplastic Double Acting Wipers

A Double acting wiper has either a sealing and a scraping lip in Nitrile (NBR) or proprietary reinforced PTFE. It is optimised when used with rod seals that have a back pumping capability. The double acting wiper is recommended for light to medium duty and is available in alternative elastomeric/PTFE grades on request.

Material Designator Codes

Material Designator	Description	Temperature Range
BPN	Bronze reinforced PTFE / NBR 70	-30°C to +100°C
BPV	Bronze reinforced PTFE / FKM 70	-20°C to +200°C
GPN	Graphite reinforced PTFE / NBR 70	-30°C to +100°C
GPV	Graphite reinforced PTFE / FKM 70	-20°C to +200°C
UPN	UHMW-PE / NBR 70	-30°C to +80°C
UPV	UHMW-PE / FKM 70	-20°C to +80°C

Machined Wear Ring / Bearing Strip

Product Overview

The design intent of a Bearing Strip or Wear Ring is to guide the piston and/or rod into a pneumatic or hydraulic cylinder. Any potential side or transverse loads applied to the piston rod will be supported by the Wear Ring, thus preventing contact between the static and sliding parts of the cylinder.

Wear Rings are non-metallic and offer advantages over traditional metallic bearings. These benefits include improved load distribution, reduced friction, easy installation and lower abrasion.

Different types of materials are available depending upon the application requirements. PTFE based Wear Rings are for use in low to medium loads, fabric composite Wear Rings are to be used under high load conditions.

Wear Rings are precision machined to mate with the customer's hardware and are available in a range of sizes, as defined by the below part numbering system.

MWR -P -125.00 -B -2.15 -14.50- B

MWR	MWR – Machined Wear Ring BT – Pre-cut Bearing Strip
P	BEARING ORIENTATION P = Piston Type R = Rod Type
125.00	BORE/ROD DIAMETER 5mm TO 999.99mm
B	TYPE OF CUT A = Angled B = Butt S = Stepped
2.15	THICKNESS (GROOVE DEPTH)
14.50	GROOVE WIDTH (mm)
B	MATERIAL DESIGNATOR V = Virgin PTFE C = Carbon Filled PTFE B = Bronze Filled PTFE F = Fabric Composite

Machined Wear Ring Dimensions

PISTON BEARINGS			
Bearing Radial Thickness (mm)	Groove Width (+0.25/0.00)	Bearing Groove Diameter	Internal Groove Radii
1.00	6.00	Bore Diameter - 2.00/2.05mm	0.25mm Max
1.50	3.20	Bore Diameter - 3.00/3.05mm	
	10.00		
1.55	2.50	Bore Diameter - 3.10/3.15mm	
	4.00		
2.00	9.70	Bore Diameter - 4.00/4.05mm	
	15.00		
2.50	4.20	Bore Diameter - 5.00/5.05mm	
	5.60		
	6.30		
	8.10		
	9.70		
	15.00		
	20.00		
	25.00		
	30.00		
3.00	20.00	Bore Diameter - 6.00/6.05mm	
4.00	9.70	Bore Diameter - 8.00/8.05mm	
	25.00		

ROD BEARINGS			
Bearing Radial Thickness (mm)	Groove Width (+0.25/0.00)	Bearing Groove Diameter	Internal Groove Radii
1.00	6.00	Rod Diameter - 2.00/2.05mm	0.25mm Max
1.50	3.20	Rod Diameter - 3.00/3.05mm	
	10.00		
1.55	2.50	Rod Diameter - 3.10/3.15mm	
	4.00		
2.00	9.70	Rod Diameter - 4.00/4.05mm	
	15.00		
2.50	4.20	Rod Diameter - 5.00/5.05mm	
	5.60		
	6.30		
	8.10		
	9.70		
	15.00		
	20.00		
	25.00		
	30.00		
3.00	20.00	Rod Diameter - 6.00/6.05mm	
4.00	9.70	Rod Diameter - 8.00/8.05mm	
	25.00		

Bearing Strip

Product Overview

Bearing Strips are skived from material billets and are available in the standard thicknesses and widths. Bearing Strip can be supplied in metre lengths.

Length Calculation for Bearing Strip

Once the bearing strip is installed it is important that a 'Gap' is present between each end of the bearing strip. This feature is required to ensure:

- There is sufficient room to allow for expansion which occurs during increases in temperature
- The prevention of pressure entrapment
- To ease installation and aid bearing strip removal

If you purchase our Bearing Strip by the metre, the length of the strip can be calculated by using the following:

For Bearing Strip used in Piston applications:-

LB = (π X (B - TH) / 1.01) – C

For Bearing Strip used in Rod applications:-

LB = (π X (R + TH) / 1.01) – C

Where:-
LB = Calculated Bearing Strip Length (mm).
B = Bore diameter (mm)
R = Rod diameter (mm).
TH = Bearing Strip thickness (mm)
C = Gap constant: 0.8
(1.8 for PTFE based materials above 120°C)

Wear Ring / Machined Bearing Strip Design Guide

Bearing Design Options

Careful consideration needs to be taken when choosing the correct bearing material. Factors influencing the design are load capacity, friction, temperature, service life and running velocity. As a general guide if wear and load bearing is paramount, then a Phenolic/fabric composite materials are favoured. If low friction is important, PTFE based materials offer the best option.

Load Capability

To ensure minimal wear and optimum performance it is important to maintain the lowest possible unit load over the bearing. The bearing load can be estimated using the below illustrated calculation.

Influencing factors such as rod/piston deflection, bearing deformation and diametrical tolerancing need to be considered when considering bearing design. Other factors including external loads, geometrical tolerances (eccentricity, concentricity, ovality) and component weight also need to be recognised.

It is good practice to minimise bearing radial cross section as for a given load the thinner the radial cross section, the less the deflection. Lifetime requirements may contradict this.

Our experts can assist you in selecting the optimal configuration for your application if required.

BT - 2.50- 15.00 - B

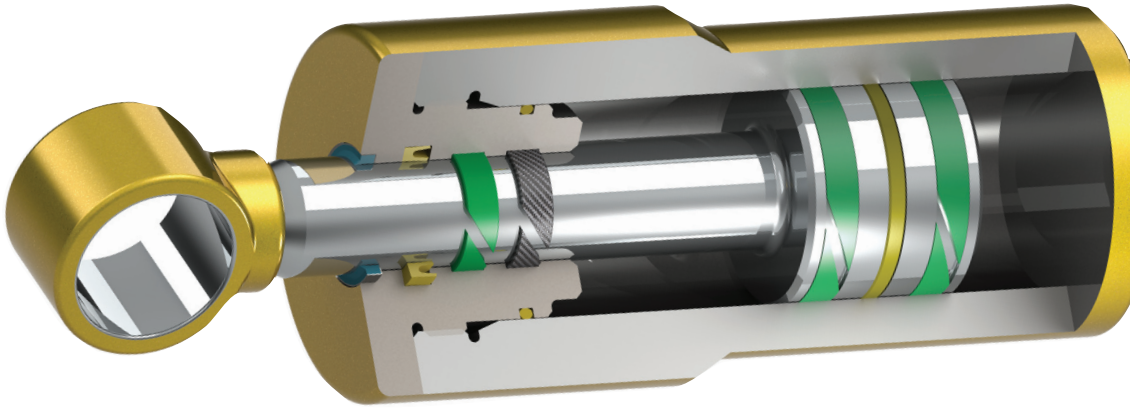
MATERIAL DESIGNATOR
V = Virgin PTFE
C = Carbon Filled PTFE
B = Bronze Filled PTFE

GROOVE WIDTH (mm)
2.50
4.00
5.60
9.70
15.00
20.00
25.00

THICKNESS (GROOVE DEPTH)
1.00mm
1.55mm
2.00mm
2.50mm
3.00mm
4.00mm

BT–BEARING STRIP

Note: For small diameters, machined wear rings are recommended to aid installation. Minimum Bearing Strip Diameters: PTFE 8mm, Fabric 60mm.

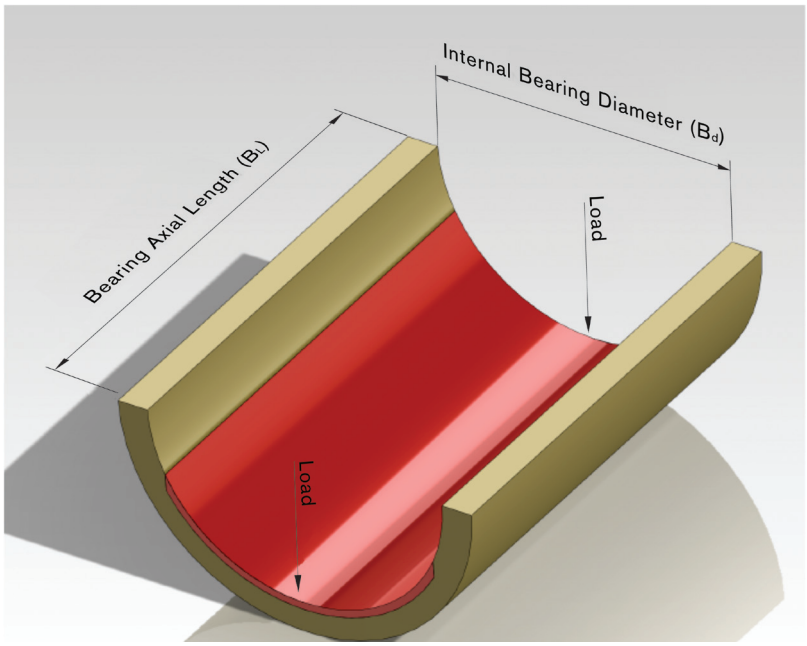


Bearing Calculation

For the Bearing Load Calculation we assume the load distribution is uniform over a project bearing area. The bearing area may be approximated by using the following calculation:

Projected Bearing Area (B_{pa}) = Internal Bearing Diameter (B_d) X Bearing Axial Length (B_L).

e.g.	Internal Bearing Diameter (B_d)	= 50mm
	Bearing Axial Length (B_L)	= 25mm
	Projected Bearing Area (B_{pa})	= 1,250mm^2

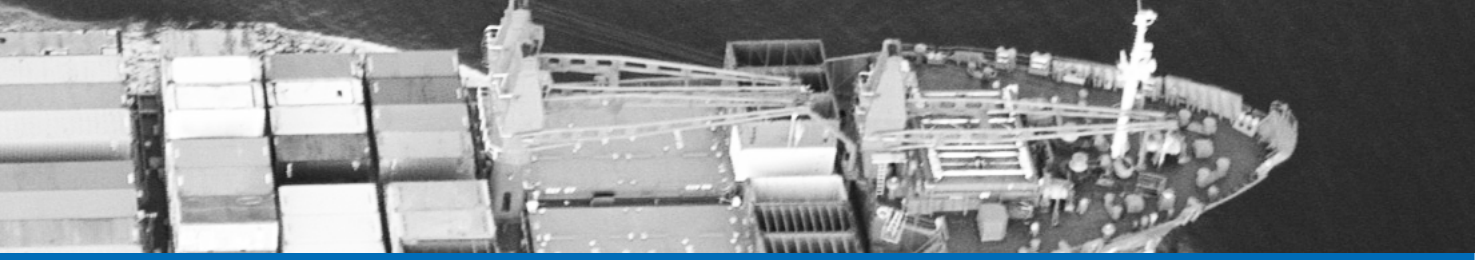


When the Projected Bearing Area (shaded red) has been approximated, the bearing pressure may be found by dividing the Total Force Load by the Projected Bearing Area. This will determine the minimum compressive strength (C_S) of the bearing material to be utilised. If your design requires the incorporation of a safety factor, it is advisable to multiply the Total Force Load (F_L) by the desired factor of safety (FOS), e.g. 2. The required bearing compressive strength can be calculated as follows:

$$C_S = \frac{FOS \times FL}{(B_d \times B_L)}$$

$$C_S = \frac{(2 \times 3000N)}{(50mm \times 25mm)}$$

$$C_S = \frac{6000}{1250} = 4.8\ MPa$$



Material Selection

Calculating the required bearing material strength is important in determining the correct material to use. Listed below are additional criteria that need to be considered:

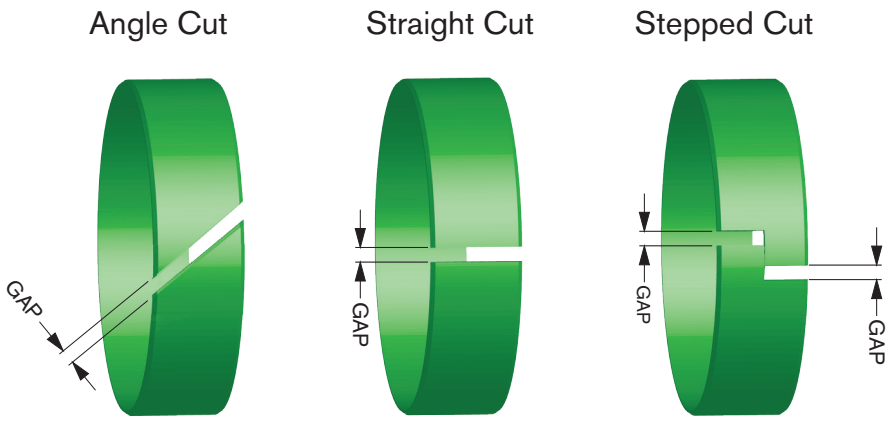
- Is the application rotary, reciprocating or static?
- What surface speed will the bearing see?
- Is lubrication present?
- What are the temperature extremes?
- What is the shaft/bore material, hardness and surface finish?
- Does the bearing have exposure to abrasive, erosive and chemically aggressive media?

Material	Compressive Strength (Max)	Max Surface Speed	Mating Surface	Size Availability	General Uses
Bronze filled PTFE	15 MPa at 25 °C 12 MPa at 80 °C 8 MPa at 120 °C	15.0 m/s	Steel Hard Chrome, Steel Hardened	Rings 8mm to 2600mm	Light load, lubricated environment
Carbon filled PTFE	12 MPa at 25 °C 9 MPa at 80 °C 5 MPa at 120 °C		Stainless Steel, Hard Anodised Aluminium	Up to 4600 in Strip form	Light duty, can run dry
Phenolic (Fabric composite)	300 MPa at 25 °C (Static) 50 MPa at 60°C (Dynamic)	1.0 m/s	Steel Hard Chrome, Steel Hardened	10mm to 1500mm (Rod Dia)	Heavy load, lubricated environment

Type of Cut

Angled cuts are recommended for use in reciprocating applications. Straight cuts are for rotary applications. Stepped cuts are used in special applications, e.g. for flow restriction.

Machined Wear Rings are application specific. Based upon application data, the appropriate dimensions and hardware tolerances will be calculated by our technical team for the entire sealing system.



Bellows, Diaphragms and Cover Seals

A wide range of custom moulded diaphragms and bellows are available. We offer expertise when selecting the correct compound, optimising modulus to achieve specified force deflection characteristics and life.

These components are available with fabric reinforcement to provide increased stiffness and pressure capability.

Circlips

Circlips, also known as retaining rings, are typically used to maintain the axial location of bearings and seals within housings. Available in metric (DIN 471/DIN 472) and imperial sizing, circlips are typically produced in high performance spring steel, although other materials, including stainless steel and phosphor-bronze are available upon request.

External circlips fit around the outside diameter of a shaft, and internal circlips are installed into a housing bore recess.

Buffers and Bump Stops

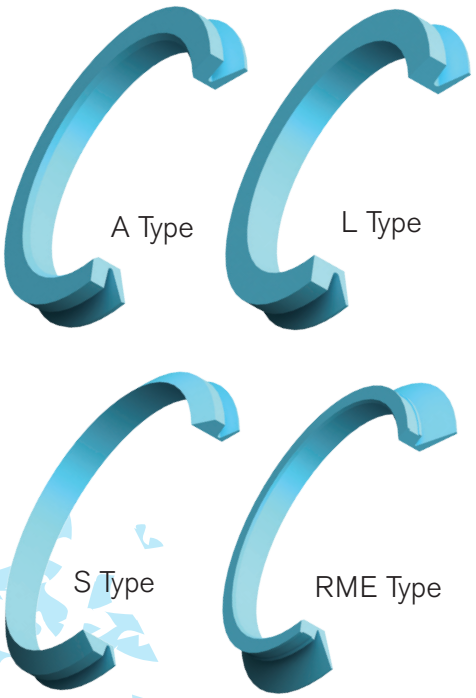
Custom design structural components to act as buffers and bump stops can be either moulded or extruded in traditional thermo-set elastomers, or in thermoplastic elastomer grades.

Traditional elastomers offer a wider variety of chemical compatibilities. Thermoplastic elastomer grades offer reduced environmental impact, due to reduced energy demand in manufacture and they may be recycled.

Advice on design and the incorporation of moulded features for location is readily available from our expert technical staff.

V-rings

V-rings are an elastomer axial seal for shafts and bearings, installed onto the shaft or counterface. This type of seal has been used widely for many applications and has proved to be reliable and effective against dust, dirt, water, oil splash and other media.



Rubber Moulded and Extruded Products

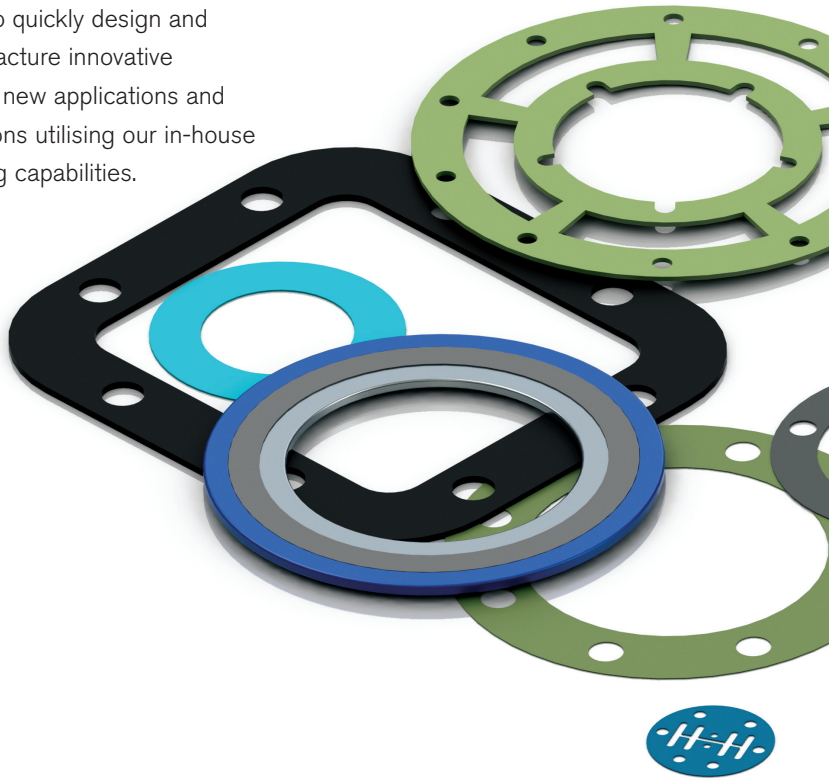
Rubber Mouldings

The moulding of rubber and elastomeric compounds is accomplished by forcing the material into a shape using heat and pressure. Rubber and elastomers can be moulded by compression, transfer and injection methods. The volume of parts and type of compound required will determine the moulding method used. Our engineers participate with you to develop innovative solutions for your production.

Extruded Rubber Profiles/ Inflatables

Our comprehensive product range incorporates not only rubber, but also Thermo Plastic Elastomer (TPE).

Our in-house CAD/CAM capability also enables us to quickly design and accurately manufacture innovative solutions to meet new applications and operating conditions utilising our in-house 3D rubber printing capabilities.

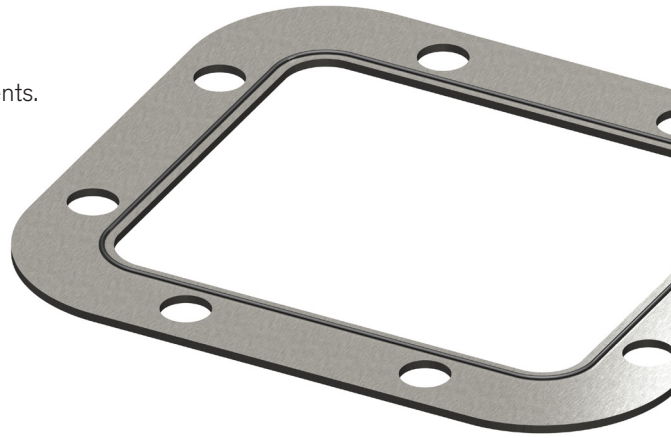


Metal Bonded Seals

Many of our elastomer grades are available as co-moulded (bonded) components.

Typical Applications

- Gaskets
- Covers



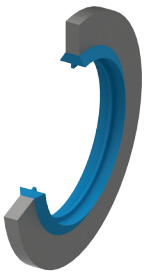
Bonded Washer Seals

Bonded Seals were originally designed to replace copper type washers in high pressure systems. The bonded seal comprises of a metal washer (square or rectangular in section), to which a trapezoidal elastomeric ring is bonded. The advantages of this system is that the metal washer resists the bursting forces applied and also limits any deformation of the elastomeric element. The metal washer also limits the compression of the seal and eliminates any over torque of the joint.

Bonded Seals

- Reliable high and low pressure sealing
- Wide temperature capability
- Over compression prevented by metal outer ring
- Wide range of metals and elastomers
- Available in a wide range of imperial and metric sixes

Self-Centering Bonded Seals



The self centering type of bonded seal has the additional benefit of pre-assembling on to threads. The thin seal membrane offers little resistance during assembly.

- All key benefits of original design
- Concentrically located
- Positively retained
- Ability to pre-assemble
- Can be automatically installed

Mechanical Seals for the Automotive Industry

A well proven Mechanical Seal profile designed for high volume, low pressure automotive cooling pump applications.

The design can be supplied as two separate components or as a unitised assembly where the stationary and rotary parts are supplied in a single unit, therefore giving the benefit of simplified installation.

This automotive Mechanical Seal range is available in a variety of material combinations to suit customer specific application requirements.

Valve Stem Seals

Valve stem seals are engineered to control the amount of lubrication to the engine valves by allowing the right amount of oil to pass the seal lip. This has a direct impact on efficiency and reliable life of the engine. Too much oil can result in increased engine emissions and too little lubrication allowed to enter the system can result in engine failure.

Valve stem seals are designed in a number of varied profiles and materials to suit specific customer application conditions. These design considerations are applied when engineering a suitable solution.

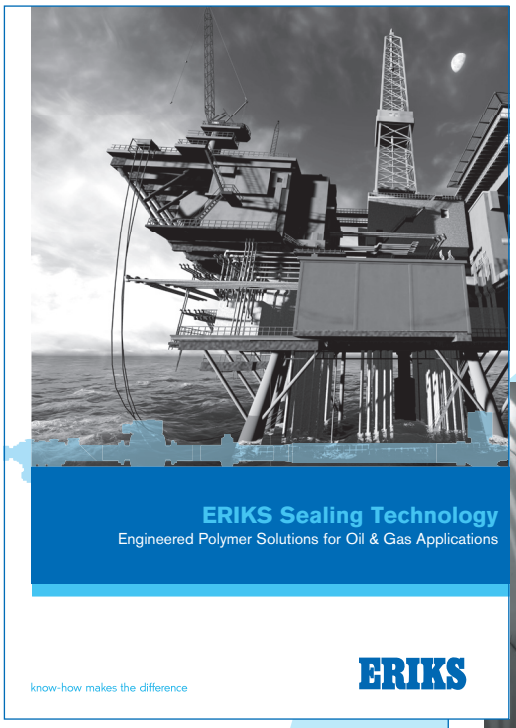
Kitting and Bagging

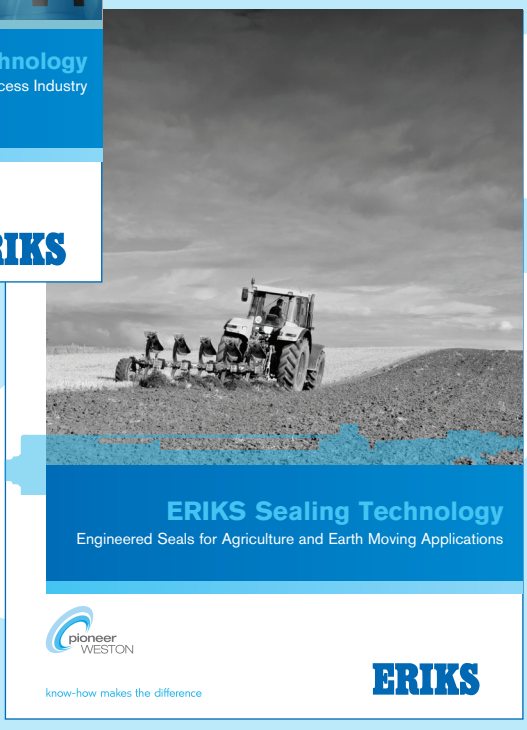
ERIKS Sealing Technology can provide bespoke kits and aftermarket bagging of individual parts to service your industry requirements.

Our specially tailored kits are assembled and packaged with clearly marked part numbering and can be supplied with our own brand, or alternatively, customer specific branding.

We are able to offer kits that include a variety of our core product, ranging from Rotary Seals and O-rings to Hydraulic Seals, Washers and Gaskets.

Other Brochures in this Series





ERIKS Sealing Technology

ERIKS Sealing Technology offers a comprehensive range of high performance sealing products, supported by a world-class technical and logistical service to deliver the right seal on time to your critical applications.

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