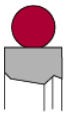
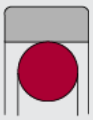
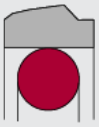
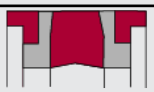
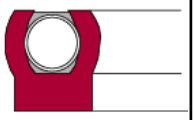
Technical Datasheet | Reciprocating Seal Profiles

Seal Profile		Type	Material	Pressure [bar]	Velocity [m/sec]	Temperature [°C]
Rod Seals		0001	Cotton/NBR Cotton/FPM	400	0.5	-30 to +100 -30 to +140
		0002	Cotton/NBR Cotton/FPM	400	0.5	-30 to +100 -30 to +100
		0049 0050 0051	ptfe.bz/NBR ptfe.bz/FPM ptfe.gl/NBR	400	5	-30 to +100 -30 to +200 -30 to +100
		0070	PUR	400	0.5	-40 to +100
Piston Seals		0003	Cotton/NBR Cotton/FPM	400	0.5	-30 to +100 -30 to +140
		00037 0038 0039	ptfe.bz/NBR ptfe.bz/FPM ptfe.gl/NBR	400	5	-30 to +100 -30 to +200 -30 to +100
		0032 0033 0034	ptfe.bz/NBR ptfe.bz/FPM ptfe.gl/NBR	400	5	-30 to +100 -30 to +200 -30 to +100
		0080	NBR/Pa	400	0.5	-30 to +100
		0073	PUR	400	0.5	-40 to +100
PTFE U Rings		0107	ptfe+ compounds	700	15	-95 to +300
Wiper Seals		0090	NBR PUR	1	1	-30 to +100 -40 to +110
		0092	NBR PUR	1 1	1 1	-30 to +100 -40 to +110
		0095	PUR	1	1	-40 to +110
		0093	NBR	1	1	-30 to +110
Bearing Bushes		SG	fabric reinforced polyester	n/a	1.5	-50 to +130
		KG	fabric reinforced polyester	n/a	1.5	-50 to +130
		GB	ptfe/bronze	n/a	5	-50 to +200

Technical Datasheet

Seal materials and their compatibility

The design guide is primarily intended for designers, specifiers and end users of reciprocating seals in oil hydraulic cylinders and actuators.
The greater majority of these applications will involve the use of a mineral oil based hydraulic fluid and a seal made from one the following four materials:
Standard nitrile elastomer [NBR], a fluoroelastomer [FPM], a polyurethane [PUR], or a PTFE compound.
Sometimes the seal manufacturer will specify a combination of more than one material.
Listed below are our standard materials used in the manufacture of range of seals.

FTL Material No.	Description
02	Nitrile elastomer [NBR] 78° A
03	Fluoroelastomer [FPM] 70° A
05	Nitrile elastomer [NBR] 85° A
06	Nitrile elastomer [NBR] 70° A
07	Nitrile elastomer [NBR] 90° A
10	Nitrile elastomer [NBR] 90° A
11	Cotton fabric/nitirle elastomer
14	Cotton fabric/Fluoroelastomer
17	Ptfe-virgin
23	Ptfe-bronze compound 50%Bz
24	Ptfe-bronze compound 40% Bz
25	Ptfe-glass fibre+MoS2 compound
26	Ptfe-carbon compound
27	Ptfe-graphite compound
28	Ptfe-organic filler
29	Ptfe-organic filler
30	PE-UHMW
31	Fibre reinforced thermoset composite material
33	Polyamide [PA + fillers]
37	Polyester thermoplastic HYTREL
40	Polyurethane [PUR]
43	Polyurethane [PUR

The FTL Technology range is, as previously mentioned aimed at oil hydraulic applications. It is true. However, that today there are many other types of hydraulic media based only partly on mineral oil. In some cases mineral oil is not present at all.
On the opposite page is a list of hydraulic media, according to the DIN classification, together with a very brief description. Alongside each fluid we have shown the results of tests where the seal material has been immersed in the fluid for set lengths of time, at different temperatures.
Changes in material properties (volume, weight, hardness, u.t.s, modulus at 100% extension and elongation at break) are noted at set intervals.
In this way a realistic operational envelope of seal material versus hydraulic media with respect to operating temperature is established.
Remember that these are laboratory results and actual operational conditions can influence the choice of seal material. For advice on material compatibility with media not listed in this table we always suggest contacting our help hot line.

Technical Datasheet

Classification of hydraulic media

Hydraulic fluids based on mineral oils

Non fire resistant fluids

Classification to DIN	Classification to ISO	Remarks
H	HH	Mineral oil - no additives - hardly ever used
H - L	HL	as above but with anti-rust and anti-oxidation additives
H - LP	HM	as HL but with anti-wear additives
H - LPD		as above but with added detergents/ dispersants
H - V	HV	as H - LP but with viscosity stabilising additives

The lower temperature limit listed below related to the performance of the elastomer. In many instance the hydraulic media would not be viable at the stated lower temperatures.

Seal material temperature range (°C)

NBR	FPM	PUR	PTFE
-30...+100	-15...+140	-40...+110	-100...+260
-30...+100	-15...+140	-40...+110	-100...+260
-30...+100	-15...+140	-40...+110	-100...+260
-30...+100	-15...+140	-40...+110	-100...+260
-30...+100	-15...+140	-40...+110	-100...+260

Biodegradable hydraulic fluids

Classification		Remarks
HEES		Fully synthetic esters, not soluble in water
HETG		natural ester (triglycerides) - based on rape seed or plant oil
HEPG		polyalkyleneglycols, known as “polyglycols”, soluble in water

NBR	FPM	PUR	PTFE
-30...+80	-15...+100	-40...+80	-100...+260
-30...+80	-15...+80	-40...+60	-100...+260
-30...+60	-15...+80	-40...+50	-100...+260

Fire resistant fluids

Hydraulic fluids containing water

Classification	Sub Group	Remarks
HFA		A group of high water (80% - 90%) based fluids
	HFAe	fluid where the concentrate (mineral oil) is in emulsion
	HFAs	fluid where the concentrate (synthetic fluid) is in solution
	HFAm?	fluid where the concentrate is a micro emulsion
	HFAt?	invert emulsions - 60% mineral oil 40% water

Please check with our technical hot line for advice on PUR elastomers and fluids in this category.

NBR	FPM	PUR	PTFE
-5...+60	-5...+60	-5...+50	-100...+260
-5...+60	-5...+60	-5...+60	-100...+260
-5...+60	-5...+60	-5...+50	-100...+260
-5...+60	-5...+60	-5...+50	-100...+260
-30...+60	-15...+60	-5...+50	-100...+260
-30...+60	-15...+60	-20...+40	-100...+260

Hydraulic fluids without water

Classification	Sub Group	Remarks
HFD		a group of fire resistant synthetic fluids containing no water
	HFD R	phosphate ester based
	HFD S	chlorinated hydrocarbon based
	HFD T	mixture of HFD S and HFD R
	HFD U	other synthetic fluids

NBR	FPM	PUR	PTFE
-	-15...+140	-	-100...+260
-	-15...+140	-	-100...+260
-	-15...+140	-	-100...+260
-	-15...+140	-	-100...+260
-	-15...+140	-	-100...+260

Technical Datasheet

Surface finish and seal life

The relationship between seal life and surface finish is generally well understood. A better surface finish means a longer seal life. There are certain instances where too fine a surface finish will lead to poor boundary layer lubrication between seal and the part to be sealed and consequently shorter life.

The “standard” measure of surface finish is normally taken to be the value Ra, which the arithmetic mean of the peak to valley heights over a set measuring length. This measurement does not however indicate the total roughness which causes the greater damage and wear. As such, the value Rt – the maximum peak t the valley height in the set measuring length is quoted as well. We normally recommend a Ra value range of 0.05 -0.3µm and a maximum Rt value of 3.0µm.

A more recent development in determining seal life with relation to surface finish has been the interest in the profile bearing length or tpi- of a surface,
This is the percentage ratio between the contact bearing and the above mentioned set measuring length, taken at an average depth. For dynamic seal surfaces we recommend a profile bearing length ration tpi of >50% average depth.
If you wish to discuss surface finish with respect to seal performance then please contact our help hotline for further information.