Parker Seals

P6000

The new dimension of polyurethane sealing compounds

P6000

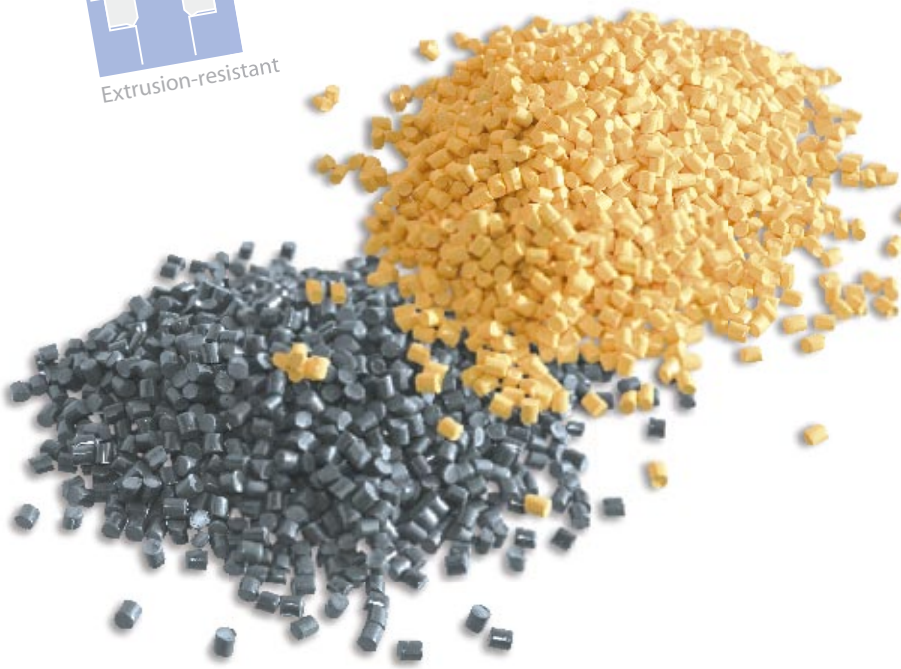
New PDF Ultrathan® sealing compounds for the most exacting demands

Modern sealing compounds must be able to meet increasingly complex and more exacting demands. Optimum compound properties have long ceased to be defined only by the traditional parameters of dynamic operation such as pressure, temperature and speed of travel. Added to these are new standards regarding service life, maintenance intervals and operating reliability. Whereas longer service life and maintenance intervals primarily relate to the cost effectiveness of the sealing elements and compounds used, improved operating reliability also serves to protect our natural resources and helps industry to comply with environmental regulations, for instance when operating hydraulic systems.

P6000 has been developed by the Parker Seal Group as a modern and forward-looking compound platform for complex and highly demanding requirement profiles. The properties of P6000 have been tested and optimised in extensive trial series – both in our own physical lab and at customer sites. This has enabled us to improve the outstanding properties of our previous standard compounds yet again. Particularly under extreme dynamic loads the performance data of P6000 clearly prove the advances made with this new compound platform.

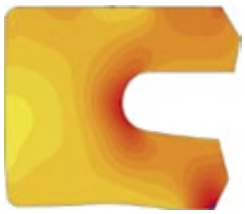
Benefits:

- Maintenance intervals are expanded significantly. Mobile hydraulics users can expect increased machine availability.
- The expanded performance spectrum of the new P6000 compound enables more compact designs. Initial prototypes already used by selected target customers confirm that P6000 is the ideally suited compound for further miniaturisation in mobile hydraulics.



Our particular strengths:

- **Manufacturing know-how:**
  For the launch of this new compound platform Parker's Prädifa Packing Division has invested in new manufacturing technology at its location in Bietigheim, Germany. In addition to in-process benefits, this enables crucial improvements of key quality characteristics to be achieved. Our manufacturing know-how based on many years of experience, combined with this new process technology, assures the outstanding profile of properties offered by this all-new compound.
- **Rapid prototyping:**
  "PHast Seal" does it. If there is no mould available, samples can be produced, using cutting technology, within a few working days.
- **Computer-aided compound and product development:**
  Parker constantly invests in the complex determination of a wide range of compound characteristics providing the basis for using highly advanced simulation techniques. By means of the Finite Elements Method the behaviour of sealing systems in field application conditions can be simulated in an early stage of the development. This helps to clearly reduce development cycles and costs.



Compound monograph

Definition:
Thermoplastic polyurethane

Characterisation:
Blockcopolymer compound

Properties:

- High elastic modulus and high mechanical strength
- Excellent wear resistance
- Very high tear strength
- Superior extrusion resistance
- Low compression set
- High elasticity
- Temperature range
  - permanent: -35 to +110 °C
  - short-term: +120 °C
- Good thermo-oxidative stability
- Excellent mineral oil resistance:
  max. volumetric swelling in mineral oils app. 5%
- High consistency regarding all required properties
- P6000 meets the criteria of the EU End-of-Life-Vehicles Directive, 53 EC

Product spectrum:

- Rod seals
- Piston seals
- Static seals, e.g. o-rings
- Moulded parts
- Composite parts

Media:

- Mineral oil-based lubricants (DIN 51524) and PAOs (max. 110 °C)
- Limited use of pressure transmission media based on biologically degradable media (HEES and HETG up to maximum of 60 °C.) We recommend testing on a case-by-case basis.

Fields of application

Mobile hydraulics:

- Excavators
- Wheel loaders
- Hydraulic hammers
- Mobile cranes
- Mobile mining equipment, e.g. dump trucks
- Forrest harvesters
- Motor graders
- Skid steers
- Forklifts

Stationary hydraulics:

- Industrial cylinders
- Elevator systems
- Differential cylinders

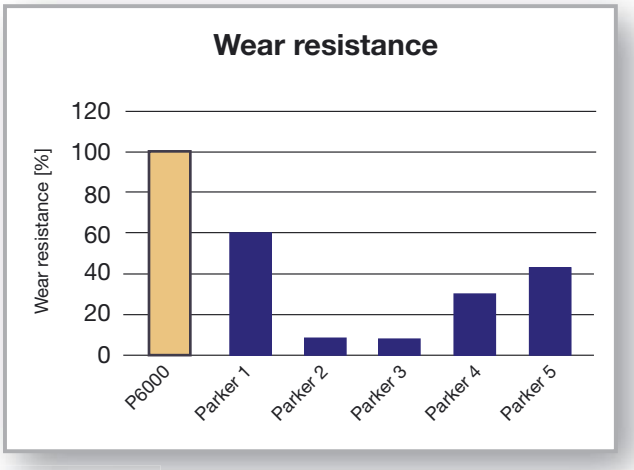
Others:

- Shock absorbers
- Gas springs

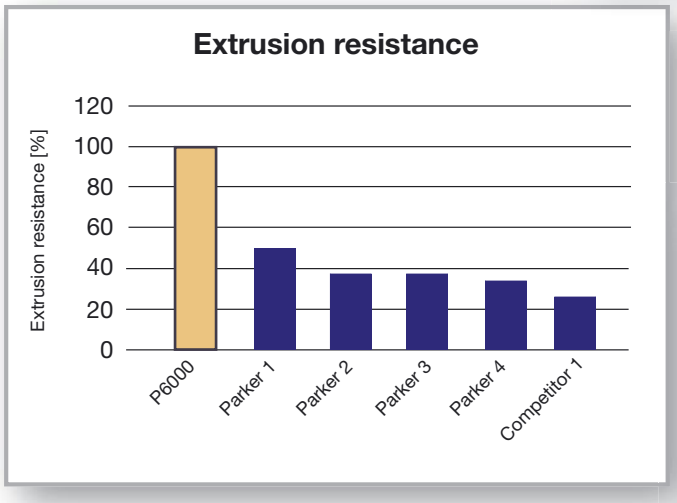
Wear and extrusion resistance

The P6000 compound is based on a completely new synthesis of compound ingredients. This has resulted in a clear improvement of the wear behaviour of dynamic seals over the current generation of compounds. Extensive trial series in our own development and testing departments as well as customer tests and – last but not least – current customer approvals have impressively confirmed these improvements.

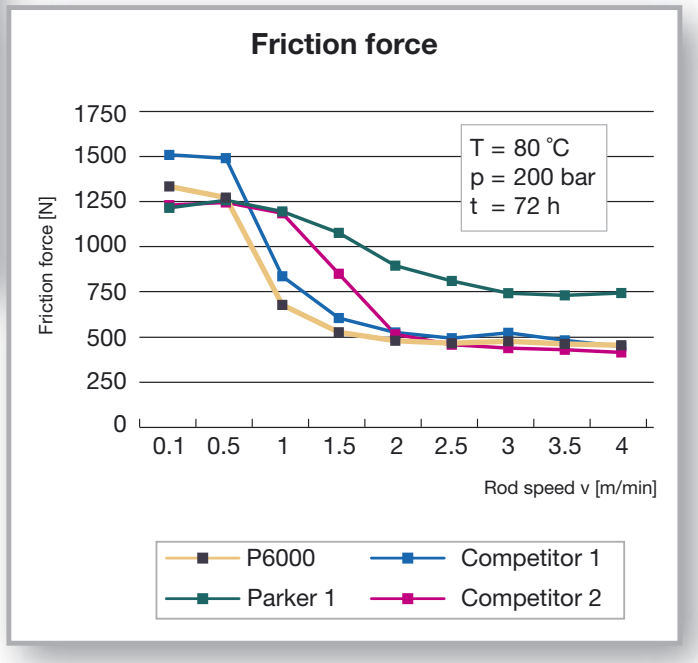
Among others, the higher stability of this compound raises the threshold of potential gap extrusion. At constant temperatures larger gaps, “e”, are permissible in field applications. This gives customers crucial benefits when determining their manufacturing tolerance limits.



Wear resistance measured on ring-shaped compound samples (Parker Standard)



Extrusion resistance measured on u-cups after an endurance test run with pressures of up to 30 MPa and temperatures of 80 °C

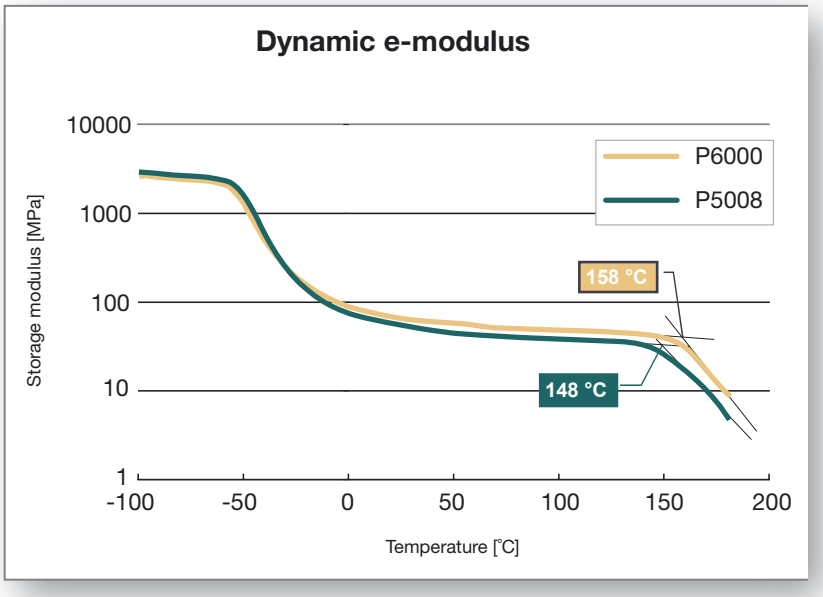


Friction behaviour of commercial, one-lip type B3 hydraulic rod seals made from polyurethane

Operating temperatures

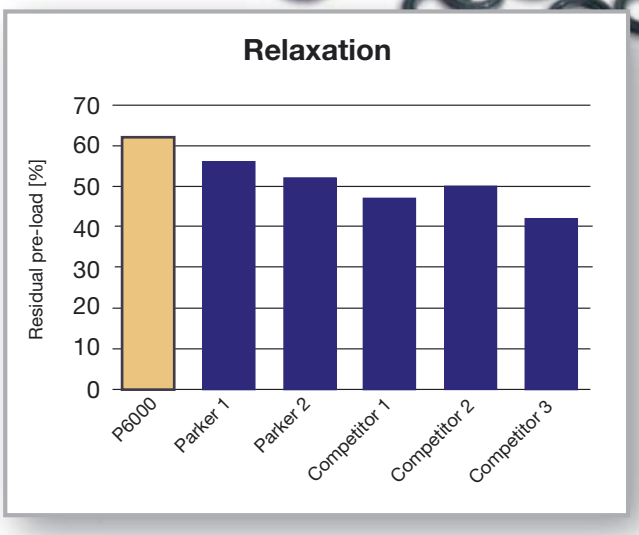
The higher stability of P6000 significantly expands the permissible temperature range compared to conventional materials. Improved temperature resistance results in longer maintenance intervals and reduces vulnerability to gap extrusion.
From the curves shown in the diagram the permissible temperature ranges for sealing applications can be derived.
Starting from the low-temperature range (left), a respective decline in the dynamic elasticity modulus of the polyurethane compounds can be noted. Compound specialists refer to this decline as the “glass transition” stage, a process during which gradually increasing entropy-elastic behaviour sets in. The application range spans the area from this particular point all the way through to the point at which there is a “sharp drop” in the curve. This sharp drop indicates the beginning of plastic deformation.

The green curve shows the dynamic e-modulus of the previous polyurethane generation, the yellow curve that of the new P6000 compound. When comparing both curves, the glass transitions indicate that the low-temperature behaviour of both compounds can be expected to be roughly the same. However, the sharp drop of the upper yellow curve shows an upward shift of app. 10 °C, proving that P6000 is the more temperature-stable material of the two.



Dimensional stability

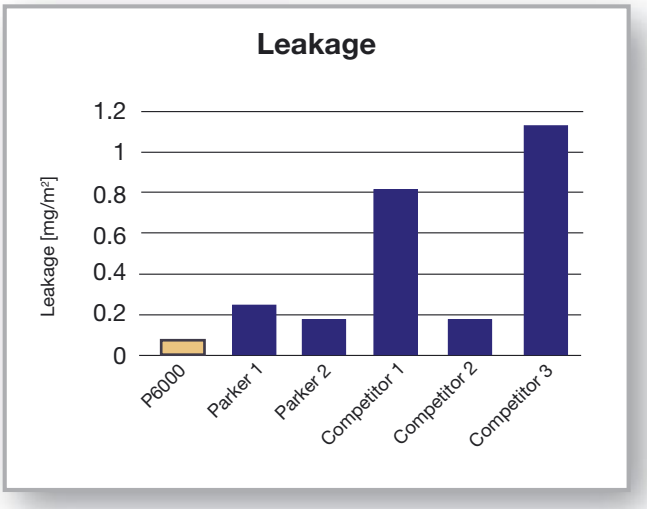
With rising system pressure the new P6000 polyurethane compound shows significantly higher dimensional stability than the previous PUR compound. The distribution of compression remains at ideal levels over a larger range. Added to this is the lower level of stress relaxation of the seal’s cross-section while the system is operating. All of this results in higher dimensional stability of the seal’s geometry and thus reduced loss of compression at the seal’s edge.



The diagram shows the residual preload of commercial type B3 hydraulic rod seals (one-lip u-cups)
Load data
Pressure: 0/30 MPa *Oil temperature: 75 °C*
Sliding speed: 0.3 m/s *Total speed of travel: 180 km*

Media resistance

The superior chemical compatibility of P6000 with commercial HLP and HLPD oils permits very low swelling rates. With mineral oils and polyalphaolefins chemical changes, which could have a dramatic impact on the functional reliability of the sealing elements, are virtually excluded. All of this results in excellent leakage behaviour of the sealing systems. Consequently, P6000 actively meets environmental as well as occupational health and safety requirements.

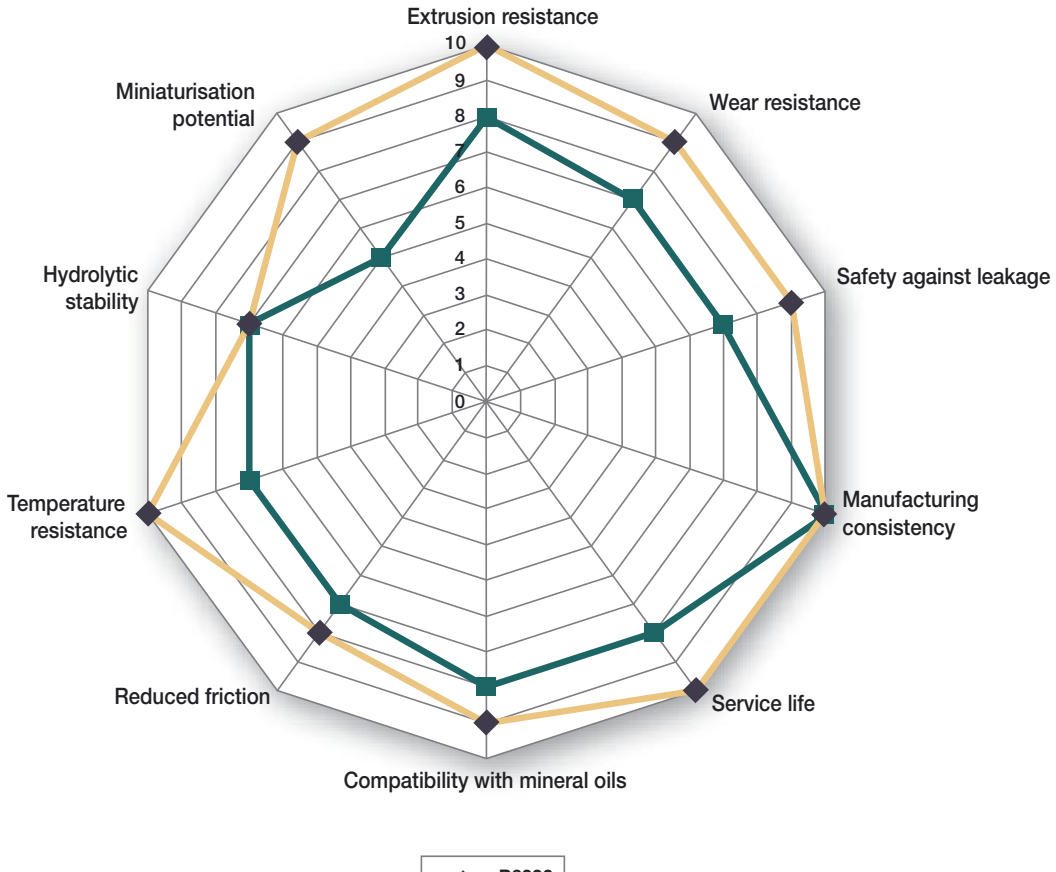


Leakage behaviour of commercial type B3 hydraulic rod seals (one-lip u-cups) made from polyurethane with piston rod travelling into the cylinder under pressure

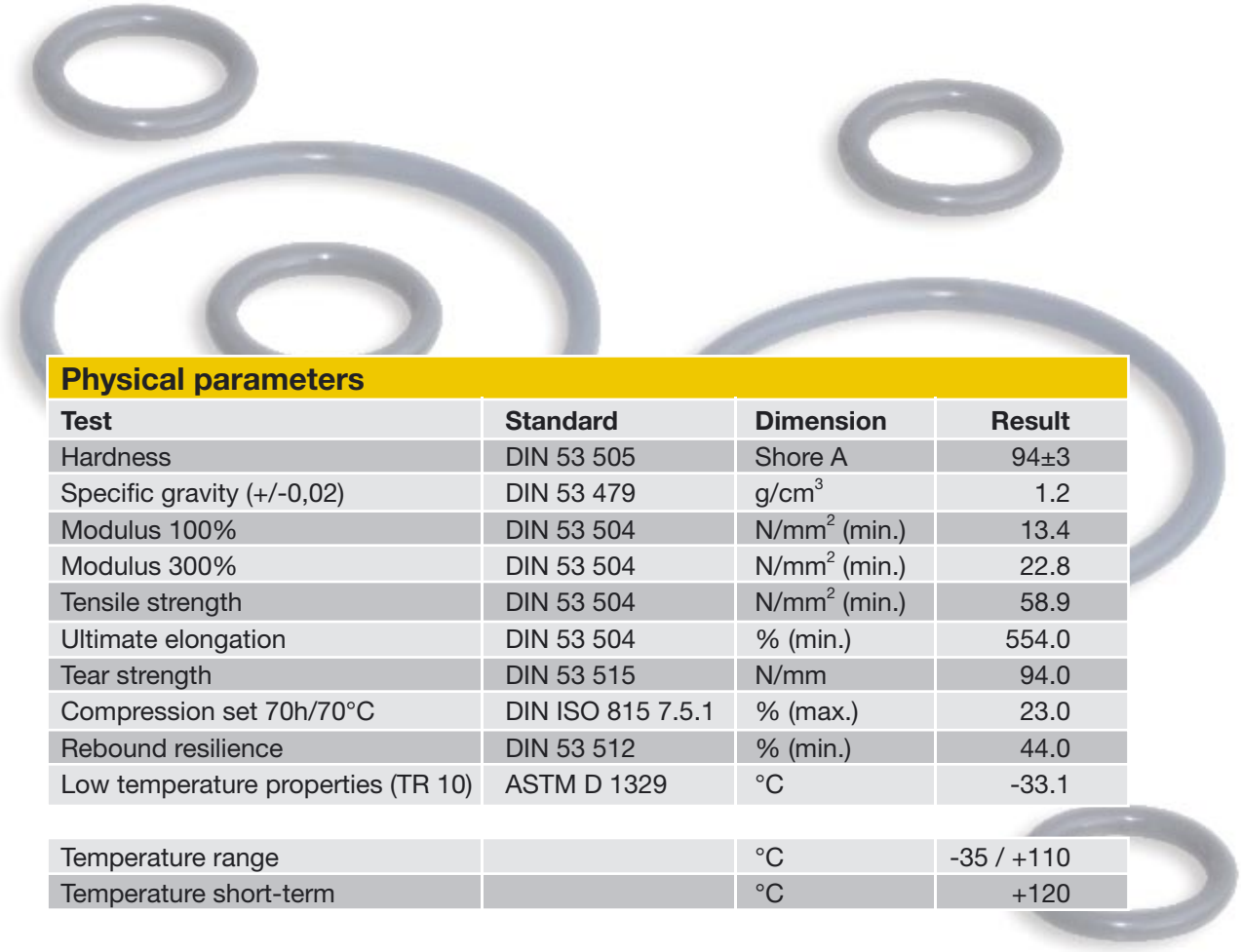
Load data:

Pressure: 0/30 MPa *Oil temperature: 75 °C*

Speed: 0.3 m/s *Total distance of travel: 180 km*



Seal Group Europe
Packing Division



Physical parameters

Test	Standard	Dimension	Result
Hardness	DIN 53 505	Shore A	94±3
Specific gravity (+/-0,02)	DIN 53 479	g/cm^3	1.2
Modulus 100%	DIN 53 504	N/mm^2 (min.)	13.4
Modulus 300%	DIN 53 504	N/mm^2 (min.)	22.8
Tensile strength	DIN 53 504	N/mm^2 (min.)	58.9
Ultimate elongation	DIN 53 504	% (min.)	554.0
Tear strength	DIN 53 515	N/mm	94.0
Compression set 70h/70°C	DIN ISO 815 7.5.1	% (max.)	23.0
Rebound resilience	DIN 53 512	% (min.)	44.0
Low temperature properties (TR 10)	ASTM D 1329	°C	-33.1
Temperature range		°C	-35 / +110
Temperature short-term		°C	+120

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