



# Polyurethane

PDF Ultrathan® Sealing Compounds

aerospace  
climate control  
electromechanical  
filtration  
fluid & gas handling  
hydraulics  
pneumatics  
process control  
sealing & shielding

# Polyurethane

## PDF-Ultrathan®-Sealing Compounds

Dimensional stability under load, accurate adherence to tolerances, extrusion and wear resistance, elasticity: these attributes of Parker-Prädifa's Ultrathan® range of sealing materials are the result of our more than 30 years of experience in researching, developing and manufacturing thermoplastic polyurethanes (TPU).

We have consistently been driving the further development of our materials and systematically modifying them to meet the needs of the market. In addition to our time-tested standard products with outstanding physical properties for hydraulics, pneumatics and industrial applications, we now offer a large number of specialty compounds for specific requirements such as

- Materials optimized for high- and low-temperature applications,
- Compounds with hydrolysis, acid and alkali resistance for use in the chemical and pharmaceutical industries and applications involving food contact,
- Friction-optimized materials or
- Materials for heavy-duty applications.

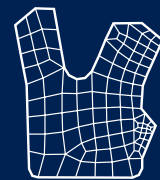
Using advanced process technology and drawing on our long-standing experience we ensure large-volume production of TPU precision seals at the highest levels of quality. With a gate-less injection-molding technique for O-rings used in mini-fluid components and miniature seals for pneumatics we have responded to the unbroken industry trend of miniaturizing sealing profiles.

In the field of TPU composite technology we possess comprehensive development and manufacturing know-how: from injecting TPU on pre-treated plastic substrates through to fully automated line production of metal composite parts.

**No matter what task you would like us to perform for you: we will deliver the appropriate solution – from compounding to the finished product.**

### Form follows function ...

When applying this maxim to the development of sealing solutions “form” not only refers to a seal’s geometry but analogously includes the selection of the compound from which the seal will be made. The geometry and the compound need to be optimally coordinated with each other. This pairing in turn has to be coordinated with the relevant application, i.e. the sealing solution’s “function.” That is why, in addition to designing the appropriate profiles, we develop our compounds in-house. If our extensive standard portfolio does not provide you with a suitable product for your application, let us know, and we will develop a customized solution for you.



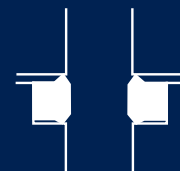
Computable



Dimensionally stable



Precise tolerances

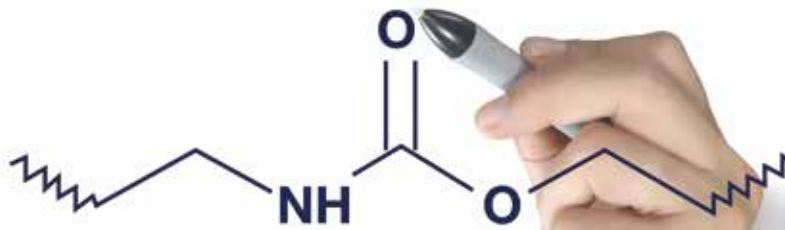


Extrusion-resistant



Wear-resistant





## The Formula for Success: Polyoles + Isocyanate

Thermoplastic polyurethanes (TPU) belong to the material category of thermoplastic elastomers and are produced from three primary raw materials:

- Long-chained polyoles form the soft segment, which has a major influence on the media compatibility and resistance of TPU compounds.
- Short-chained polyoles form the hard segment. They have a crucial impact on compound hardness and are responsible for physical crosslinking.
- Isocyanate is the connecting link between the polyoles. Isocyanate forms the macromolecule, i.e. the finished plastic compound, via step-growth polymerization reactions. Isocyanate and polyole react by forming the urethane group, which has given its name to this category of compounds.

Hard and soft segments separate from each other due to differences in polarity. This results in a physical crosslinking in which the hard segments provide the material's strength and the amorphous soft segments its rubber elasticity.

Through a suitable combination of hard and soft segments, as well as isocyanates, TPU compounds can be optimized across a broad

range. Combined with Parker-Prädifa's sealing technology know-how this results in Ultrathan® sealing compounds featuring the following properties:

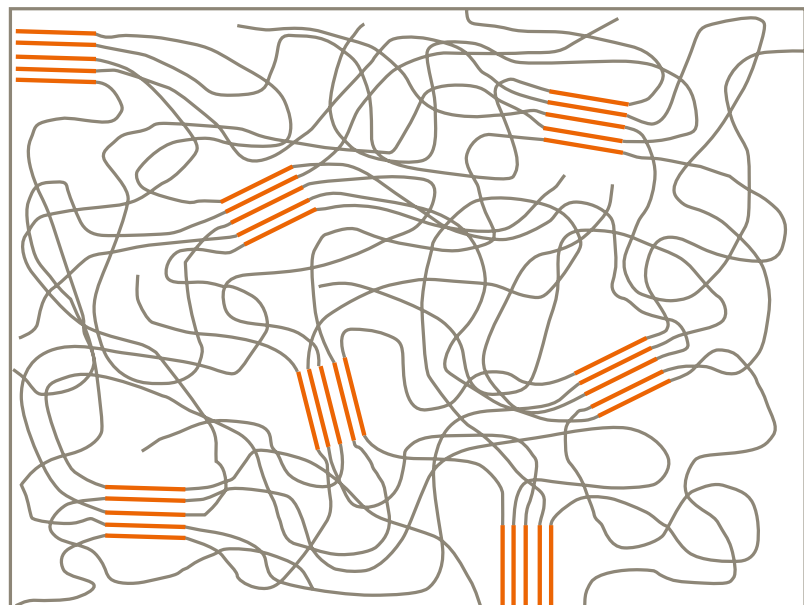
- Minimal abrasion
- Excellent tear resistance
- Good dynamic behavior
- Outstanding extrusion resistance and
- Excellent compatibility with mineral oils

Specifically modified materials extend the application range of polyurethane compounds for:

- Low-temperature application

- High hydrolysis requirements, e.g. in moist environments, in cleaning cycles or when biodegradable operating media are used
- Improved friction and stick-slip-free operation
- Heavy-duty applications
- And much more

In-house development and manufacturing ensures optimal monitoring of all process steps and enables new compound developments to be put into volume production within a short period of time.



TPU with separated hard and soft segments.

# Pressure – Medium – Temperature: The “Magic Triangle” of Compound Selection

The selection of the right material for your application essentially depends on three factors:



## **Pressure**

System pressure is the key selection criterion. Under low pressure conditions, hard compounds may not respond quickly enough. This may lead to leakage. Conversely, soft compounds may be subject to heavier extrusion and the resultant premature seal failure. That is why the general rule applies: the higher the pressure, the harder the required material.



## **Medium**

Ambient media are the second key selection factor. In addition to our standard materials, we offer a wealth of compounds specifically optimized for hydrolysis and media resistance. The resulting benefits include clearly extended service life under extremely humid conditions and in critical media or additives.



## **Temperature**

Operating temperatures are the third aspect to be considered for compound selection. Again, in addition to standard materials, special compounds which are particularly well-suited for low- or high-temperature applications are available.

# From Convenience Features to Heavy-Duty Service:

Our TPU Compounds Are Suitable for a Wide Range of Applications

With their outstanding properties the compounds of the Parker Ultrathan® family cover the requirements of diverse applications and uses. They can be found in the automotive sector as well as in food or textile production, in earth moving equipment or forklift trucks, in sanitary facilities or a wide range of tools. The following overview provides a selection from the wealth of applications in which our TPU compounds are successfully used, including the relevant requirements profiles and appropriate materials:



## Shaft Wipers for Starters in Automobiles

### Requirements

- Service life across the expected lifecycle of the passenger car or commercial vehicle in harshest ambient conditions
- Robustness against abrasive particles and high circumferential velocities
- Low breakaway and dynamic friction

### The Solution: P5011

- Resistant against abrasive wear
- Reduced friction



## Rotation Damping Element in Plumbing Applications

### Requirements

- Abrasion wear resistance against a glass fiber reinforced mating surface
- Consistent friction properties, low setting behavior

### The Solution: P5008

- TPU with surface coating



## Friction Disc for Texturing Units in Textile Industry Twine Machines for Napping Synthetic Yarns

### Requirements

- High tear strength
- High media resistance against diverse yarn preparation agents
- Optimal friction properties for consistent yarn tension and good yarn napping
- High thermal and wear resistance

### The Solution: P5654

- Aramid fiber filling for high wear resistance
- Surface texturing ensures required friction properties



### Rod Seal for Convenience Gas Springs or Light-Duty Hydraulics

#### Requirements

- High wear resistance
- Good permeation properties and gas tightness
- Low friction

#### The Solution: P6030

- Good strength and wear levels
- Low permeation



### Carriage End Position Cushioner in Power Nailers

#### Requirements

- Good cushioning effect
- Minimal rebound
- High temperature resistance
- High mechanical strength

#### The Solution: P4307

- Resistant against high temperatures
- Mechanical strength



### Wiper for Jack Hammer Strikers

#### Requirements

- High wear resistance
- High temperature stability
- Low friction
- Good wiping effect against solids

#### The Solution: P4300

- Good friction levels
- Resistant against high temperatures



### TPU Membranes for Rock Breaker Applications

#### Requirements

- Long service life
- Low gas permeability
- High elasticity for high-frequency load reversals
- Resistance against high mechanical loads

#### The Solution: P5007

- High elasticity
- Good tear propagation strength



### Microgrooved Rod Seals for Silent Sealing of Automotive Convenience Hydraulics (e.g. automatic convertible top operation)

#### Requirements

- Resistance against pressures up to 250 bar with small cross-sections
- Absolutely silent piston rod advance and return stroke
- Temperature range: -40 °C to 85 °C
- No stick-slip effect

#### The Solution: P5080

- Friction optimized
- No stick-slip resulting in silent operation
- Microgrooved texturing of the seal on the inner diameter to reduce the contact area and create an oil reservoir



### Wiper Covers (Wiper and Bellows) for Windshield Wiper System

- Optimal sealing function between vehicle chassis and wiper system
- Maximum resistance against weather influences such as UV rays and ozone
- No moisture ingress in case of ice and snow
- Wear resistance against abrasive media (e.g. fine sand) and other contaminations

#### The Solution: P5012

- Hydrolysis-resistant
- Coordinated sealing system of wiper and cover bellows



### Sealing of Filler Necks for Hydrogen Fuel Tank Systems

#### Requirements

- Very good low-temperature properties of the molded seals
- Very low permeation rates
- Safety against high pressures and explosive decompression
- Low swell rate in contact with hydrogen

#### The Solution: P5009

- Low-temperature optimized
- Low permeation
- Resistant against hydrogen





### Rod Seal/Wiper Ring and Piston Seal for Cylinders in Cheese Presses

Function: Squeezing Excess Liquid out of Curds

#### Requirements

- Good media resistance against dairy products and cleaning agents
- Average time before overhaul/refit  $\geq 7,000$  km
- Food contact substance approval

#### The Solution: P5600

- Food contact substance approval
- Very good hydrolysis / chemical resistance against aqueous media, acids and alkali
- Good wear resistance to ensure cylinder tightness across the lifecycle



### HS Profile Static Seal for Hydraulic Cylinders in Earth Moving Equipment

#### Requirements

- Ease of assembly
- High extrusion resistance
- Low compression set
- Suitability for standard O-ring grooves with back-up rings
- Long service life at temperatures of up to  $+110$  °C

#### The Solution: P6000

- Temperature resistance
- High tear resistance
- Low compression set



### HL Profile Rod Seal for Forklift Truck Lift Cylinders

#### Requirements

- Extremely low friction at low pressures and in non-pressurized conditions
- Minimized stick-slip
- Low break-away force even after longer downtime
- Good sealing function in all pressure ranges
- Long service life

#### The Solution: P6030

- Temperature-resistant
- Wear-resistant
- Friction-optimized

# Ultrathan® (TPU) Sealing Compounds

Hardness information stated in the chart represents required values with a tolerance of +/- 5 hardness points. Hardness is measured on standard samples with a thickness of 6 mm according to DIN ISO 7619-1. Finished parts typically allow only measurements of micro-hardness (IHRD) to be made according to DIN ISO 48, which results in different values.

The sub-zero temperatures stated are deemed to be general guidelines only, as functionality in cold depends on the type of seal, operating conditions and quality of the surrounding metal components. Thermoplastic materials may soften in excessively high temperatures and consequently lose their preloading. Therefore, the stated temperature range may be exceeded only for a short period of time and without mechanical loading (e.g. in paint-baking processes) up to the stated "short-term" temperature. In the presence of aggressive media or elevated friction, the stated temperature range may considerably decrease.



Compound			P 5075	P 5007	P 5070	P 5011
Color			ocher	green	green	brown
<b>Physical Properties</b>						
<b>Test</b>	<b>Standard</b>	<b>Dimension</b>				
Hardness	DIN ISO 7619-1	Shore A ± -5	80	82	84	88
Hardness	DIN ISO 7619-1	Shore D ± -3				
Spec. Gravity (+/-0,02)	DIN EN ISO 1183-1 Method M	g/cm <sup>3</sup> ± -0.02	1.12	1.16	1.16	1.16
Modulus 100%	DIN 53504	MPa (min.)	4	4.5	5.5	6
Modulus 300%	DIN 53504	MPa (min.)	5.5	9	9	10
Tensile strength	DIN 53504	MPa (min.)	40	40	40	35
Ultimate elongation	DIN 53504	% (min.)	400	400	400	400
Compression Set 70 h / 70 °C	ISO 815-1	% (max.)	28	27	30	35
Compression Set 22 h / 100 °C	ISO 815-1	% (max.)				
Rebound resilience	DIN 53512	% (min.)	60	52	48	46
Tear strength	DIN ISO 34-1	N/mm (min.)	30	40	30	40
Low temperature (Tg, DSC)	ISO 11357-2	°C (max.)	-50	-40	-40	-40
Temperature Range		°C	-45 / 80	-35 / 80	-35 / 90	-36 / 85
Temperature Range (Short-term)		°C	100	100	110	110
<b>Fields of Application</b>						
Hydraulics						
Low Pressure Hydraulics						•
Pneumatics			•	•	•	•
Mini Pneumatics			•	•	•	•
Mining						
Biologically degradable media (e.g. rape seed/ester oils)					•	•
Gas springs / shock absorbers					•	
Hydraulic accumulators						
Diaphragms / bellows			•	•		
Drive belts						
Gear pumps / motors						
Automotive						•
Chemical media (acids/lyes)						
Food						
Static seals (e.g. O-rings)						•
<b>Properties</b>						
Excellent low temperature properties			•			
Excellent dynamic behavior			•			
Very good wear properties				•		
Very good resistance to hydrolysis					•	•
Friction-optimized						•
Stick-slip optimized						
Very good high-temperature behavior						
Excellent extrusion resistance						
Resistant against acids and lyes						
<b>Media</b>						
Mineral oil based hydraulic media			•	•	•	•
Mineral oil based greases			•	•	•	•
Central hydraulic media					•	•
HEPR					•	
HETG					•	
HEES					•	
Oil/water emulsions, flame-resistant media (HFA/HFB)					•	
Polar media, acids and lyes						
Aqueous media					•	

<sup>1</sup> 40 °C max.

<sup>2</sup> Special application in the chemical processing and food industry

<sup>3</sup> Probably suitable; test required

P 5080	P 5010	P 5012	P 4300	P 5000	P5029	P 5001	P 5008	P6030	P6000	P 5009	P 5600	P 5062	P 6060
green	red	red	beige	green	colourless	orange	green	orange	grey	grey	ocher	black	yellow

88	90	90	92	94	94	94	94	93	94	94	92	55	58
1.16	1.18	1.18	1.18	1.2	1.2	1.19	1.19	1.2	1.2	1.16	1.05	1.15	1.23
6.5	7.5	8.5 - 11.5	11	13	13	12	11	10	11	11	10	16	20
11.5	14	14	16	30	30	20	20	18	20	18	13	20	30
30	43	40	50	50	50	50	55	50	50	45	15	44	35
500	450	450	480	350	350	400	400	400	400	400	300	400	300
34	27	35		27	27	30	26	28	26	27	40	50	35
			35										
44	40	40	58	30	30	38	38	40	40	44	25	38	32
50	45	60	75	90	90	45	70	80	90	60	45	100	150
-40	-40	-40	-35	-20	-20	-40	-35	-35	-35	-50	-30	-35	-35
-40 / 85	-30 / 100	-38 / 100	-30 / 110	-20 / 100	-20 / 100	-35 / 100	-35 / 100	-35 / 100	-35 / 110	-45 / 95	-20 / 80	-25 / 110	-35 / 110
110	120	120	130	120	120	120	120	120	130	115	100	130	130

			•	•		•	•	•	•	•	• <sup>2</sup>	•	•
•	•	•									• <sup>2</sup>		
•	•	•	•	•		•	•	•		•	• <sup>2</sup>		
	•												
•		•		•	•	•	• <sup>1</sup>	•	•				•
				•	•	•	•	•	•	•		• <sup>3</sup>	•
	•		•			•	•	•	•	•			
		•						•		•			
	•		•			•	•			•			
•	•	•				•	•			•			
				•	•						•		
•		•	•	•		•	•	•		•	•	•	

			•					•	•	•			
	•		•	•	•		•	•	•	•			•
•		•		•	•	•						•	
•												•	
			•						•	•			•
								•	•			•	•
											•		

•	•	•	•	•	•	•	•	•	•	•		•	•
•	•	•	•	•	•	•	•	•	•	•		•	•
•		•		•	•	•							
				•	•	•							
				•	•	•							
				•	•	•							
				•	•	•	• <sup>1</sup>						
											•		
				•	•	•					•		



Parker Hannifin GmbH  
**Engineered Materials Group Europe**  
Arnold-Jäger-Str. 1  
74321 Bietigheim-Bissingen · Germany  
Tel.: +49 (0) 7142 351-0  
Fax: +49 (0) 7142 351-432  
E-mail: [seal-europe@parker.com](mailto:seal-europe@parker.com)  
[www.parker.com/praedifa](http://www.parker.com/praedifa)