

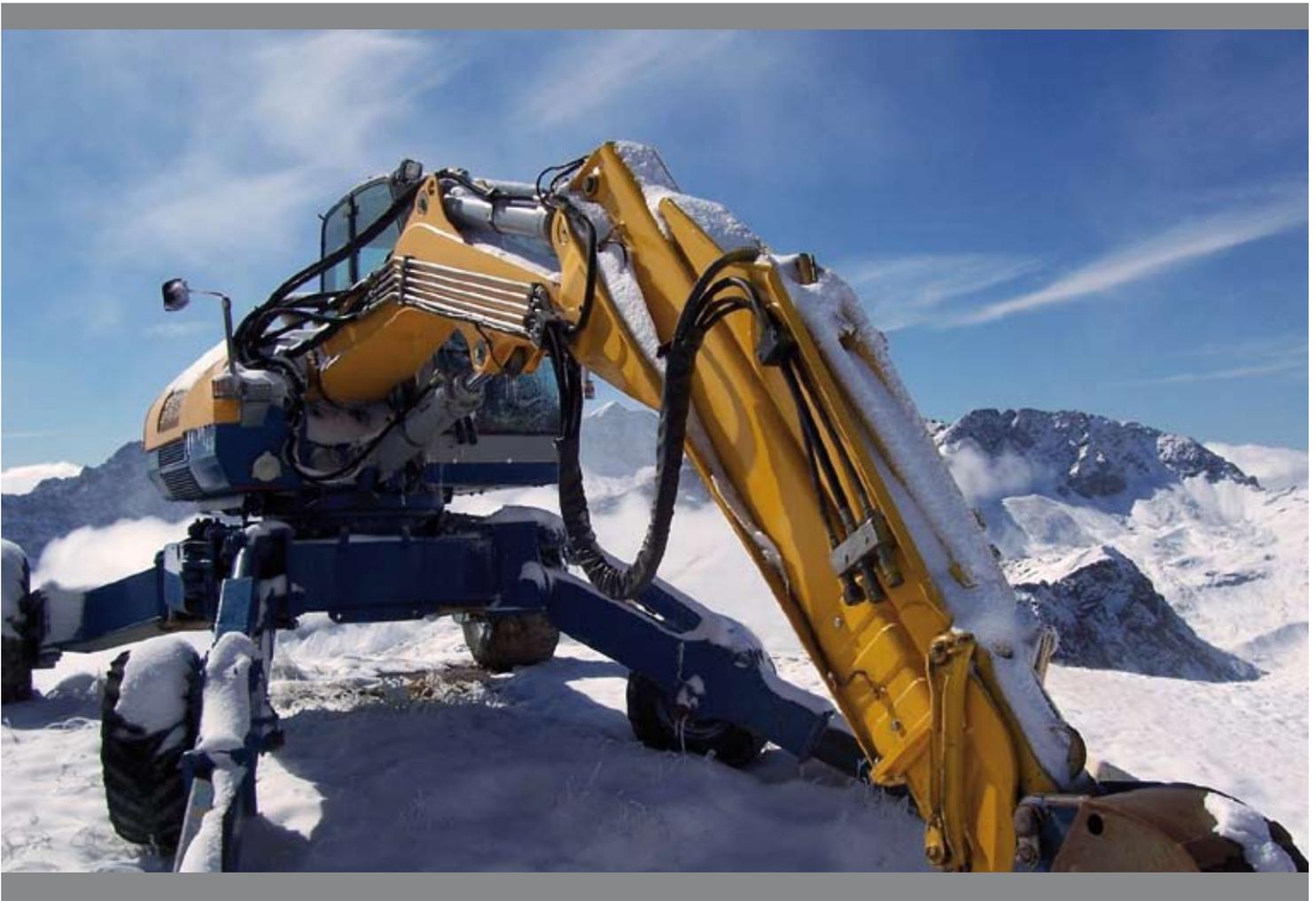
**HUNTSMAN**

Enriching lives through innovation



IROGRAN<sup>®</sup> A 92 K 5031 DP

An all-round performer for industrial applications



**ELASTOMERS**



## About IROGRAN®

IROGRAN® is the registered brand name for a broad range of thermoplastic polyurethane (TPU) from Huntsman. Delivering excellent performance, even in extreme environments, TPU materials in the IROGRAN® portfolio are renowned for their adaptability. With a grade available to suit most design and engineering challenges, IROGRAN® is hard to beat as a universally useful ingredient for injection molding and extruding projects.

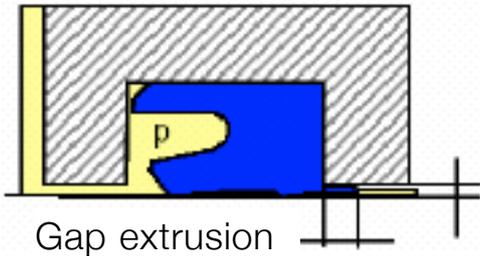
## IROGRAN® A 92 K 5031 DP

IROGRAN® A 92 K 5031 DP is the first product in a new family of premium grade TPU. Formulated with the needs of modern elastomer component manufacture in mind, it is ideal for industrial applications where compromise is not an option.

IROGRAN® A 92 K 5031 DP is a good all-round performer. It can be extruded or injection molded to create a range of products. It performs well as a base material for hydraulic seals and also has benefits for:

- Pneumatic tubes that need to perform at high operating temperatures
- Spiral hoses with good hydrolysis and heat resistance properties
- Cable jackets for high temperature applications





## IROGRAN<sup>®</sup> A 92 K 5031 DP

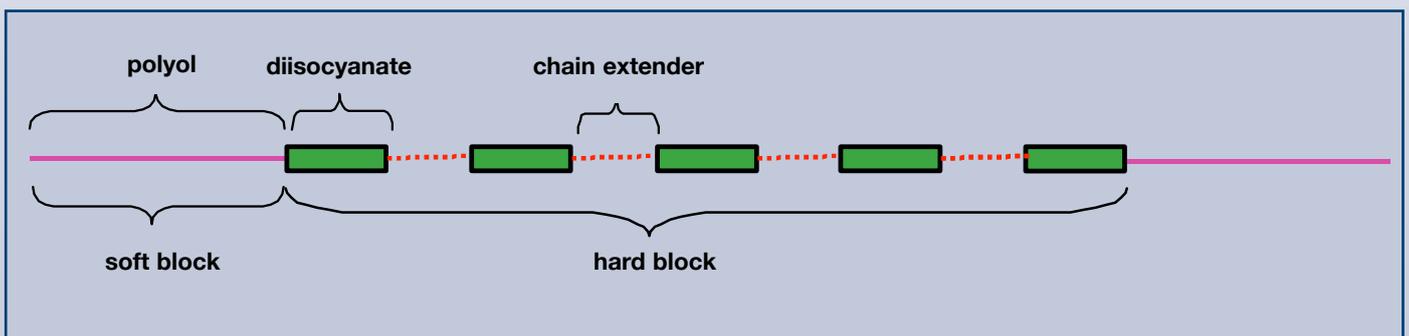
offers excellent gap extrusion performances

## Unbeatable performance

In the production of flexible elastomeric parts, the most successful materials are those that offer infinite processing possibilities and performance scope alongside consistent quality.

IROGRAN<sup>®</sup> A 92 K 5031 DP is made using a novel technique developed by Huntsman. Employing raw materials economically, this process delivers optimized hard block products of a reliable standard and with performance properties including:

- Very good hydrolytic stability
- High heat resistance
- High crystallinity
- A low compression set at 100°C
- An extensive operating temperature range from -40°C to 130°C.
- Very high strength at room temperature and consistent performance up to 120°C
- Low extrusion affinity up to 130°C (hydraulic seal appl.)
- Low oil absorption, including good resistance against bio hydraulic oils
- Good burst pressure properties even at high temperatures
- Low abrasion at high temperatures
- Good form retention and stability





## IROGRAN<sup>®</sup> A 92 K 5031 DP

- Hydraulic seals
- Pneumatic tubes

### Hydraulic seals

With excellent rebound resilience and good oil and abrasion resistance, IROGRAN<sup>®</sup> A 92 K 5031 DP is an important raw material for seals that need to perform consistently, even in harsh conditions. It offers numerous physical properties including:

- High wear resistance
- Low compression set
- High extrusion resistance
- A wide temperature operating range
- High temperature resistance



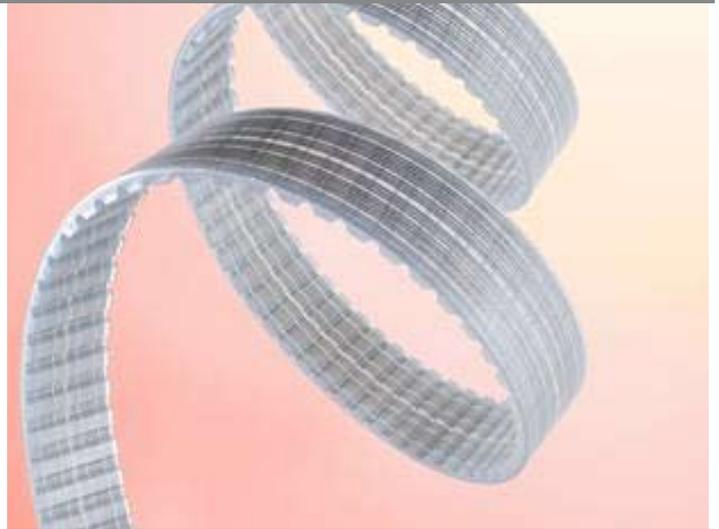
### Pneumatic tubes

IROGRAN<sup>®</sup> A 92 K 5031 DP shows very good burst pressure figures at high temperatures. It performs well up to 50°C and can be used in flexible tube applications where temperatures reach 100°C.

Offering good hydrolytic stability it can also be used in wet and humid environments as an alternative to ester-based tubes.

## IROGRAN® A 92 K 5031 DP

- Timing belts
- Cables



### Timing belts

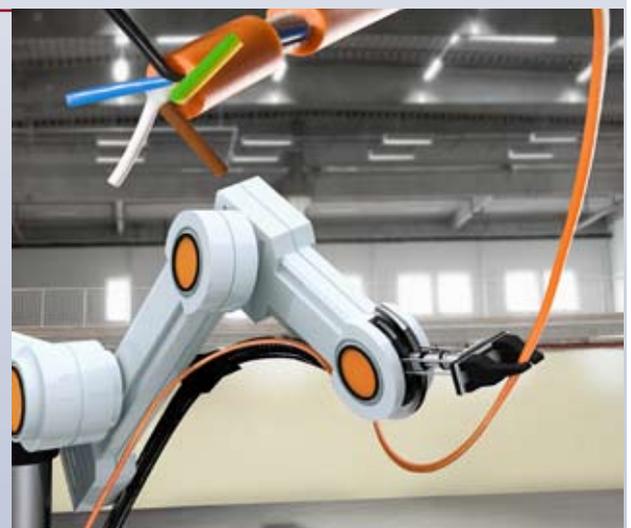
IROGRAN® A 92 K 5031 DP is a reliable solution for timing belt applications.

A practical alternative to duroplastic elastomers it can be welded and comes with added benefits including high heat stability, meaning it can be used in machines where operating temperatures reach up to 120°C.

### Cables

Cable enclosures made out of IROGRAN® A 92 K 5031 DP have high form stability and can be used at temperatures in excess of 120°C, a level far higher than normal ether-based TPU grades.

This is a key attribute for automotive specifiers who need cables that can function in high temperature brake or high power engine systems.



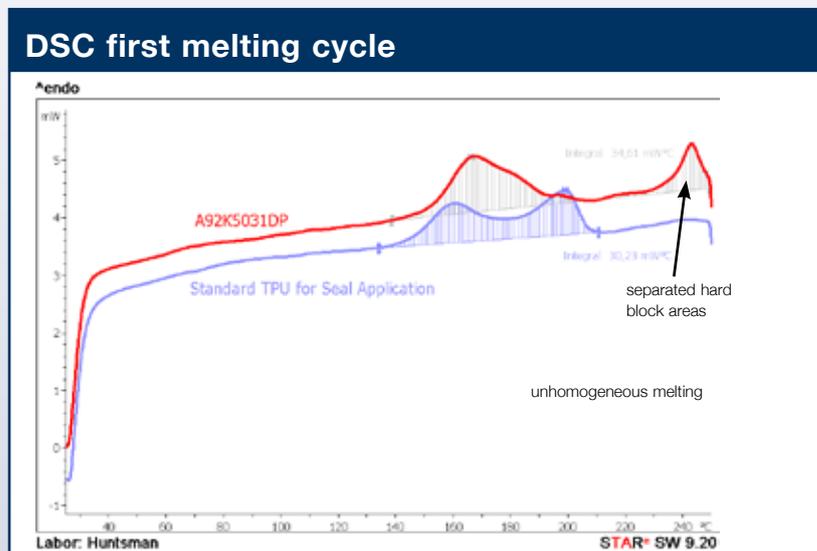


## Technical information

Our new production process enables us to deliver high performance TPU grades with an improved compression set and heat dimension stability. The new process favors the building of microcrystalline hard segment domains. These domains and the raw material composition are responsible for the properties offered by IROGRAN® A 92 K 5031 DP.

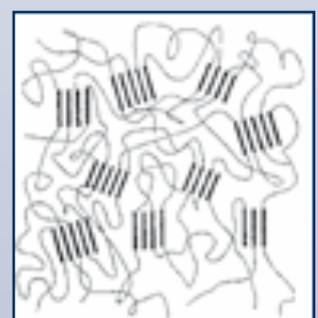
## DSC Graph

The DSC Graph (opposite) shows the melting of microcrystalline hard segment domains between 220°C to 240°C. Under normal processing temperatures these areas should not melt.



## Morphology of TPU

The image on the right shows the two-phase structure of an amorphous soft phase and a high melting microcrystalline hard domain.





## IROGRAN® A 92 K 5031 DP

### Technical information

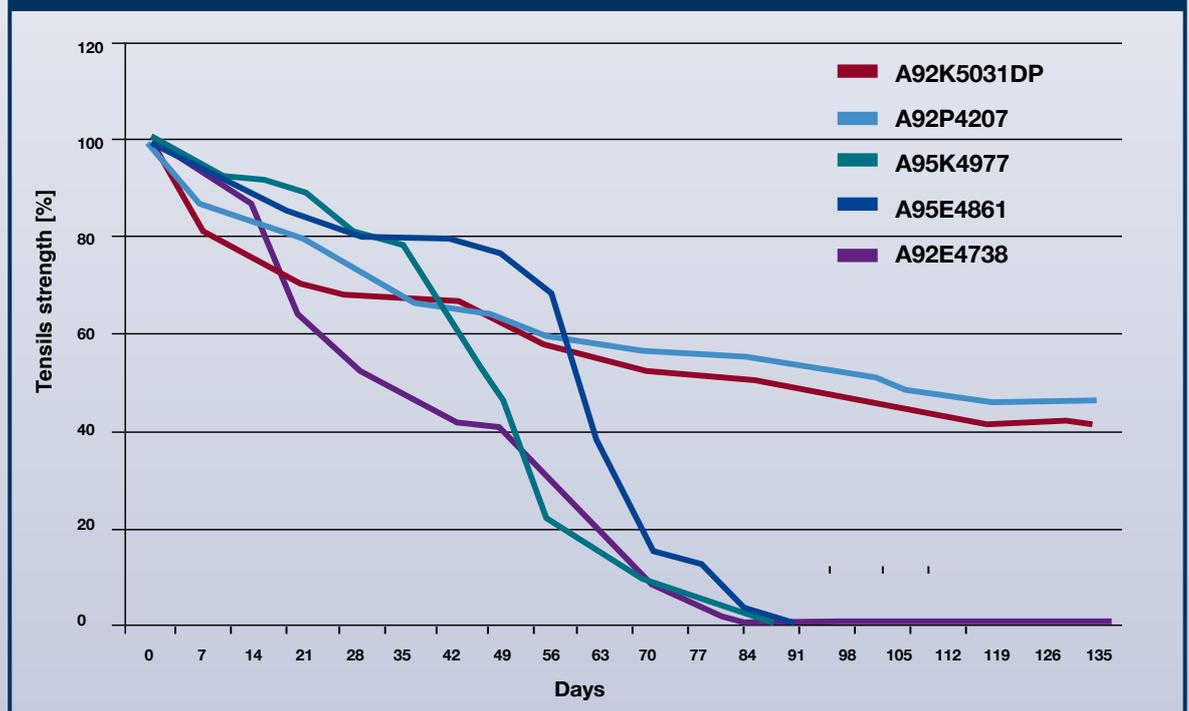
- DSC graph
- Morpholgy
- Hydrolysis

## Hydrolysis

TPU components are often employed in applications where they are exposed to different chemical substances. High humidity or hydraulic oils that contain water, could affect the physical properties of the parts, causing them to fail. In the case of hydraulic seals, this could result in an oil splash.

IROGRAN® A 92 K 5031 DP shows excellent hydrolysis resistance over a long period of time. Capable of withstanding aggressive chemical substrates it can be used in a wide range of applications.

Tensile strength after water exposition at 80 °C





## Temperature resistance



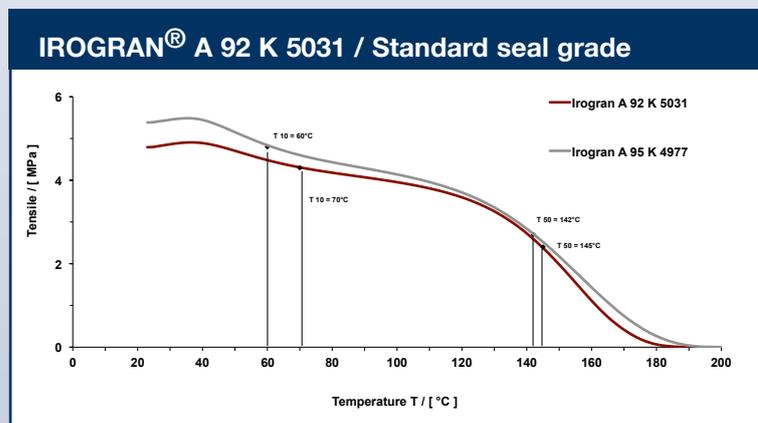
### Anisothermal stress relaxation test for characterizing elastomers and polymers

The Brabender® TSSR meter (TSSR = Temperature Scanning Stress Relaxation) measures the thermo-mechanical properties of elastomers and polymers subjected to constant stress at a continuously rising temperature. The measured data supplies reliable information about the morphology phase of the material tested.

In contrast to conventional relaxation tests carried out at a consistent temperature, the heat in a TSSR test rises at a defined rate. This allows the maximum service temperature and relaxation spectrum of the sample material to be defined

## Seals

IROGRAN® A 92 K 5031 DP shares many of the same characteristics as our premium A 95 K 4977 sealing product. It is however fractionally more flexible and its tensile strength at room temperature is less.





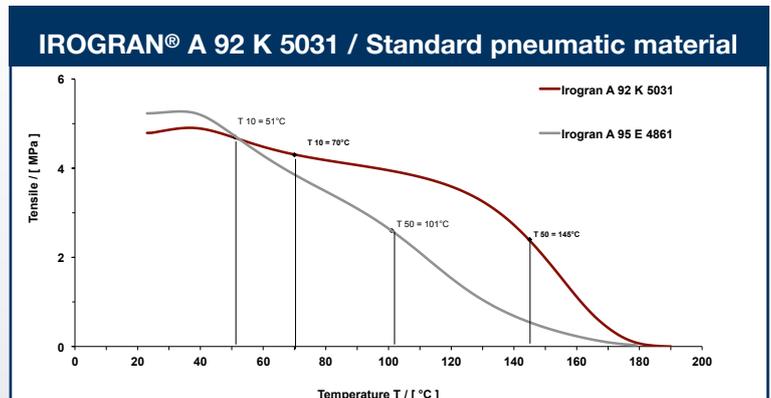
## IROGRAN® A 92 K 5031 DP

### TSSR graph

- Seals
- Pneumatic tubes
- Timing belts
- Cables

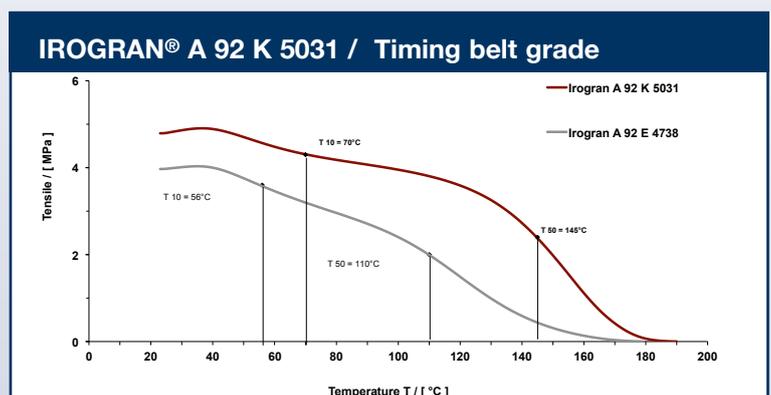
## Pneumatic

Pneumatic tubes made out of IROGRAN® A 92 K 5031 DP show good burst pressure properties up to 60°C.



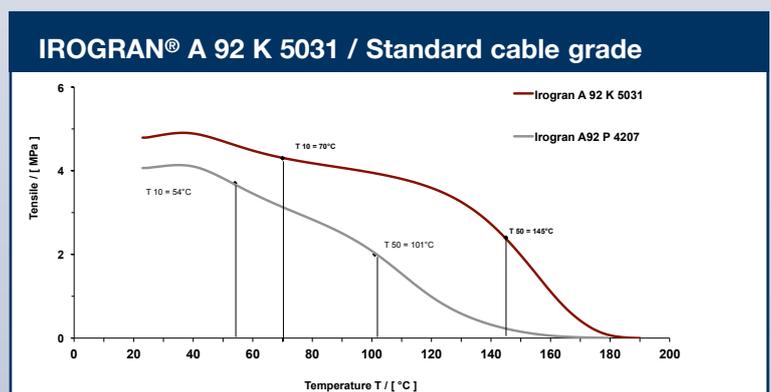
## Timing belts

IROGRAN® A 92 K 5031 DP shows excellent properties in timing belt applications where temperatures are higher than 60°C.



## Cables

IROGRAN® A 92 K 5031 DP can perform at temperatures up to 40°C higher than normal TPU materials. Cables covered with IROGRAN® A 92 K 5031 DP generally also have a much longer life cycle.





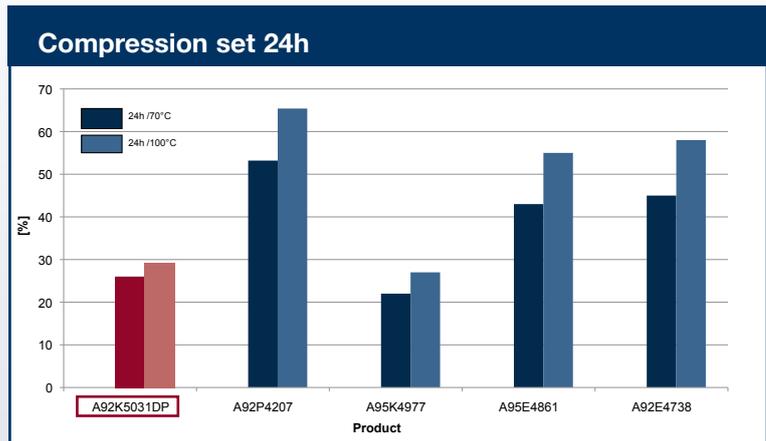
## IROGRAN® A 92 K 5031 DP

### Temperature resistance

- Compression set 24 h
- Compression set 70 h

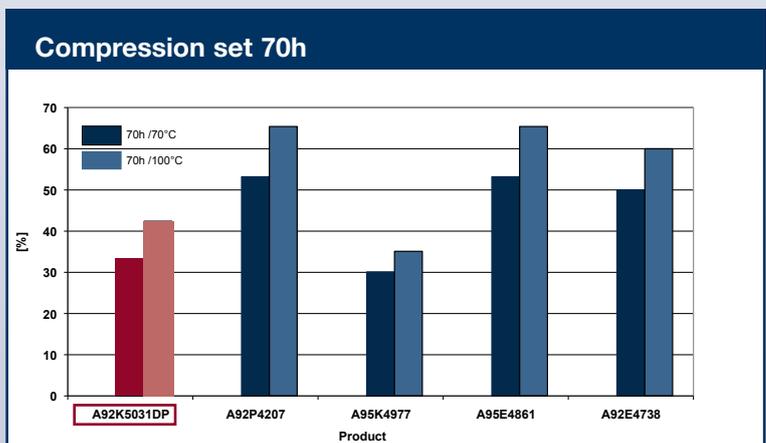
## Compression set 24 h

The compression set figures of IROGRAN® A 92 K 5031 DP are significantly lower than standard TPU grades. This enables its use in hydraulic seals. For all other applications, where good compression set properties are needed, IROGRAN® A 92 K 5031 DP is a suitable choice.



## Compression set 70 h

Under longer test conditions, IROGRAN® A 92 K 5031 DP also performs well.



# IROGRAN® A 92 K 5031 DP

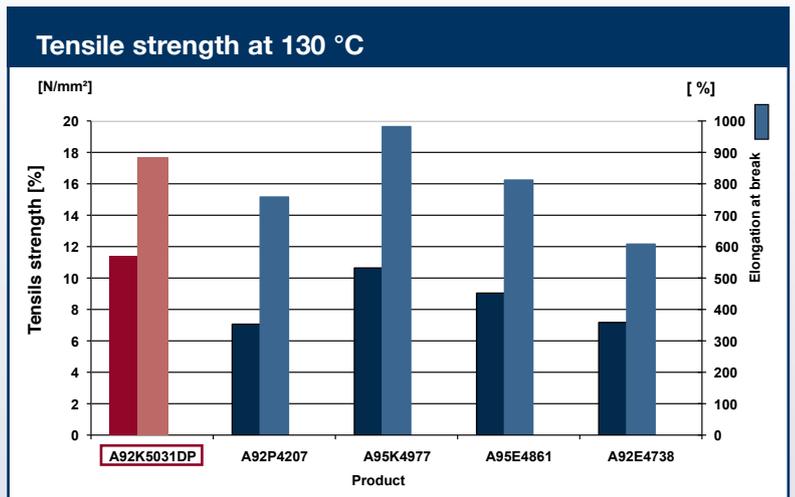
## Temperature resistance

- Tensile
- Vicat



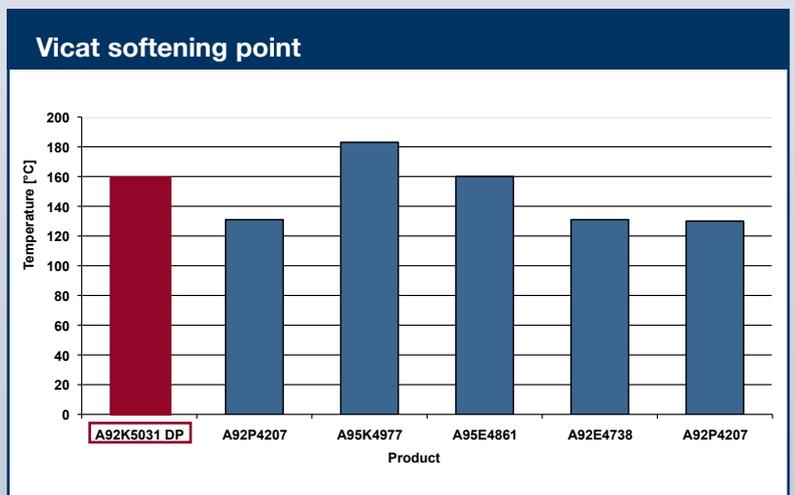
## Tensile

At 130°C IROGRAN® A 92 K 5031 DP has more than 10N/m<sup>2</sup> tensile strength. This is a better performance compared to other elastomers at room temperature.



## Vicat

The vicat softening point of IROGRAN® A 92 K 5031 DP is typically 30°C higher than standard TPU grades. Only harder seal grades based on caprolactone show higher values.





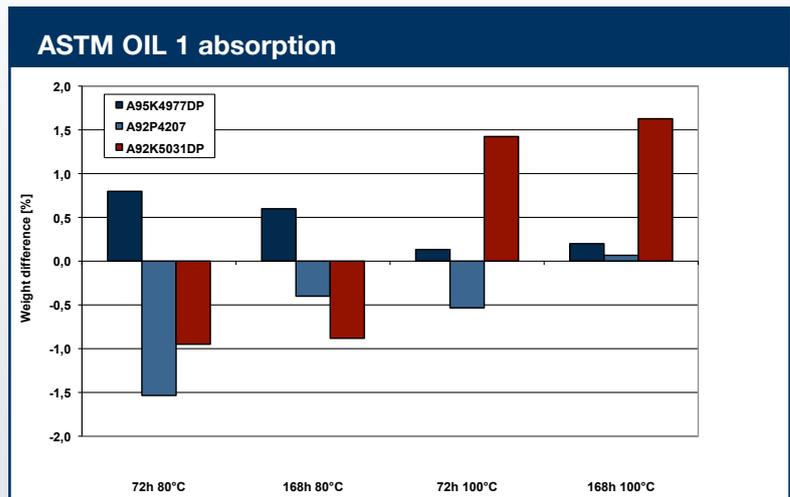
## IROGRAN® A 92 K 5031 DP

### Chemical resistance

- ASTM 1
- ASTM 2

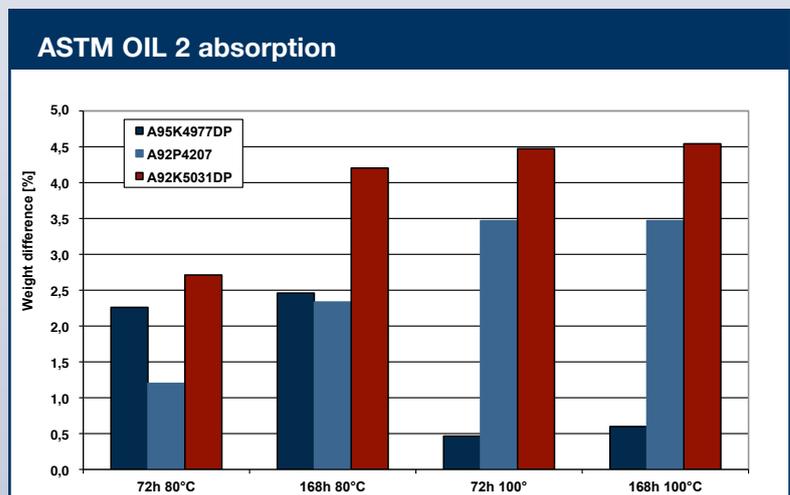
## ASTM 1

Ether-based materials absorb small quantities of water. At low temperatures the water diffuses into the oil. This is the reason for weight loss at 80°C. At higher temperatures, the material absorbs small quantities of ASTM 1.



## ASTM 2

Ether-based materials commonly absorb more oil than caprolactone-based grades – a factor to consider during part design.



# IROGRAN® A 92 K 5031 DP

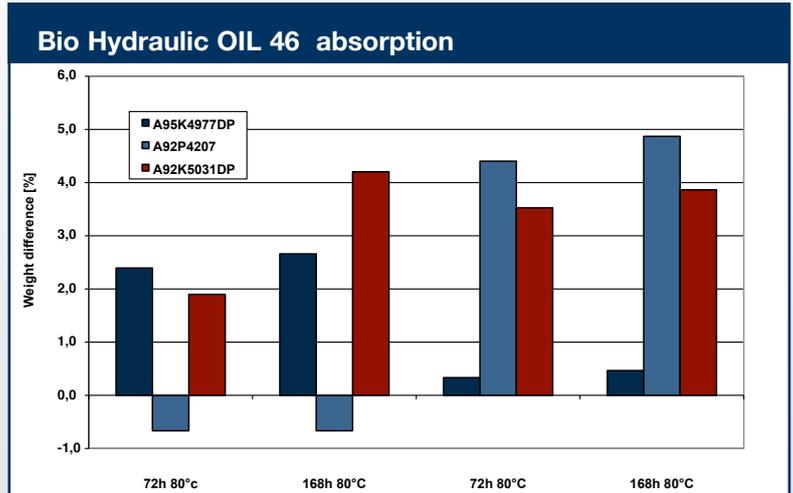
## Chemical resistance

- Bio oil
- Hydraulic oil



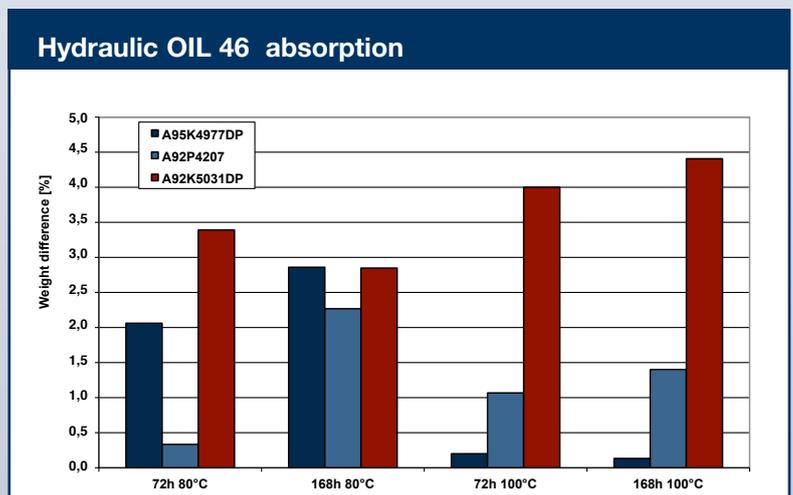
## Bio oil

IROGRAN® A 92 K 5031 DP absorbs a maximum of 5% oil. For ether-based materials this is an excellent value. Good hydrolysis resistance allows usage in bio hydraulic oils.



## Hydraulic oil

Oil absorption can have an effect on performance, especially in hydraulic applications. Reducing friction it can increase the life cycle of a seal.





## IROGRAN<sup>®</sup> A 92 K 5031 DP

### Product performance

## Material preparation

IROGRAN<sup>®</sup> TPU grades are supplied pre-dried in moisture guarded sacks. To ensure trouble free processing it is preferable to dry IROGRAN<sup>®</sup> TPU. The recommended drying conditions are:

- 3 hours at 100-110°C / 212-230 °C in circulating air
- 3 hours at 80-90°C / 176-194 °C in dehumidified air
- Dew point: -30°C / -22 °C

For further advice on the use of additives during processing, please contact the IROGRAN<sup>®</sup> TPU technical service department.

## Processing parameters

Typical processing parameters		
Processable using:	Injection molding	
MVR [2100C/ 21,6 kg]	80 cm <sup>3</sup> /10 min	
Injection molding		
Temperature profile	°C	°F
Barrel Zone 1	210-230	410-445
Barrel Zone 2	210-230	410-445
Barrel Zone 3	210-230	410-445
Nozzle 2	10-230	410-445
Mold	25-70	77-158

### Physical Form:

Type: Pellet  
Bulk density: 740 kg/m<sup>3</sup>

## Typical physical properties

Property	Key	DIN / ISO	Unit	Value	ASTM / ISO	Unit	Value
Hardness	M	ISO 868	Shore A	92	D-2240	Shore A	92
Hardness	M	ISO 868	Shore D	46	D-2240	Shore D	46
Tensile strength	M	53504	MPa	54	D-412	psi	5655
Elongation @ break	M	53504	%	550	D-412	%	580
100% Modulus	M	53504	MPa	11.4	D-412	Psi	1658
300% Modulus	M	53504	MPa	18.0	D-412	Psi	2610
Tear resistance	M	ISO 34-1	N/mm	72	D-624	Pli	742
Abrasion	M	ISO 4649	mm <sup>3</sup>	20	ISO 4649	in <sup>3</sup>	0.0012
Compression set 24hrs @ 70°C	M	ISO 815	%	26	D-395	%	26
Compression set 24hrs @ 100°C	M	ISO 815	%	30	D-395	%	30
Compression set 70hrs @ 70°C	M	ISO 815	%	33	D-395	%	33
Compression set 70hrs @ 100°C	M	ISO 815	%	42	D-395	%	42
Mold shrinkage	M		%	1.0	D-955	in/in	0.010
Density	M	ISO 1183-1	kg/m <sup>3</sup>	1.13	D-792	kg/m <sup>3</sup>	1.13

E = 0.025 extruded film cut to ASTM requirements.  
M = Injection molded parts to meet DIN & ASTM requirements. Parts tempered for 20hrs @ 120°C prior to testing.



## Storage

Supplied in easy flow pellet form to mitigate any metering problems, IROGRAN® A 92 K 5031 DP can be dried and transported dust-free. Like other IROGRAN® materials, it is hygroscopic. Even very low levels of moisture from the air and surrounding environment will impact on its final quality. This could cause an uneven surface or sticky residue to collect in extrusion tools or injection molds.

IROGRAN® grades are generally supplied in steam-tight bags or in octabins with a PE-lining. When stored in open bags, IROGRAN® can absorb up to 1.5% moisture after a relatively short period of time. It is therefore important that containers are closed after each measure of material is withdrawn.

## Handling

Because of the hygroscopic nature of IROGRAN®, pre-drying is recommended. To ensure trouble-free processing and avoid any loss of quality, we suggest drying to achieve a moisture content of  $\leq 0.05\%$ .

In general, the drying period for a newly opened bag of resin will be between two and four hours but this may vary. The extent and rate at which drying occurs will be governed by the resin type, moisture content, drying temperature and surrounding environment.

Indicators that moisture content is too high may include foaming of the plasticized material or the formation of bubbles. If the granules are too moist, the extrudate's characteristics will change from smooth and glossy to foamy and gassy. Blisters or streaks may also occur on the surface of the finished components.

Huntsman Polyurethanes is committed to working closely with its customers and can offer a fast and flexible response to your needs. We offer direct links to our laboratories with full technical backup. Commercial support and dedicated customer service is available throughout Europe, the Middle East, Asia-Pacific and the Americas.

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### The Huntsman-Story

Huntsman Polyurethanes is a business division of Huntsman Corporation, a global manufacturer and marketer of differentiated chemicals. Combining international reach with local support, Huntsman's operating companies manufacture products for a variety of global industries. These include chemicals, plastics, automotive, aviation, textiles, footwear, paints and coatings, construction, technology, agriculture, healthcare, detergent, personal care, furniture, appliances and packaging. Originally known for pioneering innovations in packaging, and later rapid, integrated growth in petrochemicals, Huntsman today has 11,000 employees and operates from multiple locations worldwide. The Company had 2009 revenues of approximately \$8 billion.

Huntsman Polyurethanes warrants only that its products meet the specifications agreed with the buyer. Typical properties, where stated, are to be considered as representative of current production and should not be treated as specifications. While all the information and recommendations in this publication are to the best of our knowledge, information and belief accurate at the date of publication, NO GUARANTY, WARRANTY OR REPRESENTATION IS MADE, INTENDED OR IMPLIED AS TO THE CORRECTNESS OR SUFFICIENCY OF ANY INFORMATION OR RECOMMENDATION OR AS TO THE MERCHANTABILITY, SUITABILITY OR FITNESS OF ANY PRODUCTS FOR ANY PARTICULAR USE OR PURPOSE. IN ALL CASES, IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE THE APPLICABILITY OF SUCH INFORMATION AND RECOMMENDATIONS AND THE SUITABILITY OF ANY PRODUCT FOR ITS OWN PARTICULAR PURPOSE. NOTHING IN THIS PUBLICATION IS TO BE CONSTRUED AS RECOMMENDING THE INFRINGEMENT OF ANY PATENT OR OTHER INTELLECTUAL PROPERTY RIGHT AND NO LIABILITY ARISING FROM ANY SUCH INFRINGEMENT IS ASSUMED. NOTHING IN THIS PUBLICATION IS TO BE VIEWED AS A LICENCE UNDER ANY INTELLECTUAL PROPERTY RIGHT.

Products may be toxic and require special precautions in handling. The user should obtain Safety datasheets from Huntsman Polyurethanes and Huntsman Performance Products containing detailed information on toxicity, together with proper shipping, handling and storage procedures, and should comply with all applicable safety and environmental standards. Hazards, toxicity and behaviour of the products may differ when used with other materials and are dependent on the manufacturing circumstances or other processes. Such hazards, toxicity and behaviour should be determined by the user and made known to handlers, processors and end users.

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