

IROGRAN®

**Thermoplastic Polyurethanes**

# Inspiring design innovation

Product Overview - Film and Sheet



# IROGRAN® TPU:

## The flexible force behind innovative film and sheet applications

For proven technical performance and clear advantages over standard thermoplastics, Huntsman's extensive range of IROGRAN® TPU grades for film and sheet applications can offer ultimate design flexibility.

### Designed to inspire innovation

To meet ever-evolving market needs, IROGRAN® TPU gives designers, engineers and manufacturers the capabilities to produce better, thinner, more durable film and sheet materials with which to innovate and gain competitive edge.

From lightweight fabrics to rugged weatherproof systems, IROGRAN® TPUs can be customized for a variety of commercial, consumer and industrial requirements.

Whether customers need a solution with strength and durability; resistance to abrasion; chemical, hydrolysis and microbial tolerance; reliable bonding capabilities; or low-temperature flexibility, IROGRAN® TPUs are the smart choice.

### Key features and benefits

With broad functionality for the creation of adhesion, barrier protection, tactile and wear layers, IROGRAN® specialty aromatic TPUs can be used across a wide range of sectors including textiles, construction, transport, consumer goods and industrial manufacturing.

Bringing desirable properties to films and sheets, and available in aromatic, polyester and polyether grades, IROGRAN® TPUs are designed for ease of use and efficient processing. Extrudable to varying degrees of thickness they can be used to create tailor made films that perform well in a variety of demanding conditions.

For established and emerging applications, different plasticizer-free grades can be modified to achieve specific performance traits including:

- Matte finish
- Anti-static properties
- Flame retardancy
- UV protection
- Faster crystallization rate
- Plasticizer free, soft drape.



### Key grades include:

IROGRAN® PS: polyester-based grades with a broad processing window ideally suited for cast, flat die and blown film lines.

IROGRAN® E: high heat resistant, polyester-based TPUs with broad processing window suitable for thin films and sheets.

IROGRAN® P: polyether-based grades for film and sheet applications that require excellent resistance to hydrolysis and microbial attack.

IROGRAN® CA: polyester-based TPUs that are specially designed for adhesives applications where high green strength and a fast crystallization rate are essential qualities.

### TPU innovation

Huntsman Polyurethanes is committed to continuous innovation and sustainability across all areas of its thermoplastics business. For customers looking to develop specific applications, achieve particular features or deliver precise performance benefits, we offer direct access to a highly experienced team of technical experts and a network of specialist laboratories located around the world. Please contact your Huntsman representative to find out how IROGRAN® TPUs can help build your product pipeline.

## Applications

IROGRAN® is the brand name for our range of polyester and polyether-based TPUs. Products from this extensive portfolio are fully customizable and can be used in an array of film and sheet and fabric-coating applications including:



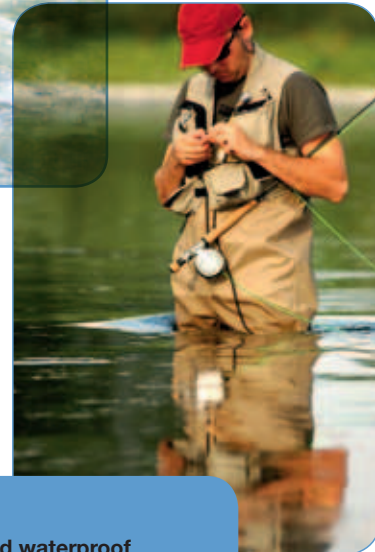
Adhesive films and decal films for footwear.



Barrier films that provide flexibility and conform in cushions.



Barrier films such as automotive seating and interior components.



Adhesive and waterproof films used in outdoor garments.

# Polyesters

Physical Properties			A 60 E 4902	PS 455-203	PS 455-204	PS 455-215	PS 370-202	PS 456-202	PS 440-200	A 92 E 4860	PS 443-201	CA 1
<b>General</b>												
Hardness	ASTM D-2240	Shore A	52	78	75	78	77	84	89	89	92	95
Hardness	ASTM D-2240	Shore D	13	30	31	31	30	37	43	48	58	51
Specific Gravity	ASTM D-792		1.15	1.19	1.19	1.20	1.18	1.20	1.21	1.19	1.22	1.16
<b>Mechanical</b>												
Tensile Strength @ Break	ASTM D-412	psi	2040	3120	5010	5690	5920	2830	7170	7500	7770	3670
Tensile Stress @ 50% Elongation	ASTM D-412	psi	110	160	100	100	80	280	560	850	1400	900
Tensile Stress @ 100% Elongation	ASTM D-412	psi	130	220	170	180	210	285	670	1020	1740	780
Tensile Stress @ 300% Elongation	ASTM D-412	psi	400	890	1010	800	1130	660	2210	2430	5010	870
Elongation @ Break	ASTM D-412	%	730	570	580	610	470	680	490	530	440	640
Tensile Set @ 200% Elongation	ASTM D-412	%	4				4					
Tear Strength	ASTM D-624	pli	130	350	360	330	310	320	500	650	750	510
Compression Set, 22 h @ 23°C	ASTM D-395	%	42	35	31	34	15	58	30	31	40	56
Compression Set, 22 h @ 70°C	ASTM D-395	%	104	91	83	82	63	102	80	78	92	n/a
Bayshore Rebound	ASTM D-2632	%	63	50	49	45	40	42	36	38	33	43
Abrasion	DIN 53516	mm <sup>3</sup>	76	134	84	54	47	n/a	28	46	36	36
Taber Abrasion	ASTM D-3389	mg/1000 cycles	65	36	5	10	8	37	18	21	63	94
<b>Thermal</b>												
DSC Midpoint Tg	ASTM E-1269	°C	-45	-39	-36	-32	-19	-34	-35	-36	-25	-43
Vicat Softening Point	ASTM D-1525	°C	n/a	55	59	61	77	38	89	106	107	47
TMA Melt Range	Huntsman	°F	216-257	246-282	257-291	264-288	252-291	160-190	318-349	369-397	336-358	190-243
	Analytical Method	°C	102-125	119-139	125-144	129-142	122-144	71-88	159-176	187-203	169-181	88-117
<b>Other features</b>												
Transparency				●	●	●	●	●	●		●	
Flame Retardancy												
Matte Surface												●

- \*\*Ester TPU**
- Excellent wear resistance
  - High physical properties
  - Compatible with other polar polymers
  - Good chemical resistance

- \* Ether TPU**
- Resistant to microbial attack
  - Excellent hydrolysis resistance
  - Excellent low temperature properties
  - High dynamic flexibility

# Polyethers

116-201	CA 116-205	CA 117-200 DP	A 78 P 4766 NM	A 80 P 4699 L	A 85 P 4380	A 85 P 4394	A 85 P 4441	A 92 P 4207	A 92 P 4637	A 92 P 4851	D 64 P 4777			
											<b>General</b>			
95	92	79	82	86	86	87	89	91	92	95		Hardness	ASTM D-2240	Shore A
51	49	30	37	43	36	43	46	44	47	65		Hardness	ASTM D-2240	Shore D
1.16	1.15	1.13	1.09	1.15	1.13	1.11	1.13	1.15	1.12	1.17		Specific Gravity	ASTM D-792	
											<b>Mechanical</b>			
2920	2770	5810	4740	4270	6340	5800	7400	6850	6440	6110		Tensile Strength @ Break	ASTM D-412	psi
860	880	240	360	620	650	550	990	1140	1250	2680		Tensile Stress @ 50% Elongation	ASTM D-412	psi
880	910	370	470	750	710	700	1190	1110	1290	3070		Tensile Stress @ 100% Elongation	ASTM D-412	psi
960	1000	900	910	1400	1640	1380	2510	2750	2520	4910		Tensile Stress @ 300% Elongation	ASTM D-412	psi
640	660	600	640	550	530	560	550	520	500	380		Elongation @ Break	ASTM D-412	%
											Tensile Set @ 200% Elongation	ASTM D-412	%	
510	530	330	430	400	480	480	590	590	580	950		Tear Strength	ASTM D-624	pli
59	n/a	25	33	30	16	21	36	20	22	57		Compression Set, 22 h @ 23°C	ASTM D-395	%
n/a	n/a	80	87	70	42	79	78	53	61	92		Compression Set, 22 h @ 70°C	ASTM D-395	%
43	44	51	47	45	43	45	40	39	39	50		Bayshore Rebound	ASTM D-2632	%
88	n/a	49	69	59	29	47	33	32	54	48		Abrasion	DIN 53516	mm <sup>3</sup>
112	108	13	129	n/a	38	178	30	31	85	77		Taber Abrasion	ASTM D-3389	mg/1000 cycles
											<b>Thermal</b>			
-38	-38	-46	-41	-44	-42	-45	-39	-41	-40	-41		DSC Midpoint Tg	ASTM E-1269	°C
47	46	69	66	80	83	84	109	96	95	137		Vicat Softening Point	ASTM D-1525	°C
171-221	160-199	282-311	277-307	331-365	320-351	307-334	369-392	331-356	329-354	370-399			Huntsman	°F
77-105	71-93	139-155	136-153	166-185	160-177	153-168	187-200	166-180	165-179	188-204		TMA Melt Range	Analytical Method	°C
											<b>Other features</b>			
											Transparency			
											Flame Retardancy			
											Matte Surface			



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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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#### About Huntsman

Huntsman is a global manufacturer and marketer of differentiated chemicals. Our operating companies manufacture products for a variety of global industries, including chemicals, plastics, automotive, aviation, textiles, footwear, paints and coatings, construction, technology, agriculture, health care, detergent, personal care, furniture, appliances and packaging. Originally known for pioneering innovations in packaging and, later, for rapid and integrated growth in petrochemicals, Huntsman approximately 12,000 employees and operates from multiple locations worldwide. The Company had 2010 revenues of approximately \$9 billion. For more information about Huntsman, please visit the Company's website at [www.huntsman.com](http://www.huntsman.com).

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