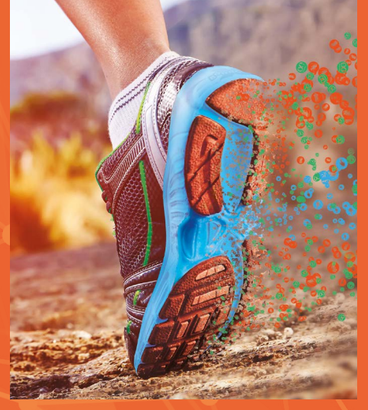
FOOTWEAR PRODUCT SELECTION GUIDE

LUBRIZOL ENGINEERED POLYMERS

ADVANCING MATERIALS. ELEVATING PERFORMANCE.

INNOVATIVE
FOOTWEAR SOLUTIONS



LEADING THE INDUSTRY

From our inception, Lubrizol Engineered Polymers has been partnering with inventive and pioneering footwear brands and value chain partners, setting the precedent for the current innovations and advancements in the industry.

To do this, we've dedicated ourselves to integrating our core guiding principles with each new innovative polymer solution we create:

Automation

AUTOMATION
Solutions that enhance customers' manufacturing efficiency through standardization and minimizing the impact from labor costs.

Performance

PERFORMANCE
Understanding of our customers' (consumers) needs and developing innovative and differentiated solutions that perform better with more durability.

Sustainability

SUSTAINABILITY
Advancing industry abilities to utilize environmentally friendly footwear materials and manufacturing processes.

LUBRIZOL'S INNOVATIVE POLYMER SOLUTIONS ARE AS VERSATILE AS THE DESIGNERS WHO CREATE THEM.

Our products, like Thermoplastic Polyurethanes (TPU), can impart a variety of properties including:

- Outstanding abrasion, wear and chemical resistance
- Bio-Based*
- Recyclable**
- Excellent cushioning and impact resistance
- Toughness and durability
- Flexibility over a wide temperature range

TRANSPARENT SERIES

Physical Properties	Test Method	Unit	Estane® S385A	Estane® S392A	Estane® S395A	Estane® S398A	Estane® S360D	Estane® S364D	Estane® S368D	Estane® S375D
Product Type			Ester	Ester	Ester	Ester	Ester	Ester	Ester	Ester
Hardness	ISO 868	Shore	87A	92A	95A	98A | 55D	63D	65D	68D	78D
Specific Gravity	ISO 2781	g/cm3	1.19	1.21	1.22	1.22	1.25	1.25	1.27	1.28
Tensile Stress at:	ISO 37									
100% Elongation		MPa	5	10	14	20	22	24	26	33
300% Elongation		MPa	10	20	28	32	36	39	39	43
Tensile Strength	ISO 37	MPa	35	45	47	43	43	44	45	45
Elongation	ISO 37	%	780	50	530	420	400	390	380	330
Tear Resistance	ISO 34-1B	kN/m	95	120	140	170	220	220	220	260
Abrasion Resistance	ISO 4649	mm3	35	35	30	30	30	30	25	25
Compression Set:	ISO 815									
23°C 70hrs		%	15	15	15	20	20	20	25	35
70°C 22hrs		%	45	45	45	45	40	40	40	40
Mold Shrinkage	ASTM D955	mm/mm	0.013	0.008	0.007	0.007	0.004	0.004	0.004	0.003
Vicat Softening Point	ISO 306	°C	95	110	115	116	123	123	125	130
Injection Guide										
Feeding		°C	180~195	185~200	190~205	190~205	200~215	200~215	205~220	210~225
Metering		°C	185~200	190~205	200~215	200~215	210~225	210~225	215~230	220~235
Nozzle		°C	190~205	195~210	205~220	205~220	215~230	215~230	220~235	225~235
Speed			Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Anti-hydrolysis reinforced version available (S395AH, S364DH). All grades contain UV stabilizer. Determined via ISO 527 (ASTM D-412).

SOFT, PLASTICIZER-FREE SERIES

Physical Properties	Test Method	Unit	Estane® T460A	Estane® T465A	Estane® T470A	Estane® S175A	Estane® T370A
Product Type			Ester	Ester	Ester	Ester	Ether
Hardness	ISO 868	Shore	66A	71A	77A	77A	74A
Specific Gravity	ISO 2781	g/cm3	1.12	1.13	1.13	1.18	1.06
Tensile Stress at:	ISO 37						
100% Elongation		MPa	2.2	2.6	3.6	3.5	3.2
300% Elongation		MPa	4	4.6	6	6.5	5.7
Tensile Strength	ISO 37	MPa	20	22	28	30	25
Elongation	ISO 37	%	860	950	900	800	900
Tear Resistance	ISO 34-1B	kN/m	60	60	75	80	70
Abrasion Resistance	ISO 4649	mm3	60	55	50	40	35
Compression Set:	ISO 815						
23°C 70hrs		%	10	10	10	15	10
70°C 22hrs		%	30	30	35	30	30
Mold Shrinkage	ASTM D955	mm/mm	0.013	0.01	0.006	0.025	0.006
Vicat Softening Point	ISO 306	°C	75	75	77	84	70
Injection Guide							
Feeding		°C	180~190	180~190	185~195	175~185	185~195
Metering		°C	185~195	185~195	190~200	180~190	190~200
Nozzle		°C	190~200	190~200	195~205	185~200	195~205
Speed			Slow	Slow	Slow	Slow	Slow

Anti-hydrolysis reinforced version availale (S175AH). Suitable for injection molding. All grades contain UV stabilizer.

*Bio-based content as certified in accordance with ASTM D-6866.
**Recyclability is based on access to a readily available standard recycling program that supports such materials. Products may not be recyclable in all areas.

To learn more, visit www.lubrizol.com/engineered-polymers.

HIGH MECHANICAL PERFORMANCE SERIES

Physical Properties	Test Method	Unit	Estane® S180A*	Estane® S185A	Estane® S190A*	Estane® S195A	Estane® S198A	Estane® S160D	Estane® S168D
Product Type			Ester	Ester	Ester	Ester	Ester	Ester	Ester
Hardness	ISO 868	Shore	83A	87A	92A	98A/55D	98A/55D	63D	68D
Specific Gravity	ISO 2781	g/cm3	1.19	1.2	1.21	1.23	1.23	1.25	1.27
Tensile Stress at:	ISO 37								
100% Elongation		MPa	4.5	6.5	9.5	16	16	22	28
300% Elongation		MPa	9	12	19	30	30	35	40
Tensile Strength	ISO 37	MPa	35	40	50	50	50	45	45
Elongation	ISO 37	%	770	650	650	520	520	480	430
Tear Resistance	ISO 34-1B	kN/m	90	110	140	180	180	230	250
Abrasion Resistance	ISO 4649	mm3	30	30	30	25	25	25	25
Compression Set:	ISO 815								
23°C 70hrs		%	15	15	15	20	20	20	20
70°C 22hrs		%	35	35	40	40	40	45	45
Mold Shrinkage	ASTM D955	mm/mm	0.02	0.01	0.009	0.008	0.008	0.007	0.006
Vicat Softening Point	ISO 306	°C	85	95	110	143	143	158	163
Injection Guide									
Feeding		°C	175~185	180~195	185~200	185~200	190~205	200~215	205~220
Metering		°C	180~195	185~200	195~205	195~205	200~215	210~225	215~230
Nozzle		°C	185~200	190~205	200~215	200~215	210~225	215~230	220~235
Speed			Slow	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Suitable for injection molding. *UV stabilized grades.

ETHER SERIES

Physical Properties	Test Method	Unit	Estane® R185*	Estane® 2103-90A	Estane® R195A*	Estane® R198A*	Estane® 2103-55D
Product Type			Ether	Ether	Ether	Ether	Ether
Hardness	ISO 868	Shore	87A	92A	95A	98A/55D	55D
Specific Gravity	ISO 2781	g/cm3	1.1	1.14	1.13	1.14	1.15
Tensile Stress at:	ISO 37						
100% Elongation		MPa	6	11	11	15	16
300% Elongation		MPa	10	24	20	26	31
Tensile Strength	ISO 37	MPa	32	44	43	44	44
Elongation	ISO 37	%	700	450	600	545	425
Tear Resistance	ISO 34-1B	kN/m	95	133	130	135	158
Abrasion Resistance	ISO 4649	mm3	30		25	25	
Compression Set:	ISO 815						
23°C 70hrs		%	15	25	15	20	25
70°C 22hrs		%	45	40	45	45	30
Mold Shrinkage	ASTM D955	mm/mm	0.015	0.008	0.007	0.007	0.006
Vicat Softening Point	ISO 306	°C	90	107	125	130	104
Injection Guide							
Feeding		°C	180~195	185~200	190~205	190~205	190~205
Metering		°C	190~200	195~205	200~210	200~210	200~210
Nozzle		°C	195~210	200~215	205~220	205~220	205~220
Speed			Moderate	Moderate	Moderate	Moderate	Moderate

Suitable for injection molding and extrusion. *UV stabilized grades.

ESTALOC™ RETPU SERIES

Physical Properties	Test Method	Unit	Estaloc™ 59150	Estaloc™ 59200	Estaloc™ 59300	Estaloc™ 59380	Estaloc™ 59600
Product Type			Ester	Ester	Ester	Ester	Ester
Hardness	ISO 868	Shore	72D	68D	72D	74D	75D
Specific Gravity	ISO 2781	g/cm3	1.35	1.45	1.45	1.41	1.64
Tensile Modulus	ISO 527	MPa	2370	2883	3636	3345	5859
Tensile Strength at Break	ISO 527	MPa	59	65	78	77	93
Elongation at Break	ISO 527	%	19	20	15	15	7
Flexural Strength	ISO 178	MPa	69	67	77	80	116
Flexural Modulus	ISO 178	MPa	2200	2360	3200	3100	5850
IZOD Impact, Notched	ISO 180/ 1U						
23 °C		J/M		694	406		427
-30 °C		J/M		198	176		182
Heat Deformation Temperature	ISO 75						
0.46 Mpa		°C	199	154	160	166	171
1.8 MPa		°C	135	126	127	123	130
Mold Shrinkage	ASTM D955	mm/mm	0.2	0.15	0.15	0.15	0.13
Injection Guide							
Feeding		°C	210~220	215~225	215~225	215~225	220~230
Metering		°C	220~230	220~230	220~230	220~230	230~240
Nozzle		°C	215~225	215~225	215~225	215~225	235~245
GF contents		%	18	30	30	30	50

Suitable for injection molding.

ISOPLAST® ETP SERIES

Physical Properties	Test Method	Unit	Isoplast® 300	Isoplast® 301	Isoplast® 101	Isoplast® 101LGF40
Product Type			Clear	Clear	Impact Modified	LGF Reinforced
Hardness	ISO 868	Shore	85D			
Rockwell Hardness	ISO 2781	R Scale		123	116	
Specific Gravity	ISO 527	g/cm3	1.214	1.20	1.19	1.51
Tensile Modulus	ISO 527	MPa	2300	2100	1500	12000
Tensile Strength at Yield	ISO 527	MPa	68	69	48	186
Tensile Strength at Break	ISO 527	MPa	70	63	48	186
Elongation at Yield	ISO 527	%	6.94	7	6	2
Elongation at Break	ISO 527	%	171	140	160	2
Flexural Strength	ISO 178	MPa	91	97	68	310
Flexural Modulus	ISO 178	MPa	2210	2300	1800	10000
IZOD Impact, Notched:	ISO 180/ IU					
23°C		J/M	94.2	128	1280	427
-40°C		J/M	59	43	160	427
Heat Deformation Temperature:	ISO 75					
0.46 MPa		°C	87	104	82	
1.8 MPa		°C	75	99	77	99
Injection Guide						
Feeding		°C	210~220	220~230	215~225	230~240
Metering		°C	215~225	225~235	220~230	245~255
Nozzle		°C	220~230	230~240	225~235	240~250
Mold Tempearture		°C	65~95	65~95	85~90	65~90

Suitable for injection molding.

*Bio-based content as certified in accordance with ASTM D-6866.
**Recyclability is based on access to a readily available standard recycling program that supports such materials. Products may not be recyclable in all areas.
***Determined via ISO 527 (ASTM D-412).

To learn more, visit www.lubrizol.com/engineered-polymers.

FILM & SHEET SERIES

Physical Properties	Test Method	Unit	Estane® 58271+	Estane® X585A*	Estane® 58277+	Estane® X595A*	Estane® ETE 50DT3	Estane® ETE 55DT3	Estane® ETE 60DT3	Estane® ETE 75DT3
Product Type			Ester	Ester	Ester	Ester	Ether	Ether	Ether	Ether
Hardness	ISO 868	Shore	85A	87A	92A	97A	50D	55D	60D	75D
Specific Gravity	ISO 2781	g/cm3	1.21	1.2	1.22	1.22	1.16	1.16	1.17	1.18
Tensile Strength at:	ISO 37									
100% Elongation		MPa	5.5	7	9.7	13.5	15	19	20	22
300% Elongation		MPa	9.7	15	29	24	35	42	44	27
Tensile Strength	ISO 37	MPa	51	48	62	50	60	58	54	41
Elongation	ISO 37	%	540	650	450	550	420	420	460	330
Tear Resistance	ISO 34-1B	kN/m	80	110	116	130	142	142	158	280
Taber Abrasion	ASTM D3389	mg	34		50		81	109	60	68
Extrusion										
Zone 1		°C	177	182	182	190	193	193	199	204
Zone 2		°C	182	185	188	195	199	199	204	210
Zone 3		°C	188	190	193	200	204	204	210	216
Zone 4		°C	193	195	199	205	210	210	210	216
Adapter		°C	193	195	199	205	210	210	210	216
Die		°C	193	195	199	205	210	210	216	218

Suitable for extrusion. *UV stabilized grades. +Low lubricant contents.

BIO TPU™ BY LUBRIZOL*

Physical Properties	Test Method	Unit	Pearlthane™ ECO* D12T80E	Pearlthane™ ECO* D12T90E	Pearlthane™ ECO* 12T95
Bio-Contents	ASTM D6866	%	42%	38%	32%
Product Type			Ester	Ester	Ester
Hardness	ISO 868	Shore	82A	91A	95A
Specific Gravity	ISO 2781	g/cm3	1.10	1.15	1.17
Tensile Stress at:	ISO 37				
100% Elongation		MPa	4	9.5	12
300% Elongation		MPa	9	25	27
Tensile Strength	ISO 37	MPa	33	39	35
Elongation	ISO 37	%	604	470	415
Tear Resistance	ISO 34-1B	kN/m	84	122	142
Abrasion Resistance	ISO 4649	mm3	20	35	28
Injection Guide					
Feeding		°C	185-195	185-195	195-205
Metering		°C	195-205	190-200	200-210
Nozzle		°C	205-215	200-210	205-215
Mold Temperature		°C	10-35	10-35	10-35

ASTM Test Methods and More Property Information Available on Product Data Sheets.

*Bio-based content as certified in accordance with ASTM D-6866.

HOT MELT ADHESIVE SERIES

Physical Properties	Test Method	Unit	Pearlbond™ 106	Pearlbond™ 1160/L	Pearlbond™ 5713	Pearlbond™ 5717	Pearlbond™ ECO 590	Pearlbond™ 1160	Pearlbond™ 960 EXP	Pearlbond™ DIPP119
Product type			Ester	Ester	Ester	Ester	Ester	Ester	Ester (aliphatic)	Caprolactone
Heat Activation Temperature+	Lubrizol	°C	60	65	65	75	80	85	95	100
Melt Range	MQSA 70A	°C	60-70	70-75	65-70	75-85	80-85	90-95	170-180	100-110
Melt flow index	Lubrizol	g/10min	10-30	4-9	20-50	20-40	30-60	20-60**	20-40**	5-20
Hardness	ISO 868	shore	93A	90A	90A	70A	52D	90A	69A	70A
Tg	MQSA 12B	°C	-39	-39	-43	-30	-40	-39	-10	-30
Thermoplastic Range	MQSA 68A		Very high	High	High	Low	Very high	High	Low	Medium
Tensile strength at break	ISO 37	MPa		25	38	10	12	30	44	20
100% elongation		MPa		5	5.7	2.5	2	5	4	3
300% elongation		MPa		5	11.2	4	3	6	13	4
Elongation at break	ISO 37	%		763	550	750	500	717	503	750
Features					Opaque High Crystallinity	Transparent High Crystallinity		Polyester, Very High Crystallization Rate	Transparent Low crystallinity	Polycaprolactone Co polyester, Elastic, Wash cycle resistance

Physical Properties	Test Method	Unit	Pearlbond™ UB400*	Pearlbond™ 305	Pearlbond™ 700 HMS EXP	Pearlbond™ 8213 NT1	Pearlbond™ 12C75	Pearlbond™ 12F75UV	Pearlbond™ 125H
Product type			Ester	Ester	Ester	Ester	Ester	Ester	Ester
Heat Activation Temperature+	Lubrizol	°C	105	115	120	120	130	130	130
Melt Range	MQSA 70A	°C	105-115	180-190	175-185	150-160	130-140	130-140	130-140
Melt flow index	Lubrizol	g/10min	20-50**	10-30**	5~20	2-10	10-30	60-90	15-40
Hardness	ISO 868	shore	78A	64A	66D	76A	78A	78A	85A
Tg	MQSA 12B	°C	-18	-50	NA	-30	-32	-30	-32
Thermoplastic Range	MQSA 68A		Low	Low	Medium	Low	Low	Low	Low
Tensile strength at break	ISO 37	MPa	34	12	35	25	20	30	26
100% elongation		MPa	4	2	15	3	4	5	5
300% elongation		MPa	7	4	30	5	5.5	6.5	7
Elongation at break	ISO 37	%	630	702	350	700	745	620	630
Features			Transparent Elastic recovery Cold flexibility		Transparent Low crystallinity	Dry Cleaning Resistance			Dry Cleaning Resistance

*UV stabilized grades. Tested at 170°C/21.6kg, others are at 170°C/2.16kg.
+Measured by Kofler Ester with film strips (100*5*0.05mm) at temperature range from 250˚C to 20˚C.

*UV stabilized grades
**Tested at 170°C/21.6kg, others are at 170°C/2.16kg
+Measured by Kofler tEster with film strips(100*5*0.05mm) at temperature range from 250˚C to 20˚C

ESTANE®

TRX TPU

AUTOMATION

- Reduced labor cost by thermoplastic injection molding
- Automated production possibility versus traditional rubber outsole molding

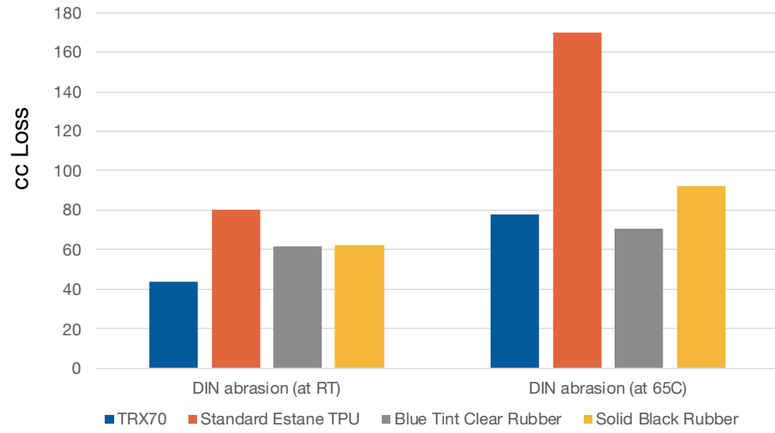
SUSTAINABILITY

- Recycling possibilities at outsole manufacturing and post with thermoplastic TPU which thermoset rubbers cannot provide

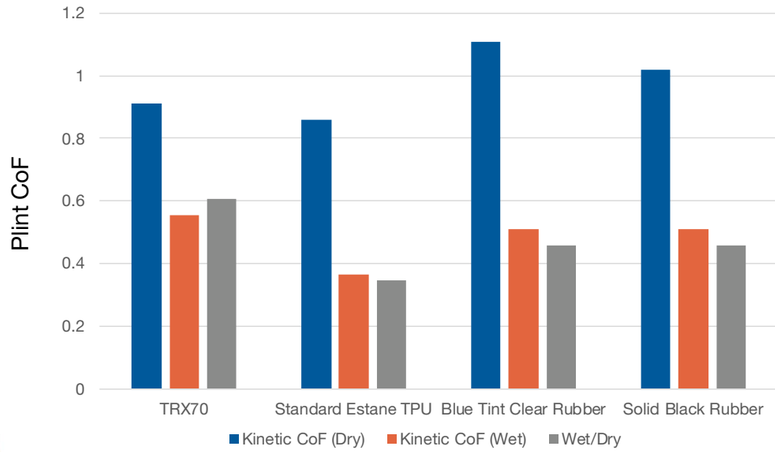
PERFORMANCE

- Exceptional slip resistance at wet ground condition
- Excellent wear resistance at room and high temperature against heat friction on the shoe outsole
- Transparent outsole enhancing color freedom for novel design.
- Thinner TPU outsole improves flexible outsole feeling and weight reduction

DIN ABRASION AT ROOM TEMPERATURE AND HIGH TEMPERATURE



COEFFICIENT OF FRICTION (COF)



* Smooth Surface Specimen against SATRA clay tile

ESTANE® TRX PRODUCT PORTFOLIO

Estane® Product	Hardness (Shore A)	Tensile Strength (MPa)	Elongation (%)	Tear Strength (kN/m)	DIN abrasion (cc loss)	Haze
TRX 70	74	22	950	65	43	5.0
TRX 65*	69	25	1000	73	73	11.37
TRX 75*	78	34	875	92	45	8.35

*Under development

BOUNCELL-X™ TPU FOAM
NITROGEN INFUSED TPU FOAM

AUTOMATION
- High Efficiency Molding Process
- Fast Production
- Less Labor Dependency

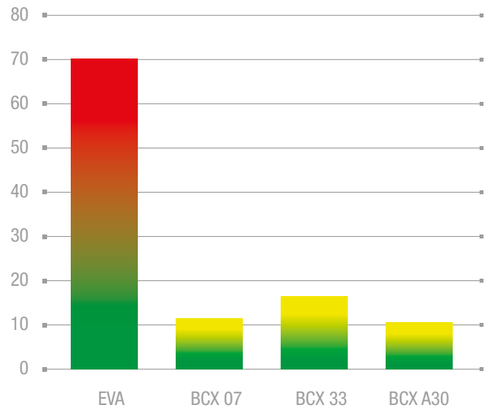
SUSTAINABILITY
- Longer Lasting Cushion
- Low Scrap Production
- Reprocessability/Recyclability

PERFORMANCE
- High Energy Return Grades
- Comfort Soft Grades
- Bottom-Out Resistance

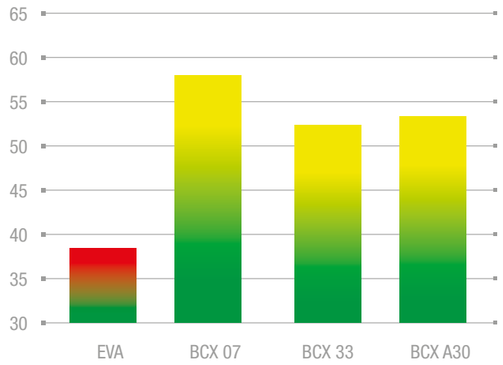
BOUNCELL-X™ (BCX) DYNAMIC PERFORMANCE TESTING

Test	Estane® BCX 07	Estane® BCX 33	Estane® BCX A30	EVA Foam
Asker C	32	45	44	57
Density (g/cm3)	0.27	0.30	0.26	0.20
Drop Ball Rebound (%)	58	53	54	38
Static Comp Set @ 50°C (%)	11	17	11	70
Dynamic Property at 50k Cycle (0.27-0.30g/cc)				
Comp Set (%)	4	7	2	10
Energy Efficiency Change (%)	21	5	0	25

ACCELERATED COMPRESSION SET TEST (ASTM D395 AT 50°C)



REBOUND (ASTM D2632)



LOCALLY PRESENT

GLOBALLY NETWORKED

With local sales and technical support, R&D and manufacturing centers of excellence in each region, and a well-networked global supply chain, we offer a convenient, single source of reliable solutions for customers across the world.

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Lubrizol