

kuraray

SEPTON[™]
HYBRAR[™]

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HYBRAR[™]

Thermoplastic Elastomers
Technical Information

SEPTON™ and HYBRAR™

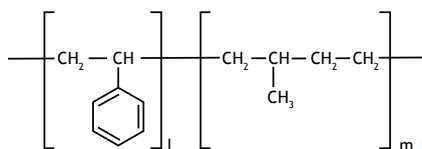
Technical Information

Kuraray manufactures styrenic block copolymers under the trademarks of SEPTON™ and HYBRAR™. These styrenic thermoplastic elastomers cover a wide range of applications including compounds (especially automotive, consumer products & vulcanized rubber replacement), polymer modification (impact modifier & compatibilizer), adhesives (hot-melts), flexible PVC substitutes and vibration damping products.

The Hydrogenated Styrenic Block Copolymers (HSBCs) consist of styrene based hard blocks and a hydrogenated diene soft block. HSBCs exhibit rubber elasticity since the hard block acts as a crosslinking point below the glass transition temperature of polystyrene and the soft block provides elasticity. Hydrogenation provides excellent heat and weather resistance.

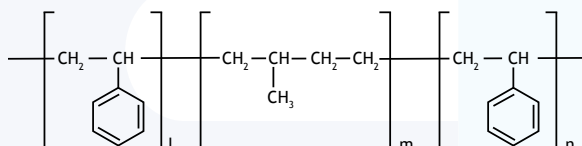
SEPTON™ Standard Grades

Grade	Type	Styrene Content	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
			230 °C, 2.16 kg (g/10min)	200 °C, 10kg (g/10min)	5wt% (mPa·s)	10wt% (mPa·s)	15wt% (mPa·s)		
1020	SEP	36	-	1.8	-	42	-	Powder	70



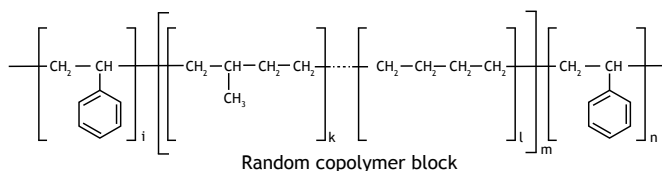
SEPTON™ 1000-series is characterized by excellent clarity and good flow ability due to its SEP structure. Main areas of application are adhesives, clear sealants, automotive products and cable/wire insulation. SEPTON™ 1000-series products can also be applied as a modifier for unsaturated polyester.

Grade	Type	Styrene Content	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
			230 °C, 2.16 kg (g/10min)	200 °C, 10kg (g/10min)	5wt% (mPa·s)	10wt% (mPa·s)	15wt% (mPa·s)		
2002	SEPS	30	70	100	-	-	25	Pellet	80
2004F	SEPS	18	5	-	-	-	145	Pellet	67
2005	SEPS	20	No flow	No flow	40	1700	-	Powder	-
2006	SEPS	35	No flow	No flow	27	1220	-	Powder	-
2063	SEPS	13	7	22	-	29	140	Pellet	36
2104	SEPS	65	0.4	22	-	-	23	Pellet	98



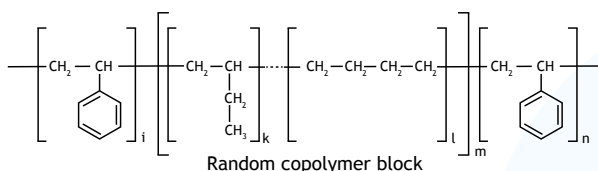
The SEPS structure generates high elongation properties as well as enhanced low temperature properties without crystallization. With its broad range of hardnesses, SEPTON™ 2000-series is used with various products like personal care, medical or automotive products as well as film applications and especially adhesives.

Grade	Type	Styrene Content	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
			230 °C, 2.16 kg (g/10min)	200 °C, 10kg (g/10min)	5wt% (mPa·s)	10wt% (mPa·s)	15wt% (mPa·s)		
4033	SEEPS	30	<0.1	<0.1	-	50	390	Powder	76
4044	SEEPS	32	No flow	No flow	22	460	-	Powder	-
4055	SEEPS	30	No flow	No flow	90	5800	-	Powder	-
4077	SEEPS	30	No flow	No flow	300	-	-	Powder	-
4099	SEEPS	30	No flow	No flow	670	-	-	Powder	-



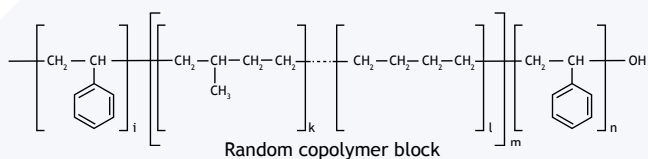
Unique SEPTON™ 4000-series shows high tensile strength, moderate elongation with exceptional oil absorbency. SEPTON™ 4000-series is produced with a wide range of molecular weights and are therefore applicable for several differentiated applications like gels, films, automotive applications and many more. Rubber-like compounds with SEPTON™ 4000-series products can also replace PVC in several applications.

Grade	Type	Styrene Content	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
			230 °C, 2.16 kg (g/10min)	200 °C, 10kg (g/10min)	5wt% (mPa·s)	10wt% (mPa·s)	15wt% (mPa·s)		
8004	SEBS	31	<0.1	<0.1	-	40	-	Powder	80
8006	SEBS	33	No flow	No flow	42	-	-	Powder	-
8007L	SEBS	30	2.0	-	-	20	-	Pellet	77



With its popular mid-block structure in HSBCs, SEPTON™ 8000-series is an excellent choice. The moderate tensile strength is one of the main features of SEBS. SEPTON™ 8000-series is widely used for adhesives, automotive and personal care applications.

Grade	Type	Styrene Content	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
			230 °C, 2.16 kg (g/10min)	200 °C, 10kg (g/10min)	5wt% (mPa·s)	10wt% (mPa·s)	15wt% (mPa·s)		
HG252	SEEPS-OH	28	26	-	-	-	70	Pellet	80



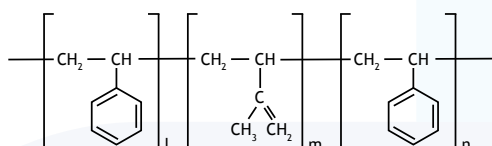
The functional group has just an end-polymer chain. As a result the reaction can be controlled. SEPTON™ HG252 is used as a modifier for polar resins and compatibilizer of polar/non-polar resins.



HYBRAR™ Grades

Unhydrogenated Grades

Grade	Type	Styrene Content	T _g	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
				190 °C, 2.16 kg (g/10min)	230 °C, 2.16 kg (g/10min)	15wt% (mPa·s)	20wt% (mPa·s)	30wt% (mPa·s)		
5125	Vinyl-bond rich SIS	20	-13	4	-	-	100	650	Pellet	60
5127	Vinyl-bond rich SIS	20	8	5	-	-	-	540	Pellet	84

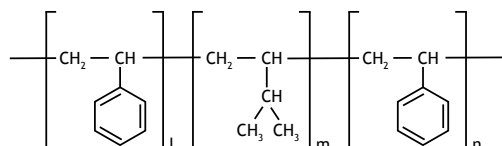


HYBRAR™ is a truly unique triblock co-polymer having polystyrene end blocks and a vinyl rich poly-diene mid-block. Due to its peak tan delta near room temperature, HYBRAR™ exhibits outstanding vibration damping and shock absorption properties.

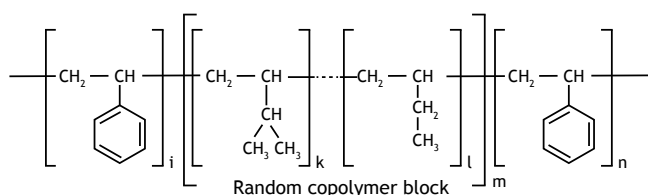
Its damping properties make HYBRAR™ the product of choice for sports equipment as well as for foamable sound damping sealants. Other application possibilities include electronic components, film and sheet for medical packaging, adhesives, coatings, sealants, hearing protection, automotive, and housing and construction components.

Hydrogenated Grades

Grade	Type	Styrene Content	T _g	MFR		Solution Viscosity (Toluene Solution 30 °C)			Physical Form	Hardness Type A
				190 °C, 2.16 kg (g/10min)	230 °C, 2.16 kg (g/10min)	15wt% (mPa·s)	20wt% (mPa·s)	30wt% (mPa·s)		
7125F	Vinyl-bond rich SEPS	20	-15	0.7	4	-	55	350	Pellet	64
7311F	Vinyl-bond rich SEEPS	12	-32	0.5	2	90	240	-	Pellet	41

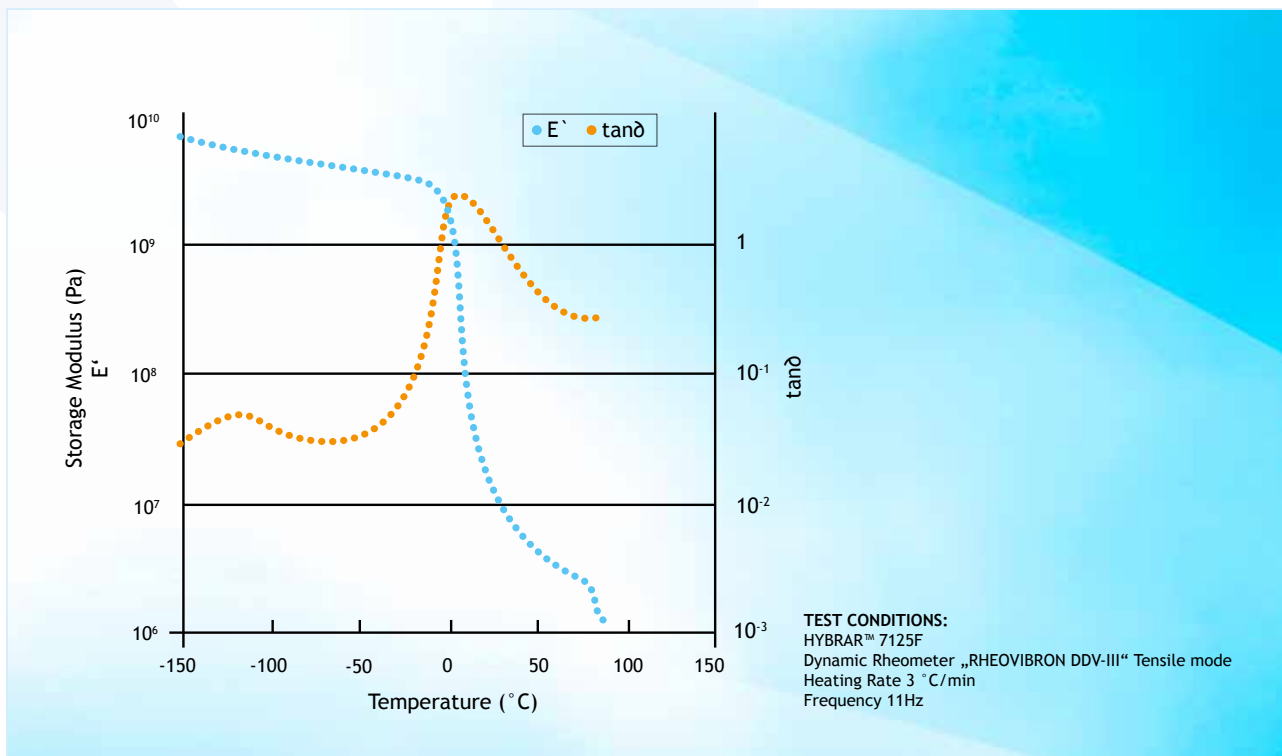
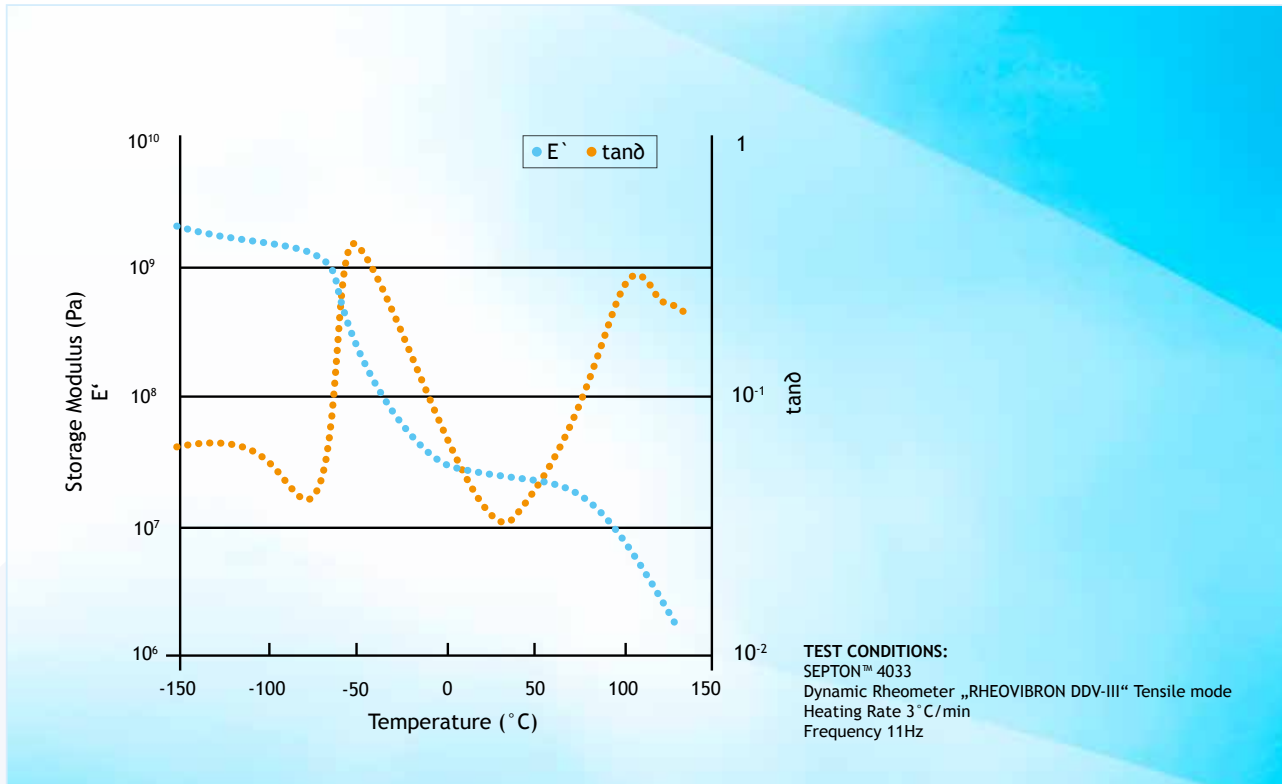


HYBRAR™ products are available as durable hydrogenated (7000-series) and non-hydrogenated (5000-series) grades. The hydrogenated grades show an excellent miscibility with polypropylene resulting in exceptional transparency and clarity when blended. Flexible film manufactured using HYBRAR™ is a more environmentally friendly alternative to PVC due to the absence of harmful plasticizers. These films also have much less environmental impact during production and disposal than PVC.

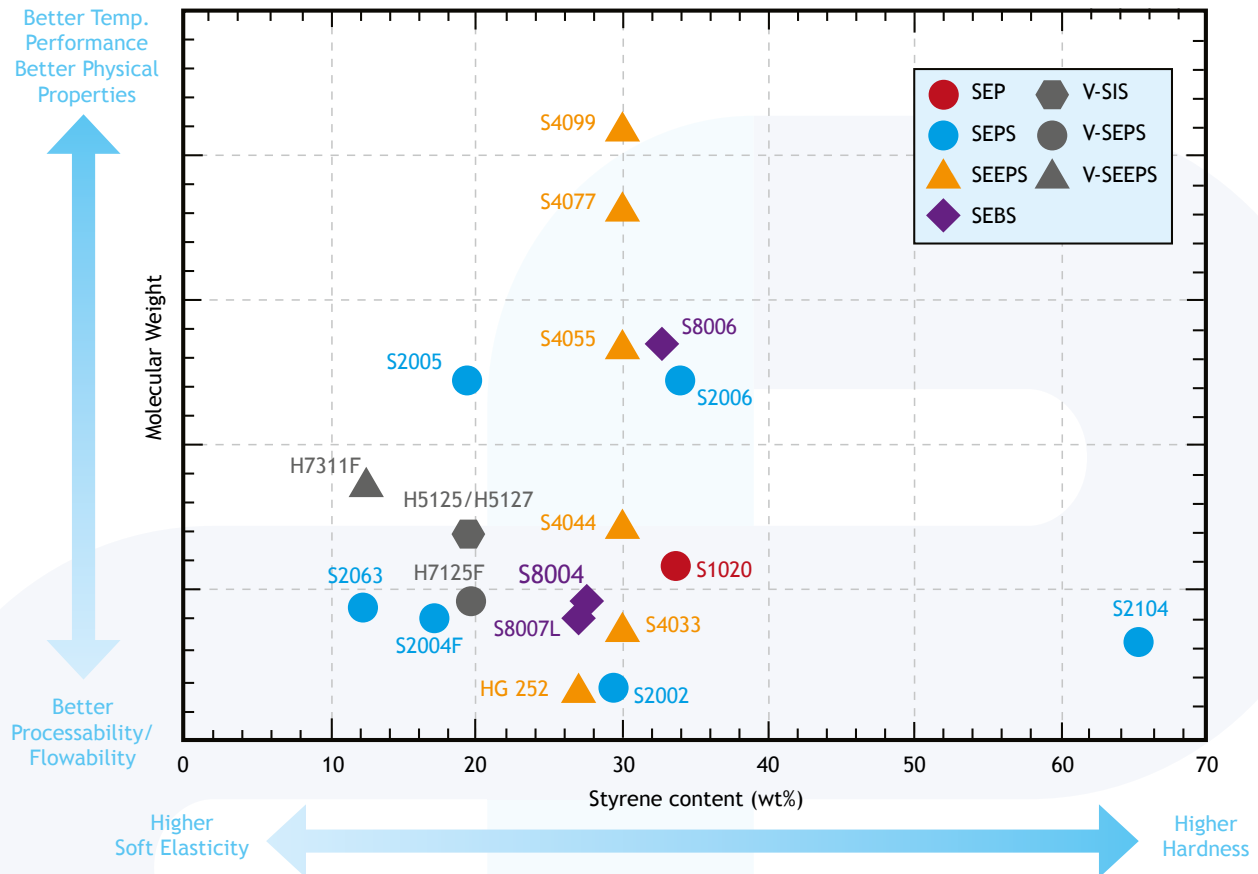


SEPTON™ and HYBRAR™ Properties

Dynamic Viscoelastic Behavior



SEPTON™ and HYBRAR™ Grade Map



Solubility data for SEPTON™ and HYBRAR™

Soluble	Partially Soluble	Insoluble
- Petroleum Benzine - Toluene - Hexane - Cyclohexane - Chloroform - Tetrahydrofuran	- Ethyl Acetate - Methyl Ethyl Ketone	- Methanol - Ethanol - Acetone - Water - Dimethyl Formamide



Application Examples

1) Soft Compounds

Range of soft compound properties possible with SEPTON™

		Effect of PP content				
	Unit	1	2	3	4	5
SEPTON™ 4055	PHR	100	100	100	100	100
Paraffin oil (visc. 382 mm ² /s at 40 °C)	PHR	100	100	100	100	100
Homo PP (MFR=10)	PHR	0	20	40	80	100
Antioxidant	Wt. %	0.1	0.1	0.1	0.1	0.1
Hardness (Type A)		21	50	72	89	92
Tensile Properties						
100% Modulus	MPa	0.3	0.9	2.1	4	5.1
300% Modulus	MPa	0.4	1.5	2.8	5	6.1
Tensile Strength	MPa	8.4	8.7	15	20	20
Elongation at Break	%	1030	900	870	840	800
Permanent Set (100% × 10min)	%	6	9	12	19	25
Compression Set (70 °C × 22h)	%	-	25	35	47	no data
MFR (230 °C, 21N)	g/10min	No flow	0.02	0.16	5.2	7.8

		Effect of Oil content				
		1	3	4	6	7
SEPTON™ 4055	PHR	100	100	100	100	100
Homo PP (MFR=11)	PHR	50	50	50	50	50
Paraffinic oil: viscosity 96 mm ² /s at 40 °C	PHR	0	60	90	150	180
Hardness (Type A)	(-)	94	77	69	54	48
100% modulus	MPa	6.7	3.9	2.7	1.1	0.8
300% modulus	MPa	8.8	5.2	3.7	1.7	1.5
Tensile strength at Break	MPa	36.3	22.5	16.7	9.8	9.3
Elongation at Break	%	740	780	800	910	990

SEPTON™ and HYBRAR™ combined compounds
for improved damping performance

	1	2
SEPTON™ 4055	100	100
HYBRAR™ 5127		100
Process Oil	180	100
Polypropylene	50	40
Resilience (%)	40	17
Hardness (Type A)	48	51
Tensile Modulus (MPa)	0.8	1
Tensile Strength (MPa)	9.3	10.3
Elongation (%)	>500	>500
Compression Set		
25° C*22h (%)		15
70° C*22h (%)	41	
MFR (230° C, 21N) (g/10min)	5	17

Mixing Condition:
Twin Screw Extruder (210 °C)

Molding Condition:
Injection Molding (Cylinder at 210 °C, mold at 50 °C)

Resilience:
ISO 4662 Lupke Type Rebound Resilience
Tester=Hr/Ho *100 (Hr: Rebound Height, Ho: Fall Height)

Tested by Kuraray Co., Ltd.

2) Adhesive Compounds

SEPTON™ based adhesive formulations

		1	2	3	
SEPTON™ 2063		100	100	100	
Aliphatic Saturated Hydrocarbon Resin (Tackifier)		100	150	200	
Process Oil		50	50	50	
Antioxidant		0.25	0.3	0.35	
Tack					
Rolling Back Tack Test (25°C)	Ball No.	12	7	<2	
*JIS Z0237: Higher No. => Higher Tack Properties					
Cohesion					
Creep Test: Holding Power	(Min.)	99	51	22	
*Sample Size 25mm*25mm, Load 1kg at 40°C					
Adhesion					
180° Peel Test: To Stainless Steel	(N/10mm)	4.1	7.0	12.0	
*Rate of peel 300mm/min. at 25°C					
Melt Viscosity					
160 °C	(mPa*s)	44200	21700	13400	
180 °C	(mPa*s)	16600	10400	6450	
*Brook Field Viscometer					
Softening Point		(°C)	118	109	100

Tested by Kuraray Co., Ltd.

Process Oil: Paraffinic oil with a viscosity of 95.54mm²/s at 40 °C
Coating Thickness: 30µm (to 50 µm PET film)

3) Polymer Modification

SEPTON™ and HYBRAR™ for PP film improvement

Layer	RPP	HYBRAR™/RPP	POE/LLDPE	SEPTON™/LLDPE
A Seal or Inner Layer	100% RPP 10 µm	80% RPP 20% HYBRAR™ 7311F 10 µm	100% LLDPE 10 µm	100% LLDPE 10 µm
B Core Layer	100% RPP 40 µm	80% RPP 20% HYBRAR™ 7311F 40 µm	80% LLDPE 20% POE 40 µm	90% LLDPE 10% SEPTON™ 2004F 40 µm
C Core Layer	100% RPP 10 µm	100% RPP 10 µm	100% LLDPE 10 µm	100% LLDPE 10 µm
Modulus (MPa)	490	140 (-70%)	N.D.	N.D.
Impact Strength	30 J/m at -20 °C	320 J/m (+960%) at -20 °C	507 g (Dart, RT)	780 g (+50 %) (Dart, RT)
Heat-Seal Strength (N/25mm)	1.5 (120 °C)	6.7 (+350%) (120 °C)	N.D.	N.D.
	2.1 (125 °C)	16.4 (+680%) (125 °C)		
	7.7 (130 °C)	17 (+120%) (130 °C)		

Tested by Kuraray Co., Ltd.

Impact Strength: RPP and HYBRAR™/RPP by Izod Notched Impact, POE/LLDPE and HYBRAR™/LLDPE Dart Drop at 21 °C

Application Examples

HYBRAR™ -

Polystyrene Blends For Added Damping Performance

	1	2
HYBRAR™ 5127		20
Polystyrene	100	80
Damping Properties		
Tan δ Loss Factor	(0 °C)	0.033
	(0 °C)	0.035
	(40 °C)	0.037
Loss Factor (Degree of Damping)	0.016	0.068
Hardness	(Type D)	83
Tensile Modulus	(MPa)	2600
Tensile Strength	(MPa)	49
Elongation	(%)	13
Flexural Modulus	(MPa)	2600
Flexural Strength	(MPa)	74

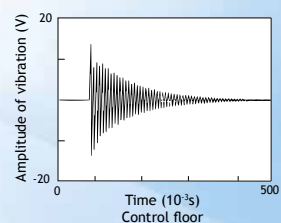
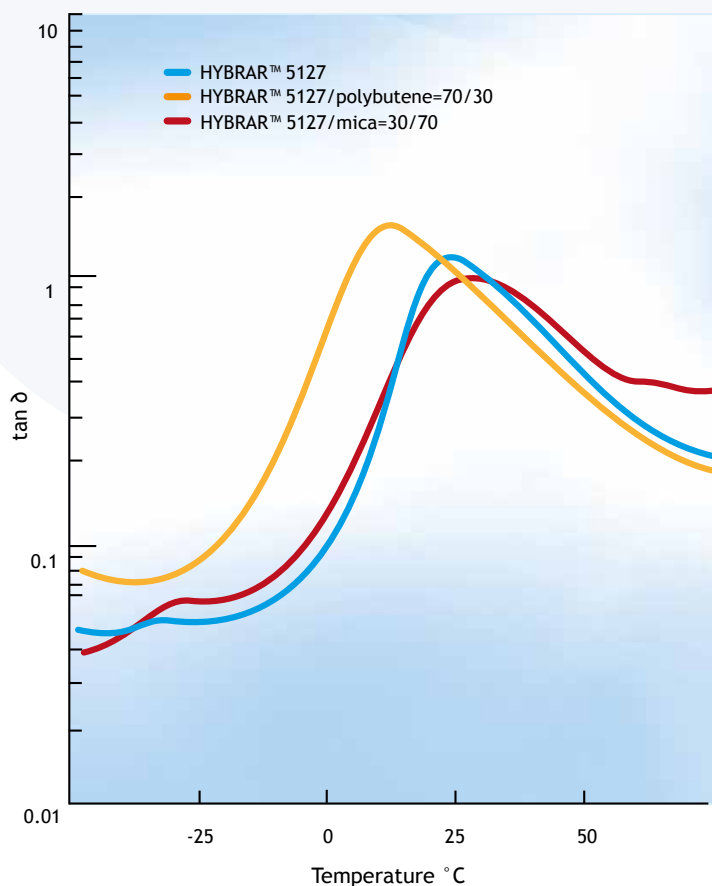
Tested by Kuraray CO., Ltd.

Blended with Twin Screw Extruder at 200 °C. Test samples molded with injection molder. (Cylinder at 200 °C, Mold at 60 °C)

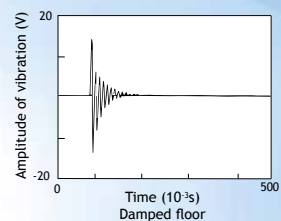
Evaluation of Damping Properties:

Tan δ measured with Rheovibron (Dynamic Viscoelastomer, Orientec) at 110Hz. Loss Factor (Degree of Damping) measured by resonance method with a cantilever beam.

HYBRAR™ Based Filler Compounds



Non HYBRAR™



With HYBRAR™

Formulation	Damping Properties	Mechanical Properties
HYBRAR™ 5127	70	Tan δ at 0 °C 0.54
Polybutene	30	25 °C 0.73
EVA	20	40 °C 0.51
Mica	150	Specific Gravity 1.83
Light Calcium Carbonate	150	
Calcium Stearate	4	
Carbon Black (GPF)	4	

Test specimen:

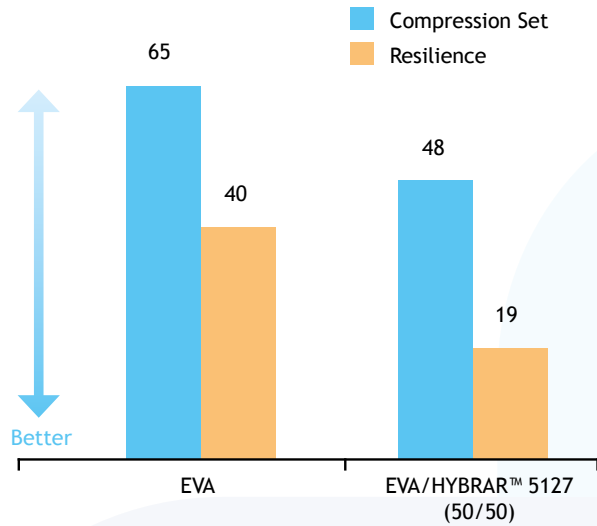
Control sample - two layer plywood (thickness = 2.4mm & 5.3mm)

Damped sample - three layer plywood (thickness = 2.4mm & 0.5mm (Damping compound) & 5.3mm)

Test Method:

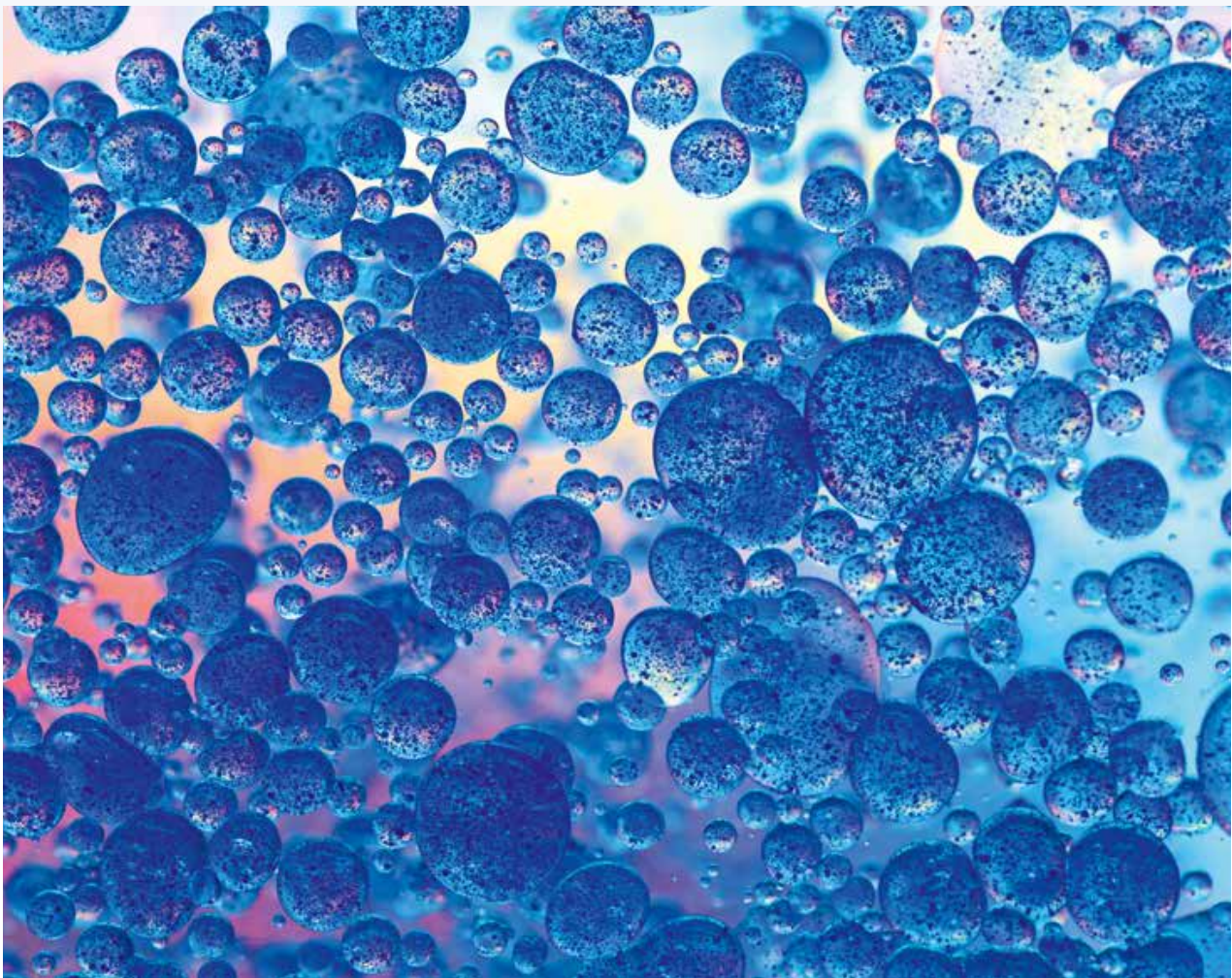
Damped Oscillation Curve was measured by the resonance method with a cantilever beam at 26 °C

HYBRAR™ in Cured Foam



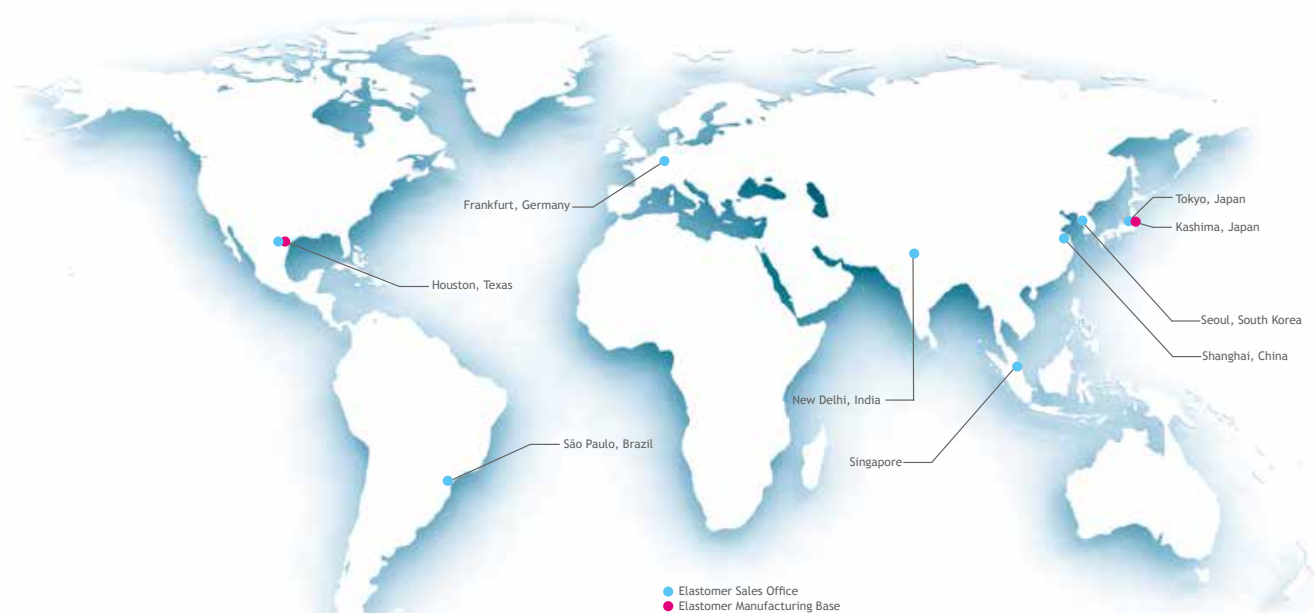
	1	2
EVA (VA Content: 19wt%)	100	50
HYBRAR™ 5127		50
Curing Agent	0.8	0.175
Foaming Agent	3	3
ZnO	2	2
Stearic Acid	1	1
TiO2	4	4

Tested by Kuraray Co., Ltd.
 Mixing Condition: Kneader and Roll-mill at 100° C - 130° C
 Curing Condition: Press Molding at 145° C for 60min. with 14.7 MPa pressure



kuraray

Adding value to your products - worldwide



SEPTON™, HYBRAR™ and KURARITY™ are Kuraray's trademarks for thermoplastic elastomers (TPEs). They are a special type of synthetic rubber that combine the elastic properties of rubber with the benefits of thermoplastics. They can be processed into almost any shape. TPEs have a pleasantly soft touch and good wear comfort. They also increase shock absorption. What's more, they are recyclable. Kuraray's TPEs are environmentally sound, free of PVC and do not need additional plasticizers. They are used for an extremely wide range of applications including many plastic compounds for every-

day products. Examples include toys, toothbrushes, medical tubes, sports equipment, sealants and car tires. The flexible types are used as lubricant additives and base components in adhesives. Kuraray is a leading supplier of TPEs and offers customers more than 30 different grades with individual properties.

For further information, please contact your local Kuraray office or visit our website.

 www.elastomer.kuraray.com

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Disclaimer: Precautions should be taken in handling and storage. Please refer to the appropriate Safety Data Sheet for further safety information. In using SEPTON™ and HYBRAR™, please confirm related laws and regulations, and examine its safety and suitability for the application. For medical, health care and food contact applications, please contact your Kuraray representative for specific recommendations. SEPTON™ and HYBRAR™ should not be used in any devices or materials intended for implantation in the human body. Nothing contained herein constitutes a license to practice under any patent and it should not be construed as an inducement to infringe any patent and the user is advised to take appropriate steps to be sure that any proposed use of the product will not result in patent infringement.

06/2019