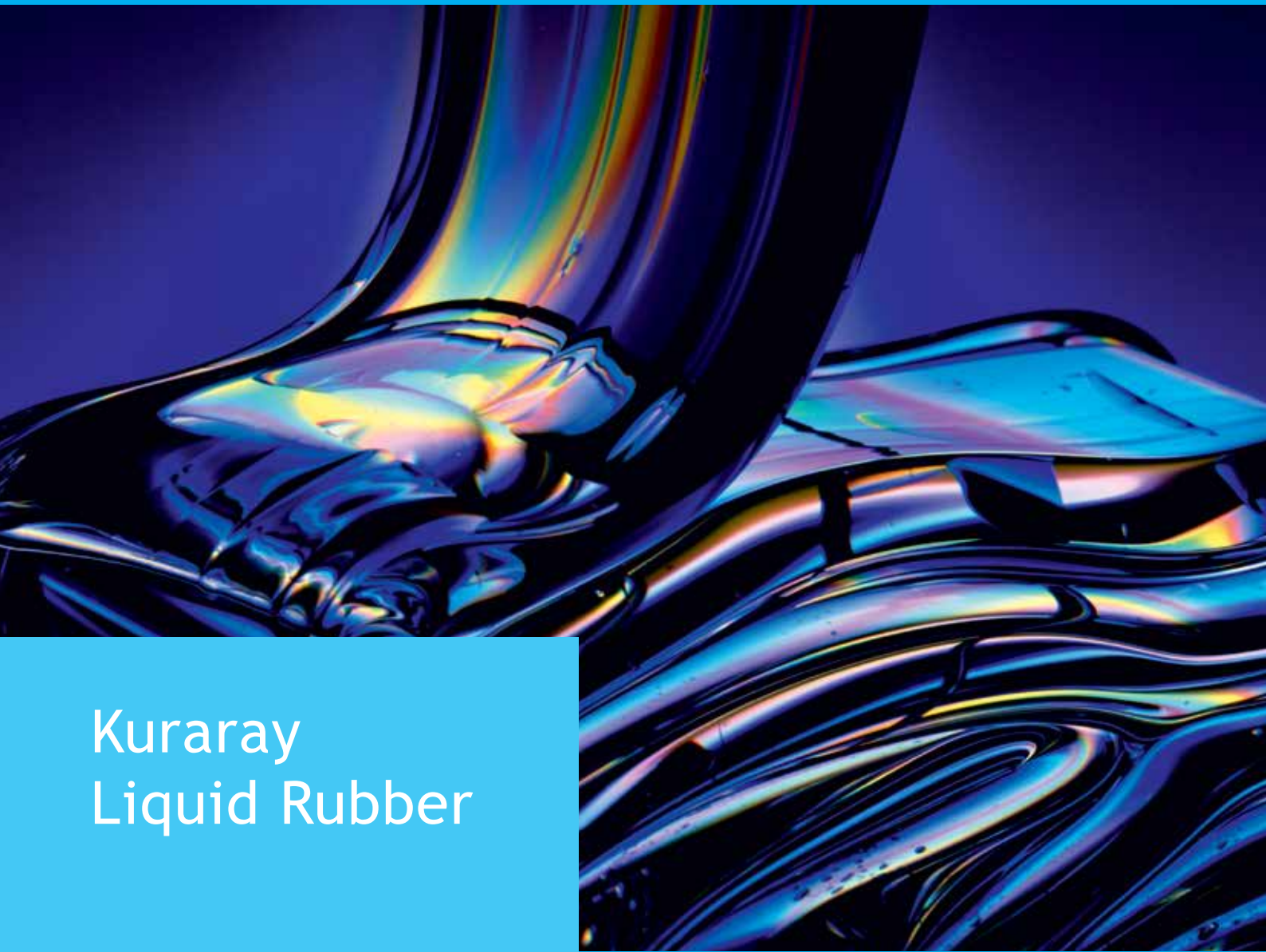
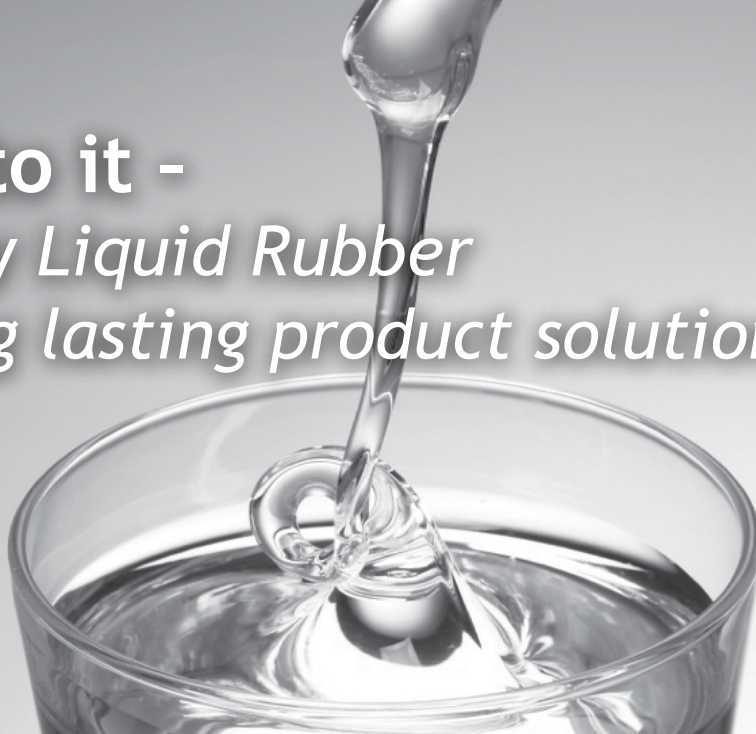


kuraray

Kuraray
Liquid Rubber



Stick to it - *Kuraray Liquid Rubber* for long lasting product solutions



Kuraray Liquid Rubber (K-LR) includes Liquid Isoprene Rubber (LIR) and Liquid Butadiene Rubber (LBR). These high-viscosity synthetic rubbers are based on isoprene, butadiene and styrene. They are colorless, transparent and almost entirely odorless with low VOC's.

Kuraray's liquid rubber grades function as reactive plasticizers but have far higher molecular weight than normal plasticizers. They are co-vulcanizable and reduce migration significantly which improves the product's shelf life. Using Kuraray Liquid Rubber during the rub-

ber compounding phase significantly reduces processing time while maintaining the rubber compounds' physical properties. This results in a product with lower processing costs.

The functionalized grades can be bonded to a wide variety of matrices for improved performance.

Common applications include tires, belts, hoses and other rubber goods. In addition, K-LR is used to produce high performance coatings, adhesives and sealants.

K-LR FOR TIRES



K-LR FOR RUBBER APPLICATIONS



K-LR FOR ADHESIVES



K-LR FOR COATINGS & SEALANTS



■ KURARAY LIQUID RUBBER IN TIRES

K-LR is a favored component in the production of high performance tires. It reduces Mooney viscosity which minimizes migration while improving the processability of the rubber compound in tires. K-LR enhances tire performance significantly by simultaneously controlling the balance of grip, fuel efficiency and wear resistance. K-LR is crosslinkable for superior performance and longer shelf life.

- Functionalized grades improve adhesion to metal
- Co-vulcanizable characteristics prevent oil migration
- Improved silica/carbon black dispersion in certain formulations
- Glass transition temperature (T_g) control enables grip control in a wide temperature range



Kuraray Liquid Rubber offers various application possibilities for tire manufacturing. Different grades can be processed in certain tire parts to contribute to a long lasting high quality product.

1 Beadfiller/APEX:

High hardness with excellent processability
Improved dimensional stability
Better filler dispersion
LIR-50, LBR-300*

2 Side wall / Carcass:

Improved dimensional stability
Enhanced surface smoothness of calendered sheet
Lower mill shrinkage
Better green tackiness
Higher production rates
LIR-50, LBR-302, LBR-307

3 Rim cushion:

Good balance of processability and physical properties
Improved abrasion resistance
LIR-50, LBR-300*

4 Tread:

Improved dynamic and physical properties (tan δ)
Excellent abrasion resistance, wet and ice grip
Excellent extrudability
LIR-50, LBR-302, LBR-307,
L-SBR-820, L-SBR-841

5 Cushion:

Enhanced surface smoothness of calendered sheet
Reduced extrusion temperature
Better green tackiness
Improvement of dynamic properties
LIR-50, LBR-302, LBR-307





■ KURARAY LIQUID RUBBER IN RUBBER APPLICATIONS

K-LR is processed in various rubber goods besides tires. Typical applications include anti-vibration rubber compounds, fenders, conveyor belts, rubber hoses and gaskets. LIR and LBR deliver a balanced performance including longer shelf life with minimal migration.

- Selected grades are suitable for EPDM applications
- Improved processability due to lower Mooney viscosity
- Co-vulcanizable with base rubber such as NR/IIR/SBR/BR/EPDM which reduces migration
- Improved adhesion to metal possible with functionalized grades
- Colorless and odorless with low VOC's

The following formulation illustrates the benefit of using LIR-50 in an extrusion.

Formulation	1	2	3
NR (RSS #3)	70	66	66
SBR 1502	30	30	30
Process Oil (Aromatic)	-	4	-
LIR-50	-	-	4
CB (FEF)	50	50	50
ZnO No. 1	2	5	5
Stearic Acid	2	2	2
Sulfur	2.2	2.2	2.2
Accelerator CBS	1.2	1.2	1.2
Antioxidant IPPD	1	1	1




[Mixing]

1 BR Banbury Mixer : 6min
2 8 inch Roll : 10min

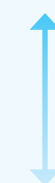
[Garvey die extrusion test]

(Test Conditions)

- Cylinder temp. : 90 °C
- Die temp. : 90 °C
- Screw rotation speed : 20rpm

	Extruded Sample	ASTM D 2230*	
		Edge	Surface
Formulation 1		6	B
Formulation 2		6	B
Formulation 3		10	A

*) EDGE 10 (excellent) SURFACE A (excellent)



1 (poor)



E (poor)



■ KURARAY LIQUID RUBBER IN ADHESIVES

K-LR is commonly used in adhesive applications such as pressure sensitive adhesives and hot melts. The lower molecular weight grades improve tack and adhesive properties. The UV crosslink-able grades provide excellent flexibility, tack, low shrinkage and moisture resistance which are ideal for flexible electronic applications.

- Preservation of rubber-like properties at low temperatures
- Colorless, transparent, odorless without halogen residuals
- Certain grades are suitable for food contact applications
- Improved adhesion to metal and glass possible with functionalized grades
- Crosslinkable by UV with methacrylic grades

Base Polymer		LIR-15* LIR-30 LIR-50	LBR-302 LBR-307 LBR-305 LBR-300* LBR-352 LBR-361*	LIR-310	LIR-390	LIR-290	LIR-403 LIR-410	UC-102M UC-203M	LIR-700	L-SBR-820 L-SBR-841
Solution	NR,IR	▪	▪							
	SBR	▪	▪							▪
	IIR	▪	▪			▪				
Latex	NR, SBR latex								▪	
Hot melt	SIS	▪	▪	▪	▪	▪				▪
	SBS	▪	▪	▪	▪	▪				▪
	SEBS, SEPS					▪				
	EVA			▪		▪				
Crosslink	NR						▪			
	NR/SBR						▪			
	LIR-403, LIR-410 as base rubber						▪			
	UV radiation							▪		

*Developmental Grade



■ KURARAY LIQUID RUBBER IN COATINGS & SEALANTS

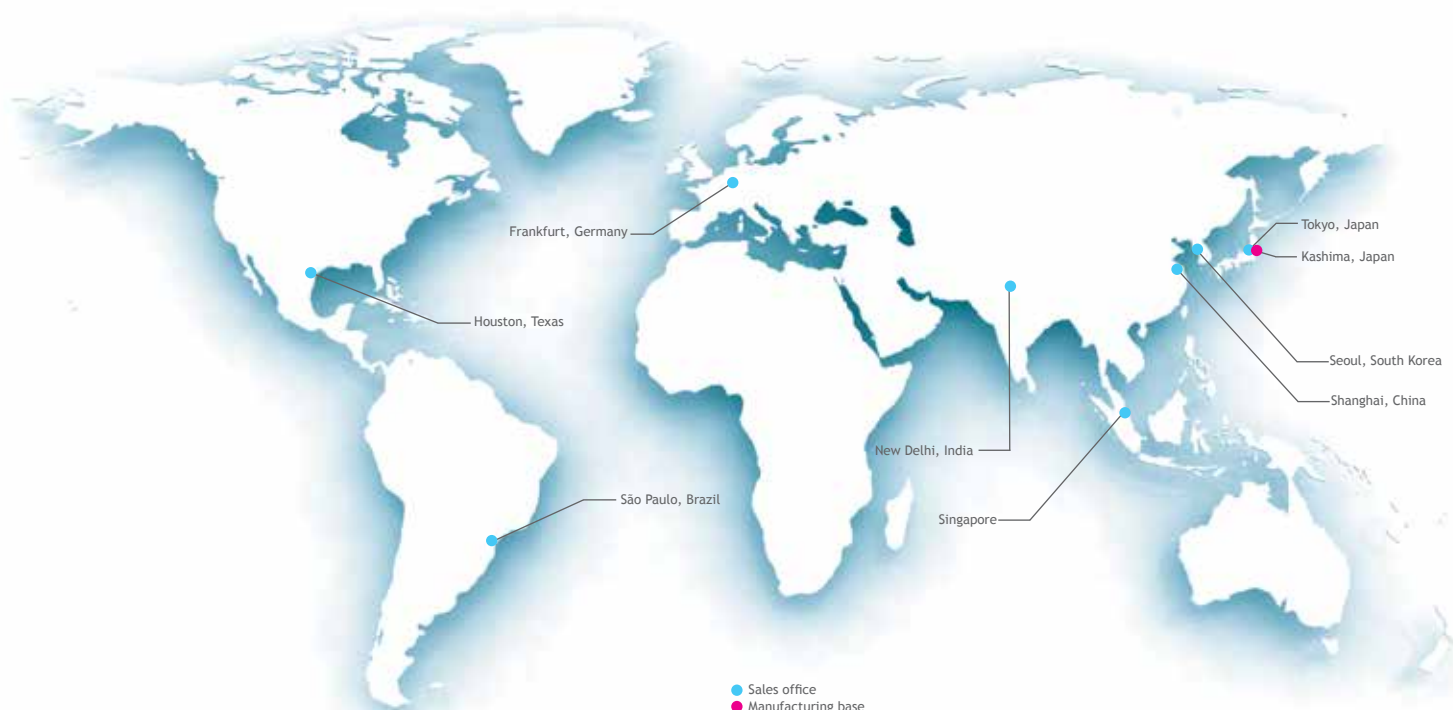
K-LR is also used in coatings and sealants. Typical applications include automotive, construction and marine coatings and sealants. K-LR's narrow molecular weight distribution ensures minimal residuals for improved quality.

- Colorless, transparent and odorless without halogen residuals
- Selected grades are suitable for food contact applications
- Low glass transition temperature (Tg) improves low temperature properties

Category	Type	Grade	Structure
LIR (Isoprene)	Homopolymer	LIR-15*	
		LIR-30	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_n$
		LIR-50	
	Block Copolymer	LIR-310	$\left[\text{CH}_2 - \underset{\text{C}_6\text{H}_5}{\underset{ }{\text{CH}}} \right]_m \left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_n$
		LIR-390	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 \right]_n$
	Carboxylated	LIR-403	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \underset{\text{C}_4\text{H}_4\text{O}_2}{\underset{ }{\text{CH}}} \right]_n$
		LIR-410	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \underset{\text{C}_4\text{H}_4\text{O}_4}{\underset{ }{\text{CH}}} \right]_n$
	UV Curable	UC-102M	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \underset{\text{C}_4\text{H}_4\text{O}_4}{\underset{ }{\text{CH}}} \right]_n$
		UC-203M	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \underset{\text{C}_4\text{H}_4\text{O}_4}{\underset{ }{\text{CH}}} \right]_n \text{O} - \text{CH}_2 - \text{CH}_2 - \text{O} - \overset{\text{O}}{\underset{ }{\text{C}}} - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH}_2$
	Hydrogenated	LIR-290	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{CH}}} - \text{CH}_2 - \text{CH}_2 \right]_m \left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_n$
	Latex	LIR-700	$\left[\text{CH}_2 - \overset{\text{CH}_3}{\underset{ }{\text{C}}} = \text{CH} - \text{CH}_2 \right]_n$
LBR (Butadiene)	Homopolymer	LBR-302 LBR-307 LBR-305 LBR-300*	$\left[\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 \right]_n$
		LBR-352 LBR-361*	$\left[\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \underset{\text{CH}=\text{CH}_2}{\underset{ }{\text{CH}}} \right]_n$
L-SBR (St/Bd)	Random Copolymer	L-SBR-820	$\left[\text{CH}_2 - \underset{\text{C}_6\text{H}_5}{\underset{ }{\text{CH}}} \right]_l \left[\text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_2 \right]_m \left[\text{CH}_2 - \underset{\text{CH}=\text{CH}_2}{\underset{ }{\text{CH}}} \right]_n$
		L-SBR-841	

Number of functional groups per molecule	Molecular Weight	Melt Viscosity (Pa·s at 38 °C)	Glass Transition Temp. (°C)	Features and main applications
-	19,500	15	-63	<ul style="list-style-type: none"> Reactive plasticizer (NR, IR, SBR, BR, IIR etc.) Tire, conveyor belt, rubber goods Pressure sensitive adhesives/hot melts Automotive sealants, coatings and adhesives Plasticizer for printing plates
-	28,000	70	-63	
-	54,000	500	-63	
-	32,000	1,400	-63	<ul style="list-style-type: none"> Hot melt adhesives/PSA (SIS, SBS, EVA) Automotive sealants, coatings and adhesives
-	48,000	400	-95	
3	34,000	200	-60	<ul style="list-style-type: none"> Improves adhesion to metals and fibers Automotive sealants, coatings and adhesives Hot melt adhesives/PSA (SIS, SBS, EVA)
10	30,000	430	-59	
2	17,000	30	-60	<ul style="list-style-type: none"> Low temperature reactivity Crosslinkable using UV Pressure sensitive adhesives (UV curing adhesives)
3	35,000	190	-60	
-	31,000	1,200	-59	<ul style="list-style-type: none"> Reactive plasticizer (EPDM) Hot melt adhesives (SEBS, SEPS) Superior heat and weather resistance
-	28,000	7.5 (at 25 °C) (Solid cont.= 60wt%)	-63	<ul style="list-style-type: none"> Good compatibility with NR latex Reactive plasticizer (NR latex, SBR latex) Adhesives
-	5,500	0.6	-85	<ul style="list-style-type: none"> Reactive plasticizer (NR, IR, SBR, BR etc.) Tire, printing plate Coagent for EPDM (peroxide curing) Automotive sealants, coatings and adhesives Hot melt/PSA Vinyl content: 5-70%
-	8,000	1.5	-95	
-	26,000	40	-95	
-	45,000	280	-95	
-	9,000	6	-60	<ul style="list-style-type: none"> Good compatibility with S-SBR and E-SBR Tire and rubber goods Automotive sealants, coatings and adhesives Partially hydrogenated grades are available
-	5,500	3.5	-49	
-	8,500	350	-14	<ul style="list-style-type: none"> Good compatibility with S-SBR and E-SBR Tire and rubber goods Automotive sealants, coatings and adhesives Partially hydrogenated grades are available
-	10,000	100 (at 60 °C)	-6	

Adding value to our products - worldwide



Kuraray is a world leader in specialty chemicals and functional materials. We are committed to developing products that ensure quality and value while helping our customers differentiate themselves from their competition.

The history of Kuraray's Elastomer division started in 1972 with the production of polyisoprene rubber and the development of new rubber materials based on Isoprene in the Kashima plant. From the

first production line, the Elastomer Division continuously grew and invented new products such as Kuraray Liquid Rubber, ISOBAM, SEPTON™, HYBRAR™, and KURARITY™.

Kuraray strives to develop new and innovative high performance products for customers around the globe. If you would like to know more about Kuraray's Elastomer products please also 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 Kuraray Liquid Rubber, 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 Liquid Rubber representative for specific recommendations. Kuraray Liquid Rubber 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.