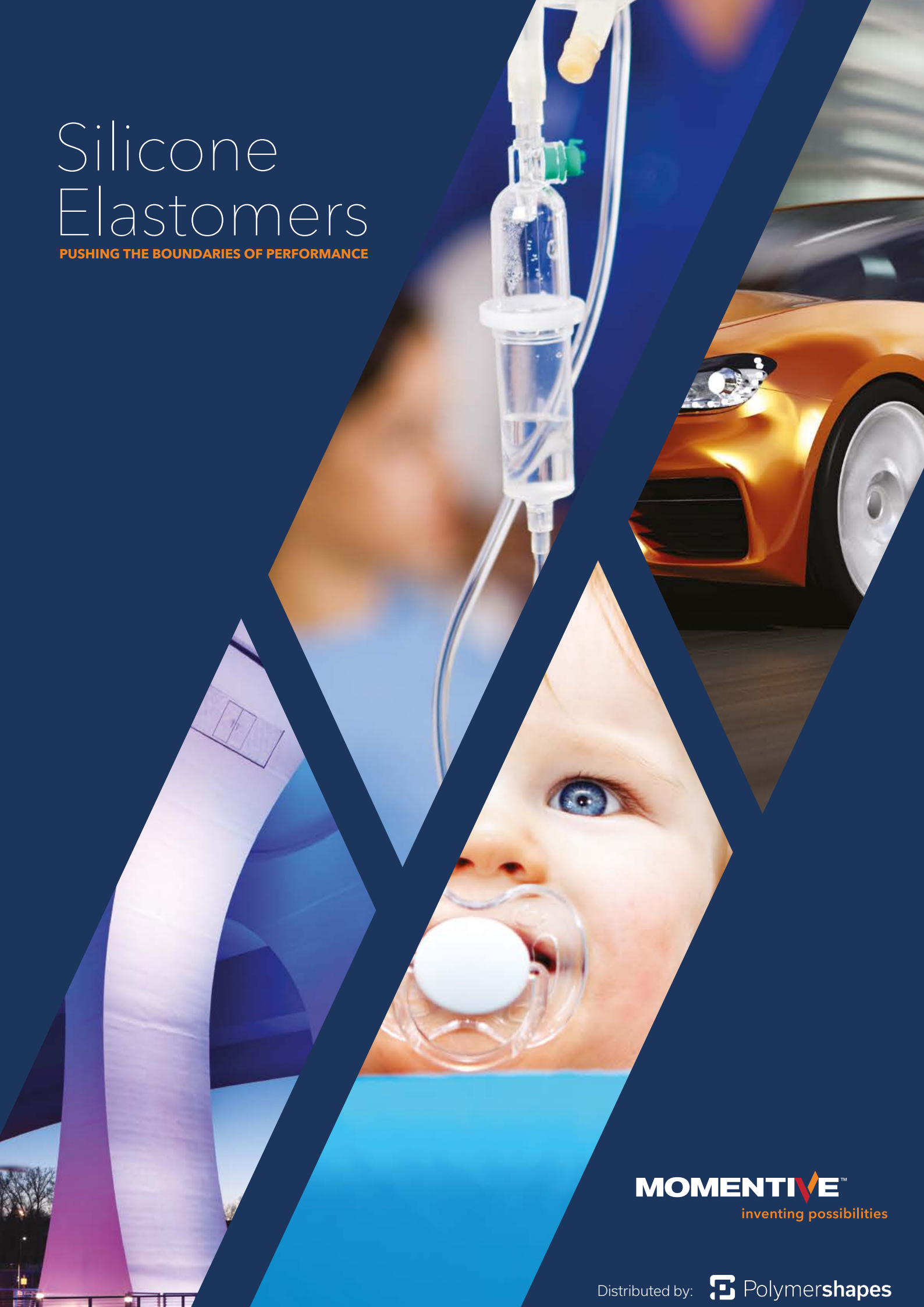


# Silicone Elastomers

PUSHING THE BOUNDARIES OF PERFORMANCE



**MOMENTIVE™**  
inventing possibilities

Distributed by:  Polymershapes

# A Leader in Silicones

Momentive Performance Materials is a global leader in silicones and advanced materials, delivering the science behind the solutions across a wide range of specialty performance applications.

For over 75 years, our rich, blended heritage of innovation and market firsts has provided product portfolios and technical competencies that link custom technology platforms to opportunities for our customers.

Momentive's silicone elastomers have been shown to provide outstanding properties to rubber products globally. Excellent heat resistance and lower impact on the environment are offered for applications in the healthcare, consumer goods, electronics and automotive industries. Electrical properties of our products have earned widespread use of silicone rubber in the energy sector. Low viscosity allows liquid silicone rubber to be pumped and used efficiently in the injection molding process.

Momentive has pioneered many of these applications and processes, and we continue to serve our customers with leading innovations and creative ideas.

We offer a portfolio of liquid silicone rubber (LSR) and high consistency rubber (HCR) products. We can also deliver ready-to-use, custom elastomers based on individual customer needs or specifications.

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## You're Global, We're Global

Our Silplus\* HCR product line is standardized to the same high-quality properties and specifications around the world, including products for extrusion, calendaring, multipurpose molding and high-strength applications. The global portfolio includes our Addisil\* products and fluorosilicones.

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## You're Local, We're Local

Momentive has facilities for Custom Elastomers in North America, Latin America, Europe and Asia Pacific and local personnel to support your local needs. Give us a call about custom formulated elastomers. Our Application Development Centers are staffed to help customers develop LSR products for their application requirements.

Demand for distinctive products is growing, and our materials are at the frontline of innovation. We offer a variety of silicone rubber products and extensive technical expertise to support your needs.

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# Industries & Applications

## Automotive

Our products are used in a wide variety of automotive applications. Momentive's silicone products are easy to process and generally maintain their elastomeric properties in extreme hot and cold environments, offer excellent dielectric properties, resist weathering and offer low compression set. Momentive's silicone elastomers are excellent candidates to consider for a variety of sealing, bonding and insulating applications. Momentive also offers specialty products that can provide excellent resistance to many types of automotive fluids.

Typical applications include:

- Gaskets
- O-rings
- Hoses
- Spark plug boots
- Diaphragms
- Connector seals
- Ignition cables
- Air-management system gaskets
- Exhaust hangers
- Fuel system valves
- Powertrain applications
- Oil-system seals

## Aviation & Aerospace

Our products are used in a wide variety of aerospace and aviation applications. Momentive's silicone products are excellent choices to consider for a variety of sealing, bonding and insulating applications. Momentive offers specialty products that can withstand stress and temperature extremes.

Typical applications include:

- Profiles
- Gasketing
- Door seals
- Masks

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## Consumer Goods

Our portfolio of products is used in a wide variety of consumer goods and home appliances. Momentive's silicone products can provide heat resistance, flame retardancy and moisture/dirt protection, making them excellent choices to consider for a variety of sealing, bonding and insulating applications.

Typical applications include:

- Infant care products
- Bakeware
- Kitchen utensils
- Gasketing
- Advanced aesthetics
- Seals
- Tubes
- Emblems
- Membranes
- Textile coating
- Shoe inserts

## Electrical and Electronics

The electronics industry encompasses a broad range of devices and components that present a wide spectrum of material performance requirements. Momentive Performance Materials' expansive portfolio of silicones offers an array of potential solutions for a variety of applications, including:

- LED
- Mobile phones
- Portable/wearable electronic devices
- Home networking and entertainment equipment
- Document handling systems
- Computers, laptops and peripherals
- Displays and projectors
- Keypads
- Optics and Lighting
- Gaskets
- Rollers

As the design trend of such equipment undergoes miniaturization, the excellent transparency or the high thermal conductivity properties and low hardness that our elastomer can offer become increasingly crucial to the success of equipment reliability and performance.

If the right material doesn't exist already, we may be able to custom compound a solution to meet your application's precise demands.

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## Healthcare

Our broad portfolio of silicone elastomers for applications in the healthcare industry has been tested against USP Class VI and/or ISO10993 biocompatibility standards. The distinctive properties of silicone elastomers - purity, clarity, strength - coupled with ease of processability, have resulted in their use in a broad range of medical device applications. Our silicone materials exhibit exceptional stability over a wide range of temperatures, lending themselves to use in applications requiring repeated sterilization performance.

Typical applications include:

- Dental / surgical devices
- Diagnostics / imaging
- Fluid and drug delivery devices
- Orthopedics / prosthetics
- Advanced Wound Care & Scar management
- Septa / stoppers / laboratory accessories
- Medical tubing
- Wound drains and bulbs
- Sterilization mats
- Pharmaceutical closures
- Instrument grips
- Dialysis o-rings
- Positioning devices
- Catheters
- Seals / o-rings / valves
- Respiratory / anesthesia
- Medical equipment keypads

## Energy

Our broad portfolio of silicone products offers innovative solutions as possible replacements for ceramic materials, such as porcelain and glass, in the field of medium and high voltage technology. Our silicone solutions generally are lighter, require less maintenance, offer improved hydrophobicity, excellent tracking and erosion resistance, ease of processing and outstanding service life.

Typical applications include:

- High voltage insulators
- Cable accessories Terminations/cable joints
- Breakers / disconnect switches
- Surge arrestors
- Wire and cable

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# Liquid Silicone Rubber (LSR)

Our family of LSR is a versatile class of liquid silicone rubbers. LSR is a two-component, platinum (addition/heat) curable and pumpable silicone elastomer that can be molded and cured with very fast cycle times at elevated temperatures.

The molding process allows complex part geometry and exact dimensions. LSR can enable short cycle time injection and fully automatic flash-less and trim-free manufacturing.

#### **This family of products can offer:**

- Fast cycle times
- High clarity
- High tear strength
- Self-bonding options
- Broad range of durometers (3 to 80 Shore A)
- Self-lubrication
- Fluorinated
- Electrical conductivity

# Liquid Silicone Rubber Grades

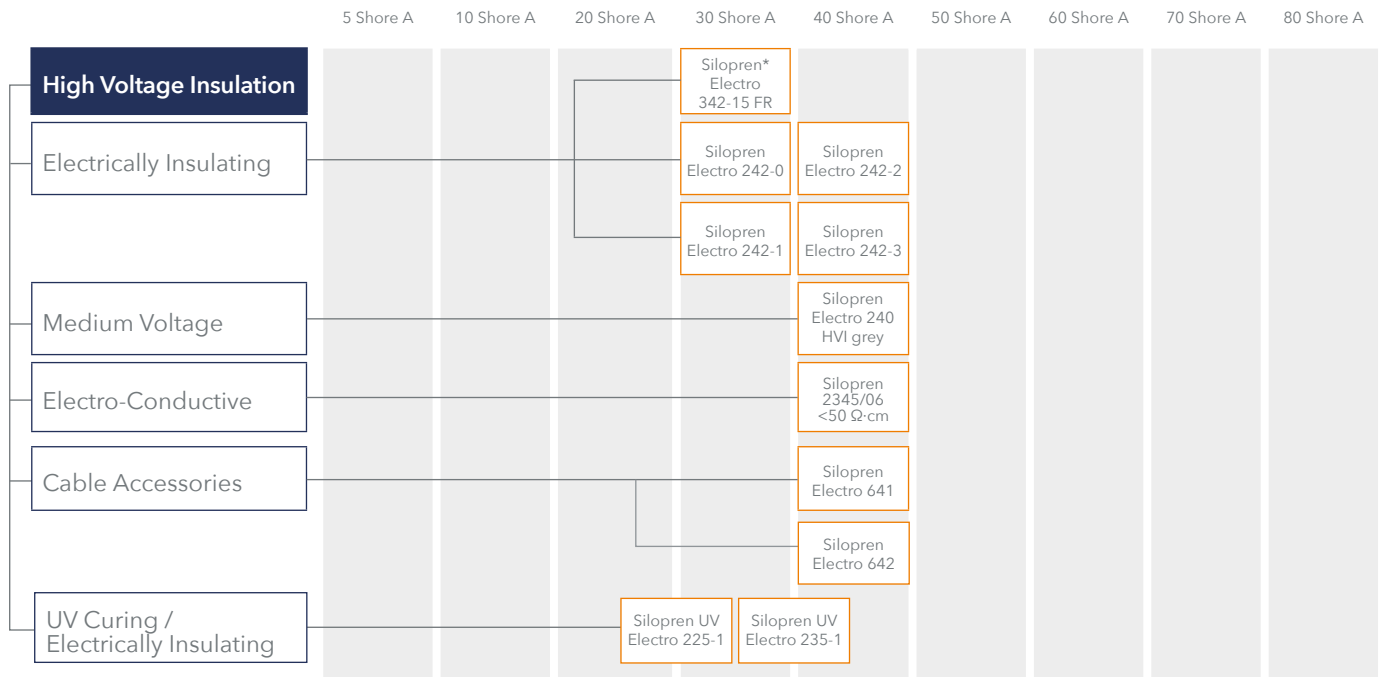
	5 Shore A	10 Shore A	20 Shore A	30 Shore A	40 Shore A	50 Shore A	60 Shore A	70 Shore A	80 Shore A
<b>Standard</b>									
General Purpose	Silopren* LSR 2003	Silopren LSR 2010 TP 3470	Silopren LSR 2020 TP 3364	Silopren LSR 2030	Silopren LSR 2040	Silopren LSR 2050	Silopren LSR 2060	Silopren LSR 2070	Silopren LSR 2080
Fast Cure / High Tear		Silopren LSR 2610	Silopren LSR 2620	Silopren LSR 2630	Silopren LSR 2640	Silopren LSR 2650	Silopren LSR 2660	Silopren LSR 2670	
High Tear - Baby Care						Silopren LSR 2645			
Baby Care					LIM* 6045				
Non Post-cure Low Compression Set				Silopren LSR 2631 TP 3729	Silopren LSR 2641 TP 3730	Silopren LSR 2651 TP 3731	Silopren LSR 2661 TP 3732	Silopren LSR 2671 TP 3733	
Textile Coating				Silopren LSR 2530	Silopren LSR 2540		Silopren LSR 2560		
Good Flex Life					Silopren LSR 2841				
Reduced Self Healing					Silopren LSR 2040 RSH	Silopren LSR 2650 RSH			
Special Modulus							Silopren LSR 2665		
UV Curing				Silopren UV LSR 2030			Silopren UV LSR 2660		
<b>Self-Lubricating</b>									
Standard						Silopren LSR 3285/50 2% oil			
				Silopren LSR 3785/30 7% oil		Silopren LSR 3485/50 4% oil			
			Silopren LSR 3485/35 4% oil						
Low Compression Set (CS)						Silopren LSR 3186/50 TP 3651 1% oil			
					Silopren LSR 3286/40 TP 3649 2% oil	Silopren LSR 3286/50 TP 4224 2% oil	Silopren LSR 3286/60 TP 0125 2% oil	Silopren LSR 3286/70 TP 3650 2% oil	
		Silopren LSR 3486/20 TP 3648 4% oil	Silopren LSR 3386/30 TP 3616 3% oil	Silopren LSR 3386/40		Silopren LSR 3486/50 TP 4268 4% oil			
		Silopren LSR 3786/20 TP 3944 7% oil							
Ultra Low CS			Silopren LSR 3696/25 6% oil	Silopren LSR 3596/35 5% oil					
				Silopren LSR 3596/30 5% oil					
Low Volatile						Silopren LSR 3376/50 3% oil			
Low Longterm CS / High Heat Stability						Silopren LSR 3366/50 3% oil			

# Liquid Silicone Rubber Grades

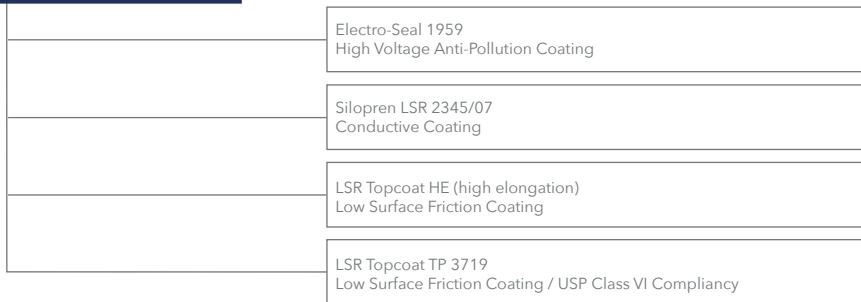
	5 Shore A	10 Shore A	20 Shore A	30 Shore A	40 Shore A	50 Shore A	60 Shore A	70 Shore A	80 Shore A	90 Shore A
<b>Self-Bonding</b>										
General Purpose				Silopren* LSR 2730 TP 3823	Silopren LSR 2740 TP 3783	Silopren LSR 2750 TP 3824				
Drinking Water					Silopren LSR 2742					
Special Purpose					LIM* 8040			LIM 9071 ET		
Adhesion to PC / FDA compliancy				Silopren LSR 2739	Silopren LSR 2749	Silopren LSR 2759				
Self-Lubricating					Silopren LSR 2725/40					
<b>Fluorinated LSR</b>										
General Purpose					FSL 7641	FSL 7651	FSL 7661			
Self-Lubricating					FSL 7586/40 5% oil					
<b>Specialties</b>										
Spark Plug Boots Automotive							Silopren LSR 2660 ZKS			
Ultra Clear	Silopren LSR 7005			Silopren LSR 7030	Silopren LSR 7040	Silopren LSR 7050	Silopren LSR 7060	Silopren LSR 7070 FC	Silopren LSR 7180 Silopren LSR 7080 HP	Silopren LSR 7090
High Productivity								Silopren LSR 2670 FC	Silopren LSR 2680 FC	
<b>Healthcare</b>										
General Purpose			Silopren LSR 4020 TP 3364	Silopren LSR 4030	Silopren LSR 4040	Silopren LSR 4050	Silopren LSR 4060	Silopren LSR 4070	Silopren LSR 4080	
		LIM 6010		LIM 6030	LIM 6040	LIM 6050				
Fast Cure / High Tear					Silopren LSR 4640	Silopren LSR 4660	Silopren LSR 4660	Silopren LSR 4670		
UV Curing				UV LSR 4030		UV LSR 4060				
Reduced Self-Healing					Silopren LSR 4040 RSH	Silopren LSR 4650 RSH				
Self-Lubricating						Silopren LSR 4655 SL				
Self-Bonding				Silopren LSR 4739	LIM 8040	CLS 8150	CLS 3060	CLS 5000		
Radio Opaque					LIM 6041					
Adhesion to PC / Copolyesters				Silopren LSR 4739	Silopren LSR 4749					

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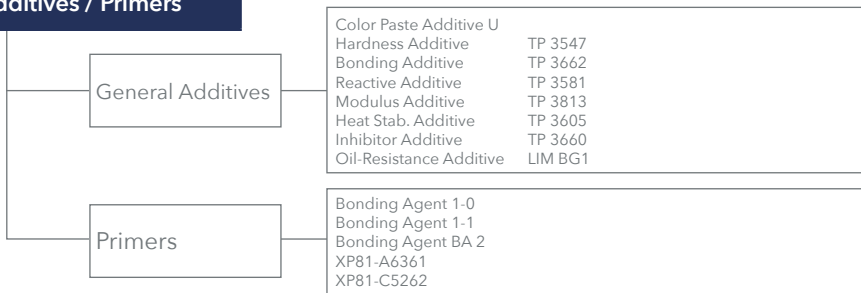
# Liquid Silicone Rubber Grades



## Coatings



## Additives / Primers



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# Liquid Silicone Rubber Grades General Purpose

Product Name	BFR <sup>a</sup>	FDA Indirect Food Contact <sup>b</sup>	European Pharmacopoeia <sup>c</sup>	UL Listing	Potable Water Standards <sup>d</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (post-cured)
<b>General Purpose</b>												
Silopren* LSR 2003	+	○	-	-	-	Transparent	1.05	50 <sup>1</sup>	3	500	4	20
Silopren LSR 2010	+	●	-	-	-	Transparent	1.07	8	3	970	6	15
Silopren LSR 2020	+	●	-	-	-	Transparent	1.08	22	6	1000	15	20
Silopren LSR 2030	+	●	●	UL94HB	●	Transparent	1.10	31	8	800	18	15
Silopren LSR 2040	+	●	●	UL94HB	●	Transparent	1.12	40	9	750	25	25
Silopren LSR 2050	+	●	●	UL94HB	●	Transparent	1.12	51	10	600	35	25
Silopren LSR 2060	+	●	●	UL94HB	●	Transparent	1.13	60	10	450	30	25
Silopren LSR 2070	+	●	●	UL94HB	●	Transparent	1.14	70	9	400	20	25
Silopren LSR 2080	+	●	●	-	●	Transparent	1.13	79	7	150	5	25
<b>Fast Cure / High Tear</b>												
Silopren LSR 2610	+	+	-	-	-	Transparent	1.04	16	3	560	9	12
Silopren LSR 2620	+	●	-	-	-	Transparent	1.08	24	5	600	20	20
Silopren LSR 2630	+	●	-	UL94HB	●	Transparent	1.10	32	8	700	35	15
Silopren LSR 2640	+	●	-	UL94HB	●	Transparent	1.12	42	8	600	40	25
Silopren LSR 2650	+	●	-	UL94HB	●	Transparent	1.12	52	10	550	50	25
Silopren LSR 2660	+	●	-	UL94HB	●	Transparent	1.13	62	9	400	45	20
Silopren LSR 2665	+	+	-	-	-	Translucent	1.13	65	10.5	400	50	25
Silopren LSR 2670	+	●	-	UL94HB	●	Transparent	1.13	69	9	350	30	20
<b>UV LSR General Purpose<sup>2</sup></b>												
Silopren UV LSR 2030	+	●	-	-	-	Translucent	1.10	28	8.0	750	20	-
Silopren UV LSR 2060	+	●	-	-	-	Translucent	1.15	59	13.0	500	25	-
<b>High Tear Baby Care</b>												
Silopren LSR 2645	+	●	-	-	-	Transparent	1.14	47	11	700	42	25
Silopren LIM* 6045	+	●	-	-	-	Transparent	1.12	44	9	650	39	-
<b>Reduced Self Healing</b>												
Silopren LSR 2040 RSH	+	●	-	-	-	Transparent	1.12	40	11	700	30	12
Silopren LSR 2650 RSH	+	●	-	-	-	Transparent	1.13	51	10.5	550	48	-

Typical physical properties are average data and are not to be used as or to develop product specifications.

All LSR grades are platinum cured materials. The mixing ratio is 1:1 by weight, except for the UV-curing LSR the mixing ratio is 100:2.

<sup>a</sup> Based on listing of ingredients in the BFR recommendation XV "Silicones".

<sup>b</sup> Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BFR XV.

<sup>c</sup> Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

<sup>d</sup> It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

<sup>e</sup> Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP. 3.1.9.

<sup>f</sup> Based on testing conducted on a representative sample of the product, as per the requirements of KTW, WRAS and W270. Please contact the Product Regulatory Group for details.

<sup>1</sup> Tested using Shore 00 scale.

<sup>2</sup> Laboratory Vulcanization Conditions: exposure to a Hg-(Fe-doped) middle pressure lamp for 2 min at 80 mW/cm<sup>2</sup> intensity, without further heat curing.

● = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant, ○ = Does not meet the requirements of Rubber Articles Intended for Repeated Use, 21 CFR 177.2600.

Additional information may be contained on the technical datasheet.

For custom opportunities, please contact your local Momentive sales representative.

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# Liquid Silicone Rubber Grades Specialties

Product Name	BFR <sup>a</sup>	FDA Indirect Food Contact <sup>b</sup>	European Pharmacopoeia <sup>c</sup>	UL Listing	Potable Water Standards <sup>d</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (post-cured)
<b>Non Post Cure / Low Compression Set</b>												
Silopren* LSR 2631	-	-	-	-	-	Translucent	1.10	29	8	850	30	25 <sup>1</sup>
Silopren LSR 2641	-	-	-	-	-	Translucent	1.11	40	9	700	35	25 <sup>1</sup>
Silopren LSR 2651	-	-	-	-	-	Translucent	1.12	50	10	650	45	25 <sup>1</sup>
Silopren LSR 2661	-	-	-	-	-	Translucent	1.13	60	9	500	50	25 <sup>1</sup>
Silopren LSR 2671	-	-	-	-	-	Translucent	1.13	69	9	450	30	25 <sup>1</sup>
<b>High Productivity LSRs</b>												
Silopren LSR 2670 FC <sup>2</sup>	-	-	-	UL94HB	•	Transparent	1.15	67	9	450	44	-
Silopren LSR 2680 FC	-	•	-	UL94HB	-	Transparent	1.15	76	7	200	10	-
<b>Textile Coating</b>												
Silopren LSR 2530	+	-	-	UL94HB	-	Translucent	1.05	30	4	500	10	-
Silopren LSR 2540	+	+	-	UL94HB	-	Translucent	1.08	40	7	500	25	20
Silopren LSR 2560	+	+	-	-	-	Translucent	1.08	60	7	300	7	-
<b>Good Flex Life</b>												
Silopren LSR 2841	+	-	-	UL94HB	-	Transparent	1.07	40	6	550	21	-
<b>Spark Plug Boots Automotive</b>												
Silopren LSR 2660 ZKS	-	-	-	-	-	Black	1.13	60	11.4	500	39	20 <sup>1</sup>
<b>Ultra Clear LSRs</b>												
Silopren LSR 7005	-	-	-	-	-	Optically Clear	0.98	5	0.3	210	-	-
Silopren LSR 7030	-	-	-	-	-	Optically Clear	1.10	30	3.5	250	3	-
Silopren LSR 7040	-	-	-	-	-	Optically Clear	1.02	40	4.4	330	6	-
Silopren LSR 7050	-	-	-	-	-	Optically Clear	1.02	50	4.7	310	8	-
Silopren LSR 7060	-	-	-	UL94HB	-	Optically Clear	1.03	60	6.5	340	11	-
Silopren LSR 7070 FC	-	-	-	-	-	Optically Clear	1.05	70	8.5	145	7	-
Silopren LSR 7080 HP	-	-	-	UL94HB	-	Optically Clear	1.06	75	10	100	6	-
Silopren LSR 7180	-	-	-	UL746C f1	-	Optically Clear	1.06	76	10.8	80	8	-
Silopren LSR 7090	-	-	-	UL94HB	-	Optically Clear	1.08	90	8	50	8	-
<b>Specialty Coatings</b>												
LSR TOPCOAT HE <sup>3</sup>	+	+	-	-	-	Matte	Physical properties subject to the substrate used					
LSR TOPCOAT TP 3719	+	•	-	-	-	Matte	Physical properties subject to the substrate used					

Typical physical properties are average data and are not to be used as or to develop product specifications.

All LSR grades are platinum cured materials which are mixed in a 1:1 ratio by weight.

<sup>a</sup> Based on listing of ingredients in the BFR recommendation XV "Silicones".

<sup>b1</sup> Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BFR XV.

<sup>b2</sup> Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

<sup>b3</sup> It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

<sup>c</sup> Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP.3.1.9

<sup>1</sup> Non post-cured

<sup>2</sup> = Based on testing conducted on a representative sample of an analogous product, as per the requirements of KTW, WRAS and W270. Differing results would not be expected for this product.

• = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

Additional information may be contained on the technical datasheet. For custom opportunities, please contact your local Momentive sales representative.

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# Liquid Silicone Rubber Grades Healthcare

Product Name	USP Class VI <sup>a</sup>	ISO10993 <sup>b</sup>	BfR <sup>c</sup>	FDA Indirect Food Contact <sup>d</sup>	European Pharmacopoeia <sup>e</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (post-cured)
<b>Healthcare</b>												
Silopren* LSR 4020	•	•	+	•	-	Translucent	1.08	22	7.0	1000	15	20
Silopren LSR 4030	•	•	+	•	•	Translucent	1.10	31	8.0	800	18	15
Silopren LSR 4040	•	•	+	•	•	Translucent	1.12	40	9.0	750	25	25
Silopren LSR 4050	•	•	+	•	•	Translucent	1.12	51	10.0	600	35	25
Silopren LSR 4060	•	•	+	•	•	Translucent	1.13	60	10.0	450	30	25
Silopren LSR 4070	•	•	+	•	•	Translucent	1.14	70	9.0	400	20	25
Silopren LSR 4080	•	•	+	•	•	Translucent	1.13	79	7.0	150	5	25
<b>Fast Cure/High Tear</b>												
Silopren LSR 4640	•	•	+	•	-	Translucent	1.12	42	8.0	600	45	25
Silopren LSR 4650	•	•	+	•	-	Translucent	1.12	52	10.0	550	50	25
Silopren LSR 4660	•	•	+	•	-	Translucent	1.13	62	9.0	400	45	20
Silopren LSR 4670	•	•	+	•	-	Translucent	1.13	69	10.0	350	30	20
LIM* 6010	•	•	+	+	-	Translucent	1.05	15	3.0	440	10	-
LIM 6030	•	•	+	•	-	Translucent	1.12	35	9.0	675	31	-
LIM 6040	•	•	+	•	-	Translucent	1.12	42	9.0	600	39	-
LIM 6045	•	•	+	•	-	Translucent	1.12	44	9.0	650	39	-
LIM 6050	•	•	+	•	-	Translucent	1.12	53	9.0	530	43	-

Typical physical properties are average data and are not to be used as or to develop product specifications.

All LSR grades are platinum cured materials. The mixing ratio is 1:1 by weight, except for the UV-curing LSR the mixing ratio is 100:2.

<sup>a</sup> Laboratory Vulcanization Conditions: exposure to a Hg-(Fe-doped) middle pressure lamp for 2min at 80 mW/cm<sup>2</sup> intensity, without further heat curing

<sup>b</sup> Based upon USP Class VI testing, on a representative sample of the product, for intramuscular implantation, intracutaneous injection and systemic injection. For some products, additional testing has been conducted. Please contact the Product Regulatory Group for details.

<sup>c</sup> Based upon ISO 10993 part 6, 10, and 11 testing conducted on a representative sample of the product. For some products additional testing has been conducted. Please contact the Product Regulatory Group for details.

<sup>d</sup> Based on listing of ingredients in the BfR recommendation XV "Silicones".

<sup>e</sup> Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BfR XV

<sup>f</sup> Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

<sup>g</sup> It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

<sup>h</sup> Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP.3.1.9.

x = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

• = Meets the requirements for passing the test standard,

- = Not tested, + = product is compositionally compliant.

Additional information may be contained on the technical datasheet.

For custom opportunities, please contact your local Momentive sales representative.

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# Liquid Silicone Rubber Grades Healthcare

Product Name	USP Class VI <sup>a</sup>	ISO 10993 <sup>b</sup>	BfR <sup>c</sup>	FDA Indirect Food Contact <sup>d</sup>	European Pharmacopoeia <sup>e</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (post-cured)
<b>UV Curing</b>												
Silopren* UV LSR 4030	•	•	+	•	-	Translucent	1.10	28	8.0	750	20	-
Silopren UV LSR 4060	•	•	+	•	-	Translucent	1.15	59	13.0	500	25	-
<b>Self-Lubricating</b>												
Silopren LSR 4655 SL	•	•	-	-	-	Translucent	1.13	55	8.0	450	45	-
<b>Reduced Self-Healing</b>												
Silopren LSR 4040 RSH	•	•	+	•	-	Translucent	1.12	40	11.0	700	30	12
Silopren LSR 4650 RSH	•	•	+	•	-	Translucent	1.13	51	10.5	550	48	-
<b>Self-Bonding</b>												
Silopren LSR 4739	•	•	-	-	-	Translucent	1.1	32	8.0	650	30	-
Silopren LSR 4749	-	•	-	-	-	Translucent	1.10	39	7.0	600	40	-
LIM* 8040	•	-	-	-	-	Translucent	1.08	43	5.0	390	37	>50
CLS 8150	•	•	-	-	-	Translucent	1.10	52	8.0	515	34	-
CLS 5000	•	•	-	-	-	Translucent	1.12	67	11.0	460	44	-
CLS3060	•	•	-	-	-	Translucent	1.12	59	11.0	500	35	-
<b>Radio Opaque (X-Ray Detectability)</b>												
LIM 6041	•	-	•	•	-	White	1.19	45	7.0	700	32	-

Typical physical properties are average data and are not to be used as or to develop product specifications.

All LSR grades are platinum cured materials. The mixing ratio is 1:1 by weight, except for the UV-curing LSR the mixing ratio is 100:2.

\*Laboratory Vulcanization Conditions: exposure to a Hg-(Fe-doped) middle pressure lamp for 2min at 80 mW/cm<sup>2</sup> intensity, without further heat curing

a Based upon USP Class VI testing, on a representative sample of the product, for intramuscular implantation, intracutaneous injection and systemic injection. For some products, additional testing has been conducted. Please contact the Product Regulatory Group for details.

b Based upon ISO 10993 part 6, 10, and 11 testing conducted on a representative sample of the product. For some products additional testing has been conducted. Please contact the Product Regulatory Group for details.

c Based on listing of ingredients in the BfR recommendation XV "Silicones".

c' Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BfR XV

d Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

d' It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

e Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP. 3.1.9.

x = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

• = Meets the requirements for passing the test standard,

- = Not tested, + = product is compositionally compliant.

Additional information may be contained on the technical datasheet.

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# Liquid Silicone Rubber Grades Self-Lubricating

Product Name	UL Listing	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (non-post-cured)
<b>Standard</b>								
Silopren* LSR 3785/30	-	Whitish	1.11	30	9	730	26	25 <sup>1</sup>
Silopren LSR 3485/35	UL94HB	Whitish	1.11	33	10	730	26	25 <sup>1</sup>
Silopren LSR 3285/50	-	Translucent	1.13	53	10.9	530	40	25 <sup>1</sup>
Silopren LSR 3485/50	-	Whitish	1.13	53	10.2	500	38	25 <sup>1</sup>
<b>Low Compression Set</b>								
Silopren LSR 3486/20 TP 3648	-	Whitish	1.1	20	6.8	760	12	18
Silopren LSR 3786/20 TP 3944	-	Whitish	1.11	19	6.5	740	14	30
Silopren LSR 3386/30 TP 3616	UL94HB	Whitish	1.12	32	9.2	720	18	25
Silopren LSR 3286/40 TP 3649	-	Translucent	1.12	41	8	620	41	25
Silopren LSR 3386/40	-	Whitish	1.12	41	8.8	620	35	20
Silopren LSR 3186/50 TP 3651	-	Translucent	1.12	49	9.7	600	43	25
Silopren LSR 3286/50 TP 4224	UL94HB	Translucent	1.12	50	8.7	560	45	20
Silopren LSR 3486/50 TP 4268	-	Whitish	1.12	51	8.1	540	44	25
Silopren LSR 3286/60 TP 0125	UL94HB	Translucent	1.14	61	9.6	480	52	20
Silopren LSR 3286/70 TP 3650	UL94HB	Translucent	1.14	69	10.5	420	37	20
<b>Ultra Low Compression Set</b>								
Silopren LSR 3696/25	-	Whitish	1.08	24	6.5	710	12	19
Silopren LSR 3596/30	-	Whitish	1.1	30	8	700	26	15
Silopren LSR 3596/35	-	Whitish	1.11	34	8.5	700	31	15
<b>Low Compression Set / Low Volatile</b>								
Silopren LSR 3376/50	-	Whitish	1.13	50	9.5	600	43	16
<b>Low Long Term Compression Set / High Heat Stability</b>								
Silopren LSR 3366/50	-	White	1.13	52	8.6	450	40	11

Typical physical properties are average data and are not to be used as or to develop product specifications.

<sup>1</sup> Post-cured

Additional information may be contained on the technical datasheet.  
For custom opportunities, please contact your local Momentive sales representative.

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# Liquid Silicone Rubber Grades Self-Bonding

Product Name	BfR <sup>a</sup>	FDA Indirect Food Contact <sup>b</sup>	European Pharmacopoeia <sup>c</sup>	UL Listing	Potable Water Standards <sup>d</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (post-cured)
<b>Self-Bonding / General Purpose</b>												
Silopren* LSR 2730	-	-	-	-	-	Translucent	1.10	30	8	750	15	-
Silopren LSR 2740	-	•	-	-	-	Translucent	1.12	38	9.3	700	20	25 <sup>1</sup>
Silopren LSR 2750	-	-	-	-	-	Translucent	1.12	50	10	650	30	-
<b>Self-Bonding / Drinking Water</b>												
Silopren LSR 2742	-	-	-	-	•	Translucent	1.12	40	8	550	35	-
<b>Self-Bonding / Special Purpose</b>												
LIM* 8040	-	-	-	-	-	Translucent	1.08	43	5	390	37	>50
LIM 9071 ET	-	-	-	-	-	Translucent	1.11	70	6	250	17	30
<b>Self-Bonding / Adhesion to PC / FDA Compliancy</b>												
Silopren LSR 2739	-	•	-	-	-	Translucent	1.10	32	8	650	30	-
Silopren LSR 2749	-	•	-	-	-	Translucent	1.10	39	7	600	40	-
Silopren LSR 2759	-	•	-	-	-	Translucent	1.10	53	7.5	430	46	-
<b>Self-Bonding / Self-Lubricating</b>												
Silopren LSR 2725/40	-	-	-	-	-	Translucent	1.11	42	7	530	34	-

Typical physical properties are average data and are not to be used as or to develop product specifications.

All LSR grades are platinum cured materials which are mixed in a 1:1 ratio by weight

a Based on listing of ingredients in the BfR recommendation XV "Silicones".

a1 Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BfR XV.

b Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

b1 It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

c Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP.3.1.9.

d Based on testing conducted on a representative sample of the product, as per the requirements of KTW and W270. Please contact the Product Regulatory Group for details.

1 Measured without postcuring, 22 h at 150 °C.

• = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

Additional information may be contained on the technical datasheet.

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# Liquid Silicone Rubber Grades Fluorosilicones

Product Name	BfR <sup>a</sup>	FDA Indirect Food Contact <sup>b</sup>	European Pharmacopoeia <sup>c</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression Set % (post-cured)
Fluorinated LSR										
FSL 7641	-	-	-	Translucent	1.23	40	6	500	20	17
FSL 7651	-	-	-	Translucent	1.23	50	6	400	20	15
FSL 7661	-	-	-	Translucent	1.26	60	7	300	32	23
FSL 7586/40	-	-	-	Translucent	1.23	40	6	380	20	17

Typical physical properties are average data and are not to be used as or to develop product specifications.

All LSR grades are platinum cured materials which are mixed in a 1:1 ratio by weight

<sup>a</sup> Based on listing of ingredients in the BfR recommendation XV "Silicones".

<sup>b1</sup> Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BfR XV.

<sup>b</sup> Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

<sup>b1</sup> It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

<sup>c</sup> Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP 3.1.9.

• = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

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# Liquid Silicone Rubber Grades High Voltage Industry

Product Name	Platinum	Tracking Resistance kV	Mix ratio by weight	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Volume Resistivity Ωcm	Surface Resistivity Ω (0,15mm)	UL Listing UL94 V0-3mm
<b>Electrically Insulating</b>												
Electro 242-0	✓	4.5	1 : 1	Translucent	1.07	30	4	300	20	-	-	-
Electro 242-1	✓	4.5	1 : 1	Grey + Translucent	1.06	32	6	620	16	-	-	-
Electro 242-2	✓	4.5	1 : 1	Grey + Translucent	1.08	36	8	720	27	-	-	-
Electro 242-3	✓	4.5	1 : 1	Translucent	1.11	40	9	770	40	-	-	-
Electro 342-15 FR	✓	4.5	1 : 1	Grey	1.08	37	7	530	24	-	-	-
<b>Cable Accessories Cold Shrink</b>												
Electro 641	✓	4.5	1 : 1	Translucent	1.12	43	10	720	35	-	-	-
Electro 642	✓	3.5	1 : 1	Translucent	1.11	39	9	620	35	-	-	-
<b>Electrically-Conductive</b>												
LSR 2345/06	✓	-	1 : 1	Black	1.08	40	7	650	40	45	-	-
<b>Medium Voltage</b>												
Electro 240 HVI grey	✓	3.5	1 : 1	Grey	1.10	43	7	500	25	-	-	-
<b>Specialty Coatings</b>												
LSR 2345/07	✓	-	1 : 1	Black	Physical properties subject to the substrate used					-	230	-
EL 1959	-	-	1 Comp	Customized	Physical properties subject to the substrate used					-	-	-
<b>UV Electro<sup>1</sup></b>												
UV Electro 225-1	✓	3.5	100:2	Translucent	1.07	25	4.5	580	90	-	-	-
UV Electro 225-2	✓	3.5	100:2	Translucent	1.09	35	4.6	520	15	-	-	-

Typical physical properties are average data and are not to be used as or to develop product specifications.

<sup>1</sup> Laboratory Vulcanization Conditions: exposure to a Hg-(Fe-doped) middle pressure lamp for 2 min at 80 mW/cm<sup>2</sup> intensity, without further heat curing  
 • = Tested with positive results, - = Not tested; + = product is compositionally compliant

All LSR grades are platinum cured materials which are mixed in a 1:1 ratio by weight  
 • = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant  
 ✓ Denotes catalyst system

Additional information may be contained on the technical datasheet.  
 For custom opportunities, please contact your local Momentive sales representative.

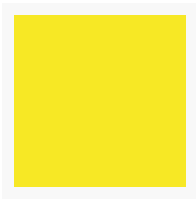
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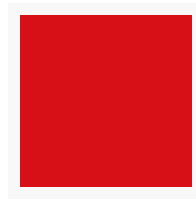
## LSR Color Pastes



**Maize Yellow**  
RAL 1007  
Pantone 130 C  
1.00 g/cm<sup>3</sup>



**Yellow**  
RAL 1016  
Pantone 604 C  
1.15 g/cm<sup>3</sup>



**Vermilion**  
RAL 2002  
Pantone 179 C  
1.02 g/cm<sup>3</sup>



**Orange New**  
RAL 2004  
Pantone 021 C  
1.03 g/cm<sup>3</sup>



**Reddish Brown**  
RAL 3011  
Pantone 484 C  
1.14 g/cm<sup>3</sup>



**Red**  
RAL 3020  
Pantone 285 C 2X  
1.02 g/cm<sup>3</sup>



**Wine Red**  
RAL 3027  
Pantone 200 C  
1.05 g/cm<sup>3</sup>



**Ultramarine Blue**  
RAL 5002  
Pantone 2738 C  
1.18 g/cm<sup>3</sup>



**Blue**  
RAL 5005  
Pantone 2945 C  
1.12 g/cm<sup>3</sup>



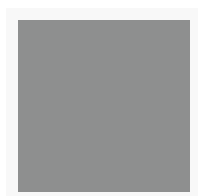
**Green**  
RAL 6010  
Pantone 364 C  
1.16 g/cm<sup>3</sup>



**Light Green**  
RAL 6032  
Pantone 356 C  
1.12 g/cm<sup>3</sup>



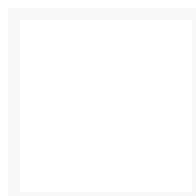
**Grey**  
RAL 7000  
1.11 g/cm<sup>3</sup>



**Light Grey**  
RAL 7040  
1.14 g/cm<sup>3</sup>



**Brown**  
RAL 8011  
Pantone 469 C  
1.10 g/cm<sup>3</sup>



**White**  
RAL 9010  
1.18 g/cm<sup>3</sup>



**Black**  
RAL 9005  
Pantone 4 C 2X  
0.98 g/cm<sup>3</sup>

Color pastes are available to pigment addition cure products such as LSRs. The recommended quantity of color to add is 0.5% to 2%, depending on the desired depth of color. The use of Momentive's color additives should not affect the performance properties of our products.

The UV Curing Silicone Rubbers from Momentive can be colored with most of the standard colors. In most cases the curing time is extended compared to the transparent silicone rubbers. Please contact our technical experts for more information.

Typical physical properties are average data and are not to be used as or to develop specifications.

# LSR: General Overview

LSR and LIM\* liquid silicone rubbers are two-component liquid silicone compounds used to produce elastic parts by chemical reaction during injection molding. Ready-for-use mixtures (components A and B) are fed directly to an injection-molding machine by means of multi-component meter-mix units.

While grade dependant, the addition cure, cross-linking silicone rubber typically vulcanizes within seconds at mold temperatures ranging from 140-230 °C. Short vulcanization times and ease of de-molding can enable automated production of a large number of articles per unit time. LSR and LIM liquid silicone rubber materials are distinguished by the following properties:

- Fast cure cycles can offer excellent productivity
- Deep and thin-section cure capability
- Low to no flash produced

## Processing

LSR and LIM liquid silicone rubbers are supplied in the form of ready-to-use components (part A and part B). Equal amounts of the two components are transferred by a multi-component metering machine from the original containers to a static mixer.

Color paste can be fed into the system as an additional component. From the static mixer, the mixture passes into the injection-molding machine and is then injected into the heated mold. The mixture vulcanizes to form a cured silicone rubber, typically within a few seconds at temperatures of 140-230 °C, depending on the grade. To prevent premature vulcanization of liquid silicone rubber in the nozzle and cylinder, these are chilled with water to a temperature of about 20 °C.

## Dosing

The components are conveyed to the mixing chamber by hydraulic piston pumps. These are sometimes connected by an interlocking system that ensures a 1:1 feed ratio. The proper mix ratio can be maintained even if the components differ greatly in viscosity.

Regulators that measure the pressure and volume flow of the components control the flow of the material between the metering device and mixing chamber. Vertically adjustable end switches on the cylinders of the drum press switch off the machine when drums are empty, preventing the sucking of air into the piston pumps.

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## Injection pressure

An injection pressure of 50 to 150 bars (specific) is normally sufficient for liquid silicone rubber. The pressure is dependent on the cross-section of the feed channel.

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## Injection into the mold

The un-vulcanized material is subjected to differing shear forces during processing. The shear forces are:

- Small at the pumping stage
- Moderate in the static mixer and screw
- High at the injection stage

---

## Holding pressure

As the injected material is heated to a high temperature, it tries to swell and force its way back through the injection nozzle. To prevent this, the nozzle is held in the forward position under a holding pressure of about 50 bars until the material in the region of the gate has started to cure.

---

## Shrinkage

In dimensioning molds, the linear shrinkage must be taken into account. The following shrinkage values were determined for 2 mm thick LSR 2050 test specimens vulcanized for 10 seconds at 200 °C.

- Without post-cure: approximately 2.7% shrinkage.
- Post-cured: approximately 3.5% shrinkage

Typically, thinner specimens shrink more than thicker specimens. The shrinkage will be highly dependent on the temperature of the mold.

## UV Curing LSR

UV curing LSR liquid silicone rubbers are two-component liquid silicone rubber compounds (mixing ratio 100:2) to produce elastomeric parts cured by UV light.

The UV curing grades offer 'cure-on-command', which enables the manufacturer to precisely control the curing starting point. In addition, curing at low temperature (RT up to 70 °C) permits the combination of LSR and temperature-sensitive plastics or other components, e.g. electronic parts. Low curing temperatures also helps minimize shrinkage and scorch. Curing with UV light can dramatically reduce cycle time, and thus increase productivity. Even cross-sections up to 100 mm, which usually take more than 30 minutes to cure in a heat-curing process, can be cured in less than 5 minutes. All mechanical data and regulatory compliance testing are listed without post curing.

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## Post-cure

Post-cure of the material may provide an improvement in the mechanical properties of the finished part (such as compression set). The content of volatile components may also be reduced. During post-curing, it is primarily siloxane-cycles that evaporates, leading to a slight loss of weight. It is recommended to maintain a supply of fresh air into the post-curing oven to prevent the formation of flammable air/siloxane mixtures (100-130 liters of fresh air per minute per kg silicone rubber).

Appropriate post-curing of the rubber article may vary depending upon the product and application. Unless otherwise indicated, test results noted in this brochure are generally for appropriately post-cured samples. For information on recommended processing, including post-curing, please contact your local Momentive sales representative.



# Troubleshooting for LSR

Typically, issues with LSR and LIM\* liquid silicone rubber injection molding can be resolved by troubleshooting three principles of molding. Time related factors are cure time, rate of injection, mold open time, residence time in the barrel, and duration of holding pressure. Temperature related factors are mold temperature; frictional heat from the screw, gate, and runners; sprue diameters; backpressure; and frictional heating during injection. Pressure related factors are high injection and/or injection hold pressure, clamp pressure, back pressure, vents, pressure drops up to the gate, and cavity pressure.

Problem	Probable Cause	Recommended Action
Blisters Air inclusion in molding (sometimes with white edges)	Incomplete curing	Extend curing time and increase temperature.
	Insufficient molding pressure	Increase pressure.
	Injection time too long	Complete air vent of pail; adjust injection velocity.
	Injection speed is too high	Reduce injection speed.
	Uneven heating	Adjust heating unit.
Voids	Incomplete curing	Extend curing time.
	Insufficient air vent	Complete air vent of pail.
Rough surface	Air bubbles	Prevent air entrapment in injection.
Uneven color	Too high temperature of metal mold	Decrease temperature of metal mold; control temperature distribution of metal mold.
	Uneven mixing	Adjust injection velocity; check mixer.
Weld marks	Fluctuation in mixing ratio and incomplete mixing	Adjust volume mixer and injection velocity.
	Improper molding pressure	Increase pressure.
	Injection time too long	Decrease injection time.
	Poor de-aeration at fused part	Provide an air vent.
	Defective gate port	Balance the gate.
Poor luster	Incomplete curing	Extend curing time; increase temperature of metal mold.
	Rough surface of metal mold	Use polished metal mold with hard chromium plating; apply adequate mold-releasing agent.
Material is sticking to the cavity	Improper curing conditions	Extend curing time; increase temperature of metal mold.
	Defective surface condition of metal mold	Clean and/or repair metal mold.
	Uneven distribution of surface temperature	Make a thermal check of the mold; check the heating controls.
	Air is present in the piston pump	Vent the pump.
	Pressure exerted by the hydraulic pressure metering unit is too low	Equalize the pressure.
	Materials are not mixed properly (the static mixer and/or the screw are partially blocked by cured material)	Clean, or possibly replace, the mixer and/or screw.
Leak from injection nozzle	Wear and incision on injection nozzle	Check injection nozzle.
Incomplete cure	Cure inhibition	Eliminate inhibitive material.
	Improper mixing ratio	Check mixing system.
Flash formation	Cavity pressure is too high	(a) Reduce injection speed and/or injection or holding pressure; or (b) Optimize the changeover from injection pressure to holding pressure.
	Locking pressure is too low	Ensure proper closing of the cavities; use a larger machine.
	Mold design is imprecise	Redesign the mold more precisely.
	Mold tolerance is too high	Modify the mold.

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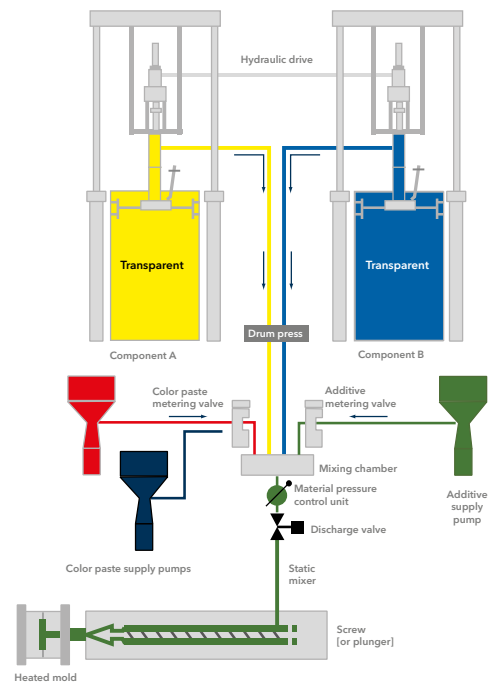
# Performance Data for LSR Materials

## Two-shot molding:

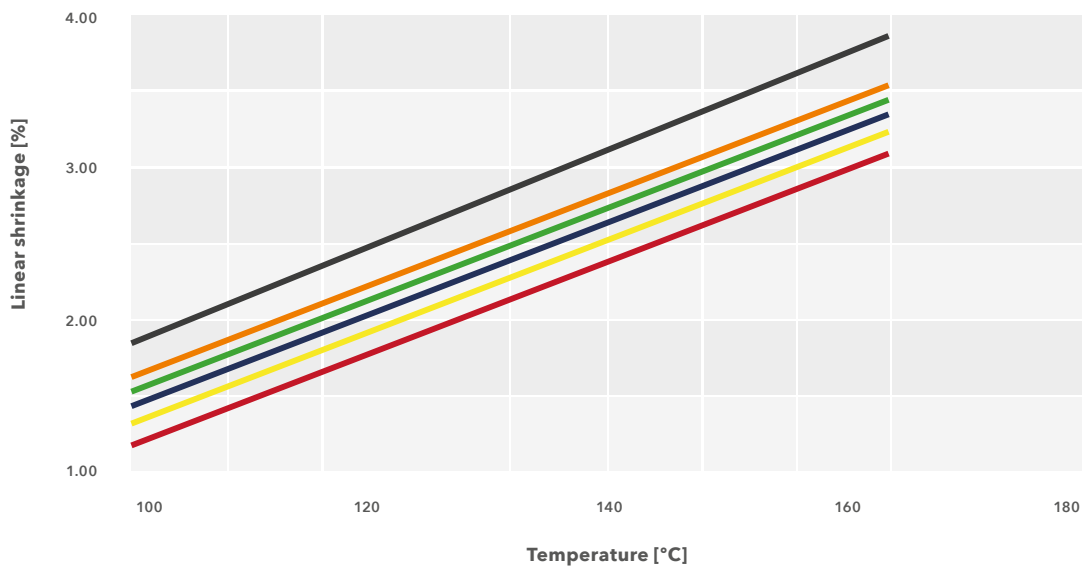
The plastic part and silicone section are molded in the same injection-molding machine with two injection units. This method can be used when:

- Higher production lots (production should be high enough to utilize the equipment) are run
- LSR (liquid silicone rubber) injection and thermoplastic injection can be done in the same cycle
- Lower probability of rejects is needed

Mixing/metering devices and injection molding machine



## Linear Shrinkage of Silopren\* LSR



Cavity pressure

— 1 bar

— 80 Bar

— 100 bar

— 120 bar

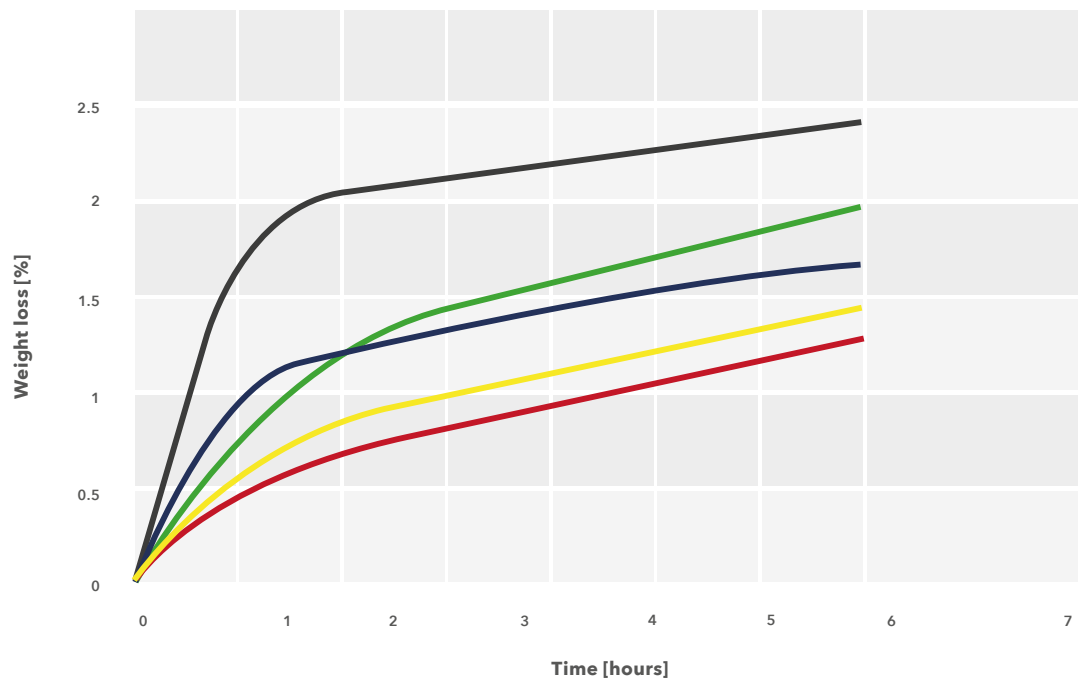
— 150 bar

— 200 bar

Note: Test data. Actual results may vary.

\*Trademark of Momentive Performance Materials Inc. or its affiliates.

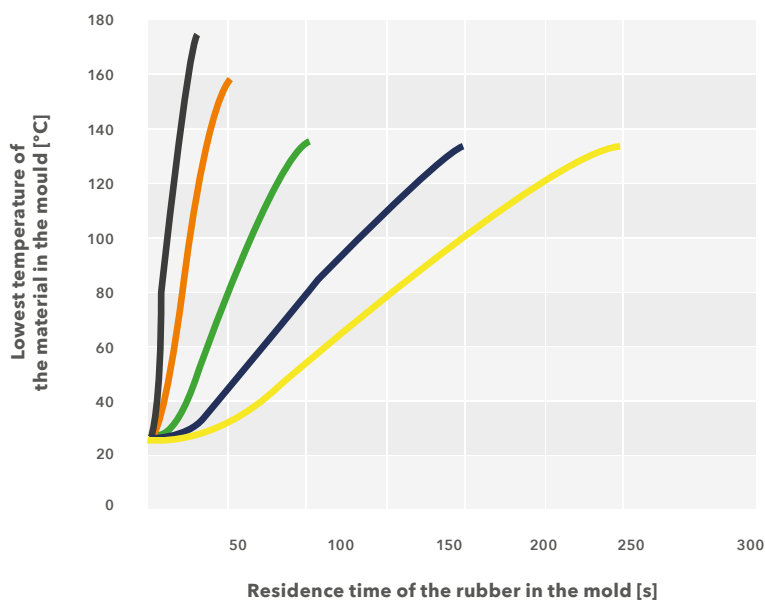
## Weight loss under varying post-cure conditions



— 200 °C / 2 mm     — 225 °C / 2 mm     — 250 °C / 2 mm  
— 200 °C / 6 mm     — 225 °C / 6 mm     — 250 °C / 6 mm

Note: Test data. Actual results may vary.

Effect of the thickness of the part of residence time using Silopren<sup>\*</sup> LSR 2040 as an example; mold temperature 200 °C, injection temperature of the compound 25 °C



Note: Test data. Actual results may vary.

— 4 mm     — 6 mm     — 10 mm     — 14 mm     — 18 mm

Note: Test data. Actual results may vary.

<sup>\*</sup>Trademark of Momentive Performance Materials Inc. or its affiliates.

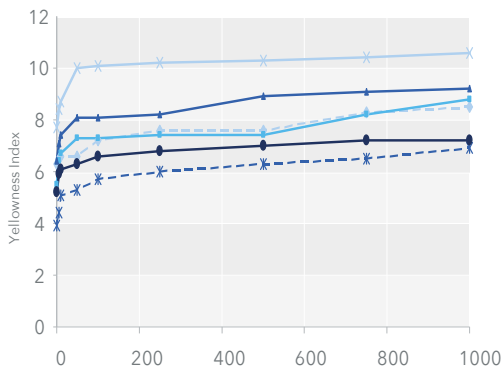
# Sterilization Performance

The strength of the silicone-oxygen backbone leads to high thermal stability of silicone elastomers. Due to this property, silicone elastomers are excellent candidates for products and applications requiring sterilization, whether by steam autoclave, ETO, or gamma radiation. These charts depict the performance of a sampling of our products after exposure to sterilization.

## Conditions

ETO concentration	600 mg/L	Chamber Temperature	54.4 °C
ETO pressure	26.6 psia	Exposure Time	2h
Pre-humidification time at 60% RH	30 min	Post vacuum	1.45 psia
Pre-vacuum	1.5 psia	Air washes	3

Sterilization resistance at 121 °C  
Yellowness Index - LSR



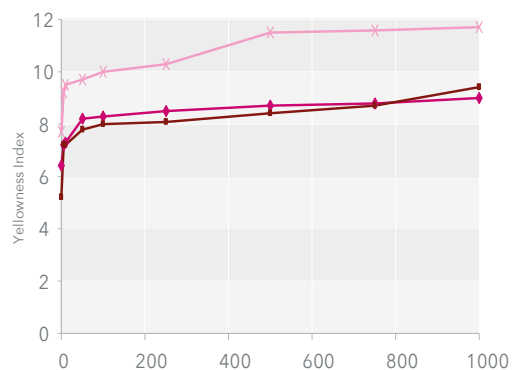
Autoclave Cycles

- ×— Silopren\* LSR 2070
- ◆— Silopren LSR 2070 Top Coat
- Silopren LSR 4050
- ▲— Silopren LSR 2040
- \*— Silopren LSR 2040 Blue
- LIM\* 6010

In most cases yellowing will occur during the first 100 cycles, independent of grades used.

Note: Test data. Actual results may vary.

Sterilization resistance at 134 °C  
Yellowness Index - LSR



Autoclave Cycles

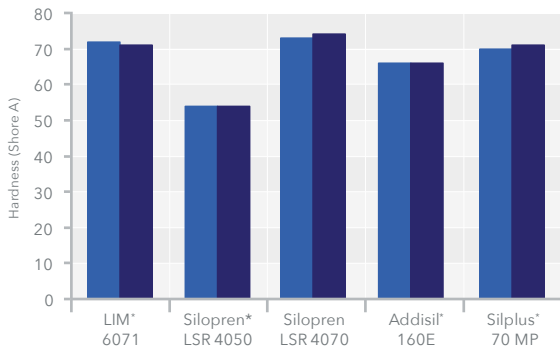
- ×— Silopren LSR 2070
- ◆— Silopren LSR 2040
- LIM 6010

In most cases yellowing will occur during the first 100 cycles, independent of grades used. Yellowing at 134 °C is slightly higher compared to sterilization at 121 °C.

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# Effects of ETO Sterilization

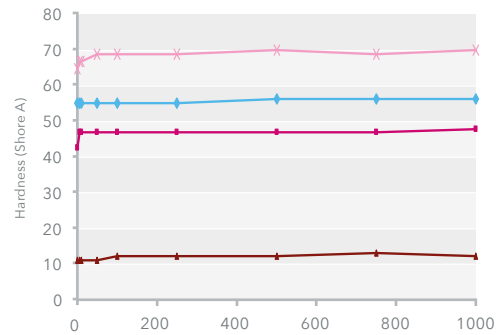
ETO Sterilization resistance<sup>1</sup> Hardness



<sup>1</sup> Exposure to ethylene oxide 30 minutes at 54,4 °C, 600 mg/l

After ETO exposure, minor changes were measured vs. baseline values.

Sterilization resistance at 134 °C Shore A Hardness - LSR

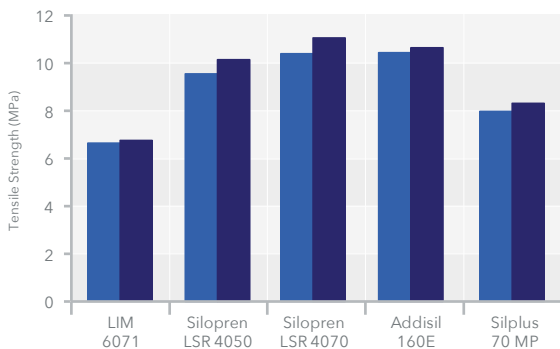


Autoclave Cycles

No significant impact on hardness, independent of hardness level.

✖ Silopren LSR 2070  
◆ Silopren LSR 4050  
◆ Silopren LSR 2040  
◆ LIM 6010

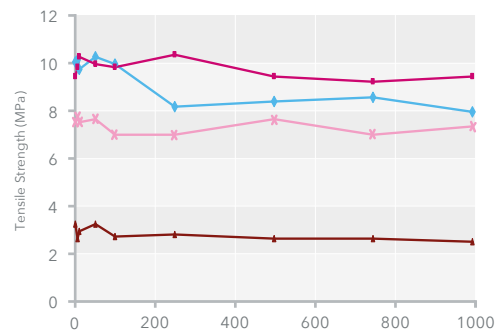
ETO Sterilization resistance<sup>1</sup> Tensile Strength



<sup>1</sup> Exposure to ethylene oxide 30 minutes at 54,4 °C, 600 mg/l

After ETO exposure, minor changes were measured vs. baseline values.

Sterilization resistance at 134 °C Tensile Strength - LSR

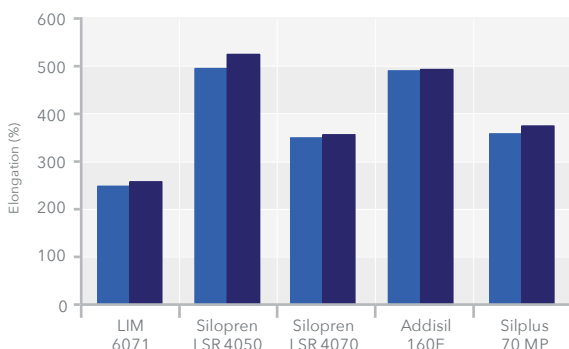


Autoclave Cycles

All LIM grades show a stable performance in terms of tensile strength. (initial fluctuations due to post curing effect)

✖ Silopren LSR 2070  
◆ Silopren LSR 4050  
◆ Silopren LSR 2040  
◆ LIM 6010

ETO Sterilization resistance<sup>1</sup> Elongation

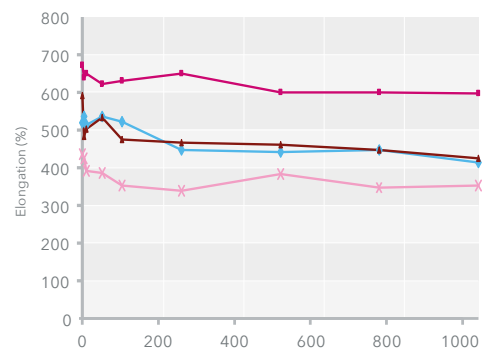


<sup>1</sup> Exposure to ethylene oxide 30 minutes at 54,4 °C, 600 mg/l

After ETO exposure, minor changes were measured vs. baseline values.

Note: Test data. Actual results may vary.

Sterilization resistance at 134 °C Elongation - LSR



Autoclave Cycles

At 134 °C, a slight reduction of Elongation over time can be observed. (initial fluctuations due to post curing effect)

✖ Silopren LSR 2070  
◆ Silopren LSR 4050  
◆ Silopren LSR 2040  
◆ LIM 6010





# Heat Cured Rubber (HCR)

Our HCR portfolio includes both peroxide and platinum (addition/heat) curable silicone elastomers. Typical processes include extrusion, calendaring and molding (injection, compression, transfer). Momentive provides base materials and ready-to-use compounds.

This family of products offers:

- Enhanced mechanical performance
- High clarity
- Low hysteresis and high resilience coupled with low compression set for highly mechanical operations
- One component, ready-to-use options
- Broad range of durometers

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## Customized Silicones

The material you choose should fit the application. Momentive's elastomer formulation services can help you identify a material engineered to the performance, processing, and production demands unique to your requirements. Drawing from an extensive product portfolio and technical expertise, Momentive can create specialized products in a fast and flexible manner. Examples of these services include:

- Improved heat age performance
- V-0 and V-1 flame retardancy
- Customized cure/rheological profiles
- Incorporation of specialty additives such as barium sulfate for radio-opacity
- Color matching
- Tailored performance attributes
- Electrically conductive or semi-conductive formulations

# Heat Cured Rubber Grades

	20 Shore A	30 Shore A	40 Shore A	50 Shore A	60 Shore A	70 Shore A	80 Shore A	
<b>Addisil* &amp; Tufel* Addition Cure Products</b>			Addisil 140 E	Addisil 150 E	Addisil 160 E	Addisil 170 E		
Healthcare 1-Comp. Extrusion			Addisil 440 E	Addisil 450 E	Addisil 460 E	Addisil 470 E	Addisil 480 E	
Healthcare 2-Comp. Extrusion			Addisil 442 E	Addisil 452 E	Addisil 462 E	Addisil 472 E	Addisil 482 E	
Healthcare 2-Comp. Extrusion	Tufel II 94206	Tufel II 94306	Tufel II 94406	Tufel II 94506	Tufel II 94606	Tufel II 94706		
Healthcare 2-Comp. Molding	Tufel II 94205	Tufel II 94305	Tufel II 94405	Tufel II 94505	Tufel II 94605	Tufel II 94705		
Healthcare Low Hysteresis/High Resilience				Tufel II 92506	Tufel II 92656			
UV Curing 2 Comp. Extrusion		Addisil UV 130 EX		Addisil UV 250 EX	Addisil UV 260 EX	Addisil UV 270 EX		
Industrial 1-Comp. Extrusion			Addisil IND 1040 E	Addisil IND 1050 E	Addisil IND 1060 E	Addisil IND 1070 E	Addisil IND 1080 E	
Industrial 2-Comp. Extrusion			Addisil IND 2040 E	Addisil IND 2050 E	Addisil IND 2060 E	Addisil IND 2070 E	Addisil IND 2080 E	
Spark Plug Boots					AC 161 SPBK			
Molding			Available as Custom Compounds					
<b>Specialty Custom Compounds</b>								
Low Dampening			Available as Custom Compounds					
High Temperature Performance			Available as Custom Compounds					
<b>Fluorosilicones</b>								
General Purpose Low Compression Set			Available as Custom Compounds					
High Tear			Available as Custom Compounds					
Ultra Low Compr. Set			Available as Custom Compounds					
<b>Misc. Specialties</b>								
Phenyl Silicone Low Temperature			Available as Custom Compounds					
Hard Ash Cable			Available as Custom Compounds					
Flame Retardant			Available as Custom Compounds					
Anti Microbial			Available as Custom Compounds					
<b>High Voltage Insulation</b>								
Peroxide Cure System					Electro 170			
Addition Cure System					Electro 1700			
<b>Your Product Need</b>	For information on further formulations or custom compounds, please contact your local Momenive sales representative.							

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# Heat Cured Rubber Grades

	30 Shore A	40 Shore A	50 Shore A	60 Shore A	70 Shore A	80 Shore A	90 Shore A
<b>Silplus* Products</b>							
Extrusion		Silplus 40 EX		Silplus 60 EX		Silplus 80 EX	
Multiple Purpose		Silplus 40 MP	Silplus 50 MP	Silplus 60 MP	Silplus 70 MP	Silplus 80 MP	
High Strength	Silplus 30 HS	Silplus 40 HS	Silplus 50 HS	Silplus 60 HS	Silplus 70 HS	Silplus 80 HS	
Cable				Silplus 60 CW	Silplus 70 CW		
High Temperature		Silplus 40 HT			Silplus 70 HT	Silplus 80 HT	
Antistatic	Silplus 30 AS						
<b>General Purpose</b>							
General Purpose	TSE221-3U	TSE221-4U	TSE221-5U	TSE221-6U	TSE221-7U	TSE221-8U	
Translucent/Clear				TSE2267U	TSE2277U	TSE2287U	TSE2297U
<b>Specialties</b>							
Electro Conductive					XE 23-703U		
						XE 23-B2484	
Steam-Resistant				HV 6/600			
<b>Additives</b>							
Mold Release							
Flame Retardant							
Reversion Stabilizer							
Heat Stabilizer							
X-Ray, Addition Cure							
				See page 39 for the grades that are offered in your region.			

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# HCR Addition Curing Portfolio

## Healthcare

Product Name	Platinum	USP Class VI <sup>a</sup>	ISO10993 <sup>b</sup>	BFR <sup>c</sup>	FDA Indirect Food Contact <sup>d</sup>	European Pharmacopoeia <sup>e</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm
<b>Addisil* Healthcare Extrusion</b>												
140 E <sup>1</sup>	✓	•	•	•	•	•	Transparent	1.15	45	10	700	35
150 E <sup>1</sup>	✓	-	-	•	•	•	Transparent	1.15	52	10	650	36
160 E <sup>1</sup>	✓	•	•	•	•	•	Transparent	1.16	61	10.5	530	32
170 E <sup>1</sup>	✓	•	•	•	•	•	Transparent	1.20	71	9.5	470	32
440 E <sup>1</sup> /442 <sup>2</sup> E <sup>3</sup>	✓	-	•	+	•	-	Transparent	1.13	40	11.5	800	35
450 E <sup>1</sup> /452 <sup>2</sup> E <sup>3</sup>	✓	-	•	+	•	-	Transparent	1.14	50	11.5	800	43
460 E <sup>1</sup> /462 <sup>2</sup> E <sup>3</sup>	✓	-	•	+	•	•	Transparent	1.14	60	11.0	600	37
470 E <sup>1</sup> /472 <sup>2</sup> E <sup>3</sup>	✓	-	•	+	•	-	Transparent	1.17	72	10.5	500	41
480 E <sup>1</sup> /482 <sup>2</sup> E <sup>3</sup>	✓	-	•	+	•	-	Transparent	1.19	81	9.0	400	30
<b>Tufel* II Low Volatile Extrusion - Extrusion or Molding</b>												
9420X <sup>4#</sup>	✓	•	-	+	•	-	Translucent	1.07	22	8.2	1000	22
9430X <sup>4#</sup>	✓	•	-	+	-	-	Translucent	1.10	28	9.3	1050	30
9440X <sup>4#</sup>	✓	•	-	+	-	-	Translucent	1.11	43	9.6	780	40
9450X <sup>4#</sup>	✓	•	-	+	-	-	Translucent	1.15	52	9.7	880	47
9460X <sup>4#</sup>	✓	•	-	+	-	-	Translucent	1.19	62	8.6	690	46
9470X <sup>4#</sup>	✓	•	-	+	-	-	Translucent	1.22	74	9.2	580	57
<b>Tufel III Biocompatible Extrusion - Low Hysteresis / High Resilience</b>												
92506 <sup>#</sup>	✓	•	•	-	+	-	Translucent	1.12	50	7.6	500	18
92656 <sup>#</sup>	✓	•	•	-	•	-	Translucent	1.14	65	8.9	350	21
<b>Radio Opaque (X-Ray Detectability)</b>												
Addisil 60 X-Ray Detectability							White	1.2	-	-	-	-

Typical physical properties are average data and are not to be used as or to develop product specifications.

<sup>a</sup> Based upon USP Class VI testing, on a representative sample of the product, for intramuscular implantation, intracutaneous injection and systemic injection. For some products, additional testing has been conducted. Please contact the Product Regulatory Group for details.

<sup>b</sup> Based upon ISO 10993 part 6, 10, and 11 testing conducted on a representative sample of the product. For some products additional testing has been conducted. Please contact the Product Regulatory Group for details.

<sup>c</sup> Based on listing of ingredients in the BFR recommendation XV "Silicones".

<sup>c1</sup> Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BFR XV.

<sup>d</sup> Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

<sup>d1</sup> It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

<sup>e</sup> Based on testing conducted on a representative sample of a single lot of the product as per the test requirements of EP. 3.1.9.

1 One part ready-to-use compound

2 Two part Addisil, Mixing ratio of A:B 1:1

3 Based on biocompatibility testing conducted on a representative sample of an analogous product; differing results would not be expected for this product. No FDA extraction testing is available.

4 "X" equals "5" for products optimized for molding processes; "X" equals "6" for products optimized for extrusion and calendaring processes

# Available in the United States

Please contact the Product Regulatory Group for details

• = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

✓ Denotes catalyst system.

Additional information may be contained on the technical datasheet.

For custom opportunities, please contact your local Momentive sales representative.

\*Trademark of Momentive Performance Materials Inc. or its affiliates.

# HCR Addition Curing Portfolio

## Addisil\* Industrial Grades

Product Name	Platinum	BFR <sup>a</sup>	FDA Indirect Food Contact <sup>b</sup>	KTW <sup>c</sup>	WRAS <sup>d</sup>	W270 <sup>e</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm
<b>Addisil Industrial Extrusion</b>												
1040 E <sup>1</sup> /2040 E <sup>3</sup>	✓	+	+	-	•	-	Transparent	1.13	40	11	800	35
1050 E <sup>1</sup> /2050 E <sup>3</sup>	✓	+	+	-	•	-	Transparent	1.14	50	11.5	800	40
1060 E <sup>1</sup> /2060 E <sup>3</sup>	✓	+	+	•	•	•	Transparent	1.15	60	11	600	37
1070 E <sup>1</sup> /2070 E <sup>3</sup>	✓	+	+	•	•	•	Transparent	1.17	72	11	450	35
1080 E <sup>1</sup> /2080 E <sup>3</sup>	✓	+	+	•	•	•	Transparent	1.21	80	8.5	350	24
<b>Addisil Industrial Molding</b>												
1140 M <sup>4</sup>	✓	+	•	-	-	-	Translucent	1.12	42	12	950	40
1150 M <sup>4</sup>	✓	+	+	-	-	-	Translucent	1.13	50	10	650	30
1160 M <sup>4</sup>	✓	+	+	-	-	-	Translucent	1.14	58	10	680	40
1170 M <sup>4</sup>	✓	+	+	-	-	-	Translucent	1.18	70	10	630	45
1180 M <sup>4</sup>	✓	+	•	-	-	-	Translucent	1.19	79	9	580	32
<b>Addisil UV Extrusion</b>												
Addisil UV 130 EX <sup>5</sup>	✓	•	•	+	•	-	Translucent	1.10	29	12	1000	38
Addisil UV 250 EX <sup>5</sup>	✓	•	•	+	•	-	Translucent	1.16	50	12.1	920	45
Addisil UV 260 EX <sup>5</sup>	✓	•	•	+	•	-	Translucent	1.17	60	10.5	580	47
Addisil UV 270 EX <sup>5</sup>	✓	•	•	+	•	-	Translucent	1.20	66	9.6	420	29

Typical physical properties are average data and are not to be used as or to develop product specifications.

a Based on listing of ingredients in the BFR recommendation XV "Silicones".

a1 Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BFR XV.

b Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

b1 It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

c Based on testing conducted on a representative sample of the product for tubes, fittings, seals and storage systems (cold and warm water), as per the requirements of KTW, German Water regulation.

d Based on testing conducted on a representative sample of the product as per the requirements of BS 6920 (cold and hot water).

e One part ready-to-use compound.

3 Two part Addisil, Mixing ratio of A:B 1:1.

4 One part ready-to-use compound, all Addisil Industrial Molding grades can be offered as 2 part system.

5 Two part Addisil, mixing ratio of base:catalyst 100:0.5; Laboratory Vulcanization Conditions: exposure to a Hg-(Fe-doped) middle pressure lamp for 2 min at 80 mW/cm<sup>2</sup> intensity, without further heat curing.

• = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant.

✓ Denotes catalyst system

Additional information may be contained on the technical datasheet.

For custom opportunities, please contact your local Momentive sales representative.

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## HCR General Purpose

Product Name	Peroxide	UL 94HB	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm
<b>General Purpose</b>								
TSE 221-3U	✓	•	Translucent	1.08	30	4.9	450	15
TSE 221-4U	✓	•	Translucent	1.13	40	8.6	520	22
TSE 221-5U	✓	•	Translucent	1.16	50	9.1	350	23
TSE 221-6U	✓	•	Off - White	1.25	60	7.3	280	18
TSE 221-7U	✓	•	Off - White	1.31	70	6.5	230	17
TSE 221-8U	✓	•	Off - White	1.42	80	6.1	170	16
<b>High Duro Translucent</b>								
TSE 2267U	✓	-	Translucent	1.21	60	10.3	400	29
TSE 2277U	✓	•	Translucent	1.23	70	9.8	360	28
TSE 2287U	✓	-	Translucent	1.24	80	7.6	190	24
TSE 2297U	✓	-	Translucent	1.28	90	7.1	300	25

Typical physical properties are average data and are not to be used as or to develop product specifications.

- = Meets the requirements for passing the test standard, - = Not tested,
- ✓ Denotes catalyst system

Additional information may be contained on the technical datasheet.  
For custom opportunities, please contact your local Momentive sales representative

## HCR General Purpose

Product Name	Platinum	Peroxide	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Tear Strength, angle N/mm	Key Features
<b>Electro Conductive</b>										
XE23-703U	-	✓	Black	1.20	70	6	240	-	16	Vol. Res. 3 Ω·cm
XE23-B2484	-	✓	Black	1.21	75	7.2	180	-	20	Vol. Res. 2 Ω·cm
<b>High Voltage Insulating</b>										
Electro 170	-	✓	Grey	1.57	70	5.5	250	16	-	Excellent tracking and erosion resistance (1A 4.5KV); improved hydrophobicity
Electro 1700	✓	-	Grey	1.58	70	5.2	270	20	-	
<b>Steam Resistant</b>										
HV 6/600	-	ü	Translucent	1.11	62	8	230	13	-	Increased steam resistance

Typical physical properties are average data and are not to be used as or to develop product specifications.

- ✓ Denotes catalyst system

Additional information may be contained on the technical datasheet. For custom opportunities, please contact your local Momentive sales representative.

# HCR Fluorosilicones

Fluorosilicones may be considered for applications in presence of fuel, oils, blow by gas and various solvents.

Product Name	Peroxide	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm	Compression set % (post-cured)
<b>General Purpose</b>								
FSE7520	✓	White	1.36	26	7.7	550	16	15
FSE7540	✓	White	1.39	44	8.3	380	13	8
FSE7560	✓	White	1.42	62	9.2	290	18	10
FSE7570-D1	✓	Off - White	1.47	66	8.2	350	35	15
<b>High Tear Resistance</b>								
FSE7340	✓	Pale Yellow	1.43	43	11.2	500	42	8
FSE7360	✓	Pale Yellow	1.47	62	10.5	400	38	12
<b>Low Compression Set</b>								
FQE205U	✓	Pale Yellow	1.42	52	9.2	290	17	4
FQE206U	✓	Light Yellow	1.45	61	11.2	280	22	5
FQE207U	✓	Light Yellow	1.53	71	8.5	190	17	3
<b>Low Compression Set - High Strength</b>								
FQE307U	✓	Light Yellow	1.45	70	10.5	260	14	4

Typical physical properties are average data and are not to be used as or to develop product specifications.

All Fluorosilicones are available as customized ready-to-use compounds.

✓ Denotes catalyst system

Additional information may be contained on the technical datasheet.

For custom opportunities, please contact your local Momentive sales representative.

Product Name	Peroxide	BFR <sup>a</sup>	FDA Indirect Food Contact <sup>b</sup>	KTW <sup>c</sup>	WRAS <sup>d</sup>	W270 <sup>e</sup>	Appearance	Density g/cm <sup>3</sup>	Hardness/Durometer Shore A	Tensile Strength MPa	Elongation %	Tear Strength, Die B N/mm
<b>Silplus Multi Purpose</b>												
40 MP	✓	+	•	-	-	-	Translucent	1.12	40	9	700	17
50 MP	✓	+	•	-	-	-	Translucent	1.15	50	11	550	25
60 MP	✓	+	•	•	•	•	Translucent	1.16	60	11	500	28
70 MP	✓	+	•	•	•	•	Translucent	1.20	70	11	420	30
80 MP	✓	+	•	-	-	-	Translucent	1.19	78	10.5	350	22
<b>Silplus Extrusion</b>												
40 EX	✓	+	•	-	•	-	Translucent	1.14	44	11	600	24
60 EX <sup>1</sup>	✓	+	•	•	•	•	Translucent	1.19	62	11	500	25
80 EX	✓	+	•	-	•	-	Translucent	1.24	80	10	440	28
<b>Silplus Cable &amp; Wire</b>												
60 CW	✓	-	-	-	-	-	Translucent	1.20	63	11	500	24
70 CW	✓	-	-	-	-	-	Translucent	1.20	72	11	380	24
<b>Silplus High Strength</b>												
30 HS	✓	+	•	-	-	-	Translucent	1.10	30	9	1100	30
40 HS	✓	+	•	-	-	-	Translucent	1.12	40	11	1000	35
50 HS	✓	+	•	-	-	-	Translucent	1.14	50	12	750	40
60 HS	✓	+	•	-	-	-	Translucent	1.15	60	12.5	700	40
70 HS	✓	+	•	-	-	-	Translucent	1.18	70	11.5	600	45
80 HS	✓	+	•	-	-	-	Translucent	1.20	80	11	450	40
<b>Silplus High Temperature</b>												
40 HT	✓	-	-	-	-	-	Translucent	1.10	40	6.5	450	10
70 HT	✓	-	-	-	-	-	Translucent	1.22	70	10.5	400	26.5
80 HT	✓	-	-	-	-	-	Translucent	1.25	80	8	250	15
<b>Silplus Antistatic</b>												
30 AS	-	-	-	-	-	-	Translucent	1.10	30	8.7	760	21

Typical data are average data and actual values may vary. Typical data shall not be used as product specifications.

a Based on listing of ingredients in the BFR recommendation XV "Silicones".

a1 Producer of the final article needs to test and confirm that the final product meets the analytical and extractive requirements of BFR XV.

b Based on compositional compliance with the requirements of 21 CFR 177.2600 - Rubber articles intended for repeated use and have been found, through extractive testing of a representative sample, to meet the extractives limitations in 21 CFR 177.2600(e) and/or (f).

b1 It is the responsibility of the user to determine that the final product complies with the extractive limitations and other requirements of 21 CFR 177.2600 under their specific manufacturing procedures.

c Based on testing conducted on a representative sample of the product for fittings, seals and storage systems (cold and warm water), as per the requirements of KTW, German Water regulation.

d Based on testing conducted on a representative sample of the product as per the requirements of BS 6920 (cold and hot water).

e Based on testing conducted on a representative sample of the product as per the requirements of the W270, Microbiological growth test.

1 Based on biocompatibility testing conducted on a representative sample of an analogous product; differing results would not be expected for this product.

• = Meets the requirements for passing the test standard, - = Not tested, + = product is compositionally compliant

✓ Denotes catalyst system

Note: All of the aforementioned test results, are based on single lots of material. Although lot-to-lot variance would not be expected to show different test results, these data should not be construed as a warranty of fitness for use. Prior to use for any application, the user has sole responsibility for determination of the suitability and safety of any Momentive material in its end use application. Additional information may be contained on the technical datasheet.

For custom opportunities, please contact your local Momentive sales representative.

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## Additives for HCR

Typical Curing Agents for HCR				
Peroxides <sup>1</sup>	Commercial Grades	Form	Typical Molding Temperature	Recommended Use
Bis (2,4-di-chlorobenzoyl) Peroxide DCBP-50	Perkadox <sup>†</sup> PD-50S-ps-a Luperox <sup>†††</sup> CST	50% active paste	104-132 °C (220-270 °F)	Hot Air Vulcanization
Benzoyl Peroxide BP-50	Perkadox <sup>†</sup> L-50S-ps	50% active paste	116-138 °C (240-280 °F)	Molding; Steam Curing
DiCumyl Peroxide	Di-Cup <sup>††</sup> 40C Varox <sup>††††</sup> DCP-40C	40% active powder	154-177 °C (310-360 °F)	Molding Thick Sections; Bonding; Steam Curing
2,5-DiMethyl- 2,5-Di (t-butyl peroxy) Hexane DBPH	Varox <sup>††††</sup> DBPH-50 Luperox <sup>†††</sup> 101 Trigonox <sup>†</sup> 101	45%-50% active powder 92%-95% active liquid	166-182 °C (330-360 °F)	Molding Thick Sections; Bonding; Steam Curing

<sup>1</sup> Peroxide catalysts are not commercially available through Momentive.

<sup>†</sup> Trigonox is a trademark and Perkadox is a trademark of AKZO Nobel Chemical B.V.

<sup>††</sup> Di-Cup is a trademark of Geo Specialty Chemicals, Inc.

<sup>†††</sup> Luperox is a trademark of Arkema, Inc.

<sup>††††</sup> Varox is a trademark of R.T. Vanderbilt Company, Inc.

Additives for HCR				
	AMR <sup>1</sup>	EMEA <sup>2</sup>	PAC <sup>3</sup>	Key Features
Mold Release	-	VH 9	ME400-MR	Improves mold release
Flame Retardancy	SE6921FR	SE6921EUFR	ME400-FR	Flame retardant additive
Heat Age	SE6916HA	SE6916EUHA	ME400-HA1, ME400-HA3	Heat age stabilizer
Reversion Stabilizer	SE6910MO	RS56, RS75	ME400-OR	Avoids decomposition of the polymer

<sup>1</sup> Available in the American Market

<sup>2</sup> Available in Europe, Africa, Middle East and India Markets

<sup>3</sup> Available in the Pacific Market



# Silicone Rubber for High Voltage Applications (HVI)

For years now, there has been a growing tendency for these innovative materials to replace ceramic materials, such as porcelain and glass, in the field of medium and high voltage technology.

Porcelain and Glass (Ceramics) were the first materials used for high voltage insulators and have over 100 years of application history across the world. Despite this incumbent position of porcelain and glass in the market, organic polymeric materials such as EPDM and epoxy have been positioned as alternative (first in 1959 by GE) insulator materials due to higher product quality, lower maintenance cost, higher performance/properties and lower per part production cost.

As organic polymers evolved and were installed in HVI applications, it became clear that these materials showed some deficiencies in higher voltage classes. One issue in particular is polymer surface hydrophobicity. The hydrophobicity, which provides a barrier to surface electro conductivity, diminishes with time (permanently). This in turn leads to problems with the tracking resistance being limited after an electrical stress event (corona/flashover). Improving the hydrophobic and electrical properties for non-ceramic HVI materials was a central effort for R&D centers in the late 1960s and early 1970s.

At that time, silicone insulators were first tested and introduced to end users. Continued improvement in the mechanical and electrical properties of silicone materials has led to a wider acceptance and use in the industry, beginning in the early to mid 1980s.

For insulation purposes, Momentive Performance Materials has developed special silicone rubbers that are included in the Silopren\* Electro portfolio. In addition to the familiar properties of silicone rubber, these products are typically characterized by the following properties when used in the field of medium or high voltage systems.

- Outstanding hydrophobicity
- High tracking and arc resistance
- Excellent weathering, ozone and UV resistance
- Flexibility from -55 up to 180 °C with no effect on insulating properties
- No melting
- Residue consists of insulating silica
- Rubber-like aspect leaves it virtually unaffected by vandalism
- Low weight for easy transportation and installation
- With surge arrestors:  
No shattering in case of flashover

Compared broadly to ceramic products, components made of Silopren Electro are lighter and require less maintenance. They do not shatter in the event of vandalism or flashover, which can help to substantially improve safety in the vicinity of the assemblies of this kind.

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# HCR: General Overview

## Fabricating & Curing: Fabrication Methods and Curing Techniques

Silicone rubber can be fabricated by all standard methods for thermoset elastomers including compression molding, transfer molding, extrusion and calendaring. Compared to many organic elastomers, silicone is relatively easy to process and often needs no secondary post cure operations. It is an excellent candidate for detailed molding applications and provides rapid cure times and relatively low odor during fabrication. The following summarizes fabrication and curing techniques.

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## Fabrication Techniques: Compression Molding

Compression molding is a widely used method for molding silicone rubber parts. The stock is usually preformed to the approximate size and weight of the final part. It is then placed in the heated cavity of the mold, where it is cured under heat and pressure. The process is labor intensive because it is a manual process and it is necessary to remove flash, but requires the lowest investment in tooling and equipment.

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## Transfer Molding

Transfer molding is a process through which uncured rubber compound is transferred from a holding vessel (transfer pot) to the mold cavities using a hydraulically operated piston. Transfer molding is especially conducive to multicavity designs and can produce nearly flashless parts.

Older designs, using hot transfer pots, resulted in considerable cured waste. Newer designs, using water-cooled transfer pots, have significantly reduced this problem. For certain applications, transfer molding is now comparably successful to injection molding.

## Injection Molding

Silicone rubber's relatively low viscosity and fast cure rate make it an excellent material for injection molding. Although the screw can be directly fed with pre-formed strip, many prefer to use a stuffer box, which insures constant feed and minimizes handling of the uncured compound.

Injection molding cure cycles are typically in the range of 0.5 - 3 minutes, depending on part size, and mold shrinkage tends to be lower than other molding methods due to high injection pressures. Balanced gates and venting are required to avoid air entrapment and insure complete fill in multicavity molds.

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## Extrusion

Extrusion is the fabricating technique for continuous profile shapes and pre-forms such as tubing and wire and cable insulation. Standard rubber extruders with water-cooling and roller feeds can be used to fabricate silicone rubber. It is suggested that barrel construction be abrasion-resistant, surface-hardened steel, such as nitrided 4140, to minimize wear. Typically, the screw may have a compression ratio in the range of 2:1 to 4:1 and an L/D (length/diameter) ratio of 8:1 to 12:1. Deep flights in the feed section can facilitate feeding of the compound. Stainless steel screens of 40 to 150 mesh may help remove contamination, increase backpressure, reduce porosity, and provide better dimensional control. Also see Curing Methods for Extrusion below.

## UV Curing HCR

UV curing high consistency rubbers are two-component silicone rubber compounds (mixing ratio 100:0.5) to produce elastomeric parts cured by UV light.

UV curing Addisil\* UV EX products are extruded using standard silicone rubber extruders. Instead of curing in high-temperature ovens, ranging in length between 10 and 15 meters, UV curing silicone rubbers are extruded at ambient temperatures using one or two UV lamps that are less than 1 m in length. Eliminating these ovens can save energy, production costs and space. The UV curing technology enables very precise extrusion of complex profiles. The absence of heat allows green strength to increase and the avoidance of bubble formation. Even continuous co-extrusion of silicone rubber with heat sensitive parts (e.g. plastics, electronics, LEDs) becomes possible with this technology. All mechanical data and regulatory compliance testing are listed without post curing.

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## Calendering

Calendering is for producing long runs of uniformly thick sheets of silicone rubber, either unsupported or on a support backing. A standard 3 or 4-roll calender with linear speed range of 0.5 to 3 m/minute is typical for silicone rubber. Firm compound with good green strength and resistance to over-milling may work best for calendering. It is suggested that soft stocks be aged a minimum of 24 hours after milling to help build up structure prior to calendering. Unsupported sheet may be partially cured by passing over a heated drum or through a hot air vulcanization unit, and then may be post-cured in an air-circulating oven. Both supported and unsupported sheet may be cured on a roll in a steam autoclave.

## Cure Techniques: Curing Methods For Extrusion

The extruded profile may be cured by hot air vulcanization (HAV), steam vulcanization (CV) or liquid-medium cure. HAV uses a heated tunnel, through which the profile is fed continuously on a moving conveyor. Air temperature reaches 315 °C [600 °F] to 648 °C [1200 °F], and cure times are usually short, on the order of 3 to 12 seconds. The recommended curing agents are DCBP-50 or addition cure, both of which can provide rapid cure with no porosity.

Steam cure commonly refers to systems (used by the wire and cable industry) that consist of chambers 100 to 150 mm in diameter and 30 to 50 meters in length. Steam pressure varies from 3,5 to 15 bar, depending on wall thickness of the insulation and line speed. A typical cure with benzoyl peroxide is 13 seconds or 400 feet/minute at 125 psig.

For liquid-medium cure, continuous lengths of extruded profile are fed into a bath of molten material (salt or lead), which cures the extrudate. This technique requires DCBP-50 to prevent porosity.

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## Oven Curing

Oven curing or post-baking is the process of heating cured silicone rubber parts in an oven to remove volatiles and peroxide decomposition by-products and thus improve dimensional stability and high temperature performance. Oven curing is recommended for parts cured with either 2,4-dichlorobenzoyl peroxide or benzoyl peroxide, as these curing agents can release an acidic byproduct. The byproduct should be removed by post-baking the material prior to exposure to high temperatures in the end use application.

Electric and indirectly fired gas air circulating ovens have been used successfully for post-baking silicone rubber parts. It is suggested that fresh airflow be maintained at a minimum of 100 liters per minute per kg of silicone rubber. Consider supporting parts on open trays to maximize exposure. Generally, it is suggested that post-bake temperature be a minimum of 10 °C [50 °F] higher than the service temperature of the part. Sections thicker than 2mm may require a stepped post-bake (gradually increasing temperatures) to avoid sponging of the part.

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# Troubleshooting for HCR

## Molding

Problem	Probable Cause	Recommended Action
Back Rind	Flash-type molds resulting from a combination of high shrinkage, high thermal expansion and compressibility of silicone	Lower mold temperature.
		Bump press as charge heats.
		Use accurately weighed preform.
		Reduce mold pressure.
		Cool mold before opening.
Brown Spots	Entrapped air	Add masking color.
		Make sure stock is freshened properly for reasonable flow.
		Use weighed pre-form, shaped and loaded to most effectively sweep out air.
		Close mold completely, and then bump several times.
		Avoid excess release agent.
		Use an even mold temperature.
		Lower temperature if charge is heavy.
		Raise mold temperature if charge is light.
Venting of mold may be necessary.		
Gassing and Decomposition	Contamination	Check for contamination. See Brown Spots above.
Flow Marks	Some hindrance to plastic flow. This is more likely to appear on light-gauge, deep draw or highly complicated moldings.	Stock should be well freshened.
		Fast loading and closing of the mold is essential to prevent premature curing.
		Reduce the molding temperature.
		Conditions may be such that elimination of flow lines may not be possible unless process or stock is modified.
Shrinkage Variation	Variations of more than +1% can result from improper molding procedures	Check plasticity of stock.
		Check mold temperature.
		Check preform weight.
		Check molding time.
		Increase shelf age.
		Use low shrink gum base.
White Spots		Raise mold temperature.
		Increase oven temperature, time and air circulation.
		Raise mold temperature.
		Shorten storage time.
"Windows" (clear spots in a pigmented stock)		Make sure freshening is not started on tight mill rolls.
		Make sure crumbs from the mill pan are not added after the stock has been broken down.

## Troubleshooting for HCR

### Milling and Freshening

Problem	Probable Cause	Recommended Action
Lumps	Improper freshening technique	Gradually reduce mill nip during freshening.
		Lengthen milling time at original wide nip setting.
		Avoid addition of un-freshened crumbs to freshened stock.
Stickiness	Over-freshening	Shorten milling time after stock has knit on mill.
Porosity	Entrapped air due to over-freshening	Shorten milling time after stock has knit on mill.
		Pass stock through wide nip to gently squeeze out entrapped air.
Brown Spots	Entrapped air	Shorten milling time after stock has knit on mill.
		Pass stock through wide nip to gently squeeze out entrapped air.
Flow Lines	Under-freshening	Extend milling of stock after mill.
Specks in Compound	Contamination from handling and/or milling	Keep compound in closed container when in storage, both before and after freshening.
		Clean all traces of organic rubber fillers, etc., from mill pan, roll guides, etc.



# Troubleshooting for HCR

## Extrusion for Wire and Cable

Problem	Probable Cause	Recommended Action
Rough Surface	Structured compound	Freshen compound.
	Scorched compound	Check cooling water screw speed, catalyst type, etc.
	Die land too long	Maintain 1:1 land to orifice ratio.
	Surface imperfections	Polish die surface.
Wavy insulation Fluctuating Diameter	Die orifice too small or too large	Orifice should approximate desired wire diameter.
	Die land too short	Maintain 1:1 land to orifice ratio.
		Install diameter control device.
Blisters	Moisture on conductor	Preheat conductor (125-150 °C).
	Oil or other contaminant on conductor	Clean, dry and preheat conductor.
	HAV temperature too high	Reduce HAV temperature or increase extrusion speed.
	Entrapped air	Increase pressure in extruder (screens, die design).
		Apply vacuum to extruder.
Humid atmosphere	Minimize moisture condensation as much as possible.	
Poor Cure	HAV temperature too low	Increase HAV temperature or reduce extrusion speed.
	Catalyst level too low	Run Mooney scorch test. Compare with O.C. limits. Adjust as necessary.
	Contamination on conductor or in compound	Clean, dry and pre-heat conductor.
	Too much air circulation in HAV tunnel	Reduce air circulation.
Porosity	Wrong catalyst	Replace material.
	Entrapped air or moisture	Add more or finer mesh screens.
		Preheat conductor.
Brittle Insulation	HAV temperature too high	Reduce HAV temperature.
	Excessive dwell time in HAV	Increase production speeds.
Mis-feeding	Poor design of extruder throat	Redesign throat.
	Poor screw design	Try single-flight screw.
	Wrong preform size	Adjust preform size.
	Soft and sticky compound	Dust lightly with talc.
	Operator carelessness	
Inadequate Delivery	Misfeeding	See above.
	Poor screw design	Increase compression ratio or use deeper flight screw.
	Blocked screen packs; Compound scorching.	Change screen packs.
		Reduce backpressure and frictional heat build-up. Change to high temperature catalyst for CV cures.
	Inadequate gum space	Increase clearance between tip and die.
Adhesion to Conductor	Organic lubricant on strand	Clean conductor prior to use.
	High lead content in lead/tin alloy	Reduce lead content or use separator.
	Too high post cure	Adjust post cure temperature to conform to conductor plating.
		Bare Copper-125 °C
		Tin Copper-150 °C
		Silver Plate-200 °C
	Stainless Steel or Nickel Clad-232 °C	
Soft insulation buried into strand interstices	Reduce extrusion and curing pressure, or use separator.	



# Momentive Custom Elastomers

Custom elastomers for demanding applications

## **A leader in custom silicones**

Our rich, 75-year heritage of innovation and market firsts provides product portfolios and technical competencies that link custom technology platforms to opportunities for our customers.

Our unique portfolio of high consistency and liquid silicone rubbers is the starting point for new and creative ideas across hundreds of commercial and consumer applications such as automotive, healthcare, consumer goods and more. The demand for distinctive products is growing, and our materials and enabling technologies are at the frontline of innovation.

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## **Your application: unique & demanding**

### **Your schedule: short & inflexible**

The material you choose should be engineered to fit the application, not the other way around. Our custom silicone formulations can help you design a material that meets the performance, processing and production demands of your product.

Your application determines our approach to suggesting a formulation that can help meet your unique challenges.

Whether your priority is performance, manufacturability, testing, packaging, or shipping; whether your industry is healthcare, automotive, consumer goods, electrical/electronics, or aerospace, Momentive Custom Elastomers can often offer a fast, productive and simple solution.

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## Application Development

Momentive is a leading innovator. We understand application development. Our customers can build upon our world-renowned resources and expertise through the ancillary Momentive Customer Application Development Center, which offers tools such as:

- Injection molding machines for prototyping and short runs
- Tabletop pumping units
- Silplus\*, Silopren\*, Addisil\* elastomers
- LSR molds
- Custom mixers
- Compression/stress relaxation

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## Your Custom Solution: Within Days

Within 24 hours of your request, you can typically expect a response from a professional Momentive technical staff member.

Momentive offers a proprietary portfolio of high-performance custom elastomers to meet your needs quickly.

Global Custom Facilities:

- Garrett, Ind., U.S.
- Chino, Calif., U.S.
- Itatiba, Brazil
- Lostock, England
- Nantong, China
- Chennai, India

## Testing in Well-equipped Facilities

After collecting a detailed work order, Momentive's technical staff can quickly help you identify optimal base compounds facilitate formulation of a potential custom solution, conduct trial runs and review whether the material meets critical performance attributes, such as durometer, viscosity, tear strength and density.

Other considerations include biocompatibility, conformance to regulation, electrical properties, heat aging, modulus, tackiness and elongation.

Our manufacturing operations are in compliance with ISO9001. We produce materials that comply with ASTM, AMS, MIL, UL, USP Class VI, ISO10993, Eur. Pharmacopeia 3.1.9, NSF and A-A59588, BS6853, NF F 16-101, BfR, KTW, W270, WRAS BS 6920, DIN 4102 Part 12, NFC 32070, BS 6387 requirements.

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## Packaging and Shipping

We work with you to deliver a compound that fits your fabrication equipment. To minimize handling at your fabrication operation, Momentive Custom Elastomers can be shaped into dozens of standard dimensions. Options include preformed pellets with tolerances of 0.2 grams, logs with diameters to 8-in, pig, wigwag, coil strip, or sheet.

Our packaging and labeling options are diverse and designed to help minimize handling and waste at your facility. From syringes to special boxes, we are committed to working with you to identify a material solution that helps meet your performance needs and helps satisfy your packaging requirements.

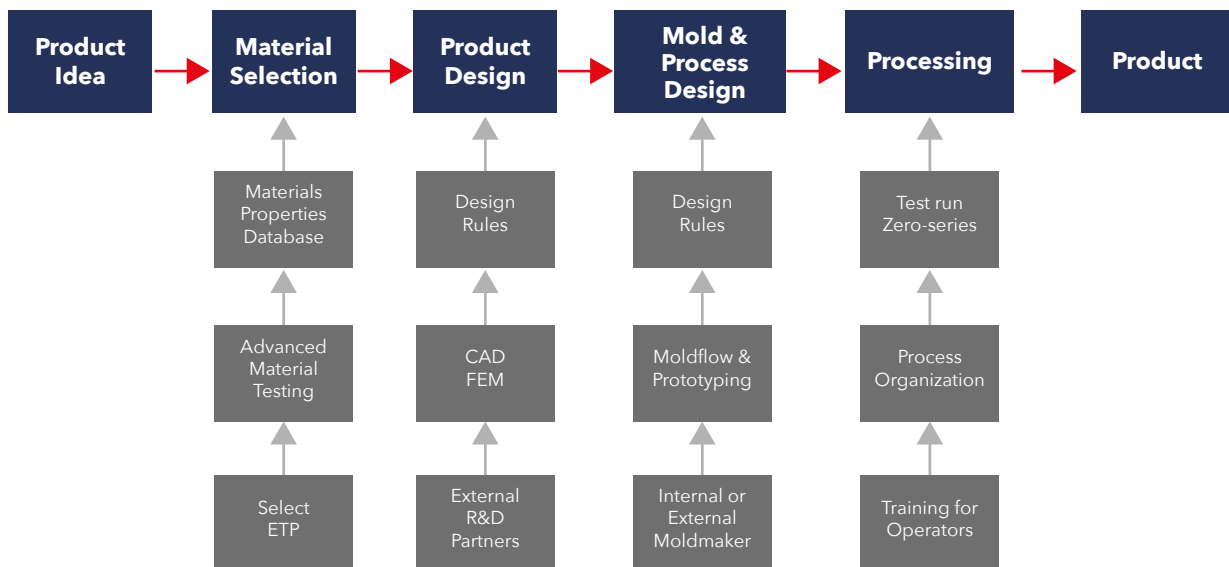
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## Application Development Center (ADC)

Our ADC provides state-of-the-art technical and managerial support. This center works in a worldwide network furnishing Momentive Performance Materials customers with the best equipment, tools and technical advice available in their industries, including process modeling, prototyping, productivity analysis and troubleshooting.

This information will help you understand the newest LSR Technology for supporting ongoing and new projects, especially in the high voltage industries.

Our support already starts at the early beginning of the project: the idea! We can offer at any stage of your ongoing projects the right support from our global experience. After advanced material selections, we like to help fix the product design as well as mold and process setup. We can deliver prototypes as well, and we continue to support when production has started.



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#### Product Safety, Handling and Storage

Customers should review the latest Safety Data Sheet (SDS) and label for product safety information, safe handling instructions, personal protective equipment if necessary, emergency service contact information, and any special storage conditions required for safety. Momentive Performance Materials (MPM) maintains an around-the-clock emergency service for its products. SDS are available at [www.momentive.com](http://www.momentive.com) or, upon request, from any MPM representative. For product storage and handling procedures to maintain the product quality within our stated specifications, please review Certificates of Analysis, which are available in the Order Center. Use of other materials in conjunction with MPM products (for example, primers) may require additional precautions. Please review and follow the safety information provided by the manufacturer of such other materials.

#### Limitations

Customers must evaluate Momentive Performance Materials products and make their own determination as to fitness of use in their particular applications.

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