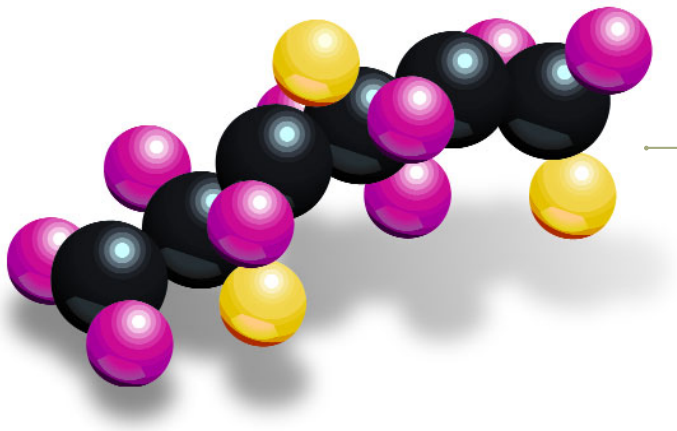
Section 3
Elastomers/Materials

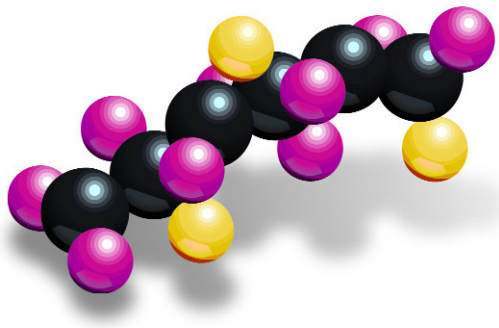


Elastomers/Materials

Chemical Terms, Abbreviations and Trade Names

Chemical Term	ASTM Designated Abbreviation	Polymer Trade Names
Acrylonitrile Butadiene	NBR, XNBR	Nipol®, Krynac®, Paracril®
Chlorinated Polyethylene	CM	Tyrin®
Chlorosulfonated Polyethylene	CSM	Hypalon®
Epichlorohydrin	CO, ECO	Hydrin®
Ethylene Acrylic	AEM	Vamac®
Ethylene Propylene Diene Monomer	EPDM	Buna-EP®, Nordel®, Royalene®, Vistalon®
Fluorocarbon	FKM, FFKM	Dyneon Fluoroelastomer®, Viton®
Fluorosilicone	FVMQ	
Highly Saturated Nitrile	HNBR	Therban®, Zetpol®
Isobutylene Isoprene	IIR / XIIR	Butyl
Polyacrylate	ACM	HyTemp®
Polybutadiene	BR	Budene®, Taktene®
Polychloroprene	CR	Neoprene, Baypren®
Polyisoprene:		
■ **Natural**	NR	SMR®, Pale Crepe, Smoked Sheet,
■ **Synthetic**	IR	Natsyn®
Silicone	VMQ, PMQ, PVMQ	Silastic®, Elastosil®
Styrene Butadiene	SBR	Plioflex®, Stereon®
Urethane (Polyester or Polyether)	AU or EU	Adiprene®, Millathane®, Vibrathane®

Polymer Types



Acrylonitrile / Butadiene (NBR)

NBR, Buna-N, and nitrile all represent the same elastomer based on a butadiene and acrylonitrile copolymer. Nitrile is inherently resistant to hydraulic fluids, lubricating oils, transmission fluids and other non-polar petroleum based products due to the polar structure of this elastomer. Nitriles are also resistant to air and water environments.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F IRM 903
366Y	70	14.1	2050	320	-4	+10
525K	70	17.2	2500	330	-1	+16
431T	70	14.6	2100	340	-13	-5
523HW	70	13.8	2000	330	-9	+19
372FX	50	10.0	1450	400	-10	+20

Utilizing the variety of nitrile polymers and compounding ingredients, Minnesota Rubber has derived nitrile compounds to withstand environments that require low compression set, abrasion resistance, low temperature flex, gas permeation resistance, ozone resistance and/or stress-stain properties.

By hydrogenation, carboxylic acid addition, or PVC blending, the nitrile polymer can meet a broader range of physical or chemical requirements.

Compound 366Y

- Excellent petroleum fluid and water resistance
- Outstanding oil resistance to aniline point oils of 130°F to 255°F (55°C to 124°C)
- Good compression set resistance

Compound 372FX

- Good oil and water resistance
- Good compression set resistance
- Low durometer and modulus
- Low temperature resistance

Compound 431 T

- Low swell to petroleum oils and fuels
- Outstanding oil resistance - aniline point oils below 130ºF (55ºC)
- Low temperature properties to -30ºF (-34ºC)
- High tensile strength and good abrasion resistance
- Good heat aging

Compound 523HW

- Excellent low temperature performance at -70ºF (-57ºC)

Compound 525K

- Excellent abrasion and wear resistance
- Good heat resistance and compression set resistance
- Frequently used for ground ball applications
- Excellent contact compatibility properties with plastics

Polymer Types-continued

Highly Saturated Nitrile (HNBR)

HNBR has been developed to withstand continuous temperatures of up to 302ºF (150ºC) while retaining resistance to petroleum oils. Obtained by hydrogenerating the nitrile copolymer, HNBR fills the gap left by NBR and FKM elastomers when high temperature conditions require high tensile strength while maintaining excellent resistance to motor oil, ATF, sour gas, amine/oil mixtures, oxidized fuels and lubricating oils

Compound	Hardness Shore A	Tensile		Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F	
		MPa	psi		ASTM #1	IRM 903
574GY	70	15.2	2200	250	+1	+18

Compound 574GY

- Saturated nitrile compound
- High temperature operations to 300ºF (150ºC)
- Excellent oil and fuel resistance

Nitrile/PVC Resin Blends (NBR/PVC)

PVC resins are blended with nitrile polymers to provide increased resistance to ozone and abrasion. The PVC also provides a significant improvement in solvent resistance yet maintains similar chemical and physical properties, commonly noted among nitrile elastomers. In non-black compounds the addition of the PVC resins also provides a greater pigment-carrying capacity that allows better retention of pastel and bright colors.

Compound	Hardness Shore A	Tensile		Elongation (%)
		MPa	psi	
567A	60	13.8	2000	400
567FG	65	17.2	2500	500
567B	80	10.0	1455	400
477B	90	14.5	2100	150

Fluorocarbon (FKM)

Fluorocarbon elastomers are highly fluorinated, carbon backboned polymers used in applications to resist harsh chemical and ozone attack with a thermal stability to 500°F (262°C). Fluorocarbons also offer low compression set and excellent aging characteristics. FKM elastomers provide excellent service in oil, gasoline, hydraulic fluids, hydrocarbon solvents and extended fuels.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F IRM 903	Fuel Aging Volume Swell (Change %) 70hr at 23°C/73°F Ref fuel B	Fuel Aging Volume Swell (Change %) 70hr at 23°C/73°F Ref fuel C
514QN	55	6.9	1000	300	+0	+3	+4	+9
514WT	60	8.3	1200	280	+2	+4	+2	+6
514AD	70	10.3	1500	200	+1	+4	+2	+3
514AQ	80	11.4	1650	180	+2	+4	+2	+4
514VN	90	10.3	1500	160	+2	+3	+2	+4
514GJ	70	14.5	2100	250	+0	+3	+2	+2
514TS	70	12.4	1800	150	+1	+2	+6	+8
514VJ	75	11.0	1600	120	0	+2	+4	-
514UE	80	11.0	1600	200	-	-	-	-

The fluorine on the elastomer backbone provides the relative inertness of FKM elastomer. Generally speaking, with increasing fluorine content, resistance to chemical attack is improved while low temperature characteristics are diminished. There are, however, a few specialty grade fluorocarbons that can provide high fluorine content with low temperature properties.

Compound 514GJ

- Superior fluid resistance as compared to general purpose fluorocarbons
- Excellent performance with herbicides, pesticides, gasoline and alcohol extended fuels

Compound 514VJ

- Provides the best low temperature flexibility for -40°F (-40°C)

Perfluoroelastomers (FFKM, see page 3-20)

Compound 514QN, 514WT, 514AD, 514AQ, 514VN

- Minnesota Rubber's general purpose FKM compound series
- Hardness range 55-90 Shore A
- Outstanding corrosive fluid resistance
- Low compression set
- Excellent seal compounds
- Low outgassing

Compound 514TS

- Low temperature service FKM -40°F (-40°C)
- Excellent extended fluid resistance and general fluids resistance

Compound 514UE

- A very chemically resistant fluorocarbon material
- Exhibits broad resistance to bases, amines, and polar solvents

Polymer Types-continued

Ethylene Propylene Diene Monomer (EPDM)

EPDM elastomers provide excellent resistance to heat, water, steam, ozone and UV light (color stability) while providing very good low temperature flexibility properties. These compounds also withstand the affects of brake fluids, alkali, mild acidic and oxygenated solvent environments. EPDM compounds are not recommended for gasoline, petroleum oil and greases, and hydrocarbon solvent environments.

EPDM's are very effective for outdoor functions requiring long term weathering properties. EPDM elastomers are also suitable for use in hot water and steam environments. EPDM's are especially suited to high temperature brake fluid applications.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
559N	70	12.4	1800	320
560CD	60	14.5	2100	250
560CF	60	11.0	1600	200
560ND	70	14.5	2100	220
559PE	70	12.4	1800	135
560VH	80	13.1	1900	190
560YH	70	13.8	2000	200
559GT	90	12.4	1800	100

Compound 559N

- Specially formulated for steam and hot water applications
- Extremely low volume swell in water
- Good tensile strength and compression set properties
- A good general purpose EPDM elastomer

Compound 560CD

- Excellent tensile strength and flex fatigue resistance
- Temperature operation up to 302ºF (150ºC)

Compound 560ND

- Tailored for use in automotive brake applications
- Exceptional resistance to brake fluid
- Outstanding temperature and compression set resistance
- Superior low temperature properties

Compound 559PE, 559GT

- Exceptionally good in chloraminated and chlorinated water. Very low compression set. NSF, KTW, and WRAS certified.
- Certified throughout the world for drinking water contact including: NSF, WRAS, KTW and ACS.

Compound 560VH, 560CF

- Similar to 559N physical and chemical properties

Compound 560YH

- Low extractables – minimal taste and odor transfer to food and beverage products

Compound 558BP

- The most chloramine resistant 70 Shore A EPDM compound available world wide.

Styrene Butadiene (SBR)

Styrene butadiene is a low cost, general-purpose elastomer. Known as Buna-S, it was originally developed to replace natural rubber in tires. SBR exhibits very good flex fatigue resistance and is resistant to many polar type chemicals such as alcohols and ketones. It is also widely accepted for use in automotive brake fluids. SBR, however, is not resistant to petroleum based fluids.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
480E	70	14.5	2100	340
480DR	65	19.7	2850	340
448AP	60	15.8	2300	280
508A	50	10.3	1500	400

Compound 480E

- Good general purpose compound
- Specified for static sealing applications

Compound 480DR

- High strength
- Excellent flex and abrasion resistance

Compound 448AP

- Developed for automotive brake applications
- Upper temperature limit of 250ºF (121ºC)

Compound 508A

- Excellent weather resistant compound
- 50 Shore A hardness

Polychloroprene (CR)

Neoprene is a commercial name for polymers comprised of chloroprene. Polychloroprene's overall physical characteristics classify it as a general-purpose elastomer. Excellent aging characteristics in ozone and weather environments, along with abrasion and flex cracking resistance, justify the general-purpose categorization.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F IRM 903
486CT	70	13.0	1880	200	-2	+41
482BJ	70	18.3	2650	350	+5	+63
337Z	50	10.3	1500	500	-5	+60
323AR	60	11.0	1600	450	+1	+58
405A	80	13.8	2000	220	-2	+48
386AE	70	10.3	1500	500	+1	+84
368GF	75	20.7	3000	250	-3	+58
405DY	90	12.4	1800	100	-1	+35

Polychloroprene is alkali and acid resistant, flame retardant, and suitable for petroleum based oils. Animal and vegetable fats and greases also provide a highly stable environment for this polymer. Polychloroprene is noted for good compression set resistance, excellent flex fatigue resistance, and resistance to weather and ozone. Its excellent adhesion to metals makes polychloroprene ideal for molding with metal inserts.

Polychloroprene is not effective in aromatic and oxygenated solvent environments.

Compound 482BJ

- High tensile and tear strength
- Excellent flex fatigue resistance
- Excellent serviceability in repeated distortion applications (o-ring drive belts)
- Good for refrigerants

Compound 337Z, 323AR, 405A, 405DY

- General purpose neoprene compounds in a range of hardnesses
- Good weather, ozone, and flex fatigue resistance
- Moderate resistance to petroleum oils and chemicals

Compound 386AE

- Good electrical resistance properties

Compound 368GF

- Excellent flex characteristics
- Excellent impeller compound

Compound 486CT

- Excellent aging characteristics
- Proven in a variety of gasket and washer applications

Isobutylene Isoprene Rubber (IIR)

Butyl is a common term used for the isobutylene isoprene elastomer. As the name implies, butyl is comprised of isobutylene with a small amount of isoprene. It is known for its excellent resistance to water, steam, alkalis, and oxygenated solvents. Another outstanding characteristic is low gas permeation. Butyl is capable of providing high-energy absorption (dampening) and good hot tear strength.

Good resistance to heat, abrasion, oxygen, ozone and sunlight are dependent upon the butyl polymer saturation level. Butyl however, displays poor resistance to petroleum oil, gasoline and hydrocarbon solvents.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
359CY	50	11.0	1600	650
359DQ	60	8.3	1200	400
501C	70	13.8	2000	320
359DN	80	8.3	1200	370
487KC	40	9.0	1300	850
487KD	50	9.0	1300	650
487KE	60	9.7	1400	420
487KF	70	8.3	1200	300

Compounds 487KC, 487KD, 487KE, 487KF

- Very low outgassing
- Excellent vibration dampening compounds
- Low extractables

Compounds 359CY, 359DQ, 501C, 359DN

- Good acid and base resistance
- Weather and high temperature resistant

Polymer Types-continued

Silicones (VMQ, PMQ, PVMQ)

Extreme temperature range stability and low temperature flexibility are characteristics of silicone compounds. Silicones provide outstanding resistance to compression set, sunlight, ozone, oxygen, and moisture. They are very clean and are used in many food and medical applications because they do not impart odor or taste.

Silicone can be compounded to be electrically resistant, conductive or flame retardant.

Compound 71417C

- Minnesota Rubber's most versatile silicone compound
- Excellent compression set properties
- Heat resistance to 450ºF (232ºC)

Compound 71115B

- Recommended for diaphragms and similar dynamic parts
- Heat resistant to 450ºF (232ºC)

Compound 74115

- High strength at low temperatures
- Performs well and remains flexible to – -150ºF (101ºC)
- High tensile strength and excellent tear resistance over a wide temperature range

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
71417C	70	6.0	870	200
71115B	50	8.3	1200	420
73117A	70	4.8	700	170
74115	55	8.3	1200	450

As well as millable grade silicones, Minnesota Rubber offers Liquid Silicone Rubber (LSR) molding. The LSR process offers design, cost and end-use options that compliment and extend beyond the capabilities of millable grade materials. Minnesota Rubber offers LSR compounds with hardness from 20 to 80 Shore A in different colors.

LSR Compound (RED)	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
76112	20	6.9	1000	300
76113	30	6.9	1000	300
76114	40	8.3	1200	300
76115	50	8.3	1200	300
76116	60	8.3	1200	300
76117	70	8.3	1200	300
76118	80	6.9	1000	300

Fluorosilicone (FVMQ)

Fluorinated silicones provide chemical properties similar to those of fluorinated organic elastomers. This property provides excellent resistance to hydrocarbon fuels, petroleum oils and silicone fluids.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F IRM 903	Fuel Aging Volume Swell (Change %) 70hr at 23°C/73°F Ref fuel C
70154	40	6.9	1000	300	-1	+3	+19
70155	50	6.9	1000	450	+1	+3	+21
70156A	60	6.9	1000	170	-1	+2	+15
70157A	70	5.5	800	150	-1	+2	+19
70158A	80	6.9	1000	130	-1	+3	+20

Fluorosilicones provide a much wider operational temperature range than fluorocarbon (FKM) elastomers -70ºF to 400ºF (-57ºC to 205ºC). Many applications for fluorosilicones are in synthetic oils, gasoline and even extended fuels since its low temperature performance is much better than that of FKM's.

Compound 70154, 70155, 70156A, 70157A, 70158A

- Good oil and compression set resistance
- Low temperature operation
- Good fuel and extended (alcohol) fuel resistance

Polyacrylate (ACM)

Polyacrylate (ACM) compounds are designed to withstand high heat while retaining oil resistance. Specially designed for sulfur bearing oil applications, ACM elastomers are suitable for high temperature, differential and bearing environments. ACM elastomers are also resistant to oxidation, ozone, aliphatic solvents, sunlight, weathering and gas permeation. ACM's are capable of withstanding high temperatures up to 1302ºF (50ºC), but their low temperature properties are relatively poor.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F IRM 903
335LW	60	8.7	1300	200	-7	+7
335GA	70	10.4	1500	250	+2	+15

Compound 335LW, 335GA

- Excellent oil and ozone resistance under high heat conditions

Ethylene Acrylic (AEM)/Vamac®

Ethylene acrylic compounds provide excellent high heat aging resistance to 347ºF (175ºC) while providing good physical properties. A high degree of oil, ozone, UV, and weather resistance along with good low temperature flexibility are also ethylene acrylic attributes.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F IRM 903
572K	60	13.8	2000	450	+6	+60
572BJ	70	13.8	2000	400	+7	+60

Compound 572K, 572BJ

- Excellent vibration dampening
- Excellent heat aging characteristics
- Moderate petroleum oil resistance
- Good dynamic property retention over a wide temperature range

Chlorosulfonated Polyethylene (CSM)/Hypalon®

Chlorosulfonated polyethylene is the base polymer for CSM synthetic rubbers.

Chlorosulfonated polyethylene compounds provide excellent ozone, oxidation, sunlight (color degradation), and weather resistance. They are also capable of providing excellent resistance to alkalis and acids.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
399BN	50	16.9	2450	450
399ES	60	12.4	1800	400
399BL	70	13.8	2000	300

Compound 399BN, 399ES, 399BL

- Acid resistant, "general purpose" type elastomers
- Oil resistance similar to polychloroprene while operating at higher temperatures

Polymer Types-continued

Chloropolyethylene (CM)

CM compounds are based on the highly saturated chloropolyethylene polymer which provides outstanding resistance to ozone, weather, oil and heat. CM elastomers also have excellent flex fatigue characteristics, abrasion resistance and resistance to refrigerant chemicals at high temperatures. CM elastomers are capable of operating at temperatures from -40 to 302ºF (-40 to 150ºC) and are flame resistant.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F IRM 903
569Z	70	17.2	2500	400	+0	+48

Compound 569Z

- Excellent flex and abrasion characteristics
- A tough vibration dampening compound
- Weather, heat, and oil resistant
- Wide temperature operating range

Epichlorohydrin (ECO/CO)

ECO's are noted for their superior gas impermeability and physical properties over a wide temperature range -40ºF to 275ºF (-40ºC to 135ºC); while maintaining excellent resistance to petroleum oils. Ozone, oxidation, weathering, and sunlight resistance are other typical ECO/CO qualities.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 150°C/302°F IRM 903	Fuel Aging Volume Swell (Change %) 70hr at 23°C/73°F Ref fuel B
571AG	50	9.7	1400	400	-3	+19	+23
571P	70	11.0	1600	260	-5	+4	+15

Compound 571P, 571AG

- Excellent general purpose physical characteristics
- Good impermeability to air and nitrogen
- Good petroleum oil resistance

Polyisoprene Natural (NR) and Synthetic (IR)

Polyisoprenes, both natural (from trees) and synthetic, are noted for outstanding resilience, resistance to tear and abrasion, excellent elasticity, and flex fatigue resistance.

Polyisoprenes also have excellent tensile strength characteristics and are operable in low temperature -65ºF (-54ºC) environments. Polyisoprenes are not recommended for high heat, ozone, sunlight, petroleum, or hydrocarbon environments.

The two isoprenes differ slightly, the purity of synthetic polyisoprene provides more consistent dynamic properties with better weather resistance. Synthetic polyisoprene's lack of "tree" organics also gives a relatively odorless rubber. Natural rubber, when compared to synthetic, provides slightly better properties in tensile strength, tear resistance, compression set, and flex fatigue resistance.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)
352AP	40	10.3	1500	500
352DG	50	17.2	2500	550
352CV	60	21.1	3050	460
326W	70	17.9	2600	330

Compounds 352AP, 352DG, 352CV, 326W

- "General purpose" isoprene compounds
- Excellent tear and abrasion resistance
- Excellent vibration isolating material
- Outstanding resilience and flex fatigue resistance

Polyurethane (EU/AU)

Polyurethanes are noted for outstanding resistance to abrasion and tear. Polyurethanes provide the highest available tensile strength among all elastomers while providing good elongation characteristics. Ozone, oxidation, sunlight, weather, oil and incidental gasoline exposure are environments suited for urethane applications. Polyether based polyurethanes (EU) are directed toward low temperature flexibility applications. The polyester based polyurethanes (AU) provide improved abrasion, heat and oil swell resistance.

Polyurethanes are not recommended for alkalis, acids and oxygenated solvents. Polyester based polyurethanes are not typically recommended for hot water, steam and high humidity applications, but can be formulated to improve resistance to these properties.

Compound	Hardness Shore A	Tensile MPa	Tensile psi	Elongation (%)	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F ASTM #1	Oil Aging Volume Swell (Change %) 70hr at 100°C/212°F IRM 903
522GN	60	18.1	2530	670	-11	-7
522MD	75	22.8	3300	280	-3	+4
522FX	70	24.8	3600	320	-2	+4
522NR	90	23.4	3400	125	+4	+0
512AJ	70	24.1	3500	480	+0	+26
512AC	80	26.2	3800	430	-5	+14

Compounds 522GN, 522MD, 522FX, 522NR

- Superior tensile strength compounds
- Excellent abrasion resistance
- Low temperature operation to -40ºF (-40ºC)

Compounds 512AJ, 512AC

- Excellent tensile and elongation properties
- Low temperature properties to -70ºF (-57ºC)

Polybutadiene (BR)

Polybutadiene provides excellent low temperature flexibility (-80ºF/-62ºC) and exceptionally high resilience (bounce). Resistance to abrasion, cut growth and flex cracking are also outstanding characteristics of butadiene.

Butadiene is not an oil, gasoline or hydrocarbon solvent resistant type rubber. Minnesota Rubber uses butadiene in blending with other polymers to take advantage of the outstanding low temperature, resilience and toughness characteristics polybutadiene is noted for.

Chemical and Physical Tables

Polymer	Tensile Strength (MPa)	Tensile Modulus at 100% (MPa)	Hardness Durometer (shoreA)	Enlongation (%)	Compression Set Rating	Low Temp Range °F	Low TempRange °C	High Temp Range °F	High Temp Range °C	Heat Aging at 212°F (100°C)	Steam Resistance	Flame Resistance	Weather Resistance	Sunlight Resistance	Ozone Resistance
NBR	6.9-27.6	2.0-15	20-100	100-650	Good-Exc.	-70 to 0	-57 to -18	210 to 250	99 to 121	Good	Fair-Good	Poor	Fair-Good	Poor-Good	Fair-Good
HNBR	31.0-10.0	1.7-20.7	30-95	90-450	Good-Exc.	-50 to 0	-46 to -18	250 to 300	121 to 149	Exc.	Fair-Good	Poor	Good-Exc.	Good-Exc.	Good-Exc.
FKM	3.4-20.7	1.4-13.8	50-95	100-500	Good-Exc.	-50 to 0	-46 to -18	400 to 500	200 to 260	Exc.	Poor-Good	Good-Exc.	Exc.	Good-Exc.	Exc.
EP	2.1-24.1	0.7-20.7	30-90	100-700	Poor-Exc.	-75 to -40	-59 to -40	220 to 300	104 to 149	Good-Exc.	Exc.	Poor	Exc.	Exc.	Good-Exc.
SBR	3.4-24.1	2.1-10.3	30-100	450-600	Good-Exc.	-75 to -55	-59 to -48	210 to 250	99 to 121	Good	Fair-Good	Poor	Fair-Good	Poor	Poor
CR	3.4-27.6	0.7-20.7	15-95	100-800	Poor-Good	-70 to -30	-57 to -34	200 to 250	93 to 121	Good-Exc.	Fair-Good	Good-Exc.	Fair-Good	Good-Exc.	Good-Exc.
IIR	13.8-20.7	0.3-3.4	30-80	300-850	Poor-Good	-70 to -40	-57 to -40	250 to 300	121 to 149	Good-Exc.	Good-Exc.	Poor	Exc.	Exc.	Exc.
VMQ, Si, PMQ, PVMQ	1.4-10.3	6.2	20-90	100-900	Good-Exc.	-178 to -90	-117 to -68	400 to 500	204 to 260	Exc.	Fair-Good	Fair-Exc.	Exc.	Exc.	Exc.
FVMQ	3.4-9.7	3.1-3.4	35-80	100-480	Fair-Good	-112 to -90	-80 to -68	400 to 450	204 to 232	Exc.	Fair	Exc.	Exc.	Exc.	Exc.
ACM	8.6 17.2	0.7-10.3	40-90	100-450	Poor-Good	-30 to 0	-34 to -18	250 to 350	121 to 177	Exc.	Poor	Poor	Exc.	Good-Exc.	Good-Exc.
EA	6.9-20.7	0.7-10.3	35-95	200-650	Poor-Good	-55 to -30	-48 to -34	250 to 350	121 to 177	Exc.	Poor-Fair	Poor	Exc.	Exc.	Exc.
CSM	3-15	0.2-10	40-100	100-700	Poor-Fair	-60 to -40	-51 to -40	225 to 270	107 to 132	Good-Exc.	Poor-Good	Good-Exc.	Exc.	Exc.	Exc.
ECO	10-15	1-10	30-95	200-800	Good-Exc.	-60 to -15	-51 to -26	225 to 275	107 to 135	Good-Exc.	Fair-Good	Poor-Good	Good	Good	Good-Exc.
NR, IR	3.4-34.5	0.5-0.8	20-100	300-900	Exc.	-70 to -40	-57 to -40	180 to 220	82 to 104	Fair-Good	Fair-Good	Poor	Poor-Fair	Poor	Poor
AU, EU	6.9-69.0	0.2-34.5	10-100	250-900	Poor-Good	-65 to -40	-54 to -40	180 to 220	82 to 104	Fair-Good	Poor	Poor-Good	Exc.	Good-Exc.	Exc.

Radiation Resistance	Oxidization Resistance (AIR)	Water Resistance	Gas Permeability Rating	Odor	Taste Retention	Adhesion to Metals	Colorability	RMA Color Code	Resilience or Rebound Rating	Vibration Dampening	Flex Cracking Resistance	Tear Resistance	Abrasion Resistance	Vacuum Weight Loss
Fair-Good	Good	Good-Exc.	Fair-Exc.	Good	Fair-Good	Exc.	Exc.	Black	Good	Fair-Good	Good	Good-Exc.	Good-Exc.	Good
Fair-Good	Exc.	Exc.	Fair-Exc.	Good	Fair-Good	Exc.	Exc.	—	Good	Good-Exc.	Good	Good-Exc.	Good-Exc.	Good
Fair-Good	Exc.	Exc.	Good-Exc.	Good	Fair-Good	Good-Exc.	Good-Exc.	Brown	Fair-Exc.	Fair-Good	Good	Fair-Good	Good	Exc.
Good-Exc.	Exc.	Exc.	Fair-Good	Good	Good-Exc.	Good-Exc.	Good-Exc.	Purple	Fair-Good	Fair-Good	Good	Fair-Good	Good	Exc.
Poor-Good	Fair-Exc.	Good-Exc.	Fair	Good	Fair-Good	Exc.	Good	—	Fair-Exc.	Fair-Good	Good-Exc.	Fair-Exc.	Good-Exc.	Poor
Fair-Good	Good-Exc.	Fair-Good	Fair-Good	Fair-Good	Fair-Good	Exc.	Fair	Red	Fair-Good	Good-Exc.	Good	Good-Exc.	Good-Exc.	Fair
Poor-Good	Exc.	Good-Exc.	Good	Good	Fair-Good	Good	Good	—	Poor-Good	Exc.	Good-Exc.	Good	Fair-Good	Exc.
Poor-Good	Exc.	Exc.	Poor-Fair	Good	Good-Exc.	Good-Exc.	Exc.	Rust	Good-Exc.	Fair-Good	Poor-Good	Poor-Good	Poor-Good	Exc.
Fair-Exc.	Exc.	Exc.	Poor-Good	Good	Good	Good-Exc.	Good-Exc.	Blue	Exc.	Good	Poor-Good	Poor-Exc.	Poor	Exc.
Poor-Good	Exc.	Poor-Fair	Good-Exc.	Fair-Good	Fair-Good	Good	Good	—	Fair-Good	Good-Exc.	Fair-Good	Poor-Good	Fair-Good	Good
Good	Exc.	Good-Exc.	Exc.	Good	Fair-Good	Good	Good	—	Poor-Fair	Good	Good	Good-Exc.	Good-Exc.	Fair-Good
Poor-Good	Exc.	Good	Good-Exc.	Good	Fair-Good	Exc.	Exc.	—	Fair-Good	Fair-Good	Fair-Good	Fair-Good	Good-Exc.	Fair
Poor	Good-Exc.	Good	Exc.	Good	Good	Fair-Good	Good	—	Good	Good	Good	Fair-Exc.	Fair-Good	Good
Fair-Good	Good	Exc.	Fair-Good	Good-Exc.	Fair-Good	Exc.	Poor	—	Exc.	Good-Exc.	Exc.	Good-Exc.	Good-Exc.	Poor
Good-Exc.	Good-Exc.	Poor-Good	Good-Exc.	Exc.	Fair-Good	Exc.	Good-Exc.	—	Poor-Good	Fair-Good	Good-Exc.	Exc.	Exc.	Good

Chemical and Physical Tables-continued

Polymer	Acids (dilute)	Acids (concentrated)	Acid, Organic (dilute)	Acid, Organic (concentrated)	Alcohols (C1 thru C4)	Aldehydes (C1 thru C6)	Alkalies (dilute)	Alkalies (concentrated)	Amines	Animal & Vegetable Oils	Brake Fluid; Dot 3,4&5	Diester Oils	Esters, Alkyl Phosphate
NBR	Good	Poor-Fair	Good	Poor	Fair-Good	Poor-Fair	Good	Poor-Good	Poor	Good-Exc.	Poor	Fair-Good	Poor
HNBR	Good	Fair-Good	Good	Fair-Good	Good Exc.	Fair-Good	Good	Poor-Good	Good	Good-Exc.	Fair	Good	Poor
FKM	Good-Exc.	Good-Exc.	Fair-Good	Poor-Good-	Fair-Exc.	Poor	Fair-Good	Poor	Poor	Exc.	Poor-Fair	Good-Exc.	Poor
EP	Exc.	Exc.	Exc.	Fair-Good	Good-Exc.	Good-Exc.	Exc.	Exc.	Fair-Good	Good	Good-Exc.	Poor	Exc.
SBR	Fair-Good	Poor-Fair	Good	Poor-Good	Good	Poor-Fair	Fair-Good	Fair-Good	Poor-Good	Poor-Good	Poor-Good	Poor	Poor
CR	Exc.	Poor	Good-Exc.	Poor-Good	Exc.	Poor-Fair	Good	Poor	Poor-Good	Good	Fair	Poor	Poor
IIR	Good-Exc.	Fair-Exc.	Good	Fair-Good	Good-Exc.	Good	Good-Exc.	Good-Exc.	Good	Good-Exc.	Good	Poor-Good	Good-Exc.
VMQ, Si, PMQ, PVMQ	Fair-Good	Poor-Fair	Good	Fair	Fair-Good	Good	Poor-Fair	Poor-Exc.	Good	Good-Exc.	Good.	Poor-Fair	Good
FVMQ	Exc.	Good	Good	Fair	Fair-Exc.	Poor	Exc.	Good	Poor	Exc.	Poor	Good-Exc.	Poor-Fair
ACM	Fair	Poor-Fair	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Good	Poor	Good	Poor
EA	Good	Poor-Fair	Good-Exc.	Poor-Exc.	Good-Exc.	Fair-Good	Good-Exc.	Poor	Good	Good	Poor	Poor	Poor
CSM	Exc.	Good-Exc.	Exc.	Good	Exc.	Poor-Fair	Good-Exc.	Good-Exc.	Poor	Good	Fair	Poor	Poor
ECO	Good	Poor-Fair	Fair	Poor	Fair-Good	Poor	Fair-Good	Poor-Fair	Poor-Good	Exc.	Poor	Poor-Good	Poor
NR, IR	Fair-Exc.	Poor-Good	Good	Fair-Good	Good Exc.	Good	Fair-Exc.	Fair-Good	Poor-Fair	Poor-Good	Good	Poor	Poor
AU, EU	Fair-Good	Poor	Fair	Poor	Good	Poor	Poor-Exc.	Poor	Poor-Fair	Fair-Exc.	Poor	Poor-Good	Poor

Esters, Aryl Phosphate	Ethers	Fuel, Aliphatic Hydrocarbon	Fuel, Aromatic Hydrocarbon	Fuel, Extended (Oxygenated)	Halogenated Solvents	Ketones	Lacquer Solvents	L.P. Gases & Fuel Oils	Petroleum Aromatic-Low Aniline	Petroleum Aliphatic-High Aniline	Refrigerant Ammonia	Silicone Oils
Poor-Fair	Poor	Good-Exc.	Fair-Good	Fair-Good	Poor	Poor	Fair	Exc.	Good-Exc.	Exc.	Good	Good
Poor-Fair	Poor-Fair	Exc.	Fair-Good	Good-Exc.	Poor-Fair	Poor	Fair	Exc.	Good-Exc.	Exc.	Good	Good-Exc.
Exc.	Poor	Exc.	Exc.	Exc.	Good-Exc.	Poor	Poor	Exc.	Exc.	Exc.	Poor	Exc.
Exc.	Fair	Poor	Poor	Poor	Poor	Good-Exc.	Poor	Poor	Poor	Poor	Good	Exc.
Poor	Poor	Poor	Poor	Poor	Poor	Poor-Good	Poor	Poor	Poor	Poor	Good	Poor
Poor-Fair	Poor	Poor-Good	Poor-Fair	Fair	Poor	Poor-Fair	Poor	Good	Good	Good	Exc.	Fair-Exc.
Exc.	Poor-Fair	Poor	Poor	Poor	Poor	Poor-Exc.	Fair-Good	Poor	Poor	Poor	Good	Poor
Good	Poor	Poor-Fair	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Good	Exc.	Poor-Fair
Good-Exc.	Fair	Exc.	Good-Exc.	Exc.	Good-Exc.	Poor	Poor	Exc.	Good	Good	Exc.	Exc.
Poor	Poor-Fair	Exc.	Poor-Good	Fair-Good	Poor-Good	Poor	Poor	Good	Fair	Poor	Fair	Exc.
Poor	Poor	Good	Poor-Fair	Fair	Poor-Good	Poor	Poor	Poor	Poor	Poor	Poor-Good	Good-Exc.
Fair	Poor	Fair-Good	Fair	Fair	Poor	Poor	Poor	Good	Poor	Fair	Good	Exc.
Poor	Good	Good-Exc.	Good-Exc.	Fair-Good	Poor	Fair	Fair	Exc.	Good-Exc.	Poor	Poor	Good-Exc.
Poor	Poor	Poor	Poor	Poor	Poor	Fair-Good	Poor	Poor	Poor	Poor	Good	Good
Poor	Fair	Good-Exc.	Poor-Fair	Fair-Good	Poor-Good	Poor	Poor	Fair-Good	Good	Good	Poor	Exc.

NOTE: The chart data herein provides general elastomer base properties. In many design applications, special compounds are required. Minnesota Rubber strongly recommends MR Lab approval in such cases. Minnesota Rubber, therefore, will not be responsible for the usage of this chart in any manner.

Special Compounds and Certifications

Wear Resistant and Lubricated Compounds

There are a variety of techniques to enhance the wear resistance of a rubber component. A common technique includes the introduction of low friction fillers, such as PTFE, molybdenum disulfide or graphite into the compound during mixing. These wear resistant compounds have proven to provide longer life in applications involving frequent reciprocation.

A unique method used by Minnesota Rubber to provide friction reduction is the addition of lubrication chemicals into the elastomer mixture. These chemicals modify the surface of the part to provide an "internally lubricated" compound which greatly reduces surface friction. (See table). The mechanism of the lubricant does not affect the long-term physical properties of the rubber part. The internally lubricated compounds are designed for intermittent or slow cycling type applications. It is recommended that designs with long idle times make use of these compounds to assure minimum startup friction.

Coefficient of Friction Comparisons

Hardness Shore A	Polymer	Compound	Type	Coefficient of Friction Static	Dynamic
70	EPDM	559N	STANDARD	0.57	0.64
		560RJ	LUBRICATED	0.18	0.17
90	EPDM	559GT	STANDARD	0.55	0.54
		561NA	LUBRICATED	0.30	0.15
70	NBR	366Y	STANDARD	1.10	1.02
		366HA	LUBRICATED	0.17	0.17
70	NBR	525K	STANDARD	2.10	2.33
		525EX	LUBRICATED	0.15	0.09

F-Treat

Minnesota Rubber uses a proprietary technology to provide ultra-low friction and low stiction of FKM compounds. This process is called “F-Treat” and provides a permanent chemical modification to the surface of the elastomer, which cannot be removed. The F-Treat process has minimal effect upon the elastomer’s original and aged properties.

Static Coefficient of Friction Comparison, FKM

Hardness Shore A	Compound	Type	Coefficient of Friction Initial	After 1 hr. of loading
55	514QN	UNTREATED	1.19	5.0
		F-TREATED	0.28	0.35
70	515AJ	UNTREATED	0.92	1.3
		F-TREATED	0.37	0.43
90	514ZD	UNTREATED	0.75	1.2
		F-TREATED	0.33	0.48
70	514GJ	UNTREATED	0.76	0.92
		F-TREATED	0.37	0.42

FDA Regulations / Food & Beverage Applications

The United States Government regulates the ingredients in rubber products that are intended for use in food contact applications. The controlling agency is the Food and Drug Administration (FDA), whose guidelines are stated through the Code of Federal Regulations (CFR). The regulations covering rubber articles are contained in CFR Title 21, Chapter 1, Subchapter B, Part 177, Subpart C, and Paragraph 2600.

The FDA provides two categories for individual food types with rubber compatibility. The Class I category designates foods, including edible oils, butter, milk and milk based products and cooking oils. Rubber compounds that meet these requirements are also compliant with foods in Class II. The second category, Class II, pertains to foods that do not contain edible oils or milk products. Water, soft drinks, alcoholic beverages and other aqueous solutions are typical Class II environments. Minnesota Rubber has a large selection of compounds with physical property ranges to meet your application needs. The following table gives a listing of recommendations as a starting point.

FDA - Food, Drug and Cosmetic Act CFR 21, Chapter 1, Sub ch. B, Part 177, Subpart C, Section 177.2600

	For foods containing milk and edible oils as well as aqueous beverages		For aqueous-based foods and beverages only	
Hardness Shore A	NBR	FKM	NBR*	EP
50	536DS	-----	372FX	565CZ
60	536AB	514ZR	445A	559PN
70	536X	514YP	525K, 366Y	559PE, 560YH, 559TM
80	536AQ	514ZM	446A	559PM
90	----	514ZC	309BK	559GT

*These NBR elastomers will provide superior heat and compression set resistance as compared to the 536 series NBR elastomers.

Most Minnesota Rubber silicones meet the above requirements. The following compounds are examples of the unique features available in silicone elastomers:

71417C	General purpose; very versatile, excellent compression set properties, heat resistant.
73117A	Ultra low temperatures.
74115	High strength at low temperatures, high tensile strength.
74115C	Tear resistant and high strength for good mechanical durability.

Minnesota Rubber has also worked extensively with a wide variety of soft drinks and has data available.

UL Listed Compounds

Underwriters Laboratories® (UL) is a non-profit organization that operates laboratories to examine and test devices, systems and materials manufactured by non-affiliated industries. UL provides a rating on how these products correspond to hazards affecting part life and properties. Products that maintain UL designated safety limits are approved and given the UL trademark label.

In order for a product to carry a UL label, a series of rigorous tests must be passed annually, insuring that the product will withstand conditions beyond those normally encountered. UL has provided the elastomer industry with set standards for compounds in different working environments.

While Minnesota Rubber no longer separately certifies our compounds to individual standards, we continue to work with customers in their UL certification process by providing compliant materials.

Special Compounds and Certifications

NSF International® - Potable Water Applications (ANSI/NSF Standard 61)

NSF International is an independent third party certifier that acts as a neutral agency among the interests of business, government and the public. Products certified and carrying the NSF mark display that they have been proven safe for contacting products intended for human consumption. NSF is particularly known for its food related and potable water standards. Like the UL label, the NSF mark is given to the finished consumer product. Minnesota Rubber will assist any customer in their quest to comply with any NSF standard. Minnesota Rubber has the largest number of ANSI/NSF Standard 61 certified compounds available today. Approved material can be used in a wide variety of water applications and other NSF standards. By choosing a Standard 61 certified compound, customers realize large savings in product testing and time to certification for their product.

Minnesota Rubber ANSI/NSF Standard 61 Listed Materials. Certified materials for the water industry

Compound	Hardness Shore A	Elastomer	Agency	Water Contact Temperature	Speciality
561NY	40	EPDM	NSF	Cold (23°C)	▪ Ultra low hardness and modulus applications. ▪ High elongation.
565CZ	50	EPDM	NSF	Hot (82°C)	▪ Low hardness. ▪ High elongation. ▪ Listed in KTW recommendations.
560CF	60	EPDM	NSF	Cold (23°C)	▪ Flow controls. ▪ Intermediate hardness
560YH	70	EPDM	NSF	Hot (82°C)	▪ Low taste and odor. ▪ Low extractables.
559N	70	EPDM	NSF	Hot (82°C)	▪ Dynamic applications.
559PE	70	EPDM	NSF	Hot (82°C)	▪ Chloramine resistant. ▪ Compression set resistant. ▪ Static applications. ▪ KTW and WRc listed to BS6920.
560RJ	70	EPDM	NSF	Hot (82°C)	▪ Self-lubricating. ▪ Dynamic and static applications.
559TM	70	EPDM	NSF	Hot (82°C)	▪ Self-lubricating.
561NZ	80	EPDM	NSF	Cold (23°C)	▪ Chloramine resistant. ▪ Compression set resistant. ▪ Higher hardness and modulus applications.
561TX	80	EPDM	NSF	Cold (30°C)	▪ Self-lubricating. ▪ Chloramine resistant. ▪ Compression set resistant. ▪ Higher hardness and modulus applications.
559GT	90	EPDM	NSF	Cold (23°C)	▪ Chloramine resistant. ▪ Compression set resistant. ▪ Ultra high hardness and modulus applications. ▪ High pressure applications. ▪ KTW and WRc listed to BS6920.
366SM	70	NBR	NSF	Hot (82°C)	▪ Oil and abrasion resistant.
534HC	70	NBR	UL	Cold (23°C)	▪ Self-lubricating. ▪ Oil and abrasion resistant.
71105B	50	SIL	UL	Cold (23°C)	▪ Low hardness and modulus applications. ▪ Tear resistant.
559YU	90	EPDM	NSF	Cold (30°C)	▪ Self-lubricating. ▪ Compression set and chloramine resistant. ▪ High pressure applications.
76155	50	LSR	NSF	Cold (23°C)	▪ Low modulus and cracking pressure applications. ▪ Chloramine resistant.
558BM	70	EPDM	NSF	Cold (23°C)	▪ Self-lubricating. ▪ Wear resistant.
534DF	65	NBR	NSF	Cold (23°C)	▪ Self-lubricating. ▪ Oil and abrasion resistant.
C2528KF	70	EPDM	NSF	Cold (23°C)	▪ Green in color.
212N	70	EPDM	NSF	Hot (82°C)	▪ Chloramine resistant. ▪ Low cost alternative. } O-Rings only
210N	70	NBR	NSF	Cold (23°C)	▪ Oil resistant. ▪ Low cost alternative. } O-Rings only

Notes:
- All EPDM compounds are designed to have low water swell.
- All compounds are available in our standard o-ring and most Quad-Ring® Brand seal products.
- Most compounds are available in ground balls.
- Compound 559GT is not available in some small Quad-Ring® Brand seal sizes.

International Certifications - Potable Water

Minnesota Rubber has the most extensive domestic and international potable water certified elastomers list in the world today. Compounds 559PE (EP, 70) and 559GT (EP, 90) feature the latest in chloramine resistant technology and are certified for potable water use throughout the world.

Drinking Water

Compound	Hardness Shore A	Elastomer	
Great Britain WRAS: British std. BS6920-1990			
558BW	50	EP	For hot and cold water.
559PE	70	EP	For cold water.
559GT	90	EP	For cold water.
565LJ	80	EP	For cold water.
C2528JW	70	EP	For cold water. Color: royal blue
C2512FW	60	Butyl	For cold water. Color: orange
212N	70	EP	For hot and cold water. O-Rings only
210N	70	NBR	For hot and cold water. O-Rings only
Germany KTW:			
559PE	70	EP	
366SN	70	NBR	
565CZ	50	EP	
559GT	90	EP	
212N	70	EP	O-Rings only
210N	70	NBR	O-Rings only
France ACS:			
559PE	70	EP	
559GT	90	EP	
366SM	70	NBR	
565CZ	50	EP	
534HZ	50	NBR	
309DP	80	NBR	

Chloramines and Other Water Treatment Chemicals

For several years there has been a strong trend for water municipalities to add ammonia and chlorine to water in order to form disinfecting chloramines. It has been well documented that chloraminated water is much more aggressive to rubber products than water containing the conventional free chlorine. We also know that chloramine disinfecting will continue to increase due to the rules set forth by the U.S. EPA Safe Drinking Water Act.

Minnesota Rubber has done extensive research on formulating rubber compounds to be chloramine resistant and offer the most free chlorine and chloramine resistant elastomers available. We are recognized industry leaders in both chloramine resistant and ANSI/NSF Standard 61 certified compounds.

Minnesota Rubber is also capable of formulating compounds with specific properties that will be used in potable water systems. See the enclosed chart labeled ANSI/NSF Standard 61 Listed Materials for specific compounds to fit your needs.

Special Compounds and Certifications -continued

Perfluoroelastomers

Perfluoroelastomers, (FFKM), are fully fluorinated hydrocarbons' whose key trait is the ability to withstand exposure to almost any chemical. Minnesota Rubber has developed 70 and 80 Shore A perfluoroelastomers with high temperature performance to 450°F (230°C). Perfluoroelastomers remain flexible to 30°F (0°C).

Relative to other elastomers, perfluoroelastomers generally exhibit higher compression set values and are the most expensive of all elastomers. In addition, FFKM elastomers are difficult to process. Compression molding is most often preferred.

Properties - FFKM Compound 610B	
Tensile, (psi)	(1998)
Elongation, %	204
Modulus, 100% (psi)	(620)
Hardness, Shore A	73
Specific Gravity	2.08
Air Aged (70 hrs @ 250°C (518°F)	
Tensile, change %	-3.2%
Elongation, change %	+8.3%
Hardness change, Shore A	0
Compression Set, 70 hrs @ 200°C (392°F)	
Buttons	21
O-Rings	34

Medical and Laboratory Requirements

"Medical grade" is a term used to designate compounds that will be put to use in diagnostic devices and medical equipment. "Medical grade" compounds can be thought of as "non-contaminating" to the surrounding media.

Many elastomeric materials can be designed to be medically acceptable using the proper ingredients. Silicone elastomers are generally the first choice for a medical part. Silicone's inertness to body fluids and ability to meet USP Class VI regulations make it a very feasible medical grade material (this includes LSR). Polyisoprene is also widely used for medical grade components. Natural rubber is noted for its compatibility with insulin. Butyl, nitrile, ethylene propylene, urethane, fluorocarbon, epichlorohydrin, polychloroprene and CSM elastomers provide serviceable parts to medical applications in non-critical areas.

Although the responsibility for medical specification compliance lies with the device manufacturer, it is necessary for us to have complete details as to the media to be encountered and the environmental conditions expected when designing parts for use in medical applications. (i.e.: gases, solution, vaccines, serums, sterilization, freezing, immersion, as well as any applicable standards and cleanliness requirements.) This will enable us to accurately recommend a specific rubber formulation for the part application.

We are a type 3 (packaging) drug master file holder and maintain FDA compliant compounds.

Taste and Odor Specifications

Minnesota Rubber has considerable experience with materials that will not impart a taste or odor into products they contact. We can provide further information about these applications upon request. Minnesota Rubber currently participates in many such food/beverage and drinking water applications worldwide.

FKM Compounds for Fuel and Chemical Industries

Minnesota Rubber offers a wide range of materials to meet the needs of fuel and chemical sealing applications. These compounds include a variety of FKM (fluorocarbon) materials, some of which offer more chemical resistance, improved cold temperature performance or heat resistance.

Explanation of fuel/chemical resistance for FKM compounds		
514AD	70 duro FKM	Gasoline/Diesel Fuel
515AS	70 duro FKM	Base/Amine Resistance
514GJ	70 duro FKM	Extended Fuels
514TS	70 duro FKM	Extended Fuels/Low Temperature
514VJ	70 duro FKM	Low Temperature Resistance
514UE	80 duro FKM	*Specialty Chemicals/Blends
514UG	70 duro FKM	*Specialty Chemicals/Blends

*Specialty chemicals include these oxygenated fuel extenders and solvents, but are not limited to: MTBE, TAME, ETBE, MeOH, EtOH, MEK and Toluene.

Compound	Type	Polymer	%Fluorine	Service Temp.	Application
514AD	Dipolymer	VDF/HFP	66	-18°C to 230°C	Low cost, general, purpose chemical
515AS	Terpolymer	TFE/Propylene/VDF	59	5°C to 200°C	Base resistant FKM
514GJ	Tetrapolymer	VDF/HFP/TFE/CSM	70	-12°C to 230°C	Specialty chemical extended fuel
514TS	Tetrapolymer	VDF/PMVE/TFE/CSM	67	-27°C to 230°C	Specialty low temp., extended fuel
514BC	Tetrapolymer	TFE/VDF/VE/CSM	67	-40°C to 230°C	Specialty low temp., extended fuel
514VJ	Tetrapolymer	VDF/PMVE/TFE/CSM	66	-35°C to 230°C	Specialty low temp., general chemical
514UE	Terpolymer	TFE/PMVE/Ethylene	66	-15°C to 230°C	Ultra-specialty chemical
Kalrez®	Dipolymer	TFE/PMVE	73	0°C to 260°C	Ultra-specialty chemical

VDF - Vinylidene Fluoride, **HFP** - Hexafluoropropylene, **TFE** - Tetrafluoroethylene , **PMVE** - Perfluoro (Methyl Vinyl Ether), **CSM** - Cure Site Monomer, **VE** - Vinyl Ether

Computer Applications

Minnesota Rubber makes rubber compounds that are ideal for vibration control and "perfect sealing" component requirements of the computer industry. A number of elastomers have been designed at Minnesota Rubber that are suited to withstand varying degrees of vibration through the absorption of mechanical energy by the rubber component. Bumper pads or shock mounts and crash stops are typical components encountered.

Certain electrical areas of computer design require separation from contaminating environments. Minnesota Rubber's low outgassing and low extractable compounds, especially the 487 butyl compound series, are good choices for these applications.