4. Basic Elastomers

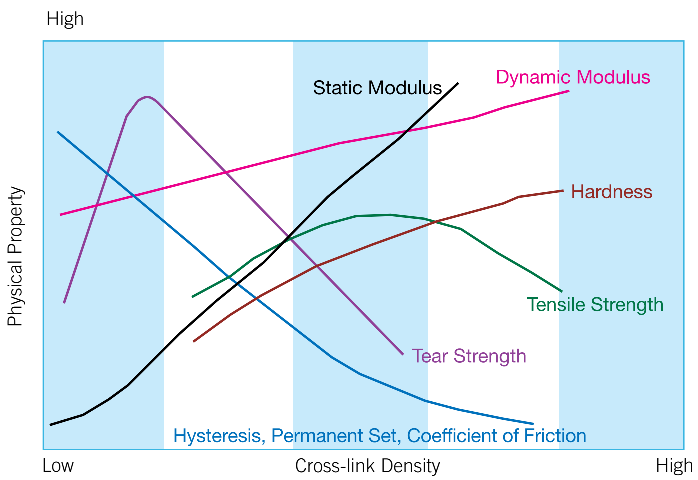
4.1. Select the elastomer

Though “elastomer” is synonymous with “rubber”, it is more formally a polymer that can be modified to a state exhibiting little plastic flow and quick or nearly complete recovery from an extending force, and upon immediate release of the stress, will return to approximately its own shape.
According to the definition of the American Society for Testing and Materials (ASTM) for the term “elastomer” it is essential that:
*An elastomer part must not break when stretched approximately 100%.
*After being stretched 100%, held for 5 minutes and then released, it must retract to within 10% of its original length within 5 minutes after release.

Resistance to the media

As used throughout this manual, the term “media” denotes the substance retained by the o-ring. It may be a liquid, a gas, or a mixture of both. It can even include powders or solids as well. The chemical effect of the media on the O-ring is of prime importance. It must not alter the operational characteristics or reduce the life expectancy of the o-ring. Excessive deterioration of the O-ring must be avoided. It is easy, however, to be misled on this point. A significant amount of volume shrinkage usually results in premature leakage of any O-ring seal, whether static or dynamic. On the other hand, a compound that swells excessively, or develops a large increase or decrease in hardness, tensile strength, or elongation, will often continue to serve well for a long time as a static seal, in spite of undesirable test results on elastomer compounds. The first step in selecting the correct material is to select an elastomer that is compatible with the chemical environment.

Relationship of Cross-link Denisity and Physical Properties



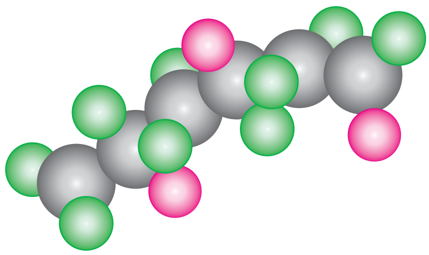
Compound

A compound is a mixture of base polymer(s) and other chemicals which form a finished rubber material. More precisely, the term ‘compound’ refers to a specific blend of ingredients tailored for particular characteristics required to optimize performance in some specific service.
The basis of compound design is selection of the polymer type. To the elastomer, the compounder may add reinforcing agents, such as carbon black, colored pigments, curing or vulcanizing agents, activators, plasticizers, accelerators, anti-oxidants or anti-radiation addiditives. There may be hundreds of such combinations.

The physics of Rubber

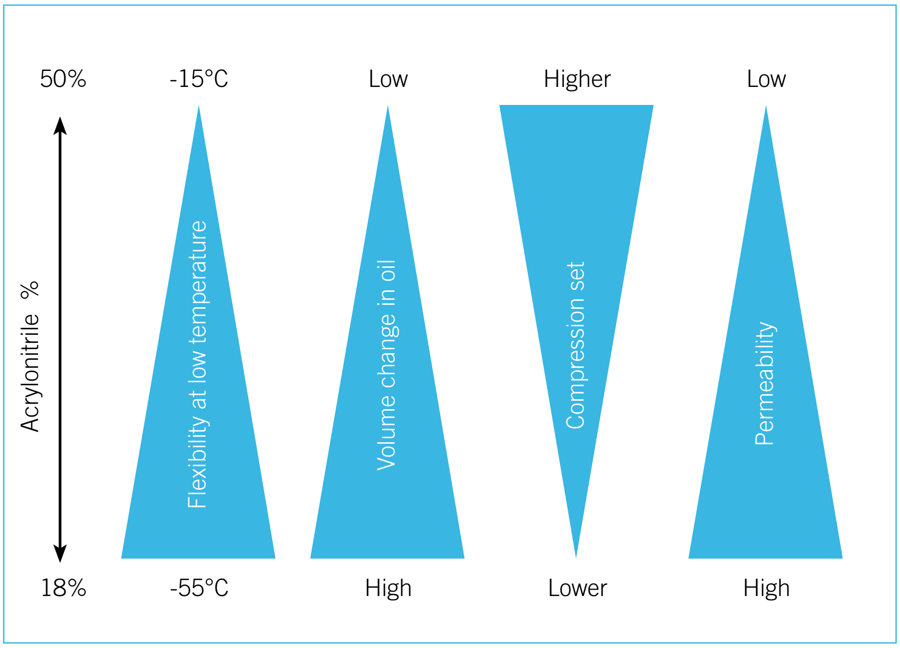
Rubber is composed of long chains of randomly oriented molecules. These long chains are subject to entanglement and cross-linking. The entanglement has a significant impact on the viscoelastic properties such as stress relaxation. When a rubber is exposed to stress or strain energy, internal rearrangements such as rotation and extension of the polymer chains occur. These changes occur as a function of the energy applied, the duration and rate of application, as well as the temperature at which the energy is applied.
ISO 1629 identifies approximately 25 elastomeric types. This chapter covers the various material types used in o-ring manufacture.

4. Basic Elastomers

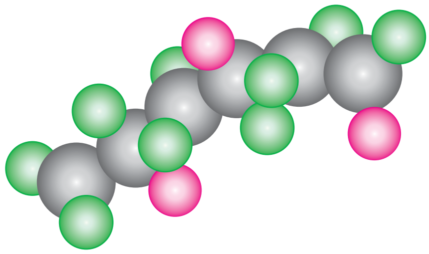


Acrylonitrile butadiene, Nitrile or Buna N (NBR)
Nitrile, chemically, is a copolymer of butadiene and acrylonitrile. Acrylonitrile content varies in commercial products from 18% to 50%. As the nitrile content increases, resistance to petroleum base oils and hydrocarbon fuels increases, but low temperature flexibility decreases.
Due to its excellent resistance to petroleum products, and its ability to be compounded for service over a temperature range of -30°F to +250°F (-35°C to +120°C), nitrile is the most widely used elastomer in the seal industry today. Also many military rubber specifications for fuel and oil resistant O-rings require nitrile based compounds. It should be mentioned that to obtain good resistance to low temperature, it is often necessary to sacrifice some high temperature resistance.
Nitrile compounds are superior to most elastomers with regard to compression set, tear, and abrasion resistance. Nitrile compounds do not possess good resistance to ozone, sunlight, or weather. They should not be stored near electric motors or other ozone generating equipment. They should be kept from direct sunlight. However, this can be improved through compounding.
NBR is the standard material for hydraulics and pneumatics. NBR resists oil-based hydraulic fluids, fats, animal and vegetable oils, flame retardant liquids (HFA, HFB, HFC), grease, water, and air.
Special low-temperature compounds are available for mineral oil-based fluids.
By hydrogenation, carboxylic acid addition, or PVC blending, the nitrile polymer can meet a more specified range of physical or chemical requirements.

The quality of Nitrile-compounds depends on the percentage of acrylonitrile in the base polymer. The following table indicates the change of properties as a function of acrylonitrile content.



4. Basic Elastomers



Hydrogenated nitrile, or highly saturated nitrile (HNBR)

HNBR has recently been developed to meet higher temperatures than standard NBR while retaining resistance to petroleum based oils. Obtained by hydrogenating the nitrile copolymer, HNBR fills the gap left between NBR, EPDM and FKM elastomers where high temperature conditions require high tensile strength while maintaining excellent resistance to motor oils, sour gas, amine/oil mixtures, oxidized fuels, and lubricating oils. HNBR is resistant to mineral oil-based hydraulic fluids, animal and vegetable fats, diesel fuel, ozone, sour gas, dilute acids and bases. HNBR also resists new bio-oils (biological oils). HNBR is suitable for high dynamic loads and has a good abrasion resistance. HNBR is suitable for temperatures from -30°C to +150°C (-20°F to +302°F).

Carboxylated nitrile (XNBR)

The carboxyl group is added to significantly improve the abrasion resistance of NBR while retaining excellent oil and solvent resistance. XNBR compounds provide high tensile strength and good physical properties at high temperatures.
XNBR is suitable for temperatures from -30°C to +150°C (-20°F to +302°F).

Nitrile/PVC resin blends (NBR/PVC)

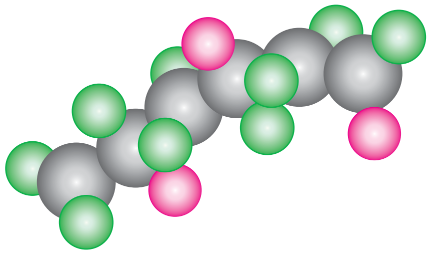
PVC resins are blended with nitrile polymers to provide increased resistance to ozone and abrasion. The PVC also provides a significant improvement in solvent resistance, yet maintains similar chemical and physical properties, commonly noted among nitrile elastomers. The addition of the PVC resins also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

Ethylene Propylene, and Ethylene Propylene Diene rubber (EPM, EPDM)

Ethylene propylene rubber is an elastomer prepared from ethylene and propylene monomers (ethylene propylene copolymer) and at times with an amount of a third monomer (ethylene propylene terpolymers). Ethylene propylene rubber has a temperature range of -50°C to +120°/150°C (-60°F to +250°/300°F), depending on the curing system.
It has a great acceptance in the sealing world because of its excellent resistance to heat, water and steam, alkali, mild acidic and oxygenated solvents, ozone, and sunlight. These compounds also withstand the affect of brake fluids and Skydrol™ and other phosphate ester-based hydraulic fluids. EPDM compounds are not recommended for gasoline, petroleum oil and grease, and hydrocarbon environments. Special EPDM compounds have good resistance to steam.

- EPDM Sulphur cured: inexpensive material for normal use, maximum temperature of +120°C (+250°F).
- EPDM Peroxide cured: for hot water, vapor, alcohols, ketones, engine coolants, organic and inorganic acids and bases. Not resistant to mineral oils. For maximum temperatures of +150°C (+300°F).

4. Basic Elastomers



Neoprene rubber Polychloroprene (CR)

Neoprene rubbers are homopolymers of chloroprene (chlorobutadiene) and were among the earliest synthetic rubbers used to produce seals. CR has good aging characteristics in ozone and weather environments, along with abrasion and flex cracking resistance. CR is not effective in aromatic and oxygenated solvent environments. Neoprene can be compounded for service temperatures of -40°C to + 110°C (-40°F to +230°F).
Most elastomers are either resistant to deterioration from exposure to petroleum based lubricants or oxygen. Neoprene is unusual in having limited resistance to both. This, combined with a broad temperature range and moderate cost, accounts for its desirability in many seal applications for refrigerants like Freon® and ammonia. CR is resistant to refrigerants, ammonia, Freon® (R12, R13, R21, R22, R113, R114, R115, R134A), silicone oils, water, ozone, vegetable oils, alcohols, and low-pressure oxygen. CR has a very low resistance to mineral oils.

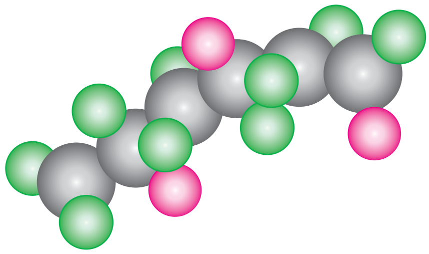
Silicone rubber (VMQ)

Silicones are a group of elastomeric materials made from silicone, oxygen, hydrogen, and carbon. Extreme temperature range and low temperature flexibility are characteristics of silicone compounds. As a group, silicones have poor tensile strength, tear resistance, and abrasion resistance. Special compounds have been developed with exceptional heat and compression set resistance. High strength compounds have also been made, but their strength does not compare to conventional rubber.
Silicones possess excellent resistance to extreme temperatures -50°C to + 232°C (-58°F to +450°F). Some special compounds resist even higher temperatures. Retention of properties of silicone at high temperature is superior to most other elastic materials.
Silicone compounds are very clean and are used in many food and medical applications because they do not impart odor or taste. Silicone compounds are not recommended for dynamic O-ring sealing applications due to relatively low tear strength and high coefficient of friction.
Silicone is resistant to hot air, ozone, UV radiation, engine and transmission oils, animal and vegetable fats and oils, and brake fluids. VMQ also has low resistance to mineral oils.
Silicone can be compounded to be electrically resistant, conductive, or flame retardant.
Many silicone compounds have a higher than normal mold shrinkage. Therefore production molds for silicone products are often different than molds for nitrile.

Fluorosilicone (FVMQ)

Fluorosilicone combines the good high- and low-temperature properties of silicone with limited fuel and oil resistance. Fluorosilicones provide a much wider operational temperature range than Fluorocarbon rubbers. Primary uses of fluorosilicone O-rings are in fuel systems at temperatures up to +177°C (+350°F) and in applications where the dry-heat resistance of silicone O-rings are required.
Fluorosilicone O-rings may also be exposed to petroleum based oils and/or hydro-carbon fuels. In some fuels and oils; however, the high temperature limit in the fluid list is more conservative because fluid temperatures approaching 200°C (390°F) may degrade the fluid, producing acids which attack fluorosilicone O-rings. For low temperature applications, fluorosilicone O-rings seal at temperatures as low as -73°C (-100°F).
Due to relatively low tear strength, high friction and limited abrasion resistance of these materials, they are generally recommended for static applications only. Fluorosilicones with high tear strength are also available. Some of these compounds exhibit improved resistance to compression set. Many fluorosilicone compounds have a higher than normal shrinkage rate so production molds for fluorosilicone products are often different from molds for nitrile.

4. Basic Elastomers



Polyurethane rubber (AU, EU)

Polyurethanes (Polyester-urethane AU), (Polyether-urethane EU) exhibit outstanding mechanical and physical properties in comparison with other elastomers. Urethanes provide outstanding resistance to abrasion and tear and have the highest available tensile strength among all elastomers while providing good elongation characteristics. Ether based urethanes (EU) are directed toward low temperature flexibility applications. The ester based urethanes (AU) provide improved abrasion, heat, and oil swell resistance.
Over a temperature range of -40°C to +82°C (-40°F to +180°F), resistance to petroleum based oils, hydrocarbon fuels, oxygen, ozone and weathering is good.
However, polyurethanes quickly deteriorate when exposed to acids, ketones and chlorinated hydrocarbons. Certain types of polyester-urethanes (AU) are also sensitive to water and humidity. Polyether-urethanes (EU) offer better resistance to water and humidity.
The inherent toughness and abrasion resistance of polyurethane (EU) seals is particularly desirable in hydraulic systems where high pressures, shock loads, wide metal tolerances, or abrasive contamination is anticipated.

Fluorocarbon rubber (FKM)

Fluorocarbon elastomers have grown to major importance in the seal industry. Due to its wide range of chemical compatibility, temperature range, low compression set, and excellent aging characteristics, fluorocarbon rubber is the most significant single elastomer developed in recent history.
Fluorocarbon elastomers are highly fluorinated carbon-based polymers used in applications to resist harsh chemical and ozone attack. The working temperature range is considered to be -26°C to +205°/230°C (-15°F to +400°/440°F). But for short working periods it will take even higher temperatures.
Special compounds having improved chemical resistance are also available with new types always being developed. Generally speaking, with increasing fluorine content, resistance to chemical attack is improved while low temperature characteristics are diminished. There are, however, specialty grade fluorocarbons that can provide high fluorine content with low temperature properties.

DuPont Performance Elastomers

4. Basic Elastomers

Fluorocarbon O-rings should be considered for use in aircraft, automobile and other mechanical devices requiring maximum resistance to elevated temperatures and to many fluids. FKM (FPM, Viton®, Fluorel®) resist mineral oils and greases, aliphatic, aromatic and also special chlorinated hydrocarbons, petrol, diesel fuels, silicone oils and greases. It is suitable for high vacuum applications.
Many fluorocarbon compounds have a higher than normal mold shrinkage rate, molds for fluorocarbon products are often different from molds for Nitrile.

Perfluorocarbons (FFKM)

The relative inertness of fluorocarbon rubbers is provided by fluorine-carbon bonds on the elastomer backbone. Generally speaking, with increasing fluorine content, resistance to chemical attack is improved. Where fluorocarbon rubbers have a fluorine content of 63 - 68 %, the perfluorocarbons have a fluorine content of 73%.
Perfluorelastomers possess excellent resistance to extreme temperatures -26°C to +260°C (-15°F to +500°F). FFKM perfuoroelastomers: (Kalrez®) offers the best chemical resistance of all elastomers.
Some types are particularly suitable for hot water, steam and hot amines. Some resist temperatures up to +326°C (+620°F).
Many perfluorocarbon compounds have unusual mold shrinkage, production molds for perfluorocarbon products are different from molds for nitrile.

Teflon®-FEP/PFA

Teflon® FEP/PFA is a copolymer of tetrafluorethylene and hexafluorpropylene. Teflon® FEP/PFA has a lower melting point than PTFE making it suitable for injection moulding. Teflon® FEP/PFA is used for encapsulation with Teflex O-rings. Teflon® FEP/PFA has a wide spectrum of chemical compatibility and temperature range and excellent aging characteristics. Maximum operating temperature for Teflon® FEP/PFA is +205°C (+400°F). A Teflon® FEP/PFA encapsulation is available for higher temperatures (260°C).

TFE/P (Aflas®) (FEPM)

TFE/P is a copolymer of tetrafluoroethylene and propylene with a fluorine content of app. 54%. This material is unique due to its resistance to petroleum products, steam, and phosphate-esters. In some respects it exhibits media compatibility properties similar to ethylene propylene and fluorocarbon. The compression set resistance at high temperatures is inferior to standard fluorocarbons. Service temperatures are -5°C (25°F) to +204°C (+400°F). TFE/P provides improved chemical resistance to a wide spectrum of automotive fluids and additives. It is resistant to engine oils of all types, engine coolants with high level of rust inhibitors, extreme pressure (EP) gear
lubricants, transmission and power steering fluids, and all types of brake fluids including DOT 3, mineral oil, and silicone oil.
TFE/P is ideal for heat transfer media, amines, acids and bases, as well as hot water and steam up to +170°C (+340°F).

4. Basic Elastomers

Polyacrylate rubber (ACM)

Polyacrylate-Acrylic Acid Ester. These compounds are designed to withstand heat while retaining oil resistance. Specially designed for sulfur bearing oil applications , ACMs are subjected to heat and bearing environments. They have good resistance to dry heat, oxygen, sunlight, and ozone but their low temperature properties are relatively poor and they have low swell in mineral oils. Service temperatures are -20°C (-5°F) to 150°C (300°F). ACM is mainly used for O-rings and shaft seals to seal heavy oils at high temperatures and in the automotive industry for transmission and power steering applications.

Epichlorohydrin (CO, ECO)

Epichlorohydrin rubber compounds are noted for their superior gas impermeability and physical properties over a wide temperature range while maintaining excellent resistance to petroleum oils. It has a stable cycling capability from low to high temperature. Resistance to ozone, oxidation, weathering, and sunlight are other typical ECO qualities. Service temperatures are -51°C to150°C (-60°F to +300°F).
Compounds from this polymer can exhibit a corrosive nature and can be difficult to process in manufacturing.

Vamac®

Ethylene Acrylate. This material exhibits properties similar to polyacrylate but can be formulated to exhibit lower temperature capabilities. It has excellent resistance to oxidation, automatic transmission, and power steering fluids.
The temperature service range is -40°C to +150°C (-40°F to +300°F).

Styrene Butadiene (SBR, Buna S)

This material is similar to natural rubber. O-ring usage has been on decline since the introduction of ethylene propylene. SBR still finds service in brake fluid applications, although the high temperature range is inferior to that of ethylene propylene compounds. Service range for this material is -50°C to +110°C (-65°F to +225°F).

Butyl (IIR)

Butyl has excellent resistance to phosphate ester fluids such as Skydrol™, but has an inferior high temperature limit when compared to ethylene propylene. Butyl exhibits the best resistance to gas permeability and some rocket propellents. For O-ring applications, butyl has been all but replaced by ethylene propylene.
The temperature service range for this material is -55°C to +105°C (-65°F to +225°F).

Special materials

ERIKS offers many possibilities in special O-rings compounds to improve certain properties like: Silicone free and Labs free Coatings - Encapsulated FEP and PFA - PTFE O-rings - Internal Lubrication - High Purity - Micro O-rings - Vulc-O-rings.

Homologations

ERIKS offers many compounds with homologations, like:
KTW – FDA – WRC – NSF – DVGW and many more.

4. Basic Elastomers

Table 3A-1

Elastomer ASTM	NBR Nitrile	EPDM	CR Neoprene	VMQ Silicone	FVMQ Fluoro silicone	EU Urethane	FKM Fluoro carbon	FFKM Perfluoro carbon	FEP/PFA encapsu-lated
GENERAL									
Hardness (Shore "A")	20/ 90	30/90	15/95	20/90	35/80	60/95	50/95	65/90	-
Temp. range °F/°C max.	230/110	266/130	248/120	446/230	446/230	176/80	410/210	620/326	400/205
Temp. range °F/°C min.	-30/-35	-67/-55	-49/-45	-67/-55	-76/-60	-22/-30	5/-15	-58/504	-76/-605
NOTE : The temperature range is strongly dependent by the specific compound									
Compression Set	B	C	C	A	B	E	C	B	E
Wear Resistance	C	C	C	E	E	A	C	C	E
Gas Permeability	C	C	C	E	E	B	C	C	E
NOTE : The compression set value for Kalrez® is relative to temperature. In low temperature applications this value is reasonable, in high temperatures this value is good to very good.									
Air	E	B	C	A	B	C	B	A	+
Alcohol	B	A	B	B	B	U	E	A	+
Aldehydes	U	B	U	C	U	U	U	Bfi	+
Aliphatic Hydrocarbons	C	U	E	E	A	C	A	A	+
Alkalis	B	A	C	B	B	B	C	A	+
Amines	B1	B1	B1	E1	B1	U	U	Bfi	+
Animal Fats	B	U	C	C	A	C	B	A	+
Aromatic Hydrocarbons	D	U	D	U	B	D	A	A	+
Esters, Alkyl Phosphate (Skydrol)	U	B	U	C	U	U	U	A	+
Esters, Aryl Phosphate	U	A	U	C	B	U	A	A	+
Esters, Silicate	C	U	E	U	B	U	A	A	+
Ethers	U	E	U	U	E	E	U	A	+
Halogenated hydrocarbons	U	U	U	U	B	E	A	A	+
Inorganic Acids	E	C	B	B	B	U	A	A	+
Ketones	U	A	A	C	A	U	U	B	+
Mineral Oil, high analine fats	B	U	C	C	B	A	A	A	+
Mineral Oil, low analine fats	B	U	U	E	B	B	A	A	+
Organic Acids	C	C	C	B	B	U	C	A	+
Silicone Oils	A	A2	A	E	E	A	A	A	+
Vegetable Oils	A	U	C	B	B	E	A	A	+
Water / Steam	C	A	E	E	E	U	B⁄	C4	+

A	Good	1	See the list "compound selection for chemicals and fluids"
B	Satisfactory	2	EPDM may shrink
C	Fair	3	Depending on FKM type
D	Doubtful	4	Depending on compound
E	Poor	5	Depending on elastomer core
U	Unsatisfactory	+	in general "A" because the encapsulation is FEP/PFA

This information is intended only as a guideline. Chemical compatibility lists should be consulted. ERIKS will provide this on request.
Whenever possible the fluid compatibility of the O-ring compound should be rated "A". For a static seal application a rating "B" is usually acceptable, but it should be tested.
Where a "B" rated compound must be used, do not expect to re-use it after disassembly. It may have swollen enough that it cannot be reassembled.
When a compound rated "C" is to be tried, be sure it is first tested under the full range of operating conditions.
It is also particularly important to test seal compounds under service conditions when a strong acid is to be sealed at elevated temperatures because the rate of degradation of rubber at elevated temperatures is many times greater than the rate of degradation at room temperature.

4. Basic Elastomers

Chemical and Physical Tables

Polymer	Tensile Strength (MPa)	Tensile Modulus at 100% (MPa)	Hardness Durometer (Shore A)	Enlongation (%)	Compression Set Rating	Low Temp Range °F	Low Temp Range °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	Poor	Poor	Poor
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.
EPDM	2.1-24.1	0.7-20.7	30-90	100-700	Poor-Exc.	-75 to -40	-46 to -18	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	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 -400	-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-Good	-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	-35 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-Fair	-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	20-10	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.

4. Basic Elastomers

Chemical and Physical Tables

Polymer	Radiation Resistance	Oxidization Resistance (AIR)	Water Resistance	Gas Permeability Rating	Odor	Taste Rentention	Adhesion to Metals	Colorability	RMA Color Code	Resilience or Rebound Rating	Vibration Dampening	Flex Cracking Resistance	Tear Resistance	Abrasion Resistance	Vacuum Weight Loss
NBR	Fair-Good	Good	Good-Exc.	Fair-Exc.	Good	Fair-Good	Exc.	Exc.	Back	Good	Fair-Good	Good	Good Exc.	Good-Exc.	Good
HNBR	Fair-Good	Exc.	Exc.	Fair-Exc.	Good	Fair-Good	Exc.	Exc.	-	Good	Good-Exc.	Good	Good Exc.	Good-Exc.	Good
FKM	Fair-Good	Exc.	Exc.	Good-Exc.	Good	Fair-Good	Good-Exc.	Good-Exc.	Brown	Fair-Exc.	Fair-Good	Good	Fair-Good	Good	Exc.
EPDM	Good-Exc.	Exc.	Exc.	Fair-Good	Good	Good-Exc.	Good-Exc.	Good-Exc.	Purple	Fair-Good	Fair-Good	Good	Fair-Good	Good	Exc.
SBR	Poor-Good	Fair-Exc.	Good-Exc.	Fair	Good	Fair-Good	Exc.	Good	-	Fair-Exc.	Fair-Good	Good-Exc.	Fair-Exc.	Good-Exc.	Poor
CR	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
IIR	Poor-Good	Exc.	Good-Exc.	Good	Good	Fair-Good	Good	Good	-	Poor-Good	Exc.	Good-Exc.	Good	Fair-Good	Exc.
VMQ, Si, PMQ, PVMQ	Poor-Good	Exc.	Exc.	Poor-Fair	Good	Good-Exc.	Good-Exc.	Exc.	Rust	Good-Exc.	Fair Good	Poor-Good	Poor-Good	Poor-Good	Exc.
FVMQ	Fair-Exc.	Exc.	Exc.	Poor-Good	Good	Good	Good-Exc.	Good-Exc.	Blue	Exc.	Good	Poor-Good	Poor-Exc.	Poor	Exc.
ACM	Poor-Good	Exc.	Poor-Fair	Good-Exc.	Fair-Good	Fair-Good	Good	Good	-	Fair-Good	Good-Exc.	Fair-Good	Poor-Good	Fair-Good	Good
EA	Good	Exc.	Good-Exc.	Exc.	Good	Fair-Good	Good	Good	-	Poor-Fair	Good	Good	Good-Exc.	Good-Exc.	Fair-Good
CSM	Poor-Good	Exc.	Good	Good-Exc.	Good	Fair-Good	Exc.	Exc.	-	Fair-Good	Fair-Good	Fair-Good	Fair-Good	Good-Exc.	Fair
ECO	Poor	Good-Exc.	Good	Exc.	Good	Good	Fair-Good	Good	-	Good	Good	Good	Fair-Exc.	Fair-Good	Good
NR, IR	Fair-Good	Good	Exc.	Fair-Good	Good-Exc.	Fair-Good	Exc.	Poor	-	Exc.	Good-Exc.	Exc.	Good-Exc.	Good-Exc.	Poor
AU, EU	Good-Exc.	Good-Exc.	Poor-Good	Good-Exc.	Exc.	Fair-Good	Exc.	Good-Exc.	-	Poor-Good	Fair-Good	Good-Exc.	Exc.	Exc.	Good

4. Basic Elastomers

Chemical and Physical Tables

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
EPDM	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-
VMQ, Si, PMQ, PVMQ	Fair-Good	Poor-Fair	Good	Fair	Fair-Good	Good	Poor-Fair	Poor-Exc.	Good	Good	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

4. Basic Elastomers

Chemical and Physical Tables

Polymer	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
NBR	Poor-Fair	Poor	Good-Exc.	Fair-Good	Fair-Good	Poor	Poor	Fair	Exc.	Good-Exc.	Exc.	Good	Good
HNBR	Poor-Fair	Poor-Fair	Exc.	Fair-Good	Good-Exc.	Poor-Fair	Poor	Fair	Exc.	Good-Exc.	Exc.	Good	Good-Exc.
FKM	Exc.	Poor	Exc.	Exc.	Exc.	Good-Exc.	Poor	Poor	Exc.	Exc.	Exc.	Poor	Exc.
EPDM	Exc.	Fair	Poor	Poor	Poor	Poor	Good-Exc.	Poor	Poor	Poor	Poor	Good	Exc.
SBR	Poor	Poor	Poor	Poor	Poor	Poor	Poor-Good	Poor	Poor	Poor	Poor	Good	Poor
CR	Poor-Fair	poor	Poor-Good	Poor-Fair	Fair	Poor	Poor-Fair	Poor	Good	Good	Good	Exc.	Fair-Exc.
IIR	Exc.	Poor-Fair	Poor	Poor	Poor	Poor	Poor-Exc.	Fair-Good	Poor	Poor	Poor	Good	Poor
VMQ, Si, PMQ, PVMQ	Good	Poor	Poor-Fair	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Good	Exc.	Poor-Fair
FVMQ	Good-Exc.	Fair	Exc;	Good-Exc.	Exc.	Good-Exc.	Poor	Poor	Exc.	Good	Good	Exc.	Exc.
ACM	Poor	Poor-Fair	Exc.	Poor-Good	Fair-Good	Poor-Good	Poor	Poor	Good	Fair	Poor	Fair	Exc.
EA	Poor	Poor	Good	Poor-Fair	Fair	Poor-Good	Poor	Poor	Poor	Poor	Poor	Poor-Good	Good-Exc.
CSM	Fair	Poor	Fair-Good	Fair	Fair	Poor	Poor	Poor	Good	Poor	Fair	Good	Exc.
ECO	Poor	Good	Good-Exc.	Good Exc.	Fair Good	Poor	Fair	Fair	Exc.	Good-Exc.	Poor	Poor	Good-Exc.
NR, IR	Poor	Poor	Poor	Poor	Poor	Poor	Fair-Good	Poor	Poor	Poor	Poor	Good	Good
AU, EU	Poor	Fair	Good-Exc.	Poor-Fair	Fair-Good	Poor-Good	Poor	Poor	Fair-Good	Good	Good	Poor	Exc.

Note: the chart data provides general elastomer base properties. In many design applications, special compounds are required. ERIKS, therefore, will not be responsible for the usage of this chart in any manner.

4. Basic Elastomers

Chemical Terms, Abbreviations, and Trade Names

Chemical Term	ASTM Designated Abbreviation	Polymer Trade Names
Acrylonitrile Butadiene	NBR	Chemigum®, Nipol®, Krynac®, Paracril®, Perbunan N®, Buna N®
Highly Saturated Nitrile	HNBR	Therban®, Zetpol®
Carboxylated Nitrile	XNBR	Nipol®, Krynac®, Chemigum®
Fluorocarbon	FKM	Viton®, Fluorel®, Technoflon®
Ethylene Propylene	EP, EPDM, EPT, EPR	Nordel®, Royalene® Vistalon®, Buna EP®, Keltan®
Styrene Butadiene	SBR	Ameripol Synpol®, SBR®, Plioflex®, Stereon®
Polychloroprene	CR	Neoprene, Baypren®, Butaclor®
Isobutylene Isoprene	IIR	Butyl®
Silicone	VMQ, PMQ, PVMQ	Silastic®, SILPLUS®, Elastosil, Wacker®
Fluorosilicone	FVMQ	FSE®, Silastic®, Sylon®
Polyacrylate	ACM	Cyanacryl®, HyTemp®, Thiacril®
Ethylene Acrylic	AEM	Vamac®
Chlorosulfonated Polyethylene	CSM	Hypalon®
Epichlorohydrin	ECO/CO	Gechron®, Hydrin®
Polyisoprene		
• Natural	NR	SMR®, Pale Crepe®, Smoked Sheet®
• Synthetic	IR	Ameripol SN®, Natsyn®
Polyurethane (Polyester or Polyether)	AU or EU	Adiprene®, Millathane®, Vibrathane®, Vulkolan®, PUR
Perfluoroelastomer	FFKM	Kalrez®, Isolast®, Chemraz®, Simriz®, Parafluor®, Perlast

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