O-RING MATERAIL GUIDE

1. Acrylonitrile-Butadiene (NBR)

Copolymers of butadiene and acrylonitrile are known by several generic names, Buna N, Nitrile Rubber and NBR. The acrylonitrile content of NBR compounds varies considerably (18% to 50%) and influences the physical properties of the finished material. The higher acrylonitrile content, the better resistance to oil and fuel, At the same time, elasticitv, compression set resistance to low temperature is adversely affected. The lower acrylonitrile content obtain, the better low temperature resistance, but sacrifice some resistance to oil and fuel. In view of these opposing realities, a compromise selection is the medium acrylonitrile content rubber. NBR has good mechanical properties when compared with other elastomers and high wear resistance.

NBR is unable to resist the weathering and ozone. Some special compound can improve this defect, such as NBR/PVC blending compound which has excellent weathering and ozone resistance and good resistence to fuel but compression set is not so good.

SERVICE TEMPERATURE

For NBR the service temperature can be designed from –55°C to 100°C or up to 125°C depending on different acrylonitrile content and formula. Generally higher than 100°C, life time will be shortened.

HARDNESS

40 to 90 Shore A are available.

COLOR

Black, Brown, green, white, rust, yellow, blue, red, orange, and gray are available, or any assigned color from customers.

APPLICATION

NBR compounds have excellent resistance to abrasion, non-polar oils and solvent, water and permeation (higher acrylonitrile content) will be better. NBR also can be used in conditions of dilute acids, alkalis and salt solution at low temperatures. Applying in aromatic hydrocarbons, chlorinated hydrocarbons and polar solvents are not suitable.

2. Fluorocarbon(FKM,FPM)

Trade name : Viton® DuPont

Fluorocarbon is a well-known high performance rubber, especially it has excellent resistance to high temperature, ozone, weather, oxygen, mineral oil, fuels, hydraulic fluids, aromatics and many organic solvents and chemicals. Now we can supply parts made by Viton® system gum like general type (A-TYPE, 66% fluorine) middle fluorine content type (B-, GBL-TYPE, 67-68.5% fluorine), high fluorine content type (F-, GF-TYPE, 70% fluorine), improving low temperature flexibility type (GLT-, GFLT) and excellent resistant to more chemicals and solvents—Viton® ETP Extreme. We also can supply excellent acid and alkali resistance parts by AFLAS® Asahi Glass Co./Japan

SERVICE TEMPERATURE

For general type the service temperature is better limited to approximately from -26°C (-15°F) to 232°C (450°F) in static application, though the service temperature can arrive to 275°C at short time but up to 232°C the parts life will be shortened. In dynamic application it is suitable between -15°C and 200°C.
For GLT-type the low temperature can be down below -40°C.

HARDNESS

For general type the hardness from 50 to 90 Shore A are available.
For others type 60 to 90 Shore A are appropriate.

COLOR

Now black, brown, green, white, rust, yellow, blue are available, or any assigned color from customers.

APPLICATION

Because FKM has excellent resistance of high temperature, oil, solvent, flame, chemical and weather, it is usually applied in automotive, chemical processing, aerospace and many industries.
Viton GLT has more broad usable thermal range of -45°C to + 275°C and outstanding aggressive HTS-type oils, applied in aerospace is a good choice.Viton ETP usually applies in chemical industrial field. Some fuels add several methanol, Viton F – and B-type are more usable than A-type especially F-type some lubtricants add a few organic amide or amine, choosing peroxide curing system Viton® will be better than bisphenol curing system.

3. Silicone Rubber (Q, MQ, VMQ, PVMQ)

Physically, silicone are based on silicone, an element derived from quartz. To create this class of synthetic elastomers, pendant organic groups such as methyl, phenyl and vinyl are attached to silicon atoms. The different addition of side chains can achieve significant variations in properties. Silicones have excellent heat, ozone and corona resistance, very well dielectric stability, and resistance to many oils, chemicals, and solvents. And for all elastomers, silicone possess the best flexible property at low temperature. But it also have some weakness like low tensile strength, poor tear and wear resistance.

SERVICE TEMPERATURE

For Silicones the service temperature are from -60°C to 225°C. Some special types can be used in extreme temperature up to 300°C and down to -100°C.

HARDNESS

25 to 90 Shore A are available.

COLOR

Black, brown, green, white, rust, yellow, blue, red, orange, transparent and gray are available, or any assigned color from customers.

APPLICATION

Silicone rubber performs well under environmental and temperature extremes, it usually be applied in automotive and aerospace industries, where flexibility and longevity are important. It also has outstanding electrical insulating properties, applying in strict performance standards are critical. And it is a suitable material for parts that need FDA approval for food handling equipment and appliances.

4. Fluorosilicone Rubber (FVMQ)

Fluorosilicone is like silicone rubber, bonding trifluoropropyl, methyl, and vinyl as side chains. The mchanical and physical properties are similar to VMQ. However, FVMQ offers improved fuel and mineral oil resistance.

SERVICE TEMPERATURE

For FVMQ the service temperature are from -60°C to 177°C. In dry heat, the serviceable temperature range can be extended to 232°C

HARDNESS

45 to 80 shore A are available.

COLOR

Yellow, blue are available, or any assigned color from customers.

APPLICATION

FVMQ offers excellent low-temperature flexibility and good for fuel and aromatic mineral oil. It is usually applied in contact with jet and automotive fuels,most solvents, or engine oil, especially in aerospace industry.

5. Ethylene Propylene Rubber (EPM,EPR,EPDM)

EPM, EPR are the copolymer of ethylene and propylene, EPDM is terpolymer of ethylene and propylene with a small amount of a third monomer (usually a diolefin) to permit vulcanization with sulfur. Generally Ethylene Propylene Rubber possess excellent resistance to ozone, sunlight and weathering, and have very good flexibility at low temperature, good chemical resistance (many dilute acids and alkalis, polar solvents), and good electrical insulation property.

SERVICE TEMPERATURE

For EPDM the service temperature can be designed from -55°C to 125°C or up to 150°C (for peroxide cured systems)

HARDNESS

60 to 90 Shore A are available.

COLOR

Black, brown, green, white, rust, yellow, blue, red, orange, and gray are available, or any assigned color from customers.

APPLICATION

In phosphate-ester based hydraulic fluids and glycol based brake fluids systems Ethylene Propylene Rubber is good choice for sealing parts. Applying in domestic water, rubber parts must pass the chloramine and chlorine resistance test. It is not suitable for any types Ethylene Propylene Rubber, higher saturated EDPM or EPM and higher ethylene content will be good for chloramine and chlorine attacking. It also usually be used in hot water or steam up to 150°C.

Ethylene Propylene Rubber is not suitable in petroleum fluid (fuels, mineral oils, greases).

6. Hydrogenated Nitrile (HNBR) or Highly Saturated Nitrile (HSN)

Hydrogenated Nitrile is a synthetic Polymer that is obtained by saturating the hydrocarbon chains of Nitrile rubber with hydrogen. This special hydrogenation process reduce lots of double bonds in main chain of NBR polymer, so HNBR possess superior heat, ozone, chemical resistance and mechanical characteristics over standard Nitriles.

SERVICE TEMPERATURE

For HNBR the service temperature is from-40°C to 150°C and some special compound can be up to 160°C.

HARDNESS

55 to 90 Shore A are available.

COLOR

Black, green, blue, brown, rust and gray are available, or any assigned color from customers.

APPLICATION

HNBR has wide applications in auto and oil industries. For environment requirement HCFC will be replaced by ozone-safe refrigerants-HFCs. In old air conditioning and refrigeration equipment Chloroprene (CR) and Fluoroelastomer (FKM) are popular material with coolant system of HCFC (or CFC) and mineral oil. But CR and FKM is not adequate in the newer coolant system HCF134a (R134a) and PAG lube, because CR will degrade PAG lube and FKM will swell more in R134a, the available rubber is HNBR.

7. Carboxylated Nitrile (XNBR)

Carboxylated Nitrile is similar to Nitrile rubber, but the polymer backbone has been chemically modified with Carboxylic Acid containing group. This result is XNBR with more excellent abrasion and tear resistance than traditional NBR. For this reason, XNBR based parts are usually applied in dynamic assembly such as seals and rod wipers.

SERVICE TEMPERATURE

For XNBR the service temperature is from -20°C to 100°C or up to 125°C. Generally higher than 100°C, life time will be shortened.

HARDNESS

50 to 90 Shore A are available.

COLOR

Black, white and gray are available, or any assigned color from customers.

8. Butyl Rubber (IIR)

Butyl rubber is composed by copolymerizing isobutylene, which with small amounts of isoprene. It is like EPDM possessing excellent resistant to chemical and polar fluid, outstanding electrical insulation and good ozone resistance. The special properties of butyl rubber are low gas, moisture permeability and high shock absorption. These properties have made butyl rubber the polymer choice in a variety of applications.

SERVICE TEMPERATURE

For IIR the service temperature can be designed from -55°C to 100°C.

HARDNESS

50 to 70 Shore A are available.

9. Natural Rubber (NR)

Natural rubber is produced from the latex of the Hevea brasiliensis, the chemical name of polymer is polyisoprene. Polyisoprene also can be synthesized by polymerization from its monomer isoprene. Natural rubber possesses many excellent physical properties including high resilience and strength, good abrasion resistance. The defects are like SBR, having poor resistant to hydrocarbon oil and not suitable in UV, oxygen, ozone because the double bond in the polymer backbone. But its poor weathering resistance can be modified by special additive.

SERVICE TEMPERATURE

For NR the service temperature can be designed from -50°C to 70°C, and up to 100°C at short time.

HARDNESS

40 to 90 Shore A are available.

10. Polyacrylate (ACM)

Polyacrylates or simply acrylate rubbers are copolymers having two major components: the backbone (monomeric acid ester of alkyl or alkoxy) are the reactive cure-site. ACMs are high heat and oil resistant, specialty elastomers. It also well resists to mineral oil,oxygen and ozone even at nigh temperature. The low temperature flexibility and chemical resistant of ACM is not good.

SERVICE TEMPERATURE

For standard ACM the service temperature is -15°C to 150°C, shortened lifetime up to 175°C. The low service temperature of some special compound can be down to -25°C.

HARDNESS

45 to 85 Shore A are available.

COLOR

Black, white, orange are available, or any assigned color from customers.

APPLICATION

Polyacrylates usually are applied in automatic indrustry, especially in automatic transmission fluid system.

11. Urethane, Polyurethane (AU, EU, PU)

Trade Names: Adiprene®, Millathane®, Vibrathane®

Polyurethane is an organic polymer. Polyurethanes are formed by reacting a polyol (an alcohol with more than two reactive hydroxyl groups per molecule) with a diisocyanate or a polymeric isocyanate in the presence of suitable catalysts and additives. Polyurethane is a widely used compound due to its superior strength, tear and abrasion resistance. Polyurethane also provides excellent permeation resistance. Good hydraulic oil and gasoline resistance. Resistant to pure aliphatic hydrocarbons (propane, butane, fuel), mineral, siliconeoils, greases, water, oxygen, ozone and aging .Not compatible with acids, ketones, esters, ethers, alcohols, glycols, hot water, steam, alkalis and amines.

SERVICE TEMPERATURE

The service temperature of PU is -54°C to 107°C, shortened lifetime up to 107°C.

HARDNESS

60 to 93 Shore A are available.

COLOR

Black, transparent, green, orange are available, or any assigned color from customers.

APPLICATION

Polyurthane usually are applied in mechanical industry, especially in the place requires material must have higher wear resistance and higher strength and abrasion resistance. Some applying environment will happen moisture condensing on the surface of rubber seal, which will cause hydrolysis of AU, so choosing EU is better. But EU doesn't resist well to oil, the lubricant must use higher aniline point oil.

12. Chloroprene or Polychloroprene Rubber(CR)

Trade name : Neoprene® Dupont

Chloroprene or polychloroprene (Trade name : Neoprene) was one of the first successful synthetic elastomers in 1931 by DuPont. It is prepared by emulsion polymerization of chloroprene, or 2-chlorobutadiene. CR is a multi-purpose elastomer which yields a balanced combination of properties. It has good resistence to sun, ozone weather and perform well in contact with oils and many chemicals. It also display outstanding physical toughness and good resistence to fire.

SERVICE TEMPERATURE

The service temperature of Chloroprene can be designed from -40°C to 100 or up to 125°C depending on different grades. Generally higher than 100°C, life time will be shortened.

HARDNESS

30 to 90 Shore A are available.

COLOR Black, white, rust, yellow and blue are available, or any assigned color from customers.

APPLICATION

Chloroprene has been used thousands of diverse of environments, including automotive, wire and cable industries.

13. Epicholorohydrin (CO,ECO,GECO)

Hydrin®is the trade name of epichlorophydrin elastomers made by Zeon Chemicals. Epichlorohydrin elastomers are available as a homopolymer (CO), copolymer (ECO,GCO), And terpolmer (GECO). All epichlorohydrin rubbers offer low temperature flexible; resistance to oils, fuel and common solvents; good weatherability and good dynamic properties.

SERVICE TEMPERATURE

The service temperature of epichlorodrin can be designed from -40°C to 125°C or up to 135°C.

HARDNESS

50 to 80 Shore A are available.

COLOR

Black is available, or any assigned color from customers.

APPLICATION

The typical application of epichlorohydrin are for automotive and industrial fields.

14. Styrene-Butadiene Rubber (SBR)

The most widely synthetic rubber in the entire world is SBR, a copolymer of styrene and butadiene. The most part of SBR rubber is used in tire by blending with natural rubber and butadiene rubber. SBR is weal and unusable without reinforcement by carbon black, but with carbon black it is strong and abrasion-resistant. The defects of SBR are poor resistant to oil and not suitable in weathering, UV, oxygen, ozone because the double bond in the polymer backbone.

SERVICE TEMPERATURE

The service temperature of SBR can be designed from -55°C to 100°C

HARDNESS

50 to 70 Shore A are available.

15. Ethylene/Acrylic elastomer (AEM)

Ethylene/acrylic elastomer is a copolymer of ethylene and methyl acrylate, plus a small amount of a cure site monomer containing carboxylic acid groups. AEM is a tough, low-compression-set rubber with excellent resistance to high temperature, hot mineral oil, fluids and weathering. The low temperature flexibility and mechanic properties are better that ACM, but it is not well resistant to low aniline oil (like ASTM No.3 oil) and polar solvents.

SERVICE TEMPERATURE

For standard ACM the service temperature is -30°C to 150°C, shortened lifetime up to 175°C.

HARDNESS

40 to 85 Shore A are available.

COLOR

Black and orange colors are available.

APPLICATION

AEM is typically chosen for applications requiring improved performance versus nitrile rubber, Neoprene or reduced cost versus higher-end elastomers such as HNBR, FKM. It also usually is applied in automatic industry.

16. Perfluoroelastomer (FFKM)

Trade names: Parofluor® Parker
Kalrez® Du Pont
Chemraz® Greene, Tweed & Co.

Kalrez has the chemical properties of PTFE (Teflon®) and the elastic properties of FKM-rubber. The processing of Perfluor Rubber is exceptionally difficult.Perfluor Rubber is only used in seldom cases because the raw material price is many times more expensive than Fluorocarbon (FKM). Normally alternative elastomers can be selected, FFKM only being taken in exceptional cases.

SERVICE TEMPERATURE

-30°C up to 327°C.

Chemical resistance:

- to nearly all chemicals
- oxygen, ozone, weather and aging
- exceptionally low weight loss in high vacuums at high temperatures.

17. Polytetrafluoroethylene (PTFE)

Virgin PTFE (Polytetrafluoroethylene) commonly referred to as Teflon or TFE in white color. The material has outstanding chemical properties and the lowest coefficient of friction of any solid material. The wide range of temperature (-200°C to +260°C) and the mechanical properties make PTFE a universal material for a wide range of applications. PTFE should not be used for dynamic applications in water.

SERVICE TEMPERATURE

PTFE has the wide range of temperature between -200°C to +260°C.

HARDNESS

ASTM D2240 Shore D 51-65.

APPLICATION

Piston Rod seals with spring or elastomer energizer, rotary seals, back-up rings, special seals and O-rings, high and low temperature applications, chemical resistance required, low-friction applications.

18. Tetrafluoroethylene /Propylene (TFE/P, FEPM)

Trade Name : AFLAS® Asahi Glass Co./Japan

Tetrafluoroethylene/Propylene copolymere (TFE/P), commonly referred to as FEPM or AFLAS®, has a very high resistance to hydraulic fluids (incl. Alkyl-Acryl-Phosphate Esters), All break fluids (on glycol, mineral and silicone base), acids, steam and hot water, sour oils/gases (H2S) and heavy formulated oils with amine additives.

HARDNESS

At 20°C : DIN 53505 Shore A 85(+/-5)

APPLICATION

Static and dynamic seals (standard and special), wipers, O-rings, flange seals, rotary seals, rubber energizers (preload elements). Applications where high temp. and/or chemical resistance is required, oil and gas industry.

19. Polyetheretherketone (PEEK)

Polyetheretherketone is a brown-beige (natural) high-performance thermoplastic commonly referred to as PEEK. The material has excellent physical and chemical properties to serve a wide range of applications at high temperatures where outstanding mechanical stability and rigidity are necessary. PEEK has good tribological characteristics and is recommended for precision parts, where close tolerances are required. PEEK is approved for the use of applications in contact with foodstuff.

SERVICE TEMPERATURE

-50°C to +250°C.

HARDNESS

Shore D 90.

APPLICATION

Guide rings, bushings, back-up rings, scrapers. Housings, high precision parts and O-Rings.

FDA, USDA, NSF 51, USP Approved Compounds

The food and Drug Administration (FDA) has established a list of rubber compounding ingredients which tests have indicated are neither toxic nor carcinogenic. Rubber compounds produced entirely from those ingredients and which also pass the FDA extraction tests are said to “meet the FDA requirements”. The FDA does not approve rubber compounds. It is the responsibility of the manufacturer to compound food grade materials from the FDA list of ingredients and establish whether they pass the necessary extraction requirements. Similar standards are established by the United States Department of Agriculture (USDA)

Additional requirements have been imposed upon seal manufacturers regarding food and beverage service. Parker has developed several materials that are certified to NSF 51, Food and Beverage Standard. In critical medical applications, seals often must be made from an even “cleaner” list of ingredients. The U.S. Pharmacopoeia (USP) Class VI outline requirements for system toxicity and intracutaneous toxicity for these “cleaner” compounds. The USP Class VI compounds must be made from ingredients with clear histories of biocompatibility that meet tighter requirements for leachates.

Typical applications for our FDA, NSF 51, USDA materials are disposable medical devices, surgical instruments and medical fluid dispensing components, as well as a wide variety of food and beverage handling equipment. The type of approval/certification required generally rests with the end customer’s regulatory expectations for the specific application.

Parker Compound	Polymer	Hardness	Color	Service
E3609-70	EPDM	70	Black	NSF 51, FDA, USP Class VI
FF350-75	FFKM	75	White	FDA, USP Class VI
V0680-70	FKM	70	Black	NSF 51, FDA, USDA
N1219-60	NBR	60	Black	NSF 51, FDA
N1220-70	NBR	70	Black	NSF 51, FDA

Parker Compound	Polymer	Hardness	Color	Service
N0508-75	NBR	75	Black	FDA, USDA
S0802-40	VMQ	40	White	FDA
S1538-55	VMQ	55	Trans-Lucent	FDA-USP Class VI
S0317-60	VMQ	60	Rust	FDA, USDA, USP Class VI
S1380-70	VMQ	70	Rust	FDA
S0355-75	VMQ	75	Rust	FDA, USDA
V1274-80	FKM	80	Black	USP Class VI

NSF 61 Approved Compounds

NSF 61 Drinking Water System Components – is the nationally recognized health effects standard for all devices, components and materials which contact drinking water. Parker’s O-Ring Division has developed several materials that are certified to NSF 61. Many of these materials are approved for use in the United Kingdom (WRAS) and Germany (KTW) as well as North America. NSF International is an industry regulating agency that was established in 1944. Recognized by ANSI (American National Standards Institute), NSF maintains qualification standards and criteria for a wide range of products, including potable water components and delivery systems.

Parker Compound	Polymer	Hardness	Color	Service
E1561-60 (63446)	EPDM	60	Commercial Hot**	NSF 61, WRAS, KTW, Ideal for High Volume Applications
E1549-70 (63447)	EPDM	70	Commercial Hot**	NSF 61, WRAS, KTW, Excellent Compression Set Resistance, Ideal for High Volume Applications
E3609-70	EPDM	70	Commercial Hot**	NSF 61, WRAS, KTW, Excellent Compression Set Resistance
N0757-70	NBR	70	Cold Water***	NSF 61
N1510-70 (67997)	NBR	70	Commercial Hot**	NSF 61

* NSF 61 listed materials given a commercial hot water rating are also certifed for cold water

** Commercial Hot = Tested at 82°C (180°F)

*** Cold Water = Tested at 23°C (73.4°F)