# Natural Rubber (NR)

Natural rubber is a product coagulated from the latex of the rubber tree, *hevea brasiliensis*. Natural rubber features low compression set, high tensile strength, resilience, abrasion and tear resistance, good friction characteristics, excellent bonding capabilities to metal substrate, and good vibration dampening characteristics.

<table>
<thead>
<tr>
<th>Temperature Range (dry heat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
</tr>
<tr>
<td>-51 °C</td>
</tr>
</tbody>
</table>

**Application Advantages**
- excellence compression set
- good resilience and abrasion
- good surface friction properties

**Primary Uses**
- O-rings, rubber seals and custom molded rubber components for:
  - rubber to metal bonded vibration isolators and mounts
  - automotive diaphragms
  - FDA applications for food and beverage seals

**Application Disadvantages**
- poor resistance to attack by petroleum oils
- poor ozone, UV resistance

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# Fluorosilicone (FVMQ)

Fluorosilicones combine most of the attributes of silicone with resistance to petroleum oils and hydrocarbon fuels. Low physical strength and abrasion resistance combined with high friction limit fluorosilicone to static seals. Fluorosilicones are used primarily in aircraft fuel systems.

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<tbody>
<tr>
<td>low</td>
</tr>
<tr>
<td>-59 °C</td>
</tr>
</tbody>
</table>

**Application Advantages**
- excellent extreme temperature properties
- excellent compression set resistance
- very clean, low odor and taste

**Primary Uses**
- O-rings, rubber seals and custom molded rubber components for:
  - seals (static) for extreme temperature applications
  - food applications
  - medical devices

**Application Disadvantages**
- typically not good for dynamic seals due to friction properties and poor abrasion resistance
### SILICONE (VMQ)

<table>
<thead>
<tr>
<th>Temperature Range (dry heat)</th>
<th>low</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>-59 °C</td>
<td>232 °C</td>
<td></td>
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</tbody>
</table>

#### Application Advantages
- excellent extreme temperature properties
- excellent compression set resistance
- very clean, low odor and taste

#### Primary Uses
- O-rings, rubber seals and custom molded rubber components for:
  - seals (static) for extreme temperature applications
  - food applications
  - medical devices

#### Application Disadvantages
- typically not good for dynamic seals due to friction properties and poor abrasion resistance

### POLYURETHANE (AU) (EU)

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<th>low</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>-51 °C</td>
<td>79 °C</td>
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</tbody>
</table>

#### Application Advantages
- excellent strength and abrasion resistance
- good resistance to petroleum oils
- good weather resistance

#### Primary Uses
- O-rings, rubber seals and custom molded rubber components for:
  - seals for high hydraulic pressure
  - highly stressed parts subject to wear

#### Application Disadvantages
- poor resistance to water
- poor high temperature capabilities

### STYRENE BUTADIENE (SBR)

Styrene-Butadiene (SBR) is a copolymer of styrene and
butadiene. SBR compounds have properties similar to those of natural rubber. SBRs primary custom molded application is the use in hydraulic brakes system seals and diaphragms, with the major of the industry usage coming from the Tire Industry. SBR features excellent resistance to brake fluids, and good water resistance.

<table>
<thead>
<tr>
<th>Application Advantages</th>
<th>Temperature Range (dry heat)</th>
<th>Application Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
<td>high</td>
<td>-46 °C</td>
</tr>
</tbody>
</table>

**Primary Uses**

- hydraulic brake systems seals and diaphragms
- plumbing applications

**Application Advantages**

- good resistance to brake fluids
- good resistance to water

**Application Disadvantages**

- poor weather resistance
- poor petroleum oil and solvent resistance

### NEOPRENE / CHLOROPRENE (CR)

Neoprene homopolymer of chlorobutadiene and is unusual in that it is moderately resistant to both petroleum oils and weather (ozone, UV, oxygen). This qualifies neoprene uniquely for certain sealing applications where many other materials would not be satisfactory. Neoprene is classified as a general purpose elastomer which has relatively low compression set, good resilience and abrasion, and is flex cracking resistant. Neoprene has excellent adhesion qualities to metals for rubber to metal bonding applications. It is used extensively for sealing refrigeration fluids due to its excellence resistance to Freon® and ammonia.

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<td>low</td>
<td>high</td>
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</tbody>
</table>

**Primary Uses**

- O-rings, rubber seals and custom molded rubber components for:
  - refrigeration industry applications
  - general purpose seals, hose and wire

**Application Advantages**

- moderate resistance to petroleum oils
- good resistance to ozone, UV, oxygen
- excellence resistance to Freon® and ammonia

**Application Disadvantages**

- moderate water resistance
- not effective in solvents environments

### FLUOROCARBON (FKM)

Fluorocarbon exhibits resistance to a broader range of chemicals combined with very good high temperature properties more so than any of the other elastomers. It is the closest available approach to a universal elastomer for sealing in the use of o-rings and other custom seals over other types of elastomers.

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</table>

**Primary Uses**

- O-rings, rubber seals and custom molded rubber components for:
Fluorocarbons are highly resistant to swelling when exposed to gasoline as well as resistant to degradation due to exposure to UV light and ozone. When exposed to low temperatures, fluorocarbon elastomers can become quite hard (-4 °F) but can be serviceable at low temperatures, although FKM compounds are not recommended for applications requiring good low temperature flexibility.

In addition to standard FKM materials, a number of special materials are available with differing monomer compositions and fluorine content (65% to 71%) for improved low temperature, high temperature, or chemical resistance performance. Fluorocarbons exhibit low gas permeability making them well suited for hard vacuum service and many formulations are self-extinguishing. FKM materials are not generally recommended for exposure to hot water, steam, polar solvents, low molecular weight esters and ethers, glycol based brake fluids, or hot hydrofluoric or chlorosulfonic acids.

Primary Uses

- O-rings, rubber seals and custom molded rubber components for:
  - Automotive fuel handling
  - Aircraft engine seals
  - High temperature applications requiring good compression set
  - General industrial seals and gaskets

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**ETHYLENE-PROPYLENE (EPDM)**

Ethylene-propylene compounds are prepared from ethylene and propylene (EPM) and usually a third monomer (EPDM). These compounds are used frequently to seal in brake systems, and for sealing hot water and steam. Ethylene propylene compounds have good resistance to mild acids, detergents, alkalis, silicone oils and greases, ketones, and alcohols. They are not recommended for applications with petroleum oils, mineral oil, di-ester lubricants, or fuel exposure.

Ethylene Propylene has gained wide seal industry acceptance for its excellent ozone and chemical resistance properties and is compatible with many polar fluids that adversely affect other elastomers.

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<th>high</th>
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<tr>
<td>-51 °C</td>
<td>149 °C</td>
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</table>

**Application Advantages**

- excellent weather resistance
- good low temperature flexibility
- excellent chemical resistance
- good heat resistance

**Application Disadvantages**

- poor petroleum oil and solvent resistance

**Modifications**

- degree of fluorination (A, B, F, GB, GF, GFLT, GBLT, GLT, ETP)
- copolymer or terpolymer of fluorinated hydrocarbon monomers
**EPDM compounds** are typically developed with sulfur or peroxide cure system. Peroxide-cured compounds are suitable for higher temperature exposure and typically have improved compression set performance.

<table>
<thead>
<tr>
<th>Primary Uses</th>
<th>Specialized Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-rings, rubber seals and custom molded rubber components for:</td>
<td>glycol-based brake system seals</td>
</tr>
<tr>
<td>- Water system seals, faucets, etc.</td>
<td>NBR NSF standard 61 for potable water applications</td>
</tr>
<tr>
<td>- Brake systems</td>
<td>NBR WRC, KTW water applications</td>
</tr>
<tr>
<td>- Ozone exposure applications</td>
<td></td>
</tr>
<tr>
<td>- Automotive cooling systems</td>
<td></td>
</tr>
<tr>
<td>- General Industrial Use</td>
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**HYDROGENATED NITRILE (HNBR)**

HNBR is created by partially or fully hydrogenating NBR. The hydrogenating process saturates the polymeric chain with accompanying improvements to the ozone, heat and aging resistance of the elastomer and improves overall mechanical properties.

HNBR, like Nitrile, increasing the acrylonitrile content increase resistance to heat and petroleum based oils and fuels, but decreases the low temperature performance.

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<td>low</td>
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<td>-30 °C</td>
<td>149 °C</td>
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**Application Advantages**

- excellent heat and oil resistance
- improved fuel and ozone resistance (approximately 5X) over Nitrile
- abrasion resistance

**Application Disadvantages**

- increased cold flow with hydrogenation
- decreased elasticity at low temperatures with hydrogenation over standard nitrile

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<th>Primary Uses</th>
<th>Modifications</th>
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<tr>
<td>O-rings, rubber seals and custom molded rubber components for:</td>
<td>acrylonitrile content (ACN) from 18% to 50%</td>
</tr>
<tr>
<td>- Oil resistant applications</td>
<td>peroxide vs. sulfur donor cure system</td>
</tr>
<tr>
<td>- Oil well applications</td>
<td></td>
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<tr>
<td>- Fuel systems, automotive, marine, and aircraft</td>
<td></td>
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<tr>
<td>- General Industrial Use</td>
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**NITRILE (NBR)**
Nitrile is the most widely used elastomer in the seal industry. The popularity of nitrile is due to its excellent resistance to petroleum products and its ability to be compounded for service over a temperature range of -30°C to 100°C. Nitrile is a copolymer of butadiene and acrylonitrile. Variation in proportions of these polymers is possible to accommodate specific requirements. An increase in acrylonitrile content increases resistance to heat plus petroleum base oils and fuels but decreases low temperature flexibility. Military AN and MS O ring specifications require nitrile compounds with low acrylonitrile content to insure low temperature performance. Nitrile provides excellent compression set, tear, and abrasion resistance. The major limiting properties of nitrile are its poor ozone and weather resistance and moderate heat resistance, but in many applications these are not limiting factors.

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<td>100 °C</td>
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Application Advantages
- excellent compression set,
- superior tear resistance
- abrasion resistance

Application Disadvantages
- poor weather resistance
- moderate heat resistance

Modifications
- acrylonitrile content (ACN) from 18% to 50%
- peroxide vs. sulfur donor cure system
- XNBR improved wear resistance formulation

Primary Uses
O-rings, rubber seals and custom molded rubber components for:
- Oil resistant applications
- Low temperature applications
- Fuel systems, automotive, marine, and aircraft
- General Industrial Use

Specialized Applications
- NBR NSF standard 61 for potable water applications
- NBR WRc, KTW water applications