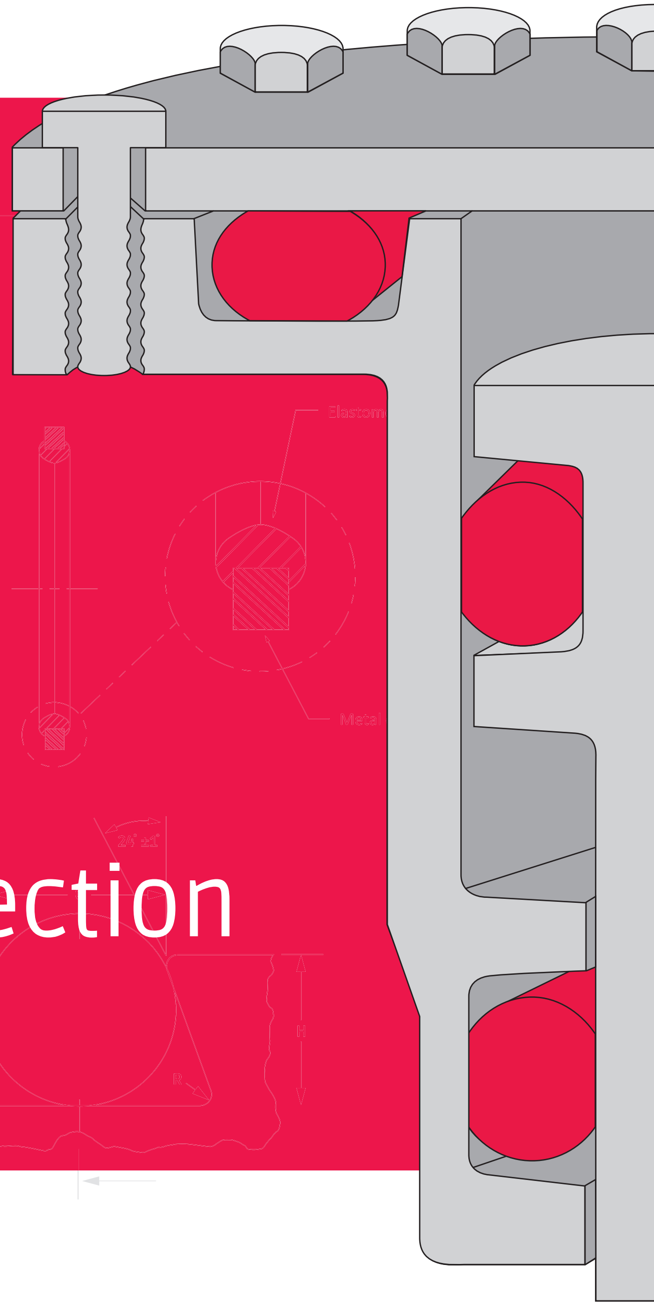
Seal Design Guide

Material Selection Guide



Apple Rubber

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Material Selection Guide

BASIC CONCEPTS OF RUBBER

What is "Rubber"?

"Rubber" refers to elastomeric compounds that consist of various monomer units forming polymers that are heat cured (vulcanized). Polymers are long molecular chains and are derived from the Greek "poly" (many) and "meros" (parts). The base monomer or monomers is used to classify the type of rubber, for example: Nitrile, Silicone or Neoprene.

What is a Rubber Compound?

Rubber is composed of many different ingredients that include the base elastomer, vulcanization agents, fillers and plasticizers. For example, the addition of fillers can reinforce or modify properties, or additional plasticizer can increase elongation and lower durometer.

Why Does Rubber Act "Rubbery"?

A polymer is considered a very viscous liquid or an elastic solid (i.e. rubber). The polymeric chains in rubber tend to be very long and flexible by nature and can rotate about their axis, which results in an entangled mass of contorted chains.

When a deformation of the rubber occurs, these tangled chains uncoil and recoil when the force is released. Therefore, elastic rebound or rubbery behavior is possible due to contortions of long, flexible polymeric chains, which allows rubber to be so resilient.

How is Rubber Made?

The elastomer is the basic component of all rubber recipes and is selected in order to obtain specific physical properties in the final product. Processing aids and softeners, such as oils and plasticizers, modify rubber to aid in mixing or molding operations. Sulfur is one of the most widely used vulcanizing agents to promote crosslinking which is used in conjunction with accelerators and accelerator activators to reduce cure times and enhance physical properties. Carbon black is one of the most common fillers because it reinforces the molecular structure. Antidegradants, such as antioxidants and antiozonants, retard the deterioration of rubber products. Lubricants, colors or any other miscellaneous ingredients may also be added.

What is Vulcanization?

The long, flexible polymeric chains of rubber, when heated, react with vulcanizing agents to form three-dimensional structures. These vulcanizing agents (usually sulfur or peroxide) are necessary to facilitate chemical crosslinking of polymeric chains. Once the rubber has been vulcanized or "cured", physical properties are enhanced and the compound is more resistant to deterioration.

What is Compression Set?

Elastic recovery is a measure of the elastomer's ability to return to its original shape once a compressive force has been removed. Failure of the seal to return to its original shape after compression is the condition termed "compression set" and all seals exhibit some degree of compression set. Determination of the amount of compression set is governed by ASTM designation D395 test procedure.

What is the difference between a Thermoset and Thermoplastic?

One classification method of polymeric materials is according to physical properties at elevated temperatures. Thermoset polymers become permanently "set" in the presence of heat and do not soften in the presence of subsequent heating. Conversely, a thermoplastic material will soften when heated (and eventually liquefy) and harden when cooled. This process is reversible and repeatable, as opposed to thermosetting polymers where the process is irreversible. Also, thermoset polymers possess superior mechanical, thermal, and chemical properties as well as better dimensional stability than thermoplastics. This is why thermoset (rubber) parts are generally preferred for sealing applications.

This section contains descriptions of the elastomers used in seal applications. These elastomers form the base of a wide variety of compounds, designated for specific applications. Every compound has specific characteristics and many compounds have common attributes. Therefore, it is important to consider all aspects of the compound prior to use. Also, as compound availability is customer driven, lead time may vary.

Butyl

Trade Name(s):
Butyl . . . Exxon Chemical, Lanxess

ASTM D1418 Designation: IIR

ASTM D2000/SAE J200 Type, Class: AA, BA

Apple Compound Designation: BU

Standard Color: Black

Description: An all-petroleum product, Butyl is a copolymer of isobutylene and isoprene. Butyl is also known as Polyisobutylene or Polyisobutene.

Key Use(s): Applications requiring an airtight seal; used for chemical weapons, agricultural chemicals, tire inner tubes, etc.

Temperature Range: Standard Compound: -50°F to +250°F

Hardness (Shore A): 40 to 80

Features: With outstanding low permeability to gases, Butyl is especially effective in airtight sealing applications. It also features good to excellent resistance to ozone and sunlight aging.

Butyl further features excellent shock dampening capabilities. Only slightly affected by oxygenated solvents and other polar liquids, Butyl is often utilized in seals for hydraulic systems using synthetic fluids. It is good with MEK, and silicone fluids and greases.

Limitations: Because it is a petroleum product, Butyl has poor resistance to hydrocarbon solvents and oils, and diester-based lubricants. Halogenated butyl has been introduced to expand oil and chemical resistance to this polymer. Chlorobutyl and Bromobutyl have better resistance. These polymers have been accepted by the medical industry for stoppers and septums for pharmaceutical applications.

Chloroprene (Neoprene)

Trade Names(s):
Neoprene . . . Denka Performance Elastomers
Baypren . . . Arlanxeo

ASTM D1418 Designation: CR

ASTM D2000/SAE J200 Type, Class: BC, BE

Apple Compound Designation: CR

Standard Color: Black

Description: One of the earliest of the synthetic materials to be developed as an oil-resistant substitute for Natural Rubber, Neoprene is a homopolymer of chloroprene (chlorobutadiene).

Key Use(s): Numerous component uses in the transportation field. Recommended for exposure to weathering. Preferred sealing material for refrigeration industry.

Temperature Range: Standard Compound:-40°F to +250°F. Special Compounds:-67°F to +250°F. (Dry Heat Only)

Hardness (Shore A): 40 to 90

Features: Neoprene can be used in innumerable sealing applications due to its broad base of such desirable working properties as: good resistance to petroleum oils; good resistance to ozone, sunlight and oxygen aging; relatively low compression set; good resilience; outstanding physical toughness; and reasonable production cost.

Limitations: Neoprene is generally attacked by strong oxidizing acids, esters, ketones, chlorinated, aromatic and nitro hydrocarbons.

Because Nitrile is economically competitive with Neoprene, and generally has superior performance characteristics in most situations, it has largely replaced Neoprene in the o-rings of today.

Epichlorohydrin

Trade Name(s):
Hydrin . . . Zeon

ASTM D1418 Designation: CO, ECO

ASTM D2000/SAE J2000 TYPE, CLASS: CH

Apple Compound Designation: EH

Standard Color: Black

Description: Available in homopolymer (CO), copolymer (ECO), and terpolymer (GECO) formats, Epichlorohydrins are oil resistant compounds.

Key Use(s): Ideal for fuel and air conditioning system components. Used in the petroleum industry where a higher temperature capability than NBR is required.

Temperature Range: Standard Compound: -40°F to 275°F

Hardness (Shore A): 50 to 90

Features: Epichlorohydrin features excellent resistance to hydrocarbon oils and fuels; low solvent and gas permeability; excellent resistance to ozone and weathering; and stable cycling from low to high temperature. Good replacement to butyl when gas permeability and oil resistance are needed.

Limitations: Compression set is only "fair" at elevated temperatures (250°F to 275°F). Epichlorohydrin is attacked by ketones; esters; aldehydes; chlorinated and nitro hydrocarbons; and is not recommended for exposure to brake fluids.

Ethylene/Acrylic (Vamac®)

Trade Name(s):
Vamac® . . . Dupont

ASTM D1418 Designation: AEM

ASTM D2000/SAE J200 Type, Class: EE, EF, EG, EA

Apple Compound Designation: VA

Standard Color: Black

Description: A copolymer of ethylene and methyl acrylate, with small amount of third monomer added to provide a cure to active groups in the polymer chain, Vamac® exhibits properties similar to those of polyacrylate, but with an extended low temperature limit and better mechanicals.

Key Use(s): Seals for automotive applications, such as automatic transmissions and power steering systems.

Temperature Rage: Standard Compound:-13°F to +338°F (Dry Heat Only)

Hardness (Shore A): 50 to 90

Features: Ideal for automotive sealing uses, Vamac® features excellent heat resistance, outstanding resistance to ozone and sunlight aging moderate resistance to swelling in oils, and very low permeability to gases.

Vamac®'s mechanical properties, adhesion to metals, tear resistance, flex life, abrasion resistance and compression set resistance are all rated as "good."

Resistance to water, engine coolant mixtures (glycols), dilute acids and alkalis is also good.

Limitations: Vamac® is not recommended for exposure to concentrated acids, aromatic hydrocarbons, gasoline, ketones, brake fluids and phosphate esters.

Ethylene-Propylene

Trade Name(s):
Vistalon. . . Exxon Mobil
Nordel . . . Dow Chemical
Kaltan . . . Arlanxeo
Royalene . . . Lion Elastomer

ASTM D1418 Designation: EPDM

ASTM D2000/SAE J200 Type, Class: AA, BA, CA, DA

Apple Compound Designation: EP

Standard Color: Black

Description: A copolymer of ethylene and propylene (EPR), combined with a third comonomer diene (EPDM), Ethylene Propylene has gained wide seal industry acceptance for its excellent ozone and chemical resistance characteristics.

Key Use(s): Outdoor weather resistant uses, automotive brake systems, automobile cooling systems, low torque drive belts, watertight applications with low water permeability.

Temperature Range: Standard Compound:-76°F to +275°F. Special Compound:-76°F to 302°F.

Hardness (Shore A): 40 to 95

Features: When compounded using peroxide curing agents, high temperature service can reach +350°F. Good resistance to acids and solvents (i.e. MEK and Acetone).

Limitations: Have no resistance to hydrocarbon fluids.

Fluorocarbon (Viton™)

Trade Name(s):
Viton™ . . . Chemours Company
DAI-EL . . . Daikin
Technoflon . . . Solvay

ASTM D1418 Designation: FKM

ASTM D2000/SAE Type, Class: HK

Apple Compound Designation: VT

Standard Color: Black

Description: Combining high temperature resistance with outstanding chemical resistance, Fluorocarbon-based compounds approach the ideal for a universal o-ring material.

Key Use(s): Seals for aircraft engines. Seals for automotive fuel handling systems. High temperature/low compression set applications. Wide chemical exposure situations. Low outgassing makes excellent vacuum seals.

Temperature Range: Standard Compound:-13°F to +446°F. Special Compounds:-40°F to +446°F.

Hardness (Shore A): 45 to 90

Features: High fluorine grades offer higher resistance to swell in high octane and oxygenated fuel blends. This gives superior performance in Ethanol/ Methanol blended gasoline. Also, Fluorocarbon offers improved resistance to steam for higher temperature services. Low temperature bases can improve performance to-40°F. New polymers being offered have improved chemical resistance and low temperature performance.

Viton™ Extreme™ ETP offers similar chemical compatibility as FFKM with temperature resistance to +446°F.

Special compounds, using new polymer technologies, provide improved low temperature performance with a TR(10) of-40°F and brittleness to-76°F.

Limitations: Fluorocarbons are not recommended for exposure to ketones, amines, low molecular weight esters and ethers, nitro hydrocarbons, hot hydrofluoric or chlorosulfonic acids, or Skydrol® fluids. They are also not recommended for situations requiring good low temperature flexibility.

Fluorosilicone

Trade Name(s):
FE . . . Shin-Etsu
Elastosil. . . Wacker
Silastic LS . . . Dow
FSE . . . Momentive Performance Silicone

ASTM D1418 Designation: FVMQ

ASTM D2000/SAE J200 Type, Class: FK

Apple Compound Designation: FS

Standard Color: Blue

Description: Fluorosilicone combines the good high and low temperature stability of Silicones with the fuel, oil, and solvent resistance of Fluorocarbons.

Key Use(s): Aerospace fuel systems. Auto fuel emission control systems. Primarily for static sealing and low outgassing applications.

Temperature Range: Standard Compound:-75°F to +400°F

Rule of Thumb

When it is said that an elastomer is good for an application, it is meant that some compounds which include that elastomer are acceptable, not all. For instance, some compounds of EP are good for brake fluid applications, but most are not acceptable.

Hardness (Shore A): 40 to 80

Features: Fluorosilicone is most often used in aerospace applications for systems requiring fuel and/or diester-based lubricant resistance up to 400°F.

Although generally specified for aerospace use, due to its excellent fuel resistance and high temperature stability, Fluorosilicone is becoming an increasingly popular material for a wider range of sealing applications.

Featuring good compression set and resilience properties, fluorosilicone compounds are suitable for exposure to air, sunlight, ozone, chlorinated and aromatic hydrocarbons.

Limitations: Due to limited physical strength, poor abrasion resistance, and high friction characteristics, Fluorosilicone elastomers are not generally recommended for dynamic sealing. They are predominantly designed for static sealing use. They are also not recommended for exposure to brake fluids, hydrazine, or ketones.

Liquid Silicone Rubber (LSR)

LSR is a low viscosity silicone elastomer intended for use in liquid injection molding (LIM) equipment. It offers high thermal stability and flexibility at low temperatures, high transparency and is easily colored. Also, self-lubricated and electrically conductive grades are available as well as FDA and medical compliant grades. Liquid silicone rubber is widely used to mold complex profiles because of its excellent flow characteristics. See Silicone for other key benefits.

Medical Grade Silicone

When properly prepared, the benefits include fulfillment of USP Class VI and ISO 10993 requirements, and can be sterilized with autoclave, gamma, ETO. Less than 30 day implant and long-term implant grades available. Medical grade pigments are also available.

Limitations: Generally, low abrasion and tear resistance, and high friction characteristics preclude silicones from effectively sealing some dynamic applications. Silicones are also highly permeable to gases and are generally not recommended for exposure to ketones (MEK, acetone) or concentrated acids.

Natural Rubber

ASTM D1418 Designation: NR

ASTM D2000/SAE J200 Type, Class: AA

Apple Compound Designation: NA

Standard Color: Black

Description: Natural Rubber is the vulcanized product of the juice of the Hevea tree (latex).

Key Use(s): Seals in brake systems. Seals in food and beverage applications. Most popular material for non-hydraulic sealing applications. Mainly used for dampeners due to its ability to absorb vibration.

Temperature Range: Standard Compound:-58°F to +158°F (Dry Heat Only)

Hardness (Shore A): 40 to 90

Features: Natural Rubber features high tensile strength, high resilience, high abrasion and high tear resistance properties, with a good friction surface and excellent adhesion to metals. Until the invention of synthetic elastomers in the 1930's, Natural Rubber was the only polymer available for o-ring manufacture.

Natural Rubber features good resistance to organic acids and alcohols, with moderate resistance to aldehydes.

Limitations: Not widely used in sealing industry due to poor compression set performance and lack of resistance to many fluids. Widely banned for medical applications.

Nitrile (Buna-N)

Trade Name(s):
Perbunan . . . Arlanxeo
Nipol . . . Zeon
Krynac . . . Arlanxeo

ASTM D1418 Designation: NBR

ASTM D2000/SAE J200 Type, Class: BF, BG, BK, CH

Apple Compound Designation: BN

Standard Color: Black

Description: Presently, the seal industry's most widely used and economical elastomer, Nitrile combines excellent resistance to petroleum-based oils and fuels, silicone greases, hydraulic fluids, water and alcohols, with a good balance of such desirable working properties as low compression set, high tensile strength and high abrasion resistance. Use of Carboxylated Nitrile can have superior abrasion resistance, while still having improved oil resistance.

Key Use(s): Oil resistant applications of all types. Low temperature military uses. Off-road equipment. Automotive, marine, aircraft fuel systems. Can be compounded for FDA applications.

Temperature Range: Standard Compound:-40°F to +257°F. Special Compounds:-67°F to +275°F (Dry Heat Only)

Hardness (Shore A): 40 to 90

Features: Comprised of the copolymer butadiene and acrylonitrile, in varying proportions. Use of Carboxylated Nitrile can have superior abrasion resistance, while still having improved oil resistance.

Limitations: Nitrile compounds are attacked by small amounts of Ozone. Phthalate type plasticizers are commonly used in compounding Nitrile rubber. These plasticizers can migrate out and cause problems with certain plastics. Also, new regulation on certain phthalates have limited their use.

Nitrile, Hydrogenated (HNBR)

Trade Name(s):
Zetpol . . . Zeon
Therban . . . Arlanxeo

ASTM D1418 Designation: HNBR

ASTM D2000/SAE J200 Type, Class: DH

Apple Compound Designation: HN, ZT

Standard Color: Black

Description: HNBR is the product of the hydrogenation of Nitrile rubber, resulting in varying degrees of saturation of the polymeric chain, along with a range of enhanced physical strength and chemical resistance properties.

Key Use(s): Oil resistant applications, including exposure to such oil additives as detergents, antioxidants and anti-wear agents. Exposure to oil soured with metal sludge. Seals for oil well applications. Seals for automotive fuel handling systems. Seals for general industrial usage.

Temperature Range: Standard Compound:-30°F to +300°F. (Dry Heat Only) Special Compounds:-76°F to +347°F.

Hardness (Shore A): 50 to 90

Features: Like Nitrile, increasing acrylonitrile content improves oil resistance at a cost of reduced low temperature performance. Saturation of polymer chains improves ozone and weathering resistance. Higher physical properties are good for downhole applications where high pressure is used.

Limitations: Like Nitrile, HNBR is not recommended for exposure to ethers, esters, ketones, or chlorinated hydrocarbons.

Perfluoroelastomer®

Trade Name(s):
Chemraz . . . Green, Tweed and Co.
Kalrez . . . DuPont
Tecnoflon PFR . . . Solvay

ASTM D1418 Designation: FFKM

ASTM D2000/SAE J200 Type, Class: N/A

Apple Compound Designation: KA

Standard Color: Black

Description: FFKM parts are made from a perfluoroelastomer possessing exceptional resistance to degradation by aggressive fluids and/or gases.

Key Use(s): Seals for use in the chemical and petroleum industries as well as for the manufacturing of semiconductors and analytical and process instruments. It is also used for high temperature applications and for paint and coating operations.

Temperature Range: Standard Compound:-13°F to +600°F

Hardness (Shore A): 65 to 90

Features: FFKM combines the toughness of an elastomeric material with the chemical inertness of Teflon™. It resists attack by nearly all chemical reagents and provides long-term service where corrosive additives can cause other elastomers to swell or degrade. In addition, FFKM parts are less likely to cold flow than Teflon™ seals.

Limitations: Withstanding degradation by virtually ALL chemicals, FFKM can swell significantly when exposed to some fluorinated solvents, fully halogenated freons and uranium hexafluoride. In addition, FFKM parts should not be exposed to molten or gaseous alkali metals.

As the thermal coefficient of expansion for FFKM is stated by the manufacturer to be “about 50% greater than for fluoroelastomers”, gland volume may have to be increased to allow for this expansion in elevated temperature situations.

Because of its high cost, FFKM is generally used when no other elastomer is appropriate.

Polyacrylate

Trade Name(s):
HyTemp ACM . . . Zeon

ASTM D1418 Designation: ACM

ASTM D2000/SAE J200 Type, Class: DH; DF

Apple Compound Designation: PY

Standard Color: Black

Description: Polyacrylates are copolymers (ethyl acrylates) possessing outstanding resistance to petroleum fuels and oils.

Key Use(s): Sealing automatic transmissions and power steering systems. Sealing petroleum oils up to 300°F.

Temperature Range: Standard Compound: -25°F to +300°F

Hardness (Shore A): 40 to 90

Features: With excellent resistance to hot oil, automatic transmission and Type A power steering fluids, the greatest use for Polyacrylate is found in automobile manufacture, where o-rings of this material are employed to seal components of automatic transmission and power steering systems.

Highly resistant to sunlight and ozone degradation, Polyacrylate also features an enhanced ability to resist flex cracking.

Limitations: While resistance to hot air aging is superior to Nitrile, Polyacrylate strength, compression set, water resistance properties and low temperature capabilities are inferior to many other polymers.

Polyacrylates are also not generally recommended for exposure to alcohol, glycols, alkalis, brake fluids, or to chlorinated or aromatic hydrocarbons.

Polyurethane, Cast

Trade Name(s):
Vibrathane . . . Lanxess

ASTM D1418 Designation: No designation at the time of publication.

ASTM D2000/SAE J200 Type, Class: No designation at the time of publication.

Apple Compound Designation: CP

Standard Color: Amber

Description: Cast Polyurethane is outstanding over other o-ring elastomers in abrasion resistance and tensile strength. Additionally, Cast Polyurethane surpasses the performance of Millable Polyurethane in its higher tensile strength.

Key Use(s): Seals for high hydraulic pressures. Situations where highly stressed parts are subject to wear. Used for wheels, rolls, slurry parts, bumpers, couplers, and shock absorbers. Wiper seals for axially moving piston rods.

Temperature Range: Standard Compound: -30°F to +175°F

Hardness (Shore A): 70 and 90

Features: With tensile strength of up to 6,000 psi, elongation of 350 to 650%, and exceedingly high abrasion resistance, the physical properties of Cast Polyurethane are among the best of all o-ring elastomers.

Although they swell slightly upon exposure, Cast Polyurethane compounds feature excellent resistance to mineral-based oils and petroleum products, aliphatic solvents, alcohols and ether. They are also compatible with hydraulic fluids, weak acids and bases, and mixtures containing less than 80% aromatic constituents.

Limitations: Cast Polyurethanes are not recommended for exposure to concentrated acids and bases, ketones, esters, very strong oxidizing agents, pure aromatic compounds and brake fluids. With the exception of special compounds, they are also not recommended for exposure to hot water or steam.

Polyurethane, Millable

Trade Name(s):
Millathane® . . . TSE Industries Inc.

ASTM D1418 Designation: AU, EU

ASTM D2000/SAE J200 Type, Class: BG

Apple Compound Designation: MP

Standard Color: Black

Description: Millable Polyurethane is outstanding over most other o-ring elastomers in abrasion resistance and tensile strength.

Key Use(s): Seals for high hydraulic pressures. Situations where highly stressed parts are subject to wear.

Temperature Range: Standard Compound: -30°F to +175°F

Hardness (Shore A): 40 to 90

Features: Millable Polyurethane offers superior seal performance in hydraulic situations, where high pressures, shock loads, or abrasive contamination is anticipated.

Millable Polyurethane possesses chemical compatibility similar to that of Nitrile, offering good resistance to petroleum-based oils, hydrocarbon fuels and hydraulic fluids, the oxidizing effects of ozone, and the aging effects of sunlight. It also has good tear resistance.

Limitations: Unless specially compounded, at elevated temperatures Millable Polyurethane begins to soften, losing its physical strength and chemical resistance advantages over other polymers.

Tending to rapidly deteriorate when exposed to concentrated acids, ketones, esters, chlorinated and nitro hydrocarbons, Millable Polyurethanes are also prone to hot water and steam degradation.

Silicone

Trade Name(s):
Elastosil . . . Wacker
KE . . . Shin-Etsu
Silastic . . . Dow
Silplus . . . Momentive Performance Materials

ASTM D1418 Designation: MQ, PMQ, VMQ, PVMQ

ASTM D2000/SAE J200 Type, Class: FC, FE, GE

Apple Compound Designation: SL

Standard Color: Red

Description: A group of elastomers, made from silicon, oxygen, hydrogen and carbon, Silicones are renowned for their retention of flexibility and low compression set characteristics, within one of the widest working temperature ranges for elastomers.

Key Use(s): Static seals in extreme temperature situations. Seals for medical devices, compatible with FDA regulations. Low outgassing and excellent dampening properties.

Temperature Range: Standard Compound:-85°F to +400°F. Special Compounds:-148°F to +400°F.

Hardness (Shore A): 5 to 80

Features: Phenyl (PVMQ) based silicones can perform to-148°F. Metal fillers and conductive carbon black make silicone conductive for EMF/RF applications.

Styrene Butadiene

Trade Name(s):
Too numerous to list.

ASTM D1418 Designation: SBR

ASTM D2000/SAE J200 Type, Class: AA, BA

Apple Compound Designation: SB

Standard Color: Black

Description: Also known as Buna S, or GR-S (Government Rubber-Styrene), Styrene Butadiene was the elastomer substituted for Natural Rubber during World War II. Compounded properties are similar to those of Natural Rubber.

Key Use(s): Isolation dampeners

Temperature Range: Standard Compound:-50°F to +212°F (Dry Heat Only)

Hardness (Shore A): 40 to 90

Features: The main use for Styrene Butadiene today is in the manufacture of automobile tires.

Limitations: SBR is not recommended for exposure to petroleum oils, most hydrocarbons, strong acids, or ozone.

This material is seldom used in modern sealing applications. It has been replaced by better performing materials.

Tetrafluoroethylene/Propylene (AFLAS®)

Trade Name(s):

AFLAS® . . . AGC Chemicals

ASTM D1418 Designation: FKM

ASTM D2000/SAE J200 Type, Class: HK

Apple Compound Designation: AF

Standard Color: Black

Description: A copolymer of tetrafluoroethylene/propylene, TFE/P can offer a combination of high temperature and chemical resistance.

Key Use(s): Seals for oil field, aerospace, chemical and general industrial environments.

Temperature Range: Standard Compound: +14°F to +446°F

Hardness (Shore A): 60 to 90

Features: Resistance to a wide range of chemicals, high temperatures and electrical capabilities give broad application diversity. TFE/P have resistance to acids and bases, steam/hot water, corrosion inhibitors, oils and lubricants, and industrial solvents. TFE/P also offer improved low temperature properties over most fluoroelastomers.

Limitations: Tests have shown that other FKM elastomers are recommended for automotive fuels since they have less volume swell than TFE/P. Also, TFE/P has shown to have less than desirable results when exposed to toluene, ethers, ketones and acetic acid.

Rule of Thumb | **Material cost does not correlate with performance, it depends on the application.**

Thermoplastic Elastomers

Description: Thermoplastic elastomers combine the processing advantages of plastics with the rubber-like performance of elastomers. Known as two-phase systems, these copolymers are comprised of both hard (plastic) and soft (elastomeric) molecular regions, with each region contributing advantages and limitations to the final material performance. Chemically, fully-cured thermoset rubber particles are dispersed throughout a continuous thermoplastic matrix. Examples of this class of material are Santoprene™ and Geolast™ from Exxon Mobil and Dynaflex™ from PolyOne.

Key Use(s): A broad range of applications that spans from bumpers to bellows, vibrational dampers, couplers, and grommets. Also used throughout the automotive, major and small appliances, and aerospace industries.

Features: In virtually all cases, the substitution of these materials for traditional thermosetting materials results in such benefits as significantly increased production speeds (via conventional plastic injection molding machines) and the ability to reuse clean scrap without a loss in physical properties. This results in a reduced part cost due to minimize scrap loss.

Also, they are available in a broad range of durometers and colors and, by adjusting the percentage of hard (plastic) segments in the copolymer matrix, the physical properties can be modified. For example, as styrene content is increased in polystyrene elastomer block copolymers, they change from weak rubber-like materials to strong elastomers, to leathery materials, to finally hard, glass-like products (with styrene content above 75%).

Limitations: The physical properties of thermoplastic elastomers are highly dependent upon the properties of the plastic and elastomeric regions of the copolymer. Consequently, as temperature changes, so does the behavior of the TPE. The low temperature limit is defined by the glass transition temperature of the rubber phase, below which the material is brittle. Likewise, the high temperature limit is defined by the melting point of the plastic phase, above which the material softens and begins to flow. This results in lowering the overall heat resistance of the copolymer.

Also, as temperature increases, compression set increases which limits the overall component size and complexity due to stack-up tolerances. Likewise, the chemical resistance of the thermoplastic is determined by the limits of BOTH materials comprising the system.

Rule of Thumb | **You must test all seals in their actual environment because every application is unique.**

PLEASE NOTE THE FOLLOWING

The applications, suggestions and recommendations contained in this book are meant to be used as a professional guide only. Because no two situations or installations are the same, these comments, suggestions, and recommendations are necessarily general and should not be relied upon by any purchaser without independent verification based on the particular installation or use. We strongly recommend that the seal you select be rigorously tested in the actual application

General Properties Of O-Ring Elastomers

E Excellent
G Good
F Fair
P Poor
● No designation at time of publication

Elastomers	Apple Rubber Material Designation	ASTM D1418 Designation	ASTM D2000/SAE J200 Type, Class	Economy	Low/High Temp. Limits °F	Tensile Strength	Hardness Range Shore A	Resilience-Rebound	Compression Set	Adhesion to Metals	Abrasion Resistance	Tear Resistance	Weather Resistance	Ozone Resistance	Water Swell Resistance	Steam Resistance Under 300°F	Gas Impermeability	Acid Resistance, Conc.	Alkali Resistance, Conc.	Alcohols	Lubricating Oils Petroleum Based	Aliphatic Hydrocarbons	Aromatic Hydrocarbonds	Halogenated Hydrocarbons	Phosphate Ester	Polar Solvents (keytones)
Butyl	BU	IIR	AA; BA	F	-50 to +250	F-G	30-90	P-G	F-G	G	F-G	G	G	G	E	G	E	G-E	G-E	E	P	P	P	P	G	G
Chloroprene (Neoprene®)	CR	CR	BC; BE	G	-40 to +250	F	40-90	G	F-G	E	G-E	E	G-E	G-E	F-G	G	F-G	P	P	G-E	G	F	P	P	P	P
Epichlorohydrin	EH	CO; ECO	CH	F	-40 to +275	F	50-90	G	G	F-G	G	E	G-E	G	F-G	F-G	F	F	P-G	G	G-E	G	E	G	P	F
Ethylene Acrylic (Vamac®)	VA	AEM	EE	F	-13 to +338	F	50-90	F	P-G	G	G	G	E	E	G	P	P	P-G	P-G	F	G	G	P	F-G	P	G
Ethylene-Propylene	EP	EPM; EPDM	AA; BA; CA; DA	E	-40 to +275	G	40-95	G	F-G	G-E	G-E	F-G	E	E	E	E	F	E	E	G-E	P	P	P	P	E	G-E
Fluorocarbon	VT	FKM	HK	F	-13 to +446	F	45-90	F-G	G-E	G-E	G	F-G	E	E	G	P-G	G-E	E	P	F-G	E	E	E	E	G	P
Fluorosilicone	FS	FVMQ	FK	P	-75 to +400	P	40-80	E	G-E	G-E	P	P	E	E	E	F-G	P-G	G	F-G	G	E	F-G	G	G	P-G	P
Natural Rubber	NA	NR	AA	G	-58 to +158	G-E	40-90	E	G	E	E	E	P	P	E	P	F-P	F-G	F-G	G	P	P	P	P	P	F-G
Nitrile (Buna-N)	BN	NBR; XNBR	BF; BG; BK; CH	E	-40 to +257	G	40-90	G	G	E	G-E	G	P-F	P	G	F-G	F-G	F-G	P-G	F-G	G-E	G-E	F-G	P-F	P	P
Nitrile, Hydrogenated	HN	HNBR	DH	F	-30 to +300	G-E	50-90	G	G-E	G-E	G-E	G	G-E	G	G	E	G	G	G	E	E	G-E	F-P	P	P	P
Perfluoroelastomer (Kalrez®, Chemraz®)	KA	FFKM	KK	P	-13 to +600	F-G	65-90	F	F-G	G-E	F-G	F	E	E	G	E	G-E	E	E	E	G	E	E	F-G	E	P
Polyacrylate	PY	ACN	DF; DH	F	-25 to +300	F	40-90	F	G	G	F-G	E	E	G	P	P	G-E	P	F	P	F-G	E	P-G	P-G	P	P
Polytetrafluoro-ethylene (Teflon™)	TF	FEP	●	P	-300 to +450	F	98	P	P	P	E	E	E	G	G	E	G	E	E	E	E	E	E	E	P	P
Polyurethane, Cast	CP	AU; EU	BG	P	-30 to +175	E	70 & 90	F-G	P-G	E	E	E	E	G	G	P	G-E	P	P	G	G	P	F	P	P	P
Polyurethane, Millable	MP	AU; EU	BG	F	-30 to +175	G-E	40-90	F-G	G	E	G	E	E	E	G	P	G-E	P	P	G	G	P	F	P	P	P
Silicone	SL	MQ; PMQ VMQ; PVMQ	FC; FE; GE	G	-85 to +400	P	5-80	G-E	G-E	E	P	F-G	E	E	E	E	P	F-G	F-G	F-G	P	P	P	P	P-G	P
Styrene Butadiene	SB	SBR	AA; BA	E	-50 to +212	G	40-90	P-G	G	E	E	P	F-G	P	G	F-G	F	G	F-E	G	P	P	P	P	G	P-G
Tetrafluoroethylene/ Propylene (AFLAS®)	AF	FKM	HK	P	+14 to +446	F	60-90	F-G	F-G	G	G	G	E	E	E	G-E	G	G	E	E	G	F	P	P	G	F

Chemical Compatibility Table

All recommendations for Room Temperature	AFLAS® [TFE/P]	Nitrile (Buna-N)	Butyl	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon (Viton™)	Fluorosilicone	FFKM	Natural Rubber	Chloroprene (Neoprene)	Nitrile, Hydrogenated	Polyacrylate	Polyurethane (Millable, Cast)	Silicone	Styrene Butadiene	Teflon™ Virgin	Vamac®
Acetaldehyde	◆	■	●	●	●	■	■	●	▲	◆	■	■	■	●	◆	●	□
Acetamide	●	●	●	□	●	▲	●	●	■	●	●	■	■	◆	■	●	●
Acetic Acid, Glacial	■	■	●	■	●	◆	■	●	▲	■	▲	■	■	▲	▲	●	■
Acetic Anhydride	●	◆	▲	■	▲	■	■	●	▲	▲	■	■	■	◆	■	●	■
Acetone	■	■	●	■	●	■	■	●	◆	■	◆	■	■	■	◆	●	■
Acetophenone	▲	■	●	■	●	■	■	●	■	■	■	■	■	■	■	●	□
Acetyl Chloride	●	■	■	■	■	●	●	●	■	■	■	■	■	◆	■	●	□
Acetylene Gas	●	●	●	▲	●	●	◆	◆	▲	●	▲	■	▲	◆	◆	●	□
Acrylonitrile	●	■	■	□	■	■	■	●	◆	●	■	■	■	■	■	●	□
Air, Below 200°	●	●	●	▲	■	●	●	●	◆	■	▲	●	●	●	▲	●	●
Alkazene	▲	■	■	■	■	▲	▲	●	■	■	■	■	■	■	■	●	□
Aluminum Acetate	▲	▲	●	▲	●	■	■	●	●	▲	▲	■	■	■	▲	●	□
Aluminum Chloride	●	●	●	●	●	●	●	●	●	●	●	●	◆	▲	●	●	●
Aluminum Fluoride	●	●	●	●	●	●	●	●	▲	●	●	□	■	▲	●	●	□
Aluminum Nitrate	●	●	●	●	●	●	□	●	●	●	●	□	◆	▲	●	●	□
Aluminum Sulfate	●	●	●	□	●	●	●	●	●	●	●	■	■	●	■	●	●
Ammonia, Gas, Hot	●	■	▲	□	▲	■	■	●	■	▲	■	■	■	●	■	●	■
Ammonia, Gas, Cold	●	●	●	□	●	■	■	●	●	●	●	■	◆	●	●	●	■
Ammonia, Anhydrous	●	▲	●	□	●	■	■	●	■	●	▲	■	■	◆	■	●	■
Ammonium Carbonate	●	■	●	▲	●	●	□	●	●	●	■	■	■	◆	●	●	□
Ammonium Chloride	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ammonium Hydroxide, Concentrated	▲	■	●	▲	●	▲	▲	●	■	●	□	■	■	●	■	●	■
Ammonium Nitrate	●	●	●	●	●	●	●	●	◆	●	●	▲	■	●	▲	●	□
Ammonium Persulfate Solution	▲	■	●	□	●	●	□	●	●	●	■	■	■	■	■	●	□
Ammonium Phosphate	▲	●	●	●	●	●	□	●	●	●	●	●	□	●	●	●	●
Ammonium Sulfate	▲	●	●	□	●	●	●	●	●	●	●	■	●	●	●	●	●
Amyl Acetate	◆	■	◆	■	◆	■	■	●	■	■	■	■	■	■	■	●	■
Amyl Alcohol	●	▲	▲	●	●	▲	●	●	●	●	▲	■	■	■	▲	●	□
Amyl Borate	▲	●	■	●	■	●	□	●	■	●	●	▲	□	■	■	●	□
Amyl Chloronaphthalene	▲	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Aniline	●	■	●	■	●	◆	◆	●	■	■	■	■	■	■	■	●	□
Aniline Oil	▲	■	▲	□	▲	■	◆	●	■	■	■	■	■	■	■	●	□
Animal Oil	▲	●	▲	●	●	●	●	●	■	▲	●	●	▲	●	■	●	■
Argon	●	●	▲	□	●	●	▲	●	■	■	●	▲	◆	▲	□	●	□
Arachlor 1248	●	◆	◆	□	◆	●	▲	●	■	■	■	■	■	▲	■	□	□

- ● Good
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- ■ Poor
- □ Insufficient data at time of publication

Chemical Compatibility Table

All recommendations for 70° temperature	AFLAS® [TFE/P]	Nitrile (Buna-N)	Butyl	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon (Viton™)	Fluorosilicone	FFKM	Natural Rubber	Chloroprene (Neoprene)	Nitrile, Hydrogenated	Polyacrylate	Polyurethane (Millable, Cast)	Silicone	Styrene Butadiene	Teflon™ Virgin	Vamac®
Aromatic Fuel 50%	▲	▲	■	□	■	●	▲	●	■	■	▲	□	■	■	■	□	■
Askarel Transformer Oil	▲	▲	■	□	■	●	▲	●	■	■	▲	■	■	■	■	●	□
ASTM Fuel A	●	●	■	●	■	●	▲	●	■	▲	●	●	●	■	■	●	●
ASTM Fuel B	●	◆	■	●	■	●	▲	●	■	■	●	■	■	■	■	●	□
ASTM Fuel C	●	◆	■	□	■	●	▲	●	■	■	▲	■	■	■	■	●	■
ASTM Fuel D	■	◆	■	□	■	●	▲	●	■	■	▲	■	▲	■	■	●	□
ASTM Oil One	●	●	■	■	●	●	●	●	■	●	●	●	●	●	■	●	●
ASTM Oil Two	●	●	■	□	■	●	●	●	■	●	●	●	▲	□	■	●	●
ASTM Oil Three	●	●	■	□	■	●	●	●	■	◆	●	●	●	▲	■	●	▲
ASTM Oil Four	●	▲	■	□	■	●	▲	●	■	■	▲	▲	■	■	■	●	●
Automatic Transmission Fluid	●	●	■	□	■	●	□	●	■	▲	●	●	▲	■	■	●	■
Automotive Brake Fluid	▲	◆	▲	□	●	■	■	●	■	▲	◆	■	■	●	●	●	□
Beer	●	●	●	●	●	●	●	●	●	●	●	■	▲	●	●	●	▲
Benzaldehyde	●	■	●	■	●	■	◆	●	■	■	■	■	■	■	■	●	■
Benzene	▲	■	■	■	■	●	▲	●	■	■	■	■	■	■	■	●	■
Benzene Sulfonic Acid	▲	■	■	□	■	●	▲	●	■	▲	■	■	■	■	■	●	□
Benzine (Ligroin)	▲	●	■	□	■	●	●	●	■	▲	●	●	▲	■	■	●	■
Benzoic Acid	▲	◆	■	□	◆	●	▲	◆	■	■	◆	◆	■	◆	■	●	□
Benzophenone	▲	◆	▲	□	▲	●	●	●	□	□	□	■	■	■	■	□	□
Benzyl Alcohol	●	■	▲	■	▲	●	▲	●	■	▲	□	■	■	▲	■	●	■
Benzyl Benzoate	▲	■	▲	□	▲	●	●	●	■	■	■	■	□	□	■	●	□
Benzyl Chloride	●	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Bleach Liquor	●	◆	●	□	●	●	▲	●	■	□	▲	■	■	▲	□	●	□
Borax Solutions	□	▲	●	□	●	●	▲	●	▲	●	●	▲	●	▲	▲	●	●
Boric Acid	●	●	●	●	●	●	●	●	●	●	●	■	●	●	●	●	●
Brake Fluid	●	■	●	■	●	■	■	●	■	■	▲	■	□	□	●	●	■
Bromine Gas	●	■	■	□	■	●	▲	●	■	■	□	■	■	■	■	●	□
Bromobenzene	▲	■	■	■	■	●	●	●	■	■	■	■	■	■	■	●	■
Bunker Oil	▲	●	■	□	■	●	●	●	■	■	●	●	▲	▲	■	●	■
Butadiene Monomer	▲	◆	■	■	■	●	▲	●	■	■	■	■	■	■	■	●	□
Butane	▲	●	■	●	■	●	●	●	■	●	●	●	●	●	■	●	●
Butter	●	●	◆	●	●	●	●	●	■	▲	●	●	●	▲	■	●	●
Butyl Alcohol	●	●	▲	□	▲	●	▲	●	●	●	●	■	■	▲	●	●	●
Butyl Carbitol	▲	■	●	□	●	◆	■	●	■	◆	■	■	■	■	■	●	■
Butyl Cellosolve	▲	◆	●	□	●	■	■	●	■	■	◆	■	■	■	■	●	■

● Good
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Chemical Compatibility Table

All recommendations for 70° temperature	AFLAS® [TFE/P]	Nitrile (Buna-N)	Butyl	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon (Viton™)	Fluorosilicone	FFKM	Natural Rubber	Chloroprene (Neoprene)	Nitrile, Hydrogenated	Polyacrylate	Polyurethane (Millable, Cast)	Silicone	Styrene Butadiene	Teflon™ Virgin	Vamac®
Butyraldehyde	▲	■	▲	□	▲	■	■	●	■	◆	■	■	■	■	■	●	■
Calcium Carbonate	●	●	●	□	●	●	●	●	●	●	●	■	■	●	●	●	●
Calcium Chloride	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Calcium Hydroxide	●	●	●	●	●	●	●	●	●	●	●	■	●	●	●	●	□
Calcium Hypochlorite	●	▲	●	▲	●	●	▲	●	◆	◆	▲	■	■	▲	●	●	▲
Calcium Nitrate	●	●	●	●	●	●	●	●	●	●	●	●	●	▲	●	●	□
Calcium Sulfide	●	●	●	▲	●	●	●	●	▲	●	●	■	●	▲	▲	●	□
Carbitol	●	▲	▲	□	▲	▲	▲	●	▲	◆	▲	■	■	▲	▲	●	■
Carbolic Acid (Phenol)	□	■	▲	□	▲	●	●	●	■	■	■	■	◆	■	■	●	■
Carbon Bisulfide	●	◆	■	■	■	●	●	●	■	■	◆	◆	■	■	■	●	□
Carbon Monoxide	●	●	●	▲	●	●	▲	●	◆	●	●	□	●	●	▲	●	●
Carbon Tetrachloride	■	◆	■	▲	■	●	◆	●	■	■	▲	■	■	■	■	●	■
Castor Oil	●	●	▲	●	▲	●	●	●	●	●	●	●	●	●	●	●	●
Cellosolve	◆	■	▲	■	▲	■	■	●	■	■	■	■	■	■	■	●	■
China Wood Oil, Tung Oil	▲	●	◆	□	■	●	▲	●	■	●	●	●	◆	■	■	●	▲
Chloracetic Acid	□	■	▲	□	●	■	■	●	■	■	■	■	■	□	■	●	□
Chlordane	▲	▲	■	□	■	●	▲	●	■	◆	▲	□	□	■	■	□	□
Chlorinated Solvents	▲	■	■	□	■	●	●	●	■	■	■	■	■	■	■	●	□
Chlorine Dioxide	▲	■	◆	□	◆	●	▲	□	■	■	■	■	■	◆	■	●	□
Chlorine, Wet	□	■	◆	▲	◆	●	▲	●	■	■	◆	■	■	■	■	●	■
Chlorine, Dry	□	■	■	▲	■	●	●	●	■	■	◆	■	■	■	■	●	■
Chlorine Trifluoride	■	■	■	■	■	■	◆	●	■	■	■	■	■	■	■	●	□
Chloroform	■	■	■	□	■	●	■	●	■	■	■	■	■	■	■	●	■
Chlorosulfonic Acid	●	■	■	□	■	■	■	●	■	■	□	■	■	■	■	●	■
Chrome Plating Solution	□	■	▲	□	▲	●	▲	●	■	■	■	■	■	▲	■	●	□
Chromic Acid	●	■	◆	□	◆	●	◆	●	■	■	■	■	■	◆	■	●	■
Citric Acid	●	●	●	●	●	●	●	●	●	●	●	□	●	●	●	●	●
Cod Liver Oil	●	●	●	□	●	●	●	●	■	▲	●	●	●	▲	■	●	●
Coffee	●	●	●	□	●	●	●	●	●	●	●	■	■	●	●	●	●
Coolanol Monsanto	▲	●	■	□	■	●	▲	●	■	▲	●	■	■	■	■	□	□
Corn Oil	▲	●	◆	●	◆	●	●	●	■	◆	●	●	●	●	■	●	●
Creosote, Coal Tar	▲	●	■	■	■	●	●	●	■	▲	●	●	◆	■	■	●	■
Creosylic Acid	●	■	■	□	■	●	▲	●	■	■	●	■	■	■	■	●	□
Crude Oil (Asphalt Base)	●	▲	■	▲	■	●	▲	●	■	◆	●	●	●	■	■	●	●

● Good

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■ Poor

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Cyclohexane	▲	●	■	□	■	●	▲	●	■	◆	●	▲	▲	■	■	●	◆
Denatured Alcohol	●	●	●	●	●	●	●	●	●	●	●	■	■	●	●	●	■
Di-ester Lubricant MIL-L-7808	▲	▲	■	□	■	●	●	●	■	■	▲	▲	■	■	■	●	□
Diacetone Alcohol	▲	■	●	■	●	■	■	●	■	▲	■	■	■	▲	■	●	■
Diacetone	▲	■	●	□	●	■	■	●	■	■	■	■	■	■	■	●	■
Dibenzyl Ether	▲	■	▲	■	▲	■	□	●	■	■	■	□	▲	□	■	●	□
Dibutyl Phthalate	▲	■	◆	▲	●	◆	◆	●	■	■	■	■	■	▲	■	●	■
Dichiaro-Butane	●	▲	■	□	■	●	▲	●	■	■	▲	■	■	■	■	●	□
Diesel Oil	●	●	■	●	■	●	●	●	■	◆	●	▲	◆	■	■	●	●
Diethylamine	■	▲	▲	□	▲	■	■	●	▲	▲	◆	■	◆	▲	▲	●	□
Diethylene Glycol	●	●	●	●	●	●	●	●	●	●	●	▲	■	▲	●	●	□
Dimethyl Formamide	●	▲	▲	□	▲	■	■	●	■	■	◆	■	■	▲	■	●	□
Dimethyl Phthalate	▲	■	▲	□	▲	●	▲	●	■	■	■	■	■	□	■	●	■
Dioxane	■	■	▲	□	▲	■	◆	●	■	■	▲	■	■	■	■	●	□
Diphenyl	●	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Dow Corning 550	□	●	●	□	●	●	▲	●	●	●	●	●	●	◆	●	●	●
Dow Guard	□	●	●	□	●	●	●	●	●	●	●	◆	◆	●	●	□	□
Dowtherm	●	■	■	■	▲	●	●	●	■	■	■	■	■	◆	■	●	□
Elco 28 Lubricant	□	●	■	□	■	●	●	■	■	◆	●	●	●	▲	■	□	●
Epoxy Resins	□	□	●	□	●	■	□	●	□	●	□	□	□	□	□	□	□
Ethane	□	●	■	□	■	●	▲	●	■	▲	●	●	◆	■	■	●	●
Ethanol	●	●	●	●	●	●	●	●	●	●	●	■	■	▲	●	●	■
Ethyl Acetoacetate	■	■	▲	▲	■	■	■	●	■	□	■	■	■	▲	◆	□	●
Ethyl Alcohol	●	●	●	●	●	●	●	●	●	●	●	■	■	▲	●	●	■
Ethyl Benzene	●	■	■	■	■	●	●	●	■	■	■	■	■	■	■	●	■
Ethyl Benzoate	▲	■	●	□	●	●	●	●	●	■	■	■	■	■	■	●	□
Ethyl Cellulose	□	▲	▲	□	▲	■	■	●	▲	▲	▲	■	▲	◆	▲	●	□
Ethyl Chloride	□	●	■	▲	◆	●	●	●	■	■	●	◆	◆	■	▲	●	■
Ethyl Chlorocarbonate	□	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Ethyl Ether	□	◆	■	▲	◆	■	◆	●	■	◆	◆	■	◆	■	■	●	◆
Ethyl Formate	□	■	▲	■	▲	●	●	●	■	▲	■	□	□	□	■	●	□
Ethyl Hexanol	□	●	●	□	●	●	●	●	●	●	□	■	■	▲	●	●	●
Ethyl Mercaptan	□	■	■	■	◆	▲	□	●	■	◆	□	□	●	◆	■	●	□
Ethyl Oxalate	□	●	■	■	●	●	▲	●	●	●	□	■	●	■	●	●	□
Ethyl Pentachlorobenzene		■	■	◆	■	●	▲	●	■	■	□	■	■	■	■	●	□

Chemical Compatibility Table

All recommendations for 70° temperature	AFLAS® [TFE/P]	Nitrile (Buna-N)	Butyl	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon (Viton™)	Fluorosilicone	FFKM	Natural Rubber	Chloroprene (Neoprene)	Nitrile, Hydrogenated	Polyacrylate	Polyurethane (Millable, Cast)	Silicone	Styrene Butadiene	Teflon™ Virgin	Vamac®
Ethyl Silicate	□	●	●	●	●	●	●	●	▲	●	●	□	■	□	▲	●	□
Ethylene	□	●	▲	□	▲	●	●	●	◆	◆	●	▲	▲	□	■	●	□
Ethylene Chloride	□	■	◆	□	■	▲	◆	●	■	■	■	■	■	■	■	□	□
Ethylene Diamine	□	●	●	●	●	■	■	●	▲	●	●	■	■	●	▲	●	□
Ethylene Dichloride	●	■	◆	■	◆	●	◆	●	■	■	□	■	■	■	■	●	■
Ethylene Glycol	●	●	●	●	●	●	●	●	●	●	●	◆	□	●	●	●	●
Ethylene Oxide	□	■	◆	■	◆	■	■	●	■	■	□	■	■	■	■	●	■
Ethylene Trichloride	□	■	◆	□	◆	●	◆	●	■	■	■	■	■	■	■	●	■
Formaldehyde	●	◆	●	▲	●	■	■	●	▲	▲	◆	■	◆	▲	▲	●	■
Freon 11 (MF)	□	▲	■	□	■	▲	▲	▲	■	■	▲	□	■	■	■	●	■
Freon 12	□	●	▲	●	▲	▲	◆	▲	▲	●	●	●	●	■	●	●	□
Freon 13	□	●	●	●	●	●	■	▲	●	●	●	□	◆	■	●	●	□
Freon 21	□	■	■	▲	■	■	□	●	■	■	■	□	□	■	■	●	□
Freon 22	□	■	■	●	●	■	■	●	▲	●	■	▲	■	■	●	●	■
Freon 31	□	■	●	□	●	■	■	▲	▲	●	■	□	□	□	▲	●	□
Freon 32	□	●	●	□	●	■	□	▲	●	●	●	□	□	□	●	●	□
Freon 112	□	▲	■	□	■	▲	□	▲	■	▲	▲	□	▲	■	■	●	□
Freon 113	■	●	■	●	■	▲	■	▲	■	●	●	●	▲	■	▲	●	□
Freon 114	□	●	●	●	■	●	▲	▲	●	●	●	●	●	■	●	●	□
Freon142b	■	●	■	□	■	■	□	▲	▲	●	▲	●	□	■	■	●	□
Freon 502 (F22+F316)	□	▲	●	□	●	■	□	▲	●	●	▲	□	□	□	●	□	□
Freon C318	□	●	●	□	●	■	□	▲	●	●	●	□	□	□	●	●	□
FREON R134A	□	▲	□	□	●	■	□	□	□	●	▲	□	□	□	□	□	□
Freon TF	■	●	◆	●	■	▲	■	▲	■	●	●	□	□	■	▲	●	◆
Fuel Oil	●	●	■	●	■	●	●	●	■	▲	●	●	▲	■	■	●	●
Furan	□	■	■	□	◆	□	□	●	■	■	■	■	■	■	■	●	□
Furfural	▲	■	▲	■	▲	■	■	●	■	■	■	■	◆	□	■	●	■
Furfuryl Alcohol	□	■	▲	□	▲	□	■	●	■	■	■	■	■	■	■	●	□
Gallic Acid	□	▲	▲	□	▲	●	●	●	●	▲	▲	■	■	□	▲	●	□
Gasoline, Automotive	▲	●	■	●	■	●	●	●	■	■	●	■	▲	■	■	●	■
Gelatin	●	●	●	●	●	●	●	●	●	●	●	■	■	●	●	●	●
Glucose	●	●	●	●	●	●	●	●	●	●	●	●	■	●	●	●	●
Glycerin	●	●	●	●	●	●	●	●	●	●	●	◆	●	●	●	●	●
Glycols, General	●	●	●	●	●	●	●	●	●	●	●	■	■	●	●	●	●
Grease, Petroleum Base	●	●	■	▲	■	●	●	●	■	▲	●	●	●	■	■	●	●

● Good

▲ Fair (OK for static seal)

◆ Questionable (OK for static seal)

■ Poor

□ Insufficient data at time of publication

Chemical Compatibility Table

All recommendations for 70° temperature	AFLAS® [TFE/P]	Nitrile (Buna-N)	Butyl	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon (Viton™)	Fluorosilicone	FFKM	Natural Rubber	Chloroprene (Neoprene)	Nitrile, Hydrogenated	Polyacrylate	Polyurethane (Millable, Cast)	Silicone	Styrene Butadiene	Teflon™ Virgin	Vamac®
Helium	□	●	●	□	●	●	●	●	●	●	●	●	●	●	●	●	●
Heptane	▲	●	■	□	■	●	●	●	■	▲	●	●	▲	■	■	●	●
Hexane	●	●	■	●	■	●	●	●	■	▲	●	●	▲	■	■	●	■
Hexyl Alcohol	●	▲	◆	□	◆	●	▲	●	●	▲	●	■	■	▲	▲	●	■
Hydraulic Oil, Petroleum Base	▲	●	■	●	■	●	●	●	■	▲	●	●	●	◆	■	●	●
Hydrazine	▲	▲	●	□	●	■	■	●	■	▲	■	□	■	◆	▲	●	□
Hydrobromic Acid	●	■	●	□	●	◆	●	●	●	■	■	■	■	■	■	●	□
Hydrobromic Acid, Gas	●	■	●	□	●	●	■	●	▲	■	■	■	■	■	◆	●	□
Hydrochloric Acid, cold	●	◆	●	■	●	●	▲	●	▲	◆	◆	■	■	◆	■	●	□
Hydrocyanic Acid	●	▲	▲	□	●	●	▲	●	▲	▲	▲	■	■	◆	▲	●	□
Hydrofluoric Acid, cold	●	■	◆	□	◆	●	■	●	■	■	■	■	◆	■	■	●	□
Hydrogen Gas	●	●	●	●	●	●	◆	●	▲	●	●	▲	●	◆	▲	●	●
Hydrogen Peroxide	●	■	◆	▲	▲	▲	▲	●	■	■	◆	■	□	◆	■	●	□
Hydroquinone	□	◆	▲	□	▲	▲	▲	●	▲	■	■	■	□	□	■	●	■
Iodine	□	▲	▲	□	▲	●	●	●	■	■	●	□	■	◆	▲	●	●
Iso Octane	●	●	■	●	■	●	▲	■	■	●	●	●	▲	■	●	●	■
Isobutyl Alcohol	●	▲	●	□	●	●	▲	●	●	●	▲	■	■	●	▲	●	■
Isopropanol	●	●	●	●	●	●	▲	●	●	▲	▲	■	■	●	●	●	■
Isopropyl Acetate	□	■	▲	□	▲	■	■	●	■	■	■	■	■	■	■	●	■
Isopropyl Chloride	□	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Isopropyl Ether	■	▲	■	□	■	■	◆	●	■	■	▲	◆	▲	■	■	●	■
JP 3 MIL-J5624	▲	●	■	●	■	●	●	●	■	◆	●	▲	◆	■	■	●	□
JP 4 MIL-J5624	□	●	■	●	■	●	●	●	■	◆	●	▲	◆	■	■	●	□
JP 5 MIL-J5624	□	●	■	●	■	●	●	●	■	◆	●	▲	▲	■	■	●	□
JP 6 MIL-J25656	□	●	■	●	■	●	●	●	■	◆	●	▲	◆	■	■	●	□
Kerosene	●	●	■	●	■	●	●	●	■	▲	●	●	●	■	■	●	●
Lacquers	□	■	■	■	■	■	■	●	■	■	■	■	■	■	■	●	□
Lacquer Solvents	■	■	■	■	■	■	■	●	■	■	■	■	■	■	■	●	■
Lard, Animal Fat	●	●	▲	●	▲	●	●	●	■	▲	●	●	●	▲	■	●	●
Lindol, Hydraulic Fluid (Phosphale EslerType)	□	■	●	□	●	▲	◆	●	■	■	●	■	■	◆	■	●	■
Linoleic Acid	□	▲	■	□	■	▲	□	●	■	■	▲	□	□	▲	■	●	□
Linseed Oil	●	●	◆	●	●	●	●	●	■	▲	●	●	▲	●	■	●	●
Liquefied Petroleum Gas (LPG)	●	●	■	●	■	●	◆	●	■	▲	●	◆	●	◆	■	●	●
Lubricating Oils, Petroleum Base	●	●	■	●	■	●	●	●	■	▲	■	●	▲	▲	■	●	●
Lye	●	▲	●	▲	●	▲	●	●	▲	●	▲	■	▲	▲	▲	●	□

● Good

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■ Poor

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Malathion	□	▲	■	□	■	●	▲	●	■	■	▲	□	■	■	■	□	□
Maleic Acid	●	■	▲	□	■	●	□	●	◆	◆	■	■	□	■	■	●	●
Mercuric Chloride	●	●	●	●	●	●	●	●	●	●	●	□	●	●	●	●	□
Mercury	●	●	●	●	●	●	●	●	●	●	●	□	●	●	●	●	●
Methane	●	●	■	●	■	●	▲	●	■	▲	●	▲	◆	■	■	●	●
Methanol	●	●	■	▲	●	◆	●	●	●	●	●	■	■	●	●	●	■
Methyl Acetate	□	■	●	■	●	■	■	●	◆	▲	■	■	■	■	◆	●	■
Methyl Acrylate	□	■	▲	□	▲	■	■	●	■	▲	■	■	■	■	■	●	■
Methyl Alcohol	●	●	●	▲	●	◆	●	●	●	●	●	■	■	●	●	●	●
Methyl Bromide	□	▲	■	□	■	●	●	●	■	■	▲	◆	■	□	■	●	□
Methyl Butyl Ketone	□	■	●	□	●	■	■	●	■	■	■	■	■	■	◆	●	■
Methyl Cellosolve	●	◆	▲	□	▲	■	■	●	■	▲	◆	■	■	■	■	●	■
Methyl Chloride	●	■	◆	□	◆	▲	▲	●	■	■	■	■	■	■	■	●	■
Methyl Ether	□	●	■	□	■	■	●	●	■	◆	●	■	□	●	●	●	□
Methyl Ethyl Ketone (MEK)	■	■	▲	■	●	■	■	●	■	◆	■	■	■	■	■	●	■
Methyl Isobutyl Ketone (MIBK)	■	■	◆	■	▲	■	■	●	■	■	■	■	■	■	■	●	■
Methyl Mercaptan	□	■	◆	■	◆	■	■	●	■	■	■	■	■	■	■	●	□
Methyl Methacrylate	□	■	■	■	◆	■	■	●	■	■	■	■	■	■	■	●	■
Methyl Oleate	□	■	▲	■	▲	▲	▲	●	■	■	■	■	□	■	■	●	□
Methyl Salicylate	▲	■	▲	□	▲	▲	□	●	◆	■	■	□	□	□	◆	●	□
Methylacrylic Acid	□	■	▲	□	▲	■	■	●	■	▲	■	■	■	■	■	●	□
Methylene Chloride	▲	■	■	□	◆	▲	▲	●	■	■	■	■	■	■	■	●	■
MIL-F-25558 (RJ-1)	□	●	■	●	■	●	●	●	■	▲	●	●	●	◆	■	●	□
MIL-F-25656	□	●	■	□	■	●	▲	●	■	■	●	▲	▲	■	■	□	□
MIL-G-25760	□	●	■	▲	■	●	●	●	◆	◆	●	◆	▲	■	◆	□	□
MIL-H-5606	●	●	■	●	■	●	●	●	■	▲	●	●	▲	■	■	□	□
MIL-H-7083	□	●	●	▲	●	▲	●	●	▲	▲	●	◆	◆	●	●	□	□
MIL-J 5624 JP-3, JP-4, JP-5	□	●	■	●	■	●	●	●	■	◆	●	▲	◆	■	■	●	□
MIL-L-25681	□	●	●	●	●	●	▲	●	▲	▲	●	▲	◆	■	●	□	□
MIL-R-25576 (RP-1)	□	●	■	●	■	●	●	●	■	◆	●	●	●	■	■	□	□
MIL-S-3136, Type 1 Fuel	□	●	■	●	■	●	●	●	■	▲	●	▲	▲	■	■	□	□
MIL-S-81087	□	●	●	□	●	●	▲	●	●	●	●	●	●	■	●	□	□
Milk	□	●	●	□	●	●	●	●	●	●	●	■	■	●	●	●	●
Mineral Oils	□	●	■	●	◆	●	●	●	■	▲	●	●	●	▲	■	●	●
Monovinyl Acetylene	□	●	▲	□	▲	●	□	●	▲	▲	●	■	■	▲	▲	●	□

- ● Good
- ▲ Fair (OK for static seal)
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N-Hexaldehyde	□	■	▲	●	●	■	■	●	■	●	■	□	▲	▲	■	■	□
N-Octane	□	▲	■	□	■	●	▲	●	■	▲	▲	■	■	■	■	●	■
Naphtha	●	▲	■	●	■	●	▲	●	■	◆	▲	▲	▲	■	■	●	■
Naphthalene	●	■	■	□	■	●	●	●	■	■	■	□	▲	■	■	●	□
Naphthalenic Acid	▲	▲	■	□	■	●	●	●	■	■	▲	□	□	■	■	●	□
Natural Gas	□	●	■	●	■	●	◆	●	▲	●	●	▲	▲	●	◆	●	●
Neatsfoot Oil	□	●	▲	□	▲	●	●	●	■	■	●	●	●	▲	■	●	□
Nitric Acid (Dilute)	▲	■	■	■	▲	●	▲	●	■	▲	■	■	◆	▲	■	●	■
Nitrobenzene	●	■	▲	■	●	▲	■	●	■	■	■	■	■	■	■	●	■
Nitroethane	●	■	▲	□	▲	■	■	●	▲	◆	■	■	■	■	▲	●	□
Nitrogen, Gas	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Nitrogen Tetroxide	□	■	◆	□	◆	■	■	▲	■	■	■	■	■	■	■	●	□
Nitromethane	●	■	▲	□	▲	■	■	●	▲	▲	■	■	■	■	▲	●	□
Nitropropane	▲	■	▲	□	▲	■	■	●	■	◆	■	■	■	■	▲	●	□
N-Pentane	□	▲	■	□	■	●	▲	●	■	▲	▲	■	■	■	■	●	□
Octyl Alcohol	□	▲	◆	□	◆	●	▲	●	▲	▲	▲	■	■	▲	▲	●	■
OleicAcid	●	◆	■	●	■	▲	□	●	■	◆	◆	■	▲	■	■	●	□
Oleum Spirits	□	▲	■	■	■	●	▲	●	■	◆	▲	◆	■	■	■	●	■
Oronite 8200	□	▲	■	□	■	●	●	□	■	●	▲	□	●	■	■	□	□
Oxalic Acid	●	▲	●	◆	●	●	●	●	▲	▲	▲	▲	▲	▲	●	●	●
Oxygen, Cold	●	▲	●	▲	●	●	●	●	▲	●	■	▲	●	●	▲	●	□
Oxygen, 200-400°F	●	■	■	■	◆	▲	■	●	●	■	■	■	■	▲	■	●	□
Ozone	●	■	▲	●	●	●	▲	●	■	▲	◆	▲	●	●	■	●	●
Peanut Oil	●	●	◆	●	◆	●	●	●	■	◆	●	●	▲	●	■	●	□
Petroleum Oil, below 250°F	□	●	■	●	■	●	▲	●	■	▲	●	▲	▲	▲	■	●	□
Phenol	●	■	▲	◆	▲	●	●	●	■	◆	■	■	◆	■	■	●	■
Phenylhydrazine	●	■	▲	□	▲	●	□	●	●	■	■	■	□	□	▲	●	□
Phosphoric Acid 20%	●	▲	▲	□	●	●	▲	●	▲	▲	▲	◆	●	▲	▲	●	▲
Phosphorous Trichloride	●	■	●	□	●	●	●	●	■	■	■	■	□	□	■	●	□
Pine Oil	●	■	■	▲	■	●	●	●	■	■	■	●	●	■	■	●	□
Potassium Nitrate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Potassium Sulfate	●	●	●	●	●	●	●	●	▲	●	●	■	●	●	■	■	□
Producer Gas	□	●	■	□	■	●	▲	●	■	▲	●	▲	●	▲	■	▲	□
Propane	□	●	■	●	■	●	▲	●	■	▲	●	●	●	■	■	●	●
Propanol	●	●	●	●	●	●	●	●	●	●	●	■	■	●	●	■	■

- ● Good
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Propyl Acetate	□	■	▲	■	▲	■	■	●	■	■	■	■	■	■	■	■	□
Propyl Alcohol	●	●	●	●	●	●	●	●	●	●	●	■	■	●	●	●	■
Propylene	□	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Propylene Oxide	□	■	▲	□	▲	■	■	●	■	■	■	■	■	■	■	●	□
Pydraul, 230C, 312C, 540C	□	■	■	■	■	●	■	●	■	■	■	■	■	■	■	●	■
Pydraul, 30E, SOE, 65E, 90E	□	■	●	■	●	●	●	●	■	■	■	■	■	●	■	●	■
Pydraul, 10E	□	■	●	■	●	●	■	●	■	■	■	■	■	■	■	●	□
Pyranol, Transformer Oil	□	●	■	■	■	●	●	●	■	▲	●	●	▲	■	■	●	●
Pyrogard 42,43, 53, 55 (Phosphate Ester)	□	■	●	□	●	●	■	□	■	■	■	■	■	■	■	●	□
Radiation	▲	◆	■	□	▲	◆	■	●	◆	◆	◆	◆	◆	▲	◆	●	◆
Rapeseed Oil	□	▲	●	●	●	●	●	●	■	▲	▲	▲	▲	■	■	●	□
Red Oil (MIC-H-5606)	□	●	■	●	■	●	●	●	■	▲	●	●	●	■	■	●	□
RJ-1 (MIL-F-25558)	□	●	■	●	■	●	●	●	■	▲	●	●	●	■	■	□	□
RP-1 (MIL-R-25576)	□	●	■	●	■	●	●	●	■	▲	●	●	●	■	■	□	□
Sea Water	●	●	●	□	●	●	●	●	●	▲	●	■	▲	●	●	●	●
Silicone Greases	●	●	●	●	●	●	●	●	●	●	●	●	●	◆	●	●	●
Silicone Oils	●	●	●	●	●	●	●	●	●	●	●	●	●	■	●	●	●
Silver Nitrate	●	▲	●	■	●	●	●	●	●	●	▲	●	●	●	●	●	□
Skydrol 500	▲	■	▲	■	●	■	◆	●	■	■	■	■	■	◆	■	●	■
Sodium Bicarbonate	●	●	●	●	●	●	●	●	●	●	●	■	●	●	●	●	●
Sodium Carbonate	●	●	●	●	●	●	●	●	●	●	●	■	▲	●	●	●	●
Sodium Chloride	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Sodium Hydroxide	●	▲	●	▲	●	▲	▲	●	●	●	▲	◆	■	▲	●	●	□
Soybean Oil	●	●	◆	●	◆	●	●	●	■	▲	●	●	▲	●	■	●	▲
Steam to 350°F	●	■	■	■	◆	■	■	●	■	■	◆	■	■	■	■	●	■
Stearic Acid	●	▲	▲	▲	▲	●	◆	●	▲	▲	▲	■	●	▲	●	●	□
Stoddard Solvent	●	●	■	●	■	●	●	●	■	▲	●	●	●	■	■	●	◆
Styrene	▲	■	■	□	■	▲	◆	●	■	■	■	■	◆	■	■	●	■
Sucrose Solutions	●	●	●	□	●	●	●	●	●	●	▲	■	■	●	●	●	□
Sulfur Chloride	□	■	◆	□	■	●	●	●	■	◆	■	■	◆	◆	■	▲	□
Sulfur Dioxide Gas, Dry	□	■	▲	□	●	▲	▲	●	▲	■	■	■	□	▲	◆	●	▲
Sulfur Dioxide Gas, Wet	●	■	●	□	●	▲	▲	●	■	▲	■	■	◆	▲	□	●	▲
Sulfur Dioxide, liquefied Under Pressure	□	■	▲	□	●	▲	▲	●	■	■	■	■	□	▲	■	□	□
Sulfur Hexafluoride	□	▲	●	●	●	●	▲	●	■	●	▲	■	▲	▲	■	●	□
Sulfur Trioxide	□	■	▲	□	▲	●	▲	●	▲	■	■	■	■	▲	■	●	□

● Good
▲ Fair (OK for static seal)
◆ Questionable (OK for static seal)
■ Poor
□ Insufficient data at time of publication

Chemical Compatibility Table

All recommendations for 70° temperature	AFLAS® [TFE/P]	Nitrile (Buna-N)	Butyl	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon (Viton™)	Fluorosilicone	FFKM	Natural Rubber	Chloroprene (Neoprene)	Nitrile, Hydrogenated	Polyacrylate	Polyurethane (Millable, Cast)	Silicone	Styrene Butadiene	Teflon™ Virgin	Vamac®
Sulfuric Acid (Concentrated)	●	■	■	■	◆	●	■	●	■	■	■	■	■	■	■	●	■
Sulfurous Acid	●	▲	●	□	▲	◆	□	●	▲	▲	▲	■	■	■	▲	●	□
Tannic Acid	●	●	●	▲	●	●	●	●	●	●	●	■	●	▲	▲	●	▲
Tartaric Acid	●	●	▲	▲	▲	●	●	●	◆	▲	●	□	●	●	▲	●	▲
Tertiary Butyl Alcohol	●	▲	▲	□	▲	●	▲	●	▲	▲	▲	■	■	▲	▲	●	■
Tertiary Butyl Mercaptan	□	■	■	□	■	●	■	●	■	■	■	■	■	■	■	●	□
Tetrabromoethane	□	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Tetrabutyl Titanate	□	▲	▲	□	●	●	●	●	▲	▲	▲	□	□	□	▲	●	□
Tetrachloroethane	□	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Tetrachloroethylene	□	■	■	□	■	●	▲	●	■	■	■	■	■	■	■	●	□
Tetraethyl Lead	□	▲	■	□	■	●	▲	●	■	▲	▲	□	▲	□	■	●	□
Tetrahydrofuran	□	■	□	□	◆	■	■	●	■	■	■	■	◆	■	■	●	■
Tetralin	□	■	■	□	■	▲	●	●	■	■	■	■	■	■	■	●	□
Toluene	■	■	■	□	■	▲	▲	●	■	■	■	■	■	■	■	●	■
Transmission Fluid, Type A	□	●	■	●	■	●	●	●	■	▲	●	●	●	▲	■	●	●
Triethanolamine	●	▲	▲	□	●	■	■	●	▲	■	◆	■	■	■	▲	●	▲
Turbine Oil	□	▲	■	●	■	●	▲	●	■	■	●	●	●	■	■	●	●
Turpentine	◆	●	■	●	■	●	▲	●	■	■	●	▲	■	■	■	●	□
Varnish	□	▲	■	□	■	●	▲	●	■	■	▲	■	◆	■	■	●	●
Vinegar	●	▲	●	□	●	●	◆	●	▲	▲	▲	■	■	●	▲	●	▲
W-H-910	□	◆	□	▲	●	●	▲	●	▲	▲	◆	□	■	□	●	□	□
Wagner 218 Brake Fluid	▲	◆	▲	■	●	■	■	●	▲	▲	◆	■	■	◆	●	●	■
Water, Fresh	●	●	●	●	●	●	●	●	●	●	●	■	◆	●	●	●	●
Whiskey	□	●	●	□	●	●	●	●	●	●	●	■	▲	●	●	●	●
White Pine Tar	□	▲	■	□	■	●	●	●	■	■	▲	□	□	■	■	●	□
Xylen	▲	■	■	■	■	●	●	●	■	■	■	■	■	■	■	●	■

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Common Military Specifications

AMS- Aerospace Material Specifications **MIL**- Military Specifications **ASTM**- Automotive Applications

Material Specification	Durometer (+/-5)	Elastomer	Temperature Range °F	Description
AMS 3208	50	Neoprene	-40 to +212	Weather Resistant
AMS 3209	70	Neoprene	-40 to +212	Weather Resistant
AMS 3237F	40	Butyl	-30 to +100	Phosphate Ester Resistant
AMS 3238F	70	Butyl	-30 to +100	Phosphate Ester Resistant
AMS 3301	40	Silicone	-85 to +401	General Purpose
AMS 3302	50	Silicone	-85 to +401	General Purpose
AMS 3303	60	Silicone	-85 to +401	General Purpose
AMS 3304	70	Silicone	-85 to +401	General Purpose
AMS 3305	80	Silicone	-85 to +401	General Purpose
AMS 3336	60	Phenyl Silicone	-121 to +446	Extreme Low Temperature Resistant
AMS 3337	70	Phenyl Silicone	-121 to +446	Extreme Low Temperature Resistant
AMS 3338	80	Phenyl Silicone	-121 to +446	Extreme Low Temperature Resistant
AMS 3382	75, 90	AFLAS®	+23 to +450	Hydraulic Fluid and Synthetic Oil Resistant
AMS 7271	65	Nitrile	-67 to +257	Fuel and Low Temperature Resistant
AMS 7272	70	Nitrile	-15 to +302	Synthetic Lubricant Resistant
AMS-R-83285	60, 80	Ethylen-Propylene	-40 to +212	General Purpose
AMS-R-83485 (MIL-R)	75	Fluorocarbon	-40 to +400	Low Temperature, Fuel Resistant, Low Compresion Set
High Temperature Fluid Resistant and Low Compression Set				
AMS 7259	90	Fluorocarbon	-20 to +400	QPL Listing
AMS 7276	75		-20 to +400	
AMS 3216	75	Fluorocarbon	-20 to +400	Non QPL
AMS 3218	90		-20 to +400	
AMS-R-83248 (MIL-R)	75, 90		-20 to +500	
AMS-R-25988 (MIL-DTL)				
Class 1	40, 50, 60, 70, 80	Fluorosilicone	-76 to +392	Oil and Fuel Resistant
Class 2	50		-76 to +392	High-Strength Oil and Fuel Resistant
Class 3	75		-76 to +437	High Modulus Oil and Fuel Resistant
A-A-59588 / ZZR-765				
Class 1A	40, 50, 60, 70, 80	Phenyl Silicone	-100 to +425	Low Temp Resistant
Class 1B	40, 50, 60, 70, 80	Phenyl Silicone	-100 to +425	Low Temp Resistant, Low Compression Set
Class 2A	25, 40, 50, 60, 70, 80	Silicone	-80 to +425	High Temperature
Class 2B	25, 40, 50, 60, 70, 80	Silicone	-80 to +425	High Temperatuere, Low Compression Set
Class 3A	30, 50, 60	Phenyl Silicone	-103 to +400	Low Temperature, Tear and Flex Resistant
Class 3B	30, 50, 60, 70, 80	Silicone	-94 to +400	Tear and Flex Resistant

( ) = Military equivalent

Common Military Specifications

AMS- Aerospace Material Specifications **MIL**- Military Specifications **ASTM**- Automotive Applications

Material Specification	Durometer (+/-5)	Elastomer	Temperature Range °F	Description
MIL-PFR-6855				
Class 1	30, 40, 50, 60, 70, 80	Nitrile	-40 to +212	Fuel and Petroleum Oil Resistant
Class 2		Neoprene		Petroleum Oil, Weather, and Ozone Resistant
Class 3		Stryene-Butadiene		Non-Oil Resistant
Class 4		Neoprene		Petroleum Oil, Weather, and Ozone Resistant (contact with Acryilic and Polycarbonate Plastic)
Class 5		Stryene-Butadiene		Non-Oil Resistant (contact with Acryilic and Polycarbonate Plastic)
ASTM D2000				
M1AA710	70	SBR, EP	-40 to +158	Non-Oil Resistant
M1BA710	70	EP	-40 to +212	Non-Oil Resistant
M1BC710	70	Neoprene	-40 to +212	Some Oil Resistant
M1BG710	70	Nitrile	-40 to +212	Oil Resistant
M1CA710	70	EP	-40 to +257	Non-Oil Resistant
M1CH710	70	Nitrile, Epichlorohydrin	-40 to +257	Oil Resistant
M1DA710	70	EP	-67 to +302	Non-Oil Resistant
M1DH710	70	HNBR, Polyacrylic	-40 to +302	Oil Resistant
M1FK606	60	Fluorosilicone	-67 to +392	Oil Resistant, High Heat, Low Temperature
M1GE706	70	Silicone	-67 to +437	High Heat, Low Temperature
M1HK710	70	Fluorocarbon	-13 to +482	Oil Resistant, High Heat

( ) = Military equivalent