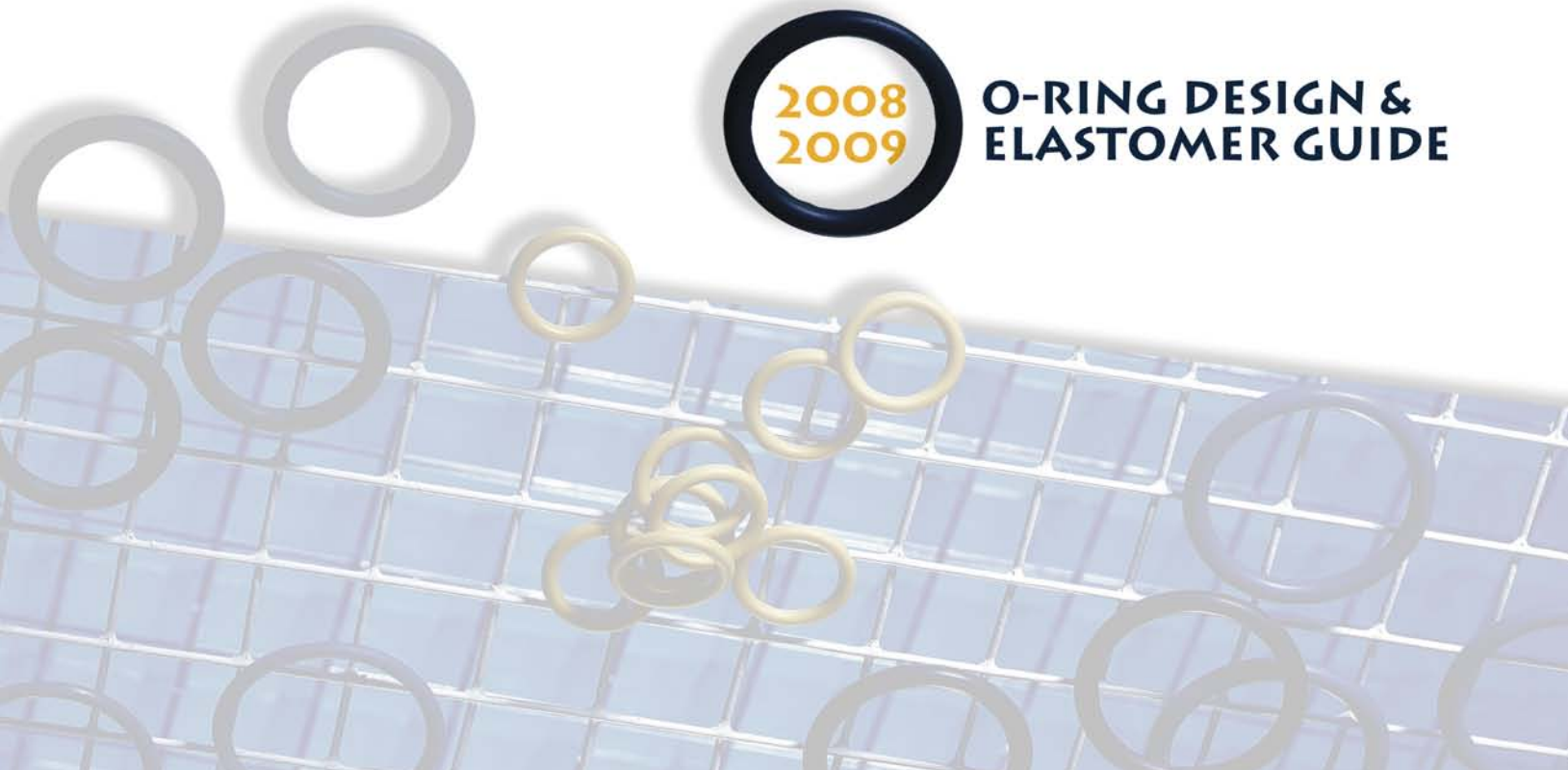


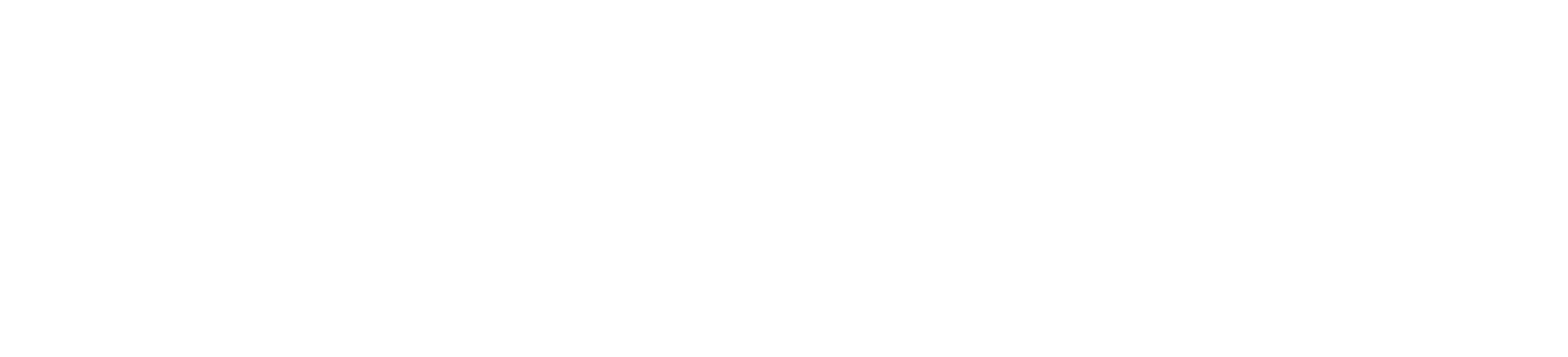
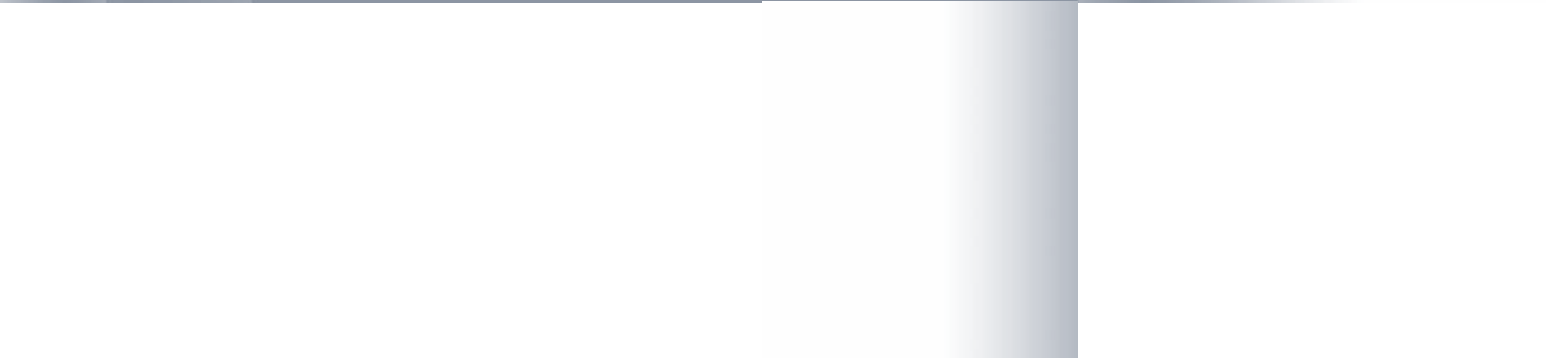
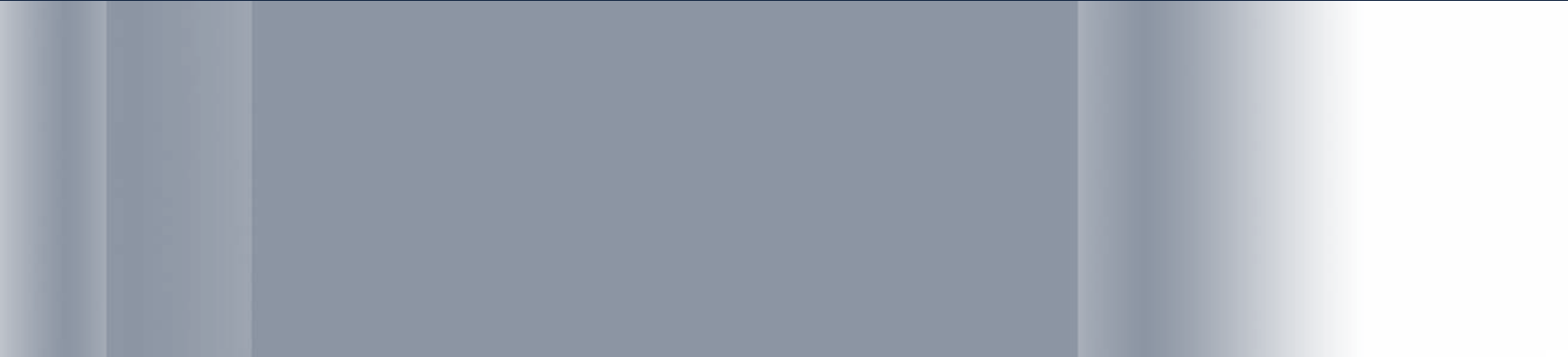
# P R E C I X<sup>®</sup>

DELIVERING SOLUTIONS THROUGH FOCUSED EXCELLENCE



## O-RING DESIGN & ELASTOMER GUIDE





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# INTRODUCTION

Precix® is a world-class manufacturer of O-Rings for the Automotive, Aerospace, Chemical Processing (CPI) and other industries. This O-Ring Design and Elastomer Guide will provide you with a mid-level view of what Precix can do for you and your customer.

Founded by a Massachusetts Institute of Technology graduate in 1910, Precix® has evolved into one of the top elastomeric solutions providers in North America, Europe and beyond. TS16949/ISO9001:2000/ISO14001/AS7115/AS9100/ISO 17025 Certified and a practitioner of Lean Manufacturing principles, Precix® is well positioned to be your elastomeric partner.

Seemingly simple in design, Precix® O-Rings perform complex and critical functions in endless applications for virtually all industries. These elastomer rings must counter the effects of chemical attack, friction, pressure and temperature while maintaining the integrity of the system of which they are components. Precix® is a proven leader in this realm, which is why Precix® O-Rings and specialty fuel seals are trusted by top companies/industries around the world.

- Complete AS568 Specification offering
- Custom molded seals and shapes available
- English and Metric sizes
- MIL/AMS, UL, FDA, NSF compounds available
- QuickRings® rapid prototyping (mold and parts in 10 working days or less)
- ISO 17025 Certified Lab
- Engineering Consultations
- Complete in-house tooling capabilities

Precix® manufactures a complete line of thermoset and injection molded elastomers. While we do the complete range our forte is clearly on higher-end elastomers including:

Perfluorocarbon (FFKM)  
Fluorocarbon (FKM)  
Low temperature Fluorocarbon (GLT® & GFLT® types)  
Low permeation FKM (GF® type)  
Conductive FKM  
Fluorosilicone (FVMQ)  
FKM/FVMQ blends  
Highly Saturated Nitrile (HNBR/HSN)  
Other OEM-specific compounds

GF®, GLT®, GFLT®, Viton®, Viton® Extreme™, Kalrez® are registered trademarks of DuPont Dow Elastomers.  
Vamac® is a registered trademark of DuPont™.  
Chemraz® is a registered trademark of Green Tweed.

## EXAMPLES OF APPLICATION AREAS WE SERVICE INCLUDE:

### AUTOMOTIVE

- Quick connects
- Fuel injectors
- Fuel rails
- Fuel tanks & pumps
- Rollover valves
- Fuel sensors: vapor, level, pressure
- Fuel filters
- Diesel/Biodiesel components
- Oil pumps, pressure sensors
- Alternative fuel systems seals
- HVAC seals
- Transmission/Transfer case

### AEROSPACE

- Engine
- Fuel system connectors
- Hydraulic systems
- Landing gear

### CHEMICAL PROCESSING

- Pumps
- Filter elements
- Mechanical seals
- Valves
- Sensors
- Instrumentation
- Air operated vents
- Quick connects
- Standard connectors

# **Materials & Elastomers**

## GENERAL PROPERTIES OF ELASTOMERS

*Selection of the correct elastomeric material for O-Ring sealing is key for successful performance.*

*Primarily seal properties are determined by the broad chemical family of the elastomer selected. "Compounding" of the elastomer by Precix chemists results in secondary properties such as compression set and hardness.*

*To help with your elastomer selection, here is a "layman's" description of the common elastomers available in the marketplace. The associated table entitled "Capsule Summary of Typical Elastomer Properties" provides further detail in a comparative format.*

*While this information is meant to provide general guidelines, please consult your Precix representative for your specific needs.*

### **NATURAL RUBBER (NR)**

Natural rubber, the only nonman-made elastomer, is noteworthy for its high strength and outstanding resilience. However, the low heat resistance and limited fluid resistance make it a seldom used sealing material.

### **SBR (SBR)**

SBR is a very cost-efficient material for general purpose applications. While heavily used in tires, its low heat resistance and limited fluid resistance limit sealing elastomer use.

### **BUTYL (IIR)**

Butyl elastomers are characterized by their outstanding impermeability to gas penetration and high damping ability in dynamic applications. Butyl rubber also possesses corrosive chemical resistance. While this combination of properties is unique, the heat resistance of butyl rubber has limited its usage.

### **EPDM (EPDM)**

EPDM elastomers are general purpose materials with excellent weathering characteristics for outdoor applications. As a family, EPDMs possess strong resistance to water and steam, as well as good resistance to most acids and alkalis. Their "polar" fluid resistance extends to materials such as automotive brake fluid and anti-freeze. These characteristics, along with moderate temperature resistance, make EPDM a niche player in the O-Ring sealing world.

### **NEOPRENE/CHLOROPRENE (CR)**

Neoprene elastomers are middle of the road materials, with very moderate heat and fluid resistance. They are much more likely to be found in applications where their weathering or inherent flame resistances are needed. Other applications can include sealing of lubricating greases or non-aggressive oils.

### **NITRILE (NBR, BUNA-N)**

Nitrile elastomers encompass a large family of materials that have been a work horse in the fluid sealing arena. While the temperature resistance is only moderate, the choice of the particular material, along with compounding, provides a wide range of properties. Most notable is their fuel and oil resistance, which ranges from moderate to excellent, depending on the particular nitrile chosen. Nitrile polymers remain a cost-efficient means of fuel and oil sealing, as long as the limited high heat resistance is not a hindrance to performance.

### **EPICHLOROHYDRIN (CO, ECO)**

This small family of polymers, usually grouped into the specialty products area, are niche players. Their overall heat and oil resistance is very good, as is their low temperature capability. Impermeability to gases and excellent weathering resistance are other strong attributes. More seal applications would use epichlorohydrin materials if their processing behavior was less challenging.

### **POLYACRYLATE (ACRYLIC) (ACM)**

Polyacrylate elastomers, another member of the specialty category, are known for their higher performance. Their combination of higher heat resistance, along with excellent compatibility with sulfur bearing oils and lubricants, makes them a mainstay in many automotive areas. These include transmission applications. A weakness can be their low temperature capability, as well as their sometimes challenging processing behavior.

### **VAMAC® (ETHYLENE/ACRYLIC) (AEM)**

Vamac® materials, a relatively new elastomer family, is an up-and-coming specialty player. While the high temperature resistance is in the same league as other specialty elastomers, its unique combination of good oil resistance coupled with strong low temperature capability affords an unusual combination of properties. Also noteworthy is the damping capability in dynamic applications. The use of Vamac® has grown as the processing challenges have been minimized.

### **URETHANE (AU, EU)**

Urethane elastomers are an unusual category of elastomer materials, characterized by their high strength. Specifically, tensile strength properties are unmatched, as is their tear and abrasion resistance. Also noteworthy is their high load bearing capability. These attributes would be the main reasons for selecting urethane, rather than their moderate heat resistance or their good oil resistance.

### **HIGHLY SATURATED NITRILE (HSN/HNBR)**

This relatively new family of elastomers is a step function improvement over the previously discussed nitrile family. On paper, the improvements in both high temperature capability and low temperature brittleness are moderate. However, the "hydrogenation process" also affords a more stable elastomer, for fluid additives. This higher cost material has seen strong growth in the automotive industry, for fuel, oil, and other applications.

### **SILICONE (VMQ)**

Silicone elastomers represent a large family of higher performance, higher cost materials. They are characterized by their large operating temperature range, with the best low temperature capability of all elastomers, as well as strong high temperature performance. They also possess good oil resistance. Silicone elastomers are available in a variety of colors, as they do not require the traditional "carbon black" for strength building purposes. Besides the automotive industry, both health care and electrical applications are heavy silicone elastomer users. While not as "mechanically tough" as other elastomers, it is their wide temperature capability that cements their niche in the marketplace.

### **FLUROSILICONE (FVMQ)**

This specialty elastomer takes the strong properties of silicone rubber elastomers and adds fuel resistance to the mix. The resulting combination affords outstanding low temperature flexibility and extremely good fuel and oil resistance. Gasahol resistance is also noteworthy. While fluorosilicones were previously thought of as "fragile" elastomers, tougher versions are also now available. Their high performance also means higher cost.

### **FLUOROCARBONS (FKM)**

The fluorocarbon elastomer family is the highest performance material available. Their high temperature performance is unmatched by any other polymer family, as is their versatile fluid resistance. Recent developments in fluorocarbon offerings have minimized the low temperature concerns. Additionally, by altering the fluorocarbon polymer chemistry, fluid resistance for both alkali materials and "polar" solvents has been added to the already strong repertoire of capabilities. While as a class of elastomers their cost is high, their properties are top notch. Precix specializes in fluorocarbons and possesses an unmatched product line offering.

### **PERFLUOROELASTOMERS (FFKM)**

Perfluorinated polymers have been designed for very demanding sealing applications in aggressive chemical and high heat environments. They are resistant to attack by nearly all chemical reagents, including organic and inorganic acids, alkalines, ketones, esters, alcohols, fuels and hot waters.

The primary uses for these high performance materials are as O-rings, seals, diaphragms, packings and other molded parts used in the chemical processing, aerospace and semiconductor industries.



# CAPSULE SUMMARY OF TYPICAL ELASTOMER PROPERTIES

Terminology	Natural Rubber	SBR	Butyl	EPDM	Chloroprene	Nitrile	Epichlorohydrin	Polyacrylate	Vamac®	Urethane	HSN	Silicone	Fluorosilicone	Fluorocarbon	Perfluorocarbon
Typical ASTM D 1418 Designation	NR	SBR	IIR	EPDM	CR	NBR	CO,ECO	ACM	AEM	AU,EU	HNBR	VMQ	FVMQ	FKM	FFKM
Typical ASTM D 2000 Designation	AA	AA,BA	AA,BA	CA,DA	BC	BF,BG	CH	DH	EE	BG	CH,DH	FE,GE	FK	HK	KK
Physical Properties															
Tensile Strength	E	G	F-G	F-G	G-E	G	F-G	F	F-G	E	G	F	F	F-G	F-G
Compression Set	G	G	F	G	F-G	G	F-G	F-G	F-G	G	G	G-E	G	G-E	G
Resilience	E	G	F	F-G	G-E	G	F	F	F	G	G	F-G	F	F	F
Tear/Abrasion	E	G	F	F-G	G-E	G	F	F-G	F-G	E	G	P-F	P-F	F-G	F-G
Impermeability (Gas)	F	F	E	F	F	F-G	E	F-G	F-G	P-F	G	P-F	P-F	G-E	E
Temperature Range (Typical)															
High, Steady Use (°C)	70	100	100	150	100	125	125-150	150-175	175	100	150	225	200	250	300
Low Temperature	E	G	G	E	F	F-G	F-G	P-F	F-G	F-G	F-G	E	E	P-F	P
Typical Fluid Resistance															
Fuels	P	P	P	P	P	G-E	G-E	F	F	F-G	G-E	P-F	E	E	E
Oils	P	P	P	P	F	G-E	G-E	E	G	G-E	G-E	G	E	E	E
Acids	F-G	F	G-E	E	F-G	G	F	P-F	F	P-F	G	F	G	G-E	E
Ketones (oxygenated)	F-G	F	G	G-E	P-F	P	P	P	P	P	P	P-F	P	P-G	G-E
Water	G-E	G	G-E	E	G	F-G	G	P	G	P	F-G	G	G	G	G
Environmental Resistance															
Weathering	F	F	E	E	E	F	G-E	E	E	G-E	G	E	E	E	E
Ozone	P	P	G-E	E	G	P	G-E	E	E	E	F	E	E	E	E
Flame	P	P	P	P	G	P	P-F	P	P	G	P	F	G	G	G

**Legend** E- Excellent G- Good F- Fair P- Poor

Vamac® is a registered trademark of DuPont™.

This summary is intended as only a guideline for typical comparative purposes. Testing is required for specific applications.

# VITON® CROSS-REFERENCE

## Viton® General Use Grades

### Precix® F40, F75, F90

#### Viton® A

Viton® A is a family of fluoroelastomer dipolymers, that is, they are polymerized from two monomers, vinylidene fluoride (VF2) and hexafluoropropylene (HFP). Viton® A fluoroelastomers are general purpose types that are suited for general molded goods such as O-Rings and V-rings, gaskets and other simple and complex shapes.

### Precix® F10, F61

#### Viton® B

Viton® B is a grade of fluoroelastomer terpolymers, that is, they are polymerized from three monomers: vinylidene fluoride(VF2), hexafluoropropylene (HFP) and tetrafluoroethylene (TFE). Viton® B fluoroelastomers offer better fluid resistance than A type fluoroelastomer.

### Precix® F48, F56, F73, F86

#### Viton® F/GF®

Viton® F/GF is a grade of fluoroelastomer terpolymers, that is, they are polymerized from three monomers: vinylidene fluoride (VF2), hexafluoropropylene (HFP) and tetrafluoroethylene (TFE). Viton® F/GF fluoroelastomers offer the best fluid resistance of all Viton® types. F/GF types are particularly useful in applications requiring resistance to fuel permeation.

## Viton® Specialty Grades

### Precix® F5I

#### Viton® GB/GBL

Viton® GB and GBL are grades of fluoroelastomer terpolymers, that is, they are polymerized from three monomers: vinyl fluoride (VF2), hexafluoropropylene (HFP) and tetrafluoroethylene (TFE). Viton® GB and GBL use peroxide cure chemistry that result in superior resistance to steam, acid and aggressive engine oils.

### Precix® F05, F19, F37, F85

#### Viton® GLT®

Viton® GLT is a fluoroelastomer designed to retain the high heat and the chemical resistance of general use grade of Viton® fluoroelastomer, while improving the low temperature flexibility of the material. Glass transition temperatures (Tg) of materials are indicative of low temperature performance in typical elastomer applications. Viton® GLT shows an 8 to 12°C lower Tg than general use Viton® grades.

### Precix® F07, F77, F78

#### Viton® GFLT®

Viton® GFLT is a fluoroelastomer designed to retain the high heat and the superior chemical resistance of the GF High Performance types, while improving the low temperature performance of the material. Viton® GFLT shows a 6 to 10°C lower Tg than general use Viton® grades.

### Precix® F65

#### Viton® Extreme™ (ETP)

Viton®Extreme™ combines the excellent thermal resistance of fluoroelastomers with unique resistance to chemicals and to environments that have historically exceeded the capabilities of conventional fluoroelastomers. This new class of fluoroelastomer, designated as FEPMs by ASTM D1418, is the choice for high pH environments.

## VITON® CROSS-REFERENCE CHARACTERISTICS COMPARISON

	GENERAL GRADES			SPECIALTY GRADES			
	A	B	F/GF	GB	GLT	GFLT	ETP
Nominal Polymer Fluorine Content, wt%	66	68	70	66	64	67	67
Percent Volume Change in Fuel C 168hr @ 23°C (73°F)	4	3	2	5	5	2	4
Percent Volume Change in Methanol 168hr @ 23°C (73°)	90	40	5	90	90	5	5
Percent Volume Change in KOH 168hr @ 70°C (158°F)	Samples Degraded						14
Low Temperature Flexibility TR-10, °C	-17	-13	-6	-19	-30	-24	-12

Precix® utilizes a variety of Fluoropolymer sources based on cost, quality and delivery. The Viton® cross-reference is provided as a tool for our customers. It is not intended to imply that all of Precix FKM compounds are produced with DuPont Dow Viton®.

Viton® and Viton® Extreme™ are registered trademarks of DuPont Dow Elastomers.

# STANDARD COMPOUND LISTING

ID	Precix Compound	Duro	Color	Typical Temperature Range-deg C (F)	Specifications/Comments
<b>Perfluorocarbons (FEKM)- commonly referred to as Kalrez® or Chemraz®</b>					
P03	13789	75	Black	-15 to 300 (5 to 572)	AMS7257
<b>Fluorocarbons (FKM)-commonly referred to as Viton®</b>					
F80	13710	60	Black	-25 to 250 (-13 to 482)	
F37	13737	60	Black	-40 to 250 (-40 to 482)	GLT® Type
F67	13767	60	Black	-32 to 250 (-25 to 482)	GFLT® Type
F18	13768	60	Brown	-25 to 250 (-13 to 482)	
F99	13799	65	Green	-22 to 250 (-8 to 482)	GF® Type (HF-high fluorine), GM6268M Type IV
F95	13795	65	Red	-22 to 250 (-8 to 482)	Volkswagen/Audi 2.8.1-A/T 70
F10	13759	70	Black	-25 to 250 (-13 to 482)	Honda (several fuel application/specifications)
E57	13671	70	Green	-25 to 250 (-13 to 482)	Delphi/Saginaw 7846478
F56	13756	70	Black	-22 to 250 (-8 to 482)	GF® Type
F07	13723	70	Black	-32 to 250 (-25 to 482)	GFLT® Type
<b>F40*</b>	13740	75	Brown	-25 to 250 (-13 to 482)	AMS7276 Type (QPL Pending)
<b>F75*</b>	13664	75	Black	-25 to 250 (-13 to 482)	AMS 7276 (M83248/1) UL Approved, QPL Listed, Hamilton Approved
F05	13705	75	Blue	-40 to 250 (-40 to 482)	GLT® Type, Delphi M54453, BMW GS93010 5516-FPM-70-M
<b>F19*</b>	13790	75	Black	-40 to 250 (-40 to 482)	AMS-R-83485 (M83485/1) GLT® Type, Pratt & Hamilton Approved
F86	13728	75	Green	-22 to 250 (-8 to 482)	GF Type (HF-high fluorine), Ford WSAM2D401A8, GM 6268M Type III, BMW GS 93010 5505-FPM-75-M, ultra low permeation, UL Approved
F78	13730	75	Black	-32 to 250 (-25 to 482)	GFLT® Type, Ford WSAM2D401A5, GM6269M Type I, UL Approved
F79	13724	75	Black	-40 to 250 (-40 to 482)	GLT® Type
F77	13729	75	Gray	-32 to 250 (-25 to 482)	GFLT® Type, Ford WSAM2D401A5
F103	13809	75	Black	-40 to 250 (-40 to 482)	AMS7XXX, True -40 TR-10 FKM
F48	13753	75	Black	-22 to 250 (-8 to 482)	Water, Base & Acid Resistance (Chlorene service)
F53	13663	75	Black	-22 to 250 (-8 to 482)	Transmission service - Dextron III and VI Tested
F38	13801	75	D.Blue	-40 to 250 (-40 to 482)	Low Temperature Fluorocarbon, SVDO Approved
F43	13742	75	Black	-22 to 250 (-8 to 482)	High Fluorine (HF): Water, Base & Acid Resistance
F44	13742	75	Black	-20 to 200 (-4 to 392)	Aflas Type replacement material (TFEP/FKM)
F65	13678	75	Black	-22 to 250 (-8 to 482)	FEPM: Viton® Extreme™
F52	13661	75	Brown	-32 to 200 (-25 to 392)	FKM/FVMQ Blend, GM6268M Type I, Ford ESA-M9P7-A, UL Approved
F98	13798	80	Black	-22 to 250 (-8 to 482)	Semi-conductive using Nanotube technology-volume resistivity (ohm-cm) 10 <sup>1</sup> -10 <sup>3</sup>
F100	13803	80	Black	-22 to 250 (-8 to 482)	Enhanced Semi-conductive using Nanotube technology - volume resistivity under 5 ohm-cm typical
F33	13743	80	Black	-25 to 250 (-13 to 482)	
F35	13755	80	Black	-22 to 250 (-8 to 482)	GF® Type
F31	13731	80	Black	-32 to 250 (-25 to 482)	GLT® Type
F91	13791	80	Black	-25 to 250 (-13 to 482)	AS43003, AS43013 (DTD 5613A, Grade 80), SBAC Rolls Royce
F17	13777	90	Brown	-25 to 250 (-13 to 482)	
<b>F90*</b>	13681	90	Black	-25 to 250 (-13 to 482)	AMS 7259 (M83248/2), AMS3581, MS9970, QPL Listed, Hamilton Approved
F92	13792	91	Black	-22 to 250 (-8 to 482)	Explosive decompression resistant, High Flourine (HF)

\*=Stock items

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# STANDARD COMPOUND LISTING

ID	Precix Compound	Duro	Color	Typical Temperature Range-deg C (F)	Comments/Specifications
<b>Fluorosilicones (FVMQ)</b>					
G04	13344	60	Blue	-60 to 200 (-76 to 392)	AMS-R-25988 CI1 Gr60 (M25988/3), Boeing Approved
<b>G16*</b>	13428	70	Blue	-60 to 200 (-76 to 392)	AMS-R-25988 CI1 Gr70 (M25988/1), Boeing Approved, Hamilton Approved
L61	L13445	70	Green	-60 to 200 (-76 to 392)	Honda and TG Approved
G20	13441	75	Blue	-60 to 200 (-76 to 392)	AMS 7273 (AS9966, AS9967), Boeing Approved
G17	13430	75	Yellow	-60 to 200 (-76 to 392)	Ford WSAM2D401A6, GM6268 & 6269M Type II, BMW GS 93010 5519-FMQ-75-M, Volkswagen/Audi 2.8.1A
G21	13504	75	Blue	-60 to 200 (-76 to 392)	AMS-R-25988 C13 Gr75 (M25988/2), Hamilton Approved
G88	13488	80	Blue	-60 to 200 (-76 to 392)	AMS-R-25988 CI1 Gr80 (M25988/4), Boeing Approved
<b>Silicones (VMQ)</b>					
L32	13388	60	Red	-65 to 225 (-85 to 437)	AMS 3303
<b>L35*</b>	13402	70	Red	-65 to 225 (-85 to 437)	AMS 7267, AMS 3304, FDA Compliant
<b>Highly Saturated Nitrile (HSN/HNBR)</b>					
H76	14576	70	Black	-34 to 150 (-30 to 302)	
M27	14481	70	Black	-32 to 150 (-25 to 302)	Ford ESWM2D247 Type I
M29	14482	75	Black	-34 to 150 (-30 to 302)	Ford ESWM2D247 Type III, Internal Lube
M84	14586	75	Green	-40 to 150 (-40 to 302)	Bosch GW3275-56-53-38-50
M98	14598	80	Black	-32 to 150 (-25 to 302)	Ford WSA-M2D451-A2
H95	14595	80	Black	-40 to 150 (-40 to 302)	BMW GS 93010 5518-HNBR-80-M
H61	14557	80	Black	-32 to 150 (-25 to 302)	
H94	14594	90	Black	-34 to 150 (-30 to 302)	
<b>Ethylene Propylene (EPDM)</b>					
E70	17401	60	Black	-46 to 150 (-50 to 302)	TRW TS2-18-034
E83	17451	70	Purple	-46 to 150 (-50 to 302)	Peroxide Cured
E71	17402	70	Black	-46 to 150 (-50 to 302)	TRW TS2-18-035
E61	17331	70	Black	-46 to 150 (-50 to 302)	NSF61 Approved
E34	17434	70	Black	-46 to 150 (-50 to 302)	UL Approved
E65	17351	70	Black	-46 to 150 (-50 to 302)	Internal Lube
E74	17405	70	Black	-55 to 150 (-67 to 302)	
E77	17416	70	Black	-55 to 150 (-67 to 302)	Internal Lube
E80	17411	80	Black	-46 to 150 (-50 to 302)	
<b>Nitrile (NBR)</b>					
H73	14573	60	Black	-34 to 125 (-30 to 257)	
<b>M31*</b>	14494	70	Black	-54 to 135 (-65 to 275)	MS28775 (MIL-P-25732), Formerly MS28775 (AMS-P-25732), QPL Listed
M07	14327	70	Black	-34 to 125 (-30 to 257)	UL Approved
H77	14577	70	Black	-34 to 125 (-30 to 257)	DaimlerChrysler MSBZ105C, SAE 5120R1 Class 1
H16	14126	75	Black	-29 to 125 (-20 to 257)	UL Approved
H80	14575	80	Black	-34 to 125 (-30 to 257)	
H52	14339	90	Black	-34 to 125 (-30 to 257)	
<b>Vamac® (AEM)</b>					
M95	07795	50	Black	-40 to 175 (-40 to 347)	
M86	07786	70	Black	-40 to 175 (-40 to 347)	
M94	07794	80	Black	-40 to 175 (-40 to 347)	DaimlerChrysler MSBZ623 Gr A

\*Denotes a stock item

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# MIL/AMS SPECIFICATION COMPOUNDS

ID	Old Drawings	Old Specification	New Drawing	New Specification	Duro	Typical Temperature Range - deg C (F)	Notes
<b>Perfluoroelastomer</b>							
P03		N/A	N/A	AMS7257	75	-15 to 300 (5 to 572)	
<b>Fluorocarbon</b>							
<b>F90 *</b>	MS9970, M83248/2	AMS7279, AMS-R-83248CL2, MIL-R-83248 CL2	AS3581	AMS7259	90	-25 to 250 (-13 to 482)	QPL Listed, Hamilton Approved
<b>F75 *</b>	M83248/1, MS9388, MS9387, AS3084 (900) AS3085	AMS7278, AMS7280, AMS-R-83248 CL1, MIL-R-83248 CL1	AS3208 (900) AS3209	AMS7276	75	-25 to 250 (-13 to 482)	QPL Listed, Hamilton Approved
<b>F19 *</b>	N/A	N/A	M83485/1	AMS-R-83485	75	40 to 250 (-40 to 482)	Pratt & Hamilton Approved
F91	N/A	N/A	AS 43003 (900) AS 43013	DTD 5613A, Grade 80	80	-25 to 250 (-13 to 482)	SBAC Rolls Royce
F103	N/A	N/A	ASXXXX	AMS7XXX	75	-40 to 250 (-40 to 482)	Pending SAE Spec
<b>Fluorosilicone</b>							
G20	MS9966 (900) MS9967	AMS 7273	AS9966 (900) AS9967	AMS7273	75	-60 to 200 (-76 to 392)	Boeing Approved
<b>G16 *</b>	M25988/1	MIL-R-25988 CL1 G70	M25988/1	AMS-R-25988 Cl1 Gr70	70	-60 to 200 (-76 to 392)	Boeing & Hamilton Approved
G21	M25988/2	MIL-R-25988 Cl3 G75	M25988/2	AMS-R-25988 Cl3 G75	75	-60 to 200 (-76 to 392)	Hamilton Approved
G04	M25988/3	MIL-R-25988 CL1 G60	M25988/3	AMS-R-25988 Cl1 Gr60	60	-60 to 200 (-76 to 392)	Boeing Approved
G88	M25988/4	MIL-R-25988 Cl1 G80	M25988/4	AMS-R-25988 Cl1 G80	80	-60 to 200 (-76 to 392)	Boeing Approved
<b>Silicone</b>							
<b>L35 *</b>	MS9385 (900) MS9386, MS9068	AMS7267, AMS3304	AS9385 (900) AS9386 AS3582	AMS7267, AMS3304	70	-65 to 225 (-85 to 437)	
<b>Nitrile</b>							
<b>M31*</b>	MS28775	MIL-P-25732, AMS-P-25732	MS28775	MIL-P-25732	70	-54 to 135 (-65 to 275)	QPL Listed

\*Denotes a stock item

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# ALPHA LIST OF OEM APPROVALS

OEM/Specification	Polymer	ID	Precix Compound #	Duro Range	Color deg C (F)	Typical Temperature
Audi (refer to Volkswagen 2.8.1 – A/T 70)	FKM	F95	13795	70	Red	-22 / 250 (-8 / 482)
Audi (refer to Volkswagen 2.8.1 / TL52424)	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
BMW GS 93010 5516-FPM-70-M	FKM (GLT® Type)	F05	13705	75	Blue	-40 to 250 (-40 to 482)
BMW GS 93010 5505-FPM-75-M	FKM (GF® Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)
BMW GS 93010 5519-FMQ-75-M	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
BMW GS 93010 5518-HNBR-80-M	HNBR	H95	14595	80	Black	-40 / 150 (-40 / 302)
Bosch GW3275-56-53-38-50	HNBR	M84	14586	75	Green	-40 to 150 (-40 to 302)
Chrysler MS-BZ105C, SAE J120R1 Class 1	NBR	H77	14577	70	Black	-34 / 125 (-30 / 257)
Chrysler MS-BZ105G	NBR	H69	14577	70	Black	-25 / 125 (-13 / 257)
Chrysler MS-BZ623 Grade A	AEM (Vamac®)	M94	7794	80	Black	-60 / 200 (-76 / 392)
Chrysler MS-BZ832, Grade A1	FKM	F80	13710	60	Black	-25 / 250 (-13 / 482)
Chrysler MS-BZ832, Grade A3	FKM	F84	13717	75	Black	-25 / 250 (-13 / 482)
Chrysler MS-BZ832, Grade A4	FKM	F33	13743	80	Black	-22 / 250 (-8 / 482)
Chrysler MS-BZ832, Grade B2	FKM	F50	13750	75	Black	-40 / 250 (-40 / 482)
Chrysler MS-BZ832, Grade B2	FKM	F69	13688	70	Black	-40 / 250 (-40 / 482)
Chrysler MS-BZ832, Grade C2	FKM	F43	13742	70	Black	-22 / 250 (-8 / 482)
Chrysler MS-BZ832, Grade F3	FKM	F77	13729	75	Gray	-32 / 250 (-25 / 482)
Chrysler MS-BZ832, Grade F5	FKM	F31	13731	80	Black	-40 / 250 (-40 / 482)
Chrysler MS-BZ832, Grade G3	FKM	F05	13705	75	Blue	-40 / 250 (-40 / 482)
Chrysler MS-BZ832, Grade G4	FKM	F79	13724	75	Black	-40 / 250 (-40 / 482)
Chrysler MS-BZ832, Grade G5	FKM	F85	13727	85	Black	-40 / 250 (-40 / 482)
Chrysler BS-BB 40	FVMQ		13494	50	Red	-60 / 200 (-76 / 392)
Delphi 2HK715A1-10B37B38EF31E078F15	FKM	F81	13711	75	Brown	-25 / 250 (-13 / 482)
Delphi 7HK915 BLACK	FKM		13722		Black	-40 / 250 (-40 / 482)
Delphi 7HK915 BROWN	FKM		13721		Brown	-22 / 250 (-8 / 482)
Delphi M54416	FKM	F84	13717	75	Black	-25 / 250 (-13 / 482)
Delphi M54427	FKM	F31	13731	80	Black	-40 / 250 (-40 / 482)
Delphi M54435	FKM		13704		Black	
Delphi M54444	FKM	F04	13329	75	Blue	-22 / 250 (-8 / 482)
Delphi M54444	FKM	F84	13717	75	Black	-25 / 250 (-13 / 482)
Delphi M54453	FKM	F05	13705	75	Blue	-40 / 250 (-40 / 482)
Delphi M54453	FKM	F79	13724	75	Black	-40 / 250 (-40 / 482)
Delphi M54472	FKM	F85	13727	85	Black	-40 / 250 (-40 / 482)
Delphi M54475	FKM		13706		Brown	-22 / 250 (-8 / 482)
Delphi M54481	FKM		13714		Red	-25 / 250 (-13 / 480)
Delphi M54489	FKM		13734		Brown	-25 / 250 (-13 / 480)
Delphi M54498	FKM	F07	13723	70	Black	-40 / 250 (-40 / 482)
Delphi M54498	FKM		13733		Green	-40 / 250 (-40 / 480)
Delphi/Saginaw 7846478	FKM	F57	13671	70	Green	-25 / 250 (-13 to 482)
Delphi M54106			14387			
Delphi M54507	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Ford ESA-M9P7-A	FKMFVMQ	F52	13661	75	Brown	-32 / 200 (-25 to 392)
Ford ESW-M2D100-A	HNBR	H76	14576	70	Black	-32 / 150 (-25 / 302)

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OEM/Specification	Polymer	ID	Precix Compound #	Duro	Color	Typical Temperature Range - deg C (F)
Ford ESWM2D247 Type I	HNBR	M27	14481	70	Black	-32 / 150 (-25 / 302)
Ford ESWM2D247 Type III, Internal Lube	HNBR	M29	14482	75	Black	-34 / 150 (-30 / 302)
Ford WSA-M2D451-A2	HNBR	M98	14598	80	Black	-32 / 150 (-25 / 302)
Ford WSA-M2D401-A5	FKM (GFLT® Type)	F77	13729	75	Gray	-32 / 250 (-25 / 482)
Ford WSA-M2D401-A5	FKM (GFLT® Type)	F78	13730	75	Black	-32 / 250 (-25 / 482)
Ford WSA-M2D401-A6	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Ford WSA-M2D401-A6	FVMQ	L53	13446	70	Orange	-60 / 200 (-76 / 392)
Ford WSA-M2D401-A8	FKM (GF®Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)
Ford WSD-M2D447-A	AEM	M94	07794	70	Black	-51 / 177 (-70 / 350)
GM/Opel 6268 & 6269M Type II	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
GM/Opel 6268 & 6269M Type III	FKM (GF®Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)
GM/Opel 6268M Type I	FKM/FVMQ	F52	13661	75	Brown	-32 / 200 (-25 to 392)
GM/Opel GM6268M Type II	FVMQ	L53	13446	70	Orange	-60 / 200 (-76 / 392)
GM/Opel GM 6268M Type IV	FKM	F99	13799	65	Green	-22 to 250 (-8 to 482)
GM/Opel GM6269M Type I	FKM (GFLT® Type)	F78	13730	75	Black	-32 / 250 (-25 / 482)
Jaguar (refer to Ford WSA-M2D401-A6)	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Jaguar (refer to Ford WSA-M2D401-A8)	FKM (GF® Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)
John Deere JDM H4R	FKM	F105	13810	90	Black	-25 / 250 (-13 / 482)
Land Rover (refer to Ford WSA-M2D401-A6)	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Land Rover (refer to Ford WSA-M2D401-A8)	FKM (GF®Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)
Magneti Marelli FKM Type A1	FKM	F75	13664	75	Black	-25 / 250 (-13 / 482)
Magneti Marelli FKM Type A2	FKM	F54	13754	75	Black	-25 / 250 (-13 / 482)
Magneti Marelli FKM Type B	FKM	F47	13757	75	Black	-25 / 250 (-13 / 482)
Magneti Marelli FKM Type C	FKM	F51	13751	75	Black	-30 / 250 (-22 / 482)
Magneti Marelli FKM Type D	FKM	F79	13724	75	Black	-40 / 250 (-40 / 482)
Magneti Marelli FKM Type E	FKM (GFLT®Type)	F78	13730	75	Black	-32 / 250 (-25 / 482)
Magneti Marelli FKM Type F	FKM	F35	13755	80	Black	-22 / 250 (-8 / 482)
Magneti Marelli FVMQ	FVMQ	L54	13443	75	Yellow	-60 / 200 (-76 / 392)
Renault 03-10-100/--D / 34-04-815/--H	FKM (GF® Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)
Renault 03-10-100/--D / 34-04-815/--H	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Renault 03-10-100/--D / 34-04-	FKM	F95	13795	70	Red	-22 / 250 (-8 / 482)
Renault 03-50-000 Type 2	FKM	F75	13664	75	Black	-25 / 250 (-13 / 482)
TRW Automotive (TS2-18-033)	EPDM	E73	17404	70	Black	-46 to 150
TRW Automotive (TS2-18-034)	EPDM	E70	17401	60	Black	-46 to 150
TRW Automotive (TS2-18-035)	EPDM	E71	17402	70	Black	-46 to 150 (-50 to 302)
TRW Automotive (TS2-18-036)	EPDM	E82	17450	80	Black	-46 / 150 (-50 / 302)
TRW Automotive (TS2-18-037)	EPDM	E73	17404	70	Black	-46 to 150
TRW Automotive (TS2-18-037)	EPDM	E82	17450	80	Black	-46 to 150
Volkswagen 2.8.1 – A/T 70	FKM	F95	13795	70	Red	-22 / 250 (-8 / 482)
Volkswagen 2.8.1.A	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Volvo (refer to Ford WSA-M2D401-A6)	FVMQ	G17	13430	75	Yellow	-60 / 200 (-76 / 392)
Volvo (refer to Ford WSA-M2D401-A8)	FKM (GF® Type)	F86	13728	75	Green	-22 / 250 (-8 / 482)

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