PRECIX

DELIVERING SOLUTIONS THROUGH FOCUSED EXCELLENCE

Compound Guide for Fuel/Transportation & Chemical Processing Applications

TABLE OF CONTENTS

INTRODUCTION

SEALS FOR FUEL/TRANSPORTATION AND CHEMICAL PROCESSING APPLICATIONS

HIGH PERFORMANCE ELASTOMERIC SOLUTIONS FOR THE MOST DEMANDING APPLICATIONS

Precix, inc., a worldwide supplier of custom elastomeric products to the automotive, aerospace and chemical processing industries, has an established reputation for customer satisfaction through continuous quality improvement.

Precix is continually pushing the performance envelope of our components so they function reliably under extremes in temperature and chemical exposure.

From concept to prototype, from approval to product production, Precix has a time-to-market performance among the best in the elastomeric industry. Rapid prototyping methods and the Finite Element Analysis process used by our engineering teams verifies design prior to production while shortening time-to-market. In addition, automatic inspection, on-site ASTM testing, and material analysis solve problems before they develop.

The Precix Development Engineering Team includes design engineers, chemists, tool designers, technicians and process experts who develop and manufacture custom elastomer solutions that deliver cost-effective and environmentally responsible high performance.

In the team atmosphere of Precix, engineers share their experience, as well as their knowledge, with our customers so that you and Precix become a seamlessly integrated development team on your project.

Unsurpassed in quality compliance certifications, Precix, inc.™ stands alone as one of the first manufacturers worldwide to have earned certification in ISO9001, ISO14001, QS9000, AS9100 & ISO17025.

For more information on components, compounds, and engineering and design capabilities, please call 508-998-4000, 800-225-8505, Fax 508-998-4100, 800-225-6172 or email us at materials-engineering@precixinc.com or product-engineering@precixinc.com.

Visit us online at www.precixinc.com.

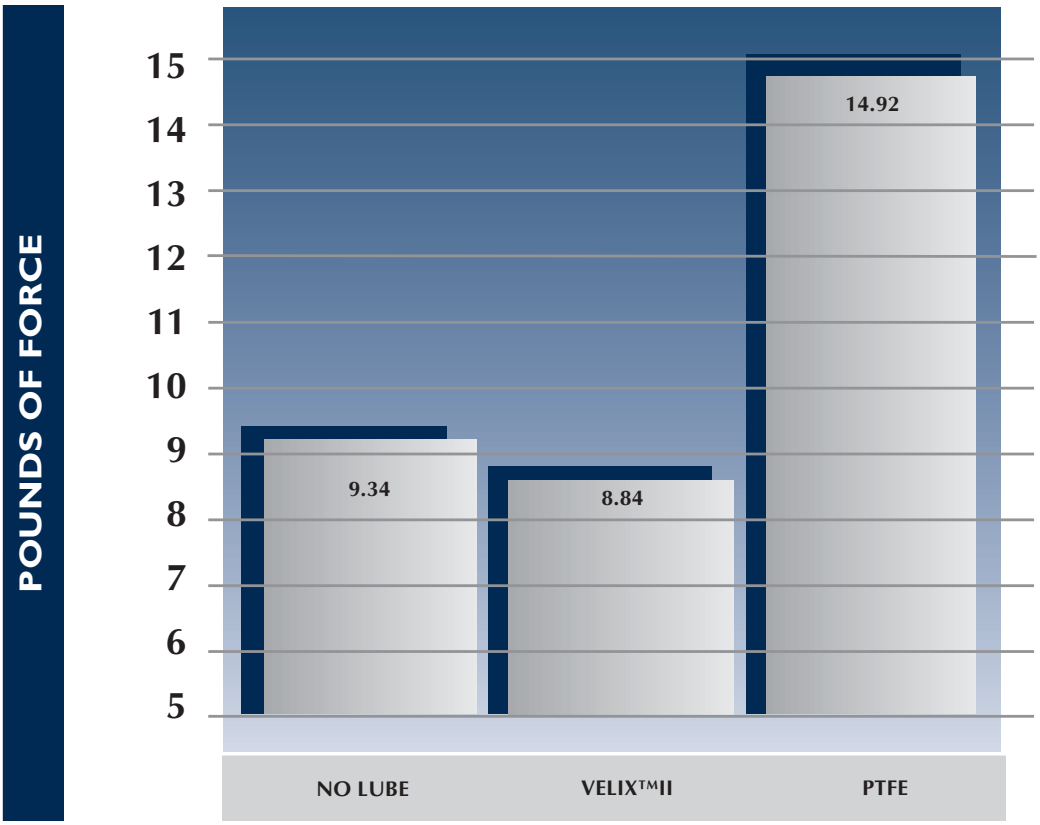
EASE OF ASSEMBLY

Precix has developed the Velix™ treatment to speed your O-Ring/Seal assembly while addressing your need to be cost competitive. These graphs illustrate the insertion force and coefficient of friction data with Precix O-Rings with no lube, Velix™ II and PTFE.

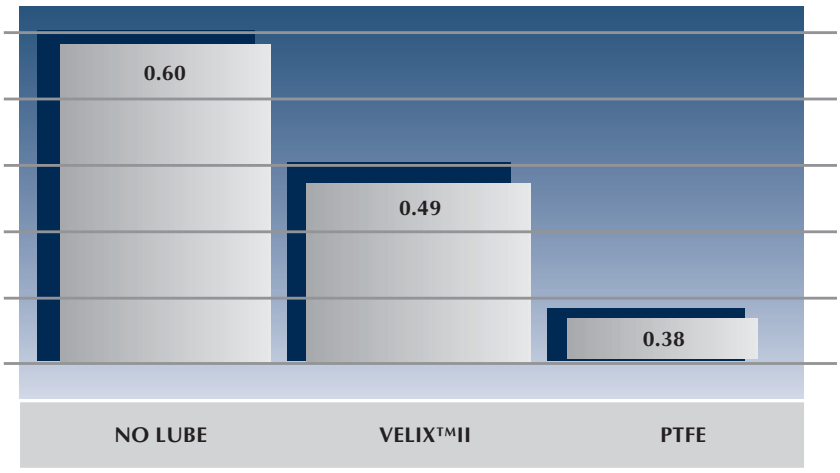
As you can see, the proprietary Precix Velix™ II treatment gives Precix customers the best of both worlds: low insertion force and coefficient of friction for ease of assembly without the mess and expense of PTFE coating. Velix™ II is an ultra low-cost treatment option that will increase your assembly speed while addressing your need for cost control and reduction. Velix™ II also reduces static buildup which eliminates stuck parts during the feeding operation.

Velix™ II treatment is a non-flaking, environmentally-friendly option that is applied during the washing of the product. MSDS and other technical information available at www.precixinc.com.

Insertion Force Comparison



Coefficient of Friction Comparison



FUEL/TRANSPORTATION APPLICATIONS

A variety of elastomeric molded applications are in the automotive and heavy duty/ off-road fuel delivery system. The most prominent sealing applications include:

- Quick Connects
- Fuel Injector
- Fuel Rails
- Fuel Pump
- In-Tank Connections
- Tank Flange Seals
- Fuel Level Sensors
- Fuel Filter Flange
- Roll-Over Valves
- Fuel Sensors
- Running Loss System Components
- Fuel Pressure Regulator
- Check Valves
- Gas Cap Vent Seals
- Fule Tank Pressure Relief Valves
- Vapor Canister Seals
- Emission Control

CHEMICAL PROCESSING

Precix seals are the best choice wherever aggressive chemicals and harsh environments are found. Precix seals made from our exclusive engineered compounds are found in the following chemical processing industry applications:

Pumps
- Centrifugal
- Positive displacement
- Metering
- Diaphragm
- Hybrids

Filter elements and housings
Mechanical seals
Valves
Sensors
Instrumentation
Air-operated vents
Connectors (hard plumbed and Quick Connects)

PRECIX SPECIFIC QUICK CONNECTOR FUEL APPLICATION RECOMMENDATION LIST

	End User	Precix Compound	Applicable Material Specification
a)	**General Motors Corp./Opel**		
	Inboard Seal:	F52 (F13661)	GM6268M Type I*
	Outboard Seal:	L54 (L13443)	GM6269M Type II
		or	or
		G17 (L13430)	GM6268M Type II, GM6269M Type II
	Barb Seal:	Same as Outboard Seal	Same as Outboard Seal
b)	**Ford Motor Co., Inc.**		
	Inboard Seal:	F86 (F13728)	WSA-M2D401-A8
	Outboard Seal:	L54 (F13443)	WSA-M2D401-A6
c)	**Fiat Corp.-Brazil**		
	Inboard Seal:	F86 (F13728)	GF® Type
	Outboard Seal:	F78 (F13730)	GFLT® Type
		or F05 (F13705)	GLT® Type
d)	**A. Raymond Engineered Products**		
	Inboard Seal:	F52 (F13661)	QE080001 Type A
	Outboard Seal:	L54 (L13443)	QE080001 Type B
	Barb Seal:	F86 (F13728)	SAE J200/ASTM D2000 3HK715A1-10B37B38 C12EF31EO78Z1Z2 Z1 = Duro 75 ± 5 Z2 = Color Green
e)	**General Recommendation**		
	Inboard Seal:	F52 (F13661)	SAE J200/ASTM D2000 M4HK810F17Z1-Z8
		or	
		F86 (F13728)	SAE J200/ASTM D2000 3HK715A1-10B37B38 C12EF31EO78Z1Z2 Z1 = Duro 75 ± 5 Z2 = Color Green
	Outboard Seal:	L54 (L13443)	SAE J200/ASTM D2000 2FK606A19C12EF31F19Z1Z2 Z1 = Duro 73 ± 5 Z2 = Color Yellow
		or	
		G17 (L13430)	SAE J200/ASTM D2000 M2FK807A19F19Z1 – Z6
f)	**General Vapor Recovery System: (One Seal/Connector)**		
	General Motors Corp.	F52 (F13661)	GM6268M Type I or GM6269M Type I*
	Ford Motor Company, Inc.	L54 (L13443)	WSA-M2D401-A6
g)	**Conductive Fluorocarbon**	F87 (F13787)	SAE J200/ASTM D2000 M2HK814A1-10B37C12F15Z1 Z1=Duro 85 ± 5

*At the time of printing the General Motors Type III Specification was being finalized. Precix F86 (F13728) meets this specification.

FUEL/TRANSPORTATION PRODUCT PROFILES

This is a listing of our most popular compounds for fuel delivery systems. Precix has a library of over 2,500 compounds. Please contact Precix Engineering at materials-engineering@precixinc.com for more information.

Low Temperature Fluorocarbon F05 (F13705) Blue GLT® Type

General
Excellent fluid resistance
Typically used in fuel applications
Superior low temperature flexibility
Good permeation resistance

Material
75 duro low temperature fluorocarbon elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
M2HK710A1-10B37F15Z1Z2
Z1 = Duro 75 ± 5
Z2 = Color Blue

Low Temperature High Fluorine Fluorocarbon F07 (F13723) Black GFLT® Type

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing Methanol and Ethanol)
Improved low temperature flexibility
Excellent permeation resistance

Material
70 duro low temperature high fluorine fluorocarbon elastomer
100 % virgin materials
Meets specifications
SAE J200/ASTM D2000
M2HK710A1-10B38EF31F15Z1
Z1 = Methanol resistance 24 hrs @ 23˚C (73˚F) volume change 0 to 10%

Low Temperature High Fluorine Fluorocarbon F31 (F13731) Black GFLT® Type

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing Methanol and Ethanol)
Improved low temperature flexibility
Excellent permeation resistance

Material
80 duro low temperature high fluorine fluorocarbon elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
M2HK810A1-10B38EF31F15Z1
Z1 = Methanol resistance 24 hrs. @ 23˚C (73˚F) volume change 0 to 10%

Fluorocarbon/Fluorosilicone Blend F52 (F13661) Brown

General
Good fluid resistance
Typically used in fuel applications
Improved low temperature capability
Good permeation resistance

Material
75 duro fluorocarbon/fluorosilicone blend
100% virgin materials
UL Approved
Meets specifications
SAE J200/ASTM D2000
M4HK810F17Z1-Z8*
*Refer to lab report

Low Temperature High Fluorine Fluorocarbon F77 (F13729) Gray GFLT® Type

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing
Methanol and Ethanol)
Improved low temperature flexibility
Excellent permeation resistance

Material
70 duro low temperature high fluorine elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
4HK715B38C12EF31EO78F17Z1Z2
Z1 = Duro 75 ± 5
Z2 = Color Gray
Gray for identification purpose

Low Temperature High Fluorine Fluorocarbon F78 (F13730) Black GFLT® Type

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing
Methanol and Ethanol)
Improved low temperature flexibility
Excellent permeation resistance

Material
70 duro low temperature high fluorine elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
4HK715B38C12EF31EO78F17Z1
Z1 = Duro 75 ± 5

Low Temperature Fluorocarbon F79 (F13724) Black GLT® Type

General
Excellent fluid resistance
Typically used in fuel applications
Superior low temperature flexibility
Good permeation resistance

Material
75 duro low temperature
fluorocarbon elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
M2HK710A1-10B37F15Z1
Z1 = Duro 75 ± 5

Low Temperature Fluorocarbon F85 (F13727) Black GLT® Type

General
Excellent fluid resistance
Typically used in fuel applications
Superior low temperature flexibility
Good permeation resistance

Material
85 duro low temperature
fluorocarbon elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
M2HK810A1-10B37F15Z1
Z1 = Duro 85 ± 5

High FluorineFluorocarbon F86 (F13728) Green GF® Type

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing Methanol and Ethanol)
Improved low temperature flexibility
Best permeation resistance

Material
75 duro high fluorine elastomer
100% virgin materials
UL Approved
Meets specifications
SAE J200/ASTM D2000
3HK715A1-10 B37B38C12EF31EO78Z1Z2
Z1 = Duro 75 ± 5
Z2 = Color Green
Green for identification purpose

Toughened Fluorosilicone G17 (L13430) Yellow

General
Excellent fluid resistance
Typically used in fuel applications
Excellent low temperature flexibility

Material
75 duro toughened fluorosilicone
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
M2FK807A19F19Z1-Z6

Semi-Conductive High Fluorine Fluorocarbon F87 (F13787) Black

General
Semi-Conductive Fluorocarbon
Excellent Resistance to Fuels/ Flex Fuels
Strong Ability to Dissipate Static Charge
Excellent Heat Resistance
Superior Property Profile

Material
Black, 100% Virgin Material
Typical Volume Resistivity of 10^{1}-10^{3} ohm-cm
Meets specifications
SAE J200/ASTM D2000
M2HK814A1-10B37C12F15Z1
Z1 = Duro 85±5

HNBR for High Temperature Oil Resistance H76 (H14576) Black

General
Good Resistance to Engine Fluids & Oils
Excellent Heat Resistance properties to 150˚ C
Good Resistance to Refrigerants & Coolants
Excellent Low Temperature Properties
Low Compression Set
Good Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2DH710A26B36EO16EO36F17

High Strength Fluorosilicone L53 (L13446) Orange

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing
Methanol and Ethanol)
Improved cut resistance
Excellent low temperature

Material
75 duro high strength fluorosilicone elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
2FK606A19C12EF31F19Z1Z2
Z1 = Duro 70 ± 5
Z2 = Color Orange
Orange for identification purpose

High Strength Fluorosilicone L54 (L13443) Yellow

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing
Methanol and Ethanol)
Improved low temperature flexibility
Excellent permeation resistance

Material
75 duro high strength fluorosilicone elastomer
100% virgin materials
Meets specifications
SAE J200/ASTM D2000
2FK606A19C12EF31F19Z1Z2
Z1 = Duro 70 ± 5
Z2 = Color Yellow
Yellow for identification purpose

UL Approved EPDM for General Purpose Applications E34 (E17434) Black

General
Excellent Resistance to Water, Anti-Freeze & Brake Fluids
Excellent Heat Resistance properties to 150˚ C
Excellent Low Temperature properties to -55˚ C
Low Compression Set
Good Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M3DA710A26B36C32EA14F19,
UL778, UL1081, & UL1563 Approval

EPDM for Potable Water & Food E61 (E17331) Black

General
ANSI/NSF Standard 61 Certified For Potable Water Applications
Conforms with FDA 21 CFR177.26 for use with Food Contact
Excellent Heat Resistance properties to 150˚ C
Excellent Low Temperature properties to -55˚ C
Low Compression Set
Good Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2DA710A26B36EA14F19

Standard Fluorocarbon F18 (F13768) Brown

General
Excellent heat resistance
Excellent resistance to engine oils and lubricants
Low compression set
Good fuel resistance
Excellent Ozone and Weathering Resistance

Material
Brown in Color
100% Virgin Materials
Meets ASTM specification M2HK610 A1-10B37F15

High Fluorine Fluorocarbon F35 (F13755) Black

General
Excellent fuel resistance.
Typically used with Fuel blends containing MTBE, Methanol or Ethanol (Flex Fuel)
Excellent resistance to brittleness at low temperatures
Excellent permeation resistance
Good compression set properties
Excellent heat resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2HK810A1-10B37B48EF31Z1
Z1= Volume Change in 100% Methanol, 70 hrs. @ 23˚C, 0 to 10%

Standard Fluorocarbon F40 (F13740) Brown

General
Excellent heat resistance
Excellent resistance to engine oils and lubricants
Low compression set
Good fuel resistance
Excellent Ozone and Weathering Resistance

Material
Brown in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2HK810A1-10B38EF31EO78Z1
Z1= Duro75±5

High Fluorine Fluorocarbon F43 (F13742) Black

General
Excellent fuel resistance.
Typically used with Fuel blends containing MTBE, Methanol or Ethanol (Flex Fuel)
Excellent permeation resistance
Very good chemical resistance
Very good steam resistance
Good compression set properties
Good resistance to amine containing fluids
Excellent heat resistance

Material
Black in Color
100% Virgin Materials
Meets ASTM specification M2HK710A1-10B38EF31F15Z1
Z1= Volume Change in 100% Methanol, 70 hrs. @ 23˚C, 0 to 5%

Special Amine Resistant Fluorocarbon F44 (F13744) Black

General
Can replace Aflas™ in Many Applications
Excellent High Temperature Properties
Excellent Resistance to Automatic Transmission Fluids, Caustic Fluids & Gear Lubricants
Excellent Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2HK810A1-10B37Z1
Z1= Duro 75±5

Standard Fluorocarbon F48 (F13753) Black

General
Excellent heat resistance
Excellent resistance to engine oils and lubricants
Low compression set
Good fuel resistance
Good chemical resistance
Excellent Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
Meets ASTM specification M2HK707A1-10B37F15Z1
Z1= Shore A Durometer 75± 5

Fluorocarbon/Fluorosilicone Blend F52 (F13661) Brown

General
Good fluid resistance
Typically used in fuel applications
Improved low temperature capability
Good permeation resistance

Material
75 duro fluorocarbon/fluorosilicone blend
100% virgin materials
UL Approved
Meets specifications
SAE J200/ASTM D2000
M4HK810F17Z1-Z8*
*Refer to lab report

High Fluorine Fluorocarbon F56 (F13756) Black

General
Excellent fuel resistance.
Typically used with Fuel blends containing MTBE, Methanol or Ethanol (Flex Fuel)
Excellent resistance to brittleness at low temperatures
Excellent permeation resistance
Good compression set properties
Excellent heat resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2HK710A1-10EF31Z1
Z1= Volume Change in 100% Methanol, 70 hrs. @ 23˚C, 0 to 10%

Extreme Chemical Resistant Fluorocarbon F65 (F13678) Black Viton® Extreme

General
Excellent Polar Solvent Resistance (Better Than GF® Types)
Excellent Resistance to Engine Oils, Gear Lubricant & Hydraulic Fluid
Excellent Resistance to Strong Acids and Bases
Best Chemical Resistance Available in a Non-Perfluoroelastomer
Good Heat Resistance
Excellent Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M3HK814B38EF31Z1
Z1=Duro 75 ± 5

Standard Fluorocarbon F75 (F13664) Black

General
Excellent heat resistance
Excellent resistance to engine oils and lubricants
Low compression set
Good fuel resistance
Excellent Ozone and Weathering Resistance

Material
Black in Color
100% Virgin Materials
UL Approved
Listed on the QPL for Aerospace specification AMS 7276
Meets specifications
SAE J200/ASTM D2000
M2HK710A1-10B38EF31EO78F15Z1
Z1= Duro 75 ± 5

High Fluorine Fluorocarbon F86 (F13728) Green GF® Type

General
Excellent fluid resistance
Typically used in flex fuels
(gasohol, fuel blends containing Methanol and Ethanol)
Improved low temperature flexibility
Best permeation resistance

Material
75 duro high fluorine elastomer
100% virgin materials
UL Approved
Meets specifications
SAE J200/ASTM D2000
3HK715A1-10 B37B38C12EF31EO78Z1Z2
Z1 = Duro 75 ± 5
Z2 = Color Green
Green for identification purpose

Chloroprene for General Purpose Applications N20 (N18538) Black

General
High Strength & Abrasion Resistance
Good Heat Resistance to 100˚ C
Good Resistance to Oils & Chemicals
Good Resistance to the Environment

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M4BC714A14B14EO14EO34

UL Approved NBR for General Purpose Applications M07 (H14327) Black

General
Good Resistance to Engine Fluids & Oils
Good Heat Resistance to 100˚ C
Good Resistance to LP & Natural Gas
Low Compression Set
Good Resistance to Fire Extinguishing Agents

Material
Black in Color
100% Virgin Materials
Meets specifications
SAE J200/ASTM D2000
M2BG710B14EF11EF21EO34

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
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 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
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 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 alkalies. 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®
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
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
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)
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)
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
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
(Hydrogenated Nitrile)
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
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.

FLUOROSILICONE
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.

FLUOROCARBON/FLUOROSILICONE BLENDS
Precix has developed unique blends of fluorocarbon and fluorosilicone specifically for fuel system seals. Good fuel resistance from the fluorocarbon is balanced with good low temperature flexibility from the fluorosilicone. Nearly two decades of commercial use validate the strong performance of our blend materials.

FLUOROCARBONS
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.

* for more detailed information: www.precixinc.com

Terminolgy	Natural Rubber	SBR	Butyl	EPDM	Neoprene®	Nitrile	Epichlorohydrin	Polyacrylate	Vamac®	Urethane	HSN	Silicone	Fluorosilicone	Fluorocarbon
Typical ASTM D 1418 Designation	NR	SBR	IIR	EPDM	CR	NBR	CO,ECO	ACM	AEM	AU,EU	HNBR	VMQ	FVMQ	FKM
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
Physical Properties														
Tensile Strength	E	G	F-G	F-G	G-E	G	F-G	F	F-G	E	G	F	F	F-G
Compression Set	G	G	F	G	F-G	G	F-G	F-G	F-G	G	G	G-E	G	G-E
Resilience	E	G	F	F-G	G-E	G	F	F	F	G	G	F-G	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
Impermeability (Gas)	F	F	E	F	F	F-G	E	F-G	F-G	P-F	G	P-F	P-F	G-E
Temperature Range (Typical)														
High, Steady Use (°C)	70	100	100	150	100	125	125-150	150-175	175	100	150	225	200	250
Low Temperature	E	G	G	E	F	F-G	F-G	P-F	F-G	F-G	F-G	E	E	P-F
Typical Fluid Resistance														
Fuels	P	P	P	P	P	G-E	G-E	F	F	F-G	G-E	P-F	E	E
Oils	P	P	P	P	F	G-E	G-E	E	G	G-E	G-E	G	E	E
Acids	F-G	F	G-E	E	F-G	G	F	P-F	F	P-F	G	F	G	G-E
Ketones (oxygenated)	F-G	F	G	G-E	P-F	P	P	P	P	P	P	P-F	P	P-G
Water	G-E	G	G-E	E	G	F-G	G	P	F-G	P-G	F-G	G	G	G
Environmental Resistance														
Weathering	F	F	E	E	E	F	G-E	E	E	G-E	G	E	E	E
Ozone	P	P	G-E	E	G	P	G-E	E	E	E	F	E	E	E
Flame	P	P	P	P	G	P	P-F	P	P	P	P	F	G	G

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

Neoprene® is a registered trademark of Dupont Dow Elastomers Dupont™ Vamac® ethylene acrylic elastomer
This summary is intended as only a guideline for typical comparative purposes. Testing is required for specific applications.

General Consideration
Fuel resistance
"Flex-fuels" (M.T.B.E., MeOH, EtOH, etc.)
Oxidized fuel resistance
Chemical resistance
Permeation resistance

Polymer to consider/used in applications
Perfluoroelastomers - FFKM
Fluorocarbons - FKM
Fluorocarbons/Fluorosilicone Blend - FKM/FVMQ
Fluorosilicone - FVMQ
Saturated Nitriles - HNBR
Nitriles - NBR

Perfluoroelastomers - FFKM
(-20˚C/-4˚F — 300˚C/572˚F)
Extreme chemical resistance
High temperature service applications
Superior permeation resistance

Fluorocarbons - FKM
(-26˚C/-15˚F — 250˚C/482˚F)
Conductive version available
Copolymers (64-66%F)
Most widely used & versatile
Terpolymers (67-70%F)
Includes GF®-types - excellent fuel & chemical resistance
Excellent flex-fuel & permeation resistance
Specialty polymers (65-67%F)
Includes GLT®, GFLT®- types
Excellent low temperature resistance
Flex-fuel resistant

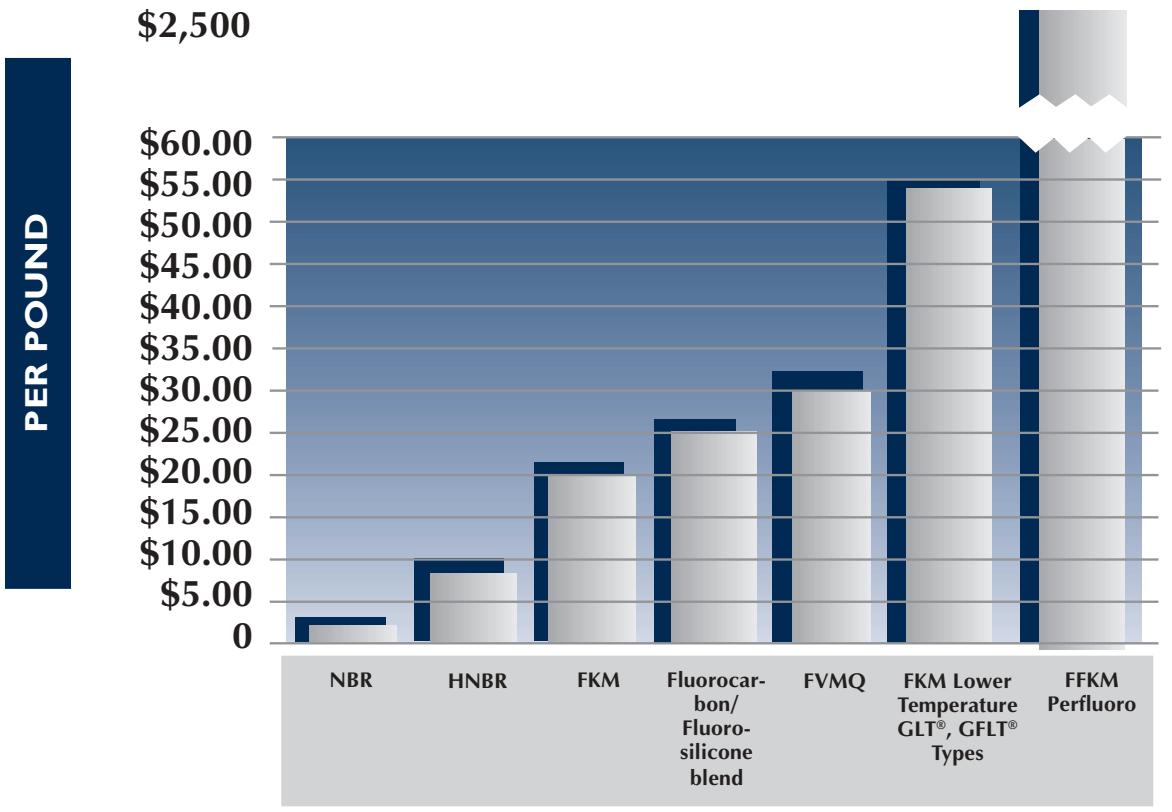
Fluorocarbon/Fluorosilicone Blend - FKM/FVMQ
(-25˚C/-13˚F — 230˚C/446˚F)
Good fuel resistance
Tougher than FVMQ
Good low temperature compatibility

Fluorosilicones - FVMQ
(-65˚C/-89˚F — 200˚C/392˚F)
Excellent low temperature performance
Good high temperature performance
Fuel resistant

Hydrogenated/Saturated Nitriles - HNBR/HSN
(-40˚C/-40˚F — 150˚C/302˚F)
Resistant to automotive oils
Good heat resistance
Higher strength

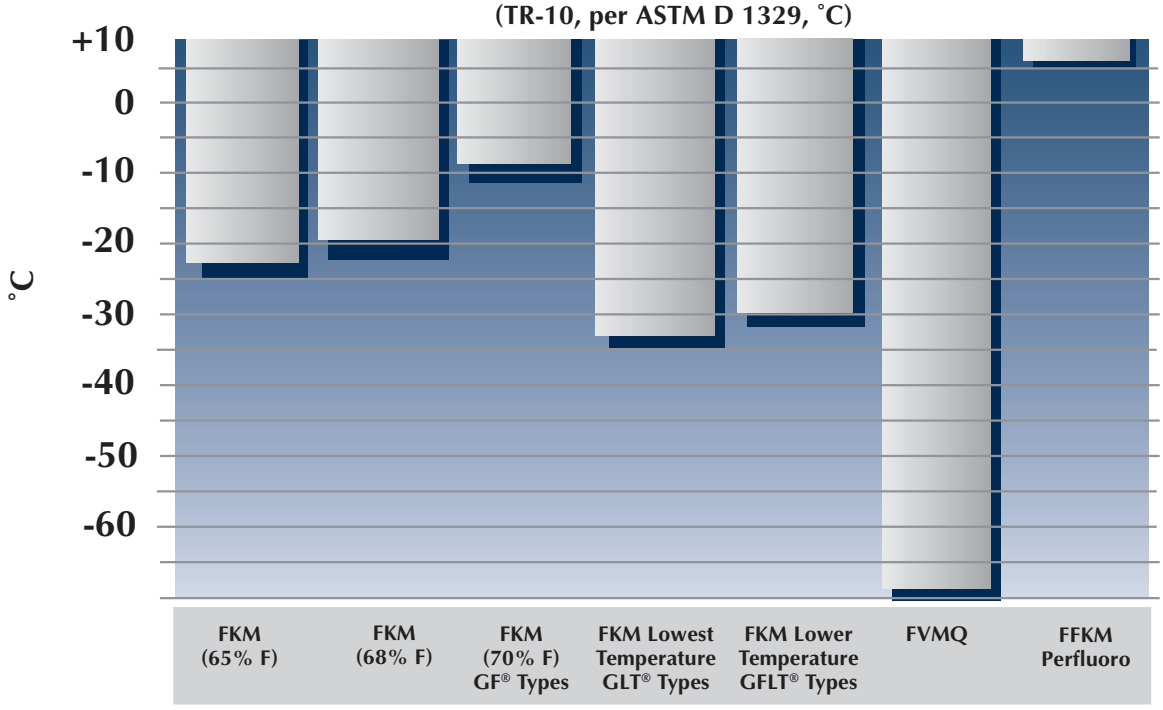
Nitrile - NBR
(-40˚C/-40˚F — 121˚C/250˚F)
Fair heat resistance
Low cost

Material Cost Matrix



Low Temperature Properties

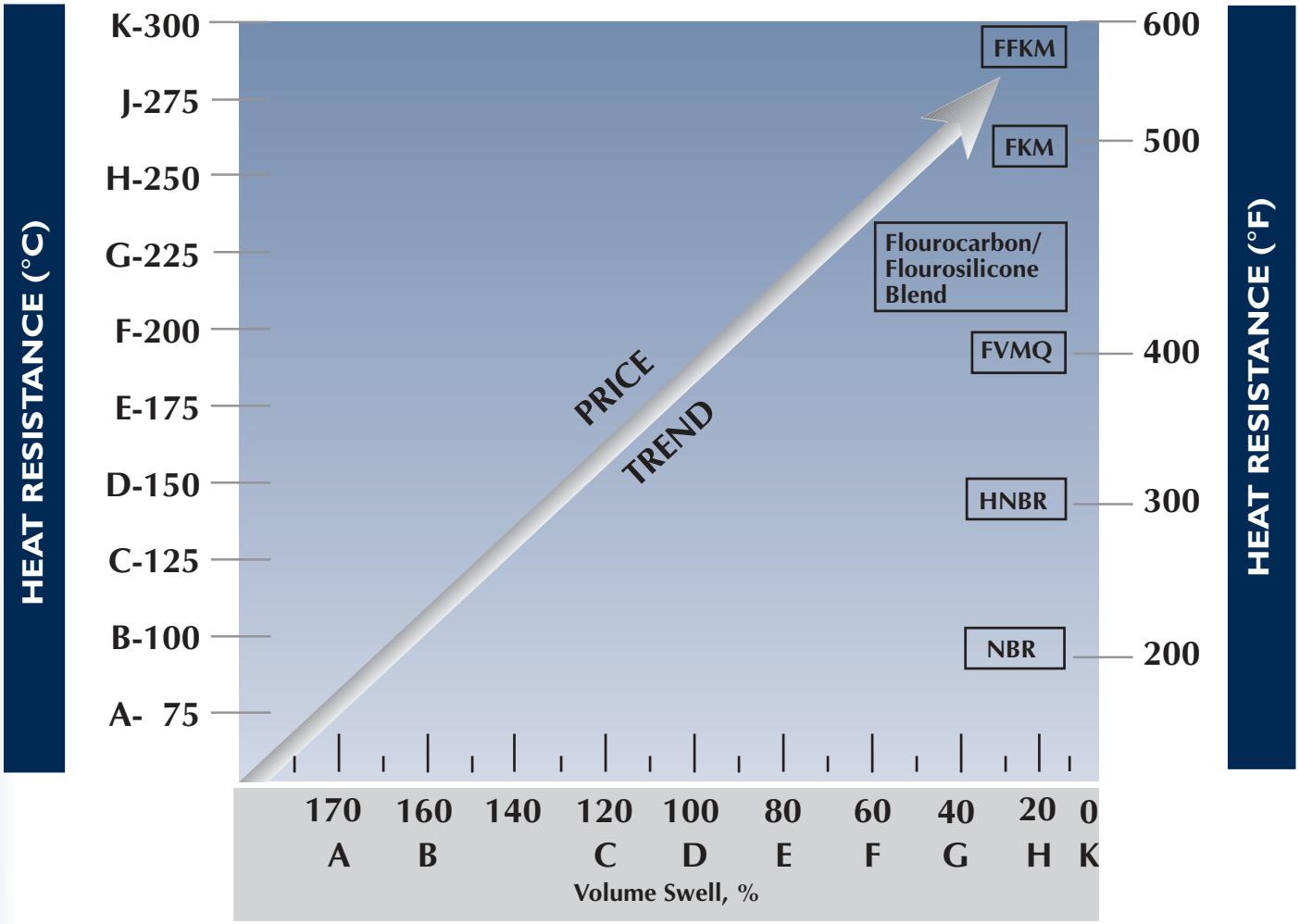
(TR-10, per ASTM D 1329, ˚C)



Base Polymer

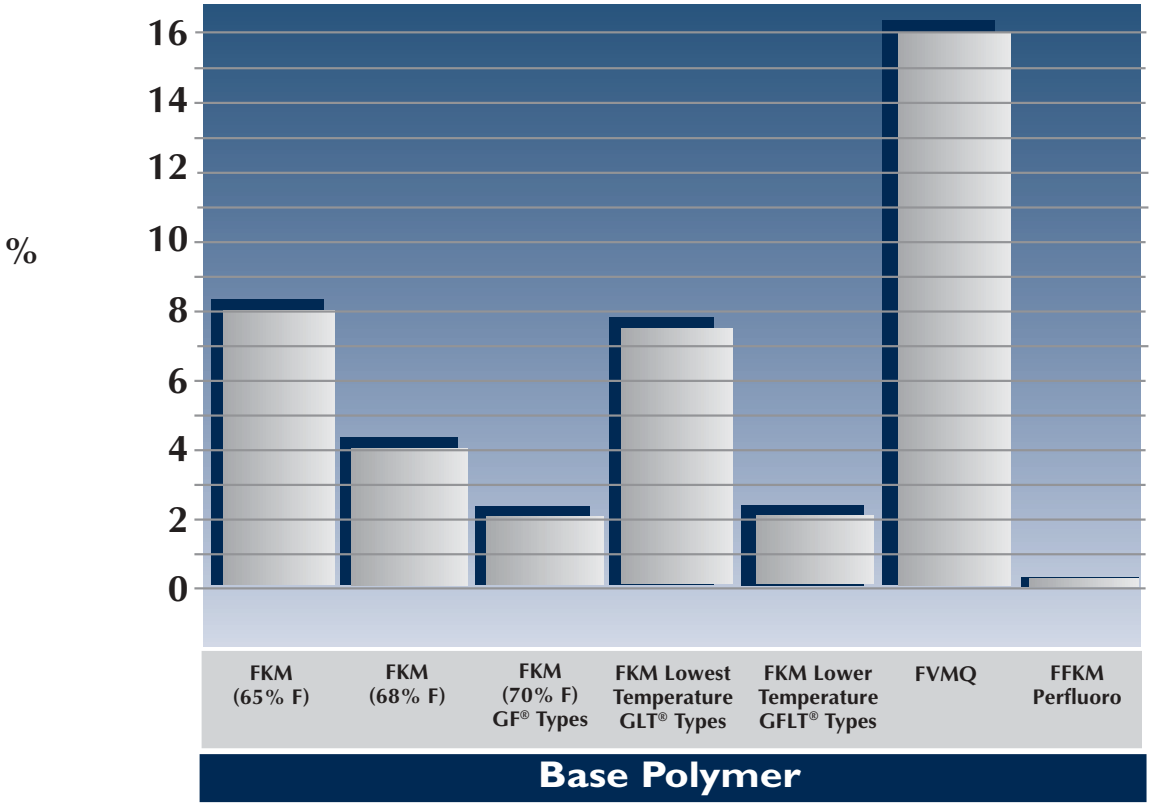
Heat & Oil Resistance

ASTM OIL RESISTANCE - IRM 903 (Per SAE J200/ ASTM D 2000)



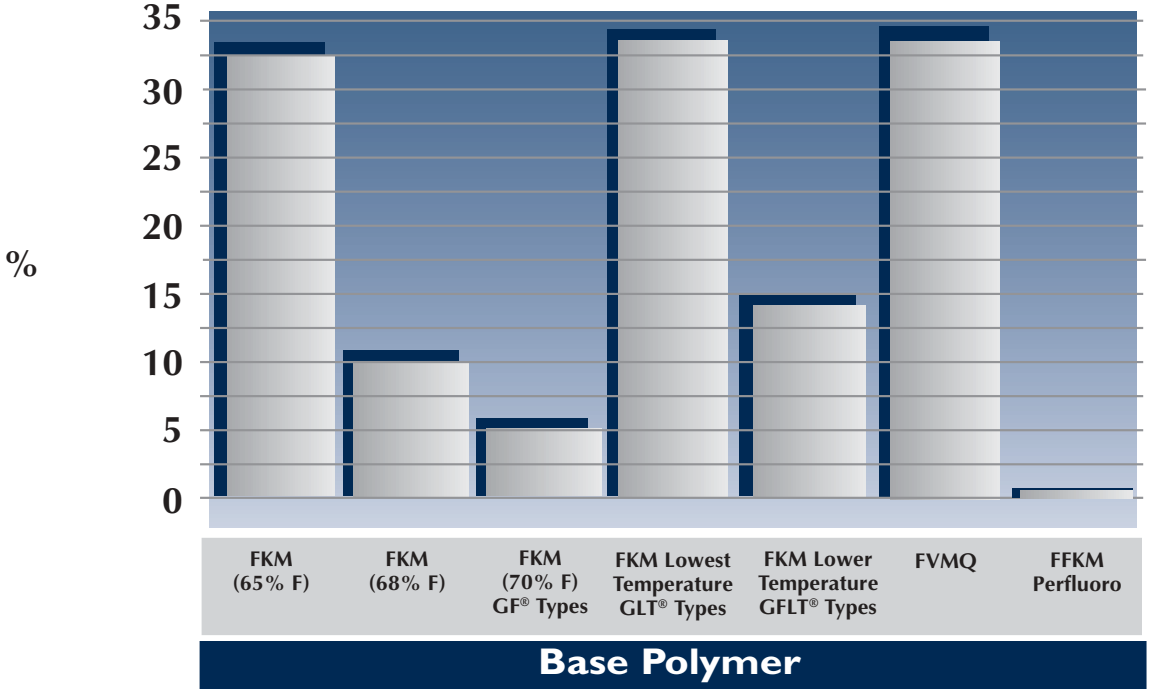
Volume Swell

(70 hours @ 23˚ C in Oxidized Fuel per Ford FLTM AZ 105-01)



Volume Swell

(70 hours @ 23˚ C in 15% Methanol / 85% Fuel "C")



FUEL/TRANSPORTATION COMPOUND MATRIX

Compound	ASTM D 1329 TR10/°C	ASTM D 2137* Brittleness	ASTM D 471 Resistance in Methanol	ASTM D 395 Compression Set 22 Hours @ 200°C	Fuel Permeability** GM/M2/24 Hours/ Fuel C
G17 (L13430)	-65	Pass@-40°C	+5.4@24/RT	25.1	100
L54 (L13443)	-60	Pass@-40°C	+5.2@24/RT	24.2	100
F52 (F13661)	-24	Pass@-40°C	+32@24/RT	32.7	60
F75 (F13664)	-15	Pass@-25°C	+100@24/RT	12.7	6
F05 (F13705)	-29	Pass@-40°C	+134@24/RT	12	6
F84 (F13717)	-16	Pass@-25°C	+108@24/RT	10.6	6
F07 (F13723)	-24	Pass@-35°C	+7@24/RT	21.1	2
F79 (F13724)	-29	Pass@-40°C	+89.9@24/RT	13.8	6
F85 (F13727)	-25	Pass@-35°C	+97@24/RT	21.7	6
F86 (F13728)	-11	Pass@-20°C	+3@24/RT	22.1	2
F77 (F13729)	-21	Pass@-36°C	+3.4@24/RT	28.2	2
F78 (F13731)	-23	Pass@-40°C	+3.3@22/RT	19.4	2
F43 (F13742)	-13	Pass@-30°C	+2.7@70/RT	11.8	6
F51 (F13751)	-23	Pass@-30°C	+58@24/RT	13.5	4
F48 (F13753)	-15	Pass@-30°C	+60@24/RT	15	6
F56 (F13756)	-11	Pass@-20°C	+3@24/RT	21	2

* Actual brittleness point may be lower than reported.

** Permeability based on commercially available data for polymer type, not actual compound test.

FUEL/TRANSPORTATION COMPATIBILITY MATRIX

Compound	Gasoline/ Fuel C	Gasoline/ Ethanol Blends	Gasoline/ Methanol Blends	100% Methanol	Gasoline/ MTBE Blends
G17 (L13430)	0	0	0	+	0
L54 (L13443)	0	0	0	+	0
F52 (F13661)	0	0	0-	—	0
F75 (F13664)	+	0	-	—	+
F05 (F13705)	+	0	-	—	+
F84 (F13717)	+	0	-	—	+
F07 (F13723)	+	+	0	+	+
F79 (F13724)	+	0	-	—	+
F85 (F13727)	+	0	-	—	+
F86 (F13728)	+	+	+	+	+
F78 (F13731)	+	+	0	+	+
F43 (F13742)	+	+	+	+	+
F51 (F13751)	+	+	0	-	+
F48 (F13753)	+	0	-	-	+
F56 (F13756)	+	+	+	+	+

LEGEND

SWELL

+ = Less than 10%
0 = 10-25%
- = 25-100%
— = Above 100%

TECHNICAL REPORTS

- **Fuel/Transportation**
- **Chemical Processing**

TYPICAL PHYSICAL PROPERTIES - F05 (F13705) BLUE FLUOROCARBON GLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK710A1-10B37F15Z1Z2

	Requirement	F05 (F13705)
ORIGINAL PROPERTIES		
Shore A Durometer, pts	70-85	72
Tensile Strength, MPa, min.	8.0	12.1
Ultimate Elongation, %, min.	150	170
Modulus @ 100%, MPa min.	2.5	6.9
Wallace IRHD, pts	65-80	68
HEAT RESISTANCE		
70 hrs. @ 250°C		
Shore A Durometer Change, pts	-5 to -10	+3
Tensile Strength Change, %, max.	-50	-3.1
Ultimate Elongation Change, %, max.	-50	-3.5
COMPRESSION SET RESISTANCE		
22 hrs. @ 175°C		
% Original Deflection, max.	50	16.9
ASTM FUEL C RESISTANCE		
70 hrs. @ 23°C		
Shore A Durometer Change, pts	0 to -15	-2
Tensile Strength Change, %, max.	-40	-35.6
Ultimate Elongation Change, %, max.	-40	-4.1
Volume Change, %	0 to +15	+5.7
METHANOL RESISTANCE		
24 hrs. @ 23°C		
Volume Change, %	+60 to +130	+106

TYPICAL PHYSICAL PROPERTIES - F07 (F13723)
BLACK FLUOROCARBON GFLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK710A1-10B38EF31F15Z1

	Requirement	F07 (F13723)
ORIGINAL PROPERTIES		
Shore A Durometer, pts.	65-80	73
Tens. Strength, MPa, min.	8.0	9.7
Ultimate Elongation, %, min.	125	281
Modulus @ 100%, MPa, min.	2.5	4.2
Wallace IRHD	55-70	70
Specific Gravity	Report	2.21
Color	Non Black	Blue
HEAT RESISTANCE		
70 hrs. @ 250°C		
Shore A Durometer Change, pts.	-5 to +10	-1
Tensile Strength Chg., %, max.	-25	-24
Ultimate Elongation Chg., %, max.	-25	+37
COMPRESSION SET RESISTANCE		
22 hrs. @ 175°C		
% Original Deflection, max.	50	28
REF. FUEL C RESISTANCE		
70 hrs. @ 23°C		
Shore A Durometer Change, pts.	-10 to 0	-1
Tensile Strength Change, %, max.	-25	-17
Ultimate Elongation Change, %, max.	-2	-1
Volume Change, %	0 to +10	+3
METHANOL RESISTANCE		
24 hrs. @ 23°C		
Volume Change, %	0 to +10	-4

TYPICAL PHYSICAL PROPERTIES - F31 (F13731) BLACK FLUOROCARBON GFLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK810A1-10B38EF31F15Z1

	Requirement	F31 (F13731)
ORIGINAL PROPERTIES		
Shore A Durometer:	80 ± 5	82
Tensile, MPa, min.	10	17
Elongation, %, min.	150	244
Color	NR	Black
Heat Age, 70 hrs. @ 250˚C		
Change in Durometer, pts., max	+10	-7
Change in Tensile, %, max.	-25	-11.6
Change in Elongation, %, max.	-25	+12
Compression Set, 22 hrs. @ 200˚C:		
% Set, max.	50	15.2
Fluid Resistance, Fuel C, 70 hrs. @ 23˚C:		
Change in Durometer, pts.	± 5	-3
Change in Tensile, %, max.	-25	-19.2
Change in Elongation, %, max.	-20	-3.3
Change in Volume, %	0 / +10	+4.2
Z1: Fluid Resistance, Methanol, 70 hrs. @ 23˚C :		
% Volume Change	0 / +10	+9

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - F52 (F13661) BROWN FLUOROCARBON/FLUOROSILICONE BLEND

SPECIFICATIONS: GM6268M TYPE I

	GM6268M TYPE 1 Requirements	F52 (F13661)
ORIGINAL PROPERTIES		
Durometer, Shore A	75 ± 5	77
Tensile Strength, MPa, min.	7.0	7.9
Modulus @ 50% Elongation, MPa, min.	2.8	3.3
Elongation, %, min.	115	153
Density	Report	1.81
Tension Set, %, max.	6.0	5.1
Tear Strength, Die C, kN/m, min.	11.0	12
HEAT RESISTANCE		
70 hours @ 225°C		
Modulus @ 50% Change, %	0 to 35	21
Elongation Change, %	0 to -30	-11
COMPRESSION SET		
22 hours @ 100°C		
% of Original Thickness, max.	30%	17
Low Temperature Properties		
TR-10, min.	-20°C	-26
IMMERSION: 80% ASTM Fuel C/ 20% Methanol		
70 hours @ 23°C		
Tensile Change, %	0 to -70	-55
Elongation Change, %	0 to -50	-31
Tear Strength Change, %	0 to -70	-37
Volume Change, %	0 to +40	+28.3
IMMERSION: 80% ASTM Fuel C/ 20% Methanol		
1008 hours @ 49°C		
Tensile Change, %	0 to -75	-62
Elongation Change, %	+25 to -65	-43
Tear Strength Change, %	0 to -75	42
Volume Change, %	0 to +40	+34.8
IMMERSION: Sour Gasoline		
168 hours @ 60°C		
Tensile Change, %	-45 to 0	-30
Elongation Change, %	-25 to 0	-12
Tear Strength Change, %	-50 to 0	-34
Volume Change, %	0 to +20	+15.1

TYPICAL PHYSICAL PROPERTIES - F77 (F13729)
GRAY FLUOROCARBON GFLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 4HK715B38C12EF31E078F17Z1Z2

	Requirement	F77 (F13729)
ORIGINAL PROPERTIES		
Hardness, I.R.H.D.	70±5	69
Hardness, Shore A	75 ± 5	71
Tensile Strength, MPa, min.	12.0	13.5
Elongation at Break, %, min.	225%	230
Modulus at 100% Elong., MPa, min.	5.0	6.1
Compression Set		
70 hours at 200°C, % set, max.	50%	23.3
Tear Strength, Die C, kN/m, min.	16	33
Ozone Resistance, max.	Rating 0	0
Procedure A		
TR-10	-21°C	-21
HEAT AGED, 1000 hours at 200°C		
Hardness Change, max.	±5	+4
Tensile Strength Change, max.	-15%	-8
Elongation at Break Change, max.	-25%	-18
IMMERSION IN FUEL C, 336 hours at 60°C		
Hardness Change, max.	-10	-7
Tensile Strength Change, max.	-50%	-41
Elongation at Break Change, max.	-40%	-22
Volume Change, max.	+15%	+13
IMMERSION IN OXIDIZED FUEL, 336 hours at 60°C (FLTM AZ 105-01, PN 180)		
Hardness Change, max.	-20	-16
Tensile Strength Change, max.	-60%	-56
Elongation at Break Change, max.	-25%	-11
Volume Change, max.	+30%	+23
IMMERSION IN 50% FUEL C AND 50% METHANOL 2000 hours at 60°C		
Hardness Change, max.	-20	-15
Tensile Strength Change, max.	-60%	-50
Elongation at Break Change, max.	-40%	-20
Volume Change, max.	+25%	+18
M50 – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-5	-1
Tensile Strength Change, max.	-60%	-10
Elongation at Break Change, max.	-40%	-5
Volume Change, max.	+10%	+1
IMMERSION IN 65% FUEL C, 20% METHANOL AND 15% MTBE 2000 hours at 60°C		
Hardness Change, max.	-20	-16
Tensile Strength Change, max.	-70%	-50
Elongation at Break Change, max.	-45%	-20
Volume Change, max.	+40%	+29
FUEL BLEND – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-3	-2
Tensile Strength Change, max.	-10%	-6
Elongation at Break Change, max.	-15%	-8
Volume Change, max.	-5%	-1

TYPICAL PHYSICAL PROPERTIES - F78 (F13730)
BLACK FLUOROCARBON GFLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 4HK715B38C12EF31EO78F17Z1

	Requirement	F78 (F13730)
ORIGINAL PROPERTIES		
Hardness, I.R.H.D.	70±5	70
Hardness, Shore A	75±5	72
Tensile Strength, Mpa, min.	12.0 (1742 psi)	19.3
Elongation at Break, %, min.	225%	310
Modulus at 100% Elong., Mpa, min.	5.0 (730 psi)	5.9
Compression Set		
70 hours at 200°C, % set, max.	50%	31
Tear Strength, Die C, kN/m, min.	16 (92 ppi)	31
FLTM Ozone Resistance, max.	Rating 0	0
BP 101-01, Procedure A		
TR-10	-21°C	-24
HEAT AGED, 1000 hours at 200°C		
Hardness Change, max.	±5	+3
Tensile Strength Change, max.	-15%	-10
Elongation at Break Change, max.	-25%	-21
IMMERSION IN FUEL C, 336 hours at 60°C		
Hardness Change, max.	-10	-8
Tensile Strength Change, max.	-50%	-45
Elongation at Break Change, max.	-40%	22
Volume Change, max.	+15%	+14.5
IMMERSION IN OXIDIZED FUEL, 336 hours at 60°C (FLTM AZ 105-01, PN 180)		
Hardness Change, max.	-20	-18
Tensile Strength Change, max.	-60%	-54
Elongation at Break Change, max.	-25%	-14
Volume Change, max.	+30%	+25.7
IMMERSION IN 50% FUEL C AND 50% METHANOL 2000 hours at 60°C		
Hardness Change, max.	-20	-12
Tensile Strength Change, max.	-60%	-45
Elongation at Break Change, max.	-40%	-10
Volume Change, max.	+25%	+14
M50 – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-5	0
Tensile Strength Change, max.	-60%	-5
Elongation at Break Change, max.	-40%	-4
Volume Change, max.	+10%	0
IMMERSION IN 65% FUEL C, 20% METHANOL AND 15% MTBE 2000 hours at 60°C		
Hardness Change, max.	-20	-17
Tensile Strength Change, max.	–70%	-45
Elongation at Break Change, max.	–45%	-15
Volume Change, max.	+40%	+33
FUEL BLEND – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	–3	-1
Tensile Strength Change, max.	–10%	-5
Elongation at Break Change, max.	–15%	-3
Volume Change, max.	–5%	-1

TYPICAL PHYSICAL PROPERTIES - F79 (F13724) BLACK FLUOROCARBON GLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK710A1-10B37F15Z1

	Requirement	F79 (F13724)
ORIGINAL PROPERTIES		
IRHD Hardness	65-80	77
Shore A Durometer, pts	70-85	79
Tensile Strength, MPa, min.	8	18.9
Ultimate Elongation, %, min.	150	306
Modulus @ 100%, MPa, min.	2.5	3.8
Specific Gravity	+-.05 (of Target)	1.84
HEAT RESISTANCE		
70 hrs. @ 250°C (482°F)		
Shore A Durometer Change, pts	-5 to +10	-4
Tensile Strength Change, %, max.	-50	-22.0
Ultimate Elongation Change, %, max.	-50	+4.6
COMPRESSION SET RESISTANCE		
22 hrs. @ 175°C (347°F)		
% Original Deflection, max.	50	18.2
FUEL C RESISTANCE		
70 hrs. @ 23°C (73°F)		
Shore A Durometer Change, pts	0 to –15	-10
Tensile Strength Change, %, max.	-40	-36.8
Ultimate Elongation Change, %, max.	-40	-36.6
Volume Change, %	0 to +15	+5.7
METHANOL RESISTANCE		
24hrs. @ 23°C (73°F)		
Volume Change, %	+60 to +130	+117.1

TYPICAL PHYSICAL PROPERTIES - F85 (F13727)
BLACK FLUOROCARBON GLT® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK810A1-10337F15Z1

	Requirement	F85 (F13727)
ORIGINAL PROPERTIES		
IRHD	80-95	83
Shore A Durometer, pts	80-95	88
Tensile Strength, psi , min.	1450	2121
Ultimate Elongation, %, min.	125	234
Modulus @ 100%, psi, min.	650	799
Specific Gravity	1.84 ± .05	1.83
HEAT RESISTANCE		
70 hrs. @ 250°C (482°F)		
Shore A Durometer Change, pts	-5 to +10	-1
Tensile Strength Change, % ,max.	-50	-5.8
Ultimate Elongation Change, %,max.	-50	-2.1
COMPRESSION SET RESISTANCE		
22 hrs. @ 175°C (347°F)		
% Original Deflection, max.	50	25
FUEL C RESISTANCE		
70 hrs. @ 23°C (73°F)		
Shore A Durometer Change, pts	0 to –15	-7
Tensile Strength Change, %, max.	-40	-16
Ultimate Elongation Change, %, max.	-40	-5.1
Volume Change, %	0 to +15	+6
METHANOL RESISTANCE		
24 hrs. @ 23°C (73°F)		
Volume Change, %	+60 to +160	+97.1

TYPICAL PHYSICAL PROPERTIES - F86 (F13728) GREEN FLUOROCARBON GF® TYPE

SPECIFICATION: FORD WSAM2D401-A8

	Ford WSA-M2D401-A8 Requirements	F86 (F13728)
ORIGINAL PROPERTIES		
Hardness, I.R.H.D.	65-80	66
Hardness, Shore A	75±5	74
Tensile Strength, MPa, min.	9.0	12.3
Elongation at Break, %, min.	160%	220
Modulus at 100% Elong., MPa, min.	40	5.4
Compression Set		
70 hours at 200°C, % set, max.	35%	24.2
Tear Strength, Die C, kN/m, min.	14	35
FLTM Ozone Resistance, max. BP 101-01, Procedure A	Rating 0	0
TR-10	-3°C (+23°F)	-11
HEAT AGED, 1000 hours at 200°C		
Hardness Change, max.	±5	-2
Tensile Strength Change, max.	±20%	-12
Elongation at Break Change, max.	±20%	+14
IMMERSION IN FUEL C, 336 hours at 60°C		
Hardness Change, max.	-15	-2
Tensile Strength Change, max.	-60%	-25
Elongation at Break Change, max.	-40%	+15
Volume Change, max.	+15%	+5
IMMERSION IN OXIDIZED FUEL, 336 hours at 60°C (FLTM AZ 105-01, PN 180)		
Hardness Change, max.	-25	-4
Tensile Strength Change, max.	-60%	-30
Elongation at Break Change, max.	-25%	+10
Volume Change, max.	+30%	+8
IMMERSION IN 50% FUEL C AND 50% METHANOL 2000 hours at 60°C		
Hardness Change, max.	-20	-6
Tensile Strength Change, max.	-60%	-30
Elongation at Break Change, max.	-40%	-10
Volume Change, max.	+25%	+10
M50 – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-5	0
Tensile Strength Change, max.	-15%	-7
Elongation at Break Change, max.	-15%	-3
Volume Change, max.	+5%	-1

SPECIFICATION: FORD WSAM2D401-A8

	Ford WSA-M2D401-A8 Requirements	F86 (F13728)
IMMERSION IN 65% FUEL C, 20% METHANOL AND 15% MTBE 2000 hours at 60° C		
Hardness Change, max.	-25	-9
Tensile Strength Change, max.	-70%	-45
Elongation at Break Change, max.	-45%	-21
Volume Change, max.	+40%	+12
FUEL BLEND – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-5	-1
Tensile Strength Change, max.	-15%	-9
Elongation at Break Change, max.	-15%	-5
Volume Change, max.	+5%	-1

TYPICAL PHYSICAL PROPERTIES - F87 (F13787) BLACK SEMI-CONDUCTIVE FLUOROCARBON

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK814A1-10B37C12F15Z1

	Requirement	F87 (F13787)
ORIGINAL PROPERTIES		
Shore A Durometer (Z1)	85±5	86
Tensile, MPa, min.	14	21.9
Elongation, %, min.	150	218
Color	NA	Black
ELECTRICAL PROPERTIES		
Volume Resistivity, ohm-cm	NR	7.4×10^3
HEAT AGE, 70 hrs. @ 250°C		
Change in Durometer, point, max.	+10	+6
Change in Tensile, %, max.	-25	-21.4
Change in Elongation, %, max.	-25	+1.8
COMPRESSION SET, 22 hrs. @ 200°C		
% Set, max.	50	18.1
FLUID RESISTANCE, ASTM FUEL C, 70 hrs. @ R.T.		
Change in Durometer	NR	-6
Change in Tensile, %	NR	-21.9
Change in Elongation, %	NR	-10.1
Change in Volume, %	NR	+8.6
LOW TEMPERATURE RESISTANCE		
Brittleness @ -25°C	Pass	Pass

Note: NR= "Not Required for this Specification."

TYPICAL PHYSICAL PROPERTIES - G17 (L13430) YELLOW FLUOROSILICONE

SPECIFICATIONS: SAE J200/ASTM D2000 M2FK807A19F19Z1-Z6

	Requirement	G17 (L13430)
ORIGINAL PROPERTIES (FK807)		
Durometer, Shore A	80 ± 5	75
Tensile Strength, MPa min.	7.0	7.1
Elongation, % min. (Z6)	125	144
LOW TEMPERATURE (Z2)		
TR-10, -40F (-40°C), min.	-40	-51
HEAT RESISTANCE (A19)		
70 hours @ 437°F (225°C)		
Hardness Change, Points max.	+15	+3
Tensile Change, % max.	-45	-27.8
Elongation Change, % max.	-45	-8.3
COMPRESSION SET (Z1)		
22 hours @ 212°F (100°C)		
% max.	30	+16.0
Gasohol, ASTM Fuel C + 10% Ethanol (Z3)		
70hours @ 73°F (23°C)		
Hardness Change, Points max.	-30	-18
Tensile Change, % max.	-50	-40.0
Elongation Change, % max.	-30	-5.6
Volume Change, % max.	+30	+24.8
Gasohol, ASTM Fuel C + 20% Methanol (Z5)		
70 hours @ 73°F (23°C)		
Hardness Change, Points max.	-30	-17
Tensile Change, % max.	-60	-38.0
Elongation Change, % max.	-50	-9.7
Volume Change, % max.	+30	+25
Oxidized Fuel Per FLTM AZ 5-1 (PN90) (Z6)		
168 hours @ 140°F (60°C)		
Hardness Change, Points max.	-22	-12
Tensile Change, % max.	-35	-17.0
Elongation Change, % max.	-22	-9.0
Volume Change, % max.	+25	+18.7

TYPICAL PHYSICAL PROPERTIES - H76 (H14576) BLACK HNBR

SPECIFICATIONS: SAE J200/ASTM D2000 M2DH710 A26 B36EO16EO36 F17

	Requirement	H76 (H14576)
ORIGINAL PROPERTIES		
Shore A Durometer	70 ± 5	69
Tensile, MPa, min.	10	16.7
Elongation, %, min.	200%	357
Color	NR	Black
Heat Age, 70 hrs. @ 150˚C		
Change in Durometer, pts., max.	+10	+3
Change in Tensile, %, max.	-25	-7.8
Change in Elongation, %, max.	-30	-13.7
Compression Set, 22 hrs. @ 150˚C		
% Set, max.	50	24
Fluid Resistance, ASTM Oil #1, 70 hrs. @ 150˚C		
Change in Durometer, pts.	-5 / +10	-1
Change in Tensile, %, max.	-20	-5.3
Change in Elongation, %, max.	-30	-4.3
Change in Volume, %	+/- 5	-2.4
Fluid Resistance, IRM 903 Oil, 70 hrs. @ 150˚C		
Change in Durometer, pts.	-15	-10
Change in Tensile, %, max.	-40	+16.8
Change in Elongation, %, max.	-40	+13.5
Change in Volume, %, max.	+25	+14.3
Low Temperature Brittleness, 3 mins. @ -40˚C		
No Cracks	Pass	Pass

Note: NR= “Not Required for this Specification.”

TYPICAL PHYSICAL PROPERTIES - L53 (L13446) ORANGE FLUOROSILICONE

SPECIFICATIONS: SAE J200/ASTM D2000 FORD WS-M2D401-A6

	Ford WS-M2D401-A6 Requirements	L53 (L13446)
ORIGINAL PROPERTIES		
Hardness, I.R.H.D. (Per D1415)	58-80	69
Hardness, Shore A (Per D2240)	73±5	75
Tensile Strength, MPa, min. (Per D412)	6.0	8.1
Elongation at Break, %, min. (Per D412)	125%	151
Modulus at 100% Elong., MPa, min. (Per D412)	3.25	4.9
COMPRESSION SET (Per D395)		
70 hours at 200C, % set, max.	55%	47
Tear Strength, Die C, kN/m, min. (Per D624)	12	15.7
FLTM Ozone Resistance, max.	Rating 0	0
Low Temperature Resistance (Per D1329)	-57˚	-71
HEAT AGED, 1000 hours at 200°C (Per D573)		
Hardness Change, max.	+10	+4
Tensile Strength Change, max.	-50%	-35
Elongation at Break Change, max.	-60%	-45
HEAT AGED, 168 hours at 250°C (Per D573)		
Hardness Change, max.	+7	+2
Tensile Strength Change, max.	-80%	-68
Elongation at Break Change, max.	-85%	-72
IMMERSION IN FUEL C, 336 hours at 60°C (Per D471)		
Hardness Change, max.	-15	-11
Tensile Strength Change, max.	-50%	-25
Elongation at Break Change, max.	-50%	-36
Volume Change, max.	+30%	+19.9
IMMERSION IN OXIDIZED FUEL 336 hours at 60°C (FLTM AZ 105-01, PN 180) (Per D471)		
Hardness Change, max.	-30	-14
Tensile Strength Change, max.	-70%	-33
Elongation at Break Change, max.	-50%	-38
Volume Change, max.	+35%	+21.2
IMMERSION IN 70% FUEL C AND 30% METHANOL 2000 hours at 60°C (Per D471)		
Hardness Change, max.	-35	-22
Tensile Strength Change, max.	-70%	-54
Elongation at Break Change, max.	-60%	-37
Volume Change, max.	+35%	+25.8
M30 – DRY OUT, 48 hours at 100°C (Per D573)		
Hardness Change, max.	+5	-3
Tensile Strength Change, max.	-40%	-7
Elongation at Break Change, max.	-20%	-8
Volume Change, max.	-5%	-1

TYPICAL PHYSICAL PROPERTIES - L53 (L13446) ORANGE FLUOROSILICONE (CONT)

SPECIFICATIONS: SAE J200/ASTM D2000 FORD WS-M2D401-A6

	Ford WS-M2D401-A6 Requirements	L53 (L13446)
IMMERSION IN 15% FUEL C AND 85% METHANOL 2000 hours at 60°C (Per D471)		
Hardness Change, max.	-25	-14
Tensile Strength Change, max.	-65%	-39
Elongation at Break Change, max.	-35%	-24
Volume Change, max.	+15%	+11.6
M85 DRY OUT, 48 hours at 100°C (Per D573)		
Hardness Change, max.	+5	-1
Tensile Strength Change, max.	-50%	-10
Elongation at Break Change, max.	-20%	-2
Volume Change, max.	-5%	-1
IMMERSION IN 60% FUEL C, 25% METHANOL AND 15% MTBE 2000 hours at 60°C (Per D471)		
Hardness Change, max.	-50	-26
Tensile Strength Change, max.	-75%	-76*
Elongation at Break Change, max.	-70%	-58
Volume Change, max.	+50%	+34.9
FUEL BLEND – DRY OUT, 48 hours at 100°C (Per D573)		
Hardness Change, max.	+5	-4
Tensile Strength Change, max.	-40%	-8
Elongation at Break Change, max.	-20%	0
Volume Change, max.	-5%	-1.3

*Discrepant Value

TYPICAL PHYSICAL PROPERTIES - L54 (L13443) YELLOW FLUOROSILICONE

SPECIFICATIONS: GM6269M TYPE II

	GM6269M TYPE II Requirements	L54 (L13443)
ORIGINAL PROPERTIES		
Durometer, Shore A	75 ±5	74
Tensile Strength, MPa min.	6.0	7.3
Modulus @ 50% Elongation, MPa min.	1.0	2.7
Elongation, % min.	150	162
Density, gm / cm^3	Report	1.56
Tension Set, % max.	6.0	3.50
Tear Strength, Die C, kN, min.	11.0	19.20
HEAT RESISTANCE		
70 hours @ 437°F (225°C)		
Elongation Change, % max.	0 to -45	-33
Modulus @ 50% Change, % max.	0 to 45	+6
COMPRESSION SET		
22 hours @ 212°F (100°C)		
% of Original Thickness	15% max	5
Low Temperature Properties		
T10	-55°C min.	-65
Plot Twist vrs. Temp.	N/A	N/A
IMMERSION: 50% ASTM Fuel C / 50% Methanol		
70 hours @ 75°F (23°C)		
Tensile Change, % max.	0 to -60	-43.0
Elongation Change, % max.	20 to -33	-28.0
Tear Strength Change, %	0 to –50	-23.0
Volume Change, % max.	0 to +35	+22.7
IMMERSION: 50% ASTM Fuel C/ 50% Methanol		
1008 hours @ 120°F (49°C)		
Tensile Change, % max.	0 to -65	-49.0
Elongation Change, % max.	0 to -50	-23.0
Tear Strength Change, %	0 to –60	-26.0
Volume Change, % max.	0 to +35	+25.0
IMMERSION: Sour Gasoline		
168 hours @ 140°F (60°C)		
Tensile Change, % max.	-42 to 0	-34.0
Elongation Change, % max.	-30 to 13	-27.0
Tear Strength Change, %	-50 to 0	-28.0
Volume Change, % max.	0 to +30	+17.1e

TYPICAL PHYSICAL PROPERTIES - L54 (L13443) YELLOW FLUOROSILICONE (CONT)

SPECIFICATIONS: FORDWSA-M2D401-A6

	Ford WSA-M2D401-A6 Requirements	L54 (L13443)
ORIGINAL PROPERTIES		
I.R.H.D. (Per D1415)	58-80	70
Hardness, Shore A (Per D2240)	73	74
Tensile Strength, MPa, min. (Per D412)	6.0	7.3
Elongation at Break, %, min. (Per D412)	125%	162
Modulus at 100% Elong., MPa, min. (Per D412)	3.25	5.3
Compression Set (Per D395) 70 hours at 175°C, % set, max.	55%	29.5
Tear Strength, Die C, kN/m, min. (Per D624)	12	18.2
Ozone Resistance, max.	Rating 0	0
Low Temperature Resistance (Per D1329) TR-10	-57°C	-65
HEAT AGED, 1000 hours at 200°C (Per D573)		
Hardness Change, max.	+10	+4
Tensile Strength Change, max.	-50%	-21
Elongation at Break Change, max.	-60%	-24
HEAT AGED, 168 hours at 250°C (Per D573)		
Hardness Change, max.	+7	+1
Tensile Strength Change, max.	-80%	-15
Elongation at Break Change, max.	-85%	-11
IMMERSION IN FUEL C, 336 hours at 60°C (Per D471)		
Hardness Change, max.	-15	-13
Tensile Strength Change, max.	-50%	-24
Elongation at Break Change, max.	-50%	-49
Volume Change, max.	+30%	+21.1
IMMERSION IN OXIDIZED FUEL 336 HOURS @ 60°C (FLTM AZ 105-01, PN 180) (Per D471)		
Hardness Change, max.	-30	-17
Tensile Strength Change, max.	-70%	-27
Elongation at Break Change, max.	-50%	-28
Volume Change, max.	+35%	+22.6
IMMERSION IN 70% FUEL C AND 30% METHANOL, M30 (Per D471) 2000 hours at 60°C		
Hardness Change, max.	-35	-19
Tensile Strength Change, max.	-70%	-46
Elongation at Break Change, max.	-60%	-45
Volume Change, max.	+35%	22.5
M30 – DRY OUT, 48 hours at 100°C (Per D573)		
Hardness Change, max.	+5	-2
Tensile Strength Change, max.	-40%	-4

TYPICAL PHYSICAL PROPERTIES - L54 (L13443) YELLOW FLUOROSILICONE

SPECIFICATIONS: FORD WSA-M2D401-A6

	Ford WSA-M2D401-A6 Requirement	L54 (L13443)
IMMERSION IN 15% FUEL C AND 85% METHANOL, M85 (Per D471) 2000 hours at 60°C		
Hardness Change, max.	-25	-13
Tensile Strength Change, max.	-65%	-27
Elongation at Break Change, max.	-35%	-15
Volume Change, max.	+15%	8.4
M85 – DRY OUT, 48 hours at 100°C (Per D573)		
Hardness Change, max.	+5	0
Tensile Strength Change, max.	-50%	-2
Elongation at Break Change, max.	-20%	0
Volume Change, max.	-5%	0.6
IMMERSION IN 60% FUEL C, 25% METHANOL AND15% MTBE 2000 hours at 60°C (Per D471)		
Hardness Change, max.	-50	-25
Tensile Strength Change, max.	-75%	-53
Elongation at Break Change, max.	-70%	-52
Volume Change, max.	+50%	30.2
FUEL BLEND – DRY OUT, 48 hours at 100°C (Per D573)		
Hardness Change, max.	+5	-1
Tensile Strength Change, max.	-40%	-6
Elongation at Break Change, max.	-20%	-14
Volume Change, max.	-5%	0

CHEMICAL PROCESSING

- Technical Reports

TYPICAL PHYSICAL PROPERTIES - E34 (E17434) BLACK EPDM

SPECIFICATIONS: SAE J200/ASTM D2000 M3DA710A26B36C32EA14F19

	Requirement	E34 (E17434)
ORIGINAL PROPERTIES		
Shore A Durometer	70±5	68
Tensile, MPa, min.	10	17.5
Elongation, %, min.	200 %	296
Color	NR	Black
A26:HEAT AGE, 70 HRS. @ 150˚C:		
Change in Durometer, pts., max.	+ 10	+4
Change in Tensile, %, max.	- 20	-2.6
Change in Elongation, %, max.	- 20	+13.2
COMPRESSION SET, 22 HRS. @ 150˚C:		
% Set, max.	25	12.4
Fluid Resistance, Water, 70 hrs. @ 100˚C		
Change in Durometer, pts.	NR	0
Change in Volume, %	±5	0
OZONE RESISTANCE, 70 HRS. @ 40˚C & 50 MPa OZONE		
Quality Retention, %	100%	100%
LOW TEMPERATURE BRITTLENESS, 3 MINS. @ -55˚C:		
No Cracks	Pass/Fail	Pass

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - E61 (E17331) BLACK EPDM

SPECIFICATIONS: SAE J200/ASTM D2000 M2DA710A26B36EA14F19Z1

	Requirement	E61 (E17331)
ORIGINAL PROPERTIES		
Shore A Durometer	70±5	68
Tensile, MPa, min.	10	14.5
Elongation, %, min.	200%	255
Color	NR	Black
HEAT AGE, 70 HRS. @ 150˚C		
Change in Durometer, pts., max.	+10	+3
Change in Tensile, %, max.	-20	-7.8
Change in Elongation, %, max.	-20	-13.7
COMPRESSION SET, 22 HRS. @ 150˚C		
% Set, max.	40	24
FLUID RESISTANCE, WATER, 70 HRS. @ 100˚C		
Change in Durometer, pts.	NR	+2
Change in Volume, %	±5	+2.2
Z1: FLUID RESISTANCE, WATER, 168 HRS. @ 100˚C		
Change in Durometer, pts.	NR	+3
Change in Volume, %	NR	+4.4
LOW TEMPERATURE BRITTLENESS, 3 MINS. @ -55˚C		
No Cracks	Pass/Fail	Pass

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - F18 (F13768) BROWN FLUOROCARBON

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK610 A1-10B37F15

	Requirement	F18 (F13768)
Original Properties:		
Shore A Durometer:	60±5	62
Tensile, Mpa, min.	10	12
Elongation, %, min.	200 %	256
Color	NR	Brown
Heat Age, 70 hrs. @ 250˚C:		
Change in Durometer, pts., max	+10	+1
Change in Tensile, %, max.	-25	-12.5
Change in Elongation, %, max.	-25	-3.5
Compression Set, 22 hrs. @ 175˚C:		
% Set, max	50	9.3
Low Temperature Resistance:		
Non-brittle after 3 min @ -25˚C	Pass	Pass

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - F35 (F13755)
BLACK FLUOROCARBON GF® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK810 A1-10B37B48EF31Z1Z2

	Requirement	F35 (F13755)
ORIGINAL PROPERTIES		
Shore A Durometer:	80±5	82
Tensile, MPa, min.	10	10.5
Elongation, %, min.	150%	192
Color	NR	Black
A110: HEAT AGE, 70 HRS. @ 250˚C		
Change in Durometer, pts., max.	+10	+1
Change in Tensile, %, max.	-25	-4.6
Change in Elongation, %, max.	-25	+32
COMPRESSION SET, 22 HRS. @ 150˚C		
% Set, max.	50	27
COMPRESSION SET, 70 HRS. @ 175˚C		
% Set	NR	30
FLUID RESISTANCE, FUEL C, 70 HRS. @ 23˚C		
Change in Durometer, pts.	±5	-3
Change in Tensile, %, max.	-25	-1.2
Change in Elongation, %, max.	-20	+14
Change in Volume, %	0 / +10	+3
Z1: FLUID RESISTANCE, METHANOL, 70 HRS. @ 23˚C ,		
% Volume Change	0 / +10	+4
Z2: LOW TEMPERATURE PROPERTIES		
TR-10, ˚C	NR	-7

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - F40 (F13740) BROWN FLUOROCARBON

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK810 A1-10B38EF31EO78Z1

	Requirement	F40 (F13740)
ORIGINAL PROPERTIES		
Shore A Durometer (Z1):	75±5	74
Tensile, MPa, min.	10	11.4
Elongation, %, min.	150%	185
Color	NR	Brown
HEAT AGE, 70 HRS. @ 250˚C		
Change in Durometer, pts.	+10	+5
Change in Tensile, %, max.	-25	-5.7
Change in Elongation, %, max.	-25	-9.3
COMPRESSION SET, 22 HRS. @ 200˚C		
% Set, max.	50	14
FLUID RESISTANCE, ASTM FUEL C, 70 HRS. @ 23˚C		
Change in Durometer, pts.	±5	+1
Change in Tensile, %, max.	-25	-10.6
Change in Volume, %	+10	+8
FLUID RESISTANCE, ASTM SERVICE FLUID 101, 70 HRS. @ 200˚C		
Change in Durometer, pts.	-15 / +5	-6
Change in Tensile, %, max.	-40	-19.8
Change in Elongation, %, max.	-20	+4.6
Change in Volume, %	0 / +15	+9.4

TYPICAL PHYSICAL PROPERTIES - F43 (F13742) BLACK FLUOROCARBON

SPECIFICATIONS: SAE J200/ASTM D 2000 M2HK710A1-10B38EF31F15Z1

	Requirement	F43 (F13742)
Original Properties		
Shore A Durometer	70±5	75
Tensile, Mpa, min.	10	13.8
Elongation, %, min.	175 %	278
Color	NR	Black
Heat Age, 70 hrs. @ 250˚C		
Change in Durometer, pts., max.	+10	+7
Change in Tensile, %, max.	-25	+37.2
Change in Elongation, %, max.	-25	-7.2
Compression Set, 22 hrs. @ 200˚C		
% Set, max.	50	10
Fluid Resistance, Fuel C, 70 hrs. @ 23˚C		
Change in Durometer, pts.	±5	-5
Change in Tensile, %, max.	-25	-25
Change in Elongation, %, max.	-20	-18
Change in Volume, %	0 / +10	+5.8
Fluid Resistance, Methanol, 70 hrs. @ 23˚C		
% Volume Change	NR	+5

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES F44 (F13744) VS. STANDARD AFLAS™ & FKM COMPOUNDS BLACK FLUOROCARBON

	F44 (F13744)	Typical Aflas™ FA 100S Compound	Typical 66% Fluorine FKM
ORIGINAL PROPERTIES			
Durometer, Shore A	76	74	75
Tensile, MPa	11.7	17.9	13.4
Elongation, %	187	250	181
HEAT RESISTANCE, 70 HRS. @250˚C			
Change in Duro., pts.	+2	+2	+2
Change in Tensile, %	-13	-16	-5
Change in Elongation, %	-10	+32	-11
COMPRESSION SET			
70 hrs. @ 150˚C, % Set	16	22	11
LOW TEMPERATURE RETRACTION			
TR-10, ˚C	-3	+3	-18
ASTM Reference Fuel C, 70 hrs. @ 23˚C			
Change in Duro., pts.	-18	-31	0
Change in Volume, %	+44	+71	+3
METHANOL, 70 HRS. @ 23˚C			
Change in Duro., pts.	0	+1	-25
Change in Volume, %	+1	0	+128
ISOOCTANE, 70 HRS. @ 23˚C			
Change in Duro., pts.	-3	-18	+2
Change in Volume, %	+5	+25	+1
IRM 903, 70 HRS. @ 150˚C			
Change in Duro., pts.	-3	-8	0
Change in Tensile, %	-13	-7	-10
Change in Elongation, %	-7	+10	+9
Change in Volume, %	+7	+15	+2
SKYDROL LD4, 70 HRS. @ 100˚C			
Change in Duro., pts.	-27	18	-43
Change in Tensile, %	-65	-25	-85
Change in Elongation, %	-46	0	-86
Change in Volume, %	+73	+26	+288
50% NaOH, 70 hrs. @ 100˚C			
Change in Duro., pts.	0	-1	+1
Change in Tensile, %	-14	+6	-47
Change in Elongation, %	-9	+2	-18
Change in Volume, %	0	0	-17

TYPICAL PHYSICAL PROPERTIES - F48 (F13753) BLACK FLUOROCARBON

SPECIFICATIONS: SAE J200/ASTM D 2000 M2HK707A1-10B37F15Z1

	Requirement	F48 (F13753)
Original Properties		
Shore A Durometer	75±5	77
Tensile, Mpa, min.	7	17
Elongation, %, min.	175%	295
Color	NR	Black
Heat Age, 70 hrs. @ 250˚C		
Change in Durometer, pts., max.	+10	+3
Change in Tensile, %, max.	-25	-8
Change in Elongation, %, max.	-25	-3
Compression Set, 22 hrs. @ 175˚C		
% Set, max.	50	12.5
Low Temperature Resistance		
Non-brittle after 3 min @ -40˚C	Pass	Pass

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - F52 (F13661)
BROWN FLUOROCARBON/FLUOROSILICONE BLEND

SPECIFICATIONS: SAE J200/ASTM D2000 M4HK810F17Z1-Z8

	Requirement	F52 (F13661)
ORIGINAL PROPERTIES		
Durometer, Shore A	75±5	77
Tensile Strength, MPa, min.	7.0	7.9
Modulus @ 50% Elongation, MPa, min.	2.8	3.3
Elongation, %, min.	115	153
Density	Report	1.81
Tension Set, %, max.	6.0	5.1
Tear Strength, Die C, kN/m	11.0	12
HEAT RESISTANCE		
70 hours @ 225°C		
Modulus @ 50% Change, %	0 to 35	21*
Elongation Change, %	0 to -30	-11
COMPRESSION SET		
22 hours @ 100°C		
% of Original Thickness, max.	30%	17
Low Temperature Properties		
Trio, min.	-20°C	-26
IMMERSION: 80% ASTM Fuel C/ 20% Methanol		
70 hours @ 23°C		
Tensile Change, % max.	0 to -70	-55
Elongation Change, %	0 to -50	-31
Tear Strength Change, %	0 to -70	-37
Volume Change, %	0 to +40	+28.3
IMMERSION: 80% ASTM Fuel C/ 20% Methanol		
1008 hours @ 49°C		
Tensile Change, %	0 to -75	-62
Elongation Change, %	+25 to -65	-43
Tear Strength Change, %	0 to -75	42
Volume Change, %	0 to +40	+34.8
IMMERSION: Sour Gasoline		
168 hours @ 60°C		
Tensile Change, %	-45 to 0	-30
Elongation Change, %	-25 to 0	-12
Tear Strength Change, %	-50 to 0	-34
Volume Change, %	0 to +20	+15.1

TYPICAL PHYSICAL PROPERTIES - F56 (F13756) BLACK FLUOROCARBON GF® TYPE

SPECIFICATIONS: SAE J200/ASTM D2000 M2HK710A1-10EF31Z1Z2

	Requirement	F56 (F13756)
ORIGINAL PROPERTIES		
Shore A Durometer	70±5	70
Tensile, MPa, min.	10	11
Elongation, %, min.	175%	264
Color	NR	Black
HEAT AGE, 70 HRS. @ 250˚C		
Change in Durometer, pts., max.	+10	+2
Change in Tensile, %, max.	-25	-10.4
Change in Elongation, %, max.	-25	+20
COMPRESSION SET, 22 HRS. @ 150˚C:		
% Set	NR	21
COMPRESSION SET, 70 HRS. @ 175˚C		
% Set	NR	26
FLUID RESISTANCE, FUEL C, 70 HRS. @ 23˚C		
Change in Durometer, pts.	±5	-1
Change in Tensile, %, max.	-25	-12
Change in Elongation, %, max.	-20	-1
Change in Volume, %	0 / +10	+2.8
Z1: FLUID RESISTANCE, METHANOL, 70 HRS. @ 23˚C		
% Volume Change	0 / +10	+3.8
Z2: LOW TEMPERATURE PROPERTIES		
TR-10, ˚C	NR	-7

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - F65 (F13678) VS. STANDARD FKM & HIGH FLUORINE FKM COMPOUNDS - BLACK FLUOROCARBON

	F65 (F13678)	Typical 66% Fluorine FKM	Typical 70% Fluorine FKM
ORIGINAL PROPERTIES			
Durometer, Shore A	76	77	79
Tensile, MPa	15	17	19
Elongation, %	175	190	215
HEAT RESISTANCE, 70 hrs. @250˚C			
Change in Duro., pts.	-3	+1	0
Change in Tensile, %	-32	-16	-4.5
Change in Elongation, %	+38	-12	-2
COMPRESSION SET			
22 hrs. @ 200˚C, % Set	21	12	18
LOW TEMPERATURE RETRACTION			
TR-10, ˚C	-11	-17	-7
FLUID RESISTANCE, 168 hrs. @23˚C in Methyl Ethyl Ketone			
Change in Duro., pts.	-11	-42	-38
Change in Tensile, %	-52	-91	-86
Change in Elongation, %	-24	-79	-77
Change in Volume, %	+19	+222	+183
FLUID RESISTANCE, 168 hrs. @100˚C in 30% Potassium Hydroxide Solution			
Change in Duro., pts.	0	-47	-49
Change in Tensile, %	-7.8	-95	-93
Change in Elongation, %	-2.4	-59	-44
Change in Volume, %	+6	+132	+12
Surface Condition	No Change	Sample Dissolving	Sample Dissolving

TYPICAL PHYSICAL PROPERTIES - F75 (F13664) BLACK FLUOROCARBON

SPECIFICATION: AMS 7276

	AMS 7276 Requirements	F75 (13664)
ORIGINAL PROPERTIES		
Shore A Durometer	75±5	77
Tensile, MPa, min.	9.65	14.7
Elongation, %, min.	125%	125
Color	NR	Black
HEAT AGE, 70 HRS. @ 270˚C		
Change in Durometer, pts.	-5 / +10	+3
Change in Tensile, %, max.	35	-8
Change in Elongation, %, max.	-15	-3
Change in Weight, %, max.	-10	-3.5
COMPRESSION SET, 22 HRS. @ 200˚C		
% Set, max.	15	10.1
COMPRESSION SET, 336 HRS. @ 200˚C		
% Set, max.	40	35.2
FLUID RESISTANCE, ARM 200, 70 HRS. @ 200˚C		
Change in Durometer, pts.	-15 / 0	-5
Change in Tensile, %, max.	-35	-12
Change in Elongation, %, max.	-20	+5
Change in Volume, %	+1 / + 25	+17
Compression Set, % Set, max.	10	8.8
FLUID RESISTANCE, ASTM FUEL B, 70 HRS. @ 23˚C		
Change in Durometer, pts.	±5	+3
Change in Tensile, %, max.	-20	-7
Change in Elongation, %, max.	-20	-8
Change in Volume, %	0 / +5	+1.3
LOW TEMPERATURE RETRACTION:		
TR10, -15˚C	Pass	Pass

TYPICAL PHYSICAL PROPERTIES - F86 (F13728)
GREEN FLUOROCARBON GF® TYPE

SPECIFICATION: FORD WSAM2D401-A8

	Ford WSA-M2D401-A8 Requirements	F86 (F13728)
ORIGINAL PROPERTIES		
Hardness, I.R.H.D.	65-80	66
Hardness, Shore A	75±5	74
Tensile Strength, MPa, min.	9.0	12.3
Elongation at Break, %, min.	160%	220
Modulus at 100% Elong., MPa, min.	40	5.4
Compression Set		
70 hours at 200°C, % set, max.	35%	24.2
Tear Strength, Die C, kN/m, min.	14	35
FLTM Ozone Resistance, max. BP 101-01, Procedure A	Rating 0	0
TR-10	-3°C (+23°F)	-11
HEAT AGED, 1000 hours at 200°C		
Hardness Change, max.	±5	-2
Tensile Strength Change, max.	±20%	-12
Elongation at Break Change, max.	±20%	+14
IMMERSION IN FUEL C, 336 hours at 60°C		
Hardness Change, max.	-15	-2
Tensile Strength Change, max.	-60%	-25
Elongation at Break Change, max.	-40%	+15
Volume Change, max.	+15%	+5
IMMERSION IN OXIDIZED FUEL, 336 hours at 60°C (FLTM AZ 105-01, PN 180)		
Hardness Change, max.	-25	-4
Tensile Strength Change, max.	-60%	-30
Elongation at Break Change, max.	-25%	+10
Volume Change, max.	+30%	+8
IMMERSION IN 50% FUEL C AND 50% METHANOL 2000 hours at 60°C		
Hardness Change, max.	-20	-6
Tensile Strength Change, max.	-60%	-30
Elongation at Break Change, max.	-40%	-10
Volume Change, max.	+25%	+10
M50 – DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-5	0
Tensile Strength Change, max.	-15%	-7
Elongation at Break Change, max.	-15%	-3
Volume Change, max.	+5%	-1

TYPICAL PHYSICAL PROPERTIES - F86 (F13728) GREEN FLUOROCARBON GF® TYPE (CONT)

	Ford WSA-M2D401-A8 Requirements	F86 (F13728)
IMMERSION IN 65% FUEL C, 20% METHANOL AND 15% MTBE		
2000 hours at 60°C		
Hardness Change, max.	-25	9
Tensile Strength Change, max.	-70%	-45
Elongation at Break Change, max.	-45%	-21
Volume Change, max.	+40%	+12
FUEL BLEND– DRY OUT, 48 hours at 100°C		
Hardness Change, max.	-5	-1
Tensile Strength Change, max.	-15%	-9
Elongation at Break Change, max.	-15%	-5
Volume Change, max.	+5%	-1

TYPICAL PHYSICAL PROPERTIES - M07 (H14327) BLACK NITRILE

SPECIFICATIONS: SAE J200/ASTM D2000 M2BG710B14EF11EF21E034

	Requirement	M07 (H14327)
ORIGINAL PROPERTIES		
Shore A Durometer	70±5	70
Tensile, MPa, min.	10	15.8
Elongation, %, min.	250%	462
Color	NR	Black
Heat Age, 70 hrs. @ 100˚C:		
Change in Durometer, pts.	±15	+4
Change in Tensile, %, max.	+/- 30	-3.2
Change in Elongation, %, max.	-50	-22
Compression Set 22 hrs. @ 100˚C:		
% Set, max.	-50	11
Fluid Resistance IRM 903 Oil, 70 hrs. @ 100˚C:		
Change in Durometer, pts.	-10 / +5	-7
Change in Tensile, %, max.	-45	-17
Change in Elongation, %, max.	-45	-25
Change in Volume, %	0 / +25	+8.4
Fluid Resistance, ASTM Fuel A, 70 hrs. @ 23˚C:		
Change in Durometer, pts.	±10	-1
Change in Tensile, %, max.	-25	-10.7
Change in Elongation, %, max.	-25	-17.3
Change in Volume, %	-5 / +10	+3.2
Fluid Resistance, ASTM Fuel B, 70 hrs. @ 23˚C:		
Change in Durometer, pts.	-30 / 0	-15
Change in Tensile, %, max.	-60	-41.3
Change in Elongation, %, max.	-60	-45.3
Change in Volume, %	0 / +40	+28

Note: NR = “Not Required for this Specification”

TYPICAL PHYSICAL PROPERTIES - N20 (N18538) BLACK NEOPRENE®

SPECIFICATIONS: SAE J200/ASTM D2000 M4BC714A14B14EO14EO34

	Requirement	N20 (N18538)
ORIGINAL PROPERTIES		
Shore A Durometer:	70±5	72
Tensile, MPa, min.	14	18.9
Elongation, %, min.	250%	269
Color	NR	Black
HEAT AGE, 70 HRS. @ 100˚C		
Change in Durometer, pts., max.	±15	+7
Change in Tensile, %, max.	-15	+15
Change in Elongation, %, max.	-40	-11.6
COMPRESSION SET, 22 HRS. @ 100˚C		
% Set, max.	25	17
FLUID RESISTANCE, ASTM OIL#1, 70 HRS. @ 100˚C		
Change in Durometer, pts.	±10	-6
Change in Tensile, %, max.	-30	-13.5
Change in Elongation, %, max.	-30	-19
Change in Volume, %	-10 / +15	+8
Fluid Resistance, IRM 903 Oil, 70 hrs. @ 100˚C:		
Change in Tensile, %, max.	-45	-25.7
Change in Elongation, %, max.	-30	-21.5
Change in Volume, %, max.	+80	+57.6

Note: NR = “Not Required for this Specification”

OEM SPECIFICATIONS & APPROVALS

Key End Users	Specification	Precix Material Designation	Color	SAE J200/ASTM D 2000 Designation
BMW	602 00.0 55.05/ FPM-65-M	F86 (F13728)	Green	3HK715A1-10B37B38C12EF31EO78Z1Z2 Z1 = Duro 75 ± 5 Z2 = Color Green
BMW	602 00.0 55.19/ FVMQ-65-M	G17 (L13430)	Yellow	M2FK807A19F19Z1-Z6
Daimler Chrysler	MS-BB 40	L13494	Red	M2FK606A19EF31F19Z1Z2Z3
Daimler Chrysler	MS-BZ832, Grade A1	F80 (F13710)	Black	M6HK610A1-10B38EF31EO88F15Z1
Daimler Chrysler	MS-BZ832, Grade A3	F84 (F13717)	Black	M2HK710A1-10B37B38EF31EO78F15Z1 Z1=DURO 75±5
Daimler Chrysler	MS-BZ832, Grade A4	F33 (F13743)	Black	M6HK810A1-11B38EF31EO88F15
Daimler Chrysler	MS-BZ832, Grade B2	F50 (F13750)	Black	M2HK710A1-10B37EF31EO78Z1 Z1=DURO 75±5
Daimler Chrysler	MS-BZ832, Grade B2	F69 (F13688)	Black	MHK710
Daimler Chrysler	MS-BZ832, Grade C2	F43 (F13742)	Black	M2HK710A1-10B38EF31F15Z1
Daimler Chrysler	MS-BZ832, Grade F3	F77 (F13729)	Gray	4HK715B38C12EF31EO78F17Z1Z2 Z1=DURO 75±5 Z2= COLOR GRAY
Daimler Chrysler	MS-BZ832, Grade F5	F31 (F13731)	Black	M2HK810A1-10B38EF31F15Z1
Daimler Chrysler	MS-BZ832, Grade G3	F05 (F13705)	Blue	M2HK710A1-10B37F15Z1Z2 Z1=DURO 75±5 Z2= COLOR BLUE
Daimler Chrysler	MS-BZ832, Grade G4	F79 (F13724)	Black	M2HK710A1-10B37F15Z1 Z1= DURO 75±5
Daimler Chrysler	MS-BZ832, Grade G5	F85 (F13727)	Black	M2HK810A1-10B37F15Z1 Z1=DURO 85±5
Delphi	M54106	H14387	Black	M2BG617A14B34EF11EF21F17
Delphi	M54416	F84 (F13717)	Black	M2HK710A1-10B37B38EF31EO78F15Z1 Z1 = DURO 75 ±5
Delphi	M54427	F31 (F13731)	Black	M2HK810A1-10B38EF31F15Z1 Z1 = METHANOL RESISTANCE
Delphi	M54435	F13704	Black	M2HK810A1-10B38EF31Z1 Z1 = METHANOL RESISTANCE
Delphi	M54444	F84 (F13717)	Black	M2HK710A1-10B37B38EF31EO78F15Z1 Z1 = DURO 75 ±5
Delphi	M54444	F04 (F13329)	Blue	M2HK710A1-10B37B38EF31EO78F15Z1 Z1 = DURO 75 ±5
Delphi	M54453	F05 (F13705)	Blue	M2HK710A1-10B37F15Z1Z2 Z1 = DURO 75 ±5 Z2 = COLOR BLUE
Delphi	M54453	F79 (F13724)	Black	M2HK710A1-10B37F15Z1 Z1 = DURO 75 ±5

Key End Users	Specification	Precix Material Designation	Color	SAE J200/ASTM D 2000 Designation
Delphi	M54472	F85 (F13727)	Black	M2HK810A1-10B37F15Z1 Z1 = DURO 85 ±5
Delphi	M54475	F13706	Brown	M2HK710A1-10B37B38EF31EO78F15Z1 Z1 = COLOR BROWN
Delphi	M54481	F13714	Red	M2HK810A1-10B38EF31F15Z1 Z1 = COLOR RED
Delphi	M54489	F13734	Brown	M2HK808A1-10B38EF31Z1 Z1 = COLOR BROWN
Delphi	M54498	F07 (F13723)	Black	M2HK710A1-10B37EF31F15Z1 Z1 = METHANOL RESISTANCE
Delphi	M54498	F13733	Green	M2HK710A1-10B37EF31Z1Z2Z3 Z1 = DURO & ELONGATION AFTER FUEL C Z2 = METHANOL RESISTANCE Z3 = COLOR GREEN
Delphi	2HK715A1-10B37 B38EF31EO78F15	F81 (F13711)	Brown	2HK715A1-10B37B38EF31EO78F15Z1 Z1 = 75 ±5
Delphi	7HK915BLACK	F13722	Black	M2HK910A1-10B38EF31
Delphi	7HK915BROWN	F13721	Brown	M2HK910A1-10B38EF31
Ford	ESA-M9P7-A	F52 (F13661)	Brown	M4HK810F17Z1-Z8
Ford	WSA-M2D401-A5	F77 (F13729)	Gray	4HK715B38C12EF31EO78F17Z1Z2 Z1 = DURO 75 ±5 Z2 = COLOR GRAY
Ford	WSA-M2D401-A5	F78 (F13730)	Black	4HK715B38C12EF31EO78F17Z1 Z1 = DURO 75 ±5
Ford	WSA-M2D401-A6	L54 (L13443)	Yellow	2FK606A19C12EF31F19Z1Z2 Z1 = DURO 73 ±5 Z2 = COLOR YELLOW
Ford	WSA-M2D401-A6	L53 (L13446)	Orange	2FK606A19C12EF31F19Z1Z2 Z1 = DURO 70 ±5 Z2 = COLOR ORANGE
Ford	WSA-M2D401-A8	F86 (F13728)	Green	3HK715A1-10B37B38C12EF31EO78Z1Z2 Z1 = DURO 75 ±5 Z2 = COLOR GREEN
GM / Opel	GM6268M Type I*	F52 (F13661)	Brown	M4HK810F17Z1-Z8

*At the time of printing the General Motors Type III Specification was being finalized. Precix F86 (F13728) meets this specification.

Key End Users	Specification	Precix Material Designation	Color	SAE J200/ASTM D 2000 Designation
GM / Opel	GM6268M Type II	G17 (L13430)	Yellow	M2FK807A19F19Z1-Z6
GM / Opel	GM6268M Type II	L53 (L13446)	Orange	2FK606A19C12EF31F19Z1Z2 Z1 = DURO 70 ±5 Z2 = COLOR ORANGE
GM / Opel	GM6268M Type II	L54 (L13443)	Yellow	2FK606A19C12EF31F19Z1Z2 Z1 = DURO 73 ±5 Z2 = COLOR YELLOW
GM / Opel	GM6269M Type I	F78 (F13730)	Black	4HK715B38C12EF31EO78F17Z1 Z1 = DURO 75 ±5
GM / Opel	GM6269M Type II	G17 (L13430)	Yellow	M2FK807A19F19Z1-Z6
GM / Opel	GM6269M Type II	L54 (L13443)	Yellow	2FK606A19C12EF31F19Z1Z2 Z1 = DURO 73±5 Z2 = COLOR YELLOW
Magneti Marelli	FKM Type A1	F75 (F13664)	Black	M2HK710A1-10B38EF31EO78F15
Magneti Marelli	FKM Type A2	F54 (F13754)	Black	M2HK710A1-10B38EF31F15Z1 Z1 = 75±5 Durometer
Magneti Marelli	FKM Type B	F47 (F13757)	Black	M2HK710A1-10B38EF31F15Z1 Z1 = 75±5 Durometer
Magneti Marelli	FKM Type C	F51 (F13751)	Black	M2HK710A1-10B38
Magneti Marelli	FKM Type D	F79 (F13724)	Black	M2HK710A1-10B37F15Z1 Z1 = 75±5 Durometer
Magneti Marelli	FKM Type E	F78 (F13730)	Black	4HK715B38C12EF31EO78F17Z1 Z1 = 75±5 Durometer
Magneti Marelli	FKM Type F	F35 (F13755)	Black	M2HK810A1-10B38B47EF31
Magneti Marelli	FVMQ	L54 (L13443)	Yellow	2FK606A19C12EF31F19Z1Z2 Z1 = 73±5 Durometer Z2 = Color Yellow
Renault	03-50-000 Type I	F86 (F13728)	Green	3HK715A1-10B37B38C12EF31EO78Z1Z2 Z1 = DURO 75±5 Z2 = COLOR GREEN
Renault	03-50-000 Type 2	F75 (F13664)	Black	M2HK710A1-10-10B38EF31EO78F15Z1 Z1 = DURO 75±5
Volkswagen	VW 2.8.1.A	G17 (L13430)	Yellow	M2FK807A19F1921-26

HOW TO ORDER/CONTACT PRECIX, INC.™/OBTAIN QUOTES

Sales/RFQ/Orders: North/South America, Australia, Pacific Rim

Via Phone: 508/998-4000 800/225-8505

Via email/Web: ..... Sales@precixinc.com, www.precixinc.com

Via Fax: 508/998-4100 800/225-6172

Via Mail: ..... Precix, inc.™, P.O. Box 6916, New Bedford, MA 02742-6916

Sales/RFQ/Orders: Europe, Central Asia, Africa

Via Phone: ..... +49 (0) 40 89 05 92 21

Via email/Web: ..... Europe@precixinc.com, www.precixinc.com

Via Fax: ..... +49 (0) 40 89 05 92 33

Via Mail: ..... Precix Europe, c/o BWD Automotive GmbH, Regerstrasse 4, D-22761 Hamburg, Germany

Technical Support

Via Phone: 508/998-4000 800/225-8505

Via email: ..... materials-engineering@precixinc.com,
product-engineering@precixinc.com

ViaWeb: ..... www.precixinc.com

Via Fax: 508/998-4105 800/225-6172

Via Mail:

Precix, inc. ™

Attn: Material/Application Engineering

P.O. Box 6916

New Bedford, MA 02742-6916

PRECIX INC.™

SUCCESS DEMANDS PRECISION™

Give Precix™ an opportunity to design and deliver the solutions you need by calling 508 998 4000 today or emailing sales@precixinc.com

744 Belleville Avenue
New Bedford
Massachusetts 02742 USA
Tel 508 998 4000
800 225 8505
Fax 508 998 4100

Precix™ Europe
BWD Automotive GmbH
Regerstrasse 4
D-22761 Hamburg, Germany
Tel +49 (40) 89 05 92 0
Fax +49 (40) 89 05 92 33
europe@precixinc.com
www.precixinc.com

MAKERS OF

ACUSHNET RUBBER

O-RINGS
SEAL RINGS
CUSTOM ELASTOMER SOLUTIONS