Science.
Applied to Life.™

Product Guide

3M™ Dyneon™ Fluoroelastomers

More options. More answers.

We offer a broad family of fluoroelastomers optimized for high performance in extreme environments. Find the right fit for your sealing and containment application.

How to use this Guide

Important Notice:
The purpose of this guide is to provide basic information to product users for use in evaluating, processing, and troubleshooting their use of certain 3M products. The information provided is general or summary in nature and is offered to assist the user. The information is not intended to replace the user's careful consideration of the unique circumstances and conditions involved in its use and processing of 3M products. The user is responsible for determining whether this information is suitable and appropriate for the user's particular use and intended application. The user is solely responsible for evaluating third party intellectual property rights and for ensuring that user's use and intended application of 3M product does not violate any third party intellectual property rights.

With harsher chemical environments, broader temperature ranges and more complex and demanding designs, sealing applications are more extreme than ever before. There are also more elastomer options than ever before. Combine all of these issues and today's rubber chemists and design engineers face some tough decisions when it comes to material specification.

3M's technical expertise and commitment to customer service help take the guesswork out of choosing the right fluoroelastomer for your application.

This product comparison guide is designed to address the basic considerations when formulating a fluoroelastomer compound: "What is the environment?" "What is the application?" "What is the manufacturing process?" and "What is the part profile?" The answers to these questions will help narrow your search for a fluoroelastomer that can deliver optimal performance.

When you need further clarification or have a particularly challenging application, our Application and Product Development Engineers and Chemists are ready to help. You will find our contact information on the back cover of this brochure.

3M™ Dyneon™ Fluoroelastomers

We offer a broad line of fluoroelastomers for critical sealing and containment applications, including:

- Fluoroelastomer (FKM) dipolymers and terpolymers containing 65–71% fluorine
- Base Resistant Elastomers (BRE)
- Low Temperature Fluoroelastomers (LTFE)
- Perfluoroelastomers (FFKM)
- Elastomer Additives

Learn more at
3M.com/fluoropolymers

Table of Contents

What's the environment?

Step 1

The first step in selecting the proper 3M™ Dyneon™ Fluoroelastomer for your application is to consider the service environment – the chemicals and temperatures your part will encounter. The charts below illustrate the broad chemical and temperature resistance of 3M fluoroelastomers. Use these charts to help guide your search for the 3M fluoroelastomers that can deliver the desired performance for the environment.

If you do not find your chemical class here, please contact us at the location on the back of this brochure or visit our web site, **3M.com/fluoropolymers**, for more information.

Note: Data in this document are not for specification purposes.

▶ **Did you know?**

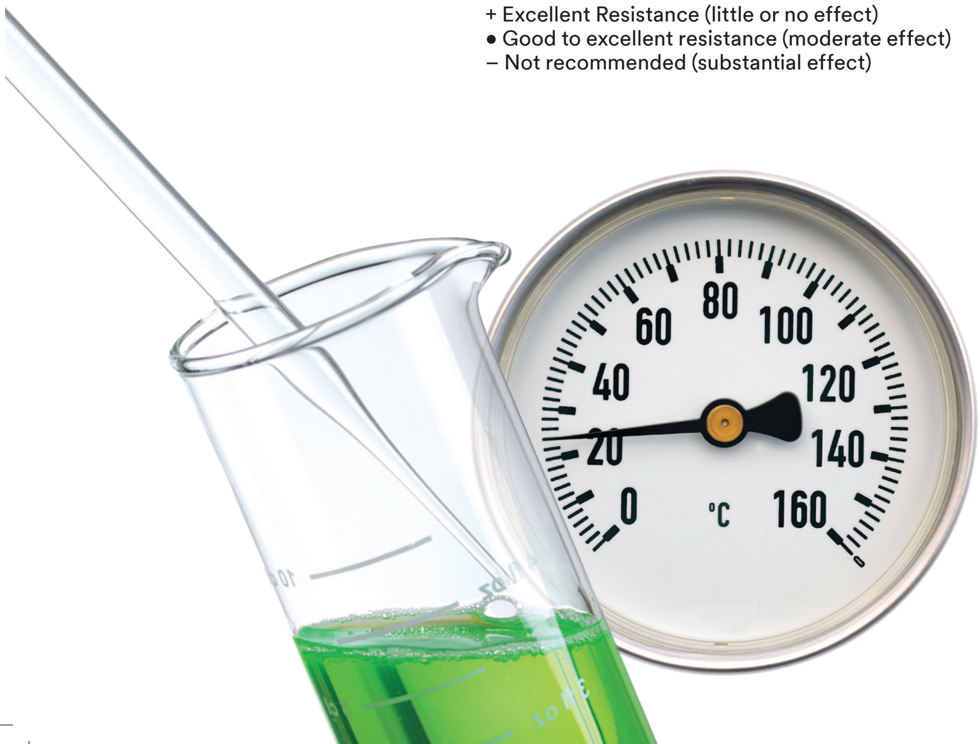
FKM (by ASTM D1418 standard) (equivalent to FPM by ISO/DIN 1629 standard) is the designation for about 80% of fluoroelastomers as defined in ASTM D1418. Other fluorinated elastomers are perfluoroelastomers (FFKM) and tetrafluoro ethylene/propylene rubbers (FEPM). All FKMs contain vinylidene fluoride as a monomer.

Chemical and Thermal Resistance of 3M™ Dyneon™ Fluoroelastomers

	Bisphenol Cure Fluoroelastomers	Peroxide Cure Fluoroelastomers	Low Temperature Fluoroelastomers
Acids	–	+	+
Alcohols (Methanol)	+*	+*	+
Alcohols (Other)	+	+	+
Aliphatic Hydrocarbons	+	+	+
Alkali (Concentrated)	–	+	+
Alkali (Dilute <5%)	●	+	+
Aromatic Hydrocarbons	+	+	+
Biodiesel	●	+	+
Fuels	**See separate chart on p. 8**		
Lubricants	+	+	+
Lubricants – highly amine additivated	●	+	+
Oxidation	+	+	+
Ozone	+	+	+
Radiation	+	+	+
Steam >150°C	–	+	+
Water <100°C	+	+	+
Water 100–150°C	●	+	+
Water >150°C	–	●	●

+ Excellent Resistance (little or no effect)
● Good to excellent resistance (moderate effect)
– Not recommended (substantial effect)

* Depending on fluorine content



Note: Data in this document are not for specification purposes.

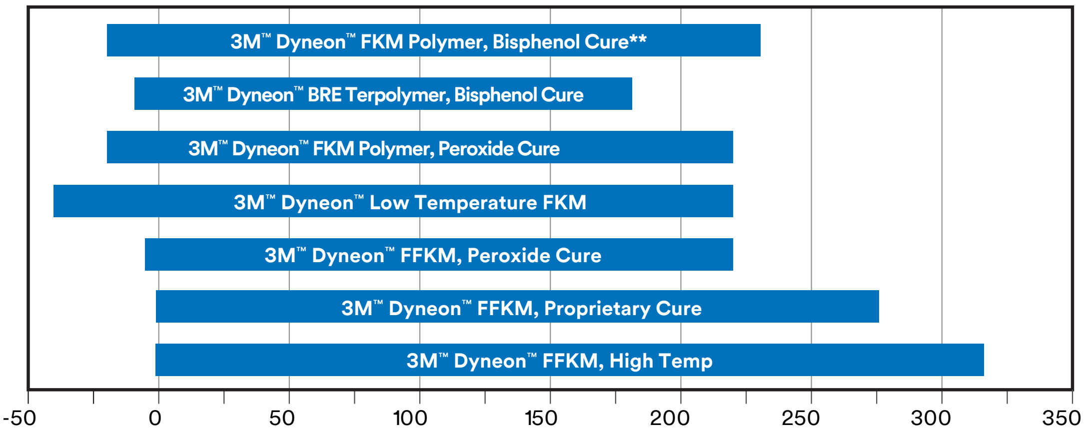
The most important determinant of thermal stability is the curative package used. As indicated in the chart below, fluoroelastomer compounds based on bisphenolic cure systems show a slightly more beneficial thermal stability than compounds based on peroxide cure systems. The best performance can be attained with perfluoroelastomer grades which are specially designed for high temperature applications. These grades take advantage of a triazine cure technology.

Chemical and Thermal Resistance of 3M™ Dyneon™ Perfluoroelastomers

Chemical Resistance	PFE 40Z	PFE 7502BZ	PFE 131TBZ
Solvents	++	++	++
Acids	++	++	++
Hydrochloric	++	++	++
Nitric Acid	++	++	++
Sulfuric Acid	++	++	++
Carboxylic Acid	++	++	++
Bases (Ammonia, NaOH)	++	++	++
Ethylene Diamine	++	+	+
Hot Water	+	++	•
Steam	++	++	+
Oxygenated Plasmas	N/A	N/A	Excellent
Fluorinated Plasmas	N/A	N/A	Excellent
Temperature Resistance			
Upper Use Temperature (°C)	220	275	316
Compression Set (%)			
70 hrs @ 200 °C	20	16	16
70 hrs @ 232°C	45	30	20

Swell: ++ <10% + 11–20% • 21–30% – 31–50%

Effective Service Temperature Range of 3M™ Dyneon™ Fluoroelastomers



Temperature range in °C; test results based on retention of physical properties
* Lowest service temperature based on TR10
** Terpolymers -7°C

What's the application?

Step 2

Note: Data in this document are not for specification purposes.

▶ **Did you know?**

- The specific gravity of Base Resistant Elastomers (BREs) is lower than standard fluoroelastomers.
- 3M has FE grades that extrude well without the need for a process aid.
- Fluoroelastomers can be bonded to a variety of plastics and elastomers.
- Fluoroelastomers can be compounded to pass a -40°C mandrel flex test and to be conductive.

Transportation

The use of fluoroelastomers in transportation (automotive, aerospace, small engine, etc.) sealing applications has increased dramatically in recent years due to changing operating conditions.

Powertrain

Extended service life warranties demand more from powertrain seals. Due to their excellent chemical and temperature resistance, 3M™ Dyneon™ Fluoroelastomers offer improved sealing and wear resistance in powertrain applications that encounter aggressive fluids such as gear lubricants, transmission fluids and engine oils.

Lubricant Applications

Valve stem seals, rotary shaft seals (axle pinion seals, gear boxes, transmission seals, transfer case input/output seals), engine gasket seals, oil pan seals, cylinder liner seals, engine head gaskets

What's important for optimum performance?

- Chemical resistance to powertrain lubricants (amine resistance) and coolants
- Adhesion to metal or plastic substrates
- Service life

Fuel Systems

Regulations around the world continue to adopt more stringent fuel emission standards. 3M fluoroelastomers are commonly used in fuel system applications because of their excellent permeation resistance, effectiveness as barriers against evaporative emissions, chemical resistance to a broad variety of fuels and long-term durability.

Fuel Applications

Fuel line hose, filler neck hose, chemical transport hose, in-tank hose, injector o-rings, gas caps, sender seals

What's important for optimum performance?

- Chemical resistance to a wide range of fuels
- Volume swell and property changes over time
- Sealability
- Permeation resistance (see chart below)
- Performance over temperature range

Permeation Testing

New global regulations have tightened the restrictions on the allowed amount of evaporative emissions from automobiles. These regulations make it increasingly important to understand and develop permeation measurement techniques that allow for accurate characterization of a polymer or part. 3M is recognized in the automotive industry for its expertise and developments in permeation test methodologies that yield results that are accurate, reproducible and can be scaled to commercial constructions. For more information, see SAE Technical Papers 2000-01-1096 and 2001-01-1126 (www.sae.org).

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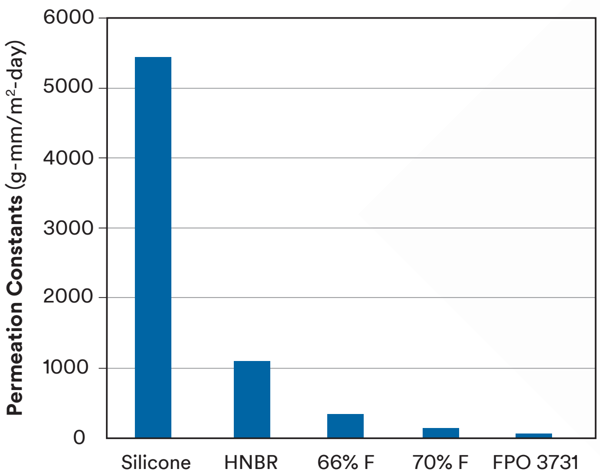
Permeation Data for Elastomers Commonly Used in Automotive Applications



*CE10 Fuel @ 40°C, 3 Weeks
66% F – Bisphenol cure dipolymer
70% F – Bisphenol cure terpolymer

Note: Data in this document are not for specification purposes.

Resistance of 3M™ Dyneon™ Fluoroelastomers to Automotive Fluids

	Test Conditions		Bisphenol Cure/Peroxide Cure	
Fuels	**Temp. (°C)**	**Duration (hours)**	**Low %F**	**High %F**
Fuel C	60	168	+	+
FAM A	60	168	●	+
CE 10	60	168	●	+
CE 22	60	168	●	+
CE 85	60	168	●	+
CM 30	60	168	–	+
FAM B	60	72	–	+
FAM B	60	168	–	+
Methanol	40	168	–	+
SME	125	1008	–	+*
RME	150	504	–	+*
Total Ad Blue	80	168	+	+
Total Ad Blue	125	168	–	–

+ Excellent Resistance (little or no effect)
● Good to excellent resistance (moderate effect)
– Not recommended (substantial effect)

* Depending on compound formulation

	Temp. (°C)	Duration (hours)	Di/Terpolymer Bisphenol Cure	Terpolymer Peroxide Cure
Blow by condensates (BMW GS 97018)				
Blow by condensate 1	120	72	–	●
Blow by condensate 2	120	72	●	+
Coolants				
AC Delco Dex-Cool™ #10-101	150	504	–	●
AC Delco Dex-Cool™ extended life	107	168	+	+
Water/Ethylene glycol	150	168	+	+
Engine Oils				
IRM 902	150	168	+	+
IRM 903	150	168	+	+
Lubrizol OS 206304	150	94	+	+
Gear Lubricants				
Burmah SAF XO	150	500	–	●
Chrysler™ MS-9763	150	168	–	●
Chrysler™ MS-9763	125	1008	●	+
Chrysler™ MS-9020	150	168	–	●
Unocal 98-01-04 MPF Gear Oil SAE 90	150	168	+	+
Transmission Fluid				
ATF Esso LT 71141	150	168	+	+
Chrysler™ MS-9602	150	168	●	+
Chrysler™ MS-9602	125	1008	●	+
Dexron™ VI, ATF	150	168	–	+

+ Excellent Resistance (little or no effect)
● Good to excellent resistance (moderate effect)
– Not recommended (substantial effect)

What's the application? (continued)

Step 2

Note: Data in this document are not for specification purposes.

Pharmaceutical and Food Processing

Often used in sealing/fluid handling systems, 3M™ Dyneon™ Fluoroelastomers help extend the life of capital equipment by providing long-term sealing and protection against high temperatures and corrosive chemicals.

Applications

Butterfly valves, ball valves, pumps, o-rings, hoses, gaskets, linings, diaphragms, seals

What's important for optimum performance?

- Broad chemical resistance
- Long-term durability
- Excellent heat resistance
- Purity requirements

Fluid Handling and Environmental Control Systems

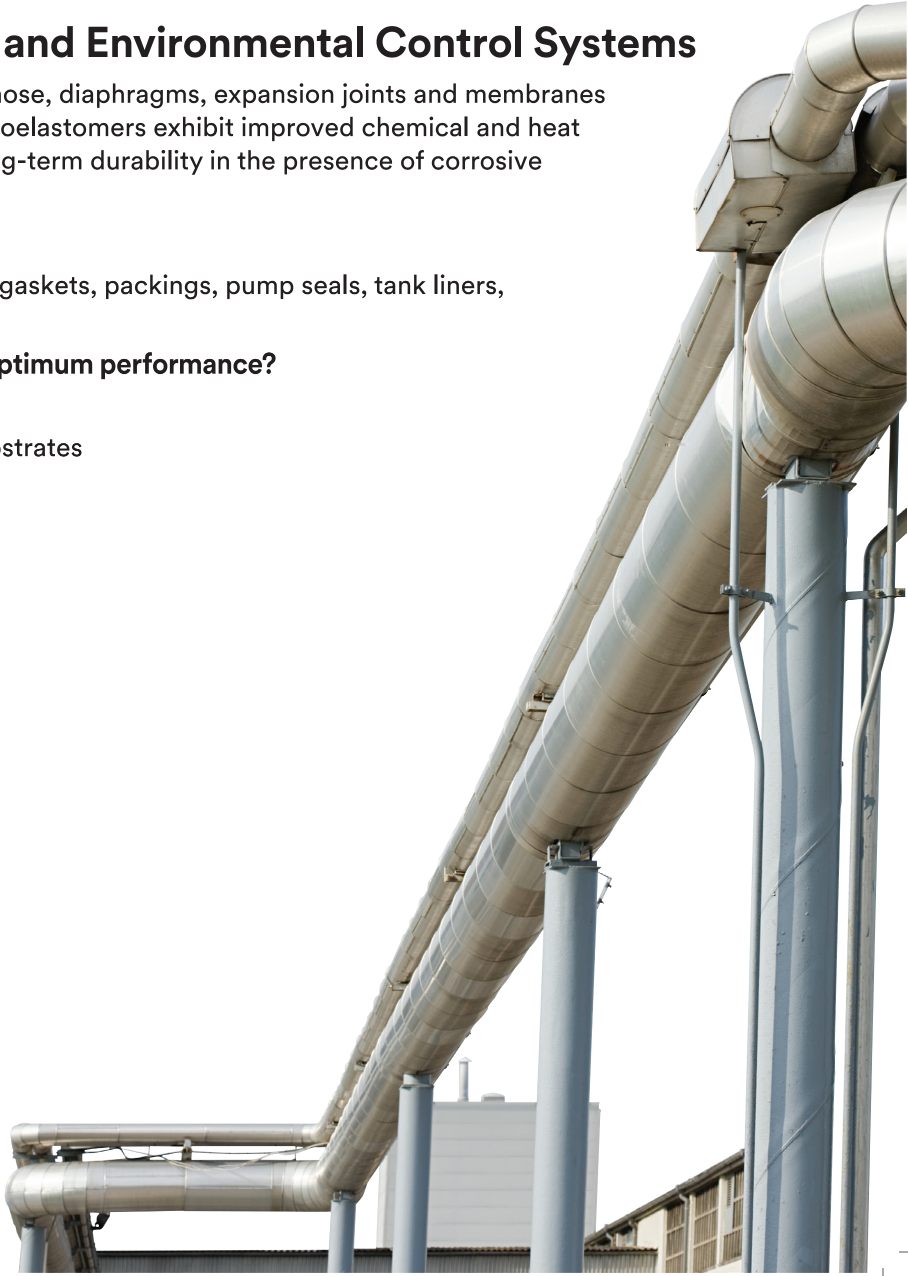
Pumps, valves, tubing, hose, diaphragms, expansion joints and membranes constructed of 3M fluoroelastomers exhibit improved chemical and heat resistance as well as long-term durability in the presence of corrosive materials.

Applications

Valve seats/liners, pipe gaskets, packings, pump seals, tank liners, expansion joints

What's important for optimum performance?

- Chemical resistance
- Adhesion to metal substrates
- Durability
- Durometer of the part



What's the application? (continued)

Step 2

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▶ **Did you know?**

- Solvent coatings can be screen printed, roll coated, spray coated or dip coated. These coatings are thin, flexible and offer excellent chemical and heat resistance.
- Increasing the crosslink density of the fluoroelastomer can increase the resistance to explosive decompression.

Oil, Gas and Mineral Extraction

From down-hole drilling to pipeline distribution systems, 3M™ Dyneon™ Fluoroelastomers offer process equipment designers and manufacturers a variety of sealing and containment solutions for aggressive environments such as sour oil and gas, amine corrosion inhibitors, acids and steam.

Applications

Down-hole packers (permanent or retrievable), safety valves, plugs, sliding sleeves, v-packing, T-seals, molded seals

What's important for optimum performance?

- Chemical resistance to production fluids, injection fluids, etc.
- Resistance to produced gases – H_2S, CO_2, etc.
- Volume swell and property changes over time and temperature range
- Resistance to explosive decompression
- Adhesion to metal substrates

Specialty Applications

3M offers over 50 grades of fluoroelastomers with varying monomer composition, mooney viscosity and fluorine content. This broad offering combined with 3M's expertise in application and product development translates into greater design flexibility. From coatings to calendered sheets, tubing to molded goods, 3M has a solution for your specialty application. Please contact us directly to discuss your needs.

What's the manufacturing process?

Step 3

Processing Considerations

The type of manufacturing process you plan to use to produce your part will have an impact on the fluoroelastomer you choose.

3M™ Dyneon™ Bisphenol-cured Fluoroelastomers are considered by many to be the best-processing fluoroelastomers on the market today. We offer a large selection of incorporated cure gums to help you develop the most robust compound for your process.

What's important for optimum performance?

- Mooney viscosity
- Cure speed
- Flow rates
- Demoldability
- Scorch safety

Note: Data in this document are not for specification purposes.

▶ Did you know?

- Post cure is critical for optimum performance and optimum compression set.
- Fluoroelastomers can be calendered to <0.25 mm thickness.
- Fluoroelastomers offer excellent resistance to weathering, including UV resistance.

Manufacturing Processes

Injection Molding

Choose a low to medium viscosity (20 to 60 MV) gum with excellent scorch safety and a fast cure.

Transfer Molding

Choose a low to medium viscosity (20 to 60 MV) gum with good scorch safety to avoid curing in the transfer pot.

Compression Molding

Choose a medium to high viscosity (50 to 90 MV) gum with a fast cure cycle.

Extrusion

Choose a low viscosity (20 to 40 MV) gum with good scorch safety. Many times process aids can be used to improve flow and surface smoothness, but are not always necessary.

Coating

Solution viscosity is determined by the solvent used and filler level. Solution stability (pot life) is of key concern.

Post Curing

To achieve the optimum physical properties, post curing fluoroelastomer parts is recommended.

For bisphenol cured compounds, optimum properties can be achieved with a post cure of 4 to 16 hours at 230°C to 250°C depending on size of part and efficiency of the oven.

For peroxide cured compounds, optimum properties can be achieved with less aggressive post cure conditions of 2 to 8 hours at 200°C.

If optimum physical properties are not required for a specific application, a post cure step may not be required.

What's the part profile?

Step 4

Key Considerations for Molded Shapes

Molded goods fall into two main categories: complex shapes and bonded seals.

When molding complex shapes, the following parameters should be considered:

- Manufacturing process
- Geometry of the part – are there undercuts?
- Mold release
- Hot tear strength
- Chemical and heat resistance
- Low temperature performance

Note: Data in this document are not for specification purposes.

Additional considerations for bonded seals are:

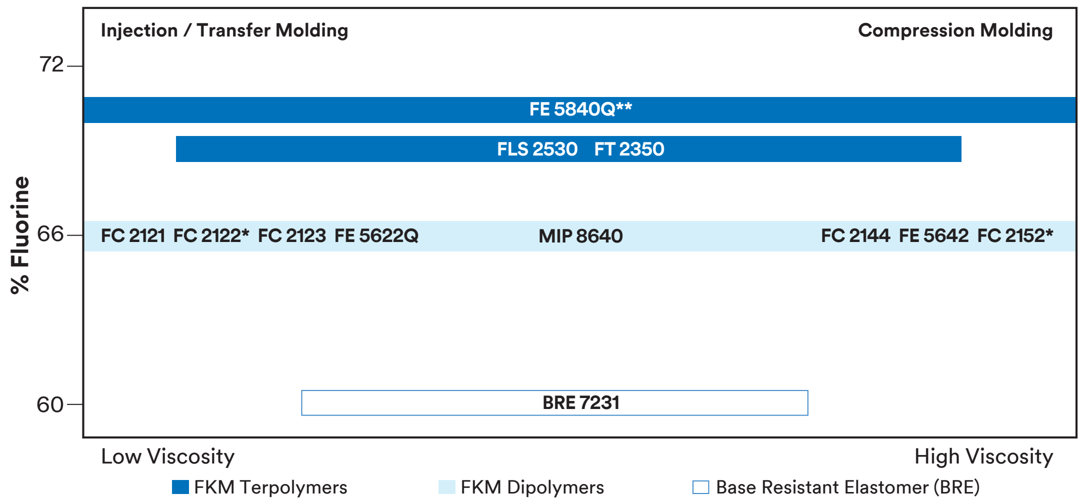
- Adhesion (to the substrate) requirements
- Post cure conditions

Choosing 3M Fluoroelastomers for Molded Shapes by Key Properties

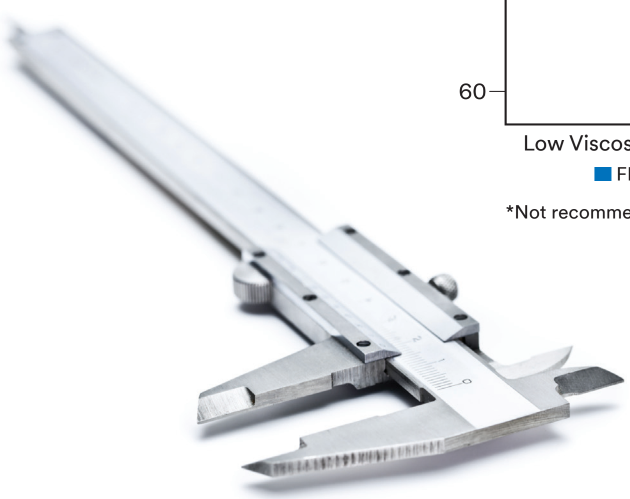
	Injection Molding	Transfer and Compression Molding
Best Compression Set	FC 2123	FC 2144
Fastest Cure Speed (Cure temperature must be >190°C)	FE 5622Q	FE 5642
Best Hot Tear Strength	FC 2122*	FC 2152*

*Not recommended for bonded seal applications.

Choosing 3M Fluoroelastomers for molded shapes by processing method



*Not recommended for bonded seal applications **Can be diluted with raw gum to improve hot tear strength



▶ **Did you know?**

- Fluoroelastomers can be formulated to offer a compression set of less than 10%.

Note: Data in this document are not for specification purposes.

Key Considerations for O-rings

The most important consideration for an o-ring application is usually the compression set. As a general rule, the higher the viscosity of the fluoroelastomer, the lower the compression set.

Viscosity can be an important consideration when choosing 3M Fluoroelastomer grades that will be injection molded.

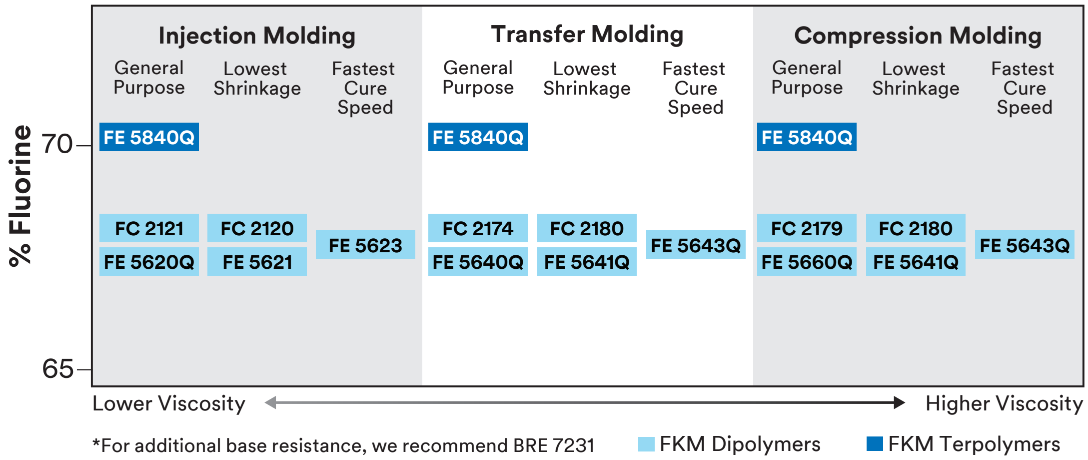
3M™ Dyneon™ FE 5620Q and 3M™ Dyneon™ FE 5621 are suitable for injection molding and offer excellent compression set resistance.

Other considerations for o-rings include:

- Manufacturing process
- Mold release
- Chemical and heat resistance
- Low temperature performance

The following chart shows the available 3M fluoroelastomer products with their respective fluorine contents and applicability to various processing techniques.

Choosing 3M™ Dyneon™ Fluoroelastomers for o-rings by processing method



*For additional base resistance, we recommend BRE 7231

▶ **Did you know?**

- For hose applications, consider using 3M™ Dyneon™ FE 5830Q. This product offers excellent processing as well as low permeation and volume swell.

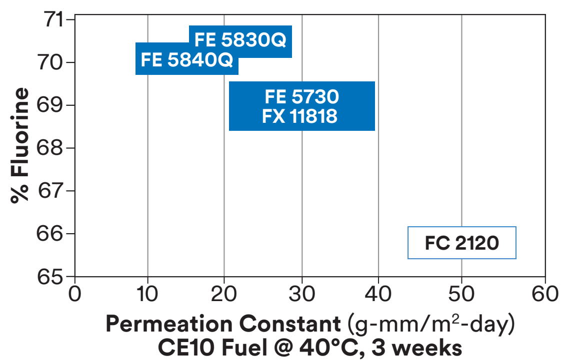
Key Considerations for Extruded Shapes

Fluoroelastomer hose is used in a variety of applications – from automotive fuel line and turbocharger hose to extruded o-ring cord.

What's important for optimum performance?

- Flexibility
- Chemical resistance, in particular permeation resistance
- Fluid pressure
- Material and surface hardness
- Sealability at the hose ends
- Performance over service temperature range
- Extrudate surface requirements

Choosing 3M Fluoroelastomers for extruded shapes by permeation



Fluoroelastomers – Incorporated Bisphenol Cure

3M has a large variety of incorporated cure products specifically tailored for many applications and processes. For example, specific products have been developed for injection molding, compression molding, smoother extrusions, faster cure cycles, low mold shrinkage, enhanced metal bonding, longer scorch safety, improved hot tear and reduced mold fouling in mind. With our large selection of incorporated cure products, it is likely that we have the right product to meet your needs.

Typical Physical Properties

Mechanical properties measured after post cure of 16 hrs @ 230°C

Product	% F	S.G.	Mooney (ML1 + 10 @121°C)	Tensile (MPa)	Elongation (%)	100% Mod (MPa)	Hardness (Type A)	Compression Set***
FC 2110Q	65.9	1.80	17*	13.8	190	5.8	73	23
FC 2120	65.9	1.80	23	15.5	210	5.9	74	22
FC 2121	65.9	1.80	24	15.5	180	7.0	78	20
FC 2122	65.9	1.80	25	14.8	350	3.3	72	28
FC 2123	65.9	1.80	25	16.1	310	3.4	72	23
FC 2144	65.9	1.80	41	17.0	260	4.2	70	18
FC 2146	65.9	1.80	46	17.2	280	4.2	70	18
FC 2152	65.9	1.80	51	16.3	330	3.4	71	22
FC 2174	65.9	1.80	40	16.0	185	7.0	77	18
FC 2176	65.9	1.80	30	15.0	270	3.9	72	22
FC 2177D**	65.9	1.80	33	14.6	250	4.8	75	29
FC 2179	65.9	1.80	80	16.5	200	7.0	74	13
FC 2180	65.9	1.80	40	16.5	185	7.0	76	18
FC 2181	65.9	1.80	44	15.7	240	4.9	72	19
FE 5610	65.9	1.80	17*	14.0	215	5.3	76	23
FE 5620Q	65.9	1.80	23	15.4	195	6.5	77	18
FE 5621	65.9	1.80	23	15.4	195	6.5	77	18
FE 5622Q	65.9	1.80	22	16.2	300	3.6	71	23
FE 5623	65.9	1.80	24	15.0	190	6.5	78	19
FE 5640Q	65.9	1.80	40	15.5	210	6.0	77	16
FE 5641Q	65.9	1.80	40	16.1	185	6.7	77	16
FE 5642	65.9	1.80	42	17.8	290	4.2	71	20
FE 5643Q	65.9	1.80	40	16.5	180	7.7	77	16
FE 5660Q	65.9	1.80	60	16.5	200	7.9	77	15
FT 2350	68.6	1.86	56	15.0	345	3.6	73	45
FX 11818	68.6	1.86	28	12.5	290	4.0	77	33
FLS 2530	69.0	1.80	39	15.0	260	5.0	79	28
FE 5840Q	70.1	1.89	37	15.0	240	6.0	86	35

Test Compound	phr
Polymer	100
N-990 MT Black	30
MgO	3
$Ca(OH)_2$	6

* Mooney Viscosity measured at 100°C
**MgO at 9 phr
***ASTM D395 Method B, 214 O-rings, 70 hrs @ 200°C

Note: Data in this document are not for specification purposes.

Typical Applications

Product	O-Rings	Bonded Seals	Molded Shapes	Hoses/ Extrusions	Coatings	Composites/ Sheet Good	Product Distinctions
FC 2110Q	x		x	x	x	x	66% fluorine, very low viscosity copolymer may be used for blending and viscosity modification
FC 2120	x			x	x	x	66% fluorine, low viscosity copolymer may be used for extrusion and calendaring applications
FC 2121	x						66% fluorine, low viscosity copolymer
FC 2122			x				66% fluorine, low viscosity copolymer, good for complex custom shapes
FC 2123		x	x				66% fluorine, low viscosity copolymer, good for bonded seals
FC 2144		x	x				66% fluorine, intermediate viscosity copolymer, good for bonded seals
FC 2146		x	x				66% fluorine, intermediate viscosity copolymer, lower shrinkage
FC 2152			x				66% fluorine, intermediate viscosity copolymer, best used for custom shapes
FC 2174	x						66% fluorine, intermediate viscosity copolymer, good for o-rings
FC 2176			x				66% fluorine, intermediate viscosity copolymer for general purpose use - good for autoclave curing
FC 2177D**		x	x				66% fluorine, intermediate viscosity copolymer, good for bonded seals, excellent tear strength
FC 2179	x						66% fluorine, high viscosity copolymer
FC 2180	x						66% fluorine, intermediate viscosity copolymer, low shrink version of FC 2174
FC 2181	x		x				66% fluorine, intermediate viscosity copolymer with improved hot tear resistance
FE 5610	x				x		66% fluorine, very low viscosity copolymer, may be used for blending and viscosity modification
FE 5620Q	x						66% fluorine, low viscosity copolymer
FE 5621	x						66% fluorine, low shrinkage version of FE 5620Q
FE 5622Q		x	x				66% fluorine, low viscosity copolymer, good for custom shapes and bonded seals
FE 5623	x						66% fluorine, faster curing version of FE 5620Q
FE 5640Q	x						66% fluorine, intermediate viscosity copolymer
FE 5641Q	x						66% fluorine, low shrink version of FE 5640Q
FE 5642		x	x				66% fluorine, intermediate viscosity version of FE 5622Q
FE 5643Q	x						66% fluorine, faster curing version of FE 5640Q
FE 5660Q	x						66% fluorine, high viscosity copolymer
FT 2350				x		x	68.6% fluorine, intermediate viscosity terpolymer
FX 11818				x		x	68.6% fluorine, low viscosity version of FT 2350
FLS 2530			x				69% fluorine, low viscosity copolymer
FE 5840Q	x		x				70% fluorine, intermediate viscosity, terpolymer - good for o-rings and custom shapes

Note: Data in this document are not for specification purposes.

Specialty Fluoroelastomer Grades

3M offers several specialty grades of fluoroelastomer with enhanced properties such as improved base resistance, low temperature flexibility and processing.

Typical Physical Properties

Mechanical properties measured after post cure of 16 hrs @ 230°C

Product	%F	S.G.	Mooney (ML1 + 10 @ 121°C)	Tensile (MPa)	Elongation (%)	100% Mod (MPa)	Hardness (Type A)	Compression Set***
BRE 7231	60.0	1.60	34	13.1	180	5.5	70	39
FG 5630Q	65.9	1.80	30	15.5	170	8.5	80	27
FG 5690Q	65.9	1.80	97	17.2	215	6.7	76	19
FE 5730	69.2	1.87	36	10.5	300	2.6	82	45
FE 5830Q	70.5	1.90	33	11.0	290	4.4	83	50

*** ASTM D395 Method B, 214 O-rings, 70 hrs @ 200°C

Typical Applications

Product	O-Rings	Bonded Seals	Molded Shapes	Hoses/ Extrusions	Coatings	Composites/ Sheet Good	Product Distinctions
BRE 7231		x	x				60% fluorine, low viscosity terpolymer, for applications requiring improved base resistance
FG 5630Q	x		x			x	66% fluorine, low viscosity copolymer for food grade applications - excellent compression set resistance
FG 5690Q	x		x			x	66% fluorine, high viscosity copolymer for food grade applications - excellent compression set resistance
FE 5730				x			69% fluorine, low viscosity terpolymer, best for extrusion applications
FE 5830Q				x			70% fluorine, low viscosity terpolymer best for extrusion applications - excellent fuel resistance

Fluoroelastomers – Raw Gums

3M offers a wide selection of fluoroelastomer raw gums ranging from 66% to 70% Fluorine and 10 to 150 Mooney Viscosity (ML 1+10 @ 121°C). Most raw gums are sold in slab form but several products are also available in crumb form.

Raw gums, bisphenol cure	% F	Mooney Viscosity (ML1 +10 @ 121°C)	TR10 (°C)
FC 1630	65.9	29	-18
FC 1643	65.9	38	-18
FC 1650	65.9	47	-18
FC 2145	65.9	28	-18
FC 2178	65.9	100	-18
FC 2211	65.9	20*	-18
FC 2230	65.9	38	-18
FC 2299	65.9	100**	-18
FE 5522	66†	29	-19
FT 2430	68.6	31	-14
FT 2481	68.6	75	-14
FLS 5841	70.1	48	-7

* ML 1 + 10 @ 100°C
** ML 1 + 10 @ 150°C
† Low fluorine content terpolymer

Note: Data in this document are not for specification purposes.

Peroxide Curable Fluoroelastomers

3M™ Dyneon™ Peroxide Curable Fluoroelastomers provide improved acid, base, steam and water resistance compared to bisphenol curable grades of similar fluorine content. 3M offers a variety of grades of different fluorine content and Mooney viscosity.

Test Compound Formulations	I	Ia	II	III	IV	V	VI	VII
Polymer	100	100	100	100	100	100	100	100
MT Black (N990)	50	30	30	30	30	30	30	30
Calcium Hydroxide, $Ca(OH)_2$							3.0	
Trigonox® 101-50pd				3.0		2.5		
Varox™ DBPH-50	2.5	2.0	4.0		4.0		2.5	3.0
Co agent TAIC (98%)	1.8	3.0						
Co agent TAIC (72%)			4.0					
Co agent TAIC (70%)				3.5	4.0	2.85	2.5	4.3
Zinc Oxide, Zn0	5.0	3.0	3.0	3.0	3.0			3.0

Post Curing
To achieve the optimum physical properties, post curing fluoroelastomer parts is recommended.
For peroxide cured compounds, optimum properties can be achieved with less aggressive post cure conditions of 2 to 8 hours at 200°C.
If optimum physical properties are not required for a specific application, a post cure step may not be required.

Typical Physical Properties

Mechanical properties measured after post cure*

Peroxide Curable Fluoroelastomers	Test Compound	%F	TR10 (°C)	Mooney Viscosity (ML1 +10 @ 121°C)	Tensile Strength (MPa)	100% Modulus (MPa)	Elongation (%)	Compression set (%)**
FPO 3600 ULV	Ia	65.9	-19	3.5+	17.7	4.1	252	46
FP0 3520	II	65.2	-19	25	22.8	6.2	210	28
FPO 3630	III	67.3	-17	37	24.0	7.0	197	24
FPO 3740	II	69.5	-7	37	22.7	6.3	220	40
FP0 3730	IV	69.8	-7	36	22.8	7.3	190	28
FP0 3731	V	69.8	-6	35	20.9	7.3	188	35
FC 2260	VI	65.9	-18	60	16.2	5.1	225	25
FLS 2650	VI	70.3	-7	50	18.0	5.3	230	28
LTFE 6400ZC	I	67.1	-40	95	13.7	5.4	180	26
LTFE 6320Z	VII	64.3	-30	20	21.2	4.2	230	24
LTFE 6350Z	VII	64.2	-30	50	21.8	4.4	250	24

+ Mooney Viscosity (ML1 +10 @ 100°C)
*Please see the technical data sheet for post cure conditions
**ASTM D395 Method B, 214 O-rings, 70 hrs @ 200°C.
For more information see the product technical data sheet

Note: Data in this document are not for specification purposes.

Perfluoroelastomers

3M™ Dyneon™ Perfluoroelastomers (PFEs) are a class of fully fluorinated fluoroelastomers that provide the highest level of heat and chemical resistance available in an elastomer. 3M offers both peroxide curable grades which provide outstanding overall chemical resistance and triazine curable grades that provide outstanding heat resistance and excellent chemical resistance.

Test Compound Formulations	VIII	IX	X	XI	XII	XIII	XIV	XV
Polymer	100	100	94	94	100	100	100	100
PFE 300C							1.1	
PFE 301C								1.1
MT Black (N990)	15	15				20		
N550 FEF Carbon Black			15		15			
Aerosil® R972			1.5	1.5				
Trigonox® 101-50pd						1.5		
Varox™ DBPH-50	1.5	0.75						
Co agent TAIC (100%)		1.5						
Co agent TAIC (72%)	2.5					2.5		
PFE 01CZ, cure catalyst			7.5	7.5				
Zinc Oxide, Zn0	5.0							
Titanium Dioxide, TiO_2				5.0				

Typical Physical Properties by Perfluoroelastomer Class

Peroxide Cure Perfluoroelastomers

Mechanical properties of PFE 60Z and PFE 90Z measured after post cure of 16 hrs @ 232°C
Mechanical properties of PFE 40Z and PFE 80Z measured after post cure of 16 hrs @ 200°C

Peroxide Curable	Test Compound	TR10 (°C)	Mooney Viscosity (ML1 +10@ 121°C)	Tensile Strength (MPa)	100% Modulus (MPa)	Elongation (%)	Hardness (Type A)	Compression Set (%)*, 70 hrs @ 200°C
PFE 40Z	XIII	-6	40	16.3	9.4	140	72	19
PFE 60Z	X	-2	60	17.9	11.0	165	75	49
PFE 80Z	IX	-2	80	11.0	4.8	230	72	49
PFE 90Z	VIII	-2	98	21.2	10.6	155	75	40

High Temperature Perfluoroelastomers

Mechanical properties measured after post cure of 24 hrs @ 250°C

High Temperature	Test Compound	TR10 (°C)	Mooney Viscosity (ML1 +10@ 121°C)	Tensile Strength (MPa)	100% Modulus (MPa)	Elongation (%)	Hardness (Type A)	Compression Set (%)*, 70 hrs @ 232°C	Compression Set (%)*, 70 hrs @ 300°C
PFE 81TZ	X	-2	80	11.9	4.7	230	71	27	50
PFE 131TZ	X	-2	80	15.9	9.1	165	77	20	43
PFE 191TZ	X	-2	80	15.6	15.2	110	80	15	33
PFE 194TZ	X	-2	95	16.4	13.5	120	80	15	31
PFE 132TBZ	XI	-2	100	15.6	6.9	241	79	36	73
PFE 133TBZ	XI	-2	110	16.0	9.1	192	79	26	60

* ASTM D1414, 18% deflection

Note: Data in this document are not for specification purposes.

High Temperature Perfluoroelastomer Catalysts

PFE Catalyst	Description	Physical Form	Composition	Application Notes
3M™ Dyneon™ Perfluoroelastomer Cure Catalyst Masterbatch PFE 01CZ	Catalyst	slab	20% masterbatch of 3M™ Dyneon™ cure catalyst	Cure with 3M™ Dyneon™ High Temp Perfluoroelastomer
3M™ Dyneon™ Perfluoroelastomer Cure Accelerator Masterbatch PFE 02CZ	Accelerator	slab	20% masterbatch of cure accelerator	Cure modifier with 3M™ Dyneon™ High Temp Perfluoroelastomer

Pre-Compound High Temperature Perfluoroelastomer

Mechanical properties measured after post cure of 16 hrs @ 250°C

Pre-Compound	Test Compound	TR10 (°C)	Mooney Viscosity (ML1 +10 @ 121°C)	Tensile Strength (MPa)	100% Modulus (MPa)	Elongation (%)	Hardness (Type A)	Compression set (%)*, 70 hrs @ 232°C	Compression set (%)*, 70 hrs @ 300°C
PFE 4131TZ	XII	-2	100	17.1	12.1	155	81	17	39

* ASTM D1414, 18% deflection

Clear/Translucent High Temperature Perfluoroelastomer Systems

Mechanical properties measured after the following step post cure:

1. Room Temperature to 150°C (302°F) over 1 hour
2. Hold at 150°C (302°F) for 7 hours
3. 150°C (302°F) to 300°C (572°F) over 2 hours
4. Hold at 300°C (572°F) for 4 hours
5. 300°C (572°F) to Room Temperature over 2 hours

PFE Kit (Gum and Catalyst)	Test Compound	TR10 (°C)	Mooney Viscosity (ML1 +10 @ 121°C)	Tensile Strength (MPa)	100% Modulus (MPa)	Elongation (%)	Hardness (Type A)	Compression set (%)**, 70 hrs @ 250°C	Compression set (%)**, 70 hrs @ 275°C
PFE 300Z	XIV	-2	80	17.9	1.7	295	60	19	33
PFE 301Z	XV	-2	110	18.9	3.6	260	72	26	32

Compound Perfluoroelastomer

Mechanical properties measured after post cure of 24 hrs @ 250°C

PFE Compound	Test Compound	TR10 (°C)	Mooney Viscosity (ML1 +10 @ 121°C)	Tensile Strength (MPa)	100% Modulus (MPa)	Elongation (%)	Hardness (Type A)	Compression set (%)**, 70 hrs @ 200°C
PFE 7502BZ	Compound	-2	-	15.8	11.6	129	75	15

** ASTM D1414, 25% deflection

Note: Data in this document are not for specification purposes.

3M™ Dyneon™ Rubber Curatives

FKM Curatives, Process Aids, and Adhesion Promoters

Product	Polymer used in	Description	Physical Form	Composition	Application Notes
FC 2172/FC 2172P	FKM	Accelerator	Slab/Pellet	Accelerator master batch on 66% FKM	Cure modifier for FKM
FC 5157 Rubber Curative	ECO	Crosslinker	Pellet	75% Crosslinker in ECO	Curative for ECO coex w/FKM
FX 5166 Rubber Curative	ECO/FKM	Accelerator	Flowing Powder	40% Accelerator	Cure modifier/use in conj. w/FC 5157
RC 5105 Rubber Curative	FKM	Crosslinker	Liquid	70% Crosslinker in EtOH	Crosslinker for FKM coatings
RC 5110 Rubber Curative	FKM	Accelerator	Liquid	Crosslinker/ Accelerator in alcohol blend	Crosslinker/ accelerator for FKM coatings
RC 5115 Rubber Curative	FKM	Crosslinker	Liquid	50% Crosslinker in EtOH	Crosslinker for FKM coatings
RC 5120 Rubber Curative	FKM	Accelerator	Liquid	50% Accelerator in MeOH	Accelerator for FKM coatings
RC 5125 Rubber Curative	FKM	Adhesion Promoter	Liquid	Functionalized Silane	Promotes metal adhesion
RC 5251Q Rubber Curative	ECO	Acid Acceptor	Flowing Powder	Sodium Carbonate	Use in conjunction with FC 5157 (replaces PbO)
RA 5300 Rubber Additive	FKM	Process Aid	Pellets	Siloxane	Processing additive for improved smoothness

Note: Data in this document are not for specification purposes.

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