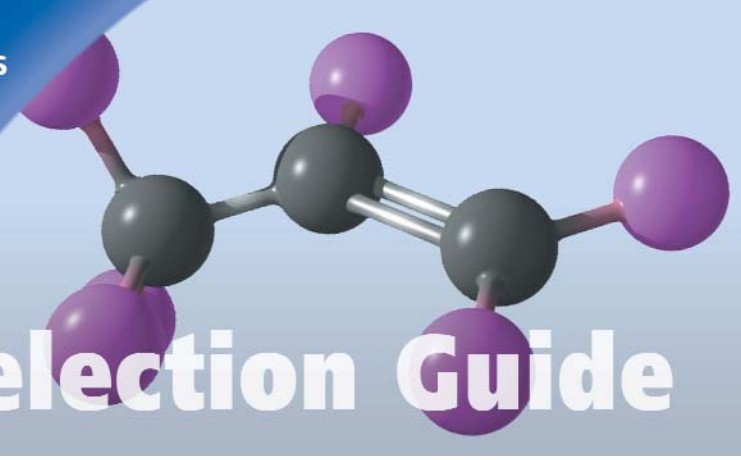
High-Performance Seals

Parco Fluorocarbon Selection Guide



FKM Seals Resist a Wide Range of Chemicals and Temperatures

Parco fluorocarbon seals offer outstanding resistance to aggressive chemicals and high temperatures. Our high-quality fluorocarbon seals have a long history of reliable performance in service temperatures from -40° to +400°F. For superior resistance to chemicals and continuous service temperatures as high as 600°F, consider Parco's perfluoroelastomer seals.

The American Society for Testing Materials (ASTM) document D1418, *Standard Practice for Rubber and Rubber Latices—Nomenclature*, uses the abbreviation FKM for compounds made from fluorocarbon polymer.

Parco offers fluorocarbon compounds to resist a wide range of chemicals and temperatures. The most common type of fluorocarbon polymer contains 66 percent fluorine and is a copolymer of vinylidene fluoride (VF2 or VDF) and hexafluoropropylene (HFP). Other types of fluorocarbon polymer contain tetrafluoroethylene (TFE) for improved chemical resistance. Some types of fluorocarbon polymer contain perfluoromethylvinyl ether (PMVE) for improved flexibility at low temperatures.

Standard fluorocarbon polymers are commonly divided into three types: A, B, and F, in order of increasing fluorine content. In general, higher fluorine content provides improved chemical resistance but decreased low-temperature flexibility. Specialty fluorocarbon polymers are also available for applications requiring improved performance in caustic fluids and low temperatures. Specialty fluorocarbons include GLT, GFLT, LTFE, and ETP.[1]

If you are unfamiliar with the different elastomers used for seals, refer to Parco's *Elastomer Selection Guide*. That guide will help you to select the correct elastomer for your application. If you determine that fluorocarbon seals are right for your application, this guide will help you select the correct compound.

Parco's fluorocarbon seals have a long history of reliable performance in service temperatures from -40° to +400°F. For continuous service temperatures as high as 600°F, consider Parco's perfluoroelastomer seals.

[1]A, B, and F are popular types of fluorocarbon polymer originally developed by DuPont Performance Elastomers. Other fluorocarbon polymer suppliers use different names for their equivalents. GLT, GFLT, and ETP are Genuine Viton® fluorocarbon polymers made by DuPont. Viton® is a registered trademark of Dupont Performance Elastomers. LTFE is a fluorocarbon polymer made by Dyneon, a 3M Company.

Characteristics of Fluorocarbon Types

Below is a brief description of the various types of fluorocarbon polymer. Figure 1 compares the resistance to common fluids among the fluorocarbon types. Low temperature resistance also varies based on the fluorocarbon type, as shown in Figure 2.

Standard Fluorocarbons

Standard fluorocarbon compounds typically use a bisphenol cure system, which provides fast cure cycles and improved resistance to compression set. Some standard fluorocarbons use a peroxide cure system to improve resistance to steam, acid, and aggressive automotive lubricating oils.

A-Type fluorocarbons or dipolymers, are used for general-purpose sealing. A-Type offers the best resistance to compression set among all fluorocarbons. A-Type is not recommended for use in amines, low molecular weight carbonyls, or flex fuels. (Fluorine content of polymer is about 66%)

> ***"Flex-fuel vehicles" can use various blends of gasoline and alcohol as fuel. "Flex fuels" refer to those blends and typically have alcohol content of 15 percent or more. Parco recommends its seals made from F-type polymer for use in flex fuels.***

B-Type fluorocarbons offer better chemical resistance than A-Type. B-Type has improved resistance to aromatic hydrocarbons and automotive fuels containing alcohols and ethers such as methyl tertiary butyl ether (MTBE). (Fluorine content of polymer is about 68%)

F-Type fluorocarbons provide excellent resistance to flex fuels. F-Type has the best fluid resistance of all the standard fluorocarbons. (Fluorine content of polymer is about 70%)

Specialty Fluorocarbons

Specialty fluorocarbon polymers use a peroxide cure system for improved resistance to steam and acid. Specialty fluorocarbons generally have better low-temperature flexibility than standard fluorocarbons. Specialty fluorocarbon polymers GLT, GFLT, and ETP are Genuine Viton®.

GLT fluorocarbons offer excellent low-temperature flexibility and fluid resistance similar to A-Type. Compounds using GLT typically have a temperature retraction value (TR-10) of -22°F. (Fluorine content of polymer is about 64%)

GFLT fluorocarbons combine excellent low-temperature flexibility and fluid resistance similar to F-Type. Compounds using GFLT typically have a TR-10 value of -11°F. (Fluorine content of polymer is about 67%)

LTFE fluorocarbons have the best low-temperature flexibility of any fluorocarbon and fluid resistance similar to GFLT. Compounds using LTFE typically have a TR-10 value of -40°F. (Fluorine content of polymer is about 67%)

ETP fluorocarbons were developed as a cost-effective alternative to perfluoroelastomers. ETP fluorocarbons offer similar reliable service in aggressive chemicals, but at a fraction of the cost. ETP fluorocarbons also have excellent resistance to low molecular weight carbonyls, amines, and caustic bases. (Fluorine content of polymer is about 67%)

Overview of Popular Parco Fluorocarbon Compounds

Below is an overview of Parco's most popular fluorocarbon compounds.[2] All compounds are black unless stated otherwise. For help choosing the appropriate Parco compound for your application, please refer to the Selection Diagram in Figure 3.

"Qualified Products Lists" (QPLs) identify companies authorized to manufacture and sell products to various specifications. Before being added to a QPL, a company must undergo a rigorous evaluation of its quality system. Parco is approved by the Air Force and Performance Review Institute to supply QPL rubber seals for aerospace and defense applications.

Compounds for Applications with Service Pressures up to 1,500 psi

9066-75[3]

75-durometer fluorocarbon; excellent resistance to compression set; improved low-temperature flexibility (TR-10 value of -25°F); meets the requirements of Aerospace Material Specification (AMS) R 83485. (Polymer: GLT)

9131-75

75-durometer fluorocarbon; excellent resistance to fuel; good resistance to compression set; improved low-temperature flexibility (TR-10 value of -10°F); UL-listed. (Polymer: GFLT)

9166-75

75-durometer fluorocarbon; excellent resistance to fuels, alcohols, and solvents; blue. (Polymer: ETP)

9167-60

60-durometer fluorocarbon; excellent resistance to compression set; superior low-temperature flexibility (TR-10 value of -40°F); UL-listed. (Polymer: LTFE)

9266-75

75-durometer fluorocarbon; general-purpose; excellent resistance to compression set; resistant to high-temperatures; meets the requirements of AMS 7276, AMS R 83248, and MIL R 83248, on Qualified Products List (QPL).[4] (Polymer: A-Type)

Fig. 1 **Fluid Resistance of Fluorocarbon Types**

Common Fluids	Fluorocarbon Types A	B	F	GLT	GFLT	LTFE	ETP	Examples
Aliphatic hydrocarbons, process fluids	●	●	●	◒	●	●	●	Propane, acetylene
Aromatic hydrocarbons, process fluids	◒	◒	●	◒	●	●	●	Toluene, benzene
Automotive & aviation fuels	●	●	●	●	●	●	●	Gasoline, JP-4
Oxygenated automotive fuels (containing MeOH, EtOH, MTBE, etc.)	○	◒	●	○	●	●	●	E85
Engine lubricating oils (SM-SL grades)	◒	◒	●	◒	●	●	●	Castrol, Mobil, Pennzoil engine oils
Acids	◓	◒	◒	●	●	●	●	Hydrochloric acid, phosphoric acid
Hot water, steam	◓	◒	◒	●	●	●	●	—
Strong bases (high pH), amines	○	○	○	◓	◓	◓	●	Diethylamine, ammonia
Low molecular weight carbonyls, ketones	○	○	○	○	○	○	●	Acetone, MEK
Fluorine content of polymer, pct.	66	68	70	64	67	67	67	
Low-temperature flexibility (TR-10 value °F)	3	9	21	-22	-11	-40	10	

Legend: ● *Recommended* ◒ *Minor-to-moderate effect* ◓ *Moderate-to-severe effect* ○ *Not recommended*

Source: Sales literature from polymer manufacturers.

[2]Compounds are listed in this brochure by compound number.
[3]Last two digits of compound number identify hardness (durometer, Shore A).
[4]Military Specification MIL R 83248 has the full title *Rubber, Fluorocarbon Elastomer, High Temperature, Fluid, and Compression Set Resistance.*

9500-75
75-durometer fluorocarbon; general-purpose; excellent resistance to compression set; low cost. (Polymer: A-Type)

9505-75
75-durometer fluorocarbon; general-purpose; excellent resistance to compression set; low cost; brown. (Polymer: A-Type)

Compounds for Applications with Service Pressures of 1,500 psi or More

9009-90
90-durometer fluorocarbon; general-purpose; excellent resistance to compression set; resistant to high-temperatures; meets requirements of specifications AMS 7259, AMS R 83248, and MIL R 83248; on QPL. (Polymer: A-Type)

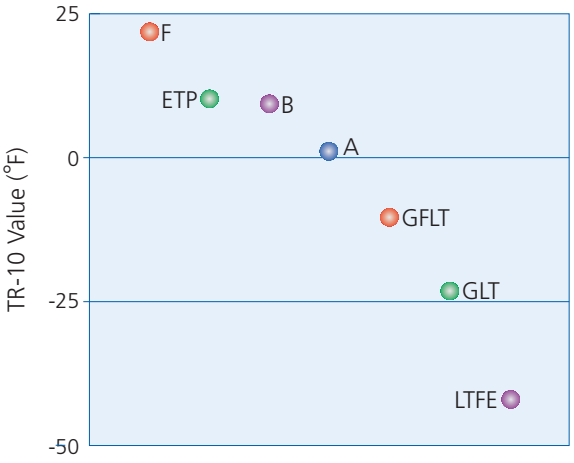
9021-95
95-durometer fluorocarbon; excellent resistance to compression set; better extrusion resistance than 9009-90. (Polymer: A-Type)

9115-95
95-durometer fluorocarbon; excellent resistance to steam and acid; good resistance to compression set; excellent resistance to explosive decompression and extrusion. (Polymer: B-type)

9162-95
95-durometer fluorocarbon; excellent resistance to compression set; excellent resistance to explosive decompression and extrusion. (Polymer: B-type)

9164-90
90-durometer fluorocarbon; excellent resistance to fuels, alcohols, and solvents. (Polymer: ETP)

Fig. 2 **Low-Temperature Flexibility of Fluorocarbon Types**



Source: Sales literature from polymer manufacturers.

Specialty fluorocarbons provide better low-temperature resistance than standard fluorocarbons. Parco's seals made from LTFE offer the best low-temperature resistance.

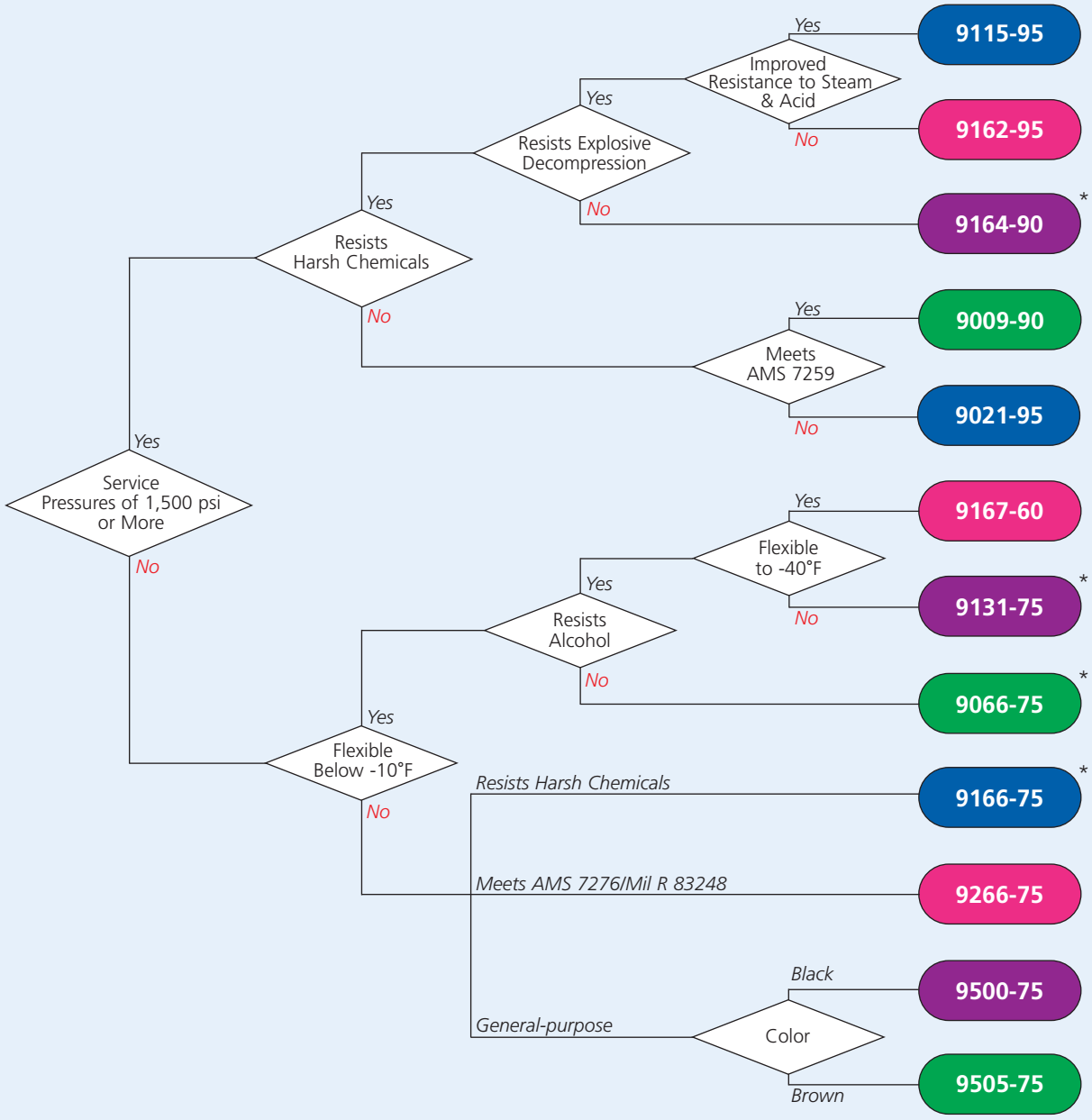
Rely on Parco

Parco is a leading manufacturer of high-performance seals. We specialize in developing proprietary elastomeric compounds and bonding techniques. Parco's seals are available in 340 compounds, more than 25 percent developed in the last five years.

Founded in 1941, Parco was the first manufacturer to specialize in O-rings. Our modern 154,000 square-foot facility is one of the largest plants in the world making molded rubber seals. Parco also makes custom-molded elastomeric products, including rubber-to-metal bonded parts. Our quality management system is certified to ISO/TS 16949:2002, AS7115, and AS9100B. Our R & D laboratory is certified to ISO/IEC 17025.

Fig. 3

Fluorocarbon Selection Diagram



Parco's fluorocarbon seals provide excellent resistance to a wide range of chemicals and temperatures. This selection diagram will help you choose among Parco's popular fluorocarbon compounds. Parco also offers more than 40 fluorocarbon compounds not shown in this diagram. If we don't have a compound for your application, we can develop one for you.

*Compound made from Genuine Viton® polymer.

Source: Parco R & D data.

Key Features

Parco's fluorocarbon seals are an excellent choice for harsh environments. Key features include the following:

- **Excellent resistance to chemicals:**
  Parco fluorocarbon seals resist a broad range of chemicals.
- **Wide range of service temperatures:**
  Parco fluorocarbon seals are suitable for applications from -40° to +400°F, depending on the compound.
- **UL-Listed:**
  Certain Parco fluorocarbon seals are UL-listed.
- **MIL SPEC conforming:**
  Parco offers fluorocarbon seals to meet demanding military and aerospace specifications.
- **Color:**
  Certain Parco fluorocarbon seals are brown or blue to prevent errors during assembly and to control after-market sales.

Typical Values for Popular Parco Compounds

Sequence: Compound no.	9009-90[1]	9021-95	9066-75*	9115-95	9131-75*	9162-95	9164-90*	9166-75*	9167-60	9266-75	9500-75	9505-75	ASTM Test Method[2]
Polymer Type	A	A	GLT	B	GFLT	B	ETP	ETP	LTFE	A	A	A	
Original Properties													
Hardness, Shore A	89	93	75	92	74	94	90	71	58	74	76	78	D2240
Tensile strength, psi.[3]	2437	2289	2342	2690	2794	3029	2499	2072	1621	2253	1704	1750	D412
Ultimate elongation, pct.	139	111	184	102	215	139	156	300	202	184	200	160	D412
Modulus at 100 pct., elongation, psi.	1790	2295	1270	2670	891	2765	1900	825	488	976	798	957	D412
Compression Set 22 hours at 200°C (392°F)													D395 Method B
Pct. of original deflection	7	11	12	20	14	11	28	30	15	3	13	14	
Heat Aging 70 hours at 250°C (482°F)													D573
Hardness change, pts., Shore A	1	-1	0	0	0	2	2	0	1	1	5	4	
Tensile strength change, pct.	-5	-6	-14	-11	-17	-19	0	2	-1	-21	-13	2	
Ultimate elongation change, pct.	-3	-19	-27	-26	31	-18	7	17	14	-5	-15	-16	
Fluid Aging, Fuel C 70 hours at 23°C (73°F)													D471
Hardness change, pts., Shore A	-3	-4	-2	-1	-3	-1	-5	-2	-5	-2	-4	-3	
Tensile strength change, pct.	-1	-12	-23	-2	-13	-13	-23	-15	-8	-5	-20	-18	
Ultimate elongation change, pct.	7	6	-15	34	20	-9	12	4	-1	11	-13	-13	
Volume change, pct.	2	2	4	2	3	2	4	4	6	2	4	4	
Low Temperature Flexibility													D1329
TR-10°C (°F)	-18(0)	-16(3)	-32(-25)	-21(-6)	-23(-10)	-18(0)	-8(18)	-7(19)	-40(-40)	-17(1)	-16(3)	-16(3)	

*Identifies a compound made from Genuine Viton® polymer.

Source: Parco R & D data.

[1]Last two digits of compound number identify hardness (durometer, Shore A).
[2]ASTM is the acronym for the American Society for Testing and Materials.
[3]To convert psi to MPa, use the relationship 145 psi = 1 MPa.

Parco, Inc., 1801 S. Archibald Ave., Ontario, California 91761
909-947-2200 Fax 909-923-0288 parcoinc.com

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