Parco

9131 Fluorocarbon Seals

Can your seals handle reformulated fuels at low temperatures?

Reformulated motor fuels are key components in the EPA strategy to control automotive air pollution. These fuels consist of blends of conventional gasoline and varying concentrations of alcohols and ethers. While serving to limit engine emissions, they can also spell trouble for the seals in truck and automobile engines and other fuel-handling systems. Many of the elastomers used to make the seals in currently operating engines and fuel delivery systems were formulated to handle just conventional fuels — not the oxygen-rich additives contained in reformulated fuels.

Parco 9131 seals employ Viton® Fuel Resistant Low Temperature (GFLT) fluorocarbon compounds and are used in automotive fuel pumps and injectors and in numerous industrial fuel-handling applications. These seals combine low volume swell in gasoline, gasohol, alcohols and reformulated fuels with excellent low-temperature performance. Parco 9131-60 and 9131-75 seal materials are UL Listed.

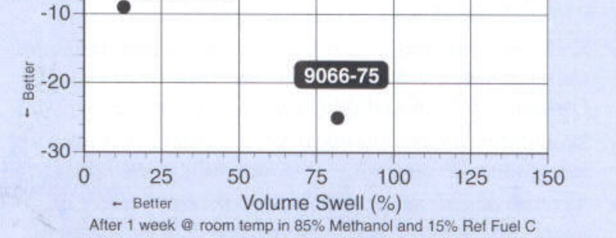
Parco 9131-60 and 9131-75 seals employ Viton Fuel Resistant Low Temperature fluorocarbon compounds specially formulated to provide excellent performance in oxygenated fuels at temperatures ranging from the extreme cold of Canada to the desert heat of the American Southwest. Where conventional fluorocarbon and fluorosilicone materials force users to choose between good low-temperature performance and adequate resistance to oxygenates, UL-Listed Parco 9131 seals offer both.

Parco 9131 seals provide superior combined performance in methanol fuels

Standard fluorocarbon elastomers have long been the seal materials of choice for hydrocarbon fuels owing to the materials' low volume swell in gasoline and diesel fuels. As the use of fuels containing alcohols spread during the '80s, high-fluorine fluorocarbon compounds were developed. While these new fluorocarbons offered excellent resistance to alcohol-fuel blends, their performance did not extend to low temperatures. Parco 9131 compounds were developed for seals that would offer excellent resistance to alcohols and other oxygen-rich fuel components at lower temperatures.

Figure 1 compares low-temperature capability and volume swell characteristics for Parco 9131-75 and three other fluorocarbon compounds in M85, a methanol-gasoline blend consisting of 85% methanol and 15% Reference Fuel C (equal parts of toluene and isooctane). Methanol is very aggressive to many seal materials, so a test fuel with a methanol content this high represents a particularly severe challenge. Com-

Fig. 1: Resistance to Methanol Blends at Low Temperatures – Parco 9131-75 and Conventional Fluorocarbons



Parco 9131-75 seals combine low volume swell (16%) with outstanding low-temperature performance (TR-10 = -9°F). Fluorocarbons with good fuel resistance typically perform poorly when cold, while those with good low-temperature performance are usually subject to excessive volume swell.

pound 9009-75 is Parco's general-purpose fluorocarbon used in a host of fuel applications. Compound 9124-75 is a high-fluorine material specifically designed for low swell in polar fluids such as alcohols. The fourth compound, 9066-75, was formulated to provide enhanced cold-weather characteristics.

As illustrated in Figure 1, Parco 9131-75 seals offer the following performance advantages:

- *Substantially better fuel resistance and low-temperature flexibility than standard fluorocarbon 9009-75 seals. Parco 9131-75 is effective over a temperature range extending 10°F lower than 9009-75 with less than one-eighth the volume swell of the standard compound.*
- *Excellent fuel resistance for service temperatures extending a full 30°F lower than 9124-75, a compound itself specially formulated for fuel resistance. Parco 9131-75 provides this low-temperature flexibility while registering a volume swell of only 16%.*
- *Low-temperature capabilities approaching those of 9066-75, a fluorocarbon compound designed for cold weather applications. Parco 9131-75 seals combine excellent low-temperature performance with far superior fuel resistance, offering only one-sixth the volume swell of 9066-75.*

With a TR-10 of -9°F, Parco 9131-75 seals can be expected to provide excellent fuel resistance in static service at temperatures as low as -25°F, a range sufficient for all but the coldest winter temperatures encountered in Canada and the United States. *When both low-temperature flexibility and fuel resistance are considered together, Parco 9131-75 offers the best combined performance of the group.*

Alcohols and Gasohol

At the beginning of the '80s, air pollution legislation was initiated to shift fuel consumption away from conventional gasolines. The consensus among alternative fuel advocates was that the principal replacement fuels would be methanol-gasoline blends with ethanol-based gasohol playing a secondary role. High-alcohol content formulations such as M85 (85% methanol) and even 100% methanol were proposed. Subsequent experience has shown:

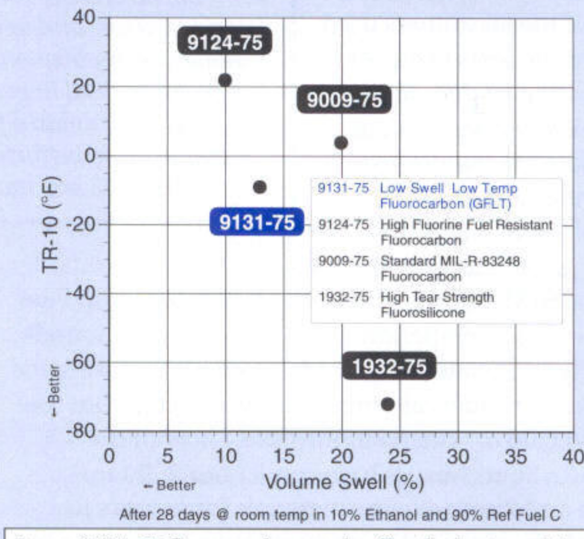
- ✔ *Both methanol and ethanol have higher vapor pressures than gasolines, so they emit more Volatile Organic Compounds (VOCs) during storage and delivery.*
- ✔ *Standard nitrile and fluorocarbon seals experience excessive volume swell in alcohols — and especially in methanol.*
- ✔ *Alcohols absorb water readily and can carry traces of water throughout a fuel system, leading to corrosion of metallic tanks and fuel lines.*
- ✔ *The toxicity and high solubility of methanol in water pose potential health problems.*

Parco 9131-75 seals provide excellent resistance to gasohol at low temperatures

Among the leading candidates for oxygenated fuels are alcohol-fuel blends employing methanol and ethanol in concentrations as high as 85%. Parco has studied the long-term performance of numerous elastomers across the range of alcohol concentrations encountered in service. Because of concerns about the health effects of methanol and its potential for high Volatile Organic Compound (VOC) emissions, any large-scale adoption of alcohol-fuel blends will probably entail the use of ethanol instead. Ethanol-based fuels are also much less aggressive toward most elastomeric seal materials than methanol blends.

Figure 2 shows the performance of four compounds in gasohol: 10% ethanol and 90% Reference Fuel C. In addition to compounds 9131-75, 9009-75 and 9124-75 described above, the test observed the performance of compound 1932-75, a fluorosilicone specially designed for low-temperature dynamic applications.

Fig. 2: Resistance to Gasohol at Low Temperatures – Parco 9131-75 and Other Fluorine-Based Compounds



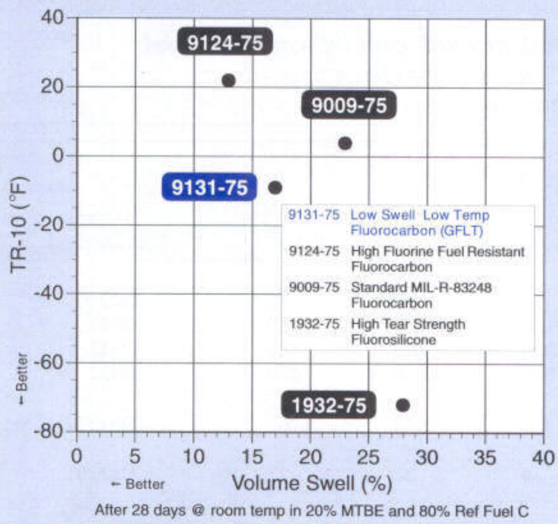
Parco 9131-75 fluorocarbon seals offer the best combination of fuel resistance and low-temperature performance in gasohol. Neither the standard fluorocarbon 9009-75 nor the low-temperature fluorosilicone 1932-75 matches the ethanol resistance of Parco 9131-75.

Figure 2 shows that Parco 9131-75 is superior to standard fluorocarbon 9009-75 in both low-temperature performance and fuel resistance. It experiences only marginally greater swell than 9124-75, a high-fluorine fluorocarbon, while offering a much lower service temperature. For a significant increase in low-temperature capabilities, a user would have to specify a relatively expensive fluorosilicone with a sacrifice in fuel resistance.

Parco 9131-75 seals easily handle ether-based reformulated gasolines

Ethers such as MTBE and ETBE have become established as the most widely used oxygenating agents in the production of reformulated gasolines. In fact, MTBE, which started as a mere octane booster and then became a clean fuel component, was the fastest growing chemical of the late '80s.

Fig. 3: Resistance to Reformulated Fuel at Low Temperatures – Parco 9131-75 and Other Fluorine-Based Compounds



In ether-based reformulated fuels as in alcohol-based gasohol, Parco 9131-75 seals offer the best combination of fuel resistance and low-temperature performance. The figure shows O-ring performance at MTBE concentrations about one-third greater than needed to meet EPA targets.

Because of the widespread use of MTBE, the seals in any gasoline engine or fuel-handling system intended for today's market must be capable of performing well in MTBE-based reformulated fuels. Figure 3 charts the performance of the same compounds as in Figure 2, but here in a blend of 20% MTBE. The EPA target for minimum oxygen content in reformulated gasoline is 2.7% by weight, which corresponds to 15.5% MTBE. Thus, the 20% values shown reflect concentrations of MTBE above those likely to be used. In the eventuality that higher concentrations might be used, Parco has obtained UL listing for 9131-75 seals at MTBE concentrations of 20%, as well as 5%, 10% and 15%.

The values for volume swell for all the compounds are marginally higher in Figure 3 than in Figure 2, reflecting the aggressiveness of MTBE. While tests indicate that MTBE in concentrations typically used is not detrimental to any of the compounds tested, Parco 9131-75 seals offer combined fuel resistance and low-temperature capabilities superior to those of the other compounds.

Clean Air Act Amendments of 1990

As amended in 1990, the Clean Air Act mandates changes in motor fuel usage in 44 areas where carbon monoxide emissions exceed EPA standards. In some cases, timetables have slipped because adequate technologies are unavailable, although the basic strategy remains intact.

- ✔ *Starting in November 1992, reformulated gasolines with at least 2.7% by weight oxygen content would be used in place of conventional gasoline during the winter months.*
- ✔ *By 1995, VOC emissions from motor fuels would be reduced by 15% through the use of reformulated fuels.*
- ✔ *By 1995, operators of fleets of 10 or more vehicles in high ozone areas would begin replacing their fleets with clean-fuel vehicles at the rate of 10% a year.*
- ✔ *By 1995, nine major urban areas with excessive ozone levels would be required to use reformulated gasolines year-round.*
- ✔ *By 2005, 25% of vehicle miles are to be traveled in clean-fuel vehicles.*

Ethers and Reformulated Fuels

Five- and six-carbon ethers such as MTBE (methyl tert-*butyl ether), ETBE (ethyl* tert-*butyl ether) and TAME (*tert-*amyl methyl ether) have won much wider acceptance than methanol and ethanol as additives for reformulating fuels. The advantages of ethers include:*

- ✔ *Ethers have lower vapor pressures than methanol and ethanol so they produce fewer VOC emissions during storage and delivery.*
- ✔ *MTBE binds with water less readily than methanol so there is little problem with water absorbtion and fuel system corrosion.*
- ✔ *Owing to its low volatility, MTBE poses fewer potential health problems than methanol and has gained wider public acceptance.*
- ✔ *MTBE and ETBE are freely interchangeable with other lead-free octane boosters such as toluene and xylene.*
- ✔ *MTBE is readily available, using excess methanol capacity built when methanol was being promoted as an alternative fuel during the '80s.*
- ✔ *MTBE is less aggressive to seal materials.*

Turn to Parco for a full line of UL-Listed low-temperature fluorocarbon seals

For more than fifty years, major industrial users have relied on Parco for quality, delivery and sealing excellence. Today, you can rely on innovative products such as 9131 fluorocarbon seals from Parco. With Parco seals, you can prepare your products to perform effectively in reformulated fuels at low temperatures.

The cold-weather reformulated fuel market can be an opportunity — if you are ready for it. Contact your local distributor for more about Parco 9131 fluorocarbon seals.

Key Features

Parco 9131 compounds are a family of a peroxide-cured Viton GFLT fluorocarbon materials designed for use in fuel systems carrying oxygenated hydrocarbons such as alcohol-fuel blends and reformulated fuels. Principal applications include: (1) aircraft seals at low temperatures requiring dynamic sealing capabilities superior to those of fluorosilicones; (2) automotive fuel injection seals; (3) fuel pump and tank seals; (4) marine engine seals operating at low temperatures with alcohol-based fuels; and (5) many low-temperature applications now using fluorosilicone seals.

Key features of Parco 9131 fluorocarbon compounds include:

- Listing to UL Standard 157 (File No. MH60405) in 60 and 75 durometers for these fuels:
  - *Gasoline*
  - *Methanol 15%, 85% & 100%*
  - *MTBE 5%, 10%, 15% & 20%*
  - *Kerosene*
  - *Ethanol 15%, 85% & 100%*
- Excellent fuel resistance — *conventional gasolines, gasohol, alcohols and reformulated fuels*
- Extended low-temperature capability — *TR-10 = -9°F (75-durometer O-ring)*
- High modulus — *593 psi @ 100% elongation (75-durometer O-ring)*

Typical Values[1]

Property	Units[2]	9131-75	9009-75	9124-75	1932-75	ASTM Test Method
ASTM Dumbbell Values						
Hardness	Shore A	72	73	75	73	D2240
Tensile strength	psi	2370	2150	1850	1210	D412
Ultimate elongation	%	160	220	180	260	D412
Modulus @ 100% elongation	psi	1170	670	1130	470	D412
Low-temperature properties:						
Brittle point	°F	-54	-27	-36	<-90	D2137
TR-10 *(O-ring values [AS568-218])* 10% recovery of 50% stretch[3]	°F	-9	4	22	-72	D1329
O-Ring Values (AS568-214)						
Compression set *(22 hrs @ 200°C [392°F])* % of original deflection	%	25	9	33	16	D1414
Volume swell *(28 days @ 75°F)*:						
Reference fuel C: 50% toluene, 50% isooctane	%	9	17	5	22	D471
Alcohol-fuel blends:						
10% methanol, 90% fuel C	%	16	31	14	27	D471
10% ethanol, 90% fuel C	%	13	20	10	24	D471
Pure alcohols:						
100% methanol	%	11	110	7	8	D471
100% ethanol	%	7	13	5	8	D471
Ether-based reformulated fuels:						
20% MTBE, 80% fuel C	%	17	23	13	28	D471
20% ETBE, 80% fuel C	%	15	10	9	31	D471
Volume swell *(1 year @ 75°F)*:						
Alcohol-fuel blend: 10% ethanol, 90% fuel C	%	13	20	12	22	D471
Ether-based reformulated fuel: 20% MTBE, 80% fuel C	%	17	24	14	25	D471

1) Values taken from Parco Test Report R-3752C.
2) To convert psi to MPa, use the relationship 145 psi = 1 MPa.
3) The TR-10 Temperature Retraction Test consists of stretching a material by 50%, freezing it, and then gradually warming it until 10% of the original 50% elongation has been recovered. The TR-10 is a generally reliable indicator of the lowest temperature at which a material exhibits the elastomeric properties that allow it to function effectively as a seal. Dynamic O-ring seals generally function reliably at or below the TR-10. O-rings in static service typically provide reliable sealing to about 15°F below the TR-10.

For more information or to obtain samples of these compounds, please contact your local Parco distributor.

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