DuPont™ Viton®

FLUOROELASTOMER

WITHSTANDS AGGRESSIVE BIOFUELS FOR LONGER SEAL LIFE AND SEAL RELIABLITY IN HOSES, GASKETS AND O-RINGS

DUPONT®

The miracles of science™

DuPont™ Viton® Takes On Biofuels...and Wins!

The increasing use of aggressive bio-diesel and alcohol components in motor fuels is posing new challenges for companies that produce, blend, transport and dispense them.

Relative to other fuel components, biodiesel has unstable chemistry subject to degradation which is exacerbated by contamination as it moves along the distribution chain. The aggressive, contaminated fuel attacks hydrocarbon rubbers such as the nitrile rubbers that are widely used in hose, gaskets, seals and other parts of fuel-handling equipment.

Ethanol-containing fuels pose another challenge—permeation—and nitrile rubbers again fall short. Excessive permeation not only increases emissions of volatile organic compounds but also loses valuable fuel.

For more than 50 years, Viton® fluoroelastomer from DuPont has proven its ability to resist attack by a wide range of solvents and fuels.

Viton® has what it takes to help meet the biofuel challenge. We have extensively tested Viton® with different compound ingredients in a variety of biofuels. The results indicate that biofuels can confidently be handled with hose, seals, gaskets and other parts made with carefully selected grades and formulations of Viton®.

- Excellent compatibility with both fresh and aggressive contaminated biodiesel, and with ethanol.
- High resistance to permeation by alcohol.
- Long-term retention of critical properties in current and emerging biofuels.
- Outstanding low-temperature sealing performance in biofuels.

Figure 1. Fluids Resistance and Low Temperature Properties for Types Of Viton®

	Cure System						
	Bisphenol			Peroxide			
Type of Viton® Fluoroelastomer	**A**	**B**	**F**	**GBL-S**	**GF-S**	**GLT-S**	**GFLT-S**
Fluid							
Hydrocarbon automotive and aviation fuels—no oxygenate or biofuel content	1	1	1	1	1	1	1
Dry, unoxidized biodiesel (B100) and blends with petrodiesel	1	1	1	1	1	1	1
Wet biodiesel* and petrodiesel blends	NR	NR	NR	1**	1**	1**	1**
Aliphatic hydrocarbon process fluids, chemicals	1	1	1	1	1	1	1
Aromatic hydrocarbon process fluids, chemicals	2	2	1	1	1	2	1
Aqueous fluids: water, steam, mineral acids (H_2SO_4, HNO_3, HCl, etc.)	3	2	2	1	1	1	1
Methanol (methyl alcohol)	NR	2	1	2	1	NR	1
Ethanol (ethyl alcohol)	2	1	1	1	1	2	1
Temperature of retraction (TR-10)	–17 °C	–13 °C	–6 °C	–17 °C	–6 °C	–30 °C	–24 °C
Static low temperature sealing (19% compression)	–32 °C	–28 °C	–23 °C	–33 °C	–19 °C	–46 °C	–40 °C

DuPont Proprietary Test Methods. Ratings based on proper formulation. 1. Excellent 2. Very Good 3. Good NR: Not recommended

* Wet biodiesel containing water and acid simulating wet, oxidized biodiesel.

** Specific formulations only — contact DuPont.

DuPont™ Viton® Resistance to Biodiesel Proven in the Field

Stands up to biofuels

Biodiesel, whether it contains FAME or FAEE, inevitably oxidizes and/or becomes contaminated by water and microbes as it moves along the distribution chain. Contaminated biodiesel is an acidic and very aggressive agent in many rubbers, including nitrile rubbers. It causes changes in susceptible rubbers that include swelling, softening and loss of strength and hardness. Such changes can eventually lead to leaks in sealed joints or hoses, for example.

DuPont™ Viton® fluoroelastomer's resistance to biodiesel is already proven in the field. Since the mid-1990s, automobile manufacturers have relied on Viton® for seals and gaskets for use in diesel fuel injectors that provide resistance to biofuel blends widely used in Europe.

DuPont has shown that specific compounds that contain Viton® fluoroelastomers provide exceptional resistance to water contaminated biodiesel. Some results of our extensive test program are shown in Figure 1.

Fights permeation by volatile alcohols

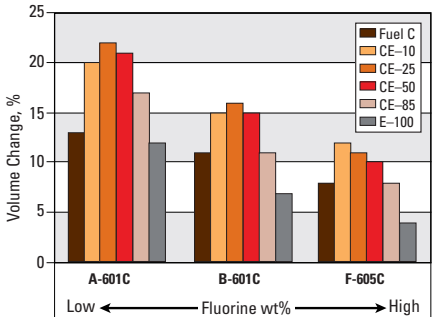
Blends of ethanol with gasoline motor fuels represent an increasing proportion of the the U.S. fuel supply. In addition, 100% ethanol fuel is common in a few countries, notably Brazil. Fuels containing butanol are on the horizon, and DPE has conducted tests that show that Viton® can meet that challenge.

Although nitrile rubber is resistant to chemical attack by ethanol, it is highly permeable to it. Viton®, by contrast, has excellent resistance to both permeation and chemical attack by either pure ethanol or blends of ethanol with hydrocarbon fuel. See Figures 2, 3 and 4.

Effective low-temperature sealing

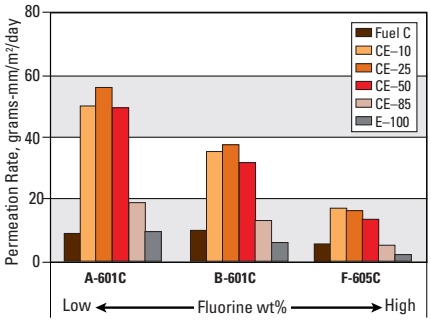
Widely used for its outstanding performance at elevated temperatures, Viton® can also provide effective seals in biofuels at low temperatures. Our tests in biofuel show that certain types perform well at temperatures in the –50 to –65 °C range when used in static sealing applications.

Figure 2. Volume Change in Ethanol Fuel Blends 1008 hr at 40 °C (weekly fuel change)



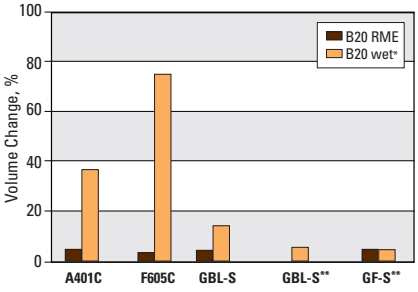
ASTM D 471-98—all fuel testing was conducted in sealed one liter 316 stainless steel Parr pressure vessels

Figure 3. Permeation of Fuel C/Ethanol Fuel Blends at 40 °C



SAE 2665 cup weight loss method

Figure 4. Volume Change B20 RME and B20 wet* RME after 1008 hr at 125 °C



* Wet biodiesel containing water and acid simulating wet, oxidized biodiesel

**Special formulation from DuPont

ASTM D 471-98—fuel testing was conducted in sealed one liter 316 stainless steel Parr pressure vessels

Put DuPont™ Viton® to work for you

DuPont has powerful technical resources in every region. We stand ready to assist you and your part supplier in upgrading your equipment to meet the challenges of handling biofuels. Industry experts based in your region can help you choose the right Viton® material and formulation for your applications, write specifications, help train your people and more. Refer to the DuPont Chemical Resistance Guide at www.dupontelastomers.com for more information on the chemical compatibility of Viton® in biodiesel fuels and more.

Get started today. Just call the nearest DuPont office.

And whenever you purchase parts using Viton®, make sure you get the real thing. We have a network of licensees who provide documentation certifying that the parts they supply are made from Viton®. Check the label for the Genuine Viton® mark, or ask for relevant documentation.

The "Made with Genuine Viton®" label is your assurance of quality and performance that only Viton® fluoroelastomers can provide.

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3. Terry, B., *Impact of Biodiesel on Fuel System Component Durability,* Technical Report, Coordinating Research Council and the National Renewable Energy Laboratory, U.S. Department of Energy, 149 pp. **http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/39130.pdf**
4. Thomas, Eric W., Fuller, Robert E., Terauchi, Kenji, *Fluoroelastomer Compatibility with Biodiesel Fuels,* DuPont, Technical paper, SAE (Society of Automotive Engineers) 10 pp. **http://www.dupontelastomers.com/Tech_Info/techPapers.asp**

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