Materials Compatibility

B100 Material Compatibility

B100 may degrade some hoses, gaskets, seals elastomers, glues and plastics with prolonged exposure. Natural or nitrile rubber compounds, polypropylene, polyvinyl, and Tygon materials are particularly vulnerable. More testing is being done to extend this list of vulnerable materials. Most elastomers used after 1993 are compatible with B100 (Viton/Teflon). Before handling or using neat biodiesel (B100) contact the equipment vendor to determine compatibility with fatty acid methyl esters.

Teflon, Viton, and Nylon have very little reaction to biodiesel and are among the materials that can be used to update incompatible equipment. B100 suppliers and equipment vendors should be consulted to ensure the most recent findings on compatibility. For the bulk fuel handlers of biodiesel it is highly recommended to speak with your hose suppliers to source hoses that are compatible with neat biodiesel.

Most tanks designed to store diesel fuel will be adequate for storing B100. Acceptable storage tank materials include aluminum, steel, fluorinated polyethylene, fluorinated polypropylene, Teflon, and most fiberglasses.

Brass, bronze, copper, lead, tin, and zinc may accelerate the oxidation process of biodiesel creating fuel insolubles or gels and salts. Lead solders and zinc linings should be avoided, as should copper pipes, brass regulators, and copper fittings. Affected equipment should be replaced with stainless steel, carbon steel, or aluminum.

B20 Material Compatibility

Biodiesel blends of 20% or less have shown a much smaller effect on these materials. The effects are virtually non-existent in low-level blends such as B2. When handling blends of B20 or less normal monitoring of hoses and gaskets for leaks is sufficient.

Blends of B20 and lower reduce the impact of metal compatibility issues.

Materials Compatibility Studies

The following summaries on material compatibility with biodiesel (methyl Oleate) are taken from research studies and compatibility guides from several o-ring and seal manufacturers.

Military Study[1]

The elastomer compatibility study was performed as recommended using ASTM D 471 and D 412. Three tensile bars of each material were place in sealed, glass containers and stored at 51.7°C (125°F) for 0, 22, 70 and 694 hours.

Summary of Hardness and Swell Characteristics

Material	*Comments*
Teflon	Relatively no changes in hardness or swell
Nylon 6/6	Relatively no changes in hardness or swell
Nitrile	Hardness was reduced approximately 20 percent; swell increased approximately 17 to 18 percent
Viton A401-C	Relatively no changes in hardness or swell
Viton GFLT	Relatively no changes in hardness or swell
Fluorosilicon	Hardness is relatively unchanged; swell increased approximately 7 percent
Polyurethane	Hardness is relatively unchanged; swell increased approximately 6 percent
Polypropylene	Hardness was reduced approximately 10 percent; swell increased from 8 to 15 percent

The effect of B20 on vulnerable materials is diluted compared to higher blends. Some slow oxidation can occur, although it may take longer to materialize. Biodiesel also can affect some seals, gaskets, and adhesives, particularly those made before 1993 and those made from natural or nitrile rubber. It is primarily for these reasons that vehicle and storage equipment are modified. Most engines made after 1994 have been constructed with gaskets and seals that are generally biodiesel resistant. Earlier engine models or rebuilds may use older gasket and seal materials and present a risk of swelling, leaking, or failure. Fuel pumps may contain rubber valves that may fail. The typical approach is to create a maintenance schedule that checks for potential failures. Users can also contact engine manufacturers for more information.

[1] E. A.Frame, G.B. Bessee and H.W. Marbach, Biodiesel Fuel Technology for Military Application, U.S. Army TARDEC Fuels and Lubricants Research Facility, Southwest Research Institute, Interim Report TFLRP No. 317, December 1997.

Materials Compatibility

Parker O-Ring Handbook[2]

Compatibility of Various Elastomers to Methyl Oleate

Elastomer	*Compound Compatibility Rating*
Nitrile NBR	4
Hydrogenated Nitrile HNBR	4
Ethylene Propylene EPDM	2
Fluorocarbon FKM	1
Hifluor FKM	1
Perfluoroelastomer FFKM	1
Aflas (TFE/Propylene) FEPM	X
Neoprene/Chloroprene CR	4
Styrene-Butadiene SBR	4
Polyacrylate ACM	X
Polyurethane AU,EU	X
Butyl IIR	2
Butadiene BR	4
Isoprene IR	X
Natural Rubber NR	4
Hypalon CSM	4
Fluorosilicone FVMQ	2
Silicone MQ, VMQ, PVMQ	X

Compatibility Rating
1 – Satisfactory
2 – Fair (usually OK for static seal)
3 – Doubtful (sometimes OK for static seal)
4 – Unsatisfactory
X – Insufficient Data

Wilden Chemical Resistance Guide[3]

Compatibility of Various Elastomers, Metals and Plastics to Methyl Oleate

Material	*Compound Compatibility Rating*
Elastomers	
Wil-Flex	C
Polyurethane	-
Neoprene	D
Buna-N	D
Nordel	C
Viton	B
Teflon	A
Saniflex TPE	-
Metals	
Aluminum	-
Cast Iron	-
Stainless Steel (316)	-
Hastelloy	-
Halar ECTFE Coated	-
Plastics	
Nylon	-
Carbon-Filled Acetal (CFA)	A
Polypropylene	-
Polyethylene	-
PVDF	-

Compatibility Ratings:
A - Minor Effect
B - Minor to Moderate Effect
C - Moderate to Severe Effect
D - Not Recommended
- - Insufficient Information

[2] Parker O-Ring Handbook, Parker Hannifin Corporation, O-Ring Division, Lexington, KY, 2001.

[3] Chemical Resistance Guide, Wilden Pump & Engineering Co., Grand Terrace, CA, May 2003.

eFunda O-Ring Chemical Compatibility Guide[4]

O-Ring Compatibilities

Elastomer	*Compound Compatibility Rating*
Aflas	0
Chemraz	4
Fluorocarbon	4
Kalrez	0
Nitrile, Hydrogenated	1
Polyurethane, Cast	0
Styrene-Butadiene SBR	1
Buna-N (Nitrile)	1
Epichlorohyrin	0
Fluorosilicone	3
Natural Rubber	1
Polyacrylate	0
Polyurethane, Millable	0
Teflon, Virgin	4
Butyl	3
Ethylene-Propylene	3
Hypalon	1
Neoprene	1
Polysulfide	0
Silicone	0
Vamac	0

Compatibility Ratings:
4 – Good, both for static and dynamic seals
3 – Fair, usually OK for static seals
2 – Sometimes OK for static seals; not OK for dynamic seals
1 – Poor
0 – No Data

[4] O-Ring Chemical Compatibility Guide, eFunda, Inc. Sunnydale, CA, 2004. www.efunda.com.