

UPEI
Guidance
document

**Compatibility of
retail station
infrastructure
with higher
biofuel blends**

Contents

1. Introduction	3
2. Materials commonly found within the fuelling infrastructure	4
3. Compatibility of ethanol with materials commonly found within the fuelling infrastructure	5
4. Compatibility of FAME biodiesel with materials commonly found within the fuelling infrastructure	8
5. Compatibility of paraffinic diesel fuel with materials commonly found within the fuelling infrastructure	9
6. Summary	10
7. References	11
8. APPENDIX - Compatibility of Equipment with BioFuel Blends.....	12
Appendix A - Tank Manufacturer compatibility with Ethanol Blends	12
Appendix B – Pipe Manufacturer and Associated Underground Storage Tank Equipment manufacturer compatibility with Ethanol Blends	13
Appendix C Dispenser, Hanging Hardware, Shear Valve and Submersible turbine pump manufacturer compatibility with ethanol blends	17
Appendix D Tank Manufacturer compatibility with Biodiesel blends	19
Appendix E Underground Equipment Manufacturer Compatibility with Biodiesel blends	20
Appendix F Above Ground Equipment Manufacturer compatibility with Biodiesel blends....	24



1. Introduction

The Renewable Energy Directive 2009/28/EC of the European Parliament and the Council of the European Union (EU) and subsequent amendments is a major policy instrument supporting the increased use of renewable fuels in the automotive sector. The Directive encourages the use of renewable fuels as blending components in both petrol and diesel fuels. These fuels are produced from renewable and sustainable resources, such as vegetable oil, corn, sugar cane and waste materials such as those derived from agriculture and forestry. Renewable fuels have gained popularity due to their sustainability, low contribution to the carbon cycle and lower amounts of greenhouse gas emissions when compared to fossil fuels.

Ethanol is the most common renewable biofuel used for petrol blending. In petrol ethanol blends are designated as Exx where xx represents the maximum ethanol content. Within Europe currently the commonly available blends include E5 (corresponding to blends with 5 % maximum ethanol content) and E10 (corresponding to blends with 10 % maximum ethanol content), both of which are included in the current European petrol standard EN 228.

In diesel fuel fatty acid methyl ester (FAME) biodiesel and/or synthetic paraffinic diesel fuel such as hydrogenated vegetable oil (HVO) and gas-to-liquid (GTL) fuels are used as alternative renewable biofuels. Biodiesel blends are designated as Bxx, where xx represents the maximum amount of FAME biodiesel in the blend. Currently within Europe the EN590 diesel fuel standard allows for up to 7% biodiesel blending, and is termed B7. Higher biodiesel blends such as B10, B20 and B30 are less common and often used for fuelling captive fleets.

Synthetic paraffinic diesel fuel generally comprises a mixture of straight chain and branched paraffins. These materials are the simplest type of hydrocarbon and are found naturally in fossil diesel fuel. Synthetic paraffinic diesel fuel can be used as a blending component in diesel fuel without any limitation, providing that the finished blend fully complies with the relevant diesel fuel standard. Where synthetic paraffinic diesel fuel is blended into diesel fuel there is no designation to identify the amount of synthetic paraffinic diesel fuel in the blend.

Ethyl tertiary-butyl ether (ETBE) has been used for many years in Europe at up to 15% blend rate in gasoline. It is the least polar of all the potential oxygenates used to blend gasoline and there are no concerns regarding compatibility of materials found within the retail station to ETBE. It is only one of a number of oxygenated materials currently allowed to be blended into gasoline. As ether oxygenates are not in the scope of this guidance document, no further investigation was conducted on their compatibility with retail station infrastructure.

In the future is it likely that renewable fuels will be needed in increasing amounts to replace fossil fuel and help meet increasing targets for lower carbon and greenhouse gas emissions from the transport sector. Current renewable fuels such as ethanol and FAME contain oxygen and are polar molecules. This polarity introduces different properties to the fuel and results in the need for different handling and distribution practices. There is potential for incompatibility between components used within the fuelling infrastructure at retail sites and these newer biofuel components. The main area of concern is elastomer materials, which are predominantly used in sealing applications. Certain metal and plastic materials can also be affected by exposure to biofuels. This purpose of this document is to summarise the major material types found within the retail fuelling infrastructure and to provide information on the compatibility of these materials with ethanol, FAME biodiesel and paraffinic diesel fuel. Fuel retailers should check with their equipment providers that equipment is suitable for use with higher biofuel blends. Where this is not possible regular monitoring should be introduced to ensure that materials used in the fuelling infrastructure are performing as intended following the introduction of higher biofuel blends.



2. Materials commonly found within the fuelling infrastructure

The fuel retail station comprises many interconnected pieces of refuelling equipment necessary to store and deliver fuel to vehicles. There are around 60 pieces of equipment designed to handle fuel and vapour. Equipment delivering fuel to a vehicle includes tanks, pipes, pumps, dispensers and other hanging hardware such as hoses, nozzles, breakaways and swivels. The remainder and majority of equipment are used to prevent, detect and contain releases such as overfill protection, leak detection, shear valves, fill and vapour caps and adaptors, containment sumps and all associated fittings and accessories.

Metals are used throughout the fuelling infrastructure and corrosion is the primary concern. The two most commonly used metals are steel and aluminium. Steel is used in the construction of underground storage tanks and piping systems, and aluminium is used in pumps, valves and nozzles. Other metallic materials such as bronze, brass and nickel are used in connections, valves and swivels.

Elastomers are a class of polymer that are used predominantly in sealing applications. They are widely used in fuel dispensing systems and exist mainly as o-rings and gasket type seals. Modern sealing compounds typically contain 50 to 60% base polymer and are often known as rubbers. The balance consists of various fillers, vulcanising agents, accelerator, aging retardants, plasticisers and other additives used to engineer physical properties to meet the specific sealing requirements. Key properties used to assess seal performance are wet volume swell, hardness and shrinkage during drying. For seal applications shrinkage of the elastomer upon drying is a critical parameter, since contraction of volume could lead to leakage around the seal.

Plastic materials are used primarily in structural applications, such as solid components, including piping and fluid containment. Volume change, especially in a rigid system will create internal stresses that may negatively affect performance. Plastic materials are divided into two classes – thermoplastics and thermoset plastics. Thermoplastic polymers are those plastics that do not undergo a chemical change in composition when heated, though they do soften or melt. Thermoset plastics on the other hand can only be cured and shaped once. Thermoplastics are used in the construction of flexible piping systems because of their pliancy. More chemically resistant grades are also used as high-performance seals. In contrast thermosets are used in rigid applications, such as matrix materials in fibre reinforced plastics and as adhesives to bond flanges and pipe sections.

Materials commonly used in the fuelling infrastructure and their location of use are summarised in the two tables below.

Table 1 – Metal materials and their location of use

Metal materials	Location of use
Nickel 201	Dispenser
Stainless steel	Storage tank/tank bottom protector, dispenser swivel, emergency shear valve protector, ball float, vent valve
Carbon steel	Storage tank, pump, dispenser
Iron	Vapour-line, shear valve, emergency share valve protector, extractor fitting

Aluminium/aluminium alloys	Storage tank/tank bottom protector, pump, dispenser nozzle, road tanker
Cartridge brass (brass)	Storage tank, dispenser, emergency shear valve protector, submersible turbine pump
Phosphor bronze	Storage tank
Terne-plated (Pb) steel	Storage tank
Galvanised (Zn) steel	Storage tank
Chromium-plated brass	Storage tank
Nickel-plated aluminium	Storage tank
Nickel-plated steel	Storage tank
Zinc alloy	Extractor fitting

Table 2 – Non metallic materials and their location of use

Non-metal material	Location of use
Fluorocarbon thermoplastics (generic)	Breakaway valve, nozzle, swivel, vapour line, shear valve, dispenser
Nitrile rubber	Storage tank, dispenser, breakaway valve, nozzle, swivel, hose/pipes, seals, gaskets
Silicone rubber	Dispenser, nozzle
Fluorosilicone rubber	Storage tank, dispenser, breakaway valve, nozzle
Fluoroelastomer (Viton, Fluorel)	Dispenser gaskets and seals
Polychloroprene	Dispenser seals, hoses, valve body gaskets – vapour only
Styrene butadiene rubber (SBR)	Dispenser
Polyurethane	Dispenser, vapour-line, shear valve, emergency shear valve protector, extractor fitting
Rubberised cork	Dispenser
Polyvinylidene fluoride (PVDF)	Piping
Polyphenylene sulphide	Piping
Polyketone	Piping
Nylon	Breakaway valve, nozzle, piping
Nylon 6,6	Dispenser seals
High density polyethylene (HDPE)	Breakaway valve, nozzle
Teflon® (PTFE)	Emergency shear vale protector, dispenser seals

3. Compatibility of ethanol with materials commonly found within the fuelling infrastructure

Ethanol is mainly produced by fermentation of corn, wheat, sugar derivatives and other agricultural biomass. Ethanol is a volatile, flammable, colourless liquid with a slight characteristic odour. It mixes readily with both gasoline and water, allowing water to become incorporated in the fuel blend. If the amount of water is high enough then the ethanol/water

mix will separate from gasoline forming a distinct layer at the bottom of the tank in a process called phase separation.

Under ambient conditions pure ethanol is not generally considered corrosive toward most metallic materials. However it has around one third of the conductivity of water and is at least 10 times more conductive than petrol. This property reduces the risk of static accumulation but can lead to the possibility of galvanic corrosion, particularly due to the formation of local corrosion cells between adjacent dissimilar metals.

The ethanol molecule is relatively small and highly polar due to its oxygen content. The size and polarity enable penetration and interaction with elastomer materials which can lead to swelling and softening. Most elastomers exhibit some level of swell upon exposure to petrol. The addition of ethanol increases the swell of most elastomers (except neoprene) and maximum swell occurs at ethanol concentrations between 10 and 25%. Accompanying the volume increase is a corresponding drop in the hardness, and the combination of high swell and increase softening could reduce the effectiveness of a seal. Cycling between wet and dry conditions exacerbates this effect. Fluorocarbon and (acrylo)nitrile butadiene rubber (NBR) are the most studied elastomer types. Fluorocarbon performance is improved with increasing fluorine content, while NBR performance improves with increasing acrylonitrile concentration. However many factors, such as processing additives and polymer quality affect fuel compatibility. Also many elastomer formulations are proprietary, meaning that the actual composition of the material is not known. Hence the suitability of any specific material to a particular application is difficult to predict without consulting the original equipment manufacturer.

The compatibility of different ethanol fuel blends with the major material types commonly found within the fuelling infrastructure is summarised in the tables below. In the tables S denotes that the material is suitable for use, and U indicates that the material is unsuitable. Blanks are where the information is either contradictory or unknown or where suitability for a specific application is dependent upon the particular material formulation. In these cases the manufacturer should be consulted.

Table 3 – Compatibility of ethanol blends with metals commonly found within the fuelling infrastructure

Metal materials	Location of use	E10	E15-25	E85	E100
Nickel 201	Dispenser			S	S
Stainless steel	Storage tank/tank bottom protector, dispenser swivel, emergency shear valve protector, ball float, vent valve	S	S	S	S
Carbon steel	Storage tank, pump, dispenser	S	S	S	S
Iron	Vapour-line, shear valve, emergency share valve protector, extractor fitting	S	S	S	
Aluminium/aluminium alloys	Storage tank/tank bottom protector, pump, dispenser nozzle, road tanker	S	U	U	U
Cartridge brass (brass)	Storage tank, dispenser, emergency shear valve protector, submersible turbine pump			S	
Phosphor bronze	Storage tank	S	S	S	

Terne-plated (Pb) steel	Storage tank	U		U	U
Galvanised (Zn) steel	Storage tank			U	
Chromium-plated brass	Storage tank			S	
Nickel-plated aluminium	Storage tank			S	
Nickel-plated steel	Storage tank	S		S	
Zinc alloy	Extractor fitting	U		U	U

S=suitable for use
U=unsuitable
Blank – check with manufacturer

Table 4 – Compatibility of ethanol fuel blends with non metallic materials commonly found within the fuelling infrastructure

Non-metal material	Location of use	E10	E15 -25	E85	E100
Fluorocarbon thermoplastics (generic)	Breakaway valve, nozzle, swivel, vapour line, shear valve, dispenser	S			
Nitrile rubber	Storage tank, dispenser, breakaway valve, nozzle, swivel, hose/pipes, seals, gaskets	U		S	S
Silicone rubber	Dispenser, nozzle	U			
Fluorosilicone rubber	Storage tank, dispenser, breakaway valve, nozzle	U	U		
Fluoroelastomer (Viton, Fluorel)	Dispenser gaskets and seals				
Polychloroprene	Dispenser seals, hoses, valve body gaskets – vapour only	S		S	S
Styrene butadiene rubber (SBR)	Dispenser				
Polyurethane	Dispenser, vapour-line, shear valve, emergency shear valve protector, extractor fitting	U	U	U	
Rubberised cork	Dispenser	U	U	U	U
Polyvinylidene fluoride (PVDF)	Piping	S	U		
Polyphenylene sulphide	Piping	S	S	S	S
Polyketone	Piping	S			
Nylon	Breakaway valve, nozzle, piping	S	S	U	
Nylon 6,6	Dispenser seals	S		U	
High density polyethylene (HDPE)	Breakaway valve, nozzle				
Teflon® (PTFE)	Emergency shear valve protector, dispenser seals	S	S	S	S

S=suitable for use
U=unsuitable
Blank – check with manufacturer

The US Department of Energy has compiled a list of specific equipment and its compatibility with ethanol fuel blends. This is reproduced from reference 9 in the Appendix to this document.

4. Compatibility of FAME biodiesel with materials commonly found within the fuelling infrastructure

FAME biodiesel is manufactured from plant oils, animal fats and recycled cooking oils and greases. Virtually all commercial products are methyl esters containing one ester linkage in each molecule. This gives rise to a material more polar than fossil diesel fuel and as a result pure FAME biodiesel (B100) is not compatible with certain elastomers, metals and plastics commonly used within the fuel supply chain. In general biodiesel blends of 20% and lower have a much smaller effect on these materials. Very small concentrations of biodiesel in the B2 to B5 range have no noticeable effect on material compatibility.

Most fuel storage tanks found at retail stations designed to store diesel fuel are fully compatible with FAME biodiesel. Acceptable storage tank materials include steel, aluminium, fluorinated polyethylene, fluorinated polypropylene, Teflon®, and most fibreglass. Where there is any doubt about materials of construction it is recommended to consult with the tank supplier. Brass, bronze, copper, lead, tin, and zinc may accelerate the oxidation of diesel and biodiesel fuels leading to the formation of insoluble material. Lead solders and zinc linings should be avoided, as should copper pipes, brass regulators, and copper fittings. The fuel or fittings tend to change colour, and insoluble materials may plug fuel filters. Affected equipment should be replaced with stainless steel, carbon steel, or aluminium. Galvanized metal and terne coated sheet metal are not compatible with biodiesel at any blend level.

FAME containing diesel fuel blends have an increased susceptibility to microbial growth. Microbial growth by bacteria and fungi in diesel storage tanks can lead to a number of problems such as blocking of fuel lines and severe filter blocking problems. This contamination has also been linked to increased corrosion rates for some steel tanks. Corrosion is due to the microbiological contamination and not properties of the FAME itself. Where biodiesel blends are used retail tank housekeeping is critical to ensure that there is no build-up of microbial growth.

FAME biodiesel as B100 will degrade, soften, or seep through some hoses, gaskets, seals, elastomers, glues, and plastics with prolonged exposure. Nitrile rubber compounds, polypropylene, polyvinyl, and Tygon® materials are particularly vulnerable to B100. Before handling or using B100, check with the equipment manufacturer or supplier to determine if the equipment is suitable for B100 or biodiesel. Oxidized biodiesel and biodiesel blends can contain organic acids and other compounds that can significantly accelerate elastomer degradation. No significant material compatibility issues have been reported with B20 and lower blends, unless the biodiesel has been oxidized.

Any equipment that is not compatible with B100 should be replaced with materials such as Teflon, Viton, fluorinated plastics, and nylon. It is recommended to consult equipment suppliers to determine materials compatibility. If compatibility cannot be verified then it is advisable to set up a routine monitoring program to visually inspect the equipment to check for leaks, seeps, and seal decomposition.

The compatibility of 100% FAME biodiesel with elastomer materials is summarised in the table below. Any material that is not identified as satisfactory in the list below should be checked with the equipment supplier/provided to verify suitability for the specific application and intended biodiesel blend rate.

Table 5 – Compatibility of FAME biodiesel with elastomer materials

Material	Compatibility with Biodiesel
Buna-N	Not recommended
Butadiene	Not recommended
Butyl	Mild effect
Chemraz	Satisfactory
Ethylene propylene (EPDM)	Moderate effect
Fluorocarbon	Satisfactory
Fluorosilicon	Mild effect – increase swelling
Fluorosilicone	Mild effect
Hifluor	Satisfactory
Hyoalon	Not recommended
Natural rubber	Not recommended
Neoprene	Not recommended
Neoprene/Chloroprene	Not recommended
Nitrile	Not recommended
Nitrile, high aceto-nitrile	Mild effect with B20, swelling and break strength affected
Nitrile, hydrogenated	Not recommended
Nordel	Moderate to severe effect
Nylon	Satisfactory
Perfluoroelastomer	Satisfactory
Polypropylene	Moderate effect, increase swelling, reduced hardness
Polyurethane	Mild effect, increased swelling
Styrene-butadiene	Not recommended
Teflon	Satisfactory
Viton	Satisfactory – type of cure affects compatibility with oxidised biodiesel.

The US Department of Energy has compiled a list of specific equipment and its compatibility with biodiesel blends. This is reproduced from reference 13 in the Appendix to this document.

5. Compatibility of paraffinic diesel fuel with materials commonly found within the fuelling infrastructure

Paraffinic diesel fuel can be produced from synthesis gas by Fischer-Tropsch synthesis, or by the hydrotreatment of vegetable oils and animal fats. The resulting fuel consists mainly of normal and iso-paraffins, although some processes can also produce a fuel containing cyclo-paraffins. These paraffin materials exist in conventional fossil diesel fuel, and as such the paraffinic diesel fuel hydrocarbons are fully miscible with the hydrocarbon matrix of a fuel blend. As a result paraffinic diesel fuel can be used as a blending component in diesel fuel without any fixed maximum percentage. Paraffinic diesel fuel has a lower density value and in practice it is this property that limits the amount that can be blended into diesel fuel while maintaining density within the specified range.

Paraffinic diesel fuel may be considered as having the same compatibility as conventional diesel towards materials commonly found in the fuelling infrastructure. Construction materials containing carbon and stainless steel that are suitable for conventional diesel fuel can be used with paraffinic diesel fuel. Paraffinic diesel fuel is compatible with nitrile rubbers, fluoroelastomers, polytetrafluoroethylene (PTFE), vinyl ester and epoxy resins. The absence of aromatic compounds may cause elastomer materials to shrink, if they have already been swollen due to contact with aromatic or FAME containing fuels. It is possible that changes in the fuel composition could cause the swelling or shrinking of elastomers, especially for older seals. If frequent changes of fuel composition are encountered then it is advisable to establish a routine monitoring program to visually inspect the equipment to check for leaks and seal decomposition.

6. Summary

In future it is likely that the use of renewable biofuels will increase as further measures are introduced to reduce the amount of greenhouse gas emissions from the transport sector. Biofuels such as ethanol and biodiesel have properties that are somewhat different from those of fossil fuels and the purpose of this guide is to highlight compatibility of the general material types commonly found within the fuelling infrastructure and these newer biofuel components. Most newer fuel retail stations have been constructed with consideration for the future role of biofuels in the fuel matrix. This and the relatively low blend rate of biofuels has mitigated any concern over incompatibility. However as the blend rate of these biofuels increases then the compatibility of materials found within the fuel systems at retail stations is a potential concern.

The results of compatibility studies presented in this document can only serve as a guide. In practice compatibility is a function of many different factors. It is important to check with the original equipment manufacturer or supplier that any equipment installed is fully compatible with fuel to be stored and dispensed at the retail station. Where this is not possible, for example with legacy equipment, then it is recommended to establish a routine monitoring programme to verify that equipment and materials are performing as expected.



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8. APPENDIX - Compatibility of Equipment with BioFuel Blends

Appendix A - Tank Manufacturer compatibility with Ethanol Blends

Table A Tank Manufacturer compatibility with ethanol blends

Table A: Tank Manufacturer Compatibility with Ethanol Blends					
	E10	E100		E10	E100
Manufacturer					
FIBERGLASS			<i>Continued from below</i>		
Containment Solutions	✓	✓	Highland Tank	✓	✓
Owens Corning (single wall 1965-1994)	✓	✗	J.L. Houston Co	✓	✓
Owens Corning (double wall 1965-July 1, 1990)	✓	✗	Kennedy Tank and Manufacturing Co., Inc.	✓	✓
Owens Corning (double wall July 2, 1990 – Dec 31, 1994)	✓	✓	Lancaster Tanks and Steel Products	✓	✓
Xerxes (single wall prior to Feb 1981)	✗	✗	Lannon Tank Corporation	✓	✓
Xerxes (single wall Feb 1981-June 2005)	✓	✗	Mass Tank Sales Corp.	✓	✓
Xerxes (single wall since July 2005)	✓	✓	Metal Products Company	✓	✓
Xerxes (double wall prior to April 1990)	✓	✗	Mid-South Steel Products Inc.	✓	✓
Xerxes (double wall April 1990 and after)	✓	✓	Modern Welding Company	✓	✓
STEEL			Newberry Tanks & Equipment LLC	✓	✓
Acterra Group Inc	✓	✓	Plasteela	✓	✓
Caribbean Tank Technologies Inc.	✓	✓	Service Welding & Machine Company	✓	✓
Eaton Sales & Service LLC	✓	✓	Southern Tank & Manufacturing Co., Inc.	✓	✓
General Industries	✓	✓	Stanwade Metal Products	✓	✓
Greer Steel Inc.	✓	✓	Talleres Industriales Potosinos, S.A. de C.V.	✓	✓
Hall Tank Co.	✓	✓	Tanques Antillanos C. xA.	✓	✓
Hamilton Tanks	✓	✓	Watco Tanks Inc.	✓	✓
			We-Mac Manufacturing Company	✓	✓

Appendix B – Pipe Manufacturer and Associated Underground Storage Tank Equipment manufacturer compatibility with Ethanol Blends

Table B1 Pipe Manufacturer compatibility with ethanol blends

Table B1 : Pipe Manufacturer Compatibility with Ethanol Blends			
Manufacturer	Product	Model	Ethanol Compatibility
Advantage Earth Products	Piping	1.5", 2", 3", 4"	E0-E100
Brugg	Piping	FLEXWELL-HL, SECON-X, NITROFLEX, LPG	E0-E100
Franklin Fueling	Piping	Franklin has third party certified piping compatible with up to E85. Contact manufacturer for specific part numbers	E0-E85
OPW	Piping	FlexWorks, KPS, Pisces (discontinued)	E0-E100
NOV Fiberglass	Piping	RedThread IIA, Ameron Dualoy	E0-E100
NUPI	Piping	Smartflex	E0-E100
OMEGAFLEX	Piping	DoubleTrac (brass and stainless steel fittings)	E0-E100

Table B2 Associated UST manufacturer compatibility with ethanol blends

Table B2 : Associated UST Manufacturer Compatibility with Ethanol Blends			
Manufacturer	Product	Model	Ethanol Compatibility
Bravo Systems	Fiberglass fittings	Series F, FF, FPE, FR, Retrofit-S, D-BLR-S, D-INR-S, FLX, FLX-INR, FPS, TBF	E0-E100
Bravo Systems	Spill Buckets	B3XX	E0-E100
Bravo Systems	Tank sumps & covers	B4XX	E0-E100
Bravo Systems	Transition sumps	B5XX, B6XX, B7XX, B8XX	E0-E100
Bravo Systems	Under dispenser containment sumps	B1XXX, 7XXX, B8XXX, B9XXX	E0-E100
Cimtek	Filter	300MB-10, 300MB-30, 400MB-10, 400MB-30, 475XLMB-10	E0-E15
Cimtek	Filter	300BHA-01, 400BHA-01, 400BHA-05, 800BHA-01	E0-E85
Clay and Bailey	AST emergency vent	354, 365, 366, 367, 368, 369, 370	E0-E85
Clay and Bailey	AST manhole	API-650	E0-E85
Clay and Bailey	AST overfill prevention valve	1228	E0-E85
Clay and Bailey	AST spill containment	all	E0-E85
Clay and Bailey	Fill cap	94, 232, 233, 234, 235, 254	E0-E85
Franklin Fueling	All	Franklin has third party certified equipment compatible with up to	

		E85. Contact manufacturer for specific part numbers	
Husky	Pressure vacuum vents	4620, 4885, 5885, 11730, 11735, 11740	E0-E85
Morrison Bros	Anodised farm nozzle	200S	E0-E85
Morrison Bros	Anti-syphon valve	912	E0-E85
Morrison Bros	AST adaptor	927	E0-E85
Morrison Bros	Ball valves	691BSS	E0-E85
Morrison Bros	Caps	305C	E0-E85
Morrison Bros	Clock gauge with alarm	918	E0-E85
Morrison Bros	Clock gauges	818	E0-E85
Morrison Bros	Combination vent/overflow alarm	922	E0-E85
Morrison Bros	Diffuser	539TO, 539TC	E0-E85
Morrison Bros	Double tap bushing	184	E0-E85
Morrison Bros	Drop tubes	419A	E0-E85
Morrison Bros	Emergency vents	244	E0-E85
Morrison Bros	Expansion relief valve	076DI, 078DI	E0-E85
Morrison Bros	External emergency valves	346DI, 346FDI, 346SS, 346FSS	E0-E85
Morrison Bros	Extractors	560/561/562/563	E0-E85
Morrison Bros	Flame arrester	351S	E0-E85
Morrison Bros	Float vent valves	317	E0-E85
Morrison Bros	Frost proof drain valve	128DIS	E0-E85
Morrison Bros	In-line check valve	958	E0-E85
Morrison Bros	Internal emergency valves	272DI, 72HDI	E0-E85
Morrison Bros	Overflow alarm	918TCP	E0-E85
Morrison Bros	Overflow prevention valve	9095A-AV, 9095SS	E0-E85
Morrison Bros	Series tank monitor adaptor and cap kits	305XPA	E0-E85
Morrison Bros	Solenoid valves (3" must be all Teflon version)	710SS	E0-E85
Morrison Bros	Spill containers	515/516/517/518	E0-E85
Morrison Bros	Strainer	285	E0-E85
Morrison Bros	Swing check valves	246ADI, 246DRF	E0-E85
Morrison Bros	Tank monitor adaptor and cap kits	305XPA	E0-E85
Morrison Bros	Vapour recovery adaptor	323	E0-E85
Morrison Bros	Vapour recovery caps	323C	E0-E85
Morrison Bros	Vent double outlet (small UST)	155	E0-E85
Morrison Bros	Vent pressure vacuum	548, 748, 749	E0-E85
Morrison Bros	Vent updraft	354	E0-E85
National Environmental Fiberglass	Sumps-dispenser	All	E0-E85

National Environmental Fiberglass	Sumps - tank	All	E0-E85
National Environmental Fiberglass	Sumps-transition	All	E0-E85
OPW	AST anti-syphon valve	199ASV	E0-E85
OPW	AST ball valve	21BV SS	E0-E85
OPW	AST check valve	175, 1175	E0-E85
OPW	AST emergency shut-off valve	178S	E0-E85
OPW	AST emergency vent	201, 202, 301	E0-E85
OPW	AST mechanical gauge	200TG	E0-E85
OPW	AST overflow prevention valve	61fSTOP A or M versions	E0-E85
OPW	AST overflow prevention valve	61fSTOP	E0-E25
OPW	AST pressure vacuum vent	523V, 623V	E0-E100
OPW	AST solenoid valve	821	E0-E25
OPW	AST spill container	211-RMOT, 331, 332	E0-E85
OPW	AST swing check valve	all	E0-E85
OPW	AST tank alarm	444TA	E0-E85
OPW	AST vapour adaptor	1611AVB-1625	E0-E100
OPW	AST vapour cap	1711T-7085-EVR, 1711LPC-0300	E0-E100
OPW	Ball float vent valve	53VML, 30MV	E0-E100
OPW	Check valve	70, 70S	E0-E100
OPW	Dispenser sumps & accessories	FlexWorks	E0-E100
OPW	Drop tube	61FT	E0-E25
OPW	Drop tube	61T, 61TC, 61TCP	E0-E15
OPW	Drop tube	61TSS	E0-E100
OPW	Extractor fittings and plug	233, 233VP	E0-E100
OPW	Face seal adaptor (threaded riser adaptor)	FSA	E0-E100
OPW	Fill adaptor-side	61AS	E0-E100
OPW	Fill adaptor-top	633T, 633TC	E0-E100
OPW	Fill cap	634TT-7085-EVR, 634LPC, 634TT-4000	E0-E100
OPW	Fill cap-side	62TT	E0-E100
OPW	Fill-swivel adaptor	61SALP-MA, 61SALP-1020-EVR	E0-E100
OPW	Flexible connectors	FCxx	E0-E100
OPW	Float kit	61SOK-0001	E0-E15
OPW	Jack screw	61JSK, 71JSK	E0-E100
OPW	Manhole	Conquistador, Fiberlite, 104A, 104FG, 104C, 6110, 6120	E0-E100
OPW	Monitoring well cap kit	634TTM	E0-E100

OPW	Monitoring well probe cap	62M, 116M, 62M-MA	E0-E100
OPW	Multi-port spill containment	6511, 6421, 6521, 6561, 6571, Fiberlite	E0-E100
OPW	Overfill prevention valve	71SOM, 61SOM, 61SOCM-4000	E0-E100
OPW	Overfill prevention valve	71SO, 71SO-C, 71SO-CT, 61SOC, 61SOP, 61SOR	E0-E15
OPW	Pressure vacuum vent	523V, 623V	E0-E100
OPW	Spill container (bucket)	1-2100, ISC-2100, 1C-2100, 1C-2200, EDGE, 1-2105, 101-BG2100	E0-E100
OPW	Tank bottom protectors	6111, 61TP	E0-E15
OPW	Tank sumps & accessories	Fiberlite, FlexWorks	E0-E100
OPW	Transition sumps & accessories	FlexWorks	E0-E100
OPW	Vapour adaptor	1611AV, 1611AVB	E0-E100
OPW	Vapour cap	1711T-7085-EVR, 1711LPC	E0-E100
OPW	Vapour-swivel adaptor	61VSA-MA, 61VSA-1020-EVR	E0-E100
Vaporless Manufacturing	Leak detector	99LD-2000/2200/3000 without stainless steel tubing/fittings	E0-E20
Vaporless Manufacturing	Leak detector	99LD-2000/2200/3000 with stainless steel tubing/fittings	E0-E100
Vaporless Manufacturing	Overfill prevention valve	OPF-2/3 with stainless steel tubing/fittings	E0-E100
Veeder-Root	Continuous interstitial tank system	P/N 857280-100, 857280-200, 857280-30X	E0-E15
Veeder-Root	Electronic line leak detector	Series 8484, 8590	E0-E15
Veeder-Root	Ground water monitoring	P/N 794380-621, 794380-622, 794380-624	E0-E15
Veeder-Root	Interstitial and secondary containment monitoring	P/N 794380-XXX, 794390-XXX, 847990-00X, 857080-XXX	E0-E15
Veeder-Root	Interstitial and secondary containment monitoring	P/N 794380-321, 794380-323, 974380-333, 794380-344, 794380-345, 794380-351, 794380-430	E0-E85
Veeder-Root	Magnetostrictive probe	Mag Plus Series 8463XX, Mag Series 8473XX	E0-E15
Veeder-Root	Tall tank probe	Mag-FLEX 889560-XXX, MAGXL-XXX	E0-E90
Veeder-Root	Vapour monitoring	P/N 394390-700	E0-E15
Western Fiberglass	Co-flex piping	all	E0-E100
Western Fiberglass	Cuff fittings	all	E0-E100
Western Fiberglass	Sumps (dispenser, tank, transition, vapour, vent)	all	E0-E100
Western Fiberglass	Co-flow hydrostatic monitoring systems	all	E0-E100

Appendix C Dispenser, Hanging Hardware, Shear Valve and Submersible turbine pump manufacturer compatibility with ethanol blends

Table C Dispenser, hanging hardware, shear valve and submersible turbine pump manufacturer compatibility with ethanol Blends

Table C : Dispenser, Hanging Hardware, Shear Valve and Submersible Turbine Pump Manufacturer Compatibility			
Manufacturers introduce and discontinue models over time. If you do not see your equipment on this list please contact the manufacturer			
Manufacturer	Product	Model	Ethanol compatibility
Gilbarco	Dispenser	An option on remote control dispenser Models NAO, NA1, NA2, NA3, NG1, NG6, NL0, NL1, NL2 and NL3. Models NG1, NG6 and NL0-NL3 are X+1 configurations where X is a number of blendable grades running through one hose on each side and the +1 indicates a dedicated, independent, set of hydraulics. E25 may only be on the +1 side (no ethanol blending). For such split-type dispensers, the independent non-E25 hydraulics may be constructed	E0-E25
Gilbarco	Dispenser	An option on remote control dispenser Models NAO, NA1, NA2, NA3, NN0, NN1, NN2, NN3, G1, G6, L0, L1, L2 and L3 and NJ4. Models NG1, NG6 and NL0-NL3 are X+1 configurations where X is a number of blendable grades running through one hose on each side. Model NJ4 is a 3+2 grade (double blender) with two distinct fuel trees as described above and the +1 indicates a dedicated, independent, set of hydraulics. Hydraulics trees marked as suitable for E85 are suitable for blending mid-level grades.	E0-E85
Wayne	Dispenser	Ovation2 B12//9 and B23//9	E0-E25
Wayne	Dispenser	Ovation 2 EB23/4, EB23/5/M Dual Blender, EB23/5/M5 Double Dual Blender, Helix 3-1-1 H(W/LU)43-43E, 3-1-1 H(W/LU)45-43E/M5 Dual Blender, 3-1-1 H(W/LU)35-33E Double Dual Blender	E0-E85

Franklin Fueling	Shear Valve	Franklin has third-party certified shear valves compatible with up to E85. Contact manufacturer for specific part numbers.	E0-E85
Franklin Fueling	Submersible turbine pump	Franklin has third-party certified STPs compatible with up to E85. Contact manufacturer for specific part numbers.	E0-E85
Husky	Nozzle	X E25, X E25 Cold Weather, XS E25, XS E25 Cold Weather	E0-E25
Husky	Nozzle	X E85, X E85 Cold Weather, XS E85, XS E85 Cold Weather	E0-E85
Husky	Breakaway	E25 Safe-T-Breaks	E0-E25
Husky	Breakaway	E85 Safe-T-Breaks	E0-E85
OPW	Balance Adaptor	28CS	E0-E25
OPW	Breakaway	66V-0492	E0-E85
OPW	Breakaway	66V-030RF	E0-E25
OPW	Nozzle	11BP*E85	E0-E85
OPW	Nozzle	11AP*E25 and 11BP*E25 Series Nozzles	E25
OPW	Swivel	241TPS-75RF	E25
OPW	Swivel	241TPS-0492	E0-E85
OPW	Shear Valve	10 series	E0-E100
OPW	Shear Valve vapour	60VS	E0-E100
Veyance	Hose	Flexsteel Futura Ethan-ALL	E0-E85
Husky	Swivel	E85	E0-E85
IRPCO	Hose dispenser	Steelflex Ultra Hardwall, Softwall (2 Braid, 4SP), Marina	E0-E15
IRPCO	Hose transfer	Kanapower ST, RED FLEXTRA, FLEXWING Versafuel	E0-E15
Veeder-Root	Submersible turbine pump	Redjacket Maxxum 410763-XXX (MXP300JX-XXX or MXP500JX-XXX)	E0-E20
Veeder-Root	Submersible turbine pump	Redjacket AG models	E0-E100
Veyance	Hose dispenser	Flexsteel Futura	E0-E15

Appendix D Tank Manufacturer compatibility with Biodiesel blends

Table D Tank manufacturer compatibility with biodiesel blends

Table D : Tank Manufacturer Compatibility with Biodiesel Blends	
Manufacturer	B100
FIBERGLASS	
Containment Solutions	✓
Owens Corning	✗
Xerxes	✓
STEEL	
Acterra Group Inc	✓
Caribbean Tank Technologies Inc	✓
Eaton Sales & Service LLC	✓
General Industries	✓
Greer Steel Inc.	✓
Hall Tank Co.	✓
Hamilton Tanks	✓
Highland Tank	✓
J.L. Houston Co.	✓
Kennedy Tank and Manufacturing Co., Inc.	✓
Lancaster Tanks and Steel Products	✓
Lannon Tank Corporation	✓
Mass Tank Sales Corp.	✓
Metal Products Company	✓
Mid-South Steel products Inc.	✓
Modern Welding Company	✓
Newberry Tanks & Equipment, LLC	✓
Plasteela	✓
Service Welding & Machine Company	✓
Southern Tank & Manufacturing Co., Inc.	✓
Stanwade Metal Products	✓
Talleres Industriales Potosinos, S.A. de C.V.	✓
Tanques Antillanos C.x A.	✓
Waatco Tanks, Inc.	✓
We-Mac Manufacturing Company	✓

Appendix E Underground Equipment Manufacturer Compatibility with Biodiesel blends

Table E Underground equipment manufacturer compatibility with biodiesel blends

Table E : Underground Equipment Compatibility with Biodiesel Blends			
Manufacturer	Product	Model	Biodiesel Compatibility
Bravo Systems	Fiberglass fittings	Series F, FF, FPE, FR, Retrofit-S, D-BLR-S, D-INR-S, FLX, FLX-INR, FPS, TBF	B100
Bravo Systems	Spill Buckets	B3XX	B100
Bravo Systems	Tank sumps & covers	B4XX	B100
Bravo Systems	Transition sumps	B5XX, B6XX, B7XX, B8XX	B100
Bravo Systems	Under dispenser containment sumps	B1XXX, 7XXX, B8XXX, B9XXX	B100
Brugg	Piping	FLEXWELL-HL, SECON-X, NITROFLEX, LPG	B100
Cimtek	Filter	200, 250, 260-10, 260-30, 260AHS, 260HS, 300-02, 300-10, 300-30, 300HS, 400-02, 400-10, 400-30, 400HS, 800-02, 800-10, 800-30, 800HS	B20
Cimtek	Filter	260bhg, 260BMG, 300BHA, 300BMG, 300MB, 400BHA, 400BMG, 400MB, 450-10, 450-30, 475XL-10, 475XL-30, 450HS-10, 450HS-30, 475XLHS-10, 475XLHS-10, 475XLHS-30, 800BHA, 800BHG, 800BMG	B100
Franklin Fueling	Other UST equipment	Franklin has third party certified equipment compatible with biodiesel blends. Contact manufacturer for specific part numbers	
Franklin Fueling	Piping	Franklin has third party certified equipment compatible with biodiesel blends. Contact manufacturer for specific part numbers	
Husky	Pressure vacuum vents	4620, 4885, 5885, 11730, 11735, 11740, 450MG-10, 475XLMB-10	B20
Morrison Bros	Overfill prevention valve	9095S	B20
Morrison Bros	Anti-syphon valve	912	B100
Morrison Bros	AST adaptor	927	B100
Morrison Bros	Ball valves	691BSS	B100
Morrison Bros	Clock gauge with alarm	918	B100

Morrison Bros	Clock gauges	818	B100
Morrison Bros	Combination vent/overflow alarm	922	B100
Morrison Bros	Drop tubes	419A, 539TO, 539TC	B100
Morrison Bros	Emergency vents	244	B100
Morrison Bros	Expansion relief valve	076DI, 078DI	B100
Morrison Bros	External emergency valves	346DI, 346FDI, 346SS, 346FSS	B100
Morrison Bros	Flame arrester	351S	B100
Morrison Bros	Frost proof drain valve	128DIS	B100
Morrison Bros	In-line check valve	958	B100
Morrison Bros	Internal emergency valves	272DI, 72HDI	B100
Morrison Bros	Overflow alarm	918TCP	B100
Morrison Bros	Overflow prevention valve	9095A-AV, 9095SS	B100
Morrison Bros	Series cap	305C	B100
Morrison Bros	Solenoid valves (3" must be all Teflon version)	710SS	B100
Morrison Bros	Spill containers	515/516/517/518	B100
Morrison Bros	Swing check valves	246ADI, 246DRF	B100
Morrison Bros	Vapour recovery adaptor	323	B100
Morrison Bros	Vapour recovery caps	323C	B100
Morrison Bros	Vent pressure vacuum	548, 748, 749	B100
Morrison Bros	Vent updraft	354	B100
National Environmental Fiberglass	Sumps and accessories	All	B100
NOV Fiberglass	Piping	RedThread IIA, Ameron Dualoy	B100
NUPI	Piping	Smartflex	B100
OMEGAFLEX	Piping	DoubleTrac (stainless steel fittings)	B100
OPW	AST anti-syphon valve	199ASV	B20
OPW	AST check valve	175, 1175	B20
OPW	AST emergency shut-off valve	178S	B20
OPW	AST emergency vent	201, 301	B20
OPW	AST mechanical gauge	200TG	B20
OPW	AST spill container	211-RMOT, 331, 332	B20
OPW	AST swing check valve	all	B20
OPW	AST tank alarm	444TA	B20
OPW	AST vapour adaptor	1611AVB-1625	B20
OPW	AST vapour cap	1711T-7085-EVR, 1711LPC-0300	B20
OPW	Ball float vent valve	53VML, 30MV	B20
OPW	Check valve	70, 70S	B20
OPW	Dispenser sumps & accessories	FlexWorks	B20

OPW	Drop tube	61FT	B20
OPW	Extractor fittings and plug	233, 233VP	B20
OPW	Face seal adaptor (threaded riser adaptor)	FSA	B20
OPW	Fill adaptor-side	61AS	B20
OPW	Fill adaptor-top	633T, 633TC	B20
OPW	Fill cap	634TT-7085-EVR, 634LPC, 634TT-4000	B20
OPW	Fill cap-side	62TT	B20
OPW	Fill-swivel adaptor	61SALP-MA, 61SALP-1020-EVR	B20
OPW	Flexible connectors	FCxx	B20
OPW	Jack screw	61JSK, 71JSK	B20
OPW	Manhole	Conquistador, Fiberlite, 104A, 104FG, 104C, 6110, 6120	B20
OPW	Monitoring well cap kit	634TTM	B20
OPW	Monitoring well probe cap	62M, 116M, 62M-MA	B20
OPW	Multi-port spill containment	6511, 6421, 6521, 6561, 6571, Fiberlite	B20
OPW	Piping	FlexWorks	B20
OPW	Piping	FlexWorks, KPS, Pisces (discontinued)	B20
OPW	Pressure vacuum vent	523V, 623V	B20
OPW	Spill container (bucket)	1-2100, ISC-2100, 1C-2100, 1C-2200, EDGE (1-3100), 1-2105, 101-BG2100	B20
OPW	Tank sumps & accessories	Fiberlite, FlexWorks	B20
OPW	Transition sumps & accessories	FlexWorks	B20
OPW	Vapour adaptor	1611AV, 1611AVB	B20
OPW	Vapour cap	1711T-7085-EVR, 1711LPC	B20
OPW	Vapour-swivel adaptor	61VSA-MA, 61VSA-1020-EVR	B20
Veeder-Root	Continuous interstitial tank system	P/N 857280-100, 857280-200, 857280-30X	B100
Veeder-Root	Electronic line leak detector	Series 8484, 8590	B100
Veeder-Root	Ground water monitoring	P/N 794380-621, 794380-622, 794380-624	B20
Veeder-Root	Interstitial and secondary containment monitoring	P/N 794380-XXX, 794390-XXX, 847990-00X, 857080-XXX, 794380-321, 794380-323, 794380-333, 794380-344, 794380-345, 794380-351, 794380-430	B20
Veeder-Root	Interstitial and secondary containment monitoring	P/N 794380-344, 794380-345, 794380-321, 794380-351	B100

Veeder-Root	Magnetostrictive probe	Mag Plus Series 8463XX, Mag Series 8473XX	B100
Veeder-Root	Tall tank probe	Mag-FLEX 889560-XXX, MAGXL-XXX	B100
Veeder-Root	Vapour monitoring	P/N 394390-700	B20
Western Fiberglass	Co-flex piping	all	B100
Western Fiberglass	Cuff fittings	all	B100
Western Fiberglass	Sumps (dispenser, tank, transition, vapour, vent)	all	B100
Western Fiberglass	Co-flow hydrostatic monitoring systems	all	B100



Appendix F Above Ground Equipment Manufacturer compatibility with Biodiesel blends

Table F Dispenser, hanging hardware, shear valves and submersible turbine pump compatibility with biodiesel blends

Table F : Dispenser, Hanging Hardware, Shear Valve and Submersible Turbine Pump Manufacturer Compatibility			
Manufacturers introduce and discontinue models over time. If you do not see your equipment on this list please contact the manufacturer			
Manufacturer	Product	Model	Biodiesel compatibility
Franklin Fueling	Shear Valve	Franklin has third party certified equipment compatible with biodiesel blends. Contact manufacturer for specific part numbers	
Franklin Fueling	Submersible turbine pump	Franklin has third party certified equipment compatible with biodiesel blends. Contact manufacturer for specific part numbers	
Gilbarco	Dispenser	All Encore models sine 1/1/2014	B20
Wayne	Dispenser	Option on Ovation and Helix models. Contact Wayne for specific model information	B20
Husky	Nozzle	VIII	B20
Husky	Breakaway	5812 Safe-T-Breaks	B20
Husky	Swivel	4860	B20
OPW	Breakaway	66V-030RF, 66V-130RF, 66V-135RF, 66RB-20RF	B20
OPW	Nozzle	7H models ending in –B20, 11A models ending in –B20, 11B models ending in –B20	B20
OPW	Swivel	241TPS-75RF, 241TPS-10RF	B20
OPW	Shear Valve	10P-0152	B20
Veyance	Hose	Flexsteel Futura	B20
Husky	Swivel	E85	E0-E85
Veeder-Root	Submersible turbine pump	Redjacket AG models	E0-E100
Veyance	Hose dispenser	Flexsteel Futura	E0-E15