

Premium diesel fuels can possibly contain several additives that can accomplish the same as buying additives and adding them to lower quality diesel fuel. A premium diesel fuel is defined by the Worldwide Fuel Charter as described on page 1.

Cummins Inc. recommends the use of a premium diesel fuel during winter (ambient conditions at  $-7^{\circ}\text{C}$  [ $20^{\circ}\text{F}$ ] or below) operating conditions.

Great care **must** be exercised in the choice and use of additives. Some fuel additives can be harmful to the engine. Fuel additives containing ash forming materials will cause combustion chamber deposits. Most legitimate fuel additives perform **only** one function. Multifunctional fuel additives are mixtures of several additives. All fuel additives perform differently in different fuels; therefore, the additive used **must** be one to which the fuel will respond. There are no known additives that increase the power or improve the efficiency of a properly maintained engine.

**NOTE: Cummins Inc. accepts no liability for engine damage resulting from the use of fuel additives which are not specifically recommended.**

## Bio-Diesel Fuel

With increased interest in emissions and reducing the use of petroleum distillate based fuels, many governments and regulating bodies encourage the use of bio-fuels. Bio-diesel fuels **must** be considered experimental at this time.

Bio-diesel fuels are methyl/ethyl ester-based oxygenates derived from a broad variety of renewable sources such as vegetable oils, animal fats, and cooking oils. Their properties are similar to diesel fuel, as opposed to gasoline or gaseous fuels, and thus are capable of being used in compression ignition engines. Soy Methyl Ester (SME) or some SME Diesel is the most common bio-diesel in the United States and is derived from soybean oil. Soy Diesel is a bio-diesel or petro-diesel blend based on SME. Rape Methyl Ester (RME) Diesel is the most common bio-diesel in Europe and is derived from rapeseed oil. These fuels are collectively known as Fatty Acid Methyl Esters (FAME).

Cummins Inc. test data on the operating effects of bio-diesel fuels indicates that typically smoke, power, and fuel economy are all reduced. However, as there are no firm industry standards on the content and properties for bio-fuels, consistency and predictability of bio-diesel operation is **not** well documented. There are provisional specifications for FAME issued in Germany under DIN V 51 606 and also recently through ASTM as PS121; however, these standards are under development and are subject to change.

Cummins Inc. certifies its engines using the prescribed EPA and European Certification Fuels. Cummins Inc. does **not** certify engines on any other fuel. It is the user's responsibility to use the correct fuel as recommended by the manufacturer and allowed by EPA or other local regulatory agencies. In the

United States, the EPA allows use of **only** registered fuels for on-highway applications. The EPA has additional alternative fuel information at: <http://www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm>.

It is the responsibility of the user to obtain the proper local, regional, or national exemptions required for the use of bio-diesel in any emissions regulated Cummins® engine.

### Warranty and the Use of Bio-Diesel Fuel in Cummins Engines

Cummins Inc. neither approves nor disapproves of the use of bio-diesel fuel blends. There is a major difference between operating on pure (100 percent concentration) bio-diesel fuels and bio-diesel or petro-diesel fuel blends. Cummins Inc. is **not** in a position to evaluate the many variations of bio-diesel fuels, and the long-term effects on performance, durability or emissions compliance of Cummins® products. The use of bio-diesel fuel does **not** affect Cummins Inc. materials and workmanship warranty. Failures caused by the use of bio-diesel fuels or other fuel additives are **not** defects of Cummins Inc. parts or workmanship and therefore will **not** be covered by Cummins Inc. warranty.

Given the current industry understanding of bio-fuels and blending with quality diesel fuel, it can be expected that blending up to a 5 percent volume-concentration will **not** cause serious problems. This is consistent with the position taken by worldwide fuel system manufacturers.

For customers intent on blending bio-fuels above a 5 percent volume-concentration, the following concerns represent what is currently known in the industry. Concentrations beyond 5 percent by volume can have an adverse affect on the engine's performance and the fuel system integrity or durability. The affects are more serious with increasing concentration levels. Areas of concern when operating with bio-diesel fuels include low temperature operability (fuel gelation, filter plugging), heat content (poor fuel economy), and storage and thermal stability (filter plugging, injector deposits). In addition, from our fuel systems suppliers, the following issues are also noted:

- Swelling and hardening or cracking of some elastomer seals within the fuel system or engine
- Corrosion of fuel system and engine hardware, especially aluminum and zinc
- Solid particle blockage of fuel nozzles and passages
- Filter plugging
- Injector coking
- Higher injection pressures due to physical flow properties, reduced fuel system life
- Added stress and heat to injection components, especially rotary fuel pumps
- Increased pump seizures and early life failures

- Poor fuel spray atomization, reduced fuel economy
- Poor lubricity, reduced service life of fuel pump and fuel system.

Pure bio-diesel fuel is **not** stable and its acid content increases over time which can damage powdered metal components.

Operational Factors to Consider:

- The oil change interval can be affected by the use of bio-diesel fuel. End users are advised to use oil sampling to monitor the engine oil condition and to determine the optimum oil change interval. Pure bio-diesel fuel can cause a chemical reaction with lube oil resulting in oil sludging.
- Bio-diesel provides approximately five to seven percent less energy per gallon of fuel when compared to distillate fuels. To avoid engine problems when the engine is converted back to 100 percent distillate diesel fuel, do **not** change the engine rating to compensate for the power loss when operated with bio-diesel fuels.
- Elastomer compatibility with bio-diesel is still being monitored. The condition of seals, hoses, gaskets, and wire coatings **must** be monitored regularly.
- Bio-diesel fuels can pose low ambient temperature problems for both storage and operation. At low ambient temperatures, fuel can possibly need to be stored in a heated building or a heated storage tank. The fuel system can require heated fuel lines, filters, and tanks. Filters can plug and fuel in the tank can solidify at low ambient temperatures if precautions are **not** taken. Consult your bio-diesel supplier for assistance in the blending and attainment of the proper cloud point fuel.
- Bio-diesel has poor oxidation stability which can result in long term storage problems. The poor oxidation stability qualities can accelerate fuel oxidation in the fuel system. This is especially true in engines with electronic fuel systems because they operate at higher temperatures. Consult the fuel supplier for oxidation stability additives.
- Bio-diesel fuel is an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging. The effectiveness of conventional anti-microbial additives, when used in bio-diesel, is **not** known. Consult your fuel and additive supplier for assistance.
- Care **must** be taken to remove water from fuel tanks. Water accelerates microbial growth. Water is naturally more prevalent in bio-diesel fuels than in distillate fuels.

Water-Emulsions

Fuel Characteristics - Water-emulsified diesel fuel is an alternative fuel that is made by blending water and other additives (e.g. detergents) into diesel fuel.

Emissions - Water-emulsified diesel fuels have been verified by EPA and some state agencies as an emissions reduction technology.