



Application Engineering Bulletin

Subject Biodiesel Fuel Usage - Application Requirements.		This AEB is for the following applications: <input checked="" type="checkbox"/> Automotive <input checked="" type="checkbox"/> Industrial <input checked="" type="checkbox"/> Marine <input checked="" type="checkbox"/> G-Drive <input checked="" type="checkbox"/> Genset	
Date: January 2007		AEB Number 21.xxx	
Engine Models included: All (Diesel) Engines / All Markets (See Exceptions List by Market)			
Owner: Keith Nolting	Approver: per Procedure 9183OPS-04-10-01	Page 1 of 1	

Purpose:

The purpose of this AEB is to provide Application Requirements and Recommendations for the use of biodiesel fuel above B5 and up to B20 in the new installations of certain engine models prescribed by Cummins. This AEB lists certain applications that are not approved for use of biodiesel above B5. For B5 and below, no special treatment is required, provided that all biodiesel fuel blends are comprised of petrodiesel meeting ASTM D975 and B100 meeting either ASTM D6751 or EN14214.

Introduction:

Cummins Service Bulletin 3379001 outlines a number of items related to the use of biodiesel fuel:

- Biodiesel terminology
- Warranty and the use of biodiesel fuel in Cummins Engines
- Requirements for using biodiesel fuel in Cummins Engines
- Acceptable biodiesel fuel standards and biodiesel fuel supplier requirements.

The requirements and recommendations given in this AEB are specific to the use of biodiesel. It is assumed that all other fuel system installation requirements are being met as well, as described in the following AEBs:

- AEB 24.10 - Fuel System - Industrial Application Installation Recommendations
- AEB 21.33 - Automotive and Bus Installation Requirements - Fuel Systems
- MAB 0.05.00-3/24/2004 - Engine Fuel System Installation - Marine
- AEB 70.28 - Generator-Drive HPI-TP & PT Fuel System Installation Requirements

Installation Requirements:

For biodiesel blends above B5 and up to B20 the following requirements must be met:

- The engine model must be approved and listed in Cummins Service Bulletin 3379001, and the application must not be listed as an exception in the market appendices of this AEB.
- All fuel wetted components must not contain the following materials; copper, brass, bronze, zinc, lead, tin, natural rubber, nitrile rubber compounds, polypropylene, and polyvinyl. Cummins is not in a position to evaluate the wide variety of non-metallic compounds with biodiesel. Contact your equipment vendor or OEM and ask if the equipment is compatible with biodiesel.
- Fuel tanks must be made from the following materials; aluminum, steel, fluorinated polyethylene, fluorinated polypropylene or Teflon.

- water from entering the fuel supply (vehicle or storage) remains very important.
- Cummins Filtration's Fuel Pro®, Diesel Pro®, Industrial Pro™, and Sea Pro® products can be used to provide remote mounted additional fuel filtration efficiency, with integrated fuel pre-heaters. Consult your local Cummins Authorized Repair Location for guidance in fuel filter selection and installation.



- **Biodiesel Fuel Storage**

- Use biodiesel fuel within 6 months of its manufacture. Biodiesel has poor oxidation stability, which can result in long term storage problems. For this reason, Cummins Inc. does not recommend using biodiesel for low use applications, such as standby power or seasonal applications. Consult your fuel supplier for oxidation stability additives.
- The poor oxidation stability qualities of biodiesel can accelerate fuel oxidation in the fuel system, especially at increased ambient temperatures. Avoid storing equipment with biodiesel blends in the fuel system for more than three months.
- If biodiesel is used for seasonal applications, the engine should be purged before storage by running at least ½ a tank of pure diesel fuel through the system.
- Care must also be taken when storing biodiesel in bulk storage tanks. All storage and handling systems must be properly cleaned and maintained. Steps should also be taken to minimize moisture and microbial growth in storage tanks. Consult your fuel supplier for assistance in storing and handling biodiesel.

- **Energy Content**

- B100 biodiesel provides approximately 7 to 10 percent less energy per gallon of fuel when compared to conventional diesel fuels. Operation with B20 biodiesel blends may or may not result in a slight decrease in fuel economy and/or power, depending on the application. To avoid engine problems when the engine is converted back to 100 percent petrodiesel, do not change the engine rating to compensate for the potential power loss when operated with biodiesel fuels.

- **Materials Compatibility**

- The engines listed in this bulletin are compatible with B20 biodiesel blends. However, the following must be taken into account:
- Natural rubber, nitrile, and butile rubber are particularly susceptible to degradation. Also, copper, bronze, lead, and zinc are all susceptible to corrosion by biodiesel. The use of these materials and coatings must be avoided for fuel tanks and fuel lines.
- Contact your vehicle manufacturer to determine if any of the OEM supplied components are at risk with biodiesel.

- **Low Temperature Performance**

- Biodiesel fuel properties change at low ambient temperatures, which may pose problems for both storage and operation. Precautions may be necessary at low ambient temperatures, such as storing the fuel in a heated building or a heated storage tank, or using cold temperature additives.
- 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. A fuel heater is recommended for ambient temperatures below -5° C (23°F). Consult a biodiesel supplier for assistance in the blending and attainment of the proper cloud point fuel.



- **Microbial Growth**

- Biodiesel fuel is an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging. The effectiveness of all commercially available conventional anti-microbial additives, when used in biodiesel, is **not** known. Consult your fuel and additive supplier for assistance.

It is strongly recommended that customers running biodiesel blends of B5 or below follow the above precautions as well.

Biodiesel Additives

- 1) Cummins Inc. approves the use of Cummins Filtration Microbicide for use in biodiesel blends. Product details can be found in the "Additives" section of this Service Bulletin.
- 2) Cummins Inc. approves the use of Cummins Filtration Asphaltene Conditioner Base for biodiesel blends. Product details can be found in the "Additives" section of this Service Bulletin.

Warranty and the Use of Biodiesel Fuel in Cummins Engines

Cummins Inc. Engine Warranty covers failures that are a result of defects in material or factory workmanship. Engine damage, service issues, and/or performance issues determined by Cummins Inc. to be caused by the use of biodiesel fuel not meeting the specifications outlined in this Service Bulletin are not considered to be defects in material or workmanship and are not covered under Cummins Inc. engine warranty.

Requirements for Using Biodiesel Fuel in Cummins Engines

Cummins Inc. provides the specifications found in Table 1 for diesel fuel and biodiesel blends up to B5. For biodiesel blends above B5 to B20, Cummins Inc. provides the specifications found in Table 3. The specifications in Table 3 have been developed by Engine Manufacturers Association (EMA), and are not an approved national or commercial fuel standard. All biodiesel fuel blends are to be comprised of petrodiesel meeting ASTM D975, and B100 meeting either ASTM D6751 or EN 14214.

Biodiesel fuel may be blended with an acceptable diesel fuel up to a 5 percent volume-concentration (B5) for all Cummins engines.

For the following Cummins Engines, biodiesel fuel may be blended with an acceptable diesel fuel up to a 20 percent volume concentration (B20).

ISB02, QSB Tier3, ISB07*, ISC/ISL05, QSC/QSL Tier 3, ISC/ISL07*

ISM02/04, QSM Tier 3, QSM Marine, QSM G-Drive, ISX02/04, QSX Tier 3, QSX G-Drive

For Cummins Engines in Daimler Chrysler Dodge Ram trucks, biodiesel fuel may be blended with an acceptable diesel fuel up to a 20 percent volume concentration (B20) for municipal, government, and commercial fleets only. This applies to selected model year 2007 and later vehicles. Please consult Daimler Chrysler for specific requirements and approved vehicle models.

*For ISB07 and ISC/ISL07 products, Cummins requires fuel dilution monitoring. See below for details.

Note: Cummins Inc. requires that the biodiesel fuel be purchased from a BQ-9000 certified supplier. Certified suppliers can be found at the following website: <http://www.bq-9000.org>

Customers choosing to run biodiesel blends above B5 and up to B20 must adhere to these requirements from Cummins Inc.

• Oil Sampling

- Fuel dilution of lube oil has been observed with the operation of biodiesel on some engines and should be monitored closely. Fuel dilution can be monitored by performing oil sampling. Fuel levels in lubricating oil should not exceed 5%. Additional information on oil contamination and fuel sampling can be found in Service Bulletin Number 3810340 (Cummins Engine Oil Recommendations).
- For ISB07 and ISC/ISL07 products, end users are **required** to use oil sampling during the first 6 months of operation with biodiesel to monitor engine oil condition and fuel dilution of lube oil in order to determine if the oil change interval needs to be modified. Consult a local Cummins Authorized Repair Location for guidance in oil sampling.

• Fuel Water Separation

- Biodiesel has a natural affinity to water, and water accelerates microbial growth. Storage tanks should be equipped with a fuel water separator to ensure that water is stripped out before entering the vehicle tank. Ensure that vehicle and storage tanks are kept full to reduce the potential for condensate accumulating in the tank.
- Due to the solvent nature of biodiesel, and the potential for "cleaning" of the vehicle fuel tank and lines, new fuel filters will need to be installed when switching to biodiesel on used vehicles. Fuel filters will need to be replaced at half the standard interval for the next two fuel filter changes.
- Cummins Inc. **requires** the use of a synthetic fuel filter media, and strongly recommends using Cummins Filtration filters equipped with StrataPore™ media. Synthetic filter media removes water more efficiently than standard cellulosic filter media, which will **not** provide adequate fuel water separation capabilities. However, even synthetic fuel filter media is not as effective in removing water from biodiesel as it is in removing water from petrodiesel. Therefore, preventing

Biodiesel portion of Cummins Fuels Bulletin # 3379001-11

Biodiesel Fuel

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, EPA allows **only** registered fuels and fuel additives to be entered into commerce. EPA has additional alternative fuel information at:

<http://www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm>.

Biodiesel Terminology

Biofuels - Fuels produced from renewable resources.

Biodiesel - A fuel comprised of methyl/ethyl ester-based oxygenates of long chain fatty acids derived from the transesterification of vegetable oils, animal fats, and cooking oils. These fuels are commonly known as Fatty Acid Methyl Esters (FAME). Biodiesel properties are similar to that of diesel fuel, as opposed to gasoline or gaseous fuels, and thus are capable of being used in compression ignition engines.

B100 - A fuel containing 100 percent biodiesel.

Petrodiesel - Diesel fuel produced purely from petroleum. Petrodiesel can also be referred to as distillate diesel.

Biodiesel Blend - A fuel comprised of a mixture of petrodiesel and B100 biodiesel. A biodiesel blend is typically designated by the percentage of biodiesel in the blend. For example, B5 is a fuel containing 95 percent petrodiesel and 5 percent B100.

Rapeseed Methyl Ester (RME) diesel - Biodiesel derived from rapeseed oil. RME diesel is the most common biodiesel used in Europe.

Soy Methyl Ester (SME or SOME) diesel - Biodiesel derived from soybean oil. SME diesel is the most common biodiesel used in the United States.

BQ-9000 - The National Biodiesel Accreditation Program, which is called BQ-9000, is a cooperative and voluntary program for the accreditation of producers and marketers of biodiesel fuel. The program is a unique combination of the ASTM standard for biodiesel, ASTM D6751, and a quality systems program that includes storage, sampling, testing, blending, shipping, distribution, and fuel management practices.

With increased interest in emissions and reducing the use of petroleum distillate based fuels, many governments and regulating bodies encourage the use of biofuels, such as biodiesel.

Cummins Inc. test data on the operating effects of biodiesel fuels indicates that typically smoke, power, and fuel economy are all reduced. There are specifications for FAME issued in Europe under EN 14214 and in North America under ASTM D6751. These specifications define **only** the biodiesel (B100) used as the blend component with diesel fuel. They are **not** applicable to fuel blends purchased by the end user. Despite the existence of these standards, the general quality of available biodiesel remains inconsistent.

CAUTION

 To successfully use biodiesel, it is imperative that the fuel be of high quality and meet or exceed the specifications outlined in this bulletin or engine damage will occur.

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

Appendix B: Power Generation Recommendations

Due to some of the properties of biodiesel fuel blends, such as cold weather operation, long term storage, it is highly recommended that extra care be exercised in the following applications:

<u>Application</u>	<u>Approved for Biodiesel</u>	<u>Recommendations</u>	<u>Comments</u>
Emergency Standby	No	Use petroleum diesel only.	Low fuel usage and critical start nature of Emergency Standby make Biodiesel impractical.
Limited Time Prime	Yes	Use fuel within 6 months of manufacture. Flush fuel system with petroleum diesel prior to seasonal storage.	Biodiesel is suitable for constant high load operation (e.g. Peak Shaving) with proper precautions.
Unlimited Time Prime	Yes	Use fuel within 6 months of manufacture. Flush fuel system with petroleum diesel prior to storage/transport.	Biodiesel is suitable for variable load operation with proper precautions.
Continuous	Yes	Use fuel within 6 months of manufacture.	Biodiesel is suitable for base load operation with proper precautions.

Installation Recommendations:

- For adequate water separation, Cummins Filtration, StrataPore™ synthetic fuel filter media should be maintained as provided with the engine. If local conditions require additional water separation capacity, reference Table 1 for auxiliary filtration/water separation. Fuel flow rates can be found on the engine data sheet
- It is highly recommended that Water in Fuel sensors be installed on electronic engines.
- A fuel heater should be used in applications where ambient temperatures are below -5 deg C (23 Deg F) and no cold weather fuel additives are available or will be used.
- Use biodiesel fuel within 6 months of its manufacture.
 - Biodiesel 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, especially at increased ambient temperatures. This is especially true in engines with electronic fuel systems, because they operate at higher temperatures. Biodiesel fuel should be used within 6 months of its manufacture. For this reason, Cummins Inc. does not recommend using biodiesel for low use applications, such as standby power or seasonal applications. Consult your fuel supplier for oxidation stability additives.
 - If biodiesel is used for seasonal applications, the engine should be purged before storage by running at least two tanks of pure distillate diesel fuel through the system.
 - Care must also be taken when storing biodiesel in bulk storage tanks. All storage and handling systems must be properly cleaned and maintained. Steps should also be taken to minimize moisture and microbial growth in storage tanks. Consult your fuel supplier for assistance in storing and handling biodiesel.
- Due to some of the properties of biodiesel fuel blends, such as cold weather operation, long term storage, material incompatibilities and other effects on engine operating characteristics it is highly recommended that specified market applications are avoided or extra care be exercised. These include low duty cycle, intermittent operation applications. This AEB provides appendices by market which lists applications to avoid and other recommendations by market.
 - Appendix A: Industrial / Mining / Agriculture
 - Appendix B: Power Generation