

Biodiesel B20 Information



May 31th, 2007

Outline

- Introduction and Terminology
- Biodiesel Approval and Requirements
- Summary

Biofuels

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.

Biodiesel

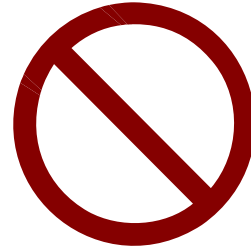
B100 - A fuel containing 100 percent biodiesel.

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.

Biodiesel



- **Biodiesel is NOT raw vegetable oil or SVO (Straight Vegetable Oil) or refined oil or filtered used cooking oil.**
- **IT HAS TO BE MANUFACTURED:**

Process reaction:

- Triglyceride + Alcohols = Glycerine + Esters
(oil or fat) (catalyst) (biodiesel)

Raw Materials:

- Oils or Fat: Soybean, Corn, Rapeseed, Cottonseed, Sunflower, Beef tallow, Pork lard, Used cooking oils (yellow grease), etc.
- Alcohol: Methanol, Ethanol
- Catalyst: Sodium hydroxide, Potassium hydroxide



B20 Approval

- Cummins Announces Approval of B20 Biodiesel Blends – March 21, 2007 (everytime.cummins.com)
- Approval limited to targeted engines - Additional approvals pending further investigation (e.g. HHP, SCR)
- Requirements specified in [Cummins Service Bulletin 3379001-11](#)



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

- There are specifications for biodiesel issued in Europe under **EN14214** and in North America under **ASTM D6751**. These specifications define **only** the biodiesel 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**.



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.



Requirements for Using Biodiesel Fuel in Cummins Engines

- Cummins Inc. provides the specifications found in Table 1 of the Service Bulletin for diesel fuel and biodiesel blends up to B5. For biodiesel blends above B5 and up to B20, Cummins Inc. provides the specifications found in Table 4.
- The specifications in Table 4 (next page) have been developed by the 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 EN14214.**

Table 4: EMA Blend Spec.



Item	Performance Characteristics	Requirements		Test Procedure
		D1 Blends	D2 Blends	
1	Flash Point, °C, min.	38	52	ASTM D93
2	Water and sediment, vol %, max.	0.05	0.05	ASTM D2709 or D1796
3	Physical Distillation, T90, °C, max.	343	343	ASTM D86
4	Kinematic Viscosity, cSt@40C	1.3~ 4.1	1.9~4.1	ASTM D445
5	Ash, mass%, max.	0.01	0.01	ASTM D482
6	Sulfur, wt%, max.	Per regulation	Per regulation	
7	Copper strip corrosion rating, max.	No. 3	No. 3	ASTM D130
8	Cetane Number, min.	43	43	ASTM D613
9	Cloud point ¹	Per footnote	Per footnote	ASTM D2500
10	Ramsbottom carbon residue on 10% distillation residue, wt%, max.	0.15	0.35	ASTM D524
11	Lubricity, HFRR@60C, micron, max.	460	460	ASTM D 6079
12	Acid number, mg KOH/g, max.	0.3	0.3	ASTM D664
13	Phosphorus, wt%, max.	0.001	0.001	ASTM D4951
14	Total Glycerin	-----	-----	N/A
15	Alkali metals (Na+K),ppm, max.	Nd	Nd	EN14108
16	Alkaline metals (Mg+Ca). ppm max.	Nd	Nd	EN14108
17	Blend fraction, vol. % ²	+/- 2%	+/- 2%	EN14078
18	Thermo-oxidative Stability, insolubles, mg/100 mL, max.	10	10	Modified ASTM D2274 ³
19	Oxidation Stability, Induction time, hours, minimum	6	6	EN14112 (Rancimat)

Requirements for Using Biodiesel Fuel in Cummins Engines

- Biodiesel fuel can be blended with an acceptable diesel fuel up to 5 percent volume-concentration **(B5) for all Cummins engines.**
- Biodiesel fuel can be blended with an acceptable diesel fuel up to a 20 percent volume concentration **(B20) for the following Cummins engines.....**



B20 Approved Engines

- ISB CM850, ISB CM2150*, ISBe Euro 3, QSB4.5 Tier 3, and QSB6.7 Tier 3.
- ISC/ISL CM850, ISC/ISL CM2150*, ISCe/ISLe Euro 3, and QSC/QSL Tier 3.

*For ISB CM2150 and ISC/ISL CM2150 products, Cummins requires fuel dilution monitoring.

- ISM CM870 and CM570, ISM CM875, ISM CM876, QSM11 Tier 3, QSM11 Marine, and QSM11 G-Drive.
- ISX CM870, ISX CM871, QSX15 Tier 3, and QSX15 G-Drive.

B20 approved engines (same as previous page but listed by program name)

- On-Highway: ISX, ISM, ISL, ISC and ISB engines certified to EPA '02 and later emissions standards, and ISL, ISC and ISB engines certified to Euro III
- Off-Highway: QSX, QSM, QSL, QSC, QSB6.7 and QSB4.5 engines certified to Tier 3/Stage IIIA, QSM Marine and QSM G-Drive



B20 Approved Engines

- For Cummins Engines in Daimler Chrysler Dodge Ram trucks, biodiesel fuel can 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** vehicles. Please consult Daimler Chrysler for specific requirements and approved vehicle models.

Requirements for Using Biodiesel Fuel in Cummins Engines

- Customers choosing to run biodiesel blends **above B5** and up to B20 **must** adhere to the following requirements from Cummins Inc.
- It is strongly recommended that customers running biodiesel blends of B5 or below follow these precautions as well.
 1. BQ-9000
 2. Oil Sampling
 3. Fuel Water Separation
 4. Biodiesel Fuel Storage
 5. Energy Content
 6. Materials Compatibility
 7. Low Temperature Performance
 8. Microbial Growth
 9. Biodiesel Additives

1) BQ-9000

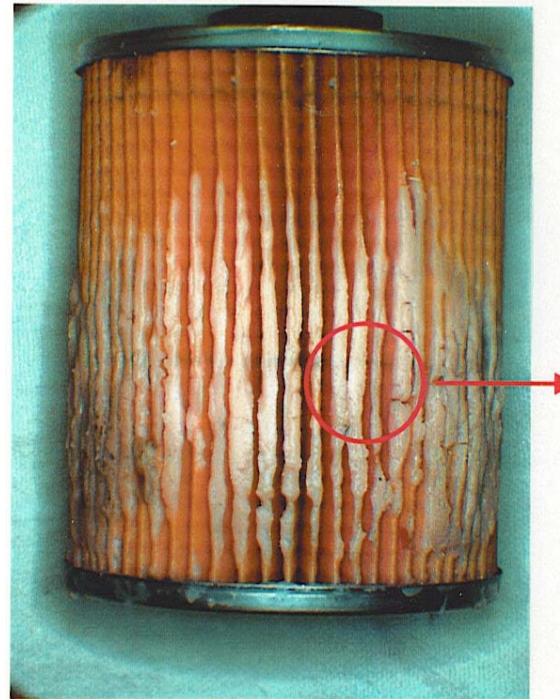
- For North American markets, Cummins Inc. requires that the biodiesel fuel blend be purchased from a **BQ-9000 Certified Marketer**.
- The B100 biodiesel fuel used in the blend must be sourced from a **BQ-9000 Accredited Producer**.
- Certified Marketers and Producers can be found at the following website: <http://www.bq-9000.org>.
- For areas outside of North America, consult your local Cummins representative for applicable fuel quality standards.



Fuel Quality

• Oxidized Fuel

- Sludge formation
- Deposits
- Filter plugging



Deposits from oxidation in a B20 field test

2) Oil Sampling

- **Fuel dilution of lubricating oil** has been observed with the operation of biodiesel under certain operating conditions. Fuel dilution monitoring can be accomplished by performing oil sampling.
- **Fuel levels in lubricating oil must not exceed 5%.** Additional information on oil contamination and oil sampling can be found in Cummins Engine Oil Recommendations, Bulletin 3810340.
- For ISB CM2150 and ISC/ISL CM2150 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 lubricating oil in order to determine if the oil change interval needs to be modified.

3) Fuel Water Separation

- Biodiesel has a natural affinity to water, and water accelerates microbial growth. **Storage tanks must be equipped with a fuel water separator** to make sure that water is stripped out before entering the vehicle tank.
- Make sure that the vehicle and storage **tanks are kept full** to reduce the potential for condensation accumulating in the fuel tank.
- Due to the solvent nature of biodiesel, and the potential for “cleaning” of the vehicle fuel tank and lines, **new fuel filters must be installed when switching to biodiesel** on used engines. Fuel filters will need to be replaced at half the standard interval for the next two fuel filter changes.

3) Fuel Water Separation (cont.)

- Cummins Inc. **requires** the use of a **StrataPore fuel filter media**, and strongly recommends using Cummins Filtration filters equipped with StrataPore media. This filter media removes water more efficiently than standard cellulosic filter media, which will **not** provide adequate fuel water separation capabilities.
- However, even StrataPore fuel filter media is not as effective in removing water from biodiesel as it is in removing water from petrodiesel. **Therefore, preventing water from entering the fuel supply (vehicle or storage)** remains very important.
- If Stratapore filter media is **not** available, a substitute synthetic filter media may be used which must provide 95 percent emulsified fuel water separation efficiency per SAE J1488. See Service Fuels Bulletin for more information.

4) Biodiesel Fuel Storage

- Use biodiesel fuel **within six 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 or fuel system damage can occur.

4) Biodiesel Fuel Storage (cont.)

- If biodiesel is used for seasonal applications, the engine system **must be purged before storage** by running the engine on pure diesel fuel for a minimum of **30 minutes**.
- Care **must** also be taken when storing biodiesel in bulk storage tanks. All storage and handling systems **must** be properly **cleaned and maintained**. Steps must be taken to **minimize moisture and microbial growth** in storage tanks. Consult your fuel supplier for assistance in storing and handling biodiesel.

5) Energy Content

- B100 biodiesel provides approximately **7% to 10% less energy per gallon** of fuel when compared to conventional diesel fuels. Operation with B20 biodiesel blends can potentially 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.

6) Materials Compatibility

- The engines listed in this bulletin are compatible with biodiesel blends up to B20. However, the following **must** be taken into account:
- **Natural rubber, nitrile, and butile rubber** are particularly susceptible to degradation. Also, **copper, bronze, brass, tin, lead, and zinc** can cause deposit formations. 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 in order to prevent engine damage.

7) Low Temperature Performance

- Biodiesel fuel properties change at low ambient temperatures, which can pose problems for both storage and operation. **Precautions can 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 your fuel and additive supplier for assistance in attaining proper cloud point fuel.**

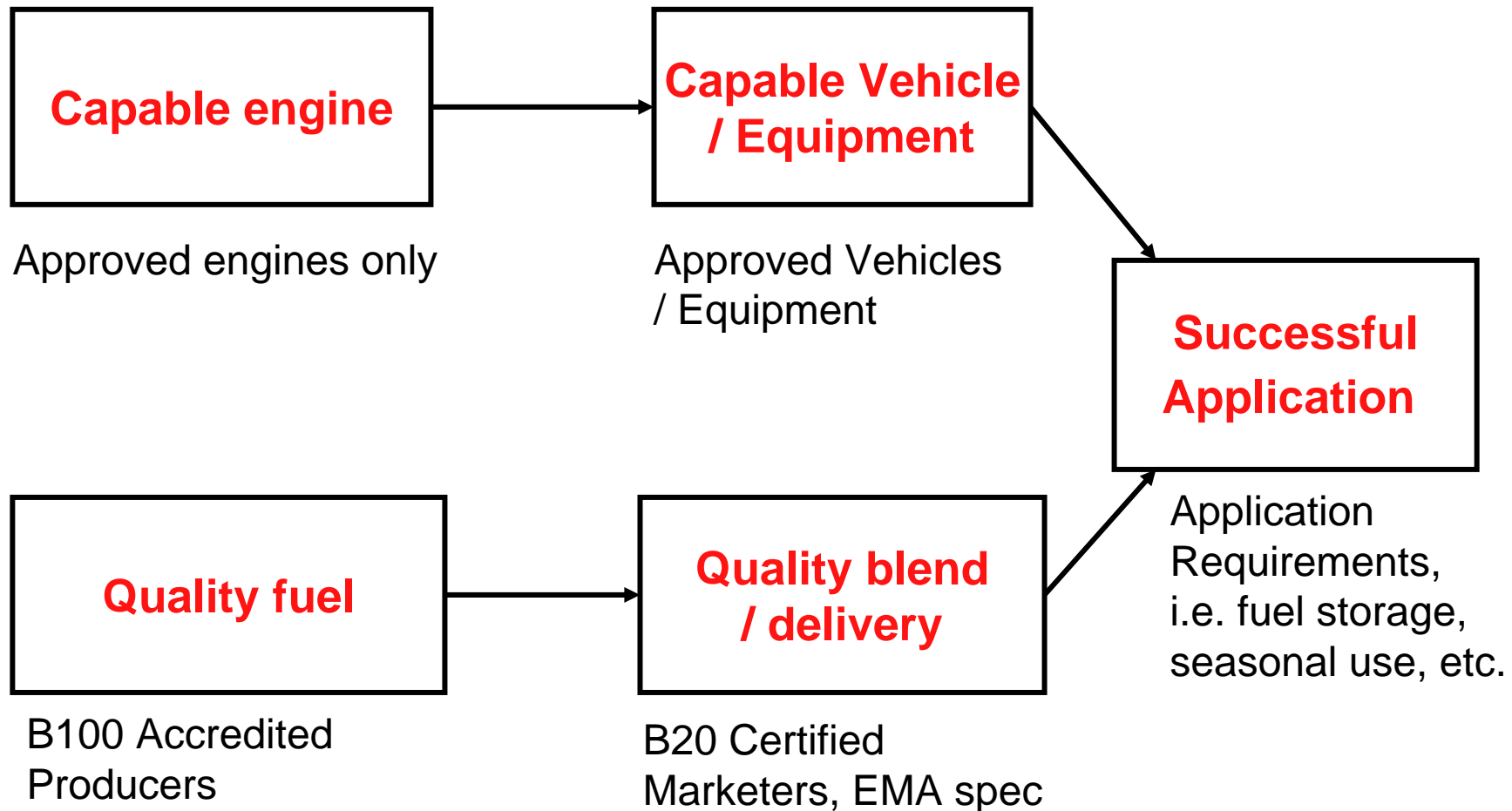
8) Microbial Growth

- 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.

9) Biodiesel Additives

- 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.
 1. 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.
 2. Cummins Filtration Biodiesel Winter Conditioner can be used to improve the pour point and cold filter plugging point of biodiesel blend, in addition to preventing ice formation in wet fuels during cold storage.
 3. Cummins Filtration Biodiesel Winter Conditioner is the **only** biodiesel fuel additive approved by Cummins Inc. for winter performance improvements. Contact your local Cummins Authorized Repair Location for product details.

Summary – Key Requirements



Summary - Key Requirements (cont.)

- Critical Document:
 - **Service Bulletin 3379001-11 “Fuels for Cummins Engines”**
- Information available on:
 - Approved engines
 - Accredited Producers and Marketers
 - EMA B20 spec.
 - Low temperature operation
 - Materials compatibility
 - Fuel storage
 - Fuel filtration
 - Seasonal operation