



## Application Engineering Bulletin

Subject <b>Biodiesel Fuel Usage - Application Requirements.</b>	This AEB is for the following applications:  <input checked="" type="checkbox"/> <b>Automotive</b> <input checked="" type="checkbox"/> <b>Industrial</b> <input checked="" type="checkbox"/> <b>Marine</b>  <input checked="" type="checkbox"/> <b>G-Drive</b> <input checked="" type="checkbox"/> <b>Genset</b>
Date: <a href="#">November 5, 2007</a>	AEB Number 21.73
Engine Models included: All (Diesel) Engines / All Markets (See Exceptions List by Market)	
Owner: Keith Nolting	Approver: per Procedure 9183OPS-04-10-01
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[This AEB Supercedes AEB 21.73 dated July 3, 2007](#)

### 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 disapproved in the market appendices of this AEB.
- All fuel wetted components should not contain the following materials; natural rubber, butyl rubber and some types of nitrile rubber (depending on chemical composition, construction and

application) may be particularly susceptible to degradation. Also, copper, bronze, brass, tin, lead and zinc can cause deposit formations. The use of these materials and coatings should be avoided for vehicle fuel tanks and lines. 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.
- All OEM supplied fuel filter seal material must be comparable to Cummins Filtration (Fleetguard) fuel filters. See Appendix A for Details.

## 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 is recommended 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 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 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.

Appendix B: Industrial / Mining / Agriculture

Appendix C: Power Generation

Table 1. Auxiliary/Supplemental Filtration and Water Separator Products

Fuel Filter and Water Separator Recommendations based on Maximum Fuel Flow Requirements of the Engine.

The recommended product is a filter head that can be equipped with filter options (micron rating) depending on application requirements. Micron rating requirements can be found in the fuel system related AEB's listed in the Introduction section of this AEB. This is not a replacement for current filtration, rather a recommendation for auxiliary remote mounted filtration

	Gal/Hr	Lb./Hr.*	Recommended Cummins Filtration Product
Flow Rate	40	284	FH232
	50	355	FH230
	60	426	FH230
	80	568	FH230
	100	710	FH230+
	120	852	Dual FH234
	150	1065	Dual FH234
	180	1278	Dual FH234
	200	1420	Dual FH234

\*Lb/Hr based on No. 2 Diesel fuel density of 850 g/liter [7.10 lb/U.S. gal] @ 25 Deg. C. [77 Deg F]

<u>Recommended Product Cummins Filtration Part Number</u>	<u>Filter Options</u>	<u>Micron</u>
FH232	FS19730	7
	FS19731	10
	FS19785	25
FH230	FS19624	7
	FS19727	10
	FS19728	25
FH234 and FH230 <sup>+</sup>	FS19763	7
	FS19764	10
	FS19765	25

## **Appendix A: Compatibility for B20**

### **Purpose:**

The purpose of this document is to ensure that seal compatibility requirements are met for applications using B20 biodiesel. If an inappropriate seal material is used in biodiesel applications, accelerated material degradation leading to potential fuel leakage issues can occur. Cummins Filtration seals have been tested extensively in B20 to ensure there are no compatibility issues.

### **Introduction:**

This specification establishes the approval requirements for filters used in B20 applications. Specifically, this document sets the testing criteria and requirements for filter seal materials in B20 applications.

### **Discussion:**

#### ❖ Laboratory Testing

- Rubber materials will degrade with time, temperature and fluid environment. ASTM testing as specified by ASTM D 2000 callouts is for quality control information and shall not be used to determine long-term performance. The desired test method is outlined in the document.
- Table A1: Aging Test Requirements for Rubber Seals and Table A2: Aging Standard Test Temperatures on page 3, outline the test requirements relevant to long-term performance at applicable temperatures and fluid environments.
- Testing per Table A1 should be tested on the actual Filter Seal.
- Table A2: Aging Standard Test Temperatures, specifies the temperature at which common materials shall be tested.
- When source approving a new material, a control sample (a Cummins Filtration seal material) shall always be tested at the same time (side-by-side) as the proposed new material.
- Test data for a new material shall be from three filters for all of the characteristics specified in Table A1: Aging Test Requirements for Rubber Seals.
- Seal materials shall be heated at the given temperatures in the above given fuel for the specified time interval. Test methods referenced in table A1 shall be performed on seal samples both before and after heating at the given conditions in the given fluid.
- Weight loss following aging in dry heat per ASTM D 573 in Table A1 shall be determined from specimens that have been desiccated for  $24 \pm 0.5$  hours, before and after

air aging. Specimens shall be weighed immediately after each desiccation period. Results shall be calculated as follows:

$$\diamond \text{ \% Weight Loss} = \{(W1-W2)/W1\} \times 100 \quad (\text{EQ 1})$$

where: W1 = weight before age  
W2 = weight after age

❖ Test Fuel Requirements

- B20 Fuel – The test fuel must be composed of 20% fatty acid methyl ester. The fatty acid methyl ester must be of a base stock that meets ASTM D6751 (Examples are soy bean methyl ester or rape seed methyl ester). The fatty acid methyl ester base stock must also be produced by a BQ9000 accredited supplier. The final B20 blend must meet ASTM D975. This will allow for all types of biodiesel used globally but will drive consistency of the test fluid by requiring minimum quality specifications.

❖ Acceptance Criteria

➤ Approving Filter Seal Material

- ◆ New materials shall be tested in accordance with Table A1: Aging Test Requirements for Rubber Seals. The results of the new materials tests shall be comparable to a current Cummins Filtration Fuel Water Separator seal material.
  - Hardness change shall be + or – 5 % that of the Cummins Filtration seal material
  - Compression set shall be + or – 5 % that of the Cummins Filtration seal material
  - Volume change shall be + or – 5 % that of the Cummins Filtration seal material

**Appendix A: Tables**

B20 SME Fuel (ASTM D 471)	Hardness (ASTM D 2240)	Compression Set(1) (ASTM D 395)	Volume Change (ASTM D 471)	Weight Change (ASTM D 573)
168 hrs ± .5	X	X	X	

Table A1: Aging Test Requirements for Rubber Seals

Dry Heat	B20
125°C± 2	100°C± 2

Table A2: Aging Standard Test Temperatures

**References:**

- a. FES 1544: Seals, Static, Rubber (Supplier Requirements, Fuel Applications)
- b. ASTM D 297, Standard Test Methods for Rubber Products – Chemical Analysis
- c. ASTM D 395, Standard Test Methods for Rubber Property – Compression Set
- d. ASTM D 412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
- e. ASTM D 471, Standard Test Method for Rubber Property – Effect of Liquids
- f. ASTM D 573, Standard Test Method for Rubber – Deterioration in an Air Oven
- g. ASTM D 975, Standard Specification for Diesel Fuel Oils
- h. ASTM D 2000, Standard Classification System for Rubber Products in Automotive Applications
- i. ASTM D 2240, Standard Test Method for Rubber Property – Durometer Hardnes

## Appendix B: Industrial / Mining / Agriculture 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>
Cold Weather Equipment	Approved with Recommendations	Extra caution recommend for fuel handling and fuel conditioning.	Examples include snow blowers, ski-lift, logging equipment and snow groomers.
Seasonal Equipment	Approved with Recommendations	Flush fuel system with petroleum diesel prior to seasonal storage. Engine should be purged before storage by running the engine on pure diesel fuel for a minimum of 30 minutes.	Examples include crop harvesting equipment, agricultural sprayers, mowers and irrigation pumps.

### Appendix C: 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	Disapproved	Use petroleum diesel only.	Low fuel usage and critical start nature of Emergency Standby make Biodiesel impractical.
Limited Time Prime	Approved with Recommendations	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	Approved with Recommendations	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	Approved with Recommendations	Use fuel within 6 months of manufacture.	Biodiesel is suitable for base load operation with proper precautions.

### Change Log

Date	Author	Description	Page(s)
November 5, 2007	K. Nolting	Fuel wetted requirements changed to match Fuel Services Bulletin Changes. Requirements have been relaxed from must not contain to should not contain for some materials.	Page 1-2
July 3, 2007	K. Nolting	Added new Requirement and Appendix section for seal compatibility requirements	2, 4-6
March 21, 2007	K. Nolting	Initial Release of Document	All