What is Cummins' position on the use of Biodiesel fuel in Cummins engines?

Background

With increased interest in emissions and reducing the use of petroleum distillate based fuels, some governments and regulating bodies are encouraging the use of bio fuels. Biodiesel fuels should be considered experimental at this time. Governmental incentives and/or environmental legislation to use bio fuels may have an impact on the sales and use of Cummins engines. This document outlines Cummins criteria and parameters when using biodiesel fuel.

SME or SOME 'Soy Methyl Ester' Diesel is the most common bio diesel in the U.S. and is derived from soybean oil. Soy Diesel is a biodiesel/petrodiesel blend based on SME. RME 'Rape Methyl Ester' Diesel is the most common biodiesel in Europe and is derived from rapeseed oil. These fuels are collectively known as Fatty Acid Methyl Esters (FAME).

Fuel Characteristics

Biodiesel 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. Biodiesel fuels have a lower energy content; about 89% of #2 diesel fuel, and is therefore a less efficient fuel. Its higher viscosity range (1.9-6.0 centistokes) vs 1.3-5.8 centistokes for diesel) helps offset the lower energy content through reduced barrel/plunger leakage resulting in slightly improved injection efficiency. Combining lower energy content and slightly improved injection efficiency, biodiesel fuel provides 5-7% less energy per gallon compared to diesel fuel. The cetane value of biodiesel fuel is 40 minimum compared to 42 minimum for Cummins diesel fuel specification. Biodiesel fuel has improved lubricity compared to standard diesel fuel.

There are provisional specifications for FAME issued in Germany under DIN V 51 606, and also recently through ASTM PS-121, however these standards are under development and are subject to change. For additional information, refer to the Cummins diesel fuel specifications listed in Table 1 and to the ASTM provisional specification PS-121 for biodiesel fuels.

Emissions

It is the responsibility of the user to obtain the proper local, regional, and/or national exemptions required for the use of biodiesel in any emissions regulated Cummins engine. From the Comprehensive Health and Environmental Effects testing, a fuel blend consisting of 20% biodiesel and 80% diesel fuel (B20) can yield percent reductions ranging from 16-33% in particulates, 11-25% in Carbon Monoxide (CO), and 19-32% in Hydrocarbon (HC) emissions. The B20 biodiesel fuel blend will cause an increase in NOx of 2%.

Performance and Durability Results

Cummins test data on the operating effects of biodiesel 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 biodiesel operation is not well documented.

Biodiesel provides approximately 5-7% less energy per gallon of fuel when compared to distillate fuels. To avoid engine problems when the engine is converted back to 100% distillate diesel fuel, do not change the engine rating to compensate for the power loss when operated with biodiesel fuels.

Elastomer compatibility with bio diesel is still being monitored. The condition of seals, hoses, gaskets, and wire coatings should be monitored regularly.

Cummins certifies its engines using the prescribed EPA and European Certification Fuels. Cummins 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

Given the current industry understanding of bio fuels and blending with quality diesel fuel, it would be expected that blending up to a 5% volume concentration should not cause serious problems. For customers intent on blending bio fuels above a 5% volume concentration, the following concerns represent what is currently known in the industry. Concentrations beyond 5% by volume could have an adverse effect on the engine's performance and the fuel system integrity/durability. The affects are more serious with increasing concentration levels.

Areas of concern when operating with biodiesel fuels include low temperature operability (fuel gelation, filter plugging), heat content (poor fuel economy), and storage and thermal stability (filter plugging, injector deposits). The oil change interval can be affected by the use of biodiesel fuels and some applications may require shortening intervals to half of the diesel equivalent. Lube oil dilution in applications with significant part load operation will fall under this guideline.

In addition, from Cummins' fuel systems suppliers, the following issues are also noted: swelling and hardening/cracking of some elastomer seals within the fuel system/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. Pure biodiesel fuel is not stable and its acid content increases over time which can damage powder metal components

Fuel System Vehicle Issues and Storage

The oil change interval can be affected by the use of biodiesel fuel. End users are advised to use oil sampling to monitor the engine oil condition and to determine the optimum oil change interval. Pure biodiesel fuel can cause a chemical reaction with lube oil resulting in oil sludging.

Elastomer compatibility with biodiesel is still being monitored. The condition of seals, hoses, gaskets, and wire coatings should be monitored regularly.

Biodiesel fuels contain residual alcohol from the esterification process, which can remove deposits from fuel tanks and lines causing filter plugging during initial testing. The fuel system should be flushed with this fuel before operation, and the fuel filters will need frequent replacement in the early stages of operation in older units.

Biodiesel fuels may pose low ambient temperature problems for both storage and operation. At low ambient temperatures, fuel may need to be stored in a heated building or a heated storage tank. The fuel system may require heated fuel lines, filters, and tanks. Filters may plug and fuel in the tank may 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.

Biodiesel has poor oxidation stability, which can result in long term storage problems. The poor oxidation stability qualities may 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.

Biodiesel 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 biodiesel 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 biodiesel fuels than in distillate fuels.

Warranty and the use of Biodiesel Fuel in Cummins Engines

Cummins neither approves or disapproves of the use of biodiesel fuel. Cummins is not in a position to evaluate the many variations of biodiesel fuels or other additives, and their long-term effects on performance, durability or emissions compliance of Cummins products. The use of biodiesel fuel does not affect Cummins Material and Workmanship warranty. Failures caused by the use of biodiesel fuels or other fuel additives are **NOT** defects of workmanship and/or material as supplied by Cummins Inc. and **CANNOT** be compensated under the Cummins' warranty.

Bosch states in their Diesel Fuel Quality -- Common Position Paper (03/05/99) that no guarantee on FIE is given so far to any alternative fuel except for Diesel + 5% FAME. There is a major difference between operating on pure (100% concentration) biodiesel fuels and biodiesel/petro diesel fuel blends.

From the ASTM provisional specification PS-121, Base 100% biodiesel must meet the following specifications before being mixed :

ASTM PS-121 Provisional Specification for Biodiesel Fuel B100				
Property	**Test Method**	**Test Method**	**Units**	**Limits**
Â	United States	International	Fuel Specific Properties	Â
Density @ 15 ^{o}C	ASTM D1298	DIN/ISO 3675	g/cm^3	0.86-0.90
Viscosity @ 40 ^{o}C	ASTM D445	DIN/ISO 3104	mm^2/s	4.0-6.0
Flash Point	ASTM D93	DIN/ISO 22719	^{o}C	100 min
Cold Filter Plugging • Summer • Winter	ASTM D4539	DIN EN 116	^{o}C	0 6 below ambient
Pour Point • Summer • Winter	ASTM D97	ISO 3016	^{o}C	-9 max -20 max
Sulfur Content	ASTM D2622	ISO 8754	% weight	0.01 max
Distillation • 10% Evaporation • 90% Evaporation	ASTM D1160	ISO 340	^{o}C	To Be Determined 345
Carbon Residue, Conradson (CCR)	ASTM D189	DIN/ISO 10370	% weight	0.5 max
Cetane Number	ASTM D613	ISO 5165	Â	45 min
Ash Content	ASTM D482	DIN 51575 ISO 6245	mg/kg	0.02 max
Water Content	ASTM D1796	DIN51777-1 ISO3733	g/m^3	500 max
Particulate Matter	DIN 51419	DIN 51419	Â	15

Copper Corrosion	ASTM D130	DIN/ISO 2160	Â	No.1
Oxidation Stability	ASTM D2274	IP 306 mod.	mg/100 mL	15 max
Esterification	Â	Â	% volume	98.0 min
Acid Value	ASTM D664	DIN 51558	mg NaOH/g	0.5 max
Methanol Content	GC Method	DIN 51608	% weight	0.2 max
Monoglycerides	GC Method	DIN 51609	% weight	0.8 max
Diglycerides	GC Method	DIN 51609	% weight	0.2 max
Triglycerides	GC Method	DIN 51609	% weight	0.2 max
Free Glycerine	GC Method	DIN 51609	% weight	0.02 max
Total Glycerine	GC Method	DIN 51609	% weight	1.2 max
Iodine Number	DIN 53241 or IP 84/81	DIN 53241 or IP 84/81	cg I_2/g	110 max
Phosphorus Content	DGF C-VI4	DIN 51440-1	mg/kg	0.2

Â

Table 1: Cummins Recommended Diesel Fuel Properties		
Property (Test Method)Â	**Recommended Specifications**	**General Description**
Viscosity (ASTM D 445, ISO 3104)	1.3 to 5.8 centistokes (1.3 to 5.8 mm per second) at 40 ^{o}C (104 ^{o}F)	Proper viscosity provides adequate pumping and lubricating characteristics to fuel system components.
Cetane Number (ASTM D 613, ISO 5165)	42 Minimum above 0^{o}C (32 ^{o}F) 45 Minimum below 0^{o}C (32 ^{o}F)	Cetane number is a measure of the starting and warm-up characteristics of a fuel. In cold weather or in service with pro- longed low loads, a higher cetane number is desirable.
Sulfur Content (ASTM D2622, ISO 4260)	Not to exceed 0.5 mass percent*	Diesel fuels contain varying amounts of various sulfur compounds. Fuel sulfur contributes to acid formation and exhaust particulates. Reduced sulfur is required to meet particulate emissions and to avoid poisoning aftertreatment devices. Higher sulfur fuel also needs higher TBN lubricants to compensate for acid corrosion.
Active Sulfur (ASTM D 130, ISO	Copper Strip Corrosion not to exceed No. 2 rating	Some sulfur compounds in fuel are actively corrosive.

2160)	after three hours at 50°C (122-F).	
Water and Sediment (ASTM DI796)	Not to exceed 0.05 volume percent.	The amount of water and solid debris in the fuel is generally classified as water and sediment. It is good practice to filter fuel while it is being put into the fuel tank. More water vapor condenses in partially filled tanks due to tank breathing caused by temperature changes. Filter elements, fuel screens in the fuel pump and fuel inlet connections on injectors must be cleaned or replaced whenever they become dirty. These screens and filters, in performing their intended function, become clogged when using a poor or dirty fuel and will need to be changed more often.
Carbon Residue (ASTM D524, ASTM D189, ISO 10370)	Not to exceed 0.35 mass percent on 10 volume per- cent residuum.	The tendency of a diesel fuel to form carbon deposits in an engine can be estimated by determining the Ramsbottom or Conradson carbon residue of the fuel after 90 percent of the fuel has been evaporated.
Density (ASTM D287, D4052, ISO 3675)	0.816 to 0.876 g/cc at 15°C (60°F).	Density is an indication of the energy content of the fuel. Higher density indicates more thermal energy and better fuel economy.
Cloud Point (ASTM D97, ISO 3015)	6°C [10°F] below lowest ambient temperature at which the fuel is expected to operate.	The cloud point of the fuel is the temperature at which crystals of paraffin wax first appear. Crystals can be detected by cloudiness of the fuel. These crystals will cause filters to plug.
Ash (ASTM D482, ISO 6245)	Not to exceed 0.02 mass percent (0.05 mass percent with lubricating oil blending).	The small amount of non-combustible metallic material found in almost all petroleum products commonly is called ash.
Distillation (ASTM D86, ISO 3405)	The distillation curve must be smooth and continuous.	At least 90 percent of the fuel must evaporate at less than 360 degC [680 degF). All of the fuel must evaporate at less than 385 degC (725 degF).
Lubricity SLBOCLE (ASTM D6078), HFRR (ASTM D6079, ISO 12156)	3100 grams or greater SLBOCLE, or Wear Scar Diameter (WSD) less than 0.45 mm at 60 °C HFRR.	Lubricity is the ability of a liquid to provide hydrodynamic and/or boundary lubrication to prevent wear between moving parts. Fuel with lower sulfur and/or viscosity tends to have lower lubricity.

*****Regional, national, or international regulations may require a lower sulfur content than 0.5%. Consult all applicable regulations before selecting a fuel for a given engine application. Fuel with sulfur higher than 0.5% is not allowed without prior approval by Cummins. Fuel system corrosion, heightened emissions, and reduced oil drain intervals are just some of the possible adverse effects of fuels with very high sulfur.

NOTE: Special hardened parts are available for some PT and HPI fuel systems to operate on fuel with lubricity lower than required. Contact Cummins distributors for options.

Where can I get warranty information on my Cummins diesel?

To receive warranty information on your Cummins engine, you need to contact your local

distributor or call 1-800-343-7357 (engine serial number is needed to obtain this information).

How can I get information about an Onan product?

Call 1-800-888-6626 to be connected toll-free to your closest Cummins/Onan distributor.

What are some causes of excessive fuel consumption?

The cause of excessive fuel consumption is hard to diagnose and correct because of the potential number of factors involved. Actual fuel consumption problems can be caused by any of the following factors: Engine Factors Vehicle Factors and Specifications Environmental Factors Driver Technique and Operating Practices Fuel System Factors Low Power/Driveability Problems Result of a Low-Power/Driveability Problem: An operator will change his driving style to compensate for a low-power/driveability problem. Some things the driver is likely to do are: (a) shift to a higher engine rpm or (b) run on the droop curve in a lower gear instead of upshifting to drive at part throttle conditions. These changes in driving style will increase the amount of fuel used. Driver Technique and Operating Practices: As a general rule, a 1 mph increase in road speed equals a 0.1 mpg increase in fuel consumption. This means that increasing road speed from 50 to 60 mph will result in a loss of fuel mileage of 1 mpg. Environmental and Seasonal Weather Changes: As a general rule, there can be as much as a 1 to 1.5 mpg difference in fuel consumption depending on the season and the weather conditions. Excessive Idling Time: Idling the engine can use from 0.5 to 1.5 gallons per hour depending on the engine idle speed. Truck Route and Terrain: East/west routes experience almost continual crosswinds and head winds. Less fuel can be used on north/south routes where parts of the trip are not only warmer, but see less wind resistance. Vehicle Aerodynamics: The largest single power requirement for a truck is the power needed to overcome air resistance. As a general rule, each 10 percent reduction in air resistance results in a 5 percent increase in mpg. Rolling Resistance: Rolling resistance is the second-largest consumer of power on a truck. The type of tire and tread design has a sizeable effect on fuel economy and performance. Changing from a bias ply to a low-profile radial tire can reduce rolling resistance by about 36 percent. Additional vehicle factors, vehicle specs and axle alignment, can also affect fuel consumption. For additional information on troubleshooting fuel consumption complaints, see Troubleshooting Excessive Fuel Consumption, Bulletin 3387245.

What causes white smoke?

White smoke is the result of incomplete combustion and is generally associated with engine start-up at low ambient temperatures. This condition is more predominant on high-horsepower fixed-injection-timing engines because the fuel and combustion systems are optimized for maximum performance and for reliability and durability under high load operating conditions. These engines can have two or three cylinders that misfire or have incomplete combustion when the engine is started at low ambient temperatures. The fuel that is injected into the cylinders that are misfiring is exhausted into the atmosphere as unburned hydrocarbons which cool, condense, and appear as white smoke. As the cylinder temperature and subsequently the coolant temperature rise, the misfiring cylinders begin to sustain combustion which decreases the hydrocarbon level in the exhaust, resulting in less white smoke being produced. Since white smoke is a normal characteristic of high-horsepower heavy-duty diesel engines during start-up at low ambient temperatures, it is extremely important to determine if the level of white smoke is significantly higher than normal for a particular engine model before making any attempt to correct a complaint. This can be accomplished by comparing the level of white smoke from one unit to another which has the same chassis configuration and engine model.

What is the hole in the bottom of the flywheel housing?

It is a weep hole that is left open to safeguard against leaks in the rear main seal or front transmission seal. The reason for threading the hole is simply a manufacturing process.

Top of page