



Technical Service Bulletin

Date: 07/30/09

Product Description: AMSOIL Premium API CJ-4 Diesel Oils (DEO, DME)

Subject: Fuel dilution issues in 2007 and newer on-highway Caterpillar C13 and C15 engines.

OBJECTIVE:

Communicate an escalating fuel dilution issue in 2007 and newer on-highway Caterpillar C13 and C15 engines and the resultant reduction in the drain interval recommendation for AMSOIL Premium Diesel Oils in these applications.

ISSUES:

AMSOIL has documented increasing fuel dilution levels in 2007 and newer Caterpillar C13 and C15 on-highway engines.

Caterpillar has recognized its fuel dilution problem as noted in a special instruction titled, *Determining the Cause of Fuel Dilution of Engine Oil for On-Highway Engines (C13, C15)*. The document states that mechanical deficiencies (i.e. leaking seals on the body or sleeve of unit injector, cracked body of unit injector, leakage from the drive shaft seal on the fuel transfer pump, etc...) are probable causes for fuel dilution.¹

Diesel fuel is a natural solvent, so high fuel dilution in motor oil causes a decrease in viscosity and can cause an increase in equipment wear rates.

TECHNICAL DISCUSSION:

Through examination of oil analysis reports, AMSOIL identified a trend of increasing fuel dilution in Caterpillar on-highway 2007-present C13 and C15 engines. A tolerable level of fuel dilution was present in 2007 engines; however, 2008 engines exhibit excessively high fuel dilution.

Fuel dilution in motor oil can be detrimental to an engine and its components. All of the following can occur if fuel enters the crankcase and contaminates the oil:

- Reduced oil viscosity
- Reduced oil film strength
- Increased engine wear (particularly in the cylinder/ring area)
- Increased volatility
- Weakened lubricant detergency
- Accelerated lubricant oxidation

- Varnish formation
- Acid formation/corrosion
- Low oil pressure

The most notable concern with increased fuel contamination is reduced viscosity and the corresponding affect it has on oil performance. Caterpillar is aware of the relationship between fuel dilution and viscosity loss and has stated:

“Fuel dilution that is greater than 4 percent will usually cause viscosity that is less than the specified viscosity grade. For example, 15W-40 oil with 4 percent fuel dilution will have a viscosity of less than 12.5 cSt.”¹

Even though Caterpillar realizes that fuel dilution has an adverse effect on viscosity, the company has not corrected the mechanical deficiencies that are causing the high fuel dilution rates. Instead, Caterpillar revised its guidelines for used oil viscosity to “slightly less than the limits of the SAE viscosity grades”¹ (See **Table 1**).

Viscosity Grade	SAE Viscosity Guideline (cSt)	Revised Caterpillar Viscosity Guideline (cSt)
SAE 40	12.5 cSt – 16.3 cSt	Greater than 11.5 cSt
SAE 30	9.3 cSt – 12.5 cSt	Greater than 8.5 cSt

Table 1 – Viscosity Guidelines at 100°C

In addition to viscosity loss, high fuel dilution also causes accelerated oxidation. Oxidation, combined with a significant loss in viscosity, can shorten engine life. The following excerpts from oil analysis reports demonstrate the effect fuel dilution has on motor oil.

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Manufacturer/Model	Caterpillar C13
Lube Time (miles)	26486
Fuel	4.5%
Soot	0.6%
Water	<0.1
Visc. 100C	10.8
Oxidation	26
Wear Metals (PPM)	
Iron	58
Lead	1
Tin	1

Sample 1

Sample 1 was collected from a 2008 Caterpillar C13 engine. AMSOIL Premium API CJ-4 Synthetic 5W-40 Diesel Oil (DEO) had accumulated 26,486 miles when sampled, not yet meeting Cat's recommended limit for normal service. The high level of fuel contamination (4.5%) reduced engine oil viscosity to 10.8 cSt. AMSOIL 5W-40 Diesel Oil did, however, maintain good overall lubrication as evidenced by the relatively low level of wear metals detected. Oxidation increased, but not to a critical level.

Manufacturer/Model	Caterpillar C13
Lube Time (miles)	27313
Fuel	6.6%
Soot	0.4%
Water	<0.1
Visc. 100C	9.9
Oxidation	29
Wear Metals (PPM)	
Iron	44
Lead	2
Tin	3

Sample 2

Sample 2 was collected from a 2008 Caterpillar C13 engine, with 27,313 miles accumulated on the oil. Fuel dilution was excessively high at 6.6% and consequently, the viscosity dropped to 9.9 cSt. Even with this high fuel dilution level, AMSOIL Premium 5W-40 Diesel Oil kept wear metals and oxidation levels below condemning limits.

For reference, the following sample was collected from a Caterpillar C13 engine that pre-dates the emission system requirements adopted with the 2007 model year. The oil analysis results are typical of diesel engines without mechanical problems.

Manufacturer/Model	Caterpillar C13
Lube Time (miles)	30000
Fuel	<1%
Soot	0.1%
Water	<0.1
Visc. 100C	14.5
Oxidation	7
Wear Metals (PPM)	
Iron	34
Lead	13
Tin	1

Sample 3

Sample 3 was collected from a 2006 Caterpillar C13 engine that had accumulated 30,000 miles on the oil and had less than 1 percent fuel dilution. Without fuel contamination, the oil maintained viscosity at near-new levels, oxidation remained well within normal limits and there was no sign of any abnormal wear metal development.

This investigation revealed a high level of fuel dilution in many 2007 and newer Caterpillar C13 and C15 on-highway engines and pointed to significant unresolved mechanical issues as the source. This information is being communicated to AMSOIL Dealers and customers to raise the level of concern and scrutiny when extending oil drain intervals.

RECOMMENDATION:

Although AMSOIL Premium Diesel Oils have shown the ability to maintain integrity in some fuel-dilution conditions, the unresolved mechanical issues have forced AMSOIL to adjust its drain interval recommendations for 2007-present Caterpillar C13 and C15 on-highway engines.

In these applications, AMSOIL recommends changing AMSOIL Premium API CJ-4 Synthetic Diesel Oils (DEO, DME) at the manufacturer-recommended drain interval. Drain intervals may be extended further for these applications, but through oil analysis only. Operating conditions and drain intervals for severe and normal service are defined by the original equipment manufacturer (OEM). Refer to your owner's manual for details.

For all pre-2007 Caterpillar C13 and C15 on-highway engines not equipped with emission system devices, the drain interval has not been affected (3X OEM, not to exceed 50,000 miles/600 hours, or one year).

REFERENCES:

1. Caterpillar Special Instruction: Determining the Cause of Fuel Dilution of Engine Oil for On-highway Engines {1250, 1348}. Publication Date 11/06/2008

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