Biodiesel 2014: FAME and Misfortune?

William Woebkenberg - US Fuels Technical and Regulatory Affairs
Mercedes-Benz Research & Development North America
July 10, 2014
Diesel passenger cars are a part of the Daimler heritage dating back to 1936, with the introduction of the 260D.

There have been Mercedes-Benz diesel passenger cars in every decade since.

Diesel is not just a powertrain option, it is tradition.
## Diesel fuels

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<td>B5 (5 %v/v max for reliable vehicle operation)</td>
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<td>B5 + X; X additional HVO or BTL 5% up to 15% depending on availability</td>
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B6-B20: A Drop-in Fuel?
Not Every OEM Agrees…

For Cummins engines in Ram trucks, B20 may be used in municipal, government and commercial fleets only. This applies to selected model-year vehicles. Please consult an authorized Ram service center for specific requirements and approved vehicle models.
Not Every OEM Agrees…

<table>
<thead>
<tr>
<th>Oil Change Interval</th>
<th>10,000 miles (≤B5 diesel fuel), 8,000 miles (B6→B20 diesel fuel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional features include:</td>
<td></td>
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<tr>
<td>• Chain-driven Dual Overhead Cam (DOHC) valvetrain with roller followers and hydraulic adjusters</td>
<td></td>
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<tr>
<td>• Oil jet cooled pistons</td>
<td></td>
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<tr>
<td>• Swirl intake ports</td>
<td></td>
</tr>
<tr>
<td>• Water-cooled Exhaust Gas Recirculation (EGR) with integral bypass valve</td>
<td></td>
</tr>
<tr>
<td>• Engine oil cooler</td>
<td></td>
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</tbody>
</table>

DISCLAIMERS
For Training Purposes Only: All product information is current at the time of production approval, April 2013. All product information is subject to change.

*Chrysler Group LLC. All rights reserved. Jeep is a registered trademark of Chrysler Group LLC.
Not Every OEM Agrees…

Volkswagen

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When I use biodiesel blends in my 2011 sold-as-
registered Volkswagen TDI Clean Diesel vehicle, what should I remember?

- Routinely check the engine oil level. A good time to do this is when you refuel, especially if you regularly do a short distance or stop-and- go driving. This will help you see if the engine oil level is getting
  higher. A rising oil level beyond the maximum indicator means an oil change is required due to the dilution of the oil in the system, a potential
  problem for biodiesel use.

- Continue to follow the oil change intervals found in the maintenance
  booklet that came with your vehicle, and use only engine oil that
  expressly complies with Volkswagen quality standard VW 607.00.

- Return only at trusted, commercial fueling stations that are located near main highways. These stations are more likely to have fresh biodiesel
  fuel that has not aged significantly.

- When your vehicle will be in storage (or not driven) for several weeks
  or months, please completely fill the fuel tank. If possible, fill the tank
  with Ultra Low Sulfur Diesel fuel (ASTM D975 standard Grade No. 2D
  530).

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Can we assist you further?

If you have additional questions about your Illinois-registered TDI Clean Diesel vehicle, please call or write to us at:

Volkswagen of America, Inc.
Attn: Customer CARE
3333 N. River Road
Arlington Heights, IL 60004
1-800-662-1222

Please keep this letter with your Warranty booklet for future reference, and deliver it to any new owner along with the owner's manual.

We hope you are enjoying the exceptional performance and fuel economy of your TDI Clean Diesel vehicle, and wish you many more miles of driving pleasure. Thank you for driving a Volkswagen!

Sincerely,

Volkswagen Service & Quality
Worldwide OEMs Desire B5…

**CATEGORY 4 DIESEL FUEL**

Markets with advanced requirements for emission control. Enables sophisticated NOx and PM after-treatment technologies.

<table>
<thead>
<tr>
<th>PROPERTIES</th>
<th>UNITS</th>
<th>Min.</th>
<th>LIMIT</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cetane Number</td>
<td></td>
<td>55.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cetane Index (1)</td>
<td></td>
<td>55.0</td>
<td>(52.0) (4)</td>
<td></td>
</tr>
<tr>
<td>Density @ 15°C</td>
<td>kg/m³</td>
<td>840</td>
<td></td>
<td>840</td>
</tr>
<tr>
<td>Viscosity @ 40°C</td>
<td>mm²/s</td>
<td>2.0</td>
<td></td>
<td>2.5 (3)</td>
</tr>
<tr>
<td>Sulfur</td>
<td>mg/kg</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trace metals (2)</td>
<td>mg/kg</td>
<td></td>
<td>I or non-detectable, whichever is lower</td>
<td></td>
</tr>
<tr>
<td>Total aromatics</td>
<td>% m/m</td>
<td>15</td>
<td></td>
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<tr>
<td>PAH (di+, tri+)</td>
<td>% m/m</td>
<td>2.0</td>
<td></td>
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<tr>
<td>T90 (4)</td>
<td>°C</td>
<td>320</td>
<td></td>
<td></td>
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<tr>
<td>T95 (4)</td>
<td>°C</td>
<td>340</td>
<td></td>
<td></td>
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<tr>
<td>Final Boiling Point</td>
<td>°C</td>
<td>350</td>
<td></td>
<td></td>
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<tr>
<td>Flash point</td>
<td>°C</td>
<td>55</td>
<td></td>
<td></td>
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<tr>
<td>Carbon residue</td>
<td>% m/m</td>
<td>0.20</td>
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<tr>
<td>CFFP or LFT or CF (7)</td>
<td>°C</td>
<td></td>
<td>Equal to or lower than the lowest expected ambient temperature</td>
<td></td>
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<tr>
<td>Water</td>
<td>mg/kg</td>
<td>200</td>
<td></td>
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<tr>
<td>Oxidation Stability Method 1</td>
<td>g/m³</td>
<td>25</td>
<td></td>
<td></td>
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<tr>
<td>Oxidation Stability Method 2a</td>
<td>hours</td>
<td>35</td>
<td></td>
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<tr>
<td>Oxidation Stability Method 2b</td>
<td>mg KOH/g</td>
<td>0.12</td>
<td></td>
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<tr>
<td>Oxidation Stability Method 2c</td>
<td>minutes</td>
<td>65</td>
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<tr>
<td>Foam volume</td>
<td>ml</td>
<td>100</td>
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<tr>
<td>Foam vanishing time</td>
<td>sec.</td>
<td>15</td>
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<tr>
<td>Biological growth</td>
<td></td>
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<td>no growth</td>
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<tr>
<td>FAME (9)</td>
<td>% v/v</td>
<td>5 (10)</td>
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<tr>
<td>Other biofuels (11)</td>
<td>% v/v</td>
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<tr>
<td>Ethanol/Hexanol</td>
<td>% v/v</td>
<td>Non-detectable (12)</td>
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<tr>
<td>Total acid number</td>
<td>mg KOH/g</td>
<td>0.08</td>
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<td>Ester content</td>
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Poor Retail Fuel Quality
In 2011, Mercedes-Benz Found B6-B20 Oxidation Stability Issues in US...
GM Has Determined Things Haven’t Changed Much Since…

Review of 2013 U.S. Retail Biodiesel Blends Quality Survey

Shailesh Martin Lopes and Pat Geng
General Motors Co.

Anke Konzack
SGS


Copyright © 2014 SAE International
15% of Retail Fuel Sampled has Out-of-Spec Oxidation Stability!
GM Conclusion in SAE Paper on Biodiesel Stability:

“Overall, the results for 2013 U.S. biodiesel blend samples were consistent with previously published surveys and showed that biodiesel fuel stability remains a concern from OEMs and end users perspective.”
What this means to your vehicle:

- With higher Biodiesel content, the risk of micro-organism growth increases due to less chemical stability and higher water solubility in Biodiesel.
- Depending on the type of micro-organisms, acids or bacteria sludge is formed.
- This can lead to heavy corrosion or filter / component plugging.
Fuel Filter Clogging due to Effects of Biodiesel Blends > B5
Deposit Formation in the High Pressure Fuel Pump due to Degraded Biodiesel Causes Low Power, Stalling
Oil Filters Can Clog with Deposits due to Biodiesel Degradation

New

10K miles

Biodiesel \( \leq B5 \)

9K miles

Biodiesel \( > B5 \)
Oil Sludging and Engine Failure Due to Biodiesel Contamination in Engine Oil
HC, CO, Particulates Down But....
ARB Says NOx Gets Worse with Higher Blends…

Inside Cal/EPA - 12/13/2013

ARB Delays New Biodiesel Rules To Address South Coast NOx Concerns

Posted: December 12, 2013

State air board officials this week postponed until March the possible adoption of new rules for biodiesel and other "alternative diesel" fuel blends, in order to consider last minute concerns raised by South Coast air district officials that the rules could increase nitrogen oxide (NOx) emissions in the region, according to sources. Board officials also want to further discuss regional compliance approaches to the rules, sources say.

The potential changes to the rules to address the South Coast concerns could trigger a backlash from the biodiesel industry, which has argued that the fuel does not generate higher NOx emissions than conventional diesel fuel.

How California regulates biodiesel and renewable diesel fuel is being closely tracked by numerous stakeholders, including engine makers, biofuel producers, the oil industry and environmentalists, in part because it will affect greenhouse gas (GHG) and other pollutant emission reductions, and will influence how companies comply with the state's low carbon fuel standard (LCFS) and federal renewable fuel standard (RFS).
No Choice?
Legally Required Misfueling… Minnesota B10 Mandate Removes Customer Choice

- Effective July 1- September 30 this year.
- April 1-September 30 starting 2015
- B20 mandate slated for 2018

“A lot of other states are watching Minnesota to see if the move to B10 would happen. They’re thinking that if it we can do it, they can, too.” — Ron Marr, biodiesel marketing director for Minnesota Soybean Processors
The takeaway…

- Biodiesel standards require significant improvement in oxidation stability and purity to increase the quality of higher biodiesel blends. The fuel standards have to be valid for the point of sale.
- Higher biodiesel blends require the introduction of a satisfactory quality management system to avoid the sale of low quality fuels.
- Higher biodiesel blends require customer interaction such as increased service frequency and cost when higher biodiesel blends are utilized.
- OEMs have stated in WorldWide Fuel Charter and other forums that FAME is not a desirable component in transport diesel fuel in blends greater than 5%.
- Mandates force customers to misfuel vehicles against manufacturer recommendations.
- Increasing NOx emissions result from increasing biodiesel blends.
The solutions…

• US retail quality biodiesel quality on par with EU
• ASTM fuel standards equivalent to EN specifications in EU
• National B5 blend standard to ensure quality

High quality HVO or 2nd generation BTL are sensible alternatives to biodiesel
Waste Not, Want Not: E20 Vehicle Test Program with Clariant and Haltermann

William Woebkenberg - US Fuels Technical and Regulatory Affairs
Mercedes-Benz Research & Development North America
### Position of Daimler concerning Biofuels

#### Gasoline fuel

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<td>E10</td>
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All current series-production gasoline vehicles of Mercedes-Benz are already applicable for E20/E25, under the precondition that an adequate fuel quality is available based on an adequate fuel standard.

An adequate share of E20/E25 capable vehicles in the legacy fleet is expected not before 2017.

Midblend ethanol fuel **should not contain more than 20-25 %v/v ethanol** as this offers the best compromise in terms of fuel economy and high octane possibility.
Mercedes-Benz fueled by petrol made from agricultural waste

Waste not, want not

Stuttgart – The vision of extracting fuels from renewable resources is getting closer: Mercedes-Benz is collaborating with speciality chemical companies Clariant and Haltermann to bring second generation bioethanol in a fleet test on the road.

The pilot project fills tanks with a new biofuel: sunliquid20 is super-grade fuel with 20 percent cellulosic ethanol. Special attribute: The fuel is produced using agricultural waste such as straw. For the next twelve months the vehicles of the Mercedes-Benz test fleet can be refilled with the new fuel at an internal petrol station in Stuttgart-Untertürkheim which was put up especially for this project. With an octane rating (RON) of more than 100, the fuel guarantees a high level of efficiency.
Mercedes-Benz, Clariant and Haltermann to Test E20 Fuel in Vehicle Fleet

Creates high quality cellulosic ethanol from agriculture waste such as wheat straw

Blends ethanol with petroleum base for test fuel

Sunliquid20

100

MINIMUM OCTANE RESEARCH METHOD
Mercedes-Benz BlueDIRECT Engines: The Future is NOW.

“Petrol with 20 percent ethanol can already be used in our latest Mercedes-Benz BlueDIRECT petrol engines. This offers ideal potential for best efficiency and high greenhouse gas savings.”

Peter Lueckert – Daimler AG Director for Engines, Powertrains and Fuel Injection
Something from Nothing…

“The production of cellulosic ethanol is virtually CO2-neutral, saving almost 100% of CO2 emissions when compared to gasoline.”

Jim Lane — Editor, Biofuelsdigest.com
“Our main task is to shape solutions for sustainable mobility of the future. We see great potential in second generation biofuels with regards to sustainability and reduction of greenhouse gases.”

Peter Lueckert – Daimler AG Director for Engines, Powertrains and Fuel Injection
What about Rules and Regulations?
EPA hints at opportunities for higher ethanol blends in its Tier 3 proposal:

“An alternative certification fuel such as a high-octane... ...ethanol blend for vehicles which [OEMs] might design or optimize for use on such a fuel...”

This could help manufacturers that wish to raise compression ratios to improve efficiency, as a step towards complying with the 2017 and later light duty greenhouse gas and CAFE standards.”

78 Fed. Reg at 29825
February 03, 2014

**MCCARTHY: RFS WILL PROMOTE BIOFUELS**

Published in [POLITICO Pro Whiteboard](http://www.politico.com)

EPA Administrator Gina McCarthy hinted this morning that the agency is considerably revising its proposed 2014 Renewable Fuel Standard to encourage greater production of biofuels.

McCarthy told a gathering of more than 100 people at the National Association of State Departments of Agriculture’s winter conference in Reston, Va., this morning that the agency is taking into account concerns from states that the RFS could hurt the fledgling biofuels industry.

"I have heard loud and clear that you don’t think we hit that right,” McCarthy said. The administration considers biofuels a priority for energy policy and as a result has sought more information for a final rule.

Given all the feedback, the final rule when released will be "in a shape that you will see that we have listened to your comments” and will continue to move the biofuels industry forward, McCarthy said.

* Return to previous page
Not so fast, though…

CHARLIE BROWN, You have ALPHAPHOBIA!! The fear of LETTERS!!
Well, I *am* worried about certain ones...

E P A...
Our rules say you can optimize on midblend ethanol...

Great!

Show me your usage first!
Clear guidance for future applicability of midblend ethanol fuels will promote the development of vehicles optimized on such fuels
For us, firsts are just second nature.