2010 Technology Dealer Update
*Detroit Diesel / Freightliner Trucks*

**41st WSHEMA Conference**
Wayne Stephan – DDC & Eric Magyar - Freightliner
August 18th, 2009
2010 emissions control system
Particulate Matter (PM) is trapped in the Diesel Particulate Filter (DPF)

DEF injected into the exhaust stream

Ammonia (NH3) and Nitrogen Oxides (NOx) react in the catalyst to form Nitrogen and Water

Exhaust leaves the engine with the pollutants NOx and PM

DEF solution ‘hydrolyzes’ into ammonia gas (NH3) which mixes with the exhaust

= Exhaust
= Diesel Exhaust Fluid (DEF)
BlueTec technology will add 3 key components [DEF tank, 1-Box configuration or 2-box configuration, Aftertreatment Control Module (ACM)] as well as some supporting hardware to the 2010 product offering. Notice how seamlessly the 1-Box SCR system fits into the chassis.
DEF Pump is mounted on the rear of the DEF tank. Its function is to extract DEF from the tank and transfer it to the SCR catalyst for the NOx and DEF reaction that creates Nitrogen and Water.

<table>
<thead>
<tr>
<th>Component</th>
<th>CAD Drawing</th>
<th>CDU/Component Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEF Pump</td>
<td><img src="image1.png" alt="CAD Drawing" /></td>
<td><img src="image2.png" alt="CDU Photo" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electric Pump</td>
</tr>
<tr>
<td>2</td>
<td>DEF Chamber</td>
</tr>
<tr>
<td>3</td>
<td>DEF Pressure Bladder</td>
</tr>
<tr>
<td>4</td>
<td>DEF Filter</td>
</tr>
</tbody>
</table>

Note: DEF Filter has a 300,000 mile change interval.
The Aftertreatment Control Module mounted on the air tanks and under to the battery box, is the brains for the BlueTec emissions system, it controls DEF dosing, NOx Sensor, regeneration strategies among many other emissions activities.

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<tr>
<th>Component</th>
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<tr>
<td>ACM</td>
<td><img src="image1.png" alt="CAD Drawing" /></td>
<td><img src="image2.png" alt="CDU/Component Photo" /></td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Item</th>
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</tr>
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<tbody>
<tr>
<td>1</td>
<td>ACM Housing</td>
</tr>
<tr>
<td>2</td>
<td>ACM</td>
</tr>
</tbody>
</table>

Note: ACM designed to not have to remove the connectors.
The sensor box is mounted on top of the 1-Box unit and is a central location for NOx, pressure and temperature sensors for the system.

<table>
<thead>
<tr>
<th>Component</th>
<th>Items</th>
<th>CDU/Component Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Box</td>
<td>Item</td>
<td>Component</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>(2) 14 pin Connections to engine harness</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>NOx Sensor</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Pressure Sensor</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Temperature Sensor Connector</td>
</tr>
</tbody>
</table>

Daimler Trucks 74
The BlueTec 1-Box solution is located under the passenger side of the vehicle, it is easily accessed by removing a side fairing.

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<tr>
<th>Component</th>
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<th>CDU/Component Photo</th>
</tr>
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<tbody>
<tr>
<td>1-Box</td>
<td><img src="image1.png" alt="CAD Drawing" /></td>
<td><img src="image2.png" alt="CDU/Component Photo" /></td>
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<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>1</td>
<td>Top Inlet</td>
</tr>
<tr>
<td>2</td>
<td>Sensor Box</td>
</tr>
<tr>
<td>3</td>
<td>DEF Metering Unit</td>
</tr>
<tr>
<td>4</td>
<td>Inboard Outlet</td>
</tr>
<tr>
<td>5</td>
<td>Rear Face Outlet</td>
</tr>
<tr>
<td>6</td>
<td>DEF Injection Nozzle</td>
</tr>
<tr>
<td>7</td>
<td>Outer Heat Shield</td>
</tr>
<tr>
<td>8</td>
<td>Front Face Inlet</td>
</tr>
</tbody>
</table>

Note: Sensor box is NOT ACM
The following diagram illustrates the follow of exhaust through the DOC and DPF. Then where the DEF enters the hydrolysis pipe and eventually meets the exhaust in the SCR device. Detroit Diesel’s dual parallel flow (ATD & SCR catalyst) reduces backpressure on the engine thus increasing fuel efficiency.

<table>
<thead>
<tr>
<th>Item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diesel Oxidation Catalyst (DOC)</td>
</tr>
<tr>
<td>2</td>
<td>Diesel Particulate Filter (DPF)</td>
</tr>
<tr>
<td>3</td>
<td>SCR Devices</td>
</tr>
<tr>
<td>4</td>
<td>DEF Hydrolysis Pipe</td>
</tr>
</tbody>
</table>
The Diesel Particulate Filter (DPF) is serviceable. SRT times have not been finalized, however it is estimated to take less than 2 hours to change the DPF. DPF change intervals are been studied, but currently have not changed from the EPA07 levels of 300,000 miles.

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</tr>
<tr>
<td>2</td>
<td>Diesel Particulate Filter (DPF)</td>
</tr>
<tr>
<td>3</td>
<td>DEF Nozzle</td>
</tr>
</tbody>
</table>

Note: DOC is integrated into the 1-Box system
For customers requiring a 2-box BlueTec system, the following is a diagram of the components in that system.
The 2-box Vertical/Horizontal is the third of three BlueTec packaging options. Increasing the options for customers ensures BlueTec packaging can be integrated for our customers.

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DPF Sensor Box</td>
</tr>
<tr>
<td>2</td>
<td>DOC/DPF Module</td>
</tr>
<tr>
<td>3</td>
<td>DPF Outlet</td>
</tr>
<tr>
<td>4</td>
<td>DEF Injection Nozzle</td>
</tr>
<tr>
<td>5</td>
<td>SCR Inlet</td>
</tr>
<tr>
<td>6</td>
<td>DEF Metering Unit</td>
</tr>
<tr>
<td>7</td>
<td>SCR Device</td>
</tr>
<tr>
<td>8</td>
<td>SCR Sensor Box</td>
</tr>
<tr>
<td>9</td>
<td>SCR Outlet</td>
</tr>
</tbody>
</table>
Particulate filter regeneration in 2010
Regeneration is a process in which Particulate Matter is “burned off” the filter in order to keep it clean. There are three types of regeneration:

- **Passive Regeneration**
  - No driver intervention, No fuel dosing
  - Burns off soot during normal operation
  - If not enough soot is burned off, active regeneration is required

- **Active Regeneration**
  - No driver intervention, requires fuel dosing
  - Burns off soot by dosing fuel to attain proper exhaust temperatures
  - Active regeneration intervals vary by engine

- **Parked Regeneration**
  - Driver intervention and fuel dosing required
  - Burns off soot by dosing fuel to attain proper exhaust temperatures while vehicle is parked
In 2010, Detroit Diesel engines will go 45-90 hours between regenerations.

Today’s DD engines regenerate every 325 miles costing about 3.2% in fuel.

Our 2010 engines will regenerate less often reducing the fuel economy penalty.
DDC fuel economy position
2010 Driver Inducements
In addition to the BlueTec hardware is a new DEF gauge. Just like filling up their diesel tank, drivers will need to remember to watch their DEF gauge and fill it when needed.

<table>
<thead>
<tr>
<th>DEF Level</th>
<th>Gauge Lamps</th>
<th>DEF Lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>75% to 100%</td>
<td>4 green lights</td>
<td>off</td>
</tr>
<tr>
<td>50% to 75%</td>
<td>3 green lights</td>
<td>off</td>
</tr>
<tr>
<td>25% to 50%</td>
<td>2 green lights</td>
<td>off</td>
</tr>
<tr>
<td>10% to 25%</td>
<td>1 green light</td>
<td>off</td>
</tr>
<tr>
<td>5% to 10%</td>
<td>1 yellow light</td>
<td>on solid</td>
</tr>
<tr>
<td>0% to 5%</td>
<td>1 red light flashing</td>
<td>on flashing</td>
</tr>
</tbody>
</table>

EMPTY Check Engine Lamp

- 25% Engine Derate
- 55 MPH Vehicle Speed Limit
- Malfunction Indicator Lamp (MIL)

Vehicle speed will be limited to 5 mph once one of the following conditions occur:
- Fuel tank is refilled by more than 30%
- Engine consumes 350 gallons of fuel and is re-started
If the driver accidentally puts an improper fluid into the DEF tank, the SCR system will detect the error and the malfunction indicator lamp will illuminate.

- The following action will be employed once this condition is detected:
  - 25% engine derate
  - 55 mph speed limit imposed

- After 1,000 miles or 20 hours of operation without remedy a vehicle speed will be limited to 5 mph once one of the following conditions occur:
  - Fuel tank is refilled by more than 30%
  - Engine consumes 350 gallons of fuel and is re-started

- Similar actions will be employed if the engine detects any tampering or failure with the after-treatment sensors or hardware.

- Under no circumstances will the engine be shutdown due to running the vehicle out of DEF or putting the improper fluid in the DEF tank.
The Driver can remove all engine derates and speed limits by simply filling the DEF tank with the proper fluid.

- It is recommended that the DEF tank be filled to at least 25% capacity with the proper fluid at any given fill.
  - Engine derates and vehicle speed limits will be removed after 1 minute of condition detection.

- At a minimum, the DEF tank must be filled to at least the 10% capacity with the proper fluid.
  - Engine derates and vehicle speed limits will be removed after 4 minutes of condition detection.

- If the improper fluid was placed in the tank, the DEF tank must be drained completely before adding additional DEF to avoid contamination of the new fill.
DDC Engine Changes for 2010
DD13 / DD15 Options Implementation

<table>
<thead>
<tr>
<th>Option</th>
<th>DD15</th>
<th>DD13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil sample valve</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Oil ESOC (short ver.)</td>
<td>Available</td>
<td>Apr 09</td>
</tr>
<tr>
<td>Extended Oil ESOC</td>
<td>Apr 09</td>
<td>Apr 09</td>
</tr>
<tr>
<td>Davco 482 (under hood)</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Fuel ESOC</td>
<td>Available</td>
<td>Available</td>
</tr>
</tbody>
</table>
# DD13 / DD15 Options Implementation

<table>
<thead>
<tr>
<th>Option</th>
<th>DD15</th>
<th>DD13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allison 4000/4500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- P2 and P3 Chassis</td>
<td>- May 09</td>
<td>- May 09 (P3 only)</td>
</tr>
<tr>
<td>- Western Star</td>
<td>- Sep 09</td>
<td>- Sep 09</td>
</tr>
<tr>
<td>Penray Need Release</td>
<td>Est. May 09 (service only)</td>
<td>Est. May 09 (service only)</td>
</tr>
<tr>
<td>Trailer Heat</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>APU Install (P3 Chassis)</td>
<td>Available</td>
<td>Available</td>
</tr>
<tr>
<td>Beauty Cover</td>
<td>2010</td>
<td>NA</td>
</tr>
</tbody>
</table>
Questions & Answers

Thank you