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Future Global Heavy Duty Specifications

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- European OEM specifications for Euro V



Heavy Duty Diesel

Drivers and trends

- All world regions are mandating more stringent emissions regulations
- Meeting these regulations requires several engine and hardware changes
 - Further combustion optimization
 - Introduction of after treatment systems
- Fuels and oil formulations must now be formulated to protect emissions control systems
 - **Need for Ultra-Low Sulfur Diesel Fuel**
 - **Need for low SAPS oils**



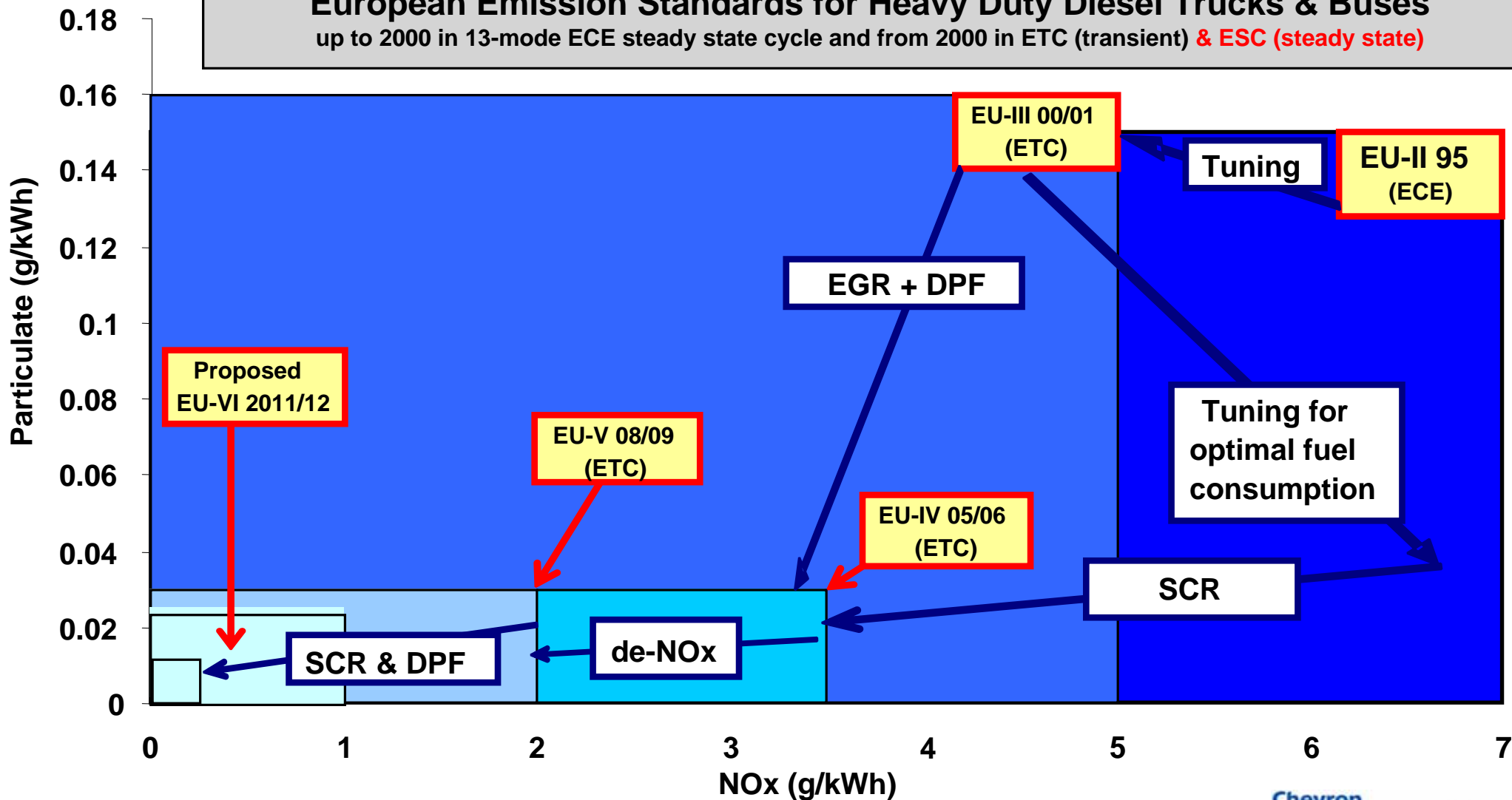
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European OEMs responses to driving forces

European Emission Standards for Heavy Duty Diesel Trucks & Buses

up to 2000 in 13-mode ECE steady state cycle and from 2000 in ETC (transient) & ESC (steady state)



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European OEMs responses to driving forces

- Euro V Heavy Duty Engine technology (2008/2009)
 - DaimlerChrysler, Volvo Trucks, Renault Trucks, Iveco
 - ▶ Same technology as used for Euro IV
 - ✦ SCR with AdBlue (urea), no DPF's, some DOC
 - ✦ Increased AdBlue dosage to reduce NOx
 - Scania
 - ▶ Tax incentive Euro V engines use SCR/AdBlue, no DPF
 - ▶ Definite Euro-V technology comes by 2009 with introduction of new engine series using high EGR, DOC (no DPF, no SCR)
 - MAN
 - ▶ Tax incentive Euro V engines use SCR/AdBlue, no DPF
 - ▶ MAN may eventually adopt their 2007/2010 technology (EGR) for Euro V
- OEMs expect use of more DPF's due to political pressures
 - Increased need for low SAPS oils

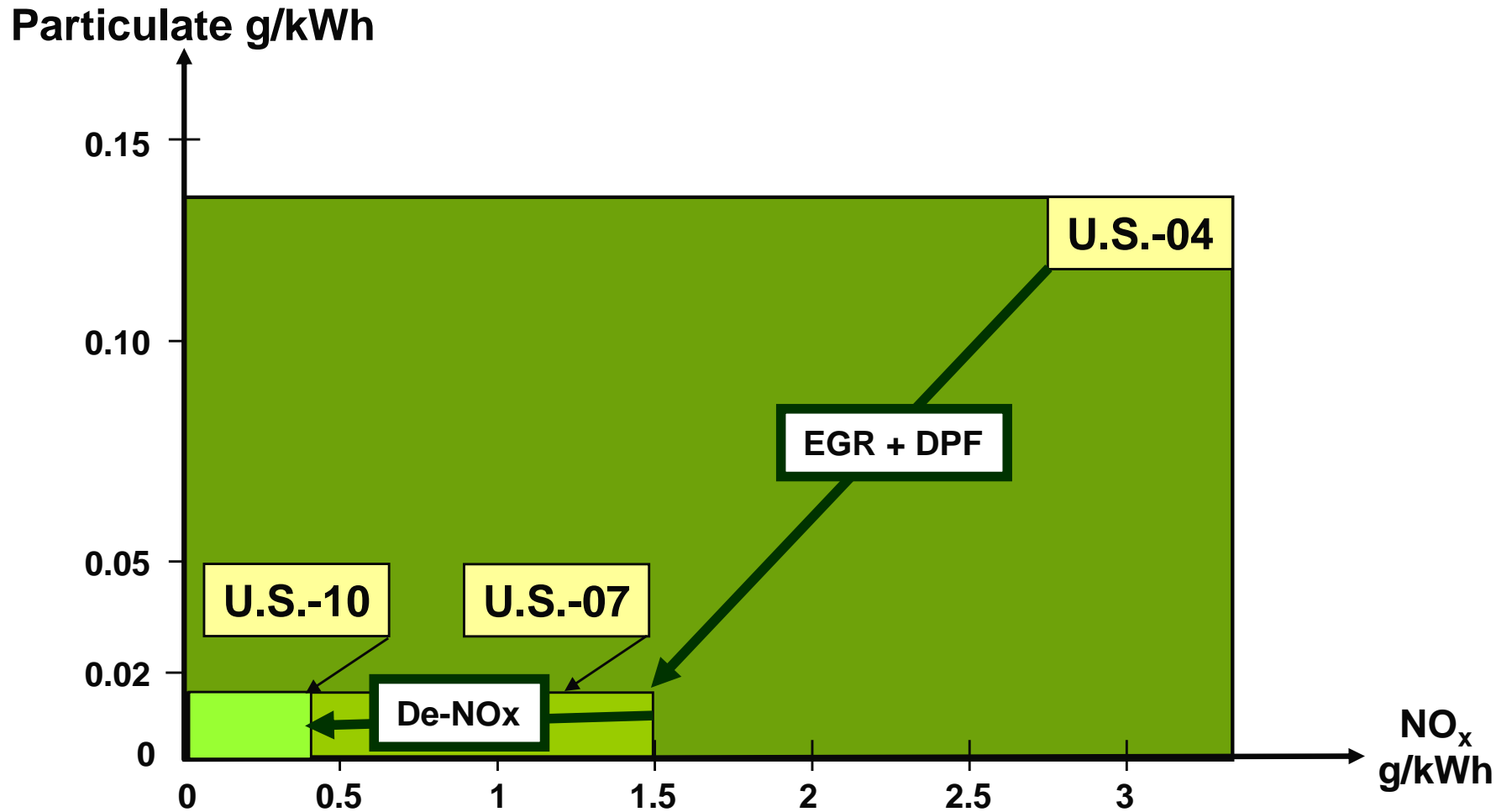


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US OEMs responses to driving forces

US EPA Emission Standards for Heavy Duty Diesel Trucks



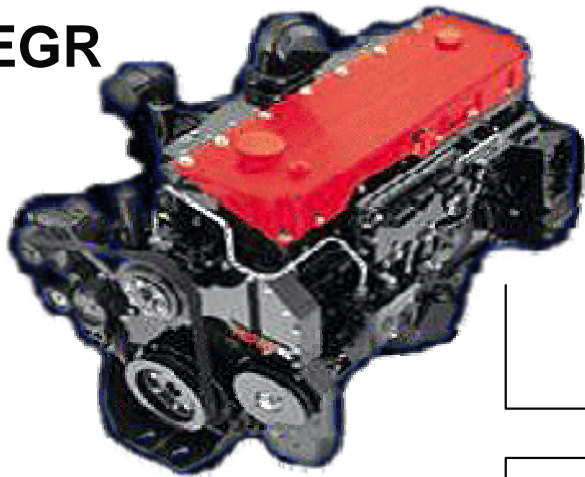
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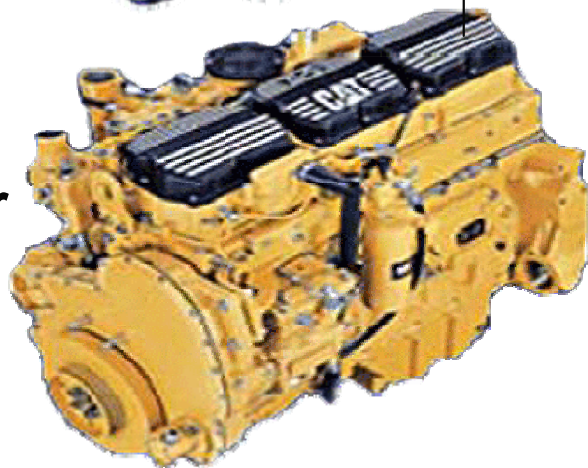
US OEMs responses to driving forces

Prime Path 2007

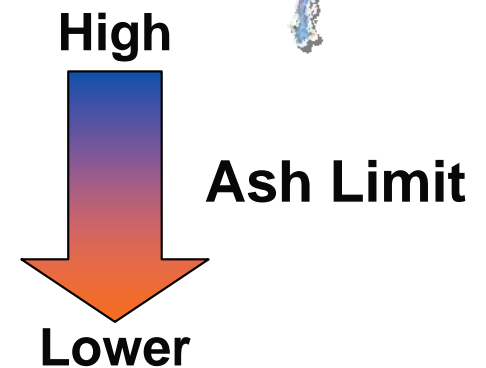
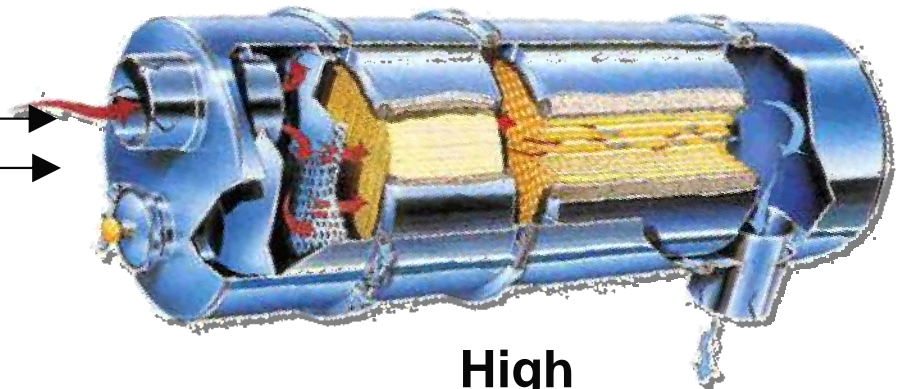
High Flow
Cooled EGR



Caterpillar
ACERT



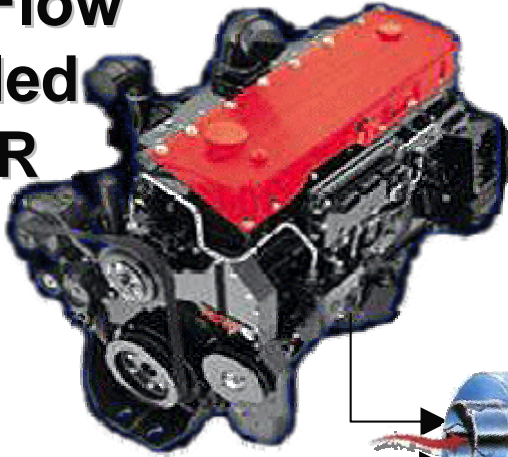
Catalyzed Diesel
Particulate Filter
(CDPF)



Heavy Duty Diesel

US OEMs responses to driving forces

High Flow
Cooled
EGR

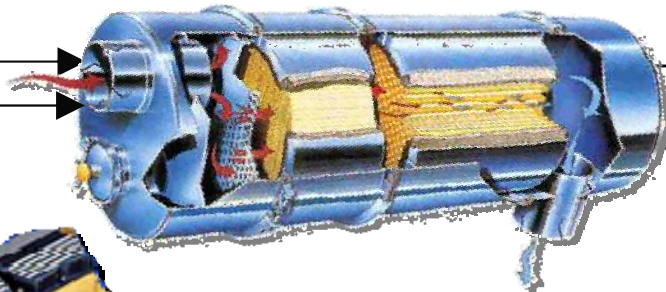


Caterpillar
ACERT



Prime Path 2010

Catalyzed Diesel
Particulate Filter
(CDPF)



High
Sulfur
↓
Lower



High
Phosphorus
↓
Lower

High
Ash
Limit
↓
Lower

Heated
UREA

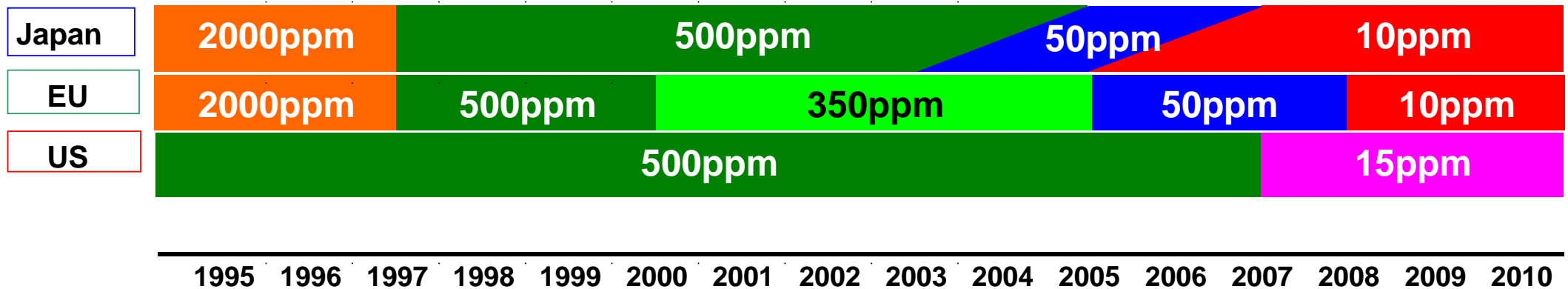


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Heavy Duty Diesel Ultra-Low Sulfur Diesel Fuel

Maximum Allowable Sulfur Levels

Actual levels in the field may be significantly lower



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Heavy Duty Diesel

Impact on engine oil technology – API CJ-4

- U.S. EPA has defined specific emission reductions of particulate and NOx
 - All US 2007 on-highway Diesels will use cooled EGR to reduce NOx and DPFs in the exhaust system
 - 95% of highway fuel will be ultra low sulfur diesel (15 ppm max) in order to reduce particulate and to ensure compatibility with the DPFs
- API CJ-4
 - New oil category issued in October 2006 for 2007 low emission Diesel engines using particulate filters
- Performance tests for API CJ-4
 - Combination of existing CI-4 Plus, CI-4 and CG-4 engine tests using today's fuel and new engine tests using ULSD fuel
 - Designed to be backward compatible with CI-4 PLUS
- Chemical limits for API CJ-4 lubricants are:
 - Sulfated Ash 1.0% max
 - Sulfur 0.4% max
 - Phosphorus 0.12% max
 - Volatility 13% max



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Heavy Duty Diesel

Impact on engine oil technology – Euro V

- Euro V Heavy Duty Engine Oil (2008/2009)
 - Engine oils not yet fully defined, expect more demand for low SAPS
 - Some ACEA members want to harmonize with US requirements
 - ▶ Proposal to align ACEA E7 with API CJ-4
 - ✦ Some OEM are concerned about phosphorus poisoning SCR and NOx sensors but no hard proof
 - ✦ ACEA suggest OM501LA is used instead of C13 and 1N
 - ✦ ACEA need a reliable steel piston deposit test and are considering using the D12D successor




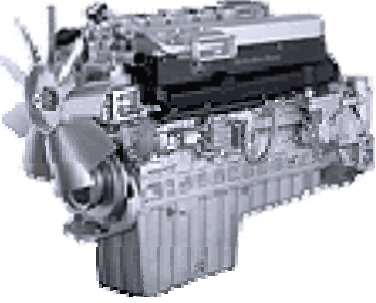

- Possibly three categories:
 - Conventional E4 oils for long drain w/o DPF's
 - Low Saps E6 oils for long drain with DPF's
 - E9 aligned with CJ-4 for SCR, EGR, DPF, etc



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US OEMs specifications associated with API CJ-4

CATERPILLAR	CUMMINS	VOLVO-MACK	DDC	INTERNATIONAL
				
<p>CAT ECF-3 specification implemented in two phases</p>	<p>Cummins CES 20081</p>	<p>VOLVO VDS-4, MACK EO-O Premium Plus, Renault RLD-3</p>	<p>PGOS 93K218</p>	<p>No Oil Approvals or List anticipated</p>



Heavy Duty Diesel

European OEMs specifications for Euro V

■ VOLVO Trucks

- Volvo VDS-4, Mack EO-O Premium Plus, Renault Trucks RLD-3
 - ▶ Volvo develops common engine oil specification for both US-07 and eventually Euro-V engines

■ DaimlerChrysler HD Trucks

- E4/MB 228.5 & E6/MB 228.51 will stay for the Long Drain
- DC GEOS HD-1 specification: MB 228.31
 - ▶ New DCX Global HD Engine Oil Specification for Mercedes-Benz & Detroit Diesel applications using DPF's
 - ▶ Basically combines Mack EO-O / CJ-4 with MB 228.3

■ MAN

- MAN still wants the lowest possible SAPS oils available to protect their after treatment systems



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Thank you !

Q & A ?

