

# Heavy Duty Diesel Fuel Economy Engine Oil

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**TOTAL**

# FUEL ECONOMY IS EPA DRIVEN

- Why fuel economy?
  - Environmental greenhouse gas—CO<sub>2</sub> reduction  
(Burning fuel generates CO<sub>2</sub>)
  - Energy savings—less foreign oil imported
- Environmental regulation will drive EPA to increase mpg requirements for heavy duty diesel engines. Currently class 8 trucks average around 6 to 7 mpg, but target by 2030 will be 10 mpg average.

# OEM POSITION

- OEM positions
  - Some OEMs are already filling with 10W30 CJ-4
    - Mack, Volvo, Caterpillar and Navistar
  - Others will start in about 1 to 2 years (Detroit Diesel, Cummins)
  - Mandated fuel economy by OEMs for trucks is coming soon
- OEM approvals
  - All except Detroit Diesel give approvals to 10W-30 due to a technical issue in their engine hardware—they will be giving approvals in near future when they go to factory fill of 10W-30.

# API ON FUEL ECONOMY

- API diesel engine oil categories currently have no fuel economy standards for diesel engine oils (as opposed to gasoline engine oils).
- The next API heavy duty diesel engine oil category (about 2017) will mandate lower viscosity engine oils (xW-30) with probably some fuel economy test such as high temperature/high shear requirements.
- A company claiming fuel economy on heavy duty engine oil has to generate their own testing using the best means of proving fuel economy.

# PROVING FUEL ECONOMY

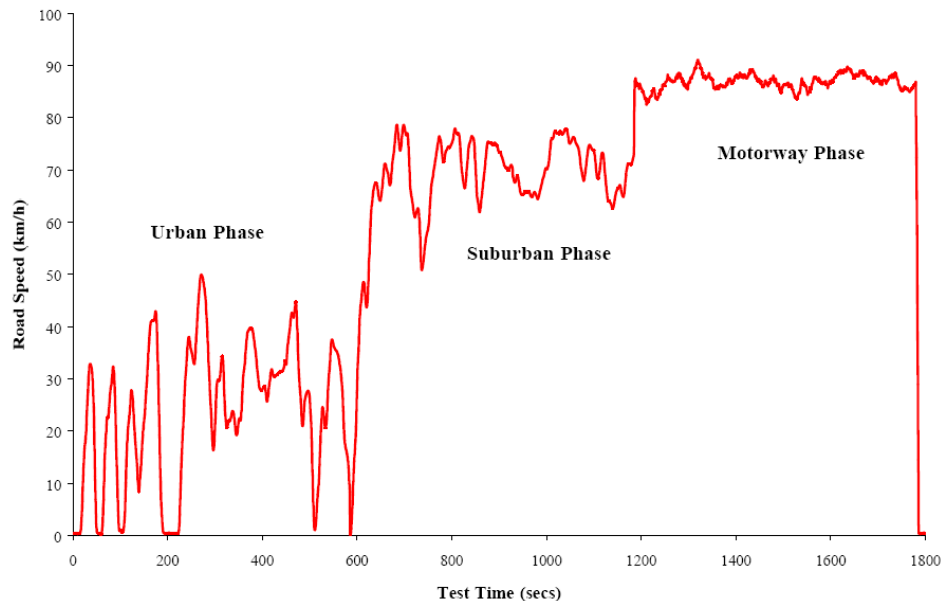
- Available means of proving fuel economy require back-to-back testing of the reference oil (15W-40) and the fuel economy oil (10W-30). The tests we used were:
  - 1. Dynamometer test stand (controlled conditions)
    - Monitor fuel consumption and CO2 emissions
  - 2. A single truck open road test (on-highway dedicated route, constant load)
    - Monitor fuel consumption and CO2 emissions
    - Monitor speed, idle time, etc
  - 3. A fleet demonstration (3 or more trucks in a fleet)
    - This is real life...non dedicated routes. Typically full loads.
    - Monitor fuel consumption vs. identical sister units

# TEST SET 1--DYNO STAND

## Test Cycle—All Labs

- Testing on a 48 inch roll heavy duty chassis dynamometer equipped with a constant volume sampling emission measurement system.
- Comparison testing performed over the European Transient Cycle (ETC) lasting 30 minutes using ultra low sulfur diesel fuel.

Vehicle  
Speed,  
km/hr



Time, Seconds (1800 = 30 minutes)

# TEST SET 1 RESULTS

- Dynamometer—independent test lab
  - European testing—10W40 synthetic ref. oil
    - Scania, DAF (0.6-0.7%)
  - North American testing—15W-40 mineral ref. oil
    - Freightliner (2010 Detroit Diesel 15 with SCR, 0.7%)
    - Cummins (2007, US07, 1.5%),
    - Cummins (2009 ISM 410, 1.2%)

# TEST SET 2. Open-Road Test

Kenworth Dump Truck (a.k.a. Blue Beast)



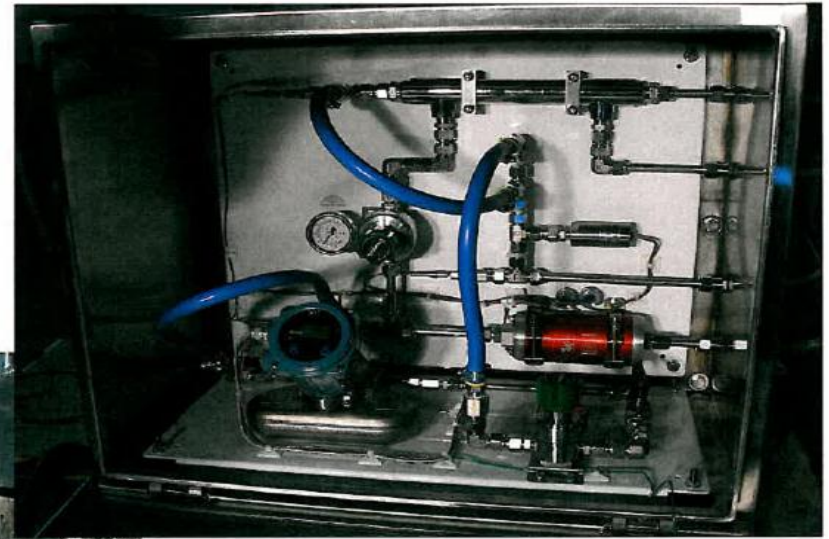
- Kenworth 2008 T800 Dump Truck
- Back to back testing of lubricants.
- 1000 miles/day on the same road for 5 days.
- Constant load—48,000 lbs gross.
- Constant diesel quality; tire pressure control.
- DPF regeneration by driver inhibited.
- 2 shifts – 2 drivers. Operated at posted speed limits.



# OPEN ROAD TEST (5000 MILES)

Kenworth --Cumins ISM 425  
(260,000 miles on Engine)

Mass Flow Fuel  
Measurement System



# TEST SET 2: On Road Testing— Additional Information & Results

- Back to back testing of lubricants
- Driving information
  - Operated at posted speed limits.
  - Average 55.8 mph baseline versus 55.4 mph with FE.
  - Operations:
    - **Cruise control 53 to 54% of the time.**
    - **Idle time 3%**
    - **Time in top gear 89%.**
  - Elevation range 596 to 1246 ft.
  - Idle time 3%.
- Fuel economy 5.91 mpg vs 6.06 mpg with FE (2.5%)
- DPF regeneration by driver inhibited.

# TEST SET 3--RESULTS

- Three-truck fleet demonstration (50,000 mile drain)
- This fleet is primarily on-highway driving with little stop and go driving.
- Results
  - Normal wear metals
  - Oil remained in grade (slight increase)
  - No unscheduled down time
  - Fuel economy versus rest of fleet: 4.4-5.2%
  - Fuel economy versus sister 2010 units: 2.9-4.1%
  - TAN (total acid number of used oil) is around 4 at oil drain. The TBN (total base number) was also 4.

# NOTABLE ASPECTS OF THIS DEMO

- Many fleets have mixtures of different manufacturers trucks. This fleet has 1000+ units.
  - This fleet has all a mixture of a single manufacture-- Detroit Diesel—by model year (all DPF types):
    - $\frac{1}{4}$  were 2006,  $\frac{1}{2}$  were 2007,  $\frac{1}{4}$  is 2010
- Many fleets do not extend drains with mineral-based 15W40 to 50,000 miles. Larger sump size and larger filters and high quality filters were required for this interval drain. Samples are also taken at 25,000 mile service interval
- Fleet used high quality fuel (not biodiesel) to go long extended drains

# OVERALL TEST SUMMARY

- Dynamometer—independent test lab vs. 15W-40 ref.
  - Scania, DAF (0.6-0.7%)—10W-40 reference oil.
  - Freightliner (2010 Detroit Diesel 15 with SCR, 0.7%)
  - Cummins (2007, US07, 1.5%),
  - Cummins (2009 ISM 410, 1.2%)
- On-highway loaded dump truck (Kenworth)
  - Cummins ISM 425, model year 2008. 2.5%-3.3% savings. 5000 mile dedicated route.
- Fleet test—3 truck (summer 2010, 500,000 mi drain)
  - Detroit Diesel 2010, DPF (diesel particulate filter), no SCR (2.9% to 4.1% vs. sister units; up to 4.5% vs. rest of fleet)
  - TBN reserve at 4, normal wear results, no operational problems

# FUEL ECONOMY OIL

- Normal 15W-40 engine oil is mineral based and is API licensed CJ-4 engine oil
- The 10W-30 fuel economy (FE) oil used in all of the testing is a licensed CJ-4 synthetic blend containing 30% synthetic in the oil. It contains a different additive blend than normal 15W-40.
  - Synthetic blends are not defined by any organization, so please ask your supplier for the percentage of synthetic in their synthetic blend.
  - Be wary of mineral-based 10W-30 without any synthetic may not give the same fuel economy as a synthetic blend.
- 10W-30 FE is blended to the high side of the grade

# GOING FORWARD—DEMO FLEET

- The three truck demo fleet
  - 10W-30 was extended into all different model years of the fleet for the winter of 2011-2012. This includes SCR equipped trucks (which require DEF fluid for the catalysts). This oil will improve cold weather starts.
  - The change in grade has been invisible to the drivers (no comments or issues). No oil pressure issues.
- Expectations
  - Better fuel economy (percentage) in the winter than during the summer due to cold starts.

# OTHER FLEETS

- Other fleets
  - 15W-40 is the current work horse grade in the US.
  - 10W-30 will become the work horse grade within 10 years. Large fleets can save a lot of fuel money by converting early, even if the oil cost is higher for the 10W-30 grade at this time.
  - 10W-30 is also recommended for stop/go fleets or high idling fleets. Fuel economy will occur, but random routes can make this impossible to see in a small 3 truck demonstration. Only a full conversion of the fleet will one see savings.
  - Synthetic blends may give some fleets an option to extend their current drain as well as giving fuel economy.



# PRODUCT GROWTH?

- Competition.
  - Current users of cutting edge product conflicts with the concern of revealing an advantage over a competitor fleet.
- Privacy.
  - Current users may not want to be pestered by competitors or other fleet owners by phone calls and want to keep a low profile.
- Economics.
  - It takes a leap of faith to believe in the true savings and justify spending an additional amount on this technology (synthetic blend vs. mineral) even if two percent fuel savings were guaranteed. If it were cost neutral, the number of large fleets would increase rapidly (no risk, high reward potential).
  - There is no true way to know actual savings in a fleet after converting the entire fleet. Directionally one can calculate the fleets corporate average fuel economy but still wonder how much was due to purchases of newer units, tires, weather, etc.

# SUMMARY

- 10W-30 FE diesel engine oils will not grow rapidly until equipment manufacturers recommend them over 15W-40. Until then only large sophisticated fleets are expected to use them.
- The API and EPA are working to define fuel economy diesel engine oils. Benefits will be fuel savings and less greenhouse gas from burning fuel
- Not all 10W-30 engine oils will be synthetic blends, and not all synthetic blends will be equal in performance (or in composition).
- No performance issues were found in the US by switching from a 15W-40 to a 10W-30, and fuel economy of over 2% should be your expectation.



# QUESTIONS

- ?????