

Detroit DD13 Taskforce Agenda Meeting Minutes

Thursday September 6, 2012

Lab/Stand Tour

Jim Matasic led a tour of the Lubrizol lab and DD13 test stand prior to the start of the meeting. The tour concluded at 9:45 a.m.

Attendance

The meeting attendance is shown in Attachment 1.

Test Needs Statement

John Cruz of Detroit Diesel presented a Test Needs Statement, which is shown in Attachment 2, pages 3-6. Riccardo Conti asked if other EMA members have expressed these concerns as well; John Cruz stated that EMA fully supports this test. Bob Campbell asked if the T-12 addressed these issues and John stated that the T-12 does not address adhesive wear.

Test Scope and Objectives

The Scope and Objectives are shown on page 7 of Attachment 2.

Timeline

The project timeline is shown on page 8 of Attachment 2.

Engine Stand Setup

Presented by Jim Matasic, shown on page 9 of Attachment 2. LZ and Jim Gutzwiller will establish the critical parts list. Engine control and diagnostics will be provided by Detroit Diesel. Jim noted that aftercooler dp will likely be a controlled parameter.

Initial Testing Cycle/Results

Jim Matasic summarized the testing done to date, shown in Attachment 2, page 10. Through two tests, no scuffing occurred. The third test has just completed; higher wear metals were noted, but no operational indications of scuffing, and the inspection of the liners has not yet occurred. Next steps are to find the engine test conditions that produce repeatable scuffing that can be then resolved through chemistry. Possible changes could be: reduced flow to piston cooling nozzles; increased power; piston ring hardware change.

Oil Analysis Scheme

The oil analysis scheme is shown on page 11 of Attachment 2.

Wear Measurement Methods

Wear measurement methods are shown on page 12 of Attachment 2. In addition to liner measurements, ring and bearing weight loss, and wrist pin/connecting rod bushing surface finish measurements are also being taken.

Critical Hardware

A critical hardware list is shown on page 13 of Attachment 2. This is just an initial list and is still being developed. Detroit Diesel will be working with TEI to provide the test kits.

Hardware Procurement

Detroit Diesel is working on a life of category supply of engines and critical parts (statement shown on pag14, Attachment 2)

Test Oils

John Loop of Lubrizol discussed the test oils (page 15 of Attachment 2). The oils are 2.9 HTHS blended for the DD13. The DI package is from a CJ-4 platform. The two oils are specifically formulated to be poor performers in regards to adhesive wear. Once scuffing is obtained, other 2.9 HTHS oils will be tested to demonstrate scuffing resistance. Some concerns were expressed that it would be nice to have an oil with known field scuffing problems for use in the test development.

The meeting adjourned at approximately 11:35 am.

ATTACHMENT 1

| Member | Company | E-Mail Address | Phone Number | Sign-In |
|-----------------|------------------|--|--------------|------------------------|
| Bob Campbell | Afton | bob.campbell@aftonchemical.com | 804-788-5340 | <i>ACC</i> |
| Tom Wingfield | Chevron Phillips | wingftm@cpchem.com | | |
| Shawn Whitacre | Cummins | shawn.whitacre@cummins.com | 812-377-6215 | |
| Bob Shureb | Detroit | robert.shureb@daimler.com | 313-592-7435 | |
| Greg Brazianas | Detroit | gregory.brazianas@daimler.com | 313-592-7007 | |
| Jason Krietsch | Detroit | jason.krietsch@daimler.com | 313-592-7975 | |
| John Cruz | Detroit | john.cruz@daimler.com | 313-592-7469 | |
| Mesfin Belay | Detroit | mesfin.belay@daimler.com | 313-592-5970 | <i>Mesfin Belay</i> |
| Jeremy Dean | Detroit | jeremy.dean@daimler.com | 313-592-7434 | <i>JD</i> |
| Mike Alessi | ExxonMobil | michael.alessi@exxonmobil.com | 856-224-2309 | |
| Riccardo Conti | ExxonMobil | riccardo.conti@exxonmobil.com | 856-224-2681 | <i>Riccardo Conti</i> |
| Bob Salgueiro | Infineum | bob.salgueiro@infineum.com | 908-474-2492 | <i>Bob Salgueiro</i> |
| Jim Gutzwiller | Infineum | james.gutzwiller@infineum.com | 210-732-8123 | |
| Joan Evans | Infineum | joan.evans@infineum.com | 908-474-6510 | <i>Joan Evans</i> |
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| Chris Castanien | LZ | chris.castanien@lubrizol.com | 440-347-2973 | <i>Chris Castanien</i> |
| Jess Hamilton | LZ | jesse.hamilton@lubrizol.com | 440-347-4019 | |
| Jim Matasic | LZ | james.matasic@lubrizol.com | 440-347-2487 | |
| Greg Shank | Mack/Volvo | greg.shank@volvo.com | 301-790-5817 | |
| Ken Goshorn | Mack/Volvo | kenneth.goshorn@volvo.com | 301-790-5848 | |
| Jim Rutherford | Oronite | jaru@chevron.com | 510-242-3410 | <i>Jim Rutherford</i> |
| Mark Cooper | Oronite | mawc@chevron.com | 210-731-5606 | <i>Mark Cooper</i> |

ATTACHMENT 2



Detroit DD13 Task Force

Wickliffe, Ohio 9-6-12

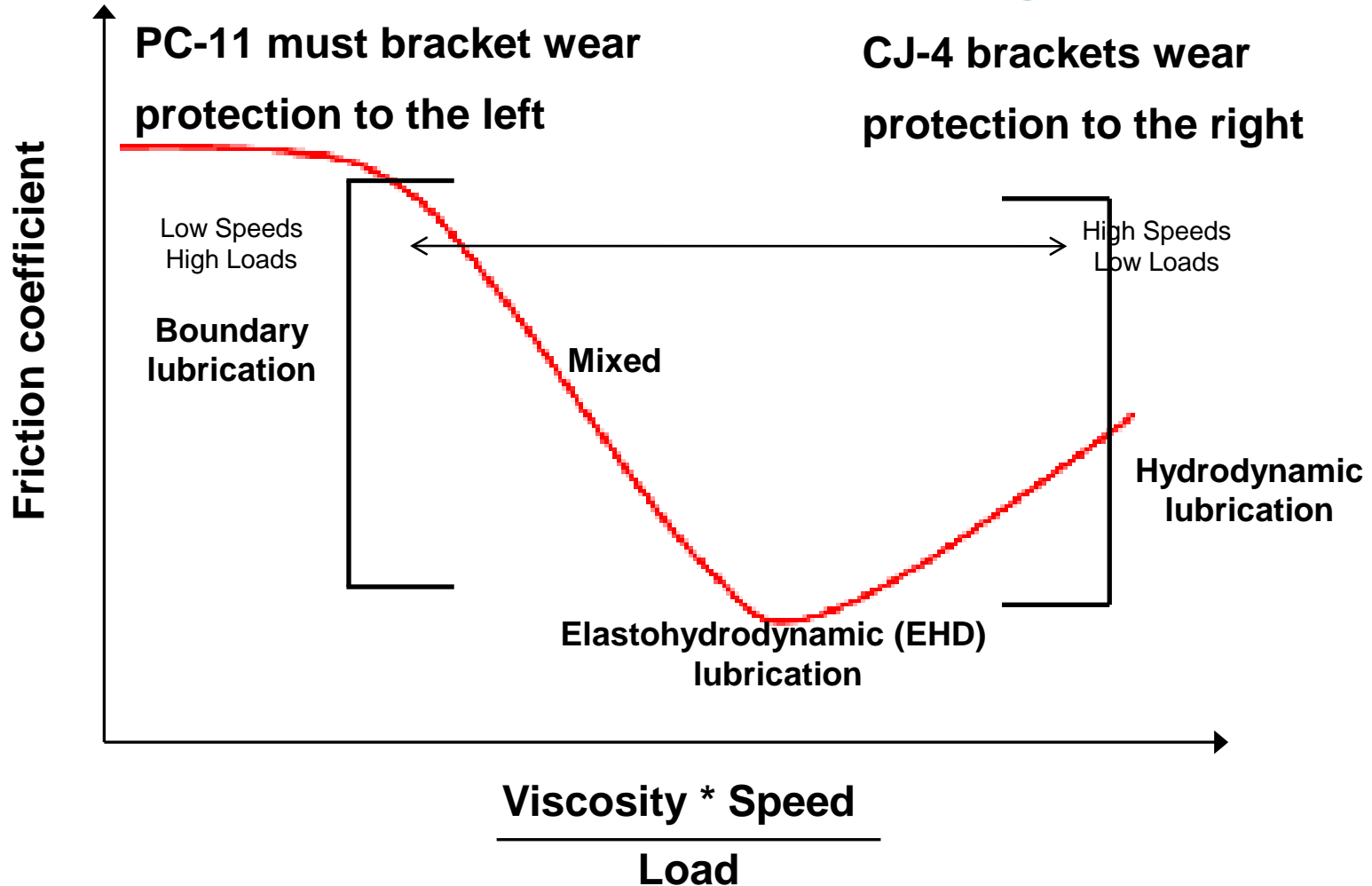


Agenda

- **Lab/Stand Tour** **Jim Matasic**
- **Test Needs Statement** **Detroit**
- **Test Scope and Objectives** **Jim Matasic**
- **Timeline** **Jim Matasic**
- **Engine Stand Setup** **Jim Matasic**
- **Initial Testing Cycle/Results** **Jim Matasic**
- **Oil Analysis** **Jim Matasic**
- **Wear Measurement Methods** **Jim Matasic**
- **Critical Hardware** **Jim Matasic**
- **Hardware Procurement** **Jim Matasic**
- **Test Oils** **John Loop**
- **Topics for next meeting** **Jim Matasic**
- **Schedule for Next Meeting** **Jim Matasic**

Why do we need a scuffing test

Stribeck Curve of Lubrication Regimes



Test Needs Statement

- The industry has done a good job creating specifications which put high quality lubricants in the field to address manufacturer's needs.
- However, the industry tends to look backwards at older needs, not forward to the needs that are coming
- PC-10 did not include protection against adhesive wear – and that protection was needed. There are many spots in an engine where inadequate film thickness and insufficient additive protection can lead to adhesive wear. Not just with lower viscosity oils but even with oils that meet today's CJ-4 HTHS limits.
- Daimler has tested certain engine hardware and different engine calibrations which have shown the possibility of adhesive wear with CJ-4 oils. While Daimler has no issues with adhesive wear in the field, this risk has not been addressed by the existing API heavy duty engine oil specifications.
- PC-11 will move the manufacturers to even lower film thicknesses and clearly increases the possibility of adhesive wear. PC-11 oils must address this need. That is why Daimler is sponsoring this test and want it included in PC-11, both for low and high HTHS specifications.

CJ-4 Testing

- Risks identified in control fleet
 - Potential for increased warranty rates
- Does not reflect final component selections for production engines

| | 15W-40 | 5W-30 | 10W-30 |
|------------------------|-----------|-----------|-----------|
| Dyno | 24 | 33 | 15 |
| Fleet | 28 | 20 | 14 |
| Total | 52 | 53 | 29 |
| Engine Seizures | 0 | 1 | 2 |

Test Needs Statement

From: robert.shureb@daimler.com [mailto:robert.shureb@daimler.com]

Sent: Wednesday, September 05, 2012 12:27 PM

To: Castanien, Chris; Duncan, David; Matasic, James

Cc: gregory.braziunas@daimler.com; jeremy.dean@daimler.com; john.cruz@daimler.com; Loop, John; mesfin.belay@daimler.com; wolfgang.sladek@daimler.com; admir.kreso@daimler.com; uwe.boehn@daimler.com; mark.groeneweg@daimler.com

Subject: RE: DD13 Task Force Presentation

All,

Daimler HDEP Engineering fully endorses the DD13 scuff test as an integral part of PC-11 test protocol. A reliable test of the "scuff resistance" of new oil's will be needed to support the industry as the new oil technologies unfold. We are committed to meeting the challenges of developing a reliable and efficient test with the DD13 engine. We are grateful for Lubrizol's collaboration and teamwork in this effort.

Bob Shureb

Manager, Component Engineering

Cooling, Lube Oil, and CCV Systems

Daimler Trucks North America

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Test Scope and Objectives

Scope

This Task Force is responsible for development of the Detroit DD13 engine test. It is accountable to the ASTM Heavy Duty Engine Oil Classification Panel and subsequently to ASTM Sub-Committee B0.02.

The Task Force will strive to achieve its objectives via close cooperation and interaction with the test sponsor, participating test laboratories, and other ASTM functions (including Task Force Sub-Groups, the Test Monitoring Center, and the designated Central Parts Distributor).

Objectives

- Evaluate preliminary test configuration and operational conditions and develop accordingly.
- Expedite test procedure consistent with PC-11 timeline.
- Identify and evaluate key performance criteria.
- Demonstrate discrimination with respect to key performance criteria.
- Optimize test procedure for maximum test precision and reliability.
- Monitor PC-11 matrix execution.
- Monitor/assist statistical evaluation of matrix data.
- Recommend HDEOCP endorsement of DD13 test, key performance criteria and associated limits.
- Complete ASTM ballots for test standard approval.
- Complete ASTM ballots of Detroit DD13 research report

Specific Activities

- Develop Primary Test Parameters
 - Power Cylinder Scuffing
 - Determine best method of scuffing evaluation, pass/fail/etc
- Evaluate and Compare Range of Secondary Test Parameters
 - Con Rod Bearings
 - Top Ring Weightloss
 - Cylinder Liner Wear

Timeline

- Test demonstration
 - 4Q 2012 thru 1Q 2013
- Installation at other labs to begin
 - 1Q 2013
- Test standard finalized and discrimination testing
 - 2Q 2013 thru 4Q 2013
- Precision matrix to begin
 - 1Q 2014

Engine Stand Set-Up

- EPA10 DD13 Engine
 - To transition to 2013 parts as soon as available
 - Parts list will be put together by LZ and Jim Gutzwiller
- Engine control/diagnostics provided by Detroit
- Stand specifics will be provided to labs at time of install
 - Temperature locations, pressure locations, specific controls, etc
 - CAC differential controlled
 - Intake air restriction controlled

Initial Testing Updates

- 3 tests run at LZ
- 1st Test (new build)
 - 96 hours
 - 3 stages with modified MCM calibration to stress liners
 - 1300rpm/2371Nm (8 hours)
 - 1700rpm/2191Nm (8 hours)
 - Soak (4 hours)
 - No scuffing, but high liner distress
 - Liner Wear (3 microns)
 - Top Ring Weightloss (17 mg)
 - Upper Rod bearing Weightloss (22 mg)
- 2nd Test (new build)
 - 100 hours with factory MCM calibration
 - Steady state with reduced flow piston cooling nozzles
 - 1400rpm / 1400Nm (cautious)
 - No scuffing
- 3rd Test (continued on build from 2nd Test)
 - 100 hours
 - 1600rpm/1800Nm (in progress)

Oil Analysis

- Analytical results will be compiled and distributed to the task force at a later date
- Samples every 20 hours
 - TGA
 - Viscosity
 - Fuel Dilution
 - HTHS
 - ICP
 - TBN
 - TAN
 - 90 Pass Shear
 - Oxidation/Nitration

Wear Measurement Methods

- Liner Scuffing
 - Visual rating
 - Crankcase pressure increase is operational signal
- Liner Wear, Ring Weightloss, Bearing Weightloss
 - Standard Mack T-12 Methods
- Wrist Pin/Connecting Rod Bushing Surface Finish
 - Using surface analyzer at multiple positions
 - Compare NEW to EOT
 - Nothing seen on first test

Critical Hardware

- Detroit to work with TEI
 - Cylinder Liners
 - Piston Rings
 - Pistons
 - Rod Bearings
 - Main Bearings
 - Connecting Rods
 - Wrist Pins

Hardware Procurement

- Detroit working on PC-11 Supply of hardware for engines and critical parts

Test Oils

1. Fully formulated 2.9 HTHS oils have been blended for DD13 test.
2. These 2.9HTHS oils have not run in field tests or CJ-4 engine tests
3. However, DI packs are built from an existing CJ-4 core DI platform
4. Two oils specifically targeted to be poor performers. One oil was formulated with characteristics of the oils which Daimler (DDC) has seen adhesive wear concerns with when testing certain hardware and engine calibrations.
5. The poor performer target oils are being tested at DDC and LZ to establish repeatable levels of scuffing. Once that is established, other 2.9 HTHS oils will be tested to demonstrate scuffing resistance
6. Oils being tested are demonstration oils. Specifics (beyond what has been provided above) regarding formulation strategies will not be shared. Physical / Analytical characteristics will be published by TMC for reference oil(s) that are selected for the DD13 Scuffing test.

Next Meeting

- Topics
 - ???
- Date
 - ???