DD13 Task Force Meeting Minutes

June 5, 2014

Paulsboro, NJ

Attendance

SwRI - Martin Thompson, Jim McCord, Bob Warden
TEI - Mark Sutherland
Intertek - Brad Carter, Jim Moritz
Volvo - Bengt Otterholm, Allison Athey, Greg Shank
Afton - Christian Porter, Bob Campbell
Chevron - Shawn Whitacre
Infineum - Jim Gutzwiller, Joan Evan, Elisa Santos, Bob Salgueiro
Oronite - Mark Cooper, Jim Rutherford (via conference call)
TMC - Jeff Clark, Sean Moyer (via conference call)
Lubrizol - Jim Matasic, Mike Conrad, Kevin O'Malley (via conference call)
John Loop (via conference call)
ExxonMobil - Steve Kennedy, Mike Alessi
Daimler - Mesfin Belay, John Cruz, Greg Braziunas

CPD Report - Mark Sutherland (presentation attached)
In general parts supply is in good order.

- There are two different part numbers for liners. There is no difference in the parts, they are basically identical. Labeling appears to be the only difference.
- There has been a change in piston pins. The end of the new pins have a recess. The test will run the old design until further notice.
- TEI presented the comprehensive parts list. Items in red indicate an item that has changed.

Meeting Goals - John Cruz
Two main goals for the meeting are to determine 'Fit for purpose' and 'Matrix readiness' status.

Data Review - Jim Matasic (presentation attached)
Jim noted that EOT soot was higher for Lubrizol's tests compared to SwRI and IAR (oil C runs). A change to new injectors appears to have reduced soot generation and it was noted that SwRI and IAR tests were with new injectors. An injector life limit or soot limit may need to be considered.

Fit for Purpose - John Cruz
John stated that Daimler believes that the test is fit for purpose because it addresses a PC-11 need, it responds to formulation differences, and it correlates to the field. John asked if there were any questions and none were forth coming. Jim Matasic moved, and John Cruz second, that the task force declared the test was fit for purpose. Discussion notes:

- Shawn Whitacre of Chevron asked what was the relevance of the test running with uncoated rings to the field. John Cruz responded that he felt it correlates to oils C and D.
- Bob Salgueiro reiterated Infineum's concerns regarding the reversing of relative performance of oils A and B when hardware was changed. John stated he is more confident of the results of the current procedure rather than the version the earlier A and B results were generated from.
- Infineum was also concerned about the use of uncoated rings. Greg Braziunas stated that the service concern is mountain routes and the uncoated rings are used in the test to accelerate the engine wear.
- Bob Campbell echoed Infineum's concerns and stated he was not convinced that it is understood how oils A and B perform in the field and therefore doesn't have confidence that the test will properly screen oils. He was also worried that shutdowns appear to be driving scuffing. Jim Matasic responded that the scuffing response to shutdowns is varied and may not be directly causing the scuffing. Jim also stated that oils A and B were run on a different version of the procedure. The relative performance of those oils is not relevant to the pass/fail regime.
- Greg B stated that the field scuffing failures originally associated with Oil B were later to determined unrelated to oil performance. Bob asked if that was the motivation for the test, is there then still a need? Greg stated that there is no other scuffing protection in PC-11, so they believe the test is still needed, especially with lower viscosities and the scuffing events aren't the main motivator for the test.
- Mark Cooper of Oronite stated they are very concerned about the use of uncoated rings. They also have field data on low HTHS oils and have not seen any scuffing. Greg B stated that he believes those oils would pass, but there is still a need to screen out oils that would scuff.
- Sean Moyer asked if oil C was a passing oil if it had scuffing in the field. Greg responded that oil C's performance in the field is acceptable and can be used to set passing performance level. After a question from Bob Campbell, Greg conceded that the task force does not currently have a failing oil, but what they are trying to protect against is a borderline formulation that only changes viscometrics to meet lower viscosity limits.

- At this point in the meeting, Daimler reviewed some information to hopefully address questions (see attached presentation). Daimler proposes using comparison to reference oil results to determine pass/fail of a candidate, using a margin of measurement error. It was noted that Matrix oils are not necessarily viewed as potential reference oils. Daimler desires an oil that performs similar to oil C. Daimler proposes that each stand run the reference oil both before and after the matrix runs. After lots of free flowing comments, questions, and discussion, the vote was taken.

  Vote:
  Daimler - Yes
  Lubrizol - Yes
  ExxonMobil - No
  TMC - Waive
  Afton - No
  Oronite - No
  Infineum - No
  Chevron - No
  Volvo - Waive
  Intertek - Yes
  TEI - Yes
  SwRI - No

The motion failed to carry with 4 Yes, 6 No, 2 Waive. It was commented by Daimler and Lubrizol that they believe fit for purpose has been met but the discussion and the results reflect more of a vote on matrix readiness. Much more discussion occurred without resolution or a clear path forward. Steve Kennedy suggested that perhaps the first step is for EMA to examine this issue and then bring a position forward regarding the DD13 test, recognizing a delay may be unavoidable.

At this point, the meeting was approaching the end of its published time and members were leaving to meet their travel arrangements.

The meeting adjourned at roughly 4 p.m.

Detroit Diesel DD13

CPD Report

Mark Sutherland 6/4/2014

DD13 CPD Report
Contents

- Issues/Updates/Observations
  - Liners
  - Piston Pins
  - Parts List

DD13 CPD Report
Parts

- Liners
  - 2 different part numbers possible
    - R4710112910 and R4710110810
    - No difference in the part
      - Both machined on the same line

DD13 CPD Report
Parts

DD13 CPD Report
Parts

- Piston Pins
  - Change in part and part number
    - R47102001 and R47104001
  - R47104001 supersedes 2001


A 471 02 001
A 471 04 001

DD13 CPD Report
Original Parts List

DDC 13 Rebuild Kit Parts List

	Part Number	Definition (DIBS)	QTY
1	A4710302217	Piston Assembly	6
2	A4710380110	Upper Con Rod Bearings	6
3	A4710380111	Lower Con Rod Bearings	6
4	A4710330101	Upper Main Bearing	6
5	A4710330202	Lower Main Bearing	6
6	A4710300020	Connecting Rod	6
7	A4710112010	Liner	6
8	A4710110259	CSR	
9	A0249943945	Top Liner Seal	
10	A0239975545	Bottom Liner Seal	
11	A4710161120	Cylinder Head Gasket for CSR	
12	A4710160069	Head Bolts	38
13	A4710507	Upper Thrust Bearing	2
14	A4710508	Lower Thrust Bearing	
15	A4719940241	Piston Pin Retainer	12
16	EA4710501231	Intake Rocker Shaft	1
17	A4729920350	Intake Rocker Shaft Narrow Spacer	6
18	A4729920650	Intake Rocker Shaft Wide Spacer	6
19	A4710500033	Intake Rocker Arm	6
20	EA4710500831	Exhaust Rocker Shaft	1
21	A4710550151	Ring (Exh Rocker Shaft Spacer)	6
22	EA4720501334	Exhaust Rocker Arm	6
23	A4720501634	Exhaust Rocker Arm	6
24	EA4710500034	Exhaust Rocker Arm	6
25	A4710160720	Upper End Gasket Set	
26		Special Made Top Ring	6

DD13 CPD Report
Current Parts List

DD13 Rebuild Kit Number _____

Date: **Assembler:** **Shipped to:**

Item	Qty	Delivered	Part Number	Description
1	6		A4710303017	Piston
2	6		A4710517	Second Ring
3	6		A4710818001	Oil Ring
4	6		A47104001	Pin
5	12		A4719940241	Retainer
6	6		A4710380110	Upper Con Rod Brgs
7	6		A4710380111	Lower Con Rod Brgs
8	7		A4710330101	Upper Main Bearing
9	6		A4710330202	Lower Main Bearing
10	6		A4710300020	Connecting Rod
11	6		A4710112910	Liner
12	6		A4710110259	CSR
13	6		A0249943945	Top Liner Seal
14	6		A0239975545	Bottom Liner Seal
15	6		A4711800043	Cooling Nozzles
16	38		A4710160069	Head Bolts
17	2		A4710507	Upper Thrust Bearing
18	2		A4710508	Lower Thrust Bearing
19	1		EA4710501231	Intake Rocker Shaft
20	6		A4729920350	IR Shft Narrow Spacer
21	6		A4729920650	IR Shft Wide Spacer
22	6		A4710500033	Intake Rocker Arm
23	1		EA4710500831	Exhaust Rocker Shaft
24	6		A4710550151	Ring (ER Shft Spacer)
25	6		EA4720501334	Exhaust Rocker Arm
26	6		A4720503034	Exhaust Rocker Arm
27	6		EA4710500034	Exhaust Rocker Arm
28	1		A4710161120	Head Gasket
29	6		HNF471C026	Special Made Top Ring
30	1		A4712030680	Gasket
31	1		A4712030780	Gasket
32	1		A4711420180	Gasket
33	1		A4711420280	Gasket
34	6		A4600700487	Bolt w/seals
35	1		A4722000154	Tube Seal
36	1		A4721400548	Tube Seal
37	1		A4721420880	Gasket
38	6		A4720980080	Gasket
39	1			Grooved O-ring
40	1			O-ring
41	1		A4712031180	Small Cover Seal
42	1		A4710160480	Valve Cover Gasket
43	1		A4710160221	Valve Cover Gasket
44	1		A0159975746	Seal Kit
45	1		A4720110180	Front Cover Seal
46	1		A0159974946	Seal Kit
47	1		A4710140422	Oil Pan Gasket
48	1		A4722010080	Waterpump Gasket
49	1		A4710150180	Seal Kit

Questions ?

DAIMLER

DD13 Scuffing Test Task Force Meeting

Paulsboro, NJ

June 5, 2014

Task Force Agenda

- Task Force Meeting Goals: Fit for Purpose & Matrix Readiness
- CPD Report
- Data Review
- Fit for Purpose
- Test Discussion
  - Scuffing Characteristics
  - Reference Oil Discussion
- Matrix Readiness
- Procedure/Test Report
- Next Steps

Task Force Meeting Goals

- Two topics of focus:
  1. Fit for Purpose
     - Does the test meet a need by an OEM?
     - Does the test discriminate in a meaningful way?
     - Does the test show relevance to the field?
  2. Matrix Readiness
     - Are the parts available for testing?
     - Are the stands ready for testing?
     - Does the test show the repeatability and reproducibility required for matrix testing?

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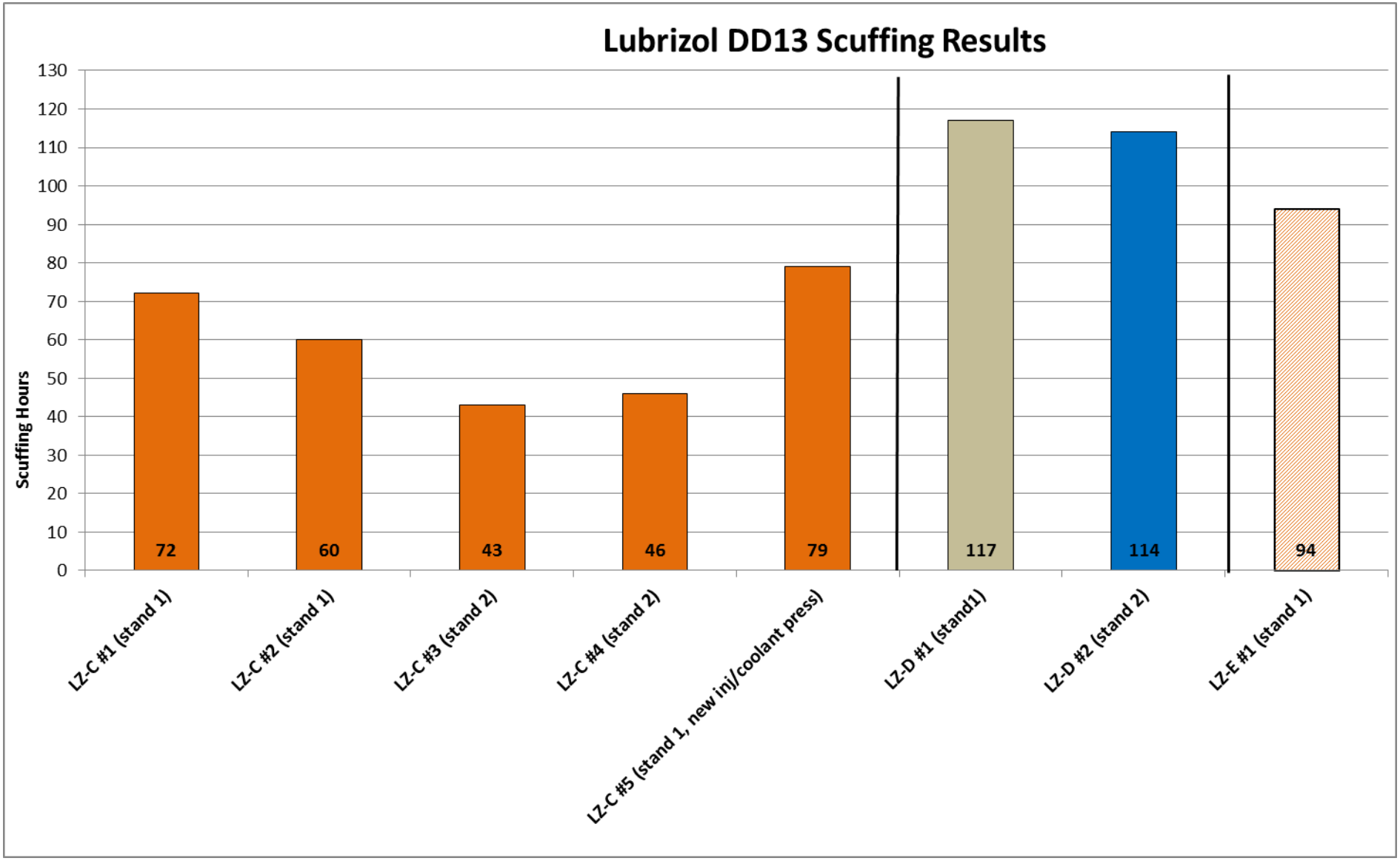
Data Review



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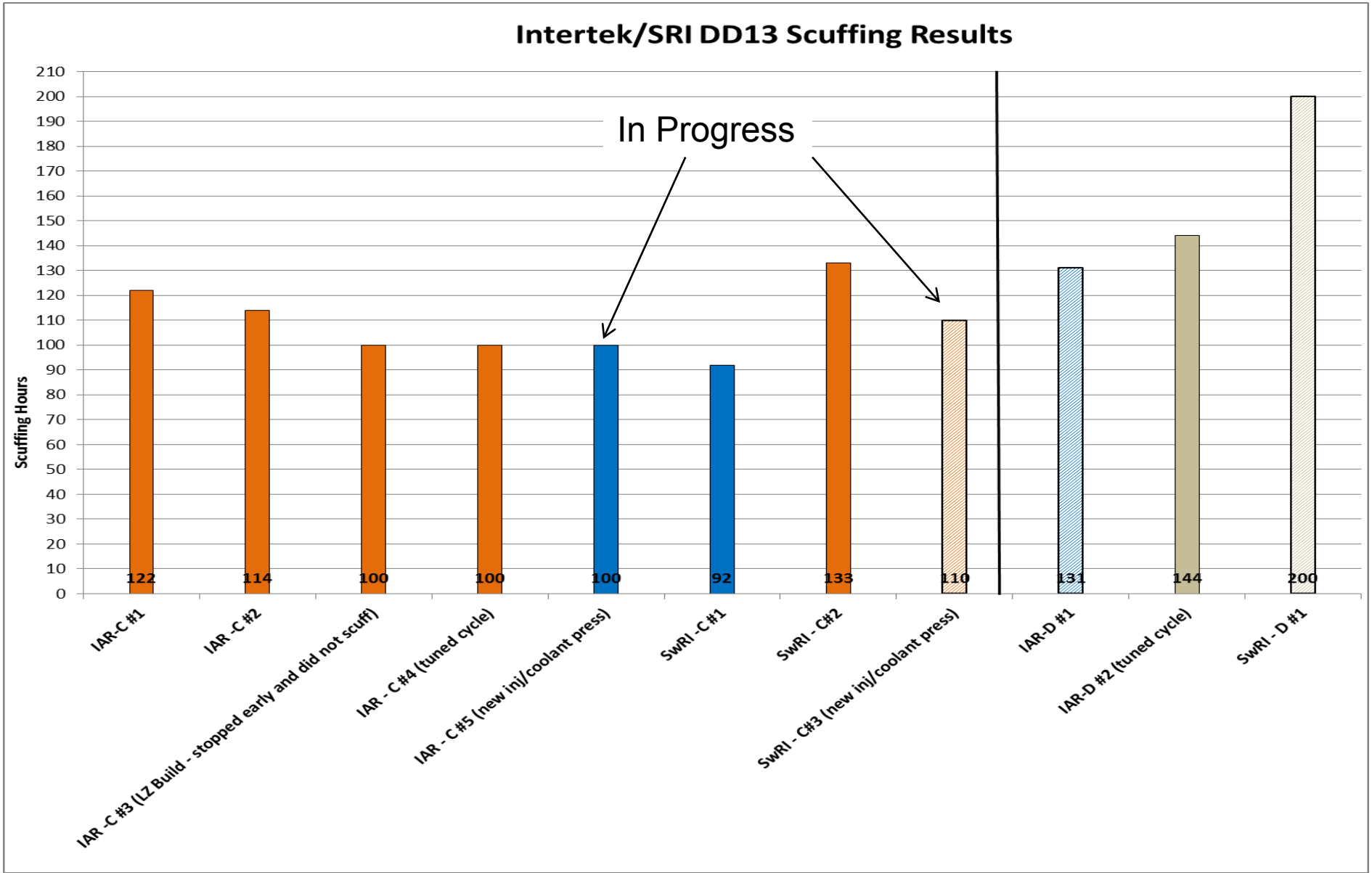
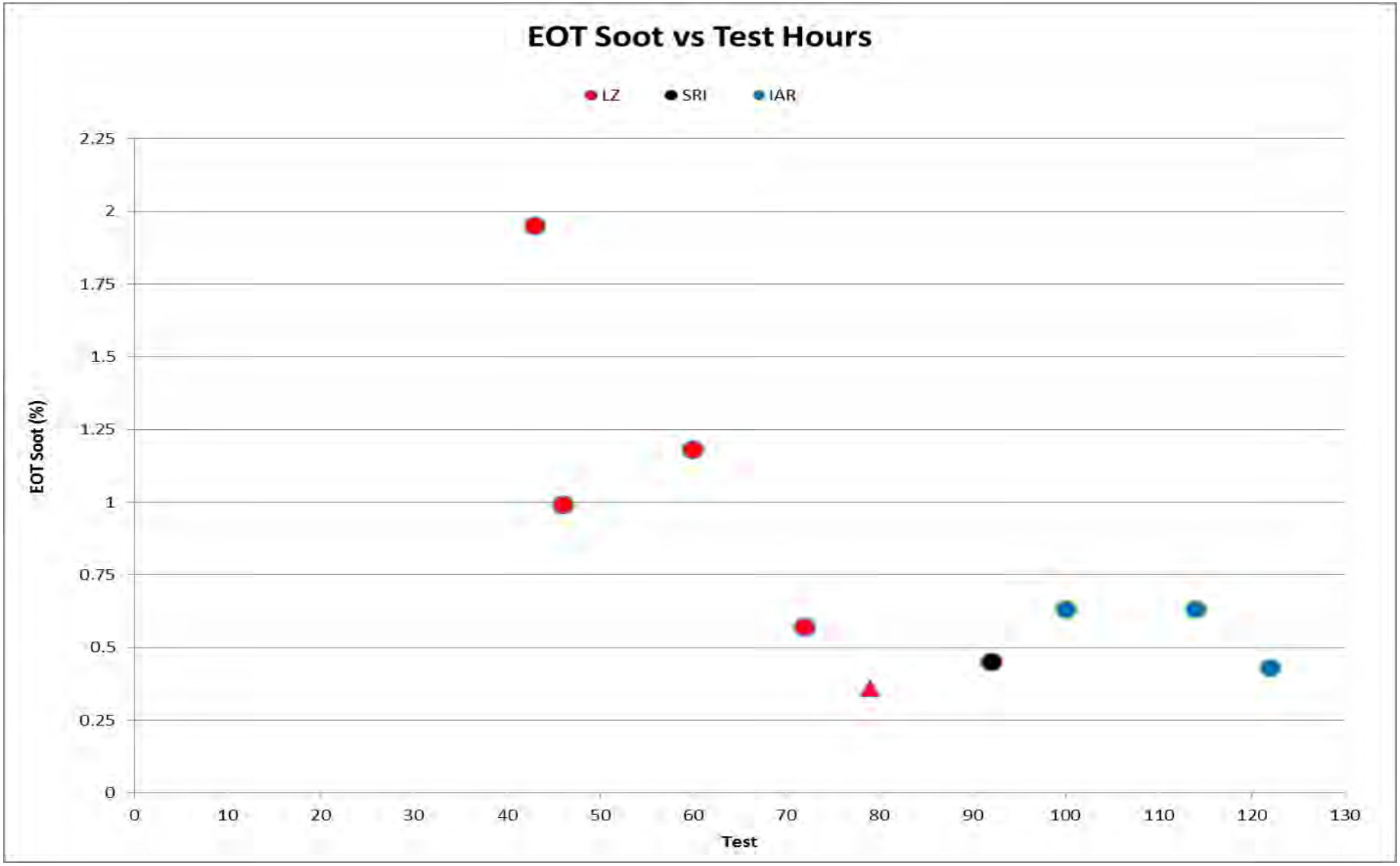
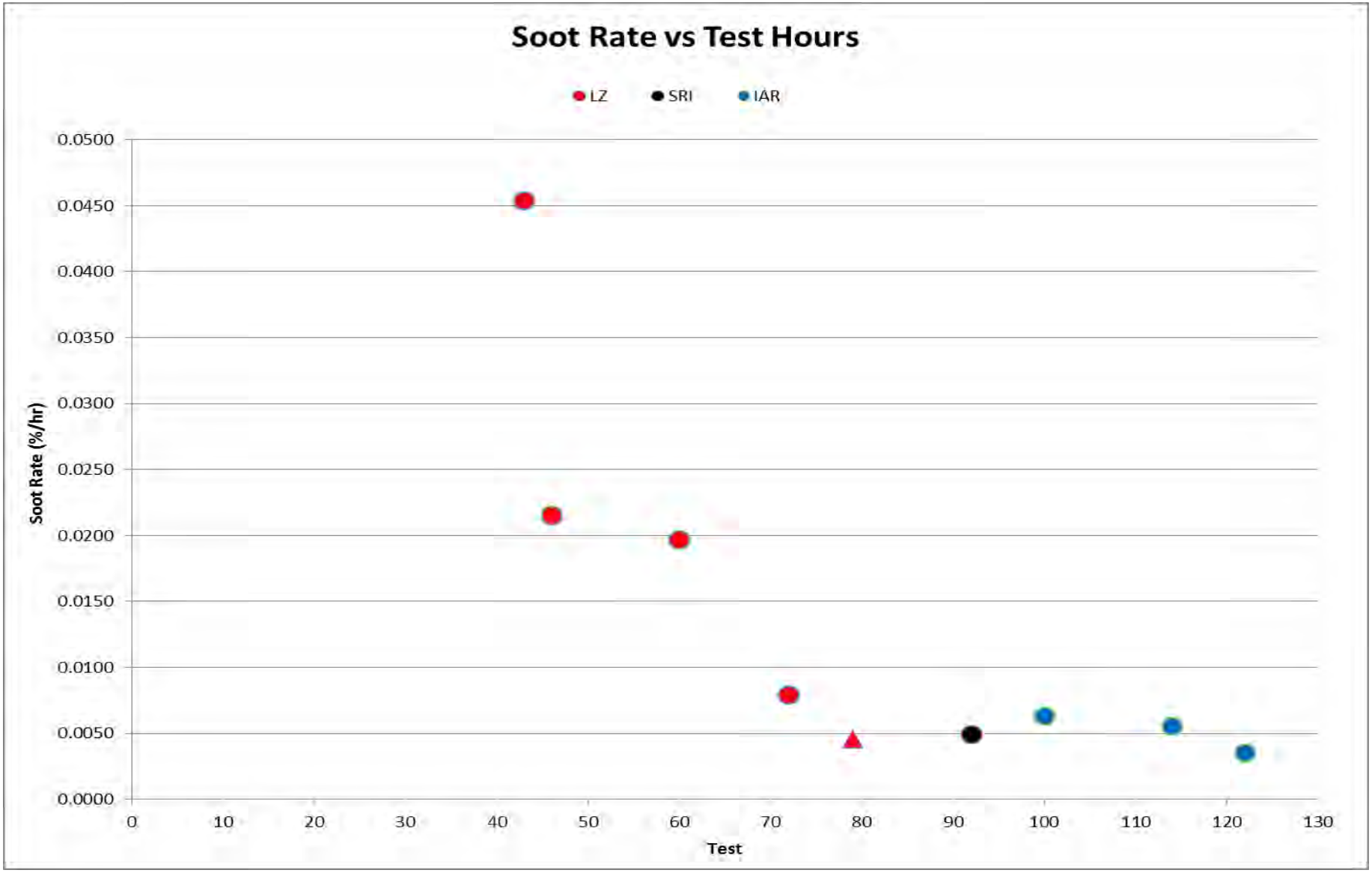
Data Review



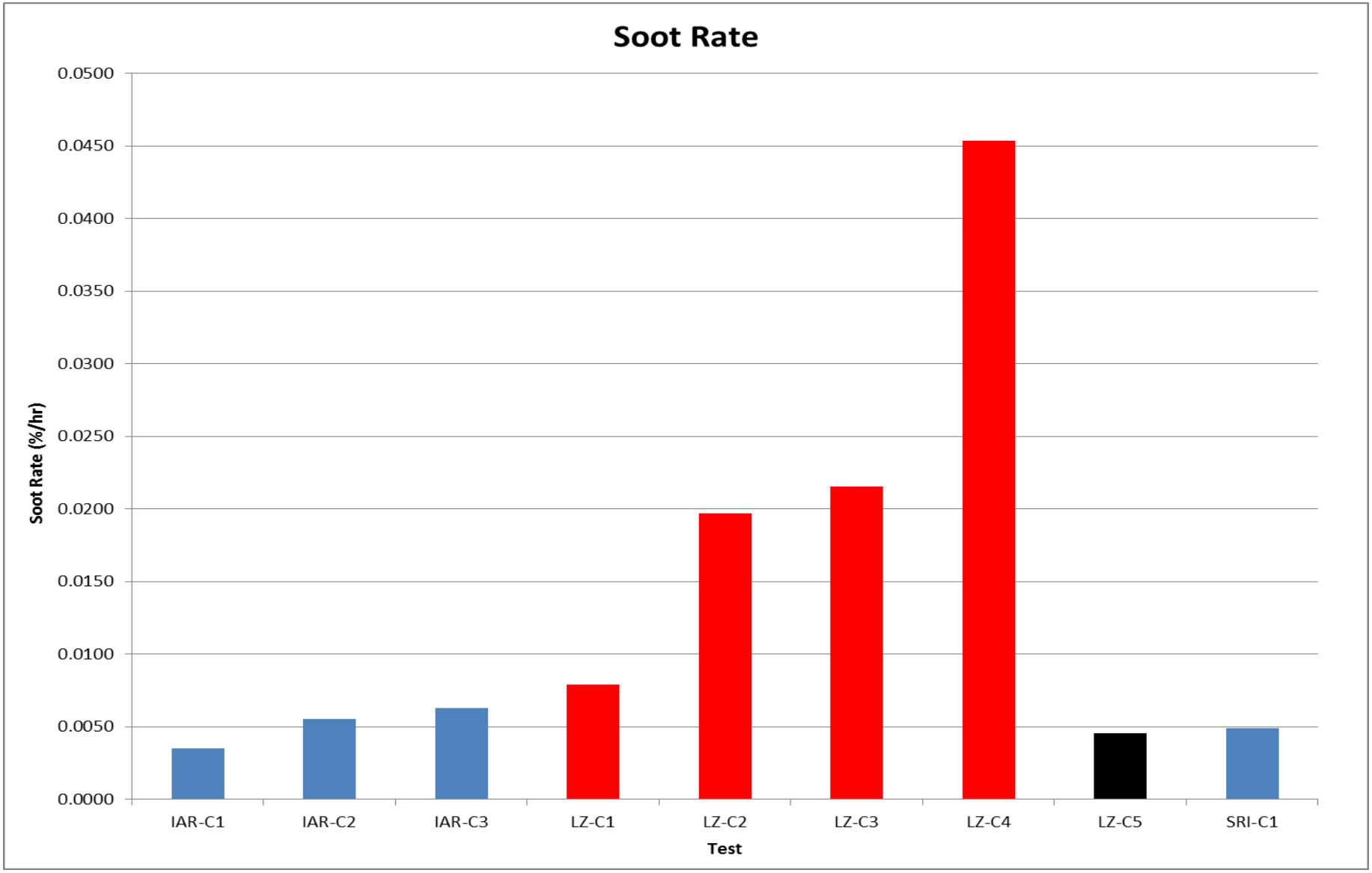
Data Review


EOT Soot vs Test Hours
LZ
SRI
IAR
EOT Soot (%)
2.25
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Test

Data Review


Soot Rate vs Test Hours
LZ
SRI
IAR
Soot Rate (%/hr)
0.0500
0.0450
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Test

Data Review


Soot Rate
0.0500
0.0450
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
Soot Rate (%/hr)
IAR-C1
IAR-C2
IAR-C3
LZ-C1
LZ-C2
LZ-C3
LZ-C4
LZ-C5
SRI-C1
Test

Fit for Purpose

The DD13 Scuffing Test has met the intended goals it had set to accomplish.

Goal	Rationale
Addresses a PC-11 Need	• Lower viscosity oil → More boundary / mixed lubrication → adhesive wear • No CJ-4 tests address adhesive wear • EMA requested scuffing test in June 21, 2011letter
Responds to formulation differences (not driven by oil viscometrics)	• All Labs discriminate Field Oils C & D • C & D share similar viscometrics →discrimination is based on formulation, not viscometrics
Field Correlation	• DDC field data on oils C and D

Scuffing Characteristics

- Scuffing is predominantly adhesive wear, characterized by localized welding, metal transfer, and extreme wear rates.
- A good engine can get into scuff mode by any number of conditions: oil performance, coolant temperature, combustion temperature, injection pressure and spray pattern.
    - Scuffing test eliminates possibility of oil performance.
- Evidence from scuffing tests shows that there is no meaningful parameter for scuffing over time – oil eventually “breaks” in a repeatable and discriminating manner. Scuffing is simply an ON / OFF failure mode.
- Time is a relative term – the test is a “run to failure” evaluation.
- **Based on this information, a simple pass / fail criteria can be achieved, all based on relative performance of a known reference oil.**

Proposal for Reference Oil

- Each lab has shown repeatability and correct directional or statistical discrimination between the field tested oils (Oil C and Oil D) in the DD13 Scuffing test
- Proposal: We would like to establish an in-lab pass / fail criteria in reference to a known oil
- If a stand consistently shows correct discrimination, then pass/fail limits could be determined by Reference Oil result at each stand as is done with referenced ACEA tests
- Potential criteria for rerunning reference oil could be set based on time, number of tests, test stand changes, and base engine changes
- Based on DD13 scuff test and field data, Oil C has been determined to be the borderline reference oil. The pass criteria is proposed to be $\geq$ Oil C with Oil C being a passing result
    - If Oil C cannot be made available as a permanent reference oil, then an oil with equal performance characteristics will need to be developed.

Reference Oil Precedence (Industry Tests)

- Several ACEA engine testing protocols determine Pass/Fail limits at individual stands based upon the candidate oil having equal or better performance as compared to a reference oil result in that stand

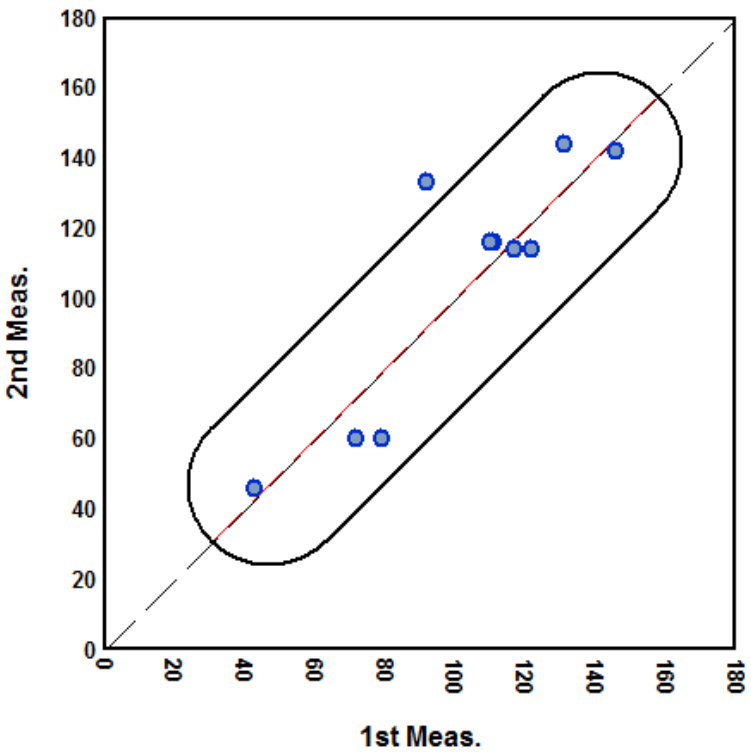
Examples:

Test Protocol	Measurement	Reference Oil Comparison
CEC K-088-02 (TU5JP-L4)	Piston Varnish Merits	≥ RL 216
	Viscosity Increase	≤ 0.8 x RL 216
CEC L-093-04 (DV4TD)	Viscosity Increase @ 100° C / 6% Soot	≤ 0.6 x RL 223
	Piston Deposits (Merits)	≥ (RL 223 – 2.5pts)
CEC L-078-99 (VW TDi)	Piston Cleanliness (Merits)	≥ RL 206 minus 4 points or ≥ RL 206
Daimler M271 test	Engine Sludge	≥ RL 140 + 4σ
CEC L-54-96 (M111)	Fuel Economy (%)	RL 191 (≥ 3, ≥2.5, or ≥ 1)

Daimler tests

Overall Measurement Margin of Error

- An overall measurement error term should be applied to acceptance criteria
- Data from current dataset was reviewed for a potential measurement error – example as follows
- Isoplot method (Shainin) used to calculate overall measurement error from all labs
- Based on this example, a ± 23 hour is a potential margin of error for test
- Margin of error would apply to all scuffing test measurements relative to the reference oil



Delta P = 123
Delta M = 46
Discrimination Ratio = 2.7

Proposal for Matrix Testing

Based on the matrix testing recommendations, one proposal could be that the reference oil be run before and after all four tests at each stand.

DD13	
Stands	4
Number of Technologies	2
Number of Base Oils	1 or 2
Number of Oils	2
Number of Tests	16
GpII-GpII BOI Exploration	No
Tests per Oil	8,8
Tests per Stand	4,4,4,4
df for s*	11
95% CI for Precision*	(0.71,1.7)
Highest Detectable Oil Difference*	1.54
Lowest Detectable Oil Difference*	only 2 oils
Highest Detectable Stand Difference*	2.89
Lowest Detectable Stand Difference*	2.89

Matrix Readiness

The DD13 Scuffing Test meets the criteria for matrix testing

Goal	Rationale
Parts availability	• Over 2000 test rings purchased by TEI (Supply for over 300 tests) • Parts defined and distributed by TEI
Stand Availability	• Currently 4 available stands with 3 additional stands underway
Repeatability and Reproducibility	• Repeatability is evident from statistical evaluation • Data is reproducible from reference oil standpoint

Procedure/Test Report

- Test procedure draft is nearly complete and will be sent out/discussed in the coming weeks

- Test Report draft is also nearly complete and will be sent out for review in a couple weeks

Next Steps – Open Discussion