

HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
December 11, 2018
Atlanta Marriott Marquis Hotel – Atlanta, GA

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ACTION ITEMS

- 1.0 TMC incorporate the request for additional test life information.**
 - 2.0 CPChem provide data from the fuel aromatics methods that have been compiled.**
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MINUTES

- 1.0 Call to order
 - 1.1 The Heavy Duty Engine Oil Classification Panel (HDEOCP) was called to order by Chairman Shawn Whitacre at 1:30 p.m. on Tuesday December 11, 2018, in the Kennedy Room of the Atlanta Marriott Marquis Hotel – Atlanta, GA.
 - 1.2 There were 16 members present and 68 guests present. The attendance list is included as Attachment 2.
- 2.0 Agenda
 - 2.1 The agenda circulated prior to the meeting had one update regarding the method for measuring the aromatic content of diesel fuel for new business. **Attachment 1.**
- 3.0 Minutes
 - 3.1 Minutes from June 2018 were approved as written.
- 4.0 Membership
 - 4.1 Two membership changes noted. Nathan Siebert is the acting member from GM. Mike Deegan replaces Ron Romano for Ford.
- 5.0 Existing Categories
 - 5.1 Sean Moyer from TMC provided a status update. **Attachment 3.** The COAT is unavailable with no calibrated stands. 1K/1N Single Cylinder tests doing well. Labs working on auxiliary equipment to extend the test. 1P/1R no issues. C13 new liners were approved earlier this year. COAT matrix on reference oil reblands is complete; matrix on original blends of reference oils to start this month. Mack tests T-8/T-11/T-12; not much of an update. T-13 issue with getting connecting rod bearings. T-13 uptick in test activity in the last few months. Cummins ISM introducing a new batch of injector adjusting screws. ISB cams are an issue. One batch rejected due to shipping and handling problems. Next batch is on the way; anticipated in January. RFWT no issues, IIIF/IIIG hardware depletion. EOAT

can get one more rebuild. After the COAT is back, then the correlation with the EOAT will begin.

6.0 LSDRG Request for detail on test life.

- 6.1 Joan Evans spoke for the group. **Attachment 4.** The group is developing a plan for test replacement plans. Improvements in test and category development are desired. Representatives from all stakeholders are included. Test development is different across tests and the group is looking at ways to improve test development.
- 6.2 Angela Willis explained the Passenger Car Test Life model. The model is front-end loaded at 100% utilization already due to GF-6, so ACEA use does not affect the front end of the model. Later the model drops to an assumed 50% rate and ACEA use could affect that. The model will be updated based on data as it becomes available. Passenger Car tests usually have a Lifetime Buy of test parts. ACEA testing demand could deplete the parts faster than projected.
- 6.3 Heavy Duty is looking out to 2024 for new requirements. For HD, already need to start now. A more accurate model will be better. This request for more accurate usage data starts the process with the goal of good data for June 2019. EMA has talked about test availability and going forward. Hind Abi-Akar: last 3 points on slide are important. OEM is constantly taking care of tests for their life.
- 6.4 Chairman Whitacre asked for a point person to collect the data. Angela offered to share the PC model. PC is not including dependent labs. Sean Moyer and the TMC will continue to work this. Cory Koglin of Afton also offered to help. Bill O’Ryan: Point 2 is key: Does the test need to be replaced for a specification? A verbal update will be given at DEOAP.

7.0 COAT Update

- 7.1 Hind Abi-Akar of CAT presented an update on the COAT. **Attachment 5.** Some history and an update on the details of the improvements were provided. Two matrices were designed: a first for repeatability, reproducibility and discrimination and the 2nd matrix to tie back to original limits. A small group of lab engineers and industry experts met weekly. Matrix 1 is complete. Matrix 2 will use original reference oils and tie back to original limits. Matrix 1 results look good. SP approved moving to Matrix 2. API LG agreed to fund Matrix 2. What about back to EOAT? Once COAT is available, then need to run tests on EOAT reference oil to determine equivalency. Hind also asked for comparison data on oils with results from both tests; tests from COAT would need to be on latest version after it is available again. Funding for that effort is to be determined.

8.0 DD13 Scuffing

- 8.1 Suzanne Neal of Daimler gave a DD13 update. **Attachment 6.** Next Surveillance Panel meeting will be scheduled in Q1 2019. Parts update: 40-50 engine build kits remaining so more liners and 2nd rings will be ordered, and references run to introduce.

9.0 Ford 6.7L

- 9.1 Mike Deegan of Ford provided the update on the 6.7L development effort. **Attachment 7.** There had been some issues with soot generated wear in this engine. An outline of the tests and results so far was shown. New soot control procedure has been introduced and levels are equal to prior tests, but wear results from the first test are less than earlier runs for that High Wear Oil (HWO). Soot control is manageable. What is the path forward? Next step is re-running tests to confirm results, then consider a precision matrix.

10.0 New Business

- 10.1 Laura Birnbaumer requests to update D4485. **Attachment 8.** The original request included all items in one ballot, which received a negative. The requests will now be separate. The first is some definition clarification: remove Energy Conserving from HD and add the new F Category. **Laura moved to send this ballot to Subcommittee B, John Loop seconded. 17 for, 0 against, 0 waives. Motion Carries.**
- 10.2 Jonathan VanScoyoc of CPChem is looking for direction from the panel. Needs guidance on D1319 aromatics test; a reagent dye is now unavailable. Need to replace the test for aromatics in the fuel spec. Jonathan is looking for advice. Other test methods exist, so a method should be chosen. Sub E discussed this earlier in the week: Joe Franklin summarized from that previous presentation. D6379 is one proposed method. Activity is also ongoing to validate another dye for D1319. D1319 is still available and some dye batch is still available at some labs until mid 2019. Guidance from HDEOCP is labs have availability and work in the industry is ongoing. D5186 is another aromatics method and CPChem has run both methods and has the data. The HDEOCP requested that CPChem bring the data and look at the comparison between the methods. A change to the fuel spec could be made based on equivalency data.

11.0 Change in secretary.

- 11.1 Secretary Moritz announced he was stepping down and offered Juan Vega of Intertek as the next secretary.

12.0 Next meetings

- 12.1 The next meeting is scheduled for June 25, 2019 at 1:30 pm MDT at the Sheraton Denver Downtown Hotel in Denver, Colorado USA.

13.0 The meeting was adjourned at 2:40 pm.

AGENDA
D02.B0.02.1
Heavy-Duty Engine Oil Classification Panel
Tuesday, December 11, 2018 1:30pm EST
Marriott Marquis
Atlanta, Georgia USA

- 1) Call to Order/Anti-trust statement**
- 2) Minutes** – Approval of Minutes from June 26, 2018 Meeting in Phoenix, AZ, USA
- 3) Membership**
 - a) Review current panel membership
- 4) Existing tests/categories**
 - a) Review of status of carry-over engine tests that support API CK-4, FA-4 and legacy categories (Sean Moyer, TMC)
 - i) LSDRG Request for details on hardware availability to support current engine tests (Joan Evans, Infineum)
 - b) Update on CAT Oil Aeration Test (Hind Abi-Akar, Caterpillar)
 - c) Update on DD13 Scuffing Test (Suzanne Neal, DTNA)
- 5) Old Business**
 - a) Update on Ford 6.7L Wear Test Development (Michael Deegan, Ford)
- 6) New Business**
 - a) ASTM D4485 Definitions (Laura Birnbaumer, Chevron Oronite)
- 7) HDEOCP Adjournment (transition to DEOAP)**

HDEOCP Attendance: December 11, 2018

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HDEOCP Attendance: December 11, 2018

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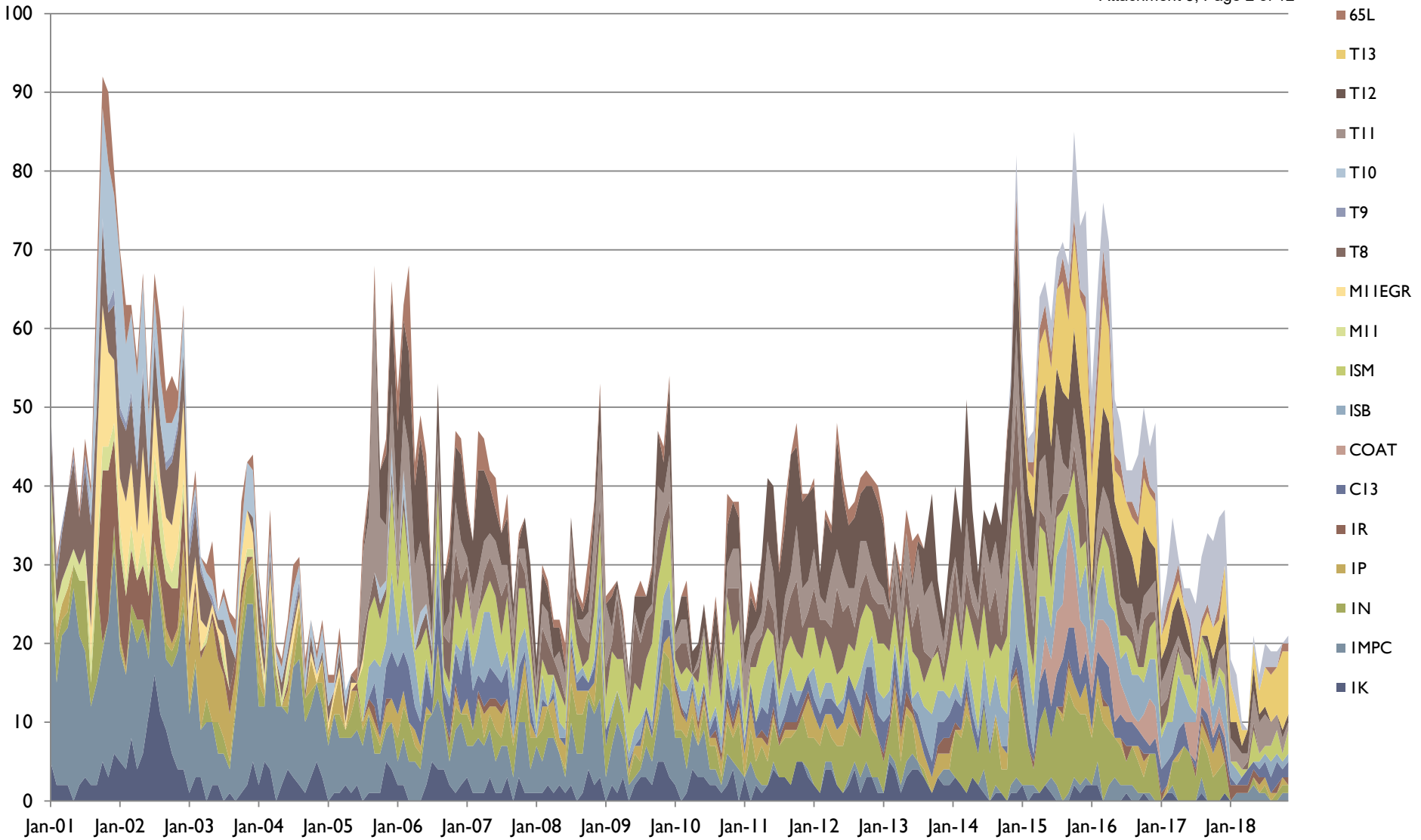
HDEOCP Attendance: December 11, 2018

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D02.B0.02 Maintenance Report

December 2018

ALL TEST CANDIDATE ACTIVITY



Calibrated Labs and Stands*

Test	Labs	Stands
IK	1	1
IN	3	5
IM-PC	0	0
IP	3	3
IR	1	1
CI3	4	4
ISB	2	2
ISM	4	4
EOAT	1	1
RFWT	1	1
T-8/E	2	2
T-11	4	5
T-12/T-12A	4/4	4/4
T-13	4	9
COAT	0	0
DDI3	3	4

*As of 09/30/2018

Availability of API CH-4 through CJ-4 Tests

Test	Hardware Issues	Availability Through 2023	Notes
IK/IN	Auxiliary components	Likely	Ongoing resolution of issues with stand auxiliary systems and miscellaneous components.
IP/IR	No current issues	Likely	None
CI3	No current issues	Likely	<p>Engine block, injectors, turbos only available through reman.</p> <p>Liners with new material and processing but same specs were introduced IQ 2018.</p>



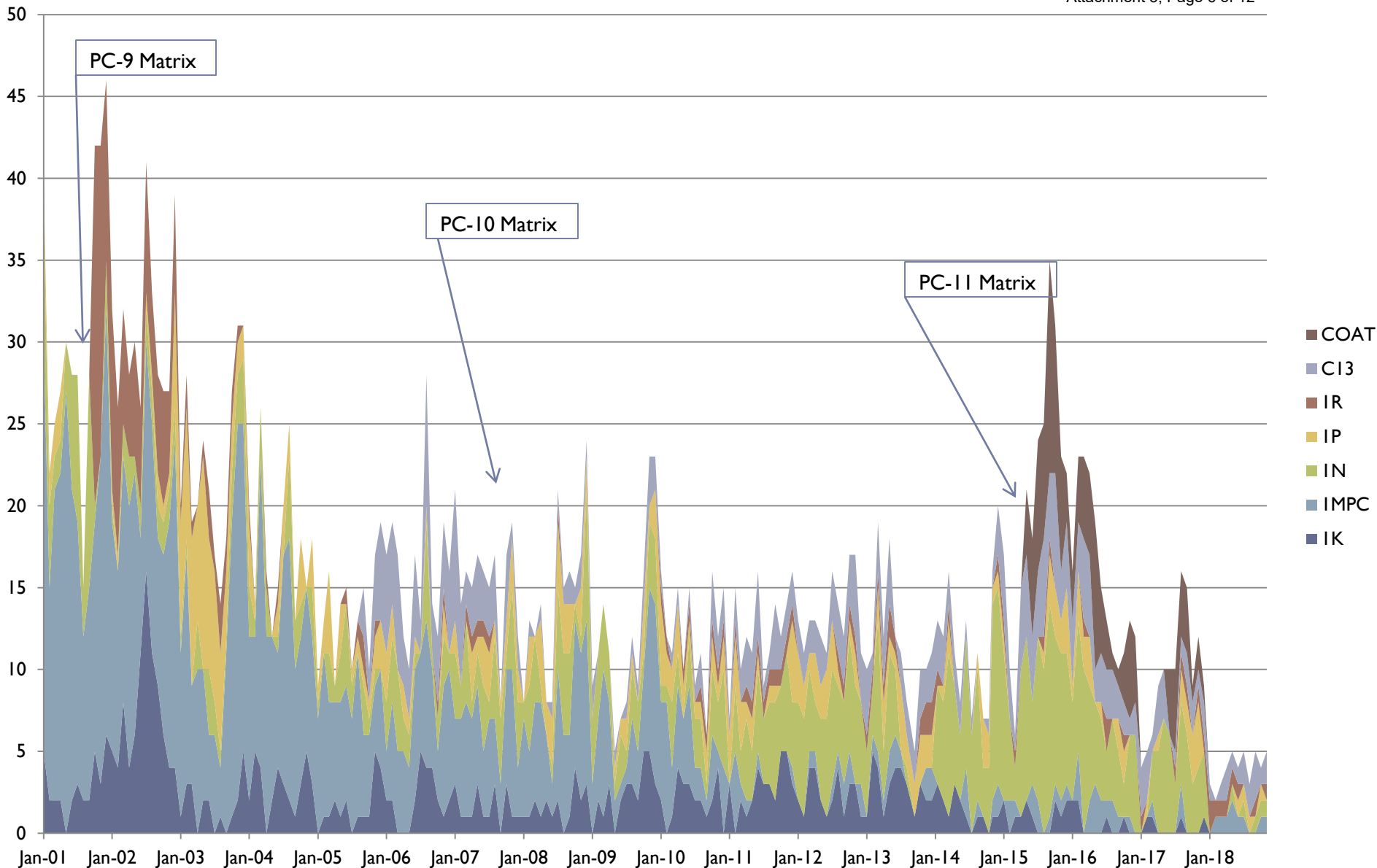
Additional Caterpillar Test Issues

➤ **Caterpillar Oil Aeration Test**

- Aeration test procedure improvement ongoing. Reference oil test matrix on new reference oil blends complete. Preliminary analysis in process. Reference oil test matrix on original oil blends for correction factor generation scheduled to start December 2018.



CATERPILLAR CANDIDATE ACTIVITY

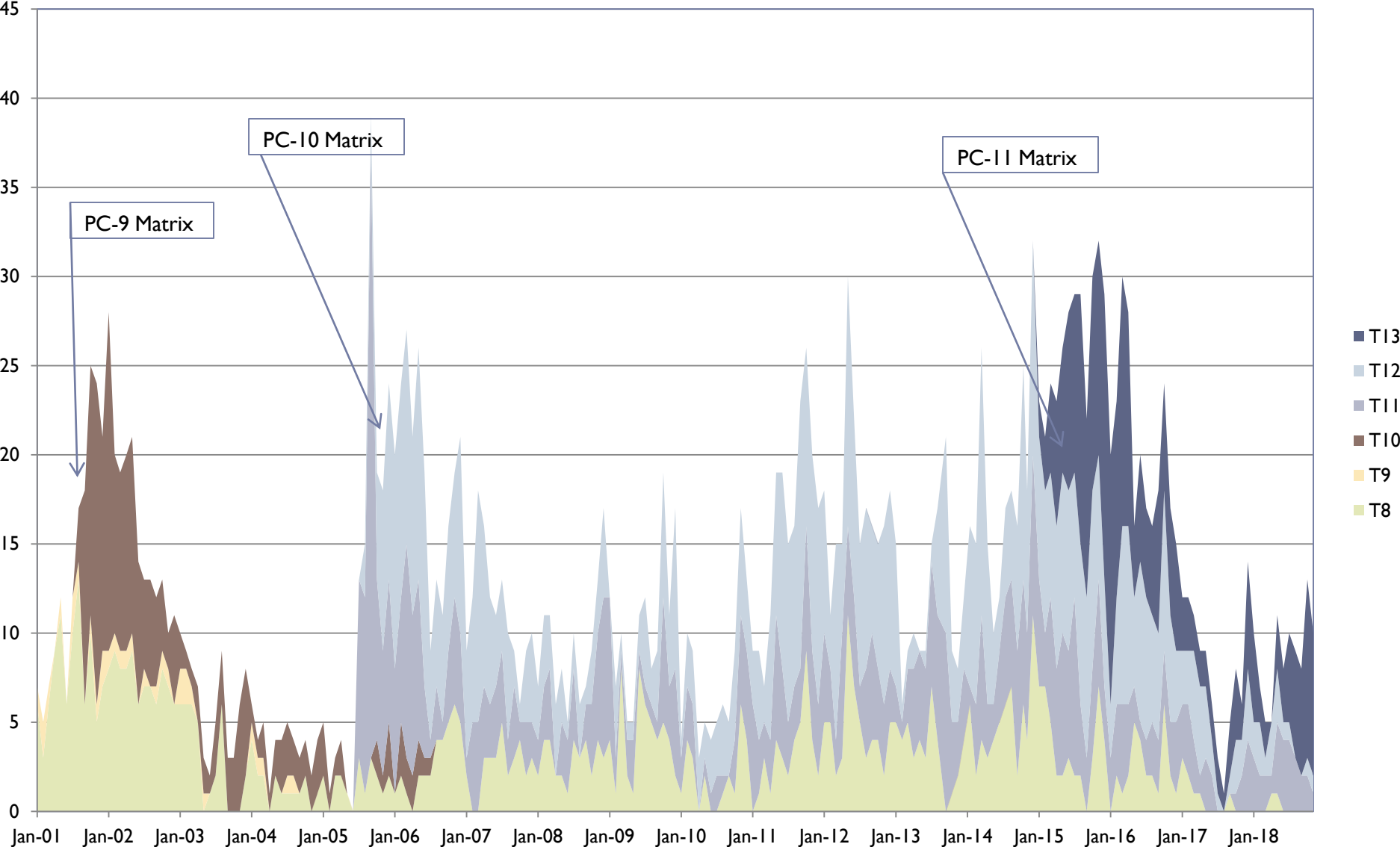


Availability of API CH-4 through CJ-4 Tests

Test	Hardware Issues	Availability Through 2023	Notes
T-8	No current issues	Likely	Engine block supply limited.
T-11	Oil Consumption	Likely	<p>Engine production ended 2006. Finite number of engine blocks.</p> <p>Engine build life issues with oil consumption.</p>
T-12	Oil Consumption, head gasket	Likely	Engine production ended 2006. Low demand.
T-13	Connecting rod bearings	Likely	<p>New batch of connecting rod bearings being pursued from new supplier. Current batch nearly exhausted.</p>



MACK CANDIDATE ACTIVITY

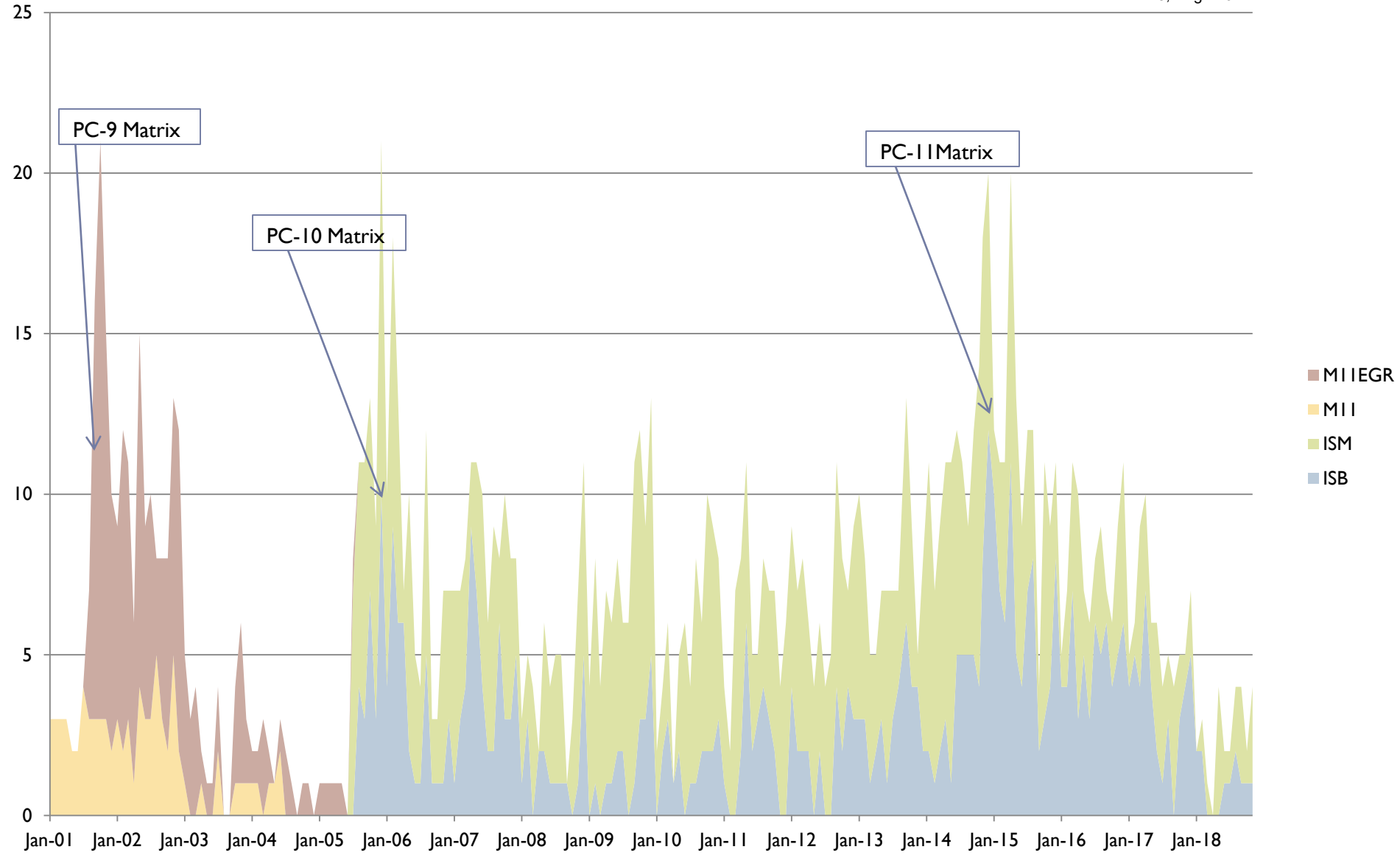


Availability of API CH-4 through CJ-4 Tests for PC-11

Test	Hardware Issues	Availability Through 2023	Notes
ISM	New hardware batch introduction	Likely	Injector Adjusting Screw new batch validation-Reference oil tests on new batch of screws is in progress
ISB	Camshafts	Likely	Camshaft batch nearly exhausted. Last batch rejected due to shipping/handling issues. Cummins working to expedite new batch and ensure no issues with shipping/handling.



CUMMINS CANDIDATE ACTIVITY



Availability of API CH-4 through CJ-4 Tests for PC-11

Test	Hardware Issues	Availability Through 2023	Notes
RFWT	None	Likely	<p>Long term supply of test parts at CPD.</p> <p>6.5 L engine no longer in production at AM General, but available through supply network.</p> <p>Injection pump still available.</p>
Seq III F/III G	Hardware depletion imminent	No	None
EOAT	Using last known hardware	No	<p>Oil Temperature runs higher w/ current EOAT engine. Still no official EOAT / COAT correlation. Engine hardware available for one rebuild.</p>

B2 Action Items

- **No Action Items**
- **Comments**





HDD Test/Hardware Viability

Joan Evans for
API Lubes Standard Development Review Group
HDEOCP 12/6/18



Summary of Request for Information from Surveillance Panels

- The API LSDRG (Lubes Standard Development Review Group) is focused on improving the current test development and category development processes.
 - Test Development
 - Current process is ‘ad hoc’ up to the point of developing the test into an ASTM method. LSDRG is developing a front end to this process which incorporates more planning into the process.
 - The Surveillance Panels currently review the inventory for critical parts and report to the Class Panel
 - Taking that information and determining usage rates, understanding the viability of the tests in the API specs, knowing where else the test is used and is proposed to be used, communicating the outcome of the analysis broadly is not done on a consistent basis.
 - As part of the ILSAC GF-6 specification development, PCEOCP put more emphasis on test viability and outlook for usage and hardware limitations.
 - LSDRG would like HDEOCP to consider adopting a similar methodology to understand the viability of the current API CK-4/FA-4 tests.
 - Requires input from the Surv Panel’s on critical parts inventory
 - Requires input on current and future specs requiring the test
 - Will be used to determine need and timing of replacement tests
-



Example: PCEOCP Summary of Data for Independent Labs

Test	Total # of Tests Available	Total Estimated Tests per Year Independent Labs Can Run	Based on Tests per Year	Hardware Inventory Disposition (select only one)		Comments
				Single lifetime purchase	Engines or rebuild kits can be reordered in batches by OEM	
	Based on Hardware Inventory		Number years with hardware inventory?	Once hardware runs out; test is obsolete	Support any shortage if needed	Detail out any assumptions here
Seq. IIIG	27	27	1	X		Hardware is expected to be depleted 1Q/2Q of 2018.
Seq. IIIH	4674	553	8	X		Total # of tests is based on latest FCA inventory report. Labs purchase as needed from FCA and OHT.
Seq. IVA	415	135	3	X		Approximately a 3 year supply with 3 stands at close to 100% utilization.
Seq. IVB	N/A	220	n/a		X	Engine hardware currently in production. As of 2012, Toyota estimated hardware to be available for approximately 15 years. Labs purchase as needed from OHT.
Seq. VG	25	25	1	X		Hardware is expected to be depleted 1Q/2Q of 2018.
Seq. VH	1200	175	7	X		Approximately a 6 to 7 year supply.
Seq. VIE	1512	227	7	X		Split inventory and capacity 50/50 between Seq. VIE and VIF tests.
Seq. VIF	1512	227	7	X		
Seq. IX (LSPI)	6000	772	8	X		Split inventory 50/50 between Seq. IX and X tests.



Forecast based on running at 100% of Capacity

SN+
Launch

GF-6
Launch

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Seq. III G	27	0	0	0	0	0	0	0	0	0
Seq. III H	4674	4121	3568	3015	2462	1909	1356	803	250	0
Seq. IV A	415	280	145	10	0	0	0	0	0	0
Seq. IV B	220	220	220	220	220	220	220	220	220	220
Seq. V G	25	0	0	0	0	0	0	0	0	0
Seq. V H	1200	1025	850	675	500	325	150	0	0	0
Seq. VI E	1512	1285	1058	831	604	377	150	0	0	0
Seq. VI F	1512	1285	1058	831	604	377	150	0	0	0
Seq. IX (LSPI)	6000	5228	4456	3684	2912	2140	1368	596	0	0
Seq. X (CW)	1500	1320	1140	960	780	600	420	240	60	0



Summary

- Model is not perfect but it can be manipulated to change the usage rate of the tests over the time period.
 - Gives a picture of the 'pinch points' so that we can focus on the tests in some priority order:
 - Will the test last the expected life time of the category?
 - Does the test need to be replaced for a specification?
 - Is it anticipated that the test will be needed in future specifications?
-

COAT Update

HDEOCP, Atlanta, GA, Dec 11, 2018

Hind Abi-Akar
Caterpillar Inc.

- Introduction & Objectives
- COAT Timeline & Summary
- Test Improvements
- Results and Matrix 2 Testing Schedule

Introduction & Objectives

The purpose of this presentation is to:

- Provide API an update on the activities of the Caterpillar Surveillance Panel in improving the COAT, with a goal of being able to resume candidate testing
- Update on Dec SP meeting results

COAT status: Currently Unavailable

- Testing was halted to improve precision: Reduce variation across labs

During the last 11 months the Caterpillar Surveillance Panel's focus has been to ***improve the COAT:***

- To improve test precision
- To reduce variation across engine test labs
- To understand why TMC-833/TMC-832 discrimination became reduced and to re-establish discrimination (if possible)



COAT Test Timeline and Summary

2017

- Noticed reduced discrimination between the two reference oils at two of the labs
- Observed high lab to lab variability
- Batched oil filters introduced to try and reduce variability
- By end of 2017 COAT test becomes unavailable for candidate testing

Early
2018

- Common aeration measurement system for all three labs built by single lab for uniformity and tested/proven before distribution to the other labs
- Reduced discrimination between the two reference oils persisted
- Consensus: lab to lab variation needed more work

Middle
2018

- Deeper harmonization of parts and test setups, updated test procedure, tightened warm-up procedure, calibration procedure and standardized aeration calculations
- Selected a final engine set up

End of
2018

- Statistically designed 2 Phase testing Matrix on final set up combining all test improvements
- **Phase 1 Matrix** – Discrimination, repeatability & reproducibility testing using Reference oil re-blends
- **Phase 2 Matrix** – tie back improved test to original targets using original Reference oils



Test improvements: Implemented changes

Common Measurement System

- One lab built the systems for the three labs to ensure exact parts and orientation and reduce variation

Updated parts and hardware harmonization

- New Caterpillar Oil Filter Base Assembly with Oil Filter Bypass functioning as designed by CAT
- Uniform and new External oil cooler
- Uniform external oil lines and fittings
- Uniform Insulation of fittings from engine block to Heated Line

Updated test procedure

- Drain external oil cooler and lines at the end of test and after each flush run to set initial oil volume

Tightened warm-up procedure

- Engine should reach 900 rpm within 1 minute of startup; then after 5 minutes of run, ramps over the next 60 seconds to 1800 rpm for the rest of the warmup period. Total of 40 minutes from the time engine starts

Updated density meter calibration procedure

- Evaluation of the use of two calibration fluids (Decane and EF-411) versus the use of agreed slope and offset of, respectively, one and zero. Its use will be decided after a review of the matrix results.
- Setting the insulated box temperature

Updated aeration calculations

- Updated to using original density meter coefficients from supplier
- Labs agreed to use 7 significant figures for raw tube frequency in calculation

Test improvements: process followed

Weekly meetings held by a COAT Engineering Sub-group

- Led by Surveillance Panel Chairman, Jim Gutzwiller
- Test sponsor Caterpillar: Hind Abi-Akar and Mark Jarrett
- Engine test lab engineers who were running the test
- A few others from industry who asked to participate

Activities included:

- A Deep dive into engine operational parameters impact on aeration variability
- Parts swaps among labs to assess impact on COAT aeration
- Developing detailed specifications for lab components
- Completing a detailed review of test labs operation
- Improving measurement system calibration procedure



Test improvements: Proof of Performance Plan

1. Matrix 1: Generate data on the final **2018 MM system/set up/ calibration/ aeration calculation method**
 - a. Use reference oil re-blends: TMC 833-1 and TMC 832-1
 - b. Evaluate **discrimination** between TMC 833-1 and TMC 832-1
 - c. Evaluate **consistency** of tests results across labs (**repeatability & reproducibility**)

2. Matrix 2: Generate data on the final **2018 MM system/set up/ calibration/ aeration calculation method**
 - a. Use remaining quantities of original reference oils TMC 833-0 and TMC 832-0
 - b. Determine if an Industry Correction Factor for the new measurement system is appropriate. This will allow a tie-back to the precision matrix and limit setting.

3. Evaluate Labs calibration and acceptance of reference oil re-blend results (TMC 833-1 and TMC 832-1)

4. Caterpillar Surveillance Panel to agree when the COAT is ready to resume candidate oil testing again



Matrix Testing Schedule and Phase 1 Matrix results

Approximately two months to complete work

- **target completion: end of January 2019**
- **Phase 1 Matrix: Complete**
 - Operational data analysis by test: **done**
 - **Test improvements implemented**
 - **Oil Discrimination is restored**
 - **Consistency** of test results across labs seems to have **improved**
 - Test results (summary table on the right) to be confirmed by the TMC
 - **Surveillance Panel approved by unanimous vote start phase 2** of the plan: Dec 5, 2018

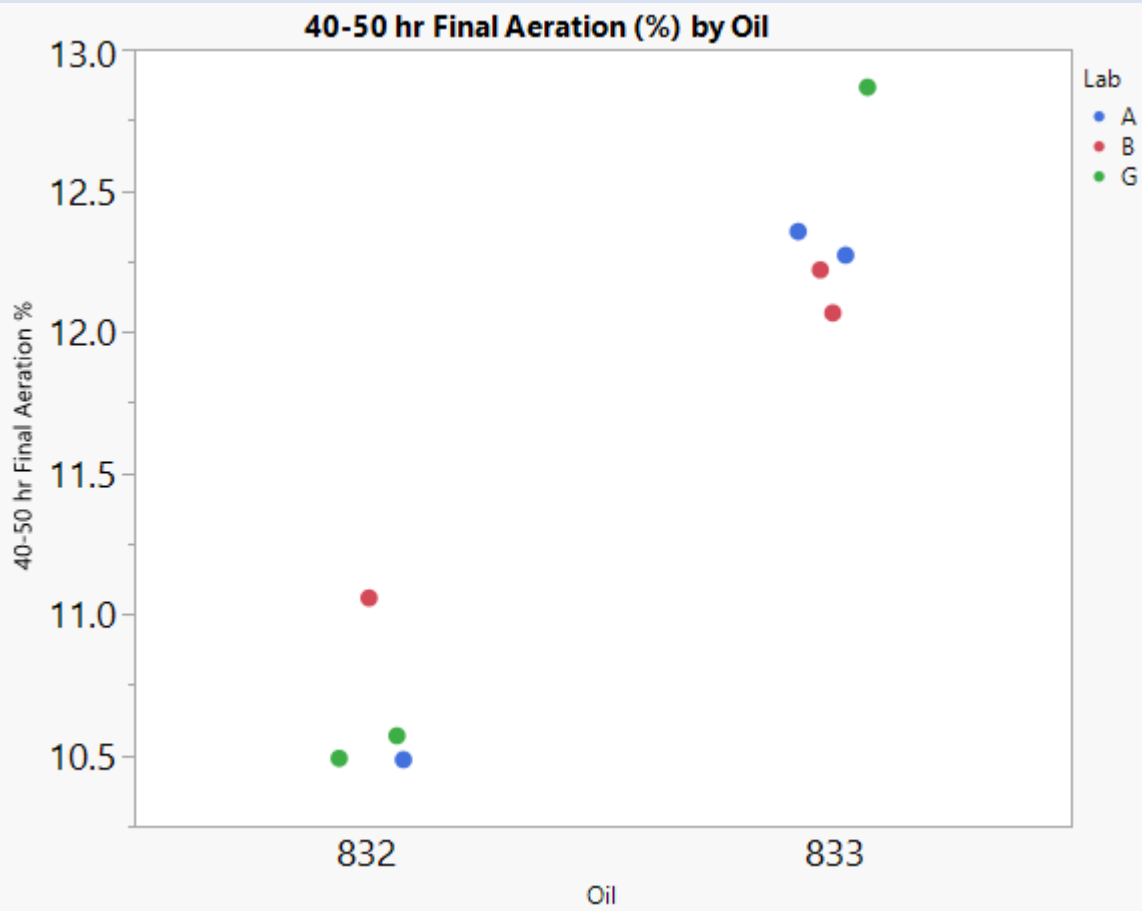
Phase 1 Matrix

40-50 hr Final			
TMC Test ID	Aeration (%)	Lab	Oil
137600	10.49	A	832
135582	12.36	A	833
137604	12.27	A	833
137601	10.49	G	832
137602	10.57	G	832
137603	12.87	G	833
136206	12.07	B	833
140669	12.22	B	833
140670	11.06	B	832
Oil	Mean	standard deviation	
832	10.65	0.2740	
833	12.36	0.3039	



Data from Matrix 1

Oil re-blends: TMC 833-1 and TMC 832-1



- Oil Discrimination is restored
- Consistency of test results across labs seems improved

Oil	Mean	standard deviation
832	10.65	0.2740
833	12.36	0.3039



Phase 2 Matrix

Phase 2 Matrix:

- Run the matrix and report results
- Analyze Operational Data and Phase 2 Matrix results
- Surveillance Panel to meet and decide on COAT test status

Phase 2
matrix

	833 = 3 tests			832 = 6 tests		
	Lab					
Run	A	B	G			
1	832-0	833-0	833-0			
2	833-0	832-0	832-0			
3	832-0	832-0	832-0			

COAT Matrix Funding:

- LG group agreed that API fund Matrix 2
 - Funding will facilitate availability of the test
 - Test optimization costs and time (past 10 months) has been carried by the tests labs

Questions?



DAIMLER

ASTM 8074 - DD13 Scuffing Test

Suzanne Neal & Patrick Joyce

ASTM D02 - Atlanta, GA

December 11th, 2018

Daimler Trucks



Daimler Surveillance Panel

Next Meeting:
Q1 2019



Test Status & Parts Availability

Parts	Batch	Remaining Parts	Estimated Build Kits (6 Parts Per Kit)
Top Rings	B	1,378	229
Pistons	A	936	156
Liners	C	250-300	41-50
2 nd Ring	A	327	54
Oil Ring	A	988	164
Summary			41-50 (Kits are limited by Liners and 2 nd Oil Rings)

Ford 6.7L VTW Test Update ASTM December 2018

Patrick Joyce (Lubrizol)/Michael Deegan (Ford)

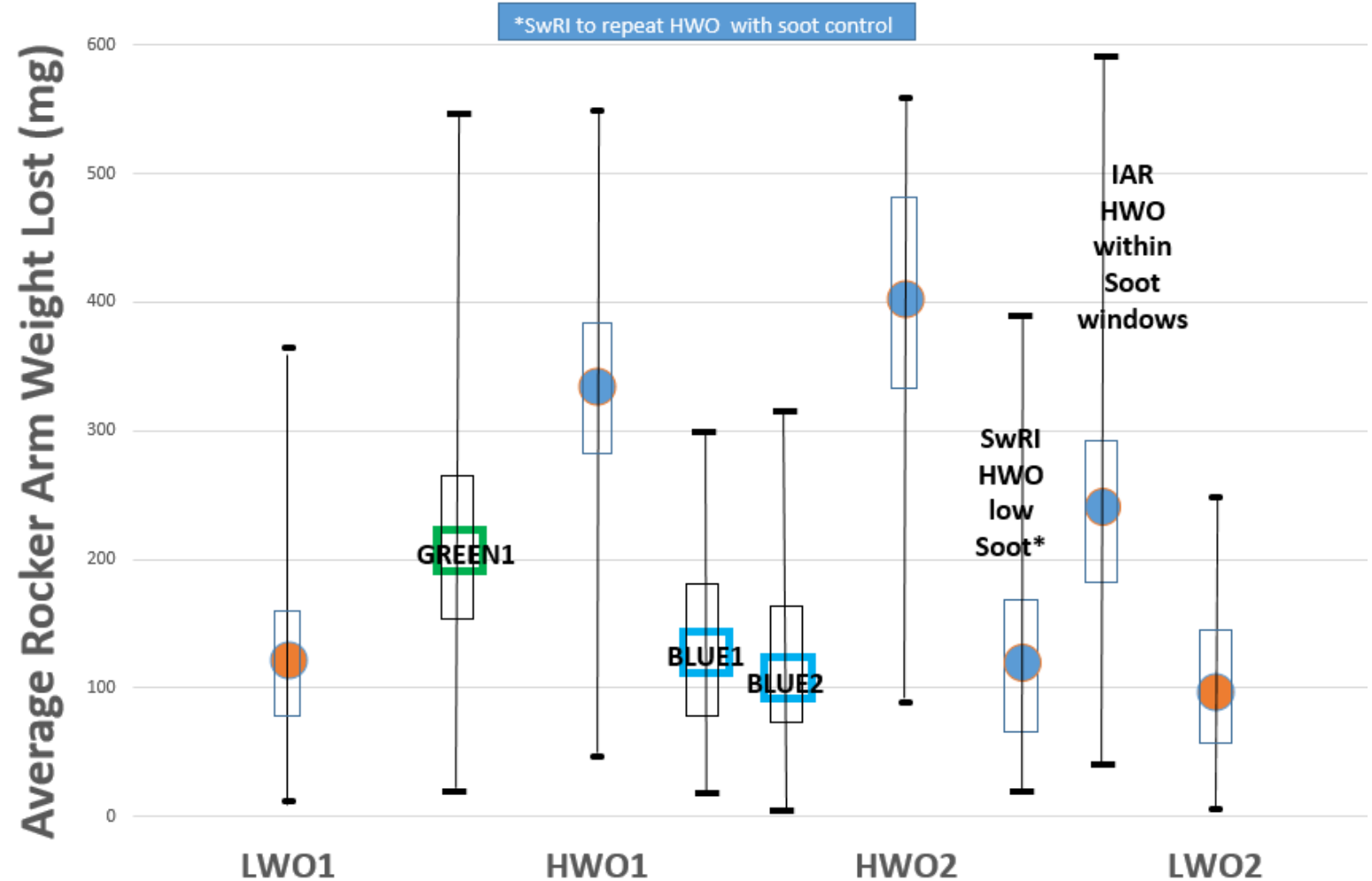
VTW Test Development Progress

- Completed Soot Generation Investigation
 - Soot Generation controlled by adjusting Coolant Temp Signal to PCM which in turn changes Fuel Injection Timing.
- Proveout Testing at All Labs.
 - Intertek complete first Proveout test on High Wear Oil (HWO).
 - Test hit the proposed soot windows.
 - HWO test results fell between previous HWO & LWO Lubrizol tests.
 - SWRi Proveout test in progress complete by Week of Dec 10.
 - Lubrizol test plan January 2019 start.
- Test procedure Update in progress.
 - Test report forms and data dictionary are planned to be complete by year end.

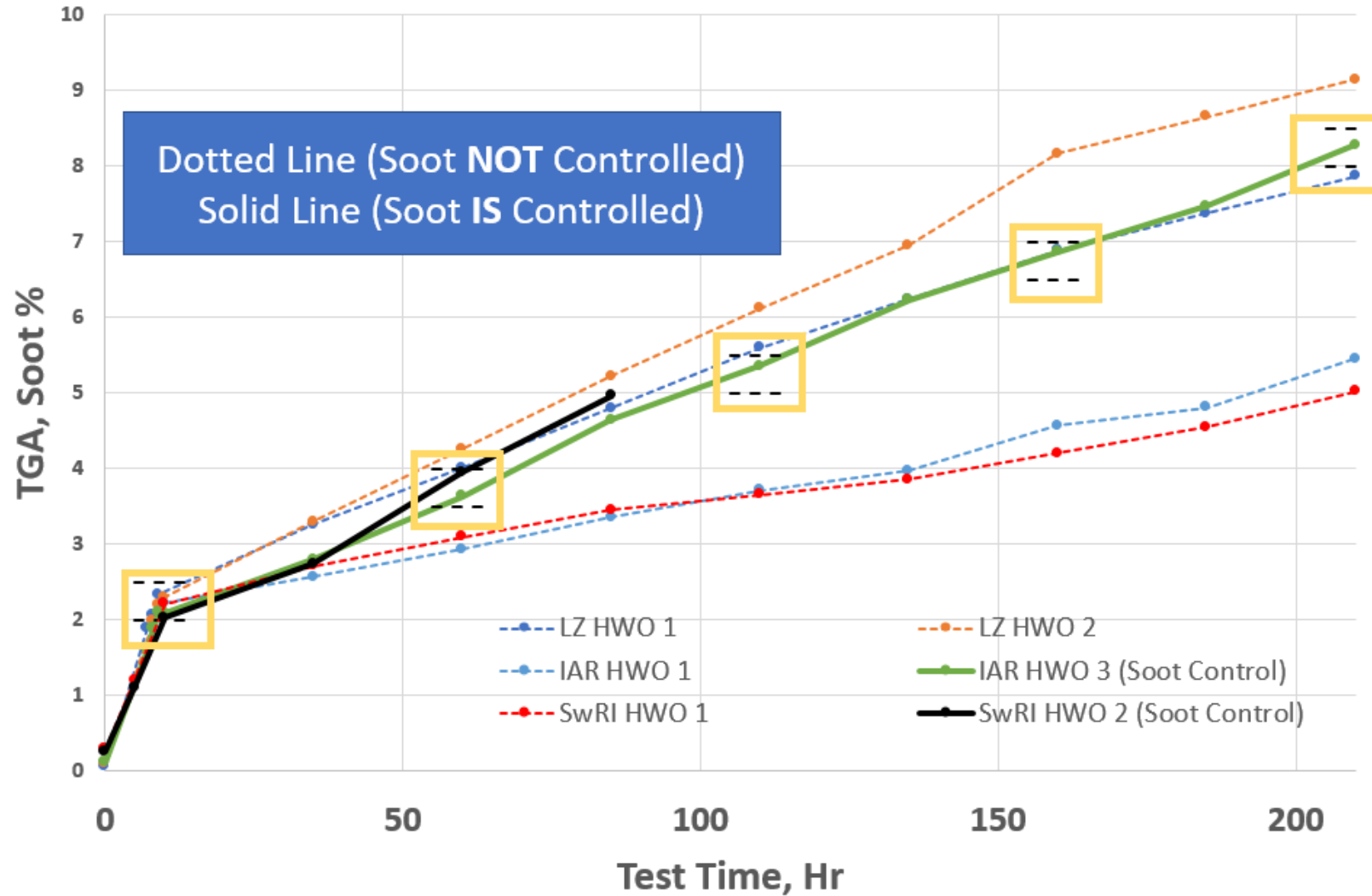
Test Development Data

- HWO – “PC11B”
 - 3.0 HTHS150
 - 800 ppm phosphorus
- LWO – CJ-4 Factory Fill
 - 3.5 HTHS150
 - 1100 ppm phosphorus
- Blue – CJ-4 Factory Fill blended down to Low HTHS
 - 3.0 HTHS150
 - 1100 ppm phosphorus
- Green – HWO blended up to High HTHS
 - 3.5 HTHS150
 - 800 ppm phosphorus
- SwRI: HWO run before soot control (July 2018)
- Intertek: HWO run with soot control (Nov 2018)
 - inside all five windows

6.7L Ford VTW Test: Rocker Arm Weight Loss



Test Development Data: Soot Content (%) vs Test Time (hr)



- Test to include soot windows at 10, 60, 110, 160 and 210hrs
- Intertek HWO 3 (green) was run using soot control and made all five windows



Oronite

ASTM D4485 4 Performance Classification Update

Laura Birnbaumer

Automotive Engine Oil Product Qualification

D02.B Heavy Duty Engine Oil Classification Panel

Atlanta, GA

December 11, 2018



ASTM D4485

4 Performance Classification Update

- 4.1 Automotive engine oils are classified in three general arrangements, as defined in 3.2; that is, S, C and ~~F~~ **Energy Conserving**. These arrangements are further divided into categories **and classifications** with performance measured as follows:



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Document

- I move that the Heavy Duty Engine Oil Class Panel accept this proposal and recommend to D02.B for ballot.