HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL

OF

ASTM D02.B0.02

May 18, 2004

DoubleTree Hotel – O'Hare, Rosemont, IL

ACTION ITEMS

1.	**Issue "Exit" ballot on PC-10 Chemical Limits.**	**Jim McGeehan**
2.	**Should D4485 reflect variable pass/fail limits on seals test.**	**HDEOCP**

MINUTES

1.0 Call to Order

1.1 The May 18, 2004 meeting of the HDEOCP was called to order at 8:00 a.m. by Chairman Jim McGeehan at the DoubleTree Hotel of Rosemont, IL. There were 19 members present or represented and there were 18 guests present. The attendance list is shown as Attachment 2.

2.0 Agenda

2.1 The published agenda (Attachment 1) was reviewed, with no suggested changes.

3.0 Membership

3.1 Scott Harold will replace Michael Weismiller for Ciba.

4.0 Previous Meeting Minutes

4.1 Several people noted an incorrect reference oil designation for the ISM in paragraph 10.11 of the February 19, 2004 minutes. The reference oil listed as 870-2 should have been identified as oil 830-2.

4.2 The minutes of the February 19, 2004 meeting were approved with the change noted above.

5.0 PC-10 Matrix Funding

5.1 Steve Kennedy reported that API had agreed on up to one million dollars in funding for PC-10 matrix tests, contingent on equal commitments from EMA and ACC. See Attachment 3. Chairman McGeehan asked if funding commitments from these two organizations would be firm by the June meeting in Salt Lake City. Representatives from ACC indicated their commitment would probably be firm by then and EMA said they would try.

6.0 PC-10 Chemical Limits

6.1 Rick Finn presented the recommendations of the Chemical Limits Task Force (see Attachment 4). The Task Force agreed on a 1% maximum sulfated ash limit, a 0.12%

maximum phosphorus limit and a 0.4% maximum sulfur limit. Rick Finn moved and Pat Fetterman seconded that these proposed limits be sent to all "B" and API "Lubes" committee members as an "exit" ballot. The intent of the ballot being to flush out potential support and / or opposition for the limits before a HDEOCP vote in June. The motion passed with 14 for, 1 against, 1 abstain. The "exit" ballot is to be returned in time for review by the Task Force prior to the June 22 meeting of the HDEOCP and is to be structured such that abstentions are prohibited.

6.2 Jim McGeehan distributed a letter (see Attachment 5) from the Kline Co. regarding a potential study by them of base stock supply and availability. Lew Williams spoke in favor of the study. An API member was concerned this was headed toward a non-technical reason for limits and West Alexander suggested that ILSAC had contributed to funding for the study conducted a few months ago on GF-4 questions. Tom Franklin suggested waiting until the exit ballot results are in and then see if the study is needed. There is some thought that the first study (PCMO) already included potential HD use of Group II stocks.

7.0 PC-10 Timeline

7.1 Bill Runkle presented three timelines (see Attachment 6) depicting the current scenario and two versions of an ACC suggested scenario where technology demonstration occurs before limits are set and commercial qualification begins.

8.0 PC-10 Test Development

8.1 Cummins ISB

8.11 Dave Stehouwer reported on the ISB (see Attachment 7) and moved that the ISB be declared ready for matrix testing. Greg Shank seconded the motion. There is no formal recommendation from the ISB Task Force on this and Pat Fetterman suggested this declaration is premature. The motion passed, sort of, with 4 votes in favor, 3 against and 10 abstains. This item will be back on the June meeting agenda. A Cummins Surveillance Panel meeting is scheduled for June 21, in Salt Lake City.

8.2 Cummins ISM

8.21 Dave Stehouwer also reported on the status of the ISM (see Attachment 8), noting three development tests have completed with a fourth underway.

8.3 Caterpillar C13

8.31 Abdul Cassim reported on C13 status (see Attachment 9) and stated that for PC-10, the C13 might adopt closed crankcase ventilation and use ultra low sulfur fuel. They also want to use the 1P test to help ensure protection against high temperature piston deposits and aid in backward compatibility…and not use the 1N test.

8.4 Mack T-12

8.41 Greg Shank reported on T-12 test development status (see Attachment 10). The engine platform and fuel sulfur level are undecided at this time. They hope to have more resolved by the June meeting. Concern was raised over how "production" representative the test would be if it were based on T-10/T-11 hardware.

9.0 PC-10 Matrix Design

9.1 Steve Kennedy reported on the Matrix Design Task Force status (see Attachment 11) and solicited additional task force volunteers. He also brought up the subject of additive

technology selection and plans to ask the API Lubes committee how many technologies they feel are needed if the matrices are sized for precision only.

10.0 Other

10.1 Pat Fetterman made a motion that the engine tests for PC-10 be frozen at the December 2004 HDEOCP meeting and Bill Runkle seconded it. The motion passed with 13 votes for, 0 against, 4 abstains.

10.2 Jim McGeehan again emphasized his thoughts about the need for contingency backup tests (see Attachment 12), should the anticipated tests falter.

11.0 CI-4 Seal Test Monitoring

11.1 Joe Franklin, as a member of the Seal Test Surveillance Panel, made a presentation relating the history of the CI-4 seal test results and questioning the value of full TMC monitoring of the test (see Attachment 13). Joe made a motion to repeal the request for full TMC monitoring of the CI-4 seals test, but keep in place the current informal monitoring. Charlie Passut seconded the motion. During discussion, John Zalar noted that many times the TMC would receive reference oil results in batches and since those results would effect acceptance bands and targets, more timely reporting was needed. Also, during the discussion, it was estimated full TMC monitoring would add 15% to 20% to the cost of the tests. The motion failed with 4 in favor, 7 against, and 5 abstains.

11.2 John Zalar raised the question should D4485 reflect that the seals pass / fail limits are being adjusted based on reference oil test results. This is to be looked at and brought up again at the June meeting.

12.0 Next Meeting

12.1 The next meeting is scheduled for 1:00 p.m. on June 22, 2004 in the Grand America Hotel, Salt Lake City, Utah.

13.0 Adjournment

13.1 The meeting was adjourned at 11:15 a.m.

Submitted by:

Jim Wells
Secretary to the HDEOCP

ATTACHMENT 1

Final Agenda
ASTMSECTION D.02.BO.02
HEAVY-DUTY ENGINE OIL CLASSIFICATION PANELS

DoubleTree Hotel, Rosemont, IL (tel# 847-292-9100)
May 18th, 2004
8:00 am to 12 noon (Coffee at 7:30 am)

Chairman/ Secretary: **Jim Mc Geehan/Jim Wells**
Purpose: **PC-10**

Desired Outcomes: **PC-10 timing, tests, chemical limits.**

Note all presentations will be made from the computer to Focus projector. Bring USB for minutes.
Also need money for the rooms and other room items. Approximately $35.00

TOPIC	PROCESS	WHO	TIME
Agenda Review	• Desired Outcomes & Agenda	Group	8:00-8:05
Minutes Approval	• February 19th 2004	Group	8:05-8:10
Membership	• Changes: Additions • Chairman's comments focusing on PC-10 in 2004	Jim Mc Geehan	8:10-8:20
Funding	• Status of funding for PC-10 matrix • Timing	Steve Kennedy	8:20-8:30
Chemical Limits	• Task-force recommendations • Freeze chemical limits June 2004 • Send out Exit-Criteria ballot • Kline study on availability of API Group II. Recommendation of panel for API funding	Rick Finn Jim Mc Geehan	8:30-9:30
NCDT report	• Time-line for program • Freeze engine tests Dec 2004 • Send out Exit-Criteria ballot	Bill Runkle	9:30-10:00
PC-10 Test Development report	• Cummins ISM • Cummins ISB (Ready for matrix) • Caterpillar C13 • Mack T-12 • Back-up tests	Dave Stehouwer Abdul Cassim Greg Shank Jim Mc Geehan	10:00-11:15
Task-Force for Matrix	• Team selection • Matrix oils	Steve Kenndy	11:15-11:30
TMC API CI-4 seals	• Full monitoring of seals: value?	Joe Franklin	11:30-11:45
Next meeting June 22nd 2004			

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PC-10 Engine Test Matrix

Funding

- **On May 4, the API LC passed a motion to contribute up to $1MM to match cash and in-kind contributions by ACC & EMA for the PC-10 Precision & BOI Matrices**

- **Next steps**
  - **Establish the level of funding from ACC & EMA**
  - **Provide this information to the PC-10 MDTF for us in designing the test matrices**

PC-10 Chemical Limits Task Force

Report to HDEOCP

May 18, 2004

R. F. Finn, Jr.

Status Update

- Consensus has been reached on a set of Chemical Limits for the API Proposed Category PC-10:
  - Sulfated Ash (D874) – 1.0% max
  - Phosphorus (D4951) – 0.12% max
  - Sulfur (D4951 or D2622) – 0.4% max
- The Task Force was unanimous in this conclusion

Status Update

- Some issues remain surrounding the Sulfur limit
  - Small data population exists to support both
    - the need to restrict Sulfur content to 0.4% max,

      or
    - that after-treatment device durability will be adequate at 0.4% Sulfur
  - Engine durability takes priority over potential after-treatment systems durability (per the Task Force Charter)
    - EMA member companies will design their engines and after-treatment systems around lubricants meeting the agreed chemical limits and will support them (including the 0.4% sulfur maximum) for their 2007-2009 MY engines unless they encounter ‘catastrophic problems’. ‘Catastrophic problems’ are defined as the inability to meet 2007 emissions standards despite good faith efforts to resolve any issues with after-treatment technology changes before requesting any lubricant changes

Next Steps

- Exit Criteria Ballot by HDEOCP
  - Request no ‘Abstains”
  - Fast turn-around (10day?) so the task force can access and analyze the results
- Task Force Meeting at June ASTM to discuss Exit Criteria Ballot results

Kline and COMPANY

Thursday, June 03, 2004

Mr. James A. McGeehan
Chairman, HDEOCP
ChevronTexaco Global Lubricants
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Dear Jim:

We appreciate your giving us the opportunity to further assist the lubricant industry with base stock supply issues that originally surfaced during GF-4 development. The purpose of this letter is to serve as a proposal outline regarding scope, time, and cost of additional work. I recognize that you might use this letter as an outline of a deliverable for the Heavy Duty Engine Oil Classification Panel or it might pass this letter on to API for them to consider sponsorship of the work.

We have split the problem into two independent parts, the costs of which I will itemize separately: (1) how we might duplicate the ILSAC/OIL presentation (October 22, 2003 in Detroit) with an eye toward PC-10 and (2) how we might gather a detailed, refinery-by-refinery profile of North America supply and then report it as aggregated supply by API Group and Viscosity Grade. What follows touches on each piece of the problem, one part at a time.

Item (1): We will again take some of our multiclient work that is already complete and update pieces of it in a focused way. Key items that we will check are formulation assumptions for the key PC-10 viscosity grade, SAE 15W40. We will need to sort through which of the formulation issues will have a direct effect, an indirect effect, or no effect on basestocks. As you may know, the GF-4 presentation was billed to ILSAC/OIL at US$ 7,500, which was paid by the API.

Even though these programs are similar in scope, we will not be able to do the assignment for the same price this time. Frankly, Jim, we were hammered on profitability for the last assignment. The time we spent refreshing the model and designing a presentation for the Detroit meeting turned out to be only a small part of the assignment. We underestimated the amount of follow up time required answering questions and explaining the approach that we took. If we had priced this correctly relative to our time invested, we should have billed it at about US$15,000-US$20,000.

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In addition, we realized that we needed to do more interviewing around formulation options... we only used a "few points to draw the line". If we were to do another project/model/presentation/follow-up, then I would be looking for something in the US$23,000 - US$25,000 range. We would need some lead time (about a month or so) from the authorization to proceed to get the program done.

Item (2): A detailed, refinery-by-refinery analysis would be a bit simpler. We could limit, as was suggested by some, this study to just looking at Group II facilities. Although we could take that approach, but we would still need to do a certain amount of work on each of the Groups (especially Group I) to triangulate data and account for the refiners that choose not to disclose their data to Kline. My estimate for the work outlined in Item (2) would be approximately US$18,000 - US$20,000 range for that assignment.

In case you were wondering about synergies, there would be some savings to doing both Item (1) and (2) together, but we don't need to execute (2) fully to get the answers to (1). Let me know if you want to explore that in more detail.

We understand that the HDEOOCP has a meeting on June 22nd that might be a good forum for the completed program. If you wish us to complete the work and present to this meeting, we would need an authorization to proceed next week, the week of May 3, 2004. Please let me know if you have any questions; I will be in the office all of next week.

Regards,

W.R. Downey
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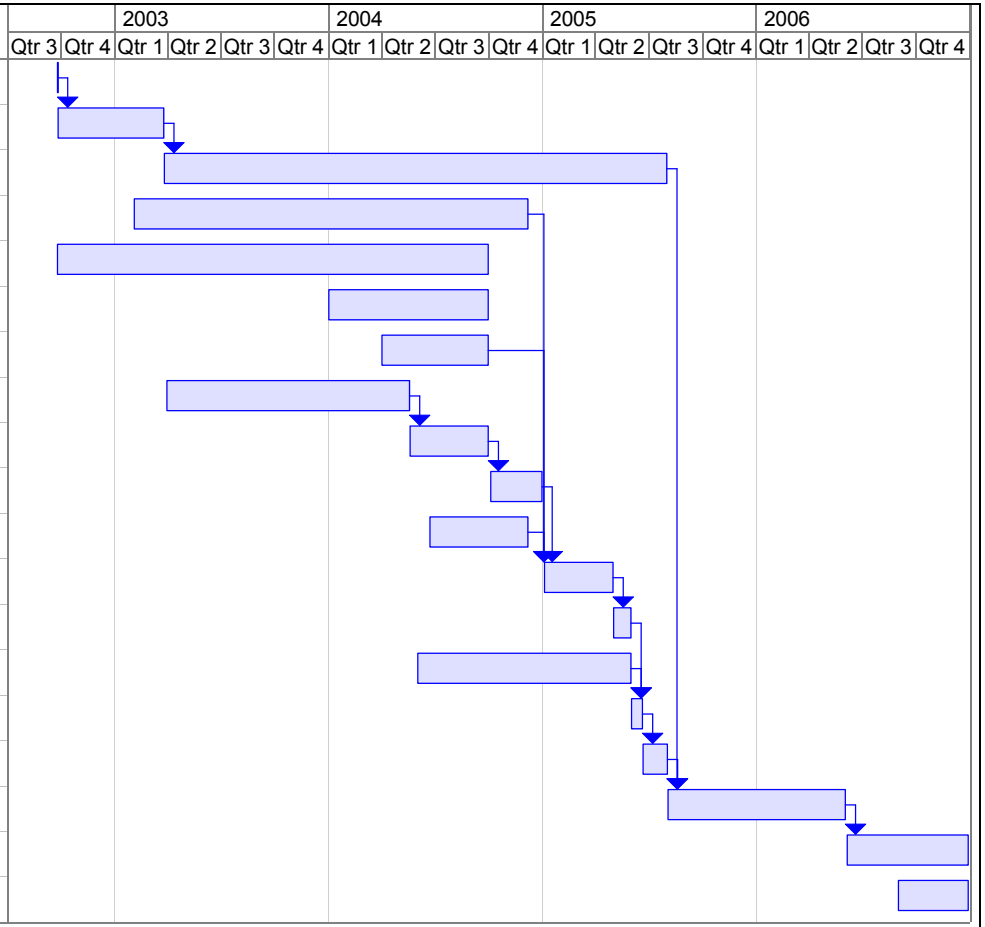
ID	Task Name
1	EMA Request
2	NCET Activity
3	NCDT Activity
4	Funding Group
5	New Test Development
6	New Test Discrimination
7	Matrix Design
8	Chemical Limits Selection
9	Select Matrix Oils
10	Matrix Oil Prep
11	Accept Parameters/Tests
12	Matrix Testing
13	Analyze Matrix
14	Select Reference Oils
15	HDEOCP Acceptance & Limits Approval
16	API Lubes Committee Final Approval
17	Minimum Product Qualification Interval
18	API Licensing
19	Engines in Field



Project: PC-10
Date: Wed 3/31/04

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

ID	Task Name
1	EMA Request
2	NCET Activity
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5	New Test Development
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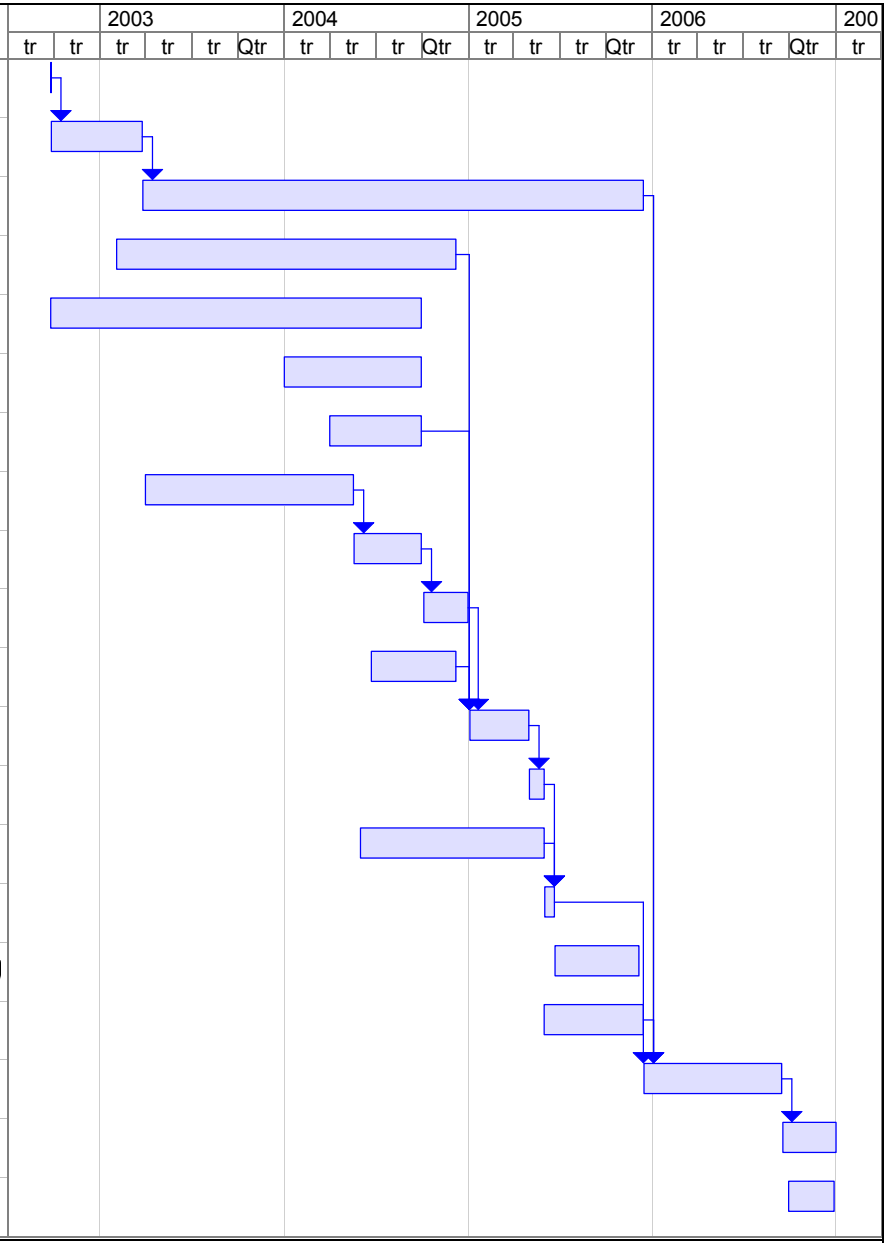

Project: PC-10 ACC-1
Date: Wed 3/31/04

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

ID	Task Name
1	EMA Request
2	NCET Activity
3	NCDT Activity
4	Funding Group
5	New Test Development
6	New Test Discrimination
7	Matrix Design
8	Chemical Limits Selection
9	Select Matrix Oils
10	Matrix Oil Prep
11	Accept Parameters/Tests
12	Matrix Testing
13	Analyze Matrix
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17	API Lubes Committee Final Approval
18	Minimum Product Qualification Interval
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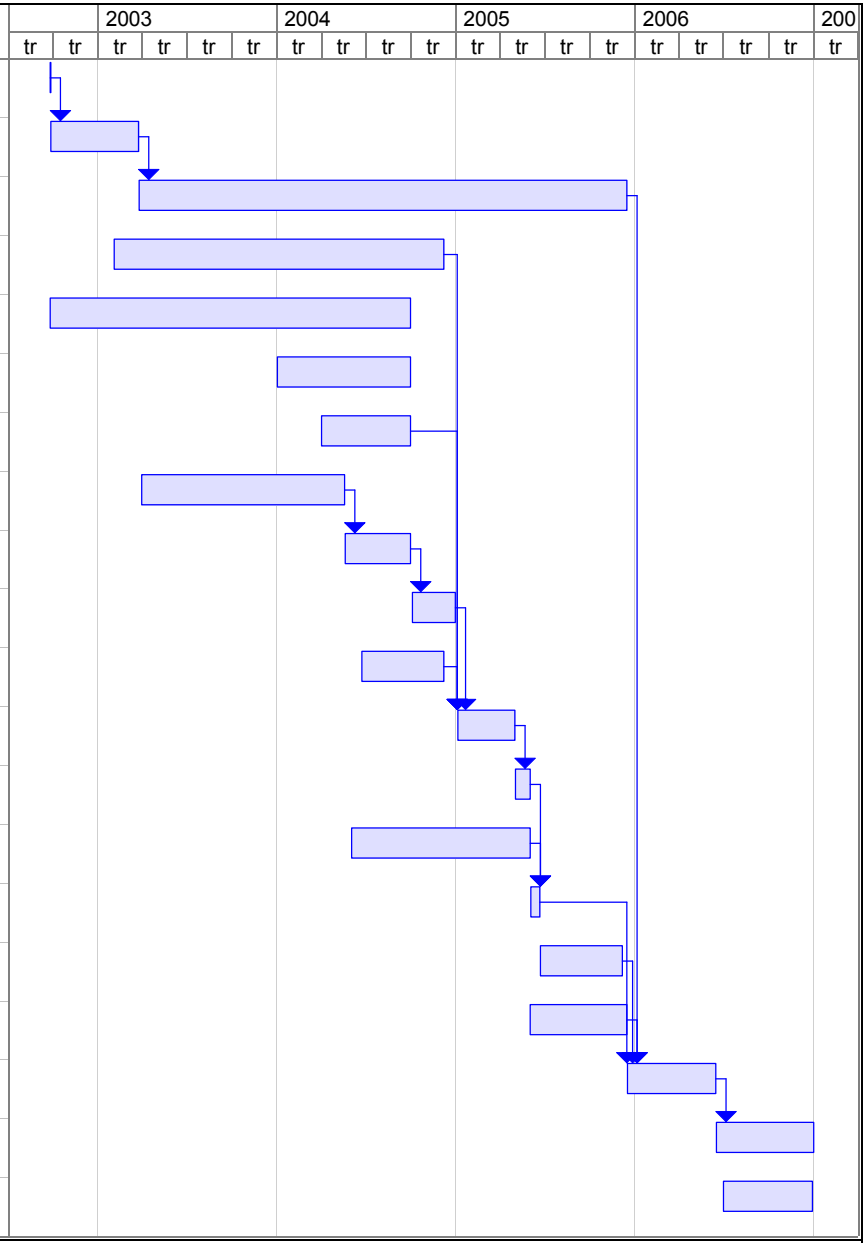
20	Engines in Field



Project: PC-10 ACC-2
Date: Wed 3/31/04

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

ISB Cam and Tappet Test
Industry Report Packet

Warren Totten

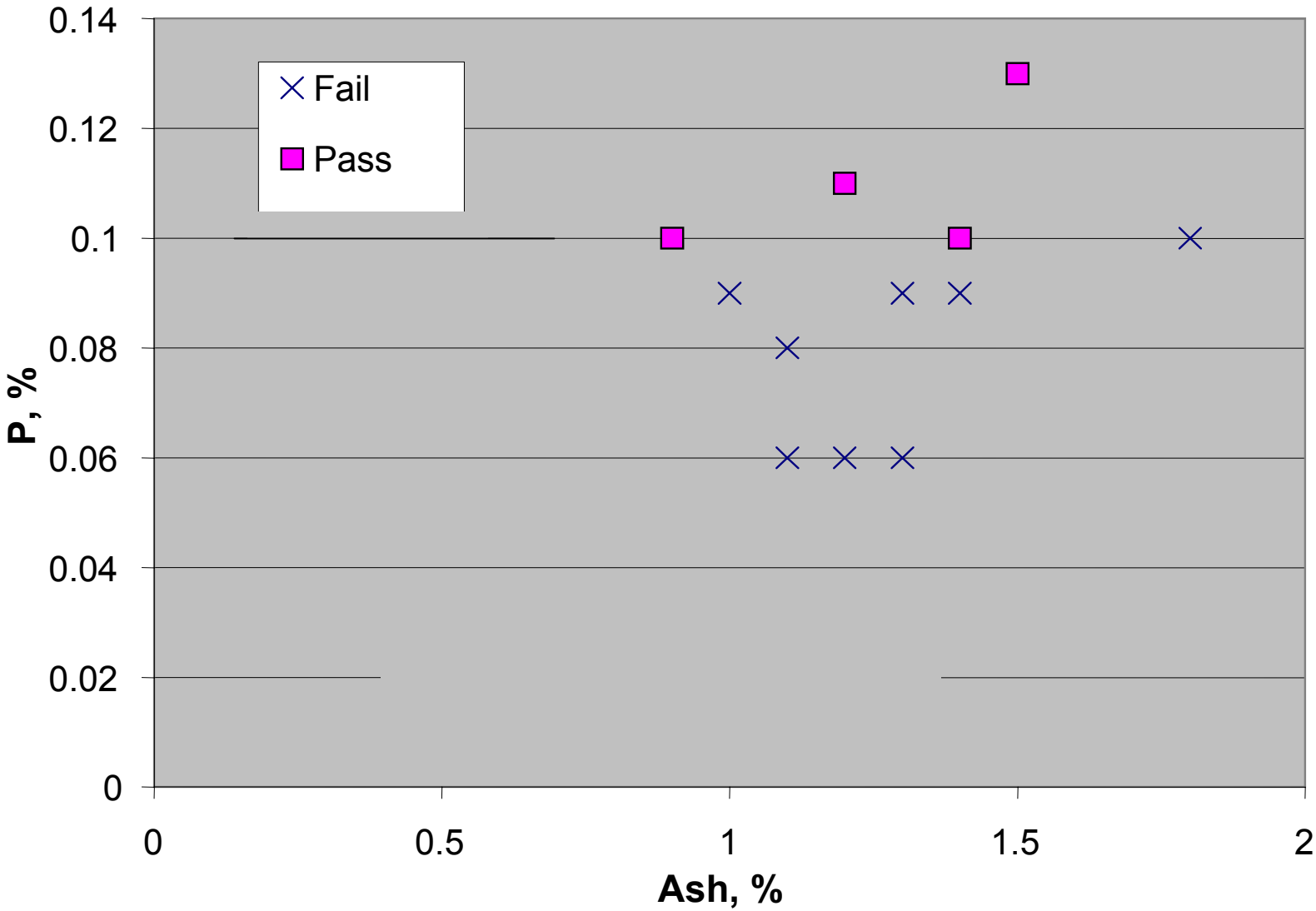
May 2004

Test History

- Based upon the an internal Cummins accelerated camshaft and tappet test
- Cam lobe pitting directly correlated with oil quality
- Cam lobes and tappets are rated on a 5 point scale from good to strong pitting observed.
- 12 engine oils representing North America and SE Asia regions,
  - 6 of the oils tested failed to meet the wear criteria.
  - 20% were represented by intake cam lobes the remaining were represented by the exhaust lobes.

Test History – B Camshaft Pitting

Phosphorus and Ash Effects



Test History
Lessons Learned

- **Test cycle limits lubricant entrainment.**
- **Pre-sooting the oil prior to the accelerated cam cycle test provides for the most severe wear scenario.**

Test Development

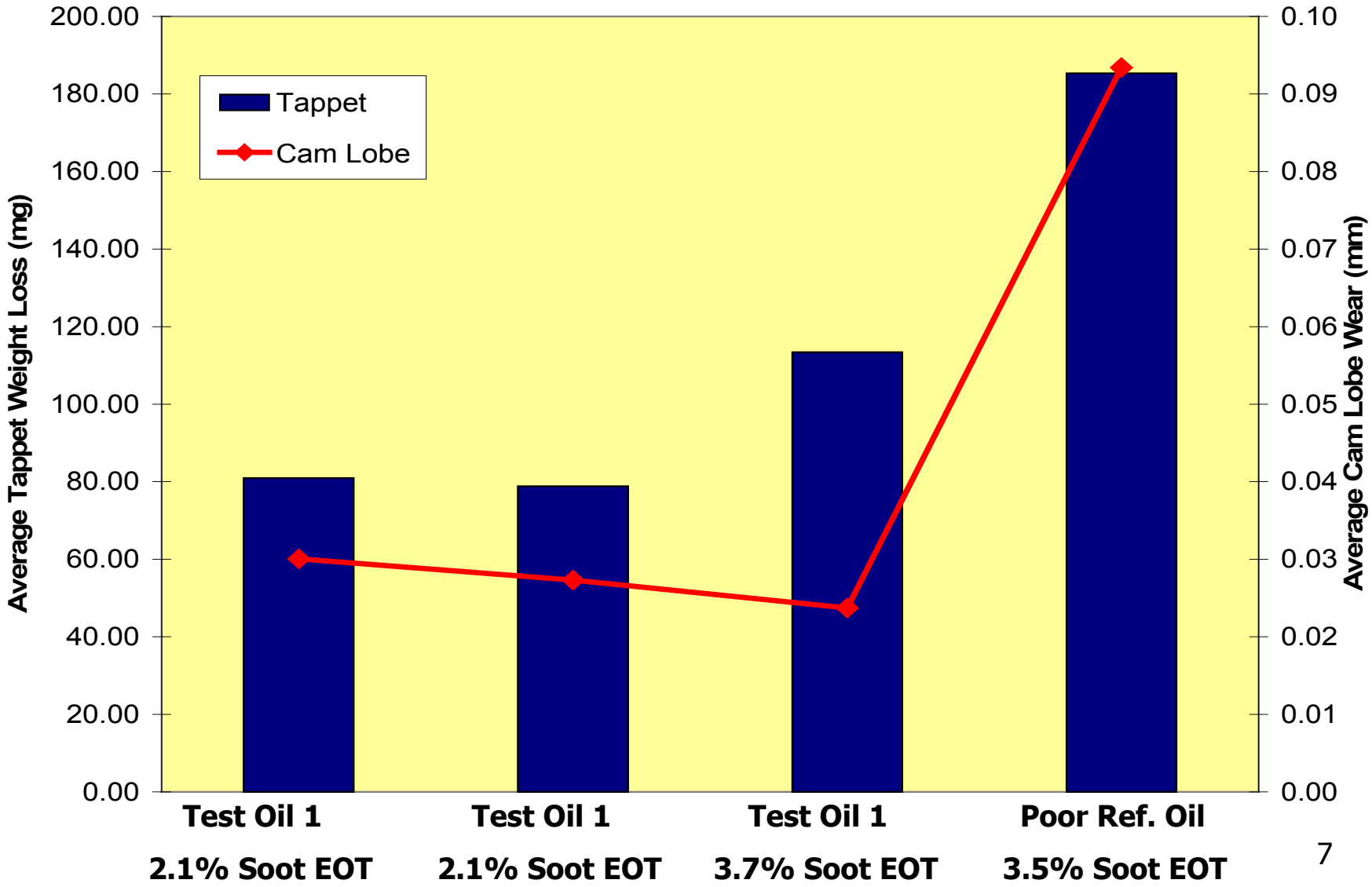
- Quantify end of test measurements from internal cam and tappet test.
- Test procedure was proposed, drafted and developed with Cummins support.
- Procedure is now being finalized with the help of the industry through the ASTM ISB Task Force.
  - Six labs participating on the task force.
    - One actively running data
    - Two preparing stands will be up by end of May
    - Remaining three running in June.

Looking Forward
Meeting the Timing

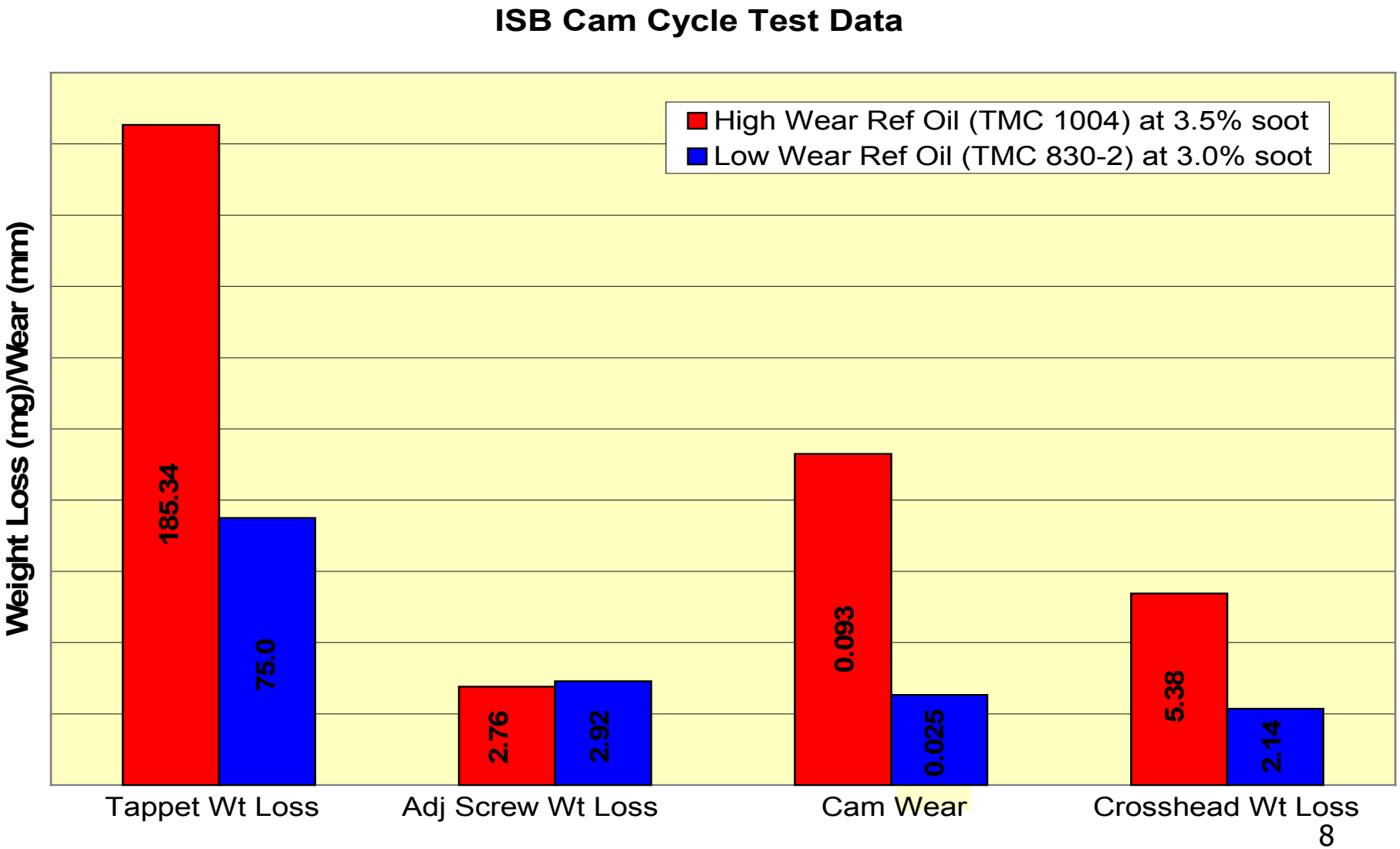
- Cummins proposes that the matrix testing begin on the ISB test as soon as the test is ready.
- First, proof of concept data indicating test discrimination and repeatability must be presented to the HDEOCP.
- This data is included in the presentation.
- When remaining stands are on line, and
- Operation and Hardware subgroup of the ISB Task Force indicates all test stands are ready
- Cummins will move that the ISB matrix begin.

B Engine Camshaft and Tappet Testing

Repeatability and Discrimination



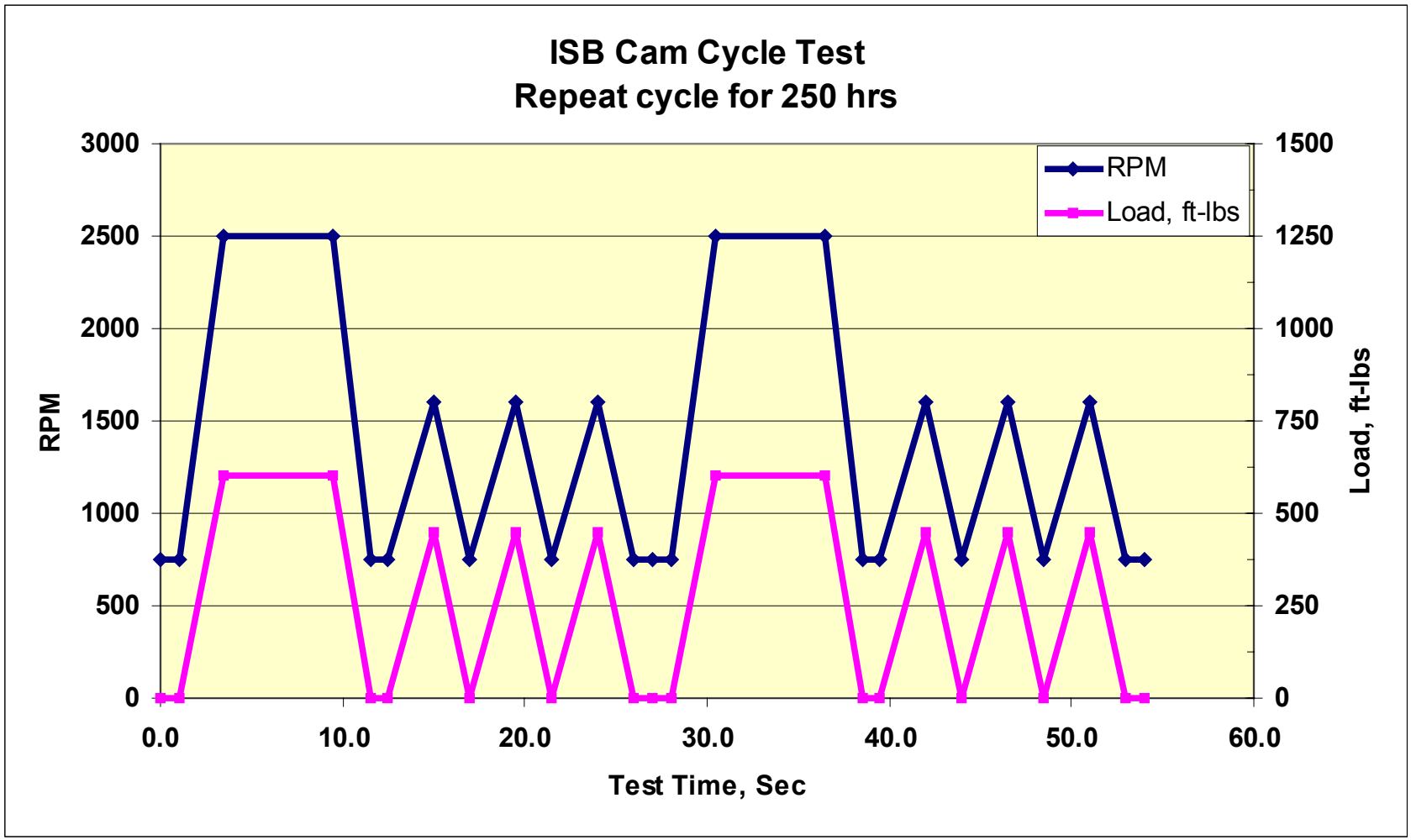
ISB '02 Camshaft and Tappet Data
Discrimination



ISB Test Overview

- The ISB Cam and Tappet Test is:
  - Based upon a 2004 EPA Compliant engine
  - Rated at 300 HP and 600 ft-lbs torque.
- First portion; a 100 hour soot generation cycle:
  - 1600 RPM and 325 ft-lbs torque.
  - Timing retarded
  - Soot window of 3.25 +/- 0.25%.
- Oil level is verified as full.
- Continues on a 28 second accelerate wear cycle for 250 hours.
- Wear components and other test parameters are evaluated at EOT.

Second Phase Cycle



Scope

To develop a lubricant performance test on a Cummins ISB test platform that can discriminate and provide a quality assessment of motor oils in a sliding tappet engine under cyclic conditions. The ISB test development will consider the following parameters for lubricant quality evaluation:

Primary Parameters

Tappet Weight Loss

Cam Lobe Wear

Cam Journal Wear

Secondary Parameters

Push tube scuffing

Sludge

Oil filter delta P

Adjusting screw wt. loss

Crosshead weight loss

Objectives

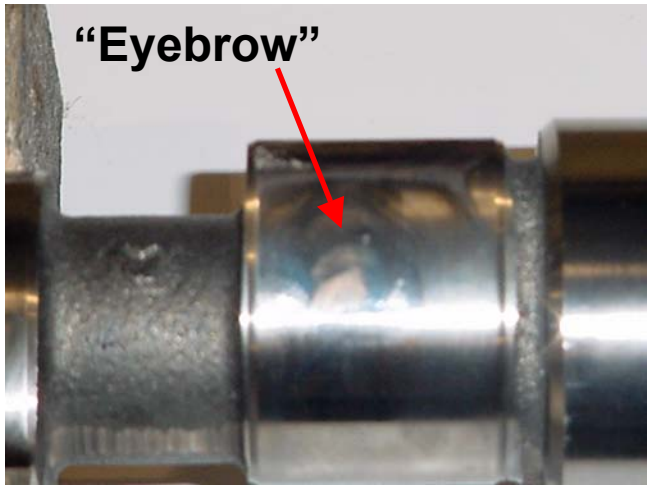
- Draft of test procedure 12/03
  - **Preliminary draft completed 01/04**
  - **Work continues within the ISB Task Force to refine and standardize the procedure**

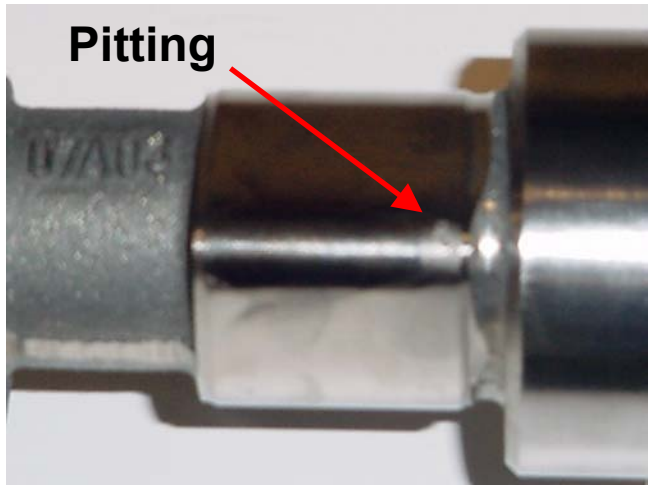
- Test engines to six labs 1/04
  - ExxonMobil, Lubrizol, PerkinElmer, SwRI, Valvoline
  - Ethyl engine 5/04

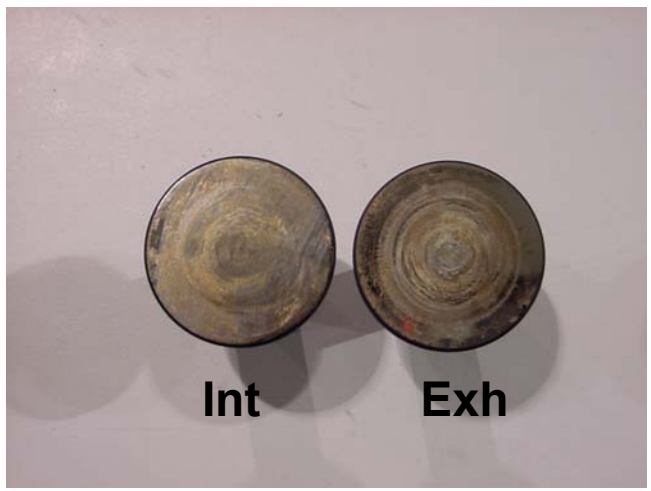
3. Initiate matrix design 1/04
   - **Preliminary proposal based upon 4 labs attached**

4. Begin matrix testing To meet API timing

Cam and Tappets After Test







ISB Test Parameters

- Parameters to be rated
  - –Primary Parameters
    - •Tappet Wear
      - –mg wt loss
    - •Cam lobe wear
      - – mm wear
        - »ADCOLE measurement
        - »Cams will be pre and post measured by CPD
        - »The O&H Sub-group is evaluating alternative wear measurement methods
    - •Cam journal wear
      - – mm wear
        - »ADCOLE measurement

ISB Test Parameters

- Parameters to be rated
  - –Secondary Parameters
    - •Overhead wear
      - –Crosshead Weight Loss, mg loss
      - –Adjusting Screw Weight Loss, mg loss
      - –Push Tube Scuffing
    - •Other parameters
      - –Oil Filter Delta Pressure, kPa
      - –Sludge, rocker cover and oil pan

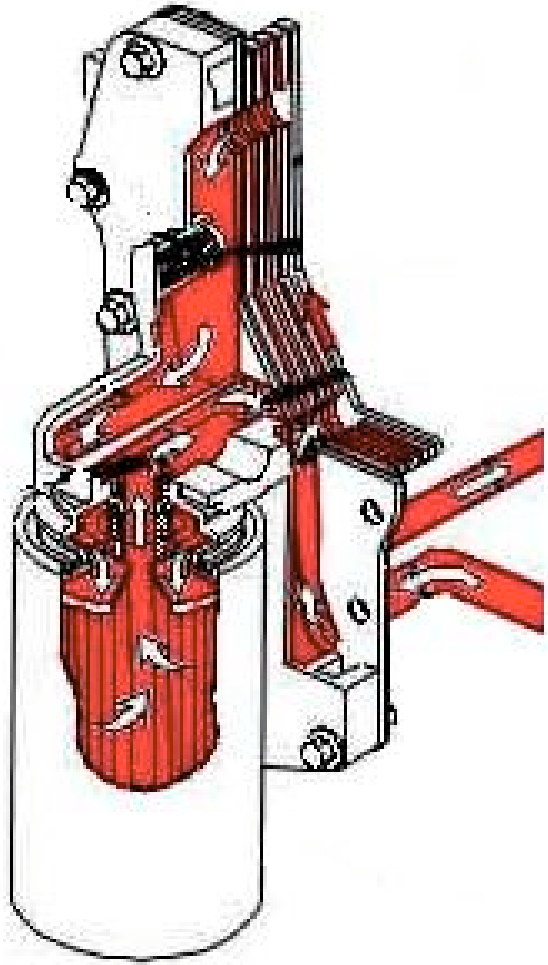
Precision ISB Matrix Design

Reducing the costs

Ideas

- Each test stand will demonstrate similar wear performance as the Cummins test stand
  - based on comparison to historical data (mean and standard deviation)
- Cost effective matrix based on 4 oils.
- 3 DI/VI combinations, 1 base oil, and 1 Reference Oil
- Each successful test generates 12 tappet, cam and crosshead wear points
- No VGRA or BOI included in matrix design

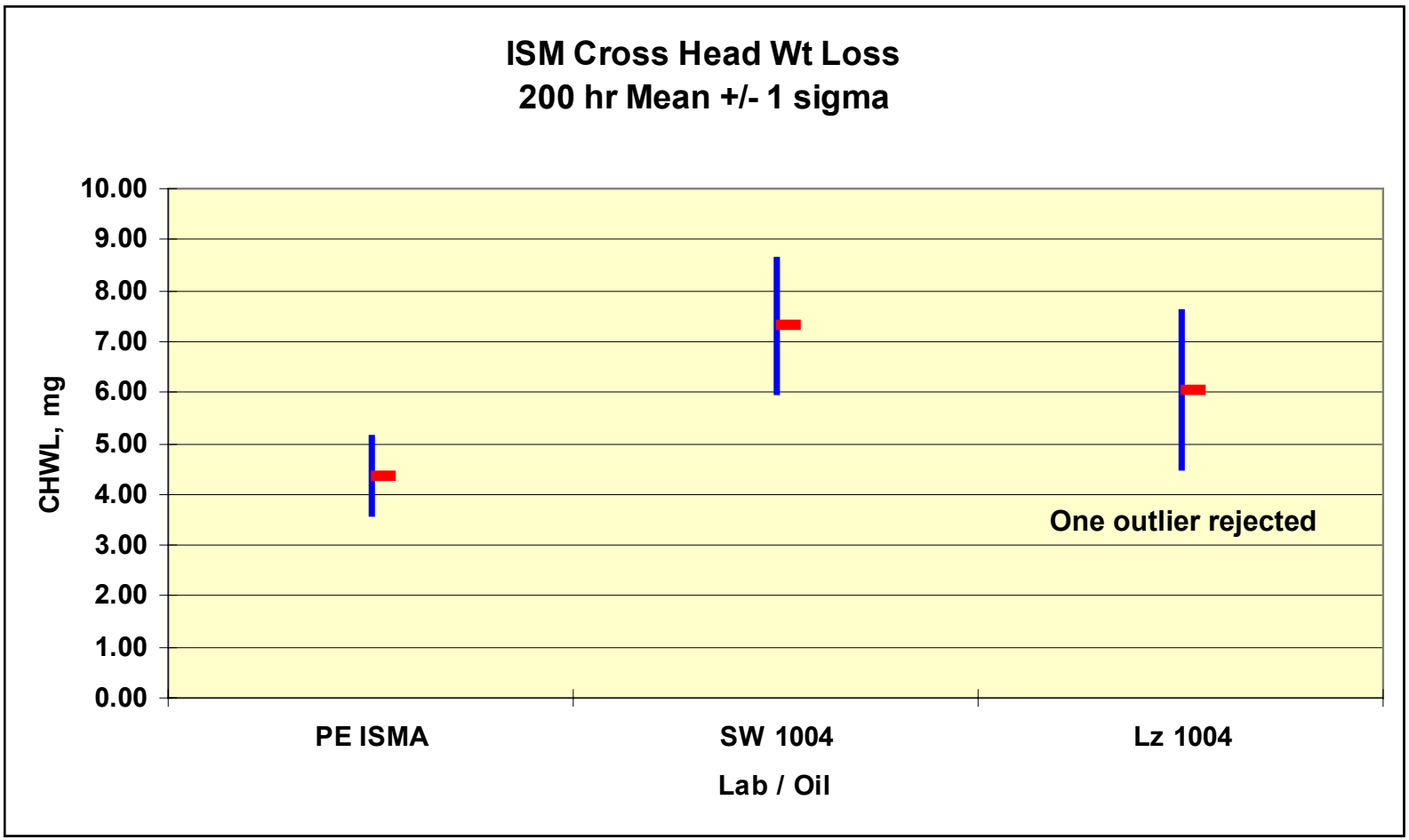
Hardware Modifications



ISM Status Report

- Three Tests Completed
  - PE ISMA (Excellent Oil)
  - SW 1004
  - Lz 1004
- Data analysis in progress by ISM working group
- Next run will be to 300 hr with a 200 hr inspection

ISM Cross Head Wt Loss
Uncorrected for soot



Caterpillar ECF-2 Test Criteria

500 hour – Steady State Test Cycle

Test Pass/Fail Criteria:

1. No Loss of Oil Consumption Control
2. No stuck rings/Loss of ring side clearance
3. No Liner Scuffing or Bore Polish
4. No Loss of Blowby Control
5. Measured Piston Deposits
6. EOT Oil Quality to be monitored




Caterpillar ECF-2 Test Matrix

Test Conditions	IMT	Coolant	Oil	Fuel Rate
	°C	Oil #1	Oil #2	Oil #3
High Temperature	75	OK	OK	OK
Intermediate Temp	55	Sluggish	Stuck	OK
Low Temperature	40	Stuck	Stuck	Stuck

Low Temperature Issue




Caterpillar ECF-2 Test Matrix

	#	Ref 1	Ref X
Intermediate Temps	1	36% Inc OC, Stuck Ring	41 % Inc OC, Sluggish Rings
Hot Temps	2	16 % Inc OC, Rings Free	49% Inc OC, Rings Free (Ref #2)
Low Temps	3	105 % Inc OC, Stuck Rings*	31% Inc OC, Stuck Rings* (Ref #2)
	4	62 % Inc OC, Stuck Ring	43% Inc OC, Rings Free Comm B
	5	61 % Inc OC, Stuck Ring	
	6	78 % Inc OC, Rings Free	46% Inc OC, Rings Free Comm A

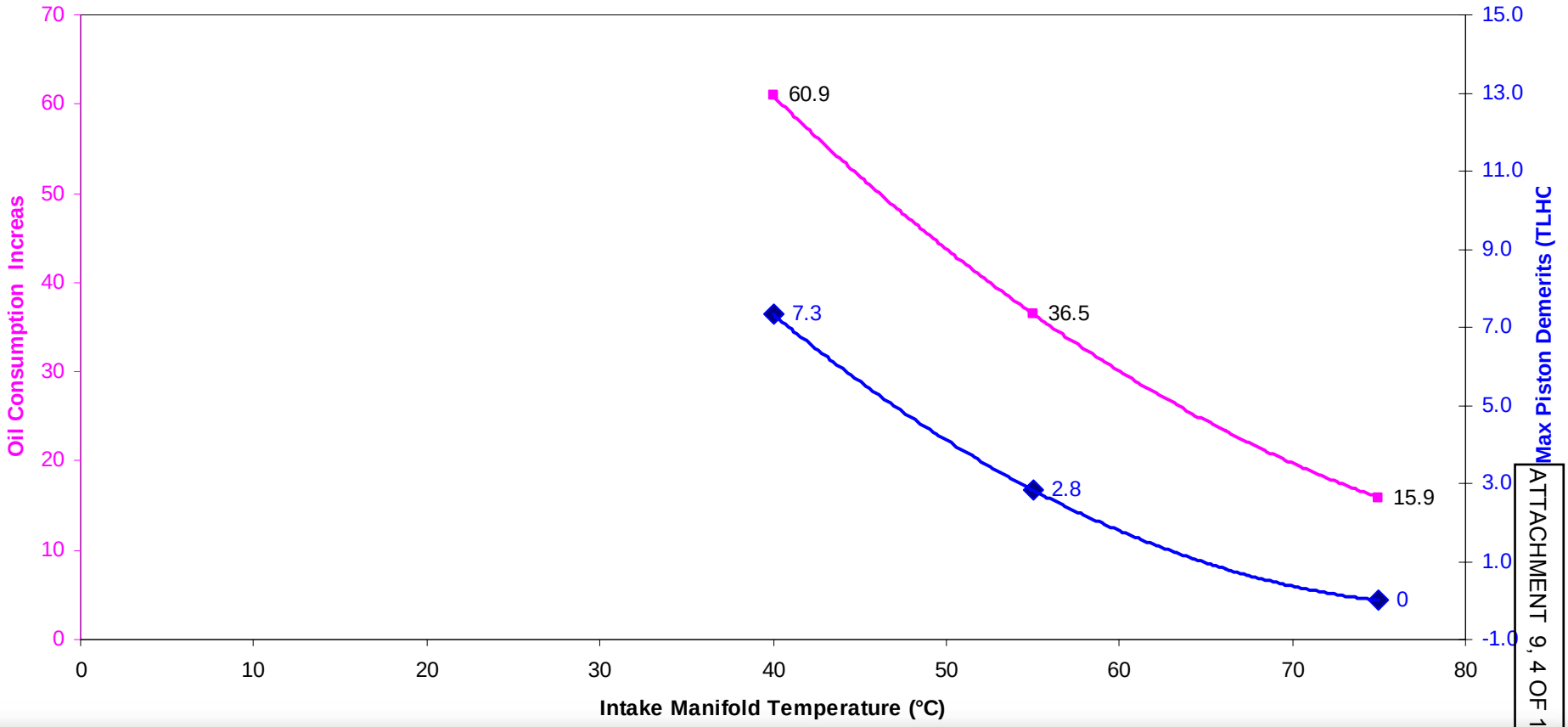
- Test started at hot temp for first 100-150 hrs, then switched to Low Temp
- Test 6 was a new engine on a new oil batch run at new test stand




Caterpillar ECF-2 Test Results Summary

C13 Max TLHC

Temperature Effects on Deposits

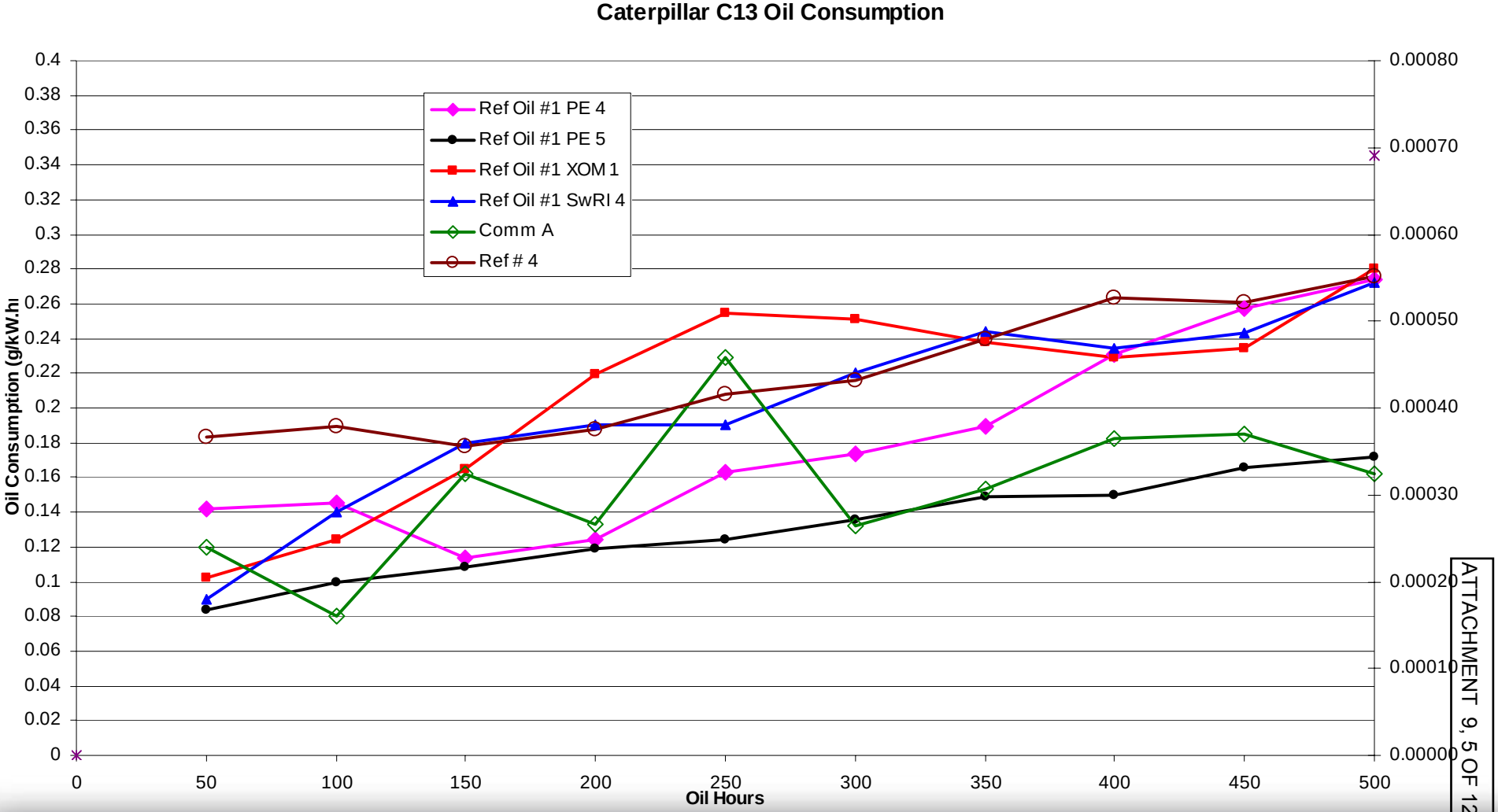


ATTACHMENT 9, 4 OF 12




CATERPILLAR®

Caterpillar ECF-2 Test Results Summary



ATTACHMENT 9, 5 OF 12




CATERPILLAR®

Caterpillar C13 Test Summary

1. Oil Consumption Control – unacceptable/variable
2. Get New PRL – Repeat temperature study

   – Extend operating range sensitivity
3. No Correlation – Oil consumption with deposits

   – 2nd ring stick with OC
4. Failing Ref #1 oil is marginal




Caterpillar PC-10 HDEOCP UPDATE

- Low Temperature deposits issue validated
- May take opportunity to update and specify closer tolerances of Production hardware for Oil Test engine
- Low Reference Oil (Ref 1) selected
- High reference being sought




Caterpillar PC-10 Test Proposals

Forward and Backward Compatibility

- High Temp deposits tests in past
- New lower Temp combustion with lower Piston Temps

This will drive two piston deposit tests for PC-10:

1) 1P for High Temperature Backward Compatibility
2) C13 for lower temperature (low NOx) engines




Caterpillar PC-10 Test Proposals

Fuel Sulfur for PC-10 Tests:

1) 1P 500 ppm for Backward Compatibility
2) C13 <15 ppm for Forward Compatibility

3) CCV test




Caterpillar PC-10 Test Proposals

Phase II Test Development:

1) Test Cycle Completed
2) C13 Test engines installed – 7
3) C13 Test engines provided to date - 13
4) Installing 2 C13s at CAT




Caterpillar PC-10 Test Proposals

Phase II Test Development:

1) Likely upgrade Piston and rings
2) Looking at acceptable Ref Oil
3) Complete test by Dec 04




Caterpillar ECF-2 Test For 2007

1. Time to explore other deposit effects
   - CCV
   - ULSDF
   - Aftertreatment
   - Engine Durability of low Ash oils




Mack PC10 Engine Test Update

ATTACHMENT 10, 1 OF 2

Ring & Liner Wear (Corrosive),TBN Retention, Bearing Corrosion,Oxidation, Oil Consumption

- Mack T-12
- Hardware (Piston / Liner / Ring / Bearings) ?
- With ULSD Fuel ?????
- Length - ~ 300 Hours
- Increased EGR Flow (Heavy EGR)
- Higher Oil Temp (260 F)
- 5 % Soot in Phase 1
- Precision Matrix Required
- Hardware Available 2nd QTR
- Test Procedure & Discrimination 4th QTR 04

- Next Generation Hardware – Limited Availability
- Back Up Plan Would be to Modify T10 / T11
- Decision In June

ATTACHMENT 10, 2 OF 2

PC-10 Engine Test Matrix

Design Task Force

- **Membership established**

Nancy Diggs (Infineum)
Charlie Passut (Ethyl)
Bill Runkle (Valvoline)
Jim Rutherford (Oronite)
Elisa Santos (Infineum)
Phil Scinto (Lubrizol)
Greg Shank (Volvo-Mack)
Matt Urbanak (Shell)
Jim Wells (SWRI)

Any other volunteers?

- **Next steps -- collect input to determine the scope of the matrix design**
  - **Funds available**
  - **Number of new tests**
  - **Number of test stands & labs; calibration criteria**
  - **Precision only or Precision plus BOI**

PC-10 List of Back-Up Tests

- Need to develop a list of back-up tests to meet the performance requirements if the proposed tests do not meet the dead-line of Dec 2004 meeting, ie:
- Mack T-12: Mack T-10 or T-10 cycle with T-11 hardware using low sulfur.
- Caterpillar C13: Cat 1P/1R or MB 441LA.
- Cummins ISB: Mit. 4D34T4 cam test.
- Cummins ISM: Cummins M11 EGR.

Jim Mc Geehan • ChevronTexaco

EOEC(PC-9/10 Seals) Presentation To the HDEOCP, Value of TMC Monitoring

Joe Franklin

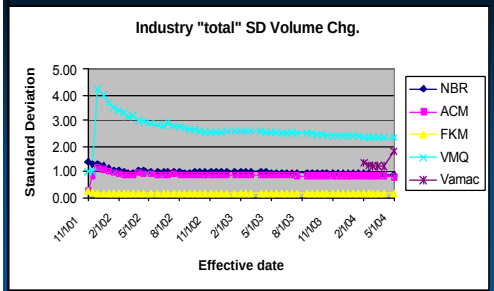
May 18, 2004

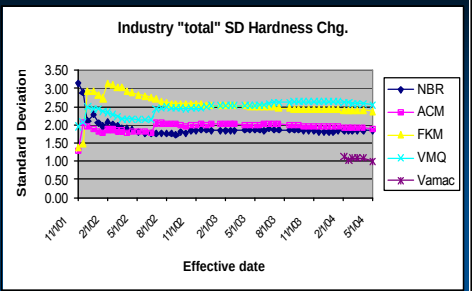
Test Design - Background

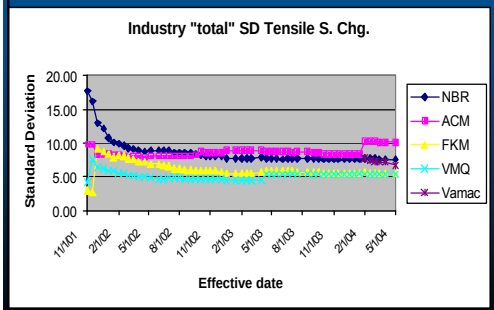
- **Current Process:**
  - **Each candidate set run with TMC Service Fluid 105(1006)**
    - **Acquired in bulk from TMC.**
  - **Candidate limits calculated based on reference run data.**
  - **Calculations include direct reference data as well as industry calculated standard deviations for inter-lab and intra-lab.**
  - **Data is reported with reference data to the test requestor.**
  - **Reference data is reported to the TMC for inclusion in the SD calculations.**

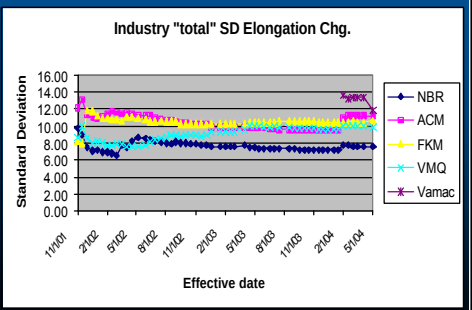
ATTACHMENT 13, 1 OF 5

Test Precision History

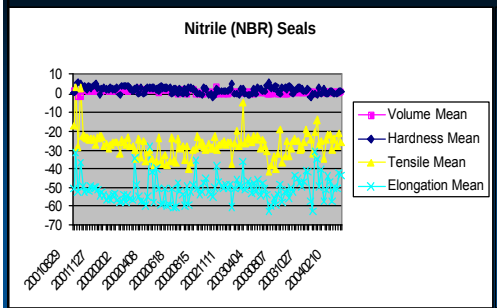


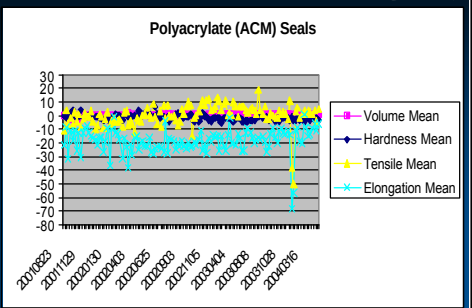


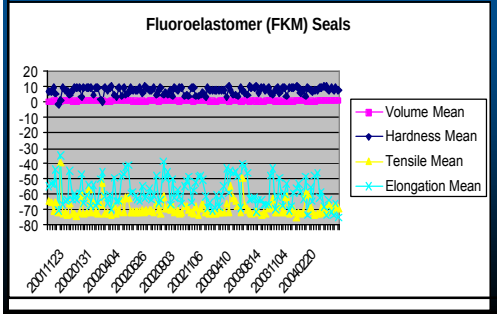


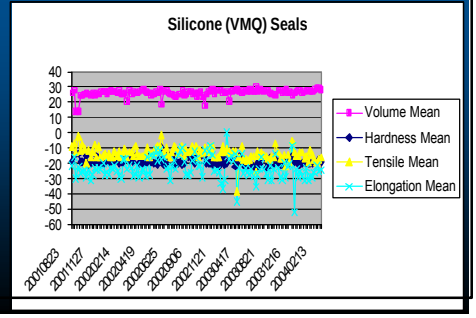


Test Result History



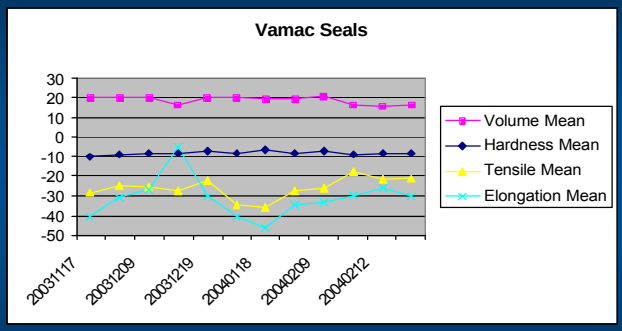






ATTACHMENT 13, 2 OF 5

Test History (continued)



Details of Pass/Fail calculations

	Volume Chg.		Hardness Chg.		Tensile S. Chg.		Elongation Chg.	
Type	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
NBR	(-3)	(+5)	(-5)	(+7)	Ref.	(+10)	Ref.	(+10)
VMQ	(-3)	Ref.	Ref.	(+5)	(-45)	(+10)	(-30)	(+20)
ACM	(-3)	(+5)	(-5)	(+8)	(-15)	(+18)	(-35)	(+10)
FKM	(-2)	(+5)	(-7)	(+7)	Ref.	(+10)	Ref.	(+10)

Typical values for Ref. oil TMC SF 105 (1006) (Specific values are generated w/ Candidate)

NBR	0.6	0.2	-25	-52
VMQ	26	-15	-12	-22
ACM	1.1	-1.7	0.9	-20
FKM	0.8	5	-66	-48
Vamac	19	-8	-26	31

*Values in ( ) are non-critical and adjusted by a factor of the industry "total" SD. (= + or - [s /Ö6]*2)*

*Ref. values are also non-critical and adjusted by a factor of the industry "within Lab" SD .(= + or - [s /Ö6]*2)*

ATTACHMENT 13, 3 OF 5

Proposed Changes based on December 03 Request

- *TMC modified Data Dictionary(done).*
- *Establish Limit data for the current reference oil.*
  - *Choice needed about how much data to use.*
  - *Choice needed about use of LTMS or Acceptance bands*
  - *Choice needed about how to account for material batch changes.*
  - *Choice needed for format of the new data set at TMC.*
- *Bottle Reference oil in small quantities.*
  - *Each bottle will contain only enough fluid for 1 run of 1 elastomer type.*
- *Assign CMIR's to each bottle.*
  - *5 CMIR's will be assigned to the lab for each set of reference elastomer tests (5 materials)*
- *Distribute to participating labs.*
- *Discontinue acceptance of data from bulk reference oils already at the participating labs.*

General Statements

- **TMC makes sure that tests have adequate precision.**
  - **Test precision is generally getting better or leveling off over time.**
- **TMC makes sure that data which is not normally distributed about the mean is not validated.**
  - **Test mean values are generally normally distributed despite batch changes in the elastomers.**
- **TMC maintains control of the tests it monitors.**
  - **Test is in control.**
- **TMC takes action to control variation between labs and across material/hardware batches.**
  - **Test is designed to account for lab and material variation when determining pass / fail. The limits are also set up in a "no harm" scenario.**

ATTACHMENT 13, 4 OF 5

Conclusions

- **Adding a full TMC monitoring system would not likely advance the usefulness of the test data.**
- **The Features of a proposed monitoring system would serve to further complicate the scheduling and operation of the test.**
- **The fees to the laboratories combined with the additional complication would increase the cost of the test without increasing the value of the data.**

ATTACHMENT 13, 5 OF 5