HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL

OF

ASTM D02.B0.02

March 31, 2005

Embassy Suites Hotel – Rosemont, IL

ACTION ITEMS

1. Issue "Exit Ballot" on T-12 matrix readiness.	**Jim McGeehan**
2. Issue "Exit Ballot" on ISM / M-11 EGR correlation limits.	**Jim McGeehan**
3. Issue "Exit Ballot" on revised T-10 limits for T-9.	**Jim McGeehan**
4. Issue "Exit Ballot" on T-10 limits for T-6.	**Jim McGeehan**
5. Issue "Exit Ballot" on ISB matrix readiness when ISB TF approves.	**Jim McGeehan**

MINUTES

1.0 Call to Order

1.1 A meeting of the Heavy Duty Engine Oil Classification Panel (HDEOCP) was called to order at 8:10 a.m. on March 31, 2005 in the Walden Room of the Embassy Suites Hotel of Rosemont, Illinois by chairman Jim McGeehan. There were 20 members present or represented and approximately 21 guests present. The attendance list is shown as Attachment **2**.

2.0 Agenda

2.1 The published agenda (Attachment **1**) was reviewed and it was noted that Bengt Otterholm had inadvertently been omitted in the latest version of the agenda. Bengt's presentation on turbocharger deposit testing was reinstated to the agenda before lunch.

3.0 Previous Meeting Minutes

3.1 Tom Cousineau suggested that "Surveillance Panel" be inserted in section 12.1 of the February 23, 2005 minutes, after "RFWT". He also suggested that more detail be added in section 13.2 with regard to Charlie Passut and Afton's concern regarding CF-4. Essentially, since the Mack T-9 is no longer available, there needs to be discussion on the future of CF-4.

3.2 The minutes of the February 23, 2005 meeting were approved with the above suggested additions, via voice vote.

4.0 Membership

4.1 There was no change to the panel membership. Frank Fernandez represented Bill Kleiser. Glenn Mazzamaro represented Scott Harold. Dave Stehouwer represented Warren Totten.

5.0 PC-10 Matrix Design and Funding

5.1 Steve Kennedy reported on the current matrix design proposals and funding situation. See Attachment **3**. Steve proposed that the ISB and T-12 matrix designs A-1, B-1, C-1 be accepted with the appropriate one used depending on the number of labs involved when the time comes. Greg Shank seconded the motion which was approved with a vote of 19 for, 0 against, 0 abstains.

6.0 C13 Exit Ballot Review

6.1 Jim McGeehan reviewed the exit ballot responses. See Attachment **4**.

6.2 Pat Fetterman indicated Infineum would move their negative to a positive if "Oil D" were included in the matrix. They also continue to have concern with regard to the method used to assess oil consumption. See Attachment **5**.

6.3 Charlie Passut indicated Afton is concerned about insufficient discrimination by the test, especially for oil consumption, and lack of adequate test parts. See Attachment **6**. Abdul Cassim stated that if oil consumption does not demonstrate discrimination in the matrix, it would be dropped as a pass/fail parameter.

6.4 Lew Williams indicated Lubrizol is also very concerned that the test has insufficient discrimination. See Attachment **7**. They are willing to go forward if discrimination is demonstrated, but otherwise the matrix should stop.

6.5 Abdul Cassim reviewed C13 data and emphasized that the C13 is a piston deposit test. See Attachment **8**. He also stated that all test kit parts for the matrix are now on hand and that parts for the rest of 2005 would be in stock soon.

6.6 Jim McGeehan expressed concern, shared by others that "Oil D" may not discriminate from the low SAP matrix oils. Abdul indicated two additive companies had reported to him, better performance than "Oil D" with low SAP oils. Charlie Passut stated that if oil consumption is not necessarily a pass/fail parameter, then Afton would change their negative to a positive. Lew Williams observed that nothing had changed and there was still no plan to obtain adequate discrimination data before starting the matrix.

6.7 Greg Shank proposed (with a little help from his friends) that the C13 proceed to matrix testing with conditions that the matrix pause after the first seven tests (3 on "Oil D", 2 on "PC-10 B" and 2 on "PC-10 E") for analysis of Top Land Carbon (TLC), Top Land Heavy Carbon (TLHC), Top Groove Fill (TGF), Top Groove Carbon (TGC) and Oil Consumption (OC), where OC is defined as the percent increase in oil consumption from the average of the 100 to 150 hour oil consumption to the average of the 450 to 500 hour oil consumption. The analysis is to include the five pre-matrix tests on "Oil D" and "Oil A" using alpha of 0.5 as the indication of significant difference. Abdul Cassim seconded the motion which passed with 19 for, 0 against, 0 abstains.

7.0 PC-10 Matrix Oils

7.1 John Zalar reported several oils had arrived at the TMC…oils PC-10B, PC-10D, PC-10E and PC-10F. However, oil PC-10B was not blended as one batch, so it will have to be homogenized. Oil PC-10D has an analytical discrepancy and may need to be re-blended. Even so, if a re-blend is necessary, it is expected to be received by next week, along with oils PC-10A and PC-10C.

8.0 PC-10 Test Development Status

8.1 Greg Shank reported on the Mack T-12 development results. See Attachment **9**. Greg said TEI would have all needed matrix parts by April 8, 2005. Jim Rutherford reviewed

the statistical analysis of the T-12 data, see Attachment **10**. It was noted there is some question with regard to the IR data and that there is an IR method round robin in progress. Greg Shank proposed that the T-12 test is ready for matrix testing. Steve Kennedy seconded the motion. Discussion ensued over whether this should really go to exit ballot first. The motion as originally proposed, passed with 18 for, 0 against, 1 abstention. Pat Fetterman then proposed that an exit ballot on accepting the T-12 as ready for matrix testing be conducted with a one week turnaround, followed by an HDEOCP teleconference if necessary. Lew Williams seconded the motion which passed with 19 for, 0 against, 0 abstains.

8.2 Dave Stehouwer reported on the Cummins ISM and ISB test status. See Attachment **11**. Dave thanked Daryl Baumgartner, Mark Sarlo, Jeff Clark and the statisticians for all their work and help on these test procedures. He then reviewed the ISM / M-11 EGR correlation protocol shown in Attachment **11** and proposed adoption of the pass/fail limits shown on slide 4. During discussion, Lew Williams expressed concern that the OFDP limit of 55 KPa is too low. Greg Shank seconded the motion, which passed with 18 for, 0 against, 1 abstention. Lew Williams then proposed that these limits be exit balloted, including tiered limits, for the ISM to be accepted as an alternate test to the M-11 EGR in previous categories. Pat Fetterman seconded the motion, which passed via voice vote with none against and one abstention.

8.3 Dave then reported on the ISB (Attachment **11**) and indicated all discrimination requirements and parts supply should be complete by April 15. He proposed that an exit ballot for ISB matrix testing approval be issued when the ISB Task Force declares the test matrix ready. Greg Shank seconded the motion, which passed with 19 for, 0 against, 0 abstains.

9.0 Turbocharger Deposits

9.1 Bengt Otterholm reviewed the cause of and concern for turbocharger deposits. These concerns have prompted the development of a new bench test utilizing an actual turbocharger. See Attachment **12**. The test is being developed outside of CEC, but plans are to present it to CEC later this year for inclusion in a future oil category. This issue is still an EMA PC-10 concern, but at this time seems more applicable to PC-11.

10.0 NCDT

10.1 Bill Runkle presented an NCDT report (Attachment **13**) and an update on the PC-10 timeline (Attachment **14**). No action has been taken on including the 1P test in PC-10. Tom Cousineau asked the labs which have run “Oil A” for the C13 to see if they have any left – to try and consolidate enough to run a 1P test on “Oil A” at Afton. An NCDT meeting / teleconference will be called before the June ASTM meeting to make a decision by then (possibly before the May 10 LC meeting) on whether or not to include the 1P in PC-10. In reviewing the timeline, Bill noted the current predicted first license date is 12/28/06. EMA replied that is unacceptable.

11.0 Mack T-10 for T-9 Limits – Exit Ballot Review

11.1 Oronite, Infineum and Lubrizol negative responses are shown as Attachments **15, 16** and **17**.

11.2 After the concerns were reviewed, Greg Shank proposed an exit ballot of new proposed one test limits of 32 microns for ALW, 150 mg for TRWL and 50 ppm for EOT delta lead. Pat Fetterman seconded the motion, which passed via unanimous voice vote. A two week turnaround for the exit balloted was requested. See Attachment **18** for the tiered limit details.

12.0 CF-4 Concerns

12.1 Charlie Passut presented Afton's concerns with CF-4 now that the T-9 test is no longer available. See Attachment **19**. Lubrizol and Afton feel CF-4 should not be obsoleted. So, Charlie proposed an exit ballot for T-10 limits of 47 microns ALW and 180 mg TRWL as alternative to 90 merits for the T-6 test. Lew Williams seconded the motion, which passed via unanimous voice vote.

13.0 C13 / 1P Data

13.1 Abdul Cassim presented some 1P / C13 data he had acquired. The data appear to be for three oils that have both 1P and C13 test results. In general, it seems that the C13 produced higher deposits than the 1P for these oils. See Attachment **20**.

14.0 Next Meeting

14.1 Next meeting not discussed, but there probably will be one called by the chairman, before the June semi-annual meeting.

15.0 Adjournment

15.1 This meeting was adjourned at 1:50 p.m. on March 31, 2005.

Submitted by:

Jim Wells
Secretary to the HDEOCP

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

ATTACHMENT 1

Embassy Suites Hotel O'Hare-Rosemont
March 31 , 2005
8:00 am-2:00 pm

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

Desired Outcomes: **Select engine tests for matrix**

TOPIC	PROCESS	WHO	TIME
Agenda Review	• Desired Outcomes & Agenda	Group	8:00-8:05
Minutes Approval	• February 23, 2005	Group	8:05-8:10
Membership	• Changes: Additions	Jim Mc Geehan	8:10-8:15
Matrix design	• Caterpillar C13 with reference oil D and BOI matrix.	Steve Kennedy	8:15-8:45
Funding status	• Review status of funding	Steve Kennedy	8:45-9:00
Matrix oil status	• Blending and shipping of matrix oils, including oil D	John Zalar	9:00-9:15
Caterpillar C13	• Review "Exit-Criteria" ballot results • Discussion • Vote on starting matrix	Jim Mc Geehan	9:15-10:00
Coffee break	• Collect money for room, coffee and lunch	Jim Mc Geehan	10:00-10:30
PC-10 Test Development report	• Mack T-12 • Cummins ISB • Cummins ISM • Exit-Criteria ballots and remaining actions.	Greg Shanks Dave Stehouwer	10:30-11:30
Lunch	•		11:30-12:15
NCDT Team	• Recommendation on EMA's request for Cat1P to be included in PC-10 • Discussion • Vote	Bill Runkle	12:15-12:45
PC-10 Time-line review	• Review time-line based on to-days decisions	Bill Runkle	12:45-1:00
Mack T-10 limits for Mack T-9	• Review "Exit-Criteria" ballot • Discussion and vote	Jim Mc Geehan	1:00-1:30

TOPIC	PROCESS	WHO	TIME
API CF-4	• API CF-4 contains the Mack T-6 • Need support data for T-6 to T-10 or obsolete the category	Greg Shank Charles Passut	1:30-2:00
Next Meeting	•		

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PC-10 Engine Test Matrix Design and Funding

ASTM HDEOCP Meeting
March 31, 2005
Chicago, IL

PC-10 Engine Test Matrix

Matrix Design Task Force

- **The PC-10 MDTF met March 15 via teleconference to review and select "final" matrix designs**
- **Issues considered**
  - **Adding current reference oils to the ISB & T-12 Precision-only matrix designs**
  - **Inclusion of a known oil (Oil D from the mini-matrix) to the C13 Precision / BOI matrix**
- **MDTF recommendations:**
  - **Unanimous vote approving the addition of**
    - **TMC 830 to the ISB matrix**
    - **TMC 820 to the T-12 matrix**
  - **Addition of 3 Oil D runs to the C13 Matrix approved 8-1-2**
    - **Running the 3 Oil D tests ahead of the balance of the matrix might resolve the negative vote on this MDTF recommendation**

PC-10 Engine Test Matrix

Matrix Design Task Force

Detailed Designs

Matrices	A ISB/T12 Case 1	B ISB/T12 Case 2	C ISB/T12 Case 3	A-1 ISB/T12 Case 1	B-1 ISB/T12 Case 2	C-1 ISB/T12 Case 3	D C-13 Case 1	D-1 C-13 Case 2
No. of Stands	4	4	4	4	4	4	7	7
No. of Labs	2	3	4	2	3	4	5	5
No. of Oils	2	2	2	3	3	3	6	6
Total No. of Tests	14	15	16	14	15	16	26	23
								+3 on Oil D
No. of Tests/Oil	7,7	7,8	8,8	5,5,4	5,5,5	5,5,6	6,6,4,4,3,3	6,6,3,3,3,2
Detectable Difference in s of variable and using t	1.95	1.86	1.78	2.48	2.31	2.28	2.85	3.25
Detectable Difference in s of variable and MC	1.95	1.86	1.78	2.96	2.73	2.68	3.98	4.65
Comparing reference oils only				2.79	2.73	2.68	2.81	2.94
No. of Tests/Stand	4,3,4,3	4,3,4,4	4,4,4,4	4,3,4,3	4,3,4,4	4,4,4,4	4,3,4,3,4,4,4	4,3,4,3,4,4,4
Detectable Difference in s of variable and using t	2.78	2.75	2.52	2.83	2.78	2.55	2.67	2.72
Detectable Difference in s of variable taking the	3.63	3.55	3.23	3.72	3.63	3.29	3.85	4.04
multiple comparison into account for several	3.36	3.29		3.45	3.36		3.57	3.74
sample size combinations	3.88			3.98			4.12	4.32
No. of Tests/ Lab	7,7	7,4,4	4,4,4,4	7,7	7,4,4	4,4,4,4	7,7,4,4,4	7,7,4,4,4
Detectable Difference in s of variable and using t	1.95	2.26	2.52	1.98	2.28	2.55	2.19	2.23
Detectable Difference in s of variable taking the	1.95	2.66	3.23	1.95	2.71	3.29	2.93	3.05
multiple comparison into account for several		3.00			3.05		2.50	2.60
sample size combinations							3.30	3.44
Degrees of Freedom								
Oil	1	1	1	2	2	2	5	5
Stand(Lab)	2	1	0	2	1	0	2	2
Lab	1	2	3	1	2	3	4	4
Mean	1	1	1	1	1	1	1	1
Error	9	10	11	8	9	10	14	11
Total	14	15	16	14	15	16	26	23
95% CI for Sigma, Width	1.14	1.06	0.99	1.24	1.14	1.06	0.84	0.99

PC-10 Engine Test Matrix

Matrix Design Task Force

- **MDTF move that the HDEOCP approve the following:**
  - **For the ISB and T-12 Precision-only Matrices**
    - **Use Design A-1, B-1, or C-1 based on the number of labs & stands**
    - **Matrix oils: PC-10B, PC-10E, and TMC 830 for the ISB**
      PC-10B, PC-10E, and TMC 820 for the T-12
    - **TMC to assign from the 3 oils for stand calibration outside the matrix**
  - **For the C-13 Precision / BOI Matrix**
    - **Use Design D-1 (or slight variant if the matrix runs in 6 labs / 27 tests)**
    - **Matrix Oils: PC-10A thru PC-10F (B & E featured) plus Oil D**
    - **Three tests on Oil D *(all 3 to be run, analyzed, and accepted by the C13 TF & HDEOCP before starting the remainder of the matrix)***
    - **Protocol for stand calibration outside the matrix to be determined**
- **Statisticians ready to finalize testing sequence when parameters are set**

PC-10 Engine Test Matrix

Funding

- **Preliminary plan established at October 20 meeting**
  - **ACC & API each contribute $1MM in cash**
  - **EMA to provide $350M in cash and >$650M in-kind**
- **Initial matrices could be supported by stand calibration testing plus trade association funding ($2.35MM)**
- **Increases in test costs from preliminary estimates cause a small shortfall in stakeholder funding**
- **PC-10 NCDT identified two stand/lab allocation options to balance lab participation and minimize shortfall**

PC-10 Engine Test Matrix

Lab / Stand Allocation & Funding

		NCDT Proposal				NCDT Alternate			
			Hardware Adjusted Test Costs				Hardware Adjusted Test Costs		
	Lab	No.	Plan	Submitted	Prop. Adj.	No.	Plan	Submitted	Prop. Adj.
C13	IND-1	2				4			
	IND-2	4				4			
	DEP-1	2				2			
	DEP-2	2				0			
	DEP-3	2				2			
	DEP-4	2				2			
	Sub-totals	14	1,330,000	1,369,920	1,354,941	14	1,330,000	1,391,170	1,363,761
ISB	IND-1	4				4			
	IND-2	2				2			
	DEP-4	2				2			
	Sub-totals	8	400,000	374,052	369,962	8	400,000	374,052	366,682
T-12	IND-1	2				2			
	IND-2	2				2			
	DEP-1	2				2			
	DEP-4	2				2			
	Sub-totals	8	600,000	632,008	625,097	8	600,000	632,008	619,556
	Grand Total		2,330,000	2,375,980	2,350,000		2,330,000	2,397,230	2,350,000
	Surplus / Shortage		20,000	-25,980	0		20,000	-47,230	0

Note: **NCDT proposal includes the recommendation that test development TF/SP groups establish matrix readiness of each potential test lab by April 15**

PC-10 Engine Test Matrix

Next Steps

- **Obtain agreement from test labs to participate based on**
  - **NCDT proposed Lab/Stand allocation**
  - **Need for price adjustment (~1 to 2% of last estimates)**

- **Finalize MOA**
  - **Review of revised document with comments incorporated**
  - **Addition of specific lab and cost information**

3/24/05

ASTM-HDEOCP EXIT CRITERIA BALLOTS:
1st Motion:

- **Acceptance of the proposed Mack T-10 limits to qualify an oil as passing the Mack T-9 test.**

Company	Name	Affirmative	Negative
Afton Chemical	Charles Passut	X	
Caterpillar Inc	Abdul Cassim	X	
Chevron Oronite LLC	Wm. Kleiser		X
Ciba Specialty Chemicals	Scott Harold	X	
ConocoPhillips	David E. Taber	X	
Cummins	David M. Stehouwer	X	
DDC	Mesfin Belay	X	
Dana Corporation	Howard Robins	X	
Deere & Co	Ken Chao	X	
EMA	Roger Gault	X	
ExxonMobil	Steven Kennedy	X	
GM	Robert Stockwell	X	
Infineum	Pat Fetterman		X
Int'l Truck & Engine	Heather DeBaun	X	
Lubrizol	Lewis Williams		X
Mack Division-Volvo Powertrain	Greg Shank	X	
PerkinElmer	Thomas M. Franklin	X	
RohMax USA	Steven Herzog	X	
Shell	Matthew Urbanak	X	
Valvoline	Wm. Runkle Jr.	X	
	Totals	17	3

3/24/05

ASTM-HDEOCP EXIT CRITERIA BALLOTS:
2nd Motion:

- **The Caterpiller mC13 to proceed to matrix testing, after all the operation data is posted on the TMC web site**

Company	Name	Affirmative	Negative
Afton Chemical	Charles Passut		X
Caterpillar Inc	Abdul Cassim	X	
Chevron Oronite LLC	Wm. Kleiser	X	
Ciba Specialty Chemicals	Scott Harold	X	
ConoccoPhillips	David E. Taber	X	
Cummins	David M. Stehouwer	X	
DDC	Mesfin Belay	X	
Dana Corporation	Howard Robins	X	
Deere & Co	Ken Chao	X	
EMA	Roger Gault	X	
ExxonMobil	Steven Kennedy	X	
GM	Robert Stockwell	X	
Infineum	Pat Fetterman		X
Int'l Truck & Engine	Heather DeBaun	X	
Lubrizol	Lewis Williams		X
Mack Division-Volvo Powertrain	Greg Shank	X	
PerkinElmer	Thomas M. Franklin	X	
RohMax USA	Steven Herzog	X	
Shell	Matthew Urbanak	X	
Valvoline	Wm. Runkle Jr.	X	
	Totals	17	3

ATTACHMENT 5

EXIT CRITERIA BALLOT

ASTM-HDEOCP BALLOT FOR VOTING MEMBERS ONLY Reference: Jim Mc Geehan, Chairman	Issue Date: March 2th 2005 Receipt Deadline: March 24th , 2005

RETURN BALLOT TO: Pat Connelly via email (preferred): patconnelly@chevrontexaco.com or via Fax: 510-242-3758	Name: Pat Fetterman Organization: Infineum Date: 3/24/05 Phone No.: (908) 474-3099

Motion	Affirmative	Negative
The following motion was made at the HDEOCP and passed unanimously. **MOTION** The Caterpillar C13 to proceed to matrix testing, after all the operational data is posted on the TMC web site. Microsoft PowerPoint Presentation	☐	X☐

Comments: Infineum made its support of C-13 matrix readiness contingent on extending more testing with "oil D" into the matrix. This motion does not incorporate that requirement, so we cannot vote affirmative. If the motion is revised to incorporate testing with "oil D", we will change to affirmative.

In addition, we continue to share industry concern over the method used to assess oil consumption control and discrimination, and we encourage the C-13 Task Force to develop a more meaningful measure of oil consumption control.

EXIT CRITERIA BALLOT

ASTM-HDEOCP BALLOT FOR VOTING MEMBERS ONLY Reference: Jim Mc Geehan, Chairman	Issue Date: March 2th 2005 Receipt Deadline: March 24th , 2005

RETURN BALLOT TO: Pat Connelly via email (preferred): patconnelly@chevrontexaco.com or via Fax: 510-242-3758	Name: Charles Passut Organization: Afton Chemical Date: March 24, 2005 Phone No.: 804-788-6372

Motion	Affirmative	Negative
The following motion was made at the HDEOCP and passed unanimously. **MOTION** **The Caterpillar C13 to proceed to matrix testing, after all the operational data is posted on the TMC web site.** Microsoft PowerPoint Presentation	☐	X

Comments:

Afton Chemical votes negative on the readiness, for matrix testing, of the CAT C-13 engine test.

1) We do not believe that the test has shown sufficient separation, in oil consumption, of the reference oils A and D.
2) We are concerned that the low SAP matrix oils will not perform satisfactorily and the BOI goals of the matrix will not be obtained.
3) There has been a shortage of test parts which has reduced the testing of

low SAP candidate oils.

Afton will withdraw it's negative ballot if:

1) Additional reference oil data is provided which improves the statistical separation, of the oil consumption, of oils A&D or data is provided on low SAP oils which demonstrates that some oils have poor performance which is significantly worse that reference oil D.
2) Caterpillar guarantees an adequate supply of parts for both reference oil and candidate oil tests.

ATTACHMENT 7

EXIT CRITERIA BALLOT

ASTM-HDEOCP BALLOT FOR VOTING MEMBERS ONLY Reference: Jim Mc Geehan, Chairman	Issue Date: March 2th 2005 Receipt Deadline: March 24th , 2005

RETURN BALLOT TO: Pat Connelly via email (preferred): patconnelly@chevrontexaco.com or via Fax: 510-242-3758	Name: Lewis Williams Organization: Lubrizol Date: 3/24/05 Phone No.: 440-347-1111

Motion	Affirmative	Negative
The following motion was made at the HDEOCP and passed unanimously. **MOTION** **The Caterpillar C13 to proceed to matrix testing, after all the operational data is posted on the TMC web site.** Microsoft PowerPoint Presentation	☐	X☐

Caterpillar C13 Test Criteria

500 hour – Steady State Test Cycle

Test Pass/Fail Criteria:

1. Piston Deposits
2. No Loss of Oil Consumption Control
   a) Limits to be recommended by Taskforce
   b) Calculation to be recommended by Taskforce
3. No stuck rings or sluggish rings
4. Other parameters to be determined by Taskforce




C13 Test Exit Ballot Status

1. **There were significant oil differences and Discrimination for TGC, TLHC and TLC**
2. Marginal Significant Discrimination on TGF and Oil Consumption would be improved with Oil temperature and other controls
3. Oil D 3 runs included in Matrix
4. Parts are not an Issue

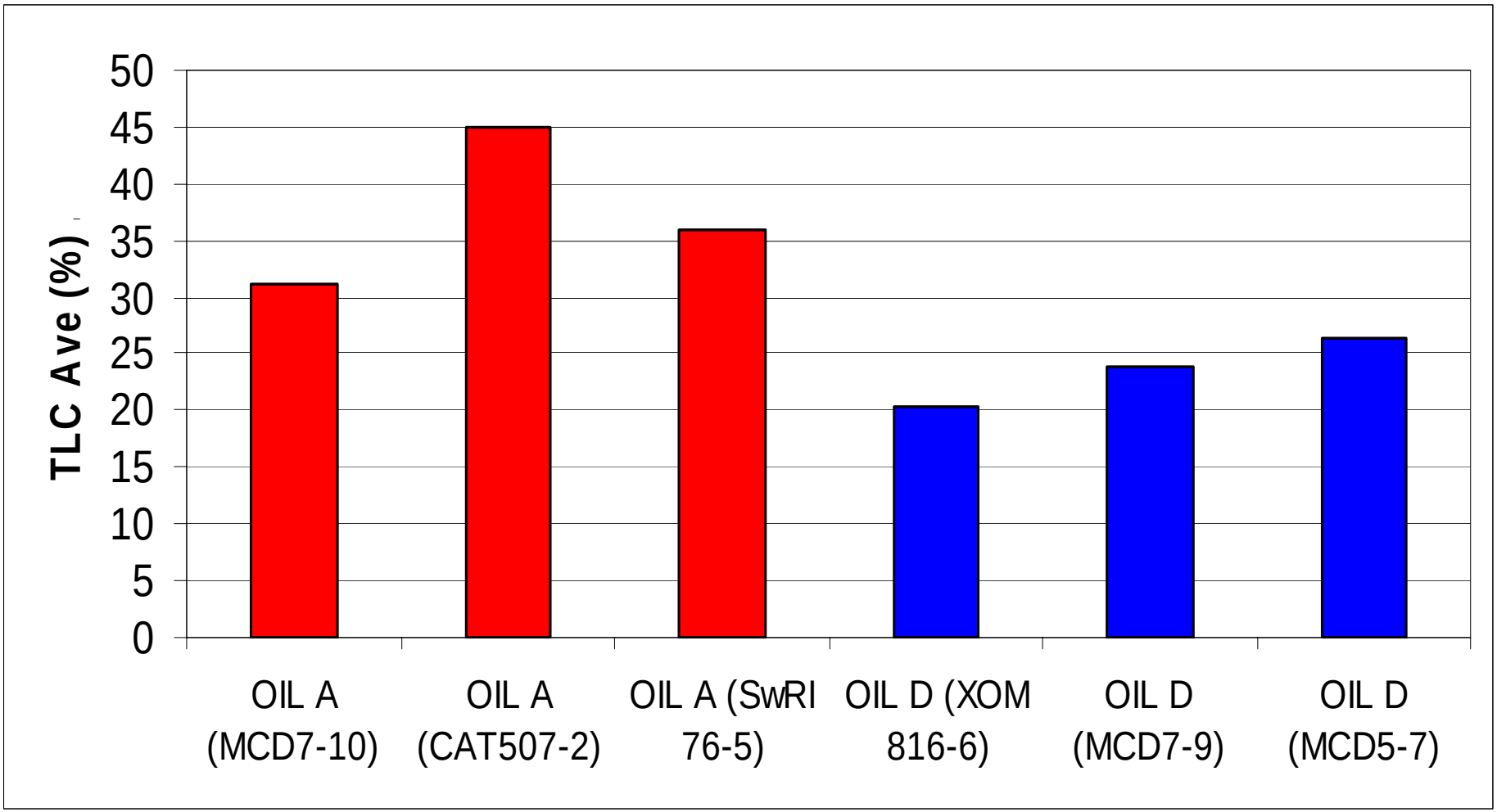



Caterpillar C13 Test Discrimination

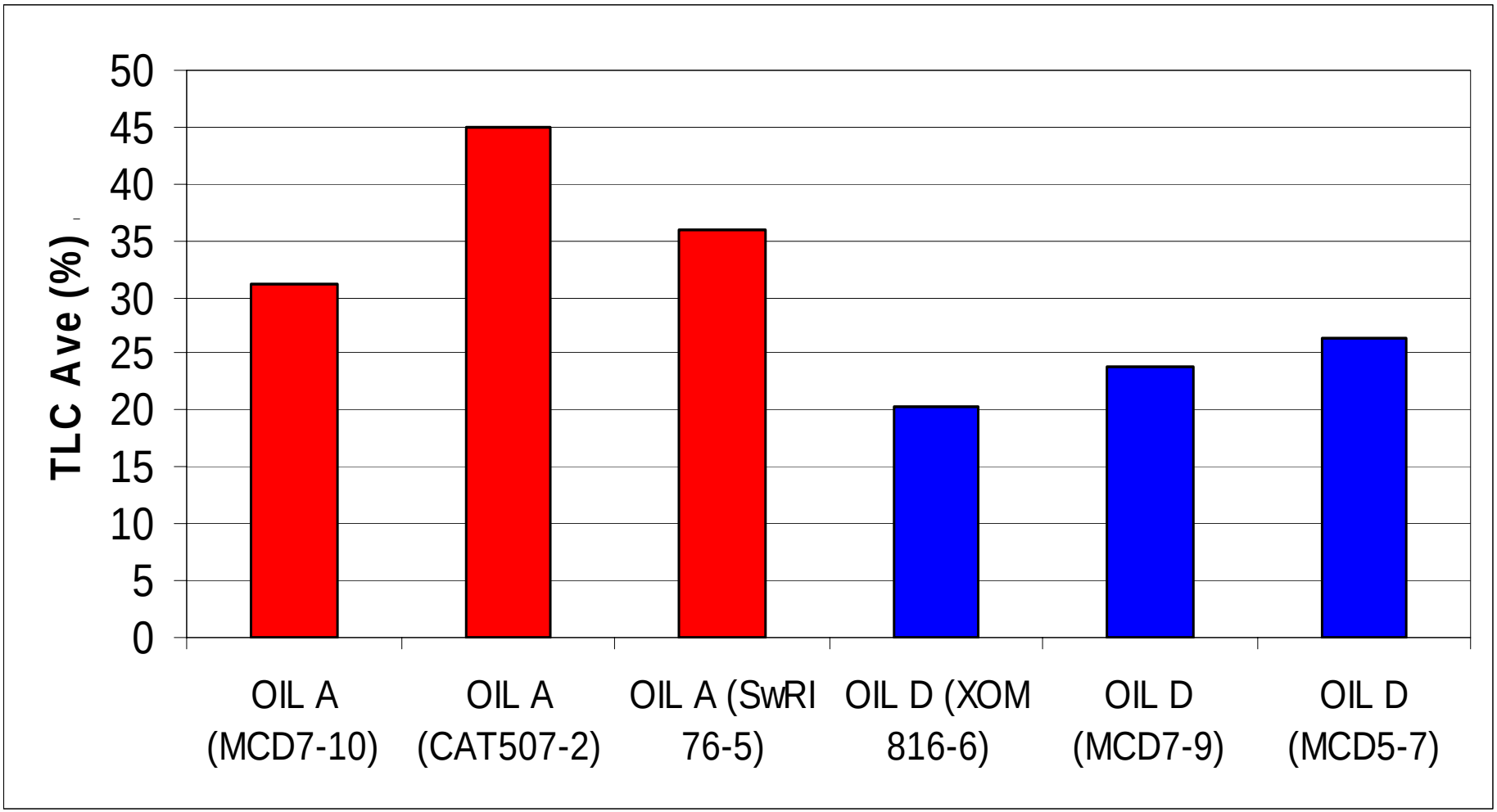
Oil	Oil A	Oil D	%
TLHC (Ave)	19.1	6.4	196
TLC (Ave)	37.4	23.5	59.1
TGC (Ave)	54.9	44.4	23.6
TGF (Ave)	57.7	43.3	33
IGF	7.7	5	53.3
IGC	25.4	9.8	158
Oil Cons Increase	64.7	40.7	59




Caterpillar C13 Test Update



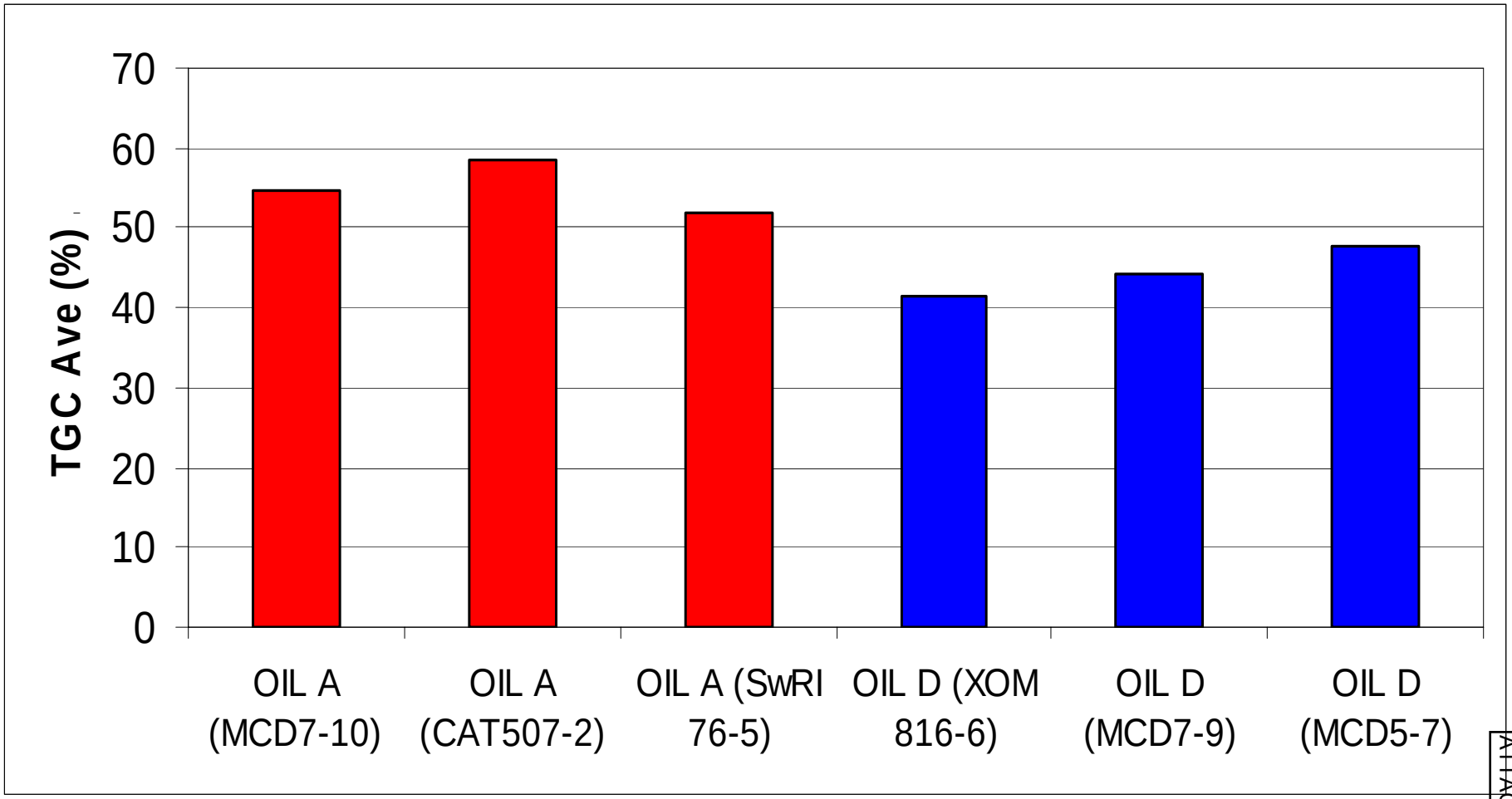
Caterpillar C13 Test Update






CATERPILLAR®

Caterpillar C13 Test Update






CATERPILLAR®

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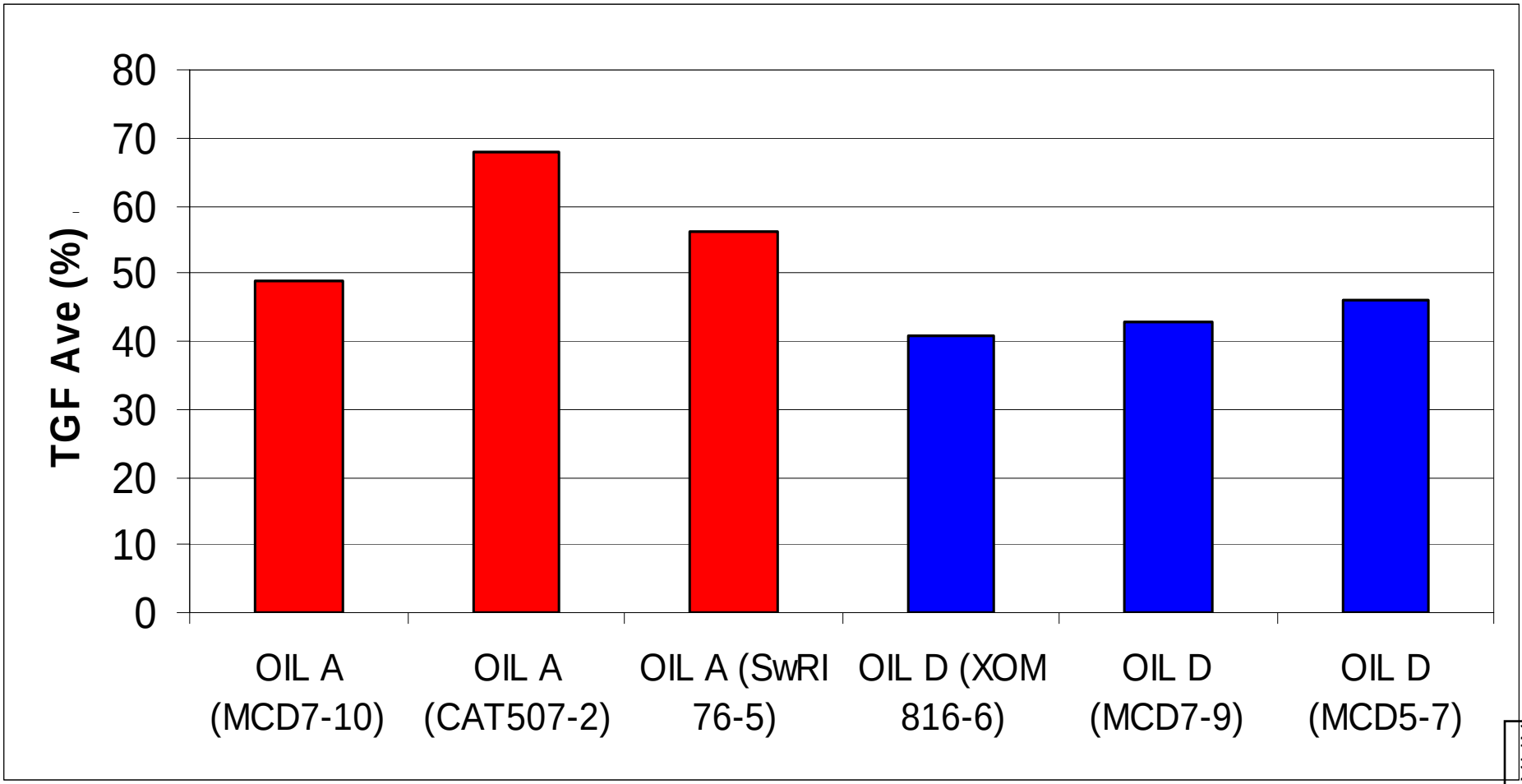




CATERPILLAR®

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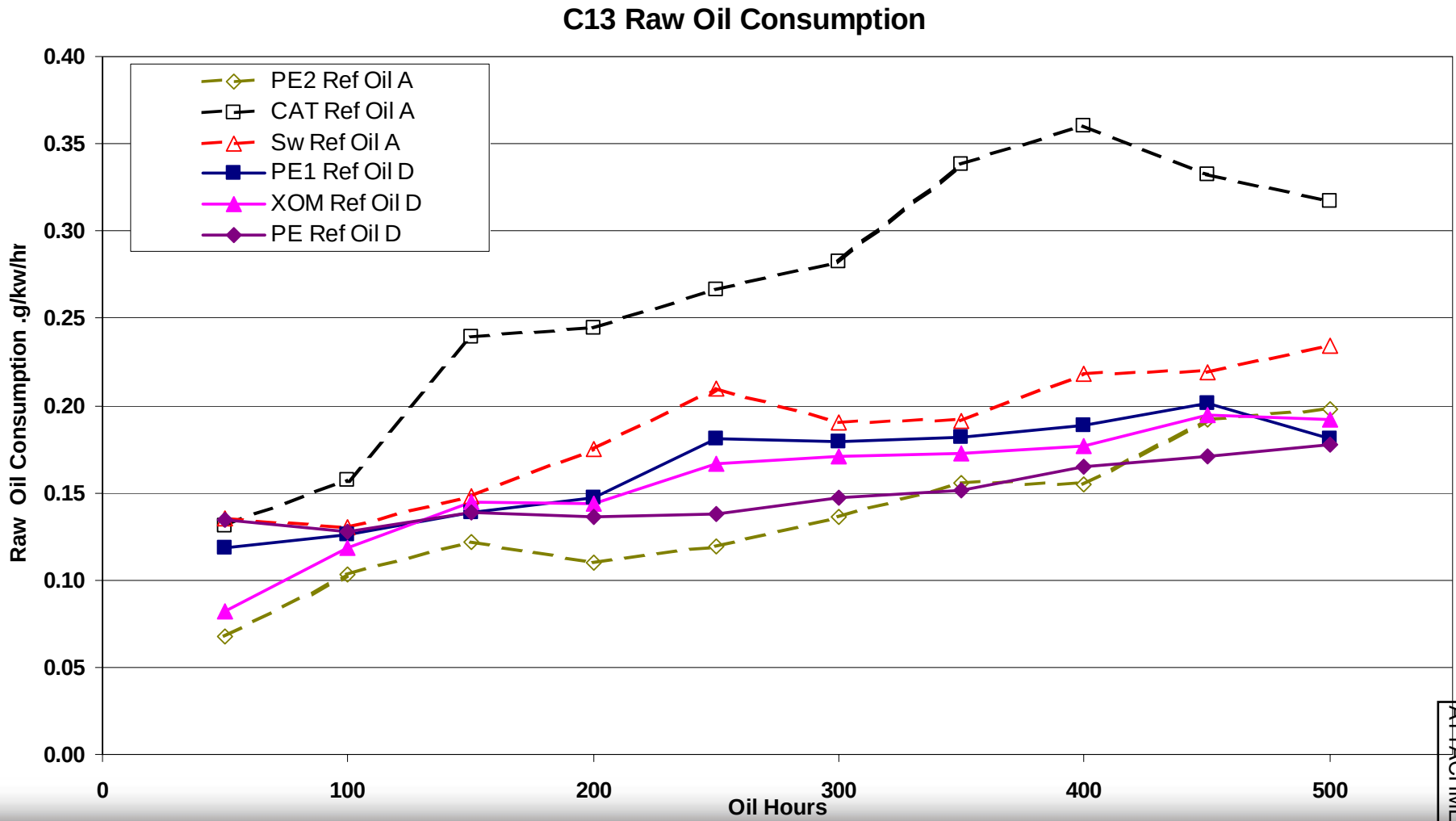
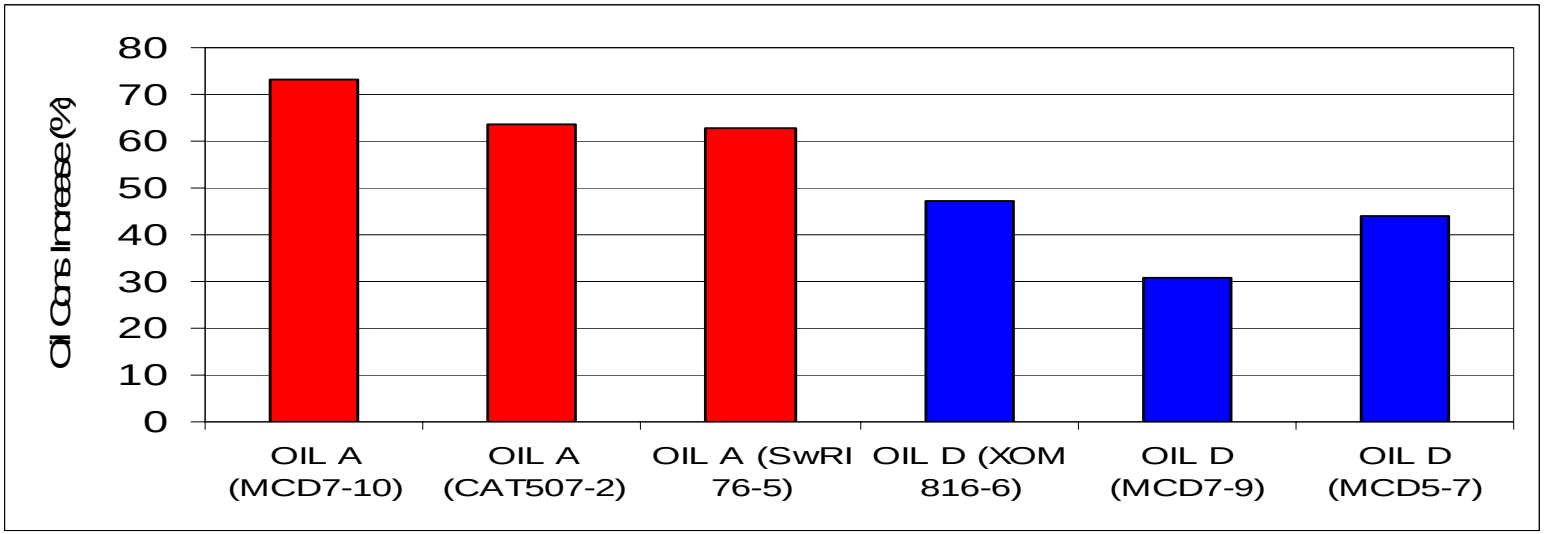


Caterpillar C13 Test Update



Oil	Test Hours	Oil Cons Inc
Oil A (MCD7-10)	500	73.3
Oil A (CAT507-2)	500	63.8
Oil A (Sw76-5)	500	62.9
Oil D (XOM816-6)	500	47.1
Oil D (MCD7-9)	500	30.7
Oil D (MCD5-7)	500	44.2

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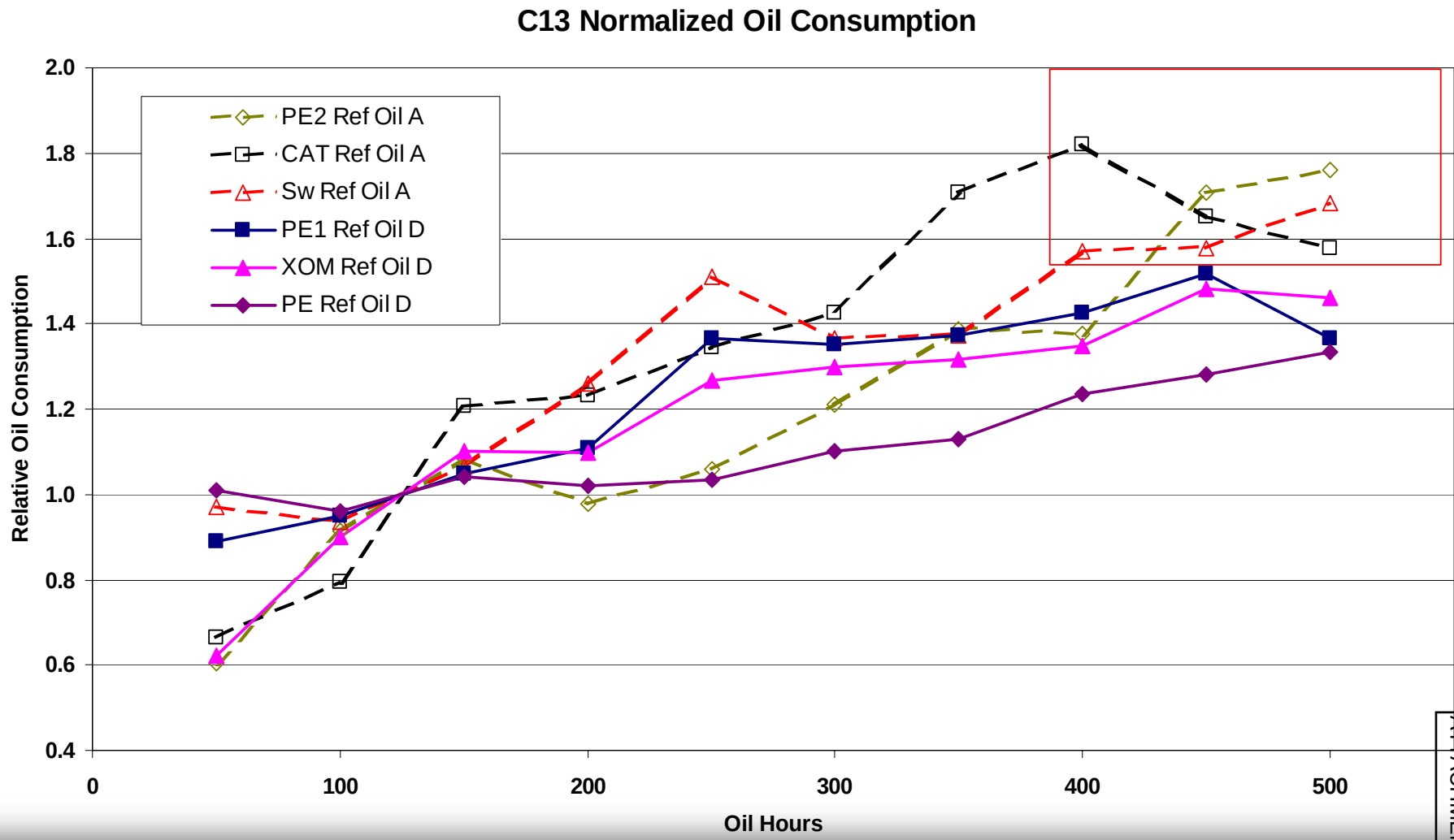
Caterpillar C13 Mini-matrix Test Status



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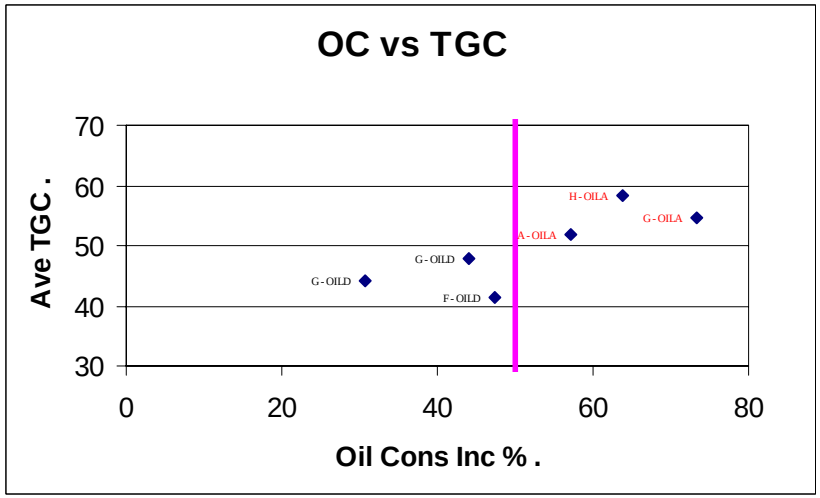
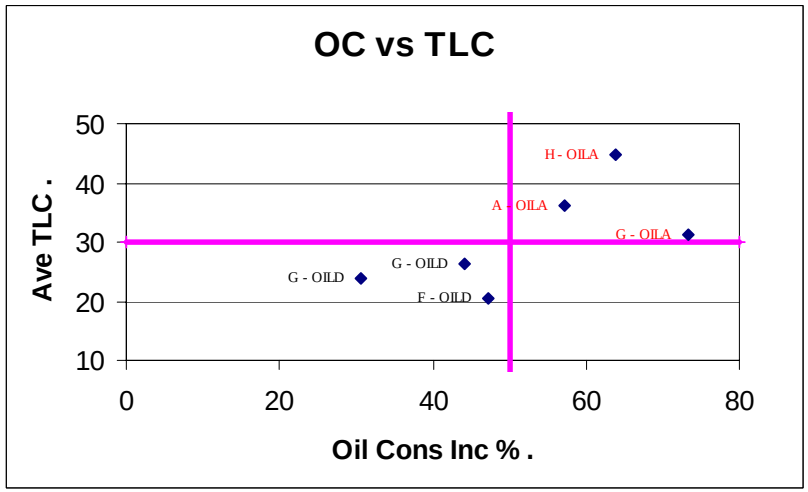
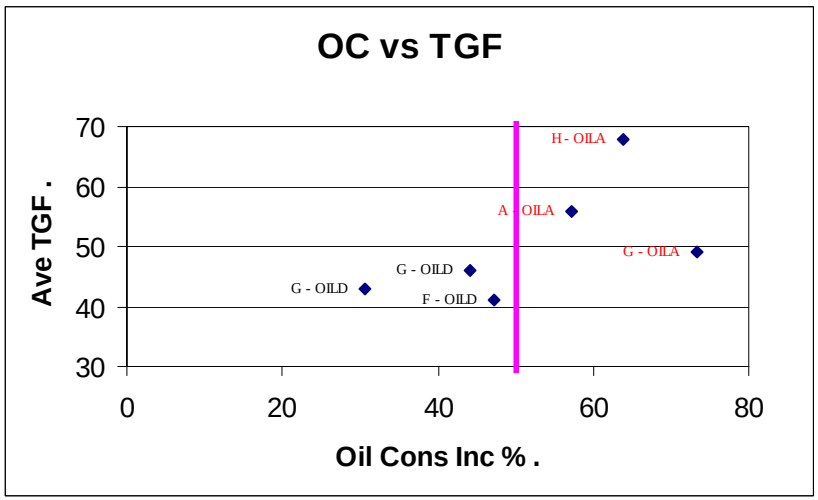
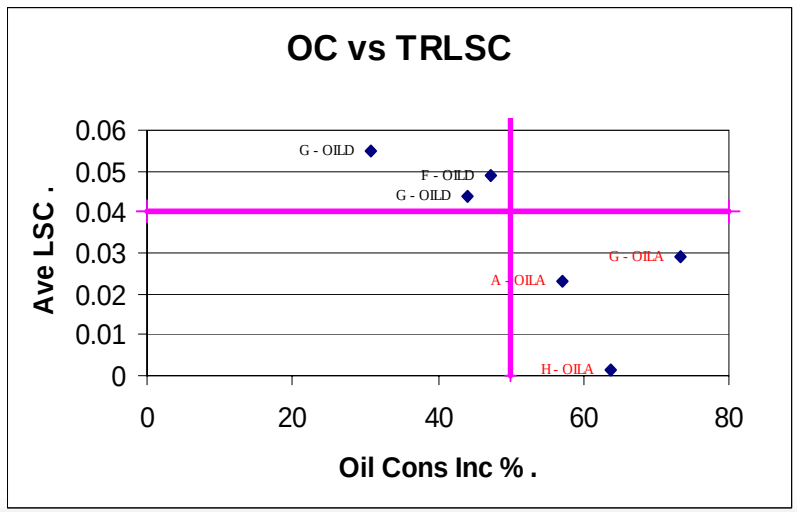
C13 Discrimination Status









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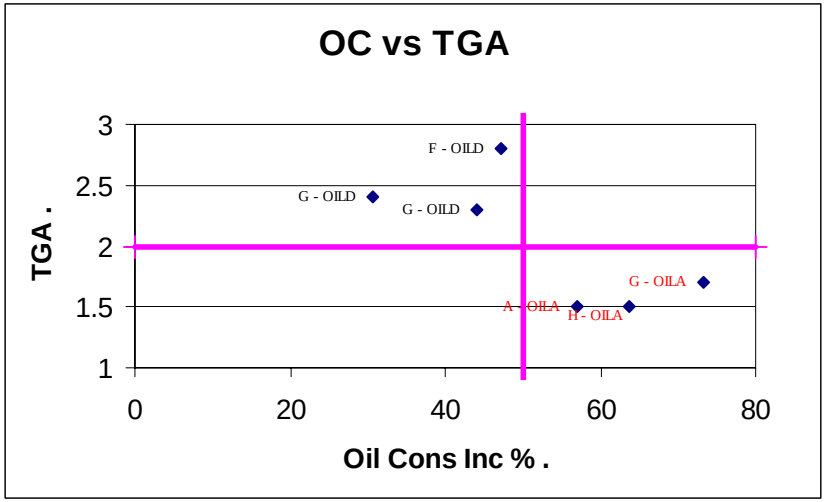
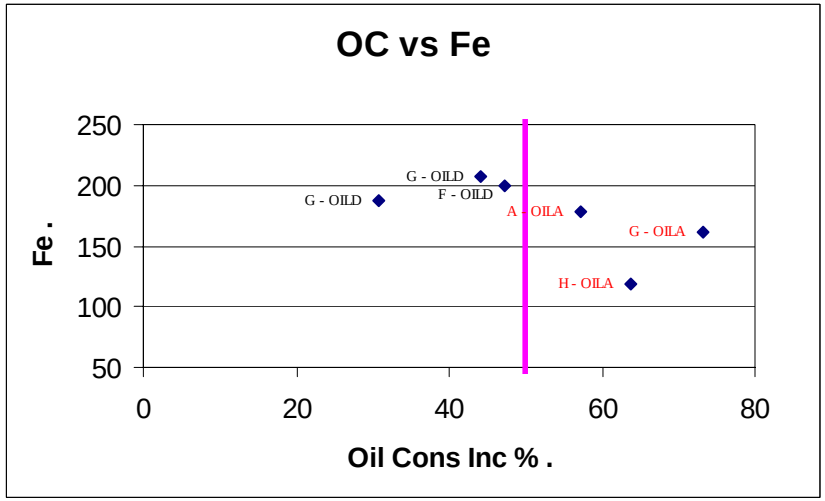
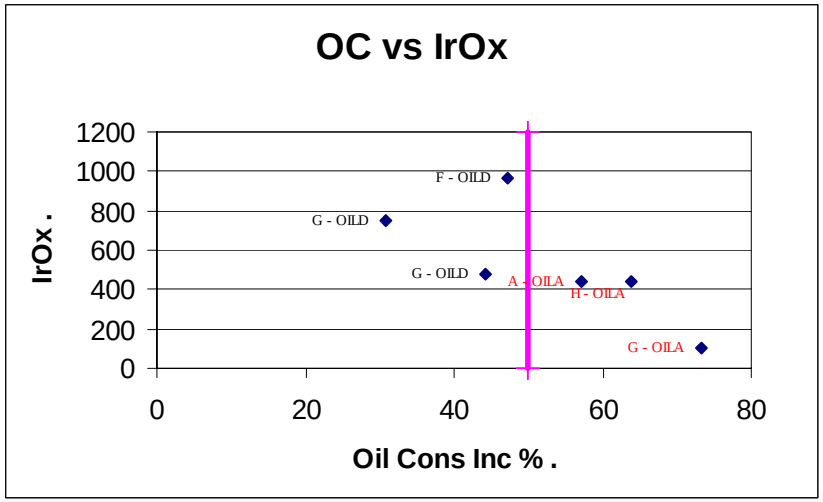
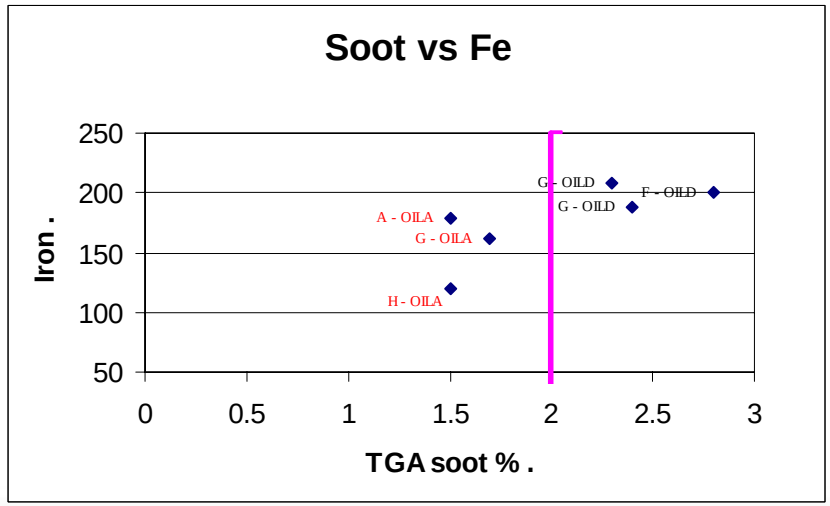
C13 Discrimination Status









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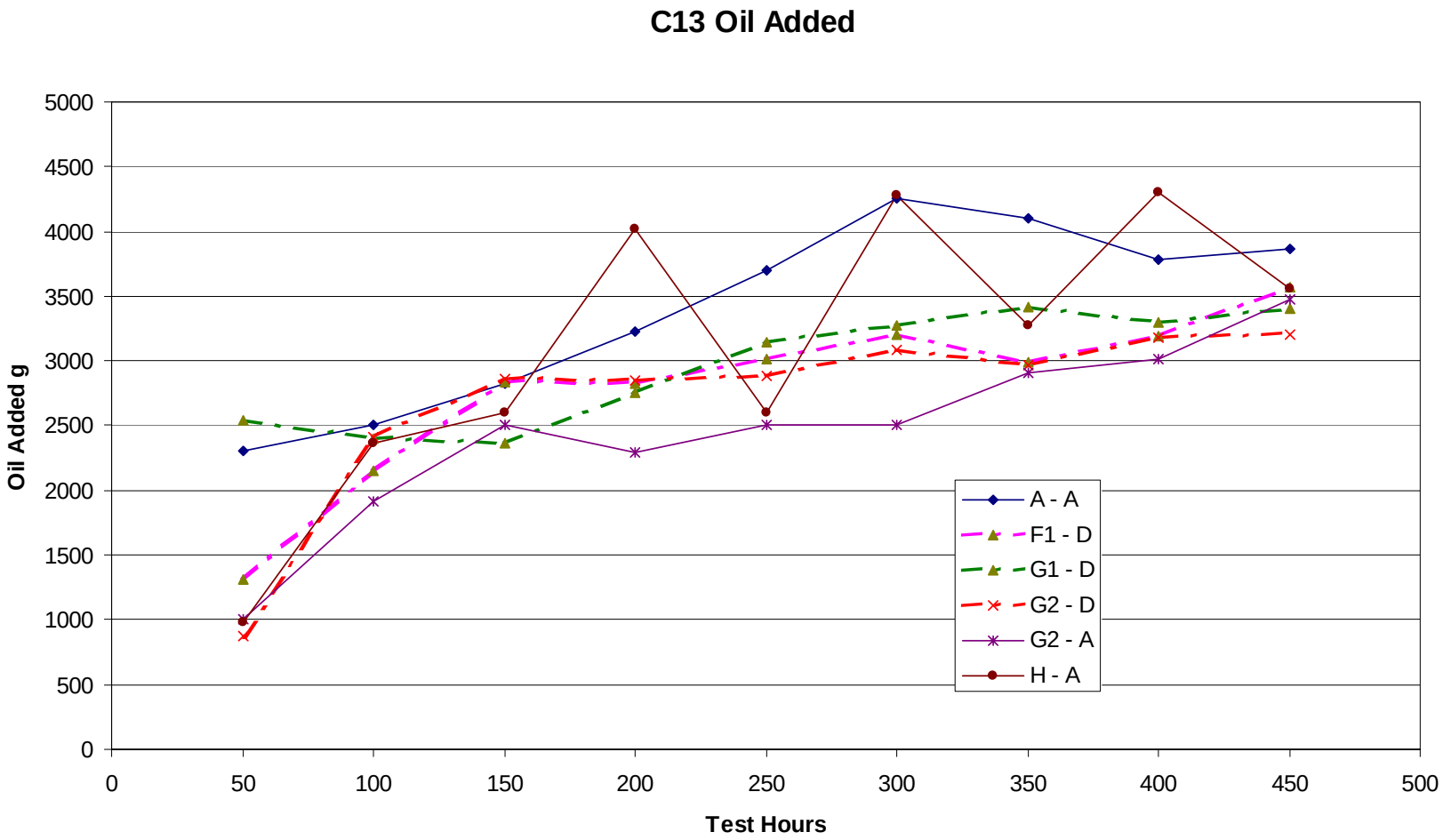




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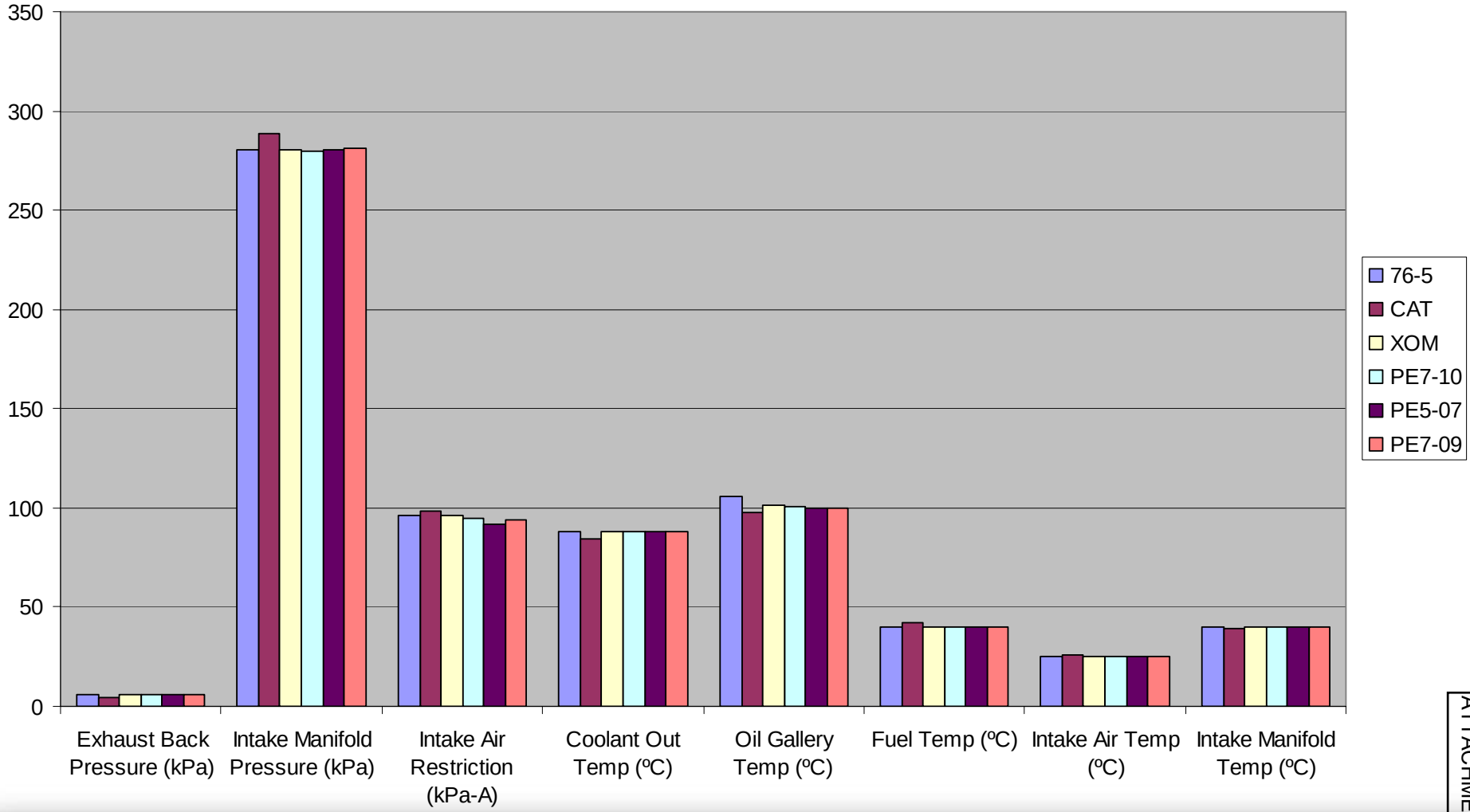
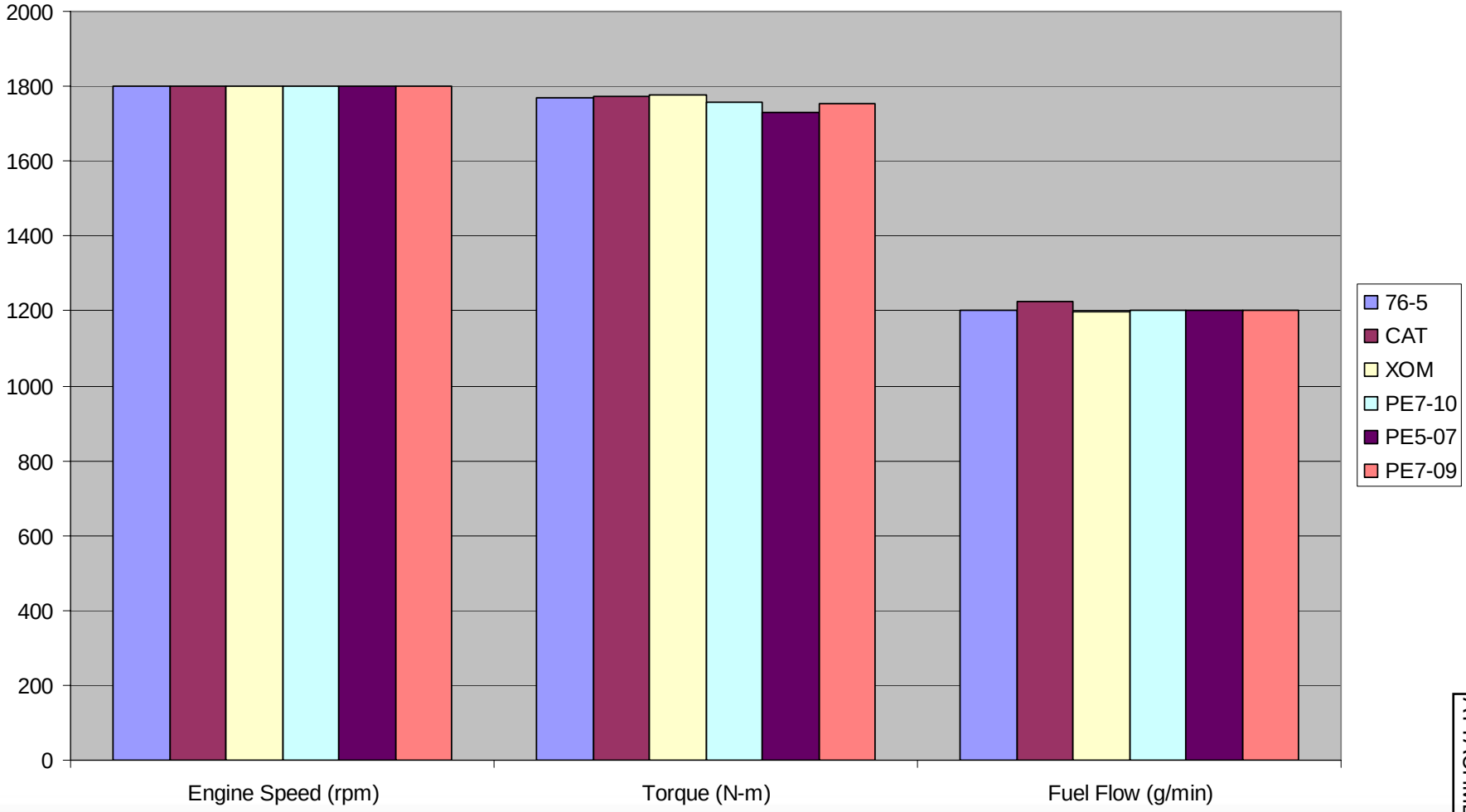





C13 Discrimination Status






C13 PRL Status

	April runs	May runs	June runs	July runs
Piston				
Liner				
Top ring				
2nd ring				
Oil ring				

	Parts in stock
	Parts available end Feb
	Parts available end Mar

- Can now lift Matrix restrictions on parts
- Schedules and focus drive parts thru 2006




Mack T12 Engine Test Update

March 31 2005

- Mack T-12
- Based on Mack T10 & Mack T11
- With ULSD Fuel
- Length - ~ 300 Hours
- Two Phase Test
- Phase 1 100 hr (4.0 % Soot)
- Phase 2 200 hr (EOT of 6 % Soot)
- Phase 2 260 F Oil Temp
- Increased EGR Flow (Heavy EGR)
(35% Phase 1 – 15-% Phase 2)
- Precision Matrix Required

•2 Production EGR Coolers (Breadboard) Replaces Tube Cooler

Now 90C IMT – Phase 1

T12 Conversion Kits Sent to Labs

•T12 TASK FORCE –
Numerous Teleconferences,
Oct 20 Mtg in San Antonio – Meeting Nov 22nd @ ExxonMobil- Next Mtg Jan 12th
in San Antonio - Meeting – Feb 22nd SWRI – ExMob-March 17th

•Test Procedure (Draft 3 Completed)- T12 Parts List Completed

•Completed 7 Test on 820-2 (T10 Ref Oil)

• Data From 9 PC10 Prototype Oils

•Engines in 5 Labs Running week of March 28th

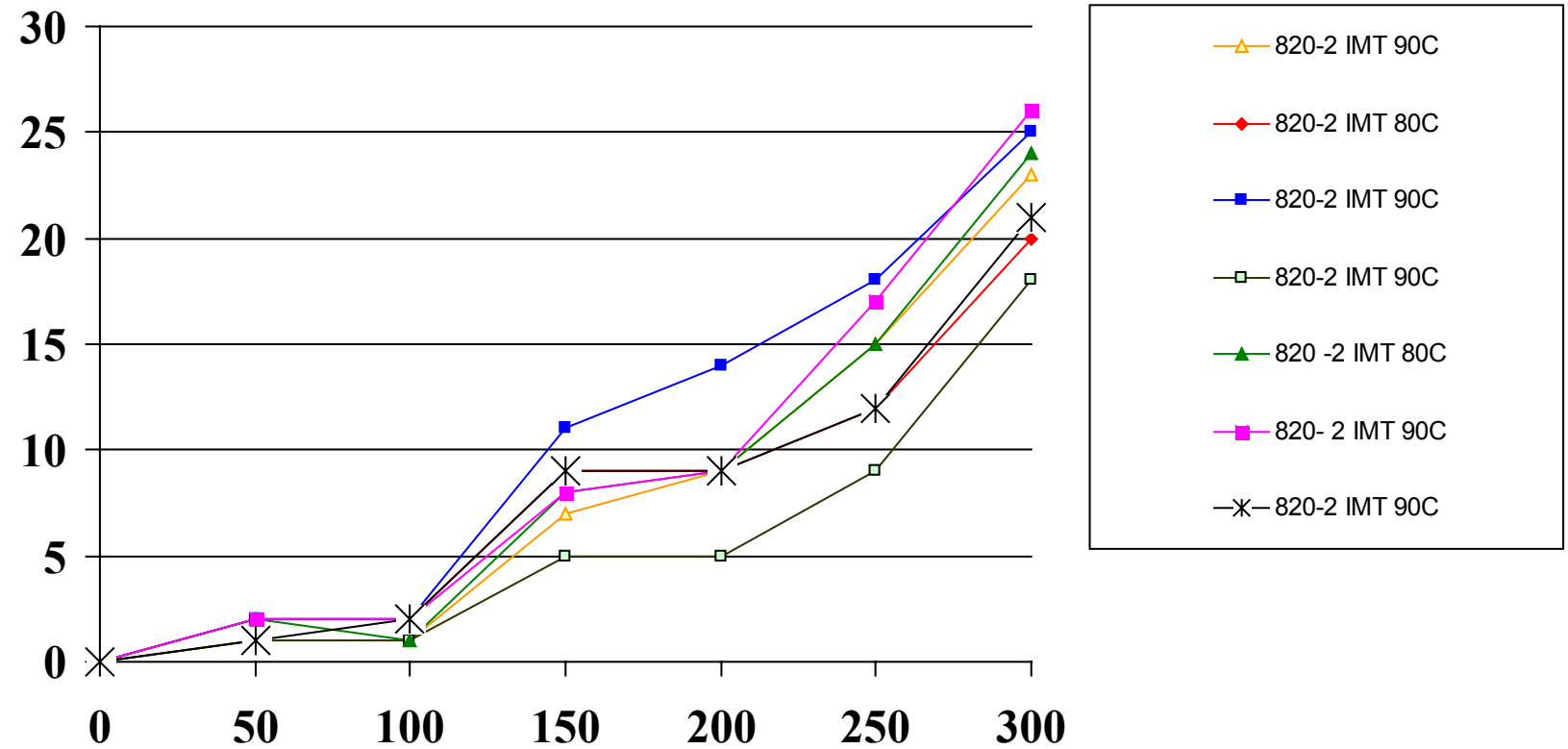
•Approved Operational Data

•Lab Visitations Complete

• Reviewed Data for Initial Precision & Discrimination

• 820-2 Will be Part of Precision Matrix

T12 820-2 Pb (ppm)

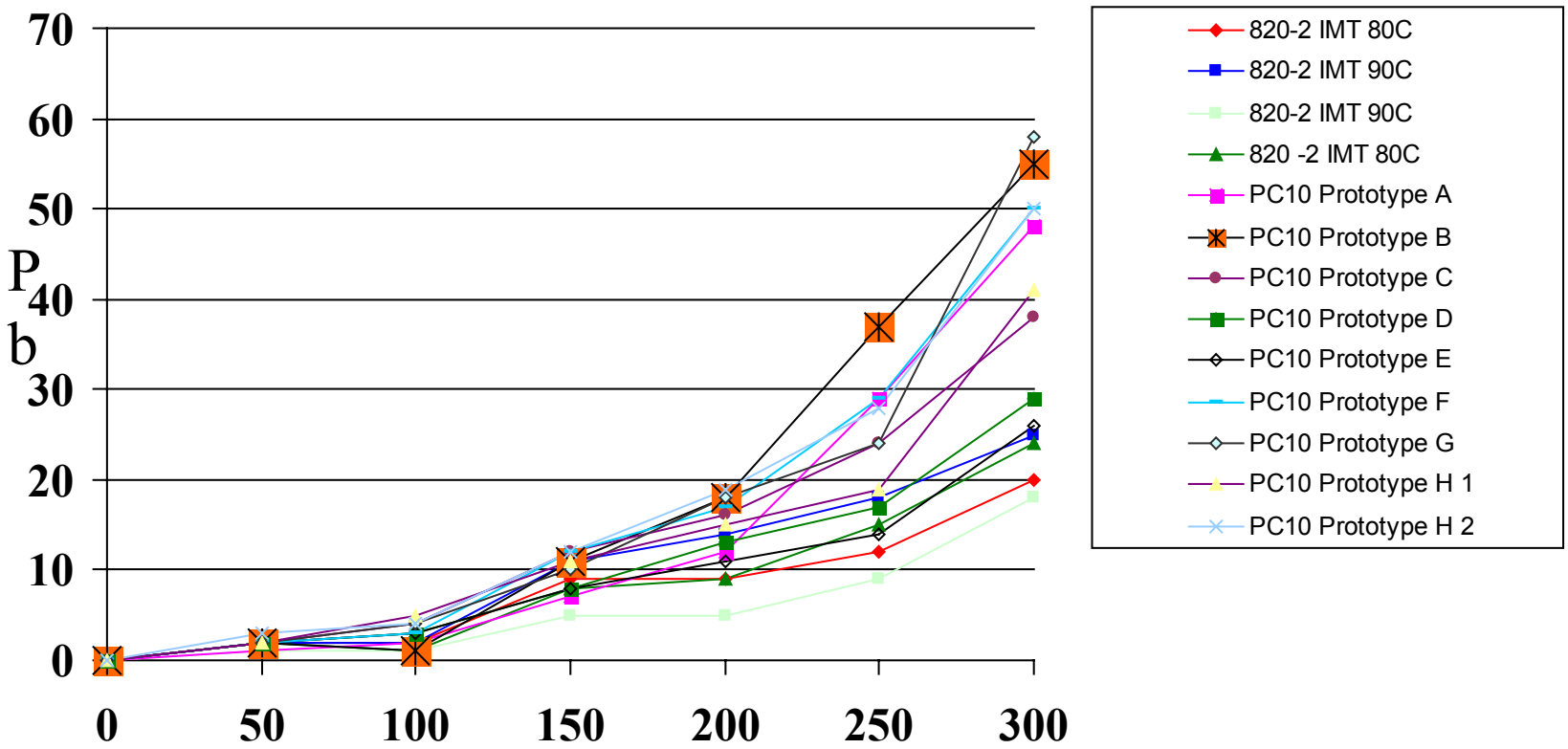


Oil Hours

GLS 3/17/05

ATTACHMENT 9, 4 OF 9

T12 Pb (ppm) Discrimination

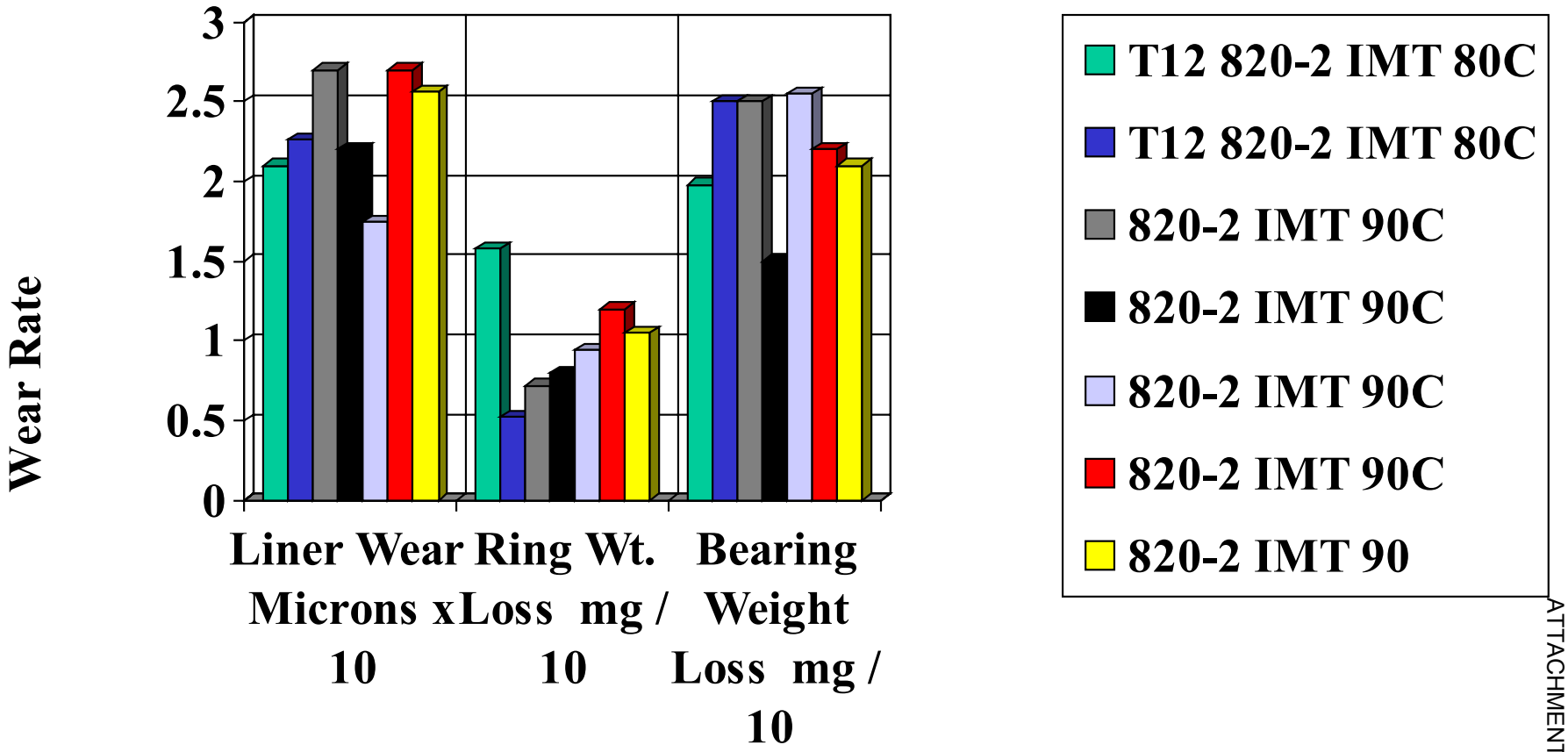


GLS 3/31/05

Oil Hours

ATTACHMENT 9, 5 OF 9

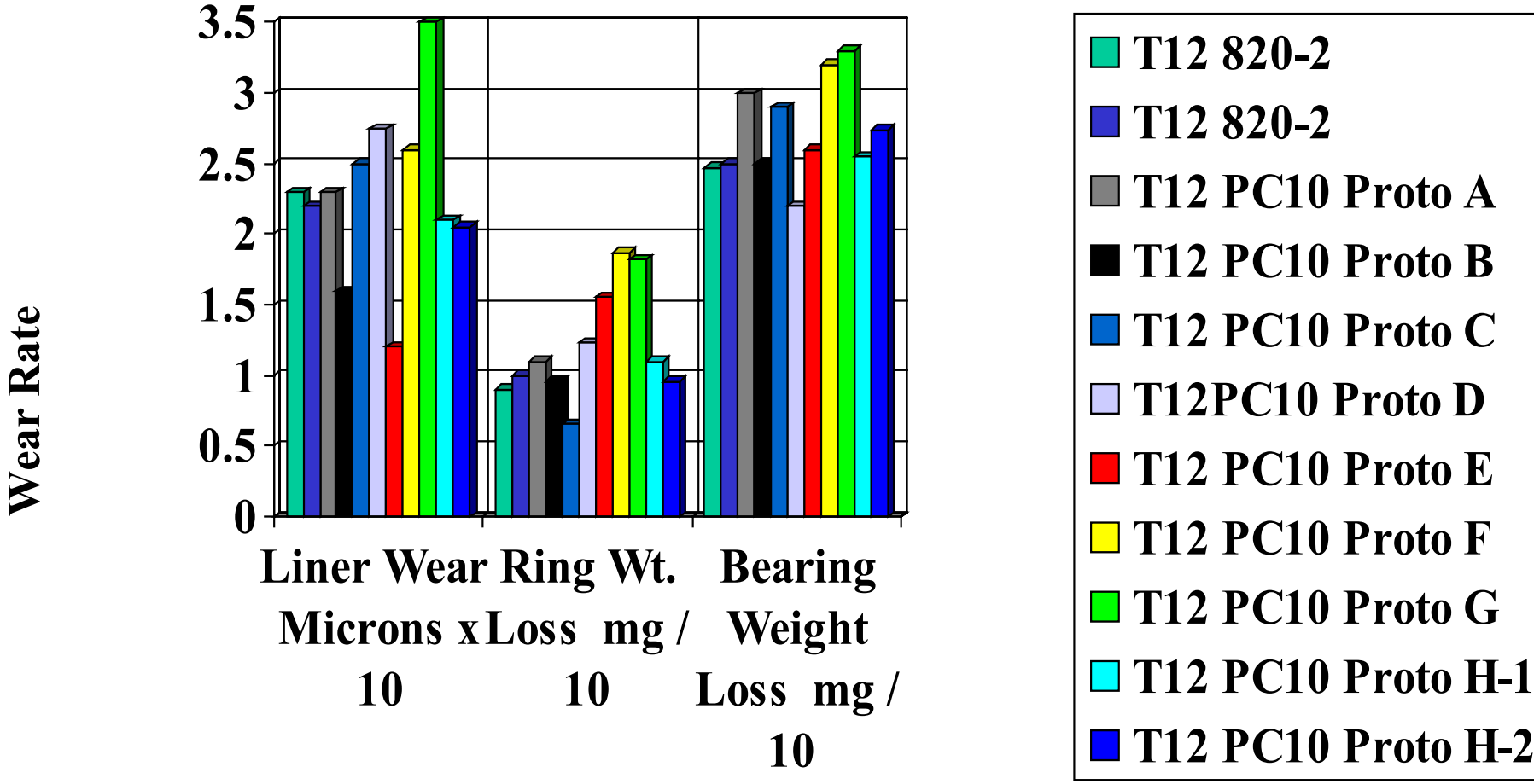
T12-820



GLS 3/17/05

ATTACHMENT 9, 6 OF 9

T12-820-2 vs. PC10 Prototype



GLS Feb 18th[H] 2005

PC 10 Prototype Oil 2 Labs

		Oil H	Oil H		
		Lab 1	Lab 2		
		T12	T12		
TRWL		110.3	94.8		
2ndRWL		33.7	32.8		
EOTPB		41	50.5		
250-300PB		22	18.5		
O.C.		64.6	68.8		
FTIROXID		334.8	510		
URBWL		254.2	274.6		
Liner Wear		21.1	20.4		

Task Force Recommends T12 is Ready for Matrix

Chevron ORONITE

Mack T-12
Pre-Matrix Data Analyses
Version 5

Presented to HDEOCP
March 31, 2005

Jim Rutherford
(510) 242-3410
jaru@chevrontexaco.com

TEAM ORONITE
EMPOWERED TO EXCEL.

Summary

- These analyses used six tests in the on oil 820-2 plus ten tests on nine low SAPS oils.
- Variability for the 820-2 tests compares well with T10 matrix variability.
- It is surprising to be able to find significant differences with so few reference tests and only one test on most of the other oils.
- The charts show each test result plus the mean for 820-2 and upper and lower limits for determining whether individual test results on the low SAPS oils are significantly (p=0.05) different from 820-2. {For OILK, the average of two results is shown.}
- Outlier screening was done with no profiles and not for all tests. Pb was corrected for the UBWL outlier using the T-10 method when possible.
- Significant differences were seen for
  - Delta Pb 0 to 300 {more differences are seen when corrected for UBWL outlier, or when the Lab G test was removed};
  - Top Ring Weight Loss;
  - Delta Pb 250 to 300;
  - Second Ring Weight Loss; and
  - DeltaIR 250 to 300 hours (some numbers questionable).

Pre-matrix Tests with 820-2

Variable	Label	Max	Mean	Min	N	sd
DPbOR	DPbOR	26	21.2	16	5	4.4
DPbOS	DPbOS	34.9	23.5	16	6	6.8
DPBFNL	DPBFNL	40	24.7	17	6	8.3
CLWFNL	CLWFNL	27.7	23.7	17.4	6	3.9
ATRWLFNL	ATRWLFNL	121	88.2	50	6	25.1
ATRWLFNLh	ATRWLFNLh	105.4	81.2	50	6	19.4
OCFNL	OCFNL	82.5	75	63.4	6	6.8
DPB2FNL	DPB2FNL	11	9.2	8	6	1.2
ABWLU	ABWLU	290.2	234.8	146.4	6	48.6
OABWLU	OABWLU	255	224.1	146.4	6	42.1
AR2WL	AR2WL	38.4	29.7	17.1	6	8.9
IR250300	IR250300	349.6	191.1	123	5	92.3

Replicate Tests with low SAPS Oil K

Lab	DPbOS	DPBFNL	CLWFNL	ATRWLFNL	OCFNL	DPB2FNL	ABWLU	OABWLU	AR2WL	IR250300
1		41	21.1	110.3	64.6	22	254.2		33.7	334.8
2		50.5	20.4	94.8	68.8	18.5	274.6		32.8	510

ATTACHMENT 10, 4 OF 17

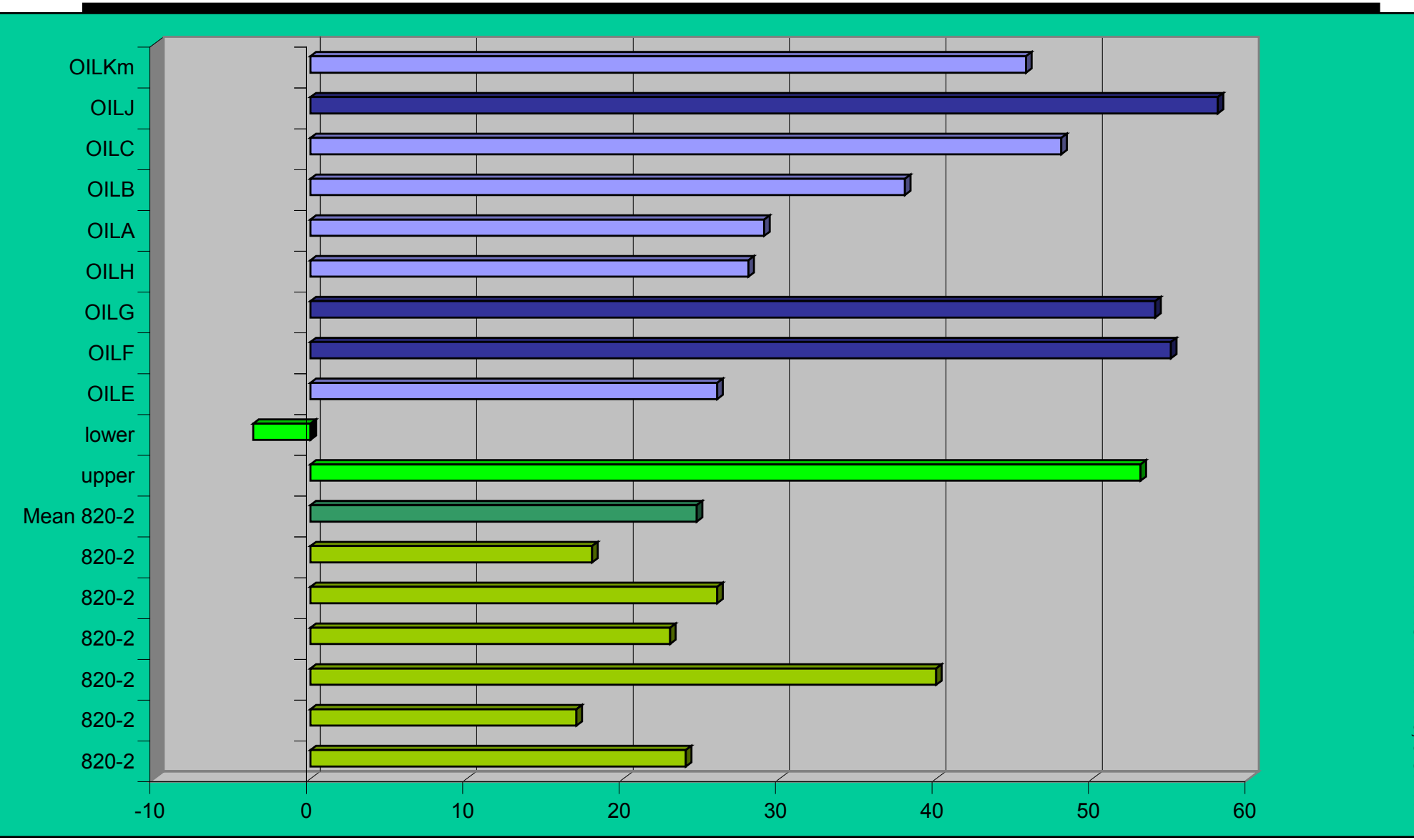
Comparison of Standard Deviations

	lnDPBFINAL	DPB2FNL	ATRWLFNL	CLWFNL	OCFNL	IRINH300
T10 LTMS	0.2339	3.5	18	4.2	7.2	
T10 Matrix*	0.2946	6	25	3.7	8.9	181
T12 820-2	0.3065	1	25	3.9	6.8	126

*9/14/01 Analysis of T10 matrix -- 27 tests (2 operationally valid tests removed)

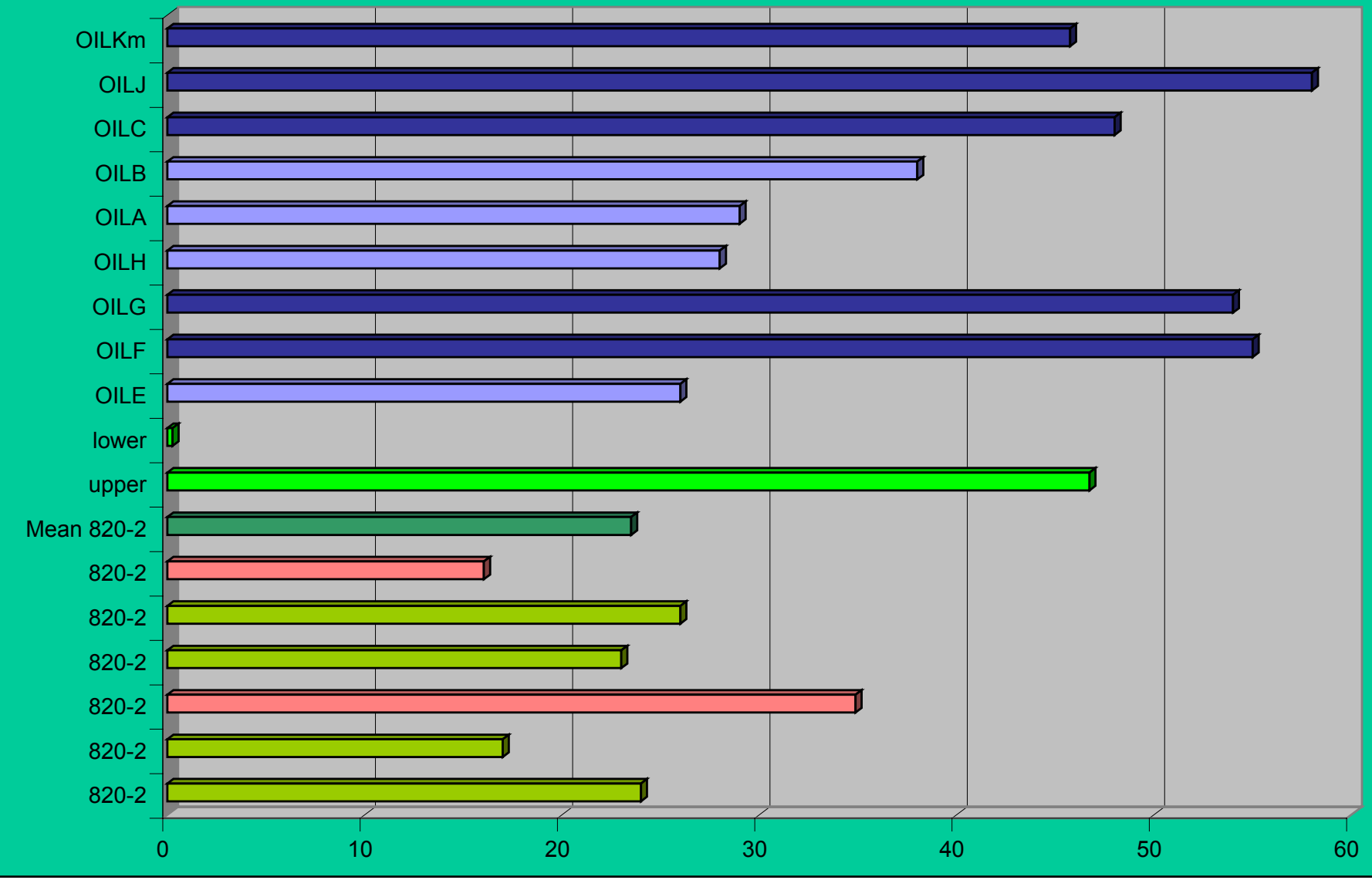
ATTACHMENT 10, 5 OF 17

Delta Pb 0 to 300



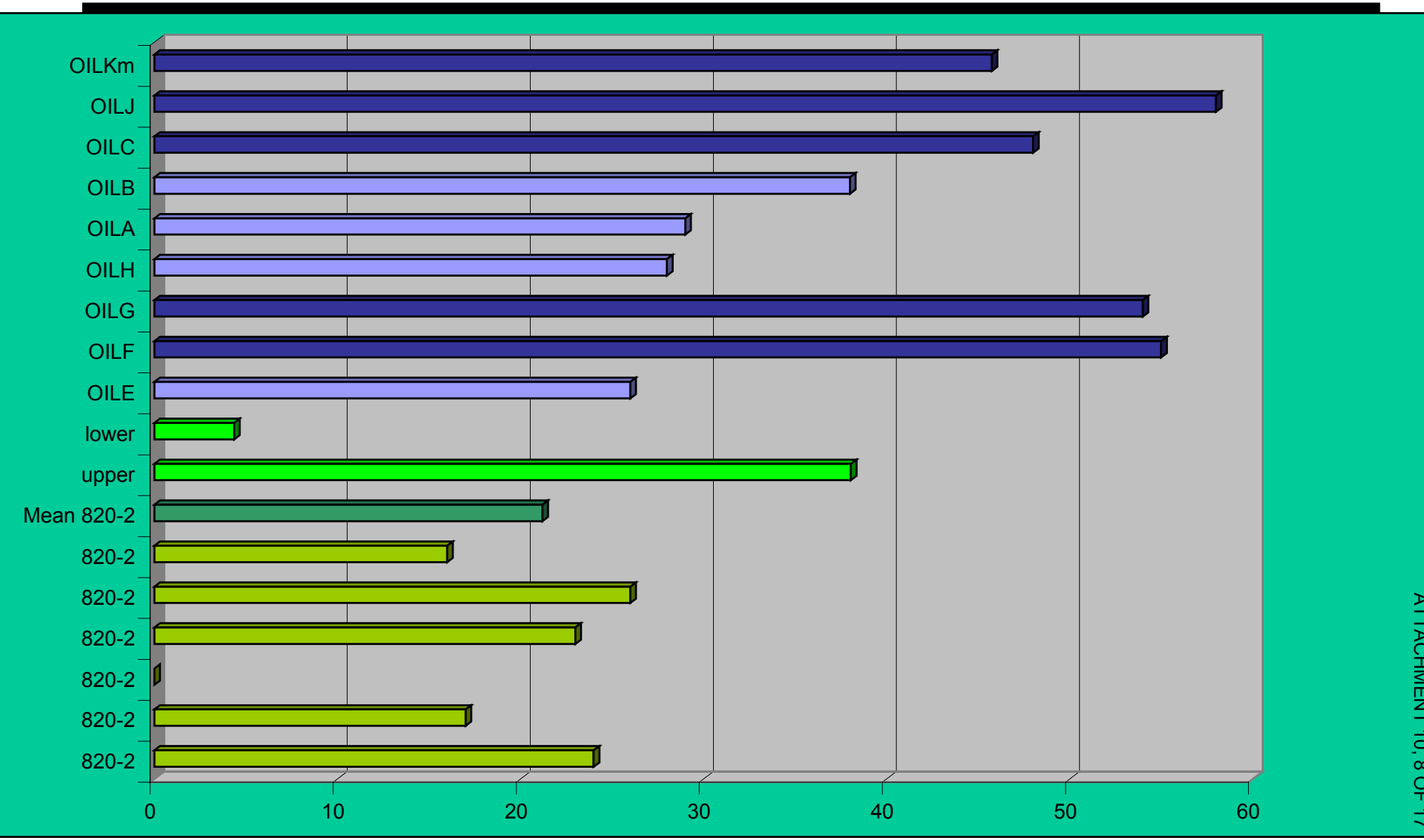
ATTACHMENT 10, 6 OF 17

Delta Pb 0 to 300 UBWL OSC



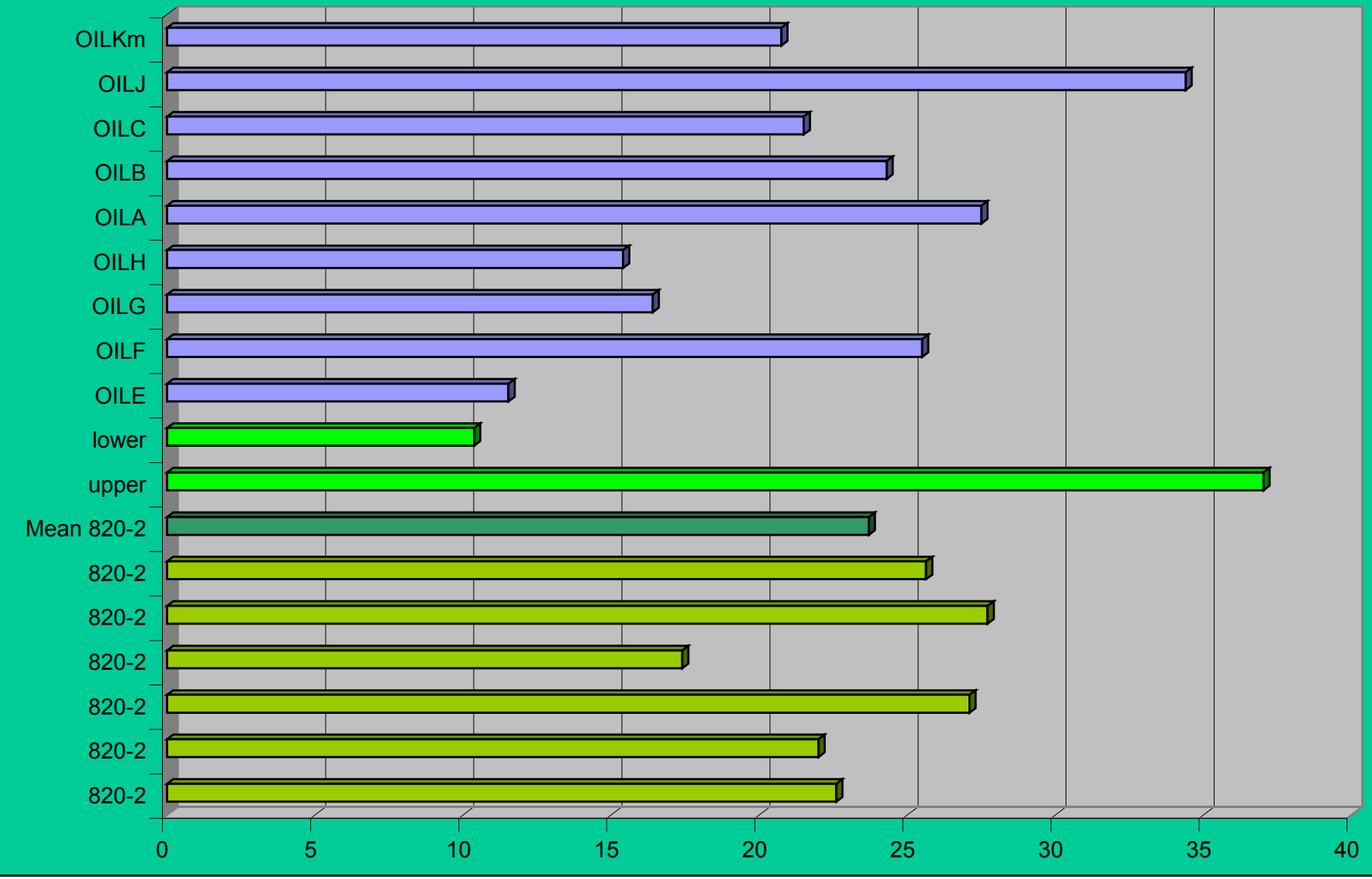
ATTACHMENT 10, 7 OF 17

Delta Pb 0 to 300 Lab G Test Removed



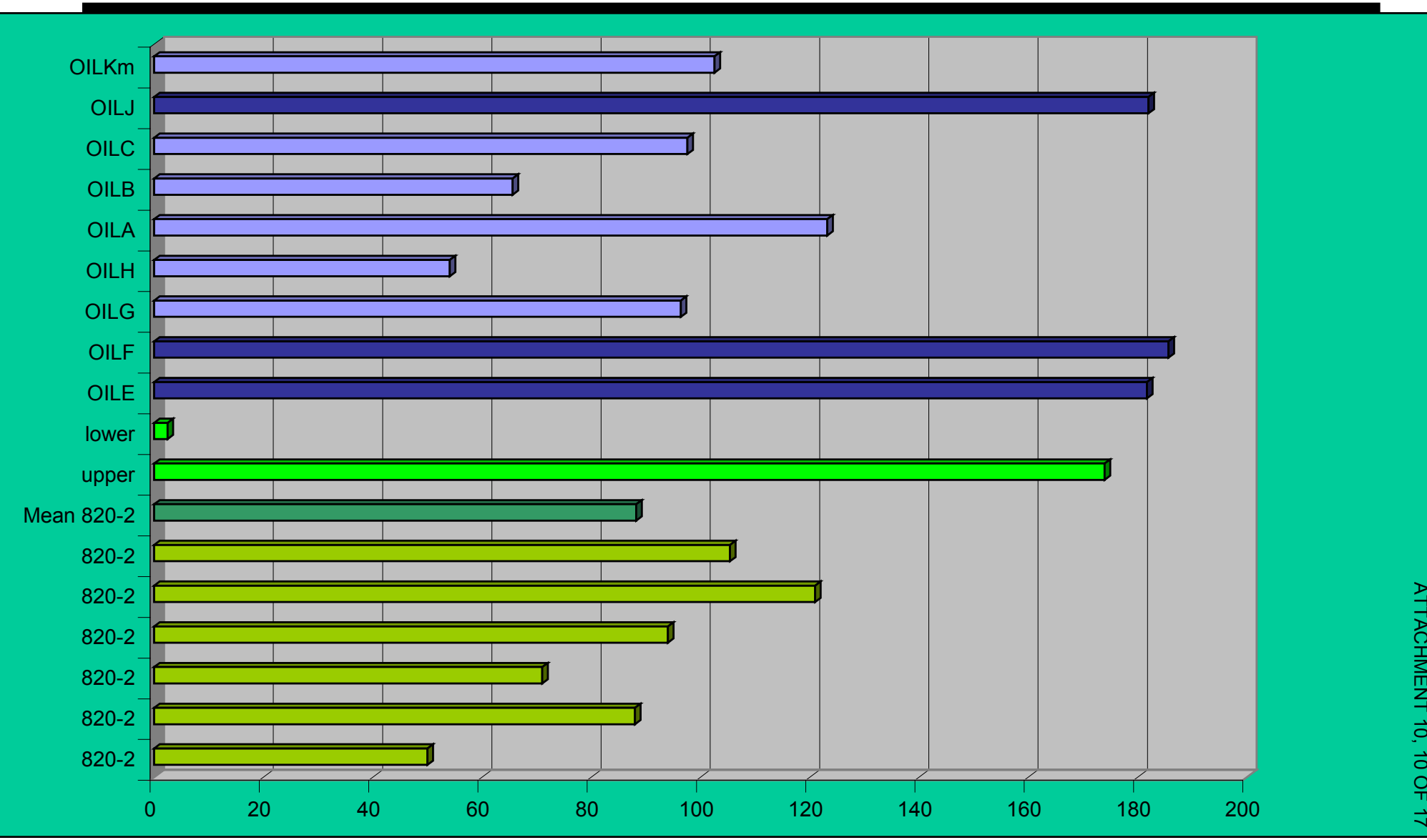
ATTACHMENT 10, 8 OF 17

Cylinder Liner Wear



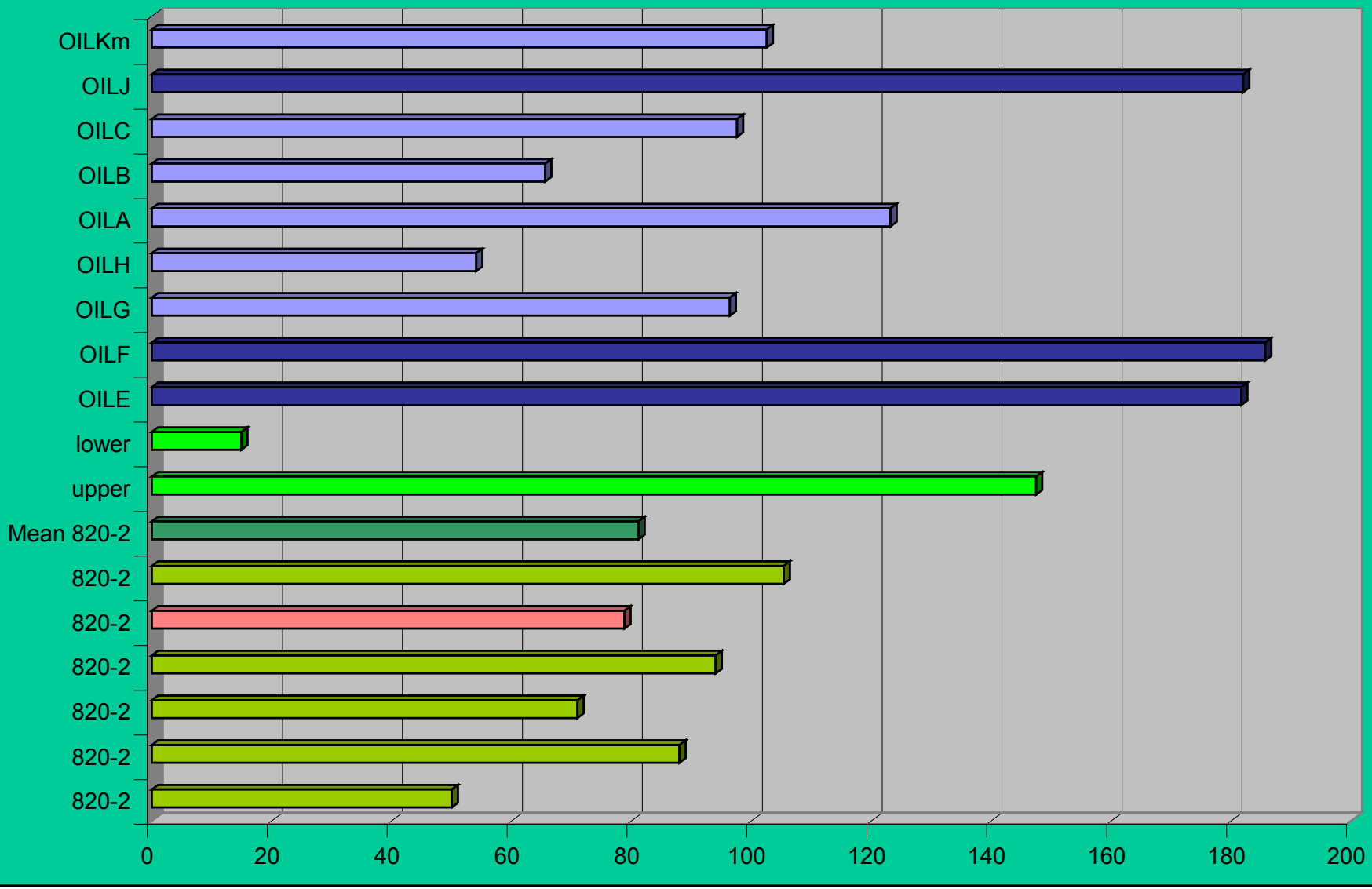
ATTACHMENT 10, 9 OF 17

Top Ring Weight Loss



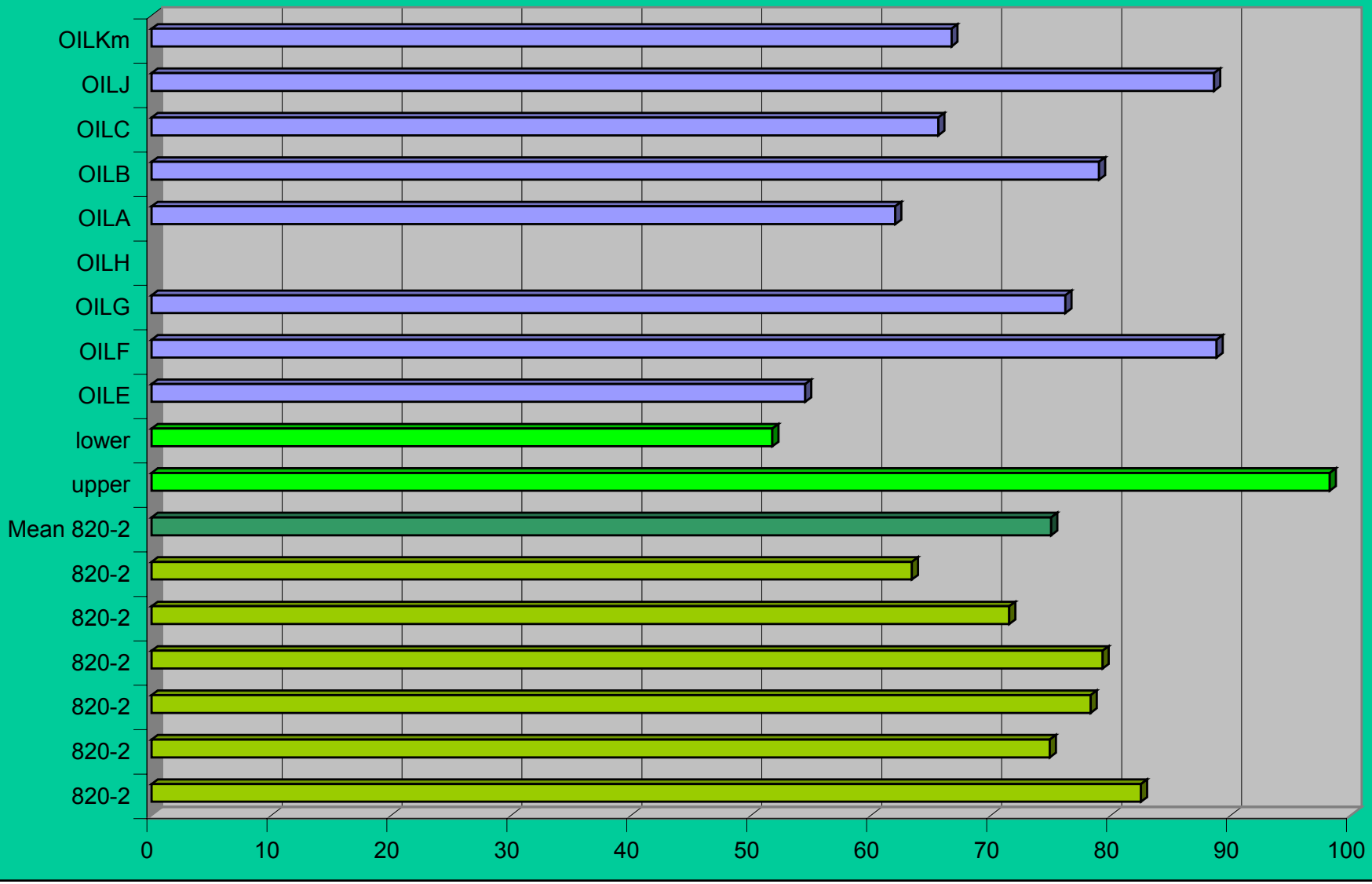
ATTACHMENT 10, 10 OF 17

Top Ring Weight Loss (Lab A Near Outlier Removed)



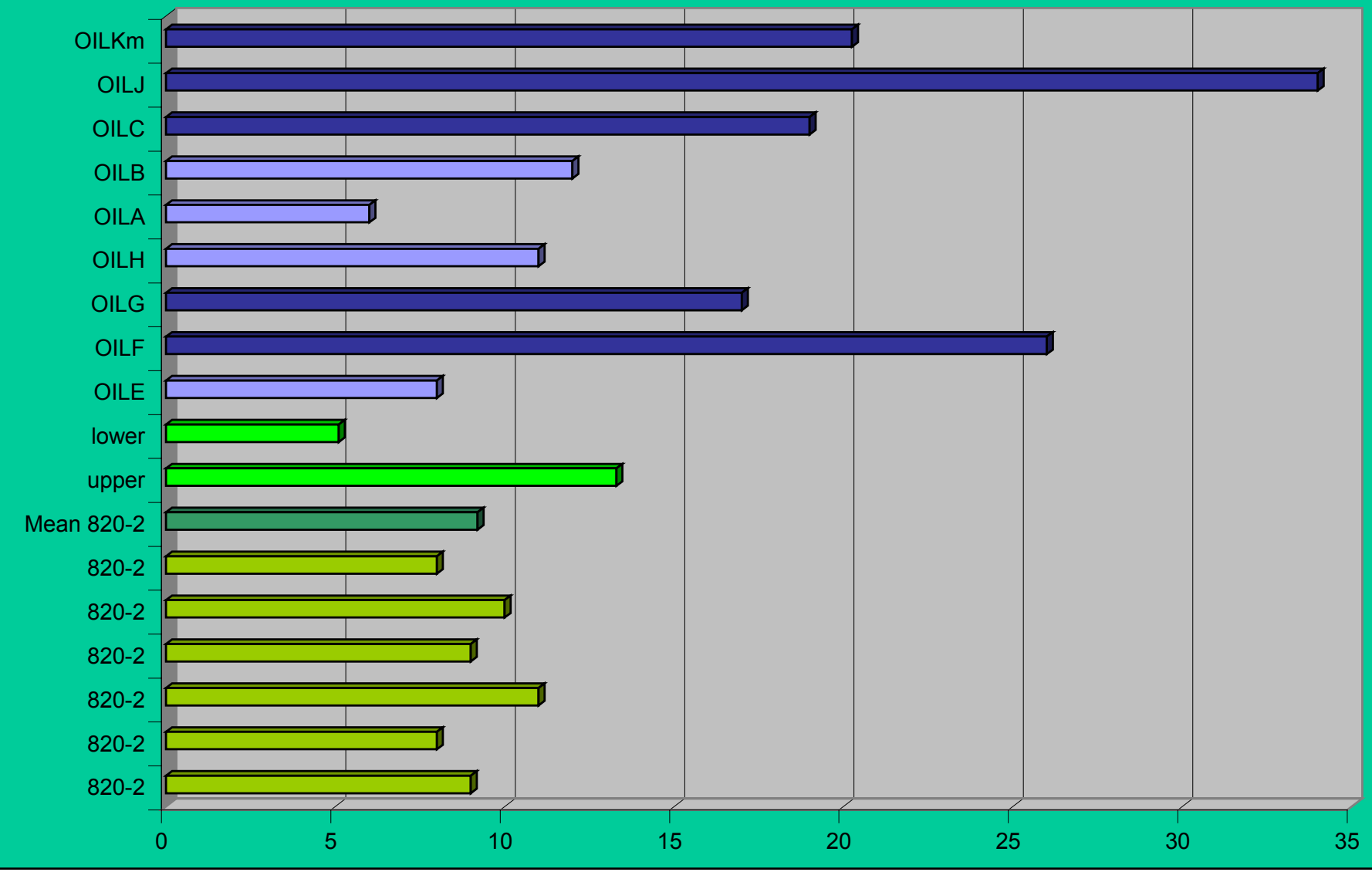
ATTACHMENT 10, 11 OF 17

Oil Consumption



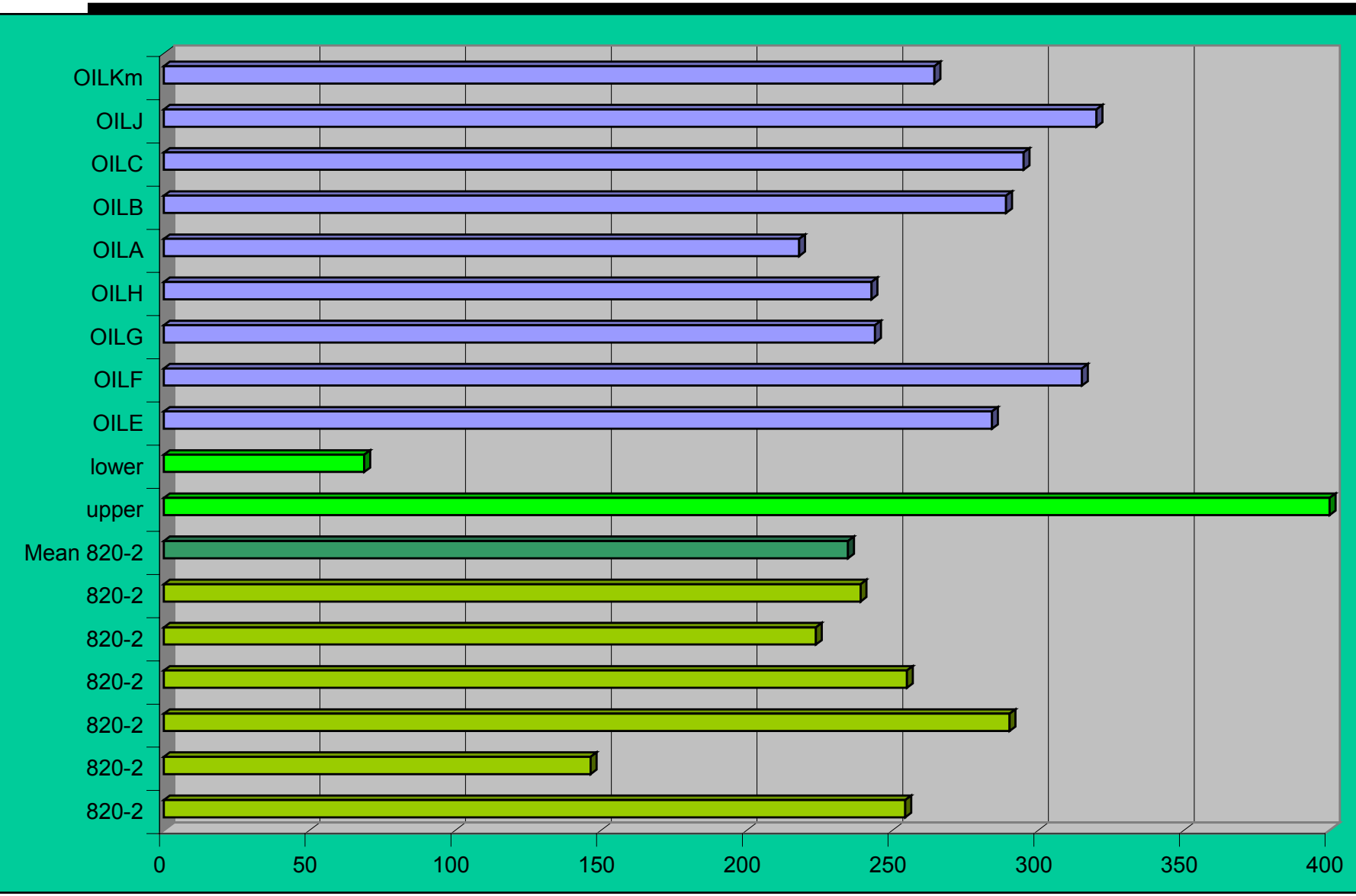
ATTACHMENT 10, 12 OF 17

Delta Pb 250 to 300



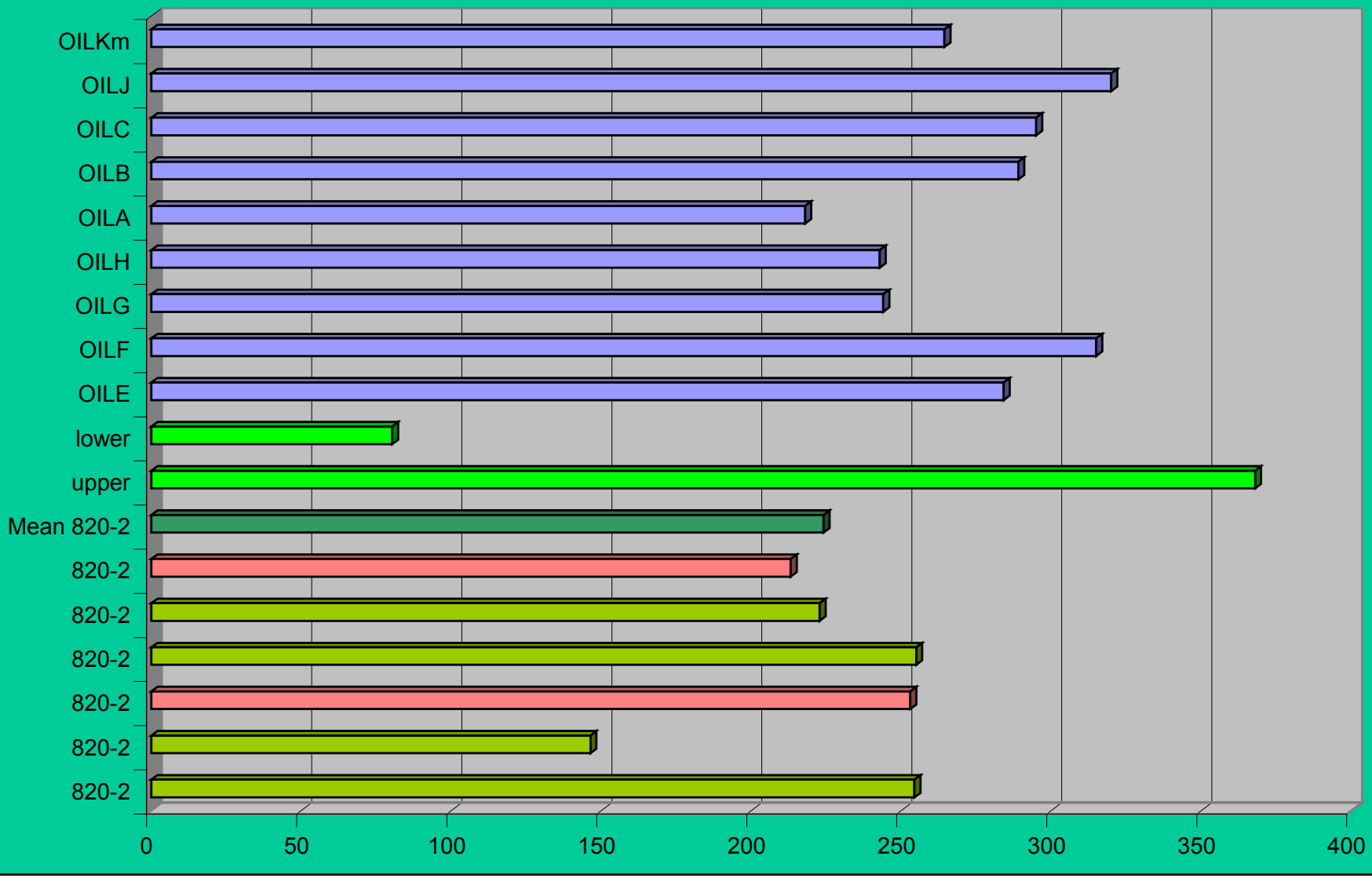
ATTACHMENT 10, 13 OF 17

Upper Bearing Weight Loss



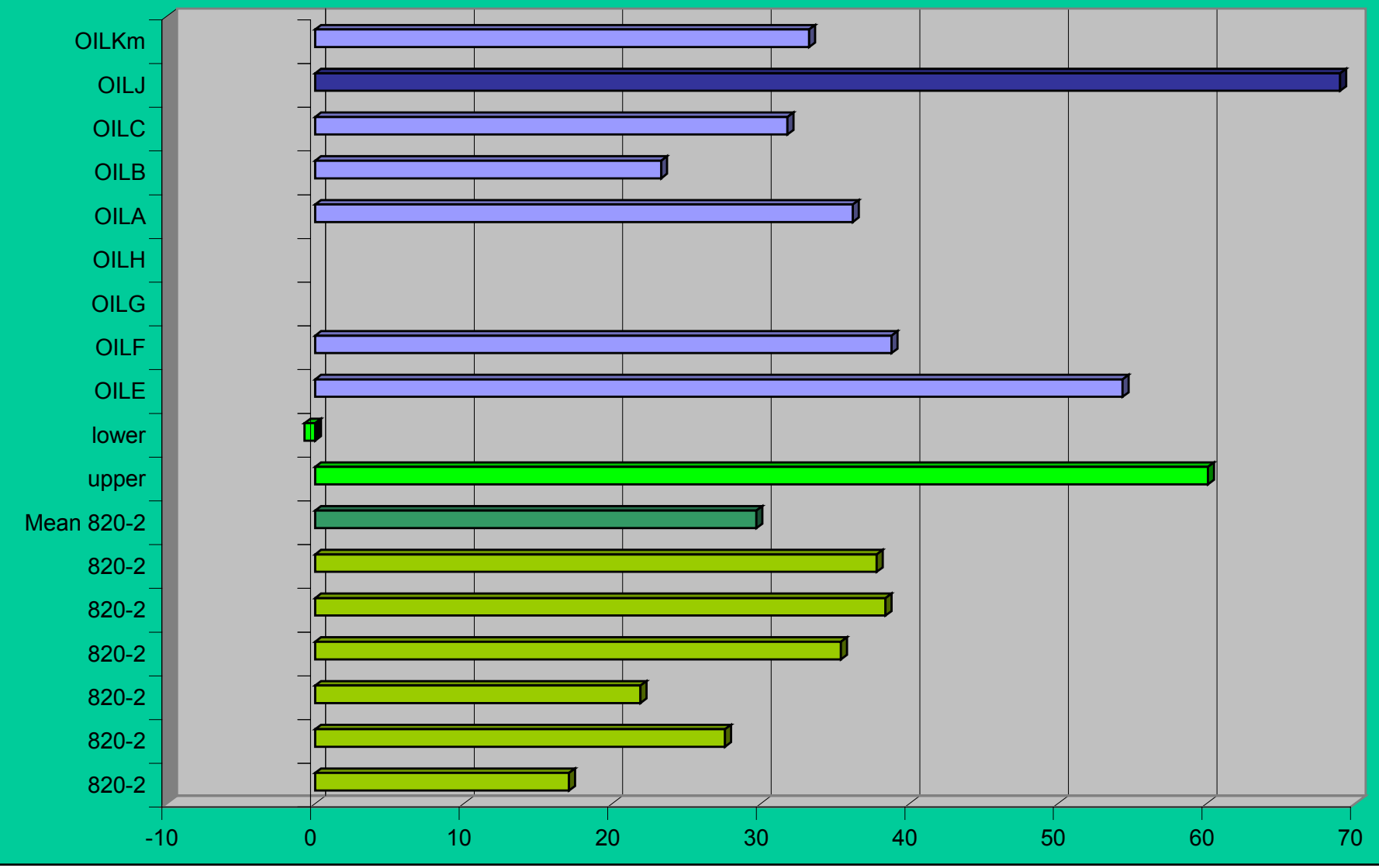
ATTACHMENT 10, 14 OF 17

Upper Bearing Weight Loss (Outlier Screened)



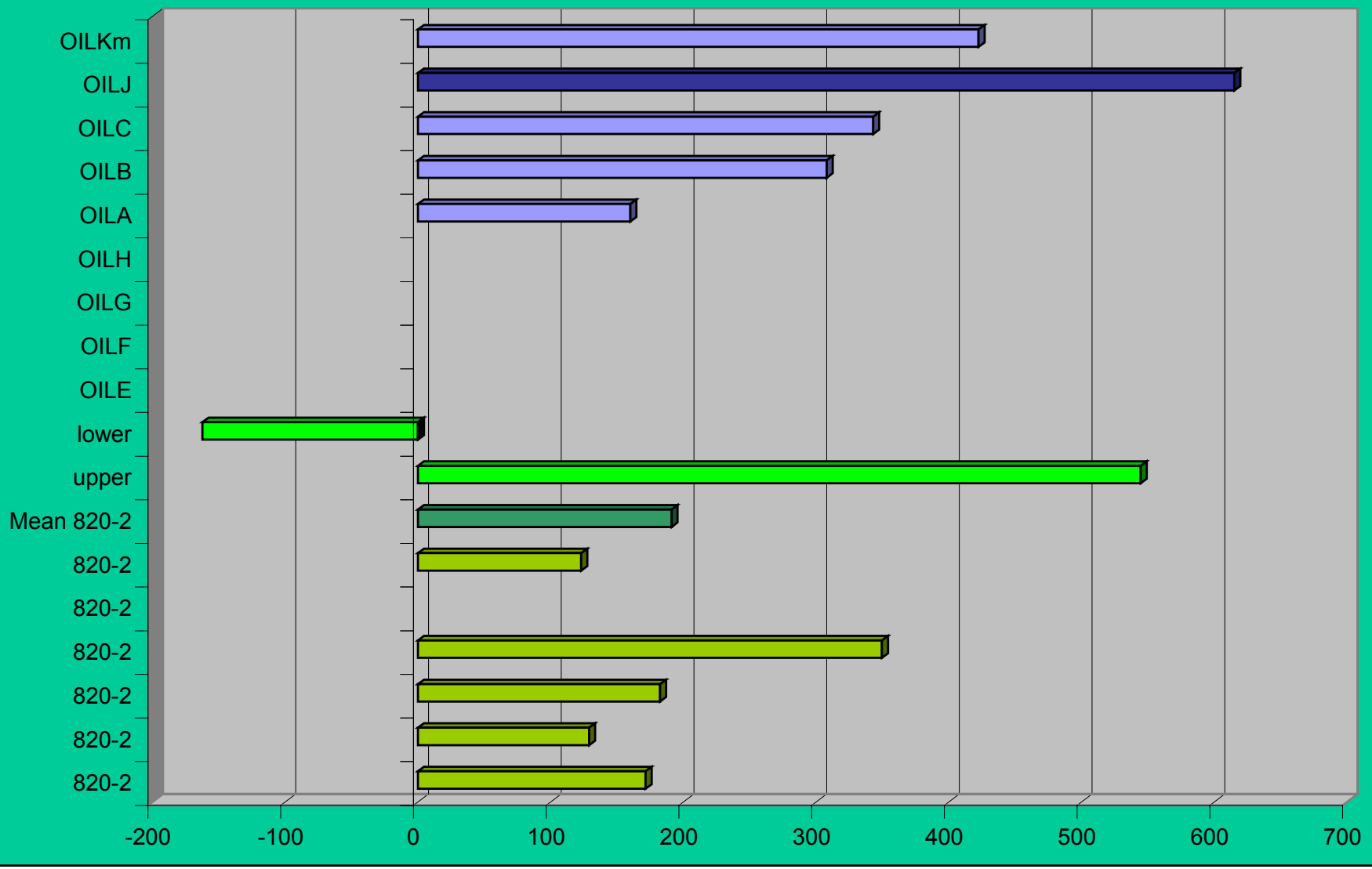
ATTACHMENT 10, 15 OF 17

Second Ring Weight Loss



ATTACHMENT 10, 16 OF 17

Delta IR Method 5 (300 Hours - 250 Hours)



ATTACHMENT 10, 17 OF 17

Status of ISM Test

D M Stehouwer

To HDEOCP

3/31/05

ISM / M11 EGR Correlation Methodology

- Ordinary Least Squares regression was used to establish the correlation for all of the pass fail parameters in the M11EGR test.
- The data set used for the correlation included:
  - ISM matrix runs on reference oil 830-2
  - Two candidate test oils that were submitted to the Test Monitoring Center as part of a solicitation for correlation data.
- The 830-2 data was outlier screened on CHWL and soot corrected to an average of 3.9%soot.
  - It is unclear if the candidate data was outlier screened
    - Verification is in progress
  - The correction for CHWL for soot was 3mg/%soot.
  - All CHWL data was soot corrected to 3.9 % soot.

ISM / M11 EGR Correlation Methodology

- For OFDP a natural log transform was used for the ISM data.
- A square root transformation was used for the M11EGR data.
- For sludge the 830-2 and candidate data was so close to each other correlation was very difficult.
  - To aid in establishing a correlation the sludge values were transformed using the following equation (10-sludge rating) then the correlation line was forced through zero.

ISM / M11 EGR Correlation

	M11EGR performance	Equivalent ISM performance
CHWL	20 mg	7.5 mg
OFDP	275 kPa	55 kPa
Sludge	7.8 merits	8.1 merits

- **Note: these values are for correlation with M11 EGR, not PC10**
- **PC 10 limits will be defined around the performance of 830 in the ISM**

Status of ISB Test

D M Stehouwer

To HDEOCP

3/31/05

ISB Status / Summary of Actions

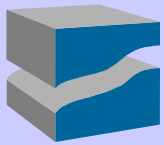
- Draft of test procedure is under revision
- Definition of the test cycle was refined
- Intake and Exhaust restriction more closely defined
- Valve lash adjustment procedure defined
- Next batch of cams in hand and being measured
  - Will be at TEI by mid April
- Cam measurement procedure decided for matrix
  - Labs to measure before and after test with Seq. III procedure
  - Adcole measurement will be provided for full 360^{o} before and after test
  - Decision on which to use going forward will follow matrix

ISB Lab Status

- Test discriminates at two labs
  - IND-2 and AEI
    - AEI will not be in matrix
- Lab visitations complete
- IND-1 will run 830-2 and 1004
- DEP-4 will run 830-2
- Both are on track to be complete by 4/15

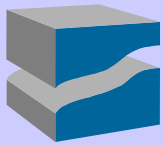
ISB Matrix Readiness: Task Force Report

- **Test discriminates and is ready**
- **Procedure has been finalized**
- **All hardware for matrix and beyond will be in place by 4/15**
- **Labs *should* be matrix ready by 4/15**
- **ISB Task Force proposes that HDEOCP finalize an exit criteria ballot and declare the ISB matrix ready *following ISB TF telcon confirming lab discrimination.***



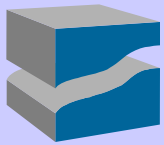
Turbo charger deposits Background

- **Crankcase gases will be included in regulated emissions**
  - ✓ **Korea**
  - ✓ **Japan New Short Term (JNST, 2004-5)**
  - ✓ **US07**
  - ✓ **Euro 5**
- **Closed Crankcase Ventilation (CCV)**
- **Oil mist/oil residue through TC and CAC**
- **May result in heavy deposits in TC and/or CAC**



Turbo charger deposits Background

DEPOSITS = f(TEMPERATURE, OIL QUALITY, OIL QUANTITY, TIME)



Turbo charger deposits Background

- **Available tests**
  - ✓ **OM 441LA (Boost pressure loss)**
    - ❑ **Not available after 2006**
  - ✓ **MTU test (Glass ware)**
    - ❑ **Problems with precision and field correlation**

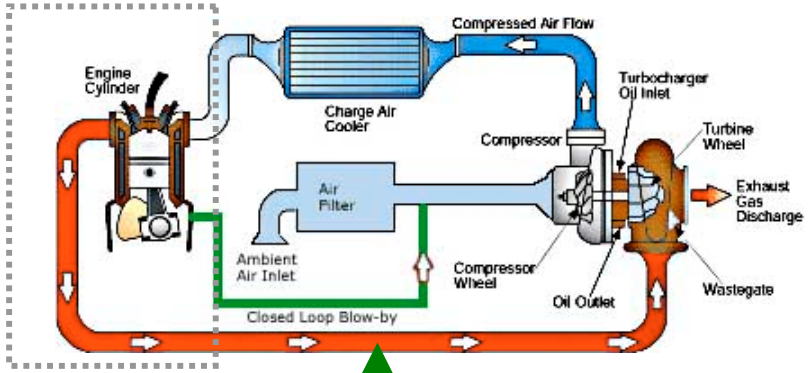
Turbo charger deposits
New Test Development @ APL, Germany

- **Lab test instead of engine test**
  - ❑reliable
  - ❑cost efficient
  - ❑short
  - ❑as close as possible to real life

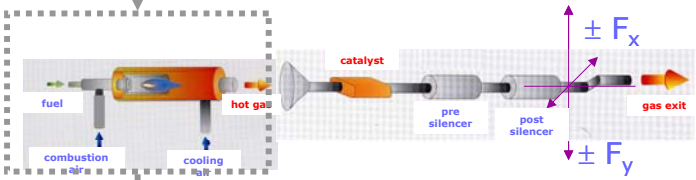
- **Given APL criteria**
  - ❑real TC
  - ❑no glass ware; no metal strips
  - ❑temperatures & pressures similar to engine
  - ❑oil amount similar to engine
  - ❑„oil preparation“ similar to engine

ACEA

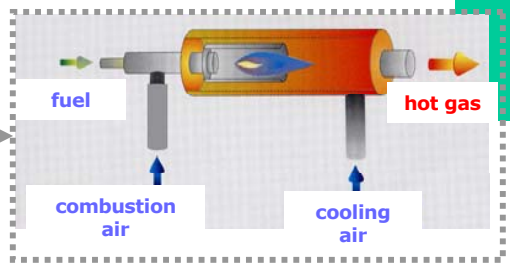
Turbo charger deposits
Principles of APL test



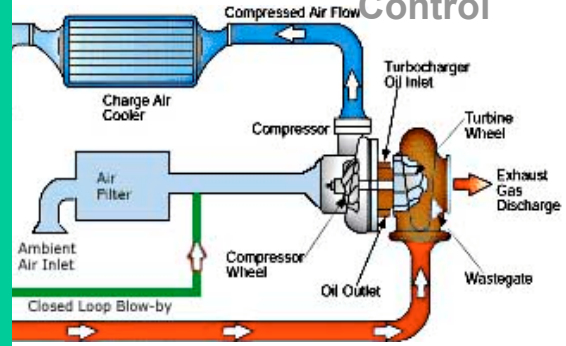
hot gas blow-by



Air, Oil, (Fuel)



Pressure Control



TC Lubrication

VOLVO

Turbo charger deposits
Principles of APL test

- TC from VW 1.9L TDI
  - Compression ratio and temperature similar to HD
- Reference oils
  - RL 196 (OM 441LA high ref)
  - RL 133 (OM 441LA low ref)
  - Oil A (between RL 196 and 133)
- Rating criteria: deposit weight

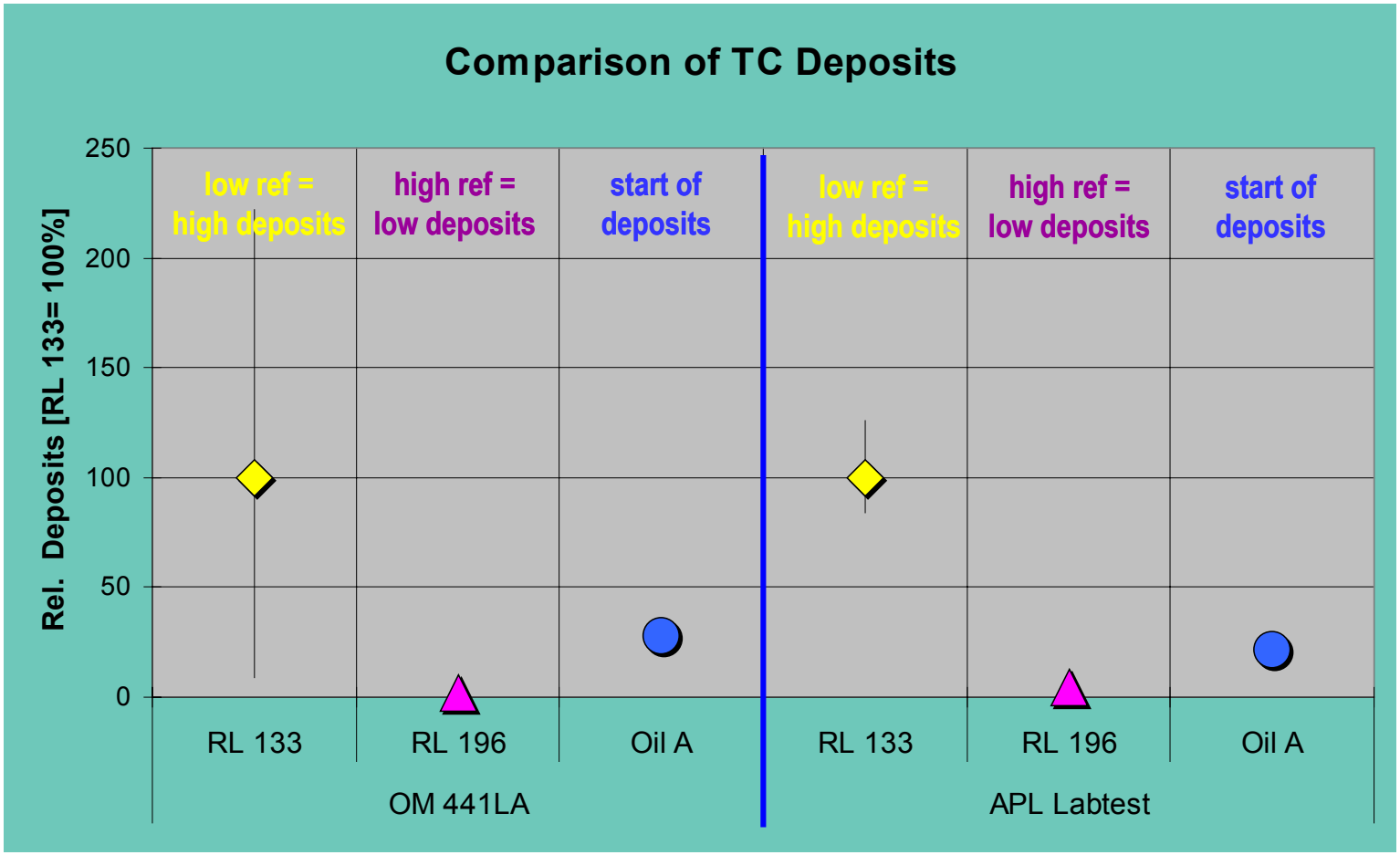
Turbo charger deposits
Principles of APL test

- **Cost estimate per test**
  - ❑ **~ 4.500 € [TC reused]**
  - ❑ **~ 5.200 € [1 TC/test]**

- **Cost estimate per test installation [hot gas burner, test rig control system, TC lubrication, blow-by preparation system, etc.]**
  - ❑ **~ 100.000 – 130.000 €**

ACEA

Turbo charger deposits
Results of APL test



VOLVO

ACEA

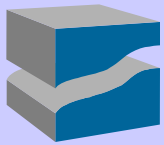
Turbo charger deposits
Results of APL test

RL 133

RL 196

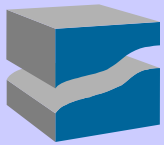
Oil A

VOLVO



Turbo Charger Deposits
Current Status

- **Active working group**
- **Large membership**
  - ❑ European OEMs
  - ❑ Oil and additive industry
  - ❑ TC manufacturer
  - ❑ Independent labs
- **Need established**



Turbo Charger Deposits
Next Steps

- **Alternative test criteria**
  - ❑ TC efficiency
- **Increase severity**
  - ❑ Duration
  - ❑ Temperature
- **Identify current pass and fail oils with field correlation**
- **Next meeting @ APL April 13**

PC-10 NCDT STATUS REPORT

ASTM - HDEOCP MEETING
EMBASSY SUITES - O'HARE
MARCH 31, 2005

ATTACHMENT 13, 1 OF 9

EMA Request to Add Caterpillar 1P Test

- No NCDT action since last HDEOCP Meeting
- Awaiting 1P Test at Afton on C-13 “Oil A”
- Awaiting 1P test data from Caterpillar on “Oil D”
- When received NCDT meeting will be called to review data and develop recommendation to API Lubricants Committee.
- If data received in time, objective is to present NCDT recommendation at May 10 API-LC Meeting

PC-10 Engine Test Matrix

Lab/Stand Selection & Funding Proposal
March 24, 2005

PC-10 Engine Test Matrix

Lab / Stand / Funding Proposal

			Hardware Adjusted Test Costs		
	Lab	No.	Plan	Submitted	Prop. Adj.
C13	IND-1	2			
	IND-2	4			
	DEP-1	2			
	DEP-2	2			
	DEP-3	2			
	DEP-4	2			
	Sub-totals	14	1,330,000	1,369,920	1,348,719
ISB	IND-1	4			
	IND-2	2			
	DEP-4	2			
	Sub-totals	8	400,000	385,012	379,054
T-12	IND-1	2			
	IND-2	2			
	DEP-1	2			
	DEP-4	2			
	Sub-totals	8	600,000	632,008	622,227
	Grand Total		2,330,000	2,386,940	2,350,000
	Surplus / Shortage		20,000	-36,940	0

Discount on Test Costs (%)

vs. Submitted	1.42%
vs. Hardware Adj.	1.55%

Discount per Test ($)

Average	1,231
Minimim	623
Maximim	1,627

- **Objectives**
  - Allow all volunteer labs to participate
  - Treat Ind. labs the same
  - Minimize overall cost to meet budget
- **Proposal Outcomes**
  - No labs excluded
  - Each Ind. lab has 2 stands for 1 test; stands dropped using cost
  - $37K shortfall requires 1.5% test cost reduction
  - Use cost to replace stands if necessary; would lead to increased shortfall (up to $90K)

ATTACHMENT 13, 4 OF 9

PC-10 Engine Test Matrix

Lab / Stand / Funding Proposal

	Lab	No.	Hardware Adjusted Test Costs Plan	Submitted	Prop. Adj.
C13	IND-1	4			
	IND-2	4			
	DEP-1	2			
	DEP-2	0			
	DEP-3	2			
	DEP-4	2			
	Sub-totals	14	1,330,000	1,391,170	1,357,555
ISB	IND-1	4			
	IND-2	2			
	DEP-4	2			
	Sub-totals	8	400,000	385,012	375,709
T-12	IND-1	2			
	IND-2	2			
	DEP-1	2			
	DEP-4	2			
	Sub-totals	8	600,000	632,008	616,737
	Grand Total		2,330,000	2,408,190	2,350,000
	Surplus / Shortage		20,000	-58,190	0

Discount on Test Costs (%)

vs. Submitted	2.22%
vs. Hardware Adj.	2.42%

Discount per Test ($)

Average	1,940
Minimim	973
Maximim	2,540

Alternate 1

- Replaces a dependent lab that may not be matrix ready
- Creates an imbalance between the two independent test labs
- Increases the funding short fall and proposed price adjustments

PC-10 Engine Test Matrix

Lab / Stand / Funding Proposal

	Lab	No.	Hardware Adjusted Test Costs Plan	Submitted	Prop. Adj.
C13	IND-1	4			
	IND-2	4			
	DEP-1	2			
	DEP-2	0			
	DEP-3	2			
	DEP-4	2			
	Sub-totals	14	1,330,000	1,391,170	1,339,937
ISB	IND-1	4			
	IND-2	4			
	DEP-4	0			
	Sub-totals	8	400,000	429,068	413,266
T-12	IND-1	4			
	IND-2	4			
	DEP-1	0			
	DEP-4	0			
	Sub-totals	8	600,000	619,616	596,797
	Grand Total		2,330,000	2,439,854	2,350,000
	Surplus / Shortage		20,000	-89,854	0

Alternate 2

- Assumes the questionable test lab will not be matrix ready
- Uses dependent labs only in the Cat C13 test; cuts 3 stands at 2 dependent labs
- Significant Increase in funding short fall and the proposed price adjustments

Discount on Test Costs (%)

vs. Submitted	3.38%
vs. Hardware Adj.	3.68%

Discount per Test ($)

Average	2,995
Minimim	1,484
Maximim	3,872

PC-10 Engine Test Matrix

Lab / Stand / Funding Proposal

	Lab	No.	Hardware Adjusted Test Costs Plan	Submitted	Prop. Adj.
C13	IND-1	2			
	IND-2	4			
	DEP-1	2			
	DEP-2	2			
	DEP-3	2			
	DEP-4	2			
	Sub-totals	14	1,330,000	1,369,920	1,355,758
ISB	IND-1	4			
	IND-2	2			
	DEP-4	2			
	Sub-totals	8	400,000	385,012	381,032
T-12	IND-1	4			
	IND-2	4			
	DEP-1	0			
	DEP-4	0			
	Sub-totals	8	600,000	619,616	613,210
	Grand Total		2,330,000	2,374,548	2,350,000
	Surplus / Shortage		20,000	-24,548	0

Alternate 3

- Assumes all labs will be matrix ready
- Eliminates dependent labs from the Mack T-12 matrix
- Balances independent labs based on test costs
- Lowest possible short fall and test cost adjustment

Discount on Test Costs (%)

vs. Submitted	0.95%
vs. Hardware Adj.	1.03%

Discount per Test ($)

Average	818
Minimim	416
Maximim	1,087

PC-10 Engine Test Matrix

Lab / Stand / Funding -- Next Steps

- **NDCT recommend approach to assign matrix test stands**
  - **Prioritize the different options**
- **Obtain agreement from the test labs**
  - **Distribution of stands**
  - **Test cost adjustments**
- **Establish firm deadlines to confirm lab matrix readiness**
  - **To be judged by appropriate TF/SP**
  - **Fixed date or relative to HDEOCP test acceptance?**
- **Use output from above to finalize MOA**

ATTACHMENT 13, 8 OF 9

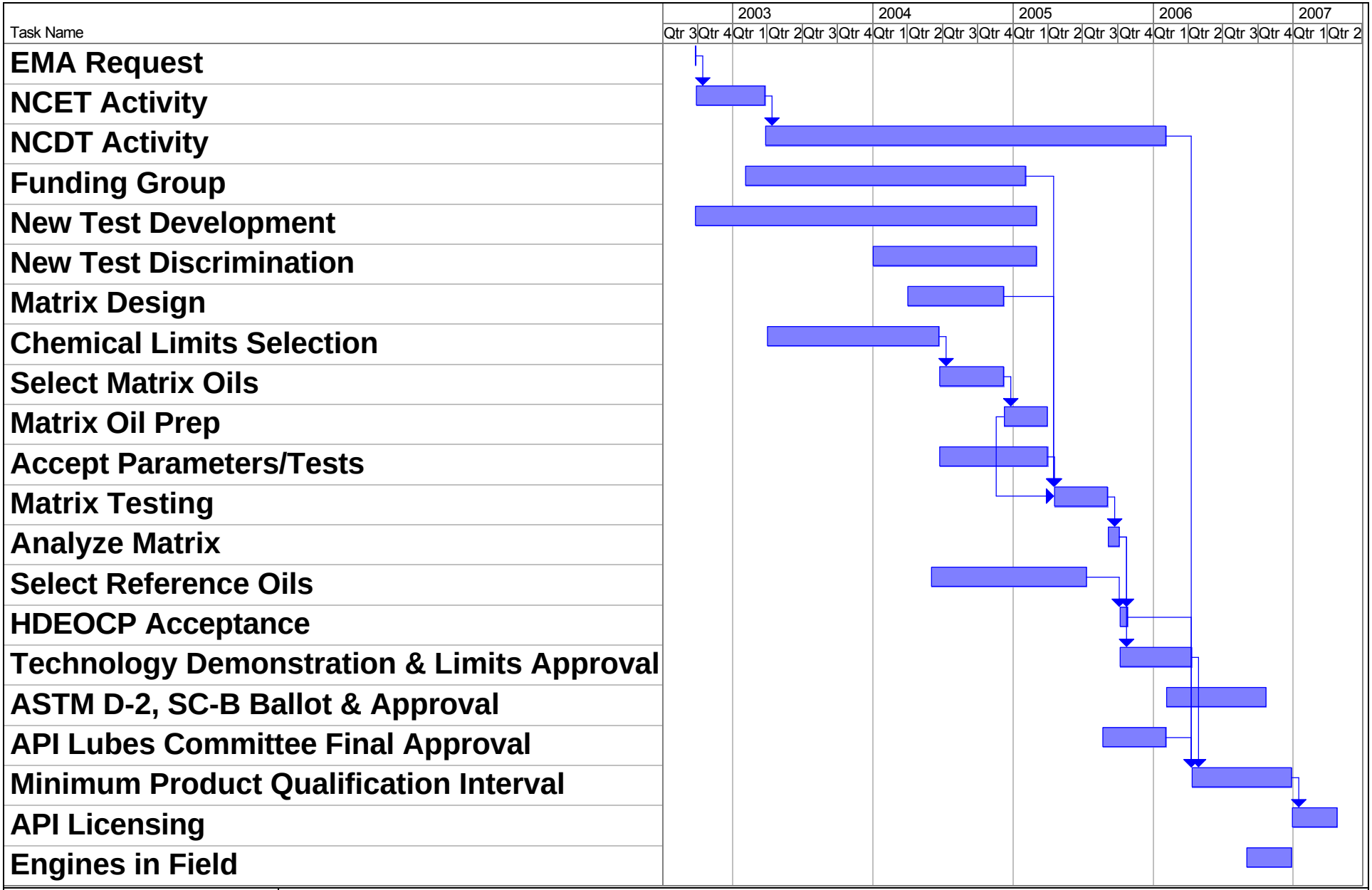
Conference Call Decisions

- **NCDT recommends adoption of the laboratory / stand combinations of the basic proposal (Slide 2) provided all participating laboratories are declared ready by the involved Test Development Task Forces by April 15, 2005; with Alternate 1 (Slide 3) as a fall-back position if Dependent Laboratory 2 is not declared ready by this date.**

- **Bill Runkle will request DEOAP approval of this NCDT recommendation.**

- **Steve Kennedy will resolve test costs with the laboratories consistent with available funding and circulate revised proposals including final funding for presentation to the DEOAP.**

- **An ACC initiative to conduct additional testing beyond the PC-10 Matrix to develop Group III BOI data was discussed. This will be addressed by BOI/VGRA TF.**



Project: PC-10 ACC-1 03312005
Date: Thu 3/31/05

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

ATTACHMENT 14

EXIT CRITERIA BALLOT

ASTM-HDEOCP BALLOT FOR VOTING MEMBERS ONLY Reference: Jim Mc Geehan, Chairman	Issue Date: March 2th , 2005 Receipt Deadline: March 24th , 2005

RETURN BALLOT TO: Pat Connelly via email (preferred): patconnelly@chevrontexaco.com or via Fax: 510-242-3758	Name: William Kleiser Organization: Chevron Oronite LLC Date: March 21, 2005 Phone No.: 510 242 3027

Motion	Affirmative	Negative
The following motion was made at the HDEOCP and passed unanimously. **MOTION** **Acceptance of the proposed Mack T-10 limits to qualify an oil as passing the Mack T- 9 test. (Reference limits below)** Microsoft PowerPoint Presentation	☐	☒

Comments:

Chevron Oronite supports the approach of using a variety lubricants run in both the Mack T9 and T10 tests to establish equivalent pass limits. However, we feel that the limits proposed for API CH-4 based on the T10 require some revision for the following two reasons:

1) According to the data presented there appears to be a linear relationship between T9 and T10 lead described by the following equation: T9Pb=0.5089(T10Pb)-5.486. Using this equation we can calculate that based on the CH-4 Pb increase limit of 25ppm, the equivalent T10 limit is 60ppm. The current proposed one run limit of 40ppm corresponds to a T9 limit of 15ppm, which is significantly different from the CH-4 pass limit and would represent a change in the performance standard.
2) Based on the average difference in Top Ring Weight Loss (TRWL), there is a 30mg off set in severity. The T-9 CH-4 one run limit is 120mg, this would translate to 150mg in the T10, based on this data.

Based on the above issues, Chevron Oronite would be willing to accept limits similar to those listed below which we feel represent a direct conversion from the T9 to T10 based on the data presented.

T10 Top Ring Weight Loss, mg: 150
T10 Liner Wear Step, um: 30
T10 EOT Lead Increase, ppm: 60

ATTACHMENT 16

EXIT CRITERIA BALLOT

ASTM-HDEOCP BALLOT FOR VOTING MEMBERS ONLY Reference: Jim Mc Geehan, Chairman	Issue Date: March 2th , 2005 Receipt Deadline: March 24th , 2005

RETURN BALLOT TO:

Pat Connelly via email (preferred):

patconnelly@chevrontexaco.com

or via Fax: 510-242-3758

Name: Pat Fetterman

Organization: Infineum

Date: 3/24/05

Phone No.: (908) 474-3099

Motion	Affirmative	Negative
The following motion was made at the HDEOCP and passed unanimously. **MOTION** **Acceptance of the proposed Mack T-10 limits to qualify an oil as passing the Mack T- 9 test. (Reference limits below)** Microsoft PowerPoint Presentation	☐	X☐

Comments: Infineum does not support the proposed liner wear step limit for the T-10 as a surrogate for the T-9. TMC1005 shows a many-test wear step average right at the pass/fail limit in the T-9, yet the proposed T-10 limits would make TMC1005 a fail (even at the three test limit) in the T-10.

If the three test wear step limit in the T-10 is changed to the TMC1005 actual result of 34, and the two test and one test limits calculated from there, Infineum will change this response to affirmative.

ATTACHMENT 17

EXIT CRITERIA BALLOT

ASTM-HDEOCP BALLOT FOR VOTING MEMBERS ONLY Reference: Jim Mc Geehan, Chairman	Issue Date: March 2th , 2005 Receipt Deadline: March 24th , 2005

RETURN BALLOT TO:

Pat Connelly via email (preferred):

patconnelly@chevrontexaco.com

or via Fax: 510-242-3758

Name: Lewis Williams

Organization: Lubrizol

Date: 3/23/05

Phone No.: 440-347-1111

Microsoft PowerPoint Presentation

Motion	Affirmative	Negative
The following motion was made at the HDEOCP and passed unanimously. **MOTION** **Acceptance of the proposed Mack T-10 limits to qualify an oil as passing the Mack T- 9 test. (Reference limits below)**	☐	X☐

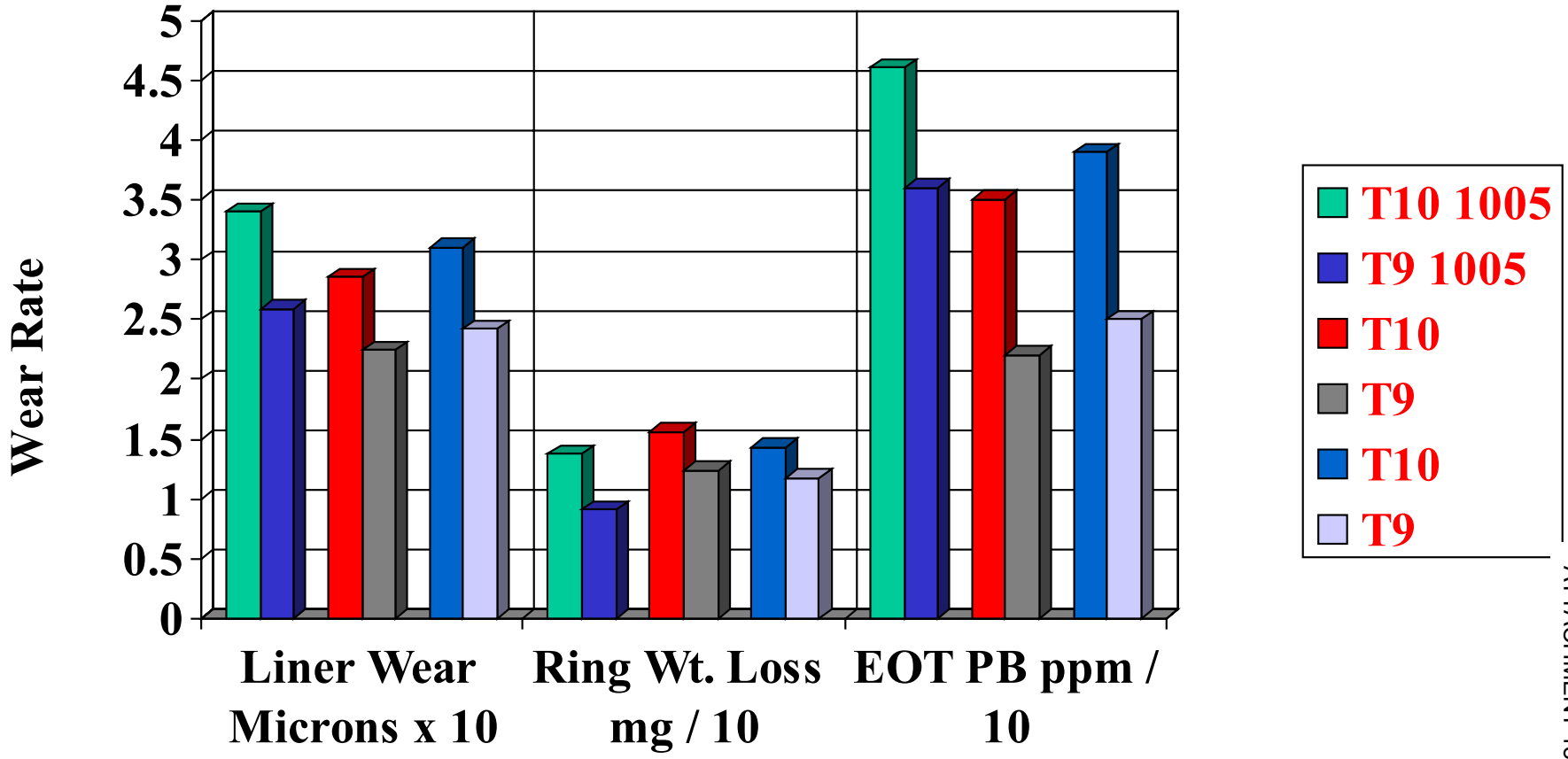
Comments:

Mack Wear Test Proposals using the T-10

Mack T-9	Oil A 10W30 Group I Additive A	Mack T-10	Oil A-1 10W30 Group I Additive A	
Mack T-9		Mack T-10		
Avg Liner Wear, um	26.2	Avg Liner Wear, um	30.5	
Avg TRWL, mg	120	Avg TRWL, mg	107	
Delta Pb, eot	18	Delta Pb, eot	29	
	Oil B 15W40 Group I Additive A		Oil B-1 15W40 Group I Additive A	Oil B-2 15W40 Group II Additive A
Mack T-9		Mack T-10		
Avg Liner Wear, um	21.5	Avg Liner Wear, um	18.6	22.5
Avg TRWL, mg	66.4	Avg TRWL, mg	140	87
Delta Pb, eot	10	Delta Pb, eot	33	28
	Oil C 15W-40 Group II Additive B		Oil C-1 15W-40 Group II 1.1 X Additive B	
Mack T-9		Mack T-10		
Avg Liner Wear, um	23.8	Avg Liner Wear, um	26.1	
Avg TRWL, mg	49	Avg TRWL, mg	82	
Delta Pb, eot	11	Delta Pb, eot	30	

LUBRIZOL

Wear / T10 vs. T9



GLS Mar 31, 2005

ATTACHMENT 18, 1 OF 2

Limits Proposal

CH 4 T9 - T10

Liner Wear (um)

T9 – 25.4 T10 - 30,32,33
32,34,35 NEW

Top Ring Weight Loss (mg)

T9 – 120 T10 – 145,154,158
150,159,163 NEW

EOT Delta Lead (ppm)

T9 – 25 T10 – 40,45,47
50,56,59 NEW

Current D 4485 CF-4

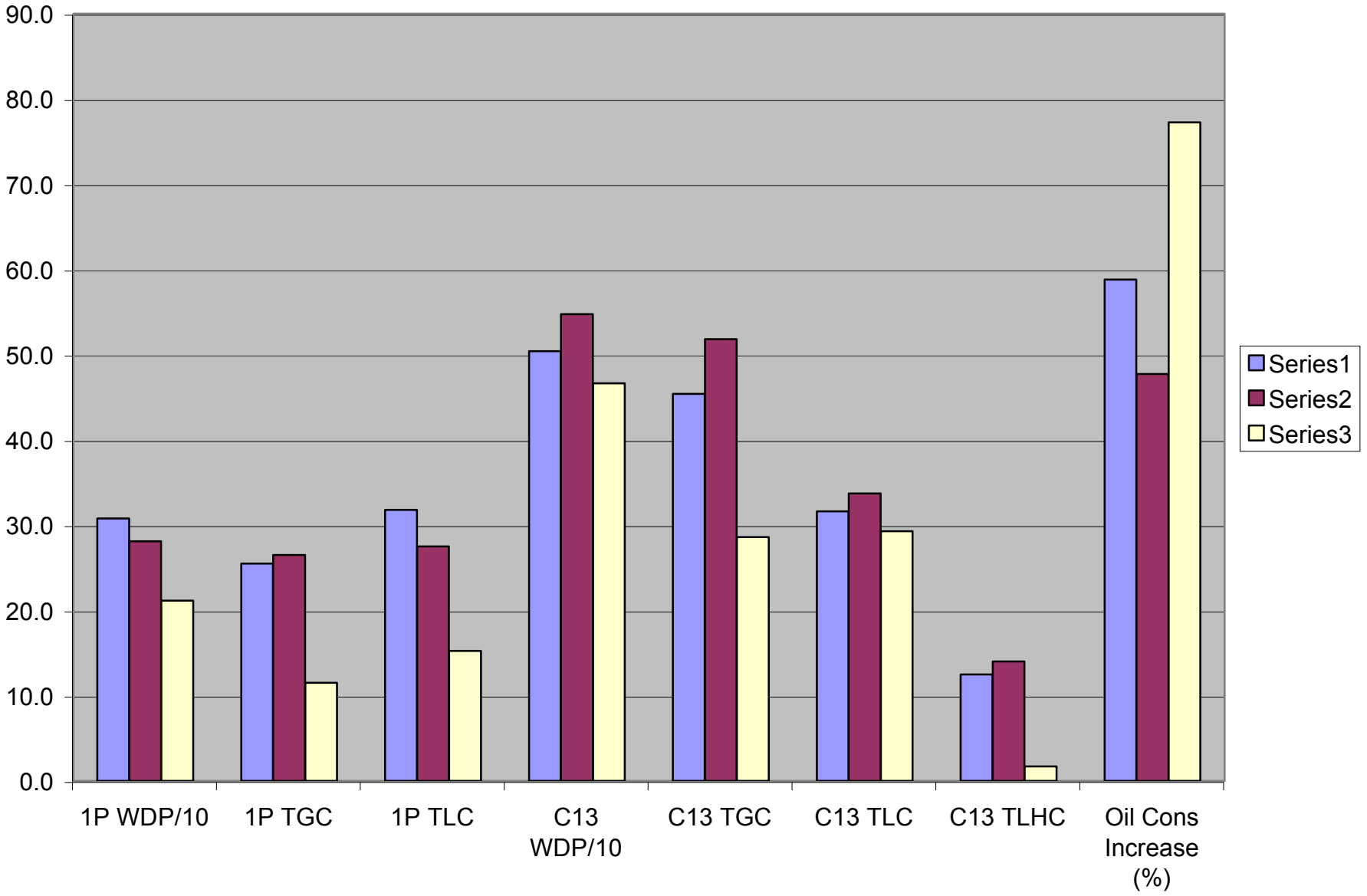
- T-6 Merit Rating, min 90
- Or D 6483 (T-9)
  - TRWL avg. mg, max 150
  - Liner wear, um, max 40

Afton CHEMICAL

A Passion for Solutions™

D 4485 CF-4

- The T-9 test is no longer available
- Referenced tests can not be run to license the CF-4 category
- Data relating the T-6 and the T-10 are limited
- No new correlation data is expected
- Based on the proposed limits for T-9 vs T-10 using the same offset of 5 um and 25 mg, the T-10 could be substituted for the T-6.
- Proposed limits would be 45 um max liner wear and 175 mg max TRWL.



ATTACHMENT 20