

MEETING MINUTES

HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL OF

D02.B0.02

February 23, 2000

Holiday Inn – O'Hare International Hotel, Rosemont, IL

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ACTION ITEMS

1. **Resolve oxidation test issues - EMA; Oxidation Task Force**
2. **Develop repeatability and discrimination data - EGR tests Task Forces**
3. **Resolve matrix base oil issues - Somebody**
4. **Send EOT oil samples to Chris May - Anybody with 5% soot samples**

MINUTES

- 1.0 Call to Order
 - 1.1 Chairman McGeehan called the meeting to order at 7:37 AM on February 23, 2000 in the Holiday Inn O'Hare International Hotel of Rosemont, IL. There were 12 members or representatives present and approximately 35 guests. The attendance list is Attachment 2.
- 2.0 Agenda
 - 2.1 The agenda for the meeting (Attachment 1) was reviewed and the status reports on the EGR tests were moved ahead of the Oxidation Task Force report.
- 3.0 Meeting Minutes
 - 3.1 The minutes of the December 7, 1999, meeting were approved as posted on the TMC's website.
- 4.0 Membership

- 4.1 There were no membership changes. Frank Bondarowicz held a proxy for Danny Larkin for any votes at this meeting.
- 5.0 EGR Test Development Status
 - 5.1 Greg Shank gave an update on the T-10 status and indicated they had delivered 8 engines. He presented some severity and discrimination data from the test (Attachment 3) and hoped to have sufficient data by April to be ready for matrix testing. He urged that T-10 EOT oil samples be sent to Joe Franklin at Perkin-Elmer for task force analysis procedure development.
 - 5.2 Dave Nycz reported for Mike Quinn on the 1Q status (see Attachment 4). CAT currently has a second test in progress on a commercial CH-4 oil. Dave indicated EGR kits were being shipped to the labs and then raised the issue about what oils should be run when other stands become available. Dave wants to see more data on oil 1005 because he said he was looking for better performance than 1005. Brian Lawrence felt 1005 might not be appropriate to discriminate against and after some discussion, Dave indicated that perhaps they were not looking for discrimination as much as “no worse performance”. Somewhere in this discussion the emerging importance of undercrown deposits was brought up. Teri Crosby then called everyone’s attention to the fact that the test must show discrimination to be accepted and the discussion concluded with the note that “more data are needed”.
 - 5.3 Shawn Whitacre reported for John Graham on the M-11 EGR status (see Attachment 5). No data were available yet.
 - 6.0 PC-9 Timeline
 - 6.1 Brent Shoffner presented an update on the PC-9 Timeline (Attachment 6) and indicated he felt the “API License date” would slip to later than May of 2002. He also expressed great concern that lab visits for the new tests had been postponed.
 - 7.0 Oxidation Test
 - 7.1 Rich Lee gave the Oxidation Task Force report (Attachment 7) indicating they had met three times and considered numerous suggestions for evaluating an oil’s ability to cope with oxidation. They currently propose using the 1Q for thin film oxidation effects; the T-10 / CBT for bearing corrosion oxidation effects; the 3F (standard length) for bulk oil viscosity increase oxidation effects.

- 7.2 Greg Shank, speaking for the EMA on oxidation, indicated they felt heading toward use of the 3F is unwise at this time. They still favor using the JDQ-78A test for oxidation.
 - 7.3 Chairman McGeehan asked the Oxidation Task Force to continue to gather data and report at the next HDEOCP meeting.
 - 7.4 Charlie Passut asked for JDQ-78A piston deposit data to be posted on the TMC website. Ken Chao is to pursue this and see if Deere can provide the data. Charlie then suggested that perhaps the JDQ-78A could be used for both bulk oil oxidation and aluminum piston deposits and thus eliminate the 1N test from inclusion in PC-9.
 - 7.5 Jim Wells reported for Robert Stockwell that the JDQ-78A Task Force has met once and are working on putting the test procedure into ASTM format. They have also reviewed the CMA template guidelines and have a number of other areas to address along with the procedure.
- 8.0 Elastomers
- 8.1 Tom Boschert presented the Elastomer Task Force report (Attachment 8). Essentially, they are recommending the GF-3 approach to compatibility wherein a heavy duty engine oil would be selected which is deemed the most aggressive toward the selected elastomers that is acceptable. Then, any new heavy duty engine oil would have to be equal to or less aggressive than the reference oil and any new elastomer would have to be compatible with the reference oil.
- 9.0 Matrix Base Oils
- 9.1 Ralph Cherrillo reported for the Base Oil Task Force (see Attachment 9). They eventually came up with three options to present to the API Lubricants Committee. Option 1 would be to use a group 1, a group 2 and a group 2+ as the three base oils. Option 2 would be to use a group 1, a mixture of the group 1 and a group 2 to end up with a mix that would qualify as group 2 with 92% saturates and then another group 2. Option 3 would be to use a group 1 and two group 2's which are very close together in viscosity index and saturate level.
 - 9.2 There was some concern raised from the floor that trying to mix group 1 and group 2 stocks to get the desired properties would confound the blending of the finished lubricant. Concerns were also expressed about volatility with the blend approach and that maybe the matrices should be run with just two base oils.
- 10.0 LOTRUO

- 10.1 Chris May presented a report from the Low Temperature Rheology of Used Oil Task Force (Attachment 10). He indicated they desperately need 1 gallon samples of end of test oils, quickly, so they can proceed with test selection and development. They would like to get reference oils with around 5% soot in them.
- 11.0 Sequence III E Parts Supply
 - 11.1 Brent Shoffner reported that the 3E parts will run out in May. API and the PCMOCP will pursue replacement tests.
- 12.0 1K / 1N
 - 12.1 The EMA do not want the 1K test included in PC-9 and indicated the 1N limits could change for PC-9. There was considerable discussion on this issue, with no resolution.
- 13.0 Adjournment
 - 13.1 The meeting was adjourned at 11:37 AM on February 23, 2000. The next meeting is scheduled for April 26, 2000, at this same venue.

Submitted by:
Jim Wells
Secretary to the HDEOCP

FEBRUARY 23, 2000

**Holiday Inn O'Hare International
5440 North River Road
Rosemont IL (Tel. #847-671-6350)
7:30-12:00 Noon**

Chairman/Secretary: Jim McGeehan/Jim Wells
Topic: PC-9

Desired Outcome:

- Select Oil Oxidation Test
- Select Seal Test
- Matrix base oil recommendation
- Time Line To meet Introduction Date

TOPIC	PROCESS	WHO	TIME
Agenda	<ul style="list-style-type: none"> ● Review Agenda & Desired Outcome ● Add/Chance 	Group	7:30-7:45
Minutes Approval	<ul style="list-style-type: none"> ● December 1999 Minutes 	Group	7:45-8:00
Oil Oxidation	<ul style="list-style-type: none"> ● Oil Oxidation Task Force Report ● John Deere Task Force Report ● Recommendations ● Discussion and vote 	Rich Lee Robert Stockwell	8:00-9:30
Seal Test	<ul style="list-style-type: none"> ● Task Force Report ● Discussion ● Recommendations 	Tom Boschert	9:30-10:00
Matrix Base Oils	<ul style="list-style-type: none"> ● Matrix Base Oils Recommendations 	Ralph Cherrillo	10:00-10:30
Status of EGR tests	<ul style="list-style-type: none"> ● Mack T-10 ● Cat 1Q ● Cummins M-11 	Greg Shank Mike Quinn John Graham	10:30-11:15
Oil Pumpability	<ul style="list-style-type: none"> ● Status: samples from EGR engines 	Chris May	11:15-11:30
Timing line	<ul style="list-style-type: none"> ● Status ● Samples from EGR engines 	Brent Shoffner	11:30-11:45
111E Test Parts	<ul style="list-style-type: none"> ● Part supply status 	Brent Shoffner	11:45-11:50
Room Cost	<ul style="list-style-type: none"> ● Collect money for room and coffee 	Group	11:50-12:00

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

FEBRUARY 23, 2000

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FEBRUARY 23, 2000

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Miss

Miss

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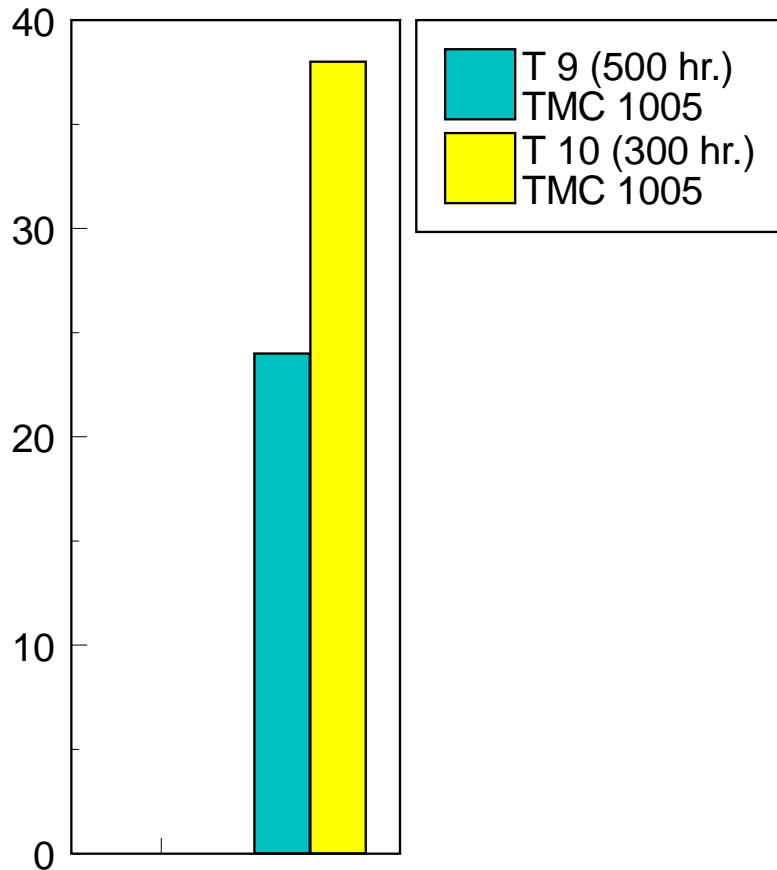
Name:	Phone No.	ROOM
Company:	Fax No.	FEE
Address:	e-mail add.	
Name: <u>Dick Clark</u>	<u>202-682-8182</u>	
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<u>Waterloo Iowa 50704-8000</u>		
Name: _____		
Company: _____		
Address: _____		

Name: _____		
Company: _____		
Address: _____		

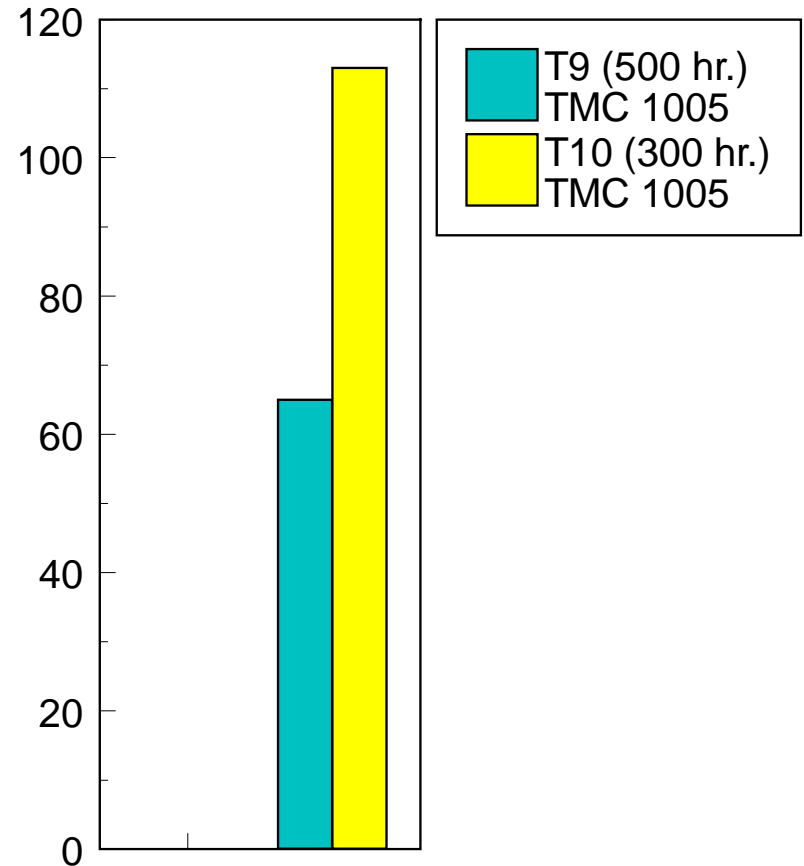
Name: _____		
Company: _____		
Address: _____		

T10 vs T9 Severity

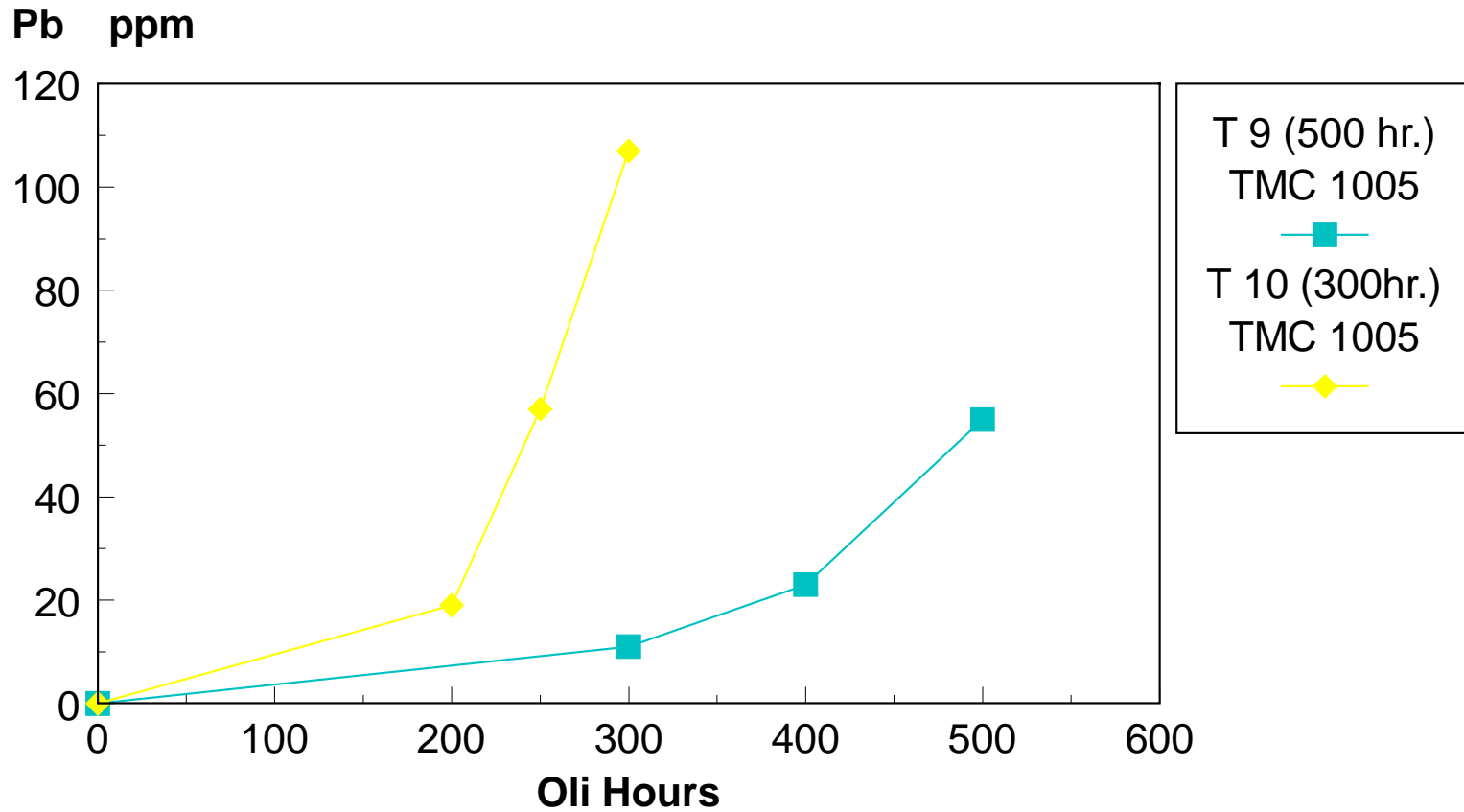
EOT Liner Wear (um)



EOT Top Ring Weight Loss (mg)

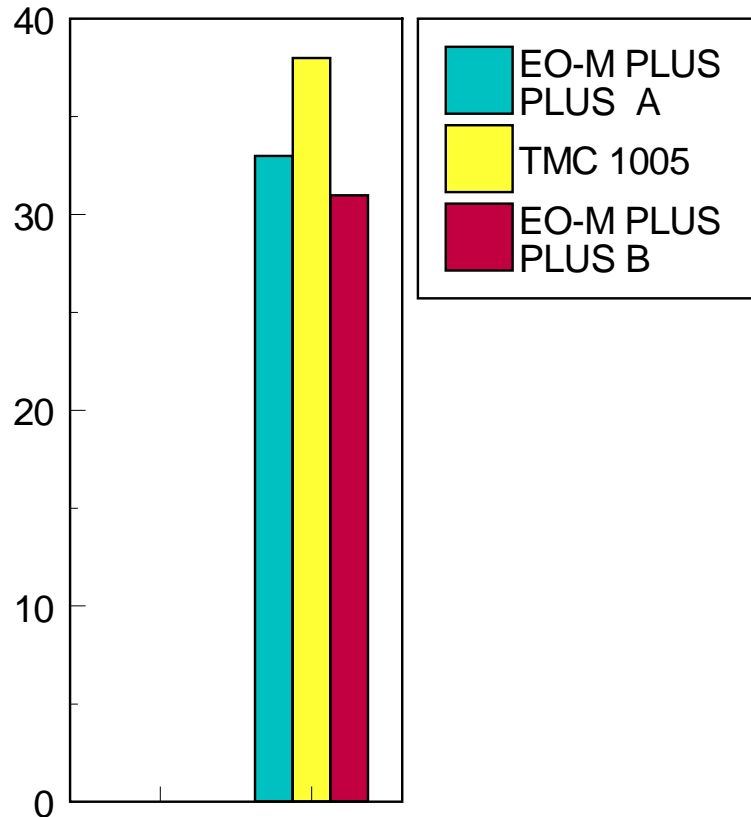


T9 vs T10 Test Severity

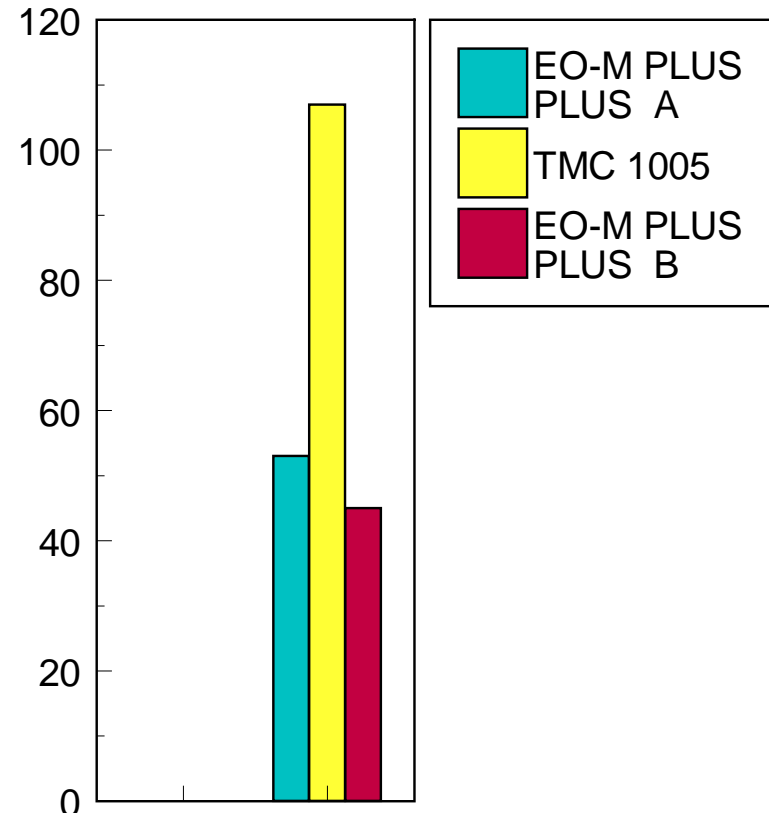


T 10 EGR Test Discrimination

Liner Wear (um)

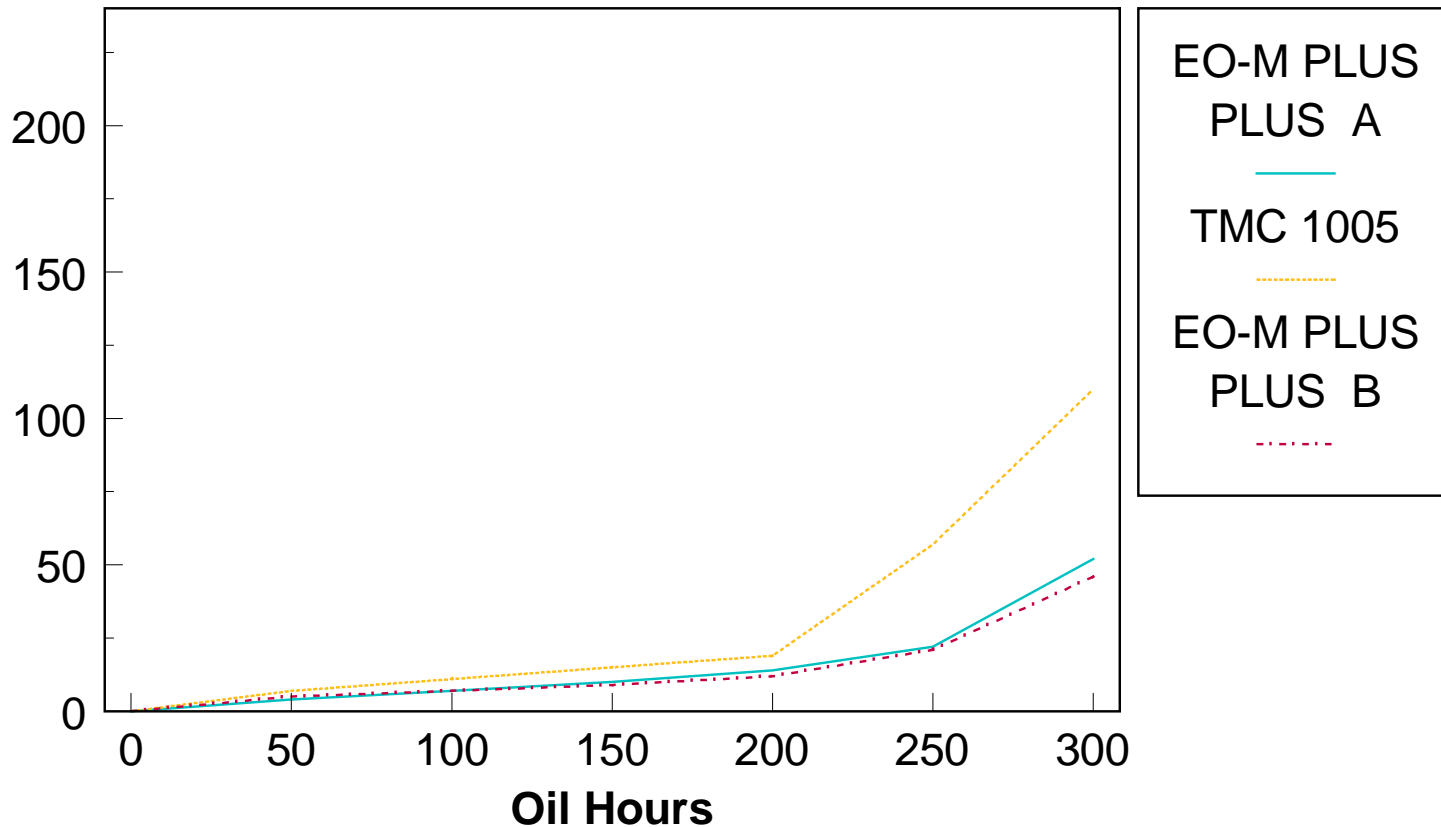


EOT Pb (ppm)



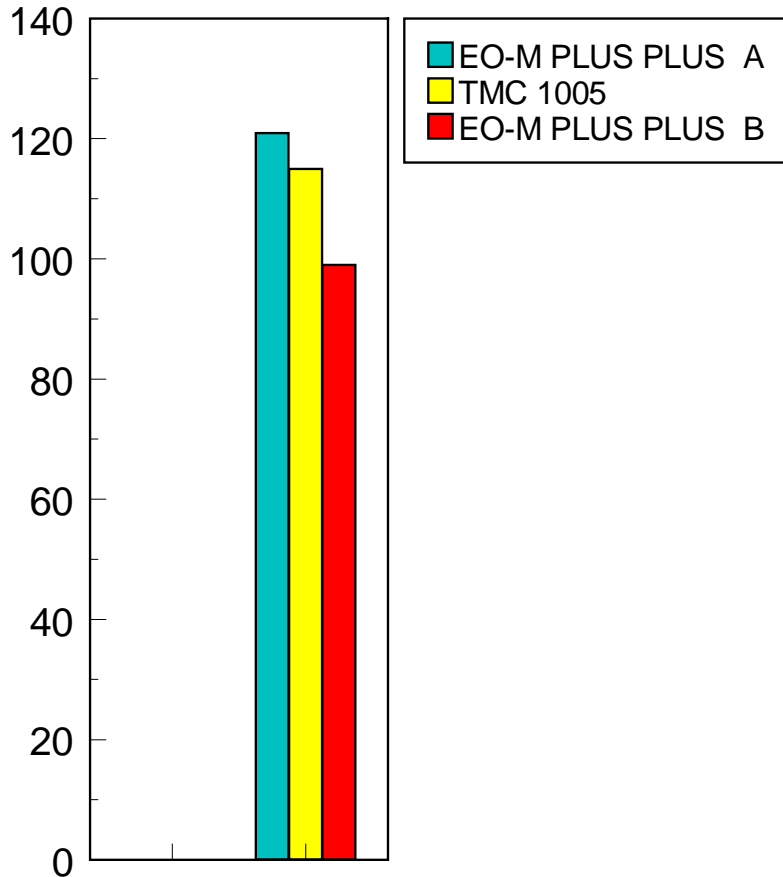
T 10 EGR Test Discrimination

EOT Pb (ppm)

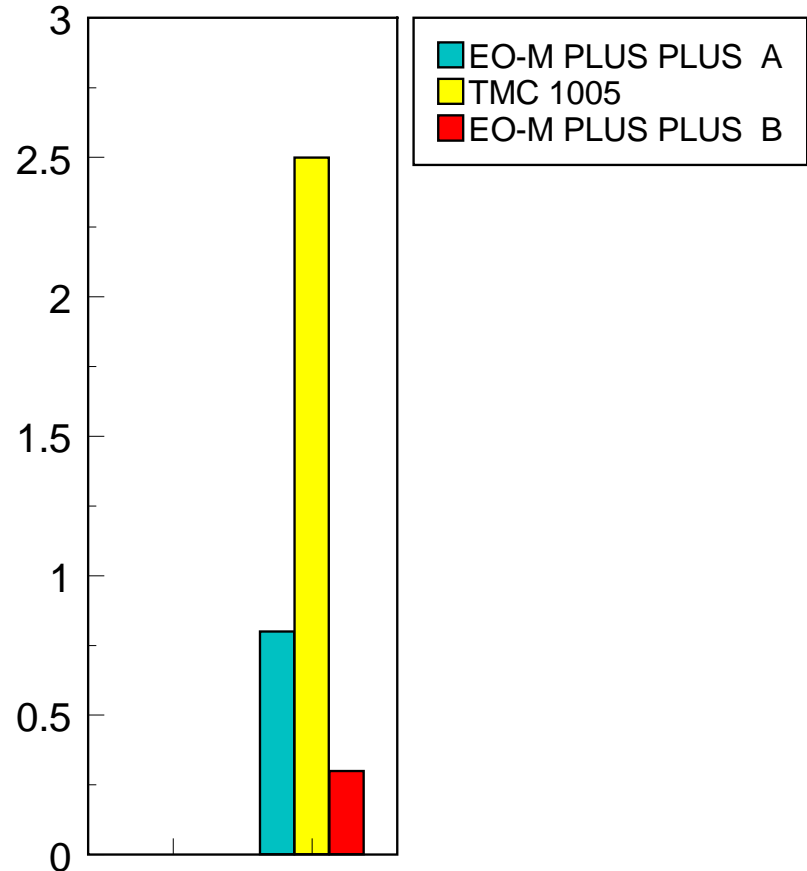


T 10 EGR Test Discrimination

EOT Top Ring Weight Loss (mg)

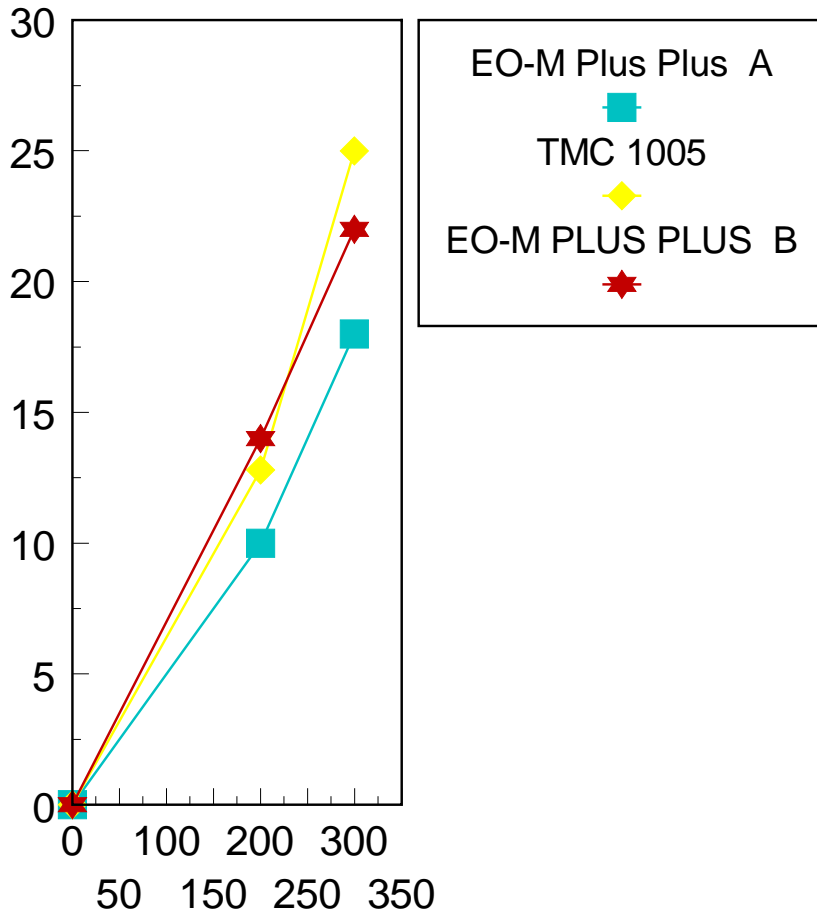


EOT Delta TAN

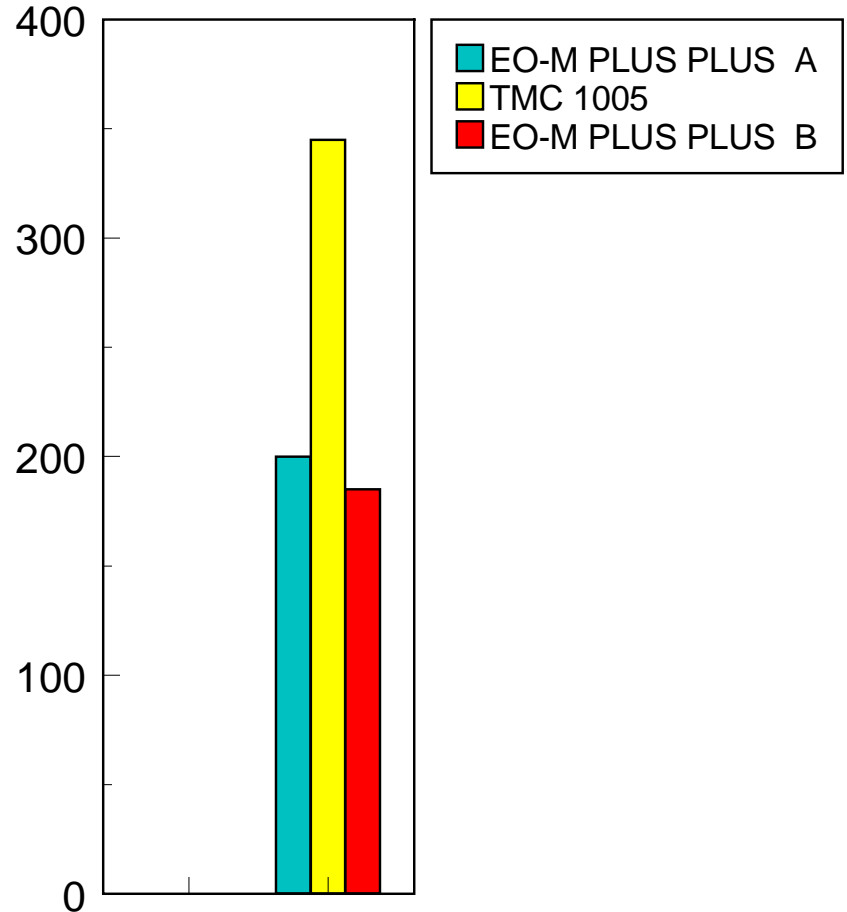


T 10 EGR Test Discrimination

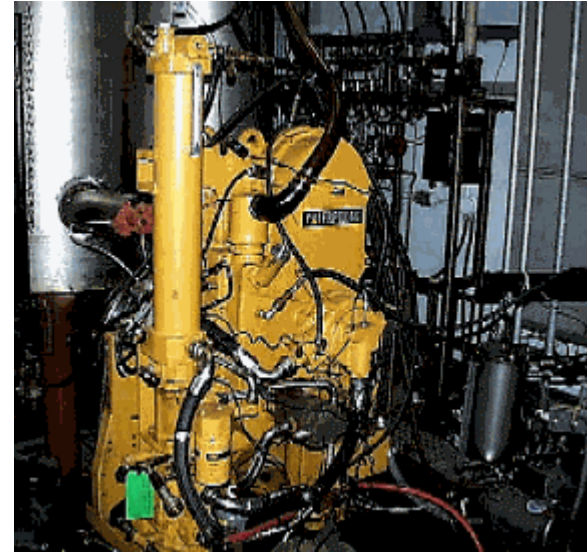
FTIR Oxidation @ 5.8



EOT Upper Rod Bearing Weight Loss



1Q Test Update for PC-9



1. Pre-1Q test summary
2. 1Q results with EGR
3. 1Q EGR hardware
4. ASTM Matrix status

1Q Test Update for PC-9

- Pre-1Q Test Observations
 - TMC1005 produced low variability for TGC and WDP.
 - TLC absolute values are lower than the 1P.
 - Two of the commercial CH-4 oils showed improved performance in TGC.
 - Oil consumption is flat or decreasing on most of the runs, even with the longer 500 hour test.

1Q Test Update for PC-9

- Pre-1Q Test Results

Test Lab	Oil Type	Piston Deposits			Oil Cons. g/hr		Soot	Fe	Cr	Cu	Pb
		TLC %	TGC %	WDP	36 hrs	504 hrs	TGA - %				
EG&G	TMC 1005	15	25	298	8.5	6	0.8	145	16	18	3
ALI	TMC 1005	2	31	288	10	8.2	0.3	40	0	5	0
Mobil #1	TMC 1005	21	38	306	13.4	8.7	0.6	17	1	13	2
Cat TSD	TMC 1005	31	31	293	12.4	12.2	0.5	42	1	154	5
Mobil #2	TMC 1005	22	27	304	11	5.7	0.6	52	6	8	6
Pre-1Q Mean	TMC 1005	18	30	298	11.1	8.2	0.6	38	2		3
<i>PC-7 Matrix</i>	<i>TMC 1005</i>	<i>30.9</i>	<i>28.7</i>	<i>285.3</i>							
	CH-4-X	12	33	428	11.7	8.7	6.9	270	2	3	4
	CH-4-X	19	36	460	11.4	12.4	0.7	43		17	5
	CH-4-Y	10	23	298	6.7	6.8	0.1	25		24	5
	CH-4-Z	12	27	367	8.3	7.3	0.4	62	6	8	2

1Q Test Update for PC-9

- 1Q Test Observations
 - Pre-1Q conversion to an EGR test
 - Steady state operation at 14% EGR
 - Timing advanced from 6° to 13° BTC
 - Exhaust back pressure used instead of venturi to ingest exhaust gasses
 - 1Q piston deposits with EGR are higher and directionally similar to 3406E EGR piston deposits
 - 1Q oil condition is directionally similar to 3406E EGR piston deposits

1Q Test Update for PC-9

- 1Q Test Results

Test Lab	Oil Type	Piston Deposits			Oil Cons. g/hr		Soot	Fe	Cr	Cu
		TLC %	TGC %	WDP	36 hrs	504 hrs	TGA - %			
EG&G	TMC 1005	15	25	298	8.5	6	0.8	145	16	18
ALI	TMC 1005	2	31	288	10	8.2	0.3	40	0	5
Mobil #1	TMC 1005	21	38	306	13.4	8.7	0.6	17	1	13
Cat TSD	TMC 1005	31	31	293	12.4	12.2	0.5	42	1	154
Mobil #2	TMC 1005	22	27	304	11	5.7	0.6	52	6	8
Pre-1Q Mean	TMC 1005	18	30	298	11.1	8.2	0.6	38	2	
1Q (EGR)	TMC 1005	36.0	31.0	388.0	12.0	14.0	1.6	74.0	7.0	21.0
3406E EGR	CH-4	~50	~60				1.6	86	13	114
98 3406E	CH-4	15	45	193						

1Q Test Update for PC-9

- 1Q Test Results
 - The Cat 1Q SCOTE is completing a second EGR run with a commercial CH-4.
 - Predicted end of test is February 23
 - Soot and wear metals slightly higher than previous run with 1005
 - Oil consumption steady, and similar to 1005

1Q Test Update for PC-9

- 1Q EGR Hardware
 - The 1Q test is ready for matrix testing .
 - EGR hardware for the matrix engines has arrived and the test labs are currently installing these components.
 - Sufficient quantities of pistons and rings are available through the Cat parts system.
 - Additional spare EGR coolers will be available by mid March.

1Q Test Update for PC-9

- 1Q ASTM Matrix
 - Matrix test stands should be ready for initial testing by March 9.
 - Baseline runs with TMC 1005 could be initiated, based on ASTM HDEOCP approval.
 - The ASTM HDEOCP should formulate a policy on Non-matrix testing, if delays are encountered in the selection and procurement of PC-9 reference oils.

M11-EGR Taskforce
Report to
HDEOCP

February 23, 2000

M11-EGR Test Objectives

- **Evaluate Heavy Duty Engine Oils Ability to Control Wear, Deposits & Filter Plugging**
 - Identify & Rate Lubricant Related EGR Risks
 - Design Test for Precision
 - Minimum Test Duration
- **Build on M11-HST Experience**
 - Simple Test Cycle
 - Non-Condensing Conditions
- **Provide Oils that Maintain Customer Satisfaction with Engine Durability & Service Intervals**

Phase III M11 EGR Hardware Status

- **M11 EGR Oil Test Engines Running or Ready to Run at Cummins, ETS, SwRI, EG&G, Lubrizol & Ethyl**
- **Eleven EGR Conversion Kits Delivered**
- **All Special Components Available off the shelf**
- **Parts to Build Ten EGR Engines In-Stock**

Engine Control

- **Developed Engine Control Software meeting requirements for control to test specifications.**
- **Validated Soot Target of 9% Through Field Testing.**

Phase III M11-EGR Test Conditions

- **Soot Loading Phase 50 hr at 330 hp**
 - **Target 9% TGA Soot at 250 hr**
 - **17% EGR**
- **High Load Cycle 50 hr at 430 hp**
 - **10% EGR**
- **Repeat Soot & High Load Phases 3X**
 - **240 F Oil Rifle Temperature**
 - **150 F Coolant Out**
 - **150 F Inlet Air Temperature**
- **Test Duration 300 hr**

Test Validation Plan

- **Test Procedure Ready for Validation Testing**
- **Conduct Tests on Three Oils at Each Lab**
 - TMC 1005
 - PC-9 Prototype A
 - PC-9 Prototype B
- **Matrix Ready May 2000**

PC-9 Timeline Notes

Brent Shoffner 2/23/2000

- The T-10 timeline published in late November is on schedule.
- The 1Q Surveillance Panel updated the 1Q timeline at a meeting on January 12, 2000.
- After discussions with John Graham of Cummins on 2/17/00, the M11 EGR timeline has been updated.
- The individual test timelines are linked to the Summary PC-9 Timeline by two dates:
 - Test procedures adequate for oil development

✓ 1Q	03/01/00
✓ M11 EGR	02/18/00
✓ T-10	12/06/99
 - HDEOCP accepts the 1Q – 6/1/00.
- When the decision is made on an engine test for oxidation, the test will be added to PC-9 timing.
- Precision Matrix oil definition, blending, and shipping dates are based on a letter dated 1/7/00 from the NCDT PC-9 Matrix Oil Selection Criteria Task Force.
- The “License allowed date” has slipped slightly to 3/27/2002.
- Based on my experience with the current ASTM system, the “API License Date” will be later than May 2002.

Time Line for the 1Q Test

Brent Shoffner - 1/14/2000

ID	Task Name	Start	Finish	2000											
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun			
1	Design EGR Hardware	03/01/99	11/30/99	[Bar from Oct to Dec]											
2	Produce and ship test kits to labs	12/01/99	02/01/00		[Bar from Nov to Dec]										
3	Specify Installation/Prelim. Procedure	12/01/99	01/12/00		[Bar from Nov to Dec]										
4	Install test kit	02/02/00	03/01/00					[Bar from Jan to Feb]							
5	Write final procedure	03/01/99	03/31/00	[Bar from Oct to Jun]											
6	Develop EGR rate measurement	03/01/99	01/12/00	[Bar from Oct to Dec]											
7	Lab Visits	05/01/00	06/01/00								[Bar from Mar to May]				
8	Discrimination Matrix Design Complete	01/29/99	03/02/00	[Bar from Oct to Jun]											
9	Discr. Oils Available at the labs	02/15/00	03/15/00					[Bar from Jan to Feb]							
10	Run Discrimination Tests	03/02/00	05/01/00						[Bar from Feb to Apr]						
11	Data Analysis	05/02/00	05/15/00									[Bar from May to Jun]			
12	HDEOCP Approves Proof of Concept*	05/16/00	06/01/00										[Bar from May to Jun]		

* Contingent on HDEOCP Meeting Date

Time Line for the M11 EGR Test

Brent Shoffner - 02/17/00

ID	Task Name	Start	Finish	2000													
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
1	Initial Kits/Parts Available	04/21/99	04/21/99														
2	Develop Procedure	04/22/99	11/16/99														
3	Procedure Available	11/17/99	11/17/99														
4	Lab Visits for Precision Matrix	04/03/00	04/18/00														
5	Procedure Adequate	02/18/00	02/18/00														
6	Run Preliminary Tests & Report Data**	02/21/00	04/14/00														
7	Data Analysis	04/17/00	04/28/00														
8	HDEOCP Approves Proof of Concept*	05/01/00	05/01/00														

* Contingent on HDEOCP Meeting Date

** Will include TMC 1005-1

Time Line for the T-10 Test

Brent Shoffner - 02/18/00

ID	Task Name	Start	Finish	2000											
				Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	
1	Final Kits/Parts Available (1 per lab)	07/14/99	08/24/99												
2	Install engines and run shakedown	08/25/99	11/15/99	■	■	■									
3	Procedure Available	11/16/99	11/16/99		■										
4	Lab Visits for Precision Matrix	04/03/00	04/18/00											■	■
5	Procedure Adequate	12/06/99	12/06/99			●									
6	Run Preliminary Tests & Report Data**	01/03/00	03/03/00				■	■	■						
7	Data Analysis	03/06/00	03/17/00							■	■				
8	HDEOCP Approves Proof of Concept*	04/03/00	04/03/00											★	

* Contingent on HDEOCP Meeting Date

** Will include TMC 1005-1

Summary of Events Required for PC-9 Licensing

Brent Shoffner 1/19/2000

ID	Task Name	Start	Finish	1999				2000				2001				2002	
				Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	
1																	
2	Define PC-9 Performance Parameters	03/16/99	03/16/99	◆													
3	Design Prec. Mtx. Appr. API Lubes Comm.	03/17/99	11/08/99		▶												
4	PC-9 Funding MOU Signed	11/09/99	05/01/00					▶									
5	All eng. tests are adequate for oil devel. (1C)	03/01/00	03/01/00						◆								
6	Identify Test Oils (with validation)	03/02/00	03/31/00						▶								
7	EMA Select Base Stocks for Prec. Mtx.	11/09/99	03/31/00						▶								
8	EMA Selects Additives for Prec. Mtx.	01/06/00	03/31/00						▶								
9	Base Oils Recd by Additive Companies	04/03/00	04/21/00						▶								
10	Blend Prec. Mtx. Oils>TMC>Labs	04/24/00	06/16/00						▶								
11	Final Acceptance of New Engine Tests *	06/01/00	06/01/00						◆								
12	Final Acceptance of Test Parameters	06/01/00	06/01/00						◆								
13	PC-9 Demonstration Oil is Validated	12/15/00	12/15/00												◆		
14	PC-9 Precision Matrix Testing	06/23/00	11/02/00							▶							
15	Precision Matrix Data Analysis	11/03/00	12/11/00										▶				
16	HDEOCP Post Matrix Test Acceptance	12/12/00	01/10/01										▶				
17	CMA Registrations Allowed	01/11/01	02/07/01										▶				
18	Finalize Pass/Fail Criteria (Sub B Mtg)	01/11/01	03/26/01										▶				
19	New Product Development	03/27/01	03/26/02											▶			
20	API Licensing Allowed	03/27/02	03/27/02													▶	

* Acceptance of each engine test (by HDEOCP) for discrimination and preliminary precision prior to starting the precision matrix.

**Precision Matrix Duration Estimate by Test Type
01/19/2000**

Test Type	Total Test Hours	Days per Test	Days to Next Test	Total Days per Test	Maximum in a Stand	Safety Factor**	Total Days	Week Days
1Q	504	21	4	25	4	33%	133	95
M11 EGR	300	13	4	17	4	33%	90	64
T-10	300	13	4	17	4	33%	90	64

** For every 3 valid tests, one invalid test is assumed.

ASTM HDEOCP

Feb 23rd 2000

Oxidation Task Force Report

Task Force Membership

Chairman

Rich Lee

Oronite

Members

John Graham

Cummins

Steve Kennedy

ExxonMobil

Brian Lawrence

Infineum

Glenn Mazzamaro

Ciba

Charlie Passut

Ethyl

Greg Shank

Mack

Brent Shoffner

Perkin Elmer AR

Virginia Carrick

Lubrizol

Cyril Migdal

CK Witco

Jim Wells

SwRI

Steve Roby

Chevron

Cliff Venier

Pennzoil Quaker State

Augie Birke

Equilon

Scope: To review proposals and make recommendations to the HDEOCP regarding measurement techniques to evaluate oxidation performance for lubricants meeting the proposed performance standard API PC-9

Key Issue: Should the JDQ 78A test be part of the PC-9 engine test slate?

Task Force Meetings

- December 7th 1999 - Reno
- January 19th 2000 - Arlington
- February 22nd 2000 - Chicago

Summary of Task Force Efforts (1)

- Oronite proposal for evaluating oxidation performance for API PC-9 based on Cat 1P, Seq. IIIE and Mack T-9 data
 - Thin film oxidation Cat. 1Q/PDSC
 - Bulk oil viscosity increase due to oxidation Seq. IIIF
 - Bulk oil acid build-up due to oxidation Mack T-10
- Ciba proposed the PDSC (included in ACEA E-5) on an EOT oil
- Oronite data indicated that an extended Seq. IIIF was more severe on vis. inc. and IR oxidation than a Seq. IIIE
- Perkin Elmer AR presented concerns re an extended Seq. IIIF test
 - Cost savings only if PC-9/SL is feasible
 - Use of IIIF LTMS only if ref. oils provide discrimination at extended length
 - Efficiencies/cost savings vs. using the JDQ 78A

Summary of Task Force Efforts (2)

- Infineum presented data showing:
 - The impact of NO₂ on oxidation inhibitor performance
 - The negative impact of EGR on oxidation
 - Carbon (soot) can be an oxidation catalyst
 - Photo acoustic method for measuring oxidation in soot laden oils
- Ciba presented data showing:
 - The negative impact of NO_x on oxidation stability
 - How EGR can lower NO_x but increase severity
 - The Seq. III E/F could be more severe than a non EGR diesel engine test
 - Need to measure FTIR on the new EGR tests
- SwRI compiled a chart showing engine and bench oxidation test oil temperatures
 - Seq. III E/F hotter than all CH-4 and PC-9 diesel engine tests
 - Bench tests generally much hotter

Summary of Task Force Efforts (3)

- Chevron reviewed the JDQ 78A data:
 - High abort rate (27%)
 - Lack of good correlation around the majority of the data
 - Infineum suggested soot level differences may be important
- ExxonMobil showed data indicating:
 - The vis. inc. severity of the Seq. IIIF>IIIE>JDQ 78A on two HDMO technologies
 - IR oxidation for Seq. IIIF at 160 hours > JDQ 78A at 400 hours
- Ethyl data indicated:
 - The vis. inc. of the Seq.IIIF > JDQ 78A > Seq. IIIE
 - But oxidation in JDQ 78A > Seq. IIIE > Seq. IIIF
 - Cat Pre 1Q deposits do not correlate with FTIR oxidation except for TLC
 - FTIR oxidation in one of the new PC-9 tests may be a good measure

Summary of Task Force Efforts (4)

- Cummins:
 - Engine test data from L-10 & M-11 (no EGR) with oil temperatures increasing from 250°F to 275°F and higher
 - 100% plus viscosity increase at >275°F
 - Faster TBN depletion at higher temperatures
 - Potential bearing corrosion
- Infineum:
 - Increasing the temperature in the Mack T-10 to 235°F (gallery)
 - TMC 1005 could not complete the test
 - Very high wear and oil consumption
- CK Witco:
 - Presented information on the Uniroyal Nitro Oxidation Test (UNOT)
 - Discriminates between different base stocks and antioxidants
 - Oxidation is more severe with NOx
 - Needs verification with reference oils

Summary of Task Force Efforts (5)

- Chevron:
 - Proposed looking at the Seq. VIII as a severe oxidation test
 - Oil temperatures >300°F
 - Possibly extended length
- ExxonMobil showed extended length Seq. IIIF data :
 - TMC 1005 does not complete a double length Seq. IIIF
 - Viscosity increase breaks at ~ 70 hours
 - FTIR oxidation breaks at ~ 50 hours
- Oronite showed data on an API CH-4+ oil indicating:
 - The vis. inc. of the Seq.IIIF > Mack T-10 > JDQ 78A
- CIBA showed some used oil analysis data from a Mack T-10:
 - ~150 hour samples
 - Large TAN increase
 - High IR oxidation levels
 - Small viscosity increase
 - High ZDTP depletion

Possible Proposals for HDEOCP

- Thin film oxidation addressing undercrown deposit concerns:
 - Caterpillar 1Q
 - PDSC on fresh/used oil
- Acid build-up control to address bearing corrosion concerns:
 - Mack T-10
 - CBT
 - Cummins M-11
 - Seq. VIII
- Bulk oil oxidation leading to viscosity increase:
 - John Deere JDQ 78A
 - 80 hour Seq. IIIF
 - Extended Seq. IIIF
 - Uniroyal Nitro Oxidaton Test
 - Photo-acoustic IR
 - FTIR oxidation on used oil

Proposed Proposal for HDEOCP

- Thin film oxidation addressing undercrown deposit concerns:
 - Caterpillar 1Q cooling gallery deposit limit
 - PDSC on fresh oil
- Acid build-up control to address bearing corrosion concerns:
 - Mack T-10
 - CBT
- Bulk oil oxidation leading to viscosity increase:
 - 80 hour Seq. III F
 - Investigate further
 - Photo-acoustic IR
 - FTIR oxidation on used oil from an EGR test

**PC-9 Elastomer Task Force Report
February 23, 2000**

The PC-9 Elastomer Task Force -

Using D 471 (PC-7 method):

Survey Industry to select the most aggressive Reference Fluid(s) with field service

This reference fluid(s) will be used to provide a baseline for oil, additive and elastomer manufacturers – as practiced in ILSAC GF-3 and individual OEM specifications

An oil cannot be more aggressive than the reference fluid(s) toward elastomers

An elastomer must be compatible with the reference fluid(s)

Because there are no rigid limits to this approach, it is not suggested that this become part of ASTM D 4485 but rather become part of an EMA specification or individual OEM specifications similar to OEM PCMO specs or the GF-3 ILSAC spec.

There are several items that must occur for this to happen:

- 1. The D471 PC-7 method must be recognized and accepted in ASTM – preferably in D11.15 who oversee the D471 test method**
- 2. A continued source of elastomers must be identified and distribution assured**
- 3. Once Reference oil(s) is identified distribution of it must be assured**

At the recent Task Force meeting we agreed to the following:

- 1. We agreed that the elastomer sheets should be from one source. We have identified two distributors who have expressed interest in distributing the materials and will ask them to bid on supplying the material.**
- 2. The additive companies will estimate the number of tests to be run over the next 2 year period to give an idea of the demand for this test**
- 3. It is requested that those supplying PC-9 matrix oils run the elastomer test on the oils to add to the tests on 20 oils already run.**
- 4. Companies will be developing PC-9 fluids – the request for reference fluids continues until the end of the PC-9 matrix and limits are set by the HDEOCP. At that time, reference fluid selection must be made from the available data.**

Note: It is assumed that the TMC will be distributing the fluids, however that must first be approved by the TMB and Subcommittee B.

PC-9 Matrix -- Base Oil Selection

Base Stock Description (list cuts that may be used)	Typical Properties					
	KV @ 100C	KV @ 40C	VI	%Sulfur (a)	%Saturates (D2007)	Volatility (b)
Base Oil Submission A (Group I)						
SB-A1	4.05	19.8	102	0.2	78.9	25.2 *
SB-A2	8.15	63.0	96	0.5	70.5	4.9 *
Base Oil Submission B (Group II)						
SB-B1	4.2 cSt	20.8 cSt	95	< 1 ppm	>99	24.3 / 14.3 **
SB-B2	7.0 cSt	50.0 cSt	95	< 1 ppm	>99	10.3 / 5 **
Base Oil Submission C (Group II)						
SB-C1	4.9	27.5	103	0.0011	97.5	9.2 ***
SB-C2	7.5	54.1	100	0.0021	94.8	3.6 ***

(a) Sulfur by D2622, D4294, D4927, or D3120

(b) Report Evaporative Loss and/or Simulated Distillation; indicate test method used

* ASTM D5800

** ASTM D5800 / D2887

*** ASTM D2887E

PC-9 Matrix -- Base Oil Selection

Base Stock Description (list cuts that may be used)	Typical Properties					
	KV @100C	KV @40C	VI	%Sulfur (a)	%Saturates (D2007)	Volatility (b)
Technology Candidate A -- Group II / II+						
TC-A1	4.0	19.7	100	0.001	>99	27 / 15 *
TC-A2	6.5	43.0	100	0.001	>99	12 / 5 *
TC-A3	12.5	116.0	100	0.001	>99	2 / 0*
TC-A4	4.7	23.5	117	< .0006	>99	15 / 3 *
Technology Candidate B -- Group I and II						
TC-B1	5.16	30.68	95	0.24	79.7	11.5 **
TC-B2	12.21	114.93	96	0.45	69.9	2.8 **
TC-B3	4.97	27.82	103	< 30 ppm	> 95	
TC-B4	7.47	53.56	100	< 30 ppm	> 94	

(a) Sulfur by D2622, D4294, D4927, or D3120

(b) Report Evaporative Loss and/or Simulated Distillation; indicate test method used

* Noack (ASTM D 5800) / GCD % evaporated @ 700°F (ASTM D 2887)

** ASTM D 2887

**ASTM HDEOCP Mtg
Feb. 23, 2000 - Chicago, IL**

**ASTM TASK FORCE ON LOW
TEMPERATURE RHEOLOGY OF USED
ENGINE OILS (LOTRUO)**

C.J. May, K.O. Henderson

Scope & Objectives

"To determine the suitability of current rheological methods in measuring low temperature properties of used engine oils (relating to cold cranking and pumpability), provide recommendations for any modifications to those methods, and determine the precision of those modified or unmodified methods."

- **Current Scope & Objectives do not cover the *correlation* of engine pumpability to rheological methods or precision associated with used oils generated from repeat engine tests on the same oil**

Recent LOTRUO Activities

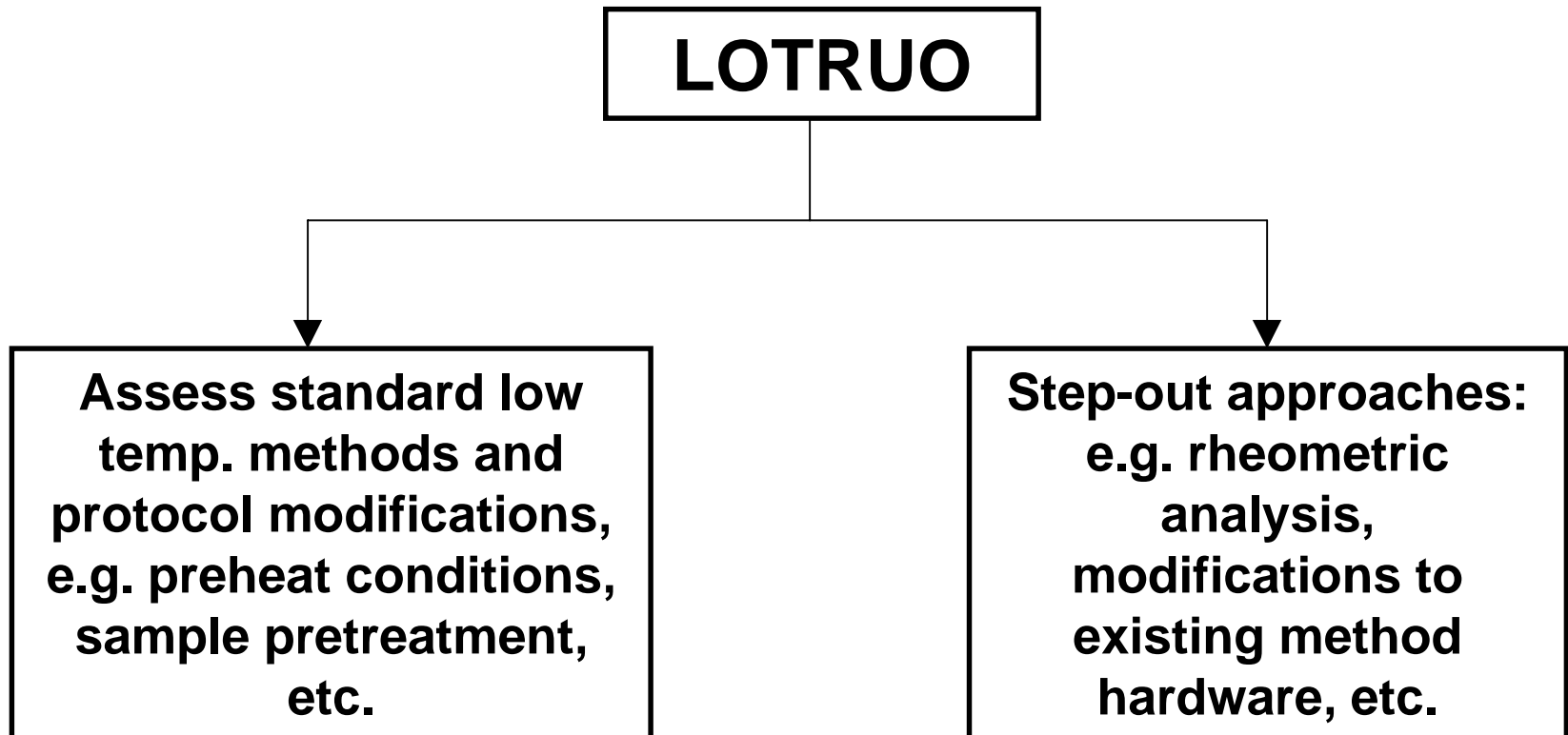
- **At Dec. '99 ASTM D02.07 meeting, 15 labs expressed interest in participating in used oil testing**
 - **Participants will evaluate available used oils in standard tests including MRV, CCS, etc.**
 - **6 labs also indicated capability to run tests on research rheometers (additional exploration of rheological properties under non-standard conditions)**
- **Solicited assistance of HDEOCP members (including surveillance panel chairs) to obtain relevant used reference oil samples for analysis**
- **Have separately contacted TMC rep. to reinforce this request**

Recent LOTRUO Activities

- **We understand the very short timelines associated with the HDEOCP PC-9 program, and the need to provide meaningful information to assist you in establishing specifications but**

We need relevant used oil samples to work with!

Draft LOTRUO Organization



Conduct activities in parallel

KEY QUESTIONS THAT WILL NEED TO BE ADDRESSED ON USED OIL SAMPLES

- **What should the soot loading levels of the used oils be for our investigations?**
 - e.g. specified soot level (e.g. 5%) or simply end-of-test drain
- **What are appropriate test temperatures for evaluation?**
 - e.g. 15W-40 may thicken to 20W-50; should pumpability assessment be on basis of CCS performance?
- **For MRV evaluations, is 1-day or 2-day cooling profile most relevant?**

KEY QUESTIONS THAT WILL NEED TO BE ADDRESSED (CONT'D)

- **What is effect of preheating (standard part of low-shear methods to dissolve wax)?**
 - **Instrument manufacturer will make software modifications available for us to assess**
 - **Preshearing of samples also important consideration**