

**HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
November 2, 2000
Holiday Inn – O’Hare International Hotel, Rosemont, IL**

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ACTION ITEMS

- | | | |
|-----------|---|------------------------|
| 1. | Address recommendation for standardized EGR cooler cleaning. | 1Q Task Force |
| 2. | Acquire new 1M-PC cylinder liner source. | Caterpillar |
| 3. | Resolve potential lab to lab variation in crosshead wear. | M-11 Task Force |
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MEETING MINUTES

- 1.0 Call to Order
 - 1.1 Chairman Jim McGeehan called the meeting to order at 8:57 a.m. on November 2, 2000, in the Holiday Inn O’Hare-International Hotel of Rosemont, Illinois. There were 12 members or representatives and approximately 22 guests in attendance. The attendance list is shown as Attachment 2.
- 2.0 Agenda
 - 2.1 The agenda for the meeting (Attachment 1) was reviewed. Danny Larkin requested time to talk about the “35” viscosity grade and Chris May requested an earlier time slot if possible because of his flight schedule.
- 3.0 Meeting Minutes
 - 3.1 The minutes of the September 20, 2000, meeting were approved as posted on the TMC website.
 - 3.2 Several people experienced problems in trying to open, read or print the last minutes, probably because of the large file size. To help reduce future file sizes, the attendance list will no longer be scanned in but will be copied in electronically and annotated to indicate who was in attendance. Also, attachments will be presented as separate files so no one file will be very large.
- 4.0 Membership
 - 4.1 There were no membership changes.

5.0 CAT 1Q

- 5.1 Dave Nycz presented a review of the 1Q status (Attachment 3) and noted that the discrimination oil they had evaluated in the test was an ACEA E4 level, 10W-40 oil, with 1.8 to 1.9% ash. He also indicated that Caterpillar's desire for PC-9 oils performance in this test would average WDQ of 300, TLC of 25 and TGC of 30. Dave concluded with a recommendation that the 1Q is ready for matrix testing. Tom Boschert moved that the 1Q is ready to start matrix testing. The motion was seconded and passed, 11 for, 0 against, 1 abstain.
- 5.2 Discussion arose regarding EGR cooler fouling and cleaning. Some labs seem to be unable to operate much more than 100 hours before exceeding the exhaust backpressure limit and having to clean their EGR coolers. Other labs can complete the entire test with no need to stop and clean. In the interest of a more standardized procedure for all locations, Pat Fetterman moved and Aimin Huang seconded that the HDEOCP recommend that the 1Q Task Force incorporate two scheduled EGR cleanings into the test procedure. The motion passed via a voice vote with no dissent. Dave will contact Jim McGeehan after the Task Force addresses this issue and Jim will poll the HDEOCP members electronically.

6.0 CAT 1M-PC

- 6.1 Dave Nycz reported CAT had found another 30 to 40 cylinder liners for the 1M-PC and will use them to supply those labs which have exhausted their own inventory. CAT is looking for another supplier to make the liners and Dave felt that process could take six months.

7.0 MACK T-10

- 7.1 Greg Shank presented a T-10 update (Attachment 4) and said the T-10 is ready to start matrix testing as soon as the oils are available.....thought to be November 13th.

8.0 Cummins M-11 EGR

- 8.1 Shawn Whitacre presented the Task Force report (Attachment 5) and a recommendation that the test is ready for matrix testing.
- 8.2 Lew Williams made a presentation (Attachment 6) expressing Lubrizol's concern with lab to lab variability and their feeling that the test is not ready to start the matrix yet. Since the data they base this on is convoluted, they indicated they plan to conduct tests in each of the independent labs and the Lubrizol lab using the identical oil. They want to postpone start of the M-11 matrix tests until after these tests complete. After much discussion, Lew moved to have a face to face M-11 EGR Task Force meeting / lab visitation in San Antonio to review the issue of lab to lab variation in crosshead wear. All stakeholders to provide data to the Task Force 3 days prior to the meeting, which is scheduled to be held on November 9, 2000. If the Task Force, after this meeting, agrees to support their current recommendation, then the matrix goes ahead as planned. All M-11 EGR labs are to conduct an operations review. Tom Boschert seconded this motion which passed with 7 for, 0 against and 5 abstains.
- 8.3 Tom Boschert moved that pending review by the M-11 EGR Task force, the HDEOCP agrees the test is ready for matrix testing. Lew Williams seconded the motion which passed with 12 for, 0 against, 0 abstain.

9.0 LOTRUO

- 9.1 Chris May reported on the used oil low temperature rheology work (Attachment 7) and indicated they now have nine samples ranging from 5 to 9% soot, available for round robin evaluations. They hope to have evaluations from 12 labs completed and analyzed by year end. They would welcome additional 1 gallon samples of appropriately sooted oils to use in evaluating alternate test methods.

10.0 Matrix Affairs

- 10.1 John Zalar reported the TMC had received 7 of the 9 matrix oils and the remaining two (C & H) are supposedly in transit. Six of the oils will be at the labs by November 13th.
- 10.2 Dick Clark reported that eight of nine signatures for the Memorandum of Agreement (MOA) had been obtained and he was expecting the ninth that day (since obtained).
- 10.3 Don Marn reported on the matrix designs (Attachment 8). Brent Shoffner expressed concerns that they felt the 'preferred' oils should be run first on all stands, at all the labs, just to provide a check that everyone is on the same playing field. The statisticians seem to feel that this interferes with 'randomness', but several others feel it is a prudent idea.

11.0 Volatility

- 11.1 Cliff Venier reported for the Oil Volatility Task Force (Attachment 9) and recommended that all PC-9 viscosity grades be limited to 15% evaporation loss via the NOACK method (D5800). The motion was seconded and passed with 11 for, 0 against and 1 abstain.

12.0 Elastomer Task Force

- 12.1 Tom Boschert presented the Elastomer Task Force report (Attachment 10). He plans to hold a teleconference with the group after a ballot of the method closes. It looks like the proposed process can be part of D-4485 with a comparative limit.

13.0 PC-9 Timeline

- 13.1 Brent Shoffner presented the timeline update (Attachment 11) which still shows July, 2002, as the earliest API license date.

14.0 3E – 3F Comparisons

- 14.1 Brent Shoffner presented 3E / 3F data (Attachment 12) on oxidation and felt there may be a relationship between the two tests, but not necessarily a strong correlation.
- 14.2 Bill Nahumck presented an analysis of 3E / 3F data along with some possible equivalency limits using the 3F, based on one oil. (Attachment 13)

15.0 "35" Viscosity Grade

- 15.1 Danny Larkin reported that the proposed "35" viscosity grade to allow designation of pseudo 30 grade oils with HTHS of 3.3 or higher, was not acceptable to the SAE Engine Oil Viscosity Task Force at this time. That position may change, but Danny raised the question of could it be included in D-4485. He wants this brought forward as a December meeting agenda item.

16.0 Adjournment

- 16.1 The meeting was adjourned at 12:54 p.m. on November 2, 2000. The next meeting is scheduled for 1:00 p.m. on December 5, 2000 at the Opryland Hotel in Nashville, TN.

Submitted by:

Jim Wells
Secretary to the HDEOCP

**Holiday Inn
O'Hare International
Rosemont, Illinois
Phone: 847-671-6350
November 2, 2000
9:00 A.M. - 1:00 P.M.**

Chairman/Secretary: Jim McGeehan/Jim Wells

Topic: PC-9

Desired Outcome: • CAT 1Q: Ready for Matrix Testing

TOPIC	PROCESS	WHO	TIME
Agenda	<ul style="list-style-type: none"> Review Agenda & Desired Outcome Voting members 	Group	9:00 - 9:05
Minutes Approval	<ul style="list-style-type: none"> September 20, 2000 	Group	9:05 - 9:10
Membership	<ul style="list-style-type: none"> Changes 	Group	9:10 - 9:15
CAT 1Q	<ul style="list-style-type: none"> Data Review Discrimination Oil (E-4) Test Results - New Test Procedure: Modified oil cooler results and coated cooler plans Recommendation for Matrix 1M-PC liners status: API CF & CF-2 licensing 	Dave Nycz	9:15 - 10:00
Status of EGR tests New Data	<ul style="list-style-type: none"> Mack T-10 Cummins M-11 Recommendation for Matrix 	Greg Shank Shawn Whitacre	10:00 - 10:45
Matrix Start Issue	<ul style="list-style-type: none"> Memorandum of Agreement 	John Zalar	10:45 - 11:00
Oil Volatility	<ul style="list-style-type: none"> Oil Volatility Task Force Formation Recommendation 	Clifford Venier	11:30 - 11:45
Elastomers	<ul style="list-style-type: none"> Elastomer Test Inclusion in D4485 	Tom Boschert	11:45 - 12:00
Low Temperature Pumpability	<ul style="list-style-type: none"> Round Robin Data 	Chris May	12:00 - 12:15
PC-9 Time line	<ul style="list-style-type: none"> Total overview 	Brent Shoffner	12:15 - 12:30
III F	<ul style="list-style-type: none"> Initiate Discussion Oxidation Limits to Replace III E 	Bill Nahumch	12:30 - 1:00

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL****ATTENDANCE LIST****NOVEMBER 2, 2000****PREVIOUS GUESTS**

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Righi, Dino Lubrizol Corp. 29400 Lakeland Blvd. Wickliffe, OH 44092	(440) 347-4436 (440) 943-9013 dwri@lubrizol.com		
Romanoschi, Ovidiu Infineum USA LP. P.O. Box 735 Linden, NJ 07036	(908) 474-3335 (908) 474-2298 ovidiu.romanoschi@infineum.com		
Rosenbaum, John Chevron Products Co. 100 Chevron Way Richmond, CA 94802-0627	(510) 242-5673 (510) 242-3758 rosj@chevron.com		
Rumford, Robert H. Specified Fuels & Chemicals, LLC 1201 South Sheldon Rd. Channelview, TX 77530-0429	(281) 457-2768 (281) 457-1469 rhumford@specified1.com		
Runkle Jr., William A. Valvoline Company LA 3 South P.O. Box 14000 Lexington, KY 40512-4000	(859) 357-7686 (859) 357-3343 wrunkle@ashland.com	WAR	JW
Rutherford, Jim Chevron / Oronite 100 Chevron Way Richmond, CA 94802-0627	(510) 242-3410 (510) 242-1930 jaru@chevron.com		
St. Germain, Bob Crompton Corp. 6847 Napier Lane Houston, TX 77069	(281) 587-2393 (281) 587-0338 robert_stgermain@cromptoncorp.com		
Sander, John Lubrication Engineers, Inc. 1919 E. Tulsa Wichita, KS 67216	sanderj@lubricationengineers.com		

ASTM**SECTION D.02.B0.02
HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL****ATTENDANCE LIST****NOVEMBER 2, 2000****PREVIOUS GUESTS**

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Schuettenburg, Alex Phillips Petroleum 148 AL, PRC Bartlesville, OK 74004	(918) 661-3863 (918) 661-8060 adschue@ppco.com		
Selby, Ted Savant, Inc. 4800 James Savage Rd. Midland, MI 48642	(517) 496-2301 (517) 496-3438 tselby@savantgroup.com	TWS	JW
Al-Shamrie, Sowilem G. Saudi Aramco P.O. Box 10538 Dhahran, Saudi Arabia 31311	(966) 3-673-5187 (966) 3-673-1260 shamrisg@aramco.com.sa		
Shipinski, John Toyota 1588 Woodridge Ann Arbor, MI 48105	(734) 995-3754 (734) 995-5971 shipinski@ttc-usa.com		
Shoffner, Brent Perkin Elmer 5404 Bandera Rd. San Antonio, TX 78238	(210) 647-9457 (210) 523-4607 brent_shoffner@perkinelmer.com	BAS	JW
Smith, Clinton Imperial Oil 111 St. Clair Ave. Toronto, Ontario M5W1K3	(416) 968-8308 (416) 968-5680 clinton.smith@esso.com		
Smith, Roy (A09) Detroit Diesel Corp. 13400 W. Outer Loop Dr. Detroit, MI 48239-4001	(313) 592-5758 (313) 592-7888 roy.smith@detroitdiesel.com		
Stehouwer, Dave Cummins Engine Co. Box 3005, MC 50183 Columbus, IN 47202	(812) 377-9209 (812) 377-7808 dmstehouwer@fleetguard.com		

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SECTION D.02.B0.02

HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

NOVEMBER 2, 2000

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Stevens, Mark G. Infineum USA LP. P.O. Box 735 Linden NJ 07036	(908) 474-2700 (908) 474-3637 mark.stevens@infineum.com	MS	JW
Sutherland, Mark Ethyl Corporation 9901 IH10 West, Suite 800 San Antonio, TX 78230	(210) 558-2818 (210) 696-4029 mark_sutherland@ethyl.com		
Tarbox, Steven R. 76 Lubricants Company 1920 E. Deere Avenue Santa Ana, CA 92705	(714) 428-7400 (714) 428-7498 starbox@tosco.com		
Tharby, Ron Tharby & Associates 273 Juniper Ave. Burlington, Ontario L7L2TS	(905) 632-1568 (905) 333-8194		
Tietze, Gary Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249	(210) 877-0223 (210) 690-3621 gtietze@testeng.com		
Tucker, Richard Shell International Petroleum Co. P.O. Box 1380 Houston, TX 77251-1380	(281) 544-8354 (281) 544-6196 rtucker@shellus.com		
Van Dam, Wim Oronite P.O. Box 1627 Richmond, CA 99802	(510) 242-1404 (510) 242-3173 wvda@chevron.com	WVD	JW
Venier, Cliff Pennzoil-Quaker State P.O. Box 7569 The Woodlands, TX 77381-2539	(281) 363-8060 (281) 363-8002 cliffordvenier@pzlqs.com	CYV	JW

ASTM

SECTION D.02.B0.02

HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

NOVEMBER 2, 2000

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Vidal, Andre Total Raffinage Distribution Cedex 47 92069 Paris La Defense, FRANCE	33 (1) 41 35 2482 33 (1) 41 35 8561		
Wakem, Mark Shell Research Ltd. P.O. Box 1 Chester, England CH1 3SH	44 (0) 151 373 5779 44 (0) 151 373 5475 mark.p.wakem@opc.shell.com		
Whitacre, Shawn D. Cummins Engine Co. 1900 McKinley Ave. MC 50183 Columbus, IN 47201	(812) 377-9842 (812) 377-7808 s.d.whitacre@ctc.cummins.com	SDW	JW
Wilson, Malcolm W. Chevron Global Lubricants 100 Chevron Way Richmond, CA 94802	(510) 242-1292 (510) 242-2358 maww@chevron.com		
Windhorst, Frank Southwest Research Institute 6220 Culebra Road San Antonio, TX 78238	(210) 522-3007 (210) 522-3658 fwindhorst@swri.org		
Zalar, John 6555 Penn Ave. ASTM TMC Pittsburgh, PA 15206	(412) 365-1047 (412) 365-1005 jlz@tmc.astm.cmri.cmu.edu	JLZ	JW
Ziemer, Jim Chevron Products Co. 100 Chevron Way Richmond, CA 94802	(510) 242-2362 (510) 242-1156 jnzi@chevron.com		

ASTM

SECTION D.02.B0.02 HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

NOVEMBER 2, 2000

GUESTS

	Phone No. Fax No. e-mail add.	ROOM FEE
Name: _____ Nancy Z. Diggs _____	(908) 474-2038 _____	JW
Company: _____ Infineum USA _____	(908) 474-3637 _____	
Address: _____ P.O. Box 735 _____ _____ Linden, NJ 07036 _____	Nancy.Diggs@Infineum.com	
Name: _____ Stacey McCarthy _____	(313) 592-5176 _____	JW
Company: _____ Detroit Diesel _____	(313) 592-3892 _____	
Address: _____ 13400 Outer Drive W. _____ _____ Detroit, MI 48239 _____	Stacey.McCarthy@DetroitDiesel.com	
Name: _____		
Company: _____		
Address: _____		
Name: _____		
Company: _____		
Address: _____		
Name: _____		
Company: _____		
Address: _____		
Name: _____		
Company: _____		
Address: _____		
Name: _____		
Company: _____		
Address: _____		

1Q Test Report for PC-9

1. Precision Results
2. Effects of EGR on Deposits
3. Discrimination & Oil Performance
4. EGR cooler modifications

1Q Test Report for PC-9 Precision

- 1Q Precision with TMC 1005
 - Seven 1Q tests have been completed in six labs.
 - ✧ Five of these labs will participate in the matrix.
 - All seven runs completed the 504 hour test with stable oil consumption.
 - Piston deposit levels were very consistent between runs.

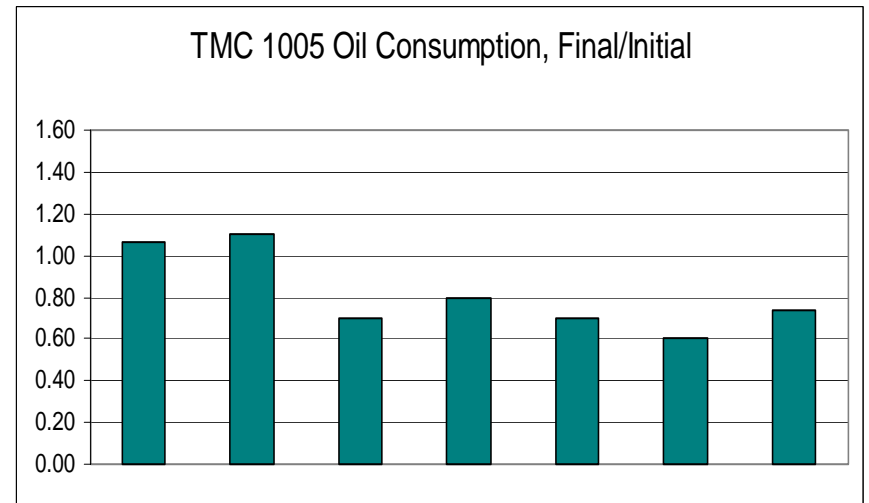
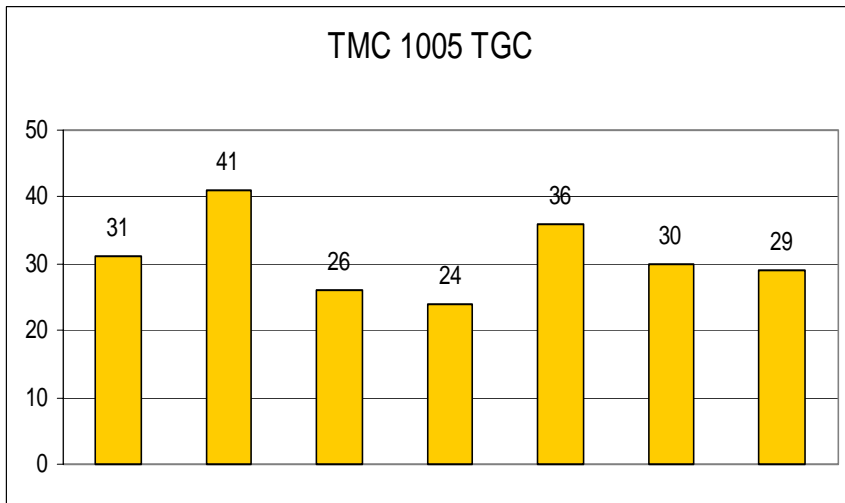
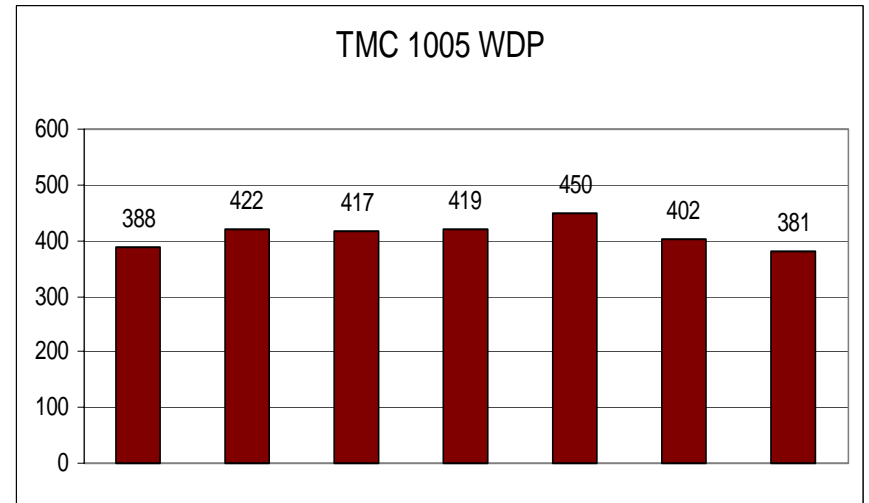
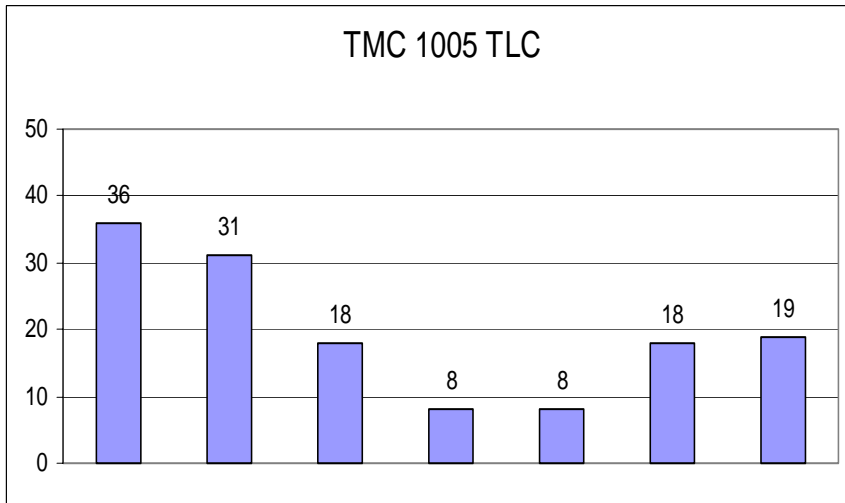
1Q Test Report for PC-9 Precision

- 1Q results with TMC 1005

Test Type	1Q Oil Type	Piston Deposits			Oil Consumption			Soot and Wear Metals				
		TLC	TGC	WDP	Initial g/hr	Final g/hr	Ratio F/I	TGA - %	Fe	Cr	Cu	Pb
1Q (EGR)	TMC 1005	36	31	388	11.2	11.9	1.1	1.6	74	7	21	9
	TMC 1005	31	41	422	12.8	14.0	1.1	3.6	201	23	7	7
	TMC 1005	18	26	417	9.6	6.9	0.7	2.8	172	12	6	6
	TMC 1005	8	24	419	12.2	9.2	0.8	2.8	220	11	32	9
	TMC 1005	8	36	450	10.6	7.5	0.7					
	TMC 1005	18	30	402	11.2	6.9	0.6		113	12	44	3
	TMC 1005	19	29	381	10.4	7.5	0.7					
	mean	20	31	411	11.1	9.1	0.8	2.7	156	13	22	7
1 sigma	11	6	23	1	3							

ATTACHMENT 3, 3 OF 15

1Q Test Report for PC-9 Precision



ATTACHMENT 3, 4 OF 15

1Q Test Report for PC-9 Precision

Test Type	Oil Type	Piston Deposits			Oil Consumption			Tests
		TLC	TGC	WDP	Initial g/hr	Final g/hr	Ratio F/I	
1Q Mean	TMC 1005	20	31	411	11.1	9.1	0.8	7
1Q Sigma		11	6	23	1	3		
1P Mean	TMC 1005	31	30	308	6.2	4.3		6
1P Sigma		9	8	44	3.5	2.3		

- ▶ The 1Q test has demonstrated improved precision in the areas of oil consumption and WDP, compared to the 1P test.
- ▶ The 1Q test has similar precision to the 1P in the Top Groove Carbon measurement.
- ▶ The 1Q precision on Top Land Carbon is worse than the 1P.

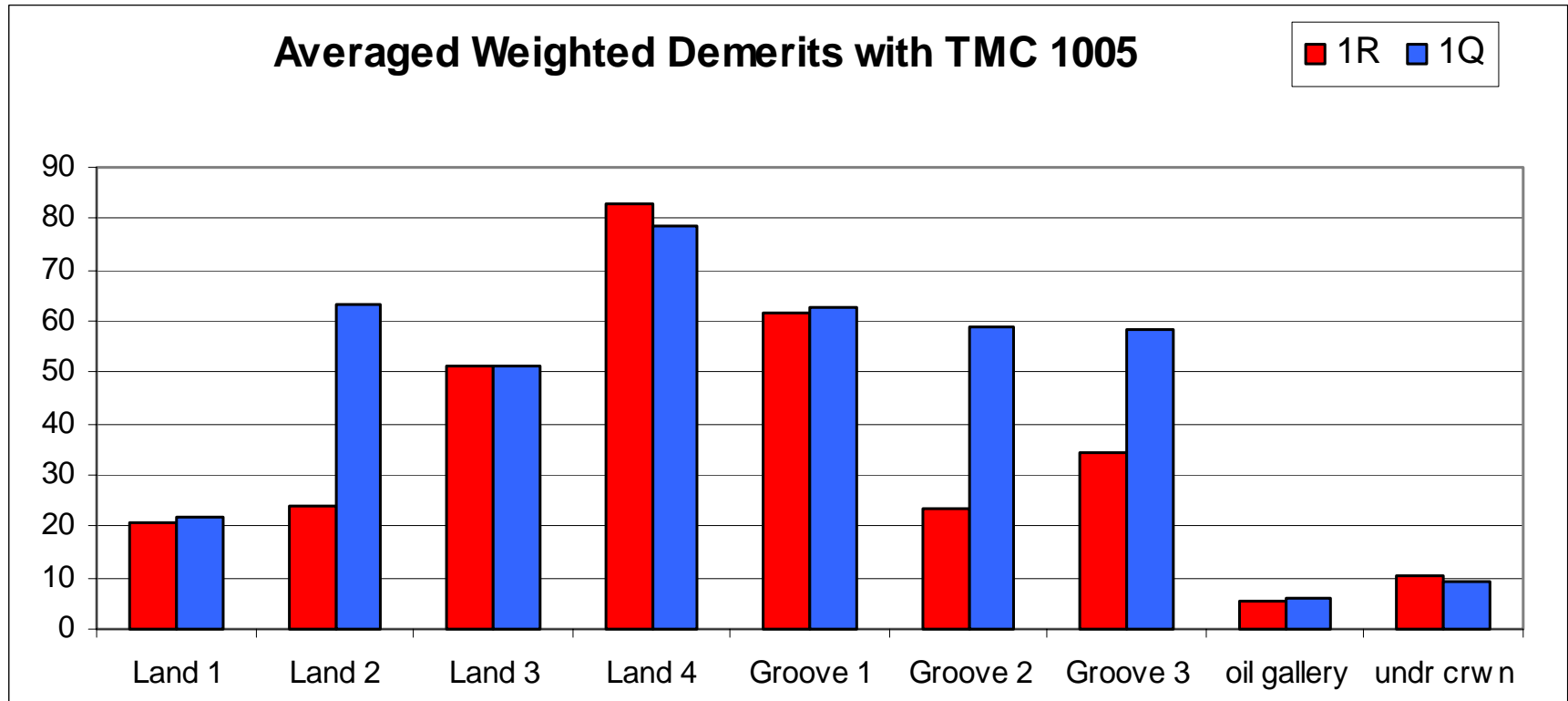
1Q Test Report for PC-9 Deposits

Test Type	Oil Type	Piston Deposits			Oil Consumption			Soot	Comments
		TLC	TGC	WDP	Initial g/hr	Final g/hr	Ratio F/I	%TGA	
1R Mean	TMC 1005	18	30	315	9.1	8.4	0.9	0.6	5 tests, No EGR
1R Sigma		11	5	35					
1R	E4	54	46	374	10.1	13.6	1.3		single run
1Q Mean	TMC 1005	20	31	411	11.1	9.1	0.8	2.7	7 tests with EGR
1Q Sigma		11	6	23					
1Q Mean	E4	35	57	582	7.5	22.4	2.8		average of 2 tests
3406E	PC-9X	36	47	200			1.2	0.7	550 HP for 500 Hrs
3406E EGR	PC-9X	35	42	252			?	0.9	475 HP 16% EGR for 500 Hrs
1Q	PC-9X	25	57	442	8.9	10.0	1.1	1.5	1 test with EGR

- Effects of EGR on Deposits

- ▶ EGR increases weighted demerits.
- ▶ Increased deposit levels are present in the 2nd and 3rd ring grooves and on the 2nd land.
- ▶ Deposits in these areas can result in ring sticking and loss of oil control.

1Q Test Report for PC-9 Deposits



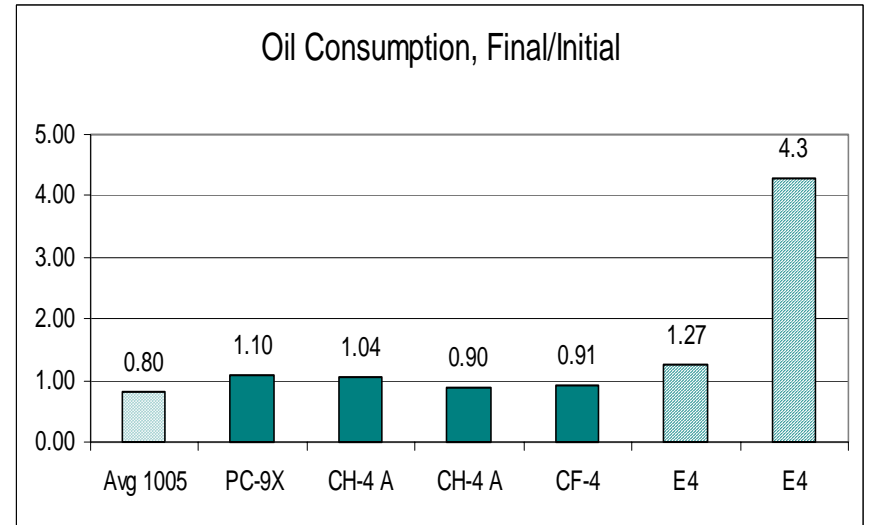
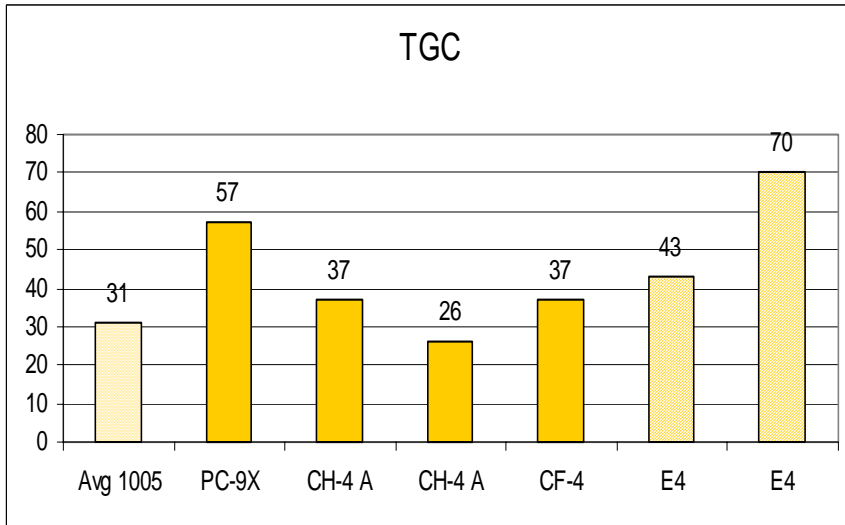
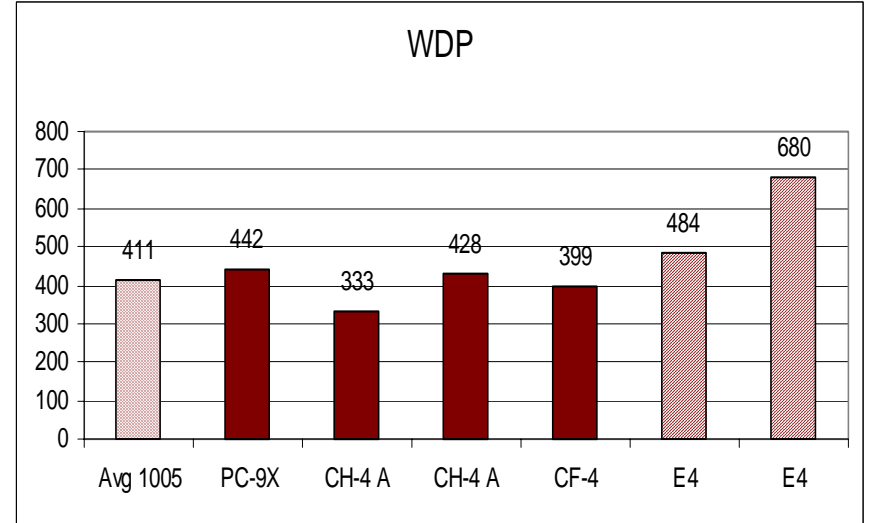
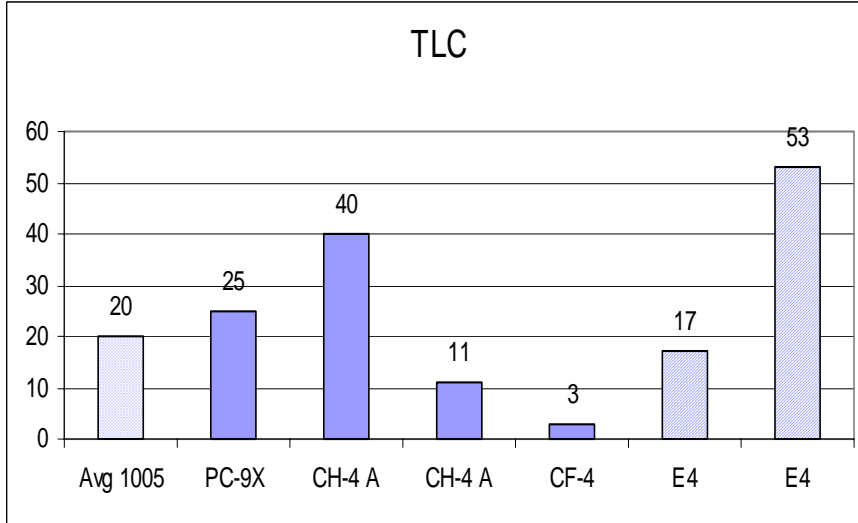
► Effects of EGR on Deposits

- ✧ Increased deposit levels are present in the 2nd and 3rd ring grooves and on the 2nd land.

1Q Test Report for PC-9 **Discrimination**

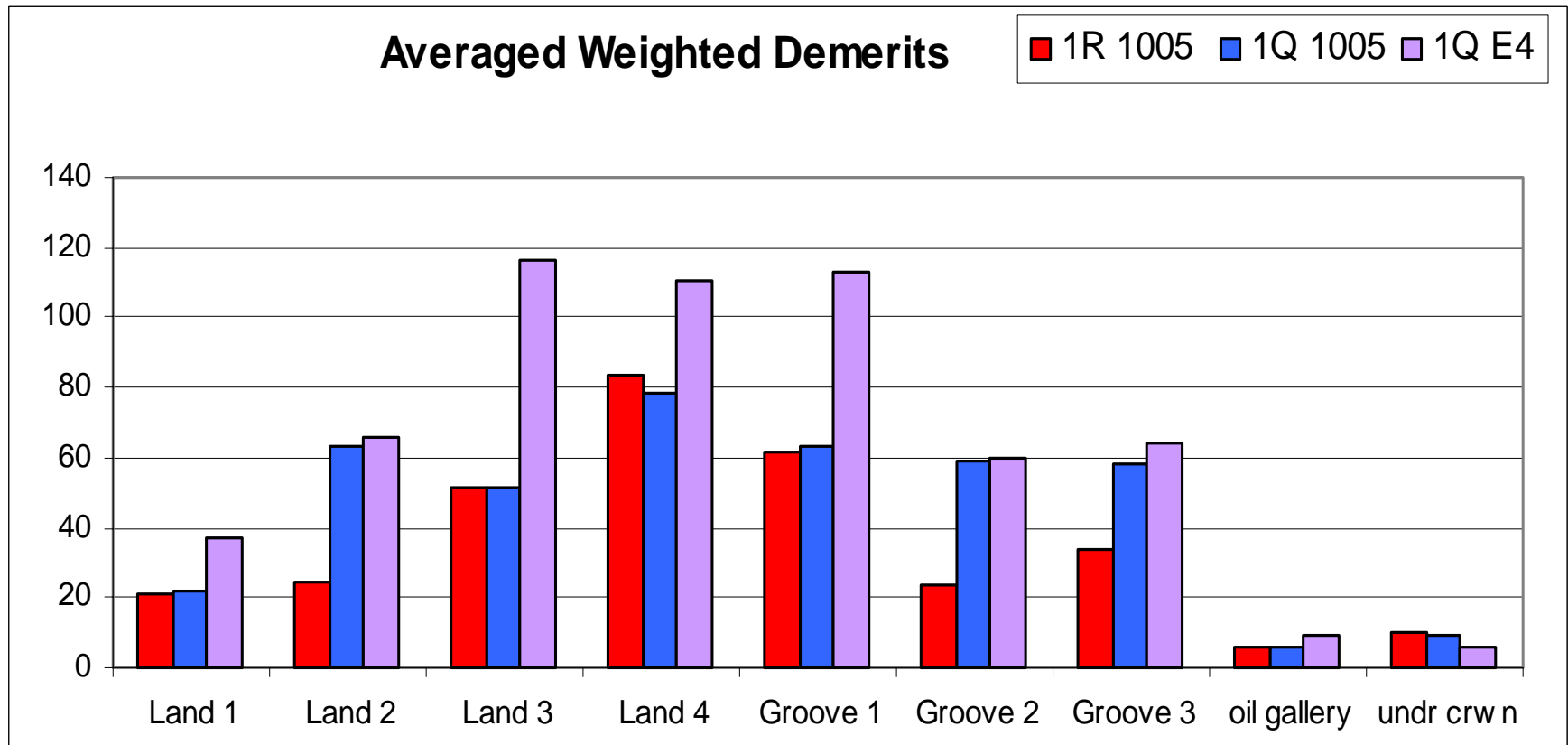
- Several oils were tested to identify performance differences.
- None of these oils provided adequate deposit control for the lower part of the piston.
 - Oils Tested
 - ✧ PC-9X
 - ✧ CH-4 15W-40
 - ✧ CF-4 15W-40
 - ✧ ACEA E4 10W-40

1Q Test Report for PC-9 Discrimination



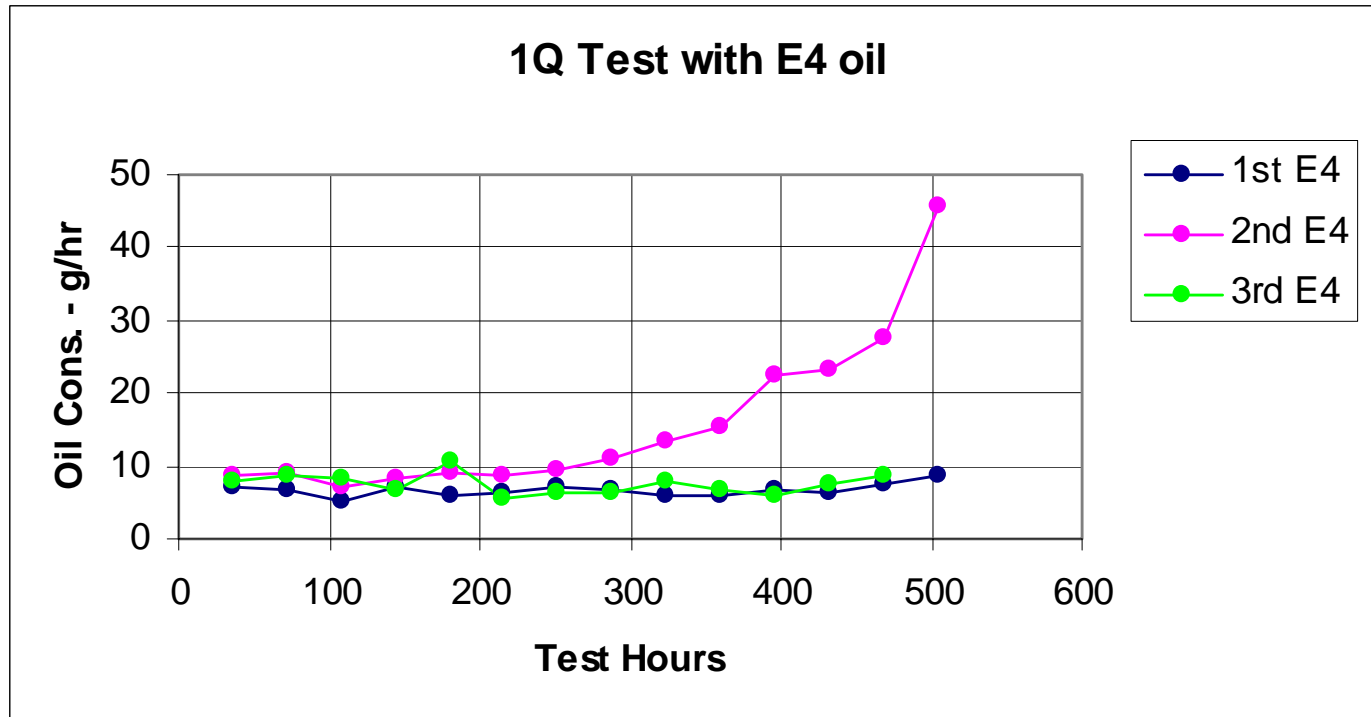
ATTACHMENT 3, 9 OF 15

1Q Test Report for PC-9 Discrimination



- ▶ The E4 oil increased deposits on the 3rd and 4th land, and in the 1st groove

1Q Test Report for PC-9 Discrimination



- ▶ A third run with the E4 oil is almost completed.
- ▶ Oil consumption is very similar to the first run.

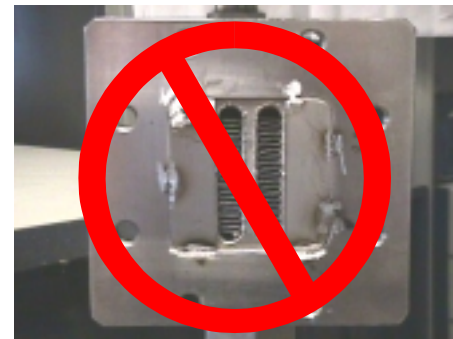
1Q Test Report for PC-9 Discrimination

- Additional development must be done to provide a discrimination oil.
 - Reduced deposits in the 2nd and 3rd ring grooves.
 - No loss of deposit control on the upper portion of the piston.
 - Desired average performance (not limits)
 - ✦ 300 WDP
 - ✦ 30 TGC
 - ✦ 25 TLC

1Q Test Report for PC-9 EGR Cooler

▸ Modified 1Q EGR Cooler

- ✧ The modified EGR cooler, with two tubes, did not adequately reduce fouling.
- ✧ This modification will not be used for the matrix tests. All EGR coolers will maintain their current four tube configuration.
- ✧ The heat exchanger will be cleaned as needed during a 1Q run. This procedure has been in place throughout the development of the test.



1Q Test Report for PC-9 EGR Cooler

- ▶ Modified 1Q EGR Cooler
 - ✧ Caterpillar is pursuing alternate EGR cooler designs for the 1Q test.
 - ✧ If one these designs proves acceptable, it would be incorporated in the 1Q test after completion of the matrix.

1Q Test Report for PC-9 **Summary**

- ✧ The 1Q test has demonstrated precision with reference oil TMC 1005.
 - ✧ The 1Q test discriminates differences in piston deposits when EGR is applied to a HD diesel engine.
 - ✧ The 1Q test demonstrates discrimination between CH-4 type oils and a high ash E4 type oil.
 - ✧ The 1Q task force has approved the 1Q test procedure and hardware configuration.
- ▶ Based on the above statements, 1Q test is ready for matrix testing in PC-9.



RENAULT

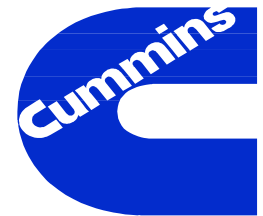


Mack T 10 Test Status

- Discrimination & Precision Data to HDEOCP
- Matrix Ready - Sept 20
- Task Force Conference call Nov 7
- Ready to Start Matrix Nov 13
- 4 of 5 Labs Ready to Start within 2 weeks

M11-EGR Task Force Report HDEOCP

Shawn D. Whitacre
November 2, 2000
Chicago, IL



M11-EGR (300 hr) Test Conditions:

Parameter	Unit	A (Soot)	B (Rated)
Stage Length	H	50	50
Engine Speed	r/min	1800	1600
Torque	N·m (lb·ft)	1300 (960)	1930 (1424)
Fuel Rate	Kg/hr (lb/hr)	58 (128)	64.4 (142)
Intake Manifold Air Temperature	°C (°F)	80 (176)	65.5 (150)
Coolant Out Temperature	°C (°F)	65.5 (150)	65.5 (150)
Oil Gallery Temperature	°C (°F)	115.5 (240)	115.5 (240)

250 hr soot: 8.0% - 9.5%

10/30/00 Task Force Mtg. Summary

- Crossheads (new batch)
 - Results to date indicate similar performance to “old” crossheads.
- Soot generation and 250-hr target
 - Labs concerned about meeting EOT soot window
 - All labs will run 16.1 timing (full retard) for the first 25 hours with a 2.8% soot min. at 50 hours.
 - The 250 hour target remains at 9.0% with a new range of 8.0% to 9.5%.

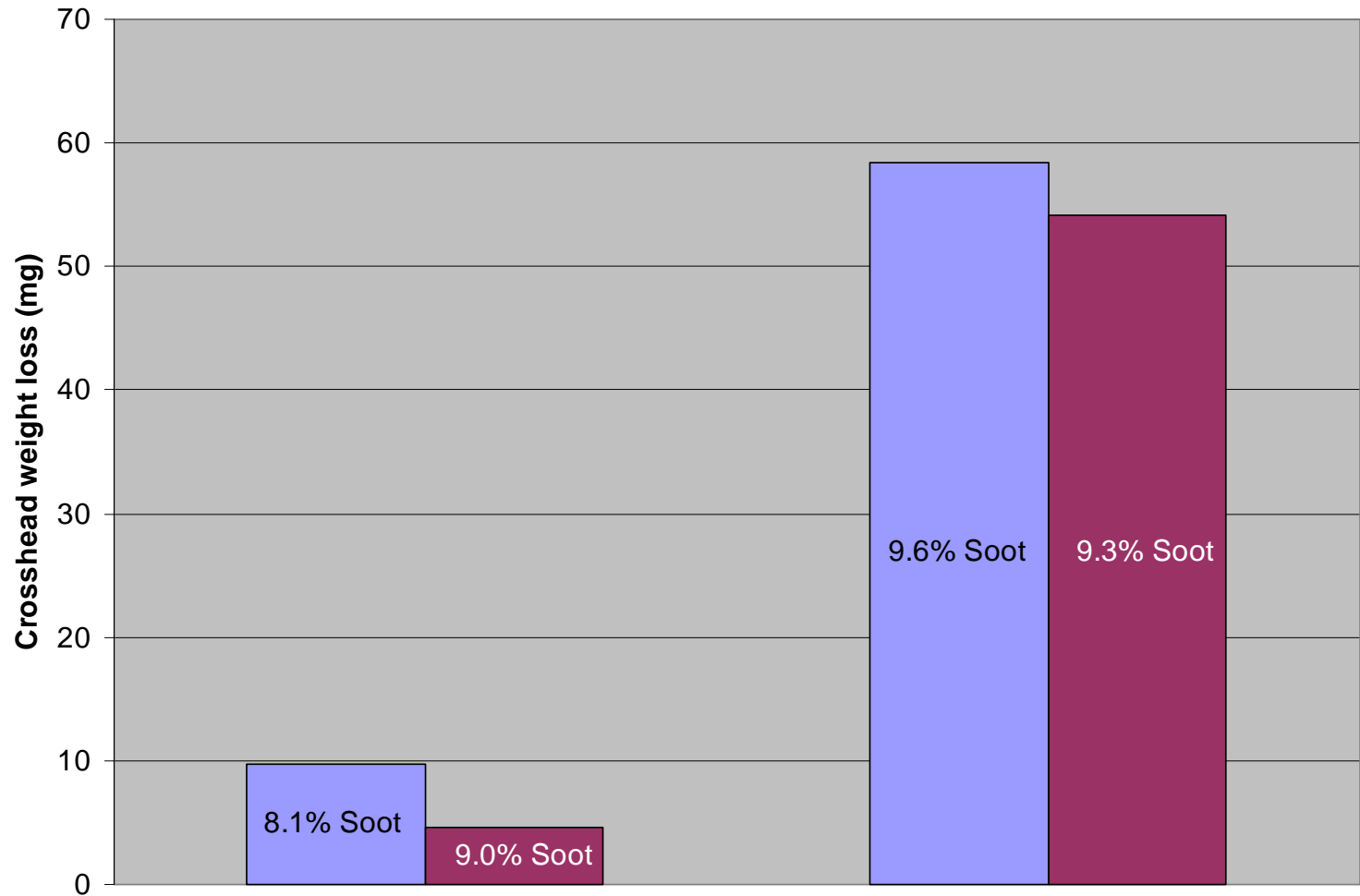
Task Force Recommendation

- The M11 EGR Task Force recommends that the M11-EGR test is matrix ready.
 - 10 Approve
 - 1 Disapprove (Lubrizol)
 - 0 Waive

Action Plan (update)

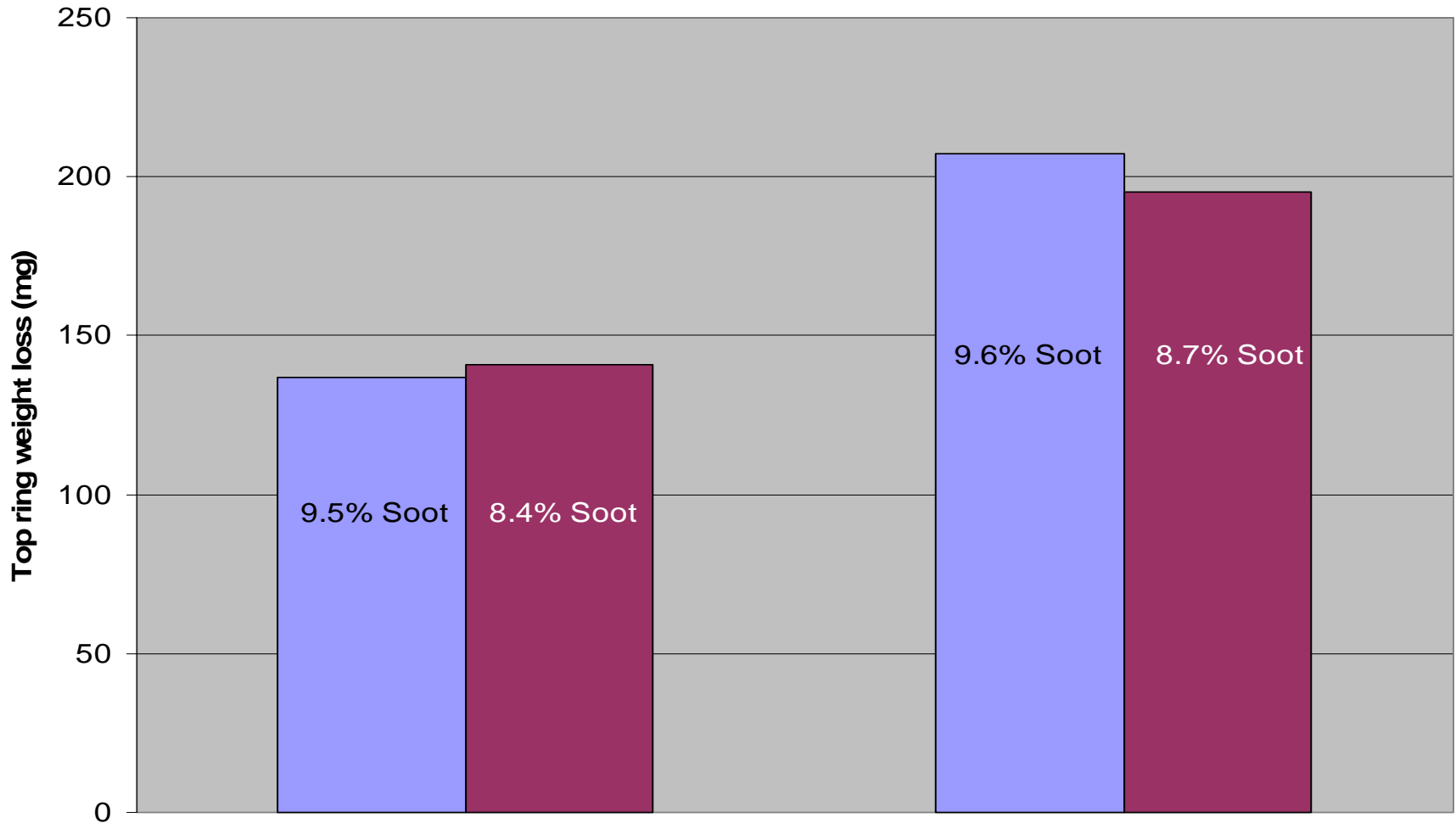
- ASTM formatted procedure distributed to TF (Complete)
- IMP minimum established for Stage A and B (complete)
- NDE and destructive testing on samples from new crosshead batch (in progress)

300-hr M11 EGR Test Results: Crosshead Weight Loss

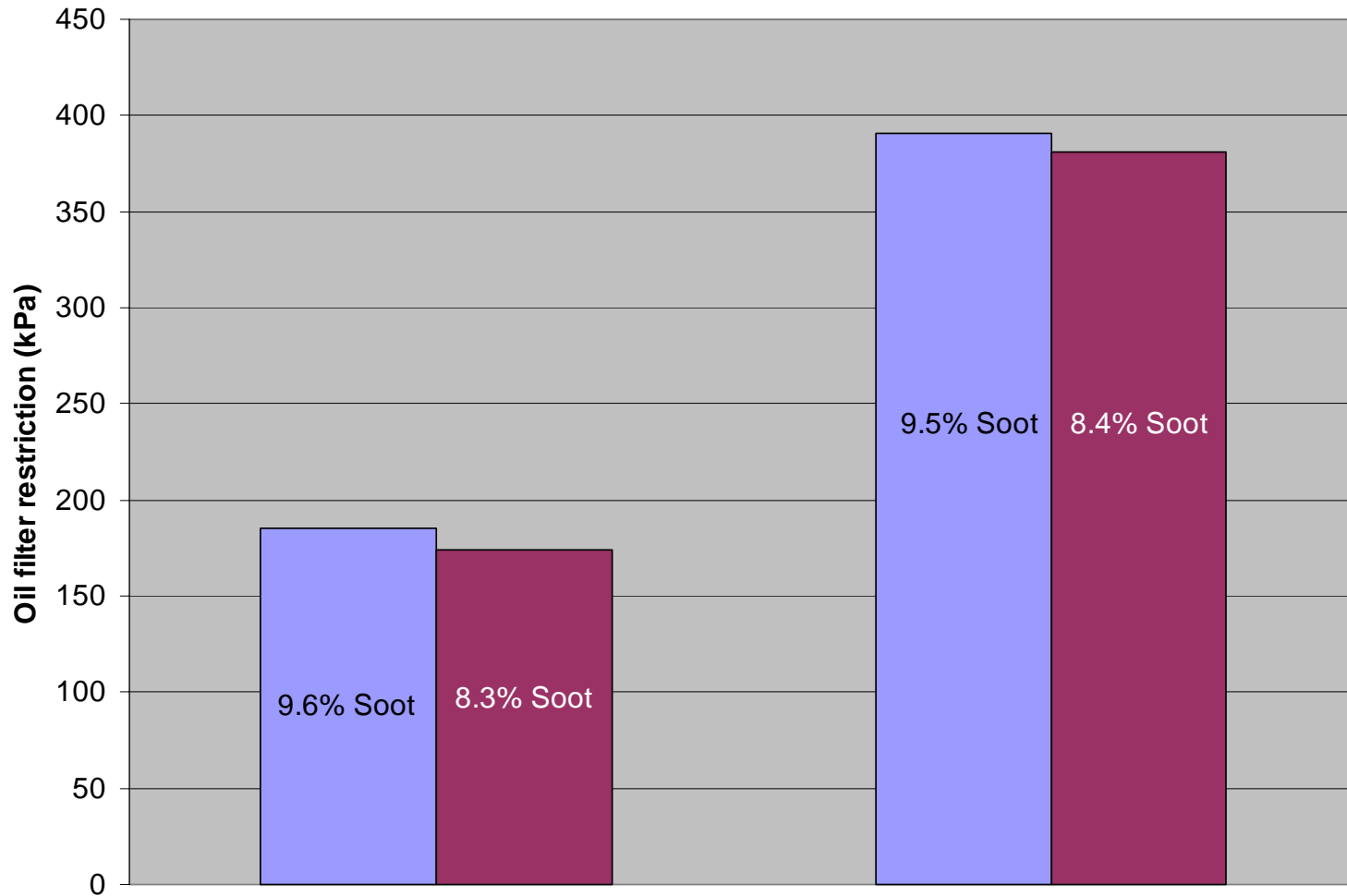


300-hr M11 EGR Test Results:

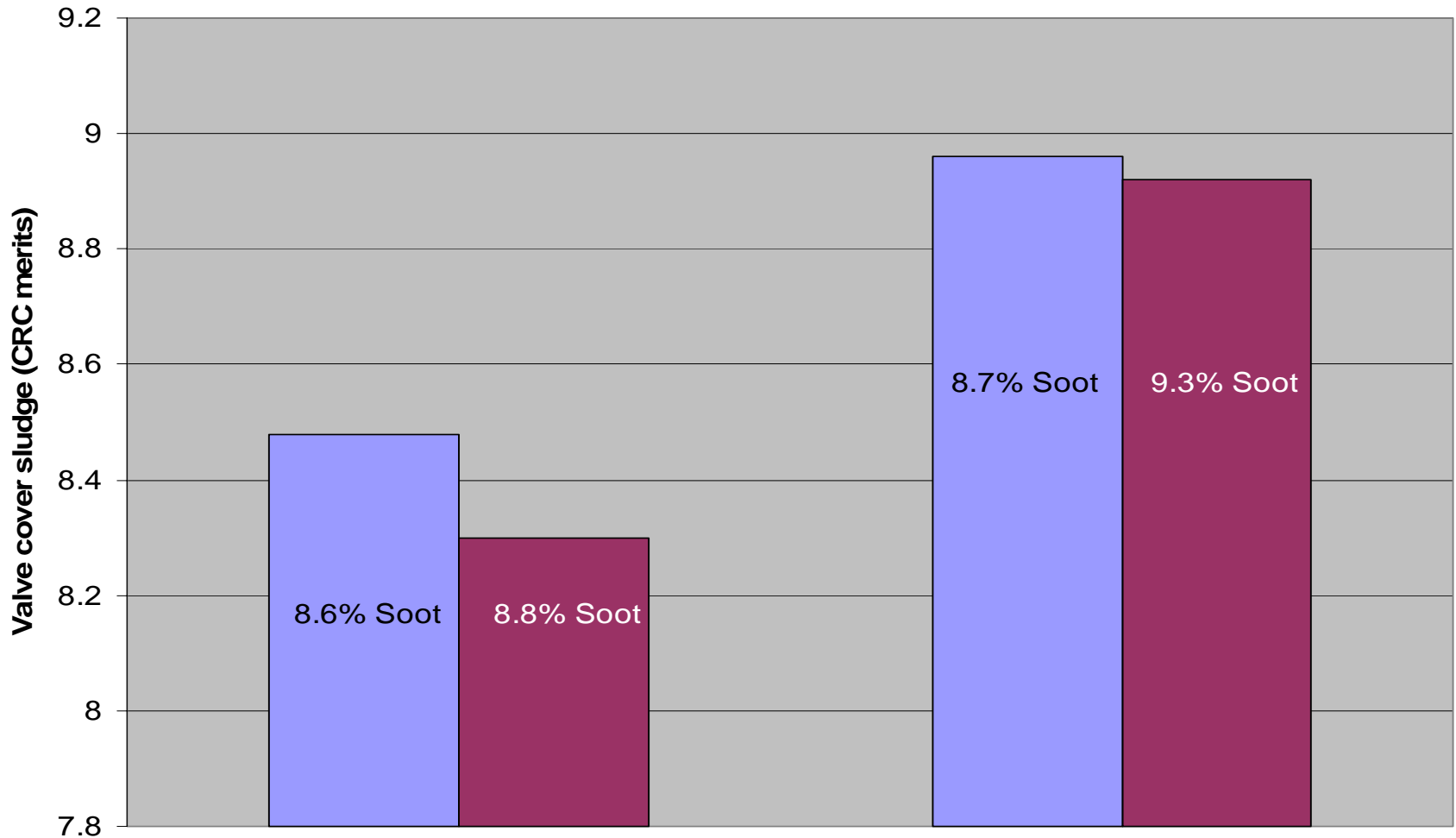
Top Ring Wear



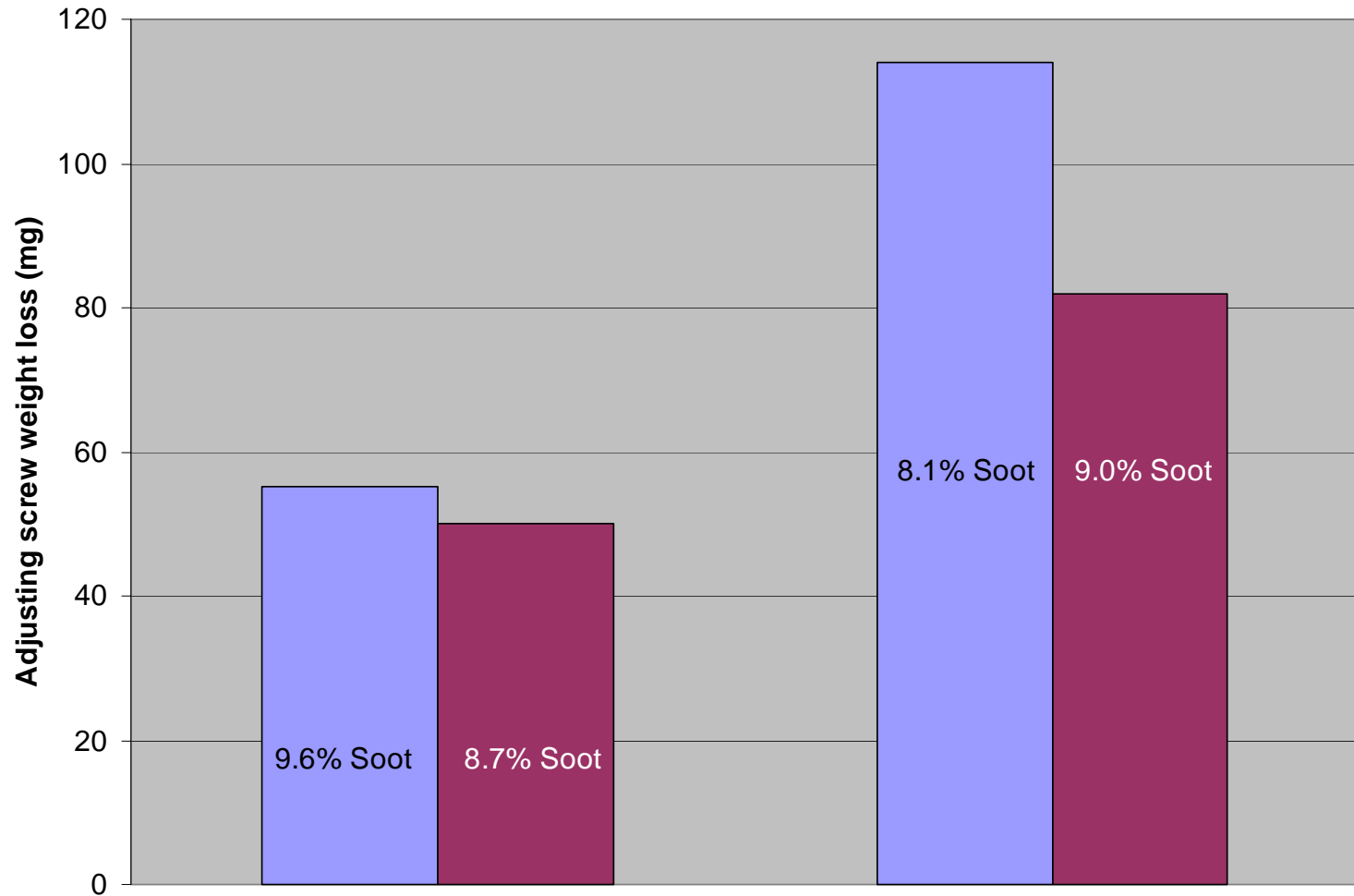
300-hr M11 EGR Test Results: Oil Filter delta P



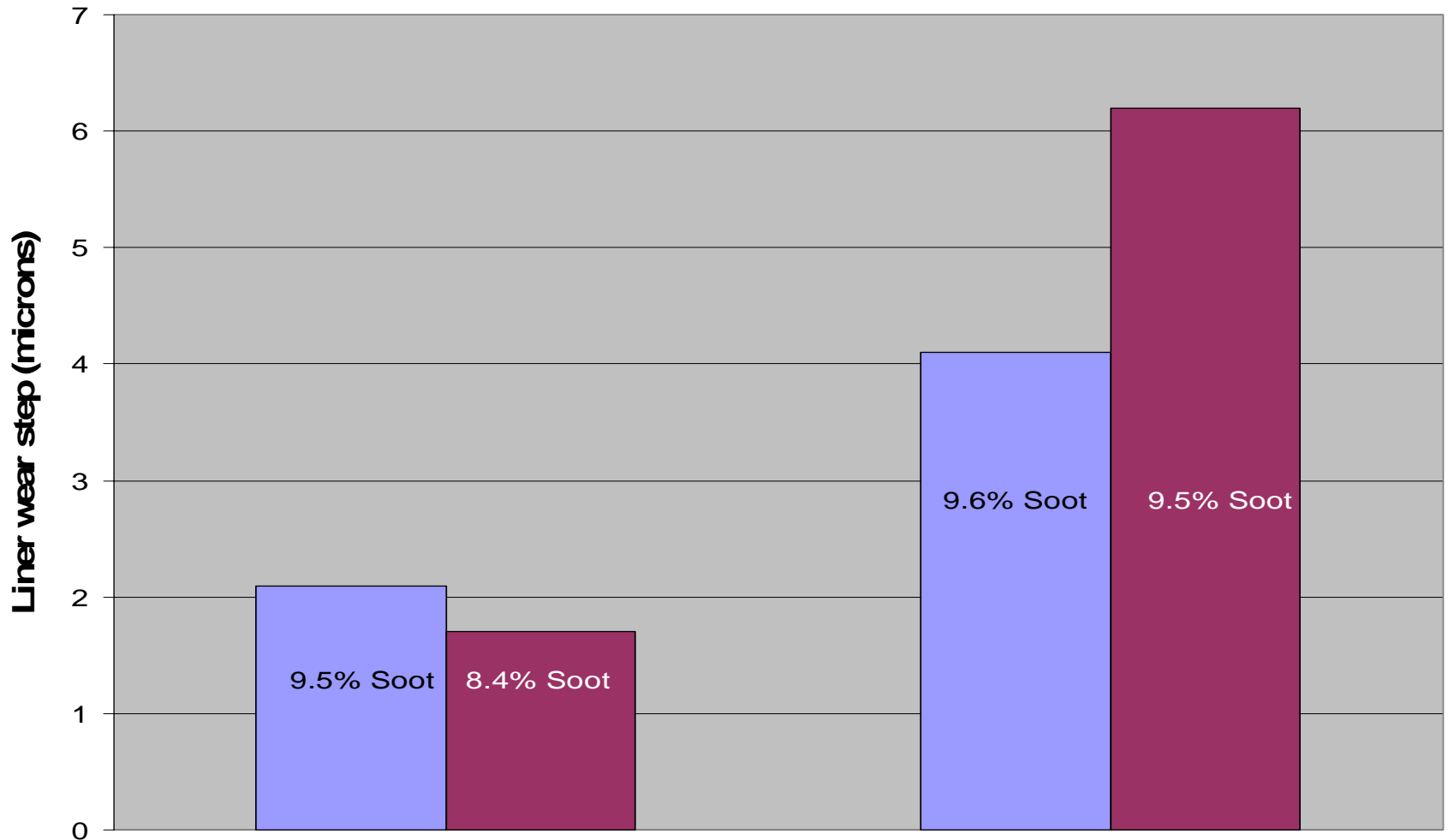
300-hr M11 EGR Test Results: Rocker Cover Sludge



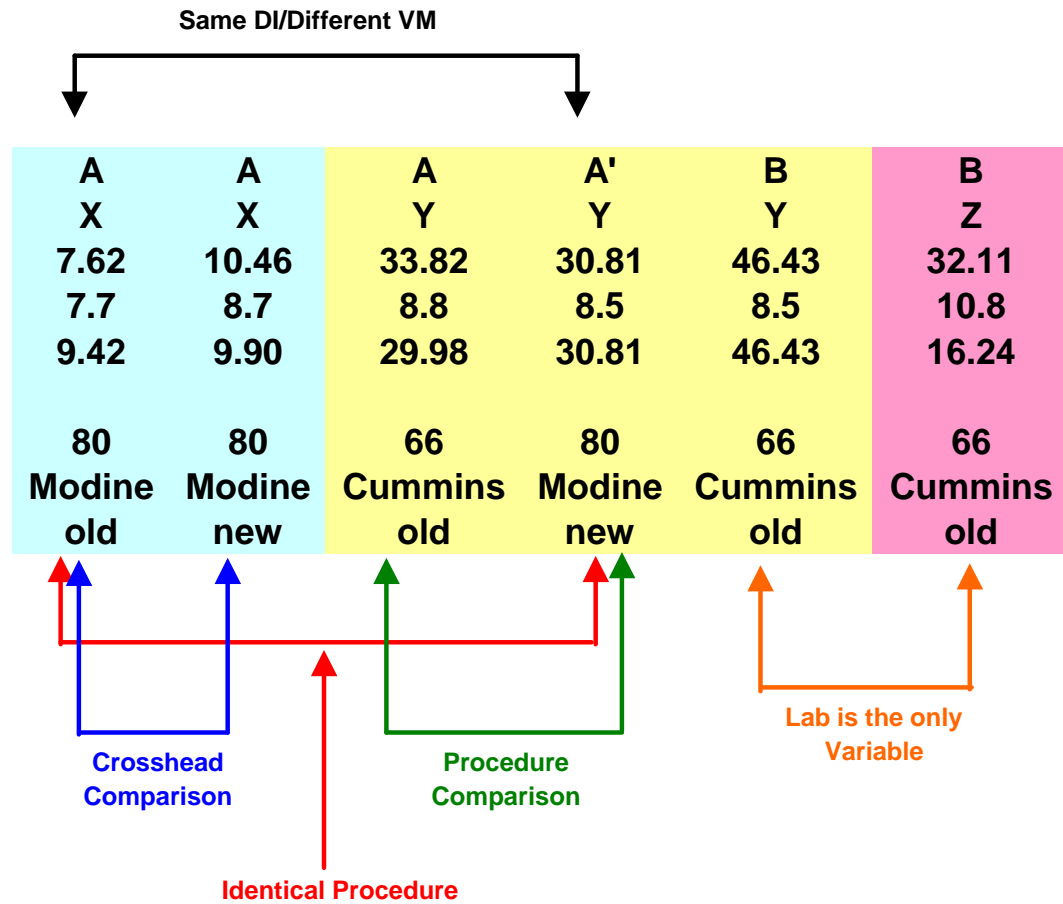
300-hr M11 EGR Test Results: Injector Adjusting Screw Weight Loss



300-hr M11 EGR Test Results: Liner Wear Step



OIL
 LAB
 Avg. CrossHead (RAW)
 Soot @ 250 Hours
 Avg. CrossHead at 8.5% Soot
 Procedures
 Intake Manifold Temp Degrees C
 Aftercooler
 Crossheads



OS Number	155609	155609	155609	159257	152587	152587
Oil	A	A	A	A'	B	B
LAB	X	X	Y	Y	Y	Z
EOT Date			Jul-00	Oct-00	Jun-00	Jul-00
Soot @ 250 hours	7.7	8.7	8.8	8.5	8.5	10.8
Avg. CrossHead at 8.5% Soot	9.42	9.90	29.98	30.81	46.43	16.24
Oil Filter Delta P (kPa)	171.3	402.0	442.0	173.0		430.0
EOT Vis	28.83	34.8	38.5	22.4		95.5
EOT Wear Metals						
Fe	206	236	356	204	321	359
Pb	0	9	9	4	9	10
Al	0	3	81	4		10
Procedure differences						
Intake Manifold Temp Degrees C	80	80	66	80	66	66
Aftercooler	Modine	Modine	Cummins	Modine	Cummins	Cummins
Crossheads	old	new	Old	new	Old	Old

The DI packages in OS 155609 and 159257 are identical. The VMs are different.

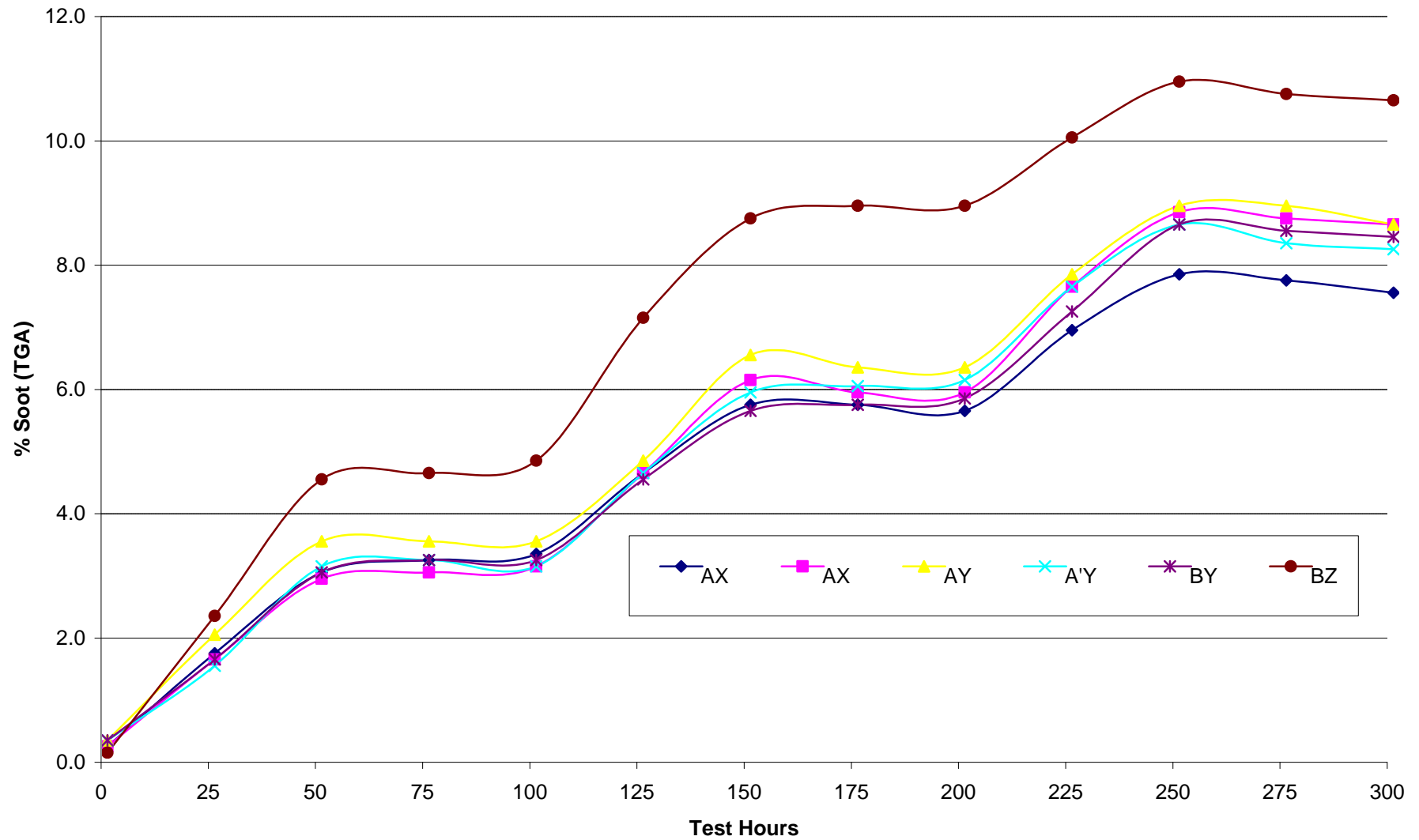
OS Number	155609	155609	155609	159257	152587	152587
Oil	A	A	A	A'	B	B
LAB	X	X	Y	Y	Y	Z
1E	5.69		29.73	14.67	42.73	41.5
1I	10.17		30.14	46.03	70.17	33.4
2I	10.33		83.15	47.22	55.67	40.5
2E	10.15		23.51	67.44	45.36	40.5
3E	8.77		15.75	6.96	18.83	27.6
3I	5.56		40.96	23.96	71.51	31.2
4I	5.50		24.29	14.44	53.42	5.4
4E	6.46		37.5	42.14	19.51	35.1
5E	4.79		15.81	6.49	36.04	16.9
5I	6.05		17.17	15.58	65.30	51.9
6I	12.95		62.55	32.17	47.61	35.2
6E	5.09		25.27	52.65	31.05	26.1
Avg. CrossHead weight loss (mg)	7.62	10.46	33.82	30.81	46.43	32.11
Soot @ 250 hours	7.7	8.7	8.8	8.5	8.5	10.8
Avg. CrossHead at 8.5% Soot	9.42	9.90	29.98	30.81	46.43	16.24
Procedure differences						
Intake Manifold Temp Degrees C	80	80	66	80	66	66
Aftercooler	Modine	Modine	Cummins	Modine	Cummins	Cummins
Crossheads	old	new	Old	new	Old	Old

The DI packages in OS 155609 and 159257 are identical. The VMs are different.

OS Number	155609	155609	155609	159257	152587	152587
Oil	A	A	A	A'	B	B
LAB	X	X	Y	Y	Y	Z
Hours	% Soot	% Soot	% Soot	% Soot	% Soot	% Soot
0	0.1	0.1	0.2	0.2	0.2	0
25	1.6	1.5	1.9	1.4	1.5	2.2
50	2.9	2.8	3.4	3.0	2.9	4.4
75	3.1	2.9	3.4	3.1	3.1	4.5
100	3.2	3.0	3.4	3.0	3.1	4.7
125	4.5	4.5	4.7	4.5	4.4	7
150	5.6	6.0	6.4	5.8	5.5	8.6
175	5.6	5.8	6.2	5.9	5.6	8.8
200	5.5	5.8	6.2	6.0	5.7	8.8
225	6.8	7.5	7.7	7.5	7.1	9.9
250	7.7	8.7	8.8	8.5	8.5	10.8
275	7.6	8.6	8.8	8.2	8.4	10.6
300	7.4	8.5	8.5	8.1	8.3	10.5
Procedure differences						
Intake Manifold Temp Degrees C	80	80	66	80	66	66
Aftercooler	Modine	Modine	Cummins	Modine	Cummins	Cummins
Crossheads	old	new	Old	new	Old	Old

The DI packages in OS 155609 and 159257 are identical. The VMs are different.

M11 EGR Soot Generation Rates



ASTM HDEOCP Mtg
Nov. 2, 2000 - Chicago, IL

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

C.J. May, K.O. Henderson

Recent LOTRUO Activities

- **Thanks to the donation of used oil samples from HDEOCP participants and others over the past few months, the LOTRUO task force now has a sufficient range of test oils for MRV round robin evaluation:**
 - **9 samples including drains from Mack T8/T8E, Cummins M11-EGR and Mack T10 engine tests**
 - **Soot levels of ~5 - 9 %**
 - **MRV viscosities (-25°C) range from <20,000 cP to >800,000 cP**
 - **Samples distributed in mid Oct. to 12 labs for D4684 evaluation at -20°C and -25°C**
 - **In addition, 7 of the labs have indicated they can run modified MRV tests (80°C preheat/sample agitation/MRV cooling)**
 - **Participants agreed to complete the work within 8 weeks**

Recent LOTRUO Activities (Cont'd)

- **Current plan is to have at least the D4684 results completed and some preliminary analysis of the data by year-end**
- **We still welcome additional 1+ gal. samples of relevant used oils should follow-up work be required**
 - **current round robin has depleted available test oil volumes to <1L in some cases**
 - **the task force will continue to look at new low temperature methods that could be of potential use (e.g. extended range SBR, modified gap MRV, etc)**

PC-9 Matrix Design Task Force

Status Report

To

ASTM Heavy Duty Engine Oil Classification Panel

Thursday November 2, 2000

Holiday Inn O'Hare

Chicago, IL

PC-9 Matrix Design Task Force Update

Final Formulations Matrix (9 Test Oils)

Code	Technology	Base Oil	Featured Oil for This Test
PC-9A	X	1	T-10/EGR
PC-9B	X	2	---
PC-9C	X	3	---
PC-9D	Y	1	---
PC-9E	Y	2	M11/EGR
PC-9F	Y	3	---
PC-9G	Z	1	---
PC-9H	Z	2	---
PC-9J	Z	3	1Q/EGR

PC-9 Matrix Design Task Force Update

Final Experimental Test Matrix Designs

PC-9 Matrix Design Task Force Update

I. Assumptions

- o 3 DI /VI combinations, 3 base oils, and 1 Featured Oil
- o Every factor level should be run at least 3 times to maintain Power, and at least 4 valid test results in each Matrix Test Stand to account for bias
- o At least 8 degrees of freedom (DF) to estimate test variability, and at least 6 repeats on identified Featured Oils
- o Maximize the percentage of Featured Oils runs in the Matrix
- o Main effects and 2-Way Interactions (Except with Stand) are estimable
- o Decision rules for Industry Matrix Testing have been satisfied

PC-9 Matrix Design Task Force Update

II. Experimental Test Matrix Design Oils

Nine Matrix Oils are Formulated (Blended Lubricants).

Note:

PC-9A is the featured oil for the T-10/EGR,

PC-9E is the featured oil for the M11/EGR,

PC-9J is the featured oil for the 1Q/EGR.

	Technology		
Base Oil	X	Y	Z
1	PC-9A	PC-9D	PC-9G
2	PC-9B	PC-9E	PC-9H
3	PC-9C	PC-9F	PC-9J

PC-9 Matrix Design Task Force Update

III. T-10/EGR Test Design

Lab/Stand						
Lab 1		Lab 2	Lab 3		Lab 4	Lab 5
1	2	3	4	5	6	7
G	B	G	D	E	A	D
E	H	B	H	F	E	A
C	F	A	C	J	J	J
A	A	A	A	A	A	A

PC-9 Matrix Design Task Force Update

IV. M11/EGR Test Design

Lab/Stand					
Lab 1		Lab 2	Lab 3		Lab 4
1	2	3	4	5	6
H	D	H	B	G	B
A	G	D	G	A	D
F	C	C	F	J	J
E	E	E	E	E	E
		E			E

PC-9 Matrix Design Task Force Update

V. 1Q/ EGR Test Design

Lab/Stand						
Lab1		Lab2	Lab3		Lab4	Lab5
1	2	3	4	5	6	7
C	H	C	F	E	J	F
E	B	H	B	D	E	J
G	D	J	G	A	A	A
J	J	J	J	J	J	J

PC-9 Matrix Design Task Force Update

Proposed Timeline:

- PC-9 Formulations Matrix

- Technologies Selected
- Technologies Available
- Base Oils Available
- Blends Prepared (Available)

April 11, 2000

September 7, 2000

October 10, 2000

November 7, 2000

- PC-9 Matrix Testing

- Matrix Start
- Matrix Completion
- Data Evaluation Completed

November 10, 2000

March 22, 2001

April 30, 2001

Oil Volatility Task Force

The following was adopted by the Task Force without objection:

For the PC-09 category, the volatility specification shall be 15% Evaporation Loss by the Noack Method, ASTM D5800.

**PC-9 Elastomer Task Force Report
Nov. 2, 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.

Lyle Bowman has given the opinion that it can be incorporated into D 4485 as a comparative limit.

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**

D11.15 have agreed to ballot in their group to oversee this test method and add new Service Fluids The new method is undergoing comments on the ASTM Standards Web site. It will be balloted in late October and reviewed at D11.15 December meeting. There have been no changes to the actual test procedure, all changes to the standard have been in identifying part distributor, adding report forms, and some editorial corrections.

The procedure is currently undergoing balloting.

- 2. A continued source of elastomers must be identified and distribution assured**

A source has been identified and is being recommended to the Task Force

- 3. Once Reference oil(s) is identified distribution of it must be assured**

The TMC has agreed to procure and distribute reference oil(s)

At our most 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. OH Technologies has been selected and currently has a supply of the elastomer materials.**
- 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 This has been accomplished**
- 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. An E-mail has gone to the matrix manger requesting that he forward it on to those blending the matrix oil. It requests PC-9 elastomer tests on all 9 Matrix oils.**

The oil suppliers have been requested to run the PC-9 matrix test. We have had approx. 30 oil formulations tested to date.

- 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.**

As a practical matter elastomer manufacturers need to work on seal materials now since they run 3000 hour life tests.

I will schedule a conference call of the Task Force to review the ballot results and preliminary review of oil data. I will be targeting the afternoon of Nov. 27.

I intend to convene a meeting of the Task Force after receipt of PC-9 matrix oil elastomer data and after D11.15 ballot results – probably in January.

Original report of 2-23-00

Report of 6-27-00

Report of 9-20-00

Report of 11-02-00

PC-9 Timeline Notes

Brent Shoffner 11/2/2000

- Both the HDEOCP and the appropriate Surveillance Panel / Task Force accept proof of concept and “test readiness” for the Precision Matrix:

	SP / Task Force	HDEOCP
1Q	10/31/00	11/02/00
M11 EGR	10/30/00	11/02/00
T-10	10/07/00	09/20/00

- At least 5 of the 9 oils should be available at the Precision Matrix Laboratories **11/10/2000**.
 - The oil test order will be adjusted to allow the start of all the matrix stands.
- It is assumed that all the stakeholders will approve the Memo of Agreement by November 10, 2000.
- The Precision Matrix is projected to start **November 13, 2000**.
- The PC-9 “license allowed date” is currently **July 2002**.
- Based on experience with the current ASTM system, the “API License Date” will be later than October 2002.

Summary of Events Required for PC-9 Licensing

Brent Shoffner 11/2/2000

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	Qtr 2	Qtr 3	
1																			
2	Define PC-9 Performance Parameters	03/16/99	03/16/99	◆															
3	Design Prec. Mtx. Appr. API Lubes Comm.	03/17/99	05/31/00		■														
4	PC-9 Funding MOA Signed	01/03/00	11/10/00					■											
5	1Q & M11EGR adequate for oil devel.	05/15/00	05/15/00						●										
6	Finalize Base Oil selections for Prec. Mtx.	05/31/00	05/31/00						●										
7	Finalize Additive selections for Prec. Mtx.	01/06/00	06/30/00					■											
8	Base Oils Recd by Additive Companies	07/03/00	09/20/00							■									
9	Blend Prec. Mtx. Oils>TMC>Labs **	09/21/00	11/10/00							■									
10	Final Acceptance of New Engine Tests	11/02/00	11/02/00															★	
11	PC-9 Demonstration Oil is Validated	03/22/01	03/22/01															★	
12	PC-9 Precision Matrix Testing (1Q)	11/13/00	03/23/01							■									
13	Precision Matrix Data Analysis	03/26/01	04/06/01											■					
14	HDEOCP Post Matrix Test Acceptance	04/09/01	05/08/01											■					
15	CMA Registrations Allowed	05/09/01	06/05/01											■					
16	Finalize Pass/Fail Criteria (Sub B Mtg)	05/09/01	07/20/01											■					
17	New Product Development	07/23/01	07/22/02												■				
18	API Licensing Allowed	07/23/02	07/23/02															★	

** At least 5 of the 9 oils should be available at the Precision Matrix Laboratories 11/10/00. The oil test order will be adjusted to allow the start of all the matrix stands.

Comparison of IIF versus IIE Oxidation

Brent Shoffner 11/2/00

- Major differences between the IIE and IIF include:

	IIE	IIF
Fuel	Leaded	Unleaded
Oil Filter Temperature	149C	155C
Coolant Out Temperature	115C	122C
Engine Speed	3000 RPM	3600 RPM
Engine Power	67.5 HP	100 HP

- There may *not be a strong correlation* between the IIE and IIF for oxidation, but *there may be a “relationship”*.
- The following is an analysis of four oils run in the IIF Discrimination Matrix, which have both IIE and IIF oxidation results.

Sequence IIIF vs. IIIE Viscosity Increase Comparison Oil Data

From Figure 9 in the Sequence IIIF Research Report

Oil Code	Oil Quality	SAE Viscosity Grade	Base Oil Group	IIIE % Viscosity Increase	IIIE Hr to 375%	Expected IIIF Viscosity Performance	IIIF % Viscosity Increase
1006	SJ ¹	5W-30	I	314	65.9	Fail	4058
GPS1	GF-3	5W-30	II+	85	73	Pass	36
GPS8	PC-9/SL	15W-40	I	74	77.9	Pass	328
GPS12	GF-2	5W-30	II	94	76.4	Pass	153

¹ D5480 = 18.5 per 1999 ASTM Reference Oil Book.

Figure 9- SEQUENCE IIIF REDEVELOPMENT PROGRAM OXIDATION DISCRIMINATION OILS

Oil Code	Supplier	Oil Quality	SAE Viscosity Grade	Base Oil Group	Sequence IIIE Performance				Field Data	Sequence IIIF (Precision Matrix Configuration)				Expected IIIF Performance	
					% Viscosity Increase	Hr to 375%	Avg Wear	Max Wear		% Viscosity Increase	Hr to 100%	Avg Wear	Max Wear	Viscosity Increase	Wear
GPS1	A	GF-3	5W-30	II+	85	73	26	99	Low Vis Inc, Wear in Ext Drain Taxi Testing	65 ⁽²⁾	--	Low	Low	Pass	Pass
GPS2	A	GF-3	10W-30	I	--	--	--	--	--	80 ⁽²⁾	--	4	12	Pass	Pass
GPS3	A	GF-3	10W-30	II+	--	--	--	--	--	--	--	--	--	Pass	Pass
GPS4	B	SF	5W-30	II/II+	Fail ⁽³⁾	--	Pass	Pass	--	98	--	11	15	Fail	Pass
GPS5	B	<GF-2	5W-30	II/II+	32,000	--	11	51	--	46	--	3	6	Fail	Pass
GPS6	B	GF-3	5W-30	II/II+	14	--	4	5	Good Perf in Extended Drain Mixed Driving	Pass	--	--	--	Pass	Pass
GPS7	C	PC-9/SL	15W-40	I	B/L Fail ⁽³⁾ ⁽⁶⁾	--	--	--	--	--	--	--	--	B/L Fail	Pass
GPS8	C	PC-9/SL	15W-40	I	74	77.9	5.2	9	Running in several fleets.	--	--	--	--	Pass	Pass
GPS9	C	GF-3	5W-30	II+	B/L Fail ⁽³⁾ ⁽⁷⁾	--	--	--	--	--	--	--	--	B/L Fail	Pass
GPS10	C	GF-3	5W-30	II+	Robust Pass ⁽³⁾	--	--	--	See Note 5	62	--	96 ⁽⁴⁾	1066	Pass	Pass
GPS11	D	GF-2	5W-30	I	125 ⁽¹⁾	--	Pass	Pass	Low Vis Inc, Wear in Ext Drain Taxi Testing	785	--	Pass	Pass	Pass	Pass
GPS12	D	GF-2	5W-30	II	94	76.4	13	25	Low Vis Inc, Wear in Ext Drain Taxi Testing	--	--	--	--	Pass	Pass

⁽¹⁾ 80 to TVTM in 5 tests with same DI and different base oils

⁽²⁾ Earlier version of IIIF test

AO.

⁽³⁾ Predicted performance based on fundamental formulation expertise

AO.

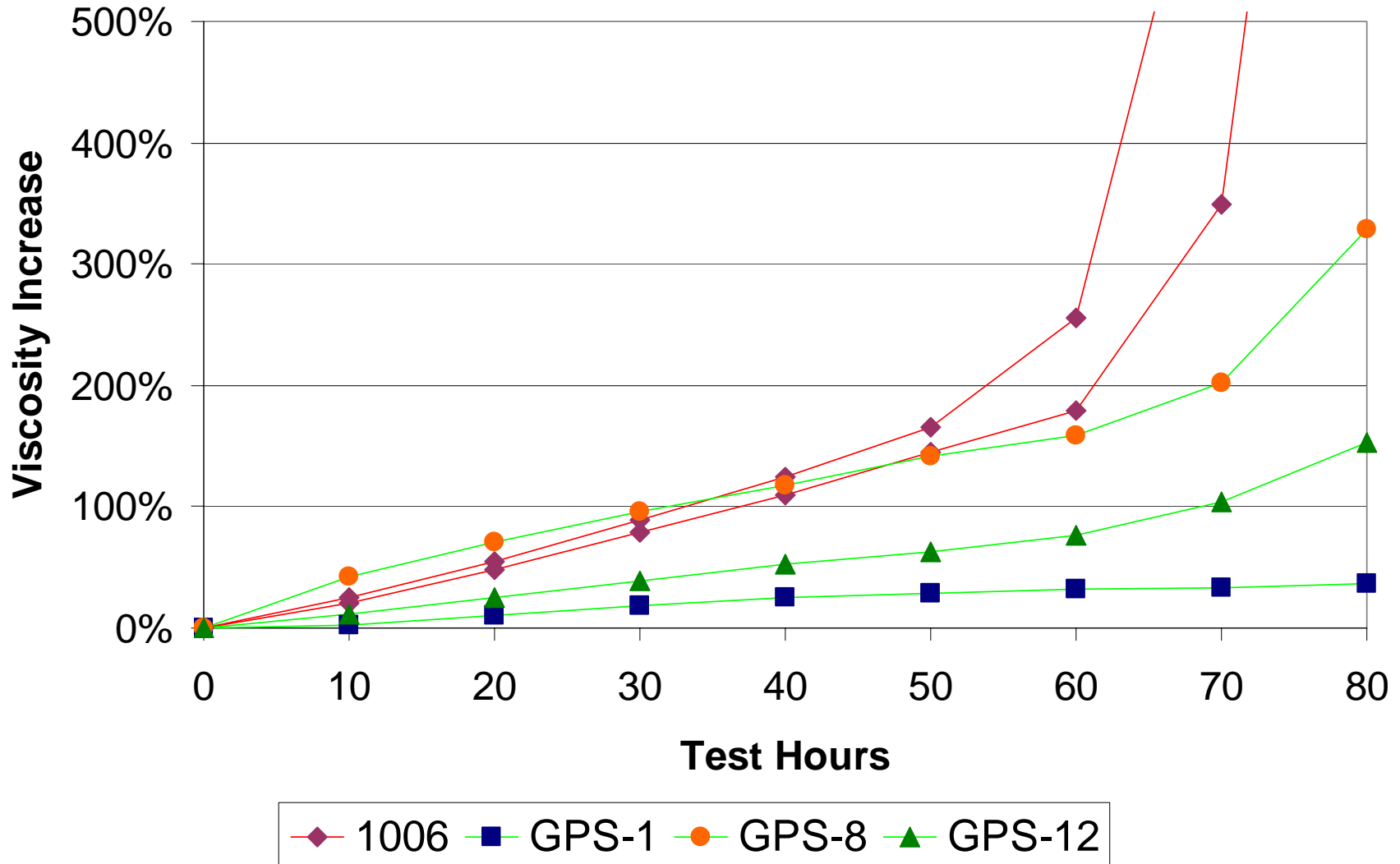
⁽⁴⁾ Single-point wear

⁽⁵⁾ Similar formulation styles tested in NYC taxis.

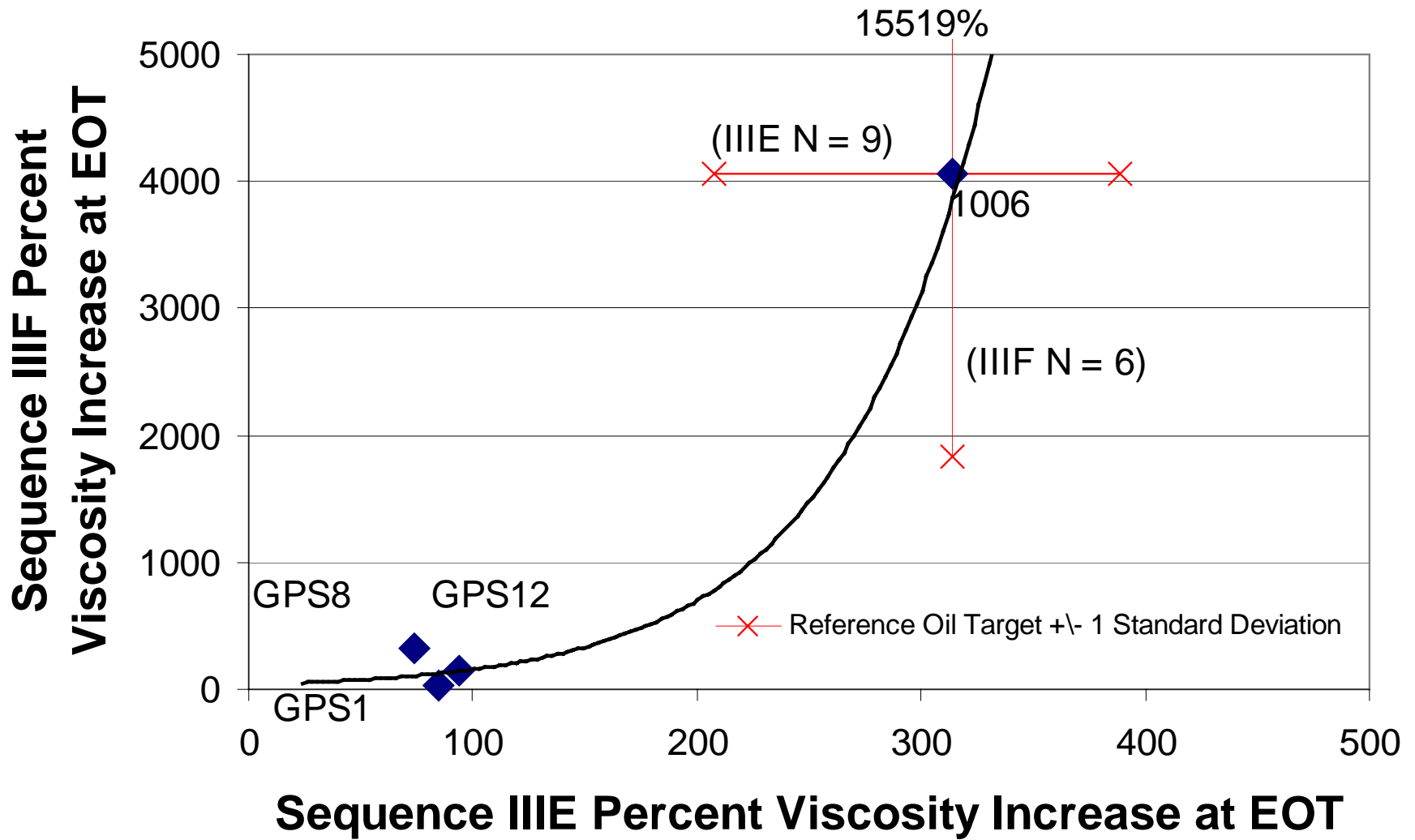
⁽⁶⁾ Same formulation as GPS8, with reduced amount of supplemental

⁽⁷⁾ Same formulation as GPS10, with reduced amount of supplemental

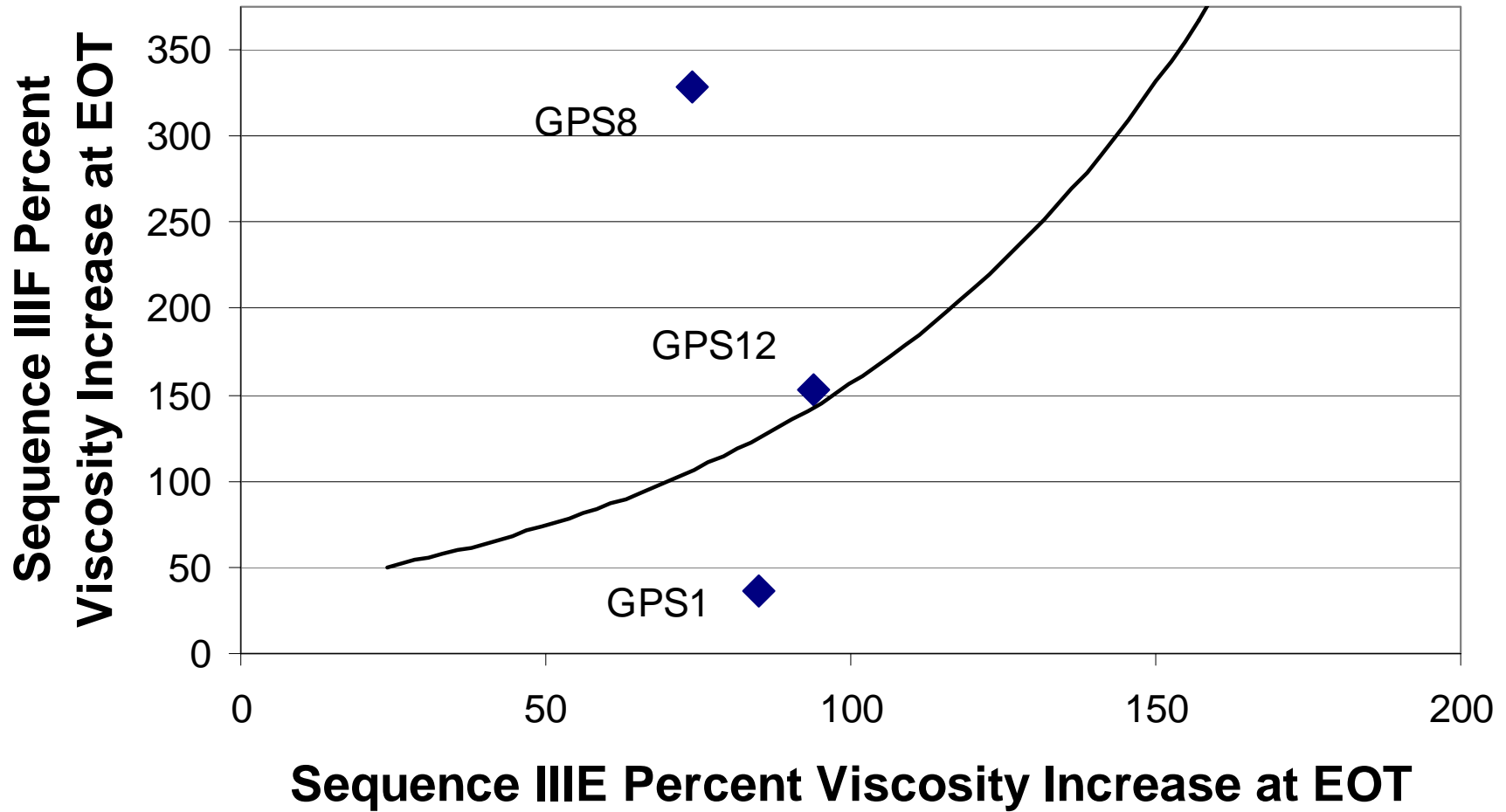
IIIF Discrimination Matrix Viscosity Increase



Sequence IIIF vs. IIIE Viscosity Increase



Sequence IIIF vs. IIIE Viscosity Increase



An Initial Look at Equivalency Limits in a Sequence IIF Test

**William Nahumck
Sequence IID/IIIE Surveillance Panel Chairman**

**Presented to HDEOCP
November 2, 2000
Chicago, IL**

Caveats

- 1. Data presented today is only one analysis done by one statistician, this is not a consensus position.**
- 2. Using only one oil, RO1006, which was considered borderline in the IIIE.**
- 3. This oil is a 5W-30.**
- 4. Other data is being gathered but has not been presented prior to today.**
- 5. Severity Adjustments will need to be developed if this concept is considered.**

Equivalency Limits in a Sequence IIIF Test

Using RO1006 data set from TMC for Acceptable Reference Tests

Estimated IIIE 375% Viscosity Increase at 64 hours

For a IIIF at 70 hours, the IIIE equivalent pass should be 995%.

For a IIIF at 60 hours, the IIIE equivalent pass should be 270%.

Estimated IIIE 200% Viscosity Increase at 64 hours

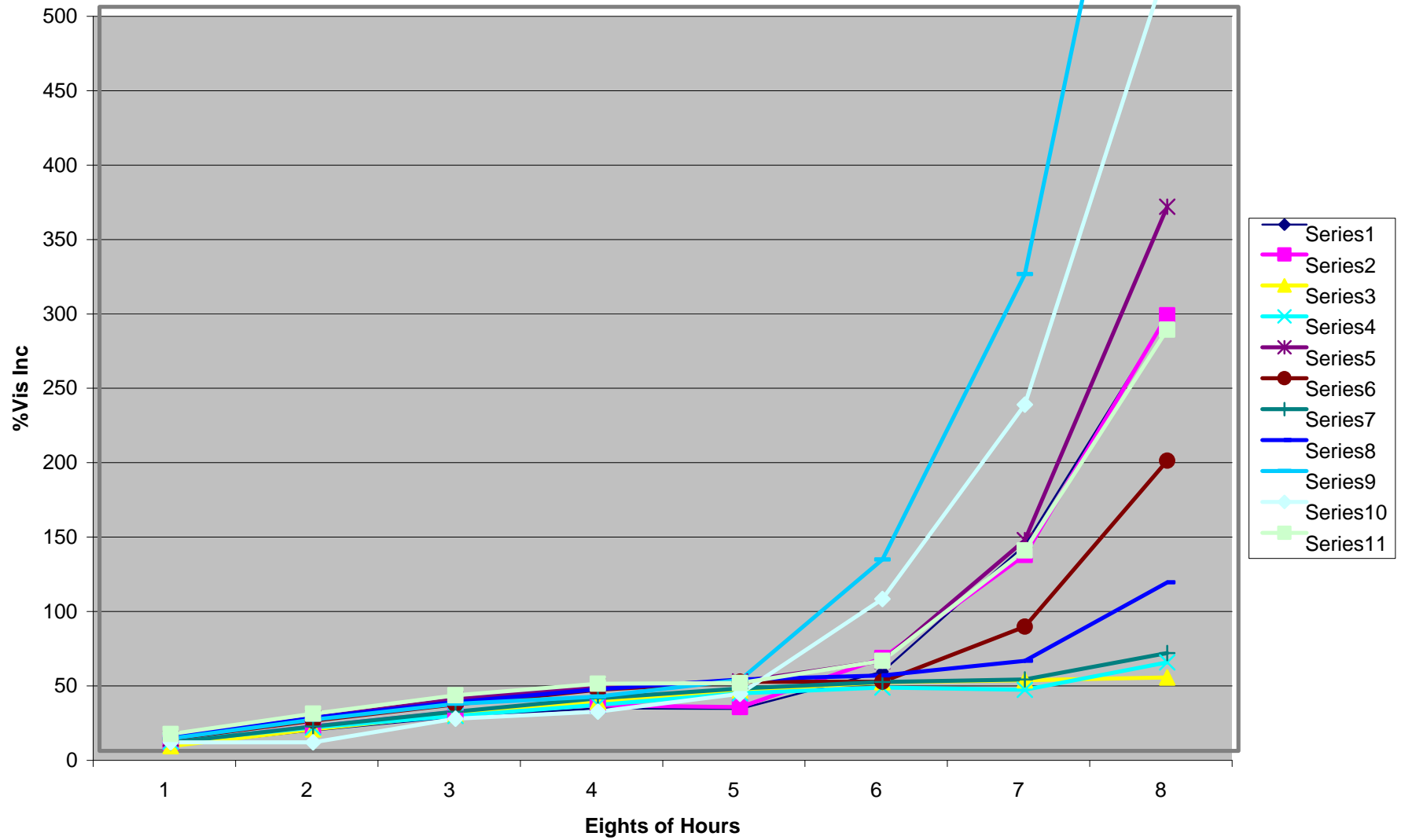
For a IIIF at 60 hours, the IIIE equivalent pass should be 240%.

Estimated IIIE 100% Viscosity Increase at 64 hours

For a IIIF at 60 hours, the IIIE equivalent pass should be 205%.

Remember Reference Oil 1006 is the GF-2 category oil and is a 5W-30.

III E %Vis Inc as a Function of Test Time for Oil 1006



IIIF %Vis Inc as a Function of Test Time for Oil 1006

