

HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL

OF

ASTM D02.B0.02

December 5, 2000

Opryland Hotel, Nashville, TN

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ACTION ITEMS

- | | | |
|----|--|---------------------------------------|
| 1. | Operational matrix test data to TMC within one week of EOT. | Matrix Labs |
| 2. | One gallon samples of all EOT matrix oils to Chris May. | Matrix Labs |
| 3. | Review matrix data after five tests. | 1Q, T-10, M-11 EGR Task Forces |
| 4. | 3F for 3E in previous C categories. | 3F/3E Task Force |
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MEETING MINUTES

- 1.0 Call to Order
 - 1.1 Chairman Jim McGeehan called the meeting to order at 1:05 p.m. on Dec. 5, 2000, in the Memphis A room of the Opryland Hotel in Nashville, TN. There were 13 members present or represented and approximately 68 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 and the Cat 1Q discussion was moved up to just after membership.
- 3.0 Meeting Minutes
 - 3.1 The minutes of the November 2, 2000 meeting were approved as posted on the TMC website.
- 4.0 Membership
 - 4.1 Ken Chao of John Deere was added as a member. Robert Stockwell will replace Bob Olree as a member from GM and Shawn Whitacre will replace John Graham as a member from Cummins.
- 5.0 Cat 1Q
 - 5.1 Dave Nycz presented a report on the Cat 1Q status (Attachment 3) and moved that the HDEOCP affirm the test ready to start matrix testing. Steve Kennedy seconded the motion. With regard to the data Dave presented, Charlie Passut asked if the means of oils 1005 and E4 still separated if a pooled standard deviation was used. Dave had not

made that calculation and did not know. Lew Williams was concerned with oil consumption on the test and felt that lately, oil consumption control has been worse than when the test first started. He stated that the results causing his concern may be chemistry related, but he wanted to know if anyone else had experienced similar concerns.....no response. The motion to agree that the 1Q is ready for matrix testing passed with 12 for, 0 against, 0 abstain.

6.0 PC-9 Matrix Status

6.1 John Zalar reported on the PC-9 matrix status (Attachment 4). He indicated that three T-10 matrix tests had started and one 1Q test. He stated that he and the other statisticians will confer on matrix results and conclusions before issuing any reports to the test task forces. He also stated that all matrix test results will be posted on the TMC website. The TMC needs to be notified of all matrix test aborts and EOT's as soon as possible. Likewise, they need to receive the test operational data, via comma delimited or Excel files, within one week of EOT.

6.2 Don Marn showed the Matrix Design Task Force changes requested at the Nov. 2, 2000 HDEOCP meeting (Attachment 5).

7.0 Mack T-10

7.1 Wim Van Dam reported on the T-10 status (Attachment 6) and talked about pausing the matrix to review the data from the first runs on the preferred oil. He plans to have a teleconference of the Task Force during the first week in January and a Task Force meeting the week of January 15th, if necessary.

8.0 Cummins M-11 EGR

8.1 Lew Williams expressed concern about lab-to-lab variability with the test (Attachment 7) and wanted to delay start of its matrix until the problem is resolved.

8.2 Shawn Whitacre reported on the last Task Force meeting and an engine build workshop, both held in San Antonio in mid-November. He showed the individual crosshead wear data from two of the recent Lubrizol tests (Attachment 8) and noted that data from a third test was not being considered because of high silicon levels in the oil. The individual results from the other two labs were very close except for four positions. The results from those four positions look like anomalies or outliers, but since there are two each, intake and exhaust, statistically, they could not be removed. Metallurgical data from several crossheads of this batch have looked very consistent, so it is quite possible that the significant wear differences have cropped up because of differences in the rocker levers. The rocker levers and possible operational differences are now being investigated.

9.0 PC-9 Matrix: Start, Pause, Review

9.1 Lew Williams moved and Charlie Passut seconded, to have each matrix test type pause after at least five test results are available on the featured oils, for review by the test type Task Force. The Task Force is to complete review of the data within one week of EOT of the fifth test. The TMC is not to issue a second oil for those stands until the Task Force gives the go ahead. The motion passed with 12 for, 0 against and 1 abstain.

10.0 PC-9 Timeline

10.1 Jim Wells presented the timeline update for Brent Shoffner (Attachment 9). Dick Kuhlman reminded the group that tests could be brought online individually, thus possibly shortening the overall timeline.

11.0 Elastomer Task Force

- 11.1 Dave Stehouwer presented the Elastomer Task Force report for Tom Boschert (Attachment 10) and noted that a ballot of the procedure in D11.15 received two negatives. It will be re-balloted next year after some round-robin work. The Task Force will meet in mid-January to review the procedure and re-write the ballot.
- 12.0 Emissions Status
 - 12.1 Greg Shank reviewed the latest twists in the fluctuating emissions saga. It seems there is now an initiative by certain states to have all diesel engine manufacturers use the European 13 mode plus the transient cycle and a Not-To-Exceed limit for the 2004 – 2007 timeframe.
- 13.0 III F / III E
 - 13.1 Bill Nahumck reviewed the proposed 3F limits to be used to demonstrate 3E performance for older passenger car categories (Attachment 11).
 - 13.2 Ralph Cherrillo questioned what was being proposed for older heavy duty categories which included the 3E. After a fruitless attempt soliciting a volunteer to chair a task force to work on this problem, Jim McGeehan said he would chair it himself. Among the volunteers then, to participate in this task force, were Pat Fetterman, Bill Nahumck, Charlie Passut, Lew Williams and Bill Kleiser.
- 14.0 Low Temperature Used Oil
 - 14.1 Steve Kennedy raised the question about which test type will be chosen to provide the “used” oil for low temperature viscosity evaluation.
 - 14.2 Chris May reported the LOTRUO group now has several labs running development evaluations on the ‘used’ oils already provided.
 - 14.3 Since the answer to Steve’s question has not been decided, it was agreed to provide Chris with one gallon samples from the EOT drain oil of each matrix test. This means Chris and his group should end up with 82 gallons of used oil from the matrix. It was noted each sample should be homogenized (ala the VIT8 procedure) before it is split.
- 15.0 L-38
 - 15.1 A similar scenario to the 3E/3F situation is developing with the L-38 / Seq. 8 tests. At some point in the future it may be necessary to consider use of the Seq. 8 results for older C categories which call for L-38 results.
- 16.0 Adjournment
 - 16.1 The meeting was adjourned at 3:03 p.m. The next meeting will be at the call of the chairman.

Submitted by:

Jim Wells
Secretary to the HDEOCP

OPRYLAND HOTEL

ATTACHMENT 1

NASHVILLE, TN

December 5th, 2000

Room: Memphis A

1:00 - 4:15 pm

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 OutcomeVoting members	Group	1:00 - 1:05
Minutes Approval	<ul style="list-style-type: none">November 2nd, 2000	Group	1:05 - 1:10
Membership	<ul style="list-style-type: none">Changes	Jim McGeehan	1:10 - 1:20
Status of Matrix Testing	<ul style="list-style-type: none">Mack T-10 EGRCummins M-11 EGR	John Zalar	1:20 - 1:45
Lab Severity	<ul style="list-style-type: none">Cummings M-11 Update	Lewis Williams	1:45 - 2:00
CAT 1Q Status	<ul style="list-style-type: none">Engine ShutdownsE-4 ResultsRecommendation of Surveillance PanelOil Consumption ConcernsVote on Recommendations for Matrix Testing	Dave Nycz Lewis Williams	2:00 - 2:45
PC-9 Time-Line	<ul style="list-style-type: none">Total Overview	Brent Shoffner	2:45 - 3:00
PC-10 Timing	<ul style="list-style-type: none">Emission Limits for 2007 moves to 2005 for 13 StatesImpact on timing for "PC-10"	Greg Shank Shawn Whitacre	3:00 - 3:15
Elastomers	<ul style="list-style-type: none">Task Force Report	Tom Boschert	3:15 - 3:30
IIIF/IIIE Limits	<ul style="list-style-type: none">Oxidation Limits to replace IIIE for other categories	Bill Nahumch	3:30 - 4:00
New/Old Business			4:00 - 4:15

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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	JMR	
Rumford, Robert H. Haltermann Products 1201 South Sheldon Rd. Channelview, TX 77530-0429	(281) 457-2768 (281) 457-1469 rhrumford@haltermann_usa.com	RHR	
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	
Rutherford, Jim Chevron Oronite 100 Chevron Way Richmond, CA 94802-0627	(510) 242-3410 (510) 242-1930 jaru@chevron.com	JR	
St. Germain, Bob Crompton Corp. 6847 Napier Lane Houston, TX 77069	(281) 587-2393 (281) 587-0338 robert_stgermain@cromptoncorp.com	RDS	

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

ATTENDANCE LIST

DECEMBER 5, 2000

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Sander, John Lubrication Engineers, Inc. 1919 E. Tulsa Wichita, KS 67216	(316) 529-2112 (316) 529-4654 sanderj@lubricationengineers.com	JRS	
Schuettenburg, Alex Phillips Petroleum 148 AL, PRC Bartlesville, OK 74004	(918) 661-3863 (918) 661-8060 adschue@ppco.com	ADS	
Selby, Ted Savant, Inc. 4800 James Savage Rd. Midland, MI 48642	(517) 496-2301 (517) 496-3438 tselby@savantgroup.com		
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	JS	
Shoffner, Brent Perkin Elmer 5404 Bandera Rd. San Antonio, TX 78238	(210) 647-9457 (210) 523-4607 brent_shoffner@perkinelmer.com		
Smith, Clinton Imperial Oil 111 St. Clair Ave. Toronto, Ontario M5W1K3	(416) 968-8308 (416) 968-5680 clinton.smith@esso.com	CRS	
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		

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SECTION D.02.B0.02

HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

DECEMBER 5, 2000

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Stehouwer, Dave Cummins Engine Co. Box 3005, MC 50183 Columbus, IN 47202	(812) 377-9209 (812) 377-7808 david.m.stehouwer@cummins.com	DMS	
Stevens, Mark G. Infineum USA LP. P.O. Box 735 Linden NJ 07036	(908) 474-2700 (908) 474-3637 mark.stevens@infineum.com	MS	
Sutherland, Mark Ethyl Corporation 9901 IH10 West, Suite 800 San Antonio, TX 78230	(210) 558-2818 (210) 696-4029 mark_sutherland@ethyl.com	MS	
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 rftucker@shellus.com		
Van Dam, Wim Chevron Oronite P.O. Box 1627 Richmond, CA 99802	(510) 242-1404 (510) 242-3173 wvda@chevron.com	WVD	

ASTM**SECTION D.02.B0.02
HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL****ATTENDANCE LIST****DECEMBER 5, 2000****PREVIOUS GUESTS**

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Venier, Cliff Pennzoil-Quaker State P.O. Box 7569 The Woodlands, TX 77381-2539	(281) 363-8060 (281) 363-8002 cliffordvenier@pzlqs.com	CV	
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		
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	
Ziemer, Jim Chevron Products Co. 100 Chevron Way Richmond, CA 94802	(510) 242-2362 (510) 242-1156 jnzi@chevron.com	JNZ	

ASTM**SECTION D.02.B0.02
HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL****ATTENDANCE LIST****DECEMBER 5, 2000****GUESTS**

	Phone No. Fax No. e-mail add.	ROOM FEE
Name: <u>Marv Hart</u>	<u>(913) 441-7160</u>	
Company: <u>Century Lubricants</u>	<u>(913) 441-2333</u>	
Address: <u>2140 S. 88th St.</u> <u>Kansas City, KS 66111</u>	<u>mhart@centurylub.com</u>	
Name: <u>Barb Berzinis</u>	<u>(708) 458-2261</u>	
Company: <u>ITS Caleb Brett</u>	<u>(708) 458-3368</u>	
Address: <u>7315 S. 76th Ave.</u> <u>Bridgeview, IL 60455</u>		
Name: <u>Ben Weber</u>	<u>(210) 522-5911</u>	
Company: <u>Southwest Research Institute</u>	<u>(210) 684-7530</u>	
Address: <u>6220 Culebra Rd.</u> <u>San Antonio, TX 78238</u>	<u>bweber@swri.edu</u>	
Name: <u>Jeff Clark</u>	<u>(412) 365-1032</u>	
Company: <u>ASTM TMC</u>	<u>(412) 365-1047</u>	
Address: <u>6555 Penn Ave.</u> <u>Pittsburg, PA 15206</u>	<u>jac@tmc.astm.cmri.cmu.edu</u>	
Name: <u>Michael Zaiontz</u>	<u>(210) 647-9483</u>	
Company: <u>Perkin Elmer</u>	<u>(210) 523-4607</u>	
Address: <u>5404 Bandera Rd.</u> <u>San Antonio, TX 78238</u>	<u>mike.zaiontz@perkinelmer.com</u>	
Name: <u>Jim Paboucek</u>	<u>(410) 682-9408</u>	
Company: <u>Castrol HD Lubricants</u>	<u>(410) 780-8632</u>	
Address: <u>9300 Pulaski Highway</u> <u>Baltimore, MD 21220</u>	<u>jim_paboucek@burmahcastrol.com</u>	
Name: <u>Vijam N. Reddy</u>	<u>(650) 688-7075</u>	
Company: <u>Thermo Haake</u>	<u>(650) 688-7202</u>	
Address: <u>Thermal Lab, 149 Commonwealth Dr.</u> <u>Menlo Park, CA 94025</u>	<u>vijam.reddy@thermohaake.com</u>	
Name: <u>Jim Ferrara</u>	<u>(201) 265-7865_x428</u>	
Company: <u>Thermo Haake</u>		
Address: <u>53 W. Century Rd.</u> <u>Paramus, NJ 07652</u>	<u>jim.ferrara@thermohaake.com</u>	

ASTM**SECTION D.02.B0.02
HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL****ATTENDANCE LIST****DECEMBER 5, 2000****GUESTS**

	Phone No. Fax No. e-mail add.	ROOM FEE
Name: <u>Dennis Malandro</u>	<u>(908) 474-3895</u>	
Company: <u>Infineum USA LP</u>	<u>(908)474-2298</u>	
Address: <u>1900 E. Linden Ave.</u> <u>Linden, NJ 07036</u>	<u>dennis.malandro@infineum.com</u>	
Name: <u>Mark Matson</u>	<u>(419) 421-4239</u>	
Company: <u>Marathon Ashland Petroleum, LLC</u>	<u>(419) 421-2264</u>	
Address: <u>539 S. Main</u> <u>Findlay, OH 45840</u>	<u>mlmatson@mapllc.com</u>	
Name: <u>Carl Stephens</u>	<u>(606) 329-5198</u>	
Company: <u>Ashland Inc.</u>	<u>(606) 329-3009</u>	
Address: <u>22nd and Front Streets</u> <u>Ashland, KY 41101</u>	<u>cstephens@ashland.com</u>	
Name: <u>Mark Sarlo</u>	<u>(210) 522-3754</u>	
Company: <u>Southwest Research Institute</u>	<u>(210) 523-6919</u>	
Address: <u>6220 Culebra Road</u> <u>San Antonio, TX 78238-5766</u>	<u>msarlo@swri.org</u>	
Name: <u>James McCord</u>	<u>(210) 522-3439</u>	
Company: <u>Southwest Research Institute</u>	<u>(210) 523-6919</u>	
Address: <u>6220 Culebra Rd.</u> <u>San Antonio, TX 78238-5766</u>	<u>jmccord@swri.org</u>	
Name: <u>Irwin Goldblatt</u>	<u>(732) 980-3606</u>	
Company: <u>Castrol NA</u>	<u>(973) 686-4224</u>	
Address: <u>240 Centennial Ave.</u> <u>Piscataway, NJ 08854</u>	<u>irwin.goldblatt@castrolna.com</u>	
Name: <u>Tom Kiovsy</u>	<u>(440) 248-3198</u>	
Company: <u>Fuels & Lubes Asia</u>		
Address: <u>33078 Allenbury Drive</u> <u>Solon, OH 44139</u>	<u>t.kiovsy@att.net</u>	
Name: <u>Michael Weismiller</u>	<u>(914) 785-5515</u>	
Company: <u>Ciba Spec. Chemicals</u>		
Address: <u>540 White Plains Rd.</u> <u>Tarrytown, NY 10591</u>	<u>michael.weismiller@cibasc.com</u>	

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

ATTENDANCE LIST

DECEMBER 5, 2000

GUESTS

	Phone No. Fax No. e-mail add.	ROOM FEE
Name: <u>Luis Mulford</u>	<u>(517) 496-2301</u>	
Company: <u>Savant</u>		
Address: <u>4800 James Savage Rd.</u> <u>Midland, MI 48642</u>	<u>savant@savantgroup.com</u>	
Name: <u>Jerry Wilkins</u>	<u>(610) 859-1663</u>	
Company: <u>Sunoco Inc.</u>		
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Name: <u>Paul Strigner</u>	<u>(613) 746-0647</u>	
Company: <u>31 Seguin St.</u>	<u>(613) 746-9292</u>	
Address: <u>Ottawa, Ontario</u> <u>Canada K1J 6P2</u>		
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.

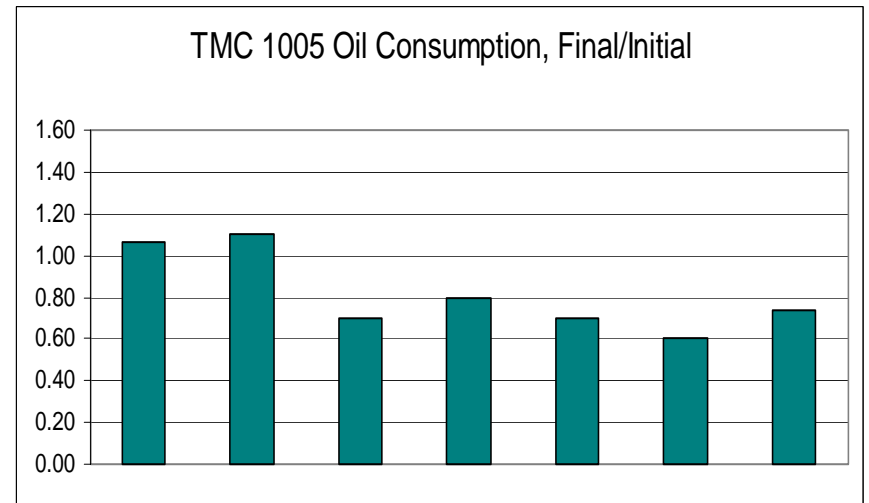
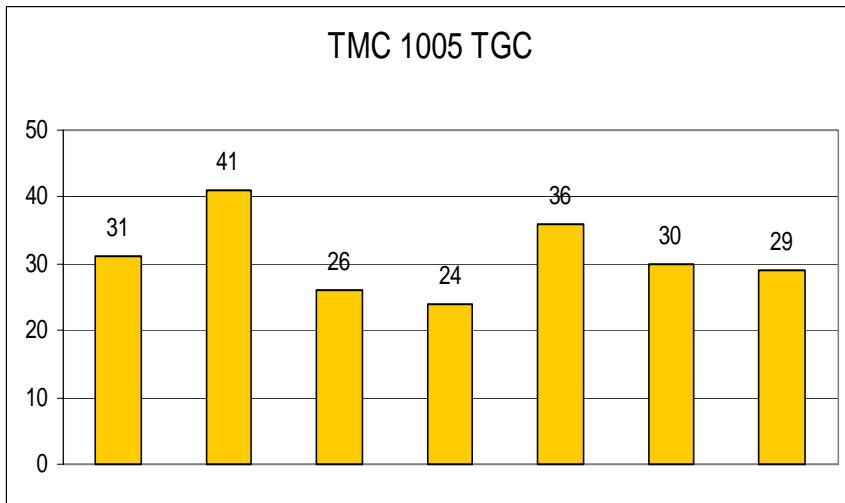
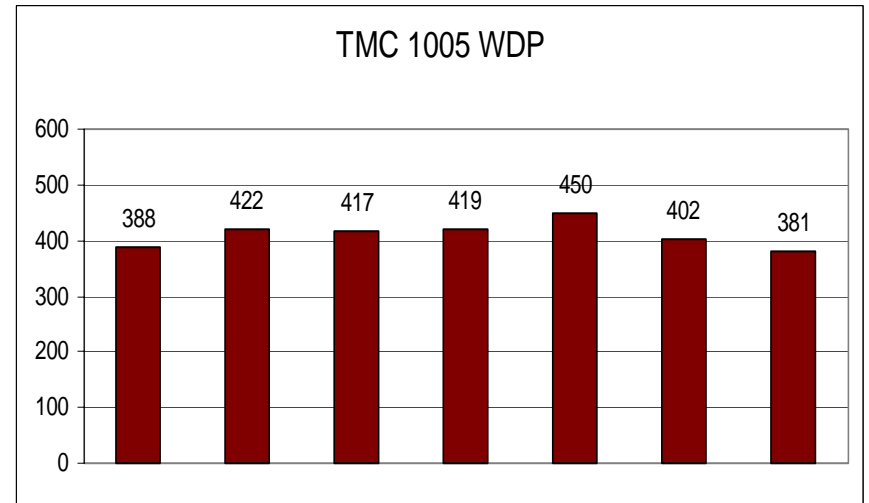
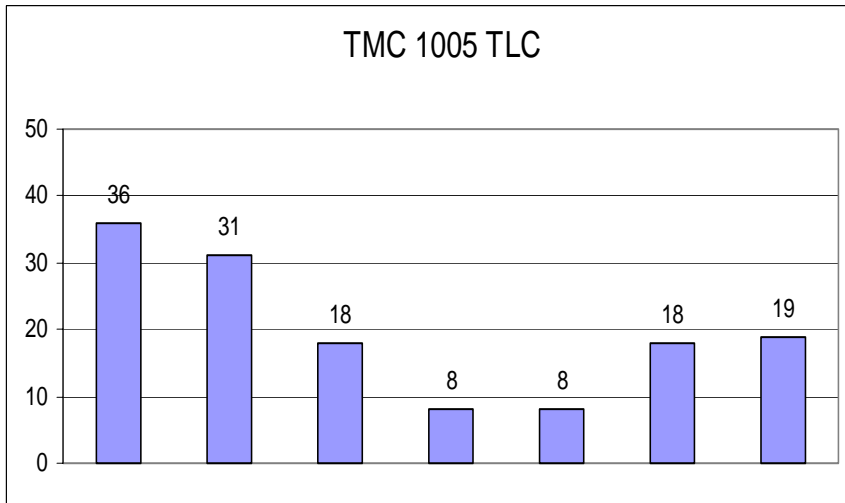
1Q Test Report for PC-9 Precision

- 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.

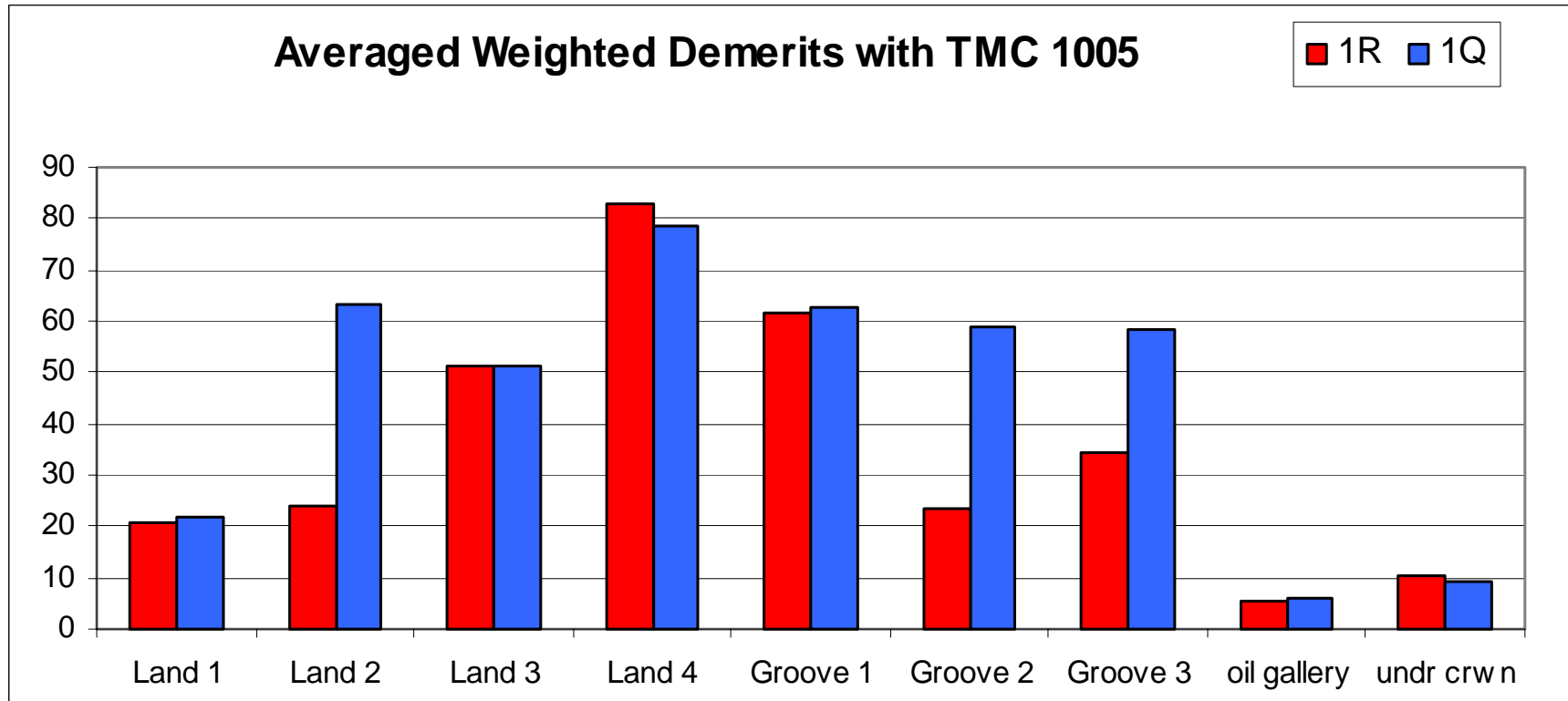
1Q Test Report for PC-9 Deposits

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



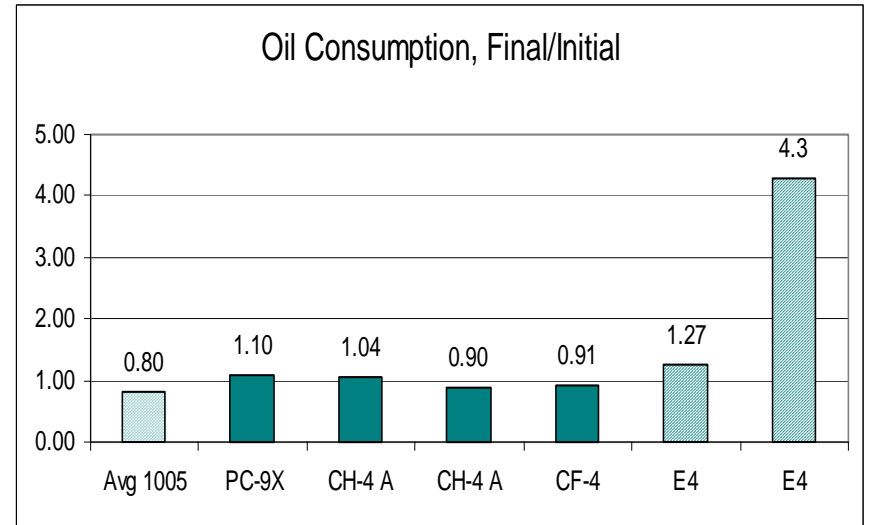
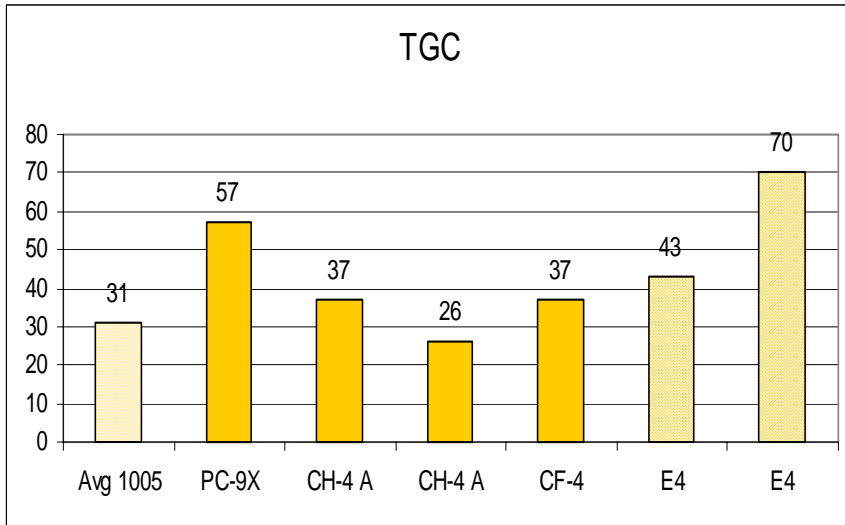
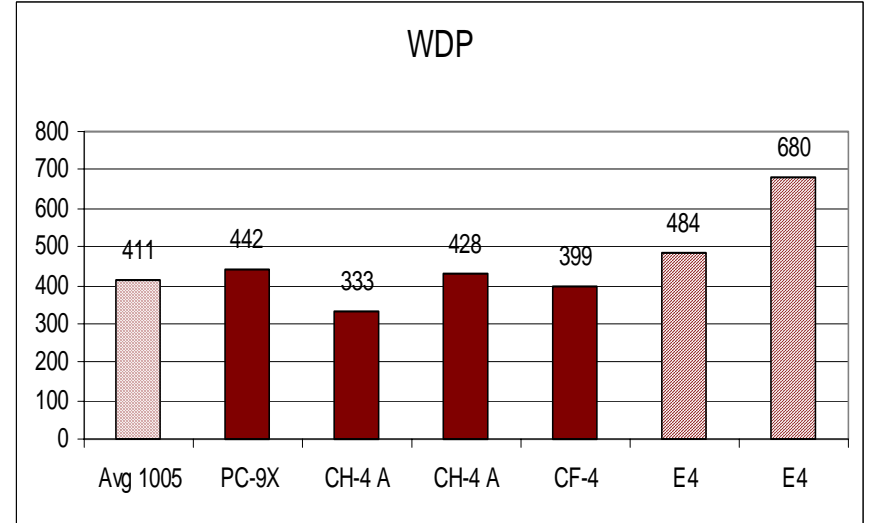
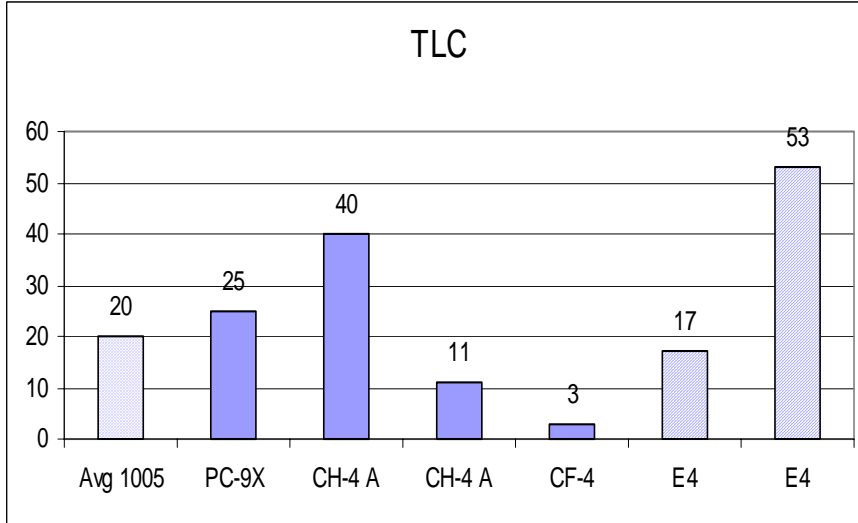
► Effects of EGR on Deposits

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

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

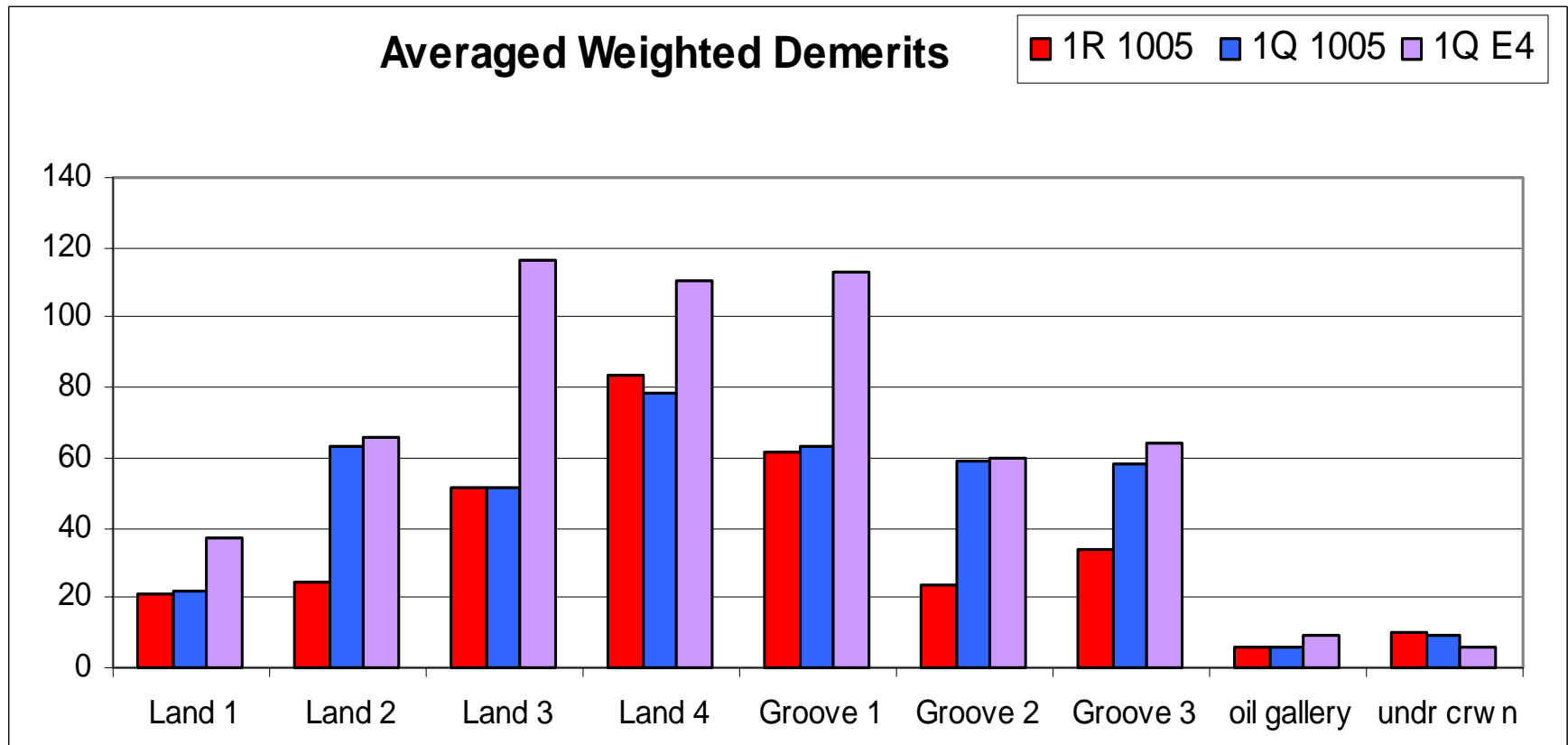
- Several oils were tested to identify performance differences.
- None of these oils provided adequate deposit control for the lower part of the piston.
 - Oils Tested
 - ✧ PC-9X
 - ✧ CH-4 15W-40
 - ✧ CF-4 15W-40
 - ✧ ACEA E4 10W-40

1Q Test Report for PC-9 Discrimination



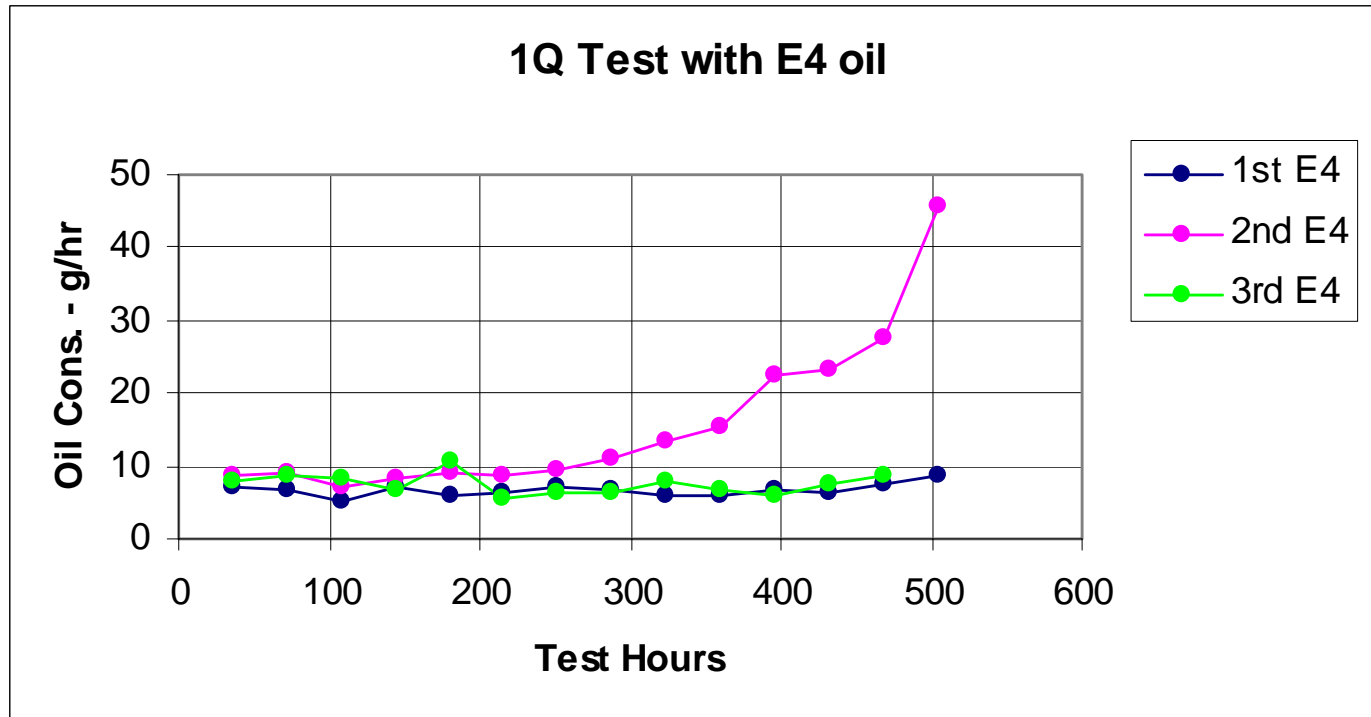
ATTACHMENT 3, 9 OF 15

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.

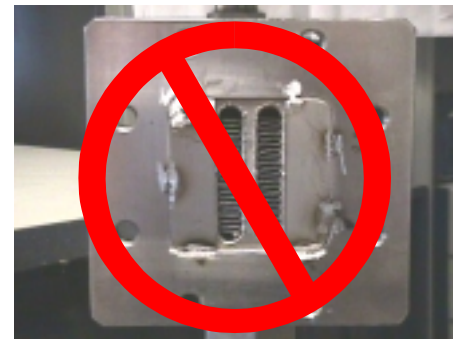
1Q Test Report for PC-9 Discrimination

- 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.

PC-9 Matrix Status Report

Presented to
ASTM Heavy Duty Engine Oil
Classification Panel
December 5, 2000

Matrix Oils

- All 9 oils have been blended and verified
- All labs have received oils needed to begin matrix testing
- First runs in all matrix stands will be on the “featured oil”

Test Starts / Completions

Test Type	Planned Tests	Tests Started	Invalid Tests	Completed Tests
T-10	28	3	0	0
M11-EGR	26	0	0	0
1Q	28	1	0	0

PC-9 Matrix Design Task Force

Status Report

To

ASTM Heavy Duty

Engine Oil Classification Panel

December 5, 2000

(Modified to address Changes Requested
by the HDEOCP on November 2, 2000)

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 (The Movie*)

PC-9 Matrix Design Task Force

Revised -- November 10, 2000

PC-9 Matrix Design Task Force Update

I. Assumptions

- o 3 DI/VI combinations, 3 base oils, and 1 Featured Oil/Test type**
- o Every factor level should be run at least 3 times to maintain Power, and at least 4 valid test results in each Matrix 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 Main effects and 2-Way Interactions (Except with Stand) are estimable**
- o Independent Labs must run the majority of the Featured Oils (HDEOCP)**
- o Dependent Labs are Limited to 4 runs per stand (HDEOCP)**
- o Featured Oils should be run first in the Matrix (HDEOCP)**
- 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)

	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

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.

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
A	A	A	A	A	A	A
G	A	G	D	A	A	D
E	E	B	H	E	H	B
C	J	F	C	J	F	J

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
E	E	E	E	E	E
H	E	H	B	E	B
A	G	D	G	A	D
F	C	C	F	J	J
E			E		

PC-9 Matrix Design Task Force Update

V. 1Q/ EGR Test Design

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

PC-9 Matrix Design Task Force Update

VI. NOTES

- o The Featured Oil is run 10 Times in every Test
- o Each Stand Tests every Base Oil and Technology

PC-9 Matrix Design Task Force Update

Proposed Timeline:

- **PC-9 Formulations Matrix**
 - Technologies Selected *April 11, 2000*
 - Technologies Available *September 7, 2000*
 - Base Oils Available *October 10, 2000*
 - Blends Prepared (Available) *November 27, 2000*

- **PC-9 Matrix Testing**
 - Matrix Start *December 2000*
 - Matrix Completion *March 2001*
 - Data Evaluation Completed *April 30, 2001*



Mack T 10 Test Status

- Matrix Ready - Sept 20
- Task Force Conference Call Nov 7
- Conference Call & Lab Visit wk of Nov 13
- Matrix Started in 3 stands (2 Labs)
- Next 4 Stands (3 Labs) to start on or before Dec 11
- All 7 stands to finish 1 Test before end of year
- Task Force Meeting Mid January to evaluate data

**Lubrizol Presentation
to the
HDEOCP on
M-11 EGR Crosshead Wear
Lab-to-Lab Variation**

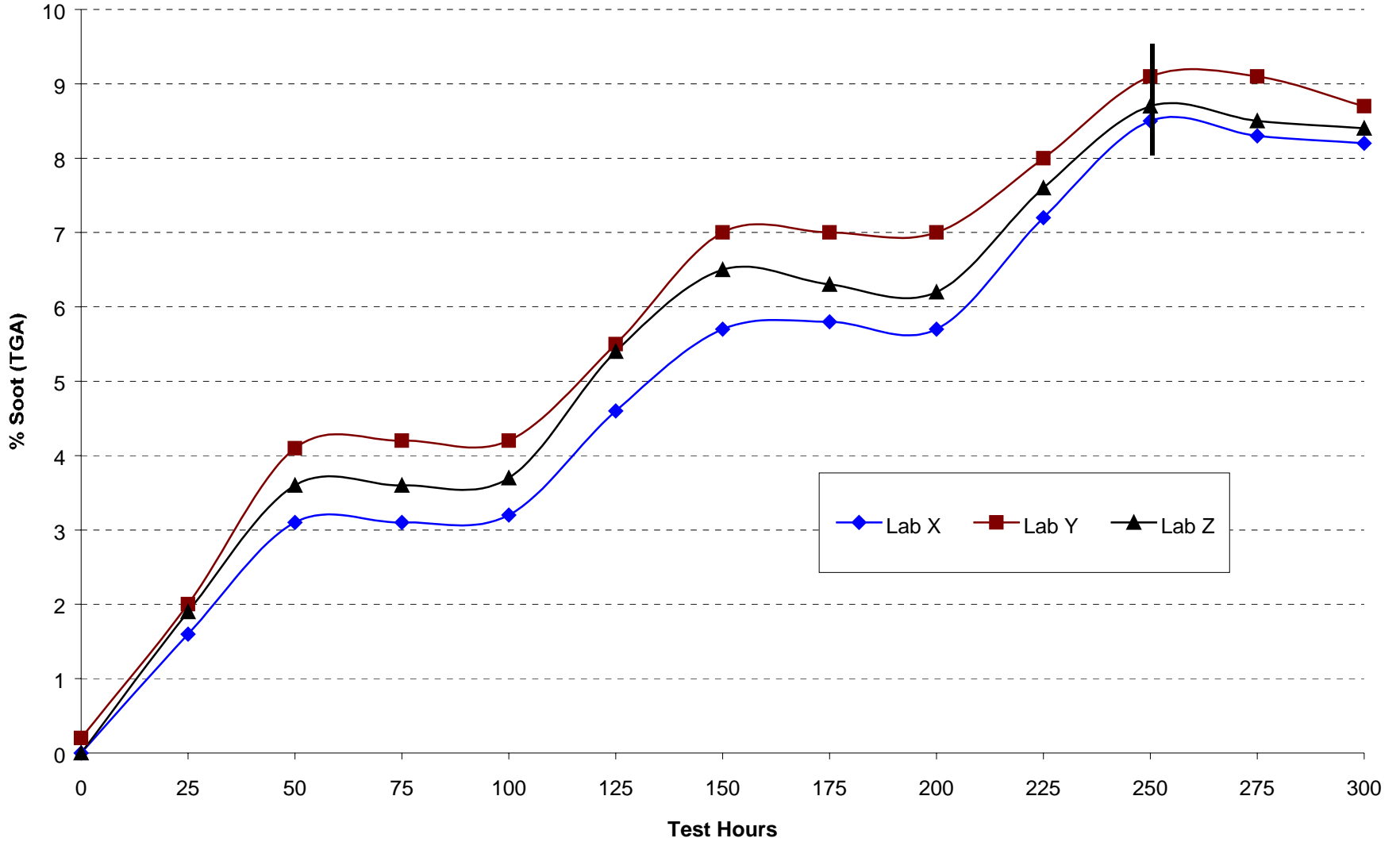
December 5, 2000

M-11E GR Test Results

Oil	C*	C	C
Lab	X	Y	Z
Avg. Crosshead Wear, mgs	7.2	26.1	62.2
Avg. Crosshead Wear @8.5% Soot, mgs	7.2	21.0	56.6
% Soot at 250 hrs.	8.5	9.1	8.7
EOT Date	11/27/00	11/22/00	11/28/00

*15W40 PC-9 Prototype – Single blend ran at all three labs

M11 EGR Soot Generation



Conclusions

- The data represents a direct lab-to-lab comparison of M-11 with EGR crosshead wear on the exact same oils.
- All three labs reported that they ran a clean valid test with no anomalies.
- Lubrizol has serious reservation concerning the lab-to-lab variation on the critical crosshead wear parameter.
- We would like to see data from other stakeholders to either support or refute these results.
- We, as an industry, need to investigate further.

Recommendations

- Additional time is needed to allow for the investigation of M-11 EGR crosshead wear variability before we start the matrix. Time is available with no delay in the completion of the overall matrix if we start the M-11 EGR matrix such that it will EOT at the same time as the longest test, the CAT 1Q.
- Continue to investigate parts, build, and procedure for root causes of the crosshead wear lab-to-lab variability.

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

PC-9 Timeline Notes

Brent Shoffner 12/5/2000

- 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	<i>11/17/00</i>	<i>12/05/00</i>
M11 EGR	<i>11/09/00</i>	<i>11/17/00</i>
T-10	<i>10/07/00</i>	<i>09/20/00</i>

- Featured oils are available to start the Precision Matrices
- The last 1Q Stand in the Precision Matrix is projected to start *12/12/2000*.
- The PC-9 “license allowed date” is currently *August 2002* assuming a one year test period.
- Based on experience with the current ASTM system, the “API License Date” will be later than November 2002.

Summary of Events Required for PC-9 Licensing

Brent Shoffner 12/5/2000

ID	Task Name	Start	Finish	1999				2000				2001				2002		
				Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1																		
2	Define PC-9 Performance Parameters	Tue 03/16/99	Tue 03/16/99															
3	Design Prec. Mtx. Appr. API Lubes Commr	Wed 03/17/99	Wed 05/31/00	[Blue Bar]														
4	PC-9 Funding MOA Signed	Mon 01/03/00	Fri 11/10/00					[Red Bar]										
5	1Q & M11EGR adequate for oil devel.	Mon 05/15/00	Mon 05/15/00						◆									
6	Finalize Base Oil selections for Prec. Mtx.	Wed 05/31/00	Wed 05/31/00						◆									
7	Finalize Additive selections for Prec. Mtx.	Thu 01/06/00	Fri 06/30/00					[Blue Bar]										
8	Base Oils Recd by Additive Companies	Mon 07/03/00	Wed 09/20/00							[Blue Box]								
9	Blend Prec. Mtx. Oils>TMC>Labs **	Thu 09/21/00	Mon 11/27/00							[Blue Box]								
10	Final Acceptance of New Engine Tests	Tue 12/05/00	Tue 12/05/00															
11	PC-9 Demonstration Oil is Validated	Tue 04/24/01	Tue 04/24/01															★
12	PC-9 Precision Matrix Testing (1Q)**	Tue 12/12/00	Mon 04/23/01															★
13	Precision Matrix Data Analysis	Tue 04/24/01	Mon 05/07/01															
14	HDEOCP Post Matrix Test Acceptance	Tue 05/08/01	Wed 06/06/01															
15	CMA Registrations Allowed	Thu 06/07/01	Wed 07/04/01															
16	Finalize Pass/Fail Criteria (Sub B Mtg)	Thu 06/07/01	Mon 08/20/01															
17	New Product Development	Tue 08/21/01	Tue 08/20/02															
18	API Licensing Allowed	Wed 08/21/02	Wed 08/21/02															★

** Last 1Q Stand

ASTM PC-9 Elastomer TF Report
To D02.B HDEOCP
December 5, 2000

- The PC-9 Elastomer Test Procedure has been balloted in D11.15.
 - There were 2 Negatives received, one which will be upheld
 - Resolution of the negative has been tentatively agreed to but involves a round robin w/in D11.15
 - New ballot to be issued for the next D11.15 meeting in June 2001. After talking with negative voters, it is expected to pass.
 - Tom Boschert will be attending the D11.15 meeting Dec. 6 in Orlando to help ensure this happens as presented

- A large batch of elastomer sheets for all 4 elastomer types (PC-9 Elastomer Test Rubber Sheets) has been procured and is available through OH Technologies

- The Task Force will be meeting January 16 in San Antonio
 - Review Final Standard write-up for re-ballot in D11.15
 - Review Oil Test Data (including PC-9 matrix oils) for selection of reference oils – Several oils have been identified as most likely candidates for reference oils (note: this does not preclude additional reference oils)
 - Agree on Statistical methodology

- The negative in D11.15 will result in a better procedure but approval is delayed until June 2001. This will not affect the ability to include an elastomer requirement in PC-9.

Tom Boschert
Leader, PC-9 Elastomer TF

***Report from the
Sequence III F Surveillance Panel For
Proposed SJ And SJ-Related Limits***

*PCEOCP Meeting
Nashville, TN
December 5, 2000*

William M. Nahumck
Chairman, Sequence III F Surveillance Panel

The proposed SJ And SJ-Related Limits are from the data presented at the Sequence IID/IIIE Surveillance Panel meeting held on November 17, 2000 in San Antonio, Texas.

- Presentations were given from Ethyl, Oronite, Infineum and Lubrizol.
- Reference Oil 1006, the GF-2 Category Oil, was the primary source of the data used for making our recommendation. This oil has the largest multiple test database for both the IIIE and IIIF tests.
- Other GPS matrix oils were included as well as some proprietary data. Most of these were one-to-one comparisons.
- The Surveillance Panel used a simplified approach for implementing backward compatibility that utilizes the existing LTMS and SA system. Desirable to utilize the same test procedure and reporting system.
- The Sequence IID/IIIE Surveillance Panel moved to submit the following recommendation for SJ And SJ-Related Limits to the PCEOCP:

Recommendation from the Sequence IIIF Surveillance Panel for PROPOSED SJ AND SJ-RELATED LIMITS

Test	Rated Parameter	Current SL Limits	SJ Equivalent Limits
IIIF	40C % Vis Increase @ 80 Hours, Max	275	NA
	40C % Vis Increase @ 60 Hours, Max	NA	325¹
	WPD, Min	4.0	3.2²
	PSV, Min	9.0	8.5²
	Hot Stuck Rings, Max	None Allowed	None Allowed²
	Oil Consumption, Max	5.2	6.5^{2,3}

- 1 Percent viscosity increase is determined at 60 test hours. The TMC will develop a severity adjustment system based on reference test data at 60 hour.
- 2 The Sequence IIIF for SJ is run under standard conditions (80 hours).
- 3 Oil consumption is only for test interpretability. Any test exceeding this value is to be labeled as “not interpretable” for the purposes of MTAC.