HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
May 10, 2001
Sheraton World Resort, Orlando, FL

ACTION ITEMS

1.	**Resolve lead and rod bearing weight loss variability.**	**T-10 Task Force**
2.	**Resolve filter pleat collapse effect on filter delta P.**	**M-11 EGR Task Force**
3.	**IR Oxidation data loaded on TMC website.**	**Joe Franklin**
4.	**Piston Deposit Task Force.**	**Bill Kleiser**
5.	**Letter to Seq. III S. P. regarding 60 hr. III F data.**	**Jim McGeehan**

MEETING MINUTES

1.0 Call to Order

1.1 Chairman Jim McGeehan called the meeting to order at 8:07 a.m. on May 10, 2001, in the Indian room of the Sheraton World Resort of Orlando, Florida. There were 13 members or representatives present, along with approximately 25 guests. The attendance list is shown as Attachment 2.

2.0 Agenda

2.1 The announced agenda (Attachment 1) was reviewed and John Zalar will give a PC-9 matrix update after membership review.

2.2 The summer meeting schedule is shown as Attachment 3.

2.3 Greg Shank presented Dan Larkin with an award for serving as the EMA Lubricants Committee chairman for so many years.

3.0 Previous Meeting Minutes

3.1 The minutes of the February 22, 2001 meeting in Chicago were approved as posted on the TMC website.

4.0 Membership

4.1 Mark Rees of Ethyl will replace Charles Passut as a member.

5.0 PC-9 Matrix Update

5.1 John Zalar presented an update on the status of PC-9 matrix testing (Attachment 4). There was some discussion with regard to the time allotted for new product development, currently shown as 9 months in the timeline, but that is not “official”.

6.0 Mack T-10

6.1 Greg Shank gave an update on T-10 matrix status (Attachment 5) and indicated there was some unanticipated variation in lead and rod bearing weight loss. Some tests may need to be re-run, but he felt preliminary matrix analysis will be done by the June ASTM meeting.

7.0 Cummins M-11 EGR

7.1 Dave Stehouwer reported on the M-11 EGR matrix status (Attachment 6) and on proposed soot normalization schemes (Attachment 7). He also revealed that some of the variation seen in oil filter delta pressure may be the result of filter pleat pinching. The test filters were built without any hot melt glue bands which help keep the filter media pleats from bunching together and thus effectively reduce the media surface area available for flow. See the picture in Attachment 6.

8.0 Oxidation

8.1 Dwayne Tharp was missing in action at the time, so Joe Franklin reported on the IR Oxidation T.F. status (Attachment 8) and noted they have standardized on IR units per cm of cell thickness. They are also looking at revisions to the TAN method to help reduce its variability. Chairman McGeehan stressed that the IR oxidation data for the matrix tests needs to be loaded on the TMC website and all the available data should be ready by the May 25th meeting.

8.2 Jim Ziemer presented concerns his organization has with IR oxidation determination (Attachment 9). He feels that normalization for soot content should occur if IR analysis for oxidation is adopted. Ted Selby suggested that perhaps soot in the samples could be removed using membrane dialysis. Jim Ziemer felt that perhaps the Seq. III F test with no soot would be a better approach to oxidation resistance demonstration.

8.3 Dave Stehouwer felt that the category should stick with a diesel test.

8.4 Greg Shank showed some slides from the Rich Lee oxidation task force which indicate that EGR has an effect on oxidation (Attachment 10).

9.0 CAT 1Q

9.1 Dwayne Tharp gave an update on the 1Q matrix status (Attachment 11) and said the task force had a teleconference scheduled for the next day (May 11) to discuss recent problems.

10.0 Piston Deposits

10.1 In light of the 1Q report, there was lengthy discussion with regard to piston deposit results from the T-10 and M-11 EGR matrix tests. That data has been collected, but not posted, on the TMC website. Both test sponsors will work to get their test’s weighted deposits and oil consumption data posted.

10.2 Steve Kennedy suggested that a task force be formed to look at deposits from these other tests, along with the 1Q data. Bill Kleiser "volunteered" to form this task force and was supported by "volunteers" Lew Williams, Greg Shank, Steve Kennedy, Mark Rees, Dave Stehouwer and Dwayne Tharp.

11.0 Low Temperature Pumpability

11.1 Chris May presented an update on the LOTRUO work (Attachment 12) and indicated significant progress in method development. He expects they will have statistical analysis of their testing completed by the June ASTM meeting and will be able to issue a research report shortly thereafter.

11.2 Dave Stehouwer showed some data from a proprietary cold room study looking at time to oil for various fresh and sooted oils (Attachment 13). Since they had also looked at the cold temperature viscosities, he felt that a much lower limit than currently exists is warranted for viscosity at cold temperatures.

12.0 Elastomer Compatibility

12.1 Mark Rees presented the Elastomer Task Force report for Tom Boschert (Attachment 14). Round robin tests are underway. Data and the procedure are posted on the TMC website. They plan to have all the testing completed and the data analyzed by the July meeting.

13.0 Other PC-9 Limits

13.1 Greg Shank spoke about limits for tests other than the new engine tests. He indicated that the T-8E limit for PC-9 may come down. He then addressed the high temperature, high shear issue for multi-vis 30 grade oils (Attachment 15). and indicated the EMA felt a minimum of 3.5 cP is needed.

13.2 Dan Larkin requested that "exit ballots" be used again for the less controversial, older tests and Chairman McGeehan agreed to use them.

14.0 Backward Compatibility

14.1 Bill Kleiser made a pitch for backward compatibility of oils meeting PC-9 requirements (Attachment 16). Lew Williams seconded Bill's motion that it be the intent of the HDEOCP that oils meeting PC-9 requirements would be deemed as also fulfilling CH-4 requirements. The motion passed with 11 for, 0 against and 0 abstains.

15.0 Seq. III F for Seq. III E

15.1 Lew Williams reported for the Seq. III E Replacement Task Force (Attachment 17). They proposed limits using the Seq. III F in place of the Seq. III E of 325% @ 60 hours for CG-4 heavy duty oils and 295% @ 60 hours for CH-4 oils. Pat Fetterman raised concerns that the LTMS system would not provide alerts or severity adjustments for 60 hour results. After some discussion, it was proposed that the LTMS system could monitor the 60 hour data as well as the 80 hour data, but the Sequence III Surveillance Panel needs to be advised of the request and agree to cooperate. Chairman McGeehan indicated he could send the Seq. III S.P. a letter. Lew Williams moved and Pat Fetterman seconded adoption of the above proposed III F limits for CG-4 and CH-4 oils. The motion passed with 13 for, 0 against and 0 abstains.

16.0 Other Business

16.1 Greg Shank announced that the TMC and CAT Surveillance Panel would be asked at the June ASTM meeting to begin monitoring the CAT 1R test.

16.2 The June meeting in San Diego will be planned for all day and will switch rooms with the PCEOCP.

17.0 Adjournment

17.1 The meeting was adjourned at 11:29 a.m.

Submitted by:

Jim Wells
Secretary to the HDEOCP

ATTACHMENT 1

ASTM-HDEOCP

Sheration World Resort
May 10th 2001
8:00 am - 12:45-- Room Indian—Coffee at 7:30 am

Chairman/ Secretary: **Jim Mc Geehan/Jim Wells**
Purpose: **PC-9**

Desired Outcomes:
- **Feature oil performance in EGR tests**
- **Set limits on all tests, except EGR, Oxidation and used oil viscometrics tests**

TOPIC	PROCESS	WHO	TIME
Agenda Review	• Desired Outcomes & Agend	Group	8:00-8:05
Minutes Approval	• February 22th 2001	Group	8:05-8:10
Membership	• Changes	Group	8:10-8:15
Mack T-10	• Matrix results" • Timing of matrix completion	Greg Shank	8:15-8:45
Cummins M11 EGR	• Matrix results • Timing of matrix completion	Dave Stehouwer	8:45-9:15
Caterpillar 1Q	• Feature oils A and E results • Other matrix runs • Discussion	Dwayne Tharp Group	9:15-9:45
Deposit/Oil Consumption Back-up tests	• Discussion • Mack T-10/Cummins M-11/Cat 1N and other potential tests	Group	9:45-10:15
Oxidation	• Mack T-10 Integrated IR for matrix test oils • IR oxidation method issues	Joe Franklin Jim Ziemer	10:15-10:45
Low Temp Pumpability	• Status of round-robin testing in MRVTP-1 • Low Temp. pumpability in M11 with highly sooted oils	Chris May Dave Stehouwer	10:45-11:15
Elastomers	• Status of Program	Tom Boschert	11:15-11:30
Other PC-9 tests	• Limits for all the other PC-9 tests	Greg Shank/Group	11:30- 12:15
Backward compatibility	• Backward compatibility of PC-9 for API CH-4 tests	Bill Kleiser Group	12:15-12:30
IIIF/IIIE limits	• Proposed limits • Discussion/Vote	Lewis Williams Pat Fetterman	12:30 - 12:45

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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		
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	(316) 529-2112 (316) 529-4654 sanderj@lubricationengineers.com		
Sarlo, Mark Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78238	(210) 522-3754 (210) 523-6919 msarlo@swri.org		
Schuettenburg, Alex Phillips Petroleum 148 AL, PRC Bartlesville, OK 74004	(918) 661-3863 (918) 661-8060 adschue@ppco.com		

ASTM

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

ATTENDANCE LIST

MAY 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Selby, Ted Savant, Inc. 4800 James Savage Rd. Midland, MI 48642	(517) 496-2301 (517) 496-3438 tselby@savantgroup.com	TS	☺
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		
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		
Stephens, Carl Ashland Inc. 22nd and Front Sts. Ashland, KY 41101	(606) 329-5198 (606) 329-3009 cstephens@ashland.com		
Strigner, Paul 31 Seguin St. Ottawa, Ontario Canada KIJ 6P2	(613) 746-0647 (613) 746-9292		
Sutherland, Mark Ethyl Corporation 9901 IH10 West, Suite 800 San Antonio, TX 78230	(210) 558-2818 (210) 696-4029 mark_sutherland@ethyl.com		

ASTM

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

ATTENDANCE LIST

MAY 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Weber, Ben Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78238	(210) 522-5911 (210) 684-7530 bweber@swri.edu		
Weismiller, Michael Ciba Spec. Chemicals 540 White Plains Rd. Tarrytown, NY 10591	(914) 785-5515 michael.weismiller@cibasc.com		
Wilkins, Jerry Sunoco Inc. P.O. Box 1135 Marcus Hook, PA 19061	(610) 859-1663 gerald_w_wilkins@sunoil.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		
Zaiontz, Michael Perkin Elmer 5404 Bandera Rd. San Antonio, TX 78238	(210) 647-9483 (210) 523-4607 mike.zaiontz@perkinelmer.com		
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	JAZ	☺

ASTM

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

ATTENDANCE LIST

MAY 2001

GUESTS

		Phone No. Fax No. e-mail add.	ROOM FEE
Name:	Jai G. Bansal		
Company:	Infineum USA LP	908-474-2322	☺
Address:	1900 E. Linden Ave. Linden, NJ 07090	jai.bansal@infineum.com	
Name:	West Alexander		
Company:	Chevron Products Co.	510-242-2246	☺
Address:	100 Chevron Way Richmond, CA 94802	510-242-3758 alex@chevron.com	
Name:	Mark Sztenderowicz		
Company:	Chevron Products Co.	510-242-1022	☺
Address:	100 Chevron Way Richmond, CA 94802-0627	510-242-3758 mlsz@chevron.com	
Name:	David Clark		
Company:	Citgo	918-495-5922	☺
Address:	6100 S. Vale Tulsa, OK 74136	918-495-5022 dclark@citgo.com	
Name:	Frank Fernandez		
Company:	Chevron Oronite	210-731-5603	☺
Address:	4502 Centerview Dr. Suite 210 San Antonio, TX 78228	210-731-5699 ffer@chevron.com	
Name:	Robert Sutherland		
Company:	Pennzoil – Quaker State	281-363-8029	☺
Address:	1520 Lake Front Circle The Woodlands, TX 77380	281-363-8002 robertsutherland@pzlqs.com	

Name:_____
Company:_____
Address:_____
_____

Name:_____
Company:_____
Address:_____
_____

Revision: April 12, 2001

Meeting Date	Location	Hotel	Cut off dates for ASTM Room Rate of $129 at Holiday Inn	Time	Comments
May 10	Orlando	Sheraton World Resort (SAE meeting Hotel)	SAE Room Rate $139.00	8:00 am - 12:15 pm	Indian Room
May 25	Chicago	Holiday Inn O'Hare International	5-3-01	8:30 am - 1:00 pm	
June 19	San Diego	Sheraton Annual Meeting	ASTM Rate	2:00 pm - 5:00 pm	
July 11	Chicago	Holiday Inn O'Hare International	6-19-01	8:30 am - 1:00 pm	
August 15	Chicago	Holiday Inn O'Hare International	7-24-01	8:30 am - 1:00 pm	
September 5	Chicago	Holiday Inn O'Hare International	8-14-01	8:30 am - 1:00 pm	

ATTACHMENT 3

Status of PC-9 Matrix Testing

Presented to HDEOCP

May 10, 2001

John L. Zalar

T-10

- **Planned Tests: 28**
- **Total Starts: 27**
- **Completed Tests**
  - **Verified and posted on TMC web site: 16**
  - **EOT and being reviewed/verified: 4**
  - **Aborted/Invalid: 3**
- **Tests Currently Running: 4**
- **Best case matrix completion date: 6/1/01**

M11-EGR

- **Planned Tests: 26**
- **Total Starts: 26**
- **Completed Tests**
  - **Verified and posted on TMC web site: 14**
  - **EOT and being reviewed/verified: 4**
  - **Aborted/Invalid: 2**
- **Tests Currently Running: 6**
- **Best case matrix completion date: 6/18/01**

1Q

- **Planned Tests: 28**
- **Total Starts: 20**
- **Completed Tests**
  - **Verified and posted on TMC web site: 5**
  - **EOT and being reviewed/verified: 6**
  - **Aborted/Invalid: 5**
- **Tests Currently Running: 4**
- **Best case matrix completion date: 8/10/01**

1Q Aborted Tests

- **PC-9A - high oil consumption (being rerun)**
- **PC-9D - aborted following shutdown at 403 hours to replace air filter**
- **PC-9E - coolant hose failure (being rerun)**
- **PC-9M (1005-1) - scuffed**
- **PC-9M (1005-1) - scuffed**

T-10 STATUS

PC-9 MATRIX											
TEST TYPE	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10
MATRIX LAB NO.	4	2	1	5	4	2	1	3	4	3	2
MATRIX STAND NO.	6	3	1	7	6	3	1	4	6	5	3
PC-9 OIL CODE	PC-9A	PC-9A	PC-9A	PC-9A	PC-9H	PC-9F	PC-9C	PC-9H	PC-9A	PC-9A	PC-9B
BASE OIL CODE	1	1	1	1	2	3	3	2	1	1	2
TECHNOLOGY CODE	X	X	X	X	Z	Y	X	Z	X	X	X
MATRIX RUN NO.	1	1	1	1	2	2	2	- -	3	1	3
START DATE	27-Nov-00	11-Dec-00	6-Dec-00	15-Dec-00	2-Feb-01	2-Feb-01	20-Feb-01	28-Feb-01	2-Mar-01	8-Mar-01	15-Mar-01
EOT DATE	11-Dec-00	24-Dec-00	19-Dec-00	31-Dec-00	17-Feb-01	15-Feb-01	5-Mar-01	18-Mar-01	15-Mar-01	30-Mar-01	1-Apr-01
VALID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RESULTS											
LINER WEAR	36.3	38.0	35.1	24.4	33.3	27.0	25.3	34.0	48.2	33.0	31.2
TOP RING WEIGHT LOSS	139	139	158	349	150	69	116	156	171	125	125
DELTA Pb	33	12	23	11	73	21	33	115	35	37	17
SOOT - 75 HR	4.9	4.9	5.0	5.1	4.9	5.0	4.9	5.0	5.0	4.7	4.6
SOOT - EOT	5.7	5.5	6.0	6.6	- -	5.3	5.4	7.1	5.8	5.9	5.1
OIL CONSUMPTION	0.238	0.193	0.149	0.107	0.157	0.157	0.137	0.195	0.213	0.199	0.152

J.L. Zalar
5/18/01

PC-9 MATRIX											
TEST TYPE	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10	T-10
MATRIX LAB NO.	1	1	3	3	1						
MATRIX STAND NO.	2	1	4	5	2						
PC-9 OIL CODE	PC-9A	PC-9E	PC-9C	PC-9J	PC-9A						
BASE OIL CODE	1	2	3	3	1						
TECHNOLOGY CODE	X	Y	X	Z	X						
MATRIX RUN NO.	1	3	- -	2	2						
START DATE	23-Feb-01	16-Mar-01	2-Apr-01	4-May-01	26-Mar-01						
EOT DATE	13-Mar-01	29-Mar-01	20-Apr-01	19-Apr-01	8-Apr-01						
VALID	Yes	Yes	Yes	Yes	Yes						
FAX BACK	Yes	Yes	Yes	Yes	Yes						
ASTM NOTIFIED	Yes	Yes									
RESULTS											
LINER WEAR	38.0	21.2	35.1	35.4	27.4						
TOP RING WEIGHT LOSS	168	118	133	119	87						
DELTA Pb	19	18	77	90	16						
SOOT - 75 HR	5.0	4.5	5.3	4.8	4.6						
SOOT - EOT	6.0	4.8	7.6	5.7	4.8						
OIL CONSUMPTION	0.161	0.105	0.212	0.118	0.111						

J.L. Zalar
5/18/01

M11 EGR STATUS

PC-9 MATRIX											
TEST TYPE	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR
MATRIX LAB NO.	2	3	3	1	4	3	1	1	2	1	1
MATRIX STAND NO.	3	4	5	1	6	4	2	1	3	1	2
PC-9 OIL CODE	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9B	PC-9E	PC-9F	PC-9D	PC-9E	PC-9E
BASE OIL CODE	2	2	2	2	2	2	2	3	1	2	2
TECHNOLOGY CODE	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y
MATRIX RUN NO.	1	1	1	1	1	2	2	2	2	3	1
START DATE	7-Dec-00	14-Dec-00	11-Jan-01	11-Jan-01	18-Jan-01	20-Feb-01	23-Feb-01	6-Mar-01	11-Mar-01	27-Mar-01	12-Jan-01
EOT DATE	21-Dec-00	27-Dec-00	27-Jan-01	29-Jan-01	2-Feb-01	6-Mar-01	11-Mar-01	21-Mar-01	26-Mar-01	10-Apr-01	26-Jan-01
VALID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes*
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RESULTS											
CROSSHEAD WEAR	23.4	51.0	28.8	20.7	42.3	23.8	22.6	15.8	16.5	18.7	17.7
OIL FILTER DELTA P	210	204	330	706	407	675	144	310	301	417	204
AVERAGE SLUDGE	9.1	7.4	8.0	9.0	8.7	8.8	8.8	8.2	7.8	8.4	8.9
SOOT - 250 HR	8.2	9.1	8.0	9.1	8.5	8.2	9.0	8.8	8.7	8.7	7.9*
INJ. SCREW WT. LOSS	98.9	108.4	51.2	160.5	116.6	43.7	404.0	160.9	136.1	96.6	110.2
TOP RING WEIGHT LOSS	113	172	116	104	147	125	19	197	163	148	144

J. L. Zalar
5/21/01

PC-9 MATRIX											
TEST TYPE	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR
MATRIX LAB NO.	3	3	3								
MATRIX STAND NO.	4	5	5								
PC-9 OIL CODE	PC-9G	PC-9J	PC-9E								
BASE OIL CODE	1	3	2								
TECHNOLOGY CODE	Z	Z	Y								
MATRIX RUN NO.	3	2	3								
START DATE	15-Mar-01	21-Feb-01	20-Mar-01								
EOT DATE	1-Apr-01	10-Mar-01	6-Apr-01								
VALID	Yes	Yes	Yes								
FAX BACK	Yes	Yes	Yes								
ASTM NOTIFIED											
RESULTS											
CROSSHEAD WEAR	13.6	27.7	19.4								
OIL FILTER DELTA P	304	535	332								
AVERAGE SLUDGE	7.3	7.7	7.6								
SOOT - 250 HR	8.2	8.2	8.2								
INJ. SCREW WT. LOSS	68.2	71.8	82.1								
TOP RING WEIGHT LOSS	125	170	139								

J. L. Zalar
5/21/01

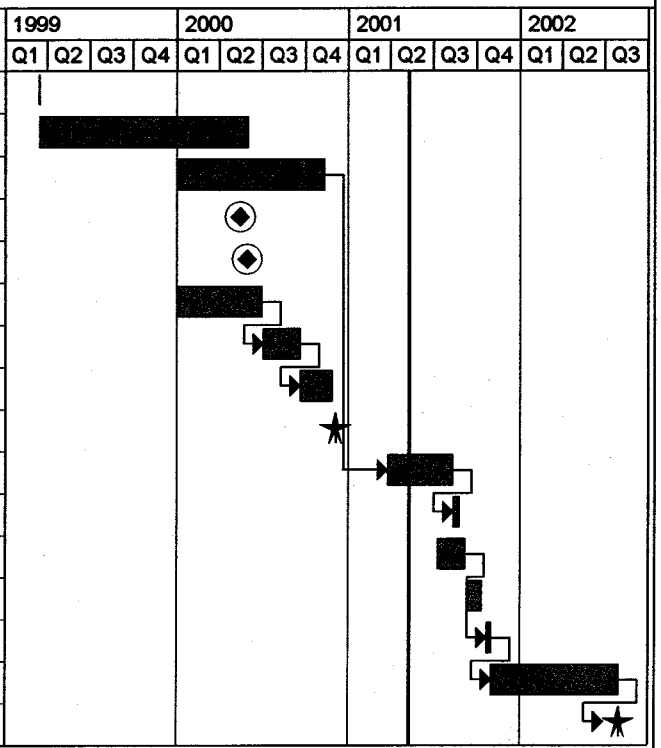
PC-9 MATRIX											
TEST TYPE	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q
MATRIX LAB NO.	3	2	1	4	5	1	1	3	4	3	1
MATRIX STAND NO.	4	3	2	6	7	1	2	4	6	5	1
PC-9 OIL CODE	PC-9M	PC-9M	PC-9M	PC-9M	PC-9M	PC-9M	PC-9A	PC-9B	PC-9B	PC-9E	PC-9E
BASE OIL CODE	4	4	4	4	4	4	1	2	2	2	2
TECHNOLOGY CODE	W	W	W	W	W	W	X	X	X	Y	Y
MATRIX RUN NO.	1	1	1	1	1	1	2	2	2	1	2
START DATE	5-Jun-00	3-Aug-00	22-Jun-00	14-Jun-00	11-May-00	2-Feb-01	23-Mar-01	24-Mar-01	2-Apr-01	28-Mar-01	13-Apr-01
EOT DATE	28-Jun-00	29-Aug-00	16-Jul-00	17-Aug-00	24-Jun-00	25-Feb-01	14-Apr-01	17-Apr-01	25-Apr-01	18-Apr-01	
VALID	Yes	Yes	Yes	Yes	Yes						
FAX BACK	Yes	Yes	Yes	Yes	Yes						
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes						
RESULTS											
WEIGHTED DEMERITS	402.4	450.4	417.5	381.2	419.9	405.8	420.7	247.5	482.3		
TOP GROOVE CARBON	30.50	36.50	26.00	29.25	24.00	33.50	36.50	33.75	31.25		
TOP LAND CARBON	18.75	7.75	18.00	19.50	8.25	21.25	14.75	20.25	14.25		
AVE. OIL CONSUMPTION	9.9	9.3	8.6	9.1	10.5	9.6	9.2	7.5	8.4	6.9	
EOT OIL CONSUMPTION	6.9	7.7	7.0	7.4	9.0	7.8	9.3	7.4	8.3	6.6	

J. L. Zalar
5/21/01

Summary of Events Required for PC-9 Licensing

J. L. Zalar 5/10/01

ID	Task Name	Start	Finish
1	Define PC-9 Performance Parameters	3/16/99	3/16/99
2	Design Precison Matrix	3/17/99	5/31/00
3	PC-9 Funding MOA Signed	1/3/00	11/10/00
4	1Q & M11EGR Adequate for Oil Devel.	5/15/00	5/15/00
5	Finalize Base Oil Selections for Prec. Mtx.	5/31/00	5/31/00
6	Finalize Additive Selections for Prec. Mtx.	1/6/00	6/30/00
7	Base Oils Recd. by Additive Companies	7/3/00	9/20/00
8	Blend Matrix Oils > TMC > Labs	9/21/00	11/27/00
9	Final Acceptance of New Engine Tests	12/5/00	12/5/00
10	PC-9 Matrix Testing *	3/27/01	8/10/01
11	Precision Matrix Data Analysis	8/13/01	8/24/01
12	HDEOCP Post Matrix Test Acceptance	7/11/01	9/5/01
13	Subcommittee B Ballot	9/10/01	10/10/01
14	Finalize Pass/Fail Criteria (Sub B Mtg)	10/22/01	10/31/01
15	New Product Development	11/1/01	7/31/02
16	API Licensing Allowed	8/1/02	8/1/02



ATTACHMENT 4, 11 OF 11

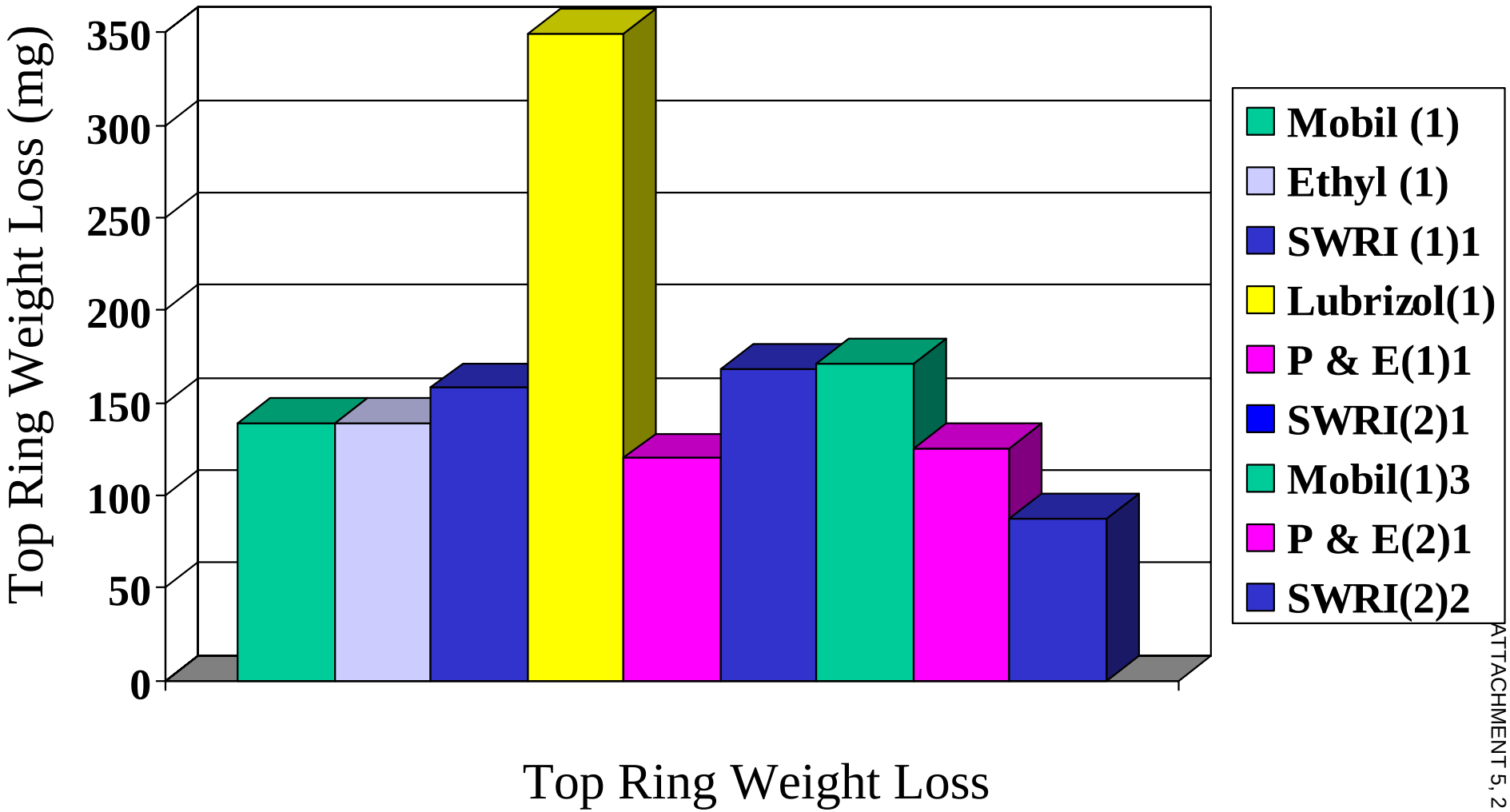
* Last 1Q Stand

Mack T10 Status

- 17 Test Completed (15 Evaluated)
- Task Force Meeting’s in March & April
- Issues : Measurements for Oxidation,Oil Consumption & Deposits
- Estimated Matrix Completion - June 15

T10 Matrix Data

Oil A

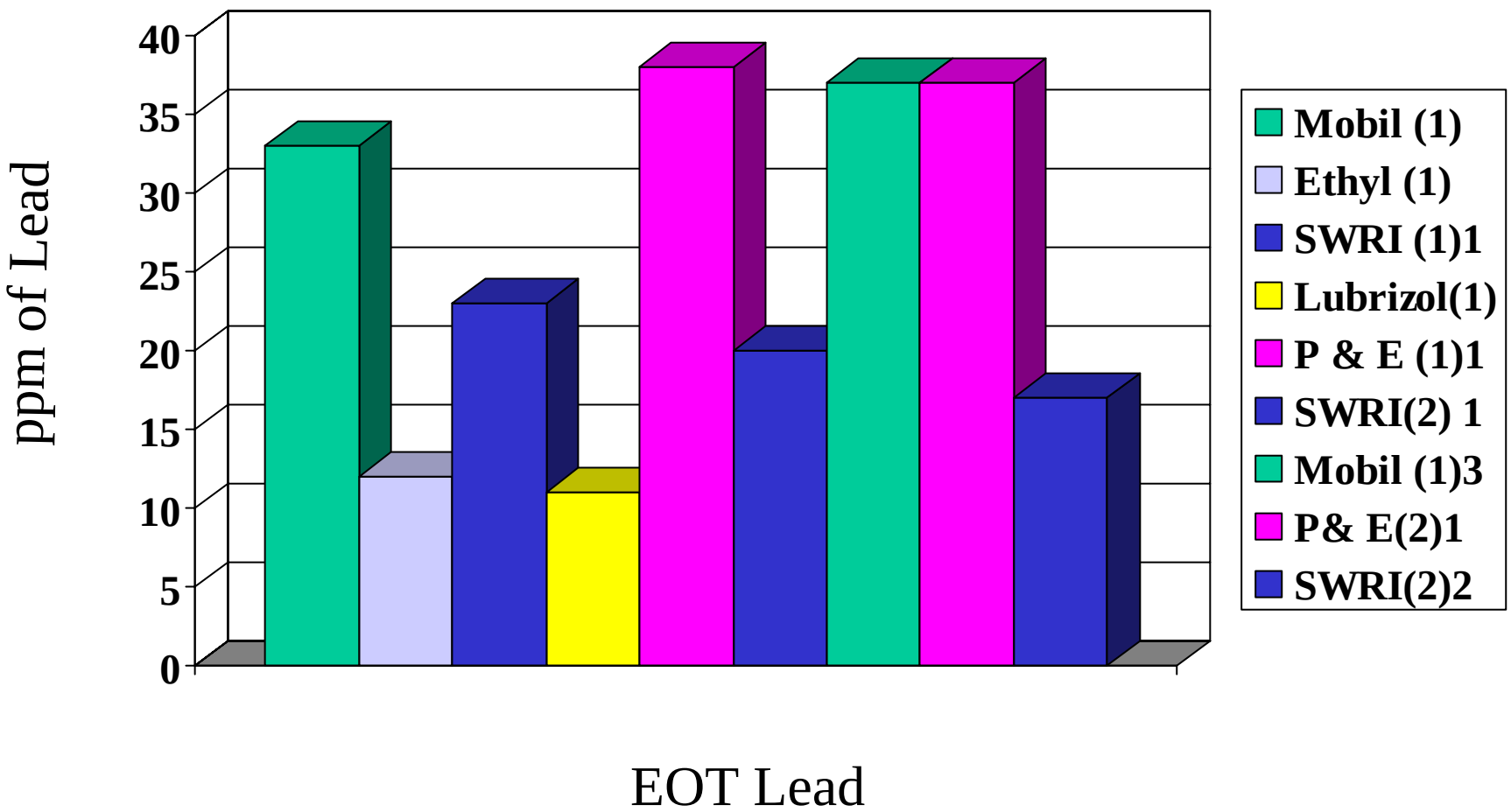


April 20 01

ATTACHMENT 5, 2 OF 8

T10 Matrix Data

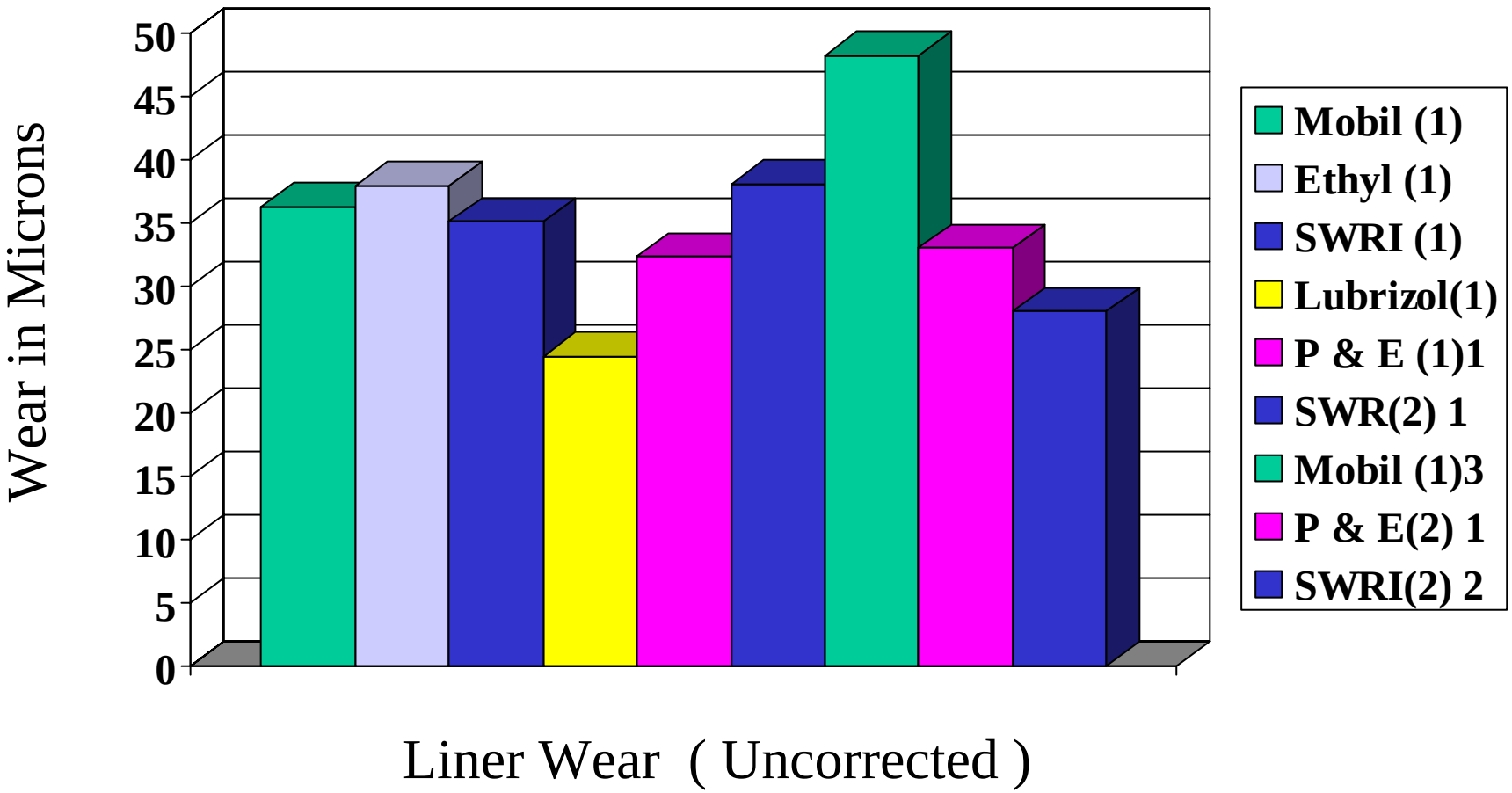
Oil A



April 20 01

T10 Matrix Data

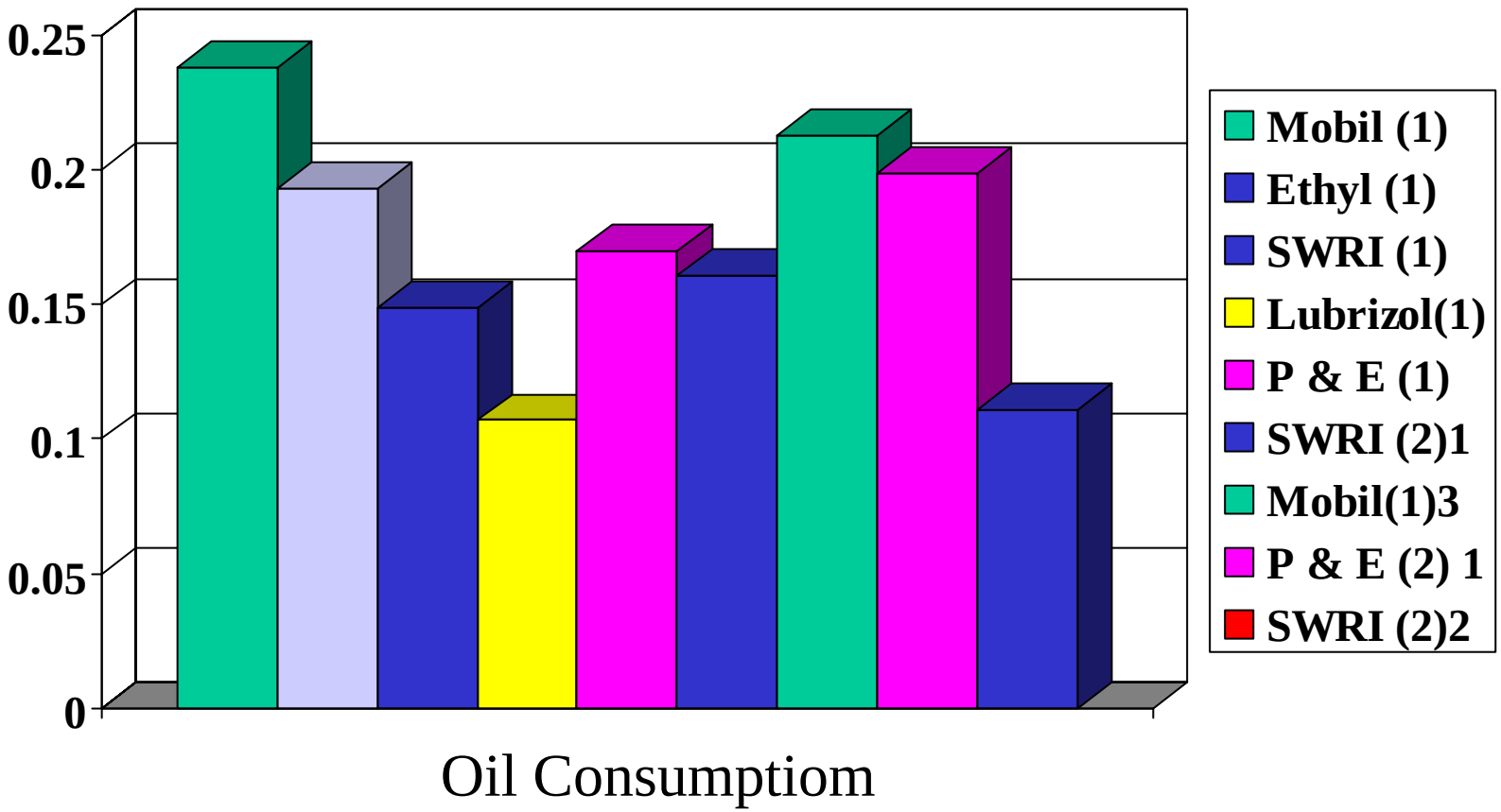
Oil A



April 20 01

T10 Matrix Data

Oil A

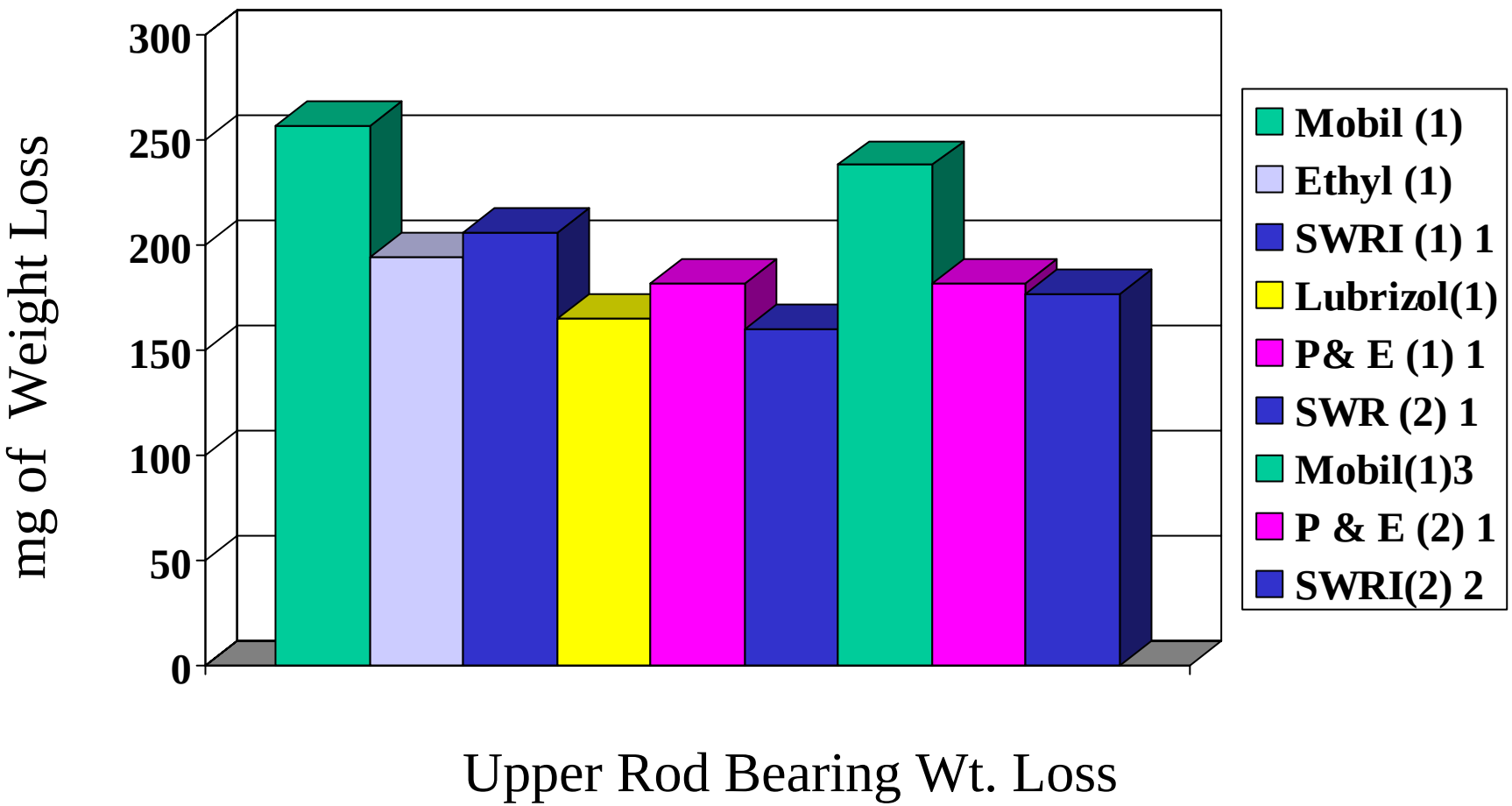


Oil Consumptiom

April 20 01

T10 Matrix Data

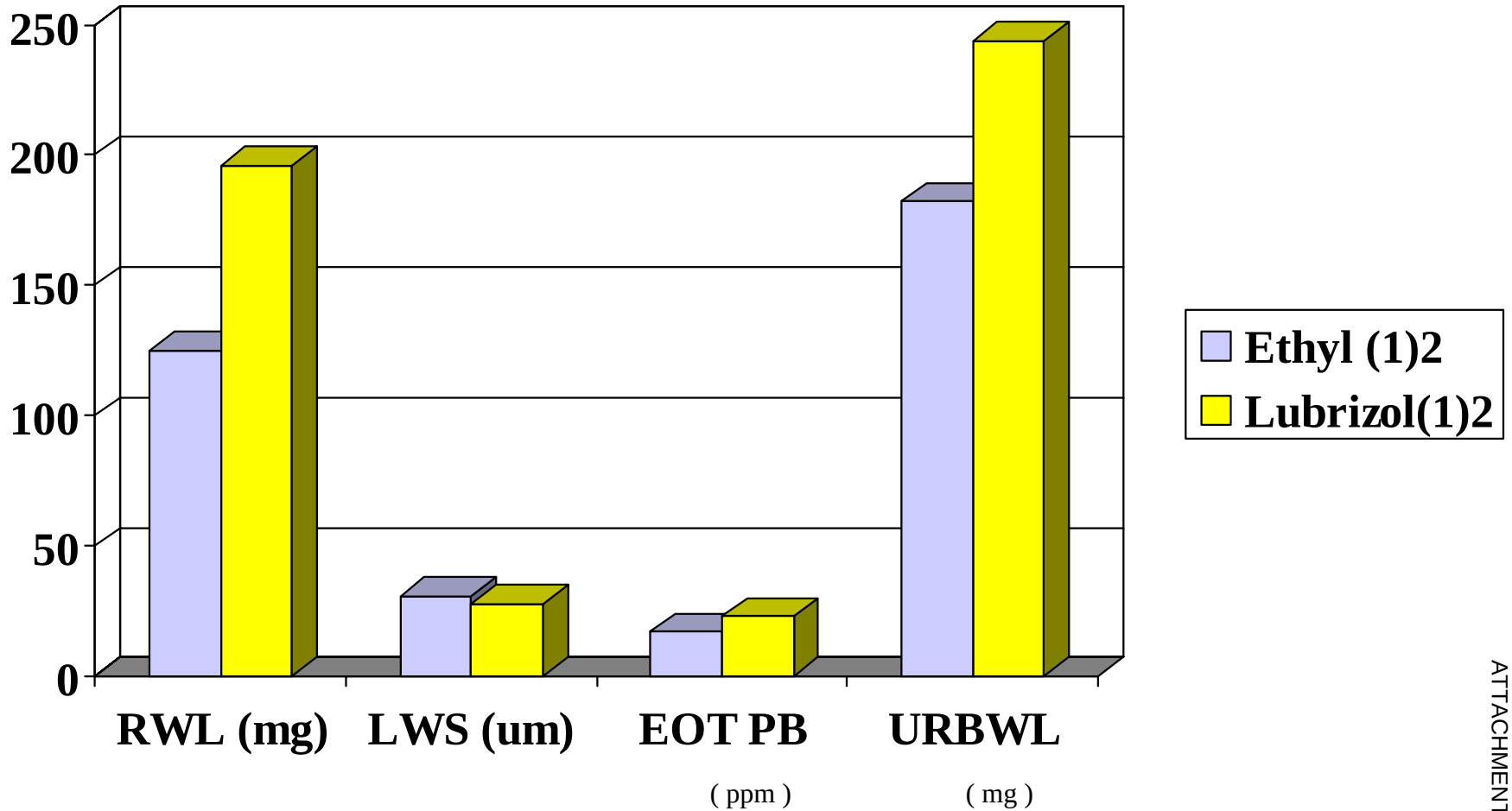
Oil A



April 20 01

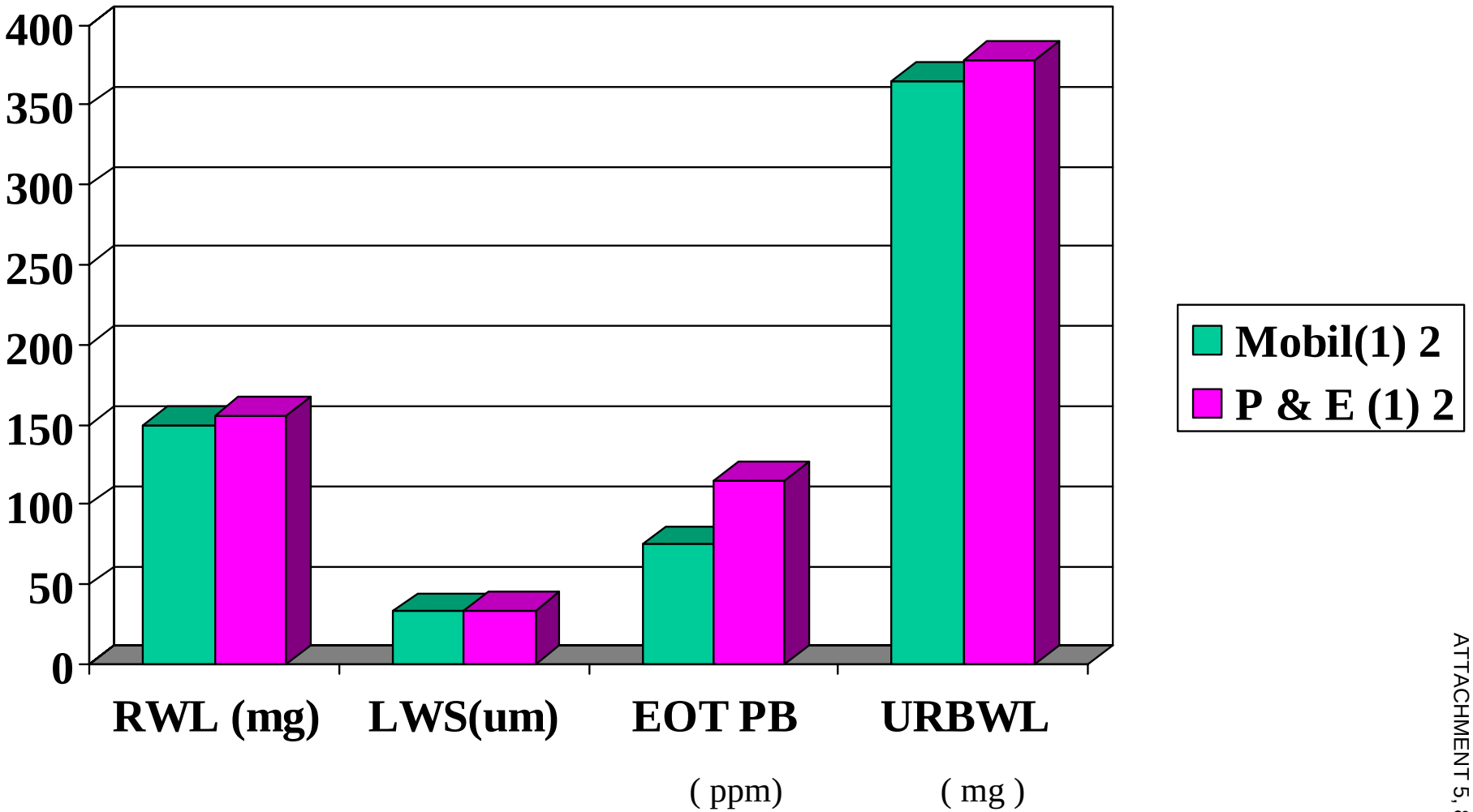
ATTACHMENT 5, 6 OF 8

T 10 Matrix Oil B



April 20 01

T 10 Matrix Oil H



April 20 01

M11 EGR Test Matrix Status

Presentation to
HDEOCP
May 10, 2001
David M Stehouwer

David M Stehouwer, Cummins Inc.

M-11 EGR Test Matrix Status

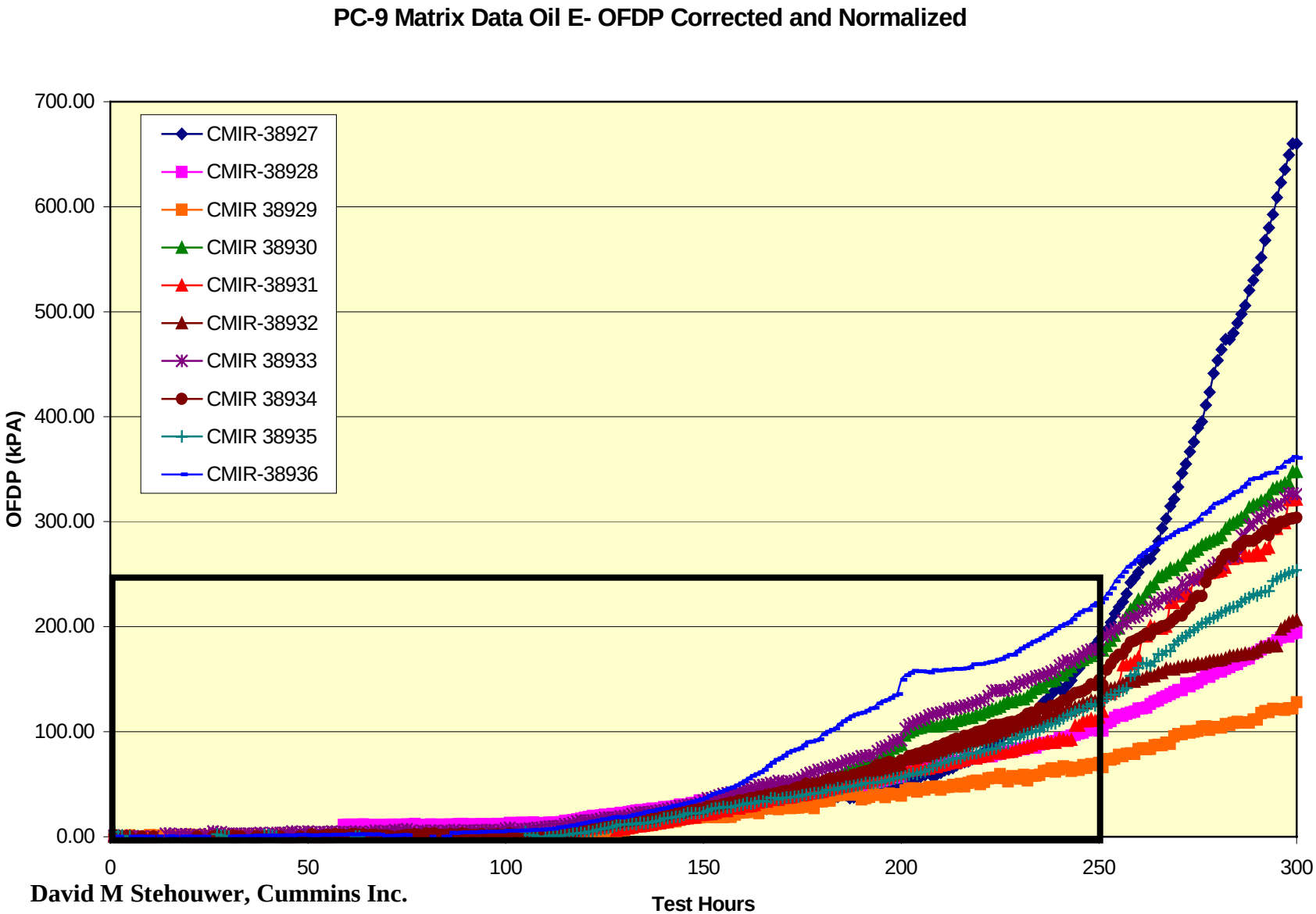
- All runs on Oil E are Complete
- Expect Matrix completion by 5/30

Cummins Inc. M11 - EGR Test Matrix Design Featured Oil E					
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		

Complete
Pending

David M Stehouwer, Cummins Inc.

PC9 Matrix Data Oil E, Corrected & Normalized



David M Stehouwer, Cummins Inc.

Filter Analysis

- 5 Filters completed
- Not enough data to correlate weight with delta P, yet.
- Signs of Pleat Pinching
- Cause of inconsistent results above 250 hrs

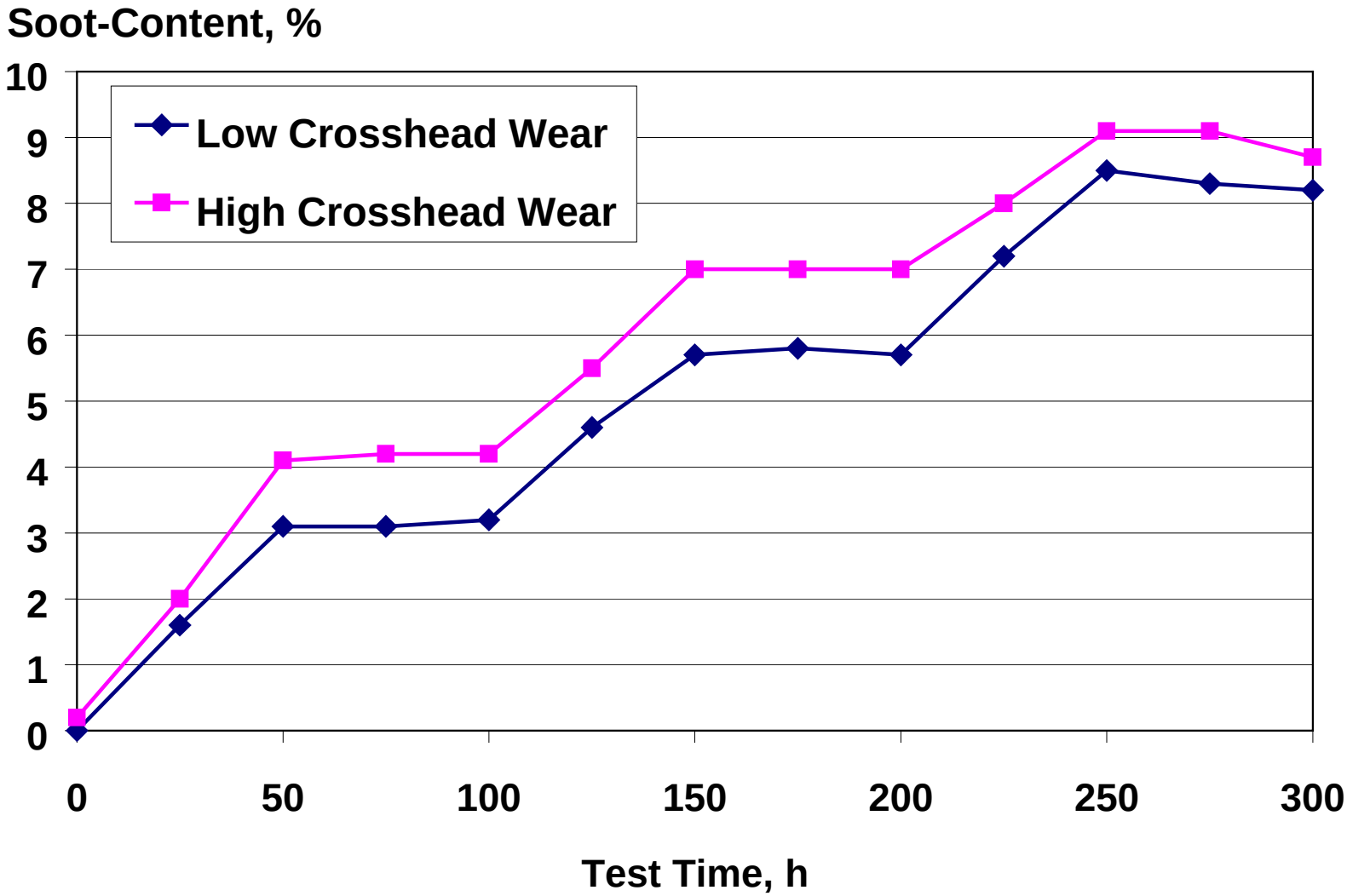
Cummins M11 EGR
Crosshead Wear Normalization

Presented at the April 23, 2001 ASTM Task Force Meeting in San Antonio

History of M11 Wear Normalization

- Crosshead wear normalization has been applied to the M11 HST since 1996
  - Based on exponential equation
  - Using “EOT” soot level as the basis for normalization
- Early M11 EGR data showed similar variability of crosshead wear
- Use of “EOT soot” as a basis for normalization does not seem to be the proper approach
- The M11 EGR requires a different normalization
  - Consider integration of soot level
  - Normalize to the “bottom of the soot window”

Soot versus Test Time



Normalization Equation for Matrix Oil E

- **Normalized wear = 10^(LOG(XHW)-0.26*(Soot-5))**

Where : XHW is the raw crosshead weight loss

Soot is the integrated soot / 300

The Impact of Normalization

- **Before normalization the data set has :**
  - **Average Wear 27.2 mg**
  - **Standard Deviation 11.7**
  - **Coefficient Of Variation 0.43**
- **After normalization the data set has :**
  - **Average Wear 22.4 mg**
  - **Standard Deviation 8.1**
  - **Coefficient Of Variation 0.36**
- **In conclusion, the normalization has some positive impact on the precision of the test**
- **Normalizing the wear might help in identifying outliers**

Raw and Normalized Data

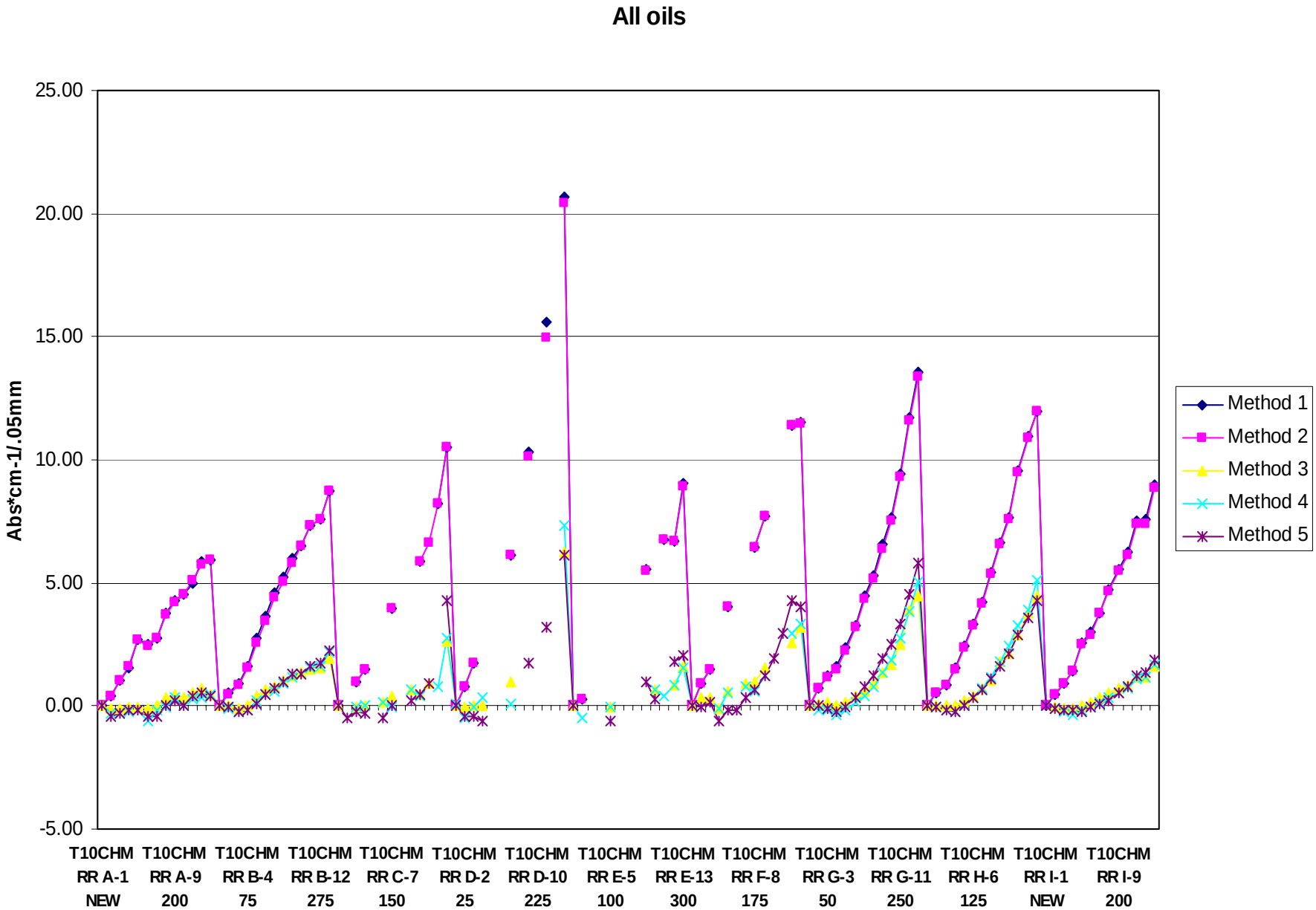
CMIR	Raw Crosshead Wear	Soot	Normalized
38932	51.02	5.72	33.2
27	20.42	5.58	14.4
28	19.45	4.90	20.7
31	23.39	5.04	22.8
36	42.28	5.55	30.4
33	28.77	4.75	33.5
29	22.61	5.76	14.4
34	17.91	4.98	18.1
30	18.70	5.50	13.8

Integrated IR

- Comments received editorial or less specific
- Will input comments and release.

TAN

- Reviewing procedures used for D664 mini round robin underway.
- Data to be available by May 15th from 6 used samples including 2 used diesel oils.
- Uses very specific parameters.


All oils
Abs*cm-1/.05mm
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
T10CHM RR A-1 NEW
T10CHM RR A-9 200
T10CHM RR B-4 75
T10CHM RR B-12 275
T10CHM RR C-7 150
T10CHM RR D-2 25
T10CHM RR D-10 225
T10CHM RR E-5 100
T10CHM RR E-13 300
T10CHM RR F-8 175
T10CHM RR G-3 50
T10CHM RR G-11 250
T10CHM RR H-6 125
T10CHM RR I-1 NEW
T10CHM RR I-9 200
Method 1
Method 2
Method 3
Method 4
Method 5

CHEVRON CONCERNS OVER PROPOSED INTEGRATED IR METHOD FOR EVALUATING MACK-T10 OIL OXIDATION

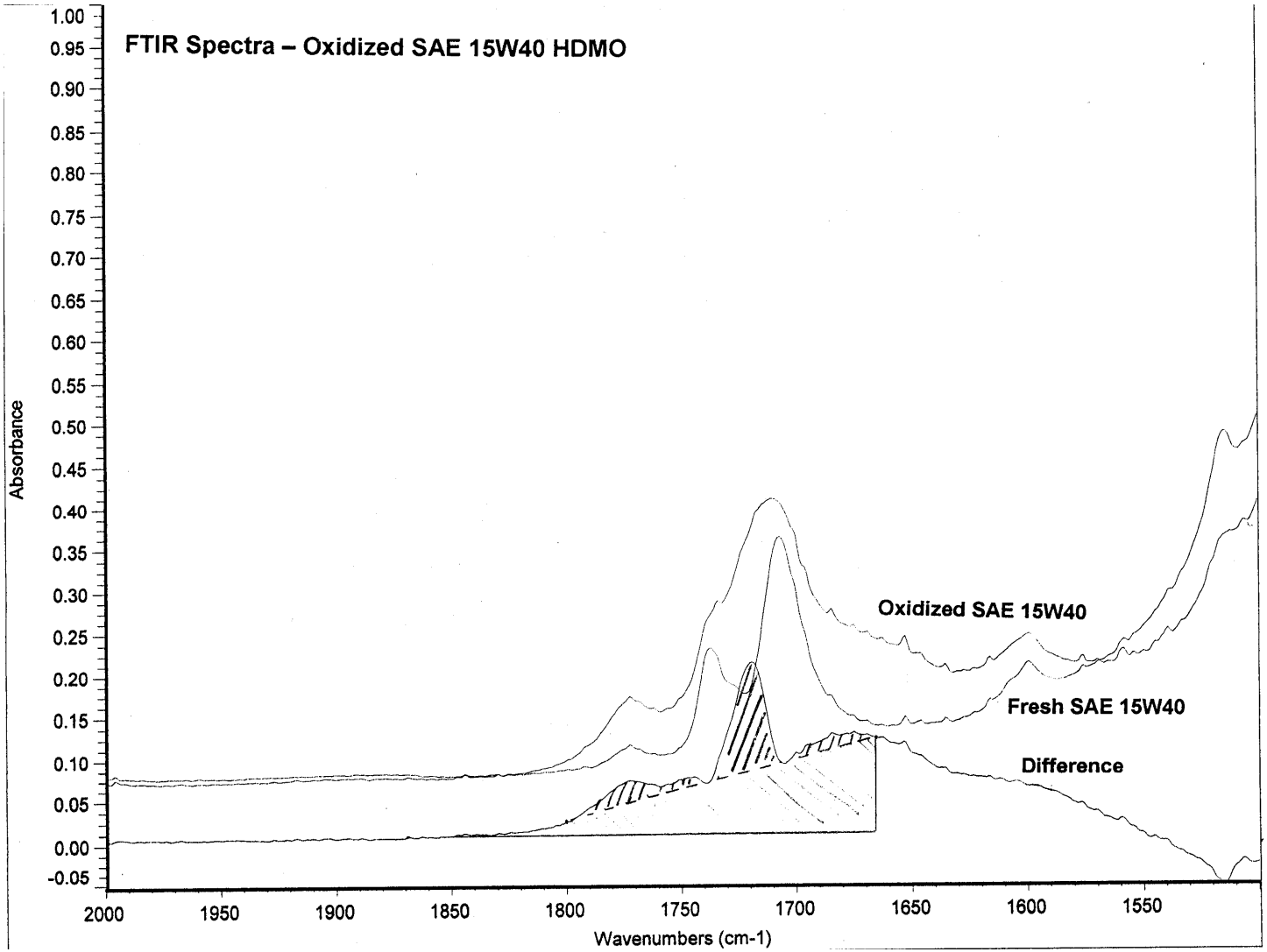
- **The Presence of Soot in Used Engine Oils Complicates the Interpretation of Results**
- **Both Oil and Soot Undergo Oxidation During Test. Both Contribute to Carbonyl Absorbance in the 1800-1665 cm^{-1} Region.**
- **Complications from Soot Apparent from Controlled Oxidation / Soot Addition Expts.**

Chevron

Lubricants

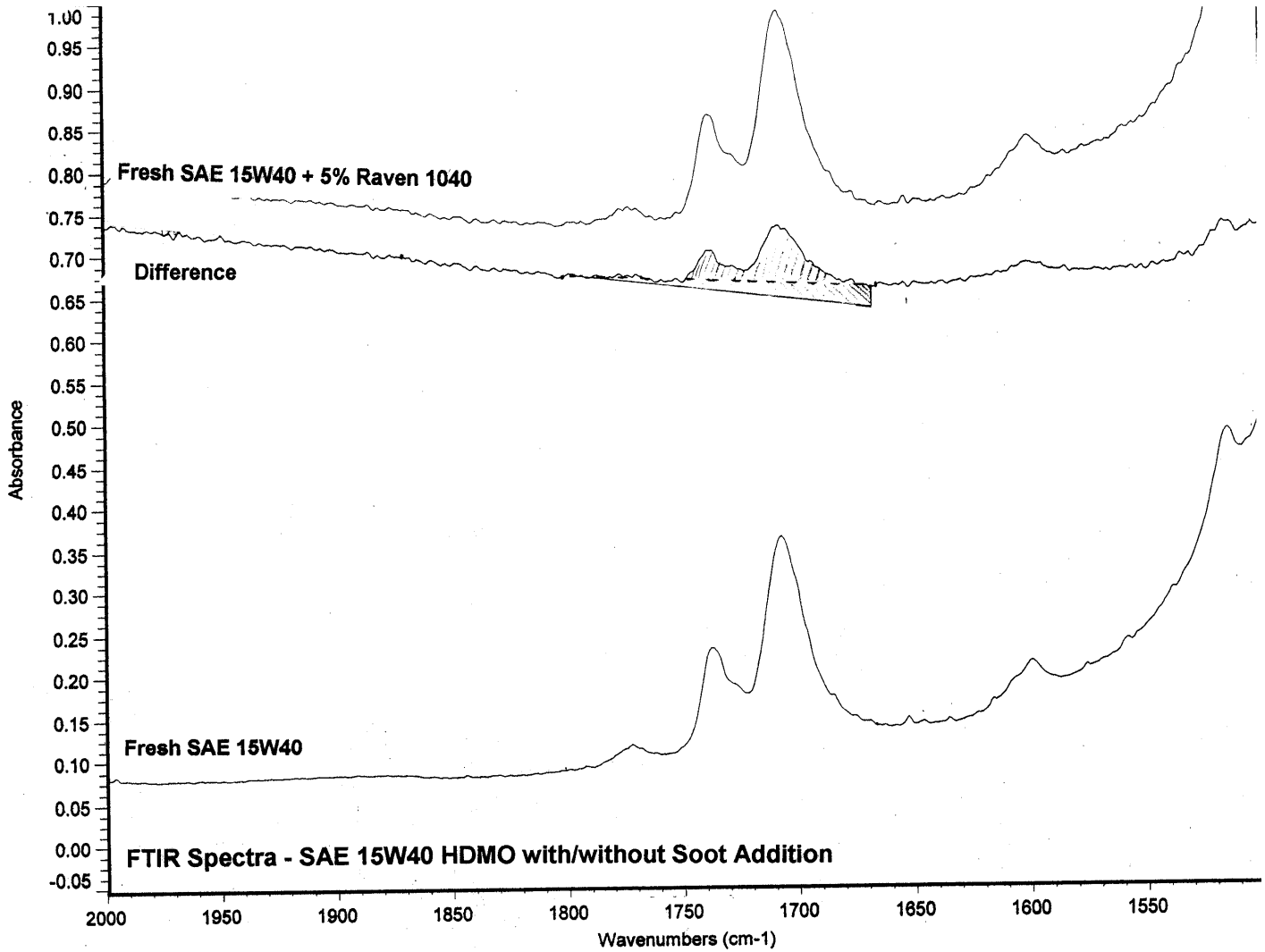
CONTROLLED OXIDATION / SOOT ADD. EXPERIMENTAL DESCRIPTION

- **Commercial SAE 15W-40 HDMO Oxidized under the following conditions:**
  - **Oil heated to 340ºF in a closed/stirred glass tube with metal naphthenate catalyst added.**
  - **O_2 uptake controlled volumetrically - stopped after addition of 1 liter O_2/100 grams oil**
- **Duplicate Oxidation Experiments conducted with "Soot" Additized Oil**
  - **Fresh Oil spiked with 2% - 6% commercial carbon black**
  - **Carbon black** [Raven 1040, Columbian Chemicals Co.] **chosen to resemble engine soot** [part.size 28nm; SA = 100 M^2/gram; ρ = 0.19 g/cc; pH [D1512] = 2.8]



Chevron

Lubricants



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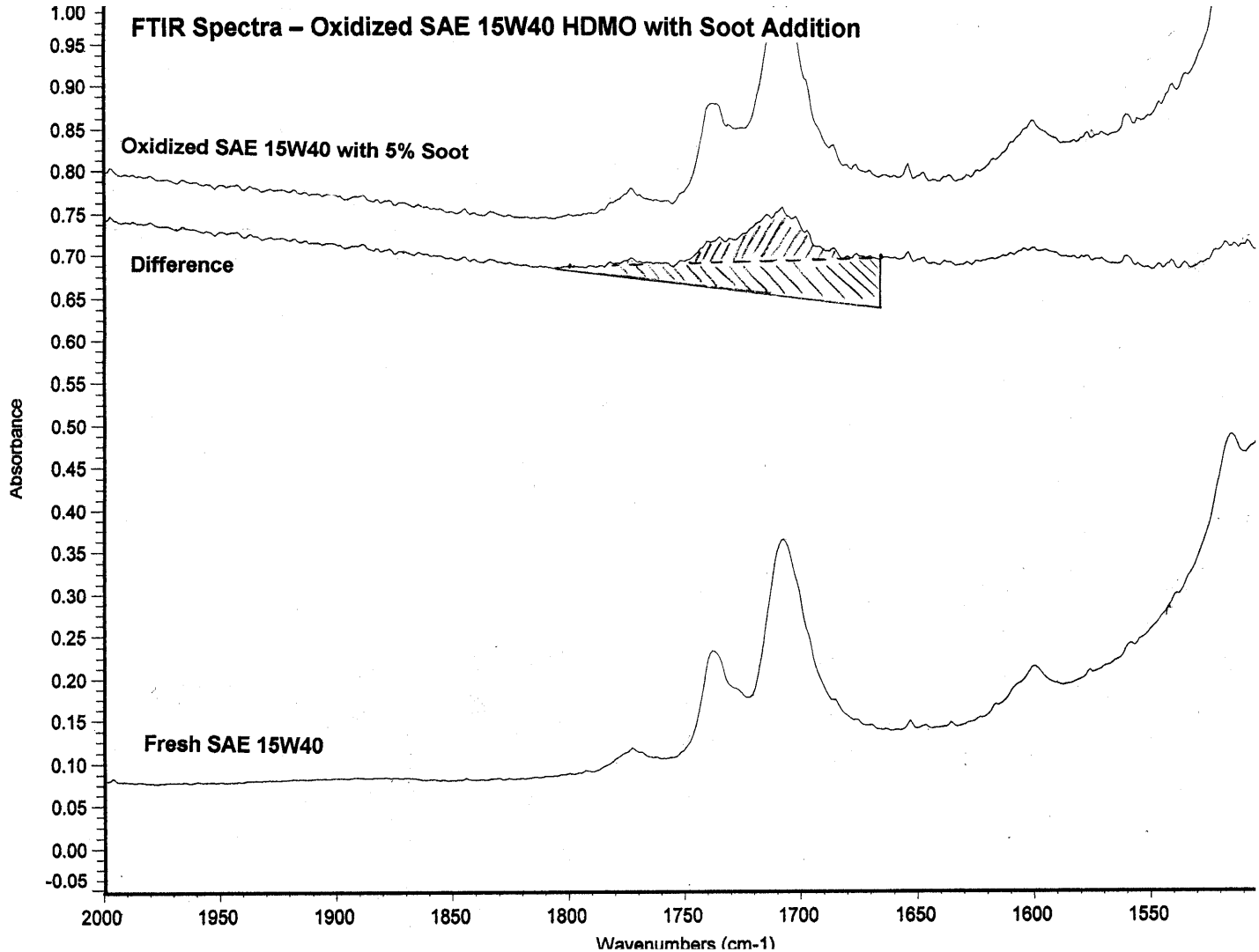
Lubricants



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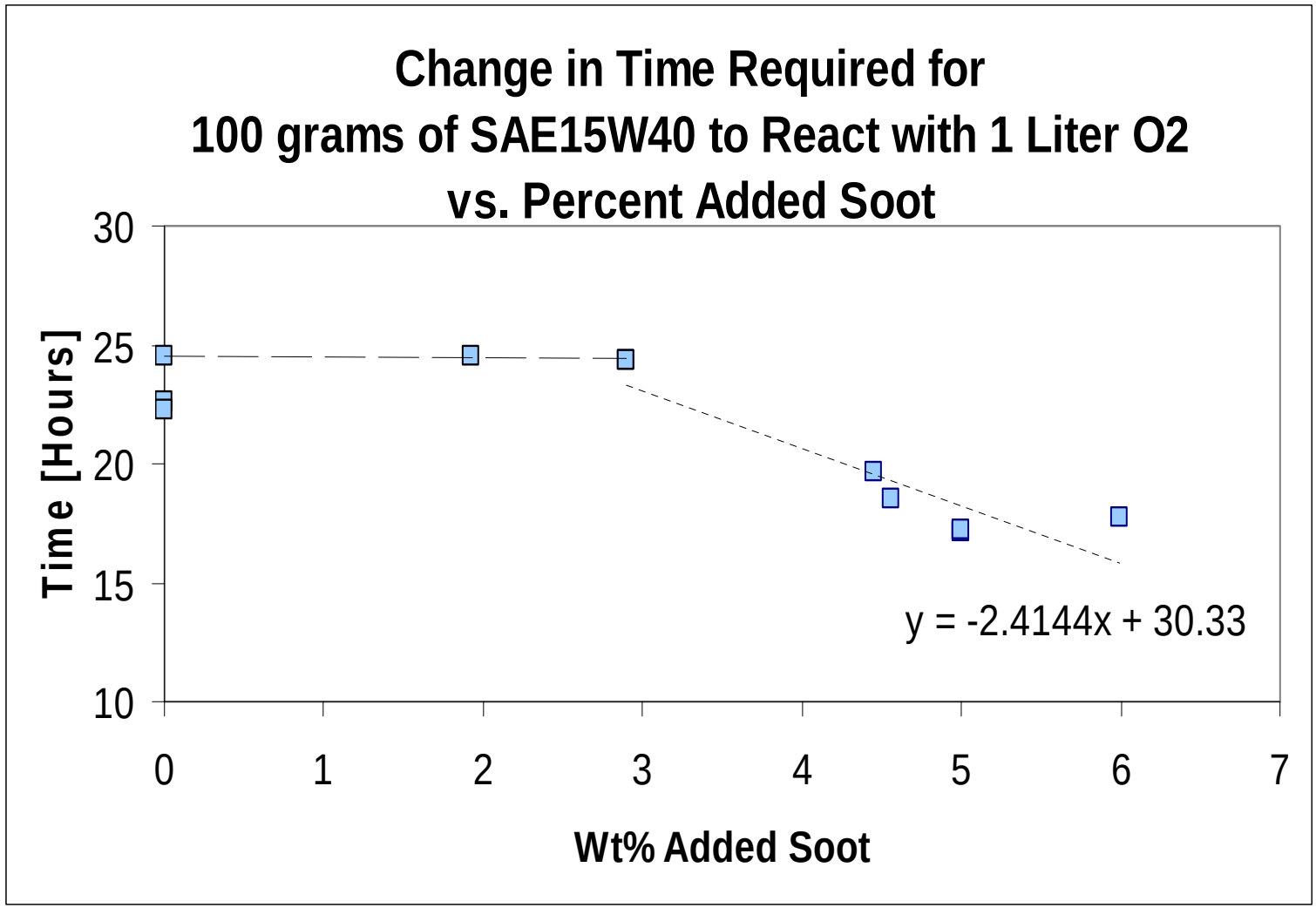
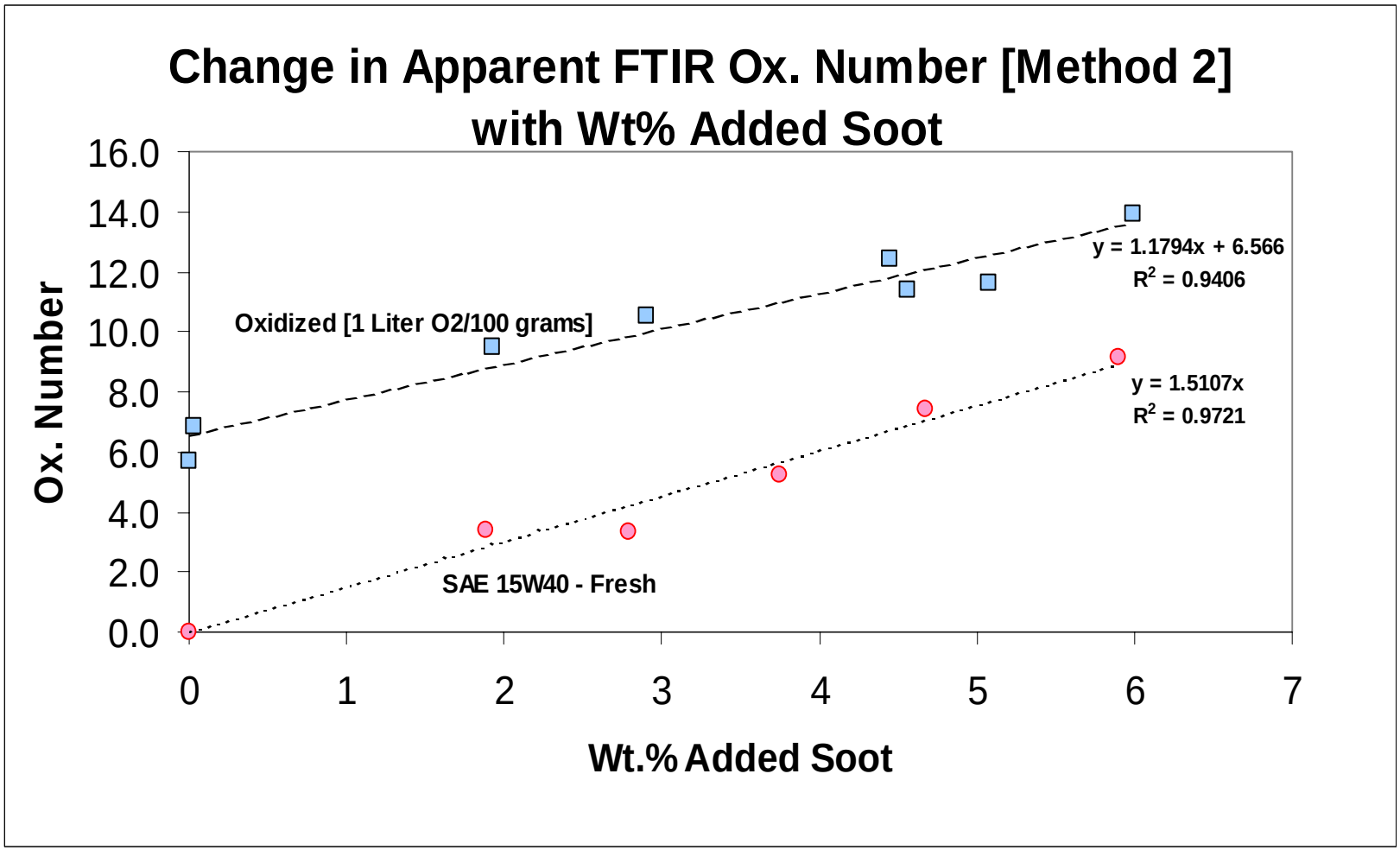
Lubricants



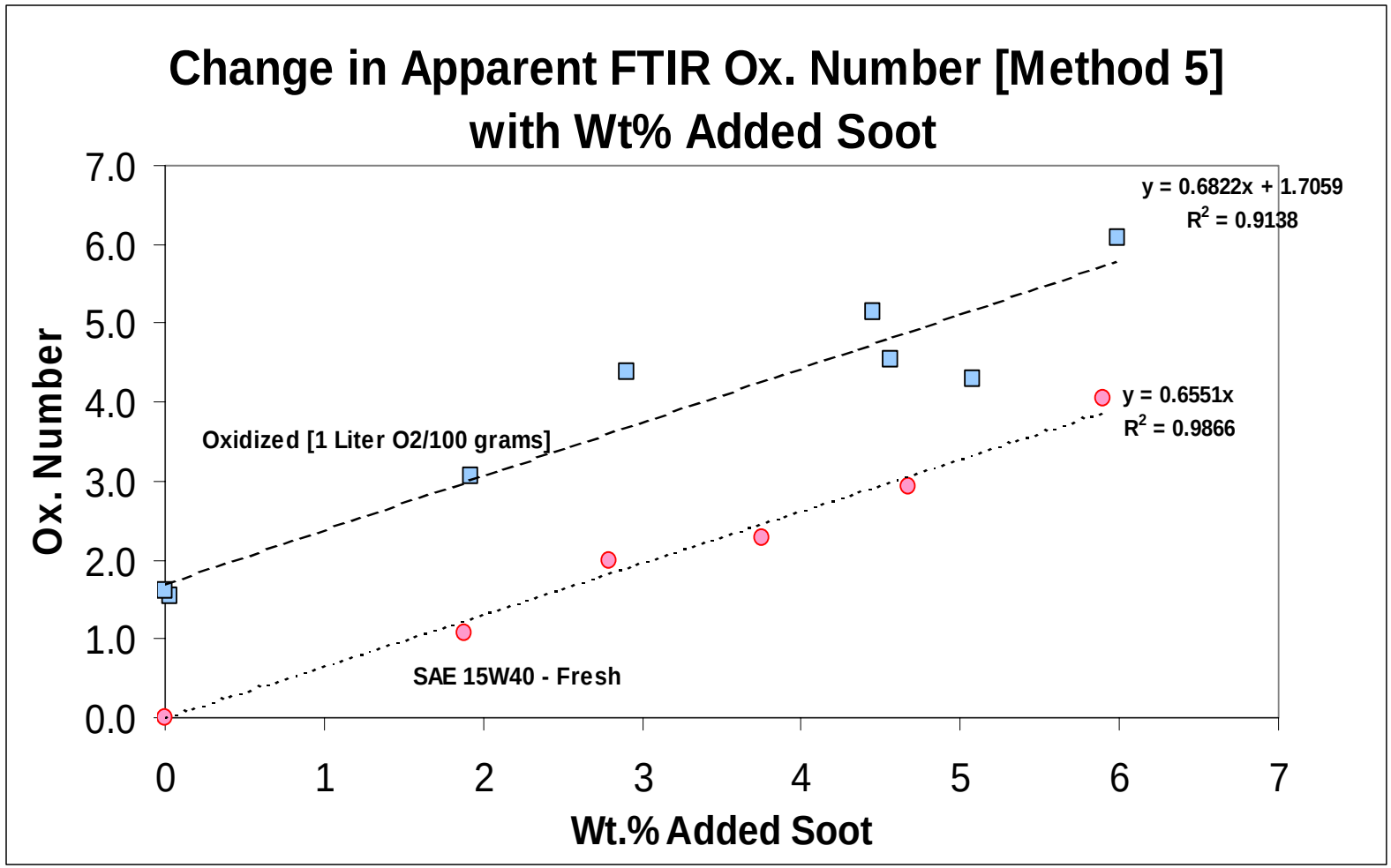
Chevron

Lubricants



Chevron

Lubricants



Chevron

Lubricants

SUMMARY

- **Soot Complicates Measurement of "True" Oil Oxidation**
  - **Soot levels >3% accelerate oxygen uptake rate**
  - **Oxidized soot particles contribute to the 1800-1665 cm^{-1} abs.**
  - **Soot degrades method precision by requiring special sample dilution procedures / use of thin layer cells**
- **Mack T10 300 hr. Soot Loadings Vary from 5.4-6.5%. Soot Content Normalization Procedure Will Be Needed**
- **HDMO Oxidation Resistance Best Evaluated Using Severe Gasoline Engine Tests [e.g. Sequence IIIF] to Eliminate Soot Effects**

The slides Greg Shank used at the meeting have not been made available yet. In the event that they are, I will insert them here.

JW 5/21/01

ATTACHMENT 10

1Q Test Update – 5/11

- **11 Complete Tests**
  - 6 PC-9M
  - 2 PC-9B
  - 2 PC-9E
  - 1 PC-9A
- **4 Aborted Tests**
  - 1 PC-9A (Oil Consumption)
  - 1 PC-9D (Oil Consumption, 403 hr)
  - 1 PC-9E (Coolant Hose)
  - 1 PC-9M (Non-oil Related)

Estimated Completion Date: 27 July 2001

ATTACHMENT 11

ASTM HDEOCP Meeting - Orlando, FL

May 10, 2001

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

K.O. Henderson, C.J. May

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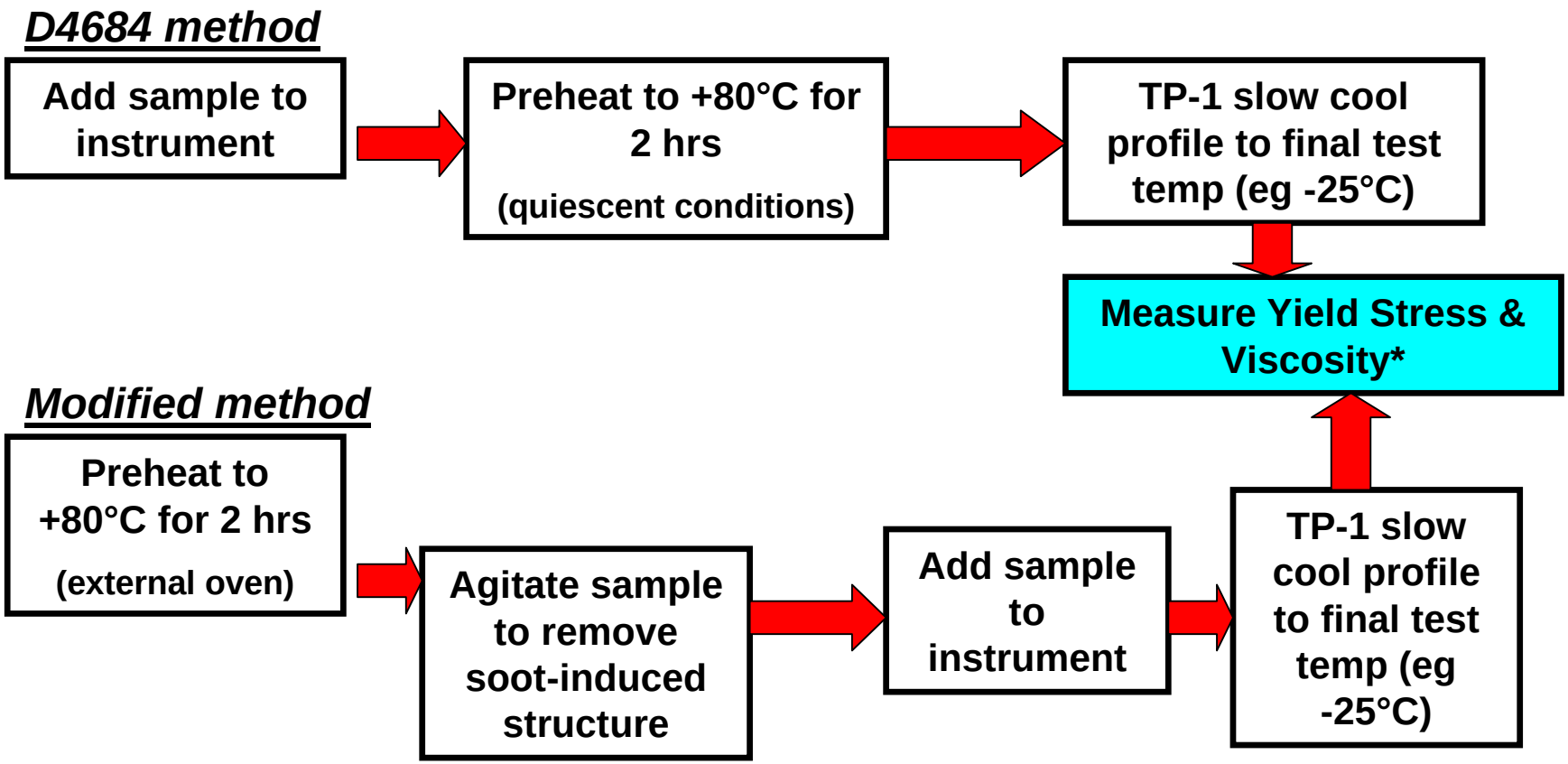
Discussion Topics

- **MRV Used Oil Round Robin**
  - ➢ **Round robin and analysis completed on 9 samples at two temperatures (-20/-25°C) using two methods (D4684 or modified preheat); results will be previewed with HDECOP today (to be discussed in detail with the LOTRUO task force membership in June**

- **Review information on E-O-T oil samples from the PC-9 precision matrix received by IOL for potential LOTRUO work**

2 DIFFERENT METHODS COMPARED IN LOTRUO ROUND ROBIN

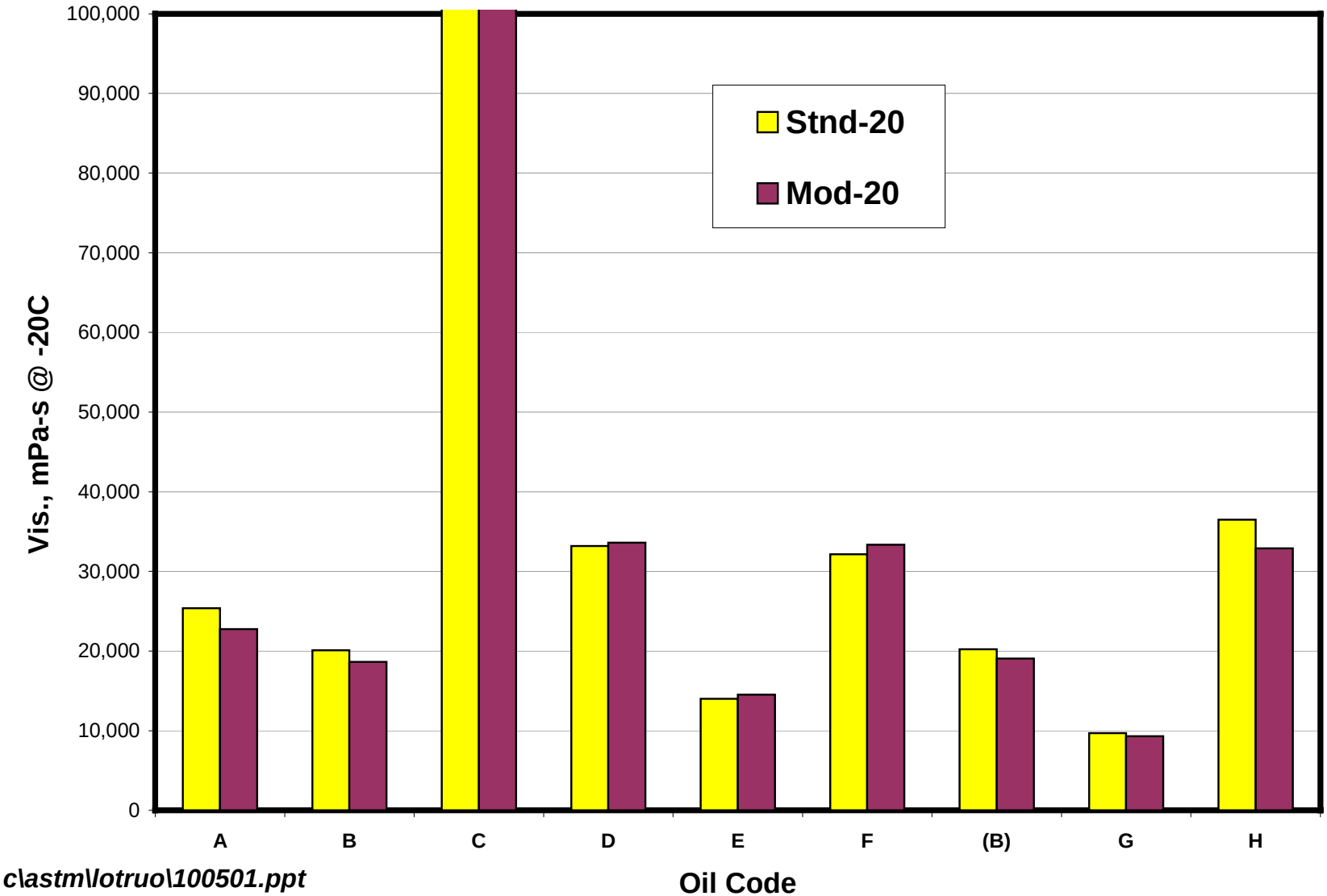


✹ *Note that MRV test evaluates both yield stress and viscosity; for >35 Pa yield stress (failing), viscosity not normally measured, but for round robin, labs asked to report both*

Test Oils / Labs

- **Nine oil samples (including double-blind sample)**
  - ➢ **Four T8 drain samples (~5% soot)**
  - ➢ **One T8E drain sample (~9% soot)**
  - ➢ **Two M11 EGR drain samples (8-9% soot)**
  - ➢ **One Mack T10 drain sample (soot not measured)**
- **Oils screened to ensure a range of viscosity/yield stress values at -20/-25°C**
- **9 labs reported D4684 results, 6 labs reported modified MRV results**
  - ➢ **Cannon Inst., Chevron, Citgo, Conoco, Imperial Oil, Infineum, Lubrizol, Pennzoil-Quaker State, RohMax GmbH, RohMax USA**
  - ➢ **Data analyzed using ASTM D2PP software**

Comparison of Viscosity Results @-20°C



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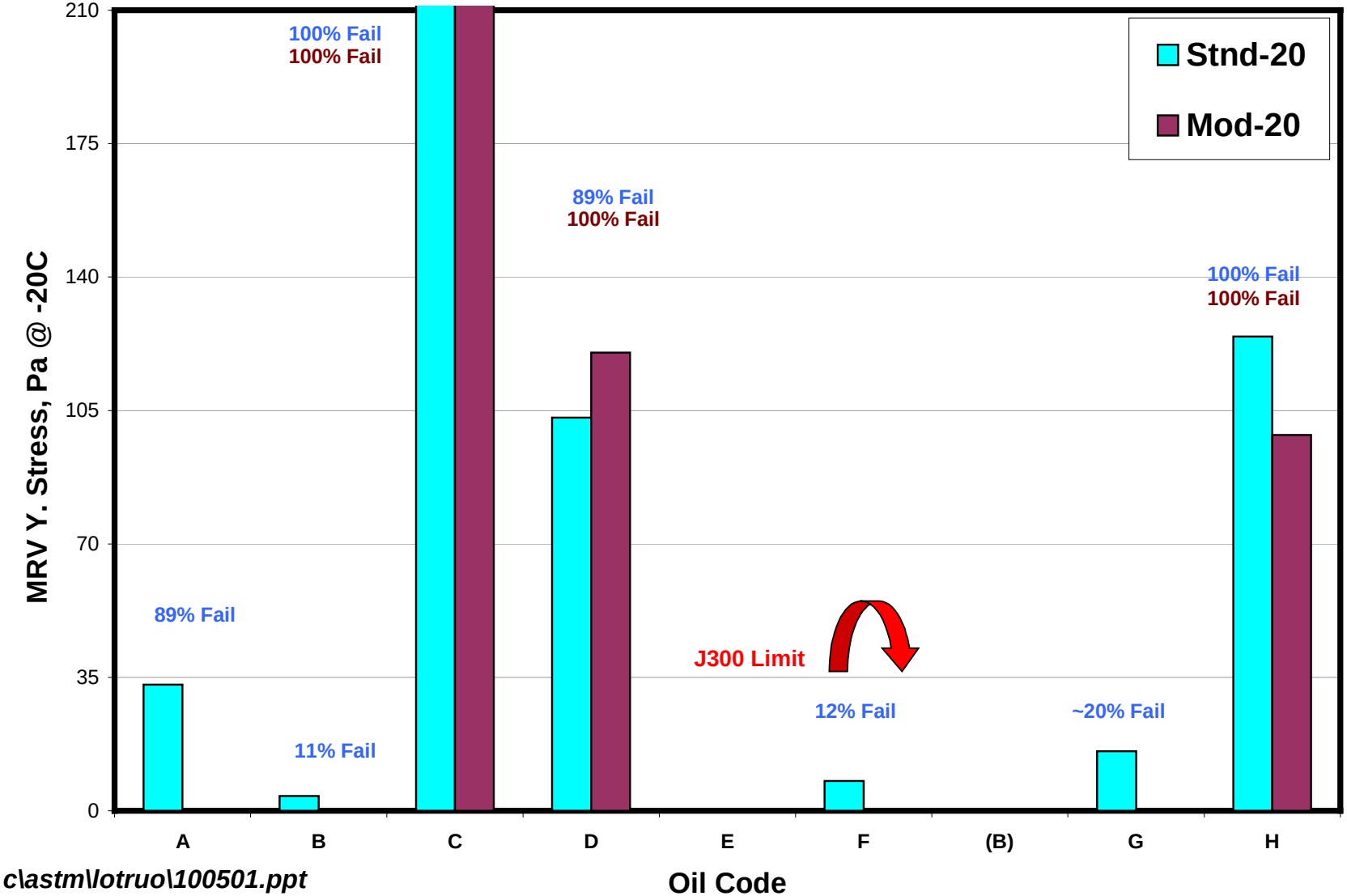
Comparison of Yield Stress Results @-20°C



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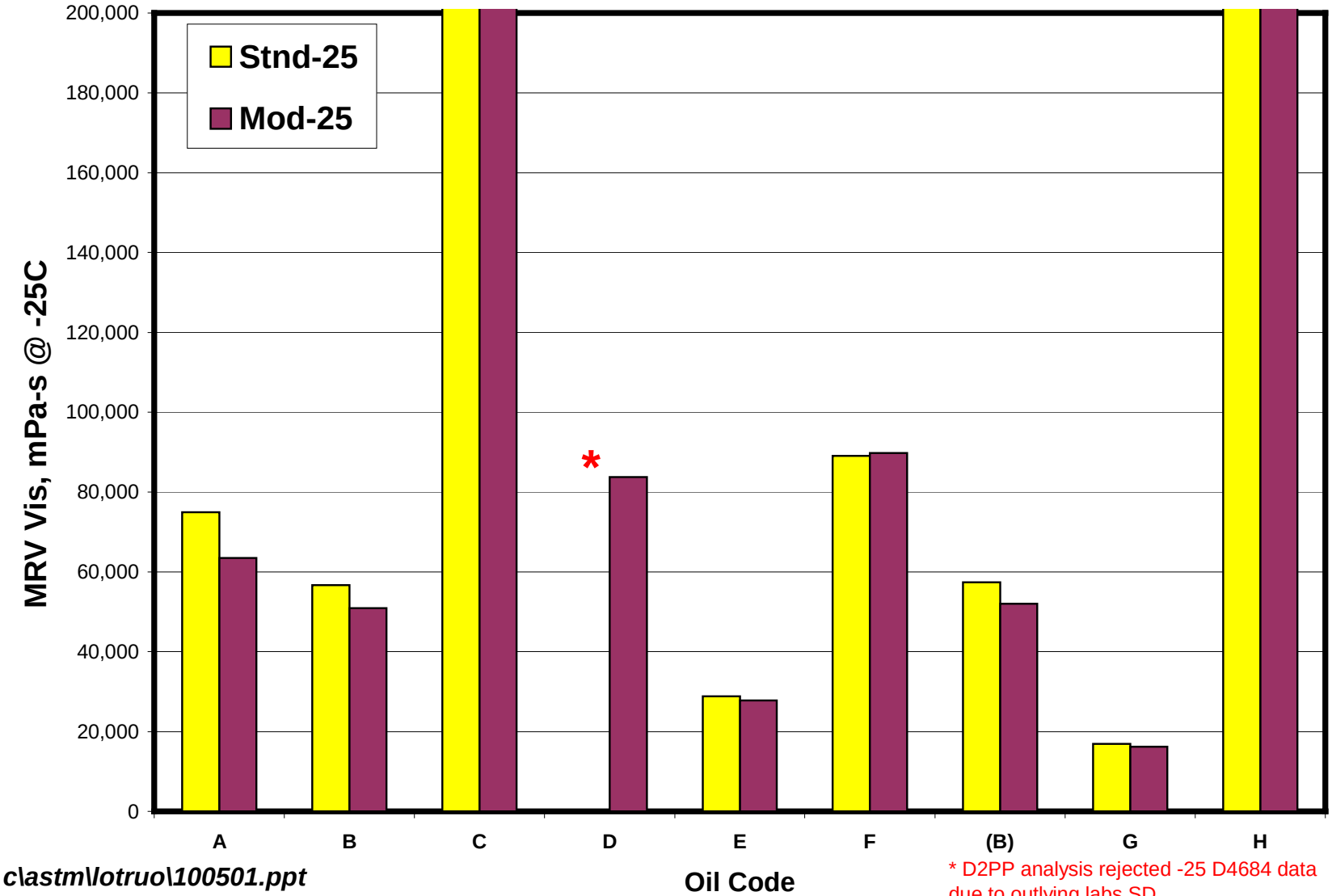
Comparison of Viscosity Results @-25°C



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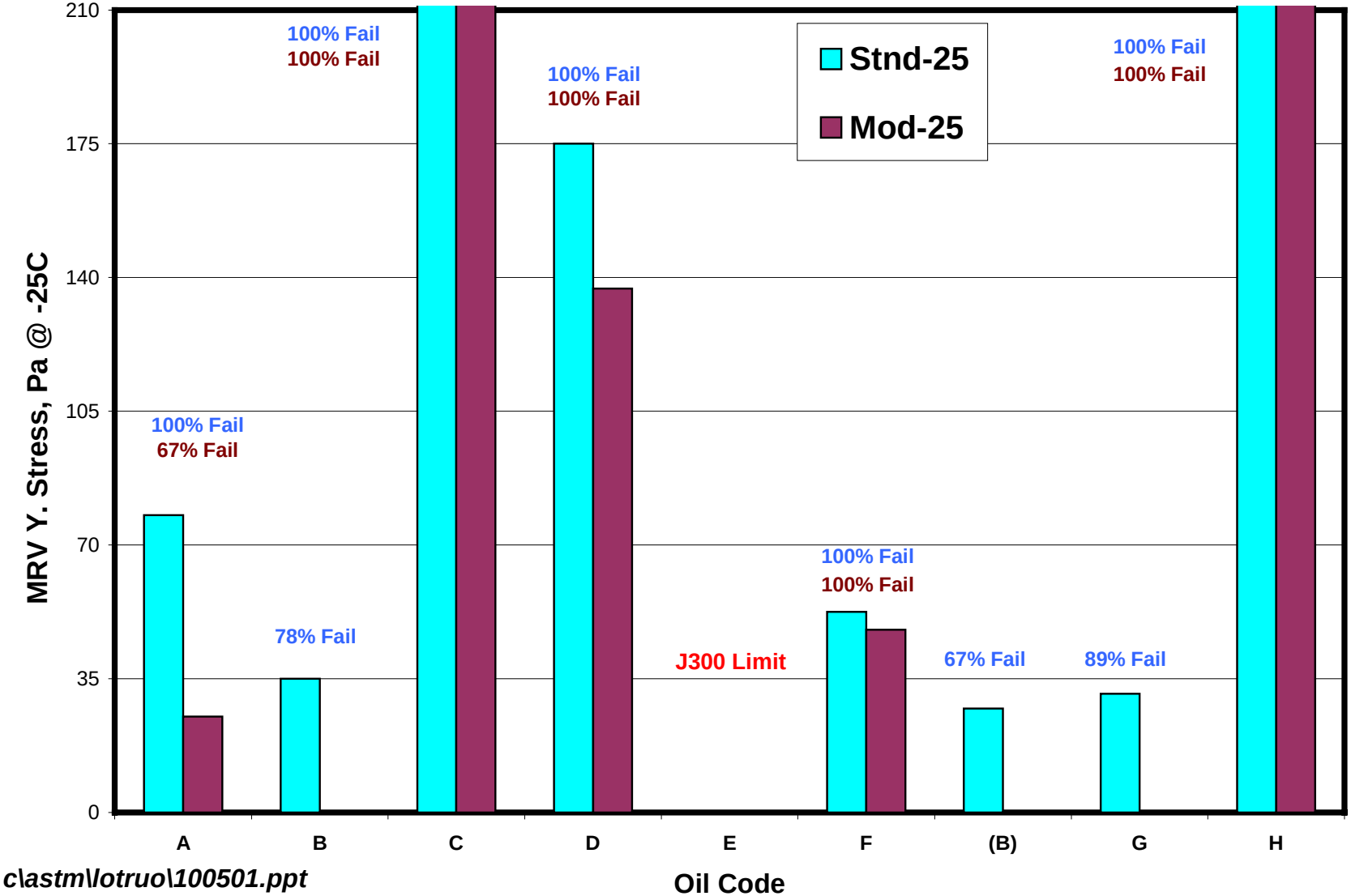
* D2PP analysis rejected -25 D4684 data due to outlying labs SD

Comparison of Yield Stress Results @-25°C



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Overall Results of Statistical Analysis

- **For oils with measurable viscosity (<400,000 mPa-s)**

Method	Temp., °C	This Study (used HDEO's) r, % of mean	This Study (used HDEO's) R, % of mean	D4684 Published (fresh oils) r, % of mean	D4684 Published (fresh oils) R, % of mean
D4684	-20	14.3	21.1	7.3	12.1
	-25	10.3	20.8	11.7	17.5
Modified D4684	-20	8.8	18.6	---	---
	-25	6.2	20.9	---	---

- **All labs detected oils with gross viscosity failure (>400,000 mPa-s); at this point, test becomes go/no-go**
- **D4684 yield stress precision appears consistent with step-function nature of measurement**

Conclusions

- **Used Diesel Engine Oil Round Robin successfully completed**
  - ➢ **Soot levels and viscosity/yield stress ranges expected to be relevant to PC-9 category development**
  - ➢ **D4684 MRV viscosity at -20°C has poorer precision than stated for fresh oils, but at -25°C, appears to be close to that stated for D4684**
  - ➢ **Modified D4684 viscosity measurements at -20/-25C (separate external preheat/agitation) have better repeatability but about the same reproducibility**
    - – **the two methods give similar mean viscosities but significantly higher percentage of oils show yield stress with the standard D4684 procedure ⇨ evidence of soot agglomerization during sample preheat**

Next Steps

- **Review Round Robin results to be reviewed with working group/task force (June 18th)**
  - ➢ **completed statistical analysis (incl. Y. Stress)**
  - ➢ **research report on used oil R/R**
  - ➢ **potential to incorporate results into D4684 (or new method?) along with guidelines for handling of used oils**

- **Input/Guidance from HDEOCP?**

Imperial Oil has received 25 E-O-T Oil Samples for Potential LOTRUO use

					TGA Soot, %		-20°C D4684		-25°C D4684	
CMIR Code	Ind. Oil Code	Lab Code	Engine Source	Qty Given	TMC	SRC	-20C MRV Vis., cP	-20C MRV Y. Str., Pa	-25C MRV Vis., cP	-25C MRV Y. Str., Pa
38811	PC-9A	D	T-10	1 gal	5.5	5.1	19,900	0<Y<=35	43,900	0<Y<=35
38814	PC-9A	F	T-10	1 gal	5.7	5.5	26,400	0<Y<=35	59,300	0<Y<=35
38810	PC-9A	A	T-10	4L	6.0		24,500	0<Y<=35	53,100	0<Y<=35
38951	PC-9A	G	T-10	4L	5.9		23,400	0<Y<=35	51,000	0<Y<=35
38967	PC-9B	A	M11 EGR	8L	8.0		22,600	0<Y<=35	70,400	0<Y<=35
38939	PC-9C	A	T-10	4L	5.4		23,200	0<Y<=35	61,300	0<Y<=35
38931	PC-9E	D	M11 EGR	1 gal	8.1	7.7	28,200	0<Y<=35	214,100	105<Y<=140
38932	PC-9E	A	M11 EGR	1 gal	8.7	8.5	38,900	0<Y<=35	305,400	175<Y<=210
38933	PC-9E	A	M11 EGR	2 gal	7.7	7	24,000	0<Y<=35	135,000	140<Y<=175
38929	PC-9E	G	M11 EGR	4L	8.8		29,400	0<Y<=35	208,500	140<Y<=175
38930	PC-9E	G	M11 EGR	4L	8.6		31,200	0<Y<=35	343,100	140<Y<=175
38927	PC-9E	G	M11 EGR	4L	9.1		26,300	0<Y<=35		
38937	PC-9E	A	T-10	4L	4.8		19,000	0<Y<=35	102,400	140<Y<=175
38962	PC-9F	G	M11 EGR	4L	8.7		28,900	35<Y<=70	133,600	70<Y<=105
38945	PC-9F	D	T-10	1 gal	5.3	5.09	17,300	0<Y<=35	76,100	35<Y<=70
38953	PC-9H	F	T-10	1 gal	NR	5.1	14,600	0<Y<=35	45,300	0<Y<=35
38947	PC-9H	G	T-10	4L	7.1		19,900	0<Y<=35	57,100	0<Y<=35
38821	?		1Q	1 gal		2.6	20,800	0<Y<=35	50,600	0<Y<=35
38966	?		M11 EGR	4L			31,800	105<Y<=140	77,900	140<Y<=175
38969	?		M11 EGR	8L			66,000	175<Y<=210	683,700	315<Y<=350
38934	?		M11 EGR	8L			31,000	0<Y<=35	262,300	140<Y<=175
38958	?		M11 EGR	4L			20,800	0<Y<=35	55,100	0<Y<=35
38928	?		M11 EGR	4L			22,300	0<Y<=35		
38813	?		T-10	1 gal		5.8	25,900	0<Y<=35	60,200	0<Y<=35
38942	?		T-10	4L			19,100	0<Y<=35	42,100	0<Y<=35

M11 EGR	**13**
T-10	**11**
1Q	**1**

All data generated by IOL to date

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IOL D4684 Data Comparing Same Oil, Different Runs

CMIR Code	38931	38932	38933	38929	38930	38927
Ind. Oil Code	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E
Lab Code	D	A	A	G	G	G
Engine Source	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR
% Soot Reported	8.1	8.7	7.7	8.8	8.6	9.1
-20C MRV Vis., cP	28,200	38,900	24,000	29,400	31,200	26,300
-20C MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35
-25C MRV Vis., cP	214,100	305,400	135,000	208,500	343,100	
-25C MRV Y. Str., Pa	105<Y<=140	175<Y<=210	140<Y<=175	140<Y<=175	140<Y<=175	

CMIR Code	38811	38814	38810	38951	38953	38947
Ind. Oil Code	PC-9A	PC-9A	PC-9A	PC-9A	PC-9H	PC-9H
Lab Code	D	F	A	G	F	G
Engine Source	T-10	T-10	T-10	T-10	T-10	T-10
% Soot Reported	5.5	5.7	6.0	5.9	NR	7.1
-20C MRV Vis., cP	19,900	26,400	24,500	23,400	14,600	19,900
-20C MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35
-25C MRV Vis., cP	43,900	59,300	53,100	51,000	45,300	57,100
-25C MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35

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IOL D4684 Data Comparing Same Oil, T10 vs M11

CMIR Code	38931	38932	38933	38929	38930	38927	38937
Ind. Oil Code	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E
Lab Code	D	A	A	G	G	G	A
Engine Source	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	T10
% Soot Reported	8.1	8.7	7.7	8.8	8.6	9.1	4.8
-20C MRV Vis., cP	28,200	38,900	24,000	29,400	31,200	26,300	19,000
-20C MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35
-25C MRV Vis., cP	214,100	305,400	135,000	208,500	343,100		102,400
-25C MRV Y. Str., Pa	105<Y<=140	175<Y<=210	140<Y<=175	140<Y<=175	140<Y<=175		140<Y<=175

CMIR Code	38962	38945
Ind. Oil Code	PC-9F	PC-9F
Lab Code	G	D
Engine Source	M11 EGR	T10
% Soot Reported	8.7	5.3
-20C MRV Vis., cP	28,900	17,300
-20C MRV Y. Str., Pa	35<Y<=70	0<Y<=35
-25C MRV Vis., cP	133,600	76,100
-25C MRV Y. Str., Pa	70<Y<=105	35<Y<=70

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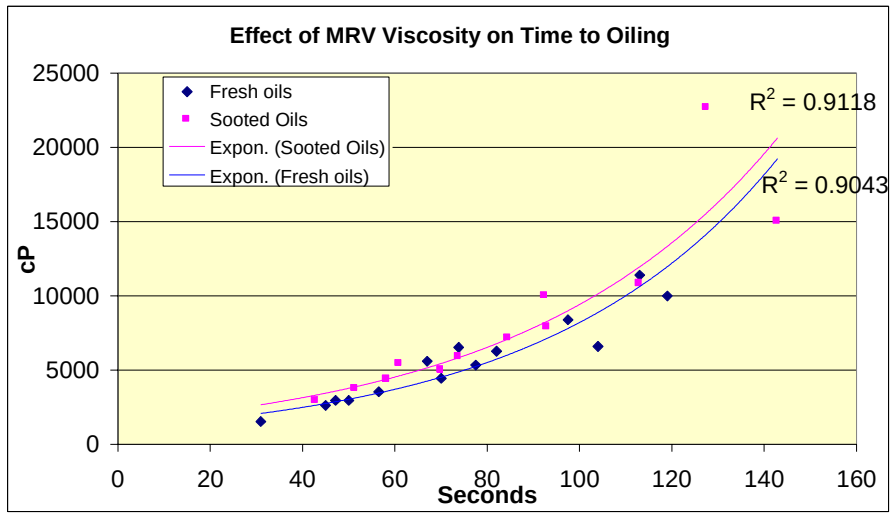
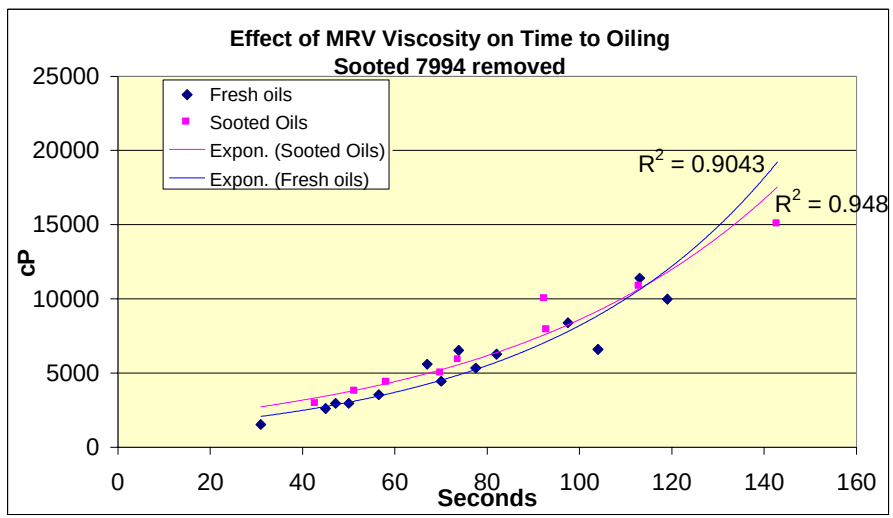
Correlation between MRV and Time to Oil Pressure





David M Stehouwer, Cummins Inc.

Relation of MRV Vis to Cold Pumpability in M11 Engine

- Cummins Inc. and Mack sponsored cold pumpability work in an M11 engine
- Fresh oils were compared to oils sooted to 6.0% to 6.5%
- Used oils with low dispersancy showed higher than expected viscosity in MRV.
- There is a strong correlation between MRV viscosity by modified ASTM D4684

ATTACHMENT 14

ASTM PC-9 Elastomer TF Report
To D02.B HDEOCP
May 10, 2001

Round Robin Status

- 7 labs have been sent oil and Elastomers to run in a round robin
- 3 labs have finished testing and results are available
- Messages have been sent to the remaining labs urging them to complete their tests
- It is hoped to have the results completed within the next month so that results can be sent to statisticians for their analysis

Procedure Status

- The Procedure is posted to the ASTM web site until the end of the round robin for comment
- 15 persons have access including all 7 labs. If anyone would like access please contact Tom Boschert at Tom_Boschert@ethyl.com

Next Steps

- Finish the Round Robin and data Analysis (~6 weeks)
- Convene the Elastomer TF to review the data & analysis - make recommendations to ASTM B0.2 HDEOCP and ASTM D11.15
- D11.15 to ballot procedure with round robin data
- HDEOCP to incorporate into PC-9

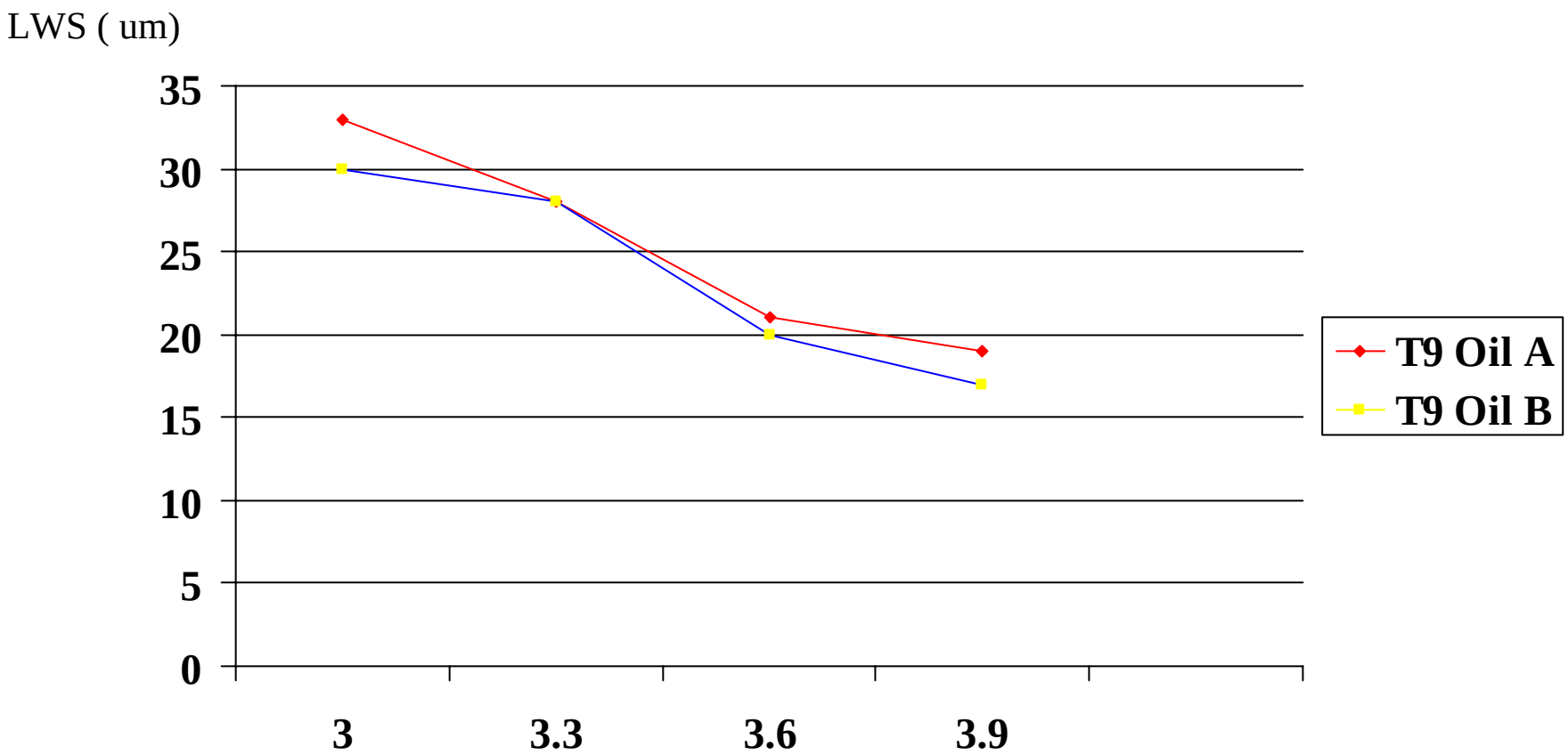
PC9 HT/HS Recommendation

- 3.5 Minimum for 10W 30 Visc Grade

  Engine Test Wear Data

  Precedent’s of 3.5 in European & Global DHD-1 Specifications

Mack T9
Liner Wear vs HTHS



GLS 5-4-01

Bearing Wear and HTHS

- US heavy duty diesel engine
- 2 x upper journal bearings
- Modified ETC test cycle
- On and off-line measures for integrity of data
- Same chemistry…different basefluid viscosities
- Independent statistical analysis

PC-9 to CH-4 Backward Compatibility

W.M. Kleiser

Chevron Oronite Technology

May 10, 2001

For Use by ASTM Heavy Duty
Engine Oil Classification Panel Only

Backward Compatibility of PC-9

- **Proposal: HDEOCP formalize the intent that oils meeting the requirements of API PC-9 will also meet the requirements of API CH-4.**
- **Purpose:**
  - **Promote cost effective testing and approval**
  - **Enable more rapid introduction of API PC9 quality products**
  - **Increase available PC9 test capacity**
- **Support:**
  - **Comparative testing in key PC-9 and CH-4 tests shows greater severity of PC-9 tests**

Backward Compatibility of PC-9

- **Motion:** ***The Heavy Duty Engine Oil Classification Panel resolves that it is intended that oils meeting the performance requirements of API PC9 will also fulfil the performance requirements of API CH-4.***

LUBRIZOL

Fluid technologies for a better world™

Lubrizol Proposal for Sequence IIIF to Sequence IIIE Correlation for API "C" Categories

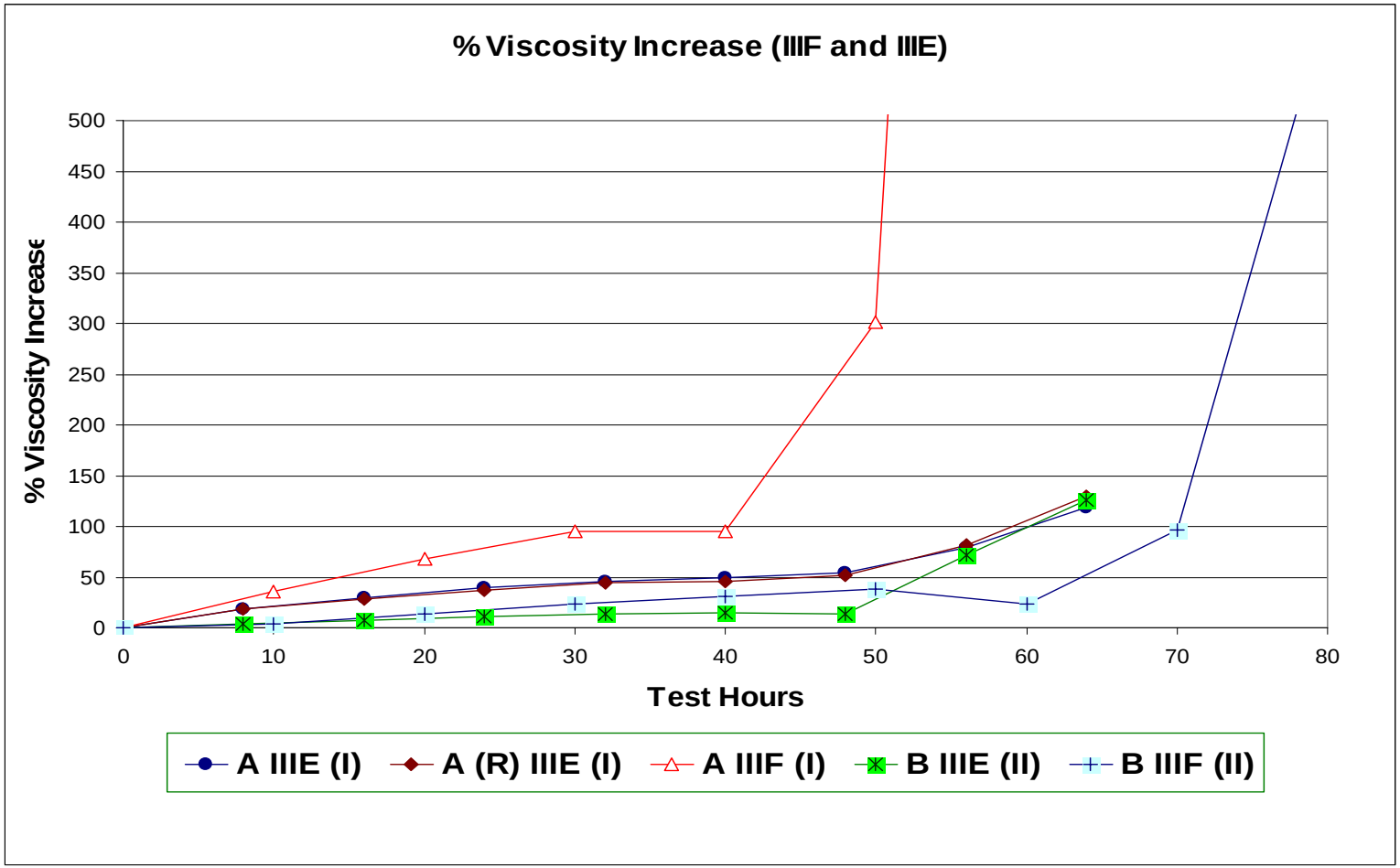
May 10, 2001

Correlating the Sequence IIIF to IIIE for use in API “C” Categories

Oil Code	Oil Quality	SAE Viscosity Grade	Base Oil Group	IIIE% Viscosity Increase @ 64 hrs.	Predicted IIIF Viscosity Performance	IIIF% Viscosity Increase @ 60 hrs.	IIIF% Viscosity Increase @ 80 hrs.
Oil A (Original)	CH-4/SJ	15W-40	I	A IIIE (1) 119	Fail	A IIIF (I) 2784	A IIIF (I) 9761
Oil A (Repeat)	CH-4/SJ	15W-40	I	A (R) IIIE (I) 130	Fail		
Oil B	CH-4/SJ	15W-40	II	B IIIE (II) 126	Pass	B IIIF (II) 23.2	B IIIF (II) 614.2

LUBRIZOL

Correlating the Sequence IIIF to IIIE for use in API "C" Categories



Correlating the Sequence IIIF to the Sequence IIIE for use in API “C” Categories

- Recommendations:

  Viscosity increase limits based on the data from the oils run in both IIIE and IIIF Tests.

  – Adopt a IIIF Limit for API CG-4:

  325% Viscosity Increase @ 60 hours

  – Adopt a IIIF Limit for API CH-4:

  295% Viscosity Increase @ 60 hours