HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
June 19, 2001
Sheraton Hotel & Marina, San Diego, CA

ACTION ITEMS

1.	**Issue first set of 'exit' ballots.**	**J. McGeehan**
2.	**Resolve HTHS issue.**	**HDEOCP**
3.	**Report on matrix data analysis.**	**M-11 EGR & T-10 TF**

MINUTES

1.0 Call to Order

1.1 Chairman Jim McGeehan called the meeting to order at 9:02 a.m. on June 19, 2001, in the Harbor Island Room of the Sheraton Harbor Island Hotel of San Diego, CA. There were 13 members present or represented and approximately 75 guests present. The attendance list is shown as Attachment 2.

2.0 Agenda

2.1 The announced agenda (Attachment 1) was reviewed and due to conflicts with other meetings, the used oil viscometrics and 'B' ballot reports were moved ahead of exit ballots, HTHS and elastomer discussions.

3.0 Previous Meeting Minutes

3.1 The minutes of the May 25, 2001, meeting in Chicago were approved as distributed and posted on the TMC website.

4.0 Membership

4.1 Chairman McGeehan reviewed the panel membership (Attachment 3). Tom Cousineau replaces Mark Rees of Ethyl as a member.

5.0 Chairman's Comments

5.1 Chairman McGeehan reviewed the PC-9 development program and the proposed meeting / objective timeline. Attachment 4.

6.0 PC-9 Matrix Status

6.1 John Zalar presented a report (Attachment 5) on the status of the matrix tests. All M-11 EGR and T-10 testing should complete by July 2nd and the 1R tests could complete by August 10th. Dale Carroll asked if T-10 / M-11 tests currently running would replace existing tests posted on the TMC website and would the existing test data then disappear. The answer was that the existing data would not disappear.

6.2 Steve Kennedy reported that the ACC and API had not yet approved use of MOA funds for the 1R, but he expected that to happen by next week. Ralph Cherrillo said the API BOI / VGRA Task Force had not yet fully approved use of the 1P BOI guidelines for the 1R, but he expected that to complete soon.

7.0 Mack T-10

7.1 Greg Shank gave an update on T-10 matrix testing and presented the T-10 matrix piston deposit data (Attachment 6). He mentioned that upper rod bearing average weight loss (URBWL) could be used instead of oil lead level. When asked about piston deposits, he said he did not want them to become an additional pass/fail parameter for the T-10, unless they were directly connected to oil consumption.

7.2 Jim Rutherford presented some 'preliminary' analysis of the T-10 matrix data (Attachment 7) and also stated that review of the ACC template with the Task Force revealed no major obstacles at this time.

7.3 Joe Franklin reviewed the FTIR oxidation data to date (Attachment 8) and the panel requested that the raw data be included in the minutes.

8.0 Cummins M-11 EGR

8.1 Dave Stehouwer presented an update on M-11 EGR matrix activity and results (Attachment 9). He showed the results from one test completed with a re-worked oil filter and indicated a second test was underway. He also indicated he is looking for more tests to help determine how much difference the filter re-work might make in filter delta P, since the one test falls within the band of matrix results with that oil.

9.0 Caterpillar 1R

9.1 Dwayne Tharp indicated CAT supports the 1R and listed some of the commonalities and differences from the 1Q (Attachment 10).

9.2 Don Marn presented the Matrix Design Task Force recommendations for the 1R matrix (Attachment 11). After considerable discussion on the merits of using two or three oils in this matrix, Lew Williams moved to accept the MDTF "Alternate" proposal, which uses three oils. Dwayne Tharp seconded the motion, which passed unanimously by voice vote. The 3 oils will be PC-9A, PC-9D and PC-9M (1005). All 1R matrix stands had already started tests on oils A or M, to allow time for completion by August.

10.0 Used Oil Viscometrics

10.1 Dave Stehouwer presented results from a low temperature engine oil flow study, done with sooted oils (Attachment 12).

10.2 Chris May presented an update on the LOTRUO activities (Attachment 13) and indicated they plan to ballot the modified D4684 method (MRV) in a couple of months as an annex to D4684, since it would not be mandatory. Chris agreed to send the data he had as a spreadsheet to Jim Rutherford.

10.3 Jim McGeehan presented low temperature sooted oil data from an SAE paper of his, #2000-01-1989 (Attachment 14).

11.0 Sequence IIIF for Sequence IIIE

11.1 Bill Nahumck reported on the Sequence III Surveillance Panel activity and presented several things they agreed to do to accommodate use of the IIIF test in older HD categories (Attachment 15). The proposals would require a procedure change and thus a 'B' ballot, probably in conjunction with a ballot on D4485.

11.2 Jim McGeehan presented proposed limits for multiple Seq. IIIF tests in the CH-4 and CG-4 categories (Attachment 16).

12.0 Ballot Results

12.1 Jim McGeehan reported that the 'B' ballot to replace the L-38 in older HD categories with the Sequence VIII was a passing ballot with no negatives (Attachment 17).

13.0 Lunch Break

14.0 High Temperature / High Shear

14.1 Bill Kleiser presented some data and observations with regard to HTHS (Attachment 18).

14.2 Pat Fetterman presented more data and observations on HTHS (Attachment 19).

14.3 Greg Shank presented some data and EMA's recommendations for HTHS limits (Attachment 20). Dave Stehouwer moved to accept the recommendation of 3.5 cP minimum HTHS limit for xW-30 new oil. Don Marn seconded the motion. After lots of discussion between the opposing camps, the motion passed with 6 votes for, 4 against and 1 abstain. Since this result seemed to guarantee 'B' ballot negatives, it was decided to see how the other two proposals might fare. Greg Shank moved and Don Marn seconded to adopt the 3.3 cP minimum HTHS from EOAT (HEUI) samples at 5 or 10 hours. This proposal also passed, but with a 5 for, 4 against, 2 abstain vote. This was even less favorable, so the third proposal was tried. Greg Shank moved and Don Marn seconded that the HTHS limit be set at 3.3 cP minimum for xW-30 oils, after shear (in the Bosch injector apparatus). This motion also passed with a 6 for, 4 against, 1 abstain vote – not exactly consensus either. So, work remains to be done on this issue.

15.0 Exit Ballots

15.1 Jim McGeehan presented (Attachment 21) how he plans to split the 'exit' ballots up and indicated he would send them to the 'B' membership to help surface potential problems earlier.

15.2 Pat Fetterman voiced a concern over adopting existing limits for the 1N without any data on PC-9 oils.

16.0 Elastomer Compatibility

16.1 Dave Stehouwer presented the Elastomer Task Force report for Tom Boschert (Attachment 22) and noted there is a proposal being considered on statistically handling a candidate oil's results versus the reference oil, but it needs more work.

17.0 Next Meeting

17.1 Chairman McGeehan cautioned everyone to plan for full day meetings on August 15th and September 5th.

18.0 Adjournment

18.1 The meeting was adjourned at 3:21 p.m. on June 19, 2001.

Submitted by,

Jim Wells

Secretary to the HDEOCP

ASTM-HDEOCP

Sheraton San Diego Hotel
June 19th 2001
Room Harbor Island II—9:00 am –4:30 pm

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

Desired Outcomes: **- Matrix results in EGR tests**
Matrix results in Cat 1R tests

TOPIC	PROCESS	WHO	TIME
Agenda Review	• Desired Outcomes & Agenda	Group	9:00-9:10
Minutes Approval	• May 25th 2001	Group	9:10-9:15
Membership	• Changes • Chairman's comments	Group Jim Mc Geehan	9:15—9:20
Matrix Status	• Mack T-10; Cummins M11-ERG; Cat 1R • Time line for PC-9	John Zalar	9:20-9: 45
Cat 1R Approval	• Stack-holder approval of Cat 1R	Steve Kennedy	9:45-10:00
Mack T-10	• All Matrix results" • Ring-Liner wear • Bearing wt loss and lead increase • Oil consumption and piston deposits • IR oxidation of used oil • Statistical analysis of data • Discussion	Greg Shank Joe Franklin	10:00-10:45
Cummins M11 EGR	• All Matrix results • Cross-head and injector screw wear • Filter delta p • Sludge • New filter results • Statistical analysis of data • Discussion	Dave Stehouwer	10:45-11:30
Caterpillar 1R	• Caterpillar buy-in of 1R • Matrix task-force recommendations • Timing	Dwayne Tharp Don Marn	11:30-12:00-

TOPIC	PROCESS	WHO	TIME
Lunch			12:00-2:00
Exit Criteria Ballot for test from API CH-4	• Review test limits • Issue ballot for July 11th meeting	Jim Mc Geehan	2:00-2:15
SAE 10W-30 HT/HS limits for PC-9	• Data to support a 3.5 HT/HS limit • Other data • Discussion	Greg Shank Pat Fetterman	2:15-3:00
Used oil viscometrics	• Cummins M11 pumping times with high soot oils compared to fresh oils. • MRV TP-1/SB with 9% soot from M11 • MRV TP-1 Precision • Recommended test	Dave Stehouwer Jim Mc Geehan Chris May	3:00-3:45
Elastomers compatibility	• Task-force recommendations on tests and precision	Tom Boschert	3:45-4:15
Next meeting	• July 11th, August 15th and Sept 5th • Holiday Inn O'Hare, Chicago • Action items for next meeting	Jim Mc Geehan	4:15-4:30
New or Old Business			

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McFall, David Lubes'N'Greases Magazine 1300 Crystal Dr., Suite 1203 Arlington, VA 22202	(703) 416-7284 (703) 416 0015 david.vmc@verizon.net	DM	
Migdal, Cyril Crompton Corporation 199 Benson Rd. Middlebury, CT 06749	(203) 573-2532 (203) 573-2165 cyril_migdal@cromptoncorp.com	CAM	
Mitchell, Bill John Deere & Co. P.O. Box 8000 Waterloo, IA 50704-8000	(319) 292-8241 (319) 292-8441 MitchellWilliamE@jdcorp.deere.com		
Mulford, Luis Savant 4800 James Savage Rd. Midland, MI 48642	(517) 496-2301 savant@savantgroup.com		
Nahumck, William M. The Lubrizol Corp. 29400 Lakeland Blvd. Wickliffe, OH 44092	(440) 347-2596 (440) 347-4096 wmn@lubrizol.com	WMN	
Nann, Norbert Nann Consultants Inc. 59 Edgehill Drive Wappinger Falls, NY 12590	(845) 297-4333 (845) 297 4334 norbnann1@aol.com	NN	
Oliphant, Tom American Refining Group 77 N. Kendall Ave. Bradford, PA 16701	(814) 368-1353 (814) 368-1328 toliphant@amref.com	TO	
Oliver, Rick RSI 2805 Beverly Dr. Flower Mound, TX 75022	(972) 726-2136 crickoliver@home.com	CRO	

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

ATTENDANCE LIST

JUNE 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Olszewski, T. A. Exxon Company USA 800 Bell Street Houston, TX 77252	(713) 656-4398 (713) 656-5301 tom.a.olszewski@exxon.com		
Orrin, Douglas MathSoft 1573 Martinique Drive Troy, MI 48084	(248) 816-3332 (248) 816-5858 dorrin@splus.mathsoft.com		
Paboucek, Jim Castrol HD Lubricants 9300 Pulaski Highway Baltimore, MD 26220	(410) 682-9409 (410) 780-8632 jim_paboucek@burmahcastrol.com		
Parry, Barb Mohawk Lubricants Ltd. 130 Forester St. North Vancouver, BC VTH2M9	(604) 924-2703 (604) 929-8371 bparry@mohawklubes.com		
Patrick, Dick Citgo Petroleum Corporation P.O. Box 3758 Tulsa, OK 74102	(918) 495-5937 (918) 495-5935 rpatri1@citgo.com	RJP	
Pearse, Steven Castrol Technology Centre Whitchurch Hill Pangbourne Reading Berkshire, England RG8 7QR	44 (0) 118 976 5459 steven_pearse@burmahcastrol.com		
Peckham, Jack Lubricants World 4545 Post Oak Place, #210 Houston, TX 77027	(713) 993-9320 jpeckham@phillips.com		
Place, William E. Oronite 30150 Telegraph Rd., Suite 416 Bingham Farms, MI 48025	(248) 540-3277 (248) 540-3279 wepl@chevron.com	BP	

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

JUNE 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Ratliff, Kevin BP 150 W. Warrenville Rd. Naperville, IL 60563	 (630) 420-5073 (630) 961-7979 ratlifks@bp.com		
Reddy, Vijay N. Thermo Haake 149 Commonwealth Dr. (Thermal Lab) Menlo Park, CA 94025	 (650) 688-7075 (650) 688-7202 vijay.reddy@thermohaake.com		
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	JAR	

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

ATTENDANCE LIST

JUNE 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
St. Germain, Bob Crompton Corp. 6847 Napier Lane Houston, TX 77069	(281) 587-2393 (281) 587-0338 robert_stgermain@cromptoncorp.com	RDS	
Sander, John Lubrication Engineers, Inc. 1919 E. Tulsa Wichita, KS 67216	(316) 529-2112 (316) 529-4654 sanderj@lubricationengineers.com	JRS	
Sarlo, Mark Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78238	(210) 522-3754 (210) 523-6919 msarlo@swri.org	MS	
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		
Shah, Mayur Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092			
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		

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

JUNE 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
Smith, Clinton Imperial Oil 111 St. Clair Ave. Toronto, Ontario M5W1K3	(416) 968-8308 (416) 968-5680 clint.smith@esso.com	CNS	
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	PJS	
Sutherland, Robert Pennzoil-Quaker State 1520 Lake Front Circle The Woodlands, TX 77380	(281) 363-8029 (281) 363-8002 RobertSutherland@pzlqs.com	RAS	
Sztenderowicz, Mark Chevron Products Co. 100 Chevron Way Richmond, CA 94802-0627	(510) 242-1022 (510) 242-3758 mlsz@chevron.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		

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

JUNE 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
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 Oronite P.O. Box 1627 Richmond, CA 99802	 (510) 242-1404 (510) 242-3173 wvda@chevron.com	WvD	
Venier, Cliff Pennzoil-Quaker State P.O. Box 7569 The Woodlands, TX 77381-2539	 (281) 363-8060 (281) 363-8002 cliffordvenier@pzlqs.com	CGV	
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		
Weber, Ben Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78238	 (210) 522-5911 (210) 684-7530 bweber@swri.edu	BW	
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		

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

JUNE 2001

PREVIOUS GUESTS

	Phone No. Fax No. e-mail add.	INITIAL WHEN PRESENT	ROOM FEE
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) 365-1005 (412) 365-1047 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		

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

JUNE 2001

GUESTS

		Phone No. Fax No. e-mail add.	ROOM FEE
Name:	Phil Scinto		
Company:	Lubrizol	(440) 347-2161	
Address:	29400 Lakeland Blvd.	(440) 347-9031	
	Wickliffe, OH 44092	prs@lubrizol.com	
Name:	Tom Karol		
Company:	R.T. Vanderbilt Co.	(203) 853-1400	
Address:	23 Winfield St.	(203) 831-0648	
	Norwalk, CT 06855	tkarol@rtvanderbilt.com	
Name:	Mark Cooper		
Company:	Chevron Oronite	(210) 731-5606	
Address:	4502 Centerview Dr., Ste 210	(210) 731-5699	
	San Antonio, TX 78228	mawc@chevron.com	
Name:	Don-Hak Bae		
Company:	Pennzoil-Quaker State	(281) 363-8052	
Address:	P.O. Box 7569	(281) 363-8092	
	The Woodlands, TX 77387	donhakbae@pzlqs.com	
Name:	Steve Spence		
Company:	Mohawk Lubricants Ltd.	(604) 924-2701	
Address:	130 Forester St.		
	N. Vancouver, Canada V7H 2M9	sspence@mohawklubes.com	
Name:	Angela Edwards		
Company:	Crompton Corporation	(203) 573-2308	
Address:	199 Benson Rd.	(203) 573-2525	
	Middlebury, CT 06749	angie_edwards@cromptoncorp.com	
Name:	Jim Newcombe		
Company:	Infineum USA, LP	(248) 476-8171	
Address:	34388 Quaker Valley Rd.	(248) 474-0739	
	Farmington Hills, MI 48331	james.newcombe@infineum.com	
Name:	M. N. Al-Lahiani		
Company:	Saudi Aramco	(966) 3-572-4276	
Address:	P.O. Box 5894		
	Dhahran, Saudi Arabia 31311	lahianmn@mail.aramco.com.sa	

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HEAVY DUTY ENGINE OIL CLASSIFICATION PANEL

ATTENDANCE LIST

JUNE 2001

GUESTS

		Phone No. Fax No. e-mail add.	ROOM FEE
Name:	Dwight Bowden		
Company:	OH Technologies Inc.	(440) 354-7007	
Address:	P.O. Box 5039	(440) 354-7080	
	Mentor, OH 44061-5039	dhbowden@ohtech.com	
Name:	Dean Schoppe		
Company:	PerkinElmer Automotive Research	(210) 523-4605	
Address:	5404 Bandera Rd.	(210) 523-4607	
	San Antonio, TX 78238	dean.schoppe@perkinelmer.com	
Name:	Hans Siemelink		
Company:	Shell Oil		
Address:	One Shell Plaza, 910 Louisiana Rd.		
	Houston, TX 77002	hsiemelink@shell.com	
Name:	Rich Lee		
Company:	Chevron Oronite	(510) 242-2988	
Address:	100 Chevron Way	(510) 242-3170	
	Richmond, CA 94802	rhle@chevron.com	
Name:	Dennis Florkowski		
Company:	Daimler Chrysler, CIMS 482-00-13	(248) 576-7477	
Address:	800 Chrysler Dr.		
	Auburn Hills, MI 48326-2757	df11@daimlerchrysler.com	
Name:	Chene Cotter		
Company:	California Air Resources Board	(916) 322-5550	
Address:	P.O. Box 2815	(916) 322-6088	
	Sacramento, CA 95812	ccotter@arb.ca.gov	
Name:	Terry Bates		
Company:	Manesty Consultancy Ltd.	44-151-348-4084	
Address:	50 Tower Hill Rd., North	44-151-348-4084	
	Heswall, Wirral, UK CH60 6RS	batesterryw@cs.com	
Name:	Jim Moritz		
Company:	PerkinElmer Automotive Research	(210) 523-4601	
Address:	5404 Bandera Rd.	(210) 523-4607	
	San Antonio, TX 78238	jim.moritz@perkinelmer.com	

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

ATTENDANCE LIST

JUNE 2001

GUESTS

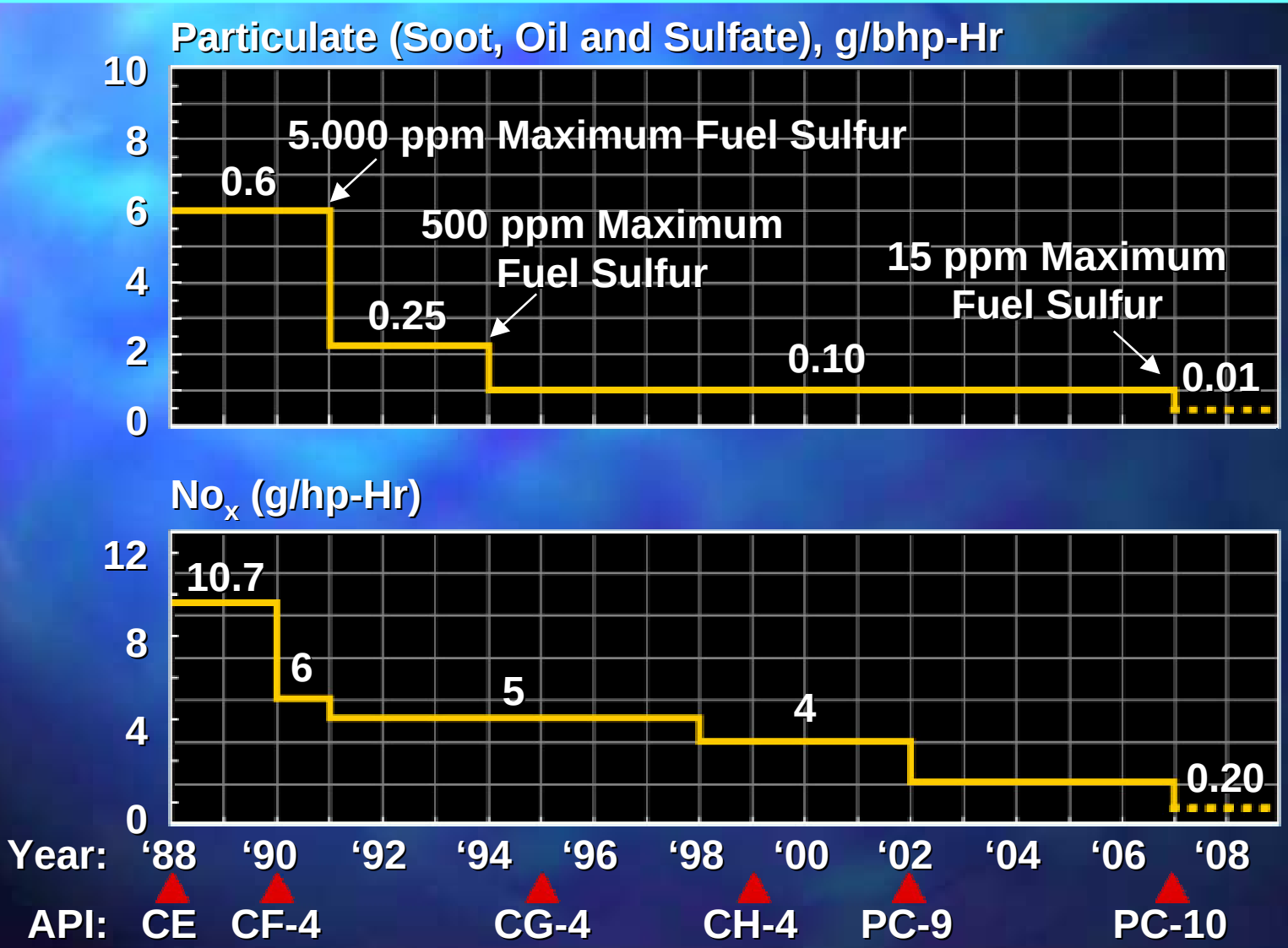
		Phone No. Fax No. e-mail add.	ROOM FEE
Name:	Bill Buck		
Company:	ExxonMobil Research and Engineering	(856) 224-3939	
Address:	600 Billingsport Rd.	(856) 224-3613	
	Paulsboro, NJ 08066	william.h.buck@exxonmobil.com	
Name:	Hal Shaub		
Company:	Center For Innovation	(972) 518-1223	
Address:	1112 Hidden Ridge Dr., #1071	(972) 756-1063	
	Irving, TX 75038	hshaub@webtv.net	
Name:	Lyle Bowman		
Company:	Consultant	(415) 479-3004	
Address:	728 Montecillo Rd.		
	San Rafael, CA 94903	jbfoodie@aol.com	
Name:	Ed Miller		
Company:	Consultant	(845) 297-8276	
Address:	42 Edgehill Dr.		
	Wappingers Falls, NY 12590	milleredf@aol.com	
Name:	Arnold Shugarman		
Company:	Consultant	(714) 206-6136	
Address:	1906 E. Catalina Ave.		
	Santa Ana, CA 92705	shugarman@earthlink.net	
Name:			
Company:			
Address:			
Name:			
Company:			
Address:			
Name:			
Company:			
Address:			

HDEOCP Voting Members
Balance Between OEM's and Oil Companies and Additive Suppliers

- G. Shank
  - Mack Trucks
- D. Stehouwer
  - Cummins Engine Company
- M. (Mesfin) Belay
  - Detroit Diesel Corp.
- K. Chao
  - John Deere
- F. Bondarowicz
  - Internal Truck and Engine Corp.
- R. Stockwell
  - GM Powertrain
- D. Tharp
  - Caterpillar Inc.
- J. Mc Geehan
  - Chevron Products
- S. Kennedy
  - ExxonMobil
- A. Huang
  - Equilon Enterprises
- M. Rees
  - Ethyl Corp.
- W. Kleiser
  - Oronite
- P. Fetterman
  - Infineum USA LP
- L. Williams
  - Lubrizol Corp.

ATTACHMENT 3

Timely Delivery of High Quality Engine Oils



G9901217

PC-9 Testing Status of New Tests

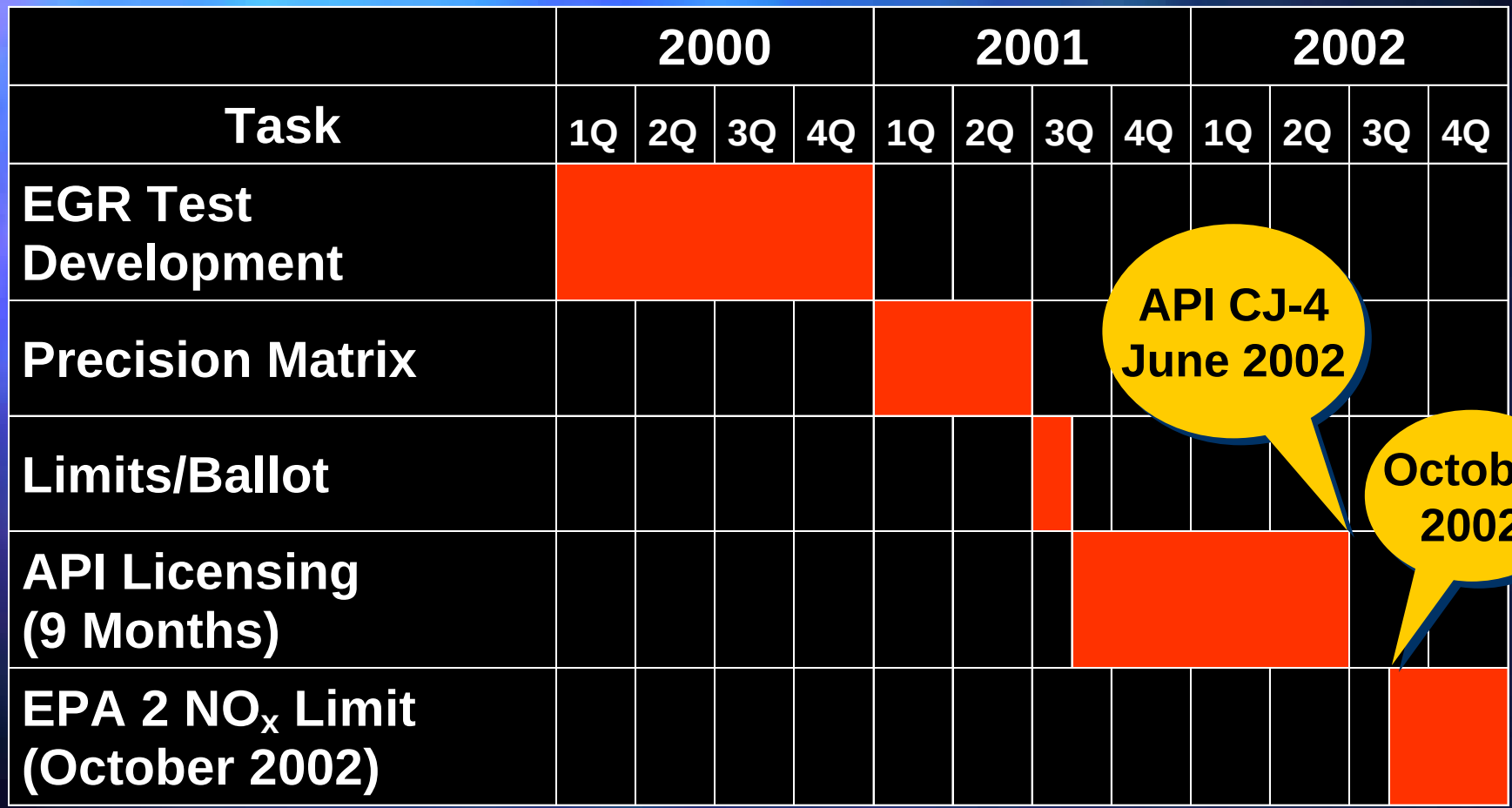
Test	Matrix	Statistical Analysis	Limit Setting
Mack T-10	June Completion	August 15th Limit Discussion	September 5th
Cummins M11 (EGR)	June Completion	August 15th Limit Discussion	September 5th
Cat 1Q	Aborted*	None	–
Cat 1R	Started June – End August	–	September 5th

*Aborted on High Oil Consumption and Scuffing on All Feature Oils and Base Oil Types

PC-9 Tests Status of New Tests

Performance	Engine and Bench Tests	Limit Setting Discussions	Limit Setting
Viscosity Control	Mack T-8E	August 15th	September 5th
Oxidation	FT-IR Mack T-10/Cat 1R	August 15th	September 5th
Volatility	Noack: All Grades	–	Completed
Elastomer Compatibility	Equal to Reference Oils	August 15th	September 5th
Used Oil Viscometrics (Low Temperature)	J300 Bench Test	August 15th	September 5th
HT/HS for SAE 10W-30 (3.5 Min.)	SAE J300	August 15th	September 5th

PC-9 Overview Timeline



Three Matrix Base Oils

API Group	% Saturates	Sulfur, ppm	VI
I	75	2000-5000	96-102
II	90	20-30	>95
II	99	1	>95

Three Additive Technologies

	Sulfate Ash %	TBN D 2896
X	1.5	11
Y	1.4	12
Z	1.3	8

Matrix Cost $5.7 Million

EGR Engines	Number of Tests
Mack T-10	28
Cummins M11 EGR	26
Caterpillar 1Q	28
Total Number of Tests	82

T-10/EGR Test Design – Feature Oil A

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

Cummins M11/EGR Test Design – Feature Oil E

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		

Caterpillar 1Q/EGR Test Design – Feature Oil J

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

Status of PC-9 Matrix Testing

Presented to HDEOCP

June 19, 2001

John L. Zalar

T-10

- **Planned Tests: 28**
- **Total Starts: 30**
- **Completed Tests**
  - **Verified and posted on TMC web site: 26**
  - **EOT and being reviewed/verified: 1**
  - **Aborted/Invalid: 3**
- **Tests Currently Running: 1**
- **Earliest EOT for Last Matrix Test: 6/28/01**

M11-EGR

- **Planned Tests: 26**
- **Total Starts: 28**
- **Completed Tests**
  - **Verified and posted on TMC web site: 20**
  - **EOT and being reviewed/verified: 5**
  - **Aborted/Invalid: 2**
- **Tests Currently Running: 1**
- **Earliest EOT for Last Matrix Test: 6/20/01**

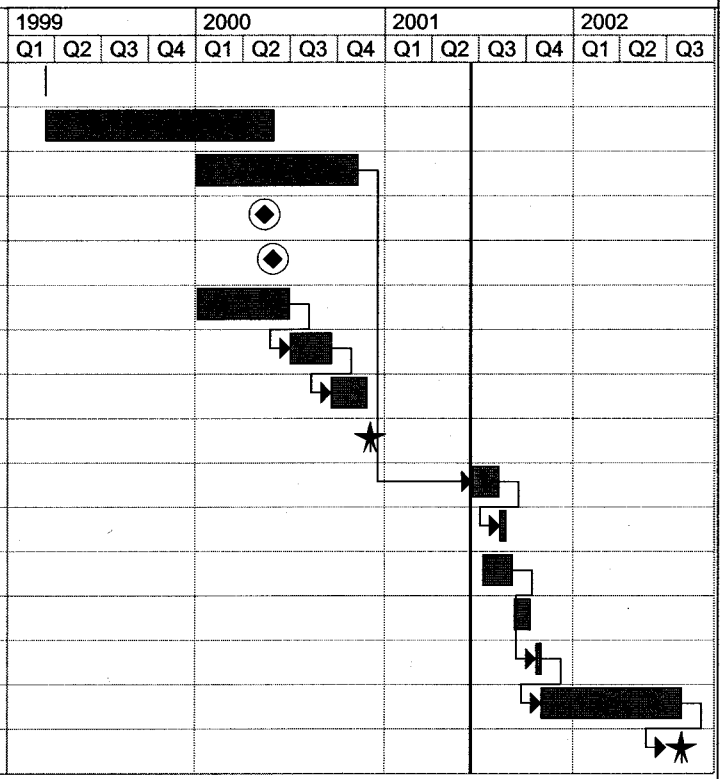
1R

- **Planned Tests: 18**
- **Total Starts: 9**
- **Completed Tests**
  - **Verified and posted on TMC web site: 0**
  - **EOT and being reviewed/verified: 0**
  - **Aborted/Invalid: 0**
- **Tests Currently Running: 9**
- **Earliest EOT for Last Matrix Test: 8/10/01**

Summary of Events Required for PC-9 Licensing

J. L. Zalar 6/19/01

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*	6/20/01	8/10/01
11	Precision Matrix Data Analysis (1R)	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 5, 5 OF 9

* Last 1R Stand

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	T-10	T-10	T-10	T-10	T-10
CMIR NO.	38814	38811	38809	38815	38953	38945	38939	38947	38954	38951	38943	38810	38937	38949	38948	38942
MATRIX LAB NO.	4	2	1	5	4	2	1	3	4	3	2	1	1	3	3	1
MATRIX STAND NO.	6	3	1	7	6	3	1	4	6	5	3	2	1	4	5	2
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	PC-9A	PC-9E	PC-9C	PC-9J	PC-9A
BASE OIL CODE	1	1	1	1	2	3	3	2	1	1	2	1	2	3	3	1
TECHNOLOGY CODE	X	X	X	X	Z	Y	X	Z	X	X	X	X	Y	X	Z	X
MATRIX RUN NO.	1	1	1	1	2	2	2	1	3	1	3	1	3	2	2	2
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	23-Feb-01	16-Mar-01	2-Apr-01	4-May-01	26-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	13-Mar-01	29-Mar-01	20-Apr-01	19-Apr-01	8-Apr-01
VALID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes	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	30.9	38.0	21.2	35.1	35.4	27.4
TOP RING WEIGHT LOSS	139	139	158	349	150	69	116	156	171	125	125	168	118	133	119	87
DELTA Pb	33	12	23	11	73	21	33	115	35	37	17	19	18	77	90	16
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	5.0	4.5	5.3	4.8	4.6
SOOT - EOT	5.7	5.5	6.0	6.6	5.2	5.3	5.4	7.1	5.8	5.9	5.1	6.0	4.8	7.6	5.7	4.8
OIL CONSUMPTION	79.00	52.10	52.30	32.20	61.00	56.00	62.85	64.01	79.60	53.29	43.90	46.49	53.35	65.95	46.93	40.53

J.L. Zalar
7/5/01

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	T-10
CMIR NO.	38941	38938	38952	38957	38946	38950	38956	38944	40919	38940		
MATRIX LAB NO.	1	1	4	5	3	3	5	2	5	1		
MATRIX STAND NO.	1	2	6	7	4	5	7	3	7	2		
PC-9 OIL CODE	PC-9G	PC-9J	PC-9F	PC-9D	PC-9D	PC-9E	PC-9J	PC-9G	PC-9B	PC-9E		
BASE OIL CODE	1	3	3	1	1	2	3	1	2	2		
TECHNOLOGY CODE	Z	Z	Y	Y	Y	Y	Z	Z	X	Y		
MATRIX RUN NO.	4	3	4	2	3	3	3	4	4	4		
START DATE	9-Apr-01	20-Apr-01	7-Apr-01	15-Mar-01	1-May-01	27-Apr-01	20-Apr-01	18-Apr-01	15-May-01	15-May-01		
EOT DATE	22-Apr-01	4-May-01	19-Apr-01	3-Apr-01	17-May-01	12-May-01	9-May-01	4-May-01	29-May-01	28-May-01		
VALID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
RESULTS												
LINER WEAR	29.0	31.4	26.0	45.7	33.0	28.3	29.5	39.4	23.6	20.4		
TOP RING WEIGHT LOSS	107	153	106	204	108	109	127	154	121	67		
DELTA Pb	69	44	62	25	206	52	50	27	34	22		
SOOT - 75 HR	4.8	5.0	4.9	5.3	5.5	5.4	5.3	5.0	4.6	5.0		
SOOT - EOT	5.5	6.2	5.4	6.8	8.2	6.2	6.4	5.5	5.5	5.9		
OIL CONSUMPTION	60.72	57.70	51.00	53.60	71.07	55.47	34.50	46.70	53.90	- - -		

J.L. Zalar
7/5/01

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	M11 EGR	M11 EGR	M11 EGR	M11 EGR
CMIR NO.	38931	38932	38933	38927	38936	38967	38929	38962	38963	38930	38928	38969	38966	38934	38935
MATRIX LAB NO.	2	3	3	1	4	3	1	1	2	1	1	3	3	3	3
MATRIX STAND NO.	3	4	5	1	6	4	2	1	3	1	2	4	5	5	4
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	PC-9G	PC-9J	PC-9E	PC-9E
BASE OIL CODE	2	2	2	2	2	2	2	3	1	2	2	1	3	2	2
TECHNOLOGY CODE	Y	Y	Y	Y	Y	X	Y	Y	Y	Y	Y	Z	Z	Y	Y
MATRIX RUN NO.	1	1	1	1	1	2	2	2	2	3	1	3	2	3	4
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	15-Mar-01	21-Feb-01	20-Mar-01	9-Apr-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	1-Apr-01	10-Mar-01	6-Apr-01	25-Apr-01
VALID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ASTM NOTIFIED	Yes	Yes	Yes	Yes	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	13.6	27.7	19.4	19.7
OIL FILTER DELTA P (300 HR)	210	204	330	706	407	675	144	310	301	417	204	304	535	332	266
OIL FILTER DELTA P (250 HR)	- - -	127	66	178	246	308	55	171	- - -	190	111	175	265	143	97
AVERAGE SLUDGE	9.1	7.4	8.0	9.0	8.7	8.8	8.8	8.2	7.8	8.4	8.9	7.3	7.7	7.6	8.1
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	8.2	8.2	8.2	8.1
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	68.2	71.8	82.1	85.0
TOP RING WEIGHT LOSS	113	172	116	104	147	125	19	197	163	148	144	125	170	139	129

J. L. Zalar
7/5/01

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
CMIR NO.	38968	38970	38959	38961	38971						
MATRIX LAB NO.	3	3	1	1	4						
MATRIX STAND NO.	5	5	1	2	6						
PC-9 OIL CODE	PC-9A	PC-9F	PC-9A	PC-9G	PC-9D						
BASE OIL CODE	1	3	1	1	1						
TECHNOLOGY CODE	X	Y	X	Z	Y						
MATRIX RUN NO.	4	5	4	3	2						
START DATE	18-Apr-01	1-May-01	4-May-01	26-Apr-01	- - -						
EOT DATE	4-May-01	16-May-01	18-May-01	12-May-01	30-Apr-01						
VALID	Yes	Yes	Yes	Yes	Yes						
FAX BACK	Yes	Yes	Yes	Yes	Yes						
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes						
RESULTS											
CROSSHEAD WEAR	28.7	23.6	11.3	19.7	38.2						
OIL FILTER DELTA P (300 HR)	532	292	345	332	294						
OIL FILTER DELTA P (250 HR)	288	186	76	160	191						
AVERAGE SLUDGE	8.9	7.0	8.9	7.4	6.9						
SOOT - 250 HR	8.0	8.1	8.8	8.8	8.6						
INJ. SCREW WT. LOSS	56.6	42.7	246.2	117.4	196.6						
TOP RING WEIGHT LOSS	145	134	176	164	145						

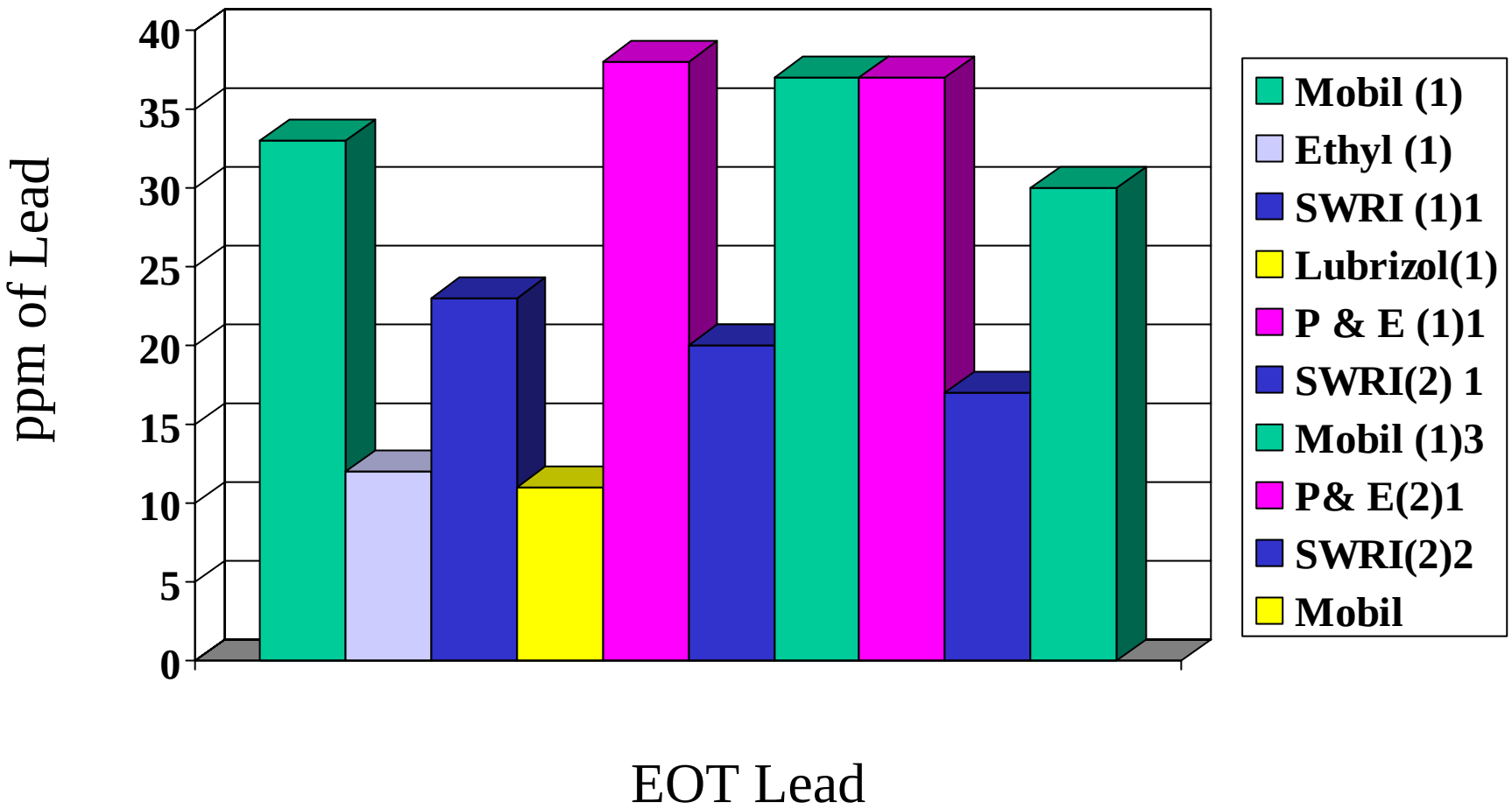
J. L. Zalar
7/5/01

Mack T10 Status

- 30 Test Completed (1 Test(A)to start wk 6/18)
- Task Force Meeting's in March,April,June & July 10(Chicago)
- Issues:Oxidation,Oil Consumption,Deposits & EOT pb variability
- Estimated Matrix Completion - July 4

T10 Matrix Data

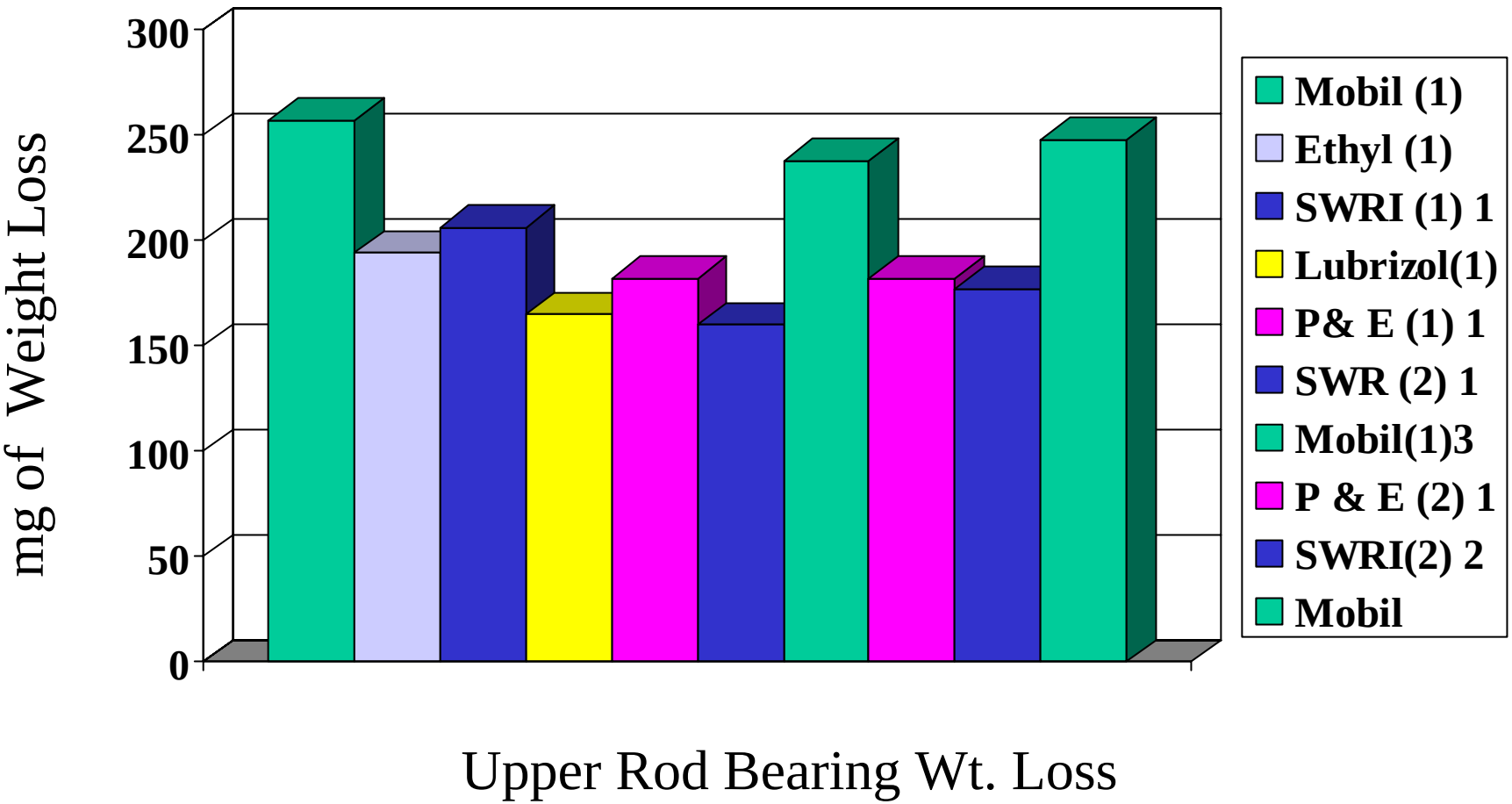
Oil A



June 15 01

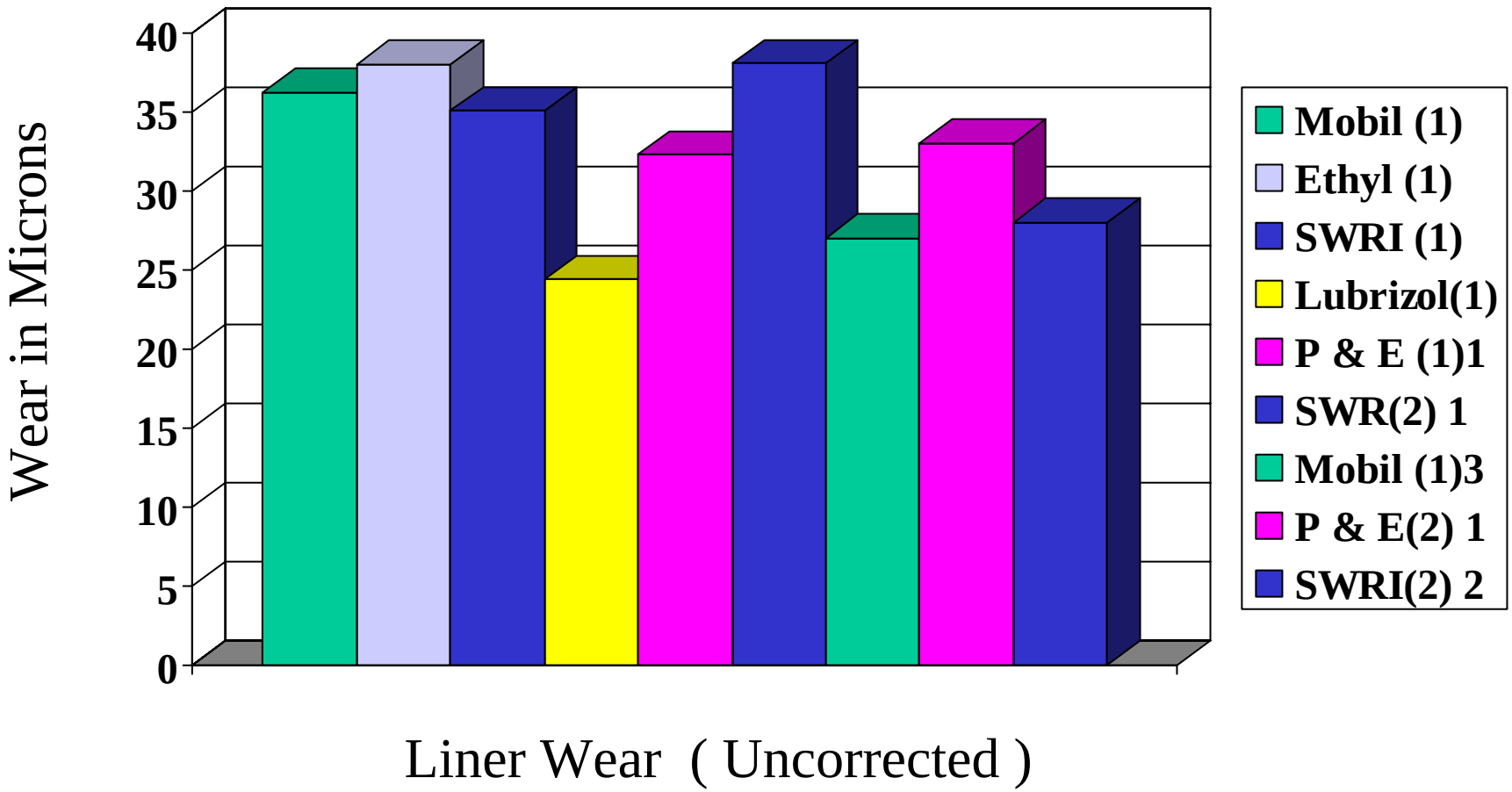
T10 Matrix Data

Oil A



T10 Matrix Data

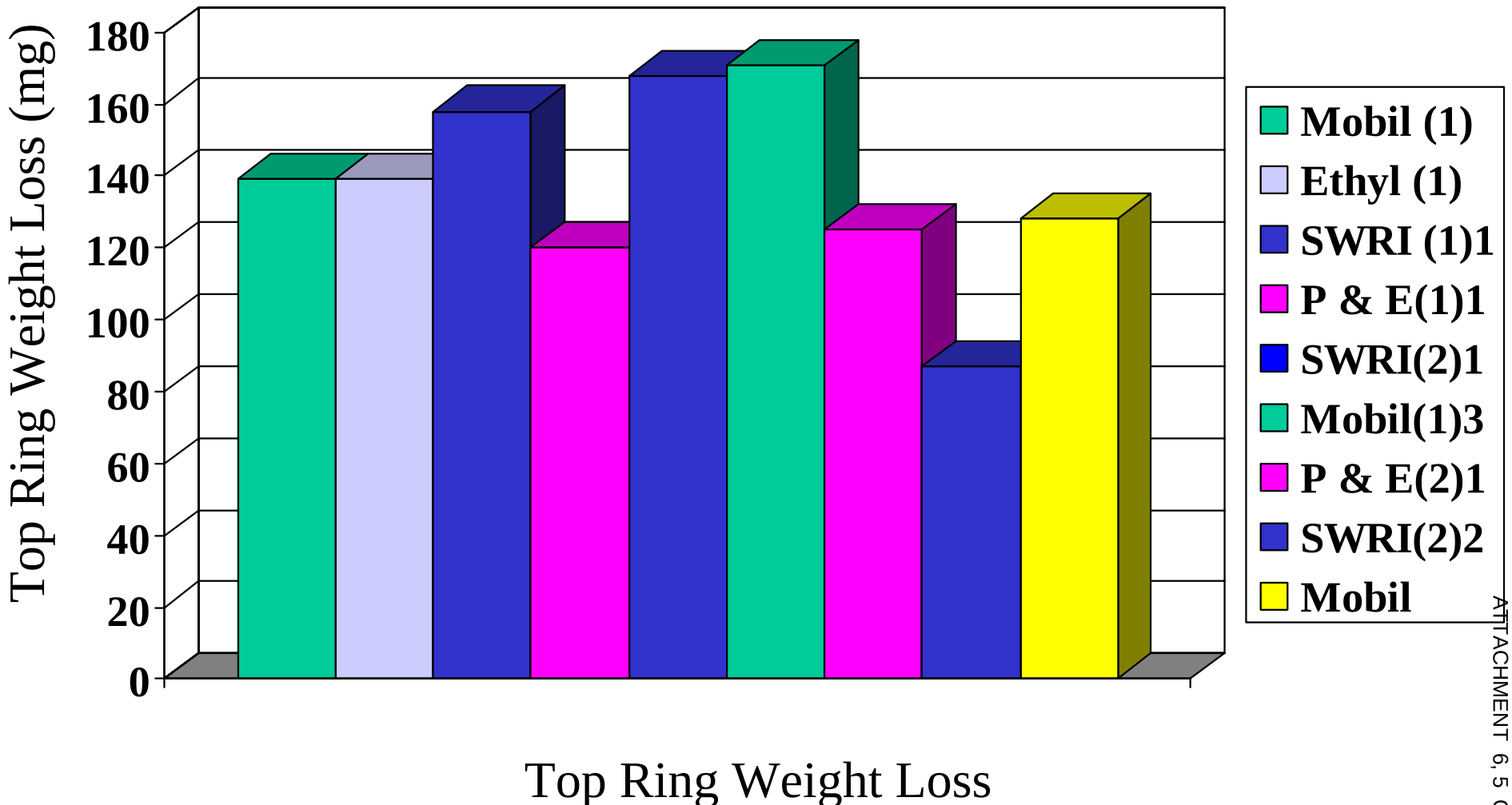
Oil A



June 15 01

T10 Matrix Data

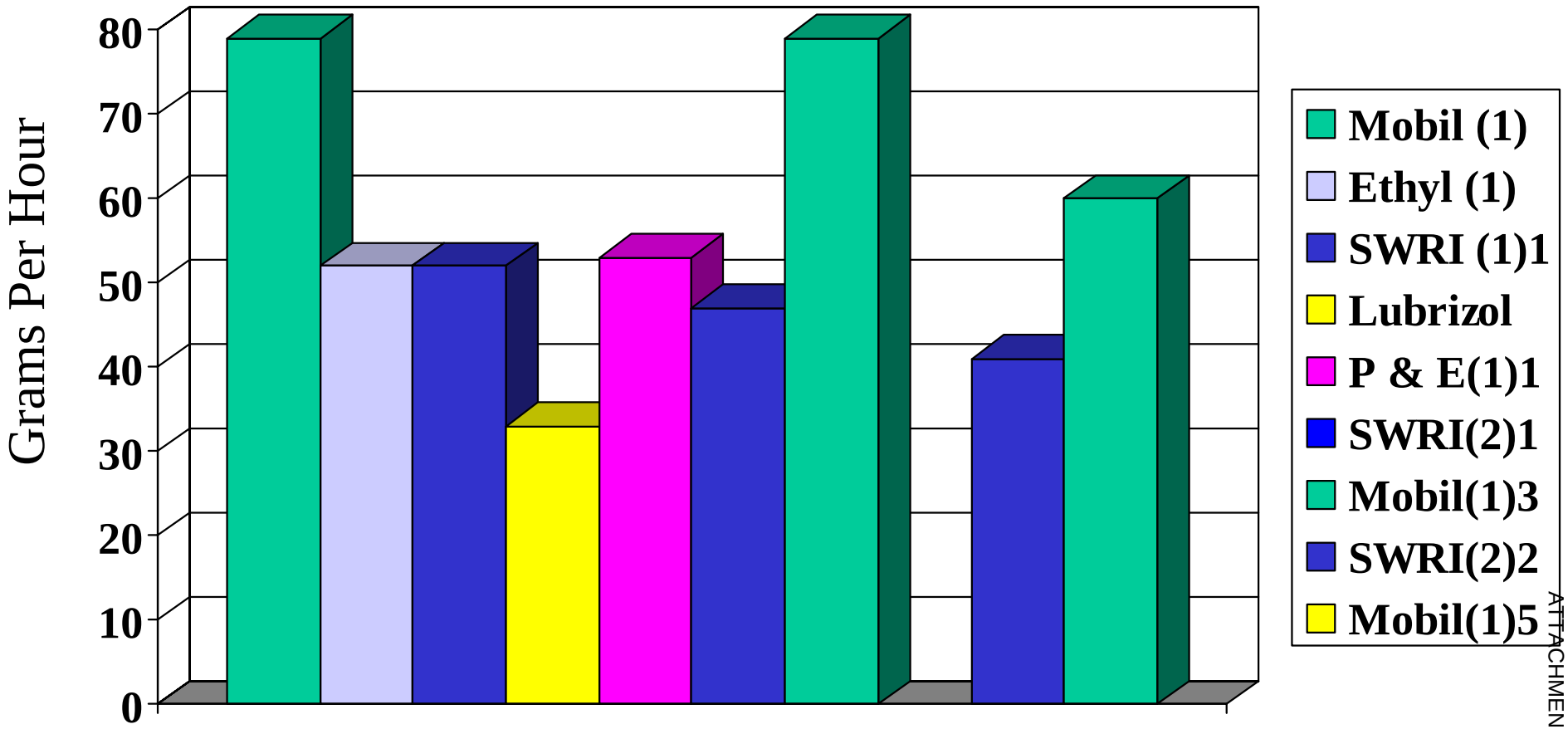
Oil A



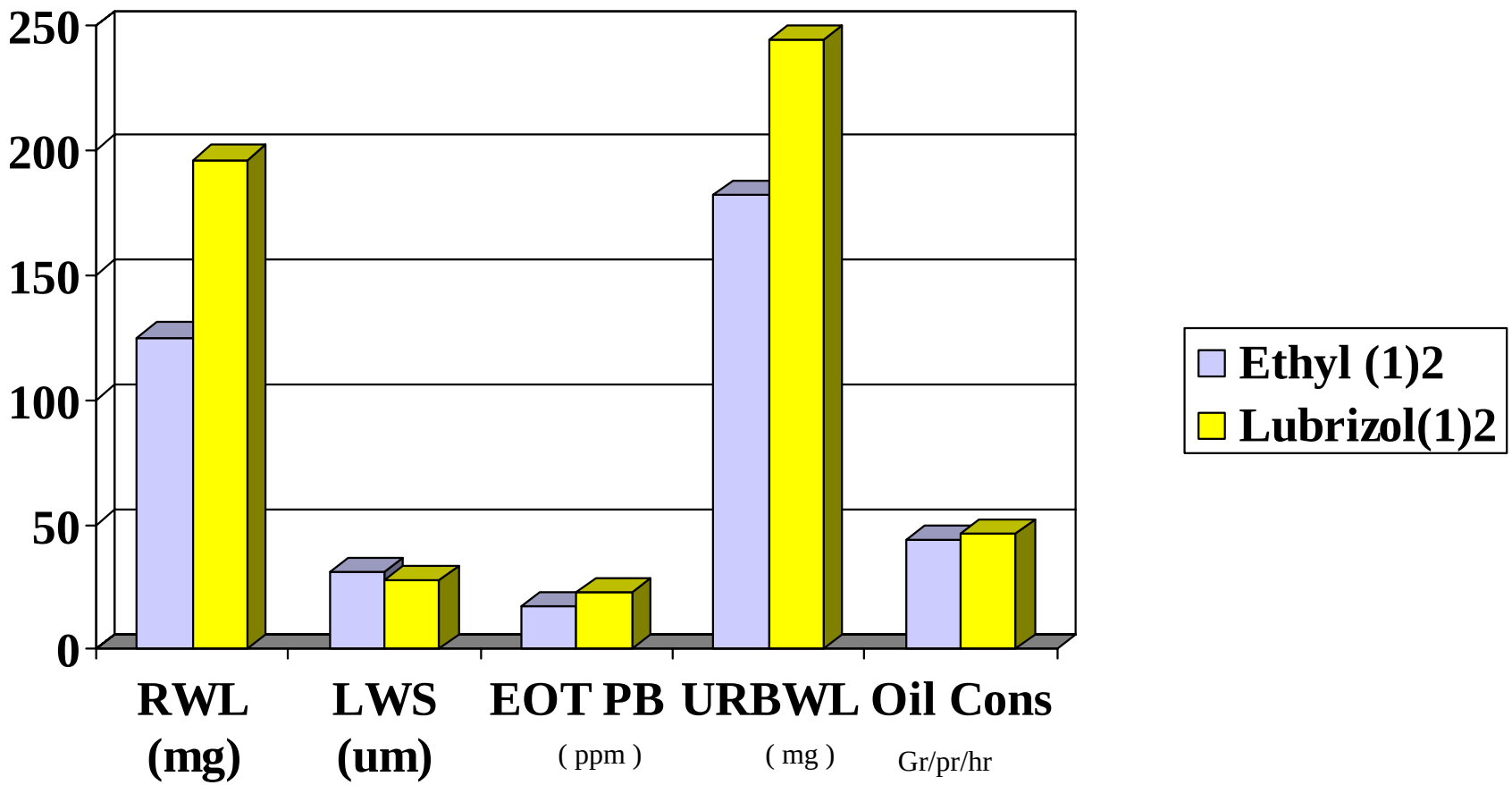
June 15 01

T10 Matrix Data

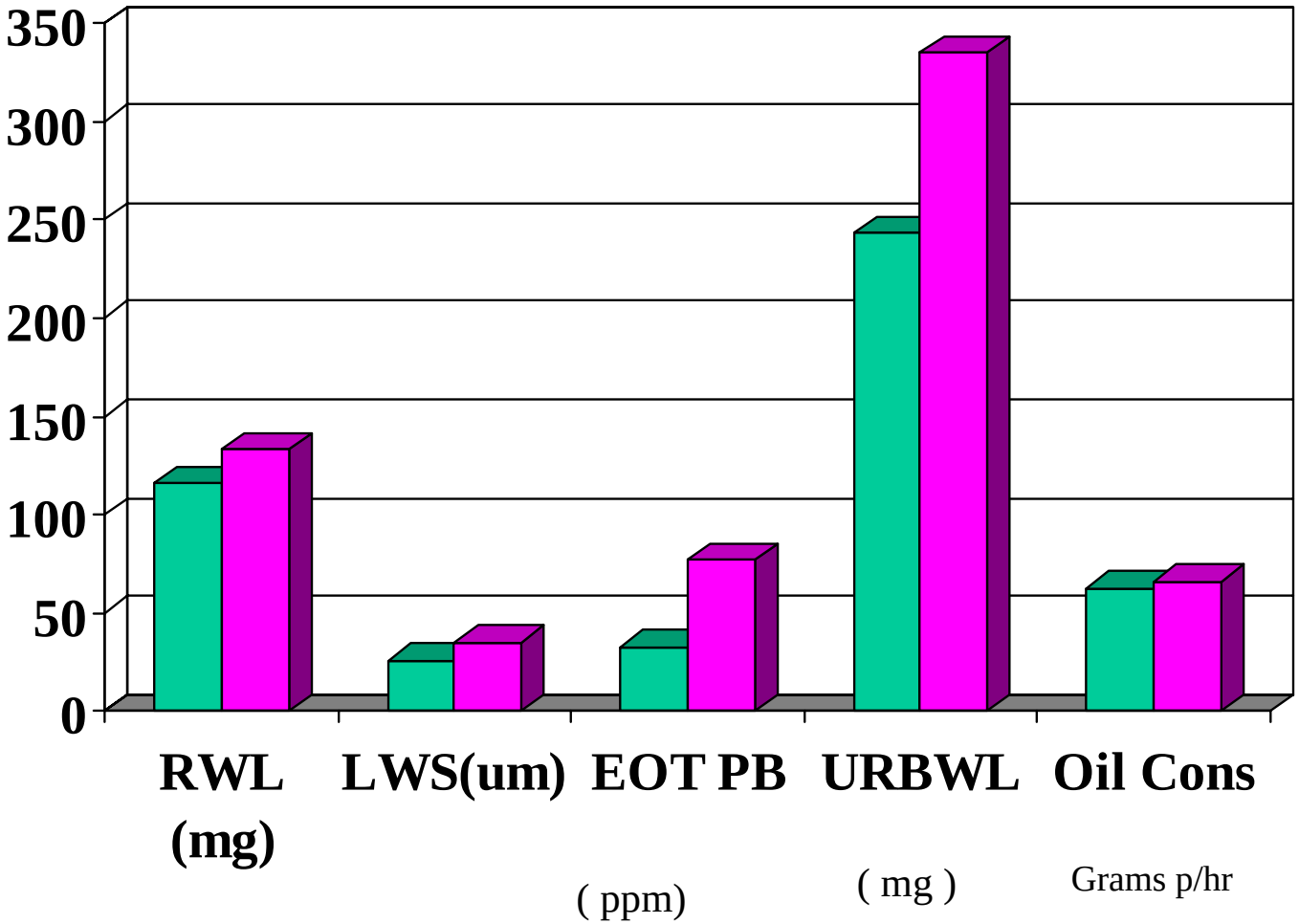
Average Oil Consumption Oil A



T 10 Matrix Oil B



T 10 Matrix Oil C



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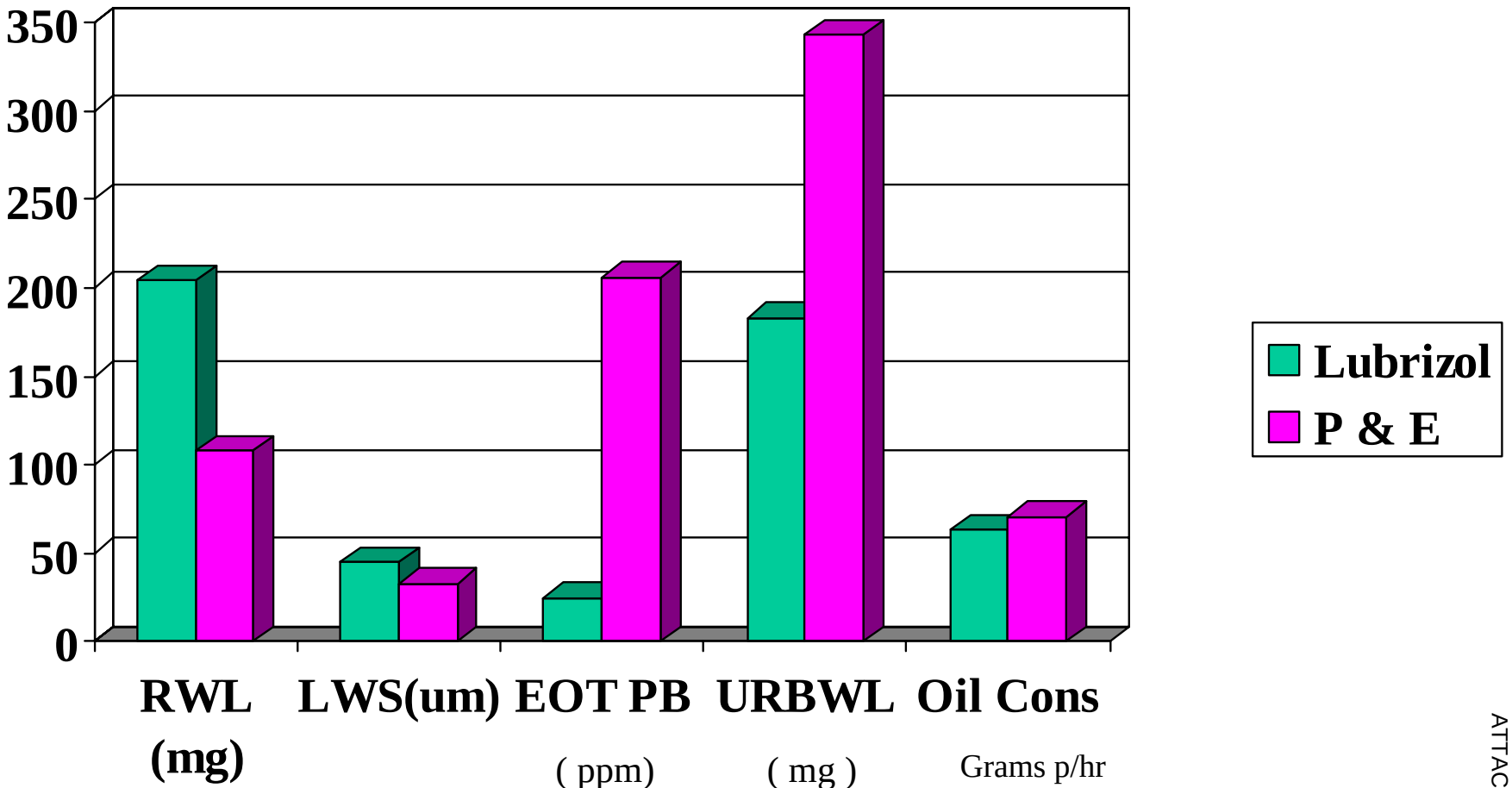
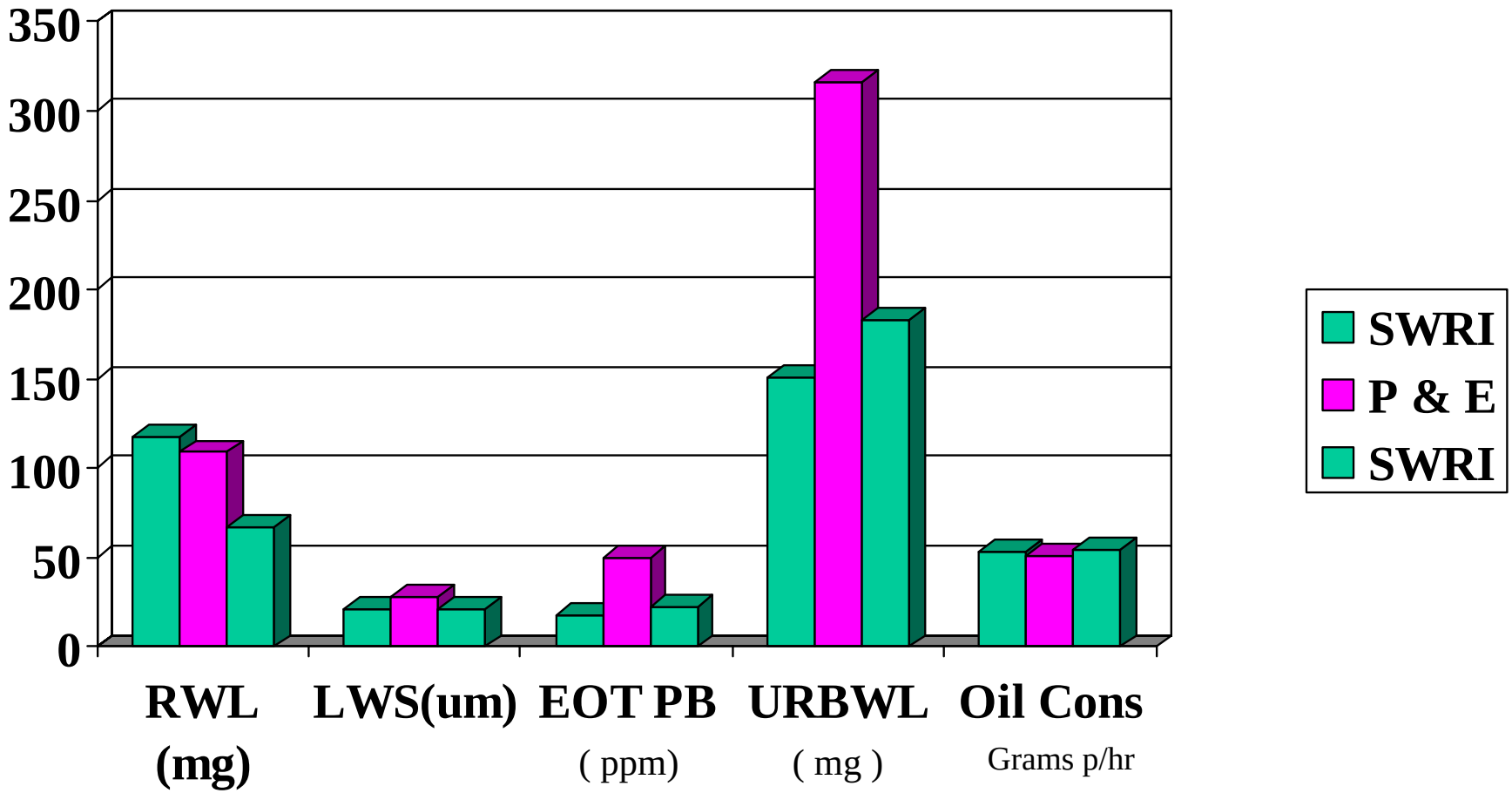
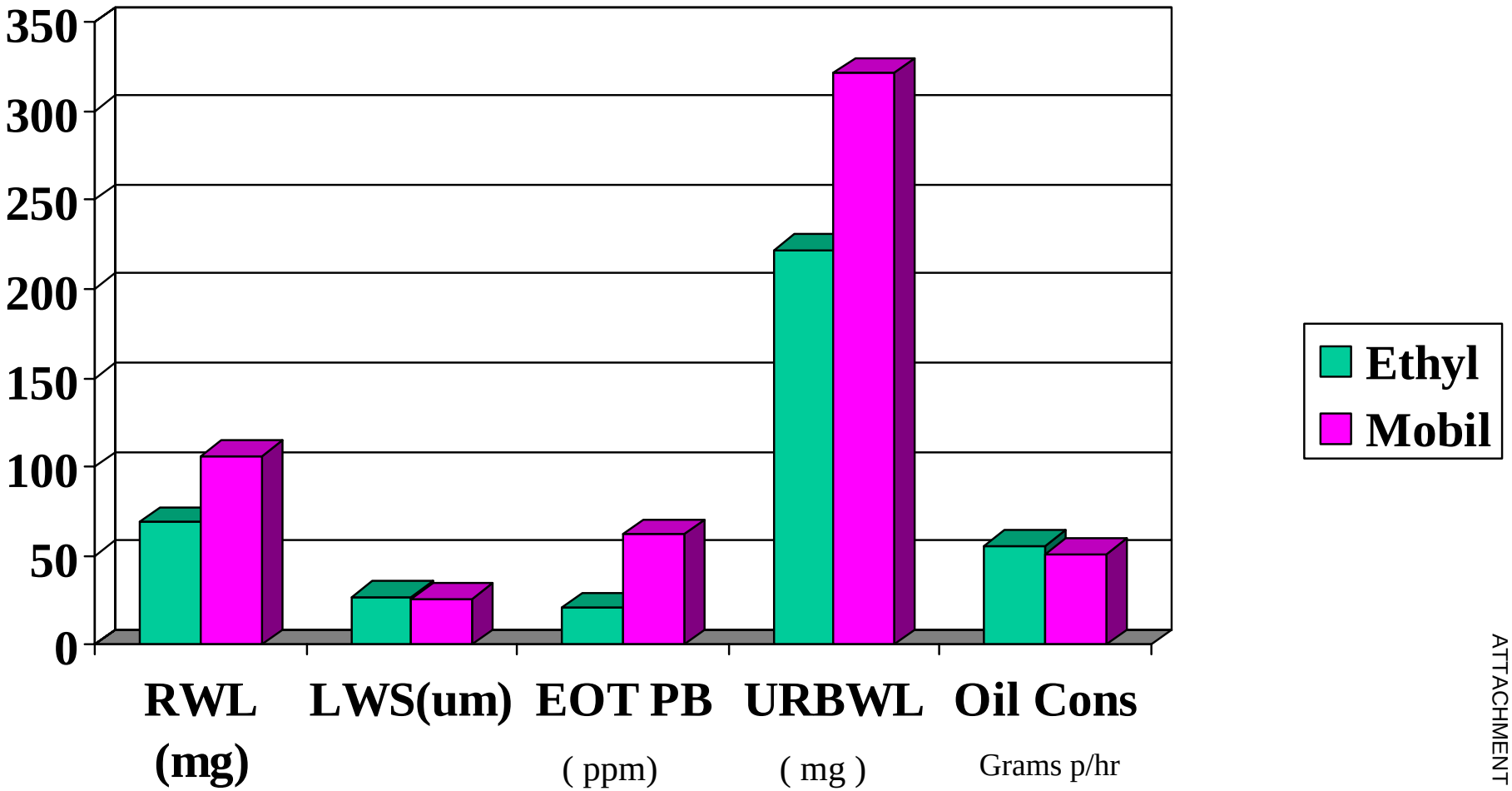


June 15 01

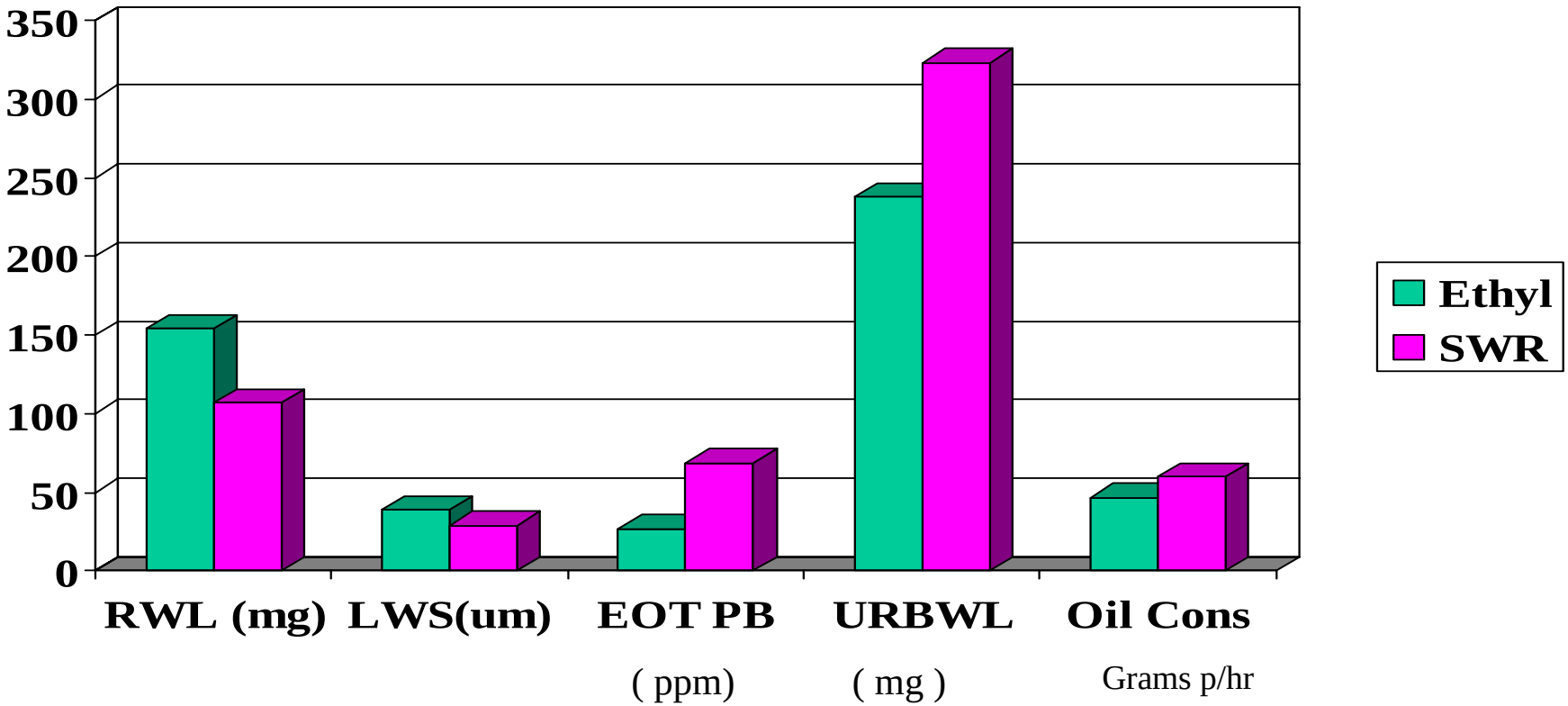
T 10 Matrix Oil E



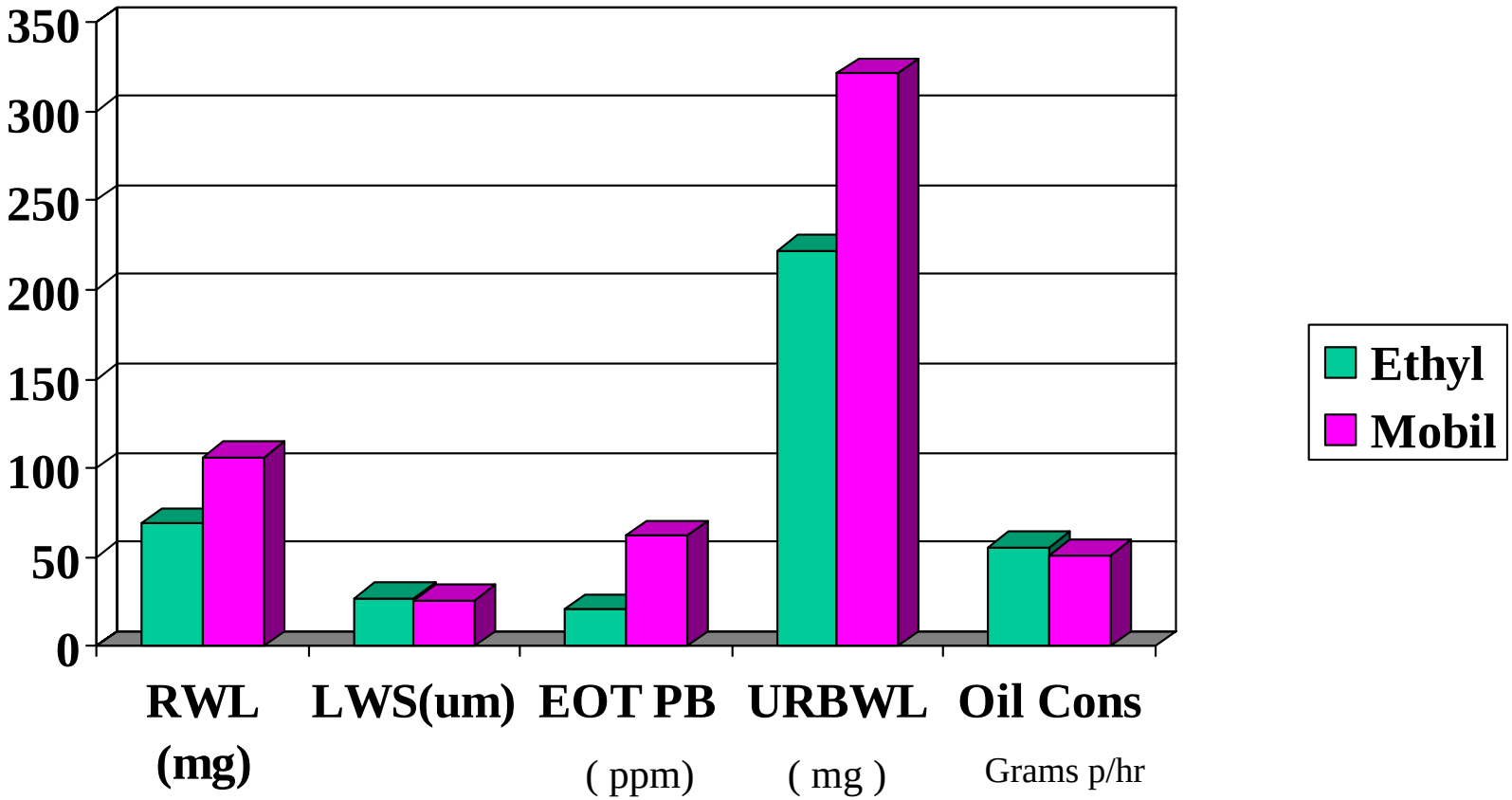
T 10 Matrix Oil F



T 10 Matrix Oil G

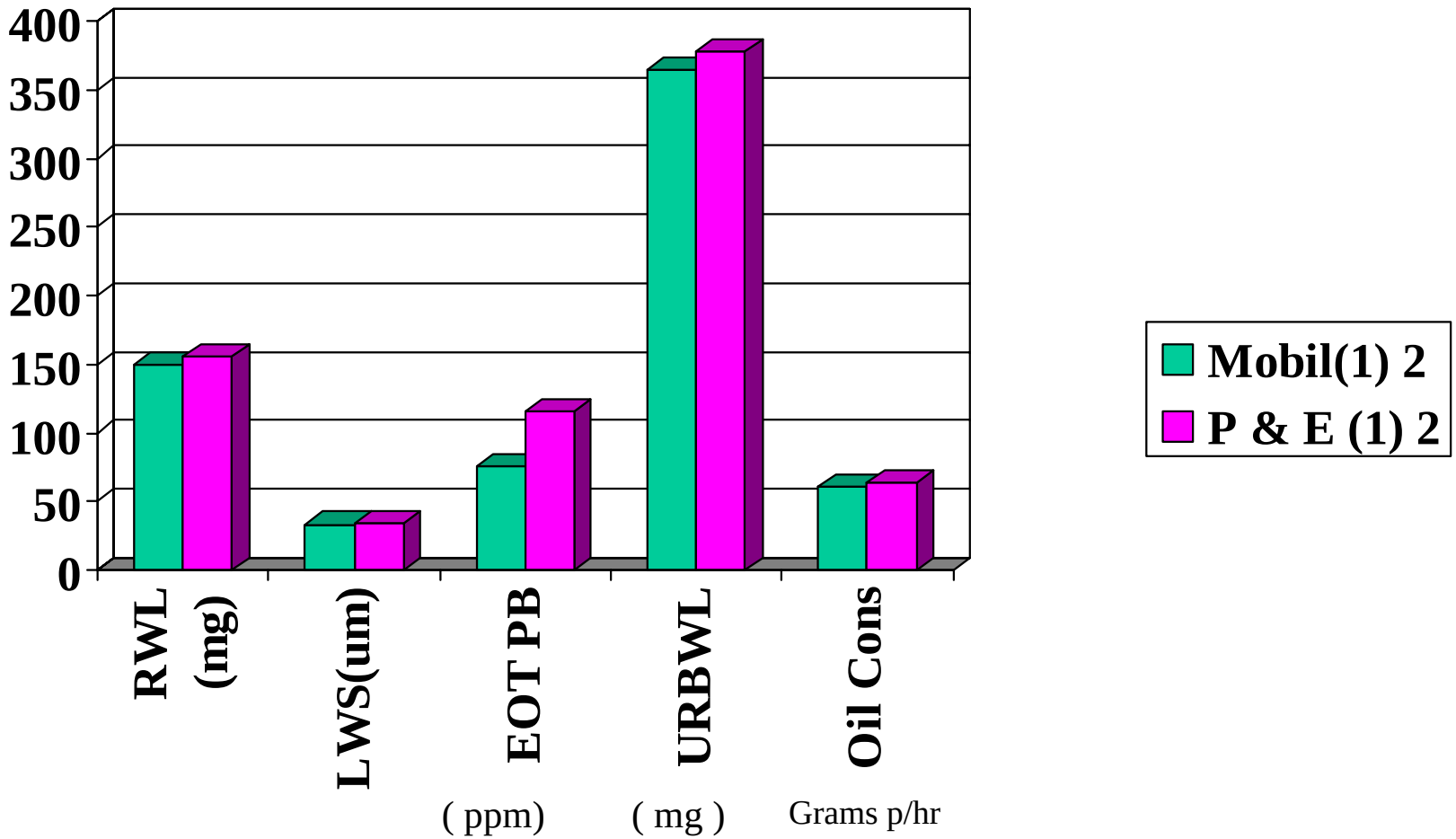


T 10 Matrix Oil F

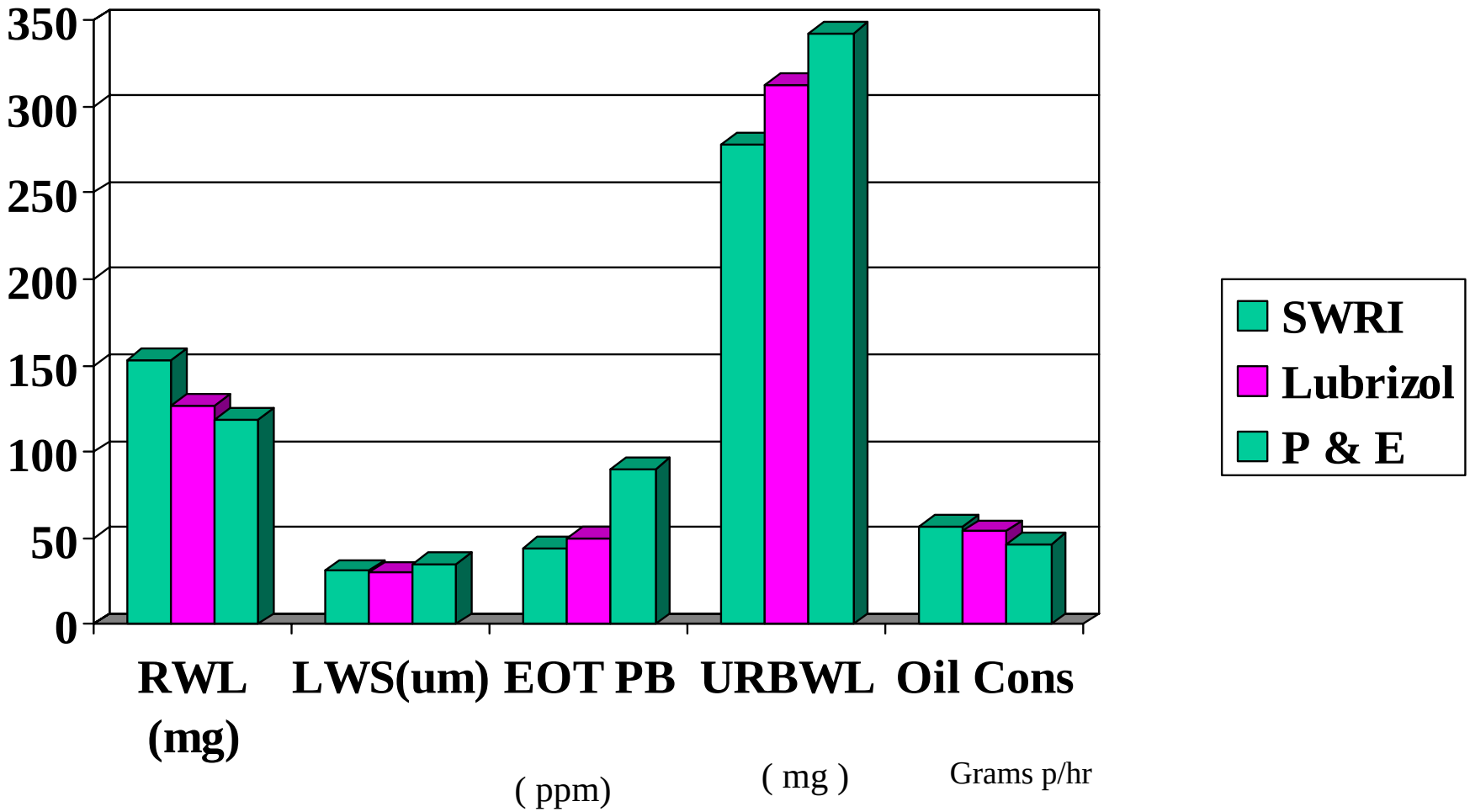


June 15 01

T 10 Matrix Oil H

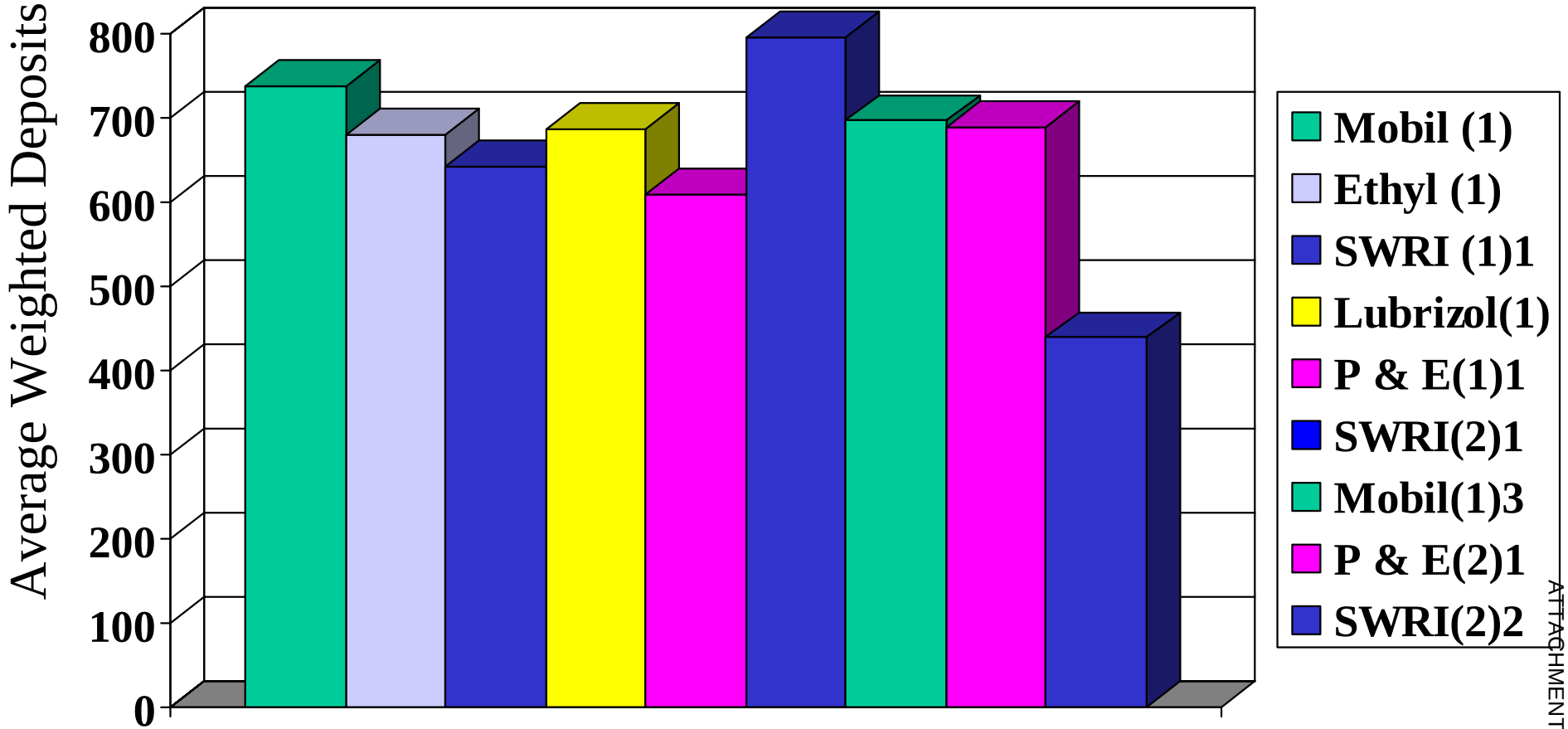


T 10 Matrix Oil J



T10 Matrix Data

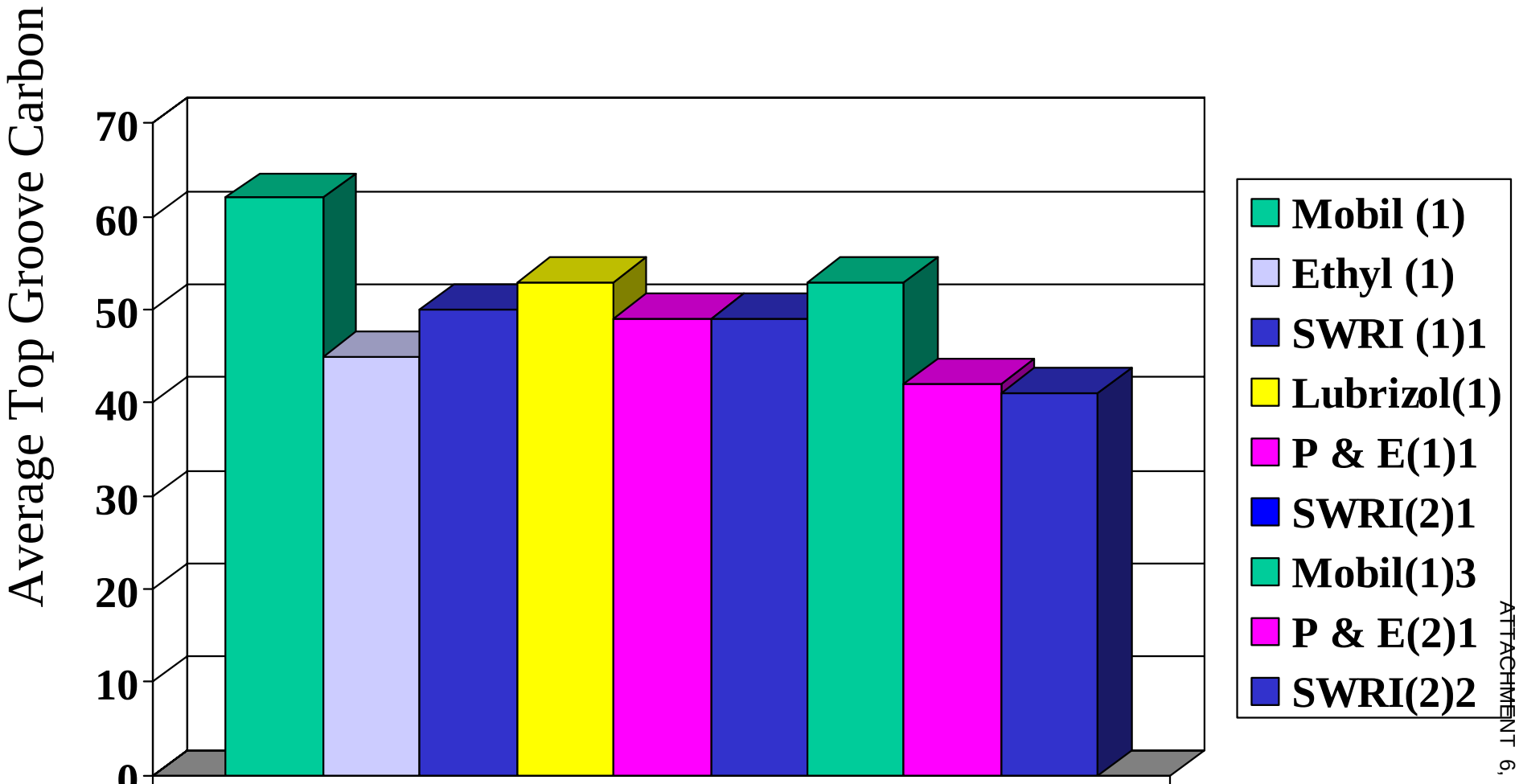
Average Weighted Deposits Oil A



May 18 01

T10 Matrix Data

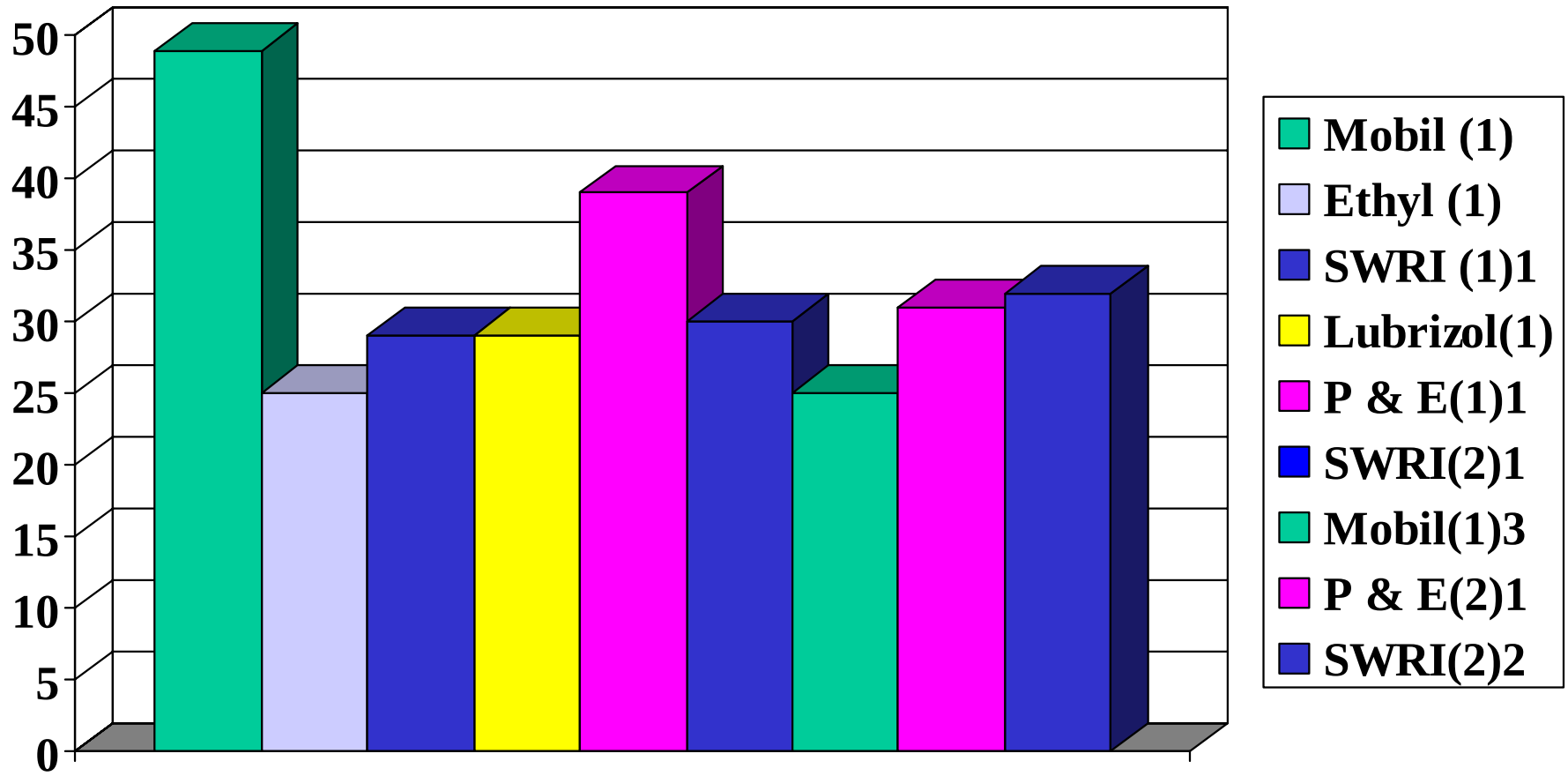
Top Groove Carbon Oil A



June 15 01

T10 Matrix Data

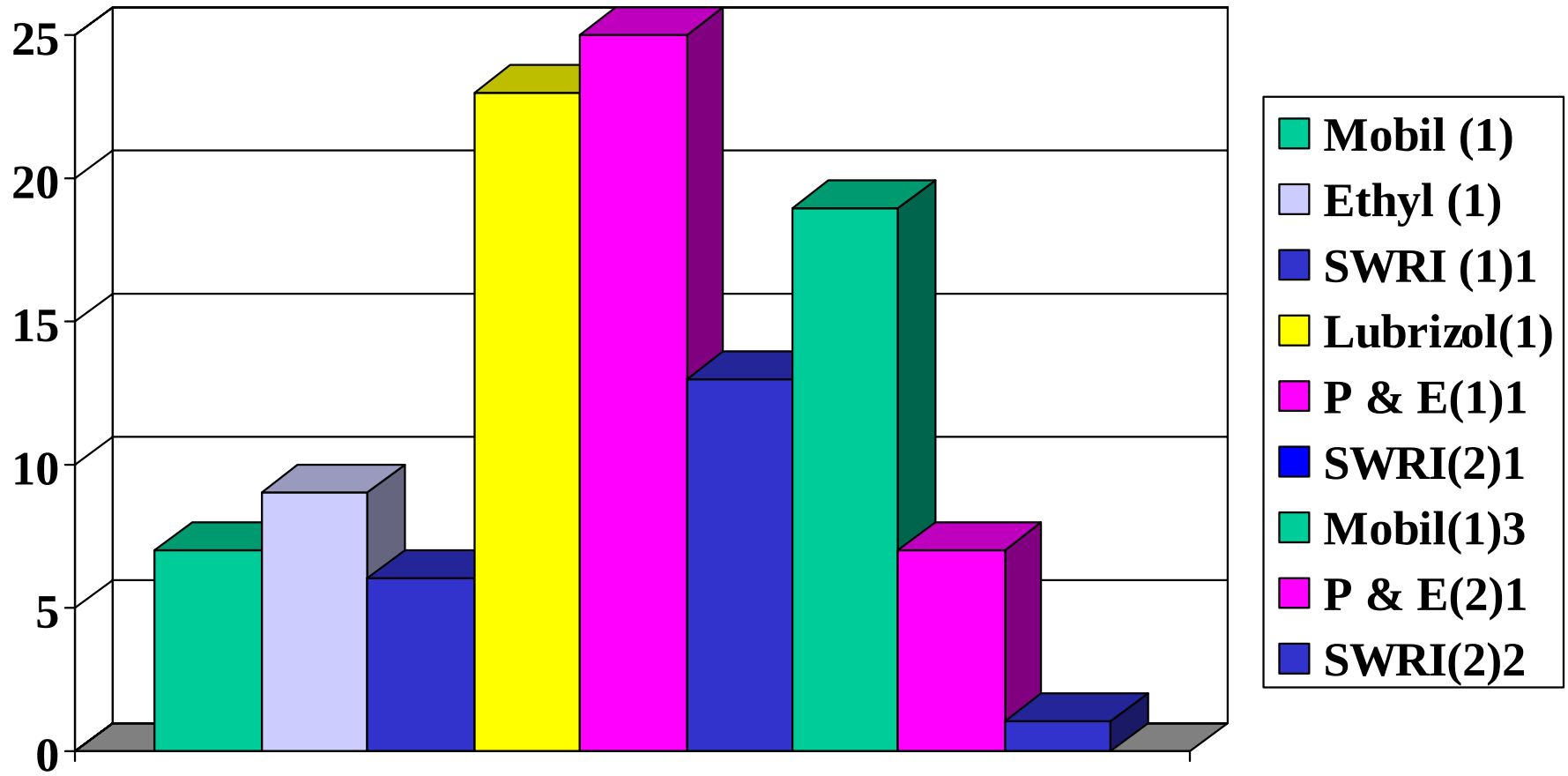
Top Land Carbon Oil A



June 15 01

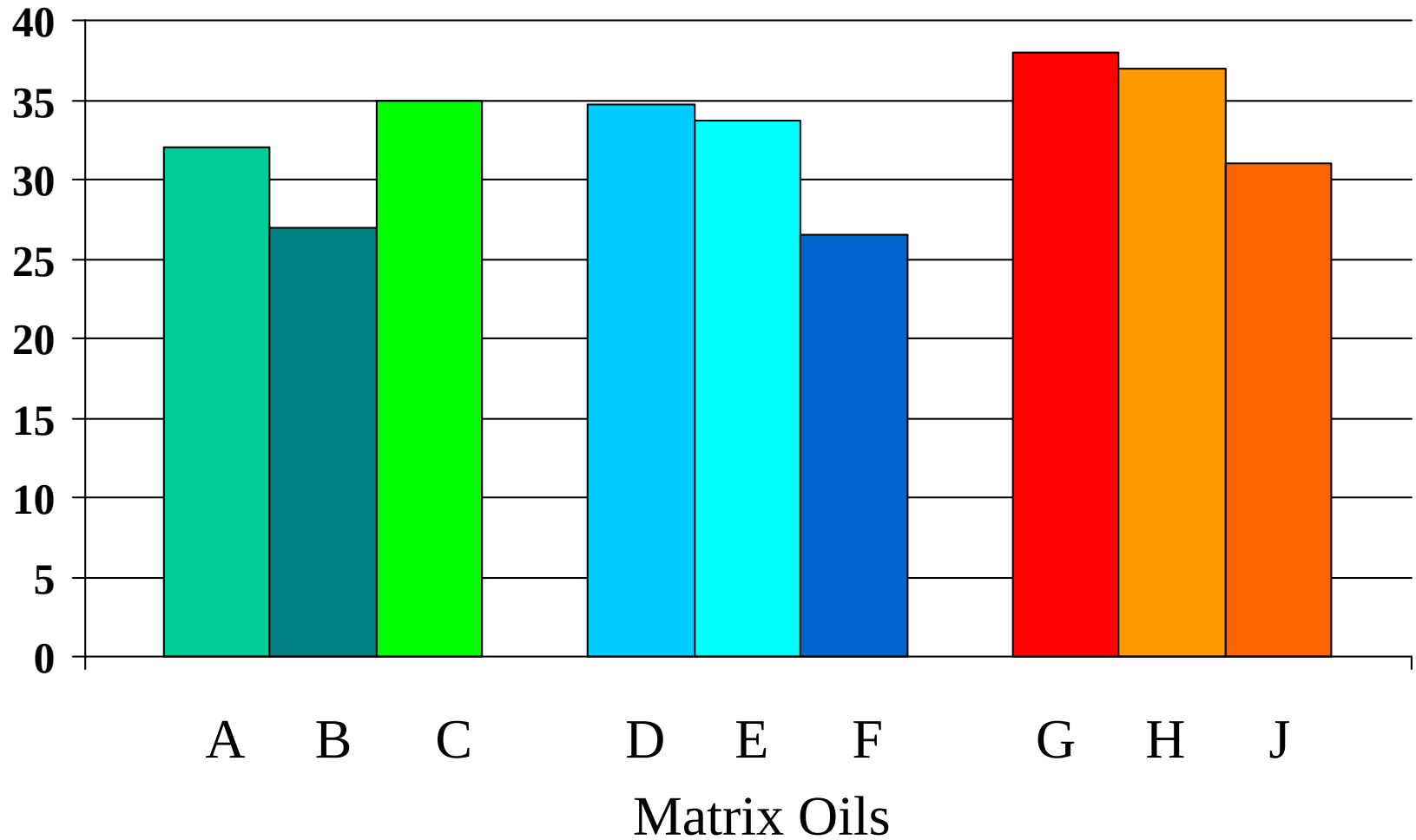
T10 Matrix Data

Average Undercrown Deposit Oil A



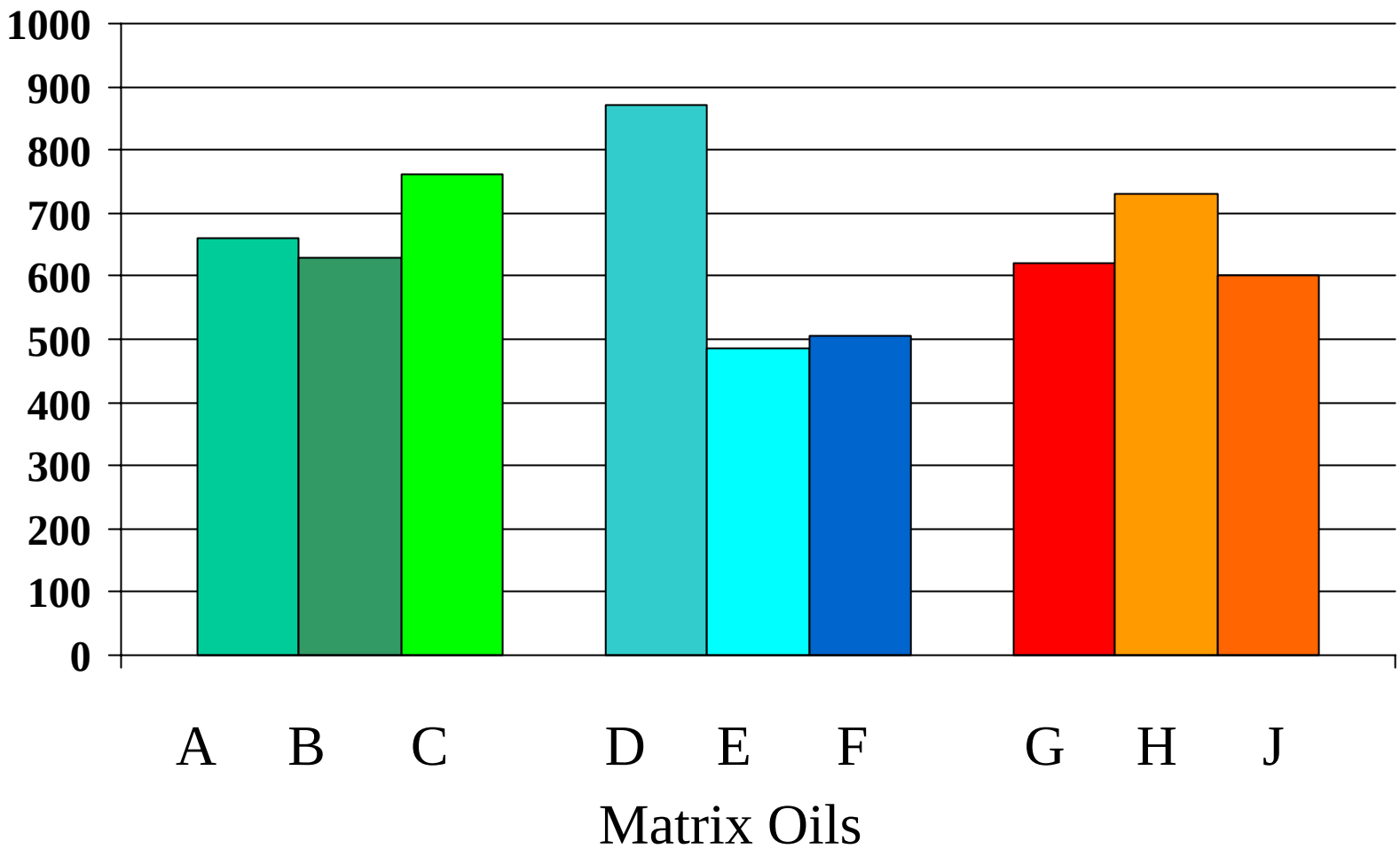
June 15 01

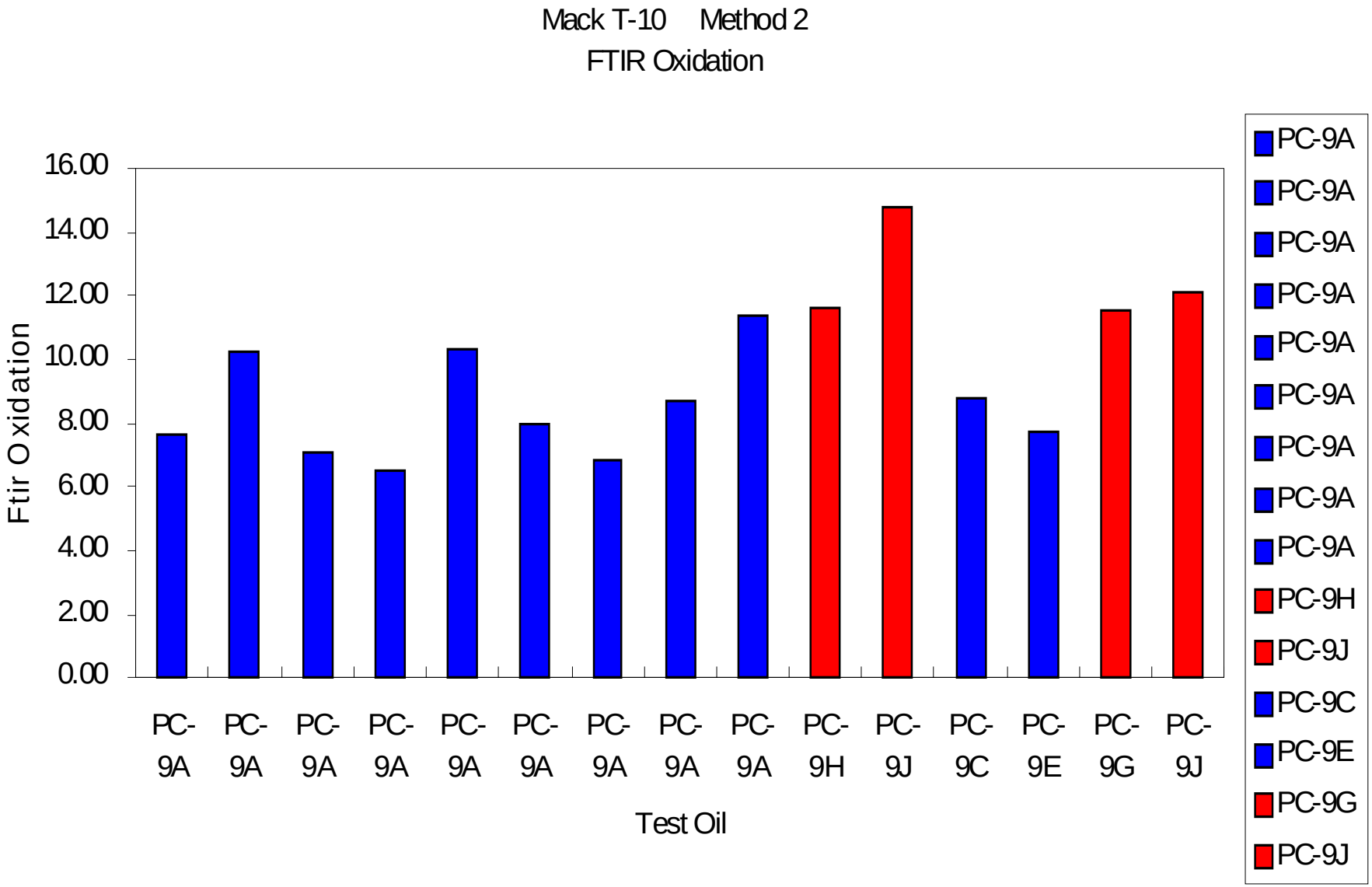
T 10 Matrix
Top Land Carbon



GLS 5-23-01

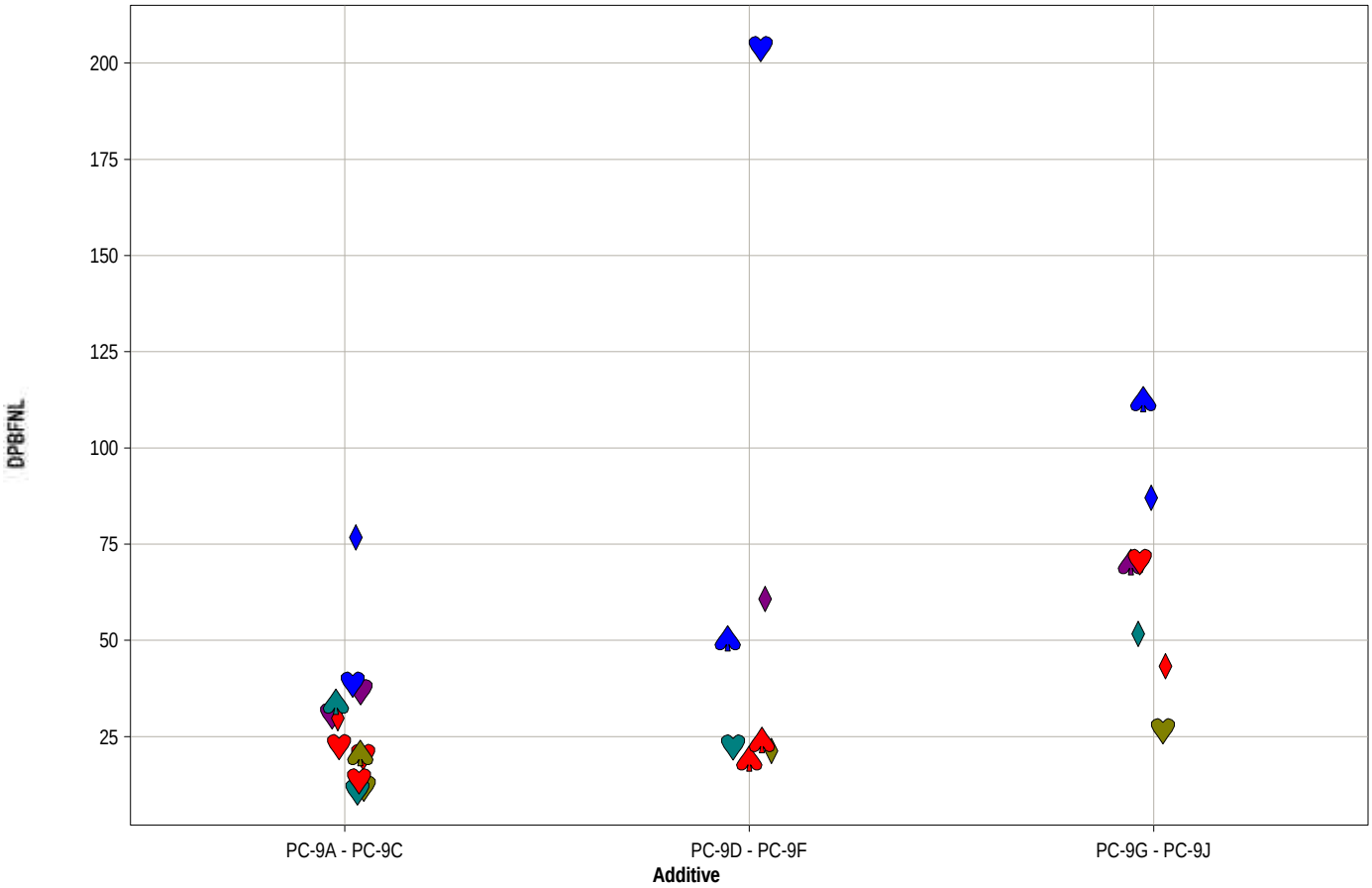
T 10 Matrix
Average Weighted Deposits




Mack T-10 Method 2
FTIR Oxidation
Ftir Oxidation
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9H
PC-9J
PC-9C
PC-9E
PC-9G
PC-9J
Test Oil
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9A
PC-9H
PC-9J
PC-9C
PC-9E
PC-9G
PC-9J

Obs	TESTKEY	LTMSLAB	LTMSAPP	LTMSDATE	IND	OILCON	TBNEOT	DPBFNL	ABWLU	CLWFNL	ATRWLFNL
1	38814	F	1	20001211	PC-9A	79	0	33	257.2	36.3	139
2	38809	A	1	20001219	PC-9A	52.3	2	23	206.2	33.3	158
3	38811	D	1	20001224	PC-9A	52.1	4.8	12	194.6	38	139
4	38815	B	1	20001231	PC-9A	0.107	1.9	11	164.8	24.4	349
5	38945	D	1	20010215	PC-9F	56	4.9	21	222.2	27	69
6	38953	F	1	20010217	PC-9H	61	.	73	363.5	33.3	150
7	38939	A	1	20010305	PC-9C	62.85	1.8	33	242.8	25.3	116
8	38810	A	2	20010313	PC-9A	46.49	2.1	19	159.4	38	168
9	38954	F	1	20010315	PC-9A	79.6	.	35	238	48.2	171
10	38947	G	1	20010318	PC-9H	0.195	0	115	378.3	34	156
11	38937	A	1	20010329	PC-9E	53.35	2.4	18	150.6	21.2	118
12	38951	G	2	20010330	PC-9A	0.199	2	37	218	33	125
13	38943	D	1	20010401	PC-9B	43.9	1.8	17	181.6	30.9	125
14	38957	B	1	20010403	PC-9D	0.18	1.2	25	183.4	45.7	204
15	38942	A	2	20010408	PC-9A	40.53	2	16	181.7	27.4	87
16	38948	G	2	20010419	PC-9J	0.118	0.1	90	342.6	35.4	119
17	38952	F	1	20010419	PC-9F	51	.	62	321.1	26	106
18	38949	G	1	20010420	PC-9C	0.212	1.9	77	335.8	35.1	133
19	38941	A	1	20010422	PC-9G	60.72	0.3	69	323.9	29	107
20	38938	A	2	20010504	PC-9J	57.7	0.7	44	277.8	31.4	153
21	38944	D	1	20010504	PC-9G	46.7	2.2	27	238.2	39.4	154
22	38956	B	1	20010509	PC-9J	3.4	0	50	313.5	29.5	127
23	38950	G	2	20010512	PC-9E	0.156	0	52	316.7	28.3	109
24	38946	G	1	20010517	PC-9D	0.176	0.5	206	343.9	33	108
25	38940	A	2	20010528	PC-9E	.	1.8	22	183.9	20.4	67
26	40919	B	1	20010529	PC-9B	5.3	0.9	34	234.2	23.6	121

T10 Matrix Data from TMC Website 060701



Color by LTMSLAB

A B D F G

Shape by IND

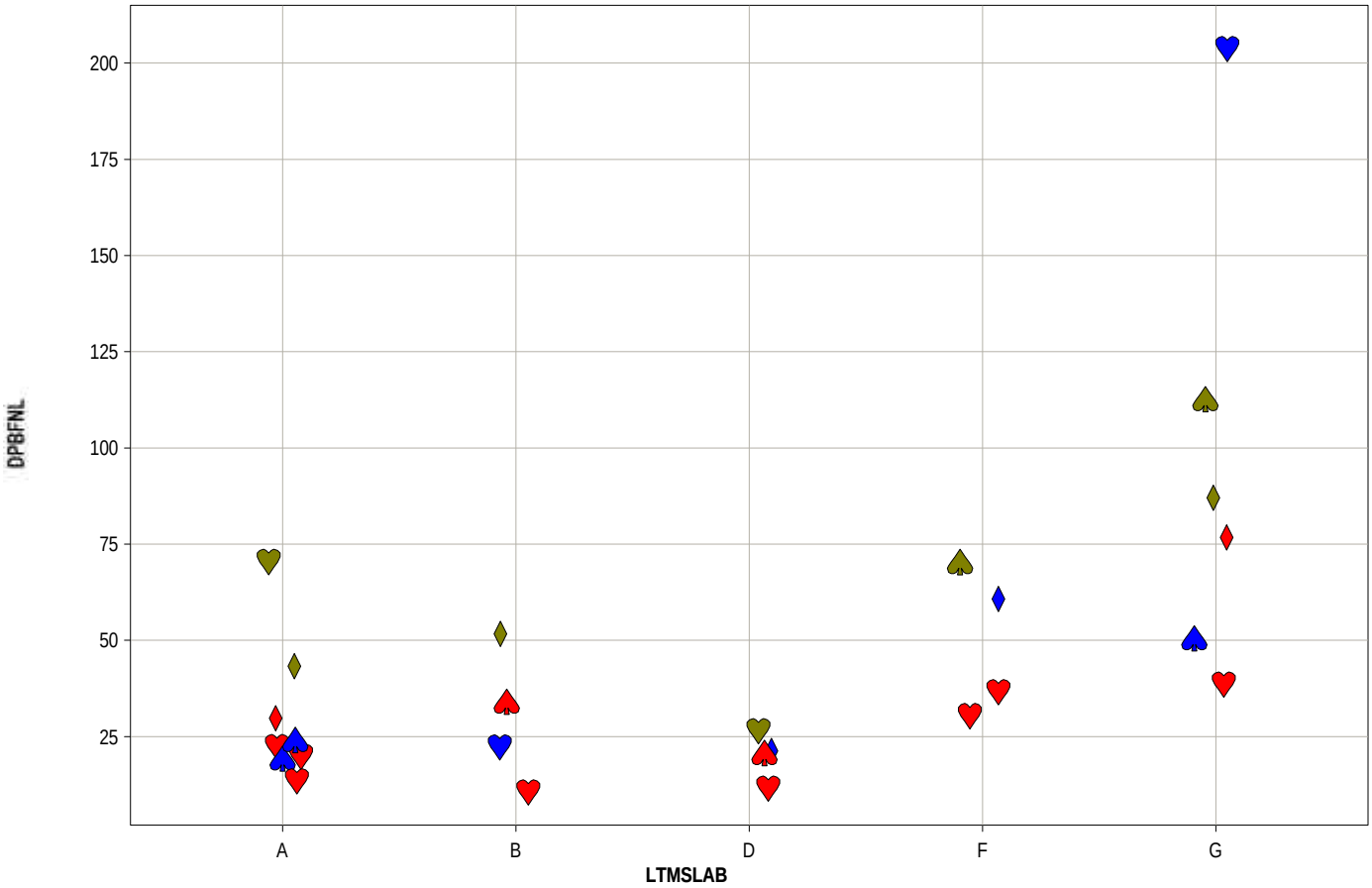
PC-9A PC-9B PC-9C PC-9D PC-9E PC-9F PC-9G PC-9H PC-9J

The markers are jittered.

Query:
SELECT * FROM Embedded

ATTACHMENT 7, 2 OF 14

T10 Matrix Data from TMC Website 060701



Color by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

Shape by IND

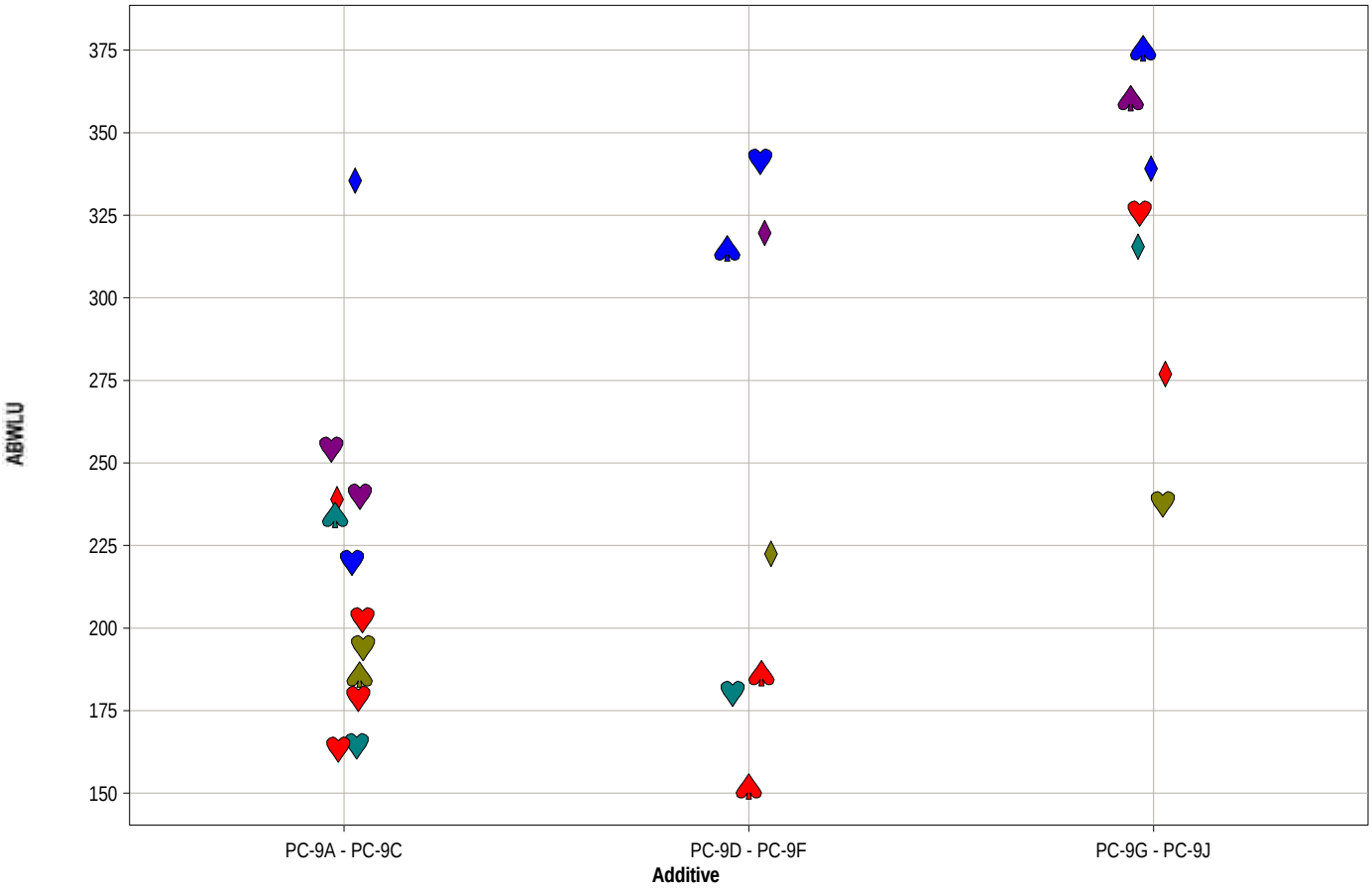
PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

The markers are jittered.

Query:
SELECT * FROM Embedded

ATTACHMENT 7, 3 OF 14

T10 Matrix Data from TMC Website 060701



Color by LTMSLAB

A B D F G

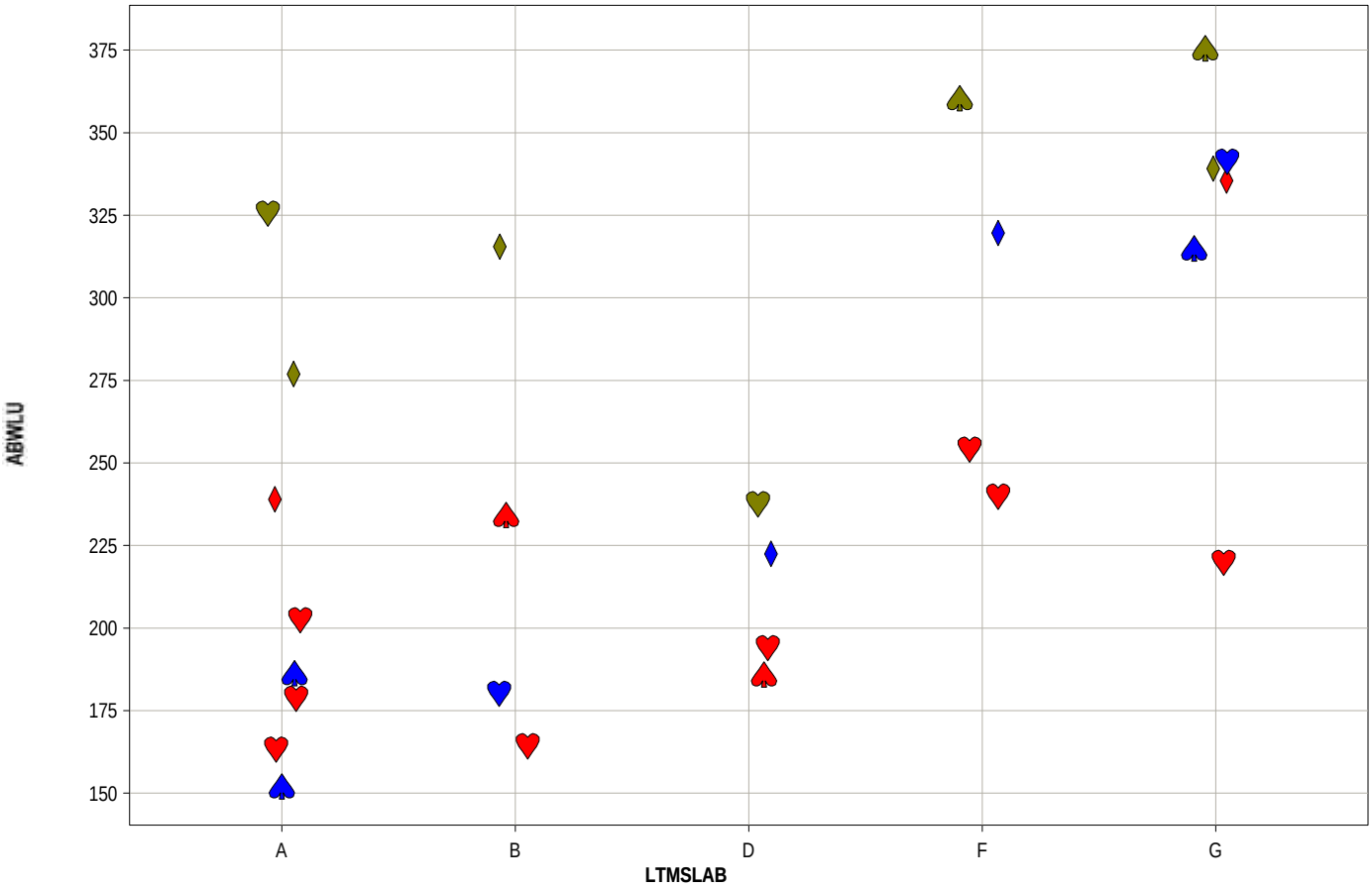
Shape by IND

PC-9A PC-9B PC-9C PC-9D PC-9E PC-9F PC-9G PC-9H PC-9J

The markers are jittered.

Query:
SELECT * FROM Embedded

T10 Matrix Data from TMC Website 060701



Color by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

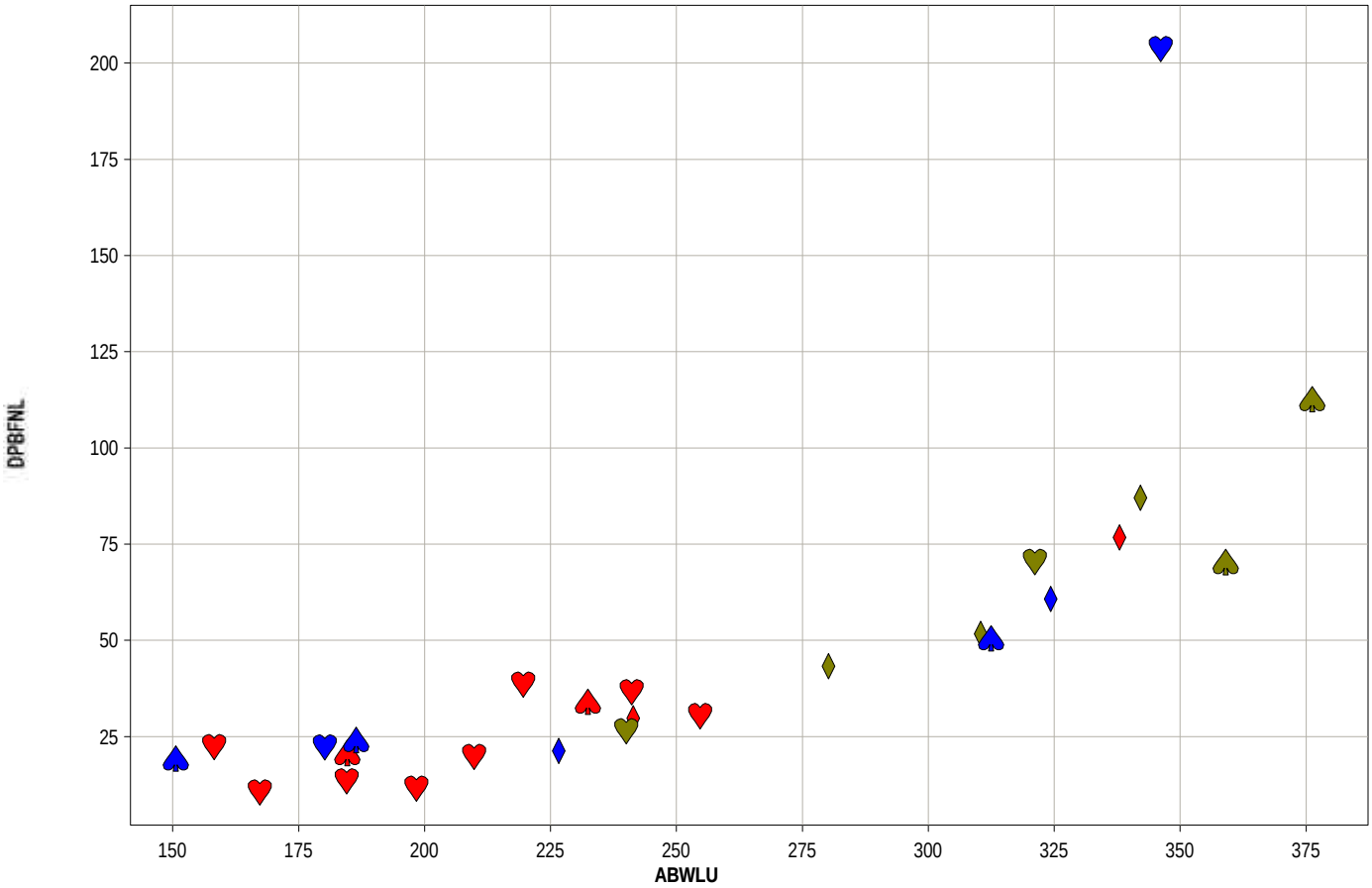
Shape by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

The markers are jittered.

Query:
SELECT * FROM Embedded

T10 Matrix Data from TMC Website 060701



Color by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

Shape by IND

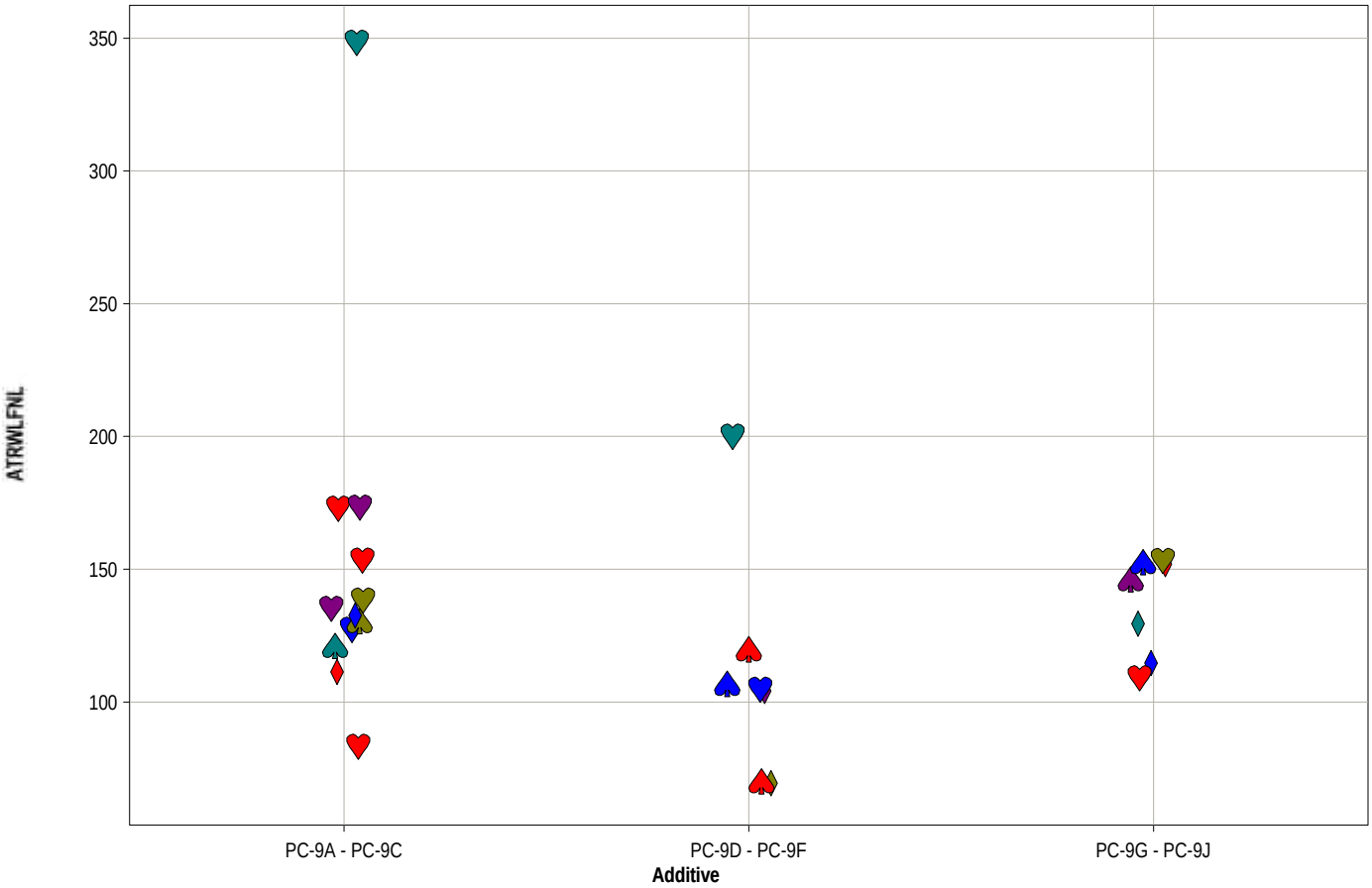
PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

The markers are jittered.

Query:
SELECT * FROM Embedded

ATTACHMENT 7, 6 OF 14

T10 Matrix Data from TMC Website 060701



Color by LTMSLAB

A B D F G

Shape by IND

PC-9A PC-9B PC-9C PC-9D PC-9E PC-9F PC-9G PC-9H PC-9J

The markers are jittered.

Query:
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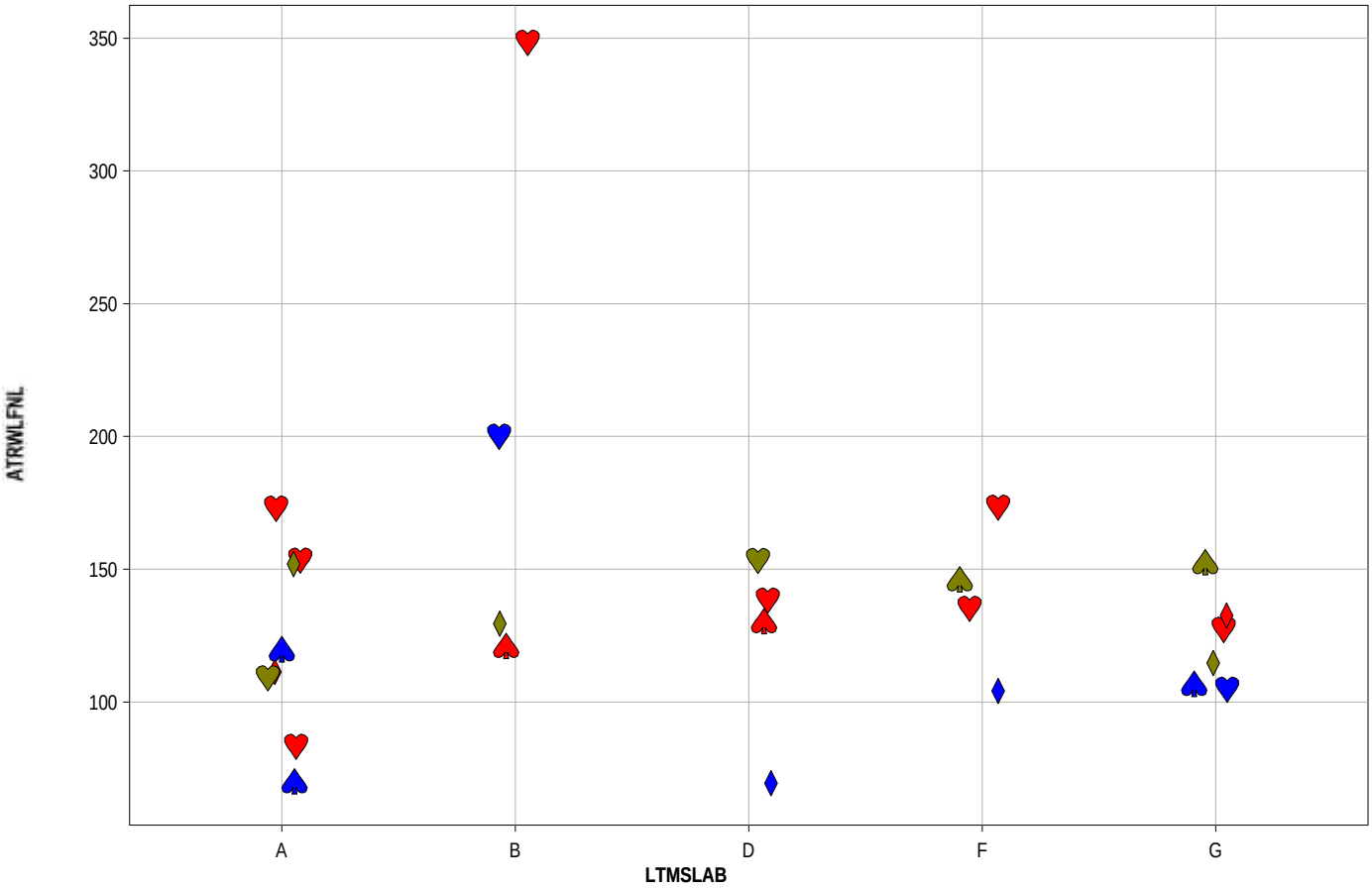
T10 Matrix Data from TMC Website 060701



Color by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

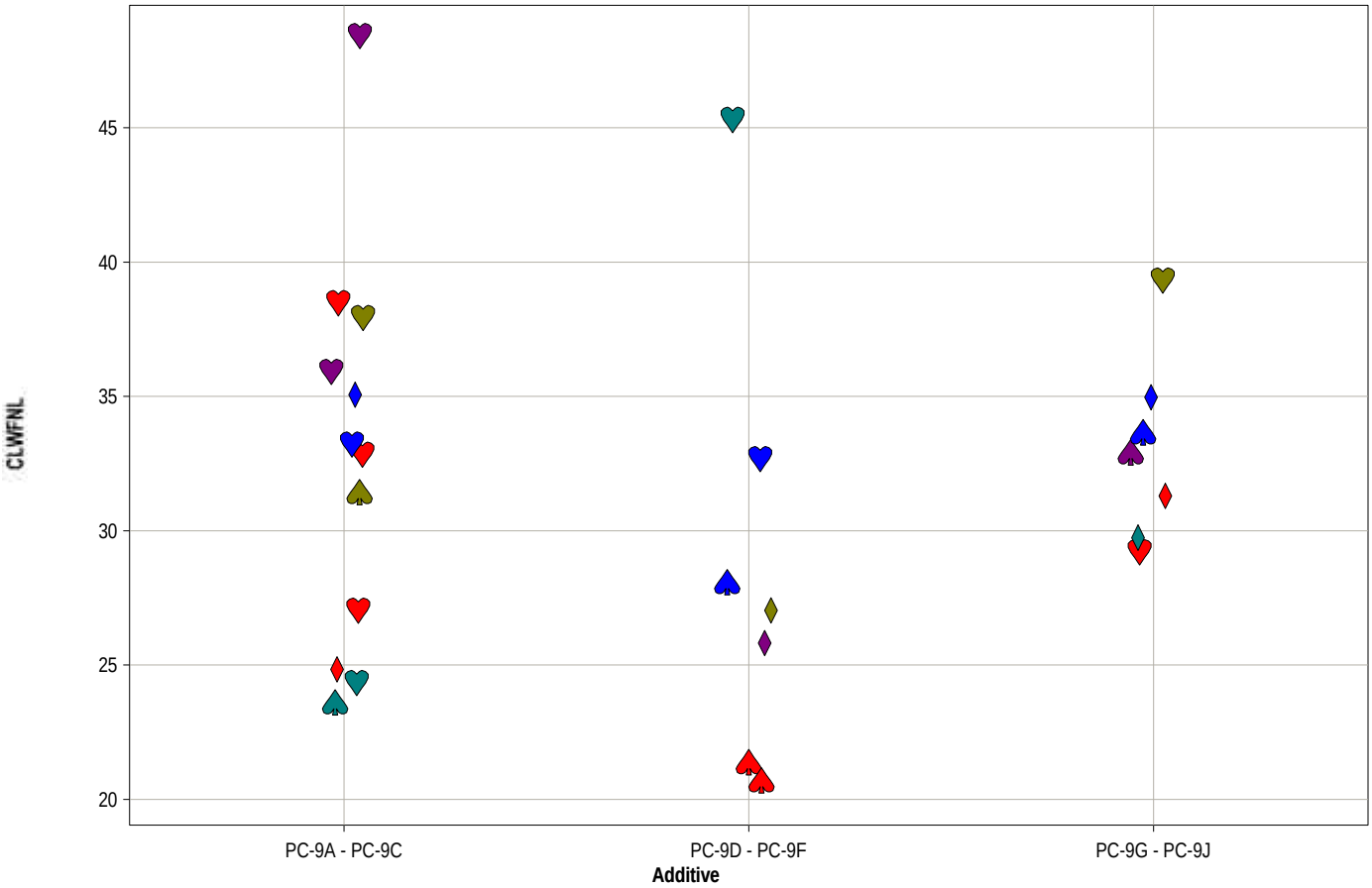
Shape by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

The markers are jittered.

Query:
SELECT * FROM Embedded

T10 Matrix Data from TMC Website 060701



Color by LTMSLAB

A B D F G

Shape by IND

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The markers are jittered.

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ATTACHMENT 7, 9 OF 14

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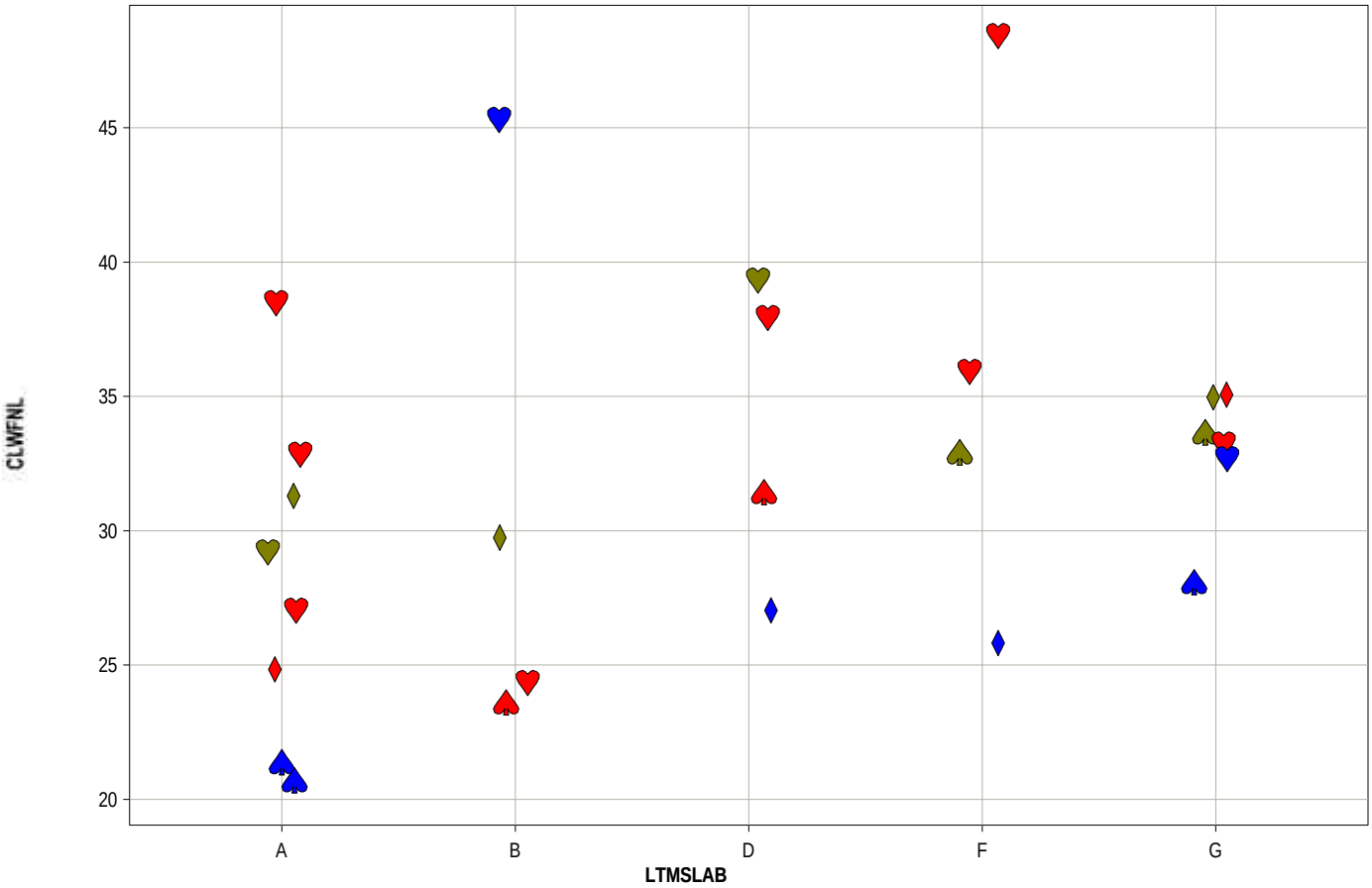

Color by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

Shape by IND

PC-9A PC-9B PC-9C
PC-9D PC-9E PC-9F
PC-9G PC-9H PC-9J

The markers are jittered.

Query:
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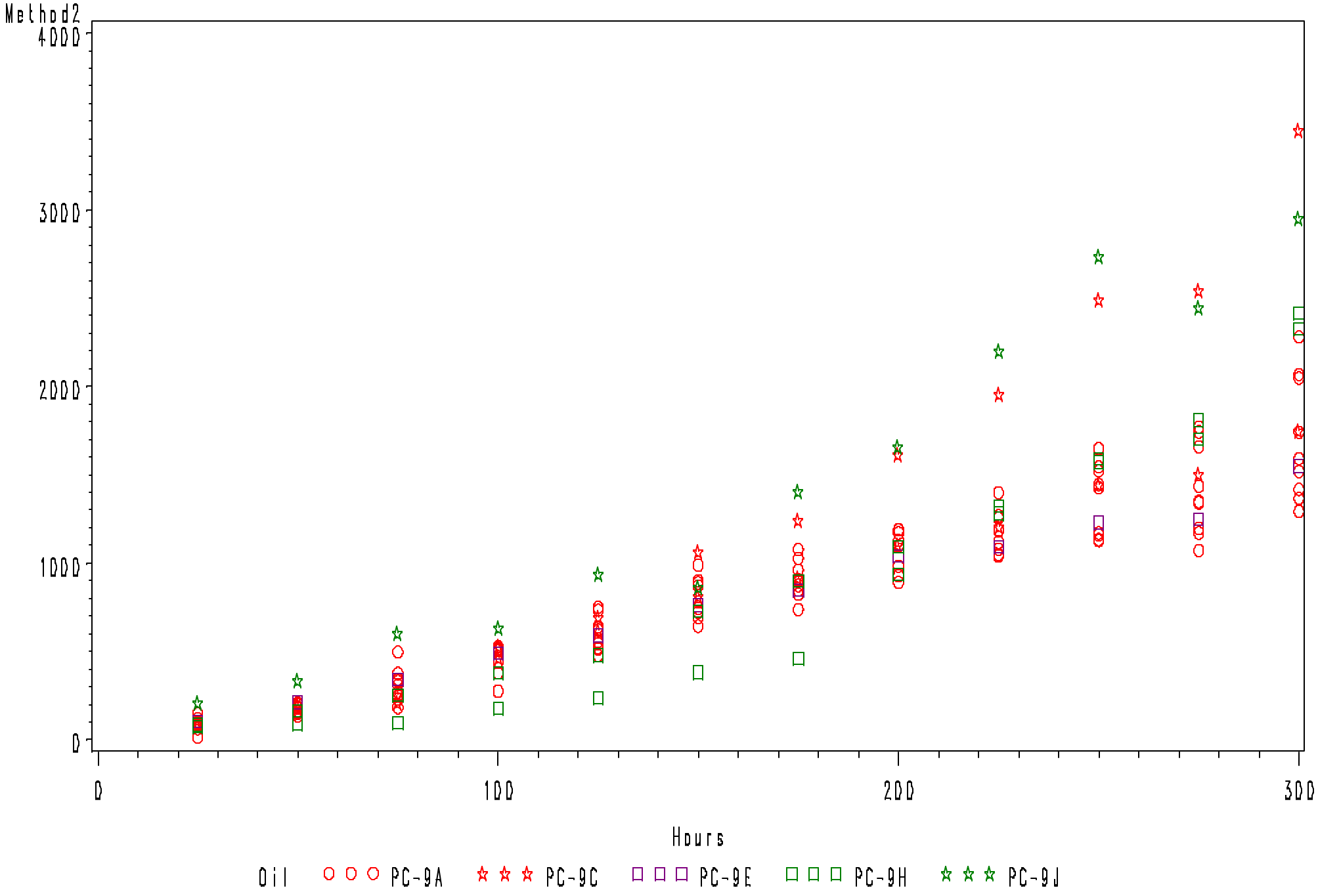
ATTACHMENT 7, 10 OF 14

T10 Matrix IR Data from 060101



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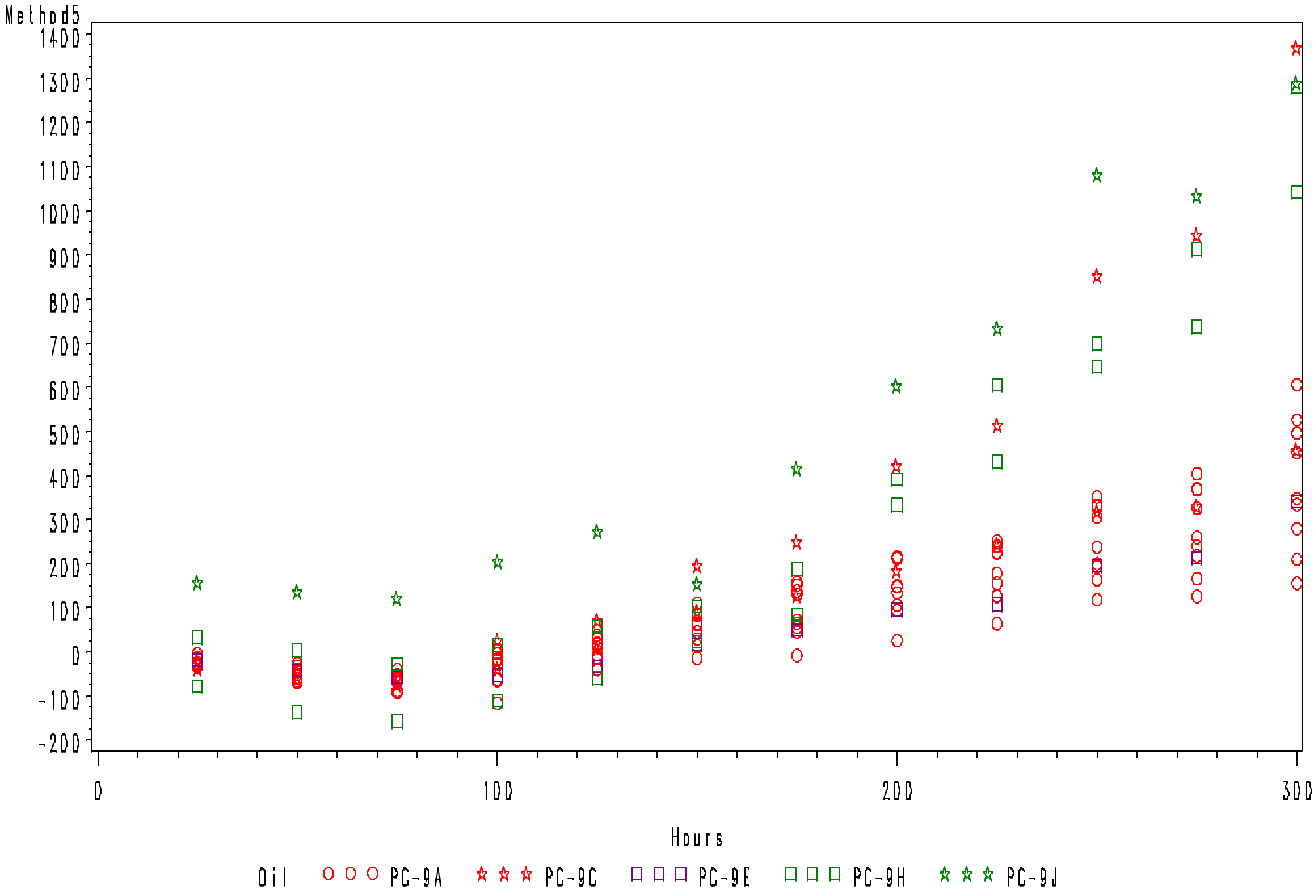

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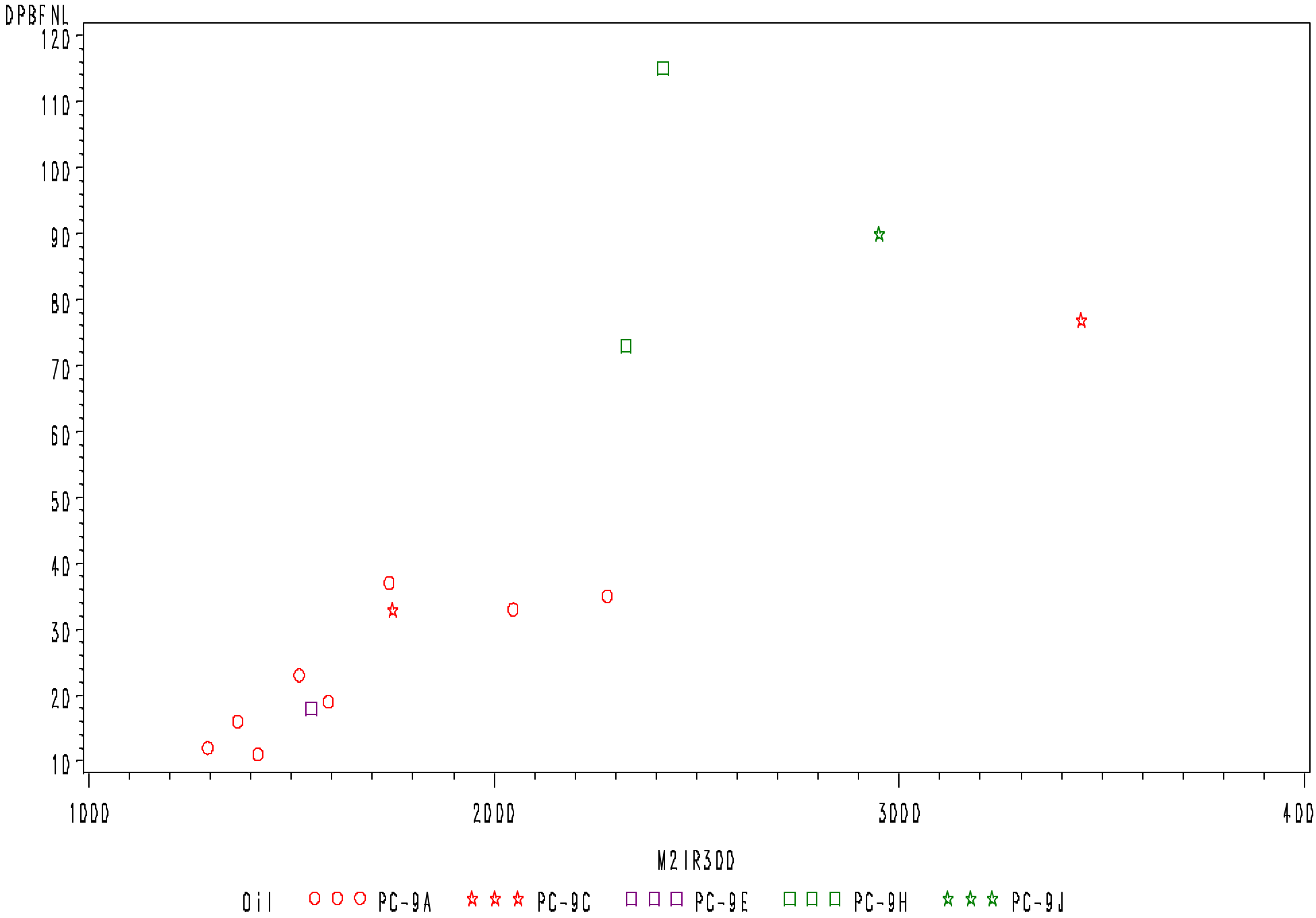
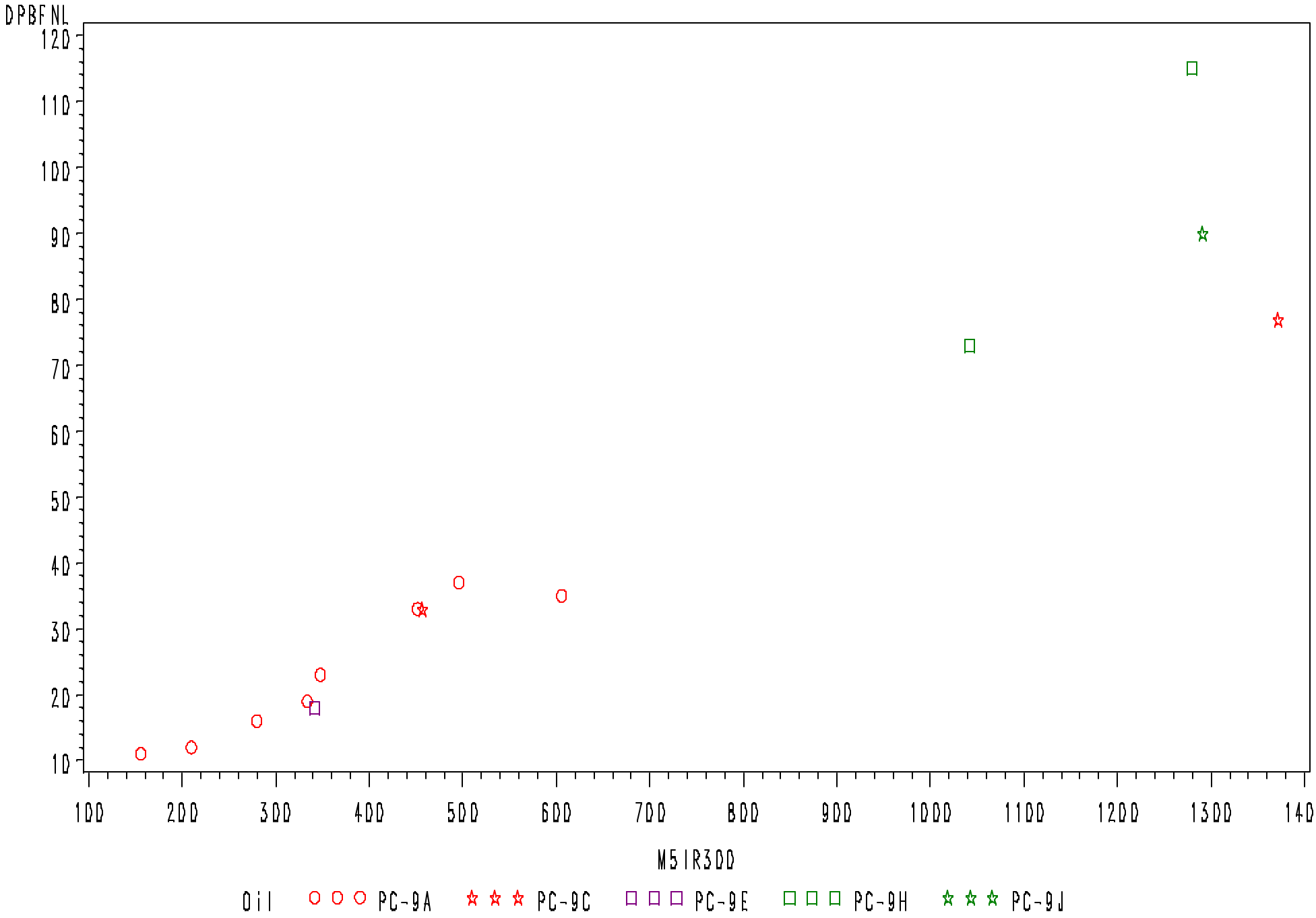


T10 Matrix IR Data from 060101



This Attachment did not work well as a PDF file, so it can be found as an Excel file in the directory for this meetings minutes on the TMC website.

ATTACHMENT 8

M11 EGR Test Matrix Status

Presentation to
HDEOCP
June 19, 2001
David M Stehouwer

M-11 EGR Test Matrix Status

- All runs are complete
- M11 EGR Task Group to meet July 9/10
- Accept data and analyze statistics
- Report to next HDEOCP

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		

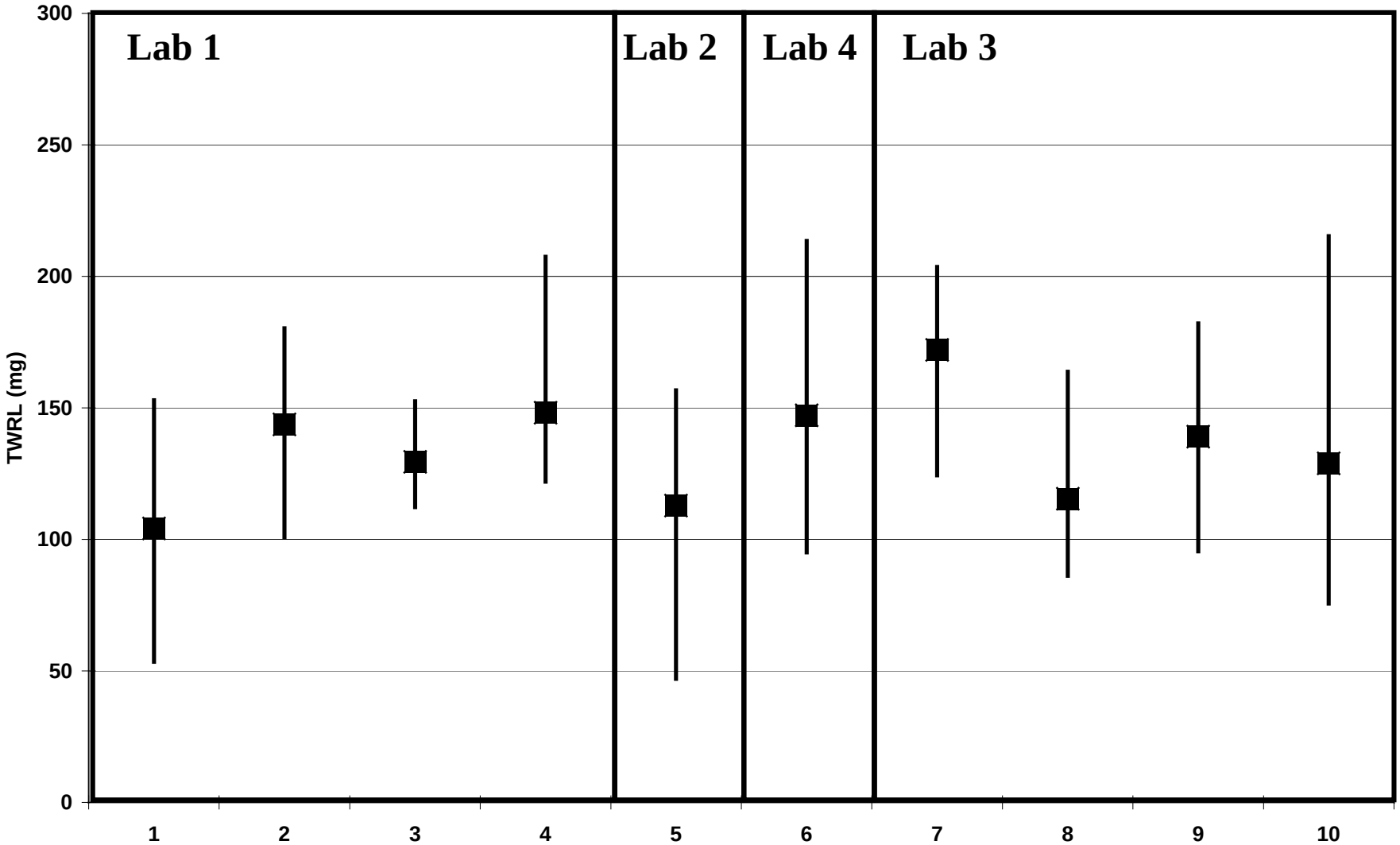
Complete

Pending

* assumed complete 19-Jun

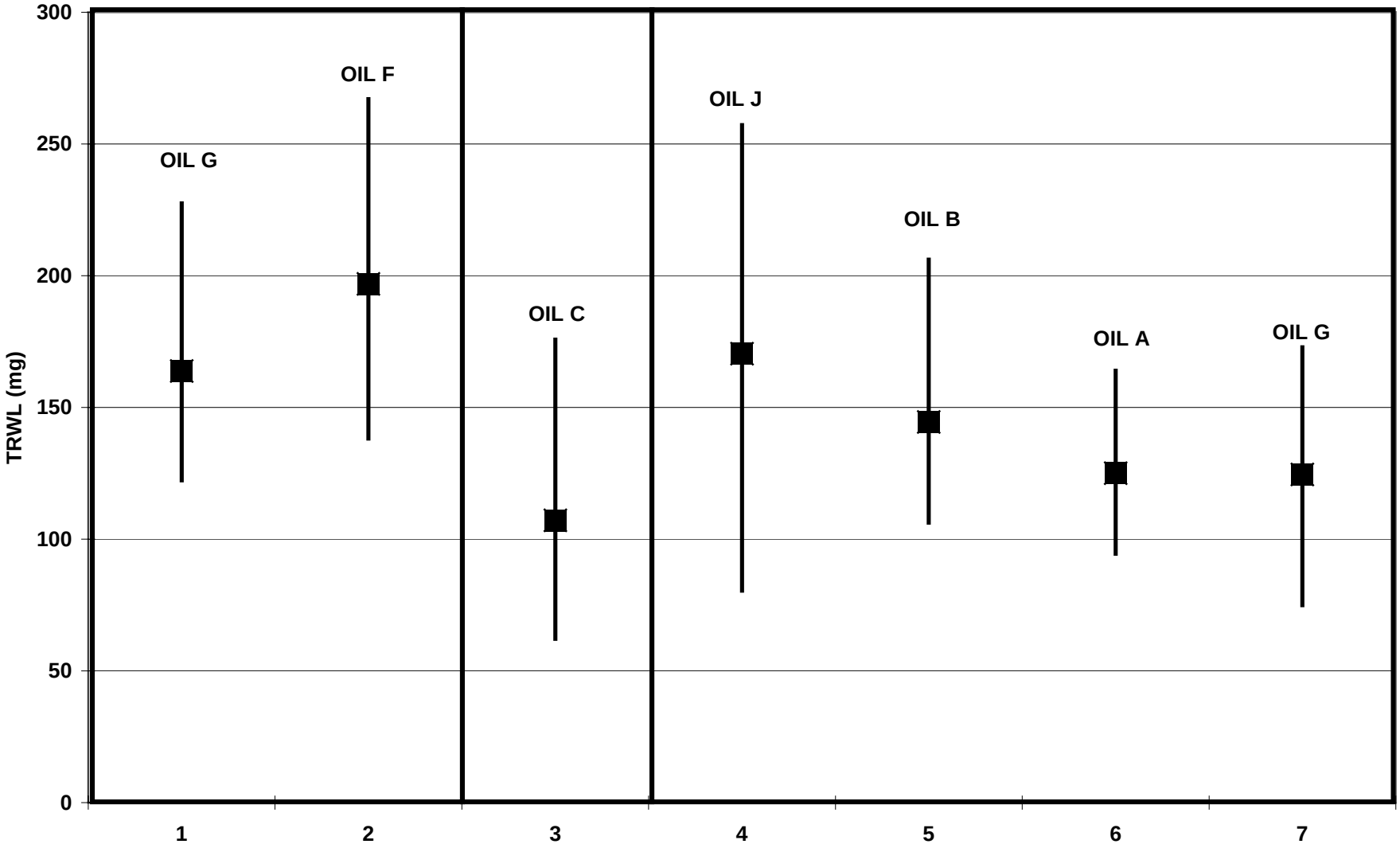
David M Stehouwer, Cummins Inc.

Top Ring Weight Loss - Matrix Oil E



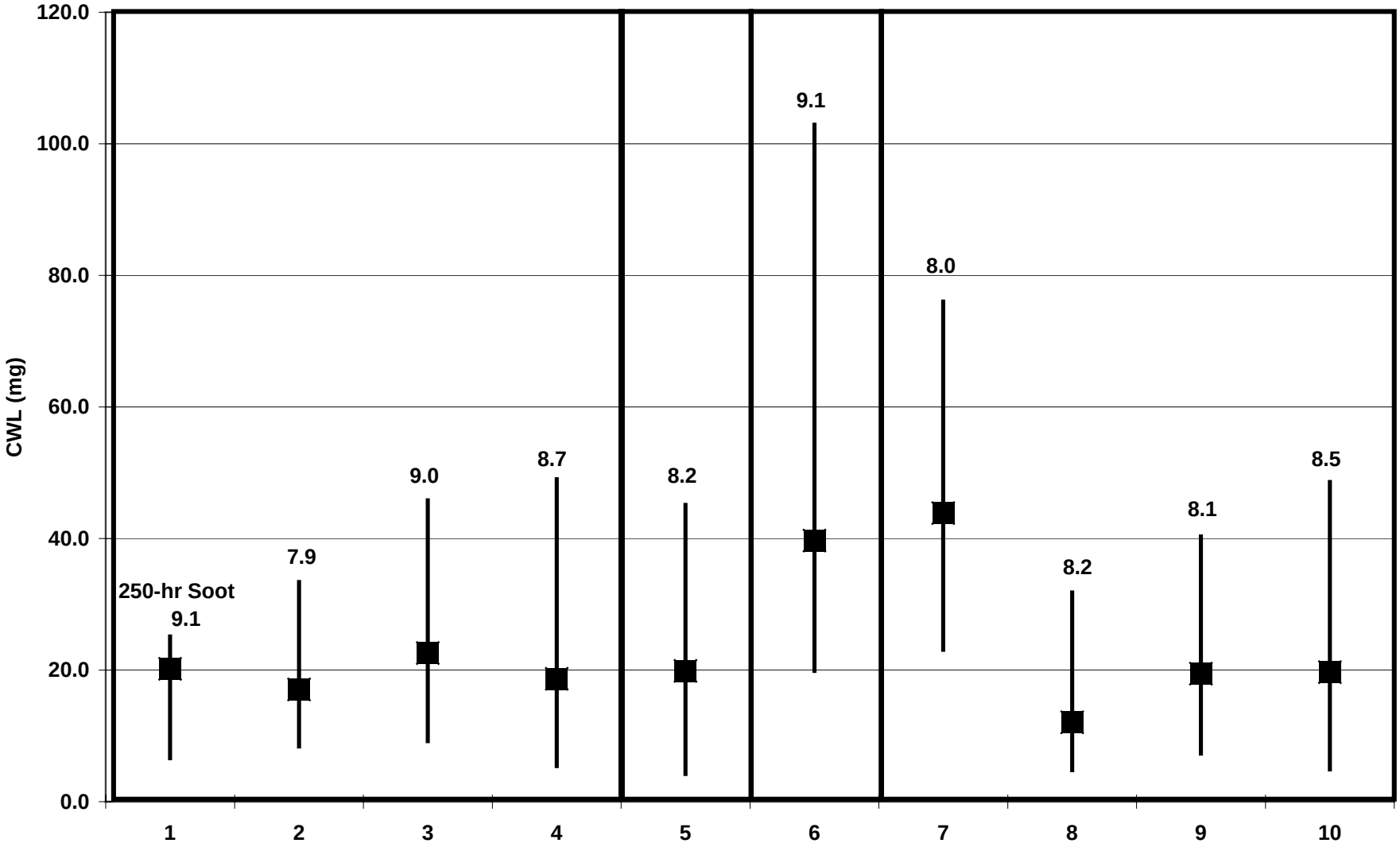
David M Stehouwer, Cummins Inc.

Top Ring Weight Loss



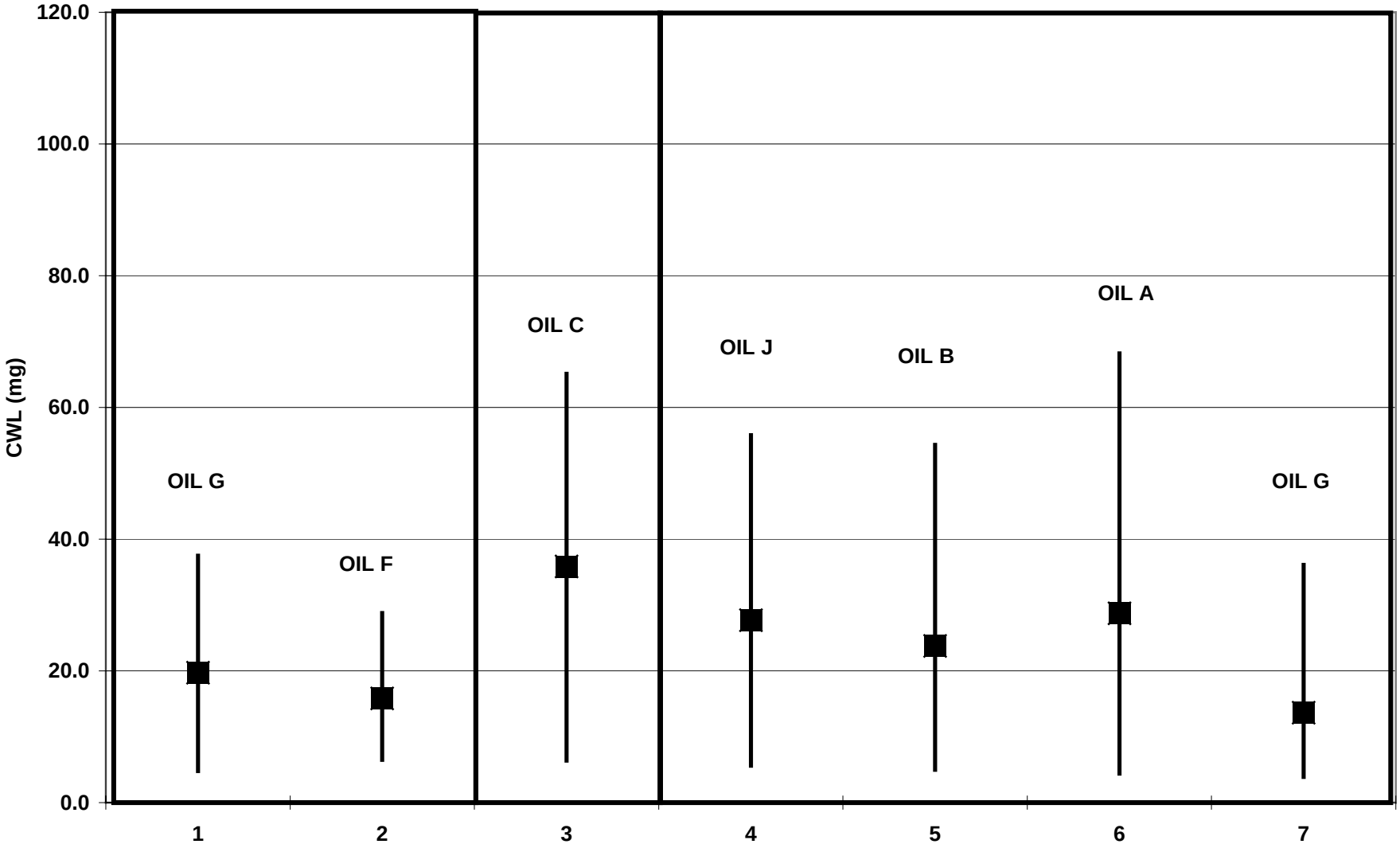
David M Stehouwer, Cummins Inc.

Crosshead Weight Loss - Matrix Oil E



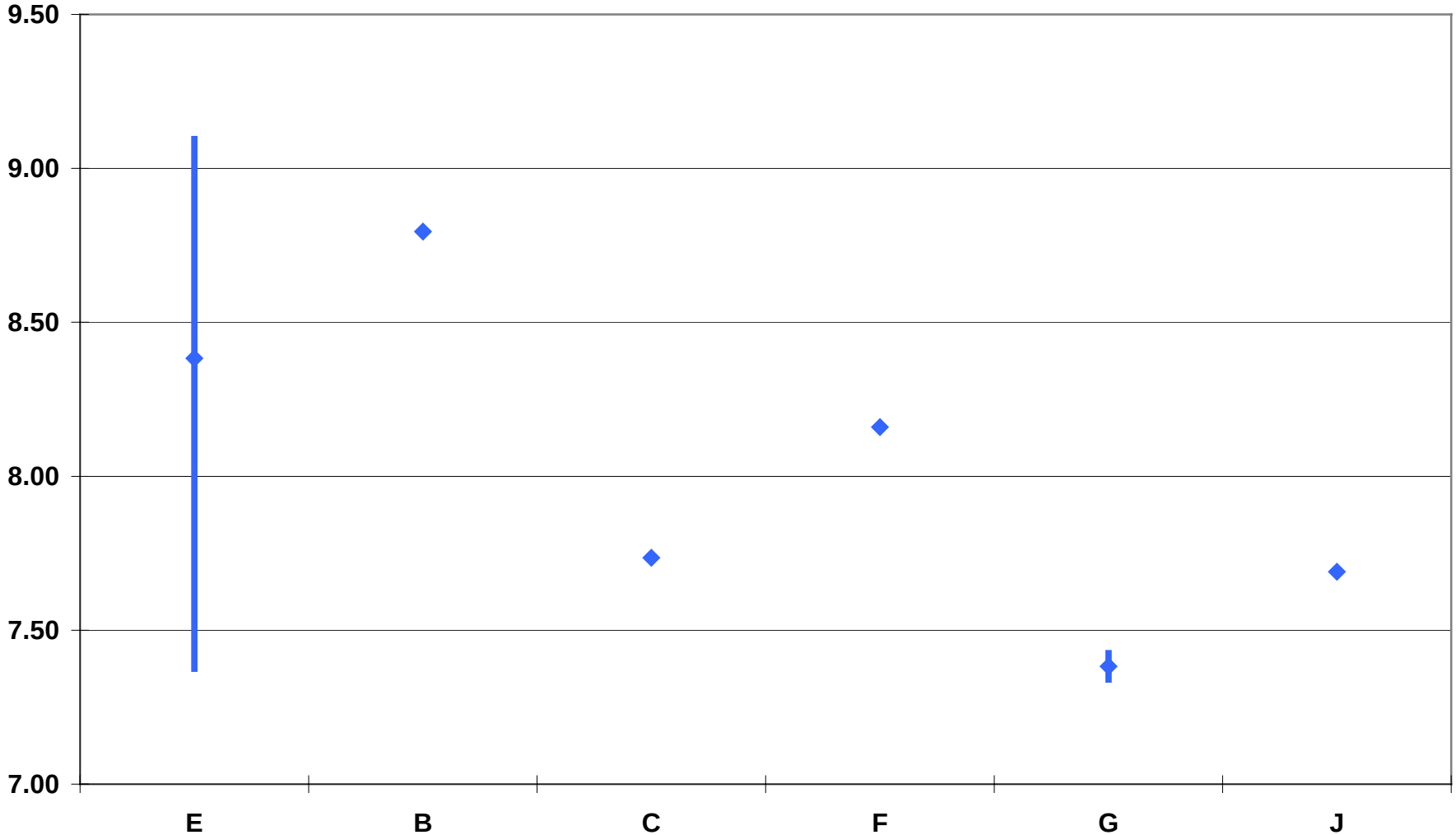
David M Stehouwer, Cummins Inc.

Crosshead Weight Loss



David M Stehouwer, Cummins Inc.

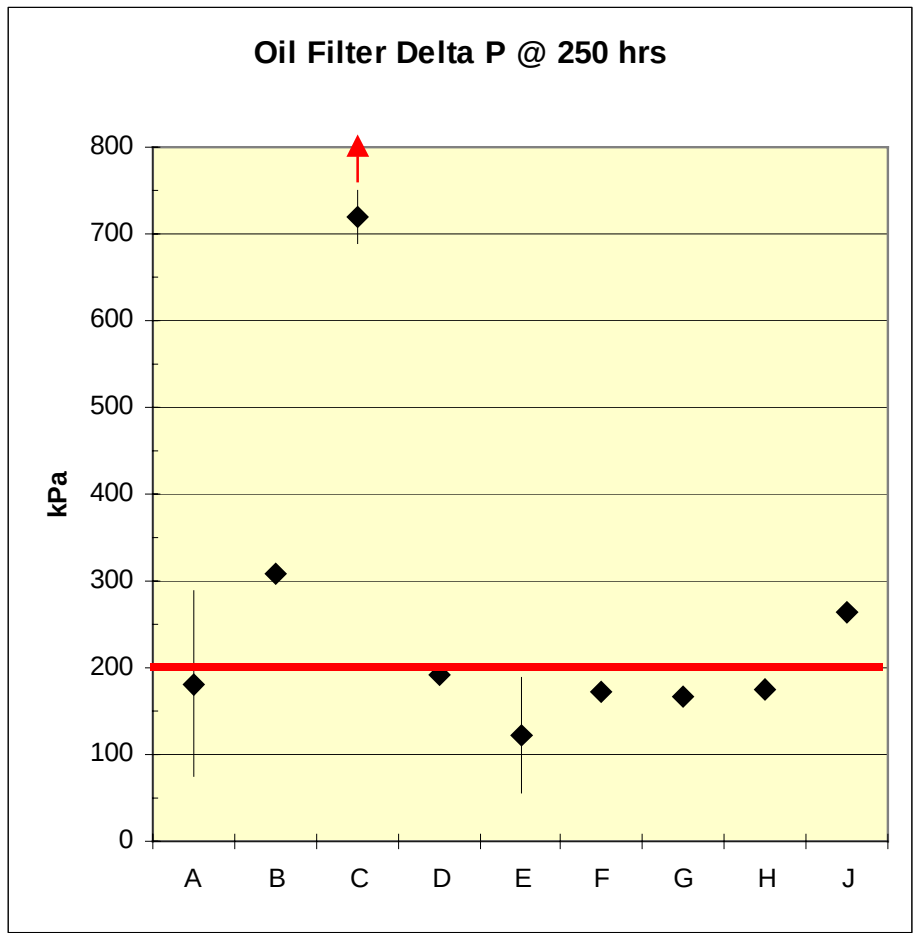
M11 EGR Sludge Ratings



David M Stehouwer, Cummins Inc.

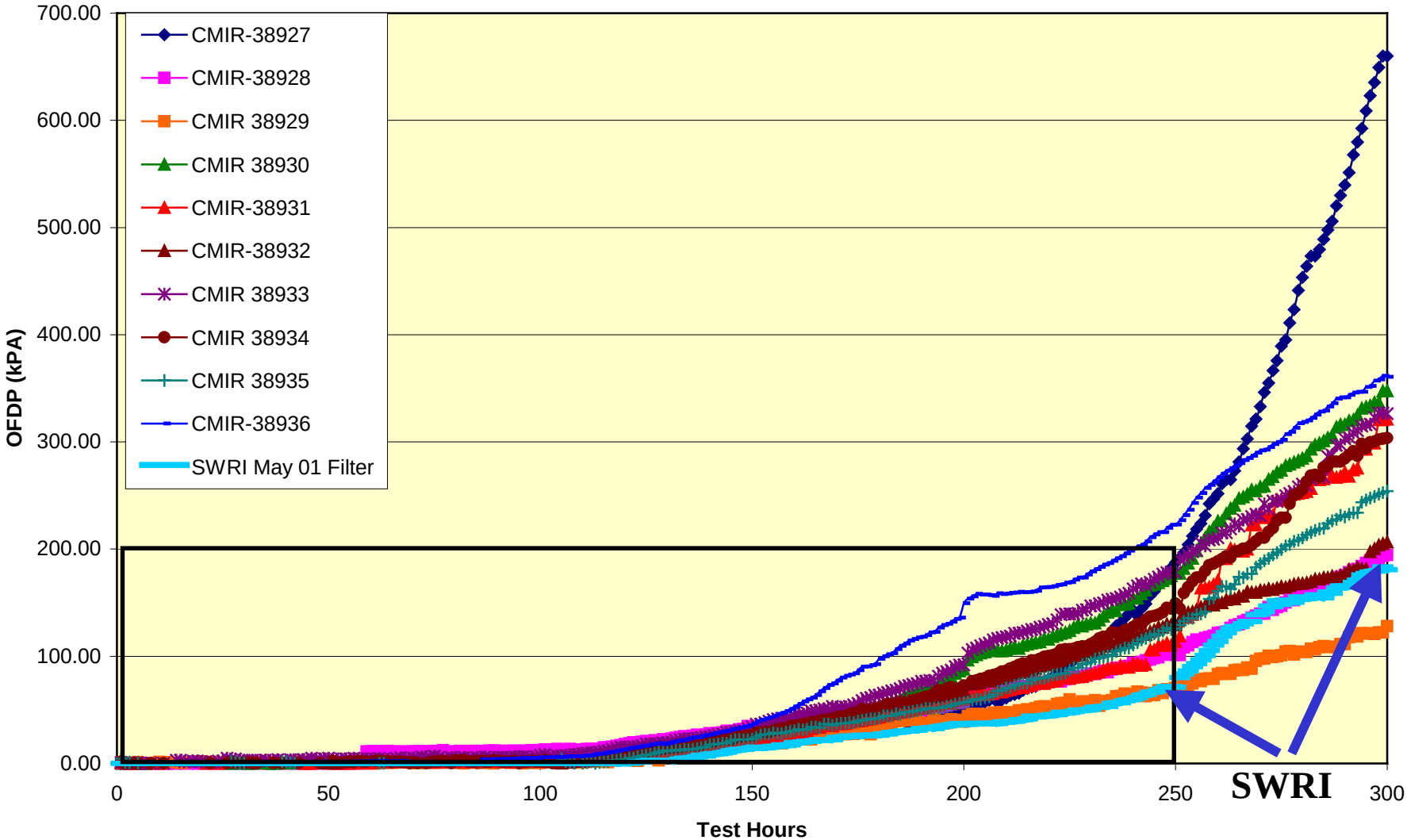
M11 EGR: Filter Delta P Matrix Results

- Apply HST correction factor to delta P
- Plots show range and mean
- Set limit at 250 hr



David M Stehouwer, Cummins Inc.

PC9 Matrix Data Oil E, Corrected & Normalized

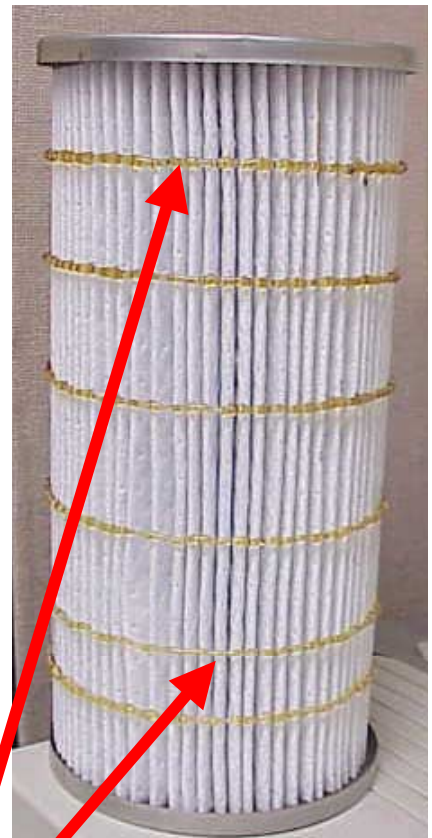


David M Stehouwer, Cummins Inc.

Filter Modification

- SWRI ran oil E with modified filter
- Other volunteers welcome
- Surveillance Panel to review proper action

Shifting pleats cause loss of flow area



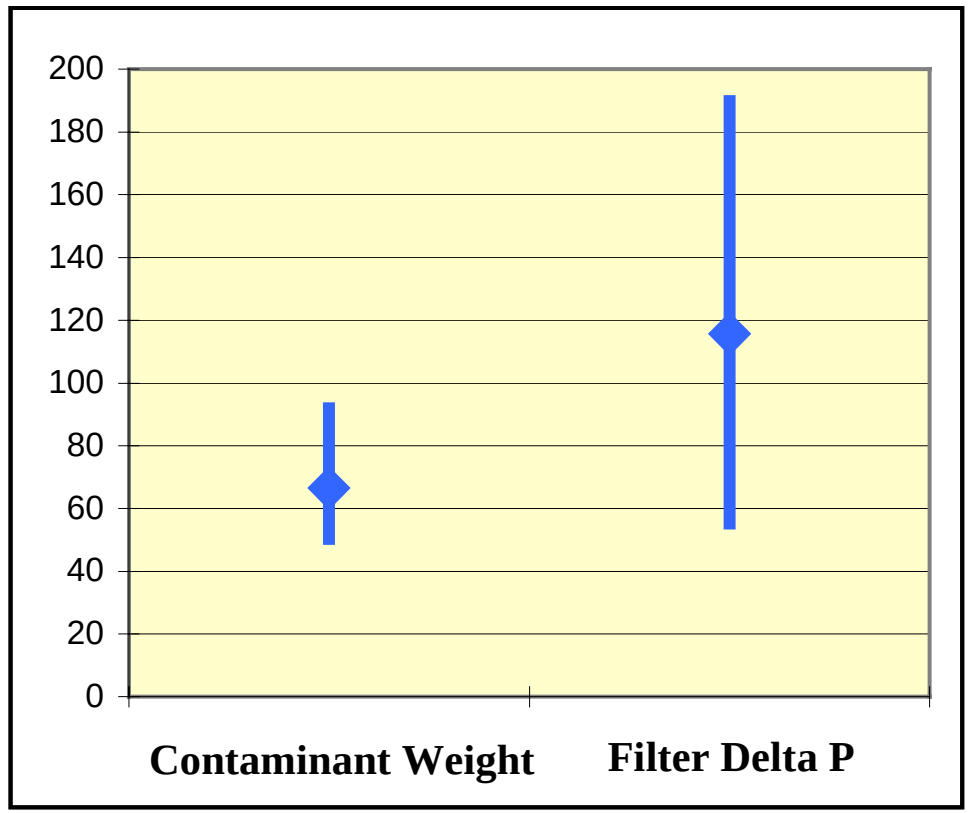
Used Filter shows stable pleats

Hot-melt beads stabilize pleats

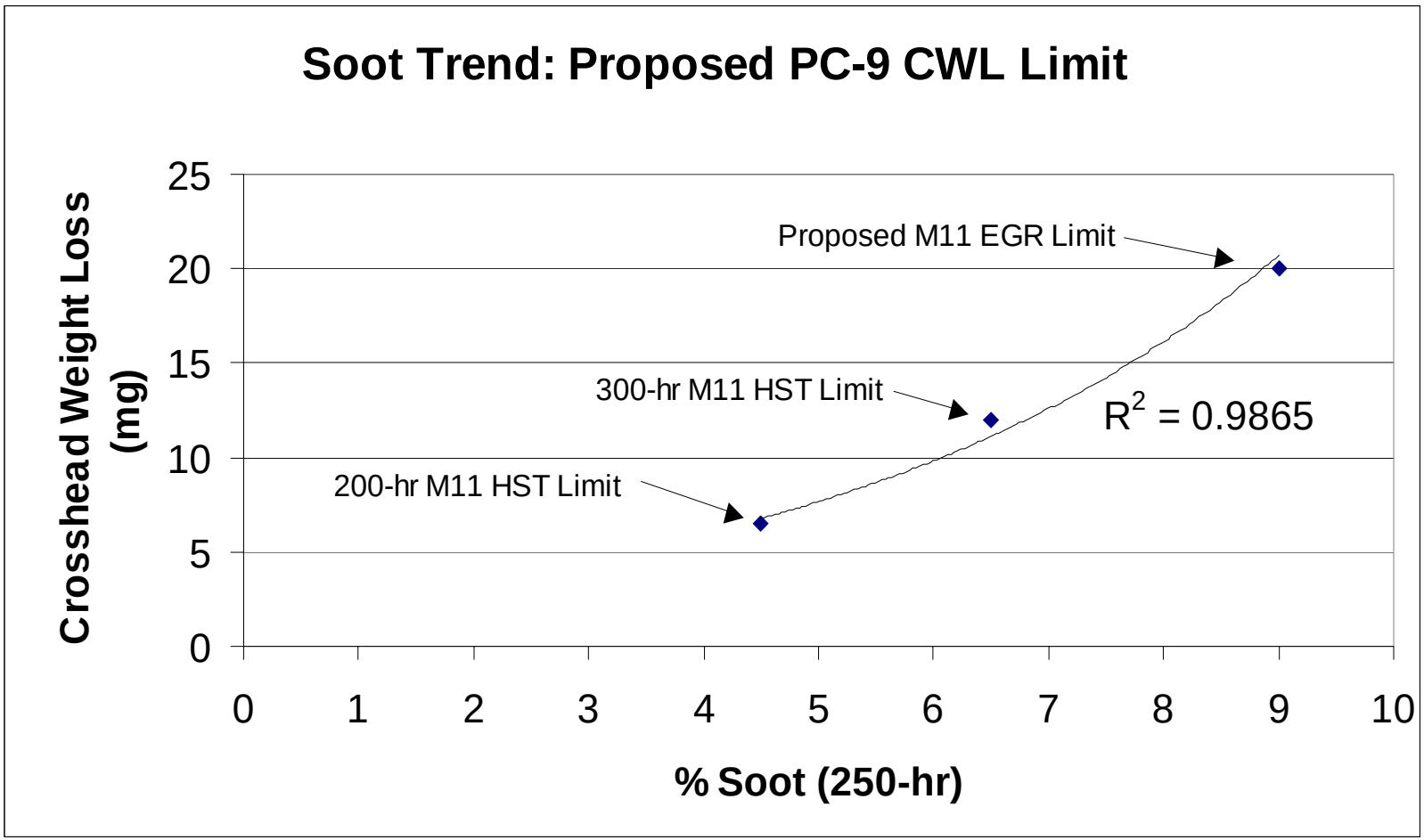
David M Stehouwer, Cummins Inc.

M11 EGR Used Filter Properties: Oil E

- Delta P variation caused by filter structure
- Filter contaminant more repeatable than delta P
- Engine test generating same contaminant each run
- Filter removing same contaminant each run



Soot vs. Wear in M11 Tests



Caterpillar 1Q vs. 1R Test

- Common Parameters
  - Same Piston and Rings as 1Q
  - Same Liner as 1Q
- Different Parameters
  - No EGR
  - 1Q Inlet Air Temperature – 85 °C
  - 1R Inlet Air Temperature – 60 °C

LUBRIZOL

Fluid technologies for a better world™

PC-9 Matrix Design Task Force

Caterpillar 1R Test Matrix Proposal

Presented to
ASTM D02.B.02
Heavy Duty Engine Oil Classification Panel
San Diego, CA
June 19, 2001

ATTACHMENT 11, 1 OF 10

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Caterpillar 1R Matrix Testing

- **Caterpillar 1Q**

  … Matrix Terminated at HDEOCP Meeting May 25, 2001

- **Caterpillar 1R**

  … Will Replace 1Q

  … Pre-1Q Tests completed on Oil PC-9M Indicate Possibility of Success for the 1R as a 1Q Replacement

  … API BOI/VGRA Working Group has been asked to approve use of 1P BOI Guidelines for the 1R

  … PC-9 MDTF Proposes a Formulations Matrix and 1R Test Plan (for Precision only If the 1P BOI Guidelines are acceptable for the 1R)

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Caterpillar 1R Matrix Testing

Stand/Lab Test Capacity For PC-9 (1-R) Matrix Project

Calibration Requirements For Each Lab:

All Matrix Stands:

First Stand (In a Lab) = 3 Tests

Additional Stands (In a Lab) = 2 Tests

1R Matrix Stands = 2 Tests/Stand For the Caterpillar 1R Matrix

Note: Labs and Stands not in the 1Q/1R Matrix Project will revert to the original requirements above

	M-11/EGR	1R	T-10
Maximum Number of Stands	6	9	7
Number of Labs Participating	4	5	5

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Caterpillar 1R Matrix Testing

PC-9 Test:	M11/EGR		1R		T-10		Total Cost	
	# Tests	$	# Tests	$	# Tests	$	# Tests	$
Number of Tests:	26	2.210	18	1.080	28	1.820	72	5.110
Project Cost (Funding Group)	10	0.850	9	0.540	9	0.585	28	1.975

Test Prices Used	M-11/EGR	$85,000
For Matrix Project	1R	$60,000
Cost Estimates	T-10	$65,000

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Caterpillar 1R Matrix Testing

Code	Technology	Base Oil	Featured Oil for the Test Listed
PC-9A	X	1	T-10
PC-9D	Y	1	---
PC-9E	Y	2	M11/EGR
PC-9P	Y	4	---
PC-9M	W	4	1R

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Caterpillar 1R Matrix Testing

PC-9 Matrix Test Plan								
Caterpillar 1R (Preferred)								
Lab 1			Lab 2	Lab 3			Lab 4	Lab 5
Stand 1	Stand 2	Stand 8	Stand 3	Stand 4	Stand 5	Stand 9	Stand 6	Stand 7
PC-9A	PC-9M	PC-9A	PC-9M	PC-9A	PC-9M	PC-9A	PC-9M	PC-9A
PC-9M	PC-9A	PC-9M	PC-9A	PC-9M	PC-9A	PC-9M	PC-9A	PC-9M

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Caterpillar 1R Matrix Testing

PC-9 Matrix Test Plan

Caterpillar 1R (Alternate)

Lab 1			Lab 2	Lab 3			Lab 4	Lab 5
Stand 1	Stand 2	Stand 8	Stand 3	Stand 4	Stand 5	Stand 9	Stand 6	Stand 7
PC-9A	PC-9M	PC-9A	PC-9M	PC-9A	PC-9M	PC-9A	PC-9M	PC-9A
PC-9M	Oil #3	PC-9M	PC-9A	PC-9M	Oil #3	PC-9M	PC-9A	PC-9M

Oil #3 = PC-9D or PC-9P

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Caterpillar 1R Matrix Testing

- **Caterpillar 1R Proposal Summary**
  - … Five Labs / Nine Stands / Eighteen Tests
  - … Pre-1Q Tests completed on Oil PC-9M Indicate Possibility of Success for the 1R
  - … API BOI/VGRA Working Group has been asked to approve use of 1P BOI Guidelines for the 1R
  - … PC-9 MDTF Proposal for Formulations to be used and Testing Plan for Precision Only have been accepted (Contingent upon 1P BOI Guidelines being acceptable for 1R)
  - … All Five Participating Labs have 1R tests Running

LUBRIZOL

Caterpillar 1R Matrix Testing

- **PC-9 MDTF Primary Recommendation**
  - Five Labs – Nine Test Stands – 18 Tests (Two Tests/Stand)
  - Nine Tests/Oil PC-9A and Nine Test/Oil PC-9M
  - Each Stand will run Oils PC-9A and PC-9M
  - Propose Runs to be Alternated between PC-9A and PC-9M across the Nine Stands as shown on Page 7 the Preferred 1R Testing Plan
  - Test Run Sequence to be determined by the PC-9 Matrix Manager (John Zalar)

LUBRIZOL

Caterpillar 1R Matrix Testing

- **PC-9 MDTF Alternate Proposal**

  (This Proposal Is Offered in Response to an EMA Request)

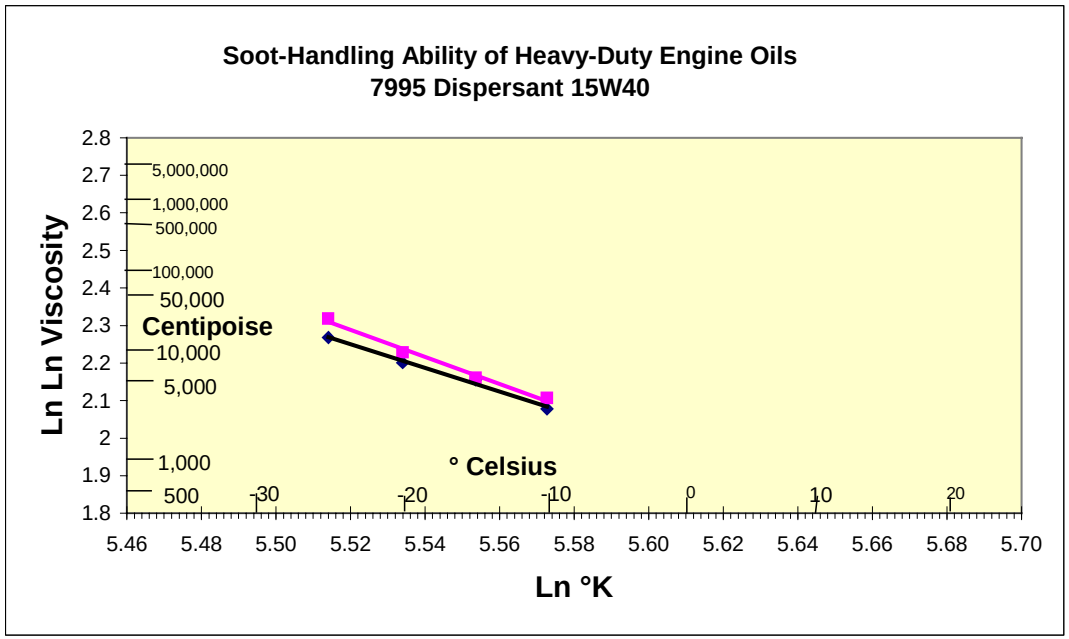
  - Five Labs – Nine Test Stands – 18 Tests (Two Tests/Stand)
  - Nine Tests/PC-9M; Seven Tests/PC-9A; and Two Tests PC-9D
  - Each Stand will see PC-9A or PC-9M (7of 9 stands see both)
  - Oil PC-9D to be run as the Second Test in One of the Two Original 1Q Stands at each Independent Lab as a Substitute for Oil PC-9A in that Stand *(This requirement is to allow for calibration of all Nine tests stands at the conclusion of the 1R Matrix Testing)*

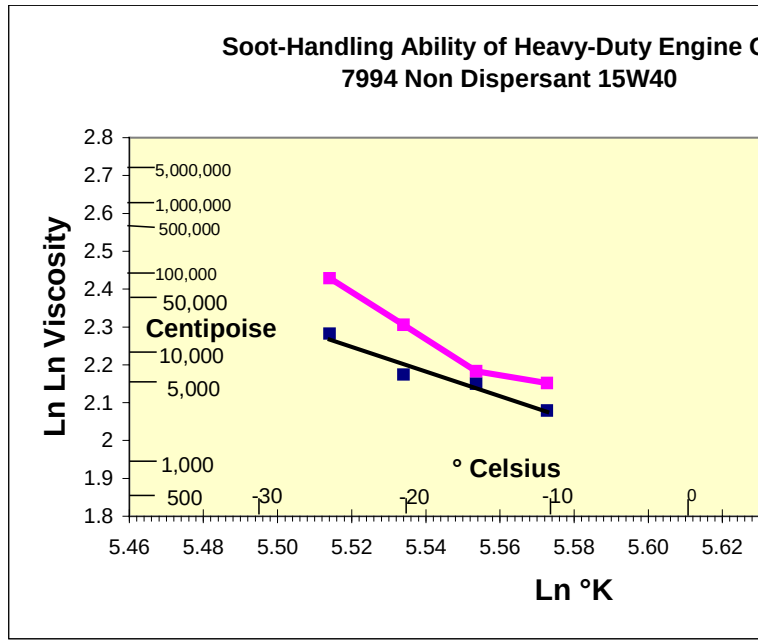
M11 Low Temperature Flow

Presentation to
HDEOCP
June 19, 2001
David M Stehouwer

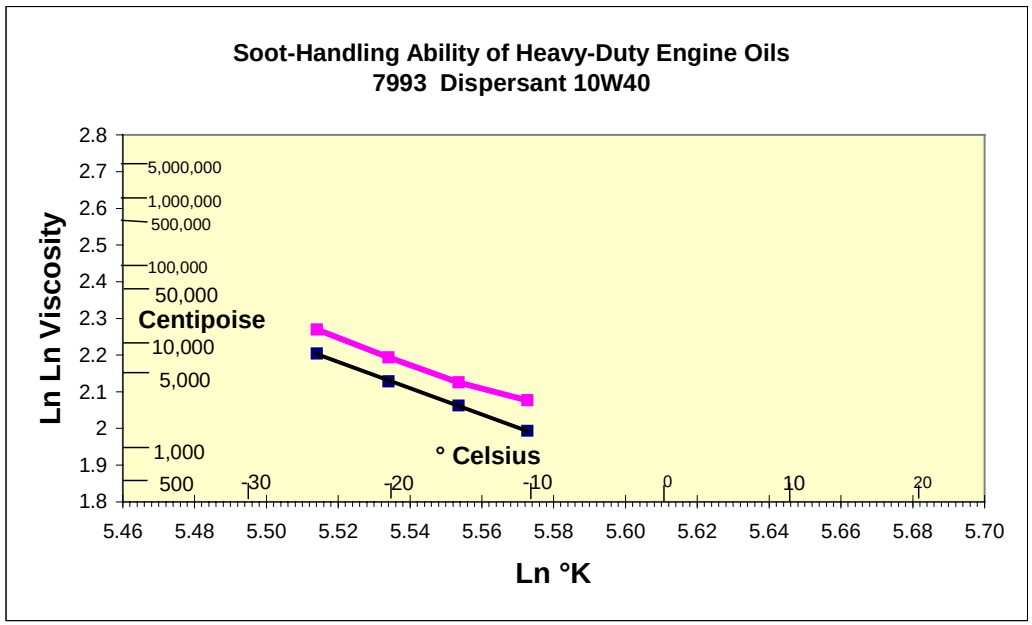
David M Stehouwer, Cummins Inc.

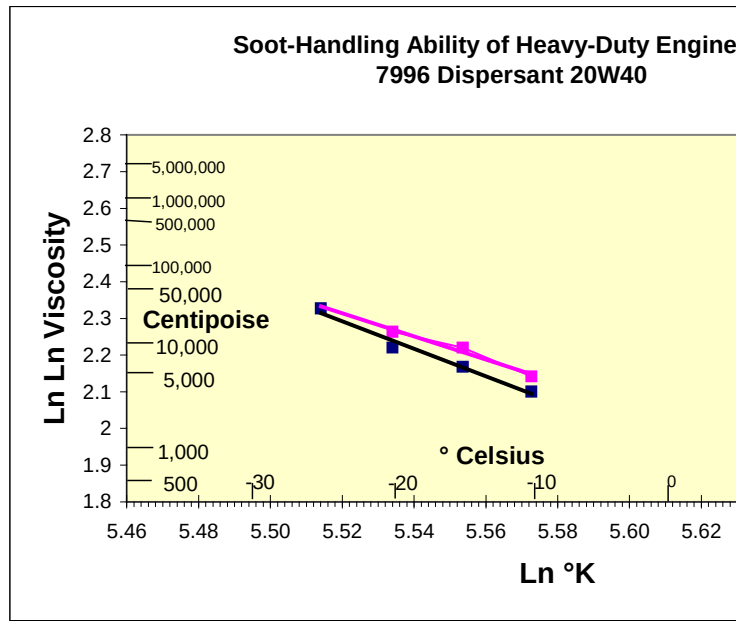
Oils Blended for Low Temp Pumping Study





Oils Blended for Low Temp Pumping Study

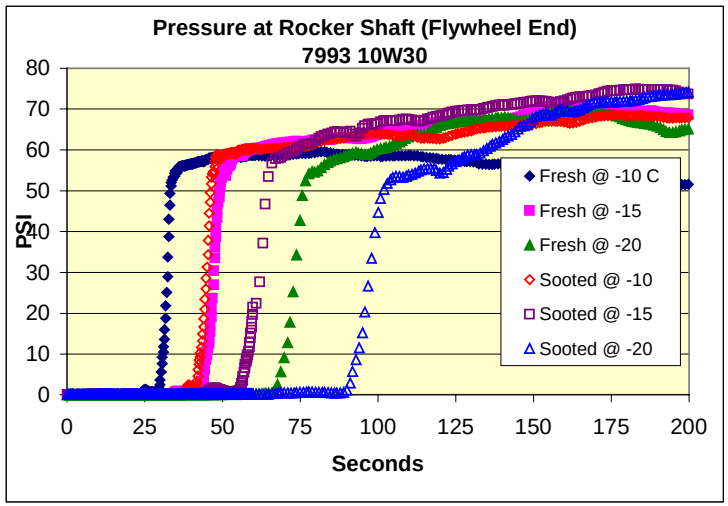


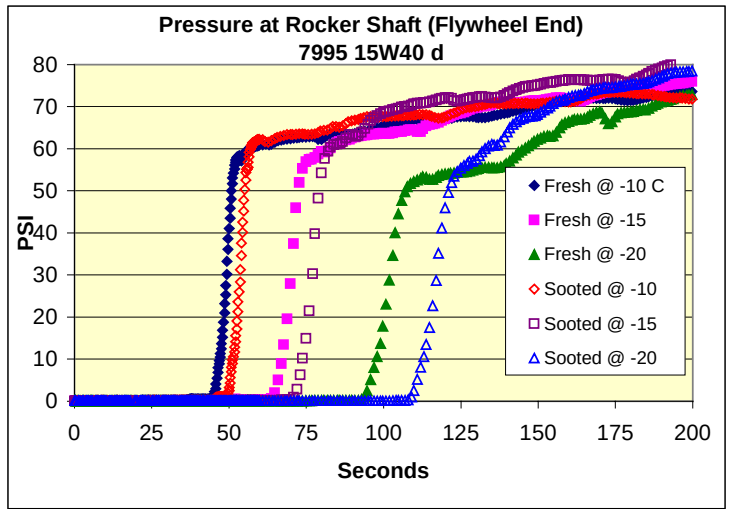


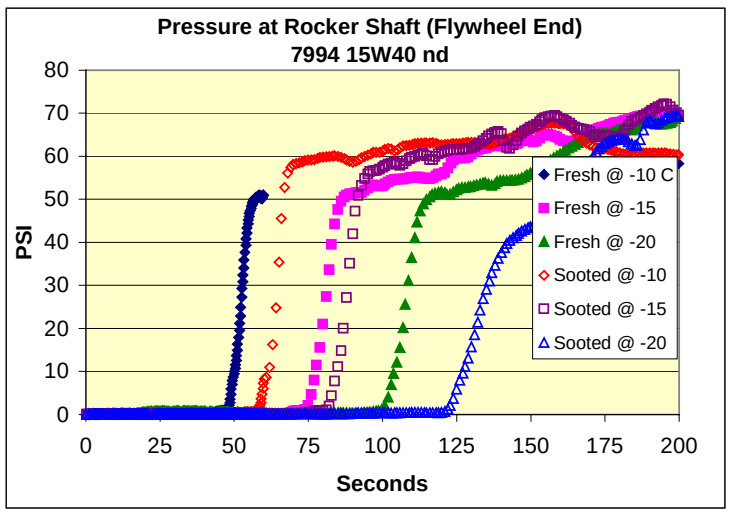
M-11 Low Temp Pumpability

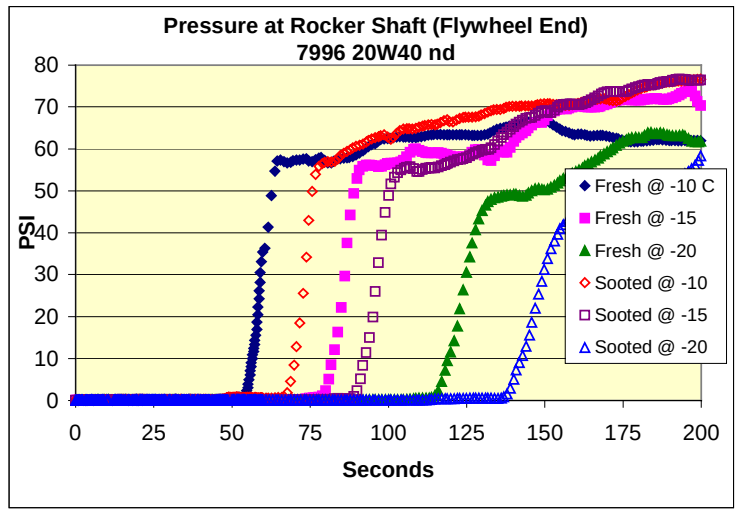
- Oils sooted to 6.1% to 6.5% soot in Mack T-8
- Fresh and sooted oils placed in Cummins M11
  - ✓Motored to 80 C sump
  - ✓Cooled to test temp and soaked overnight
  - ✓Motor to 600 rpm
  - ✓Measure time and pressure at several engine locations
- Test Temperatures
  - ✓-10 C
  - ✓-15 C
  - ✓-20 C

Flow to Rocker Shaft (Flywheel End)

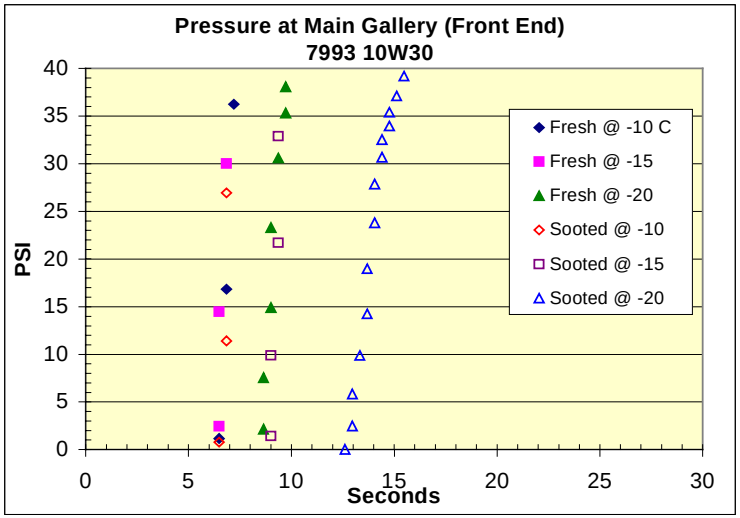


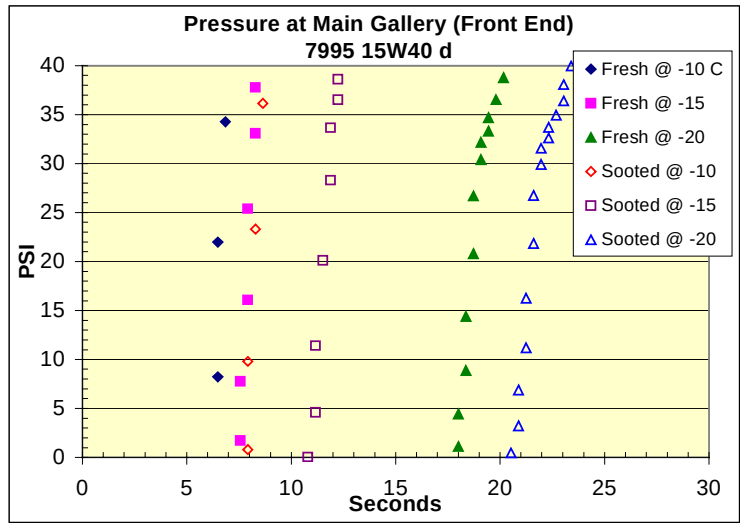


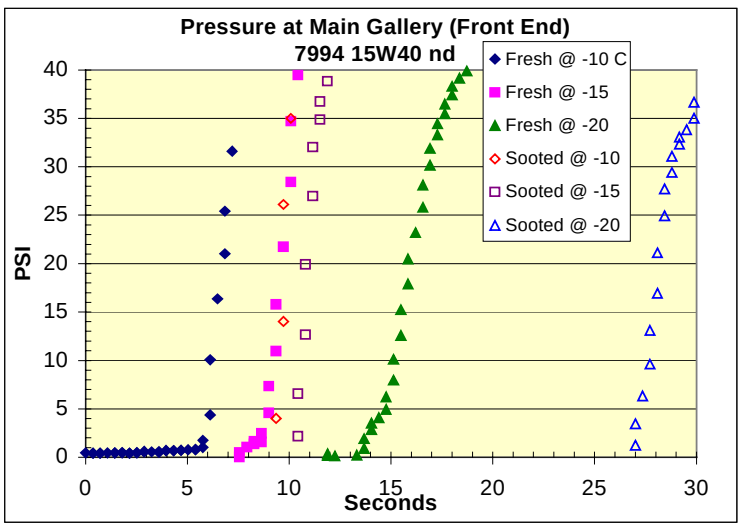


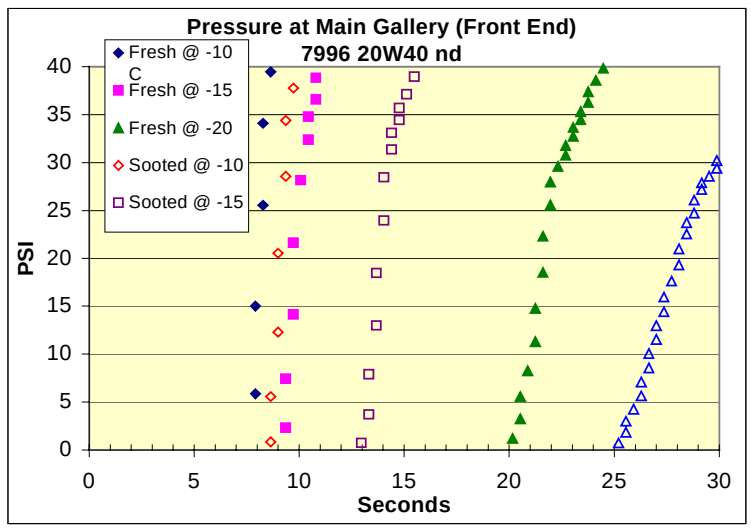


Flow to Main Gallery (Front End)

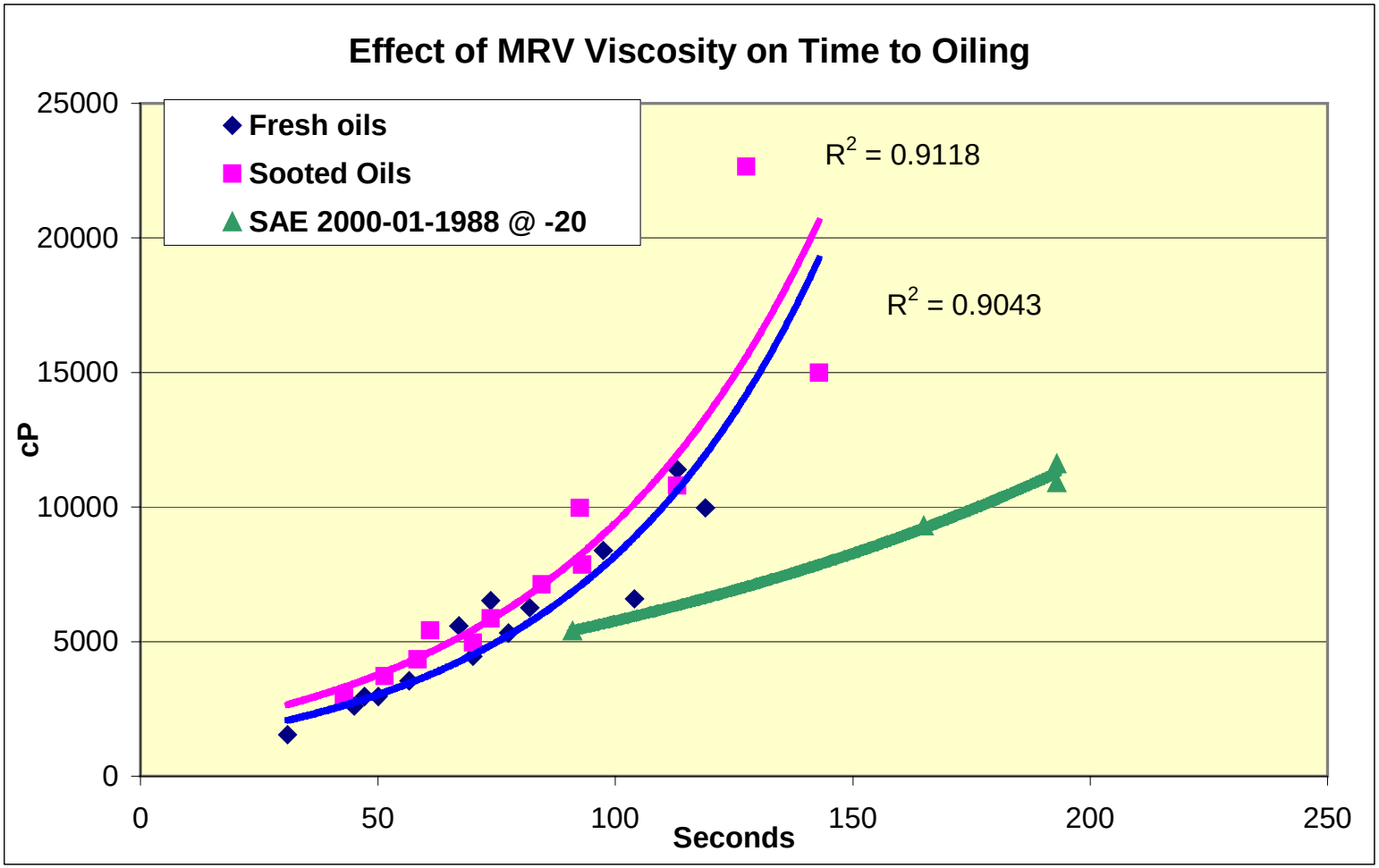








Correlation of MRV to Engine Flow



Preliminary Conclusions

- It is possible for poorly dispersed soot to increase viscosity dramatically
- Well dispersed soot increases lube viscosity as soot increases
- For well dispersed soot in lubricants, and for fresh lubricants pumping time through the engine correlates with MRV viscosity.
- Based on very limited data, correlation seems best with modified MRV.

ASTM D2 Meeting - San Diego, CA

June 19, 2001

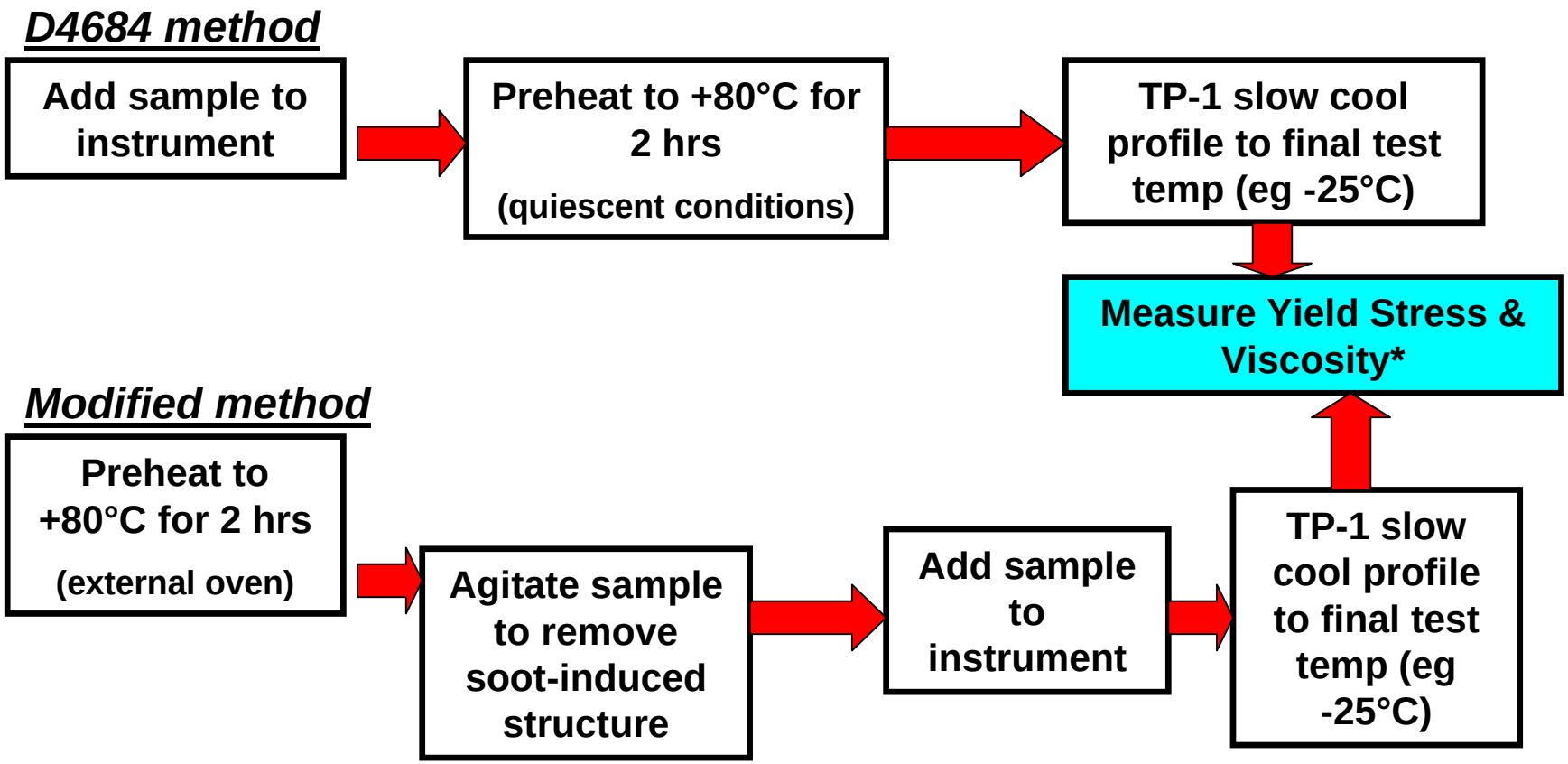
UPDATE ON ASTM LOTRUO ACTIVITIES AND LOW TEMPERATURE PROPERTIES OF PC-9 MATRIX OILS

C.J. May

Used HD Engine Oil MRV Round Robin

- **Round robin and analysis successfully completed in 1Q2001**
  - ➢ **9 samples at two temperatures (-20/-25°C) using two methods (D4684 or modified preheat); results distributed to working group members and reviewed with HDEOCP in mid-May**
- **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**
  - ➢ **poorer precision of used oils displaying structure (yield stress) consistent with early D4684 MRV round robin on similar fresh oils**
- **Modified D4684 viscosity measurements at -20/-25°C (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**

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 <u>both</u>*

c\astm\HDEOCP\190601.ppt

Next Steps

- Complete statistical analysis of yield stress
- Generate research report on used oil MRV R/R
- Incorporate results into D4684 (likely as annexs to the method) along with guidelines for handling of used oils
  - ➢ obvious need for precautions associated with hazardous material
  - ➢ have noted in MRV clean-up that more flushing necessary
- Also looking at other methods of relevance (e.g. extended range SBR)

- To date, Imperial Oil has received 32 E-O-T drain samples from the PC-9 precision matrix including 16 M11-EGR, 15 Mack T-10 and 1 Cat 1Q sample (volumes range from 4-6 L) >> an excellent range of samples for future potential use by the task force
  - ➢ IOL has conducted CCS, MRV and modified MRV testing on a number of these oils

LOW TEMP DATA ON T10 MATRIX OILS

SRC Data, Updated: June 14, 2001

SRC Code	CMIR Code	Matrix Code	Lab Code	Lab	Test	Qty	TGA Soot %	D5293 -15C, cP	D5293 -20C, cP	-20°C D4684 MRV Vis., cP	-20°C D4684 -25C MRV Y. Str., Pa	-25°C D4684 MRV Vis., cP	-25°C D4684 -25C MRV Y. Str., Pa	-20°C Mod. MRV -20C MRV Vis., cP	-20°C Mod. MRV -25C MRV Y. Str., Pa	-25°C Mod. MRV -25C MRV Vis., cP	-25°C Mod. MRV -25C MRV Y. Str., Pa
S201-077	38810	PC-9A	A	SWRI	T-10	4L	6.0	7,030		24,500	0<Y<=35	53,100	0<Y<=35			54,200	0<Y<=35
S201-044	38811	PC-9A	D	Ethyl	T-10	4L	5.5	5,900	11,910	19,900	0<Y<=35	43,900	0<Y<=35			43,100	0<Y<=35
S201-048	38814	PC-9A	F	EMRE	T-10	4L	5.7	7,990		26,400	0<Y<=35	59,300	0<Y<=35			59,400	0<Y<=35
S201-122	38942	PC-9A	A	SWRI	T-10	4L	4.8	5,900		19,100	0<Y<=35	42,100	0<Y<=35			41,800	0<Y<=35
S201-117	38951	PC-9A	G	PEAR	T-10	4L	5.9	7,090		22,800	0<Y<=35	51,000	0<Y<=35			51,500	0<Y<=35
S201-079	38939	PC-9C	A	SWRI	T-10	4L	5.4	7,650		23,200	0<Y<=35	61,300	0<Y<=35			58,700	0<Y<=35
S201-137	38949	PC-9C	G	PEAR	T-10	4L	7.6	12,350		37,300	0<Y<=35					96,200	0<Y<=35
S201-118	38937	PC-9E	A	SWRI	T-10	4L	4.8	5,190		19,500	0<Y<=35	102,400	140<Y<=175			203,500	175<Y<=210
S201-055	38945	PC-9F	D	Ethyl	T-10	4L	5.3	6,020		17,300	0<Y<=35	76,100	35<Y<=70			69,100	0<Y<=35
S201-076	38947	PC-9H	G	PEAR	T-10	4L	7.1	7,270		19,900	0<Y<=35	57,100	0<Y<=35			58,100	0<Y<=35
S201-051	38953	PC-9H	F	EMRE	T-10	4L	5.2	5,630		14,600	0<Y<=35	45,300	0<Y<=35			44,900	0<Y<=35
S201-183	38941	PC-9G	A	SWRI	T-10	4L	5.5									46,900	0<Y<=35
S201-176	38938	PC-9J	A	SWRI	T-10	4L	6.2			17,100	0<Y<=35					44,000	0<Y<=35
S201-136	38948	PC-9J	G	PEAR	T-10	4L	5.7			17,600	0<Y<=35						
S201-054	38813			PEAR	T-10	4L		8,290		25,900	0<Y<=35	60,200	0<Y<=35			59,900	0<Y<=35
S201-184	*38940*	PC-9E	A	SWRI	T-10	4L	5.9										

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LOW TEMP DATA - M11 EGR & 1Q MATRIX OILS

SRC Data, Updated: June 14, 2001

SRC Code	CMIR Code	Matrix Code	Lab Code	Lab	Test	Qty	TGA Soot %	D5293 -15C, cP	D5293 -20C, cP	-20°C D4684 MRV Vis., cP	-20°C D4684 Y. Str., Pa	-25°C D4684 MRV Vis., cP	-25°C D4684 Y. Str., Pa	-20°C Mod. MRV -20C MRV Vis., cP	-20°C Mod. MRV Y. Str., Pa	-25°C Mod. MRV -25C MRV Vis., cP	-25°C Mod. MRV Y. Str., Pa
S201-081	38967	PC-9B	A	SWRI	M11 EGR	8L	8.0	6,320		22,600	0<Y<=35	70,400	0<Y<=35			70,700	0<Y<=35
S201-125	38927	PC-9E	G	PEAR	M11 EGR	4L	9.1	5,590		26,300	0<Y<=35						
S201-124	38928	PC-9E	G	PEAR	M11 EGR	4L	7.8			22,300	0<Y<=35						
S201-078	38929	PC-9E	G	PEAR	M11 EGR	4L	8.8			29,400	0<Y<=35	208,500	140<Y<=175				
S201-121	38930	PC-9E	G	PEAR	M11 EGR	4L	8.6			32,900	0<Y<=35	343,100	140<Y<=175				
S201-045	38931	PC-9E	D	Ethyl	M11 EGR	4L	8.1	5,320		28,200	0<Y<=35	214,100	105<Y<=140				
S201-046	38932	PC-9E	A	SWRI	M11 EGR	4L	8.7	5,630		38,900	0<Y<=35	305,400	175<Y<=210				
S201-049	38933	PC-9E	A	SWRI	M11 EGR	6L	7.7	5,190		24,000	0<Y<=35	135,000	140<Y<=175				
S201-120	38934	PC-9E	A	SWRI	M11 EGR	6L	7.8	5,380		31,300	0<Y<=35	262,300	140<Y<=175			311,200	140<Y<=175
S201-075	38962	PC-9F	G	PEAR	M11 EGR	4L	8.7	6,460		28,900	35<Y<=70	133,600	70<Y<=105			106,800	35<Y<=70
S201-174	38968	PC-9A	A	SWRI	M11 EGR	4L	7.9			23,000	0<Y<=35						
S201-126	38935	PC-9E	A	SWRI	M11 EGR	4L	8.0			23,800	0<Y<=35						
S201-119	38969	PC-9G	A	SWRI	M11 EGR	8L	7.8	5,520		64,800	210<Y<=245	683,700	315<Y<=350			529,700	210<Y<=245
S201-080	38966	PC-9J	A	SWRI	M11 EGR	4L	8.0			31,800	105<Y<=140	77,900	140<Y<=175				
S201-123	38958			PEAR	M11 EGR	4L				20,800	0<Y<=35	55,100	0<Y<=35				
S201-175	*38970*	PC-9F	A	SWRI	M11 EGR	4L	7.9			24,600	0<Y<=35						
S201-047	38821			SWRI	1Q	4L				20,800	0<Y<=35	50,600	0<Y<=35				

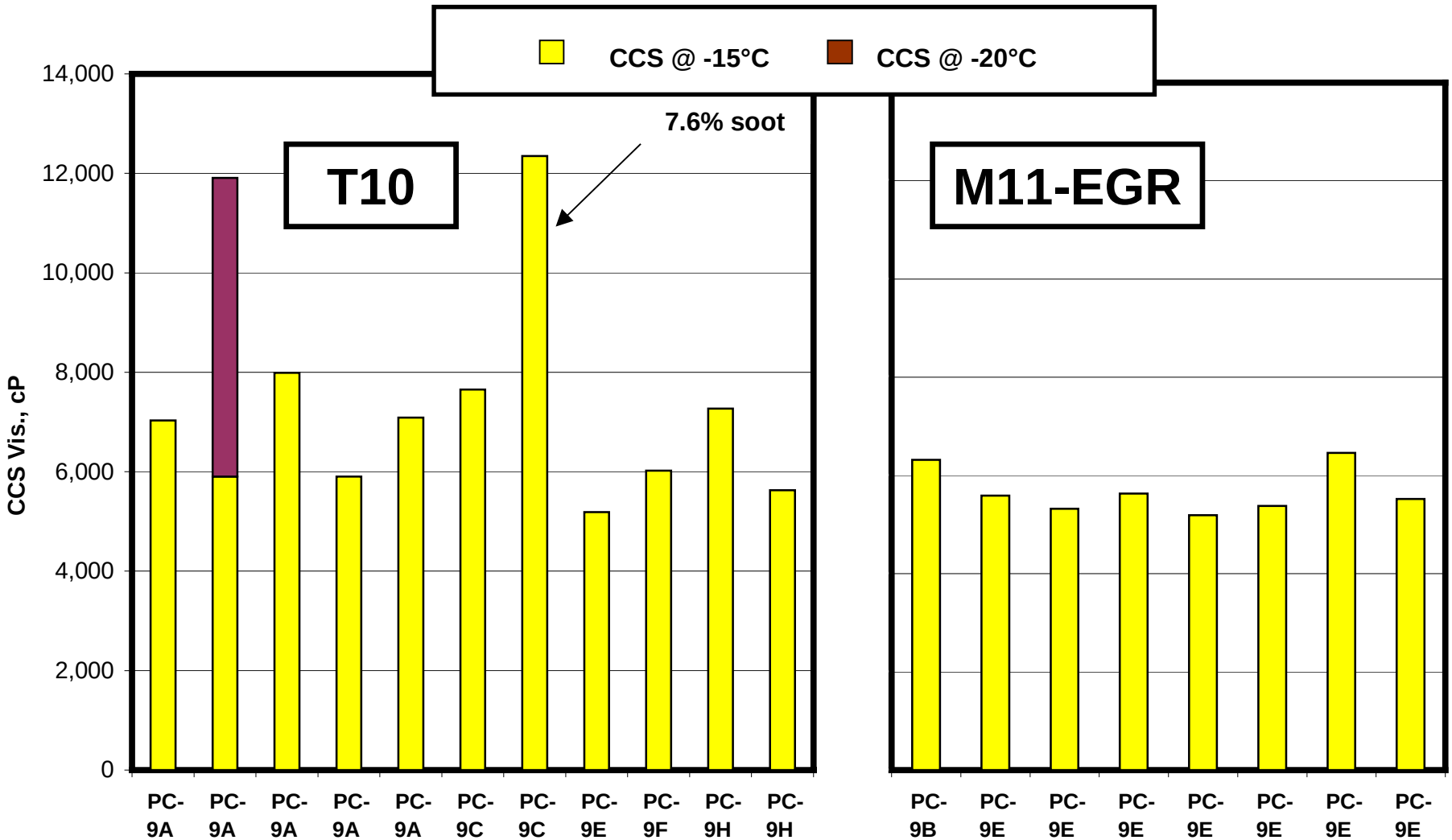
M11 EGR	**16**
T-10	**15**
1Q	**1**

MATRIX TESTS POSTED BY TMC, BUT NO USED OIL SAMPLES RECEIVED

SRC Data, Updated: June 14, 2001

SRC Code	CMIR Code	Matrix Code	Lab Code	Lab	Test	Qty
	38809	PC-9A	**A**	SWRI	T-10	
	38815	PC-9A	**B**		T-10	
	38954	PC-9A	**F**	EMRE	T-10	
	38943	PC-9B	**D**	Ethyl	T-10	
	38957	PC-9D	**B**		T-10	
	38952	PC-9F	**F**	EMRE	T-10	
	40919	PC-9B	**B**		T-10	
	38946	PC-9D	**G**	PEAR	T-10	
	38950	PC-9E	**G**	PEAR	T-10	
	38944	PC-9G	**D**	Ethyl	T-10	
	38956	PC-9J	**B**		T-10	
	38936	PC-9E	**B**		M11-EGR	
	38963	PC-9D	**D**	Ethyl	M11-EGR	
	38968	PC-9A	**A**	SWRI	M11-EGR	
	38935	PC-9E	**A**	SWRI	M11-EGR	
	38959	PC-9A	**G**	PEAR	M11-EGR	
	38971	PC-9D	**B**		M11-EGR	
	38961	PC-9G	**G**	PEAR	M11-EGR	

CCS ANALYSIS: MOST USED OILS IN THE 5-8,000 cP RANGE AT -15°C (~10-16,000 cP @ -20°C



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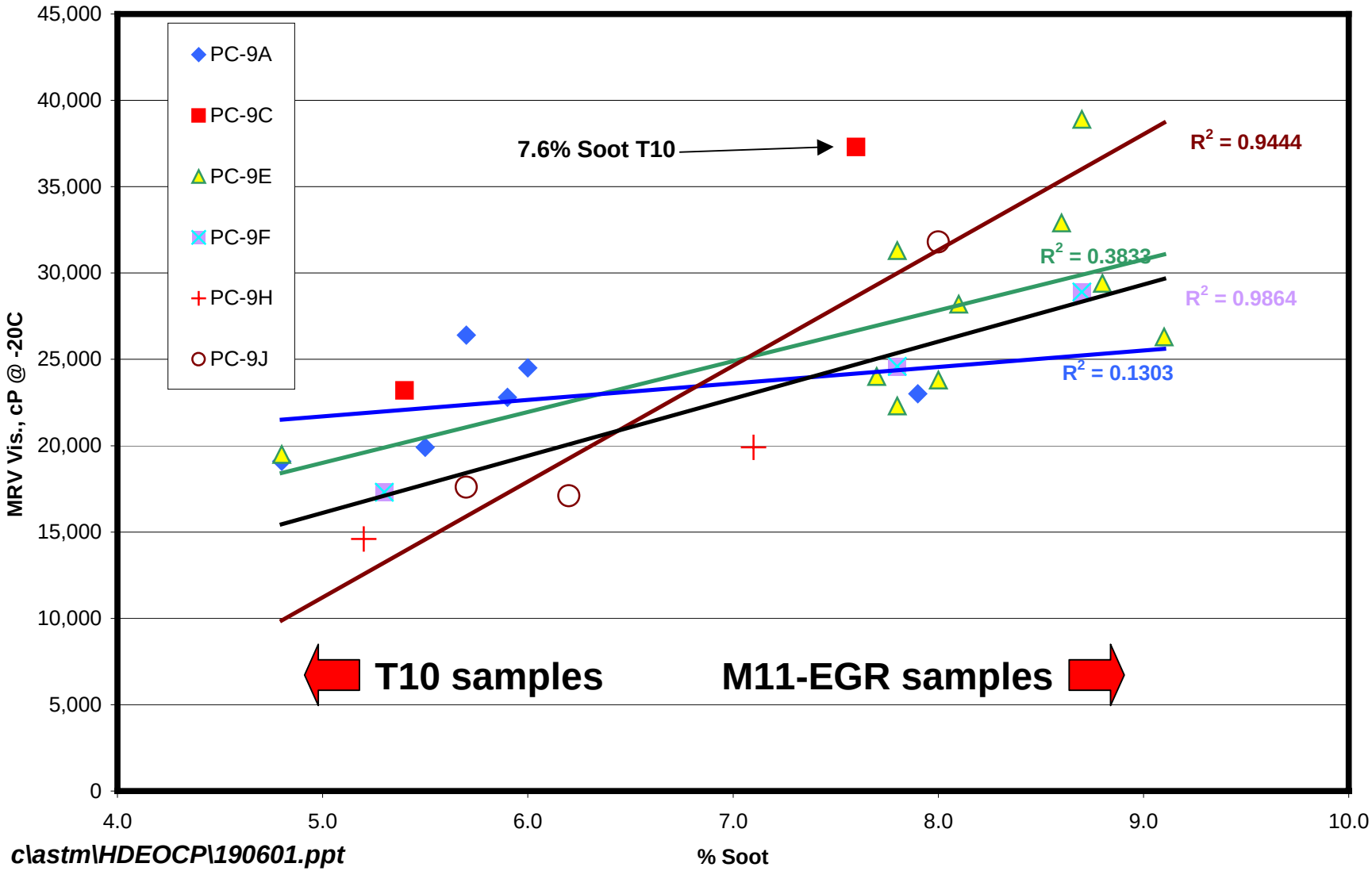
SOOT:MRV-20 RELATIONSHIP, T10 & M11EGR DRAINS



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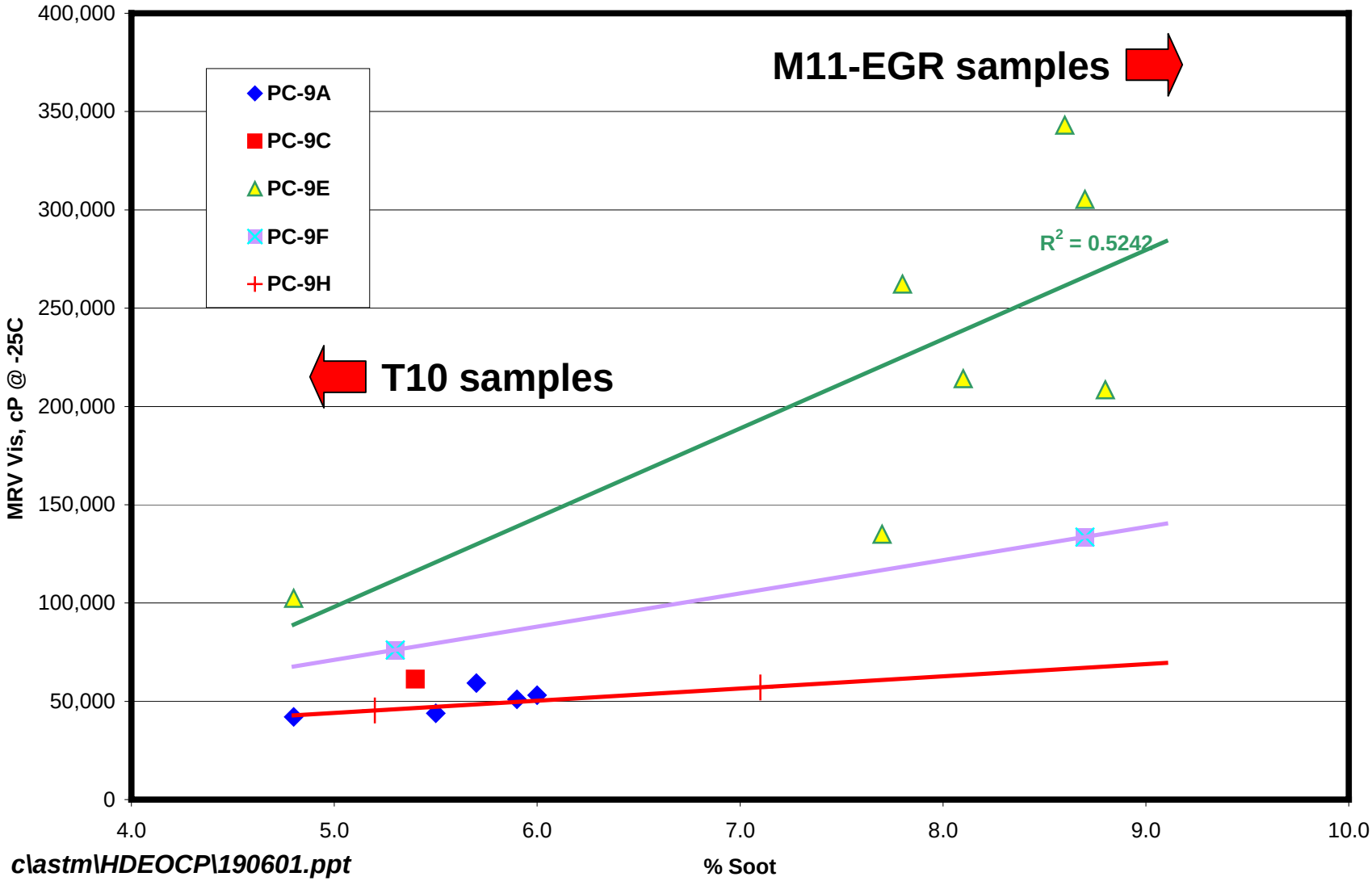
SOOT:MRV-25 RELATIONSHIP, T10 & M11EGR DRAINS



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REPEAT T10 TESTS, MRV USED/FRESH

CMIR Code	38811	38814	38810	38951	38942	
Ind. Oil Code	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A
Lab Code	D	F	A	G	A	
Engine Source	T-10	T-10	T-10	T-10	T-10	(Fresh)
% Soot Reported	5.5	5.7	6.0	5.9	4.8	
@ -20°C						
MRV Vis., cP	19,900	26,400	24,500	23,400	19,100	
MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	
@ -25°C						
MRV Vis., cP	43,900	59,300	53,100	51,000	42,100	23,900
MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35
@ -25°C						
Mod. MRV Vis., cP	43,100	59,400	54,200	51,500	41,800	
Mod. MRV Y. Str., Pa	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	0<Y<=35	

REPEAT T10 TESTS, MRV USED/FRESH (Cont'd)

CMIR Code	38931	38932	38933	38929	38930	38927	38928	38934	
Ind. Oil Code	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E
Lab Code	D	A	A	G	G	G	G	A	
Engine Source	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	(fresh)
% Soot Reported	8.1	8.7	7.7	8.8	8.6	9.1	7.8	7.8	
@ -20°C									
MRV Vis., cP	28,200	38,900	24,000	29,400	31,200	26,300	22,300	31,300	
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	0<Y<=35	
@ -25°C									
MRV Vis., cP	214,100	305,400	135,000	208,500	343,100			262,300	59,300
MRV Y. Str., Pa	105<Y<=140	175<Y<=210	140<Y<=175	140<Y<=175	140<Y<=175			140<Y<=175	105<Y<=140
@ -25°C									
Mod. MRV Vis., cP								311,200	
Mod. MRV Y. Str., Pa								140<Y<=175	

REPEAT M11-EGR TESTS, MRV USED/FRESH

CMIR Code	38931	38932	38933	38929	38930	38927	38928	38934	
Ind. Oil Code	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E	PC-9E
Lab Code	D	A	A	G	G	G	G	A	
Engine Source	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	M11 EGR	(fresh)
% Soot Reported	8.1	8.7	7.7	8.8	8.6	9.1	7.8	7.8	
@ -20°C									
MRV Vis., cP	28,200	38,900	24,000	29,400	31,200	26,300	22,300	31,300	
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	0<Y<=35	
@ -25°C									
MRV Vis., cP	214,100	305,400	135,000	208,500	343,100			262,300	59,300
MRV Y. Str., Pa	105<Y<=140	175<Y<=210	140<Y<=175	140<Y<=175	140<Y<=175			140<Y<=175	105<Y<=140
@ -25°C									
Mod. MRV Vis., cP								311,200	
Mod. MRV Y. Str., Pa								140<Y<=175	

TMC POSTED PROPERTIES OF PC-9 MATRIX OILS

Oil	Base Oil	Technology	SAE Vis	KV@100C	CCS@-15C	HTHS D4683	MRV @-25C
PC-9A	1	X	15W-40	15.20	3304	4.22	23,900/NYS
PC-9B	2	X	15W-40	15.18	3466	4.27	27,950/NYS
PC-9C	3	X	15W-40	15.14	3500	4.26	25,168/NYS
PC-9N	4	X	15W-40	- - -	- - -	- - -	- - -
PC-9D	1	Y	15W-40	15.76	3128	4.17	51,600/30g
PC-9E	2	Y	15W-40	15.47	3249	4.29	59,300/40g
PC-9F	3	Y	15W-40	16.03	3430	4.32	51,100/NYS
PC-9P	4	Y	15W-40	15.61	3201	4.28	26,000/NYS
PC-9G	1	Z	15W-40	15.13	3450	4.07	29,500/NYS
PC-9H	2	Z	15W-40	15.13	3350	4.14	19,100/NYS
PC-9J	3	Z	15W-40	15.07	3155	4.16	17,300/NYS
PC-9K	1	W	15W-40	15.49	3212	4.32	- - -
PC-9L	2	W	15W-40	15.51	3093	4.32	18,700/NYS
PC-9M	4	W	15W-40	15.88	3120	4.31	- - -

» ***Should verify whether PC-9D,9E,9F MRV properties are as poor as reported; would have relevance to used oil properties***

USED PC-9 MATRIX OIL ANALYSES: CONCLUSIONS TO DATE

- **E-O-T CCS VISCOSITIES @ -15°C IN THE 5-8,000 cP RANGE IN MOST CASES (Est. 10-16,000 cP @ -20°C)**
  - ➢ **1992 published cold-starting studies* on HD engines under idealized conditions indicated maximum CCS starting viscosities of ~7,000 cP for 2 engine types, ~14,000 cP for a 3rd engine type**
- **T-10 E-O-T MRV VISCOSITIES GENERALLY IN THE 19,000-26,000 cP RANGE AT -20°C (ex. one 7.6% soot oil)**
  - ➢ **3-5x higher viscosities at -25°C**
  - ➢ **-25°C comparisons indicate modified MRV method gives comparable viscosities, generally same or lower yield stress than D4684 at this temperature**
- **M11 EGR E-O-T MRV's ~22-65,000 cP @ -20°C**
  - ➢ **consistent with general trend to higher MRV with more soot**

SAE Paper Number 2000-01-1989

J. A. Mc Geehan and K. L. Eiden

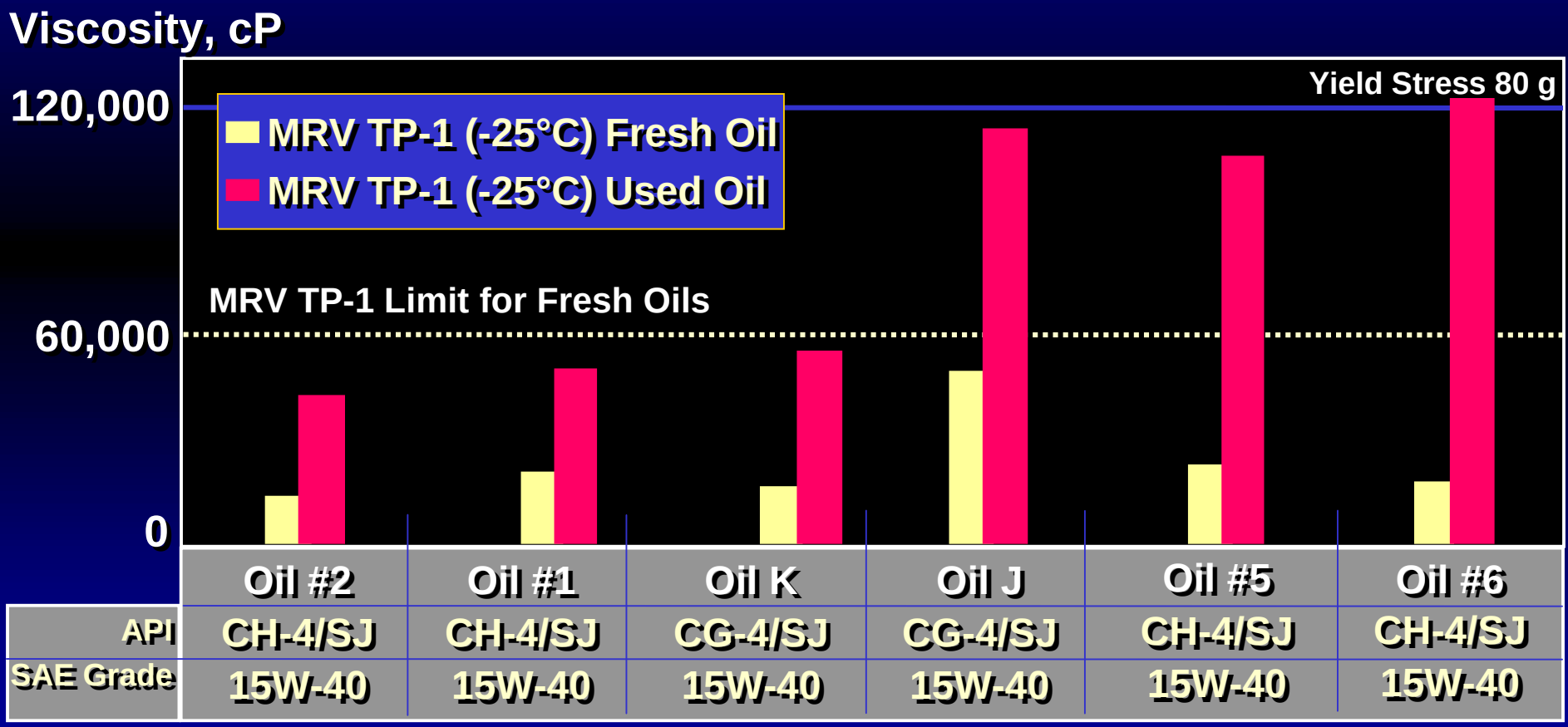
PRESENT

Low Temperature Oil Pumpability in Emission Controlled Diesel Engines

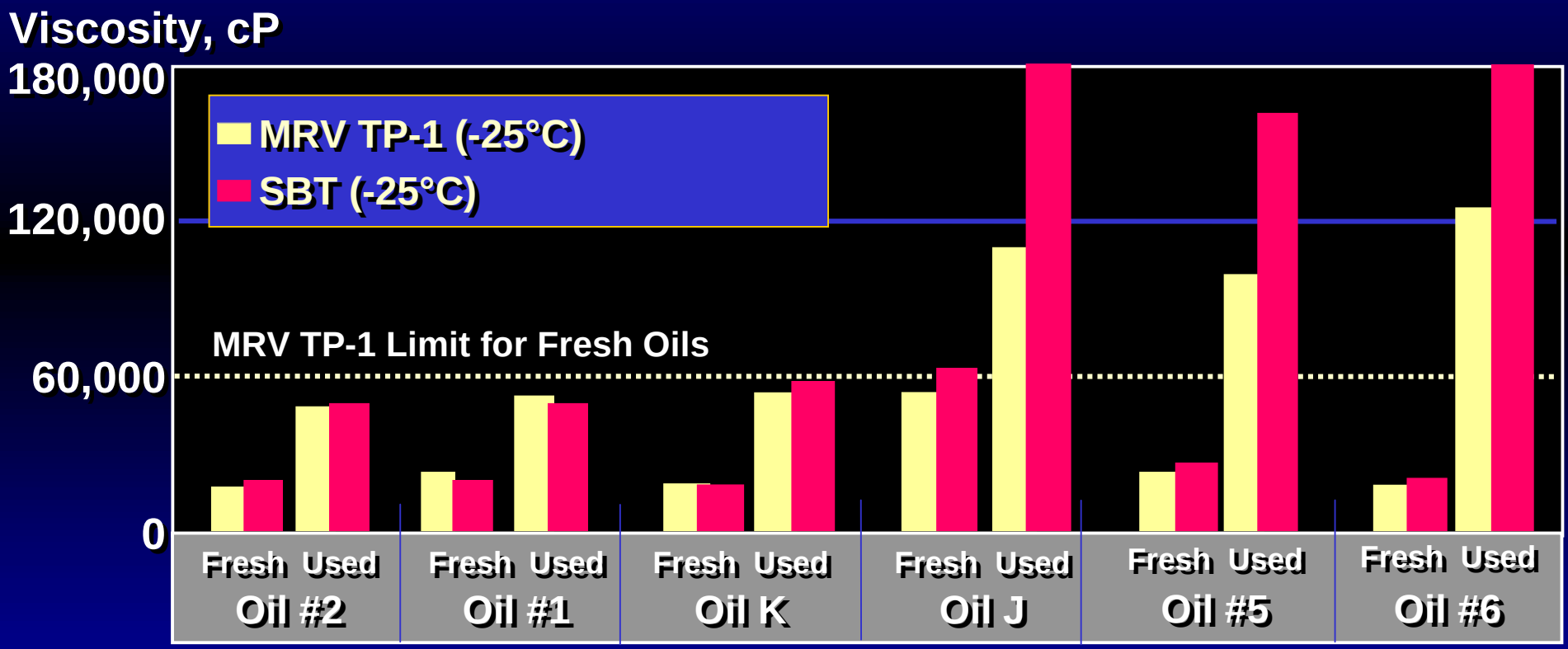
Chevron

Lubricants

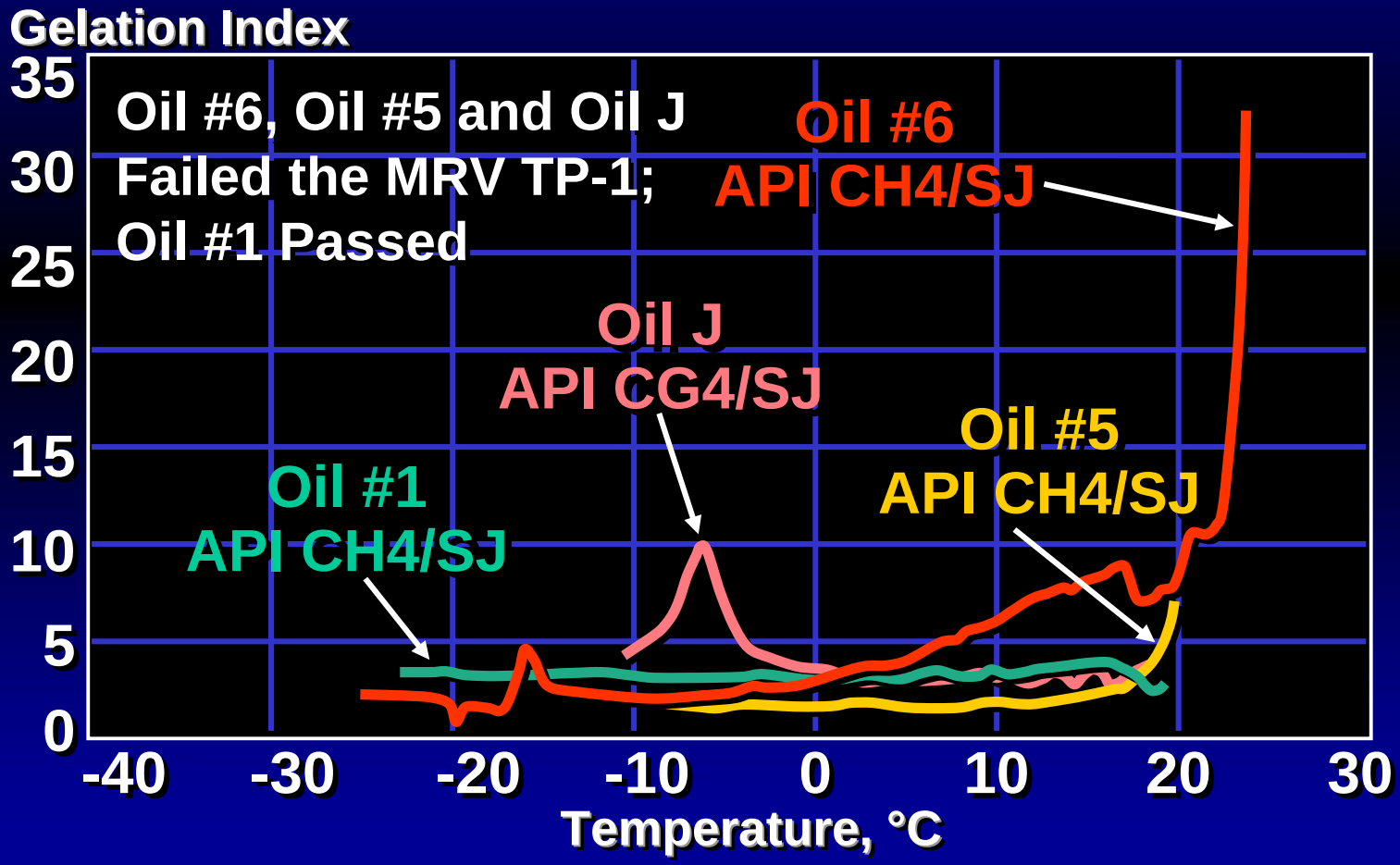
SAE 15W-40 Used Oils Containing 9% Soot 3 Passed and 3 Failed MRV TP-1



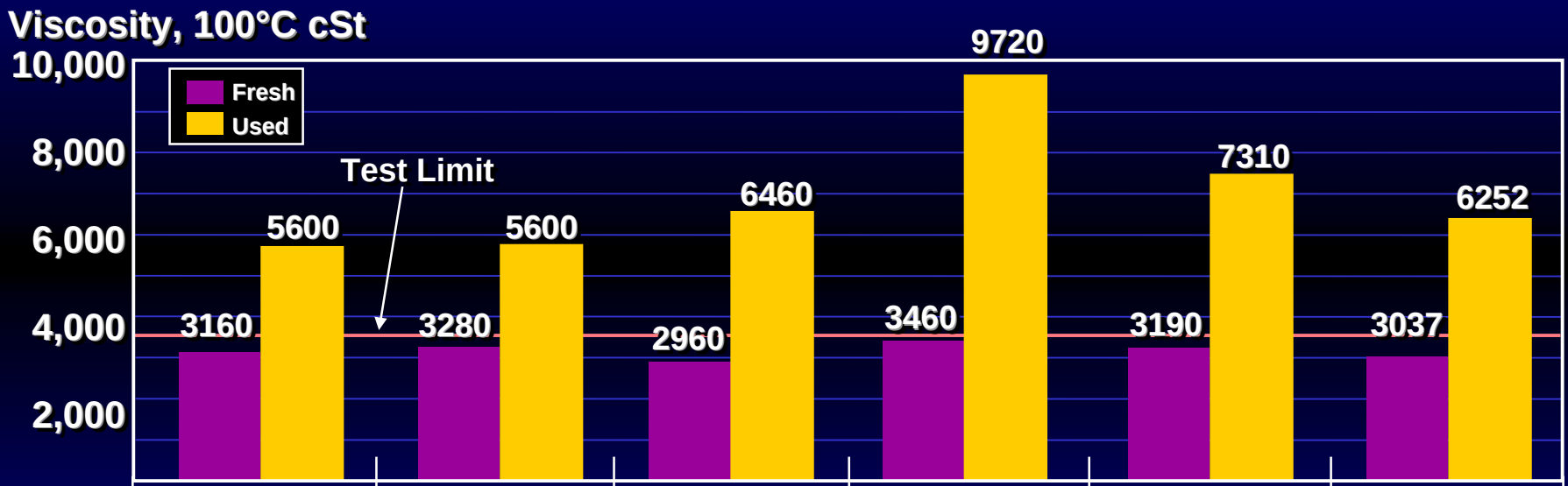
Failing Oils Have High Viscosities in MRV TP-1 & Scanning Brookfield Tests



Failing Oils Have Soot Structures Within Oils at +20 to +25°C

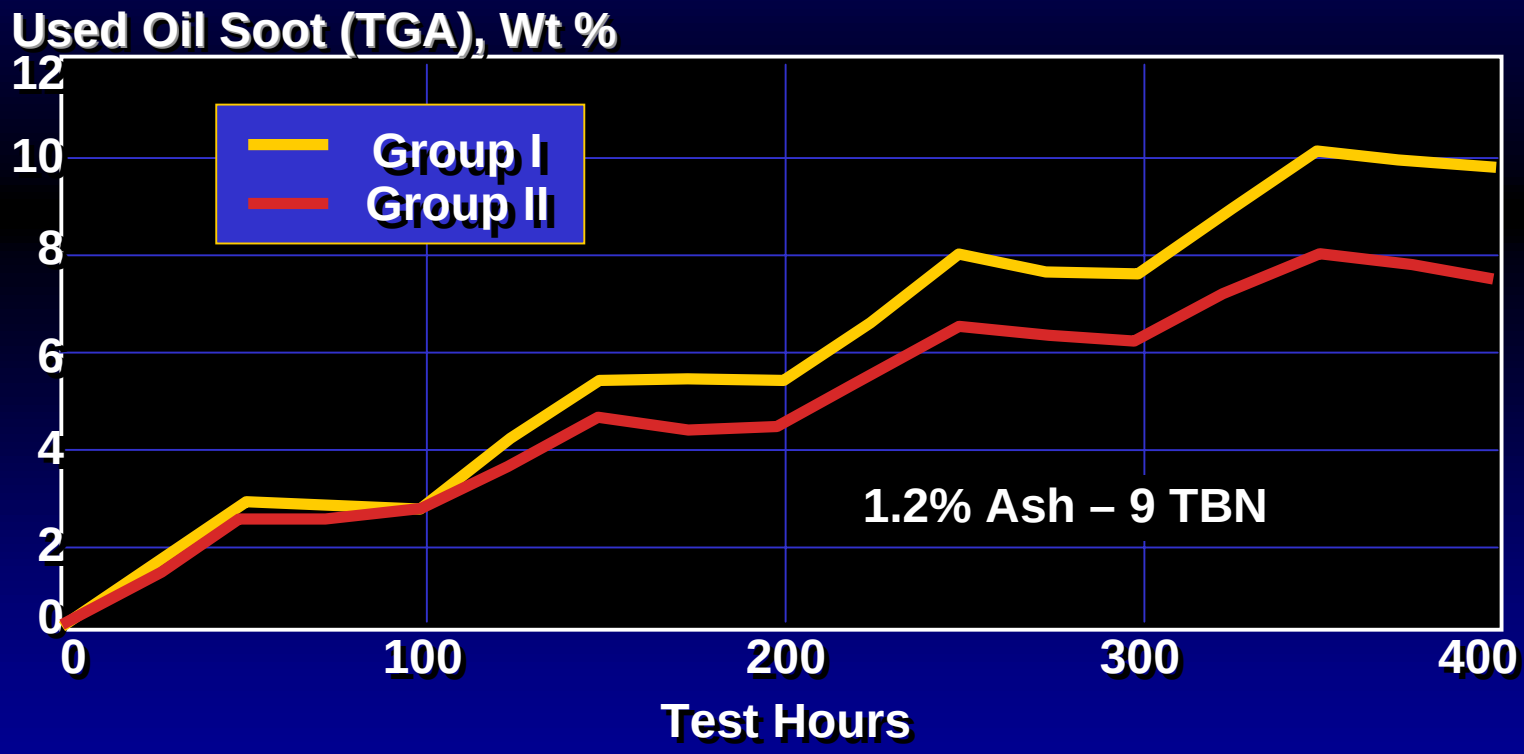


Cold Crank Simulators (D 5293) of Fresh and Used Oils After 400 Hours in Cummins M-11 Test

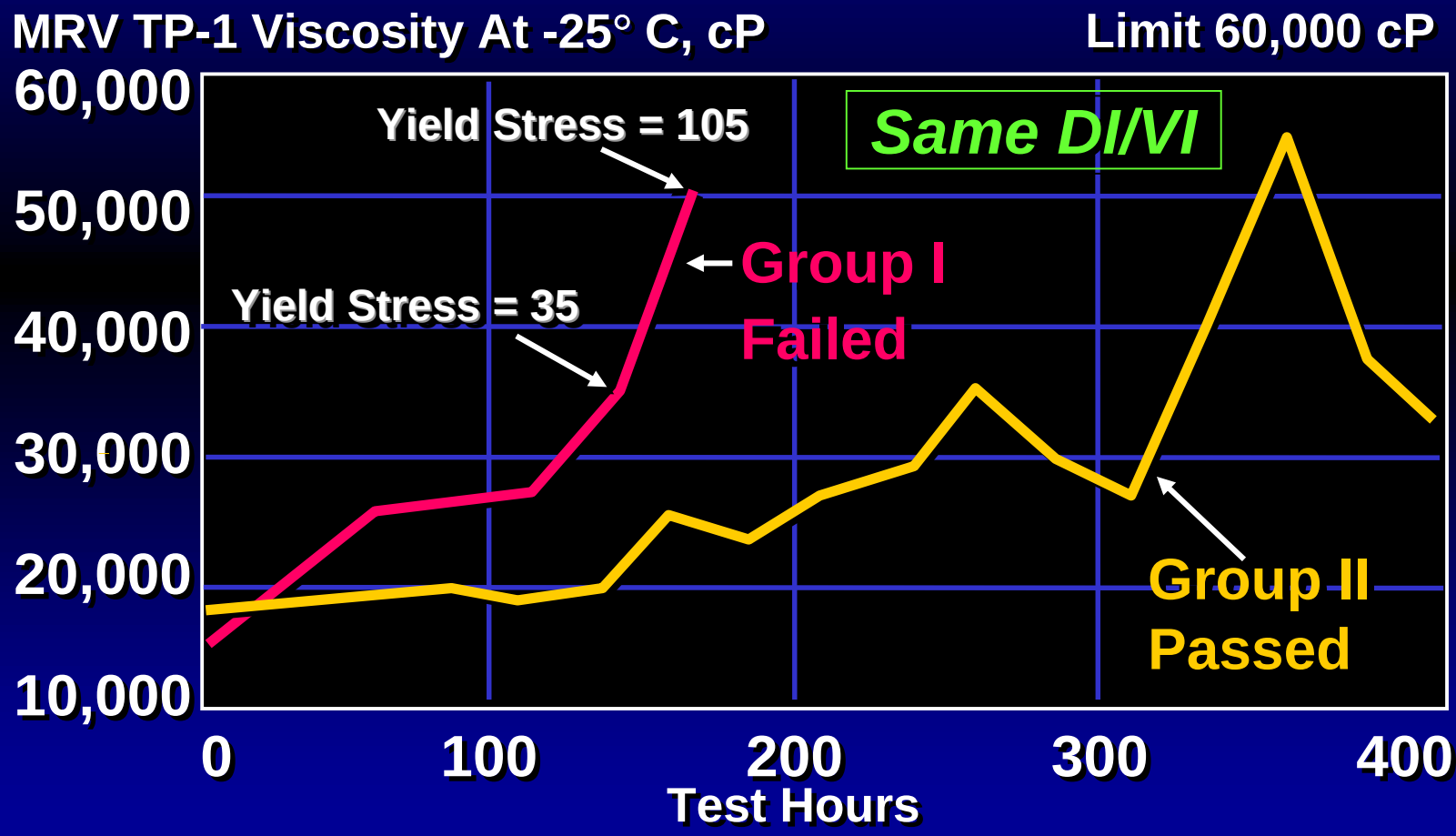


	Oil #2	Oil #1	Oil K	Oil J	Oil #5	Oil #6
API	CH-4/SJ	CH-4/SJ	CG-4/SJ	CG-4/SJ	CH-4/SJ	CH-4/SJ
SAE Grade	15W-40	15W-40	15W-40	15W-40	15W-40	15W-40
Soot %	8.3	8.5	8.3	9.4	9.3	8.5
MRV TP-1	Pass	Pass	Pass	Fail	Fail	Fail

Cummins M-11 High Soot Test



MRV TP-1 Viscosities From Double Length Cummins M-11 High Soot Test



Sequence IIIF Surveillance Panel
Report to the HDEOCP

William M. Nahumck
Chairman, Sequence IIIF Surveillance Panel
June 19, 2001
San Diego, California

THE SEQUENCE IID AND SEQUENCE IIIE SURVEILLANCE PANELS WERE OFFICALLY DISBANDED ON MAY 23, 2001.

SEQUENCE IIIF SURVEILLANCE PANEL ACTIVITY

SP Meeting on May 23, 2001 ……San Antonio, Texas

Received subpanel reports,

SEQUENCE IIIF ACTION ITEMS FOR HDEOCP ENDORSEMENT

- Designate a derivative of the IIIF test as the IIIFHD
- Define results desired by HDEOCP – only the 60 hour % Viscosity Increase
- Report Form changes
- TMC LTMS and SA for 60 hour result
- Natural Log transform suggested for 60 hour % Viscosity Increase
- Stands will be referenced thru the IIIF Test
- If a full 80 hour test is desired, dual registration will be needed thru ACC. (Similar to Mack T8 tests)
- Will require a procedure change – Subcommittee B Ballot, possibly concurrent with the upcoming D4485 ballot

Sequence IIIE/IIIF
ASTM D 4485 - B Ballot

Sequence IIIF 60-Hour Viscosity at 40ºC Max. Increase From 10 Min., Sample %

	First Test	Second Test	Third Test
API CG-4	325	349	360
API CH-4	295	295 (MTAC)	295 (MTAC)

ATTACHMENT 16

B Ballot to Replace L-38 With Sequence VIII, Revision D 4485-00

- **Ballot Passed**
- **69% Return**
- **84% Affirmative**
- **16% Abstain**
- **No Negatives**
- **One Comment by L. O. Bowman on Footnote -- To Be Corrected**

Shear Stability and the Relationship to Heavy Duty Engine Lubricants

ASTM HDEOCP

June 19, 2001

For ASTM D02.B0.02 Heavy Duty
Engine Oil Classification Panel Use Only

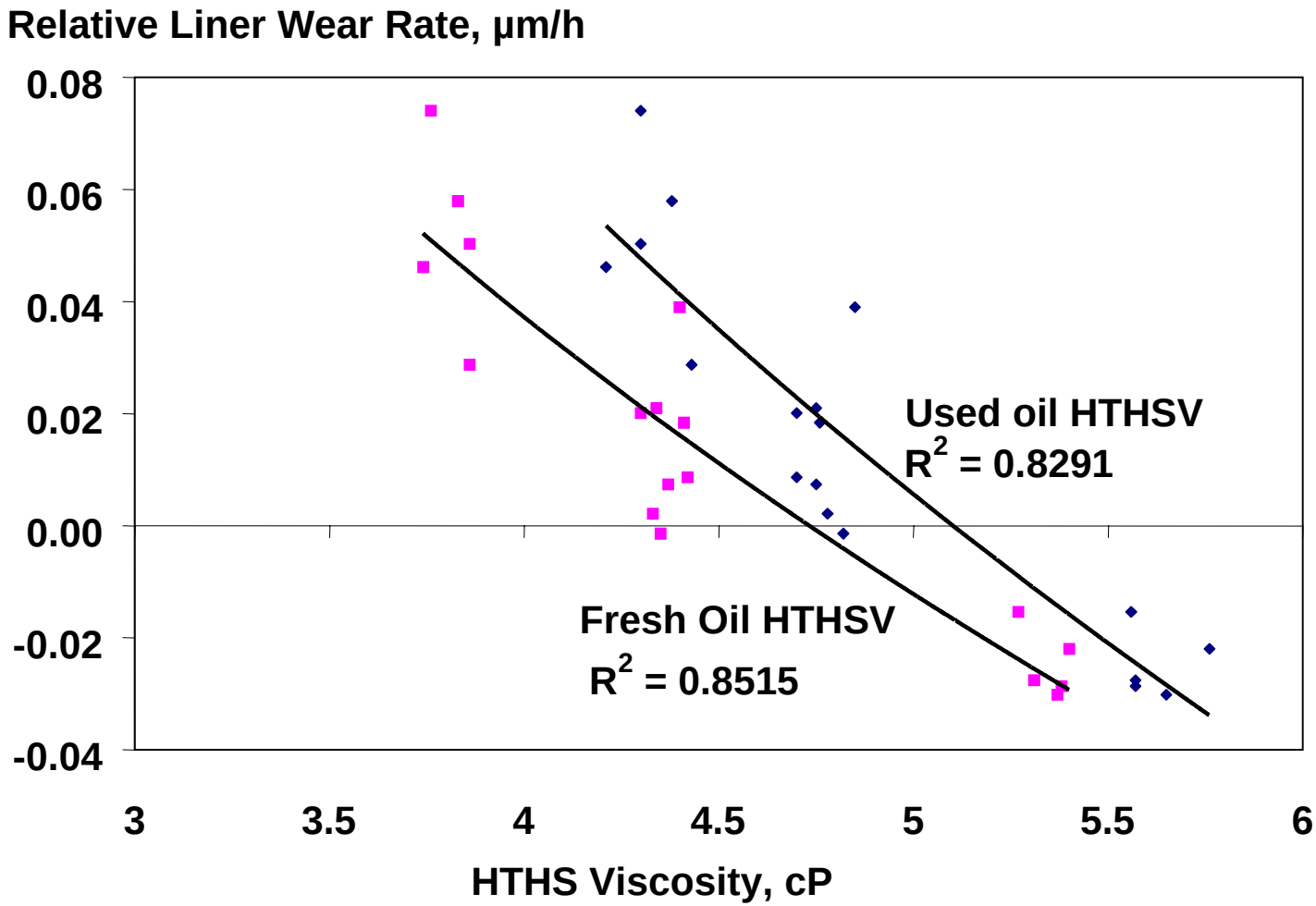
Issues Considered

- **Temporary shear loss (reversible):HTHS viscosity**
  - **Relationship of HTHS viscosity to wear**
  - **Fresh versus used HTHS viscosity**
- **Permanent shear stability**
  - **Mechanisms of shearing**
  - **Measurement techniques**
    - » Real world
    - » Engine tests
    - » Bench tests
  - **Issue: Bosch Injector (Kurt Orbahn) does not correlate with heavy duty field use when comparing different polymer chemistries**

Temporary Shear Stability: HTHS Viscosity

- **HTHS viscosity relates to oil film thickness in high shear conditions**
  - **Bearing film thickness and wear**
  - **Liner wear**
  - **Engine tests do not represent full range of potential conditions which could be encountered in the field**
- **Fresh oil HTHS viscosity and used oil HTHS viscosity give similar relationship to wear**
- **With permanent shearing, both Kv and HTHS viscosity decrease**

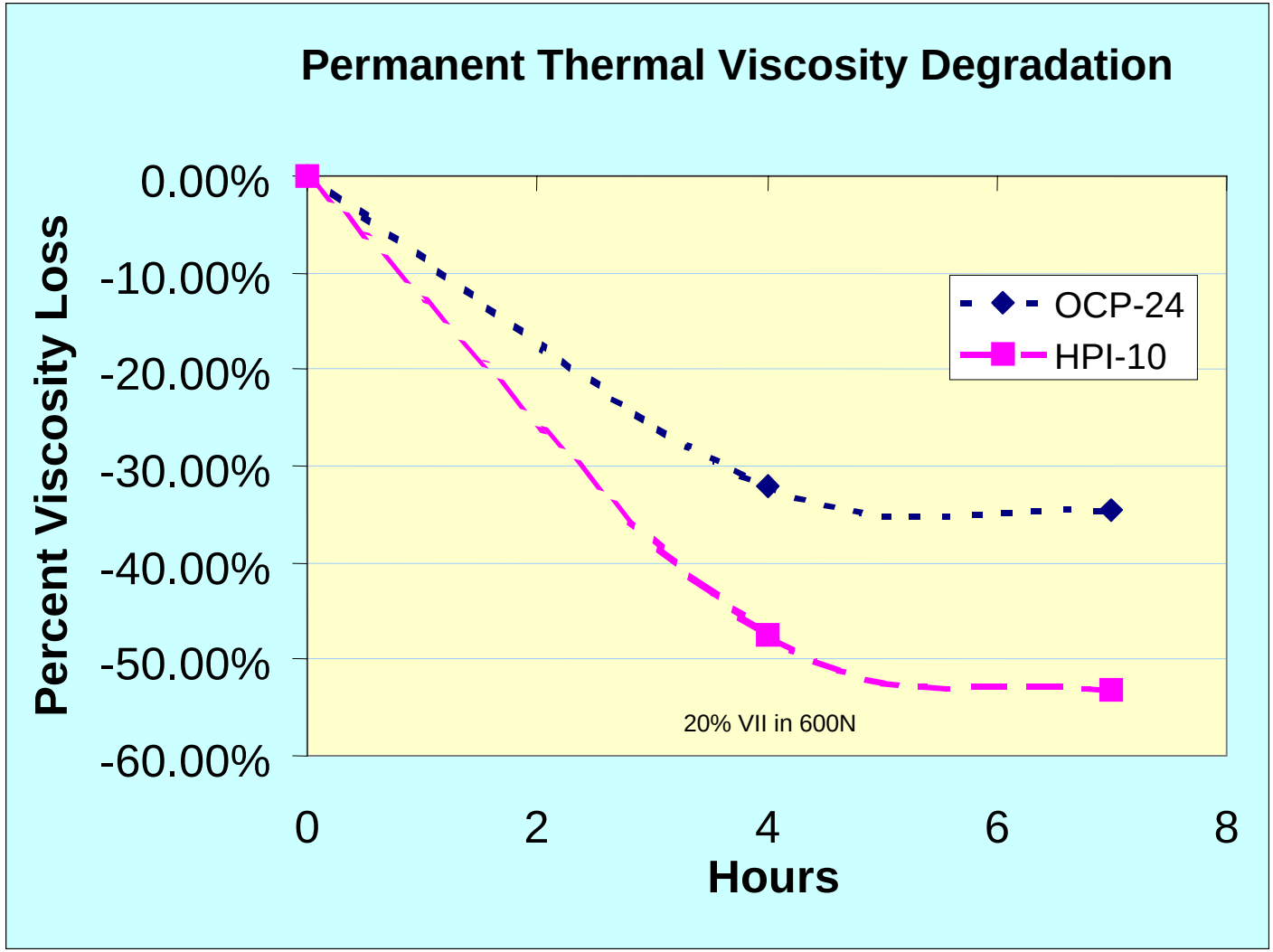
Relationship of HTHS viscosity to Cylinder Liner Wear



Permanent Shear Stability

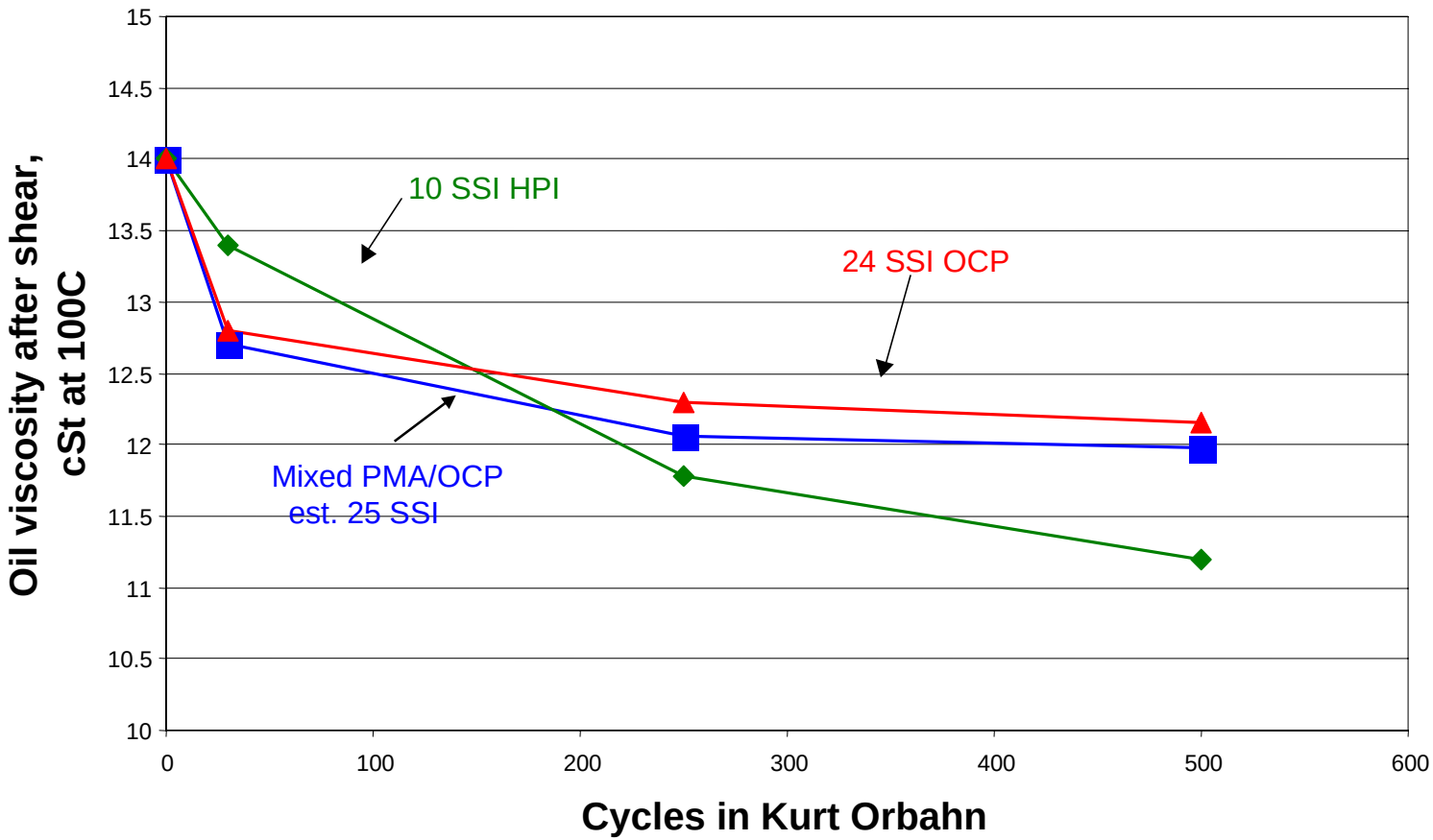
- **Kurt Orbahn (Bosch Injector):**
  - **Basis of 'Permanent Shear Stability Index' (SSI)**
  - **Designed to correlate to European passenger car application**
    - » short drain
    - » no or very little oxidative, nitration, acidic contamination impact
  - **Mechanical shearing only**
  - **Data show it does not correlate to HD diesel field service**
  - **Even within KO test, different test lengths can change conclusions**
- **Field data from multiple tests indicates:**
  - **Kurt Orbahn will rank oils differently than the field**
    - » OK within a VII chemistry but not across chemistries
  - **Degree of protection assumed from KO test may be less than in the real world**

VII Thermal Shearing



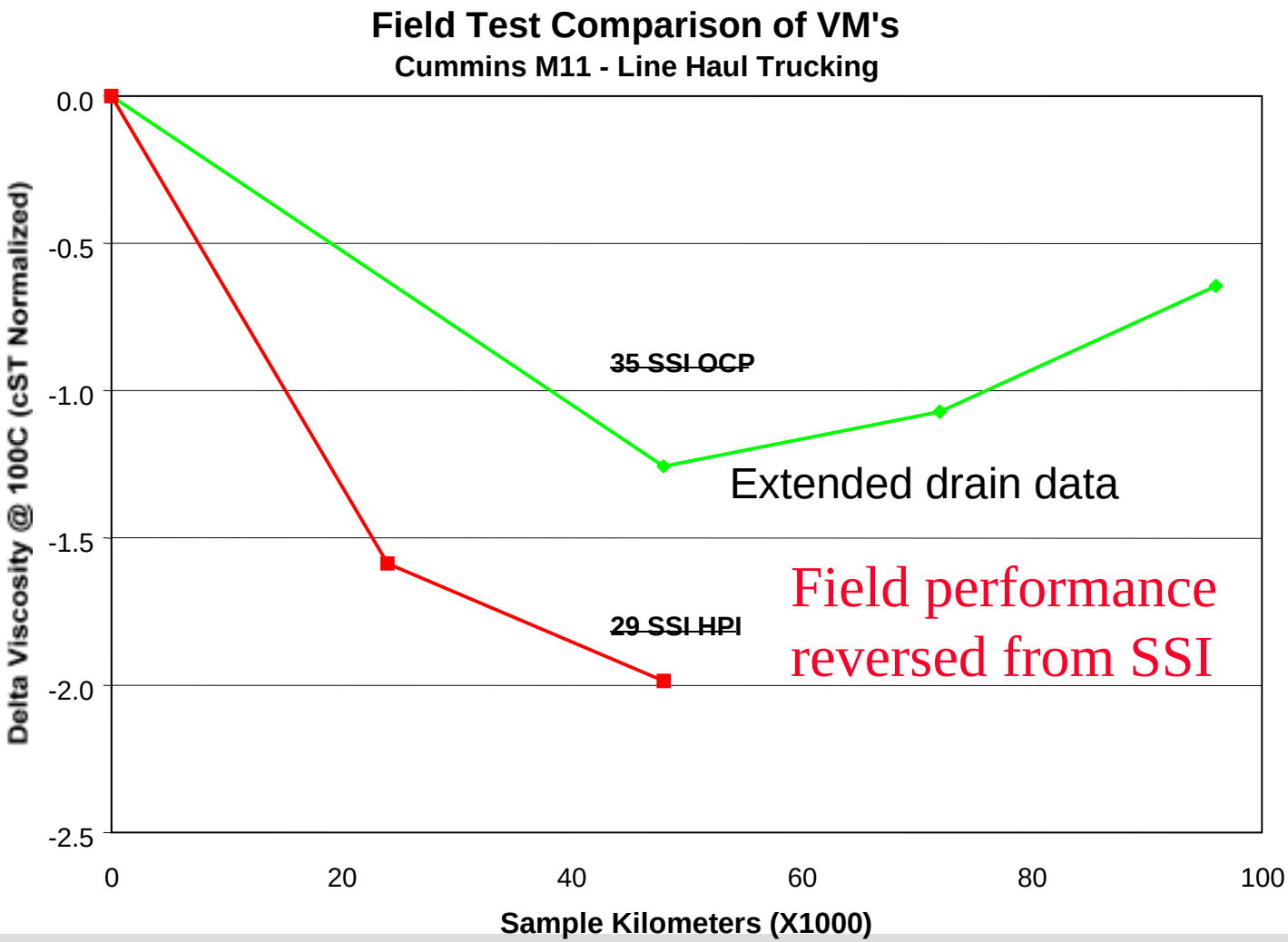
Extended Kurt Orbahn

Viscosity loss after extended Kurt Orbahn

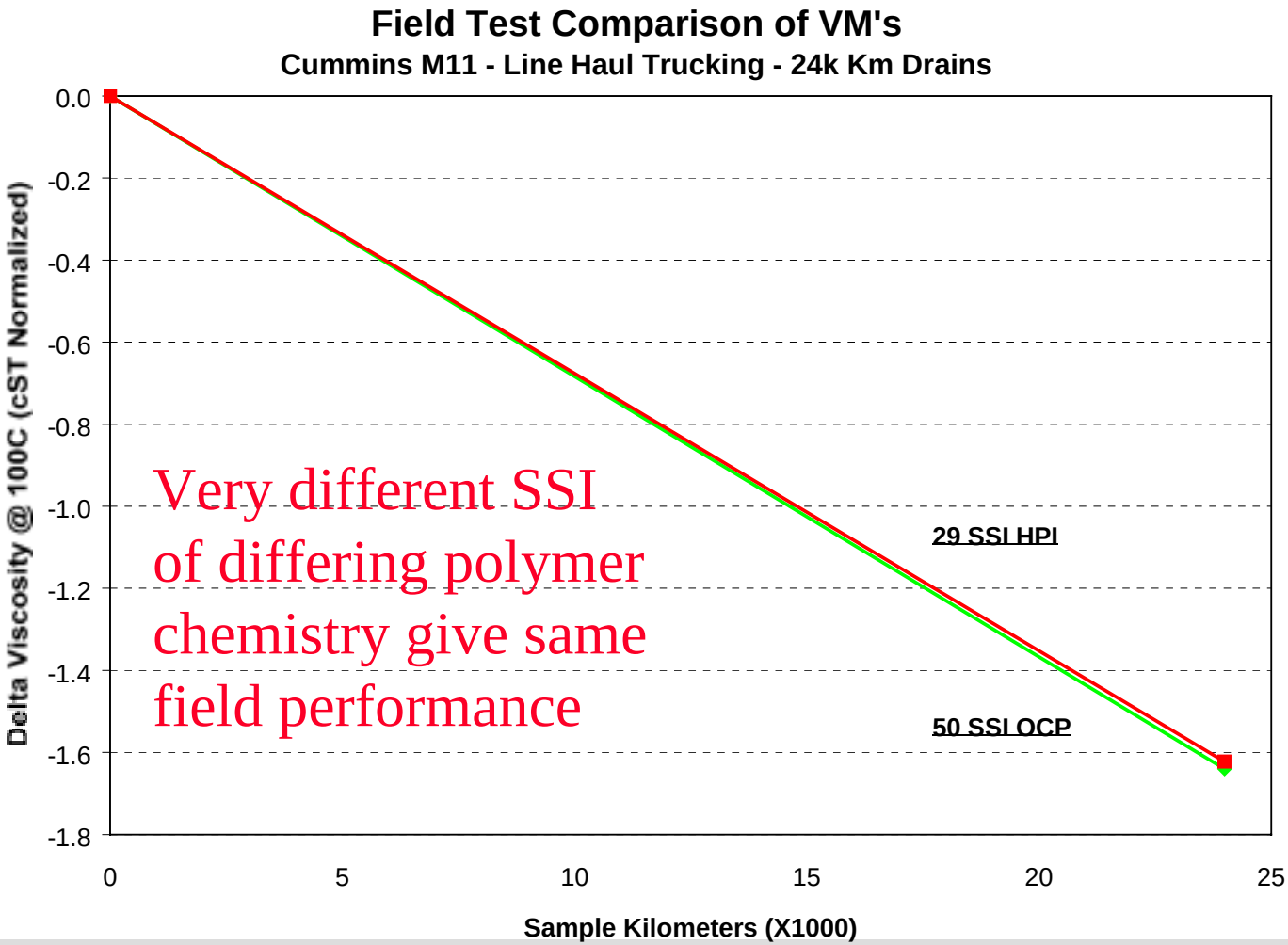


- **Extended shearing can dramatically impact relative performance**

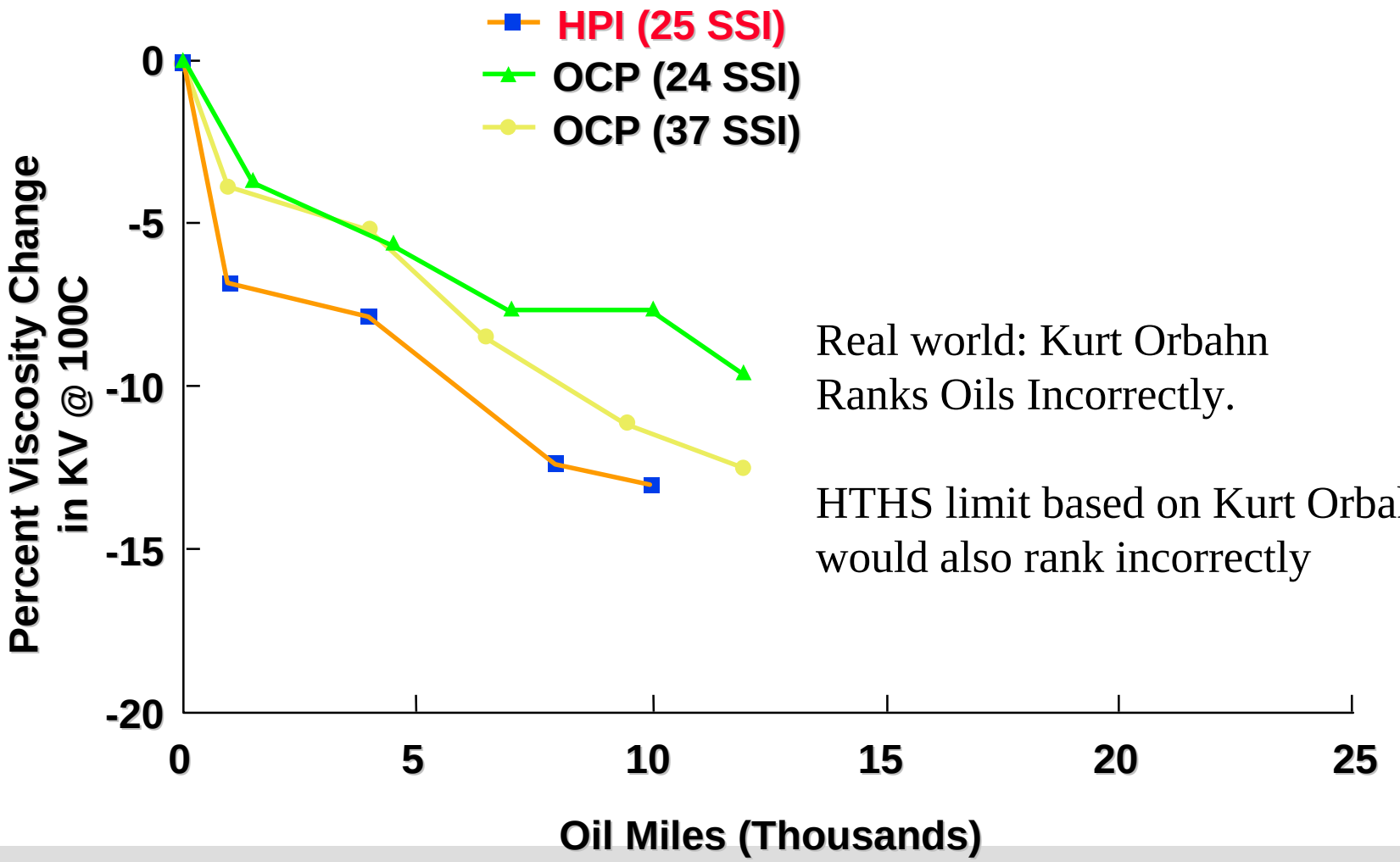
Diesel Engine Field Service Permanent Shear Stability



Diesel Engine Field Service Permanent Shear Stability



CUMMINS N14 - VII SHEAR STABILITY STUDY VISCOSITY LOSS COMPARISON



Real world: Kurt Orbahn Ranks Oils Incorrectly.

HTHS limit based on Kurt Orbahn would also rank incorrectly

ATTACHMENT 18, 10 OF 12

Permanent Shear Stability and HTHS Viscosity

- **Data already shown relating loss of Kv to losses of HTHS viscosity (May 2th HDEOCP)**
- **Kurt Orbahn shearing does not predict HD field**
  - **“Correlations” based on very short drain data**
  - **Lacks thermal component**
  - **Extended shearing can impact polymers in different ways**
  - **Significantly more shearing than SSI predicts has been shown in multiple HD field trials when real world drains used**
  - **Oils blended to take advantage of SSI ‘advantage’**
    - » May be blended low in Kv range
    - » Have lower HTHS viscosity and thus less initial protection
    - » Greater than predicted (by Kurt Orbahn) viscosity loss in field may result in lower than anticipated real world HTHS viscosity.
    - » May provide less engine protection in the field

Rheological Property Requirements

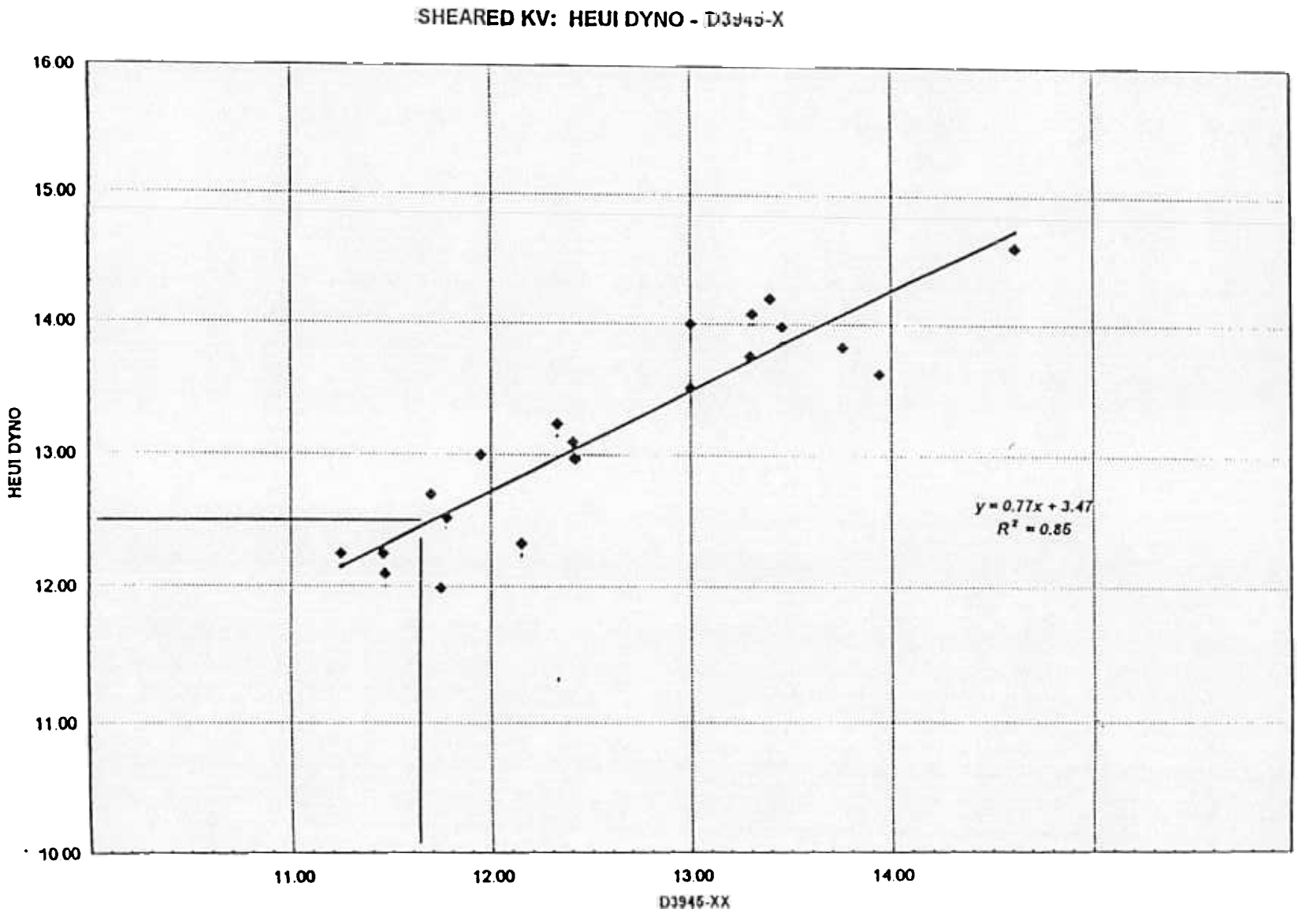
- **HTHS Viscosity based on sheared oil?**
  - **Good in theory *but would need way to permanently shear oils in a way which correlates with HD diesel experience - Do we want to develop this?***
  - **Kurt Orbahn shows major misalignments with real world**
    - » Not appropriate for performance determination of HD oils
- **HTHS viscosity minimum**
  - **Fresh oil HTHS viscosity is an established rheological specification (it is not a chemical specification).**
    - » HTHS viscosity has been shown to relate to wear
    - » Current engine tests don't capture full range of field conditions - doesn't guarantee viscometrics are suitable in the field
  - **Appropriate limit? Issues:**
    - » Other global specifications
    - » OEMs in best position to recommend what they need

Comments on proposed mits for D3945 XX injector r g test for PC 7

Presented to the HDEOCP

June 24 997

Pat Fetterman



11

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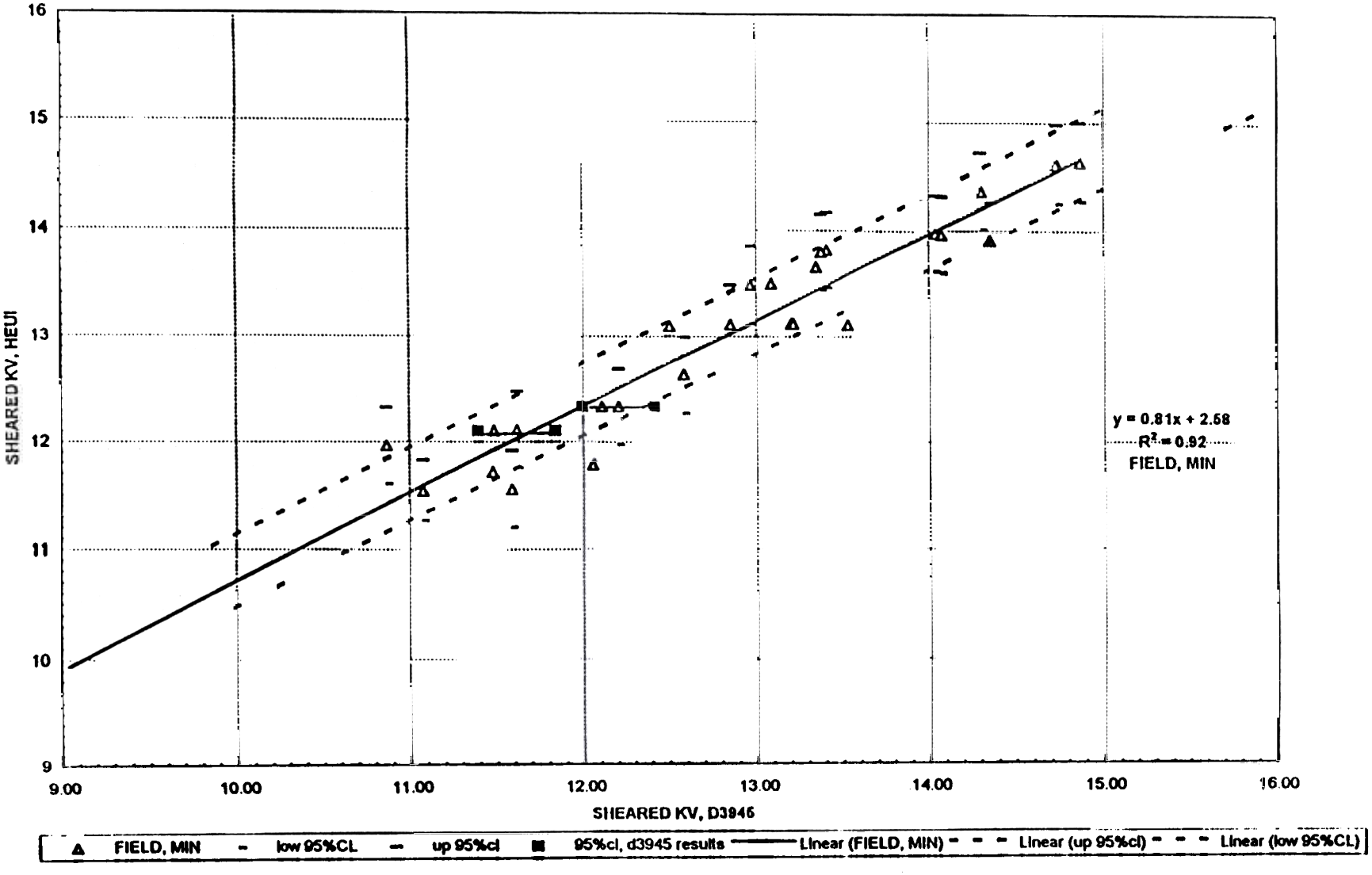
EXCLUDES TF RR DATA

HEUI FIELD (MIN) - D3945 CORRELATIONS WITH 95%CL LIMIT



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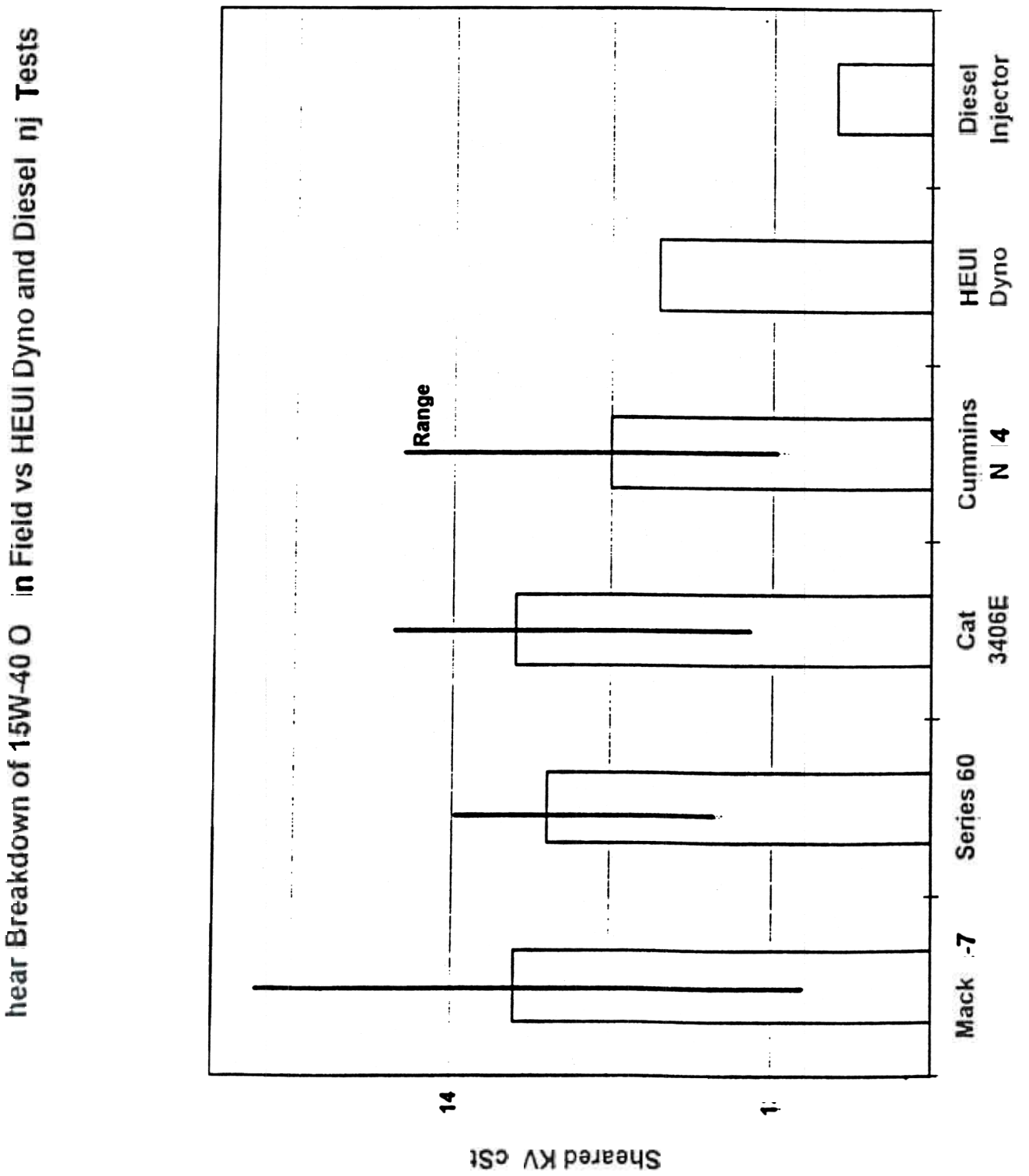
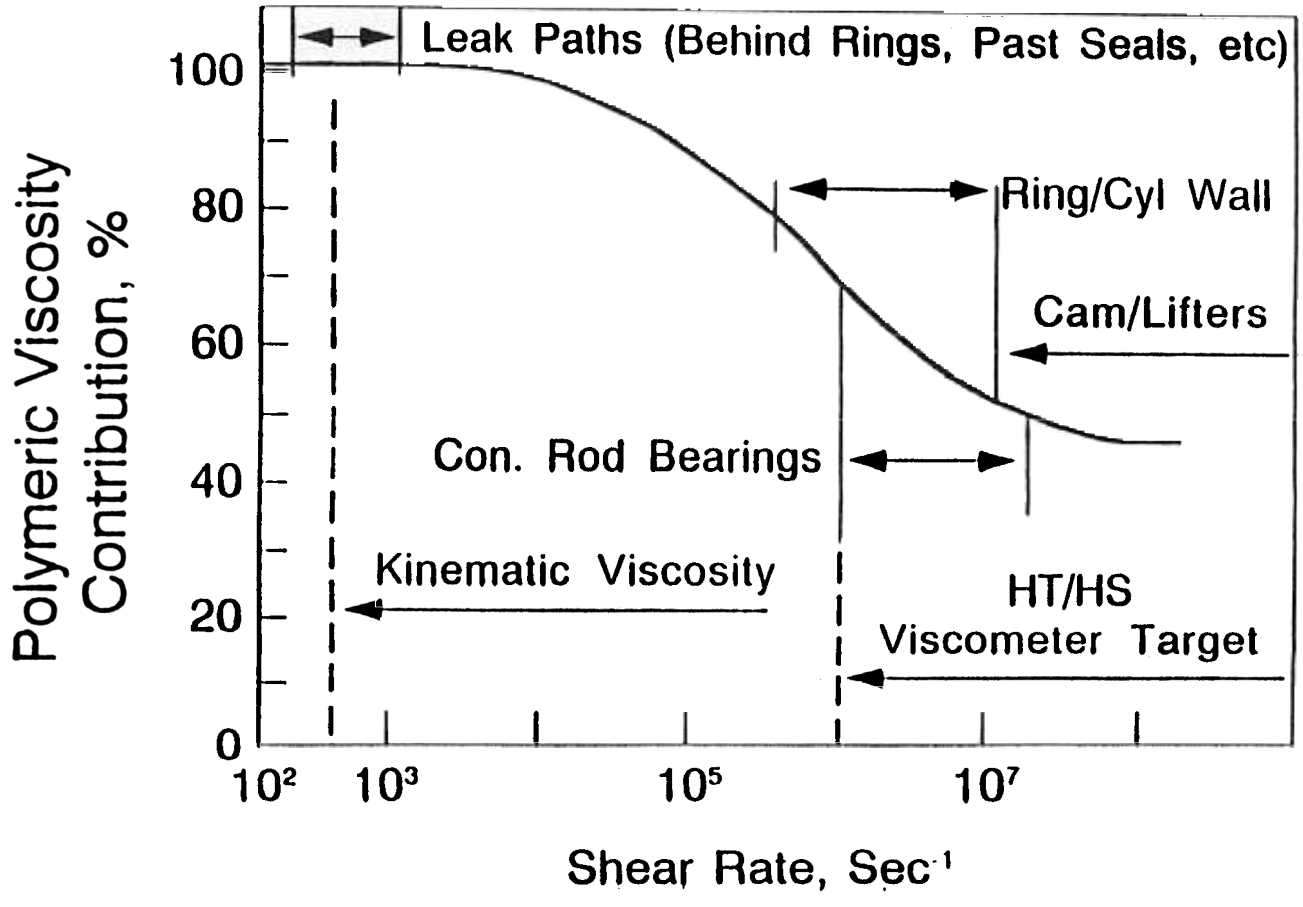
ATTACHMENT 3 PG. 21


hear Breakdown of 15W-40 O in Field vs HEUI Dyno and Diesel nj Tests
Sheared KV cSt
14
Range
Mack -7
Series 60
Cat 3406E
Cummins N 14
HEUI Dyno
Diesel Injector

SHEAR RATES IN VARIOUS ENGINE REGIMES

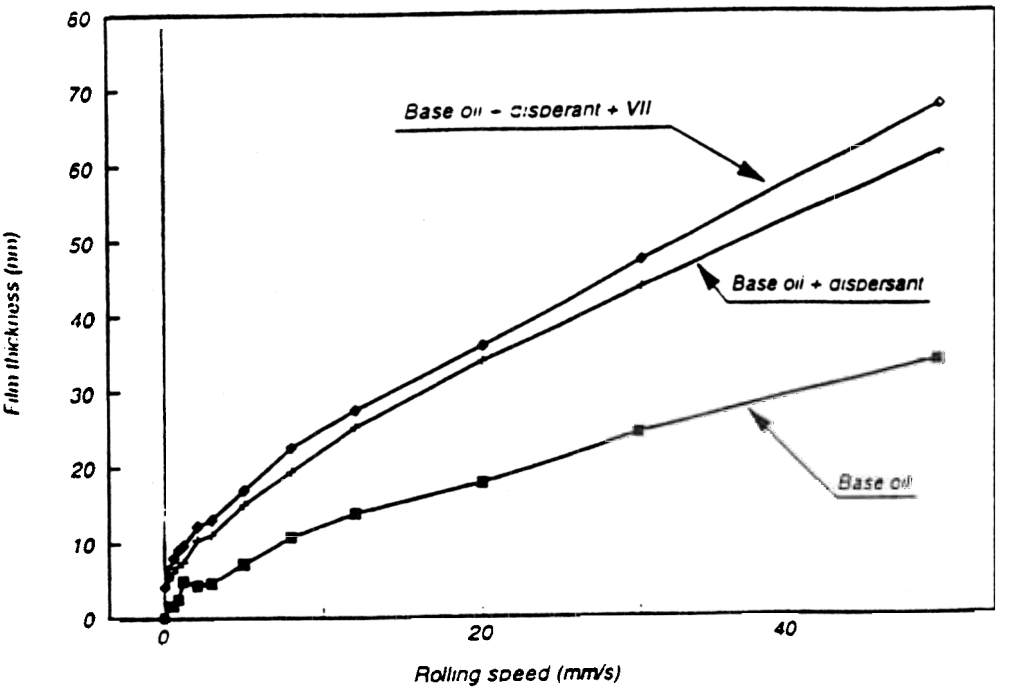


FACTORS AFFECTING HT/HS VISCOSITY

- Viscosity Modifier (V.M.) Chemistry
- Viscosity Modifier Molecular Weight
- Base Stock Viscosity Index

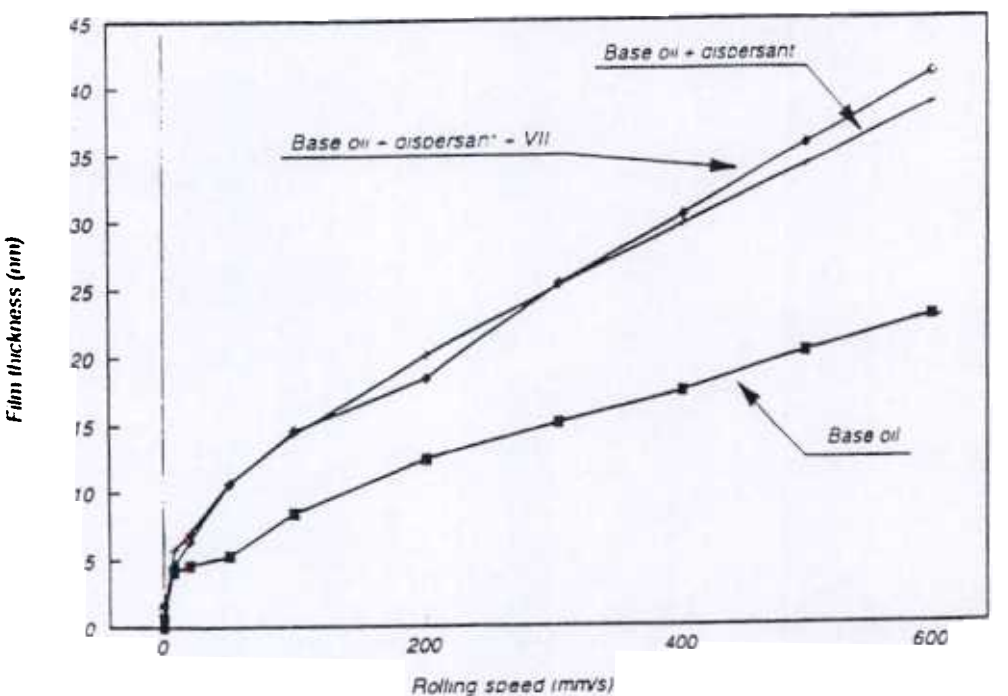
Fig 21. EFFECT OF CONSTITUENTS ON OFT

Studies completed at 30 degs C



EFFECT OF CONSTITUENTS ON OFT

Studies completed at 100 degs C



c:\fhot

Summary of key technical points

- Minimum oil film thickness at engine working surfaces is not related to KV100 for non-Newtomian fluids
  - HTHS for bearings, rings, liners

    Basestock plus Newtonian D.I. components for E.P.
- Engine wear is also controlled by D.I. technology
- PC-7 oils must pass wear tests to qualify

  Mack T-9
  - Cummins M11

    RFWT

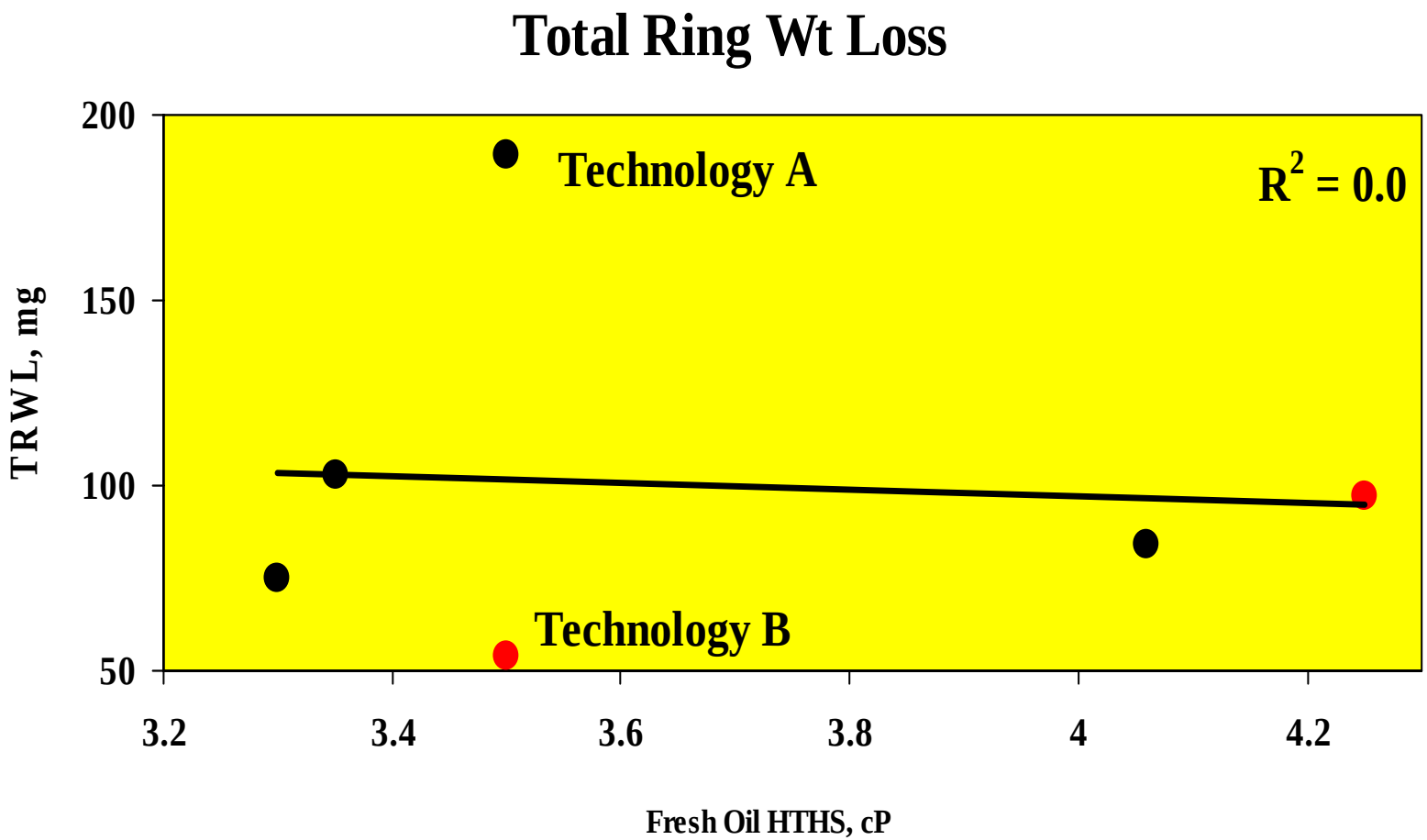
Summary of key technical points (cont.)

- Dyno wear tests show little or no response to viscosity changes as great as 15W-40 to 10W-30
- Field test data show no advantage for S.I.G. performance at KV100

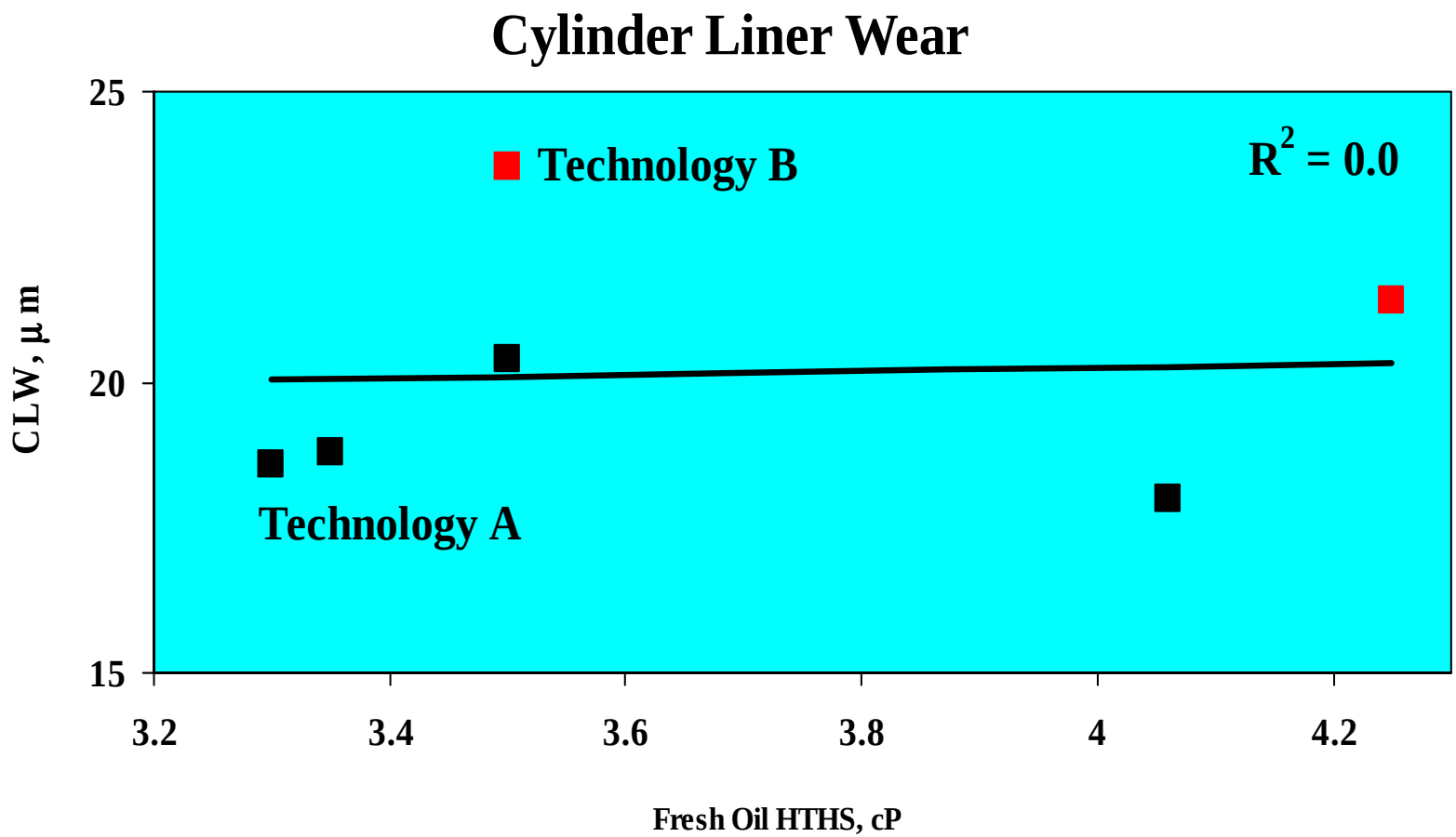
  However field oils should remain in grade most of the time for field "cosmetics"
- HEUI is slightly more severe than most truck on-highway truck engines

  HUEI S.I.G. correlates to 12.0 in 30 pass injector rig
  - 12.0 also roughly correlates to 3.7 HTHS w/50 SSI VM

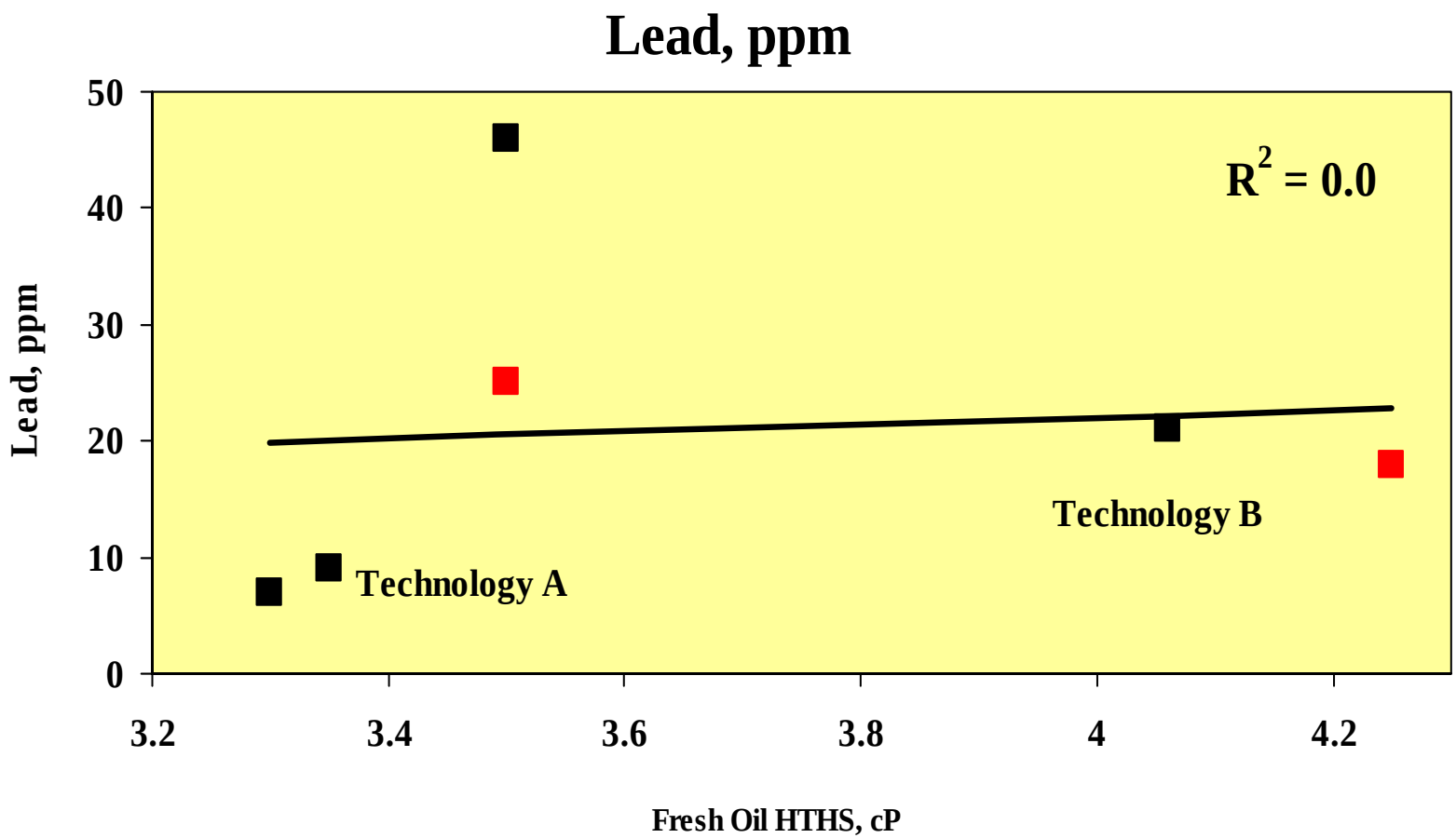
Mack T-9 Performance versus HTHS



Mack T-9 Performance versus HTHS



Mack T-9 Performance versus HTHS

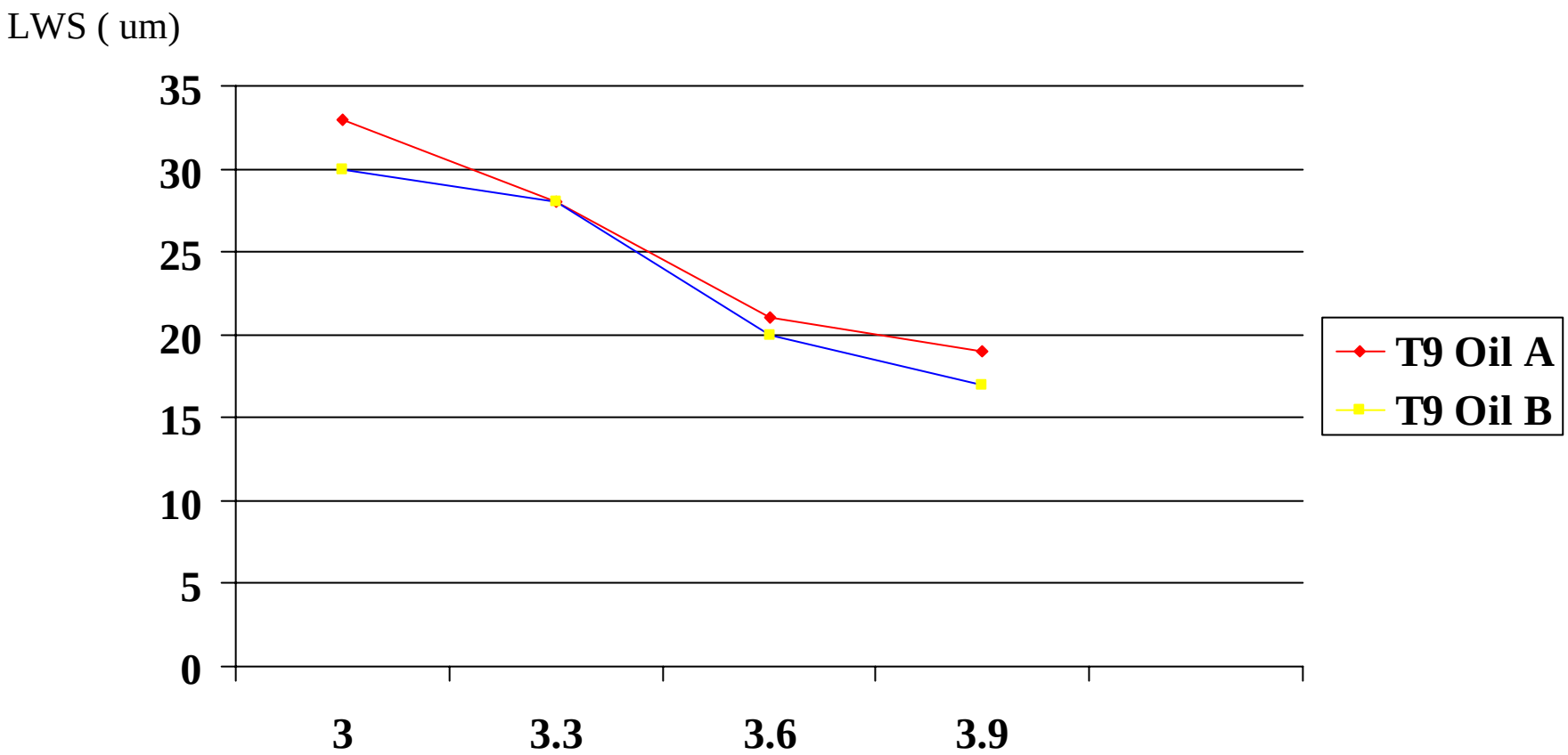


EMA'S PC9 HT/HS Recommendation

- 3.3 Minimum for XW30 after Shear
  Engine sees sheared oil
  No physical or chemical spec
- 3.5 Minimum for XW30 for new oil
  Engine Test Wear Data
  ACEA & Global DHD-1
- 3.3 Minimum in HEUI Test @ 5,10 hrs
  Heavy Duty Diesel Engine Test

GLS June 19,2001

Mack T9
Liner Wear vs HTHS



GLS 5-4-01

Engine Manufactures Association (EMA)
Proposed PC 9 Tests

Performance Characteristics	Engine and Bench Tests	Limits
Ring Liner and Bearing Wear	Mack T-10	PC-9
Valve-Train and Ring Wear/Filter ΔP, Sludge	Cummins M11 EGR	PC-9
Oil Consumption and Deposits	Caterpillar IQ EGR (Steel Piston)	PC-9
Viscosity Control	Mack T-8E	PC-9
Oxidation	John Deere JD9-78A	PC-9
Roller-Follower Wear	GM 6.5 Liter	CH-4
Aeration	Navistar 7.3 Liter	CH-4
Oil Consumption and Deposits	Caterpillar 1N	CH-4
High Temperature Corrosion	ASTM D 5968	CH-4
Shear Stability	Bosch Injector (ASTM D 3945)	CH-4
Volatility	Noack (ASTM D 5800)	PC-9
Foaming	ASTM D 892	CH-4
Elastomer Compatibility	Equal to Reference Oils	PC-9
Used Oil Viscometrics (Low Temperature)	J300 Bench Test	PC-9
HT/HS for SAE 10W-30 (3.3cP Min.)	SAE J300	PC-9

Exit Criteria Ballot
PC-9 Tests Using API CH-4 Limits

Performance Characteristics	Engine and Bench Tests	Limits
Roller-Follower Wear	GM 6.5 Liter	CH-4
Aeration	Navistar 7.3 Liter	CH-4
Oil Consumption and Deposits	Caterpillar 1N (Aluminum Piston)	CH-4
High Temperature Corrosion	ASTM D 5968	CH-4
Shear Stability	Bosch Injector (ASTM D 3945)	CH-4
Foaming	ASTM D 892	CH-4

Exit Criteria Ballot
PC-9 Tests With Limits to Be Defined

Performance Characteristics	Engine and Bench Tests	Limits
Viscosity Control	Mack T-8E	PC-9
Oxidation	FT-IR Mack T-10/Cat 1R	PC-9
Volatility	Noack: All Grades	15% (Max.)
Elastomer Compatibility	Equal to Reference Oils	PC-9
Used Oil Viscometrics (Low Temperature)	J300 Bench Test	PC-9
HT/HS for SAE 10W-30 (3.5 Min.)	SAE J300	PC-9

ATTACHMENT 22

PC-9 Elastomer TF Report to ASTM D02.B0 HDEOCP
June 19, 2001

- TF Meeting held in Detroit June 13

- TF reviewed results of a Round Robin completed by 5 labs

- Tentative conclusions reached by the TF
  - Two Reference oils may be all that is necessary with one of the two oils being SF 105 (TMC 1006).
  - A statistical method for proposing how to determine if a candidate oil is no worse than the reference oil was proposed and needs further evaluation
  - For those elastomer properties that show very small change with current oil formulations, a statistical method is not appropriate and nominal max./min. limits need to be proposed and evaluated
  - Review of results and subsequent information concerning some variable results indicate the method has reasonable precision
  - Some additional runs will be made on TMC 1006 and the polyacrylate elastomer to fill in some missing data

- TF will meet July 10 in Chicago prior to the next HDEOCP meeting to reach final recommendations to HDEOCP

- Test procedure will be proposed for standardization ballot to D11.15 in June 27 meeting.

Tom Boschert
PC-9 Elastomer TF leader