HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
February 22, 2001
Holiday Inn – O'Hare International Hotel, Rosemont, IL

ACTION ITEMS

1. Get 1R matrix started.	**Nearly Everybody**
2. Resolve filter pleat collapse effect on filter delta P.	**M-11 EGR Task Force**
3. HTHS proposed limit.	**EMA**
4. Review N, K, P deposit data.	**Alternate Test TF**
5. Seal compatibility recommendation.	**Elastomer Task Force**

MINUTES

1.0 Call to Order

1.1 Chairman Jim McGeehan called the meeting to order at 8:31 a.m. in the Kitty Hawk room of the Holiday Inn – O'Hare International Hotel of Rosemont, Illinois, on May 25, 2001. There were 13 members present or represented and approximately 17 guests present. The attendance list is shown as Attachment 2.

2.0 Agenda

2.1 The announced agenda (Attachment 1) was reviewed and additions made for Pat Fetterman on HTHS, Tom Boschert on Seals and Ted Selby on the Scanning Brookfield.

3.0 Previous Meeting Minutes

3.1 The minutes of the May 10, 2001 meeting in Orlando were approved as distributed.

4.0 Membership

4.1 Chairman McGeehan reviewed the panel membership (Attachment 3).

4.2 Mesfin Belay of Detroit Diesel will replace Dan Larkin as a member.

5.0 PC-9 Matrix Update

5.1 John Zalar presented an update on the status of the PC-9 matrix (Attachment 4).

6.0 Mack T-10

6.1 Greg Shank reviewed the T-10 status (Attachment 5). He then asked the panel if a test development task force could decide on the validity of a development (matrix) test. Considerable discussion ensued. Normally, the test laboratory decides on the validity of a test. Ralph Cherrillo made a motion to empower a task force to make test validity decisions for matrix tests in the event such a question arose, with the understanding this authority could be revoked by the HDEOCP in the future. Bill Kleiser seconded the motion. The motion passed 13 for, 0 against, 0 abstain.

6.2 Greg also presented data on T-10 deposits and IR oxidation (Attachment 6).

7.0 Oxidation

7.1 Joe Franklin presented an update on T-10 oxidation analysis by FTIR (Attachment 8). He indicated that method 5 gives a separation range of approximately 2.5 while method 2 gives a range of approximately 2.0 for the matrix oils. His analysis indicates no correlation with soot level.

8.0 Cummins M-11 EGR

8.1 Dave Stehouwer reported on the M-11 EGR status and results (Attachment 8). He noted the Task Force decision to allow oil filter replacement in order to complete matrix tests and indicated Cummins would consider a filter with a delta pressure increase from new of 20 psi, as being plugged.

8.2 Dave also presented the available piston deposit data from M-11 EGR matrix tests (Attachment 9).

9.0 Caterpillar 1Q

9.1 Dwayne Tharp reported on the 1Q status (Attachment 10) and noted there definitely was a problem with the test.

9.2 Bill Kleiser reported for the Alternative Test Task Force (Attachment 11). They recommended the 1Q matrix be stopped and the remainder of the time and funding available be used to conduct 1R tests. They also requested that RSI and TMC provide piston deposit data for all oils with 1N/1P or 1K/1P results. If the 1R were to stumble also, this data could establish whether any correlation exists between the aluminum piston deposits of the 1K/1N and the steel piston deposits of the 1P. They also recommended adoption of the 1P BOI guidelines for the 1R, until such time that sufficient 1R data is accumulated which indicates the guidelines should change. Bill Kleiser moved and Pat Fetterman seconded that the panel accept the recommendations of the Task Force. The motion passed with 13 for, 0 against, 0 abstain.

9.3 Bill Kleiser moved and Steve Kennedy seconded that the scope and objectives of the Task Force be clarified to encompass other problems (besides piston deposits) for alternate tests. The motion passed with 13 for, 0 against, 0 abstain.

9.4 The Alternative Test Task Force plans to meet again on June 18th in San Diego, to review the N/K/P data.

10.0 High Temperature, High Shear

10.1 Pat Fetterman presented Infineum concerns with a previously proposed HTHS limit (Attachment 12). He cited concerns with any arbitrary physical or chemical limits and with the adverse effect on fuel economy of higher viscosity. He also pointed out that the lower limit for KV100 for 10W-30 oils will give a HTHS value of 3.0 cP in a low VI, group 1 base stock. Thus, a HTHS value above 3.0 will raise the minimum viscosity for an oil or restrict the choice of base stocks.

10.2 Greg Shank presented a response for EMA (Attachment 13), supporting a HTHS limit of 3.? for "sheared" new oil. He said they would have a firm proposed limit for the San Diego meeting.

11.0 Other Topics

11.1 John Zalar reported that the Sequence 3F Surveillance Panel is already working on recording viscosity increase at 60 hours. They do need more definitive input from the HDEOCP though. Lots of discussion on 60 hour versus 80 hour requirements for heavy duty oils. Lew Williams moved and Pat Fetterman seconded that Seq. 3F candidate oils be run as long as needed by the test sponsor (either 60 or 80 hours). Reference test length would remain 80 hours. The motion passed with 13 for, 0 against, 0 abstain.

11.2 Tom Boschert gave an Elastomer Task Force report (Attachment 14) and indicated he has round robin data from 4 labs with a fifth due soon. The procedure is posted on the TMC website and he plans to present the procedure and data to committee D11 for them to ballot the procedure. He plans to have a recommendation for the next HDEOCP meeting.

11.3 Ted Selby made a presentation (Attachment 15) with regard to the extended range Scanning Brookfield technique. He feels it could provide additional useful information in regard to low temperature pumpability of used oils.

11.4 Greg Shank requested that "exit" ballots be used for those tests which already have limits proposed for PC-9.

11.5 Jim McGeehan reminded everyone that the panel meeting in San Diego will start on Tuesday (6/19/01) morning and could go all day.

11.6 Steve Kennedy to write a letter requesting an amendment to the MOA to accommodate the 1R.

12.0 Adjournment

12.1 The meeting was adjourned at 11:48 a.m.

Submitted by:

Jim Wells
Secretary to the HDEOCP

ATTACHMENT 1

ASTM-HDEOCP

Holiday Inn O'Hare International
May 25th 2001
8:30 am – 12:30 pm—Coffee at 8:00 am

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

Desired Outcomes: **- Feature oil performance in EGR tests**

TOPIC	PROCESS	WHO	TIME
Agenda Review	• Desired Outcomes & Agenda	Group	8:30-8:35
Minutes Approval	• May 10th 2001	Group	8:35-8:40
Membership	• Changes	Group Jim Mc Geehan	8:40-8:50
Matrix Status	• Mack T-10; Cummins M11-ERG; Cat 1Q • Time line for PC-9	John Zalar	8:50-9:15
Mack T-10	• All Matrix results" • Timing of matrix completion • Discussion	Greg Shank	9:15-9:45
Cummins M11 EGR	• All Matrix results • Timing of matrix completion • Discussion	Dave Stehouwer	9:45-10:15
Caterpillar 1Q	• All Matrix results • Timing of matrix completion • Discussion	Dwayne Tharp	10:15-10:45
Coffee break	• Collect room and coffee money	Jim Mc Geehan	10:45-11:00
Oxidation	• Mack T-10 Integrated IR for matrix test oil • Discussion	Joe Franklin	11:00-11:30
Piston Deposits and Oil Consumptions Task Force	• Cummins M11-EGR and Mack T-10 members • Data analyis to date and plans	Bill Kleiser	11:15-11:45
SAE 10W-30 HT/HS	• Proposed EMA limit of 3.5 • Discussion	Group	11:45-12:15
Other topics		Group	12:15-12:30

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PREVIOUS GUESTS

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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		

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:_____Frederick Fischl **Company:__Infineum USA LP** **Address:___P.O. Box 735 / 1900 Linden Ave.** **___Linden, NJ 07036**	**(908) 474-2720** **fred.fischl@infineum.com**	☺
Name:_____Mayur Shah **Company:__Lubrizol Corporation** **Address:___29400 Lakeland Blvd.** **___ Wickliffe, Ohio 44092**		☺
Name:_____Dale Carroll **Company:__Lubrizol** **Address:___29400 Lakeland Blvd.** **___ Wickliffe, Ohio 44092**		☺
Name:______________________________ **Company:**____________________________ **Address:**_____________________________ ______________________________		
Name:______________________________ **Company:**____________________________ **Address:**_____________________________ ______________________________		
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
- D. Larkin
  - 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 (C. Passut)
  - Ethyl Corp.
- W. Kleiser
  - Oronite
- P. Fetterman
  - Infineum USA LP
- L. Williams
  - Lubrizol Corp.

ATTACHMENT 3

Status of PC-9 Matrix Testing

Presented to HDEOCP

May 25, 2001

John L. Zalar

ATTACHMENT 4

T-10

- **Planned Tests: 28**
- **Total Starts: 30**
- **Completed Tests**
  - **Verified and posted on TMC web site: 20**
  - **EOT and being reviewed/verified: 2**
  - **Aborted/Invalid: 3**
- **Tests Currently Running: 5**
- **Earliest EOT for Last Matrix Test: 6/1/01**

ATTACHMENT 4

M11-EGR

- **Planned Tests: 26**
- **Total Starts: 27**
- **Completed Tests**
  - **Verified and posted on TMC web site: 16**
  - **EOT and being reviewed/verified: 6**
  - **Aborted/Invalid: 2**
- **Tests Currently Running: 3**
- **Earliest EOT for Last Matrix Test: 6/18/01**

ATTACHMENT 4

1Q

- **Planned Tests: 28**
- **Total Starts: 25**
- **Completed Tests**
  - **Verified and posted on TMC web site: 6**
  - **EOT and being reviewed/verified: 6**
  - **Aborted/Invalid: 7**
- **Tests Currently Running: 6**
- **Earliest EOT for Last Matrix Test: 8/10/01**

ATTACHMENT 4

1Q Aborted Tests

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

ATTACHMENT 4

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
6/9/01

ATTACHMENT 4

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	1	1	4	5		
MATRIX STAND NO.	2	1	4	5	2	1	2	6	7		
PC-9 OIL CODE	PC-9A	PC-9E	PC-9C	PC-9J	PC-9A	PC-9G	PC-9J	PC-9F	PC-9D		
BASE OIL CODE	1	2	3	3	1	1	3	3	1		
TECHNOLOGY CODE	X	Y	X	Z	X	Z	Z	Y	Y		
MATRIX RUN NO.	1	3	- -	2	2	4	3	4	2		
START DATE	23-Feb-01	16-Mar-01	2-Apr-01	4-May-01	26-Mar-01	9-Apr-01	20-Apr-01	7-Apr-01	15-Mar-01		
EOT DATE	13-Mar-01	29-Mar-01	20-Apr-01	19-Apr-01	8-Apr-01	22-Apr-01	4-May-01	19-Apr-01	3-Apr-01		
VALID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
RESULTS											
LINER WEAR	38.0	21.2	35.1	35.4	27.4	29.0	31.4	26.0	45.7		
TOP RING WEIGHT LOSS	168	118	133	119	87	107	153	106	204		
DELTA Pb	19	18	77	90	16	69	44	62	25		
SOOT - 75 HR	5.0	4.5	5.3	4.8	4.6	4.8	5.0	4.9	5.3		
SOOT - EOT	6.0	4.8	7.6	5.7	4.8	5.5	6.2	5.4	6.8		
OIL CONSUMPTION	0.161	0.105	0.212	0.118	0.111	0.156	0.136	0.161	0.18		

J.L. Zalar
6/9/01

ATTACHMENT 4

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
* Lab has declared this test operationally valid, however, this test fails to meet the 250 hour soot requirement for operational validity											

J. L. Zalar
6/9/01

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	3	3						
MATRIX STAND NO.	4	5	5	4	5						
PC-9 OIL CODE	PC-9G	PC-9J	PC-9E	PC-9E	PC-9A						
BASE OIL CODE	1	3	2	2	1						
TECHNOLOGY CODE	Z	Z	Y	Y	X						
MATRIX RUN NO.	3	2	3	4	4						
START DATE	15-Mar-01	21-Feb-01	20-Mar-01	9-Apr-01	18-Apr-01						
EOT DATE	1-Apr-01	10-Mar-01	6-Apr-01	25-Apr-01	4-May-01						
VALID	Yes	Yes	Yes	Yes	Yes						
FAX BACK	Yes	Yes	Yes	Yes	Yes						
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes						
RESULTS											
CROSSHEAD WEAR	13.6	27.7	19.4	19.7	28.7						
OIL FILTER DELTA P	304	535	332	266	532						
AVERAGE SLUDGE	7.3	7.7	7.6	8.1	8.9						
SOOT - 250 HR	8.2	8.2	8.2	8.1	8.0						
INJ. SCREW WT. LOSS	68.2	71.8	82.1	85.0	56.6						
TOP RING WEIGHT LOSS	125	170	139	129	145						
* Lab has declared this test ope											

J. L. Zalar
6/9/01

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	2	1	4	6	5	1
PC-9 OIL CODE	PC-9M	PC-9M	PC-9M	PC-9M	PC-9M	PC-9A	PC-9M	PC-9B	PC-9B	PC-9E	PC-9E
BASE OIL CODE	4	4	4	4	4	1	4	2	2	2	2
TECHNOLOGY CODE	W	W	W	W	W	X	W	X	X	Y	Y
MATRIX RUN NO.	1	1	1	1	1	2	1	2	2	1	2
START DATE	5-Jun-00	3-Aug-00	22-Jun-00	14-Jun-00	11-May-00	23-Mar-01	2-Feb-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	14-Apr-01	25-Feb-01	17-Apr-01	25-Apr-01	18-Apr-01	4-May-01
VALID	Yes	Yes	Yes	Yes	Yes	Yes					
FAX BACK	Yes	Yes	Yes	Yes	Yes	Yes					
ASTM NOTIFIED	Yes	Yes	Yes	Yes	Yes	Yes					
RESULTS											
WEIGHTED DEMERITS	402.4	450.4	417.5	381.2	419.9	420.7	405.8	408.7	405.8	385.2	478.3
TOP GROOVE CARBON	30.50	36.50	26.00	29.25	24.00	36.50	33.50	33.75	31.25	25.25	33.75
TOP LAND CARBON	18.75	7.75	18.00	19.50	8.25	14.75	21.25	20.25	14.25	14.50	17.50
AVE. OIL CONSUMPTION	9.9	9.3	8.6	9.1	10.5	9.2	9.6	7.5	8.4	6.9	9.2
EOT OIL CONSUMPTION	6.9	7.7	7.0	7.4	9.0	9.3	7.8	7.4	8.3	6.6	8.2
Shaded tests have not been TMC verified.											

J. L. Zalar
6/9/01

PC-9 MATRIX											
TEST TYPE	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q	1Q
MATRIX LAB NO.	5										
MATRIX STAND NO.	7										
PC-9 OIL CODE	PC-9A										
BASE OIL CODE	1										
TECHNOLOGY CODE	X										
MATRIX RUN NO.	2										
START DATE	17-Apr-01										
EOT DATE	9-May-01										
VALID											
FAX BACK											
ASTM NOTIFIED											
RESULTS											
WEIGHTED DEMERITS	313.6										
TOP GROOVE CARBON	24.50										
TOP LAND CARBON	4.00										
AVE. OIL CONSUMPTION	7.9										
EOT OIL CONSUMPTION	8.8										
Shaded tests have not been TM											

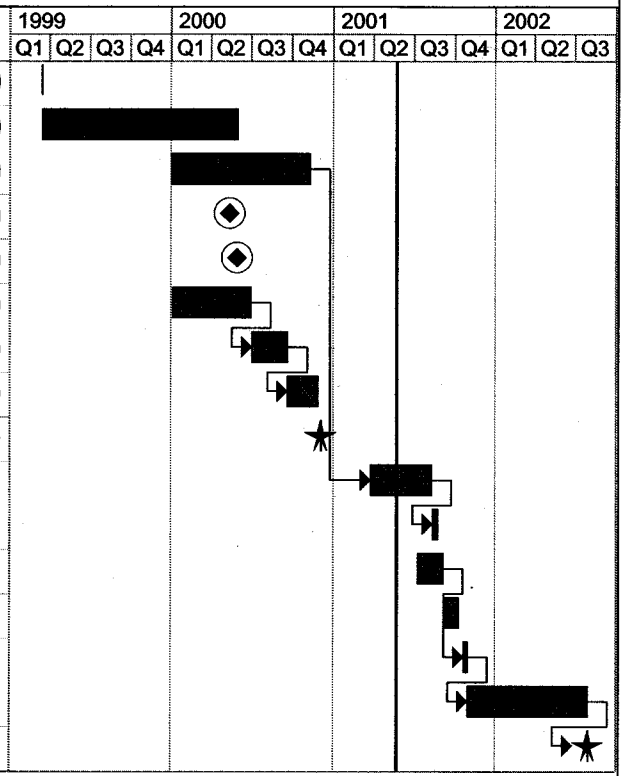
J. L. Zalar
6/9/01

ATTACHMENT 4

Summary of Events Required for PC-9 Licensing

J. L. Zalar 5/24/01

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

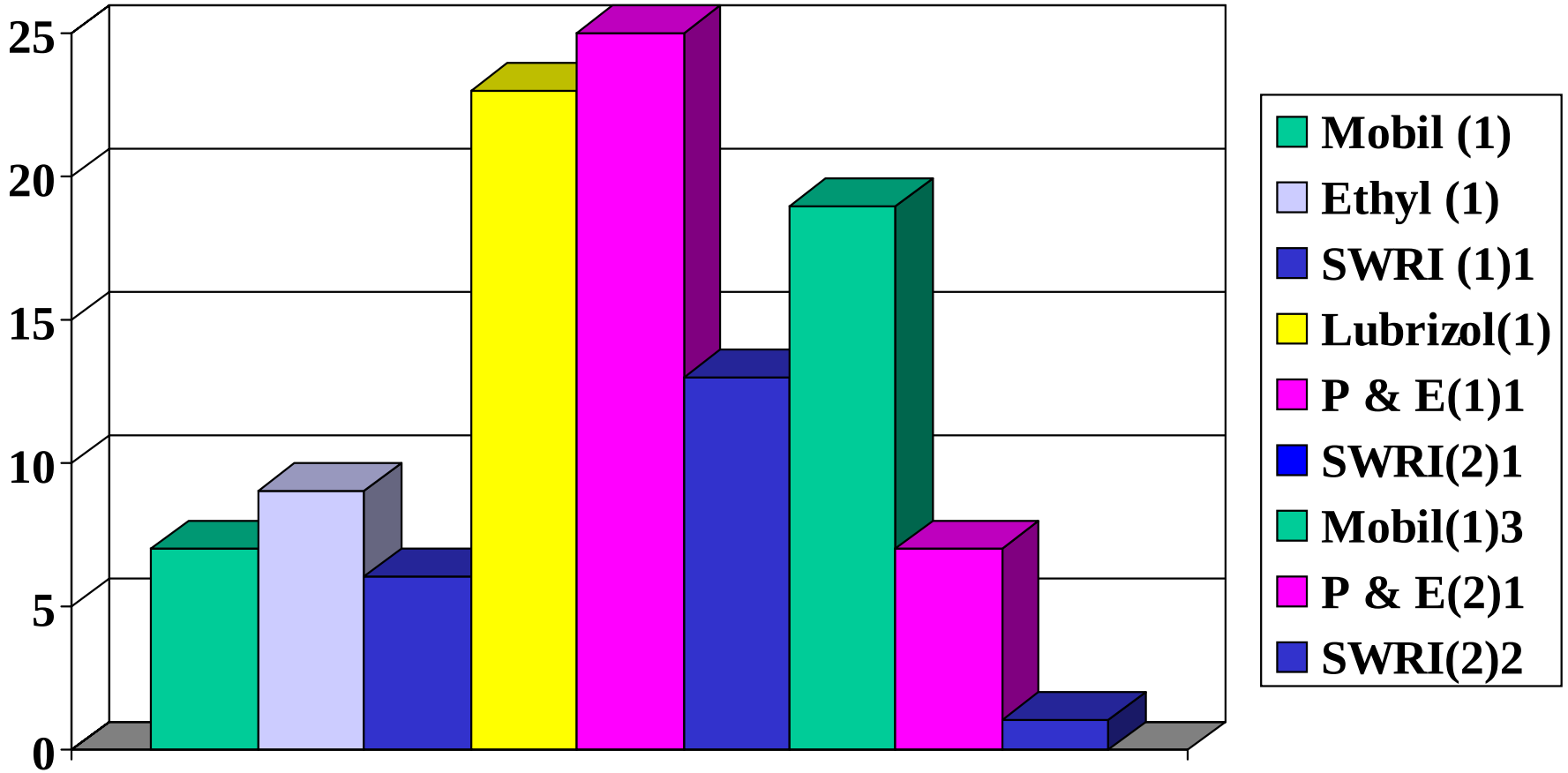
* Last 1Q Stand

Mack T10 Status

- 26 Test Completed (20 Verified , 3 ?,)
- Task Force Meeting's in March & April
- Issues : Measurements for Oxidation,Oil Consumption & Deposits
- Estimated Matrix Completion - June 15

T10 Matrix Data

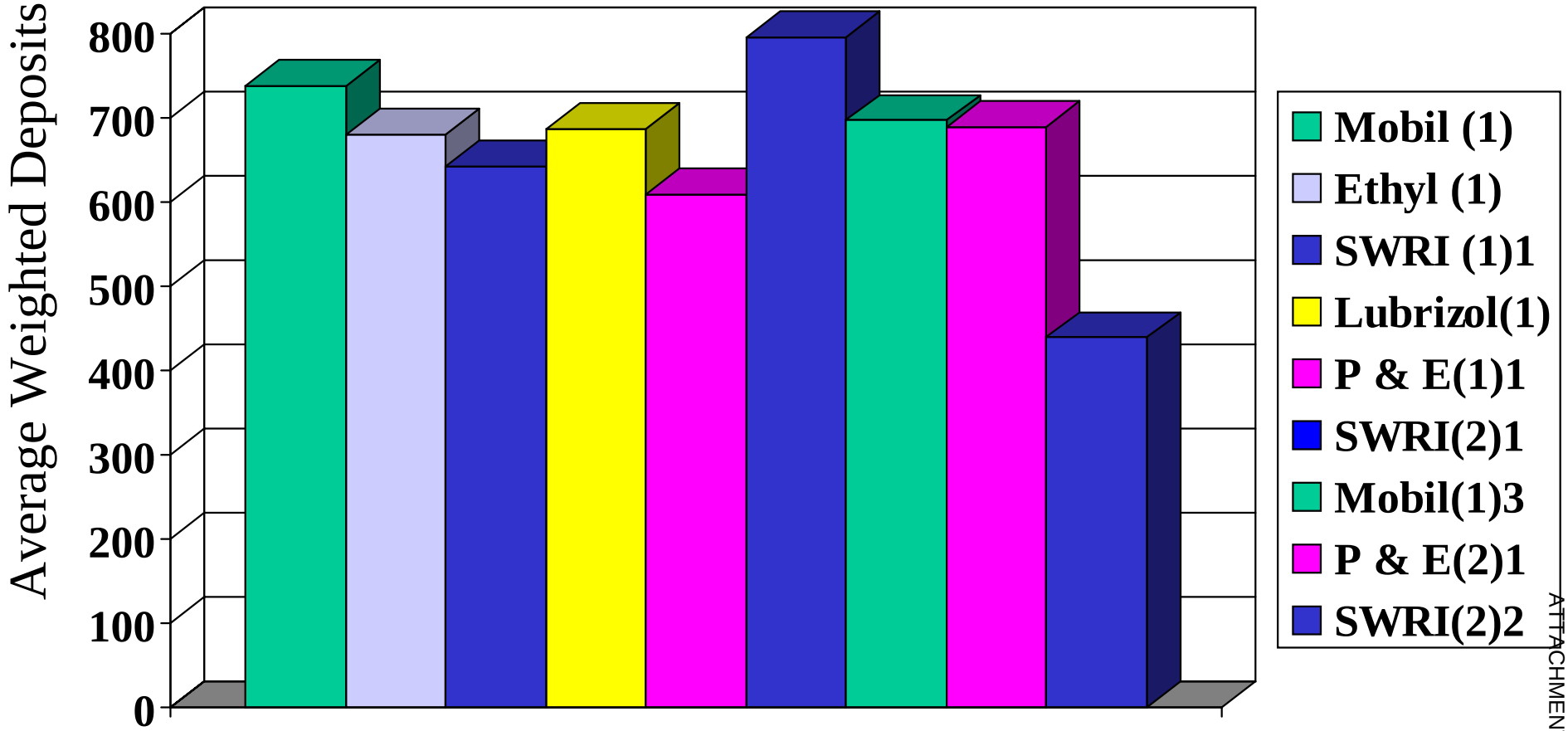
Average Undercrown Deposit Oil A



May 18 01

T10 Matrix Data

Average Weighted Deposits Oil A

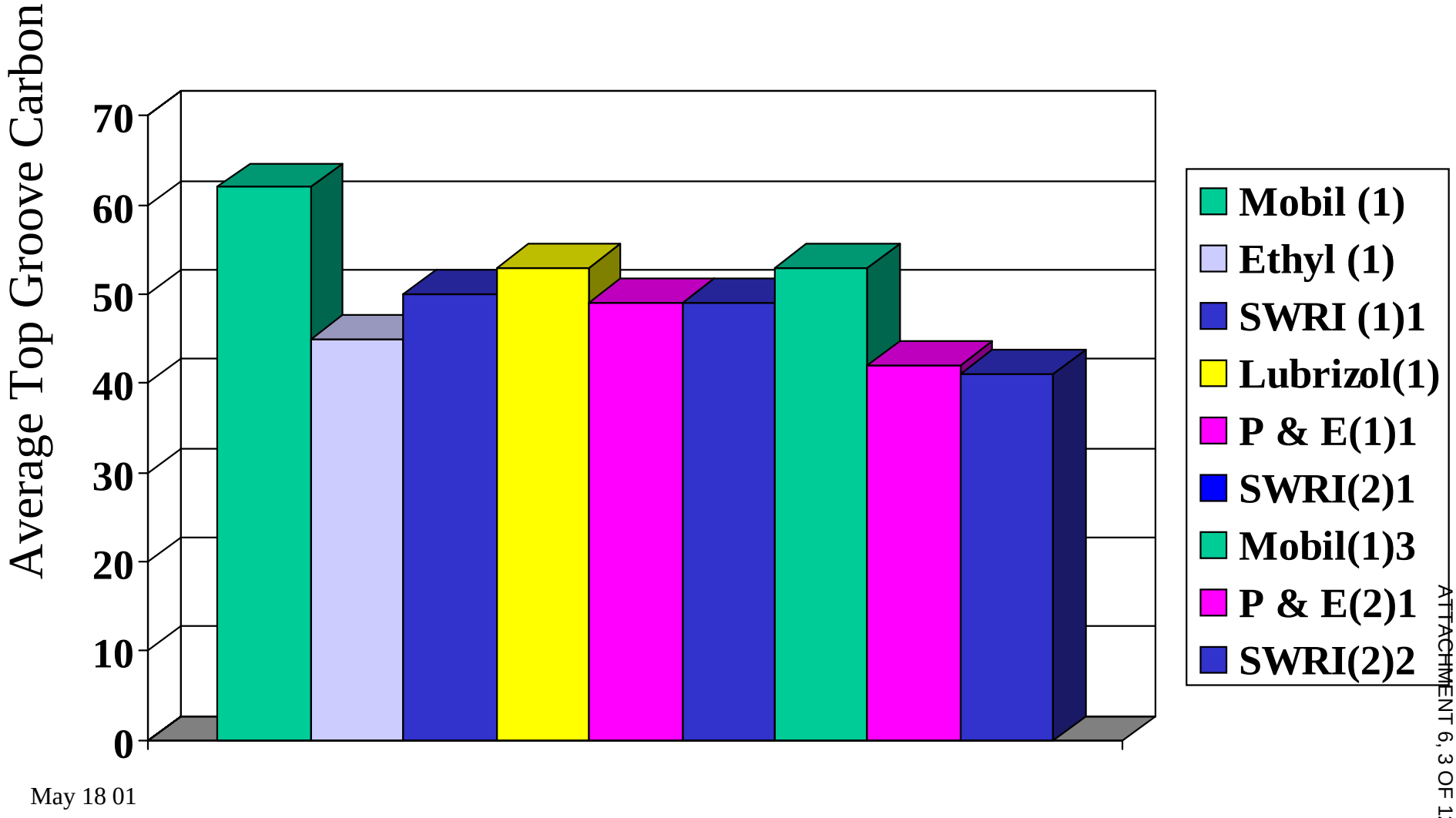


May 18 01

ATTACHMENT 6, 2 OF 12

T10 Matrix Data

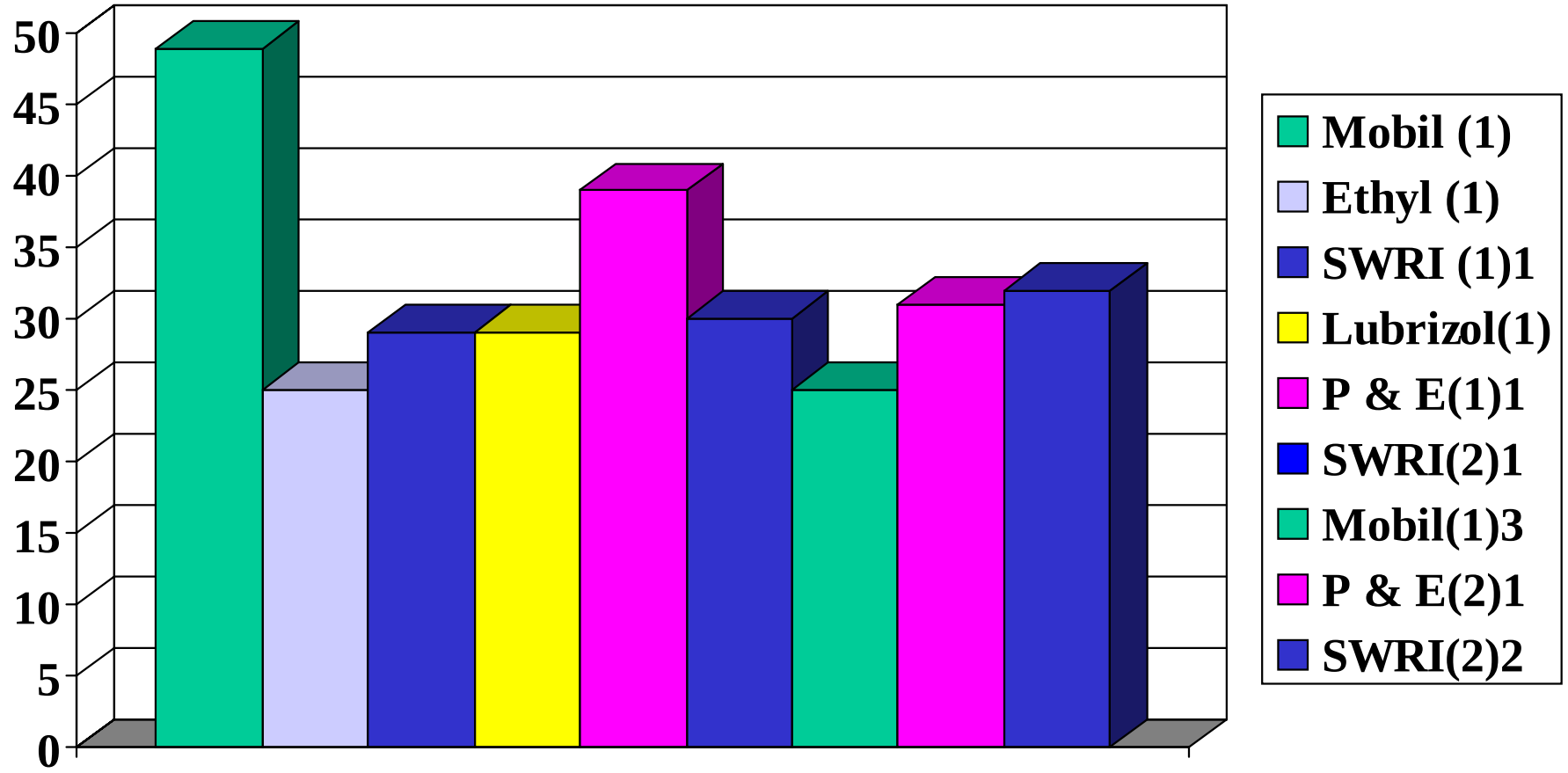
Top Groove Carbon Oil A



May 18 01

T10 Matrix Data

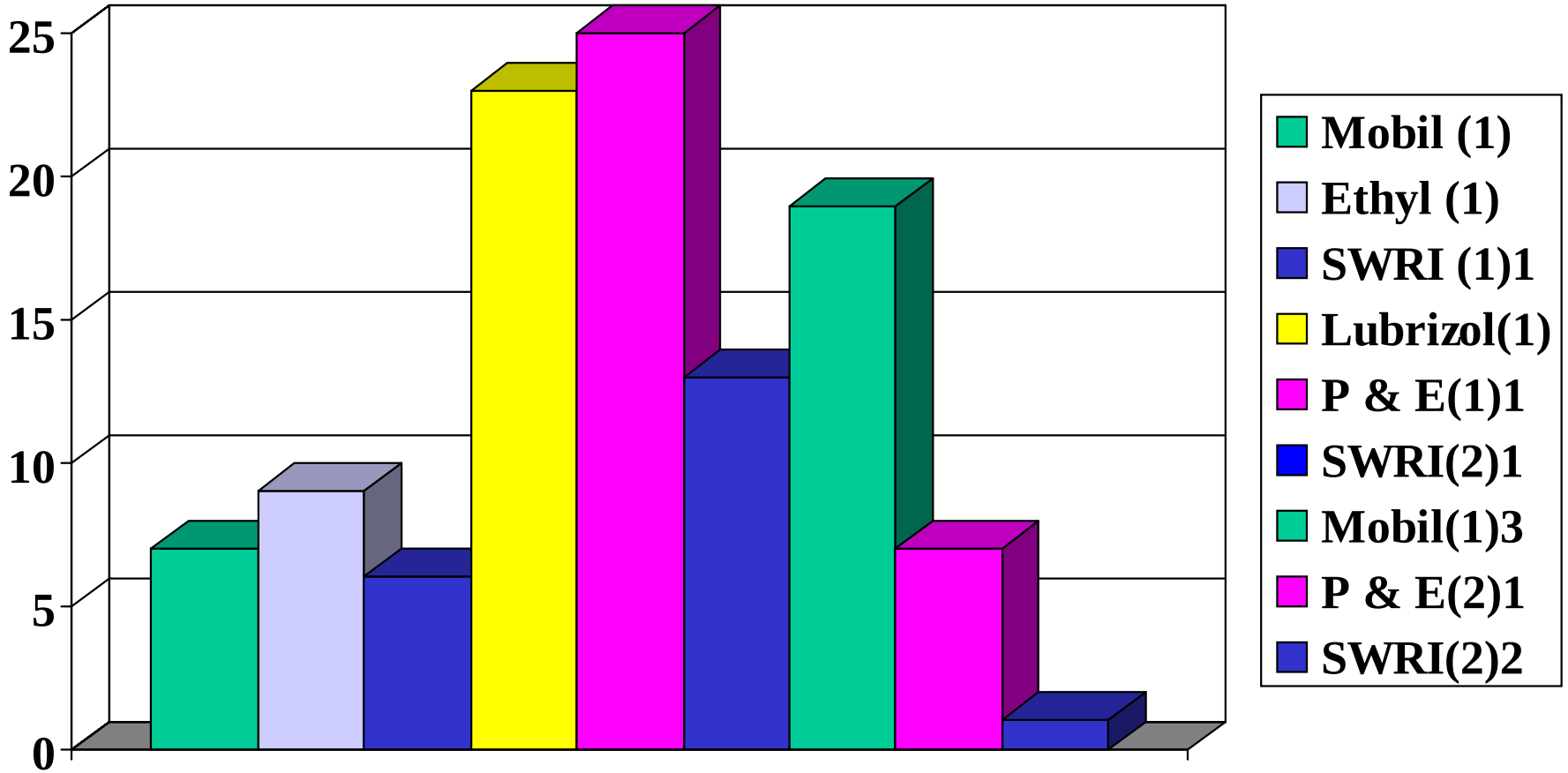
Top Land Carbon Oil A



May 18 01

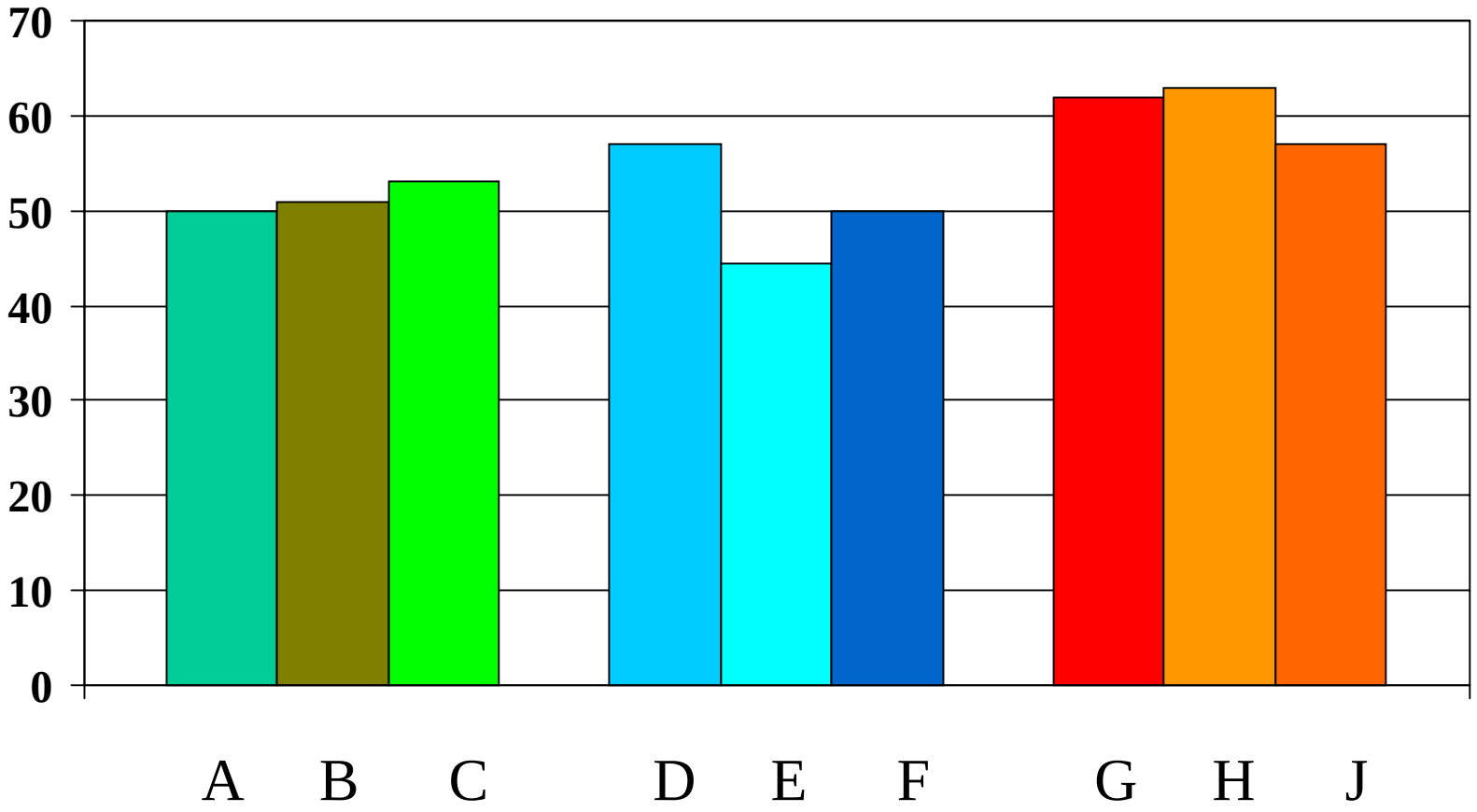
T10 Matrix Data

Average Undercrown Deposit Oil A

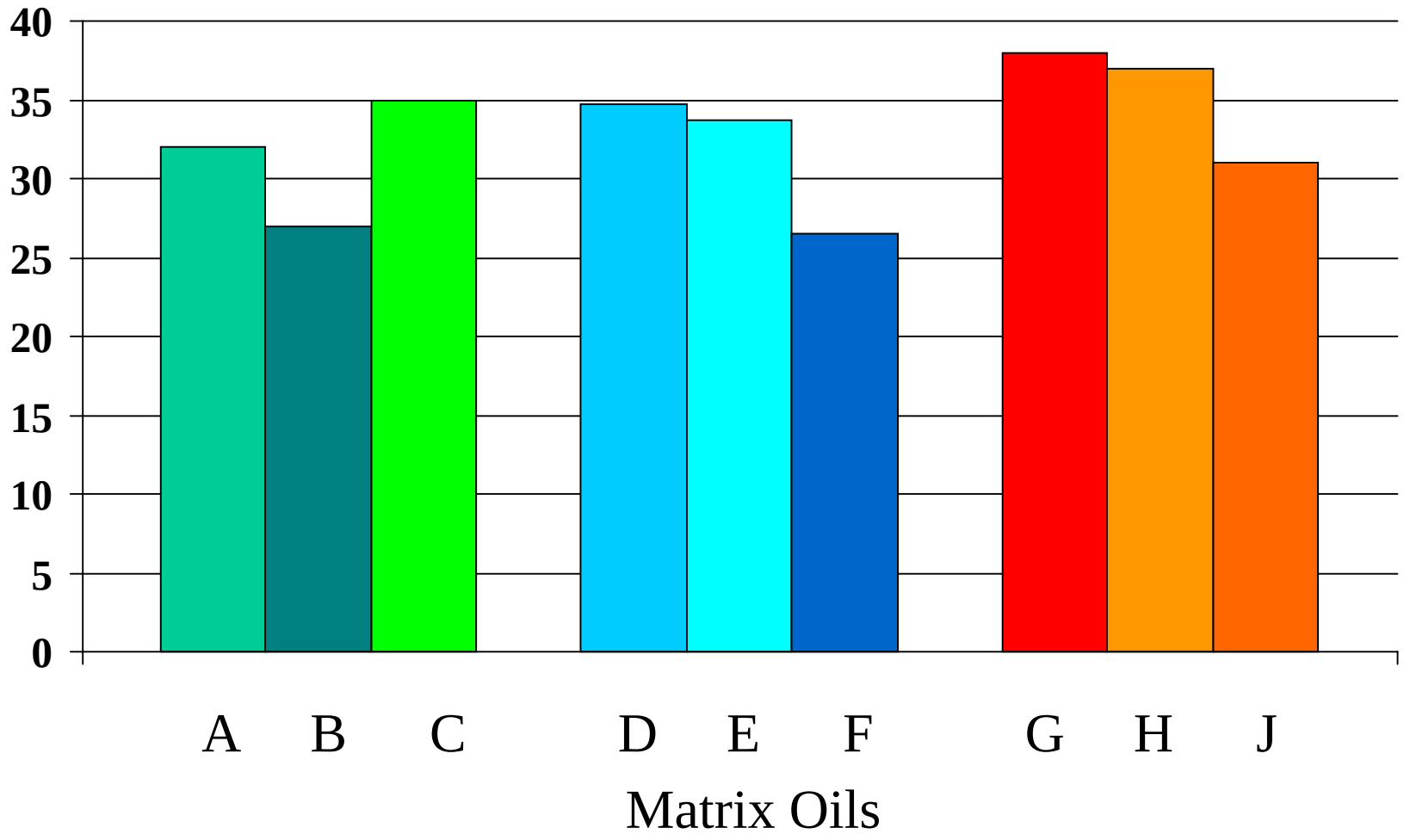


May 18 01

T 10 Matrix
Top Groove Carbon

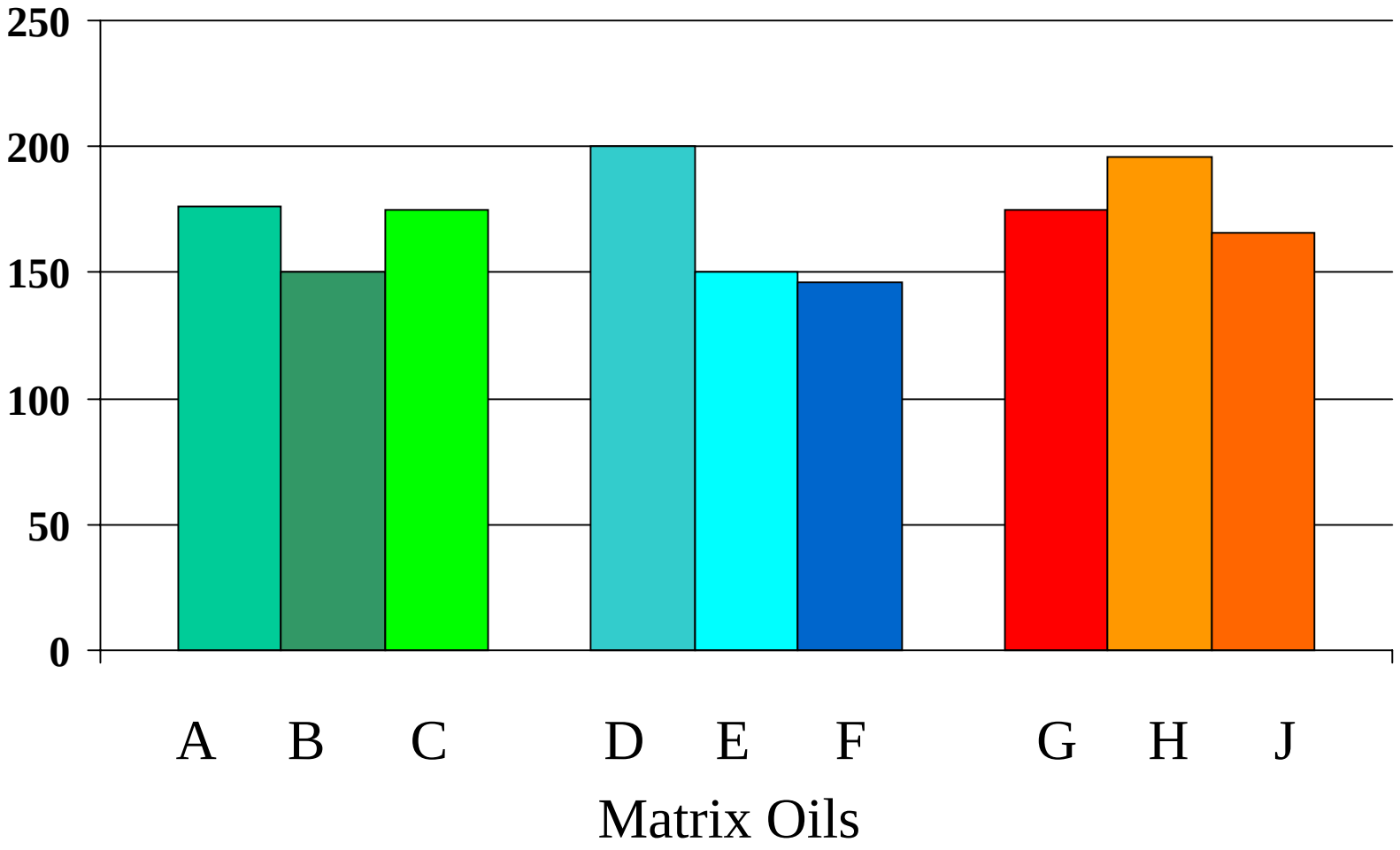


T 10 Matrix
Top Land Carbon

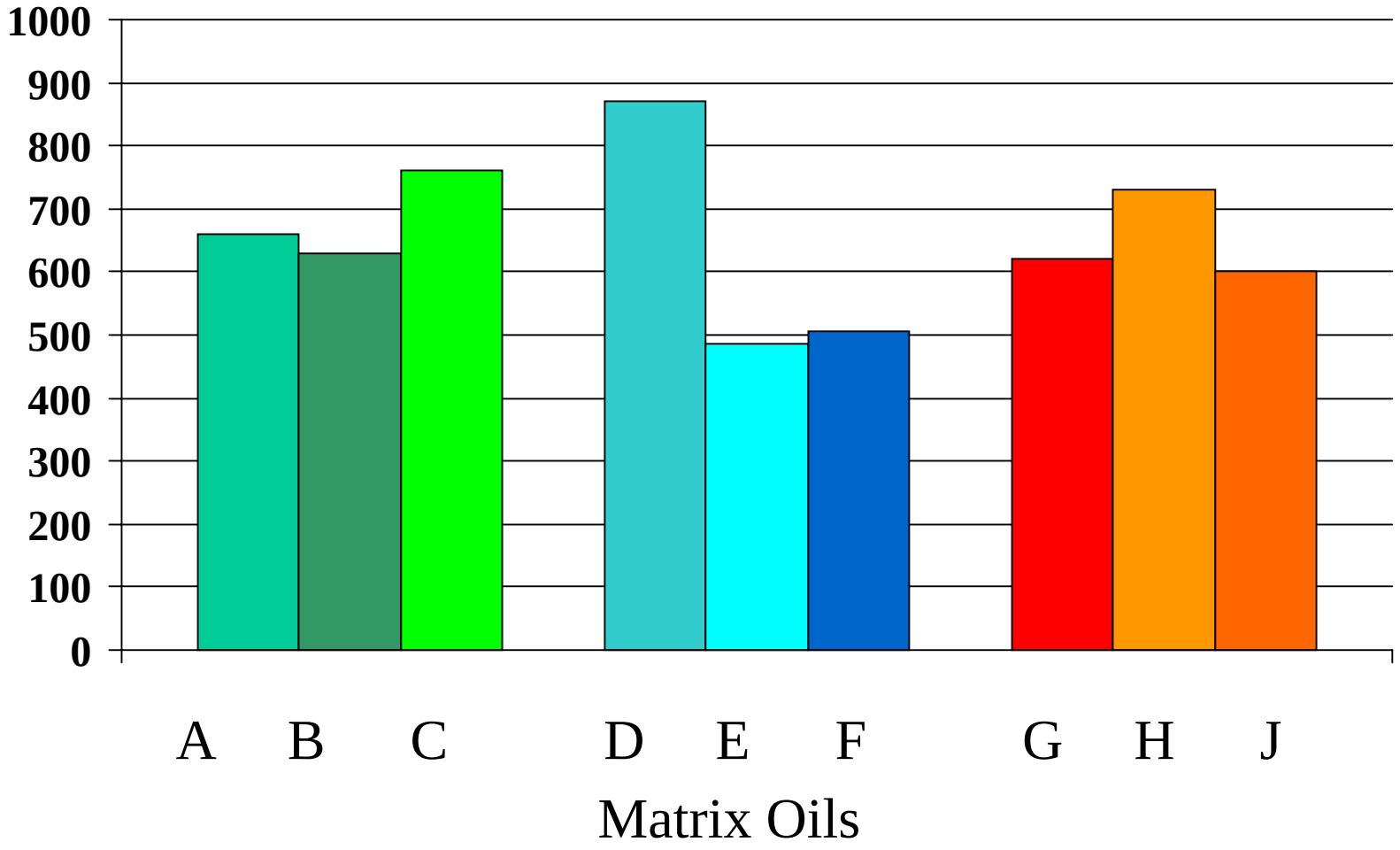


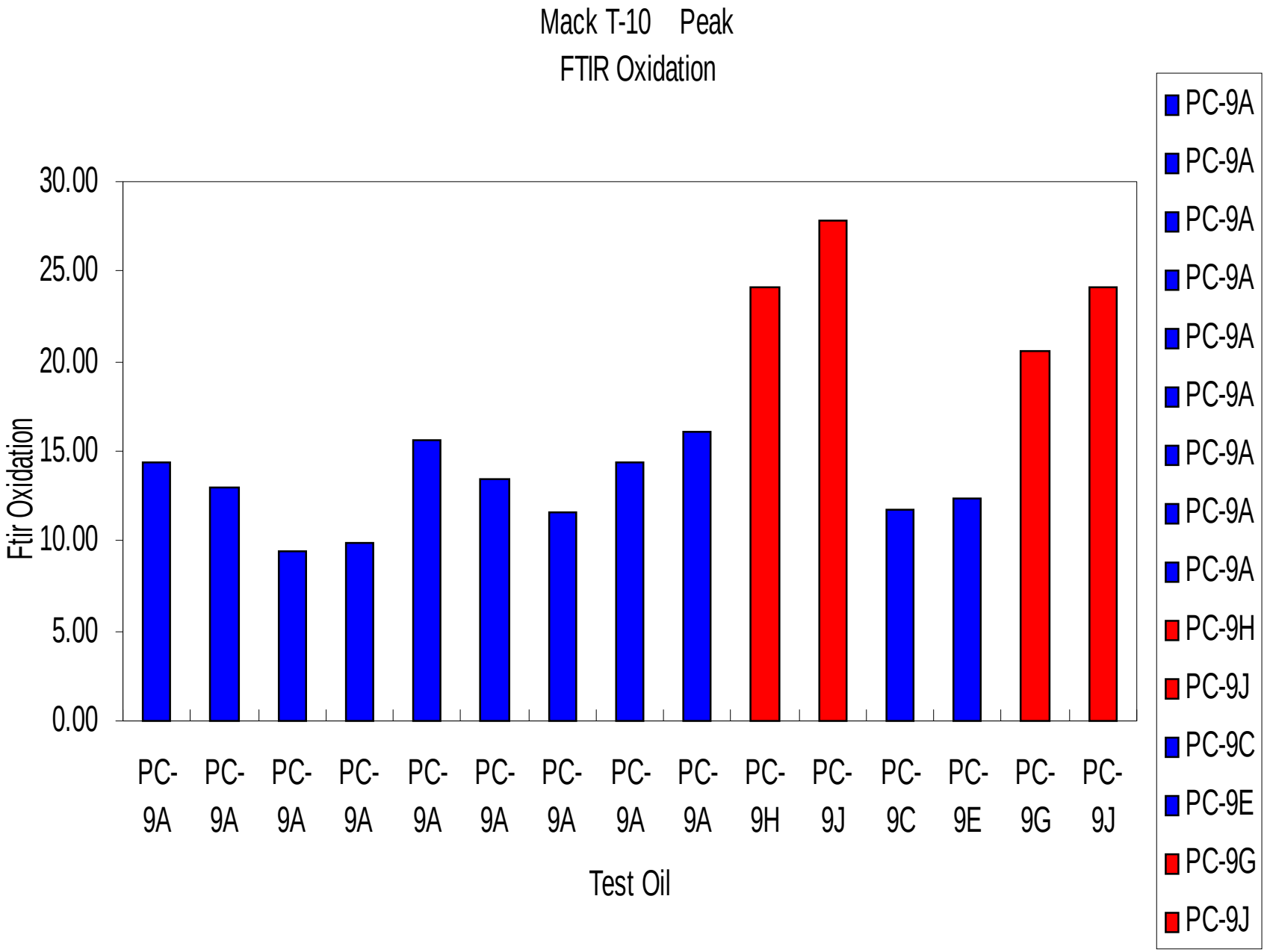
GLS 5-23-01

T 10 Matrix
Average Unweighted Deposits



T 10 Matrix
Average Weighted Deposits




Mack T-10 Peak
FTIR Oxidation
Ftir Oxidation
30.00
25.00
20.00
15.00
10.00
5.00
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
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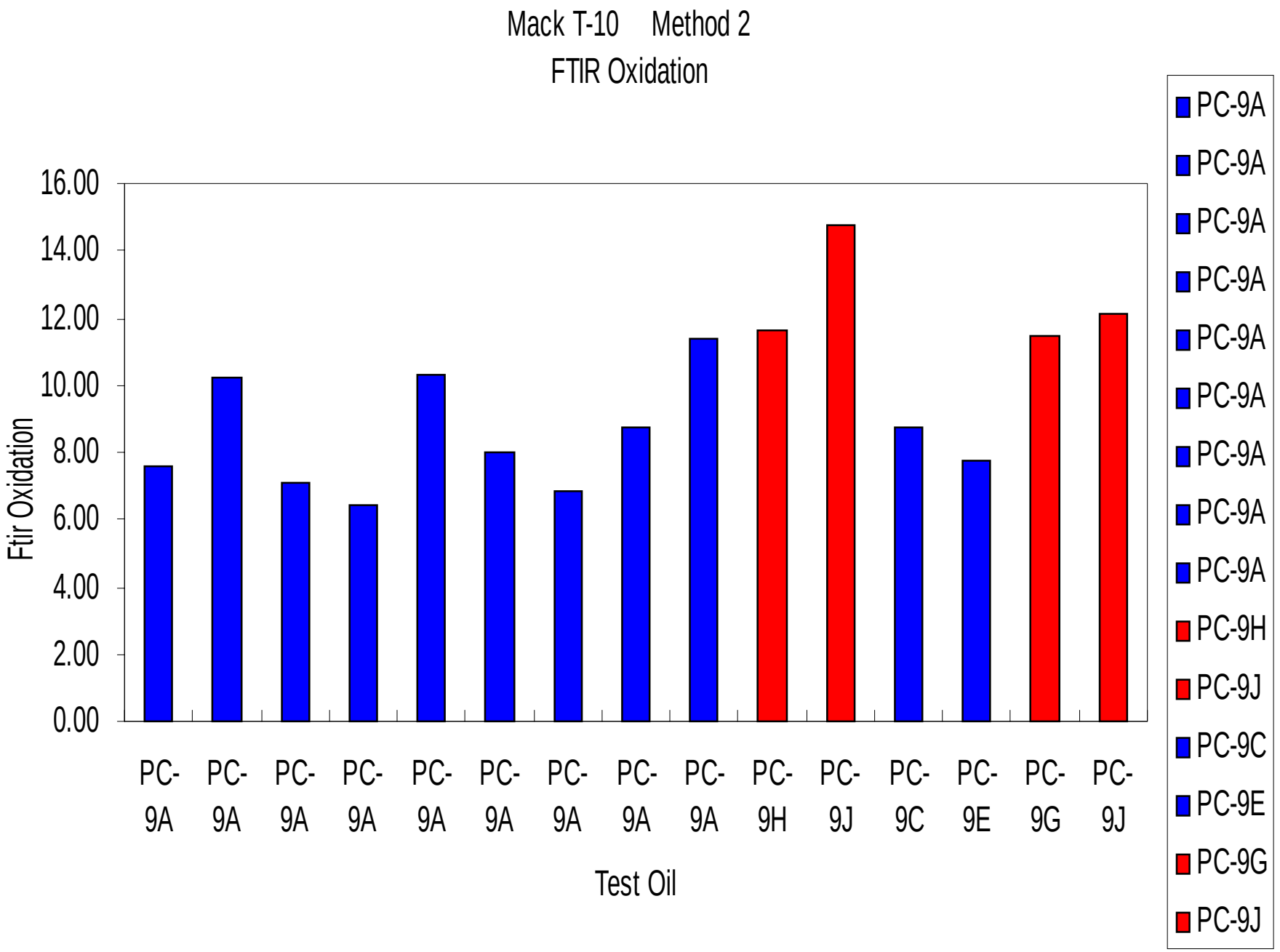
PC-9J
PC-9C
PC-9E
PC-9G
PC-9J


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
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PC-9A
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PC-9H
PC-9J
PC-9C
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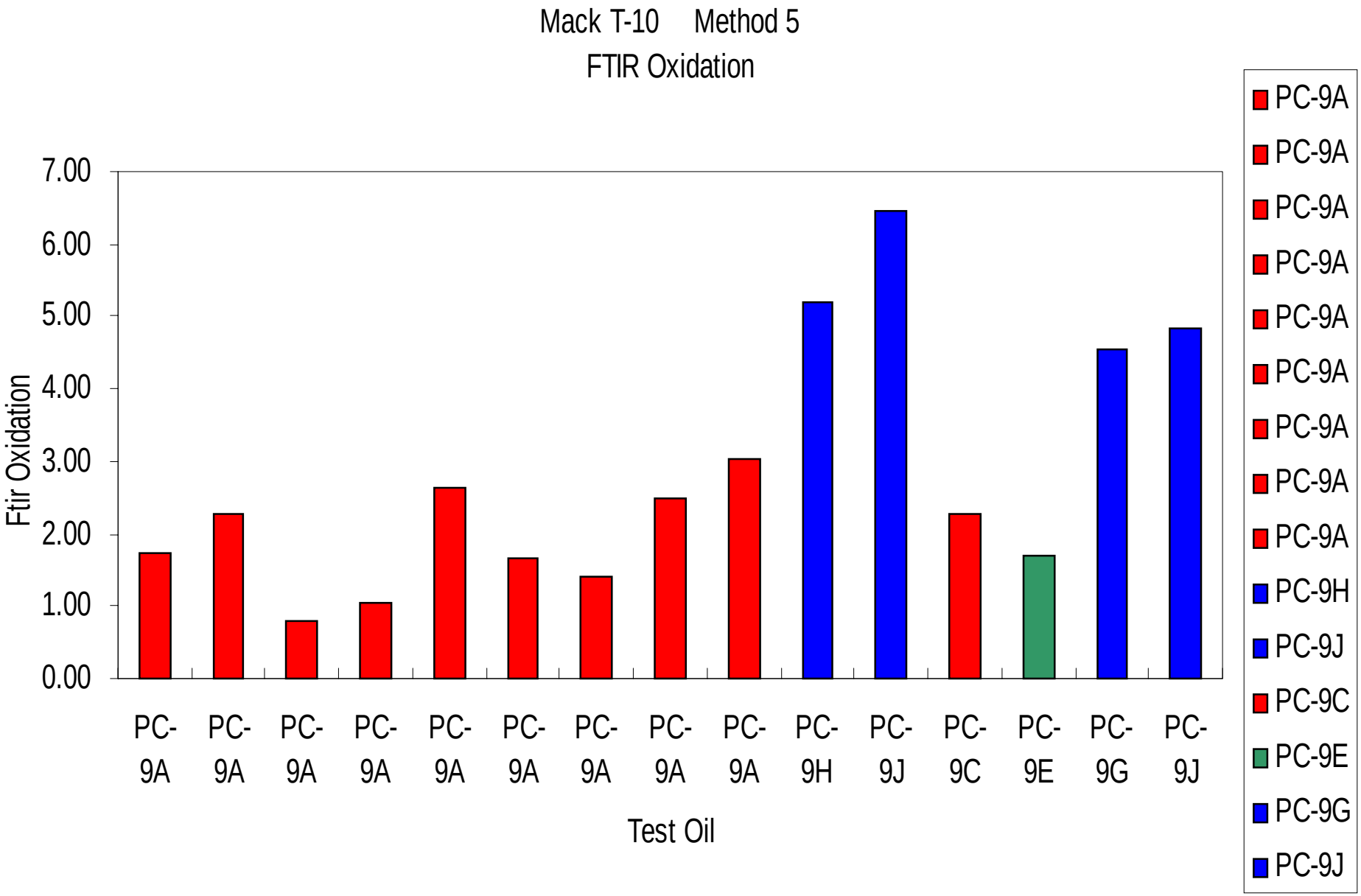
PC-9J


Mack T-10 Method 5
FTIR Oxidation
Ftir Oxidation
7.00
6.00
5.00
4.00
3.00
2.00
1.00
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
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PC-9J
Test Oil
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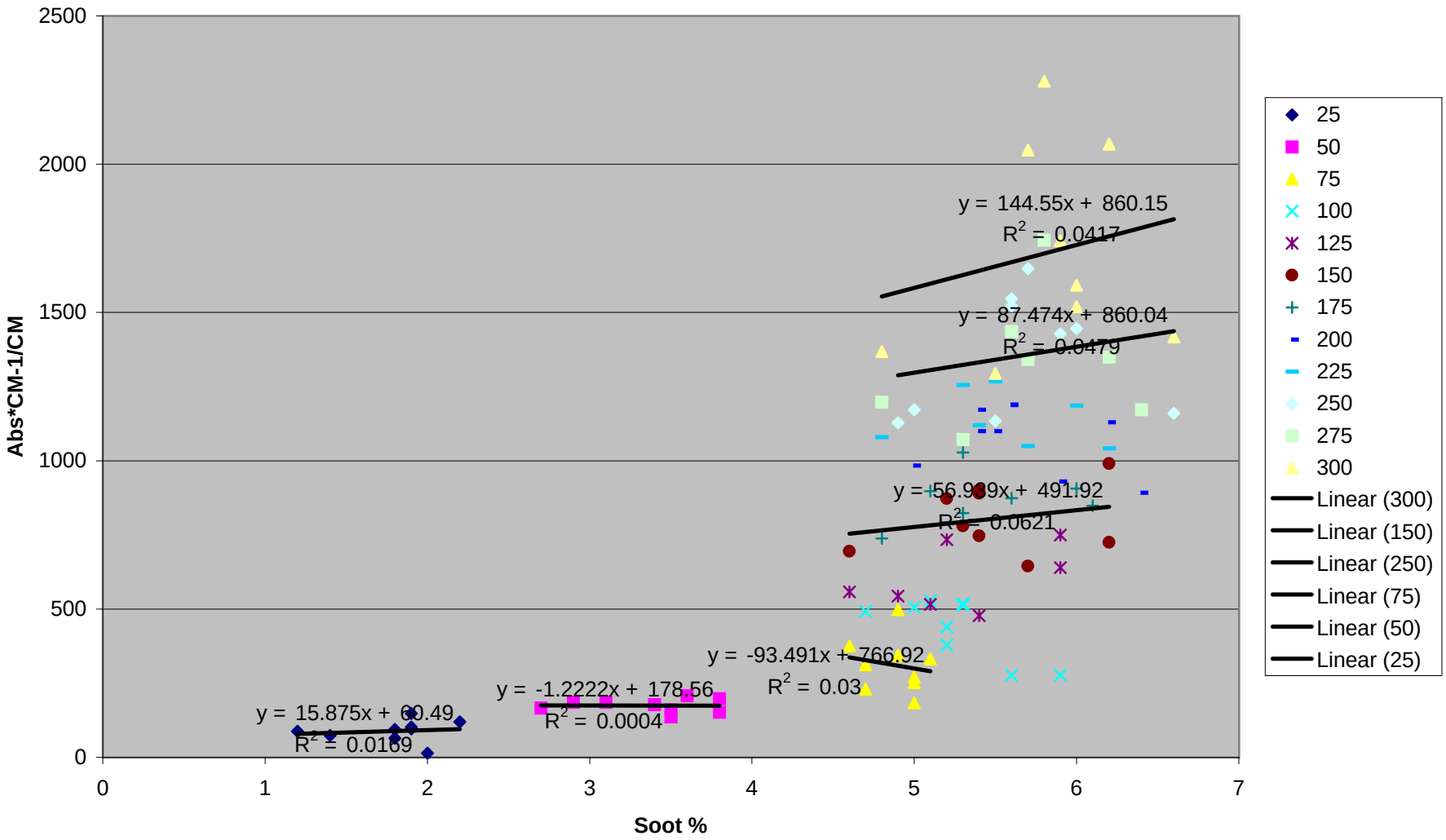
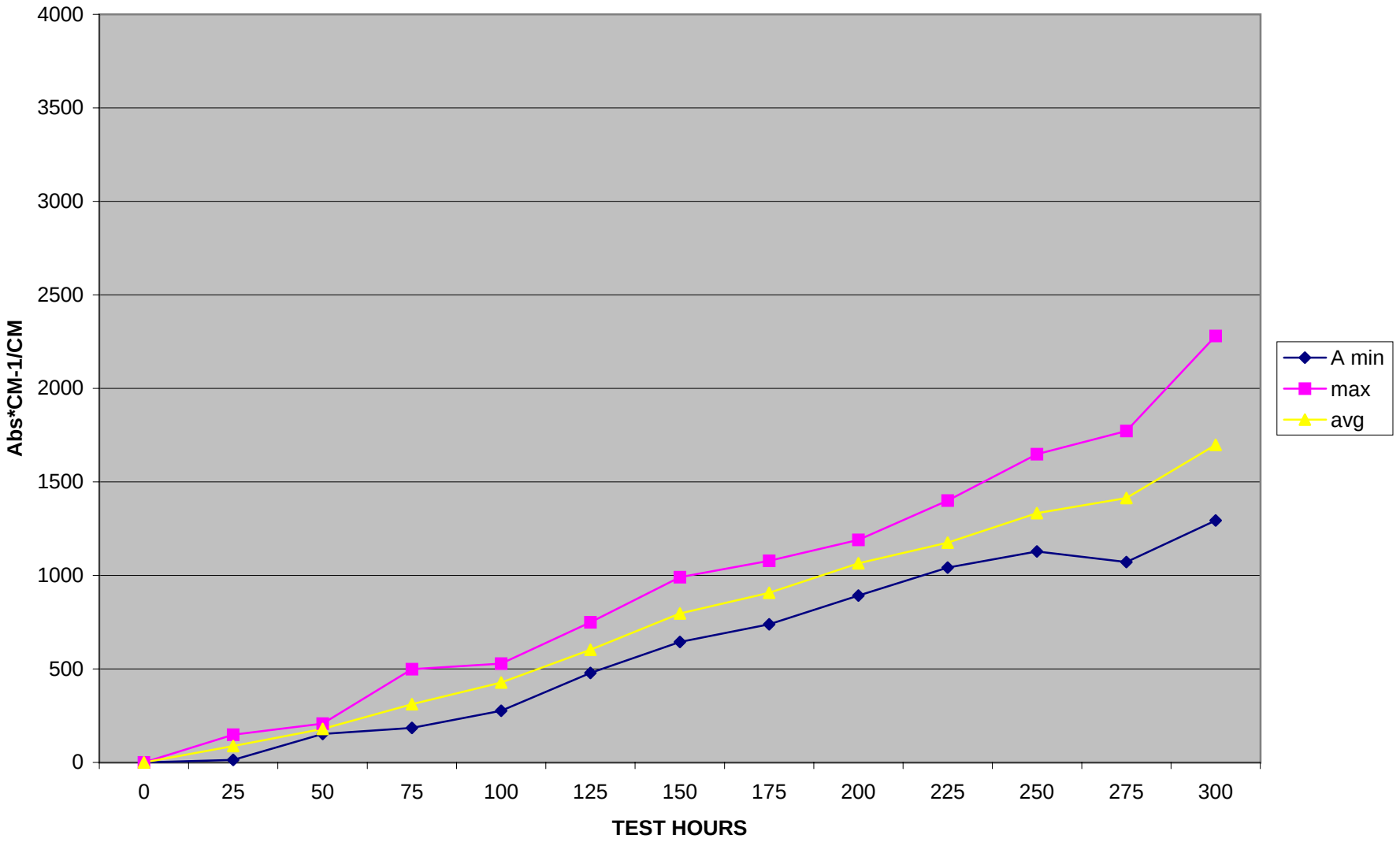
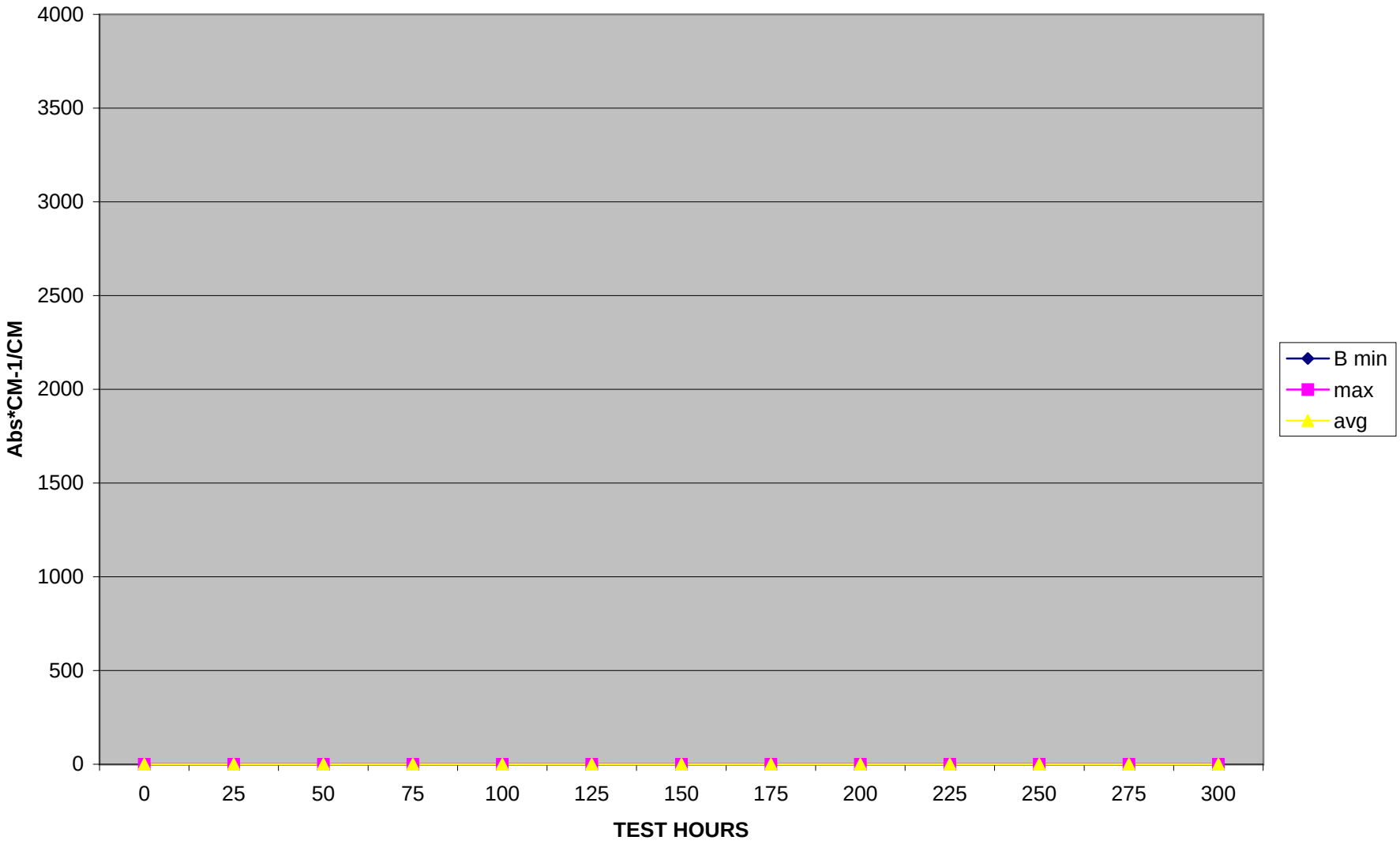
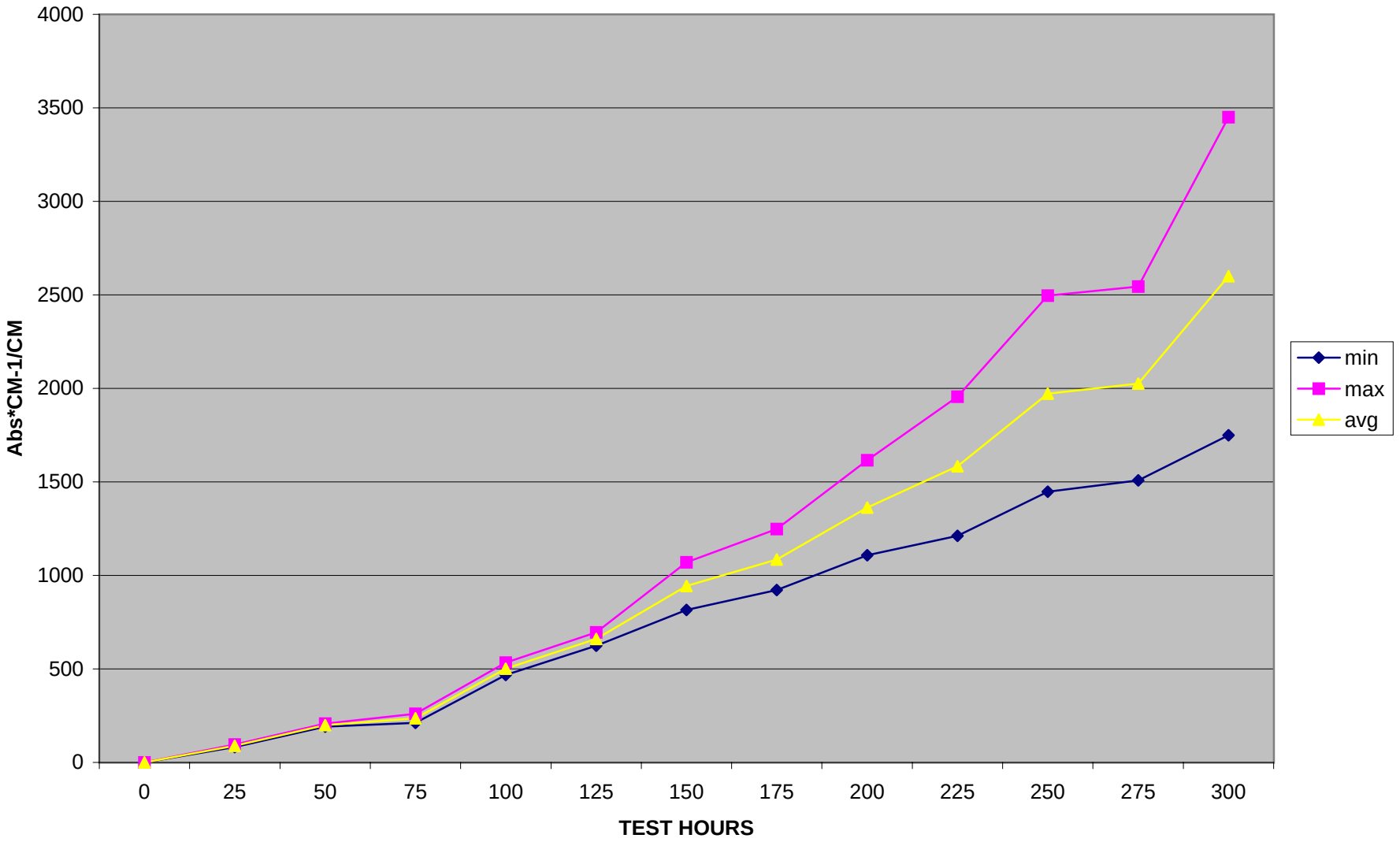
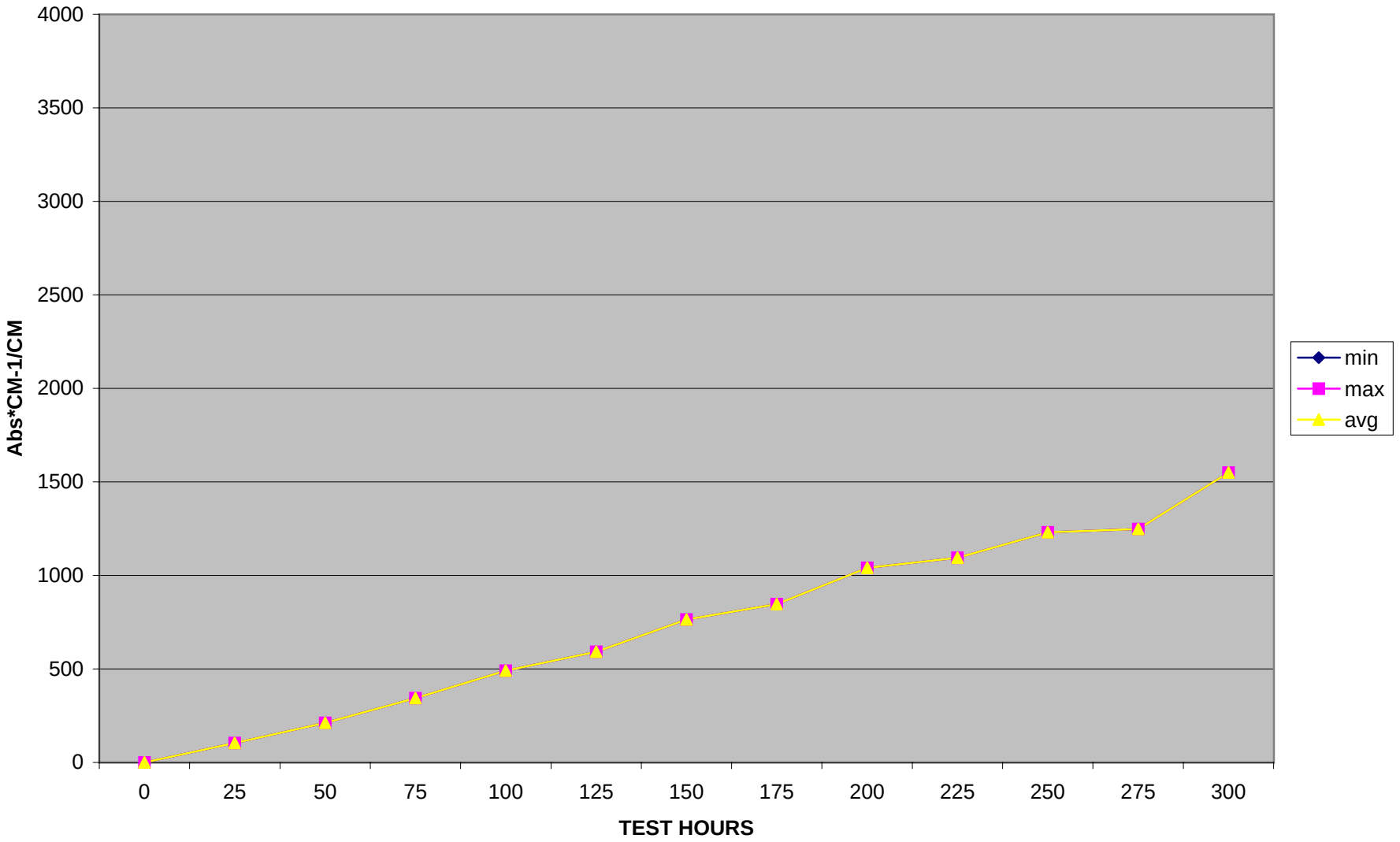
PC-9A
PC-9A
PC-9A
PC-9A
PC-9H
PC-9J
PC-9C
PC-9E
PC-9G
PC-9J

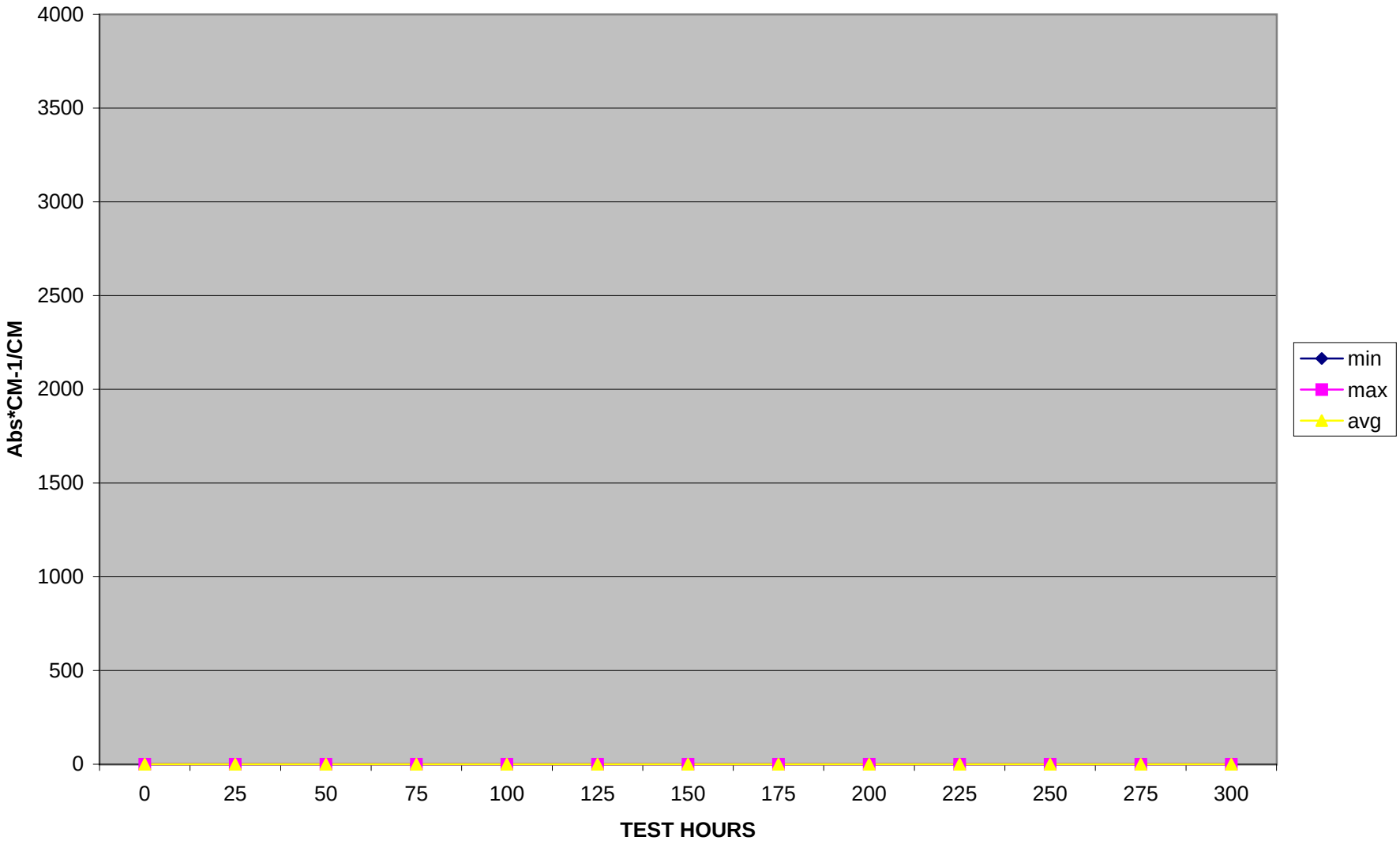

Soot vs. FTIR OX for OIL PC-9A by hours
Method 2 data
Abs*CM-1/CM
Soot %
2500
2000
1500
1000
500
0
0
1
2
3
4
5
6
7
y = 144.55x + 860.15
R2 = 0.0417
y = 87.474x + 860.04
R2 = 0.0479
y = -56.939x + 491.92
R2 = 0.0621
y = -93.491x + 766.92
R2 = 0.03
y = -1.2222x + 178.56
R2 = 0.0004
y = 15.875x + 60.49
R2 = 0.0169
25
50
75
100
125
150
175
200
225
250
275
300
Linear (300)
Linear (150)
Linear (250)
Linear (75)
Linear (50)
Linear (25)

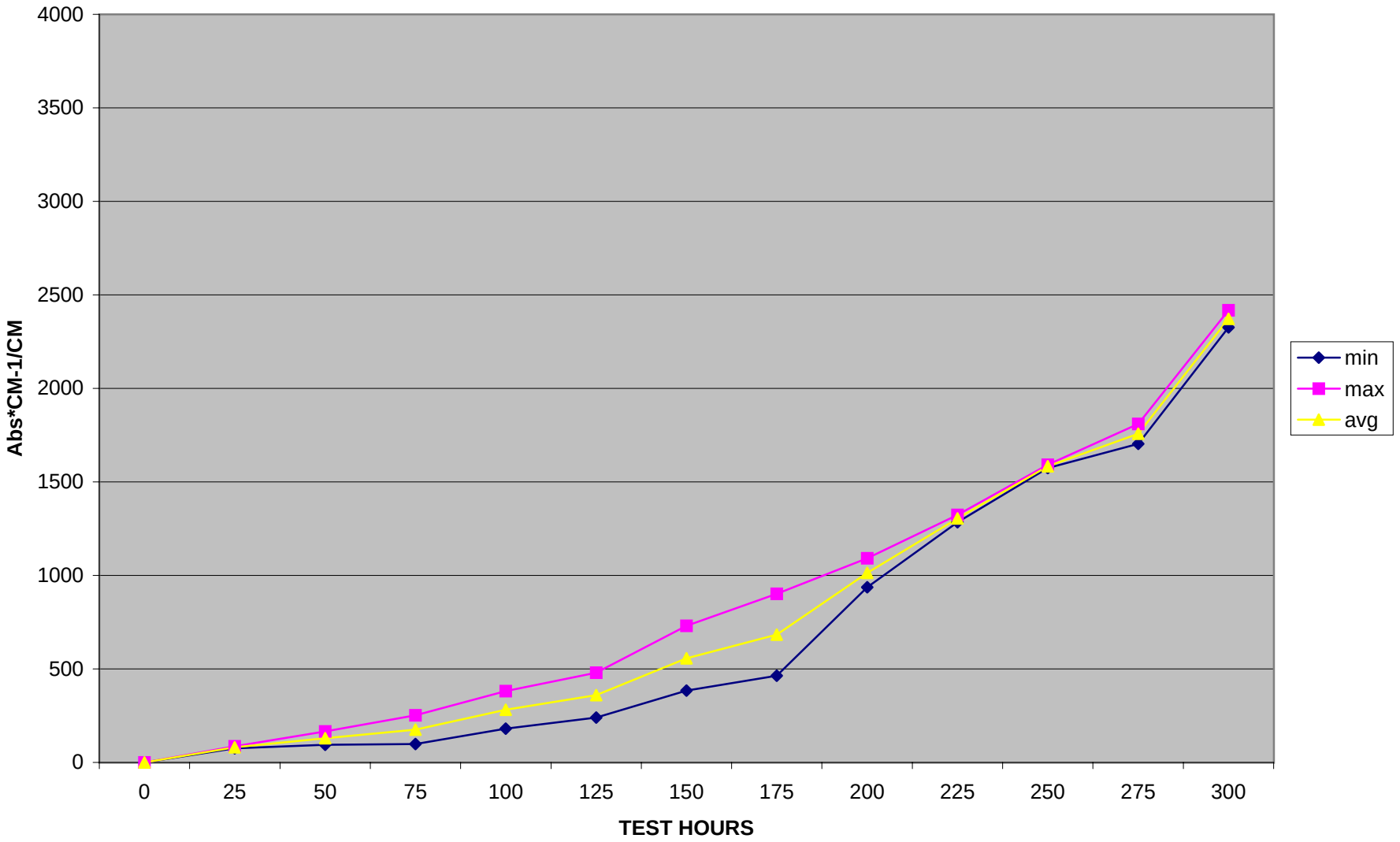

OIL PC-9A min/max/avg Method 2
Abs*CM-1/CM
4000
3500
3000
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
250
275
300
TEST HOURS
A min
max
avg


Oil PC-9B MIN/MAX/AVG Method 2
Abs*CM-1/CM
4000
3500
3000
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
250
275
300
TEST HOURS
B min
max
avg

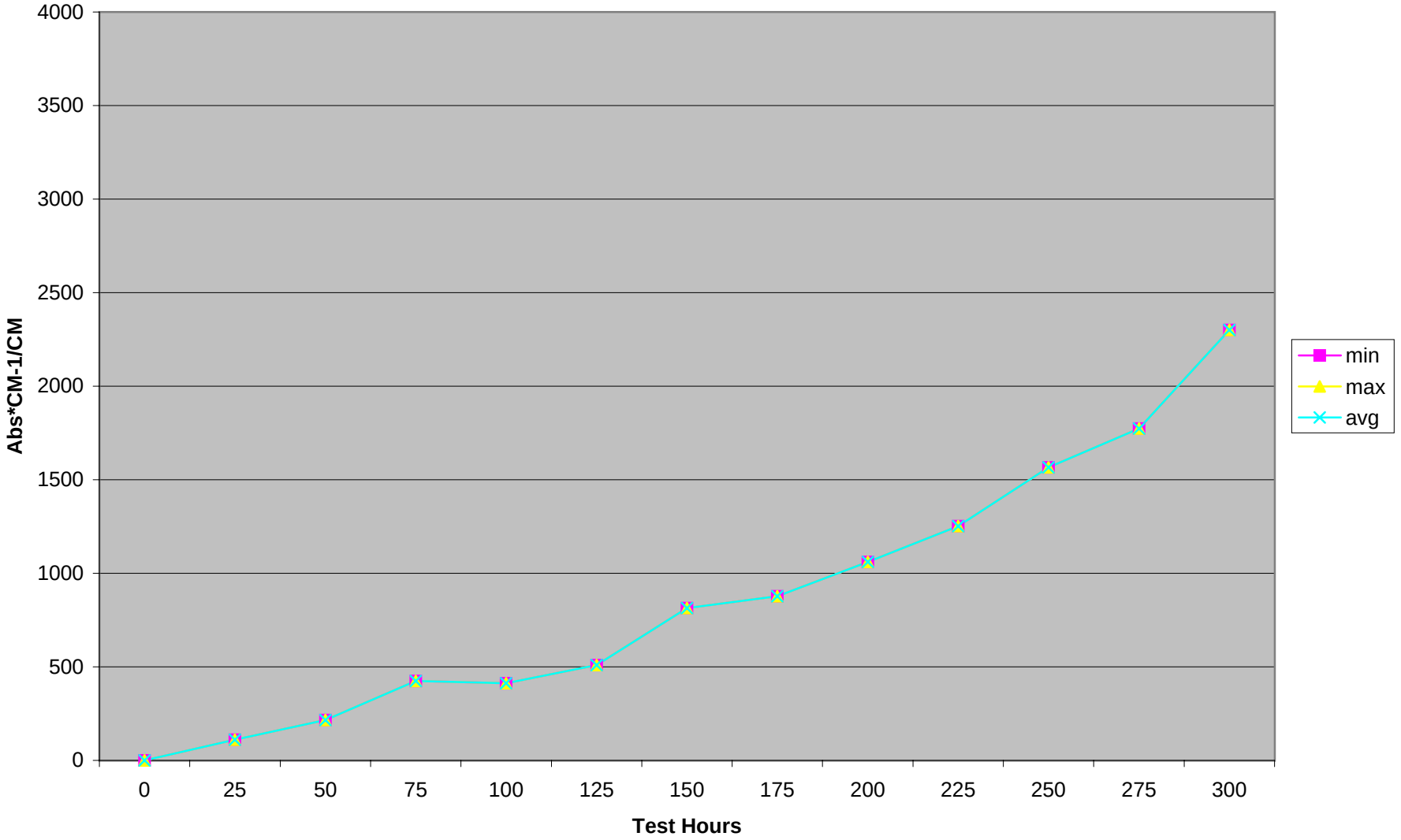

OIL PC-9C MIN/MAX/AVG Method 2
Abs*CM-1/CM
4000
3500
3000
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
250
275
300
TEST HOURS
min
max
avg

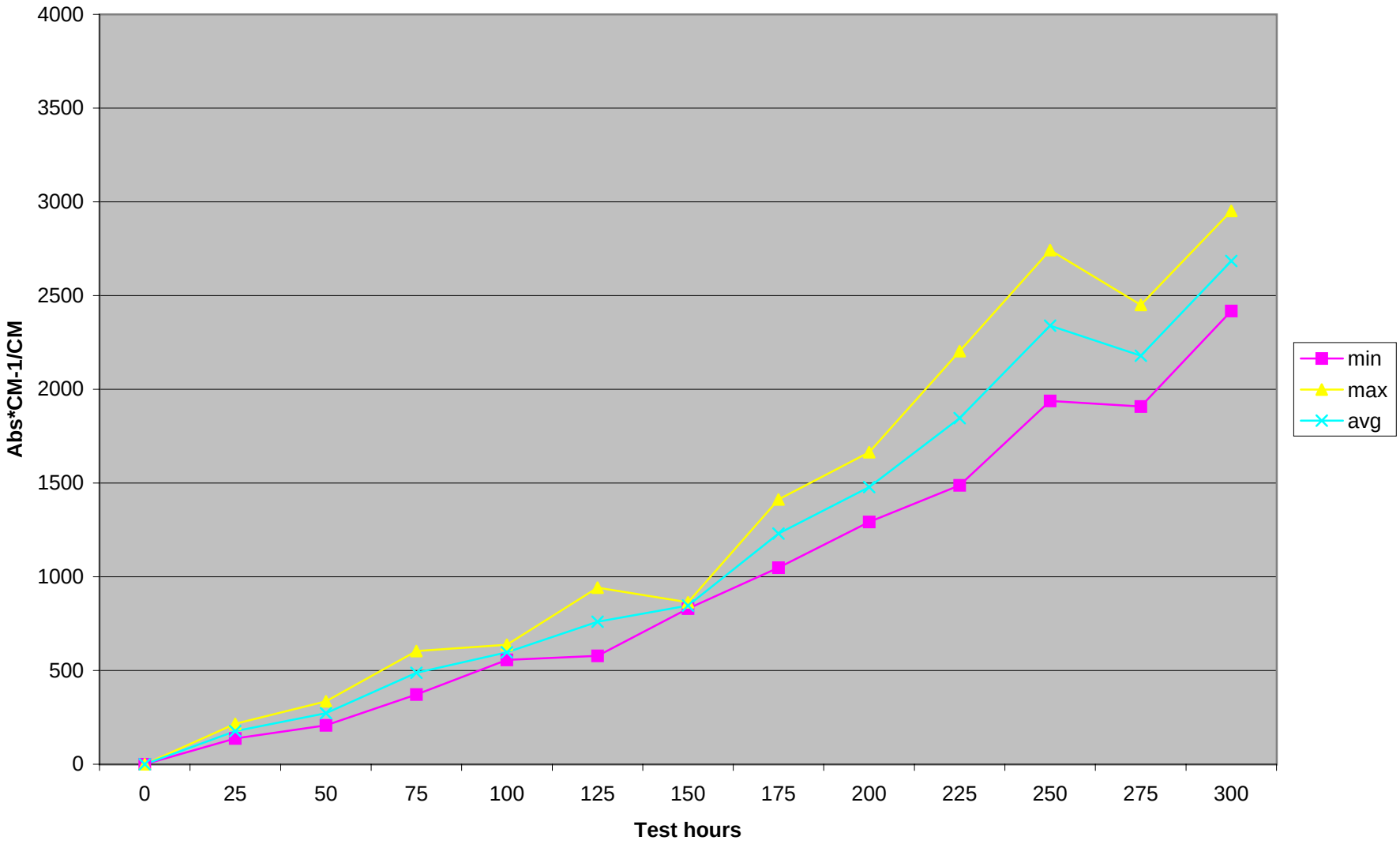

OIL PC-9E MIN/MAX/AVG Method 2
Abs*CM-1/CM
4000
3500
3000
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
250
275
300
TEST HOURS
min
max
avg


OIL PC-9F MIN/MAX/AVG Method 2
Abs*CM-1/CM
4000
3500
3000
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
250
275
300
TEST HOURS
min
max
avg

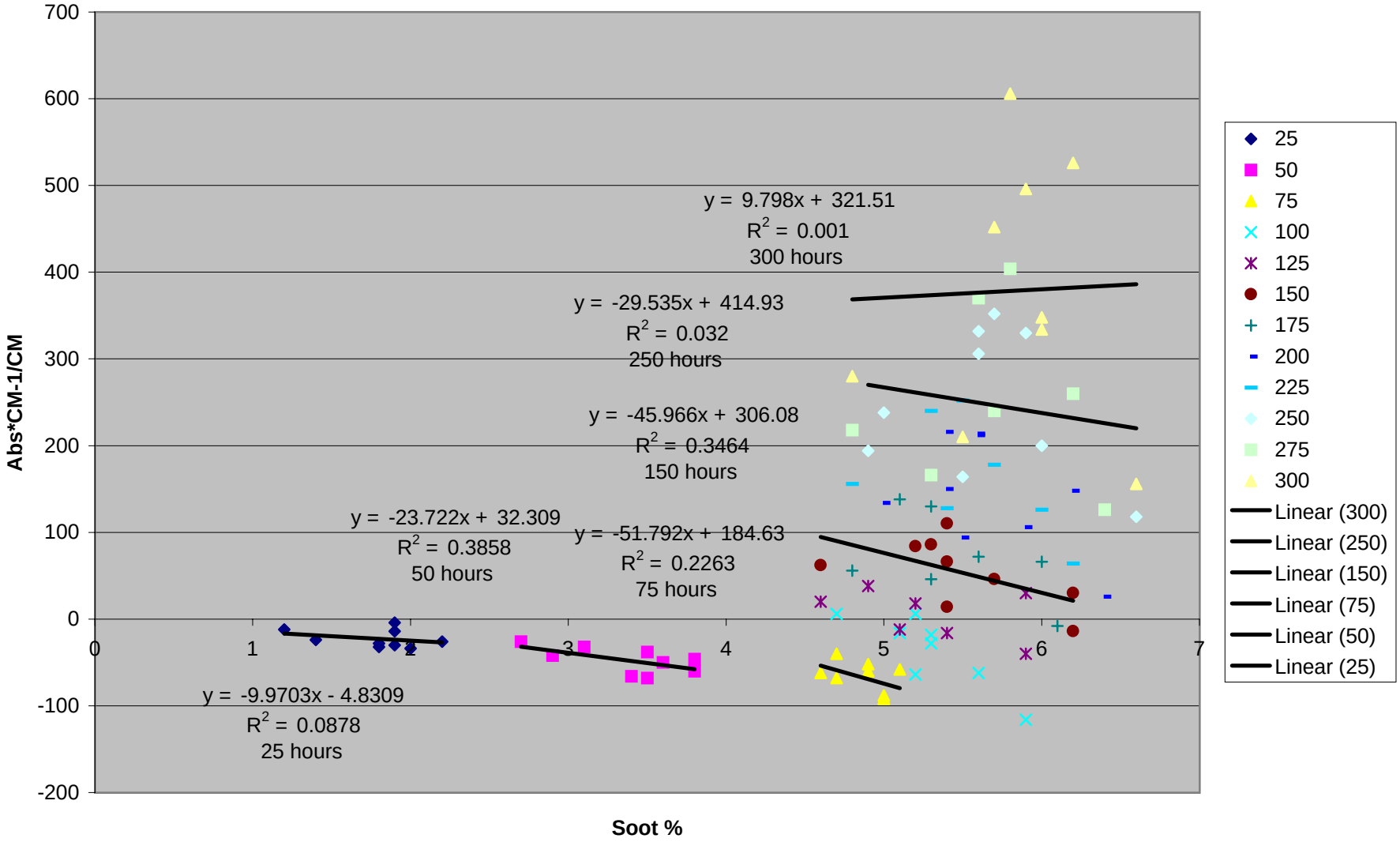

OIL PC-9H MIN/MAX/AVG Method 2
Abs*CM-1/CM
4000
3500
3000
2500
2000
1500
1000
500
0
0
25
50
75
100
125
150
175
200
225
250
275
300
TEST HOURS
min
max
avg

Oil PC-9G Min/Max/Avg. Method 2

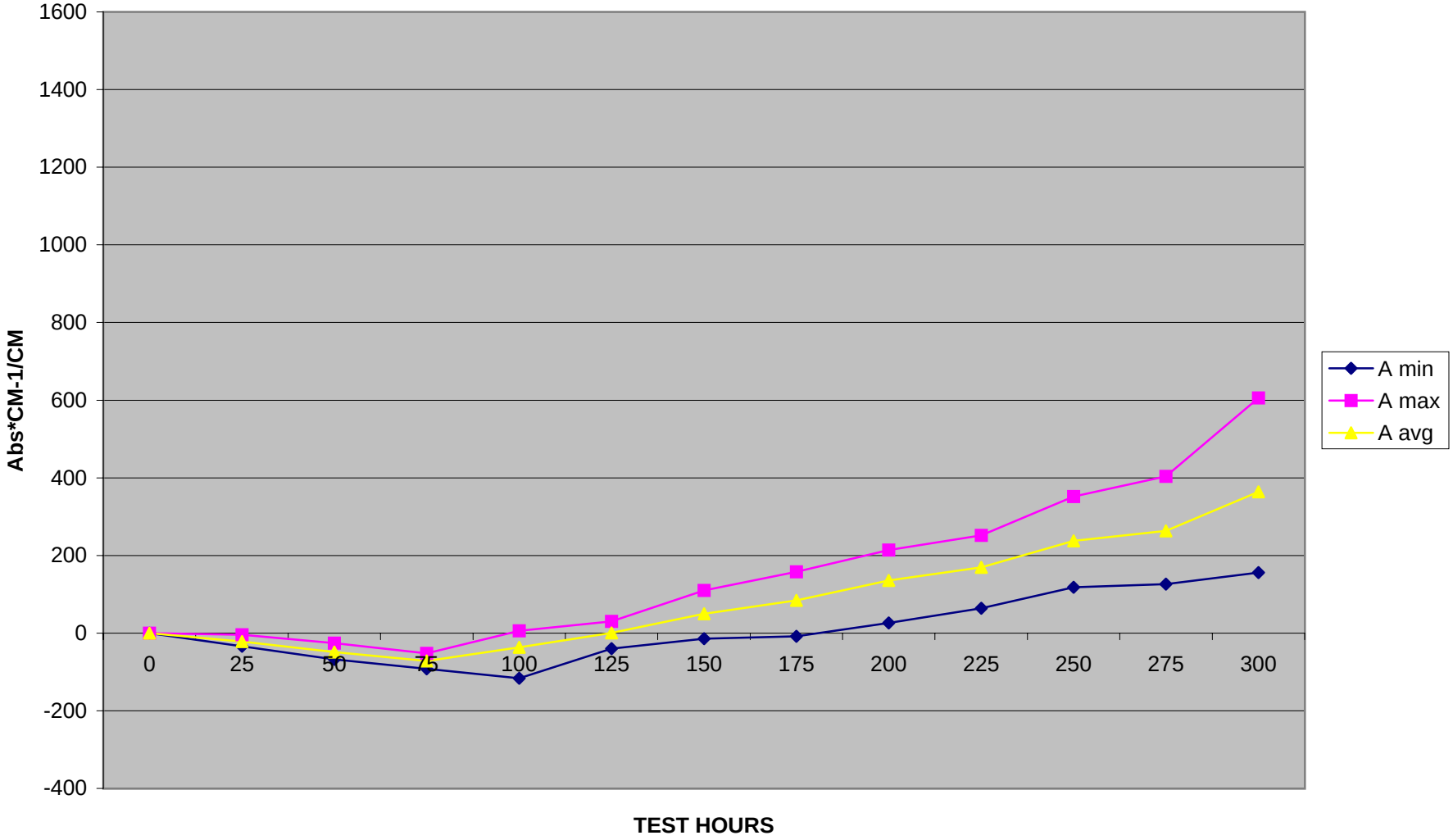




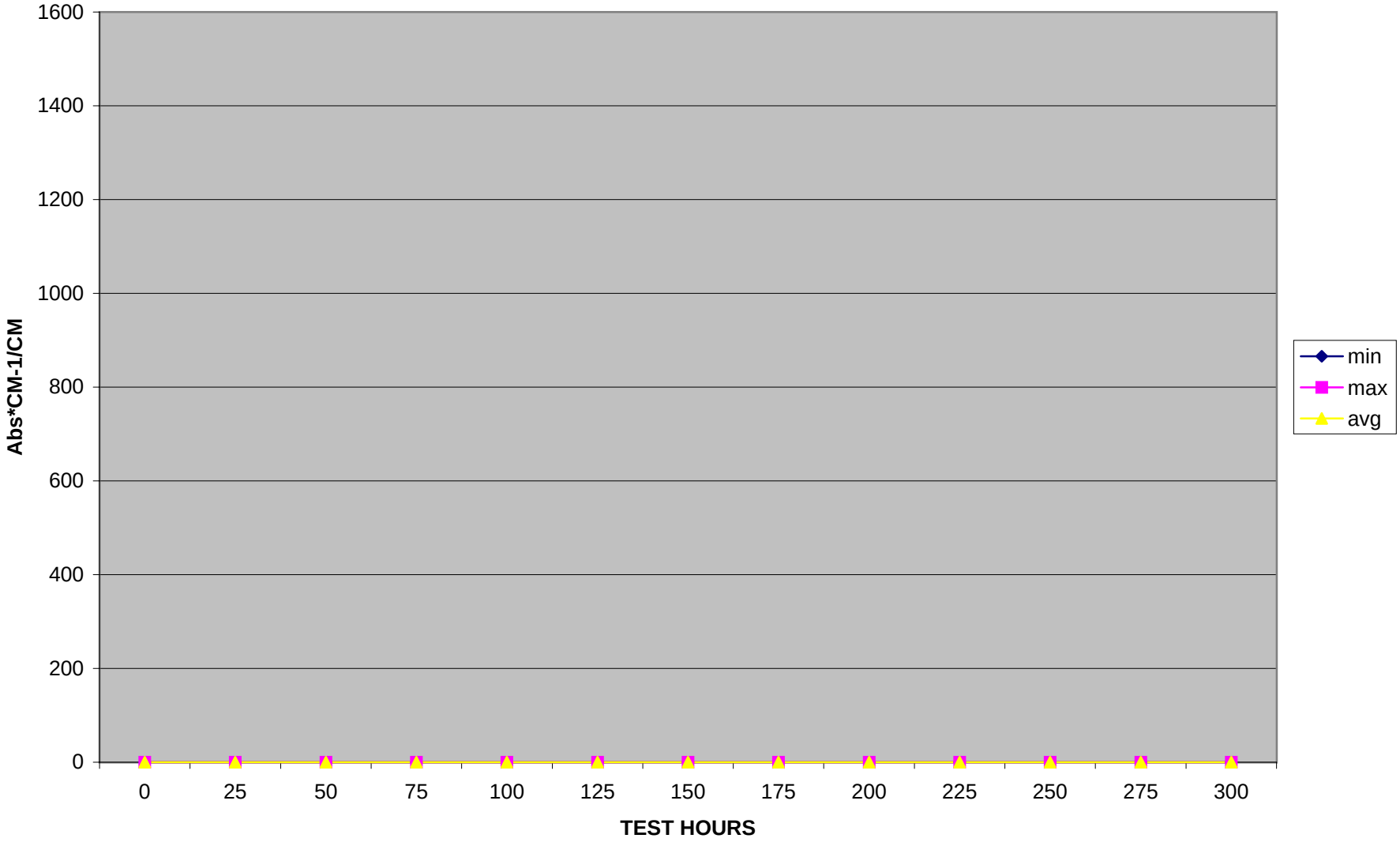
Soot vs. FTIR OX by hours Method 5

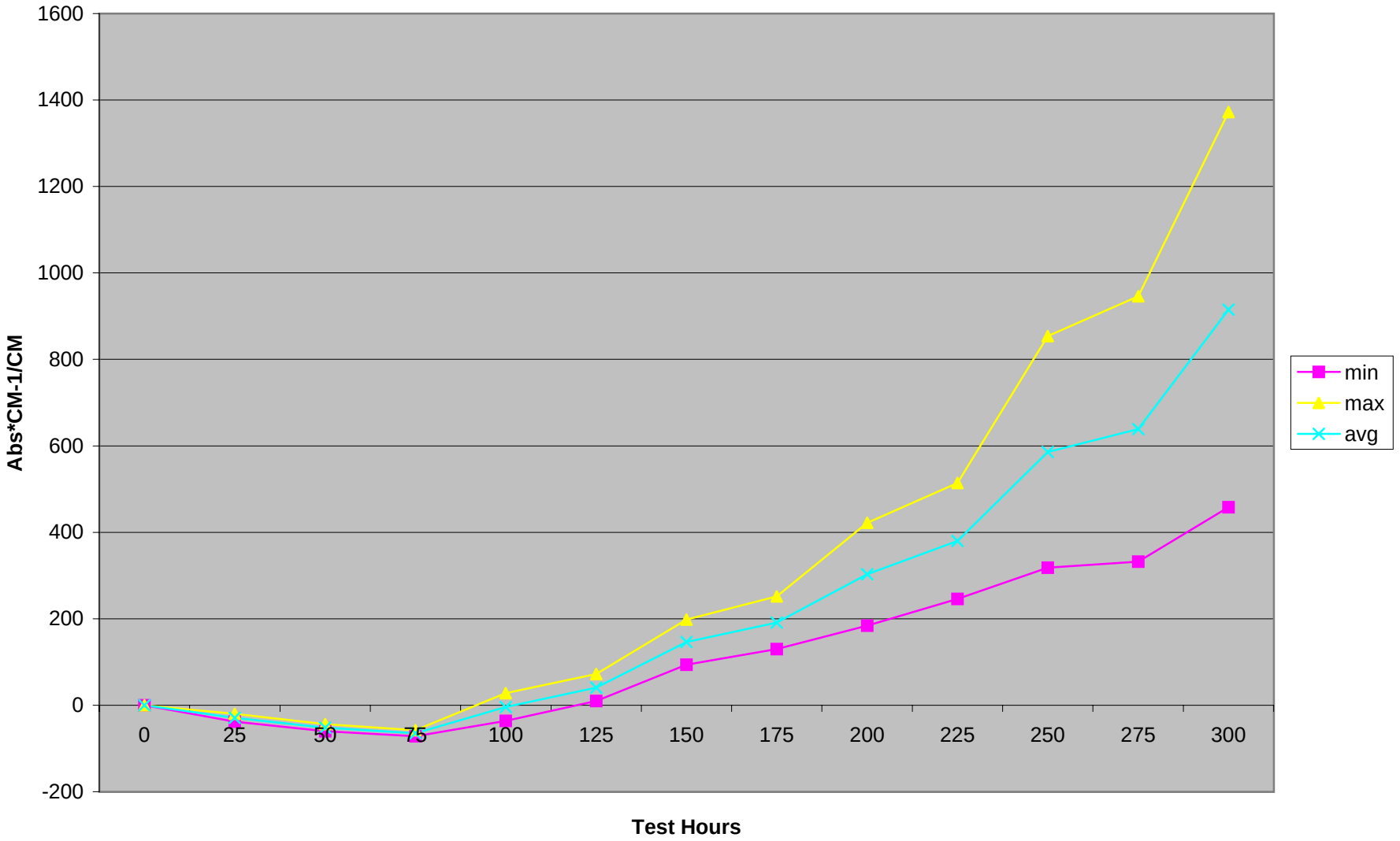


OIL PC-9A MIN/MAX/AVG
Method 5

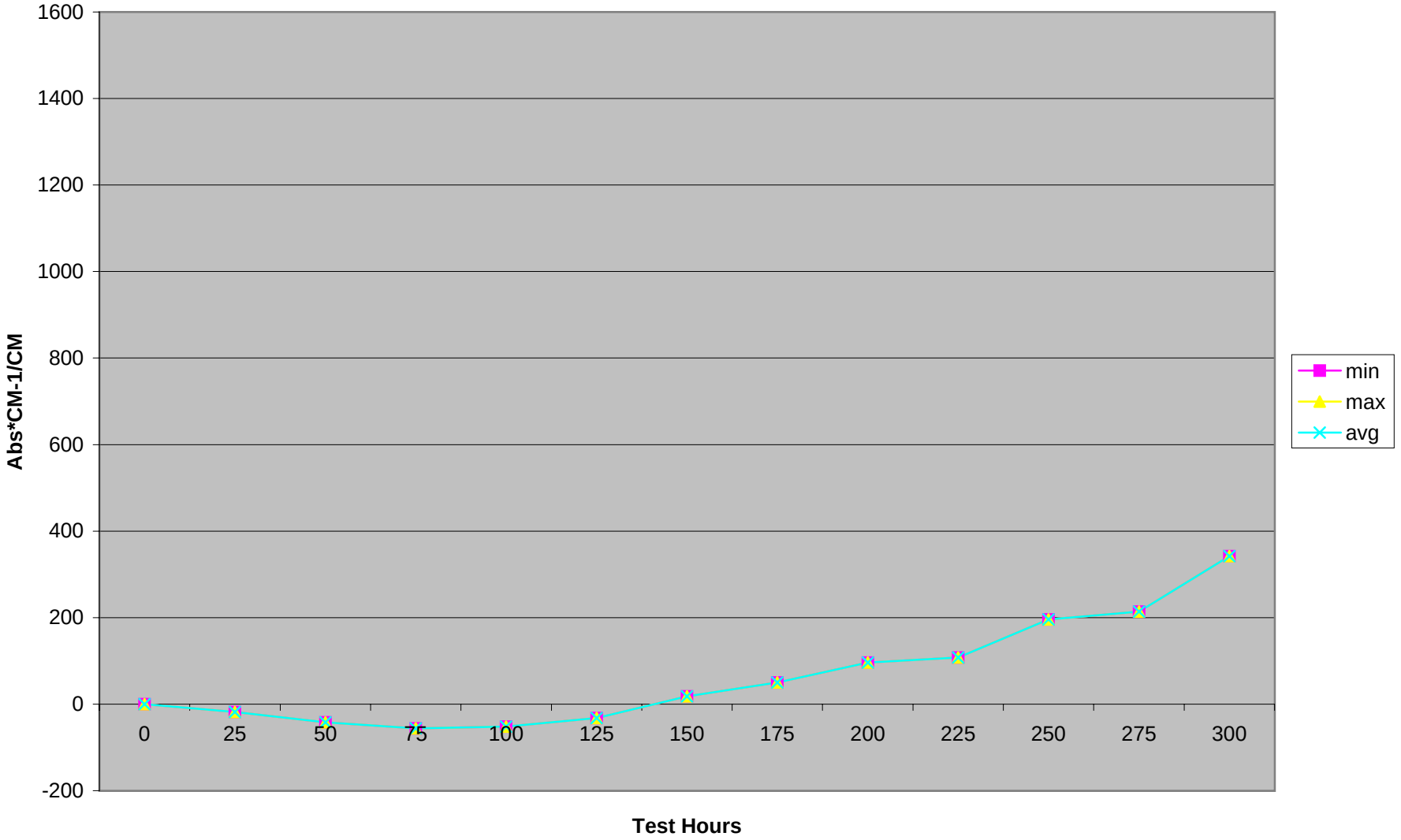


OIL PC-9B MIN/MAX/AVG Method 5

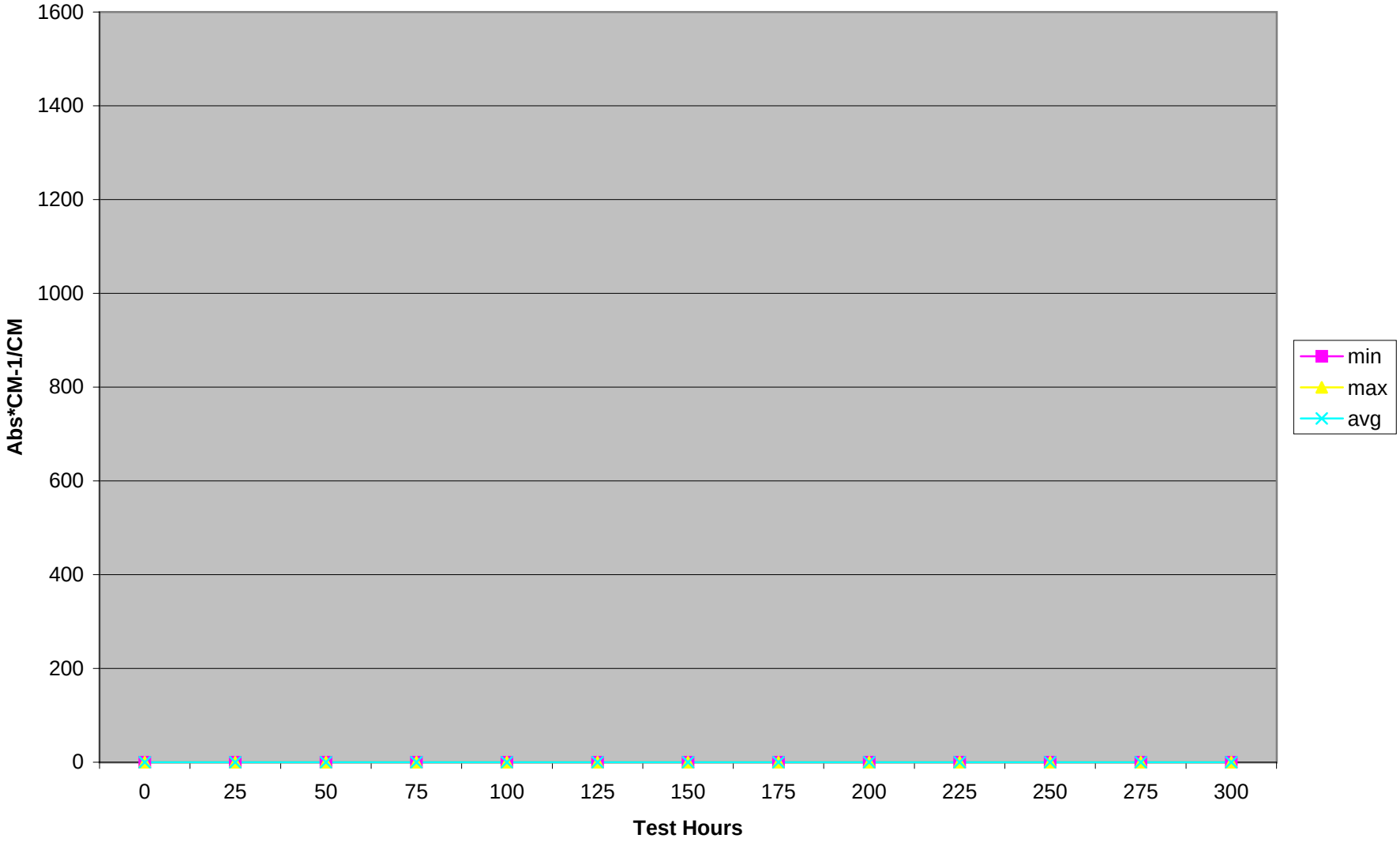



OIL PC-9C Min/Max/Avg Method 5
Abs*CM-1/CM
1600
1400
1200
1000
800
600
400
200
0
-200
0
25
50
75
100
125
150
175
200
225
250
275
300
Test Hours
min
max
avg

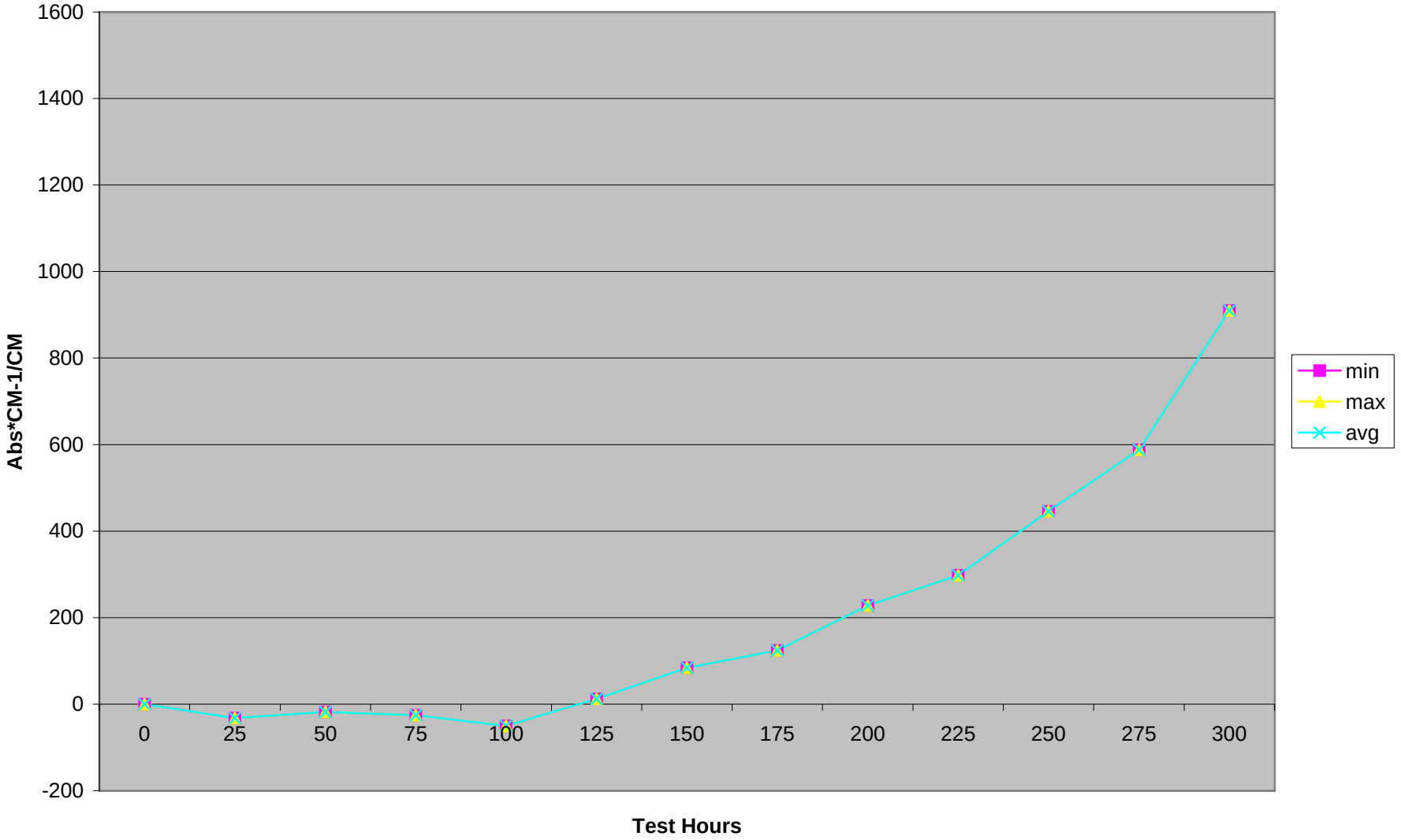
OIL PC-9E Min/Max/Avg Method 5

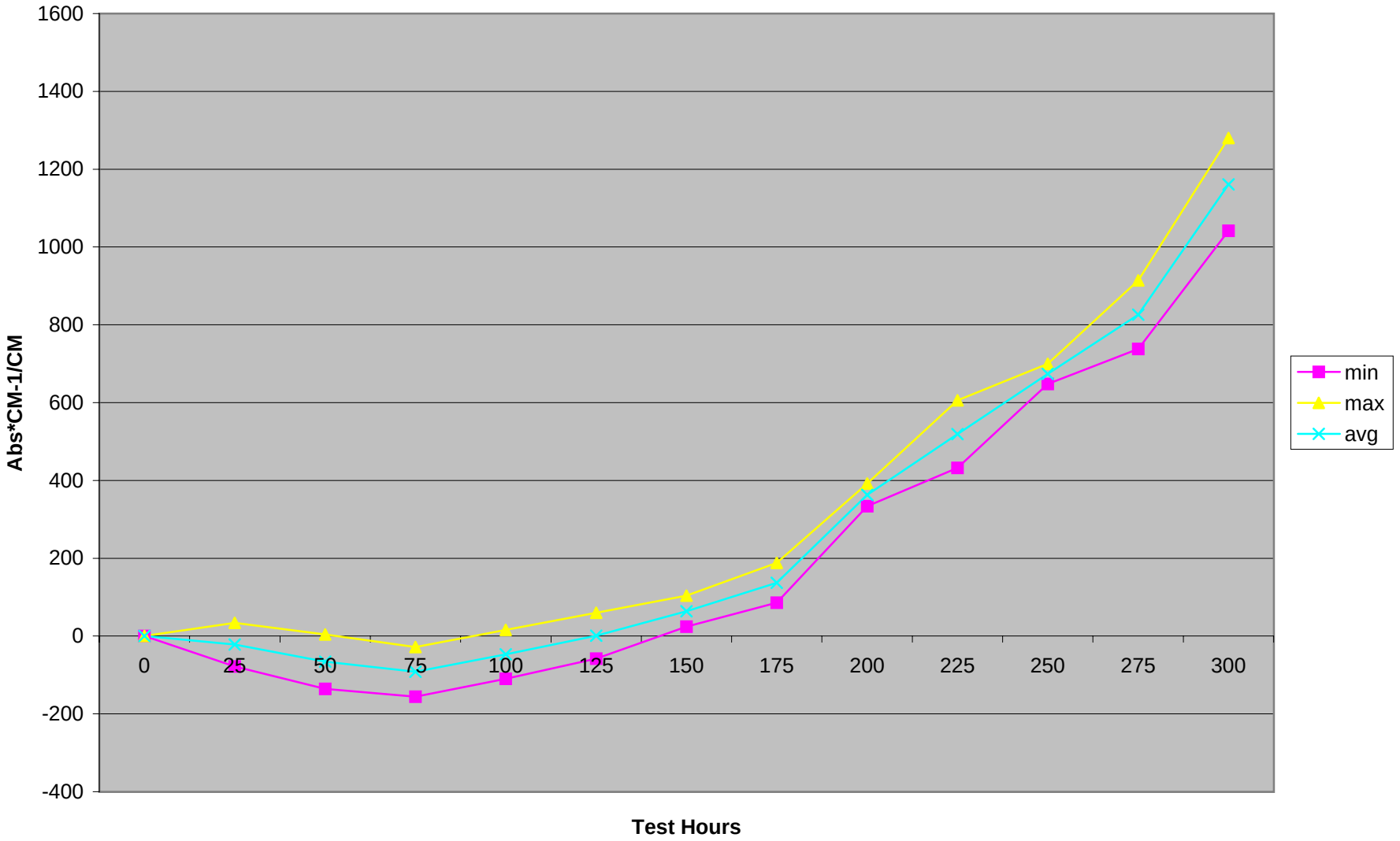


OIL PC-9F Min/Max/Avg Method 5

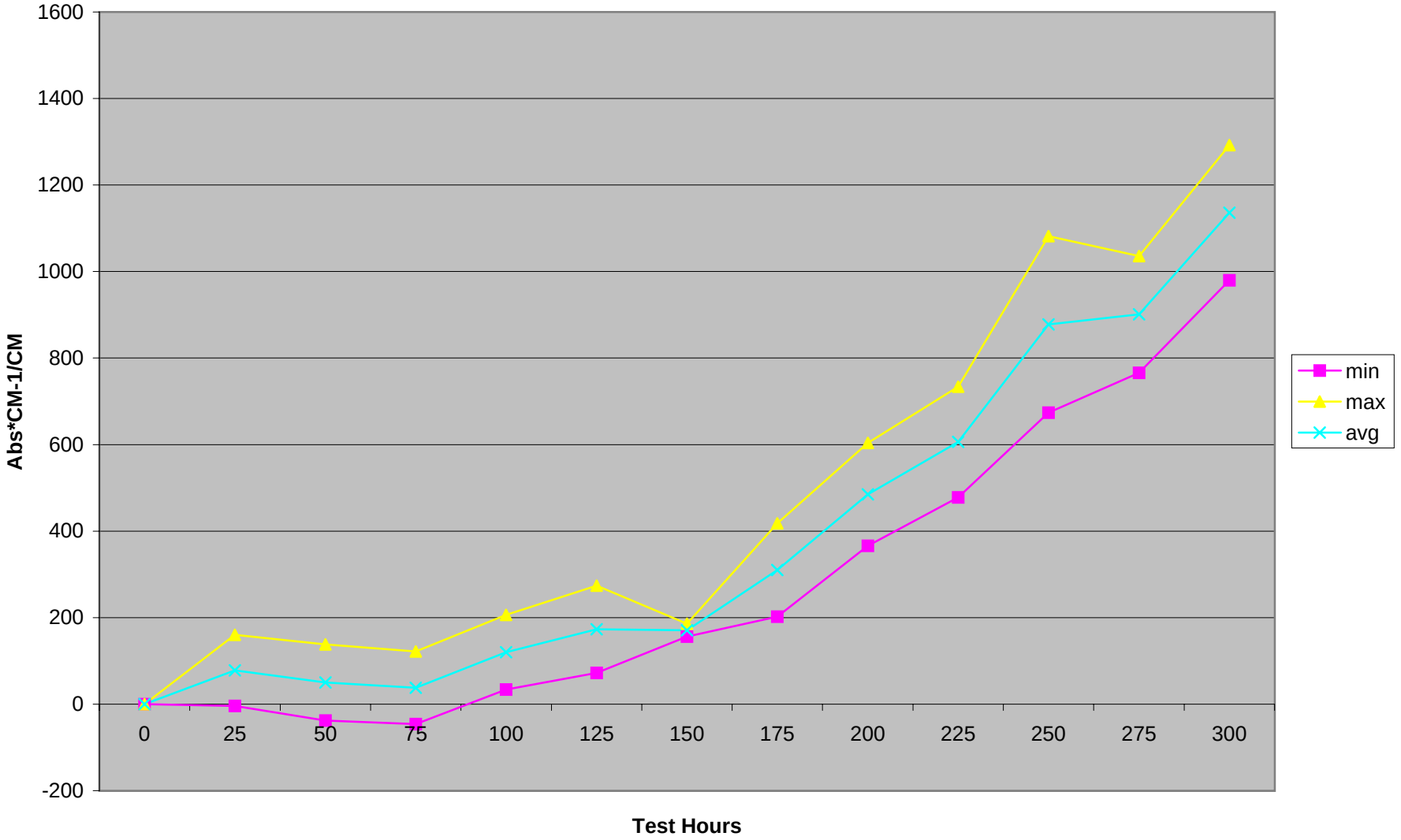


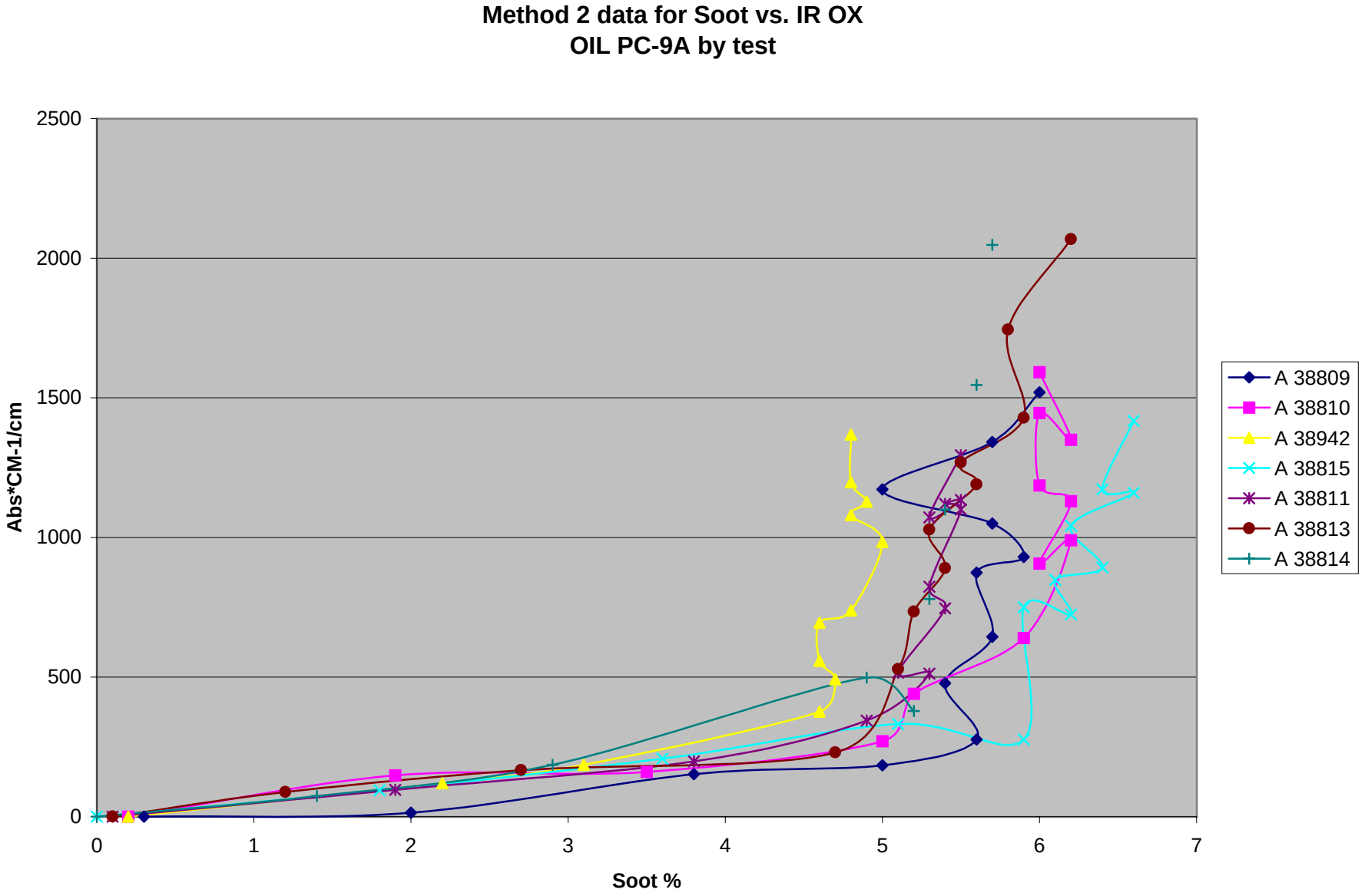
OIL PC-9G Min/Max/Avg Method 5



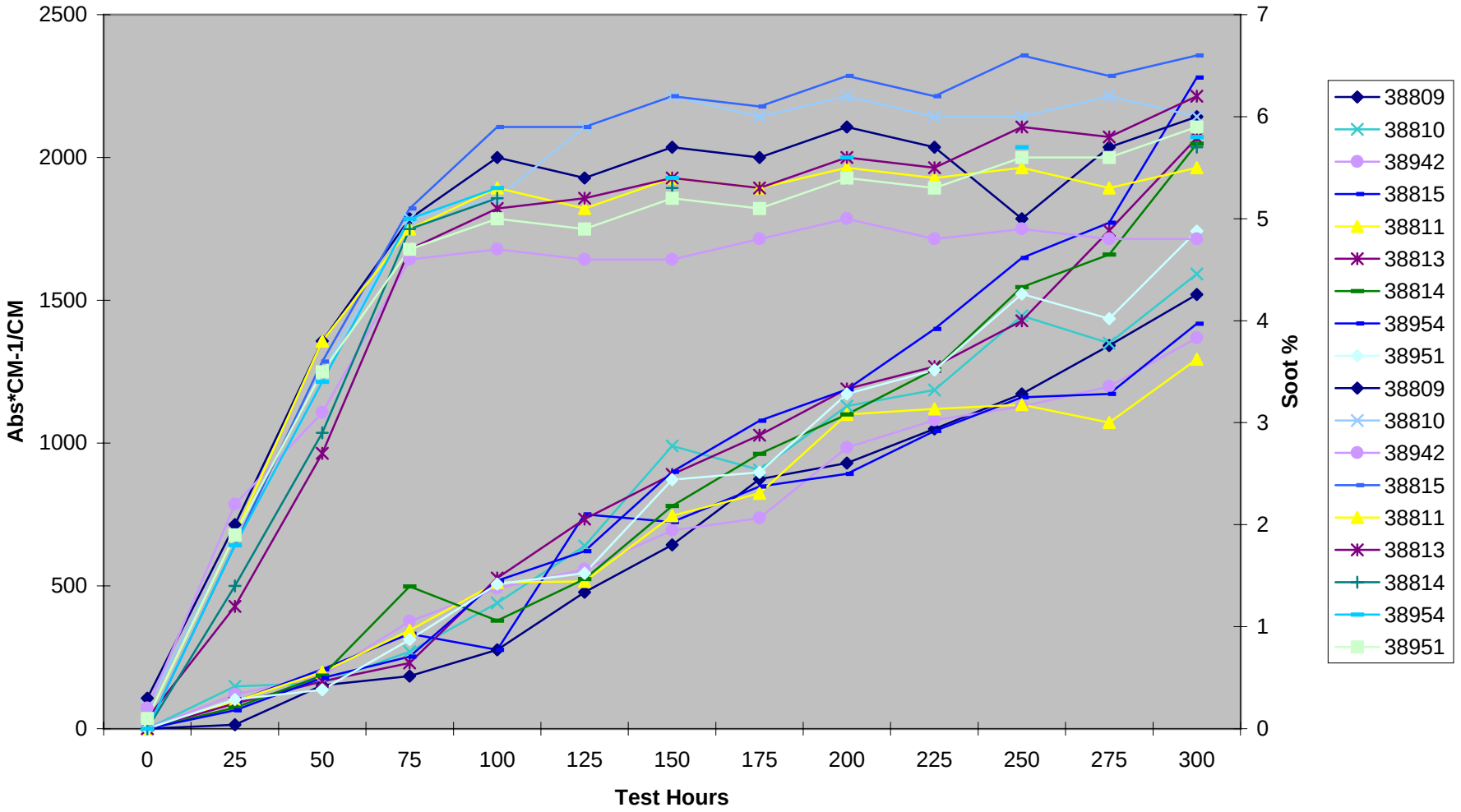

OIL PC-9H Min/Max/Avg Method 5
Abs*CM-1/CM
1600
1400
1200
1000
800
600
400
200
0
-200
-400
0
25
50
75
100
125
150
175
200
225
250
275
300
Test Hours
min
max
avg

OIL PC-9J Min/Max/Avg Method 5

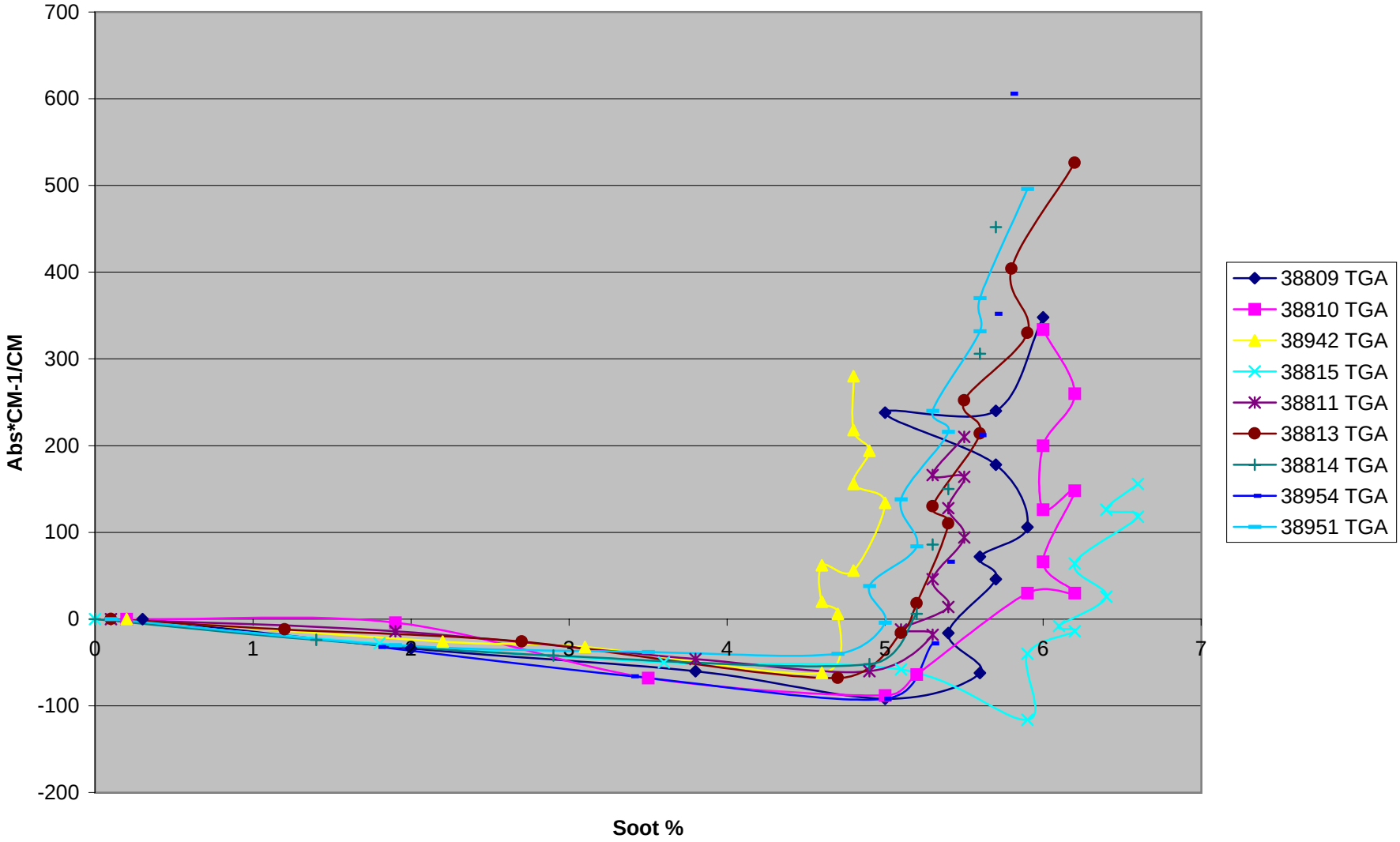



Method 2 data for Soot vs. IR OX
OIL PC-9A by test
Abs*CM-1/cm
2500
2000
1500
1000
500
0
0
1
2
3
4
5
6
7
Soot %
A 38809
A 38810
A 38942
A 38815
A 38811
A 38813
A 38814

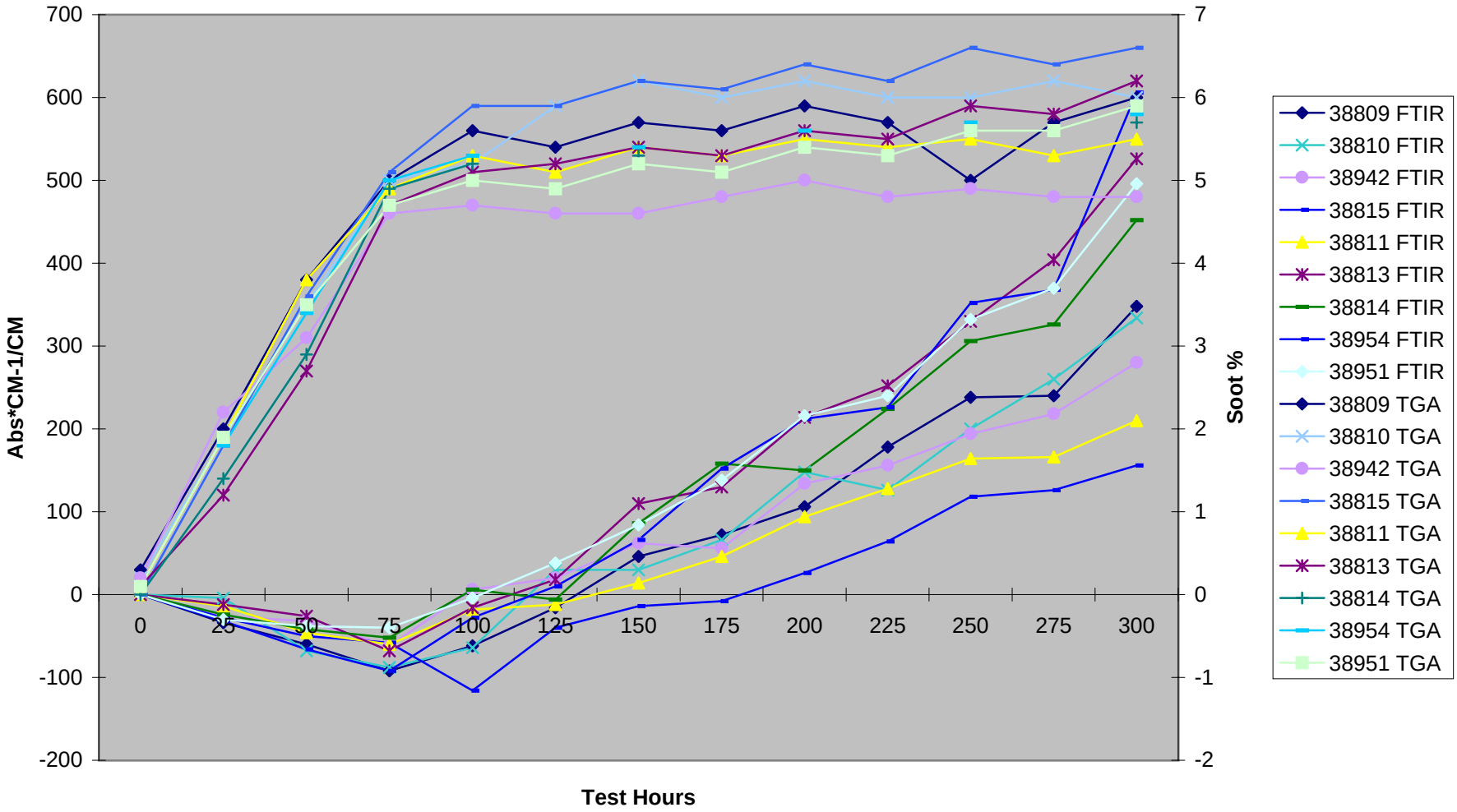
2 Axis Plot of Soot and FTIR
Oil PC-9A data
Method 2



Soot vs. FTIR OX by test Method 5



2 Axis Plot of Soot and FTIR
Oil PC-9A data
Method 5



M11 EGR Test Matrix Status

Presentation to
HDEOCP
May 25, 2001
David M Stehouwer

M-11 EGR Test Matrix Status

- All runs on Oil E are Complete
- Only 3 runs remain
- Expect Matrix completion no later than 6/18

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

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M11 EGR: Status of Data Analysis

- Full data sets from 16 of 26 runs
- 7 additional runs are completed and in process

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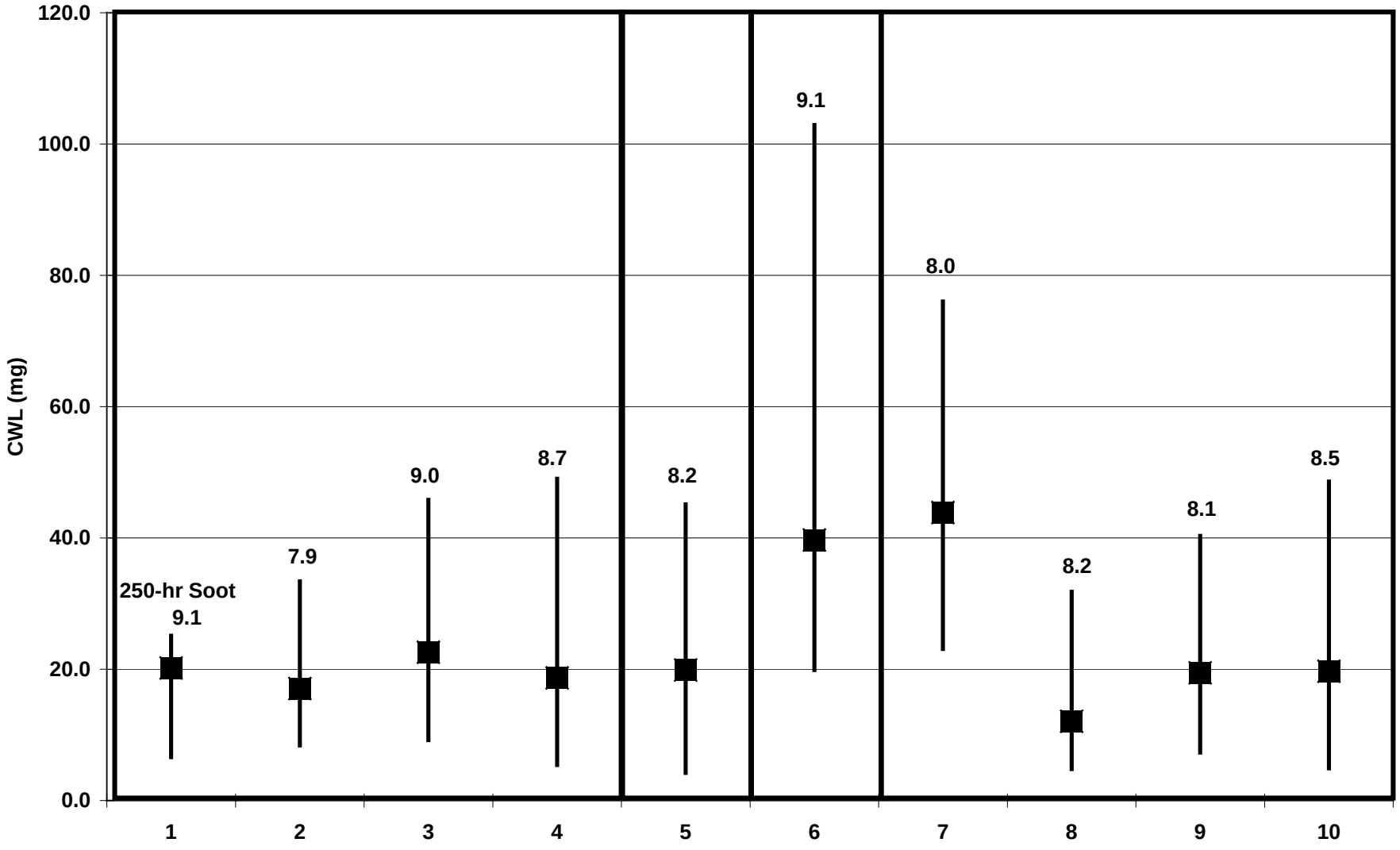
Crosshead Weight Loss - Matrix Oil E



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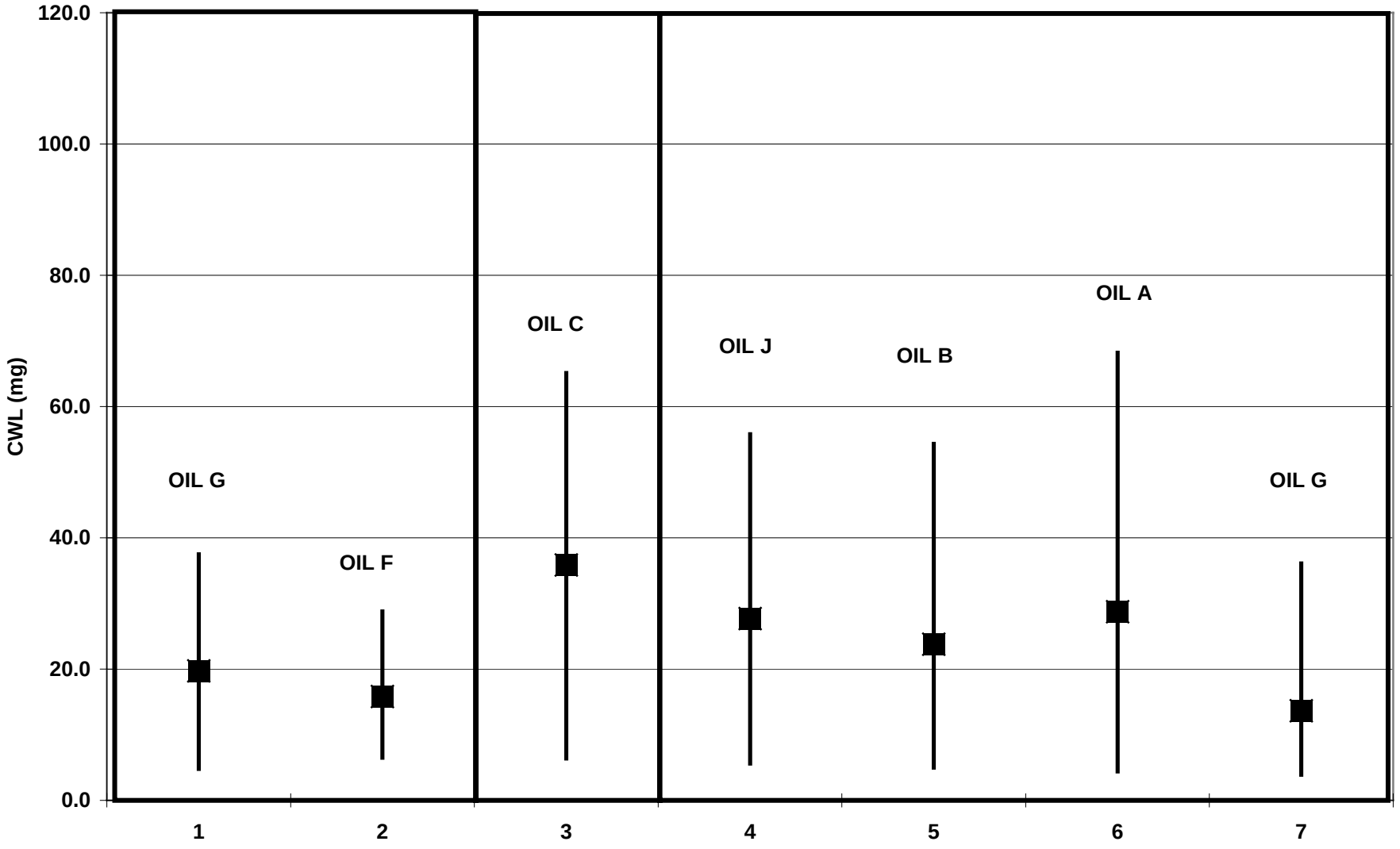
Crosshead Weight Loss



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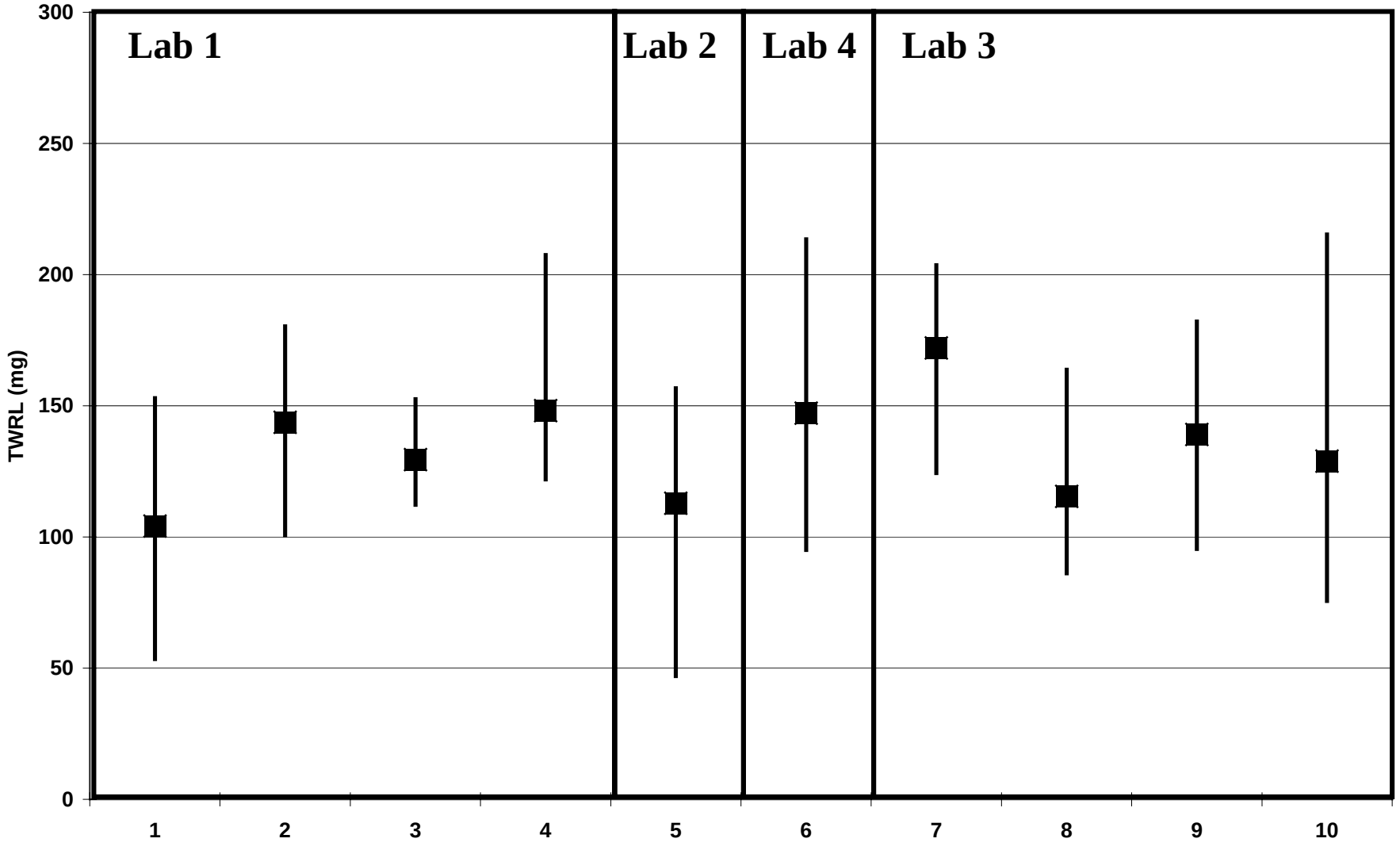
Top Ring Weight Loss - Matrix Oil E



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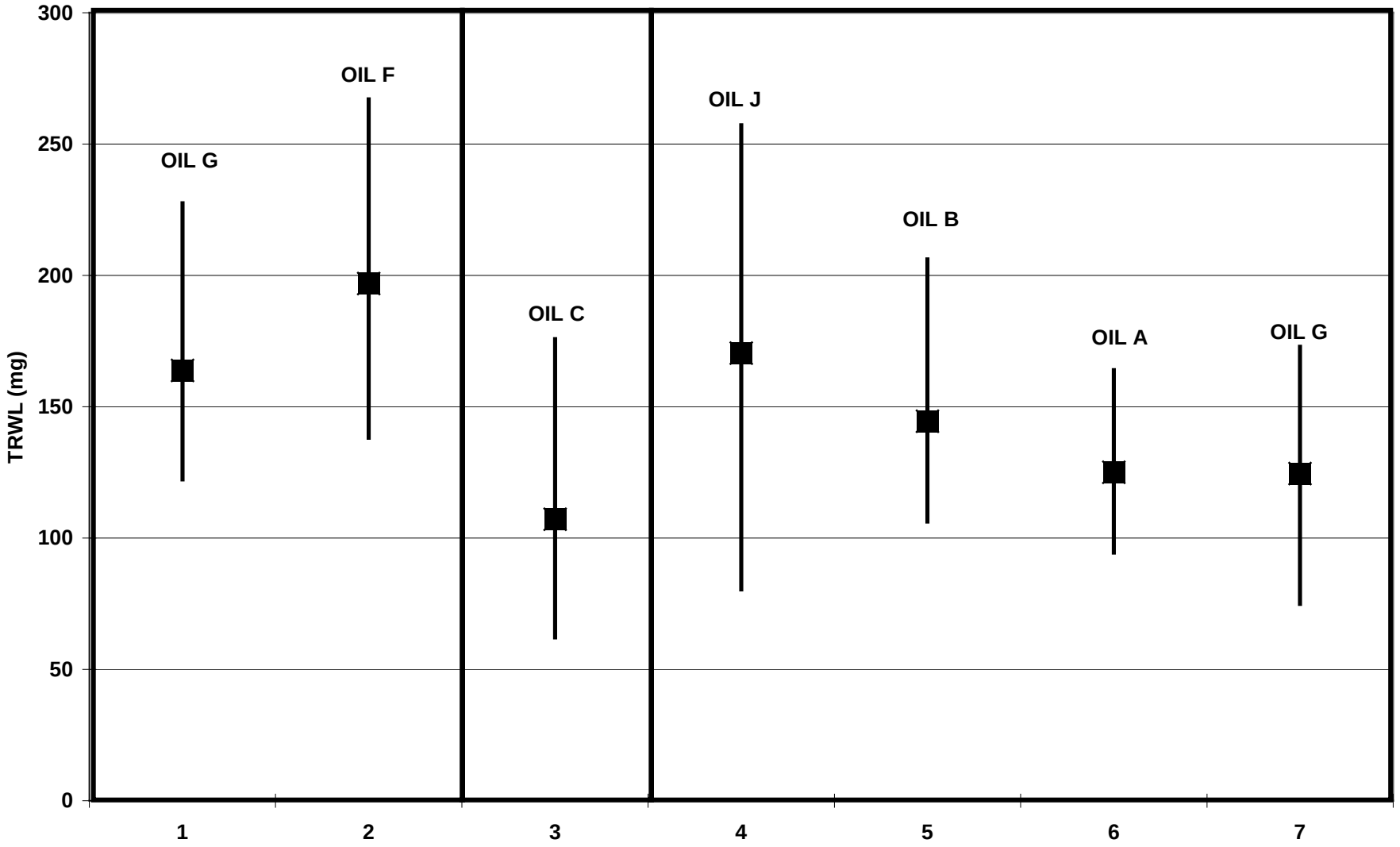
Top Ring Weight Loss



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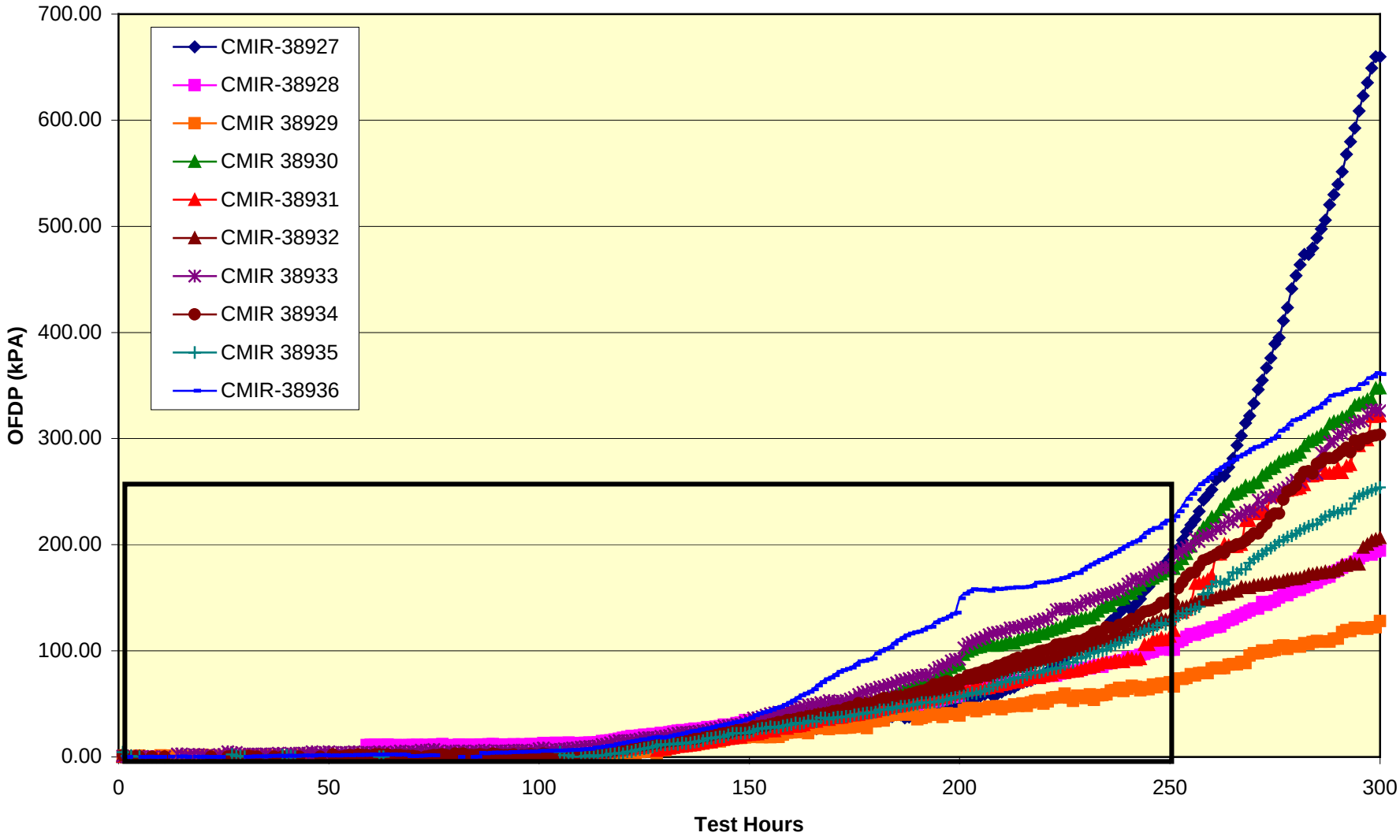
PC9 Matrix Data Oil E, Corrected & Normalized



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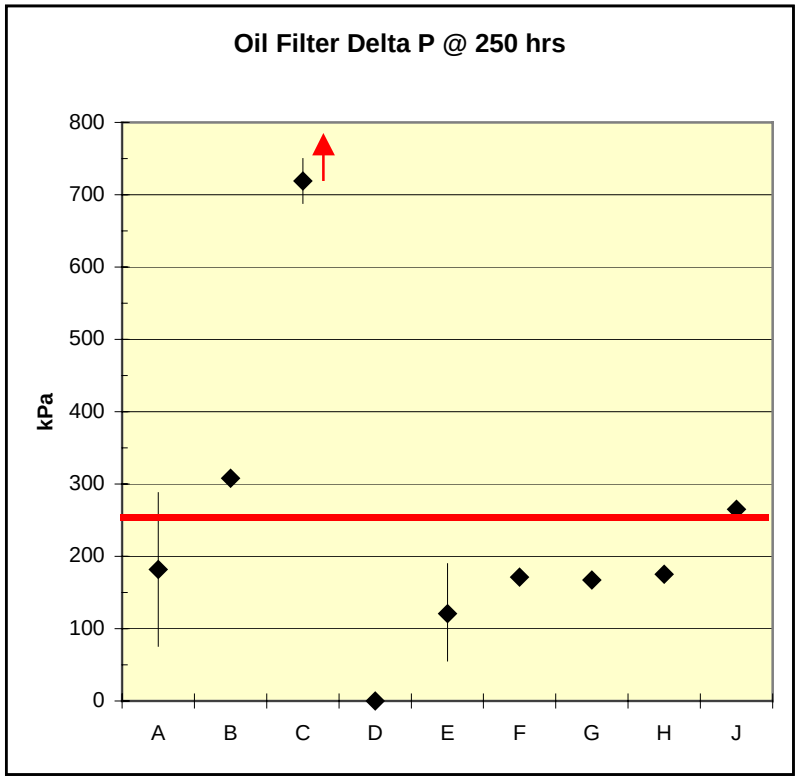
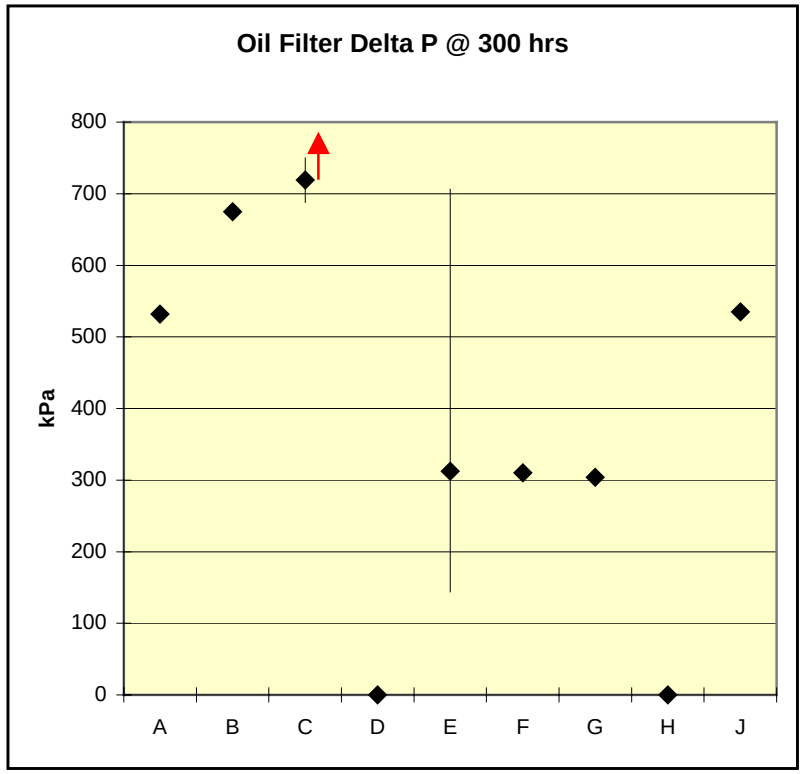
M11 EGR: Filter Delta P Matrix Results

- Apply HST correction factor
- Report 250 hr and 300 hr corrected DP
- Plots show range and mean
- Set limit at 250 hr





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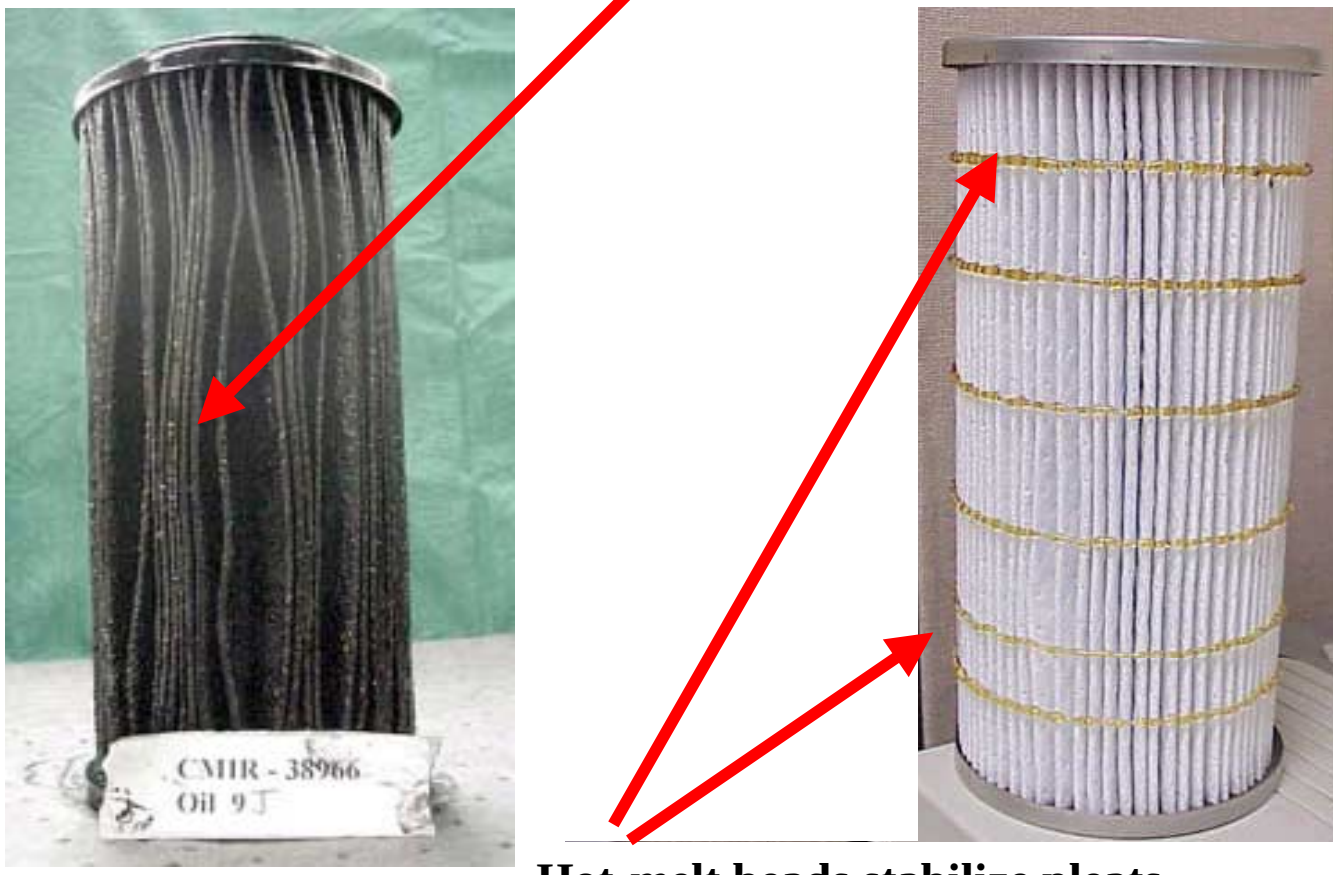
Filter Modification

- SWRI will run oil E with modified filter
- Surveillance Panel to review proper action

Shifting pleats cause loss of flow area



Hot-melt beads stabilize pleats

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M11 EGR Test
Piston Deposit Data

Presentation to
HDEOCP
May 24, 2001
David M Stehouwer

David M Stehouwer, Cummins Inc.

Piston Deposit Ratings: Data

	CYLINDER AVERAGE													
Oil Code	L1	L2	L3	L4	G1	G2	G3	UC	OCG	UNWTD	WTD DMRT	TGC	TLC	OIL CON.
CMIR-38927 (E)	25.112	23.402	1.738	1.5	51.125	35.625	1.51	5.35	3.603	149	467	51	25	28
CMIR 38928 (E)	20.147	17.907	2.223	1.5	38.292	28.513	1.617	7.071	7.223	124	413	38	17	26
CMIR-38929 (E)	25.25	24.018	2.022	1.5	47.333	36.155	1.6	2.75	2.95	144	467	47	25	40
CMIR-38930 (E)	23.873	21.27	1.942	1.5	36.958	27.908	1.5	3.875	1.64	120	409	37	23	24
CMIR-38931 (E)	21.128	12.32	1.903	1.44	32.093	28.877	1.563	5.7	4.2	109	372	32	20	24
CMIR-38936 (E)	23.692	16.598	2.338	1.462	42.737	30.915	1.365	9.792	5.375	134	426	43	22	16
CMIR-38932 (E)	20.717	11.035	3.355	1.4	29.375	26.192	1.65	6.175	3.925	104	383	29	18	30
CMIR 38933 (E)	22.04	15.022	2.165	1.5	50.167	28.8	1.35	6.225	5.55	133	423	50	20	38
CMIR-38934 (E)	21.985	17.368	1.675	1.412	37.442	30.125	1.43	6.65	6.8	125	396	37	20	37
CMIR-38935 (E)	22.415	14.797	1.92	1.057	43.742	31.26	1.09	6.15	7.19	130	381	43	21	35
									Average E	125	408	40	21	30
CMIR-38961 (G)	23.375	28.932	2.052	1.5	34.875	36.345	1.6	4.475	3.13	136	458	35	22	24
CMIR-38962 (F)	24.423	16.242	2.097	1.5	36.625	35.05	1.57	4.2	2.377	124	420	36	24	28
CMIR-38965 (C)	19.987	14.7	2.84	0.59	34.9	62.5	2	8.29	7.07	153	465	37	18	38
CMIR-38966 (J)	21.415	17.953	2.28	1.287	34	31.85	1.113	9.008	5.675	125	396	34	19	35
CMIR-38967 (B)	20.848	15.833	2.682	1.15	52.542	41	0.992	5.765	3.875	145	447	53	19	33
CMIR-38968 (A)	19.205	21.758	2.203	1.5	39.083	26.227	1.475	6.275	5.02	123	414	39	16	39
CMIR-38969 (G)	19.24	25.203	2.22	1.287	46.542	33.208	1.683	6.429	4.975	141	452	47	16	41

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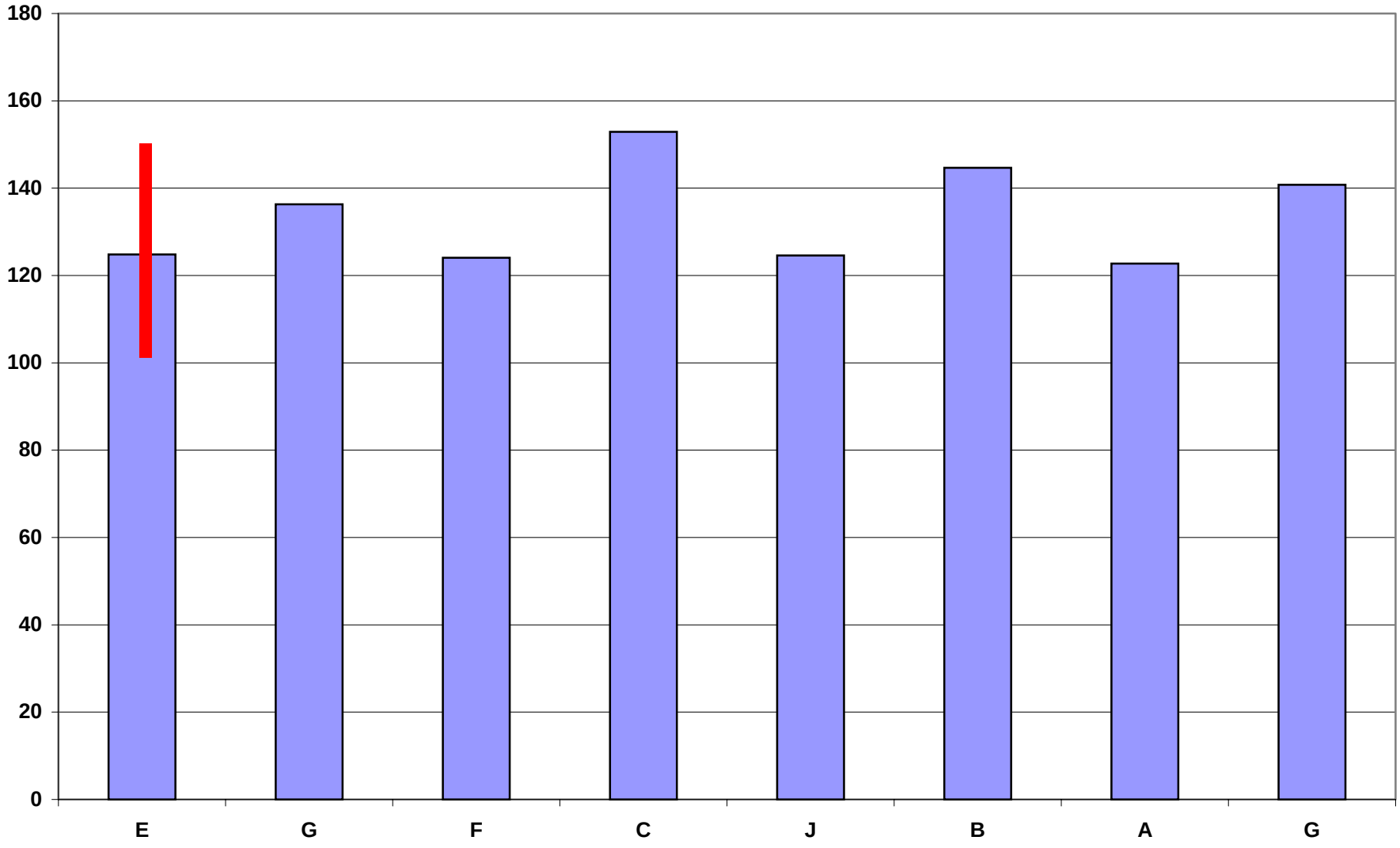
Unweighted Deposits All Oils



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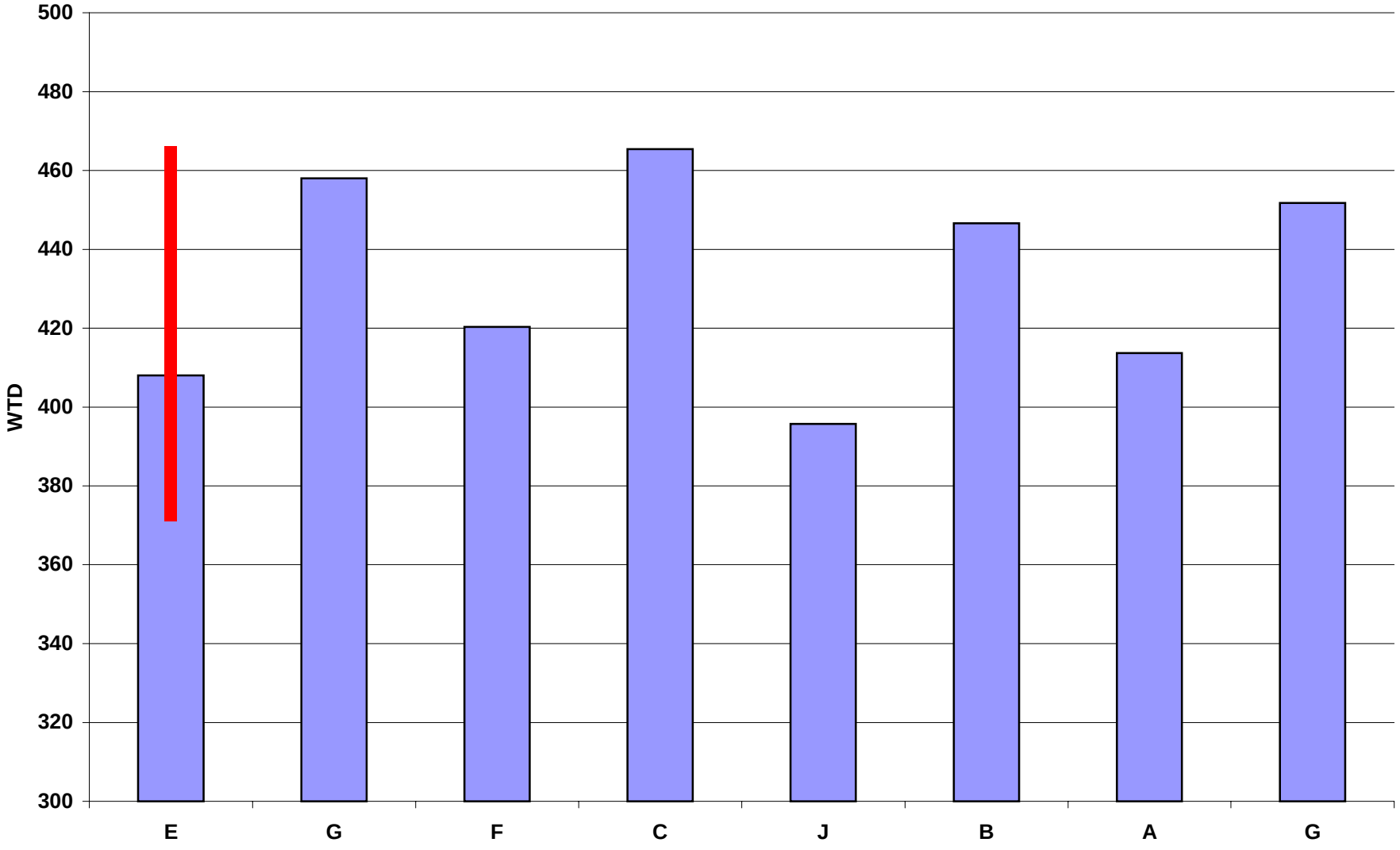
WEIGHTED DEPOSITS ALL OILS



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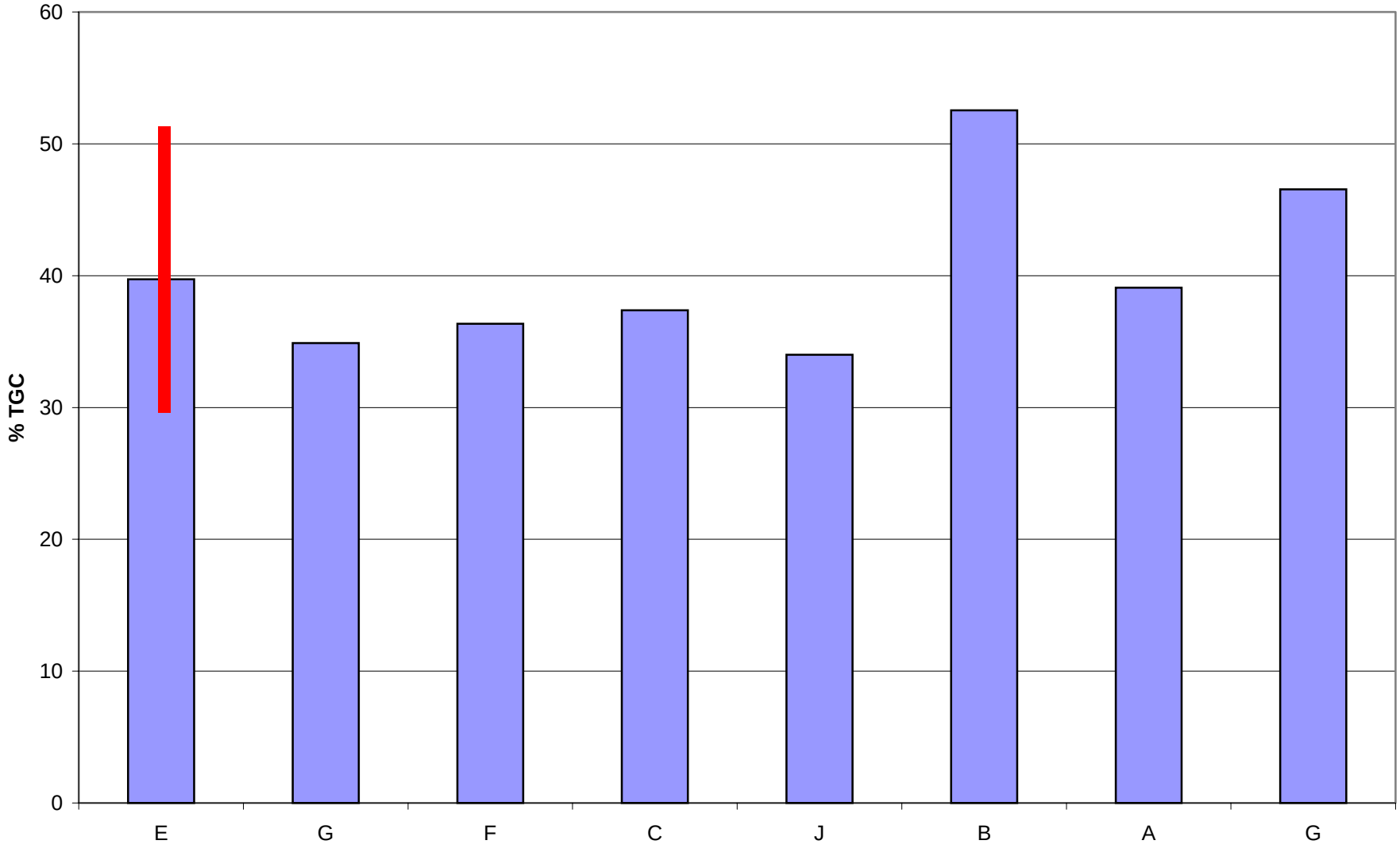
TOP GROVE CARBON



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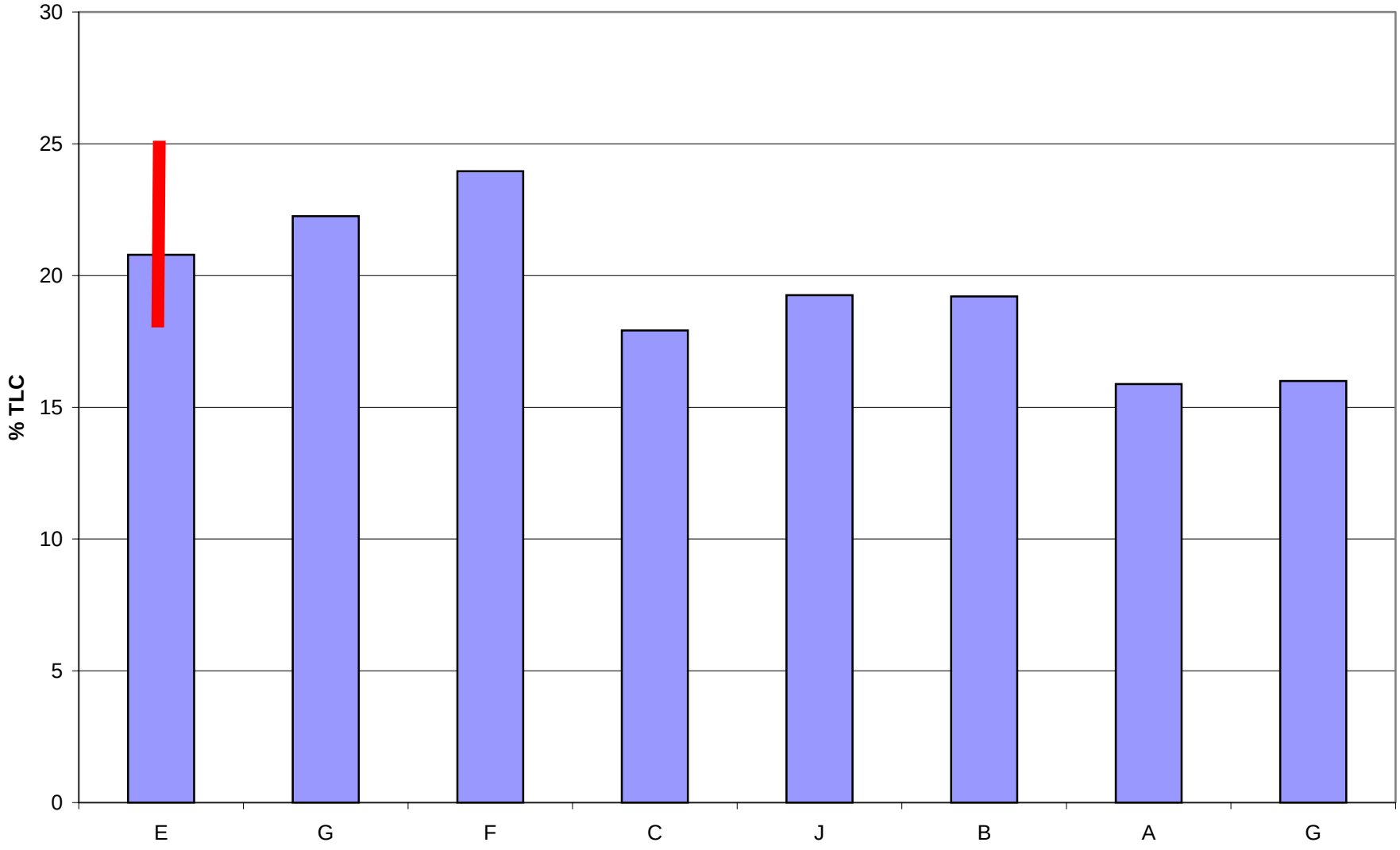
TOP LAND CARBON ALL OILS



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1Q Test Status – 5/24

- 6 stands running, 1 in turn-around
- 12 complete tests
  - 6 valid (in TMC database)
  - 6 awaiting validation

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1Q Challenges

- 5 oils have failed
  - 3 x M, A, D, E, and P
  - 5 have scuffed, 1 lost oil control, 1 operational
  - 28% failure rate
- 4 of 5 labs have experienced failures
- 6 of 7 stands involved

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Possible Causes

- Test too severe/Oils not robust enough
- Temperature
  - 60 °C for the 1P vs. 85 °C in the 1Q
    - Higher temperature required to avoid condensation
- Hardware Limitations
  - Lose averaging effect with Single-Cylinder engine

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Suggested Solutions

- Run a “modified 1R” test
  - Timing and duration same as 1Q
  - Oil known to scuff (PC-9J)
  - 60 °C and 85 °C
- If oil J scuffs at 85 and not at 60, temperature is a factor.
- Try 1Q test at lower temperature

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Suggested Solutions

- Measure piston deposits using either the T-10 or M-11 Tests
- Use 1P test
  - Sensitive to ash level
- Use “1R” test
  - 1Q without EGR

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Piston Deposits and Oil Consumption Task Force
Scope and Objectives

- Clearer definition of scope and objectives requested
- Group recommends the following scope:
  - scope of the task force activity be defined to address any alternative tests which may be required for PC-9
- Issue of immediate concern are piston deposits and oil consumption due to concerns about the 1Q test.

Piston Deposits and Oil Consumption Task Force Status Update

- Meeting held May 24th PM
- Reviewed status of 1Q test
- Reviewed piston deposit and oil consumption data from Cummins M11 EGR and Mack T10 Tests
- Discussed and evaluated options including the above tests and alternative deposit test not currently in PC9
- Recommendation to HDEOCP follows....

Piston Deposits and Oil Consumption Task Force Recommendation -1

- Stop the current 1Q Matrix
  - Propose to re-configure to the 1R and use the remainder of the matrix funds to run ~ 10 tests to develop precision data in the 1R test. 1Q parts would be used.
  - Request approval from the matrix stakeholders (EMA/API/ACC) to allow use of the matrix funds on this revised target.
  - Continued...

Piston Deposits and Oil Consumption Task Force Recommendation - 2

- We recommend to retain the current base oil interchange guidelines in place for the 1P. These may be revised as data is generated in the 1R.
- The Surveillance panel would have to re-define stand calibration requirements.
- The matrix design task force would have to reconvene quickly to design a 1R matrix.
- We recommend that included oils would be TMC 1005, Oil A and Oil E.

Piston Deposits and Oil Consumption Task Force

Recommendations - 3 - in addition to 1R

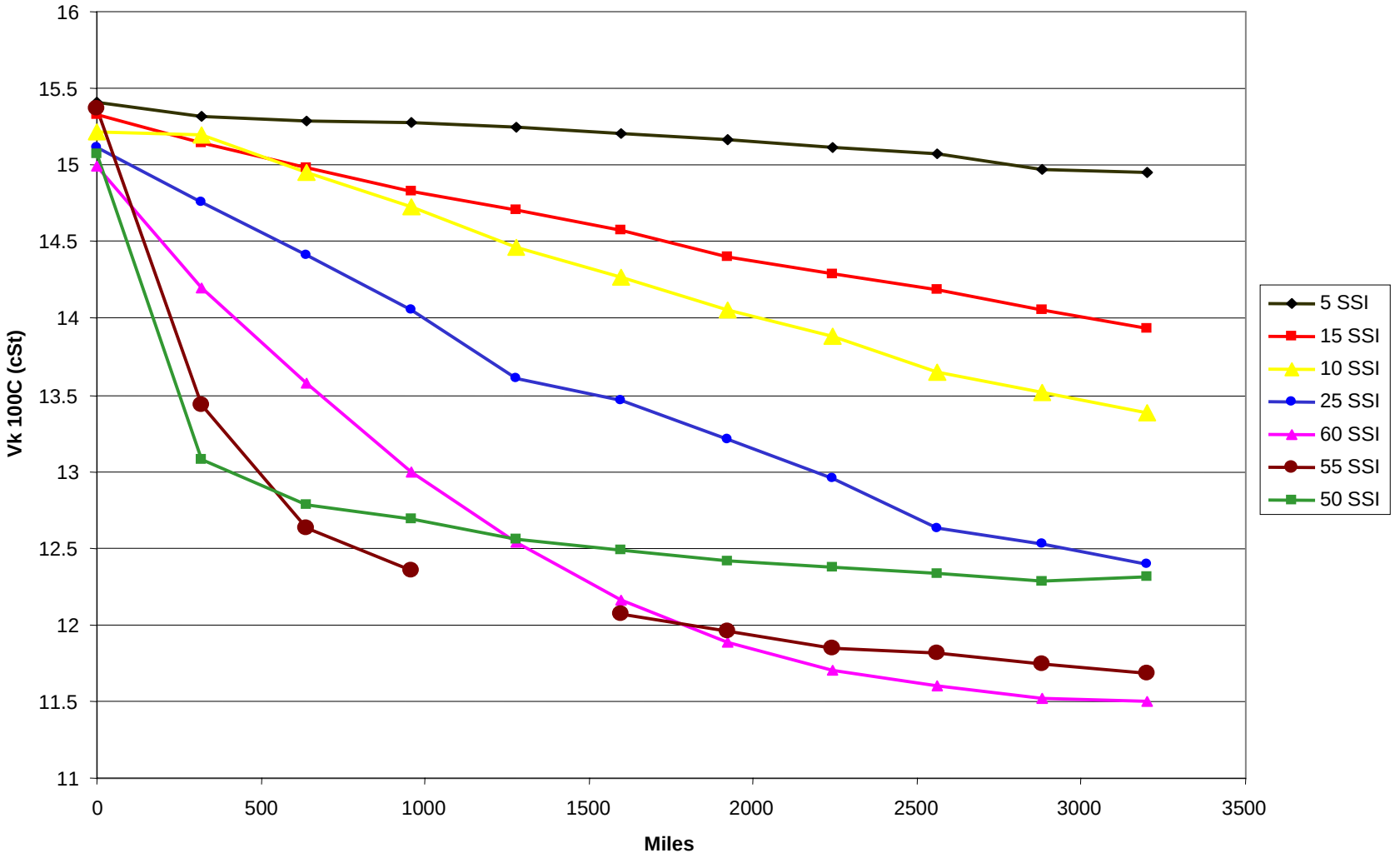
- Request ACC PAPTG to provide data from the RSI database comparing results of oils which have run in 1K and 1N, 1N and 1P, 1K and 1P,
  - Review to determine if there is relationship between deposits in Al piston and articulated piston
- ASTM TMC to provide reference oil mean and standard deviation where same reference oils used in the combinations of tests above.
- Meet June 18 to review this additional data

Infineum Comments on HTHS Limits for PC-9

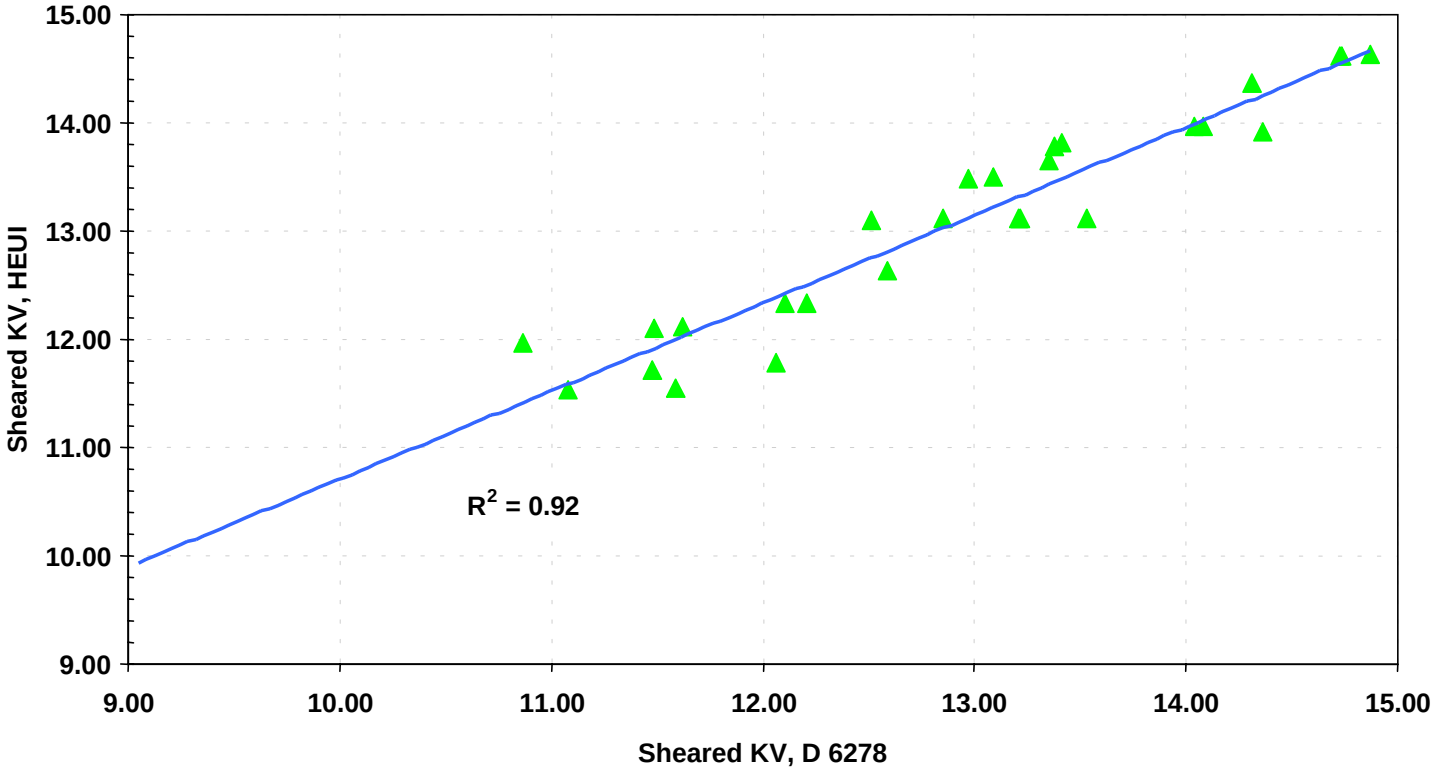
Potential HTHS Concerns

- Current SAE J300 limit of 2.9 cP for 10W-30 viscosity grade is biased toward passenger car fuel economy.
- Limits applied to fresh oil may not reflect actual performance in engine after even short periods of service.
  - A 2.9 cP oil with a 50 SSI viscosity modifier will shear to 2.5 cP.
  - Even the previously requested 10W-35 limit of 3.3 cP on a fresh oil with a 50 SSI viscosity modifier would shear to 2.9 cP.
- Idle oil pressure and minimum oil film thickness in bearings are related to lubricant viscometrics.
  - Both KV100 loss and HTHS loss after shear are related to one another as well as to the SSI of the viscosity modifier.

Viscosity Loss in the HEUI Equipped Trucks

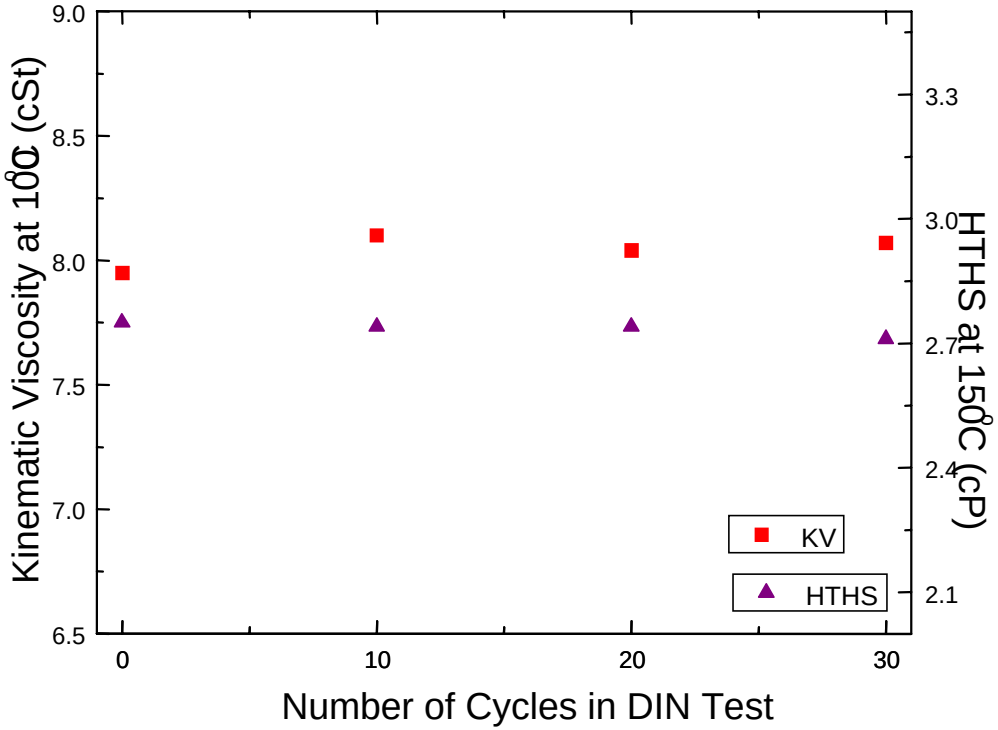


HEUI - D 6278 Correlation for 15W40 Formulations



Excellent correlation between field performance in HEUI equipped trucks and D-6278 bench shear stability test demonstrated for CH-4 development.

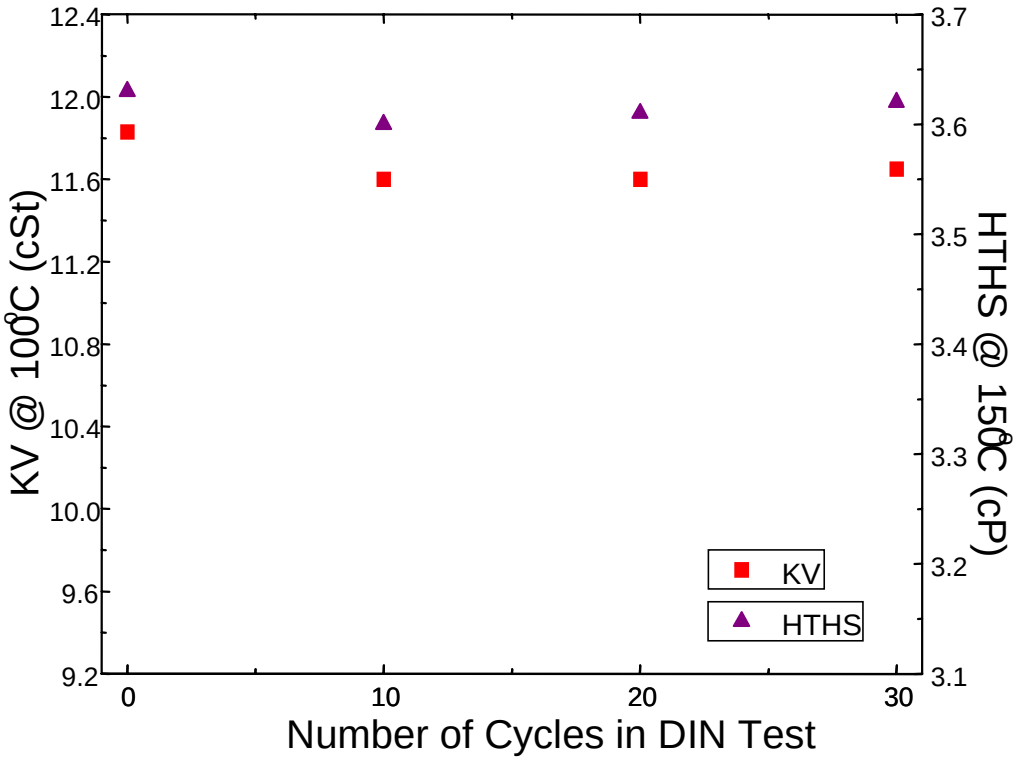
KV and HTHS Viscosity in Formulation without VM



- **Basestocks, DI and LOFI do not shear down under DIN test conditions.**
- **Changes in KV and HTHS can be attributed to the shear down of VMs only.**

KV @ 100 °C and HTHS @ 150 °C vs. Number of Cycles

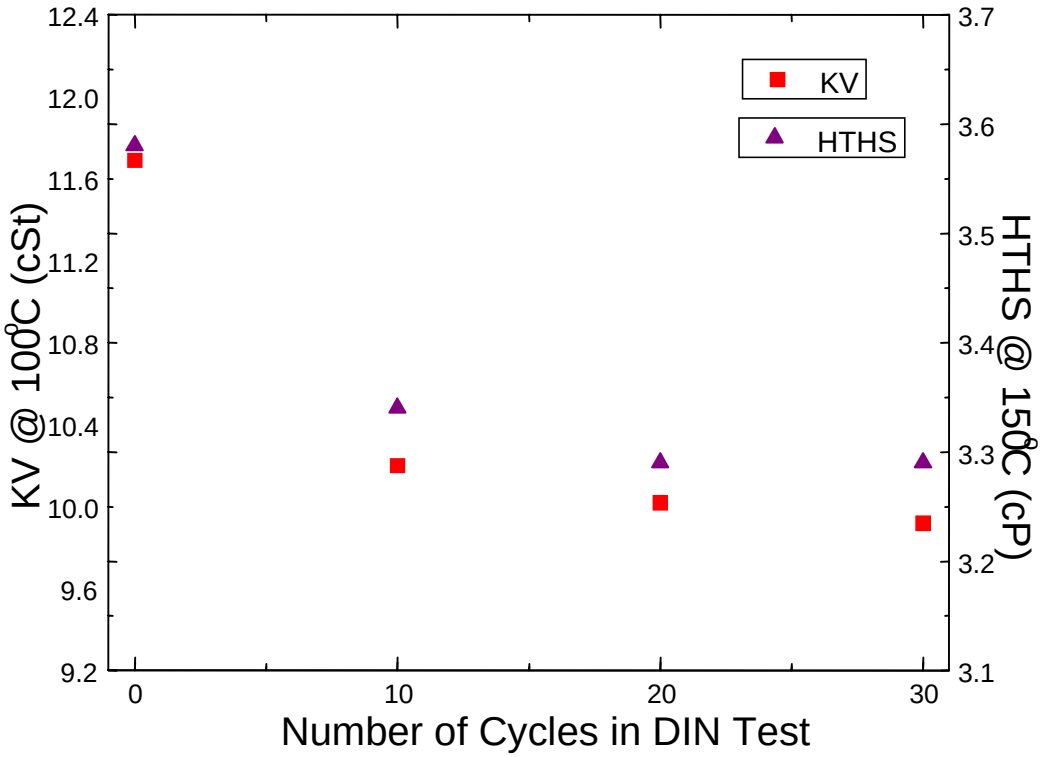
VM with SSI < 10:



- **HTHS tracks well with KV**
- **Insignificant loss of HTHS at the end of test.**

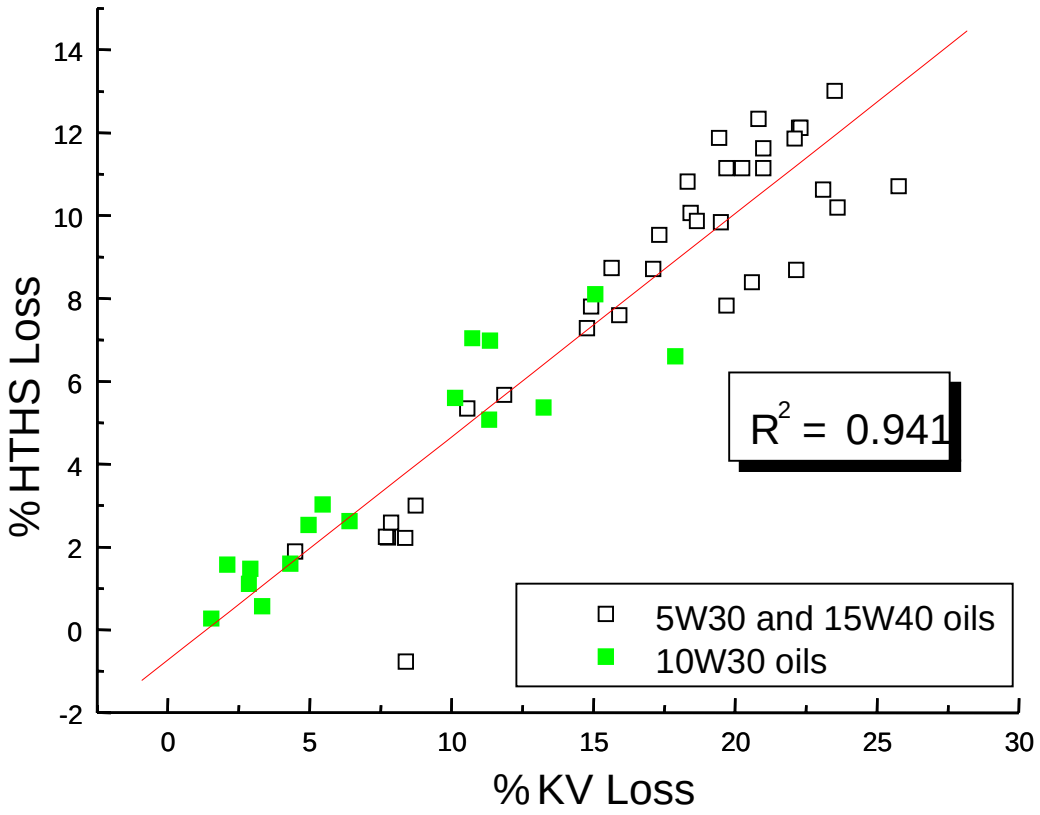
KV @ 100 °C and HTHS @ 150 °C vs. Number of Cycles

VM with SSI ~ 50:



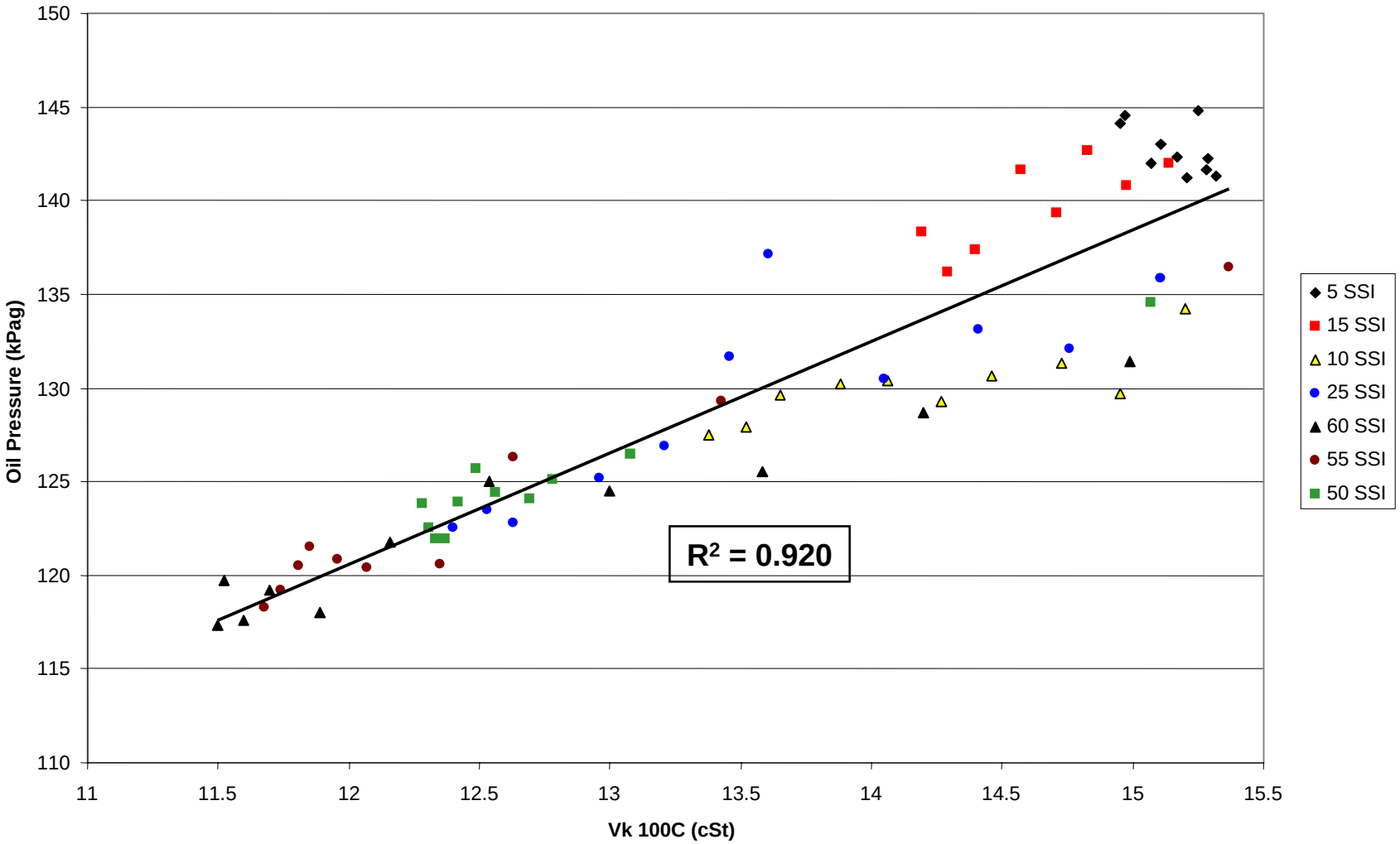
- **HTHS tracks well with KV**
- **Significant loss of HTHS at the end of test.**

% HTHS Viscosity Loss vs. % KV Loss (5W30, 10W30 and 15W40 Grades)



- **Good correlation between % HTHS loss and % KV loss for wide range of viscosity grades.**

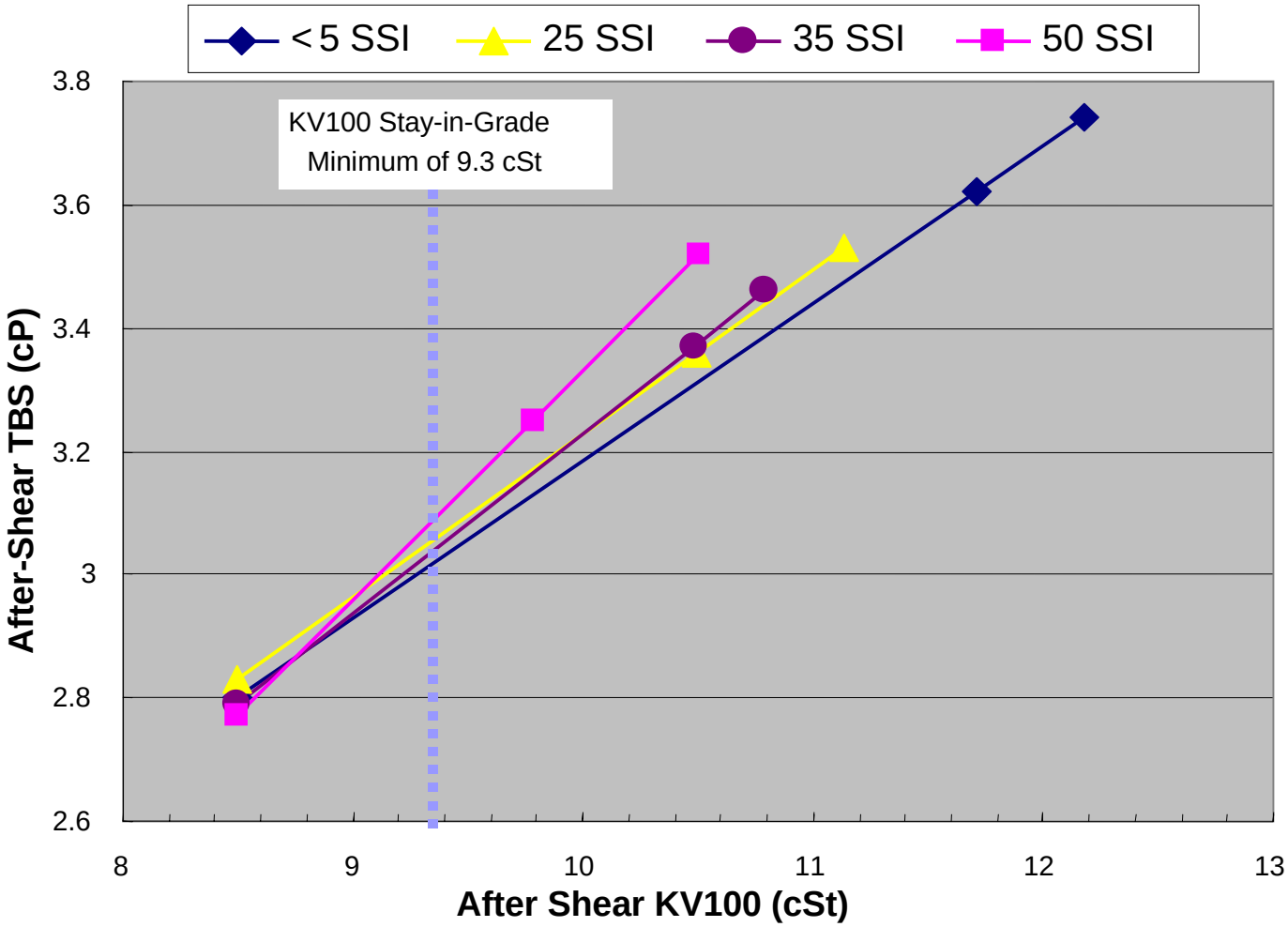
Oil Pressure as a Function of KV 100C for 15W40 Oils



Infineum Concerns

- Inherent dislike for any arbitrary chemical or physical limits on oil formulations.
- Strong preference for performance specifications.
- Any viscometric limits on fresh oils can discriminate against the use of more shear-stable polymers.
  - As noted previously, KV100 loss and HTHS loss are related.
  - The current KV100 stay in grade limits in API CH-4 apply to oils after shear, not fresh.
- No data has been shown to support the need for increased HTHS viscosity.
  - Higher HTHS viscosity will adversely impact fuel economy.

Impact of Existing KV100 Stay-in-Grade Requirement on After-Shear HTHS



Observations on 10W-30 HTHS.

- KV100 loss and HTHS loss are related to both one another and to the shear stability of the viscosity modifier.
  - The existing KV100 stay in grade requirement of 9.3 cSt after shear guarantees a minimum after shear HTHS of 3.0 cP, regardless of VM SSI.
  - This is well above the 2.5 cP after shear minimum which could happen with a 50 SSI polymer oil just meeting J300.
- The EMA accepted viscosity grade read for the new PC-9 tests looking at, among other parameters, engine wear is from 10W-30 to 15W-40.
  - 10W-30's must prove wear capability!

Summary

- The use of an after shear HTHS limit makes the parameter a performance test, not an arbitrary chemical/physical limit
- The existing KV100 limit of 9.3 cSt minimum guarantees an after shear HTHS minimum of 3.0 cP
- No data has been shown to support higher HTHS viscosity.
- Lower HTHS viscosity improves fuel economy.
- SAE 10W-30 oils will need to pass the engine wear tests to prove their performance capability.
- Infineum recommends an after shear HTHS to 3.0 cP minimum to conform to the current 9.3 cSt KV100 limit.
  - 15W-40 after shear HTHS of 3.7 cP minimum is not a problem.

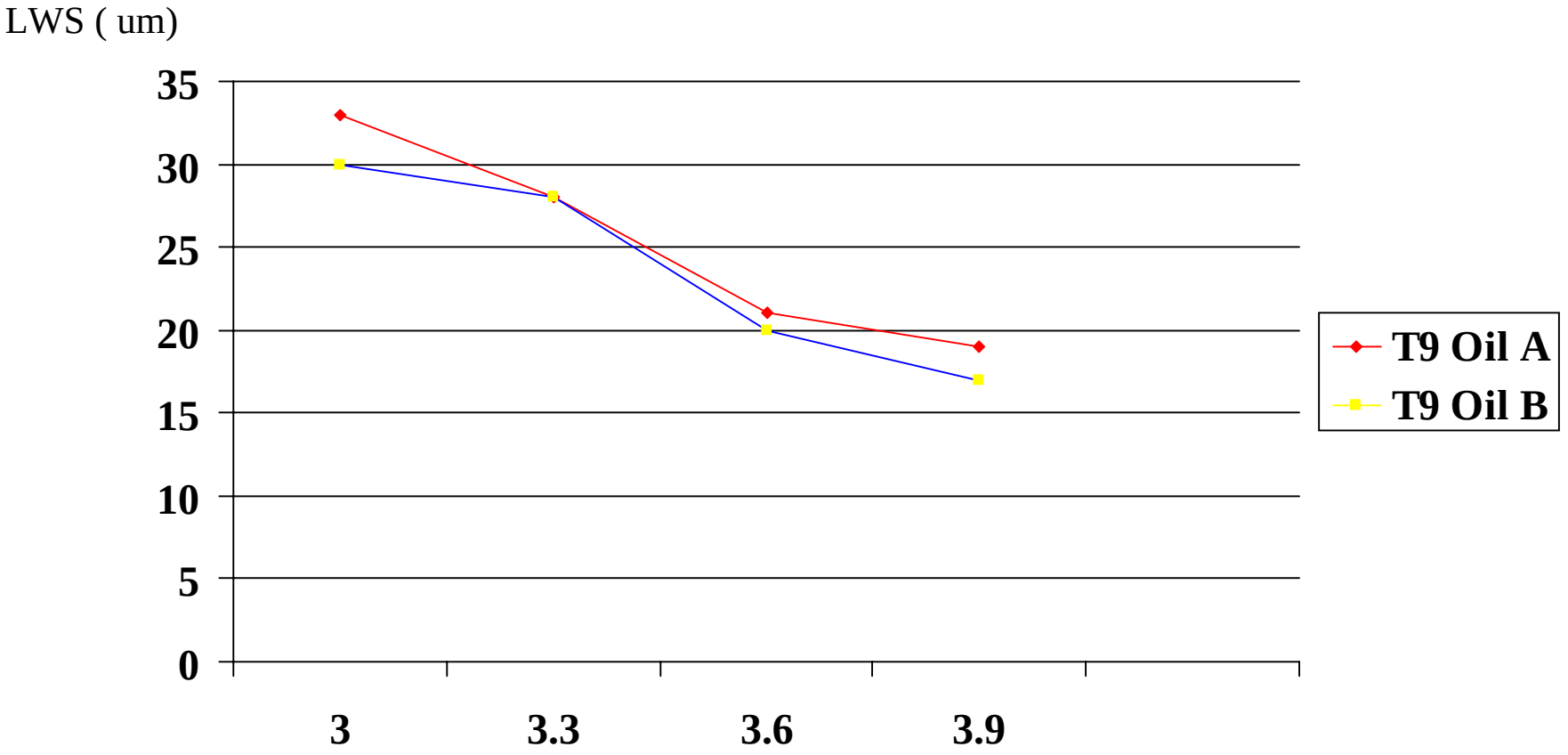
PC9 HT/HS Recommendation

- 3.? Minimum for 10W 30 Visc Grade After Shear

  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

ATTACHMENT 13, 2 OF 2

ATTACHMENT 14

ASTM PC-9 Elastomer TF Report
To D02.B HDEOCP
May 25, 2001

Round Robin Status

- 7 labs have been sent oil and Elastomers to run in a round robin
- 4 labs have finished testing and results are available a fifth will soon be available
- Messages have been sent to the remaining labs urging them to complete their tests
- Completed results will be sent to statisticians and TF for their analysis within the next week

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

- Convene the Elastomer TF June 13 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

Studies of the Pumpability of Sooted Oils

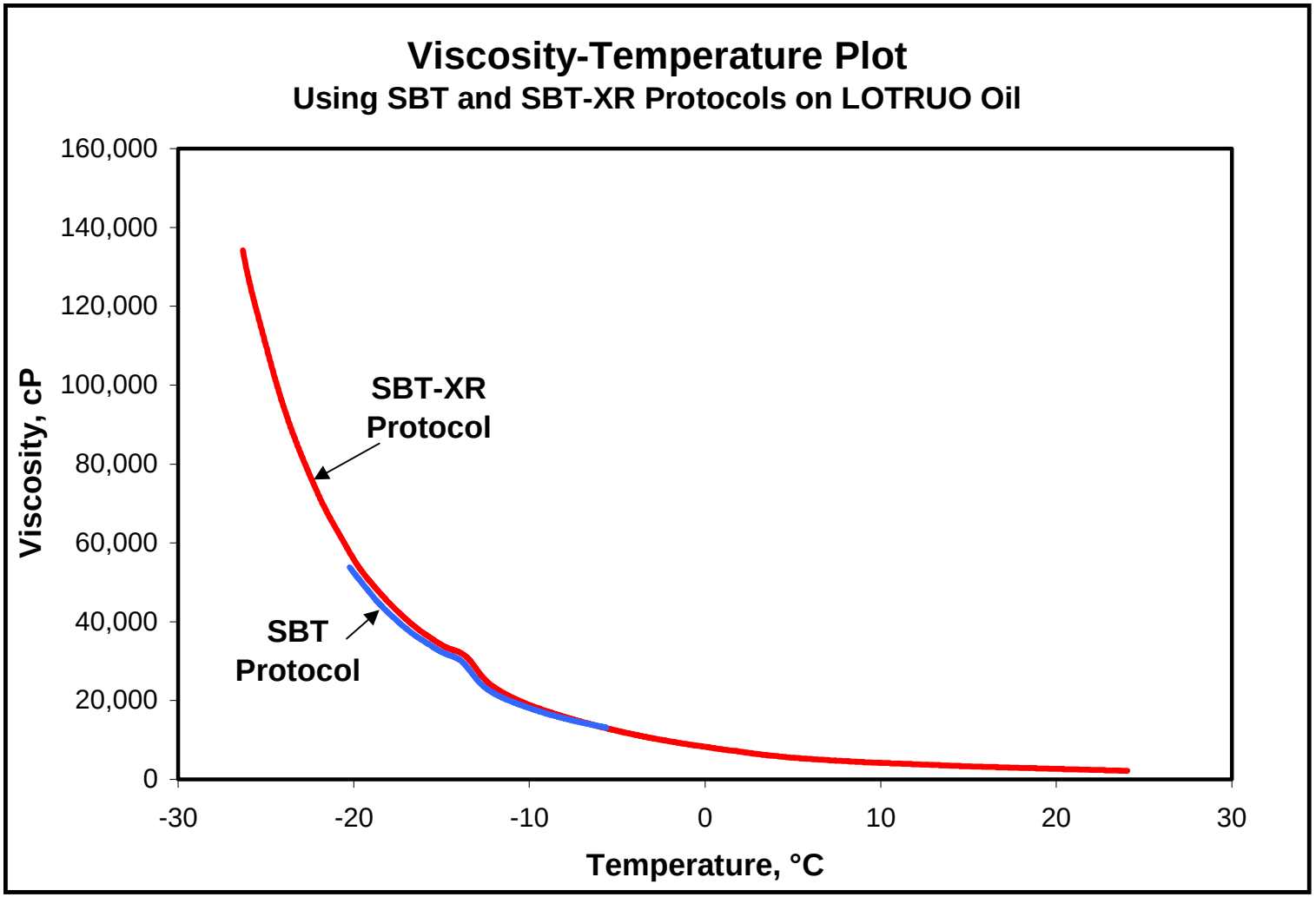
Using the Extended Range Scanning Brookfield Technique

- Highly sooted diesel engine oils (>5% soot) have been identified as a source of pumpability problems at moderately low temperatures.
- As a consequence, the HDEOCP requested ASTM Subcommittee 7 to establish a task force (LOTRUO) to investigate methods of determining the low-temperature pumpability of sooted oils.
- The primary concern is that soot may not only contribute viscosity to the oil but may also develop structures that alone, or in concert with oil gelation, curtail engine oil circulation under starting conditions.
- Recent reports to the HDEOCP have primarily covered activities using the MRV-TP1.
- Commensurate work using the Extended Range Scanning Brookfield Technique was also thought to be of interest to the HDEOCP since it has provided considerable amount of information on sooted oils

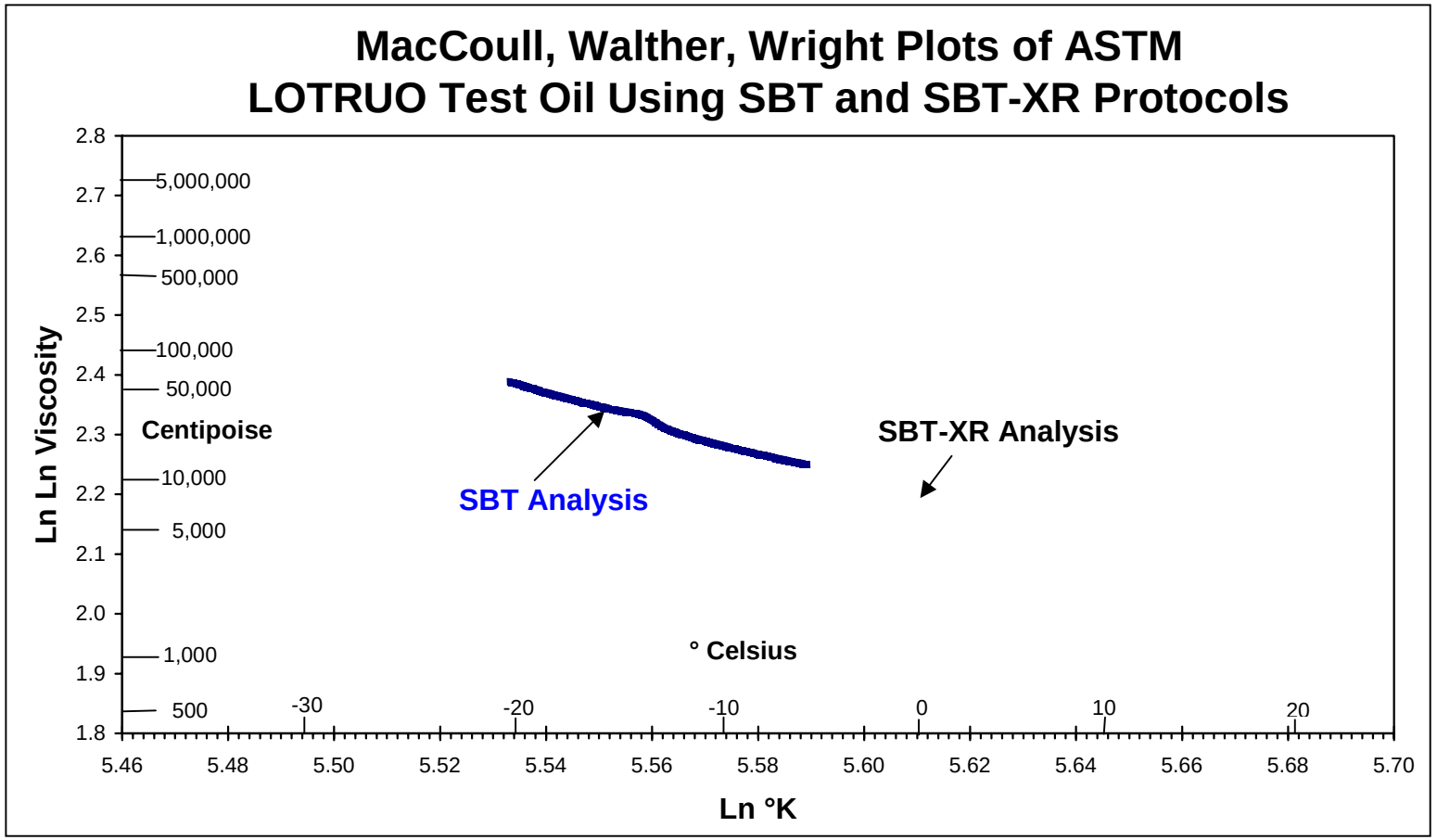
The Extended Range Scanning Brookfield Technique (SBT-XR)

- The SBT-XR generates the entire viscosity-temperature curve of a sooted oil over a wide temperature and viscosity range. From this information viscosities at desired temperatures can be obtained.
- Although the SBT-XR analysis is more rapid than the single-value approach of the MRV-TP1, results using well-behaved oils (normal exponential viscosity-temperature relationship) agree.
- The technique is sensitive and repeatable with both gelation and soot structures.
- The SBT-XR technique can cover a viscosity range of 300 to approximately one million centiPoise from 25°C down to -60°C.

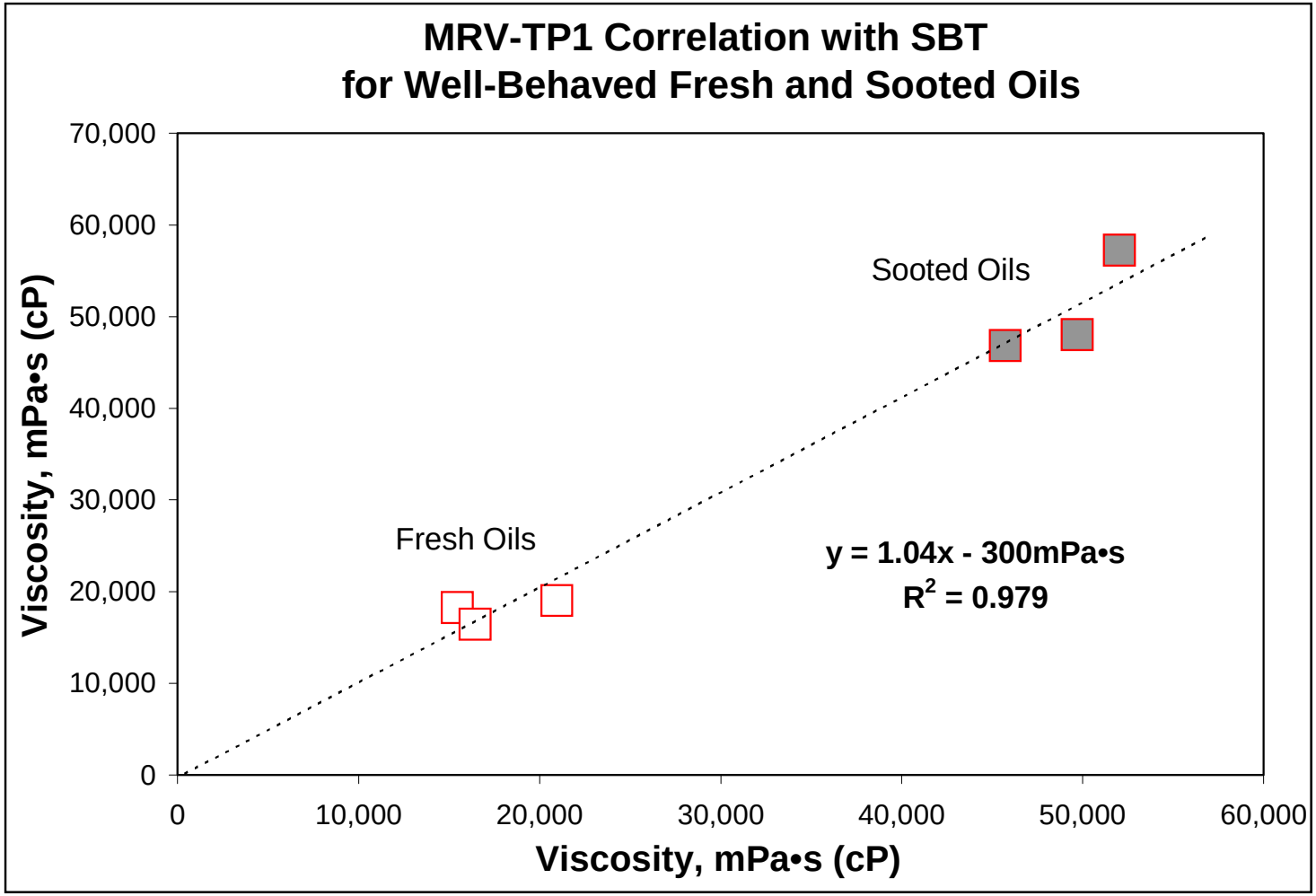
- Results using the SBT-XR agree closely with shorter viscosity range Scanning Brookfield data.



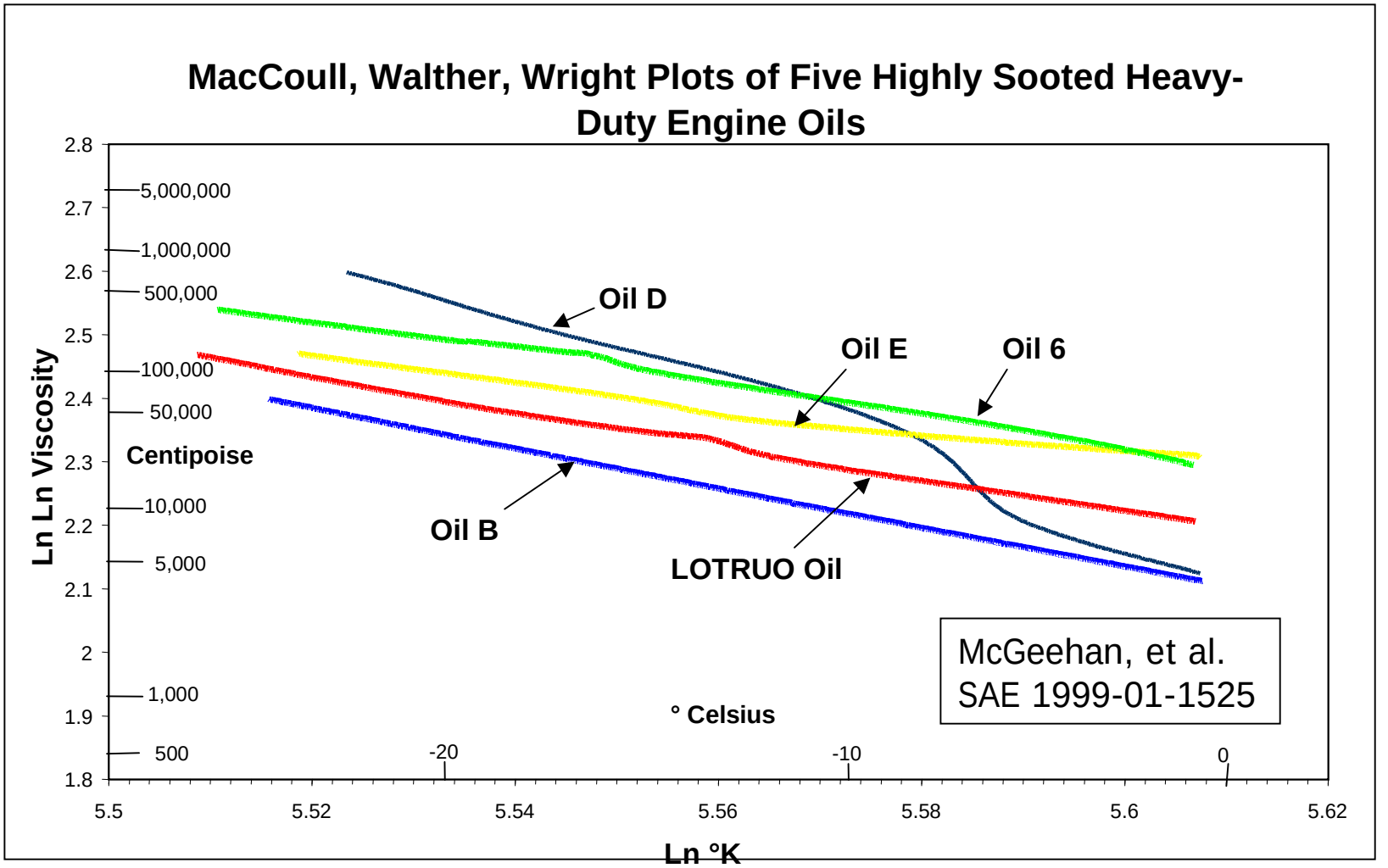
- MacCoull, Walther, Wright plot of both the SBT and SBT-XR shows the close agreement



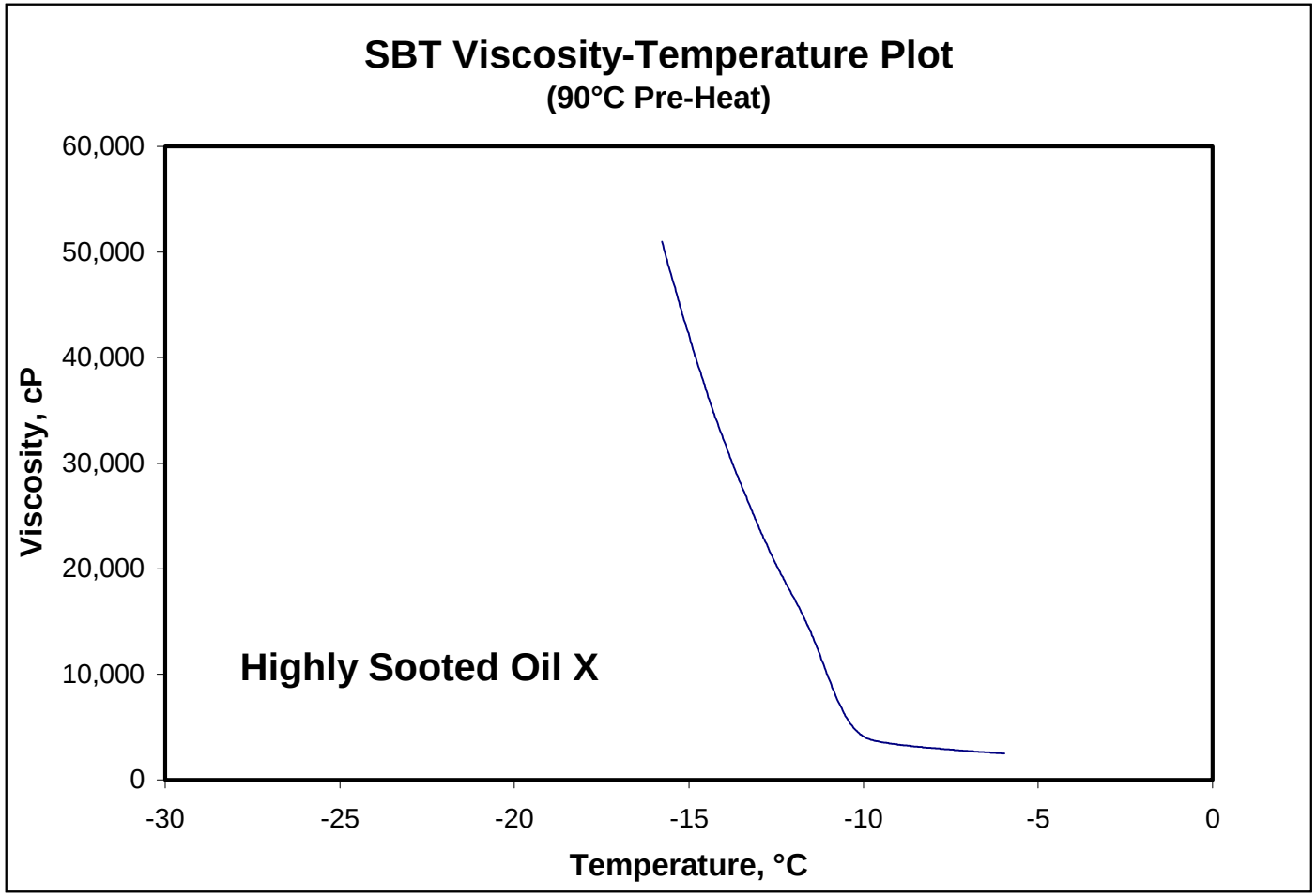
- The MRV-TP1 and SBT-XR correlate closely with well-behaved oils



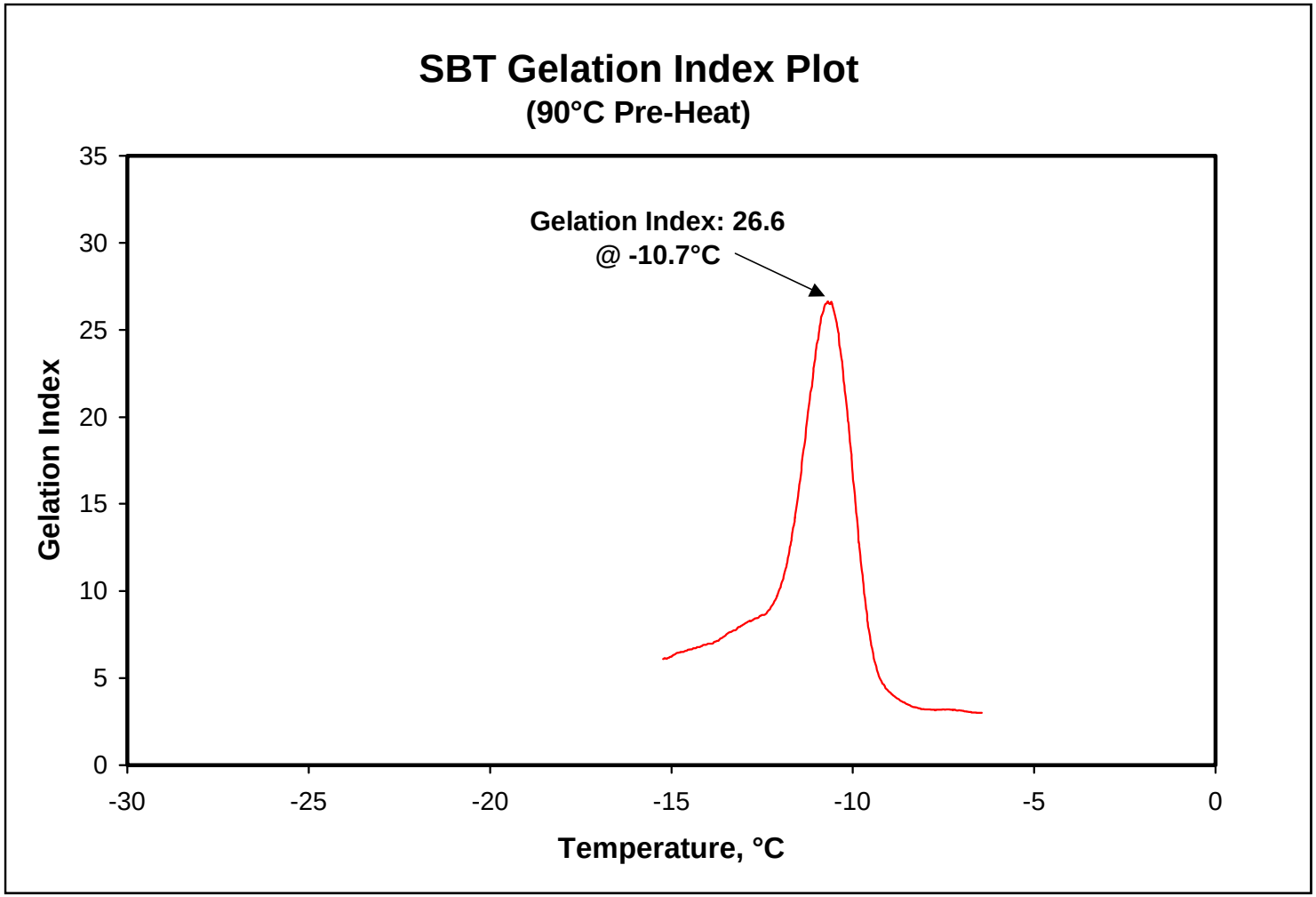
- Sooted oils show a wide range of viscosity-temperature response not evident from single point measurements



- Some sooted oils also show significant gelation



- The Gelation Index of sooted oils may result in air-binding pumpability problems



Summary

- The extended range Scanning Brookfield protocol (SBT-XR) can provides the complete viscosity-temperature regime of sooted oils in one test.
- The procedure is repeatable and reproducible.
- The SBT-XR and MRV-TP1 agree closely with well-behaved oils (oils showing the exponential viscosity-temperature relationship of non-structure-forming engine oils.
- Gelation and soot structures are both evident in the SBT-XR data thus far generated.
- Results using the SBT-XR agree closely with shorter viscosity range Scanning Brookfield data.
- A round-robin on sooted oils using the SBT-XR protocol is being considered. Viscosity values will be taken at desired low temperatures as well as indicate Gelation Index or presence of soot structures.