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Reply to: Michael S. Griggs
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29400 Lakeland Boulevard
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August 28, 2001

To: Members of the Single Cylinder Oil Test Engine (SCOTE) Surveillance Panel and guest attending the August 21, 2001 meeting.

Enclosed are the minutes of the SCOTE Surveillance panel meeting held in San Antonio, Texas. Please forward any corrections or additions to my attention.

Michael S. Griggs
Secretary, SCOTE Surveillance Panel

MEETING MINUTES

SINGLE CYLINDER DIESEL SURVEILLANCE PANEL

HELD AUGUST 21, 2000 1
PERKINELMER
SAN ANTONIO, TEXAS

ACTION ITEMS

1. Include liner wear step data in future web postings- Scott Parke

2. Caterpillar to come up with an inclusive list of additional pass/fail parameters that may need to be looked at- Al Hahn

3. Ensure use of double valve spring arrangement in Cat 1Y3700 engine- Test labs

4. Use 9X2378 replacement bulk hose for coolant hoses in the Cat 1Y3700 engine- Test labs

5. Calibration of the Barco venturi (Cat 1Y3700 engine) is an alternative to replacement of the venturi- Test Labs

6. Investigate ways to address presence of copper in Cat 1R oil analyses and propose possible copper handling protocols- Jim McCord

7. Forward experiences and observations regarding use of Cat Dispersant Flush to Mike Griggs- Test Labs

8. Determine realistic 1R parameter ranges from reported data- Scott Parke

9. Provide 1R airflow meter alternate procedures and data- Mike Zaiontz

10. Provide Sierra mass aifflow meter calibration instructions to test labs- Jim McCord

1.0 CALL TO ORDER AND MEMBERSHIP CHANGES

Chairman Mike Zaiontz opened the meeting at 8:30 am. The agenda is attachment 1.

2.0 MEETING MINUTES

2.1 The meeting minutes for the September 19, 2000 meeting were previously approved in an earlier teleconference.

2.2 The attendance list is attachment 2. Mike Zaiontz issued attachment 3, which is a revised membership list. Subsequent to this meeting, Mark Sutherland replaced Mark Copper for Oronite.

3.0 MATRIX DESIGN REVIEW

3.1 Phil Scinto presented the Cat 1R PC-9 matrix summary (attachment 4), which includes statistical analyses for 17 of 18 tests. Bob Campbell commented that Ethyl's test was approximately half way through completion and would EOT around September 2nd.

3.2 The analysis is broken down by the three matrix oils (A, M and D) and includes averages, standard deviations and both ±1.8 and ±3.0 standard deviation bands for WD, TGC, TLC, OC and EOTOC.

3.3 Phil Scinto pointed out that PC-9M tests 1, 2 and 7 were run at the low coolant flow conditions and that all the oil M tests showed no outliers at ±1.8 and ±3.0 sigma. PC-9A tests showed only one outlier at ± 1.8 sigma. This was lab B's test on CMIR 41547 which was slightly outside the upper 1.8 sigma level for WD and TLC. The 2 tests on PC-9D were within the f3.0 sigma range and showed slightly better performance than oil A and M.

4.0 MATRIX DATA REVIEW AND DISCUSSION

4.1 Mike Zaiontz opened the discussion with a motion to declare that each matrix test is operationally valid and shall be included in the calculation of LTMS limits (attachment 5). Bob Campbell questioned how those tests that ran with low coolant flow should be handled with respect to validity. Mike Zaiontz replied that the panel had earlier declared the low coolant flow issue a non-event. Al Hahn reminded the panel that the validity assessment for these tests was deferred to a later date. Scott Parke added that the TMC issued a position statement on validity saying that low coolant flow would be grounds to declare the test invalid. Mike Zaiontz amended his motion to read: "Each of the Cat 1R matrix tests submitted shall be included in the calculation of LMTS limits". The motion was approved 7/0/1 (F/A/W).

4.2 Mike Zaiontz commented that the data review focused only on Cat 1P parameters. It was brought out that liner wear step needs to be looked. Scott Parke replied that this information is part of the TMC database and agreed to review the information to make a recommendation on liner wear step reporting. Bob Campbell expressed his concern over using liner wear step as a test parameter and that he needed more positive assurance that all labs are measuring wear step the same way.

5.0 PRELIMINARY STATISTICAL SUMMARY OF 1R PRECISION MATRIX

5.1 Phil Scinto presented his draft of the preliminary statistical summary of the Caterpillar 1R precision matrix (attachment 6).

5.2 The summary includes a draft analysis of 16 of the 18 matrix runs. The statistician work group has not reviewed the presentation.

5.3 Phil Scinto pointed out that there is evidence of discrimination in oil consumption for oils A, D and M. He commented that no transformations are necessary among the major parameters, however, TGF needs a transformation and possibly TLHC and UCWD.

5.4 Phil Scinto mentioned that high copper may affect UCWD, but does not seem to affect other parameters. He pointed out that AAIRFLO (average intake air flow) has some very strange results in the dataset. Several panel members surmised that some of the values reported were from labs that did not run with functional flow meters (either not installed or out of range on calibration).

5.5 Possible lab effects exist for OC, ETOC and UCWD. Also, there are possible outliers in TLHC and UCWD. There are positive correlations among the parameters, especially TGF/TGC and OC/ETOC.

5.6 Phil Scinto gave the following additional preliminary observations:

5.6.1 Cat 1R correlations at 0.85 and above represent high correlation.

5.6.2 There is some evidence that oil D differs from A and M in weighted deposits (WD).

5.6.3 There is no evidence of any effects for TGC, TLC, TGF and TLHC.

5.6.4 For OC and EOTOC, there is evidence that oils differ and some evidence that labs differ.

5.6.5 For UCWD, there is very weak evidence of a lab effect.

6.0 **STAND/LAB CALIBRATION**

6.1 Phil Scinto presented attachment 7, which proposes a new and improved LTMS system for PC-9. The proposal is intended to improve the power of LTMS in detecting shifts and trends. The key point in the proposal is that if a lab runs at least 4 scheduled reference tests per year, then the lab would have a good chance of catching a 1 standard deviation shift in the process within a year. Anything less than 4 scheduled tests per year would take longer.

6.2 Phil Scinto proceeded to review the 5 motions outlined in the proposal. Bob Campbell voiced objections that motions 1 and 2 do not create a level playing field for labs with only 1 or 2 stands. There was quite a lengthy discussion on the pros and cons of the proposal. It was generally agreed that the revised LMTS system would provide more robust data but that cost is prohibited. Bob Campbell provided an alternative motion where the calibration period would be 5 tests/5months for stands making the initial referencing, then referencing would be done every 9 months. Phil Scinto reiterated that anything less than 4 tests per year would not be of benefit. He did acknowledge that the proposal could work with labs that have many stands.

6.3 An amended motion proposed that matrix stands be calibrated for 12 months from the date of the acceptable calibration test and that the last candidate can start on or before the last day of the period. The following motion (attachment 8) was approved 8/0/0:

The 1R calibration period is 365 days from the EOT date of the acceptable calibration test. The last candidate can start on or before the last day of the period.

6.4 The following motion was also approved 8/0/0:

The calibration period begins on the day registration is allowed

6.5 Mike Zaiontz motioned that the Cat 1R matrix stands are considered acceptable and are calibrated for one calibration period. The following motion (attachment 9) was approved 8/0/0:

All Cat 1R matrix stands are considered acceptable and are calibrated for one calibration period (EV=1*, LZ=l, PE=3, SwRI=3, XMOB=1). The labs are given "existing lab" and the stands are given "existing stand" status.
*** when 2nd operationally valid test is received**

6.6 Phil Scinto presented attachment 10, which describes the LTMS constants for the EWMA and Shewhart analyses for the one test parameter case. He explained that the K values expand in value as more parameters are added. Mike Zaiontz asked the panel for input for removing penalties to labs that trip precision alarms and requested to revisit motions 3 and 4 of attachment 7. Ben Weber added that the consequences for tripping precision alarms in the Mack T-10 have been eliminated. Phil Scinto commented that he wants to avoid situations where variability trips a precision alarm and that it doesn't make sense to trip an alarm as a result of getting back on target. Mike Zaiontz made the following 1R motions which were accepted 7/0/1:

Remove the EWMA, lab, warning, precision alarm and all Shewhart precision alarms.

The consequence of the EWMA lab and stand action, precision alarm is a letter to all test sponsors and OEM citing the alarm and its meaning. Also, all test reports during the alarm period must comment that the lab, or offending stand, is currently in precision alarm status.

6.7 Phil Scinto advised the panel that EWMA K values may have to be adjusted. Expanded K values keep the test from being in continuous industry alarm. He made the following motion which was accepted 8/0/0:

Use the one test parameter LTMS constants template with the K values indicated except use 2.45 K vice 1.8 K for EWMA stand severity.

6.8 The panel discussed various protocols to implement reduced K for Shewhart severity and the requirements for existing lab status. Mike Zaiontz presented the following motion (attachment 11) which was accepted 8-O-O:

Existing lab- A lab that has conducted at least 3 operationally valid Cat 1R calibration tests.

Existing stand- A test stand, within an existing lab, that has conducted at least 2 operationally valid Cat 1R calibration tests.

With the wording of "existing lab" established, the panel agreed 8/0/0 on the following motion:

An existing lab will be permitted to bring in a new stand using the reduced K protocol (as described for the 1P).

Scott Parke requested the addition of wording that further clarifies the meaning of "new stand". He made the following motion, which was accepted 8-O-O:

Any stand that has not completed a calibration test for 2 or more years is required to meet "new stand" requirements.

Scott Parke also noted that substantial changes to a test stand can result in stand renumbering and assignment of "new stand" status.

6.9 The panel noted that oil 1005-l is the only calibration oil currently available. Oil A will have to be reblended. The panel passed the following motion 8/0/0 approving the use of 1005-l and PC-9A oils for calibration:

The TMC is to assign 1005-l (PC-9M) as the initial calibration oil until such a time as oil A is available.

7.0 ACC TEMPLATE CHECHKLIST REVIEW

7.1 Phil Scinto presented attachment 13, which is the Cat 1R Template Checklist. Modifications to the ratings (A through D scale) are shown on the attachment.

7.2 Al Hahn agreed that Caterpillar will work on the Research Report required by section D4.1 of the template.

7.3 The comment regarding rate and report parameters was deleted from part D5.4.

8.0 HARDWARE REPORT

8.1 Al Hahn presented attachment 14 which describes several hardware issues

8.2 The 1Y3700 engine now uses a double valve spring configuration with a new rotocoil assembly. A new spec sheet was provided for this change and should be added to the engine build manual.

8.3 Al Hahn revisited the coolant hose delamination problem identified earlier by another lab. Labs should use 9X2378 replacement bulk hose.

8.4 At least one lab has seen heavy wear on the rocker arm bronze pin, which has caused unusually high copper levels. Labs should only use replacement rocker arms for the valves and injector with part dates after 5/1/1999 or parts box date after 1/1/2000. Attachment 14, page 4, shows how to decode the part numbers.

9.0 FUEL REPORT

Al Hahn presented the PC-9 fuel report (attachment 15). He noted that there is currently 1 million gallons of fuel available and that a new 1 million gallon batch would be blended when inventory levels hit 150,000 gallons.

10.0 TASK FORCE RECOMMENDATION TO THE HDEOCP

Al Hahn moved that the panel declare the 1R test ready for the PC-9 category. The motion was seconded and approved 8/0/0.

11.0 OLD/NEW/OTHER SCOTE BUSINESS

With no additional SCOTE business to conduct, the panel was adjourned for the day to resume the next morning.

12.0 DATA COMMUNICATION TASK FORCE

12.1 Mike Zaiontz opened the discussion by expressing concern that the DCC may, on occasion, promulgate changes or procedures that are not approved by the Surveillance panel. He encouraged each lab engineer to make every effort to attend DCC meetings where items affecting their test were expected to be discussed. Scott Parke assured the panel that no report changes were made without Surveillance panel approval.

12.2 Scott Parke added that there may be instances where the DCC initiates changes to make improvements, but ultimately, the Surveillance panel still has to approve the changes. When changes are proposed or suggested by the Surveillance panel, beta testing occurs and then the panel is notified. DCC changes should be communicated to the engineer.

13.0 TEST PROCEDURE REVIEW

13.1 The 1R procedure review was conducted as a page by page edit of the 1P procedure. Subsequent to this meeting, a draft 1R procedure was emailed to the panel members. Attachment 16 shows the prescribed piping configuration to the air barrel inlet. Attachment 17 shows the engine warm-up and operating conditions.

13.2 Changes to the 1Q data dictionary were made to create a 1R data dictionary.

14.0 NEXT MEETING

The next meeting will be held at the call of the chairman.

Cat 1R Task Force Meeting

Att 1, pg 1/1

Date/Time: August 21, 2001 (0830 – 16:00)
August 22, 2001 (0830 – 12:00)

Location: PerkinElmer Automotive Research
San Antonio, Texas

AGENDA

Day 1:
August 21, 2001 (08:30 – 16:00)

1. Membership	Mike Griggs
2. Matrix Design Review Base Oil and Technology	Phil Scinto
3. Matrix Data Review and Discussion Severity/Precision Overall Lab/Stand Validity Assessment	Phil Scinto / Mike Zaiontz
4. Stand/Lab Calibration Current Lab/Stand Calibration Status LTMS Severity and Precision Recommendation Calibration Oil Availability New Lab/New Stand Calibration Requirements Calibration Period	Phil Scinto / Mike Zaiontz
5. ACC Template Checklist Review	Phil Scinto
6. Hardware Report	Al Hahn
7. Fuel Report	Don Burnett
8. Task Force Recommendation to the HDEOCP	Al Hahn
9. Old/New/Other SCOTE Business	

Day2:
Auaust22, 2001 (08:30 – 12:00)

1. Test Procedure Review QI limits	Ben Weber / Task Force Scott Parke
2. Data Communication Task Force	Mike Zaiontz
3. Lab Visitation Group	Task Force

Att 2, pg 1/5

SCOTE SURVEILLANCE PANEL
Attendance Roster

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Name: Company: Address: Phone: Fax: e-mail:			

SCOTF Surveillance Panel Membership (Revised 08/20/01)

Att 3, pg 1/1

(M) = designated voting member

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Cat 1R

PC-9 Matrix Summary

Test Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
LAB	A	A	A	F	G	G	B	G	A	A	A	G	G	F	G	D	B
CMIR	41535	41536	41537	41545	41539	41541	41554	41540	41538	41760	41573	41542	41761	41546	41570	41968	41547
STAND	1	2	3	1	1	3	1	2	1	2	3	1	2	1	3	1	1
ENRUN	45	40	32	6	65	34	31	36	46	41	33	66	37	7	35	43	32
TESTLEN	504	504	504	504	504	504	504	504	504	504	504	504	504	504	504	504	504
IND	1005-1	1005-1	PC-9A	1005-1	1005-1	PC-9A	1005-1	1005-1	PC-9A	PC-9D	1005-1	PC-9A	PC-9D	PC-9A	1005-1	PC-9A	PC-9A
DTSTRT	20010612	20010613	20010615	20010619	20010618	20010619	20010618	20010619	20010707	20010707	20010711	20010712	20010713	20010713	20010712	20010731	20010723
DTCOMP	20010704	20010705	20010707	20010710	20010711	20010711	20010712	20010712	20010731	20010801	20010802	20010803	20010804	20010804	20010805	20010805	20010814
EOTTIME	0:57	11:55	3:53	21:26	1:13	5:33	8:00	20:57	16:22	0:22	5:31	18:35	14:55	16:45	2:38	16:57	
WD	364.6	315.5	331.5	356.7	323.2	310.6	331.3	356.1	327.8	290.5	301.5	371.6	281.3	311.7	304.9	317.9	407.5
TGC	51.25	30.25	43	46.25	47.25	24.5	46	29.5	33	26	25.25	40	30.25	25	29.25	23.75	49.5
TLC	22	16.5	24.25	26	27	15	21.25	22.75	25.5	7.5	11.5	16	20	13.75	23.5	21	44.25
OC	9.8	7.9	9.3	7.9	10.1	6.6	10.0	11.3	8.0	11.2	9.6	7.0	8.3	5.8	9.4	10.3	11.0

Att 4, p9 1/6

Cat 1R

PC-9M

±3 Sigma Outlier Screener

Test Total	1	2	3	4	5	6	7	8				
LAB	A	A	F	G	B	G	A	G				
CMIR	41535	41536	41545	41539	41554	41540	41573	41570				
STAND	1	2	1	1	1	2	3	3				
ENRUN	45	40	6	65	31	36	33	35				
TESTLEN	504	504	504	504	504	504	504	504				
IND	1005-1	1005-1	1005-1	1005-1	1005-1	1005-1	1005-1	1005-1				
DTSTRT	20010612	20010613	20010619	20010618	20010618	20010619	20010711	20010712				
DTCOMP	20010704	20010705	20010710	20010711	20010712	20010712	20010802	20010805				
EOTTIME	0:57	11:55	21:26	1:13	8:00	20:57	5:31	2:38	Average	StDev	-3StDev	+3StDev
WD	364.6	315.5	356.7	323.2	331.3	356.1	301.5	304.9	331.73	24.69	257.65	405.80
TGC	51.25	30.25	46.25	47.25	46	29.5	25.25	29.25	38.13	10.45	6.77	69.48
TLC	22	16.5	26	27	21.25	22.75	11.5	23.5	21.31	5.09	6.05	36.57
OC	9.8	7.9	7.9	10.1	10	11.3	9.6	9.4	9.50	1.14	6.08	12.92
ETOC	8.5	6.8	8.5	8.1	9.3	9.4	8.5	7.5	8.33	0.87	5.73	10.92

Cat 1R
PC-9M
±1.8 Sigma

Test Total												
LAB	A	A	F	G	B	G	A	G				
CMIR	41535	41536	41545	41539	41554	41540	41573	41570				
STAND	1	2	1	1	1	2	3	3				
ENRUN	45	40	6	65	31	36	33	35				
TESTLEN	504	504	504	504	504	504	504	504				
IND	1005-1	1005-1	1005-1	1005-1	1005-1	1005-1	1005-1	1005-1				
DTSTRT	20010612	20010613	20010619	20010618	20010618	20010619	20010711	20010712				
DTCOMP	20010704	20010705	20010710	20010711	20010712	20010712	20010802	20010805				
EOTTIME	0:57	11:55	21:26	1:13	8:00	20:57	5:31	2:38	Average	StDev	-1.8StDev	+1.8StDev
WD	364.6	315.5	356.7	323.2	331.3	356.1	301.5	304.9	331.73	24.69	287.28	376.17
TGC	51.25	30.25	46.25	47.25	46	29.5	25.25	29.25	38.13	10.45	19.31	56.94
TLC	22	16.5	26	27	21.25	22.75	11.5	23.5	21.31	5.09	12.16	30.47
OC	9.8	7.9	7.9	10.1	10	11.3	9.6	9.4	9.50	1.14	7.45	11.55
ETOC	8.5	6.8	8.5	8.1	9.3	9.4	8.5	7.5	8.33	0.87	6.77	9.88

Att 4, pg 3/6

Cat 1R

PC-9A

±3 Sigma Outlier Screener

Test Total	1	2	3	4	5	6	7				
LAB	A	G	A	G	F	D	B				
CMIR	41537	41541	41538	41542	41546	41968	41547				
STAND	3	3	1	1	1	1	1				
ENRUN	32	34	46	66	7	43	32				
TESTLEN	504	504	504	504	504	504	504				
IND	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A				
DTSTRT	20010615	20010619	20010707	20010712	20010713	20010731	20010723				
DTCOMP	20010707	20010711	20010731	20010803	20010804	20010805	20010814				
EOTTIME	3:53	5:33	16:22	18:35	16:45	16:57		Average	StDev	-3StDev	+3StDev
WD	331.5	310.6	327.8	371.6	311.7	317.9	407.5	339.80	36.35	230.74	448.86
TGC	43	24.5	33	40	25	23.75	49.5	34.11	10.28	3.26	64.96
TLC	24.25	15	25.5	16	13.75	21	44.25	22.82	10.50	0.00	54.33
OC	9.3	6.6	8	7	5.8	10.3	11	8.29	1.97	2.39	14.19
ETOC	8.2	5.5	7.5	6.4	5.2	10.2	12.2	7.89	2.56	0.21	15.57

Att 4, pg 4/6

Cat 1R
PC-9A
±1.8 Sigma

Test Total	1	2	3	4	5	6	7				
LAB	A	G	A	G	F	D	B				
CMIR	41537	41541	41538	41542	41546	41968	41547				
STAND	3	3	1	1	1	1	1				
ENRUN	32	34	46	66	7	43	32				
TESTLEN	504	504	504	504	504	504	504				
IND	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A	PC-9A				
DTSTRT	20010615	20010619	20010707	20010712	20010713	20010731	20010723				
DTCOMP	20010707	20010711	20010731	20010803	20010804	20010805	20010814				
EOTTIME	3:53	5:33	16:22	18:35	16:45	16:57		Average	StDev	-1.8StDev	+1.8StDev
WD	331.5	310.6	327.8	371.6	311.7	317.9	407.5	339.80	36.35	274.36	405.24
TGC	43	24.5	33	40	25	23.75	49.5	34.11	10.28	15.60	52.62
TLC	24.25	15	25.5	16	13.75	21	44.25	22.82	10.50	3.92	41.72
OC	9.3	6.6	8	7	5.8	10.3	11	8.29	1.97	4.75	11.83
ETOC	8.2	5.5	7.5	6.4	5.2	10.2	12.2	7.89	2.56	3.28	12.49

Att 4, pg 5/6

Cat 1R
PC-SD
. ±3 Sigma Outlier Screener

Test Total	1	2				
LAB	A	G				
CMIR	41760	41761				
STAND	2	2				
ENRUN	41	37				
TESTLEN	504	504				
IND	PC-9D	PC-9D				
DTSTRT	20010707	20010713				
DTCOMP	20010801	20010804				
EOTTIME	0:22	14:55	Average	StDev	-3StDev	+3StDev
WD	290.5	281.3	285.90	6.51	266.38	305.42
TGC	26	30.25	28.13	3.01	19.11	37.14
TLC	7.5	20	13.75	8.84	0.00	40.27
OC	11.2	8.3	9.75	2.05	3.60	15.90
ETOC	9.4	9.4	9.40	0.00	9.40	9.40

Att 4, pg 6/6

Motion:

Matrix Data Validity and Inclusion in LTMS –
Each of the Cat 1R matrix tests submitted ~~is operationally valid and~~ shall be included in the calculation of LTMS limits.

8/0/1
F/A/W

DRAFT of the Preliminary Statistical Summary of the Caterpillar 1R Precision Matrix

Preliminary Draft 08/17/2001
PRS

Att 6, pg 1/25

Caterpillar 1R Matrix Summary

- The 1R matrix is not yet complete. This is a draft analysis of 16 of the 18 matrix runs. The statistician work group has not reviewed the presentation.
- Only WD, TGC, TLC, OC, ETOC, TGF, TLHC, UCWD analyzed to date. Is there more?
- Three oils (A, D, M) are in the matrix. There is evidence of discrimination in Oil Consumption.
- No transformations necessary among the major parameters. TGF needs a transformation and possibly TLHC and UCWD

Att 6, pg 2/25

Caterpillar 1R Matrix Summary

- High Copper may affect UCWD, but does not seem to affect other parameters
- The variable AAIRFLO has some very strange results in the dataset
- There are possible Lab effects in OC, ETOC and UCWD.
- There are possible outliers in TLHC and UCWD
- There are positive correlations among the parameters especially TGF/TGC and OC/ETOC.

Att 6, pg 3/25

Caterpillar 1R Matrix Status

Lab A			Lab B	Lab G			Lab D	Lab F
Stand 1	Stand 2	Stand 3	Stand 1	Stand 1	Stand 2	Stand 3	Stand 1	St[redacted]
A	M	A	M	A	M	A	M	A
M	D	M	A	M	D	M	A	M

The 1R Task Force concluded that the 3 tests at a coolant flow of 63 L/m are no different from the ones run at 70 L/m.

Att 6, pg 4/25

Caterpillar 1 R Correlations

WD	0.64	0.42	-0.06	-0.05	0.62	0.08	-0.07
0.66	TGC	0.59	0.15	0.15	**0.93**	0.51	-0.11
0.26	0.64	TLC	0.11	0.23	0.64	0.52	-0.24
0.33	0.30	0.29	OC	**0.88**	0.14	0.19	0.04
0.50	0.44	0.60	0.75	ETOC	0.19	-0.01	-0.06
0.68	**0.94**	0.65	0.06	0.31	T(TGF)	0.46	-0.01
-0.17	0.54	0.55	0.33	0.20	0.43	TLHC	0.05
-0.12	-0.32	-0.24	-0.50	-0.55	-0.06	-0.23	UCWD

Raw Data Correlations on Upper Triangle; Partial Correlations on Lower Triangle

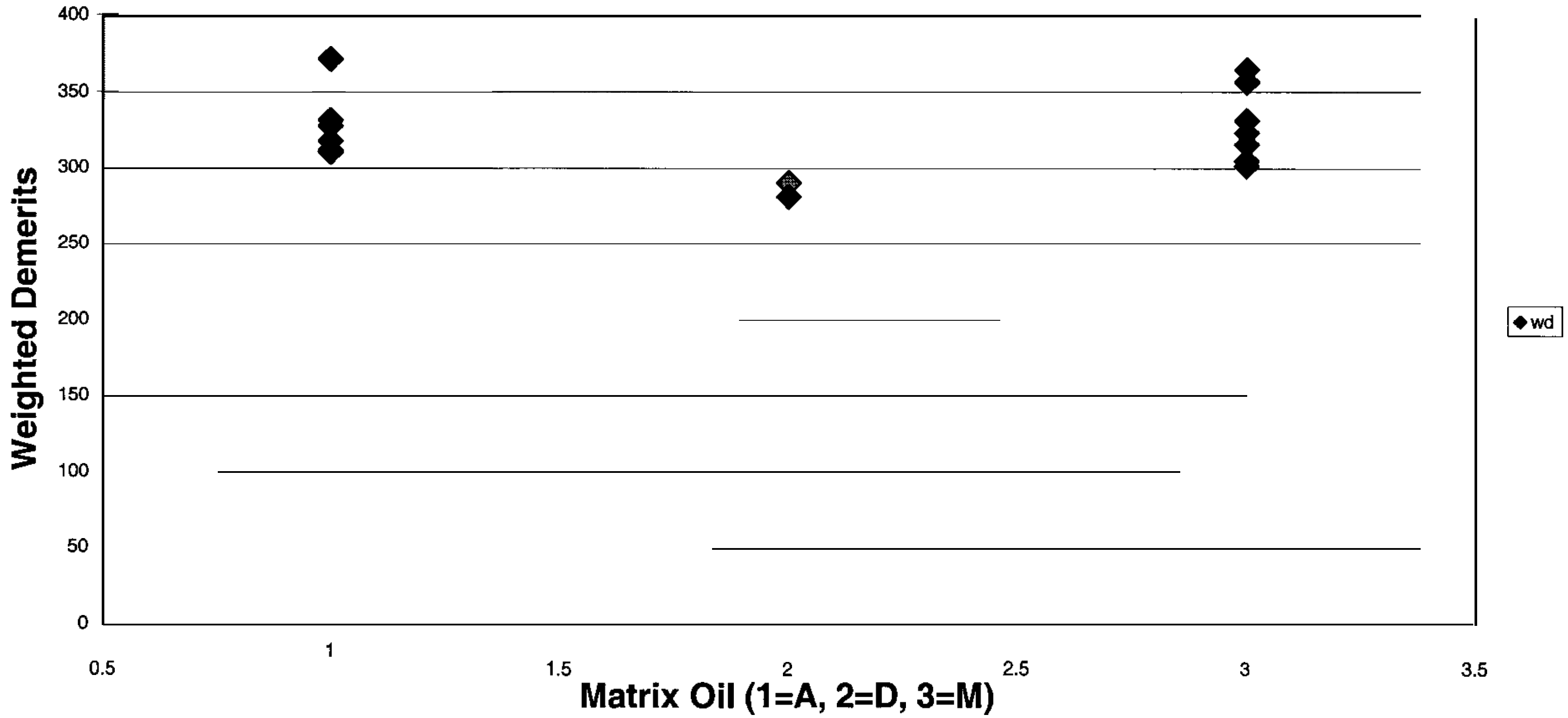
Att 6, pg 5/25

Weighted Deposits (WD)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- Some evidence that Oil D differs from A,M ($0.05<p<0.10$)
  - Root MSE = 23.03 (13 df)
  - $R^2 = 0.34$
  - No observations had large Studentized residuals
  - Final model included Oil term only

Att 6, pg 6/25

Caterpillar 1R Weighted Demerits by Oil



Top Groove Carbon (TGC)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- No evidence of any effects

    Root MSE = 9.33 (13 df)

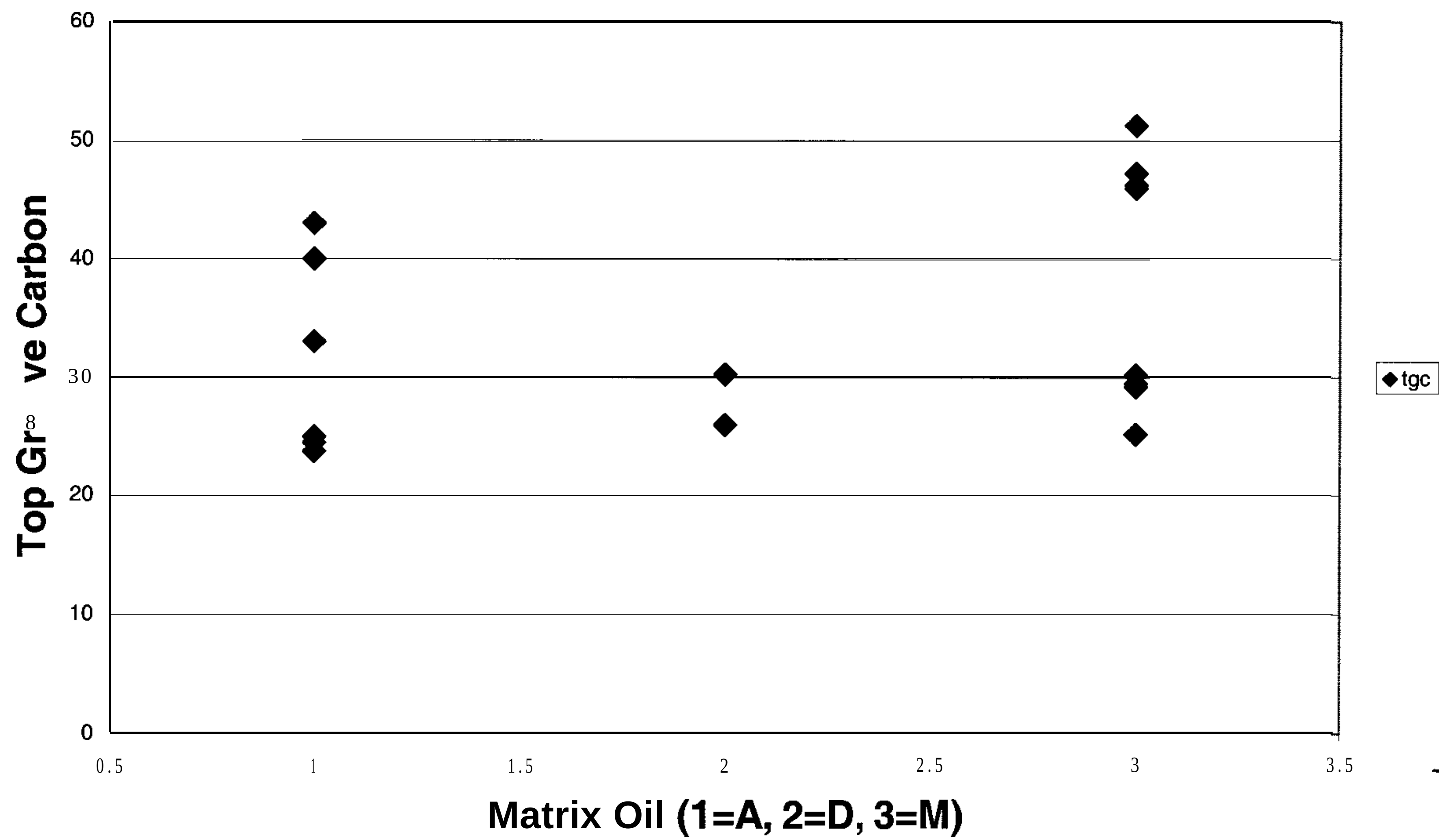
    $R^2 = 0.17$

    No observations had large Studentized residuals

    Final model included oil term only

Att 6, pg 8/25

Caterpillar 1R Top Groove Carbon by Oil



Att 6, pg 9/25

Top Land Carbon (TLC)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- No evidence of any effects

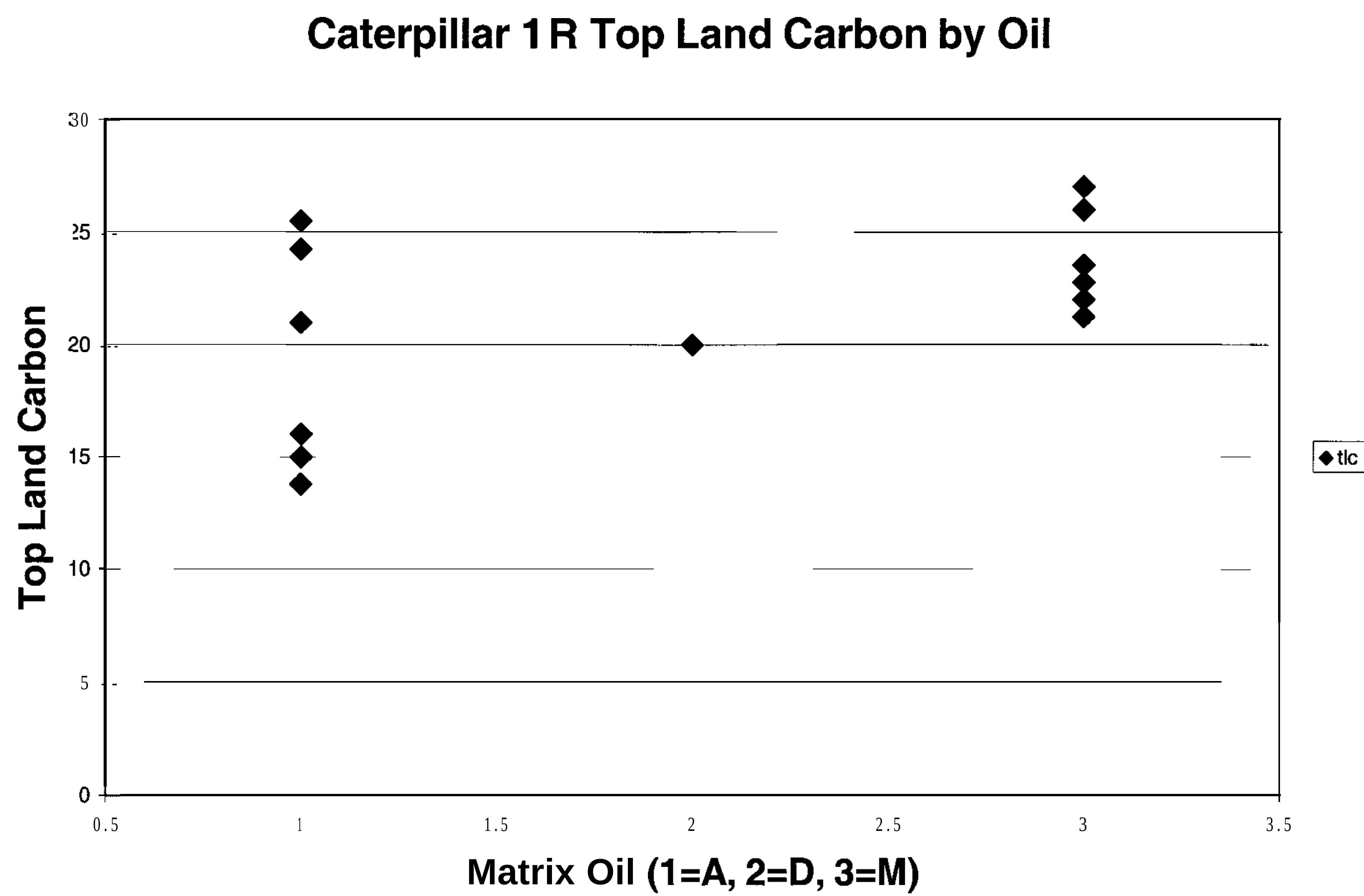
  Root MSE = 5.44 (13 df)

  $R^2 = 0.19$

  No observations had large Studentized residuals

  Final model included oil term only

Att 6, pg 10/25



Caterpillar 1R Top Land Carbon by Oil
Top Land Carbon
30
25
20
15
10
5
0
0.5
1
1.5
2
2.5
3
3.5
Matrix Oil (1=A, 2=D, 3=M)
tlc

Att 6, pg 11/25

Average Initial Oil Consumption (OC)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- Evidence that Oils differ ($p<0.05$) and some evidence that Labs differ ($0.05<p<0.10$)

    Root MSE = 1.15 (9 df)

    $R^2 = 0.68$

    No observations had large Studentized residuals

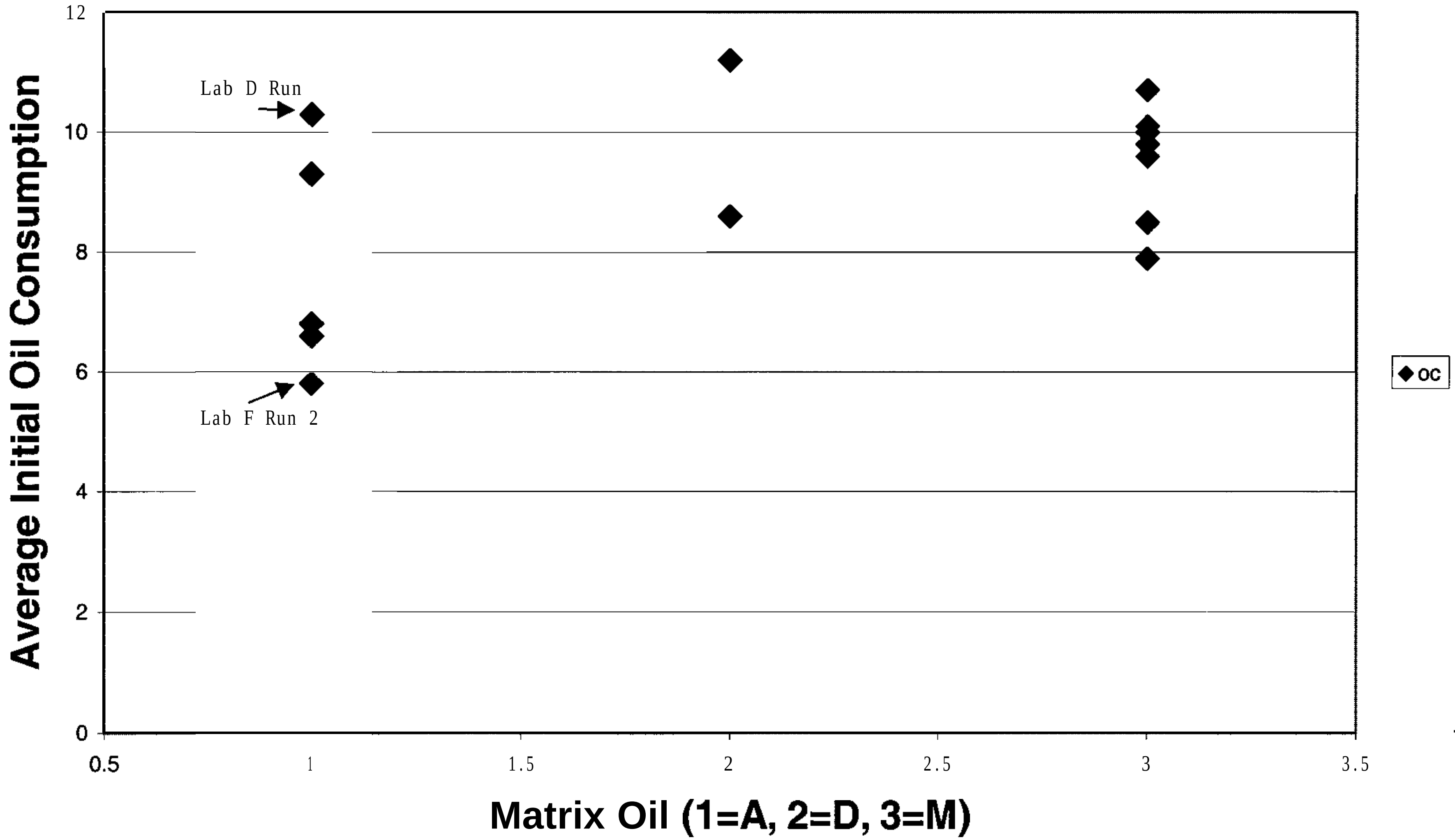
    Final model included oil and lab term

    The Lab evidence was driven by the difference between D (1 run in Lab) and F (2 runs in Lab)

    The Oil evidence was driven by Oil A

Att 6, pg 12/25

Caterpillar 1R Average Initial Oil Consumption by Oil



Att 6, pg 13/25

End of Test Oil Consumption (ETOC)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- Evidence that Oils differ ($p<0.05$) and some evidence that Labs differ ($0.05<p<0.10$)

  Root MSE = 1.03 (9 df)

  $R^2 = 0.70$

  No observations had large Studentized residuals

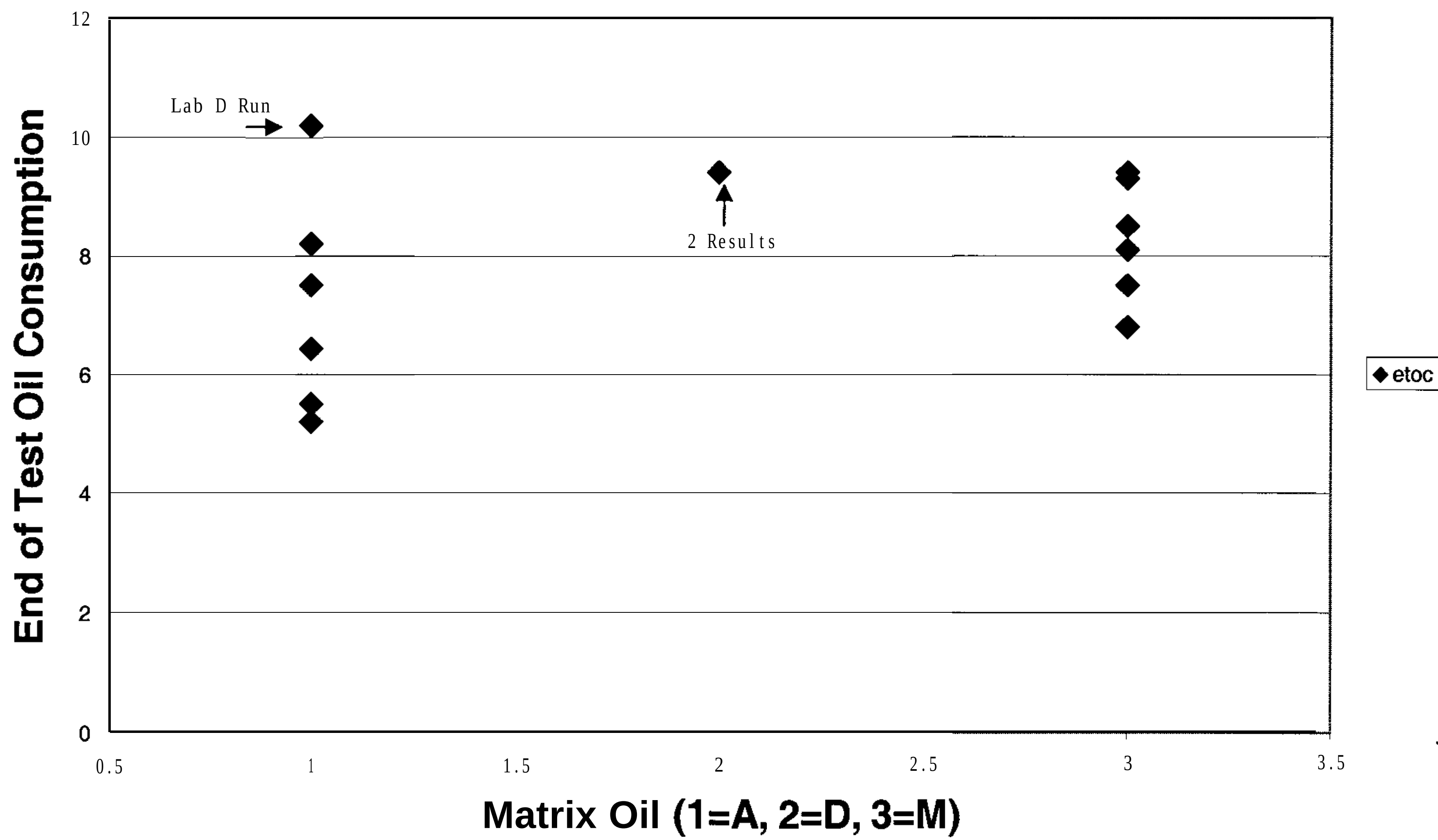
  Final model included oil and lab term

  The Lab evidence was driven by Lab D (1 run in Lab)

  The Oil evidence was driven by Oil A

Att 6 pg 14/25

Caterpillar 1R End of Test Oil Consumption by Oil



Att 6, pg 15/25

Top Groove Fill (TGF)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- Square Root Transformation was used
- No evidence of any effects

  Root MSE = 1.50 (13 df) on Square Root Scale

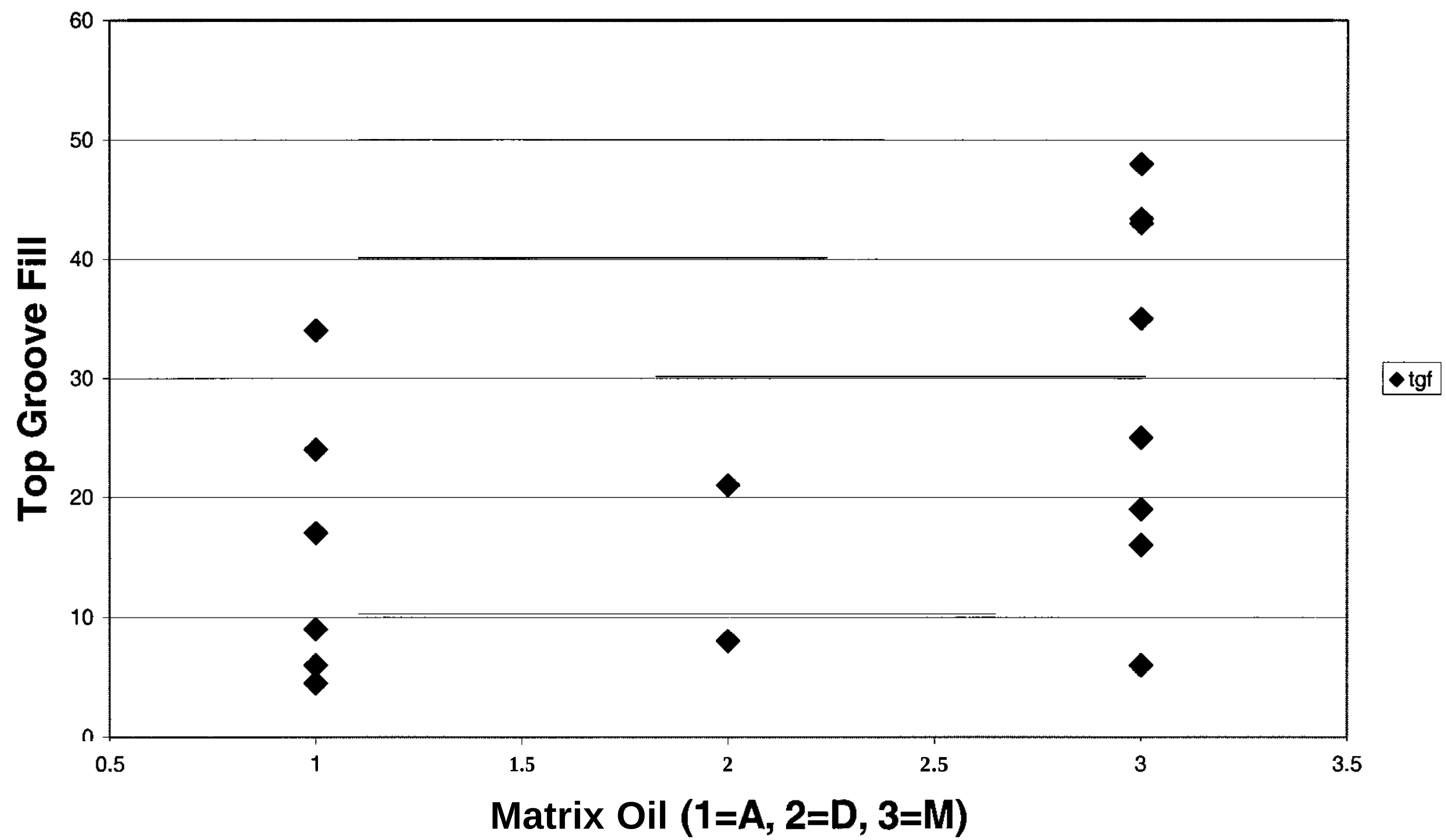
  $R^2 = 0.23$

  No observations had large Studentized residuals

  Final model included oil term only

4776, pg 16/25

Caterpillar 1R Top Groove Fill by Oil



Att 6, pg 17/25

Top Land Heavy Carbon (TLHC)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- The data are skewed, but no satisfactory transformation was found
- No evidence of any effects

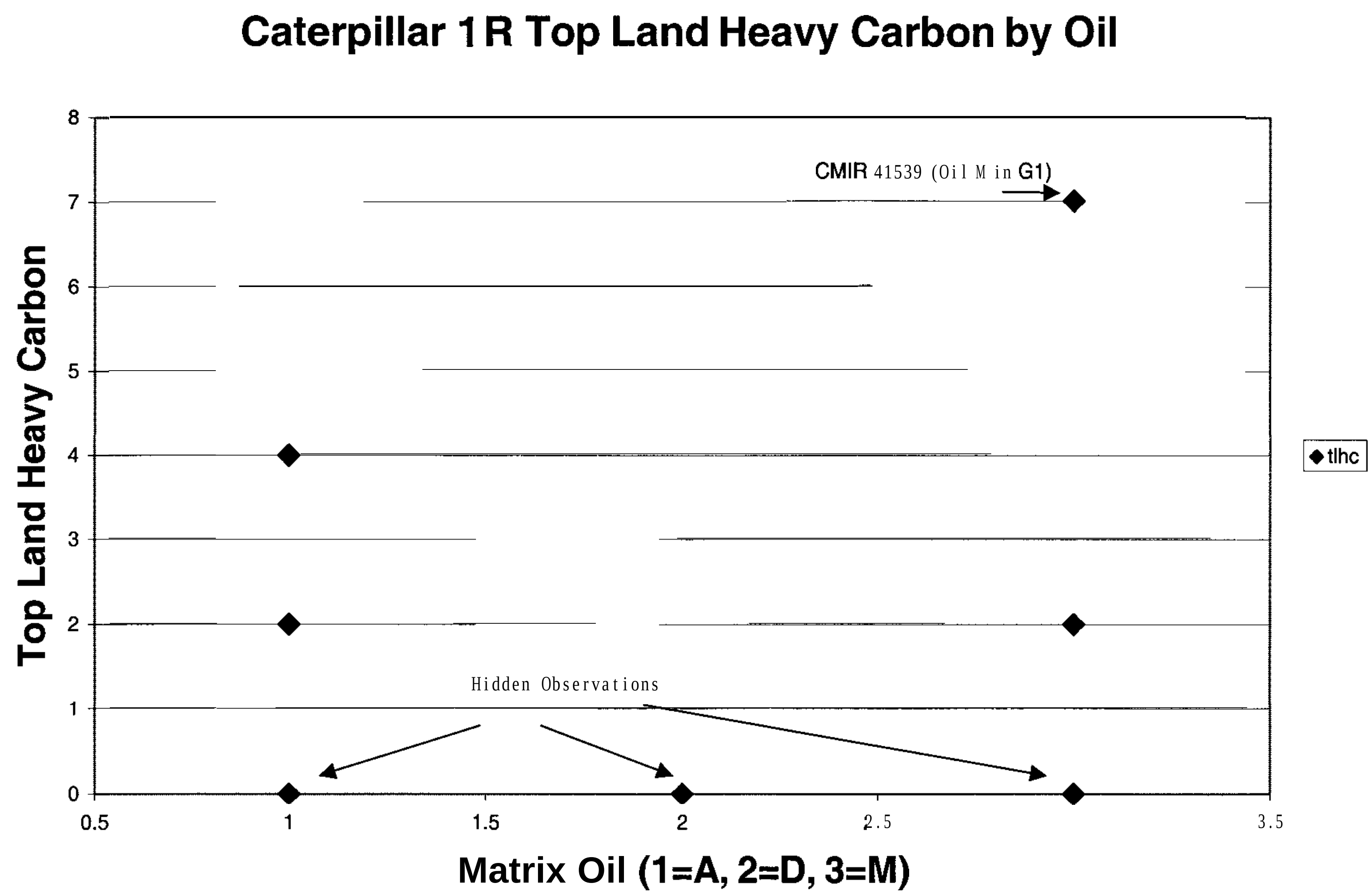
  Root MSE = 1.90 (13 df)

  $R^2 = 0.16$

  CMIR 41539 (Oil M in G1) had large Studentized residuals. The predicted result was 2 and the actual result was 7

  Final model included oil term only

Att 6, pg 18/25



Caterpillar 1R Top Land Heavy Carbon by Oil
CMIR 41539 (Oil M in G1)
Hidden Observations
Top Land Heavy Carbon
Matrix Oil (1=A, 2=D, 3=M)
tlhc
0
1
2
3
4
5
6
7
8
0.5
1
1.5
2
2.5
3.5

Att 6, pg 19/25

Under Crown Weighted Deposits (UCWD)

- Model factors include Lab (A,B,D,F,G), Stand within Lab (A1,A2,A3,G1,G2,G3) and Oil (A,D,M)
- CMIR 41536 (Oil M in A2) had a large studentized residual and may drive possible conclusions (not made here) for a transformation and stand effect. The drains indicate high Copper early in the test
- Very weak evidence of a Lab effect ($0.1<p<0.2$)

  Root MSE = 4.45 (9 df)

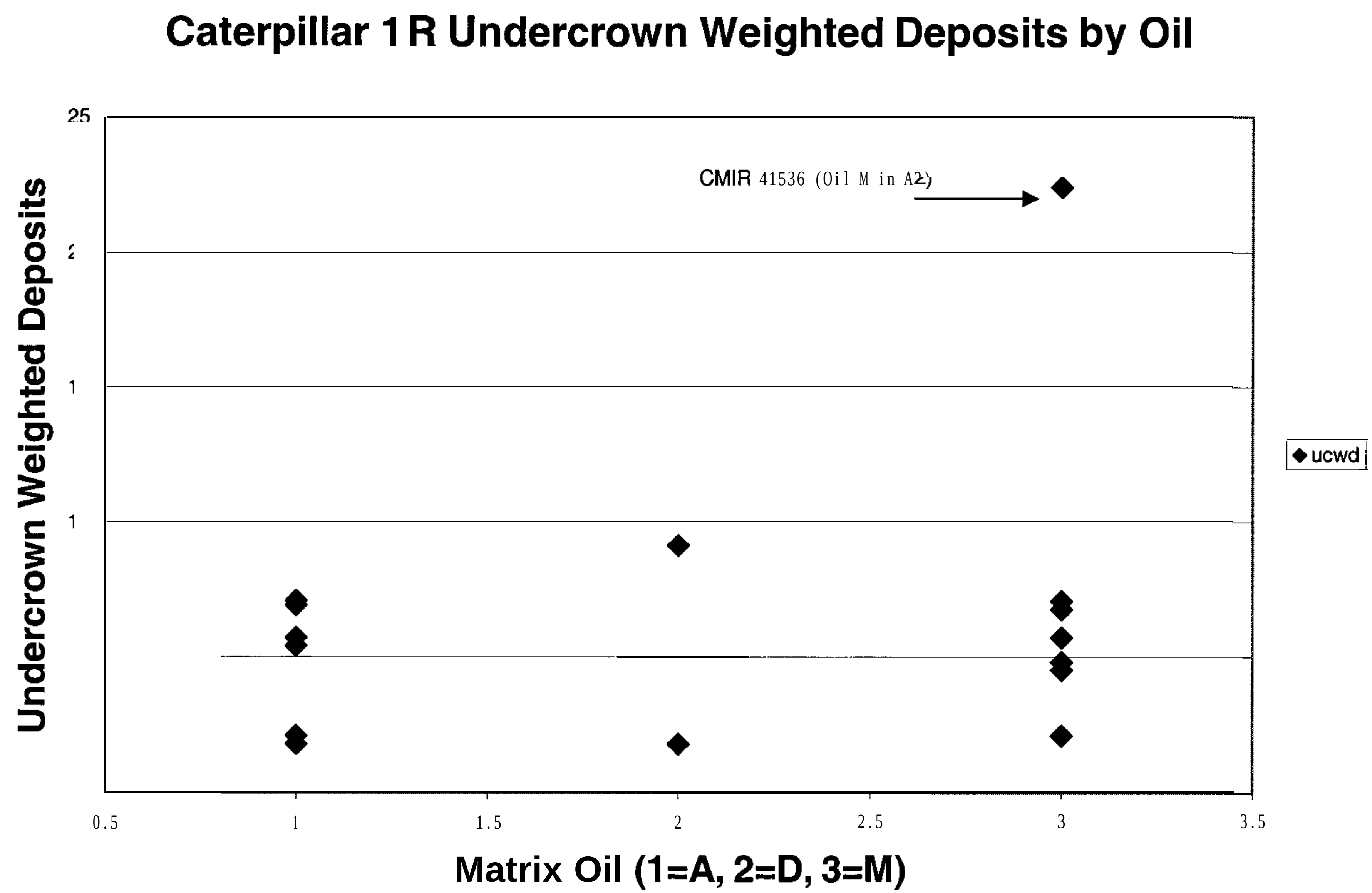
  $R^2 = 0.51$

  Final model included oil and lab term

  The Lab evidence was driven by the difference between

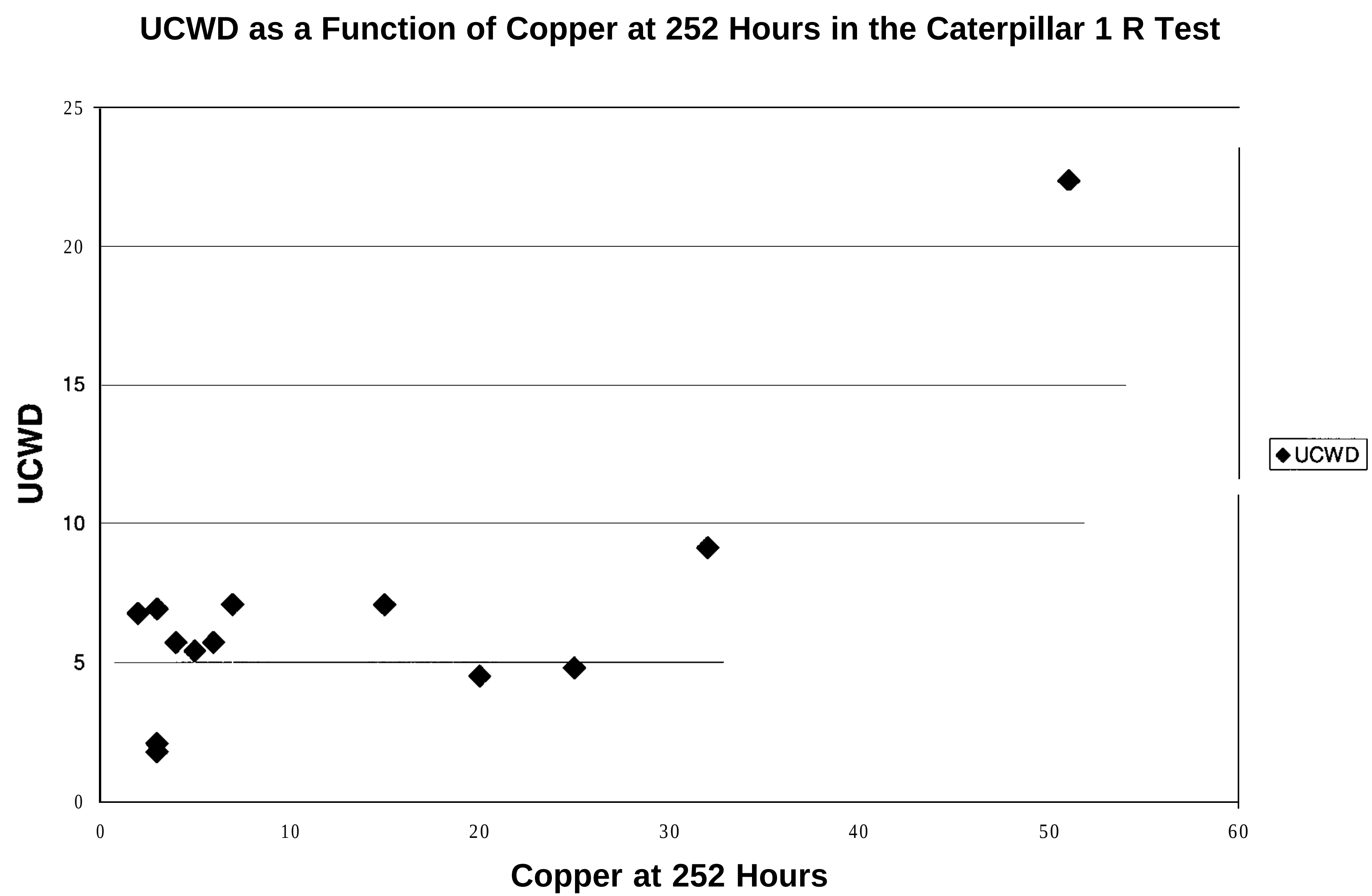
  Lab A and Lab G

Att 6, pg 20/25



Caterpillar 1R Undercrown Weighted Deposits by Oil
Undercrown Weighted Deposits
Matrix Oil (1=A, 2=D, 3=M)
CMIR 41536 (Oil M in A2)
ucwd
25
0.5
1
1.5
2
2.5
3
3.5

Att 6, pg 21/25



UCWD as a Function of Copper at 252 Hours in the Caterpillar 1 R Test
25
20
15
10
5
0
UCWD
0
10
20
30
40
50
60
Copper at 252 Hours
UCWD

Att 6, pg 22/25

Summary of 1R Oil Means and Test Standard Deviation

	WD	TGC	TLC	OC	ETOC	SQRT (TGF)	TLHC	UCWD
Oil A	328.5	31.5	19.3	7.9	7.5	3.737	1.0	4.3
Oil D	285.9	28.1	13.8	10.2	10.2	3.706	0.0	4.9
Oil M	331.7	38.1	21.3	9.8	9.1	5.225	2.1	6.8
Std Dev	23.03	9.33	5.44	1.15	1.03	1.50	1.90	4.45

Summary of 1R Relevant Lab Means

	WD	TGC	TLC	OC	ETOC	SQRT (TGF)	TLHC	UCWD
Lab A	[redacted]	[redacted]	[redacted]	9.4	8.3	[redacted]	[redacted]	9.6
Lab B	[redacted]	[redacted]	[redacted]	9.5	9.1	[redacted]	[redacted]	3.0
Lab D	[redacted]	[redacted]	[redacted]	11.7	11.6	[redacted]	[redacted]	6.5
Lab F	[redacted]	[redacted]	[redacted]	7.3	7.5	[redacted]	[redacted]	5.5
Lab G	[redacted]	[redacted]	[redacted]	8.6	7.9	[redacted]	[redacted]	2.1

lab	cmir	stand	oil	date	wd	tgc	tlc	oc	etoc	tgf	tlhc
A	41535	1	M	20010704	364.6	51.25	22	9.8	8.5	48	2
A	41536	2	M	20010705	315.5	30.25	16.5	7.9	6.8	25	2
A	41537	3	A	20010707	331.5	43	24.25	9.3	8.2	24	4
F	41545	1	M	20010710	356.7	46.25	26	7.9	8.5	43.4	2
G	41539	1	M	20010711	323.2	47.25	27	10.1	8.1	43	7
G	41541	3	A	20010711	310.6	24.5	15	6.6	5.5	6	0
B	41554	1	M	20010712	331.3	46	21.25	10	9.3	35	0
G	41540	2	M	20010712	356.1	29.5	22.75	10.7	9.4	16	0
A	41538	1	A	20010731	327.8	33	25.5	8	7.5	17	2
A	41760	2	D	20010801	290.5	26	7.5	11.2	9.4	8	0
A	41573	3	M	20010802	301.5	25.25	11.5	9.6	8.5	6	2
G	41542	1	A	20010803	371.6	40	16	6.8	6.4	34	0
G	41761	2	D	20010804	281.3	30.25	20	8.6	9.4	21	0
F	41546	1	A	20010804	311.7	25	13.75	5.8	5.2	4.5	0
G	41570	3	M	20010805	304.9	29.25	23.5	8.5	7.5	19	2
D	41968	1	A	20010805	317.9	23.75	21	10.3	10.2	9	0

Att 6, pg 25/25

New and Improved LTMS for PC-9

IDEA:

Improve the Power of LTMS in Detecting Shifts and Trends

Provide Better Incentives for "Good" Lab Behavior

Provide Less Opportunity to "Trick" the System

Use Data to Make Decisions and Engineering Judgment to Supplement them (Not the Other Way Around)

Att 7, pg 1/8

MOTIONS:

Item
~~**Motion**~~ **#1:** To remain LTMS calibrated, a Test Stand / Engine must complete at least one valid reference test once every ~~180~~ 365 days

Item
~~**Motion #**~~2: To remain LTMS calibrated, a Test Lab must complete at least one valid reference test once every 90 days Appropriate rate taken at stands as ~~determined~~ monitored by TMC

Item
~~**Motion #3:**~~ Remove the EWMA, Lab, Warning, Precision Alarm and all Shewhart Precision Alarms

Item
~~**Motion**~~ **#4:** The Consequence of the and OEM EWMA Lab or Stand Action, Precision Alarm is a Letter to all Test Sponsors citing the alarm and its meaning. Also, all Test Reports during the alarm period must comment that the Lab, or offending stand, is currently in Precision Alarm status.
7/0/1

~~**Motion #5:** Do NOT adjust Precision alarms for multiple parameters~~

Att. 7, pg 2/8

Justification for Motions:

I. Power of Control Chart Problem Detection

II. Limited Data in Small Labs

III. Large Lab Differences Before the Start of the Category

IV. Better Incentives for "Good" Lab Behavior

Att 7, pg 3/8

The Realitv Behind the LTMS

Probability of EW'MA chart detecting problem within a few tests is very, very small because EWMA places large weight on In-Control status before a bias is introduced. It takes some time before the weight of that assumption is minimized. Unless reference frequency is increased labs with only a few reference tests per year may go years before detecting problems.

After 1 test in the lab: EWMA = 0.2×(1st Reference Test) + 0.8×(On Target Number)

After 2: EWMA = 0.2×(2nd Ref Test) + 0.8×0.2×(1st Ref Test) + 0.8×0.8×(OTN)

# Reference Tests	Weight Given to On Target Status	# Reference Tests	Weight Given to On Target Status
1	0.80	6	0.26
2	0.64	7	0.21
3	0.51	8	0.17
4	0.41	9	0.13
5	0.33	10	0.11

Att 7, p9 4/8

Average Run Lengths for Different Settings of λ Given a 0.0s Shift in the Process and the False Alarm Error Rate

	Average Run Length for 0.0s Shift		
False Alarm Error Rate	$\lambda = 0.1$	$\lambda = 0.2$	$\lambda = 0.3$
10.0%	35.41	22.39	16.96
9.00%	38.55	24.52	18.56
8.00%	40.86	26.60	20.60
7.00%	45.14	29.57	23.31
6.00%	51.71	33.66	26.56
5.00%	62.47	41.13	32.22
4.00%	73.64	49.07	38.36
3.00%	89.04	60.77	48.31
2.00%	112.3	80.66	67.97
1.00%	141.2	116.2	103.6

Note: ARLs are Based upon Random Simulations from the Normal Distribution
Estimates are Biased in the Direction of Shorter Run Lengths

Att 7, pg 5/8

Average Run Lengths for Different Settings of λ Given a 0.5s Shift in the Process and the False Alarm Error Rate

	Average Run Length for 0.5s Shift		
False Alarm Error Rate	$\lambda = 0.1$	$\lambda = 0.2$	$\lambda = 0.3$
10.0%	11.70	9.740	8.740
9.00%	12.17	10.22	9.250
8.00%	12.60	10.65	9.640
7.00%	13.11	11.11	10.19
6.00%	13.76	11.86	10.98
5.00%	14.78	12.72	12.11
4.00%	16.09	13.77	13.05
3.00%	17.65	15.91	15.51
2.00%	20.37	18.89	18.57
1.00%	25.64	25.16	25.48

Note: ARLs are Based upon Random Simulations from the Normal Distribution
Estimates are Biased in the Direction of Shorter Run Lengths

Att 7, pg 6/8

Average Run Lengths for Different Settings of λ Given a 1.0s Shift in the Process and the False Alarm Error Rate

	Average Run Length for 1.0s Shift		
False Alarm Error Rate	$\lambda = 0.1$	$\lambda = 0.2$	$\lambda = 0.3$
10.0%	5.26	4.35	3.95
9.00%	5.48	4.54	4.07
8.00%	5.61	4.71	4.21
7.00%	5.86	4.86	4.40
6.00%	6.14	5.17	4.67
5.00%	6.48	5.46	4.98
4.00%	6.87	5.75	5.33
3.00%	7.31	6.14	5.80
2.00%	7.92	6.77	6.39
1.00%	9.06	7.88	7.82

Note: ARLs are Based upon Random Simulations from the Normal Distribution
Estimates are Biased in the Direction of Shorter Run Lengths

Att 7, pg 7/8

Probability of EWMA Alarm in a Lab, with a Bias of 1 Standard Deviation, given Lambda=0.2 and k=1.96

# Reference Tests	Probability of 1s Detection	# Reference Tests	Probability of 1s Detection
1	0.01	6	0.73
2	0.14	7	0.80
3	0.31	8	0.85
4	0.48	9	0.90
5	0.62	10	0.93

What is the Bottom Line of All These Figures???

The Bottom Line is that if you are running at least 4 scheduled reference tests per year, you can probably catch a 1 standard deviation shift in your process within a year. Anything less than 4 scheduled tests per year would take longer.

Att 7, pg 8/8

MOTION

Att 8, pg 1/1

IR CALIBRATION PERIOD

12 ~~months~~ (365 days) FROM THE EOT DATE OF THE ACCEPTABLE CALIBRATION TEST.

THE LAST CANDIDATE ~~MUST~~ CAN START ~~BY~~ ON OR BEFORE THE LAST DAY OF THE PERIOD.

8/0/0

Motion:

All Cat 1R matrix stands are considered acceptable and are calibrated for one calibration period (EV=1*, LZ=1, PE=3, SwRI=3, XMOB=1). The labs are given "existing lab" and the stands are given "existing stand" status.

* when 2nd operationally valid test is received

One Test Parameter

		EWMA				Shewhart Chart	
		LAMBDA		K		K	
Chart Level	Limit Type	Precision	Severity	Precision	Severity	Precision	Severity
Stand	Reduced K	--	--	--	--	--	1.48
	Action	0.30	0.30	1.48	(1.80)	~~1.48~~	1.80
Lab	Warning Action	0.3 0.3	0.2 --	m 2.33	1.9[illegible]	~~1.48~~	1.80 --
Industry	Warning	0.2	0.2	1.48	1.80	--	--
	Action	0.2	0.2	2.33	2.58	--	--

7% False Alarm Error Rate for Shewhart Charts and Stand Charts
7% False Alarm Error Rate for EWMA Warning Limits
1% False Alarm Error, Rate for EWMA Action Limits (Except for Lab Severity and Stand)
5% False Alarm Error Rate for EWMA, Lab Severity Action

Adjustment&Made fsr Multiple Parameters Except in the Case of Shewhart Severity and EWMA, Lab Severity Action

Motion:

Existing Lab --
A lab that has conducted at least 3 operationally valid Cat 1R calibration tests.
OR PARTICIPATED IN THE CAT 1R PC-9 MATRIX

Existing Stand --
A test stand, within an existing lab, that has conducted at least 2 operationally valid Cat 1R calibration tests.

New Stand --
A test stand that does not meet existing stand status.
Reduced K – TBD

8/10/0

Att 12, pg 1/1

Motion:

TMC to assign 1005-1 (PC-9M) as the ~~primary~~ INITIAL calibration oil, UNTIL SUCH A TIME AS OIL A IS AVAILABLE.

8/0/0

ADDENDUM K1

TEMPLATE CHECKLIST

Purpose

The Checklist for Comparing Tests to the Template is used to assess progress in new engine test development against the Code Acceptance Criteria and Action Plans. The checklist is updated periodically during the course of test development and is provided to, and discussed with, the appropriate ASTM test development task force.

The rating scale for comparing test development to the Template is as follows:

A -- Completed

B -- In Progress

C -- Planned

D -- No Action

Test Name Caterpillar 1 R **Assessment Date August 3, 2001**

American Chemistry Council Code of Practice
Appendix K -Template for Acceptance of New Tests
Checklist for Comparing Tests to the Template

A. Precision. Discrimination and Parameter Independence

A.1 Precision $E_p = d_p/Spp$, $E_p \geq 1.0$ for all pass/fail parameters
d_p = Smallest difference of practical importance
Spp = Pooled standard deviation at target level of performance

Parameter	Dp	Spp	Ep	≥1.0?
Top Groove Carbon, Demerits (TGC)				
Top Land Carbon, Demerits (TLC)				
Weighted Deposits, Demerits (WDR)				
Avg Oil Cnsmptn, g/k Wh (OC)				
End of Test Oil Consumption, g/k Wh (ETOC)				
Undercrown Deposits, Demerits (UC)				
Cylinder Liner Wear Step, *u*m (CLWS)				
Loss of Side Clearance, millimeters (LSC)				
% Top Land Heavy Carbon (TLHC)				
% Top Groove Fill (TGF)				

Comments:

A.2 Discrimination

For each test parameter in A.1, at least one of the oils used in proof-of-concept testing, matrix testing, or calibration testing must be statistically significantly different from at least one of the remaining oils. This difference must be in the correct direction, i.e., a poor oil should not test out as significantly better than a good oil. Significant difference may be declared with a p-value of 10% or less. Multiple comparison techniques (Tukey, Scheffe, Bonferroni, etc.) for the least-square means of the oils are preferred comparison techniques and should be stated in the analysis. Note that these least-squares means are not necessarily proposed LTMS targets.

RATING SCALE: A - Completed; B - In Progress; C - Planned; D-No Action

TGC	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey) vs 1	vs 2	vs 3
Oil 1					
Oil 2					
Oil 3					

TLC	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey) Vs 1	vs 2	vs 3
Oil 1					
Oil 2					
Oil 3					

WDR	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey) Vs 1	vs 2	vs 3
Oil 1					
Oil 2					
Oil 3					

OC	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey) Vs 1	Vs 2	vs 3
Oil 1					
Oil 2					
Oil 3					

ETOC	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey) Vs 1	vs 2	vs 3
Oil 1					
Oil 2					
oil3					

BATING SCALE: A - Completed; B -In Progress; C-Planned; D - No Action

UC	Least-Square Mean	95% Confidence Interval for Mean	u-value for t-test of equal means (Tukey)		
			Vs 1	vs 2	vs 3
Oil 1					
Oil 2					
oil3					

CLWS	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey)		
			Vs 1	vs 2	vs 3
Oil 1					
Oil 2					
Oil 3					

LSC	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey)		
			Vs 1	vs 2	vs 3
Oil 1					
Oil 2					
Oil 3					

TLHC	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey)		
			Vs 1	vs 2	vs 3
2					
3					

TGF	Least-Square Mean	95% Confidence Interval for Mean	p-value for t-test of equal means (Tukey)		
			Vs 1	vs 2	vs 3
1					

Comments:
The Precision/BOI Matrix did not contain known discrimination oils.

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action

A.3. Parameter Independence

Each pass/fail parameter has a unique and significant purpose in terms of the engine oil performance standard. Parameter redundancy is investigated if a correlation coefficient is 0.85 or greater.

Correlation Coefficients for Parameters

	TGC	TLC	WDR	OC	ETOC	UC	CLWS	LSC	TLHC	TGF
TGC										
TLC										
WDR										
OC										
ETOC										
UC										
CLWS										
LSC										
TLHC										
TGF										

Correlation Coefficients for Parameters Adjusting for Stands and Oils

	TGC	TLC	WDR	OC	ETOC	UC	CLWS	LSC	TLHC	TGF
TGC										
TLC										
WDR										
OC										
ETOC										
UC										
CLWS										
LSC										
TLHC										
TGF										

Comments:

RATING SCALE: A - Completed; B - In Progress; C - Planned; D-No Action

B. Severitv and Precision Control Chartinq

Reauirements

B.1 Is an LTMS for reference oil tests in place which is consistent with CMA Code Appendix A? _C_ A

8.2 Are appropriate data transforms applied to test results? _C_ B

Comments: *The 1P has transforms* for *OC and ETOC.* Transforms *are expected in the 1 R based on 1 P experience.*

C. Interpretation of Multiple Tests

Reauirements

C.1 Is a suitable system in place to handle repeat tests on a candidate oil? - C -
Type: MTAC Tiered Limits Other

C.2 Has a method for the determination and handling of outlier results been defined? - C -

Comments:

D. Action Plan

D.1 Reference Oils

Do the majority of reference oils represent current technology? _C_ A

Are the majority of reference oils of passing or borderline pass/fail performance? _C_

Recommended Aaaroaches

D.l.l Is reference oil supply and distribution handled through an independent organization? - A -

D.1.2 Is a quality control plan defined and in place? - A -

D.1.3 Is a turnover plan defined/in place to ensure uninterrupted supply of reference oil and an orderly transition to reblends? _A_

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action

D.1.4 Is a process for introducing replacement reference oils defined and in place? - B -

D.1.5 Are oils blended in a homogeneous quantity to last 5 years? _~~C~~ B_

Comments: Specific reference *oils* not yet *selected,* BUT use *of a Category* reference *oil would be helpful.*

D.2 Test Parts

Are all critical parts identified? _A_

Critical parts include Piston Cooling Nozzle, Piston, Rings, Liner, EPROM. Caterpillar 1L Specification is used for critical parts *without ASTM input.* Parts are *issued and used in a range of serial* numbers.

Is a system defined/in place to maintain uniform hardware? - A -

I Y part numbers are used for critical parts.

Is there a system for engineering support and test parts supply? _A_

Recommended Approaches

D.2.1 Are critical parts distributed through a Central Parts Distributor (CPD)? _A_

Morton Parts *is-functionally the CPD. Physically, dealerships distribute the* parts.

D.2.2 Are critical parts serialized, and their use documented in test report? _A_

D.2.3 Are all parts used on a first in/first out basis? - D -

D.2.4 Are all rejected critical parts accounted for and returned to the CPD? _A_

Parts are *returned to Caterpillar.*

D.2.5 Does the CPD make status reports to the test surveillance body at least semi-annually? - A -

RATING SCALE: A-Completed; B -In Progress; C-Planned; D - No Action

D.2.6 Is there a QC and turnover plan in place for critical test parts, including identification and measurement of key part attributes, a system for parts quality accountability, a turnover plan in place for simultaneous industry-wide use of new parts or supply sources? __A__

D.2.7 Is the CPD active in industry surveillance panel/group, and in industry sponsored test matrices? __A__

Comments:

D.3 Test Fuel

Recommended Anaroaches

D.3.1 Is the fuel specified and the supplier(s) identified? __A__

Phillips PC9.

Is a process in place to monitor fuel stability over time? - A -

The fuel is considered stablegiven the turnover time for batches.

Are approval guidelines in place for fuel certification? - A -

Every batch to be analyzed and certified.

D.3.2 If the test fuel is treated as a critical part of the test procedure: Is an approval plan and severity monitoring plan for each fuel batch in place? - D -

Not *deemed necessa y.*

Is a quality control plan defined and in place to assure long term quality of the fuel? __A__

TMC is on the distribution list for fuel batch certifications and must *give their approval.*

RATING SCALE: A - Completed; B - In Progress; C - Planned; D-No Action

Is a turnover plan defined, in place and demonstrated to ensure uninterrupted supply of fuel? - A -

This is based on Phillips letter of commitment.

Comments: *Fuel is not considered criticalfor this test. Note that Fuel batches that meet acceptance may be mixed.*

D.4 Test Procedure

Recommended Awroaches

D.4.1 Is a technical report published documenting, per ASTM FlowPlan:
Test precision for reference oils? __C__

Field correlation? - D -

Test development history? - C -

D.4.2 Are test preparation and operation clearly documented in a standard format, e.g., ASTM, CEC __B__

D.4.3 Are test stand configuration requirements documented and Standardized? __~~B~~ A__

D.4.4 Are milestones for precision improvements established __D__

D.4.5 Are routine engine builder workshops planned/conducted? __A__

Target one *per* calendar year.

Comments:

RATING SCALE: A - Completed; B - In Progress; C - Planned; D-No Action

D.5 Rating and Reporting of Results

Recommended Approaches

D.5.1 Are the reported ratings from single raters (i.e. not averages from various raters)? - A -

Ratings are **not** *averaged, but a* consensus *rating among raters may be used within a lab.*

D.5.2 Is a suitable severity adjustment system in place? ~~C~~ A

D.5.3 Is each pass / fail parameter unique and have a significant purpose for judging engine oil performance? ~~C~~ B

Theoretically, this is not true *at this time.*

D.5.4 Do all rate and report parameters judge operational validity, help in test interpretation or judge engine oil performance? - C -

~~*LSC and Bore Polish are examples of rate and report parameters in this test.*~~

D.5.5 Are routine rater workshops conducted / planned? __A__

Raters must attend CRC HD rating workshop at least once per 12 months.

Comments:

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action

D.6 Calibration, Monitoring and Surveillance

Recommended Approaches

D.6.1 Is a process in place for independent monitoring of severity and precision with an action plan for maintaining calibration of all laboratories? ~~C~~ A

D.6.2 Are stand, lab, and industry reference oil control charts of all pass/fail criteria parameters used to judge calibration status? ~~C~~ A

D.6.3 Does the specified calibration test interval allow no more than 15 non-reference oil test between successful calibration tests? ~~B~~ A

D.6.4 Is an industry surveillance panel in place? A

Comments:

D.7 Guidelines for Read Across

Recommended Approaches

D.7.1 Is a plan defined to establish data for development of BOI and VGRA? ~~C~~ A

In running the revised 1R Matrix without Base Oil information, there was general agreement in the Industry that BOI from the 1P would carry over to the 1R.

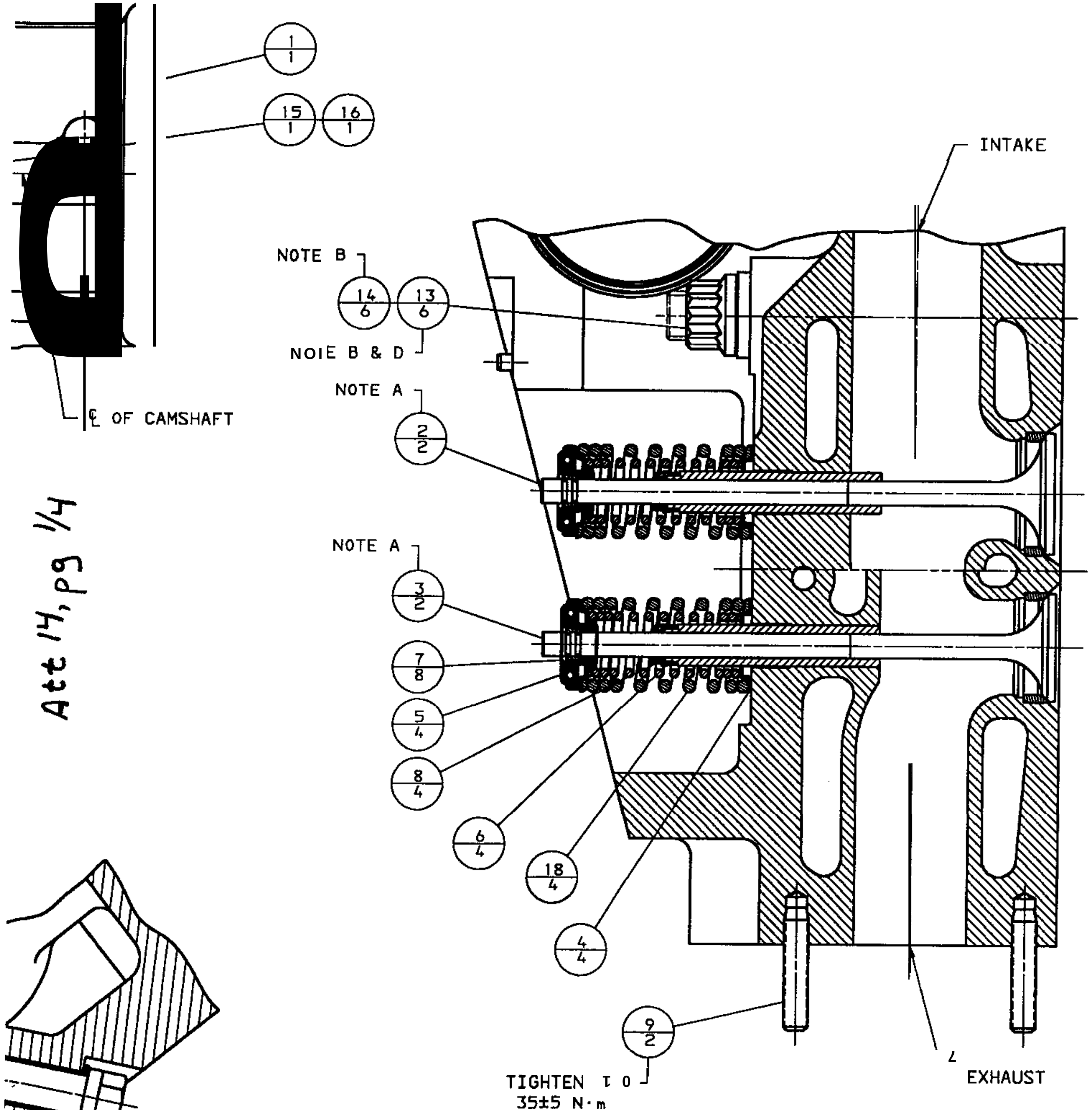
D.7.2 Has VGRA and BOI data been summarized and included in the technical report in D.4.1? ~~C~~ D

Comments:

RATING SCALE: A-Completed; B - In Progress; C-Planned; D - No Action

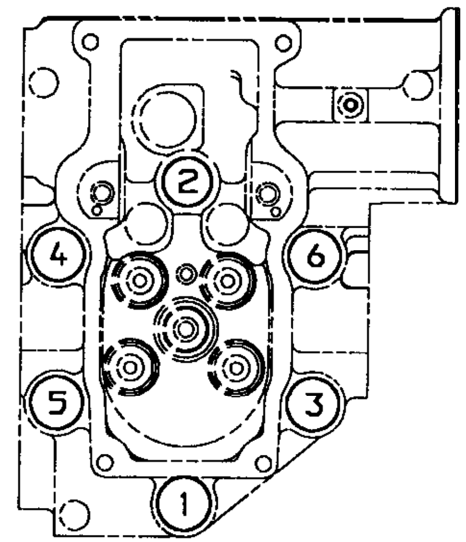
METRIC 1Y-3749

NOTE	ITEM	QTY	MEAS UNIT	PART NO.	NAME
				PARTS LIST	
	1	1		1Y-3751	HEAD AS.
	2	2		1Y-3814	VALVE
	3	2		1Y-3815	VALVE
	4	4		6I-0928	WASHER
	5	4	*	186-2001	ROTOCOIL AS.
	6	4	*	175-7523	SPRING
	7	8		4P-4661	LOCK
	8	4		102-6229	SEAL
	9	2		7X-7912	STUD (3/8)
	10	2		8H-9208	DOWEL
	11	1		1Y-3725	PLUG
	12	1		1Y-3836	WASHER
	13	6		114-6333	NUT (3/4)
	14	6		5H-1504	WASHER
	15	1		9S-4180	PLUG
	16	1		5P-7812	SEAL
	17	1		118-5068	SEAL
	18	4	*	175-7526	SPRING



SECTION 3 - 3

Att 14, pg 1/4



CYLINDER HEAD NUT TIGHTENING SEQUENCE

NOTE	SPEC NO.	NAME
	1E2514R	COMPUTER SERV
C	1E2470A	ANTISEIZE
B	1E2254	LUBRICANT
A	1E1867B	LUBRICANT
	1E0279X	TIGHTENING
	1E0011	INTPR & TOL

DRN THEMANSON

VALVES
(SHEET 2 Of 2)

<1> VALVE SPRING-OUTER (1757526) (INTAKE AND EXHAUST) SPECIFICATION:

ASSEMBLED LENGTH
67.12 mm (2.643 in)

LOAD AT ASSEMBLED LENGTH
248 ±25 N (56±5.5 lb.)

OPERATING LENGTH
51.00 mm (2.008 in)

LOAD AT OPERATING LENGTH
736±35 N (156±8 lb.)

FREE LENGTH AFTER TEST
77.88 mm (3.066 in)

OUTSIDE DIAMETER
36.29 mm (1.429 in)

VALVE SPRING-INNER (175-7523)

ASSEMBLED LENGTH
60.14 mm (2.368 in)

LOAD AT ASSEMBLED LENGTH
118±12 N (26.5± 2.7 lb.)

OPERATING LENGTH
44.02 mm (1.733 in)

LOAD AT OPERATING LENGTH
356±18 N (80±4 lb.)

FREE LENGTH AFTER TEST
71.03 mm (2.80 in)

OUTSIDE DIAMETER
25.17 mm (.99 in)

<2> VALVE STEM DIAMETER (INTAKE AND EXHAUST)
9.441± 0.008 mm (0.3717±0.0003 in)

<3> EXHAUST VALVE RECESS BELOW BOTTOM DECK OF CYLINDER HEAD
1.5 mm ± 0.3 (0.059 ±0.012 in)

<4> INTAKE VALVE RECESS BELOW BOTTOM DECK OF CYLINDER HEAD
2.5 mm ± 0.3 (0.098 ±0.012 in)

<5> EXHAUST VALVE HEAD OUTSIDE DIAMETER
41.51M.13 mm (1.646± 0.005 in)

<6> INTAKE VALVE HEAD OUTSIDE DIAMETER
47.00±0.13 mm (1.850± 0.005 in)

<7> EXHAUST VALVE FACE ANGLE
4425fo.25 DEGREES
FACE ANGLE OF EXHAUST VALVE SEAT INSERT
45.25M.5 DEGREES

<8> INTAKE VALVE FACE ANGLE
29.25M.25 DEGREES
FACE ANGLE OF INTAKE VALVE SEAT INSERT
30.25±0.5 DEGREES

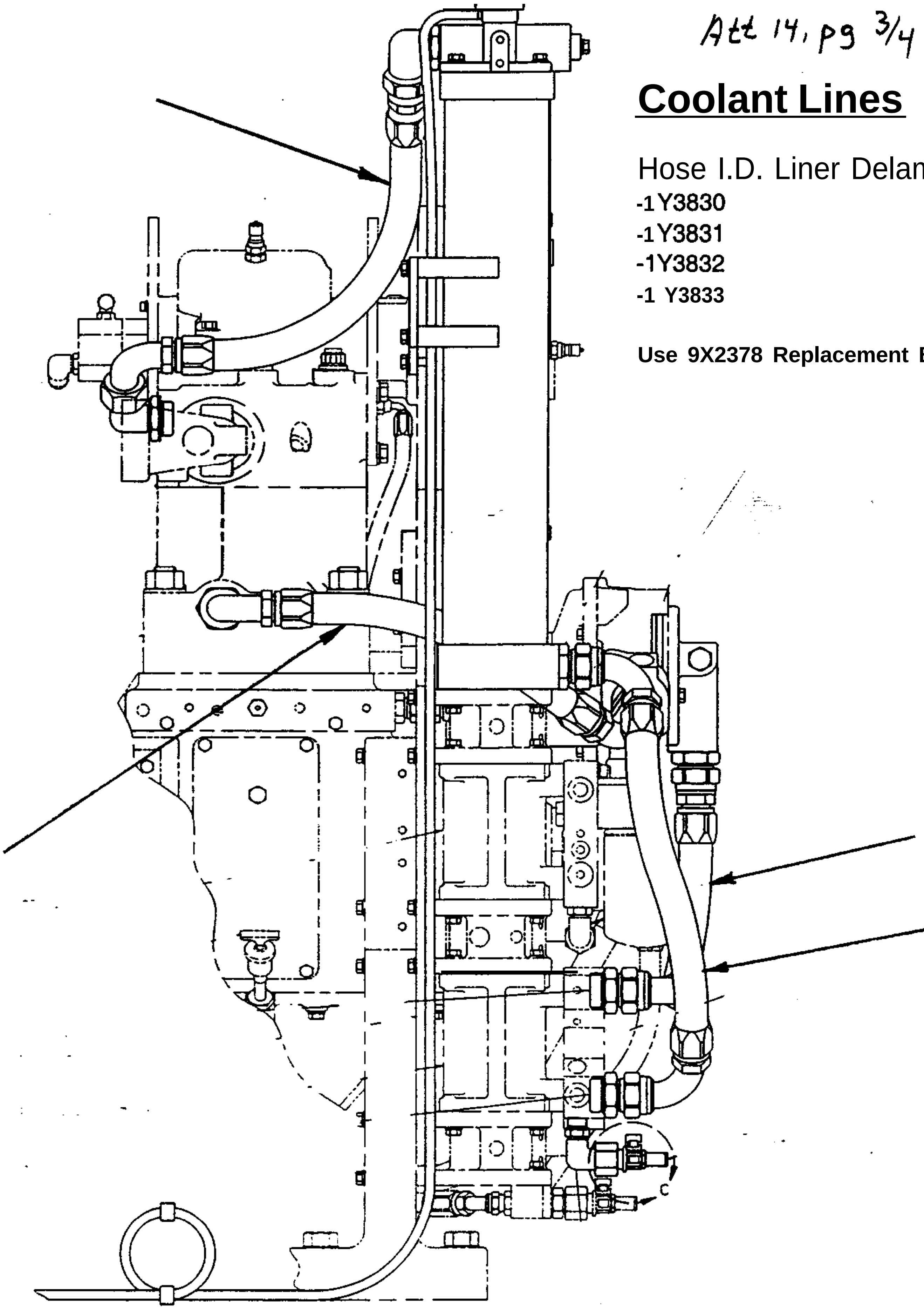
Att 14, pg 3/4

Coolant Lines

Hose I.D. Liner Delamination

-1Y3830
-1Y3831
-1Y3832
-1 Y3833

Use 9X2378 Replacement Bulk Hose



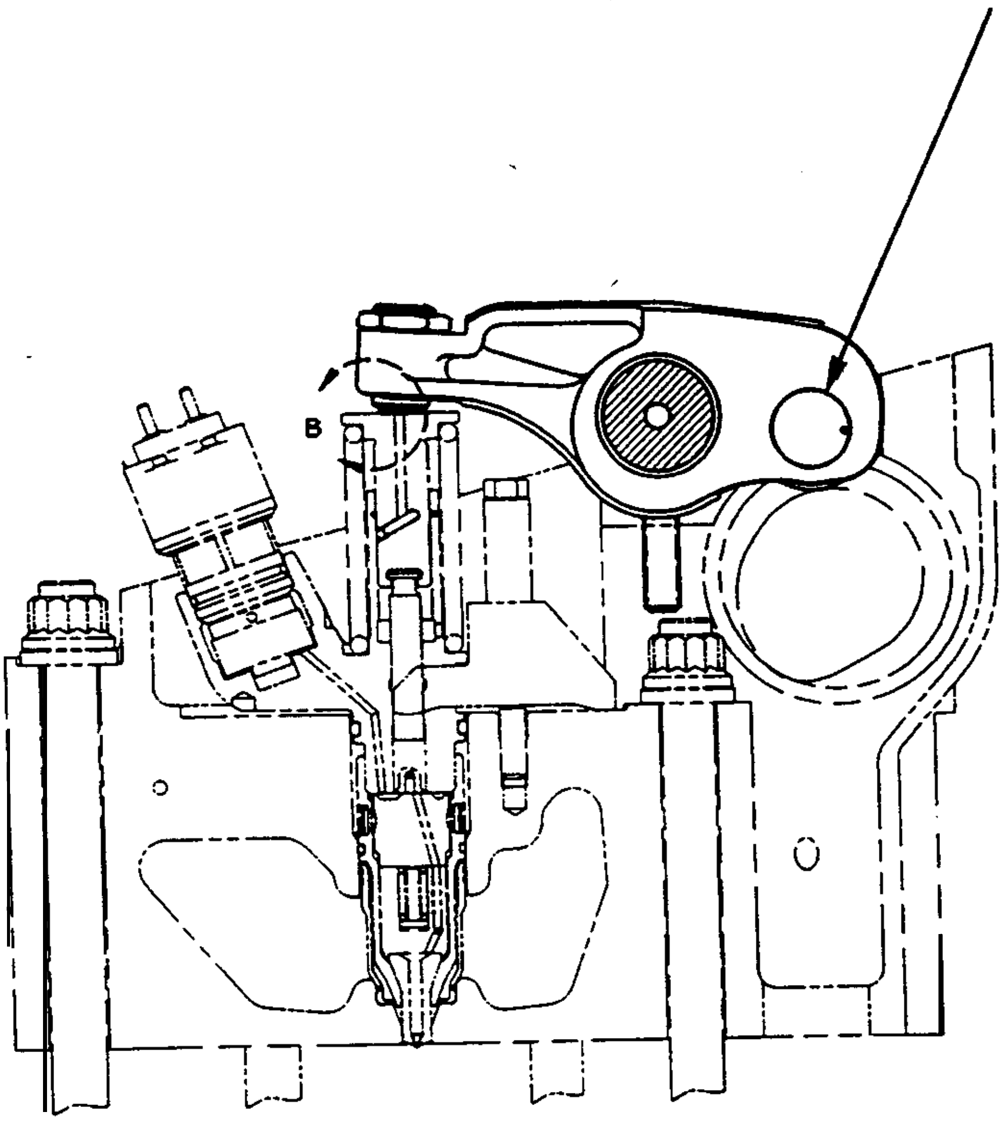
RIGHT SIDE VIEW

1Y3690 LINES GP - WATER (PART 2 OF 4)

Rocker Arm Bronze Pin Wear

Use replacement rocker arms for the valves and injector with:
- a date on parts box after 1/1/2000
- a date on rocker arm after 5/1/1999.

(The date is coded on the rocker arm casting surface: N=0; U=1; M=2; E=3; R=4; A=5; L=6; K=7; O=8; D=9
example: AUDDDD = 5/1/1999)



FRONT VIEW

VIEW OF UNIT INJECTOR MECHANISM

Att 15, pg 1/1

PC-9 Fuel Report

Current PC-9 fuel inventory --
1 Million gallons

Inventory level when a new batch is blended --
150,000 gallons

Volume of fuel blended in a new batch --
1 Million gallons

Fuel storage precautions --
1) Stored in fixed roof tank
2) Fuel analyzed monthly
3) Dedicated (exclusive) lines from storage tank to the loading facility
4) Each shipment is checked for API gravity

Contact --
Don Burnett
Chevron Phillips Chemical Company LP
Specialty Chemicals Group
1301 McKinney, Suite 2130
Houston, Tx 77010-3030

TEL: 888-766-7223
TEL: 713-289-4859
FAX: 713-289-4865

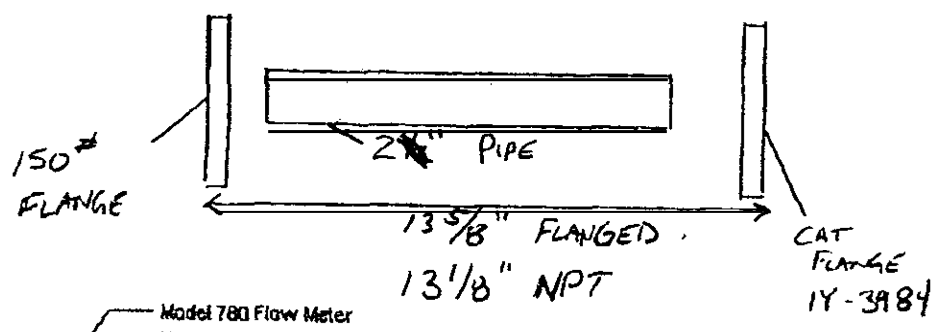
CELL: 713-305-8702
burnede@cpchem.com

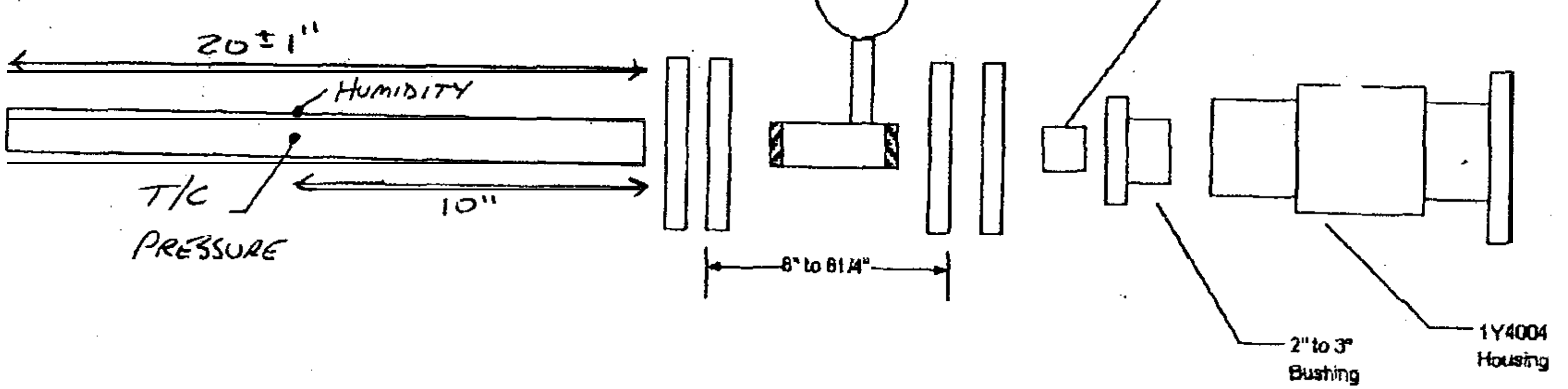
C41 + 45

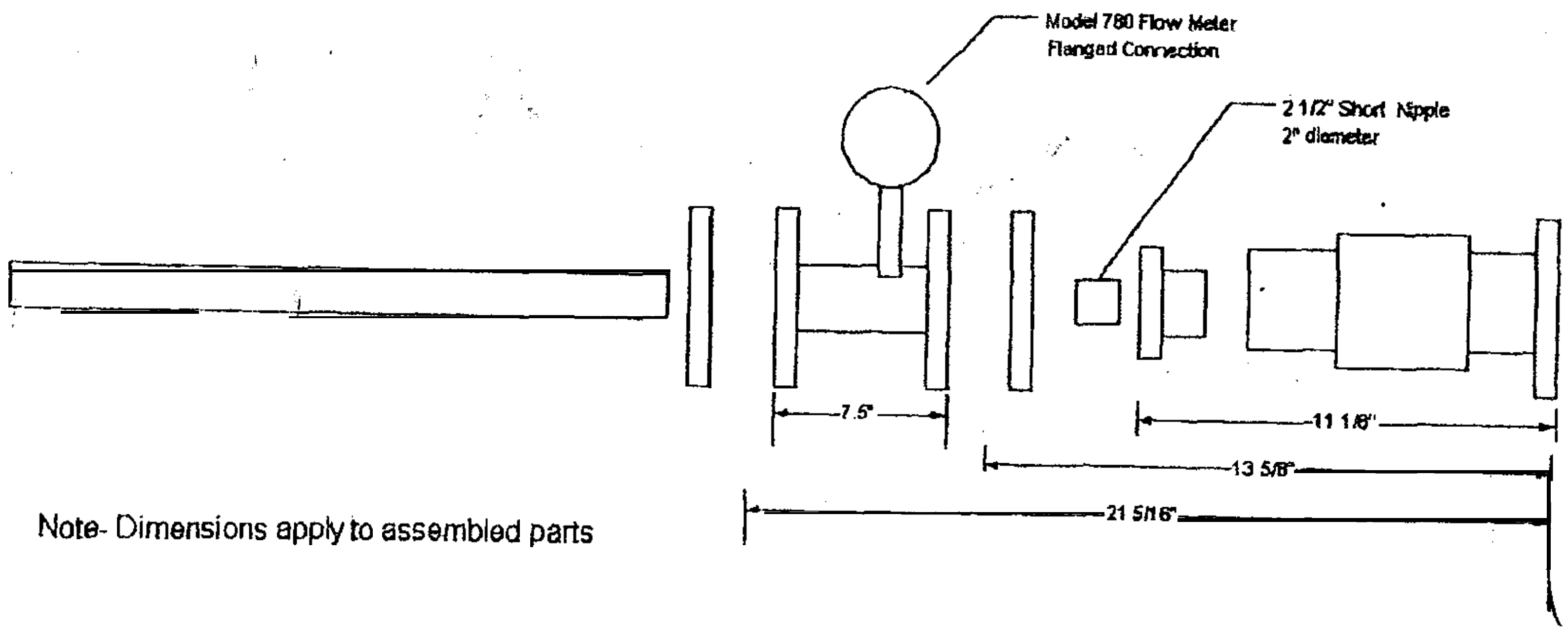
AH 4.4

Att 16, pg 1/1

Cat 1Q proposed arrangement for inlet air piping to accomodate both flanged and NPT style Sierra Model 780 flow meters. Overall lengths between different configurations should be within 1/4"







Note- Dimensions apply to assembled parts

1R SCOTE WARM-UP And OPERATING CONDITIONS 5/31/2001

PARAMETER	UNITS	TOL	TEST SPEC				
			STEP 1 5 Min	STEP 2 5 Min	STEP 3 5 Min	STEP 4 10 Min	STEP 5 60 Min
Speed	RPM	+/- 3	1000	1000	1400	1800	1800
Power	KW		IDLE	10	28	43	~68
BMEP	KPa		-	400	900	1140	~1875
Torque	NM	(a) +/- 5	-	100	175	220	~355
Fuel Rate	Gr/ Min	(b) +/- 1	-	~48	~ 95	~148	240
B.S.F.C.	Gr/Kw-Hr		-	-	219	209	-
Fuel Timing	BTC		6	6	6	6	6
Fuel Rack Pos.	mm		2.6	3.8	6.0	7.4	-
Humidity	Gr/ Kg	+/- 1.7	-	-	-	-	17.8
TEMPERATURES	DEG C						
Fuel Into Head		+/- 3	~31	~32	~33	~36	42
Coolant Into Jug			~41	~51	~82	~86	101
Coolant From Head		+/- 3	42	52	83	90	105
Oil To Cooler			-	-	-	-	-
Oil Manifold		+/- 3	-	-	-	-	120
Inlet Air Manifold		+/- 3	-	-	60	60	60
Exhaust Manifold			~120	~275	~340	~370	~605
PRESSURES	KPA						
Fuel From Head		+/- 20	275	275	275	275	275
Coolant Into Jug		(c)	~44	~44	~70	~81	~81
Oil Manifold		+/- 20	415	415	415	415	415
Inlet Air Barrel (abs)		+/- 1	120	120	157	225	292
Exhaust Barrel (abs)		+/- 1	-	104	146	217	252
Crankcase			-	-	-	~.05	~.10
FLOWS							
Coolant	LPM	+/- 2	~34	~34	~55	~75	75
Blowby	LPM		-	-	-	~35	~35
Air	Kg/ Hr		-	-	-	-	~390

NOTE:

(a) Engine controlled to Torque Spec for Steps #2, #3, #4, and 5 minutes of Step #5

(b) Engine controlled to Fuel Rate for last 55 minutes of Step #5

(c)Air Pressure at coolant tower controlled to 35 kPa

Ramp Up Conditions Between Warm-Up Steps

Torque	(1) At 5 minutes (beginning at step #2)	20 Nm/min
	(2) At 25 minutes (beginning at step #5)	14 Nm/ min
Speed	At 10 minutes (beginning at step #3)	100 rpm/min
Inlet Air Press (kPa)	At 10 minutes (beginning at step #3)	12 kPa/min
Exhaust Press (kPa)	At 10 minutes (beginning at step #3)	12 kPa/min
Inlet Air Temp (deg C)	At 0 minutes (at start of test)	5 Oeg C/min

1 R Hardware

Piston Crown	1Y4016	Tap Ring	1Y4014
Piston Skirt	1Y4015	Inter Ring	1Y4013
Oil Cooling Jet	1Y4011	Oil Ring	1Y4012
Bolt-Oil Cooling Jet	1Y4010	Liner	1Y3805

Test Parameters

Test Duration	504 hrs
Oil Additions	Every 36 hrs; Refill Oil Reservoir To Full Level (no force oil additions)
Total Oil Capacity	5800 g
ECM Chip	169-5028