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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

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May 3, 2001

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To: Members and Guests attending the Sequence IVA Surveillance Panel meeting held on November 15, 2000.

Please find attached the unconfirmed minutes of the Sequence IVA Surveillance Panel meeting held on November 15, 2000 in San Antonio, TX. Please send any corrections or additions to my attention at the above address.

Sincerely,

Mark R. Mosher
Meeting Secretary
Sequence IVA Surveillance Panel

Unapproved Minutes of the Sequence IVA Surveillance Panel November 15th, 2000 – San Antonio, TX

ACTION ITEMS

1. All laboratories should respond to the batch code part number survey from the TMC.

2. Analyze all the valid TMC 1007 reference oil data for the mean and standard deviations (refer to item #9).

3. Southwest Research Institute agreed to finalize their metallurgical study on Sequence IVA camshafts and send the report to the Surveillance Panel members.

4. The Sequence IVA Surveillance Panel Chairman will request that Nissan produce larger cam batches.

5. The Sequence IVA Surveillance Panel Chairman will pursue better process control for the manufacture of the camshafts with Nissan.

6. A flame-hardened camshaft is an option.

7. When KA24E fuel is down to about 16,000 gallons or less, Haltermann will solicit the Sequence IVA laboratories to determine which laboratories are in danger of running out of fuel. Fuel will be sold/shipped to minimize the chance of a laboratory fuel outage.

8. Organize a workshop of Metrologists who measure Sequence IVA camshafts.

9. Send out the reference oil data for TMC 1007 (original tests and 2000 matrix tests) with a letter ballot for including it back into the LTMS.

10. Continue to investigate the nickel strike oil cooler as a potential test improvement.

11. The Sequence IVA Surveillance Panel Chairman will develop an objective for long-term improvement in Sequence IVA camshaft quality.

1. *Introduction*

Chairman, Larry Bendele, called the meeting to order at 8:00 a.m. and presented the agenda, **Attachment 1.**

2. *Secretary Items*

The attendance roster is included as **Attachment 2**. Dan Worcester will replace Mike Zaiontz for Perkin-Elmer on the membership roster. Mark Mosher and Brent Shoffner were appointed Secretary and Actions/Motions Recorder, respectively, for this meeting.

The minutes from the previous Sequence IVA Surveillance Panel meeting, held May 24, 2000, were discussed and approved.

The motions for this meeting are presented, in context, as they arose during the meeting, as well as in **Attachment 3**.

3. *Chairman's Comments*

Larry Bendele mentioned the SAE paper 2000-01-1820 regarding the Sequence IVA, Nissan KA24E test, that was presented at the SAE Fuels and Lubricants meeting which was held in Paris.

Larry distributed copies of a conference call that was held among Sequence IVA testing laboratories regarding potential hardware problems associated with the test camshaft **(Attachment 4)**.

4. *TMC Reference Oil Report*

Mike Kasimirsky of the TMC presented the Semiannual Report outlining reference oil testing for the period of April 1, 2000 through September 30, 2000 **(Attachment 5)**.

There are currently four calibrated Sequence IVA laboratories with a total of five calibrated test stands. It was noted that the test rejection rate is slightly higher for this report period compared to the previous two periods (~25 vs. 10%). Reasons for lost tests over the report period were attributed to problems associated with the throttle body and throttle position sensor.

LTMS severity for cam wear was slightly mild over the report period. In addition, the test was in LTMS precision alarm throughout most of the period. Therefore, industry is investigating potential causes: hardware vs. test stand. The TMC summarized wear results and standard deviations categorized by lot codes across camshafts, heads and rocker arms. Although one cam lot code exhibited mild averaged results with a large standard deviation (based on five tests), no definite conclusion could be drawn whether the problem is hardware (batch) related or test stand related.

The TMC issued Sequence IVA Information Letters 00-2 and 00-3 this report period. There have been no hardware changes associated with the test.

It was estimated that there is more than three years supply of reference oils TMC 1006 and 1007.

The TMC's report was accepted by the Surveillance Panel.

Larry Bendele presented a summary of donated reference tests on TMC 1007 reference oil **(Attachment 6)**. There have been a total of 5 tests to date, where cam wear has ranged from 28.96 to 110.44 microns with an overall standard deviation of 33.37. Again, no firm conclusions could be drawn.

5. *RSI Candidate Precision Report Status*

Rick Oliver from RSI presented the candidate precision data for the report period April 1 through September 30, 2000 **(Attachment 7)**. There were a total of 83 candidate tests reported, of which one was deemed invalid. There was one lost test due to support equipment problems. The pooled s precision is 25.43 and is based on two tests on one oil at two labs.

The Surveillance Panel accepted RSI's report.

6. *Status of KA24E Fuel Supply*

Robert Rumford from Haltermann Products presented the specification for KA24E test fuel **(Attachment 8)**. The results of each fuel batch will be sent to the TMC. When fuel inventory is less than 16,000 gallons, labs will be solicited for their upcoming fuel needs such that the remaining fuel can be allocated so no lab has an outage while a new batch is blended.

The last fuel batch blended was more than 30,000 gallons. Labs were reminded that it might be cost effective to order split-truck loads (two different test fuels) in order to minimize freight charges.

The Surveillance Panel accepted the report from Haltermann Products.

7. *Review Cam Measurement 2000 Round-Robin*

Larry Bendele presented summarized results to-date of the 2000 Cam Wear Measurement Round-Robin **(Attachment 9)**. Two of the six labs had not yet reported data. Two camshafts were used that exhibited different wear profiles. As a result, the precision for cam B was worse than Cam A. Larry noted that several of the cam lobes were difficult to measure due to only having one non-worn lobe edge from which to reference. As a result, a Cam Measurement Workshop will likely be scheduled to address some of the differences.

8. *Review Test Performance vs. Test Kit Batch (Lot Codes)*

Daryl Baumgartner from Ethyl presented results from an in-house hardware/severity investigation **(Attachment 10)**. All tests were conducted on the same test stand using TMC 1006 (except one donated test using TMC 1007). It appears that all tests conducted on 1997 kit-year hardware, produced on-target results. Increased variability seemed to coincide with 1998 and 1999 kit-year hardware. One concern is that even within a given batch, there appears to be significant severity variability.

SwRI conducted a test on the same 1999 cam batch that Ethyl used (later determined to be 990729) which also produced a mild result of 59.28 microns.

Discussion items included:

- require that candidates be evaluated on the same batch (lot code) hardware that was used for successful reference. There were logistics problems noted with this approach, due to small batches.
- possibly pursue a Central Parts Distributor to provide cams/rocker arms with improved quality control
- make/supply cams in larger batches

Larry Bendele presented preliminary results of a metallurgical study that SwRI performed **(Attachment 11)** on two 1999 post-test cams: one which produced normal wear and the other which produced a mild result. They investigated cam surface structure under magnification and lobe micro-hardness, measured at the nose. Preliminary conclusions were that there is no measurable difference in micro-hardness between the cams. In addition, magnification of the surface microstructure did not reveal any significant differences. However, when analyzing a cross section of the nose, a ~12 micron layer of dissimilar structure was identified on the low-wear cam. Preliminary analyses showed this layer may be comprised of iron oxide, magnesium and trace amounts of aluminum, phosphorous and zinc which might serve as a lubricant or wear inhibitor.

SwRI will continue with the investigation and report the results.

Motion #1 (Gordon Farnsworth / Bill Buscher III)

The cam lot/batch code number date code (full number)* used for the last acceptable reference on a stand/engine must be used for the calibrated candidate tests on the stand/engine in the reference period.

* Or another cam lot/batch number date code (full number) that has had an acceptable reference for stand calibration in that laboratory if the laboratory does not have enough of the original batch to finish out the reference period. The motion is effective with ASTM Subcommittee B approval. **(Motion passed 7/3/3)**

It was noted that without yet knowing laboratory inventories relative to cam batches, and not having better quantification of which cam batches are "bad", it could preclude some laboratories from referencing, or maintaining reference, without a parts redistribution (i.e if a lab had "all bad hardware").

Daryl Baumgartner commented that Ethyl, with OHTechnologies, are investigating the potential use of a production aftermarket flame-hardened camshaft, reground to remove phosphate coating. It was noted that it would be difficult to introduce a new test cam into ASTM testing due to the requirement of proving equivalency.

9. *Review Test Program to Introduce Additional Reference Oil (TMC 1007)*

The Surveillance Panel again reviewed the summary of donated tests on TMC 1007 **(Attachment 6)**. Based on the limited data to date, and the concerns over cam hardware issues, the Panel was reluctant to introduce a new reference oil into the system and set targets.

There was brief discussion about possibly using reference oil 200-4, which produces ~180 microns of wear. But with no data present to review, the subject was tabled.

As an action item, the TMC will collate and distribute all valid TMC 1007 data for consideration to include as a Sequence IVA reference oil.

10. *Review Correlation of Sequence IVA to VE wear limit for API-SJ*

Larry Bendele presented the original Sequence IVA/VE correlation data which shows Sequence IVA reference test results compared to the Sequence VE reference oil targets as well as the associated regression fit **(Attachment 12)**.

Greg Guinther from Ethyl presented their proposal for the Sequence IVA API SJ pass/fail limit **(Attachment 13)** based on TMC 1006 reference runs conducted in both the Sequence VE and IVA. His recommendation to the Surveillance Panel was to set the pass/fail limit such that the mean of TMC 1006 would be the same number of standard deviations below the API SJ limit for both test types. The resulting API SJ pass/fail limit recommendation was 145 microns.

Motion #2 (Greg Guinther/no second)

The Sequence IVA Surveillance Panel recommends to the Passenger Car Engine Oil Classification Panel that the Sequence IVA API SJ equivalent limit should be 145 microns maximum, based on TMC 1006 data.

Since there was no second to the motion, the motion fails.

Motion #3 (Gordon Farnsworth/John Moffa)

The Sequence IVA Surveillance Panel recommends to the Passenger Car Engine Oil Classification Panel that the Sequence IVA API SJ equivalent limit should be 120 microns maximum (which is the API SL limit). (**Motion passed 7/1/5**)

11. Review Objectives of Surveillance Panel

Larry Bendele presented and reviewed the Sequence IVA Surveillance Panel Scope and Objectives **(Attachment 14).**

12. Old Business

- Coolant Flow Measurement of Jacketed RAC

Bill Buscher III presented photographs and an updated schematic for the Rocker Arm Cover (RAC) Coolant system along with typical temperature and flow data **(Attachment 15)**. Specifically pointed out were the incorporation of an air bleed and flowmeter for the system. Bill felt that the air bleed provides more consistent flow through the RAC and that it would be prudent to record flow during test.

Motion #4 (Bill Buscher III/Dwight Bowden)

With respect to the rocker cover jacket coolant system; revise the Sequence IVA procedure to include a flow meter (as shown or an equivalent) on the downstream side of the rocker cover and an air bleed valve (as shown or an equivalent) upstream of the rocker cover. Add the rocker arm cover coolant flow as a read-only parameter and revise the data dictionary accordingly. **(Motion passed 12/0/0)**

13. New Business

- Nickel-Plated Oil Cooler

Bill Buscher III presented data showing copper levels in used oil vs. test time and plotted cam wear vs. end-of-test copper levels (**Attachment 16**). There appears to be no strong correlation between copper and camshaft wear in the Sequence IVA. Bill commented that some formulations (TMC 1008, for one) apparently tend to leach copper out of the oil cooler. As a result, they conducted a test using a nickel-plated oil cooler which seemed to have no effect on test severity, but did reduce EOT copper levels in the used oil.

14. Next Meeting

The next meeting of the Sequence IVA Surveillance Panel is tentatively scheduled during the May 2001 Surveillance Panel week.

15. Adjourn

Larry Bendele adjourned the meeting at 11:30 a.m.

Sequence IVA Surveillance Panel

San Antonio, TX
Embassy Suites Hotel
November 15, 2000
8:00 a.m. - noon

A G E N D A

1. Membership Changes
2. Motion and Action recorder / Secretary
3. Approval of minutes May 24, 2000 meeting
4. Chairman Comments
5. TMC Reference Oil Report – Mike Kasimirsky
6. RSI Candidate Precision Report Status – Rick Oliver
7. Status of KA24E Fuel Supply
8. Review Cam Measurement 2000 Round-Robin
9. Review test performance vs. test kit batch (lot codes)
10. Review Test Program to Implement Additional Reference Oil (1007)
11. Review correlation of IVA to Sequence VE wear limit for API-SJ
12. Review objectives of Surveillance Panel
13. Old Business
    Coolant Flow Measurement of Jacketed RAC
14. New Business
    Nickel-Plated Oil Coolers
15. Next Meeting
16. Adjourn

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November 13, 2000

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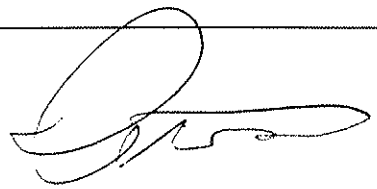
~~Zaiontz, Michael~~ Worcester, Dan	PERKINELMER FLUIDS SCIENCES AUTOMOTIVE RESEARCH 5404 Bandera Road San Antonio, TX 78238 Phone No.: ~~210-647-9483~~ Fax No.: ~~210-523-4607~~ Email: ~~mike_zaiontz@perkinelmer.com~~	

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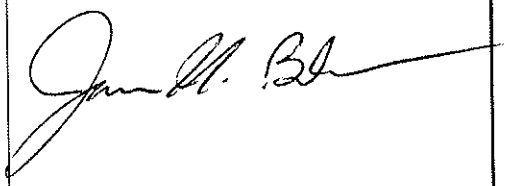
Bowden, Jason	OH TECHNOLOGIES, INC. P.O. Box 5039 9300 Progress Pkwy. Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: jhbowden@ohtech.com	
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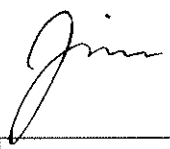
Rutherford, Jim	CHEVRON ORONITE COMPANY LLC 100 Chevron Way, #60-1211 Richmond, CA 94802 Phone No.: 510-242-3410 Fax No.: 510-242-1930 Email: jaru@chevron.com	
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"Shoffner, Brent" <brent.shoffner@perkinelmer.com>

11/20/00 09:17 AM

To: Alfredo Montez <ammn@chevron.com>, Ben Weber <bweber@swri.org>, Bob Rumford <rhrumford@specified1.com>, Carl Stephens <cstephens@ashland.com>, Dan Worcester <dan.worcester@perkinelmer.com>, Daryl Baumgartner <daryl_baumgartner@ethyl.com>, Dave Glaenzer <dave_glaenzer@ethyl.com>, Dwight Bowden <dhbowden@ohtech.com>, Frank Farber <fmf@TMC6.ASTM.CMRI.CMU.EDU>, Frank Fernandez <ffer@chevron.com>, Gary Tietze <gtietze@testeng.com>, Gordon Farnsworth <gordon.farnsworth@infineum.com>, Greg Guinther <greg_guinther@ethyl.com>, Jim Moritz <jim.moritz@perkinelmer.com>, Jim Rutherford <jaru@chevron.com>, Larry Bendele <lbendele@swri.org>, Mark Hull <mrh@lubrizol.com>, Mark R Mosher/EastCoast/Mobil-Notes, Michael Kasimirsky <mtk@TMC6.ASTM.CMRI.CMU.EDU>, Mike Riley <mriley2@ford.com>, Mike Zaiontz <Mike_Zaiontz@AR.EGGINC.COM>, Phil Scinto <prs@lubrizol.com>, Steve Haffner <Steven.Haffner@infineum.com>, William Buscher III <wbuscher@swri.org>

cc: "Glaser, John" <john.glaser@perkinelmer.com>, Al Lopez <Al_Lopez@AR.EGGINC.COM>, Brad Carter <Brad_Carter@AR.EGGINC.COM>, Charlie Leverett <Charlie_Leverett@AR.EGGINC.COM>, Cosme Escamilla <Cosme_Escamilla@AR.EGGINC.COM>, Eddie Campa <eddie.campa@perkinelmer.com>, James Chapman <James_Chapman@AR.EGGINC.COM>, Jesse Reyes <Jesse_Reyes@AR.EGGINC.COM>, Jim Collum <Jim_Collum@AR.EGGINC.COM>, John Haeglin <John_Haegelin@AR.EGGINC.COM>, Manuel Leos <MANUEL_LEOS@AR.EGGINC.COM>, Martin Chadwick <Martin_Chadwick@AR.EGGINC.COM>, Mike Yowell <Mike_Yowell@AR.EGGINC.COM>, Stacy Bond <Stacy_Bond@AR.EGGINC.COM>, "Steve D'Entremont" <steved.entremont@perkinelmer.com>, Stuart Slater <Stuart_Slater@AR.EGGINC.COM>

Subject: Sequence IVA Surveillance Panel Meeting (11/15/00)

Sequence IVA Surveillance Panel
San Antonio, Texas
11/15/00

Action Items

1. All laboratories should respond to the batch code part survey from the TMC.
2. Analyze all the valid 1007 reference oil data for the mean and standard deviations (Refer to Item #9).
3. Southwest Research Institute agreed to finalize their metallurgical study on Sequence IVA camshafts and send the report to the Surveillance Panel members.
4. The Sequence IVA Surveillance Panel Chairman will request that Nissan produce larger cam batches.
5. The Sequence IVA Surveillance Panel Chairman will pursue better process control for the manufacture of the camshafts with Nissan.
6. A flame-hardened camshaft is an option.
7. When KA24E fuel is down to about 16K gallons or less, Haltermann will solicit the Sequence IVA laboratories to determine which laboratories are in danger of running out of fuel. Fuel will be sold / shipped to

minimize the chance of a laboratory fuel outage.
8. Organize a workshop of Metrologists, who measure Sequence IVA camshafts.
9. Send out the reference oil 1007 data (original tests and 2000 matrix tests) with a letter ballot for including it back into the LTMS.
10. Continue to investigate the nickel strike oil cooler as a potential test improvement.
11. The Sequence IVA Surveillance Panel Chairman will develop an objective for long-term improvement in Sequence IVA camshaft quality.

Motions

1. Gordon Farnsworth / William Buscher III

The cam lot / batch number date code (full number)* used for the last acceptable reference on a stand / engine must be used for the calibrated candidate tests on that stand / engine in the reference period.

* Or another cam lot / batch number date code (full number) that has had an acceptable reference for stand calibration in that laboratory if the laboratory does not have enough of the original batch to finish out the reference period.

This motion is effective with ASTM Subcommittee B approval.

This motion passed 7 for / 3 against / 3 waives

2. Greg Guinther / (Not seconded)

The Sequence IVA Surveillance Panel recommends to the Passenger Car Engine Oil Classification Panel that the Sequence IVA API SJ equivalent limit should be 145 microns maximum based on 1006 data.

3. Gordon Farnsworth / John Moffa

The Sequence IVA Surveillance Panel recommends to the Passenger Car Engine Oil Classification Panel that the Sequence IVA API SJ equivalent limit should be 120 microns maximum (which is the API SL limit).

This motion passed 7 for / 1 against / 5 waives

4. William Buscher III / Dwight Bowden

With respect to the rocker cover jacket coolant system; revise the Sequence IVA procedure to include a flow meter (as shown in the presentation or an equivalent) on the downstream side of the rocker cover and an air bleed valve (as shown or an equivalent) upstream of the rocker cover.

Add the rocker arm cover coolant flow as a read only parameter and revise the data dictionary accordingly.

The effective date is 2 months from the date of the Information Letter.

Passed 12 for / 0 against / 0 waives.

Sequence IVA Laboratory Conference Call

October 12, 2000, 1:30 pm CST

Participants:	Frank Farber- TMC	Brent Shoffner – PE
	Jerry Bryce - Lubrizol	
	Dan Worcester – PE	Bill Buscher – SwRI
	Mark Mosher – ExxonMobil	Daryl Baumgartner - Ethyl
	Larry Bendele – SwRI	Carl Stephens – Ashland

Brent Shoffner volunteered to log the action items.

Purpose

Larry Bendele explained that the purpose of the conference call was to review the reference test LTMS and DONATED databases, and to study the relationship between ACW test results and test kit lot codes.

Data

The attached two spreadsheets list the reference oil test data. Note that tests declared invalid are not reported.

There are three (3) valid test results using 1999 cam lot codes. Lab E1 conducted a donated test on oil 1007 using cam lot 990727 & rocker lot 991029, and obtained a very mild 28.96 ACW. Lab A (SwRI) conducted a donated test on oil 1006 using cam lot 990729 & rocker lot 991029, and obtained a mild 51.58 ACW. Lab A reported another donated test on oil 1006, sponsored by JAMA, using cam lot 990628 & rocker arm lot code 991029. This result was OK at 108.54 ACW (no SA in effect).

Also attached is a spreadsheet from Nissan which lists lot codes that were manufactured for the Sequence IVA test.

Discussion

Daryl Baumgartner expressed his observations that 1997 parts kits seem to always get "on-target" results with reference oil 1006. However, with the 1998 cam lot codes, Daryl is seeing two different severity levels (981015 is on-target, the 98928 too mild). For 1999 cams, Daryl believes that the results are almost always too mild.
Daryl stated that he has performed a variety of camshaft measurements to try to detect any potential differences among the cam lot codes, but that he has found no significant differences.

Jerry Bryce reported that he only had experience with the 1997 hardware, and thought that the 1997 kits were performing consistently. However, he would have to use 1999 kits in the near future and had some concerns based upon the data from other labs.

Carl Stephens, Mark Mosher, and Dan Worcester echoed Jerry's report.

It was decided that all the labs need to survey their 1998 and 1999 kits to be aware of the lot codes that exist at their lab. The TMC will also send a survey form to the labs to accumulate the overall data.

Daryl reported on an initiative that Ethyl and OHT is investigating. They have manufactured a closely-controlled, gray cast-iron, flame hardened KA24E camshaft (like the Seq. IIIE) and plan to try it in a Sequence IVA test on oil 1006. Daryl said that he plans to report the result at the November Sequence IVA Surveillance Panel meeting. This raised a lot of discussion. Daryl commented that this initiative was started because OHT has a lot of knowledge for controlling test camshaft manufacturing processes and that the possibility exists that an improved Sequence IVA test could be realized if the camshafts are more consistent.

Brent mentioned that it would not be an easy process to switch from the current Nissan camshaft to a cam that would have an entirely different metallurgy. To demonstrate equivalency (same discrimination; same response to additive chemistries; etc.) and improved precision would be a very difficult and expensive hurdle. It would likely be not so simple as adopting a test correction factor.
Brent's opinion, shared by others, is that Nissan needs to manufacture larger batches of fewer lot codes, and implement additional controls, monitoring, and documentation of the manufacturing process. A test camshaft needs to be produced with the utmost precision.

Metallurgical Study

Larry Bendele stated that SwRI would take the used 1999 kit camshaft from the on-target test and the used 1999 camshaft from the mild test to investigate metallurgical differences. Perhaps this study would provide more insight to a future direction.

Closing Comment

Larry Bendele concluded that the conference call had served his purpose. All labs were now more familiar with occasional mild reference results that seem to be related to cam lot code. More emphasis on cam lot hardware will be discussed at the November Sequence IVA Surveillance Panel meeting.

Larry Bendele

Action Items Recorded

Sequence IVA Conference Call
October 12, 2000

1. The Ethyl Laboratory has stated that they will run a test on reference oil 1006 using a flame hardened test camshaft supplied by OH Technologies.
2. Use the batch code from the "unassembled" cylinder head, when documenting the batch code in the report of a test conducted with the cylinder head that comes assembled to the engine.
3. SwRI and the Ethyl Laboratory indicated that they plan to investigate the metallurgy of 1999 cams (both the 990729 and the 990628 batch) and compare the analyses to the metallurgy of other-year cam batches.
4. The TMC will develop a form and survey Sequence IVA inventories at the laboratories.

DATA SUPPLIED BY NISSAN JAPAN

No.	Parts number	Name		1998				1999	
1	A0102 76P01	ENG ASSY-BARE	Date of delivery	98.8.31	98.9.30	98.10.21	98.10.30	99.7.30	
			Number of deliver	12	13	13	1	35	
			Lot numbaer	980820	980915	981001	981001	981008	
2	A1040 40F80	HEAD COMPL	Date of delivery	98.11.16				99.8.23	
			Number of deliver	33				41	
			Lot numbaer	981030				990719 & 990720	
3	A3020 40F01	CAM	Date of delivery	98.11.16	98.11.16	98.11.16	98.11.16	99.10.8	99.10.27
	(A3020 40F01 is included in 13000 40F85.)		Number of deliver	125	125	125	105	200	252
			Lot numbaer	980928	980929	981013	981015	*1	*1
4	A3257 40F06	ROCKER-VALVE	Date of delivery	98.11.16				99.10.8	99.10.27
	(Number of delivery is number of 13000 40F85.)		Number of deliver	480				200	252
	(A3257 40F06 is included in 13000 40F85.)		Lot numbaer	981020				990928	991025

*1:Cams were delivered. But lot numbers were not added.

REFERENCE OIL 1006 LTMS DATABASE

OILCODE	TMCLAB	LTMSDATE	CamLot	HeadLot	RA Lot	VAL	ACWFNL	ACWI	ACW4E	ANW	OILCON	FUELH100	FUELCON	FEWMH100
34153	A	19991020	981013	960907	981020	AC	121.33	129.13	105.74	22.11	-40	4.3	153.16	126
33874	E	19991026	96108X		961014	AC	99.02	106.84	83.39	22.24	65	4.73	137.5	74
34436	F	19991102	98-E-2			AC	110.69	110.79	110.49	20.75	-304	3.83	139.6	114
34633	B	19991114	N/A	N/A	N/A	AC	126.02	133.79	110.48	21.50	-82	3.5	140.94	116
35186	A	19991114	980929	971001	981020	AC	128.64	135.53	114.86	22.67	-50	4.5	142.27	125
35185	F	19991123	99-08			AC	131.73	128.24	138.71	21.69	-34	3.73	140.83	131
35432	A	19991127	971103	971001	971001	AC	126.77	129.16	121.99	20.70	-20	3.7	142.09	126
35179	E	19991207	98928	N/A	981020	AC	128.22	135.21	114.24	23.33	0	3.35	145.2	107
35435	A	19991213	971103	971001	971001	AC	121.88	123.28	119.08	20.73	-20	4.6	145.23	135
35895	B	19991215	N/A	N/A	N/A	AC	119.52	133.66	91.24	21.84	4		141.97	
35896	B	19991223	N/A	N/A	N/A	AC	119.03	127.68	101.72	21.57	-130	4.3	148	106
35897	B	20000102	N/A	N/A	N/A	AC	116.36	130.42	88.24	20.87	-2	4.3	140	108
35177	A	20000201	971103	960907	971001	AC	125.31	121.77	132.38	22.01	-75	3.7	144.43	126
35913	A	20000209	971103	971001	971001	AC	109.72	106.46	116.25	18.16	-10	4	149	121
35436	A	20000209	971103	971001	971001	AC	129.25	131.09	125.58	20.91	5	3.9	151.43	144
35914	A	20000216	971103	971001	971001	AC	116.72	118.42	113.34	18.17	-60	3.9	147.85	116
35900	B	20000301	N/A	N/A	N/A	AC	108.89	123.40	79.86	20.44	-80	3.9	149.59	109
34943	C	20000314	971114	N/A	971001	AC	137.95	140.98	131.88	21.92	0	3.36	121.25	126

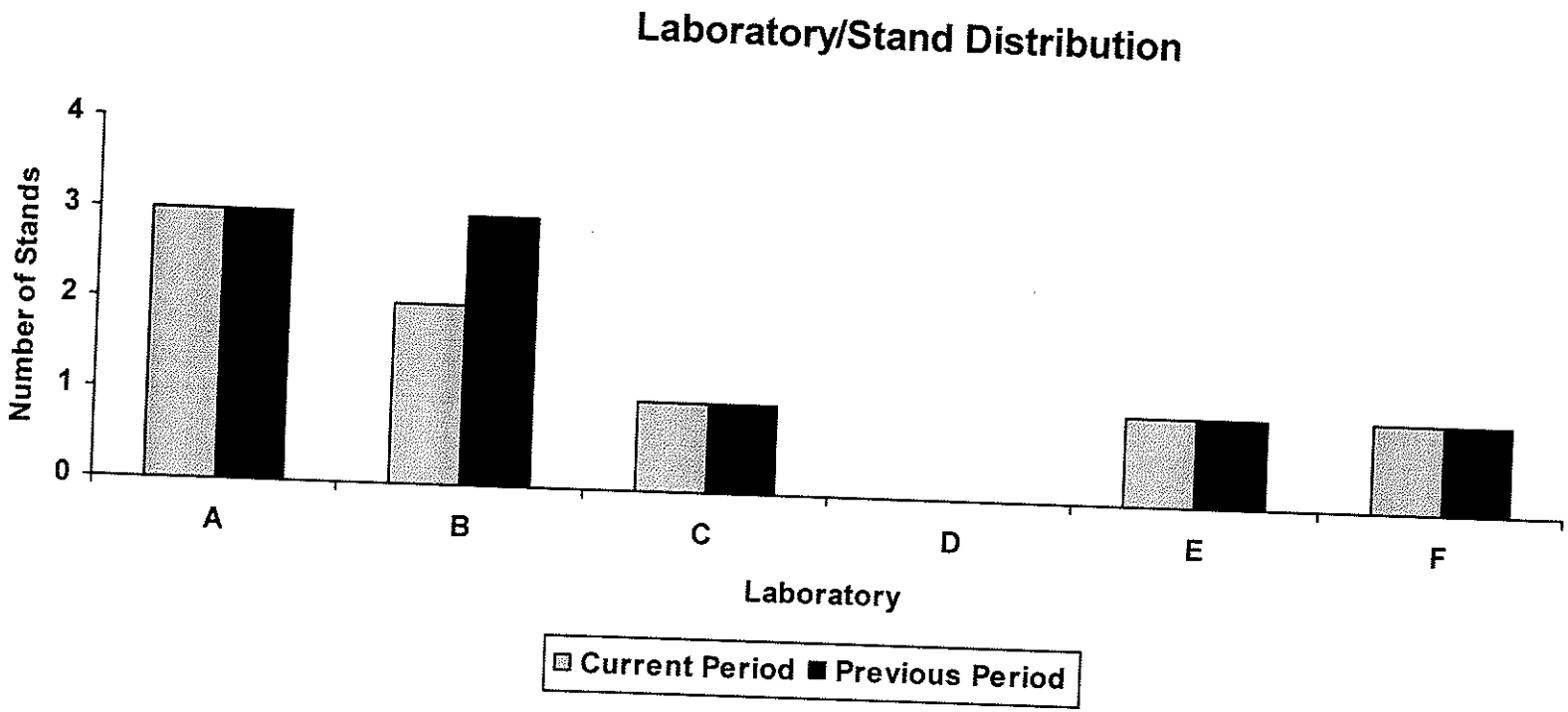
35908	E	20000319	98928	N/A	981020	OC	71.01	83.22	46.57	18.13	0	6.52	141.42	51
35909	E	20000327	98928	N/A	98120	OC	105.14	118.54	78.34	22.53	0	1.7	140.34	77
34946	C	20000402	971114	N/A	971001	AC	134.56	133.32	137.05	23.89	0	3.25	118.9	99
36546	E	20000404	981015	N/A	98120	OC	125.44	130.09	116.13	24.96	0	2.11	138.19	110
36194	B	20000411	N/A	N/A	N/A	AC	130.30	142.60	105.71	23.01	-71	4.7	151.11	130
36547	E	20000411	981015	N/A	981020	AC	121.16	128.12	107.22	26.45	0	4.37	138.06	99
36193	B	20000412	N/A	N/A	N/A	AC	131.81	139.61	116.20	24.01	-84		141.64	114
35910	F	20000430	971103	971001		AC	125.70	126.90	123.32	19.89	1	4.09	144.65	131
36548	E	20000523	98928		98120	OC	42.86	44.98	38.61	9.52	0	5.05	141.09	41
36992	E	20000530	981015		981020	OC	95.87	102.42	82.79	20.89	0	6.67	142.84	80
35915	A	20000627	971103	971001	971001	AC	117.62	113.58	125.69	21.30	-85	4.3	143.74	133
35916	A	20000702	971103	971001	971001	OC	144.29	143.76	145.35	23.13	-70	4.8	152.56	139
35917	A	20000703	971103	971001	971001	AC	131.60	128.30	138.18	21.34	-160	4	139.39	131
36994	E1	20000703	971103		971001	AC	116.87	115.84	118.92	22.69	0	3.66	141.9	99
36995	E1	20000709	971114	N/A	971001	AC	120.28	120.16	120.52	23.14	0	3.72	141.21	105
35911	F	20000711	97114	971001		OC	97.50	99.14	94.21	17.01	-42	3.83	142.49	113
35918	A	20000711	971103	971001	971001	AC	136.55	138.93	131.80	23.27	-40	4.6	143.85	141
35912	F	20000718	971103	971001		AC	104.32	113.09	86.77	18.41	-47	4.07	140.77	112
37325	A	20000912	980929	971001	981020	AC	126.30	133.58	111.76	23.09	-70	4.3	148.2	126
37326	A	20000925	980929	971001	981020	AC	115.36	119.61	106.86	20.98	-85	4.3	147.8	124
37318	E1	20000930	105		971001	C	127.12	124.64	132.09	21.04	0		143.83	140

ASTM Test Monitoring Center Semiannual Report to the Sequence IVA Surveillance Panel

November 15, 2000
San Antonio, Texas

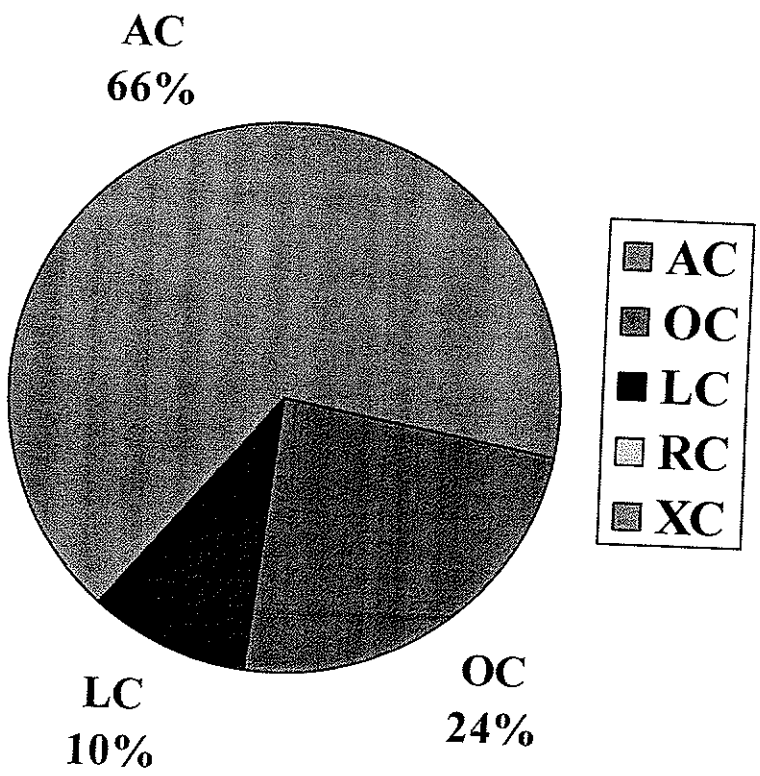
Laboratory/Stand Distribution

	Reporting Data	Calibrated as of September 30, 2000
Number of Laboratories:	5	4
Number of Test Stands:	8	5



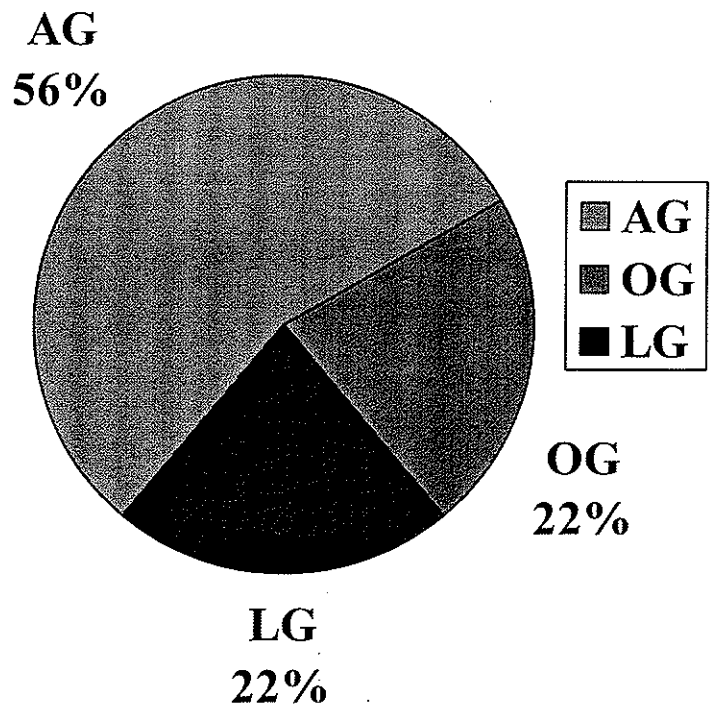
Reference Starts

- Total Reference Starts this Period: 21
  - 14 Acceptable Calibration Tests (AC)
  - 5 Unacceptable Calibration Tests (OC)
  - 2 Operationally Invalid tests - Lab Judgement (LC)

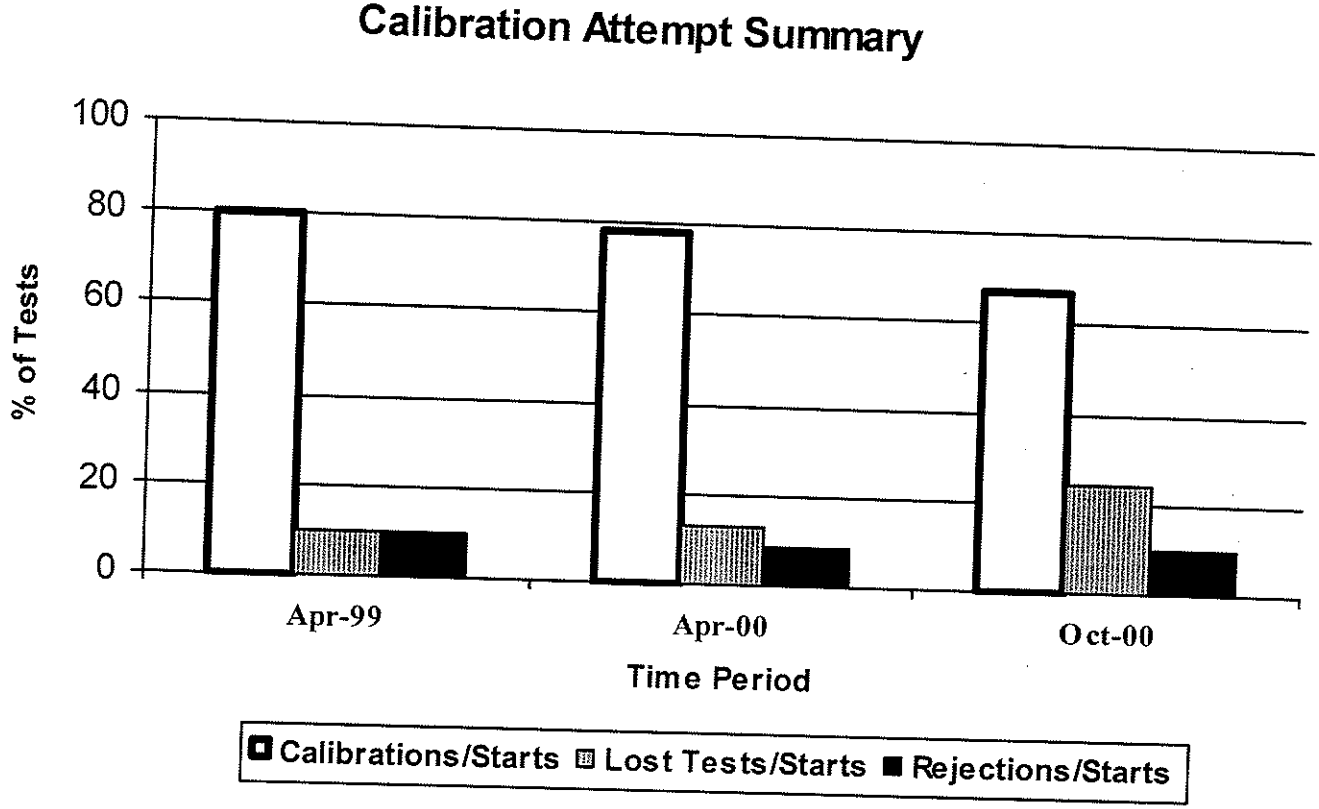


Donated & Industry Support Starts

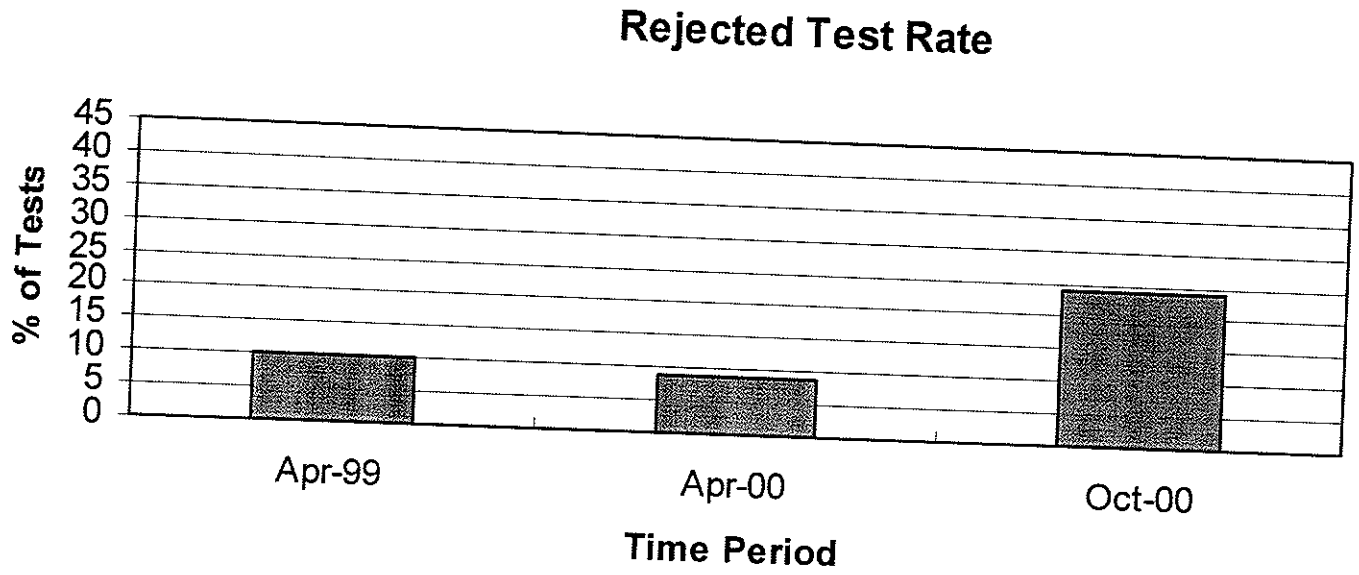
- Total Donated & Industry Support Starts this Period: 9
  - 5 Acceptable Reference Oil 1007 Runs (AG)
  - 2 Unacceptable Reference Oil 1007 Runs (OG)
  - 2 Invalid Reference Oil 1007 Runs (LG)



Summary of Calibration Attempts



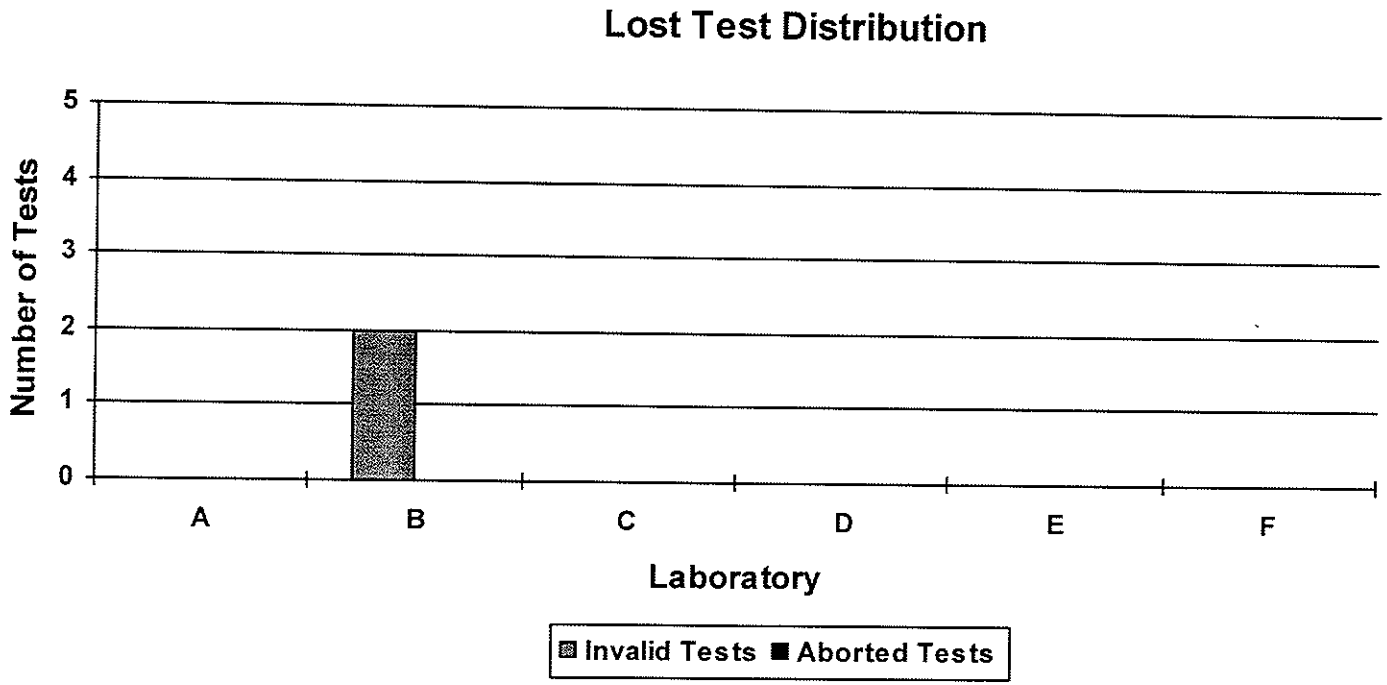
Operationally Valid Tests Rejected



Lost Test Summary

- Throttle Body Problems - 1 test
- Faulty Throttle Position Sensors - 1 test

Lost Test Distribution



LTMS Deviation Summary

- There was one LTMS deviation written this period.
- There has been one deviations from the LTMS since it's introduction in 1999.

Information Letters

- There were two Sequence IVA Information Letters issued this period.
  - Sequence IVA Information Letter No. 00-2, dated June 15, 2000
    - Revised Data Dictionary and Report Form Set.
  - Sequence IVA Information Letter No. 00-3, dated August 25, 2000
    - Revised Double-Flush Coolant Control Requirements
    - Revised Engine Starting Procedure
    - Revised Transient Ramping Requirements
    - Revised Oil Sampling Procedure
    - Revised Double Flush Oil Drain Time Requirements
    - Revised Compression Test Requirements
    - New Camshaft Cleaning Requirements

Industry Severity Summary

Industry Severity Summary			
Parameter	Average Δ/s	Pooled standard deviation (degrees of freedom)	Average Δ, in micrometers
ACW	-0.324	22.20 (df=18)	-7.19

Average Δ/s By Laboratory

ACW Results, by Laboratory	
Laboratory	Average Δ/s
A	0.734
B	0.981
C	1.337
D	-
E	-2.540
F	0.004

Figure 2 - Sequence IVA Reference Oil Data
Average Camshaft Wear

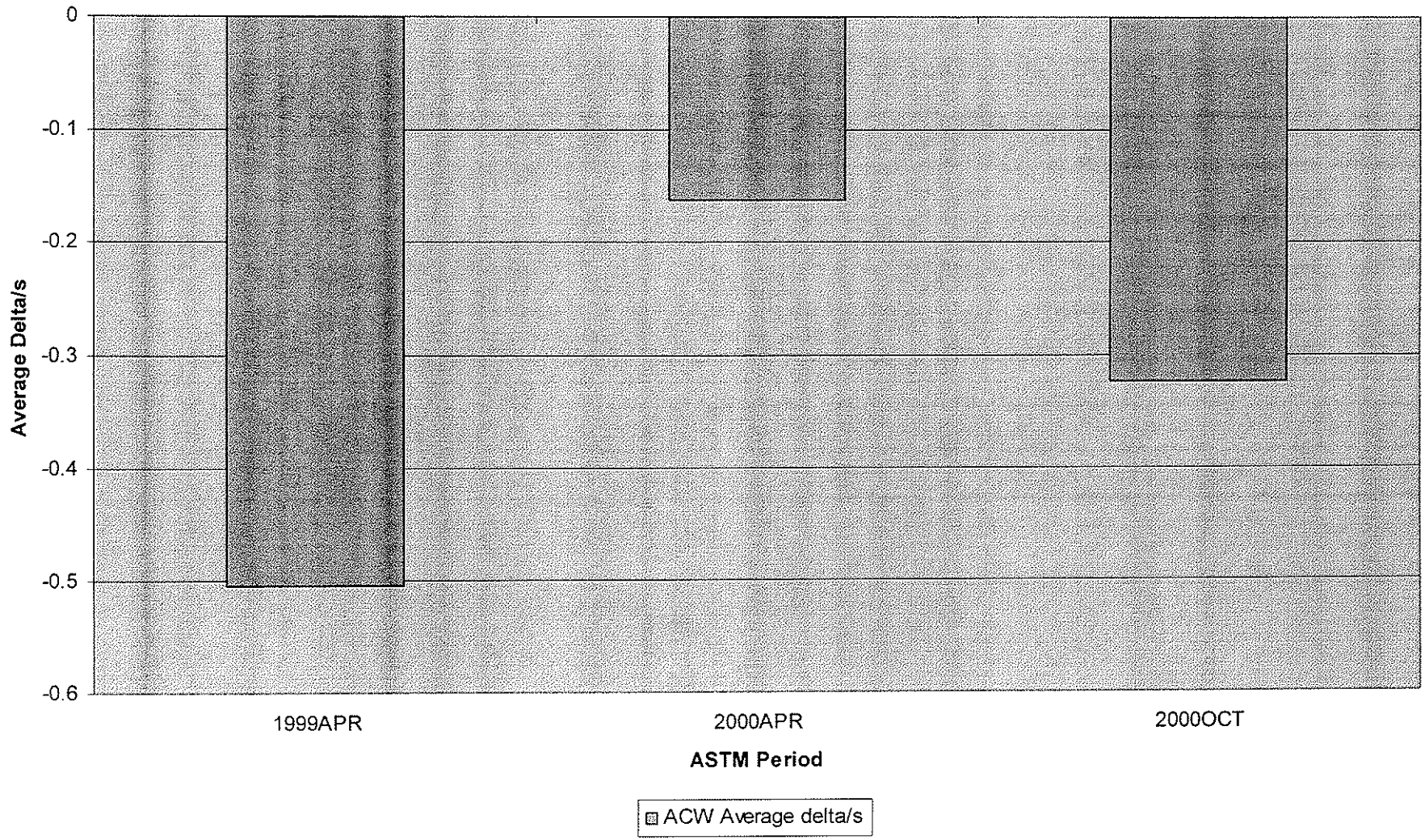
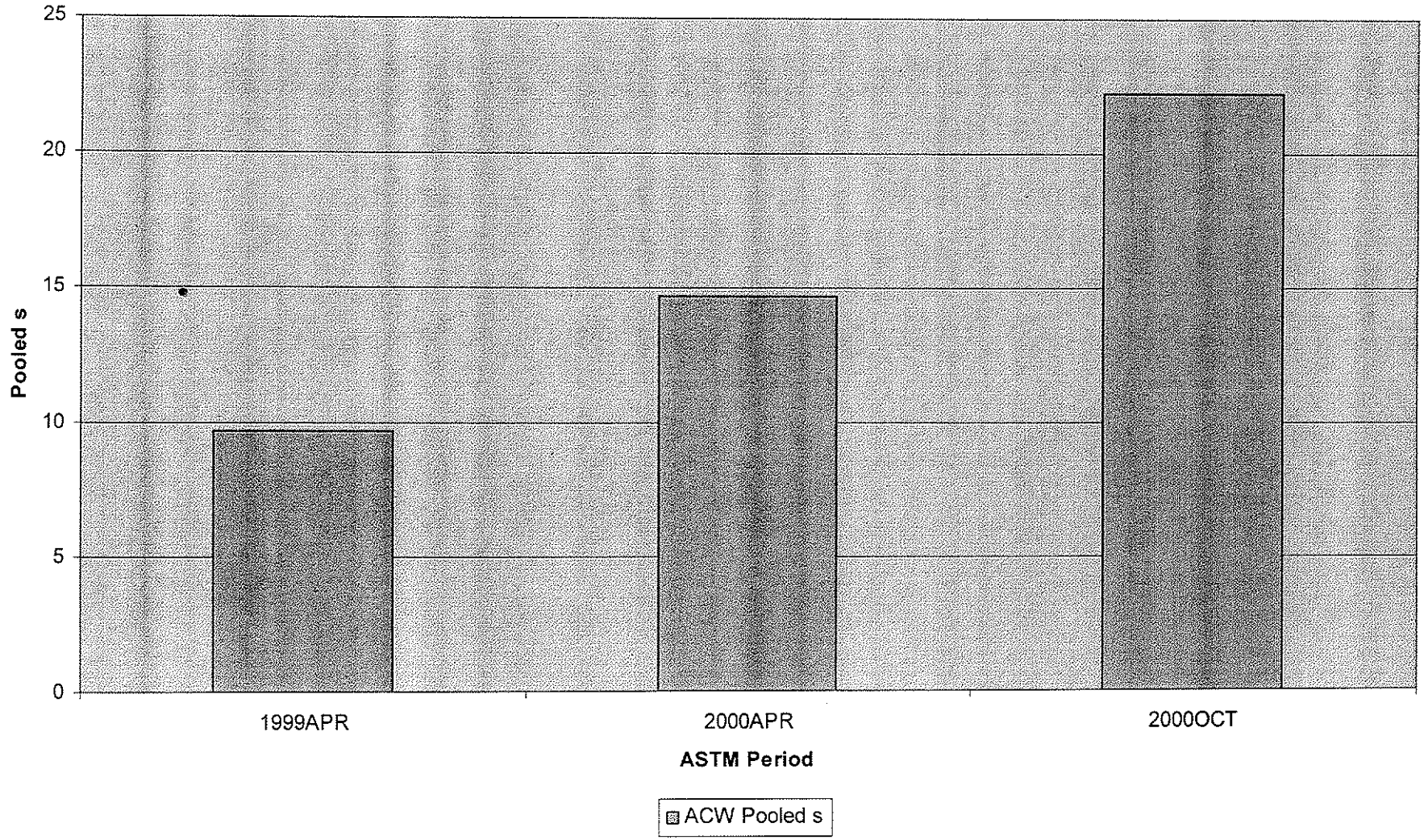


Figure 3 - Sequence IVA Reference Oil Data
Average Camshaft Wear



Hardware

- No hardware changes were made this period.

Industry Reference Oil Inventory

Oil	TMC Inventory, in gallons	TMC Inventory, in tests	Laboratory Inventory, in tests	Estimated life
1006	1,552	388	6	3+ years[1]
1007	660	165	5	3+ years[1]

[1] Multiple test area reference oil; total TMC inventory shown

Average Δ/s by Cam Lot

Cam Lot	N Size	Average Δ/s	Standard Deviation
971103	14	122.53	11.16
971114	6	121.27	16.82
980929	3	123.43	7.09
981013	4	124.72	13.92
981015	3	114.16	15.98
98928	5	100.05	43.99

Average Δ/s by Head Lot

Head Lot	N Size	Average Δ/s	Standard Deviation
960607	2	123.32	9.81
971001	17	120.61	12.26
981030	1	125.07	-

Average Δ/s by Rocker Arm Lot

Rocker Arm Lot	N Size	Average Δ/s	Standard Deviation
961014	1	99.02	-
971001	18	124.59	10.86
981020	15	114.13	27.56

OIL 1007 DONATED TESTS

OILCODE	TMCLAB	STANCODE	LTMSDATE	Cam Lot	Head Lot	RA Lot	IND	ACWFNL	ACWI	ACWE	ANW	OILCON	FUELH100	FUELCON	FEWMH100
35482	F	1	20000702	971114	971001		1007	**89.09**	86.04	95.19	17.18	-73	3.4	141.89	82
35704	B	2	20000716	N/A	N/A	N/A	1007	**108.00**	100.50	123.02	22.49	-13	3.8	138.96	81
35439	A	1	20000716	971103	971001	971001	1007	**96.58**	89.18	111.40	18.18	-90	6	141.07	86
35615	E1	1	20000722	**990727**		991029	1007	**28.96**	28.06	30.75	6.48	0	5.34	136.84	
37010	C	1	20000810	971114	N/A	971001	1007	**110.44**	106.76	117.81	20.83	0	4.09	264.15	88

Average	**86.61**
std dev	**33.37**

Figure 1
Sequence IVA Status of Reported Tests
Report Period: April 1 through September 30, 2000

STATUS	N	PERCENT
Operationally Non-Valid, Terminated	0	0
Operationally Non-Valid, Completed	1	1.2
Operationally Valid, Interpretable	82	98.8
Total Reported Tests	83	100.0

CAUSES FOR LOST TESTS	N
Support Equipment Problems	1

Figure 2
Sequence IVA Test Precision
Report Period: April 1 through September 30, 2000

COMPONENTS OF REPLICATE DATA BASE	N
Number of Tests	2
Number of Oils	1
Number of Labs	2
Number of Stands	2
Number of Severity Adjusted Average Cam Wear Tests	0

VARIABLE	Pooled s	R
Average Cam Wear, Non-adjusted	25.43	71.20
Average Cam Wear, Adjusted	25.43	71.2

Registration Systems, Inc.
American Chemistry Council (ACC) Monitoring Agency

PRODUCT INFORMATION

Haltermann PRODUCTS

Attachment 8

T (281) 457-2768 F (281) 457-1469

PRODUCT: KA24E TEST FUEL

PRODUCT CODE: HF008

Batch No.:	9910650	9903160
TMC No.:	9910650145	9903160143
Tank No.:	682	682
Analysis Date:	11/17/99	3/23/99

TEST	METHOD	UNITS	SPECIFICATIONS			RESULTS	RESULTS
			MIN	TARGET	MAX		
Distillation - IBP	ASTM D86	°F	75		95	82	85
5%		°F				108	117
10%		°F	120		135	124	131
20%		°F				147	152
30%		°F				173	178
40%		°F				203	206
50%		°F	200		230	222	222
60%		°F				232	231
70%		°F				242	240
80%		°F				260	258
90%		°F	300		325	321	320
95%		°F				342	339
Distillation - EP		°F	385		415	400	389
Recovery		vol %		Report		97.6	98.2
Residue		vol %		Report		1.0	1.0
Loss		vol %		Report		1.4	0.8
Gravity	ASTM D4052	°API	58.7		61.2	59.2	59.2
Density	ASTM D4052	kg/l	0.734		0.744	0.7410	0.7410
Reid Vapor Pressure	ASTM D323	psi	8.8		9.2	9.1	9.1
Carbon	ASTM E191	wt fraction	0.8580		0.8667	0.8621	0.8611
Carbon	ASTM D3343	wt fraction		Report		0.8645	0.8659
Sulfur	ASTM D4294	wt %	0.01		0.04	0.02	0.02
Lead	ASTM D3237	g/gal			0.05	<0.01	<0.01
Oxygen	ASTM D4815	wt %			0.05	<0.05	<0.05
Composition, aromatics	ASTM D1319	vol %			35.0	27.6	30.3
Composition, olefins	ASTM D1319	vol %	5.0		10.0	5.6	6.3
Composition, saturates	ASTM D1319	vol %		Report		66.8	63.4
Oxidation Stability	ASTM D525	minutes	1440			>1440	>1440
Copper Corrosion	ASTM D130				1	1	1
Gum content, washed	ASTM D381	mg/100ml			5	1	0
Research Octane Number	ASTM D2699		96.0		97.5	97.0	96.7
Motor Octane Number	ASTM D2700			Report		87.6	88.1
R+M/2	D2699/2700			Report		92.3	92.4
Sensitivity	D2699/2700		7.5			9.4	8.6
Net Heat of Combustion	ASTM D240	btu/lb		Report		18374	18299
Color	Visual			Green		Green	Green

ASTM Sequence IVA Test Laboratories

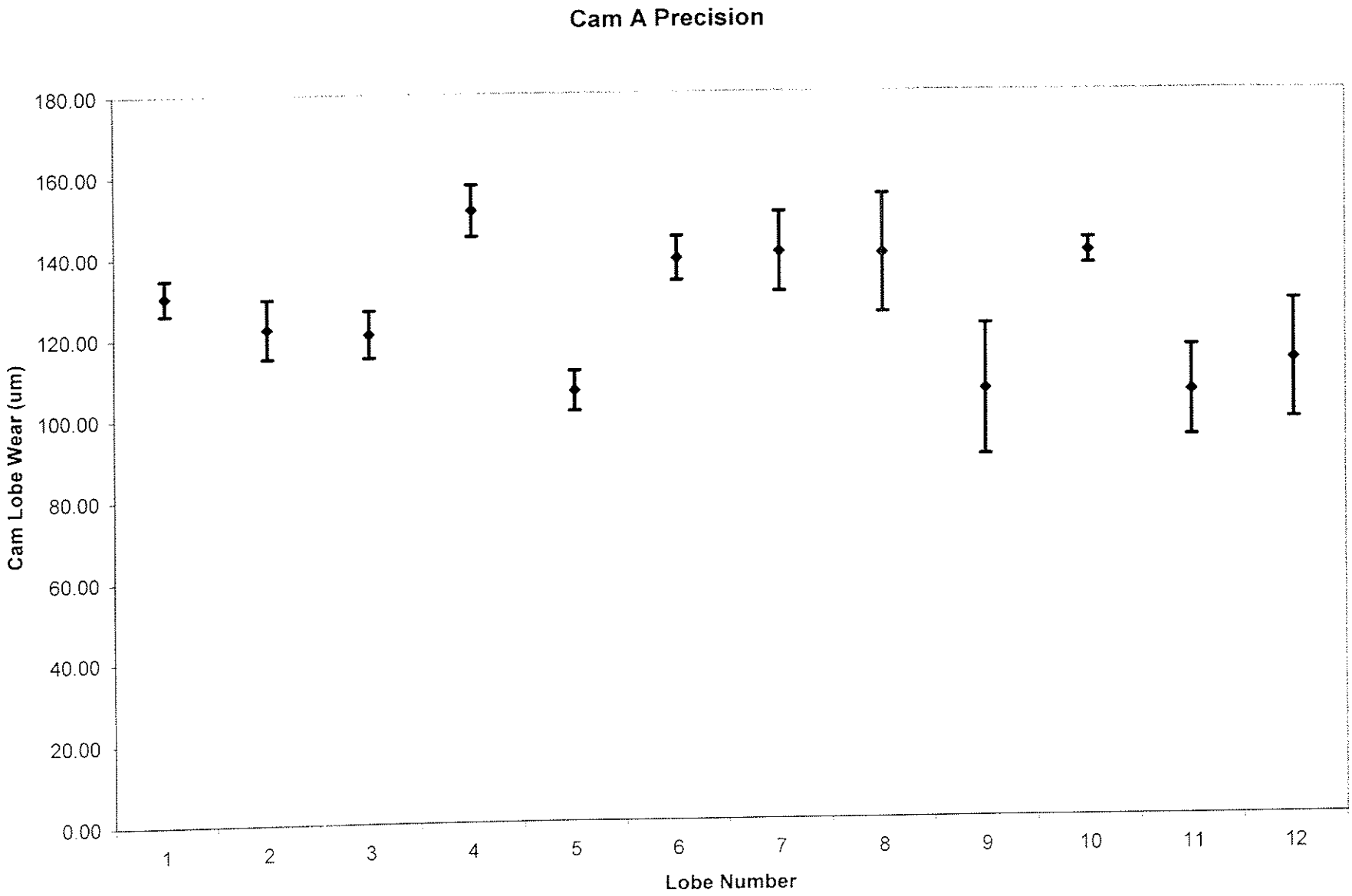
July 20, 2000

Reply To: Larry M. Bendele
Southwest Research Institute
6220 Culebra Rd
P.O. Drawer 28510
San Antonio, Texas 78228
Fax (210) 684-7523
E-mail: [Lbendele@SwRI.org]

Year 2000 CAM WEAR MEASUREMENT ROUND-ROBIN:

A Sequence IVA round-robin of cam lobe wear measurement is scheduled below:

Schedule	Laboratory	Contact & Shipping Address
July 17-21	Southwest Research Institute	Mr. William Buscher III 6220 Culebra Rd. San Antonio, TX 78228-0510
July 24 to Aug. 4	PerkinElmer Automotive Research	Mr. Michael Zaiontz 5404 Bandera Rd. San Antonio, TX 78238
Aug. 9 to Aug. 23	Lubrizol Corporation	Mr. Mark Hull 29400 Lakeland Boulevard Wickliffe, Ohio 44092 Phone: (440) 347-2748
Aug. 28 to Sept. 13	Ethyl Petroleum Additives, Inc.	Mr. Daryl Baumgartner 500 Spring Street Richmond, Virginia 23218 Phone: (804) 788-5308
Sept. 18 to Oct. 4	Ashland Oil, Inc.	Mr. Carl Stephens 22nd Front Street Ashland, Kentucky 41101 Phone: (606) 329-5198
Oct. 9 to Oct. 26	ExxonMobil R&E	Mr. Mark Mosher Paulsboro Technical Center Paulsboro, New Jersey 08066-0480 Phone: (856) 224-2132


Cam A Precision
Cam Lobe Wear (um)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
1
2
3
4
5
6
7
8
9
10
11
12
Lobe Number

Sequence IVA
Hardware / Severity Investigation

98 kits

Test #	Cam Lot #	
	981015	98928
80	129.79	
80A		71.01
80B		105.14
80C	125.44	
80D	121.16	
88		42.86
88A	95.87	

97 vs 99

Test #	Kit year	
	97	99
89		27.81
90	116.87	
91	120.28	
92		28.96
101	127.12	

Note: all runs on R.O. 1006 with the exception of run 92.

Run 92 was a donated run on R.O.1007

Metallurgical Study

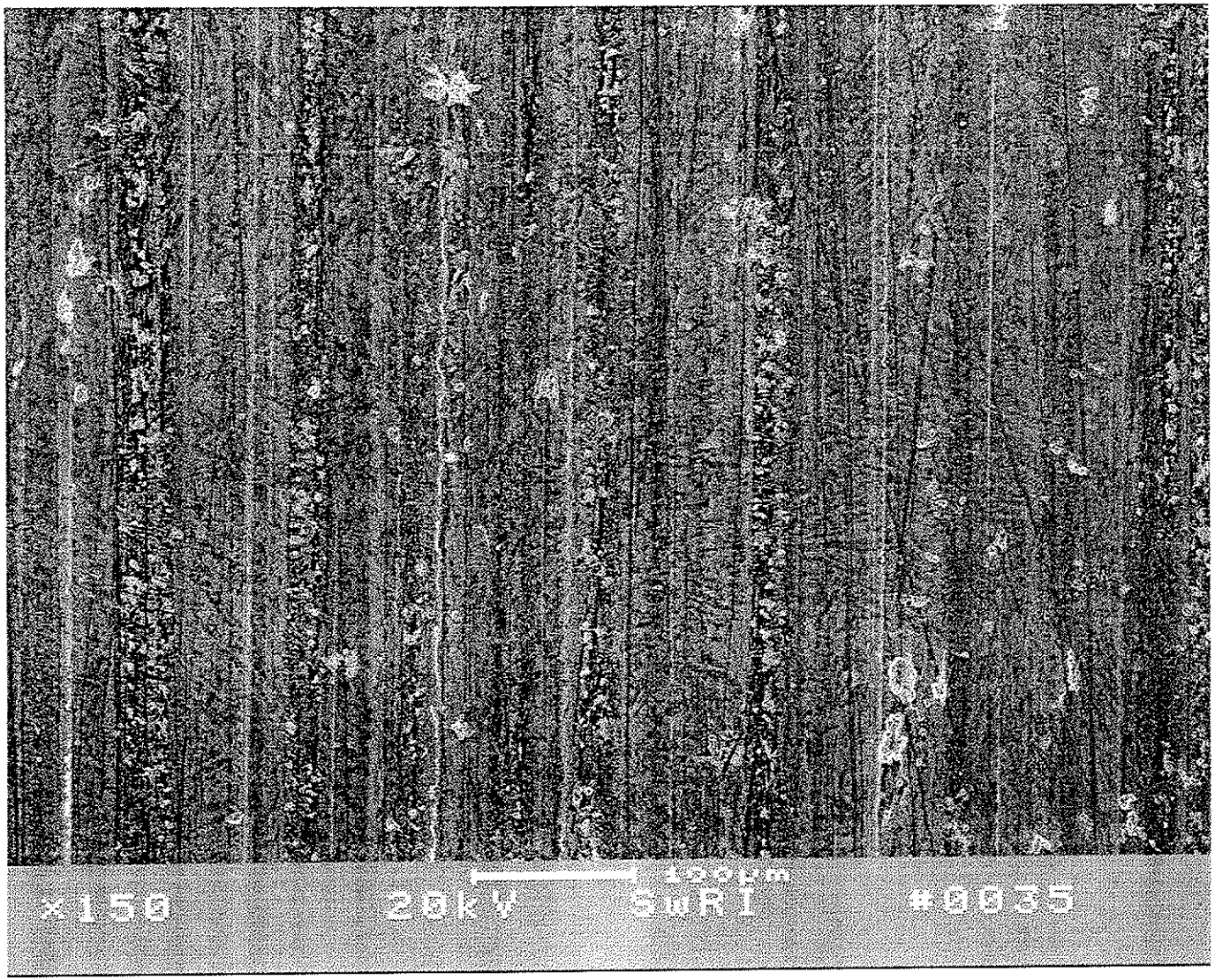
Preliminary Analysis

SwRI

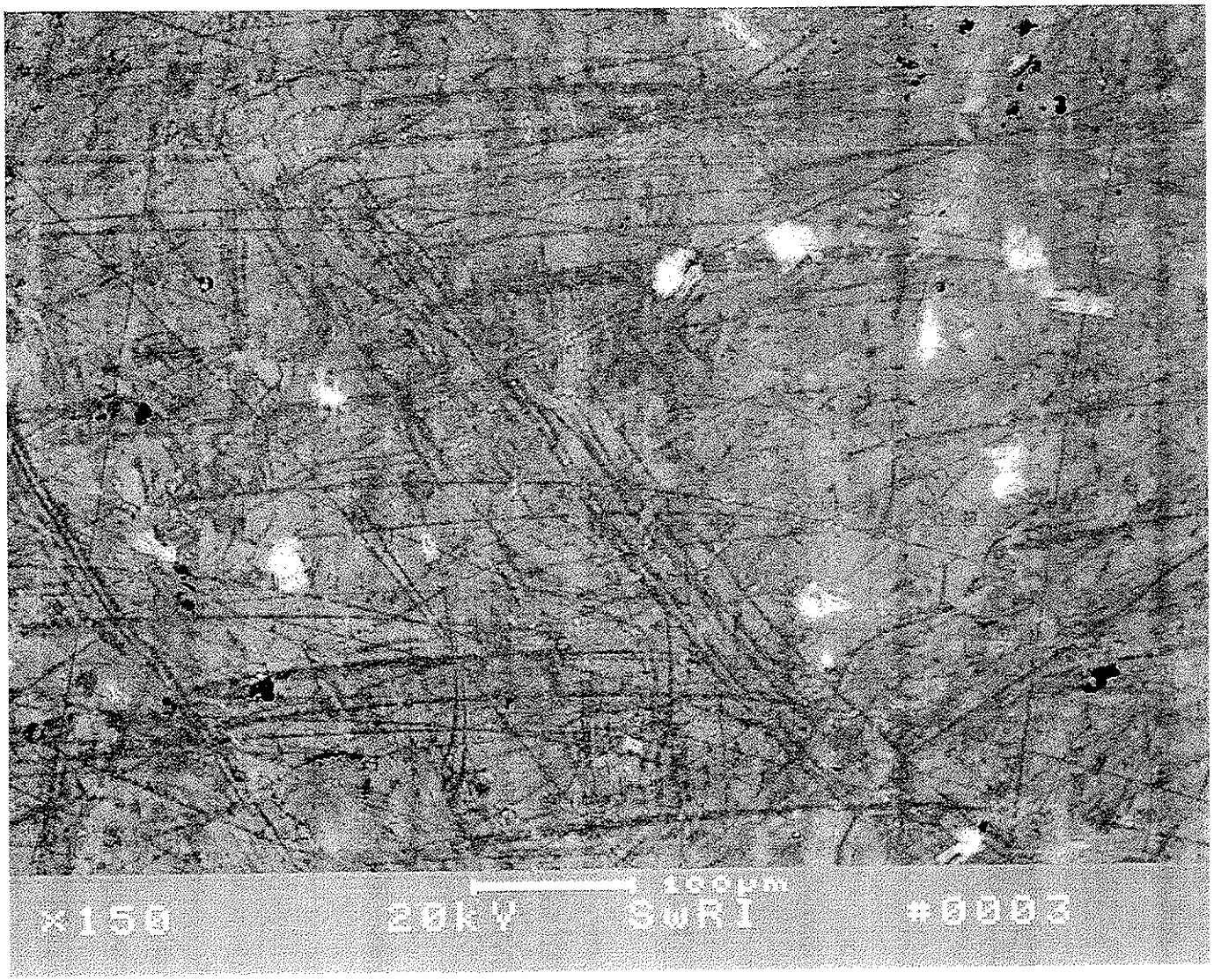
Post - Test Camshafts
Oil 1006

- Low Wear
  - 51.58 um
  - Cam Lot 990729
- Normal Wear
  - 108.54 um
  - Cam Lot 990628

Normal Wear
F2-TDC



Low-Wear
F2-TDC

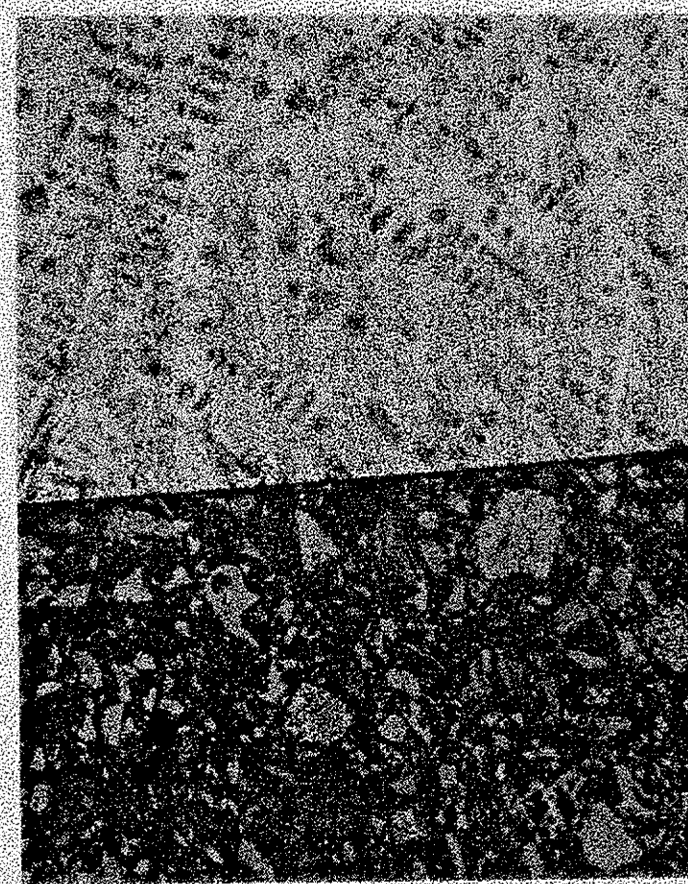


Micro Hardness

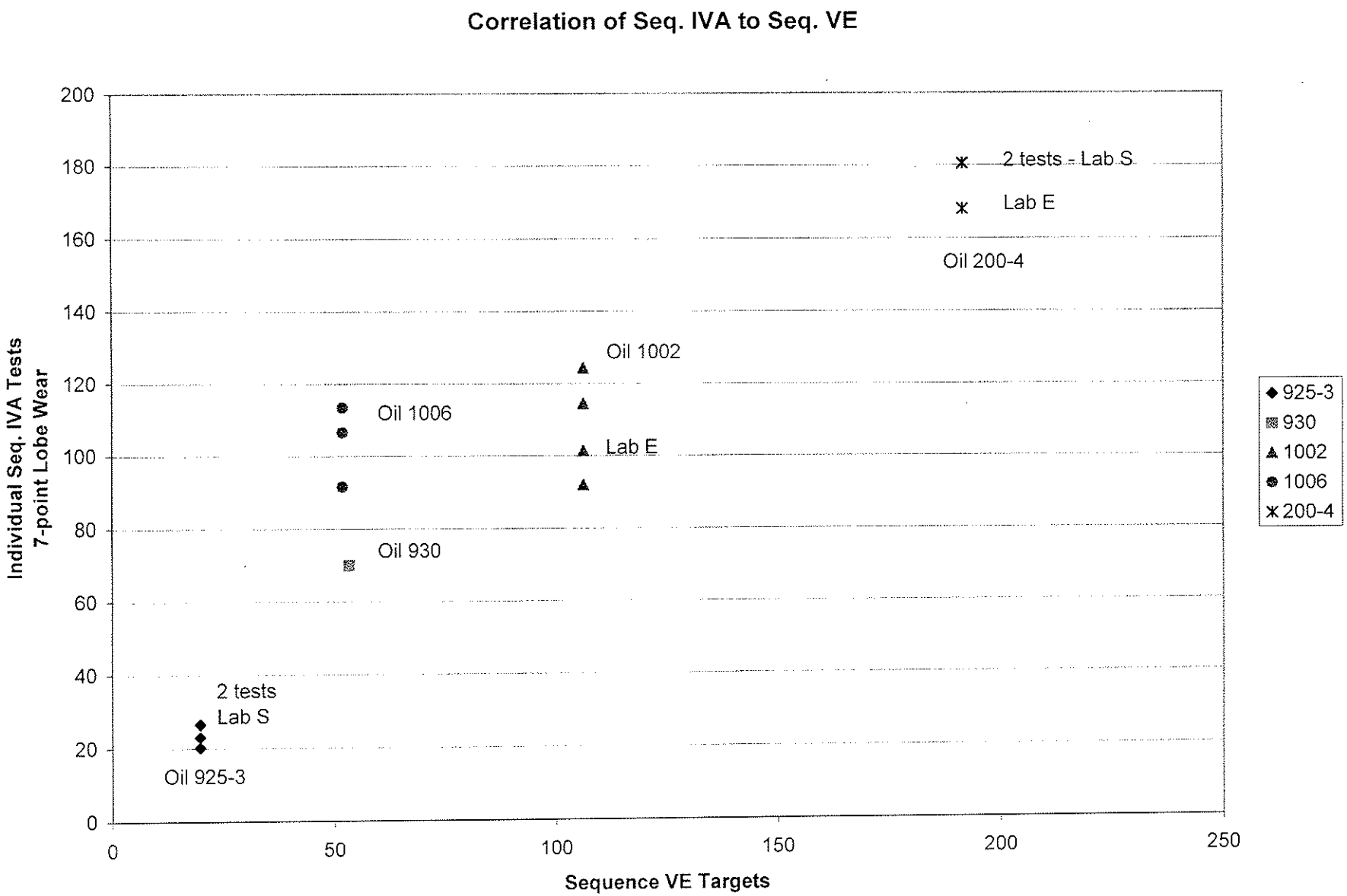
MicroHardness across Lobe at TDC

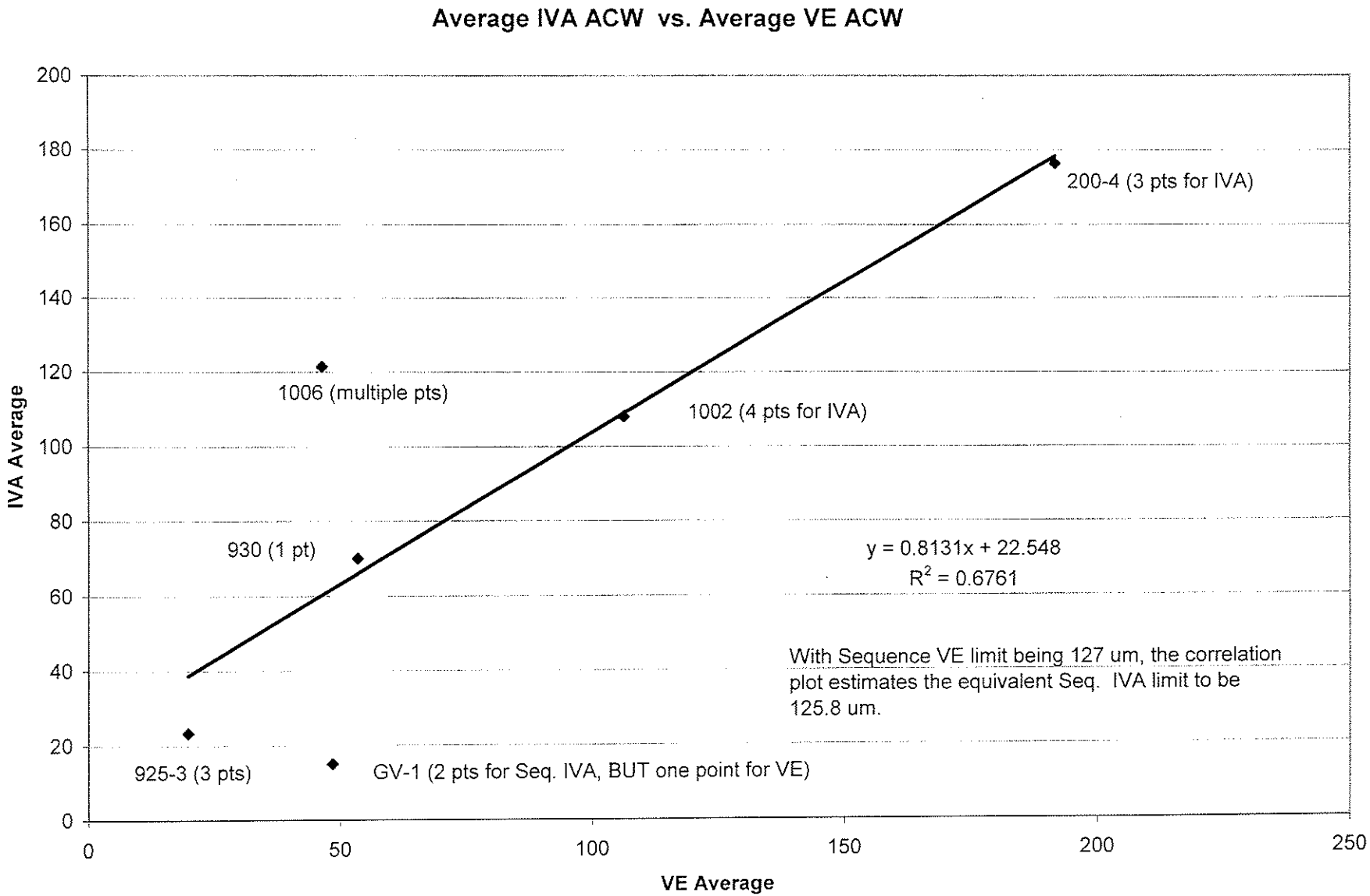
	HRC	
Distance from Edge	Low Wear	High Wear
0.002	55.2	55.8
0.005	57.1	55.2
0.010	56.6	56.4
0.015	56.3	53.7
0.020	56.1	54.9
0.030	48.1	55.2
0.040	53.5	57.0
0.050	53.2	52.9
0.070	54.5	54.6
0.100	54.7	55.1

5451 F-4 200X



5450 F-2 200X


Correlation of Seq. IVA to Seq. VE
Individual Seq. IVA Tests
7-point Lobe Wear
Sequence VE Targets
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
2 tests - Lab S
Lab E
Oil 200-4
Oil 1002
Lab E
Oil 1006
Oil 930
2 tests
Lab S
Oil 925-3
925-3
930
1002
1006
200-4

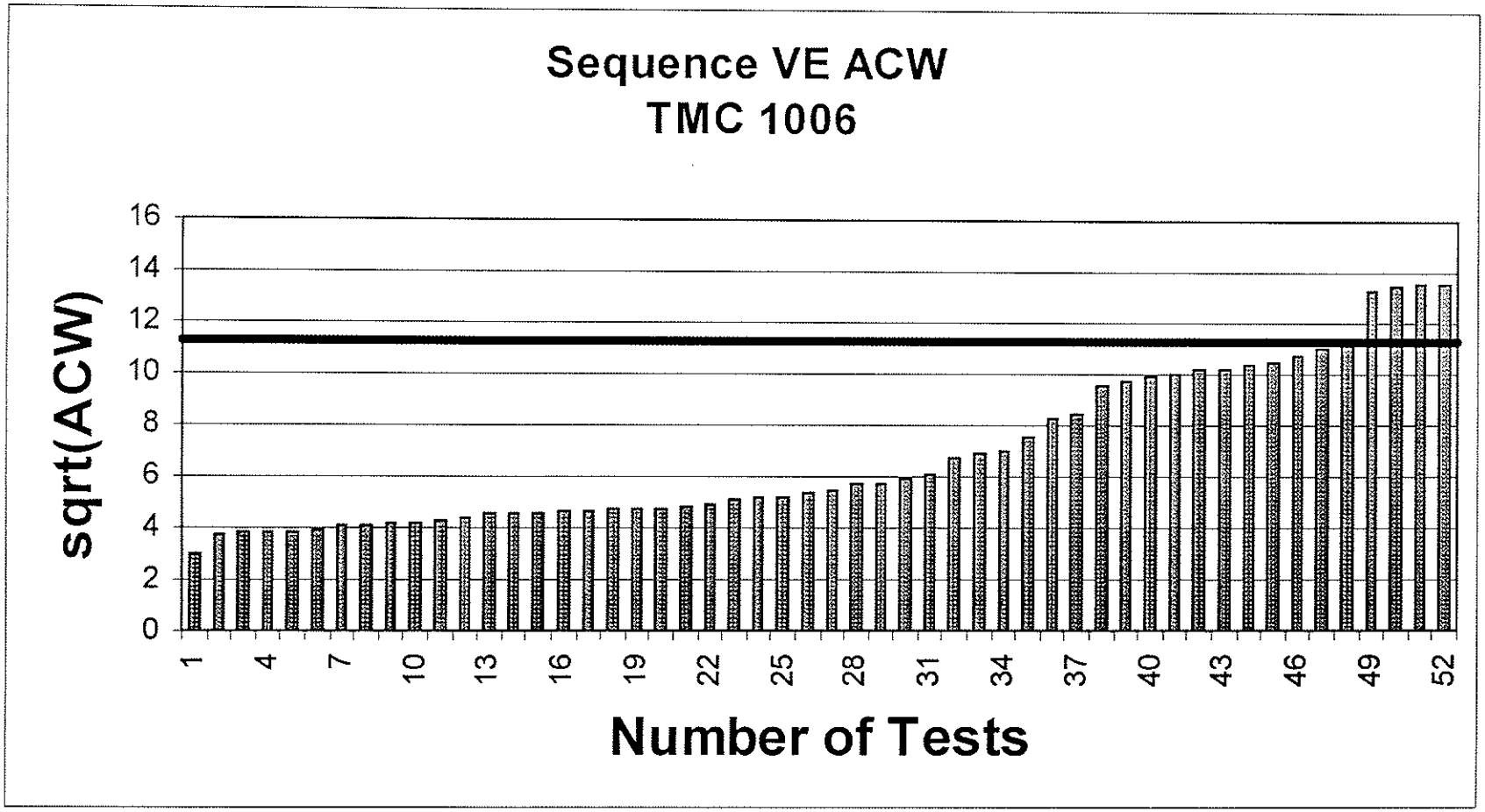

Average IVA ACW vs. Average VE ACW
IVA Average
VE Average
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
200-4 (3 pts for IVA)
1006 (multiple pts)
1002 (4 pts for IVA)
930 (1 pt)
y = 0.8131x + 22.548
R2 = 0.6761
With Sequence VE limit being 127 um, the correlation plot estimates the equivalent Seq. IVA limit to be 125.8 um.
925-3 (3 pts)
GV-1 (2 pts for Seq. IVA, BUT one point for VE)

API SJ Limit Proposal Using the Sequence IVA Test

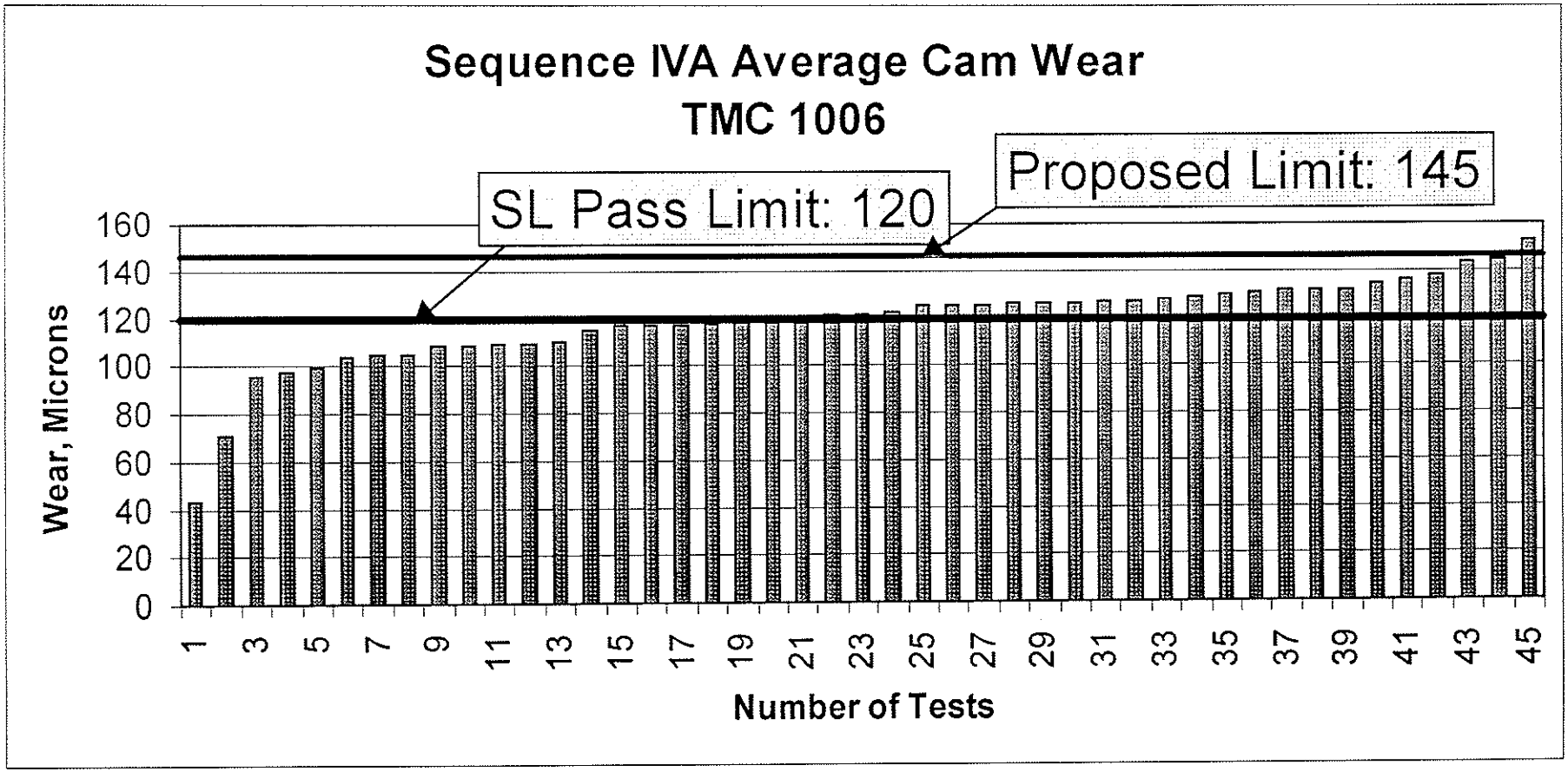
- API SJ Limit: 145 Microns, max

- Rationale:
  - Mean of TMC 1006 in Seq. VE test is 1.4 standard deviations beneath API SJ Limit
  - Mean of TMC 1006 in Seq IVA test is 1.4 standard deviations beneath proposed target.

API SJ Limit Proposal
Using the Sequence IVA Test



API SJ Limit Proposal
Using the Sequence IVA Test



ASTM Sequence IVA Surveillance Panel

Scope and Objectives

Scope

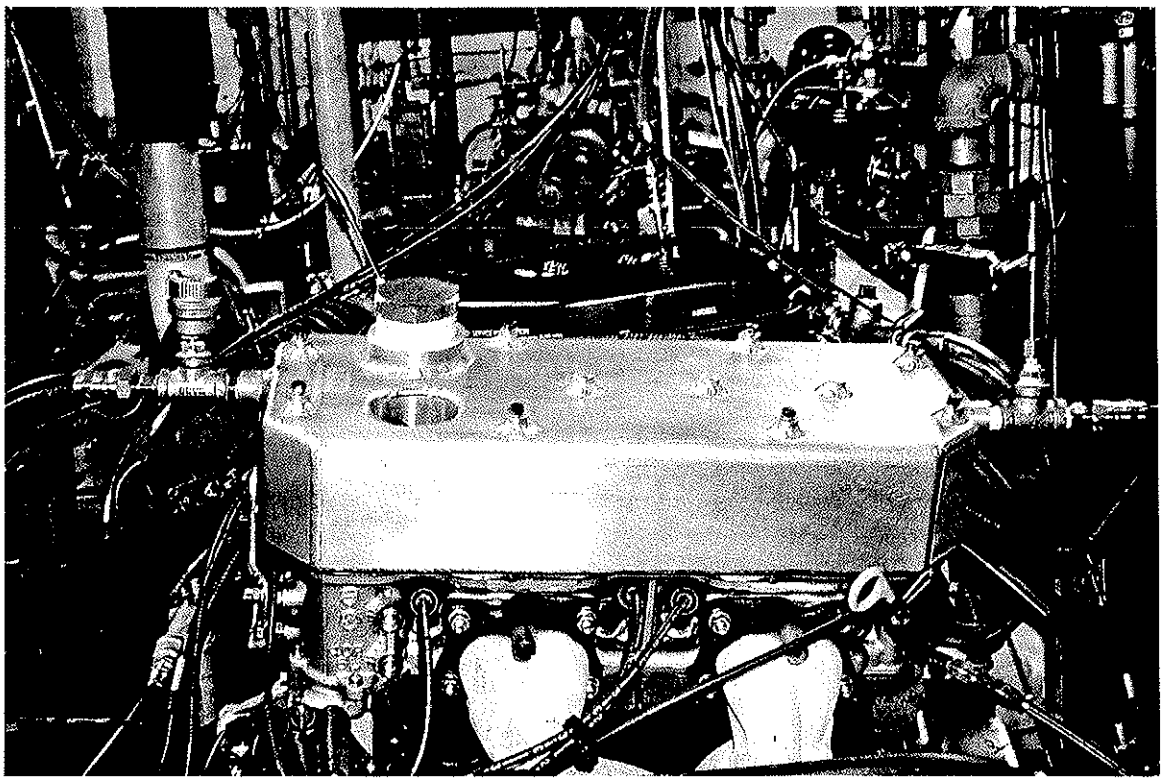
The Sequence IVA Surveillance Panel is responsible for the surveillance and continued improvement of the Sequence IVA test documented in the Research Report RR:D02.1218 as updated by the Information Letter system. Data on test precision and laboratory versus field correlation will be solicited and evaluated at least every six months. Improvements in wear measurement technique, test operation, test monitoring and test validation will be accomplished through continual communication with the Test Sponsor and Parts Distributor, ASTM Test Monitoring Center, ASTM Committee D02.B0.01 and the ASTM Passenger Car Engine Oil Classification Panel. Actions to improve the process will be recommended when deemed appropriate based on input from the proceeding. The Panel will review development and correlation of updated test procedures with previous test procedures. This process will provide a suitable test procedure for evaluating an automotive lubricant's effect on controlling cam lobe wear for overhead valvetrain equipped engines with sliding cam followers.

Objectives	Target Date
1. Issue IVA procedure as ASTM standard	Draft due 3/1/2000
2. Conduct 1999 metrology workshop (yearly)	
3. Establish LTMS for Seq. IVA	
4. Conduct 1999 wear measurement round-robin (yearly)	
5. Approve IVA method through ballot of D02.B0	
6. Conduct a one-time engine builders workshop	
7. Organize an Operations & Hardware Subpanel	

Larry M. Bendele, Chairman
Sequence IVA Surveillance Panel

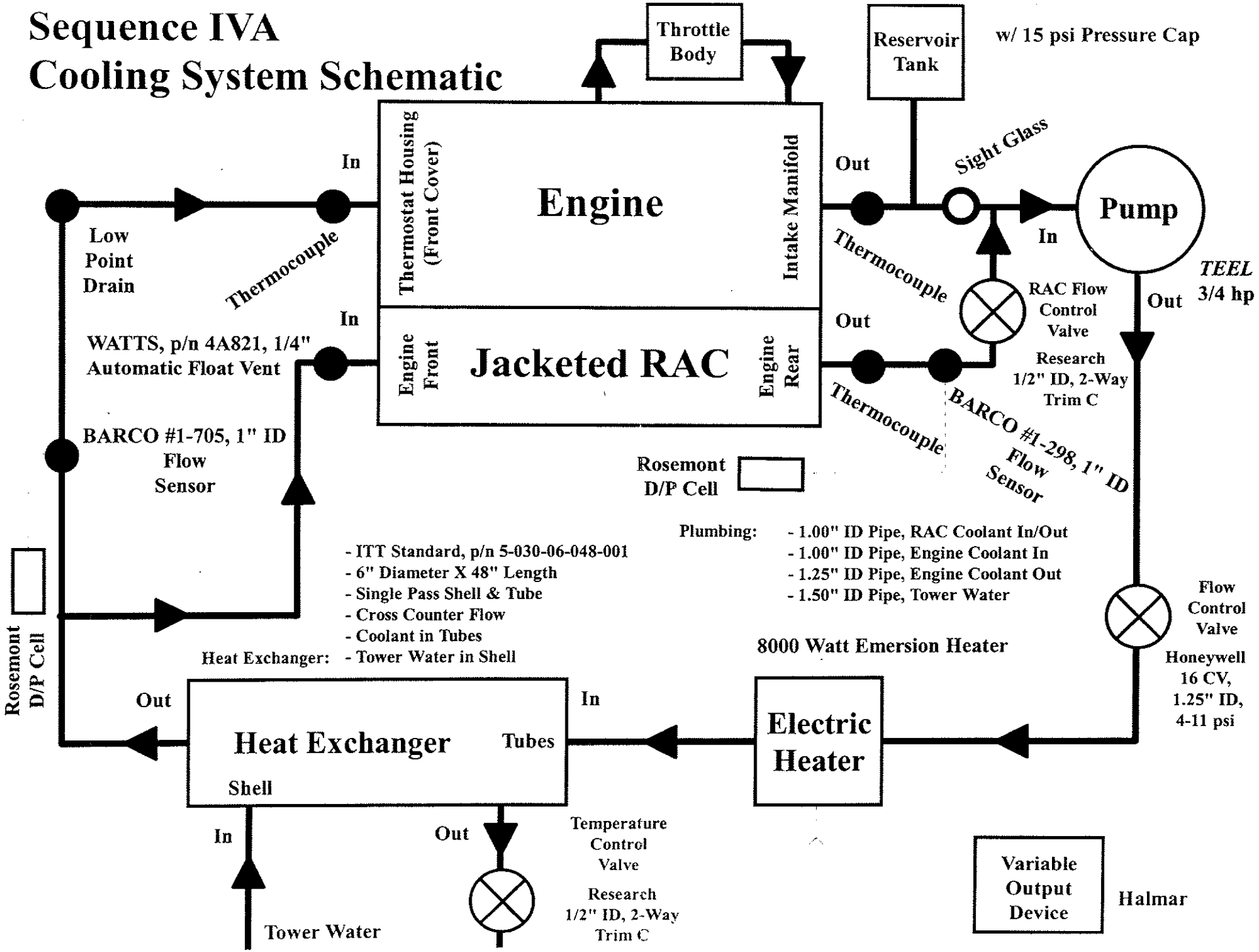
Updated: Nov. 17, 1999

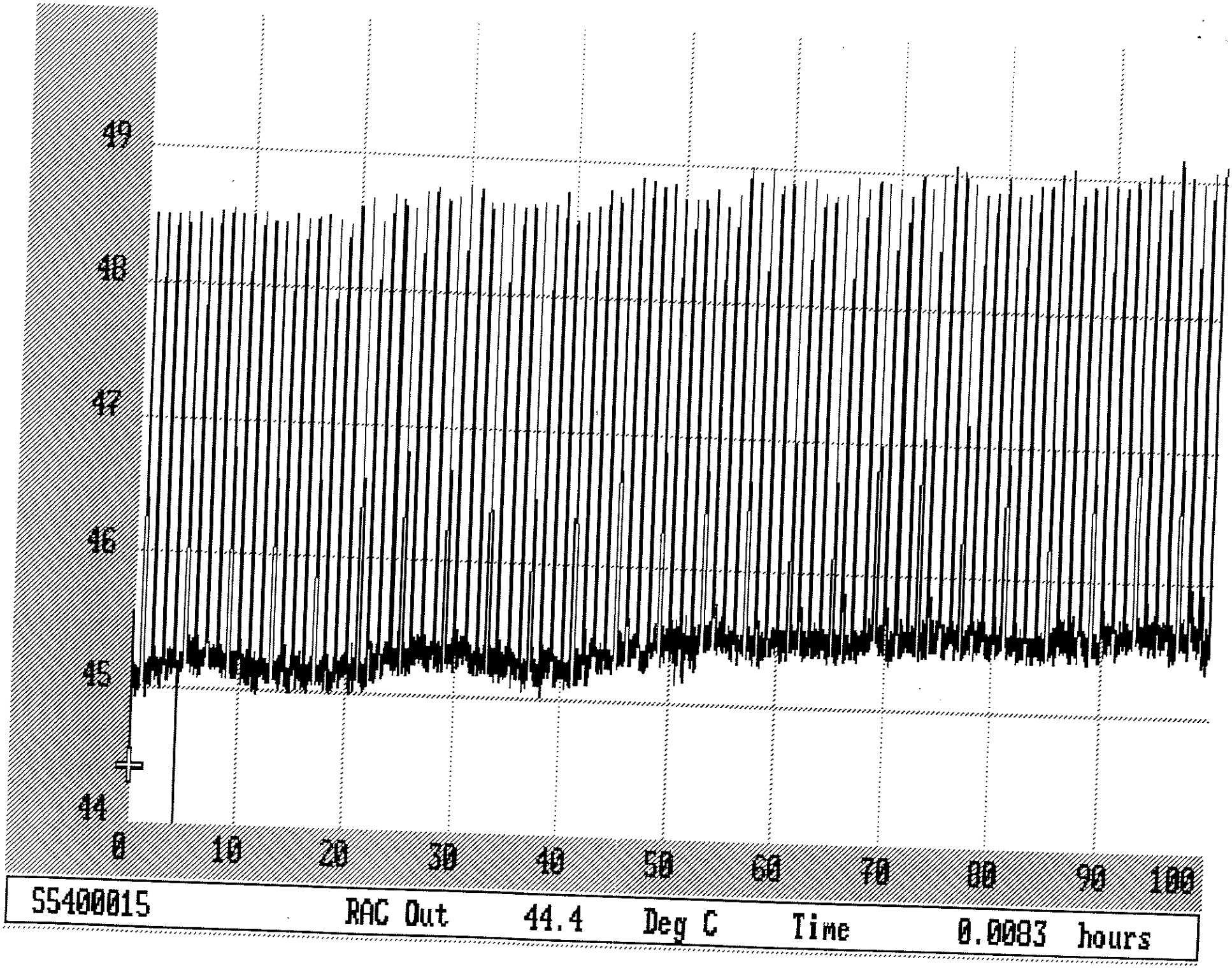
Sequence IVA
RAC Coolant System



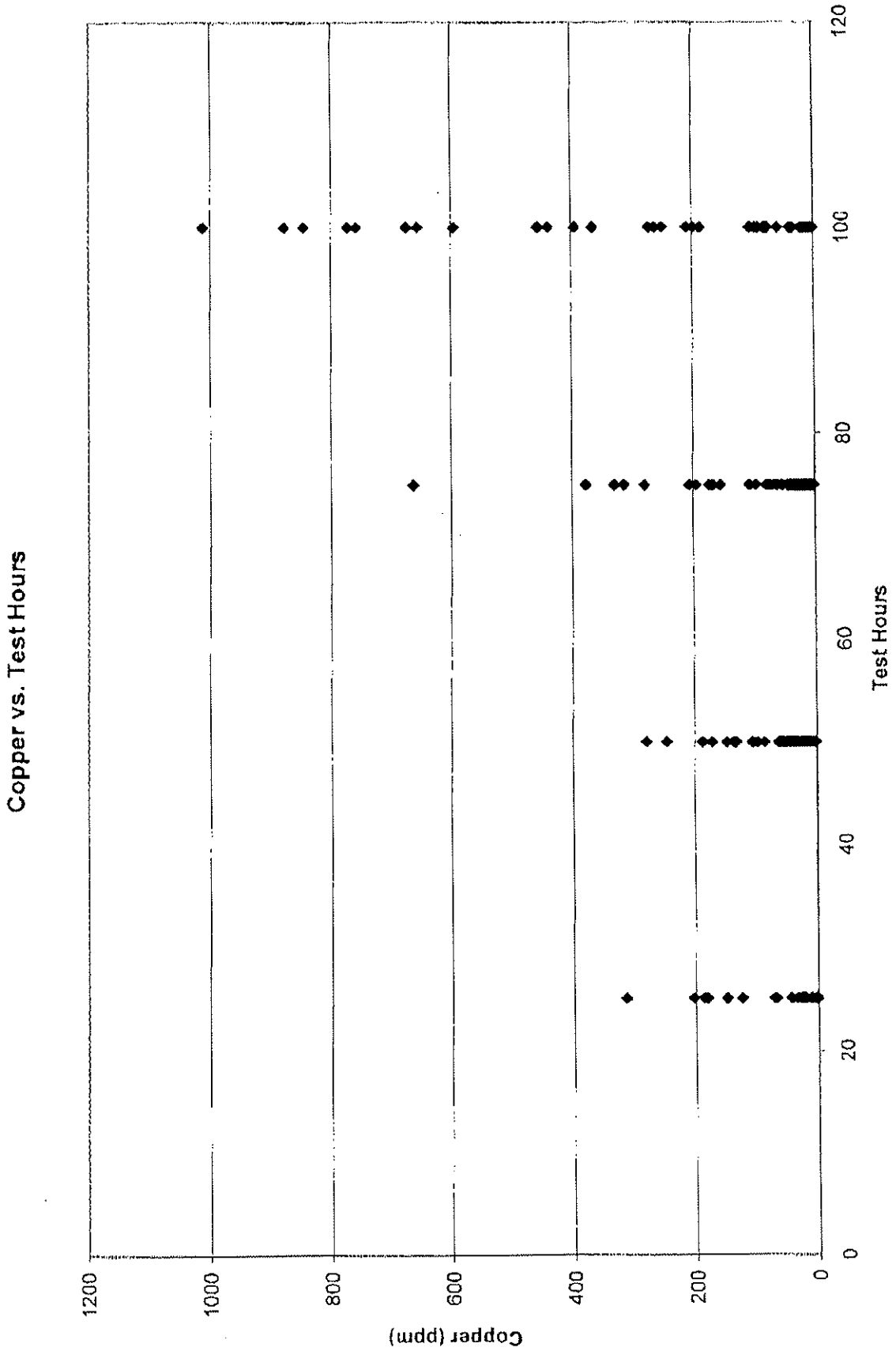
Flow Meter:	BARCO #1-298, 1" ID w/ Rosemont D/P Cell Located downstream of RAC outlet.
Flow Control Valve:	Research ½" ID, 2-Way, Trim C Located downstream of RAC flow meter.
Thermocouple:	1/8" Type J Closed Tip Located immediately after RAC outlet.
Air Bleed Device:	WATTS ¼" FV-4 (4A821) Automatic Float Vent Located immediately before RAC inlet.
Data Acquisition:	RAC Coolant Out Temperature and RAC Coolant Flow Rate data acquisition to meet the requirements stated in Section 11.1 of the Sequence IVA Test Procedure.

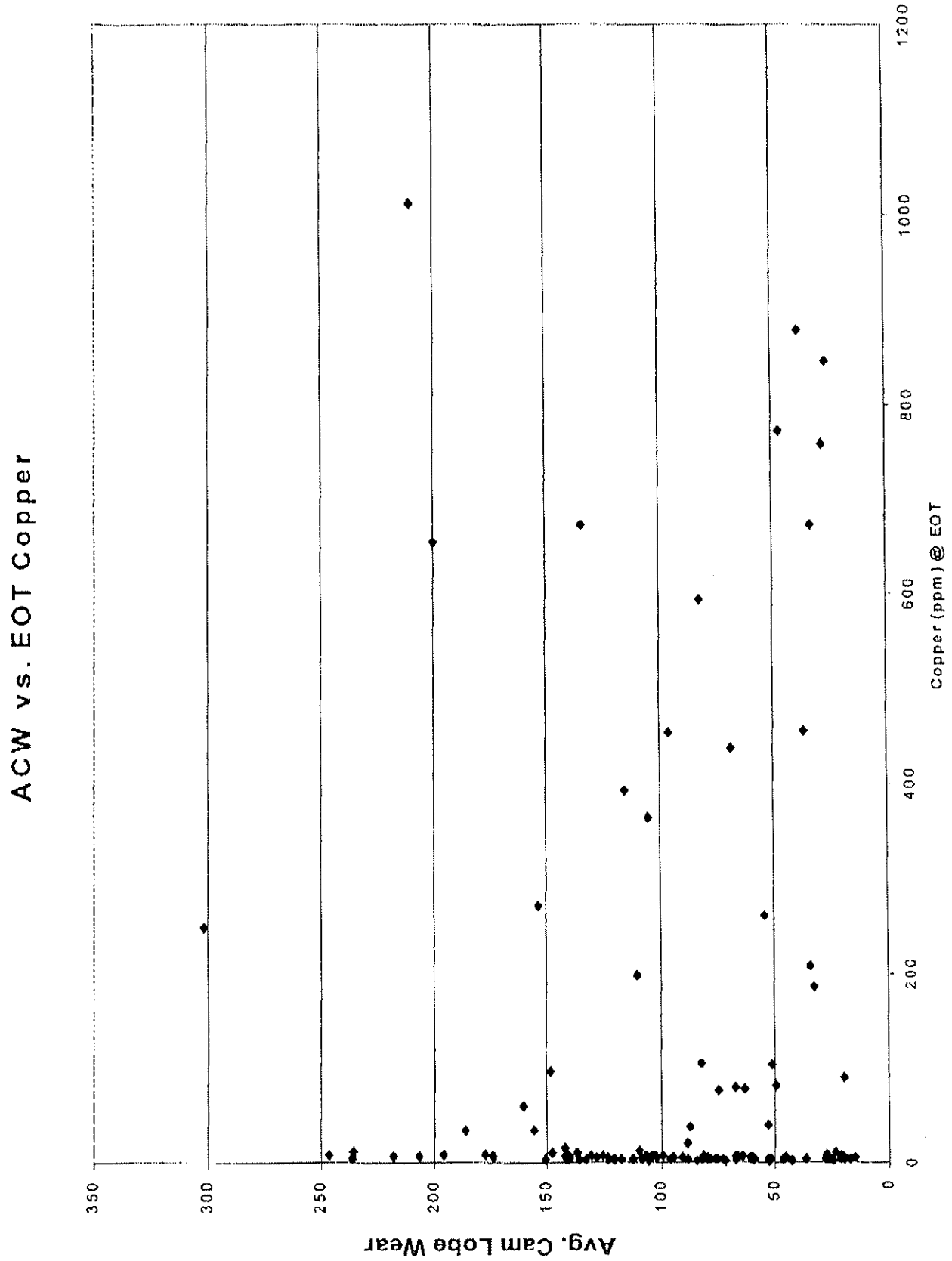
Sequence IVA
Cooling System Schematic




49
48
47
46
45
44
0
10
20
30
40
50
60
70
80
90
100
S5400015
RAC Out
44.4
Deg C
Time
0.0083
hours

Attachment 16




ACW vs. EOT Copper
Avg. Cam Lobe Wear
350
300
250
200
150
100
50
0
Copper (ppm) @ EOT
0
200
400
600
800
1000
1200