November 15, 2007

Reply to: Fred Gerhart
Southwest Research Institute
6220 Culebra Road
P.O. Drawer 28510
San Antonio, Texas 78228-0510

Phone: (210) 522-3842
Fax: (210) 684-7523

UNCONFIRMED MINUTES from the

SEQUENCE VIII SURVEILLANCE PANEL

Held in San Antonio, Texas
November 14, 2007

Welcome

Chairman Fred Gerhart called the meeting to order at 3:00 PM. The agenda was accepted and is included as Attachment 1.

Membership Changes

The attendance record of the voting membership and guests is included as Attachment 2. Phil Scinto represented Lubrizol for this meeting only. No other changes were noted in the membership.

Motion and Action Items

Bill Buscher III recorded the motion and action items of this meeting, which are included as Attachment 3.

Approval of Conference Call Minutes from July 11, 2007

The minutes from this conference call were distributed for review and were accepted by a vote of general consent. A short time later, Charlie pointed out that these minutes were not complete. An amended set of minutes was distributed to the panel from the chairman by e-mail after the meeting and is included as Attachment 4. These minutes will also be posted on the TMC web site.

Review of TMC Report by Rich Grundza

The TMC report for the reporting period of April 1, 2007 through September 30, 2007 was distributed to the panel by e-mail on October 9, 2007 by John Zalar as "Memo 07-056 - Sequence VIII Semiannual Report" and is included as Attachment 5.

At the chairman's request, Rich reviewed the current lead leaching rate, the status of industry precision and severity, and the reference oil inventory.

- The highest value of lead during the reporting period was 202 ppm. The last two values reported in this period were 37 ppm and 80 ppm.
- Industry precision is in control. Industry severity is at EWMA warning limits but should correct itself as targets continue to evolve for 1006-2. The industry is currently at n count of 13 for 1006-2 on the 0306 bearings. The next target update is to occur at n count of 20.
- There is an ample supply of reference oil.

The panel accepted the TMC report by a vote of General Consent.

TEI CPD Report – by Zack Bishop

The CPD report is included as Attachment 6.

There are 2,549 sets of 0306 bearings in Argon storage at TEI.

The latest ICP data from two sets of bearings at TEI show the lead content in the storage oil continuing to increase. Sample PAO1 increased from 98 ppm to 158 ppm. Sample PAO2 increased from 113 ppm to 190 ppm. TEI believes the source of the lead to be from a coating of lead residue left over from broaching and not due to lead leaching from the actual matrix of the 0306 bearing. The change out of bearing storage oil has not started due to supply issues by the vendor of the plastic storage containers. TEI has all other components on hand and will start the change out as soon as the plastic storage containers arrive. The bearings will be cleaned and placed into new containers of EF-411 and will be issued a new lot code of 01A. The change out is scheduled for completion by February 2008.

The annual order for 2007 has been fulfilled. A letter of solicitation for the 2008 annual order will be sent to the laboratories shortly.

There was discussion of the CPD report by the panel.

The panel agreed that laboratories are to change to the lot code 01A bearings at the start of a reference period. Existing referenced stands will be allowed to complete their calibration periods using lot code 01 bearings, which are packed in PAO8.

Sid Clark reviewed data from 0306 bearings inspections that were conducted at GM. In April of 2007, TEI provided one set of bearings that was stored PAO8 with a blanket of Argon gas. The storage oil was clear and the bearings were in perfect condition. The report from the GM metallurgical laboratory is attached as Attachment 7. This particular set of bearings had the matrix intact and showed no signs of leaching. During June 2007, Sid visually inspected a second set of bearings from SwRI on hand inventory. The storage oil for these bearings was not clear and there was a brown ring on the bottom of the container. When placed under a standard microscope, Sid could see areas where the witness marks of the broaching operation were not present indicating evidence of lead leaching from the surface of the bearing. Sid cautioned the group that when preparing surface mount samples for SEM analysis do not polish because the polishing operation will remove evidence of lead leaching and restore the surface. A better method is to

mount cross sections of the bearing, which will allow polishing and will also ensure preservation of any evidence of lead leaching. After much discussion, TEI agreed to inspect cross sections of random samples of 0306 bearings using a SEM.

Fuel Supplier Report

The fuel supplier provided the chair with a report. The report is included in this document as Attachment 8.

Old Business

Discussion took place about re-introducing 1009 as a reference oil or to pursue introduction of a "GF-5" potential reference oil from Lubrizol. TMC has two drums of this potential new reference oil and has coded it as oil 705. The consensus of the panel was to drop oil 1009 and pursue potential GF-5 reference oils that have performance close to the GF-4 pass limit of 26 mg. The panel requested TMC to provide analytical data of oil 705 for review by the panel.

The current reference interval is 3 months or 12 tests whichever comes first. After discussion, a motion was made to restore the reference interval to 6 months or 15 tests whichever comes first. Motion Passed.

New Business

The chairman called for new business. No new business was presented for panel consideration.

Review of Scope and Objectives

The panel reviewed the Scope and Objectives. An objective was added for the panel to monitor the progress of the comprehensive review of the different LTMS systems utilized by the PCMO test types and their pros and cons with a completion date of May 2008. The Scope and Objectives are attached as Attachment 9.

Adjournment

By General Consent, the meeting adjourned at 4:20 PM. The next meeting of this panel will be at call of the chair.

Attachment 1

Sequence VIII Surveillance Panel Agenda

SwRI in Building 209, Conference Room 103.

November 14, 2007 (Wednesday)

3:00 PM – 5:00 PM

1. Call to Order by Chairman – Fred Gerhart
2. Membership Changes
3. Attendance Sign-in
4. Motion and Action Items Recorder
5. Approval of Conference Call Minutes from July 11, 2007
6. TMC Report – Rich Grundza
    a. Lead leaching rate
    b. Any industry precision or severity issues?
    c. Reference oil inventory
7. CPD Report – TEI
8. Old Business
    a. Introduce New Reference Oil or Keep 1009?
    b. Restoration of Sequence VIII Reference Interval
9. New Business
10. Review Scope and Objectives
11. Next Meeting – At the call of the chairman
12. Adjournment

Attachment 2

ASTM SEQUENCE VIII SURVEILLANCE PANEL
VOTING MEMBERSHIP ATTENDANCE RECORD

Name	Address	Phone/Fax/Email	Attendance
Knight, Clayton	Test Engineering Inc. 12718 Cimarron Path San Antonio, TX 78249-3423	Phone: 210-690-1958 Fax: 210-690-1959 cknight@tei-net.com	
Caudill, Timothy	Valvoline 21st and Front Streets Ashland, KY 41101	Phone: 606-329-1960 ext 5708 Fax: 606-329-2044 Tlcaudill@ashland.com	
Bowden, Dwight	OH Technologies, Inc. P.O. Box 5039 Mentor, OH 44061-5039	Phone: 440-354-7007 Fax: 440-354-7080 dhbowden@ohtech.com	
Buscher, Jr., Bill	Buscher Consulting Services P.O. Box 112 Hopewell Jct., NY 12533	Phone: 845-897-8069 Fax: 845-897-8069 BuschWA@aol.com	
Clark, Sid	GM Powertrain Engine Engineering Building 823 Joslyn Rd. MC 483-730-322 Pontiac, MI 48340-2920	Phone: ~~248-857-9959~~ Fax: 248-977-9819 sidney.l.clark@gm.com	
Ritchie, Andy	Infineum P.O. Box 735 1900 East Linden Ave. Linden, NJ 07036-0735	Phone: Fax: andrew.ritchie@infineum.com	
Gerhart, Fred	Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228-0510	Phone: 210-522-3842 Fax: 210-684-7523 fgerhart@swri.org	
Glaenzer, David	Afton Chemical 500 Spring Street P.O. Box 2158 Richmond, VA 23218	Phone: 804-788-5214 Fax: 804-788-6358 Dave.Glaenzer@aftonchemical.com	
Ramono, Ron	FCSD, Service Product Development, SEO Diagnostic Service Center II Room 410 1800 Fairlane Drive Allen Park, MI 48101	Phone: Fax:	
Grundza, Rich	ASTM/TMC 6555 Penn Ave Pittsburgh, PA 15206-4489	Phone: 412-365-1031 Fax: 412-365-1047 reg@astmtmc.cmu.edu	
Leverett, Charlie	Intertek 5404 Bandera Road San Antonio, TX 78238	Phone: 210-647-9422 Fax: 210-523-4607 charlie.leverett@perkinelmer.com	
Miranda, Timothy	BP Lubricants USA 1500 Valley Rd Wayne, NJ 07470	Phone: 973-305-3334 Fax: 973-686-4039 Timothy.Miranda@BP.com	
Szappanos, George	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092	Phone: 440-347-2631 Fax: 440-347-4096 George.Szappanos@lubrizol.com	Phil Bento for George
Sutherland, Mark	Chevron Oronite Company LLC 4502 Centerview Ste. 210 San Antonio, TX 78228	Phone: 731-5605 Fax: 731-5621 MSUT@chevrontexaco.com	

Jason H. Bowden OH TECHNOLOGIES, INC. jhbowden@ohtech.com

ZACK BISHOP TEI

BILL BUSCHER II SWRI

Attachment 2

ASTM SEQUENCE VIII SURVEILLANCE PANEL
NON- VOTING MEMBERSHIP and GUESTS ATTENDANCE RECORD

Name	Address	Phone/Fax/Email	Attendance
Ed Altman	500 E. Spring St. Richmond VA 23219	804-788-5279 804-788-6358 (Fax) Ed.Altman@Aftonchemical.com	
Doyle Boese	Infineum 1900 E. Linden Ave Linden, NJ 07036	908-474-3176 Doyle.Boese@Infineum.com	
R			

Attachment 3

Sequence VIII Surveillance Panel
November 14, 2007
3:00PM – 5:00PM
SwRI, Building 209, Conference Room 103
San Antonio, TX

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1. Action Item – TEI to perform another SEM analysis on a random bearing set from the TEI inventory to check for indications of lead leaching, and to compare to the original SEM analysis.

2. Action Item – TMC to obtain demonstration data for proposed reference oil 705. At a minimum, TMC will request the test results and bearing batch.

3. Motion – Restore VIII reference interval back to 15 runs or 6 months from 12 runs or 3 months. Effective November 14, 2007.

Fred Gerhart / Charlie Leverett / Passed Unanimously with 1 Waive

4. Action Item – TEI will bring a few random bearing sets from the TEI inventory to Intertek, and TEI, Sid Clark and Charlie Leverett will inspect them under a high power microscope.

Attachment 4

Minutes of Sequence VIII Conference Call July 11, 2007

1. Roll Call - 8 voting members on the call. See Attachment 1

2. Motion and Action Items Recorder

3. Preservation of Bearings
   a. Fred reviewed his email - see Attachment 2
   b. Charlie has problems with new bearings already was 5 ppm is now 33 ppm
   c. Motion made for TEI to clean and pentane wipe and repack the 0306 bearings into EF411 using new containers. TEI is to also inspect, clean, and repack the bearings into fresh EF411 on an annual basis. Passed
   d. The repacked bearings will be identified as batch 0306 lot code 01A.
   e. During discussion over differences measured in lead content between bearings stored at TEI vs. bearings stored at individual laboratories, the laboratories agreed to start storing their bearings in Argon gas.

4. Action Alarm TBWL Severity
   - TMC - 704-1 and 1006-2 severities are not equivalent
   - TMC - Lead levels do not seem to impact reference results
   - TMC - both labs have experienced severity shifts.
   - Statisticians want to wait and see while the panel works on bearing storage issues.

5. Restore Sequence VIII reference interval back to six months or 15 tests.
   a. Targets have been obtained on 1006-2.
   b. Three additional references should occur based on time before fall meeting
   c. Motion made to change reference interval from 3 months or 8 runs to 3 months and 12 runs. Passed.

Attachment 4

ASTM SEQUENCE VIII SURVEILLANCE PANEL
ATTACHMENT 1 - VOTING MEMBERSHIP ATTENDANCE RECORD

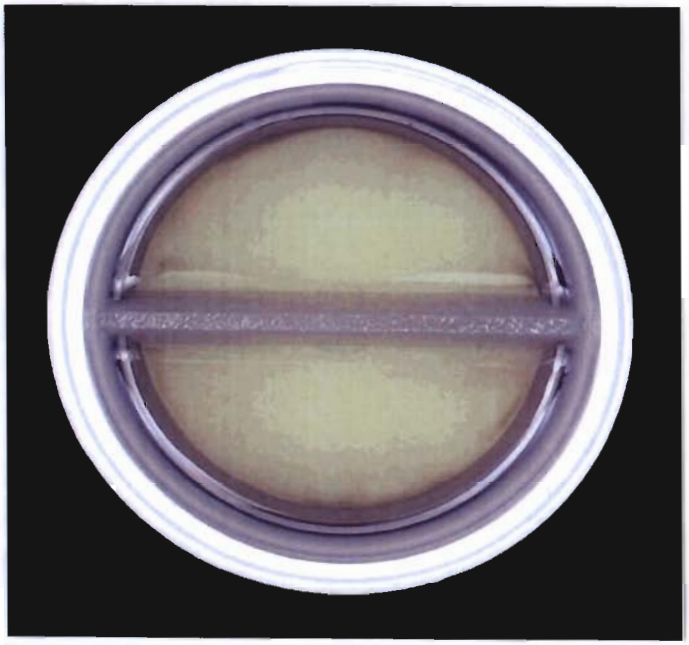
Name	Address	Phone/Fax/Email	Attendance
Knight, Clayton	Test Engineering Inc. 12718 Cimarron Path San Antonio, TX 78249-3423	Phone: 210-690-1958 Fax: 210-690-1959 cknight@tei-net.com	Present
Caudill, Timothy	Valvoline 21st and Front Streets Ashland, KY 41101	Phone: 606-329-1960 ext 5708 Fax: 606-329-2044 Tlcaudill@ashland.com	
Bowden, Dwight	OH Technologies, Inc. P.O. Box 5039 Mentor, OH 44061-5039	Phone: 440-354-7007 Fax: 440-354-7080 dhbowden@ohtech.com	
Buscher, Jr., Bill	Buscher Consulting Services P.O. Box 112 Hopewell Jct., NY 12533	Phone: 845-897-8069 Fax: 845-897-8069	
Clark, Sid	GM Powertrain Engine Engineering Building 823 Joslyn Rd. MC 483-730-322 Pontiac, MI 48340-2920	Phone: 248-857-9959 Fax: sidney.l.clark@gm.com	Present
Ritchie, Andy	Infineum P.O. Box 735 1900 East Linden Ave. Linden, NJ 07036-0735	Phone: Fax:	Present - Gordon
Gerhart, Fred	Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228-0510	Phone: 210-522-3842 Fax: 210-684-7523 fgerhart@swri.org	Present
Glaenzer, David	Afton Chemical 500 Spring Street P.O. Box 2158 Richmond, VA 23218	Phone: 804-788-5214 Fax: 804-788-6358 Dave.Glaenzer@aftonchemical.com	Present
Ramono, Ron	FCSD, Service Product Development, SEO Diagnostic Service Center II Room 410 1800 Fairlane Drive Allen Park, MI 48101	Phone: Fax:	
Grundza, Rich	ASTM/TMC 6555 Penn Ave Pittsburgh, PA 15206-4489	Phone: 412-365-1031 Fax: 412-365-1047 reg@astmtmc.cmu.edu	Present
Leverett, Charlie	Intertek 5404 Bandera Road San Antonio, TX 78238	Phone: 210-647-9422 Fax: 210-523-4607 charlie.leverett@perkinelmer.com	Present
Miranda, Timothy	BP Lubricants USA 1500 Valley Rd Wayne, NJ 07470	Phone: 973-305-3334 Fax: 973-686-4039 Timothy.Miranda@BP.com	Present
Szappanos, George	Lubrizol Corporation 29400 Lakeland Blvd. Wickliffe, OH 44092	Phone: 440-347-2631 Fax: 440-347-4096 George.Szappanos@lubrizol.com	
Sutherland, Mark	Chevron Oronite Company LLC 4502 Centerview Ste. 210 San Antonio, TX 78228	Phone: 731-5605 Fax: 731-5621 MSUT@chevrontexaco.com	

Attachment 4

Fred Gerhart

From: Fred Gerhart [fgerhart@swri.org]
Sent: Tuesday, July 10, 2007 8:36 PM
To: Andrew Ritchie; Bill Buscher; Charlie Leverett; Clayton Knight; Dave Glaenzer; Dwight Bowden; George Szappanos; Mark Sutherland; Rich Grundza; Sid Clark; Timothy Caudill; Timothy Miranda
Cc: Ben Weber; Frank Farber; Gordon Farnsworth; Irwin Goldblatt; Jim Carter; Jo Martinez; Johnny De La Zerda; Jon Carlson; Lew Williams; Martin Chadwick; Patrick M Lang; Phil Scinto; Robert Olree; William A. Buscher III; Zack Bishop
Subject: Proposal to change bearing storage oil back to EF-411

This set was 11-93 lot 12 changed to PAO8 at TEI on June 2005 per Surveillance Panel request. Please remember that TEI was told by the Surveillance panel to simply remove the bearings from the container of EF-411, allow the bearings to drain, and then place the bearings into a new container filled with PAO8. No cleaning of the bearings was permitted.



When I opened this container the PAO8 had a slight green tint and I saw the brown/tan color displacement at the bottom of the container like we have been occasionally observing on the 0306 bearings.

D5185 metals was Cu of 28 ppm and PB 190 ppm for the fluid immediately around the edge of the bearings at the bottom of the container.

Attachment 4

I then swished and stirred the oil and took a homogenous sample from the same container. D5185 metals were Cu 26 ppm and Pb 161 ppm for the homogenous sample.

These bearings had been stored at our facility since the repacking date.

On June 28 of 2007, I started an experiment with a set of 0306 bearings that had been stored at our facility since completion of the prove out matrix. The bearings were removed from the container, identifying marks applied to the back of the bearing tangs, and wiped and cleaned as per the current procedure.

One bearing half was then placed into a 250 ml Pyrex beaker and enough new EF-411 added to cover the bearing completely. The beaker was then placed into a vacuum desiccator at 25 in hg vacuum. On July 7, 2007 this bearing was removed from EF-411 and the bearing half cleaned and weighed again. There was no change in mass.

The other bearing half was also placed into a 250 ml Pyrex beaker but without the benefit of any storage oil. The beaker was then placed into the same vacuum desiccator at 25 in hg vacuum. On July 7, 2007 this bearing was removed from the Pyrex beaker and cleaned and weighed again. The mass increased by 0.7 mg.

Based on this data and the fact that EF-411 has been shown in the past to protect the bearings for about 3 years before things start changing, SwRI is in favor of changing the bearing storage fluid back to EF-411 but only if the bearings are cleaned first with Pentane and then placed into new containers with EF-411 and the bearings are cleaned, inspected, and the EF-411 replaced with new EF-411 on an annual basis.

Thanks for your considerations and time.

Fred Gerhart
Senior Research Technologist
Fuels and Lubricants Research Division
Southwest Research Institute
Office: (210) 522-3842
Mobile: (210) 317-8303
Fax : (210) 684-7523

Attachment 5

Test Monitoring Center
6555 Penn Avenue
Pittsburgh, PA 15206-4489
(412) 365-1000

Memorandum: 07-056

Date: October 9, 2007

To: Fred Gerhart, Chairman, Sequence VIII Surveillance Panel

From: Richard E. Grundza

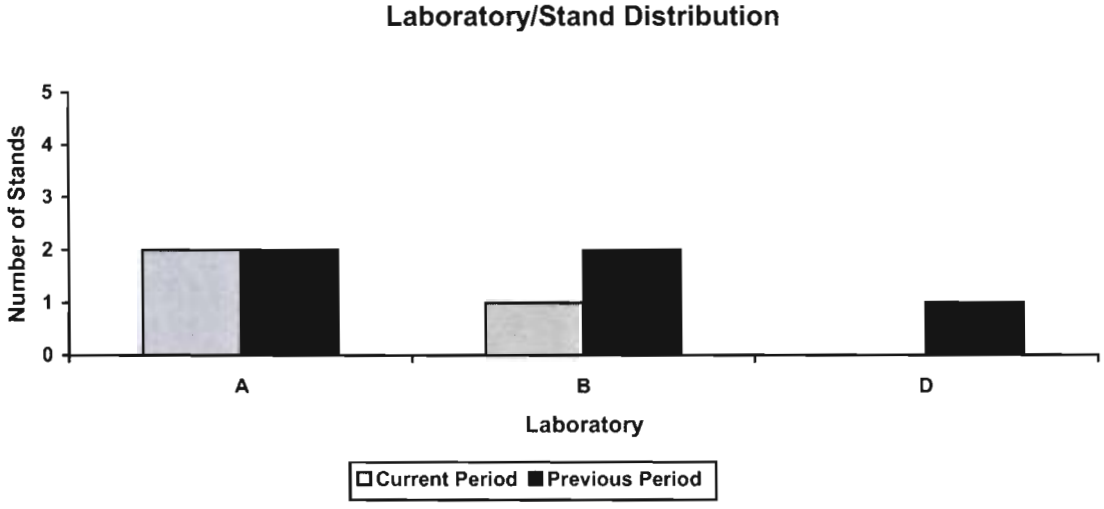
Subject: Sequence VIII Semiannual Report: April 1, 2007 to September 30, 2007

The following is a summary of Sequence VIII reference oil tests that were reported to the Test Monitoring Center during the period from April 1, 2007 to September 30, 2007.

Lab/Stand Distribution

	Reporting Data	Calibrated as of September 30, 2007
Number of Laboratories:	2	2
Number of Stand/Engine Combinations:	3	2

The following chart shows the laboratory/stand distribution:

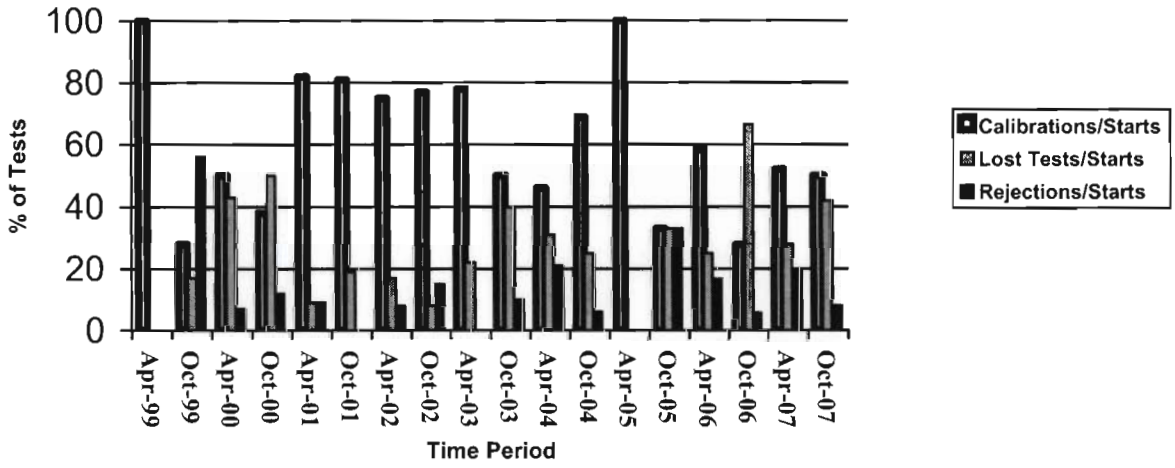


The following summarizes the status of the reference oil tests reported to the TMC:

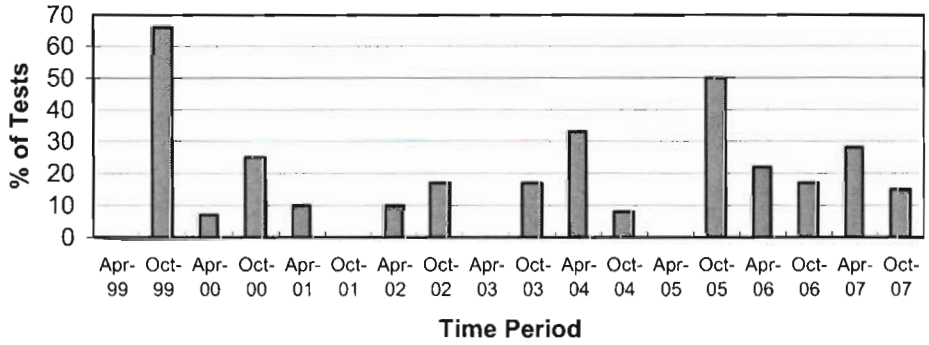
Calibration Start Outcomes	TMC Validity Code	No. of Tests
Operationally and Statistically Acceptable	AC	6
Operationally Invalid (laboratory judgment)	LC	3
Aborted	XC	2
Statistically unacceptable Calibration Test	OC	1
Total		12

Calibrations per start, lost tests per start and rejection rates are summarized below:

Calibration Attempt Summary



Rejected Operationally Valid Tests



One test failed acceptance criteria during the period, for severe BWL.

There were no LTMS Deviations this period. There have been three deviations from the LTMS to date.

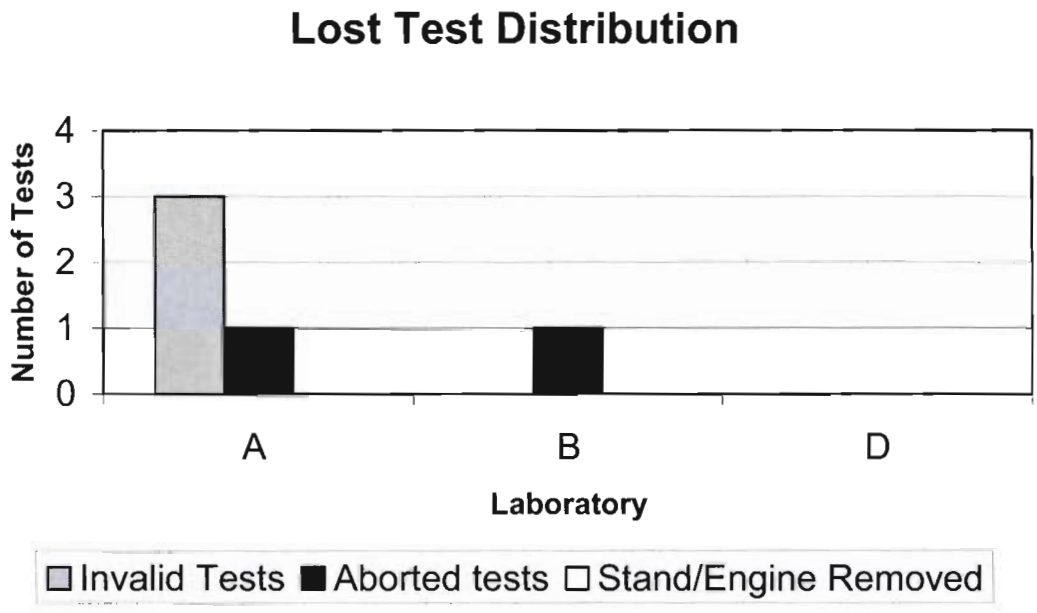
Two lab visits were conducted by the TMC this period.

Lost Test Summary

Five tests were lost this period. The reasons for the lost tests are tabulated below:

Reasons for Lost Test(s)	Number
High mechanical wear	3
Heater malfunction	1
High oil consumption	1

Aborts and operationally invalid tests, reported by laboratory, are summarized in the following chart:



Information Letters

No information letters were issued this period.

Severity and Precision Analysis

Below is a summary of the average Δ/s, pooled standard deviation, and average Δ in reported units for the tests reported during this period. Also below is a summary of the average Δ/s values for all laboratories reporting data during this period.

Industry Severity Summary			
Parameter	**Average Δ/s**	**Pooled standard deviation (degrees of freedom)**	**Average Δ, in reported units**
BWL	1.079	3.039 (df=6)	3.28 mg
SVIS	-0.143	0.086 (df=6)	-0.01 cSt

Average Δ/s by Laboratory		
Lab	BWL	SVIS
A	0.324	-0.952
B	1.644	0.464
D	-	-

Bearing Weight Loss (BWL)

The industry control charts for severity have been in warning or action alarm for the entire period. Precision control charts were in control for the period. (see Figure 1).

The Industry BWL mean Δ/s is 1.079 severe for this report period (see Figure 3). This equates to a shift of 3.28 mg in reported units. The pooled standard deviation for the period is 3.039 mg (see Figure 4), which is essentially unchanged with respect to the previous period and compares well with historical estimates.

Figures 7 and 8 graphically illustrate the lead content, in ppm, versus test severity in delta/s. The highest concentration of lead reported this period with the 03-06 batch of bearings was 202 ppm.

Stripped Viscosity (SVIS)

The industry control chart for severity began the period in warning alarm, but after the second test, the charts were within control limits for the remainder of the period. With the exception of a warning alarm at the end of the period, precision was in control for the period (see Figure 2).

The Industry SVIS mean Δ/s is -0.143 severe for this report period (see Figures 2 & 5), and equates to a shift of -0.01 cSt in reported units. The pooled standard deviation for the period is 0.086 cSt (see Figure 6), which is comparable to historical performance.

Hardware

All tests reported during this period were run on the 03-06 Batch bearings.

TMC Memorandum

No TMC Memoranda were generated this report period.

Reference Oils

Oil	TMC Inventory, In gallons	TMC Inventory, In tests	Laboratory Inventory, in tests	Estimated Life
704-1	326	163	4	5+ years
1006	43	21	1	3 months[1]
1006-2	4,492	2,246	5	3+ years[1]
1009	669	334	5	3+ years[1]

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

REG/reg

Attachments

c: F. M. Farber, TMC
Sequence VIII Surveillance Panel
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequenceviii/semiannualreports/VIII-10-2007.pdf

Distribution: Electronic Mail

List of Figures

- Figure 1 graphically presents the Industry control charts for BWL and also the CUSUM delta/s plot (by count in completion date order) of bearing weight loss for operationally valid tests.
- Figure 2 graphically presents the Industry control charts for SVIS and also the CUSUM delta/s plot (by count in completion date order) of bearing weight loss for operationally valid tests.
- Figure 3 graphically presents a historic perspective for BWL mean delta/s by report period.
- Figure 4 graphically presents a historic perspective for BWL pooled standard deviations by report period.
- Figure 5 graphically presents a historic perspective for SVIS mean delta/s by report period.
- Figure 6 graphically presents a historic perspective for SVIS pooled standard deviations by report period.
- Figure 7 graphically presents a comparison of Total Bearing Weight Loss (Delta/s) vs. the amount of lead content, in ppm, in the bearing storage oil.
- Figure 8 graphically presents the amount of lead content, in ppm, in the bearing storage oil by completion date order (Sequence VIII and L-38 data combined).
- Figure 9 is the Sequence VIII Timeline, created to track changes in test hardware and operations.

Figure 1

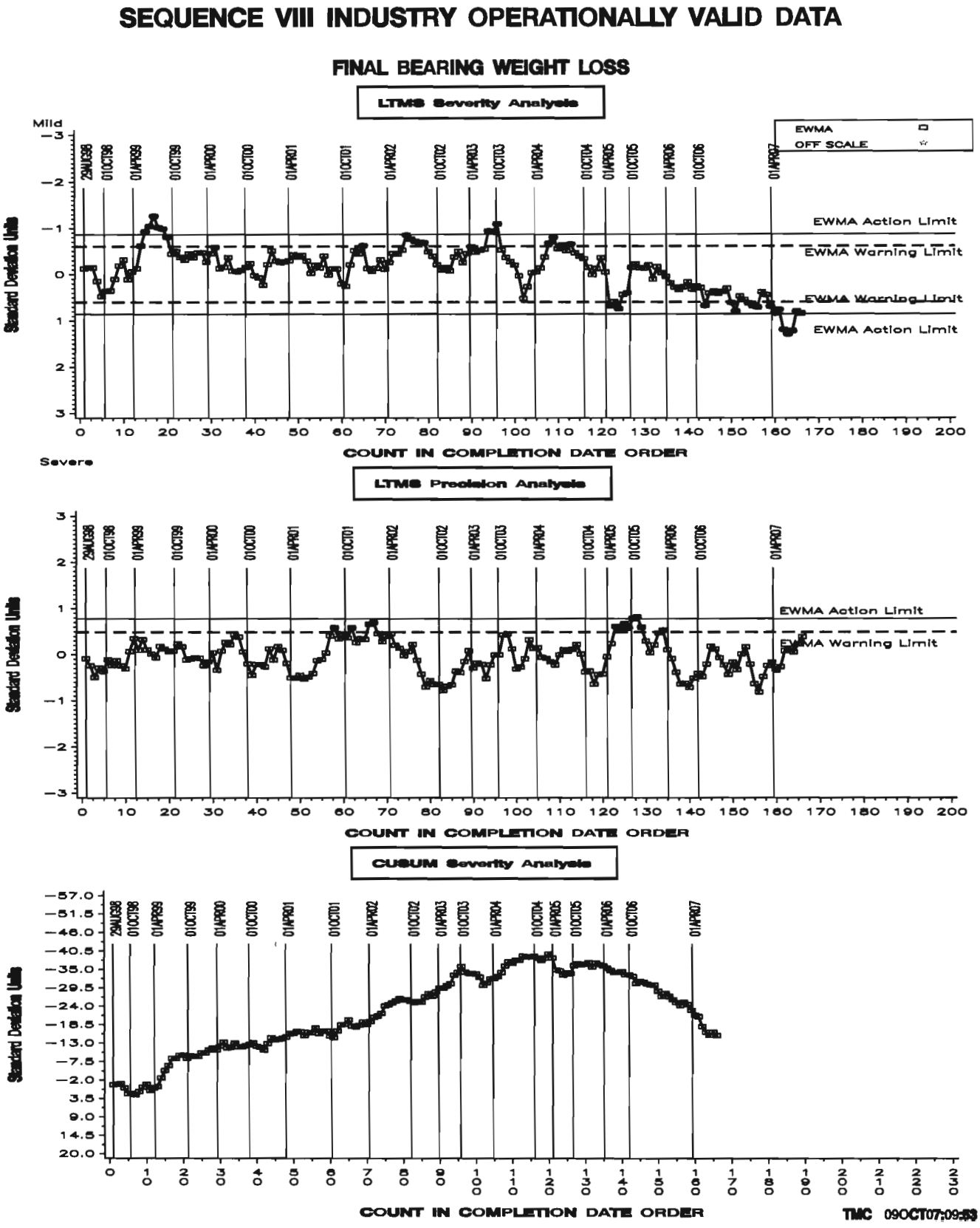

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA
FINAL BEARING WEIGHT LOSS
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
COUNT IN COMPLETION DATE ORDER
TMC 09OCT07:09:53

Figure 2

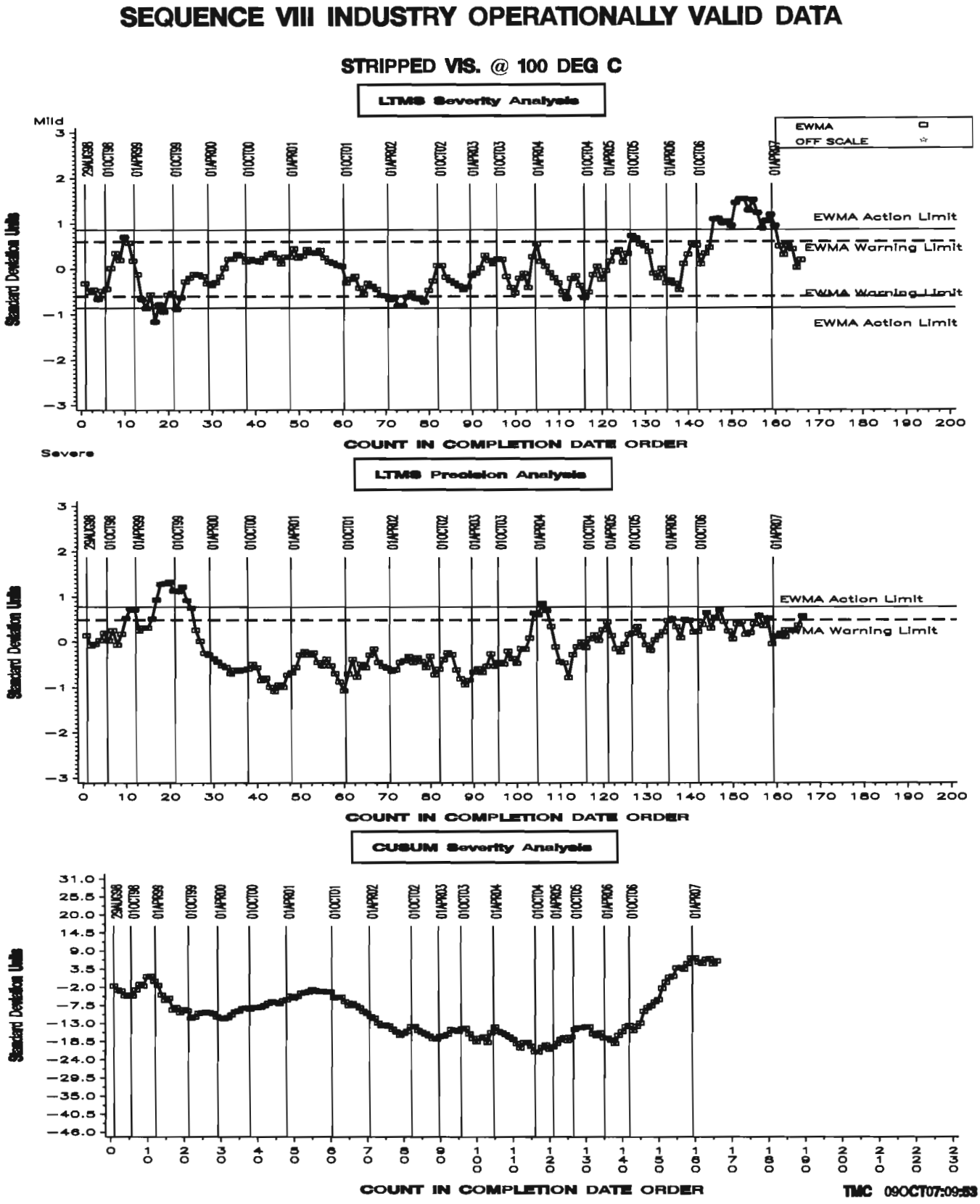

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA
STRIPPED VIS. @ 100 DEG C
LTMS Severity Analysis
Mild
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
Severe
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
TMC 09OCT07:09:53

Figure 3 - Sequence VIII Reference Oil Data
Bearing Weight Loss

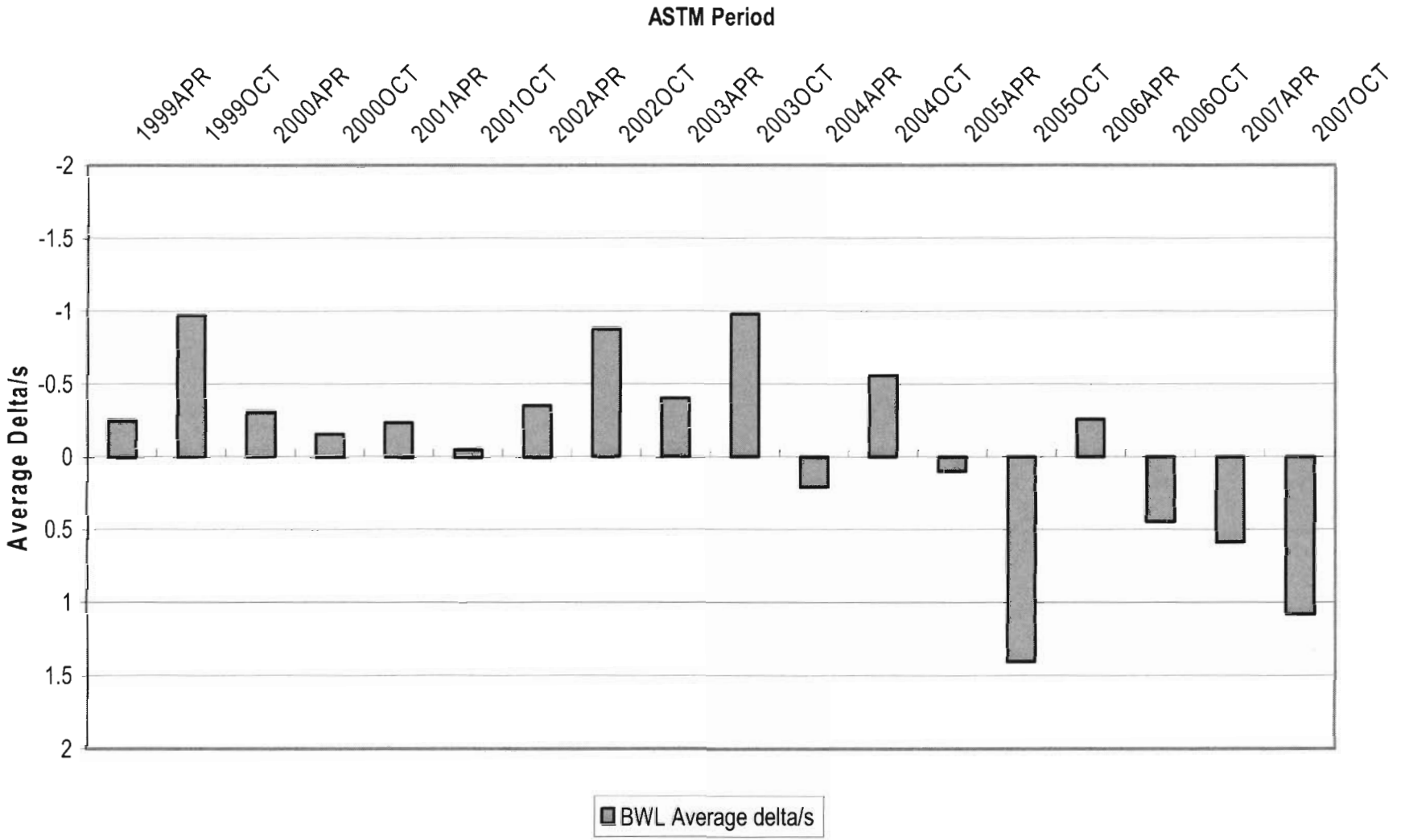


Figure 4 - Sequence VIII Reference Oil Data
Bearing Weight Loss

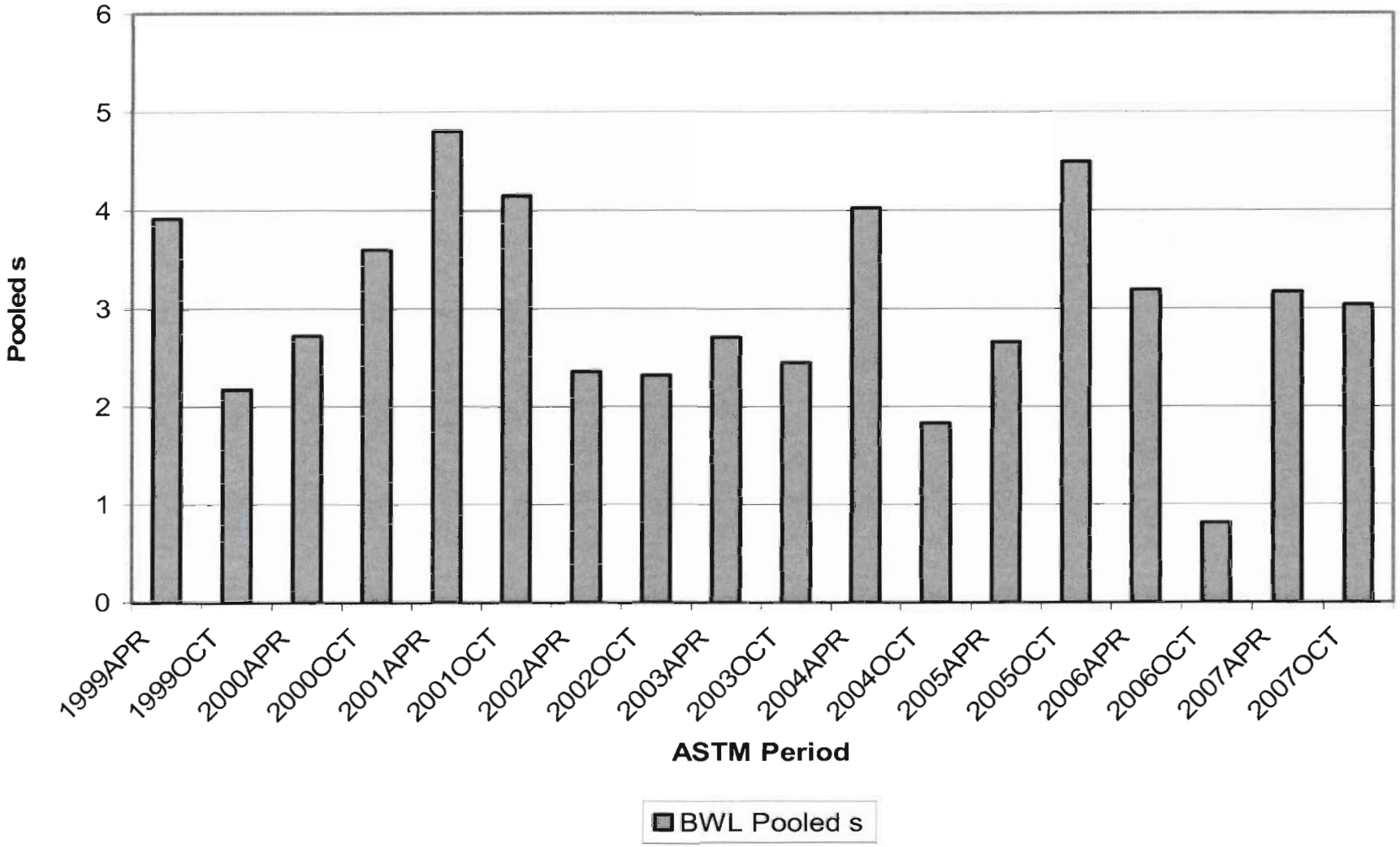


Figure 5 - Sequence VIII Reference Oil Data
Stripped Viscosity

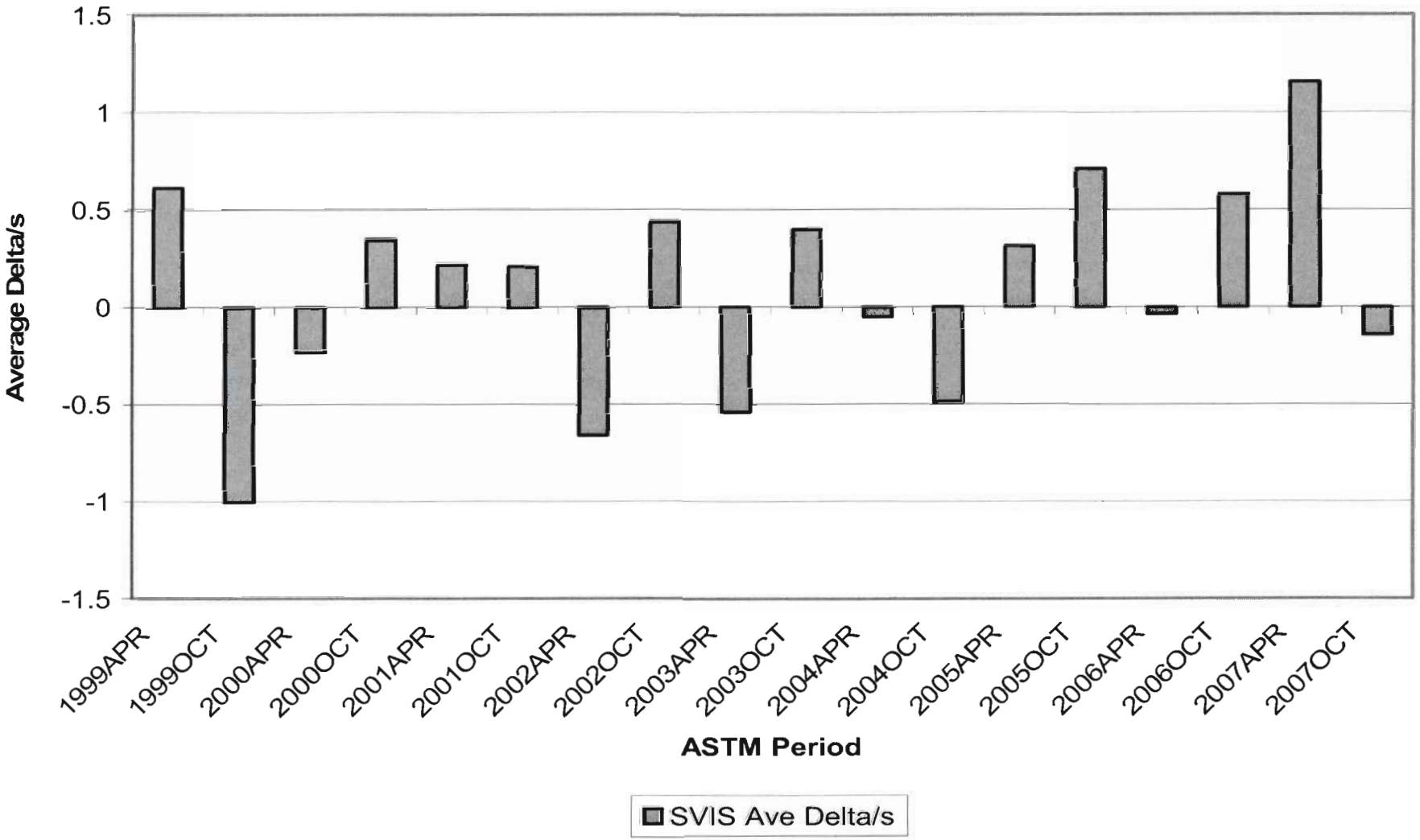


Figure 6 - Sequence VIII Reference Oil Data
Stripped Viscosity

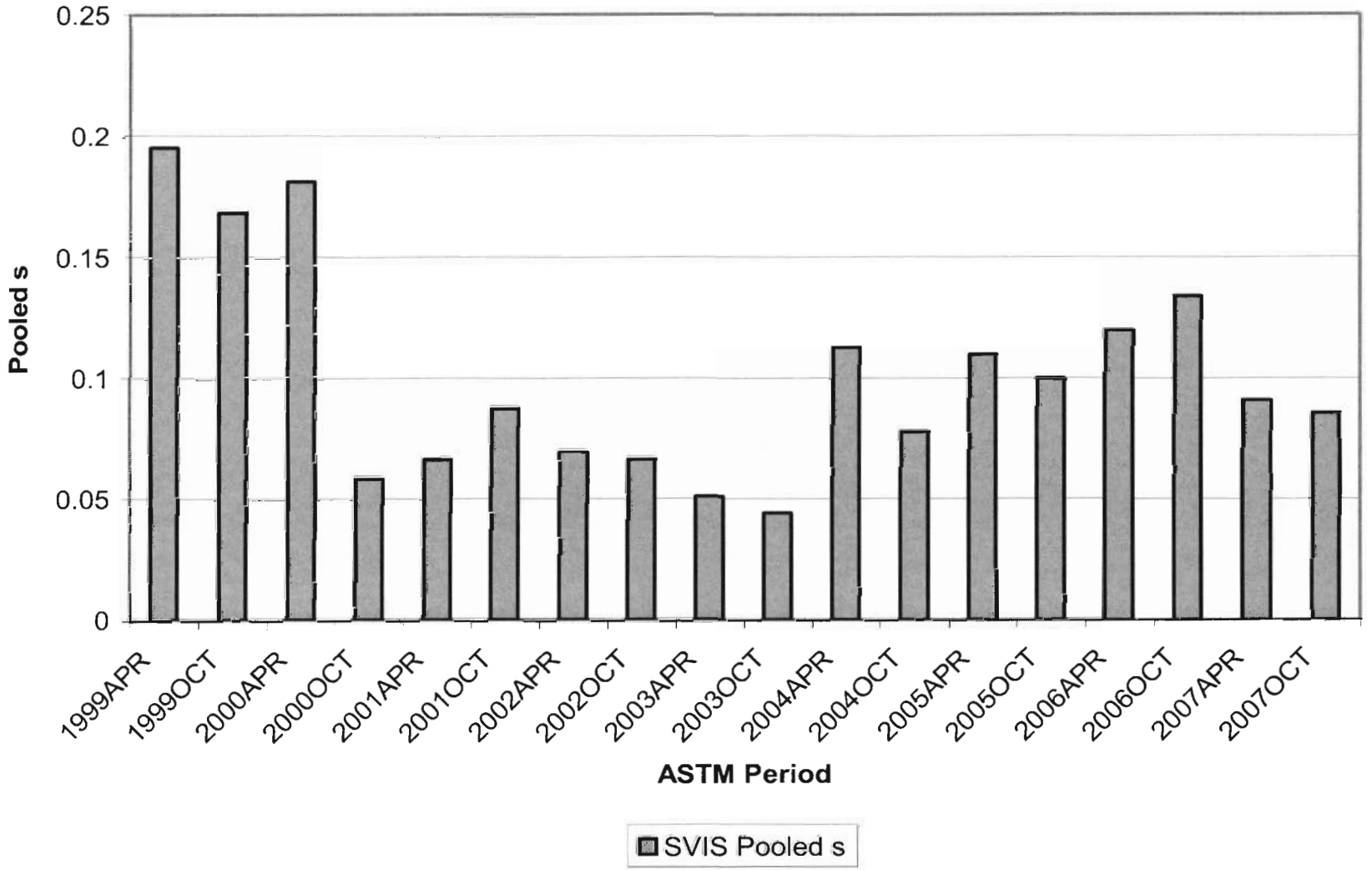


Figure 7

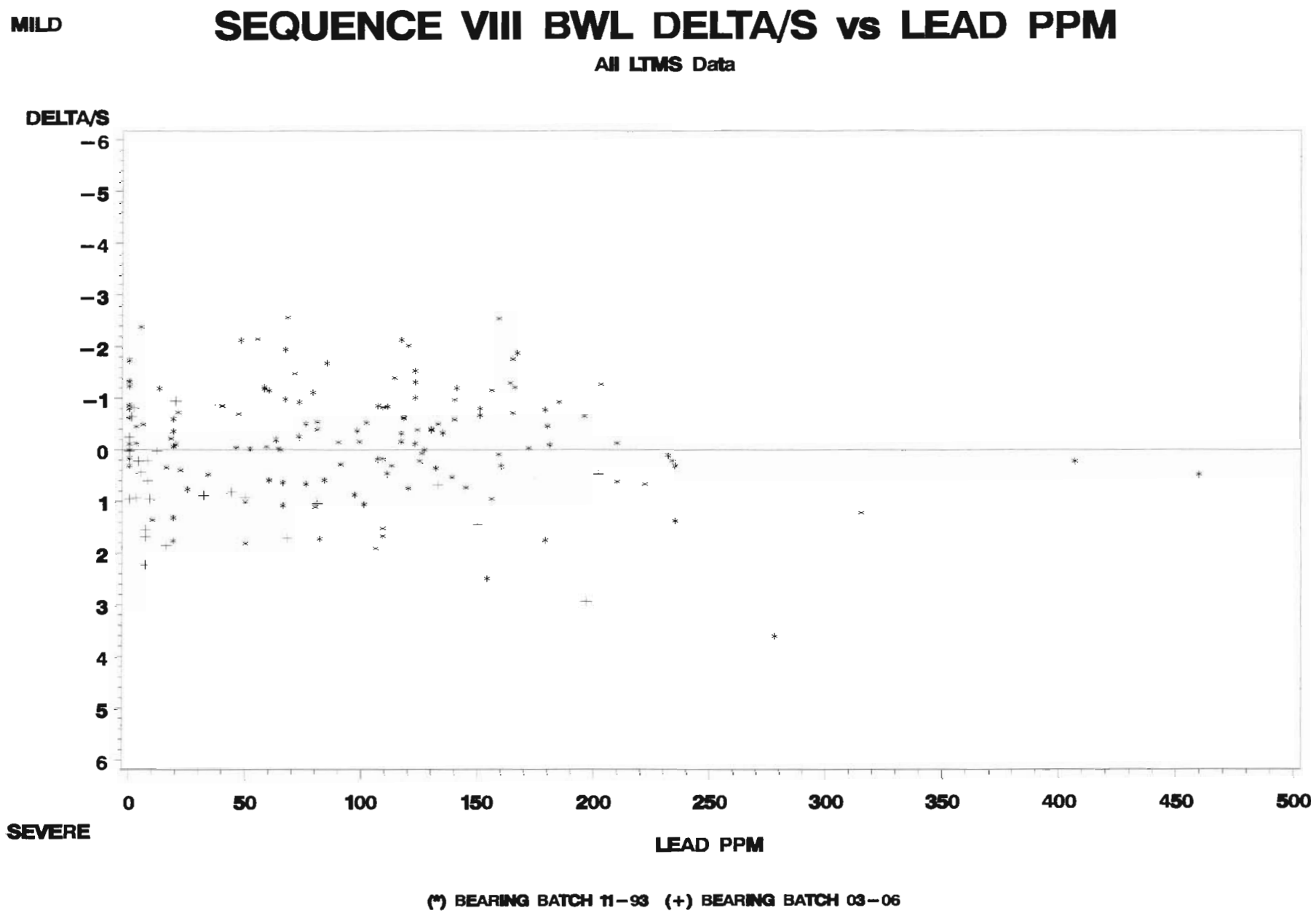

MILD
SEQUENCE VIII BWL DELTA/S vs LEAD PPM
All LTMS Data
DELTA/S
−6
−5
−4
−3
−2
−1
0
1
2
3
4
5
6
0
50
100
150
200
250
300
350
400
450
500
SEVERE
LEAD PPM
(*) BEARING BATCH 11−93 (+) BEARING BATCH 03−06

Figure 8

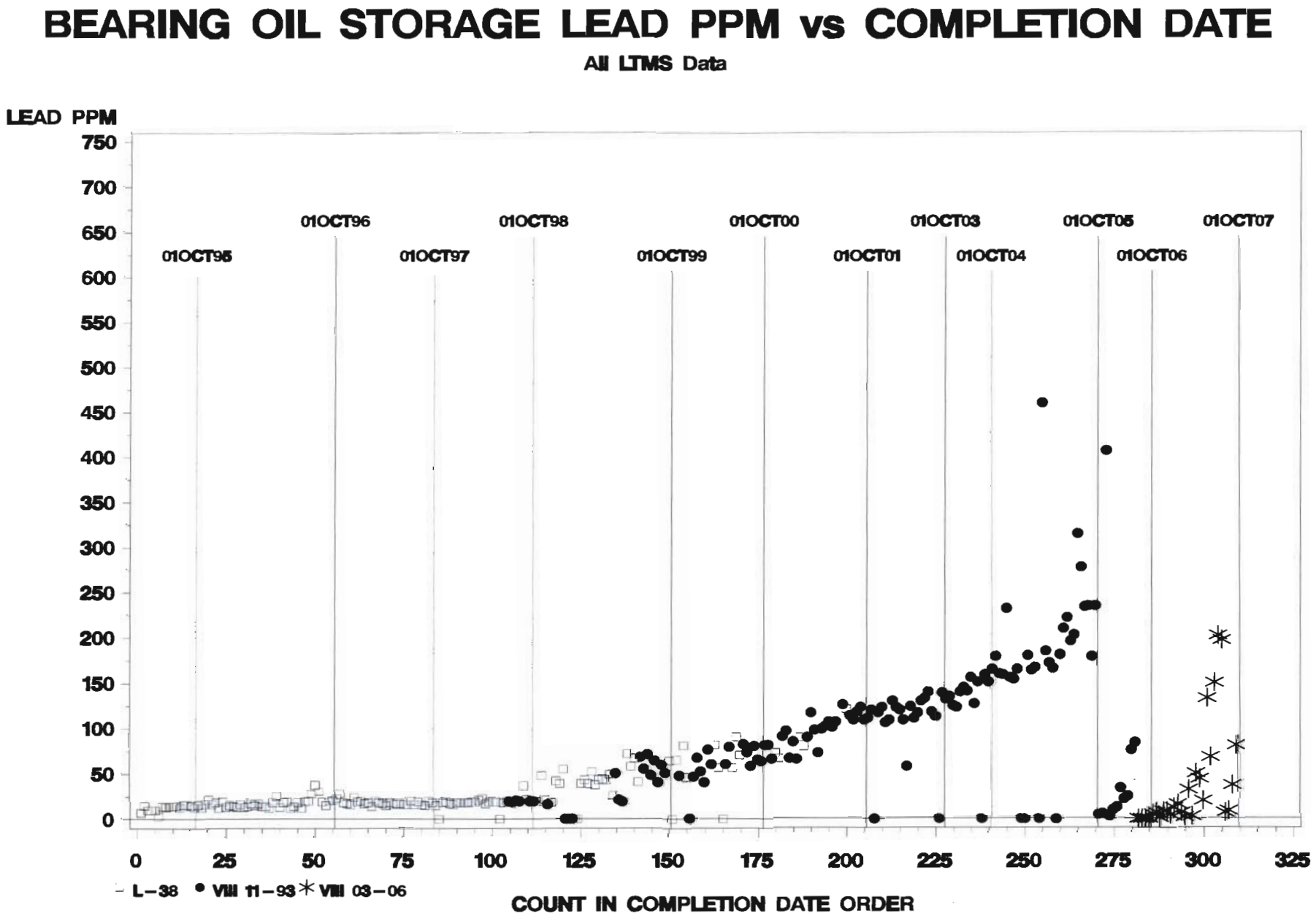

BEARING OIL STORAGE LEAD PPM vs COMPLETION DATE
All LTMS Data
LEAD PPM
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
01OCT95
01OCT96
01OCT97
01OCT98
01OCT99
01OCT00
01OCT01
01OCT03
01OCT04
01OCT05
01OCT06
01OCT07
0
25
50
75
100
125
150
175
200
225
250
275
300
325
L-38
VIII 11-93
VIII 03-06
COUNT IN COMPLETION DATE ORDER

Figure 9 - Sequence VIII Timeline		
Date	**Topic**	**Information Letter**
2/10/1999	NEW PISTON RING BATCH APPROVED FOR USE IN SEQUENCE VIII TESTING	00-1
4/16/1999	DRAFT 3.1 OF THE SEQUENCE VIII TEST PROCEDURE ISSUED	99-1
5/19/1999	REMOVAL OF RING BATCH REPORTING REQUIREMENTS	00-1
5/19/1999	NEW OIL FILTER (RAYCOR LFS-62) IMPLEMENTED INTO TESTING	00-1
11/16/1999	TEST ENGINEERING INC. NEW TEST PARTS SUPPLIER	00-1
1/28/2000	PISTON CLEANING PROCEDURE FOR REUSING PISTONS IN SEQUENCE VIII TESTING	00-1
6/15/2002	REVISED STAY-IN-GRADE PROCEDURE IMPLEMENTED	02-1
11/18/2002	EDITORIAL REVISIONS TO D6709-01	02-2
1/1/2004	NEWINERAL SPIRITS SPECIFICATION	03-1
1/26/04	BILLET CRANKSHAFT APPROVED FOR USE IN SEQUENCE VIII TESTING	
12/9/2004	CLARIFIED SOLVENT SPECIFICATION	04-1
12/9/2004	REVISED FUEL FLOW SPECIFICATION	04-1
12/9/2004	REQUIREMENTS FOR BUILDS WITH OVERSIZE PISTONS	04-1
6/23/05	DELETED ROCKER COVER INLET TEMPERATURE AND PRESSURE SENSORS, UPDATED PRECISION STATEMENT	05-1
9/20/06	FIRST TEST ON 03-06 BEARINGS	
10/24/06	REVISED BEARING CLEANING PROCEDURE IN ANNEX A9	06-1
3/12/07	TARGET UPDATE, REFERENCE OIL 1006-2	

CPD Report to
Sequence VIII Surveillance Panel
November 14, 2007

Attachment 6

03-06 Batch of Rod Bearings

Part number 1000341

Number of bearings produced 5,098 (2,549 sets)

TEI currently has 2,289 sets stored in Argon

(10+ year supply)

TEST ENGINEERING, INC.

CPD Report to Sequence VIII Surveillance Panel November 14, 2007

- **Analysis of rod bearing 03-06 storage oil**

Sample date		*Lead (ppm)*
11/01/06	(PAO 1)	12
08/02/07	(PAO 1)	98
11/12/07	(PAO 1)	158
08/02/07	(PAO 2)	113
11/12/07	(PAO 2)	190
08/02/07	(EF-411 Lot 15)	12
11/12/07	(EF-411 Lot 15)	18

TEST ENGINEERING, INC.

CPD Report to Sequence VIII Surveillance Panel November 14, 2007

Storage Oil Changeover Request (8-22-2007 email to TEI from S.P.)

Replace PAO with EF-411.

Project is in progress – estimate completion by mid February 2008.

Bearings will be cleaned per procedure outlined by the surveillance panel (see next slide).

TEI
TEST ENGINEERING, INC.

CPD Report to Sequence VIII Surveillance Panel November 14, 2007

Surveillance Panel Recommended Cleaning Procedure

1.) Exercise care when handling the bearings to prevent nicking or scratching the bearing surface. Always use latex gloves and protective tongs when handling bearings (note: TEI will also wear cotton gloves).
2. Soak bearing halves in a container of mineral spirits for a minimum of 5 minutes to remove all traces of PAO oil from both the front and back sides of the bearing.
3. Dip the bearing halves in pentane and allow to air dry.
4. Wipe bearings with a soft paper towel soaked in pentane (note: TEI will use a soft cotton cloth in lieu of paper).
5. Place bearing halves into new containers filled with EF-411 and store in Argon cabinet.

TEI
TEST ENGINEERING, INC.

CPD Report to
Sequence VIII Surveillance Panel
November 14, 2007

Annual Parts Order

- Annual orders for 2007 have been completed.

- TEI will issue a letter in the next few weeks soliciting lab orders for 2008 annual parts requirements.

TEST ENGINEERING, INC.

Attachment 7

GM Evaluation Report

1348-01 Mechanical
1348-02 Chemical

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
Engine 3.8 V6 SC	N/A	N/A	N/A	N/A	N/A	na	24729

Reference Issue Report (IR) No. NA

Category : MAT

Function x Development Validation

Method: Math Based x Hardware Based

Date: 04/20/2007

Title: Report for STR # 24729

☒ Final

☐ Interim No. _____

☐ Reissue Date of Reissue: _____

To: (Requestor) Sidney L. Clark

From: Patrick M. Hanley

Date of Request: 04/11/2007

Dates of Evaluation: 04/11/2007 - 04/19/2007

- The results published within this report relate only to the items tested.
- This report shall not be reproduced except in full, without the written approval of the laboratory manager or his/her designate.
- Tests identified with an asterisk are not included in the laboratory's current A2LA scope of accreditation.

Objective: Characterize Cu/Pb/Sn bearings used for oil evaluation sequence testing. Verify bearing composition, look for contaminants, other potential impurities on surface, check metal content in PAO storage fluid by ICP to determine if any evidence of Pb, identify floaties/flakes (possibly jar top insulation/gasket).

Conclusions: A lead/tin phase was detected in the copper matrix of a sintered powdered metal copper-lead-tin alloy from the bearing surface into the bearing cross section by Energy Dispersive Spectroscopy (EDS). Evidence of lead leaching from the bearing surface was not observed. Polyalphaolefins from bearing storage jars are free of elemental impurities, there is no evidence of lead, tin, or copper leaching from the bearings. Bearing surface composition is about 78%Cu, 20%Pb, 2%Sn. White flake-like films/floaties found in PAO storage media were identified as polyethylene/vinyl acetate copolymer, mostly polyethylene.

Based on the results of our analyses the bearings are in their original condition, we found no evidence of degradation.

Design Evaluated: **GMUTS Rating:** n/a **Veh. Mileage:**

Part/Test Object Name(s)	Veh/Buck/PT/Part No./RPO	Revision Date/Level
Engine - Bearings	npn	n/a
Material	**Vehicle/Engine/Transmission Number**	
Cu/Pb/Sn 80/10/10 - FederalMogul	3800	

Distribution:

Name: Sidney L. Clark Loc: 480-106-160
Name: Loc:
Name: Loc:
Name: Loc:
Name: Loc:

cc.

Author: Patrick M. Hanley Date: 04/20/2007
(Title/Phone) Lead Analyst / (248) 753-6512 8-238
(Location) GMNA Materials Lab - Pontiac

Peer Review: Suzette Kandow Date: 04/20/2007
Test Engineer/248-753-6915
GMNA Materials Lab - Pontiac

Approver: Patrick M. Hanley Date: 04/20/2007
Lead Engineer, Chemistry/248-753-6512
GMNA Materials Lab - Pontiac

GM Evaluation Report

1348-01 Mechanical
1348-02 Chemical

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
Engine 3.8 V6 SC	N/A	N/A	N/A	N/A	N/A	na	24729

Reference Issue Report (IR) No. NA

Category : MAT

Function Method: x Development / Math Based / Validation / x Hardware Based

Recommendations: Not provided.
Requirements: Not provided

Background:

Sample Condition as received: New bearings in PAO fluid, plastic separator?, orange/rust colored bearing side in plastic jar
Sample History: Experimental Test bearings, made in Mexico, suspect Pb leach on storage, bunch of bearings are made for testing, on storage characteristics appear to change
Unusual Circumstances: New storage PAO versus mineral, white floaties/flakes
Previous Performance: None noted.

Assumptions/Limitations:
-Sample homogeneity (i.e. sample sufficiently homogeneous and representative of material/part).
-For Semi-quantitative X-ray Fluorescence, the concentrations reported were obtained with a standardless semi-quantitative x-ray fluorescence analysis program, Uniquant. They are estimated normalized concentrations (to 100%) based on elements detected. The results do not include low atomic number elements (H, He, Li, Be, B, C, N, or O), which are not detected with this method, and may or may not comprise a substantial portion of the material analyzed (e.g. as oxides, hydrates, C based etc.).
-Results are semi-quantitative/qualitative, estimated uncertainty is +/- 1/3 to 3 times the amount reported for representative specimen analyzed.
See results text for additional assumptions/limitations.

Equipment:
Requestor Defined Chemistry Testing (List In Detailed Test Instructions)* was accomplished utilizing Personal Computer.
Sample Preparation (Chemistry)* was accomplished utilizing Mettler PR2003 Balance (ME000357).
Semi-Quantitative X-ray Fluorescence (UniQuant)* was accomplished utilizing ARL 9400 X-Ray Fluorescence Spectrometer (XRF) (ME000289).
(ASTM D5185-05) Additives/Wear metals by ICP was accomplished utilizing Thermo Electron - IRIS Intrepid II XDL ICP-AES (ME000856).
FTIR Analysis of Oil* was accomplished utilizing PE Spectrum BX-II FTIR Spectrometer (ME000251).
Sample Preparation (Oil Chemistry)* was accomplished utilizing Marvel Series 8 Bandsaw 824282-W (ME000390).
(WI-6001) EDS Analysis (Energy Dispersive Spectroscopy) was accomplished utilizing Jeol 5900 Scanning Electron Microscope with a Noran Vantage 1.5 Digital Analyzer (ME000054).

Procedure/Method:
Requestor Defined Chemistry Testing (List In Detailed Test Instructions)* was done by Patrick M. Hanley.
Sample Preparation (Chemistry)* was done by Patrick M. Hanley.
Semi Quantitative X-ray Fluorescence (UniQuant)* was done by Patrick M. Hanley.
(ASTM D5185-05) Additives/Wear metals by ICP was done by Patrick M. Hanley.
FTIR Analysis of Oil* was done by Patrick M. Hanley.
Sample Preparation (Oil Chemistry)* was done by Patrick M. Hanley.
(WI-6001) EDS Analysis (Energy Dispersive Spectroscopy) was done by Suzette Kandow.

Detailed Test Instructions: Verify bearing composition, look for contaminants, other stuff on surface, check metal content in PAO storage fluid by ICP, identify floaties/flakes (possibly jar top insulation/gasket).

GM Evaluation Report

1348-01 Mechanical
1348-02 Chemical

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
Engine 3.8 V6 SC	N/A	N/A	N/A	N/A	N/A	na	24729

Reference Issue Report (IR) No. NA

Category : MAT

Function Method: x Development / Validation; Math Based / x Hardware Based

NOTE: The specific procedure followed for each test is that described in the relevant GMNA Materials Laboratory test instruction. When standard test methods have been modified, it is labeled as "mod" or "modified" in the test list and the specific nature of such modifications is stated in the test instructions.

Results:

(WI-6001) EDS Analysis (Energy Dispersive Spectroscopy)

STR 24729
Date: 04/19/2007

Conclusions based on EDS Analysis:
A lead/tin phase was detected in the copper matrix of a sintered powdered metal copper-lead-tin alloy from the bearing surface into the bearing cross section by Energy Dispersive Spectroscopy (EDS). Evidence of lead leaching from the bearing surface was not observed.

Assumptions / Limitations:

- Homogeneity of the sample relative to sample size and area designated for analysis.
- SEM/EDS verification of resolution is performed quarterly.
- CAUTION: Due to the type of analysis technique employed, these values are relative in nature and limited to their degree of accuracy and statistical validity. Energy Dispersive Spectroscopy (EDS) semi-quantitative (standardless) results may not approximate those found by other conventional quantitative analysis techniques used in bulk material analysis.
- EDS semi-quantitative analysis of the sample was performed using both a polished metallographic mount (bearing cross section) and the as submitted sample (bearing surface).
- Any micron markers in photos denote feature size relationships. Magnification values listed for the photos are for reference only and any use related to feature size relationships is not recommended due to photo size adjustments made for publication purposes.
- Any cutting or other machining that occurred as part of sample preparation prior to evaluation was done in such a manner as to have no effect on the microstructure present.

Results:

Scanning Electron Microscopy with Backscatter Imaging (BEI) and Energy Dispersive Spectroscopy (EDS X-ray) Qualitative and Semi -Quantitative Analysis

A polished metallographic mount containing a cross section of a copper alloy running surface clad to a steel backing and a piece from the same bearing was submitted to the SEM area to determine if lead is leaching from the bearing surface.

The metallographic mount was re-polished with 1 micron diamond followed by a 0.1 micron alumina, rinsed in water then dried with methanol. It was then ultrasonically cleaned in hexane, dried and attached to an aluminum holder via a copper grounding strap and inserted in to the SEM. Scanning electron microscopy using backscatter electron imaging techniques to display atomic number contrast of the copper, lead and tin elements was conducted at 25kv acceleration voltage and various magnifications. Energy dispersive spectroscopy (EDS) x-ray and semi-

GM Evaluation Report

1348-01 Mechanical
1348-02 Chemical

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
Engine 3.8 V6 SC	N/A	N/A	N/A	N/A	N/A	na	24729

Reference Issue Report (IR) No. NA

Category : MAT

Function Method: x Development / Validation; Math Based / x Hardware Based

quantitative analysis was performed at this same acceleration voltage. The cross section of the bearing displays evidence of a lead/tin phase in the copper matrix of a sintered powdered metal copper-lead-tin alloy from the running surface into the cross section. Figure A depicts the BEI image at the left and the corresponding x-ray composite map to the right. In the BEI photo copper is displayed as the dark gray constituent in the running surface and the white areas are the lead/tin rich sites. The dark solid gray area to the right is the steel backing. Figure A1 is a representative EDS scan of one of the fields of view used for semi-quantitative analysis that is summarized in Table A.

A piece from the same bearing was ultrasonically cleaned in hexane, dried and attached to an aluminum holder and inserted in to the SEM. The same imaging and EDS techniques used on the mount were used on the as submitted bearing surface. The bearing surface displays evidence of a lead/tin phase in the copper matrix of a sintered powdered metal copper-lead-tin alloy. Figure B depicts the BEI image at the left and the corresponding x-ray composite map to the right. In the BEI photo copper is displayed as the dark gray constituent and the white areas are the lead/tin rich sites. Figure B1 is a representative EDS scan of one of the fields of view used for semi-quantitative analysis that is summarized in Table B.

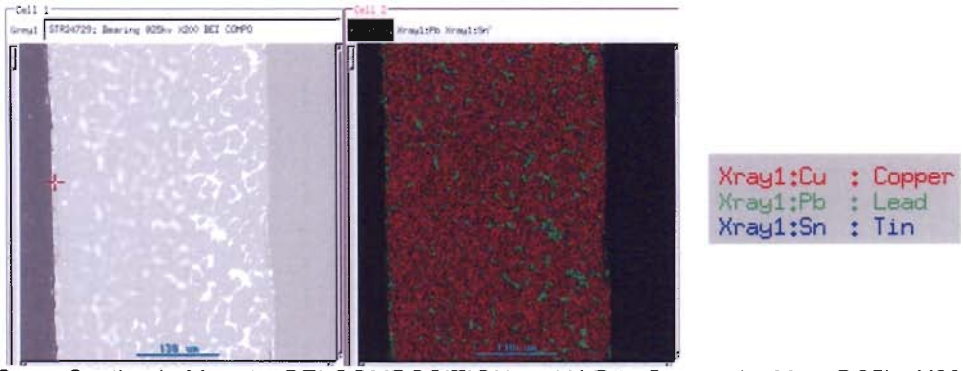


Figure A: Bearing Cross Section in Mount – BEI COMPOSITION and X-Ray Composite Map @25kv X200
(The bearing surface is at the left edge (red cross cursor).)

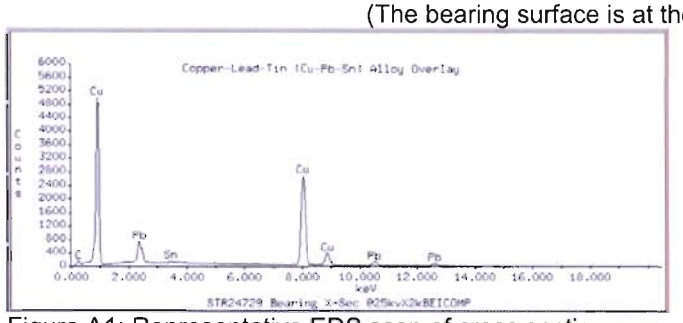


Figure A1: Representative EDS scan of cross section.

Table A: Cross Section Semi-Quantitative Analysis by EDS method

Semi-Quantitative	Element		
POINT	Pb	Sn	Cu
<unitless>	Wt.%	Wt.%	Wt.%
Average	18.1	1.4	80.5
Min	13.3	1.1	77.4
Max	21	1.6	85.2

Average of 5 fields of view

GM Evaluation Report

1348-01 Mechanical
1348-02 Chemical

Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
Engine 3.8 V6 SC	N/A	N/A	N/A	N/A	N/A	na	24729

Reference Issue Report (IR) No. NA

Category : MAT

Function Method: x Development / Validation; Math Based / x Hardware Based

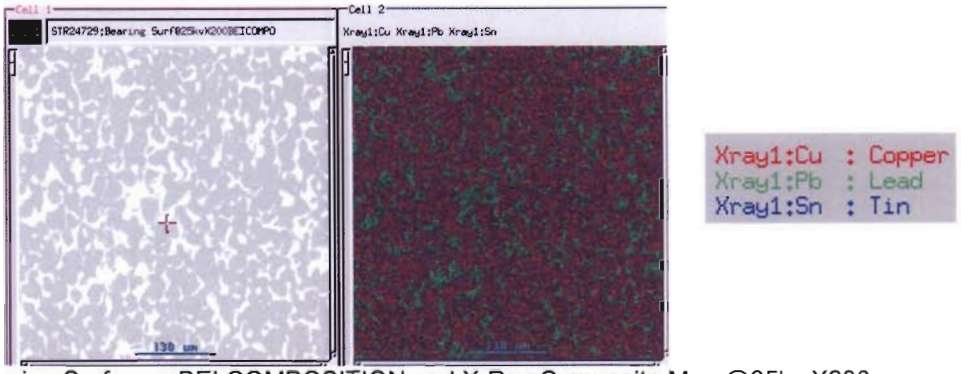


Figure B: As Submitted Bearing Surface – BEI COMPOSITION and X-Ray Composite Map @25kv X200
(The red cross cursor denotes a lead/tin rich area near a copper area.)

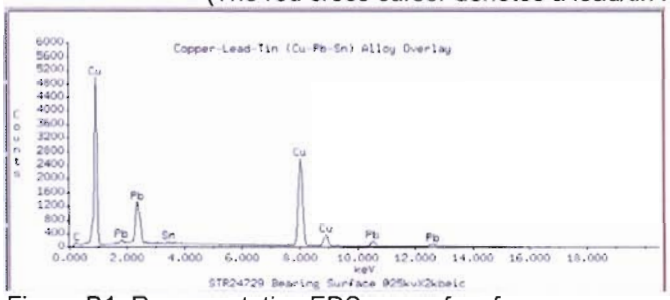


Figure B1: Representative EDS scan of surface.

Table B: Surface Semi-Quantitative Analysis by EDS method

Semi-Quantitative	Element		
POINT	Pb	Sn	Cu
<unitless>	Wt.%	Wt.%	Wt.%
Average	37.5	1.1	61.4
Min	21.9	1	51.7
Max	47.2	1.5	76.6

Average of 5 fields of viewy

(ASTM D5185-05) Additives/Wear metals by ICP

PAO's from bearing storage jars are free of elemental impurities. There is no evidence of lead, tin, or copper leaching.

	ICP (ASTM D5185)								
	all units are ug/g (ppm)								
SAMPLE	**P**	**Ca**	**Zn**	**Ba**	**Mg**	**Na**	**K**	**S**	**B**
24729-1	<20	<10	<1	<5	<10	<10	<10	178	<2
24729-2	<20	<10	<1	<5	<10	<10	<10	209	<2

SAMPLE	Fe	Al	Si	Cu	Pb	Mn	Ni	Cr	Mo	Sn
24729-1	<5	<3	<5	<5	<3	<5	<2	<2	<5	<5
24729-2	<5	<3	<5	<5	<3	<5	<2	<2	<5	<5

Assumptions/Limitations:

- Fluid (oil/atf) is homogeneous,
- Elements reported are soluble,
- Particle size effects are assumed to be zero. Accuracy decreases as particle size increases. <1micron = no effect, 1-5microns = minimal effect, >5microns = large effect.

GM Evaluation Report

1348-01 Mechanical
1348-02 Chemical

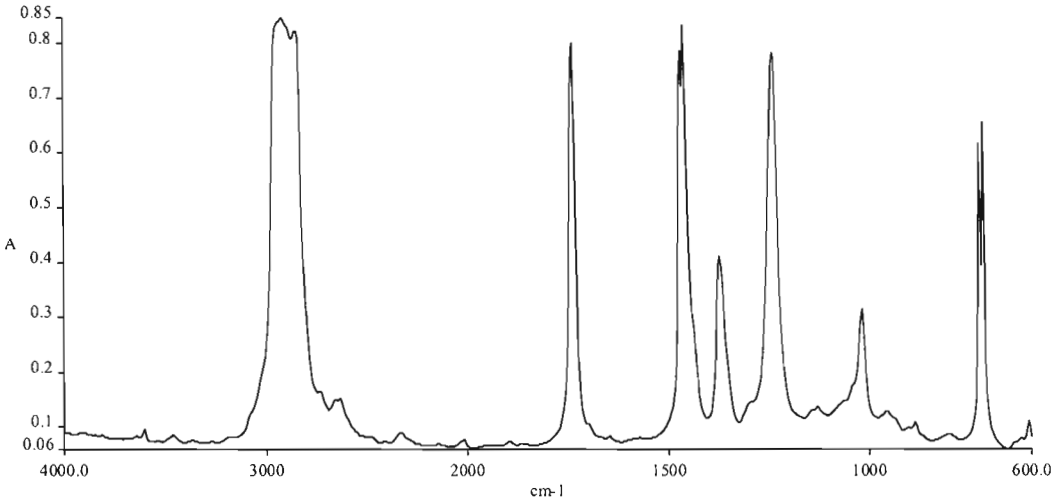
Platform	Project/EWO No.	Requirement No.	Procedure No.	VPP/VIA/UPC	Model Year	Model No.	PER/Report No.
Engine 3.8 V6 SC	N/A	N/A	N/A	N/A	N/A	na	24729

Reference Issue Report (IR) No. NA

Category : MAT

Function Method: x Development / Validation; Math Based / x Hardware Based

FTIR Analysis of Oil*
Infrared Analysis – Identification of white flake-like floaters in PAO bearing storage oil.



STR24729
Infrared spectrum of white flake-like films/floaties found in PAO storage media. Spectrum indicates white flake-like floaties are polyethylene/vinyl acetate copolymer, mostly polyethylene. Spectrum taken as thin film on ZnTe cystal.

Semi Quantitative X-ray Fluorescence (UniQuant)*
Bearing surface composition was found to be 78%Cu, 20%Pb, 2%Sn (+/-1/3 to 3 times amount reported), based on examination of and average over a 15mm diameter area of the bearing

References/File Storage:
Original reports are stored in the Engineering Document Management database.
All raw data files are stored in the laboratory or the Global Product Development Information Center (GPDIC) and can be made available upon request.
Measurement uncertainty values are available upon request.

Calibration Information:
All relevant calibration reports can be made available upon request.

Attachment 8

HALTERMANN November, 2007
FUEL REPORT -

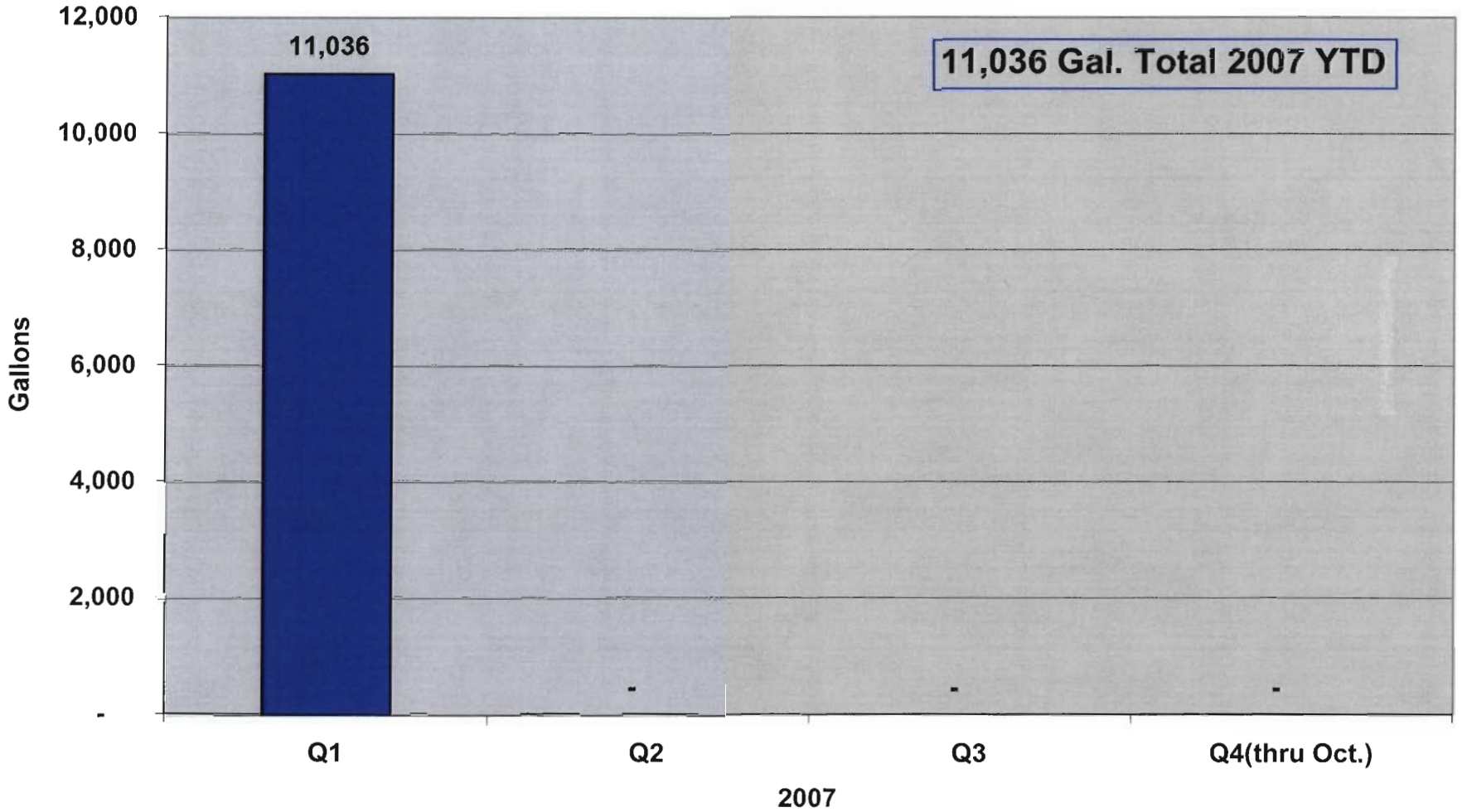
PRODUCT: KA24E TEST FUEL
PRODUCT CODE: HF008
Seq. IV & VIII

Batch No.:	VJ1121GP01	VC0921LS03
TMO No.:	MTS	MTS
Tank No.:	TK58	676
Analysis Date:	10/29/2007	3/15/2007

TEST	METHOD	UNITS	SPECIFICATIONS			RESULTS	RESULTS
			MIN	TARGET	MAX		
Distillation - IBP	ASTM D86	°F	75		95	91.6	85
5%		°F				114.1	112
10%		°F	120		135	126.3	125
20%		°F				147.9	147
30%		°F				174.2	173
40%		°F				203.9	203
50%		°F	200		230	221.4	222
60%		°F				230.7	231
70%		°F				239.4	241
80%		°F				254.8	260
90%		°F	300		325	313.9	321
95%		°F				340.5	345
Distillation - EP		°F	385		415	398.3	400
Recovery		vol %		Report		98.0	97.6
Residue		vol %		Report		0.9	1.0
Loss		vol %		Report		1.1	1.4
Gravity	ASTM D4052	°API	58.7		61.2	59.7	59.9
Density	ASTM D4052	kg/l	0.734		0.744	0.7398	0.7393
Reid Vapor Pressure	ASTM D323	psi	8.8		9.2	9.1	9.1
Carbon	ASTM E191	wt fraction	0.8580		0.8667	0.8622	0.8651
Carbon	ASTM D3343	wt fraction		Report		0.8646	0.8643
Sulfur	ASTM D4294	wt %	0.01		0.04	0.0233	0.016
Lead	ASTM D3237	g/gal			0.05	<0.01	<0.01
Phosphorous	ASTM D3231	g/gal			0.005		
Oxygen	ASTM D4815	wt %			0.05	<0.05	<0.05
Composition, aromatics	ASTM D1319	vol %			35.0	28.1	28.0
Composition, olefins	ASTM D1319	vol %	5.0		10.0	5.8	7.0
Composition, saturates	ASTM D1319	vol %		Report		66.1	64.2
Oxidation Stability	ASTM D525	minutes	1440			>1440	>1440
Copper Corrosion	ASTM D130				1	1	1
Gum content, washed	ASTM D381	mg/100ml			5	<0.5	<1
Research Octane Number	ASTM D2699		96.0		97.5	97.0	97.1
Motor Octane Number	ASTM D2700			Report		88.2	87.0
R+M/2	D2699/2700			Report		92.6	92.1
Sensitivity	D2699/2700		7.5			8.8	10.1
Net Heat of Combustion	ASTM D240	btu/lb		Report		18342	18458
Color	Visual			Green		Green	Green

Attachment B

KA24E, HF-0008
Seq. IV & VIII



SEQUENCE VIII SURVEILLANCE PANEL SCOPE AND OBJECTIVES

SCOPE

The Sequence VIII Surveillance Panel is responsible for the surveillance of the Sequence VIII test procedure (ASTM D 6709-01). This panel works in conjunction with Test Engineering Inc. (TEI) who supplies the test hardware. Improvements in the test operation, test monitoring, and test validation will be accomplished through continual communications with the test hardware supplier, the ASTM Test Monitoring Center, the Technical Guidance Committee, and the ACC Monitoring Agency.

The panel will maintain an up-to-date evaluation of the precision of the VIII reference oils and will report this precision and test severity levels to D02.BO.01 Oil Classification Panel and section.

These combined efforts will help to assure that the Sequence VIII test method will continue to provide the industry with a precise method for evaluating a lubricant's ability to protect against copper-lead bearing weight loss and to evaluate the viscosity stability of multi-viscosity-grade oils.

OBJECTIVES

Continue monitoring of lead leaching rate in storage oil	Ongoing
Request reference oils with performance close to 26 mg TBWL	Ongoing
Continue to look at improved bearing storage methods	Ongoing
Monitor the progress of the comprehensive review of the different LTMS systems utilized by the PCMO test types and their pros and cons	*May 2008*