




Test Monitoring Center

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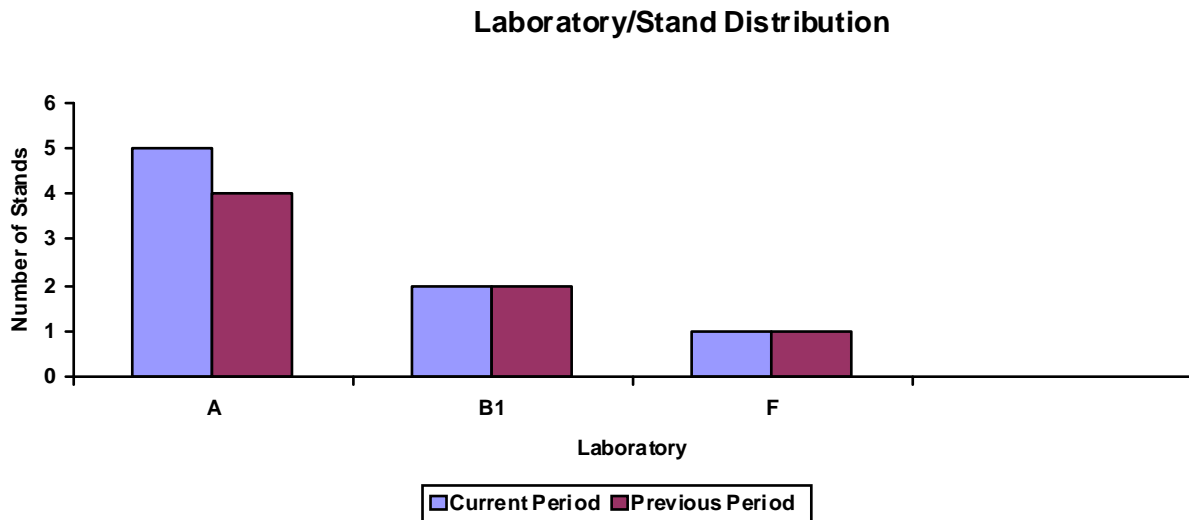
Memorandum: 10-003
Date: April 6, 2010
To: Bill Buscher, Chairman, Sequence IVA Surveillance Panel
From: Richard E. Grundza 
Subject: Sequence IVA Semiannual Report: October 1, 2009 through March 31, 2010

The following is a summary of Sequence IVA reference tests that were reported to the Test Monitoring Center during the period October 1, 2009 through March 31, 2010.

Lab/Stand Distribution

	Reporting Data	Calibrated as of March 31, 2010
Number of Laboratories:	3	3
Number of Test Stands:	8	8

The following chart shows the laboratory/stand distribution:

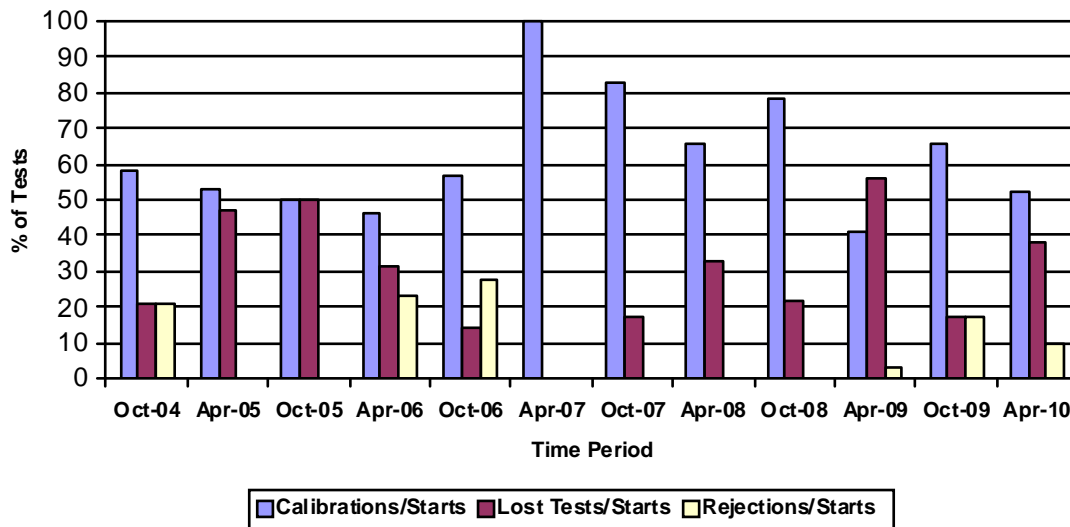


The following summarizes the status of the reference oil tests reported to the TMC:

Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	11
Operationally Valid, Statistically Unacceptable	OC	2
Operationally Invalid, Laboratory Judgment	LC	6
Aborted	XC	2
Total		21

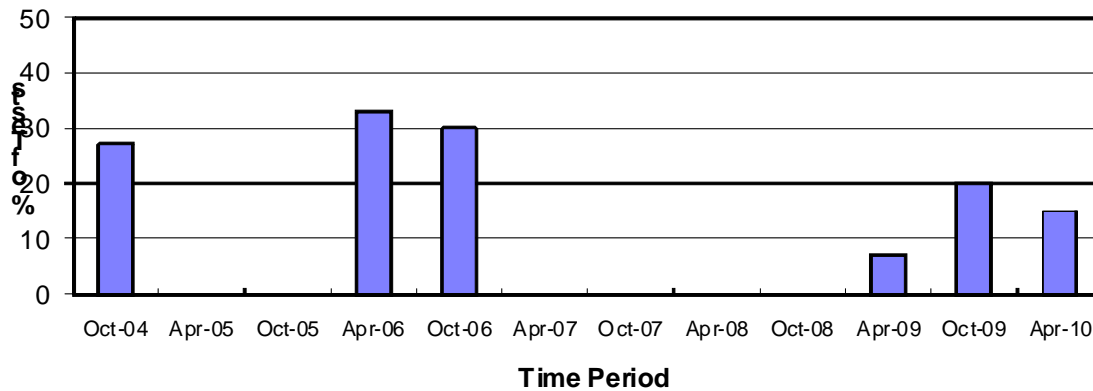
Calibrations per start, lost tests per start and rejection per start rates are summarized below:

Calibration Attempt Summary



The calibration per start rate has decreased since last period. The lost test per start rate has increased since last period. The rejected test per start rate has decreased this period.

Rejected Test Rate for Operationally Valid Tests



Two tests failed acceptance criteria. Both tests failed for stand precision EWMA alarms.

There were two LTMS Deviations written this period. Both deviations addressed stand EWMA precision alarms. Since its introduction in 1999, there have been three Sequence IVA LTMS deviation.

There was one QI Deviation written this period. The QI deviation was issued for load, exhaust backpressure, intake air pressure and temperature control generating a QI values below 0.000. A total of 26 QI deviations have been written to date.

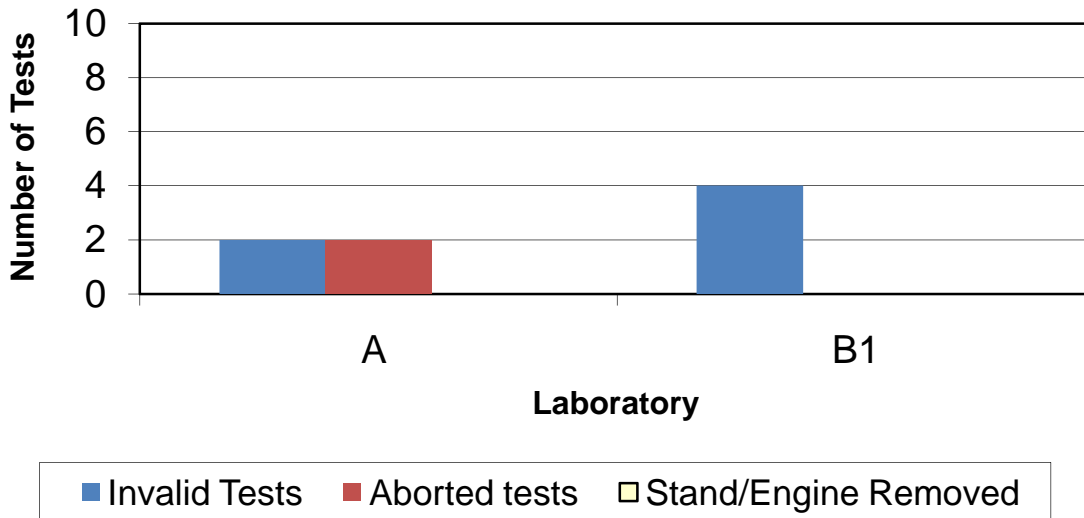
Lost Test Summary

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

Reasons for Lost Test(s)	Number
Damaged U-joints	1
Flush Not Performed Properly	1
Engine Overheated, Damaged Cylinder Head	1
Oil Leak at Oil Pan, Oil Pan Damaged	1
Temperature Ramp Control Issues	1
Fresh Air Flow Meter Calibration Error	1
Intake Air Pressure Control Problems	1
Speed Control, QI < 0.000	1

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

Lost Test Distribution



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 report period. Also below is a summary of the average Δ/s value, by laboratory.

Industry Severity Summary			
Parameter	Average Δ/s	Pooled standard deviation (degrees of freedom)	Average Δ , in micrometers
ACW	-0.104	11.22 (df = 12)	-1.17 μm

ACW Results, by Laboratory	
Laboratory	Average Δ/s
A	-0.216
B1	-0.356
F	-0.477

The industry control chart for severity began the period in severity EWMA action alarm, but quickly came back into control, where it has been for the remainder of the report period. Precision was in control for the period. (see Figure 1).

The severity alarms appear to have been caused by three severe results from one lab during the previous period, all with reference oil 1006-2. At the November 2009 Sequence IVA Surveillance Panel meeting, the panel elected to drop reference oil 1006-2 and allow the use of reference oil 1009, which had been suspended during an earlier mild trend. Following the reference oil change, severity was on or near target for the period (see Figure 2) with an average Δ/s result of -0.104 which equates to -1.17 μm in reported units.

The pooled standard deviation for the period is 11.22 μm , which has degraded when compared to the last period, but compares well with overall historical performance (see Figure 3).

Hardware

No hardware changes were made this period.

Lab Visits

Two lab visits were conducted this period. No discrepancies were identified during these visits.

Information Letters

Information Letter 10-1 was issued this period. This information letter was issued January 4, 2010 and revised figure 3 and Figure A 3.18 in Annex A3 to show a 3.2 mm valve between the intake manifold and the PCV valve and also allowed the use of an alternate blowby measurement device.

Reference Oils

Oil	TMC Inventory, in gallons	TMC Inventory, in tests (4gal/test)	Laboratory Inventory, in tests	Estimated life
1006	41	10	7	1 month or less ¹
1006-2	3,995	998	7	3+ years ^{1,3}
1007 ²	216	54	7	3+ years ¹
1009	533	133	3	3+ years ¹

¹ Multiple test area reference oil; total TMC inventory shown.

² Cannot be reblended.

³ Suspended for use by the Surveillance Panel

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REG/reg

Attachments

c: F. M. Farber, TMC

J. A. Clark, TMC

Sequence IVA Surveillance Panel

<ftp://astmtmc.cmu.edu/docs/gas/sequenceiv/semiannualreports/IVA-04-2010.pdf>

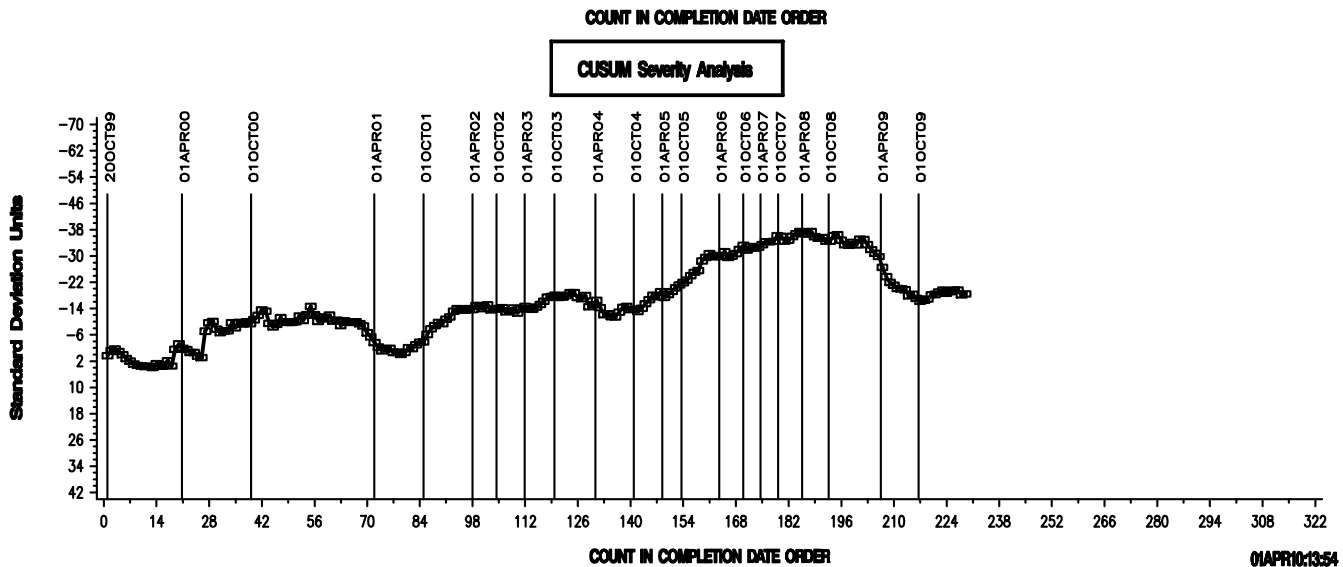
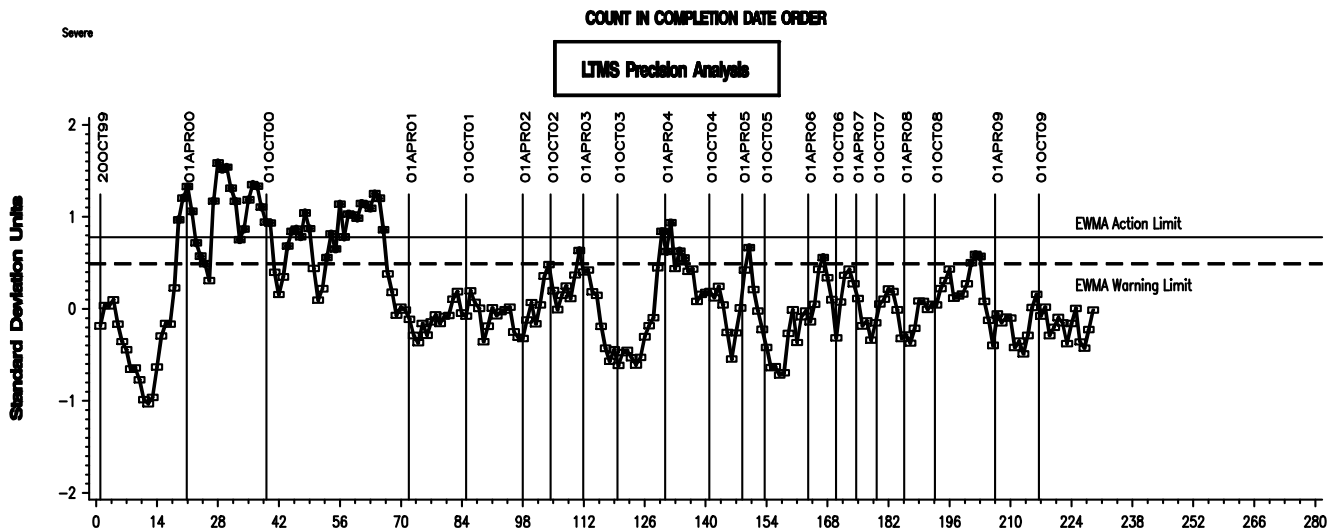
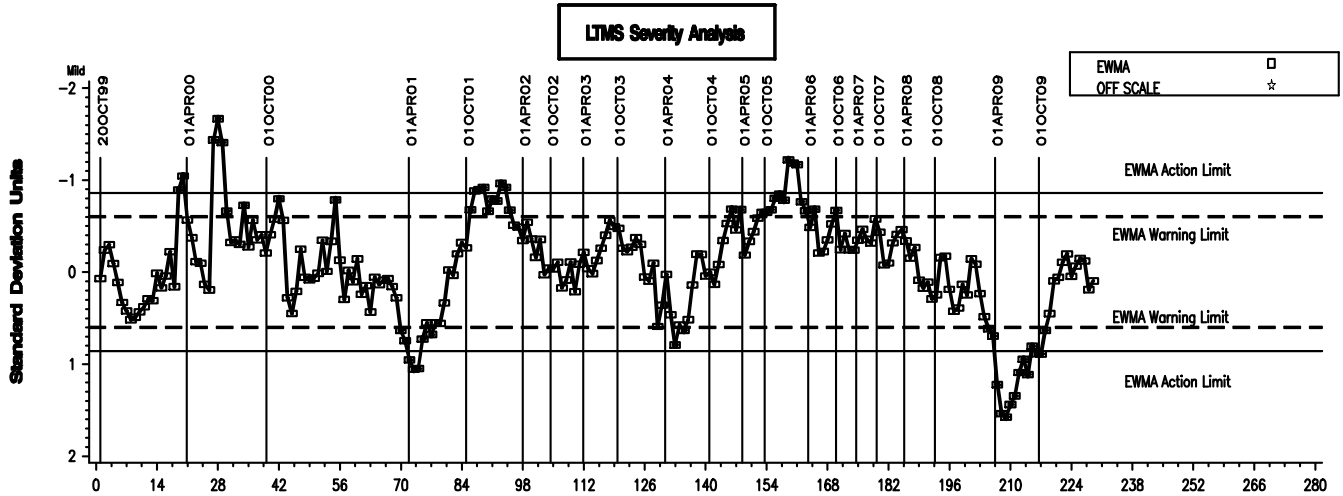
Distribution: Electronic Mail

List of Figures

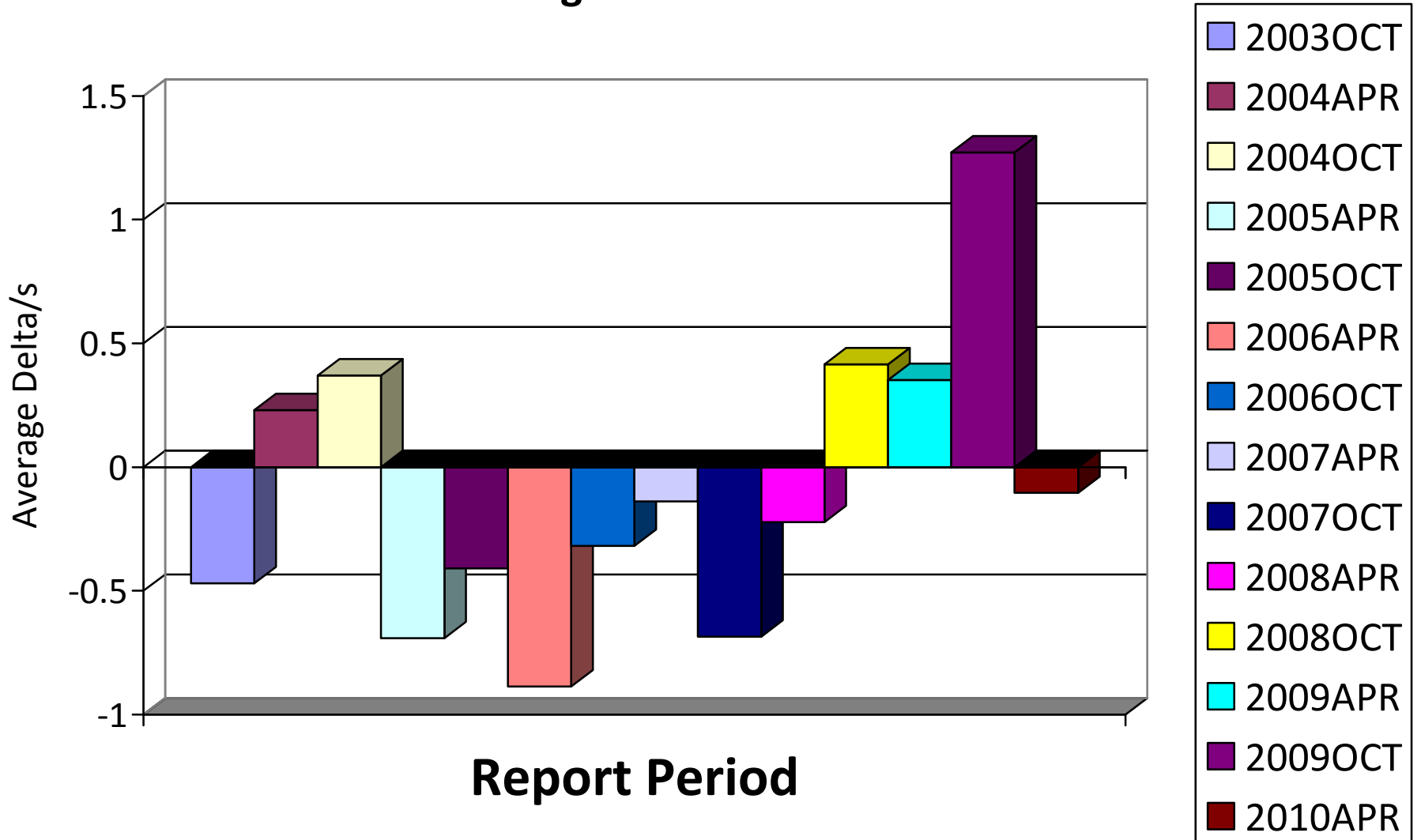
- Figure 1 graphically presents the Industry control charts for ACW and also the CUSUM delta/s plot (by count in completion date order) of average camshaft wear for operationally valid tests.
- Figure 2 graphically presents a historic perspective for ACW mean delta/s by report period.
- Figure 3 graphically presents a historic perspective for ACW pooled standard deviations by report period.
- Figure 4 is the Sequence IVA Timeline, created to track changes in test hardware and operations.

Figure 1
SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

AVERAGE CAM WEAR



**Figure 2-Sequence IVA Reference Oil Data
Average Camshaft Wear**



**Figure 3-Sequence IVA Reference Oil Data
Average Camshaft Wear**

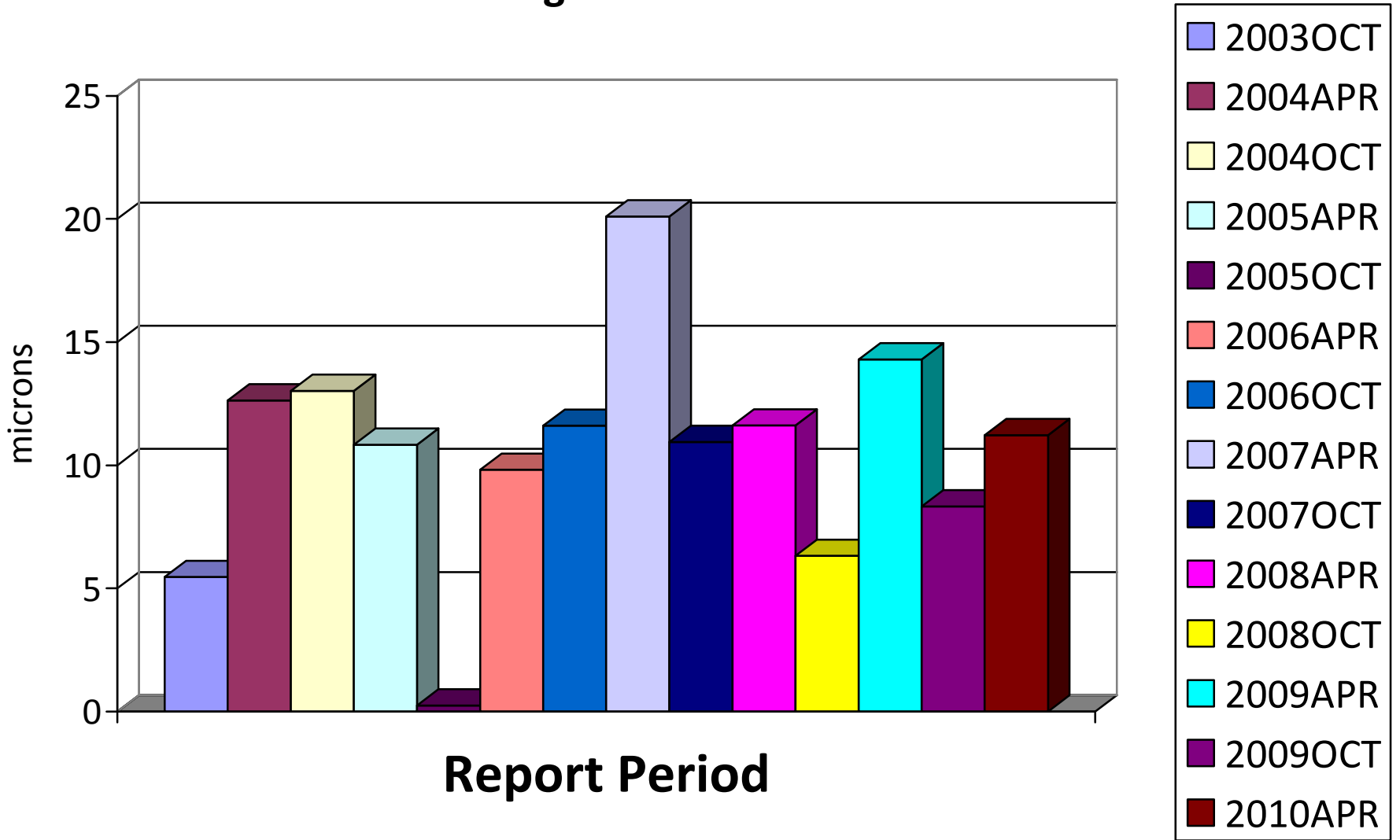


Figure 4 - Sequence IVA Timeline		
Date	Topic	Information Letter
2/10/1999	SEQUENCE IVA TEST LTMS ESTABLISHED BY SURVEILLANCE PANEL	
11/17/1999	CALIBRATION STATUS RESUMED	
2/16/2000	DRAFT 4 OF TEST PROCEDURE ISSUED. INCORPORATED JACKETED ROCKER COVER, CONTROLLED FLOW OF FRESH AIR TO ROCKER COVER, AND OIL CYLINDER HEAD AS OIL TEMPERATURE CONTROL POINT.	00-1
8/1/2000	REVISED DATA DICTIONARY AND REPORT FORM SET (VERSION 20000126) GOES INTO EFFECT.	00-2
6/12/2000	REVISED DOUBLE-FLUSH COOLANT CONTROL REQUIREMENTS EFFECTIVE	00-3
6/12/2000	REVISED ENGINE STARTING PROCEDURE EFFECTIVE	00-3
6/12/2000	ELIMINATE THE REQUIREMENT FOR LINEAR RAMPING OF TRANSIENT PARAMETERS	00-3
6/12/2000	REVISED OIL SAMPLING PROCEDURE	00-3
6/12/2000	REVISED DOUBLE-FLUSH OIL DRAIN REQUIREMENT	00-3
6/12/2000	REVISED COMPRESSION TEST REQUIREMENTS	00-3
6/12/2000	NEW CAMSHAFT CLEANING REQUIREMENTS	00-3
1/24/2001	CAMSHAFT LOT RESTRICTIONS	00-4
7/22/2001	ROCKER COVER COOLANT FLOW MEASUREMENT & REPORTING	01-1
5/24/2001	REVISED CYLINDER HEAD AND TEST ENGINE REPLACEMENT REQUIREMENTS	01-2
5/25/2001	REVISED TEST NUMBERING REQUIREMENTS	01-2
2/12/2002	REVISED ENGINE BREAK-IN SPECIFICATIONS	02-1
2/12/2002	UPDATED DRAFT STANDARD OF SEQUENCE IVA TEST PROCEDURE RELEASED	02-1
4/5/2002	REVISED CAMSHAFT MEASUREMENT PROCEDURES	02-2
5/14/2002	STAND CALIBRATION REQUIREMENT REVISIONS	02-3
5/14/2002	STAND INSTRUMENTATION CALIBRATION REQUIREMENT REVISIONS	02-3
6/1/2002	REVISED OIL SAMPLE TAP LOCATION	02-3
12/16/2002	LUBRICATION OF CAMSHAFT DURING INSTALLATION	02-4
5/11/2004	CAMSHAFT BEARING BORE MEASUREMENTS ELIMINATED EXCEPT FOR INITIAL ENGINE BUILD	04-1
6/2/2004	NEW SOLVENT SPECIFICATIONS	04-1
7/19/2004	REVISED PRECISION DEFINITIONS	04-1
11/19/2004	REVISED REPLACEMENT CRITERIA FOR CYLINDER HEADS AND ENGINES	05-1
11/19/2004	CLARIFIED SOLVENT SPECIFICATION REQUIREMENTS	05-1
11/19/2004	REVISED QI U&L VALUES FOR COOLANT OUTLET TEMPERATURE	05-1
11/19/2004	REVISED CALIBRATION FREQUENCY FOR INSTRUMENTATION CHANNELS	05-1
11/19/2004	ADDED SECTIONS AND ANNEX TO DEFINE ROLE OF TMC AND EXTEND CALIBRATION PERIODS FOR DONATED TEST PROGRAMS	05-1
6/8/2005	UPDATED PRECISION ESTIMATE	05-2
12/13/2005	ADDED TOLERANCES TO MEASUREMENT DEVICE LOCATIONS	05-3
12/13/2005	INCREASED NUMBER OF RUNS ALLOWED ON BLOCK AND HEADS	05-3
12/13/2005	ADDED/REVISED SCHEDULE FOR OIL COOLER, PCV VALVE AND COOLANT SYSTEM CLEANING/REPLACEMENT	05-3
12/13/2005	ADDED LIMITS ON LOST OPERATIONAL DATA	05-3
12/13/2005	REVISED FUEL TEMPERATURE CONTROL LIMITS	05-3
12/13/2005	REVISED TORQUE CONTROL STRATEGY	05-3
02/16/2006	REVISED WEAR MEASUREMENT TECHNIQUES	06-1
02/16/2006	ADDRESSED EDITORIAL CHANGES	06-1
2007/11/16	UPDATED REFERENCE OIL TARGETS (N = 29) REFERENCE OIL 1009	
2008/11/20	CLARIFIED CALCULATIONS FOR QI WHEN MISSING OR BAD QUALITY DATA ARE ENCOUNTERED	08-1
2008/11/20	CORRECTED TYPOGRAPHICAL ERROR	08-1
2009/06/18	DROPPED VALVE SPRING FREE LENGTH AND OUT OF SQUARE MEASUREMENTS, ADDED VACUUM CHECKS TO ASSEMBLED CYLINDER HEAD	09-1
2009/06/18	ADDED MONITORING OF ROCKER COVER INLET AND OUTLET TEMPERATURES, ENGINE COOLANT PRESSURE AND FRONT COVER FRESH AIR FLOW	09-1

2009/06/18	INCREASED THE NUMBER OF ALLOWED RUNS ON CYLINDER HEADS AND BLOCKS	09-1
2009/09/22	DELETED REQUIREMENT TO MAIL HARD COPY TEST REPORT TO TMC	09-2
2010/01/04	ALLOW ALTERNATE BLOWBY DEVICE AND 3.2 mm VALVE, REVISED FIGURE 3 AND A3.18	10-1