




# Test Monitoring Center

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412-365-1000

Memorandum: 11-042  
 Date: October 21, 2011  
 To: Bill Buscher, Chairman, Sequence IVA Surveillance Panel  
 From: Richard E. Grundza   
 Subject: Sequence IVA Semiannual Report: April 1, 2011 through September 30, 2011

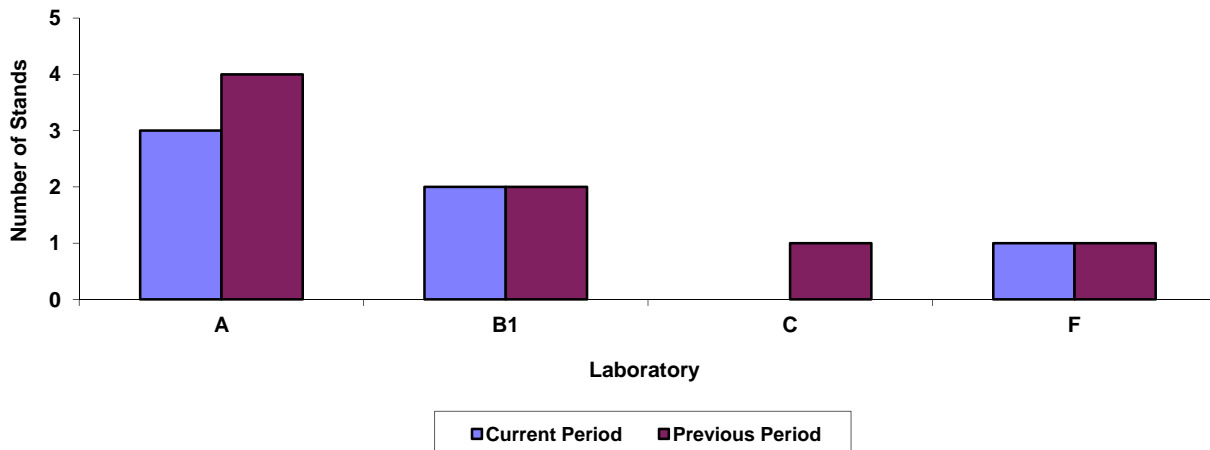
The following is a summary of Sequence IVA reference tests that were reported to the Test Monitoring Center during the period April 1, 2011 through September 30, 2011.

## Lab/Stand Distribution

	Reporting Data	Calibrated as of September 30, 2011
Number of Laboratories:	3	3
Number of Test Stands:	6	5

The following chart shows the laboratory/stand distribution:

### Laboratory/Stand Distribution



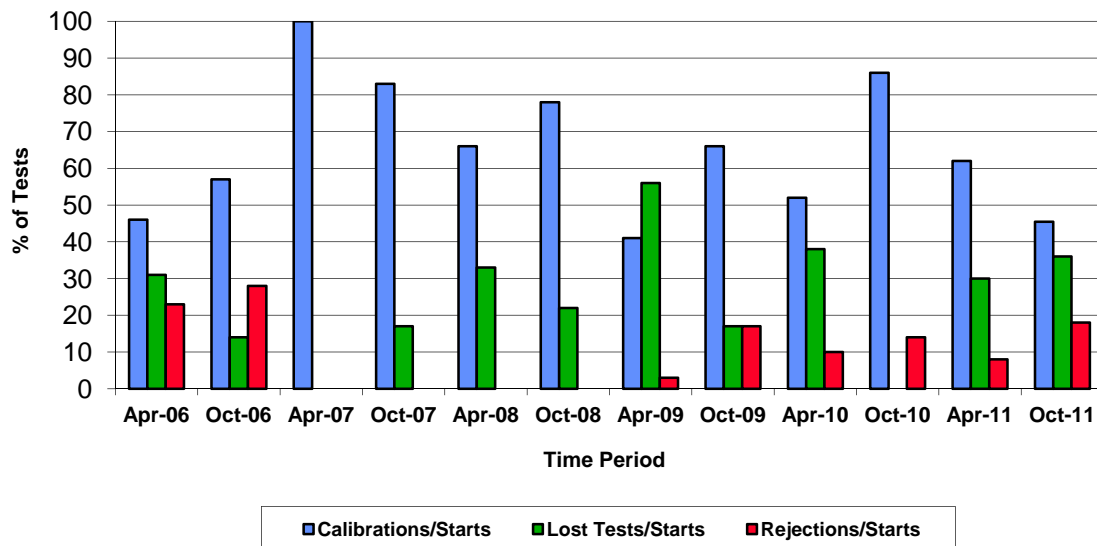
The following summarizes the status of the reference oil tests reported to the TMC:

Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	5
Operationally Valid, Statistically Unacceptable	OC	2
Operationally Invalid, Lab Determination	LC	1
Acceptable Donated Test	AG	1
Operationally Valid, Not Charted	NC	3
Total		12

One donated test was reported this period. This test was run to generate targets for the re-introduction of reference oil 1006-2.

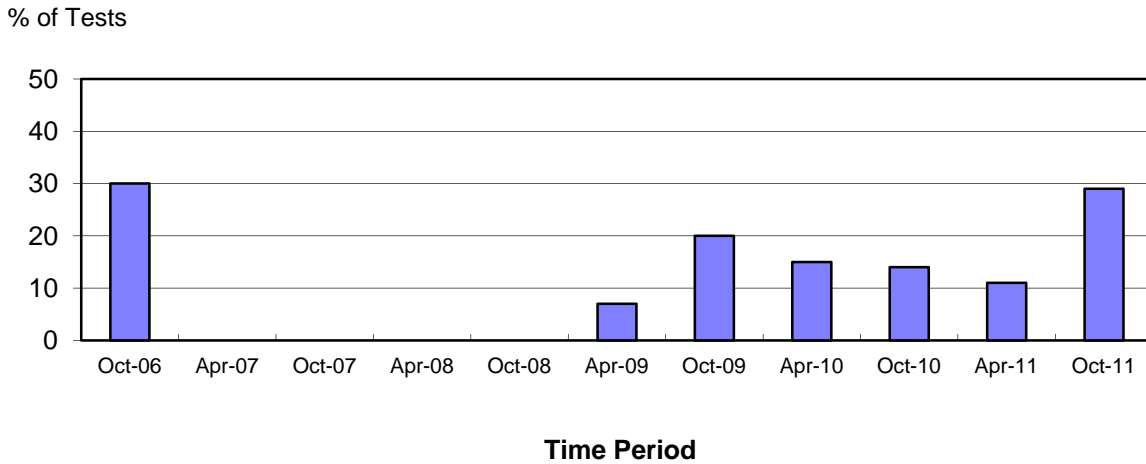
Calibrations per start, lost tests per start and rejection per start rates are summarized below:

### Calibration Attempt Summary



The calibration per start rate has decreased since last period. The rejected test and lost test per start rates have increased this period. All rates compare well with the historical rates.

### Rejected Test Rate for Operationally Valid Tests



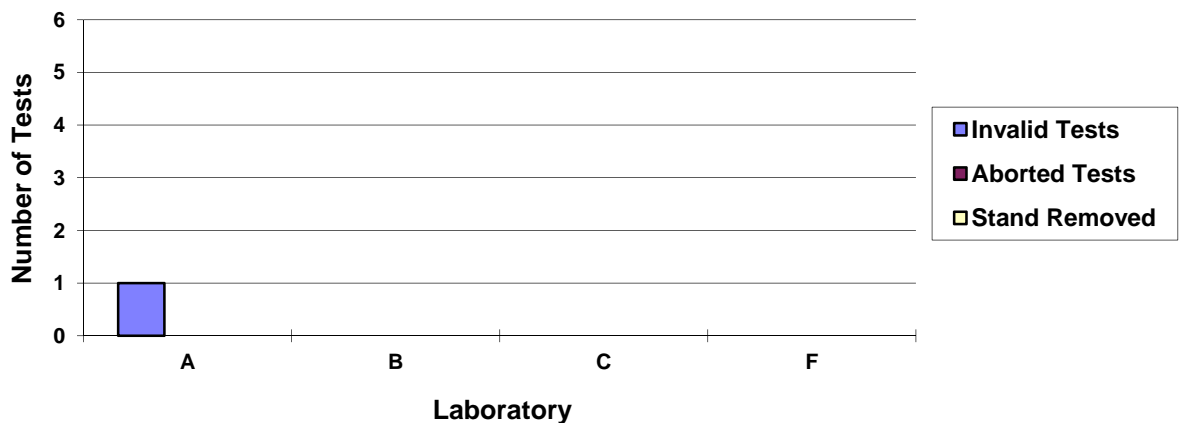
Two tests failed acceptance criteria. One test failed severe on average cam wear, while the second test failed for a stand precision alarm.

One test was declared operationally invalid by the laboratory. The test was declared invalid due to problems controlling exhaust backpressure, traced to an exhaust leak.

Three tests were operationally valid but not charted. All three of these tests were the result of driveline changes and subsequent reference oil tests were run on different driveline configurations. Driveline stiffness has been shown to effect severity and these tests were excluded from the charts to ensure proper severity adjustments were calculated.

Aborted and operationally invalid tests by laboratory are summarized with the following chart:

### Lost Test Distribution



There was one LTMS Deviations written this period. This deviation removed a failing (mild) result from a laboratory's chart. After this result, the driveline and engine mounts were replaced, returning severity to historic levels. This test was removed so as not to unduly influence laboratory severity adjustments. Since its introduction in 1999, there have been five Sequence IVA LTMS deviations.

QI Deviations

No QI Deviations were written this period. A total of 27 QI deviations have been written to date.

Severity and Precision Analysis

Below is a summary of the average  $\Delta/s$ , pooled standard deviation, and average  $\Delta$  in reported units for the tests reported during this report period. Also below is a summary of the average  $\Delta/s$  value, by laboratory.

<b>Industry Severity Summary</b>			
<b>Parameter</b>	<b>Average <math>\Delta/s</math></b>	<b>Pooled standard deviation (degrees of freedom)</b>	<b>Average <math>\Delta</math>, in micrometers</b>
ACW	0.378	15.74 (df = 6)	5.95 $\mu\text{m}$

<b>ACW Results, by Laboratory</b>	
<b>Laboratory</b>	<b>Average <math>\Delta/s</math></b>
A	-0.450
B1	0.867
F	0.605

Severity and precision charts were in control for the period. (see Figure 1). Severity was severe for the period (see Figure 2) with an average  $\Delta/s$  result of 0.378 which equates to 5.95  $\mu\text{m}$  in reported units.

The pooled standard deviation for the period is 15.74  $\mu\text{m}$ , which has degraded when compared to the last period, and compares well with overall historical performance (see Figure 3).

Hardware

No hardware changes were made this period.

Lab Visits

Four lab visits were conducted this period. Discrepancies identified included:

- 1) Rocker Cover Air Temperature thermocouple not properly installed
- 2) Temperature and pressure calibrations not performed as required by the test method.
- 3) Rocker Arm Cover inlet and outlet cover thermocouples and Rocker cover flow meter not installed.

In all cases, the laboratory(s) involved have advised the TMC that corrective action has been taken on these discrepancies.

Information Letters

No information letters were issued this report period.

Reference Oils

*Please note, 1007 cannot be resupplied and the surveillance panel needs to identify a suitable replacement oil.*

<b>Oil</b>	<b>Original Blend, in gallons</b>	<b>TMC Inventory, in gallons</b>	<b>Quantity Used past six months</b>	<b>TMC Inventory, in tests</b>	<b>Laboratory Inventory, in tests</b>	<b>Estimated life</b>
1006	5500	38	0	9	6	< 1 year <sup>1</sup>
1006-2	5500	3813	47	953	4	3+ years <sup>1,3</sup>
1007	2200	58	45	13	5	1+ years <sup>1,2</sup>
1009	1100	448	60	112	3	3+ years <sup>1</sup>
1010	1100	767	73	191	3	3+ years <sup>1</sup>

<sup>1</sup> Multiple test area reference oil; total TMC inventory shown.

<sup>2</sup> Cannot be reblended.

<sup>3</sup> Suspended for use by the Surveillance Panel

There was one donated test reported this period. This test was run as a program to generate new targets for reference oil 1006-2. The panel had suspended use of this oil, but agreed to re-introduce it with new targets generated on calibrated stands. A total of five donated tests have been committed by three laboratories.

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-10-2011.pdf>

Distribution: Electronic Mail

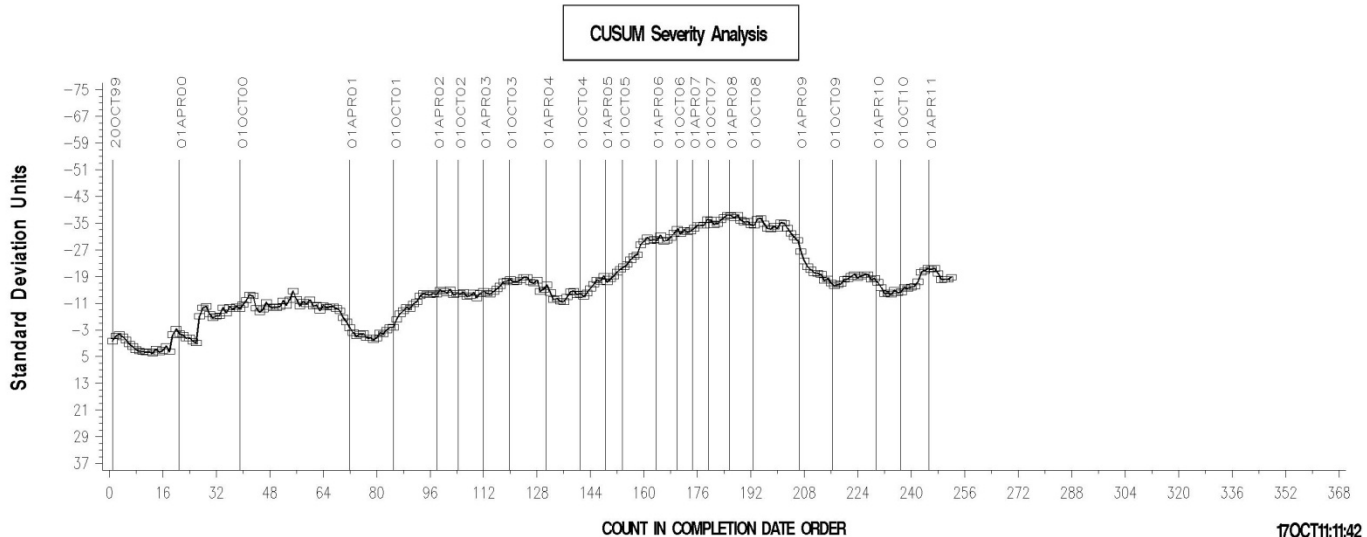
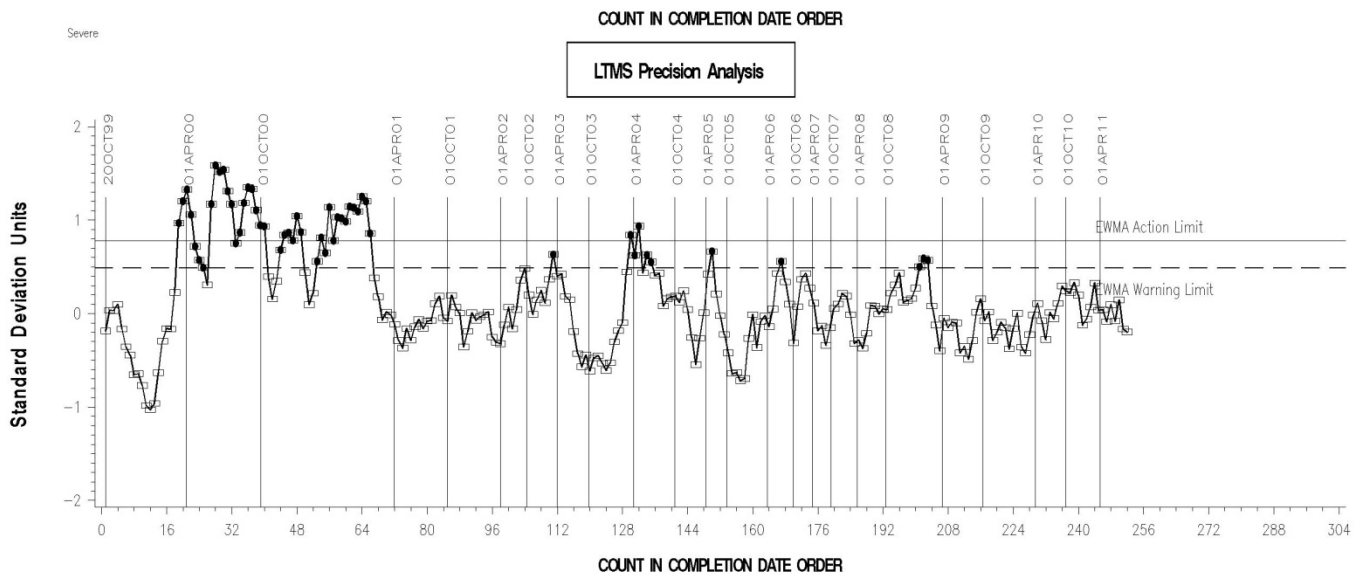
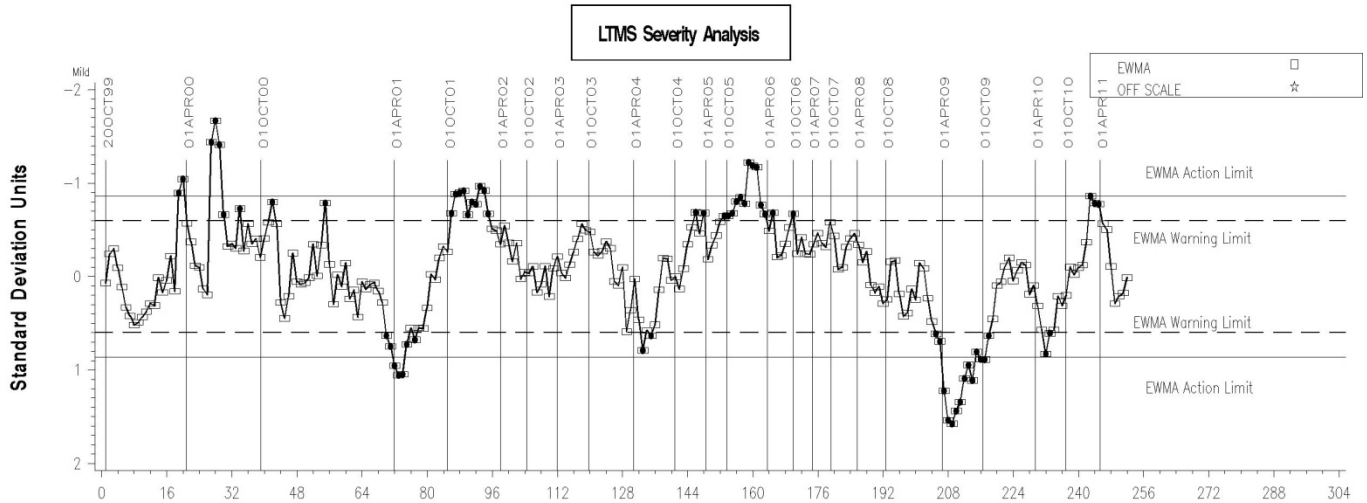
List of Figures

- 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.

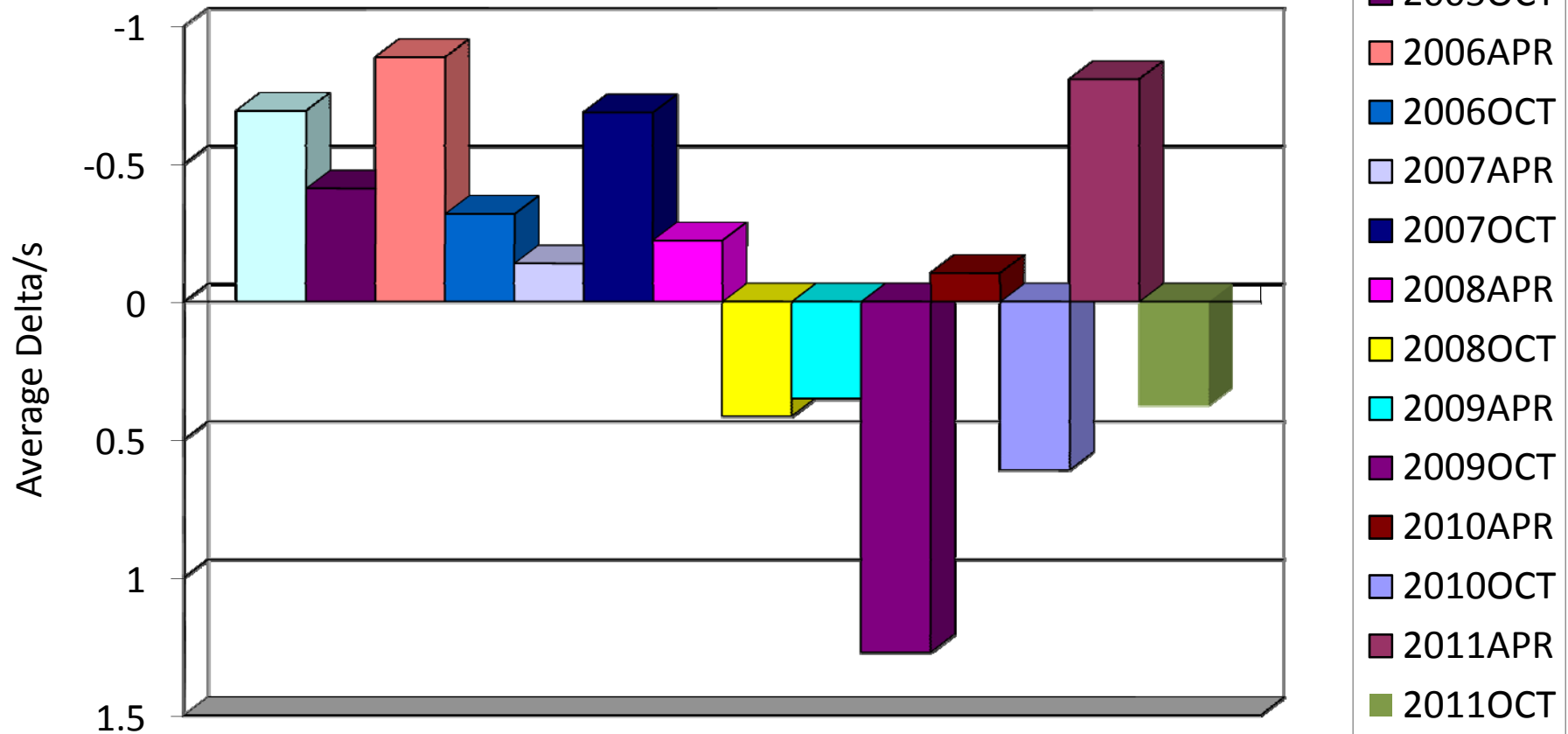
**Figure 1**  
**SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA**



**AVERAGE CAM WEAR**

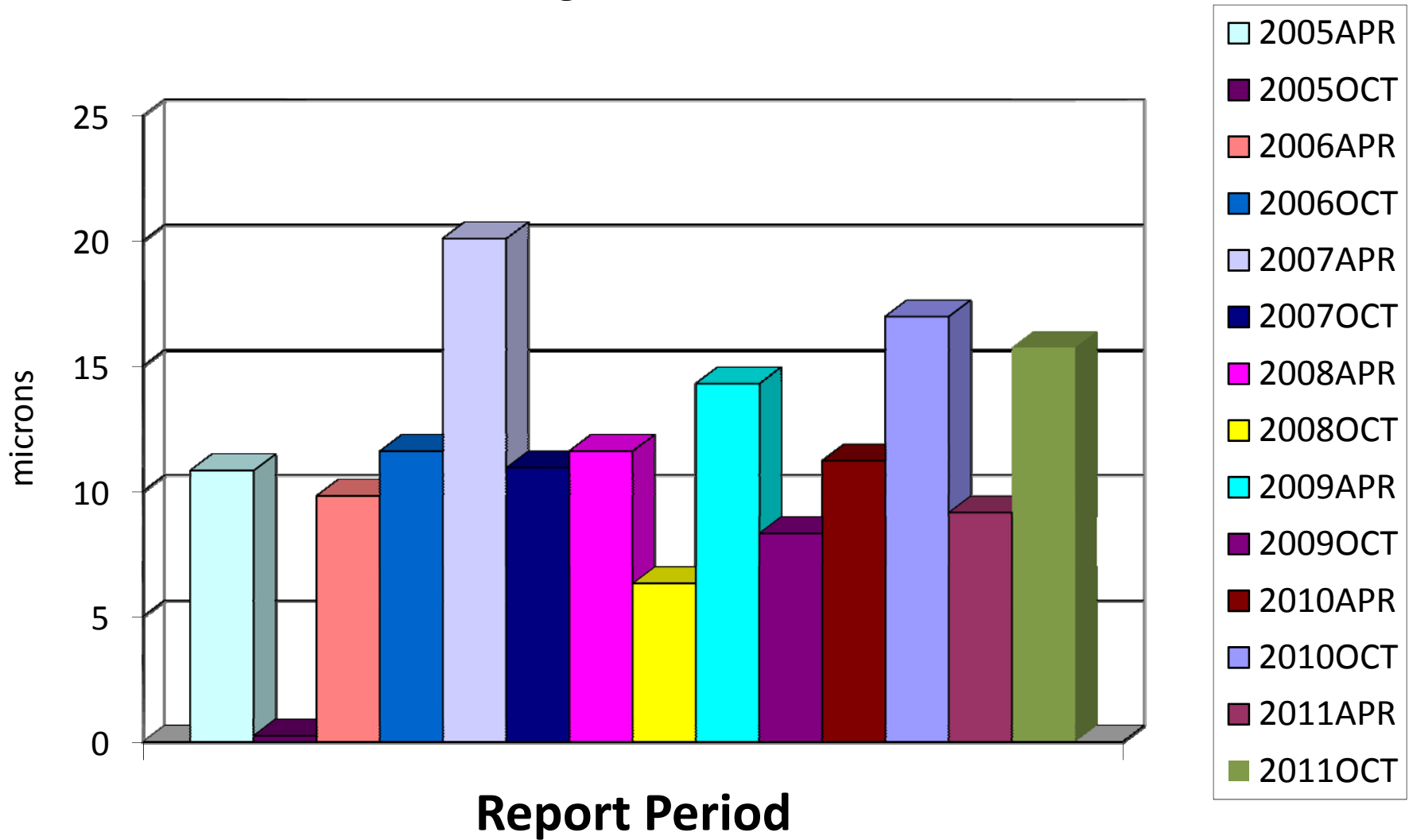


**Figure 2-Sequence IVA Reference Oil Data  
Average Camshaft Wear  
Report Period**





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



<b>Figure 4 - Sequence IVA Timeline</b>		
<b>Date</b>	<b>Topic</b>	<b>Information Letter</b>
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
11/16/2007	UPDATED REFERENCE OIL TARGETS (N = 29) REFERENCE OIL 1009	
11/20/2008	CLARIFIED CALCULATIONS FOR QI WHEN MISSING OR BAD QUALITY DATA ARE ENCOUNTERED	08-1
11/20/2008	CORRECTED TYPOGRAPHICAL ERROR	08-1
6/18/2009	DROPPED VALVE SPRING FREE LENGTH AND OUT OF SQUARE MEASUREMENTS, ADDED VACUUM CHECKS TO ASSEMBLED CYLINDER HEAD	09-1
6/18/2009	ADDED MONITORING OF ROCKER COVER INLET AND OUTLET TEMPERATURES, ENGINE COOLANT PRESSURE AND FRONT COVER FRESH AIR FLOW	09-1

6/18/2009	INCREASED THE NUMBER OF ALLOWED RUNS ON CYLINDER HEADS AND BLOCKS	09-1
9/22/2009	DELETED REQUIREMENT TO MAIL HARD COPY TEST REPORT TO TMC	09-2
1/4/2010	ALLOW ALTERNATE BLOWBY DEVICE AND 3.2 mm VALVE, REVISED FIGURE 3 AND A3.18	10-1