




# Test Monitoring Center

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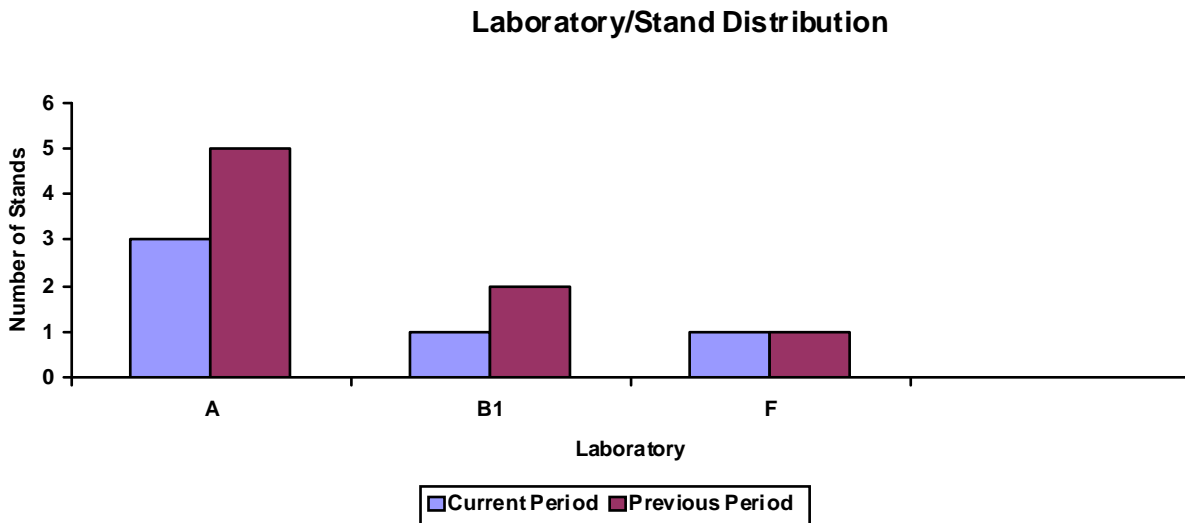
Memorandum: 10-039  
 Date: October 18, 2010  
 To: Bill Buscher, Chairman, Sequence IVA Surveillance Panel  
 From: Richard E. Grundza   
 Subject: Sequence IVA Semiannual Report: April 1, 2010 through September 30, 2010

The following is a summary of Sequence IVA reference tests that were reported to the Test Monitoring Center during the period April 1, 2010 through September 30, 2010.

### Lab/Stand Distribution

	Reporting Data	Calibrated as of September 30, 2010
Number of Laboratories:	3	3
Number of Test Stands:	5	5

The following chart shows the laboratory/stand distribution:

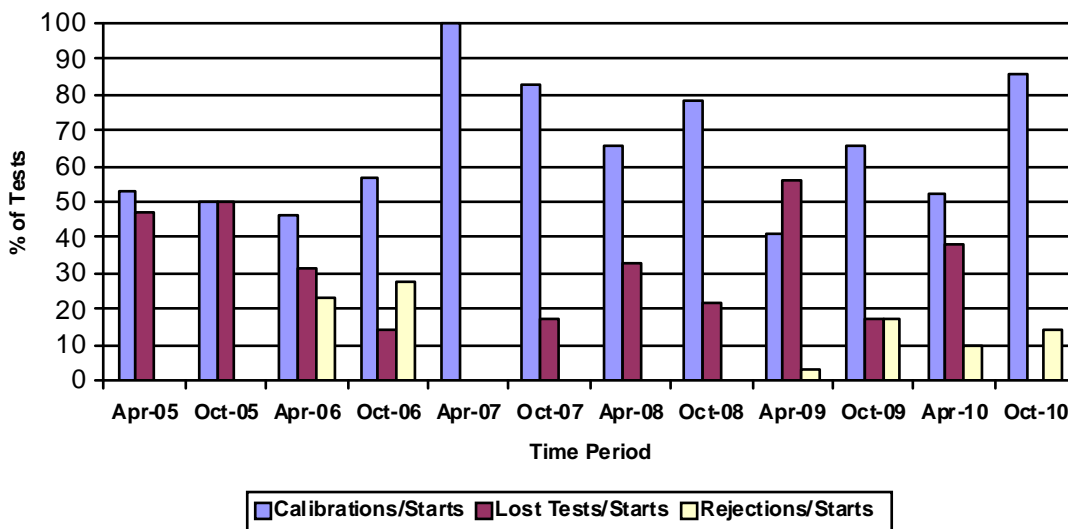


The following summarizes the status of the reference oil tests reported to the TMC:

Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	6
Operationally Valid, Statistically Unacceptable	OC	1
Total		7

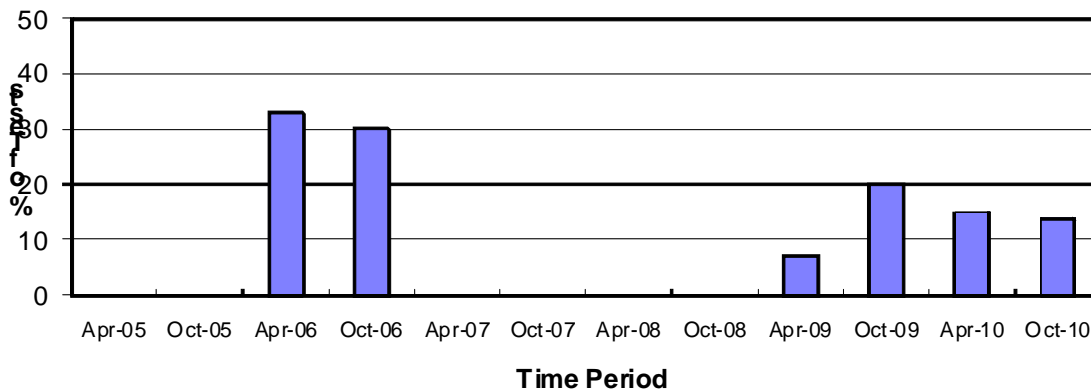
Calibrations per start, lost tests per start and rejection per start rates are summarized below:

### Calibration Attempt Summary



The calibration per start rate has increased since last period. The rejected test per start rate has increased this period. There were no lost tests this period.

### Rejected Test Rate for Operationally Valid Tests



One test failed acceptance criteria. This test failed severe on average cam wear.

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

There was one QI Deviation written this period. The QI deviation was issued for oil cylinder head temperature control generating a QI value below 0.000. A total of 26 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	0.610	16.98 (df = 6)	10.35 $\mu\text{m}$

<b>ACW Results, by Laboratory</b>	
<b>Laboratory</b>	<b>Average <math>\Delta/s</math></b>
A	0.956
B1	0.722
F	-1.234

With the exception of two warning alarms in the severe direction, industry control charts were in control for the period. Precision was in control for the period. (see Figure 1).

The severity warning alarms appear to have been caused by two severe results from one stand, using reference oil 1007. Severity was severe for the period (see Figure 2) with an average  $\Delta/s$  result of 0.610 which equates to 10.35  $\mu\text{m}$  in reported units.

The pooled standard deviation for the period is 16.98  $\mu\text{m}$ , 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

One lab visit was conducted this period. No discrepancies were identified during this visit.

Information Letters

No information letters were issued this report period.

Reference Oils

<b>Oil</b>	<b>TMC Inventory, in gallons</b>	<b>TMC Inventory, in tests (4gal/test)</b>	<b>Laboratory Inventory, in tests</b>	<b>Estimated life</b>
1006	41	10	6	1 month or less <sup>1</sup>
1006-2	3,963	990	2	3+ years <sup>1,3</sup>
1007 <sup>2</sup>	200	50	3	3+ years <sup>1</sup>
1009	511	127	4	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

A GF-5 category reference oil, designated 1010, has been obtained by the TMC and is available for introduction.

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-10-2010.pdf>

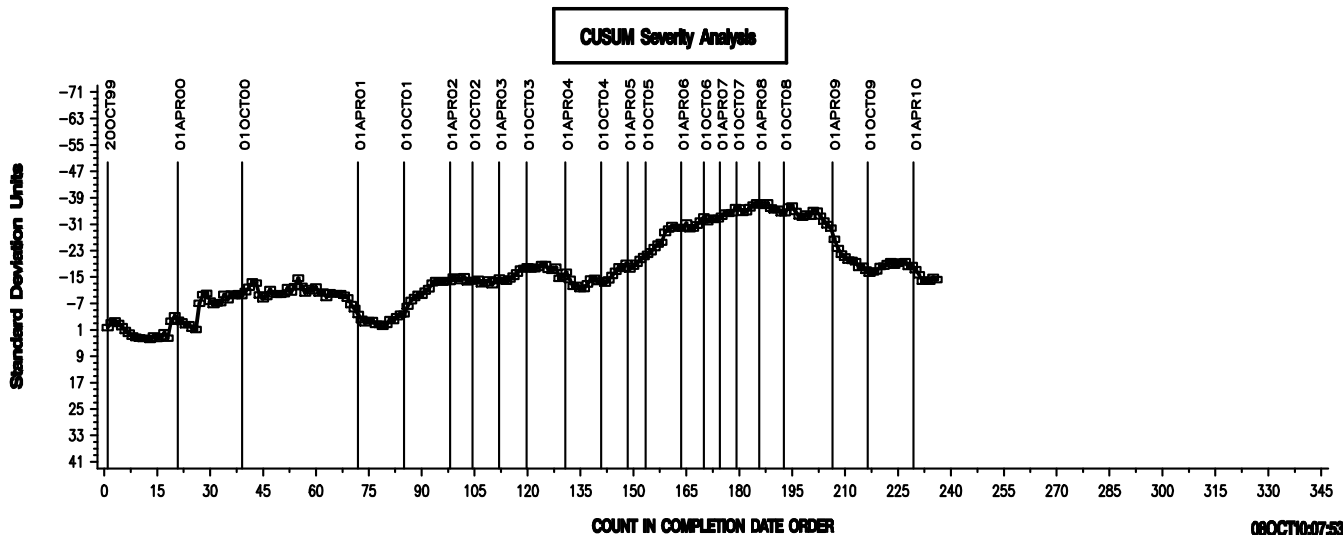
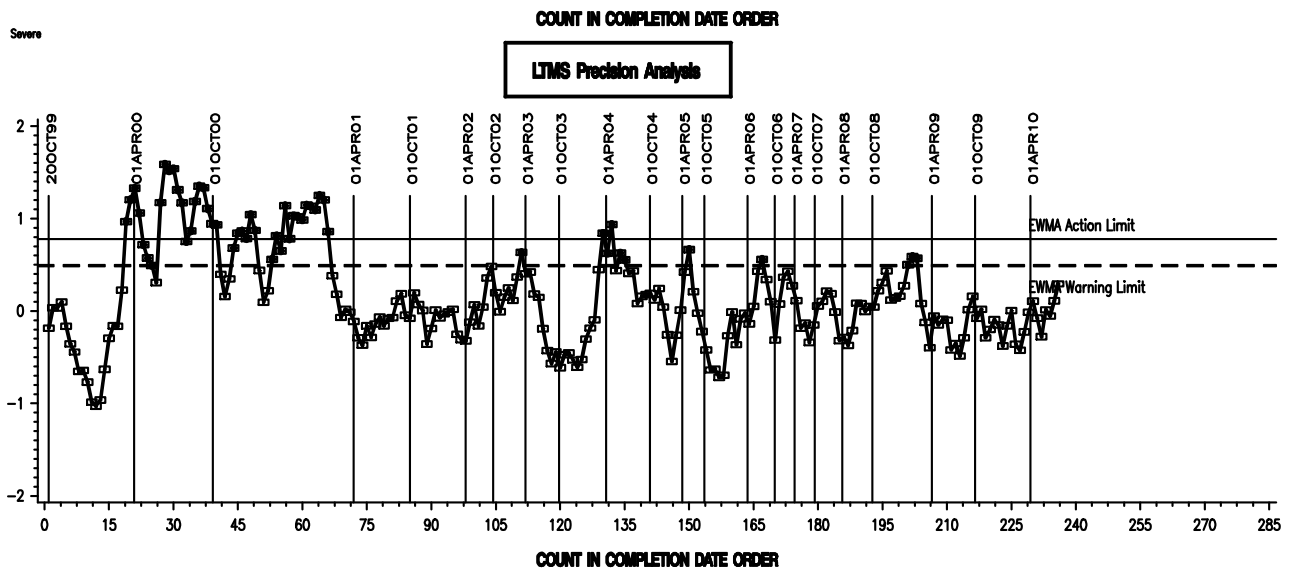
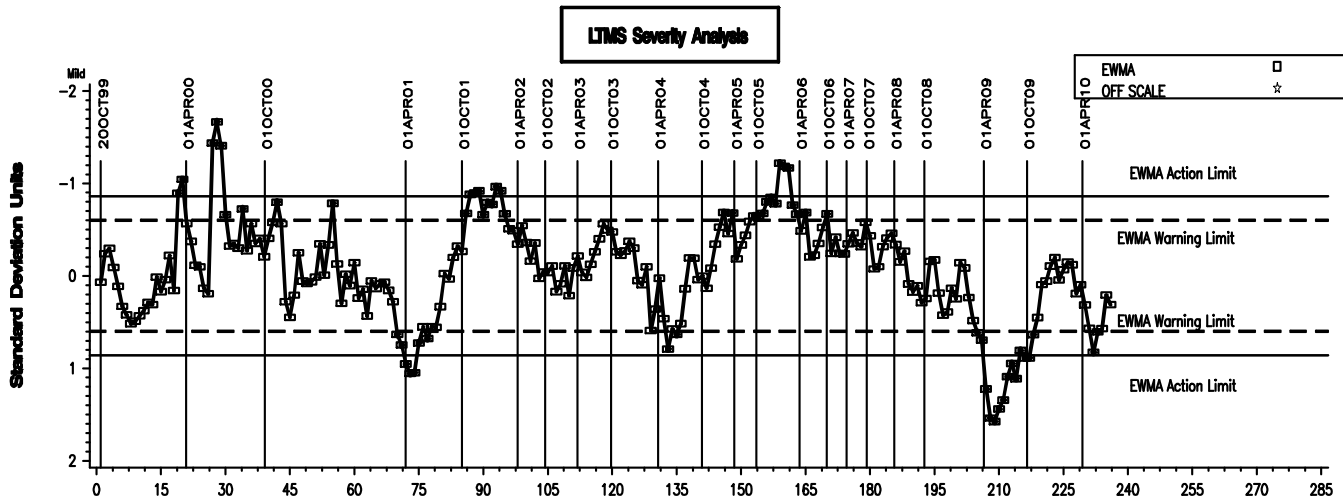
Distribution: Electronic Mail

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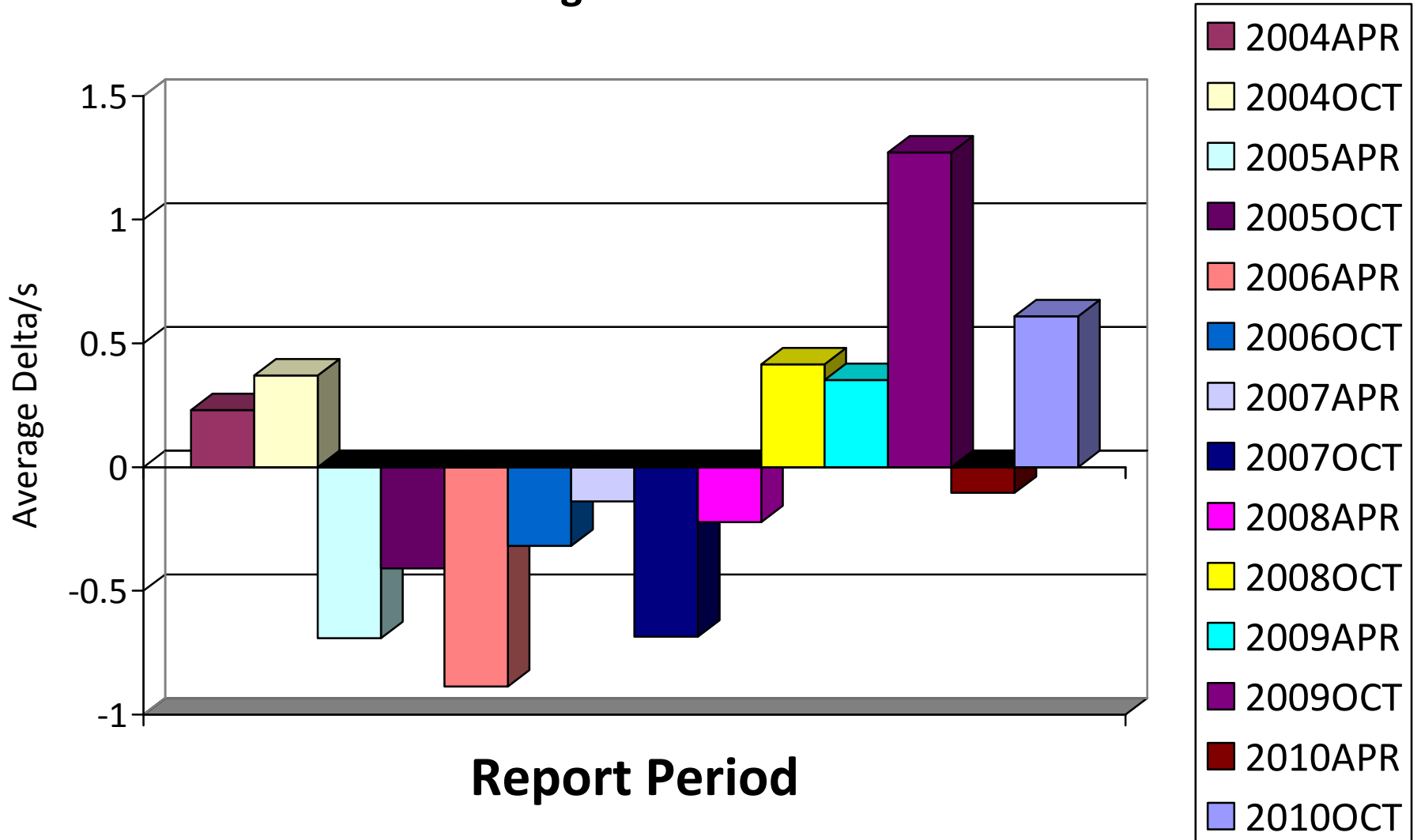
- Figure 1 graphically presents the Industry control charts for ACW and also the CUSUM delta/s plot (by count in completion date order) of average camshaft wear for operationally valid tests.
- Figure 2 graphically presents a historic perspective for ACW mean delta/s by report period.
- Figure 3 graphically 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**

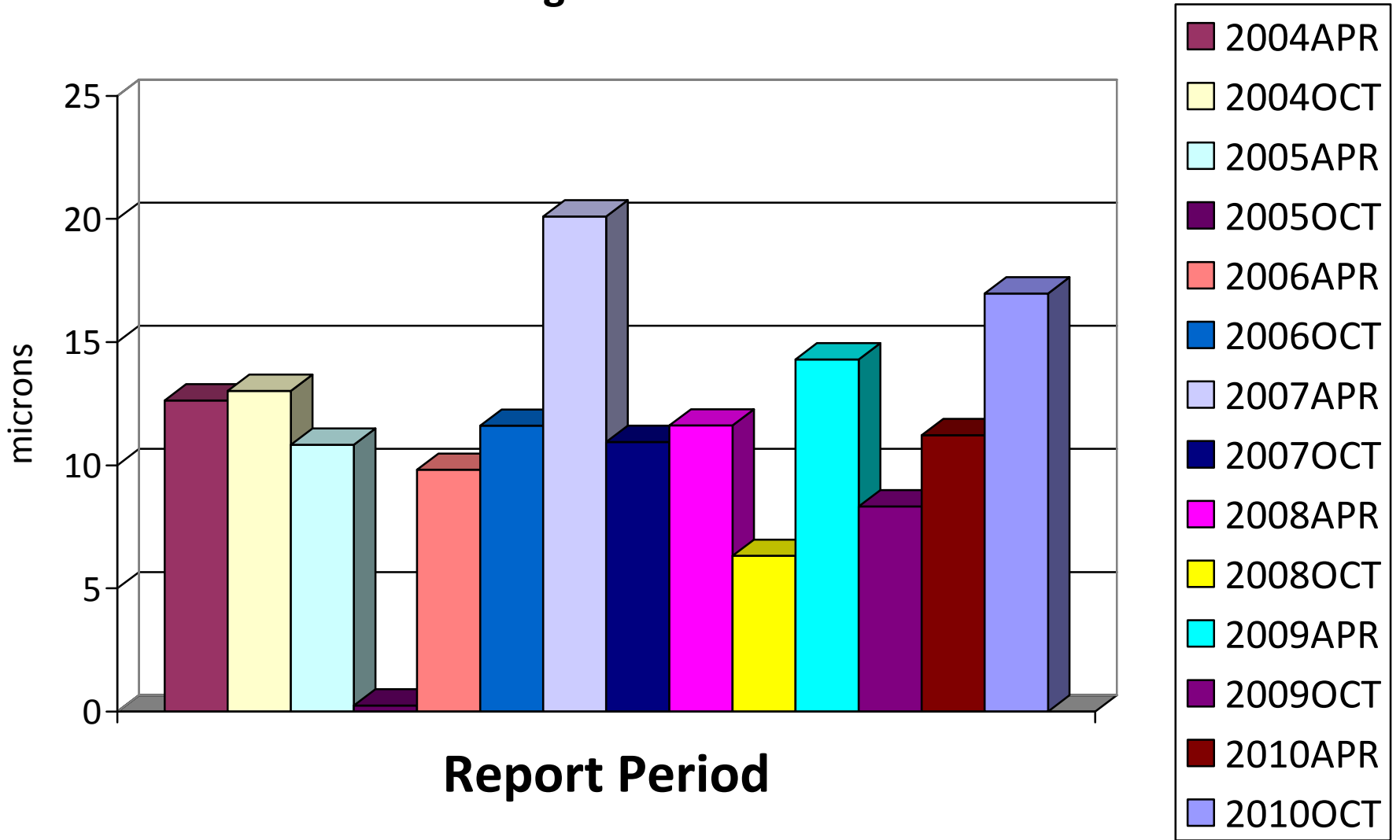
**AVERAGE CAM WEAR**



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



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





<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
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