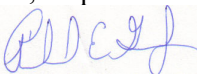




# Test Monitoring Center

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

Memorandum: 05-012  
Date: April 7, 2005  
To: Bill Buscher, Chairman, Sequence IVA Surveillance Panel  
From: Richard E. Grundza   
Subject: Sequence IVA Semiannual Report: October 1, 2004 through March 31, 2005

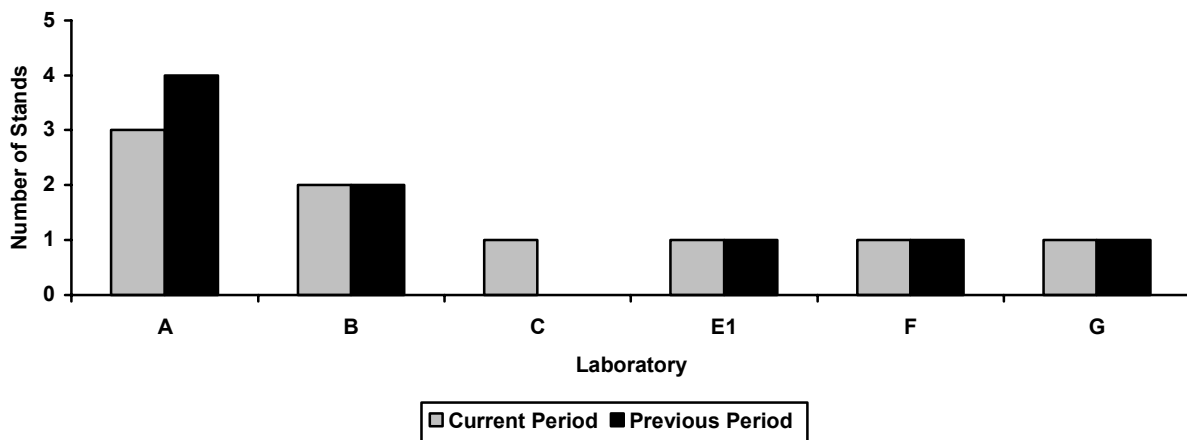
The following is a summary of Sequence IVA reference tests that were reported to the Test Monitoring Center during the period October 1, 2004 through March 31, 2005.

## Lab/Stand Distribution

	Reporting Data	Calibrated as of March 31, 2005
Number of Laboratories:	6	5
Number of Test Stands:	9	8

The following chart shows the laboratory/stand distribution:

### Laboratory/Stand Distribution



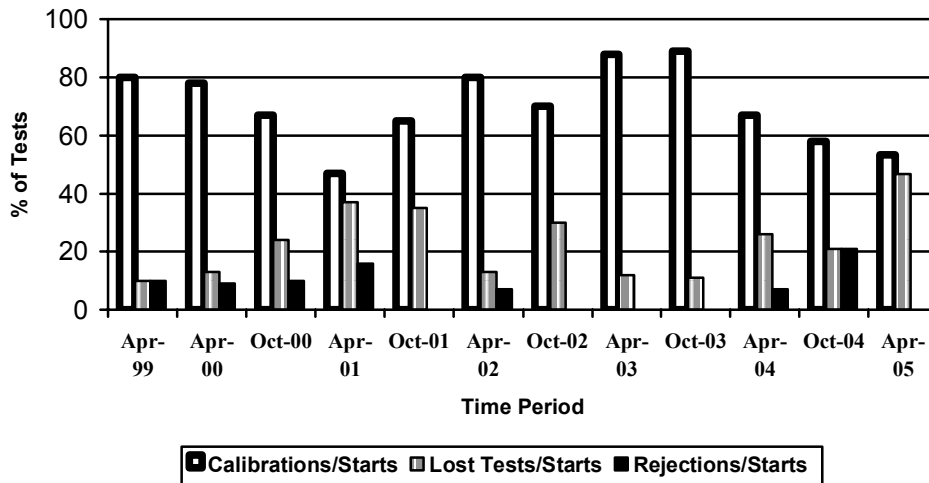
The following summarizes the status of the reference oil tests reported to the TMC:

Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	8
Decoded, Not for Industry Statistics	NI	2
Operationally Invalid (Laboratory Judgment)	LC	6
Operationally Invalid (Lab & TMC Judgment)	RC	1
Total		17

Donated & Industry Support Outcomes	TMC Validity Codes	No. of Tests
Donated Tests	AG	0
Total		0

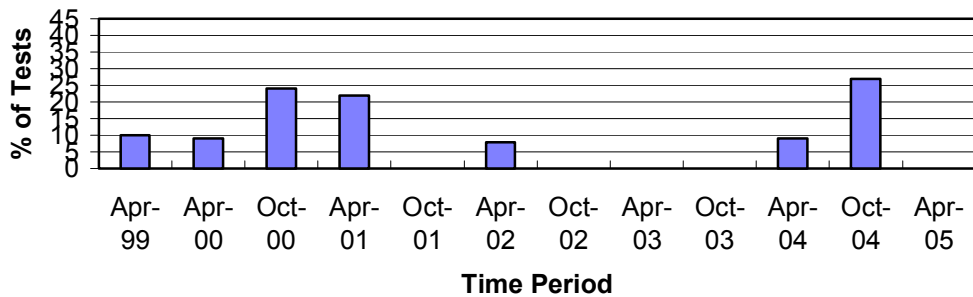
Calibrations per start, lost tests per start and rejection per start rates are summarized below:

### Calibration Attempt Summary



The calibration per start rate has decreased since last period. The lost test rate has increased with respect to the last period, and is the highest rate observed in the history of the Sequence IVA test. There were no rejected tests this period.

### Rejected Test Rate



There were no LTMS Deviations written this period. There has been one deviation from the LTMS since its introduction in 1999.

There was one QI Deviation written this period. The deviation was written due to Rocker Cover Coolant Flow Control problems.

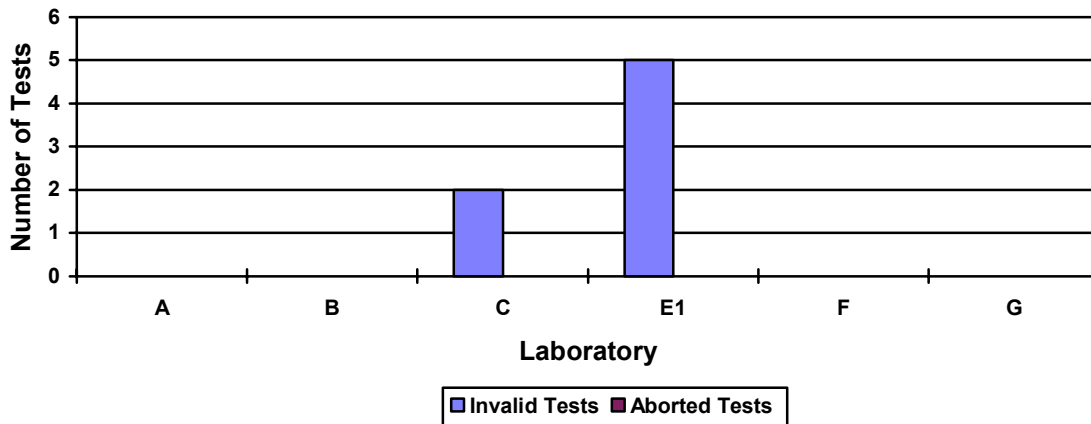
No lab visits were performed this period.

#### Lost Test Summary

Seven tests were lost this period. The causes are summarized in the following chart:

Lab	Reason for Lost Test	Number of Tests	Breakdown of Tests (LC/RC/XC)
A	Cylinder Head Contamination Problems	1	0/1/0
	Cylinder Head Calibration Problems	1	1/0/0
E1	Coolant Flow Calibration Problems	1	1/0/0
	Speed QI, Throttle Position Sensor Problems	1	1/0/0
	Oil Cylinder Head Thermocouple Improperly Installed	1	1/0/0
	Oil Cylinder Head Thermocouple Problems	1	1/0/0
	Problems Maintaining Speed Ramps	1	1/0/0

### Lost Test Distribution



#### Information Letters

Sequence IVA Information Letter No. 05-1, Sequence No. 12, dated January 7, 2005, was issued during the period and contained: Revised Cylinder Head and Engine Replacement Requirements, Clarified Solvent Specifications, Revised Coolant Out Temperature QI U & L Limits, Revised Instrumentation Calibration Frequencies, Added Sections Defining the Role of the TMC in the Method, and Added Provisions for Calibration Frequency Adjustment for Donated Test Oil Programs.

#### 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 parameter, for all laboratories reporting data during this report period.

Industry Severity Summary			
Parameter	Average $\Delta/s$	Pooled standard deviation (degrees of freedom)	Average $\Delta$ , in micrometers
ACW	-0.69	10.83 (df=8)	7.5 $\mu\text{m}$

ACW Results, by Laboratory	
Laboratory	Average $\Delta/s$
A	-1.22
B	-0.30
C	-1.56
E1	N/A
F	-0.16
G	0.45

The industry has exceeded severity warning limits twice for the period (see Figure 1). No single stand or lab was responsible for these alarms, though four of the five labs, on average, provided mild results.

The industry was mild for the period (see Figure 2) with an average  $\Delta/s$  result of -0.69, which equates to 7.5  $\mu\text{m}$  in reported units. The pooled standard deviation for the period is 10.83  $\mu\text{m}$ , which better than the last period and in line with overall historical performance (see Figure 3).

#### Hardware

No hardware changes were made this period.

#### Reference Oils

Oil	TMC Inventory, in gallons	TMC Inventory, in tests (4gal/test)	Laboratory Inventory, in tests	Estimated life
1006	42	10	9	1 month or less <sup>1</sup>
1006-2	4,719	1,189	11	3+ years <sup>1</sup>
1007 <sup>2</sup>	456	114	11	3+ years <sup>1</sup>
1009	803	200	7	3+ years <sup>1</sup>

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

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

#### Summary

Calibration per start rate has decreased and the lost test rate has increased with respect to the previous period. There were no rejected tests this period. Calibration per start rate compares with historical rates, while the lost test per start rate is the highest observed in the history of the Sequence IVA test. ACW severity trended mild for the period. Pooled precision estimates show precision has improved when compared with the previous period and compare well with historical estimates.

REG/reg

#### Attachments

c: F. M. Farber, TMC  
Sequence IVA Surveillance Panel  
<ftp://astmtmc.cmu.edu/docs/gas/sequenceiv/semiannualreports/IVA-04-2005.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

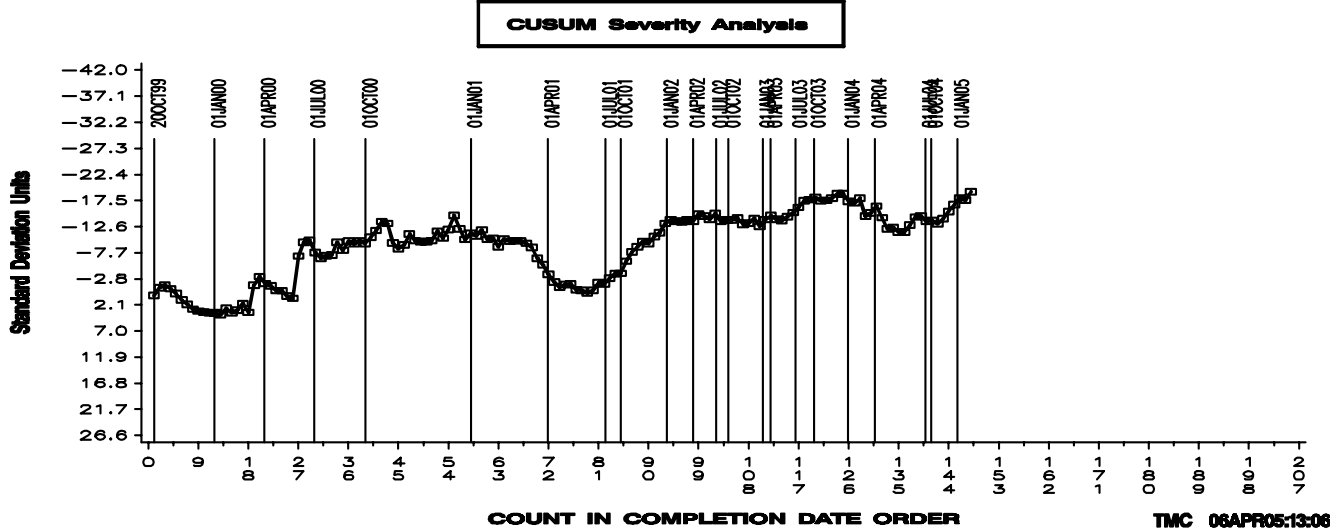
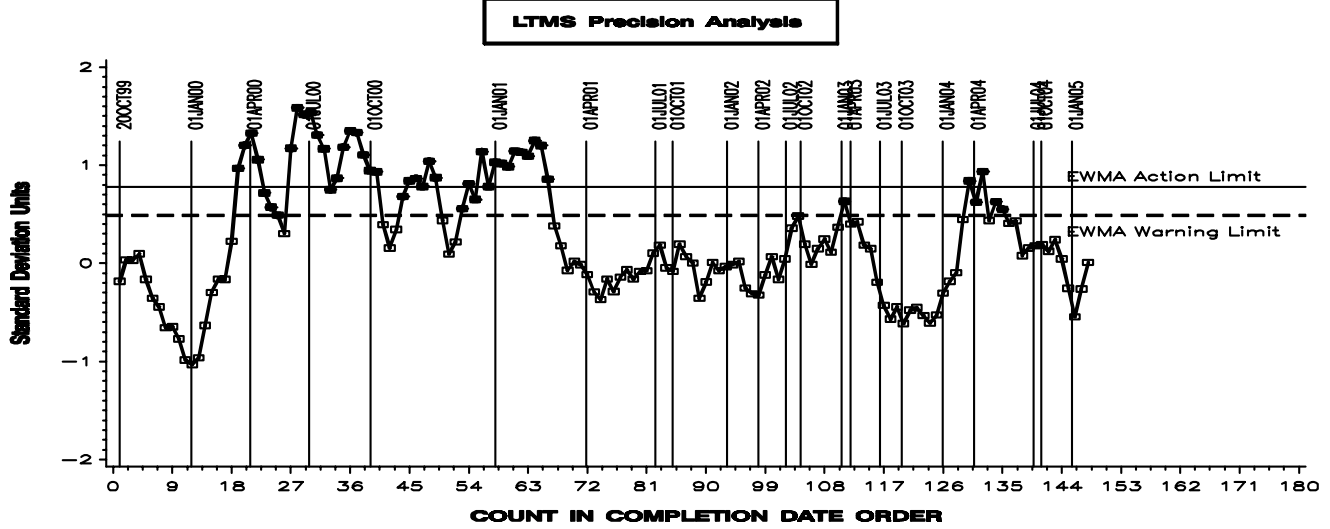
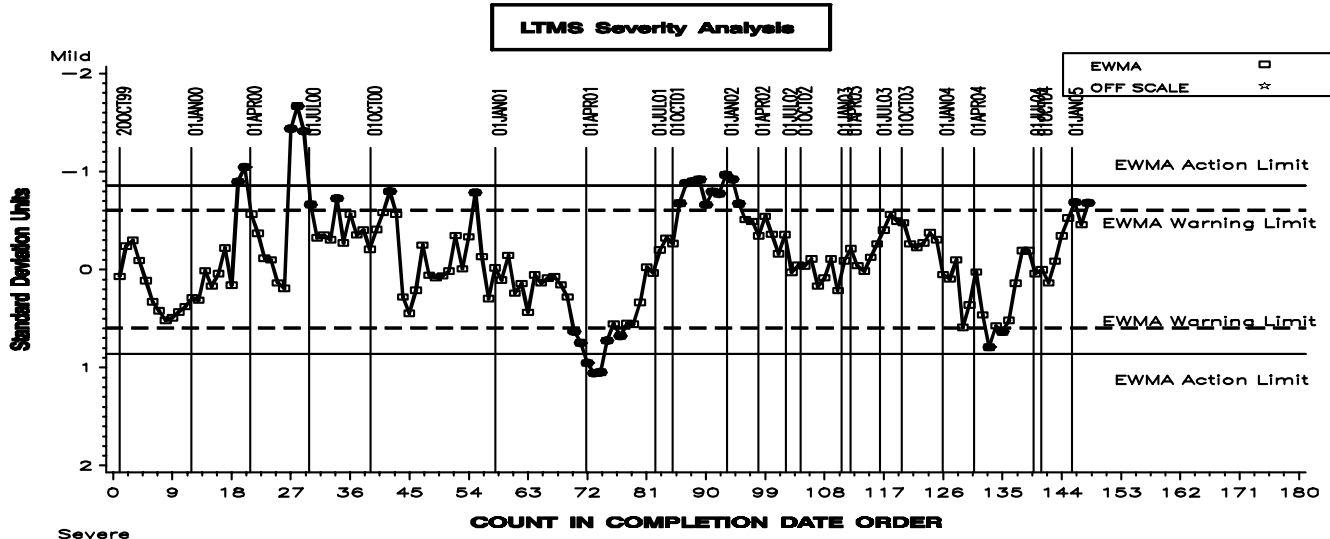
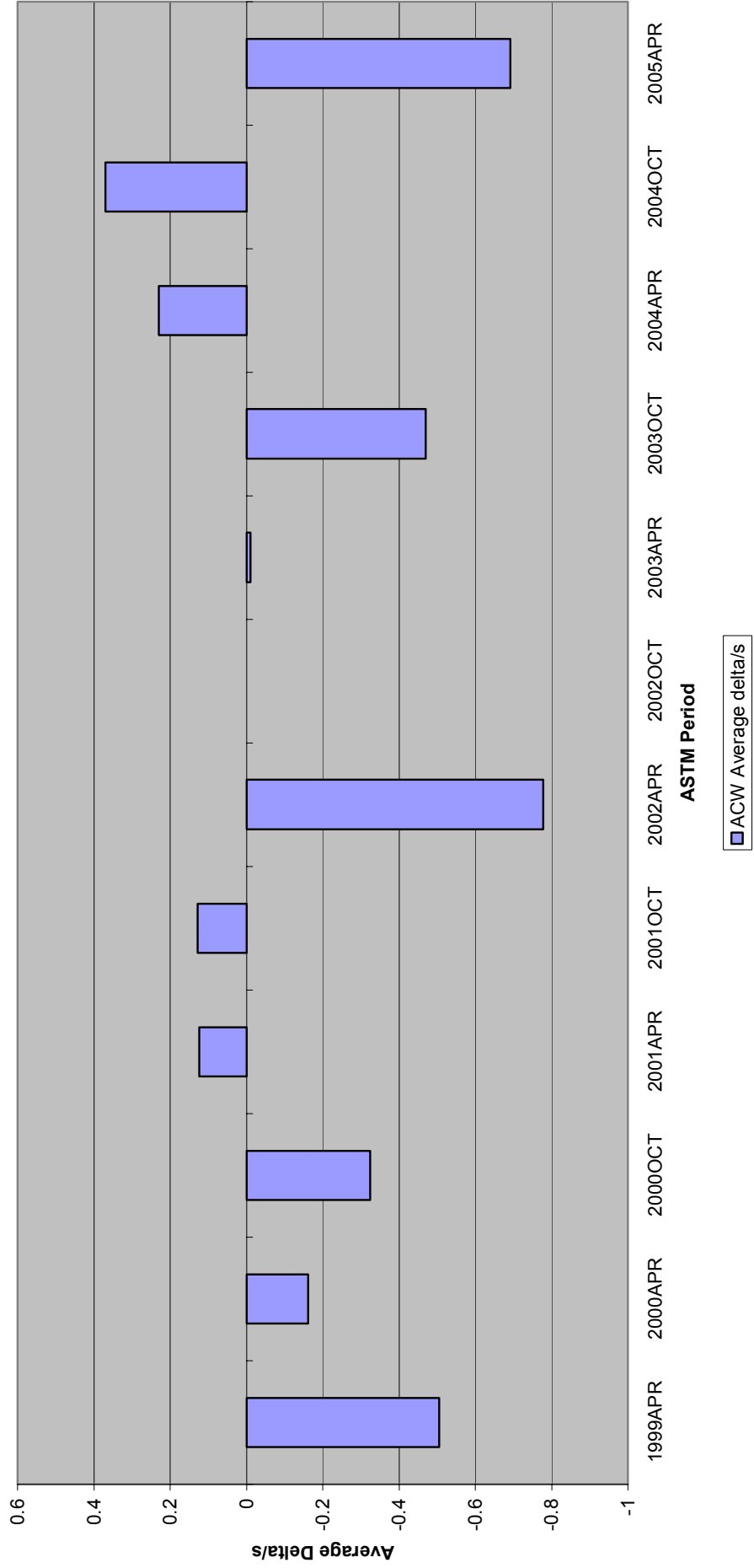
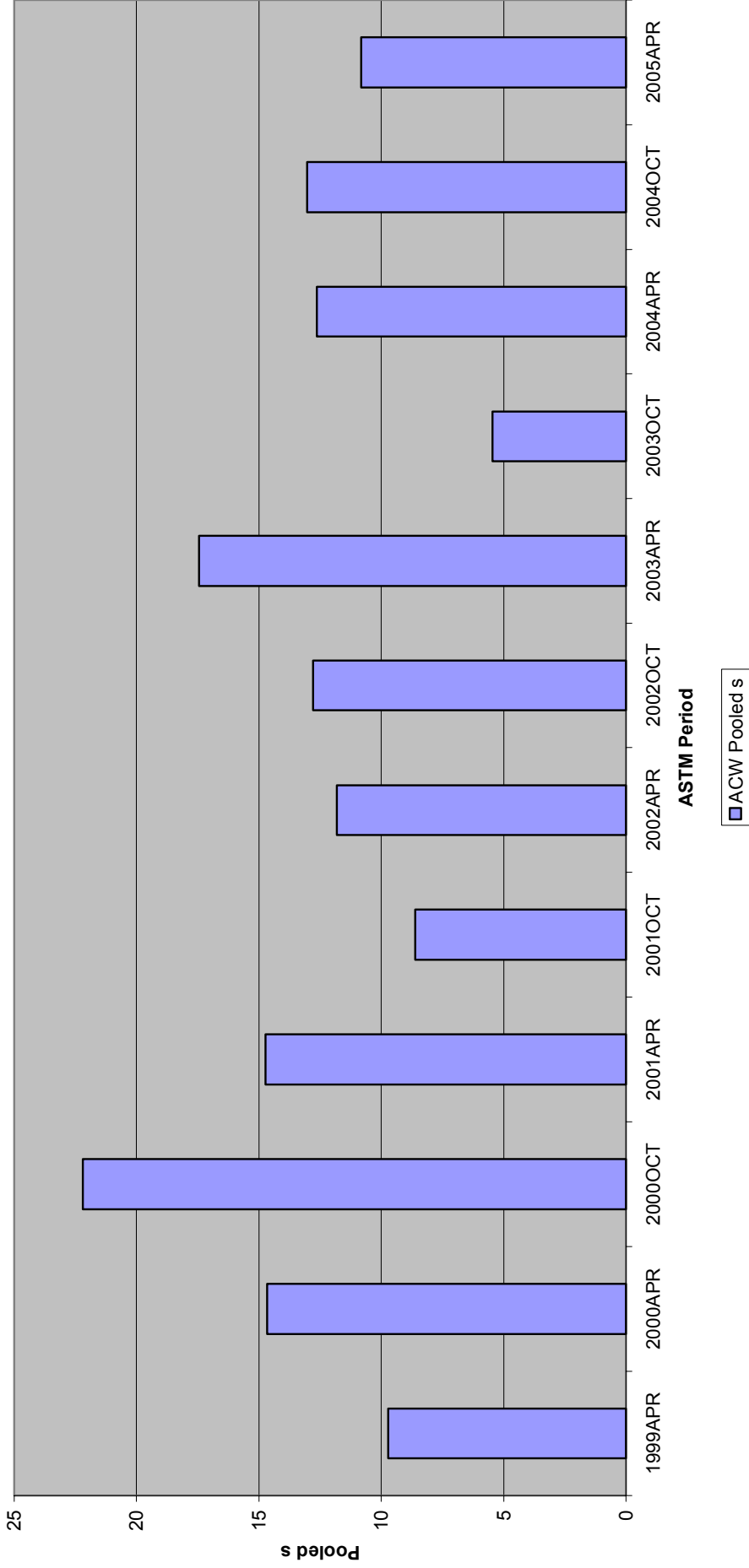


Figure 2 - Sequence IVA Reference Oil Data  
Average Camshaft Wear





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



<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