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

Memorandum: 05-013

Date: April 19, 2005

To: William M. Nahumck, Chairman, Sequence III Surveillance Panel

From: Richard E. Grundza

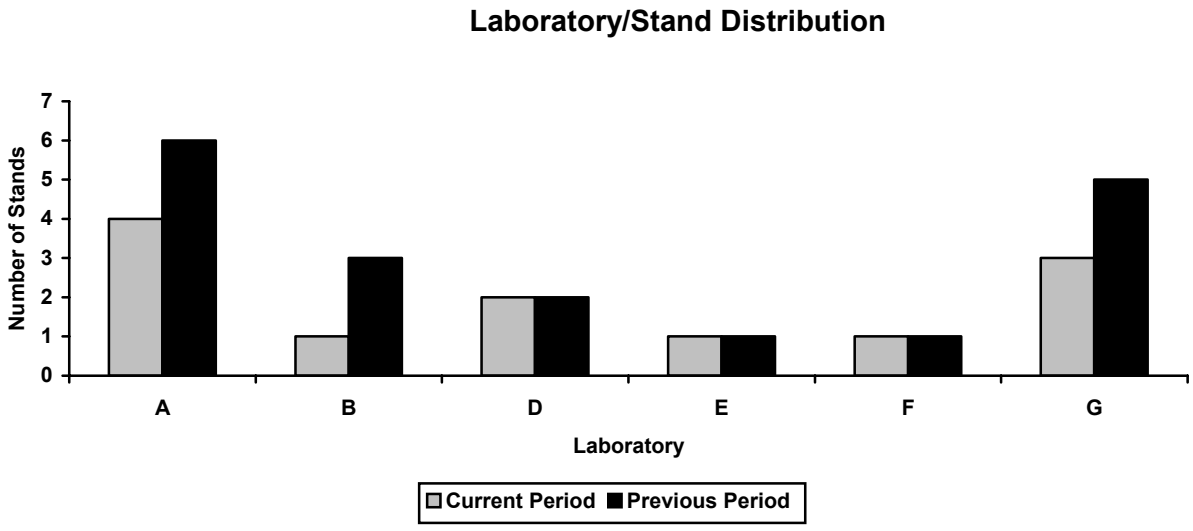
Subject: Sequence IIIG/IIIGA Semiannual Report: October 1, 2004 through March 31, 2005

The following is a summary of Sequence IIIG 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	4
Number of Test Stands:	12	7

The following chart shows the laboratory/stand distribution:

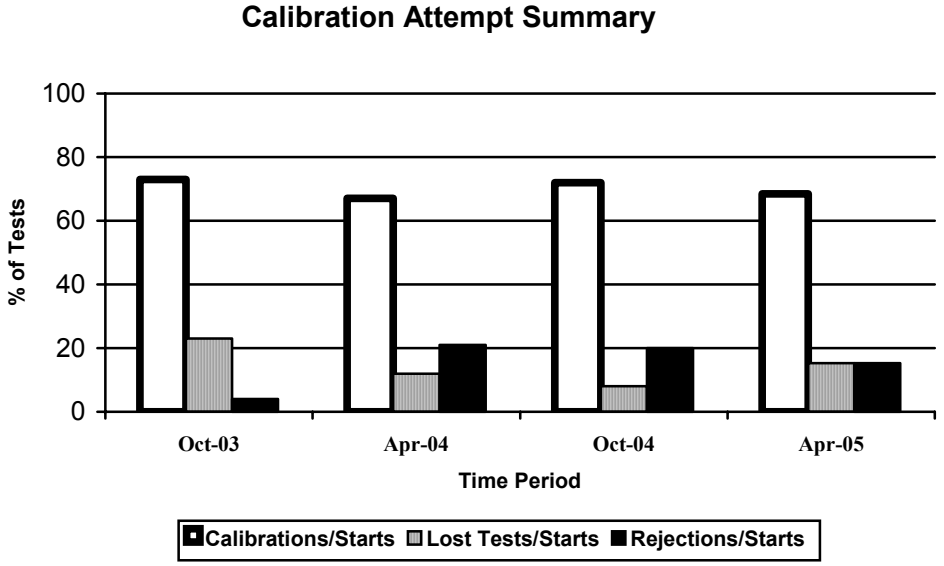


The following summarizes the status of the reference oil tests reported to the TMC:

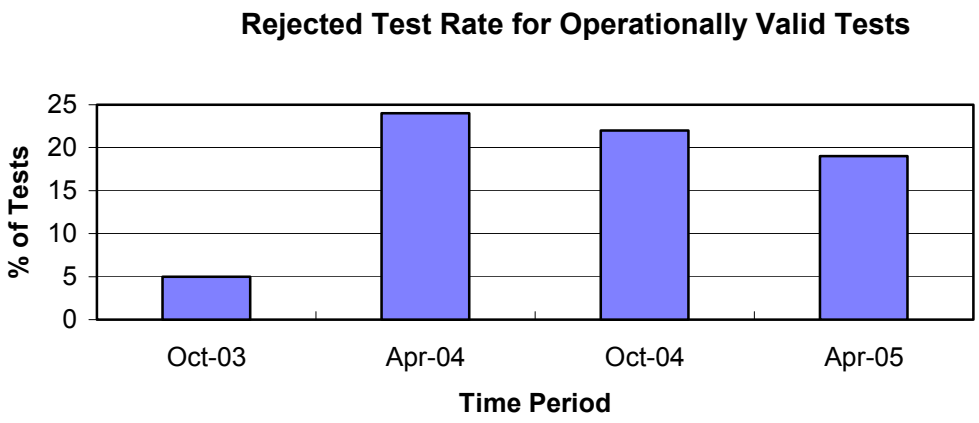
Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	13
Failed Acceptance Criteria	OC	3
Operationally Invalid (Laboratory Judgment)	LC	2
Aborted	XC	1
Total		19

Donated & Industry Support Outcomes	TMC Validity Codes	No. of Tests
Decoded Oil – Stand Investigation	OG	0
Total		0

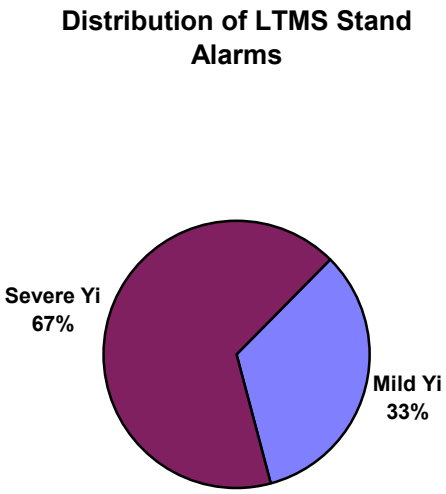
Calibrations per start, lost tests per start and rejection rates are summarized below:

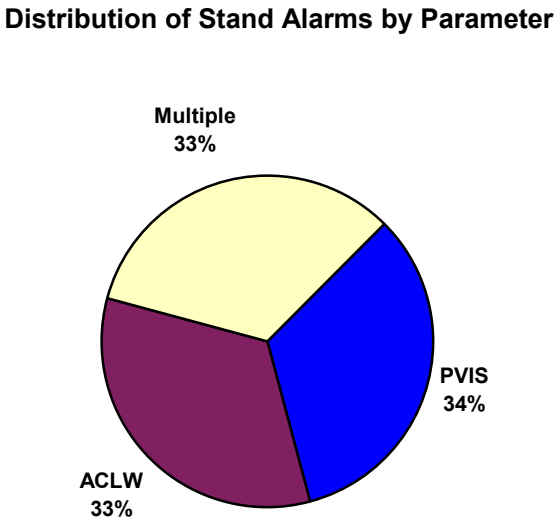


The calibration per start rate is slightly lower than last period. The lost test rate is slightly higher than last period. The rejected test rate is slightly lower than last period.



There were three failing tests for the period. The following charts summarize the reasons and breakdown by parameter for the failed test:





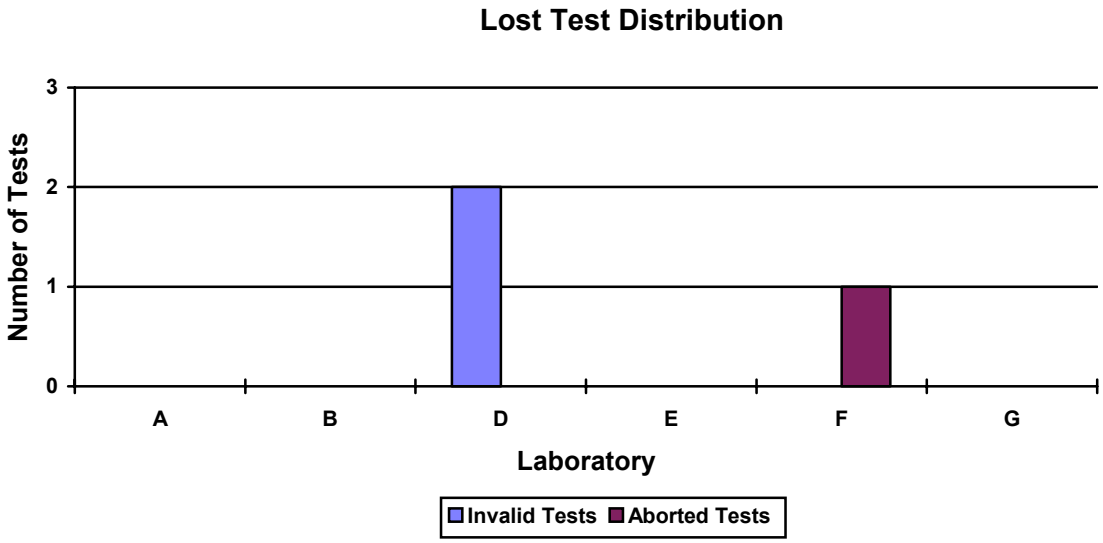
There were no LTMS Deviations written this period. There have been no deviations from the LTMS since its introduction in August of 2003.

No Sequence IIIG lab visits were performed this period

Lost Test Summary

Three tests were lost this period. The reasons for the lost tests are shown in the following table:

Lab	Reason for Lost Test	Number of Tests	Breakdown of Tests (LC/RC/XC)
D	Load Cell Problem	1	1/0/0
D	Temperature Control Problem	1	1/0/0
F	Wrong Throttle Body Modifications	1	0/0/1



Information Letters

Sequence IIIG Information Letter No. 04-3, Sequence No. 7, was issued during the period on November 4, 2004, and contained: Torque Specs for Powdered Metal Rods, New Front and Rear Main Seals, New Oil Pan Gasket, New Exhaust Valves, and Addressed Editorial Changes to the Precision Statements

Sequence IIIG Information Letter No. 05-1, Sequence No. 8, was issued during the period on January 7, 2005, and contained: Clarification of Solvent Specifications, Provisions for Reference Period Adjustment for Donated Oil Test Programs, Engine Build Worksheet, and Updated Precision Statements

Sequence IIIG Engine Assembly Manual

A new version of the Sequence IIIG Engine Assembly Manual, dated 12-6-04, was issued via TMC Memorandum 04-109, dated December 7, 2004.

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 value, by parameter, 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
PVIS	-0.639	0.732 (df=13)	-56.0 % Viscosity Increase[1]
WPD	-0.766	0.41 (df=13)	-0.31 Merits
ACLW	-0.156	0.333 (df=13)	-3.0μm[2]
MRV[3]	-0.949	0.158 (df=7)	N/A (no appropriate baseline)[4]

[1] At the proposed GF-4 Pass Limit of 150% Viscosity Increase
[2] At the proposed GF-4 Pass Limit of 60μm
[3] Sequence IIIGA Test Parameter only; Reference Oil 435 data excluded from calculations
[4] MRV does not have a specific GF-4 Pass Limit; Pass Limit is lack of Yield Stress.

Average Δ/s Results, by Laboratory				
Laboratory	PVIS	WPD	ACLW	MRV[1]
A	-0.64	-1.48	1.15	-0.81
B	-1.93	-0.64	-0.59	N/A
D	-0.95	-0.04	-0.44	-0.93
E	-1.90	-0.812	-0.55	-1.46
F	-1.42	0.97	0.06	-1.17
G	-1.24	-1.02	-1.82	-0.76

[1] Reference oil 435 data excluded from calculations

Percent Viscosity Increase (PVIS)

The industry began the period within limits for severity. Seven tests into the period the severity EWMA chart exceeded alarm limits and remained in alarm through the end of the period (see Figure 1). Precision began the period in an action alarm, then exceeded precision alarm limits four times before returning and remaining in control for the period. The precision alarms appear to have been caused by one result 6.521 Δ/s from target. The stand providing this result subsequently ran two tests which provided results of -1.558 and -1.290 Δ/s. The average Δ/s value for the period, -0.639, is milder than last period and is shown in Figure 4. The pooled standard deviation for the period, 0.732, has degraded significantly with respect to the previous period (see Figure 7). When the 6.521 Δ/s result is removed, the precision estimate improves to 0.166 which is slightly better than last period. Please note that when the 6.521 Δ/s is removed from the average Δ/s calculation, the average Δ/s becomes -1.117, significantly milder than any period to date. This shift may be rooted in hardware changes, as documented in TMC Memoranda 05-007 and 05-005.

Weighted Piston Deposits (WPD)

The industry exceeded the limits for both severity and precision during the period (see Figure 2). Severity began the period in control and sounded two single point severity warning alarms before sounding a warning and ending the period in action alarm. Hardware may have played a role in this shift as a previous analysis done by the TMC, documented in TMC Memoranda 05-007 and 05-005 reported. The analysis suggests that powdered metal rods may have contributed to this shift. The single-point precision alarm was caused by one test in the previous period, 4.45 Δ/s from target. The average Δ/s value for the period, -0.766, is more severe than last period and is the most severe period on record (see Figure 5). The pooled standard deviation for the period, 0.451, is better than last period and is the best precision estimate on record for WPD in the Sequence IIIG test (see Figure 8).

Average Camshaft-plus-Lifter Wear (ACLW)

ACLW severity was in control the entire period. The industry control chart for precision began the period in control, but exceeded precision limits six times, ending the period in action alarm (see Figure 3). No one laboratory or stand appears to have caused these alarms initially, though of the last three tests, two results were from one stand, which failed one test, with a result -3.028 Δ/s from target. The subsequent test on this stand, which was the last result this report period, was deemed acceptable under the Special K Criteria, with a result of -2.620 Δ/s from target. No cause for these mild tests has been found. The average Δ/s value for the period, -0.156, is not as mild as the last period and is shown in Figure 6. The pooled standard deviation for the period, 0.333, has degraded somewhat when compared to the last period and is shown in Figure 9.

Mini Rotary Viscometer (MRV)

The MRV control charts are shown for informational purposes in Figure 10. Industry has exceeded the EWMA mild warning limit the entire period, while precision has been in control the entire period. The average Δ/s value for the period, -0.949, is much milder than last period and is shown in Figure 11. The pooled standard deviation for the period, 0.158, is better than last period and is shown in Figure 12.

QI Deviations

No QI Deviations were written this period. There has been a total of one QI Deviation written since the test was introduced in August of 2003.

Hardware

Powdered metal connecting rods continue to see widespread use during the period. Twelve of the sixteen operationally valid tests reported this period were run on the powdered metal rods. TMC analysis, as detailed in Memoranda 05-005 and 05-007, document some potential industry severity trends which may be attributed to the widespread use of these rods.

Reference Oils

Oil	TMC Inventory, in gallons	TMC Inventory, in tests (4 gal/test)	Laboratory Inventory, in tests	Estimated life
434	258	64	8	~ 4 years
435	294	73	10	~ 5 years
438	751	187	8	~10 years

REG/reg

Attachments

c: F. M. Farber, TMC
Sequence III Surveillance Panel
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequenceiii/semiannualreports/IIIG-04-2005.pdf

Distribution: Electronic Mail

List of Figures

- Figures 1, 2, and 3 are EWMA severity and precision control charts and also the CUSUM Δ/s plots of PVIS, WPD, and ACLW, annotated with date lines, using the same data set as the EWMA severity and precision control charts. Transformed units are used, when appropriate.

- Figures 4, 5, and 6 are bar charts of average Δ/s, by report period, for PVIS, WPD, and ACLW.

- Figures 7, 8, and 9 are bar charts of pooled standard deviation, by report period, for PVIS, WPD, and ACLW.

- Figure 10 is EWMA severity and precision control charts and also the CUSUM Δ/s plots of MRV, annotated with date lines, using the same data set as the EWMA severity and precision control charts. Transformed units are used.

- Figure 11 is a bar chart of average Δ/s, by report period, for MRV.

- Figure 12 is a bar chart of pooled standard deviation, by report period, for MRV.

- Figure 13 is the Sequence IIIG/IIIGA Timeline.

Figure 1

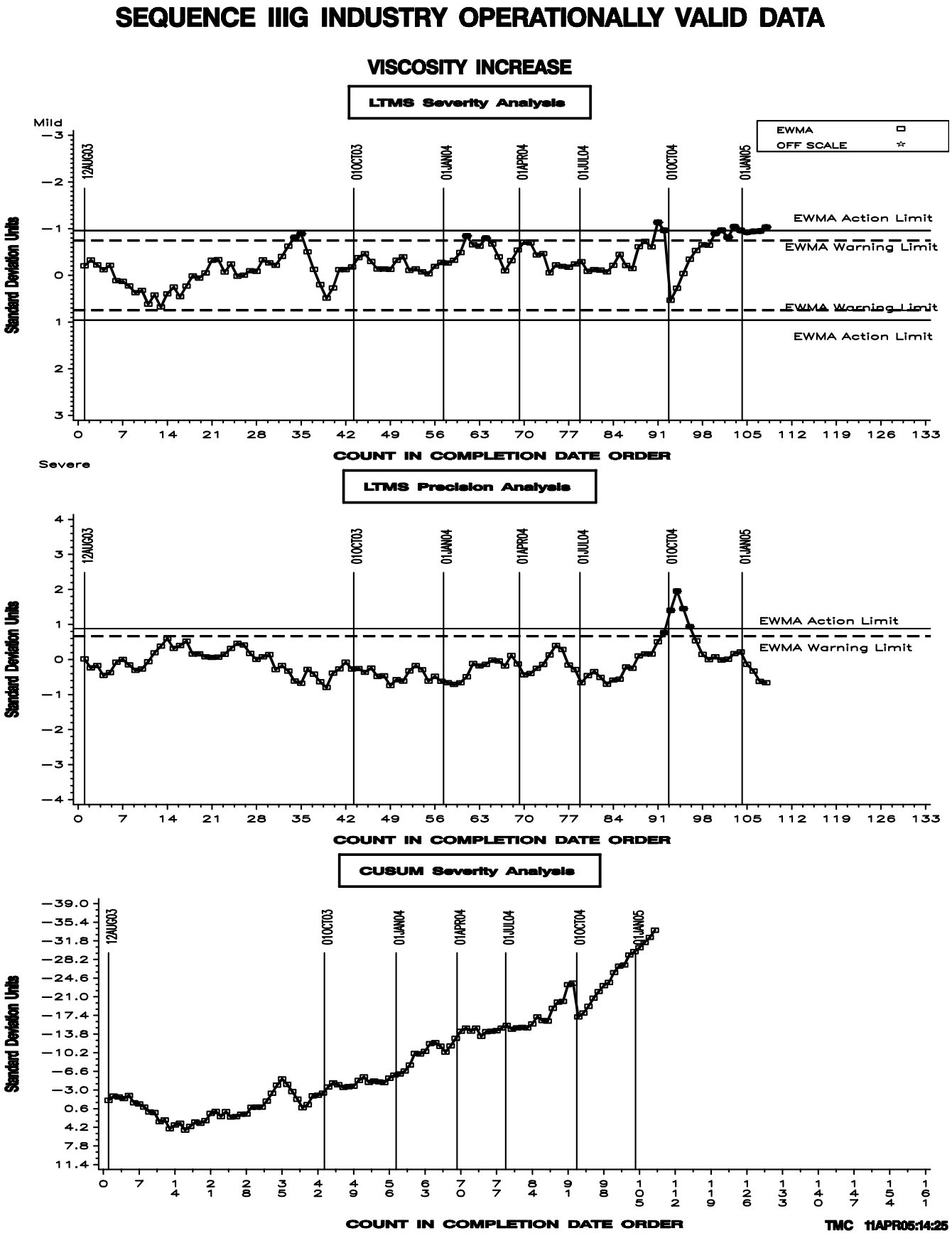

SEQUENCE IIIG INDUSTRY OPERATIONALLY VALID DATA
VISCOSITY INCREASE
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
12AUG03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
CUSUM Severity Analysis
TMC 11APR05:14:25

Figure 2

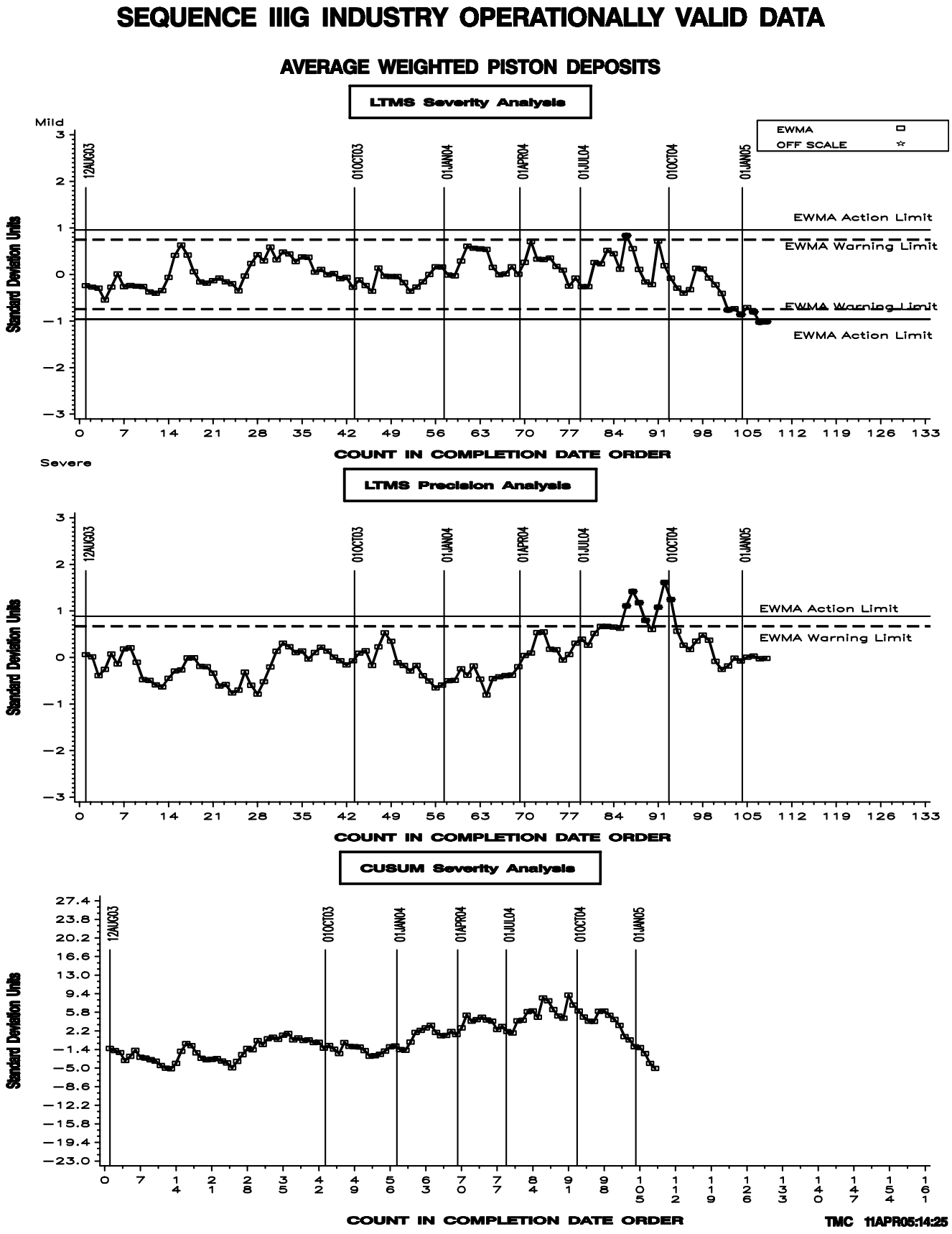

SEQUENCE IIIG INDUSTRY OPERATIONALLY VALID DATA
AVERAGE WEIGHTED PISTON DEPOSITS
LTMS Severity Analysis
Mild
Severe
EWMA
OFF SCALE
12AUG03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
EWMA Action Limit
EWMA Warning Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
CUSUM Severity Analysis
TMC 11APR05:14:25

Figure 3

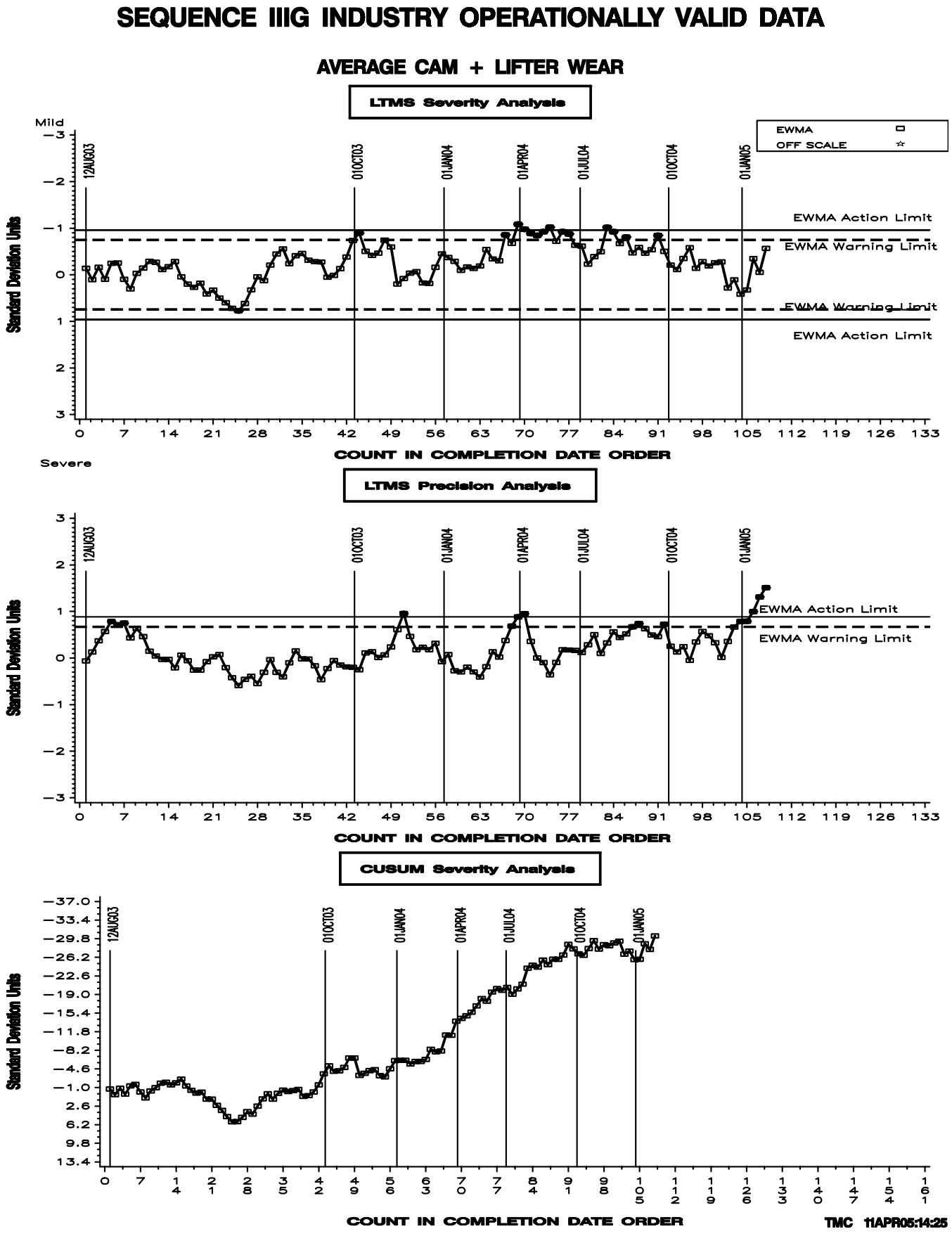

SEQUENCE IIIG INDUSTRY OPERATIONALLY VALID DATA
AVERAGE CAM + LIFTER WEAR
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
12AUG03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
CUSUM Severity Analysis
TMC 11APR05:14:25

Figure 4 - Percent Viscosity Increase, Average Delta/s

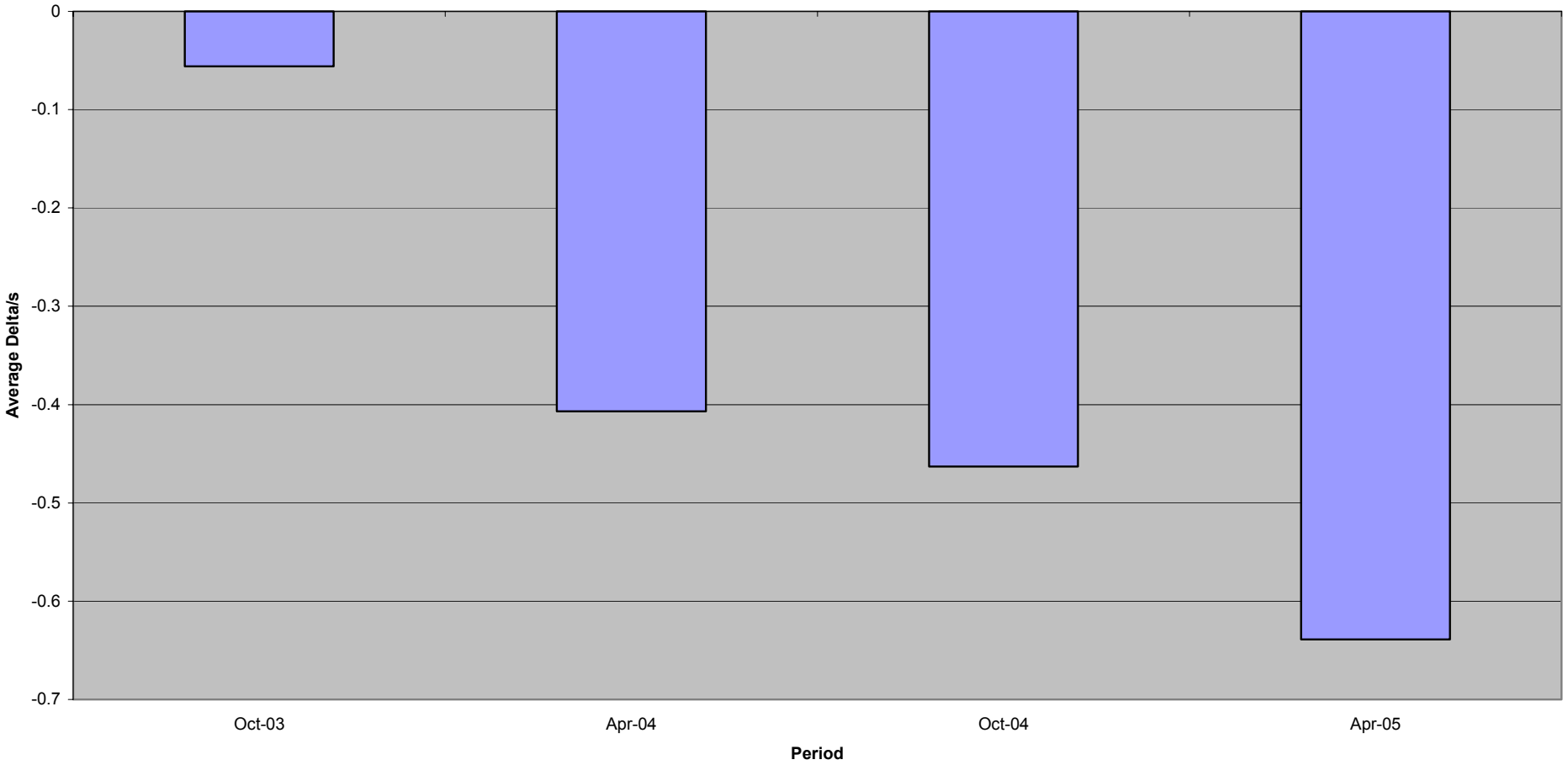


Figure 5 - Weighted Piston Deposits, Average Delta/s

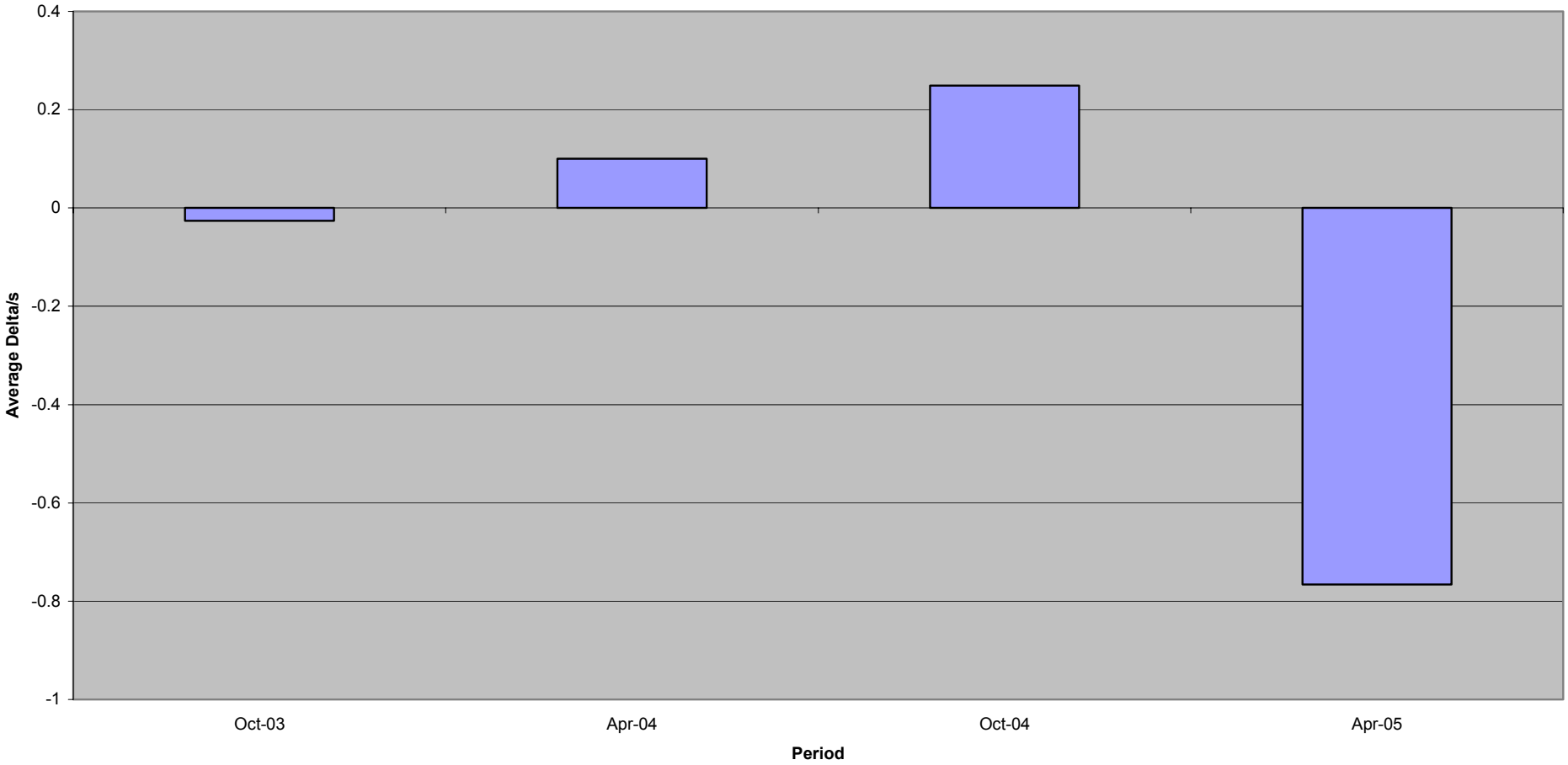


Figure 6 - Average Camshaft plus Lifter Wear, Average Delta/s

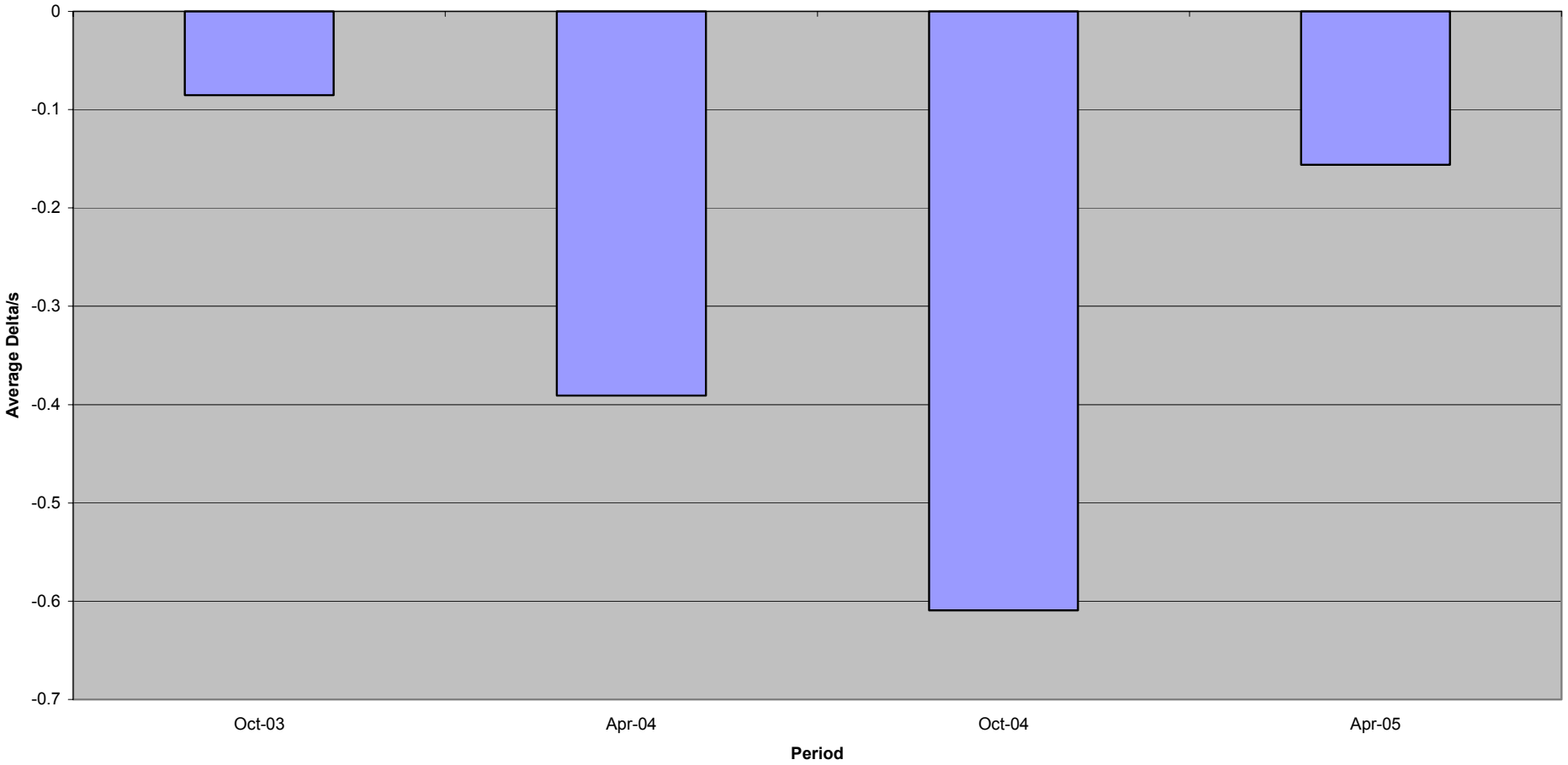


Figure 7 - Percent Viscosity Increase, Pooled Standard Deviation

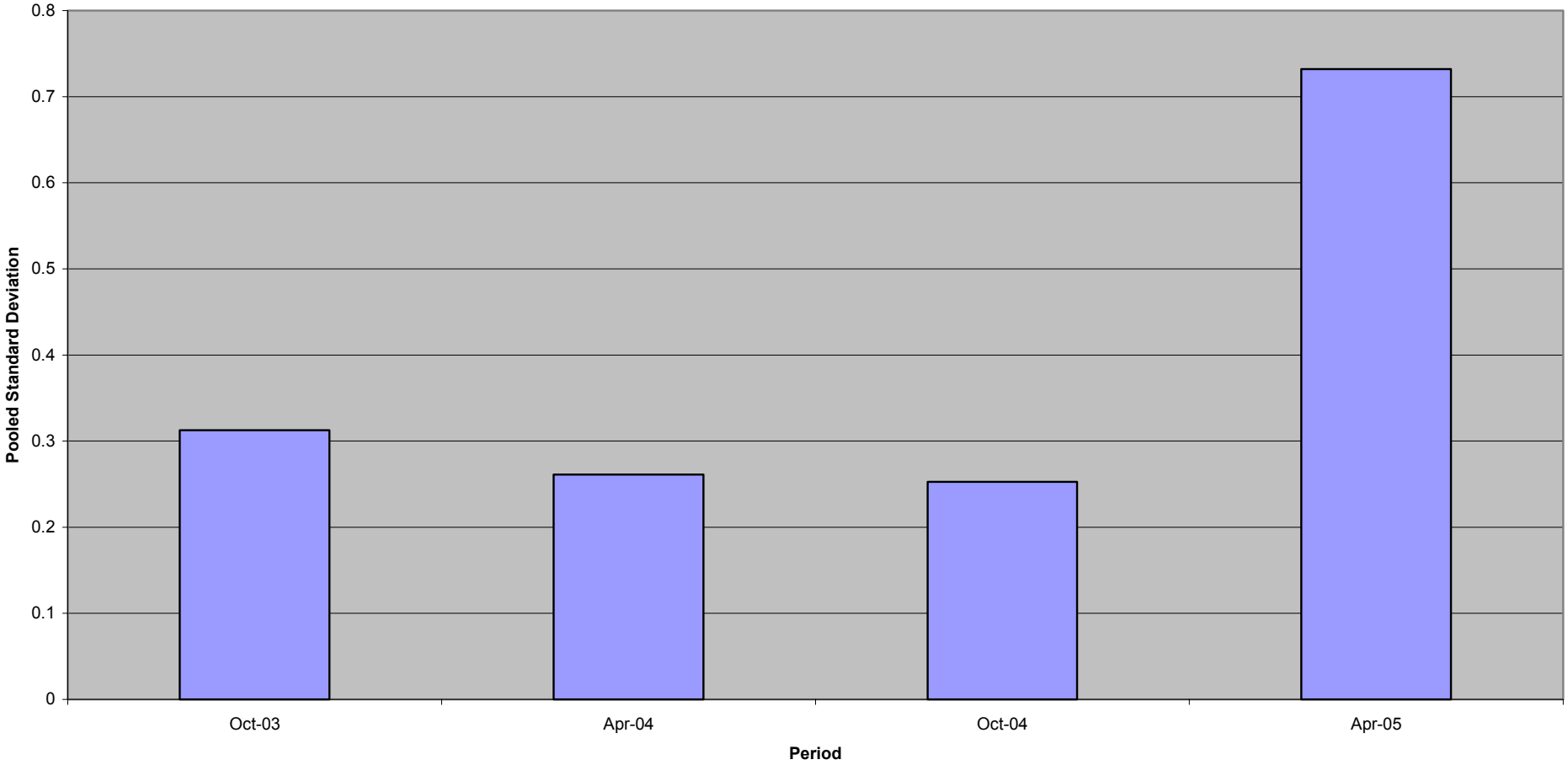


Figure 8 - Weighted Piston Deposits, Pooled Standard Deviation

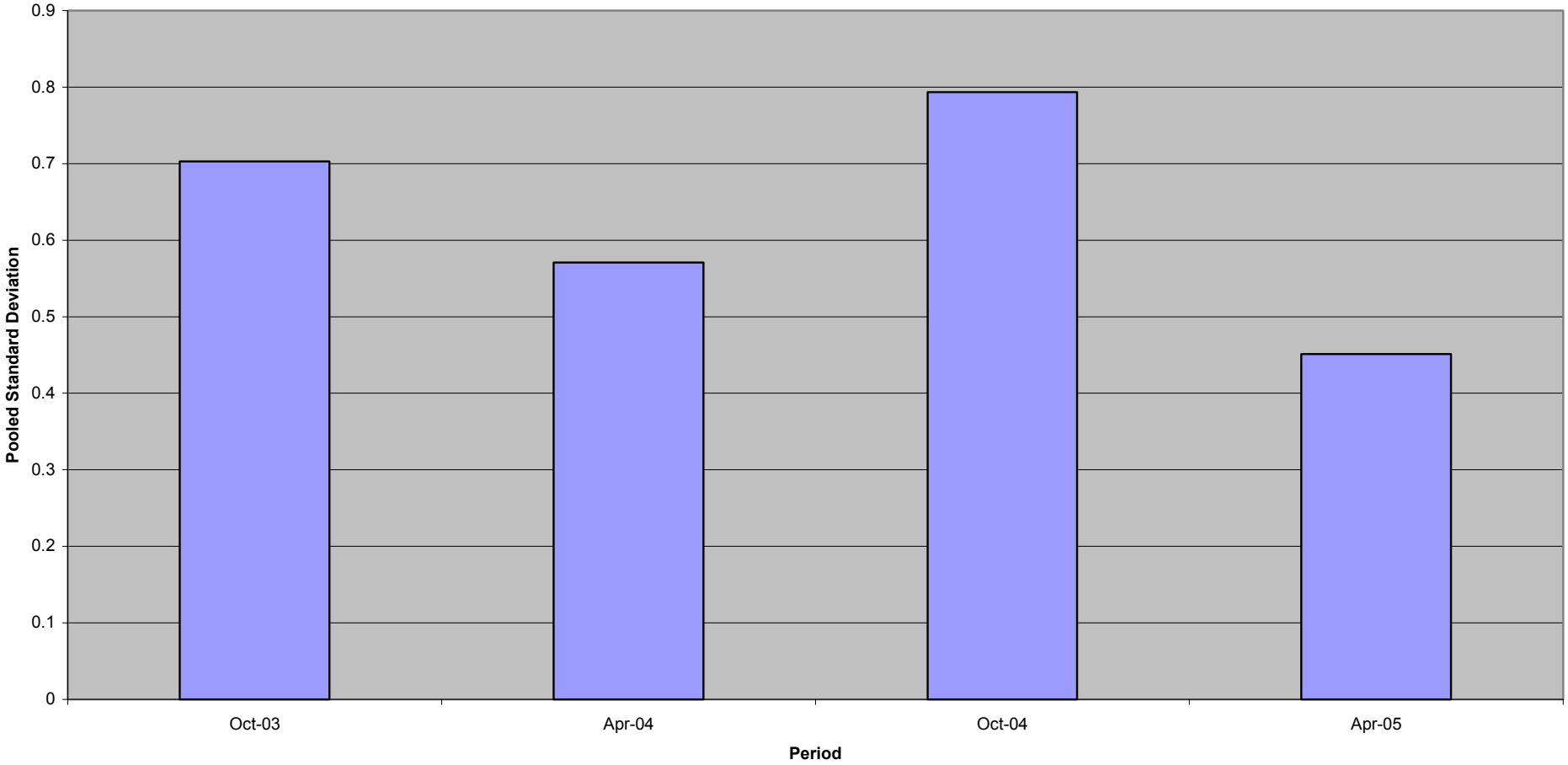


Figure 9 - Average Camshaft plus Lifter Wear, Pooled Standard Deviation

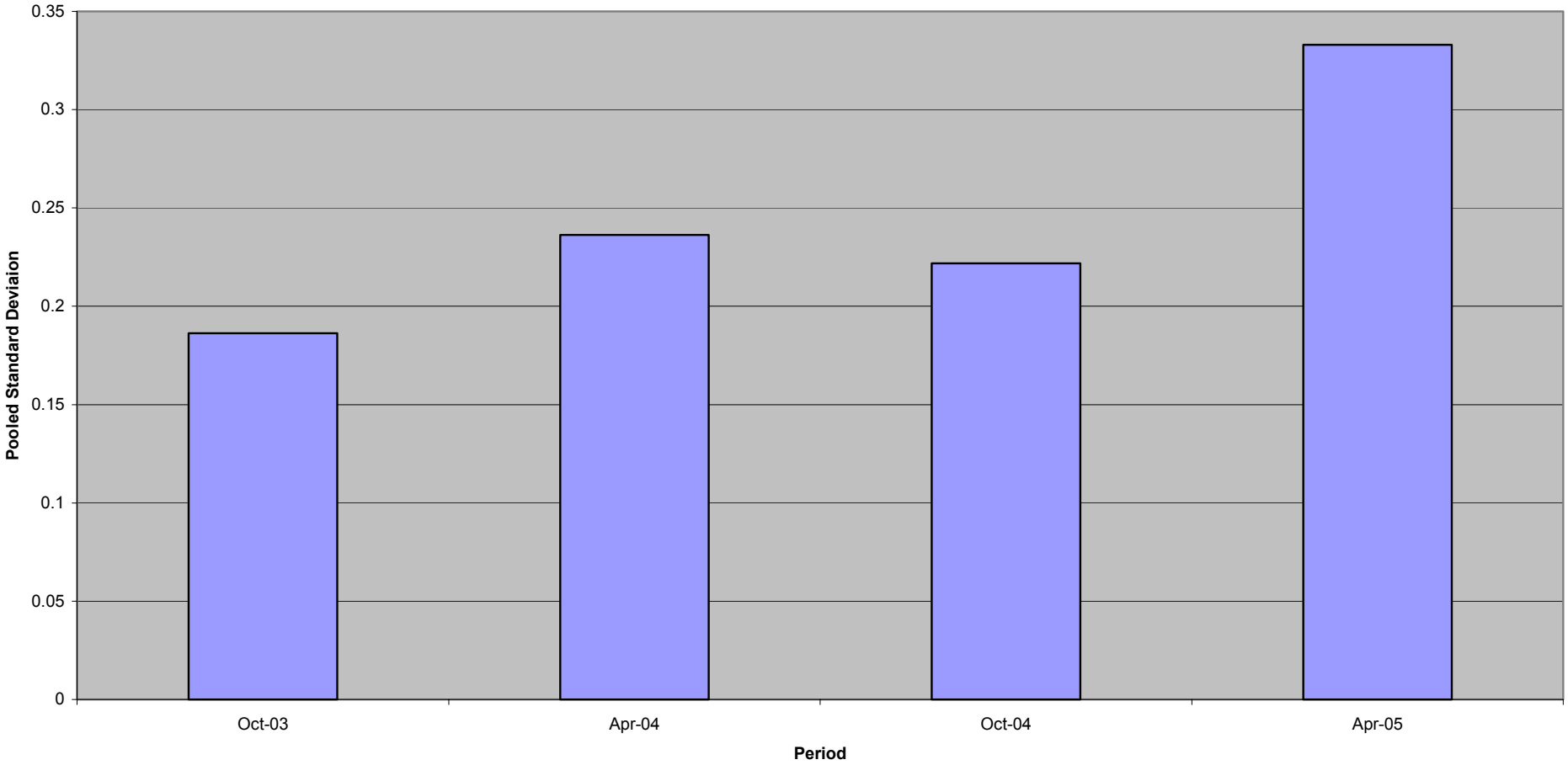


Figure 10

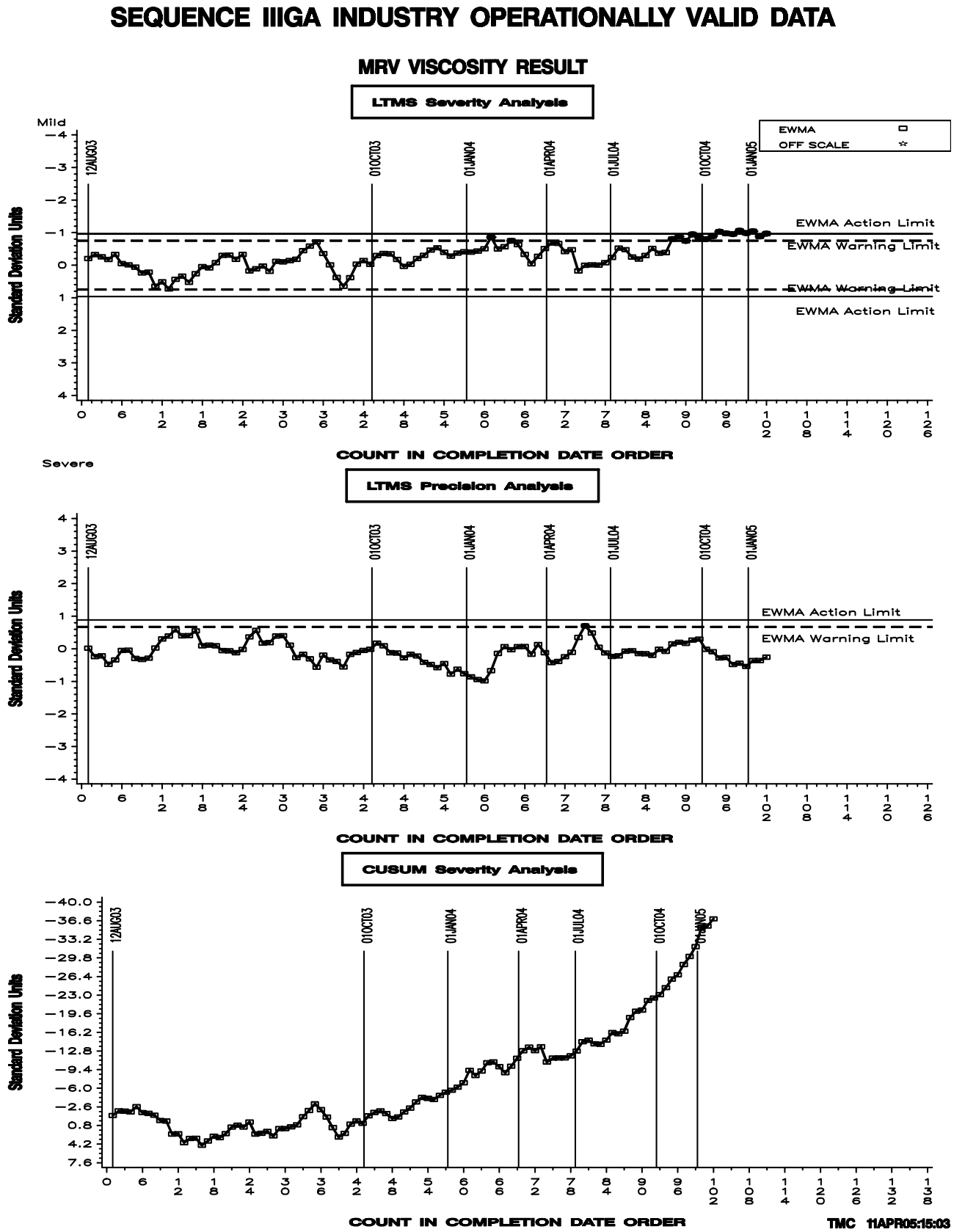

SEQUENCE IIIGA INDUSTRY OPERATIONALLY VALID DATA
MRV VISCOSITY RESULT
LTMS Severity Analysis
Mild
Standard Deviation Units
EWMA
OFF SCALE
12AUG03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
COUNT IN COMPLETION DATE ORDER
Severe
LTMS Precision Analysis
Standard Deviation Units
EWMA Action Limit
EWMA Warning Limit
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
TMC 11APR05:15:03

Figure 11 - Mini Rotary Viscometer result, Average Delta/s

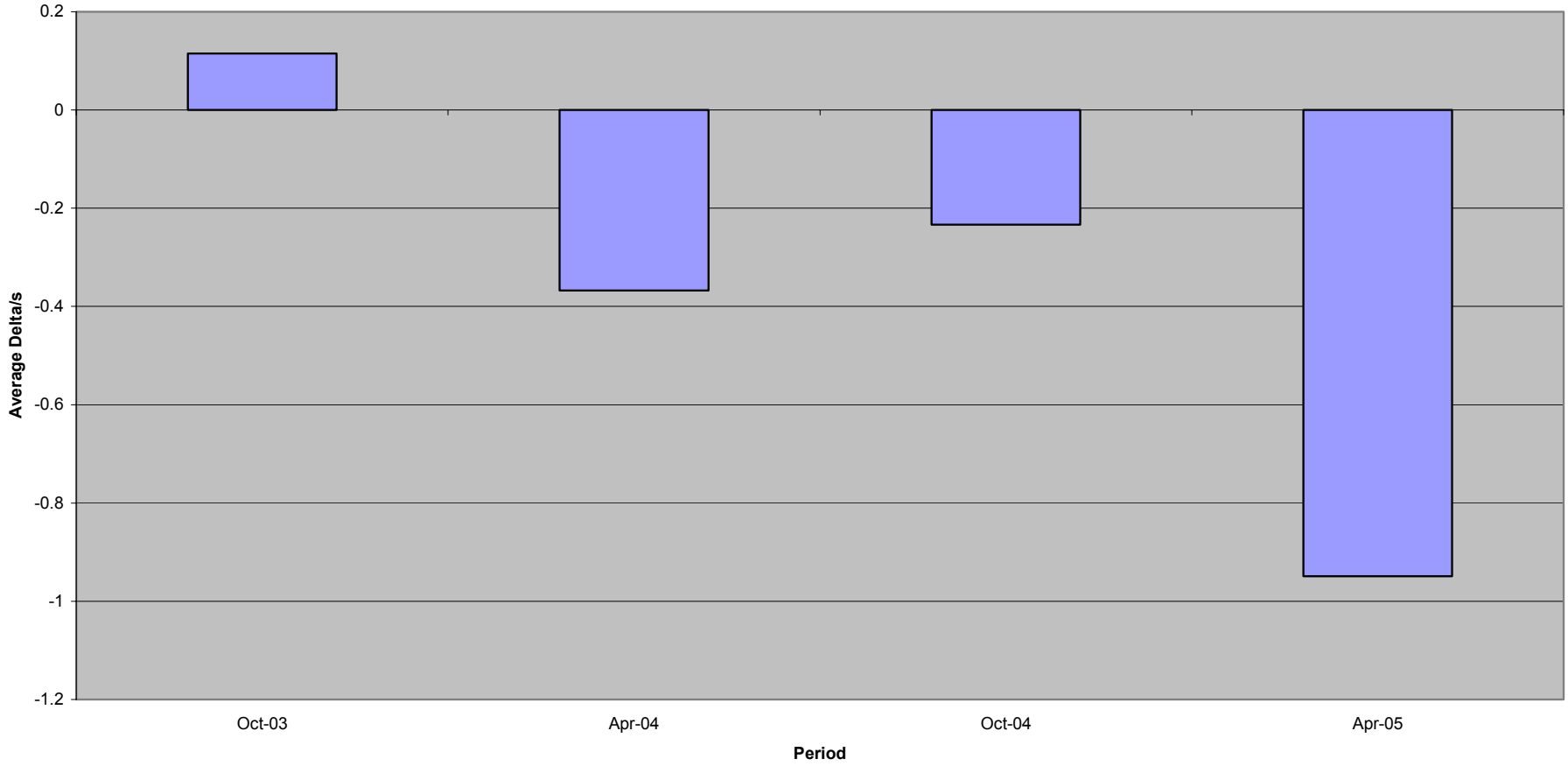


Figure 12 -Mini Rotary Viscometer result, Pooled Standard Deviation

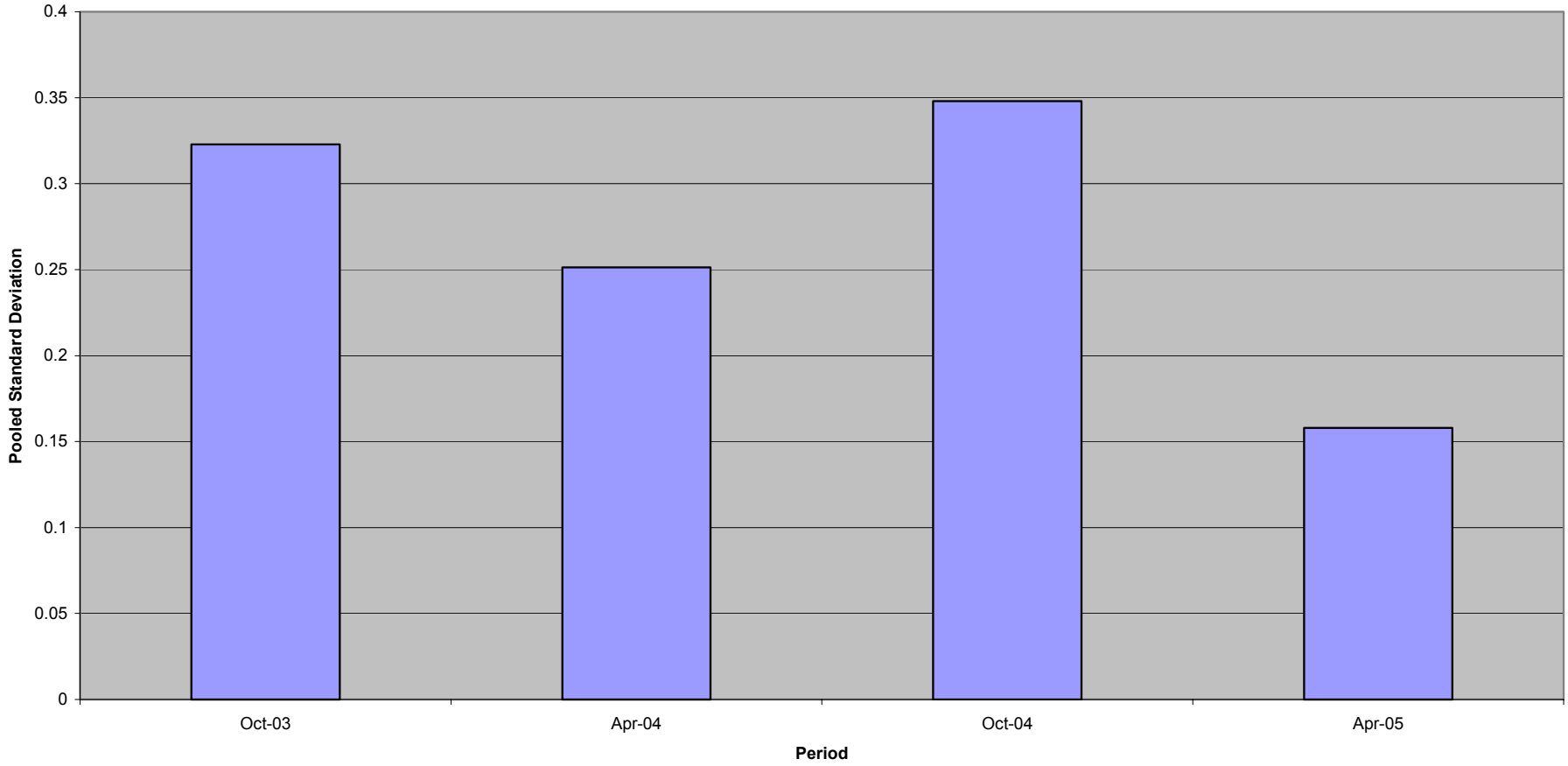


Figure 13 – Sequence IIIG/IIIGA Timeline

Effective Date	Topic	Info Letter
8/19/2003	Draft Sequence IIIG Test Procedure Issued	03-1
9/9/2003	Revised Valve Spring Load Specifications	03-2
9/23/2003	Revised Test Numbering Methodology	03-3
10/29/2003	Revised Fuel Pressure Specification	03-4
10/29/2003	Automatic Parts Cleaning Machine Maintenance Requirements Added	03-4
10/29/2003	Main Bearing Bore Mandrel Made Optional	03-4
10/29/2003	Piston Ring Cleaning Requirements	03-4
10/29/2003	Additional Allowable RTV Sealing Compound Allowed	03-4
10/29/2003	Main Bearing Cap Bolt Replacement Specifications	03-4
10/29/2003	Revised Camshaft Measurement Procedure	03-4
10/29/2003	Revised Camshaft Lubrication & Installation Procedure	03-4
10/29/2003	Revised Oil Consumption Reporting Procedure	03-4
10/29/2003	Fluid Conditioning Module Equipment Specifications	03-4
10/29/2003	Revised Camshaft Measurement Equipment Specifications	03-4
10/29/2003	Rating Workshop Attendance Requirement	03-4
11/4/2003	Elimination of CCS & MRV from IIIG test (creation of IIIGA test)	03-4
12/15/2003	New Honing Technique approved and added to Assembly Manual	
1/20/2004	Elimination of transform from ACLW results on oil 438 in LTMS; other oils still transformed	
1/20/2004	New Pooled s for ACLW SA calculation, based upon 434 and 435 only	
3/23/2004	Transform put back on 438 ACLW results, for all data. Control charts recalculated and effective today	
4/2/2004	Revised Intake Manifold Gasket	04-1
4/2/2004	Additional Allowable Sealing Materials	04-1
5/12/2004	Undercrown Rating Area Definition Clarification	04-2
5/12/2004	Flow Meter Specifications	04-2
5/12/2004	Editorial Corrections to Draft 2D	04-2
5/12/2004	MRV Reporting	04-2
5/12/2004	Amount of Oil Used for Camshaft & Lifter Lubrication	04-2
11/4/2004	Powdered Metal Connecting Rod Torque Specifications	04-3
11/4/2004	New Front and Rear Main Seals	04-3
11/4/2004	New Oil Pan Gaskets	04-3
11/4/2004	New Exhaust Valves	04-3
11/4/2004	Editorial Change to Precision Statements	04-3
1/7/2005	Updated Precision Statements	05-1
1/7/2005	Engine Build Worksheets	05-1
1/7/2005	Clarification of Solvent Specifications	05-1
1/7/2005	Provisions for Adjustment to Calibration Period for Donated Oil Test Programs	05-1