




# Test Monitoring Center

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

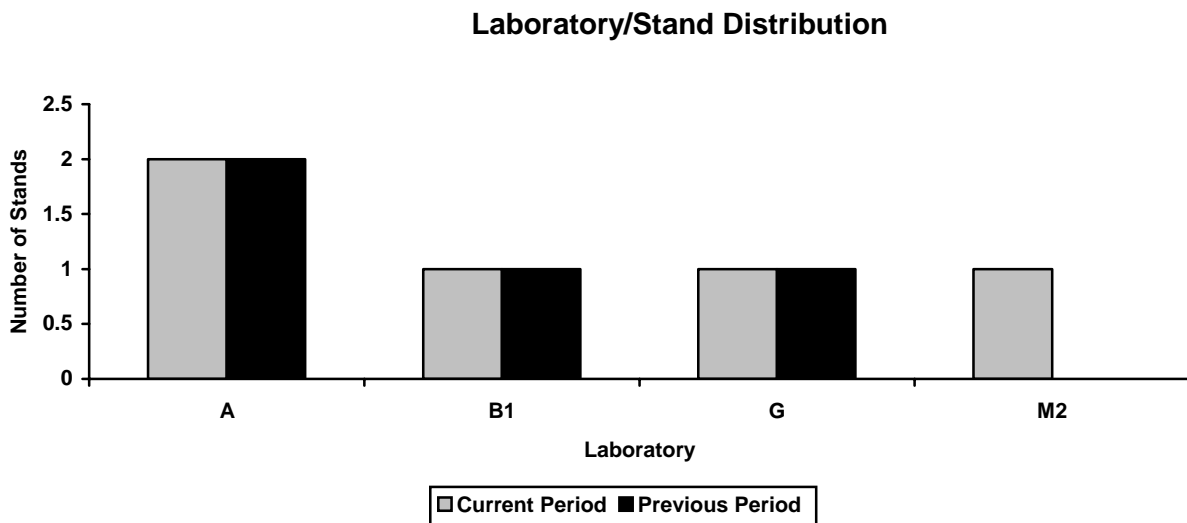
Memorandum: 07-005  
Date: April 5, 2007  
To: Dave Glaenger, Chairman, Sequence IIF Surveillance Panel  
From: Richard E. Grundza   
Subject: Sequence IIF Semiannual Report: October 1, 2006 through March 31, 2007

The following is a summary of Sequence IIF reference tests that were reported to the Test Monitoring Center during the period October 1, 2006 through March 31, 2007.

## Lab/Stand Distribution

	Reporting Data	Calibrated as of March 31, 2007
Number of Laboratories:	4	4
Number of Test Stands:	5	5

The following chart shows the laboratory/stand distribution:

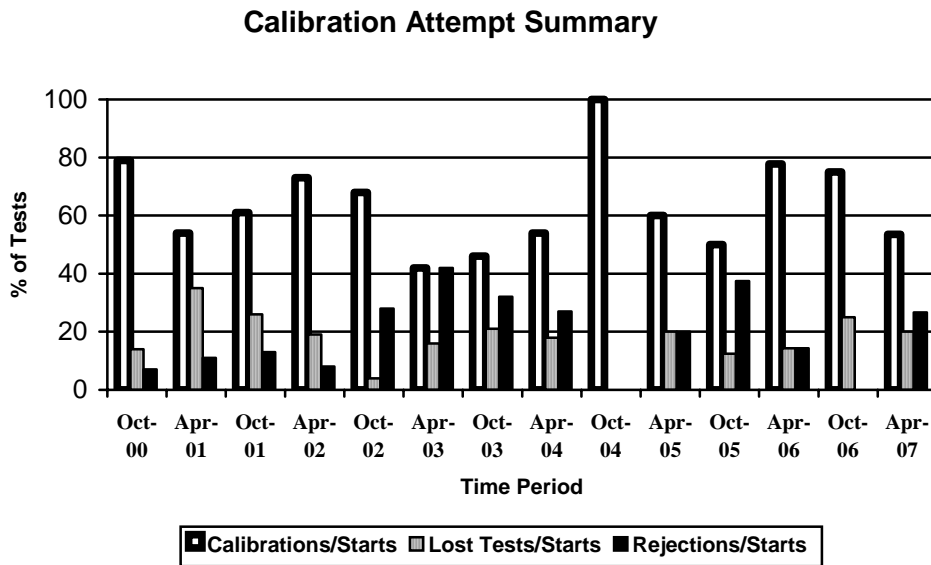


The following summarizes the status of the reference oil tests reported to the TMC:

Calibration Start Outcomes	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	8
Operationally Invalid (Laboratory Judgment)	LC	3
Operationally Valid, Statistically Unacceptable	OC	3
Aborted	XC	1
Total		15

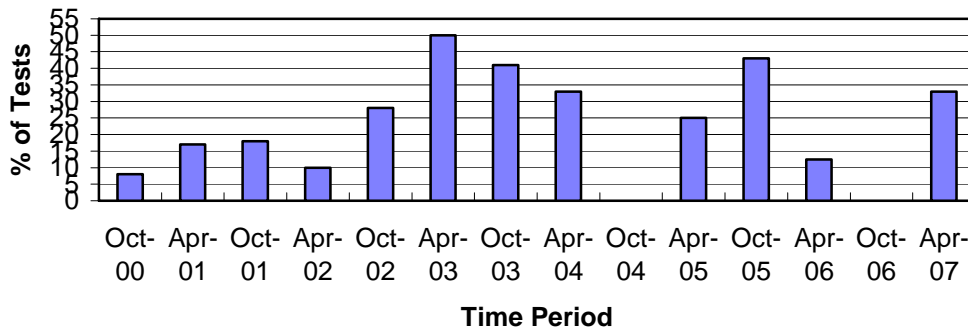
Donated & Industry Support Outcomes	TMC Validity Codes	No. of Tests
Decoded Oil	OG	0
Total		0

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



The calibration and lost test per start rates have decreased, while has rejected test per start rate has increased with respect to the previous period. All rates for the period compare well with historical rates.

### Rejected Test Rate for Operationally Valid Tests



The rate of rejection of operationally valid tests has increased from last period.

Three tests failed the acceptance criteria this report period. Two tests failed mild for viscosity increase, while the third test was severe for screened average cam and lifter wear. The tests failing for viscosity increase were run in the same laboratory.

There were no LTMS Deviations written this period. There have been four deviations from the LTMS since its introduction in June of 2000.

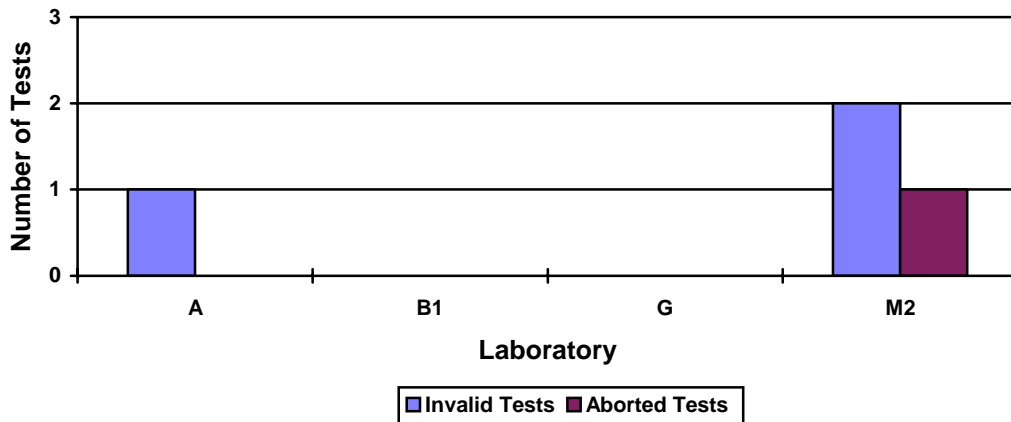
No Sequence IIIF lab visits were performed this period.

#### Lost Test Summary

Four 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/MC)
A	Intake air, load and coolant flow QI below 0.000	1	1/0/0/0
M2	Computer problem, extended idle at end of test	1	1/0/0/0
M2	Remote filter oil bypass failed	1	0/0/1/0
M2	Load cell failed	1	1/0/0/0

#### Lost Test Distribution



Information Letters

Sequence IIIF Information Letter No. 06-3 Sequence No. 22, was issued during the period on October 3, 2006 and contained: Changes in connecting rod design and updated part numbers.

Sequence IIIF Information letter 06-4 No. 23, was issued during the period on November 20, 2006, and contained: Revisions to rater requirements.

Sequence IIIF Information letter 07-1 No. 24, was issued during the period on March 19, 2007, and contained: Provisions for IIIF viscosity increase test only.

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 period. Also below is a summary of the average  $\Delta/s$  value, by parameter, for all laboratories reporting data during this period.

Industry Severity Summary			
Parameter	Average $\Delta/s$	Pooled standard deviation (degrees of freedom)	Average $\Delta$ , in reported units
PVIS	0.146	0.016 (df=10)	-20.1% Viscosity Increase <sup>1</sup>
APV	0.789	0.13 (df=10)	0.10 Merits
WPD	0.652	0.73 (df=10)	0.48 Merits
PV60 <sup>2</sup>	-0.017	0.21 (df=10)	-1.0 Viscosity Increase <sup>3</sup>

<sup>1</sup> At the GF-3 Pass Limit of 275% Viscosity Increase

<sup>2</sup> Not a pass/fail parameter in the Sequence IIIF test; Sequence IIIFHD use only

<sup>3</sup> At the CH-4 Pass Limit of 295% Viscosity Increase @ 60 Hours; Sequence IIIFHD use only.

Average $\Delta/s$ Results, by Laboratory				
Laboratory	PVIS	APV	WPD	PV60
A	-0.994	0.719	-0.072	0.960
B1	1.246	1.068	1.245	-1.705
G	-0.634	0.435	-0.052	0.865
M2	1.265	1.038	1.576	-0.991

*Percent Viscosity Increase (PVIS)*

The industry severity control charts were in control for the period (see Figure 1). With the exception of four warning alarms, occurring midway through the period, precision control charts were in control for most of the period. Industry performance was mild for the period, with an average  $\Delta/s$  value of 0.146 for the period (see Figures 1 & 5), which equates to a shift of 20.1 % in reported units. Precision for the period has improved with respect to the previous period (see Figure 9).

*Weighted Piston Deposits (WPD)*

With the exception of two warning alarms and an action alarm, severity was in control for the period. Precision was in control the entire period (see Figure 2). The severity warning and action alarms appear to be laboratory related. Industry was 0.48 merits mild for the period with an average  $\Delta/s$  value of 0.652 (see Figure 6). Precision has degraded with respect to the previous period with a standard deviation of 0.73 (see Figure 10).

*Average Piston Skirt Varnish (APV)*

Industry severity was in warning or action alarm for seven of the eleven tests reported during the period (see Figure 3). The industry precision was in control for the period. Industry was mild for the period with an average  $\Delta/s$  value of 0.789, or 0.10 merits (see Figure 7). Precision for the period has improved when compared with the previous period with a pooled standard deviation of 0.13 (see Figure 11).

*Average Camshaft-plus-Lifter Wear (ACLW)/Screened Average Camshaft-plus-Lifter Wear (SACLW)*

There was one failing test this report period.

*Percent Viscosity Increase at 60 Hours*

The industry control chart for PV60 is shown in Figure 4. The average  $\Delta/s$  and pooled standard deviation for this period, and previous report periods, are shown in Figures 8 and 12 respectively. This parameter is not a pass-fail parameter in the Sequence IIIF test and is used only in Sequence IIIFHD testing. Therefore, the industry control charts are presented for information purposes only and any alarms shown on those charts do not require action by the Sequence IIIF Surveillance Panel. A review of Figure 4 shows that the industry was in control for most of the period, sounding a mild warning alarm at the beginning of the period.

QI Deviations

There were no QI Deviations written this period. There have been a total of 25 QI Deviations written since the test was introduced in June of 2000.

Hardware

A new connecting rod type was introduced during the period, designated PMNS. This rod was used in ten of the eleven operationally valid tests reported this period. This connecting rod is similar in manufacturing and material as the previous connecting rod, except that the oil diversion slot has been removed.

Reference Oils

Oil	TMC Inventory, in gallons	TMC Inventory, in tests (4 gal/test)	Laboratory Inventory, in tests	Estimated life
1006	41	10	7	Not currently used in IIF <sup>1</sup>
1006-2	4,548	1137	7	~3+ years <sup>1</sup>
1007	420	105	4	Not currently used in IIF <sup>2</sup>
1008	29	7	8	No longer shipped <sup>1</sup>
1008-1	1,251	312	8	~3+ years <sup>1</sup>
1009	688	172	3	Not currently used in IIF <sup>1</sup>
432	117	28	10	Not currently used in IIF
433	10	2	2	No longer shipped
433-1	533	133	6	~3+ years

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

<sup>2</sup> Not reblendable

Introduction of the GF-3 Category Oil, Reference Oil 1009, has been tabled indefinitely.

REG/reg

Attachments

c: F. M. Farber, TMC

Sequence IIF Surveillance Panel

<ftp://ftp.astmtmc.cmu.edu/docs/gas/sequenceiii/semiannualreports/IIF-04-2007.pdf>

Distribution: Electronic Mail

List of Figures

- Figures 1, 2, 3, and 4 are EWMA severity and precision control charts and also the CUSUM  $\Delta/s$  plots of PVIS, WPD, APV, and PV60, annotated with date lines, using the same data set as the EWMA severity and precision control charts. Transformed units are used, when appropriate.
- Figures 5, 6, 7, and 8 are bar charts of average  $\Delta/s$ , by report period, for PVIS, WPD, APV, and PV60.
- Figures 9, 10, 11, and 12 are bar charts of pooled standard deviation, by report period, for PVIS, WPD, APV, and PV60.
- Figure 13 is the Sequence IIIIF Timeline.

Figure 1

# SEQUENCE IIIF INDUSTRY OPERATIONALLY VALID DATA

## VISCOSITY INCREASE FINAL ORIG UNIT RES

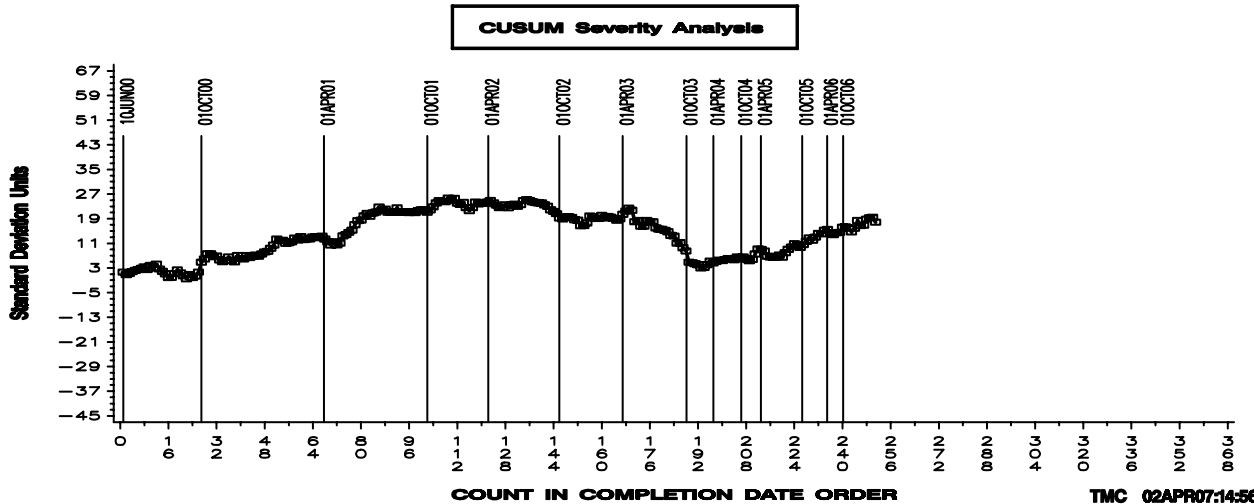
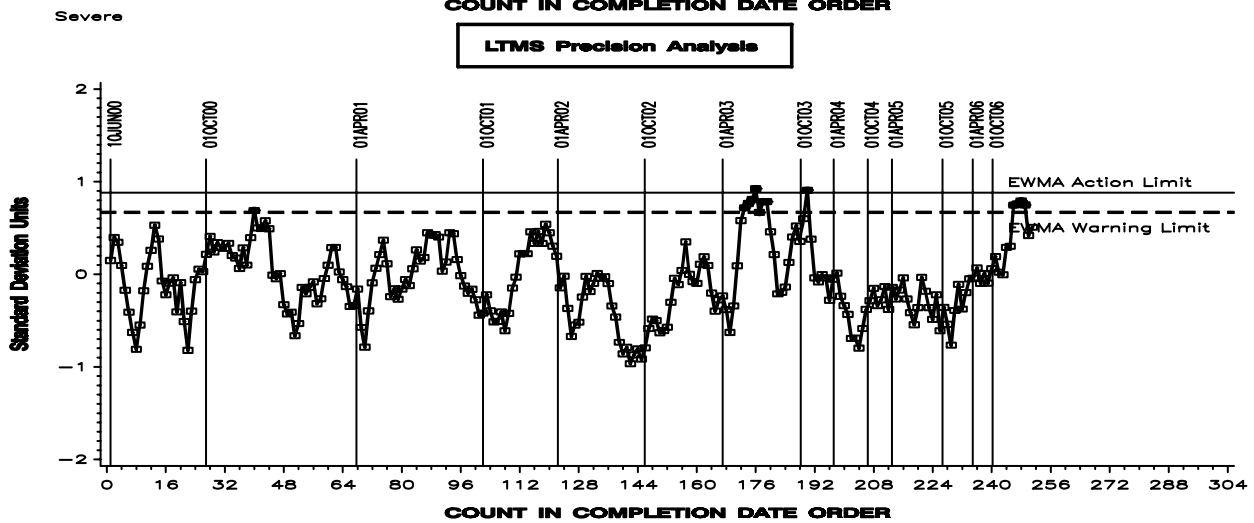
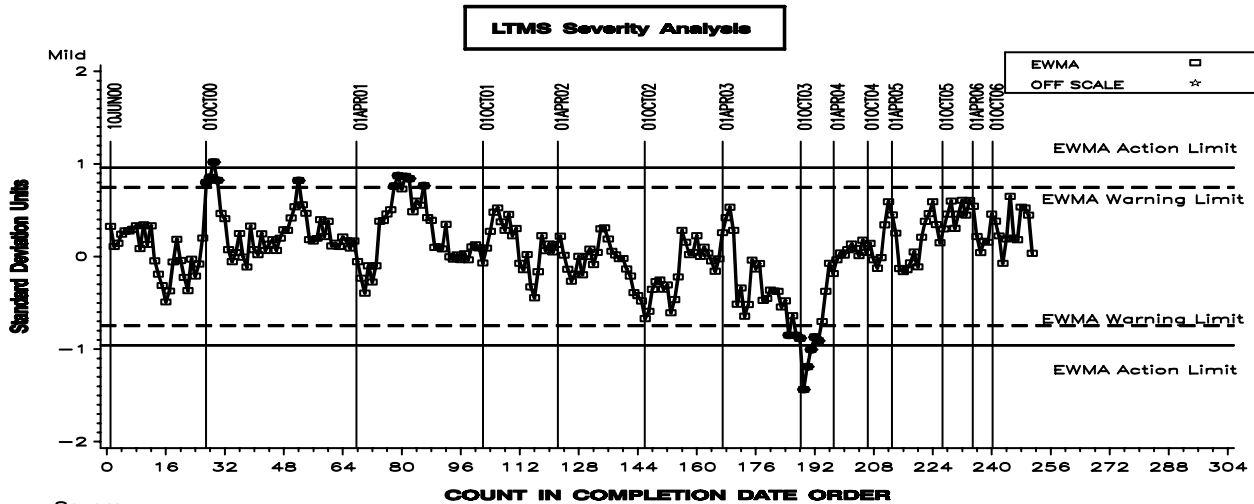




Figure 2

# SEQUENCE III F INDUSTRY OPERATIONALLY VALID DATA

## AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG UNIT RES

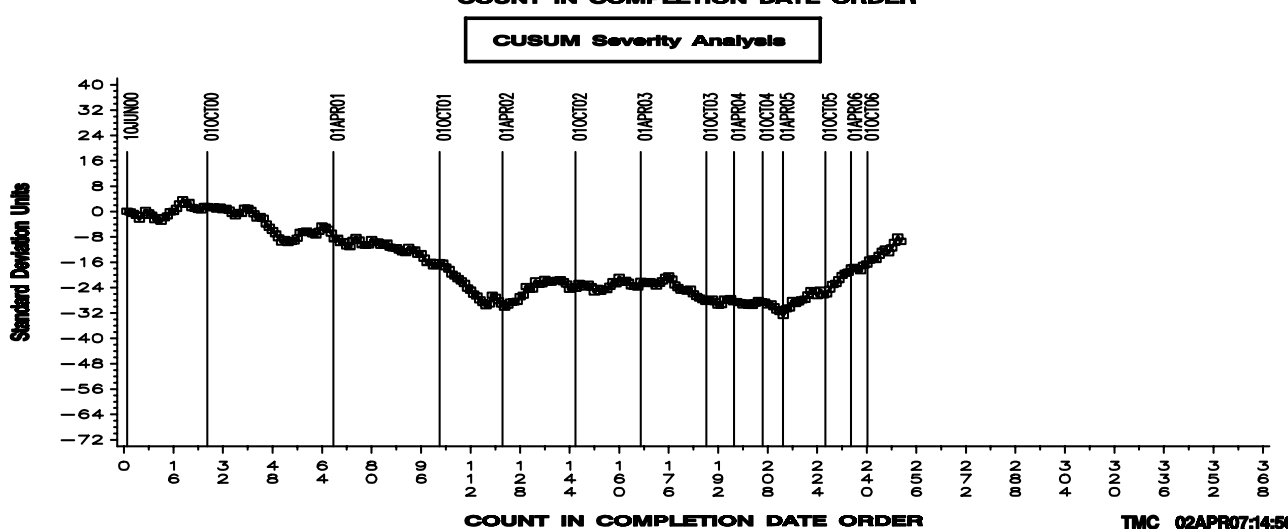
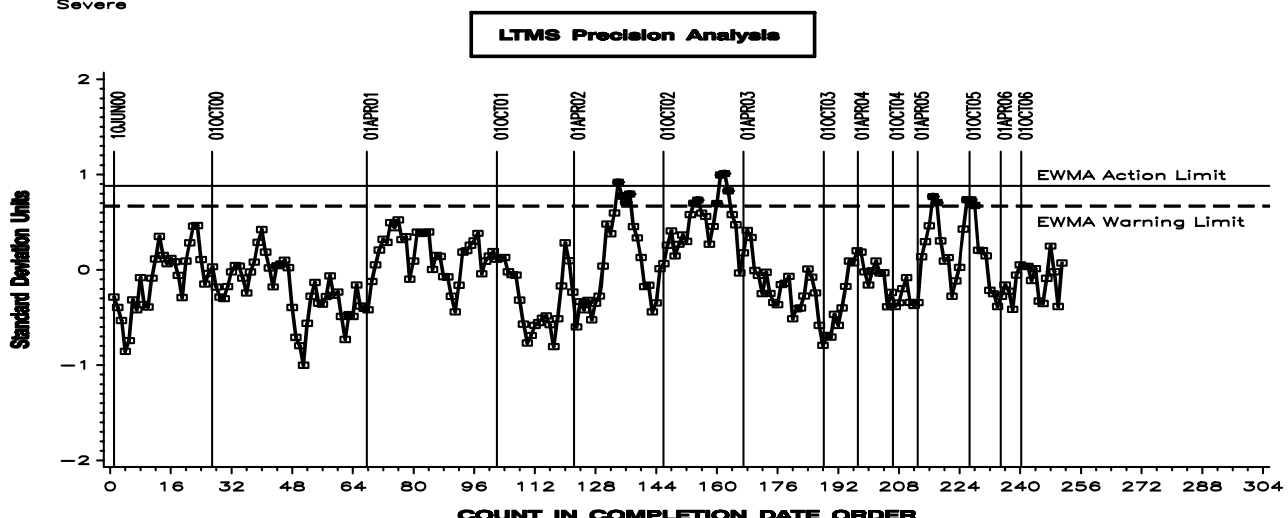
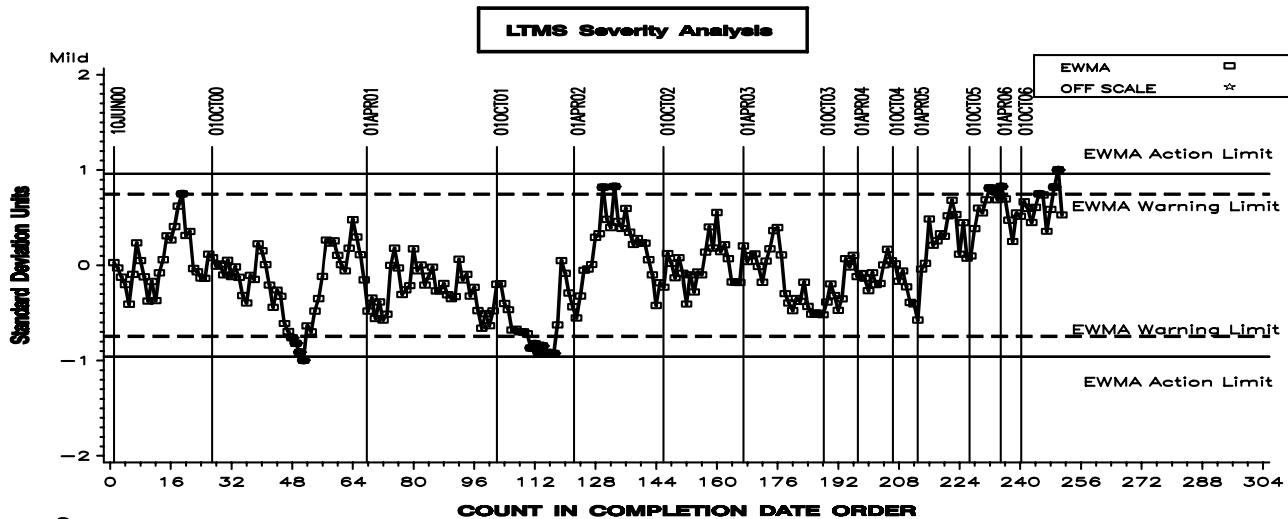


Figure 3

# SEQUENCE IIIF INDUSTRY OPERATIONALLY VALID DATA

## AVERAGE PISTON SKIRT VARNISH FINAL ORIG UNIT RES

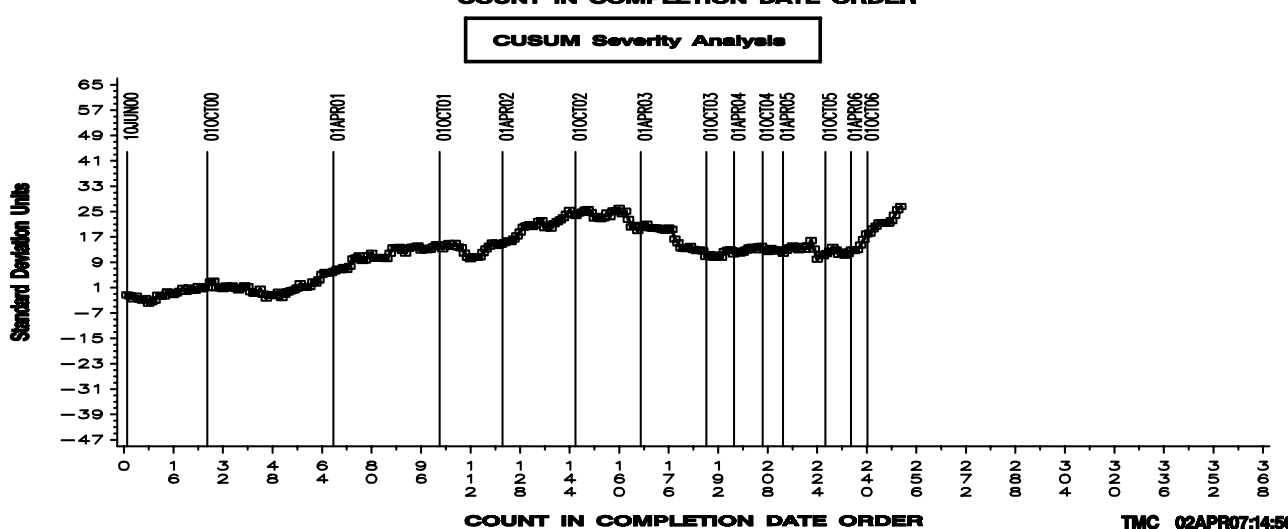
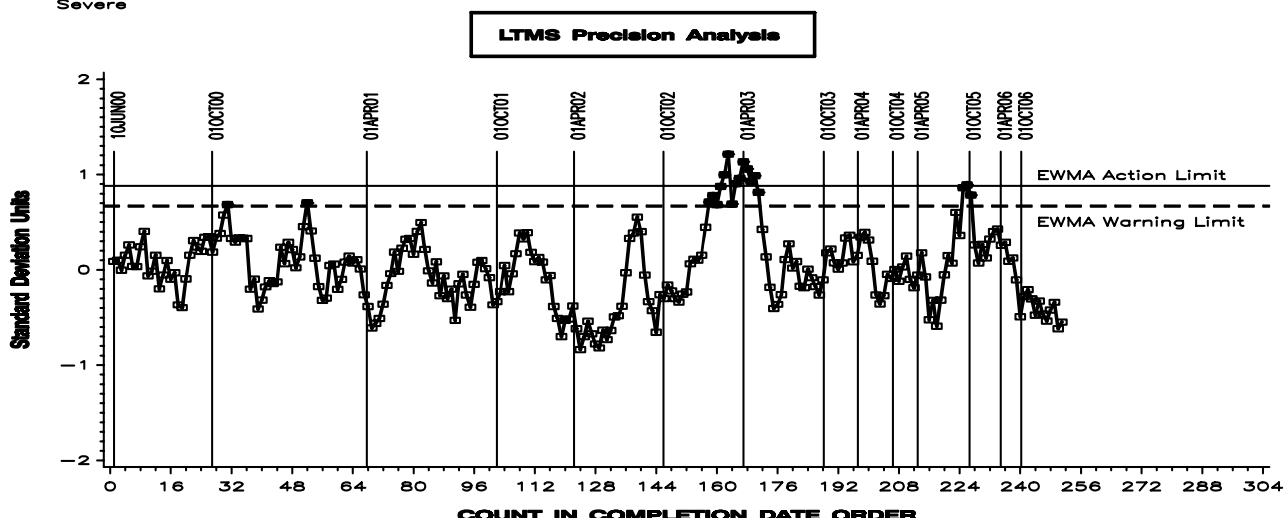
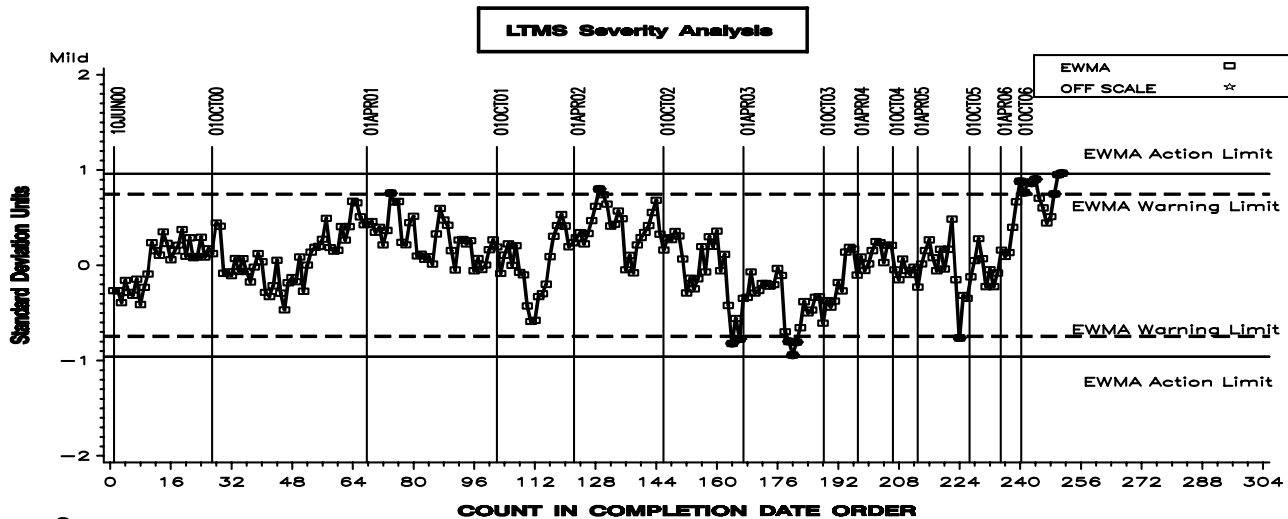


Figure 4

# SEQUENCE IIIF INDUSTRY OPERATIONALLY VALID DATA

## % VISCOSITY INCREASE @ 060 HOURS

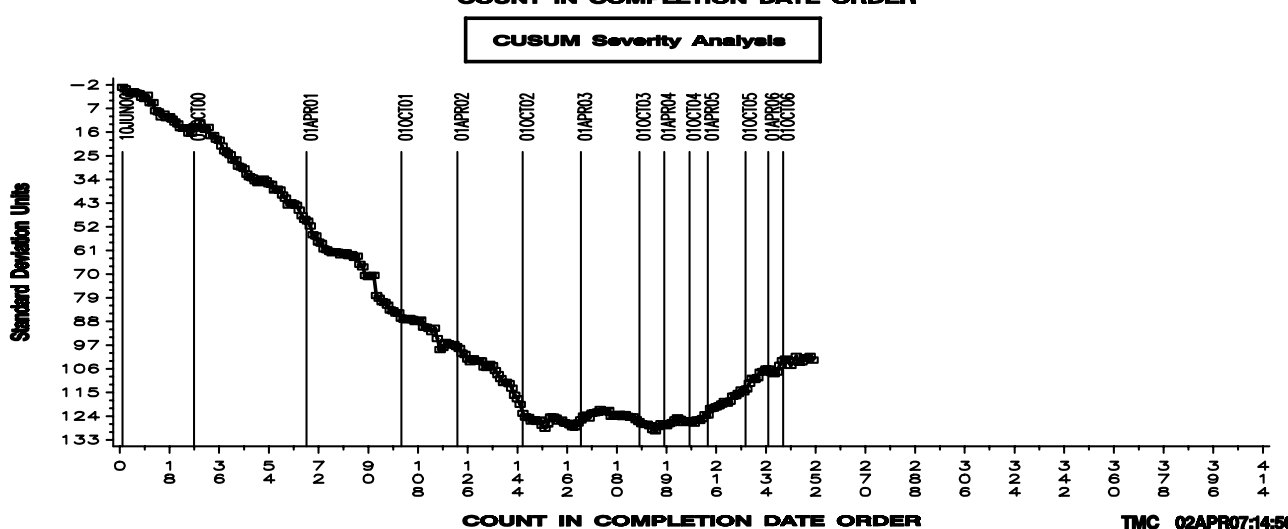
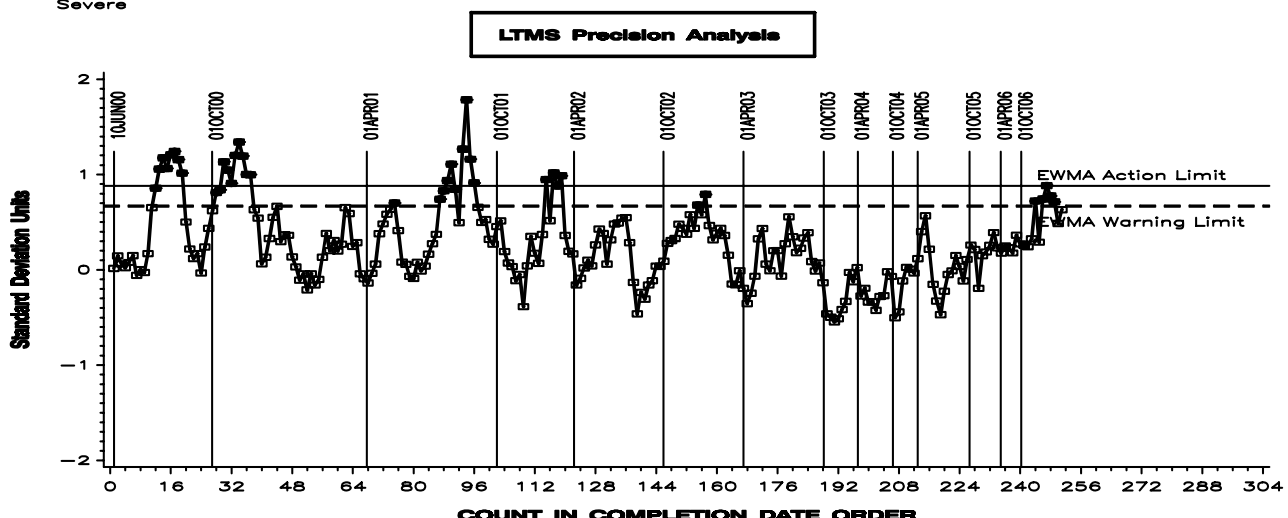
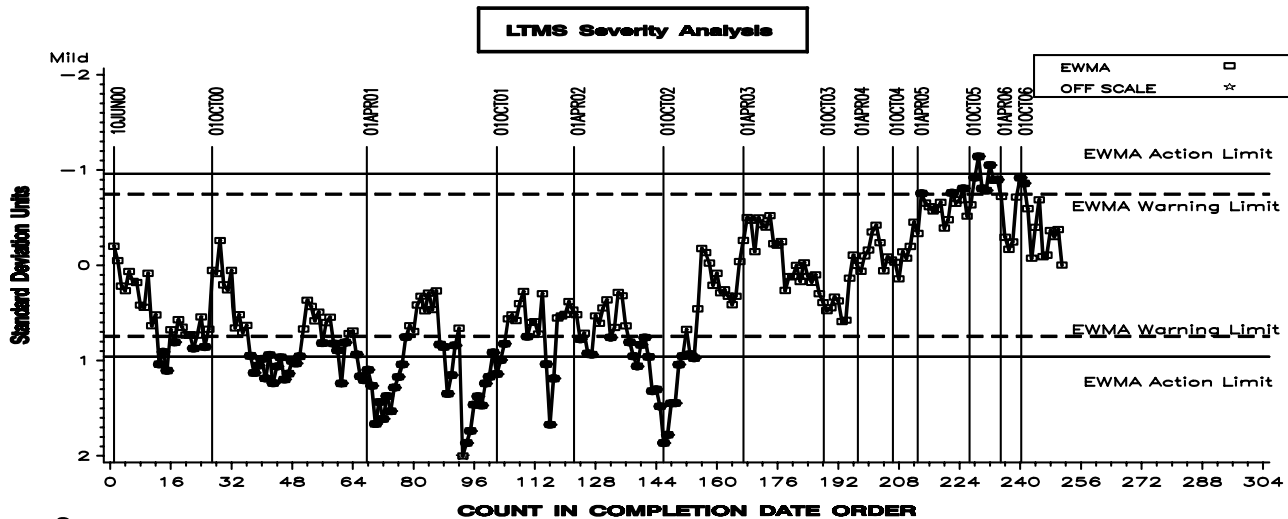


Figure 5 - Percent Viscosity Increase, Average Delta/s

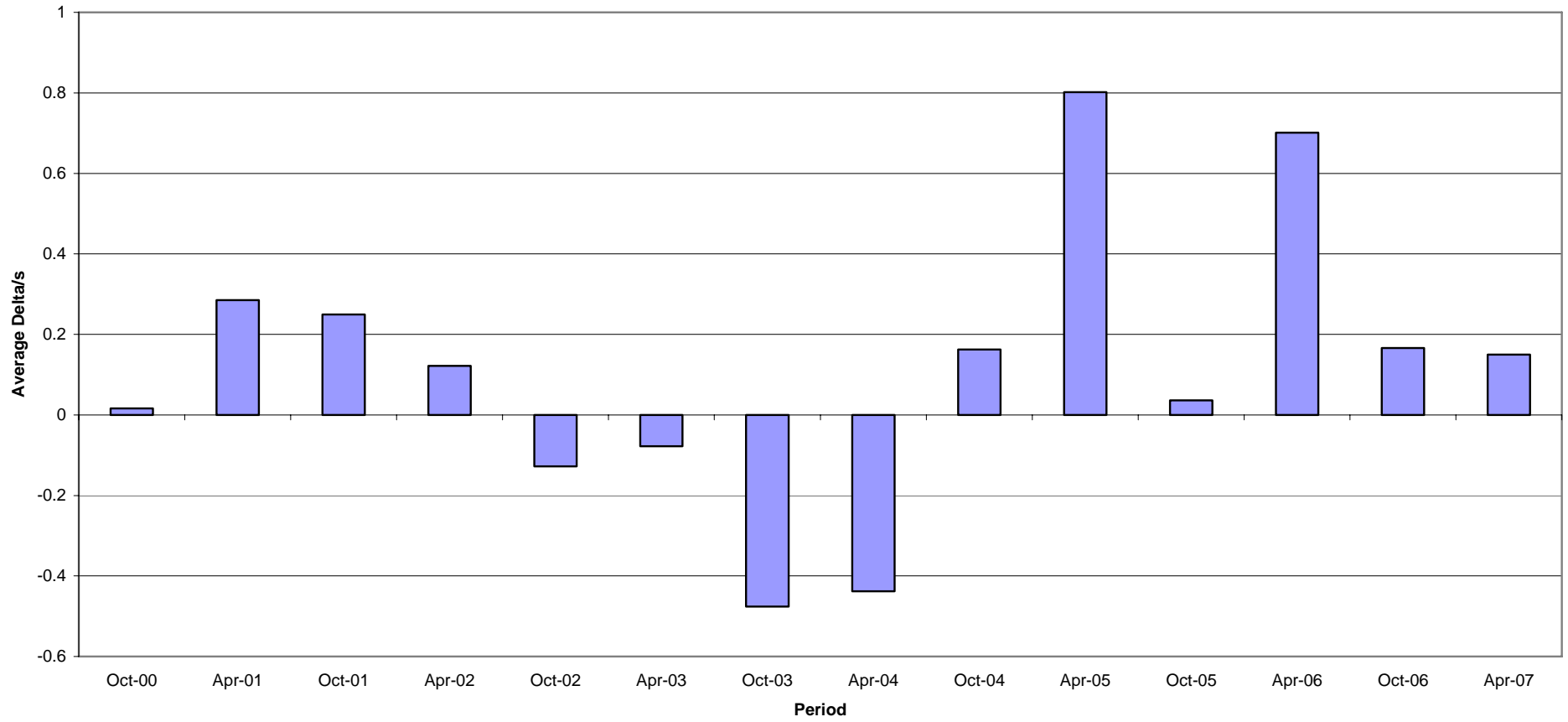


Figure 6 - Weighted Piston Deposits, Average Delta/s

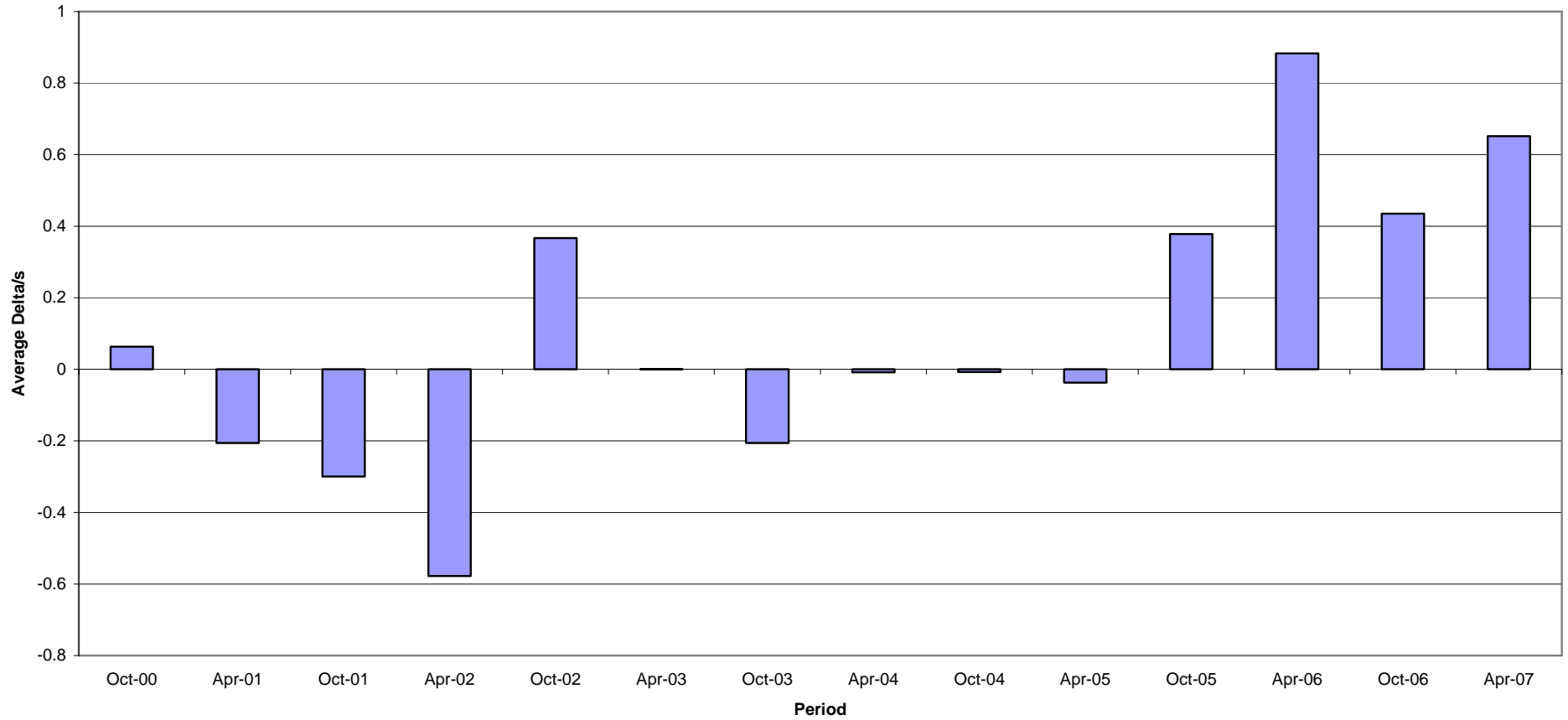


Figure 7 - Average Piston Varnish, Average Delta/s

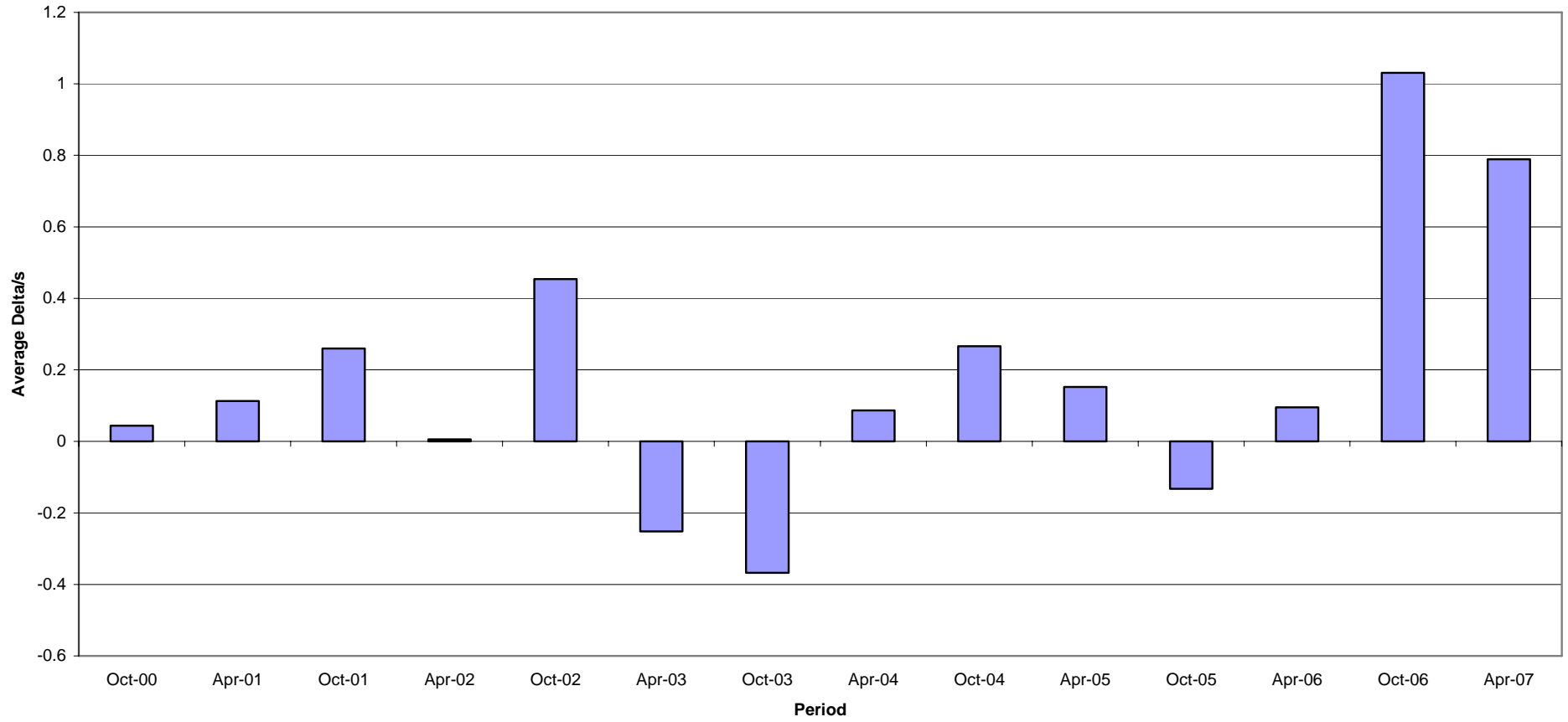


Figure 8 - Percent Viscosity Increase @ 60 Hours (Sequence IIFHD), Average Delta/s

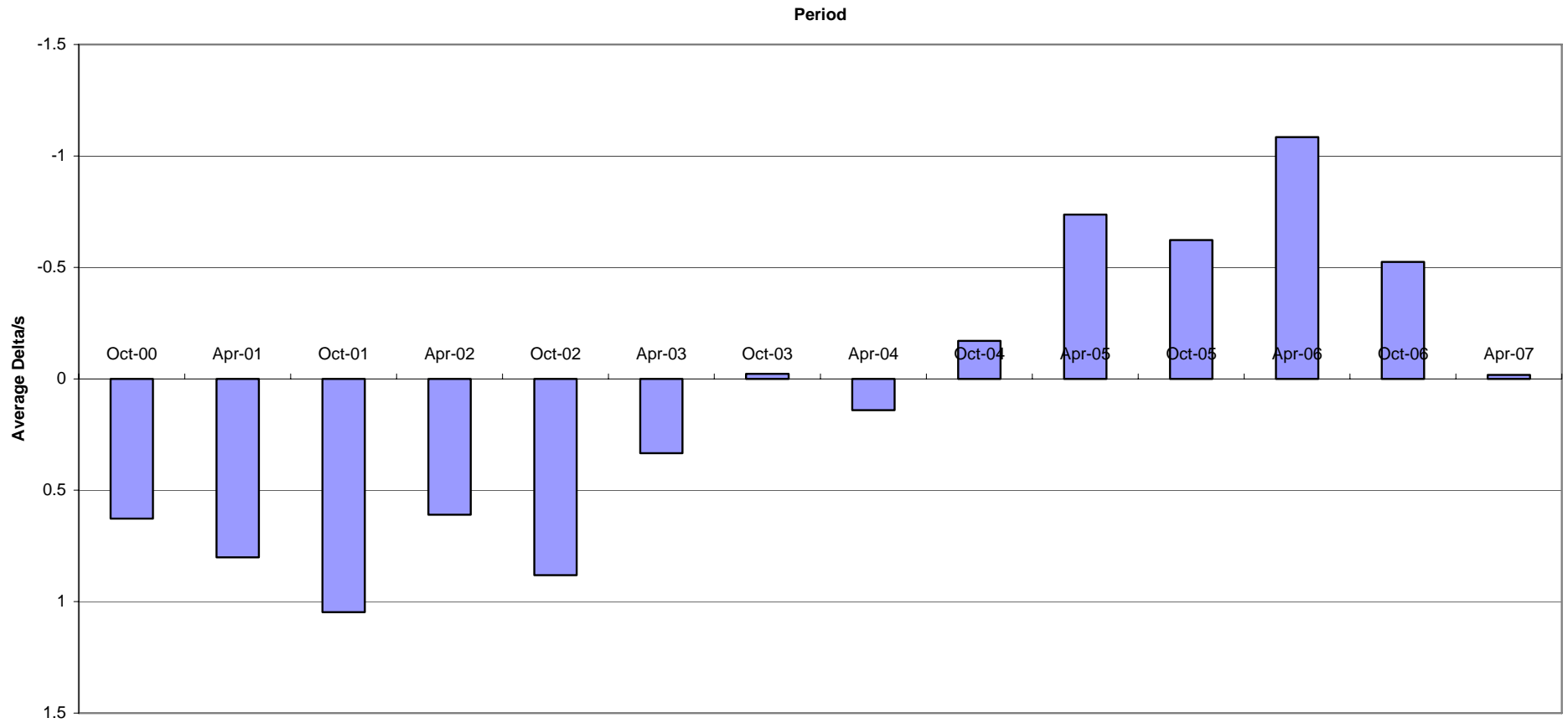


Figure 9 - Percent Viscosity Increase, Pooled Standard Deviation

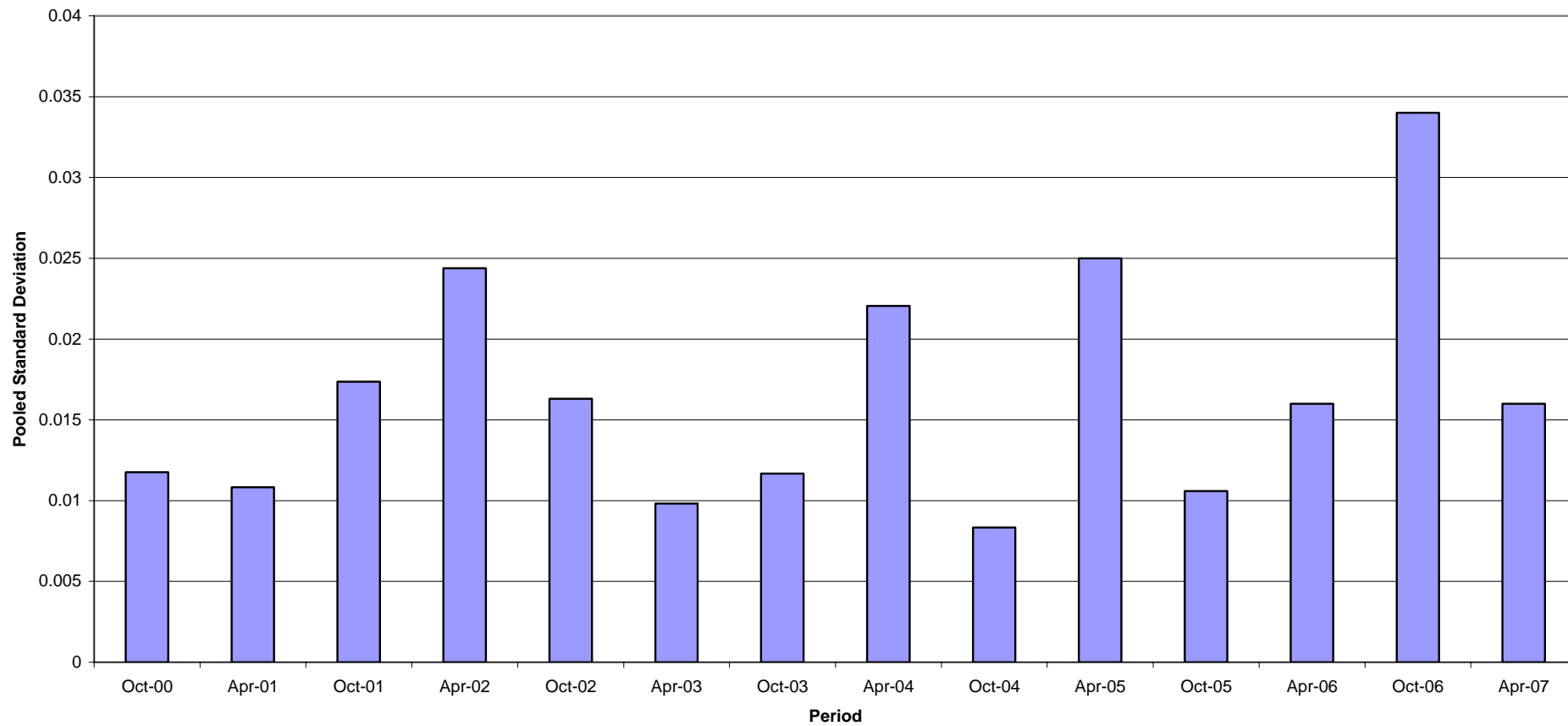




Figure 10 - Weighted Piston Deposits, Pooled Standard Deviation

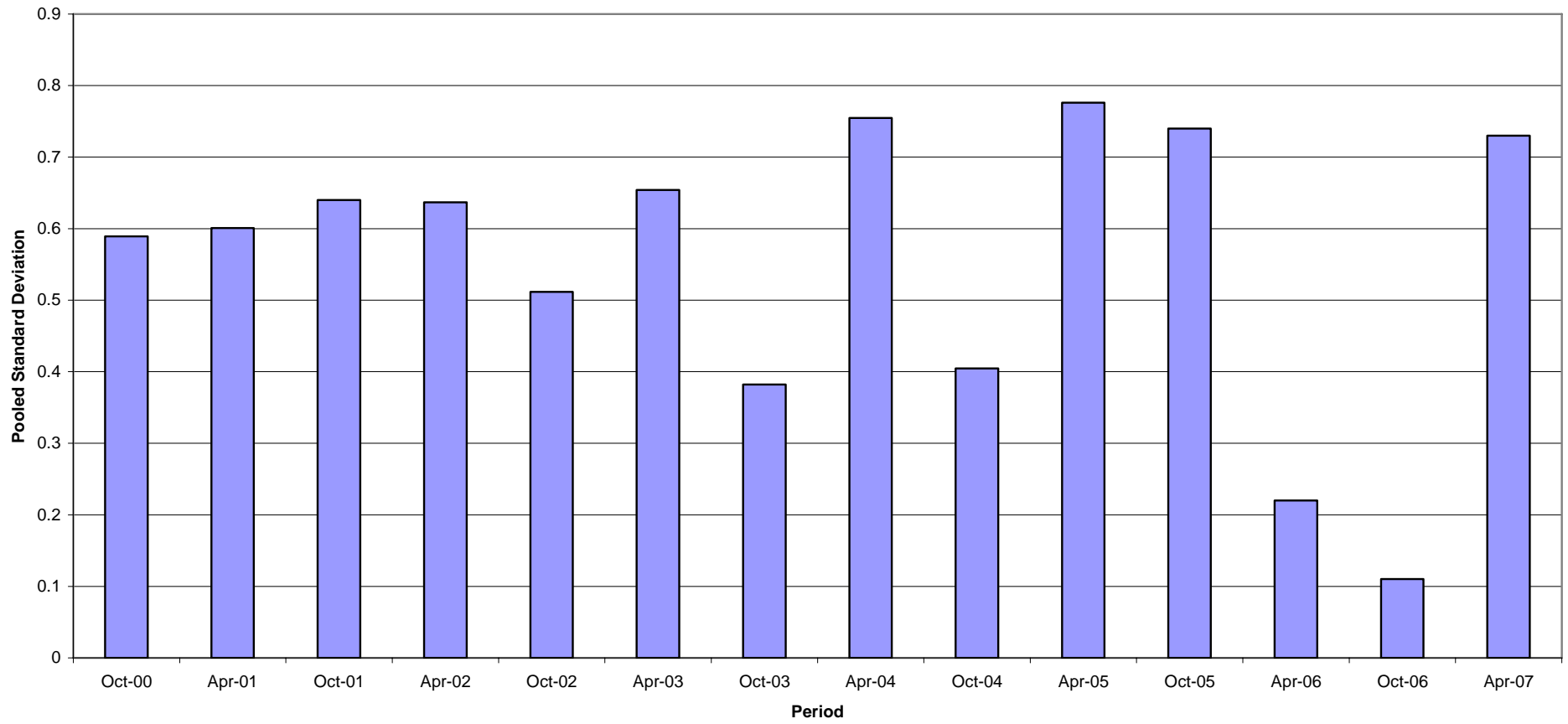


Figure 11 - Average Piston Skirt Varnish, Pooled Standard Deviation

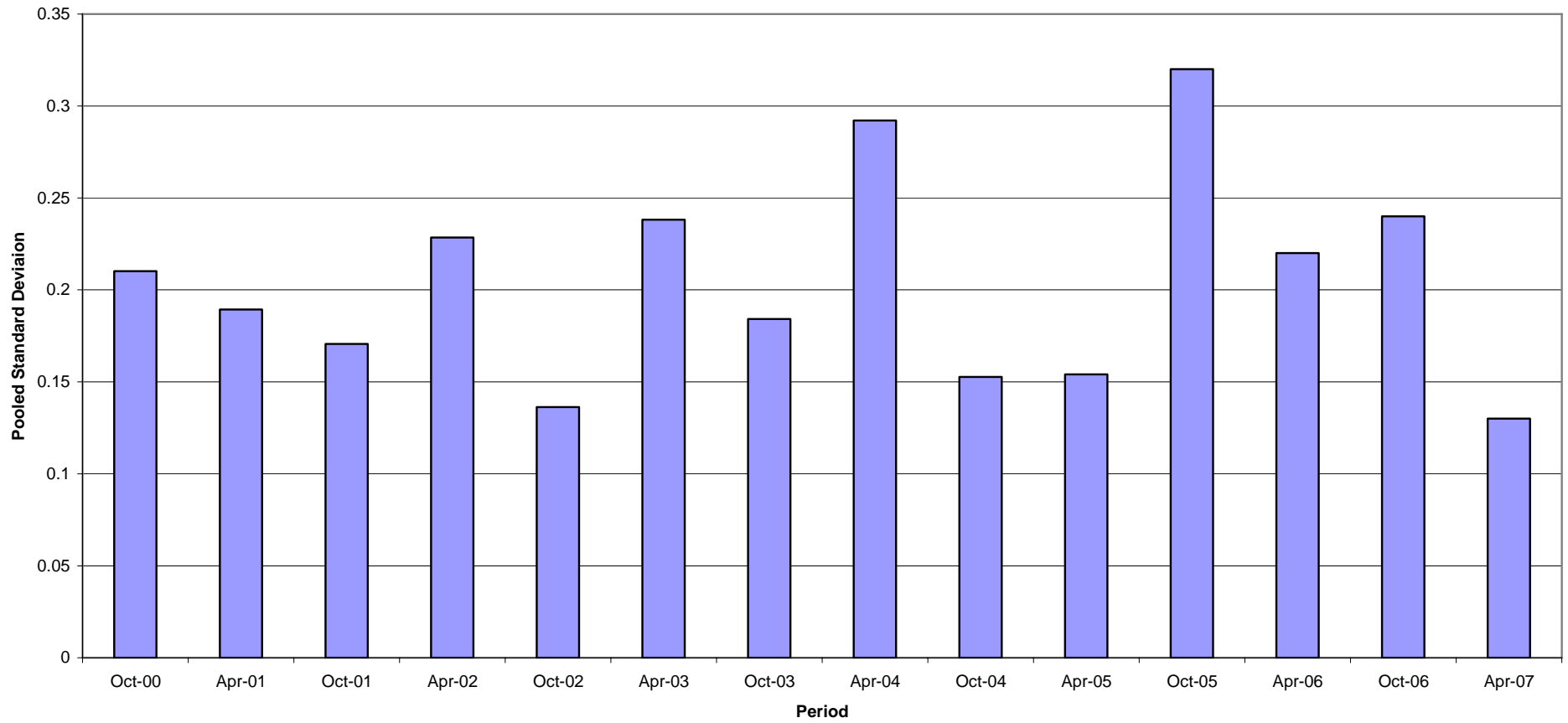


Figure 12 - Percent Viscosity Increase @ 60 Hours (Sequence IIIFHD), Pooled Standard Deviation

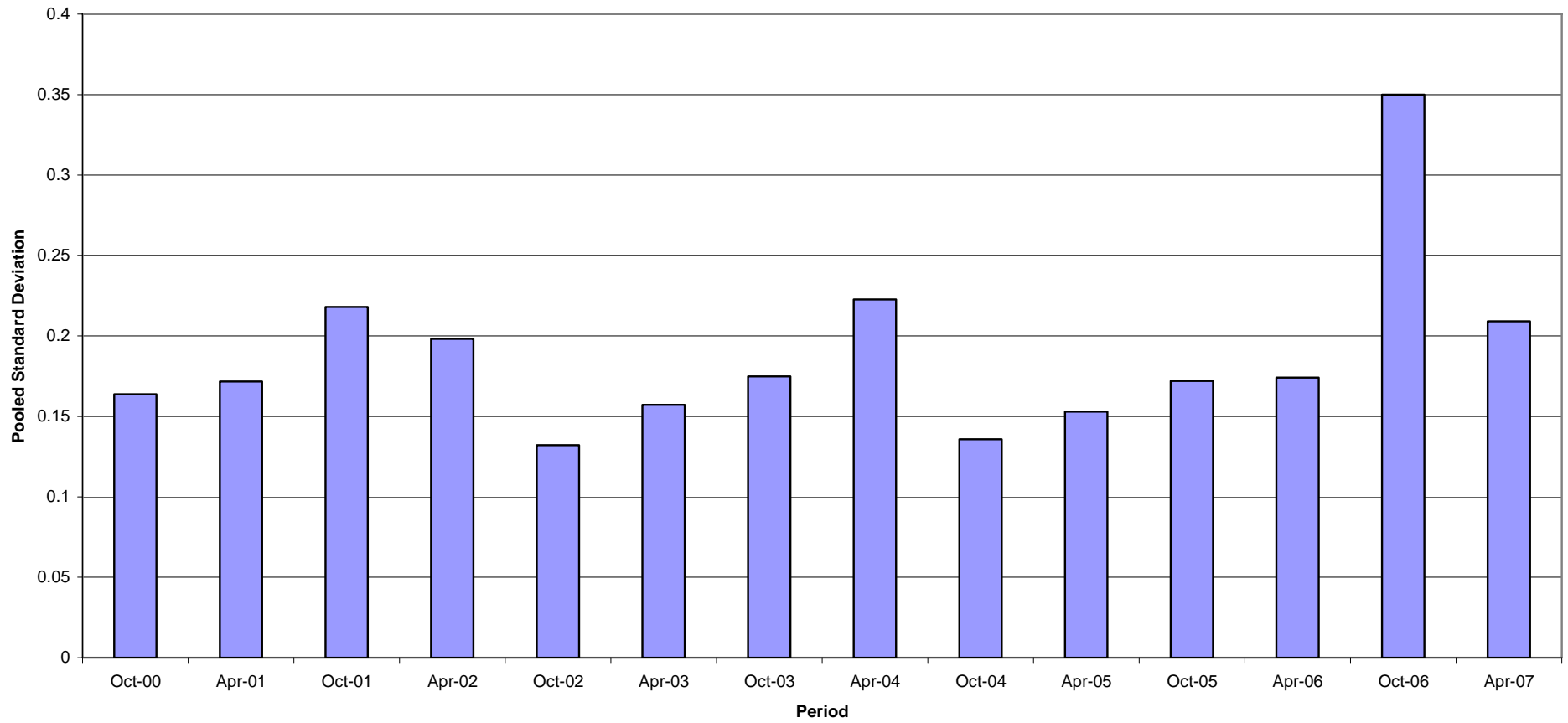


Figure 13 – Sequence IIIF Timeline

Date	Topic	Information Letter
6/10/2000	Revised Ring Sticking definitions implemented	00-2
7/25/2000	Oil Consumption as a test validity criteria dropped	00-2
8/28/2000	First occurrence of LC camshafts in LTMS data	
9/8/2000	Draft 3 of the Sequence IIIF Test Procedure released	00-1
9/27/2000	MRV & CCS Testing of used oil samples added	00-2
9/27/2000	Valve train assembly using build up oil implemented	00-2
10/4/2000	New QI U&L Values implemented	00-2
10/8/2000	First occurrence of Valve train assembly using build up oil in LTMS	00-2
12/6/2000	Oil Consumption as a test interpretability criteria added	00-3
4/25/2001	First occurrence of MB camshafts in LTMS data	
5/23/2001	Condenser Flow QI requirements dropped	01-1
5/23/2001	New oil addition at EOT dropped	01-1
5/23/2001	Condenser part number corrected	01-1
5/23/2001	Revised dipstick calibration curve implemented	01-1
5/23/2001	Revised MRV & CCS test procedures	01-1
5/23/2001	Upper limit of 8000cSt for viscosity measurements established	01-1
5/23/2001	Reexamination of Engine Speed and Condenser Coolant Out Temperature QI U&L values performed; no changes made	01-1
9/8/2001	Screened Average Cam-plus-lifter Wear (SACLW) replaces Average Cam-plus-lifter Wear (ACLW) as pass/fail parameter	01-2
9/8/2001	Valve train assembly using test oil reintroduced into IIIF test	01-2
9/12/2001	First occurrence of engine builds using test oil for valvetrain lubrication in LTMS	
11/28/2001	Sequence IIIF-HD Test Procedure Published	01-3
3/1/2002	Revised Sequence IIIF Test Procedure Published	02-1
3/15/2002	Sequence IIIFHD Test Procedure added to Revised Sequence IIIF Test Procedure. Editorial changes to IIIF Test Procedure also made and do	02-2
4/23/2002	Oil Filter and Oil Cooler Replacement Guidelines issued	02-3
6/1/2002	External Oil Bypass Valve System & Modified Oil Filter Adapter	02-4
12/15/2003	New Honing Procedure approved and added to Assembly Manual	
5/30/2003	New Oil Filter	03-1
6/30/2003	New Front Cover and Oil Filter Housing	03-1
6/30/2003	Sequence IIIG Dipstick	03-1
6/30/2003	Calibrated Flask for Initial Oil Charge	03-1
12/31/2003	New Solvent Specifications	03-1
10/29/2003	Revised Fuel Pressure Specification	03-3
10/29/2003	Automatic Parts Washing Machine Maintenance Requirement	03-3
10/29/2003	Main Bearing Bore Mandrel Procedure made optional	03-3
10/29/2003	Piston Ring Cleaning Requirements	03-3
10/29/2003	Additional Allowable RTV Sealing Compounds	03-3
10/29/2003	Main Bearing Cap Bolt Replacement Specification	03-3
10/29/2003	Revised Camshaft Measurement Procedure	03-3
10/29/2003	Revised Camshaft Lubrication & Installation Procedure	03-3
10/29/2003	Revised Oil Consumption Reporting Procedure	03-3
10/29/2003	Fluid Conditioning Module Equipment Specifications	03-3
10/29/2003	Revised Camshaft Measurement Equipment Specifications	03-3
10/29/2003	Rating Workshop Attendance Requirement	03-3
4/13/2004	Revised Intake Manifold Gasket	04-1
4/13/2004	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	MRV Reporting	04-2
5/12/2004	Amount of Test Oil used for Camshaft & Lifter Lubrication	04-2
11/4/2004	Torque Specs for Powered Metal Rods	04-3
11/4/2004	Editorial Changes to Precision Statements	04-3

11/4/2004	New Front and Rear Main Seals	04-3
11/4/2004	New Exhaust Valves	04-3
11/4/2004	New Oil Pan Gasket	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
8/10/2005	Corrections to Table A7.1	05-2
12/16/2006	Revised Rating Workshop Attendance Requirements	05-3
12/16/2006	Acceptance of Torque Wrench ETW-E180	05-3
4/4/2006	Added requirements for fuel monitoring and revised aromatic content in fuel specification	06-1
8/18/2006	Procedural enhancements from unified engine build	06-2
8/18/2006	Revised Table A4 to clarify methods and measurement units	06-2
10/3/2006	Change to PMNS connecting rods	06-3
11/7/2006	Change in rater calibration requirements	06-4
3/19/2007	Added IIFVIS test procedure	07-1