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Test Monitoring Center

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ASTM D02.B1 Semi-Annual Report Passenger Car Reference Oil Testing

October 2012

Passenger Car Engine Oil Testing Executive Summary

- ▶ **IIIF**
 - Panel to determine whether reblend will be required for oil 433-1.
- ▶ **IVA**
 - Calibration periods returned to previous length.
- ▶ **VG**
 - Panel working to introduce replacement oil for 925-3, two donated tests completed.
- ▶ **VIII**
 - High number of lost tests this period. Almost 60% of tests this period were aborted or invalid

Calibrated Labs and Stands*

Test	Labs	Stands
IIIF	3	5
IIIG/A/B	6	15
IVA	3	6
VG	4	7
VID	4	9
VIII	3	4

*As of 9/30/2012

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Test Activity Levels

»» April 1, 2012 –

September 30, 2012

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Sequence Tests

Test Status	Validity Code	IIIF	IIIG	IVA
Acceptable Calibration Test	AC	9	11	12
Failed Calibration Test	OC	4	2	0
Operationally Invalid by Lab	LC	2	0	1
Aborted	XC	0	3	0
Abandon Stand/Engine	MC	0	0	0
Operationally Invalid, Lab & TMC	RC	1	0	0
Decoded/Donated	NN/AG	0	0	0
Total		16	16	13

Sequence Tests

Test Status	Validity Code	VG	VID	VIII
Acceptable Calibration Test	AC	8	31	5
Failed Calibration Test	OC	0	4	1
Operationally Invalid	LC	1	2	6
Aborted	XC	0	3	2
Abandon Stand/Engine	MC	0	4	0
Decoded/Donated	NN/AG	2	12	0
Total		11	56	14

Failed Tests

Test Status	Test	Number of Tests
Screened ACLW >20µm	IIIF	1
Screened ACLW >20µm Severe Viscosity Increase	IIIF	1
Severe Viscosity Increase	IIIF	1
Mild Weighted Piston Deposits	IIIF	1
Severe Viscosity Increase	IIIG	2
FEI1 Mild	VID	1
FEI1 Severe	VID	2
FEI2 Severe	VID	1
Severe Bearing Weight Loss	VIII	1
Total		11

Lost Tests*

Slide 1 of 3

Test Status	Cause	IIIF	IIIG	IVA	VG	VID	VIII
Invalid	High Oil Consumption	1	0	0	0	0	0
Invalid	Incorrect Oil Filter Replacement	1	0	0	0	0	0
Invalid	AFR Calibration Issue	1	0	0	0	0	0
Aborted	High Oil Consumption	0	1	0	0	0	0
Aborted	Oil Temperature Control Issues	0	2	0	0	0	0
Invalid	Engine Mount Failure	0	0	1	0	0	0
Invalid	Engine Coolant Flow Calibration	0	0	0	1	0	0

(continued on next slide)

*Invalid and aborted tests

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Lost Tests*

Slide 2 of 3

Test Status	Cause	IIIF	IIIG	IVA	VG	VID	VIII
Invalid	Low Fuel to Flow meter pressure	0	0	0	0	1	0
Invalid	BL Before Delta >0.4	0	0	0	0	1	0
Aborted	Knock Sensor Wiring Issue	0	0	0	0	1	0
Aborted	Exceeded Downtime Limit	0	0	0	0	1	0
Aborted	Solenoid Valve Failed	0	0	0	0	1	0
Aborted	Coolant Leak	0	0	0	0	0	1
Aborted	Oil Leak	0	0	0	0	0	1

(continued on next slide)

*Invalid and aborted tests

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Lost Tests*

Slide 3 of 3

Test Status	Cause	IIIF	IIIG	IVA	VG	VID	VIII
Invalid	Build Error	0	0	0	0	0	1
Invalid	Exceeded Downtime Limit	0	0	0	0	0	1
Invalid	Test Run at Wrong Temperature For Viscosity Grade	0	0	0	0	0	1
Invalid	Excessive Mechanical Wear	0	0	0	0	0	3
Total		3	3	1	1	5	8

*Invalid and aborted tests

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Test Severity

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Test Severity

▶ IIIF

- WPD in control.
- APV
 - In severity action alarm, mild
 - Long-term mild trend continuing (Since April 2006)
- PVIS
 - Precision action alarm
- PV60
 - Precision warning alarm

- Charts shown in [Appendix 1.a.](#)

Test Severity

▶ IIIG

- PHOS and MRV are in control.
- WPD is in control
 - Long-term severe trend continuing (Since late 2004)
- PVIS
 - Severity action alarm
 - Precision warning alarm
- ACLW in control.
 - Long-term mild trend

- Charts shown in [Appendix 1.b.](#)

Test Severity

▶ IVA

- ACW in control.

- Charts shown in [Appendix 1.c.](#)

▶ VG

- AES, RAC, and OSCR are in control.
- AEV and APV in warning alarm, mild direction.
 - Milder this period than previous periods.

- Charts shown in [Appendix 1.d.](#)

Test Severity

▶ VID

- FEI1 and FEI2 are in control.
- FEI1 trending mild this period.

- Charts shown in [Appendix 1.e.](#)

▶ VIII

- BWL is in severe warning alarm.
- Stripped Viscosity in in control.

- Charts shown in [Appendix 1.f.](#)

Test Precision

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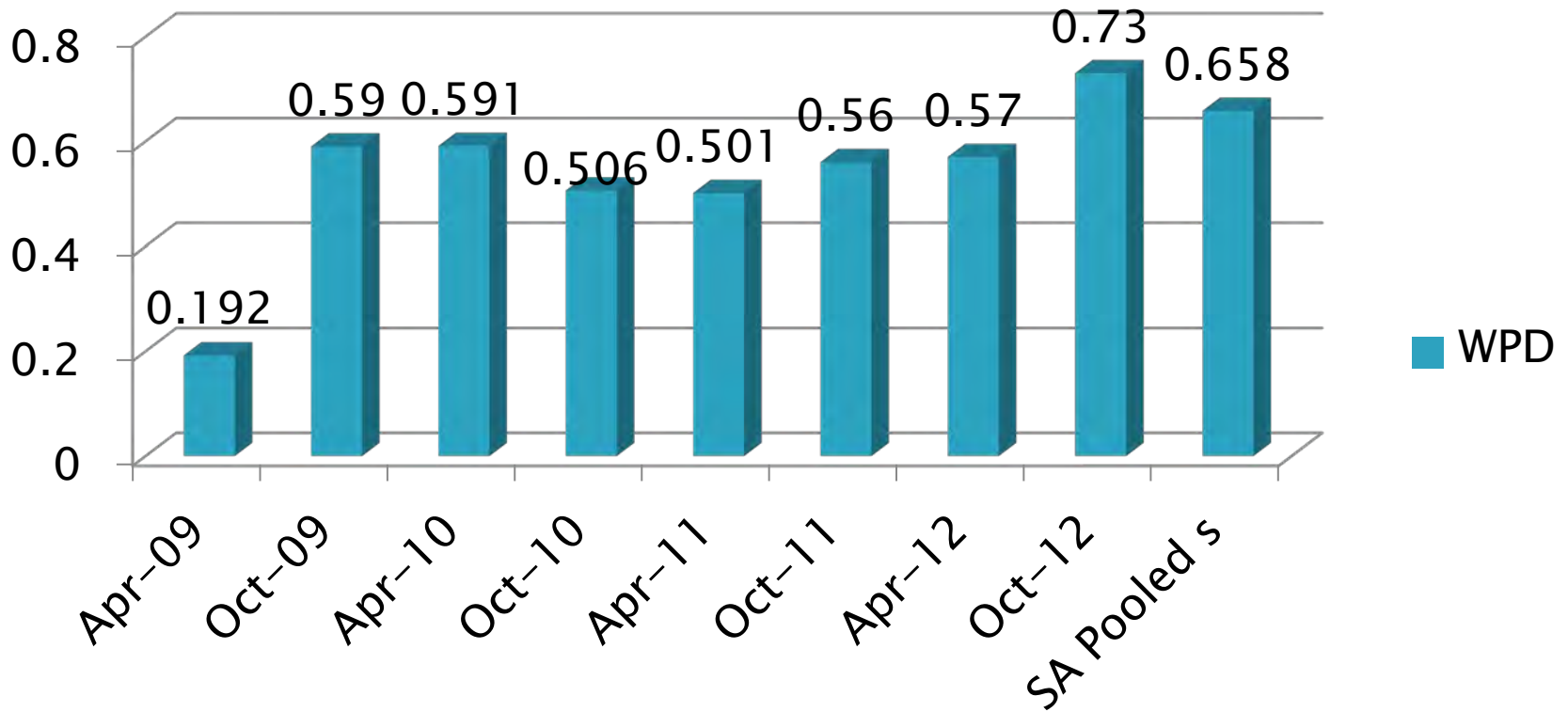
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Test Precision Estimates

- ▶ Presented on a six month basis.
- ▶ Data presented for past four years.

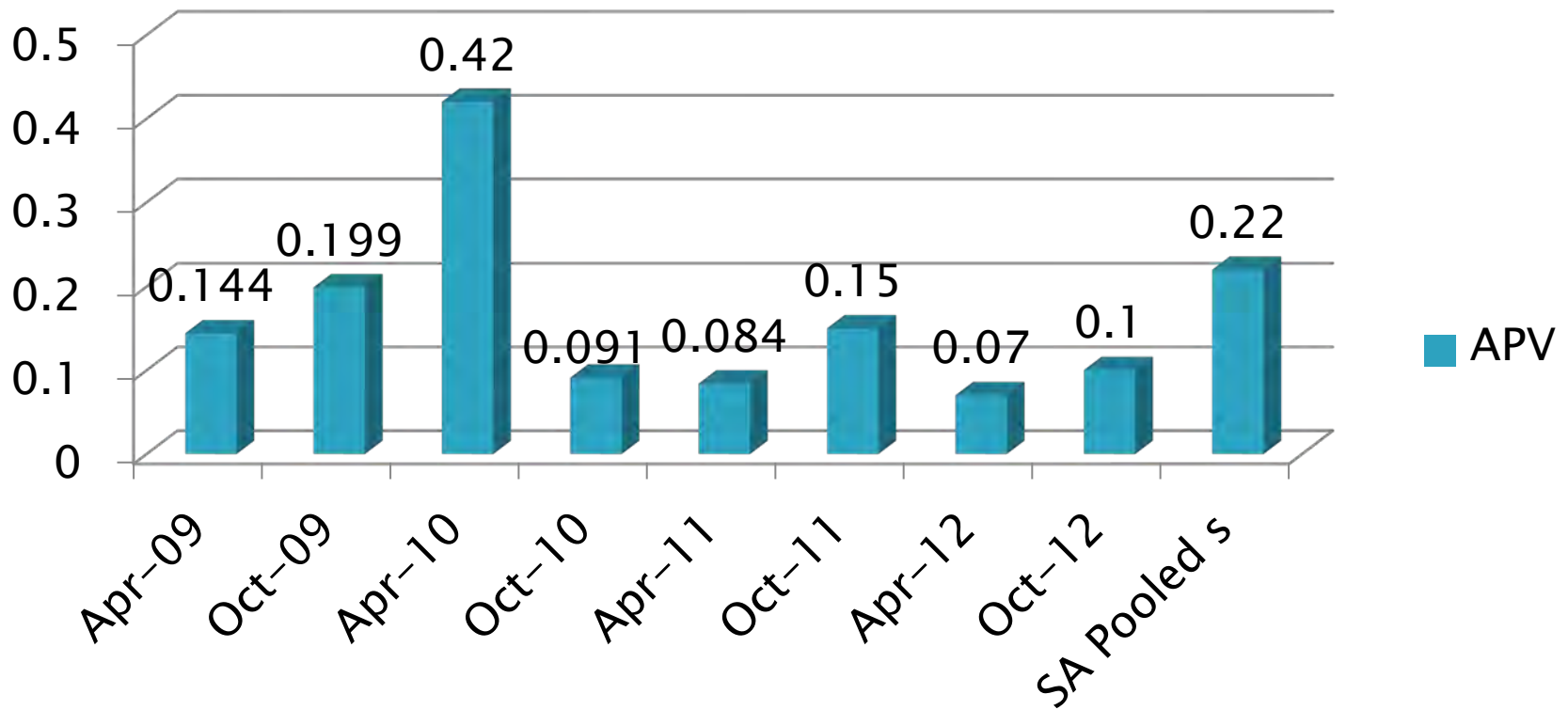
IIIF Precision Estimates

WPD



IIIF Precision Estimates

APV



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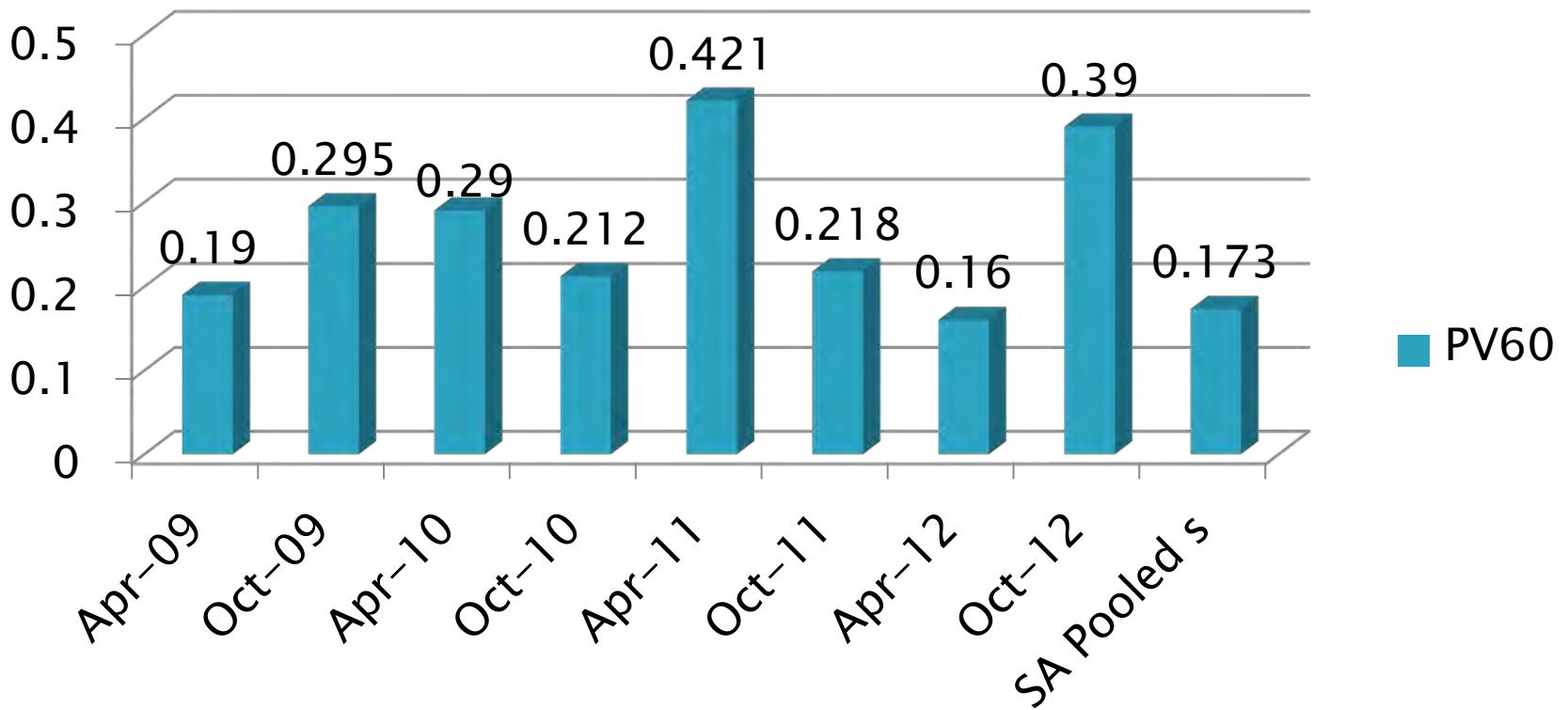
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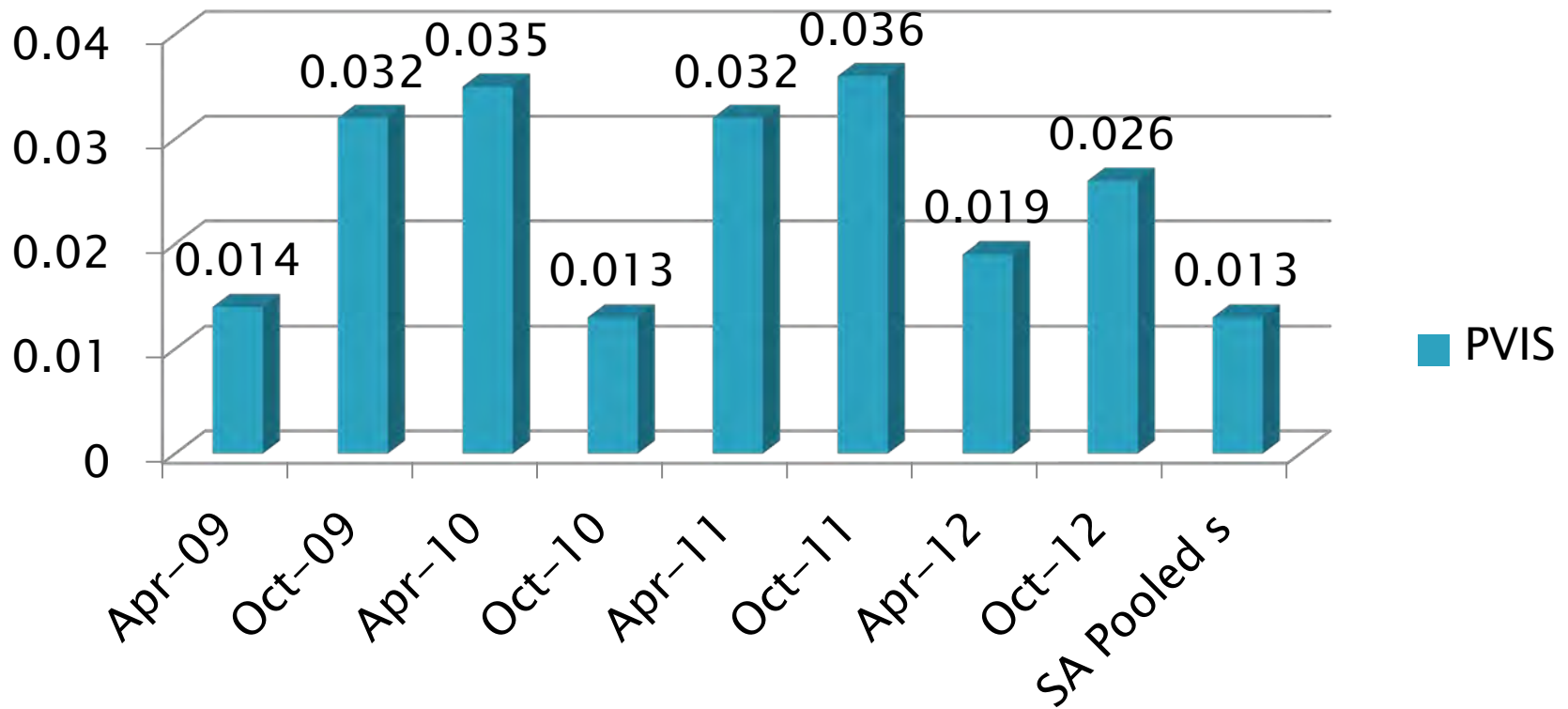
IIIF Precision Estimates

PV60

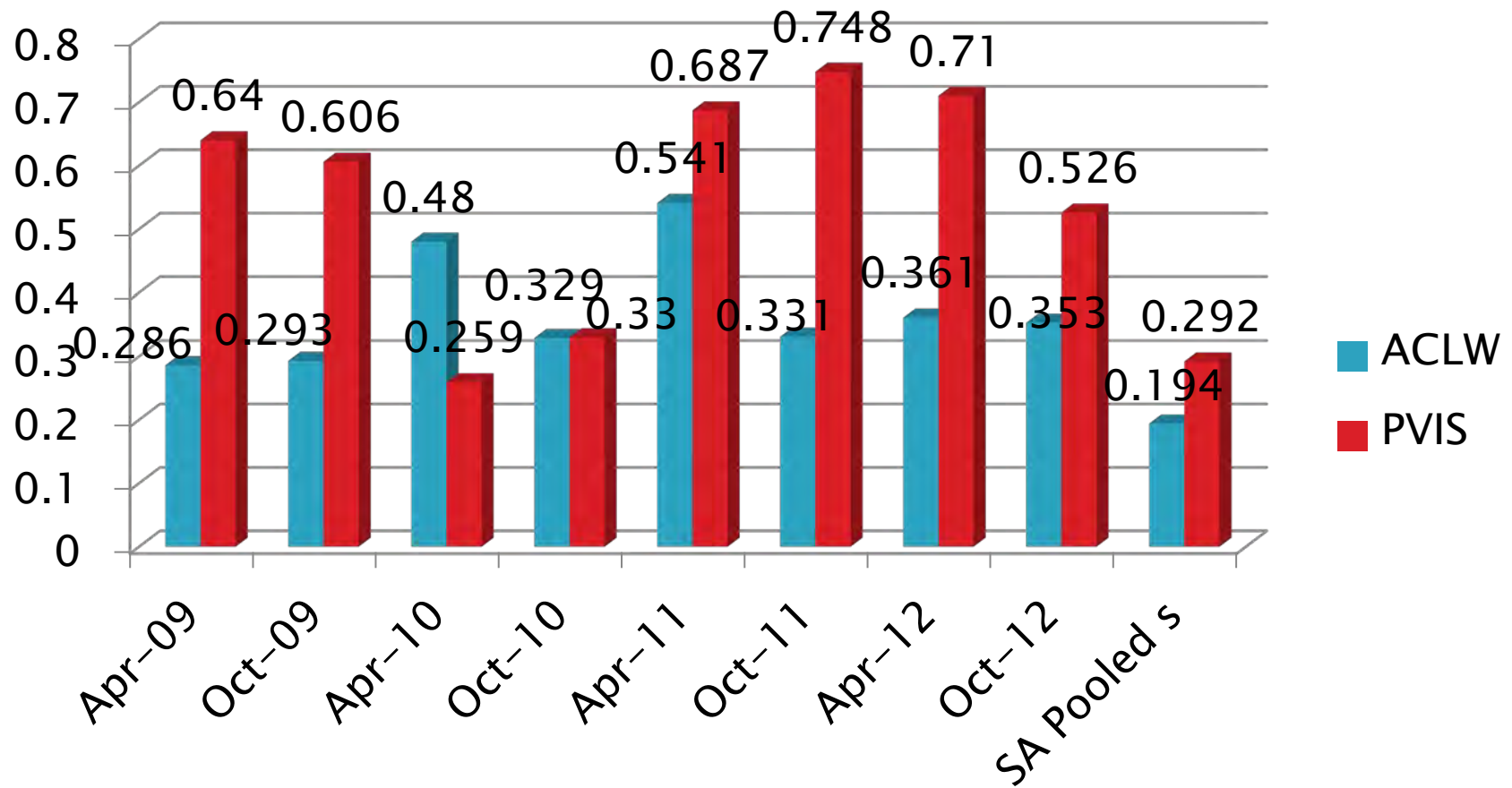


IIIF Precision Estimates

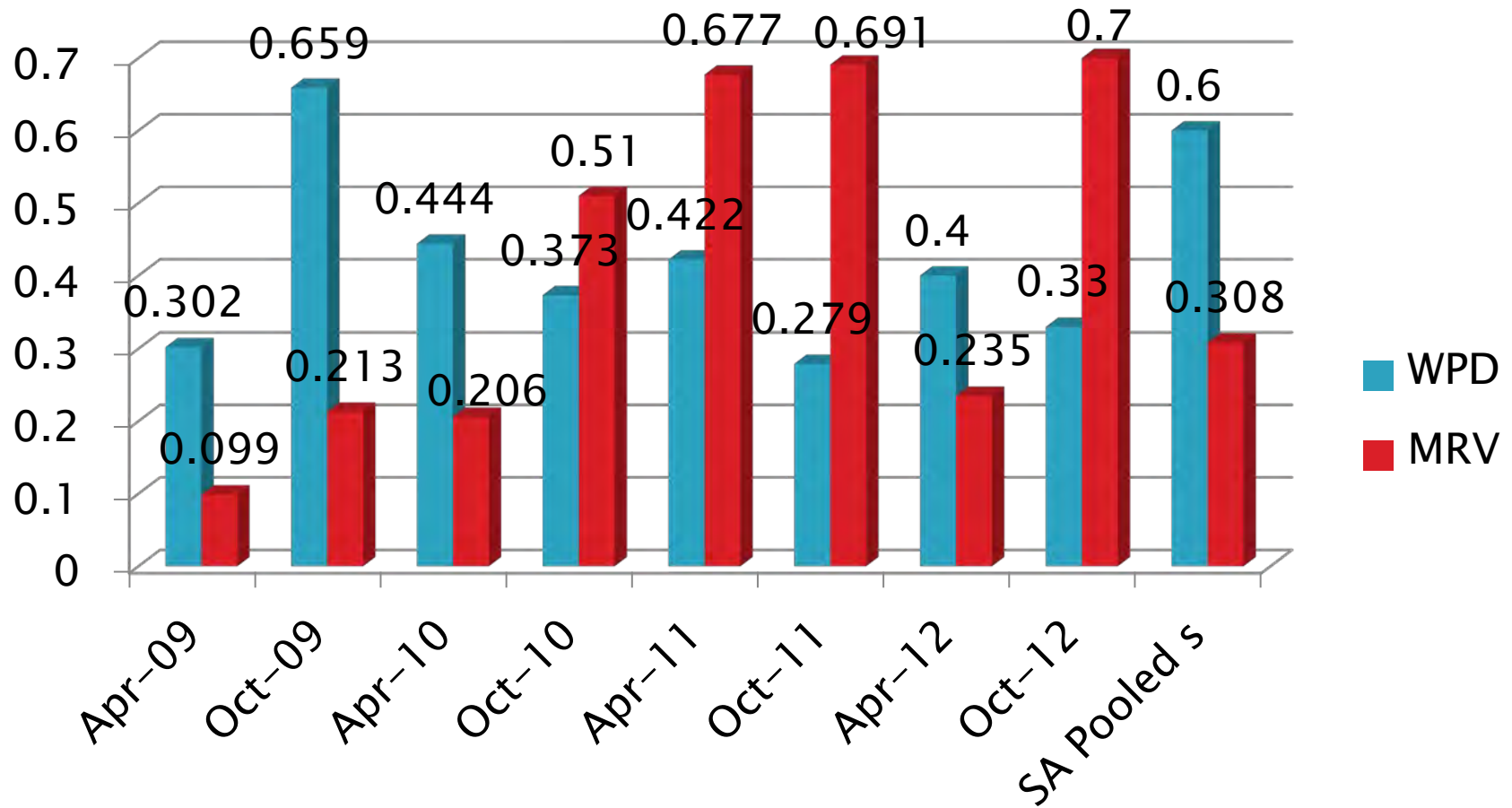
PVIS



IIIG Precision Estimates

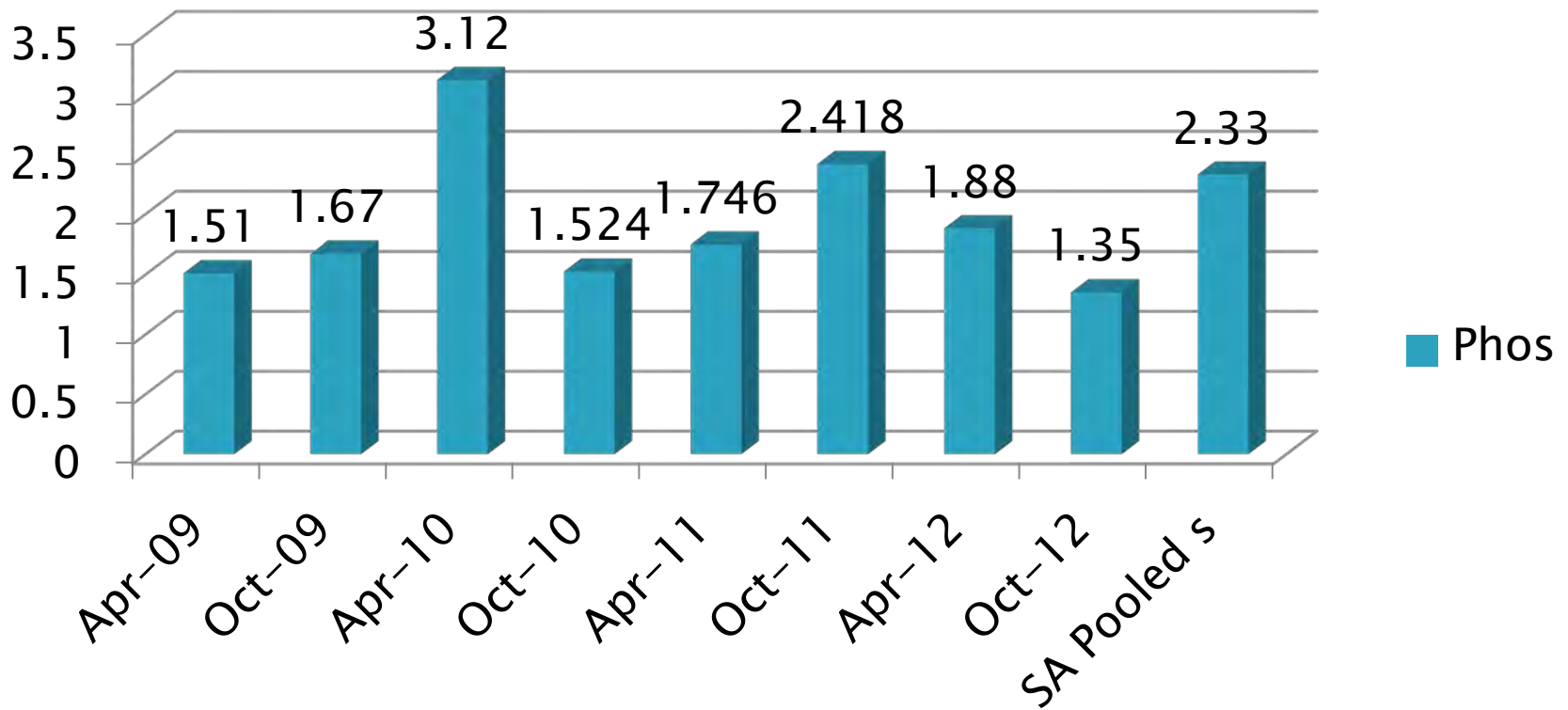


IIIG Precision Estimates



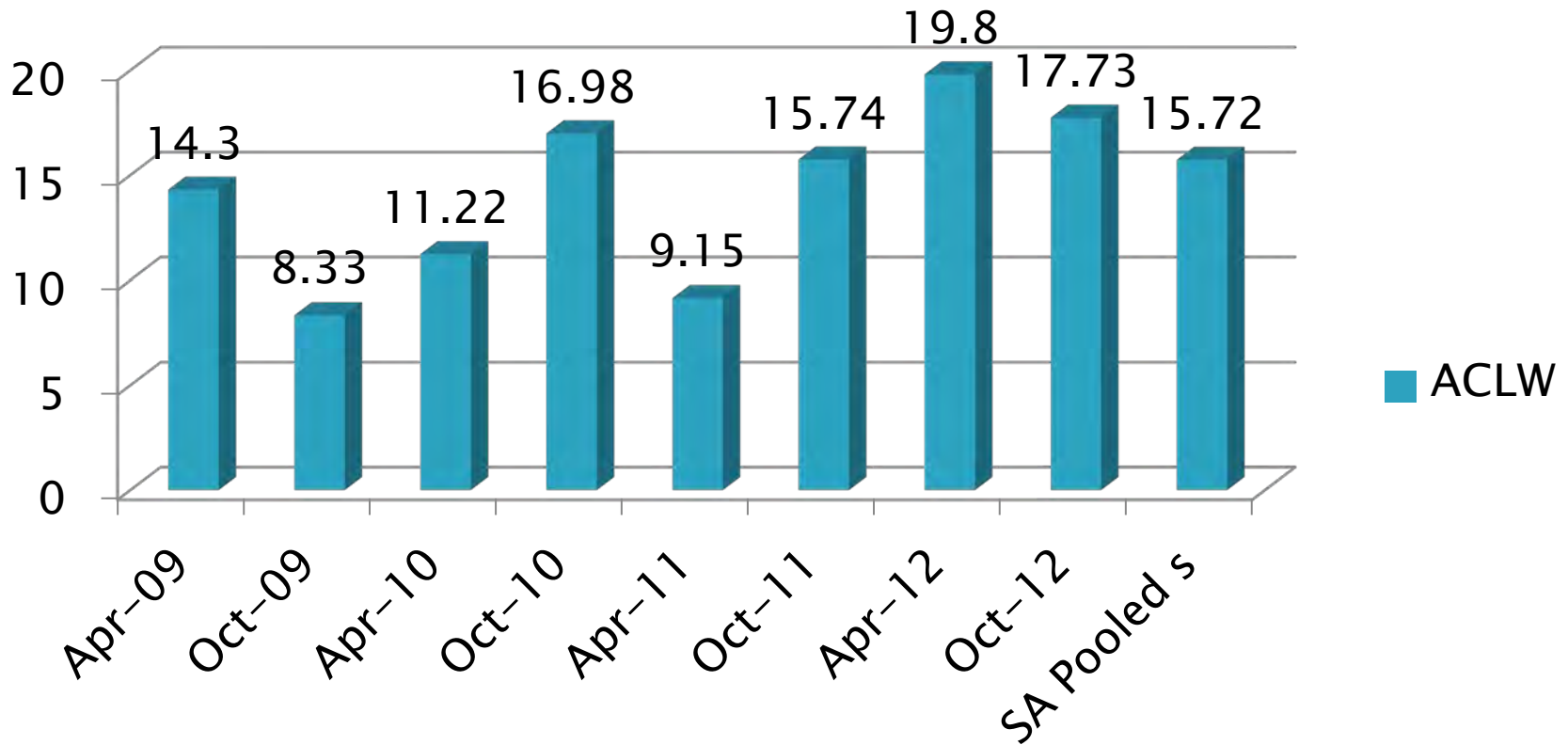
IIIG Precision Estimates

Phos

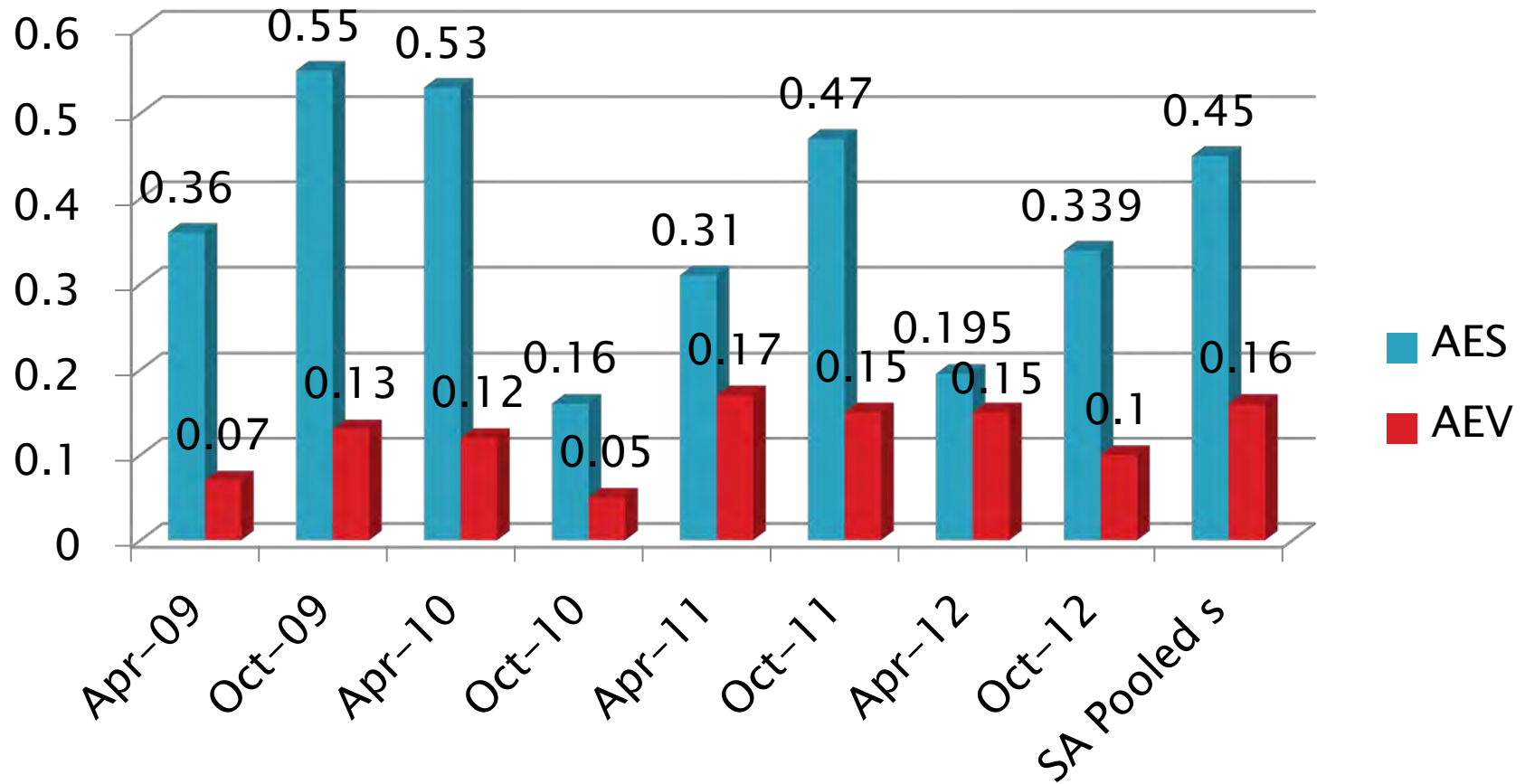


Sequence IVA Precision Estimates

ACLW

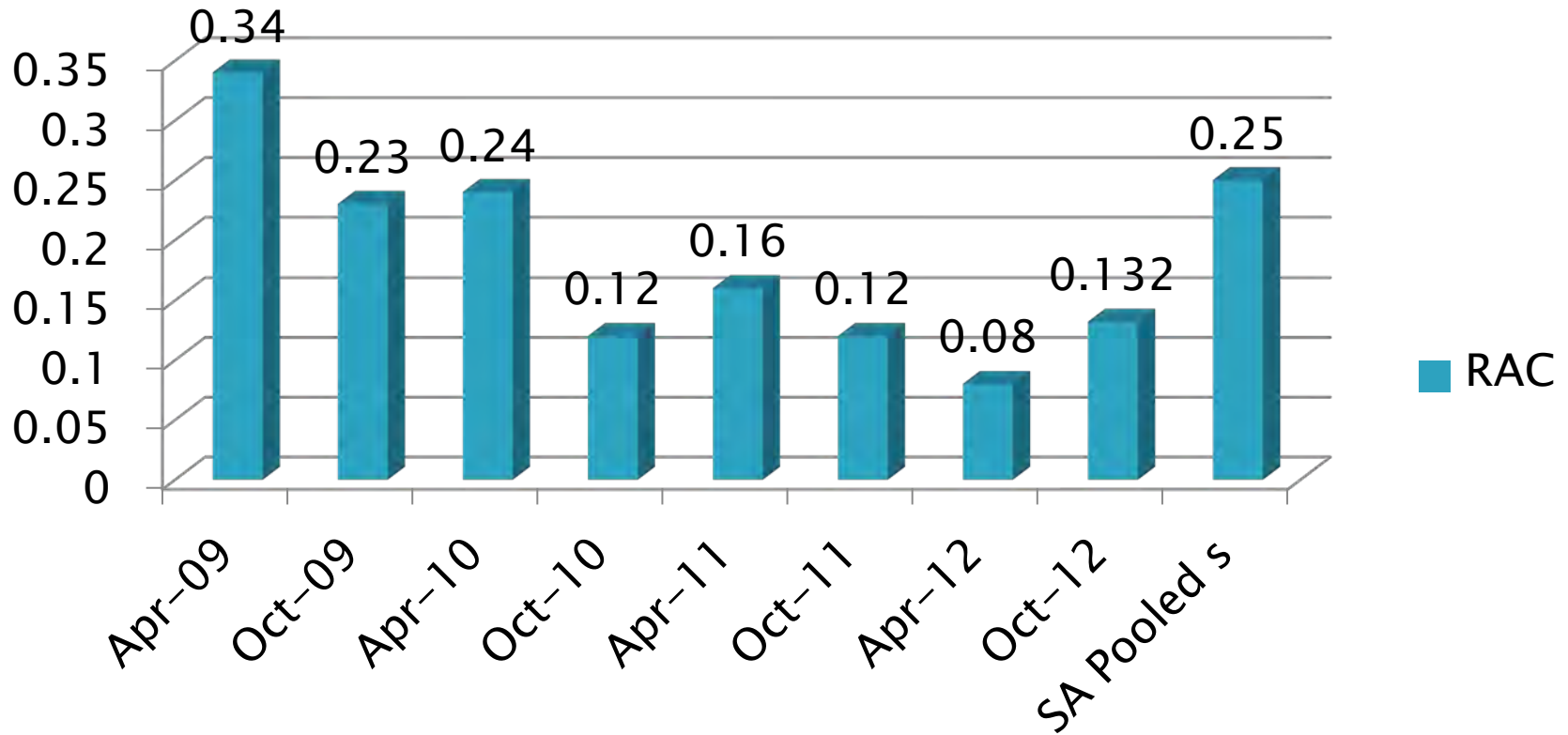


Sequence VG Precision Estimates

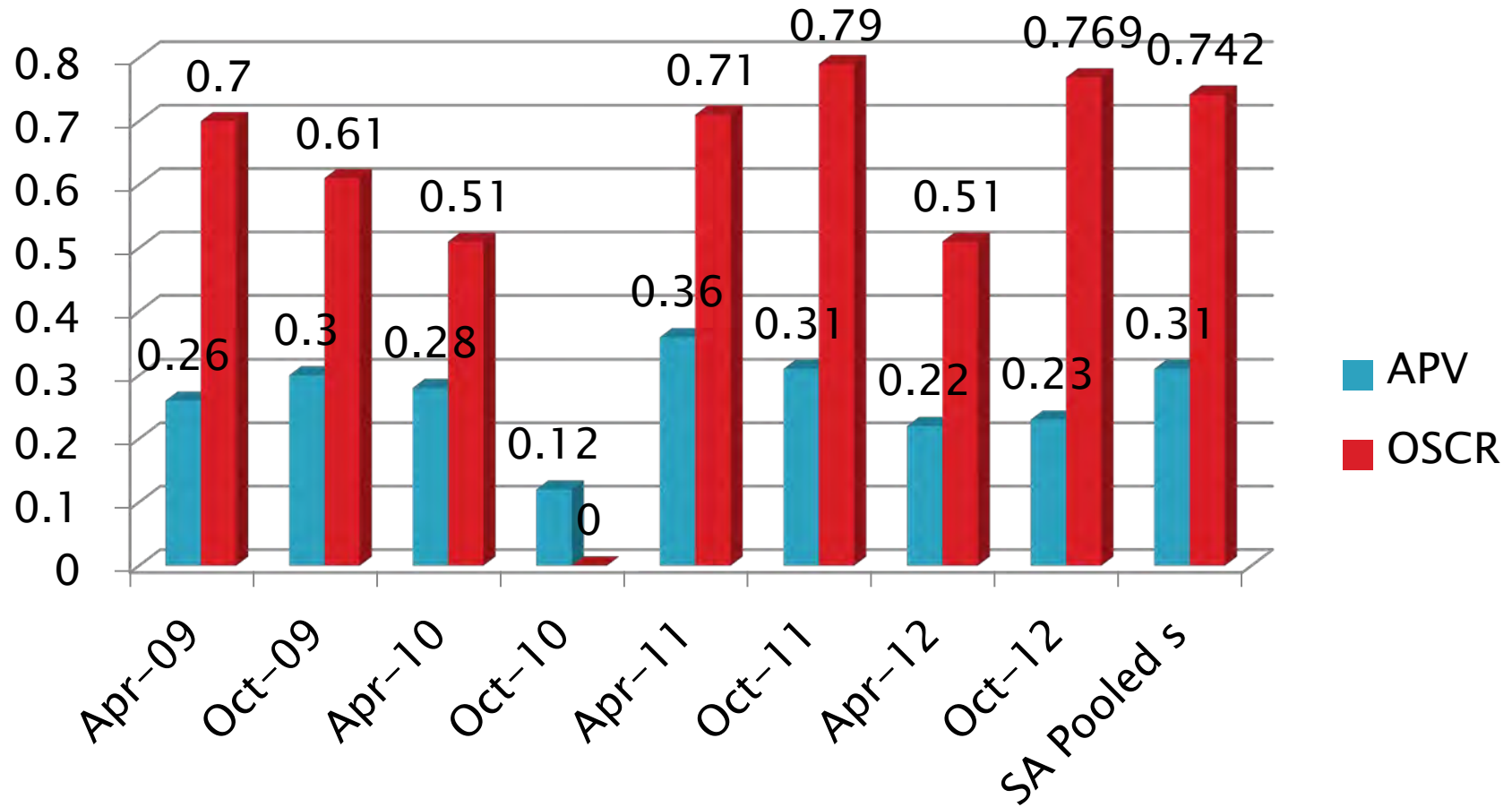


Sequence VG Precision Estimates

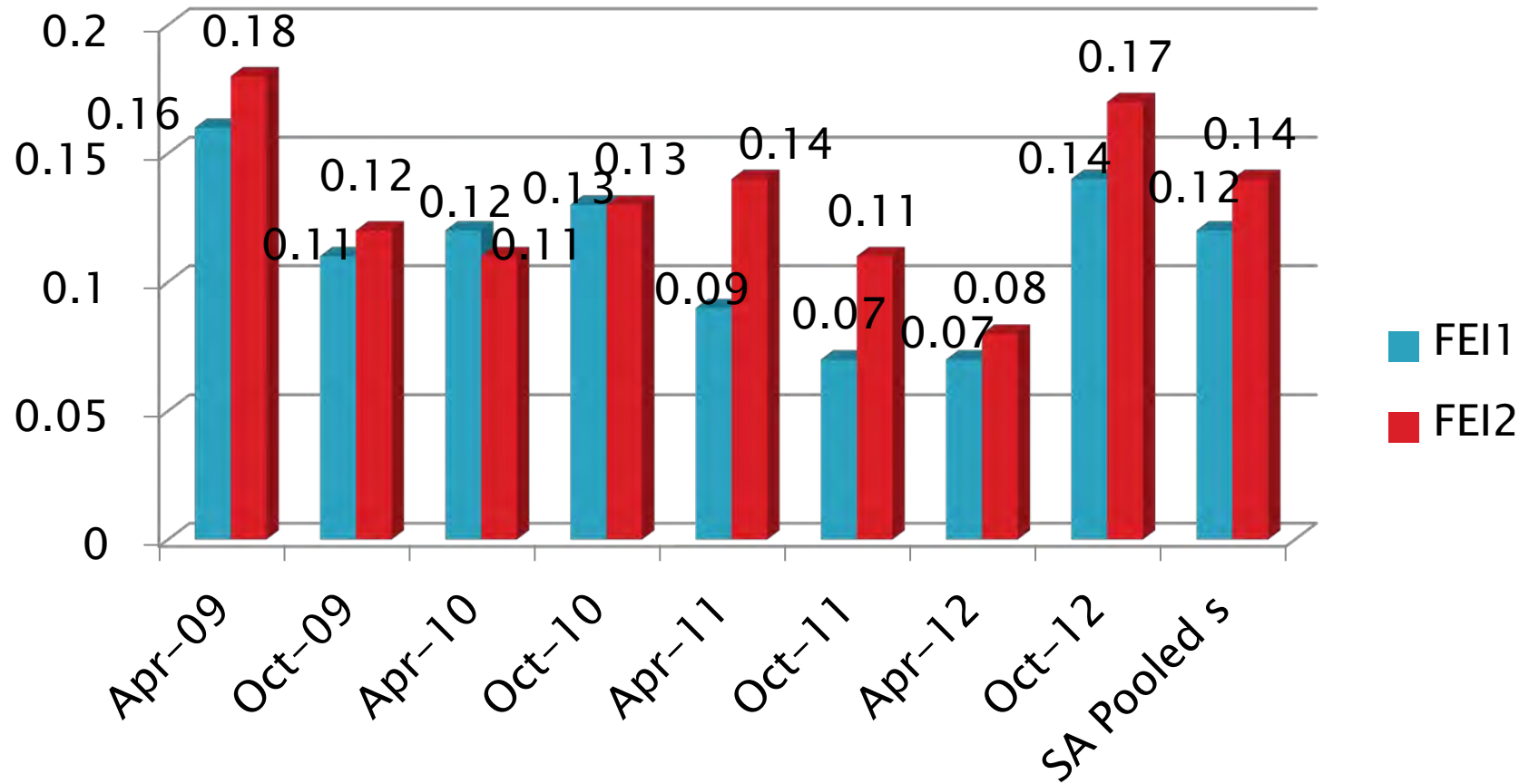
RAC



Sequence VG Precision Estimates

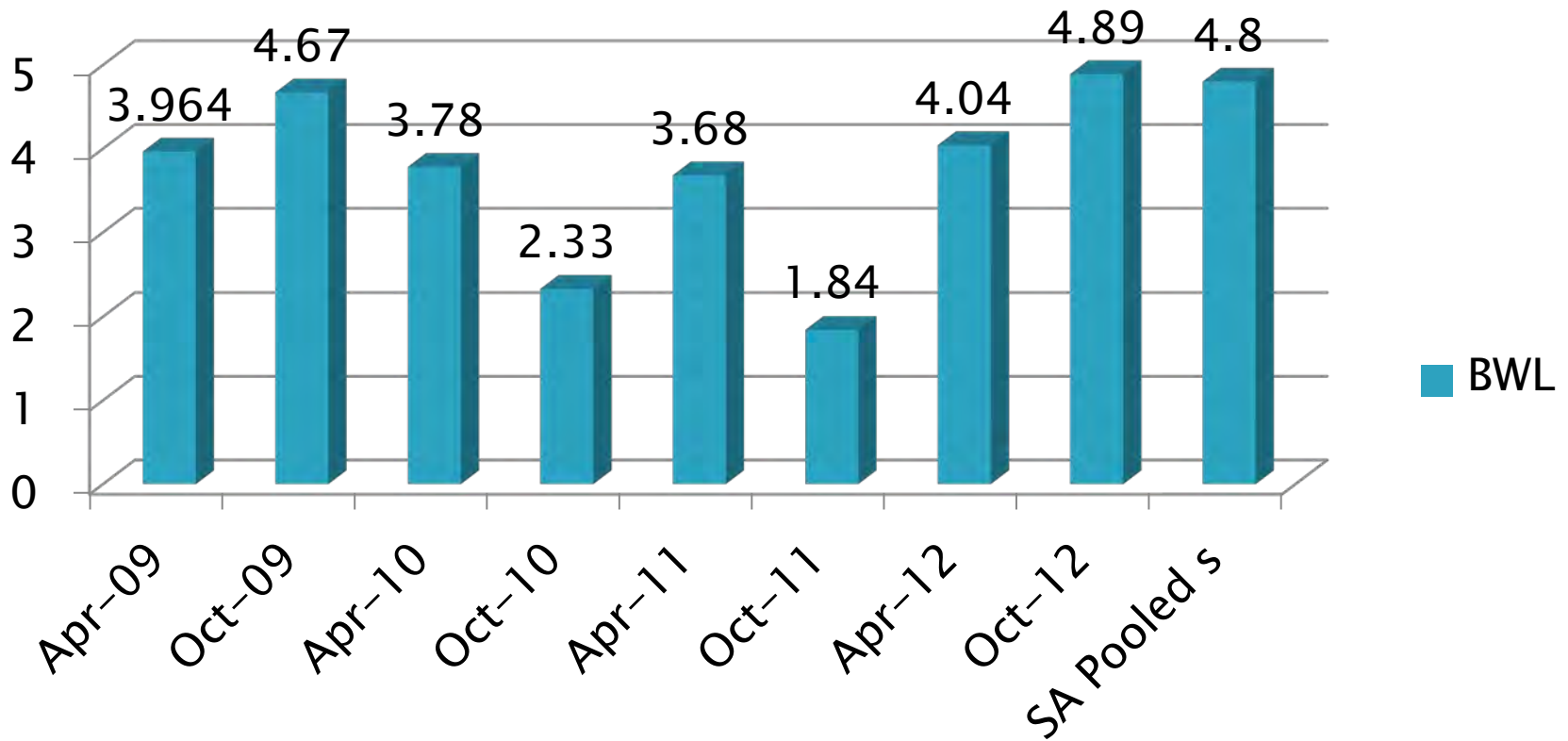


Sequence VID Precision Estimates



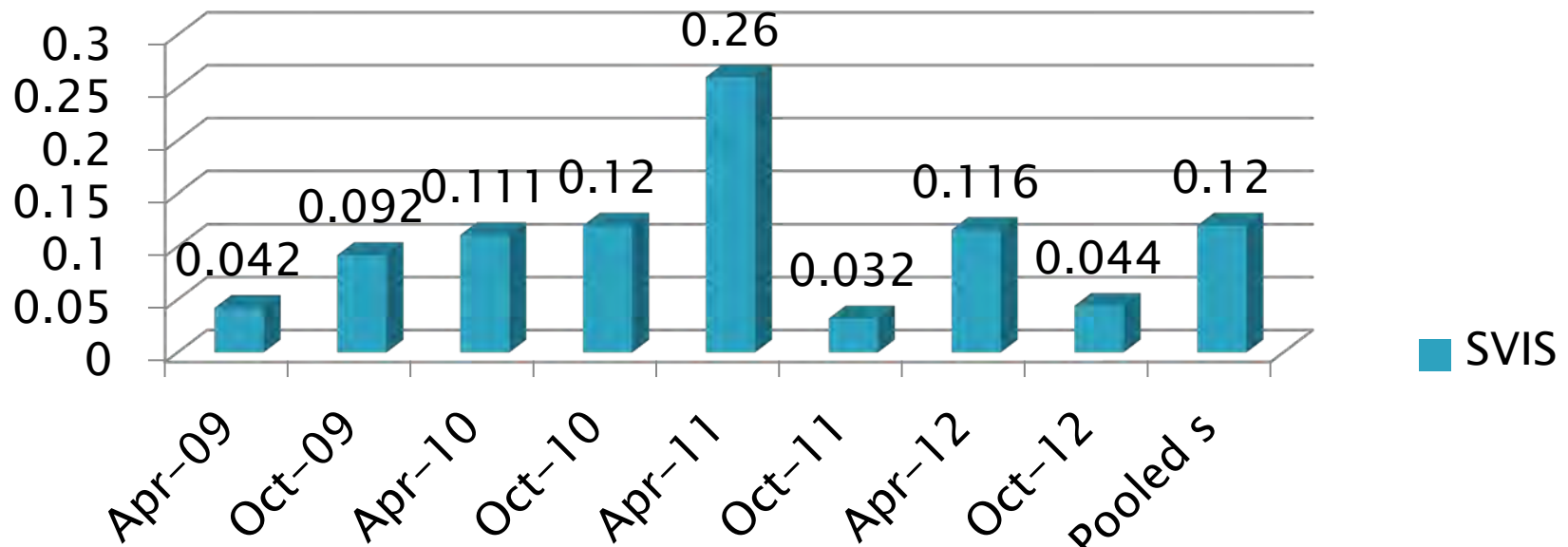
Sequence VIII Precision Estimates

BWL



Sequence VIII Precision Estimates

SVIS



Historical Pooled s used for comparison purposes, parameter is not severity adjusted.

Information Letters

»» October 1, 2011 –
March 31, 2012

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Information Letters*

Test	Date	IL	Topic
IIIF	20120413	12-1	Added First-in, First-out criteria for specific hardware and revised the change frequency for the parts washer cleaning solution.
IIIG	20120413	12-1	Revised the change frequency for the parts washer cleaning solution.
VG	20120612	12-1	Added source for used cylinder heads and vendor for refurbishing used heads.
VID	20120730	12-2	Added provisions for repeating a BSFC stage projected to have a parameter out of specification.

*Available from TMC Website

Reference Oil Inventory

»» Actions, Re-blends, Inventories
and Estimated Life

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Reference Oil Re-blends

- Oils with ~ 2 years or less supply
 - Status of Re-blends uncertain
 - Oils Affected
 - 433-1
 - *Panel to determine whether reblend will be required.*

Reference Oil Re-blends

- Oils with ~ 2 years or less supply
 - Re-blend available
 - Oil Affected: 542
 - Supplier has been contacted.

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
433-1	IIIF	1045	56	111	54	1.5 years
434	IIIG	550	0	5	12	<1 year
434-1	IIIG	660	40	193	32	2+ years
435	IIIG	550	0	2	4	<1 year
435-2	IIIG	550	16	378	24	5+ years
438	IIIG	990	16	243	32	5+ years
540	VID	1100	30	413	25	4+ years
541	VID	550	35	5	15	<1 year
541-1	VID	550	85	410	45	5+ years

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
542	VID	1100	85	274	65	1.5 years
704-1	VIII	897	20	186	10	5+ years
925-3	VG	975	0	10	6	<1 year
940	VG	560	20	511	12	5+ years
1006-2	IVA, VG, VIII	5500	154	3618	64	5+ years
1007	IVA, VG	1968	2	19	38	<1 year
1009	VG	1100	40	339	30	5+ years
1010	IIIG, VID	1100	75	637	81	5+ years

LTMS Deviations

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September 30, 2012

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LTMS Deviations

- No LTMS Deviations in Current Period

LTMS Deviations

Historical Count of PCEO LTMS Deviations

Test	LTMS Deviations
IIIF	5
IIIG	5
IVA	7
VG	8
VID	1
VIII	3

Quality Index Deviations

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Quality Index Deviations

- No PCEO Quality Index Deviations this period

Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIF	25
IIIG	11
IVA	28
VG	38

TMC Laboratory Visits

»» October 1, 2011 –
March 31, 2012

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TMC Lab Visits

Test	Number of Labs Visited
III	4
IVA	2
VG	3
VID	3
VIII	1

TMC Lab Visits

- Sequence III lab visits this period
 - Blowby heat exchangers not being flushed every 10 tests (2 labs).
 - Air not being blown through coolant system after flushing.
- Sequence IV lab visits this period
 - Analysis of delivered fuel not being performed.

TMC Lab Visits

- VID lab visits this period
 - AFR device did not meet Range Specification in method.
- VG and VIII visits did not identify any issues at any labs visited.

Test Area Timelines

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Test Area Timeline Additions

Test	Date	Topic	IL
IIIF	20120413	Added First-in, First-out criteria for specific hardware and revised the change frequency for the parts washer cleaning solution	12-1
IIIG	20120413	Revised the change frequency for the parts washer cleaning solution	12-1
VG	20120612	Added source for used cylinder heads and vendor for refurbishing used heads	12-1
VID	20120730	Added provisions for repeating a BSFC stage projected to have a parameter out of specification.	12-2
IVA	20120711	Update reference oil 1006-2, targets with N = 15	
IVA	20120711	Updated standard deviation for severity adjustments	

*As of 9/30/2012

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Additional Information

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September 30, 2012

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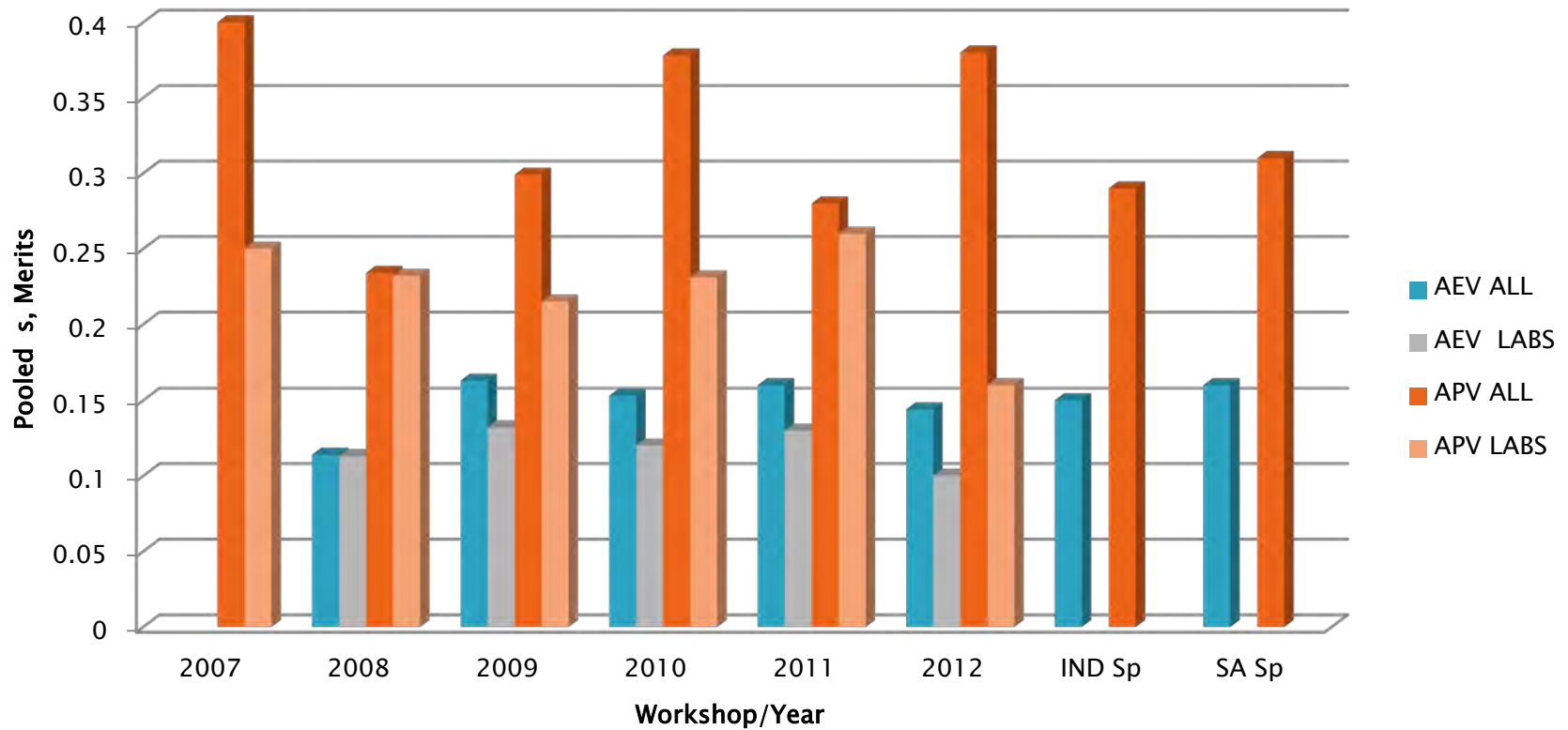
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Additional Information

- ▶ Summary of Precision Data From Light Duty Rating workshops:
 - VG Average Piston and Average Engine Varnish.
 - IIIG WPD.

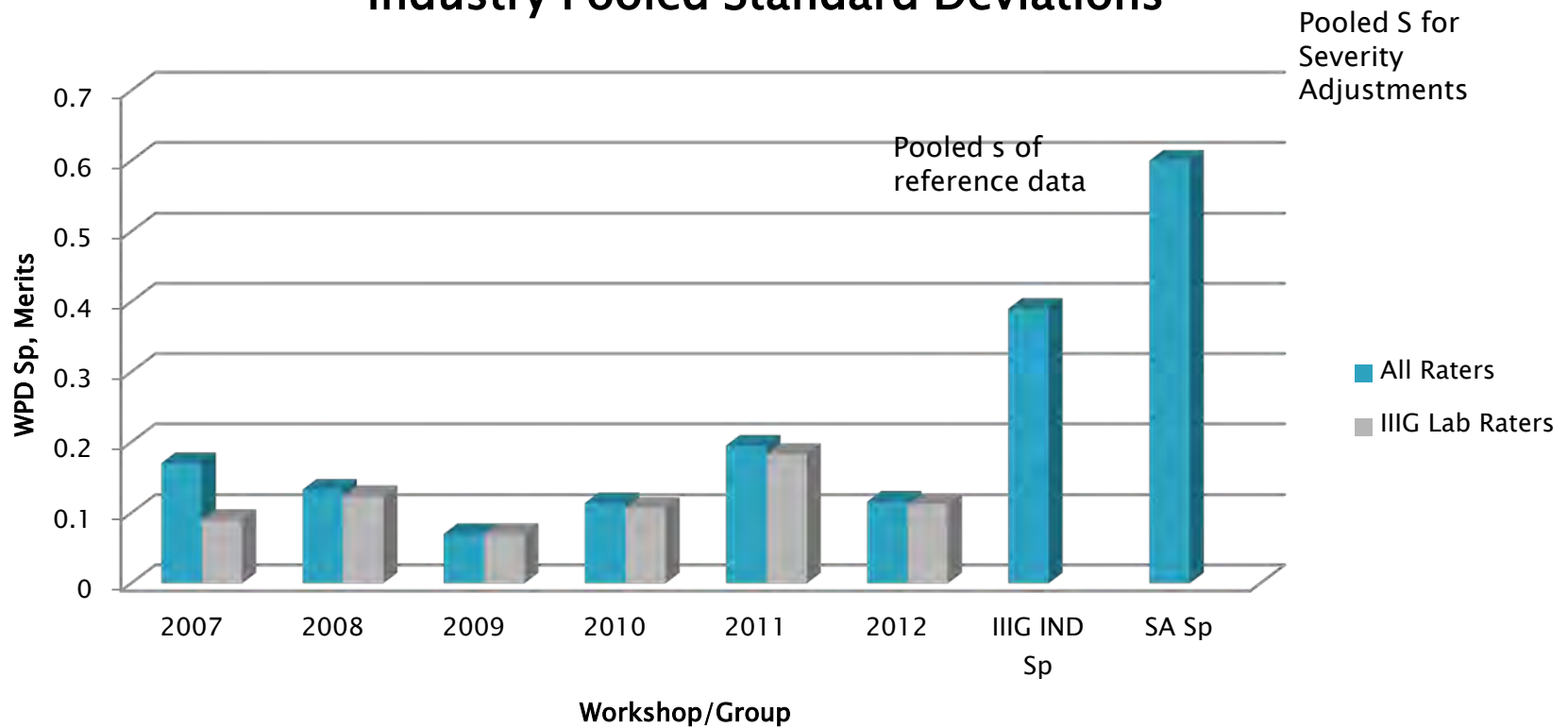
Sequence VG Precision Estimates

Workshop Data for VG Varnish



Sequence IIIG Precision Estimates

Comparison of Workshop Pooled Standard Deviations with Industry Pooled Standard Deviations



Additional Information

- ▶ Available on TMC Website:
 - Live Reference Test Data Bases
 - Surveillance Panel Meeting Minutes
 - Test Area Alarm Logs
 - Complete Test Area Timelines
 - LTMS Manual

- ▶ www.astmtmc.cmu.edu



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Appendix 1 PCMO Reference Oil Testing Control Charts October 2012

Appendix 1.a

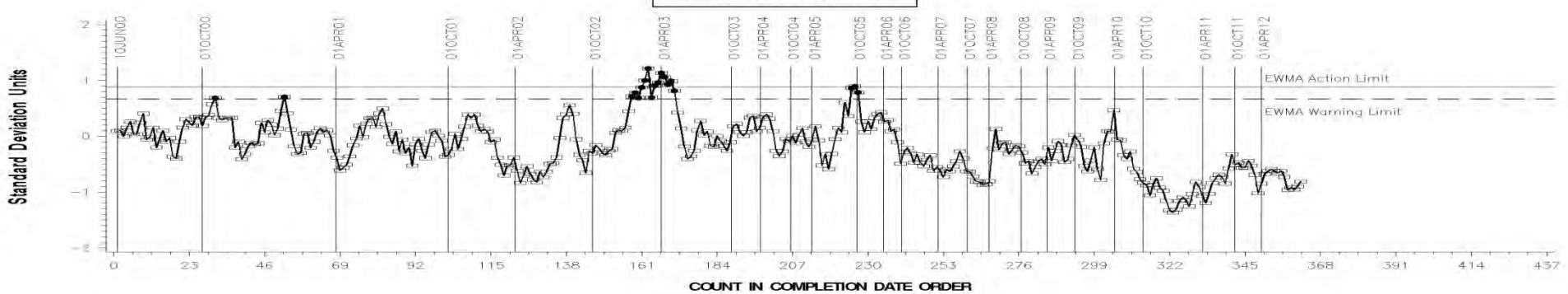
IIIF Control Charts

» Severity, Precision, and CuSum

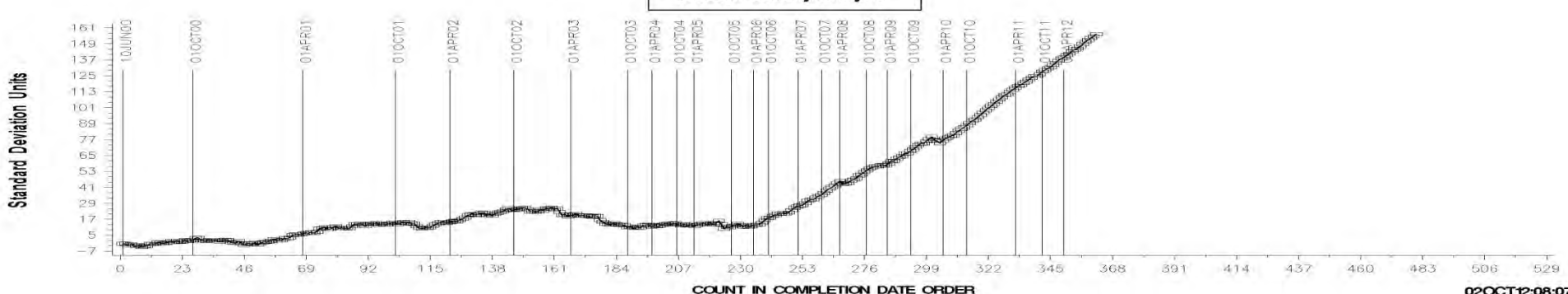
LTMS Severity Analysis



LTMS Precision Analysis

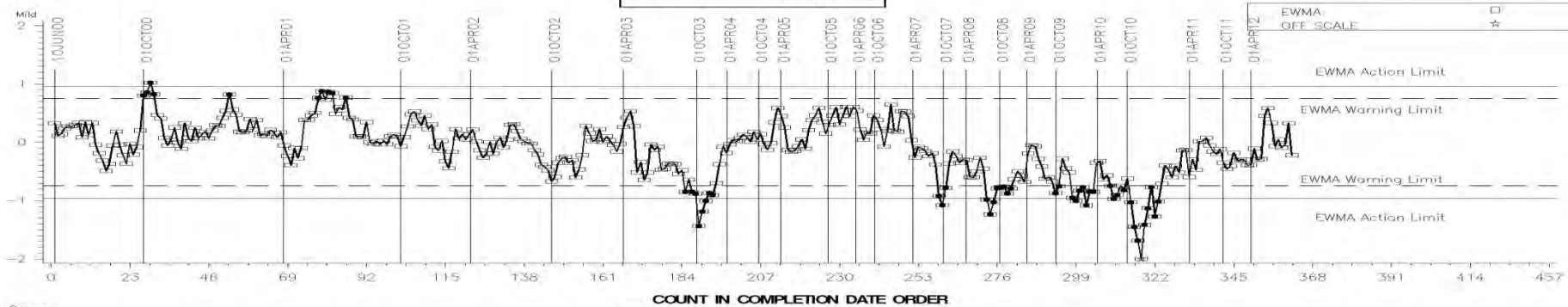


CUSUM Severity Analysis

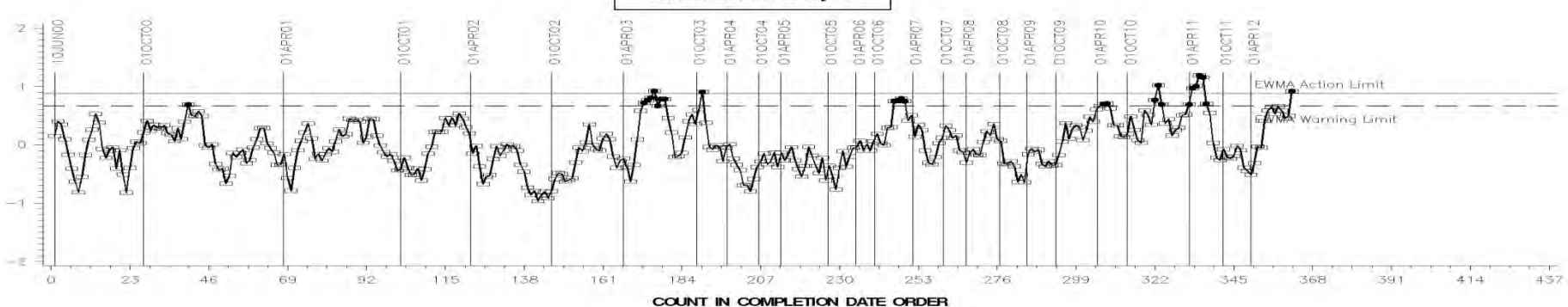


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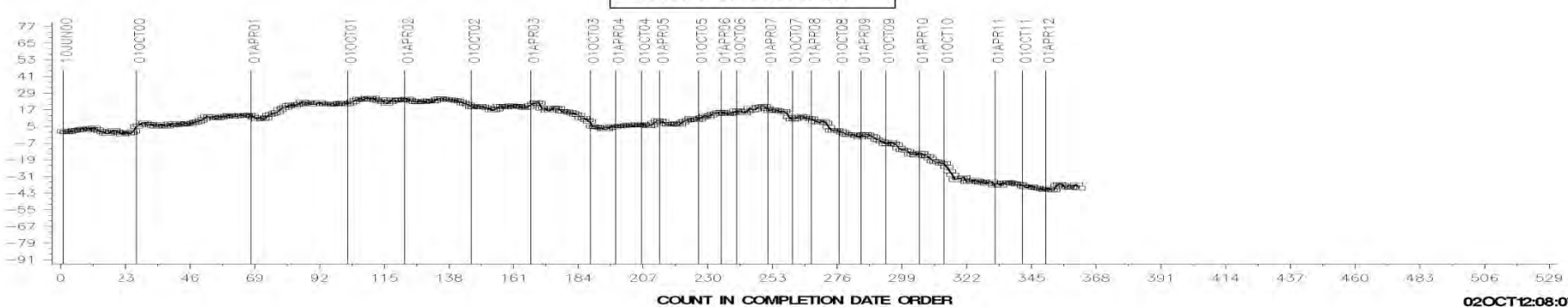
LTMS Severity Analysis



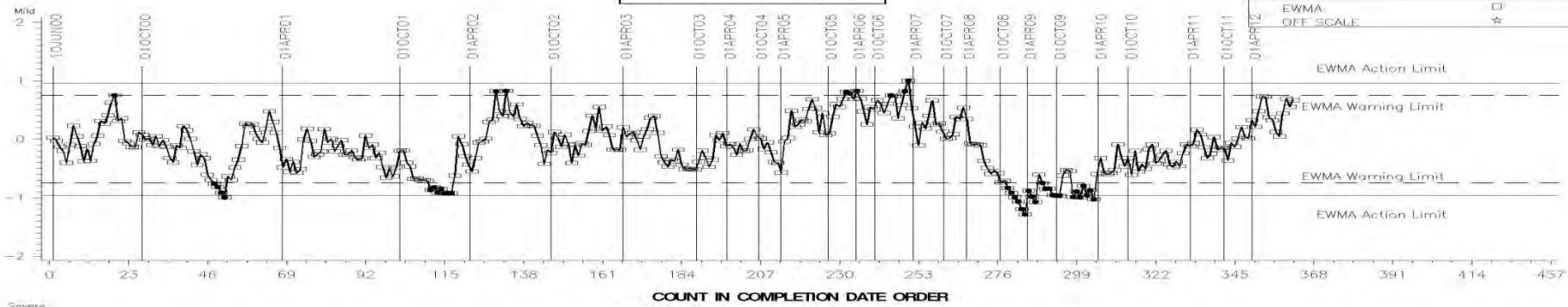
LTMS Precision Analysis



CUSUM Severity Analysis

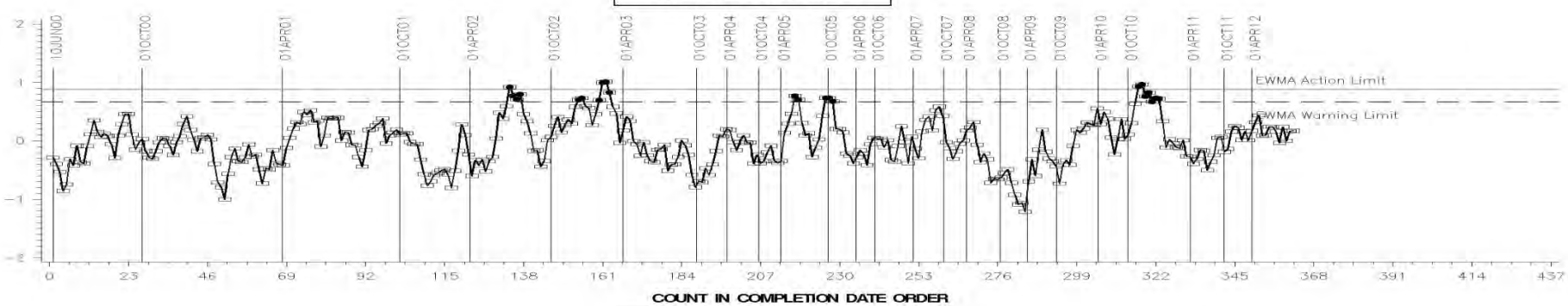


LTMS Severity Analysis



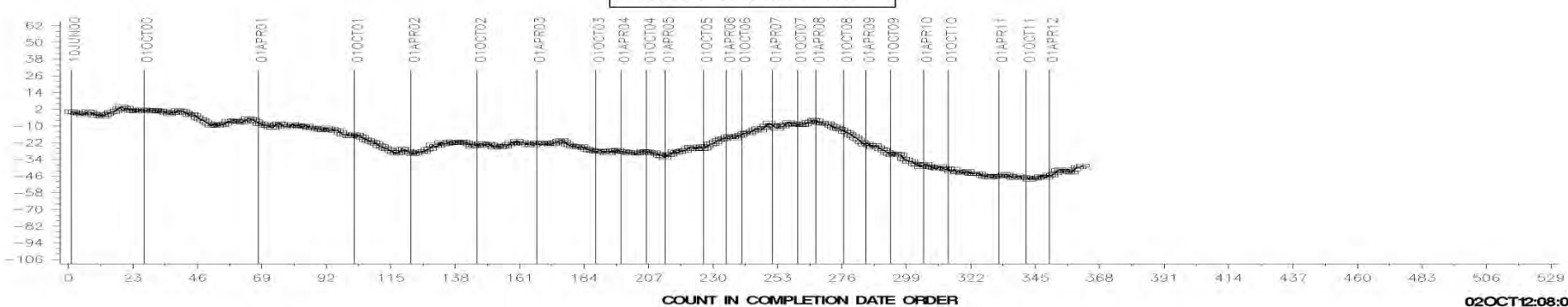
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

02OCT12:08:08

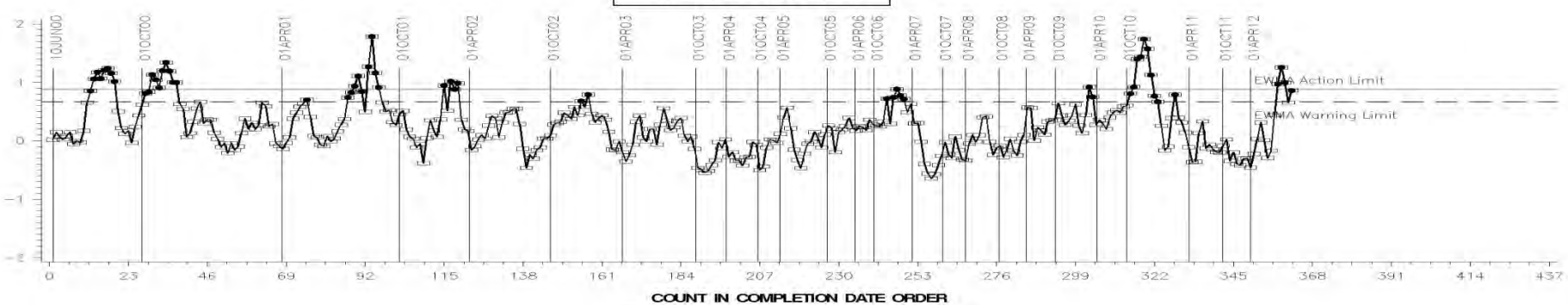
SEQUENCE IIIH CIIIH INDUSTRY OPERATIONAL VALID DATA

% VISCOSITY INCREASE @ 060 HOURS

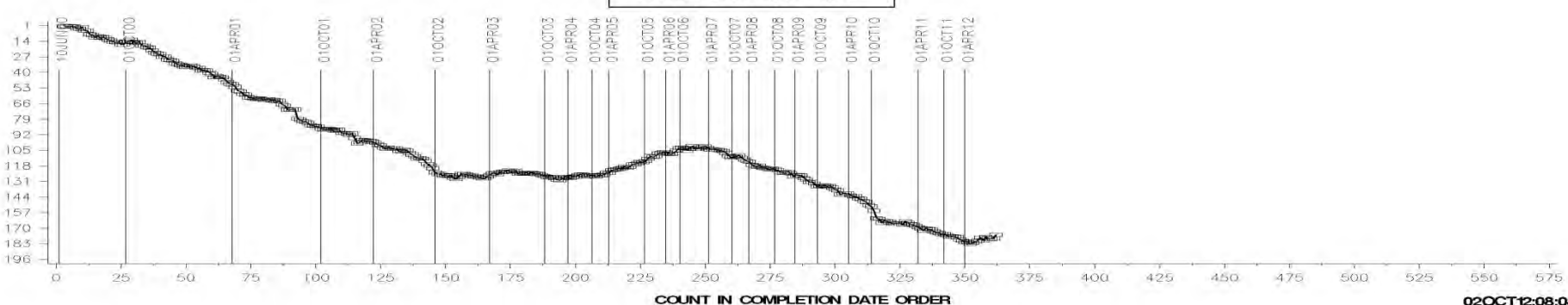
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02OCT12:08:08

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Appendix 1.b

IIIG/A/B Control Charts

» Severity, Precision, and CuSum

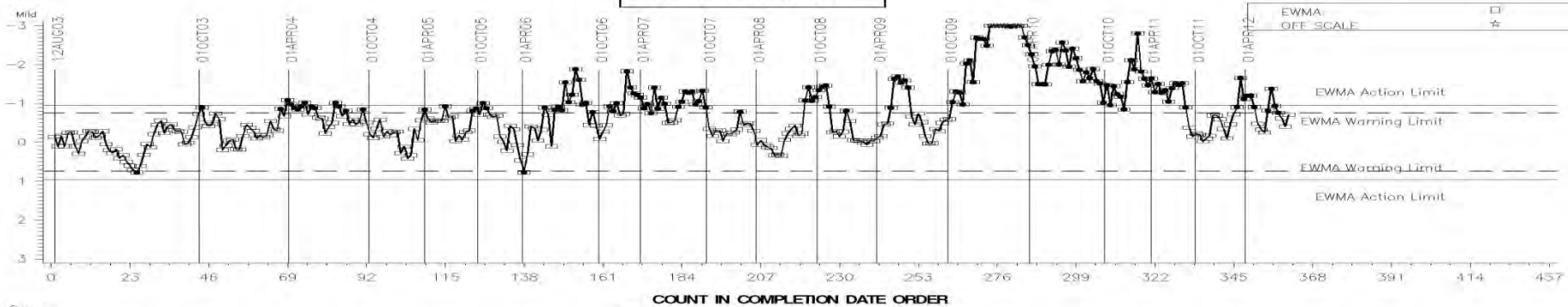
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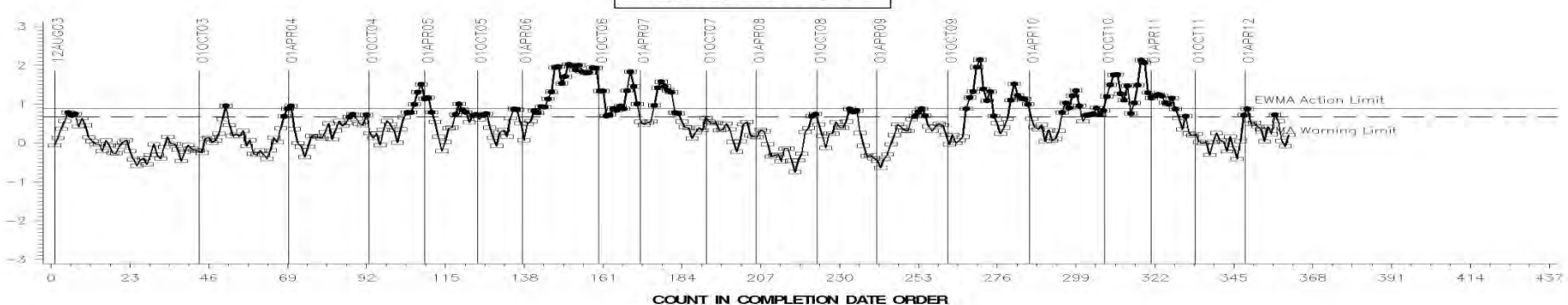
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LTMS Severity Analysis



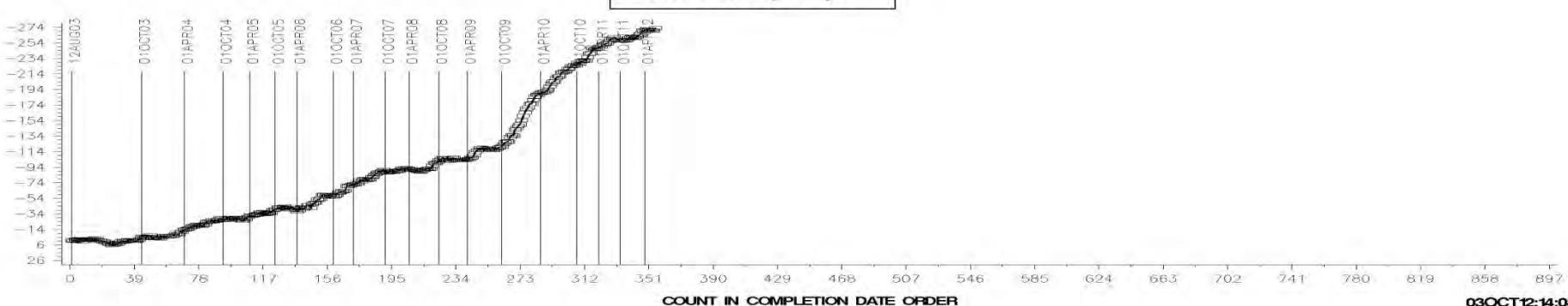
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

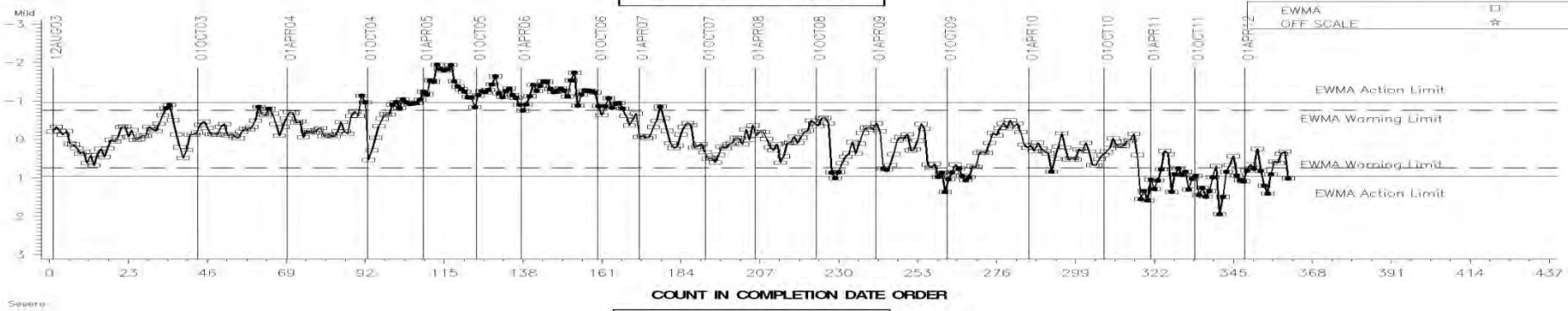
CUSUM Severity Analysis



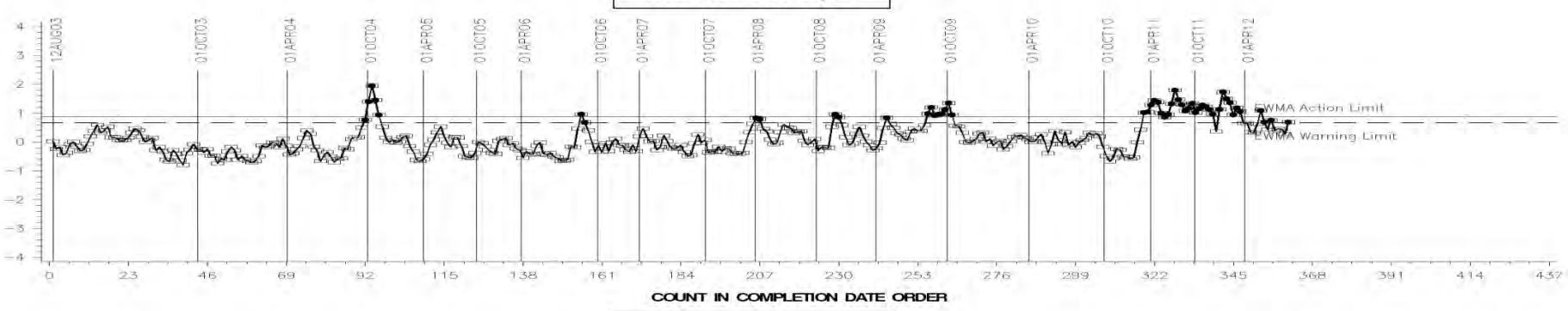
COUNT IN COMPLETION DATE ORDER

VISCOSITY INCREASE

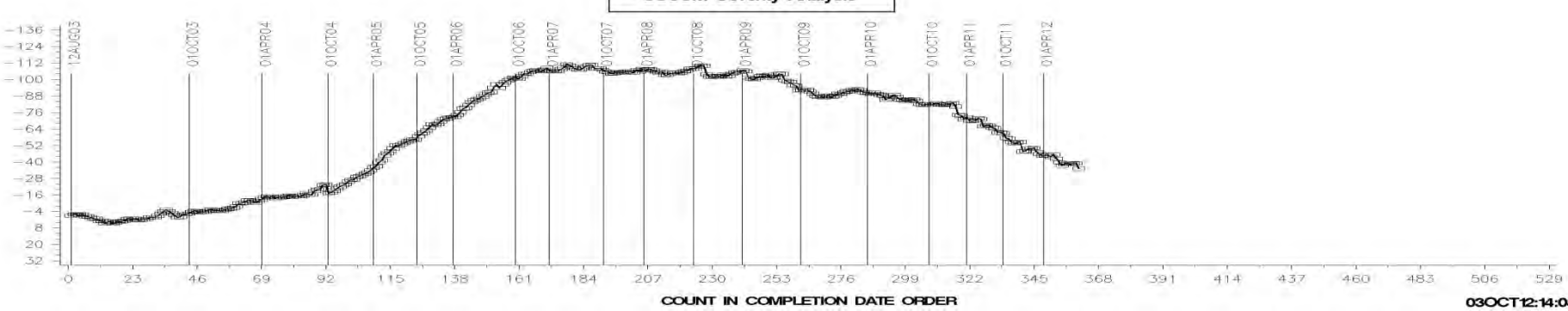
LTMS Severity Analysis



LTMS Precision Analysis

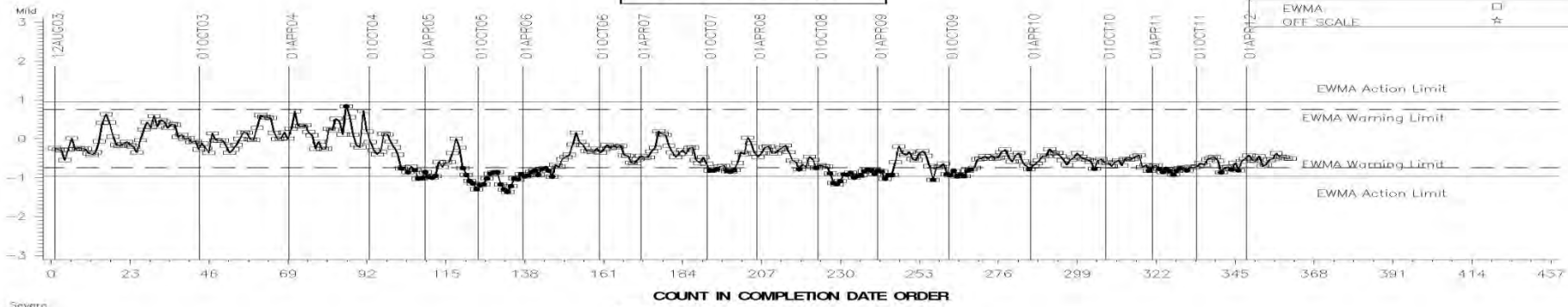


CUSUM Severity Analysis



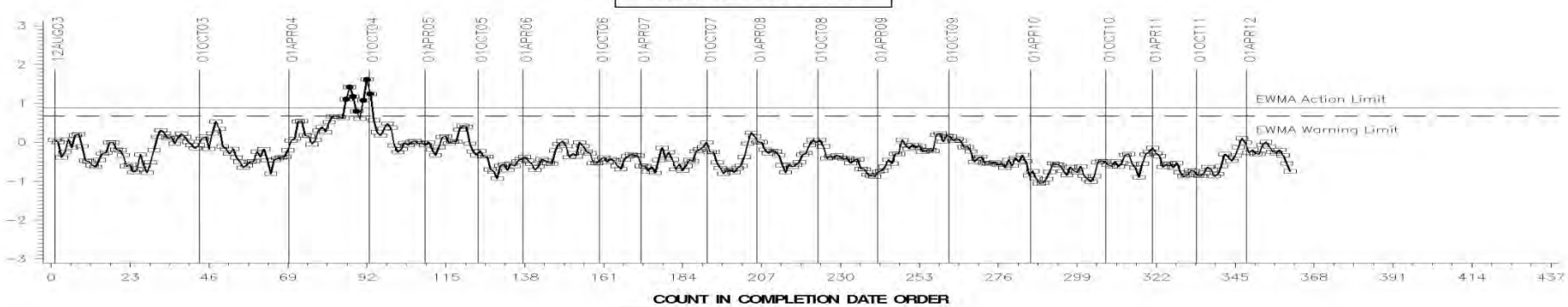
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LTMS Severity Analysis



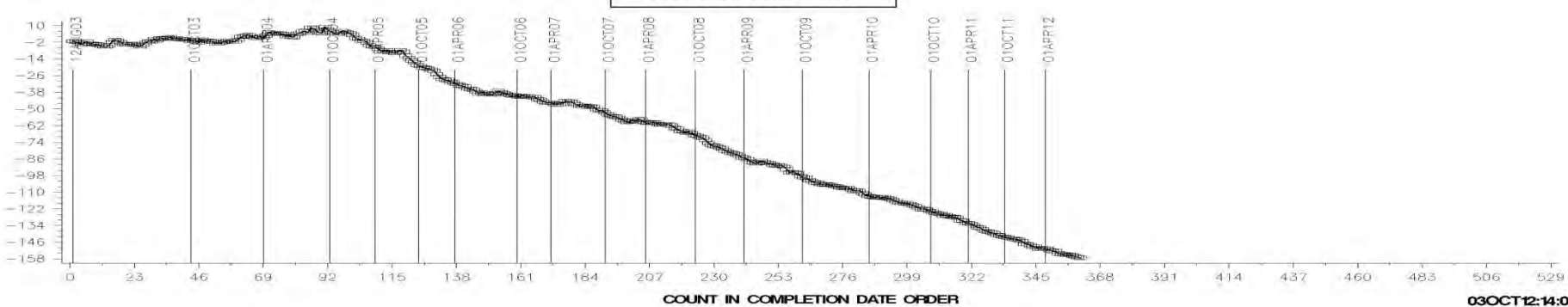
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

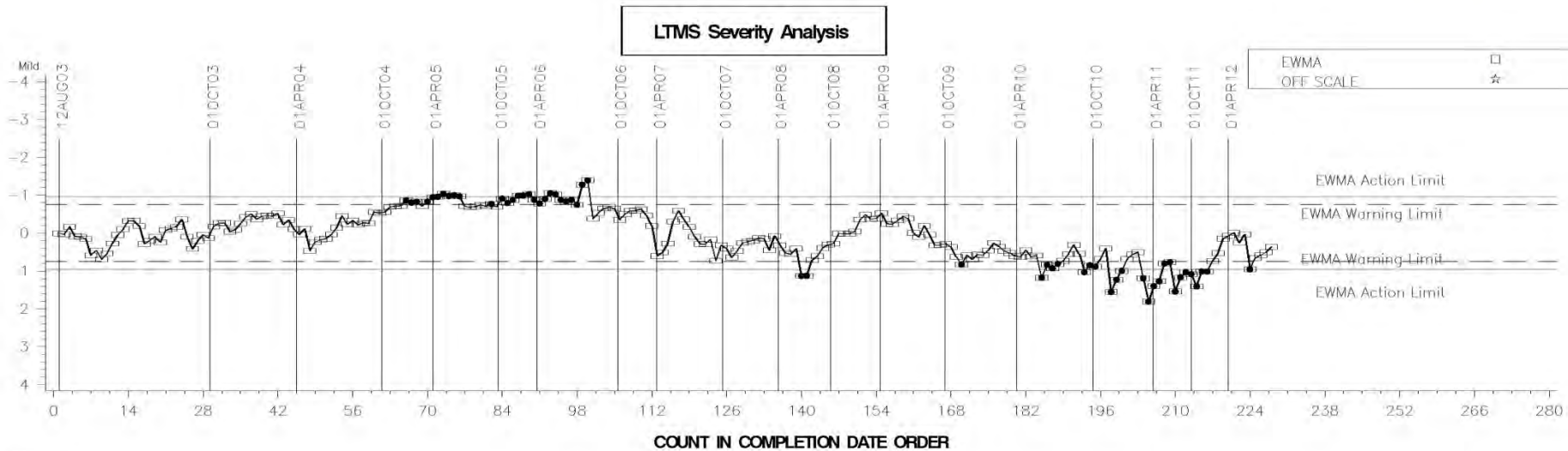


COUNT IN COMPLETION DATE ORDER

03OCT12:14:08

MRV VISCOSITY RESULT

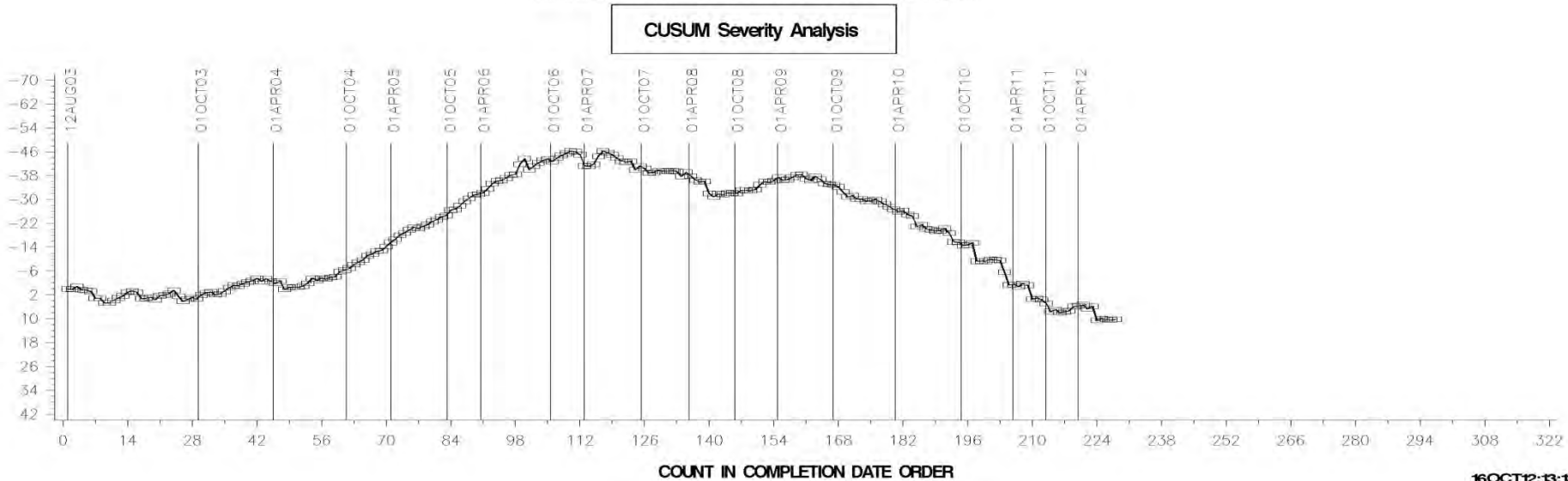
Standard Deviation Units



Severe:

TEST TARGETS BASED ON DATA REPORTED PRIOR TO 10/15/90 for Reference Oil 600
 Tests Targets for Reference Oil 600 is the Mean of the Data Used to Develop the Correction Factor

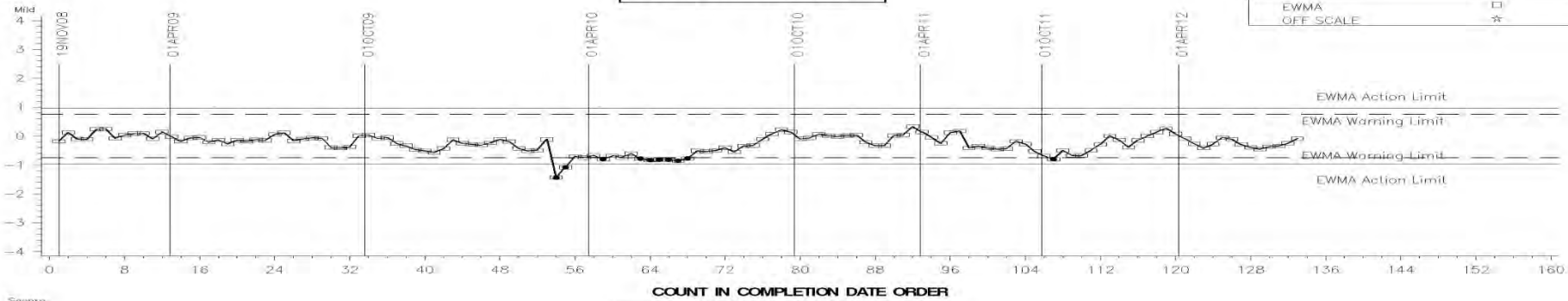
Standard Deviation Units



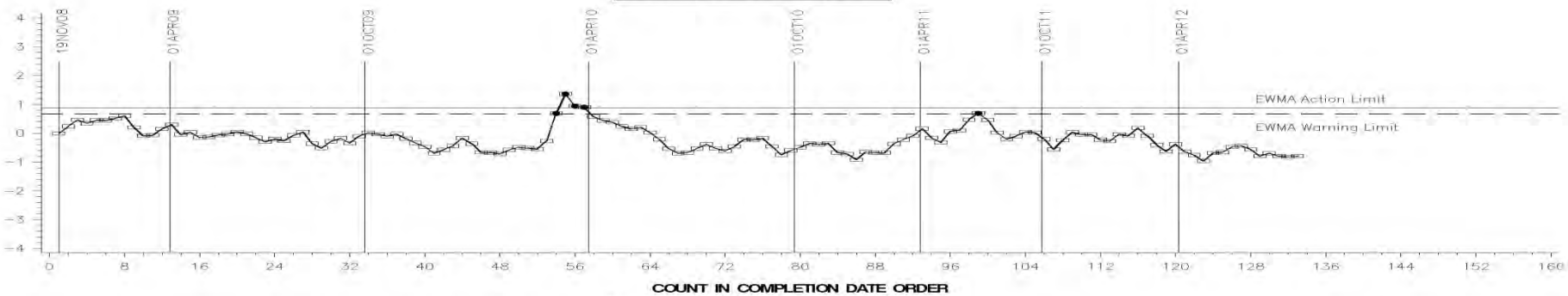
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PHOS RETENTION

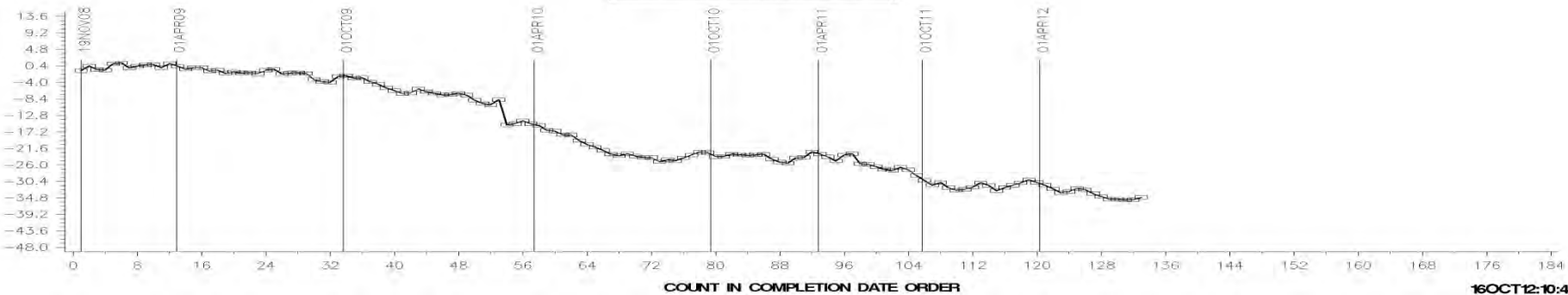
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



16OCT12:10:40

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Appendix 1.c

Sequence IVA Control Charts

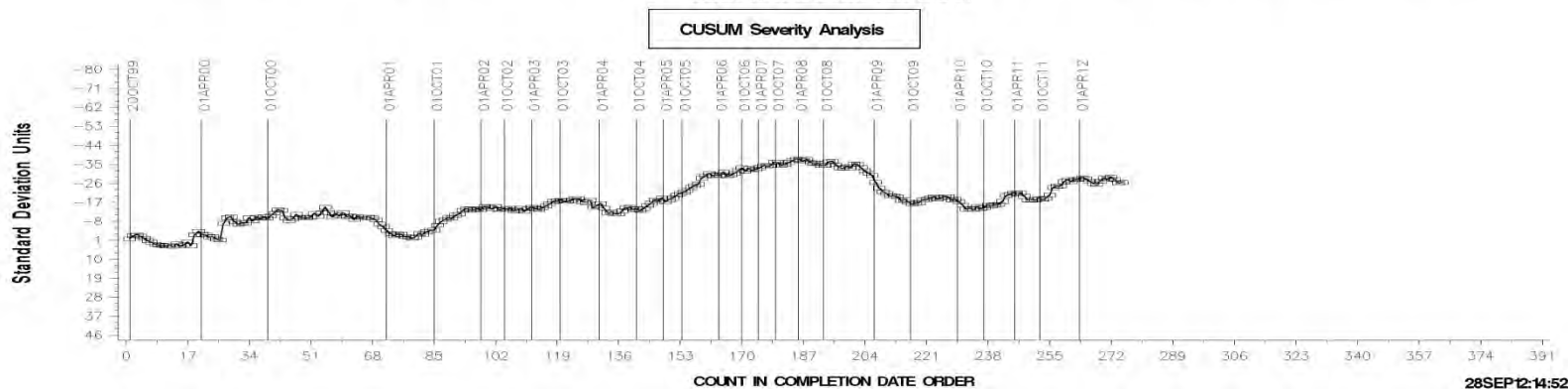
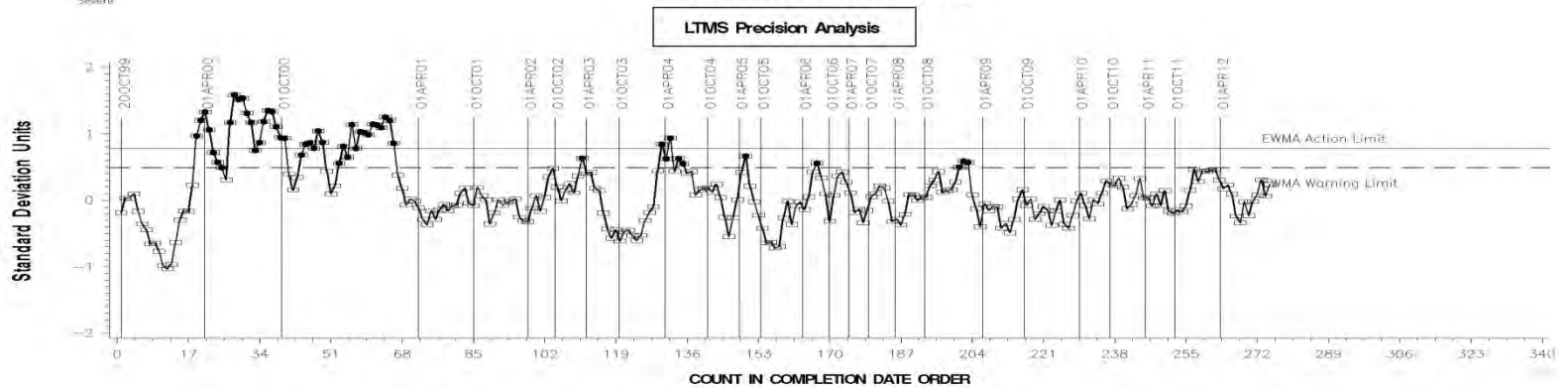
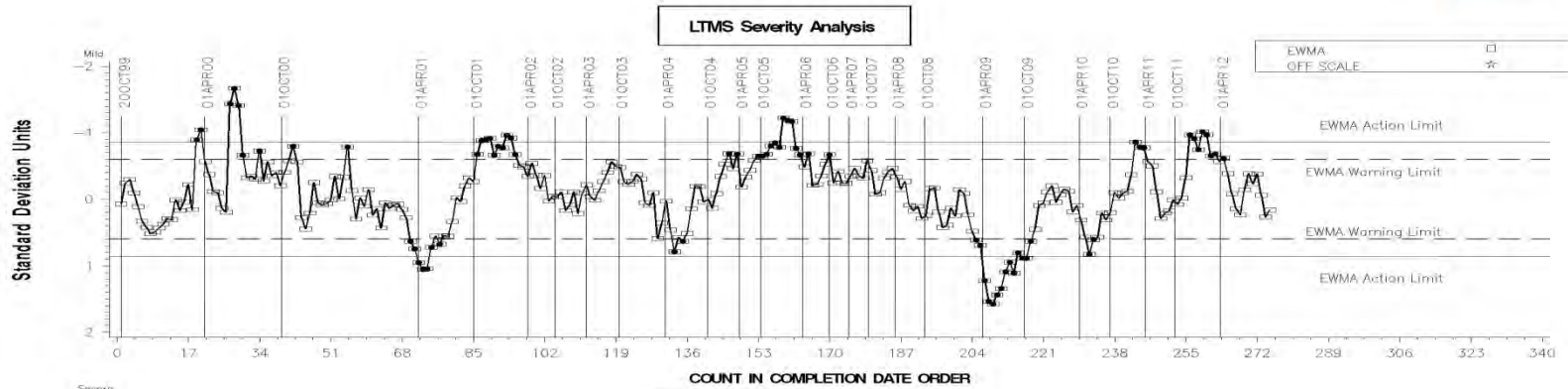
» Severity, Precision, and CuSum

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28SEP12:14:52

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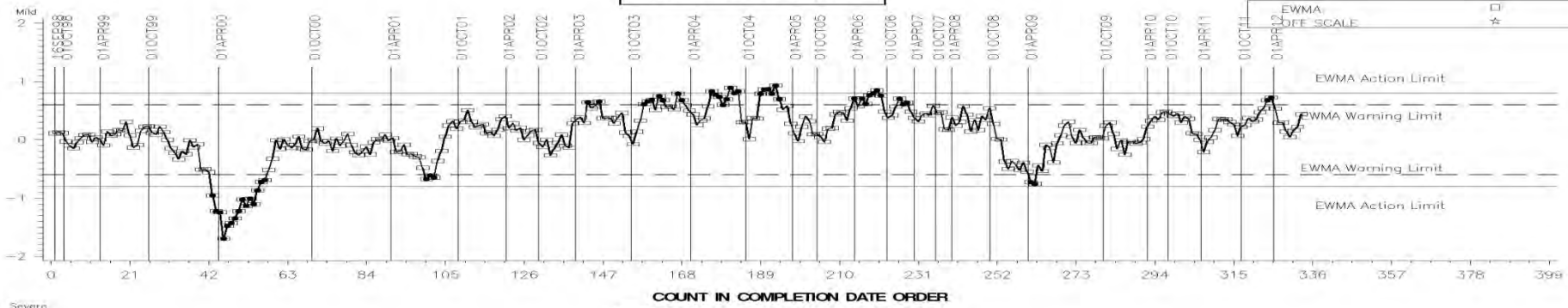
Appendix 1.d

Sequence VG Control Charts

» Severity, Precision, and CuSum

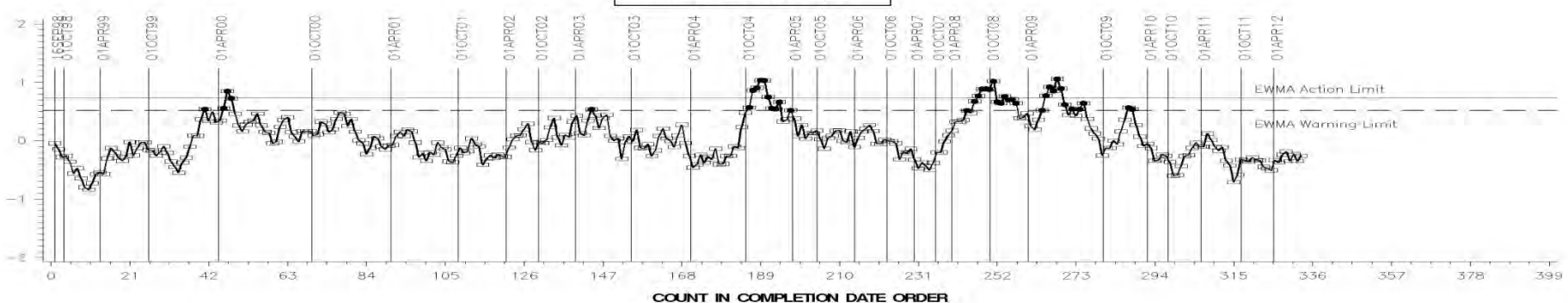
AVERAGE ENGINE SLUDGE

LTMS Severity Analysis



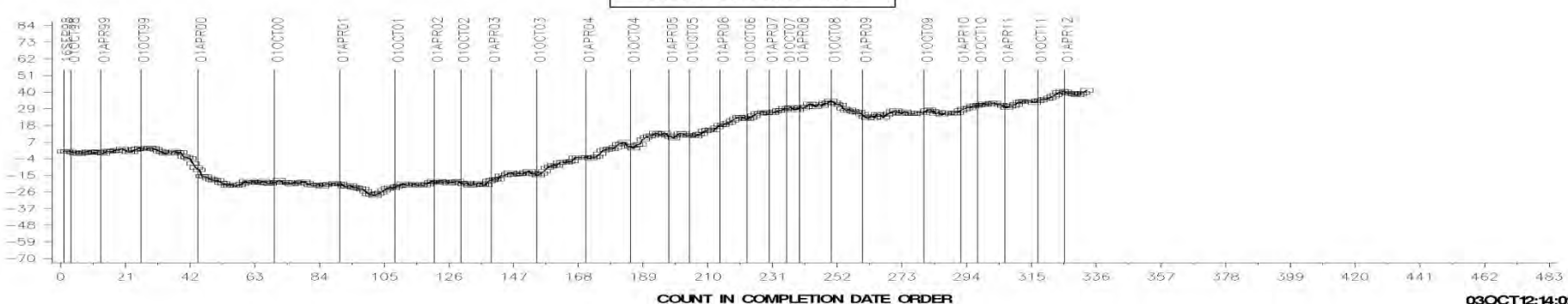
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

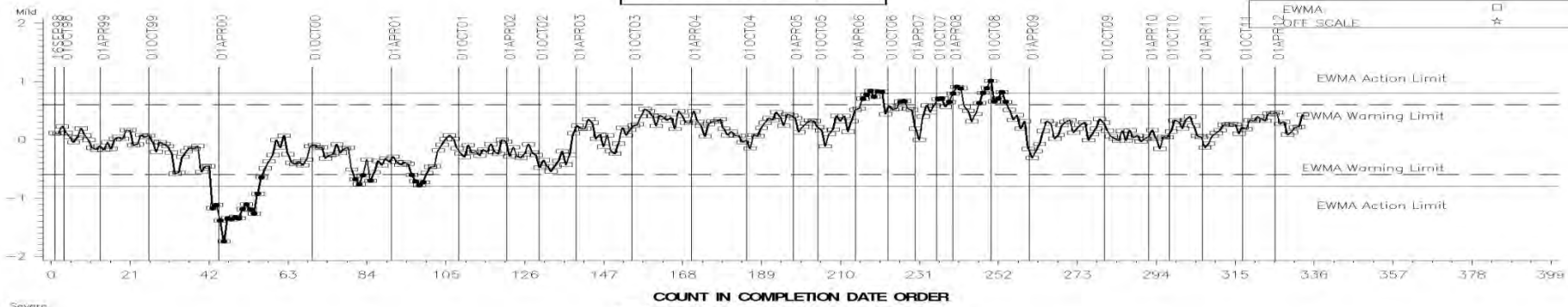
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SEQUENCE VG INDUSTRY OPERATIONAL VALID DATA

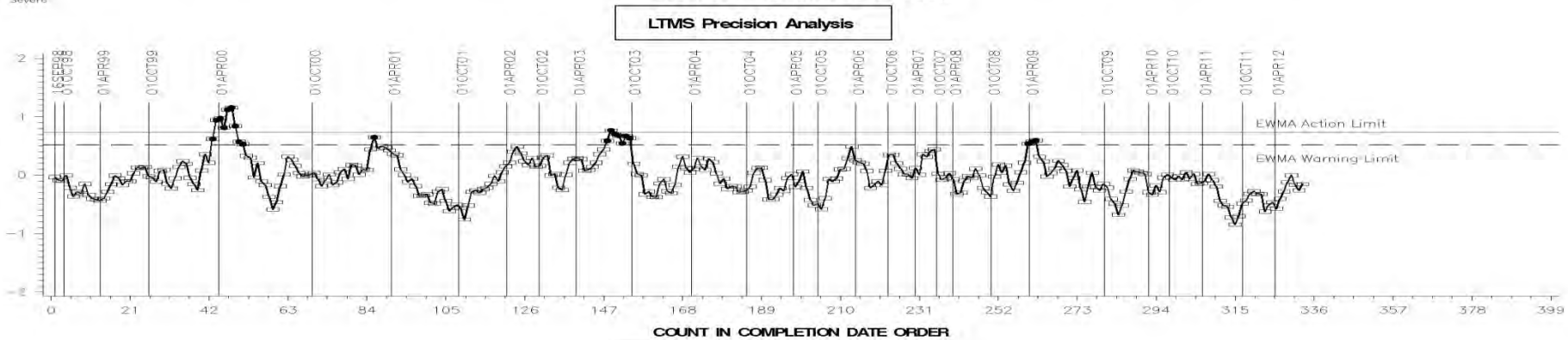
AVERAGE ROCKER COVER SLUDGE



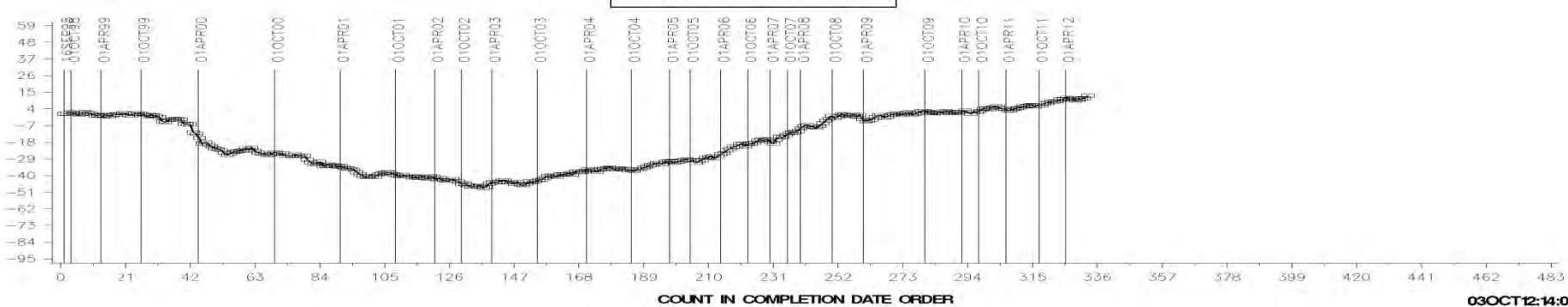
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



03OCT12:14:03

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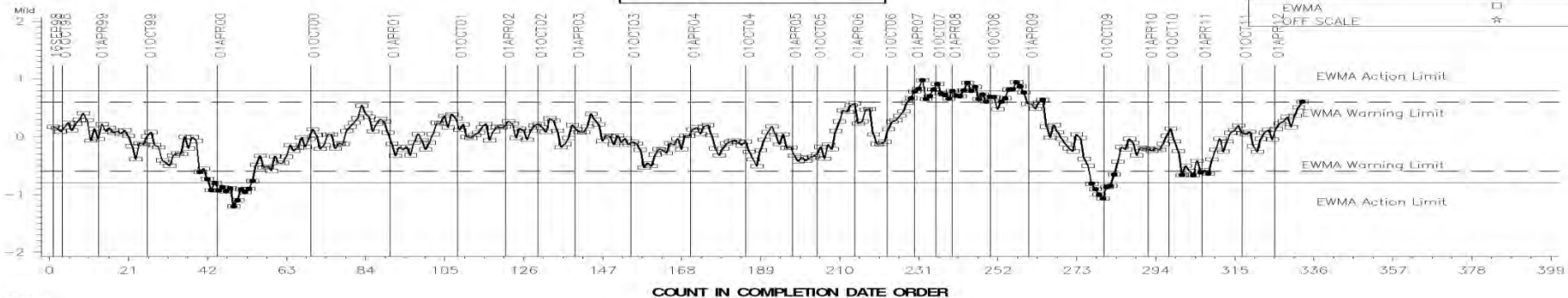


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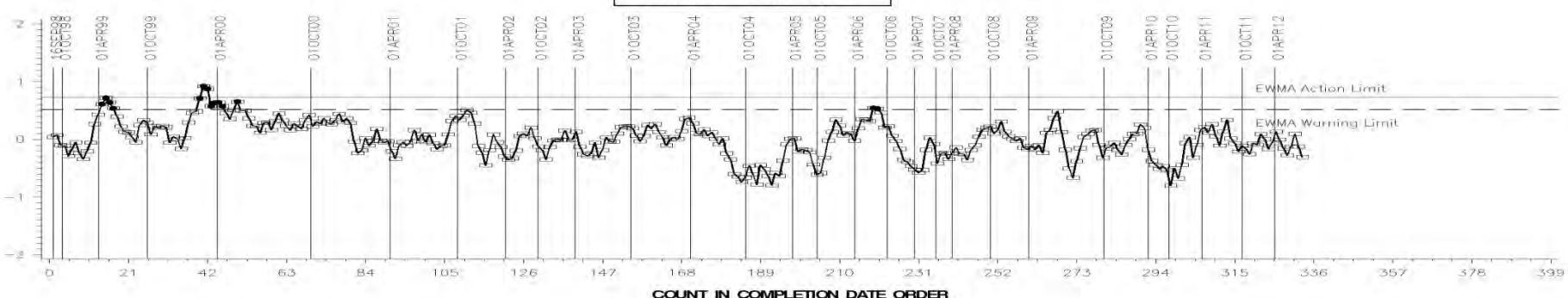
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVG. ENG. VARN. 3-PART APV + BAFFLES

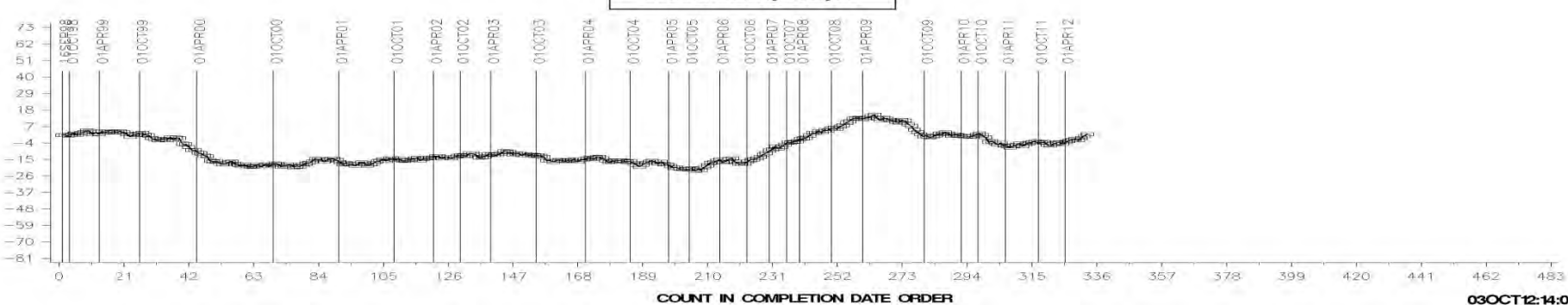
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



03OCT12:14:03

Test Monitoring Center

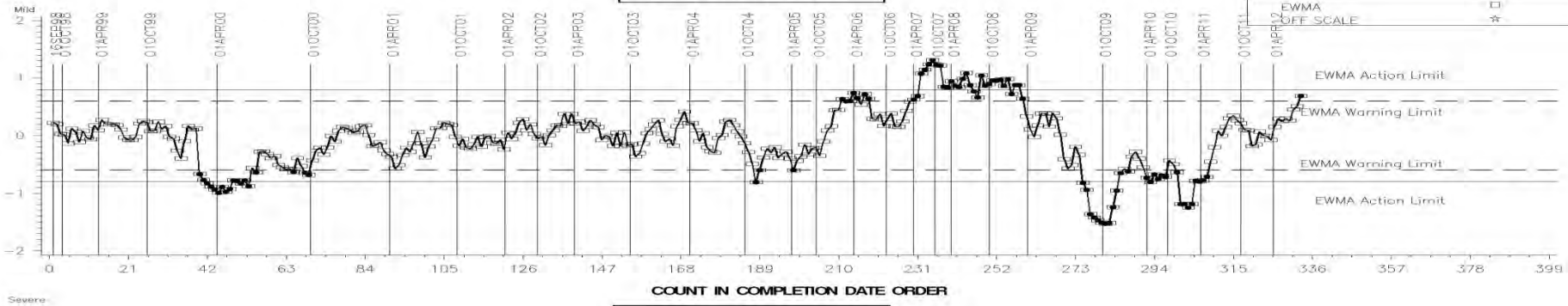
<http://astmtmc.cmu.edu>



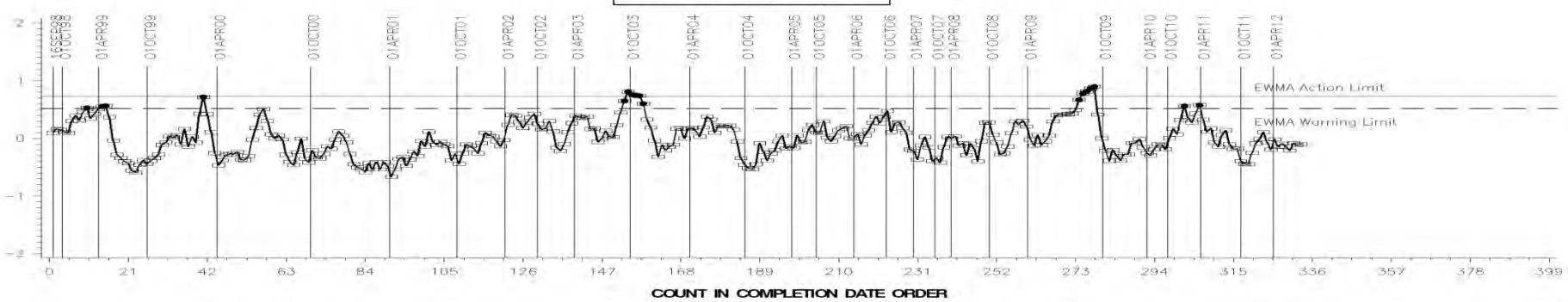
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AVG PISTON SKIRT RATING

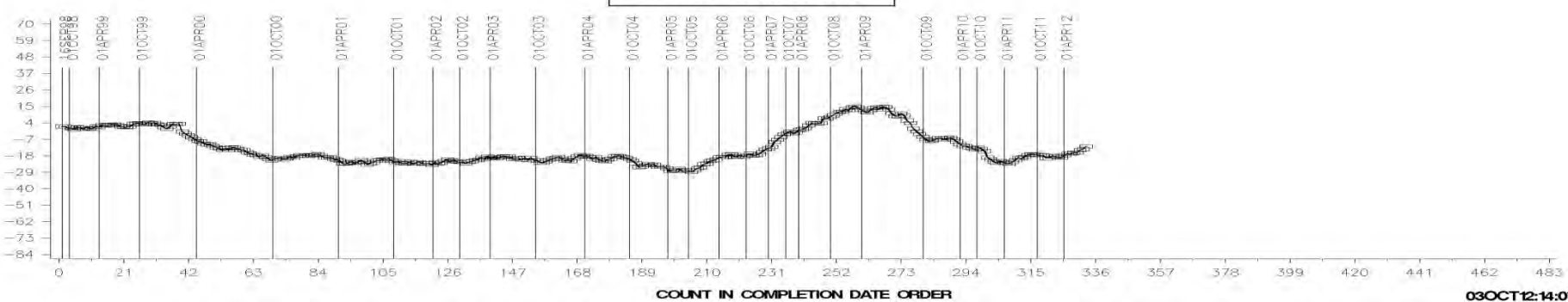
LTMS Severity Analysis



LTMS Precision Analysis



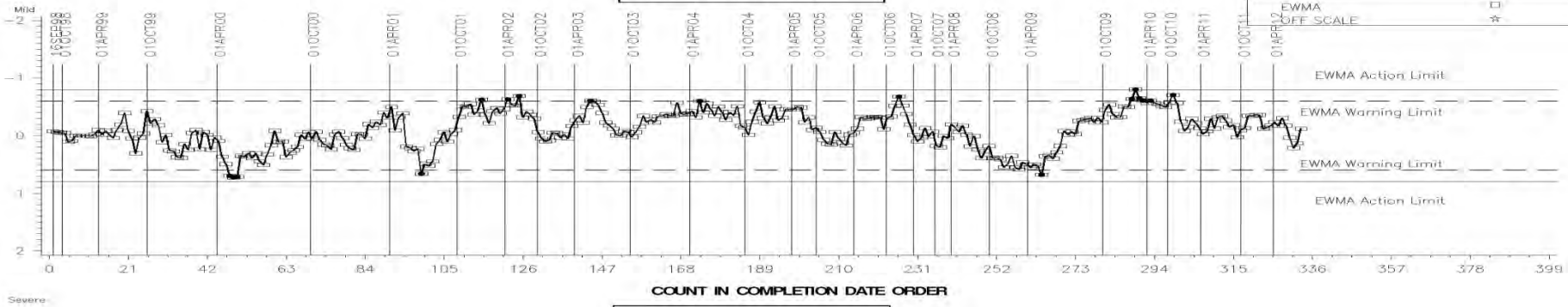
CUSUM Severity Analysis



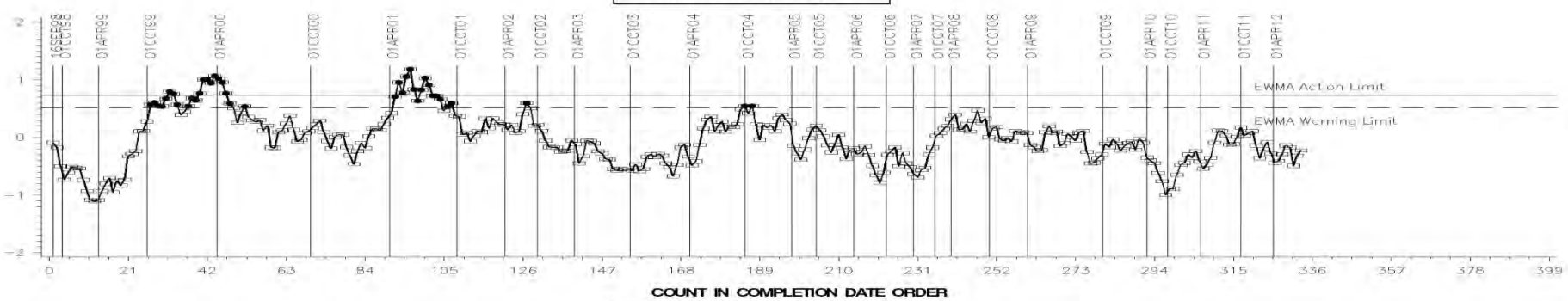
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OIL SCREEN SLUDGE

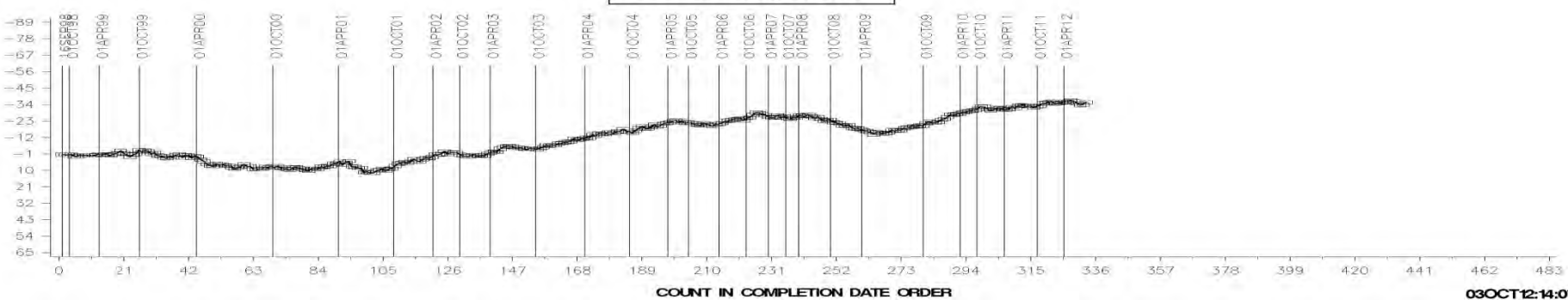
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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Appendix 1.e

Sequence VID Control Charts

» Severity, Precision, and CuSum

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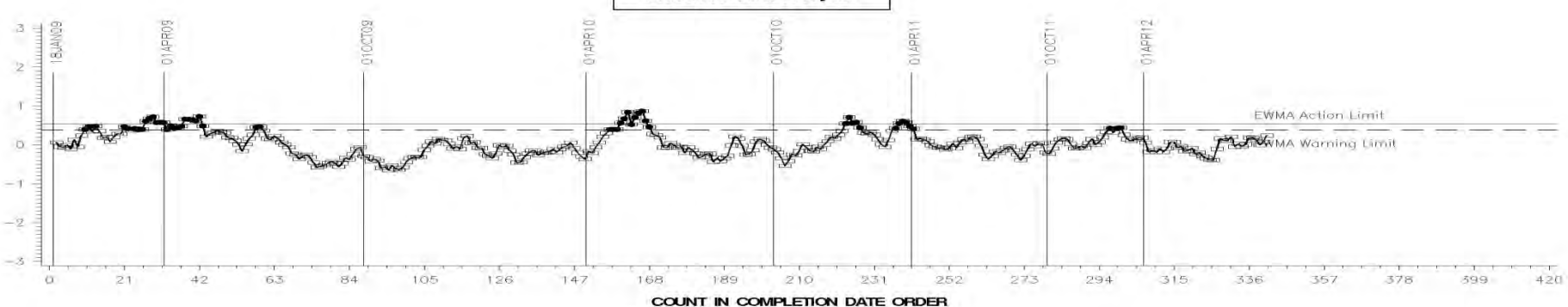
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FEI FINAL RESULT PHASE I

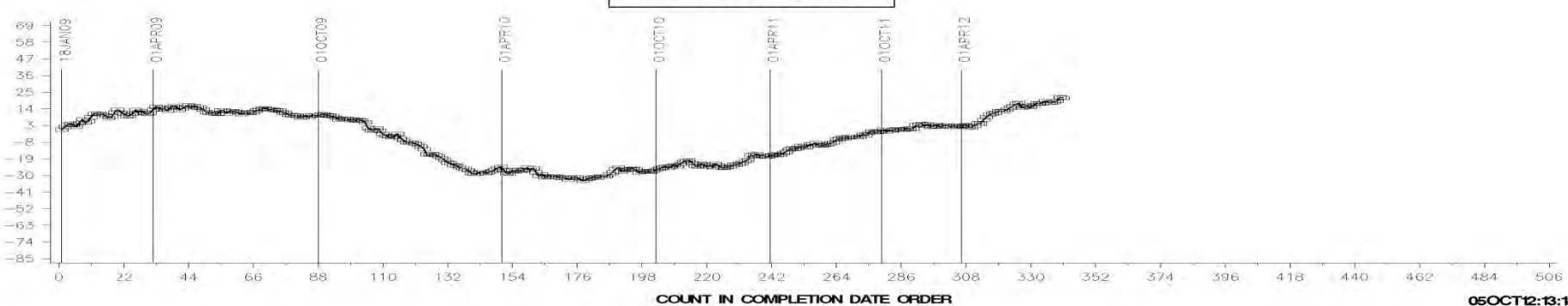
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

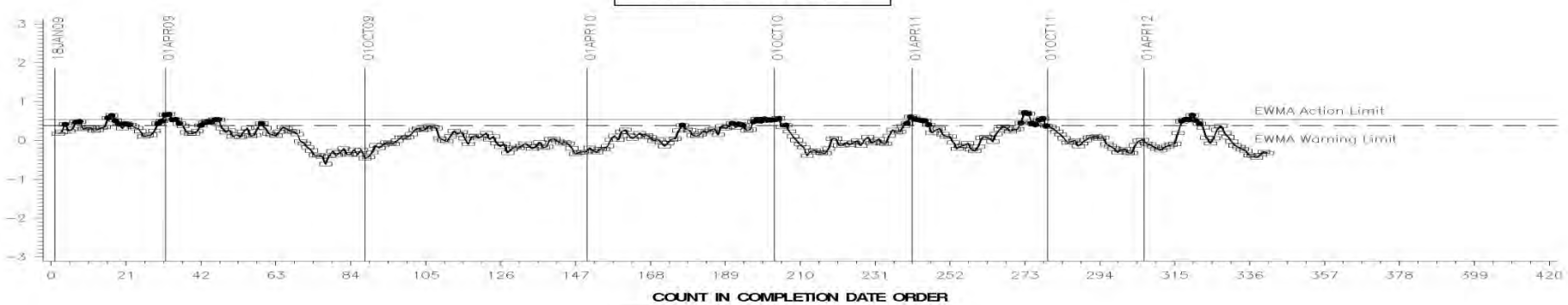


FEI FINAL RESULT PHASE II

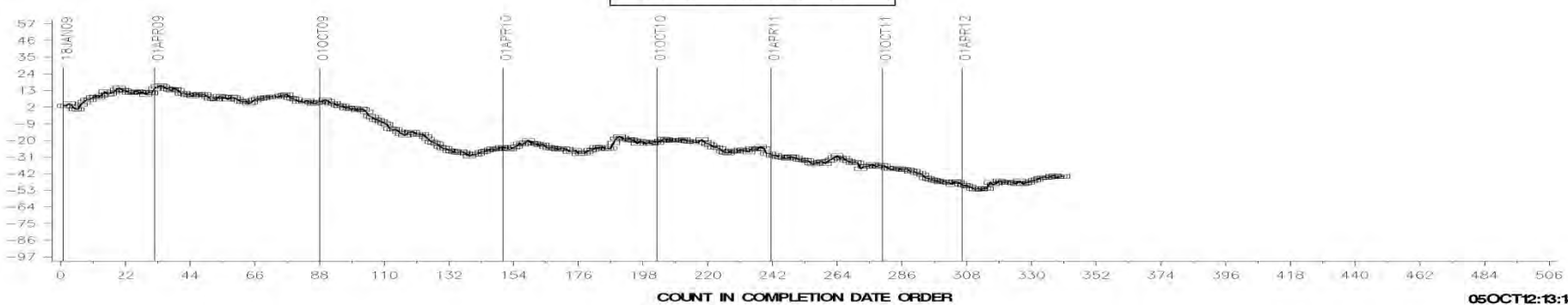
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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Appendix 1.f

Sequence VIII Control Charts

» Severity, Precision, and CuSum

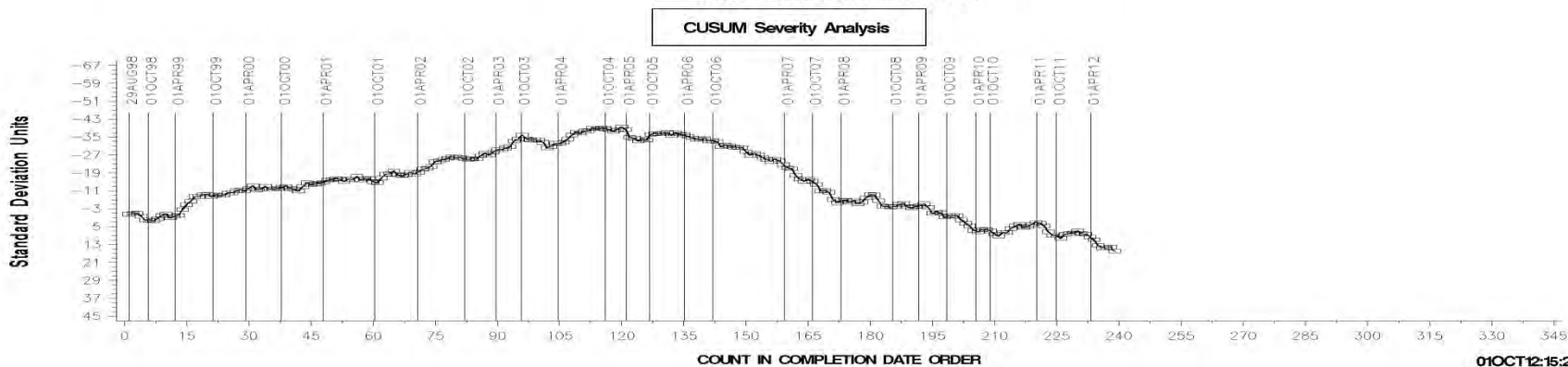
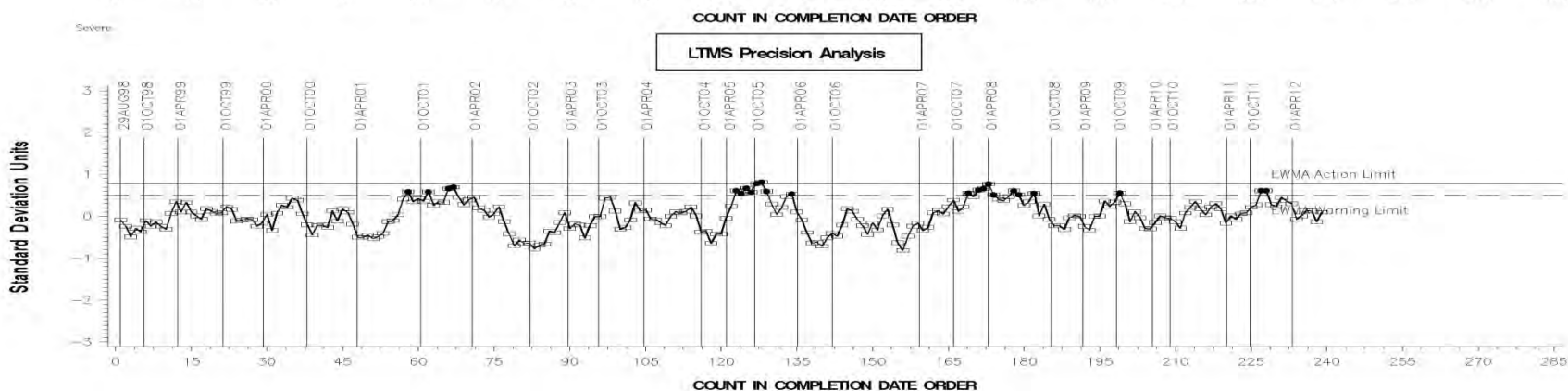
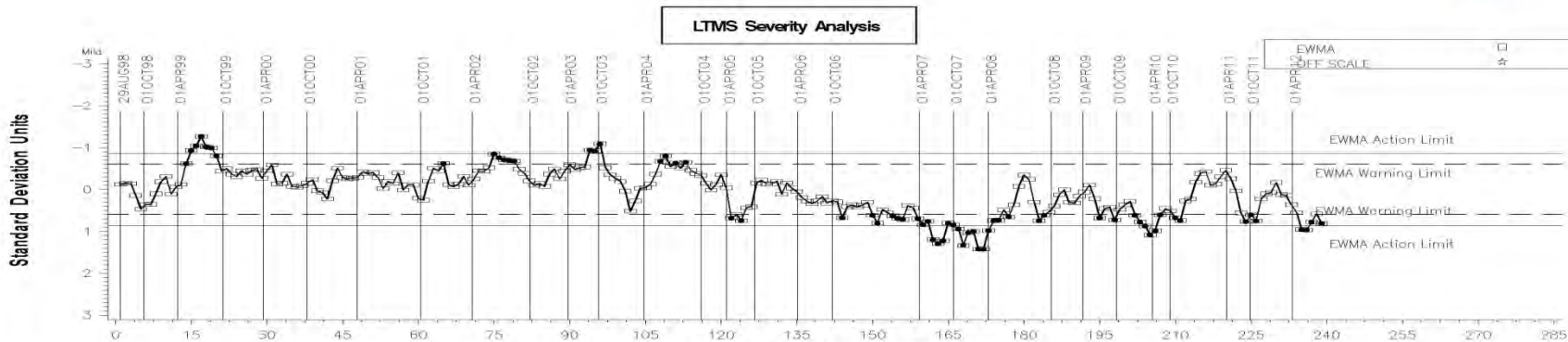
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FINAL BEARING WEIGHT LOSS



01OCT12:15:27

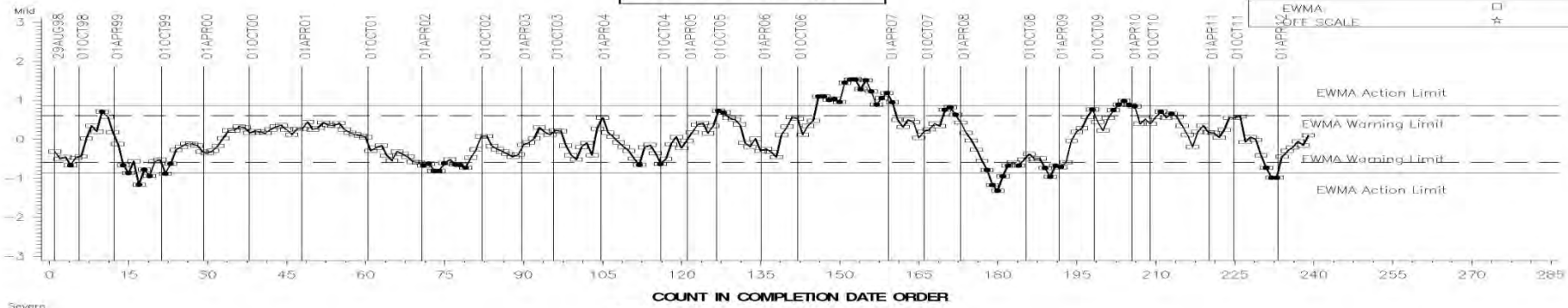
Test Monitoring Center

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LTMS Severity Analysis

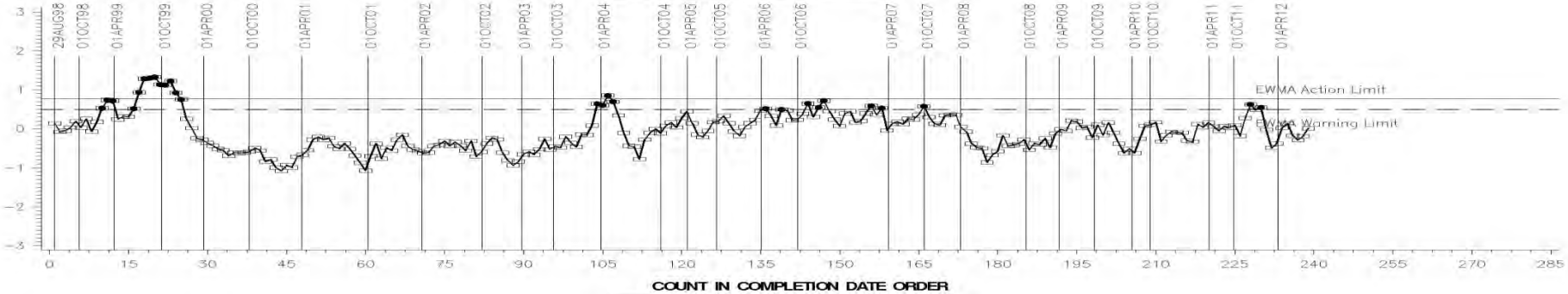
Standard Deviation Units



COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis

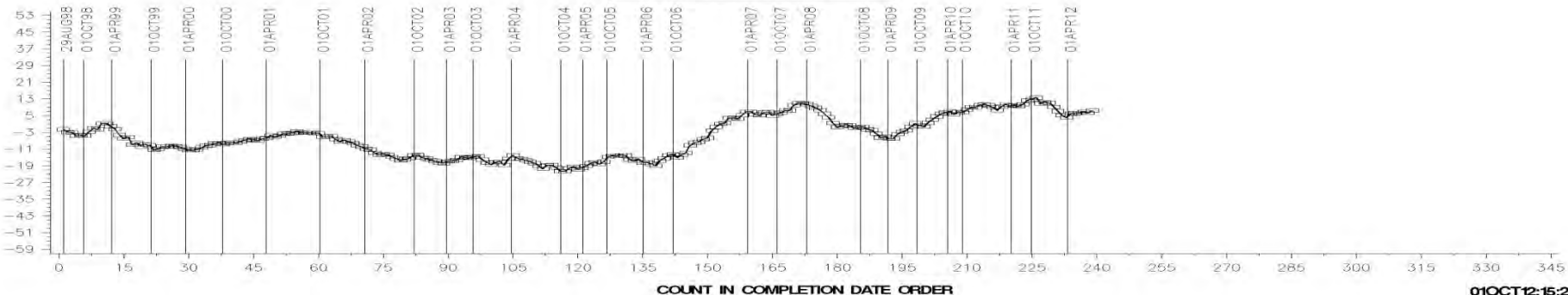
Standard Deviation Units



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

Standard Deviation Units



COUNT IN COMPLETION DATE ORDER

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