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# **Test Monitoring Center**

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

**April 2014**

# Passenger Car Engine Oil Testing Executive Summary

## ▶ Seq. IIIF

- Hardened seat heads approved for use. One lab successfully calibrated with these heads.

## ▶ Seq. IIIG

- Hardened seat heads approved for use. Three labs successfully calibrated with these heads.
- Re-blend of [oil 434](#) has been received. It has been homogenized at TMC and is now available.

# Passenger Car Engine Oil Testing Executive Summary

## ▶ Seq. IVA

- TMC reference oil 300, an oil performing in the 50–60  $\mu\text{m}$  range, has been obtained and the panel needs to address its introduction into LTMS.
- One laboratory successfully calibrated with latest reground cam batch.

# Passenger Car Engine Oil Testing Executive Summary

## ▶ Seq. VI

- Approximately 1 year supply of 541-1 remains and oil may not be able to be blended again.

## ▶ Seq. VIII

- Sequence VIII Panel approved the use of an external oil pump, to facilitate running of low vis grade oils in Sequence VIII.

# Calibrated Labs and Stands\*

Test	Labs	Stands
IIIF	3	5
IIIG/A/B	5	13
IVA	2	5
VG	3	7
VID	3	5
VIII	2	3

\*As of 3/31/2014

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# Test Activity Levels

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# Sequence Tests

Test Status	Validity Code	IIIF	IIIG	IVA
Acceptable Calibration Test	AC	9	9	6
Failed Calibration Test	OC	2	2	1
Operationally Invalid by Lab	LC	1	0	6
Aborted	XC	0	3	0
Test Stand Removed from LTMS	MC	0	0	2
Decoded/Donated	NN/AG	0	5	5
<b>Total</b>		<b>12</b>	<b>19</b>	<b>20</b>

# Sequence Tests

Test Status	Validity Code	VG	VID	VIII
Acceptable Calibration Test	AC	13	26	5
Failed Calibration Test	OC	0	2	2
Operationally Invalid	LC	0	1	2
Aborted	XC	0	1	1
Operationally Invalid, Lab & TMC	RC	0	0	1
Decoded/Donated	NN/AG	0	0	5
<b>Total</b>		<b>13</b>	<b>30</b>	<b>16</b>



# Failed Tests

Test Status	Test	Number of Tests
Severe Hours to 275% Vis Increase	IIIF	2
Severe % Vis Increase	IIIG	2
Stand Precision Shewhart Alarm, ACW	IVA	1
FEI2 Mild	VID	1
FEI1 Severe	VID	1
SVIS Severe	VIII	2
<b>Total</b>		<b>9</b>

# Lost Tests\*

Slide 1 of 2

Test Status	Cause	IIIF	IIIG	IVA	VG	VID	VIII
Invalid	Wrong Spark Plug	1	0	0	0	0	0
Aborted	Loss of Oil Temperature Control	0	1	0	0	0	0
Aborted	High Oil Consumption	0	2	0	0	0	0
Invalid	Exceeded Cylinder Head Run Count	0	0	1	0	0	0
Invalid	Driveline Failure	0	0	2	0	0	0
Aborted	Rod Bearing Failed	0	0	1	0	0	0
Invalid	Abandoned Camshaft Batch	0	0	2	0	0	0
Invalid	Driveline Misalignment	0	0	1	0	0	0

(continued on next slide)

\*Invalid and aborted tests

# Lost Tests\*

Slide 2 of 2

Test Status	Cause	IIIF	IIIG	IVA	VG	VID	VIII
Invalid	Cylinder Head Temperature T/C Insertion Depth	0	0	1	0	0	0
Invalid	Exhaust Backpressure Control	0	0	0	0	1	0
Aborted	Excessive Downtime	0	0	0	0	1	0
Invalid	High Mechanical Wear	0	0	0	0	0	1
Invalid	Off gas Deviation %	0	0	0	0	0	1
Aborted	Oil Temperature Control	0	0	0	0	0	1
Aborted	Oil Leak	0	0	0	0	0	1
<b>Totals</b>		<b>1</b>	<b>3</b>	<b>8</b>	<b>0</b>	<b>2</b>	<b>4</b>

\*Invalid and aborted tests

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# Test Severity

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# Test Severity

## ▶ IIIF

- APV
    - In severity action alarm, mild
    - Long-term mild trend continuing (Since October 2006)
  - Hours to 275% Vis Increase and WPD in control
  - PV60
    - In severity action alarm
- Charts shown in [Appendix 1.a.](#)

# Test Severity

## ▶ IIIG

- PVIS in severity and precision warning alarm
- ACLW in severity action alarm, mild
  - Long-term mild trend
- WPD is in control
  - Long-term severe trend continuing
- MRV is in control
- PHOS in control

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

# Test Severity

## ▶ IVA

- ACW in control.

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

## ▶ VG

- AES in Severity EWMA Warning Alarm (mild).
- All other parameters in control.

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

# Test Severity

## ▶ VID

- FEI1 and FEI2 are in control.

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

## ▶ VIII

- Bearing Weight Loss and Stripped Viscosity in EWMA severity warning alarm.

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



# Test Precision

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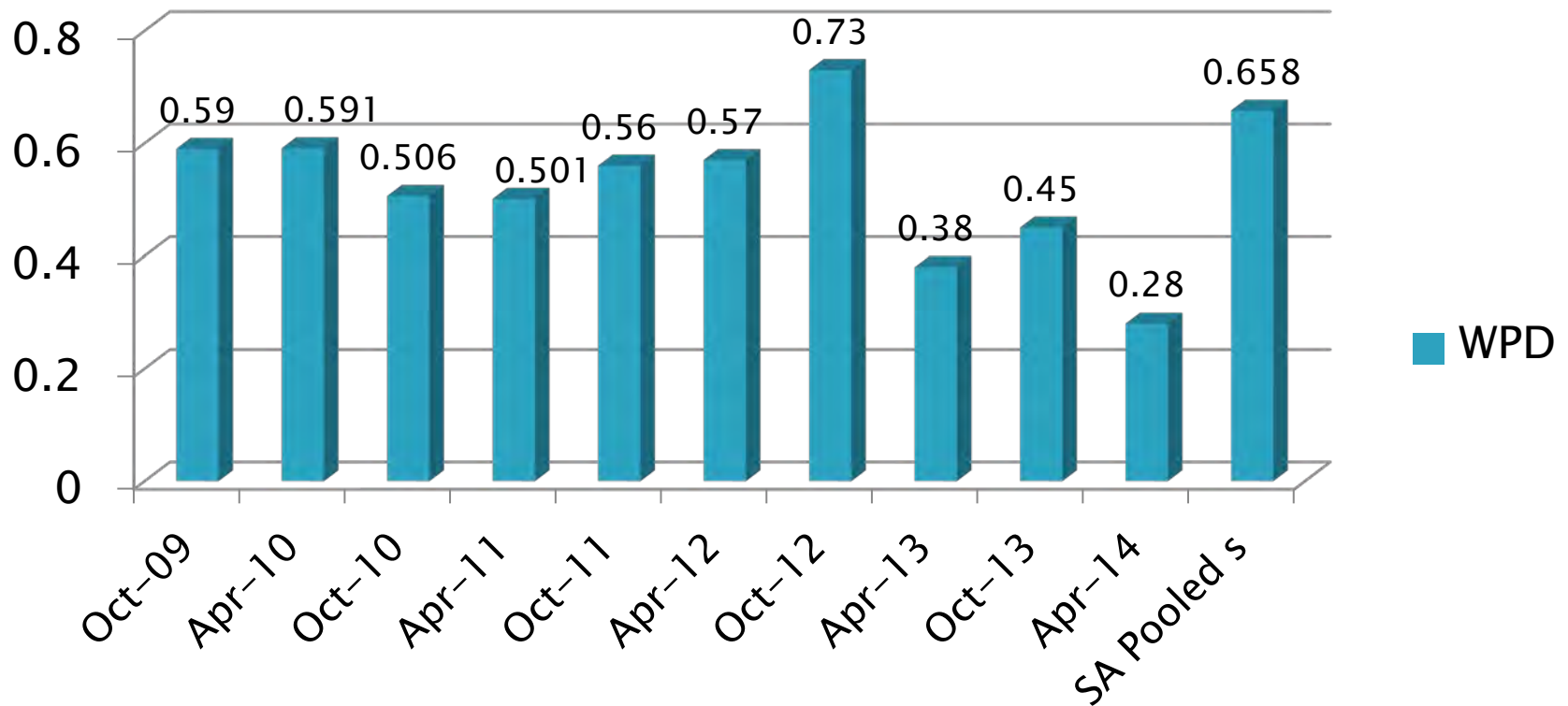
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# Test Precision Estimates

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

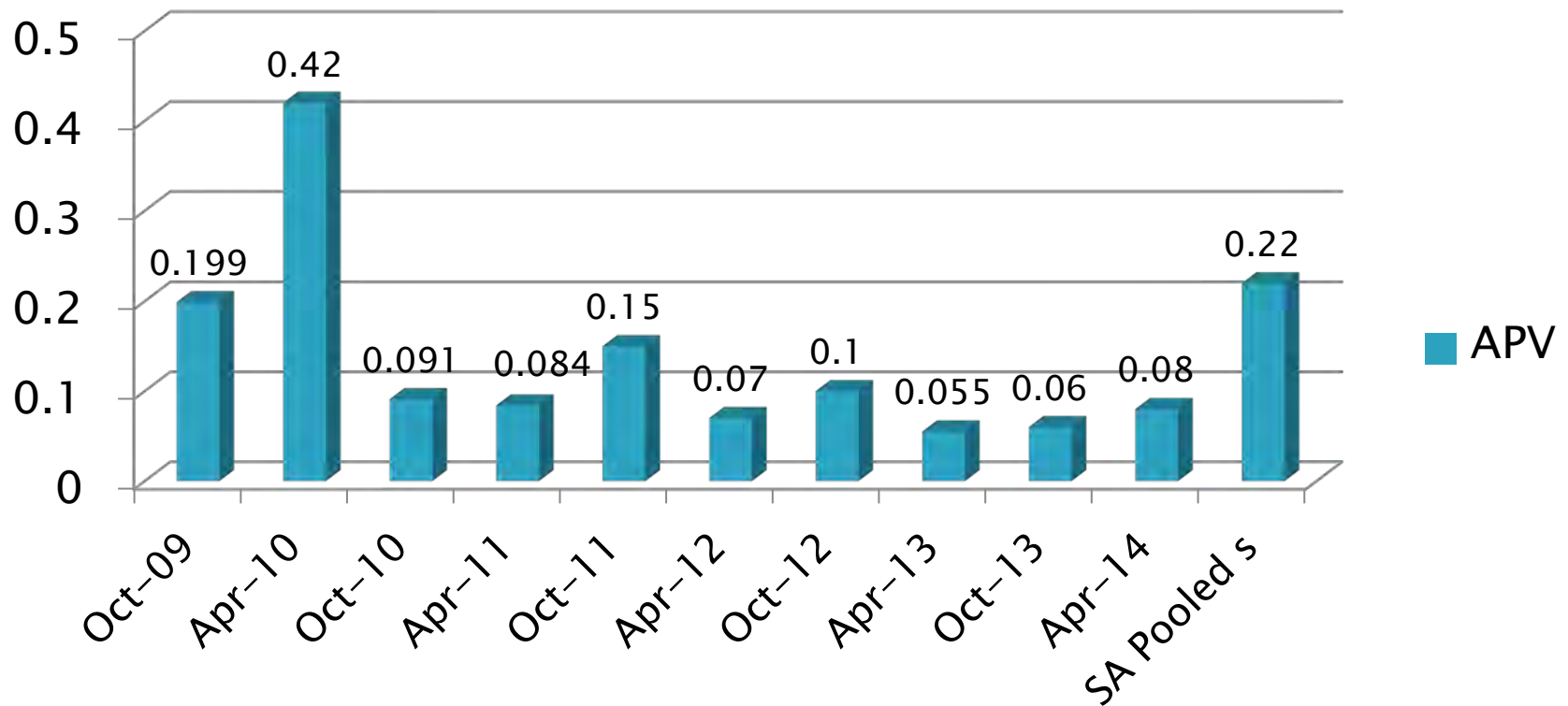
# IIF Precision Estimates

## WPD



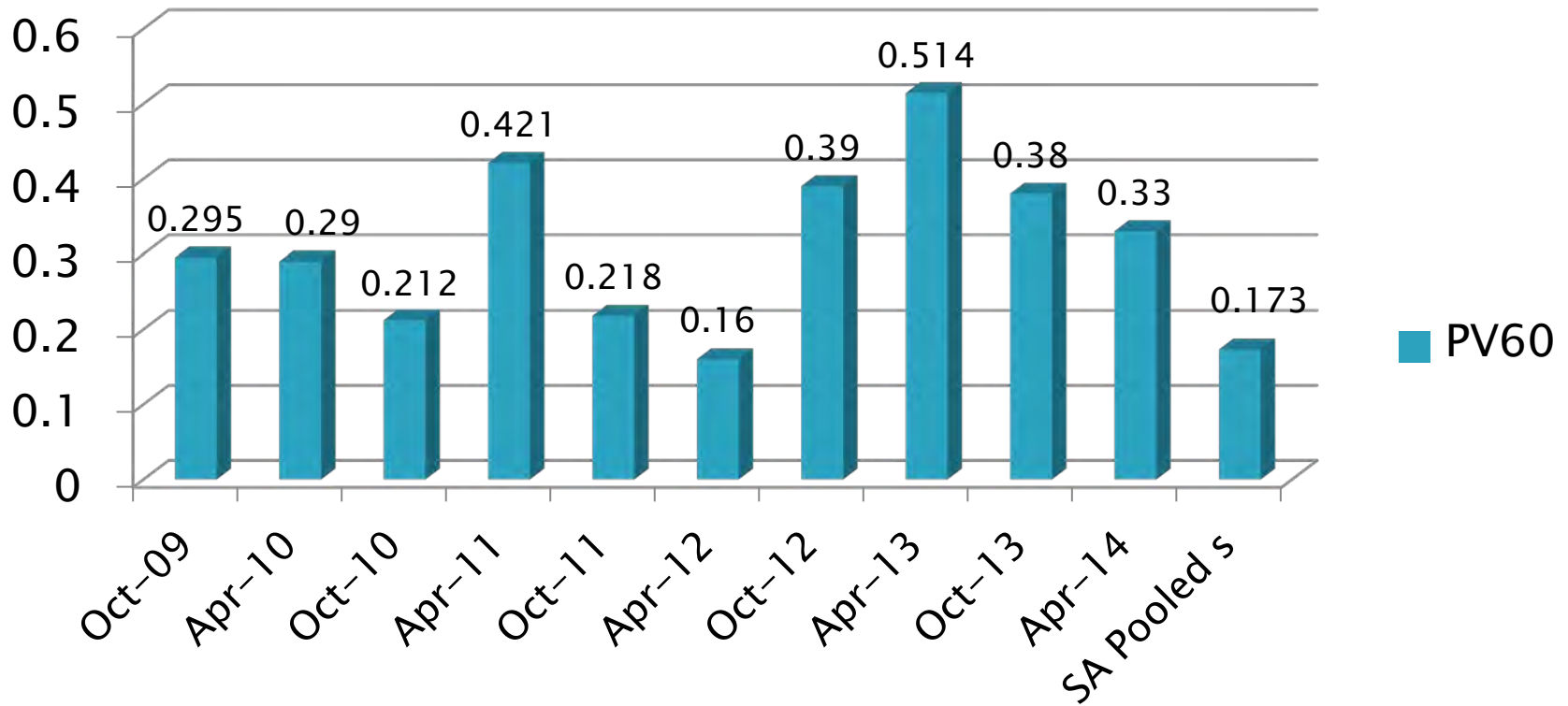
# IIIF Precision Estimates

APV



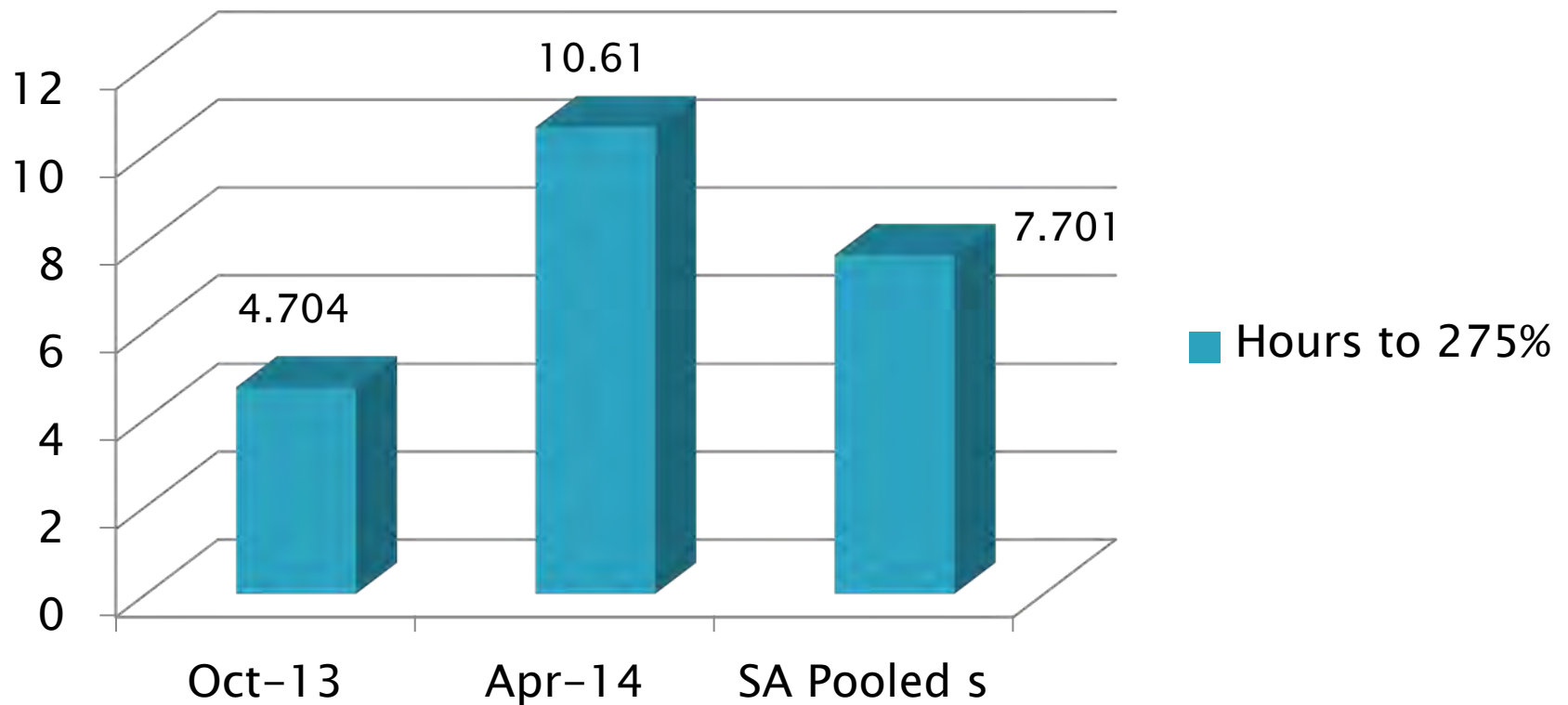
# IIIF Precision Estimates

## PV60

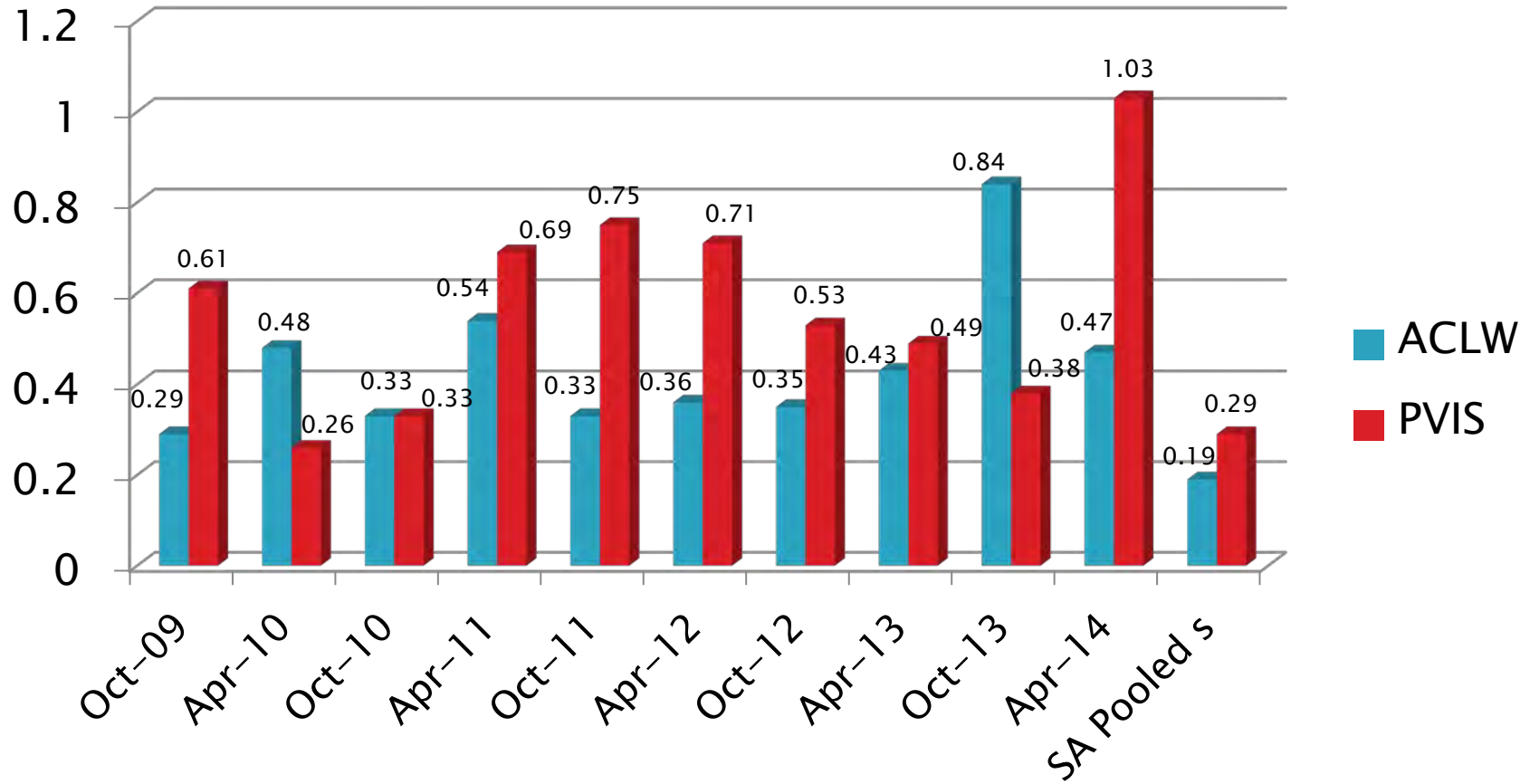


# IIIF Precision Estimates

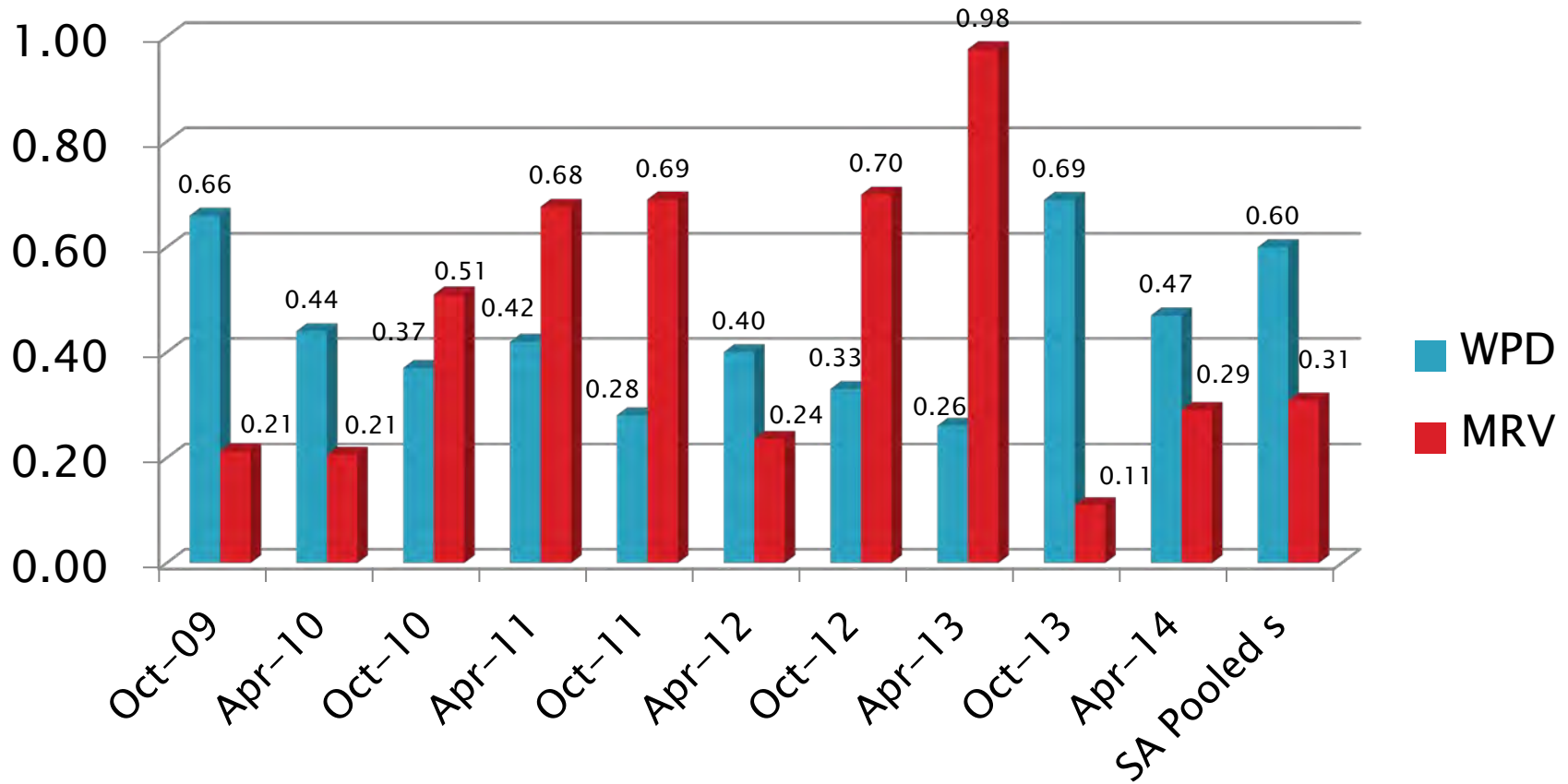
## Hours to 275%



# IIIG Precision Estimates



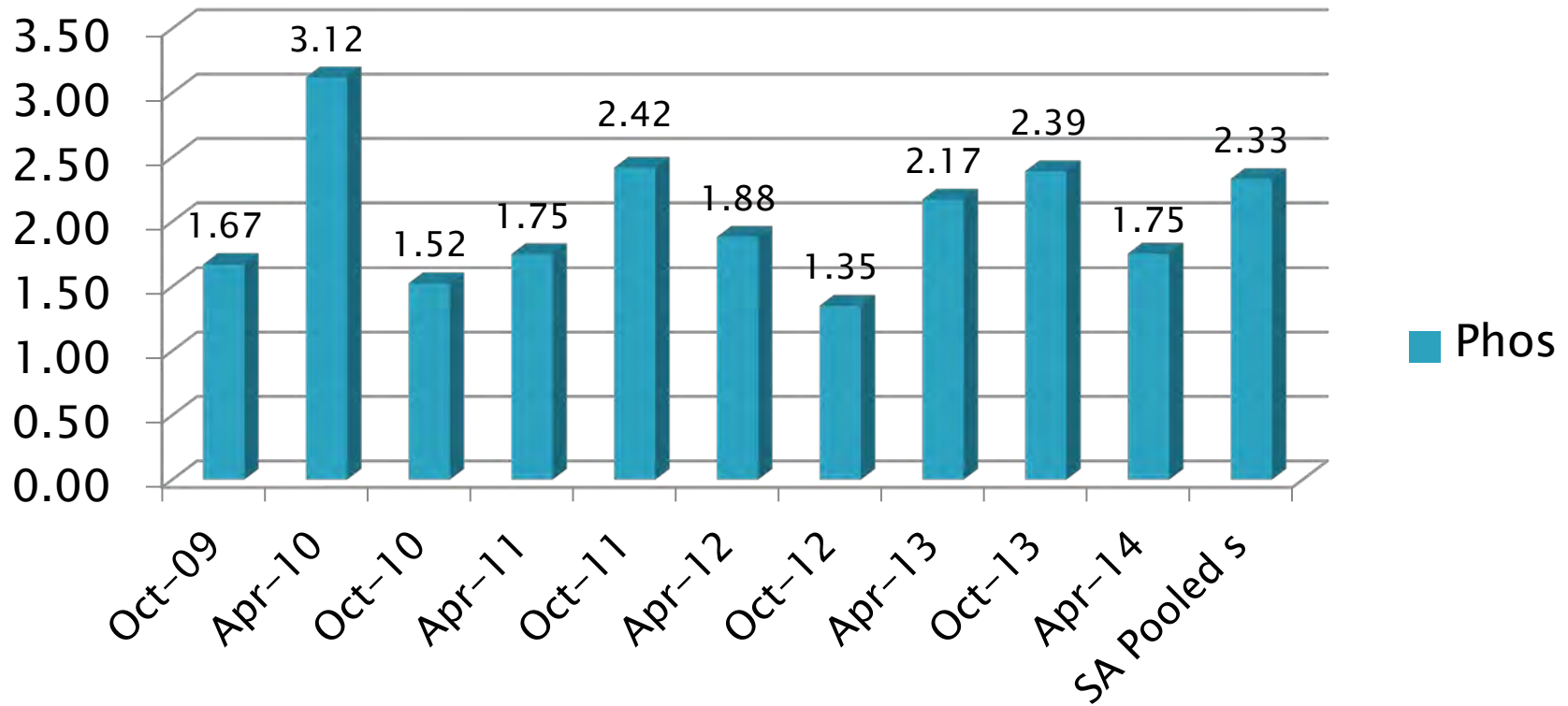
# IIIG Precision Estimates





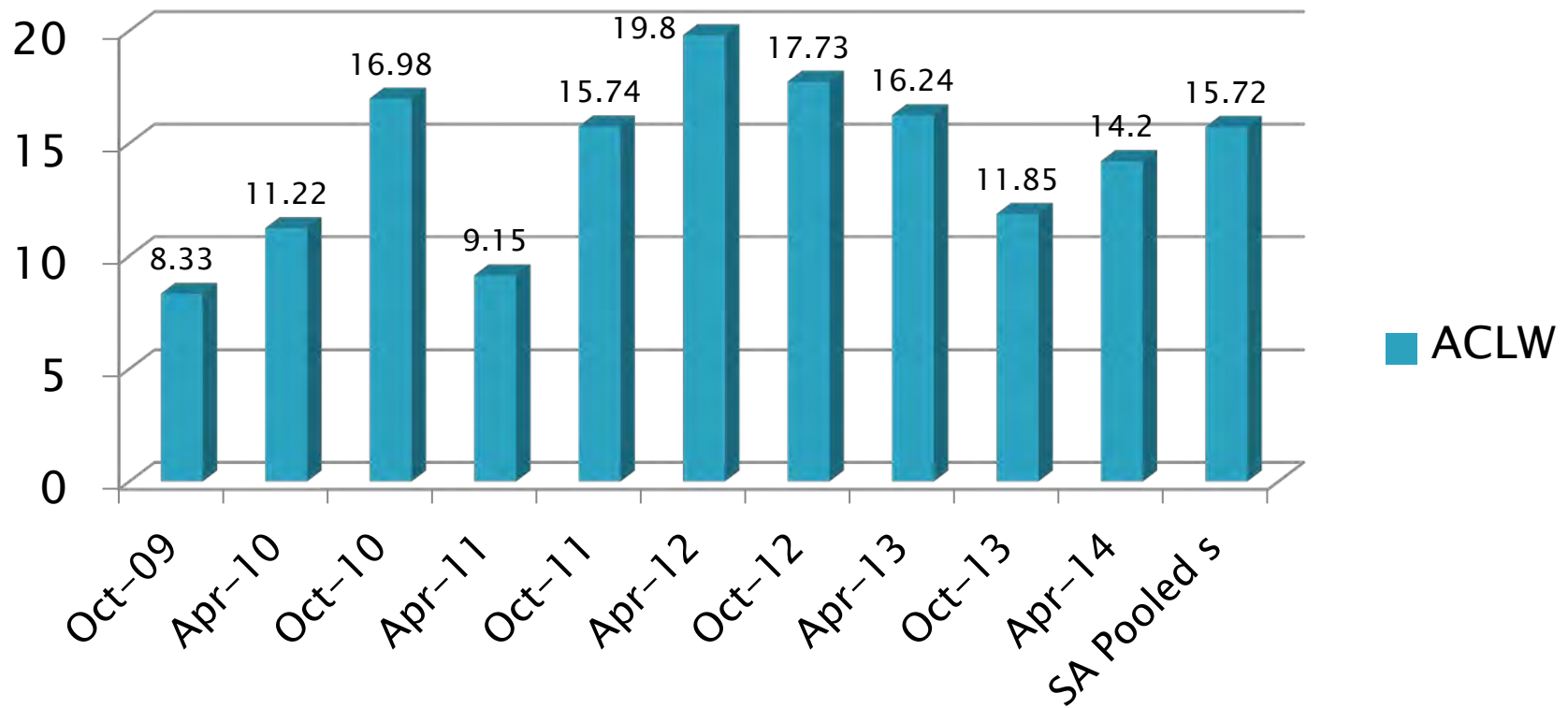
# IIIG Precision Estimates

## Phos

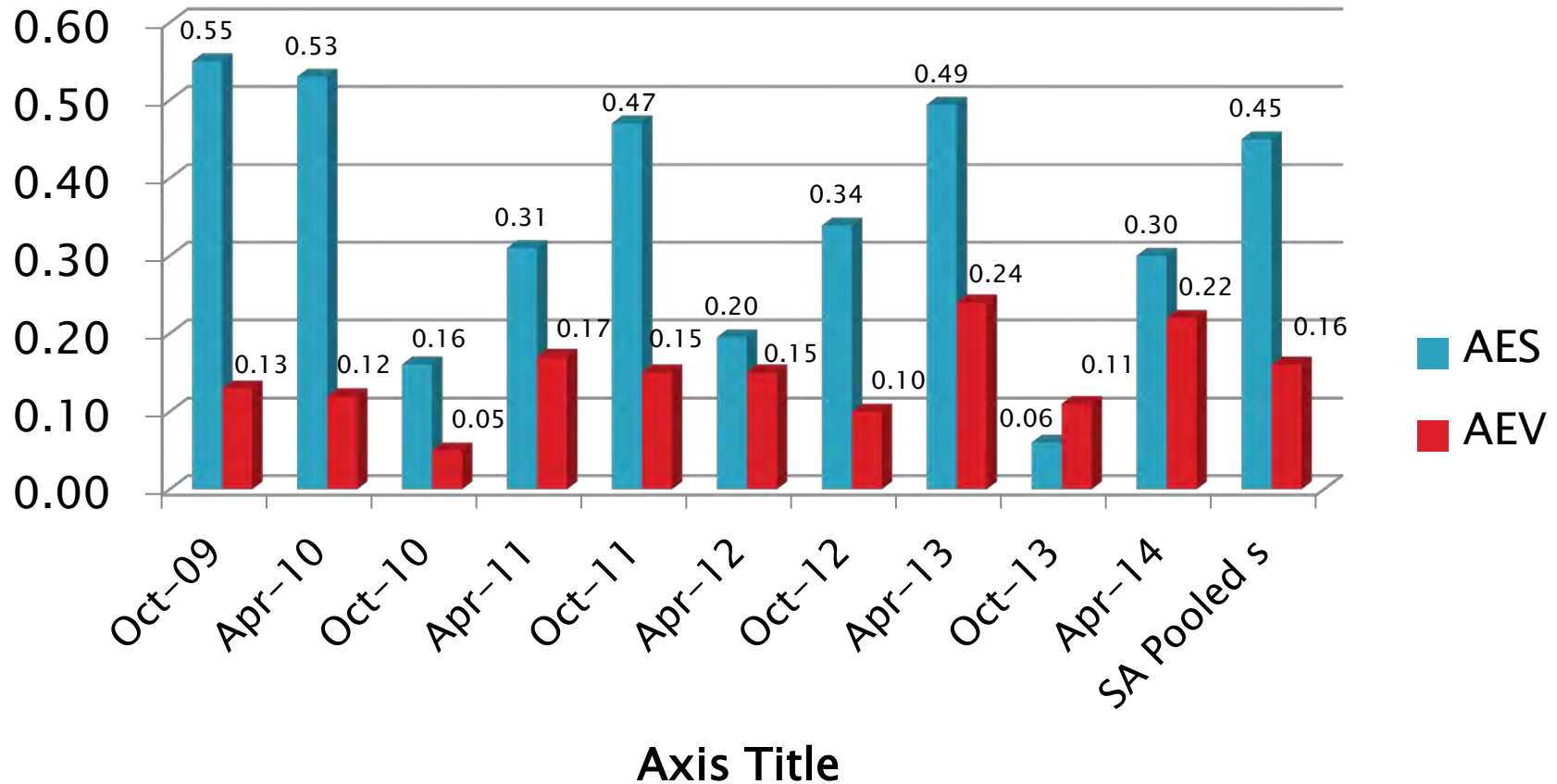


# Sequence IVA Precision Estimates

## ACW

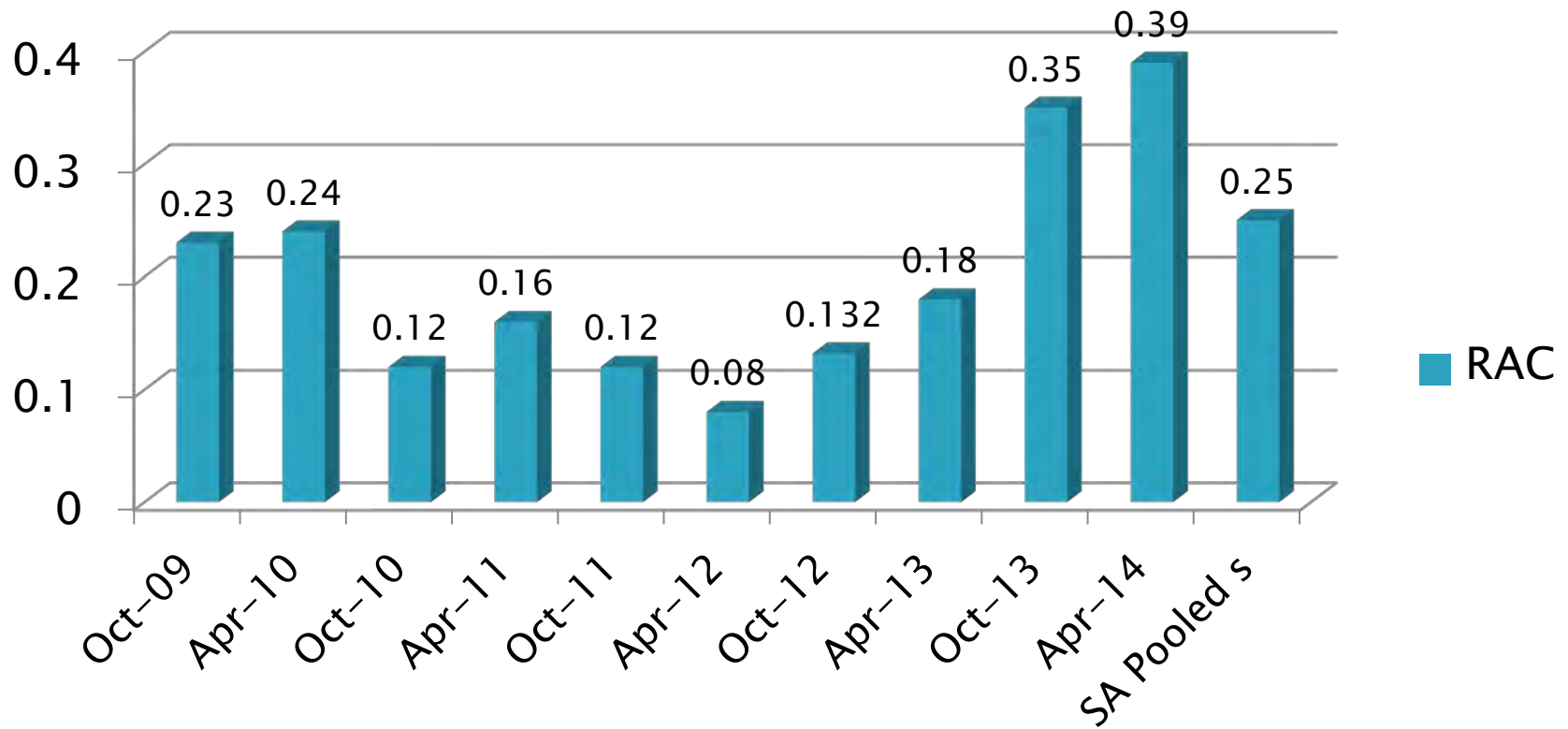


# Sequence VG Precision Estimates

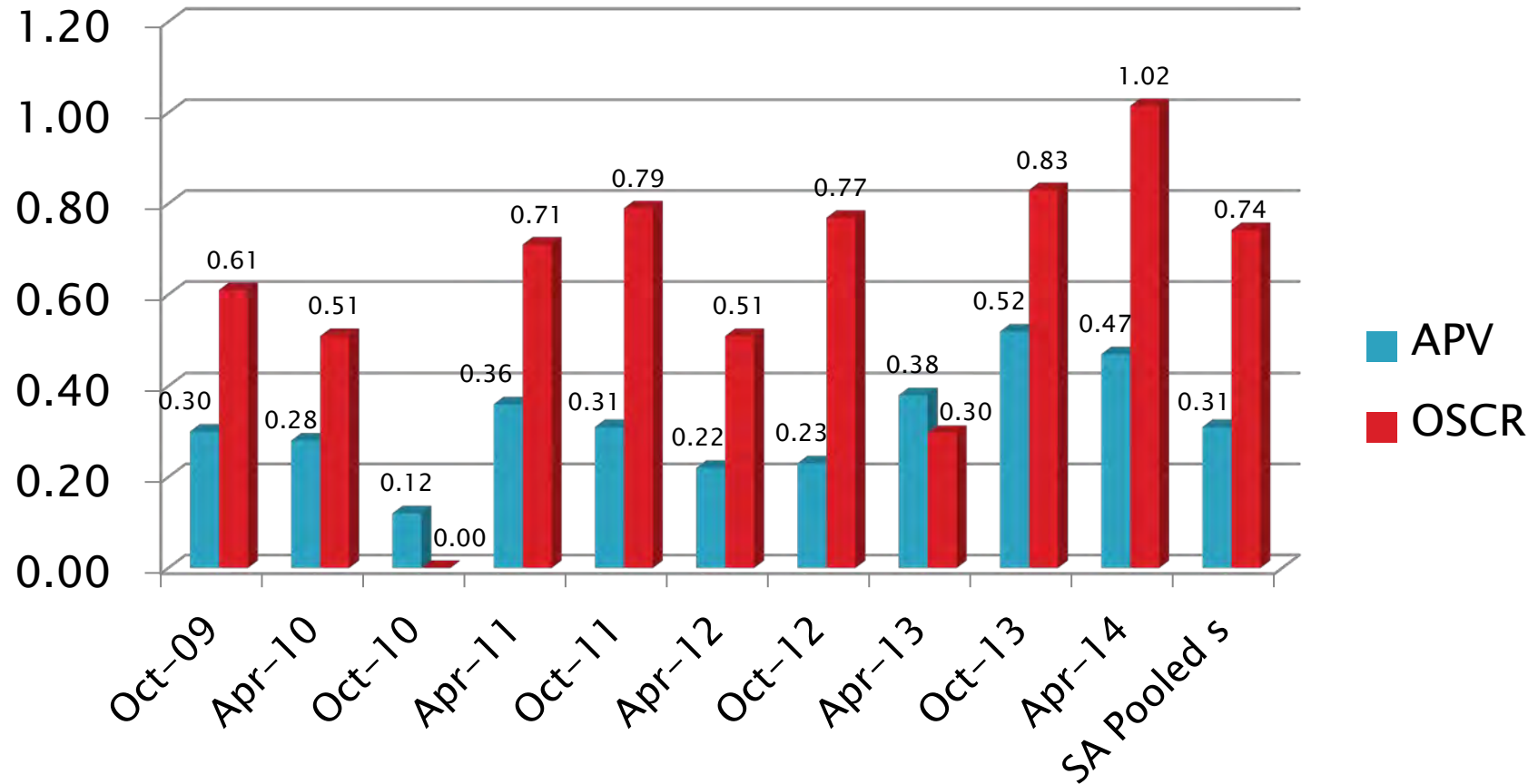


# Sequence VG Precision Estimates

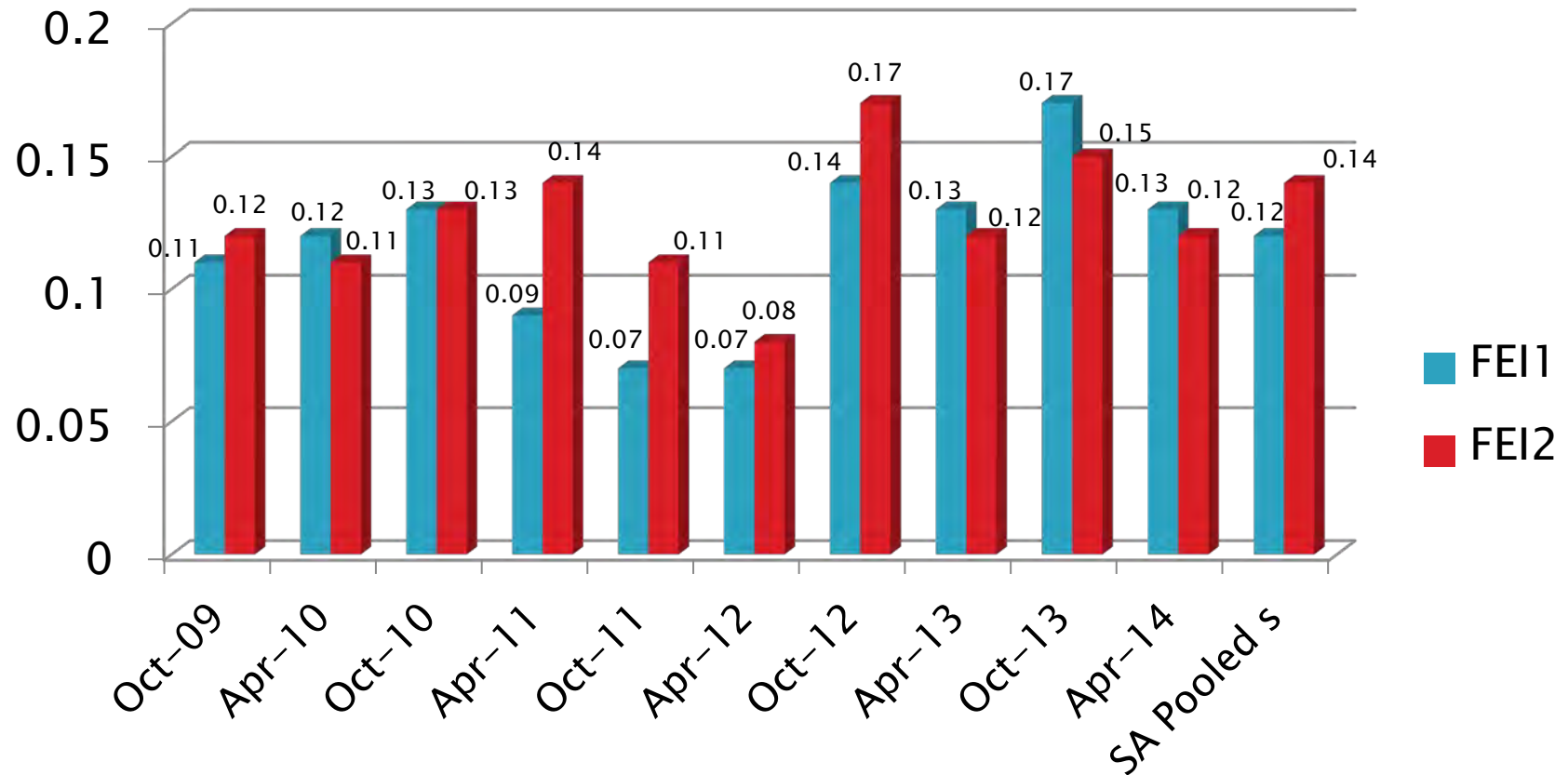
## RAC



# Sequence VG Precision Estimates

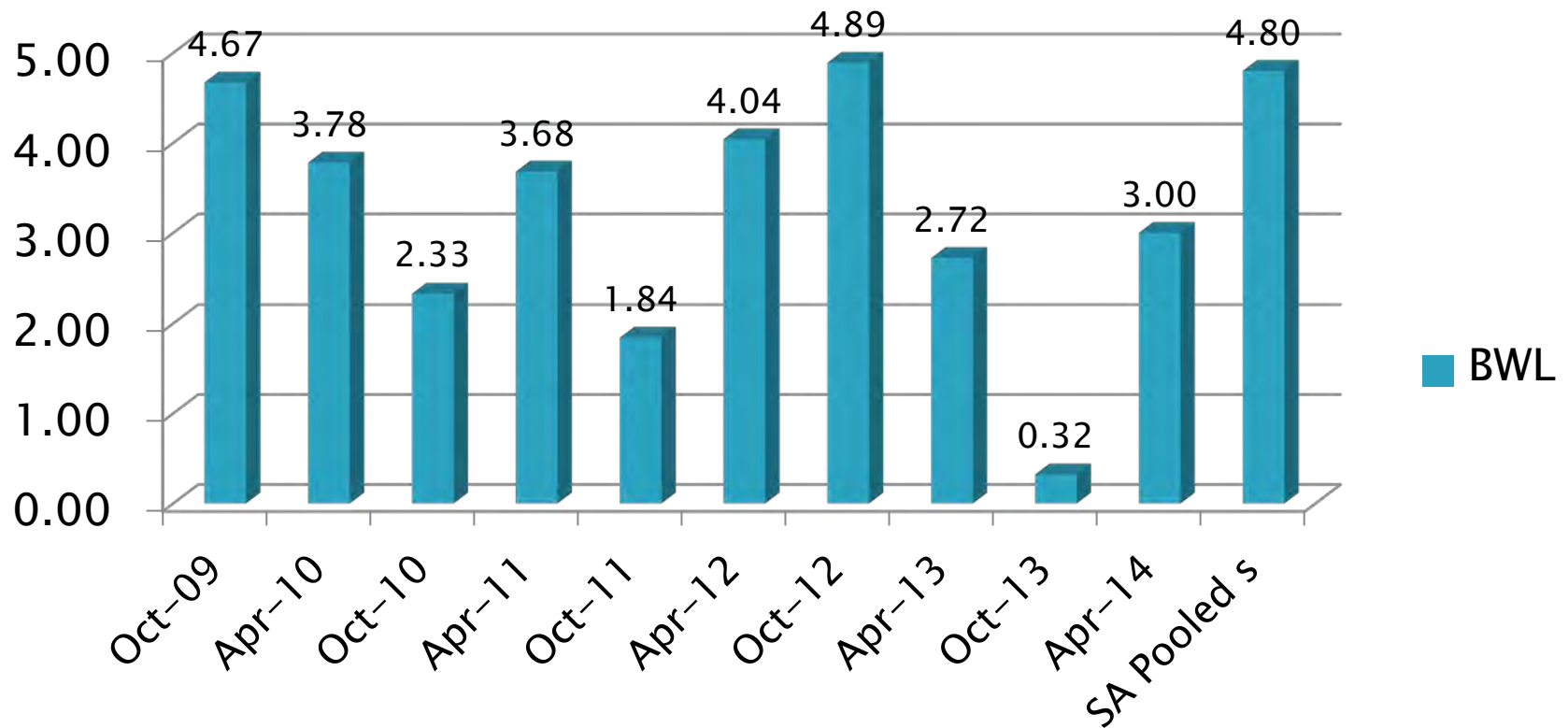


# Sequence VID Precision Estimates



# Sequence VIII Precision Estimates

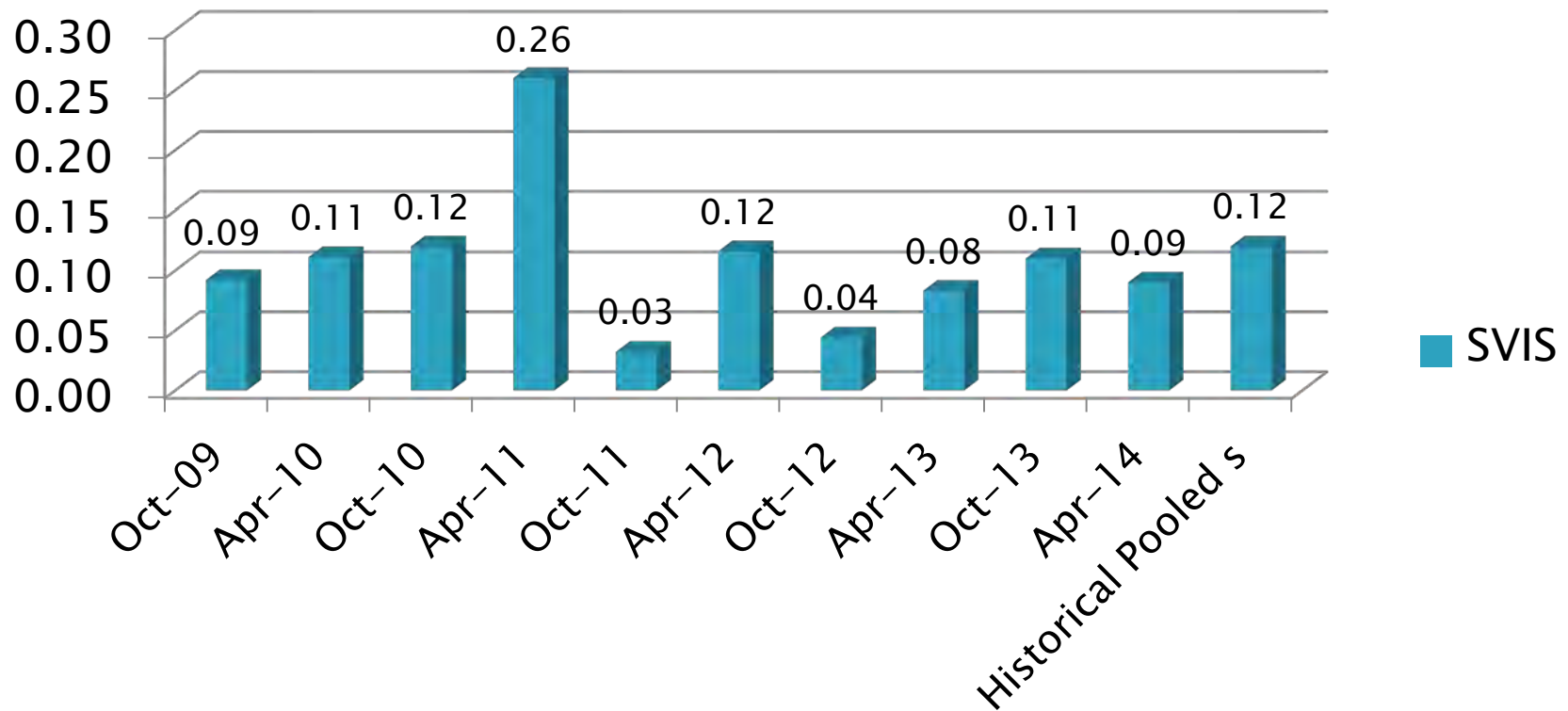
## BWL



# Sequence VIII Precision Estimates

## SVIS

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





# Information Letters

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# Information Letters\*

Test	Date	IL	Topic
IIIF	20140325	14-1	Approved hardened seat heads for use and reuse for Sequence IIIF testing.
IIIG	20140224	14-1	Approved hardened seat heads for use for Sequence IIIG testing.
IIIG	20140325	14-2	Approved hardened seat heads for reuse for Sequence IIIG testing.
IVA	20131029	13-4	Allow the use different oil cooler mounting stud and addressed how to report end of test ACW < 0.0

\*Available from TMC Website

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# Information Letters\*

Test	Date	IL	Topic
VG	20140107	14-1	Defined a procedure addressing how to accomplish fuel batch changes.
VG	20140218	14-2	Addressed reporting of final OSCR values less than 0.0.
VID	20131003	13-1	Approved Type "E" thermocouples for Sequence VID testing.
VID	20140318	14-1	Allowed test to be completed on more than one fuel batch.
VIII	20140227	14-1	Approved external oil pump for use in Sequence VIII Testing.

\*Available from TMC Website

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# Reference Oil Inventory

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

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# Reference Oil Re-blends

## ➤ TMC 434

- New re-blend, 434-2, is now available

## ➤ TMC 541-1, 542-1 and 1010

- reblends needed if used in VIE
- One year supply of 541-1, indications are that this oil may not be able to be reblended.

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# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
300	IVA	330	0	330	0	5+ years
433-1	IIIF	1045	8	0	40	<1 year
433-2	IIIF	500	52	432	40	3+ years
434	IIIG	550	0	<1	12	<1 year
434-1	IIIG	660	36	99	24	1.5 years
435	IIIG	550	0	2	4	<1 year
435-2	IIIG	550	34	288	28	3+ years
438	IIIG	990	52	139	32	2+ years
540	VID	1100	0	365	50	4+ years
541	VID	550	0	0	0	<1 year

# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
541-1	VID	550	125	75	105	~1 year
542	VID	1100	10	39	25	1 year
542-1	VID	275	120	108	25	~2 years
704-1	VIII	897	16	164	14	5+ years
925-3	VG	975	0	10	6	<1 year
940	VG	560	70	426	24	5+ years
1006-2	IVA, VG, VIII	5500	12	3138	112	5+ years
1007	IVA, VG	1968	0	0	6	<1 year
1009	VG	1100	90	205	18	5+ years
1010	IIIG, VID	1100	25	235	45	2+ years

# LTMS Deviations

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# LTMS Deviations

- No LTMS Deviations in Current Period

# LTMS Deviations

## Historical Count of PCEO LTMS Deviations

Test	LTMS Deviations
IIIF	6
IIIG	6
IVA	7
VG	8
VID	2
VIII	3

# Quality Index Deviations

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# Quality Index Deviations

- Two VG Quality Index Deviations this Report Period.
  - One lab had an issue with intake air pressure and temperature
  - A second lab had an issue with RAC coolant flow

## Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIF	25
IIIG	11
IVA	28
VG	40

# TMC Laboratory Visits

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# TMC Lab Visits

Test	Number of Labs Visited
III	2
IVA	2
VID	1
VIII	1

# TMC Lab Visits

- Visits did not identify any significant issues at different labs.

# Test Area Timelines

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# Test Area Timeline Additions\*

Slide 1 of 2

Test	Date	Topic	IL
IIIF	20140325	Approved hardened seat heads for use and reuse for Sequence IIIF testing.	14-1
IIIF	20140330	First occurrence of hardened seat heads in Sequence IIIF	
IIIG	20140224	Approved hardened seat heads for use for Sequence IIIG testing.	14-1
IIIG	20140224	First occurrence of hardened seat heads in Sequence IIIG	
IIIG	20140325	Approved hardened seat heads for reuse for Sequence IIIG testing.	14-2

(continued on next slide)

\*As of 03/31/2014

# Test Area Timeline Additions\*

Slide 1 of 2

Test	Date	Topic	IL
IVA	20131029	Allow the use of oil filter mounting adapter and addressed reporting of final ACW results less than zero.	14-1
VG	20140107	Defined procedure for changing fuel batches	14-1
VG	20140206	Addressed reporting of final OSCR results less than zero.	14-2
VID	20131001	Allow the use of Type E thermocouples.	13-1
VID	20140318	Allowed test to be completed on more than one fuel batch.	14-1
VIII	20140227	Allow use external coolant pump.	14-1

\*As of 03/31/2014

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# Additional Information

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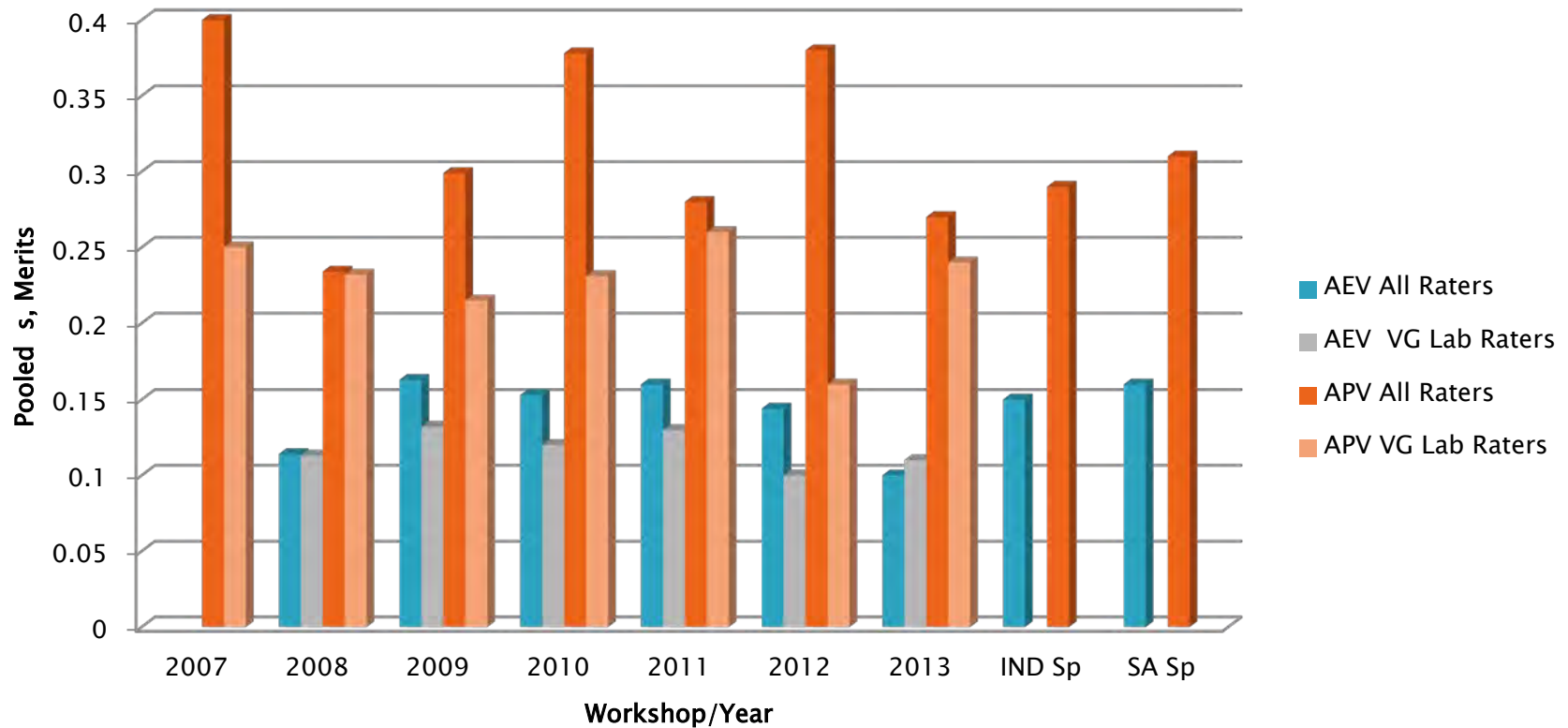
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# Additional Information

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

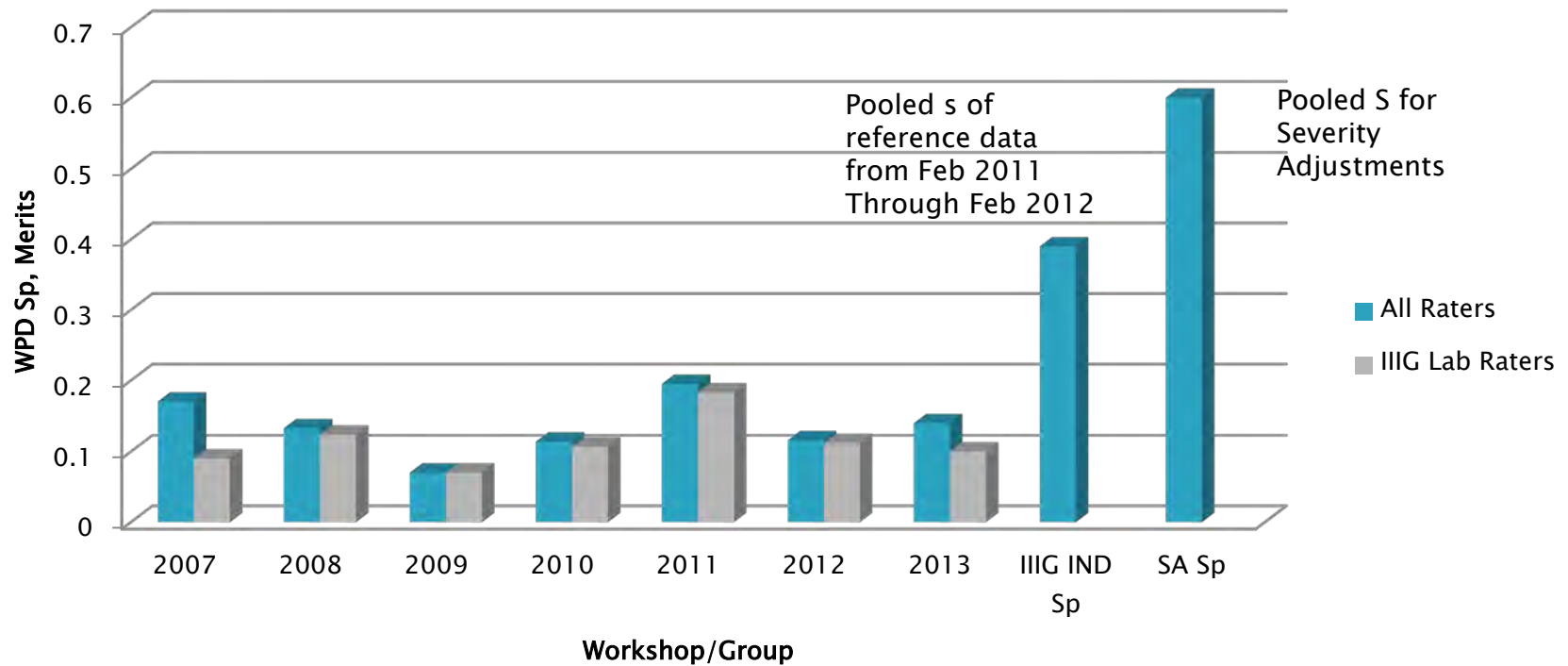
# Sequence VG Precision Estimates

## 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](http://www.astmtmc.cmu.edu)



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## Appendix 1 PCMO Reference Oil Testing Control Charts

April 2014

# Appendix 1.a

## IIIF Control Charts

» Severity, Precision, and CuSum

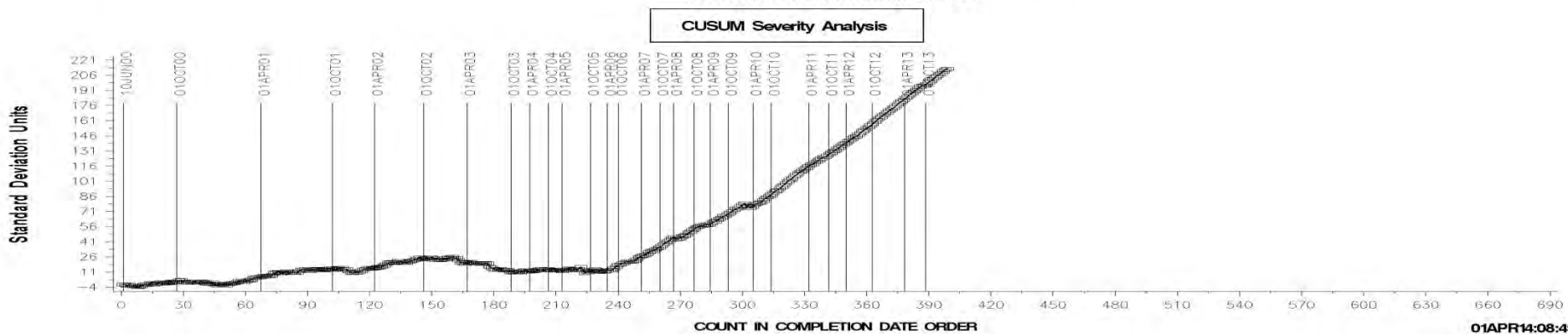
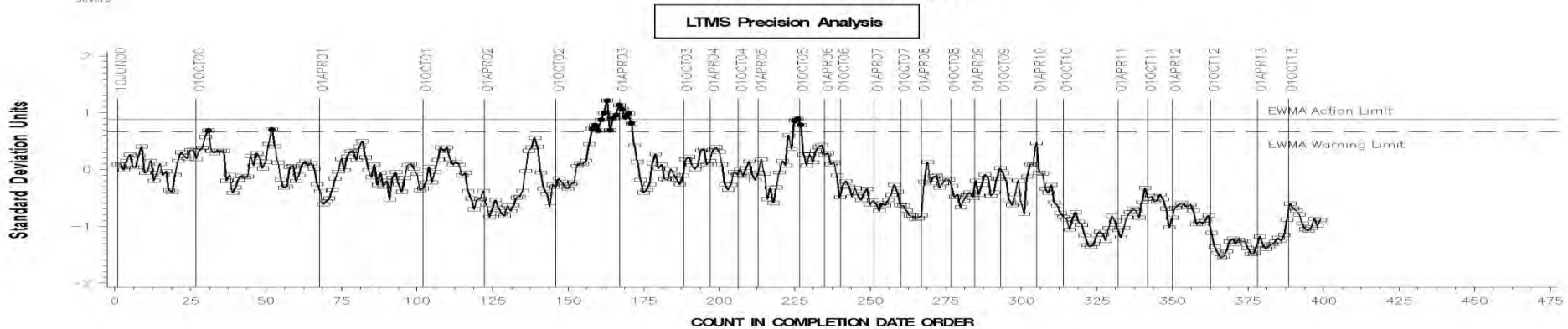
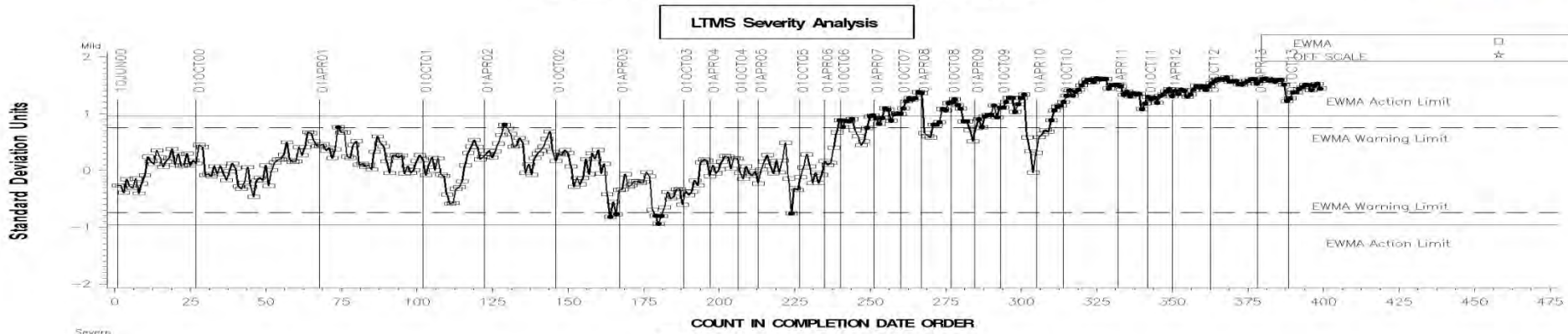
Test Monitoring Center

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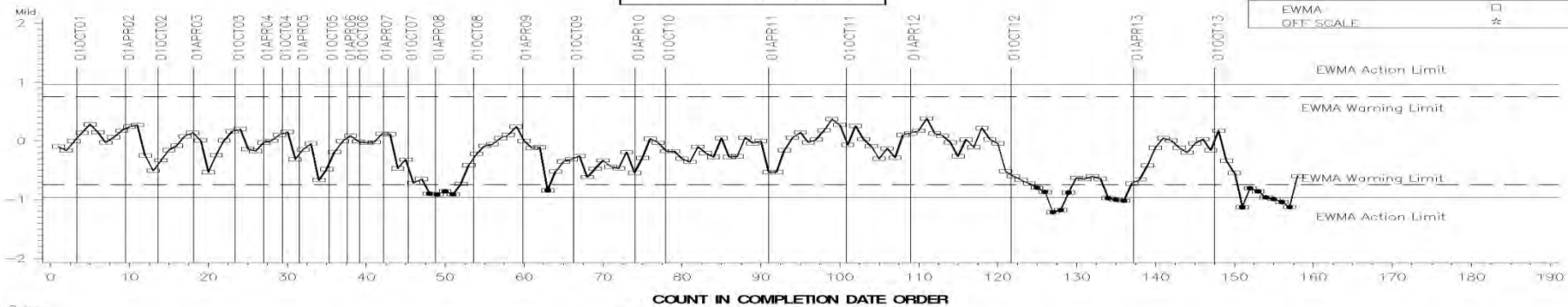
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AVERAGE PISTON SKIRT VARNISH FINAL ORIG UNIT RES

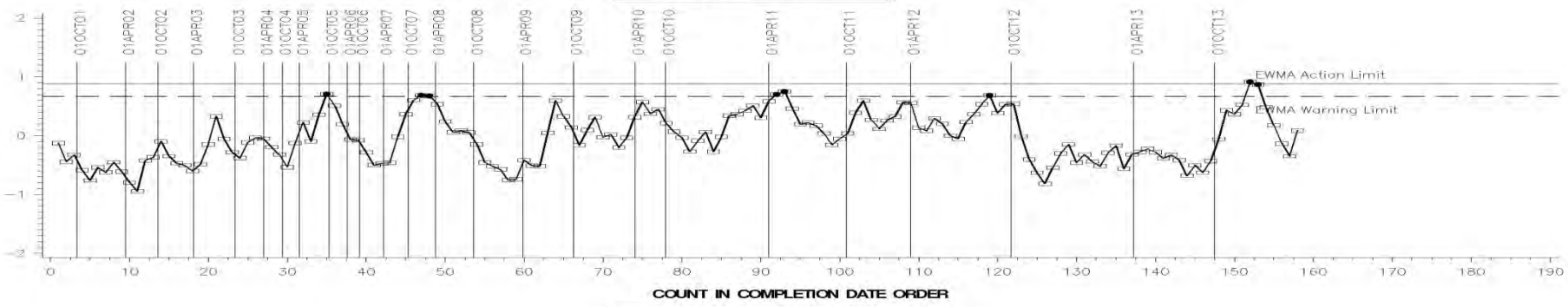


HOURS FINAL ORIG RES (REFERENCE TESTS ONLY)

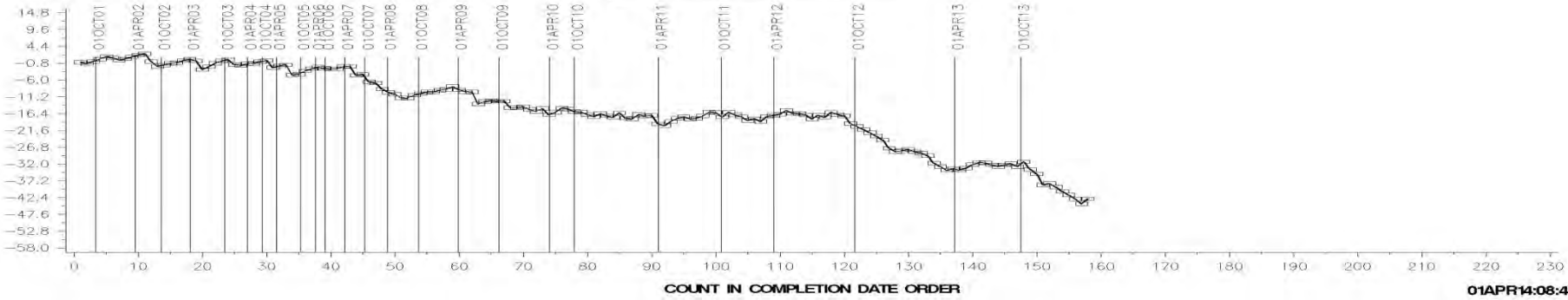
LTMS Severity Analysis



LTMS Precision Analysis



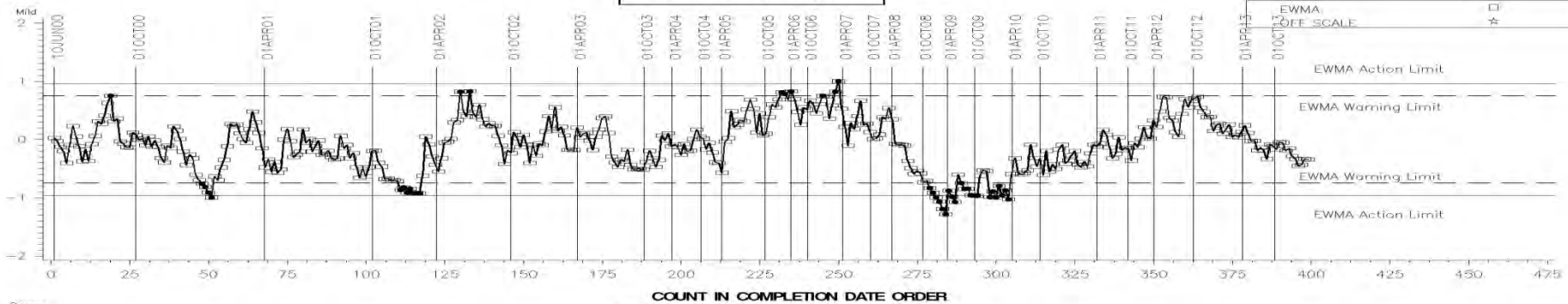
CUSUM Severity Analysis



01APR14:08:49

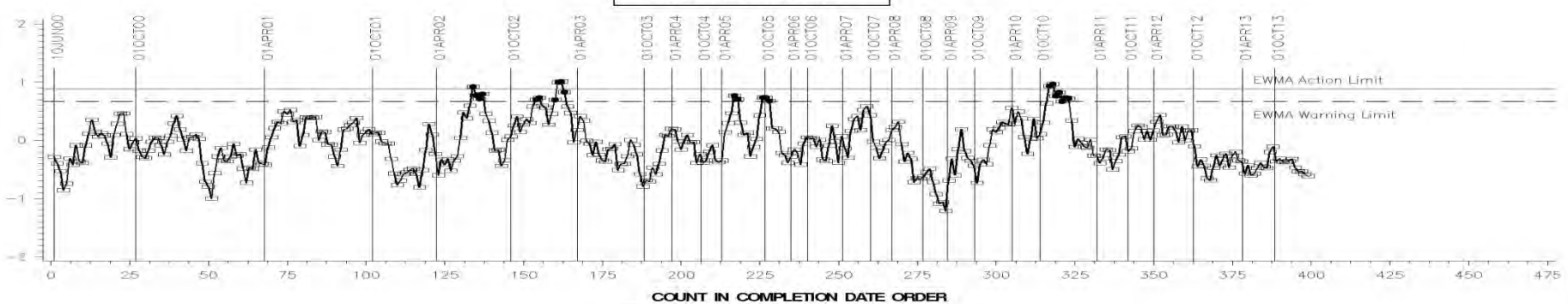
AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG UNIT RES

LTMS Severity Analysis



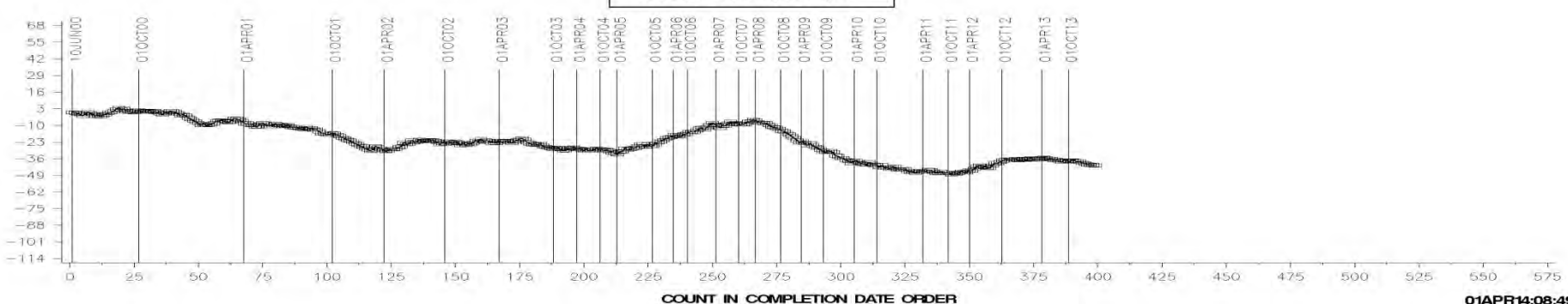
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

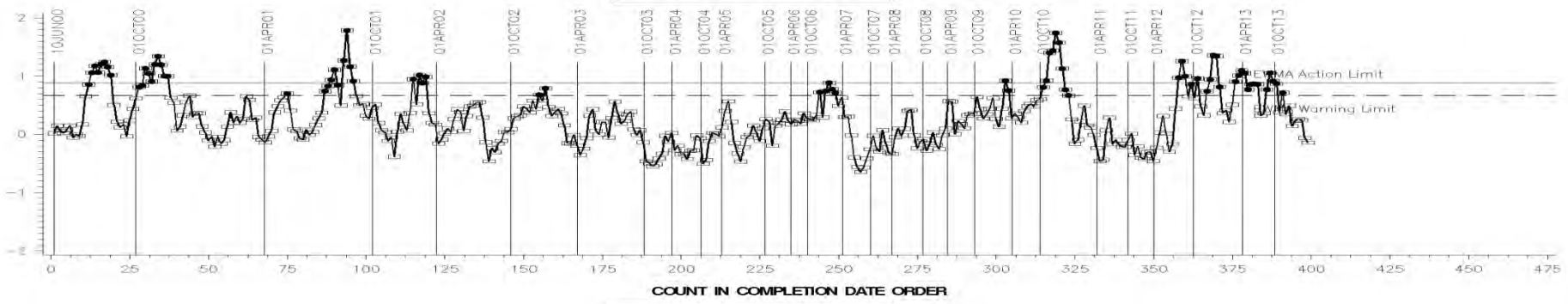
01APR14:08:49

% VISCOSITY INCREASE @ 060 HOURS

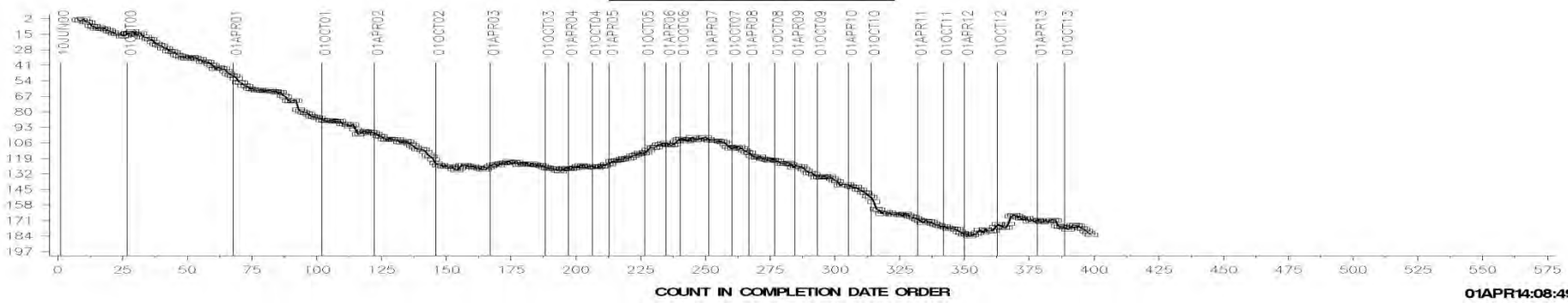
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



01APR14:08:49

[Return](#)

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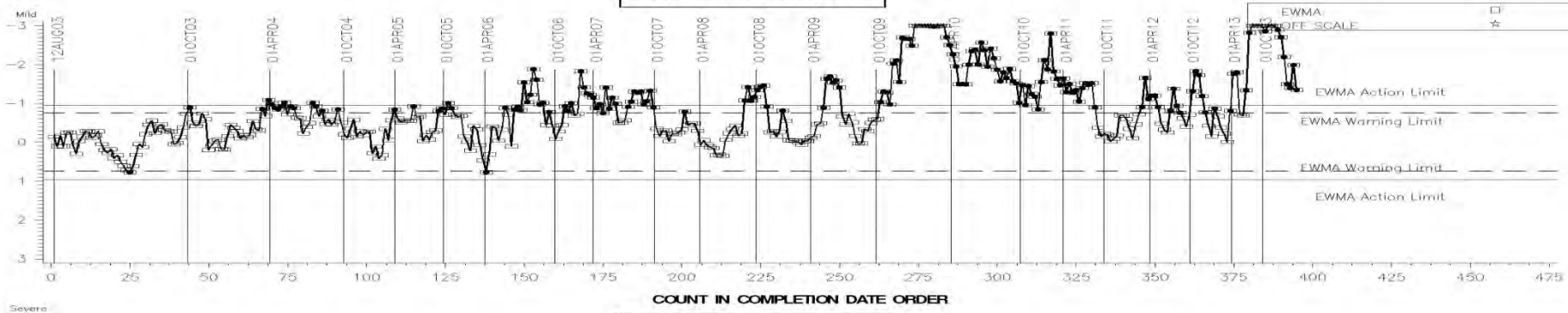
# Appendix 1.b

## IIIG/A/B Control Charts

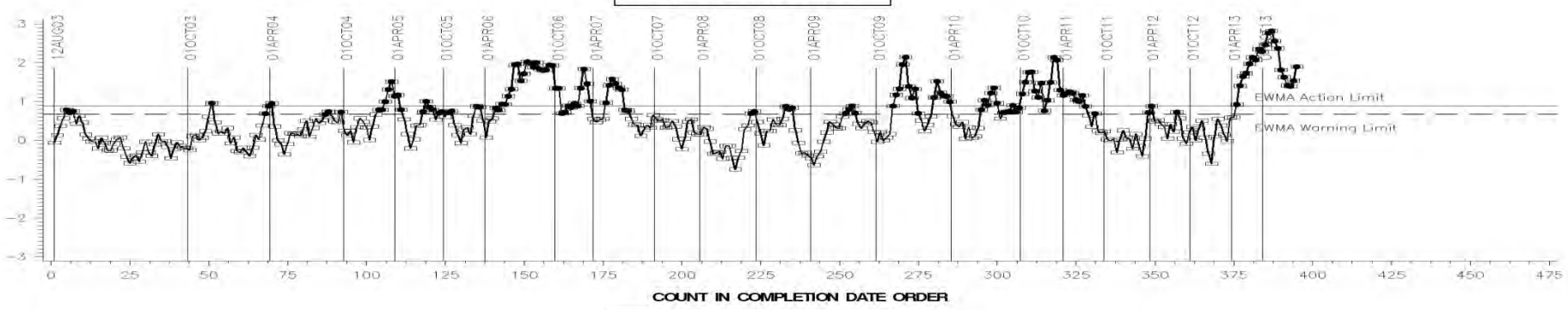
» Severity, Precision, and CuSum

AVERAGE CAM + LIFTER WEAR

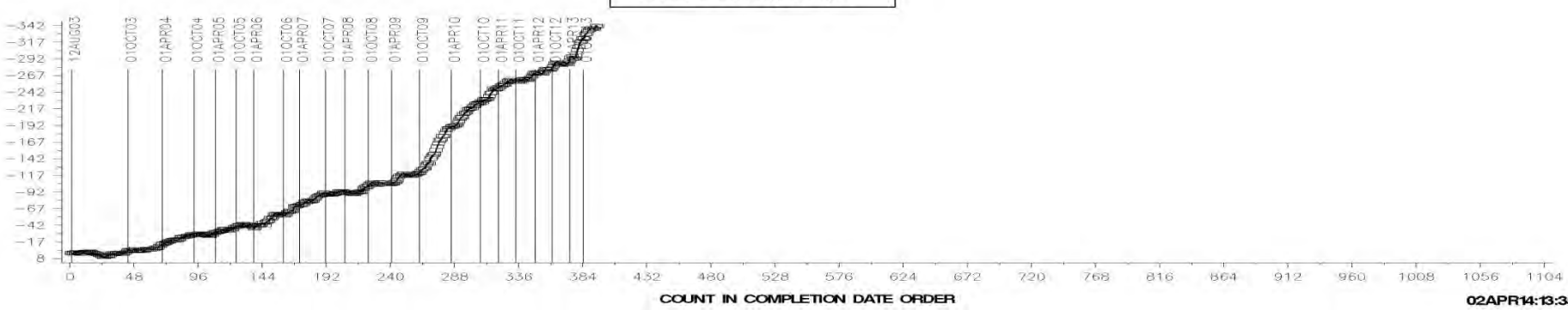
LTMS Severity Analysis



LTMS Precision Analysis



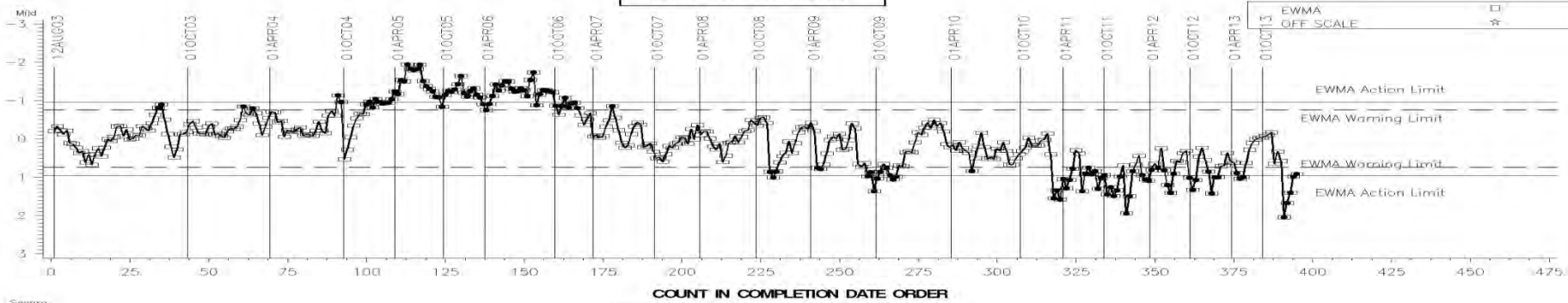
CUSUM Severity Analysis





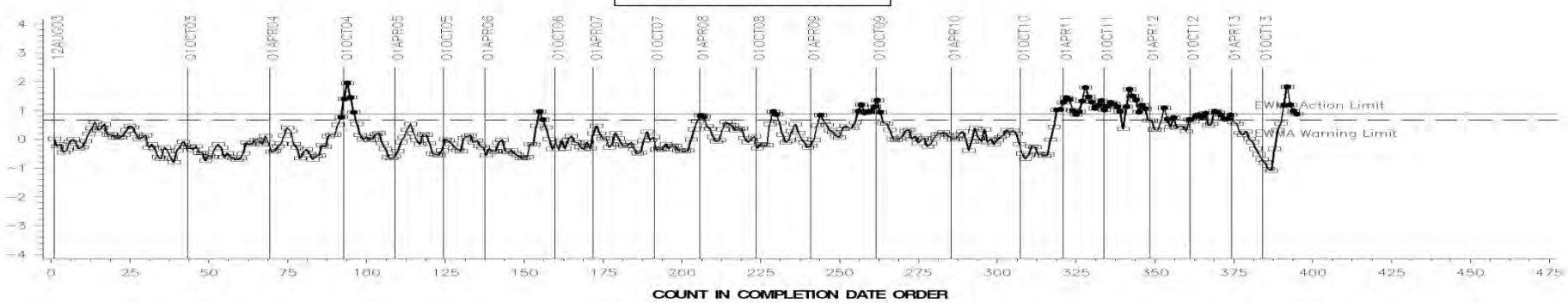
VISCOSITY INCREASE

LTMS Severity Analysis



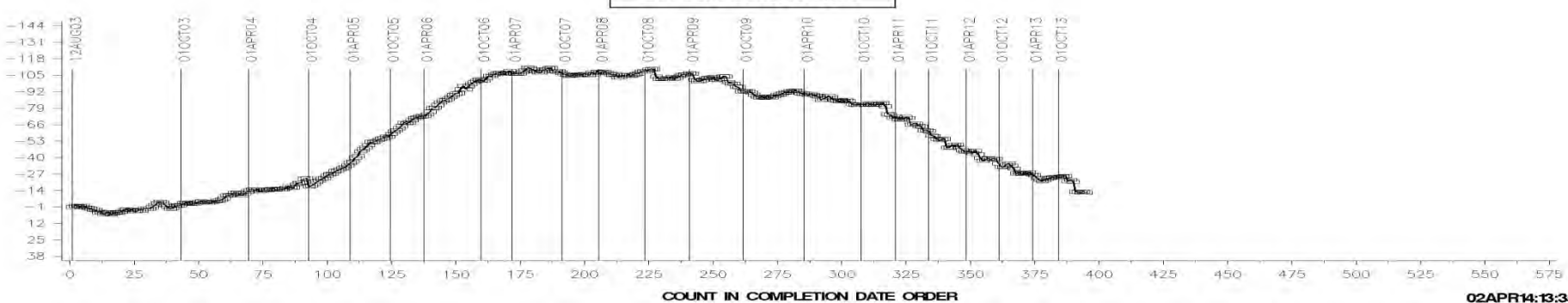
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

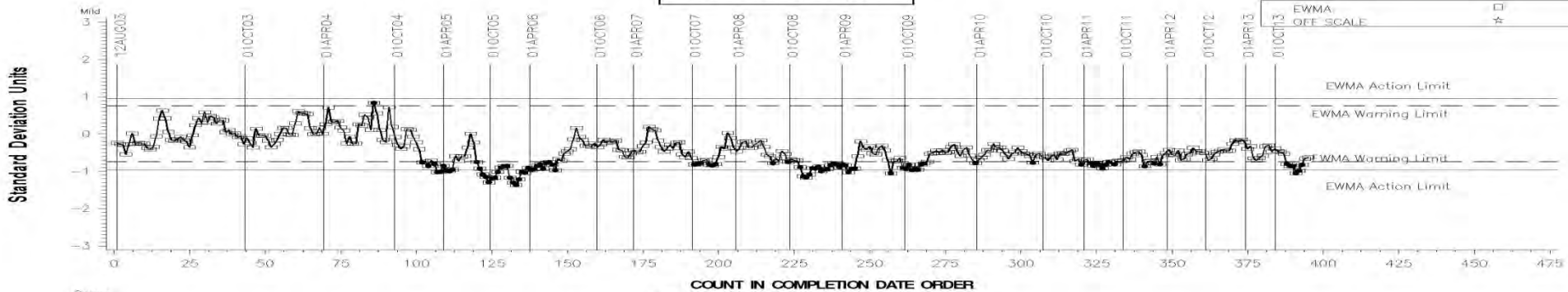


COUNT IN COMPLETION DATE ORDER

02APR14:13:35

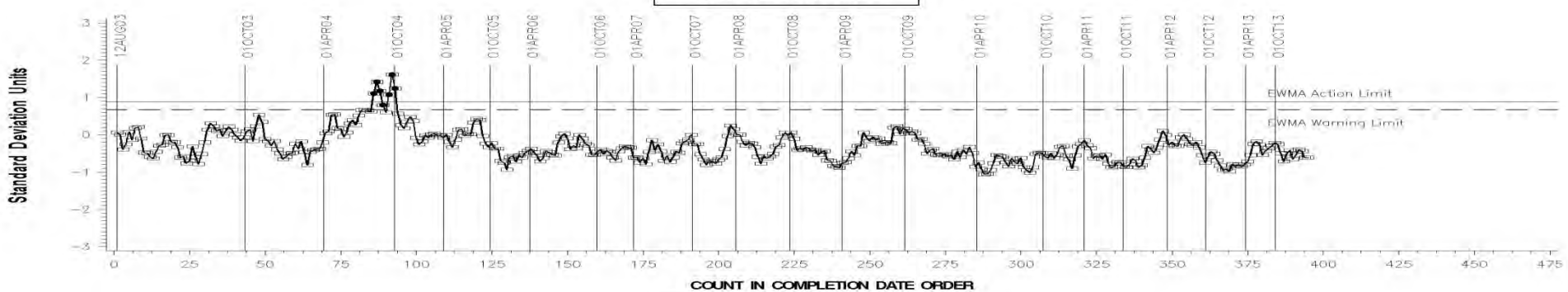
AVERAGE WEIGHTED PISTON DEPOSITS

LTMS Severity Analysis



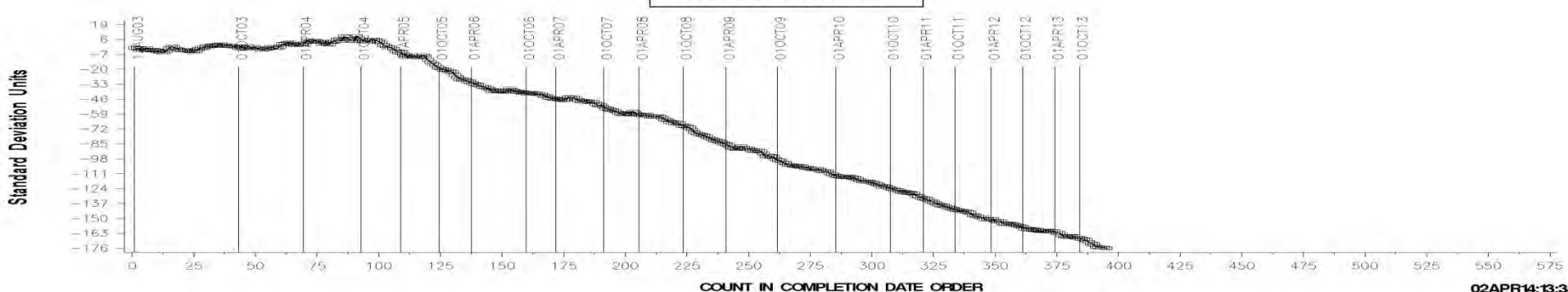
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

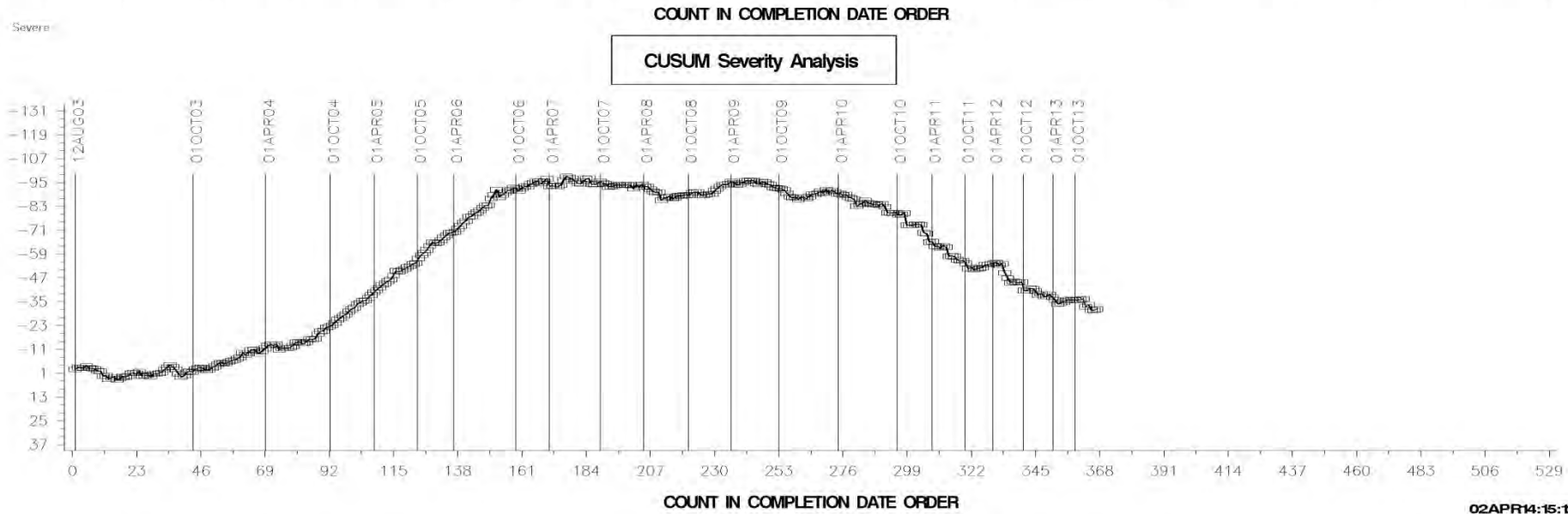
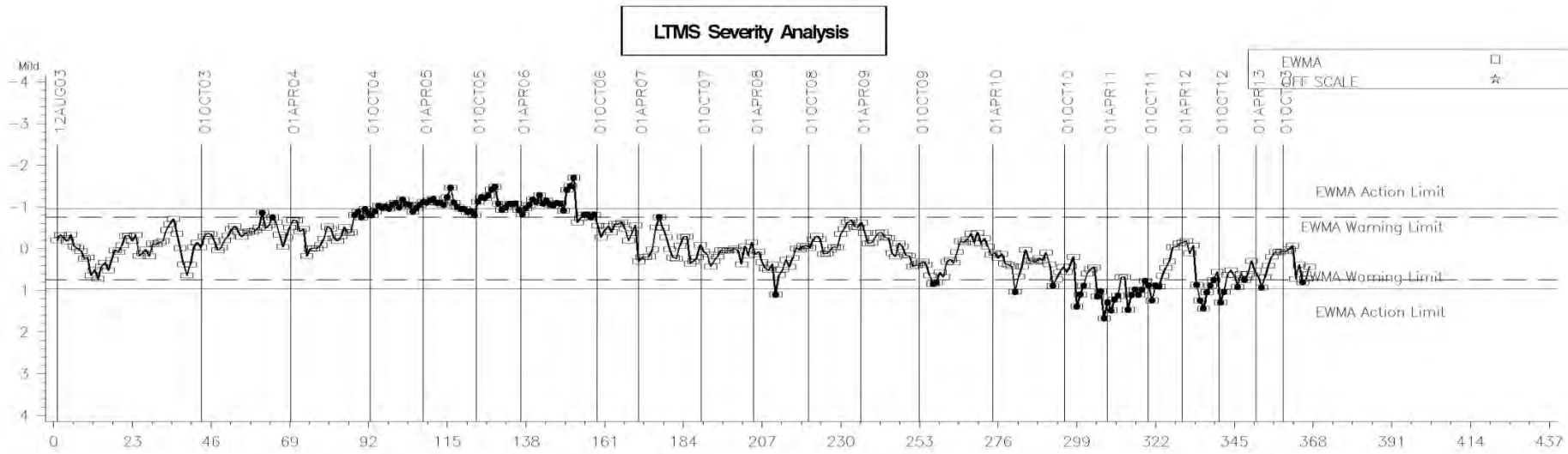
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

MRV VISCOSITY RESULT

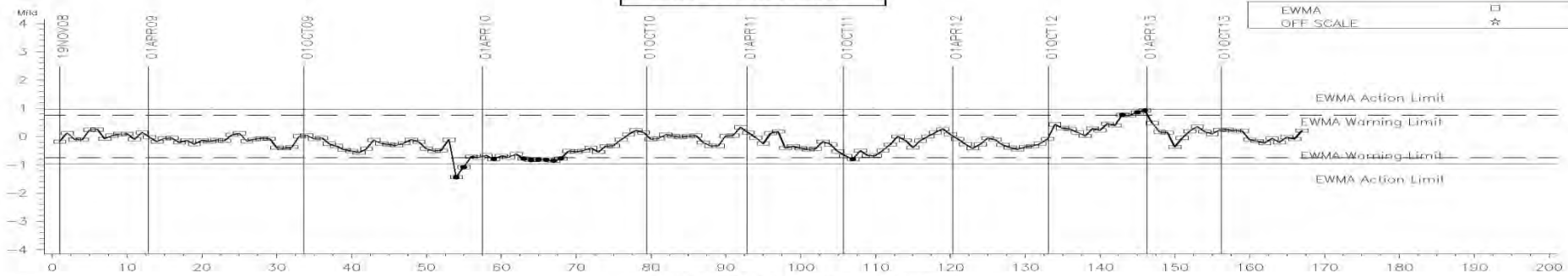
Standard Deviation Units



Standard Deviation Units

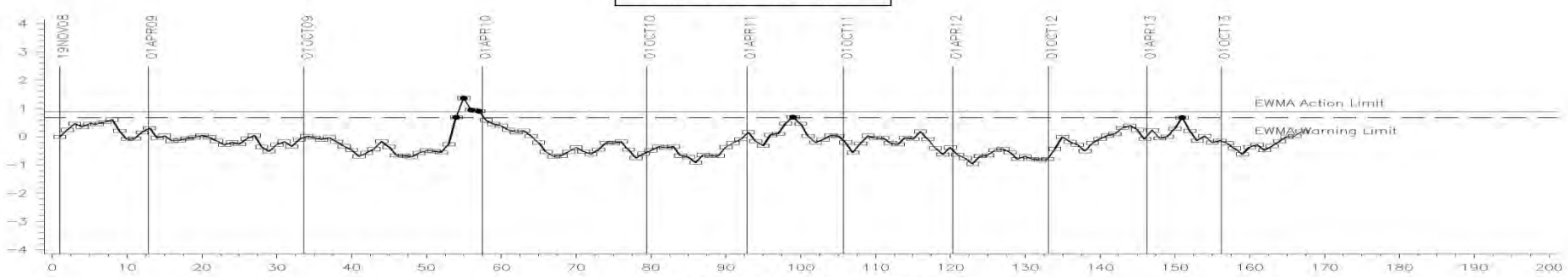
PHOS RETENTION

LTMS Severity Analysis



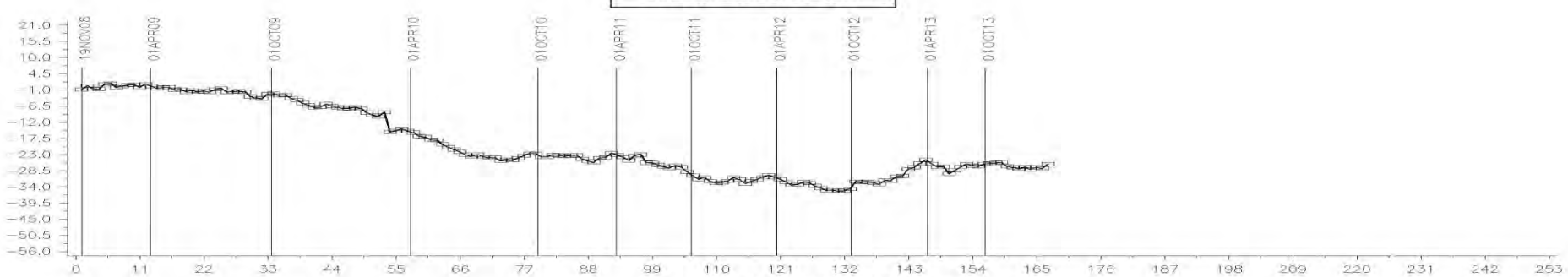
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

02APR14:13:34

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# Appendix 1.c

## Sequence IVA Control Charts

» Severity, Precision, and CuSum

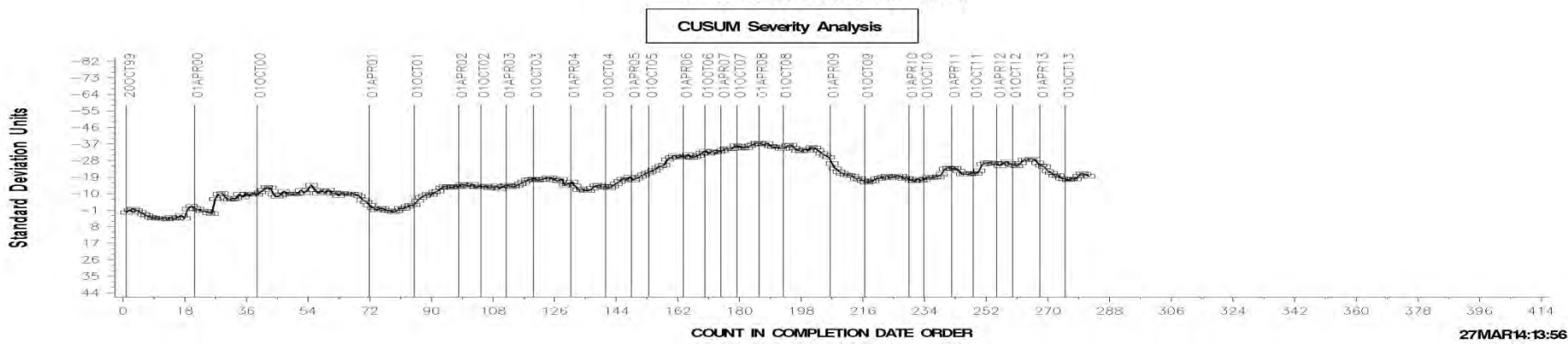
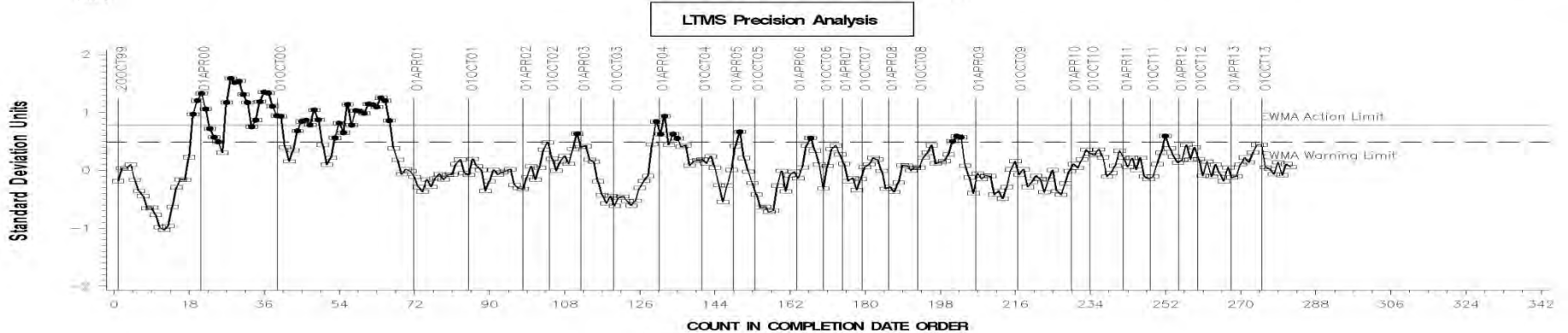
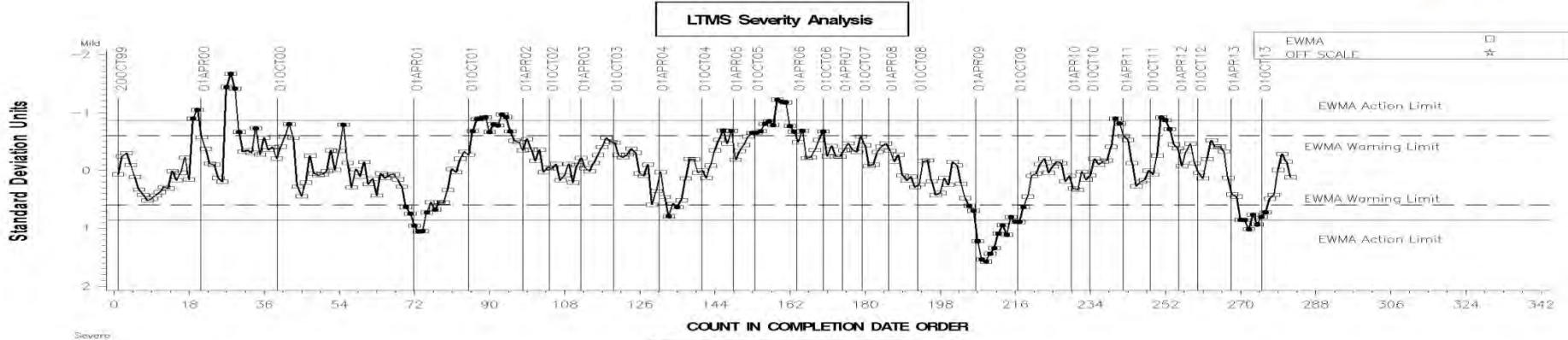
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AVERAGE CAM WEAR



27MAR14:13:56

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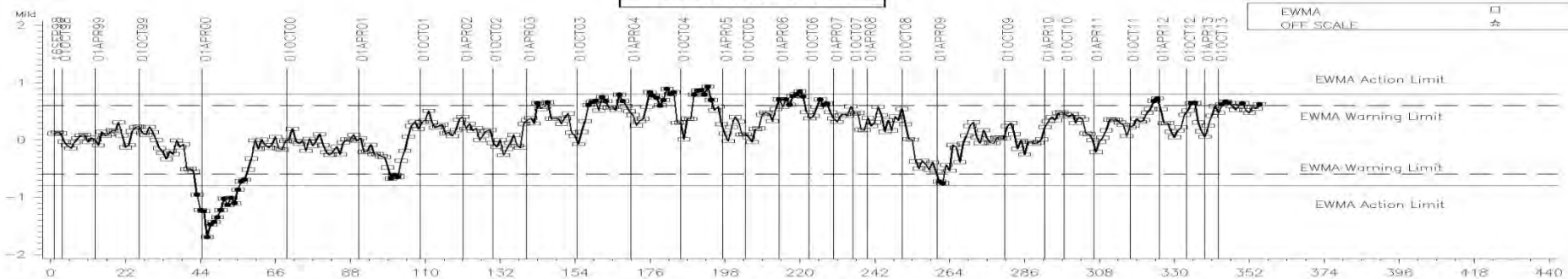
# Appendix 1.d

## Sequence VG Control Charts

» Severity, Precision, and CuSum

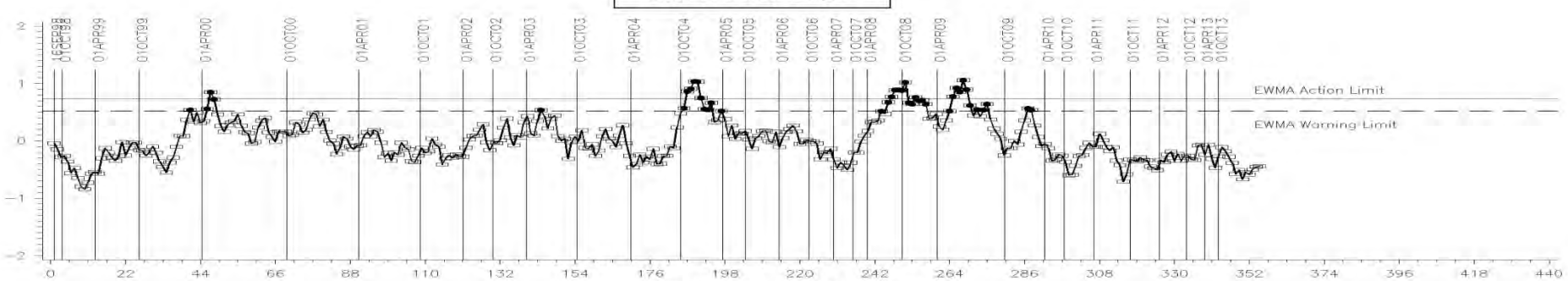
AVERAGE ENGINE SLUDGE

LTMS Severity Analysis



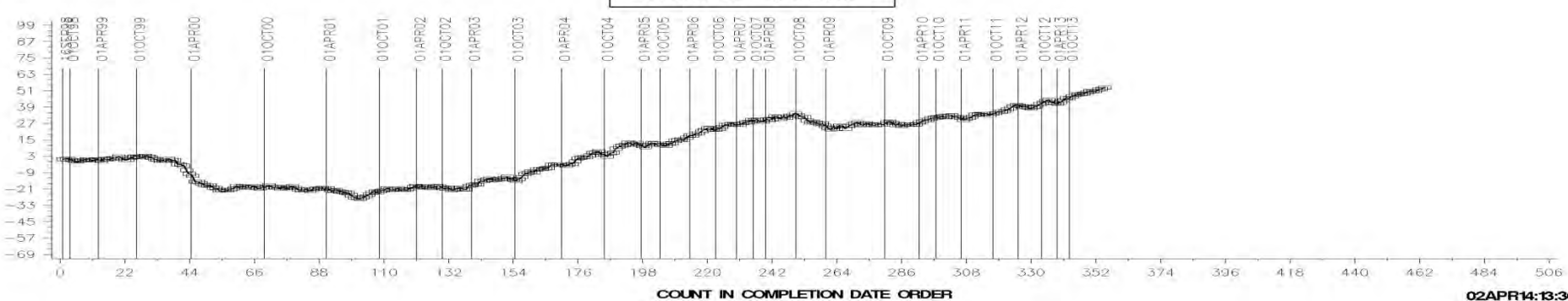
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

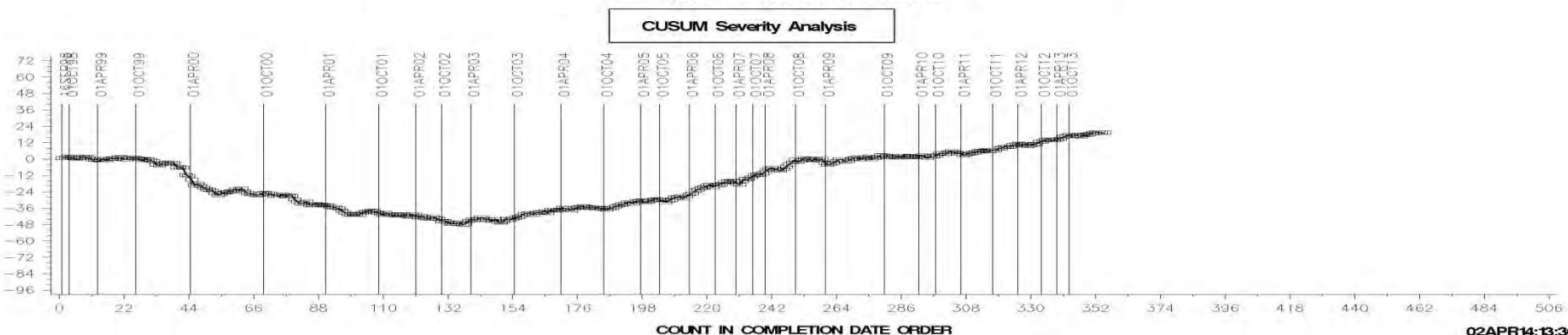
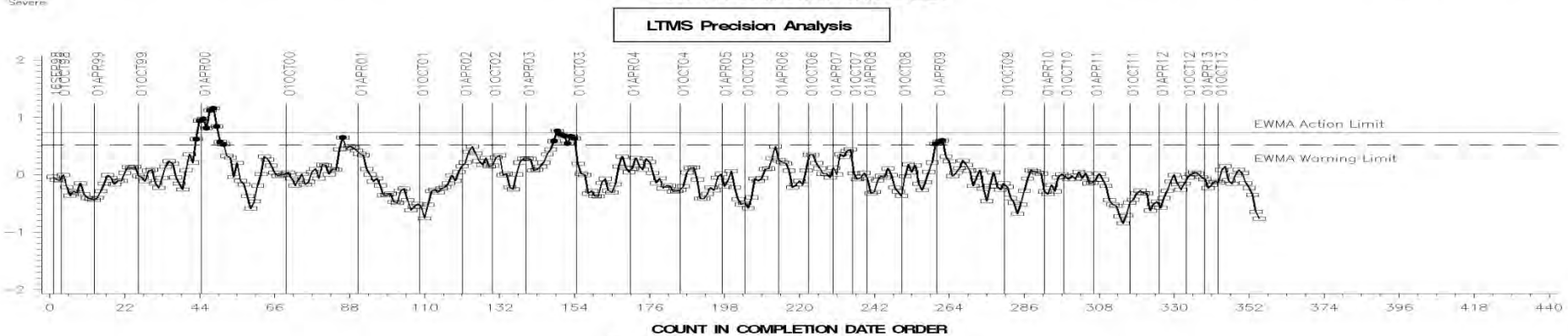
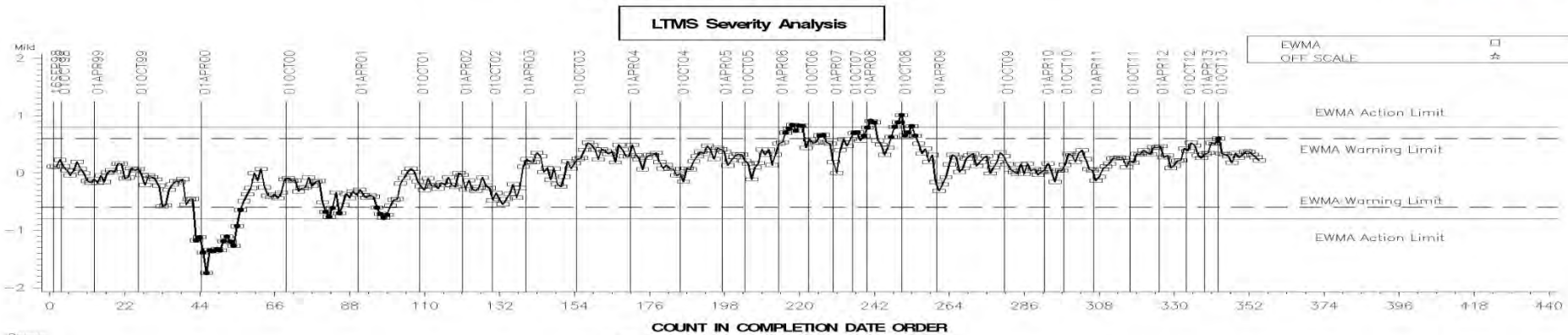
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

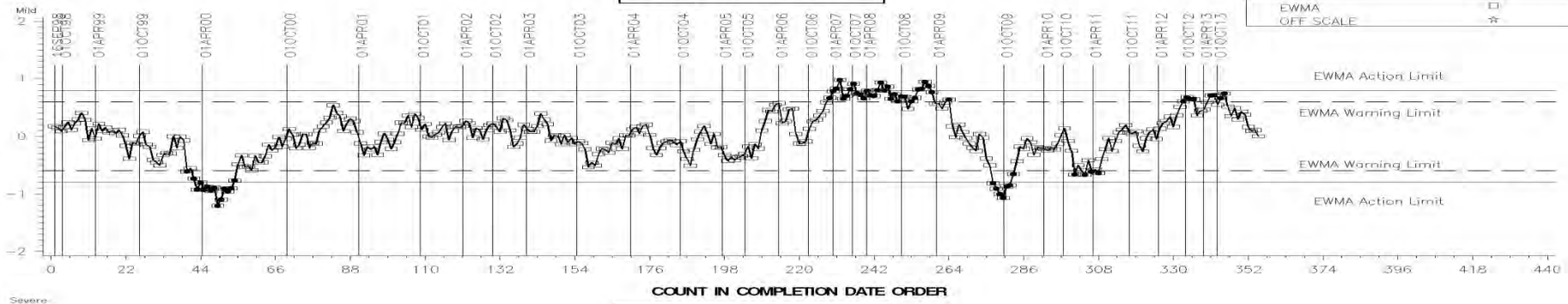


AVERAGE ROCKER COVER SLUDGE

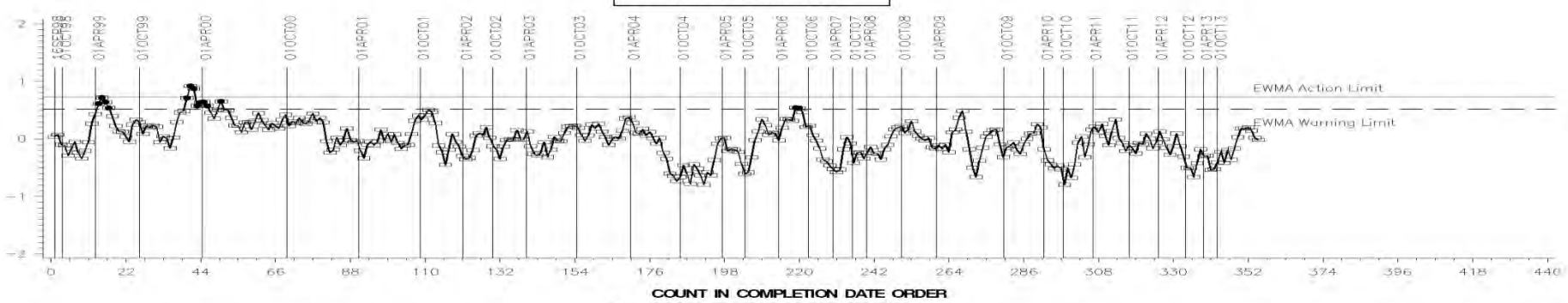


AVG. ENG. VARN. 3—PART APV + BAFFLES

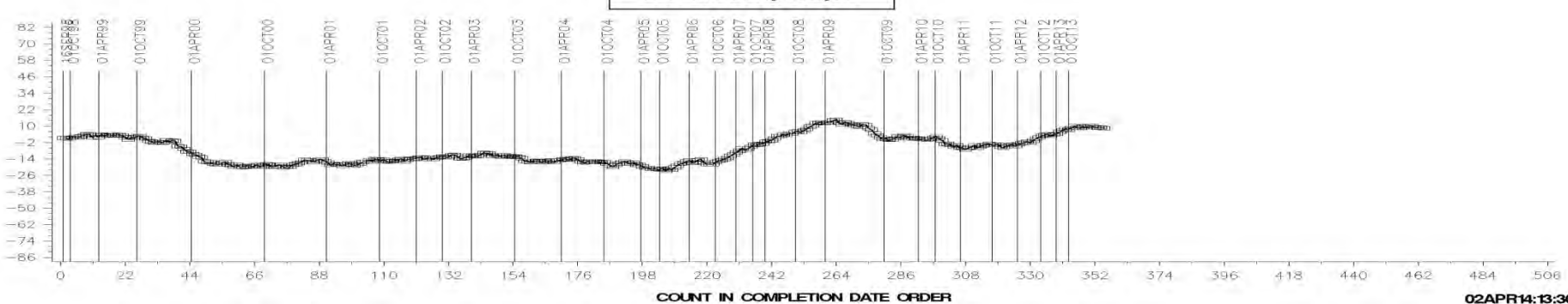
LTMS Severity Analysis



LTMS Precision Analysis



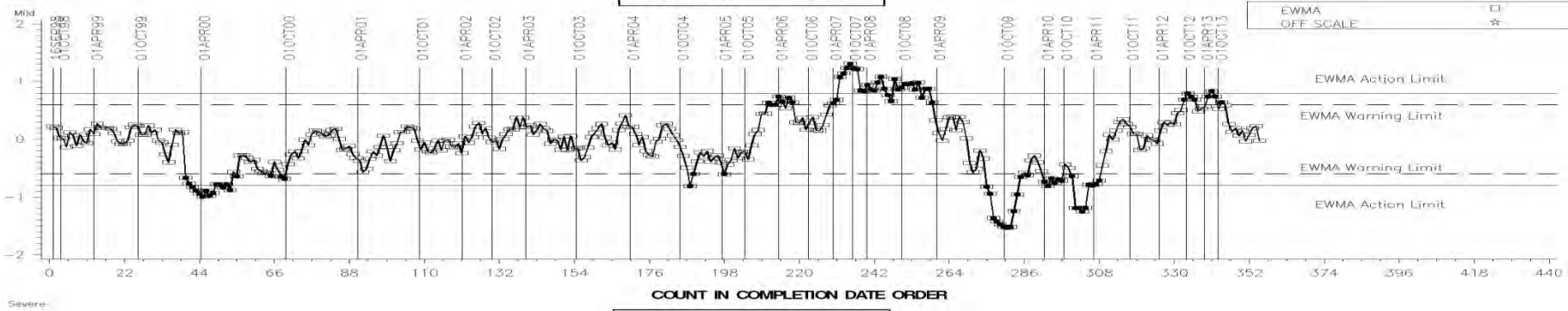
CUSUM Severity Analysis



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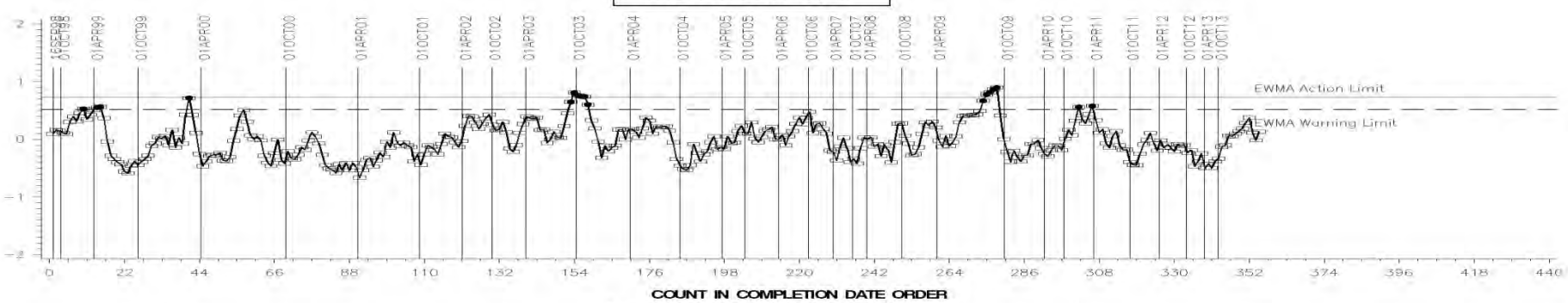
AVG PISTON SKIRT RATING

LTMS Severity Analysis



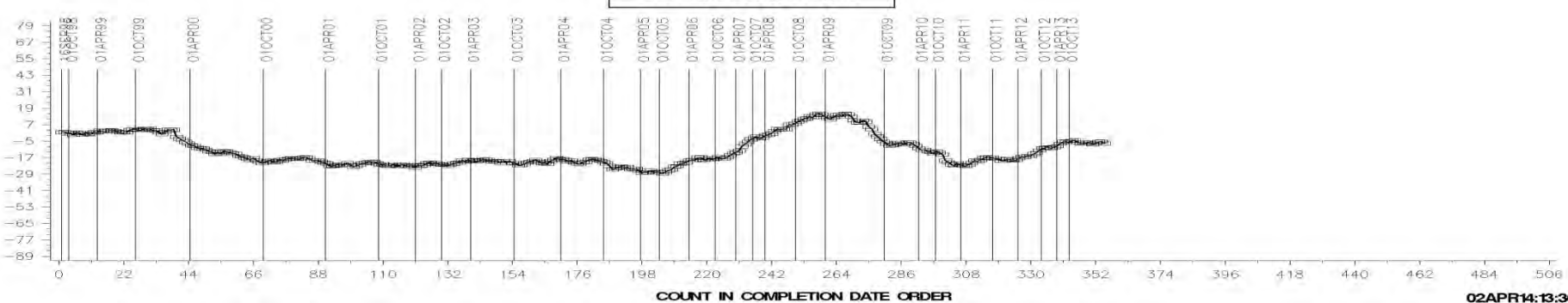
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

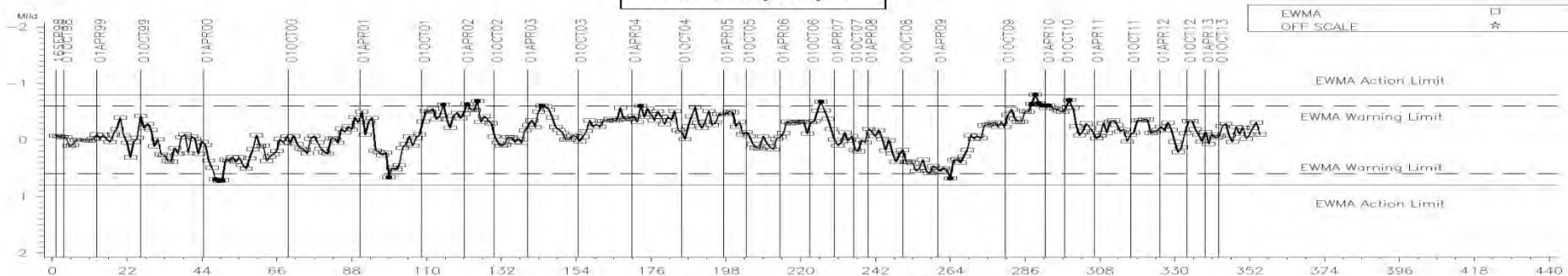


COUNT IN COMPLETION DATE ORDER

02APR14:13:30

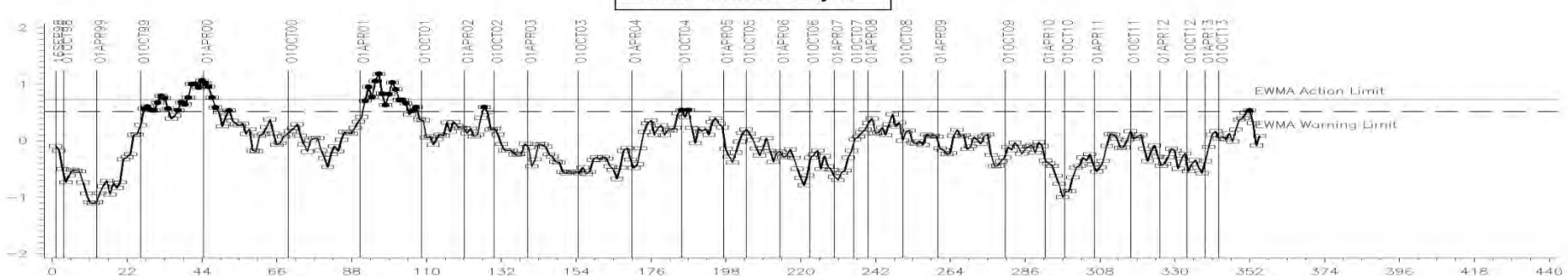
OIL SCREEN SLUDGE

LTMS Severity Analysis



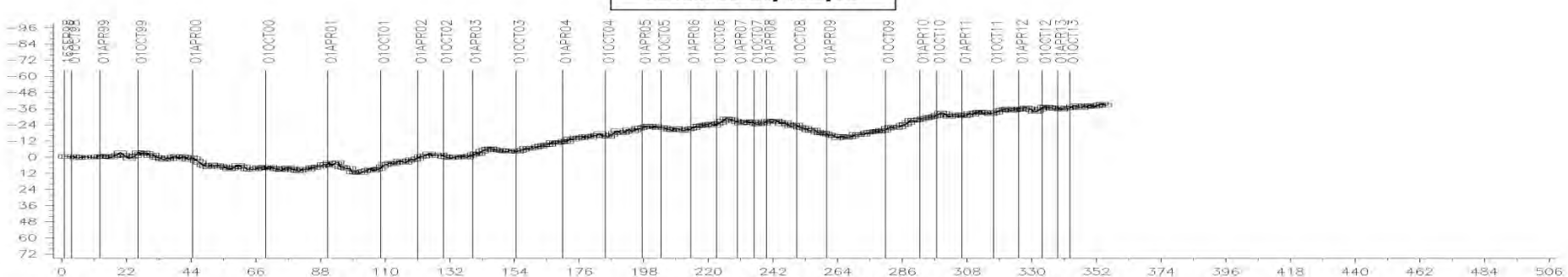
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

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# Appendix 1.e

## Sequence VID Control Charts

» Severity, Precision, and CuSum

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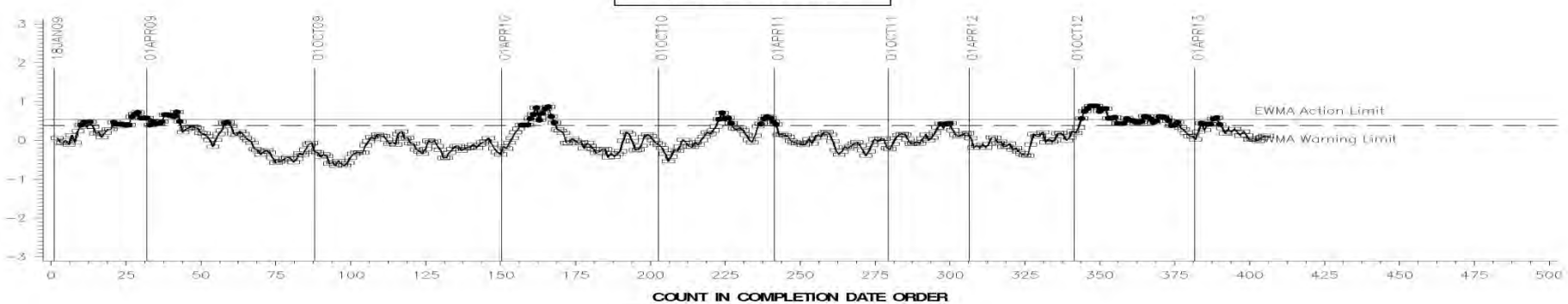
FEI FINAL RESULT PHASE I

LTMS Severity Analysis



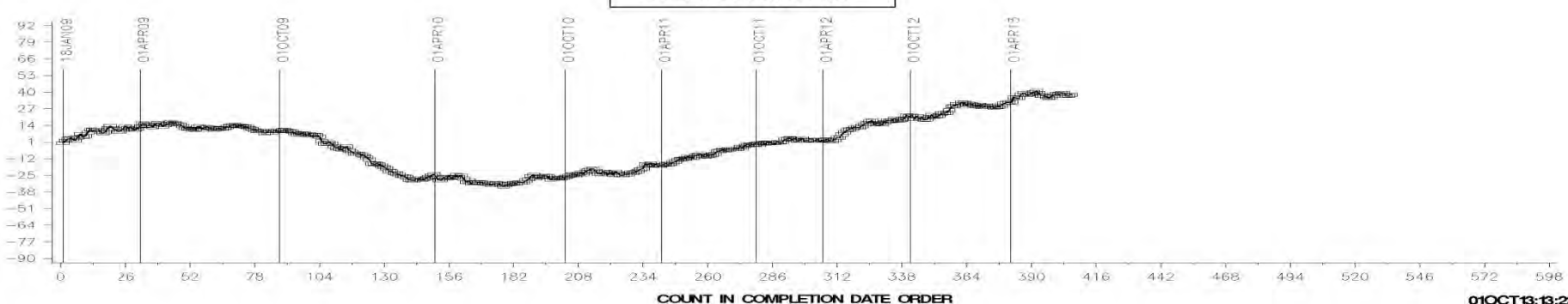
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



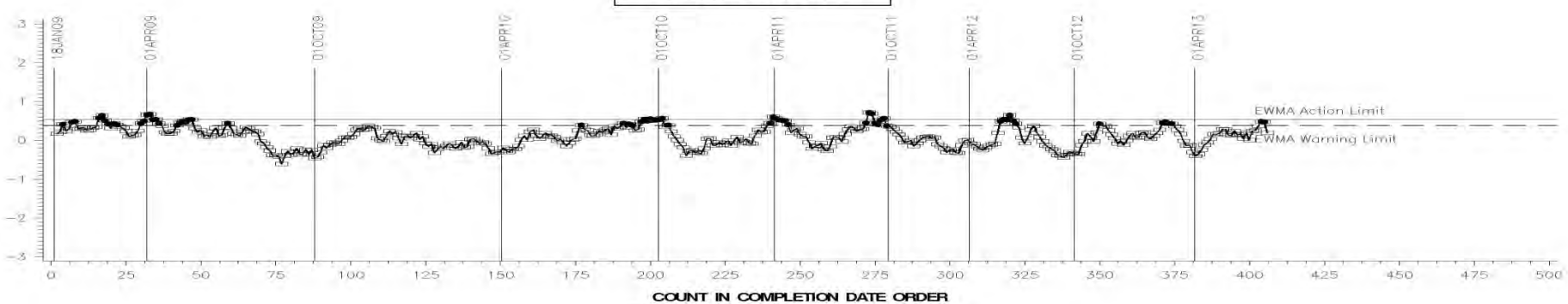
COUNT IN COMPLETION DATE ORDER

FEI FINAL RESULT PHASE II

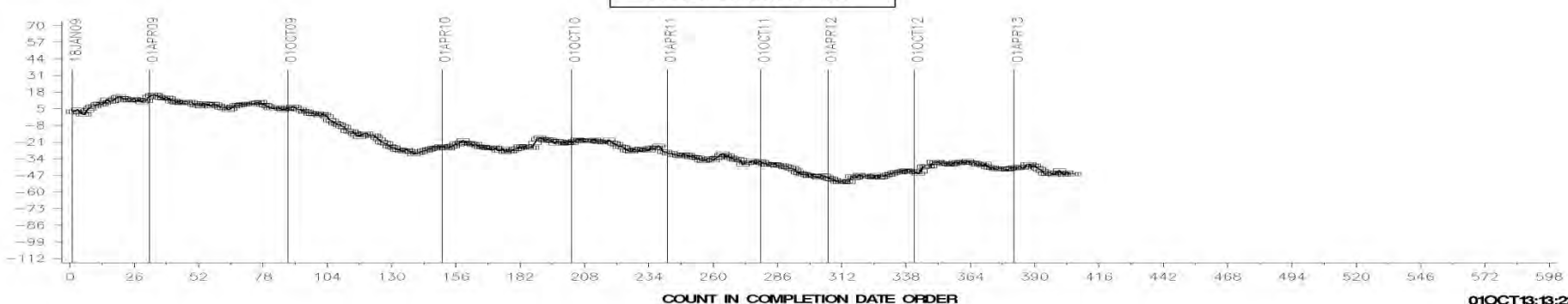
LTMS Severity Analysis



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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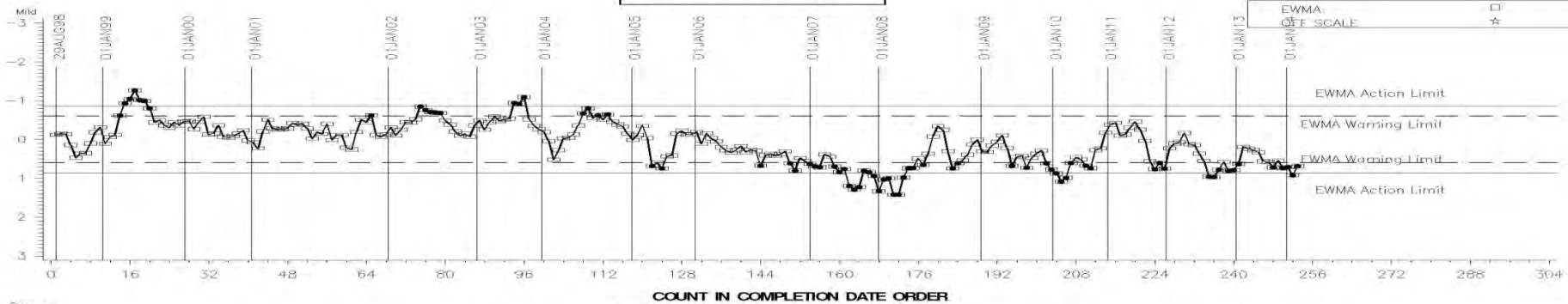


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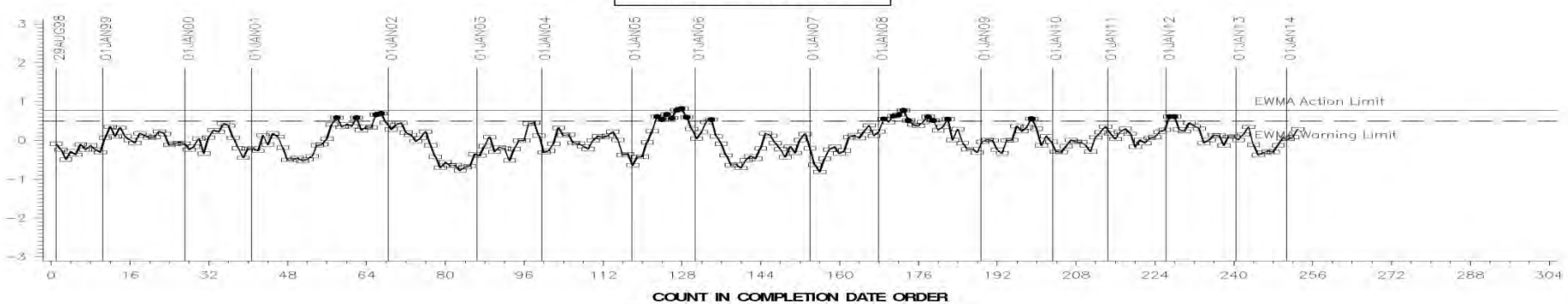
FINAL BEARING WEIGHT LOSS

LTMS Severity Analysis



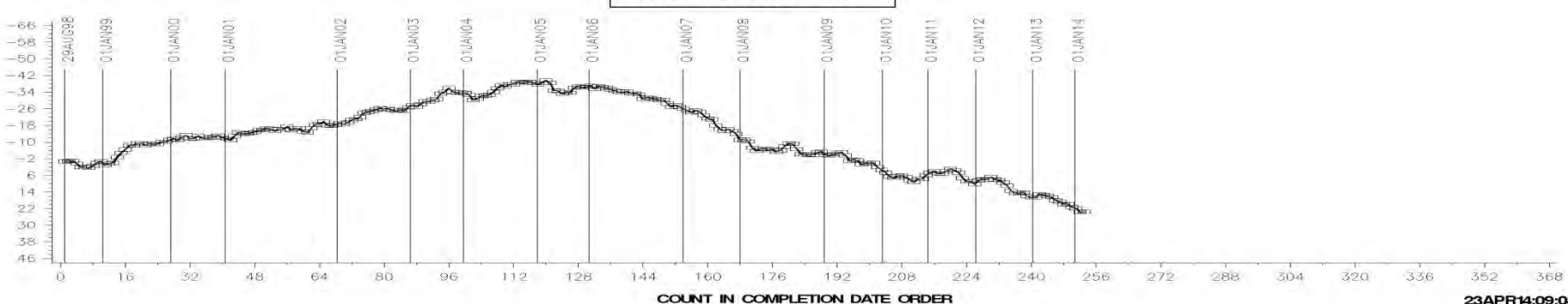
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

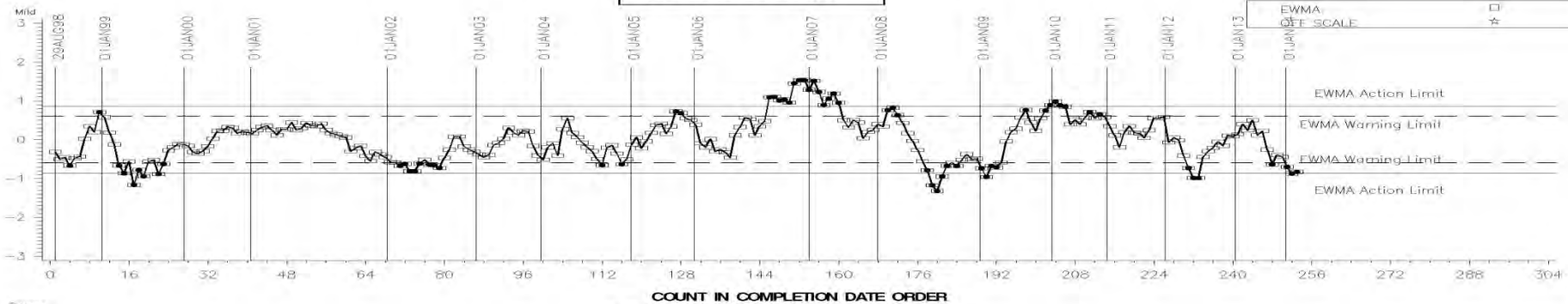
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

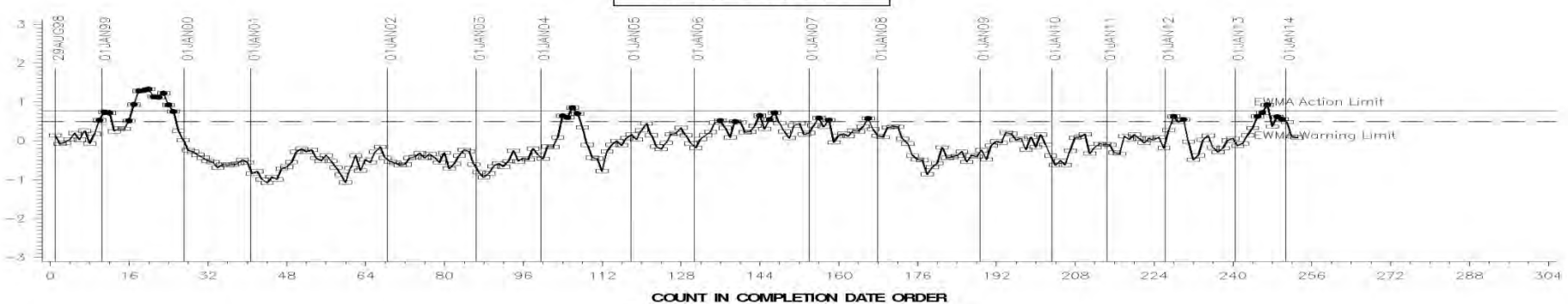
STRIPPED VIS. @ 100 DEG C

LTMS Severity Analysis



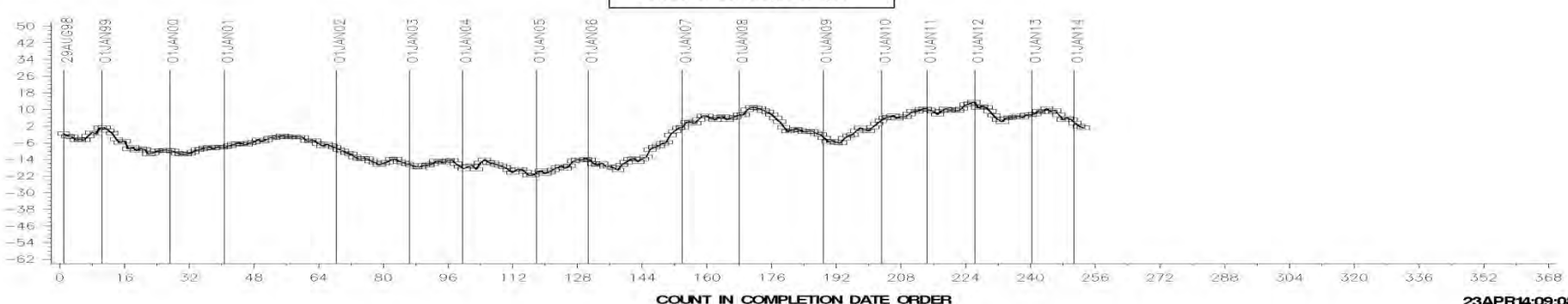
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

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