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# **Test Monitoring Center**

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## **ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing**

**April 2016**

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# Passenger Car Engine Oil Testing Executive Summary

## ▶ Seq. VI

- Industry estimates show a limited number of engines (3) remain for Sequence VID Testing
- The new blend of 542 (542-2) is being consumed at a high rate due to VIE and VIF matrix tests and for stand/engine shakedown of the VIE test. Another blend (542-3) is available at the TMC.

## ▶ Seq. VIII

- Test unavailable while a new batch of bearings is being produced. 08-15 bearings were unacceptably severe. The panel elected to obtain another batch of bearings which should be available in 2-3 months

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# Calibrated Labs and Stands\*

Test	Labs	Stands
IIIF	3	4
IIIG/A/B	4	11
IVA	3	3
VG	2	8
VID	4	6
VIII	1	1

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\*As of 3/31/2016

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# Sequence III F

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# Sequence IIF Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	8
Failed Calibration Test	OC	4
Operationally Invalid	LC	1
Terminated Early	XC	2
<b>Total</b>		<b>15</b>

# Sequence III F – Failed Tests

Test Status	Number of Tests
Severe Hours	1
Severe Hours, Mild APV	1
Mild APV	1
Mild WPD	1
<b>Total</b>	<b>4</b>



# Sequence IIIF – Lost Tests\*

Test Status	Cause	#
Aborted	Load Calibration Error	1
Aborted	Spun Rod Bearing(s)	1
Invalid	Incorrect Amount of Oil Removed at 40 Hour Leveling	1
<b>Totals</b>		<b>3</b>

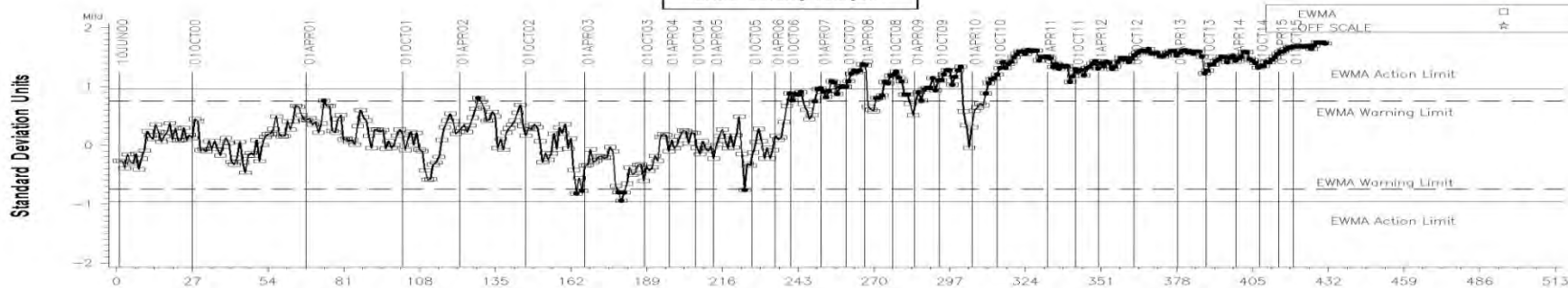
\*Invalid and aborted tests

# Sequence IIF Test Severity

- APV
  - In severity action alarm, mild
  - Long-term mild trend continuing (Since October 2006)
- Hours to 275% Vis Increase
  - In precision and severity warning alarm (severe)
- WPD
  - In severity action alarm (mild)
- PV60
  - In severity warning alarm (severe)

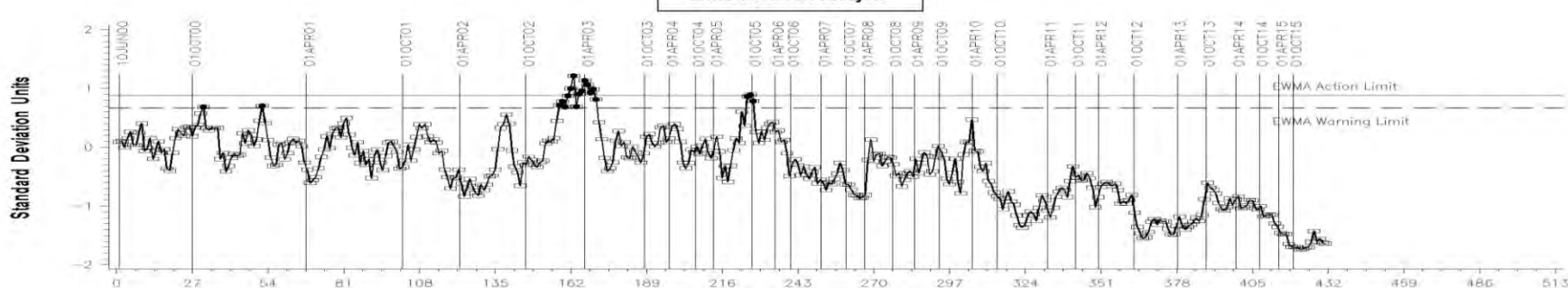
AVERAGE PISTON SKIRT VARNISH FINAL ORIG UNIT RES

LTMS Severity Analysis



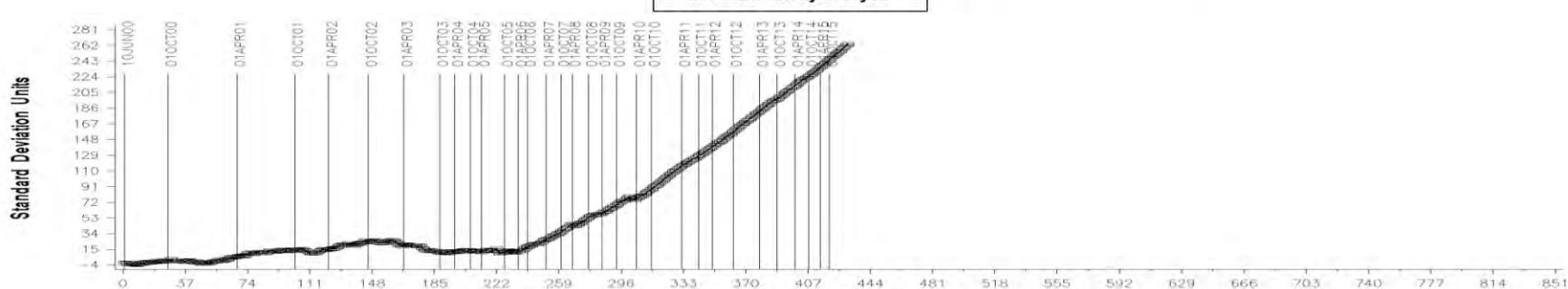
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

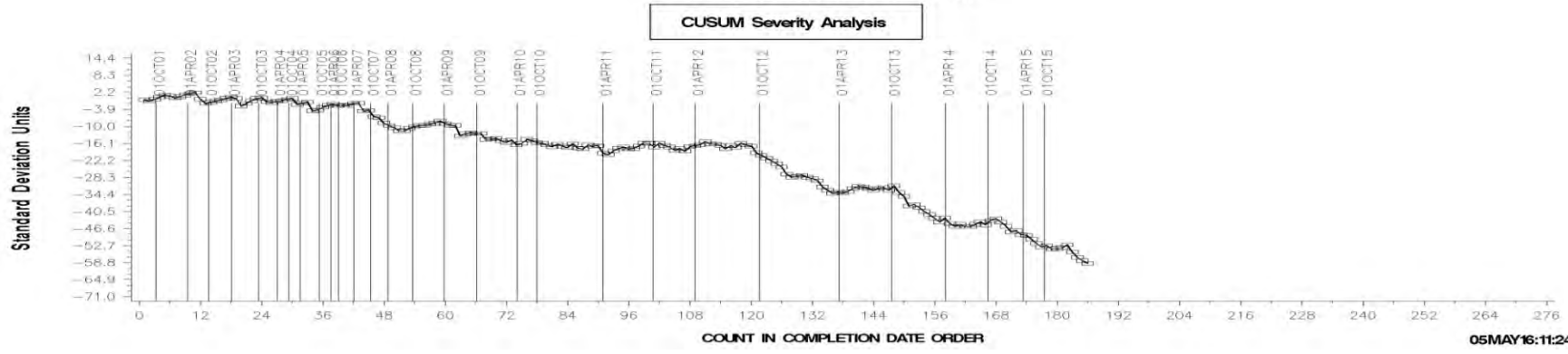
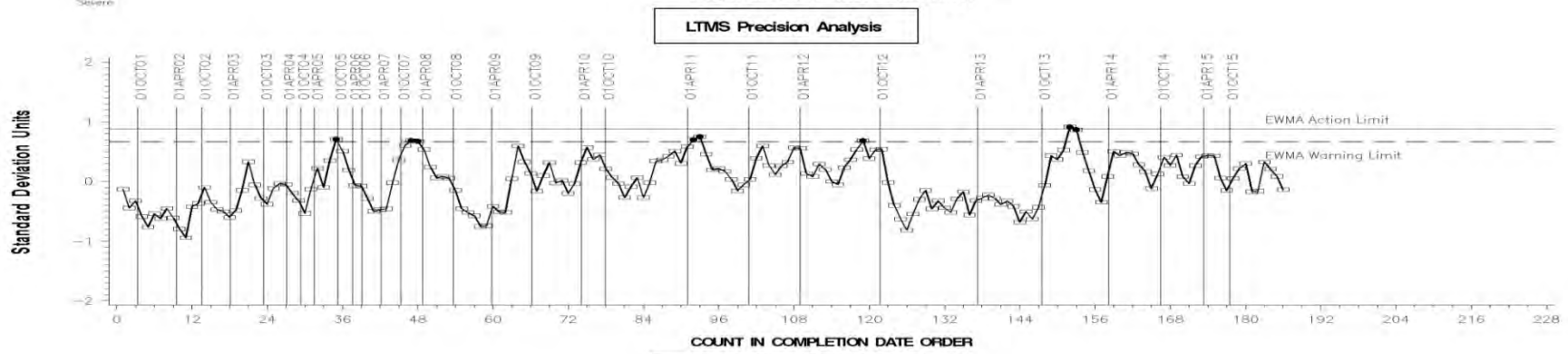
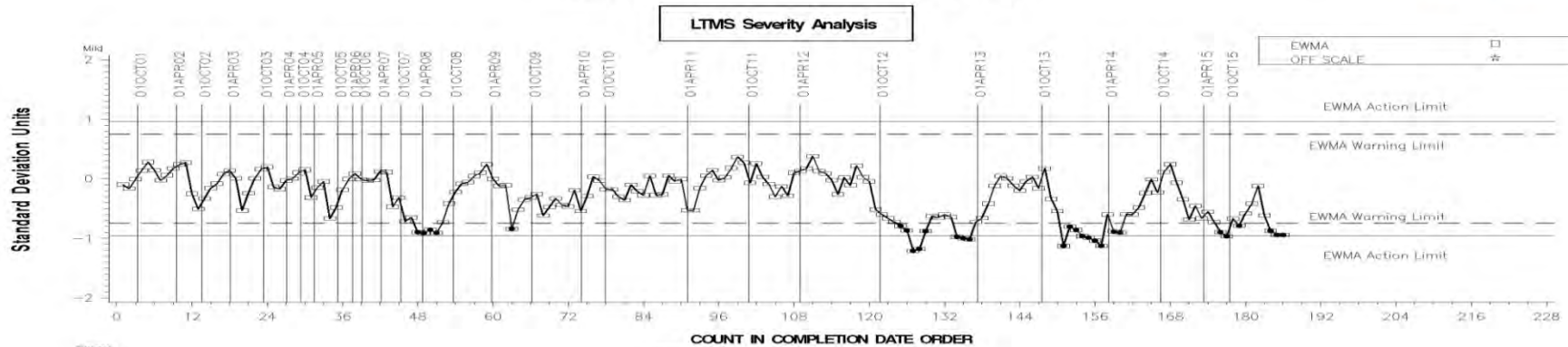
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

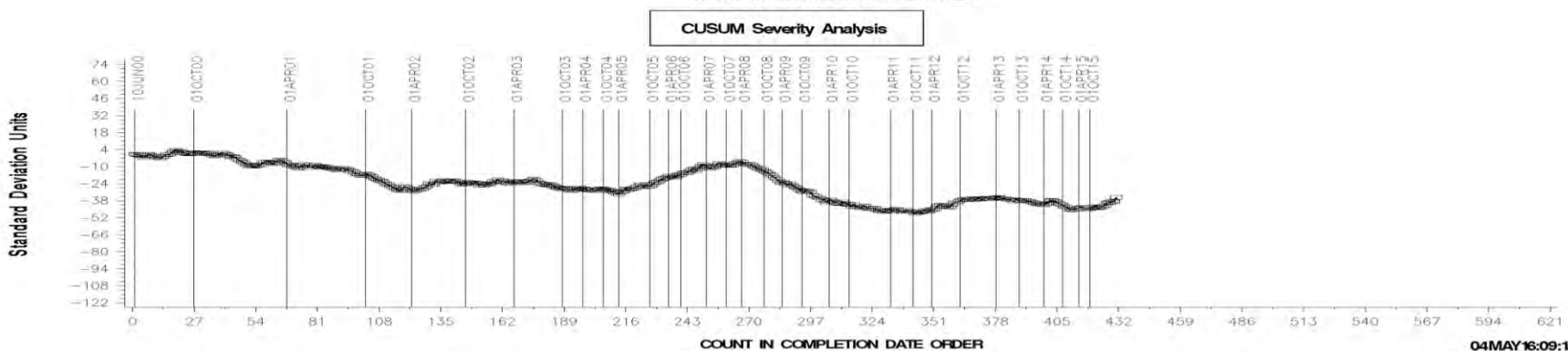
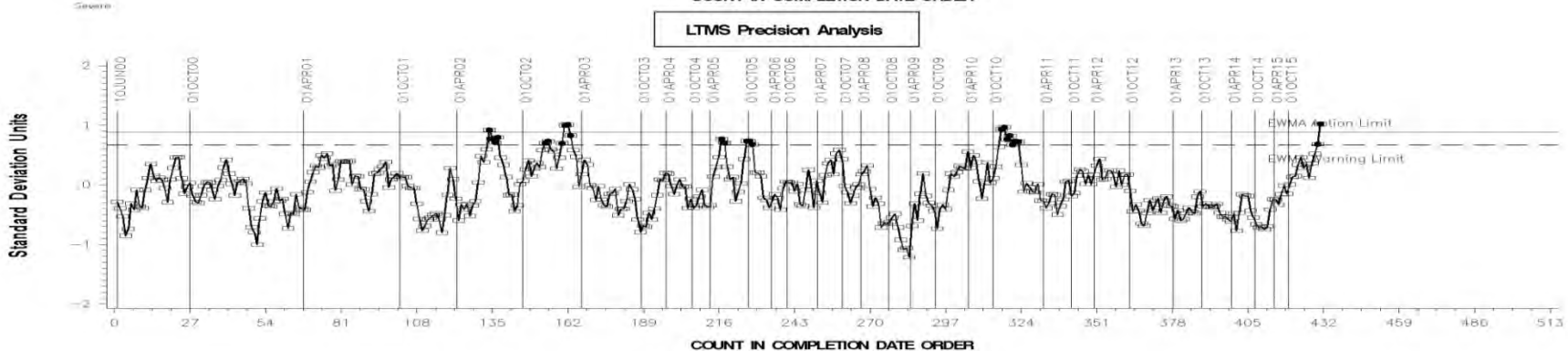
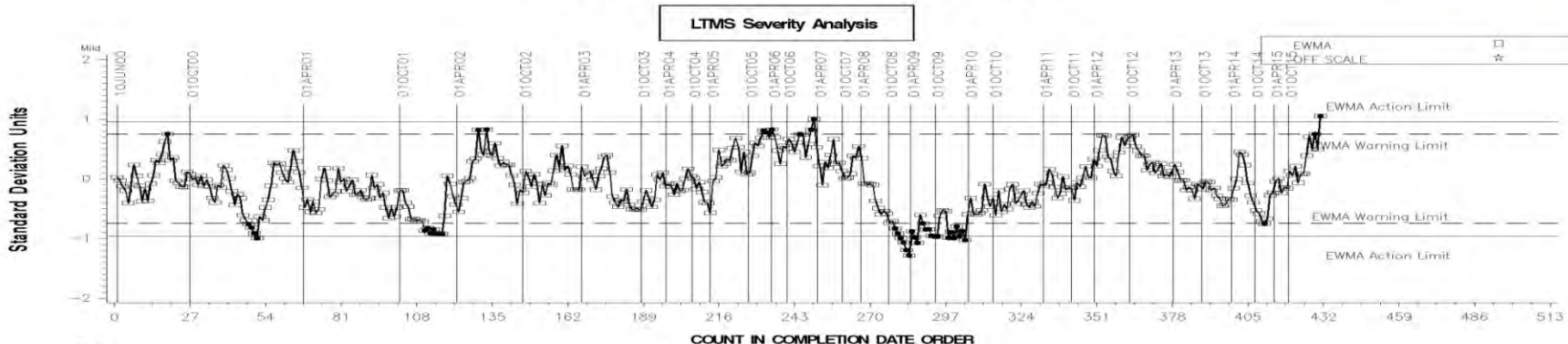
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HOURS FINAL ORIG RES (REFERENCE TESTS ONLY)

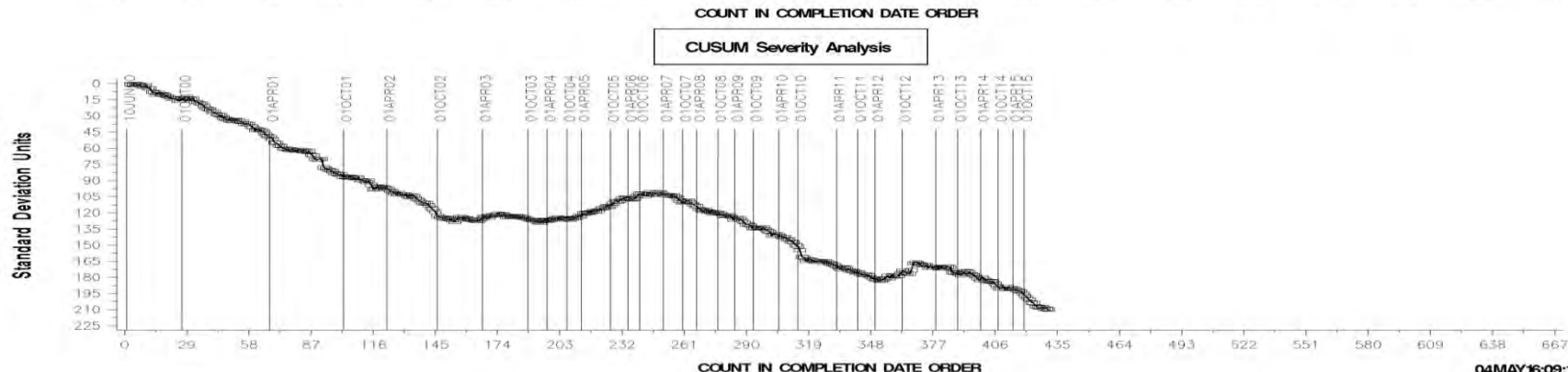
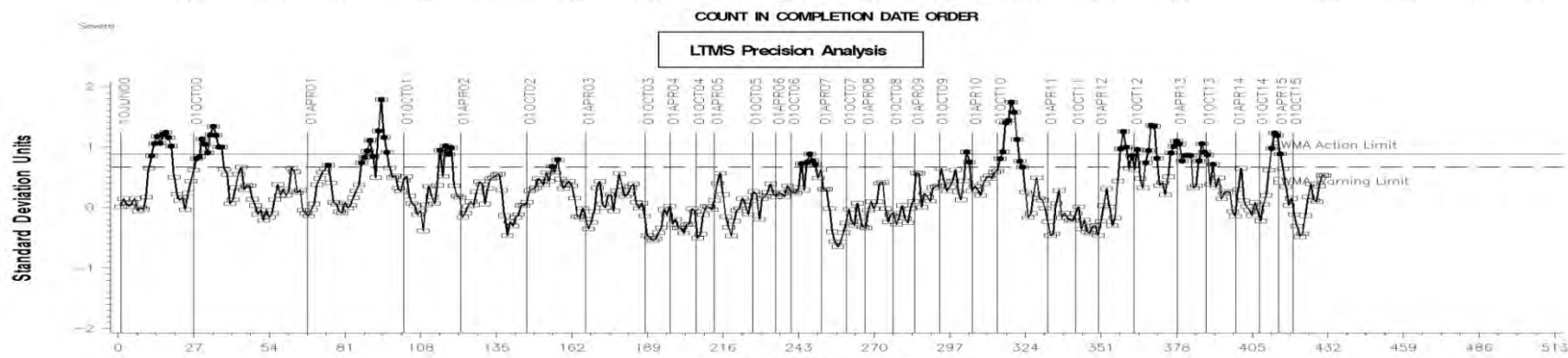
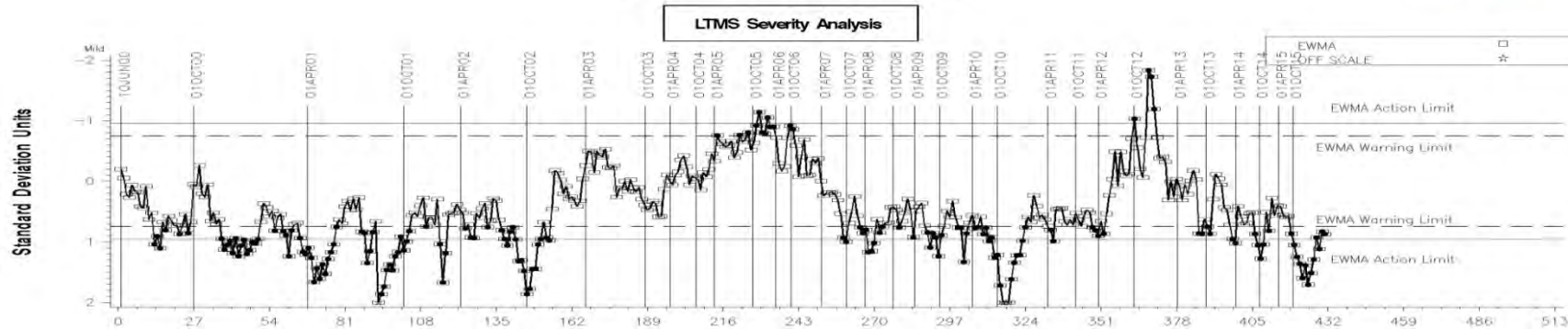


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AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG UNIT RES



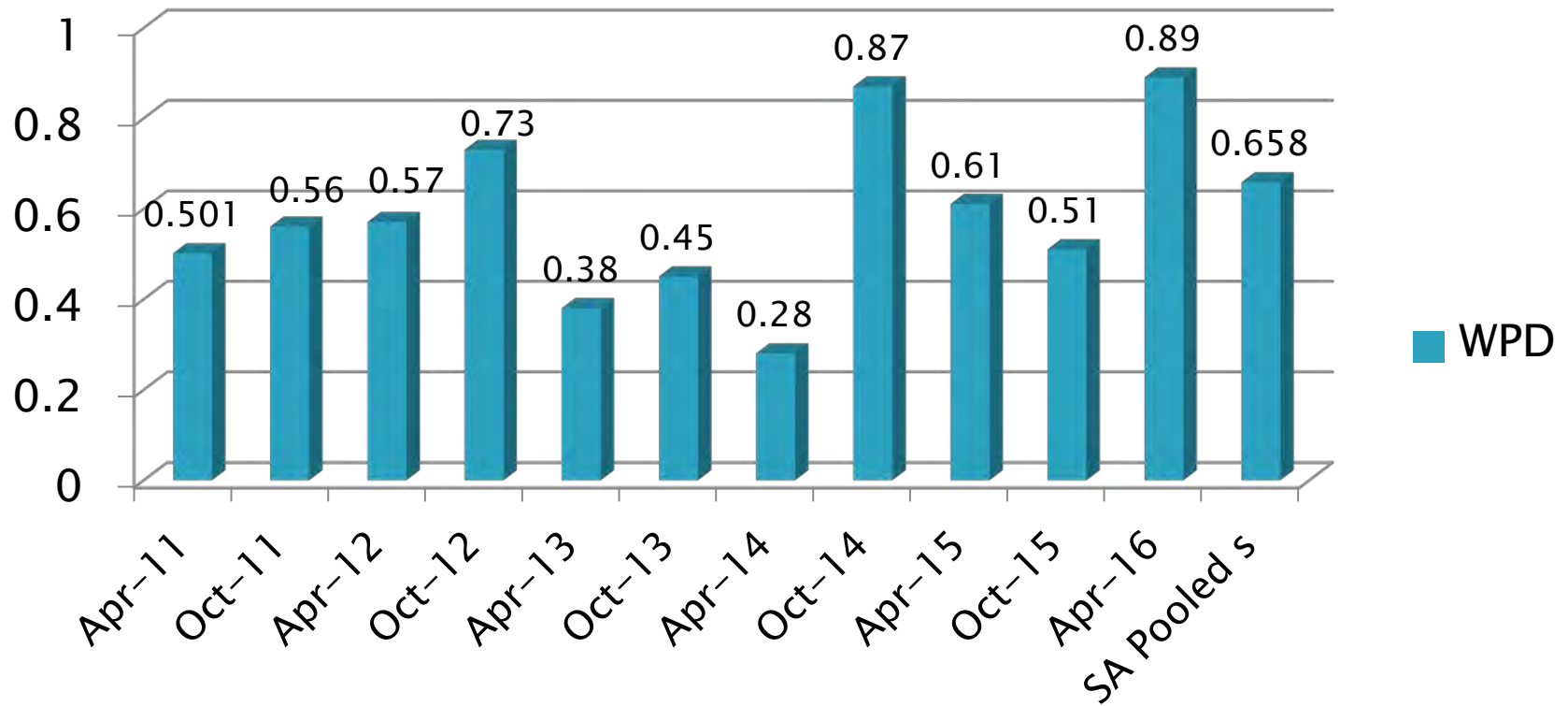
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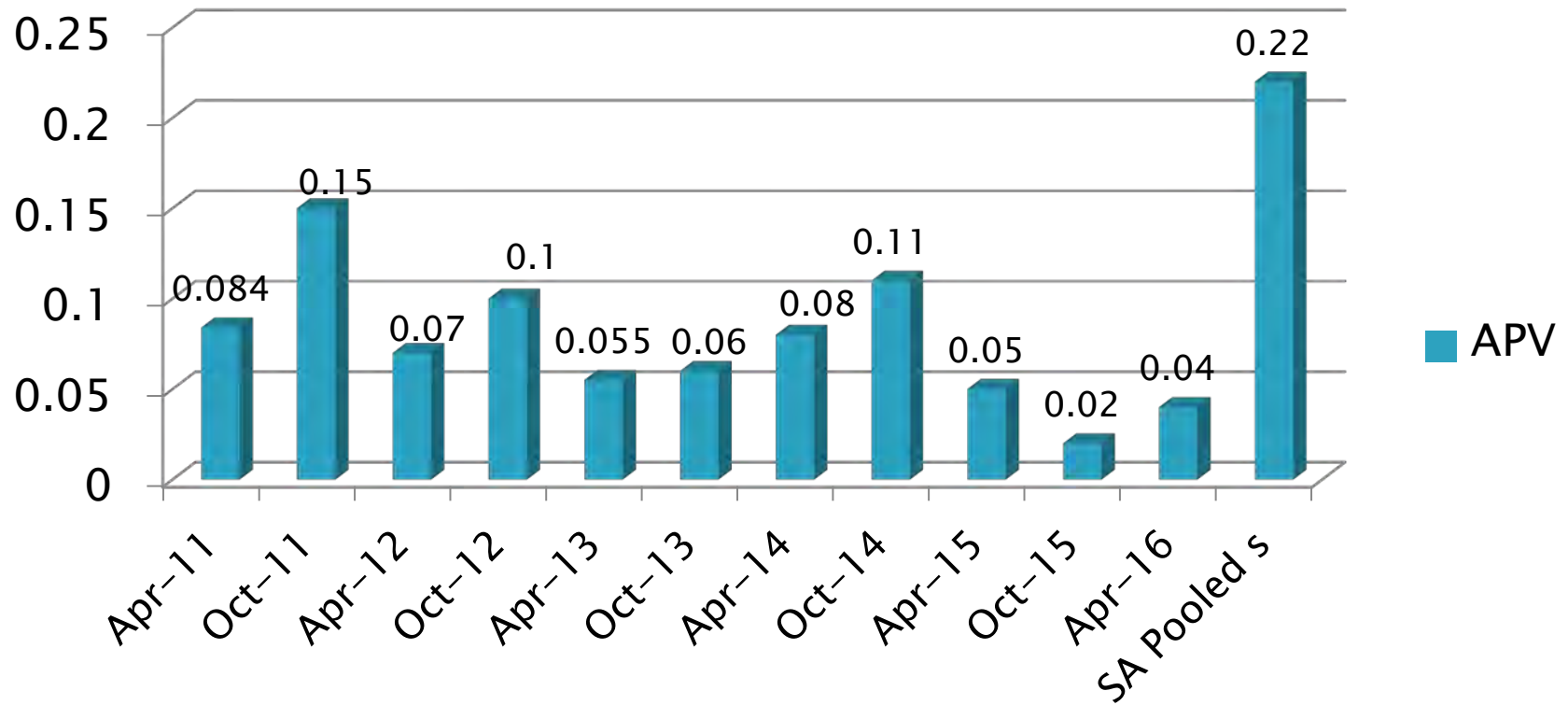
# IIIF Precision Estimates

## WPD



# IIIF Precision Estimates

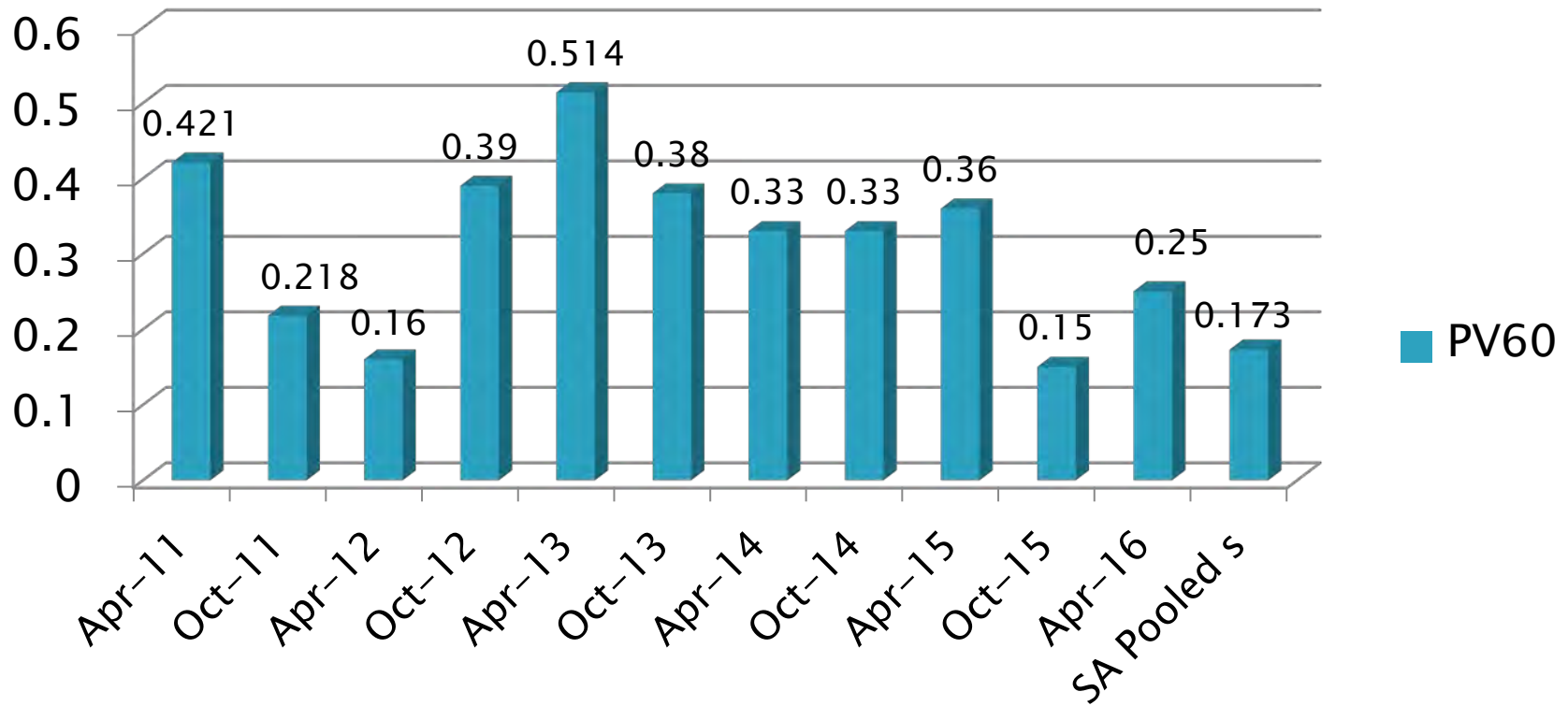
## APV





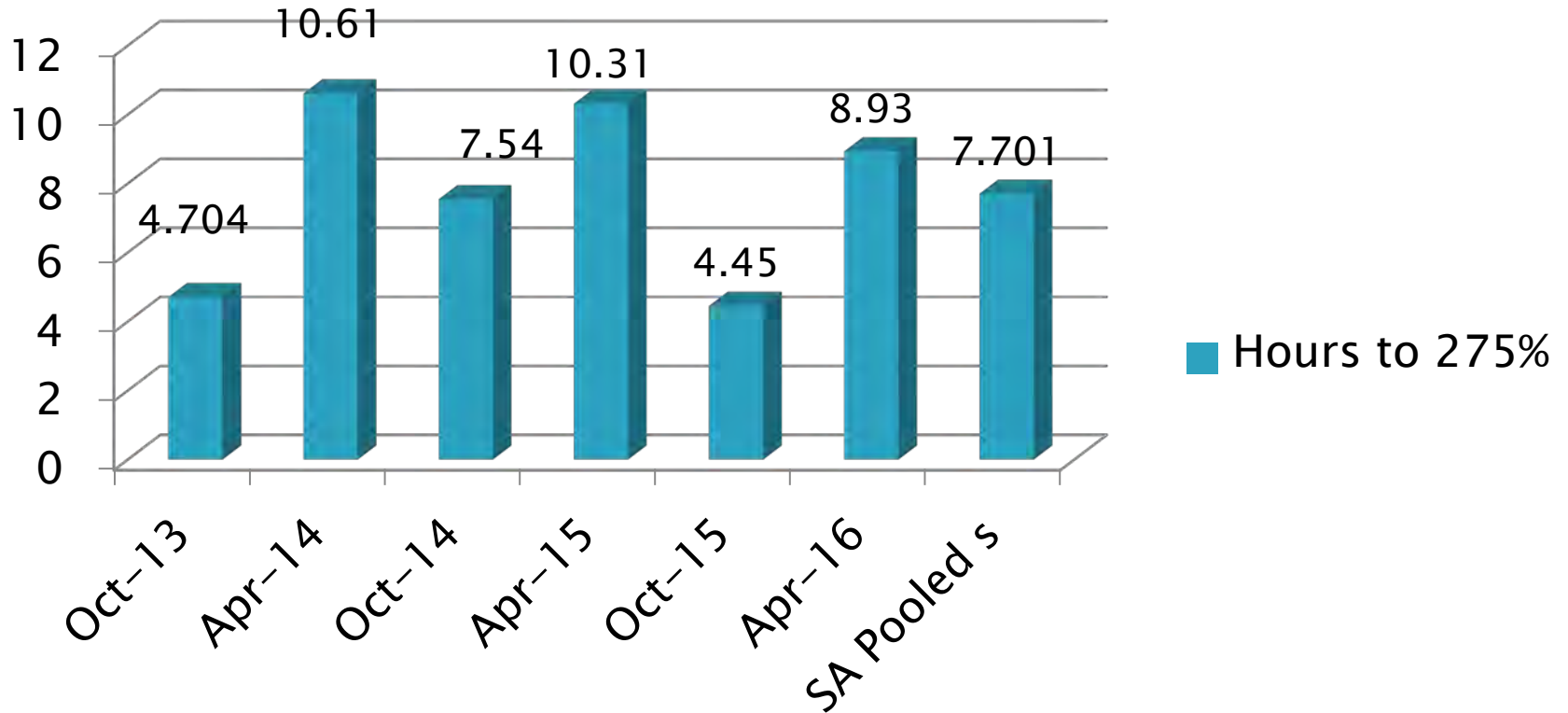
# IIIF Precision Estimates

## PV60



# IIIF Precision Estimates

## Hours to 275%



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# Sequence IIIG/A/B

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# Sequence IIIG Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	9
Failed Calibration Test	OC	2
Operationally Invalid	LC	1
Aborted	XC	1
<b>Total</b>		<b>13</b>

# Sequence IIIG – Failed Tests

Test Status	Number of Tests
Severe PVIS	2
<b>Total</b>	<b>2</b>

# Sequence IIIG – Lost Tests\*

Test Status	Cause	#
Invalid	Loss of Oil Temperature Control	1
Aborted	Blown Head Gasket	1
<b>Totals</b>		<b>2</b>

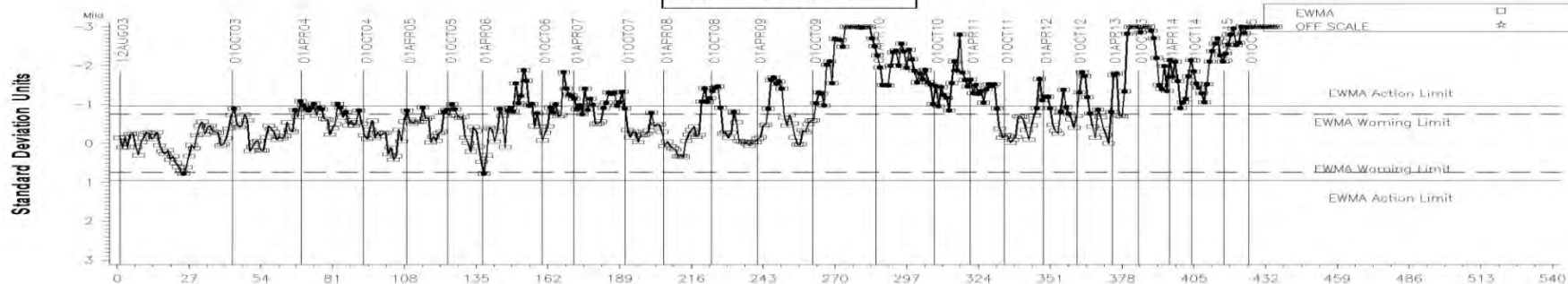
\*Invalid and aborted tests

# Sequence IIIG Test Severity

- ACLW in severity action alarm
  - Long-term mild trend
- PVIS in severity warning alarm (severe)
- WPD is in control
  - Long-term severe trend continuing
- MRV is in severity warning alarm (severe)
- PHOS in severity warning alarm (severe)

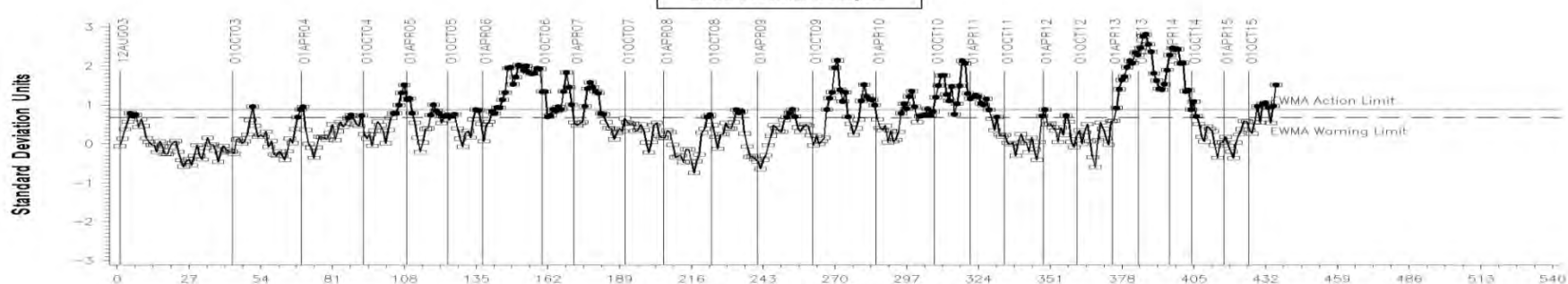
AVERAGE CAM + LIFTER WEAR

LTMS Severity Analysis



COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

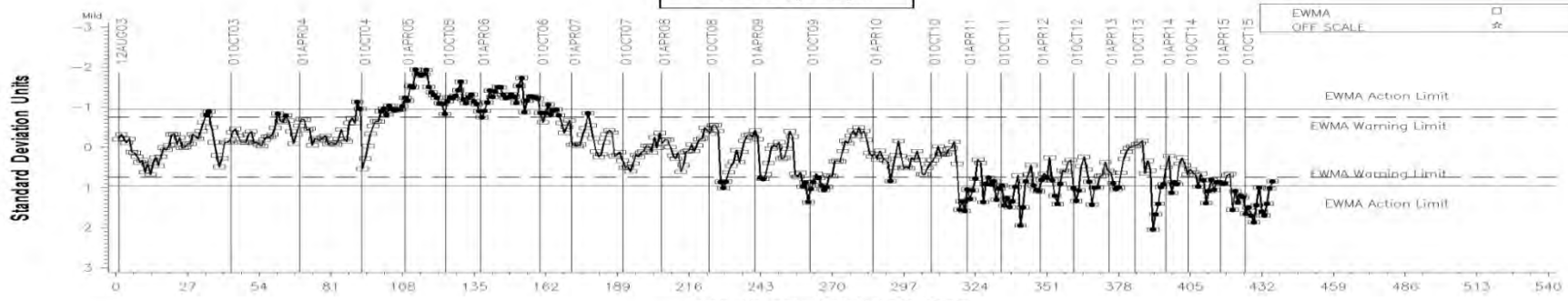


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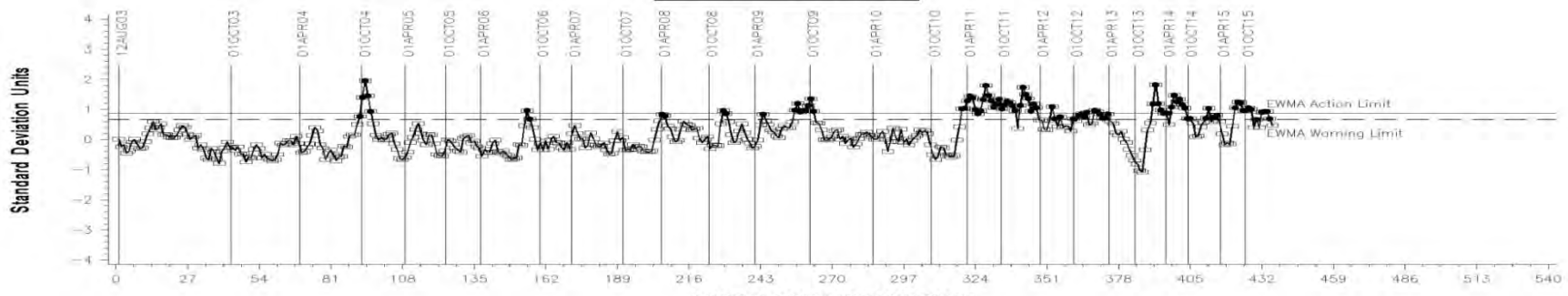
VISCOSITY INCREASE

LTMS Severity Analysis



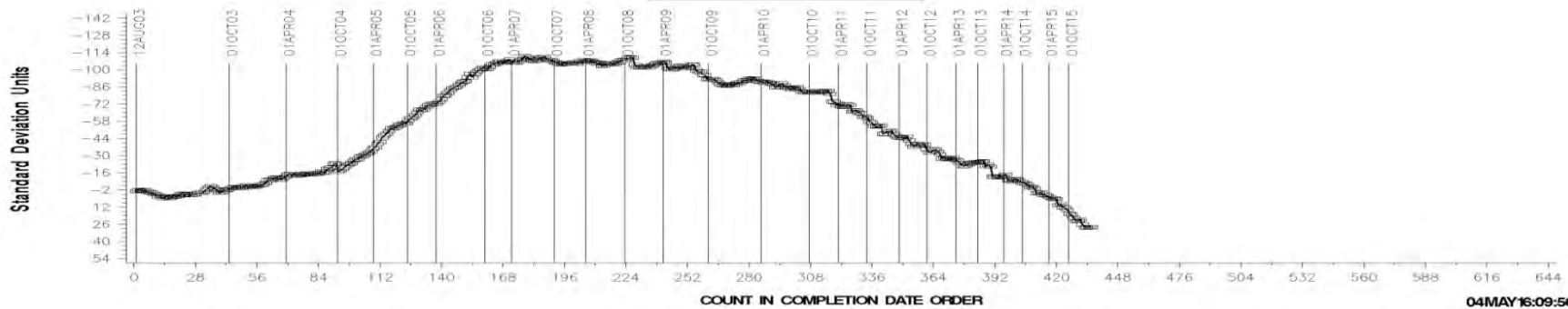
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



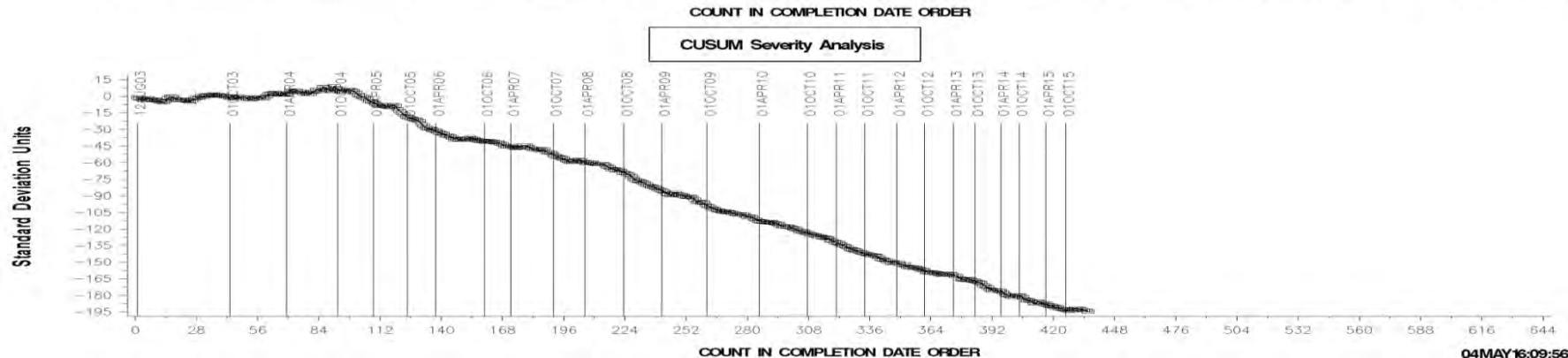
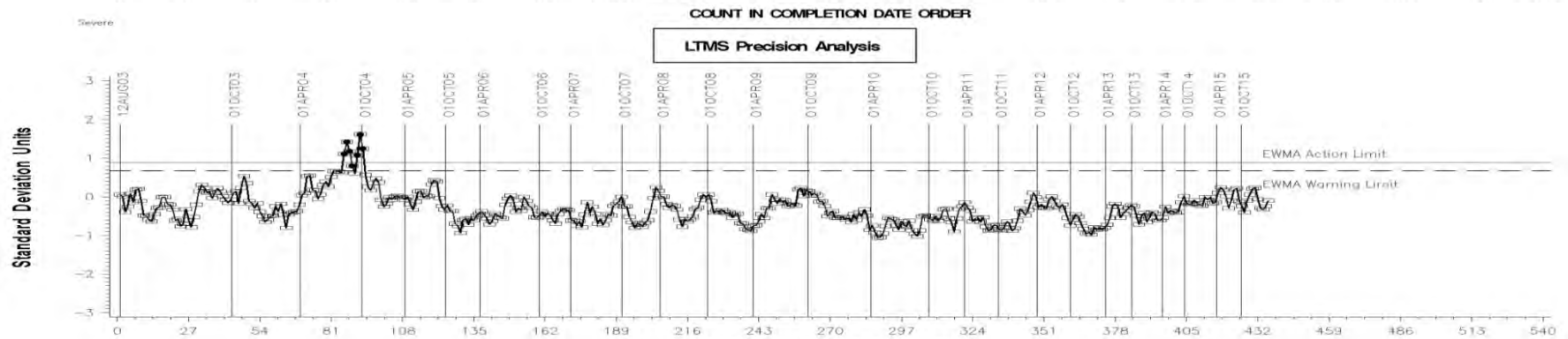
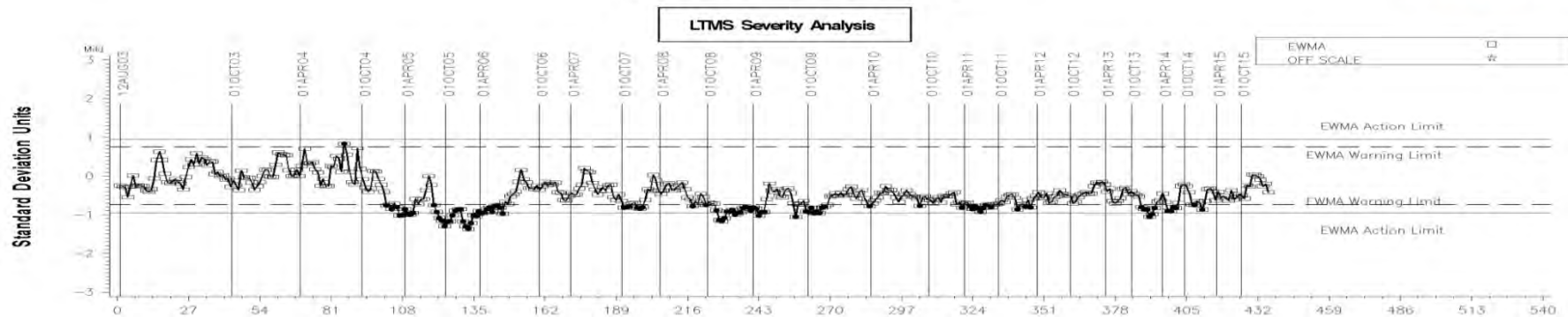
COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



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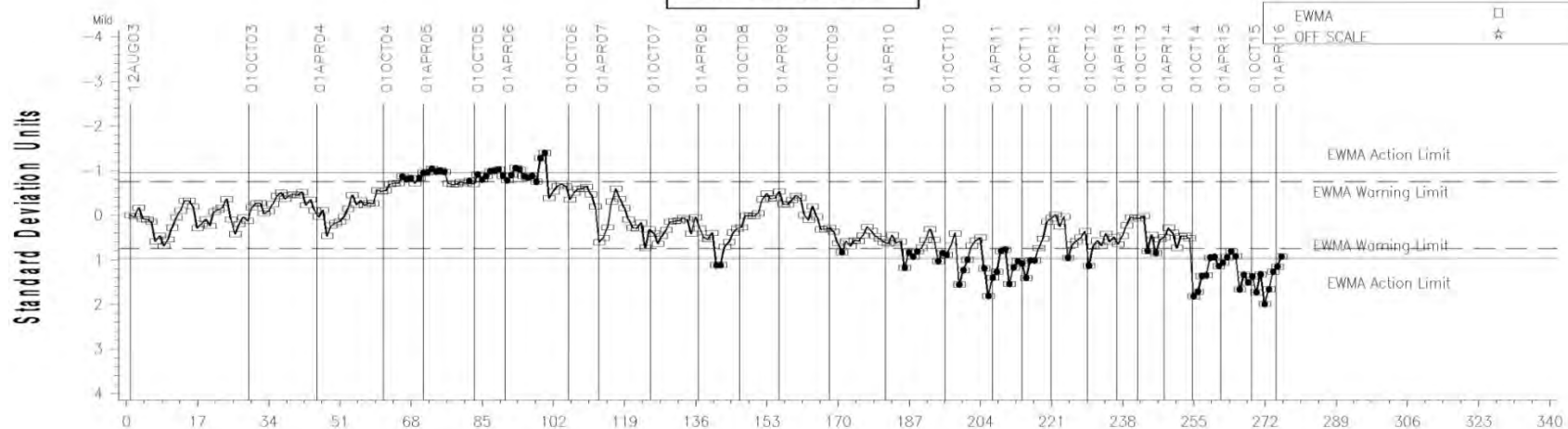
AVERAGE WEIGHTED PISTON DEPOSITS



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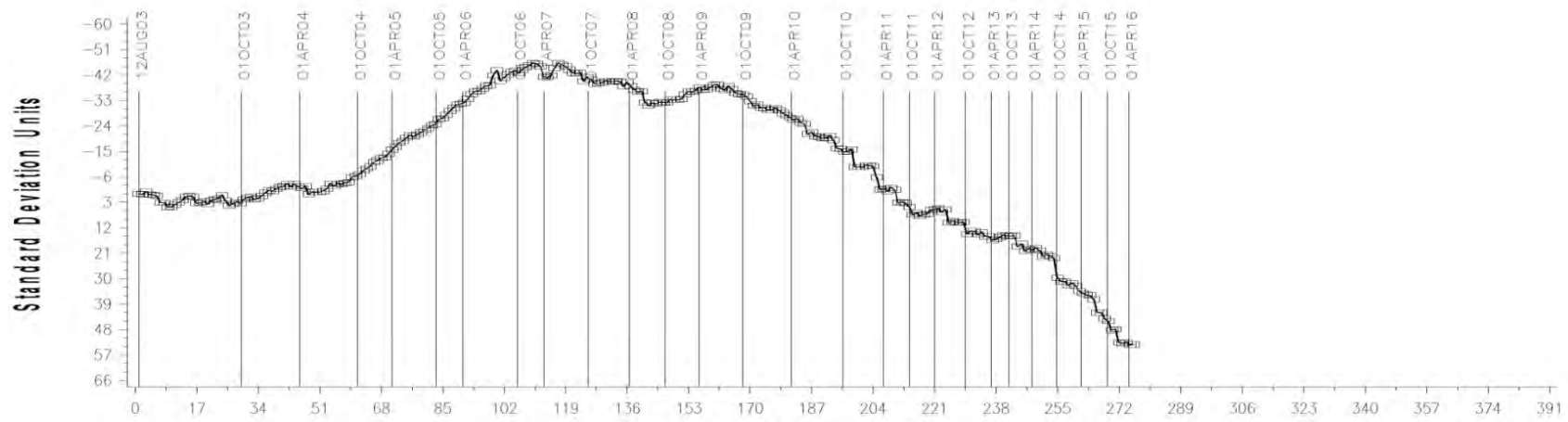
MRV VISCOSITY RESULT

LTMS Severity Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

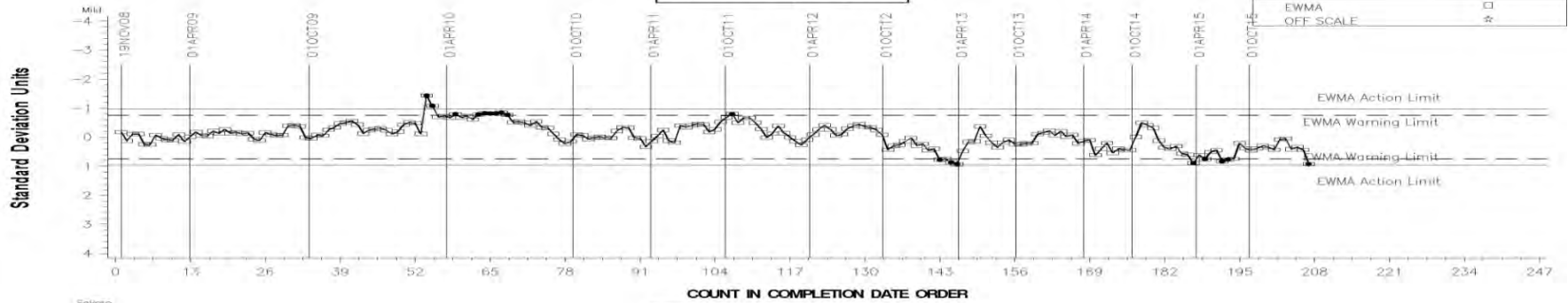


COUNT IN COMPLETION DATE ORDER

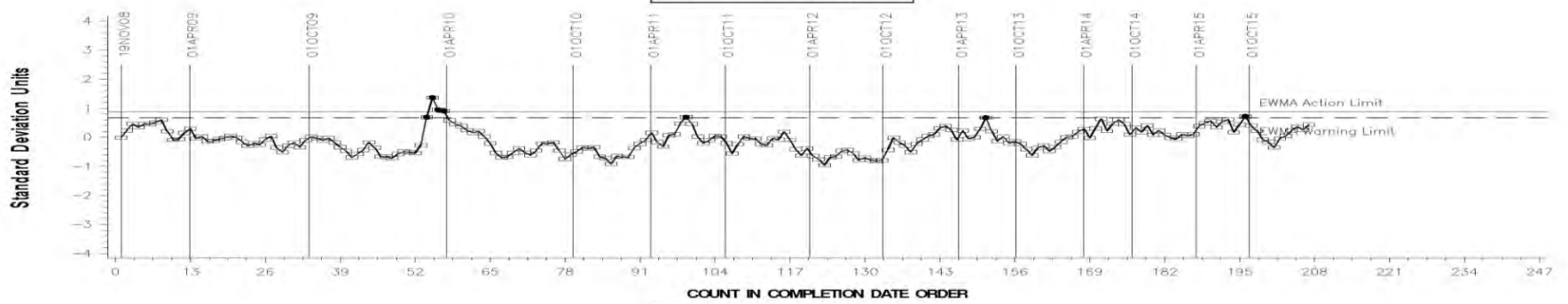
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PHOS RETENTION

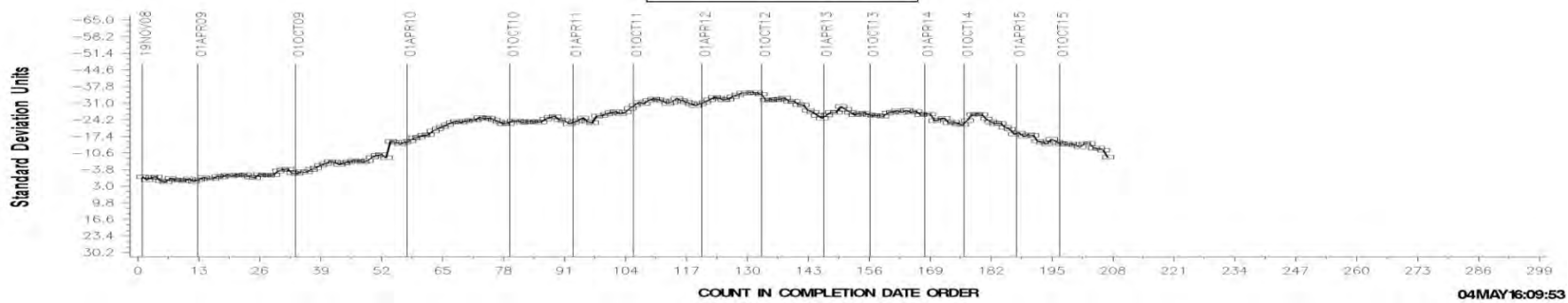
LTMS Severity Analysis



LTMS Precision Analysis

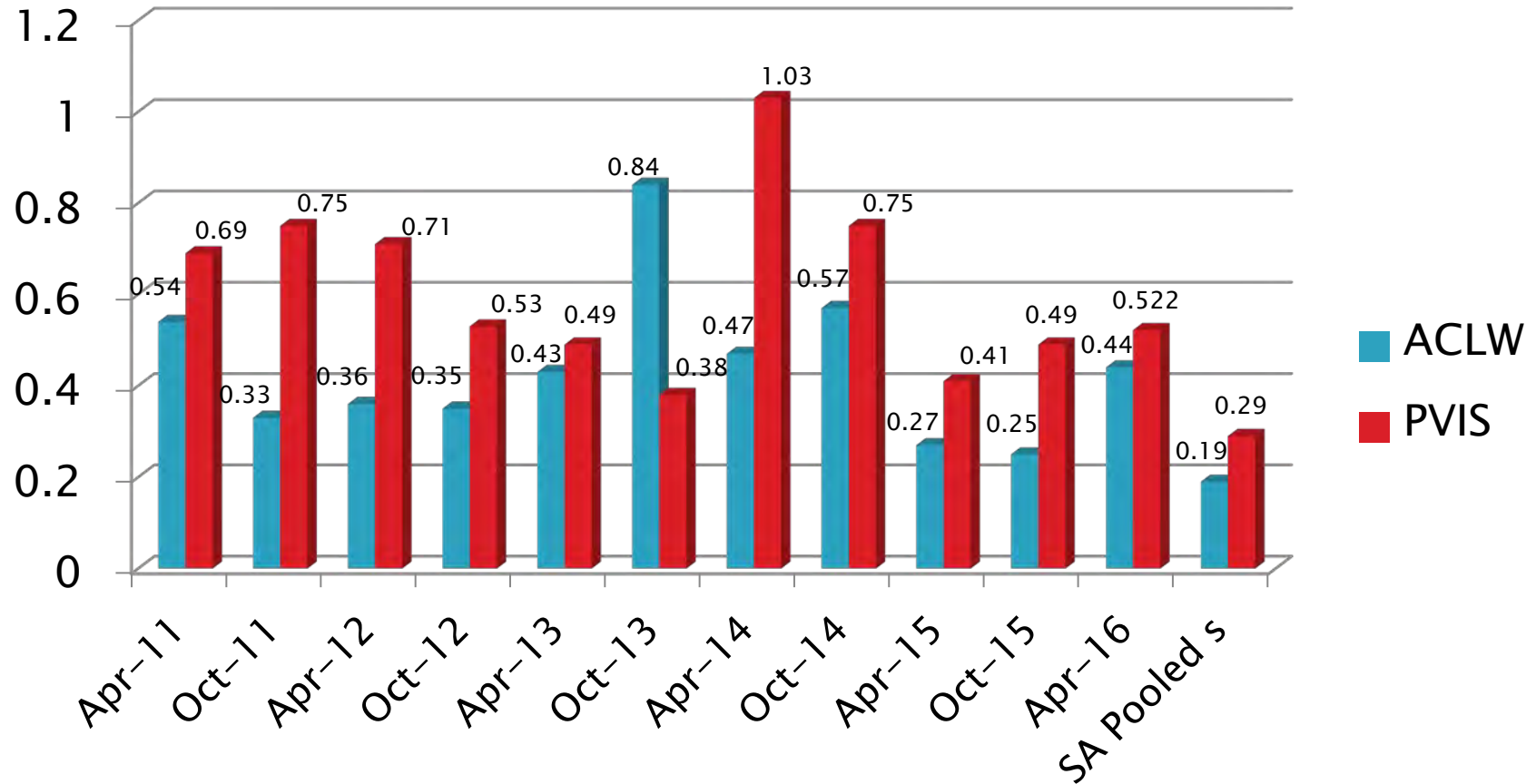


CUSUM Severity Analysis

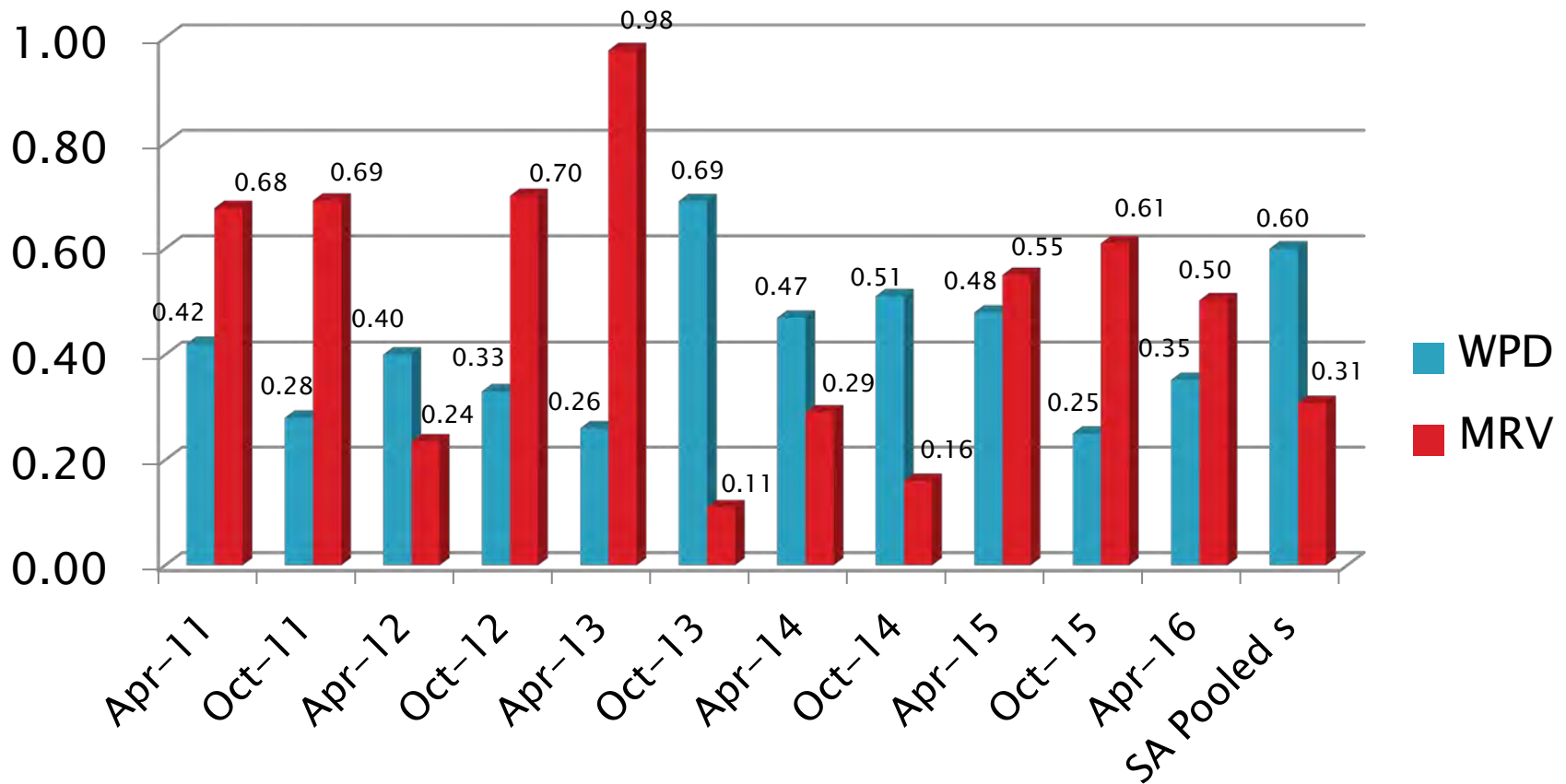


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# IIIG Precision Estimates

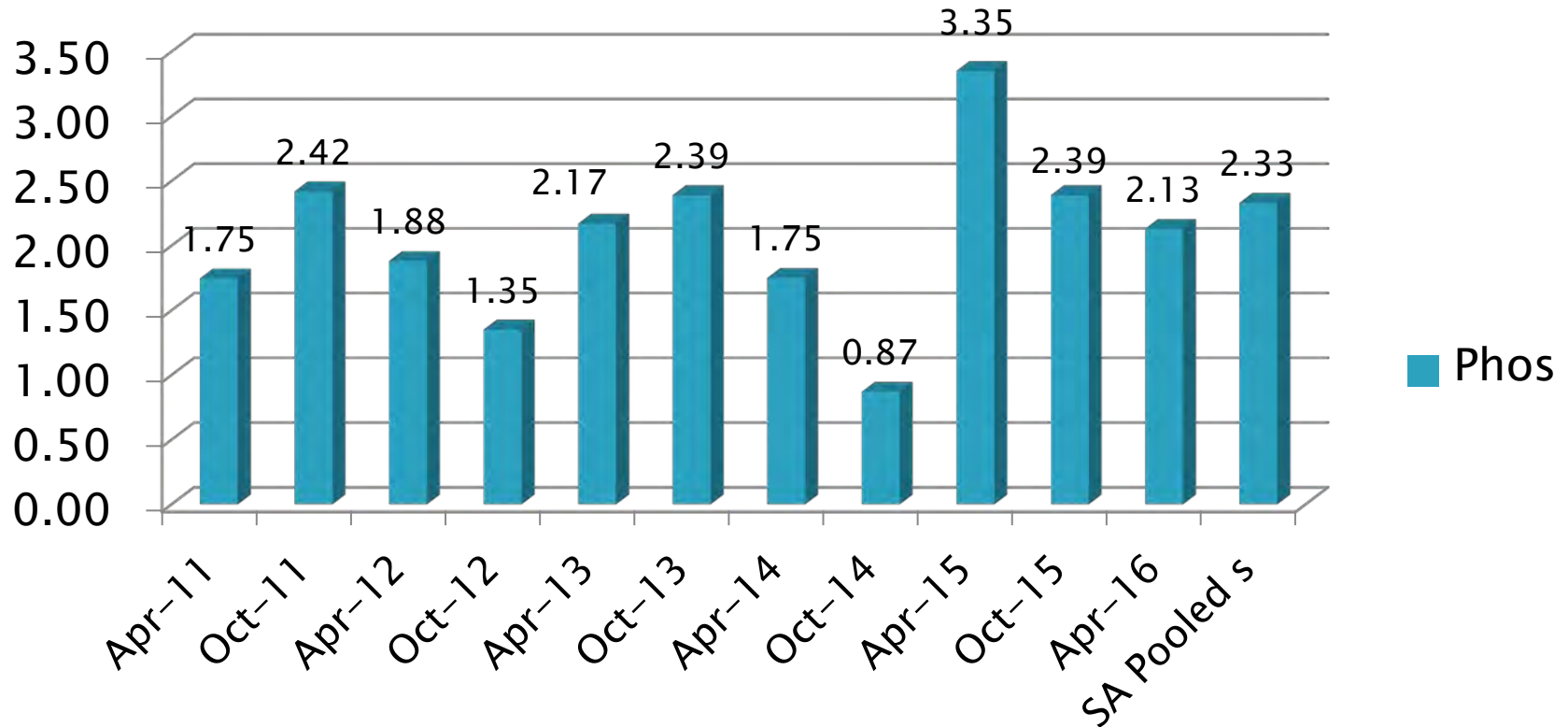


# IIIG Precision Estimates



# IIIG Precision Estimates

## Phos



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# Sequence IVA

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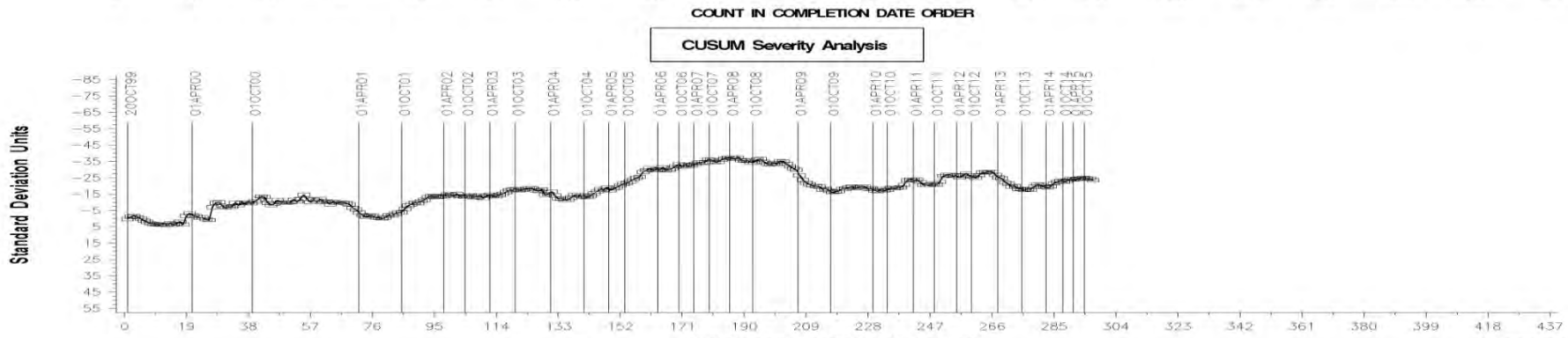
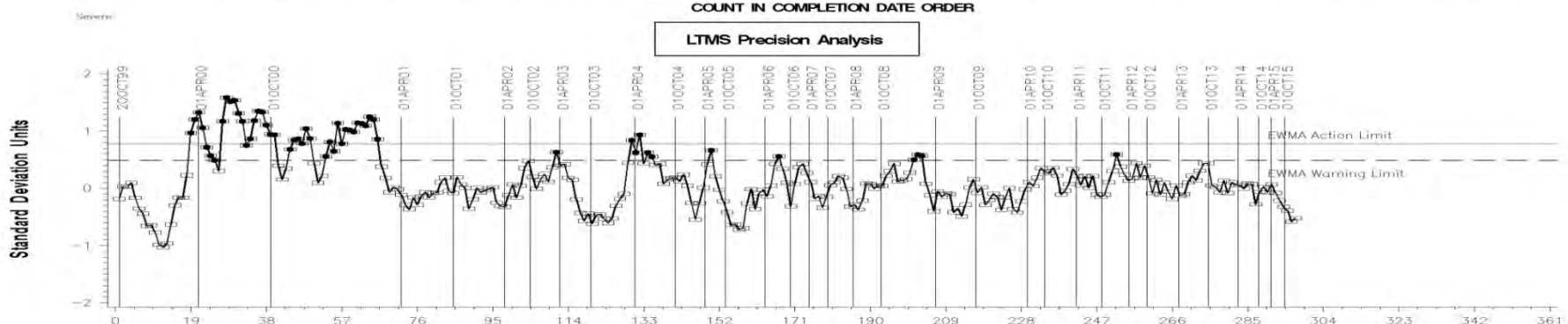
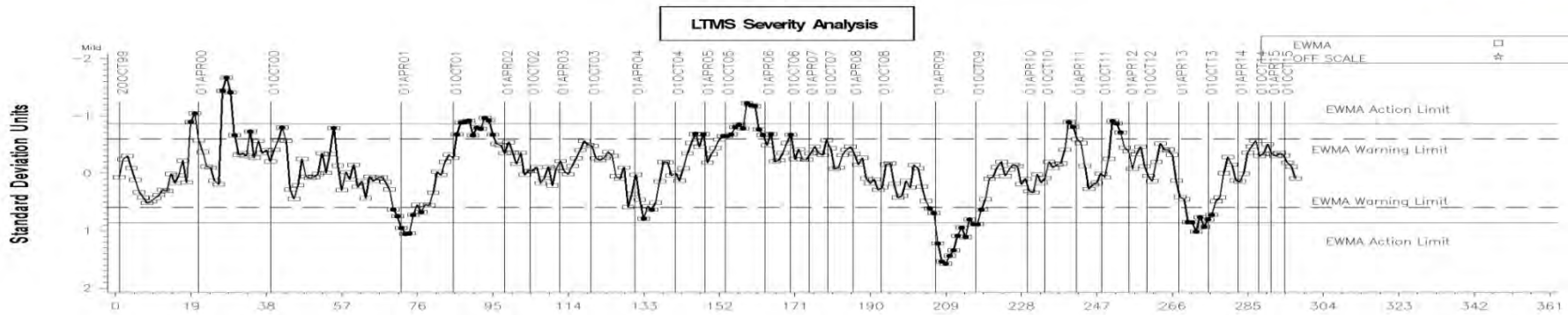
# Sequence IVA Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	3
<b>Total</b>		<b>3</b>

# Sequence IVA Test Severity

- ACW in control.

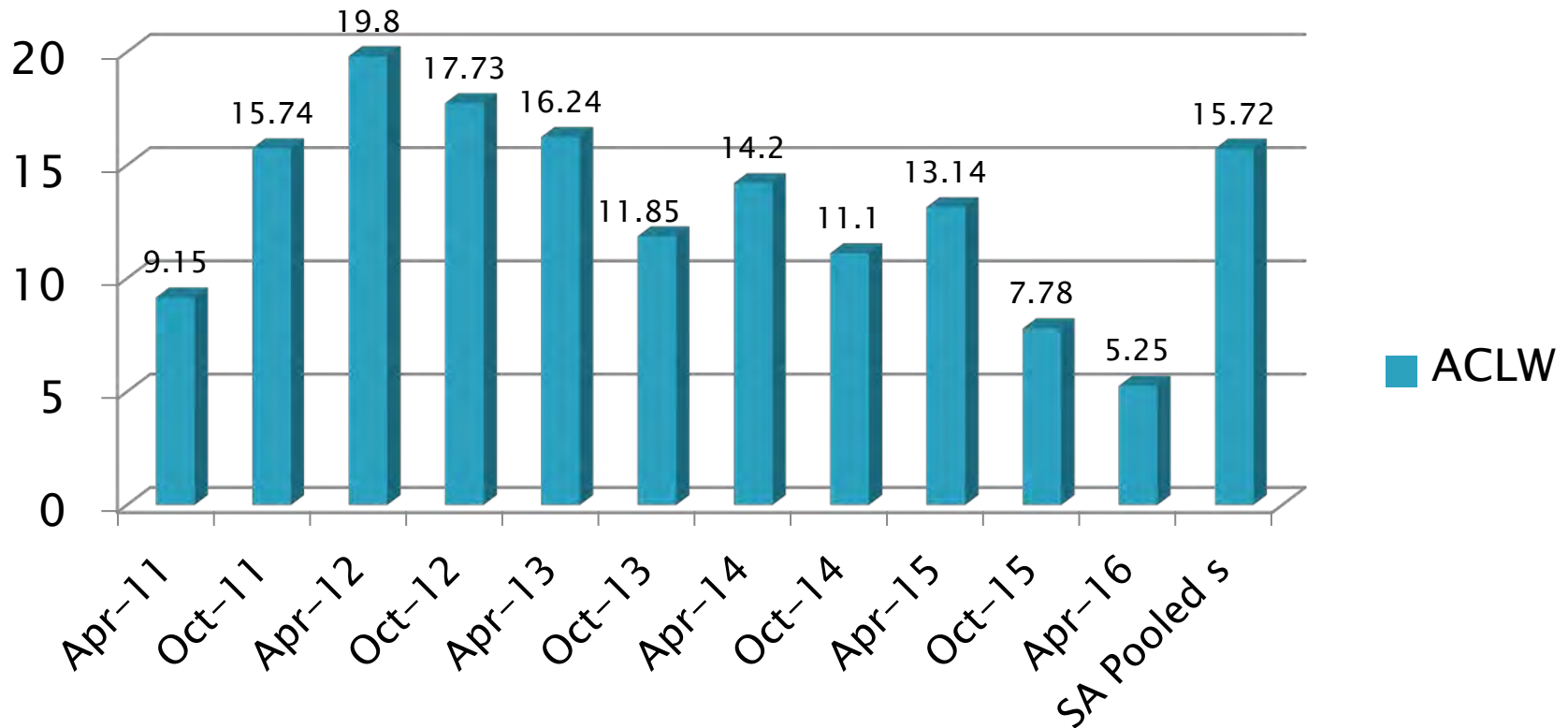
AVERAGE CAM WEAR



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# Sequence IVA Precision Estimates

## ACW



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# Sequence VG

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# Sequence VG Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	9
VG-A Development Test	NN	10
Fuel Approval, Pending Fuel Batch Acceptance	PF	6
Aborted	XC	2
<b>Total</b>		<b>27</b>

# Sequence VG – Lost Tests\*

Test Status	Cause	#
Aborted	Wrong Fuel	1
Aborted	Instrumentation Failure	1
<b>Totals</b>		<b>2</b>

\*Invalid and aborted tests

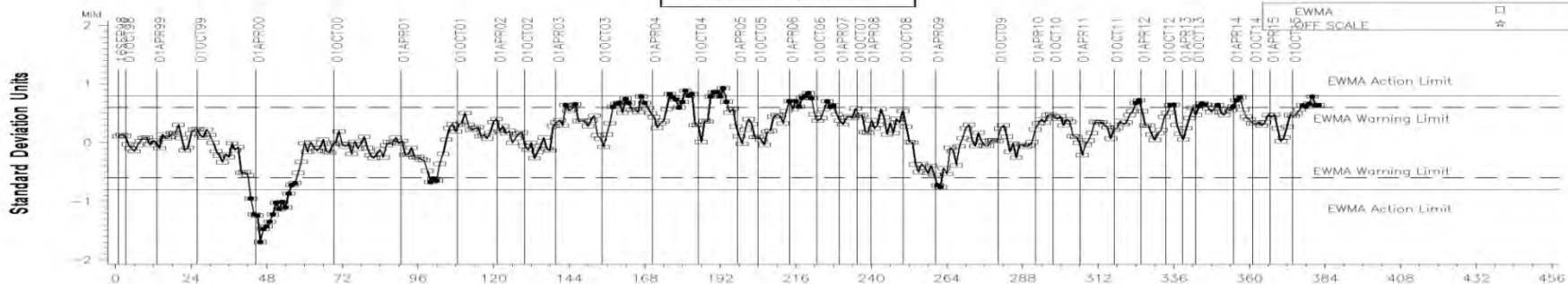
# Sequence VG Test Severity

- AES in severity warning alarm (mild)
- AEV, APV, RAC and OSCAR in control



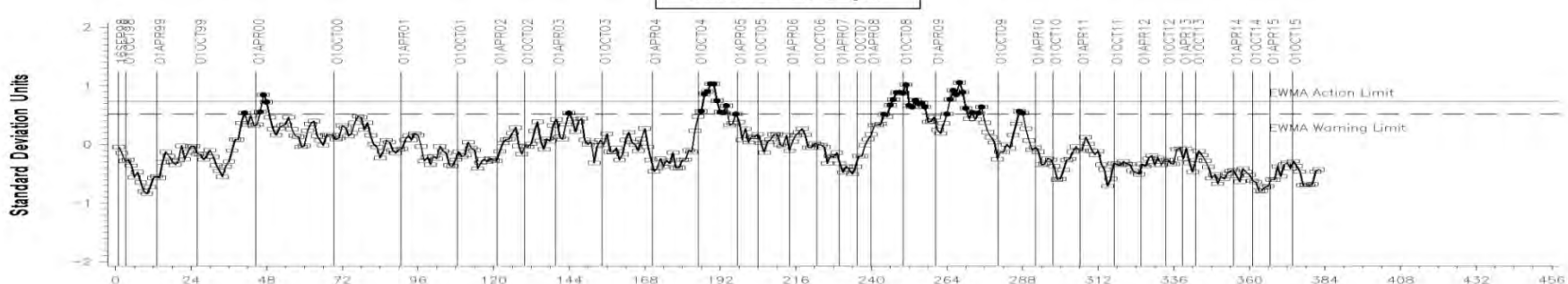
AVERAGE ENGINE SLUDGE

LTMS Severity Analysis



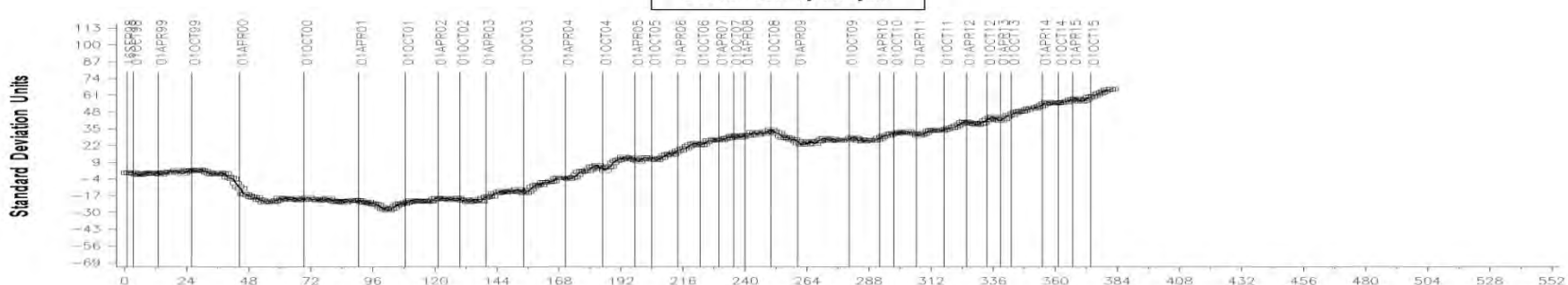
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

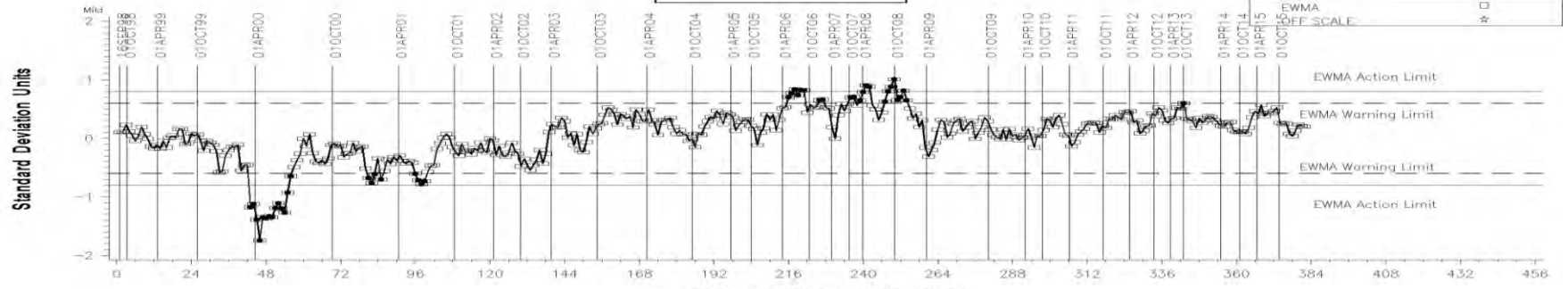


COUNT IN COMPLETION DATE ORDER

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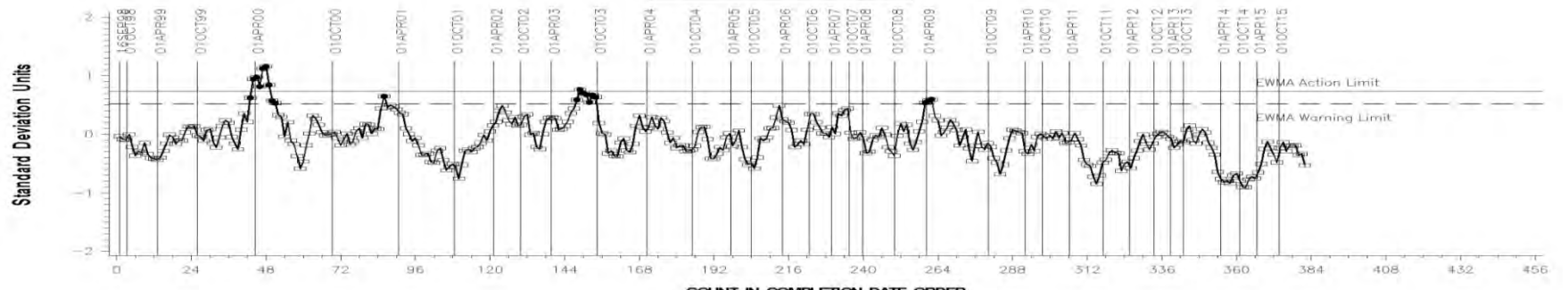
AVERAGE ROCKER COVER SLUDGE

LTMS Severity Analysis



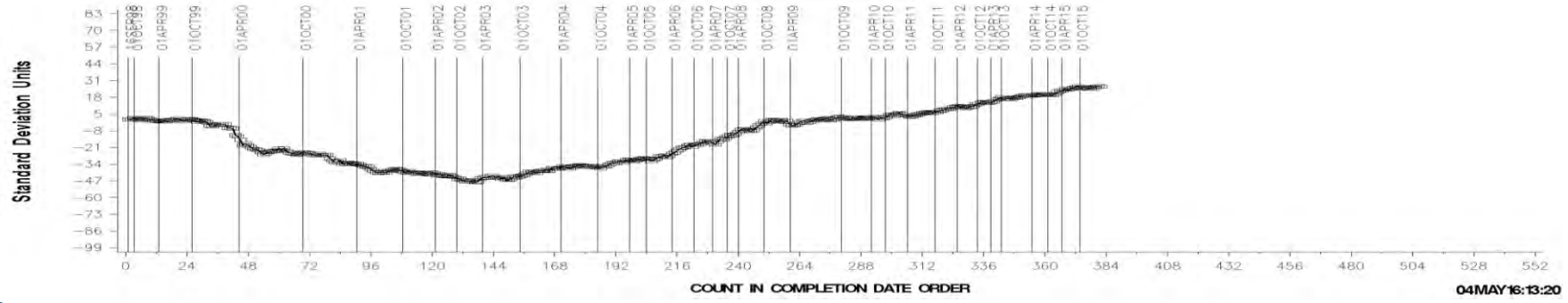
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

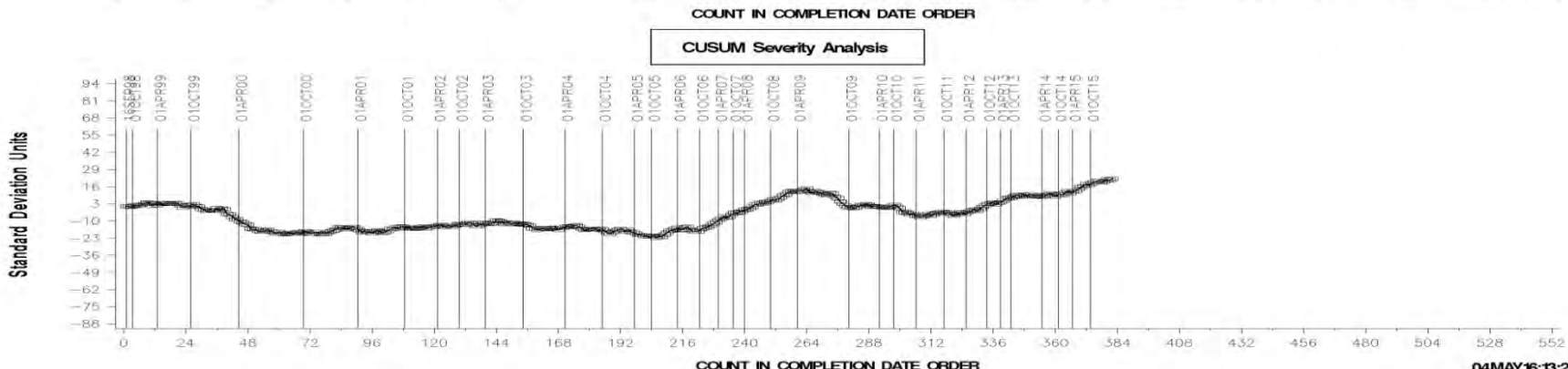
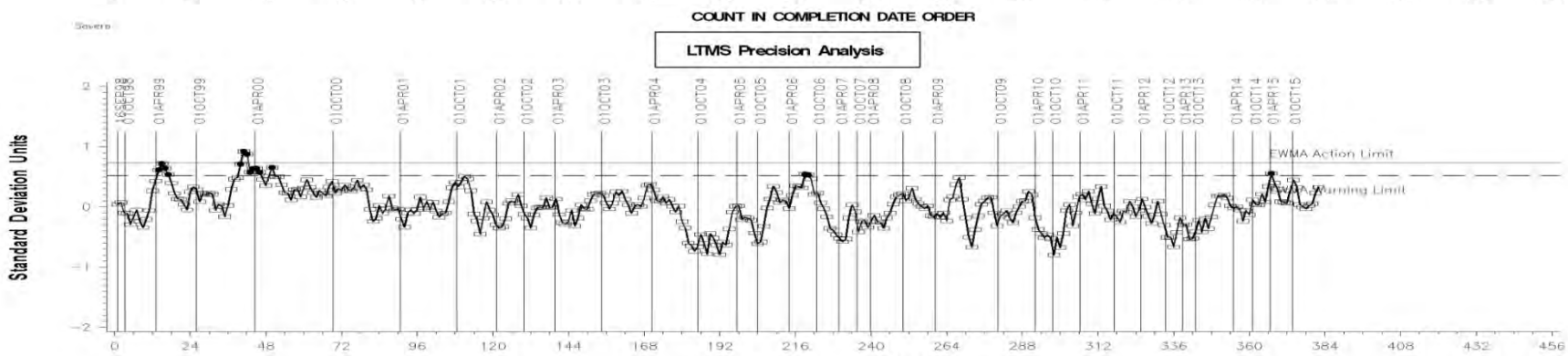
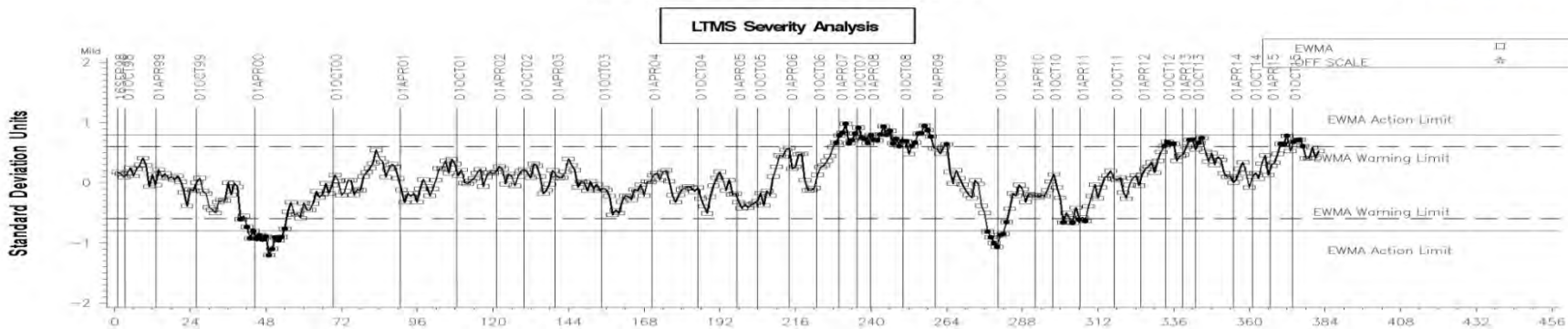
CUSUM Severity Analysis



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# SEQUENCE VG INDUSTRY OPERATIONAL VALID DATA

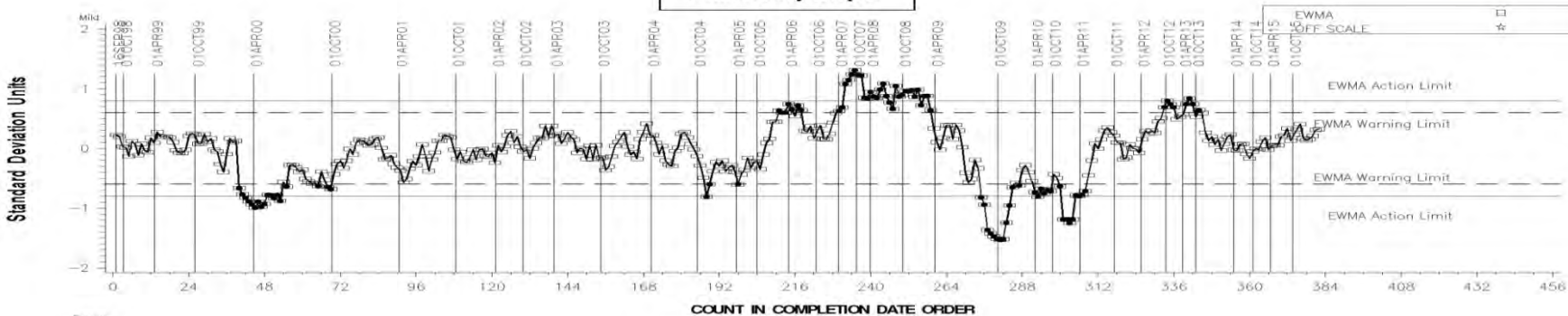
AVG. ENG. VARN. 3—PART APV + BAFFLES



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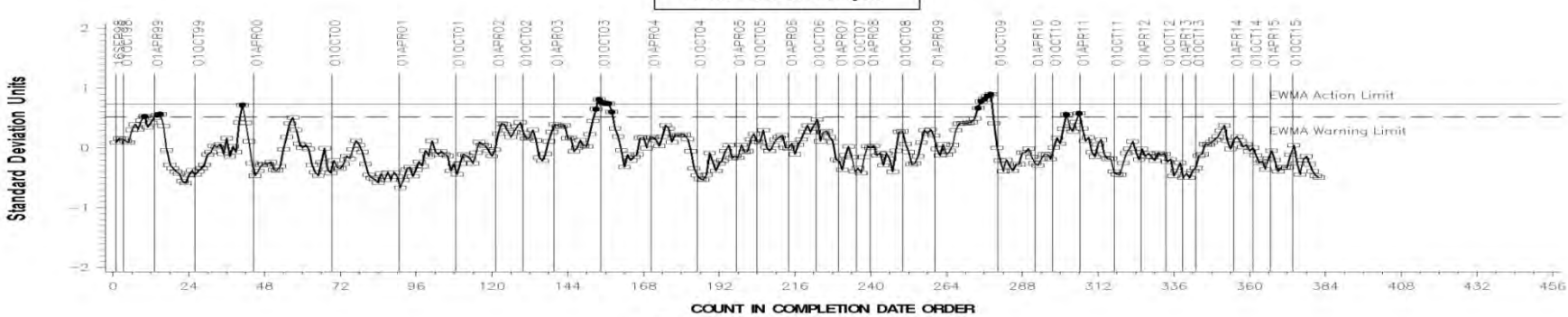
AVG PISTON SKIRT RATING

LTMS Severity Analysis



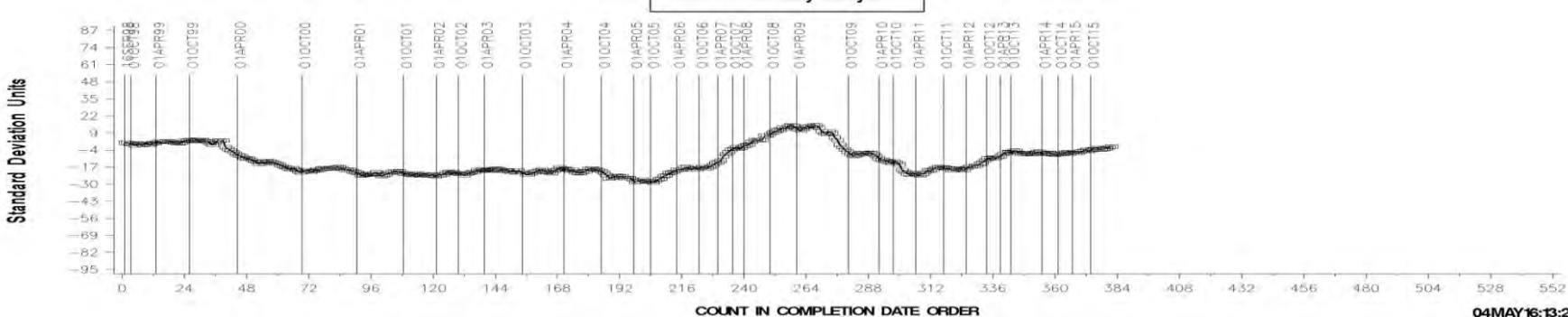
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

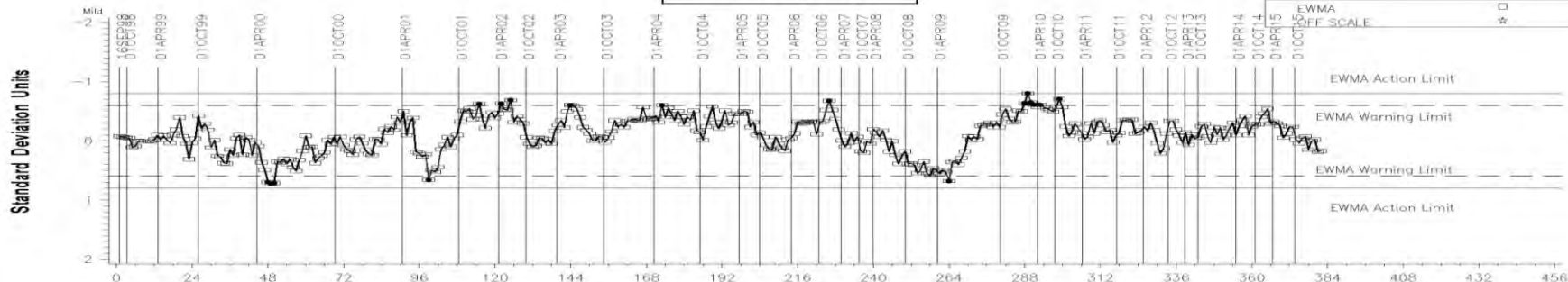


COUNT IN COMPLETION DATE ORDER

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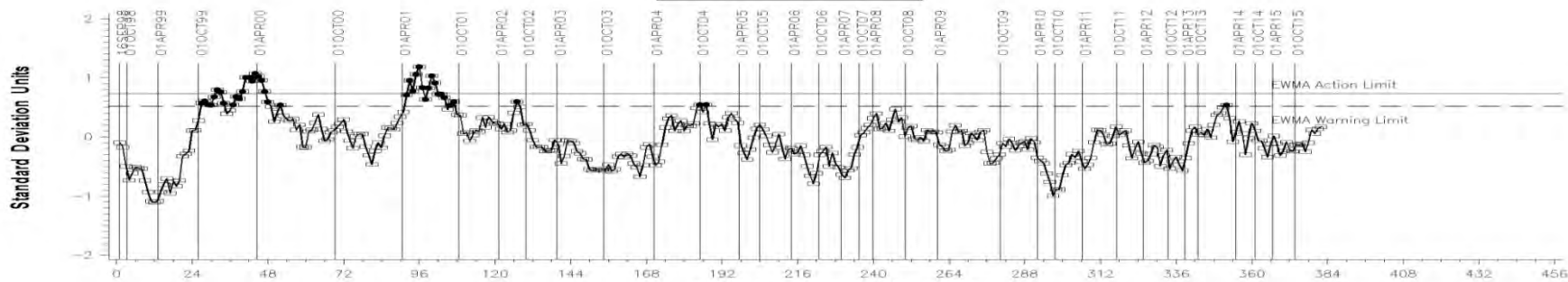
OIL SCREEN SLUDGE

LTMS Severity Analysis



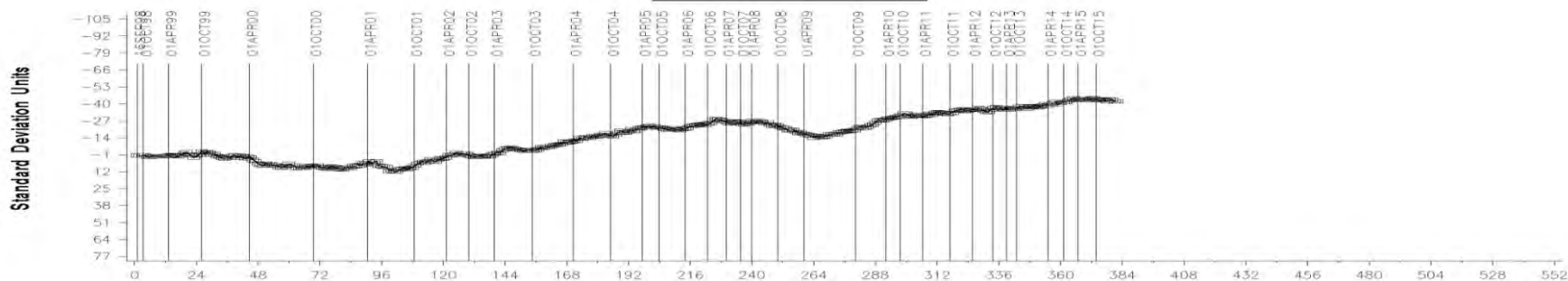
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

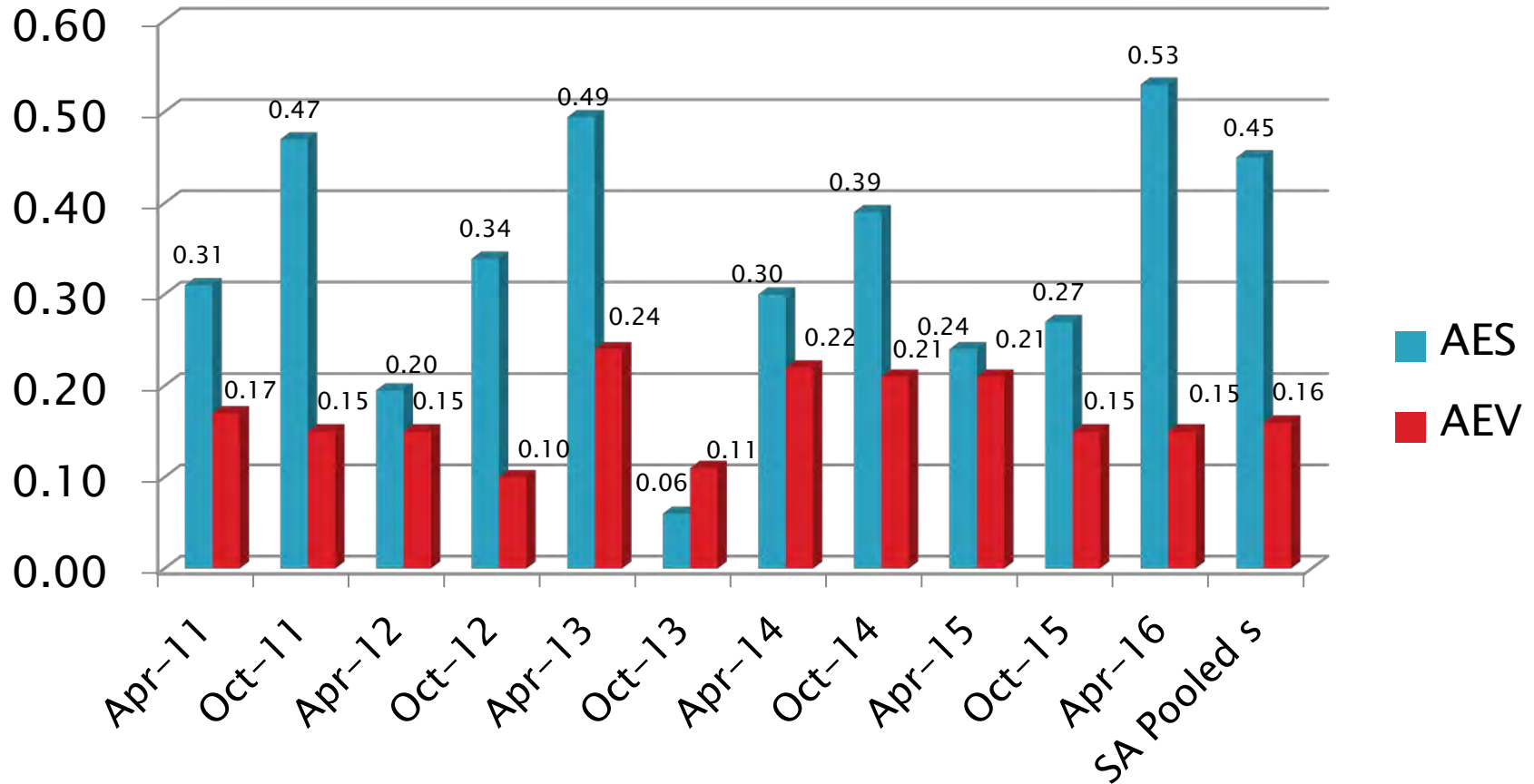
CUSUM Severity Analysis



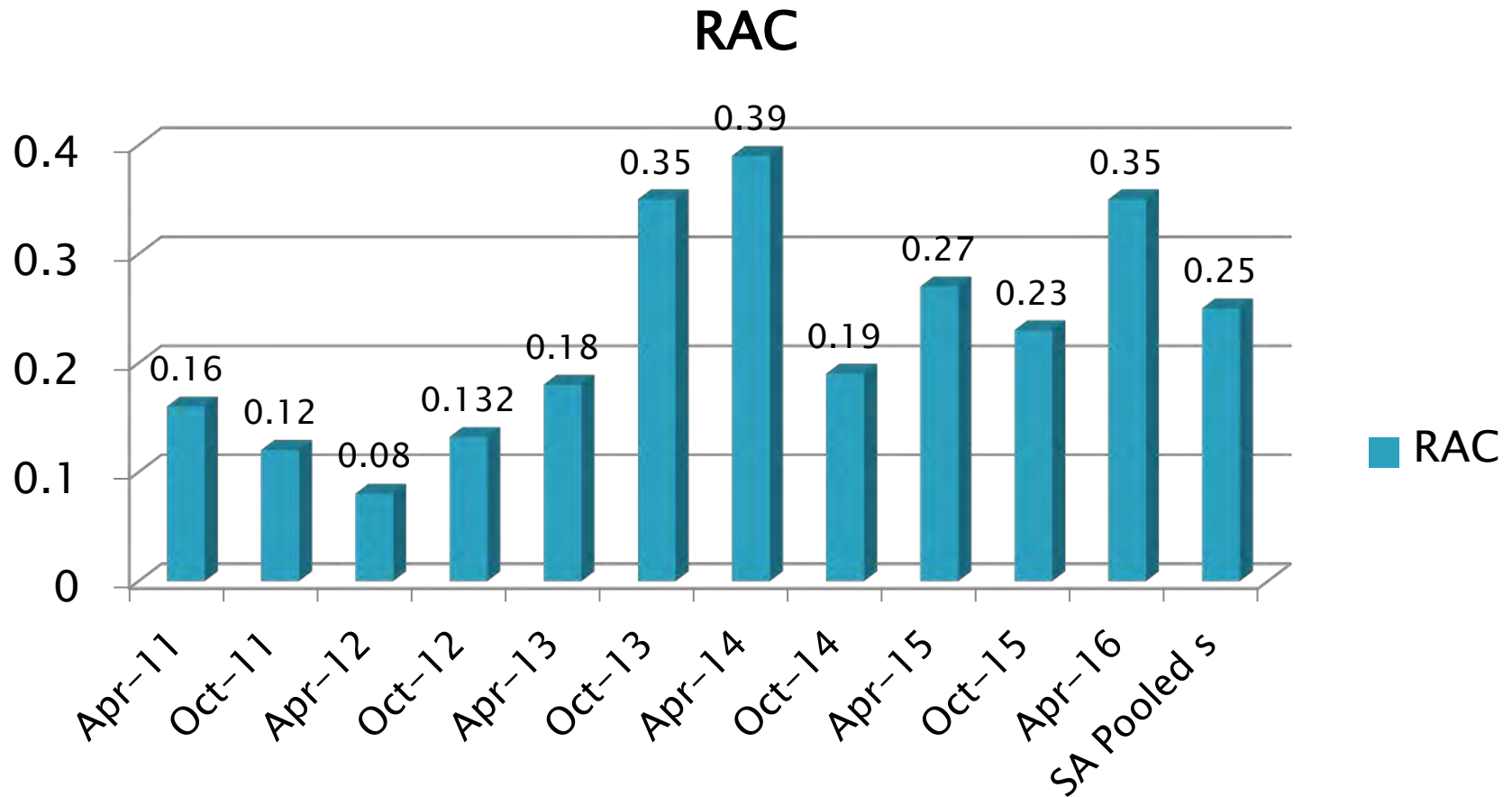
COUNT IN COMPLETION DATE ORDER

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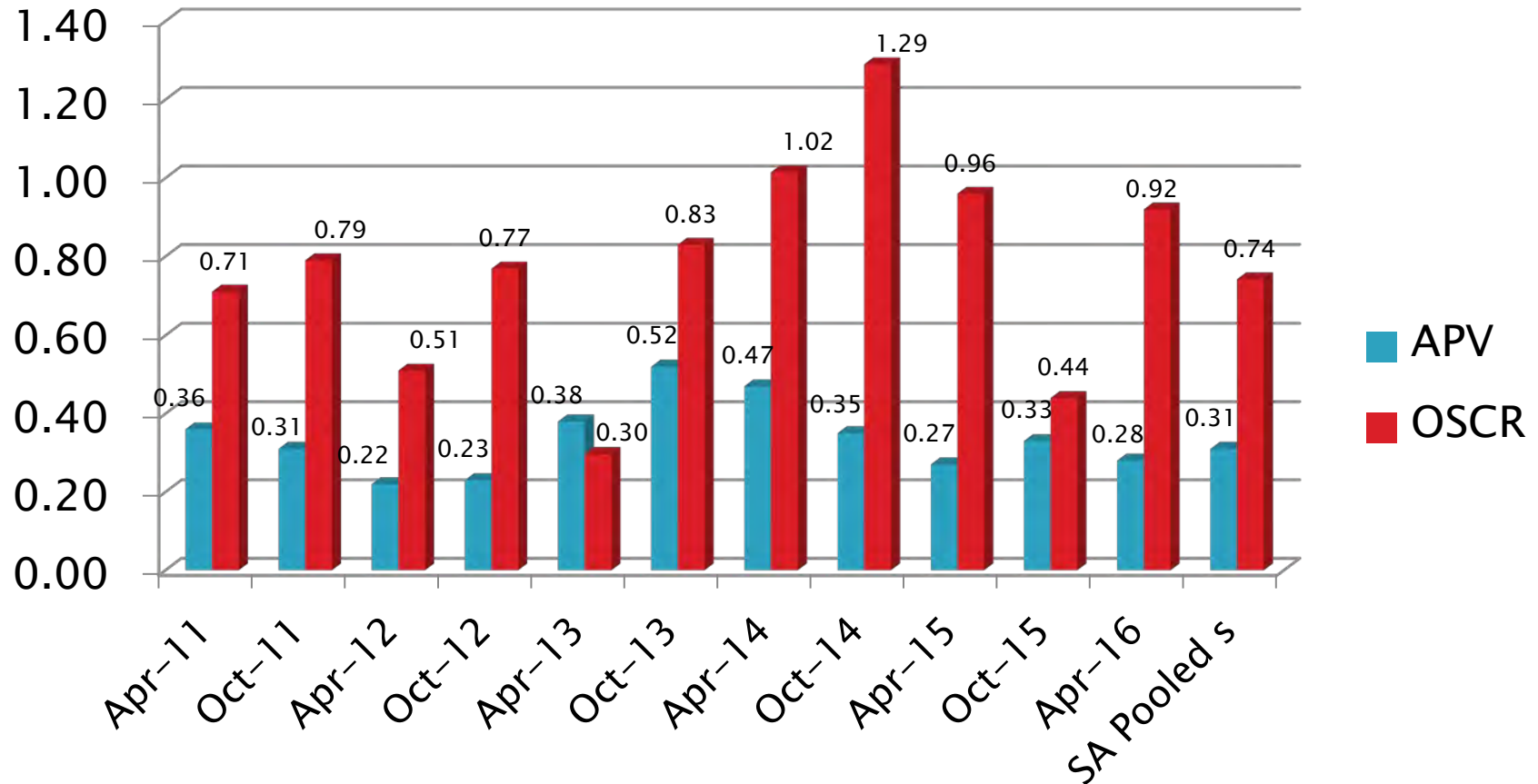
# Sequence VG Precision Estimates



# Sequence VG Precision Estimates



# Sequence VG Precision Estimates



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# Sequence VID

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# Sequence VID Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	25
Failed Statistically	OC	4
Operationally Invalid	LC	1
Aborted	XC	2
Engine Abandoned, did not calibrate	MC	1
<b>Total</b>		<b>33</b>

# Sequence VID – Failed Tests

Test Status	Number of Tests
Severe FEI1	2
Mild FEI1	1
Severe FEI2	1
<b>Total</b>	<b>4</b>

# Sequence VID – Lost Tests\*

Test Status	Cause	#
Invalid	Computer Glitch Caused Missing Test Operational Data	1
Aborted	Throttle Controller Malfunction	1
Aborted	Lack of Speed Control	1
<b>Totals</b>		<b>3</b>

\*Invalid and aborted tests

# Sequence VID Test Severity

- FEI1 is in Control
- FEI2 is in Precision Action Alarm

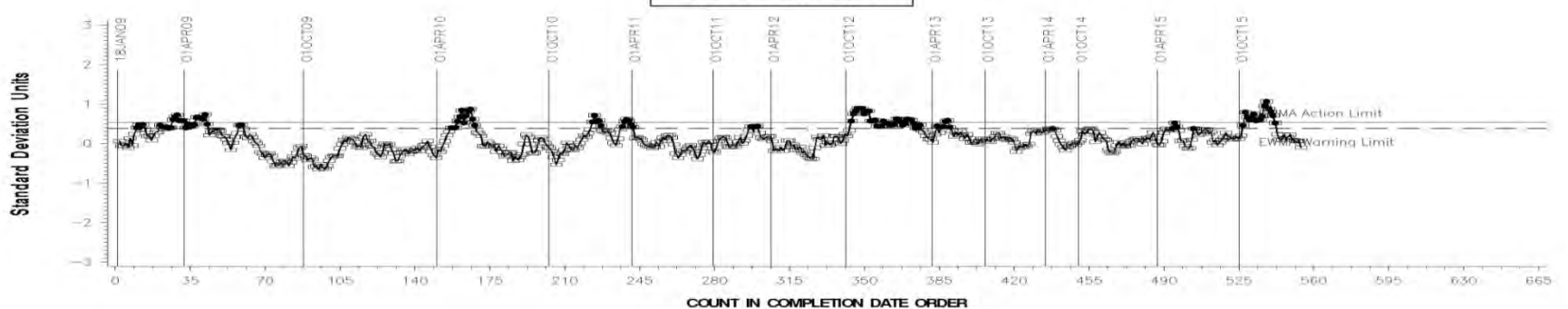
## FEI FINAL RESULT PHASE I

**LTMS Severity Analysis**



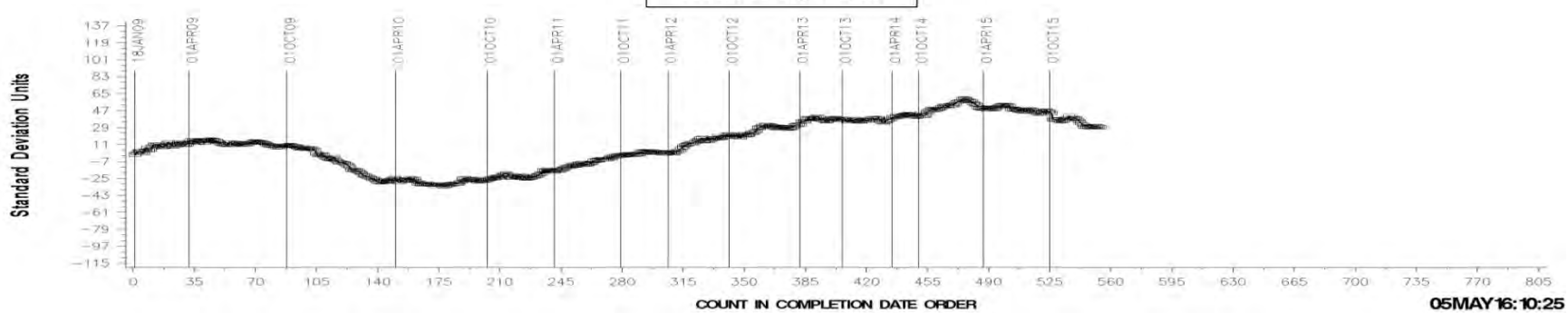
COUNT IN COMPLETION DATE ORDER

**LTMS Precision Analysis**



COUNT IN COMPLETION DATE ORDER

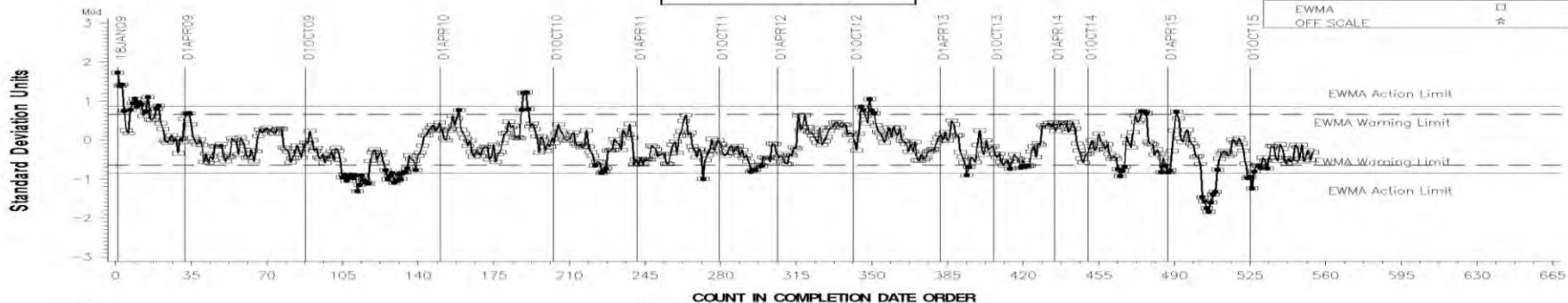
**CUSUM Severity Analysis**



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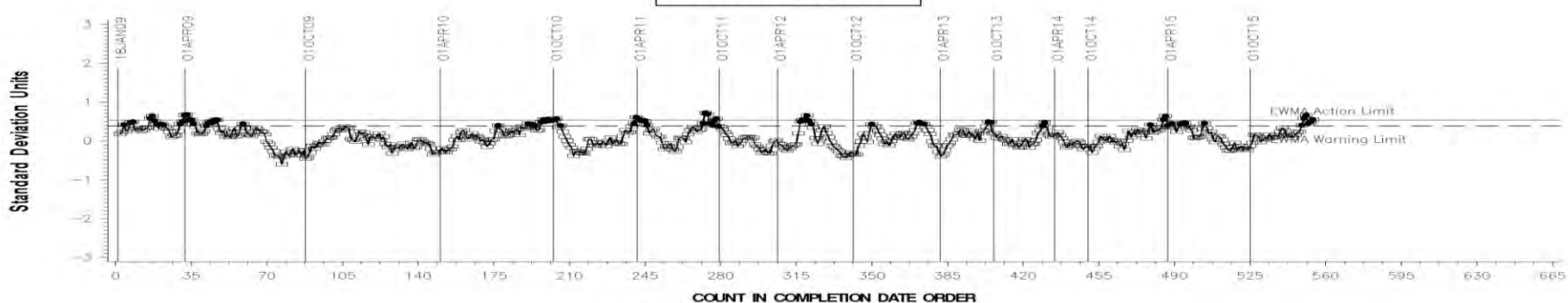
FEI FINAL RESULT PHASE II

LTMS Severity Analysis



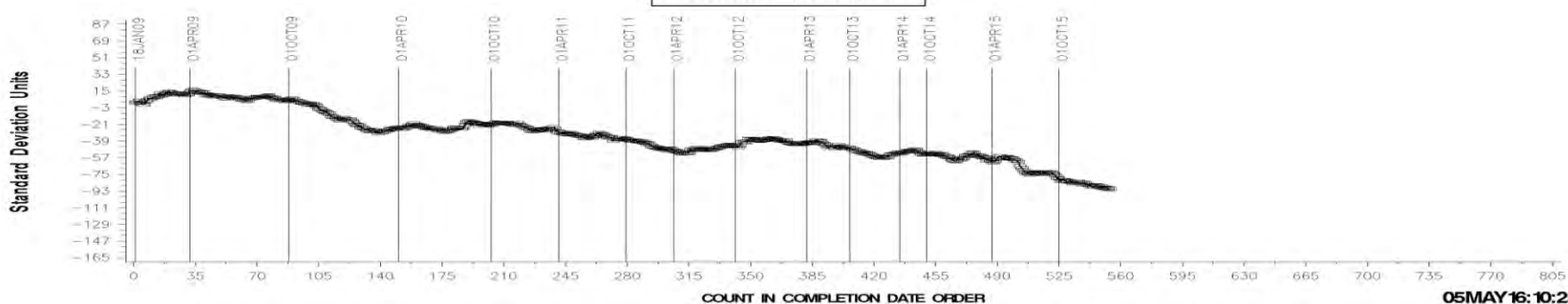
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



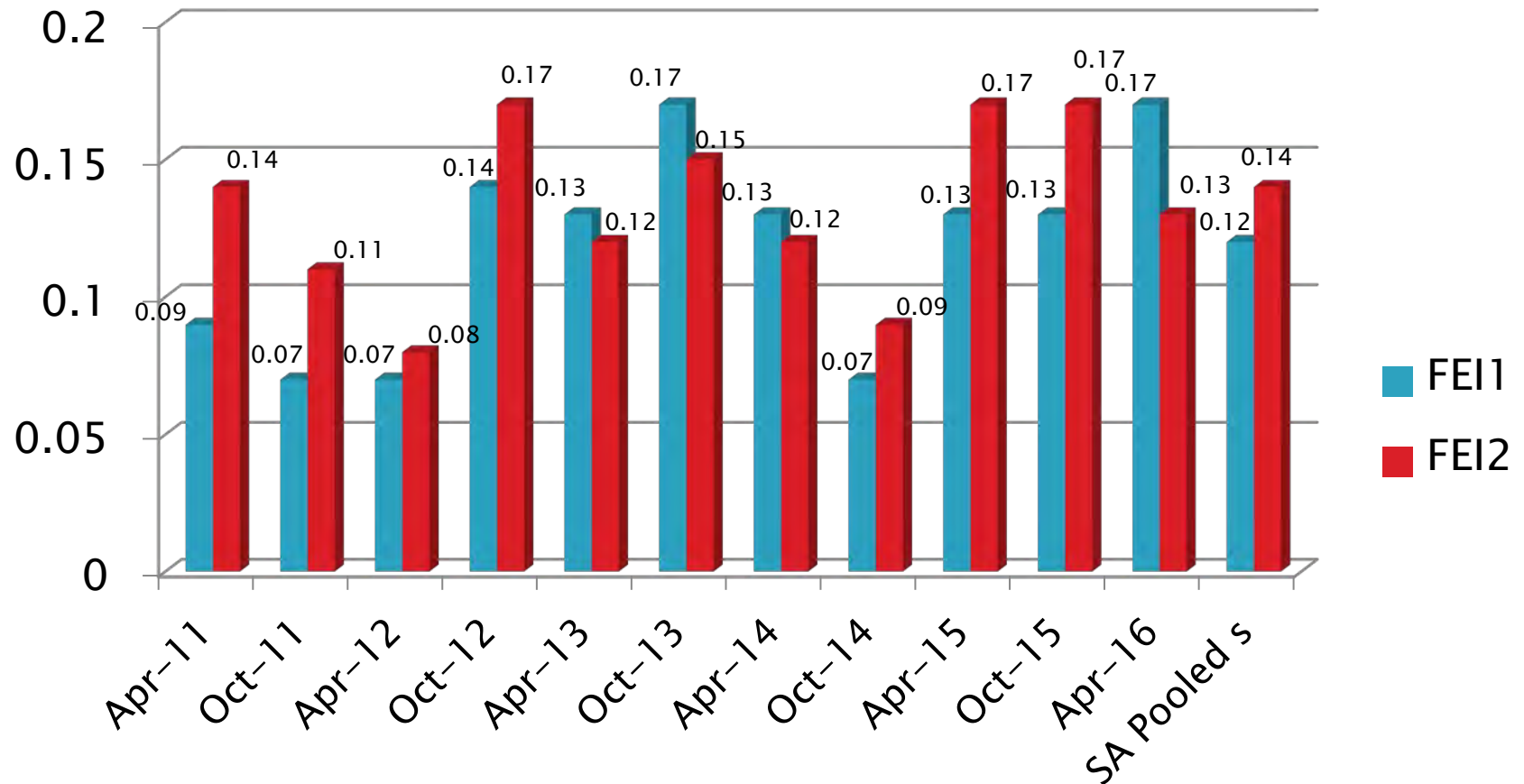
COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



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# Sequence VID Precision Estimates



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# Sequence VIII

»» April 2016

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# Sequence VIII Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Statistically Unacceptable Hardware Test	OH	7
Statistically Acceptable Hardware Test	AH	3
Operationally Invalid Hardware Test	LH	2
Aborted Hardware Test	XH	2
Total		15

# Sequence VIII – Failed Tests

Test Status	Number of Tests
Severe BWL	6
Severe BWLS and SVIS	1
<b>Total</b>	<b>7</b>

# Sequence VIII – Lost Tests\*

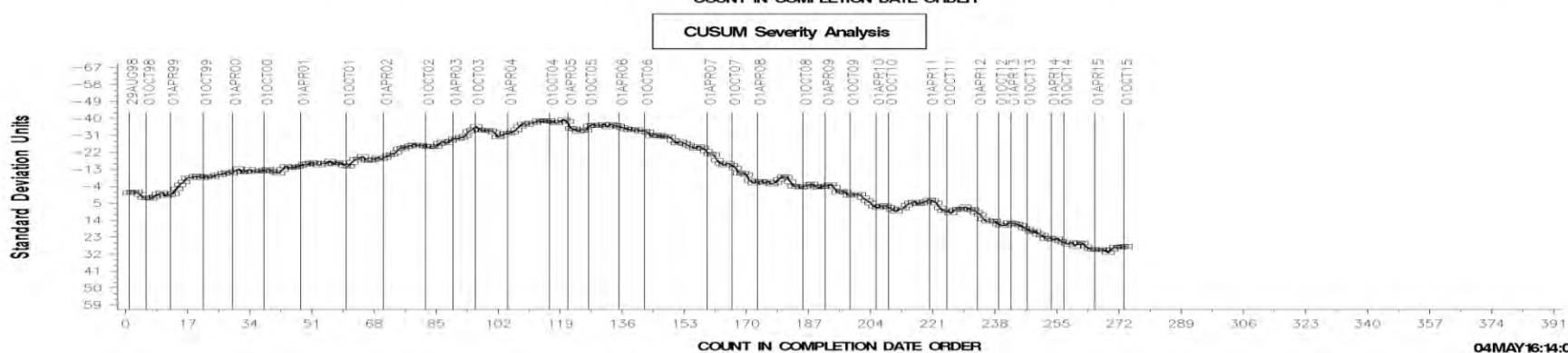
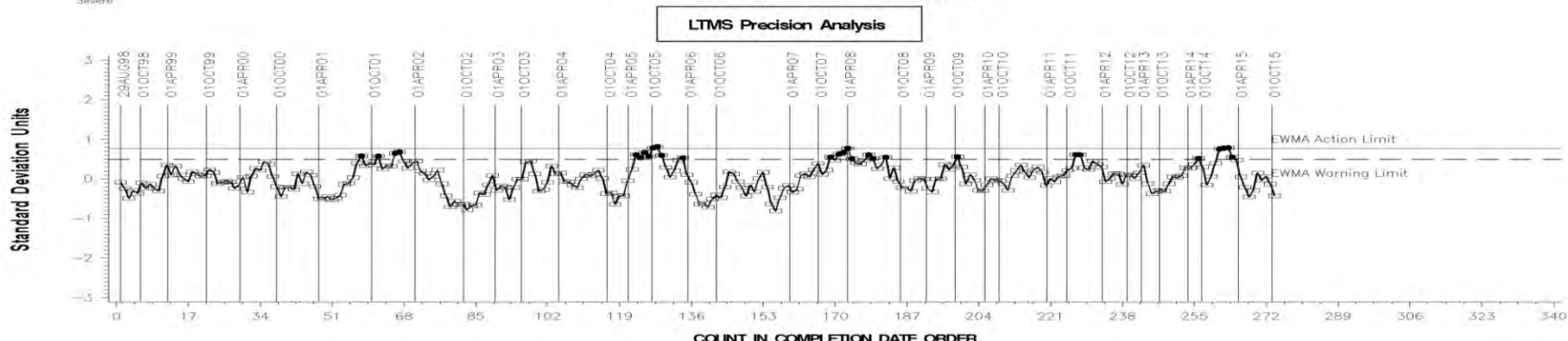
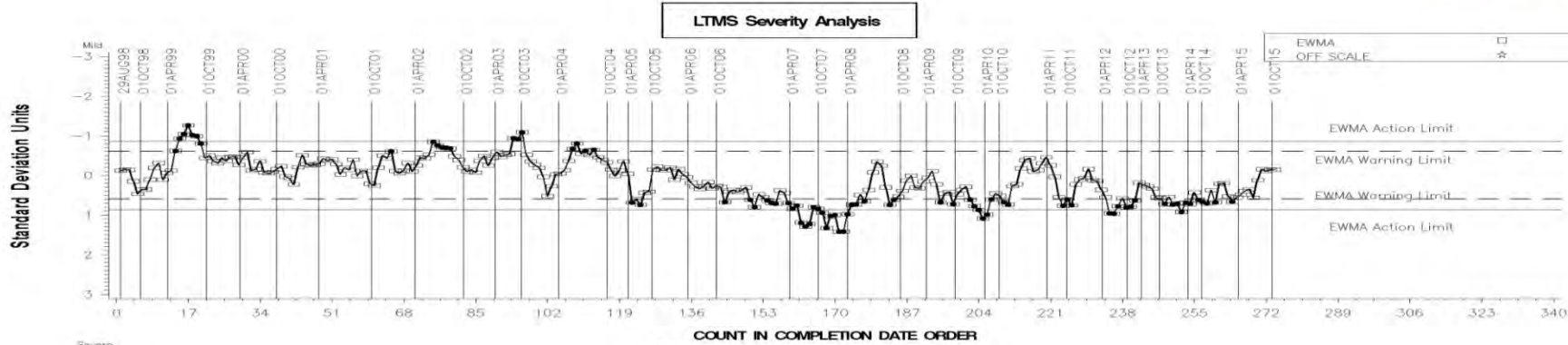
Test Status	Cause	#
Aborted	High Blowby	1
Aborted	Oil Leak	1
Invalid	Erratic Fuel Flow	1
Invalid	Exceeded Deviation Percentage for Offgas	1
<b>Totals</b>		<b>4</b>

\*Invalid and aborted tests

# Sequence VIII Test Severity

- Bearing Weight Loss is in control.
- Stripped Viscosity is in severity action (severe)

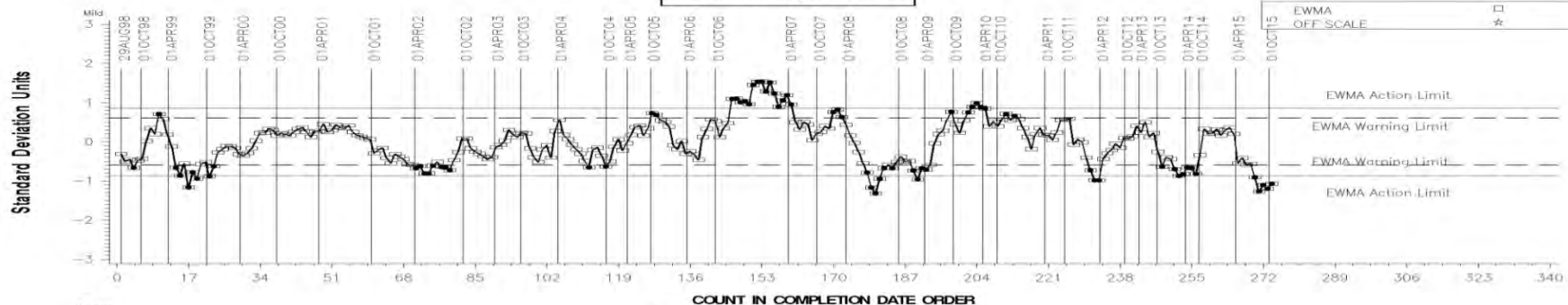
FINAL BEARING WEIGHT LOSS



04MAY16:14:03

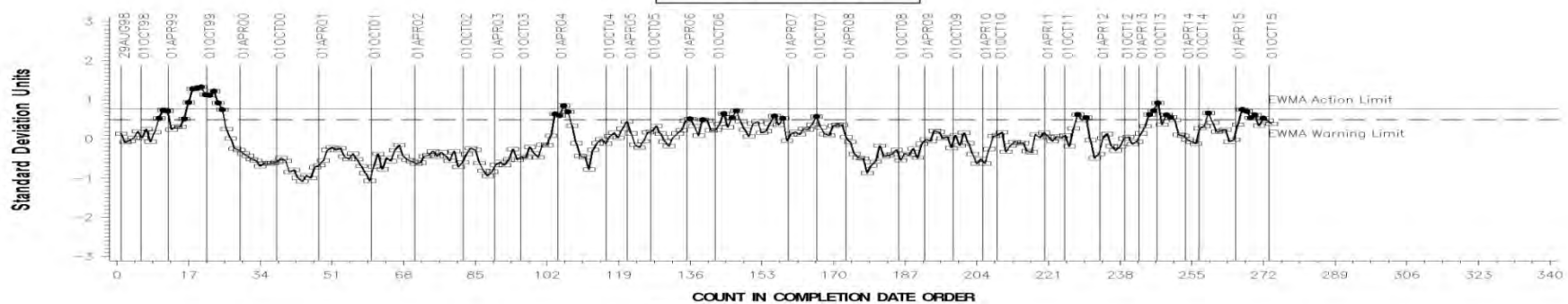
STRIPPED VIS. @ 100 DEG C

LTMS Severity Analysis



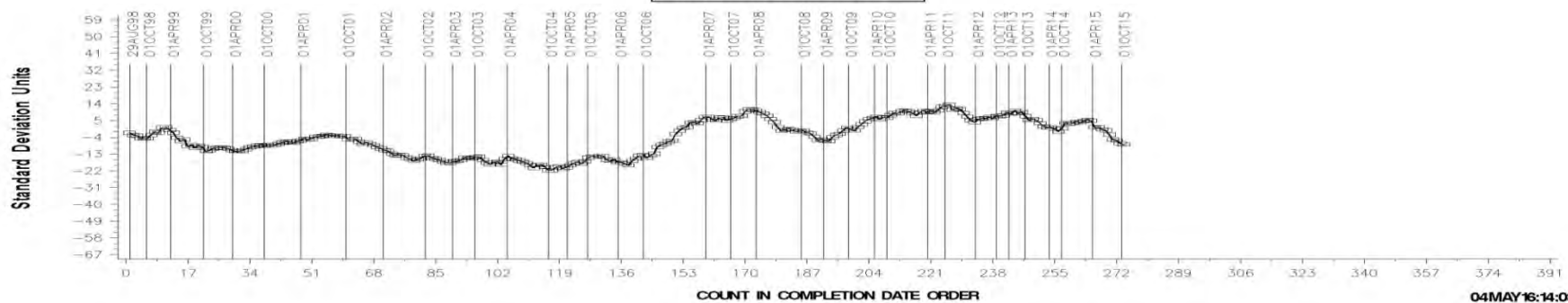
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

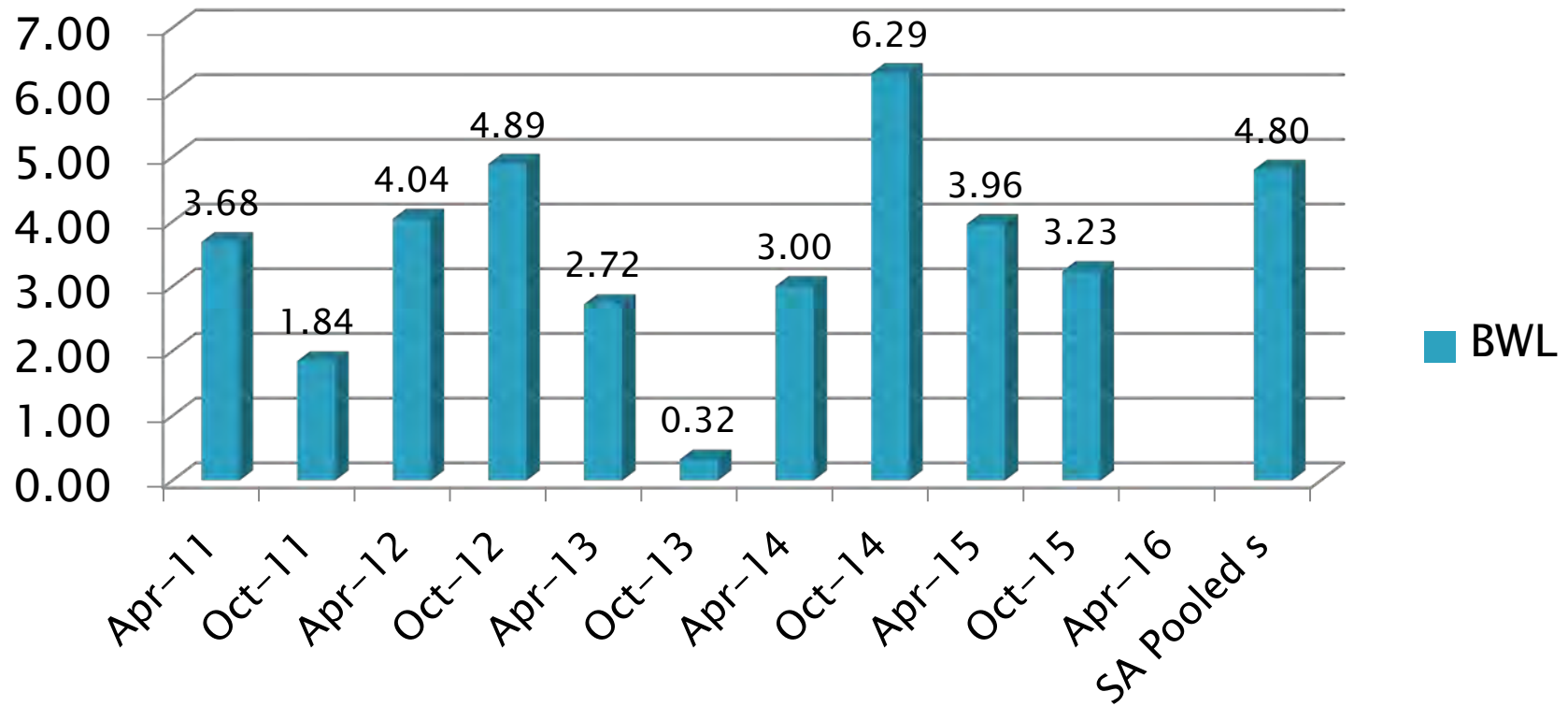
CUSUM Severity Analysis



04MAY16:14:03

# Sequence VIII Precision Estimates

## BWL

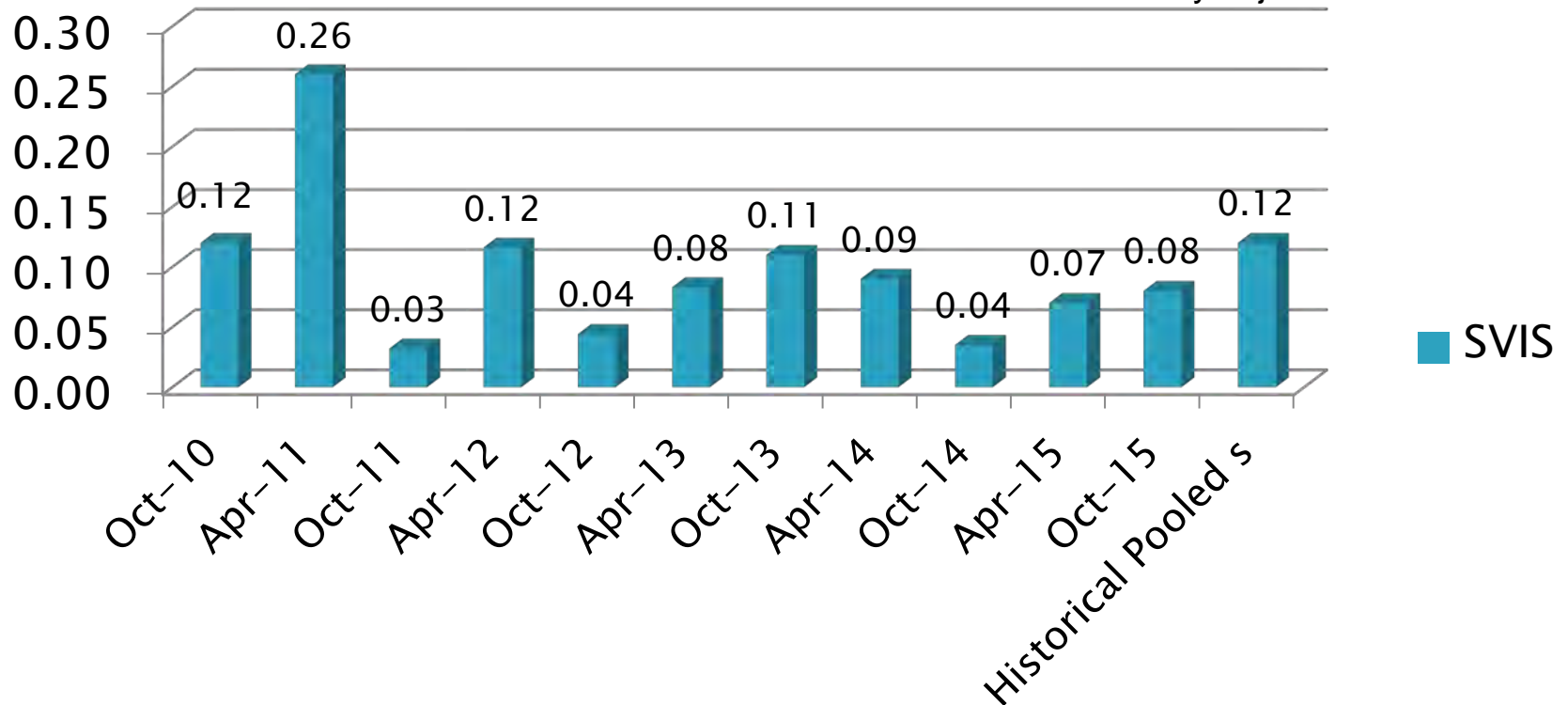




# Sequence VIII Precision Estimates

## SVIS

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



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# Information Letters

»» October 1, 2015 –  
March 31, 2016

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# Information Letters\*

Test	Date	IL	Topic
IIIF	20151016	15-2	Allowed use of alternate solution in ultrasound cleaner
IIIF	20160203	16-1	Allowed use of ultrasound cleaner for fuel injector cleaning
IIIF	20160208	16-2	Corrected spark plug number in A5.1

\*Available from TMC Website

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# Information Letters\*

Test	Date	IL	Topic
IIIG	20151016	15-2	Allowed use of alternate solution in ultrasound cleaner
IIIG	20160203	16-1	Allowed use of ultrasound cleaner for fuel injector cleaning
VG	20151104	15-2	Allow use of alternate cam bearings.

\*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 1009

- Supplier has been contacted and is working on a reblend

## ➤ TMC 542-3

- Re-blend of 542 is available

## ➤ TMC 1010-1

- Ten operationally valid VID tests have been obtained on 1010-1. Eight of the ten were statistically acceptable

# 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	68	231	40	5+ years
433-1	IIIF	1045	0	0	8	<1 year
433-2	IIIF	500	71	293	20	2+ years
434	IIIG	550	0	<1	12	<1 year
434-1	IIIG	660	52	4	24	1.5 years
434-2	IIIG	495	41	188	24	2+ years
435	IIIG	550	0	2	4	<1 year
435-2	IIIG	550	20	190	20	3+ years
438	IIIG	990	16	52	20	2 years
540	VID	1100	53	220	50	4+ 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	0	0	5	<1 year
542-2	VID	1000	231	359	35	1+ years
542-3	VIE	997	0	997	0	4+ Years
704-1	VIII	897	14	128	14	5+ years
925-3	VG	975	0	10	6	<1 year
940	VG, VH	560	43	296	30	5+ years
1006-2	IVA, VG, VIII	5500	290	2526	120	5+ years
1007	IVA, VG	1968	0	0	30	<1 year
1009	VG, VIII	1100	40	80	10	1 year
1010	IIIG, VID	1100	50	3	5	<1 year
1010-1	IIIG, VID	1760	173	1394	25	5 years

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# LTMS Deviations

»» October 1, 2015 –  
March 31, 2016

# LTMS Deviations

- LTMS Deviation VID.01.2015
  - Issued for Initial Stand/Engine Calibration Tests Being Run Out of Order Specified

# LTMS Deviations

## Historical Count of PCEO LTMS Deviations

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

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# Quality Index Deviations

»» October 1, 2015 –  
March 31, 2016

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# Quality Index Deviations

- Five Quality Index Deviations this Report Period.
  - IIIF - Right AFR
  - IIIG - Right Exhaust Back Pressure
  - IIIG - Intake Air Pressure
  - VG - Intake Air Temperature
  - VG - Oil Inlet Temperature

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# Quality Index Deviations

## Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIF	27
IIIG	16
IVA	28
VG	44

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# TMC Laboratory Visits

»» October 1, 2015 –

March 31, 2016

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# TMC Lab Visits

Test	Number of Labs Visited
No Visits This Period	0

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# Test Area Timelines

»» October 1, 2015 –  
March 31, 2016

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# Test Area Timeline Additions\*

Test	Date	Topic	IL
IIIF	20151016	Allowed use of alternate solution in ultrasound cleaner	15-2
IIIF	20160203	Allowed use of ultrasound cleaner for fuel injector cleaning	16-1
IIIF	20160208	Corrected spark plug number in A5.1	16-2
IIIG	20151016	Allowed use of alternate solution in ultrasound cleaner	15-2
IIIG	20160203	Allowed use of ultrasound cleaner for fuel injector cleaning	16-1
VG	20151104	Allow use of alternate cam bearings.	15-2

\*As of 03/31/2016

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# Rating Workshop Data

»» 2015 Light Duty Workshop

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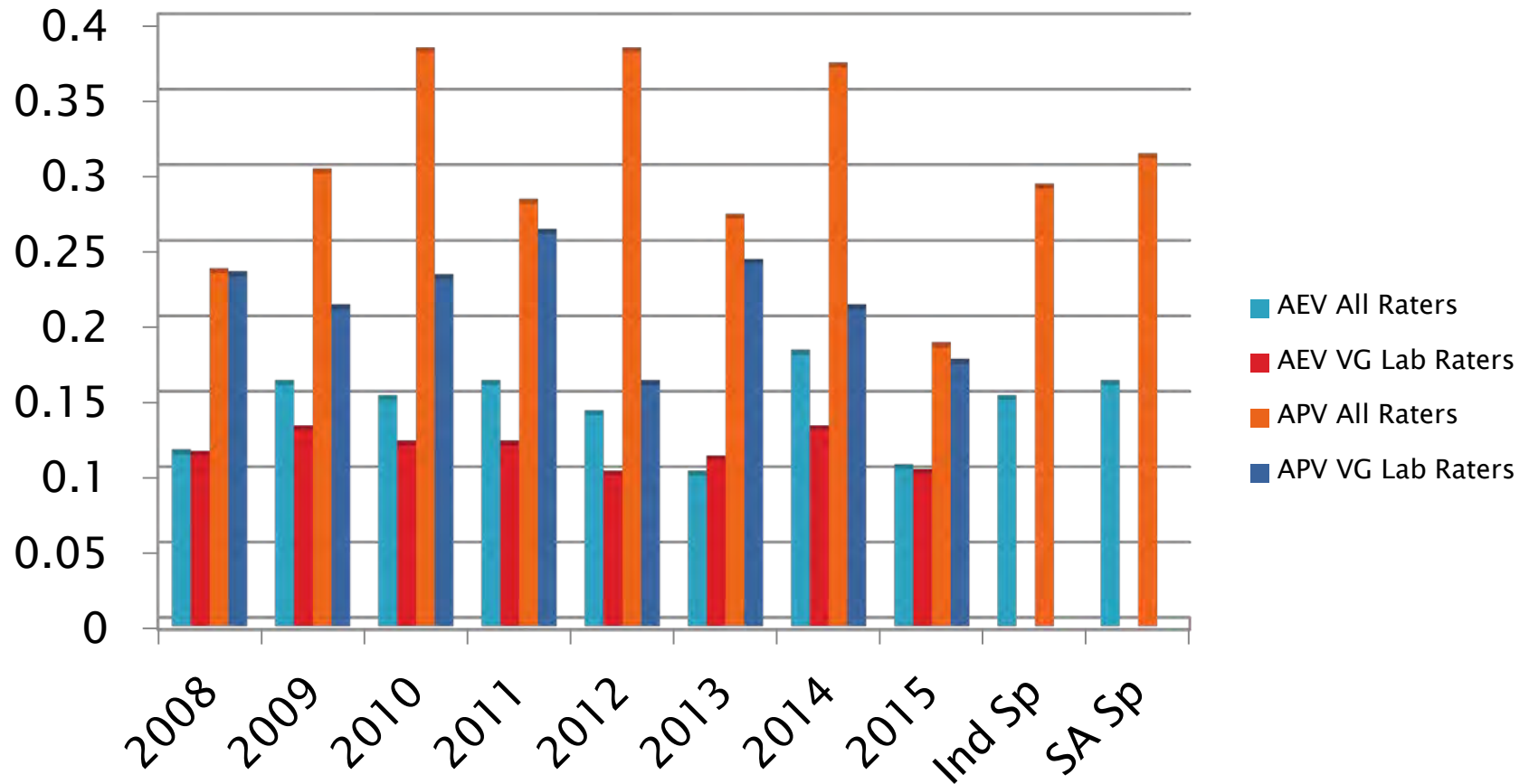
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# Rating Workshop Data

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

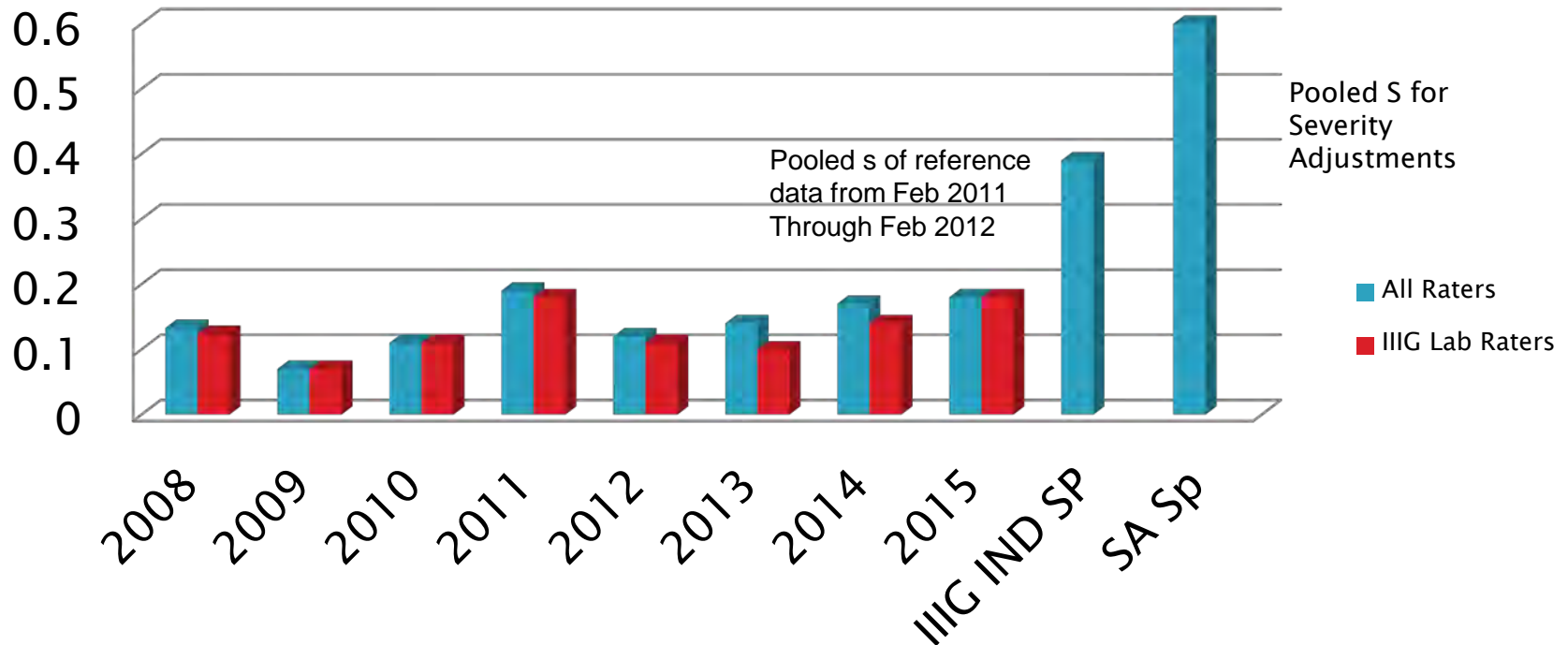
# Sequence VG Precision-Rating Workshop Data

## Workshop Data for VG Varnish



# Sequence IIIG Precision – Rating Workshop Data

## Comparison of Workshop Pooled Standard Deviations with Industry Pooled Standard Deviations



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# Miscellaneous 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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