



A Program of ASTM International

Test Monitoring Center

<https://www.astmtmc.org>

ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing

April 2024

Table of Contents

Section	Topic
Executive Summary	
	<u>Summary Items</u>
	<u>Calibrated Labs and Stands</u>
Test Area Status Summaries	
	<u>Seq. IIIH</u>
	<u>Seq. IVA</u>
	<u>Seq. IVB</u>
	<u>Seq. VH</u>

Table of Contents

Section	Topic
Test Area Status Summaries	(cont.)
	Seq. VIE
	Seq. VIF
	Seq. VIII
	Seq. IX
	Seq. IXAGED
	Seq. X

Table of Contents

Section	Topic
Additional Information	
	<u>Information Letters</u>
	<u>Reference Oil Inventory</u>
	<u>LTMS Deviations</u>
	<u>Quality Index Deviations</u>
	<u>TMC Laboratory Visits</u>
	<u>Test Area Time Lines</u>
	<u>Rating Workshop Data</u>
	<u>Misc. Information</u>

Passenger Car Engine Oil Testing

Executive Summary

- ▶ Reblends of oils 543, 542, 940 and 1010-1.
 - The Sequence VI panel is currently introducing Oils 543-1, 542-5 and 1010-2.
 - The Sequence V panel is not introducing 940-1 at this time and is re-evaluating further use of 940 in the reference system.
 - The VIII Panel has dropped reference oil 1006-2 based on input from the supplier showing concerns about its age and usefulness. The IV panel continues to use this oil.
 - A reblend of reference oil 221 is currently being pursued

[Return to Table of Contents](#)

Passenger Car Engine Oil Testing

Executive Summary (cont.)

▶ IIIH PVIS/MRV Trend

- APV, PVIS and MRV have been trending mild and have been encountering sporadic warning and action alarms. The panel is awaiting BC6 pistons.

▶ Sequence VIE Severity

- Both FEI1 And FEI2 have exhibited long term severe trends as evidenced by Cusum and EWMA charts. During this period and the previous period, the charts reflect on or near target performance for both parameters.

[Return to Table of Contents](#)

Passenger Car Engine Oil Testing Executive Summary (cont.)

- ▶ Aged Oil LSPI
 - Re-blends of both reference oils API01 and API02 have been obtained and are available for introduction.
- ▶ Sequence X
 - Due to changes in LTMS and calibration periods, no Sequence X calibration tests were reported this period. Plots are from the previous report period. All currently calibrated stands are due to recalibrate during the next report period

[Return to Table of Contents](#)

Passenger Car Engine Oil Testing Executive Summary (cont.)

- ▶ Sequence VIII became available October 5, 2023
 - The Sequence VIII test had been unavailable last period. The panel has successfully conducted matrix tests to introduce 03-22 bearings and generate targets for reference oil 1009-1 and also develop industry correction factors for both BWL and SVIS. These changes all took effect 10/5/23. The panel also is using 1009-1 as the reference oil moving forward.

[Return to Table of Contents](#)

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Calibrated Labs and Stands*

Test	Labs	Stands
IIIH/A/B	5	13
IVA	1	1
IVB	3	5
VH	4	10
VIE	4	15
VIF	2	3
VIII	2	4
IX	4	6
IXAGED	3	4
X	4	5

[Return to Table of Contents](#)

*As of 3/31/2024

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Sequence IIIH/A/B

➤➤ April 2024

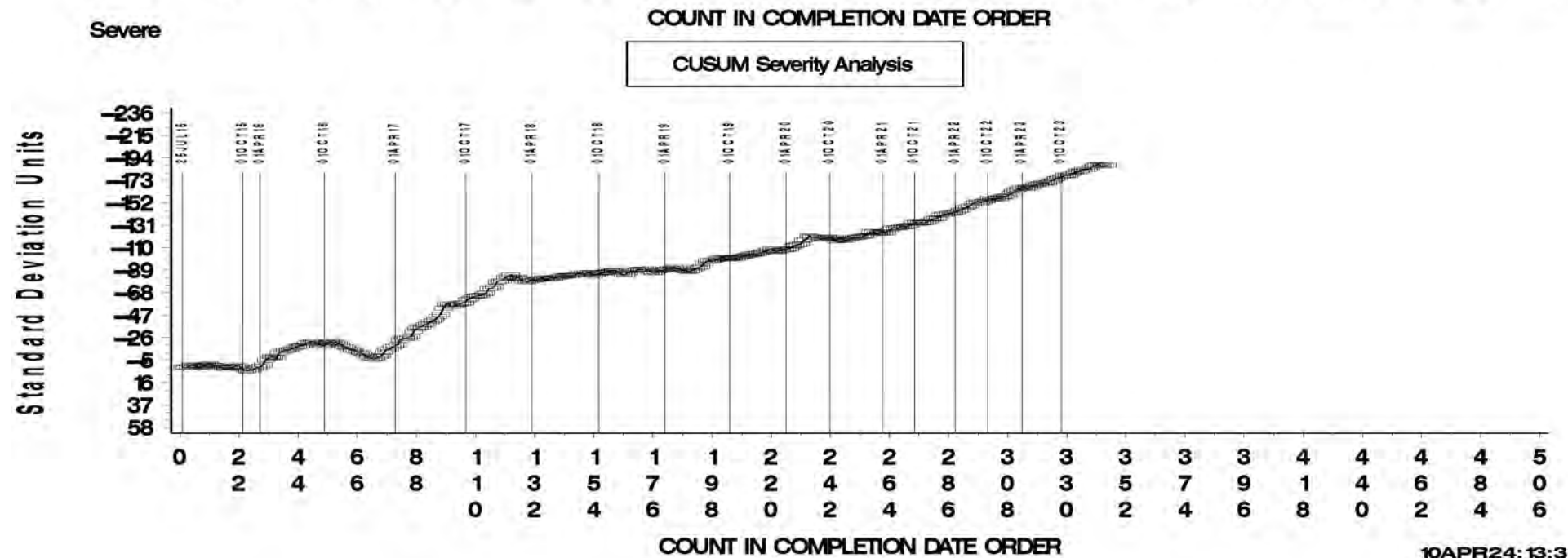
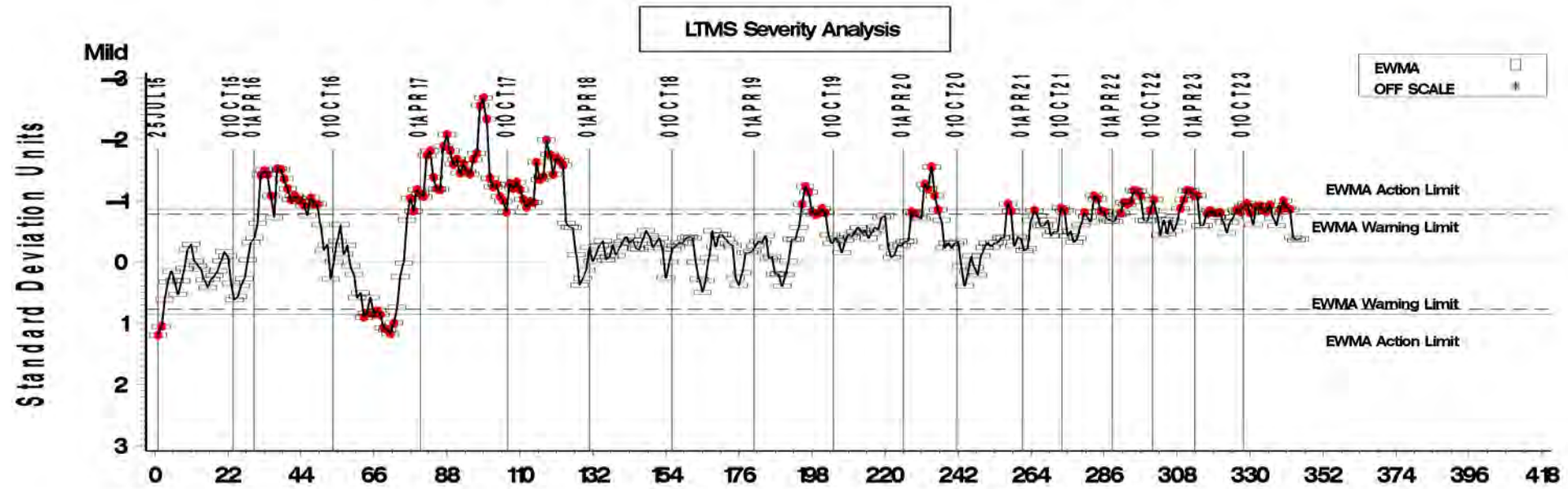
Sequence IIIH/A/B Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	18
Total		18

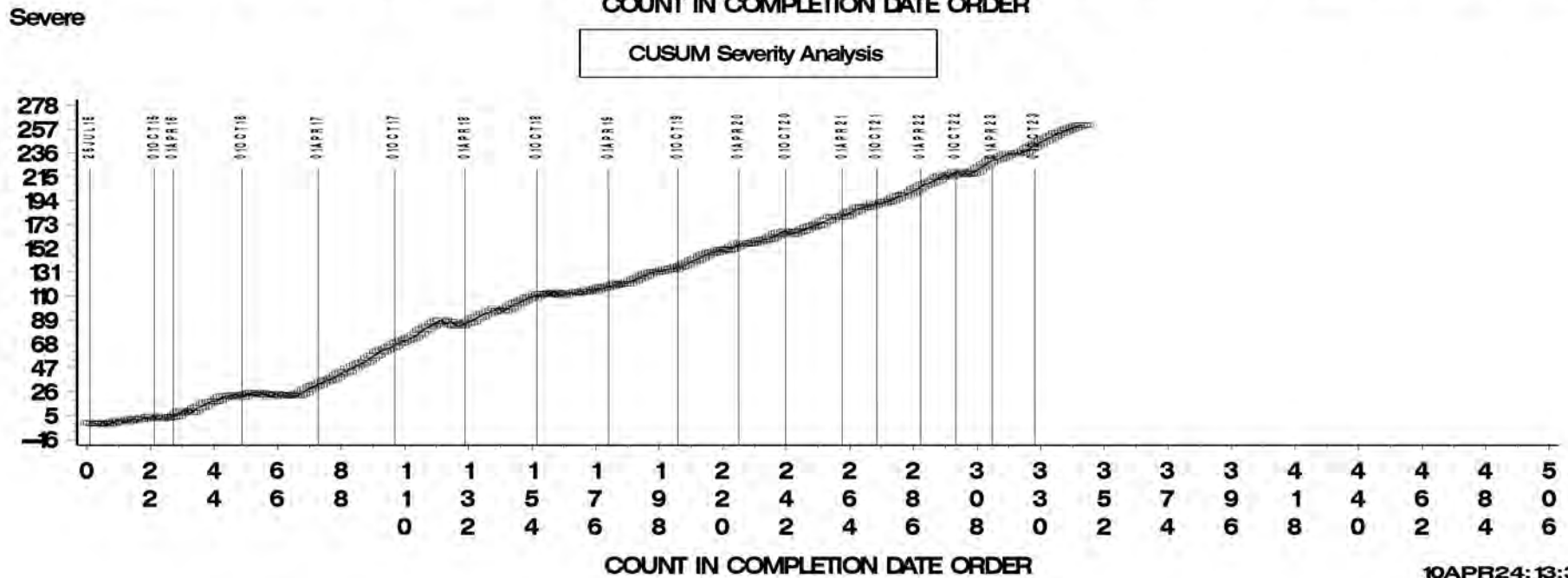
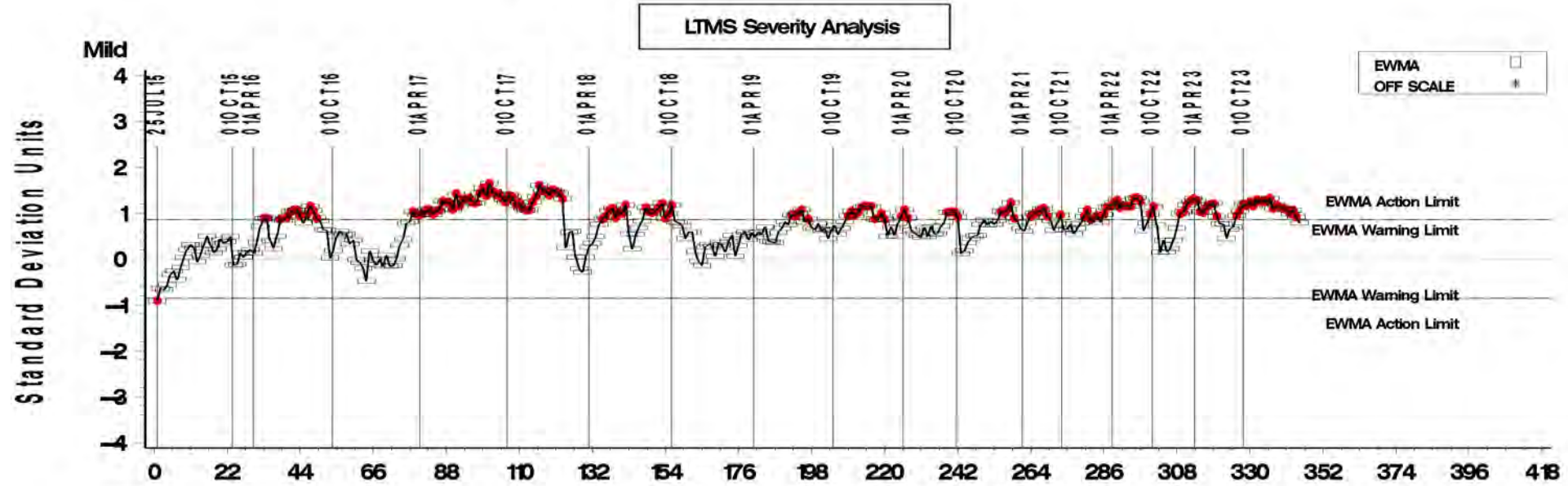
Sequence IIIH Test Severity

- APV is in warning alarm (mild direction)
- All other parameters are in control, though MRV and PVIS have encountered sporadic alarms during the period.

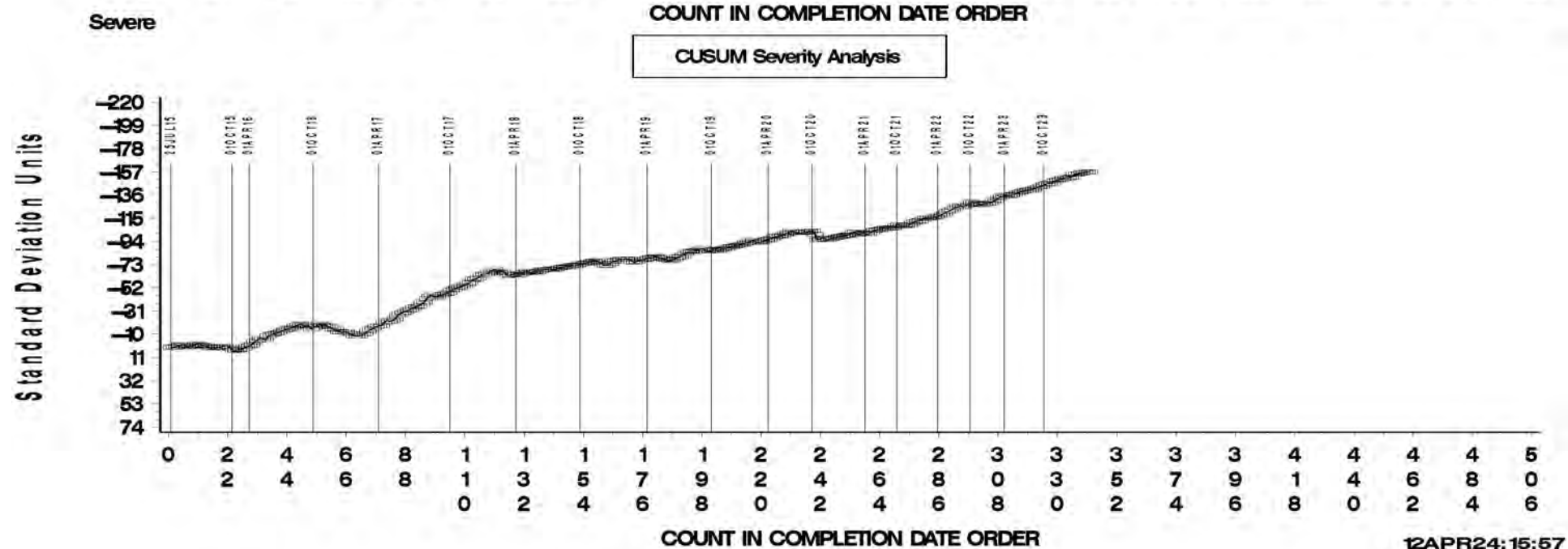
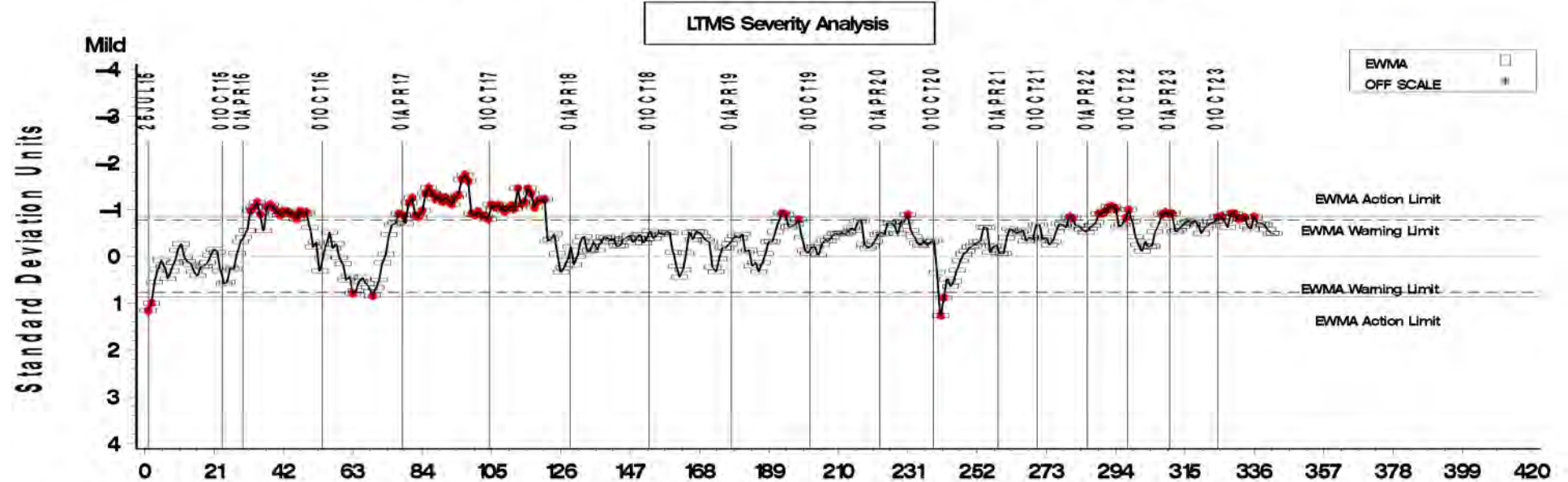
VISCOSITY INCREASE FINAL ORIG UNIT RES



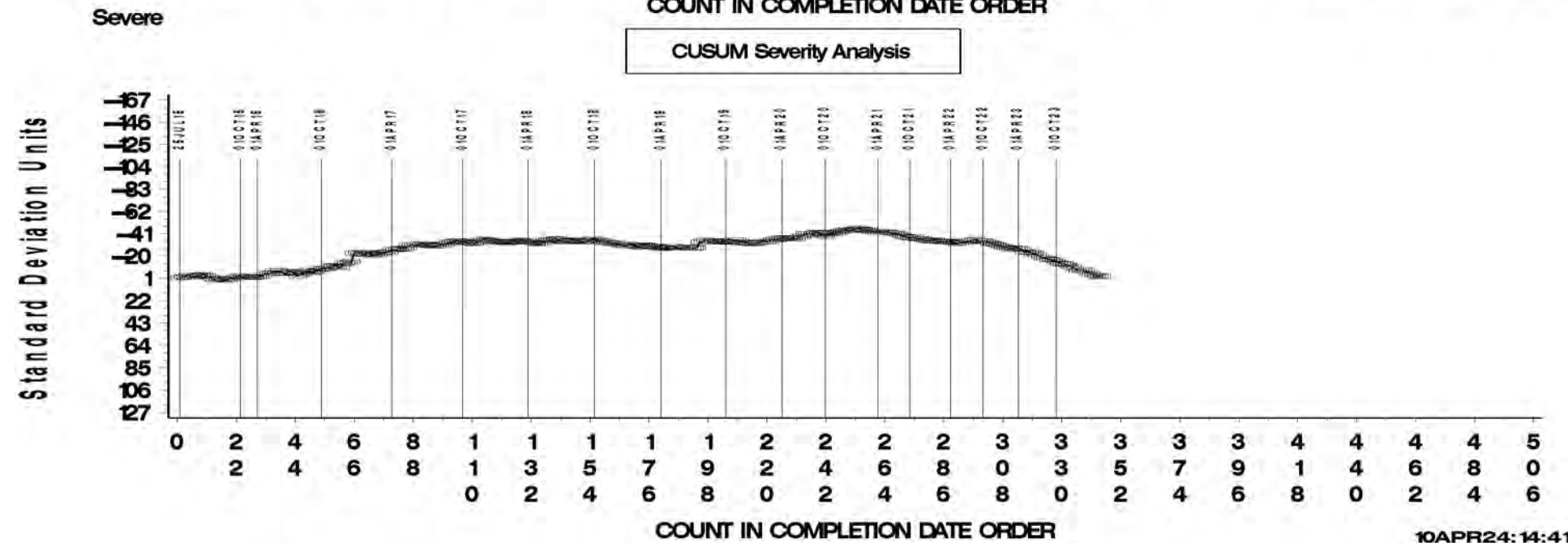
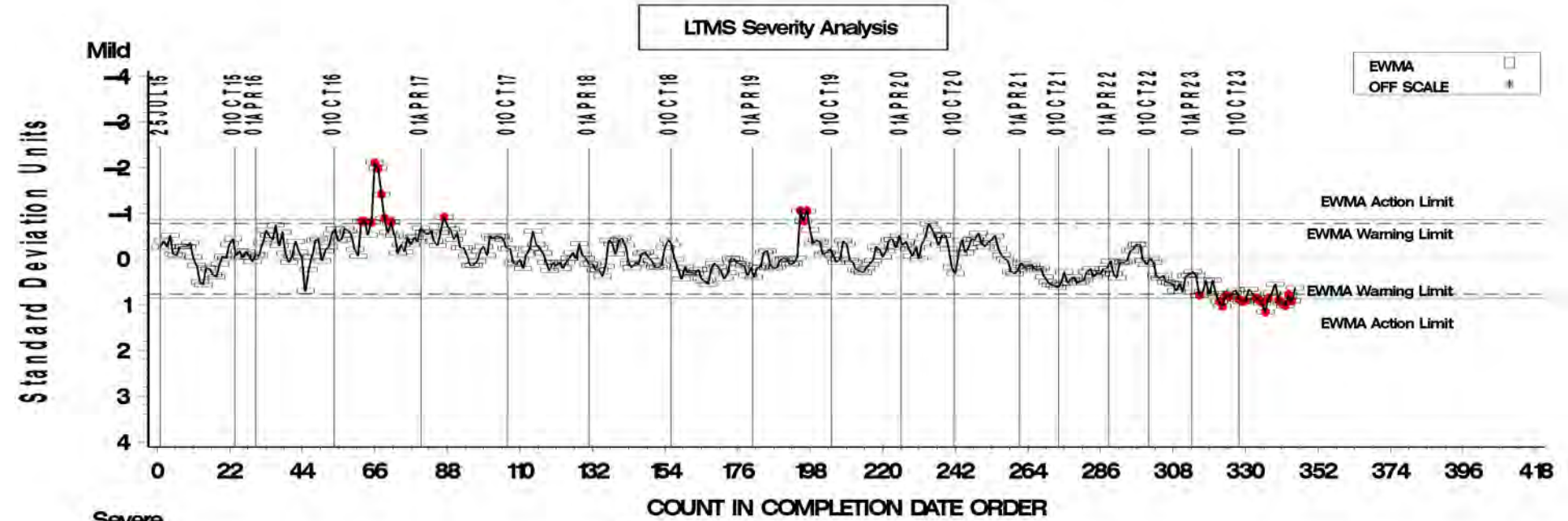
AVERAGE PISTON SKIRT VARNISH



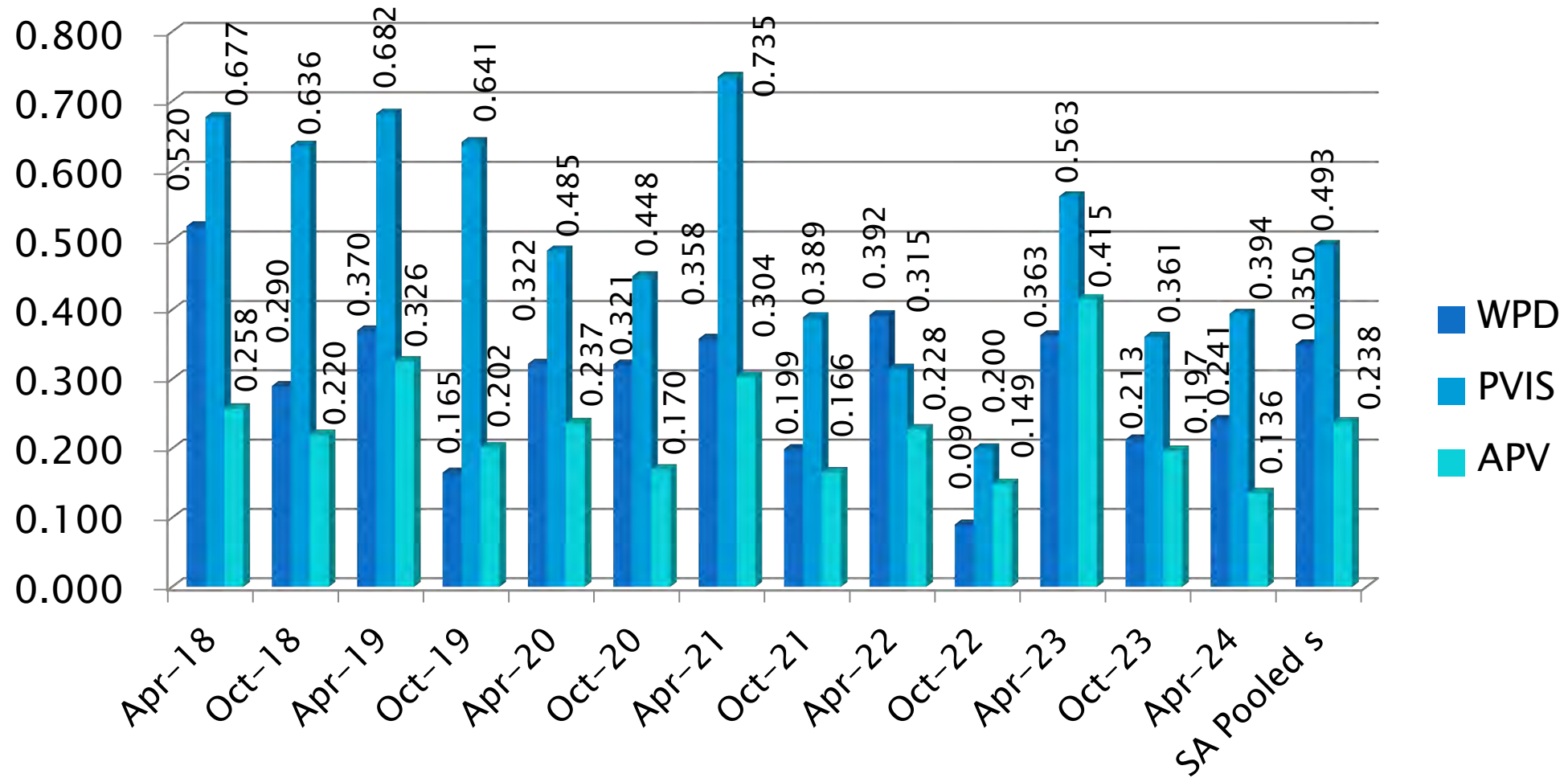
MRV FINAL ORIG UNIT RES [NM, FROZEN, SOLID]



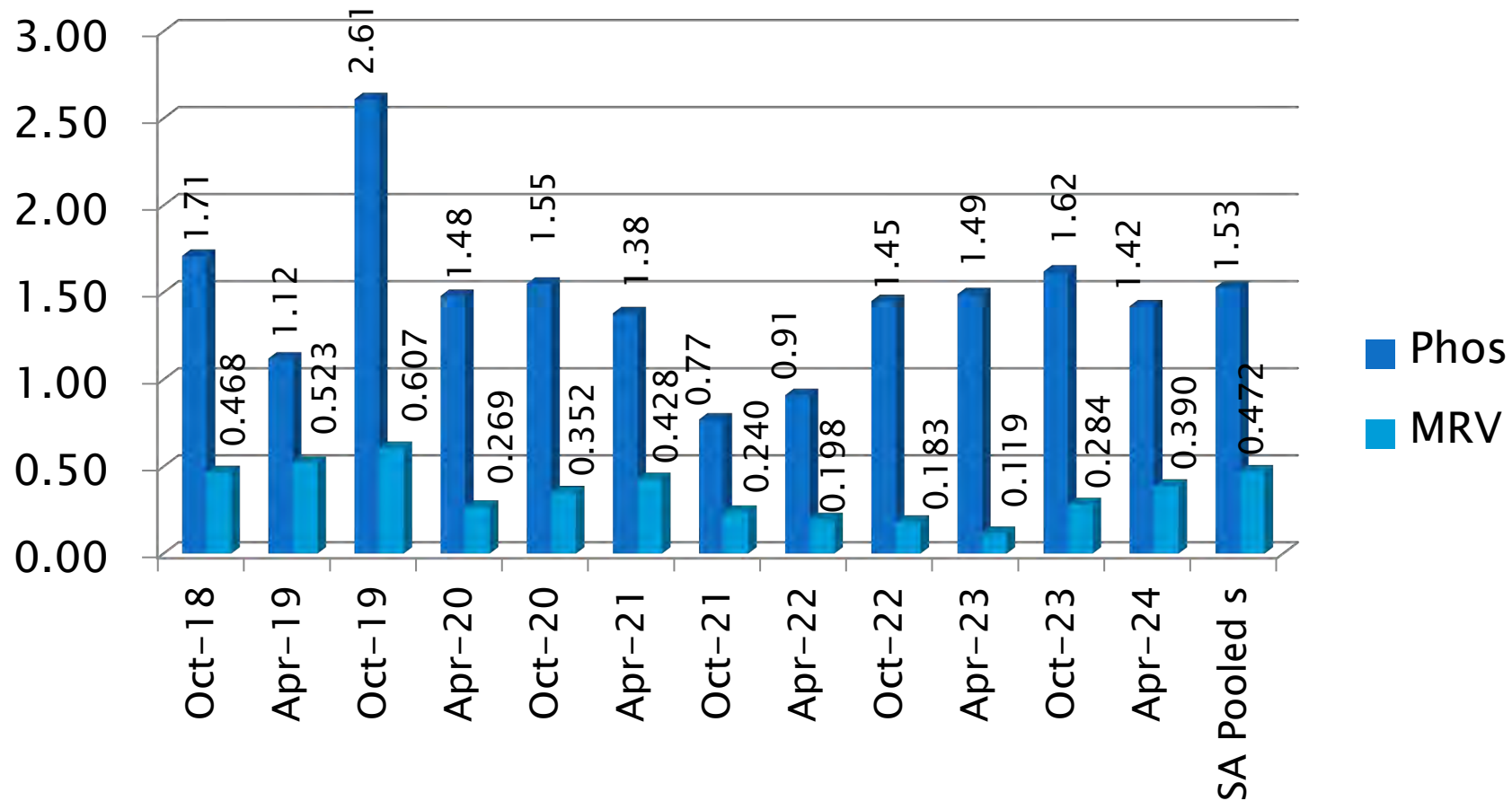
PHOSPHORUS RETENTION, FINAL RESULT



IIH Precision Estimates



IIIHA/B Precision Estimates



[Return to Table of Contents](#)

Sequence IVA

➤➤ April 2024

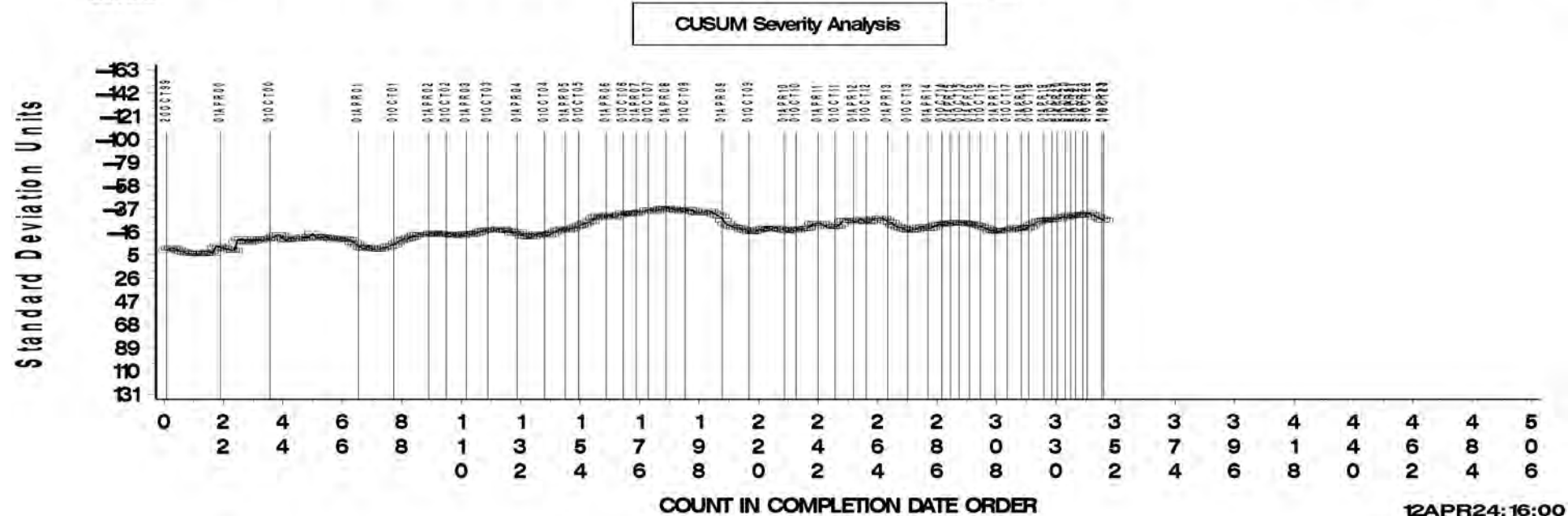
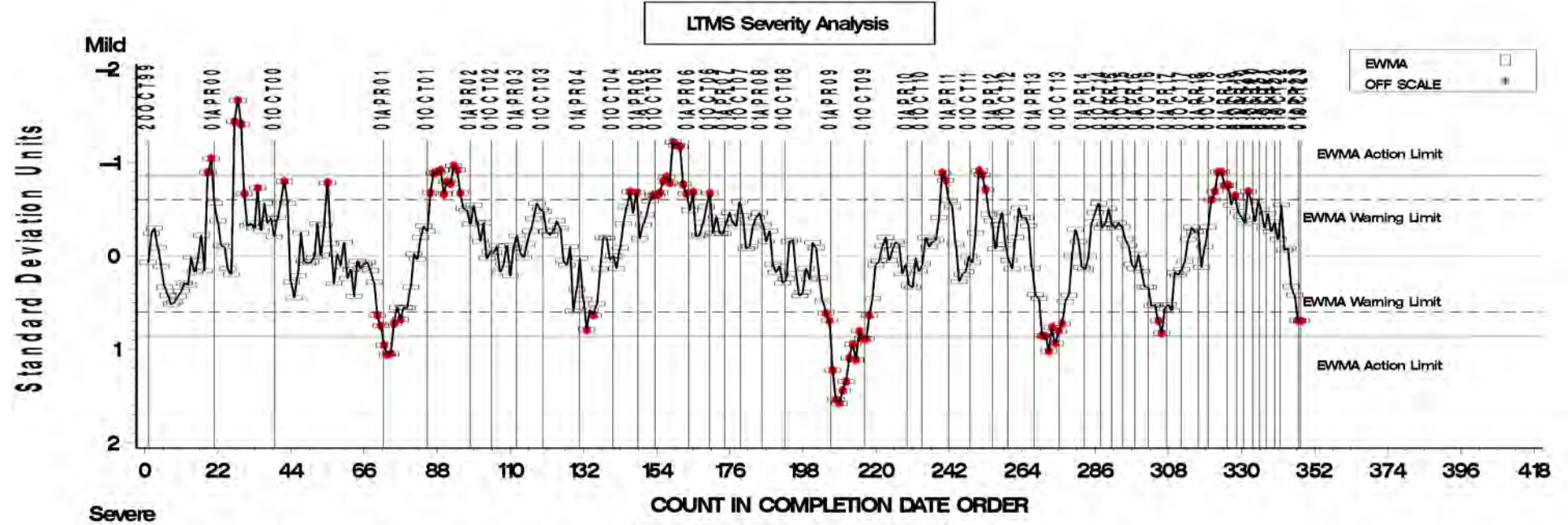
Sequence IVA Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Total		0

Sequence IVA Test Severity

- Severity and precision are in warning alarm.

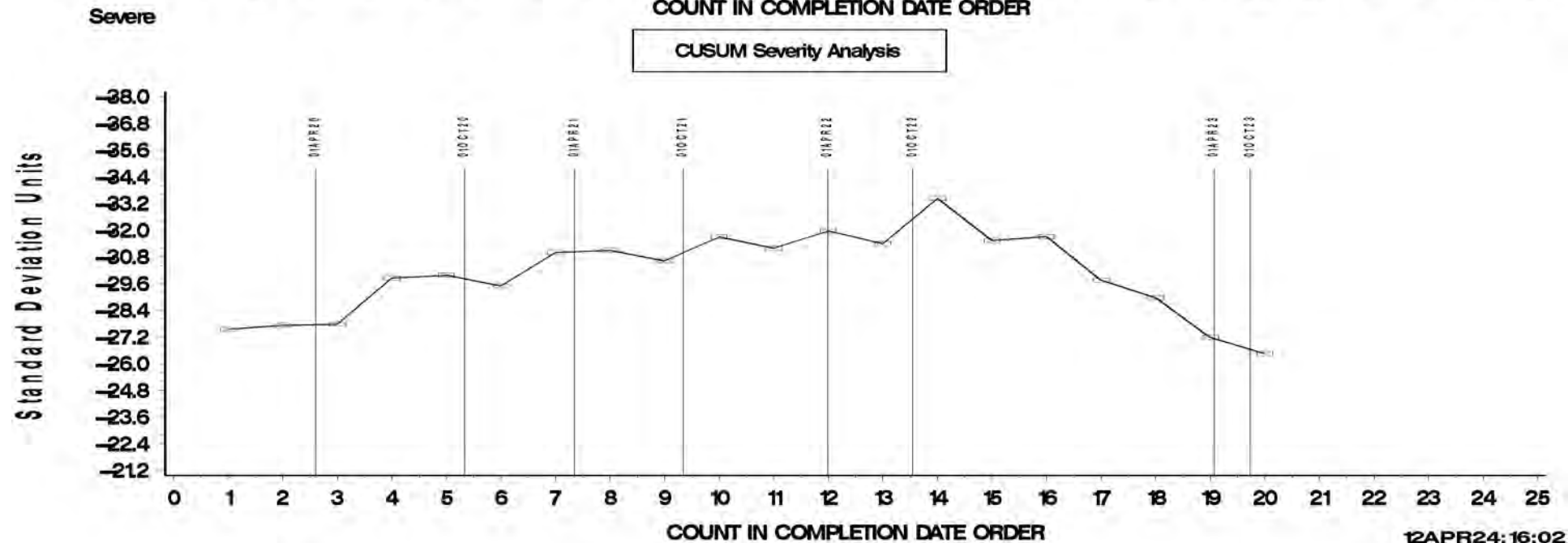
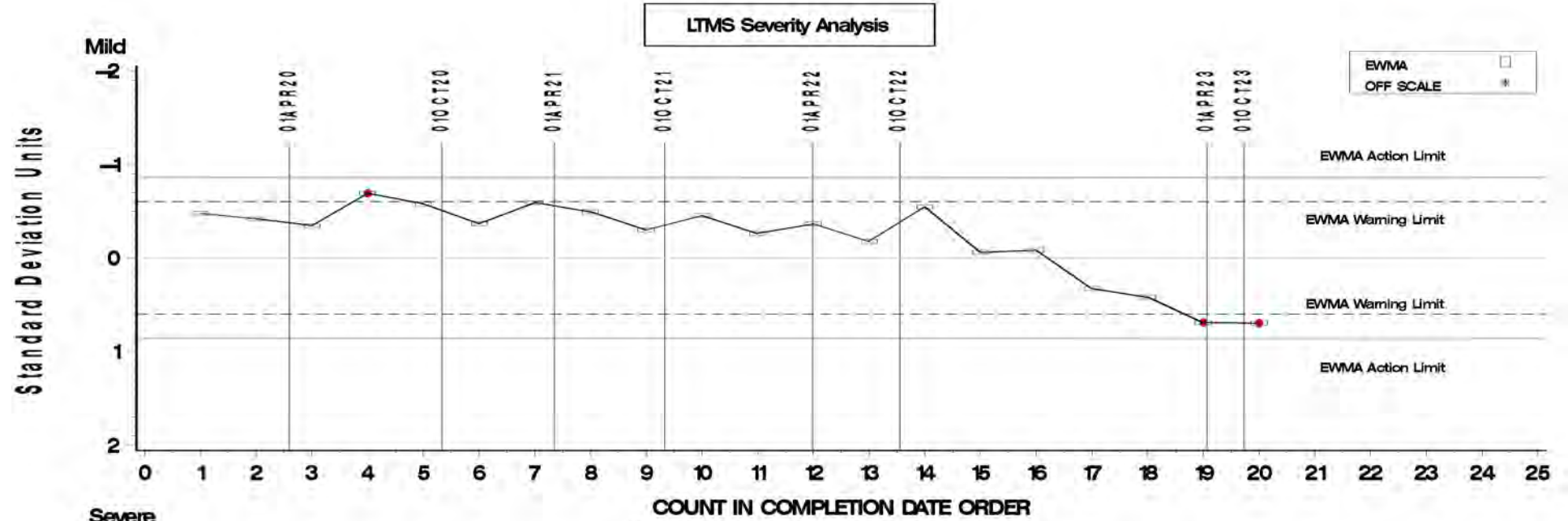
AVERAGE CAM WEAR



SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

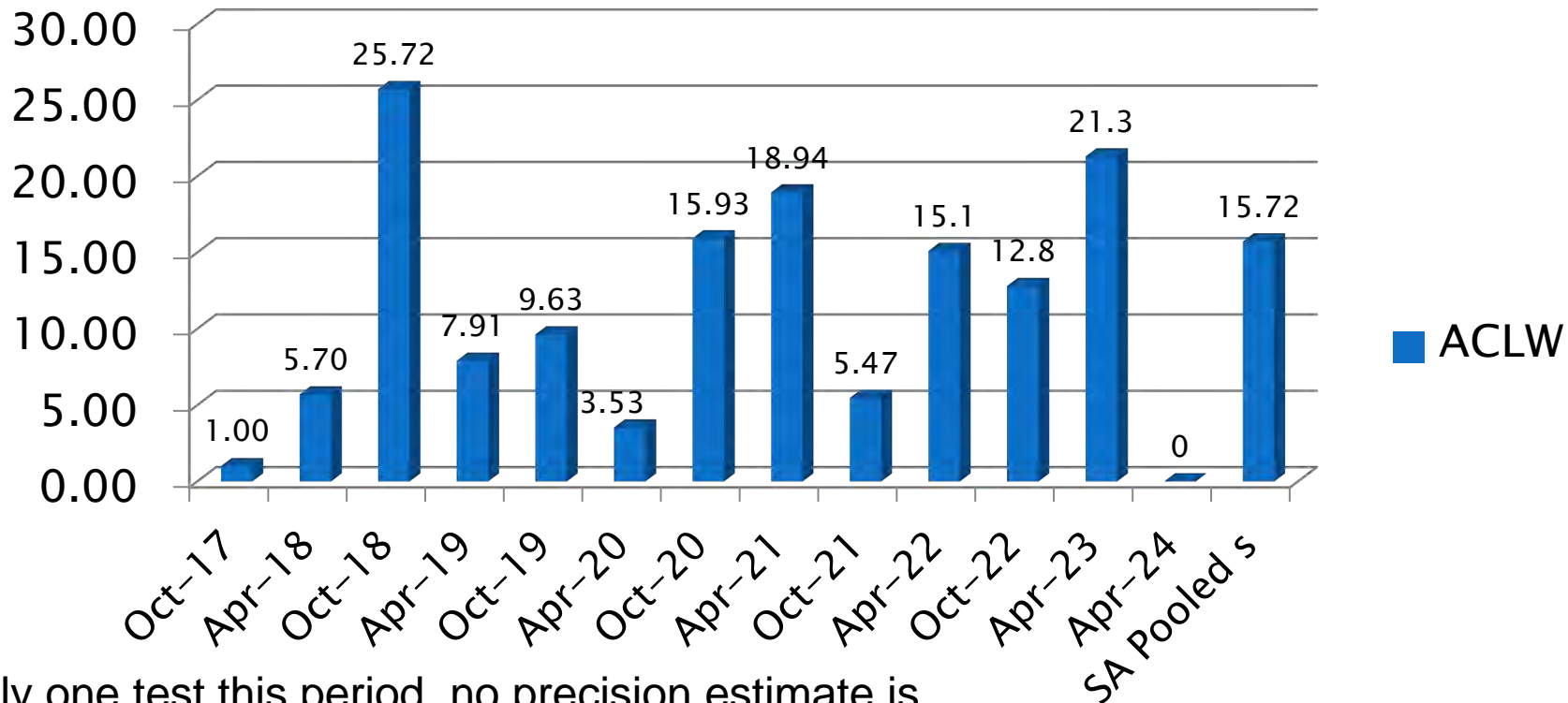
Last 20 Tests

AVERAGE CAM WEAR



Sequence IVA Precision Estimates

ACW



With only one test this period, no precision estimate is available

[Return to Table of Contents](#)

Sequence IVB

➤➤ April 2024

Sequence IVB Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Operationally Invalid Calibration Test (lab judgement)	LC	1
Operationally Invalid Calibration Test (Lab and TMC judgement)	RC	1
Total		8

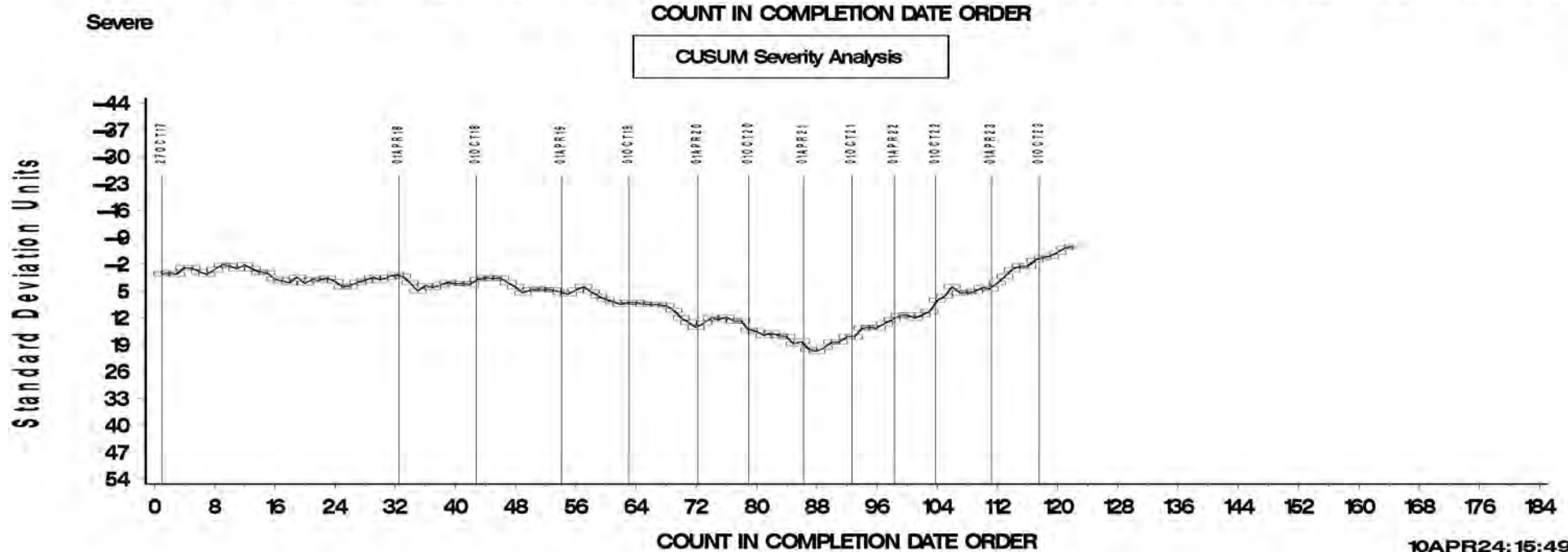
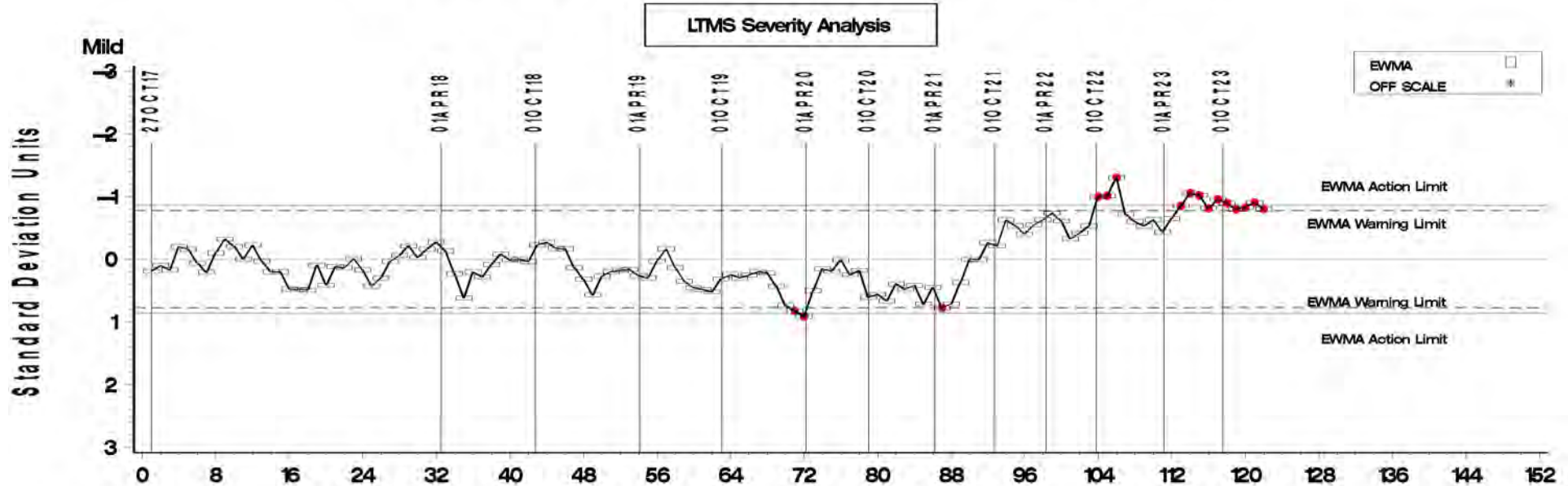
Sequence IVB – Lost Tests

Test Status	Cause	#
Invalid	High oil consumption, low oil level	1
Invalid	Oil gallery thermocouple insertion depth error	1
Totals		2

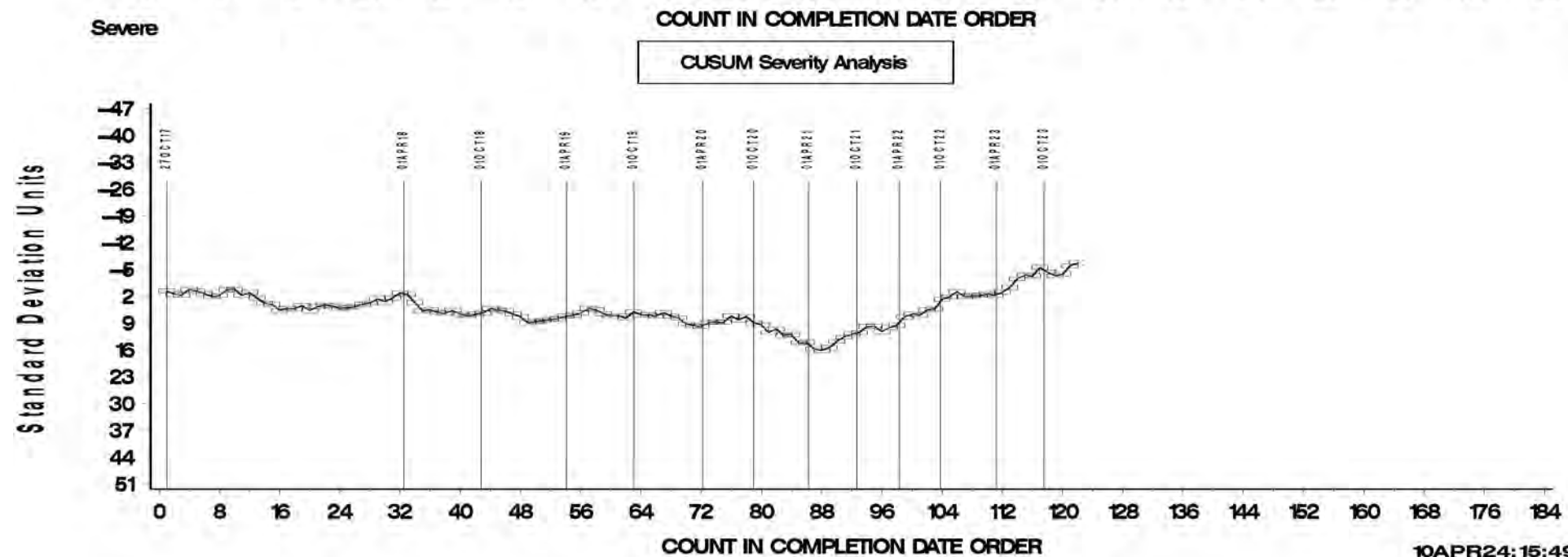
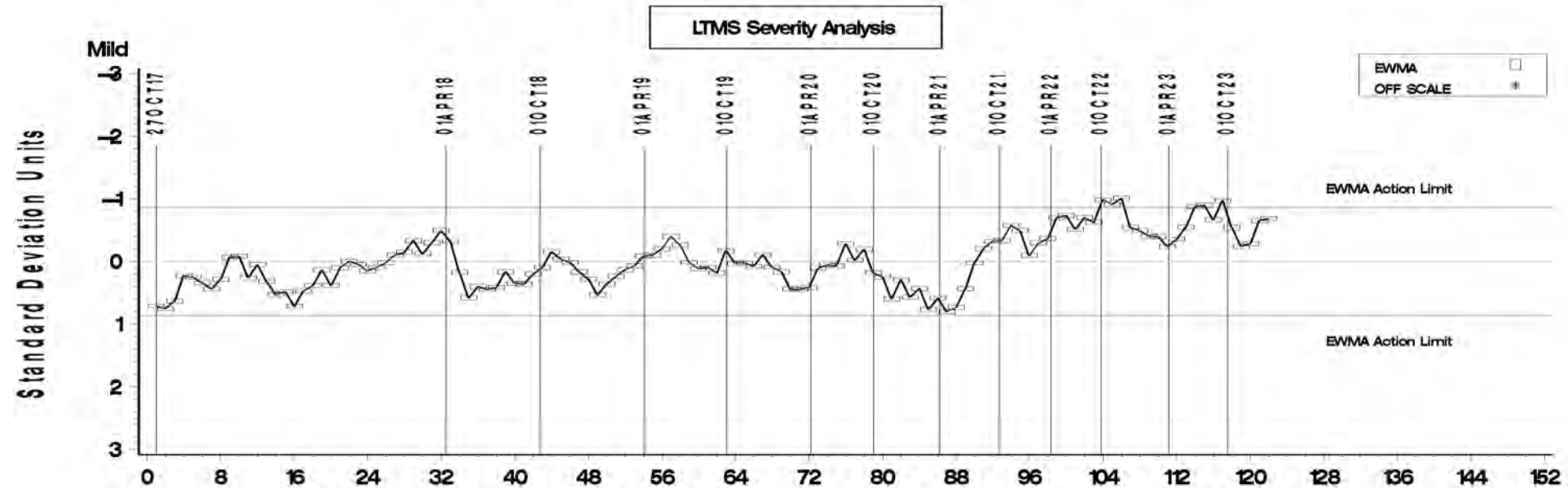
Sequence IVB Test Severity

- AVLI is in warning alarm (mild direction)
- FE is in control

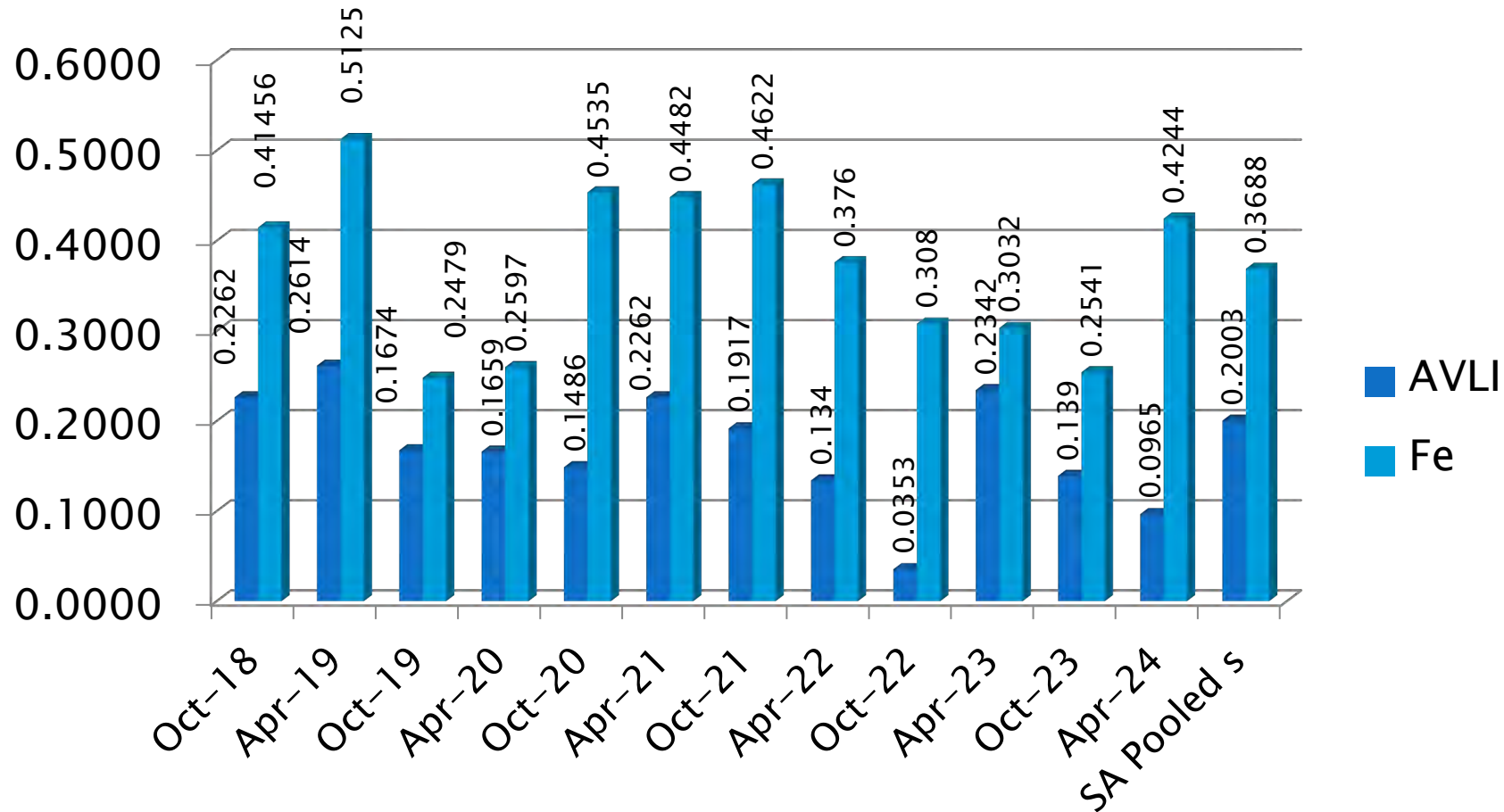
AVERAGE VOLUME LOSS BY KEYENCE INTAKE Final



END OF TEST FE FINAL Severity Adjusted RESULT



Sequence IVB Precision Estimates



[Return to Table of Contents](#)

Sequence VH

➤➤ April 2024

Sequence VH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	12
Calibration Test not on Current Reference Oil Blend	MC	1
Operationally Invalid Calibration Test	LC	1
Terminated Early Calibration Test	XC	1
Total		15

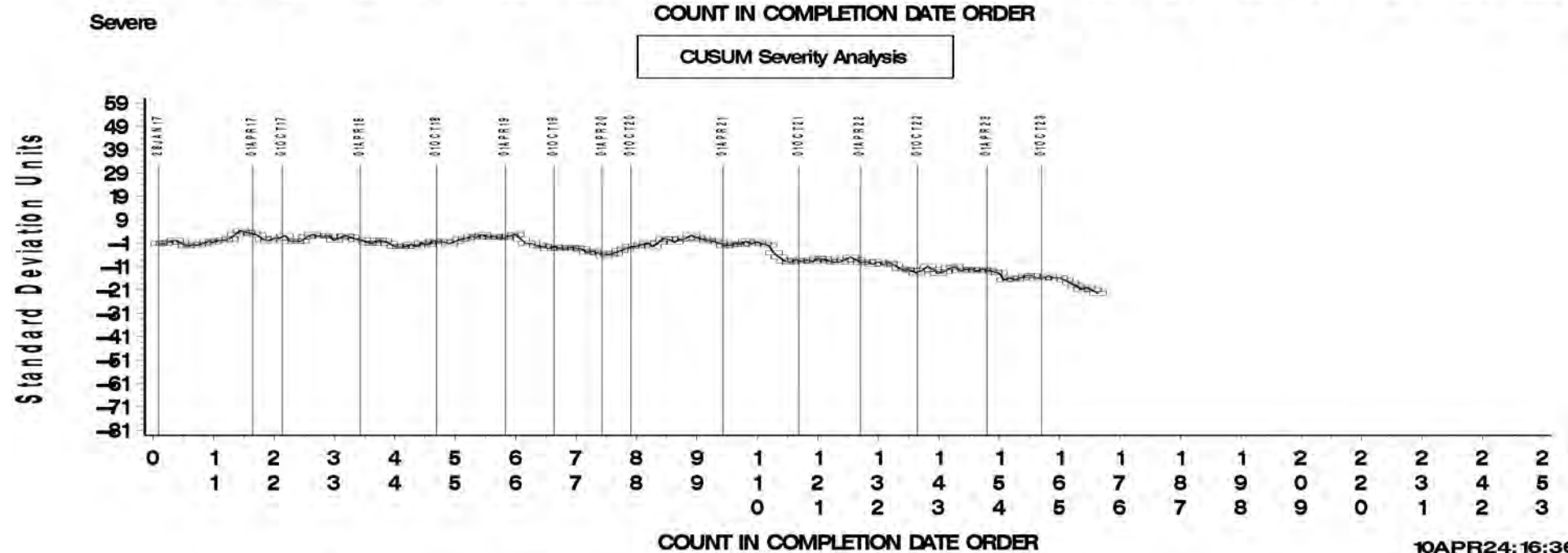
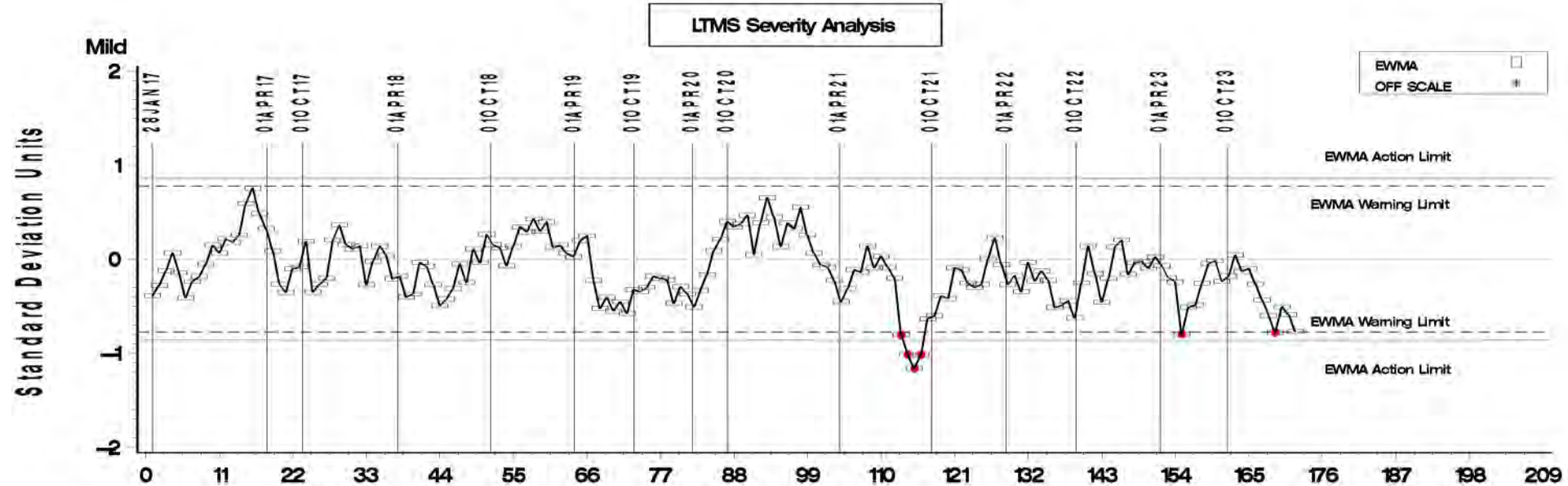
Sequence VH – Lost Tests

Test Status	Cause	#
Invalid	Cam Bearing Failure	1
Aborted	Excessive Fuel Dilution	1
Totals		2

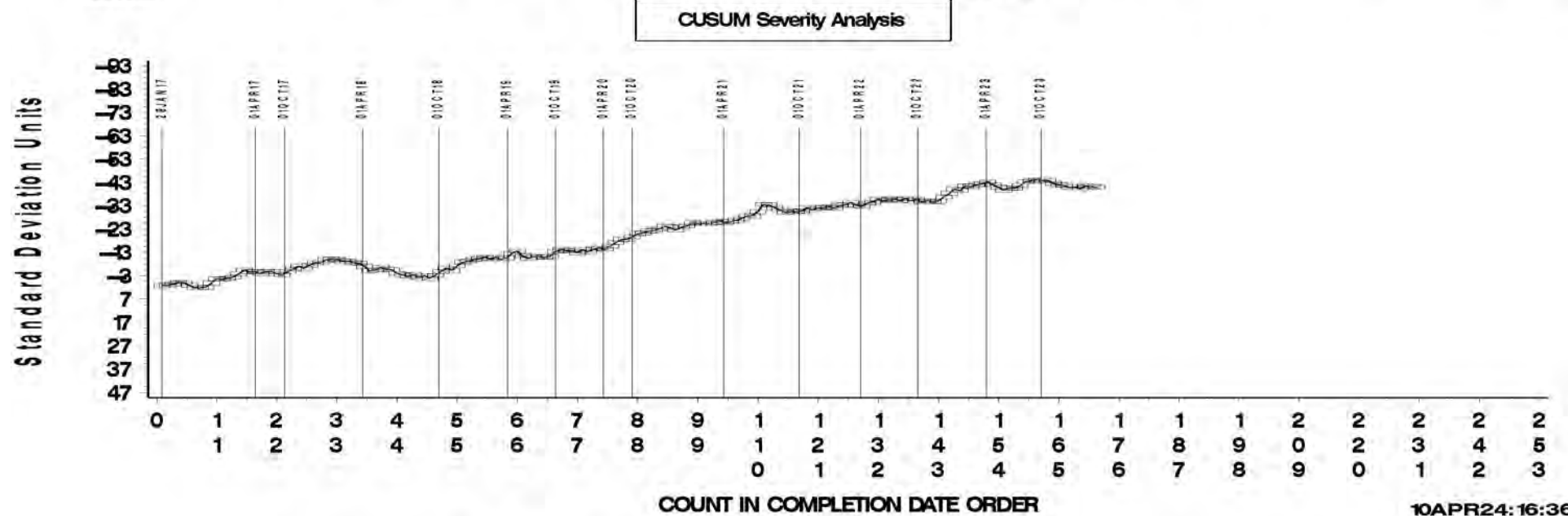
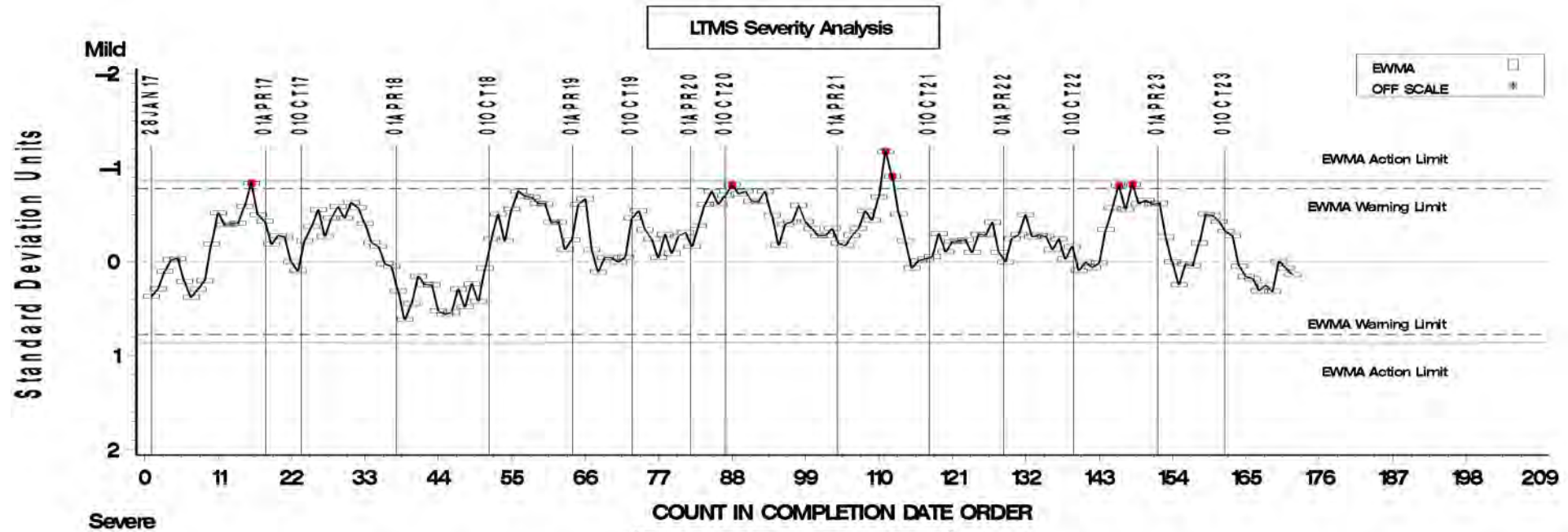
Sequence VH Test Severity

- All parameters within control limits
- AES and AE50 tripped alarms for one test during the report period (severe direction)

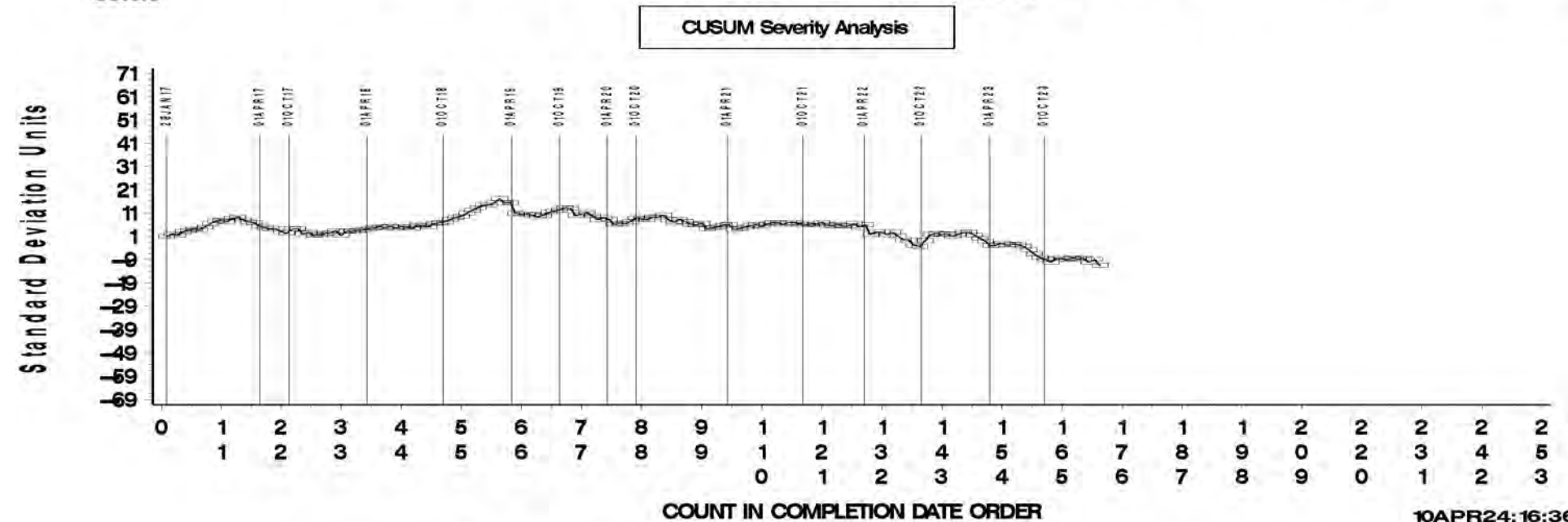
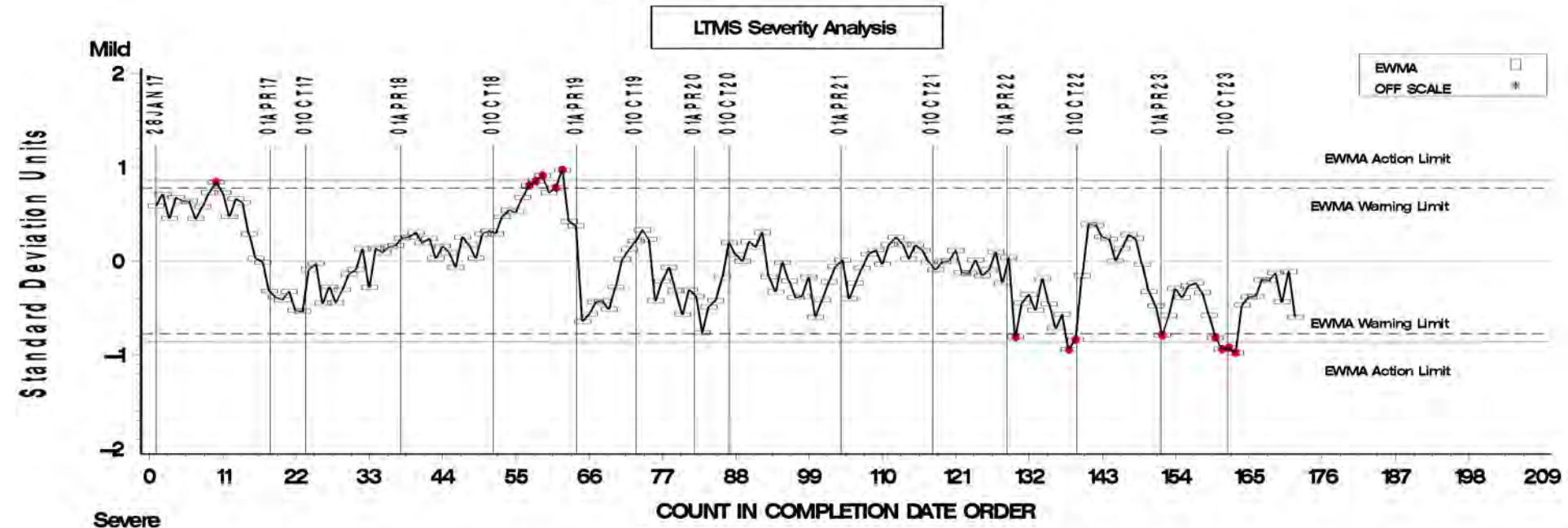
AVERAGE ENGINE SLUDGE



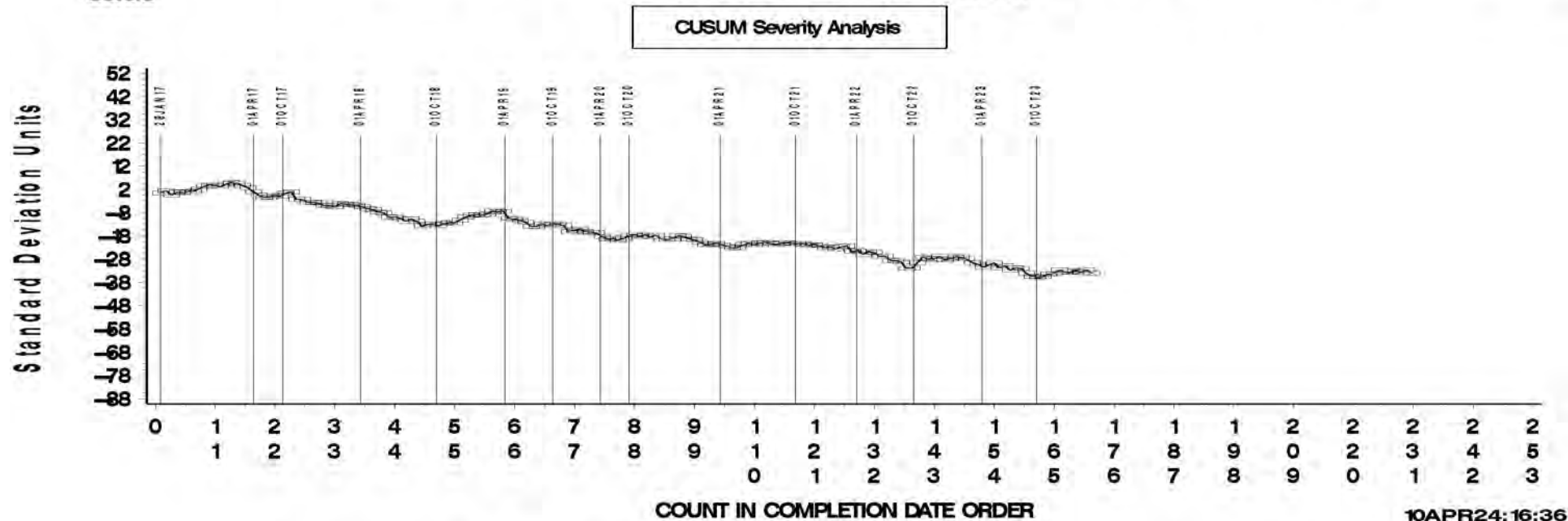
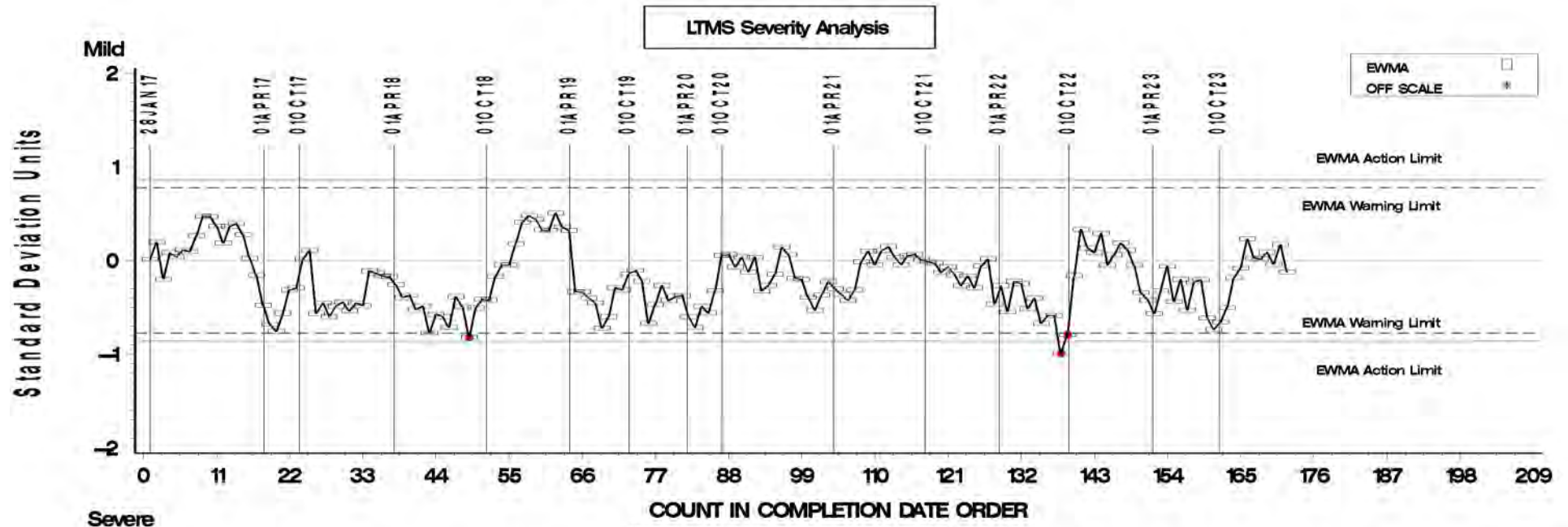
AVERAGE ROCKER COVER SLUDGE



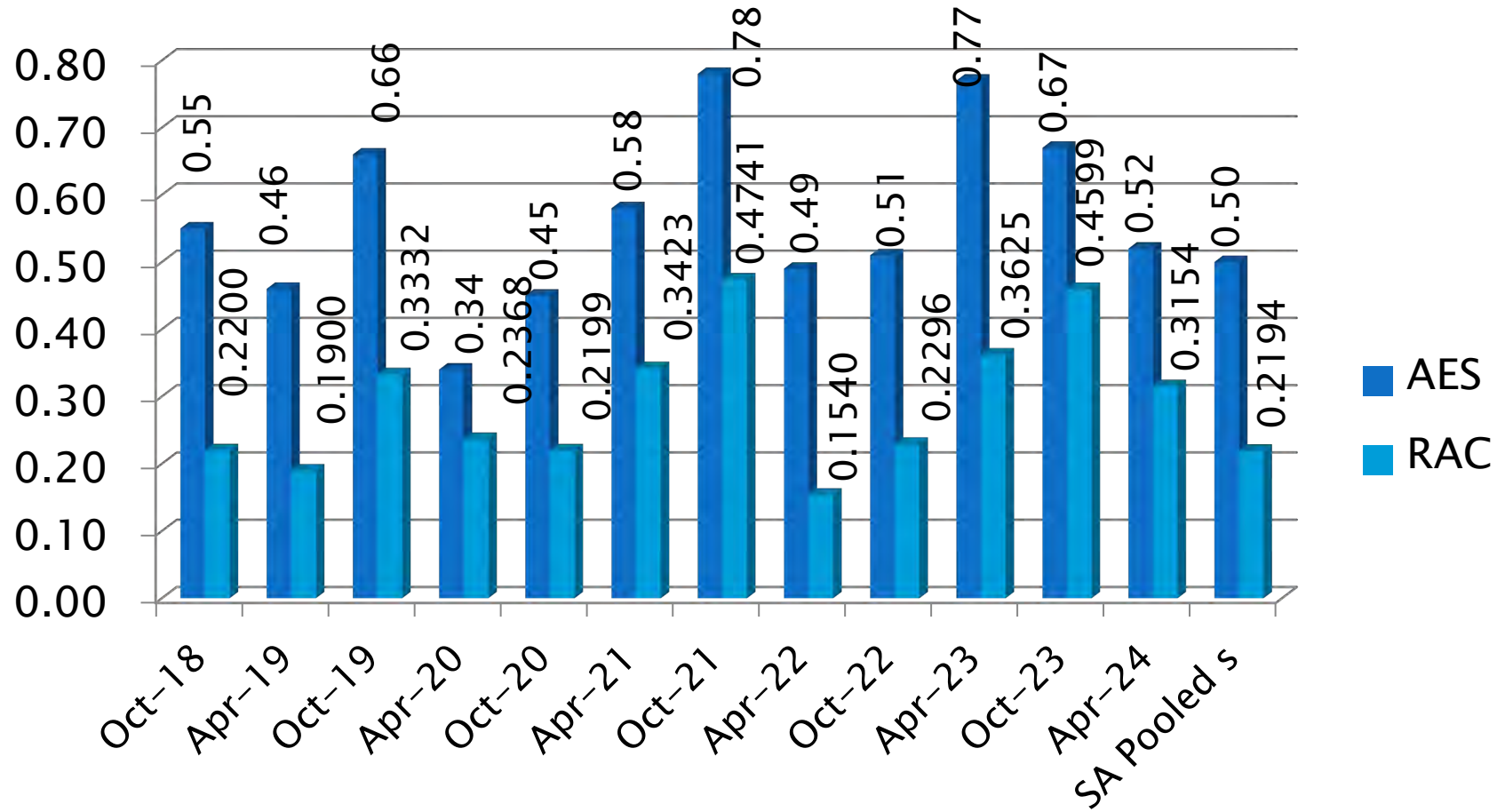
AVG. ENG. VARN. 50% RATING



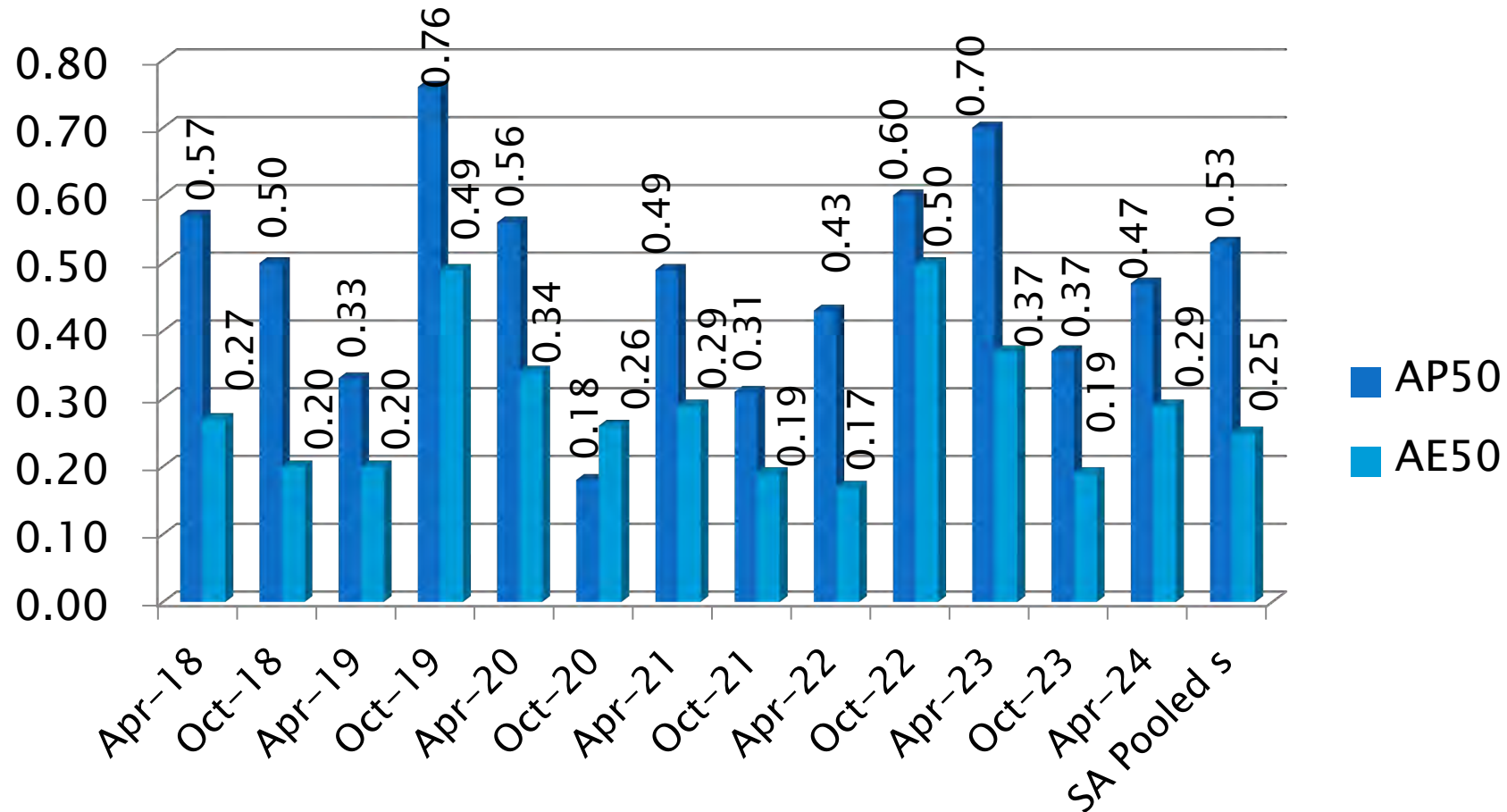
AVG PISTON SKIRT 50% RATING



Sequence VH Precision Estimates



Sequence VH Precision Estimates



[Return to Table of Contents](#)

Sequence VIE

➤➤ April 2024

Sequence VIE Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	47
Engine Abandoned	MC	2
Operationally Invalid Calibration Test	LC	1
Aborted Calibration Test	XC	2
Total		52

Sequence VIE – Lost Tests*

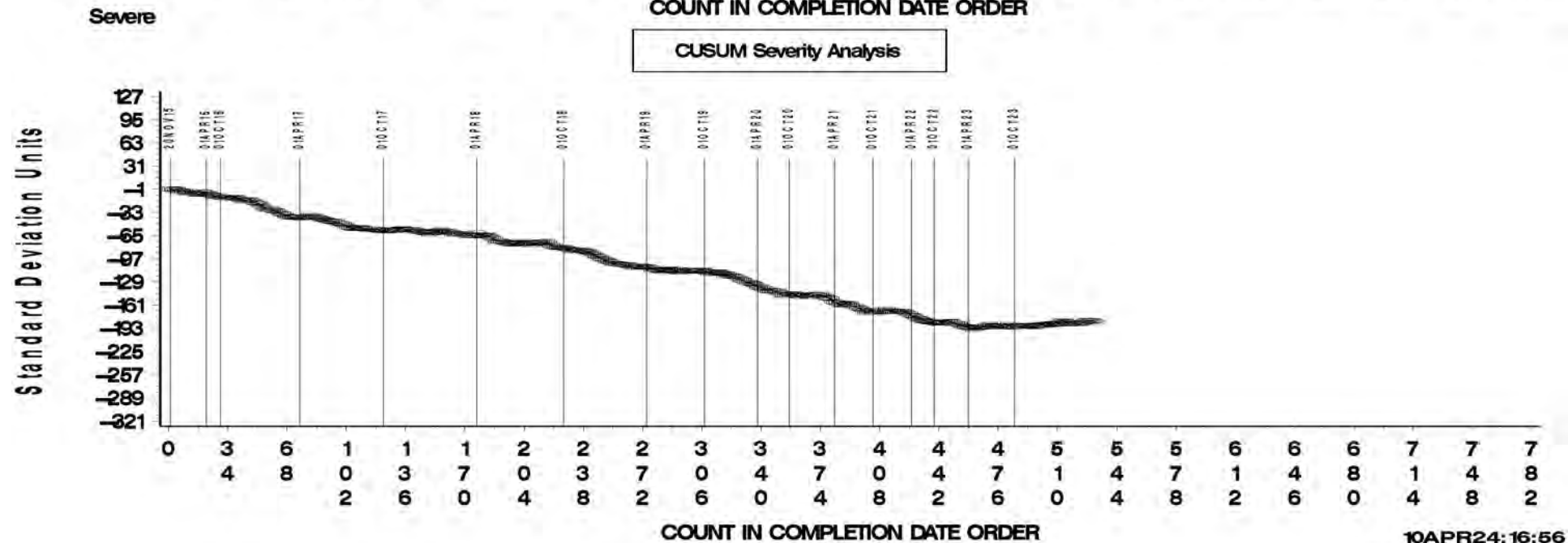
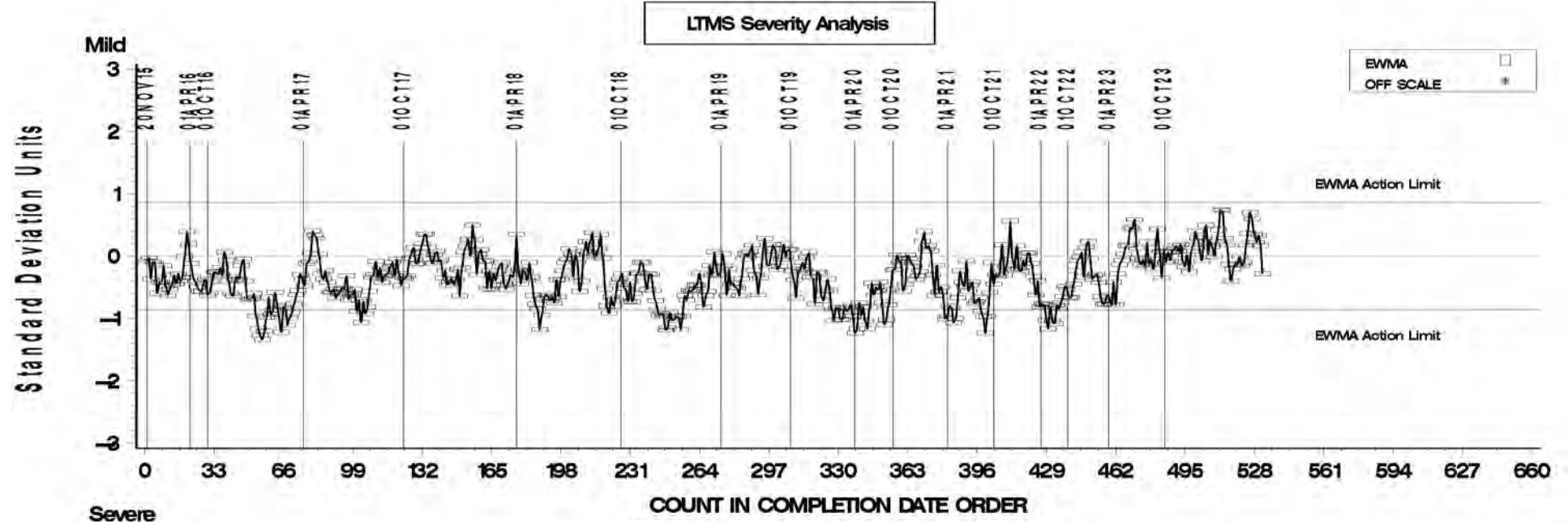
Test Status	Cause	#
Invalid	Downtime exceeded 24 hours	1
Aborted	Engine control issues	2
Totals		3

*Invalid and aborted tests

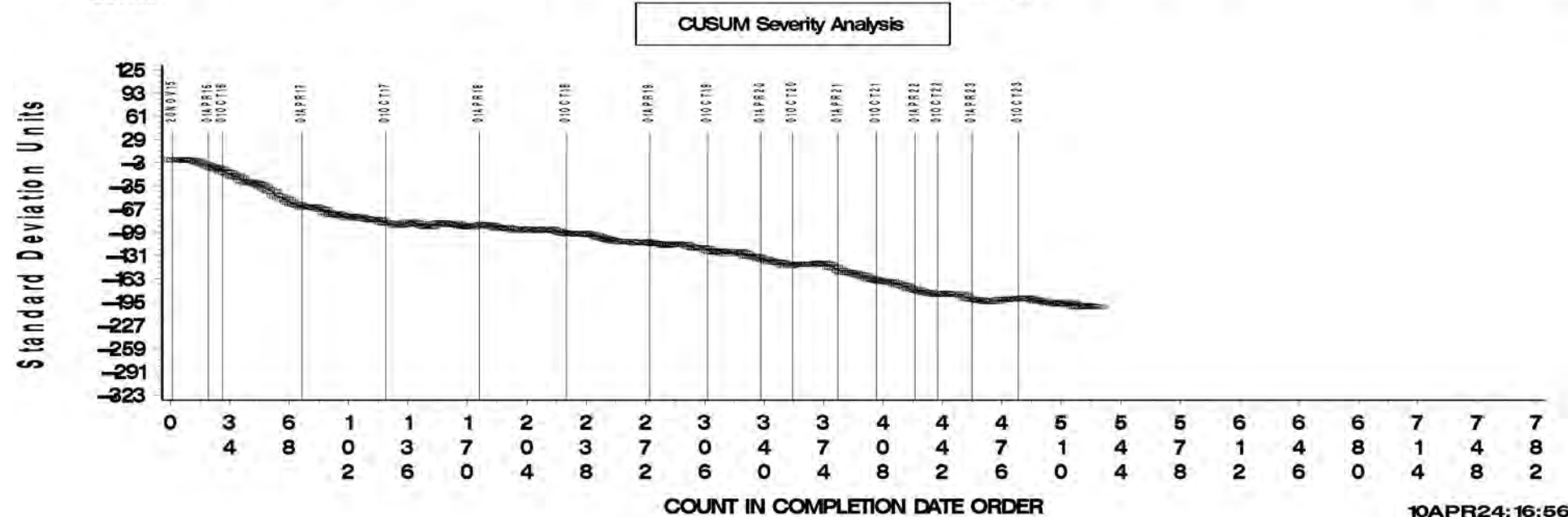
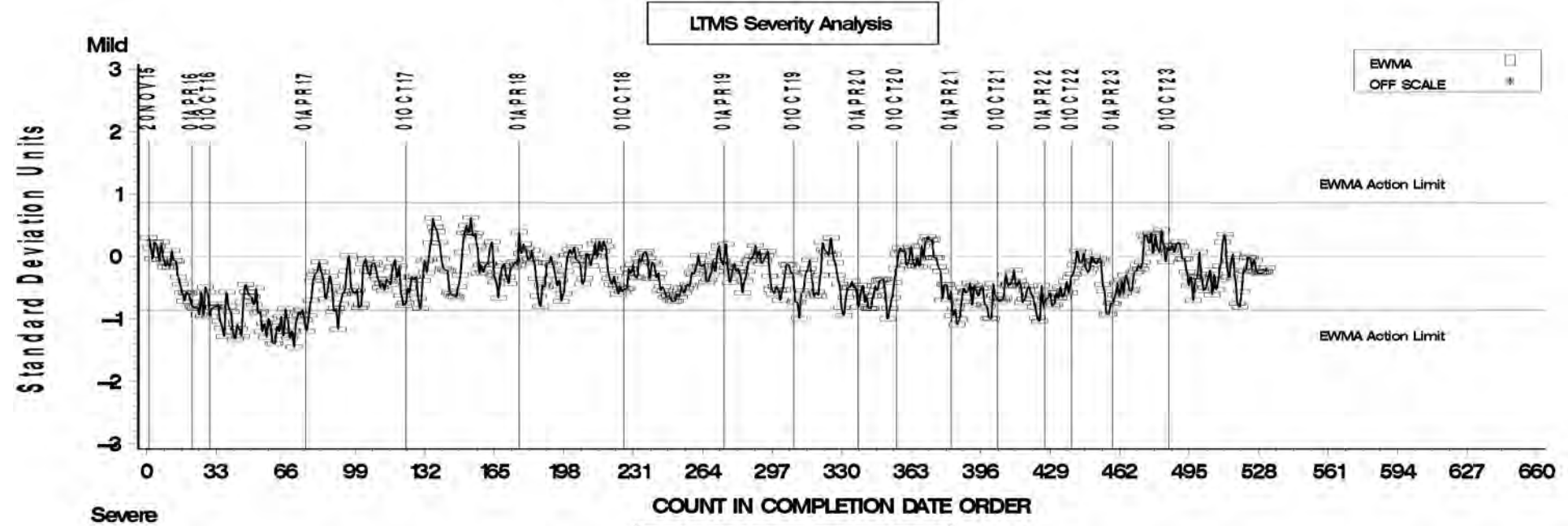
Sequence VIE Test Severity

- FEI1 and FEI2 are in control and have shown near target trends in the Cusum and EWMA charts for the past two report periods.

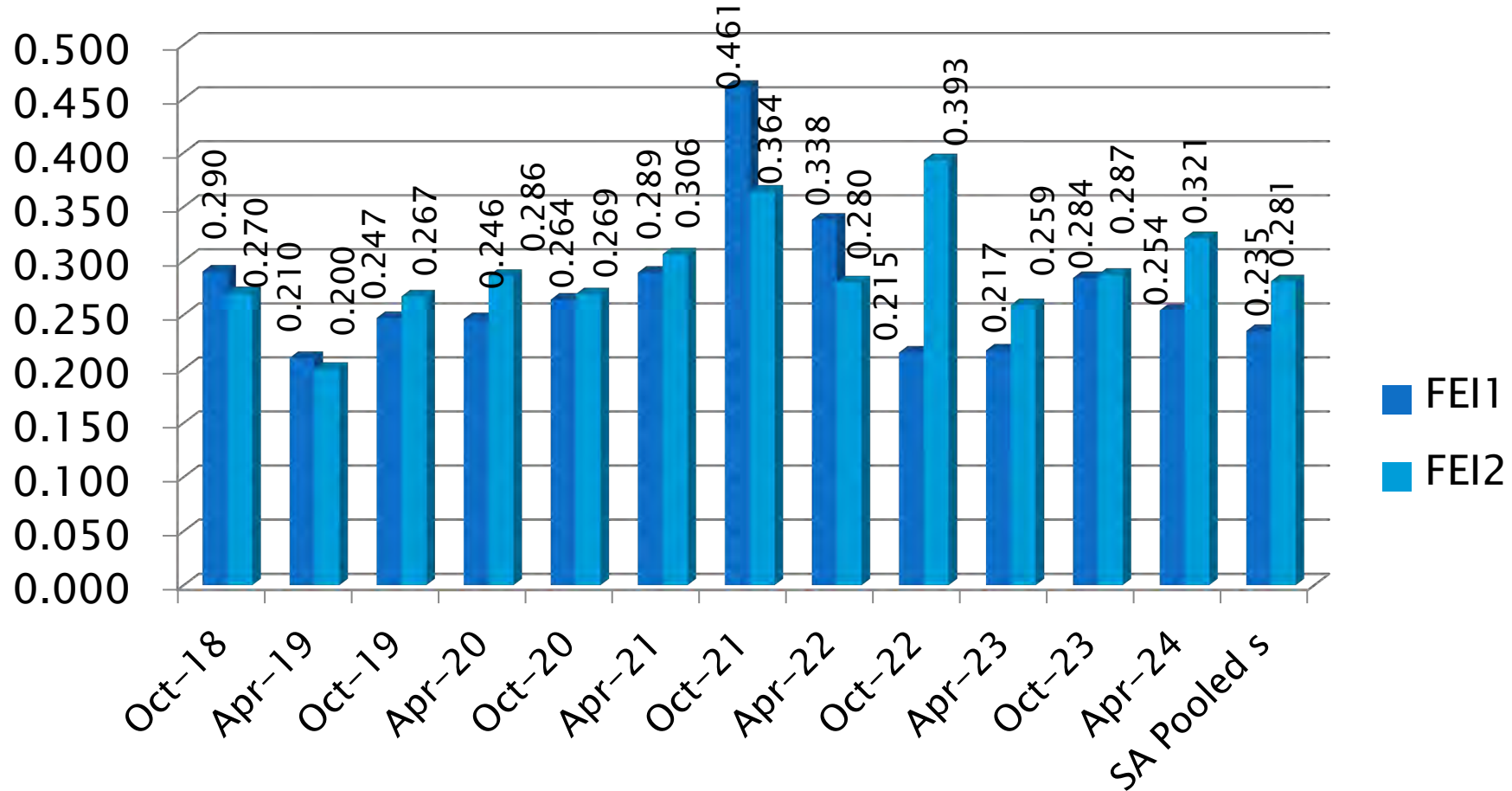
FEI FINAL RESULT PHASE I



FEI FINAL RESULT PHASE II



Sequence VIE Precision Estimates



[Return to Table of Contents](#)

Sequence VIF

➤➤ April 2024

Sequence VIF Activity

Awaiting 1 test from SwRI

Test Status	Validity Code	#
Acceptable Calibration Test	AC	11
Engine Abandoned	MC	3
Operationally Invalid Calibration Test	LC	1
Statistically Unacceptable Calibration Test	OC	1
Total		16

Sequence VIF – Failing Tests

Test Status	#
FEI2 Wi Alarm, Severe direction	1
Total	1

Sequence VIF – Lost Tests*

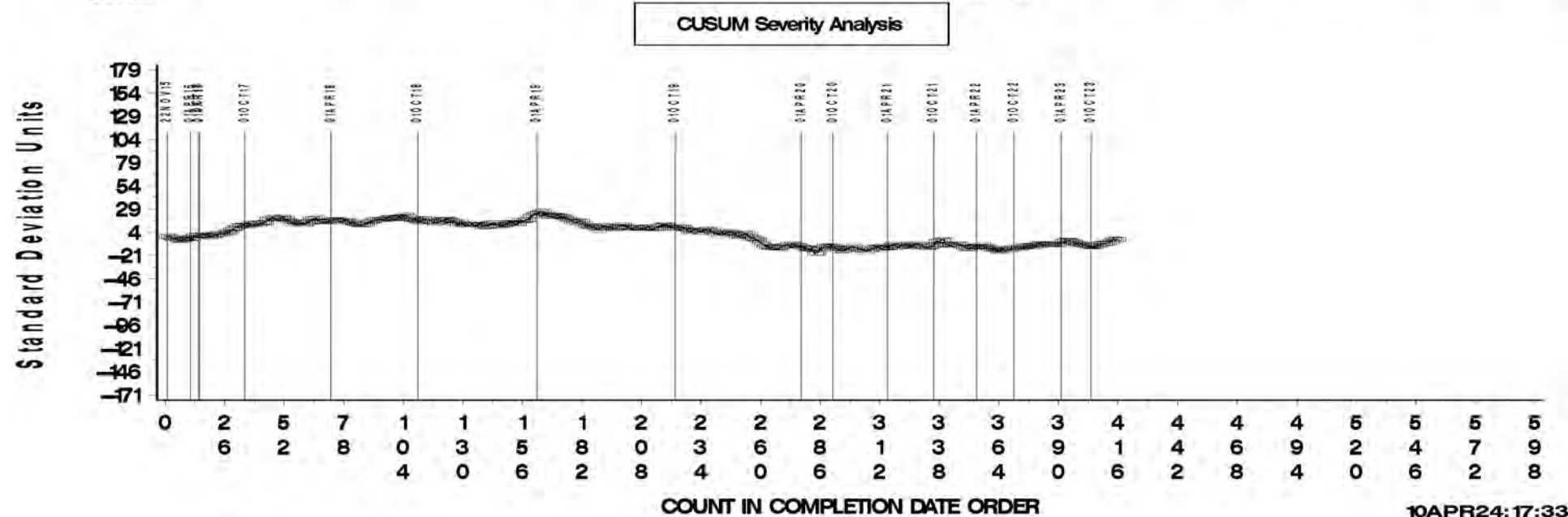
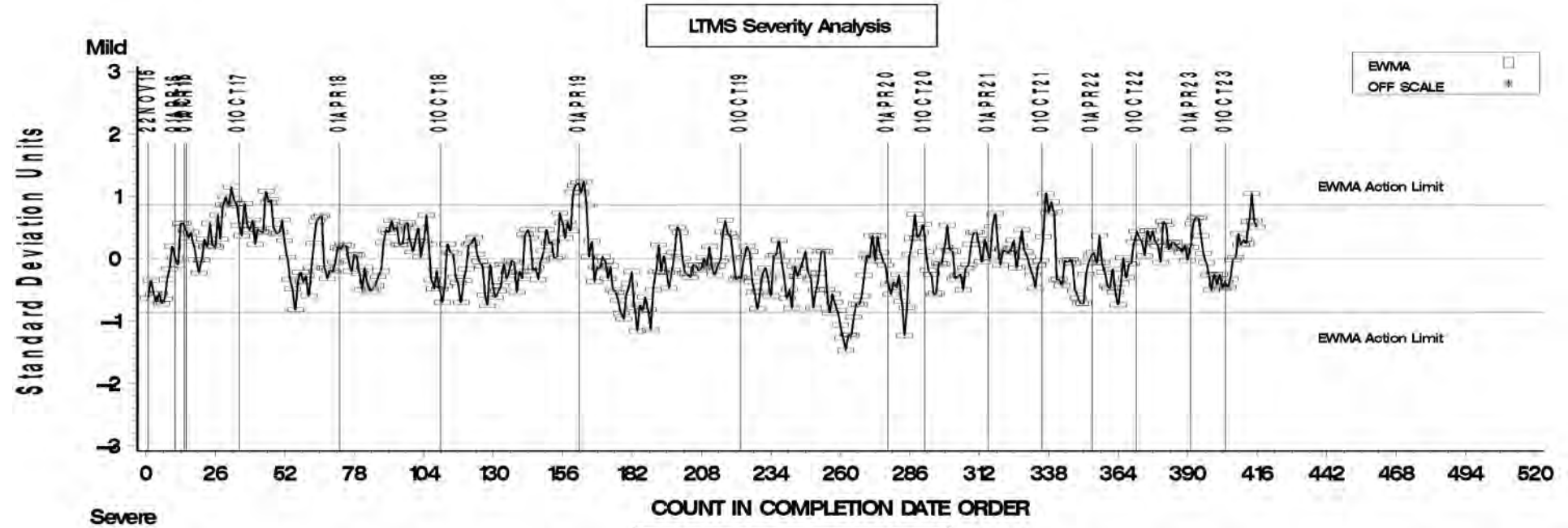
Test Status	Cause	#
Aborted	AFR, Phase I Aging out of spec	1
Totals		1

*Invalid and aborted tests

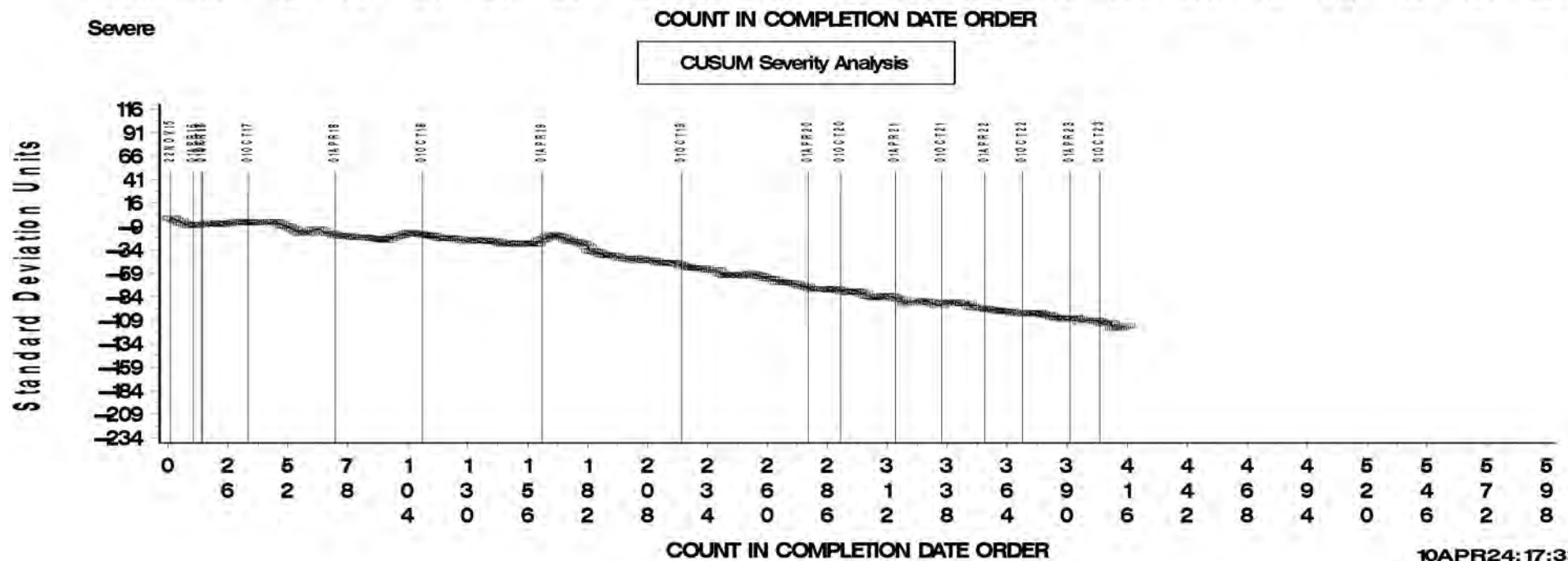
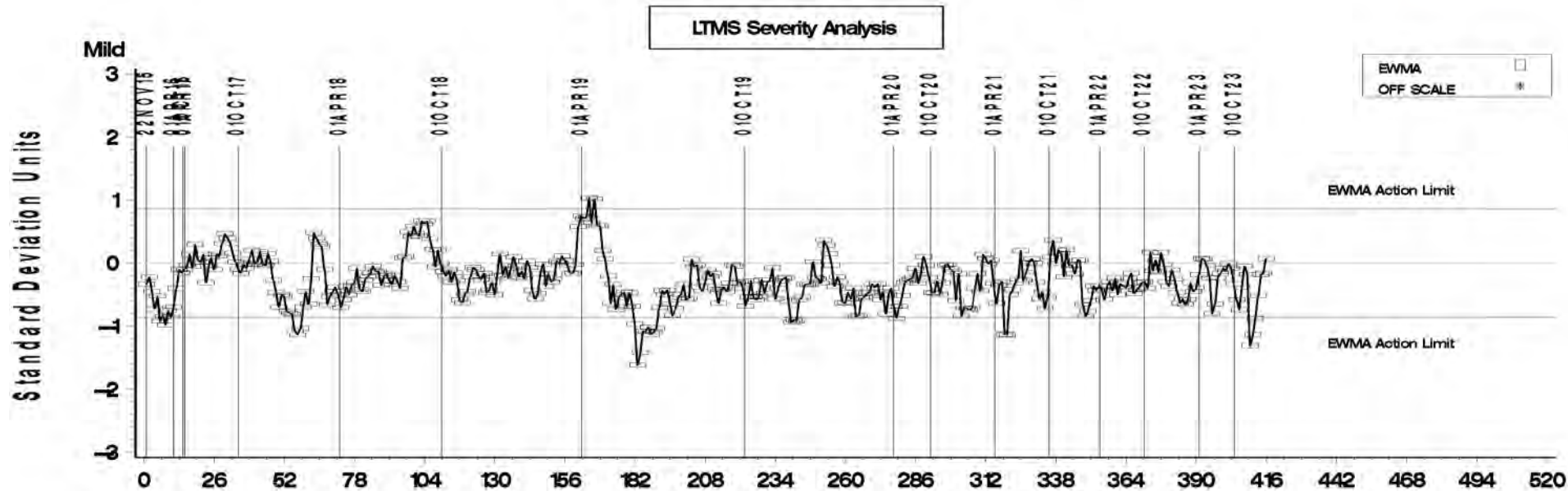
Sequence VIF Test Severity

- FEI1 is in control
- FEI2 is in control

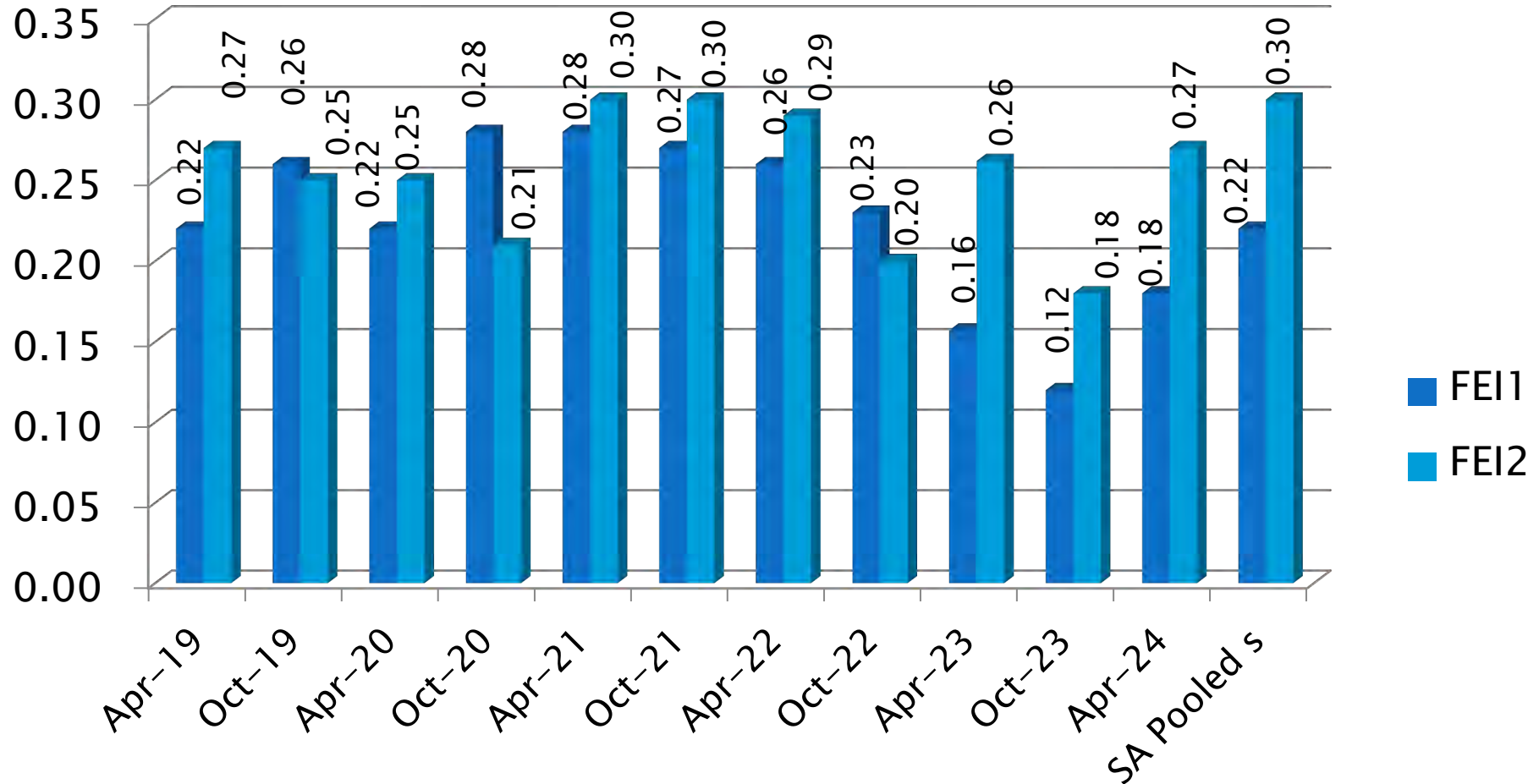
FEI FINAL RESULT PHASE I



FEI FINAL RESULT PHASE II



Sequence VIF Precision Estimates



[Return to Table of Contents](#)

Sequence VIII

➤➤ April 2024

Sequence VIII Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Failed Calibration Test	OC	1
Operationally Invalid Calibration Test (High Mechanical Wear)	LC	1
Total		8

Sequence VIII – Lost Tests*

Test Status	Cause	#
Invalid	High Mechanical Wear	1
Totals		1

*Invalid and aborted tests

Sequence VIII– Failed Tests

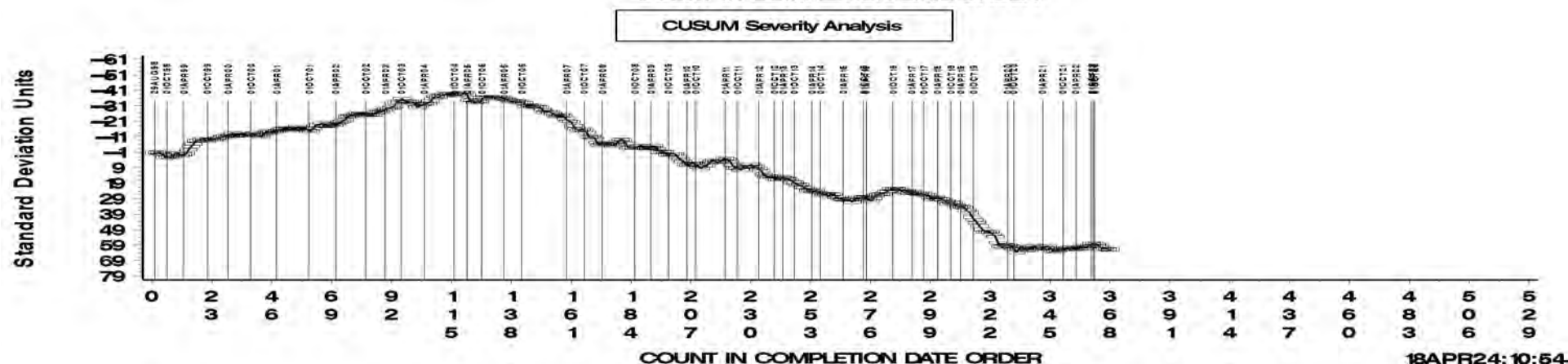
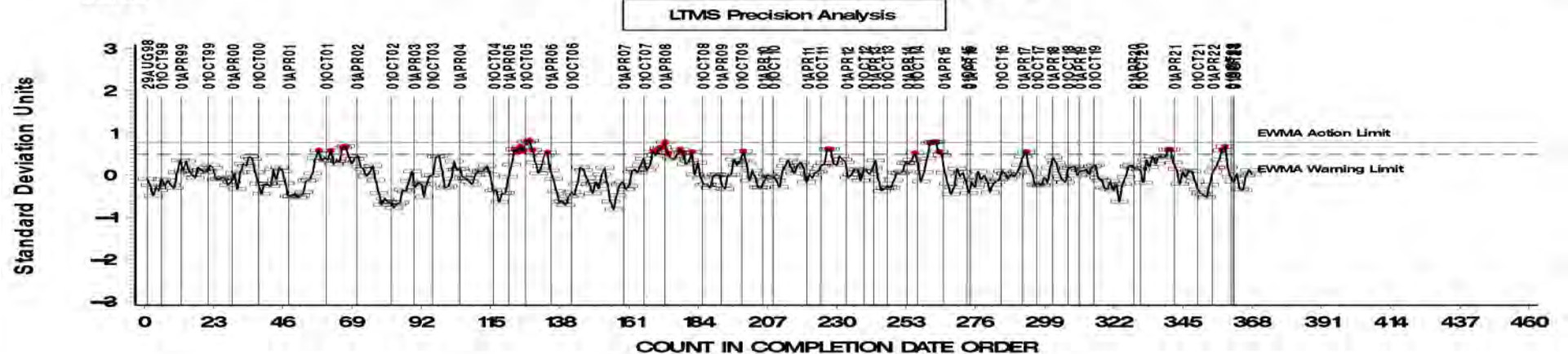
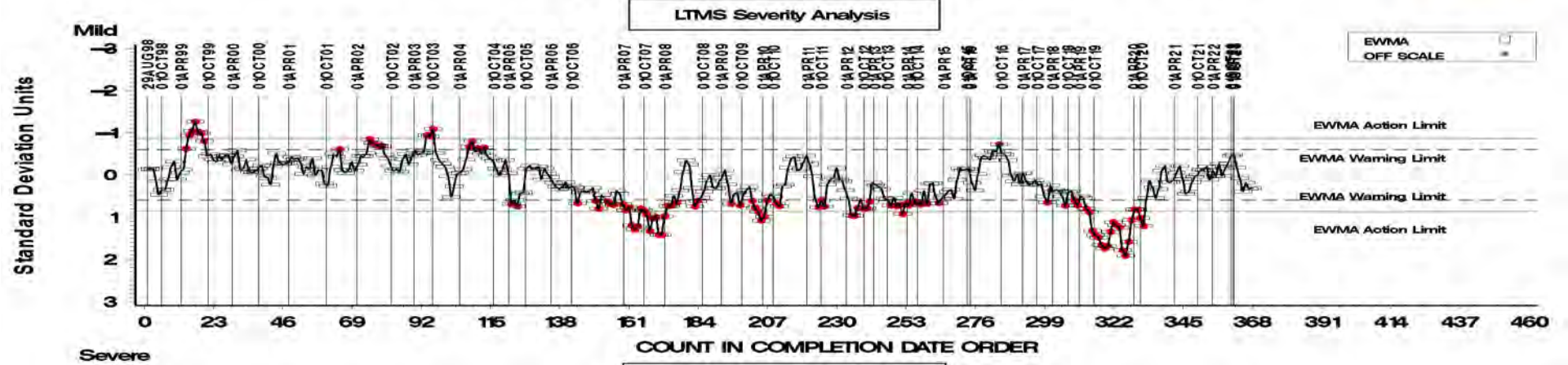
Test Status	#
Stand Precision Shewhart Alarm	1
Total	1

Sequence VIII Test Severity

- BWLS is in control
- SVIS is in control

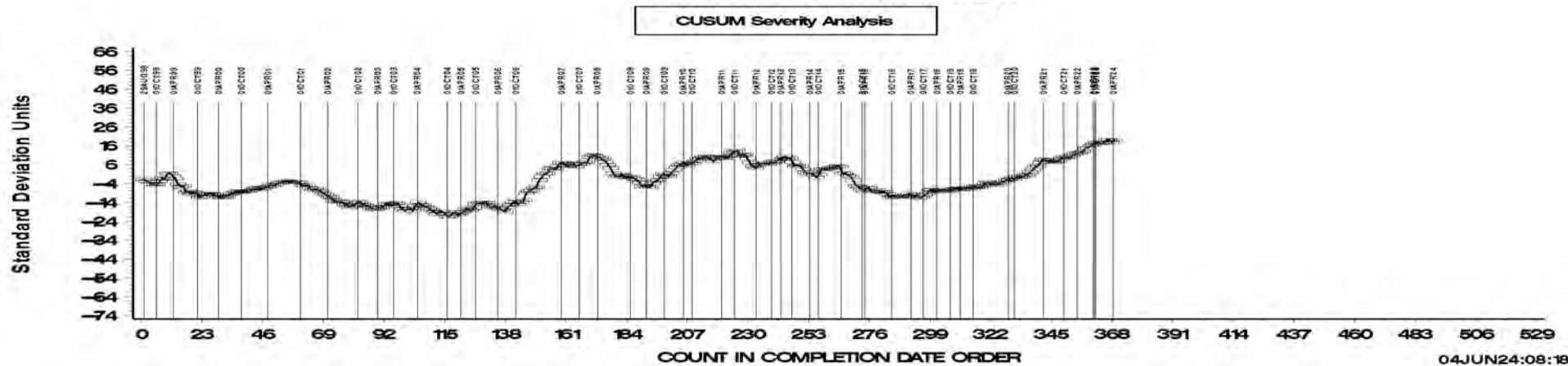
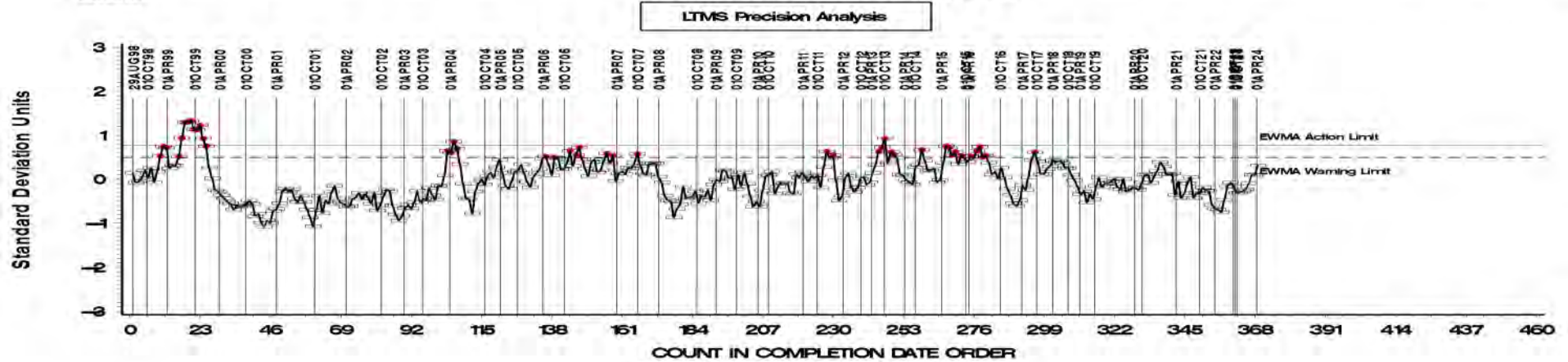
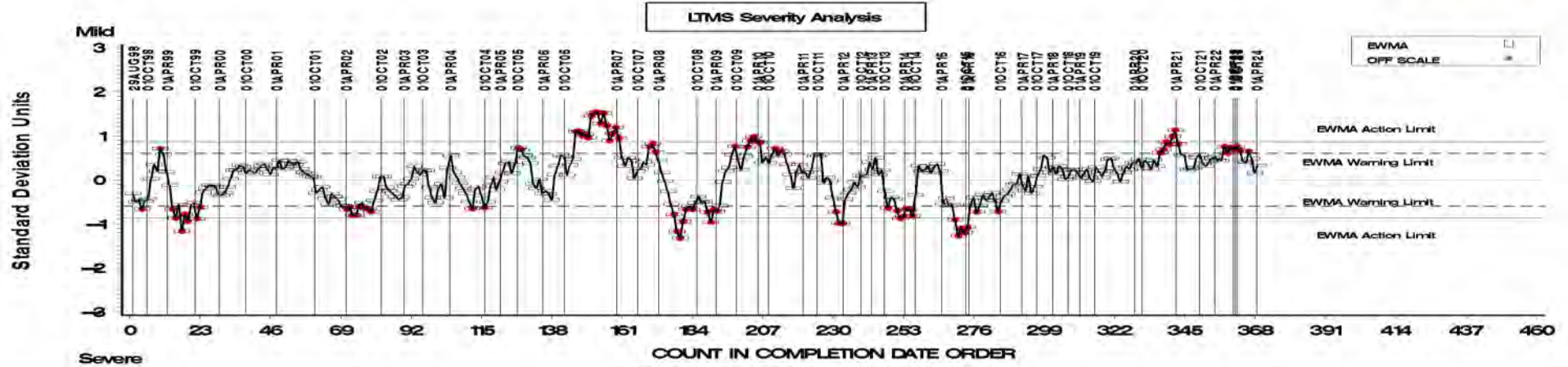
SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

FINAL BEARING WEIGHT LOSS



SEQUENCE VIII INDUSTRY OPERATIONAL VALID DATA

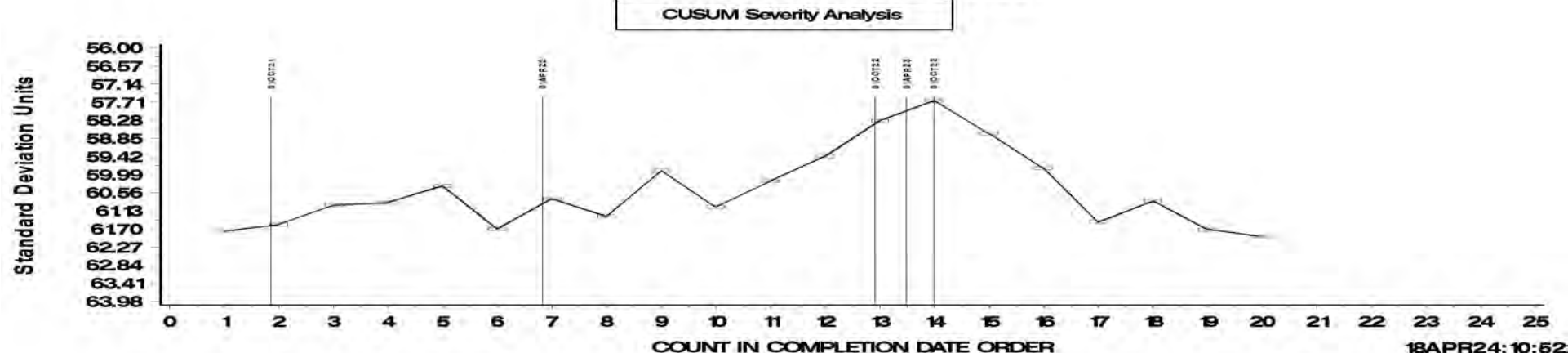
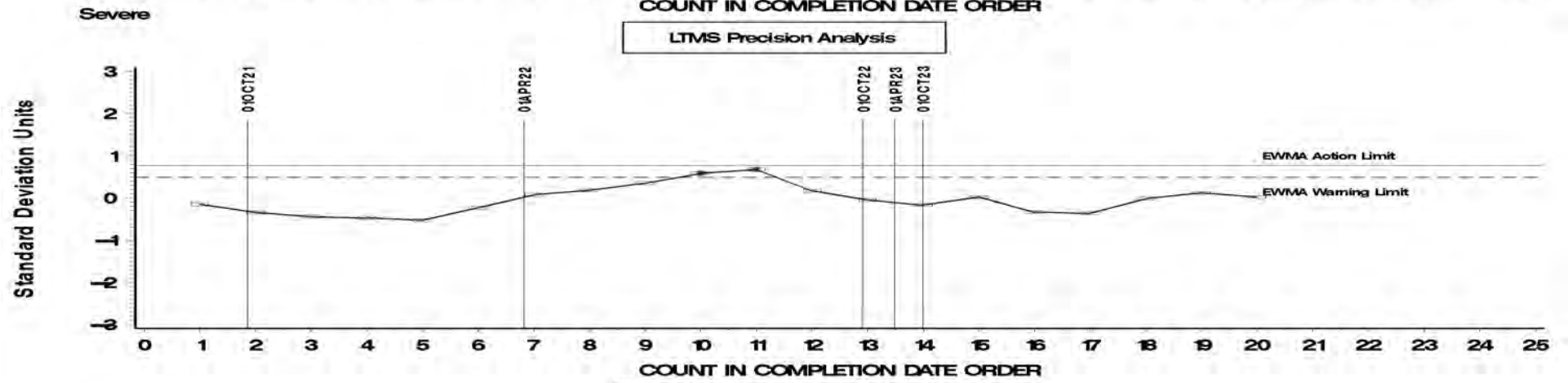
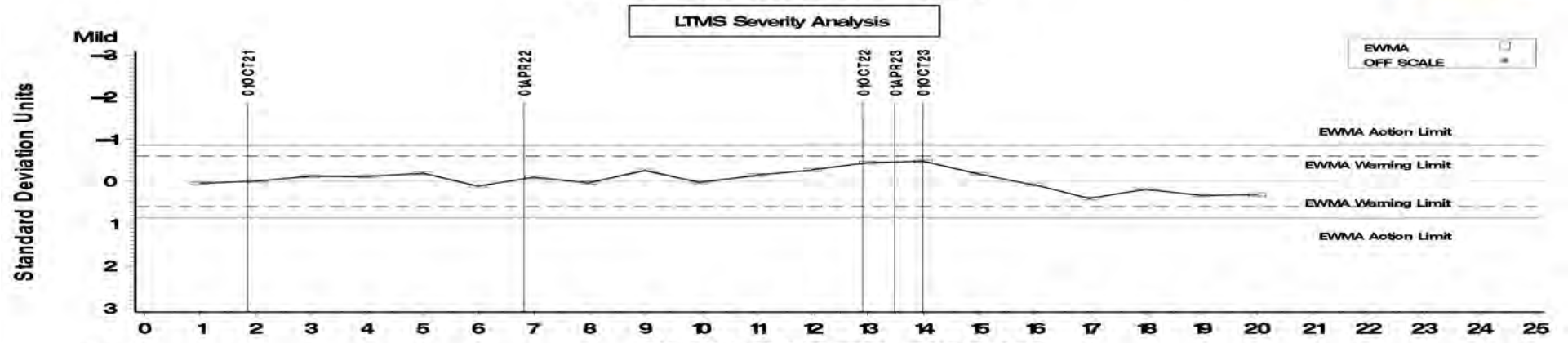
STRIPPED VIS. @ 100 DEG C



SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

Last 20 Tests

FINAL BEARING WEIGHT LOSS

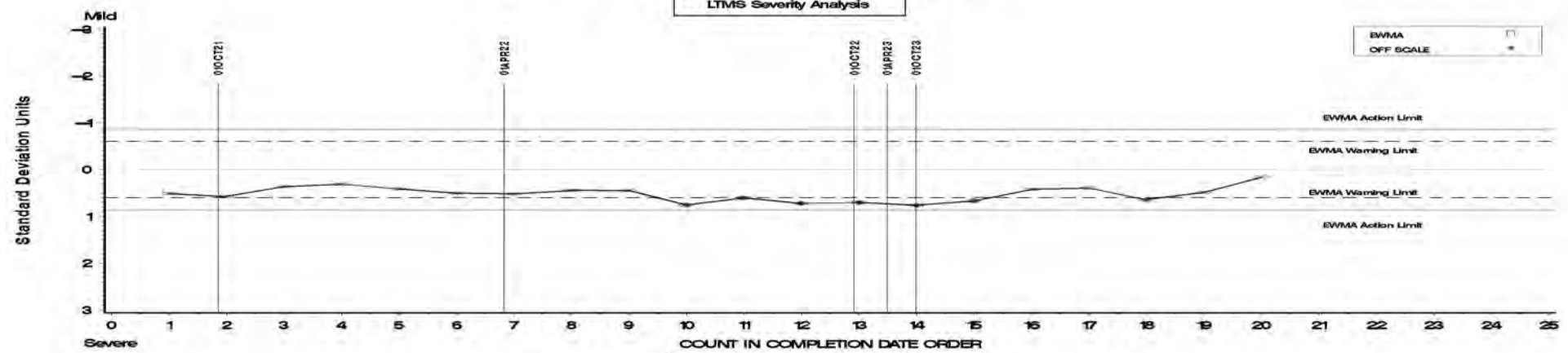


SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

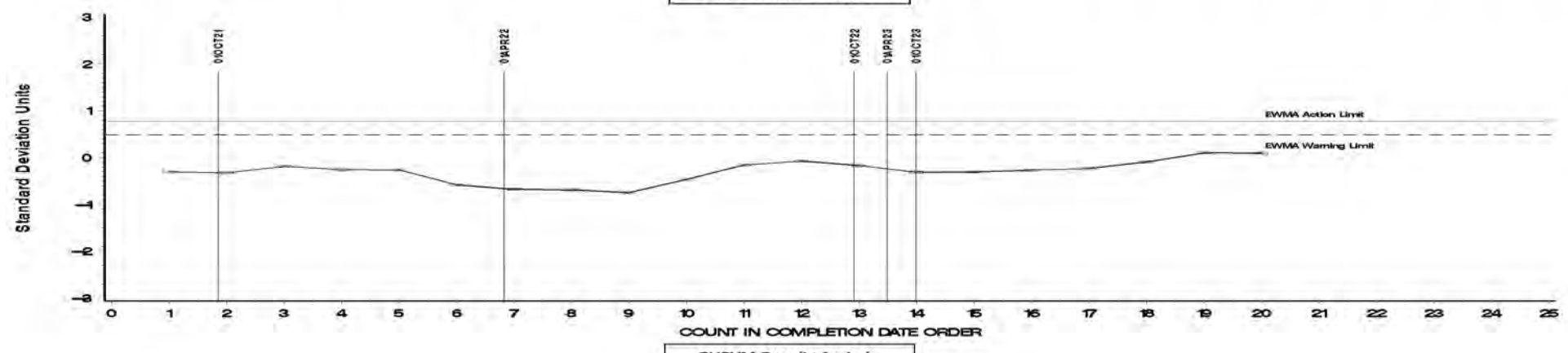
Last 20 results
STRIPPED VIS. @ 100 DEG C



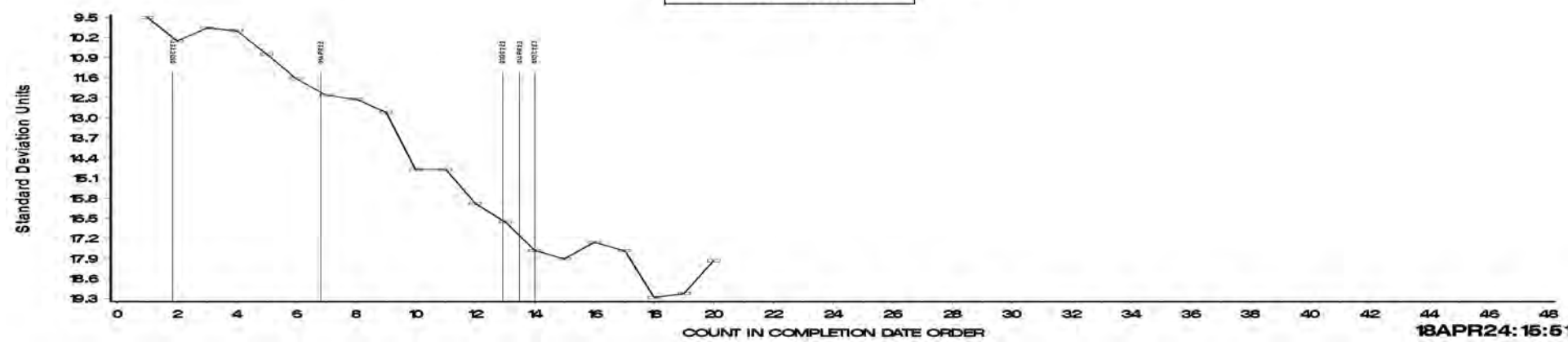
LTMS Severity Analysis



LTMS Precision Analysis

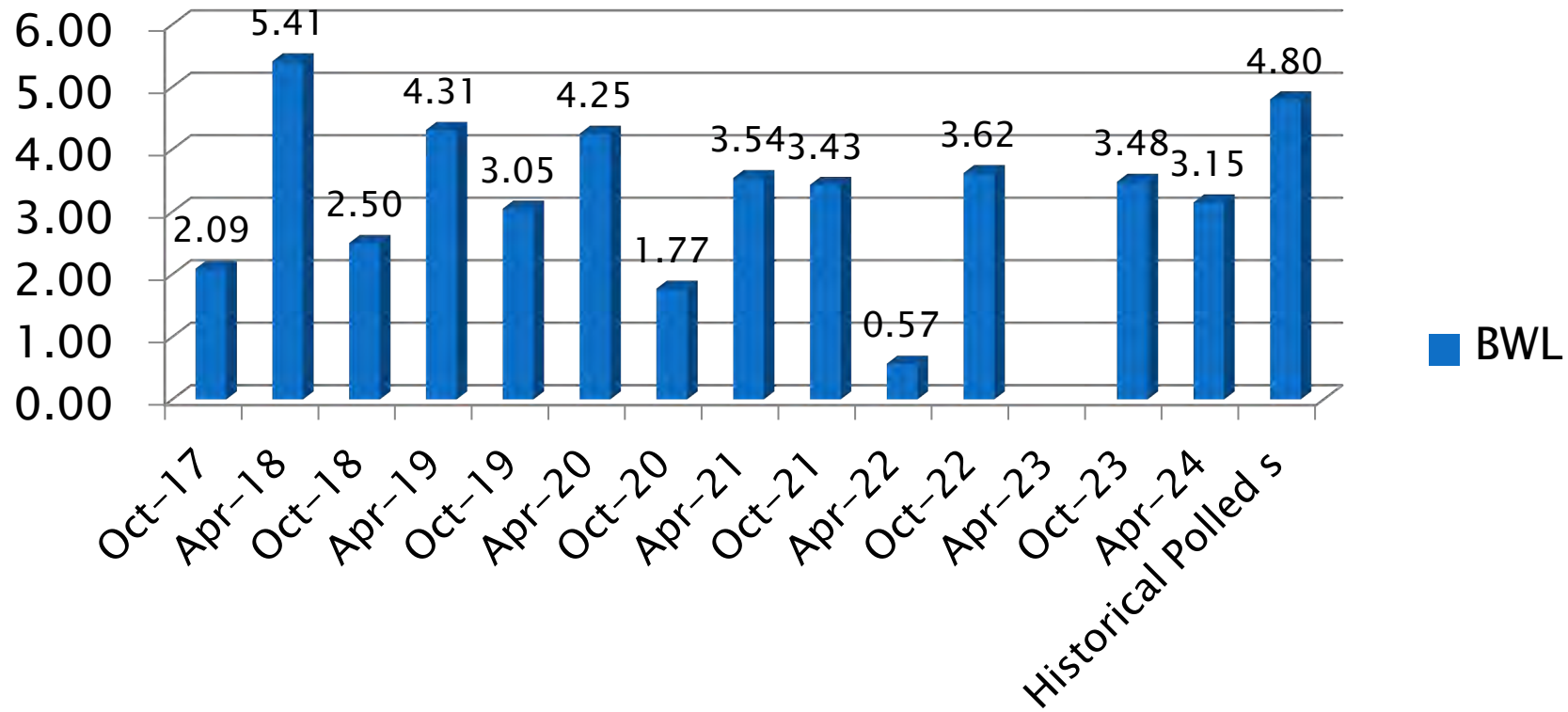


CUSUM Severity Analysis



Sequence VIII Precision Estimates

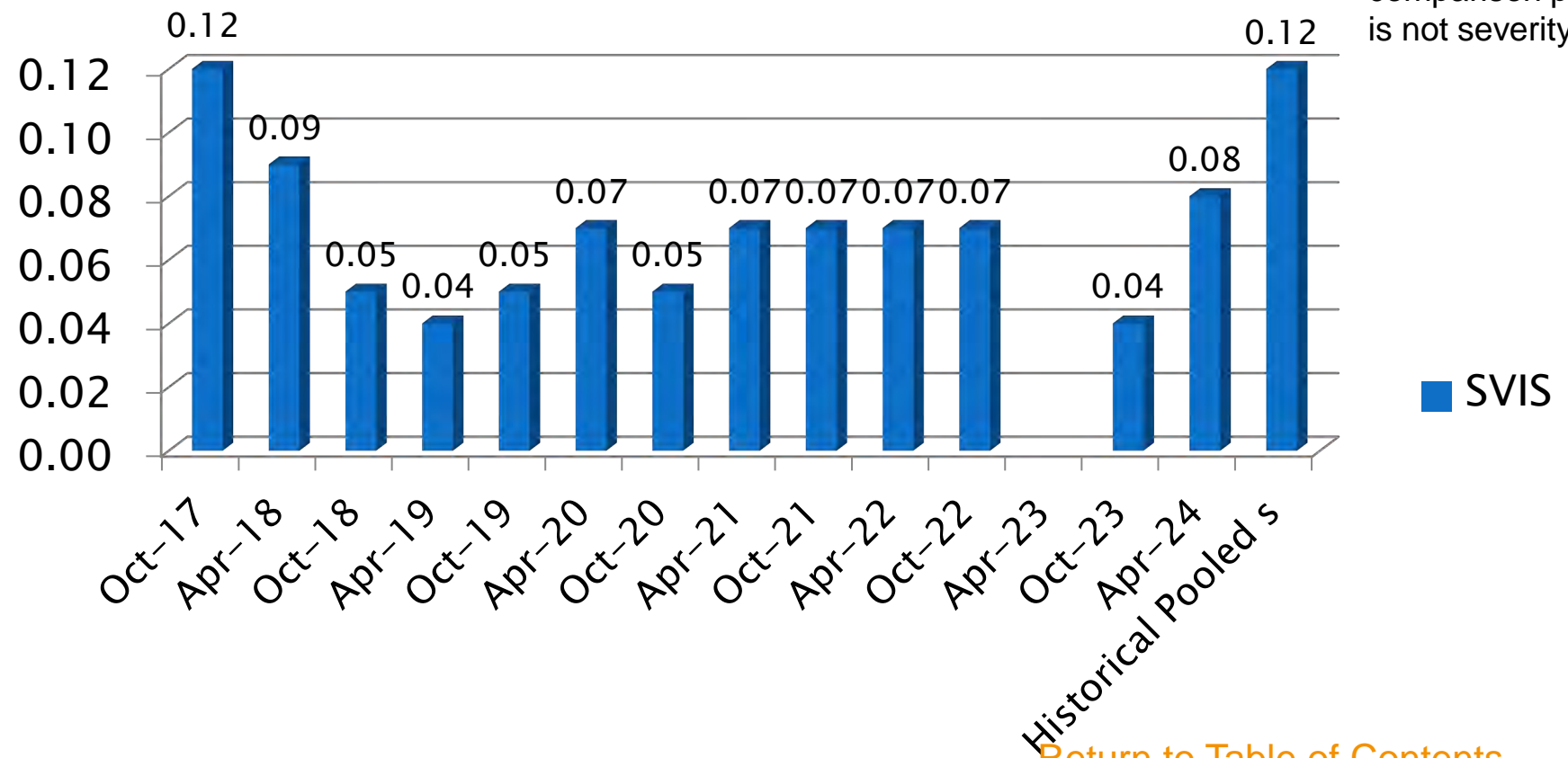
BWL



Sequence VIII Precision Estimates

SVIS

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



[Return to Table of Contents](#)

Sequence IX

➤➤ April 2024

Sequence IX Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	30
Statistically Unacceptable Calibration Test	OC	11
Operationally Invalid Calibration Test (lab judgement)	LC	2
Terminated Early Calibration Test	XC	1
Engine Abandoned	MC	2
Total		46

Sequence IX – Failed Tests

Test Status	Number of Tests
Ei Level 3 alarm (mild direction)	9
Ei Level 3 alarm (severe direction)	2
Total	11

Sequence IX – Lost Tests*

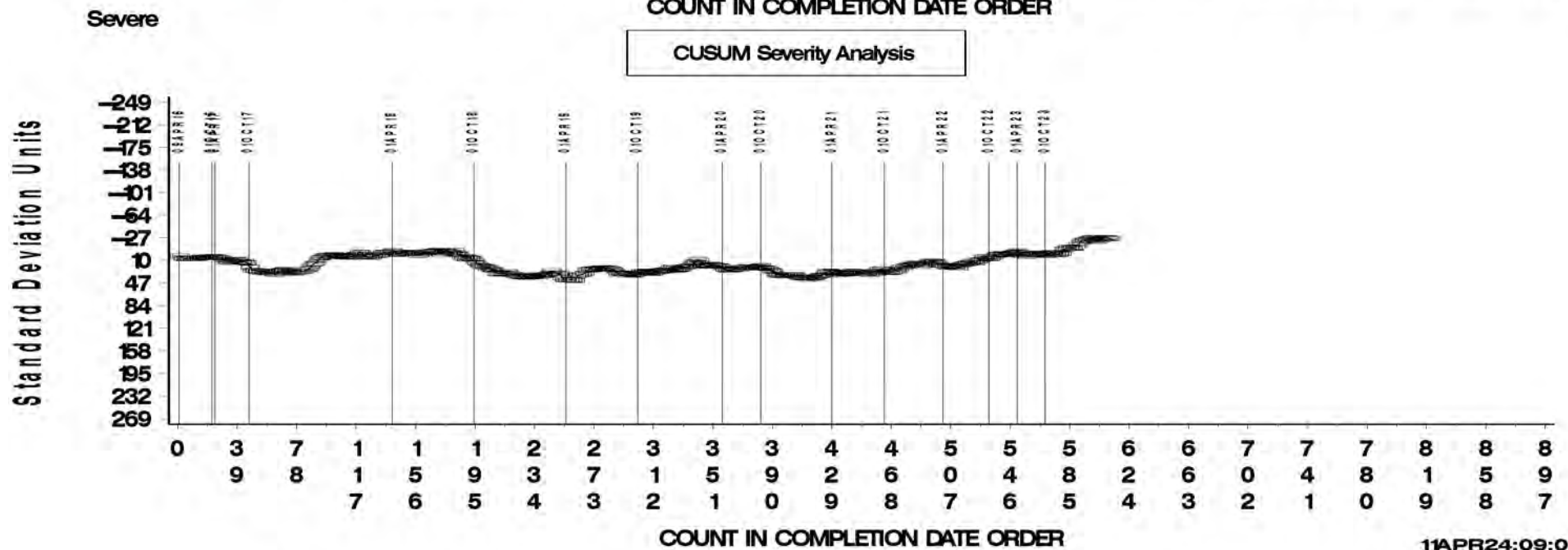
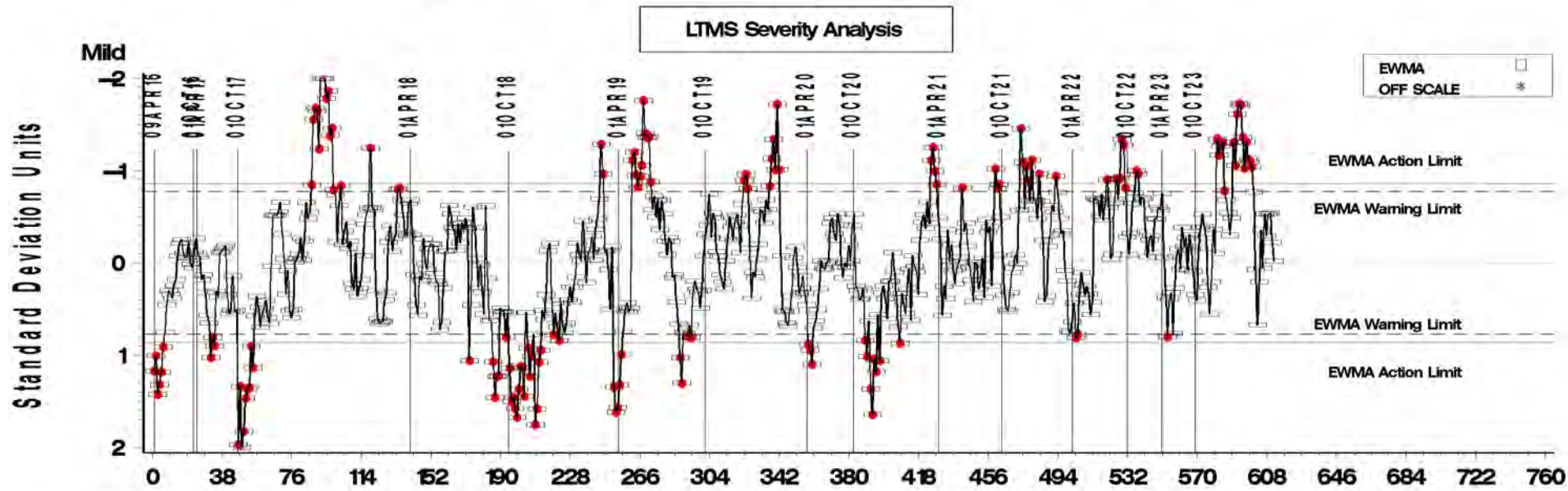
Test Status	Cause	#
Terminated	Exceeded downtime limit	1
Invalid	Coolant out control issues	1
Invalid	Transducer failure	1
Totals		3

*Invalid and aborted tests

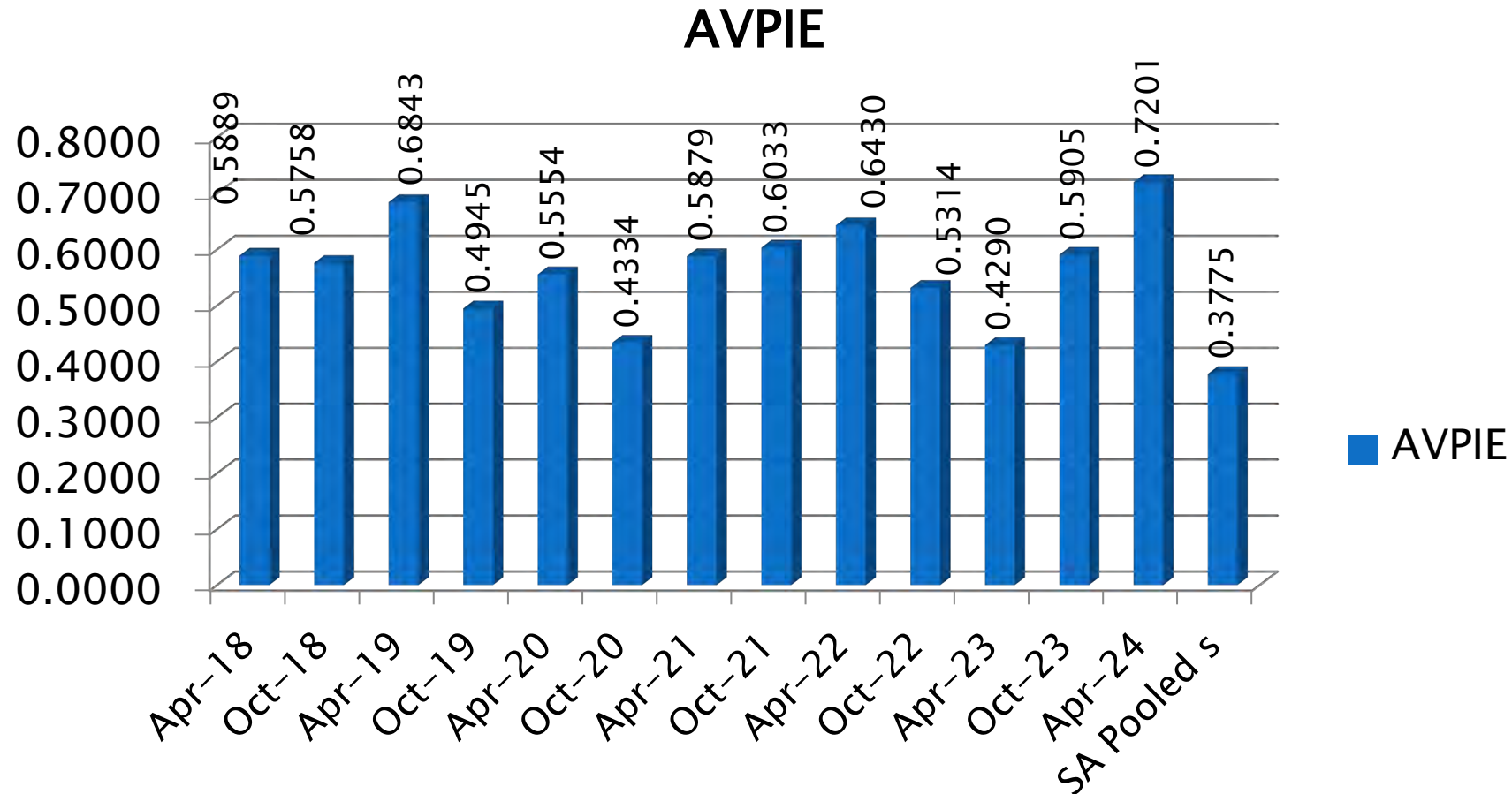
Sequence IX Test Severity

- Average number of Pre-ignitions in control.

AVERAGE NUMBER OF PREIGNITIONS FROM VALID ITERATIONS



Sequence IX Precision Estimates



[Return to Table of Contents](#)

Sequence IXAGED

»» April 2024

Sequence IXAGED Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Operationally Invalid Calibration Test (lab judgement)	LC	1
Total		7

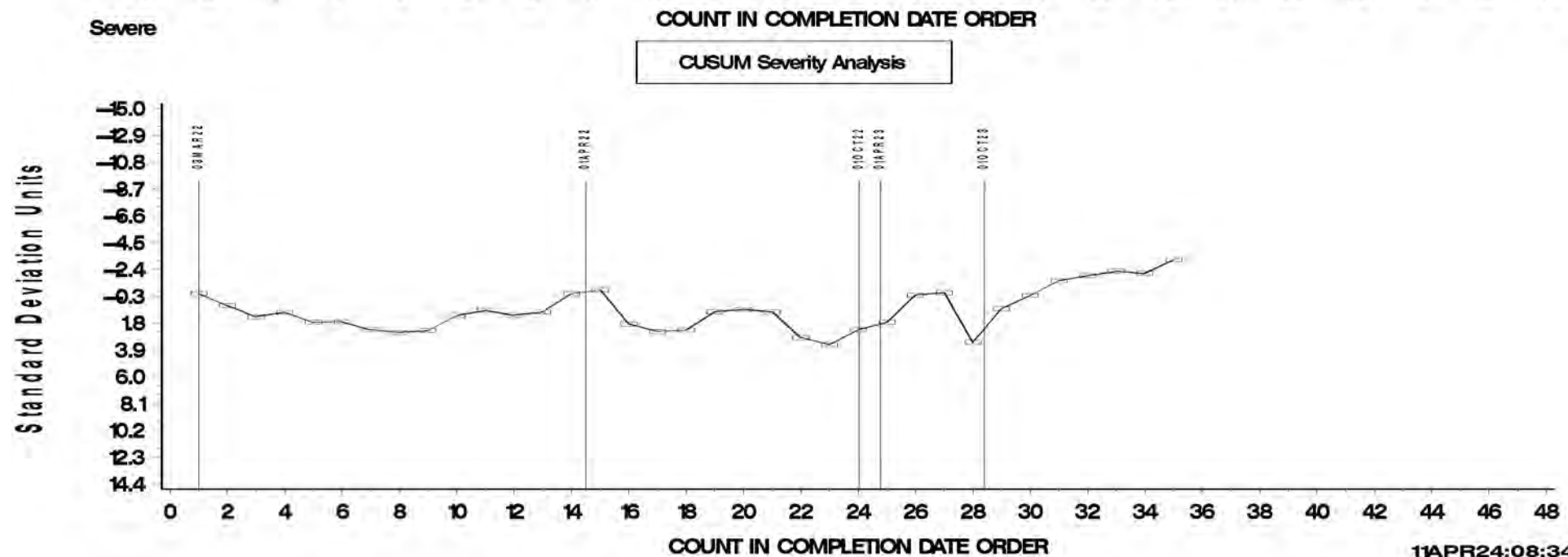
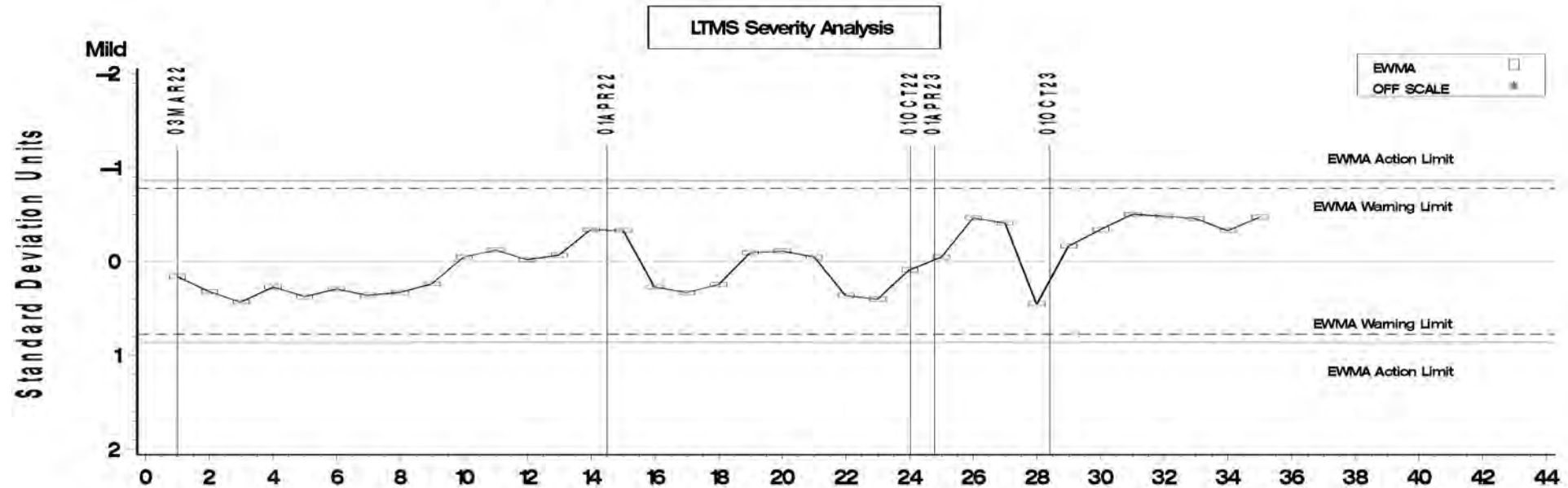
Sequence IXAGED – Invalid Tests

Test Status	Number of Tests
Blowby out of spec during oil aging	1
Total	1

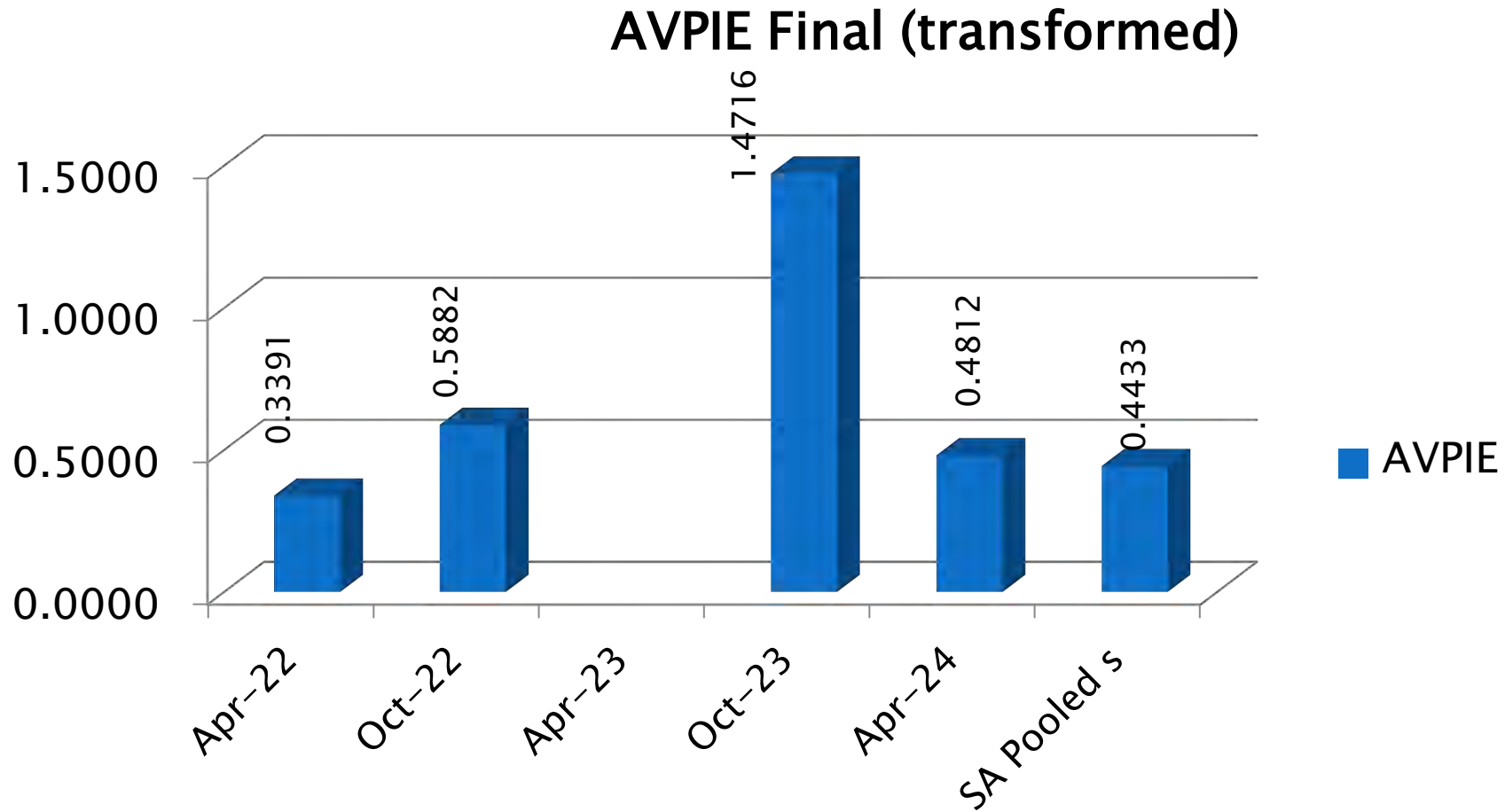
Sequence IXAGED Test Severity

- Average number of Pre-ignitions in control.

AVG # of Preignitions, original units



Sequence IX Precision Estimates



[Return to Table of Contents](#)

Sequence X

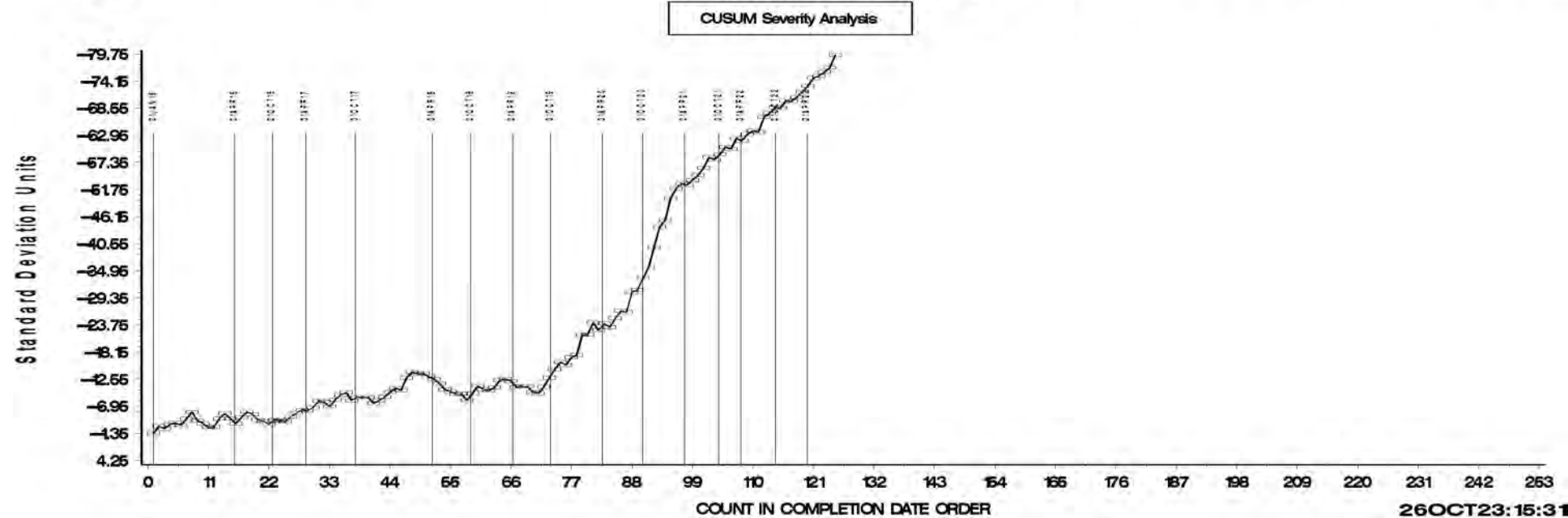
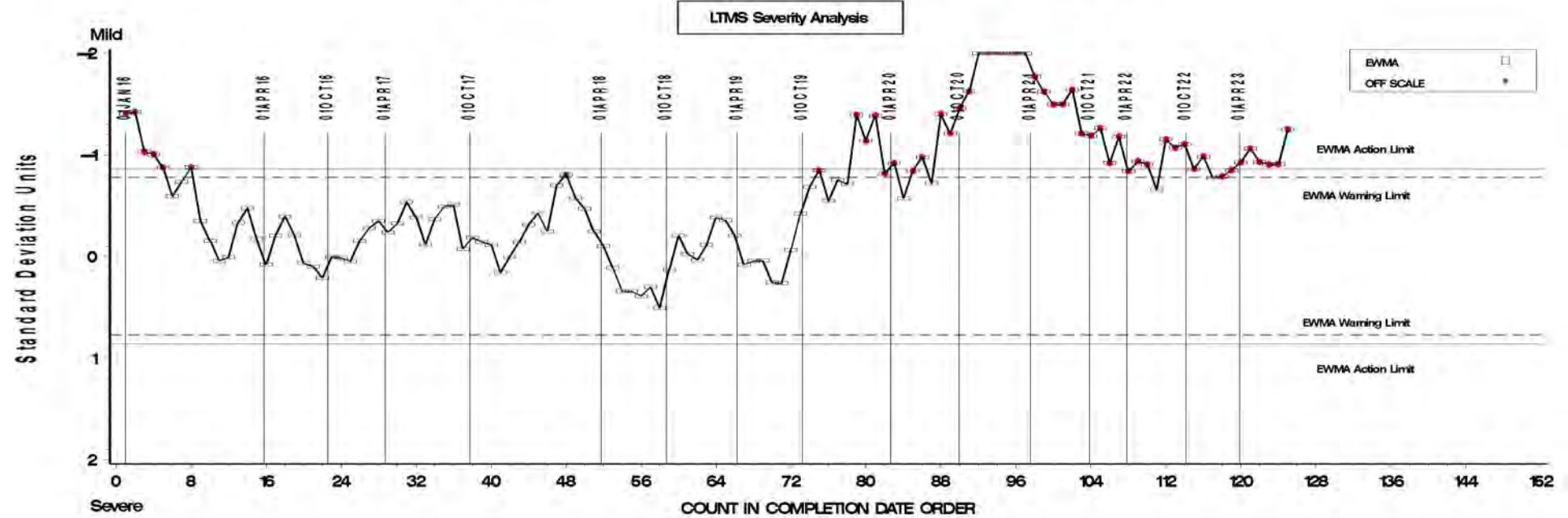


April 2024

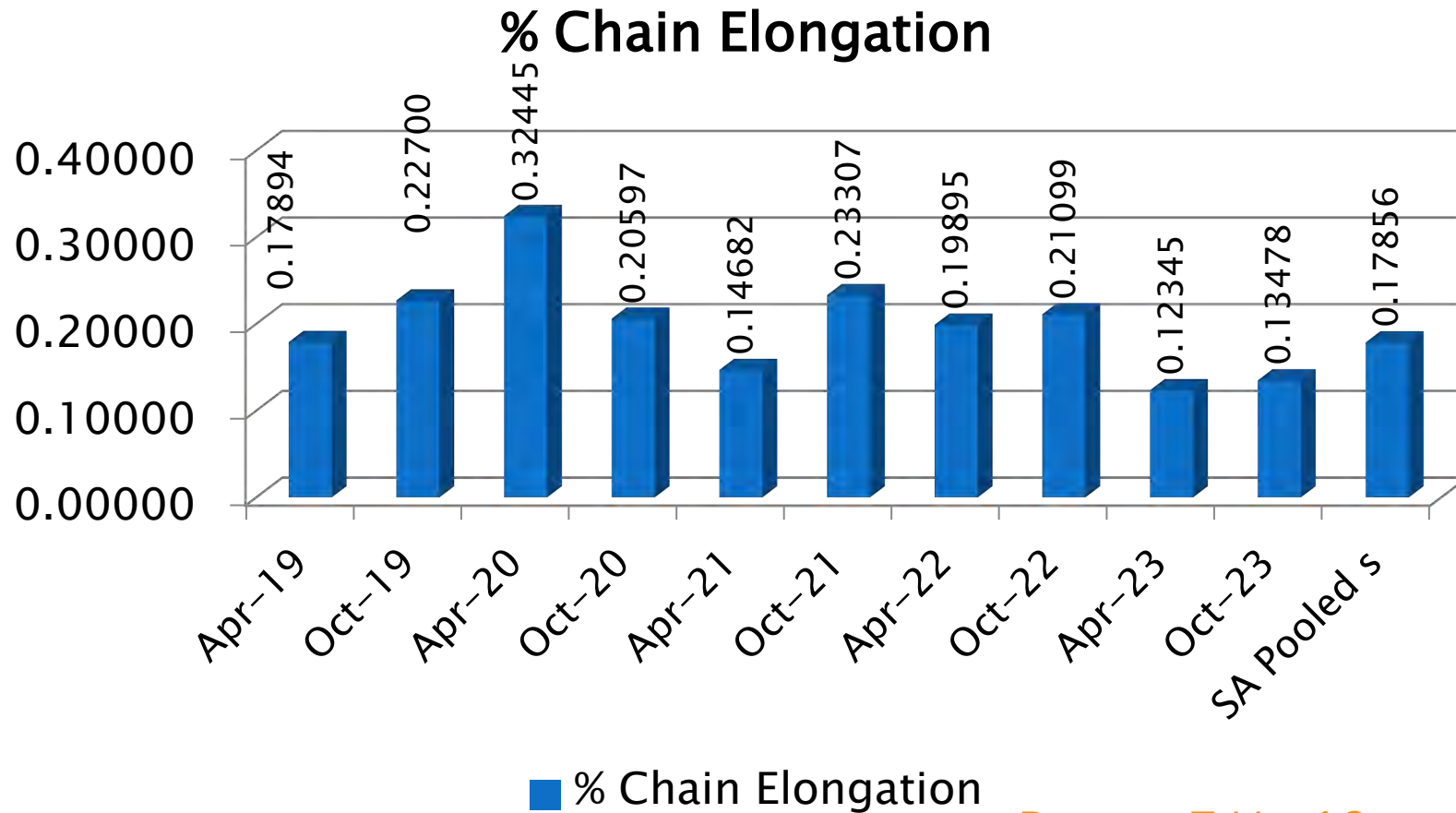
Sequence X Activity

Test Status	Validity Code	#
No Activity this report period	AC	0
Total Number of Tests		0

END OF TEST CHAIN WEAR FINAL RESULT



Sequence X Precision Estimates



[Return to Table of Contents](#)

Information Letters



April 2024

Information Letters*

Test	Date	IL	Topic
IX	20240229	24-1	Added Motorcraft CYFS-12Y-PCT and CYFS-12Y-PCTX sark plugs as alternative to test method
VH	20240229	24-1	Revision to 7.9.4 (6) to specify gasket sealer between cam cap and head and updated gasket kit part number
VH	20240315	24-2	Remove RAC and Cam Baffle Ratings Before Cleaning
VIII	20231013	23-1	Added Industry Correction Factors (ICF) for Stripped Viscosity and Bearing Weight Loss
VIII	20231103	23-2	Added method to report negative values for Bearing Weight Loss
X	20240227	24-1	Added Motorcraft CYFS-12Y-PCT and CYFS-12Y-PCTX sark plugs as alternative to test method

*Available from TMC Website

[Return to Table of Contents](#)

Test Monitoring Center
<https://www.astmtmc.org>



Reference Oil Inventory



Actions, Re-blends, Inventories
and Estimated Life

Reference Oil Re-blends

➤ TMC 220 and 224

- A reblend for reference oil 220 has been received and is currently being introduced. Reference oil 224-1 was introduced over the past few reference periods, with twenty-five results reported from four labs. No target updates for this oil are planned at this time.

➤ TMC 704-1

- The supplier has been contacted and this oil can not be reblended. The VIII panel dropped this oil.

➤ TMC 940

- A limited quantity remains of reference oil 940. A reblend of this oil, 940-1 has been obtained by the TMC. The panel agreed to suspend the use of this oil until additional results on the other two oils with the new fuel batch could be evaluated.

Reference Oil Re-blends

➤ TMC API01 and API02

- Reblends for both IXAGED reference oils are available at TMC and several labs. The panel will need to address introduction of these reference oils.

➤ TMC 1006-2

- Less than 20 gallons remain at TMC. The Sequence VIII has dropped this oil because of age concerns and replaced it with 1009-1. The Sequence IVA will continue to use this oil for the foreseeable future.

Reference Oil Inventory Estimated Life

<u>Oil</u>	<u>Tests</u>	<u>Year</u>	<u>Blend Quantity</u>	<u>TMC Inventory</u>	<u>Estimated Life</u>	<u>Comment</u>
220-1	IX	2022	1060	1020	>5	Break-In oil only
221	IX	2015	2091	69	<1	
224-1	IX	2022	220	13	<1	
270	X	2015	1100	496	5	
271	X	2015	980	607	5	
300-1	IVB	2017	378	185	3	
434-3	IIIH, GMOD	2017	980	586	>5	
436	IIIH	2014	1100	545	>5	
438-2	IIIH	2017	540	336	5	
542-5	VIE, VIF	2021	1060	557	2	
543-1	VIF	2020	1000	932	>5	
544	VIE	2015	1003	64	1	
931	VH	2020	912	755	>5	
940-1	VH	2018	485	485	>5	
1006-2	IVA, VIII	2000	5500	10	3	Beyond useful life
1009-1	VIII	2017	1000	854	>5	
1010-2	VIE	2022	555	305	2.5	
1011-1	IVB, VH, VF, X	2019	1395	824	4	
1012	IVB	2017	2145	1079	>5	
API01-1	IXAGED	2021	480	464	>5	Awaiting introduction
API02-1	IXAGED	2021	473	457	>5	

LTMS Deviations



October 1, 2023–March 31, 2024

LTMS Deviations

- No LTMS Deviations this period

LTMS Deviations

Historical Count of PCEO LTMS Deviations

Test	LTMS Deviations
IIIH	0
IVA	7
IVB	0
VH	0
VIE	0
VIF	0
VIII	3
IX	0
X	0

[Return to Table of Contents](#)

Quality Index Deviations



October 1, 2023–March 31, 2024

Quality Index Deviations

- Two deviations were issued this period:
 - Sequence IVA – Deviation for speed due to a stalling issue which picked up several low data points.
 - Sequence IX – Intake air temperature issues caused by an intermittent heater failure.

Quality Index Deviations

Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIH	8
IVA	33
IVB	2
VH	11
IX	3
X	3

[Return to Table of Contents](#)

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TMC Laboratory Visits

➤➤ October 1, 2023–March 31, 2024

Test Monitoring Center
<https://www.astmtmc.org>



TMC Lab Visits

Test	Number of Labs Visited
IIIH	3
IVB	2
IX	3
VH	4
VIE/VIF	4
VIII	0
X	1

Lab Visit Issues

- ▶ Sequence IIIH
 - No documentation to support NOx sensors being calibrated.
- ▶ Sequence IVB
 - Incorrect length thermocouple installed.
- ▶ Sequence VH
 - Oil heater not properly located.
 - VH-O₂ Sensor not installed in proper location (multiple labs).
- ▶ Sequence IX
 - IX-Instrument calibrations not being performed every 3 months.

Test Area Timelines

➤➤ October 1, 2023–March 31, 2024

Test Area Timeline Additions*

Test	Date	Topic	IL
IX	20240229	Added Motorcraft CYFS-12Y-PCT and CYFS-12Y-PCTX sark plugs as alternative to test method	24-1
VH	20240229	Revision to 7.9.4 (6) to specify gasket sealer between cam cap and head and updated gasket kit part number	24-1
VH	20240315	Remover RAC and Cam Baffle Ratings Before Cleaning	24-2
IVB	20231130	Revised method for sulfur determination in fuel and allowed alternate coolant pump motor	23-2
VIII	20231013	Added Industry Correction Factors (ICF) for Stripped Viscosity and Bearing Weight Loss	24-1
VIII	20231103	Added method to report negative values for Bearing Weight Loss	24-1
X	20240227	Added Motorcraft CYFS-12Y-PCT and CYFS-12Y-PCTX sark plugs as alternative to test method	24-1

*As of 03/31/2024

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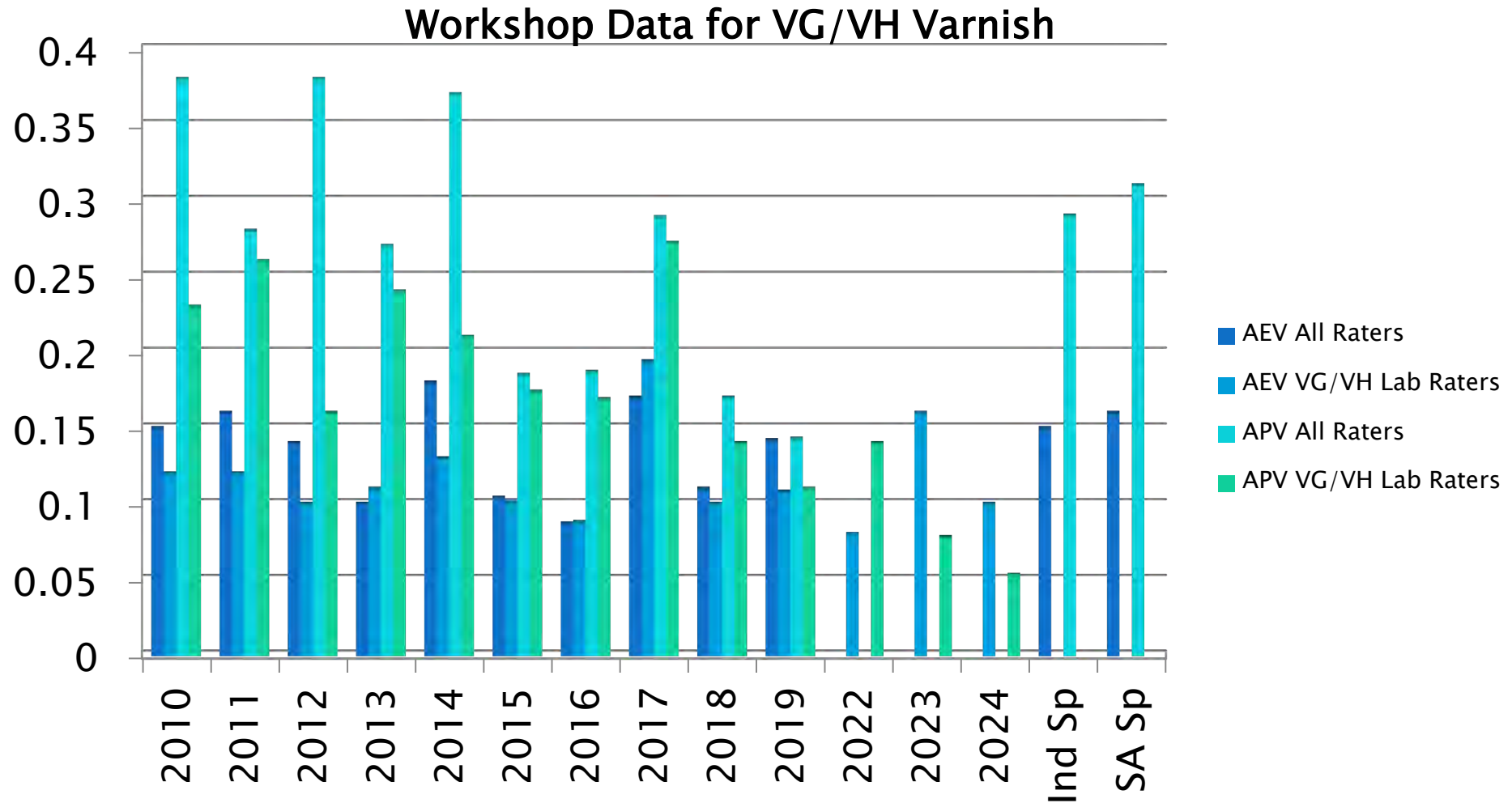
Rating Workshop Data

➤➤ 2024 ASTM Deposit Rating Workshop

Rating Workshop Data

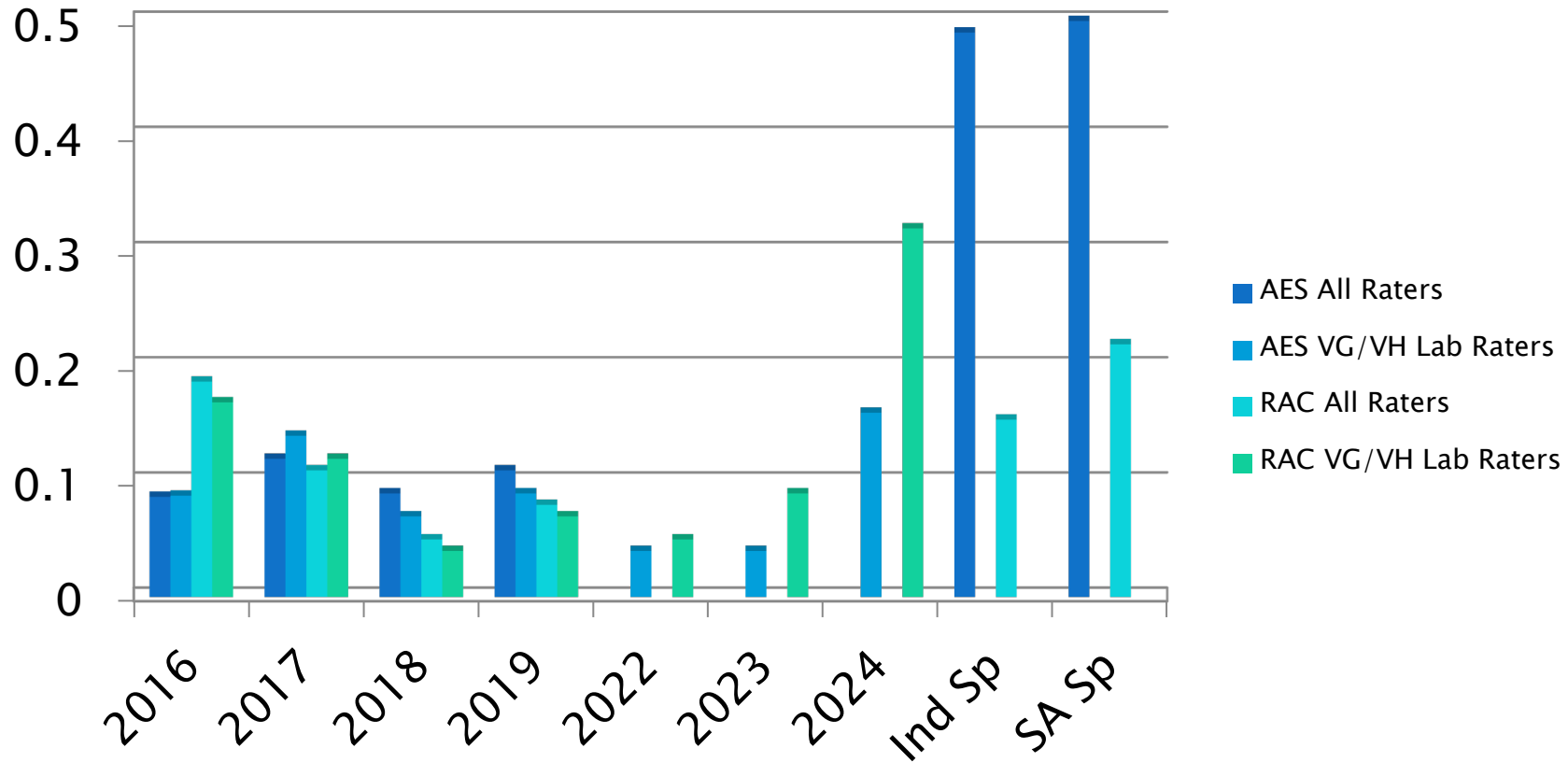
- ▶ Summary of Precision Data From Light Duty Rating workshops:
 - VH Average Piston, Average Engine Varnish.
 - VH Sludge added for this workshop as calibration requirement
 - IIIH WPD
 - The 2022 and subsequent workshops only includes raters from calibrated labs.

Sequence VG/VH Precision-Rating Workshop Data



Sequence VH Precision–Rating Workshop Data

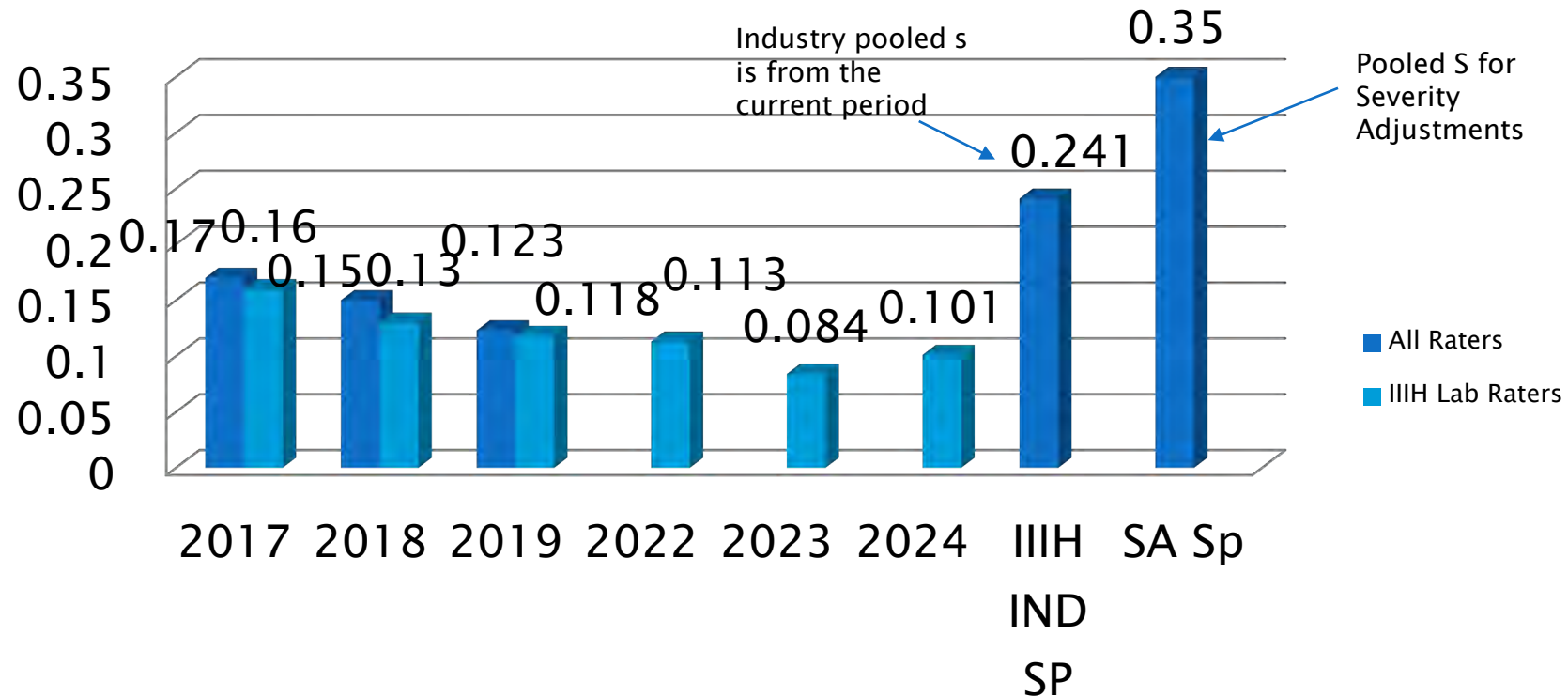
Workshop Data for VH Sludge



Sludge parameters were added for rater calibration in 2019

Sequence IIH Precision – Rating Workshop Data

Comparison of Workshop Pooled Standard Deviations with Industry Pooled Standard Deviations



[Return to Table of Contents](#)

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
- ▶ <https://www.astmtmc.org>

[Return to Table of Contents](#)

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