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Test Monitoring Center

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ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing

April 2023

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Passenger Car Engine Oil Testing Executive Summary

- Reference oils 704-1 and 224
  - Both oils have been depleted at the TMC.
  - A reblend of 224 is available for introduction.
  - Reference oil 704-1 cannot be re-blended
- Reblends of oils 1010-1, 543, 542 and 940.
  - Inventories are low on the current blends of these oils and reblends are available for introduction. Oils 542-5 and 1010-2 are currently being introduced, with four tests reported on 542-5 and two tests completed on 1010-2.

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Passenger Car Engine Oil Testing
Executive Summary (cont.)

- IIIH PVIS/MRV Trend
  - Both PVIS and MRV have been trending mild and have been encountering sporadic warning and action alarms. The panel may wish to further evaluate this situation.
- Sequence VIE Severity
  - Both FEI1 And FEI2 have exhibited long term severe trends as evidenced by Cusum and EWMA charts. The Sequence VI panel has formed a task force to try and understand the continuing severity trend and should here a report from this task force during its next meeting.

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Passenger Car Engine Oil Testing
Executive Summary (cont.)

- Aged Oil LSPI
  - The Sequence IX panel recently approved a modification to Test Method D8291 to allow for an aging process to be included in the LSPI test.

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Passenger Car Engine Oil Testing
Executive Summary (cont.)

- New blend of VH Fuel
  - A new blend of VGM2 was approved in January and a number of stands in multiple labs have successfully calibrated on the new batch.
- New blend of VIE Baseline and Flush Oil
  - A new blend of VIE Baseline and Flush oil has been obtained. Awaiting completion of additional testing and analysis for approval.

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Passenger Car Engine Oil Testing
Executive Summary (cont.)

- Sequence VIII is currently Unavailable
  - No lab is able to calibrate due to severity issues in both labs. The laboratories and panel are working to identify the cause and take corrective action.

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Calibrated Labs and Stands*

Test	Labs	Stands
IIIH/A/B	5	11
IVA	2	2
IVB	4	7
VH	5	11
VIE	4	8
VIF	2	3
VIII	0	0
IX	3	4
X	4	6

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*As of 3/31/2023

Sequence IIIH/A/B

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Sequence IIIH/A/B Activity

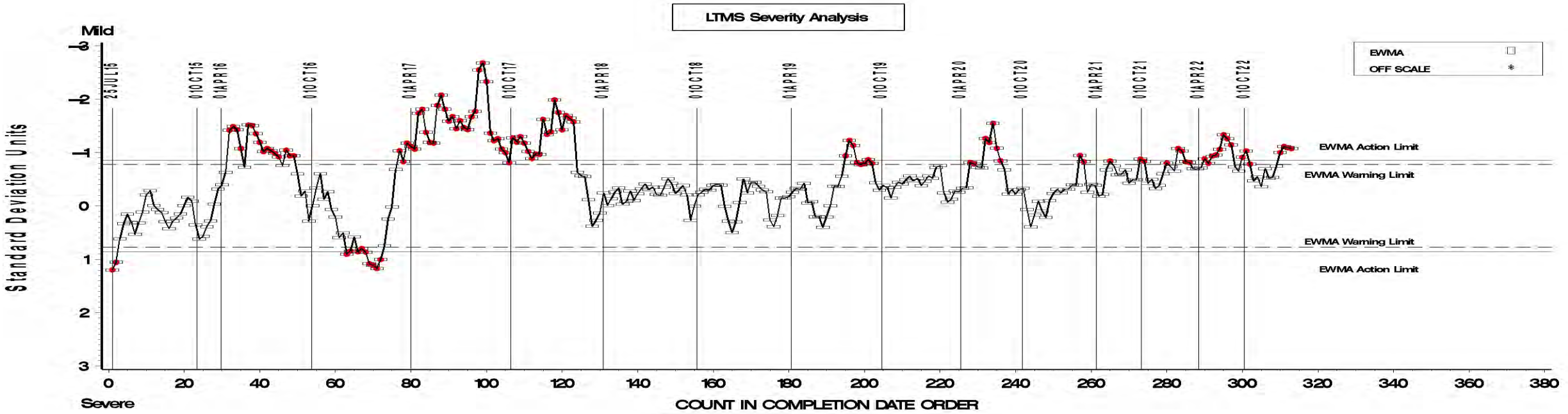
Test Status	Validity Code	#
Acceptable Calibration Test	AC	13
Total		**13**

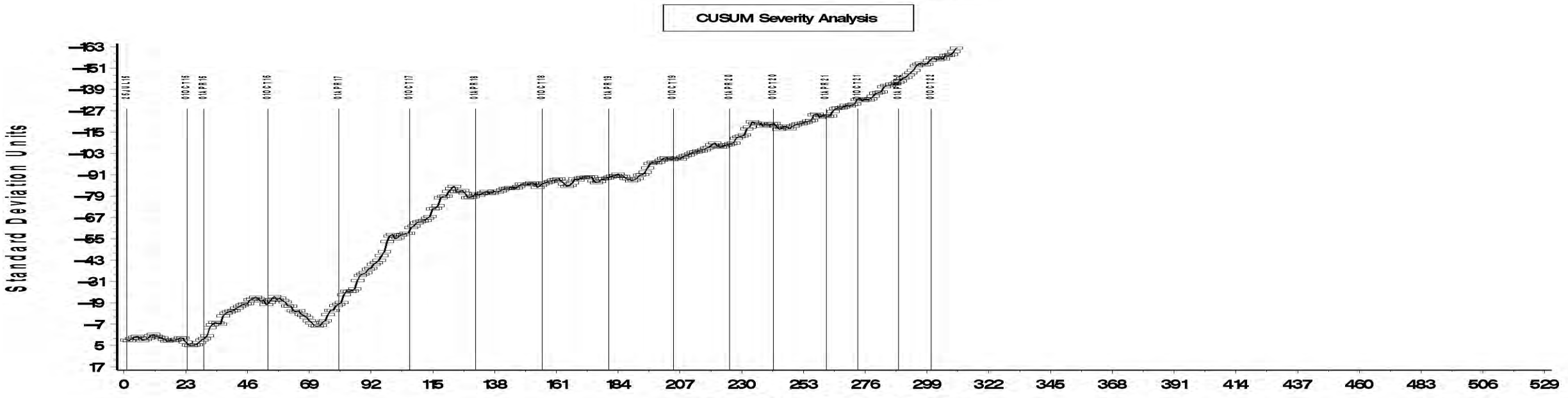
Sequence IIIH Test Severity

- APV and PVIS are in action alarm (mild direction)
- MRV is in warning alarm (mild direction)
- All other parameters are in control.

SEQUENCE IIIH INDUSTRY OPERATIONALLY VALID DATA

VISCOSITY INCREASE FINAL ORIG UNIT RES





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SEQUENCE IIIH INDUSTRY OPERATIONALLY VALID DATA

AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG U

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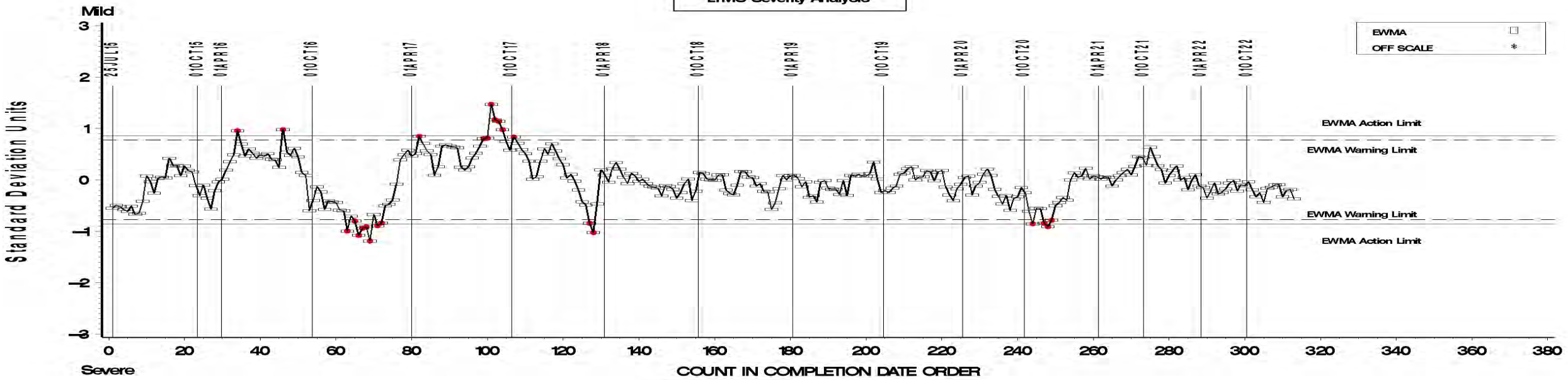
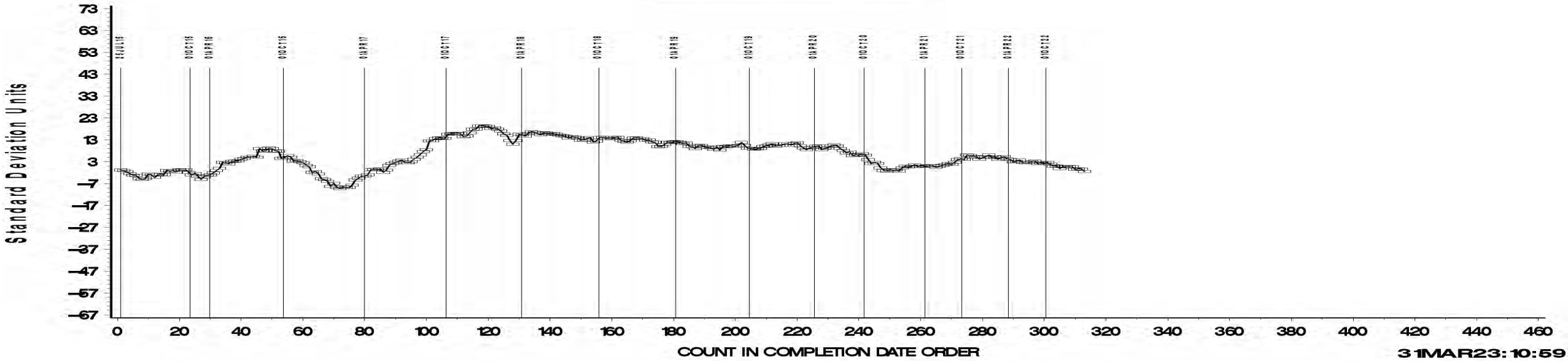
LTMS Severity Analysis



CUSUM Severity Analysis



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SEQUENCE IIIH INDUSTRY OPERATIONALLY VALID DATA

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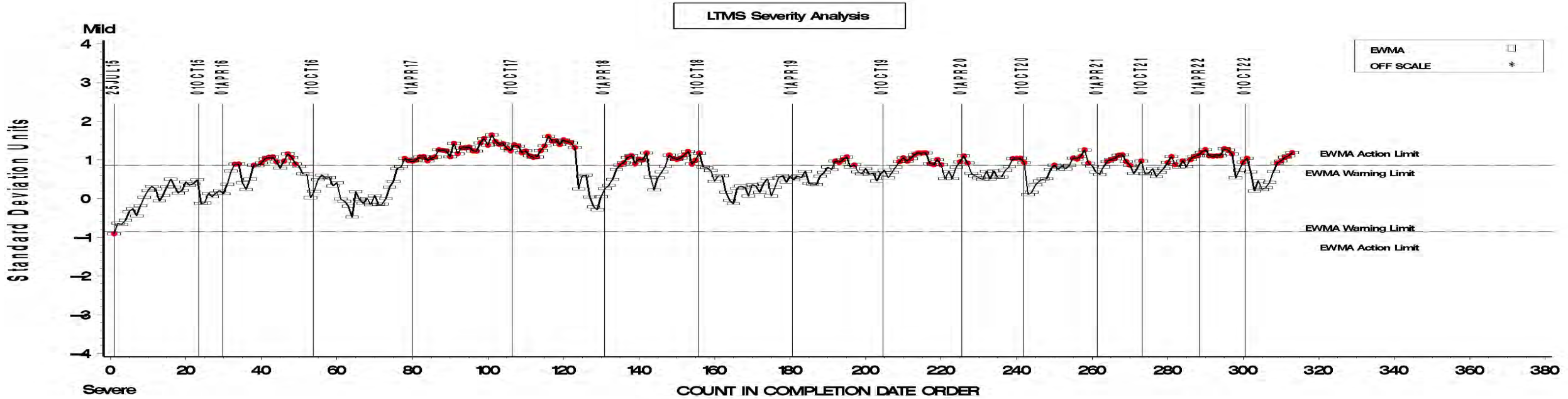
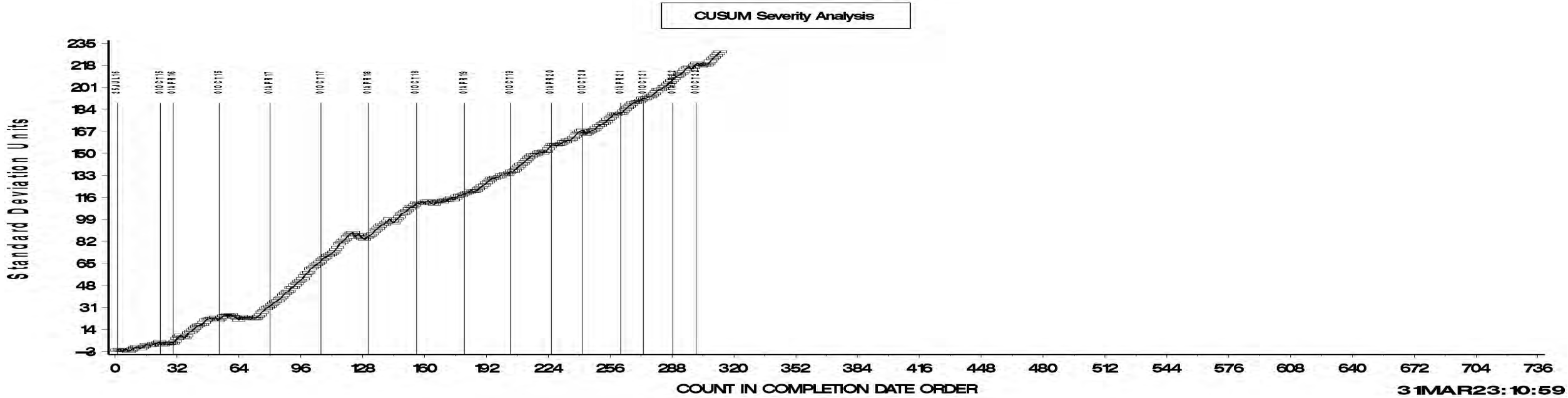
AVERAGE PISTON SKIRT VARNISH





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SEQUENCE IIIHA INDUSTRY OPERATIONALLY VALID DATA

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

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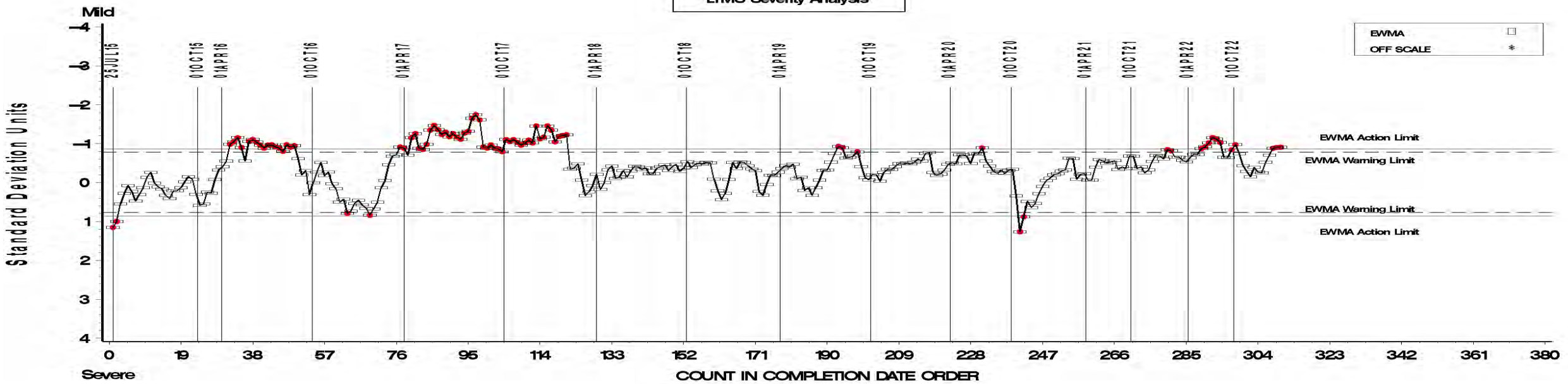
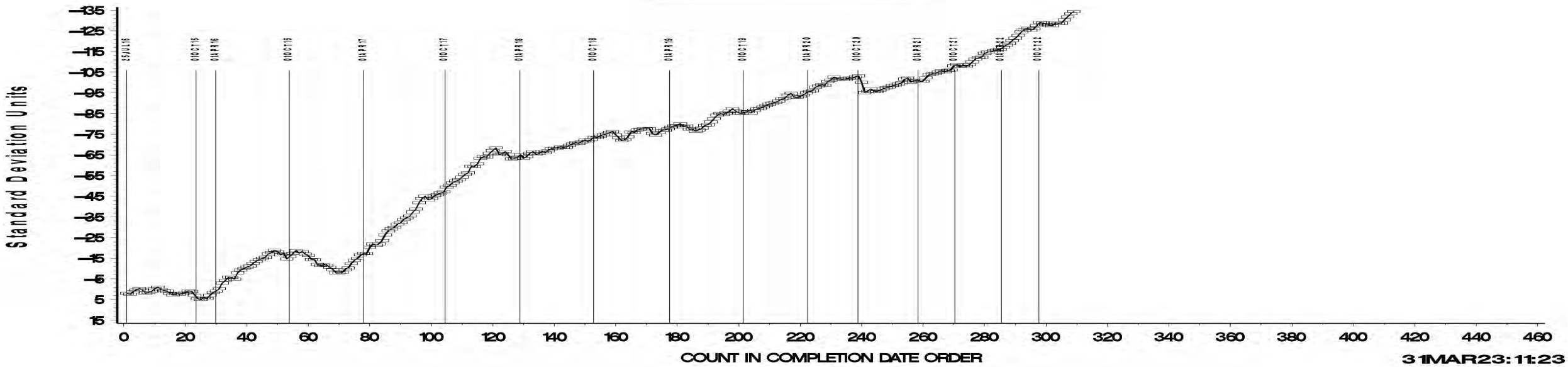
LTMS Severity Analysis



CUSUM Severity Analysis



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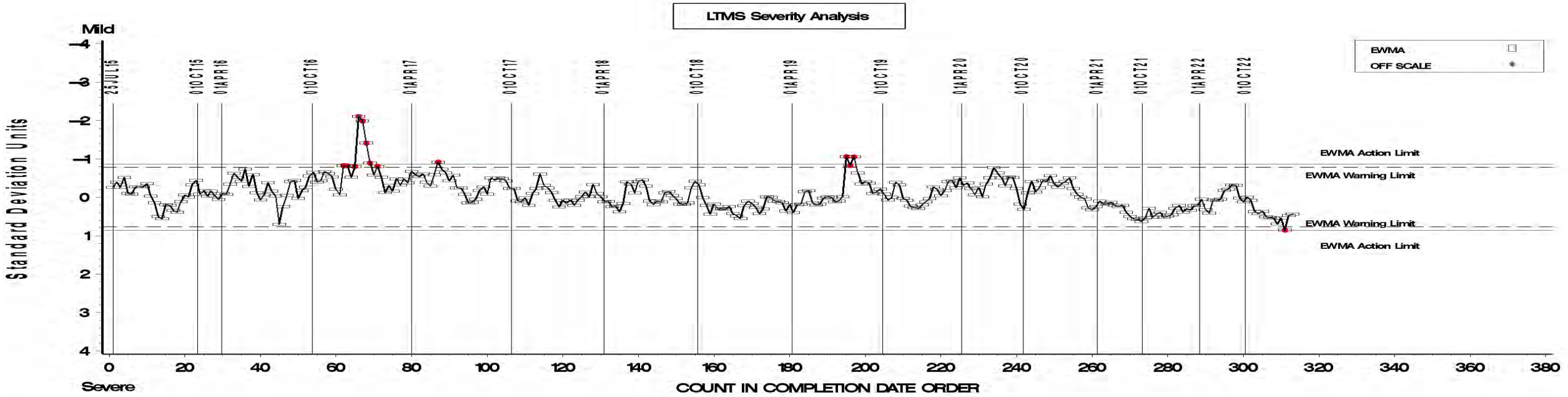
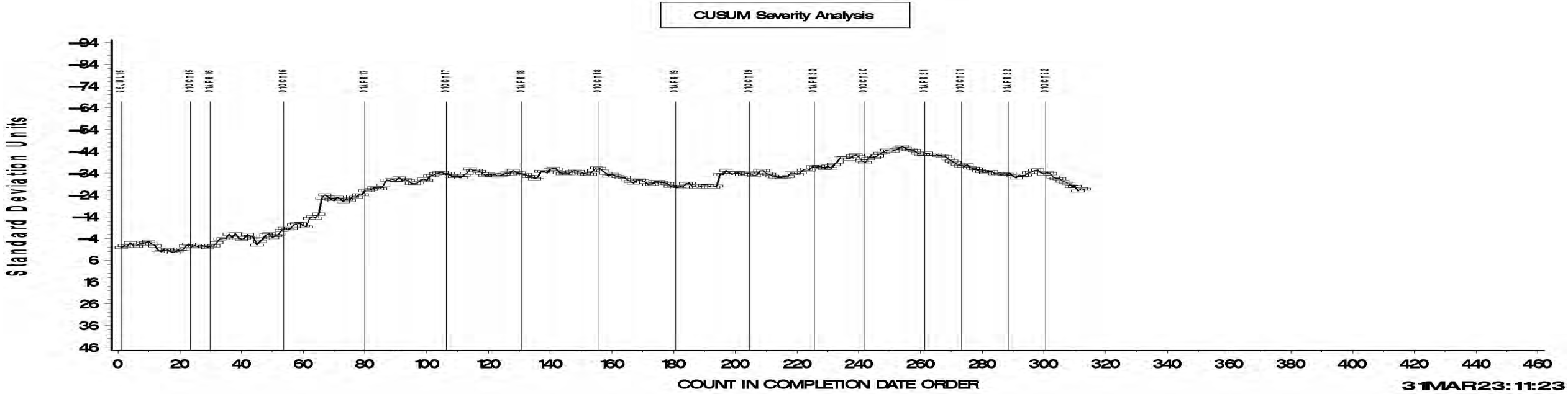
SEQUENCE IIIHB INDUSTRY OPERATIONALLY VALID DATA

PHOSPHORUS RETENTION, FINAL RESULT





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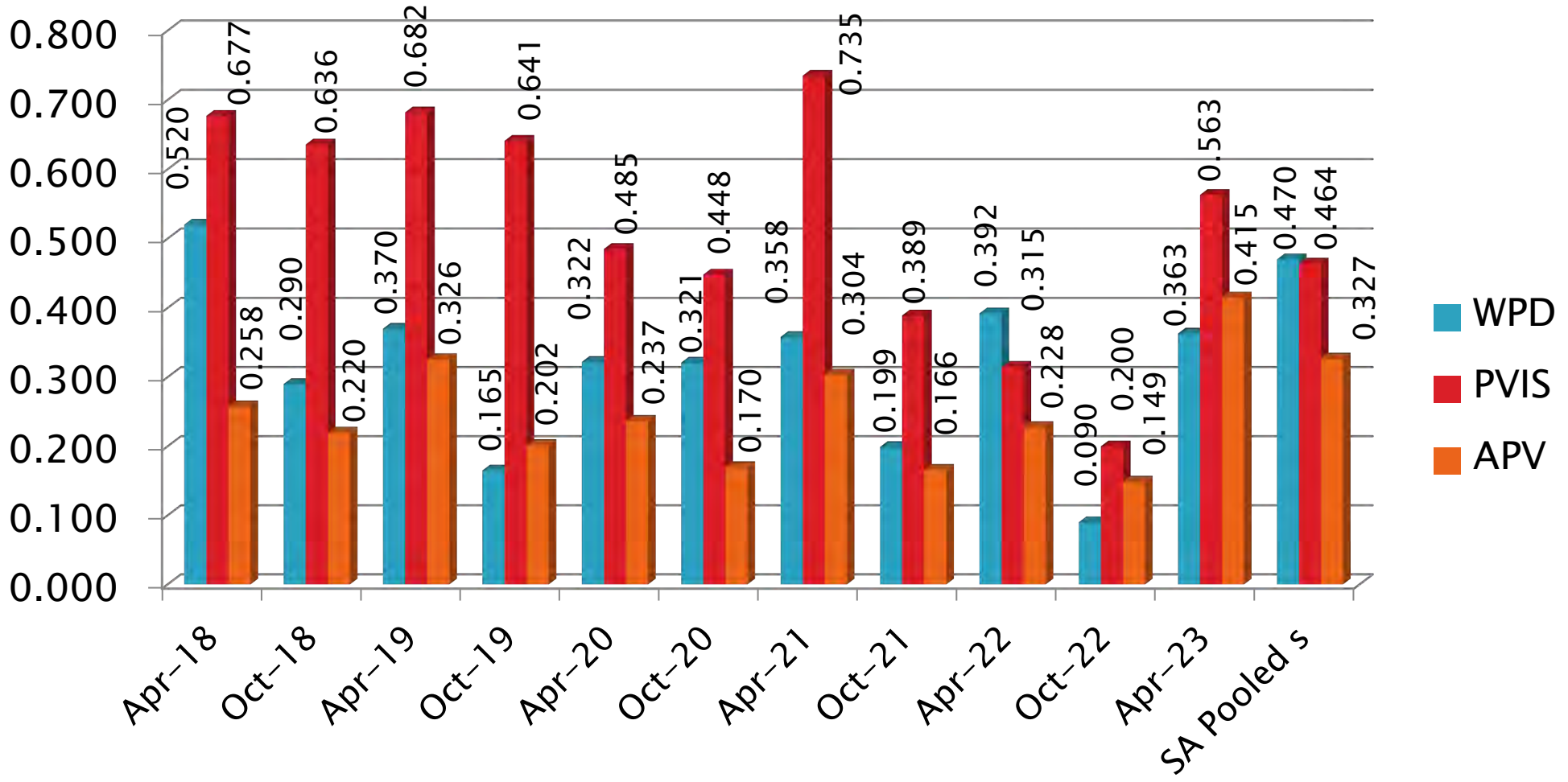
IIIH Precision Estimates



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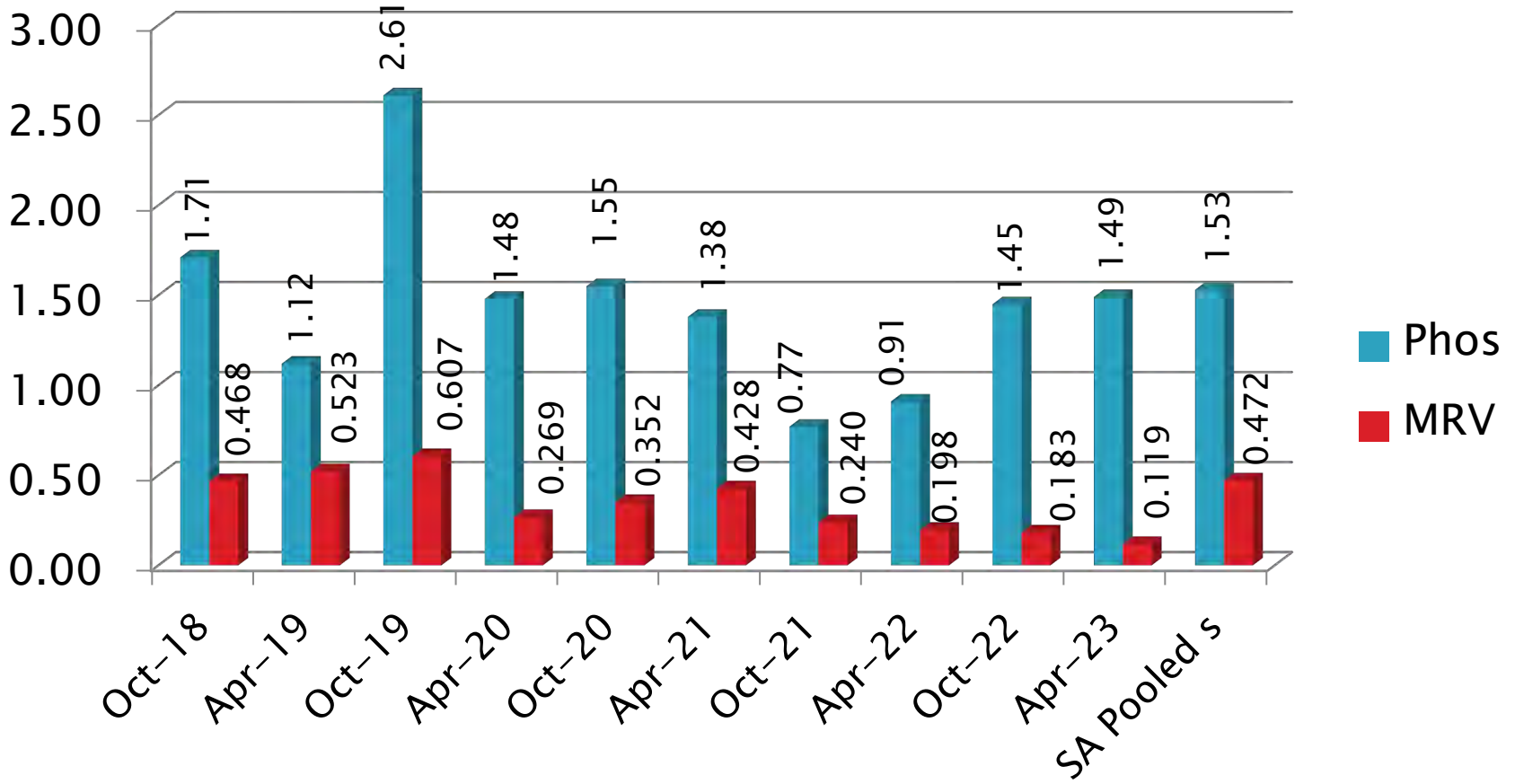
IIIHA/B Precision Estimates



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Sequence IVA

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Sequence IVA Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	3
Statistically Unacceptable Calibration Test	OC	3
Operationally Invalid Calibration Test (Lab Judgement)	LC	3
Terminated Before End of Test Calibration Test	XC	1
Total		**10**

Sequence IVA – Lost Tests*

Test Status	Cause	#
Aborted	Oil Leak at Sample Valve	1
Invalid	Oil Gallery Temperature Calibration Error	1
Invalid	Driveline Failure, Broken Flywheel Bolt	1
Invalid	Driveline Issue, Universal Joints Damaged	1
Totals		**4**

Aborted and invalid tests were all from the same stand.

*Invalid and aborted tests

Sequence IVA – Failing Tests

Test Status	#
ACW Mild	1
ACW Severe	2
Total	**3**

Sequence IVA Test Severity

- ACW is in warning alarm for both severity and precision. Precision has degraded with respect to the previous period.
- Severity and precision issues may be the result of issues on one stand. This stand did not re-calibrate and the laboratory did manage to calibrate another stand.

SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

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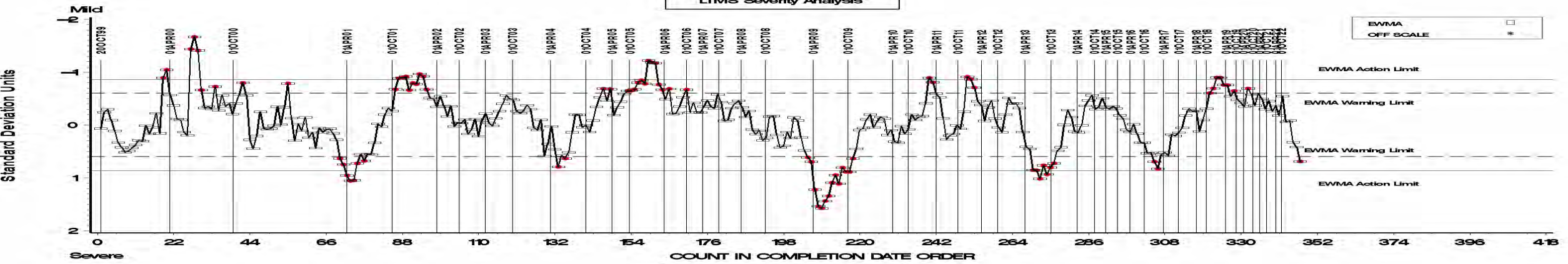
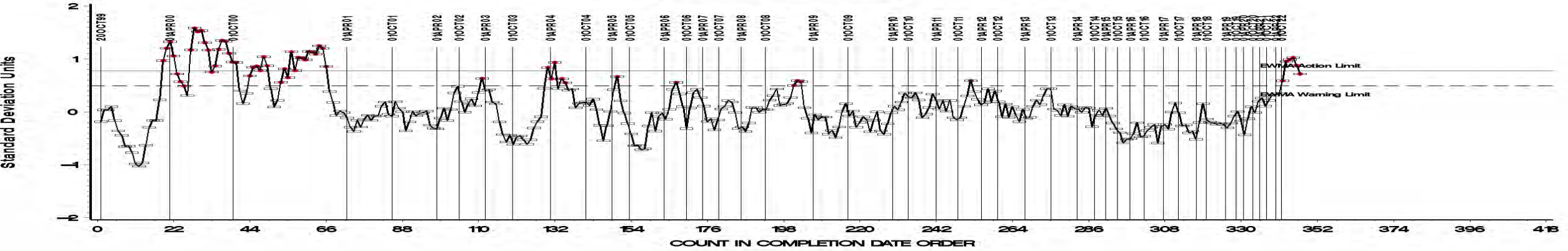
AVERAGE CAM WEAR

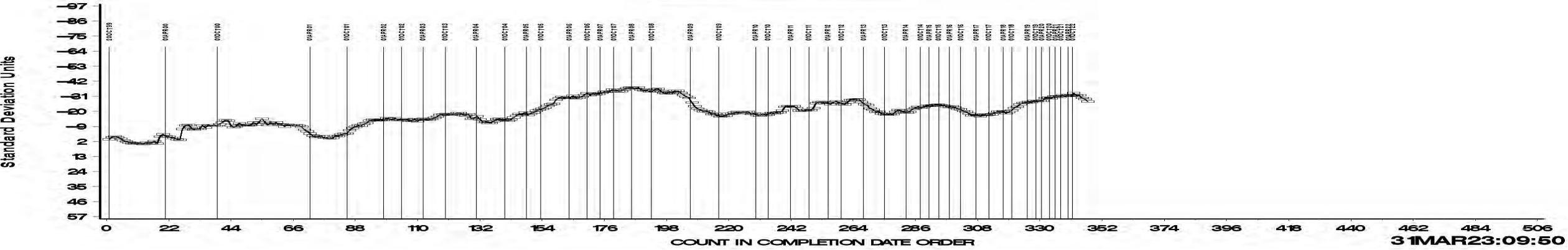
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

Last 20 results

AVERAGE CAM WEAR

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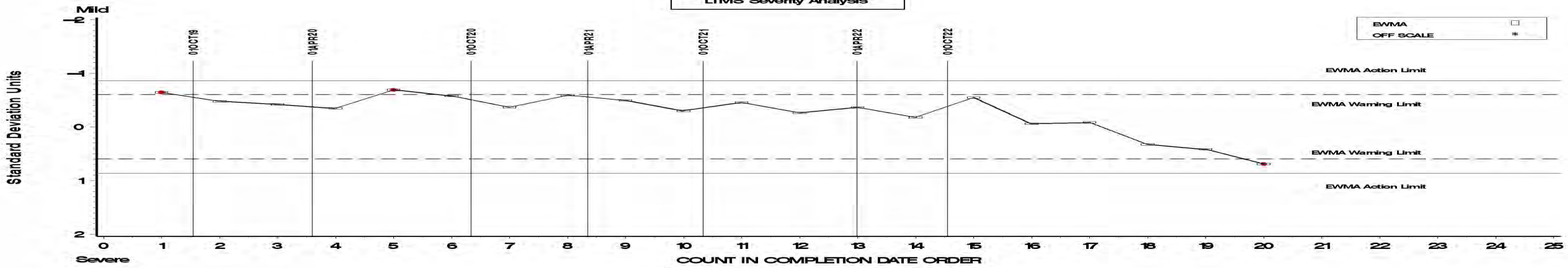
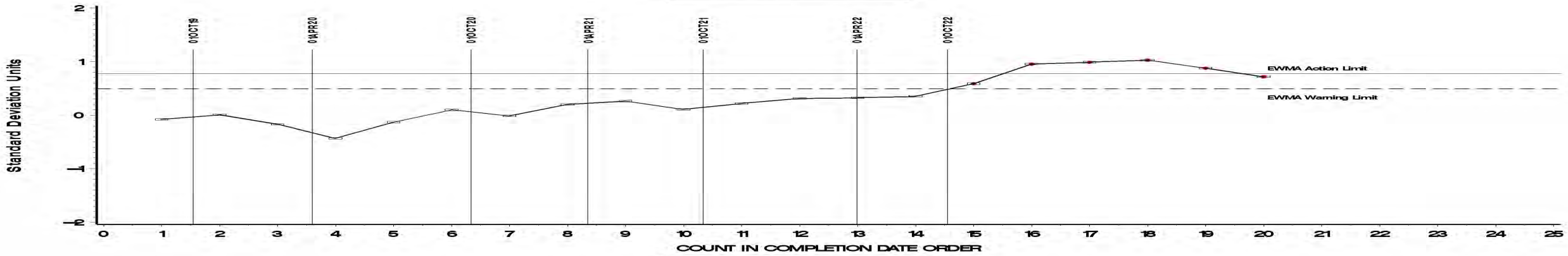
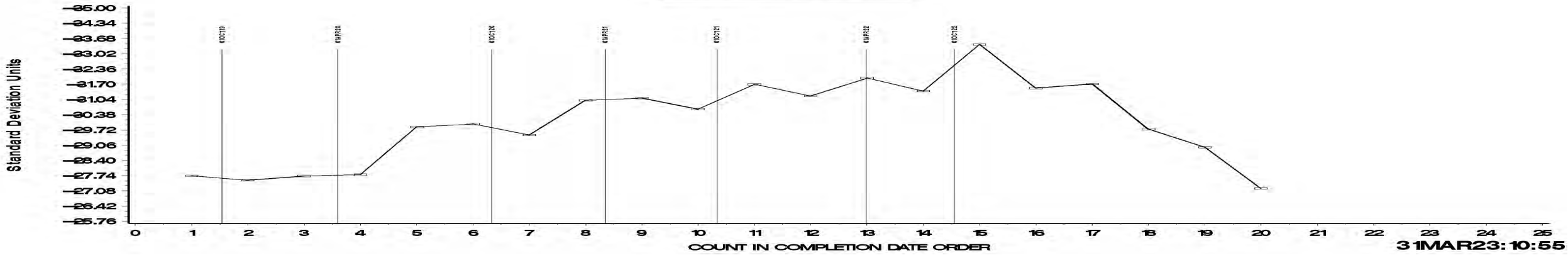
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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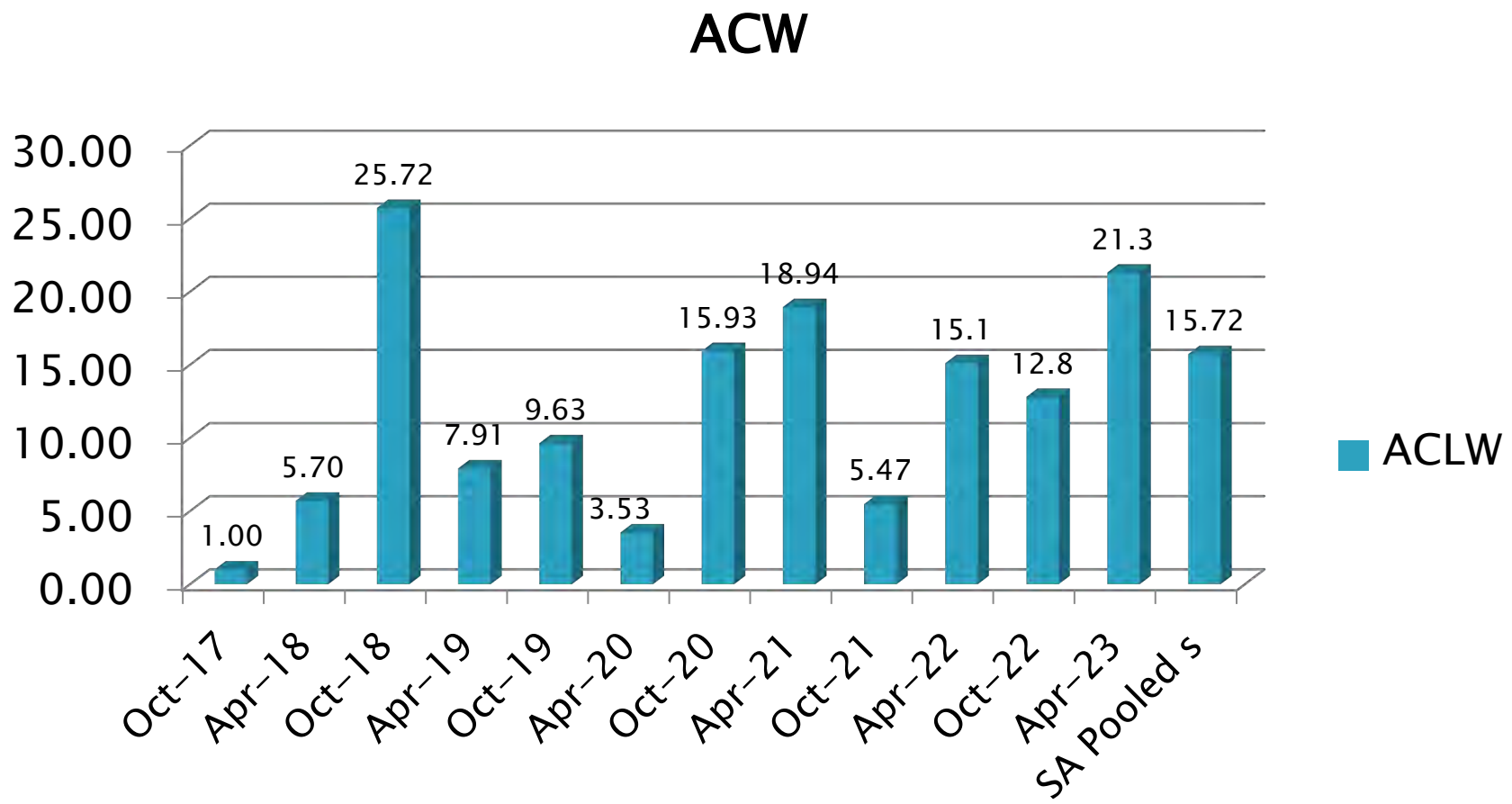
Sequence IVA Precision Estimates



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Sequence IVB

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Sequence IVB Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	7
Statistically Unacceptable Calibration Test	OC	1
Total		**8**

Sequence IVB – Failing Tests

Test Status	#
Level 3 Ei alarm (mild Direction)	1
Total	**1**

Sequence IVB Test Severity

- AVLI and Fe are in control.

SEQUENCE IVB INDUSTRY OPERATIONALLY VALID DATA

AVERAGE VOLUME LOSS BY KEYENCE INTAKE Final

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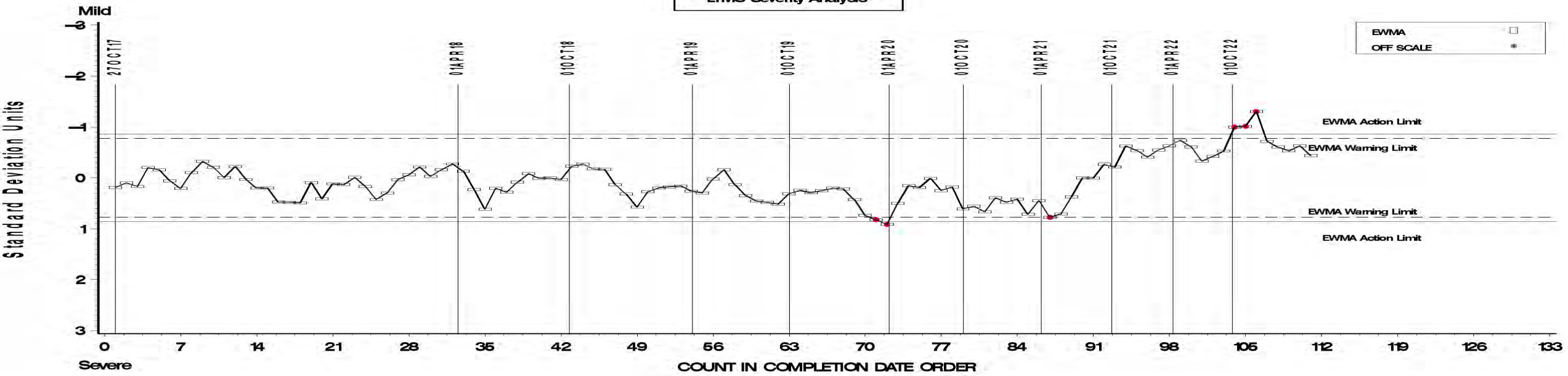
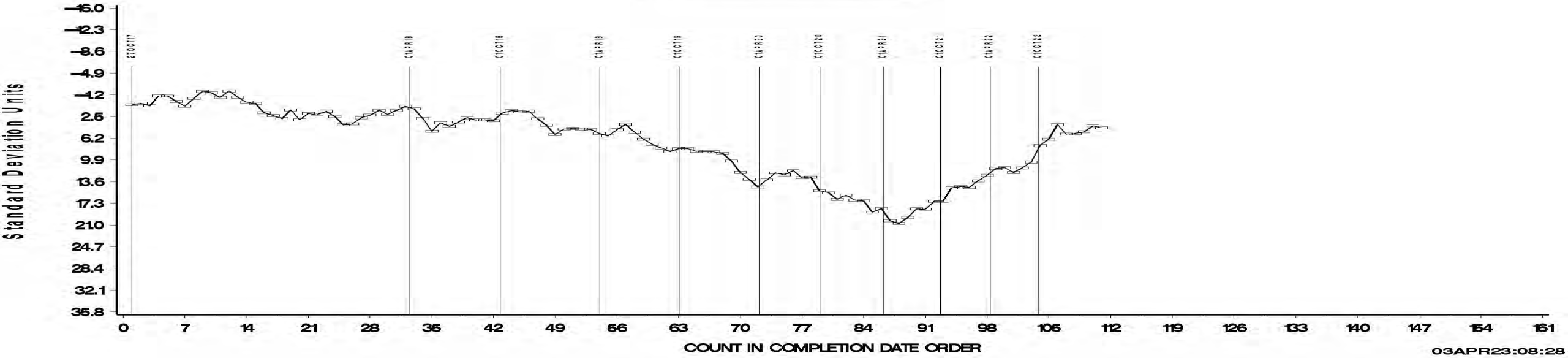
LTMS Severity Analysis



CUSUM Severity Analysis



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SEQUENCE IVB INDUSTRY OPERATIONALLY VALID DATA

END OF TEST FE FINAL Severity Adjusted RESULT

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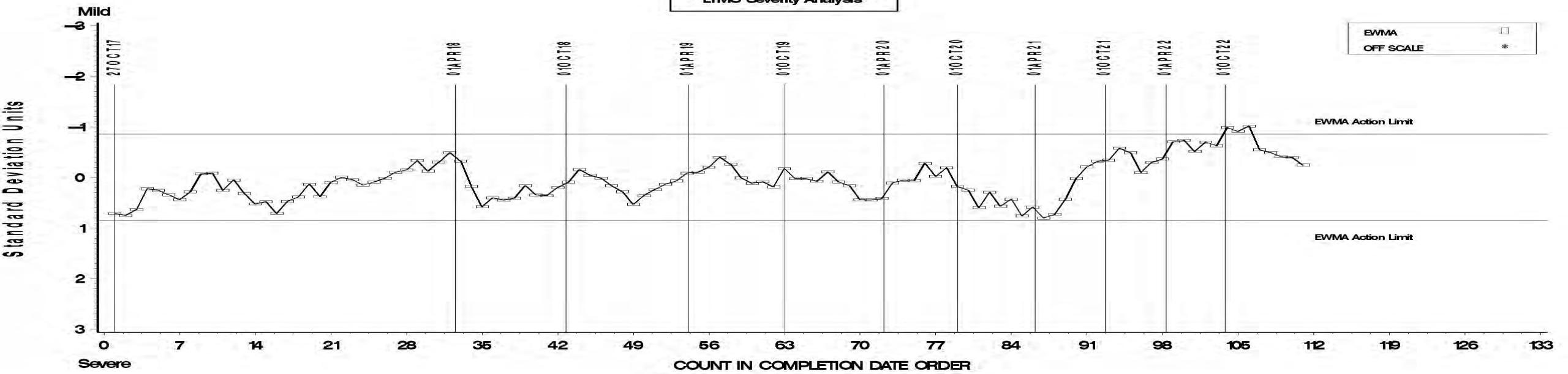
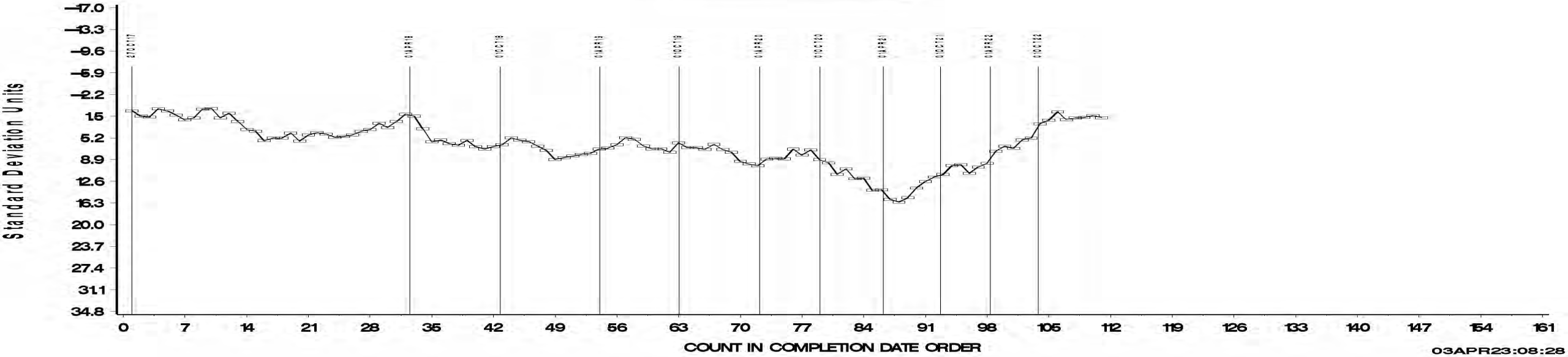
LTMS Severity Analysis



CUSUM Severity Analysis



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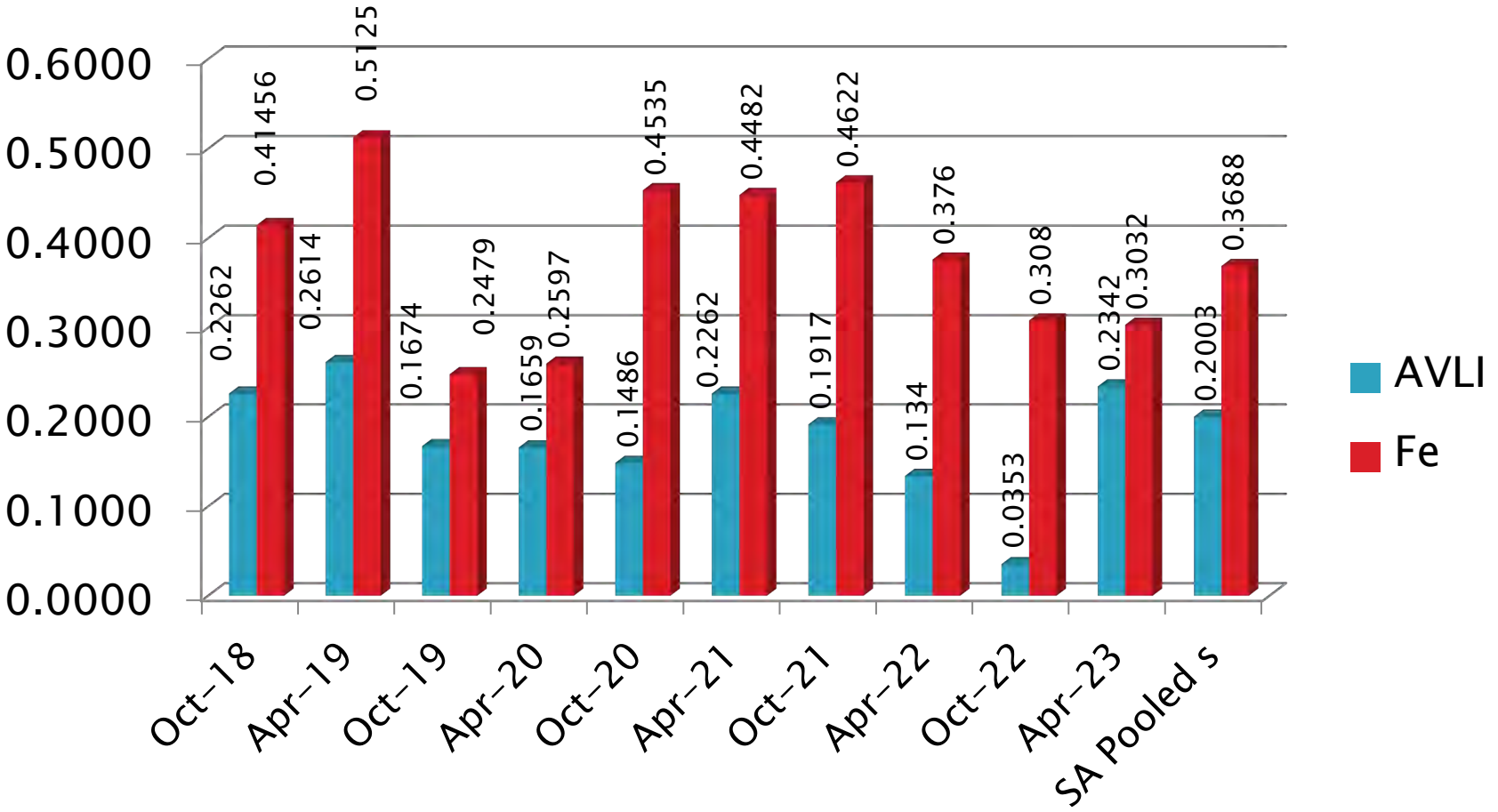
Sequence IVB Precision Estimates



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Sequence VH

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Sequence VH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	11
Statistically Unacceptable Calibration Test	OC	1
Fuel Approval Tests	AF	10
Total		**22**

Sequence VH – Failing Tests

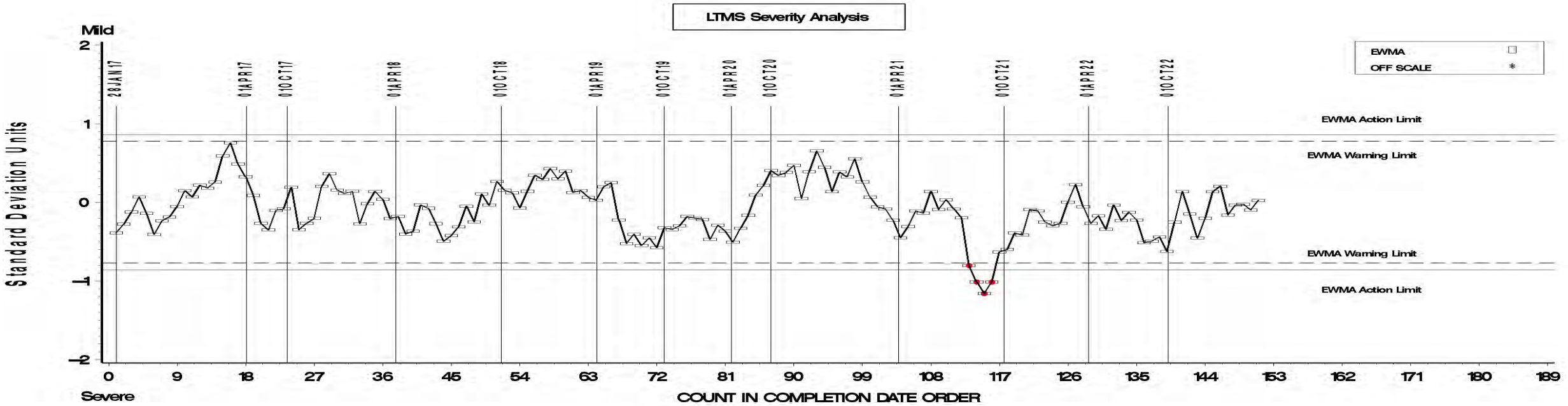
Test Status	#
AEV and APV Ei Level 3 alarms (Mild Direction)	1
Total	**1**

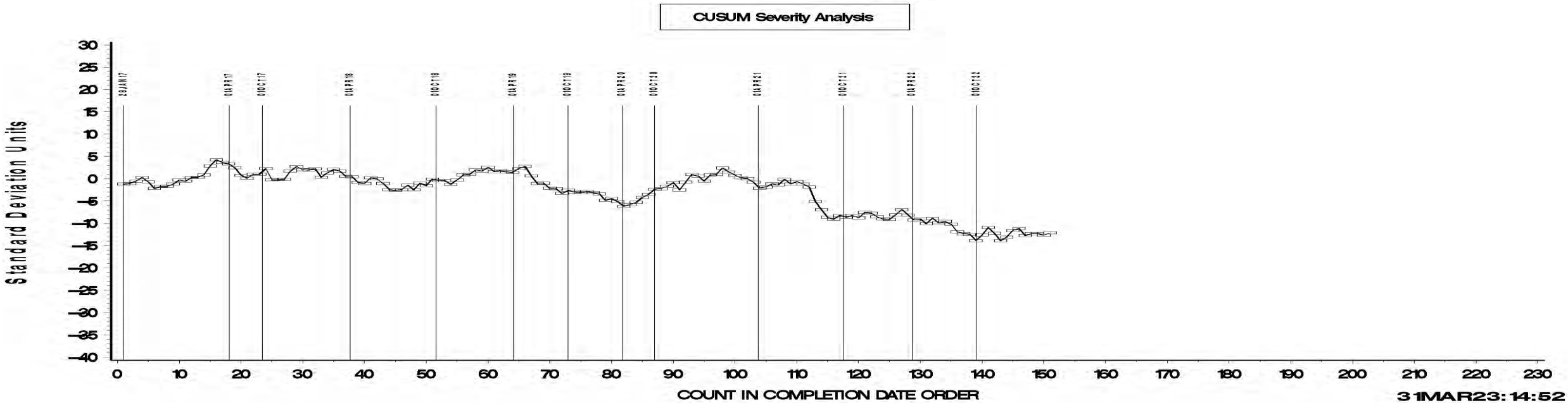
Sequence VH Test Severity

- All parameters within control limits

SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE SLUDGE FINAL RESULT





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SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

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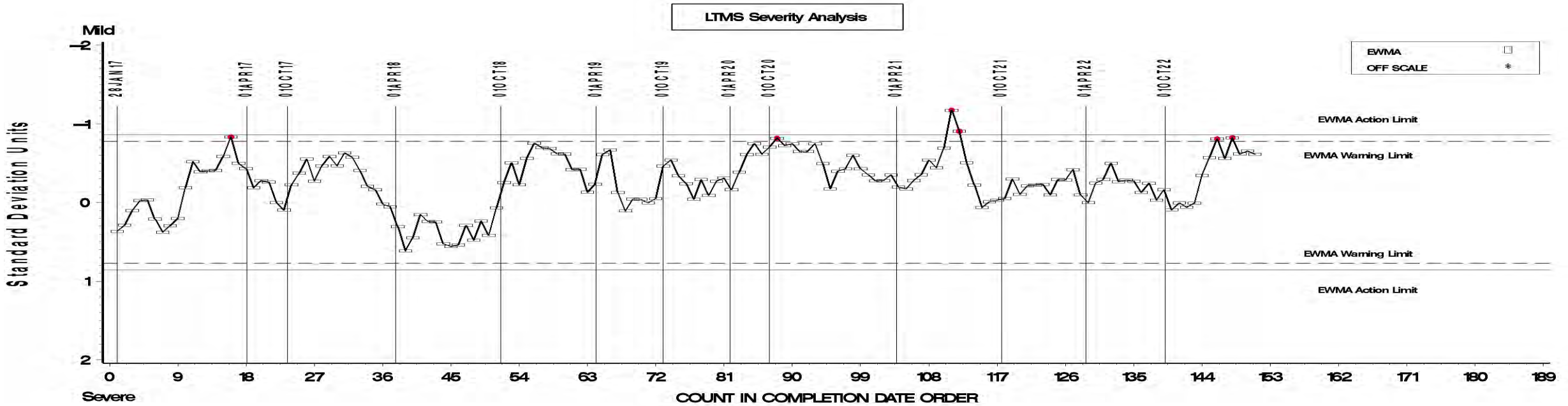
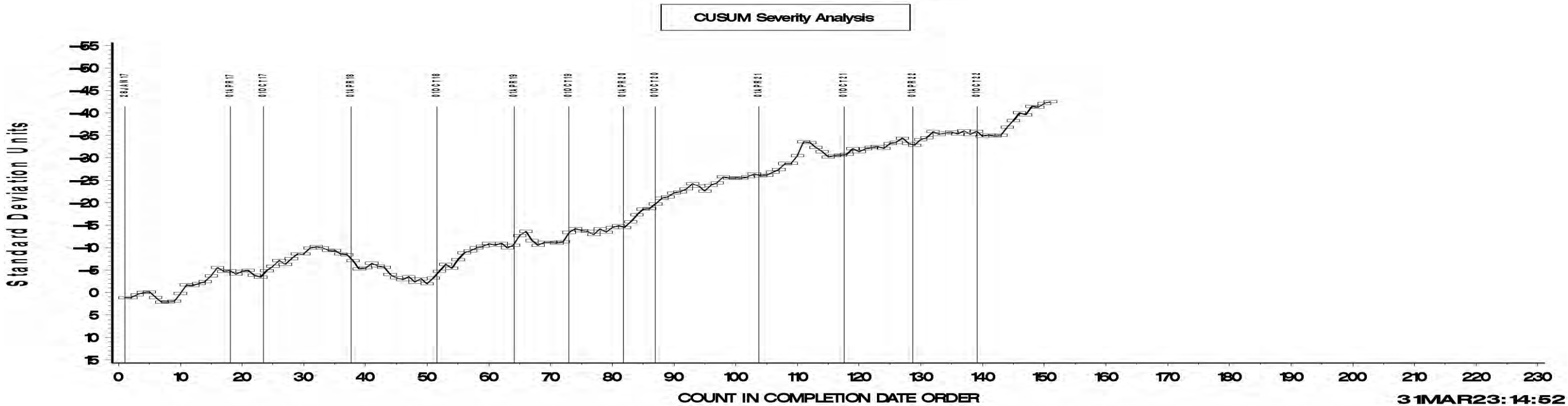
AVERAGE ROCKER COVER SLUDGE





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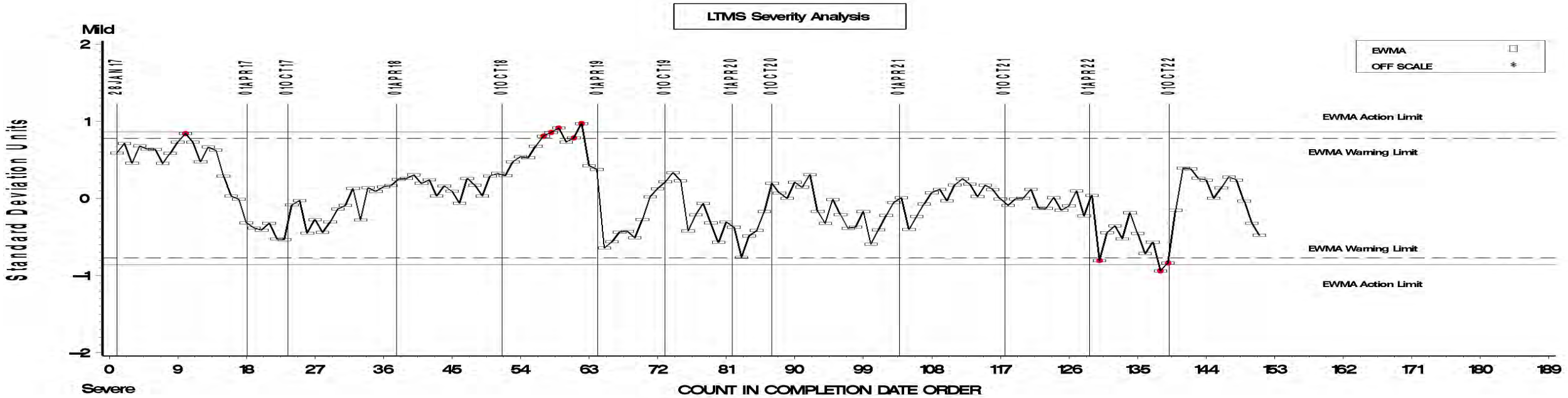
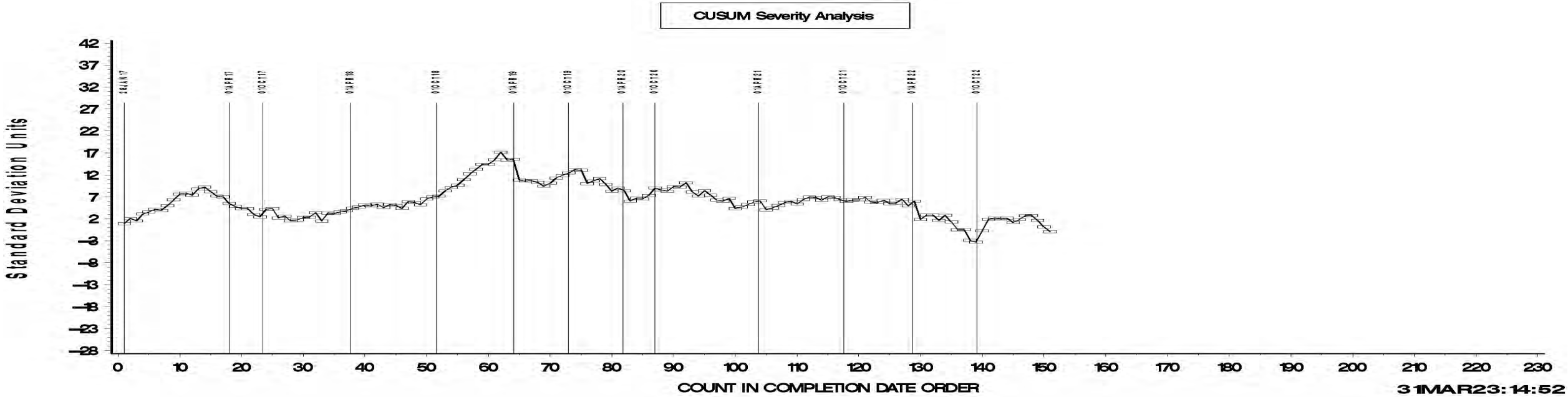
SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

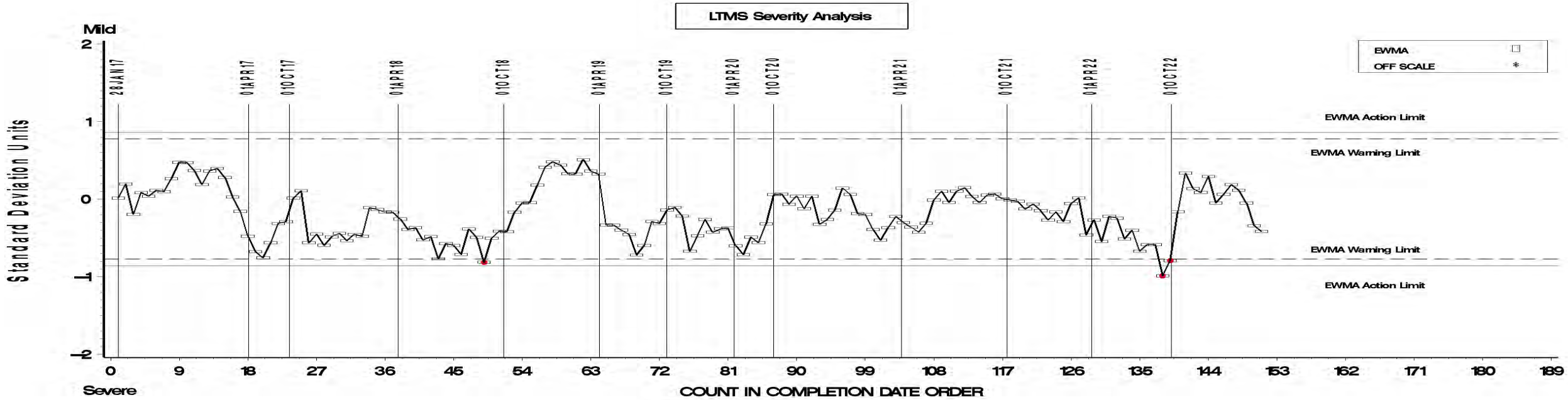
AVG. ENG. VARN. 50% RATING

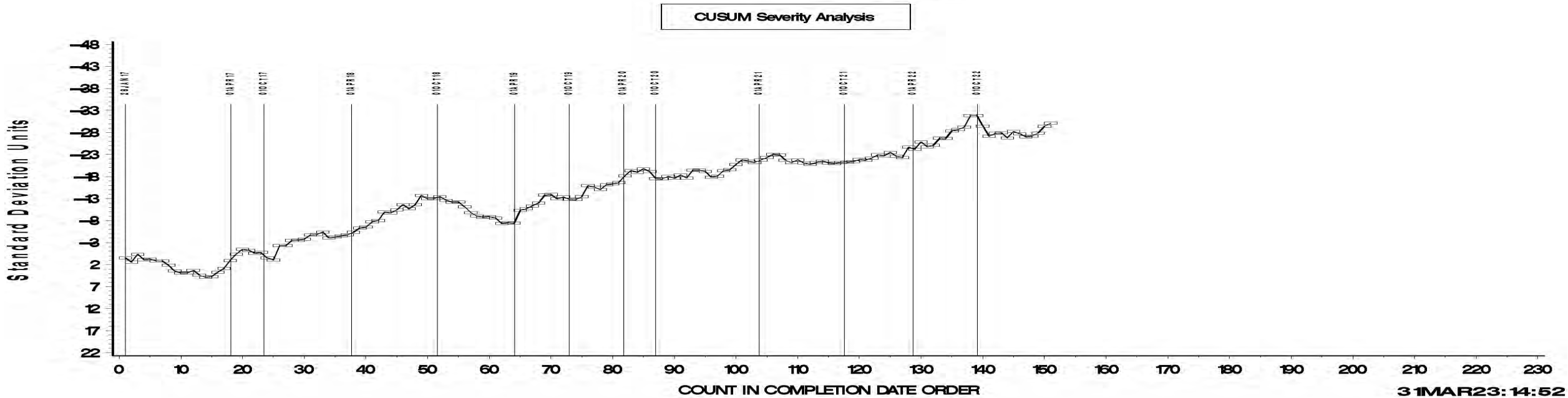




SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

AVG PISTON SKIRT 50% RATING





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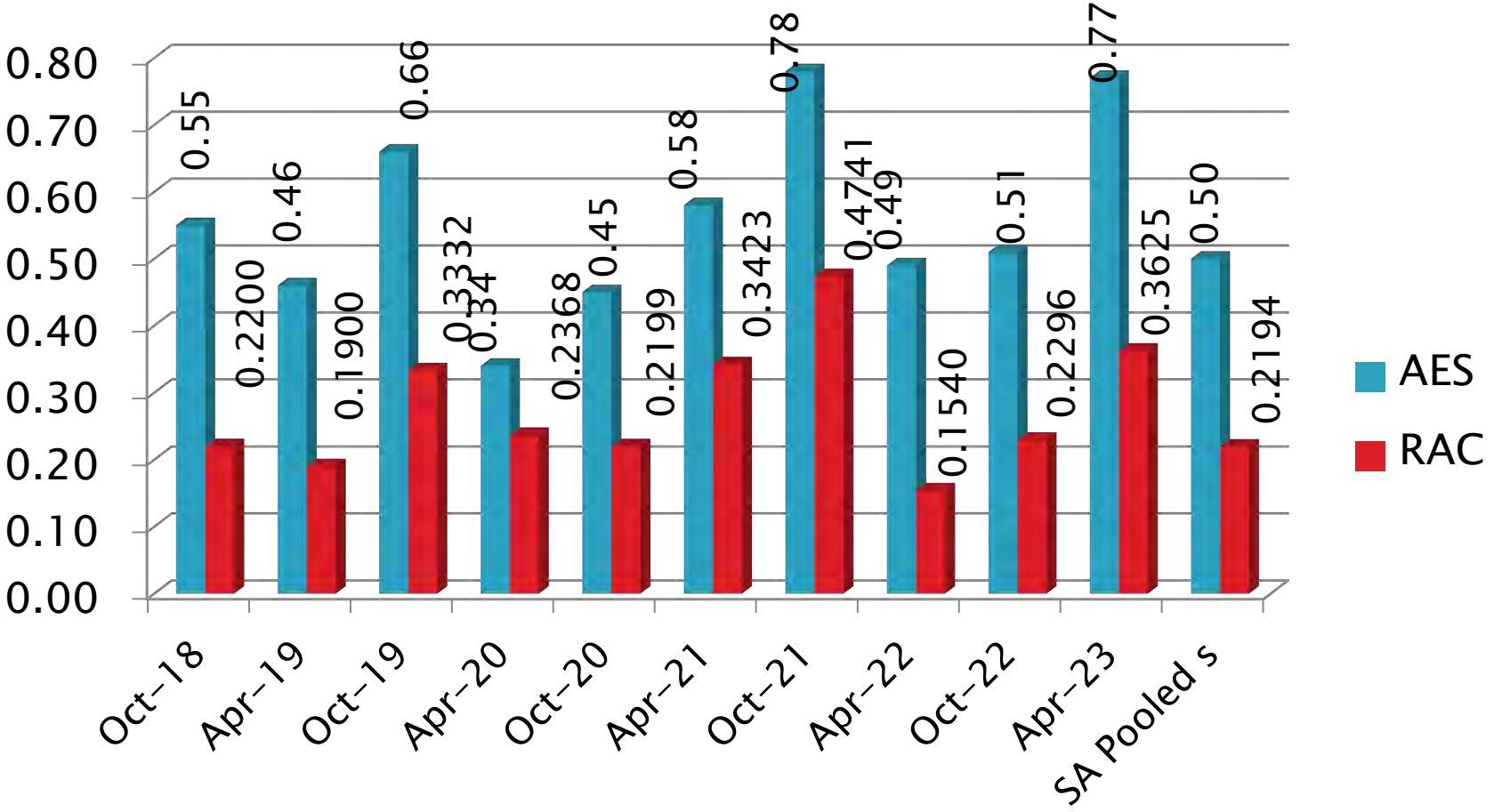
Sequence VH Precision Estimates



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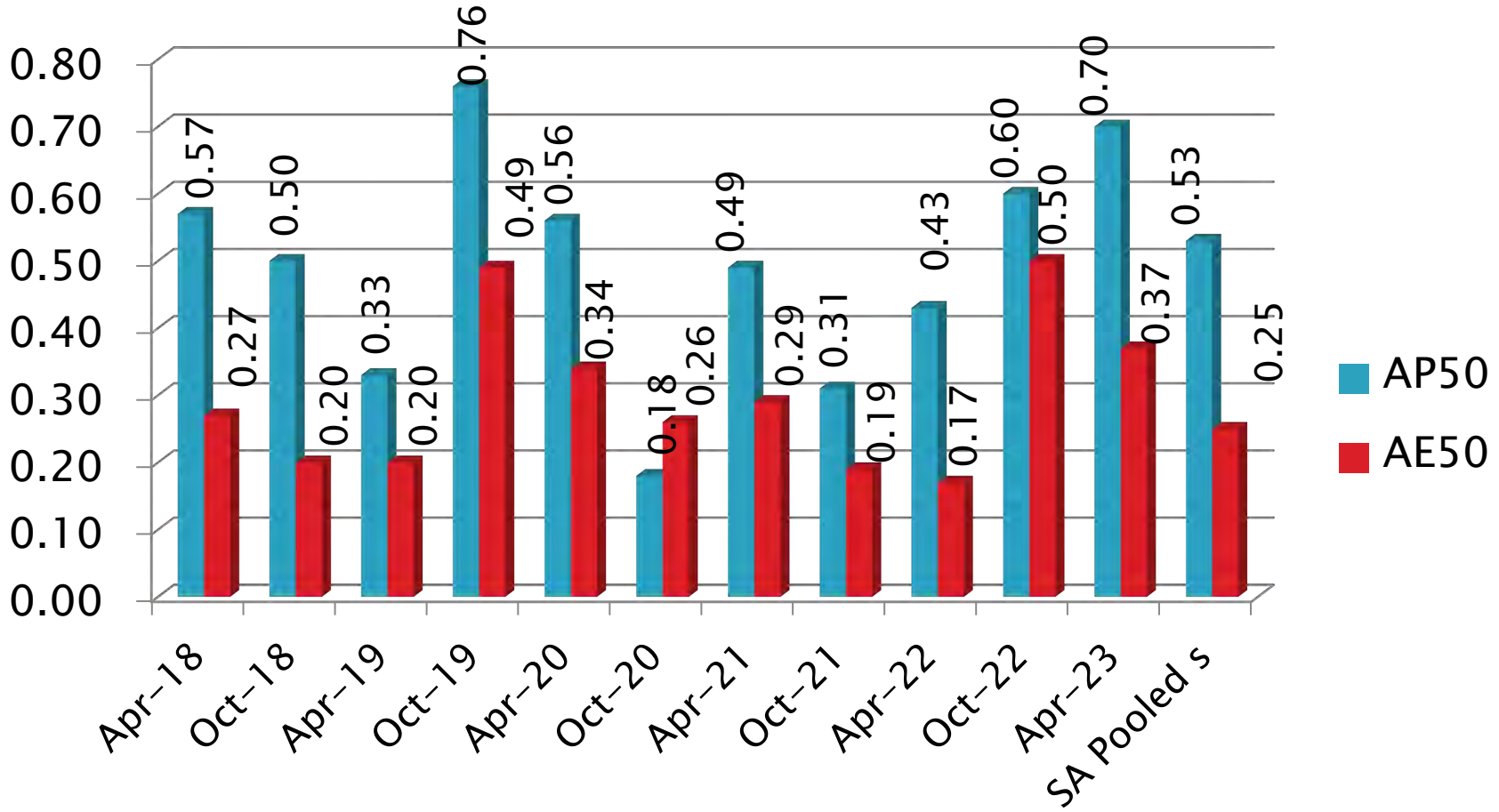
Sequence VH Precision Estimates



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Sequence VIE

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Sequence VIE Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	19
Engine Results Removed from Charts because of Additional Break-in Being Run After Failed Reference	MC	1
Operationally Invalid Calibration Test	LC	1
Total		**21**

Sequence VIE – Lost Tests*

Test Status	Cause	#
Invalid	Dyno Bearing Failure	1
Totals		**1**

*Invalid and aborted tests

Sequence VIE Test Severity

- FEI1 and FEI2 are in control but showing long term severe trends in the Cusum and EWMA charts.

SEQUNCE VIE INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE I

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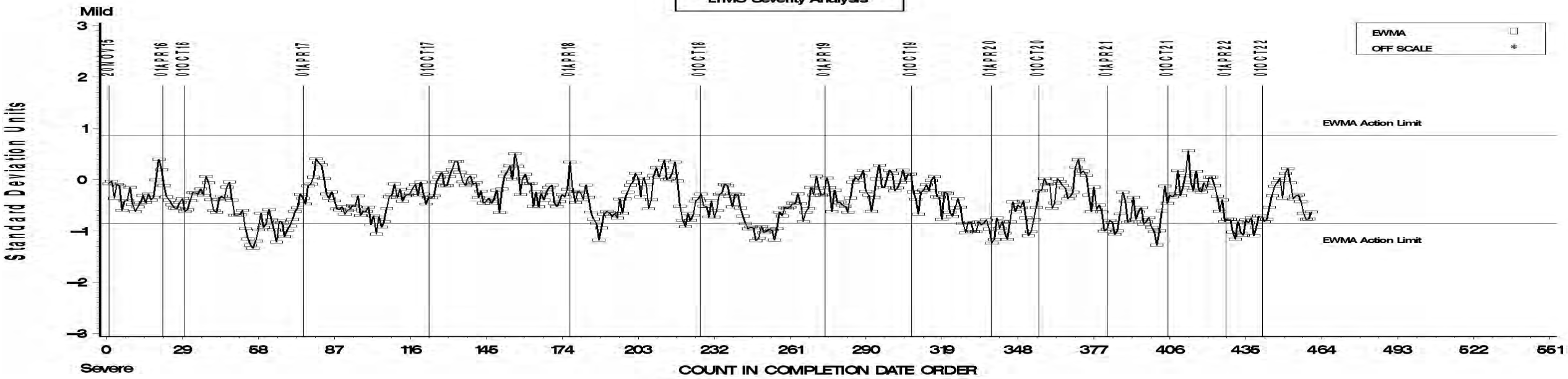
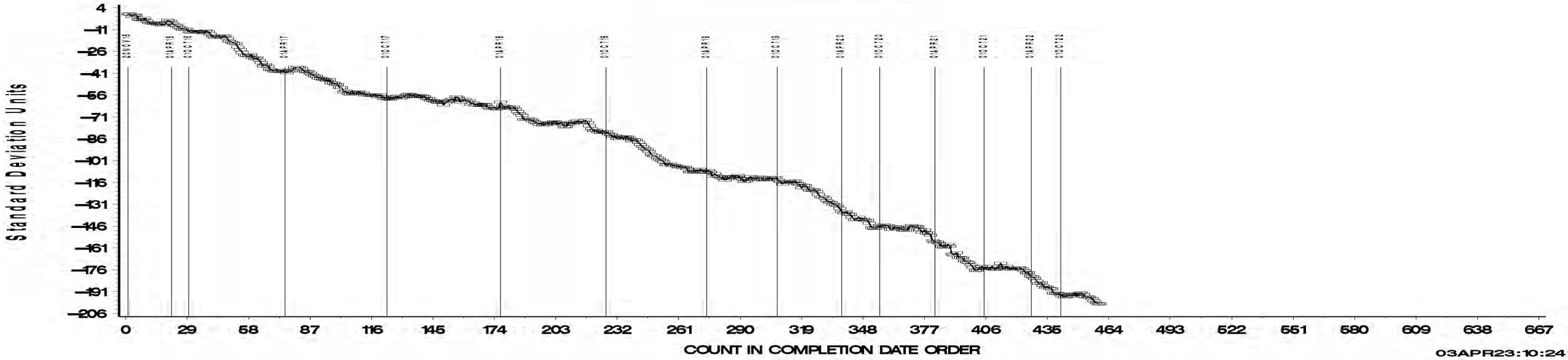
LTMS Severity Analysis



CUSUM Severity Analysis



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SEQUNCE VIE INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE II

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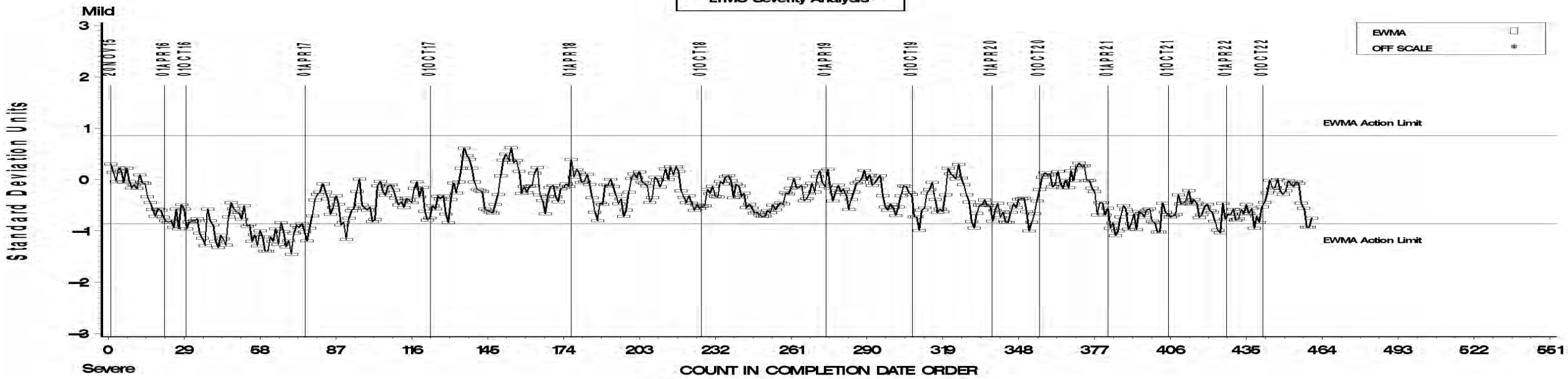
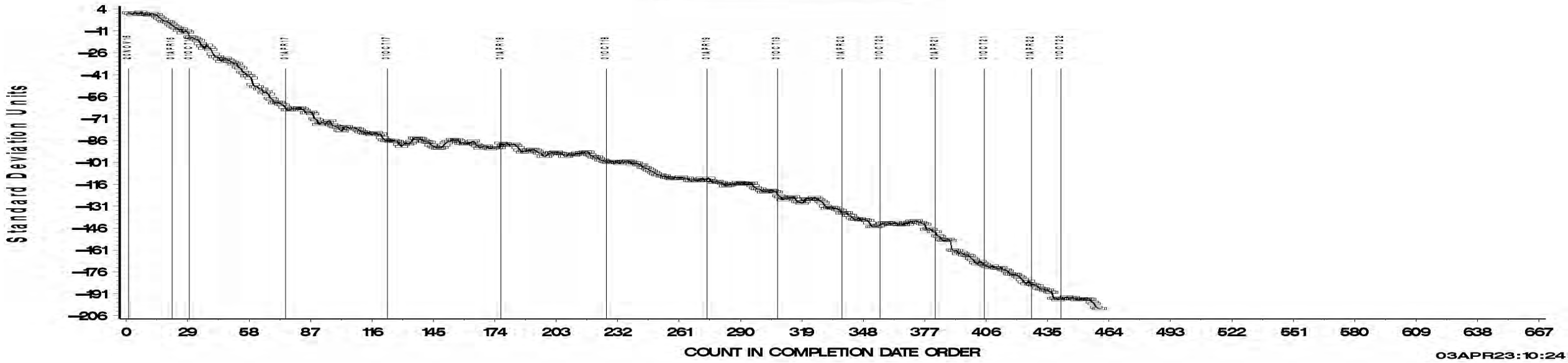
LTMS Severity Analysis



CUSUM Severity Analysis



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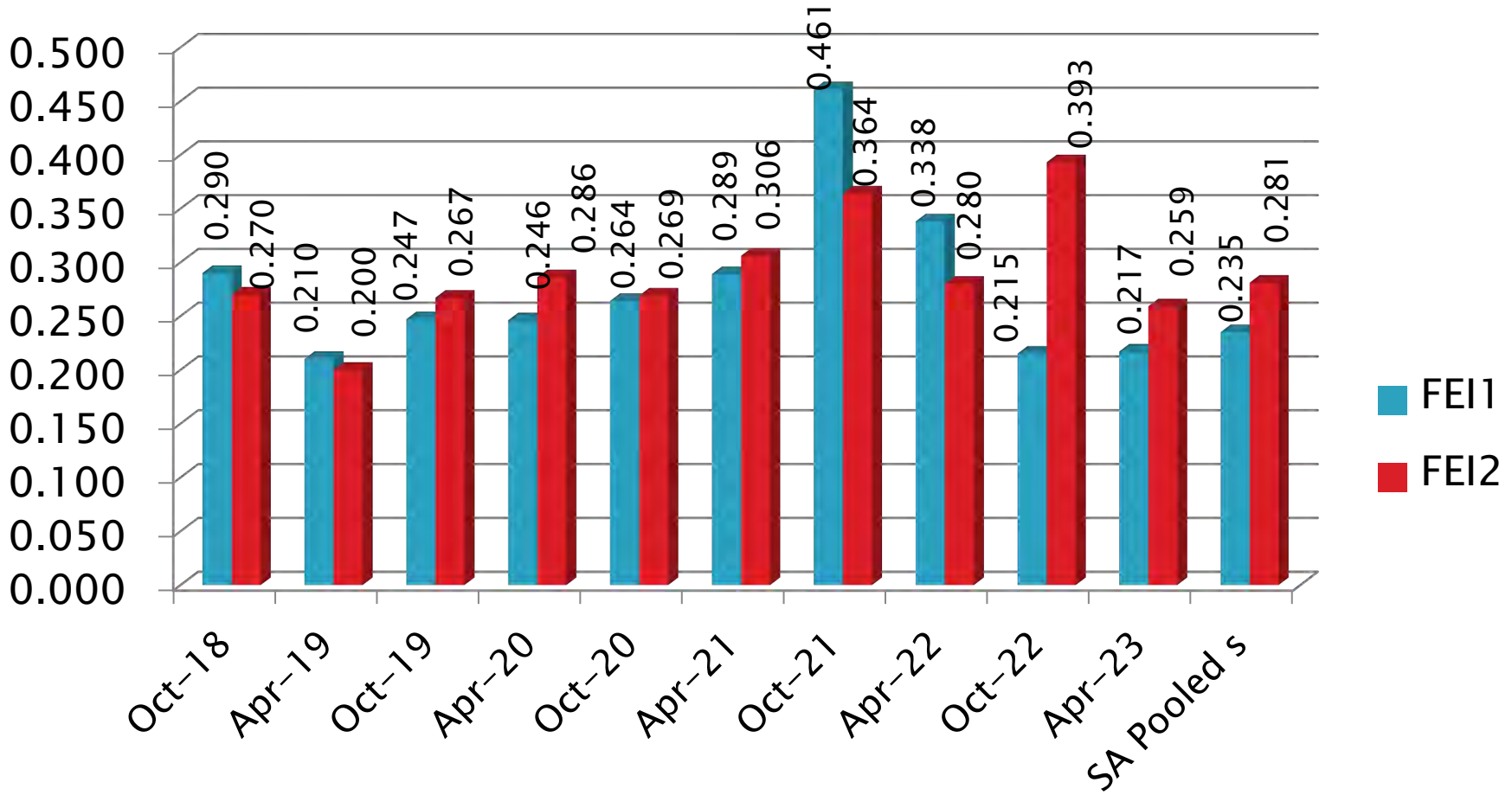
Sequence VIE Precision Estimates



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Sequence VIF

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Sequence VIF Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	16
Stage 4 BL After Exhaust Backpressure Out of Spec	LC	1
Abandon Engine	MC	1
Total		**18**

Sequence VIF Test Severity

- FEI1 is in control
- FEI2 is in control

SEQUNCE VIF INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE I

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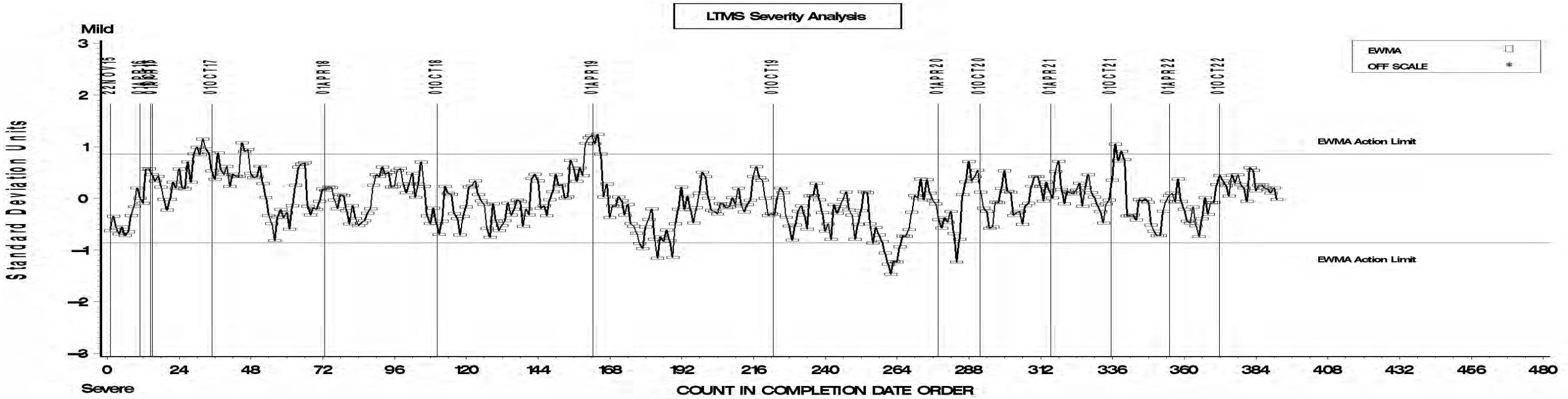

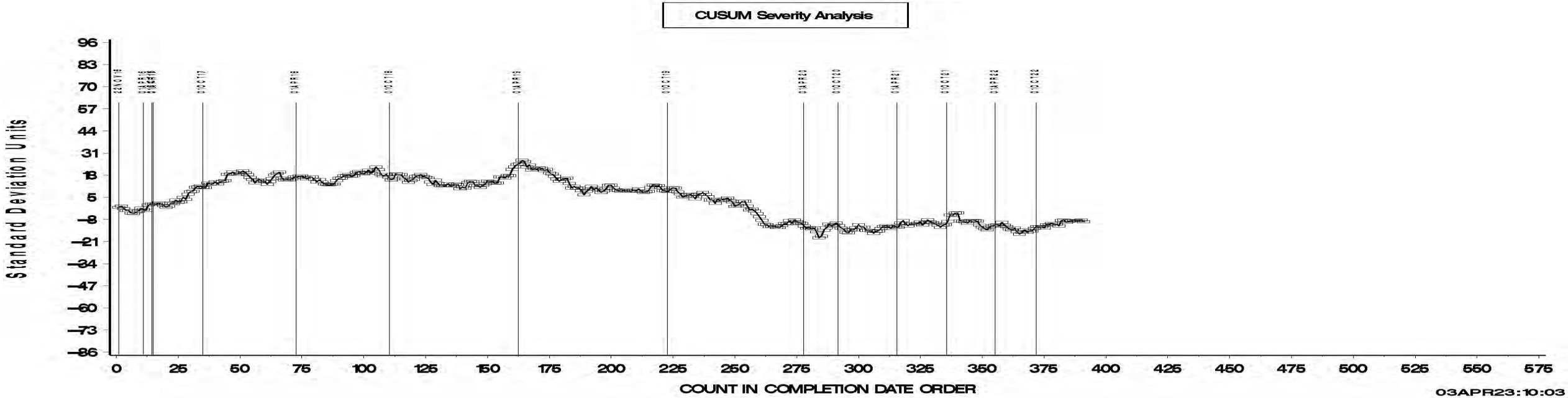

03APR23:10:03

SEQUNCE VIF INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE II

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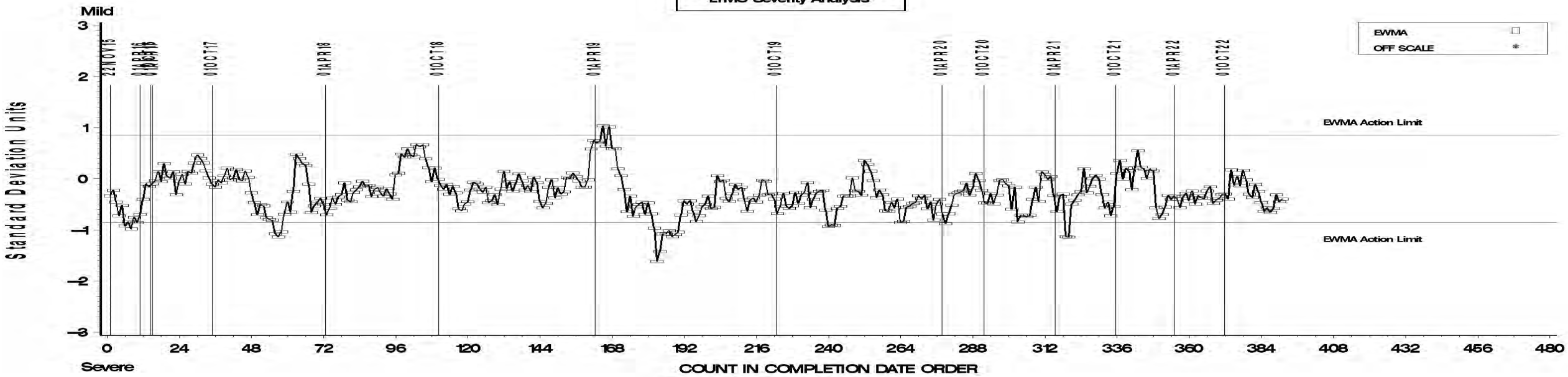
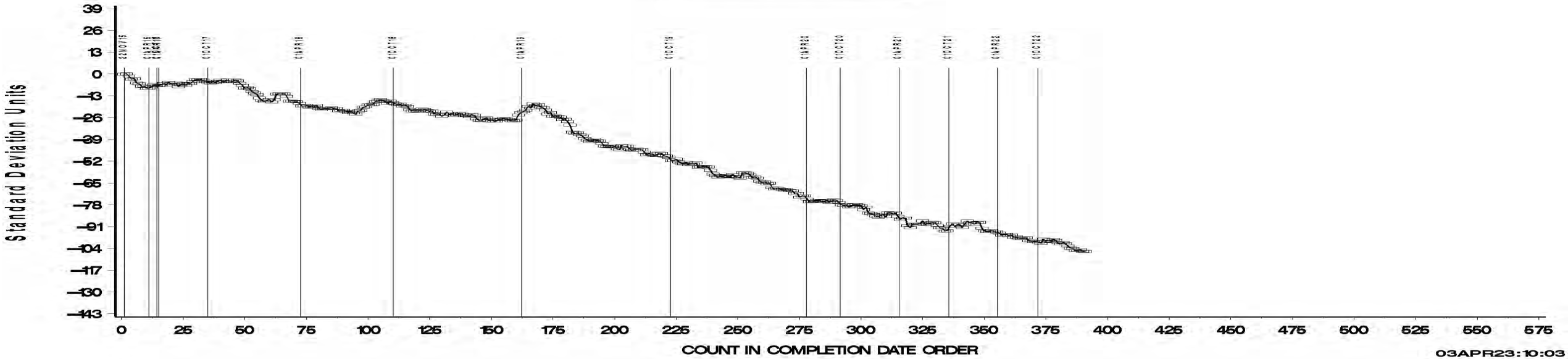
LTMS Severity Analysis



CUSUM Severity Analysis



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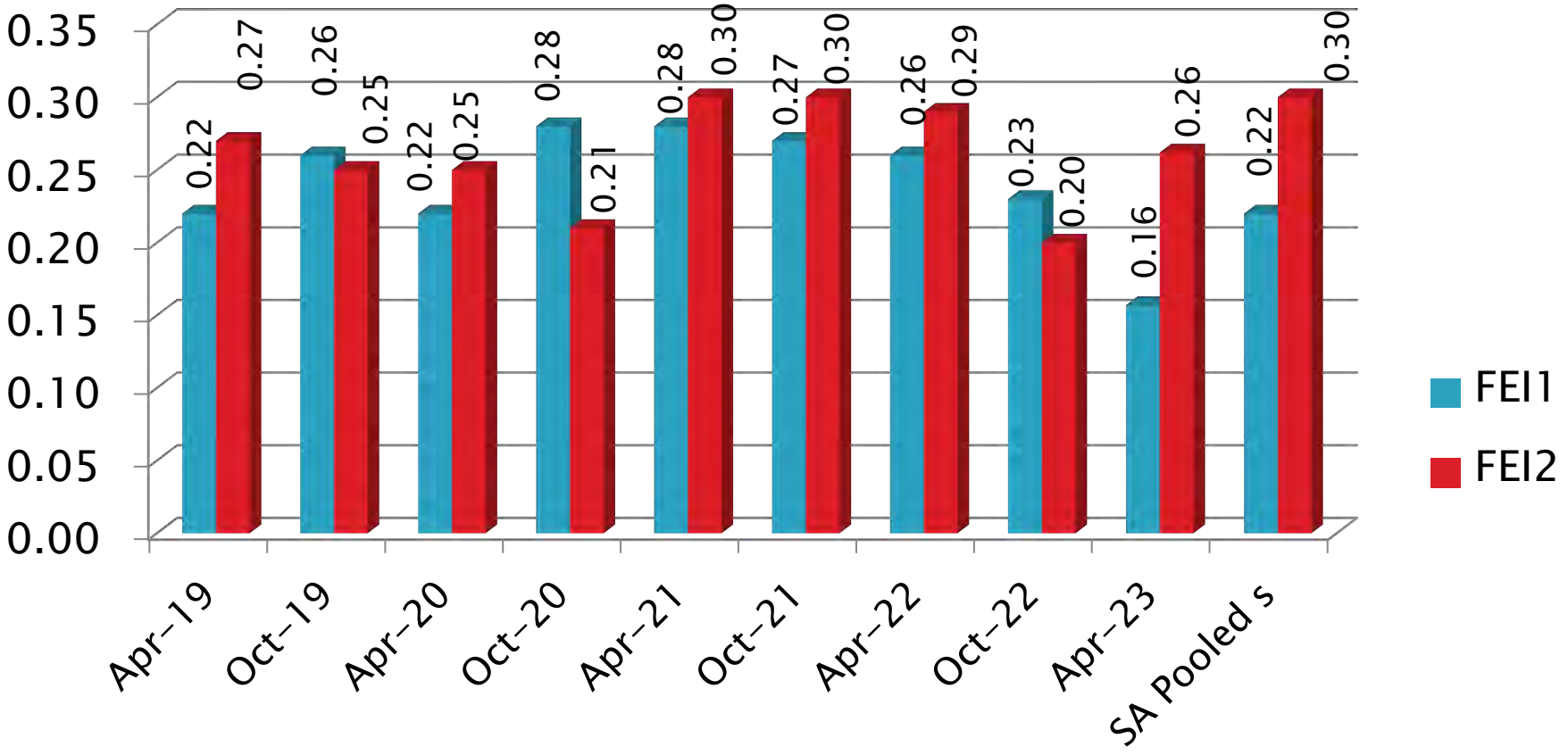
Sequence VIF Precision Estimates



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Sequence VIII

- April 2023

Test Monitoring Center
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Sequence VIII Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	6
Operationally Invalid Calibration Test	LC	3
Not for Industry Statistics (New Bearing Batch)	NI	1
Total		11

Sequence VIII – Lost Tests*

Test Status	Cause	#
Invalid	Oil Filter Bypass Failure	1
Invalid	High Mechanical Wear	2
Totals		**3**

*Invalid and aborted tests

Sequence VIII– Failed Tests

Test Status	#
BWLS Stand Precision EWMA Alarm	2
Lab EWMA Alarm and Severity Shewhart alarm, BWL (Severe Direction)	1
BWL Shewhart Severity Alarm (Severe Direction)	2
Stripped Vis and BWL Severe	1
Total	**6**

Sequence VIII Test Severity

- BWLS and SVIS are Severity Action Alarm (Severe direction)

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

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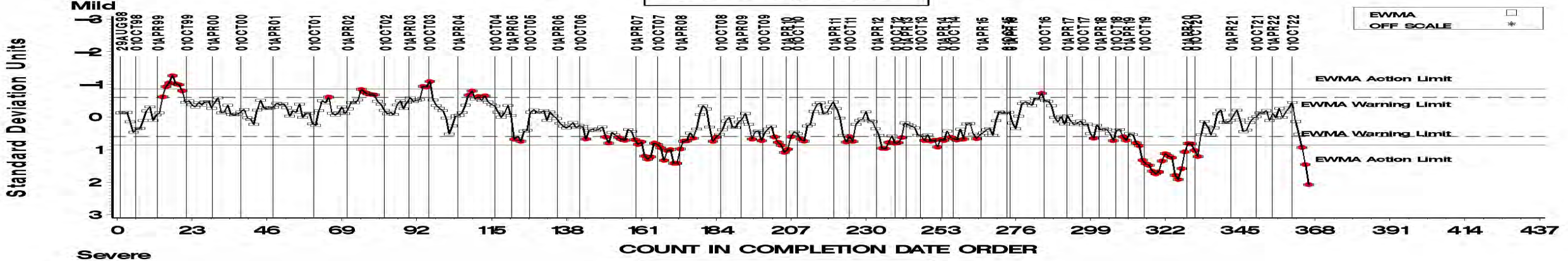
FINAL BEARING WEIGHT LOSS

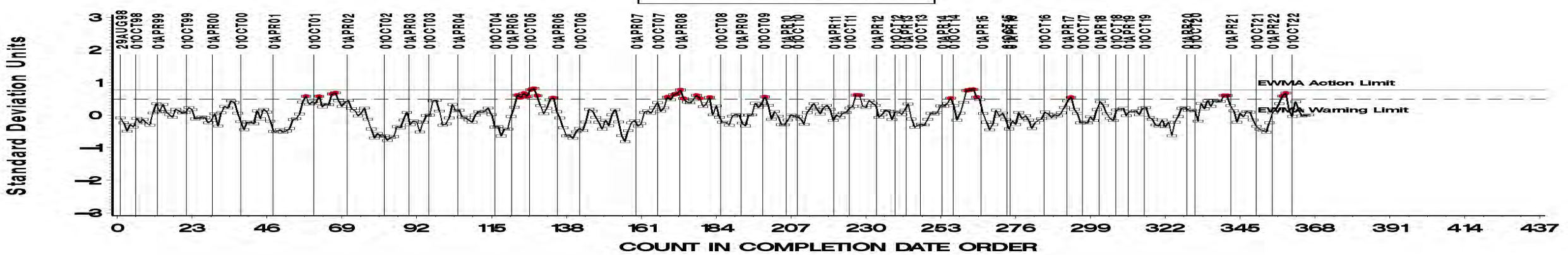
LTMS Severity Analysis

Mild

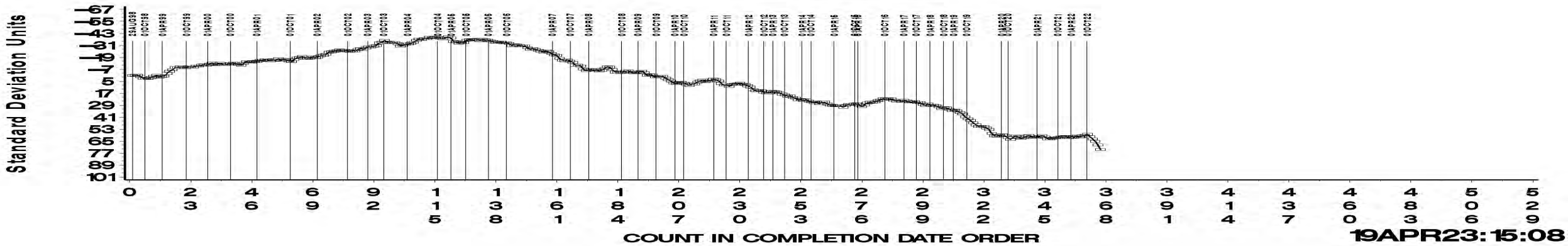


Severe

LTMS Precision Analysis



CUSUM Severity Analysis



19APR23:15:08

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

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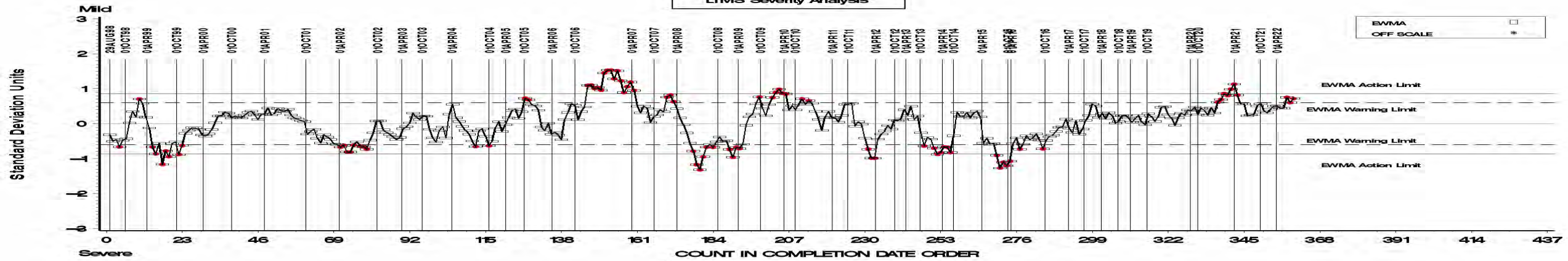
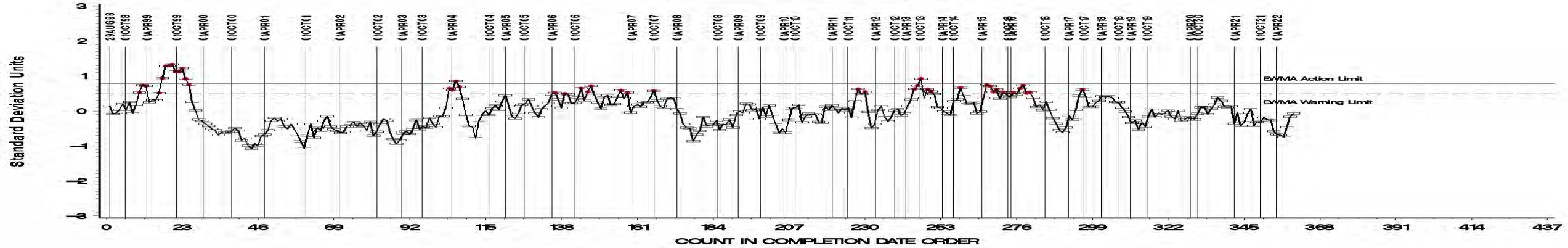
STRIPPED VIS. @ 100 DEG C

LTMS Severity Analysis



LTMS Precision Analysis



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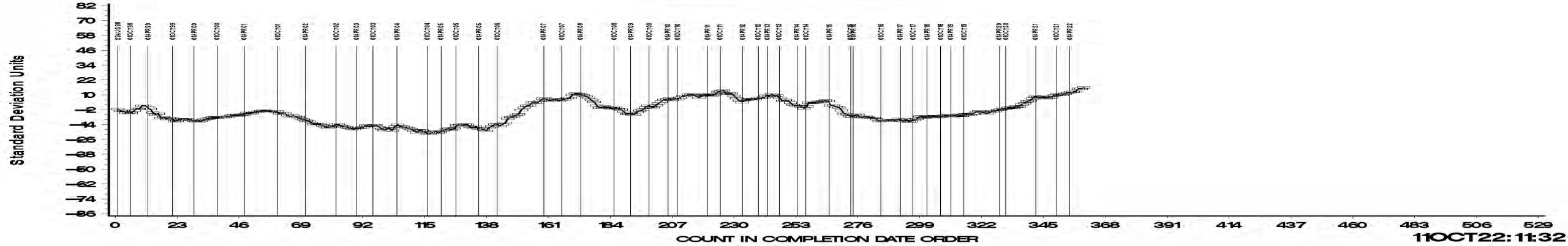

11OCT22:11:32

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

Last 30 Results

FINAL BEARING WEIGHT LOSS

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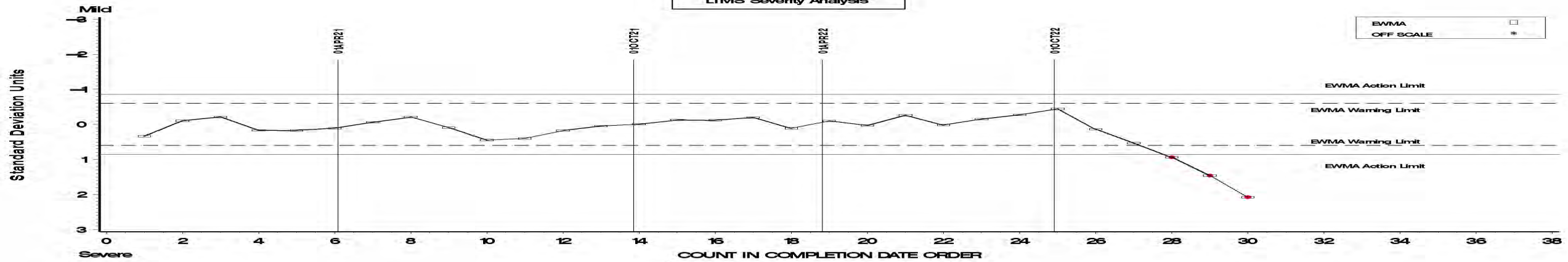
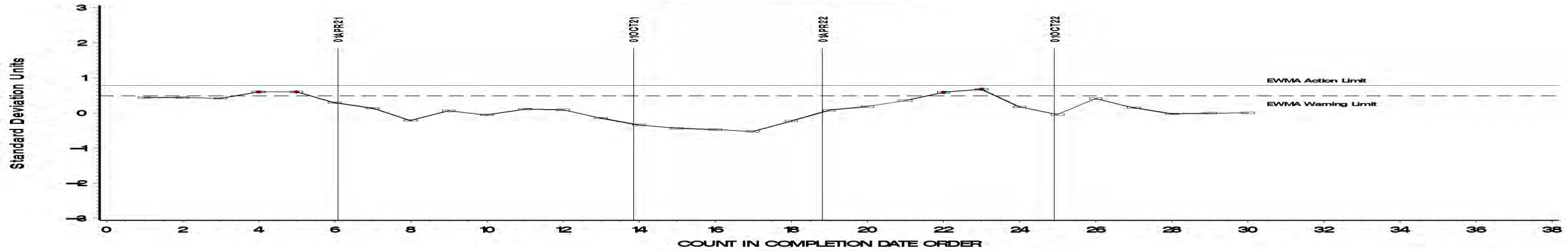
LTMS Severity Analysis



LTMS Precision Analysis



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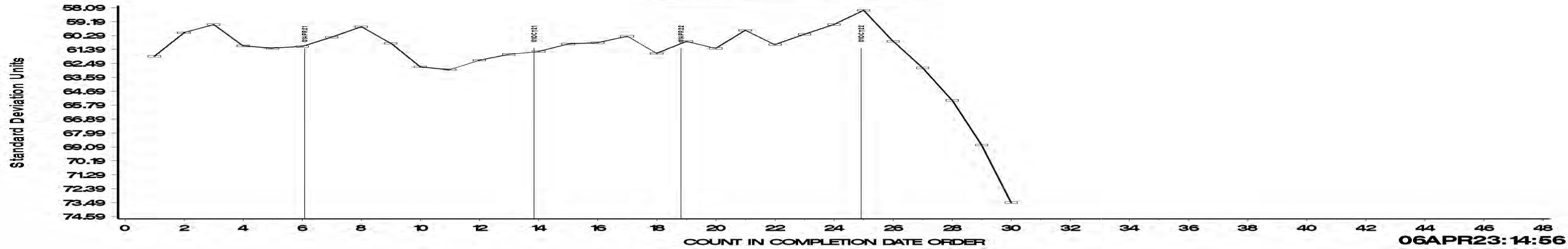

06APR23:14:56

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

Last 30 Results

STRIPPED VIS. @ 100 DEG C

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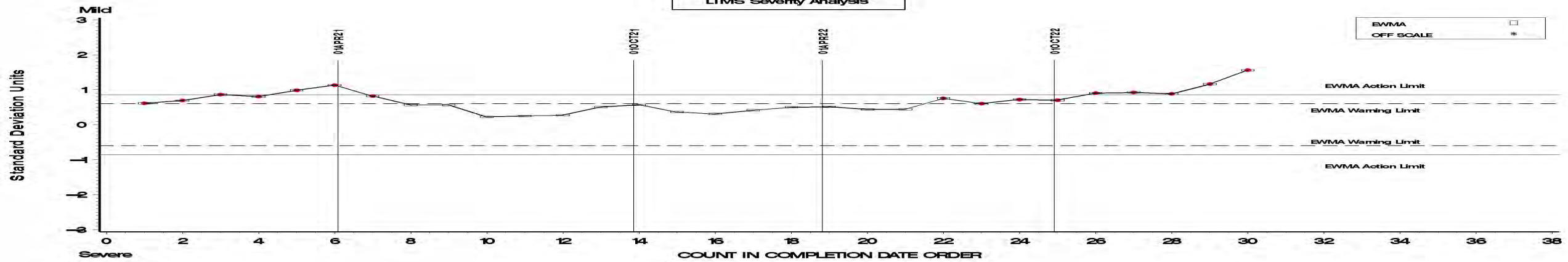
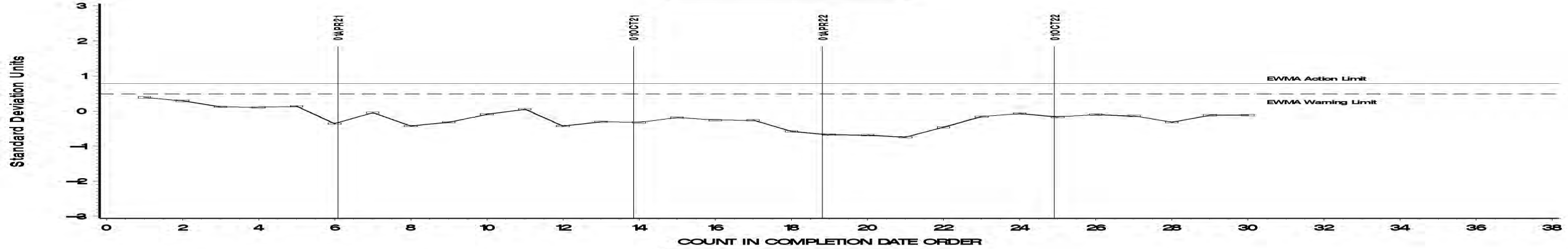
LTMS Severity Analysis



LTMS Precision Analysis



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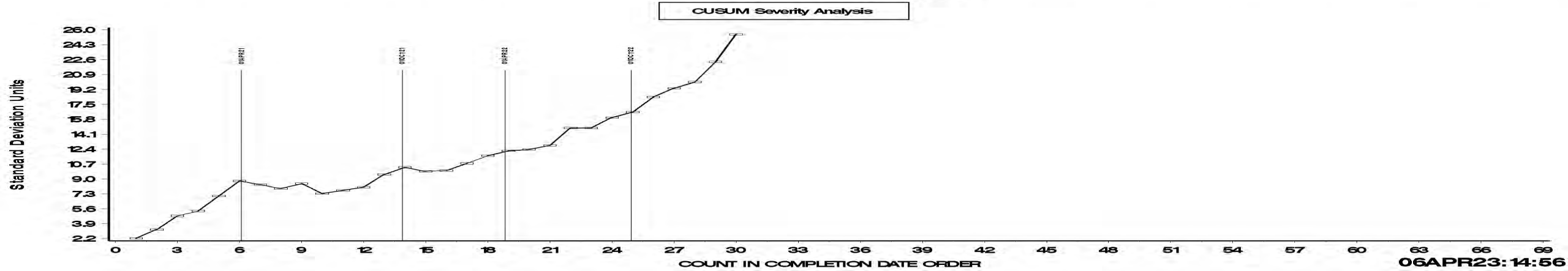

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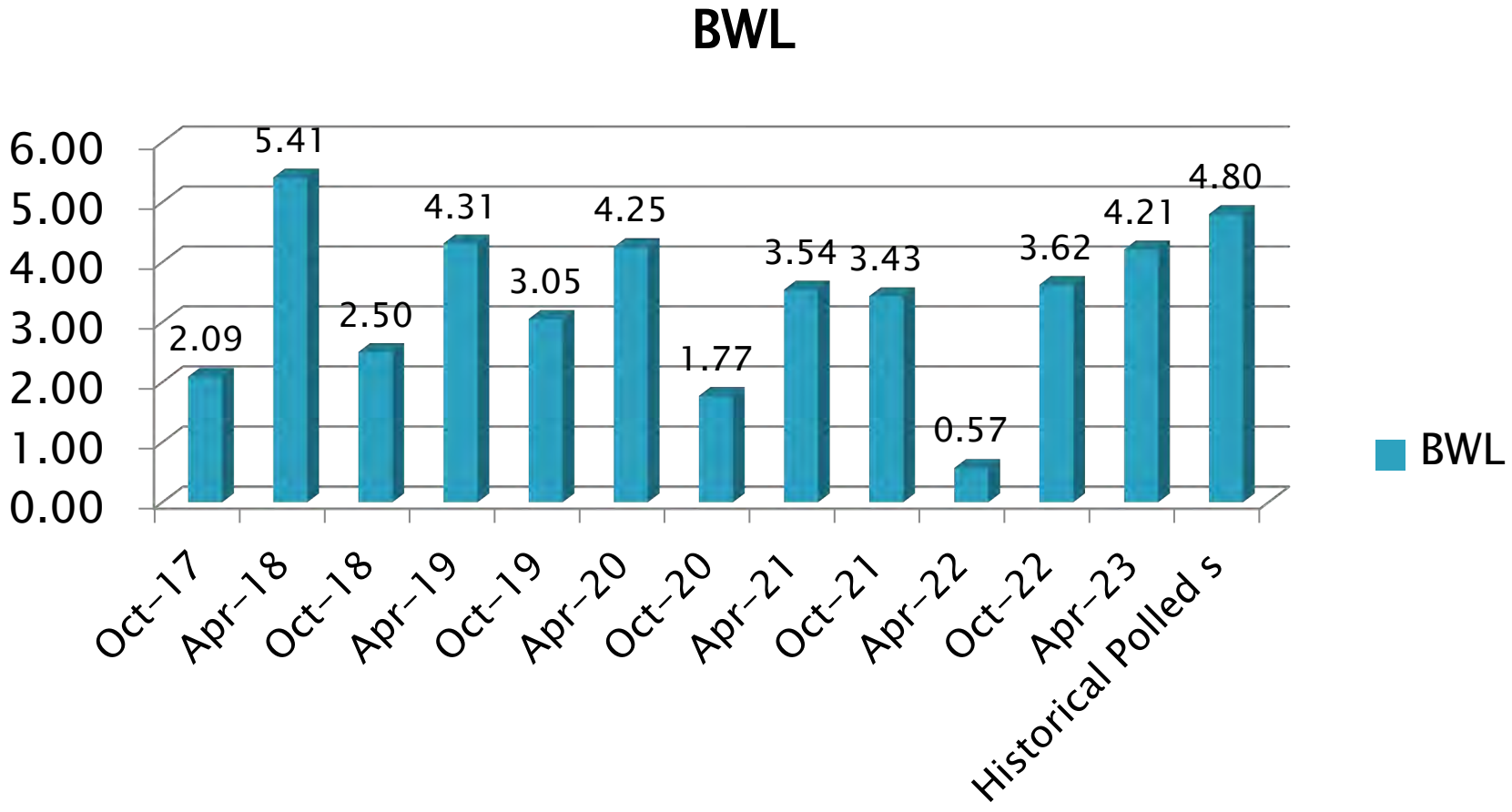
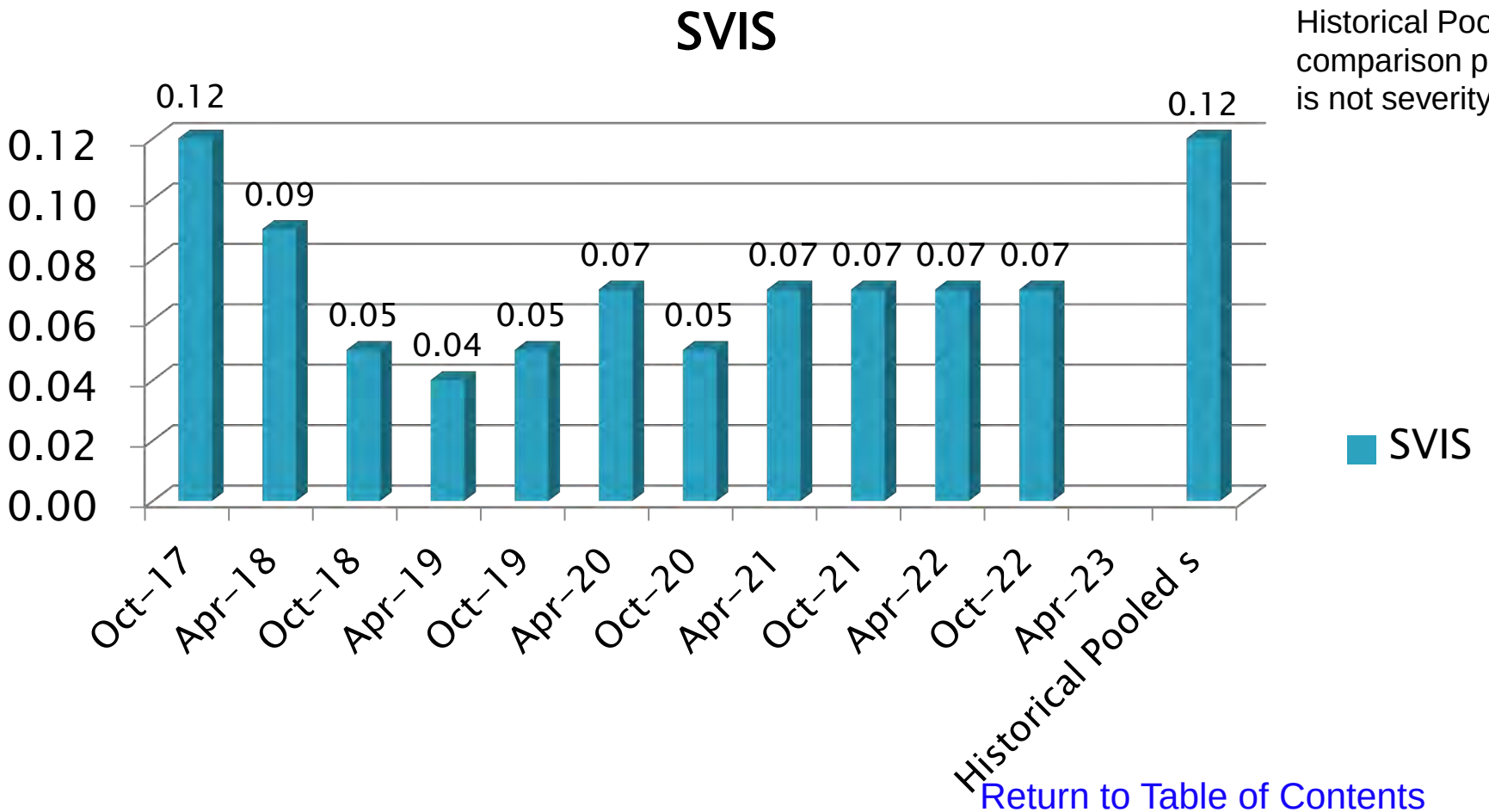
Sequence VIII Precision Estimates



Sequence VIII Precision Estimates



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

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Sequence IX

- April 2023

Test Monitoring Center
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Sequence IX Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	16
Statistically Unacceptable Calibration Test	OC	3
Operationally Invalid Calibration Test (lab judgement)	LC	1
Total		**20**

Sequence IX – Failed Tests

Test Status	Number of Tests
Ei Level 3 alarm (mild direction)	2
Ei Level 3 alarm (severe direction)	1
Total	**3**

Sequence IX – Lost Tests*

Test Status	Cause	#
Invalid	Exceeded downtime limit	1
Totals		**1**

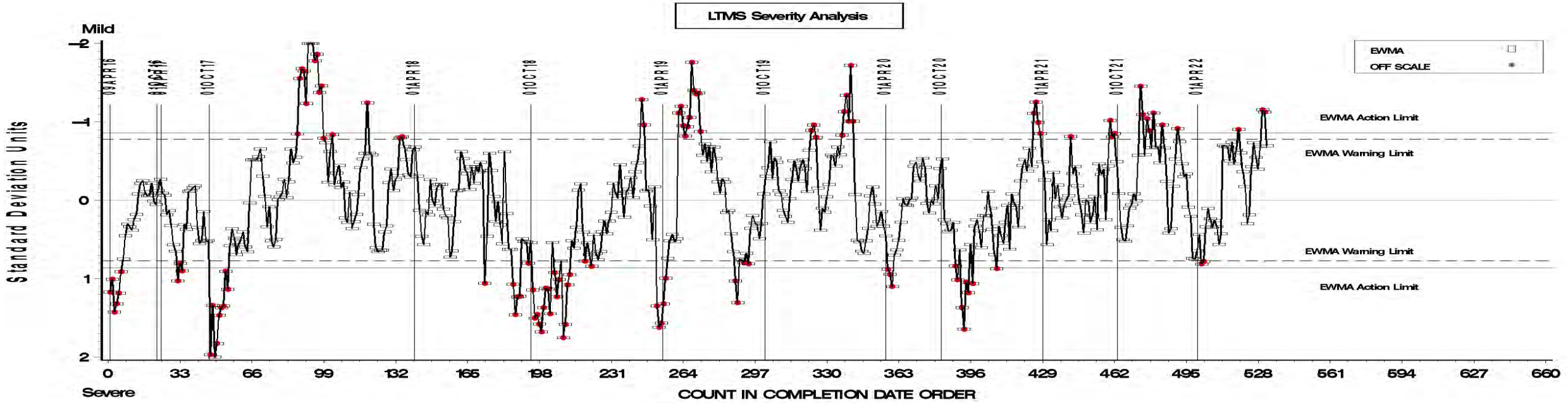
*Invalid and aborted tests

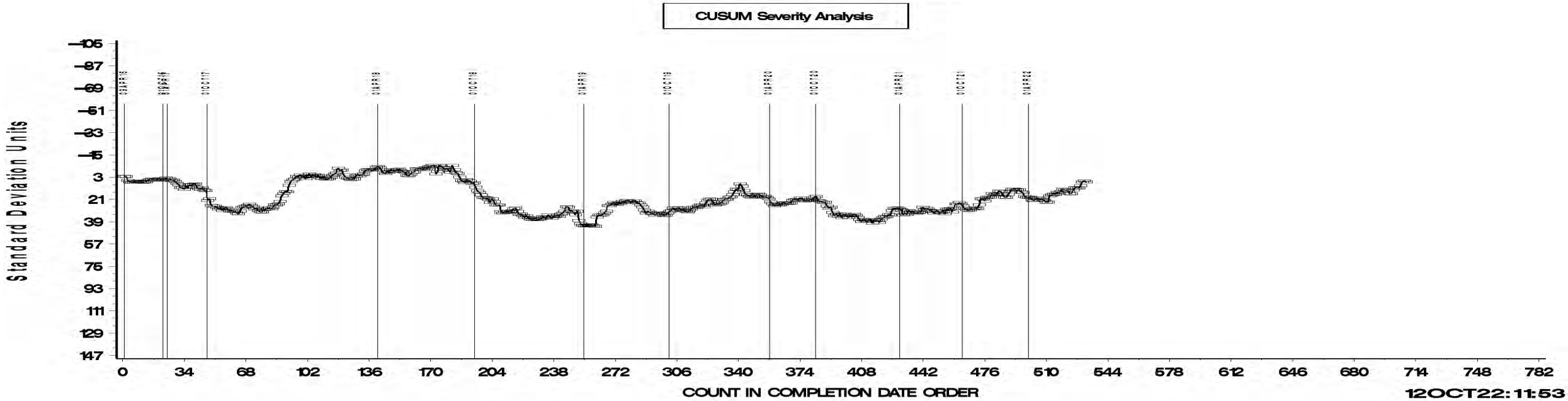
Sequence IX Test Severity

- Average number of Pre-ignitions in control. (currently near severity warning alarm)

SEQUENCE IX INDUSTRY OPERATIONALLY VALID DATA

AVERAGE NUMBER OF PREIGNITIONS FROM VALID ITERATIONS





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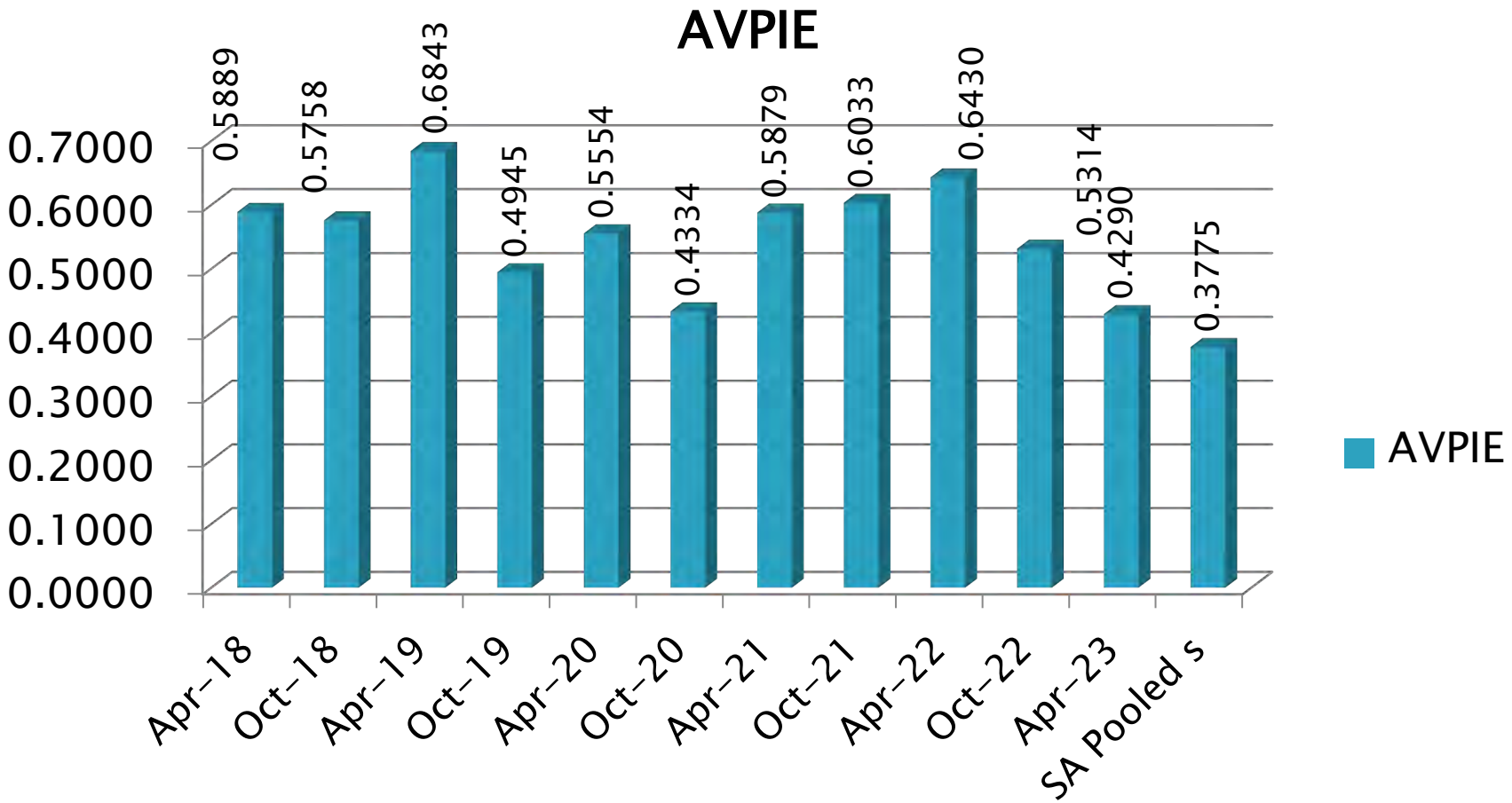
Sequence IX Precision Estimates



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Sequence X

April 2023

Test Monitoring Center
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Sequence X Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	5
Aborted Calibration Test	XC	1
Total Number of Tests		**6**

Sequence X – Lost Tests*

Test Status	Cause	#
Aborted	Test Terminated After Oil became Contaminated during Blowby Rework	1
Totals		**1**

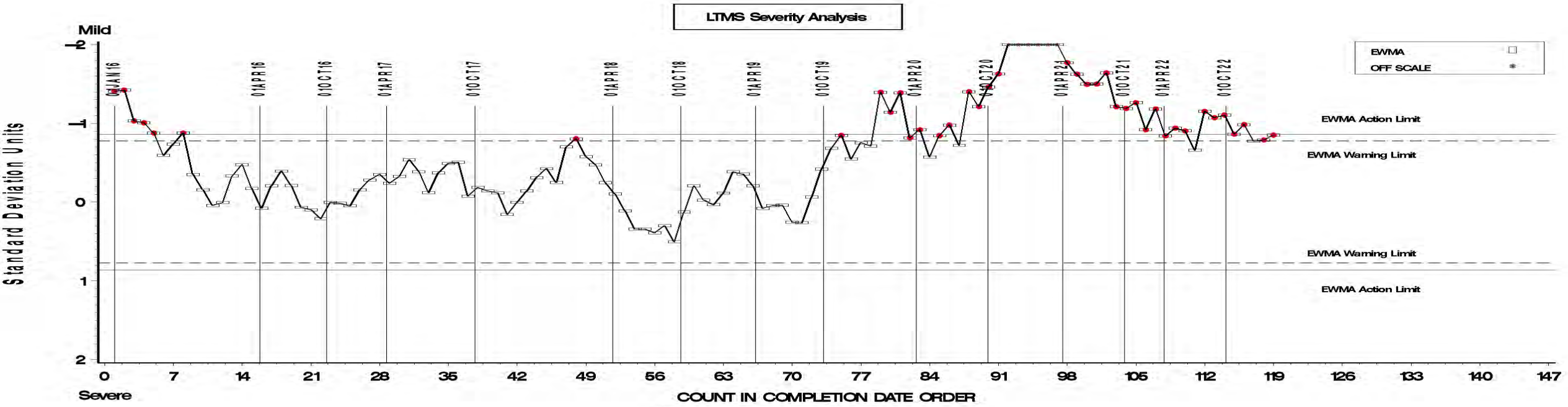
*Invalid and aborted tests

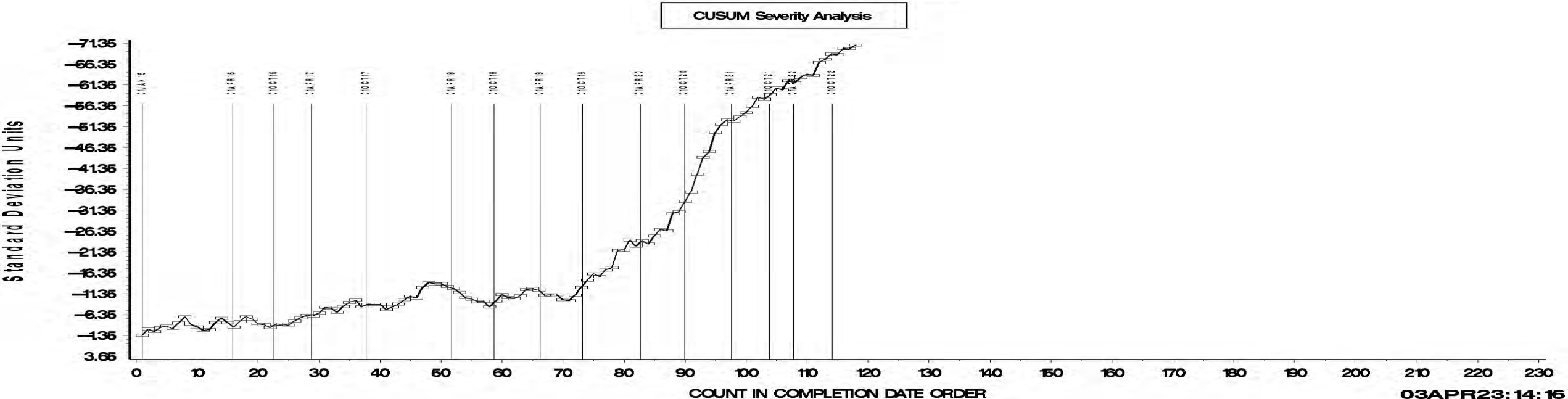
Sequence X Test Severity

- Average Chain Stretch % in Severity warning Alarm (mild).

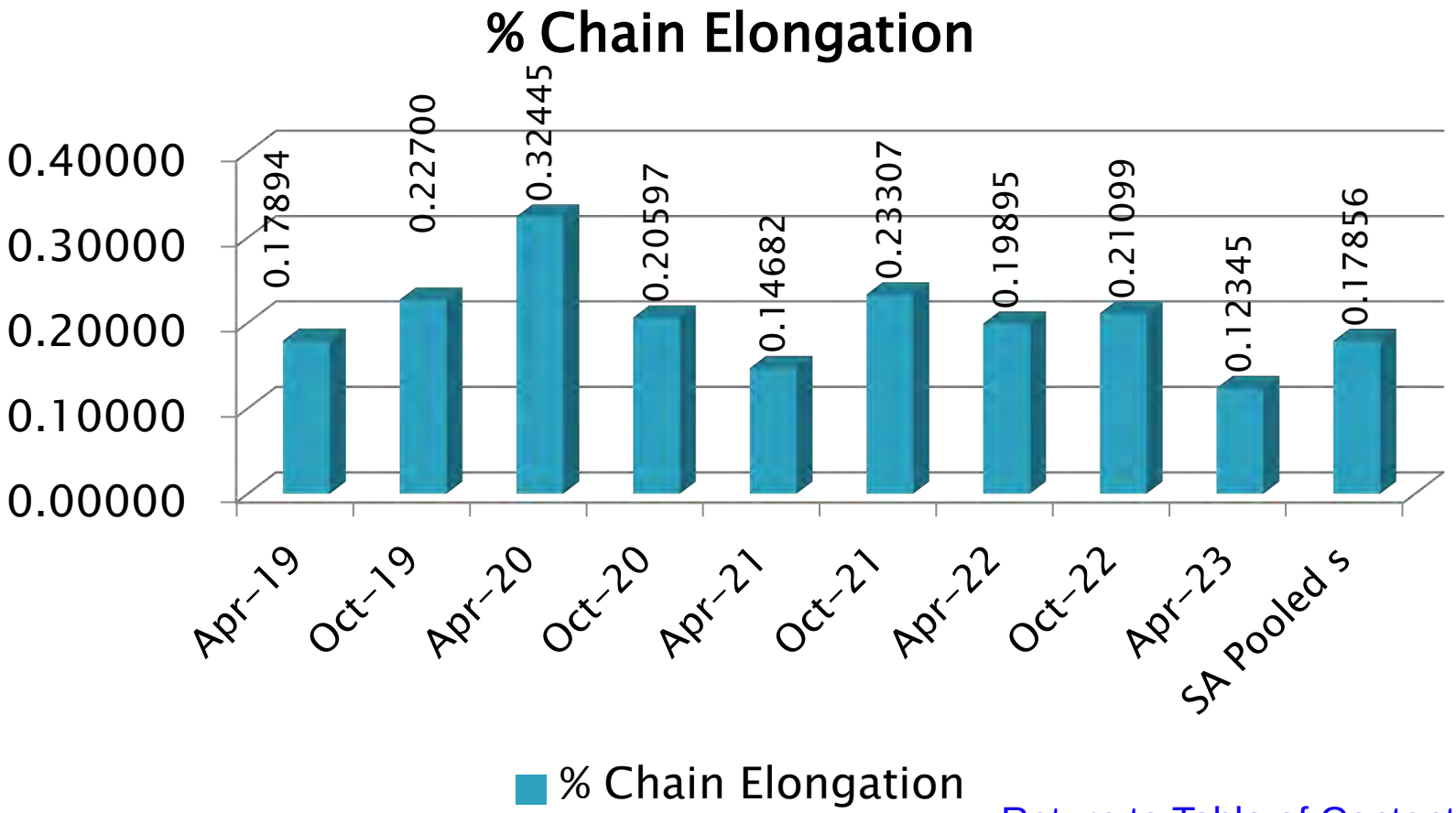
SEQUENCE X INDUSTRY OPERATIONALLY VALID DATA

END OF TEST CHAIN WEAR FINAL RESULT





Sequence X Precision Estimates



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Information Letters

April 2023

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Information Letters*

Test	Date	IL	Topic
IIIH	20221216	22-4	Allowed the use of alternate cooling pump and Type K thermocouples.
IIIH	20230223	23-1	Updated reference to Rating Workshop to ASTM Deposit Rating Workshop
IVA	20230123	23-1	Increased calibration period to One year
VH	20230310	23-1	Updated reference to Rating Workshop to ASTM Deposit Rating Workshop
X	20230313	23-1	Increased calibration period to One year

*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 220 and 224
  - A reblend for reference oils 220 has been received. A reblend of 224 has also been received and is available in the laboratories.
- TMC 704-1
  - The supplier has been contacted and this oil can not be reblended. The panel will need to search for a replacement. This oil is no longer available from the TMC. Seven tests of this oil remain in active labs.
- VIEBL and FO6
  - A new batch of VIEBL and FO6 has been blended and shipped to the labs. Additional testing is nearly complete and approval of VIEBL6 for use should be addressed shortly.

Reference Oil Re-blends

- TMC 542-4 and 1010-1
  - Both reference oils 542-4 and 1010-1 have been depleted at the TMC. Reblends for reference oils are currently being introduced in the VIE test.
- TMC 543
  - A limited quantity remains of reference oil 543. A reblend of this oil, 543-1 has been obtained by the TMC.
- TMC 940

  A limited quantity remains of reference oil 940. A reblend of this oil, 940-1 has been obtained by the TMC.

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount (gallons)	Quantity Shipped in last 6 months	TMC Inventory (gallons)	Lab Inventory (gallons)	Estimated Life
220	IX	1100	0	40.7	60	1-2 years
220-1	IX	1060	0	1060	0	5+ Years
221	IX	2120	100	212	70	2.5 years
224	IX	1026	0	0	60	<1 year
224-1	IX	220	0	220	0	3 years
270	X	1100	25	550	45	5 years
271	X	980	0	677	30	5 years
300-1	IVB	378	15	206	30	3 years
434-3	IIIH	980	49	624	25	5+ years

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount (gallons)	Quantity Shipped in last 6 months	TMC Inventory (gallons)	Lab Inventory (gallons)	Estimated Life
436	IIIH	1100	12.5	590	20	5+ years
438-1	IIIH	605	0	0	2.5	<1 year
438-2	IIIH	540	7.5	366	35	5 years
542-3	VIE/VIF	997	0	0	18	<1 Year
542-4	VIE/VIF	1100	0	0	42	<1 Year
542-5	VIE/VIF	1060	128	932	84	5+ years
543	VIF	1100	42	0	54	<1 Year
543-1	VIF	1000	24	976	24	5+ Years
544	VIE	897	6	180	36	3+ years
704-1*	VIII	897	0	0	14	1.5 years

*Reference oil 704-1 can not be reblended. Remaining oil to be used for new bearing approval.

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount (gallons)	Quantity Shipped in last 6 months	TMC Inventory (gallons)	Lab Inventory (gallons)	Estimated Life
931	VH	908	21	798	21	5+years
940	VH	560	24	0	33	1 year
940-1	VH	485	0	0	0	5+ years
1006-2	IVA, VIII	5500	64	118	27	3 years
1010-1	VIE	1760	30	5	24	~1 year
1010-2	VIE	550	48	502	48	~1 year
1011	IVB/VH/VIF/X	1100	0	0	34	Depleted
1011-1	IVB/VH/VIF/X	1395	56	1055	140	5+ years
1012	IVB	2200	70	1195	75	5+ years

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LTMS Deviations

October 1, 2022 – March 31, 2023

Test Monitoring Center
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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

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Quality Index Deviations

October 1, 2022 – March 31, 2023

Test Monitoring Center
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Quality Index Deviations

- One deviation this period, a VH Deviation for Rocker Cover Inlet temperature due to a mistake in tuning changes being made to the stand control system while the test was running.

Quality Index Deviations

Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIH	8
IVA	32
IVB	2
VH	10
IX	1
X	3

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TMC Laboratory Visits

- October 1, 2022 – March 31, 2023

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TMC Lab Visits

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

Lab Visit Issues

Sequence IIIH–Unapproved thermocouple type installed in exhaust.

Sequence IIIH–O_2 Sensor installed not the same part number as listed in procedure.

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Test Area Timelines

- October 1, 2022 – March 31, 2023

Test Monitoring Center
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Test Area Timeline Additions*

Test	Date	Topic	IL
IIIH	20221022	First Occurrence of Batch 8 rings	
IIIH	20221122	First Occurrence of Fuel Batch N-000011	
IIIH	20221216	Allow use of alternate cooling pump and type K thermocouples	22-4
IIIH	20230223	Updated the designation of the rating work shop in the test method.	23-1
IVA	20230123	Increased calibration period to one year	23-1
VH	20230126	Batch N-000013 Fuel Approved, No Correction factor applied	

*As of 03/31/2023

Test Area Timeline Additions*

Test	Date	Topic	IL
VH	20230313	Updated the designation of the rating work shop in the test method.	23-1
VIE	20221223	First Occurrence Fuel Batch N-000013	
VIE	20230128	First Occurrence Reference oil 542-5	
VIE	20230311	First Occurrence Reference oil 1010-2	
VIF	20221221	First Occurrence Fuel Batch N-000013	

*As of 03/31/2023

Test Area Timeline Additions*

Test	Date	Topic	IL
VIF	20230117	First Occurrence Reference oil 542-5	
VIII	20230301	Test Declared Unavailable Due to Severity Issues and no calibrated stands.	
IX	20221118	First Occurrence Fuel Batch N-000011	
X	20221221	First Occurrence Fuel Batch N-000011	
X	20230313	Increased calibration period to One year	23-1

*As of 03/31/2023

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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
  - Data is from 2022 workshop; 2020 and 2021 workshops were cancelled due to pandemic. The 2022 and 2023 workshops only includes raters from calibrated labs.

Rating Workshop Data

- 2023 ASTM Deposit Rating Workshop

Test Monitoring Center
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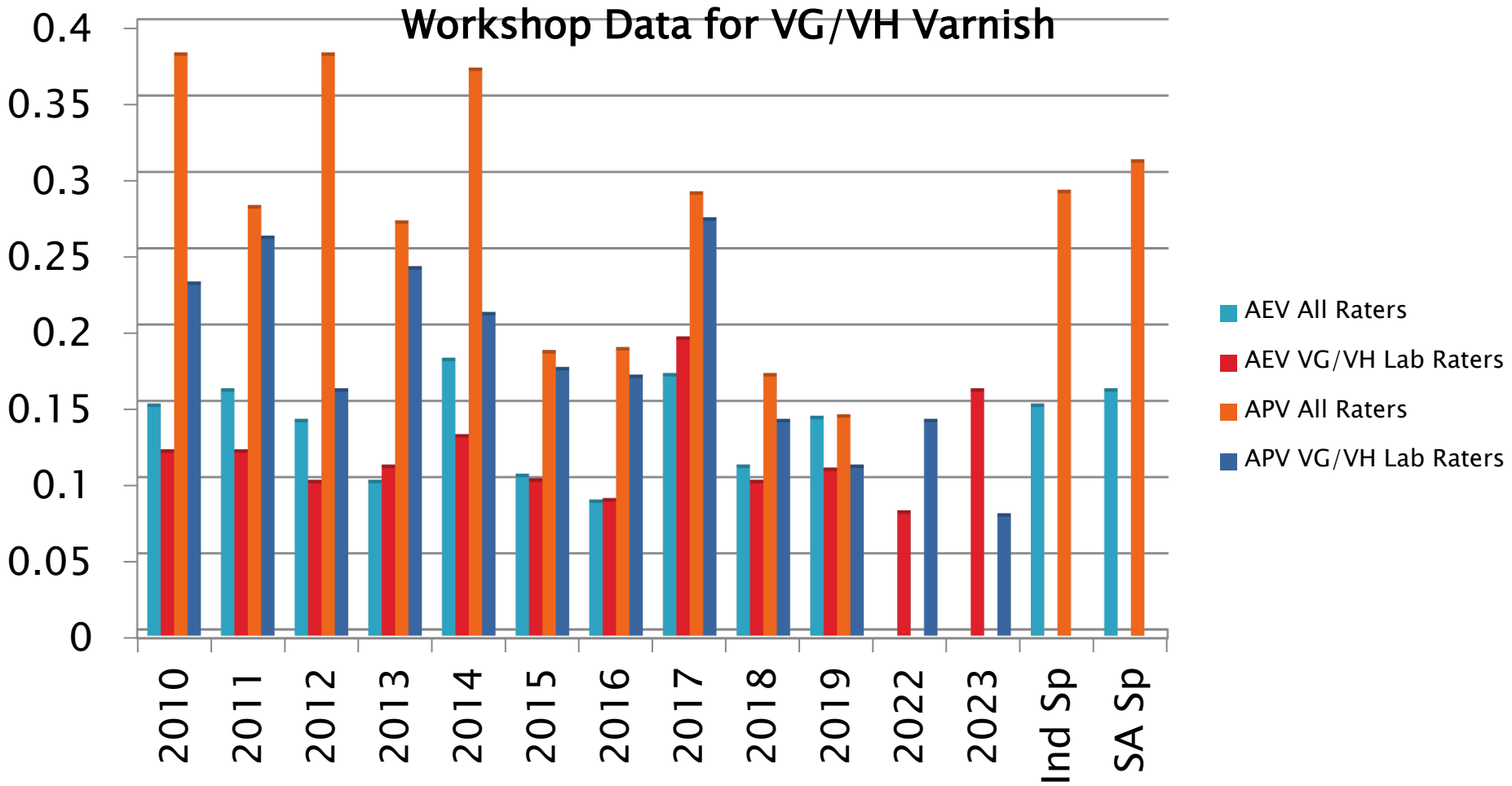
Sequence VG/VH Precision-Rating Workshop Data



Test Monitoring Center
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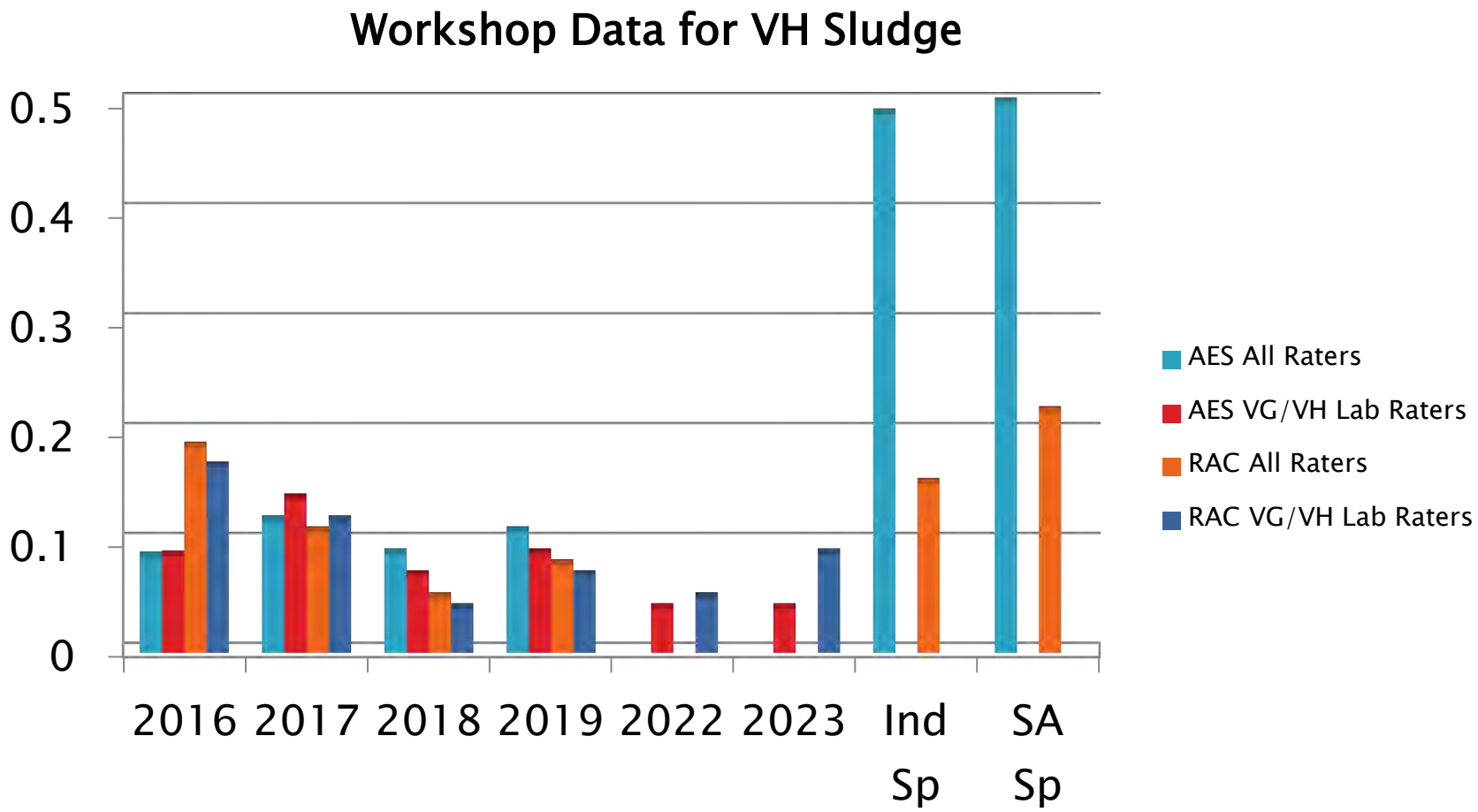
Sequence VH Precision-Rating Workshop Data



Sludge parameters were added for rater calibration in 2019
2022 and 2023 Workshop were for Lab Raters only!

Test Monitoring Center
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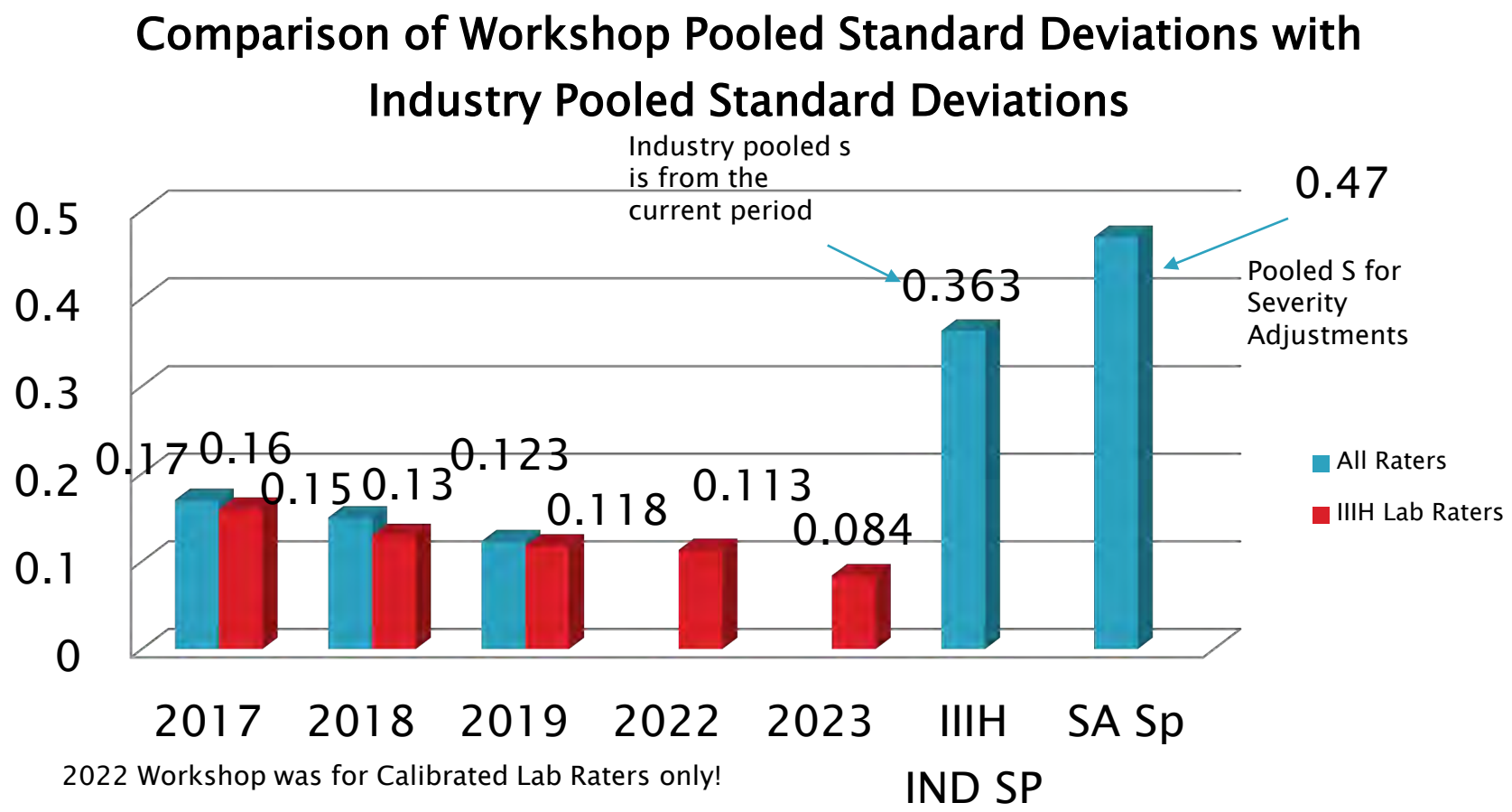
Sequence IIIH Precision – Rating Workshop Data



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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

- https://www.astmtmc.org

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