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Test Monitoring Center

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ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing

April 2021

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Passenger Car Engine Oil Testing Executive Summary

▶ Test Fuel Specifications

- The Sequence III, IV, V, VI and IX panels have moved the fuel specifications for their test(s) from the associated test method to the TMC website.

▶ Seq. VH

- The panel introduced reference oil 931 and also implemented an industry correction factor for Average Engine Sludge (AES).

▶ Rating

- The Light Duty Rating Workshop scheduled for May 2021 was cancelled due to the Covid-19 pandemic.

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Calibrated Labs and Stands*

Test	Labs	Stands
IIIH/A/B	5	14
IVA	2	2
IVB	4	7
VH	4	12
VIE	5	13
VIF	3	5
VIII	2	2
IX	3	5
X	4	5

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*As of 3/31/2021

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Sequence IIIH/A/B

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Sequence IIIH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	17
Statistically Unacceptable Calibration Test	OC	3
Total		20

Sequence IIIH – Failed Tests

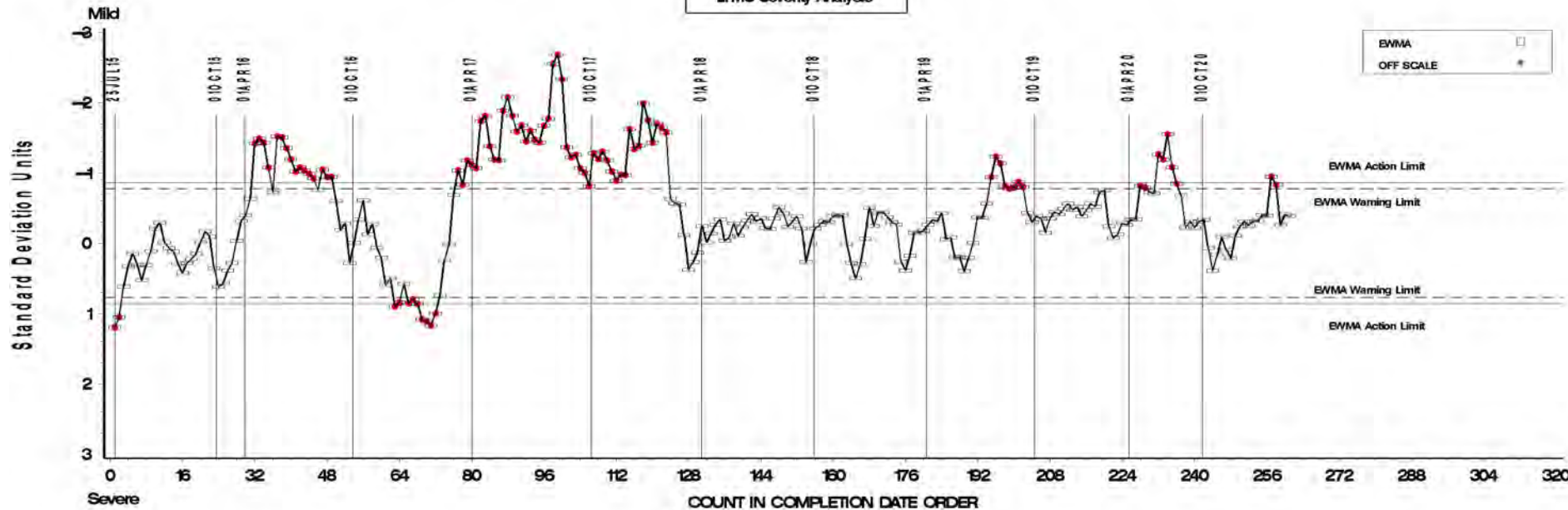
Test Status	#
Level 3 Ei alarm, PVIS (severe direction)	2
Level 3 Ei alarm, PVIS (mild direction)	1
Totals	3

Sequence IIIH Test Severity

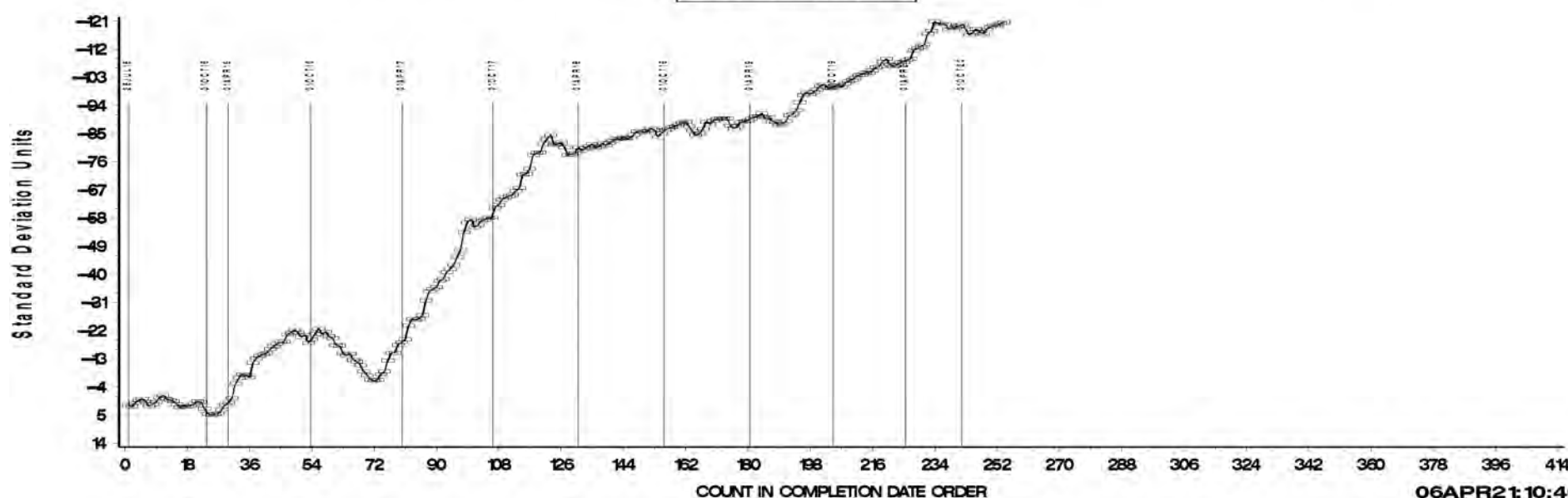
- APV trending mild but within control limits with the most recent test
- All other parameters are in control.

VISCOSITY INCREASE FINAL ORIG UNIT RES

LTMS Severity Analysis

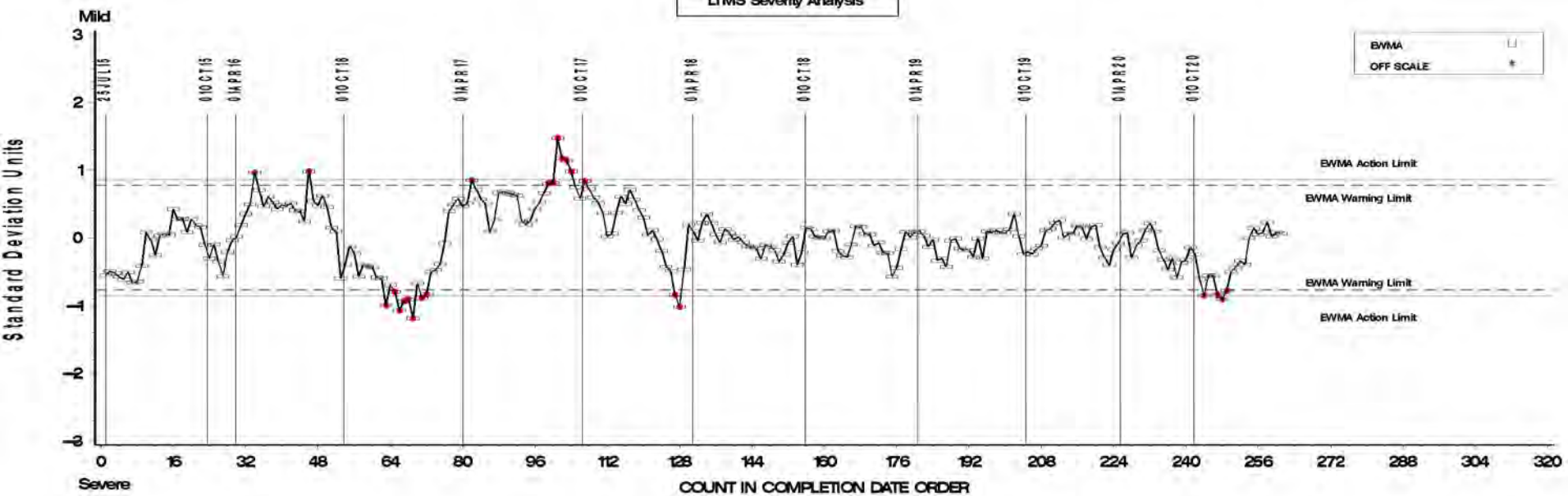


CUSUM Severity Analysis

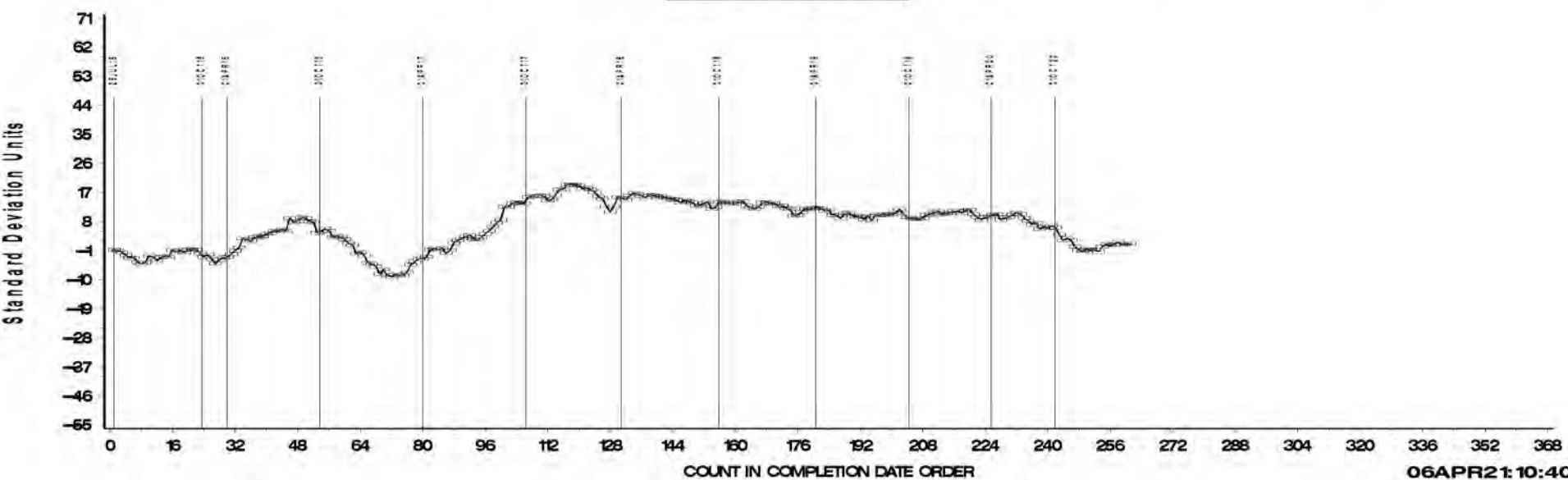


AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG U

LTMS Severity Analysis

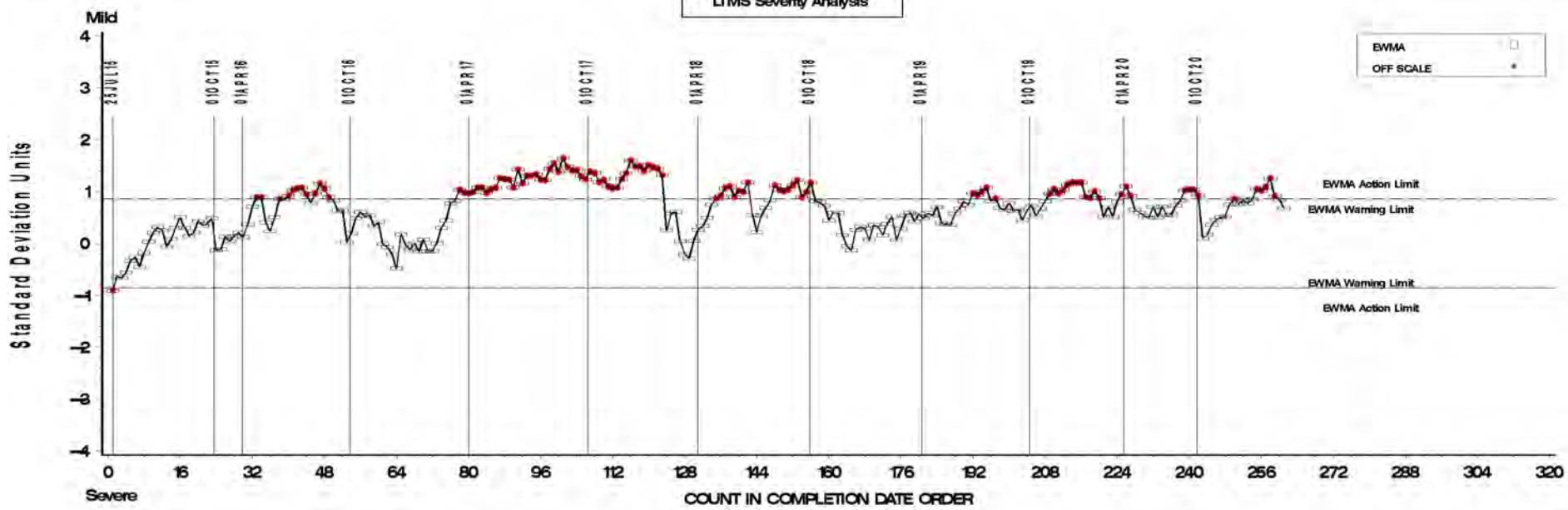


CUSUM Severity Analysis

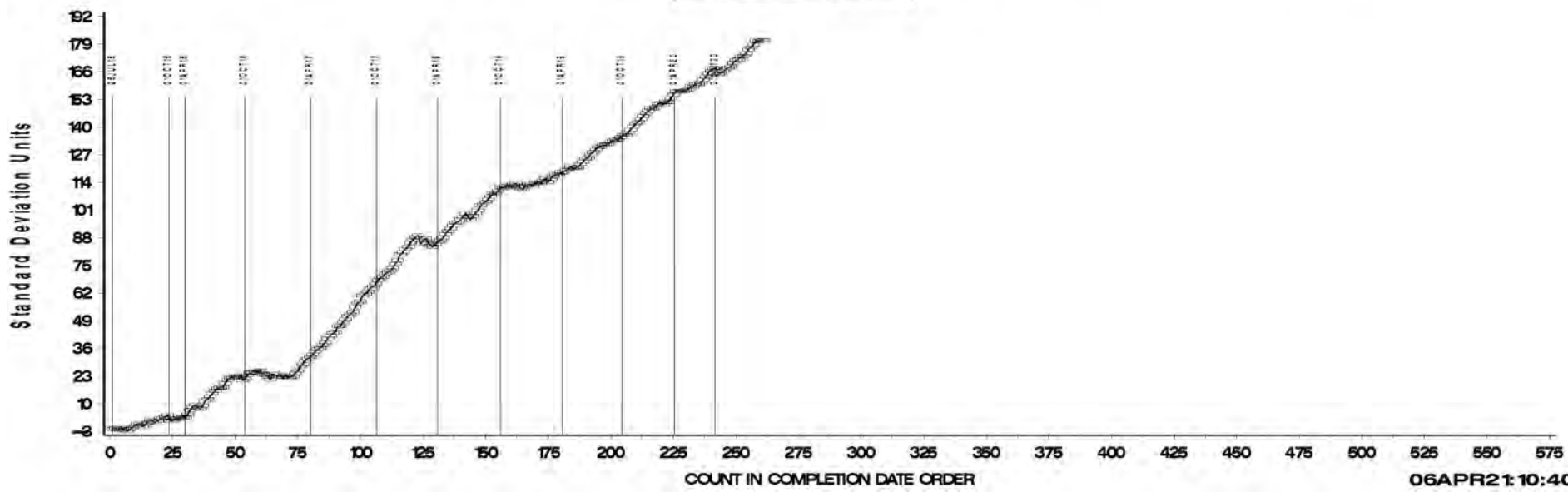


AVERAGE PISTON SKIRT VARNISH

LTMS Severity Analysis

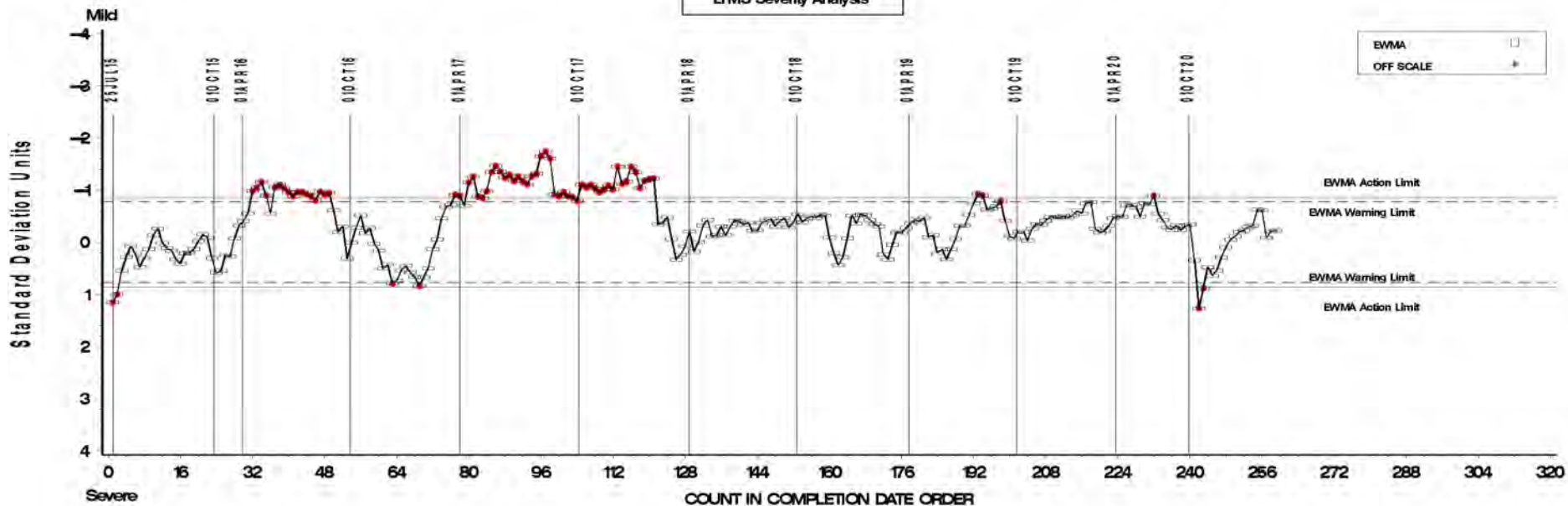


CUSUM Severity Analysis

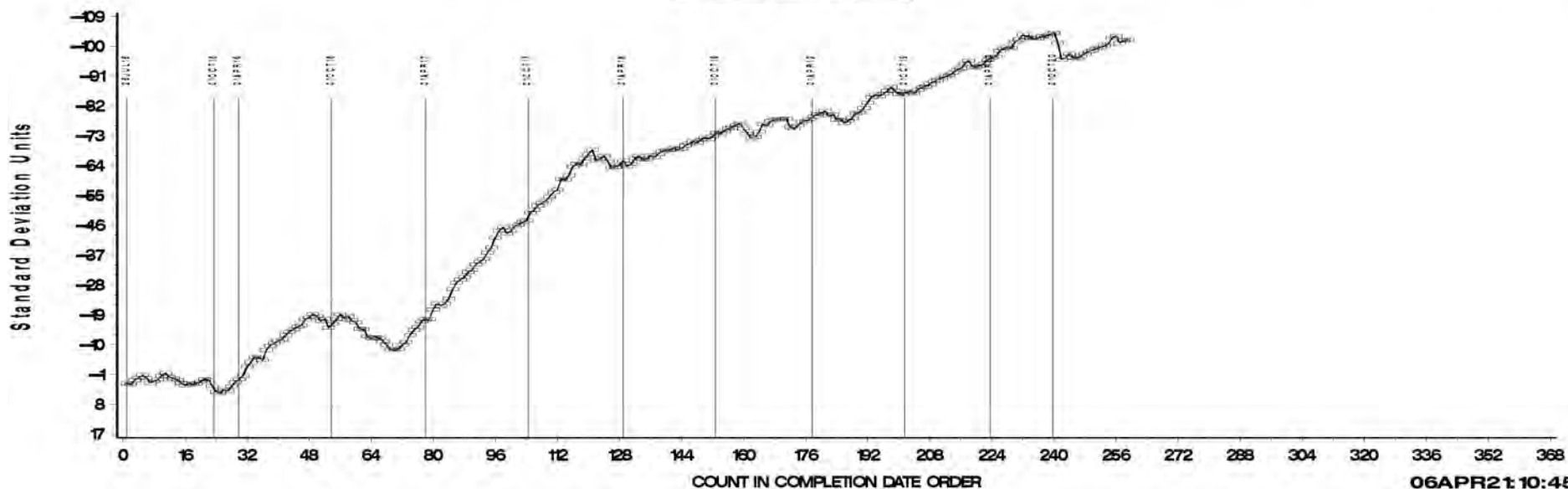


MRV FINAL ORIG UNIT RES [NM, FROZEN, SOLID]

LTMS Severity Analysis

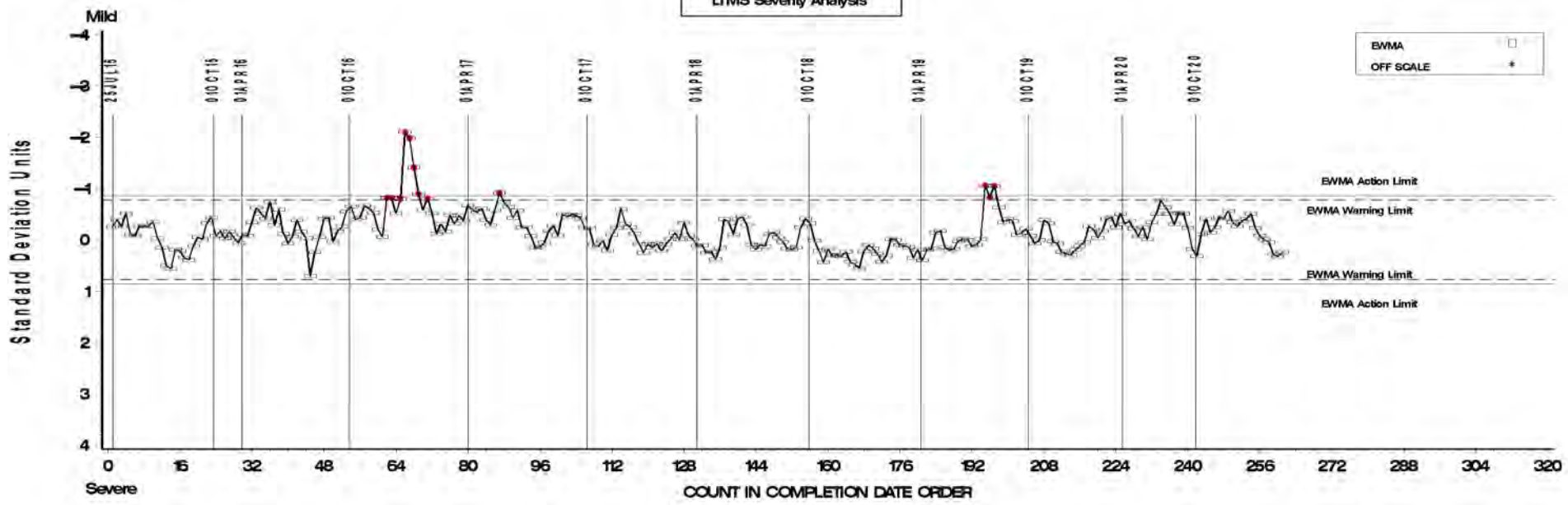


CUSUM Severity Analysis

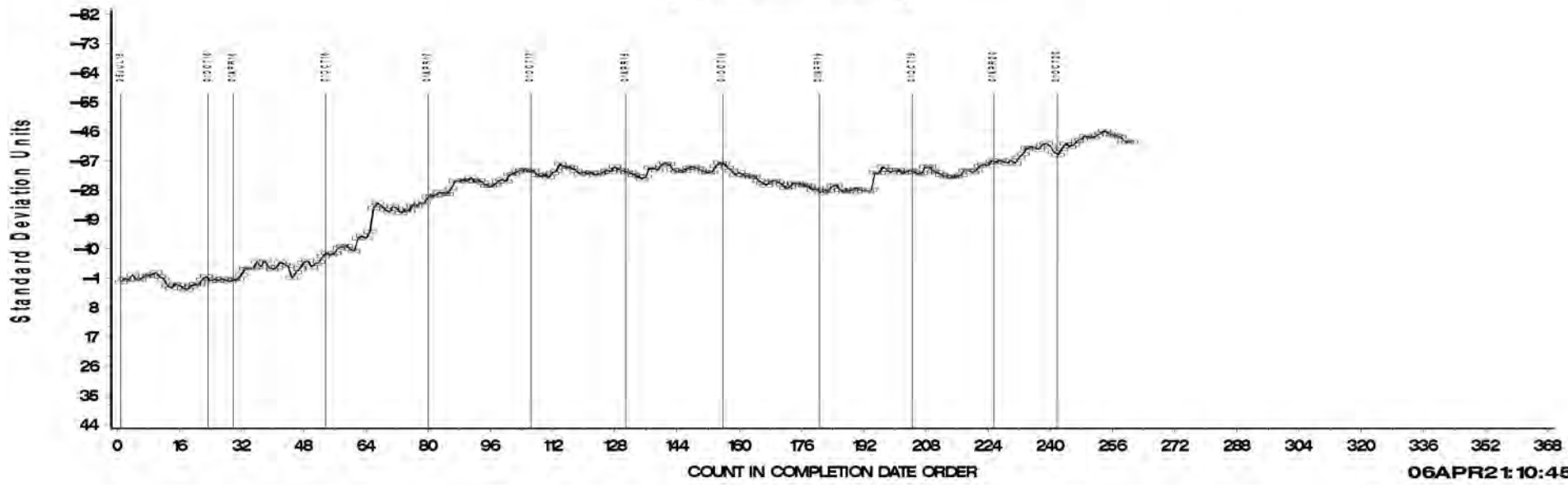


PHOSPHORUS RETENTION, FINAL RESULT

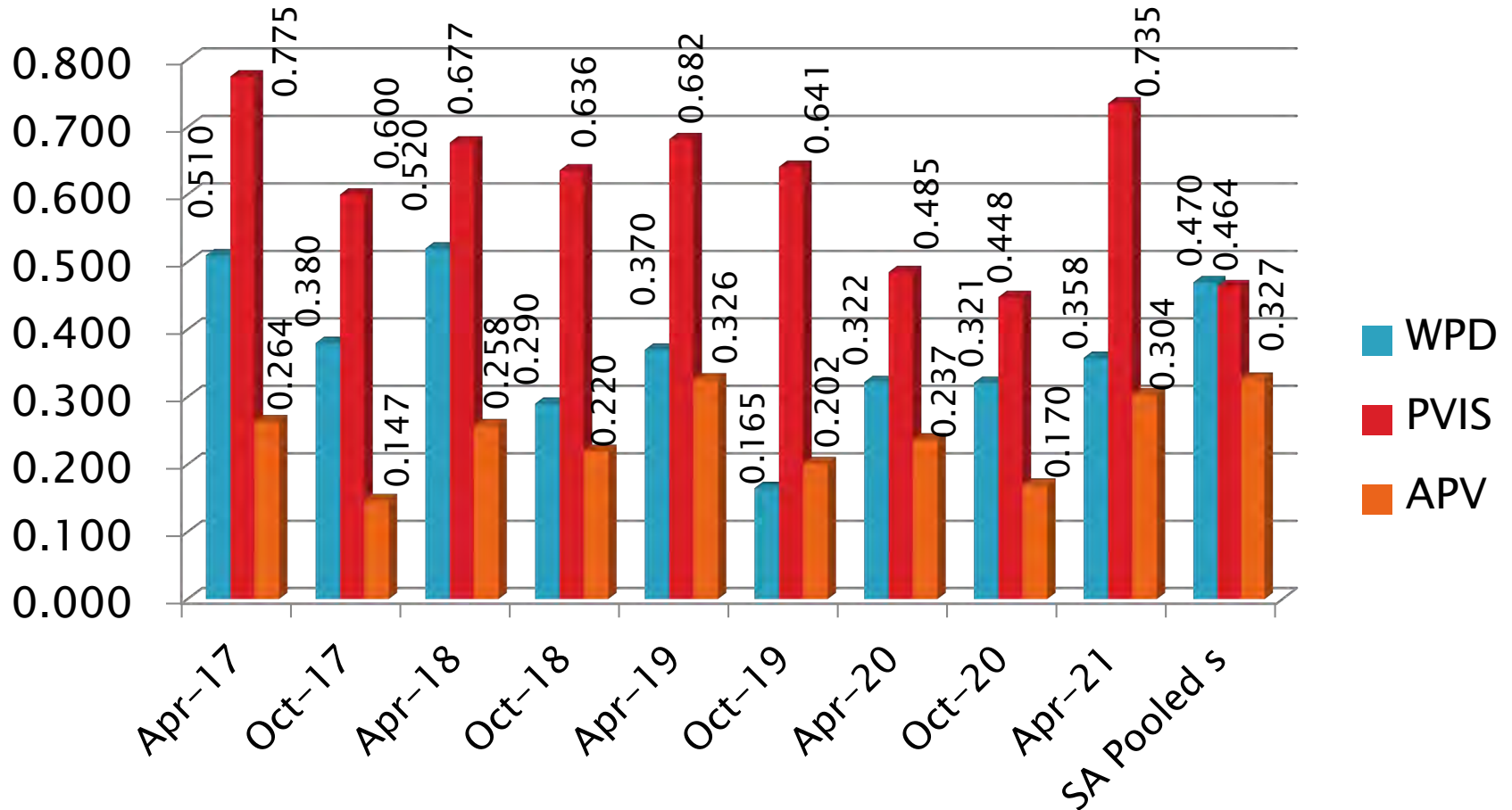
LTMS Severity Analysis



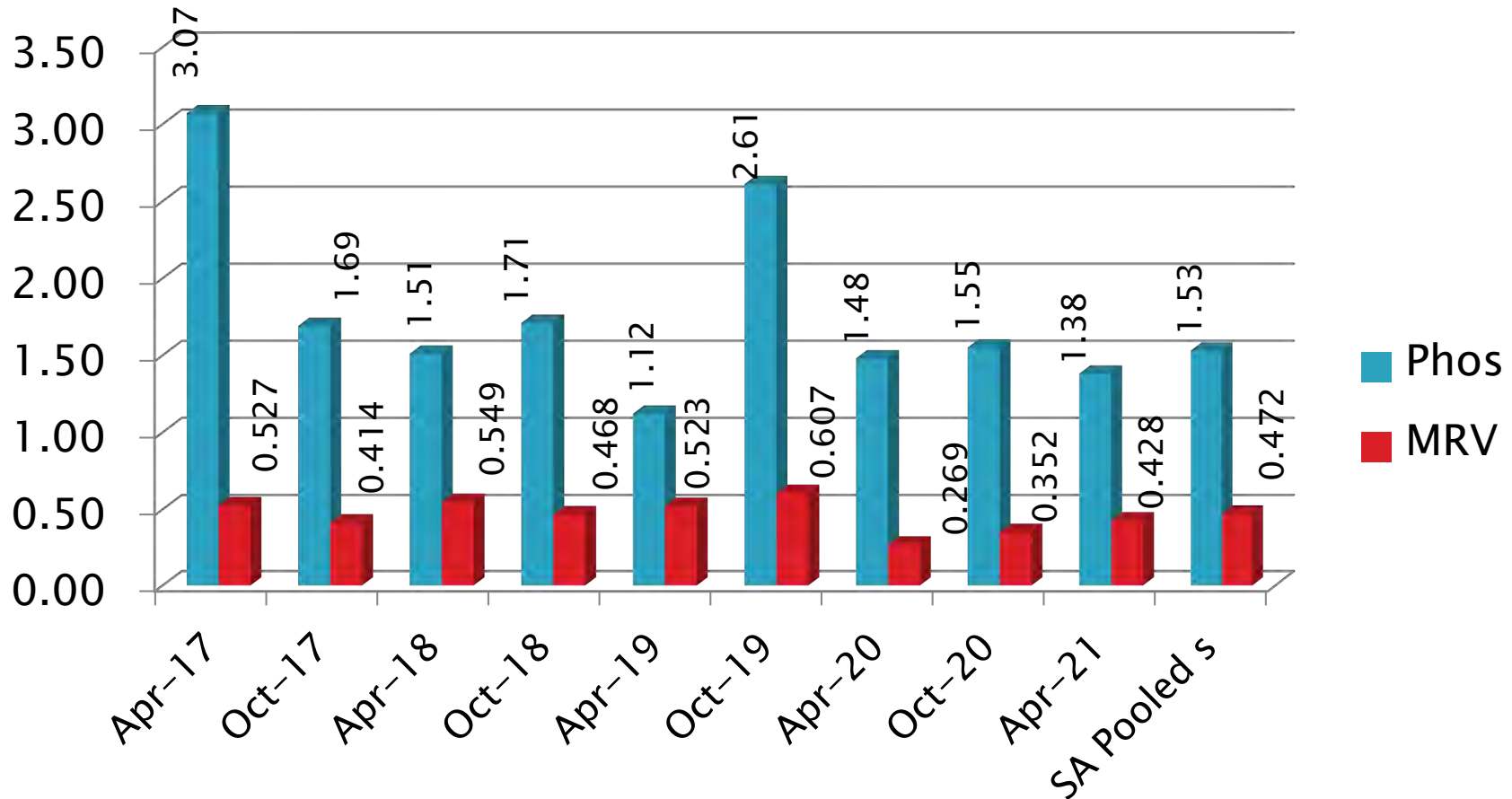
CUSUM Severity Analysis



IIH Precision Estimates



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	2
Total		2

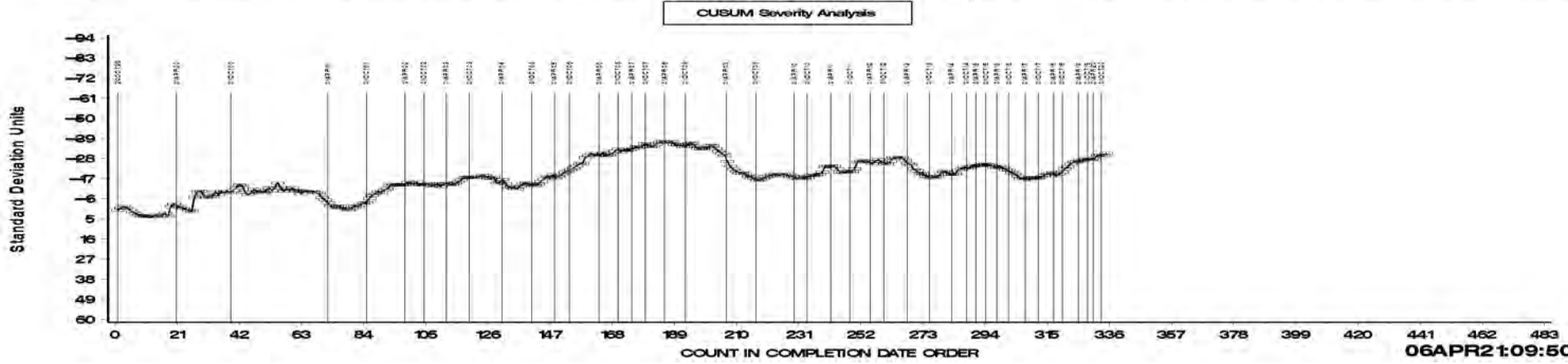
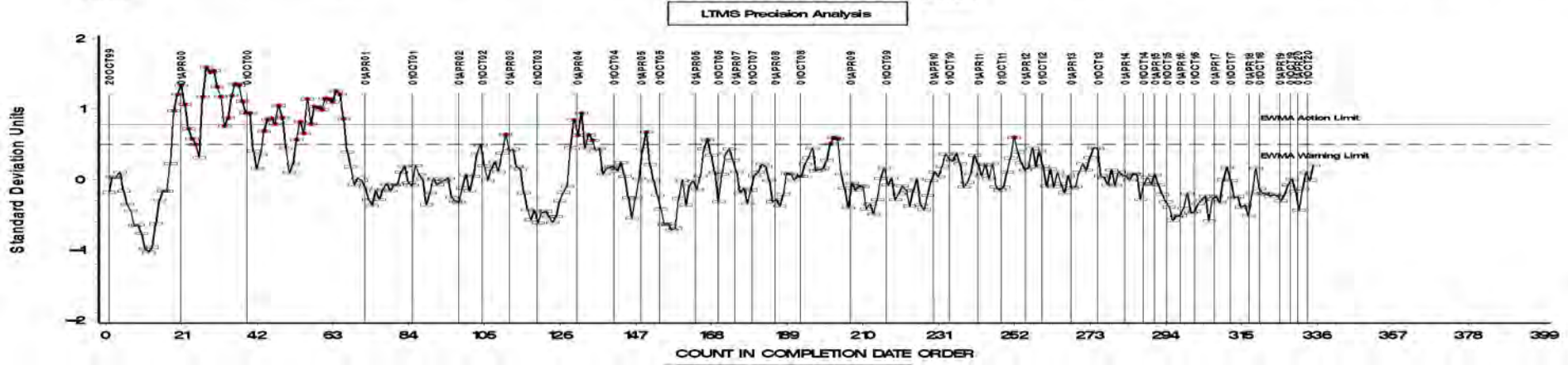
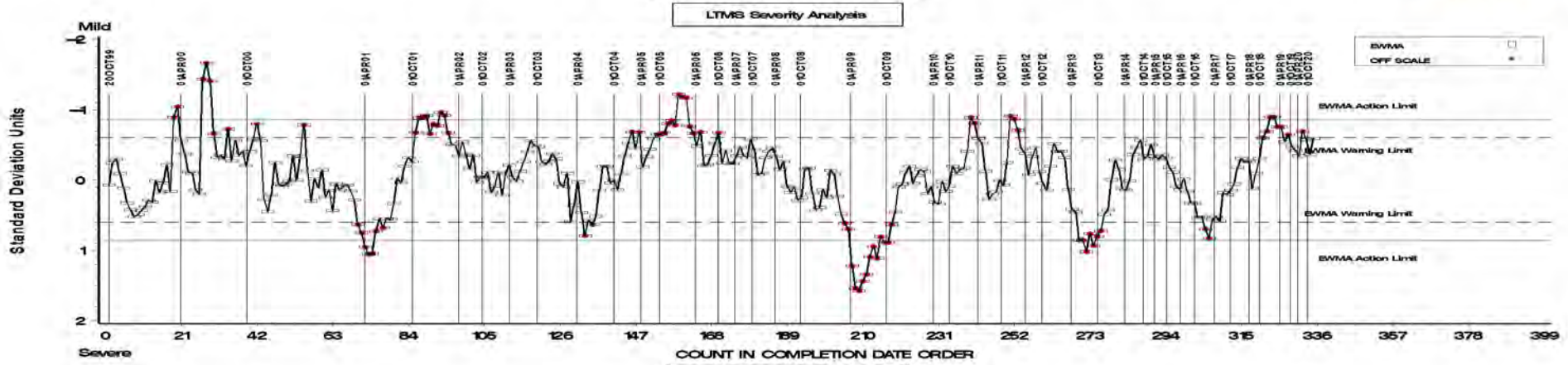
Sequence IVA Test Severity

- ACW is trending mild but within control limits with the most recent test.

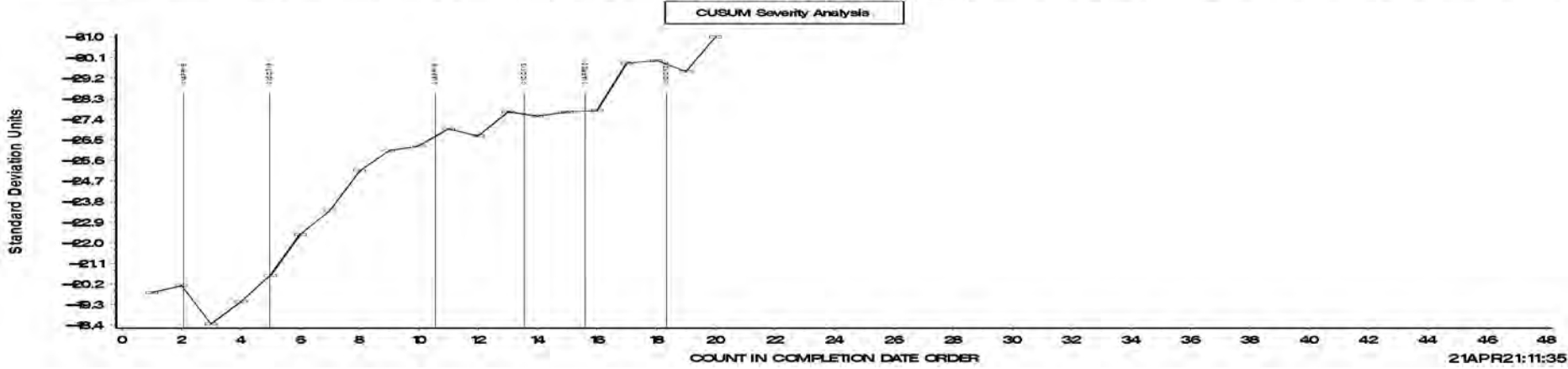
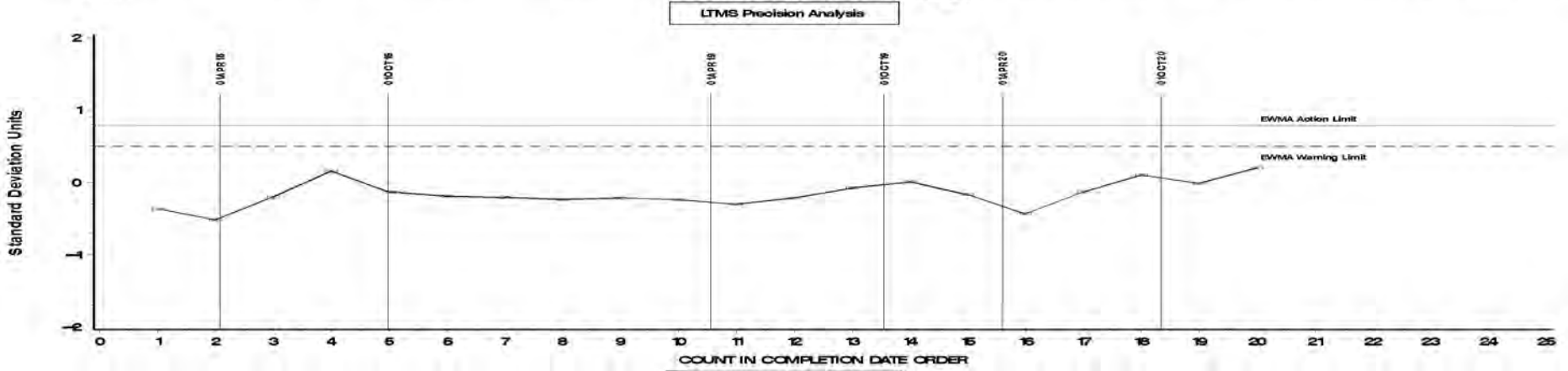
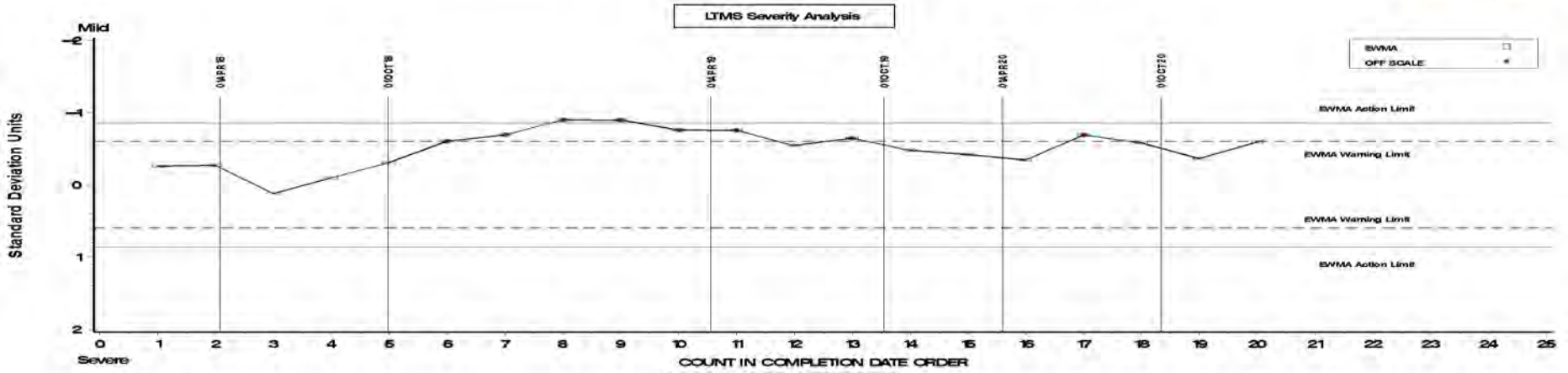
SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA



AVERAGE CAM WEAR

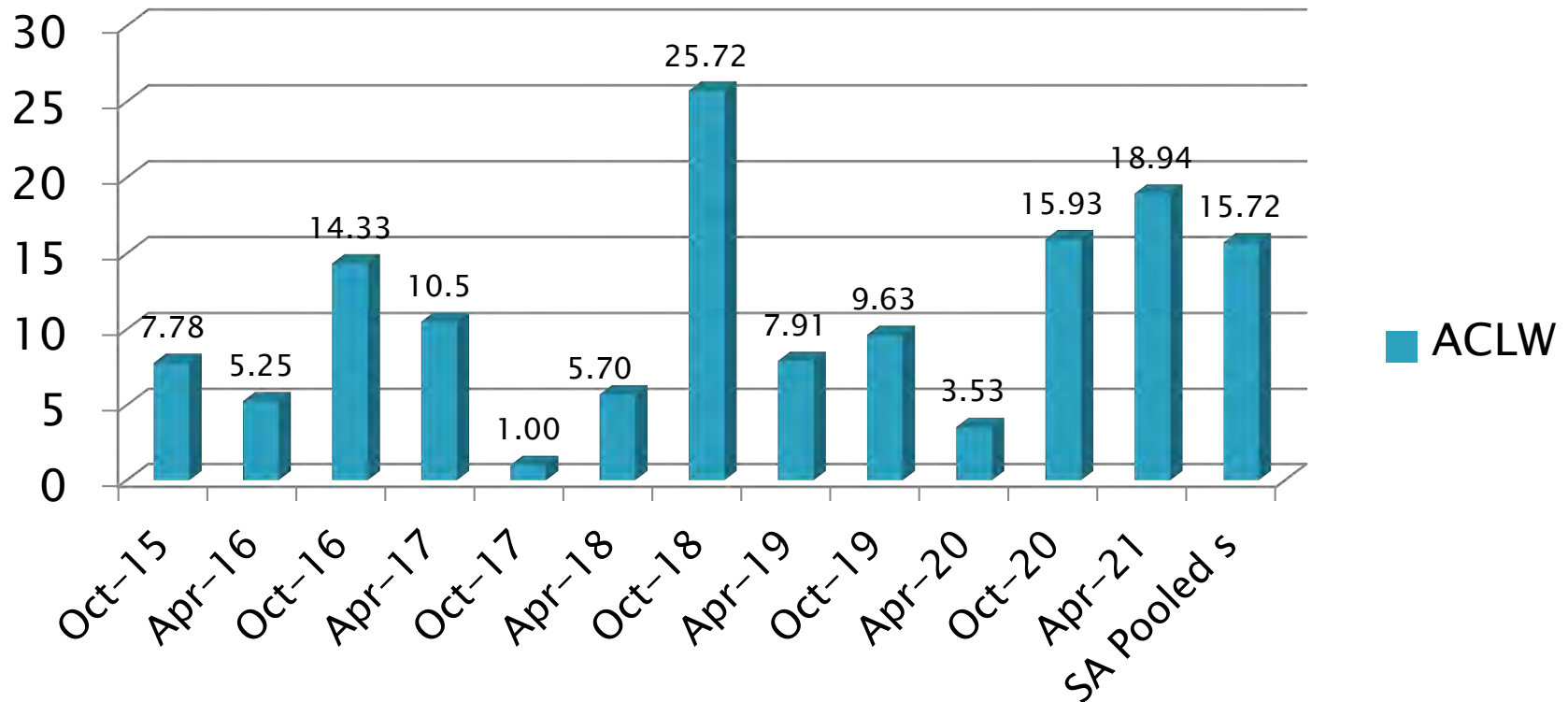


SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA
 20 most recent results
AVERAGE CAM WEAR



Sequence IVA Precision Estimates

ACW



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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

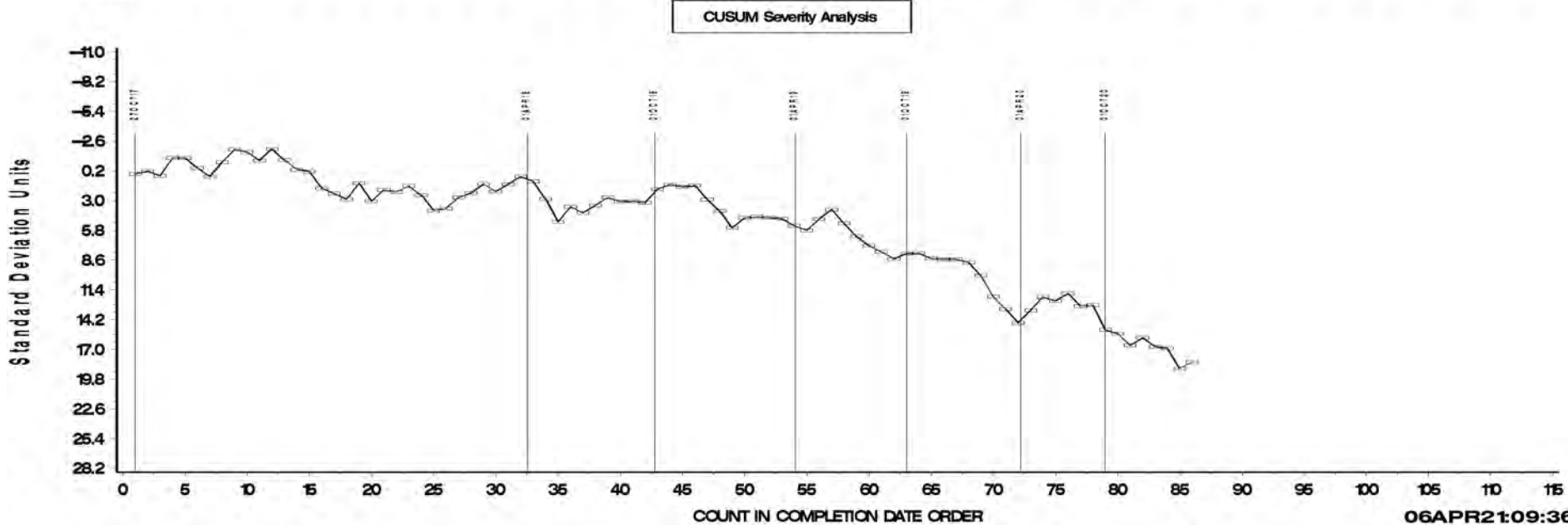
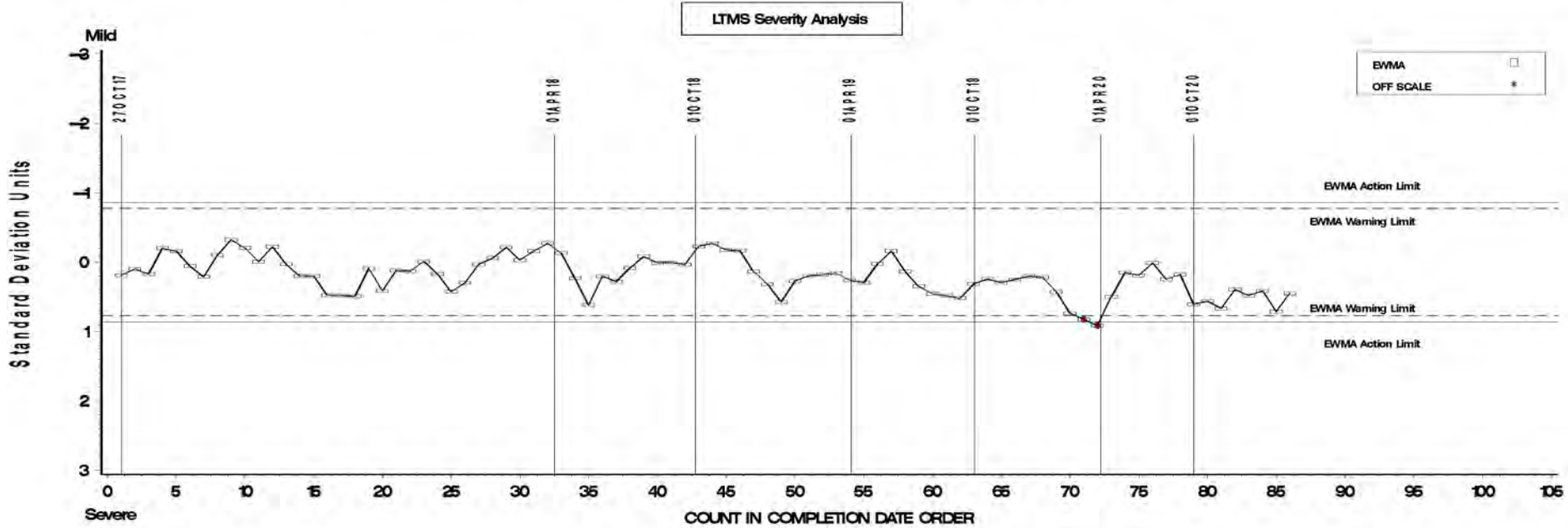
Sequence IVB – Unacceptable Tests

Test Status	#
Ei Level 3 Alarm, Fe	1
Total	1

Sequence IVB Test Severity

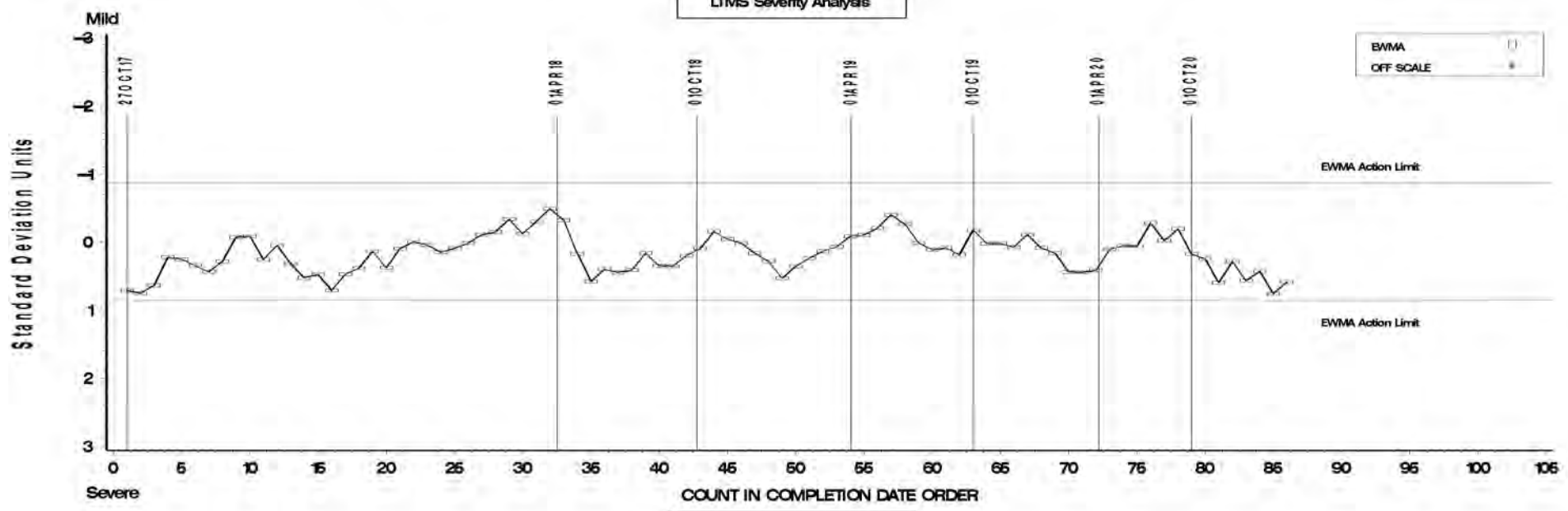
- AVLI and Fe in control.

AVERAGE VOLUME LOSS BY KEYENCE INTAKE Final

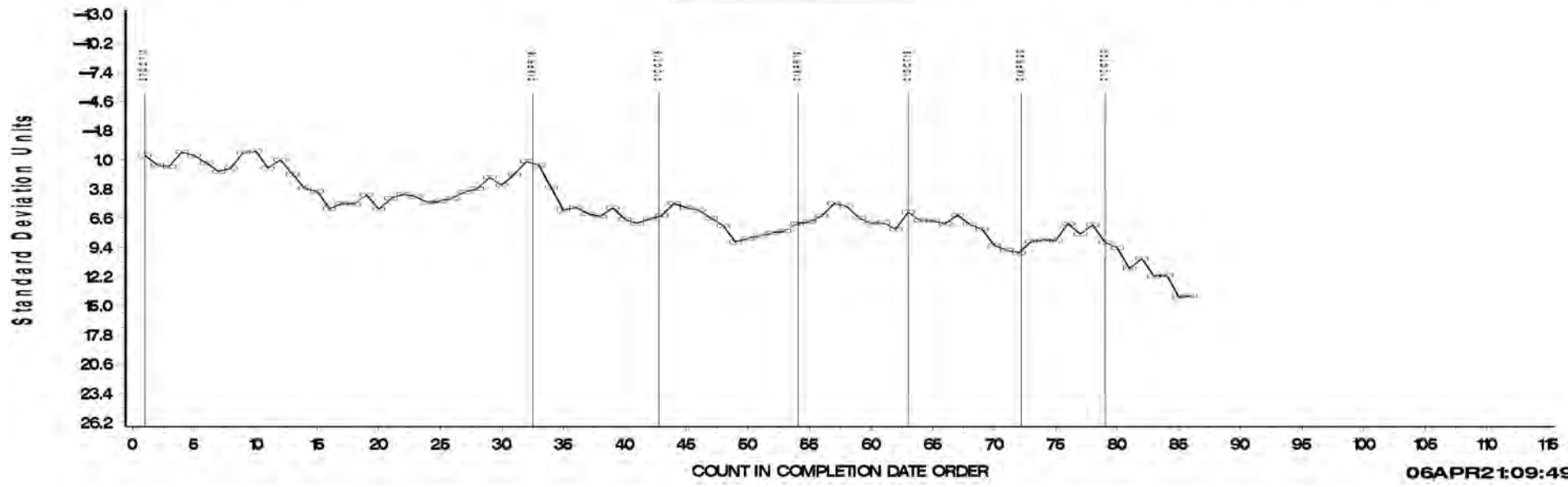


END OF TEST FE FINAL Severity Adjusted RESULT

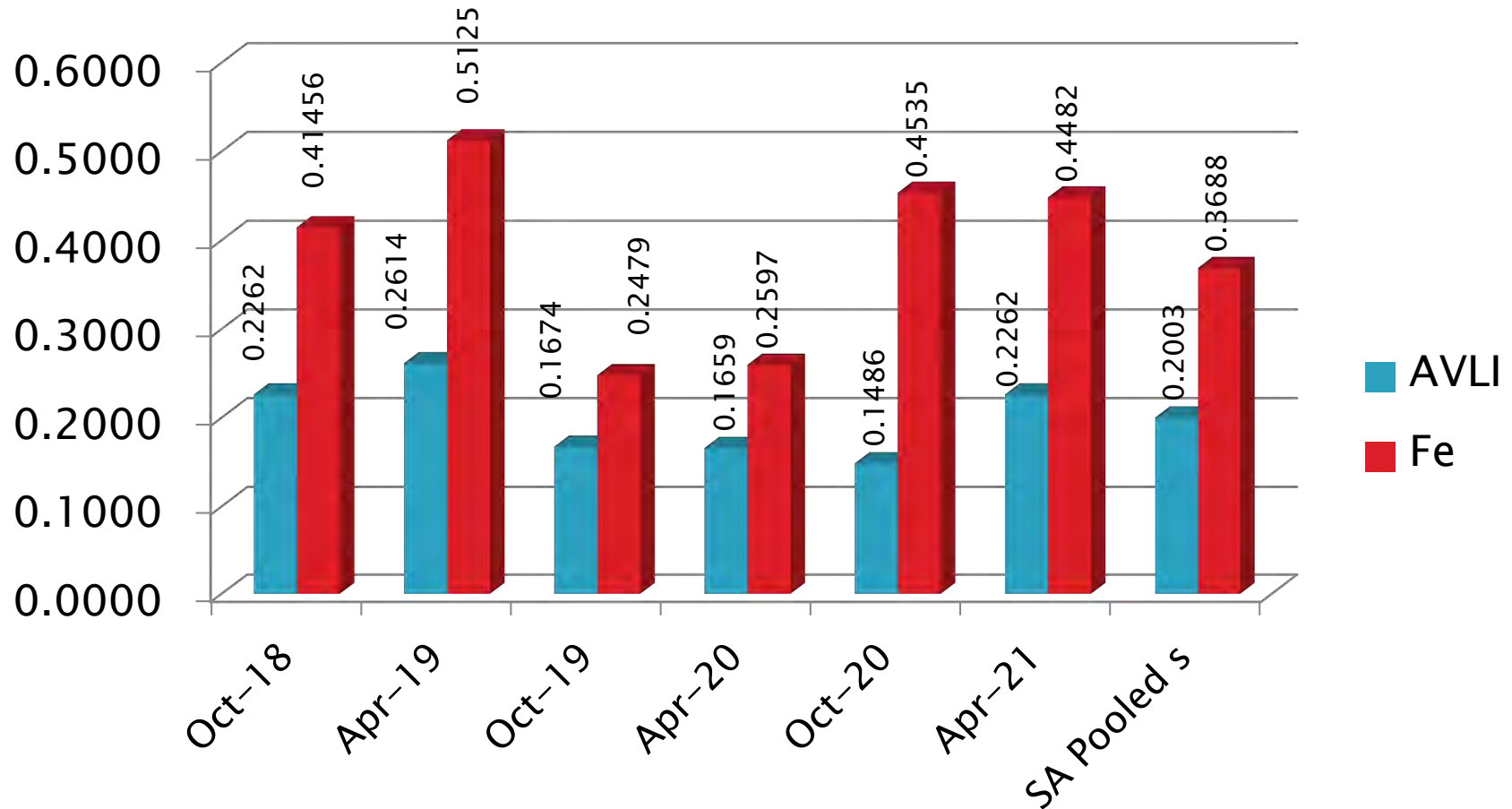
LTMS Severity Analysis



CUSUM Severity Analysis



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	15
Statistically Unacceptable Calibration Test	OC	2
Total		17

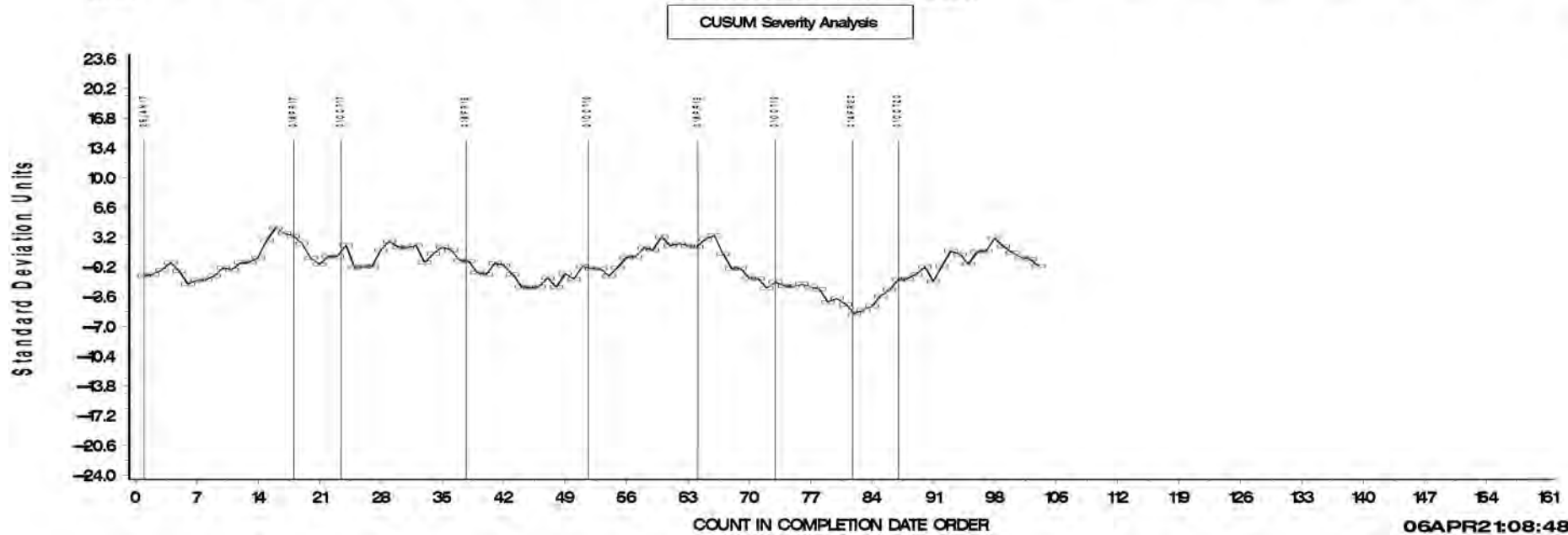
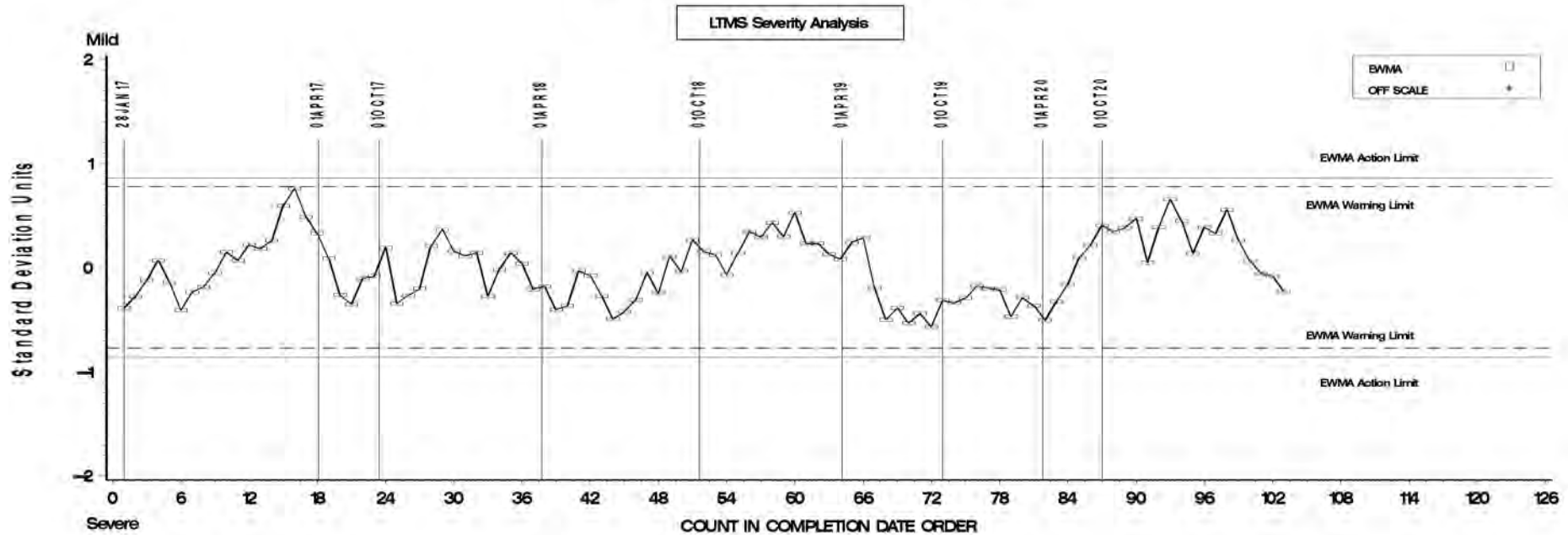
Sequence VH – Failing Tests

Test Status	#
RAC Ei Level 3 alarm (Different labs)	2
Total	2

Sequence VH Test Severity

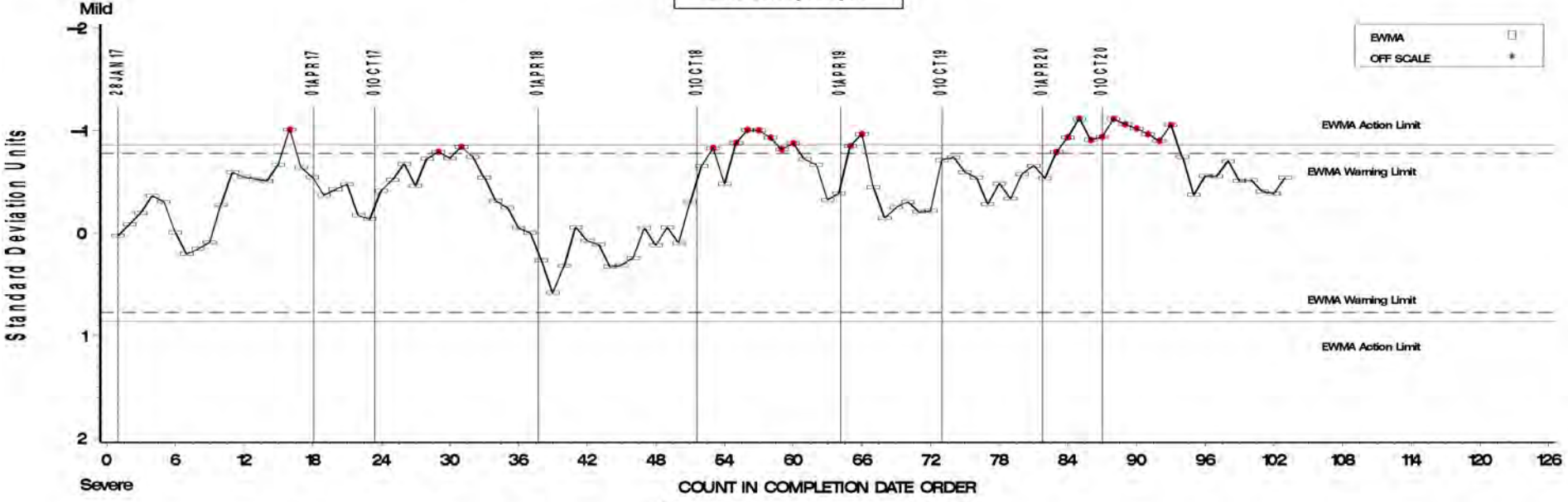
- All parameters within control limits.

AVERAGE ENGINE SLUDGE

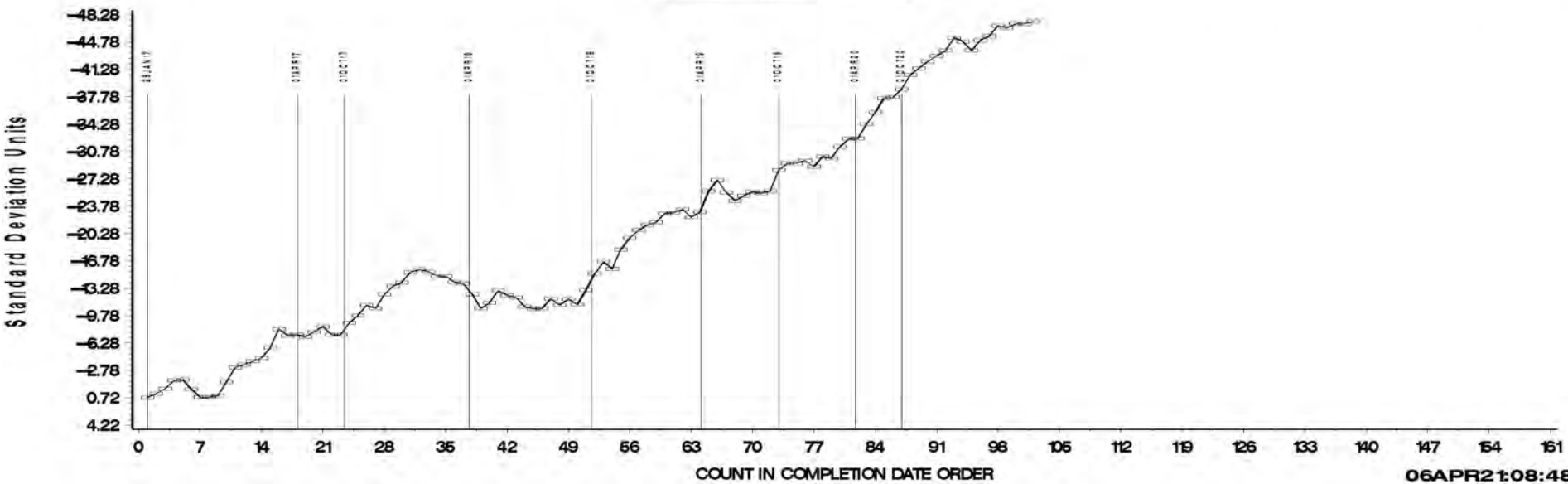


AVERAGE ROCKER COVER SLUDGE

LTMS Severity Analysis



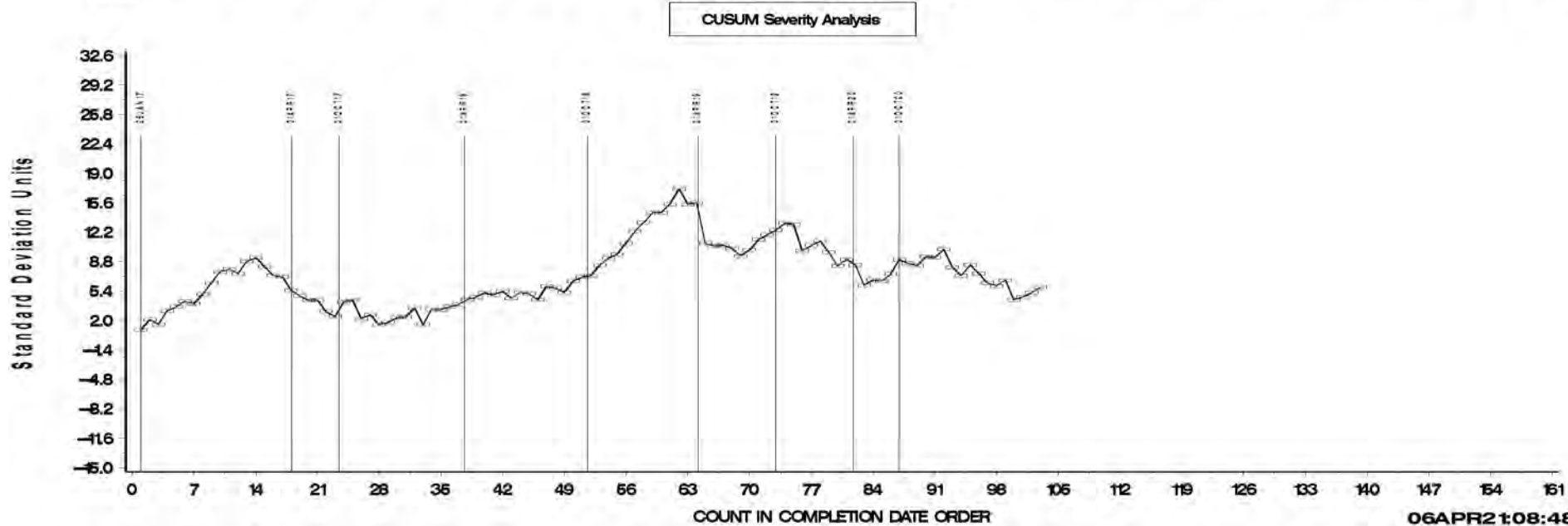
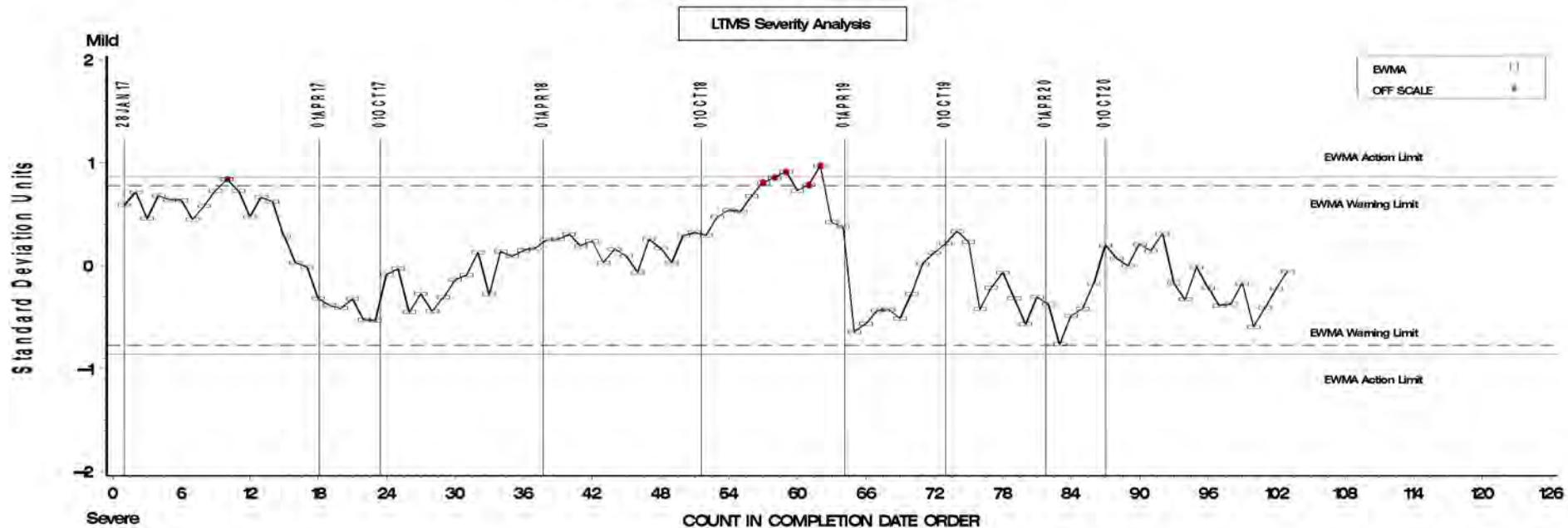
CUSUM Severity Analysis



SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

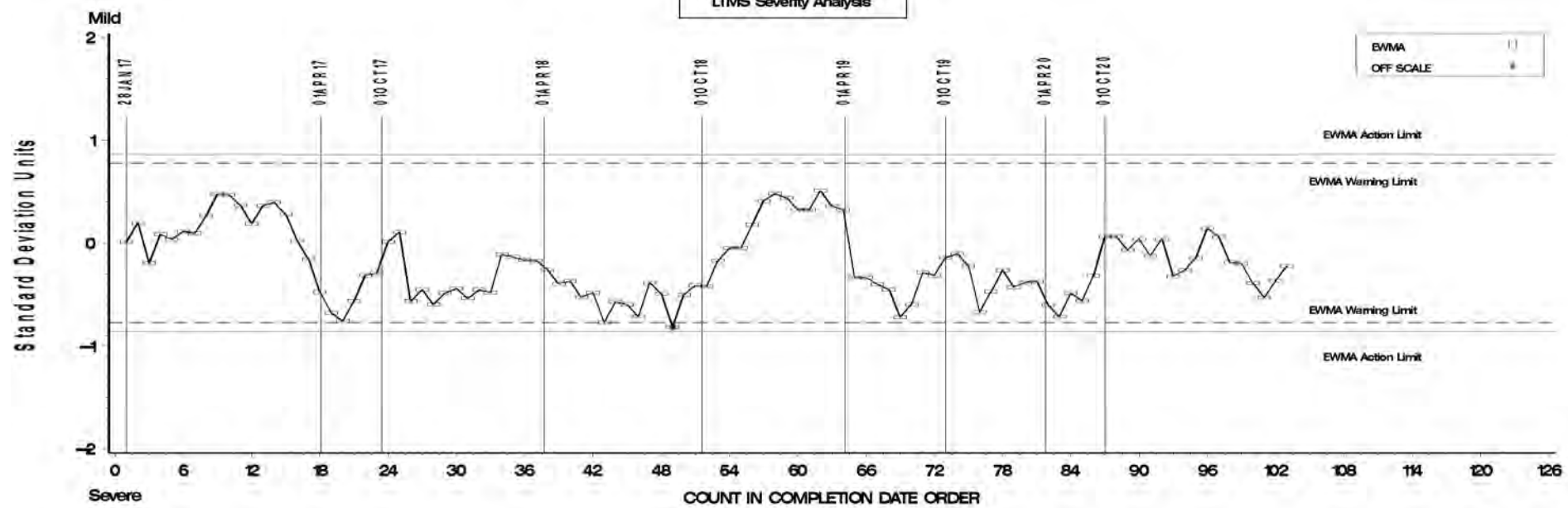


AVG. ENG. VARN. 50% RATING

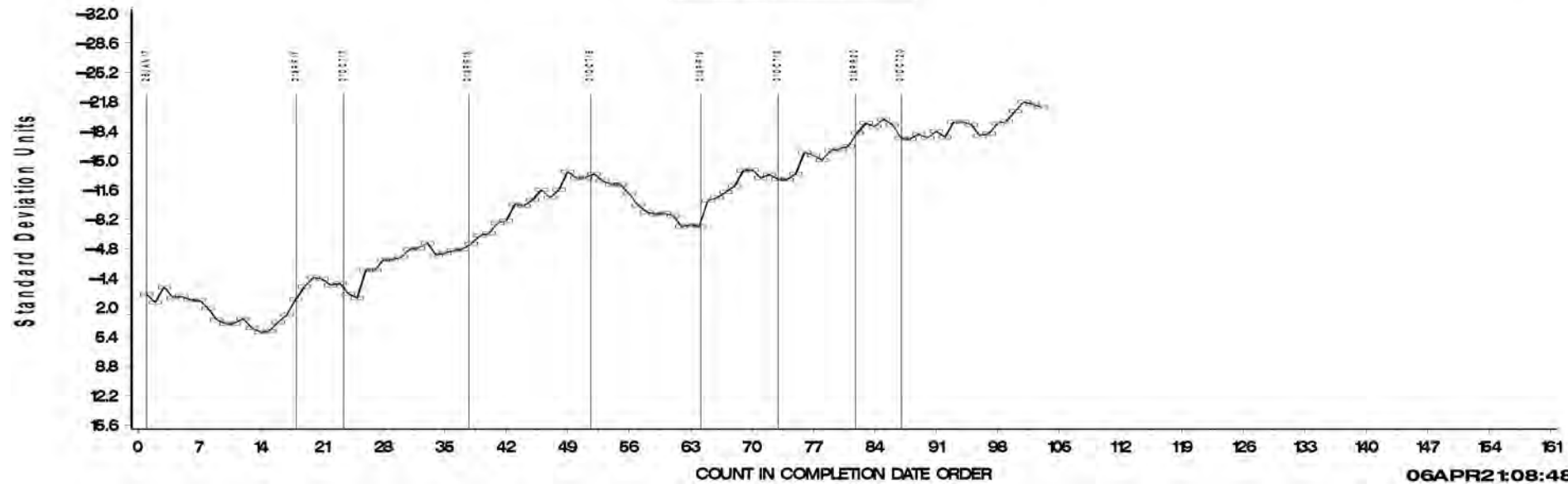


AVG PISTON SKIRT 50% RATING

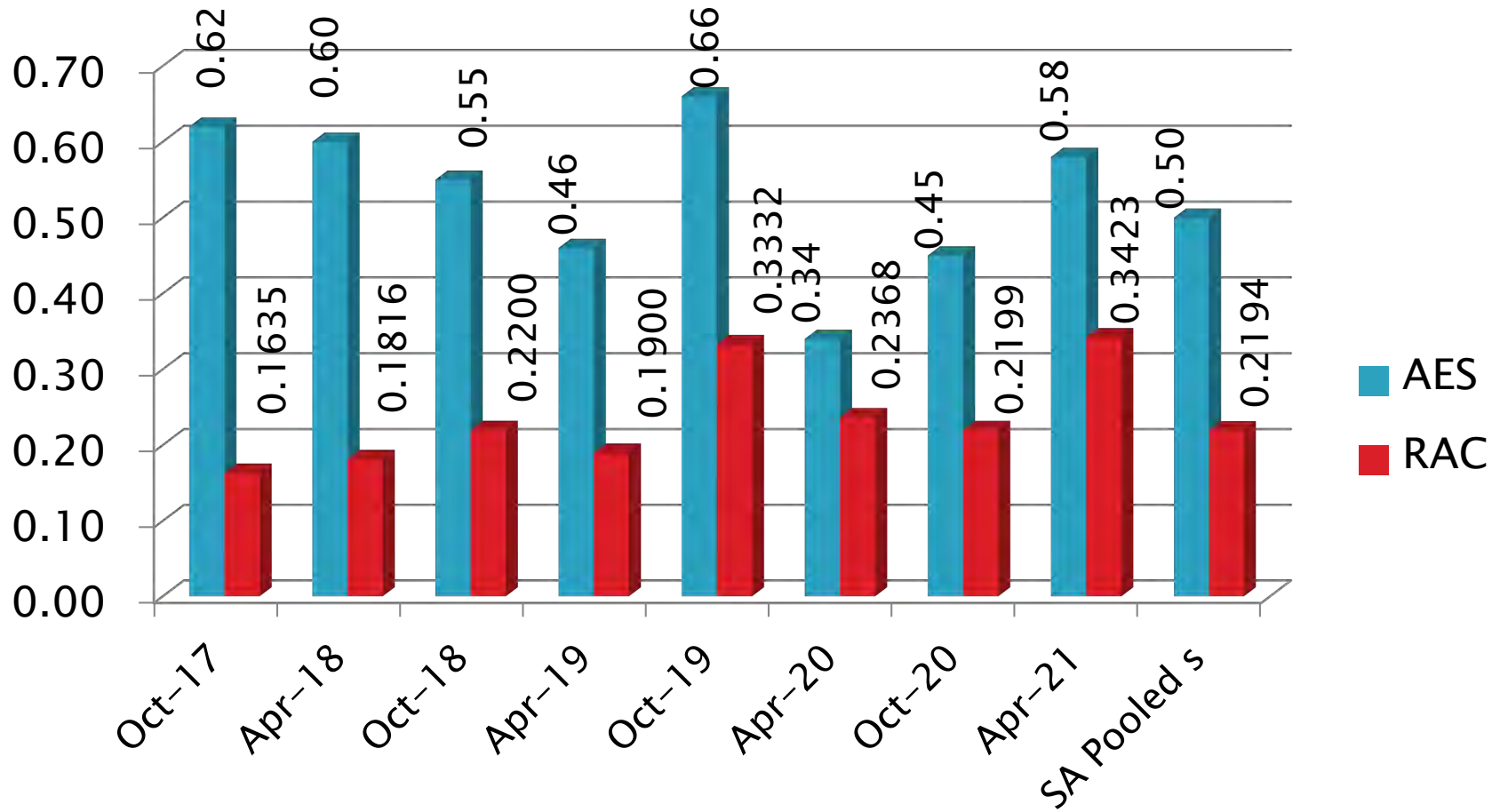
LTMS Severity Analysis



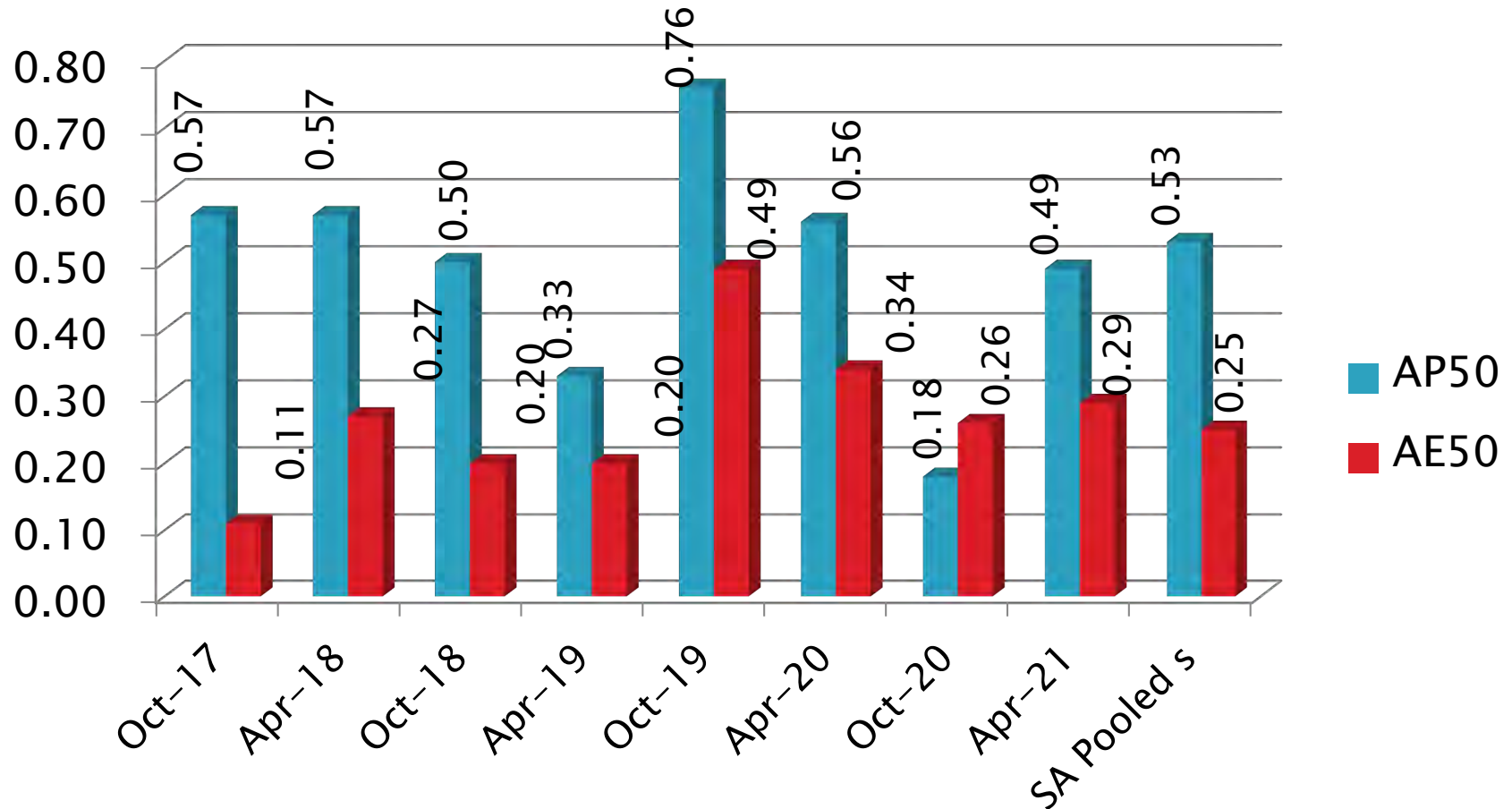
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Sequence VH Precision Estimates



Sequence VH Precision Estimates



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Sequence VIE Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	24
Statistically Unacceptable Calibration Test	OC	3
Aborted Calibration Test	XC	1
Total		28

Sequence VIE- Failed Tests

Test Status	#
FEI1 Severe	1
FEI2 Severe	1
FEI1 and FEI2 Severe	1
Total	3

Sequence VIE – Lost Tests*

Test Status	Cause	#
Aborted	Dyno Bearing Failure	1
Totals		1

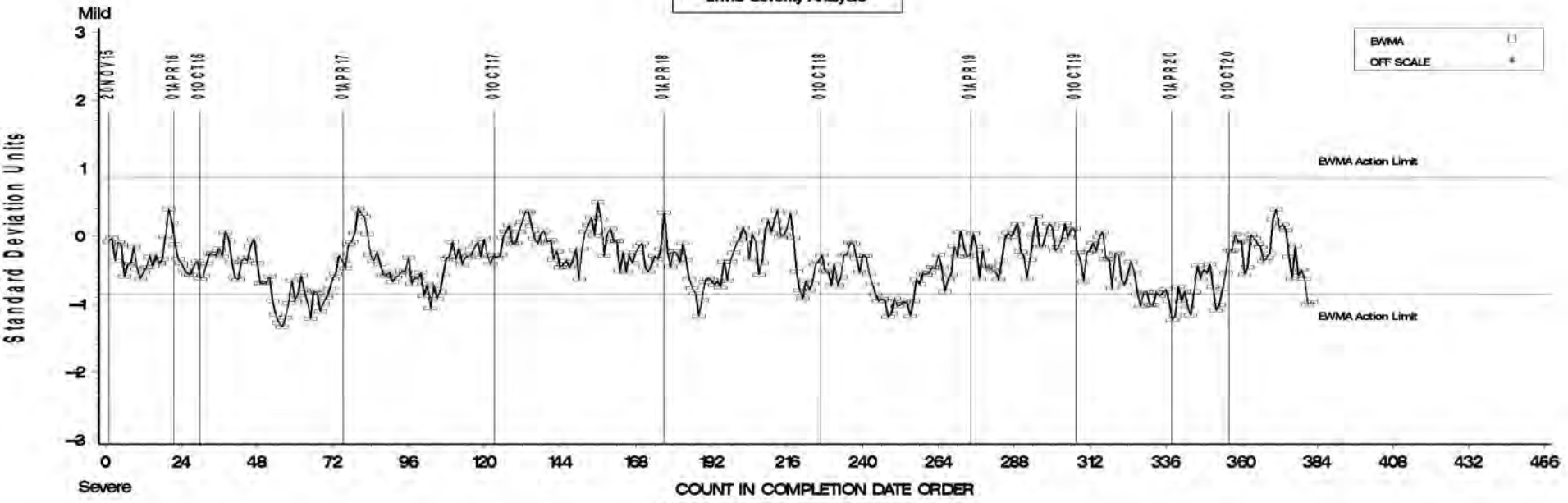
*Invalid and aborted tests

Sequence VIE Test Severity

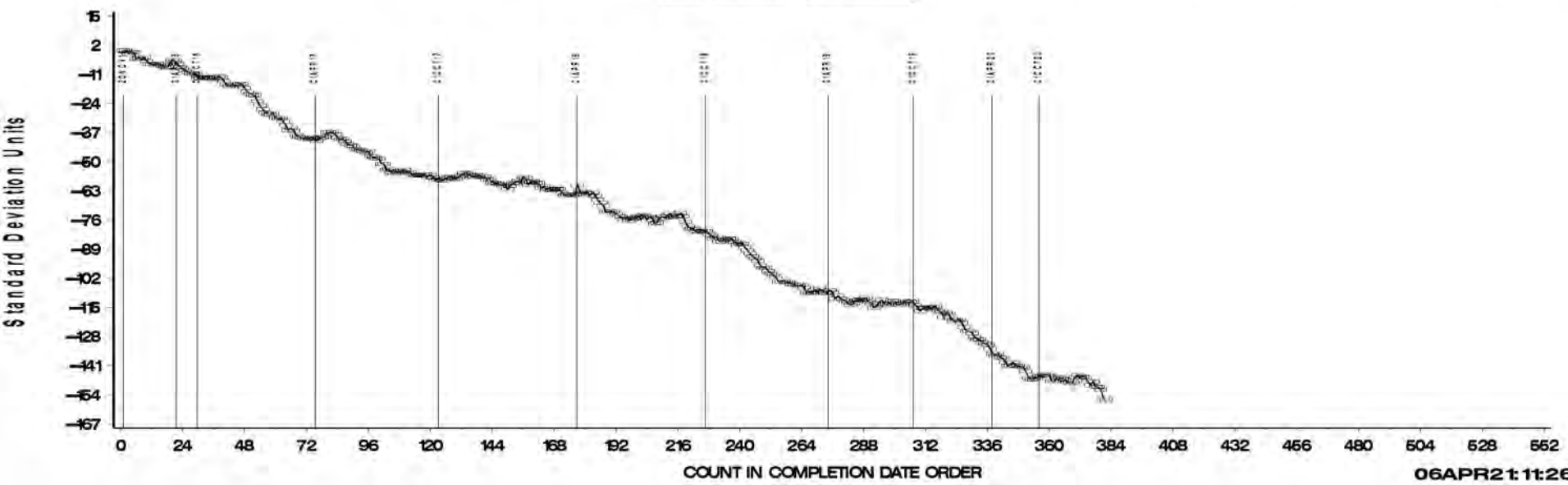
- FEI1 is in alarm (severe direction)
- FEI2 is in control

FEI FINAL RESULT PHASE I

LTMS Severity Analysis

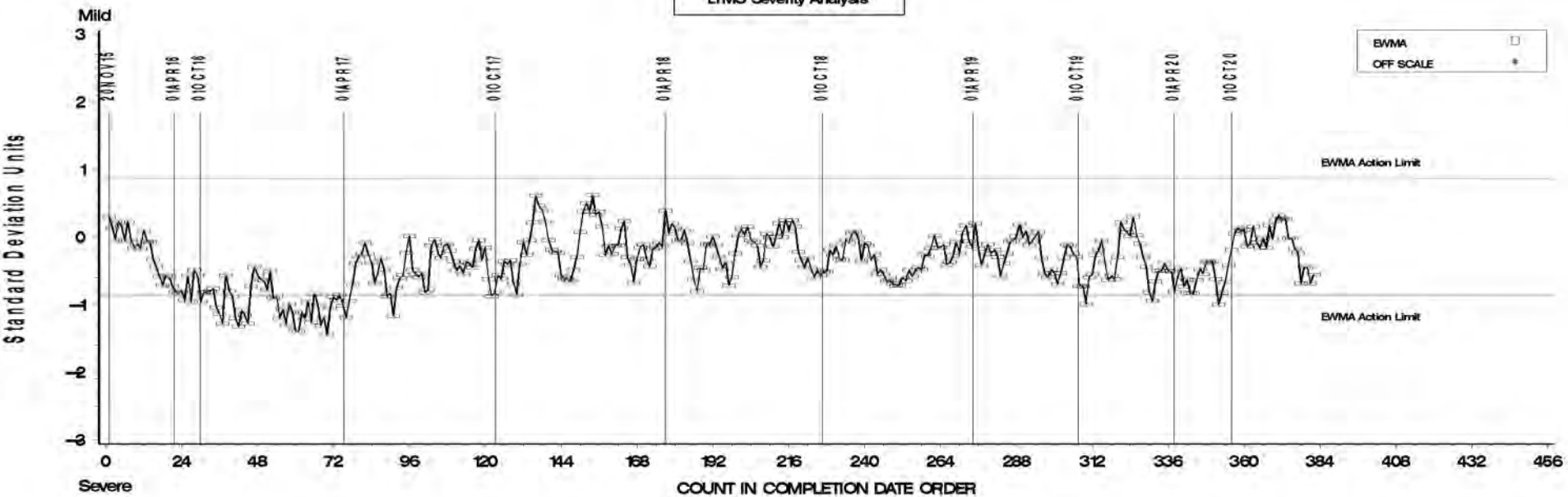


CUSUM Severity Analysis

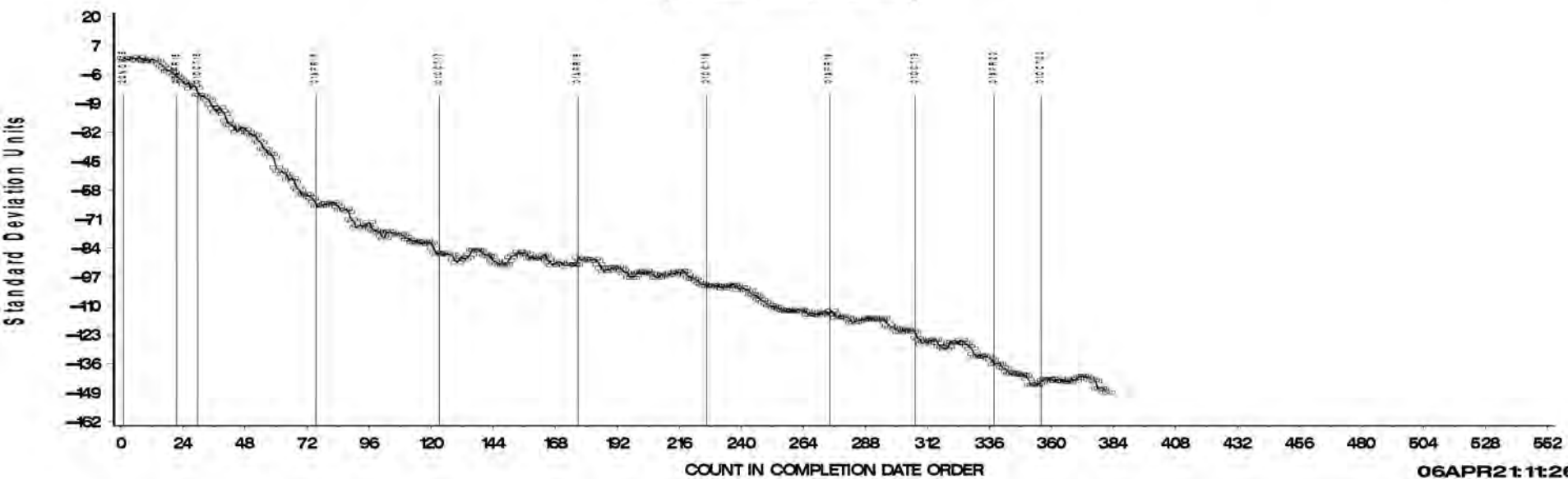


FEI FINAL RESULT PHASE II

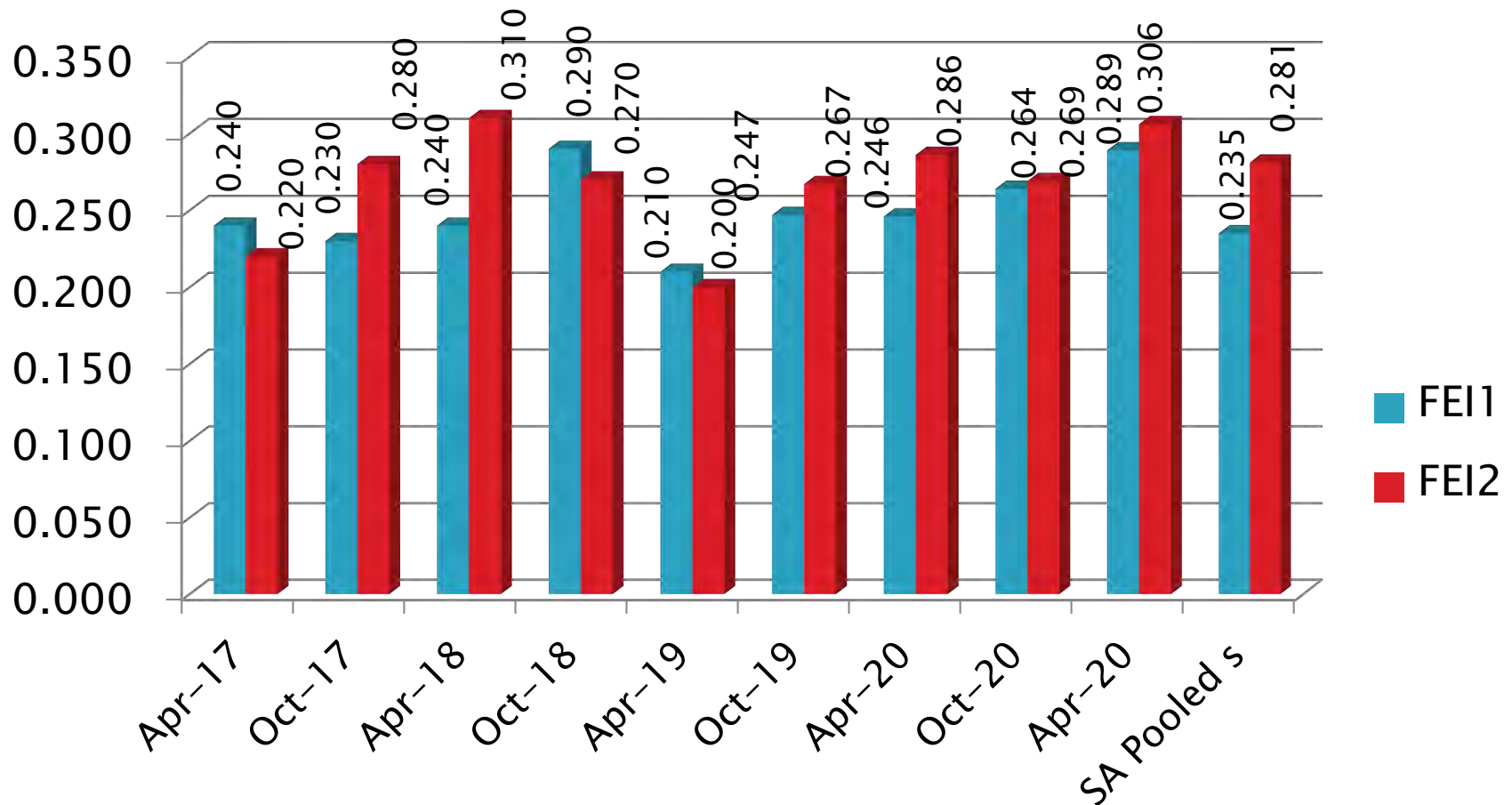
LTMS Severity Analysis



CUSUM Severity Analysis



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	23
Failed Statistically	OC	2
Engine Abandoned	MC	3
Aborted	XC	1
Total		29

Sequence VIF – Failed Tests

Test Status	Number of Tests
Severe FEI2	2
Total	2

Sequence VIF – Lost Tests*

Test Status	Cause	#
Aborted	Downtime Exceeded Procedural Limit	1
Total		1

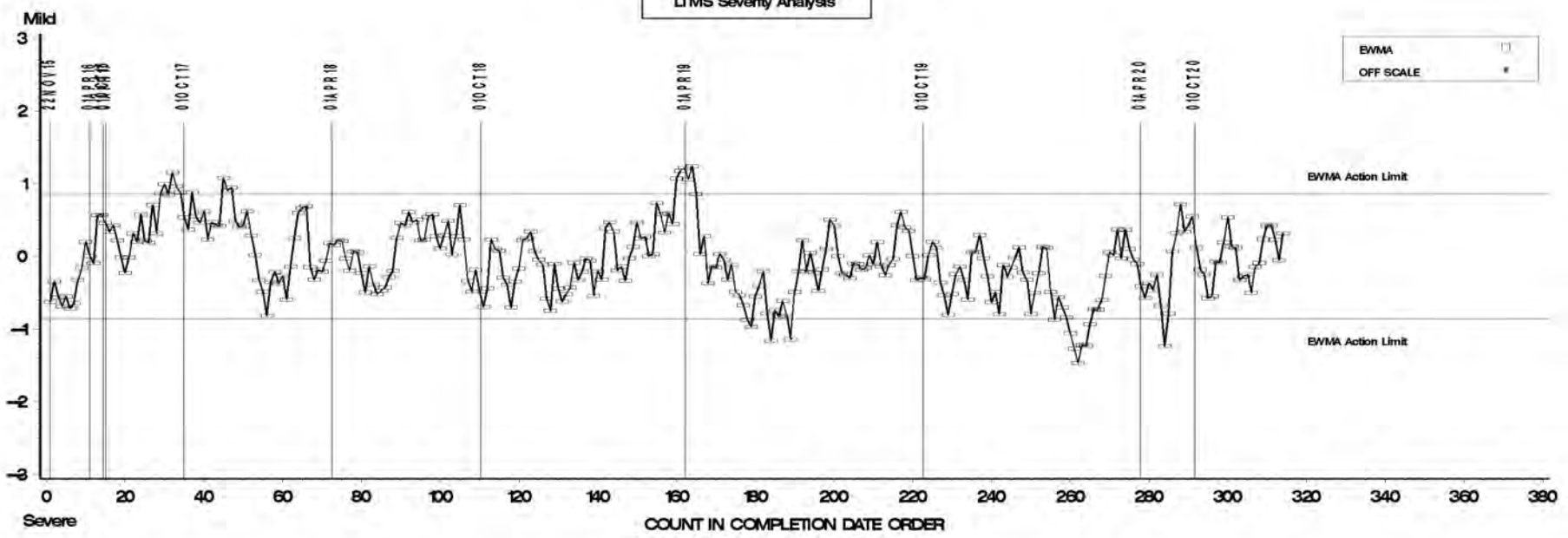
*Invalid and aborted tests

Sequence VIF Test Severity

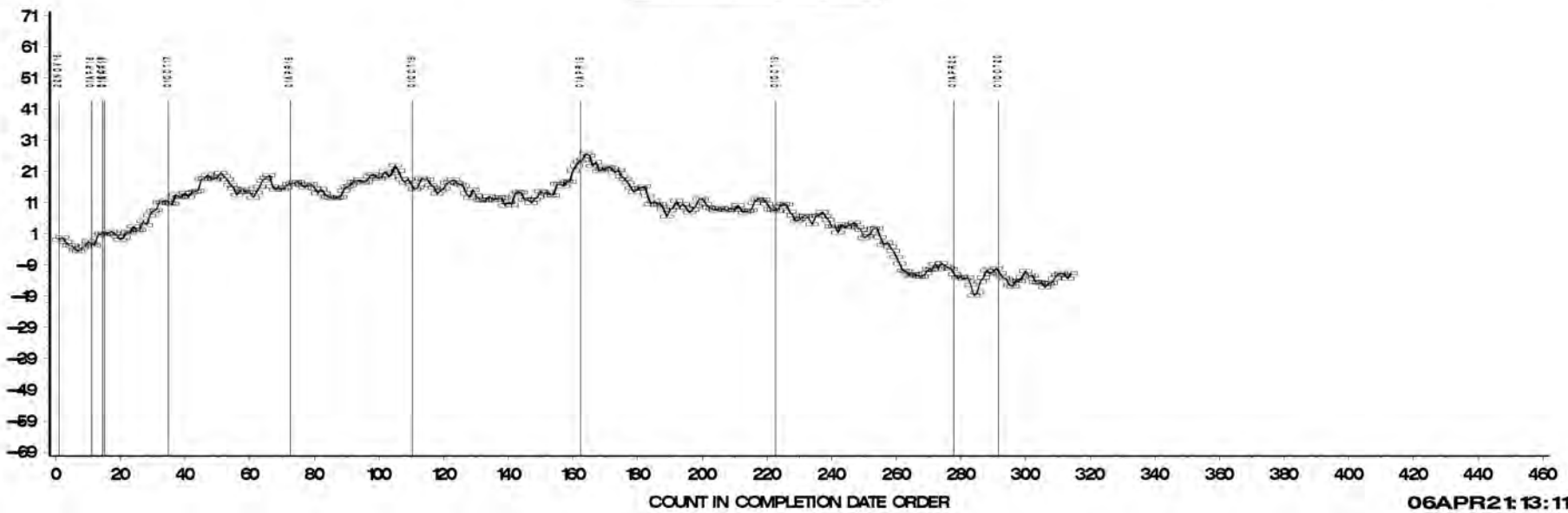
- FEI1 is in control
- FEI2 is in control

FEI FINAL RESULT PHASE I

LTMS Severity Analysis

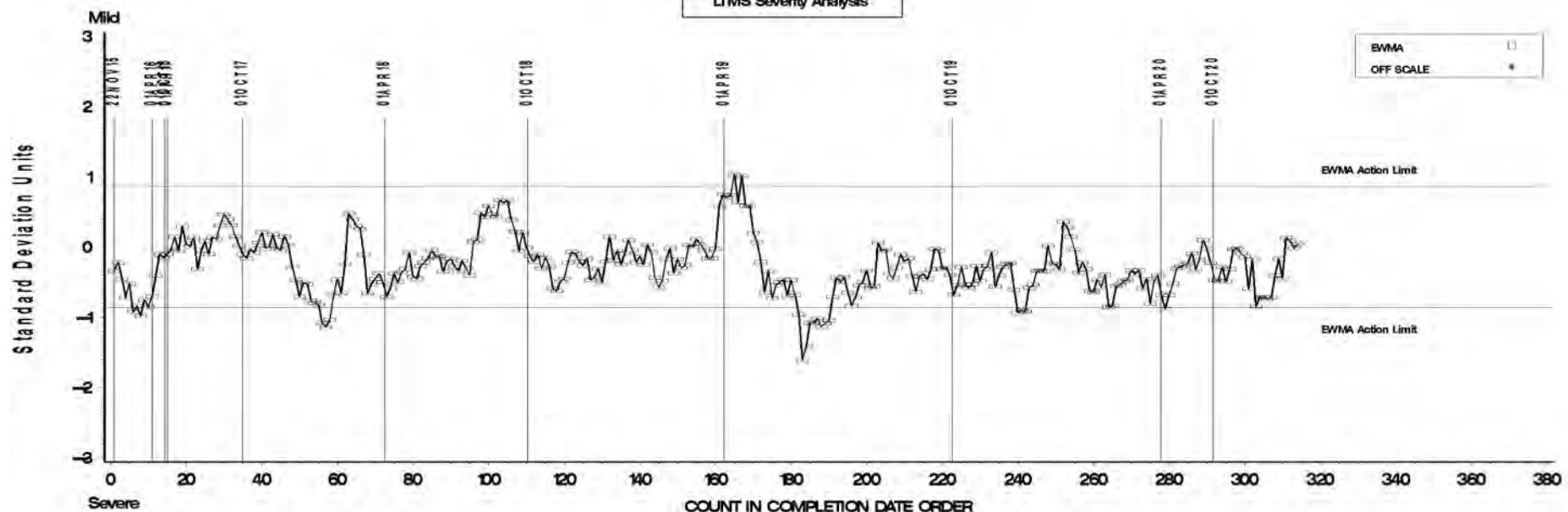


CUSUM Severity Analysis

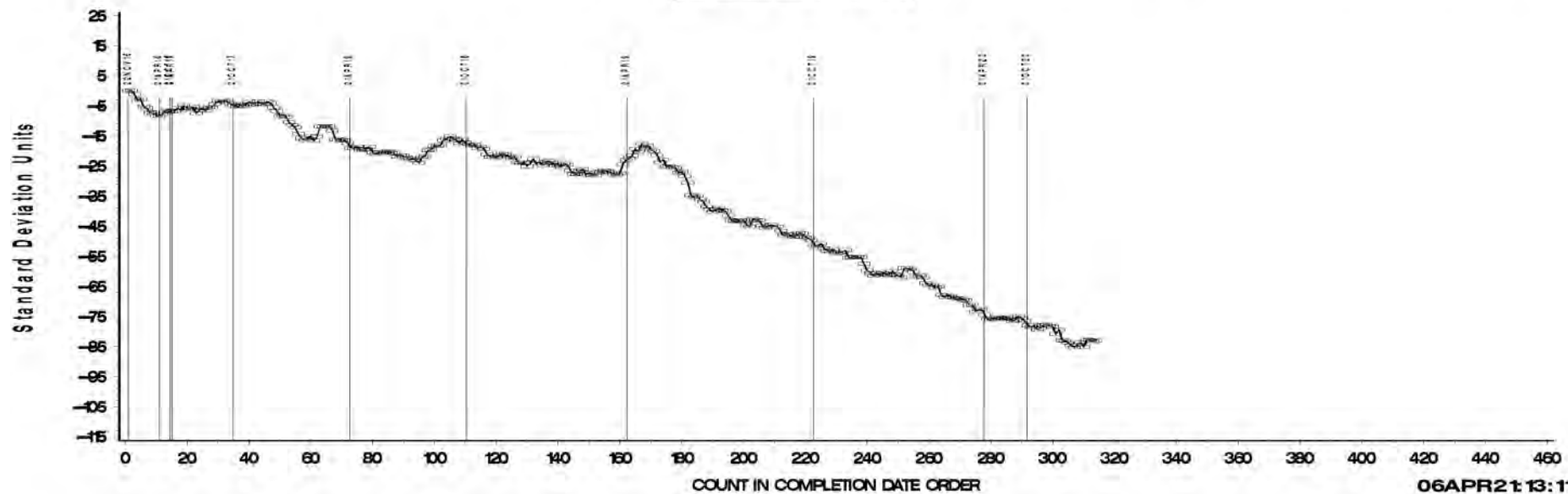


FEI FINAL RESULT PHASE II

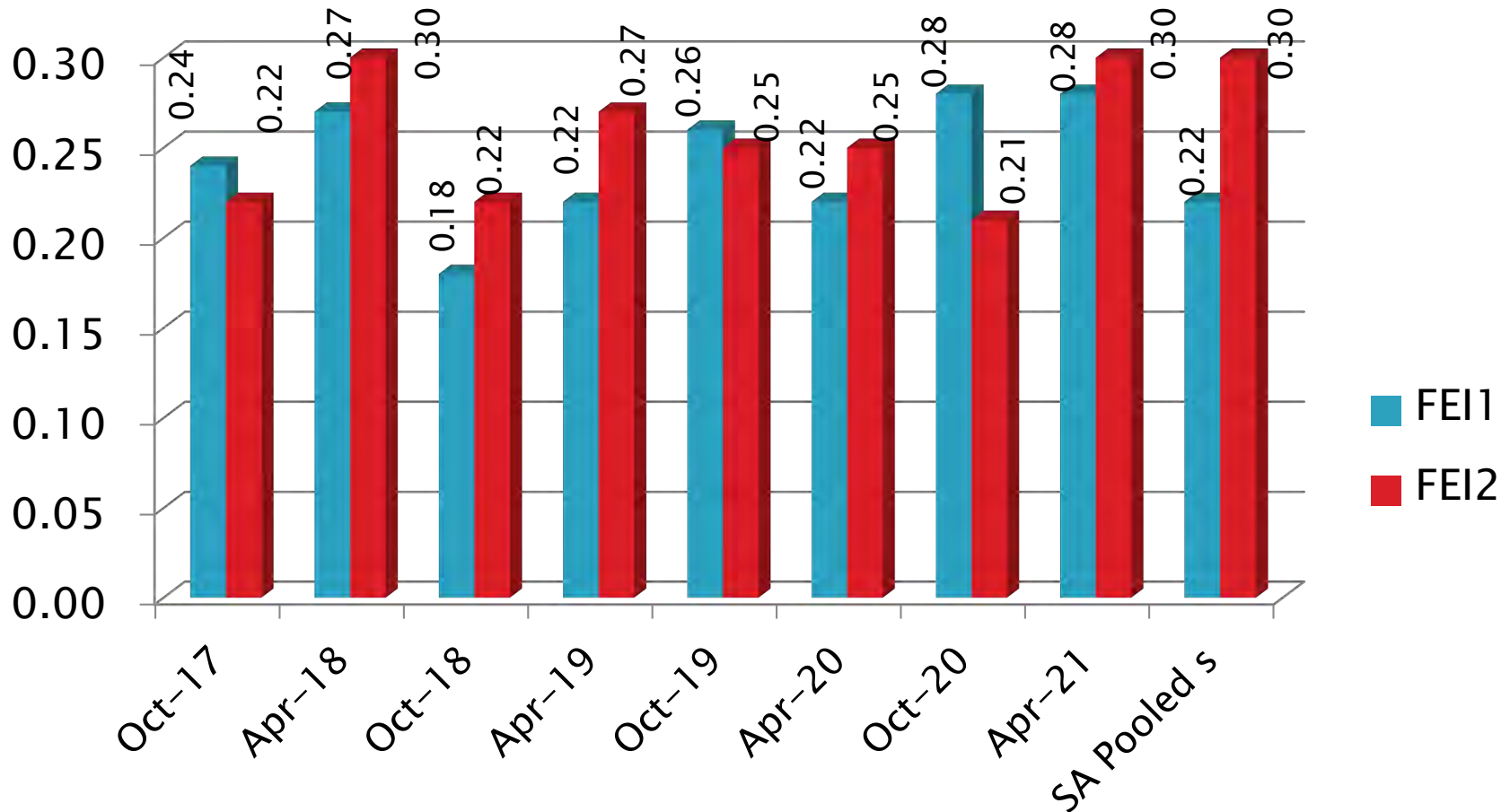
LTMS Severity Analysis



CUSUM Severity Analysis



Sequence VIF Precision Estimates



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Sequence VIII

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Sequence VIII Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	9
Statistically Unacceptable Calibration Test	OC	2
Aborted Calibration Test	XC	1
Operationally Invalid Calibration Test, Lab Judgement	LC	2
Improper Oil	MC	1
Total		15

Sequence VIII – Failed Tests

Test Status	Number of Tests
Severe BWLS	2
Total	2

Sequence VIII – Lost Tests

Test Status	Cause	#
Invalid	High Mechanical Wear, New Connecting Rod	1
Invalid	Coolant Pump Failure	1
Aborted	Coolant Leak into Engine	1
Totals		3

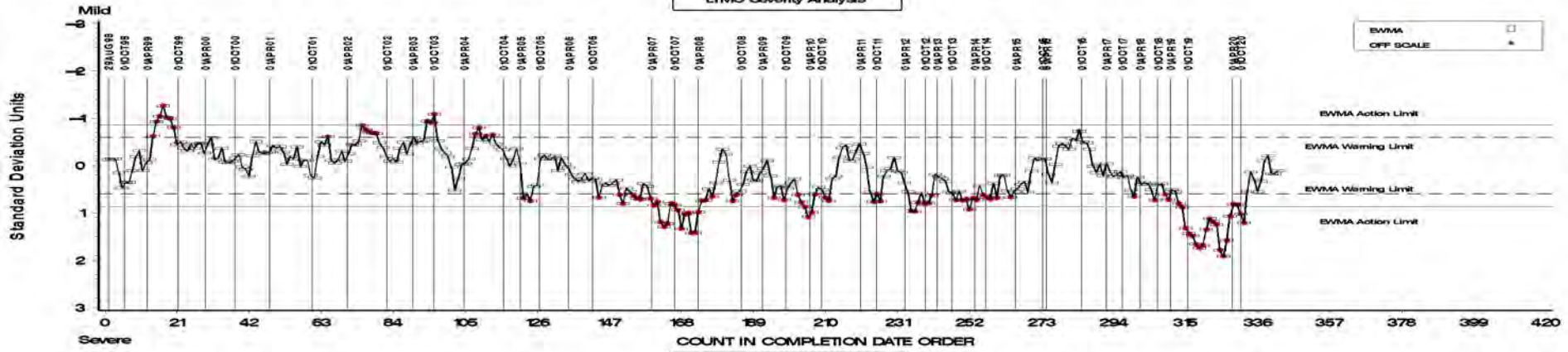
*Invalid and aborted tests

Sequence VIII Test Severity

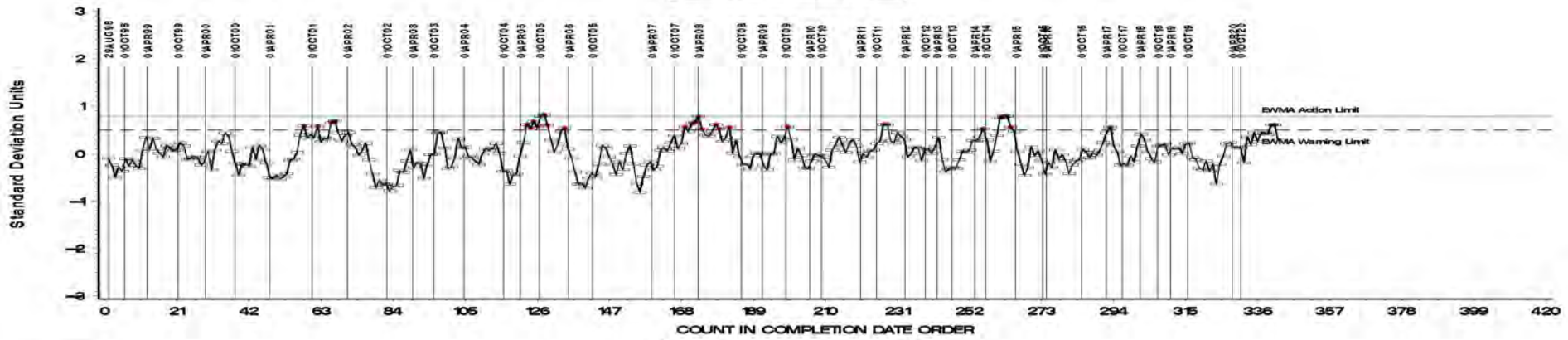
- Bearing Weight Loss is in control
- Stripped Viscosity is in severity warning alarm (mild)

FINAL BEARING WEIGHT LOSS

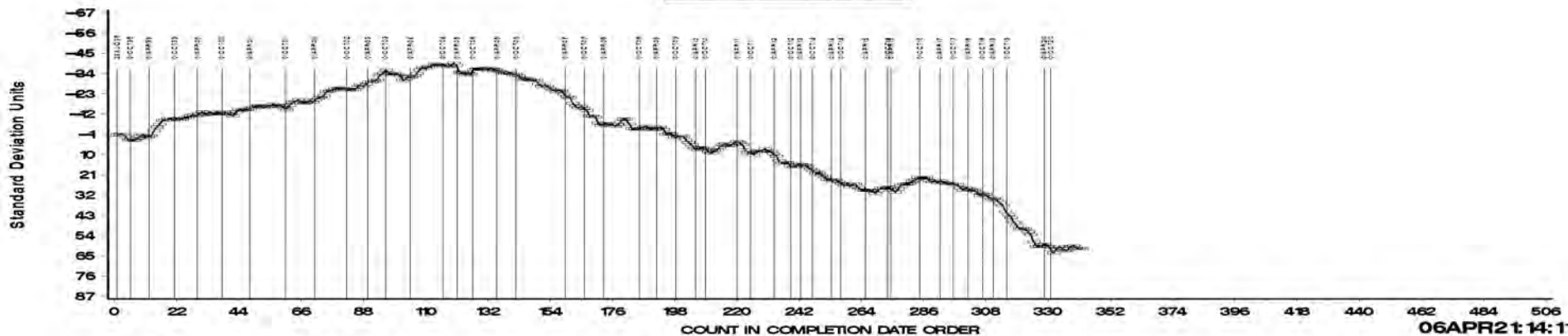
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

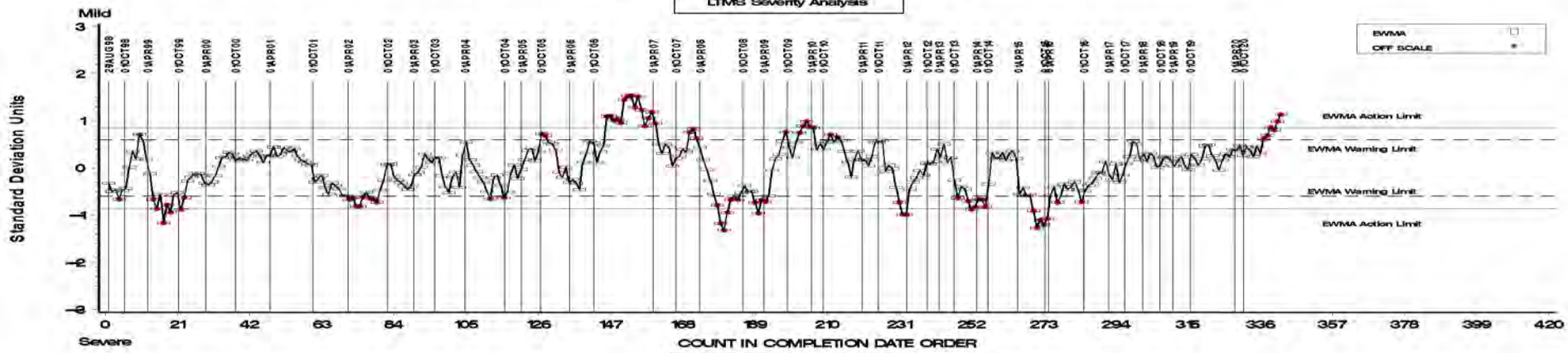


SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

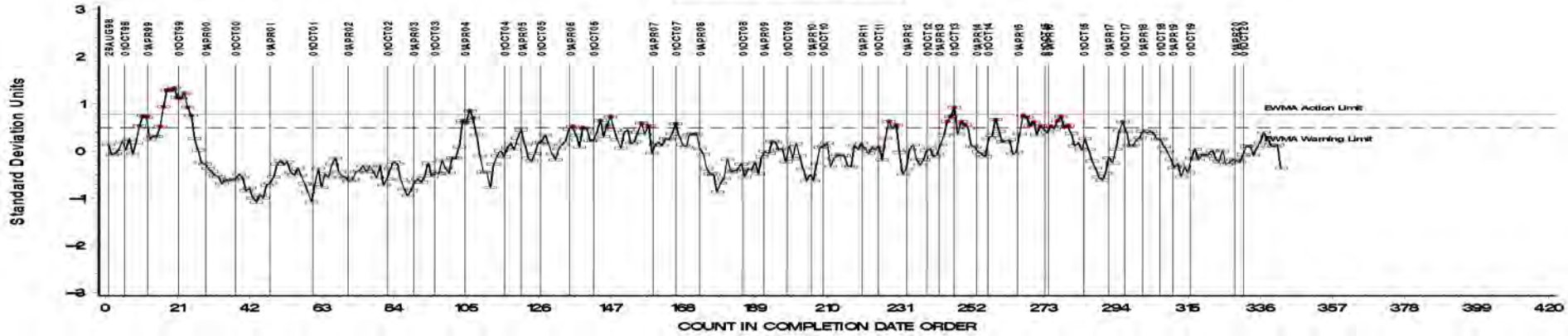


STRIPPED VIS. @ 100 DEG C

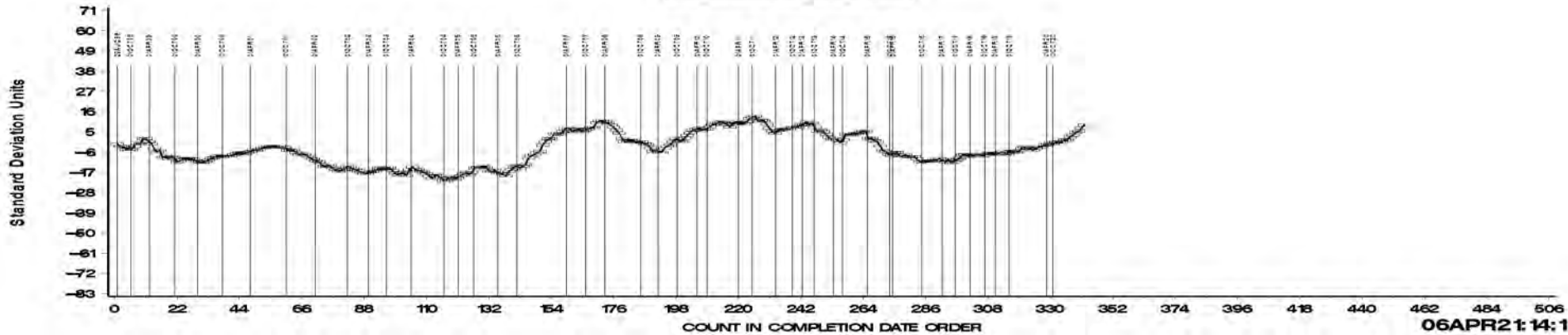
LTMS Severity Analysis



LTMS Precision Analysis

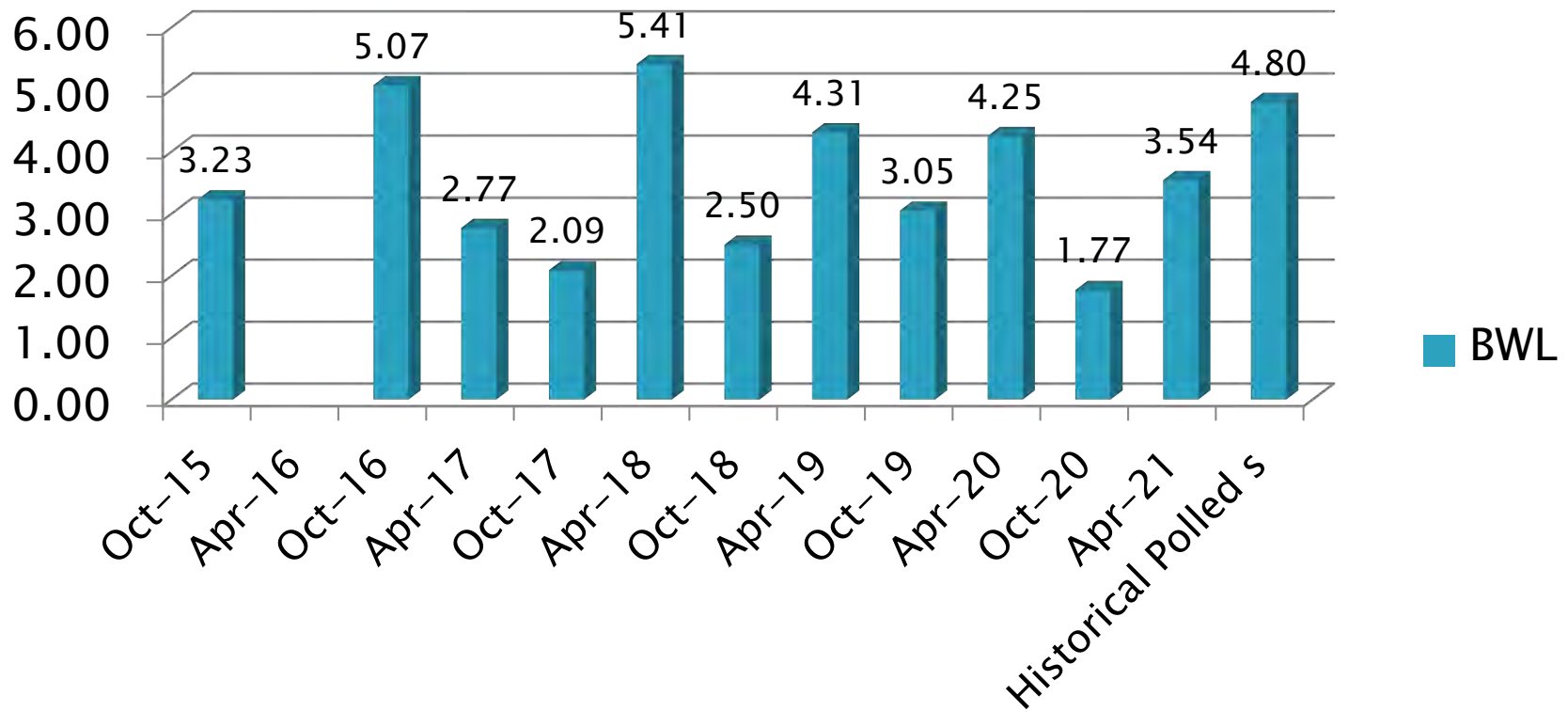


CUSUM Severity Analysis



Sequence VIII Precision Estimates

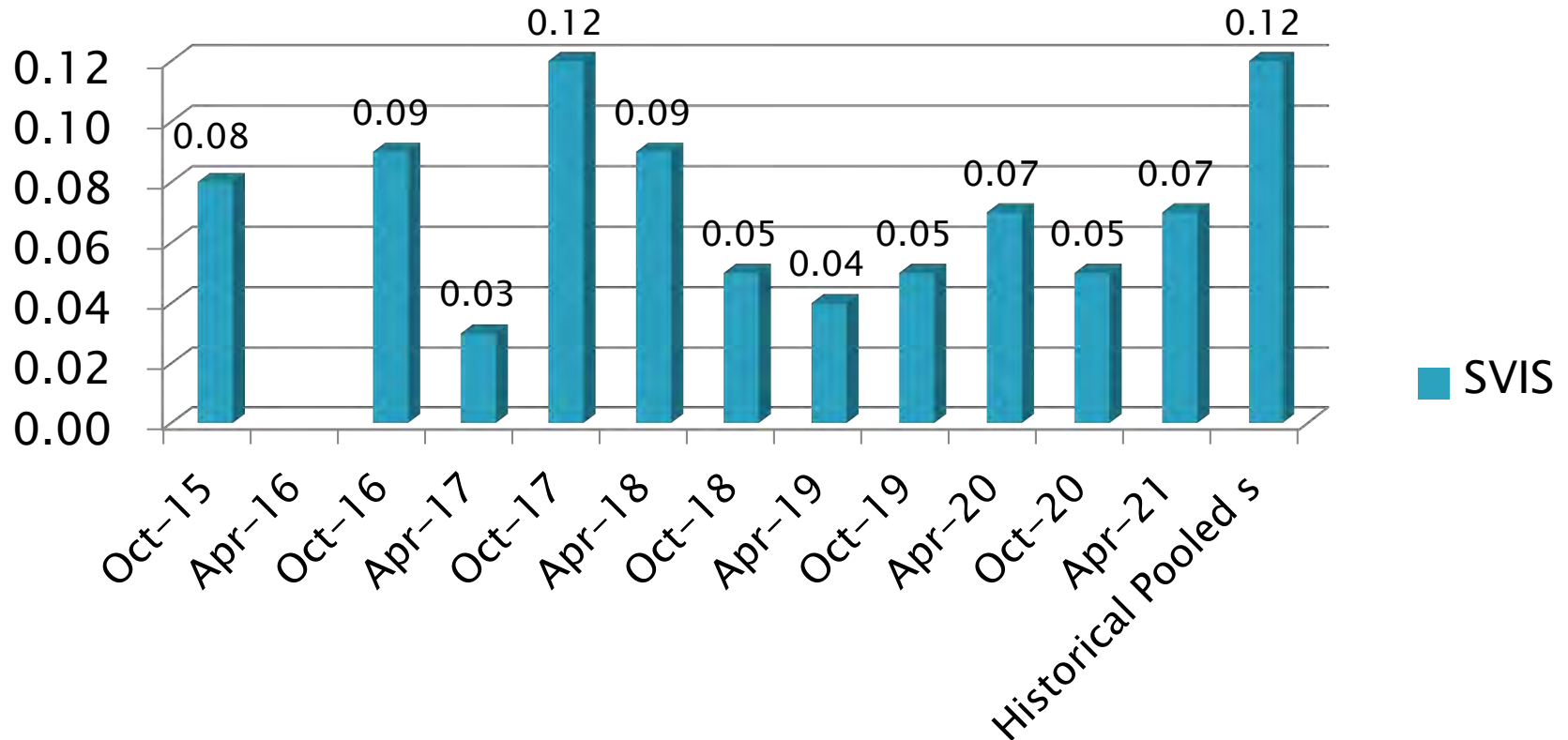
BWL



Sequence VIII Precision Estimates

SVIS

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



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Sequence IX

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Sequence IX Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	32
Statistically Unacceptable Calibration Test	OC	15
Operationally Invalid Calibration Test, lab determination	LC	1
Aborted Calibration Test	XC	2
Not for Industry Statistics Test, Alternate Fuel	NN	1
Total		51

Sequence IX – Failed Tests

Test Status	Number of Tests
Ei Level 3 alarm (mild direction)	7
Ei Level 3 alarm (severe direction)	6
Ei Level 3, Zi Level 2 (mild direction)	1
Ei Level 3, Zi Level 2 (severe direction)	1
Total	15

Sequence IX – Lost Tests*

Test Status	Cause	#
Terminated	High number of Preignitions, engine removed from system	2
Invalid	Exceeded total test time	1
Totals		3

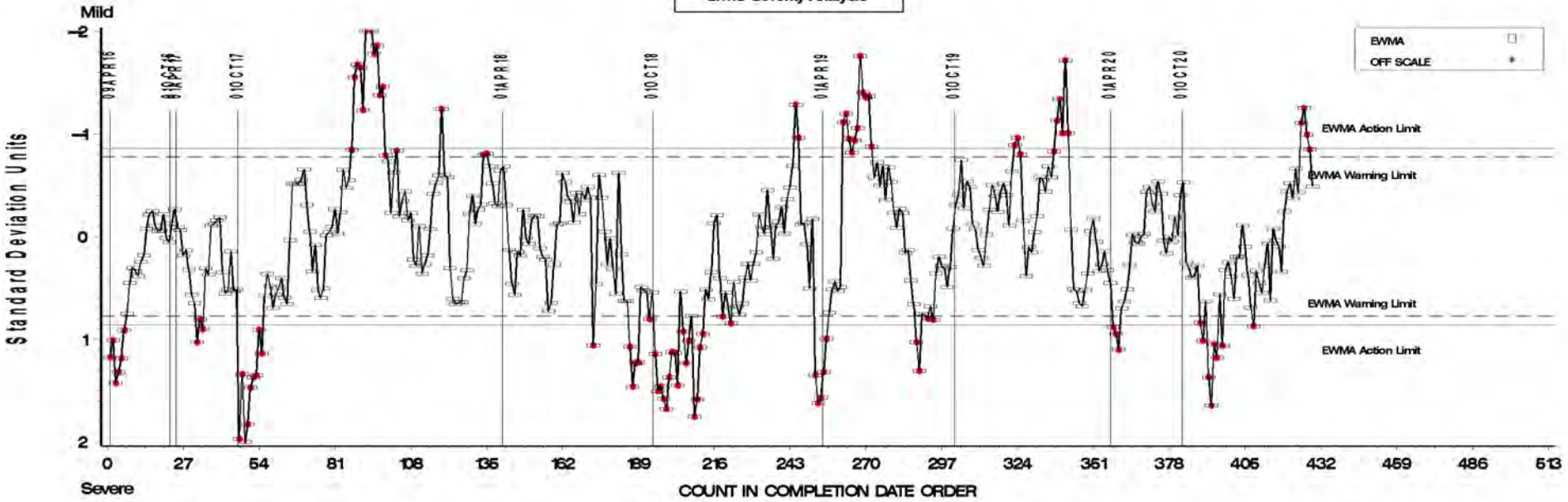
*Invalid and aborted tests

Sequence IX Test Severity

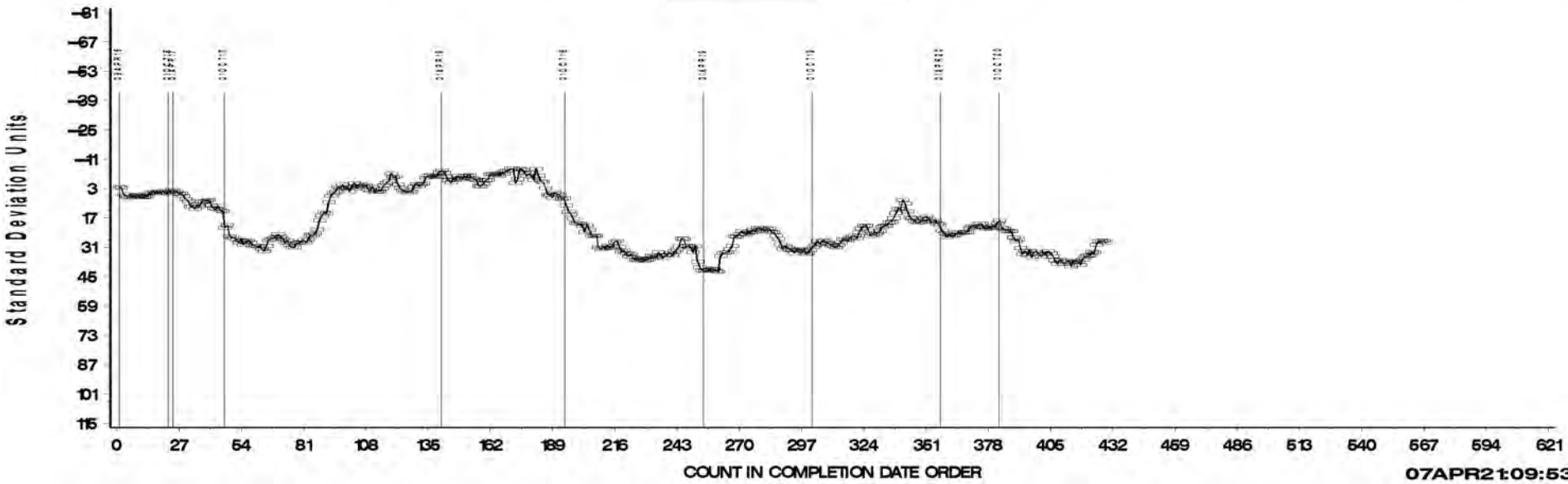
- Average number of Pre-ignitions in control.

AVERAGE NUMBER OF PREIGNITIONS FROM VALID ITERATIONS

LTMS Severity Analysis

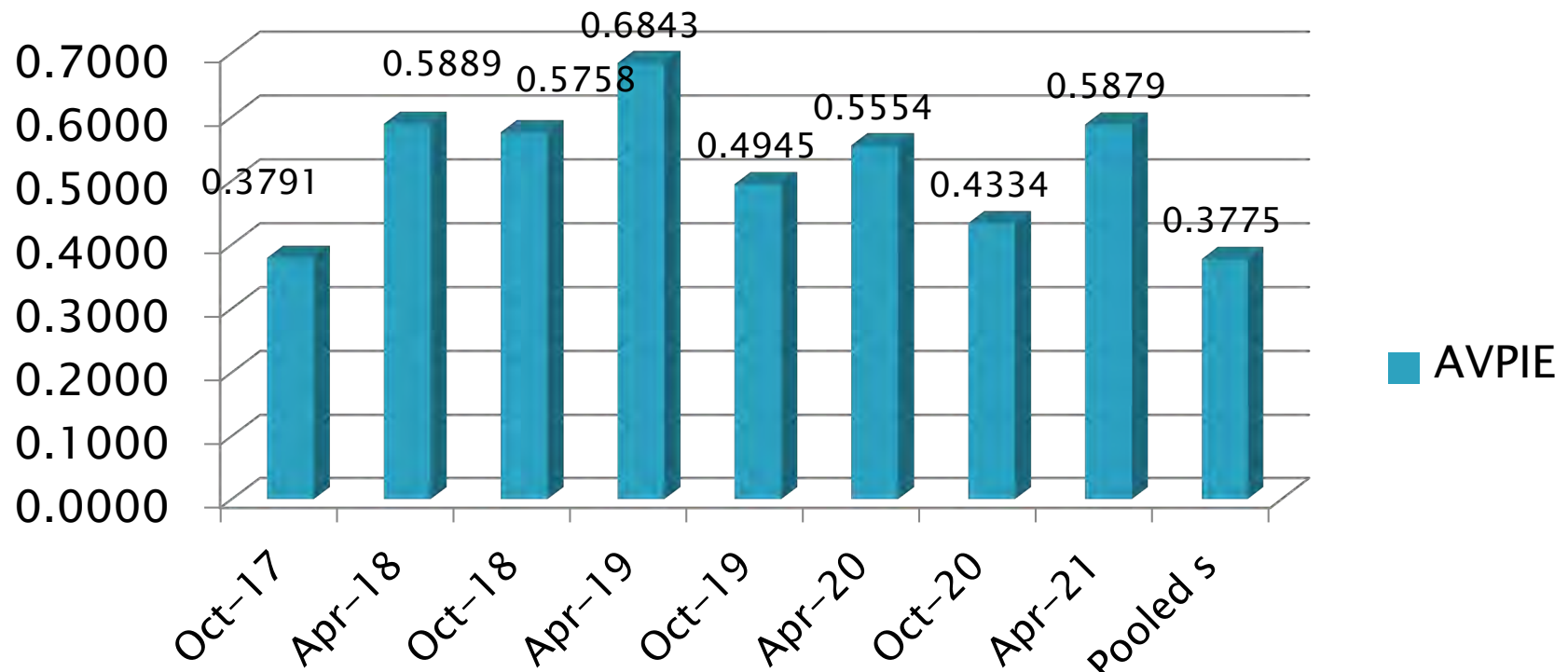


CUSUM Severity Analysis



Sequence IX Precision Estimates

AVPIE



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Sequence X Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	5
Statistically Unacceptable Calibration Test	OC	3
Total Number of Tests		8

Sequence X – Failed Tests

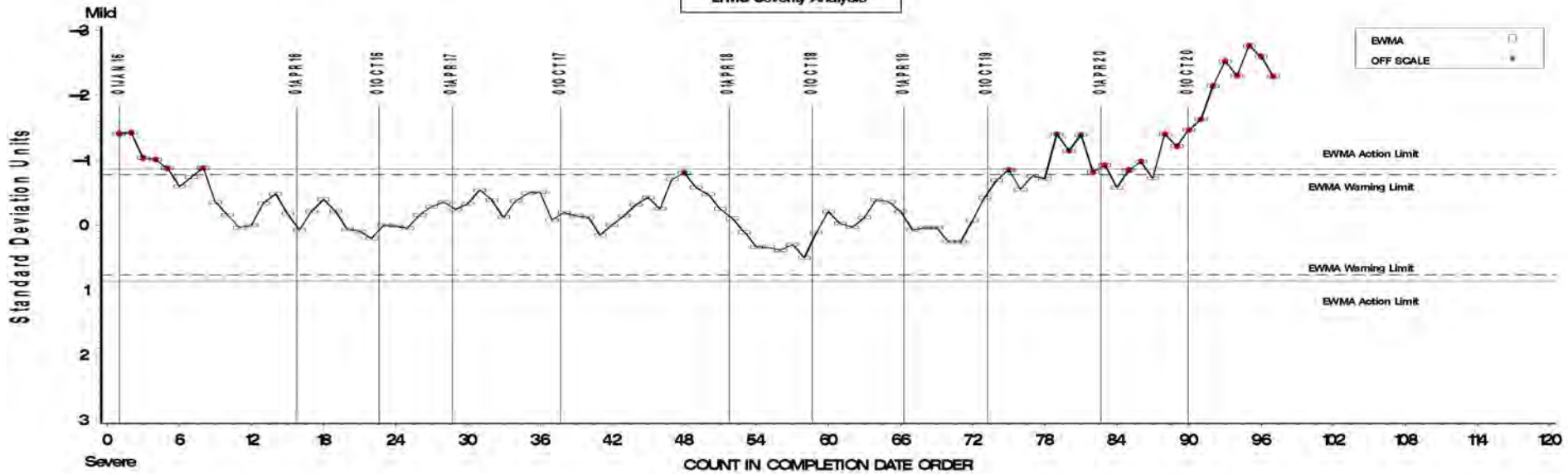
Test Status	Number of Tests
CHST Ei Level 3 alarm (mild direction)	3
Total	3

Sequence X Test Severity

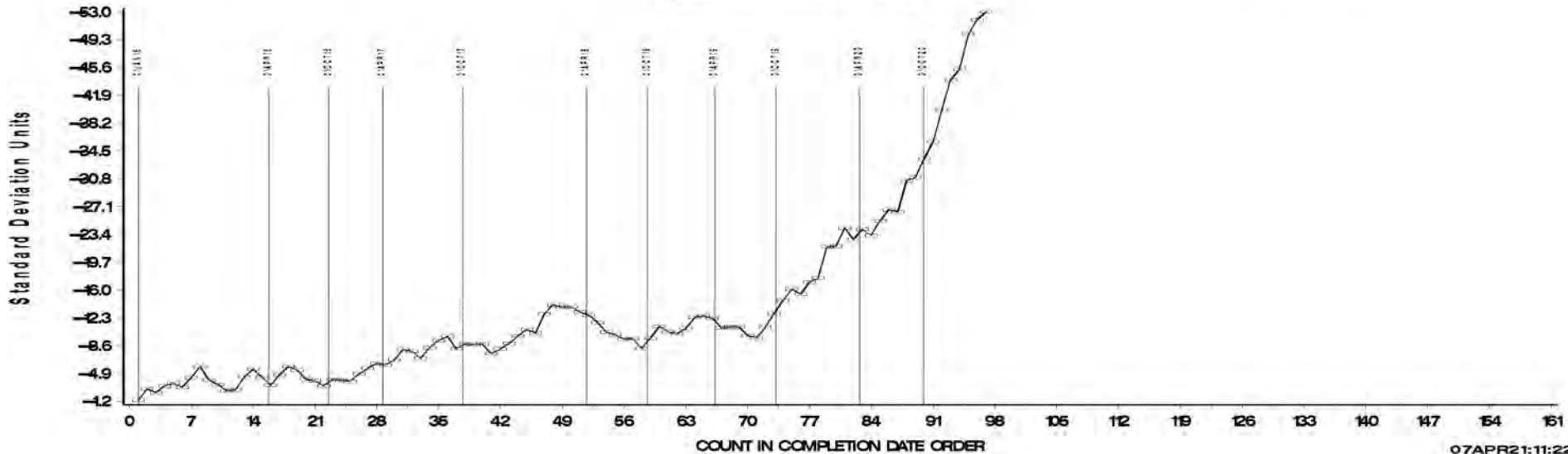
- Average Chain Stretch % in Severity Action Alarm (mild)

END OF TEST CHAIN WEAR FINAL RESULT

LTMS Severity Analysis

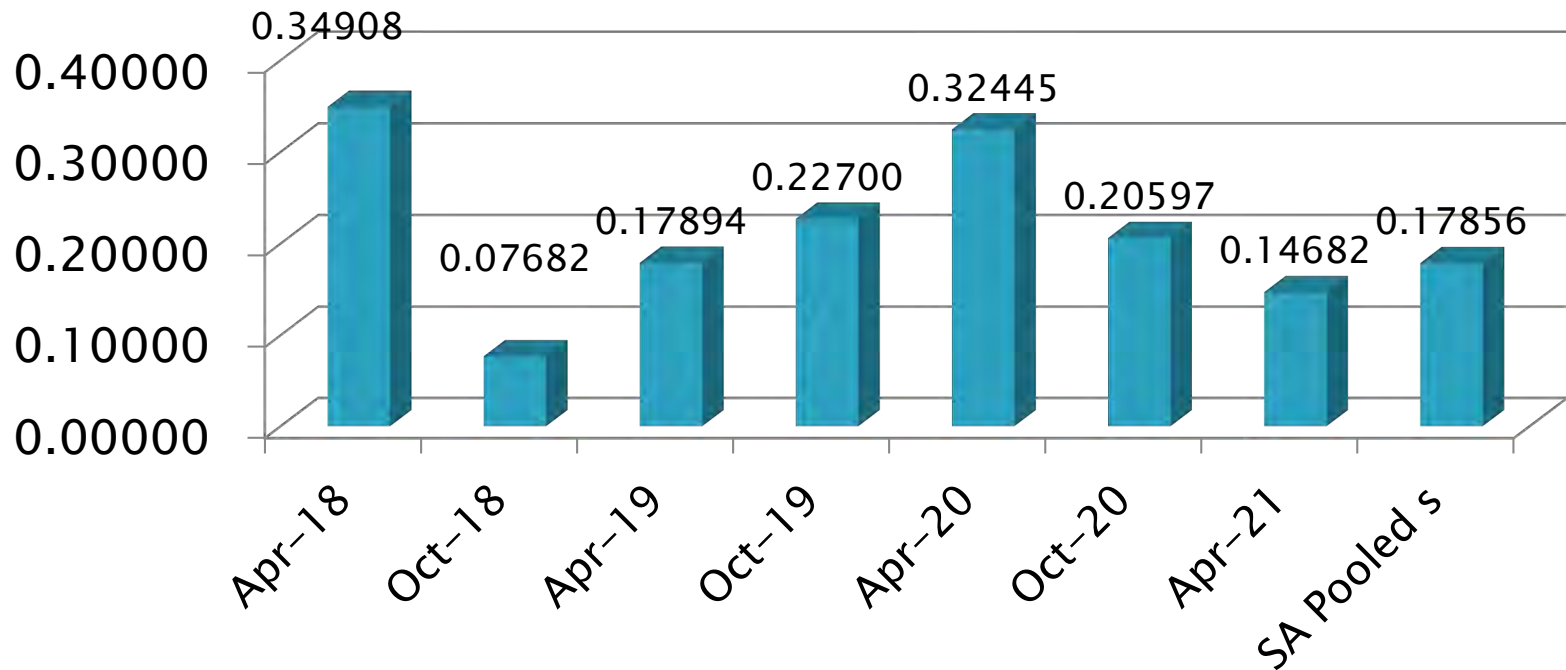


CUSUM Severity Analysis



Sequence X Precision Estimates

% Chain Elongation



■ % Chain Elongation

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Information Letters

»» April 2021

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Information Letters*

Test	Date	IL	Topic
IIIH	20201218	20-5	Defined process for approving an alternate fuel supplier.
IIIH	20210126	21-1	Removed fuel specification from test method and added over and under ranges for QI calculations.
IVA	20201201	20-1	Removed fuel specification from test method and added alternate fuel pump.
IVB	20210107	21-1	Addressed sections omitted from balloted draft of test method.
IX	20210216	21-1	Added alternate clutch part number and removed fuel specification from test method

*Available from TMC Website

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Information Letters* (cont.)

Test	Date	IL	Topic
VH	20201223	20-1	Defined process for approving an alternate fuel supplier.
VH	20210322	21-1	Added Industry Corrective Factor of -0.32 to all AES results completing on or after 3/16/21.
VIE	20201208	20-5	Removed fuel specification from test method.
VIE	20201216	20-6	Defined process for approving an alternate fuel supplier.
VIF	20201208	20-4	Removed fuel specification from test method.
X	20201018	20-4	Added correction to PCV flow measurements and corrected omission in Chain elongation calculation.

*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 543

- A re-blend has been obtained for this oil.

➤ TMC 542-5

- A re-blend has been obtained for this oil.

➤ TMC 931

- This oil is replacement for Reference oil 1009-1 and has been introduced by the panel. Targets for this reference oil were approved 3/16/21.

Reference Oil Re-blends (cont)

➤ TMC 1009-1

- The Sequence V panel agreed to remove this oil due to performance issues.

➤ TMC 1011-1

- Reblend, 1011-1, is now available and needs to be introduced (IVB/VH/X) in the near future as quantities of 1011 are nearly exhausted. Sequence VIF began to introduce this oil and two results on this oil have been report

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	67	130	85	2 years
221	IX	2120	77	559	90	2.5 years
222*	IX	1040	60	0	35	<1 year
224	IX	1026	121	263	110	1.5 years
270	X	1100	30	736	35	5 years
271	X	980	30	699	55	5 years
300-1	IVB	378	0	259	40	3 years
434-2	IIIH	495	0	0	12	<1 year

* Reference oil 222 can not be re-blended

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
434-3	IIIH	980	37.5	676	22.5	5+ years
436	IIIH	1100	10	690	22.5	5+ years
438-1	IIIH	605	0	0	2.5	<1 year
438-2	IIIH	540	17.5	410	17.5	5 years
542-3	VIE/VIF	997	0	5	18	<1 Year
542-4	VIE/VIF	1100	131	295	90	1.5 Years
543	VIF	1100	35	192	54	2+ Years
544	VIE	897	0	231	42	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
704-1	VIII	897	16	25.5	12	2 years
931	VH	908	9	869	15	5+ years
940	VH	560	15	81	18	2 years
1006-2	IVA, VIII	5500	28	222	58	4 years
1009-1	VH, VIII	1100	21	922	3	5 years
1010-1	VIE	1760	66	157	78	1.5 years
1011	IVB/VH/VIF/X	1100	0	0	69	Depleted
1011-1	IVB/VH/VIF/X	1395	50	1291	78	5+ years
1012	IVB	2200	104	1446	65	5+ years

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LTMS Deviations

»» October 1, 2020 –
March 31, 2021

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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, 2020 –

March 31, 2021

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Quality Index Deviations

- One VH Quality Index Deviations was requested this report period.
 - Deviation for oil inlet temperature control due to heater failure.

Quality Index Deviations

Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIH	8
IVA	30
IVB	1
VH	7
IX	1
X	2

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TMC Laboratory Visits

»» October 1, 2020 –

March 31, 2021

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TMC Lab Visits

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

Lab Visit Issues

No Lab Visits were conducted this report period.

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Test Area Timelines

»» October 1, 2020 –
March 31, 2021

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Test Area Timeline Additions*

Test	Date	Topic	IL
IIIH	20201218	Defined process for approving an alternate fuel supplier.	20-5
IIIH	20210126	Removed fuel specification from test method and added over and under ranges for QI calculations.	21-1
IVA	20201201	Removed fuel specification from test method and added alternate fuel pump.	20-1
IVB	20210107	Addressed sections omitted from balloted draft of test method.	21-1
IX	20210216	Added alternate clutch part number and removed fuel specification from test method.	21-1
VH	20201223	Defined process for approving an alternate fuel supplier.	20-1

*As of 03/31/2021

Test Area Timeline Additions*

Test	Date	Topic	IL
VH	20210316	Targets for reference oil 931 approved.	
VH	20210322	Added Industry Corrective Factor of -0.32 to all AES results completing on or after 3/16/21.	21-1
VIE	20200904	Corrected typo in formula for FEI2 engine hour correction	20-4
VIE	20201208	Removed fuel specification from Test Method.	20-5
VIE	20201216	Defined process for approving an alternate fuel supplier.	20-6
VIF	20201208	Removed fuel specification from Test Method.	20-4
X	20201018	Added correction to PCV flow measurements and corrected omission in Chain elongation calculation.	20-4

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Rating Workshop Data

»» 2019 Light Duty Workshop

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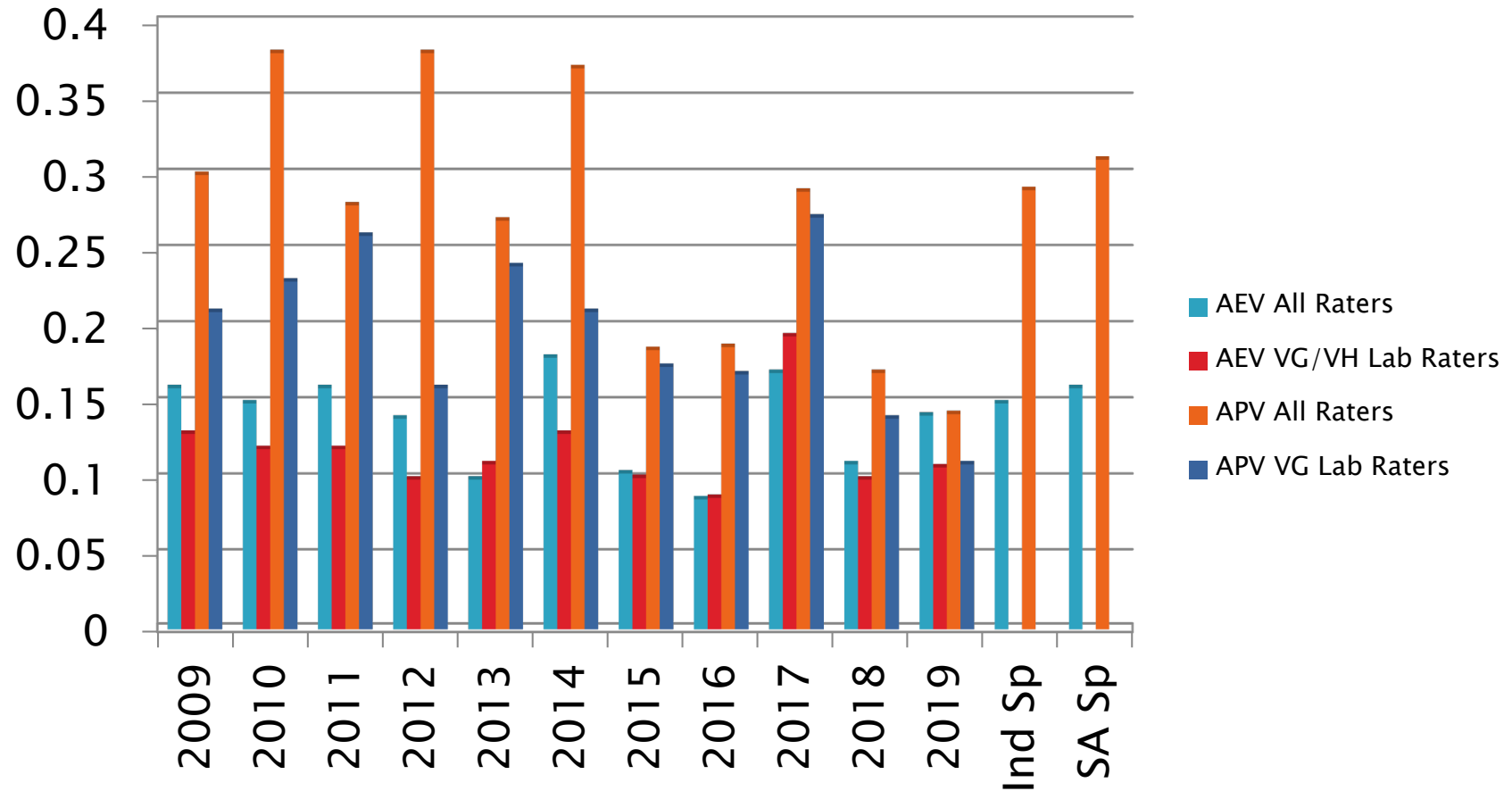
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Rating Workshop Data

- ▶ Summary of Precision Data From Light Duty Rating workshops:
 - VH Average Piston and Average Engine Varnish.
 - IIIH WPD
 - Data is from 2019 workshop; 2020 workshop was cancelled due to pandemic.

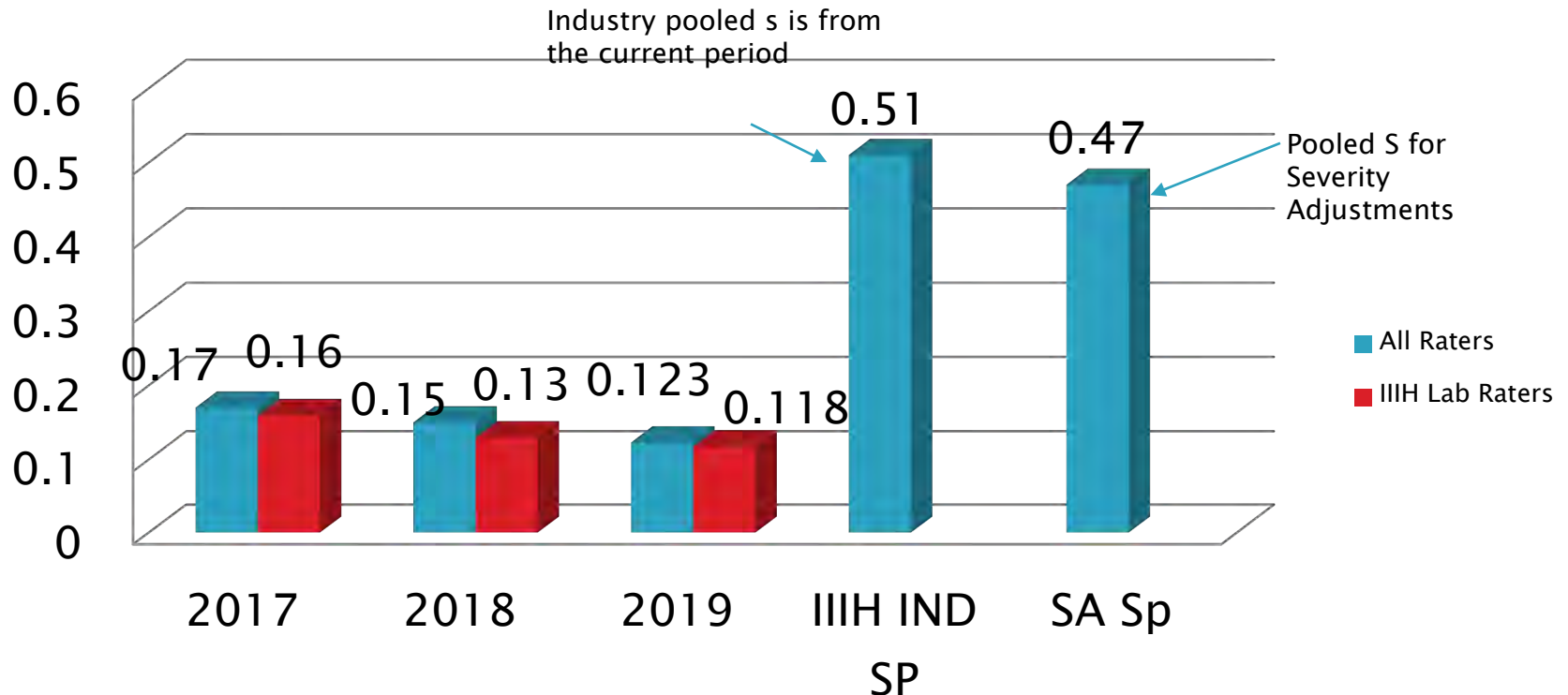
Sequence VG/VH Precision-Rating Workshop Data

Workshop Data for VG/VH Varnish



Sequence IIH 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

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