



A Program of ASTM International

Test Monitoring Center

<https://www.astmtmc.org>

ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing

April 2022

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Passenger Car Engine Oil Testing Executive Summary

- ▶ Reblend of 1011
 - Sequence VIF and IVB are introducing using current targets.
 - The Sequence VH panel has introduced reference oil 1011-1 with updated targets.
 - Sequence X is not introducing at this time due to mild trend
- ▶ Rating
 - A Light Duty Rating Workshop was conducted in February 2022 for Raters from calibrated labs only.

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Passenger Car Engine Oil Testing

Executive Summary (cont.)

▶ IIIH APV Trend

- APV has been trending mild since it was included as a parameter for severity adjustment. The panel has reviewed the situation and has elected to take no action at this time.

▶ Sequence VIE Severity

- Both FEI1 And FEI2 have exhibited long term severe trends as evidenced by Cusum charts. Adjustments were made to reference oil standard deviations in 2018 to minimize the magnitude of test Yi. The Sequence VI panel should address this continuing severity trend.

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Passenger Car Engine Oil Testing Executive Summary (cont.)

- ▶ New blend of VIE Baseline and Flush Oil
 - A new blend of VIE Baseline and Flush oil, VIEBL6 and VIF06 has been obtained and has been shipped to all purchasers.
- ▶ Aged Oil LSPI
 - The Sequence X panel is conducting a matrix to age oils to determine their ability to limit preignition as they age.

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Calibrated Labs and Stands*

| Test | Labs | Stands |
|----------|------|--------|
| IIIH/A/B | 5 | 11 |
| IVA | 2 | 2 |
| IVB | 4 | 6 |
| VH | 4 | 10 |
| VIE | 4 | 13 |
| VIF | 3 | 5 |
| VIII | 2 | 4 |
| IX | 3 | 6 |
| X | 2 | 4 |

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*As of 3/31/2022

Test Monitoring Center
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Sequence IIIH/A/B

➤➤ April 2022

Sequence IIIH/A/B Activity

| Test Status | Validity Code | # |
|---|---------------|-----------|
| Acceptable Calibration Test | AC | 12 |
| Operationally Valid, Statistically Unacceptable | OC | 3 |
| Terminated Calibration Attempt | XC | 3 |
| Operationally Invalid Calibration Attempt | RC | 1 |
| Total | | 19 |

Sequence IIIH – Failing Tests

| Test Status | # |
|---|----------|
| Ei Level 3 Alarm Percent Vis Increase Severe | 1 |
| Ei Level 3 Alarm Percent Vis Increase Mild | 1 |
| Ei Level 3 Alarm, Weighted Piston Deposits Mild | 1 |
| Totals | 3 |

*Invalid and aborted tests

Sequence IIIH – Lost Tests*

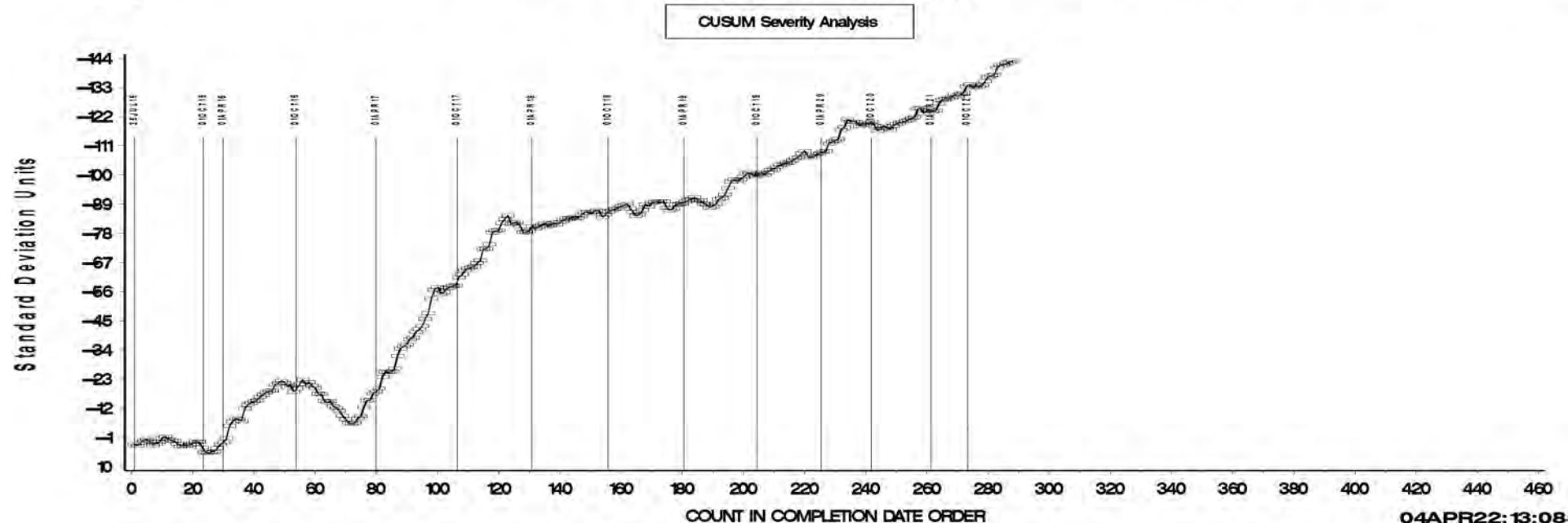
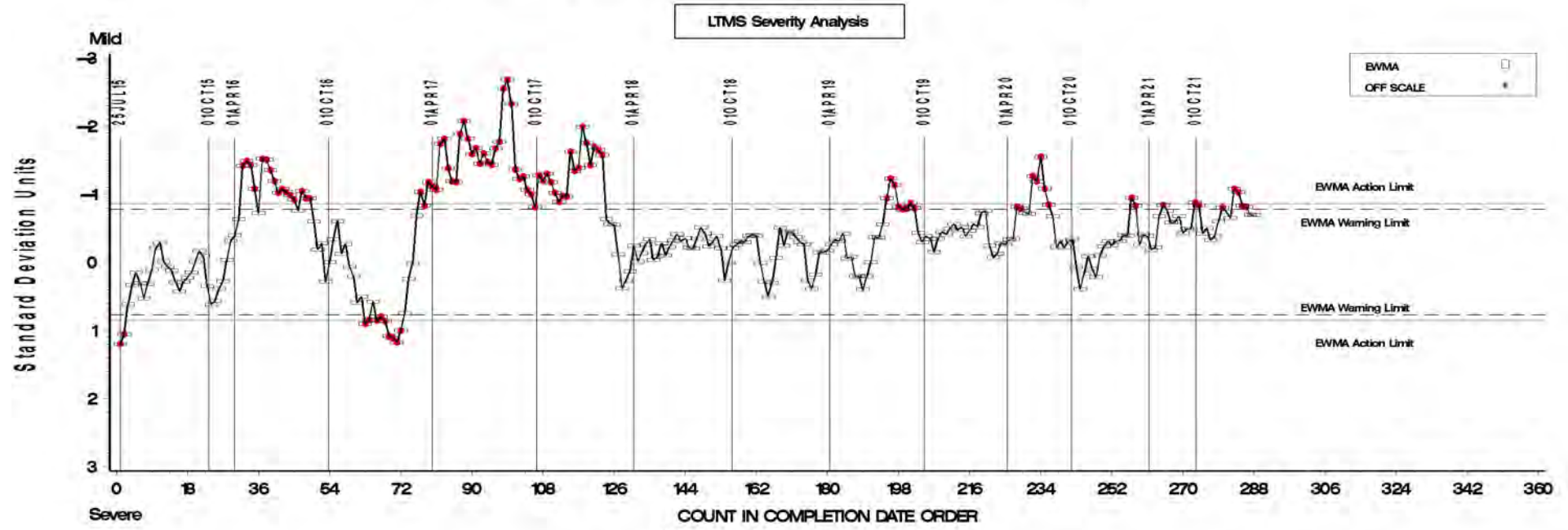
| Test Status | Cause | # |
|---------------|---------------------------------------|----------|
| Aborted | Excessive downtime, dyno issue | 1 |
| Aborted | Oil loss, main seal failure | 1 |
| Aborted | Oil Levelling error | 1 |
| Invalid | Engine coolant flow calibration error | 1 |
| Totals | | 4 |

*Invalid and aborted tests

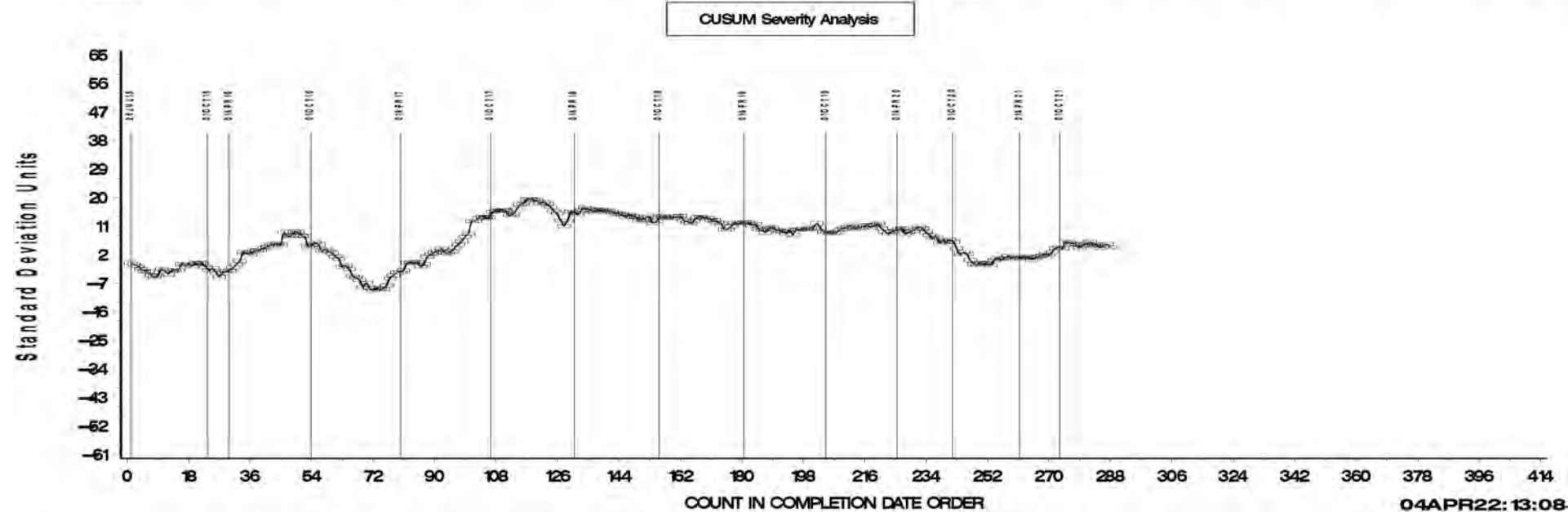
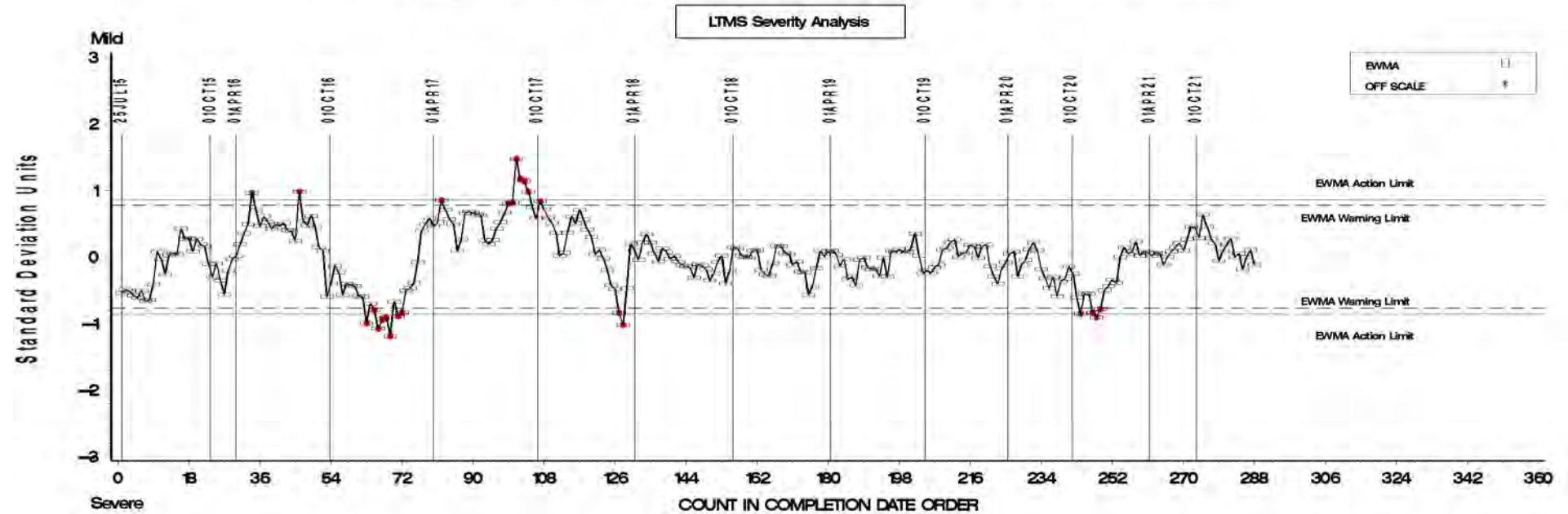
Sequence IIIH Test Severity

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

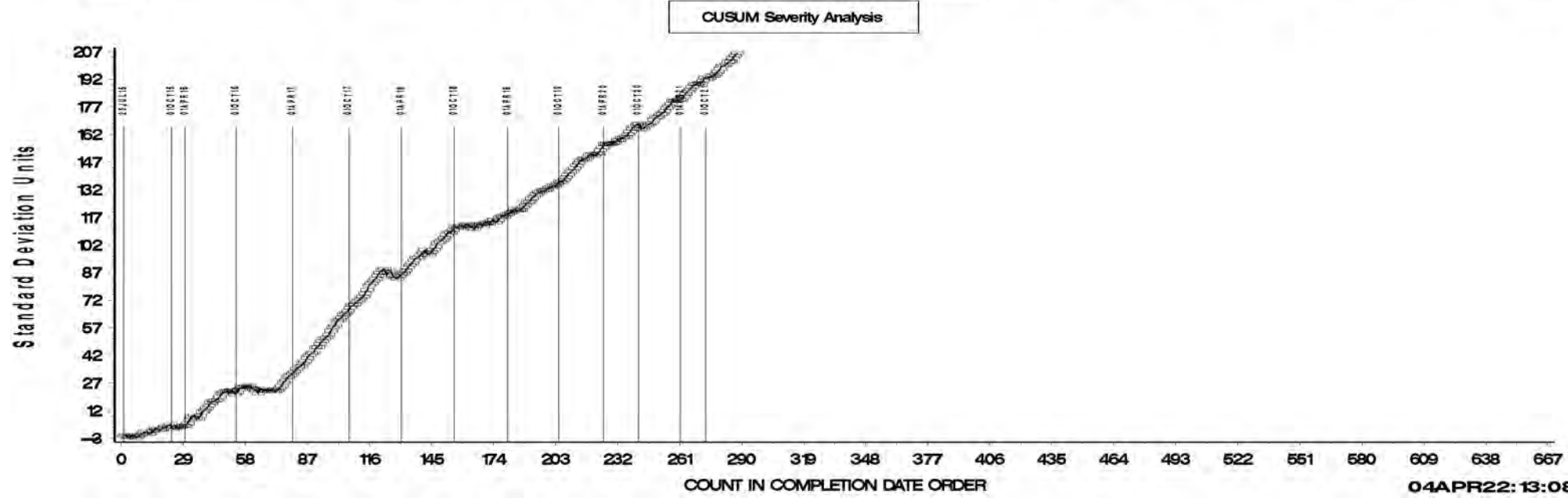
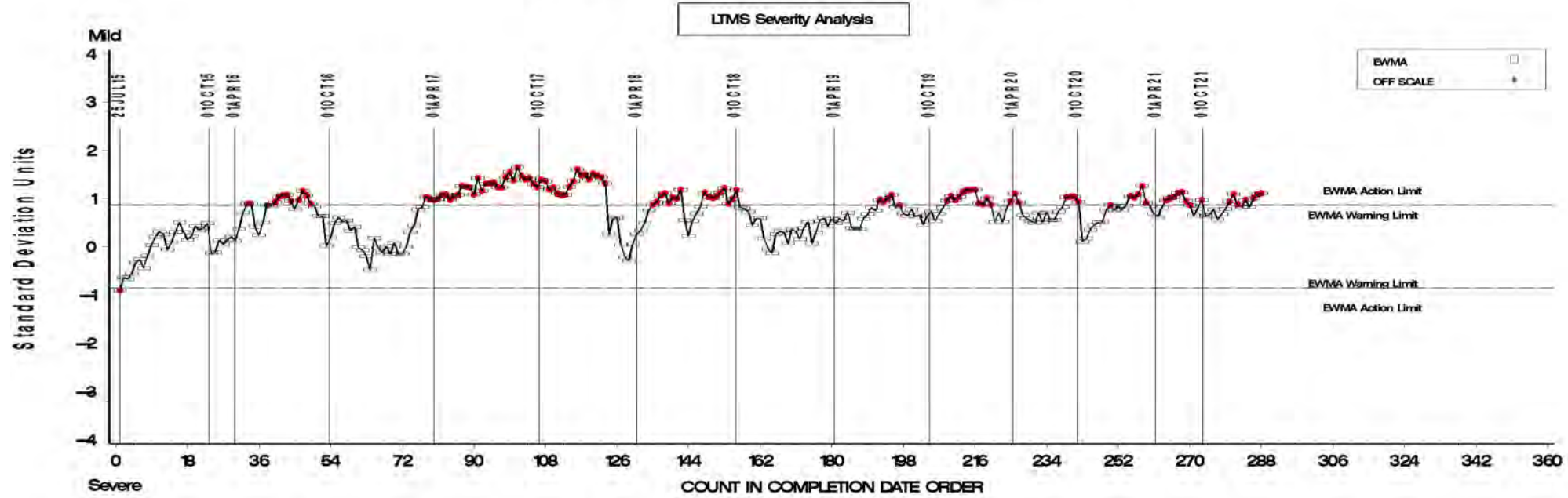
VISCOSITY INCREASE FINAL ORIG UNIT RES



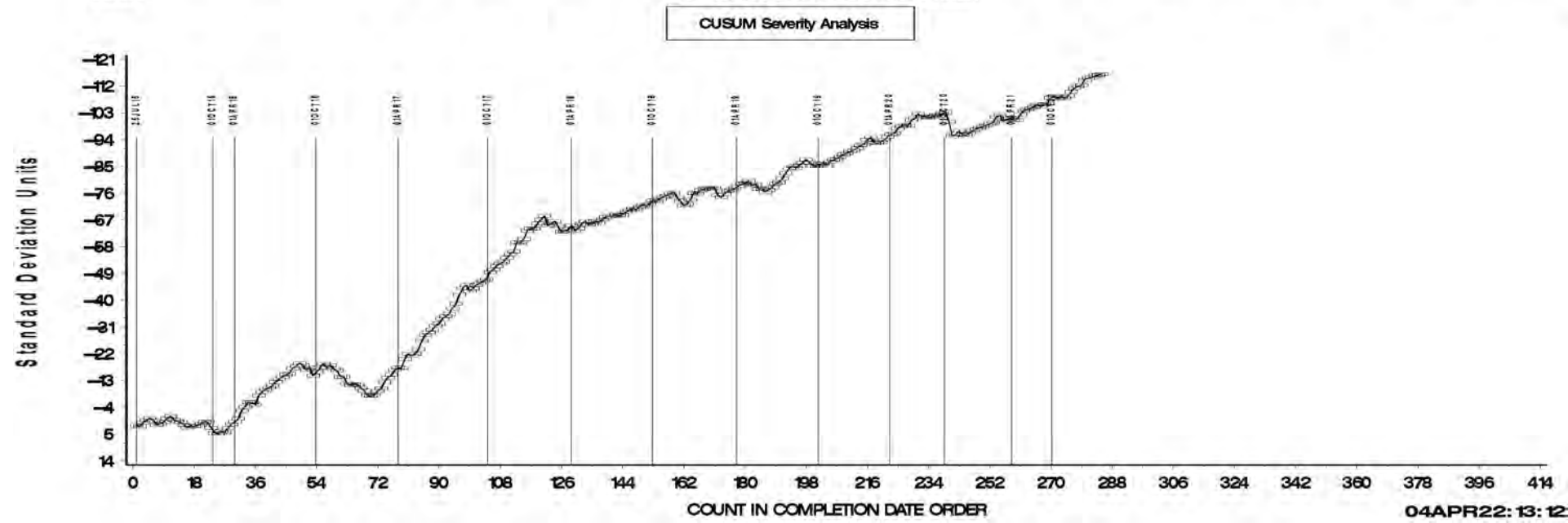
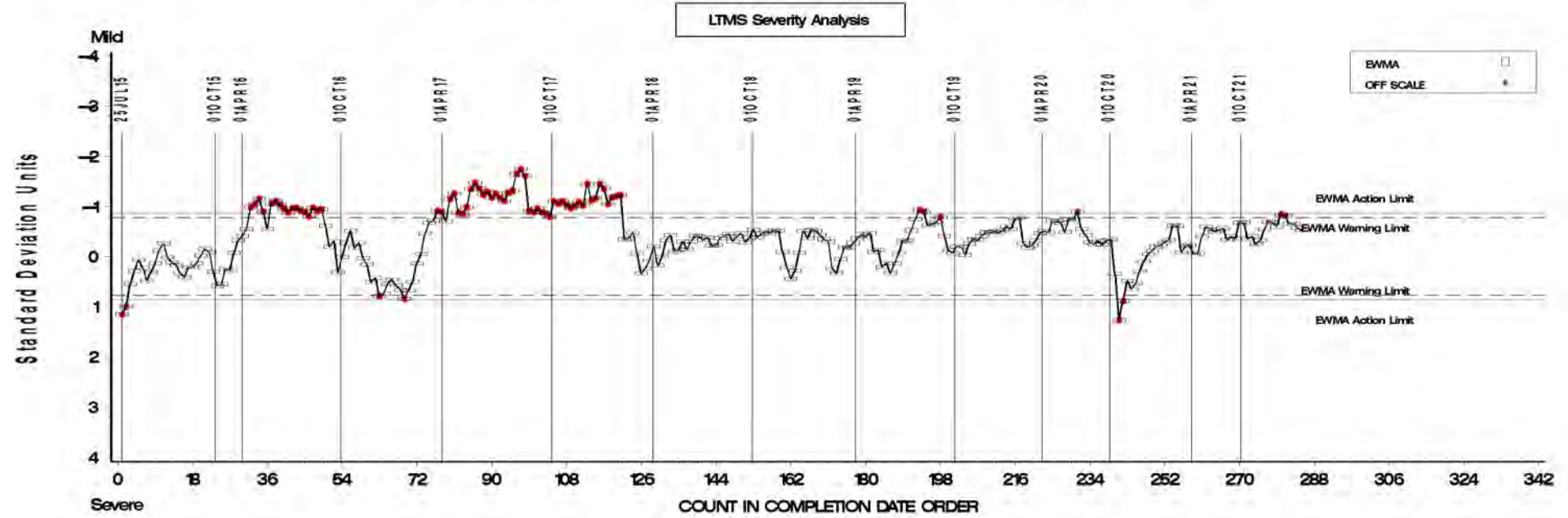
AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG U



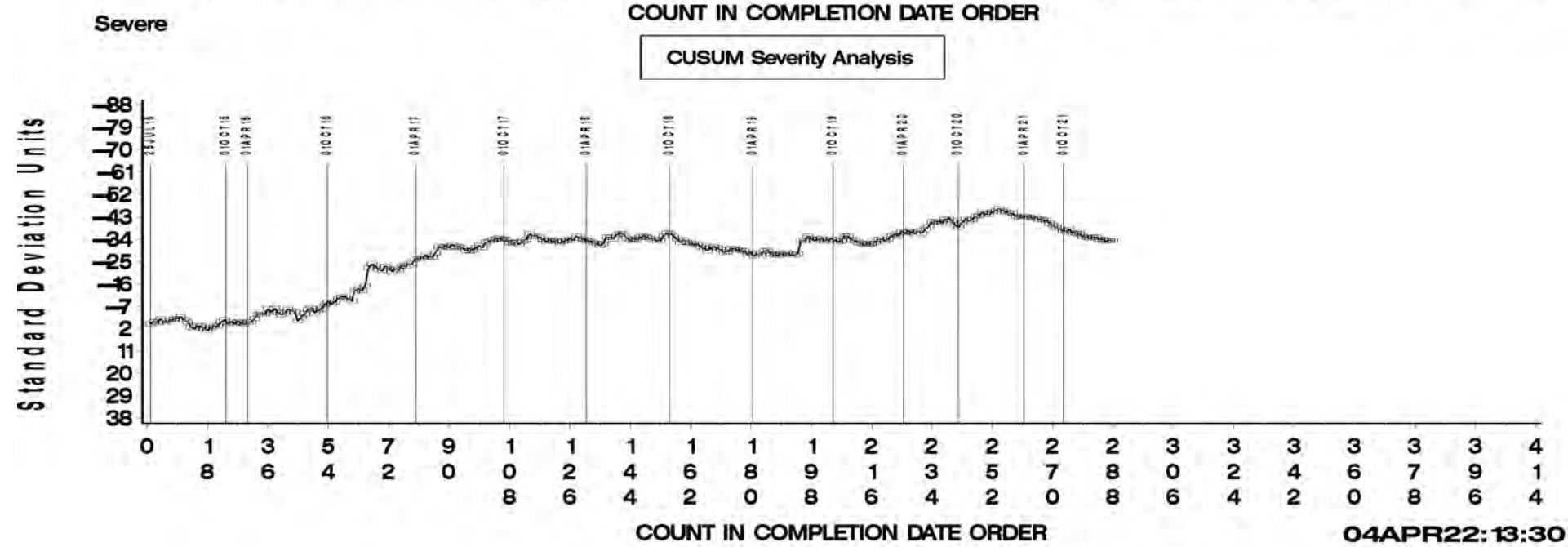
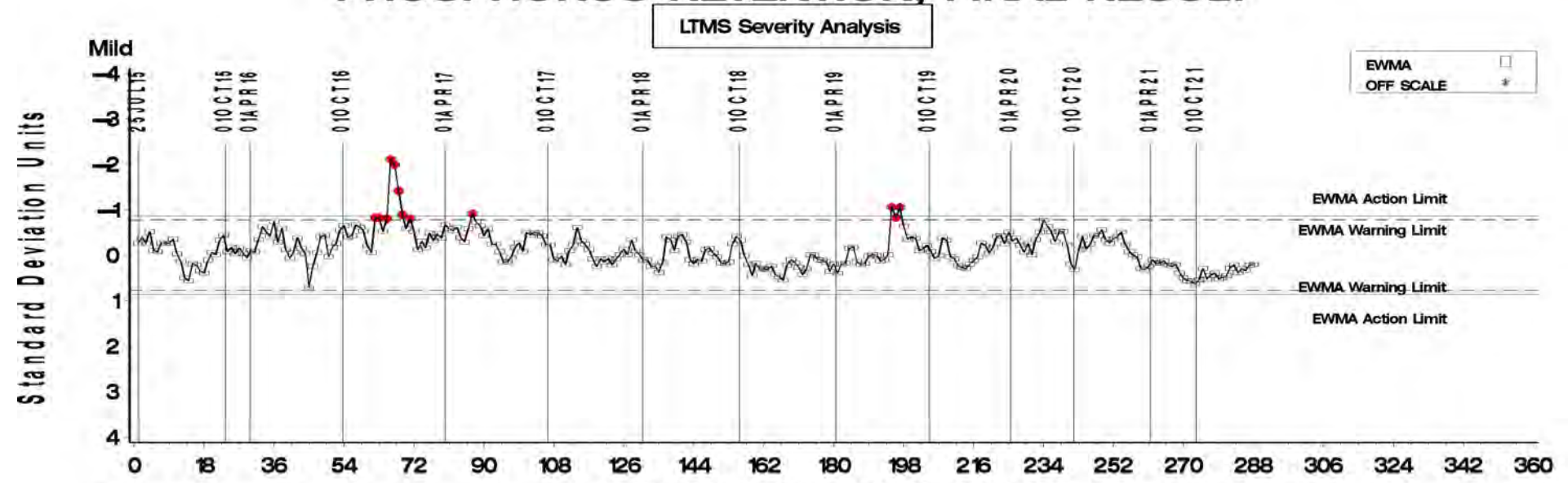
AVERAGE PISTON SKIRT VARNISH



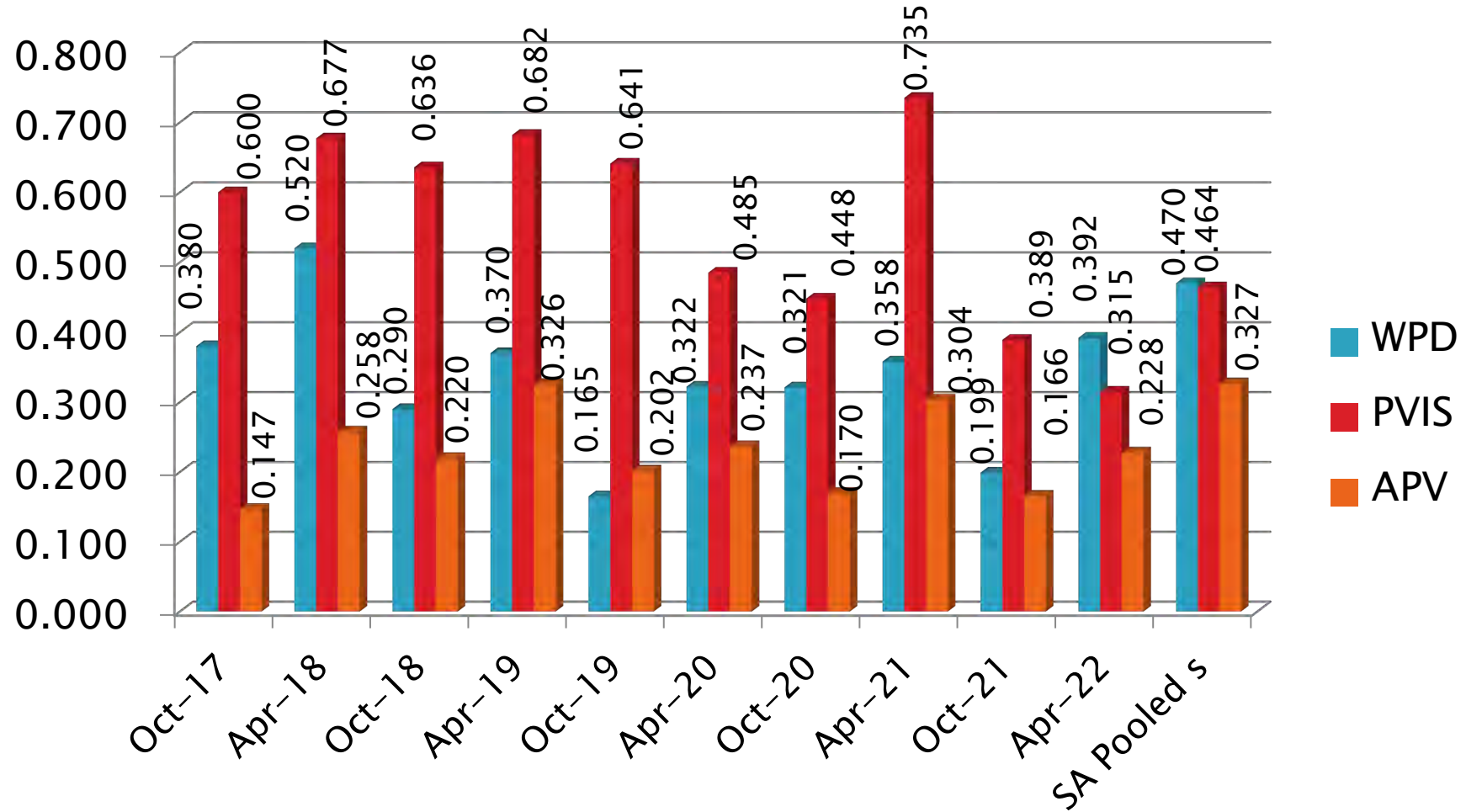
MRV FINAL ORIG UNIT RES [NM, FROZEN, SOLID]



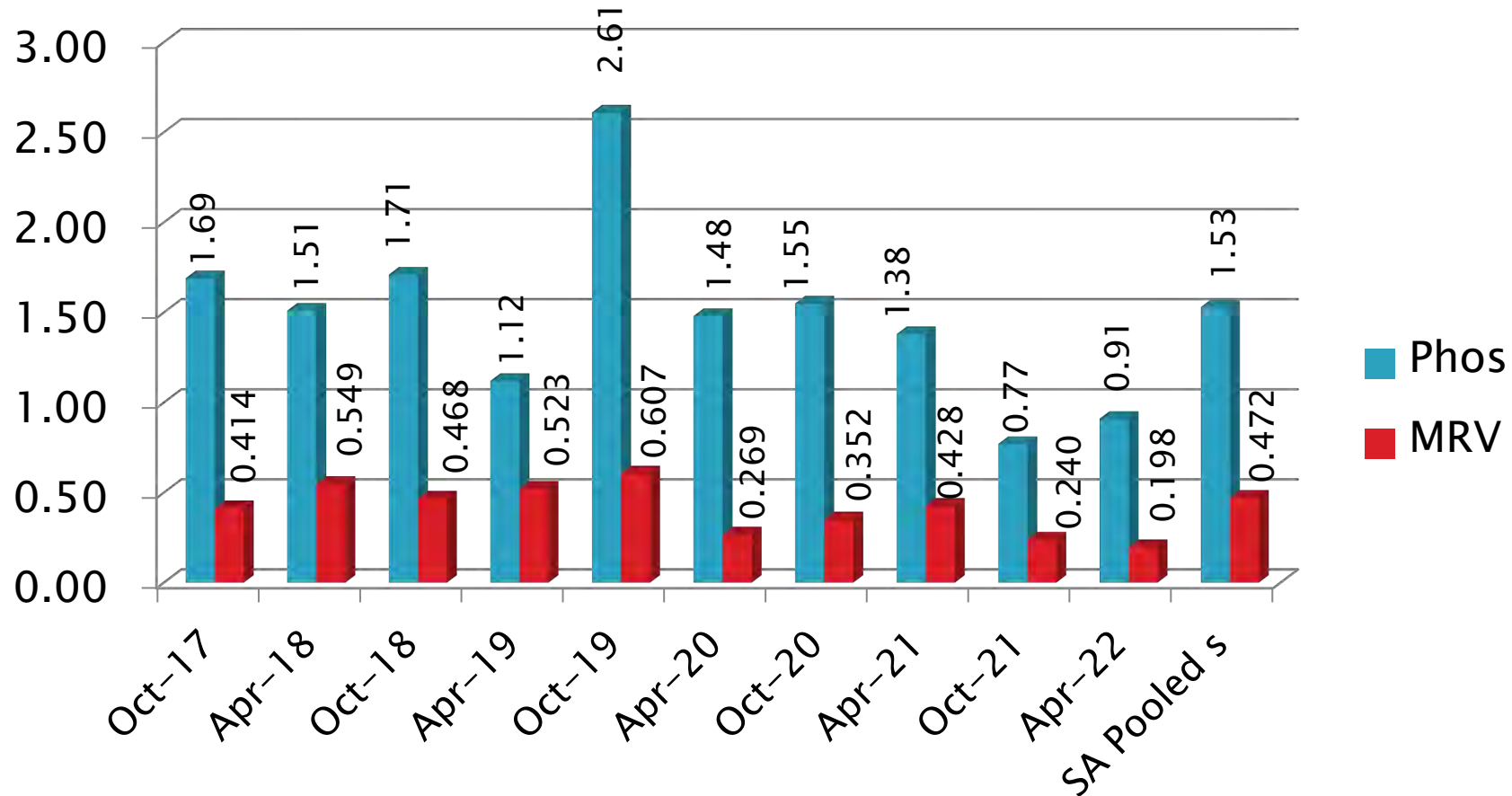
PHOSPHORUS RETENTION, FINAL RESULT



IIH Precision Estimates



IIIHA/B Precision Estimates



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Sequence IVA

➤➤ April 2022

Sequence IVA Activity

| Test Status | Validity Code | # |
|---|---------------|----------|
| Acceptable Calibration Test | AC | 2 |
| Operationally Invalid Calibration Test (lab decision) | LC | 1 |
| Total | | 3 |

Sequence IVA – Lost Tests*

| Test Status | Cause | # |
|---------------|-------------------|----------|
| Invalid | Driveline failure | 1 |
| Totals | | 1 |

*Invalid and aborted tests

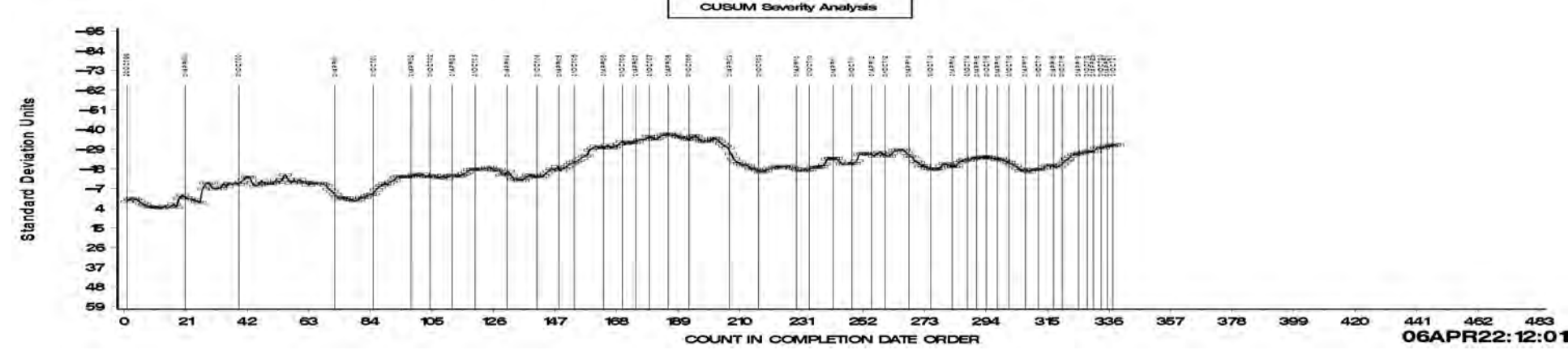
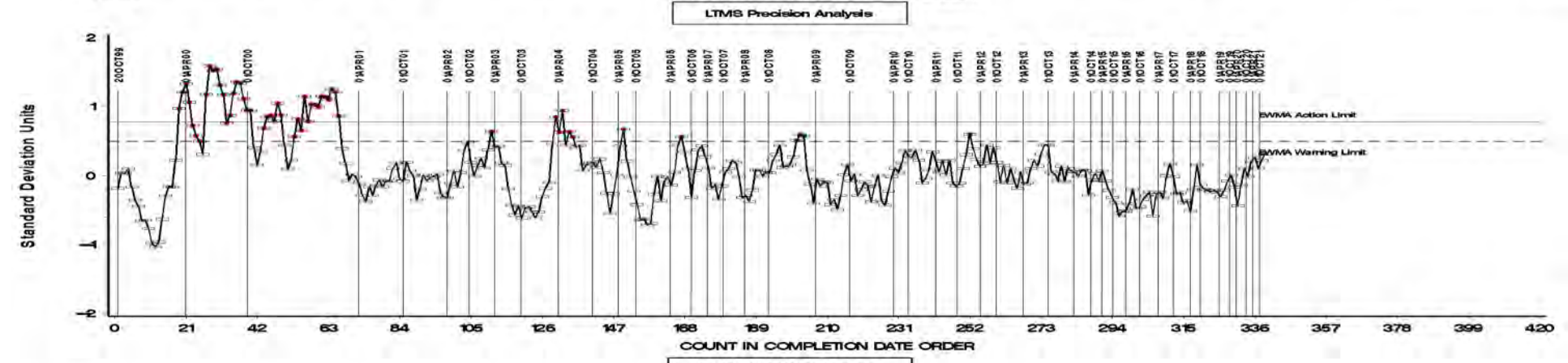
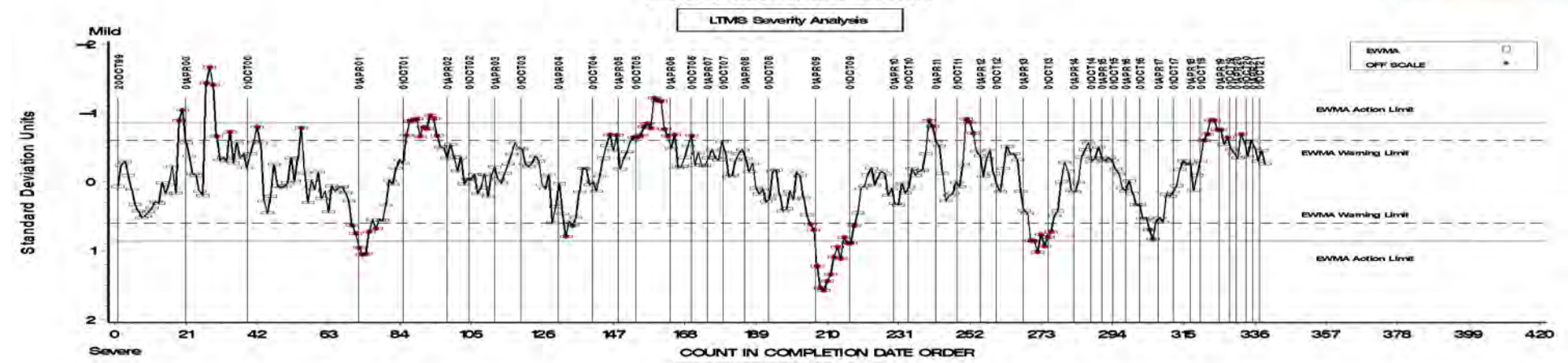
Sequence IVA Test Severity

- ACW is within control limits.

SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

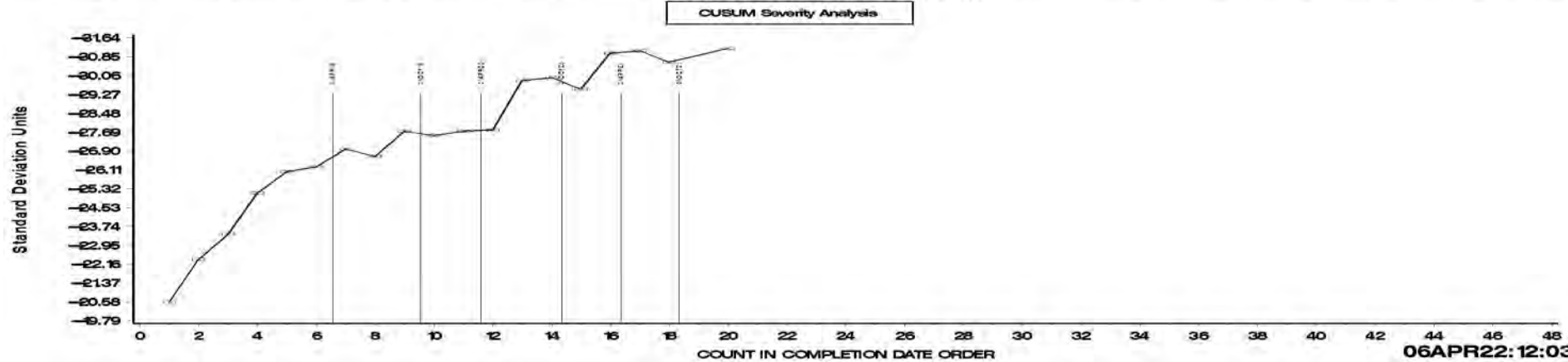
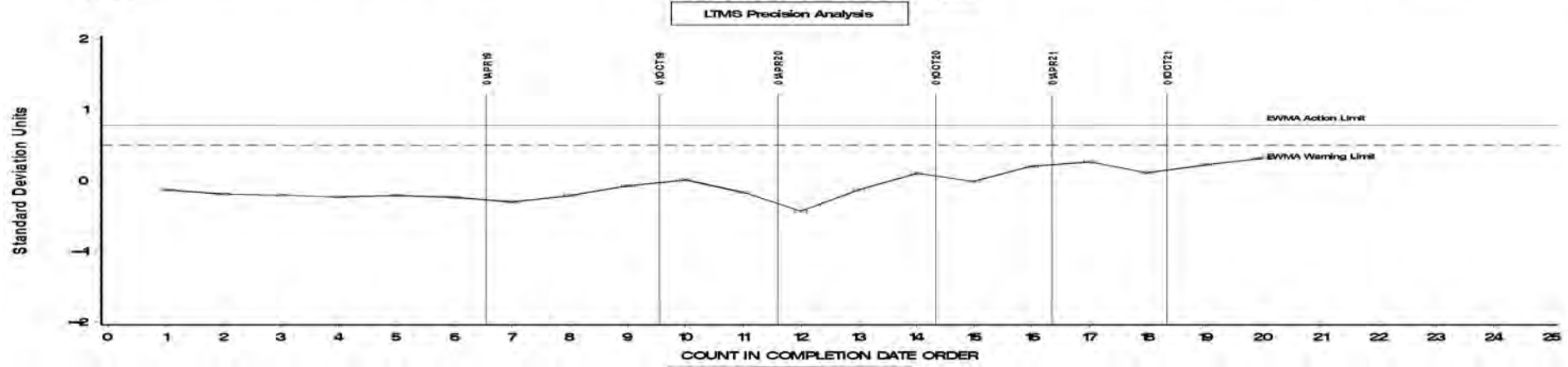
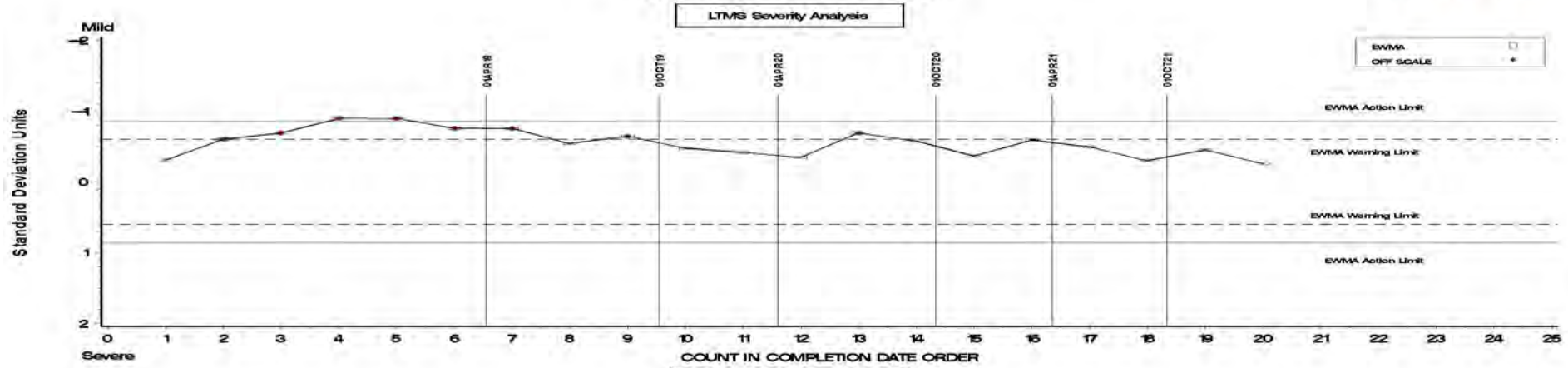


AVERAGE CAM WEAR



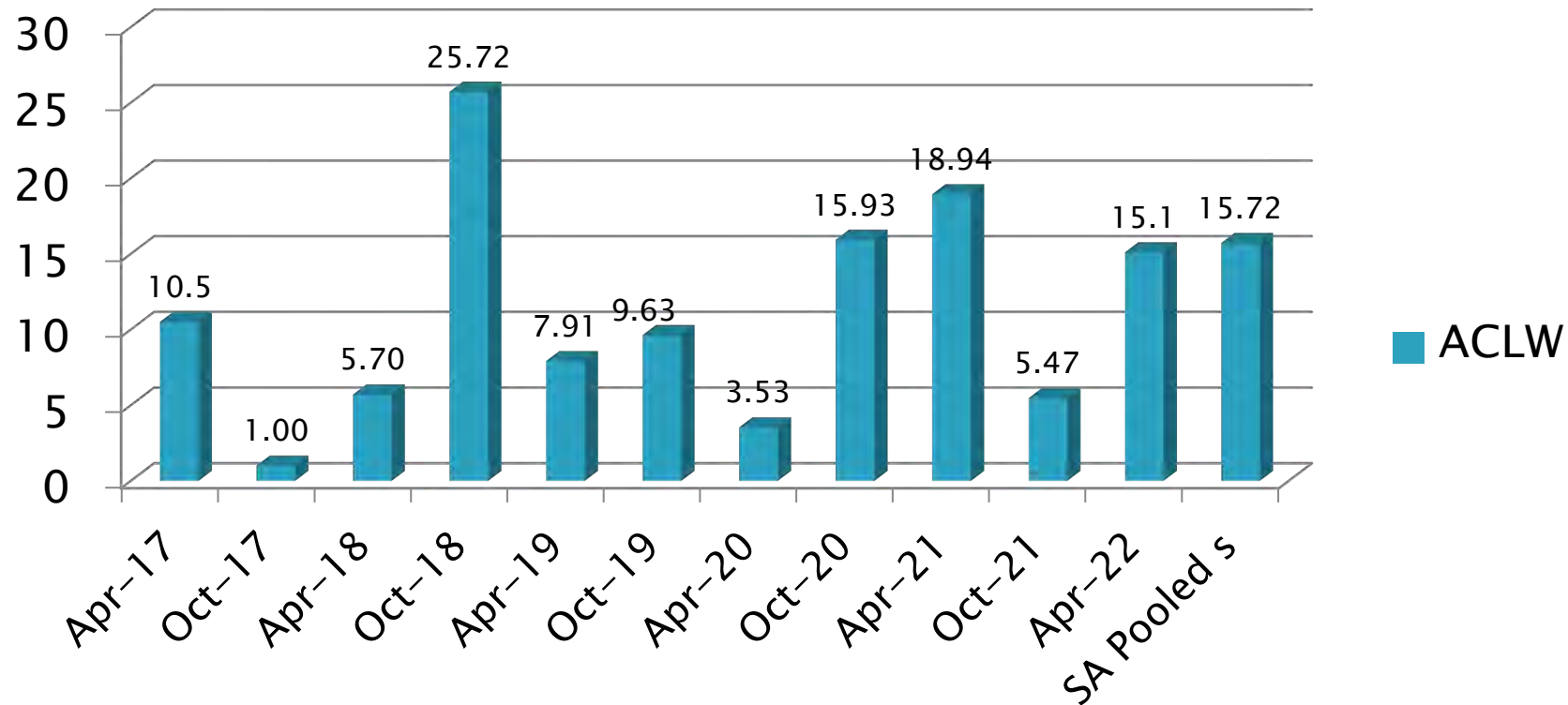
SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

Last 20 Tests
AVERAGE CAM WEAR



Sequence IVA Precision Estimates

ACW



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Sequence IVB

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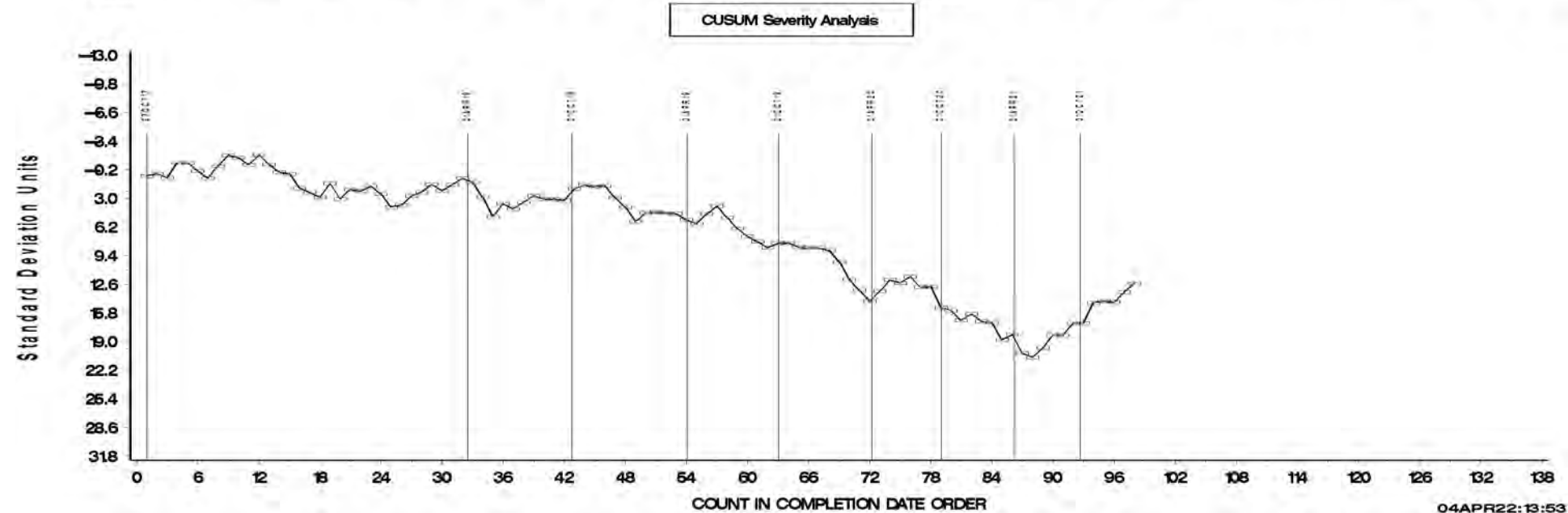
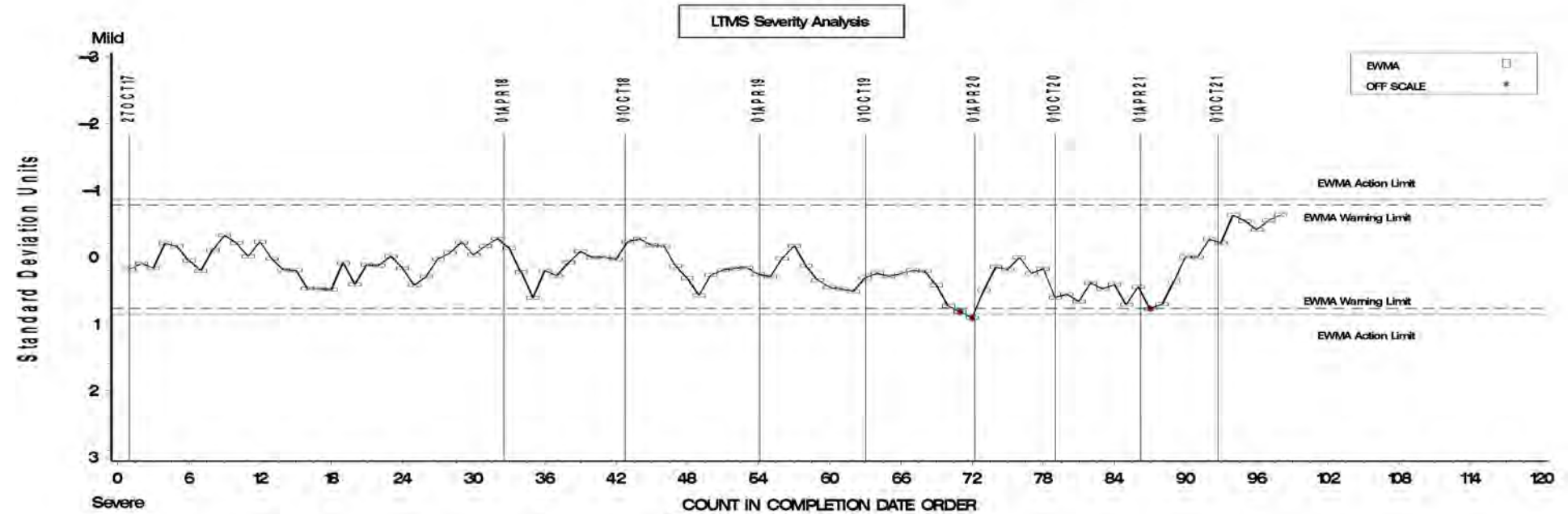
Sequence IVB Activity

| Test Status | Validity Code | # |
|-----------------------------|---------------|----------|
| Acceptable Calibration Test | AC | 6 |
| Total | | 6 |

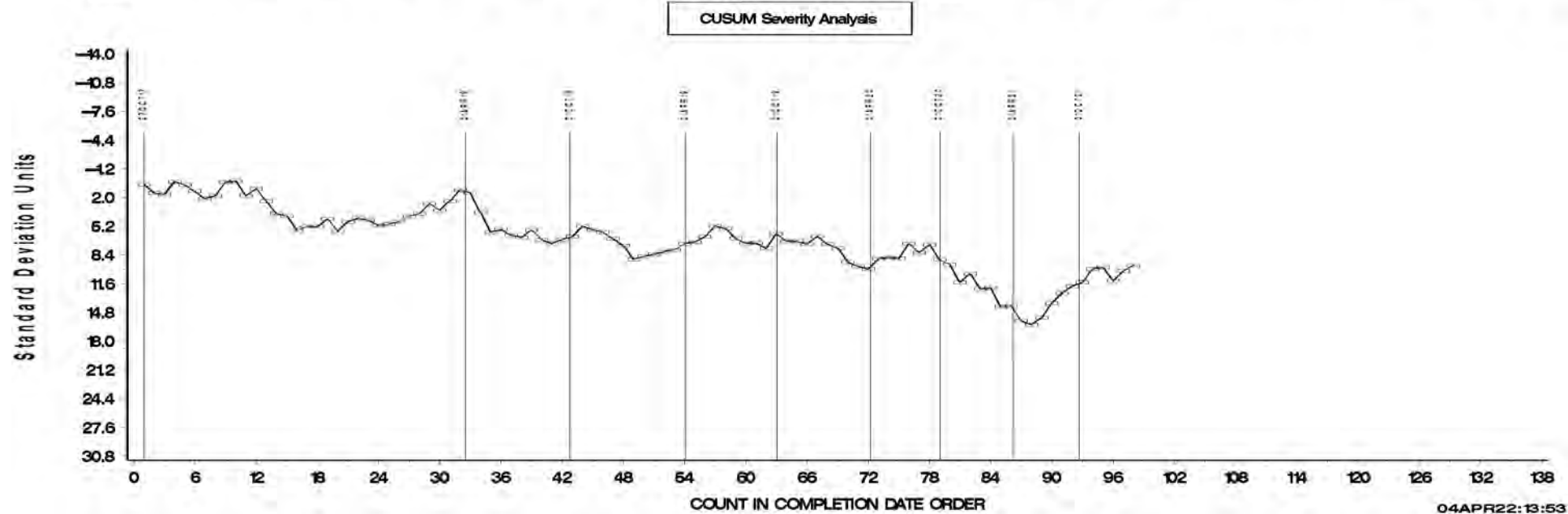
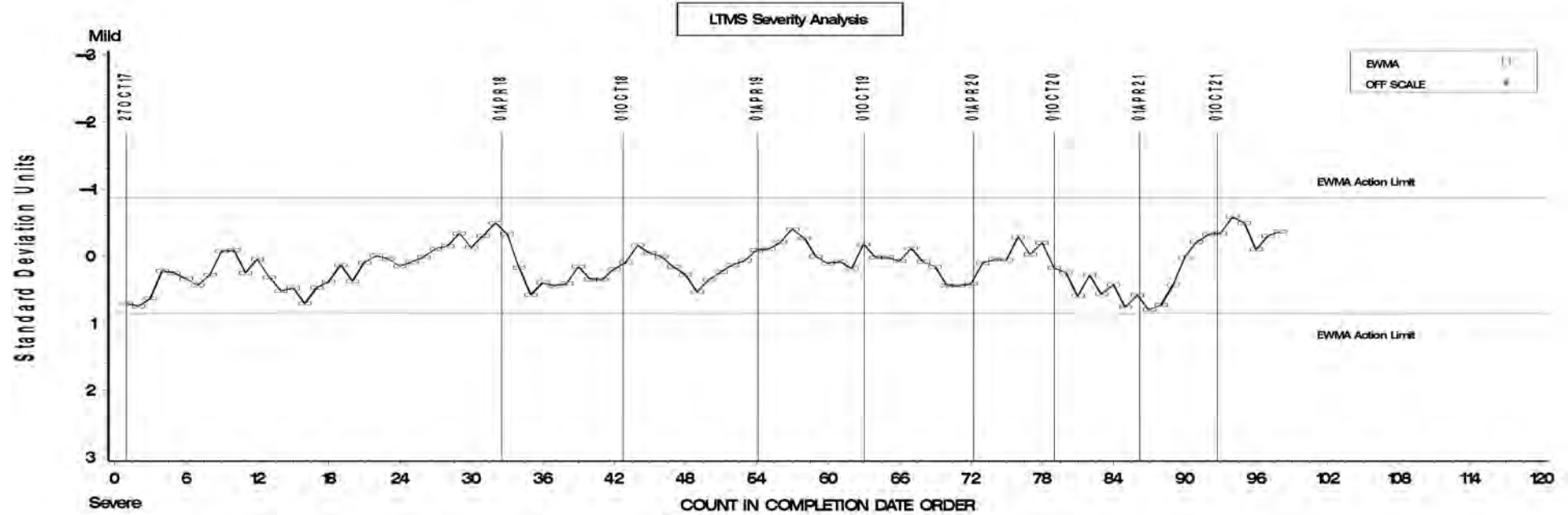
Sequence IVB Test Severity

- AVLI and Fe are in control.

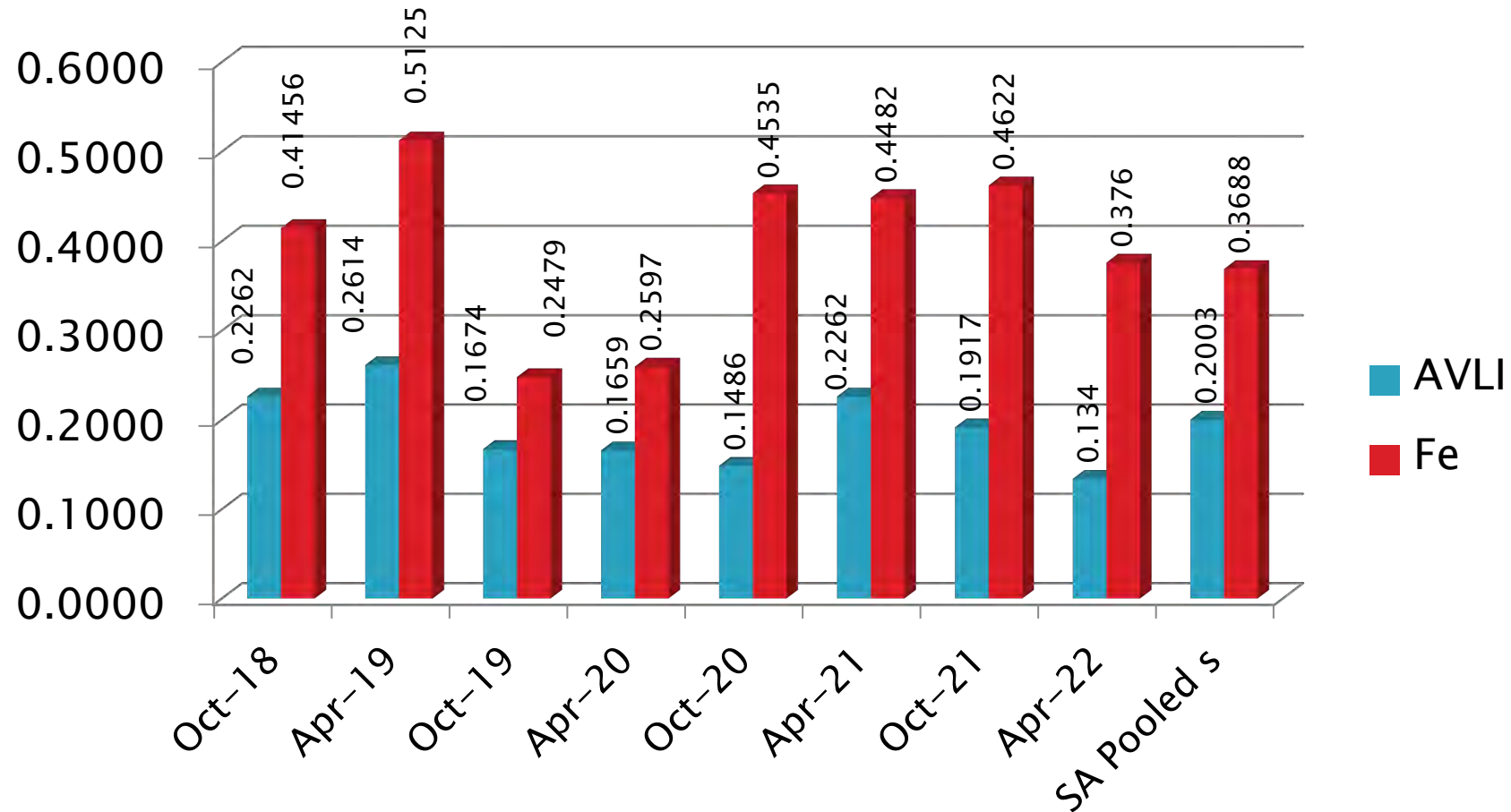
AVERAGE VOLUME LOSS BY KEYENCE INTAKE Final



END OF TEST FE FINAL Severity Adjusted RESULT



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 | 10 |
| Statistically Unacceptable Calibration Test | OC | 1 |
| Operationally Invalid Calibration Test (Lab and TMC Judgement) | RC | 2 |
| Total | | 13 |

Sequence VH – Lost Tests*

| Test Status | Cause | # |
|---------------|--|----------|
| Invalid | Rocker Cover Coolant Flow Cal Error (same stand) | 2 |
| Totals | | 2 |

*Invalid and aborted tests

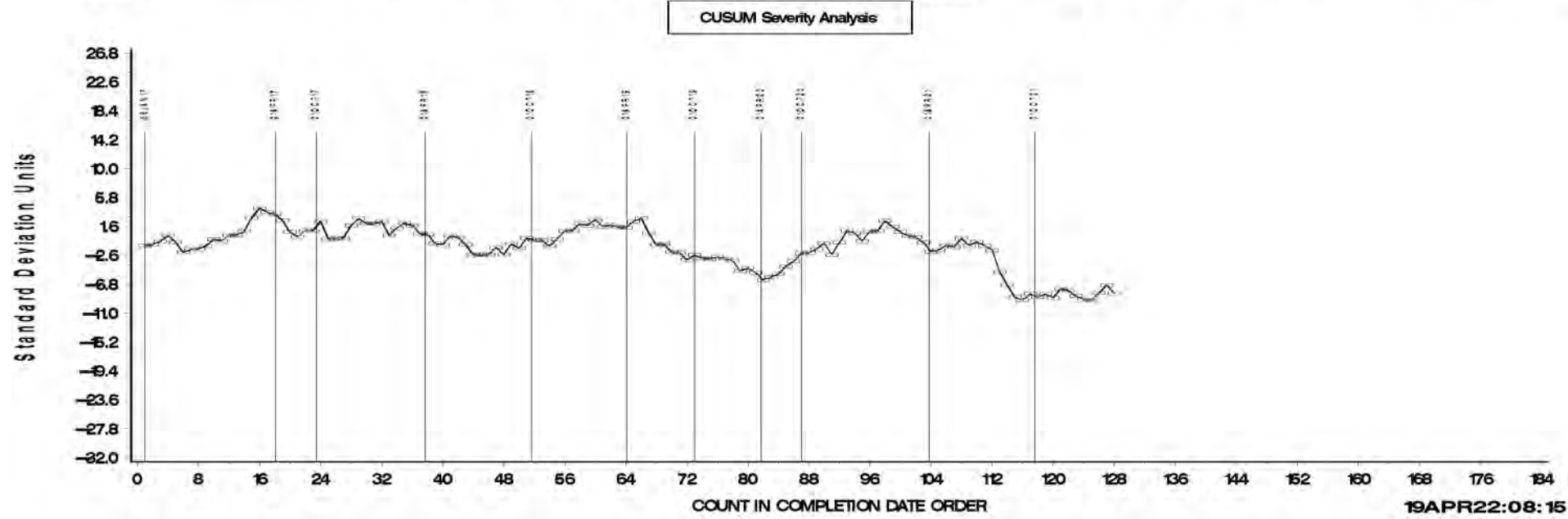
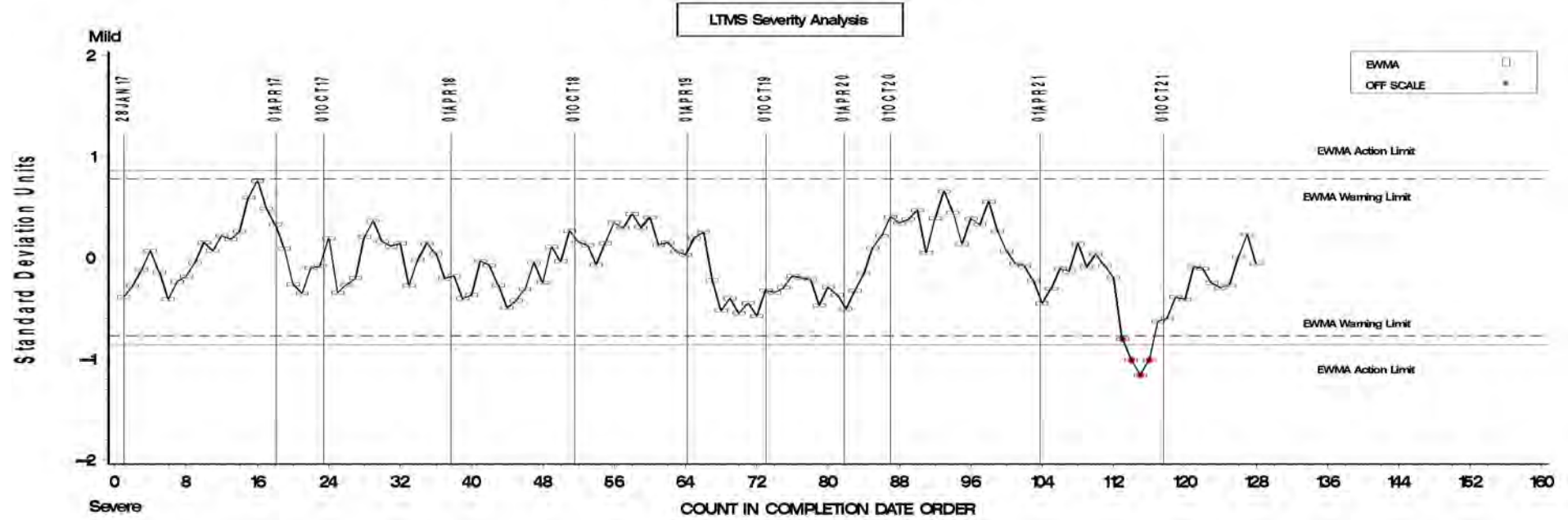
Sequence VH – Failing Tests

| Test Status | # |
|---------------------------------------|----------|
| RAC Ei Level 3 alarm (Mild Direction) | 1 |
| Total | 1 |

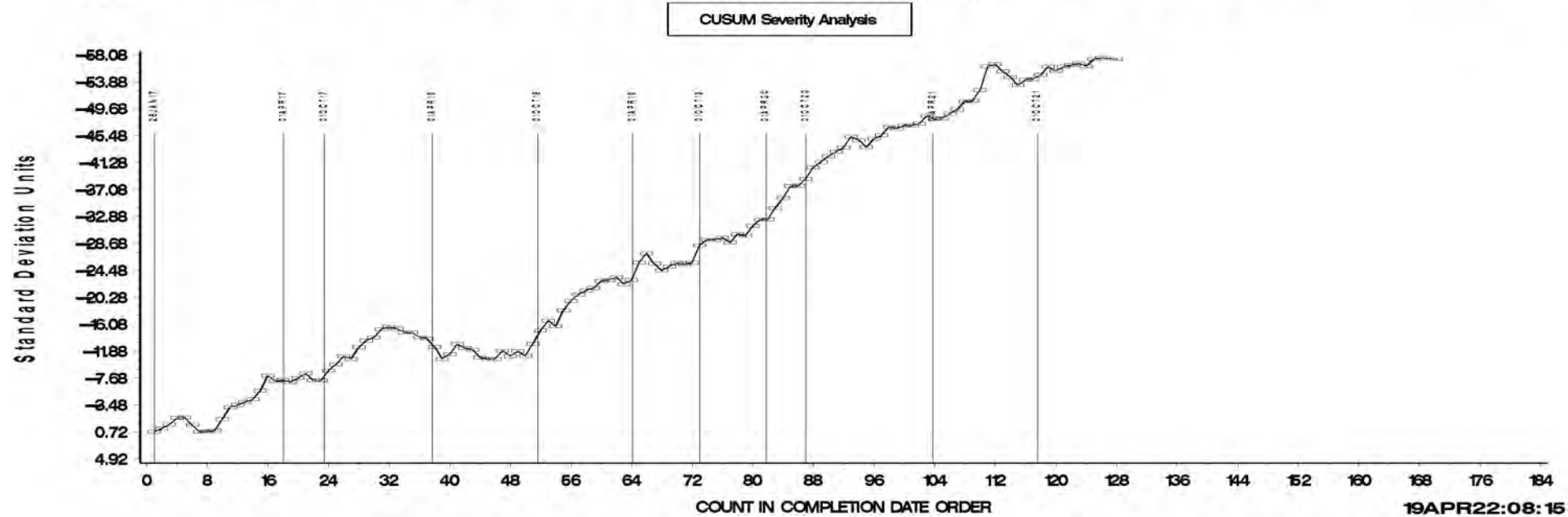
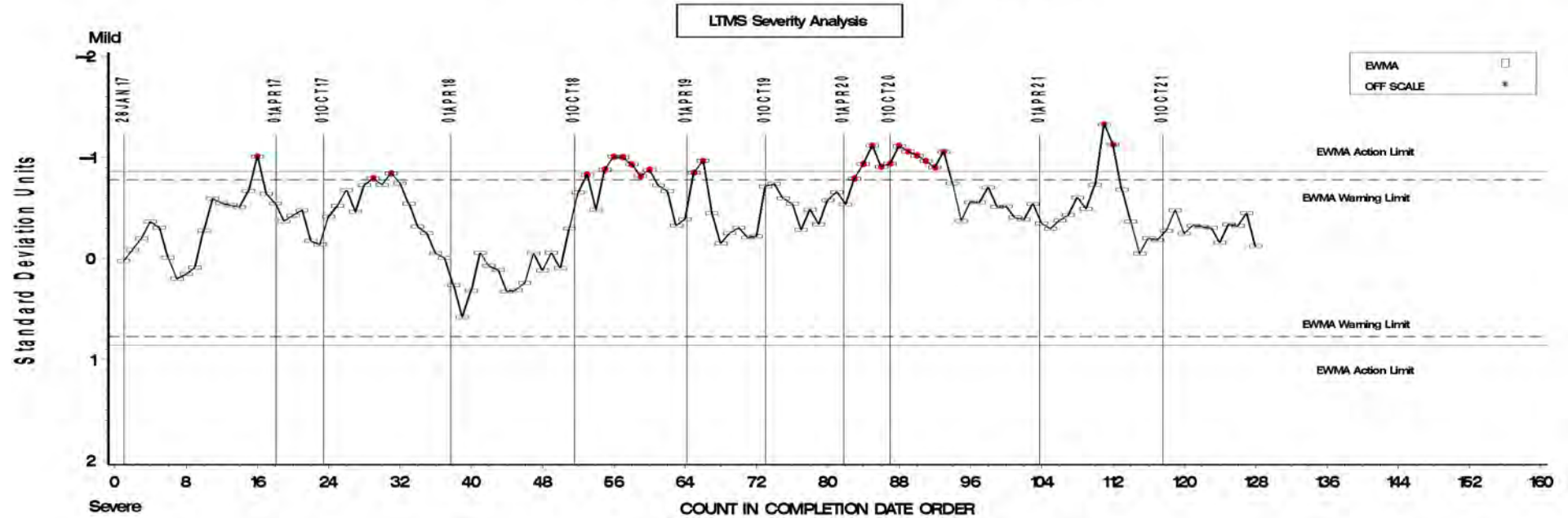
Sequence VH Test Severity

- All parameters within control limits.

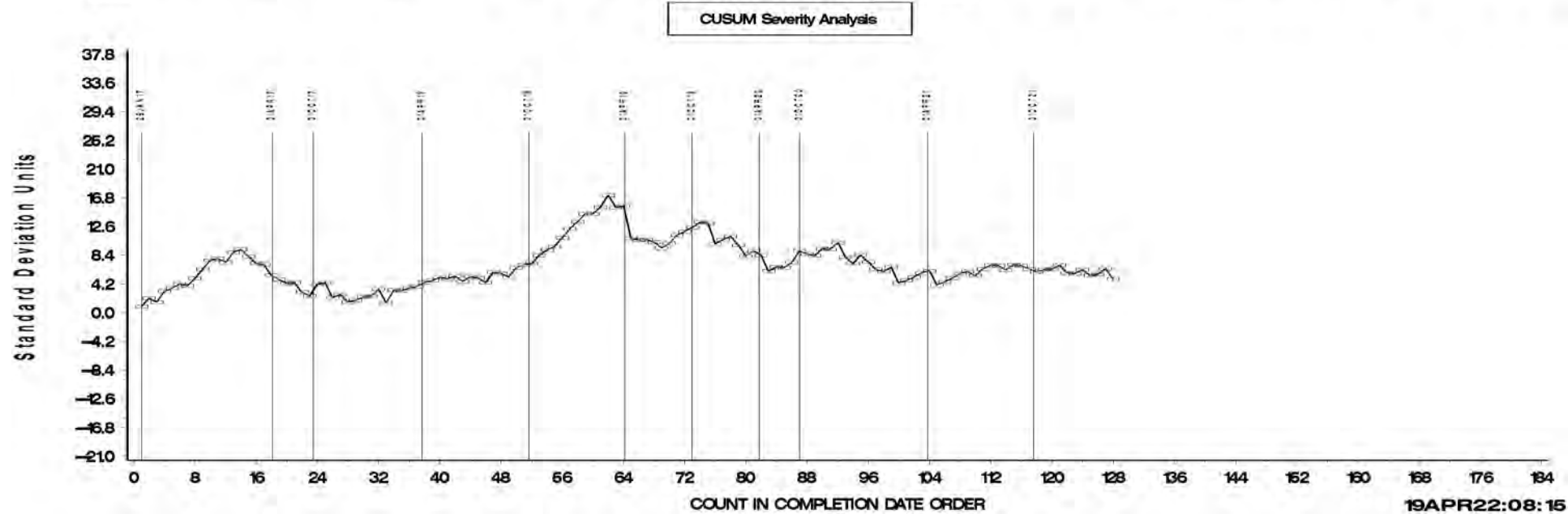
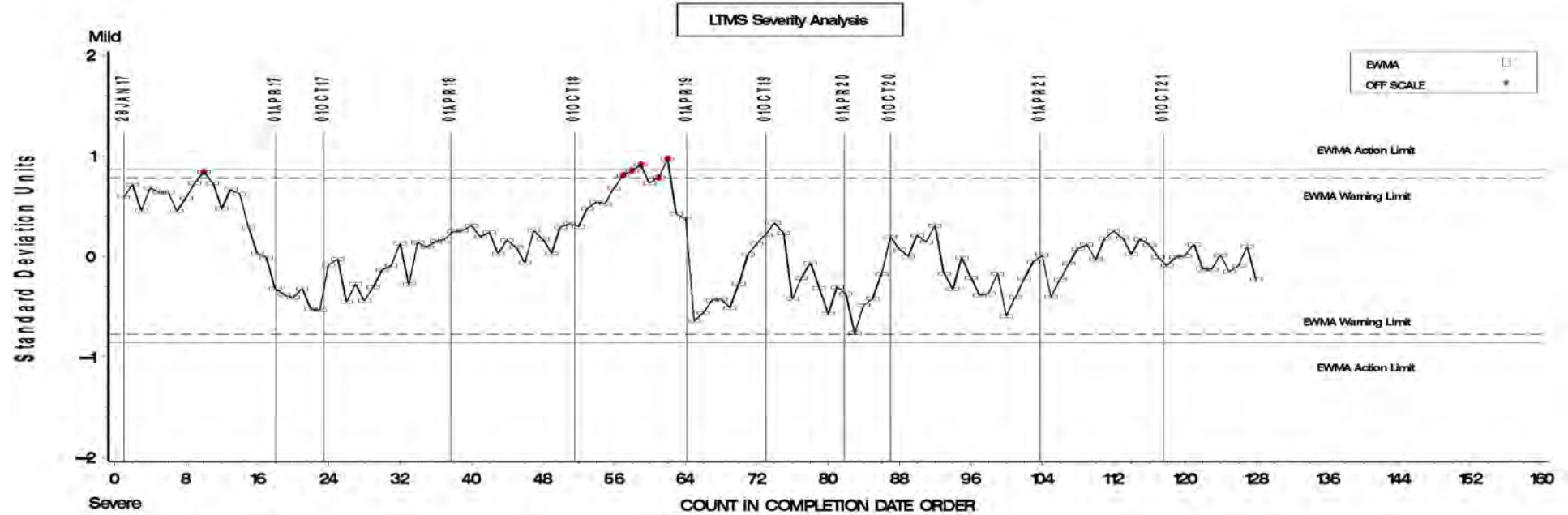
AVERAGE ENGINE SLUDGE



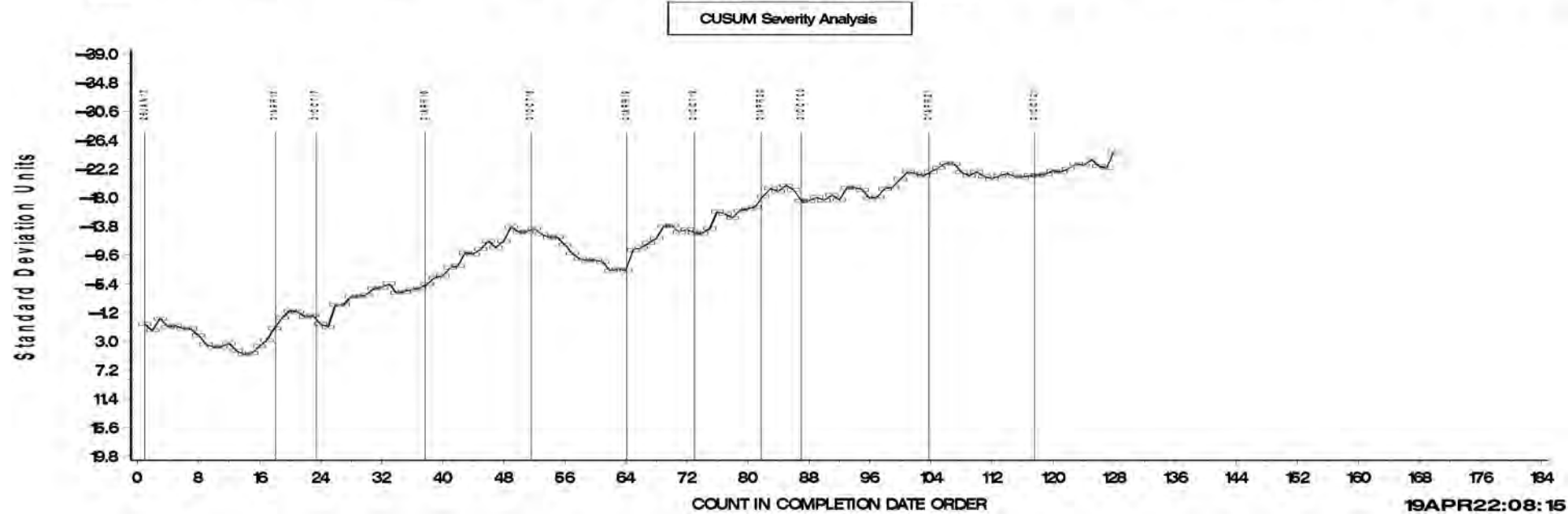
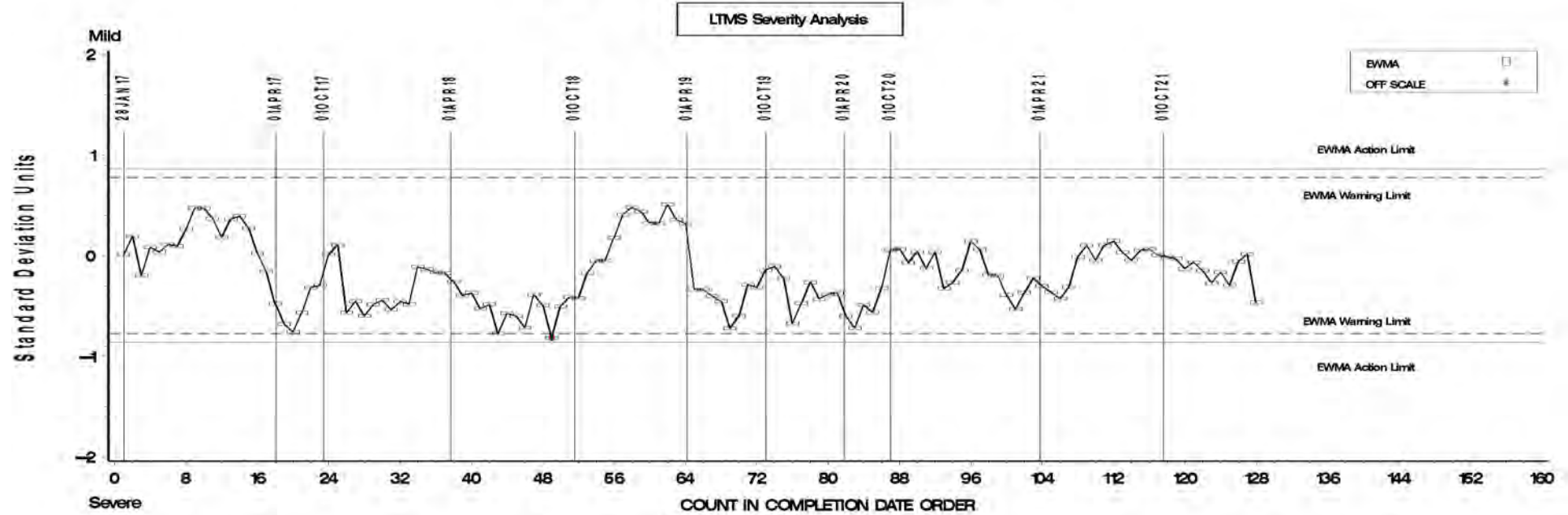
AVERAGE ROCKER COVER SLUDGE



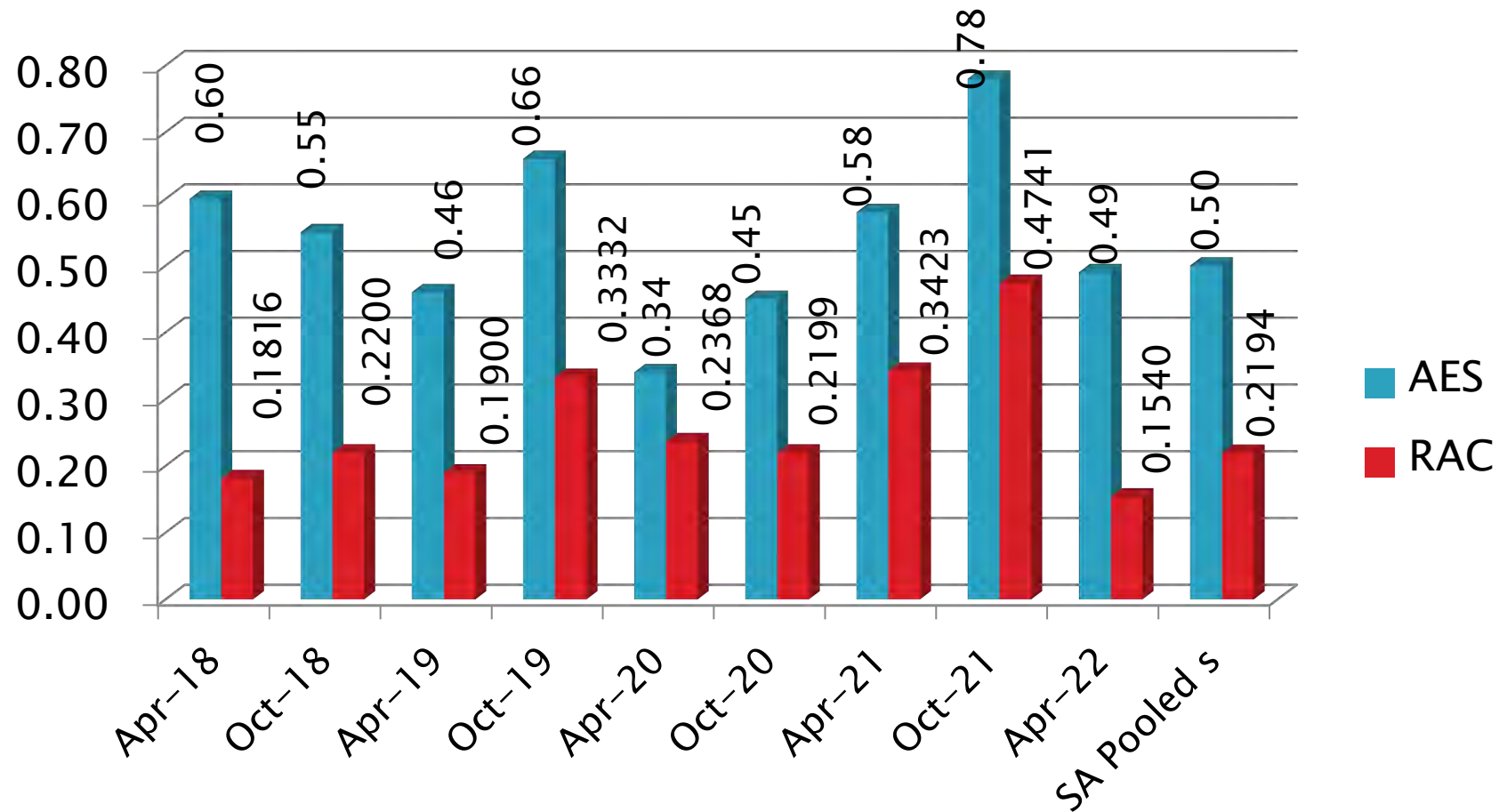
AVG. ENG. VARN. 50% RATING



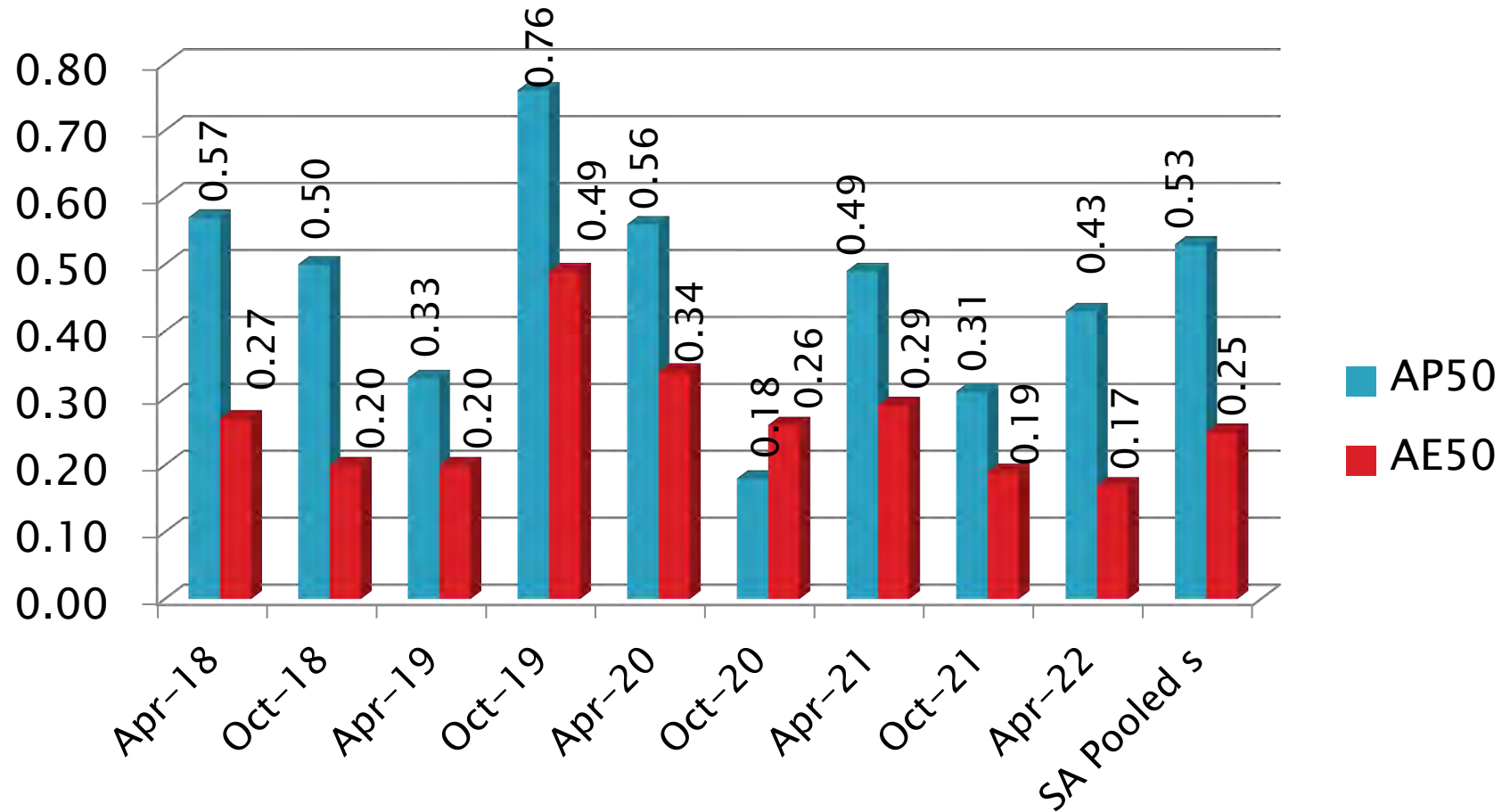
AVG PISTON SKIRT 50% RATING



Sequence VH Precision Estimates



Sequence VH Precision Estimates



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Sequence VIE

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Sequence VIE Activity

| Test Status | Validity Code | # |
|---|---------------|-----------|
| Acceptable Calibration Test | AC | 19 |
| Statistically Unacceptable Calibration Test | OC | 2 |
| Operationally Invalid Calibration Test | LC | 1 |
| Total | | 22 |

Sequence VIE- Failed Tests

| Test Status | # |
|--------------|----------|
| FEI1 Severe | 1 |
| FEI1 Mild | 1 |
| Total | 2 |

Sequence VIE – Lost Tests*

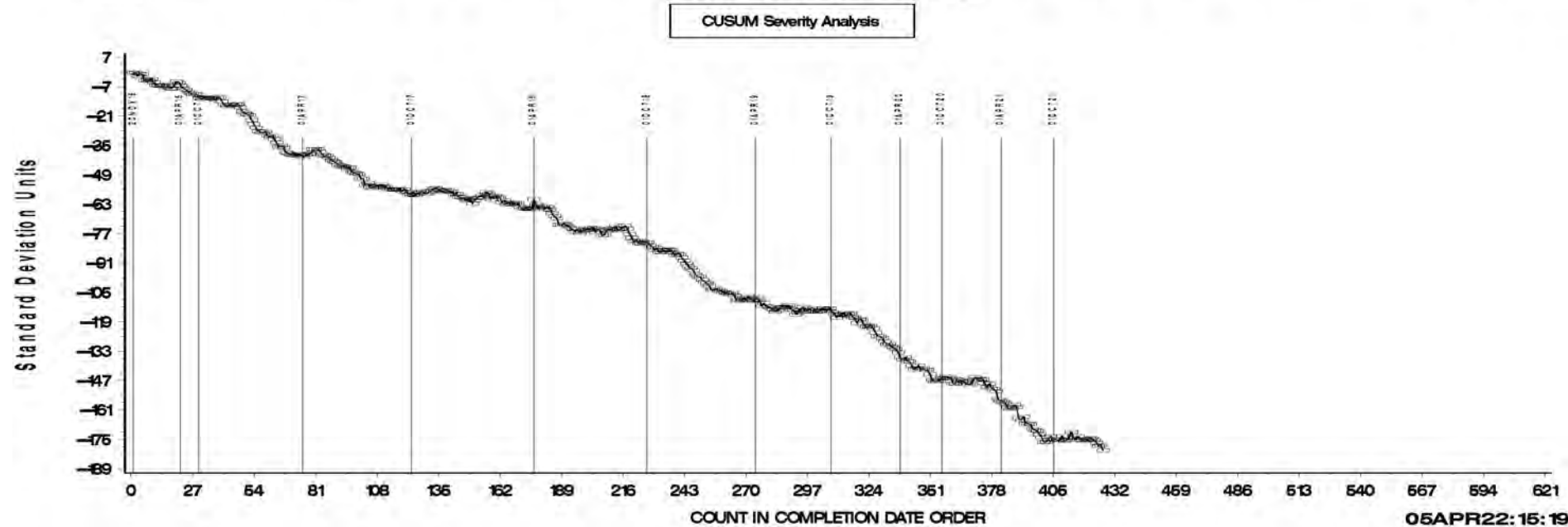
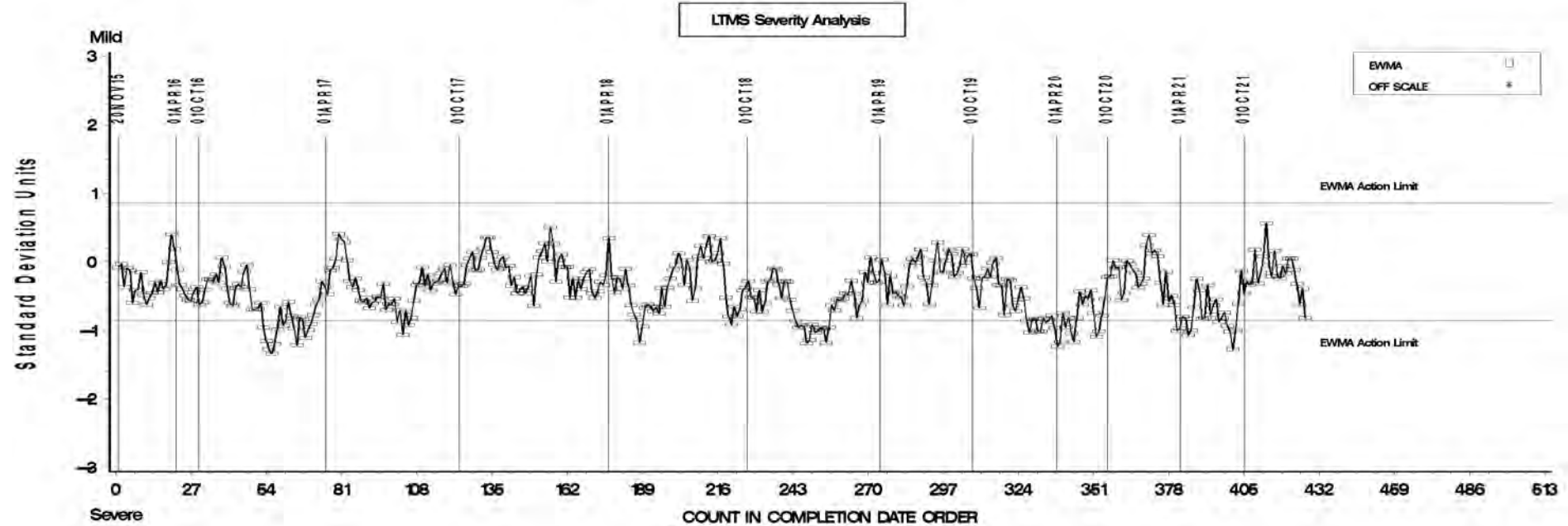
| Test Status | Cause | # |
|---------------|--------------|----------|
| Invalid | Dyno Failure | 1 |
| Totals | | 1 |

*Invalid and aborted tests

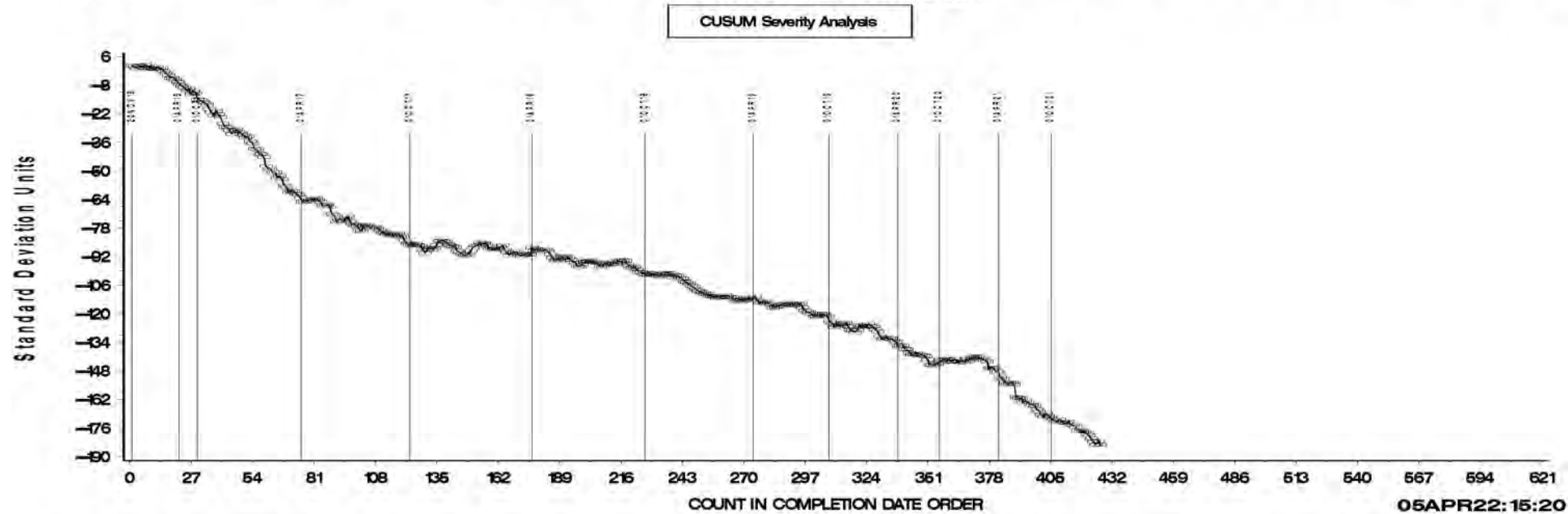
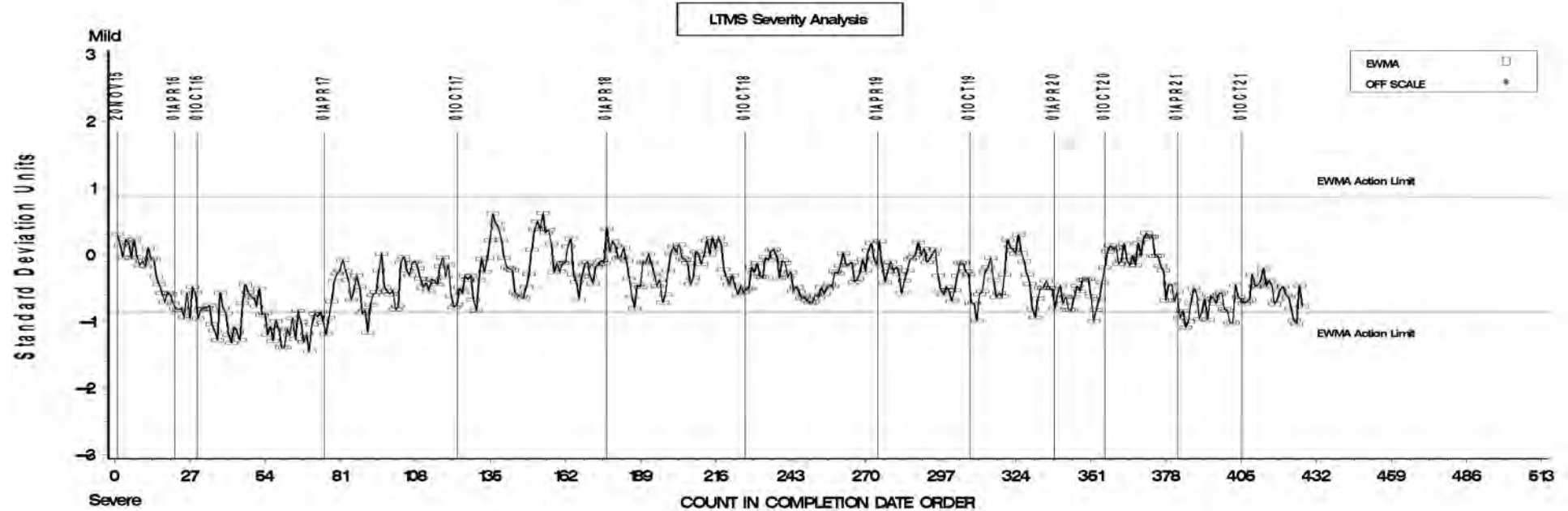
Sequence VIE Test Severity

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

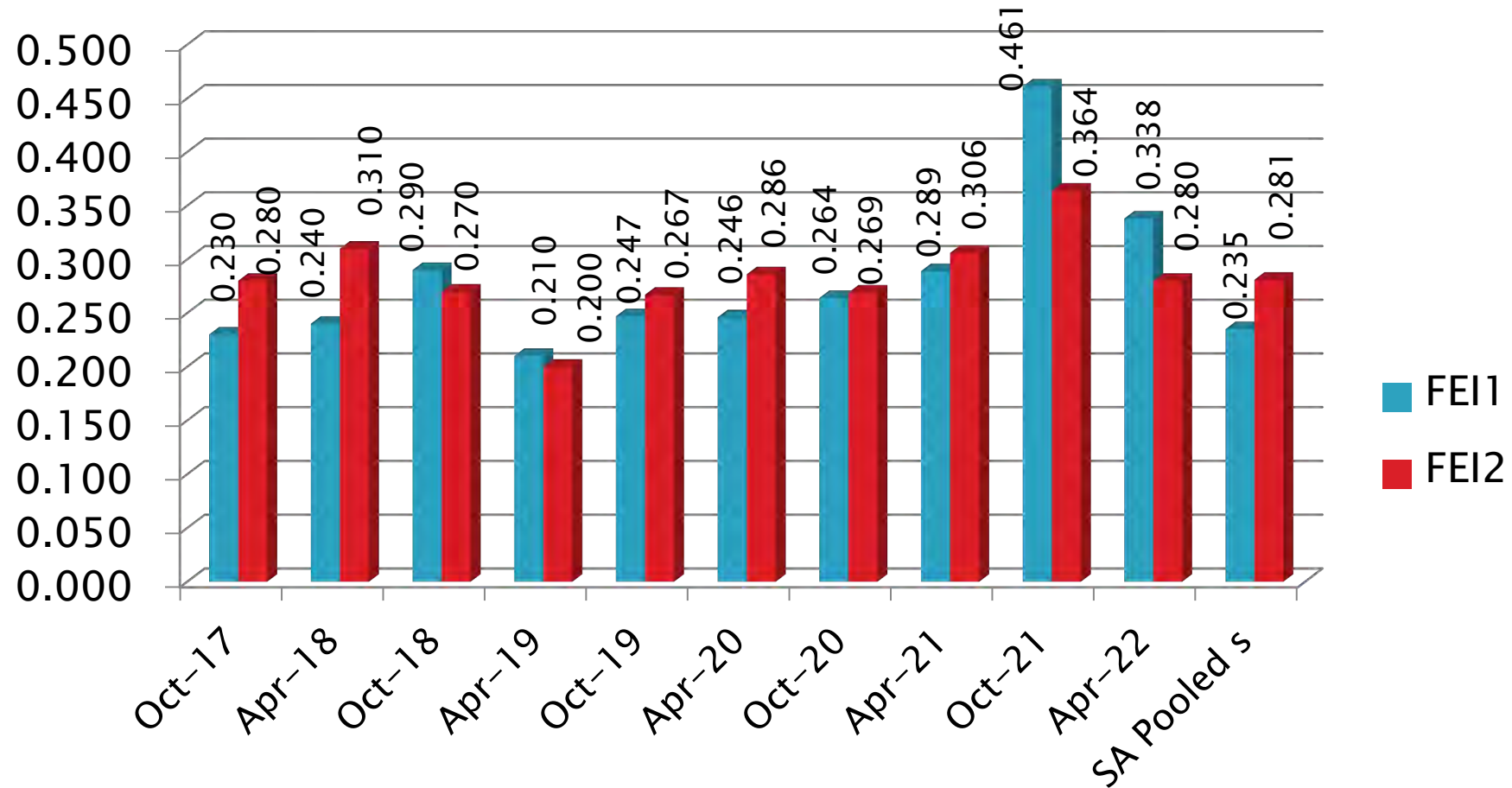
FEI FINAL RESULT PHASE I



FEI FINAL RESULT PHASE II



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 | 18 |
| Failed Statistically | OC | 3 |
| Total | | 21 |

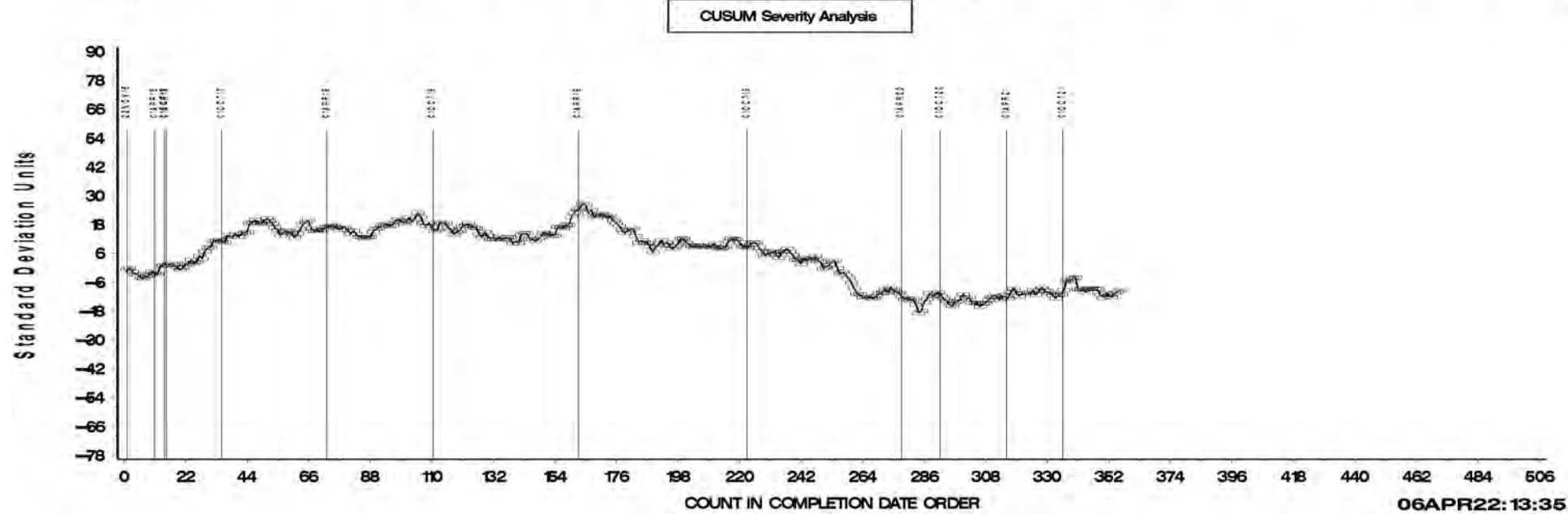
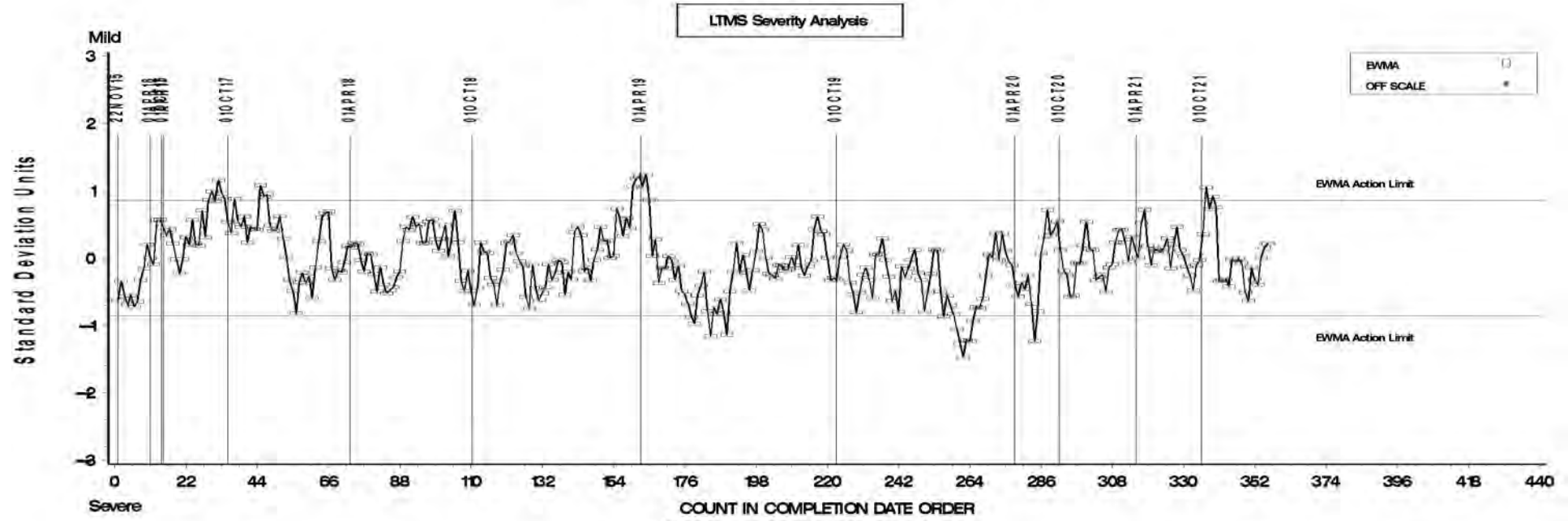
Sequence VIF – Failed Tests

| Test Status | Number of Tests |
|--------------|-----------------|
| Severe FEI1 | 1 |
| Mild FEI1 | 1 |
| Severe FEI2 | 1 |
| Total | 3 |

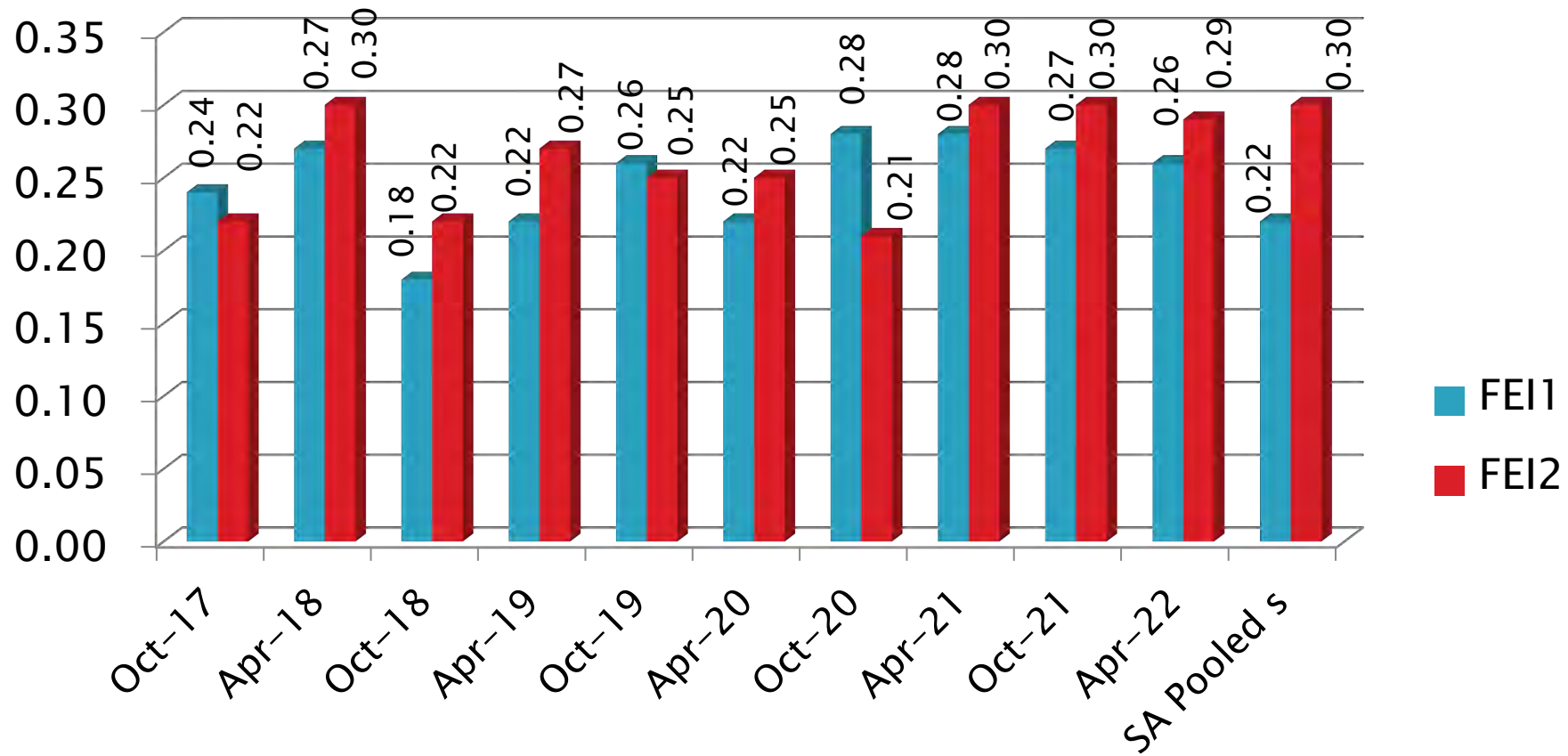
Sequence VIF Test Severity

- FEI1 is in control
- FEI2 is in control

FEI FINAL RESULT PHASE I



Sequence VIF Precision Estimates



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Sequence VIII

➤➤ April 2022

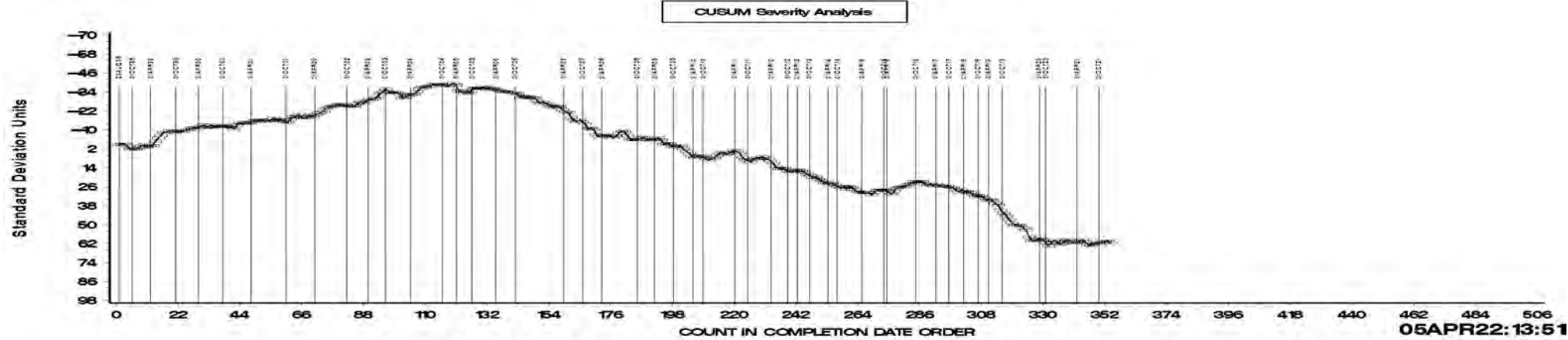
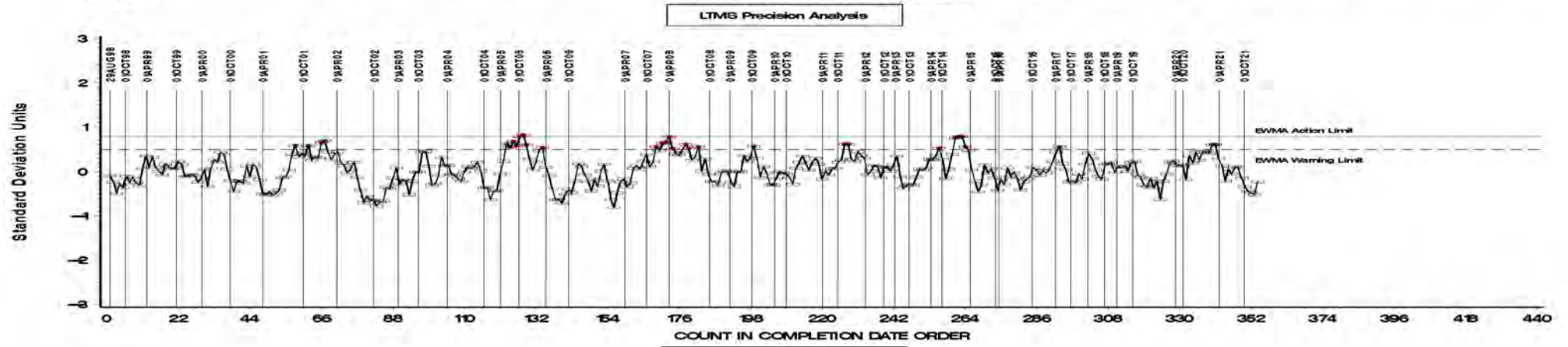
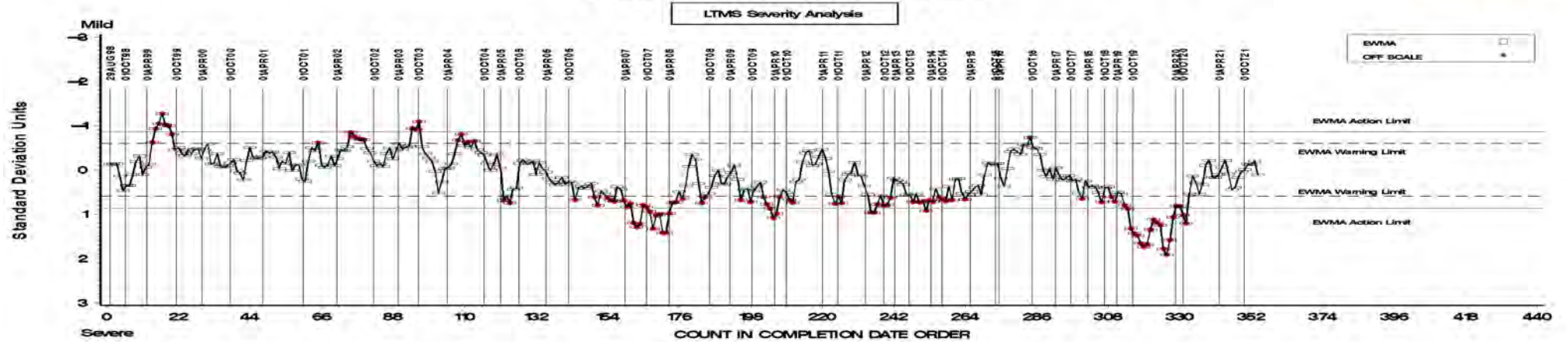
Sequence VIII Activity

| Test Status | Validity Code | # |
|-----------------------------|---------------|---|
| Acceptable Calibration Test | AC | 5 |
| Total | | 5 |

Sequence VIII Test Severity

- Both parameters are in control

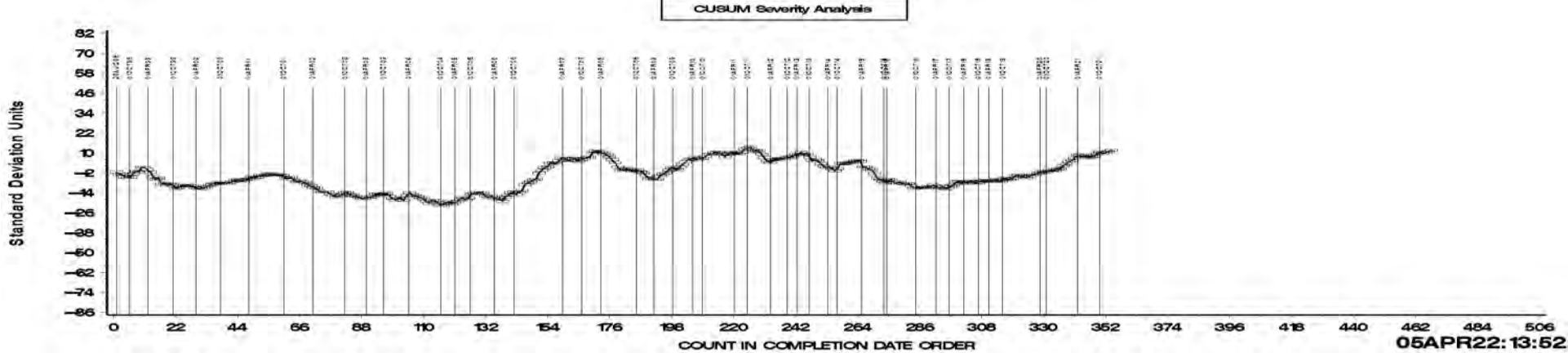
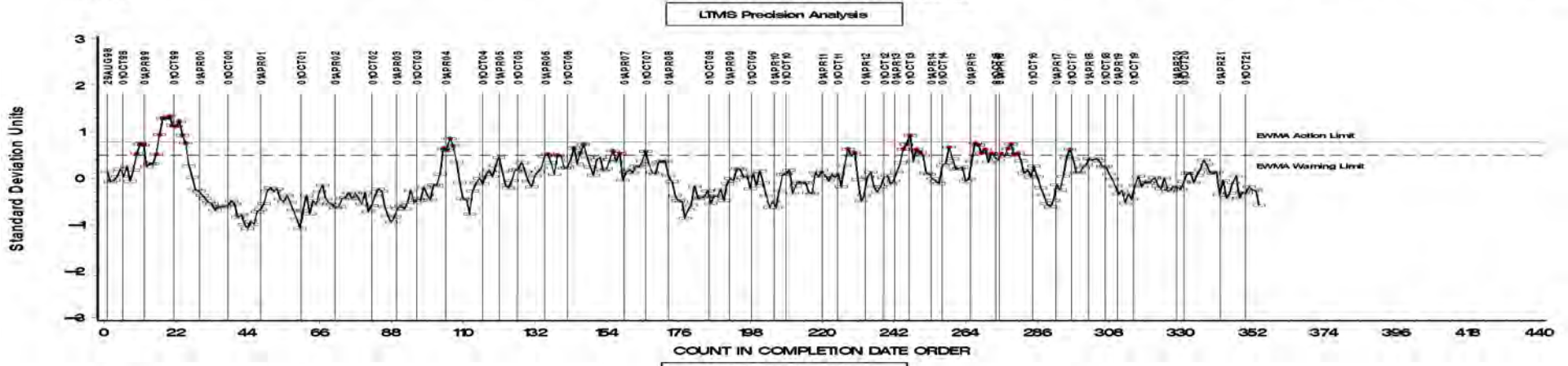
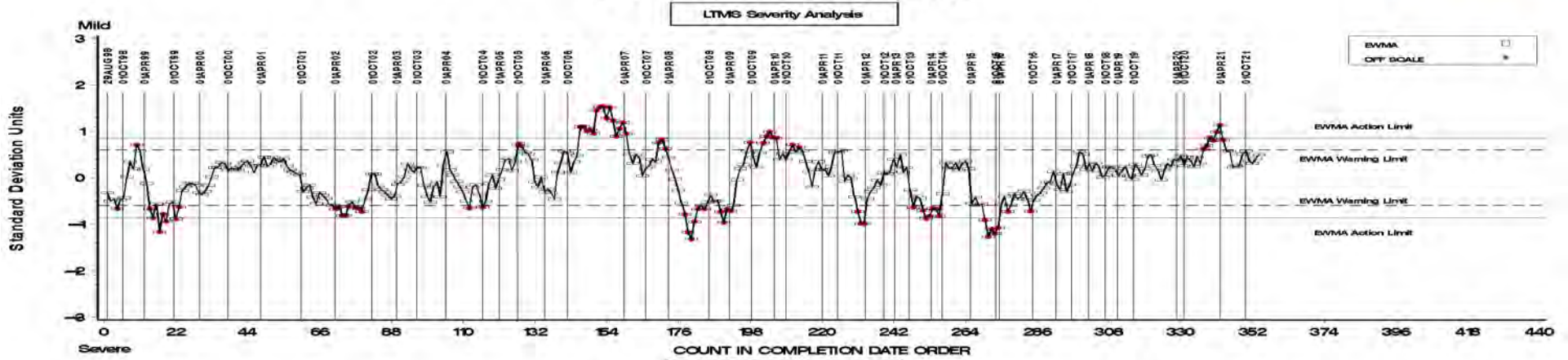
FINAL BEARING WEIGHT LOSS



SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

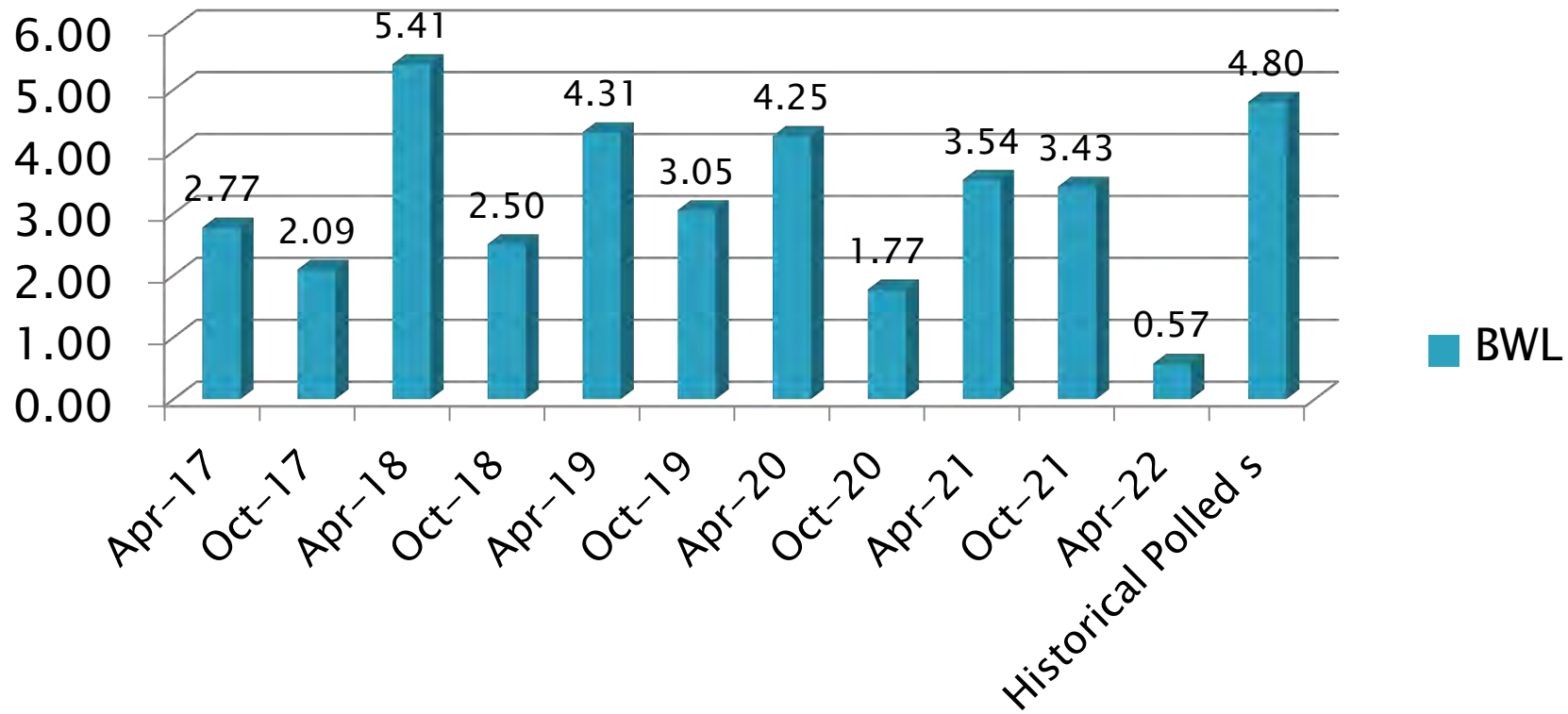


STRIPPED VIS. @ 100 DEG C



Sequence VIII Precision Estimates

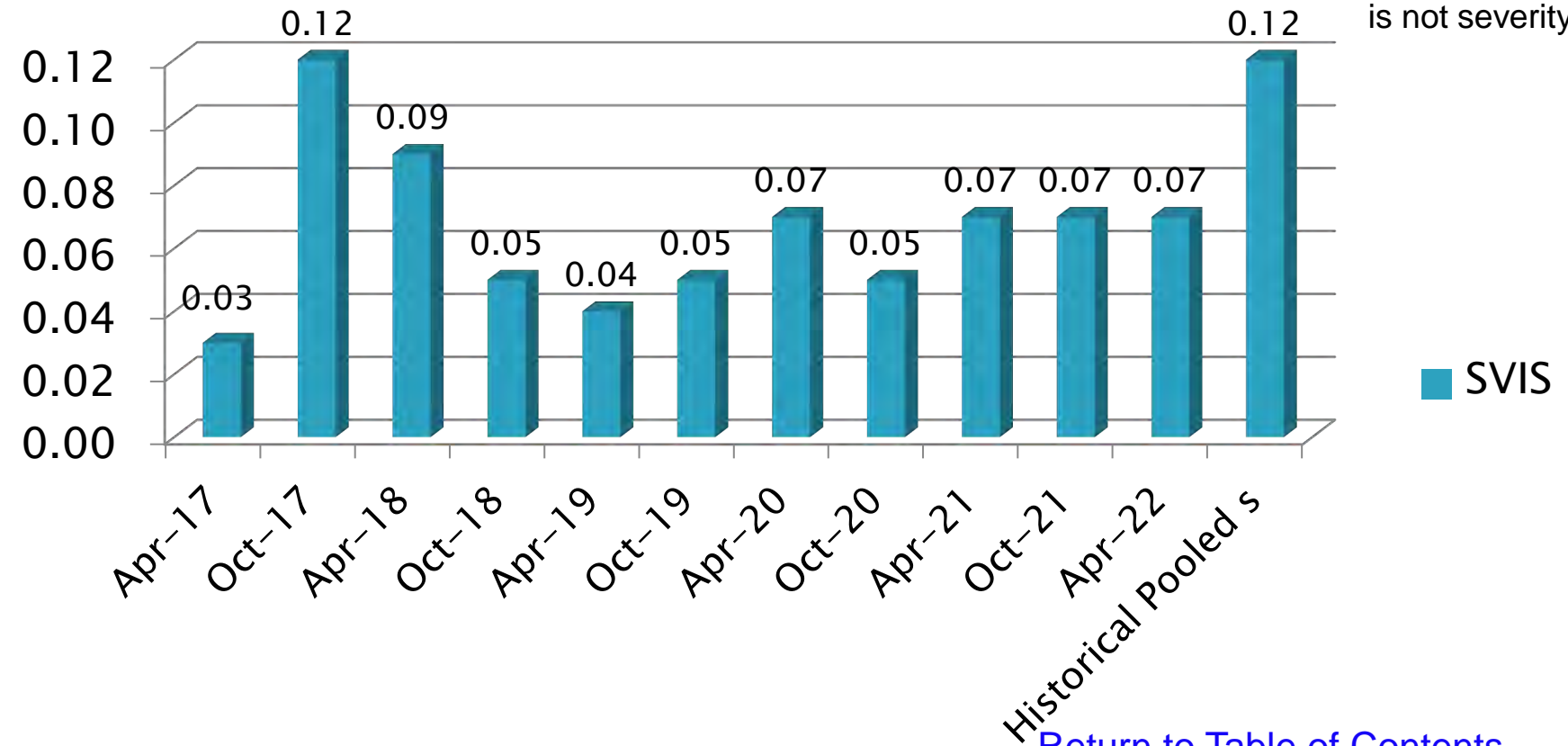
BWL



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 | 27 |
| Statistically Unacceptable Calibration Test | OC | 8 |
| Operationally Invalid Calibration Test, lab determination | LC | 2 |
| Aborted Calibration Test | XC | 1 |
| Not for Industry Statistics Test, Alternate Fuel | NN | 2 |
| Not for Industry Statistics Test, Modified BC2 Pistons | NN | 2 |
| Total | | 42 |

Sequence IX – Failed Tests

| Test Status | Number of Tests |
|-------------------------------------|-----------------|
| Ei Level 3 alarm (mild direction) | 6 |
| Ei Level 3 alarm (severe direction) | 2 |
| Total | |

Sequence IX – Lost Tests*

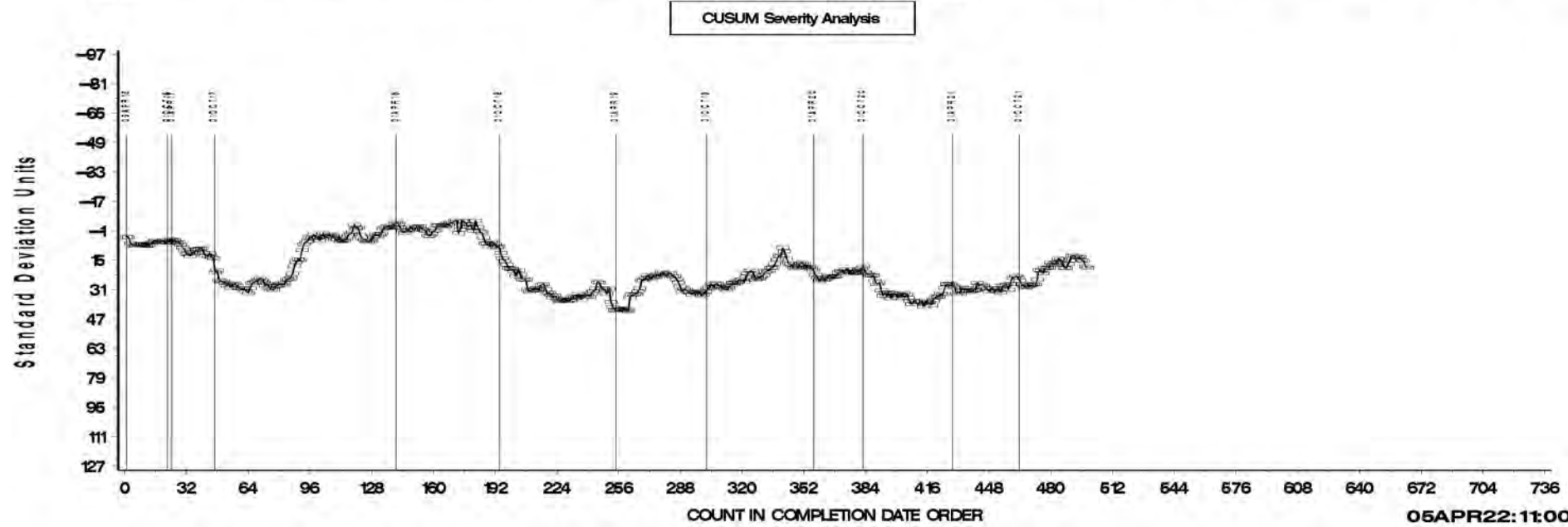
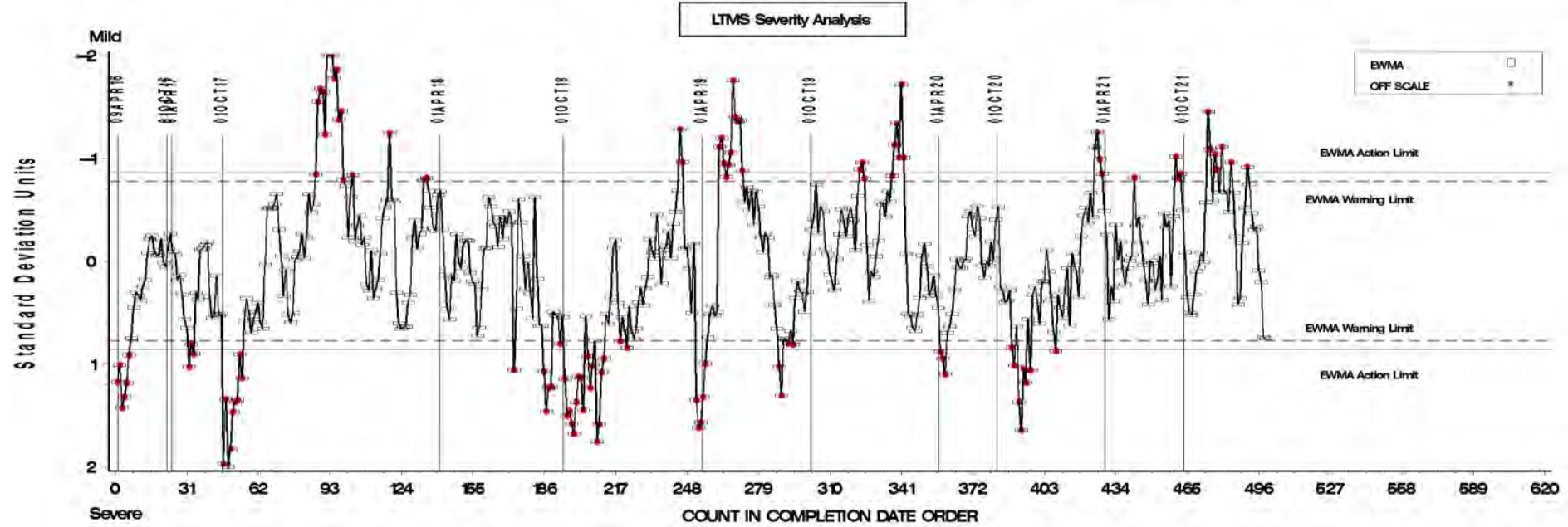
| Test Status | Cause | # |
|---------------|--|----------|
| Terminated | Exceeded down time limit | 1 |
| Invalid | Exceeded down time limit | 1 |
| Invalid | Negative QI, Fuel Temperature Iterations C and D | 1 |
| Totals | | 3 |

*Invalid and aborted tests

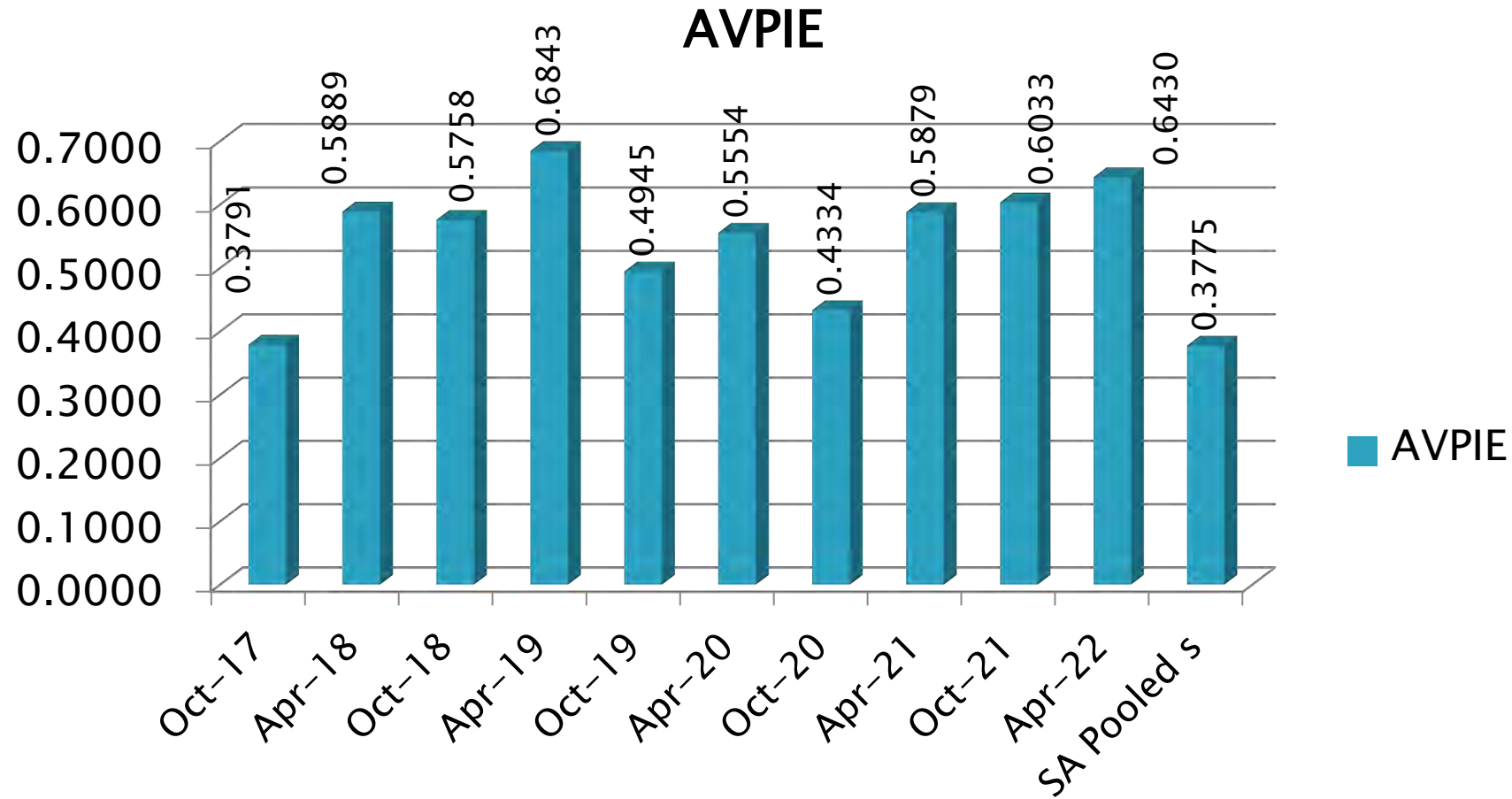
Sequence IX Test Severity

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

AVERAGE NUMBER OF PREIGNITIONS FROM VALID ITERATIONS



Sequence IX Precision Estimates



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Sequence X



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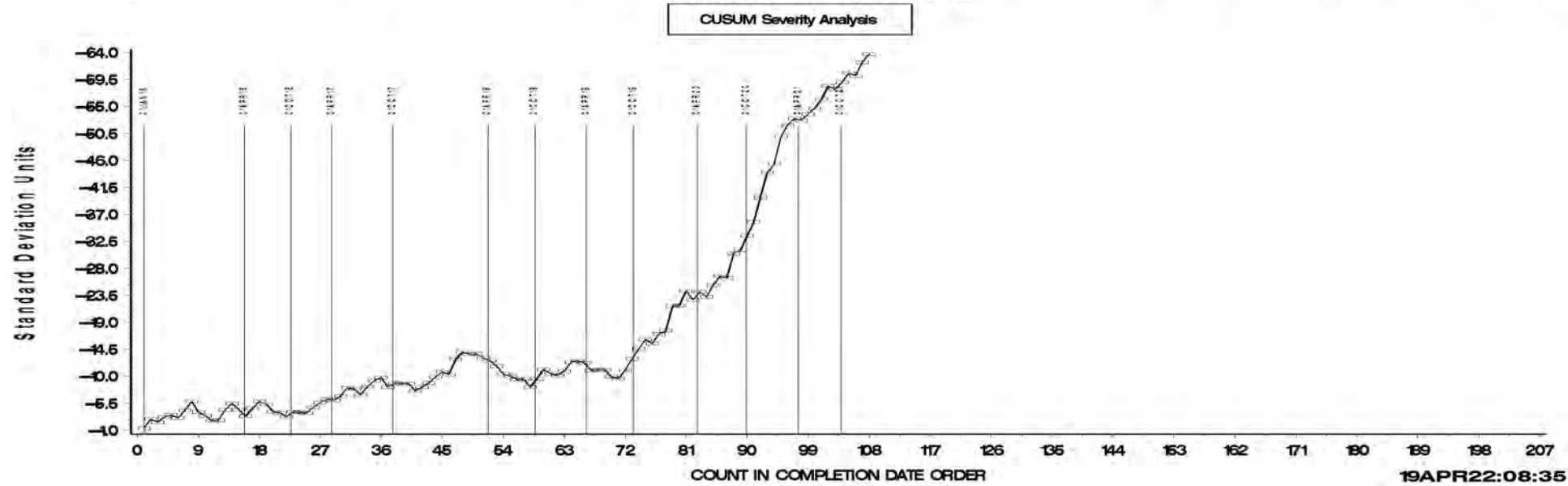
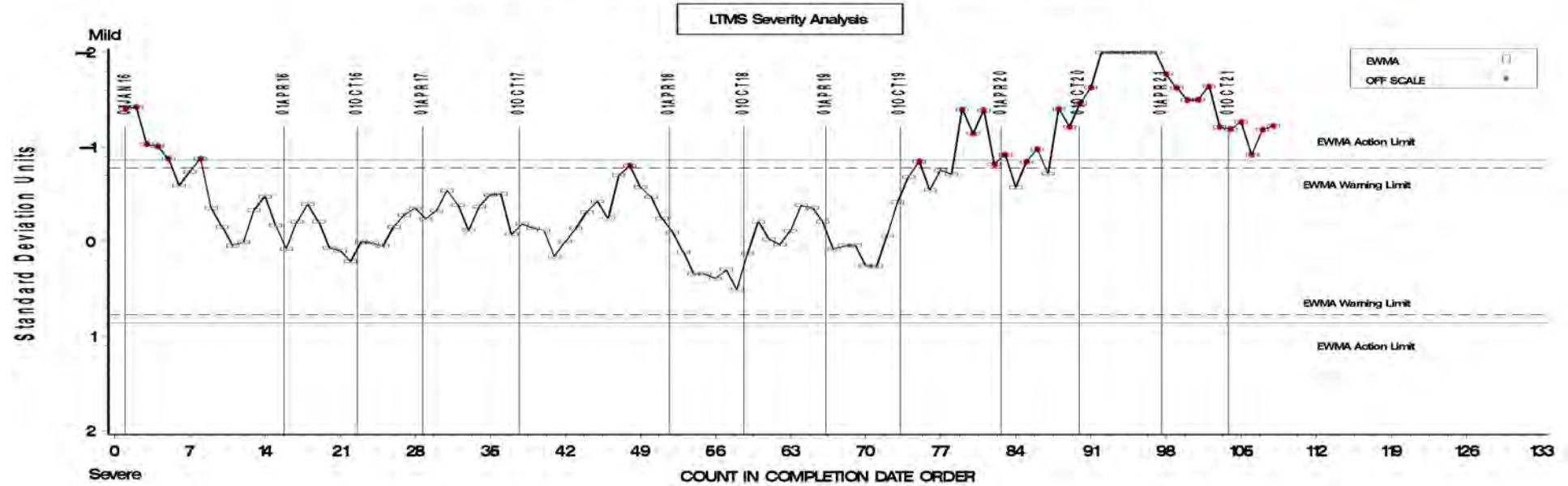
Sequence X Activity

| Test Status | Validity Code | # |
|---|---------------|----------|
| Acceptable Calibration Test | AC | 4 |
| Not for Industry Statistics Test (shakedown tests to evaluate severity changes) | NN | 3 |
| Total Number of Tests | | 7 |

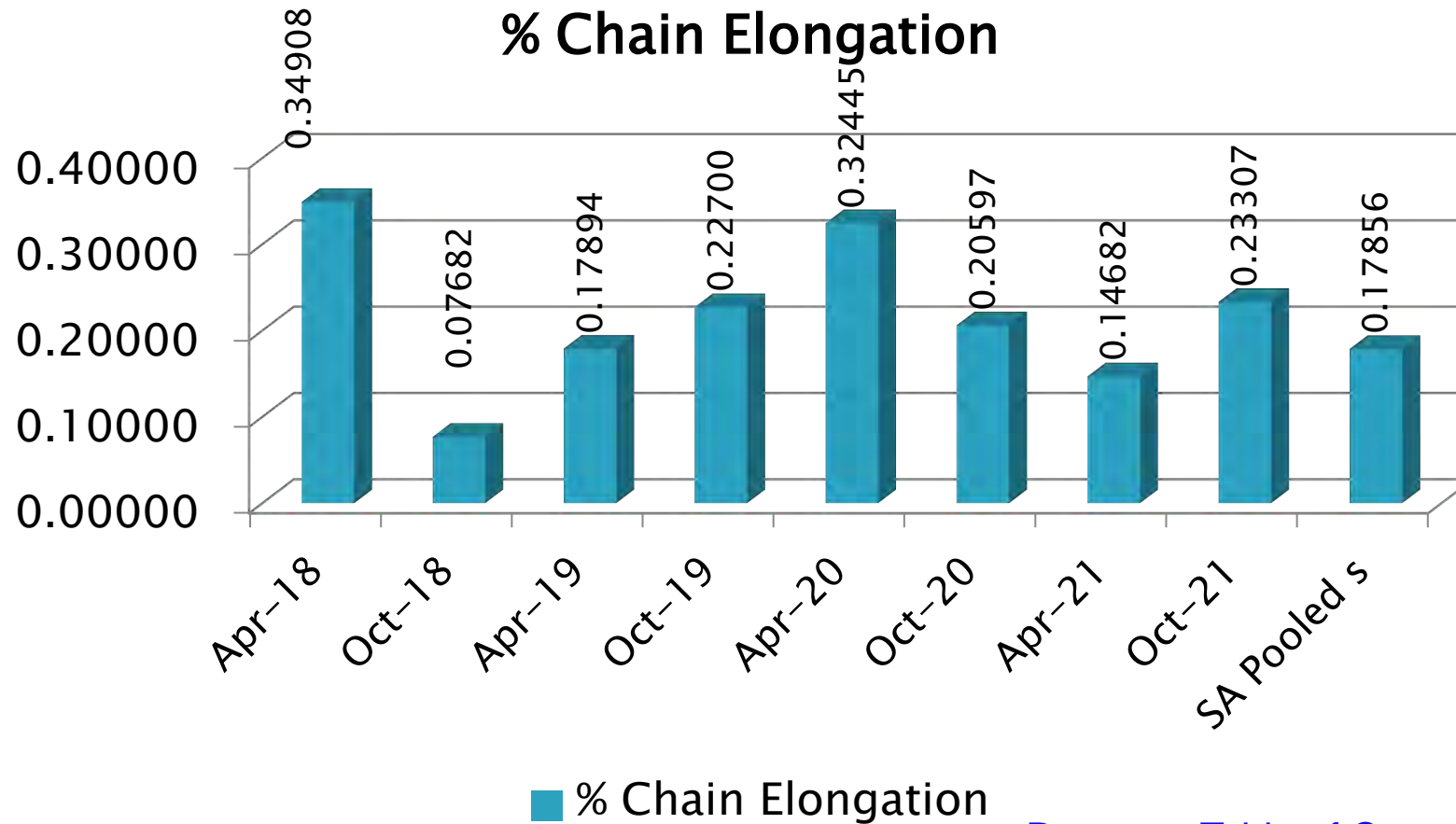
Sequence X Test Severity

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

END OF TEST CHAIN WEAR FINAL RESULT



Sequence X Precision Estimates



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Information Letters



April 2022

Information Letters*

| Test | Date | IL | Topic |
|------|----------|------|--|
| IIIH | 20220307 | 22-1 | Replacement of ShellZone with products meeting the DEX-COOL specification |
| IVB | 20220310 | 22-1 | Added oil consumption limit. |
| VH | 20220307 | 21-2 | Removed requirement for RVP to meet fuel specification when performing quarterly analysis of fuel in laboratory tanks. |
| VIII | 20211206 | 21-2 | Replaced stay in grade procedure in Annex A17 which had been deleted in error from test method |

*Available from TMC Website

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



Reference Oil Inventory



Actions, Re-blends, Inventories
and Estimated Life

Reference Oil Re-blends

➤ TMC 220, 224 and 1010-1

- Reblends are in process for reference oils 220, 224 and 1010-1.

➤ TMC 704-1

- The supplier has been contacted and this oil can not be reblended. The panel will need to search for a replacement.

➤ VIEBL and FO6

- A new batch of VIEBL and FO6 has been blended and shipped to the labs. Verification test needs to be completed for approval of VIEBL6.

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 | 76 | 40 | ~1 year |
| 221 | IX | 2120 | 125 | 313 | 85 | 2.5 years |
| 222* | IX | 1040 | 60 | 0 | 35 | <1 year |
| 224 | IX | 1026 | 88 | 67 | 85 | ~1 year |
| 270 | X | 1100 | 10 | 670 | 45 | 5 years |
| 271 | X | 980 | 9 | 680 | 35 | 5 years |
| 300-1 | IVB | 378 | 0 | 237 | 20 | 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 | 12.5 | 673 | 20 | 5+ years |
| 436 | IIIH | 1100 | 10 | 604 | 25 | 5+ years |
| 438-1 | IIIH | 605 | 0 | 0 | 2.5 | <1 year |
| 438-2 | IIIH | 540 | 7.5 | 414 | 22.5 | 5 years |
| 542-3 | VIE/VIF | 997 | 0 | 5 | 18 | <1 Year |
| 542-4 | VIE/VIF | 1100 | 83 | 49 | 114 | <1 Year |
| 543 | VIF | 1100 | 39 | 80 | 96 | ~1 Year |
| 544 | VIE | 897 | 15 | 186 | 48 | 3+ 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 | 4 | 13.5 | 20 | 1.5 years |
| 931 | VH | 908 | 0 | 826 | 27 | 5+ years |
| 940 | VH | 560 | 3 | 50 | 18 | 1.5 years |
| 1006-2 | IVA | 5500 | 24 | 182 | 15 | 4 years |
| 1010-1 | VIE | 1760 | 30 | 36 | 84 | ~1 year |
| 1011 | IVB/VH/VIF/X | 1100 | 0 | 0 | 39 | Depleted |
| 1011-1 | IVB/VH/VIF/X | 1395 | 81 | 1111 | 102 | 5+ years |
| 1012 | IVB | 2200 | 22 | 1340 | 55 | 5+ years |

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LTMS Deviations



October 1, 2021 – March 31, 2022

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, 2021 – March 31, 2022

Quality Index Deviations

- One deviation this period, a VH Deviation for speed due to a damaged intake air tube.

Quality Index Deviations

Historical Count of PCEO Quality Index Deviations

| Test | Quality Index Deviations |
|------|--------------------------|
| IIIH | 8 |
| IVA | 32 |
| IVB | 2 |
| VH | 9 |
| IX | 1 |
| X | 2 |

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TMC Laboratory Visits

➤➤ October 1, 2021 – March 31, 2022

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TMC Lab Visits

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

Lab Visit Issues

Sequence IVB–Coolant in thermocouple not at proper insertion depth.

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Test Area Timelines

➤➤ October 1, 2021 – March 31, 2022

Test Area Timeline Additions*

| Test | Date | Topic | IL |
|------|----------|--|------|
| IIIH | 20220307 | Replacement of ShellZone with products meeting the DEX-COOL spec. | 22-1 |
| IVB | 20211125 | First occurrence of Reference Oil 1011-1 | |
| IVB | 20220310 | Added oil consumption limit. | 22-1 |
| VH | 20220104 | First occurrence of Reference Oil 1011-1 | |
| VH | 20220307 | Removed requirement for RVP to meet fuel specification when performing quarterly analysis of fuel in laboratory tanks. | 22-1 |
| VIII | 20211206 | Replaced stay in grade procedure in Annex A17 which had been deleted in error from test method | 21-2 |

*As of 03/31/2021

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Rating Workshop Data

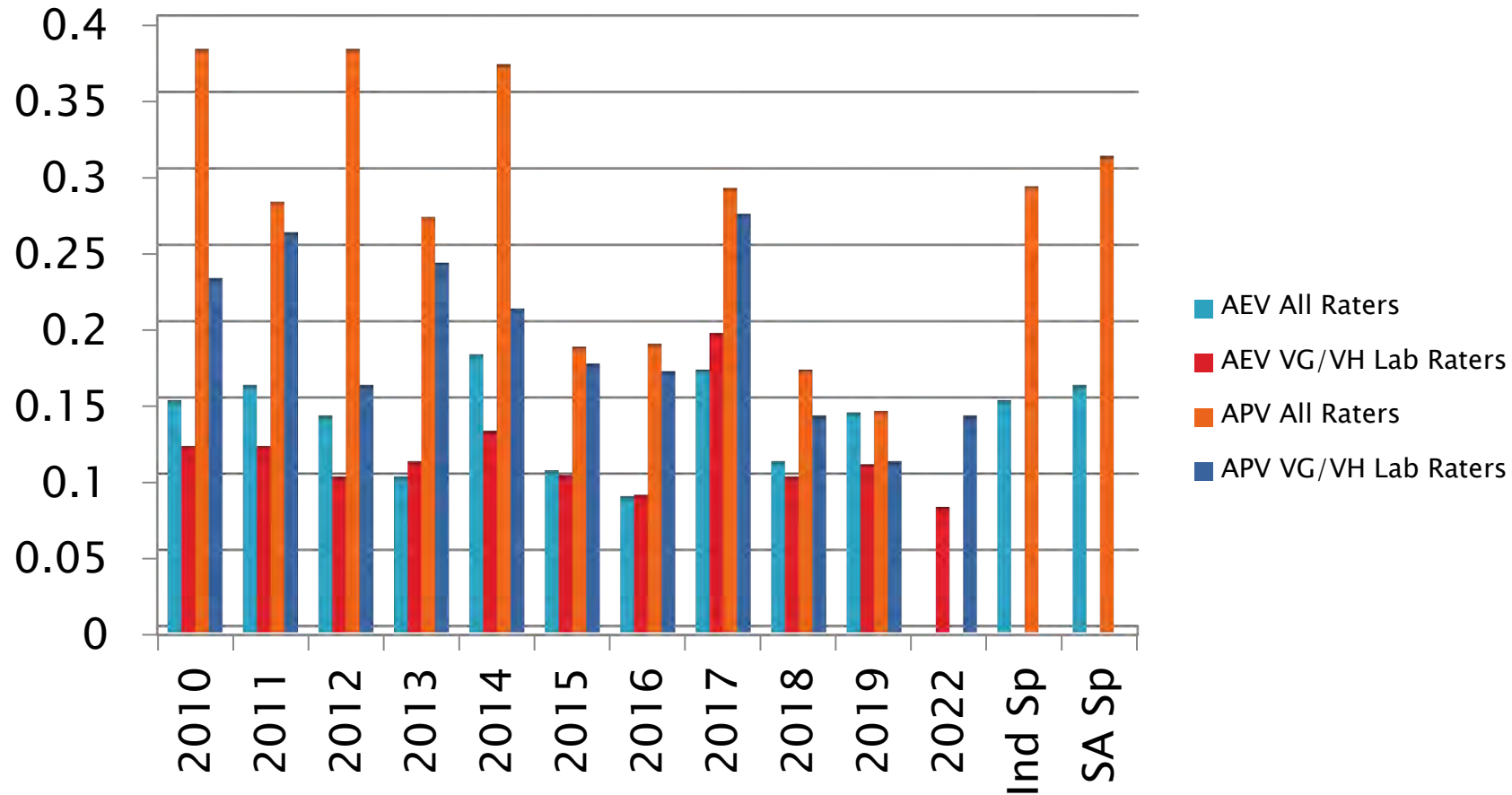
➤➤ 2022 Light Duty Workshop

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

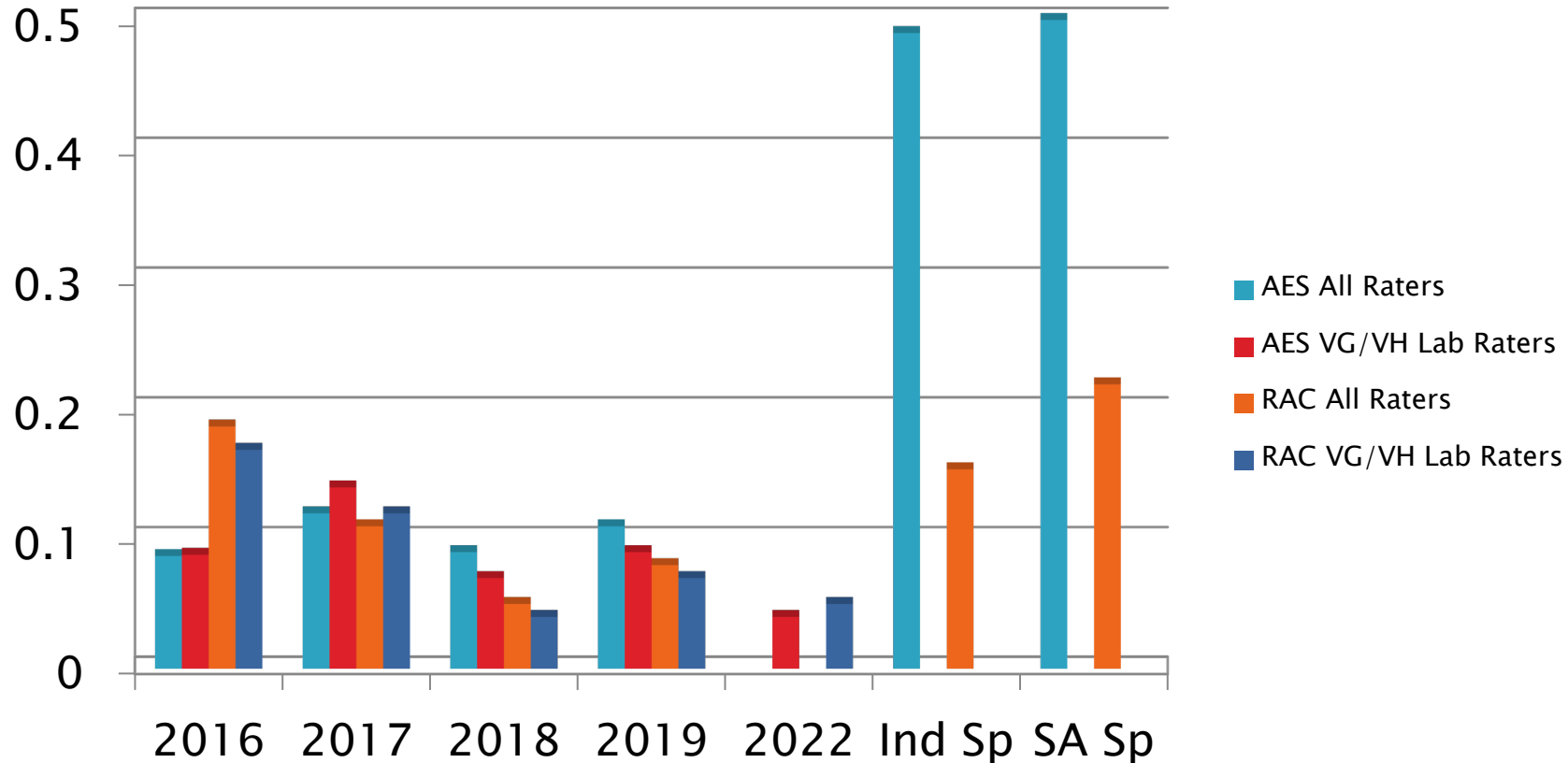
Sequence VG/VH Precision-Rating Workshop Data

Workshop Data for VG/VH Varnish



Sequence VH Precision-Rating Workshop Data

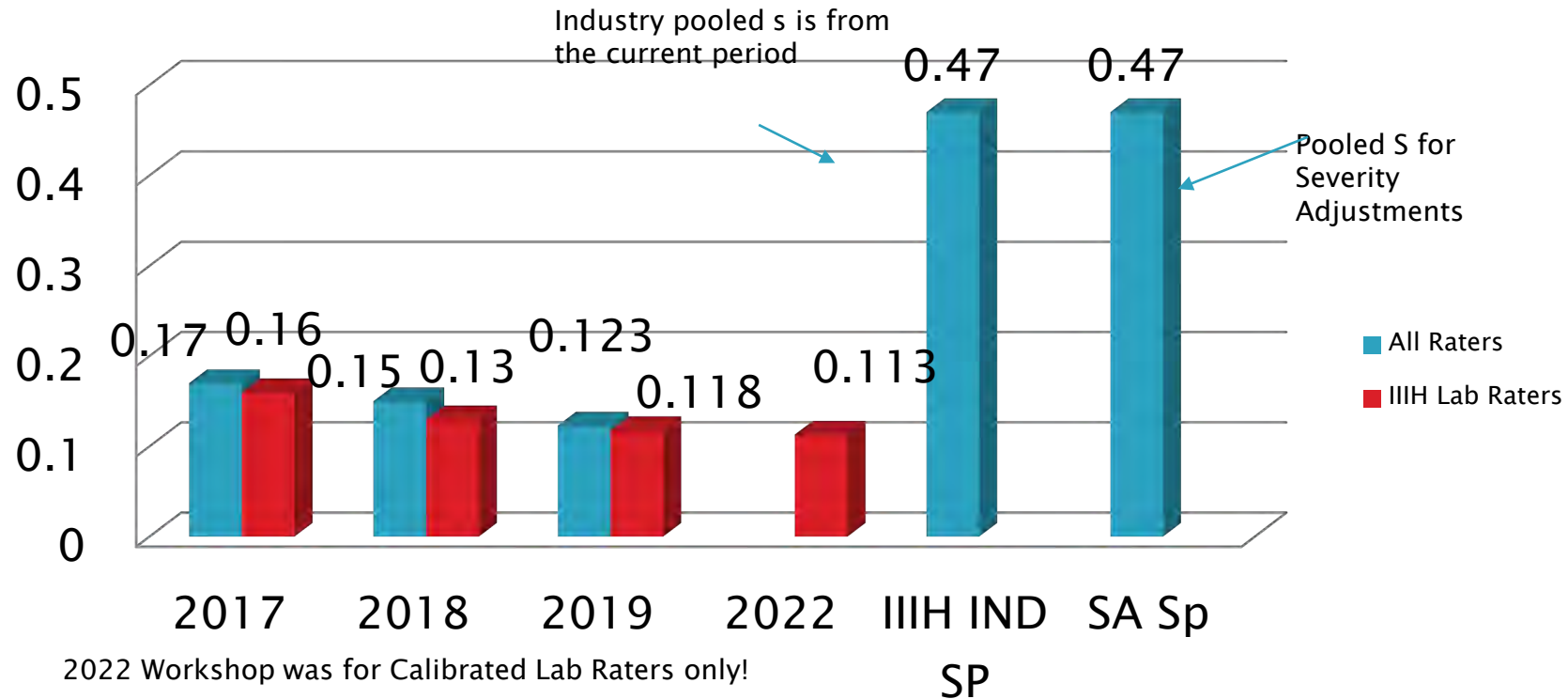
Workshop Data for VH Sludge



Sludge parameters were added for rater calibration in 2019
2022 Workshop was for Calibrated Lab Raters only!

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

- ▶ <https://www.astmtmc.org>

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