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ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing

October 2019

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Passenger Car Engine Oil Testing Executive Summary

- Seq. IVB
  - Monitoring of the Fe wear parameter began this period.
- Seq. IIIF, IIIG and VG
  - Surveillance Panels agreed to no longer monitor these tests
- Seq. IIIH
  - Batch Code 7 rings being introduced.
- Seq. IX
  - Labs are beginning to run out of Grade BB pistons.

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Calibrated Labs and Stands*

Test	Labs	Stands
IIIH/A/B	5	17
IVA	2	3
IVB	4	8
VH	4	11
VIE	4	14
VIF	3	10
VIII	2	3
IX	3	6
X	3	7

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*As of 9/30/2019

Sequence IIIH/A/B

- October 2019

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Sequence IIIH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	22
Statistically Unacceptable Calibration Test	OC	4
Total		**26**

Sequence IIIH – Failed Tests

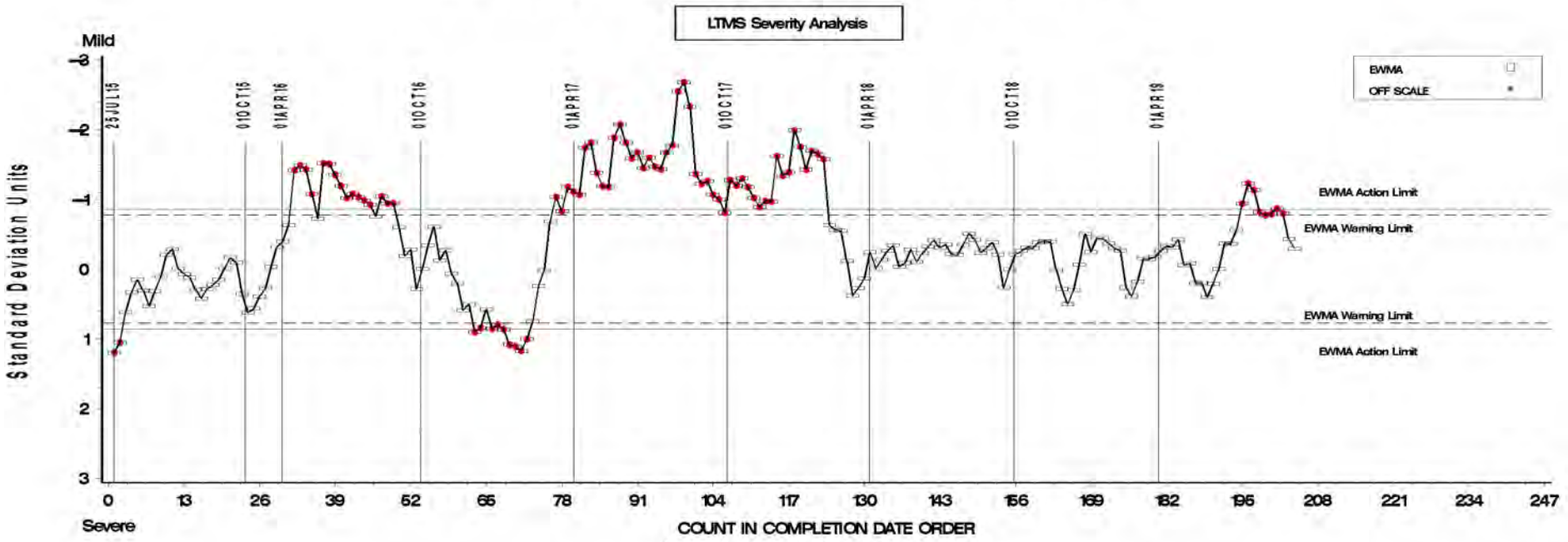
Test Status	#
Level 3 Ei Alarm PVIS	4
Totals	**4**

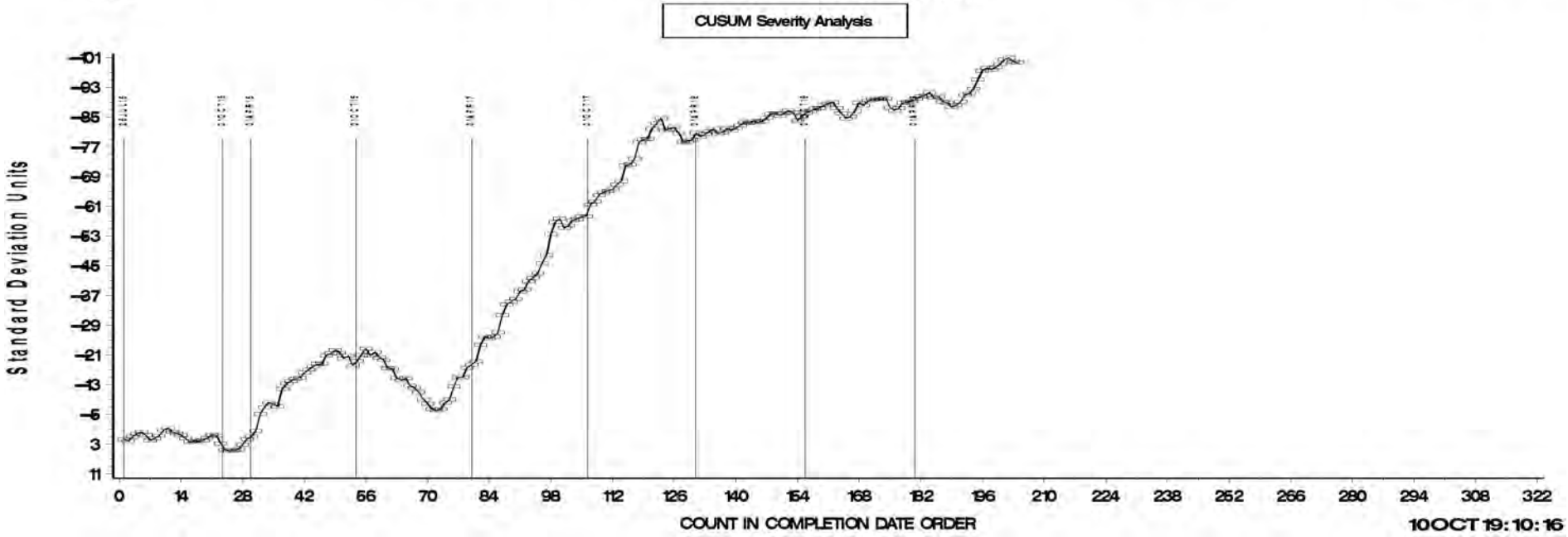
Sequence IIIH Test Severity

- All parameters are in control

SEQUENCE IIIH INDUSTRY OPERATIONALLY VALID DATA

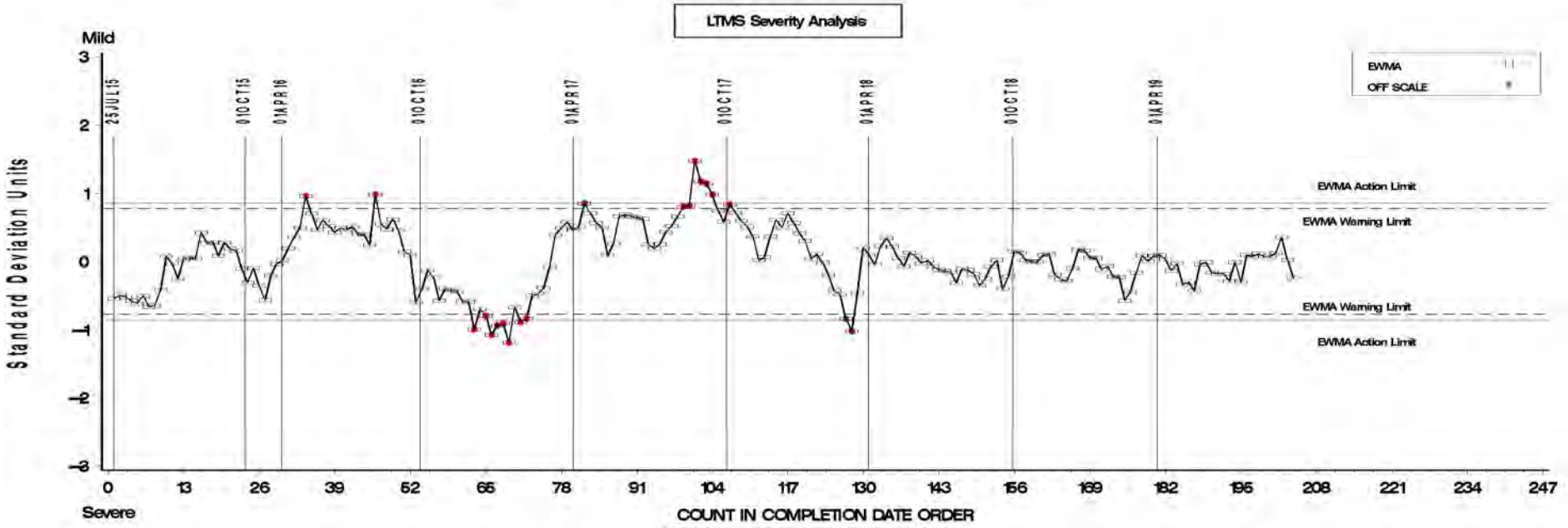
VISCOSITY INCREASE FINAL ORIG UNIT RES

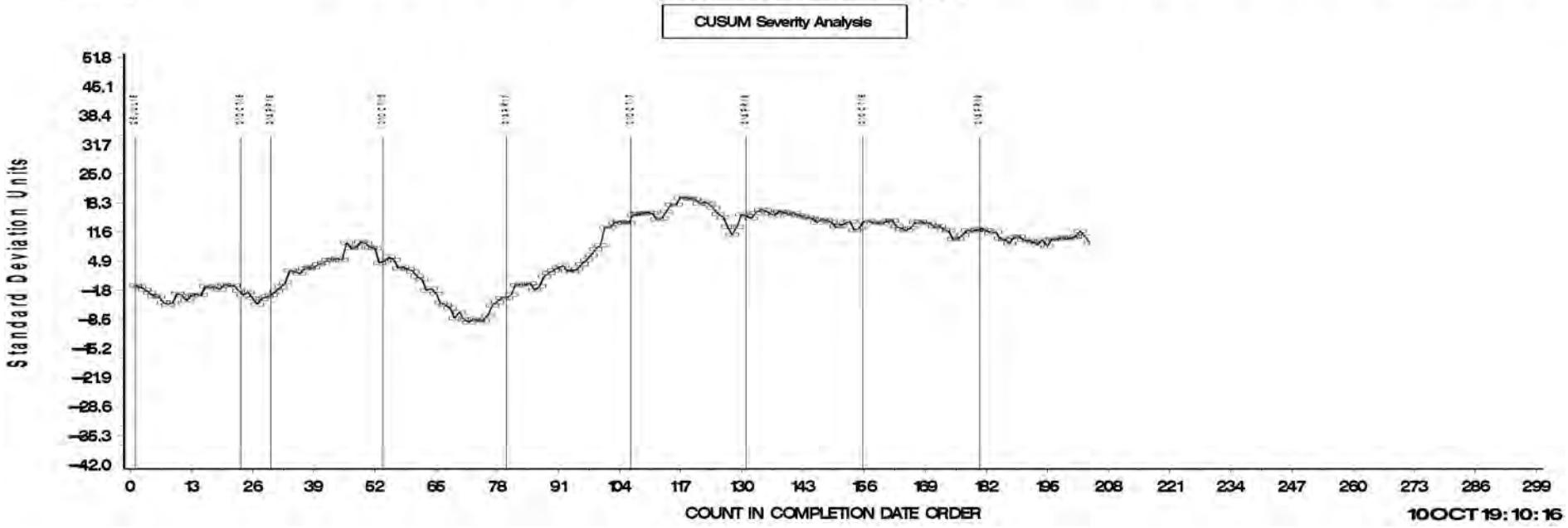




SEQUENCE IIIH INDUSTRY OPERATIONALLY VALID DATA

AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG U





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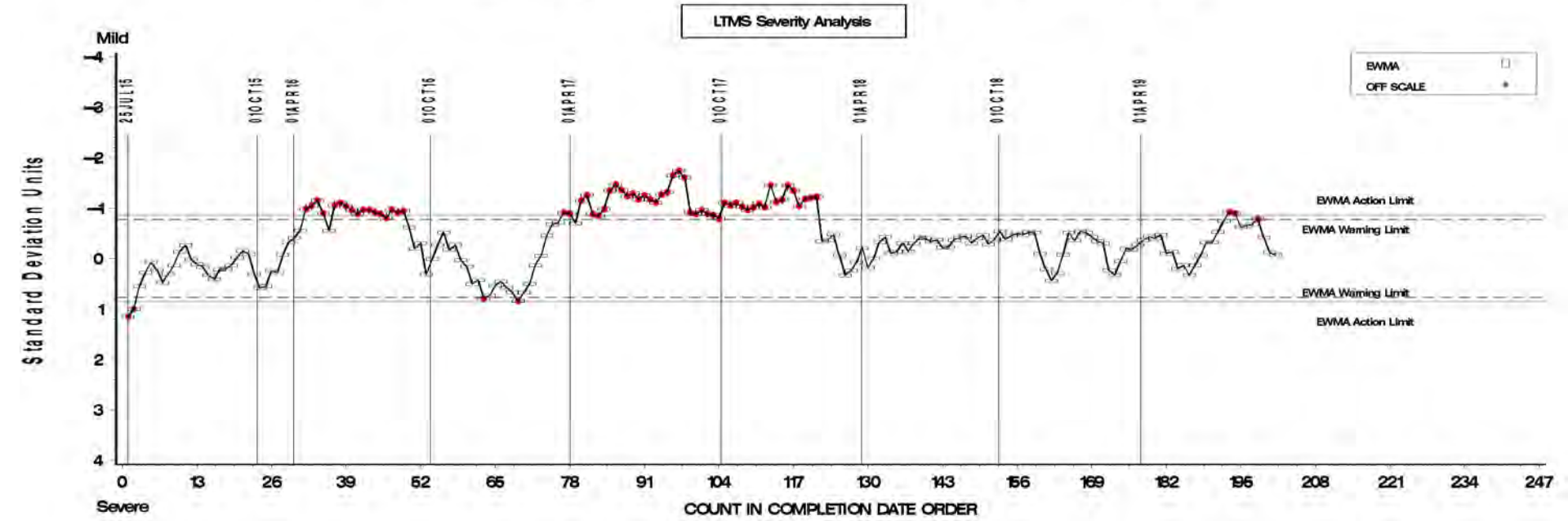
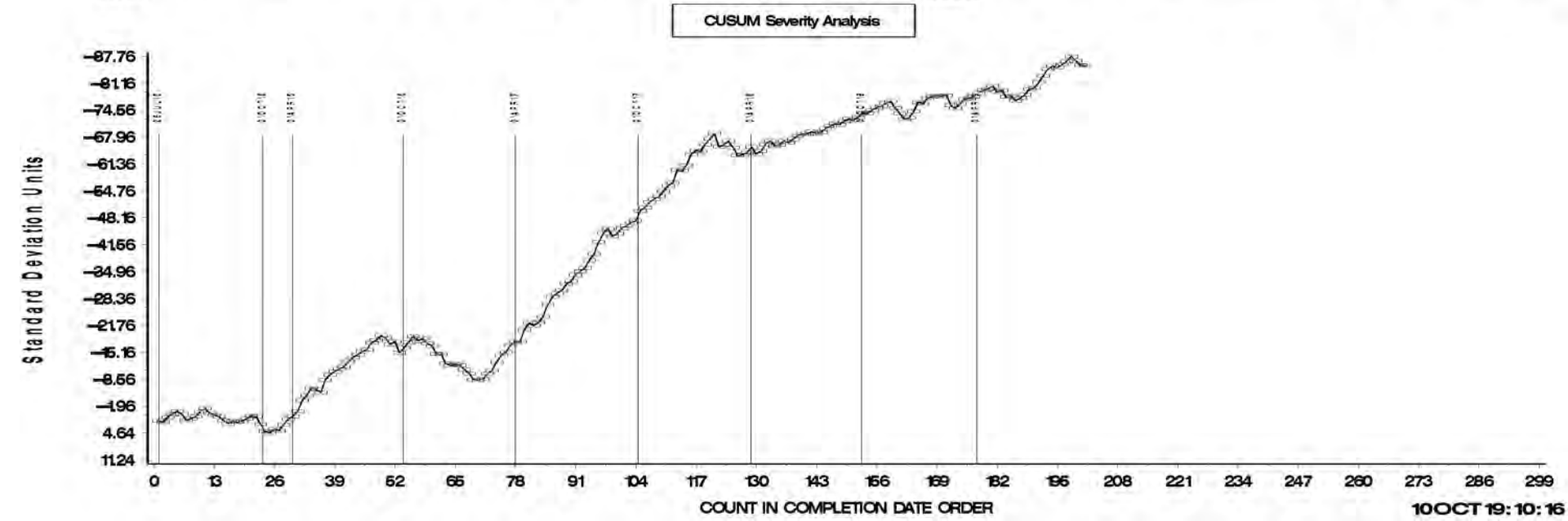
SEQUENCE IIIHA INDUSTRY OPERATIONALLY VALID DATA

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





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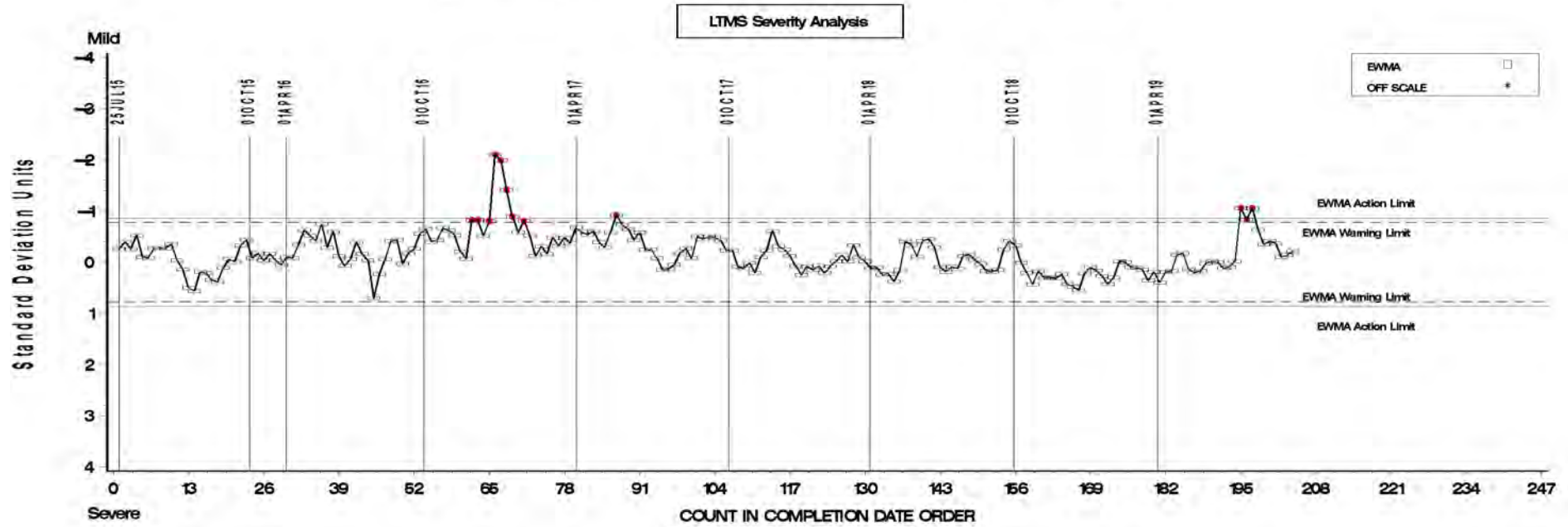
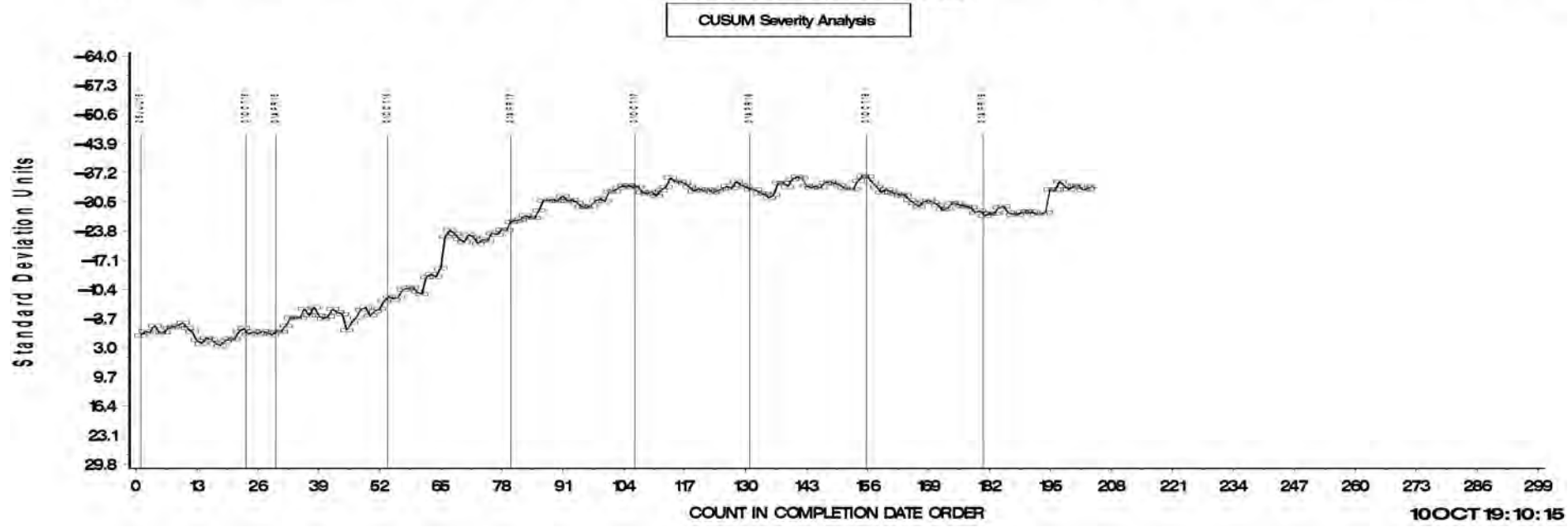
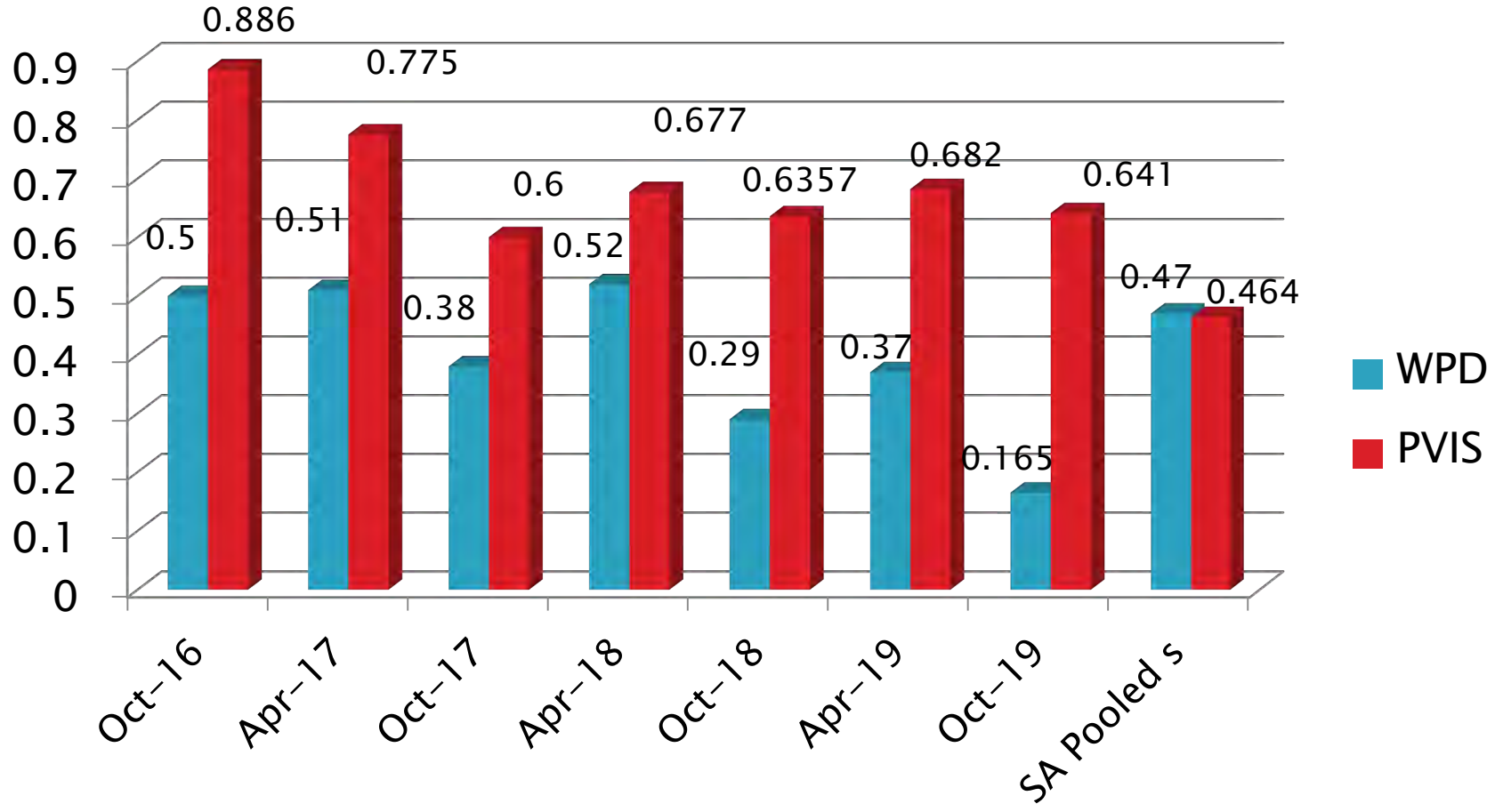
SEQUENCE IIIHB INDUSTRY OPERATIONALLY VALID DATA

PHOSPHORUS RETENTION, FINAL RESULT

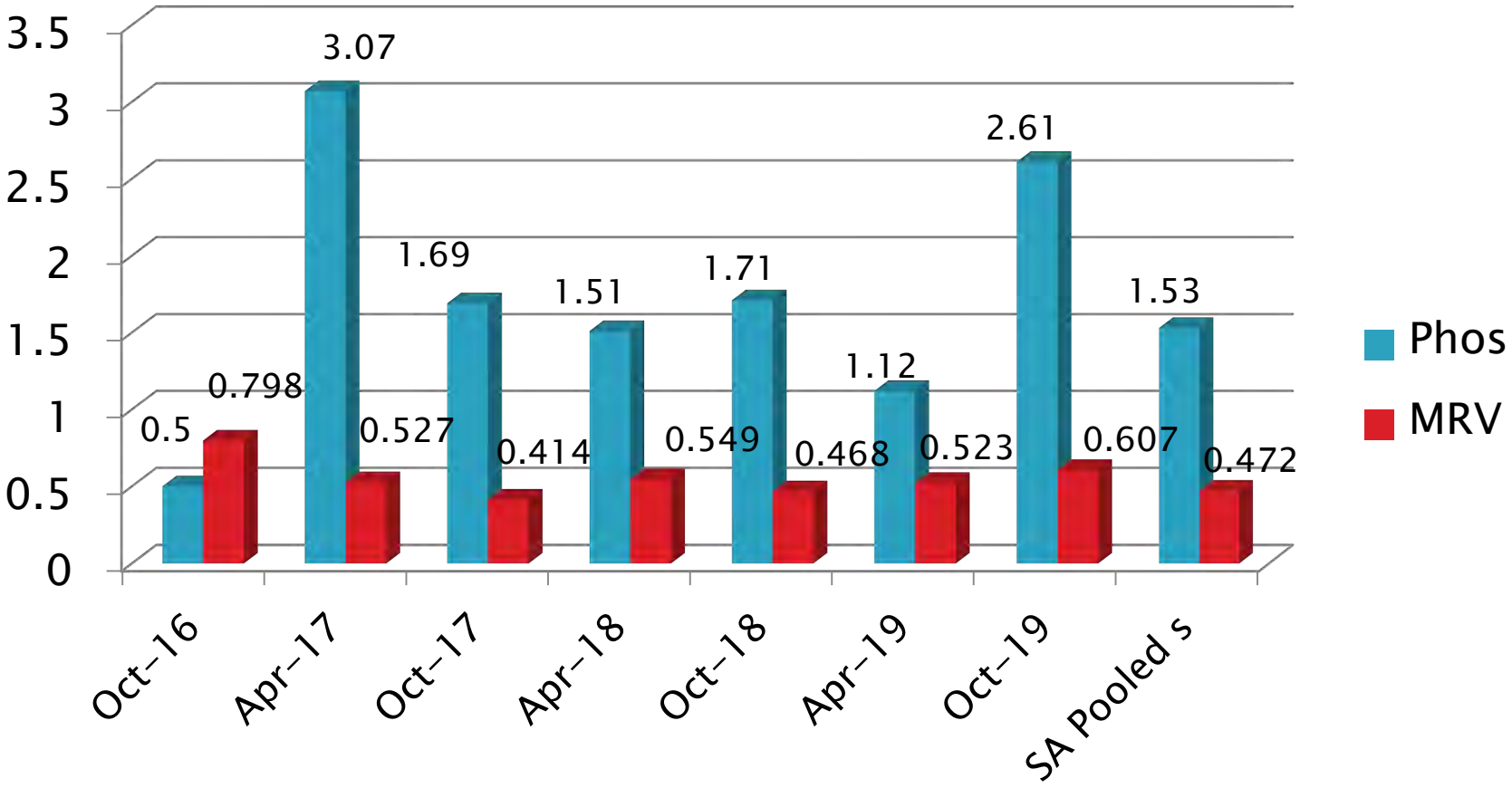




IIIH Precision Estimates



IIIHA/B Precision Estimates



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Sequence IVA

- October 2019

Sequence IVA Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	3
Statistically Unacceptable Calibration Test	LC	1
Total		**4**

Sequence IVA- Failed Tests

Test Status	#
No Failed Tests	0

Sequence IVA – Lost Tests

Test Status	Cause	#
Invalid	Timing off 5 degrees during first 60 hours of test	1
Totals		**1**

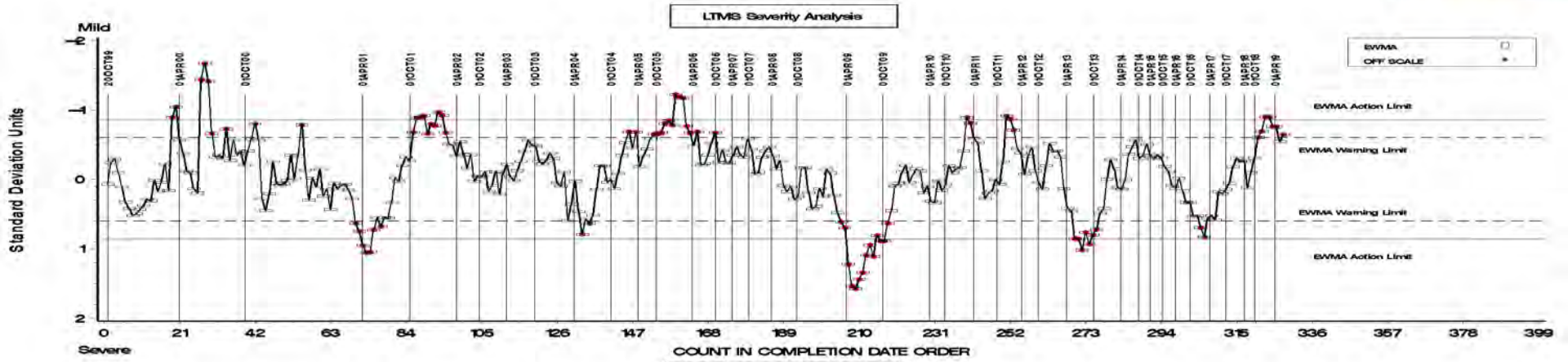
*Invalid and aborted tests

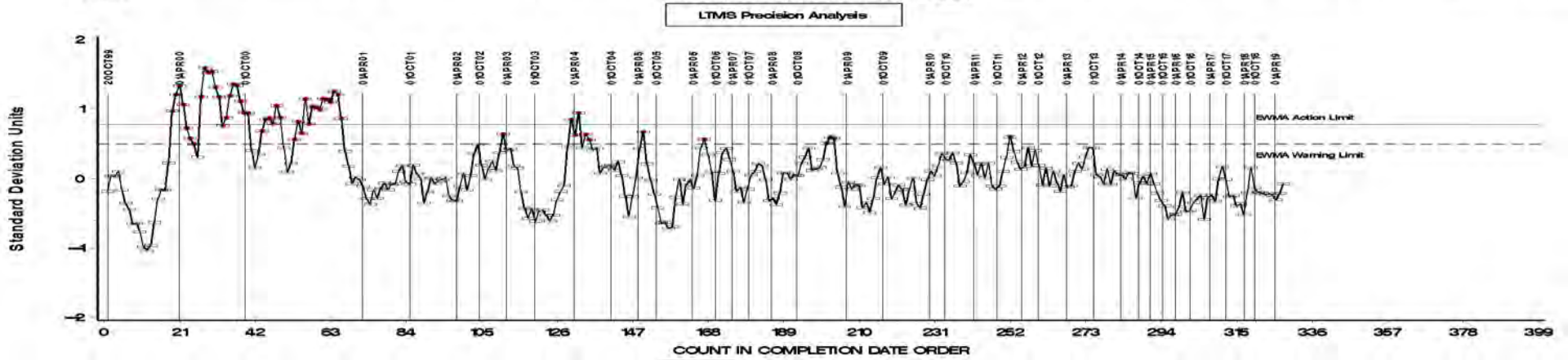
Sequence IVA Test Severity

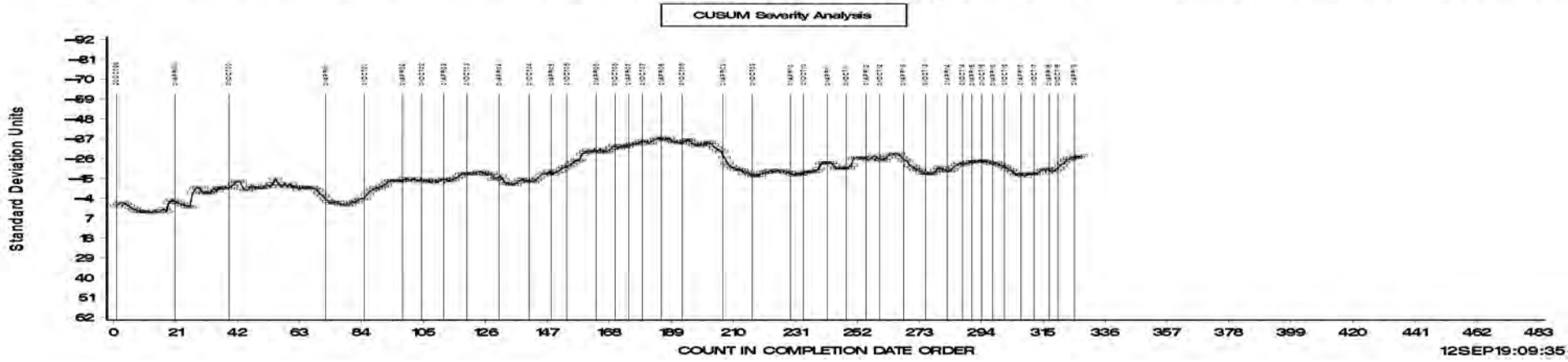
- ACW in severity warning alarm (mild direction)

SEQUENCE IVA INDUSTRY OPERATIONALLY VALID DATA

AVERAGE CAM WEAR







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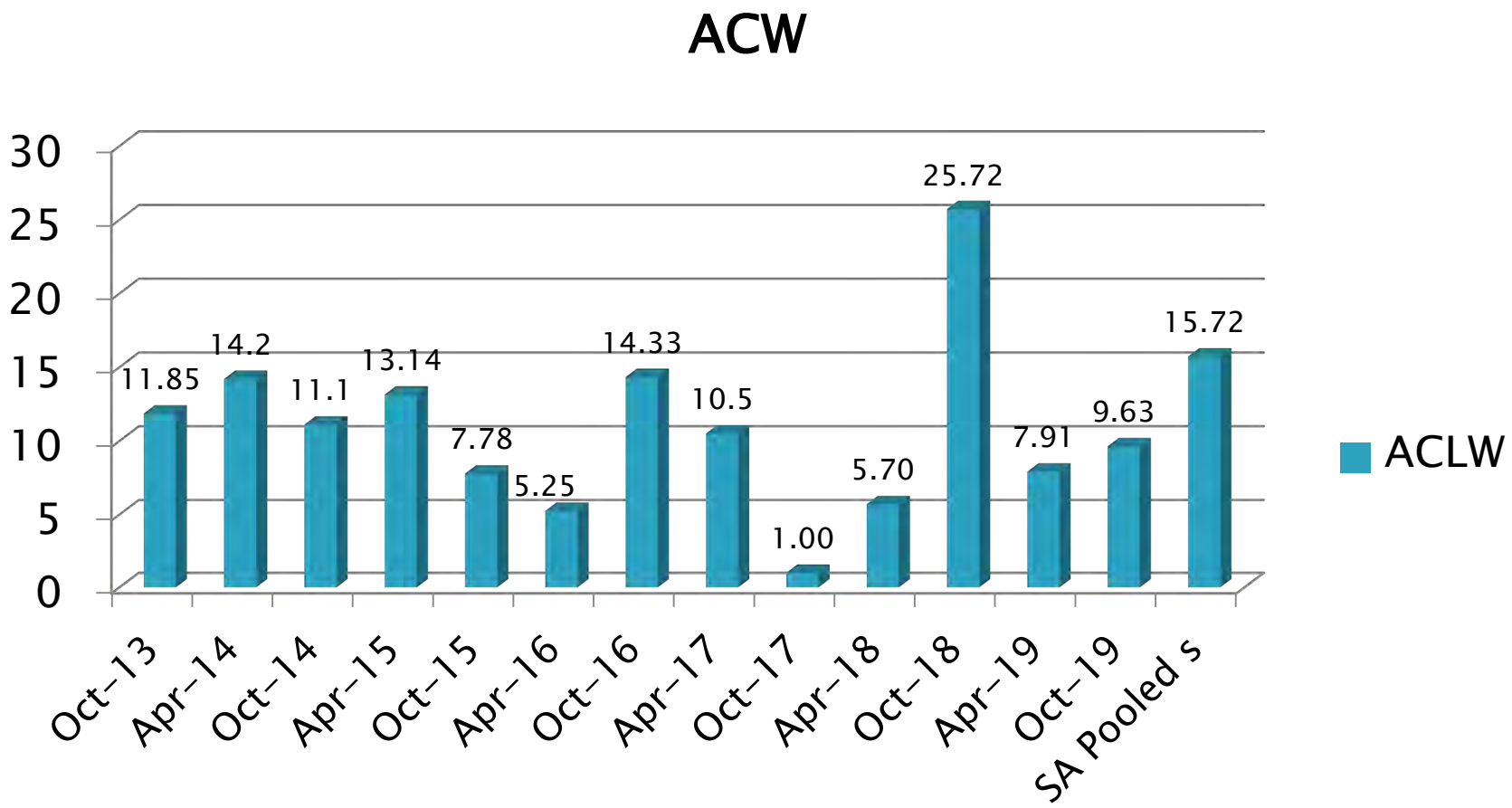
Sequence IVA Precision Estimates



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Sequence IVB

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Sequence IVB Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	8
Aborted Calibration Test	XC	1
Invalid Calibration Test	RC	1
Total		**10**

Sequence IVB- Failed Tests

Test Status	#
No Failed Tests	0

Sequence IVB – Lost Tests

Test Status	Cause	#
Aborted	Engine failure	1
Invalid	Negative QI Exhaust Back Pressure and Coolant Pressure, missing data	1
Totals		2

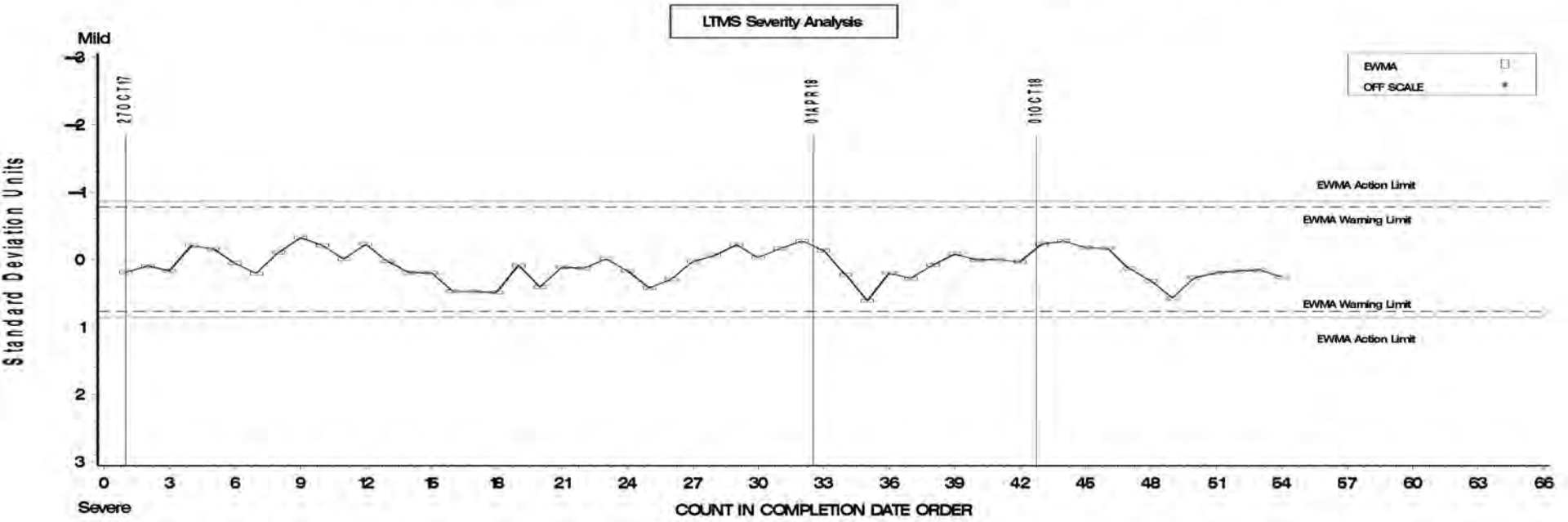
*Invalid and aborted tests

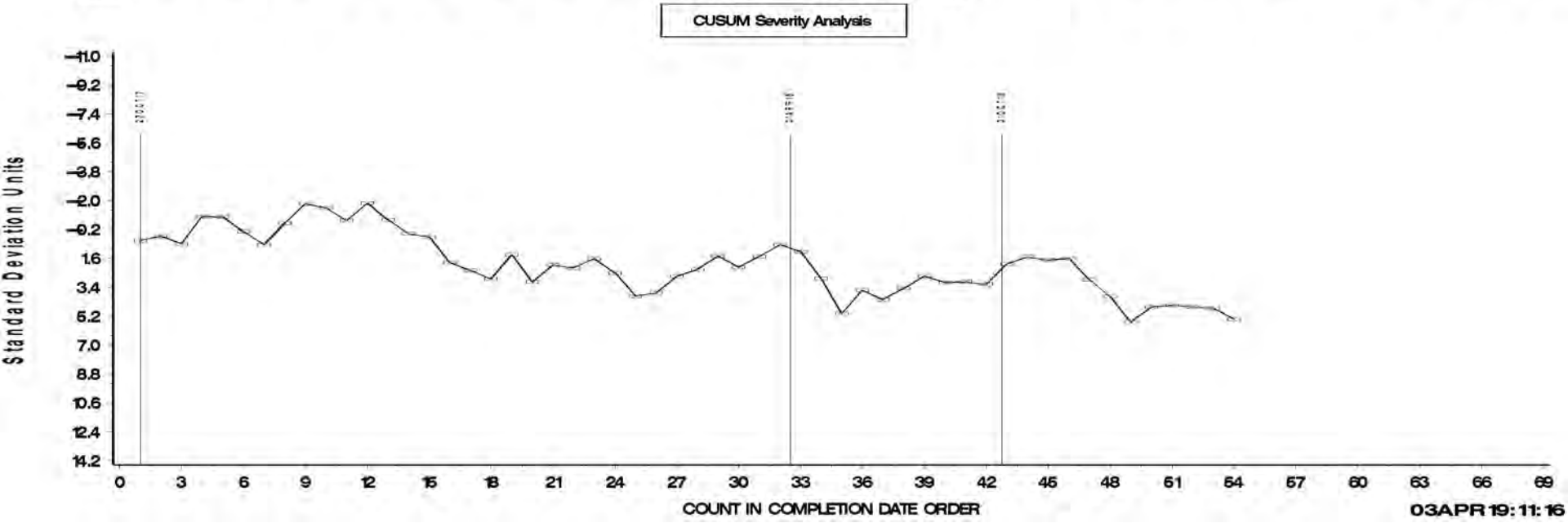
Sequence IVB Test Severity

- AVLI and Fe in control.

SEQUENCE IVB INDUSTRY OPERATIONALLY VALID DATA

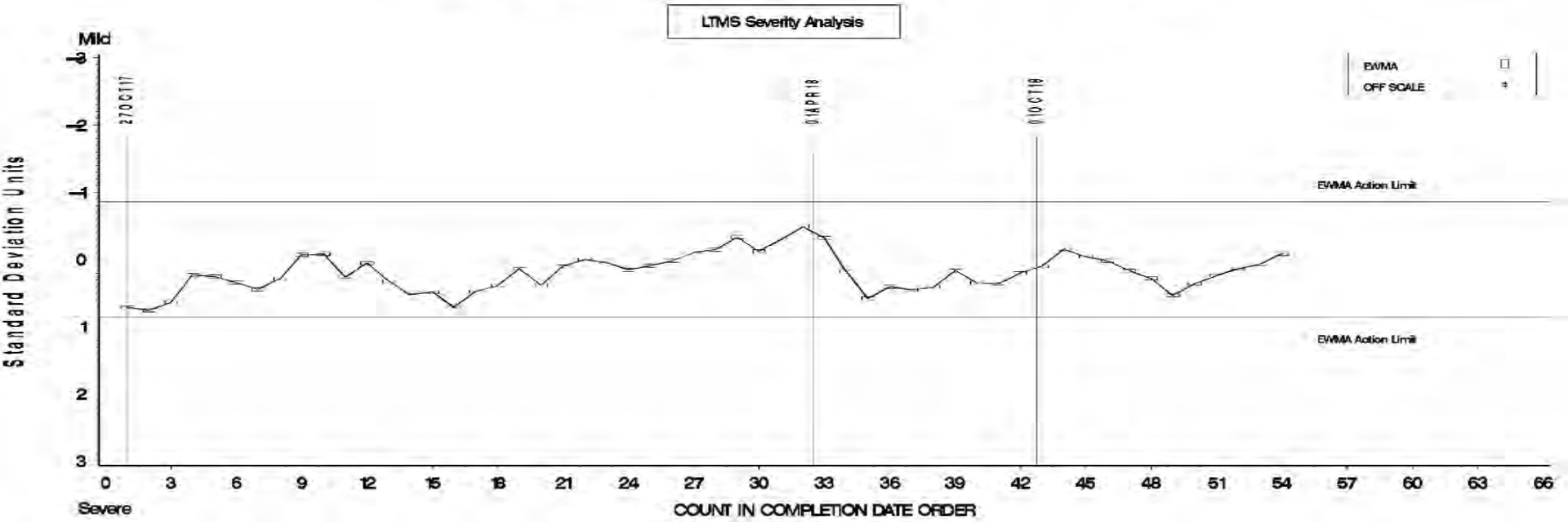
AVERAGE VOLUME LOSS BY KEYENCE INTAKE Final

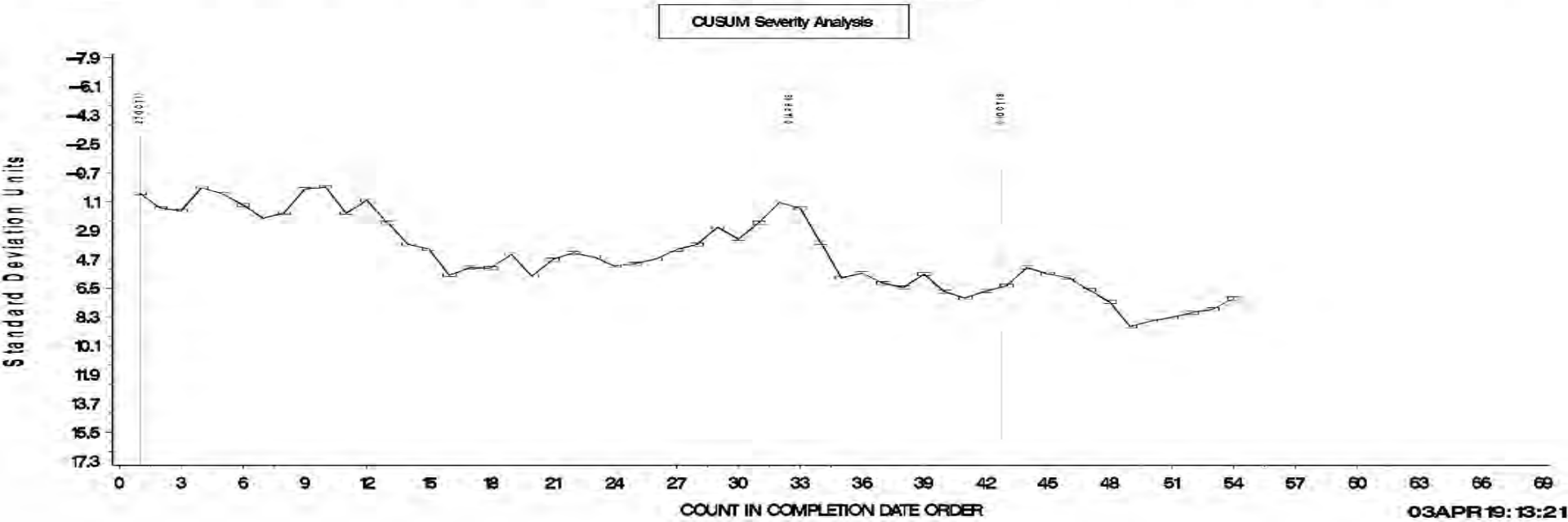




SEQUENCE IVB INDUSTRY OPERATIONALLY VALID DATA

END OF TEST FE FINAL Severity Adjusted RESULT





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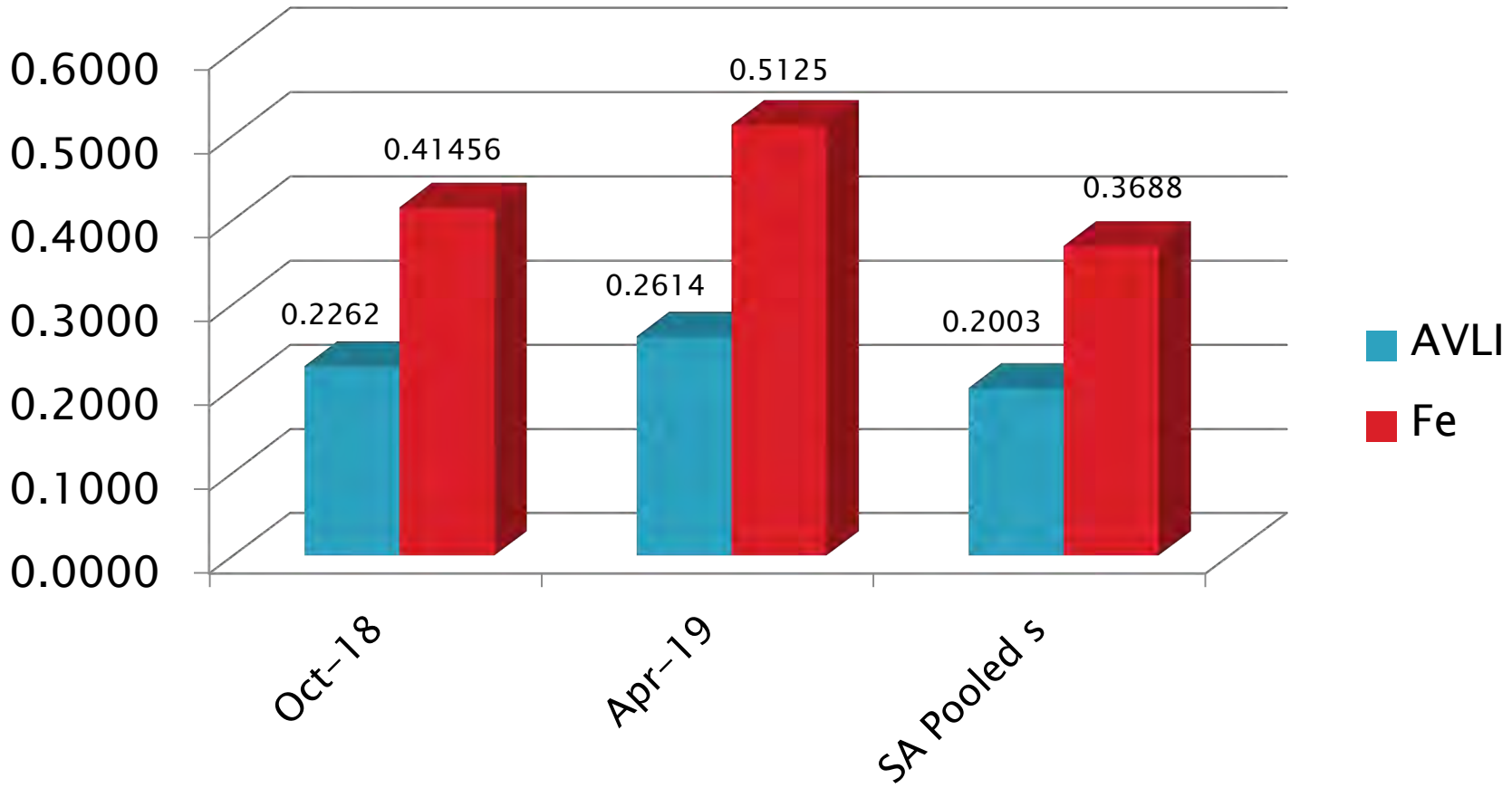
Sequence IVB Precision Estimates



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Sequence VH

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Sequence VH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	8
Statistically Unacceptable Calibration	OC	3
Aborted Calibration Test	XC	1
Operationally Invalid, Lab Determination	LC	1
Total		**13**

Sequence VH – Failing Tests

Test Status	#
Level 3 Ei Alarm RAC, AEV, APV	1
Level 3 Ei Alarm RAC	1
Level 3 Ei Alarm AES	1
Totals	**3**

Sequence VH – Lost Tests*

Test Status	Cause	#
Invalid	Oil Additions Exceeded 2000 g (Procedural Limit)	1
Aborted	Low Blowby	1
Totals		**2**

*Invalid and aborted tests

Sequence VH Test Severity

- AES In Severity Action Alarm (mild direction) with two most recent tests
- RAC, AEV and APV in control

SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

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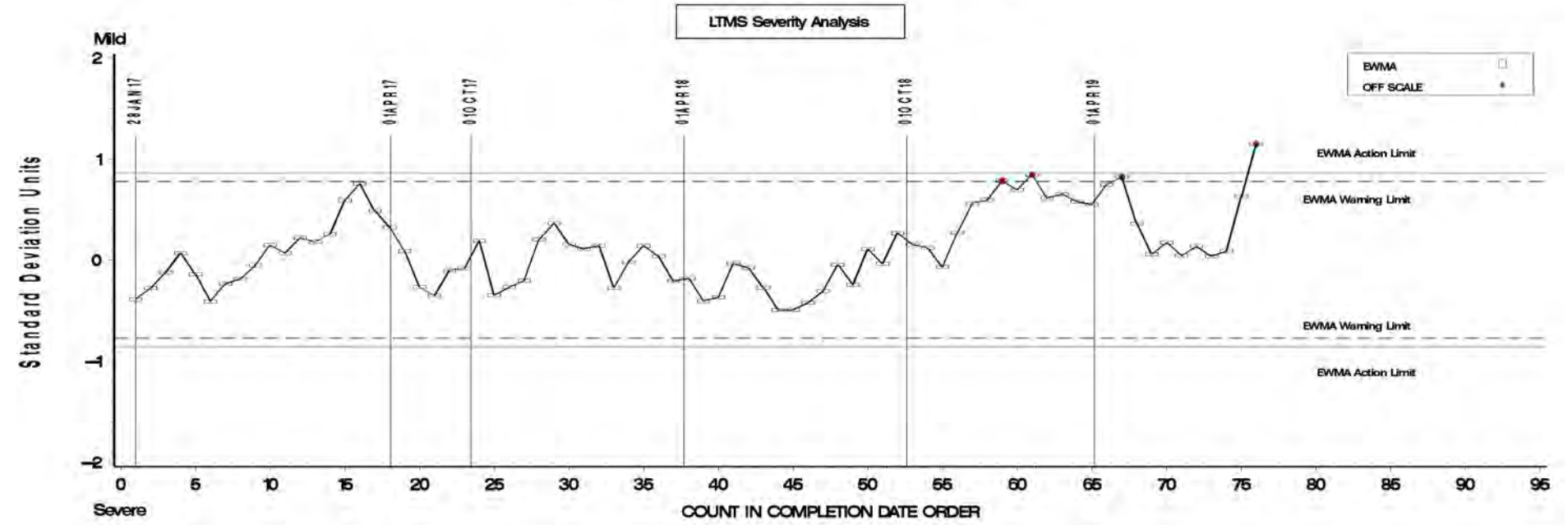
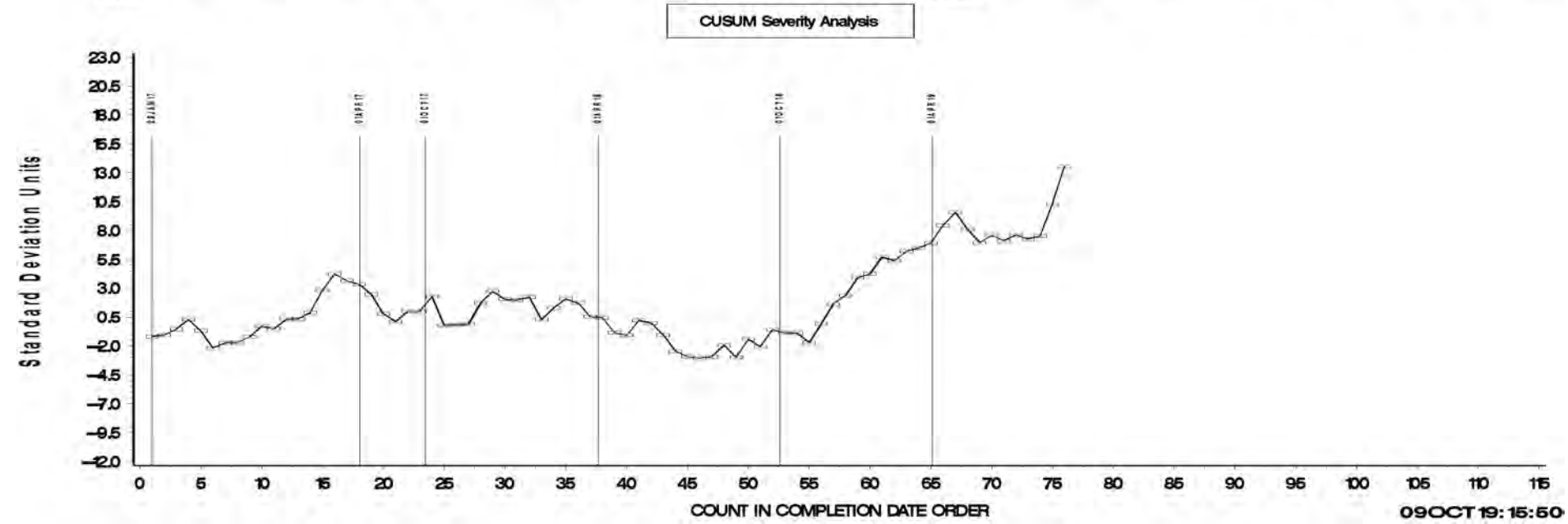
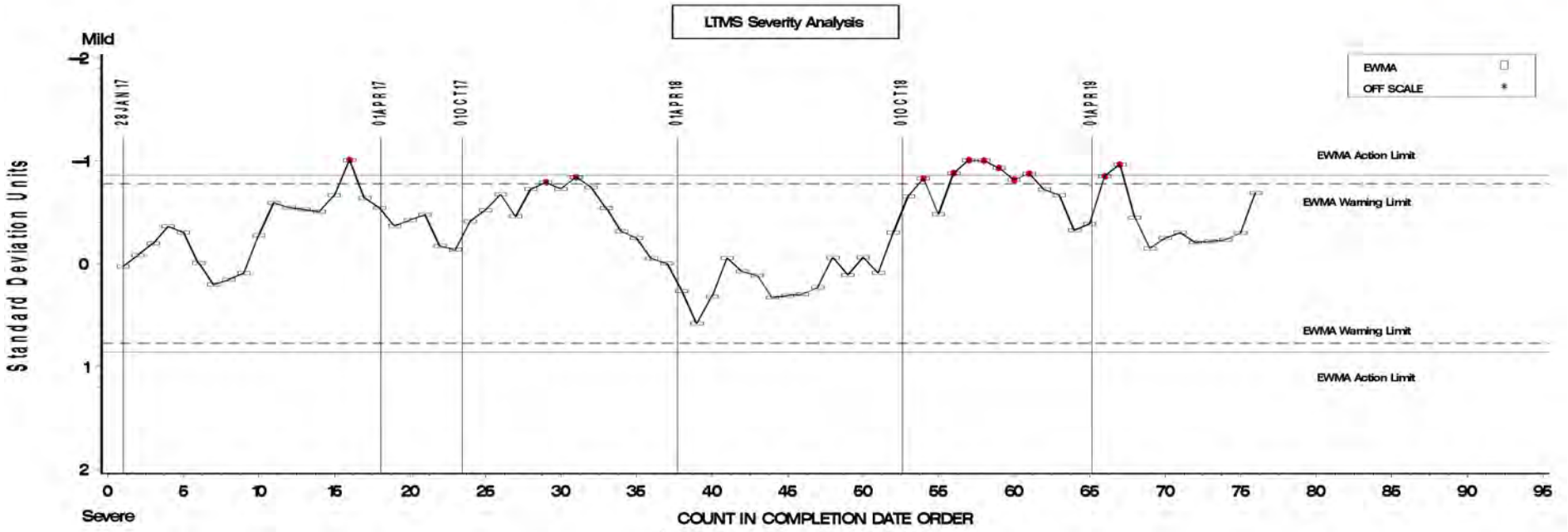
AVERAGE ENGINE SLUDGE

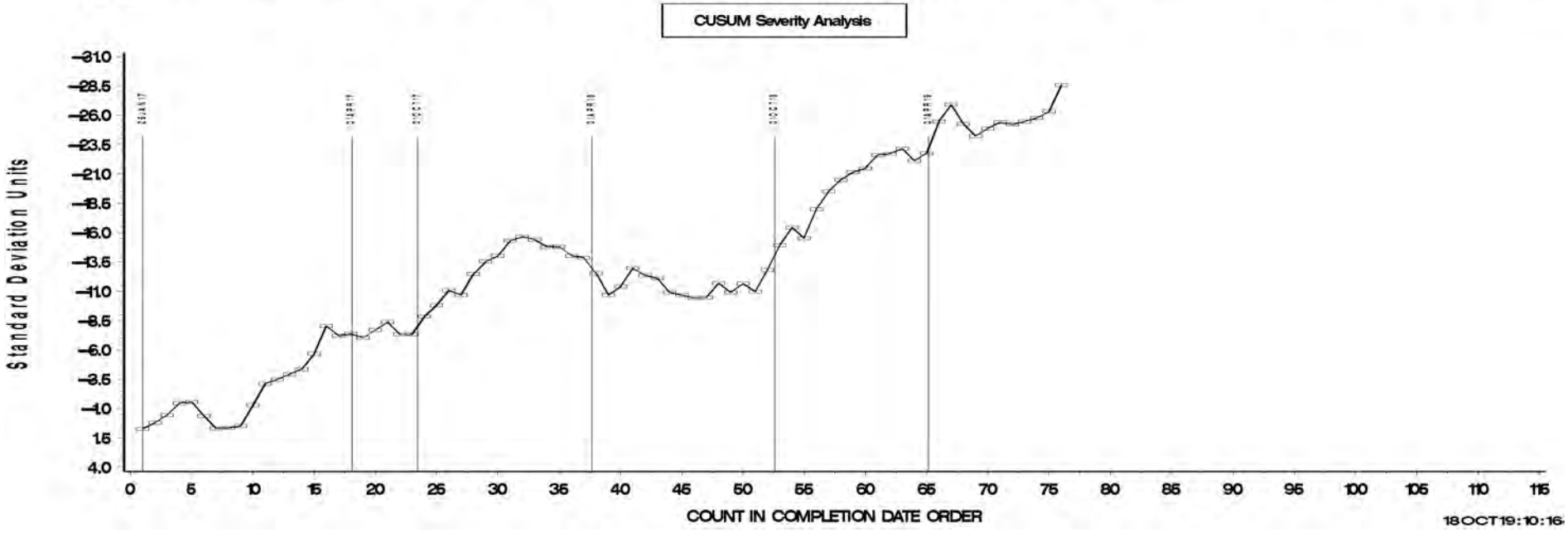




SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ROCKER COVER SLUDGE





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SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

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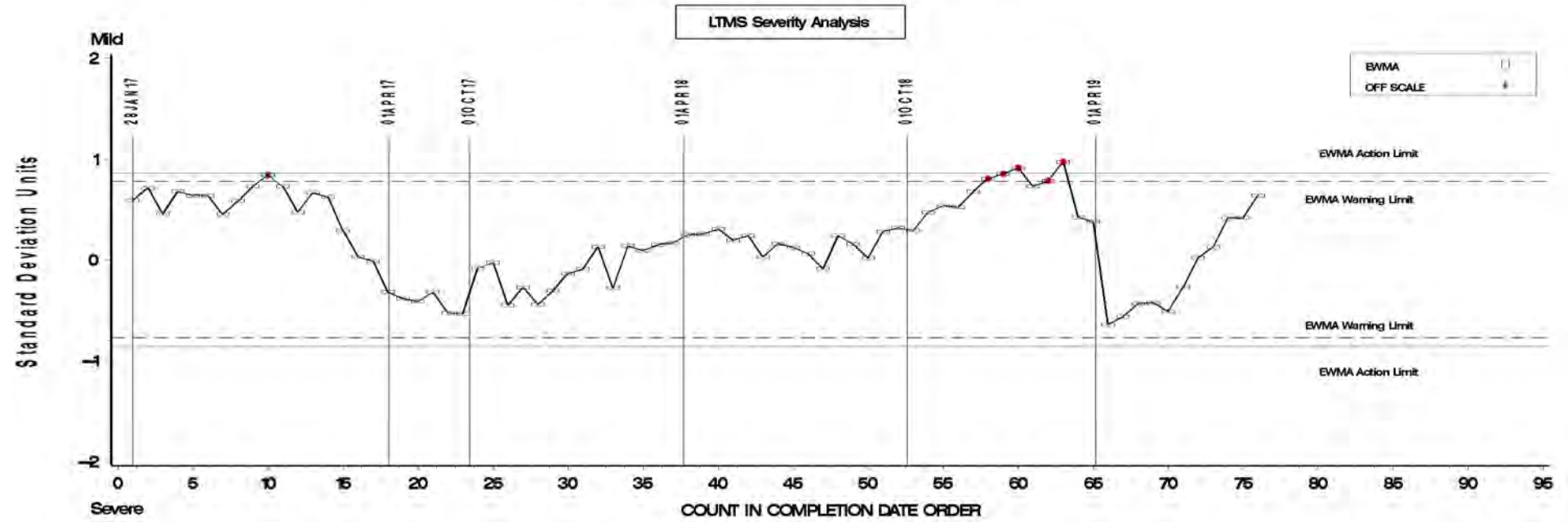
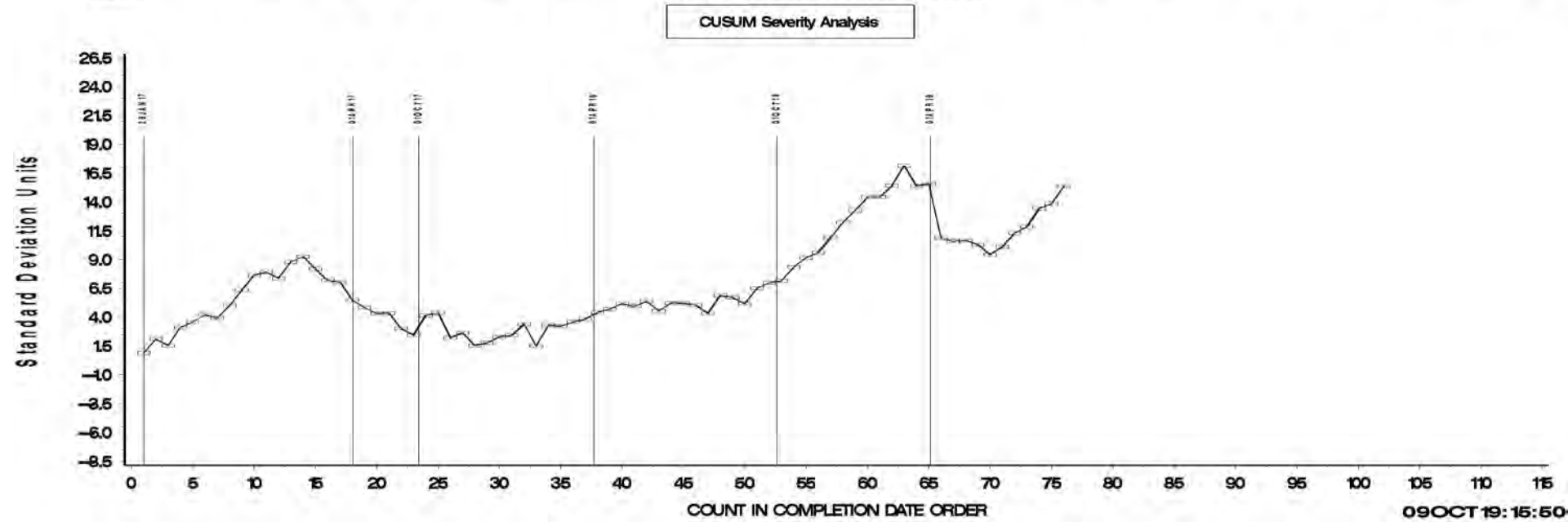
AVG. ENG. VARN. 50% RATING





SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

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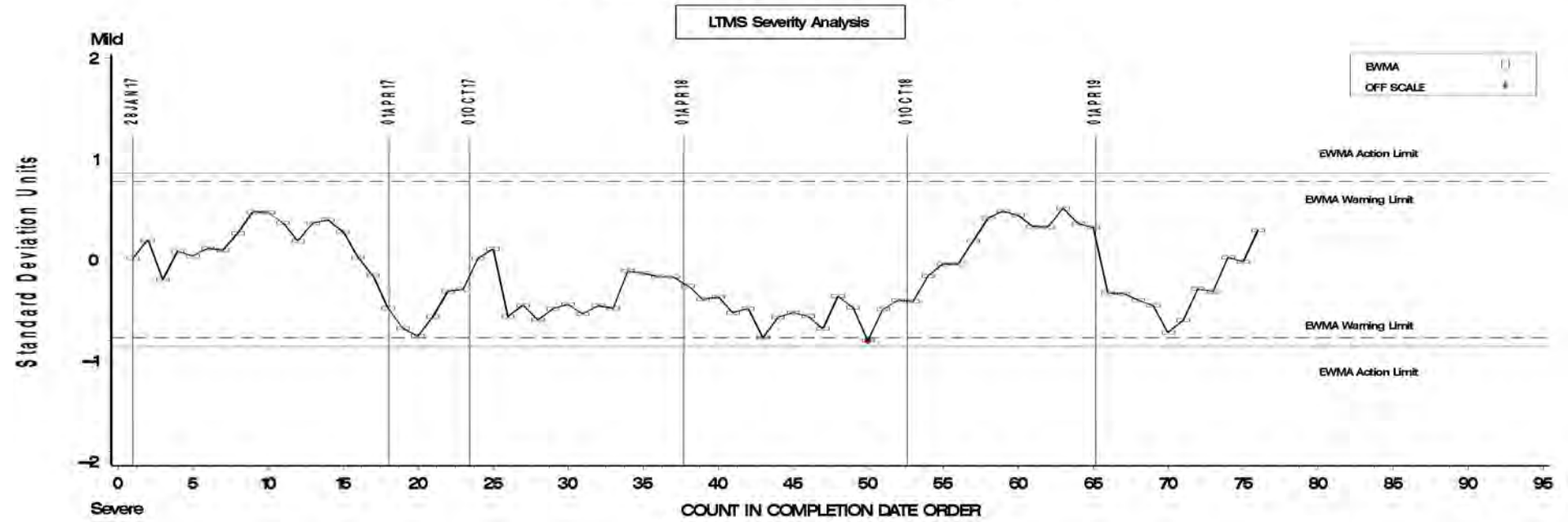
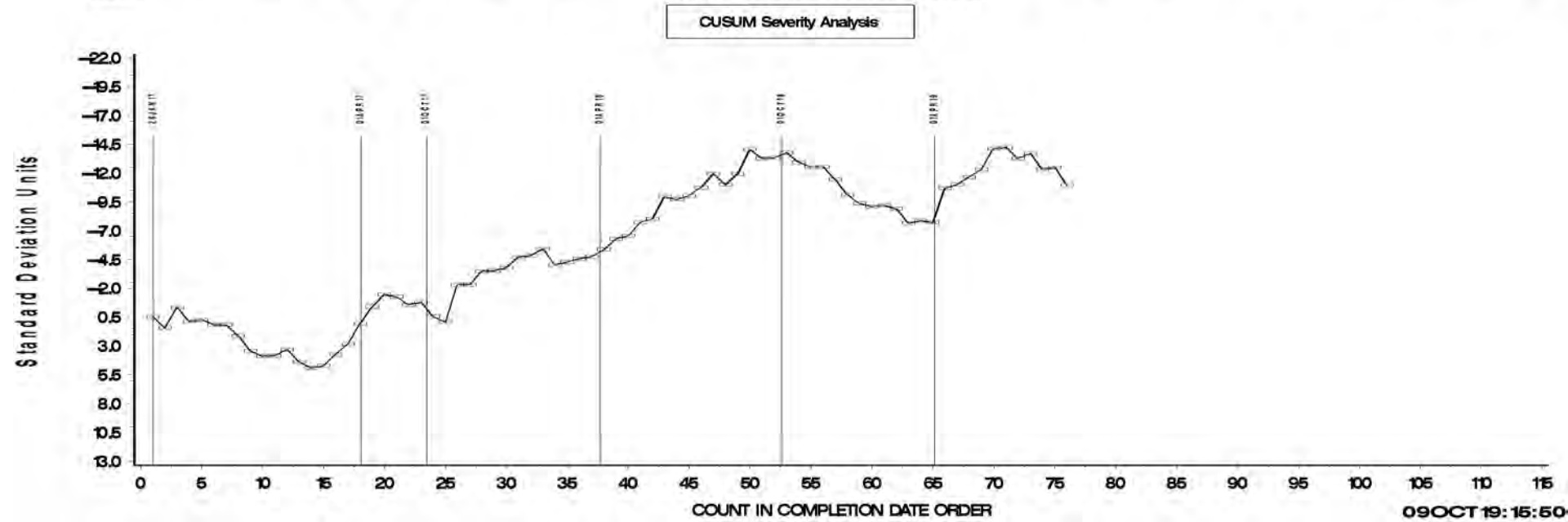
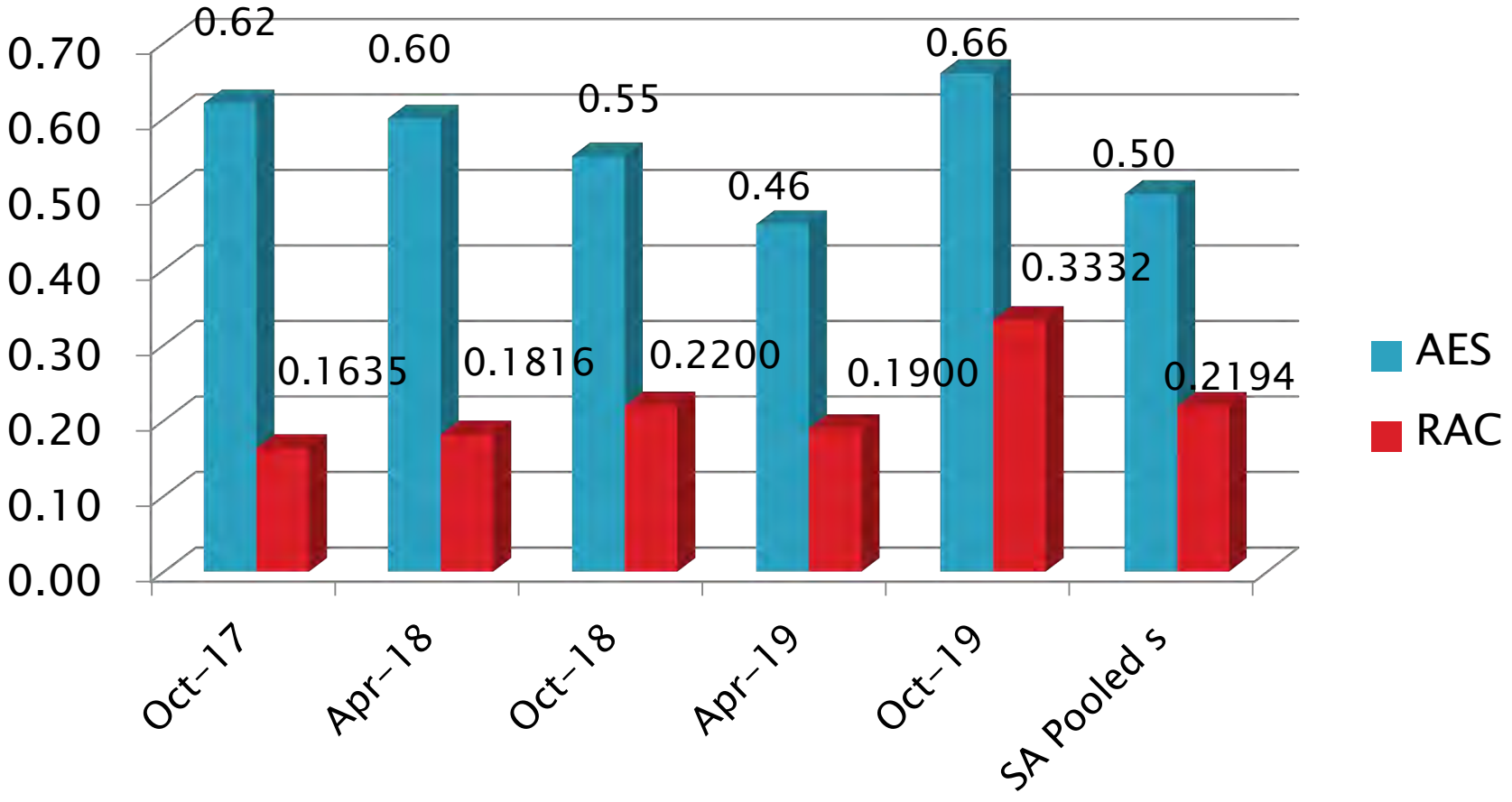
AVG PISTON SKIRT 50% RATING

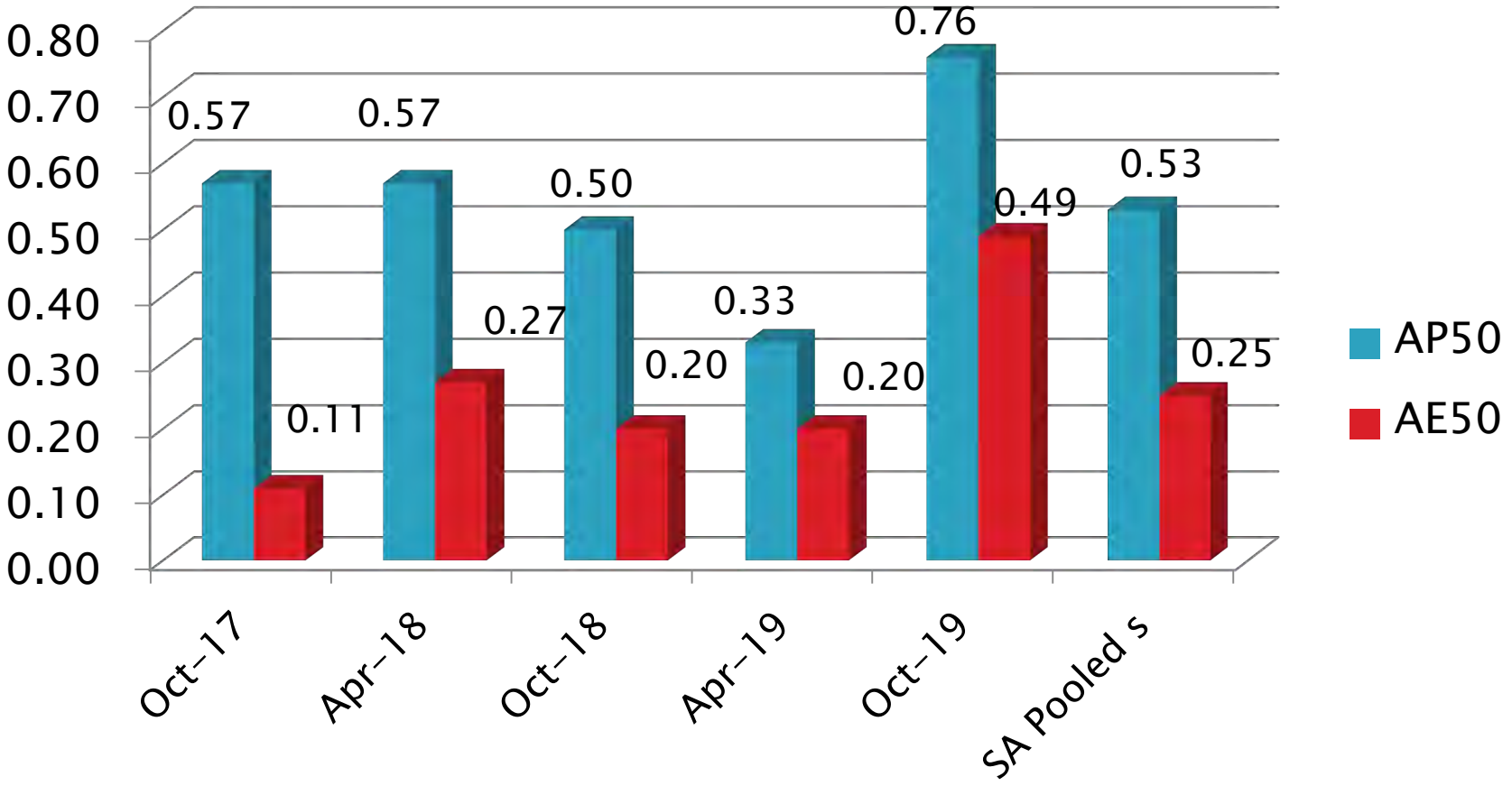




Sequence VH Precision Estimates



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	31
Operationally Invalid Calibration Test, Lab Judgement	LC	1
Abandoned engine	MC	2
Aborted Calibration Test	XC	1
Not for Industry Statistics, run to evaluate reblend 542-4	NI	2
Total		**37**

Sequence VIE- Failed Tests

Test Status	#
No Failed Tests	0

Sequence VIE – Lost Tests*

Test Status	Cause	#
Invalid	Load cell failure	1
Aborted	Dyno Failure	1
Totals		**2**

*Invalid and aborted tests

Sequence VIE Test Severity

- FEI1 and FEI2 are in control

SEQUNCE VIE INDUSTRY OPERATIONALLY VALID DATA

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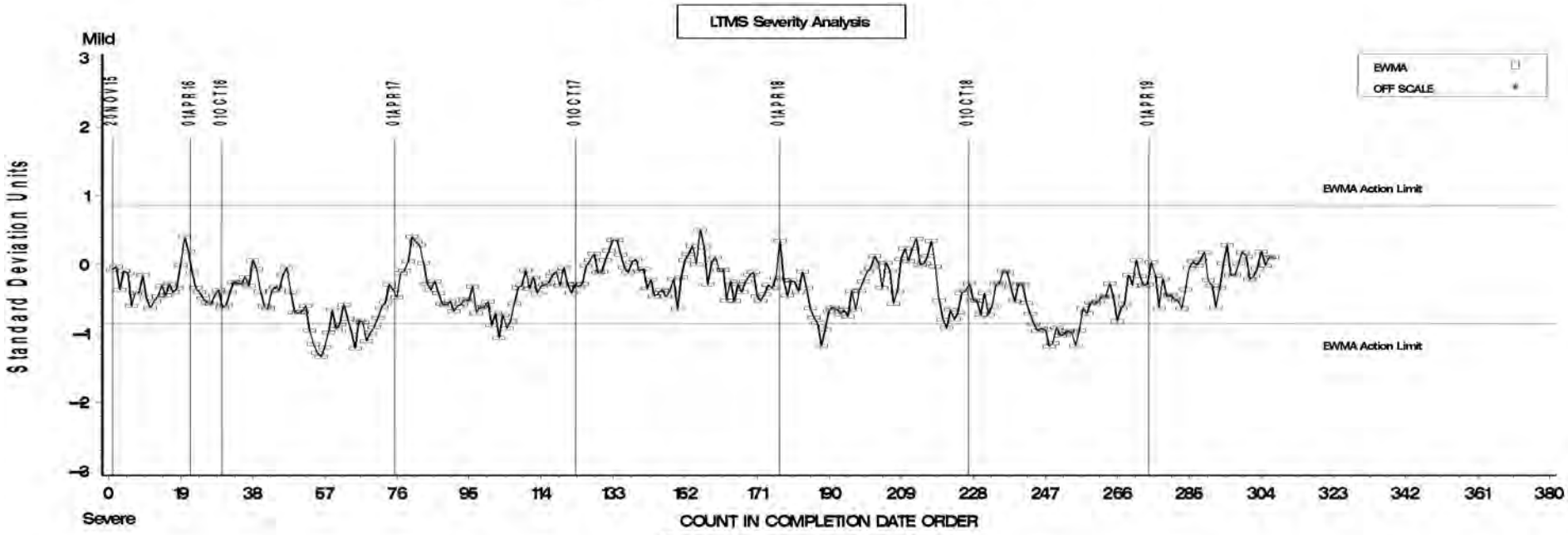
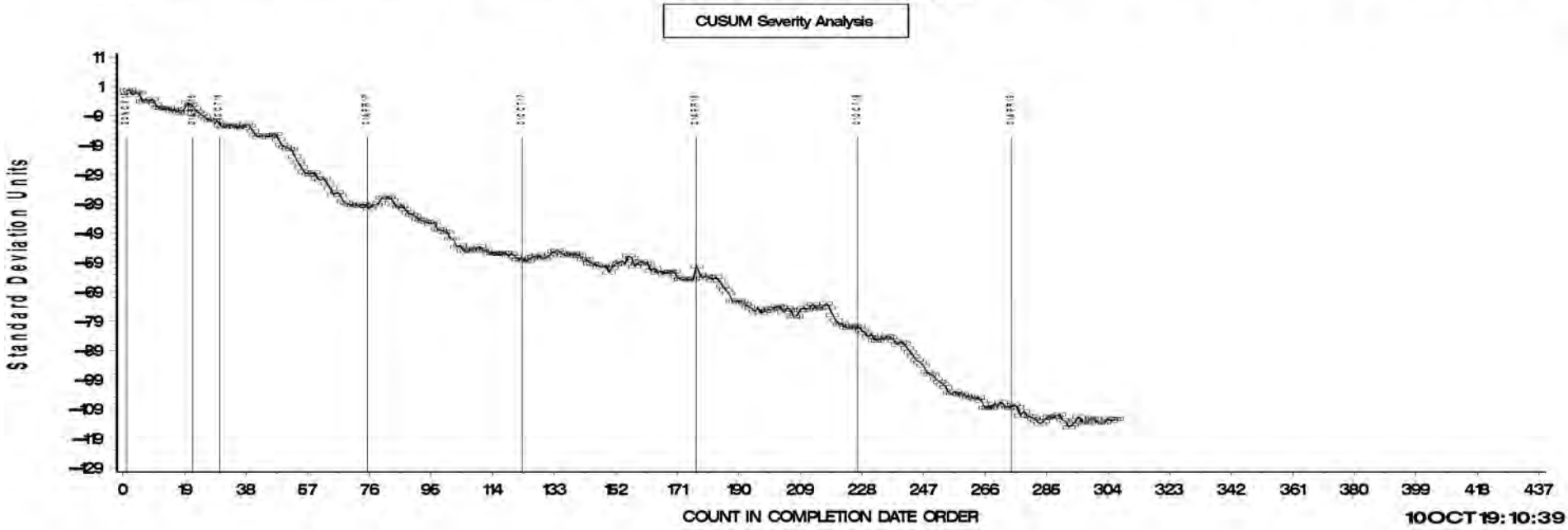
FEI FINAL RESULT PHASE I





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SEQUNCE VIE INDUSTRY OPERATIONALLY VALID DATA

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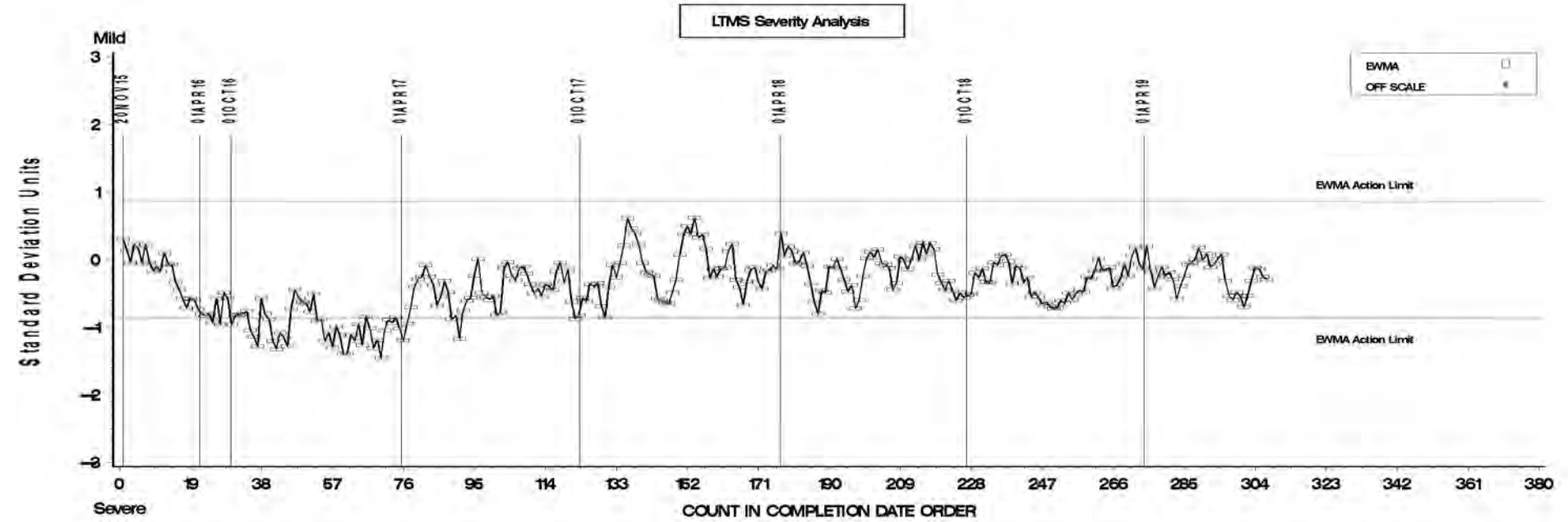
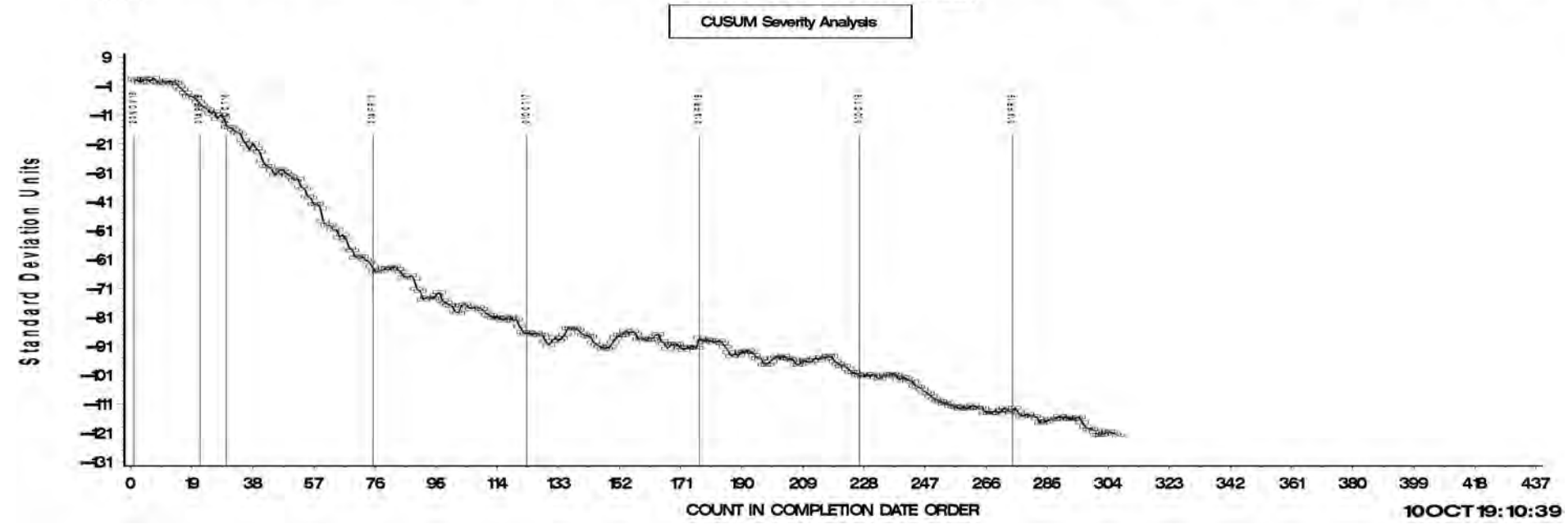
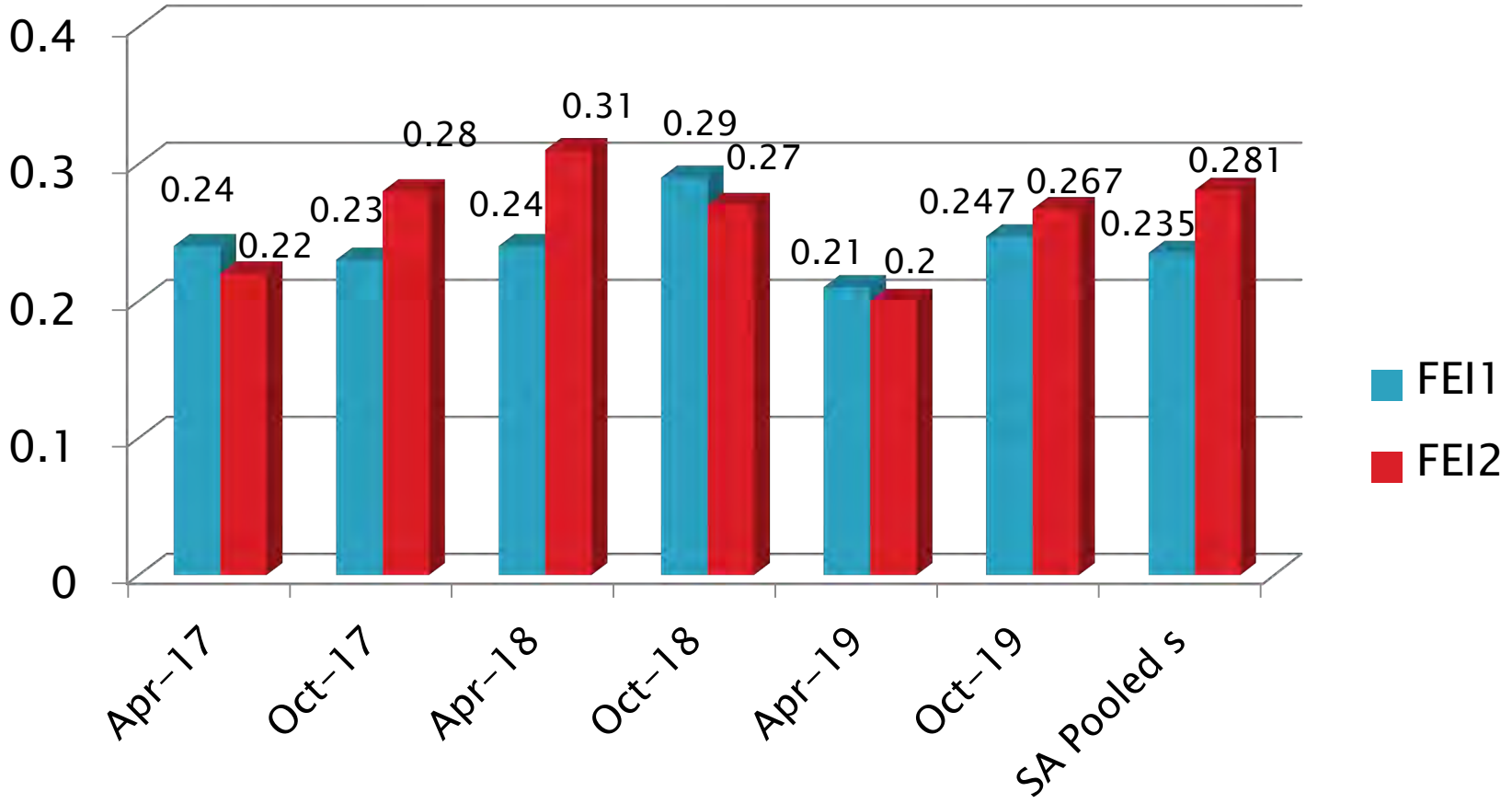
FEI FINAL RESULT PHASE II





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	54
Failed Statistically	OC	6
Aborted	XC	1
Invalid by Lab	LC	2
Invalid by Lab and TMC	RC	1
Total		**64**

Sequence VIF – Failed Tests

Test Status	Number of Tests
Severe FEI1	3
Severe FEI2	1
Severe FEI1 and FEI2	1
Vi Alarm FEI1	1
Total	6

Sequence VIF – Lost Tests*

Test Status	Cause	#
Aborted	Wrong oil charge	1
Invalid	Excessive Downtime	1
Invalid	Load cell failure	1
Invalid	Data acquisition system errors	1
Totals		4

*Invalid and aborted tests

Sequence VIF Test Severity

- FEI1 is in control
- FEI2 is in control

SEQUNCE VIF INDUSTRY OPERATIONALLY VALID DATA

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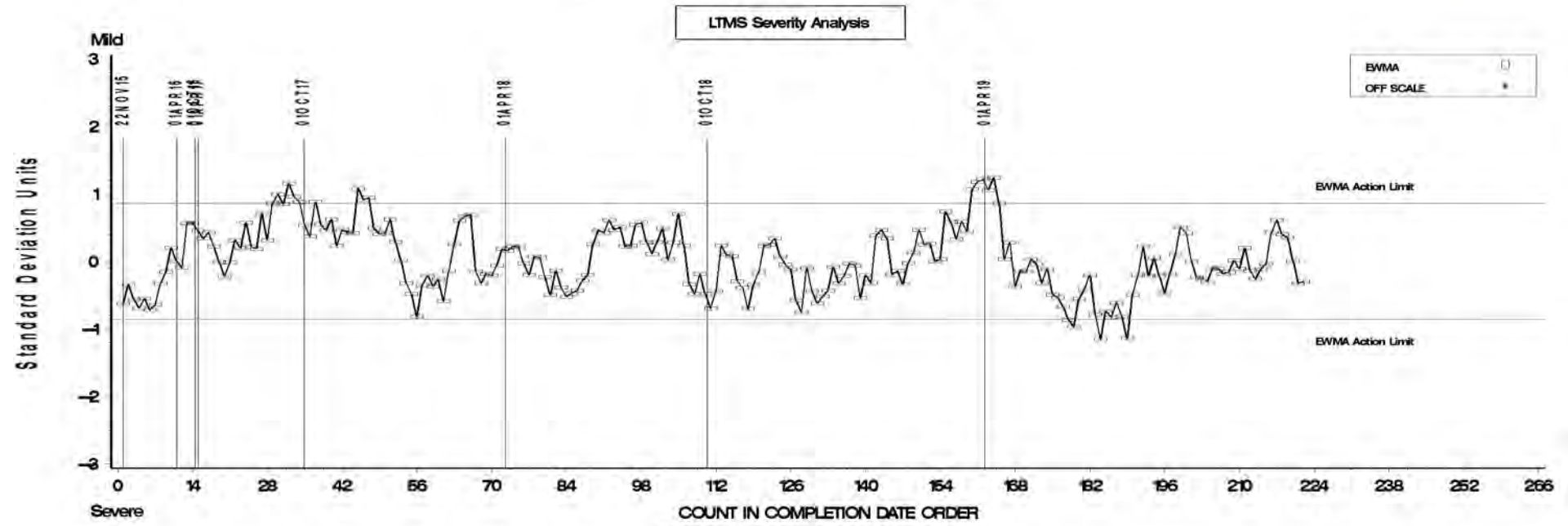
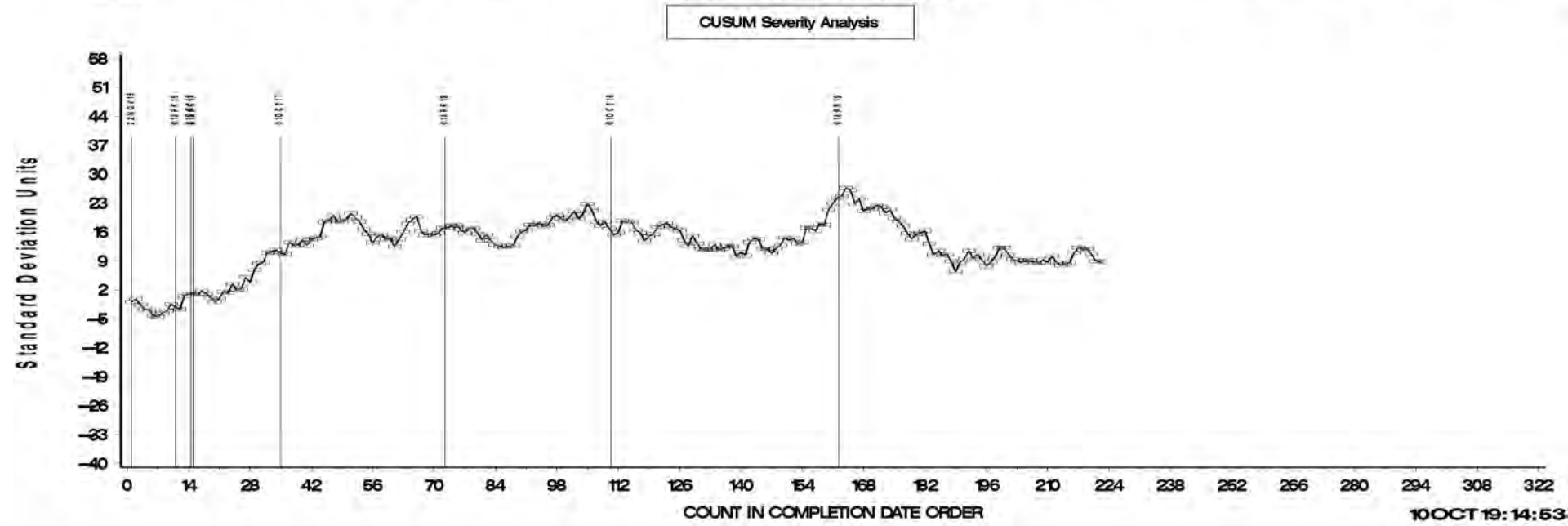
FEI FINAL RESULT PHASE I





SEQUNCE VIF INDUSTRY OPERATIONALLY VALID DATA

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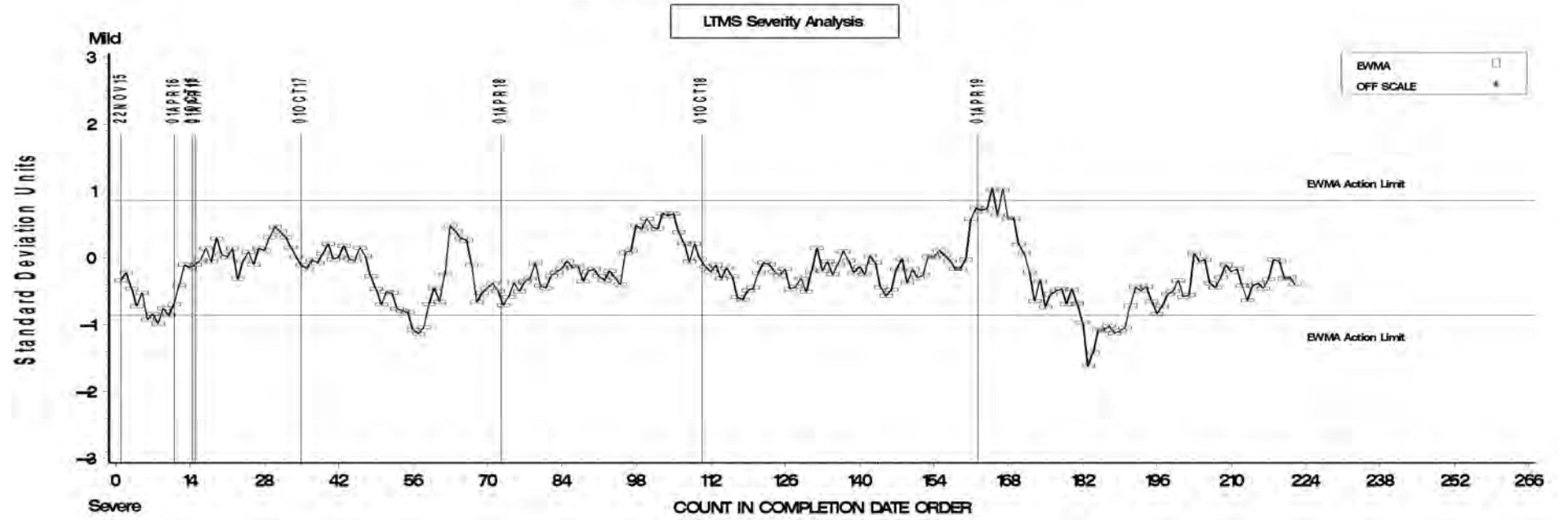
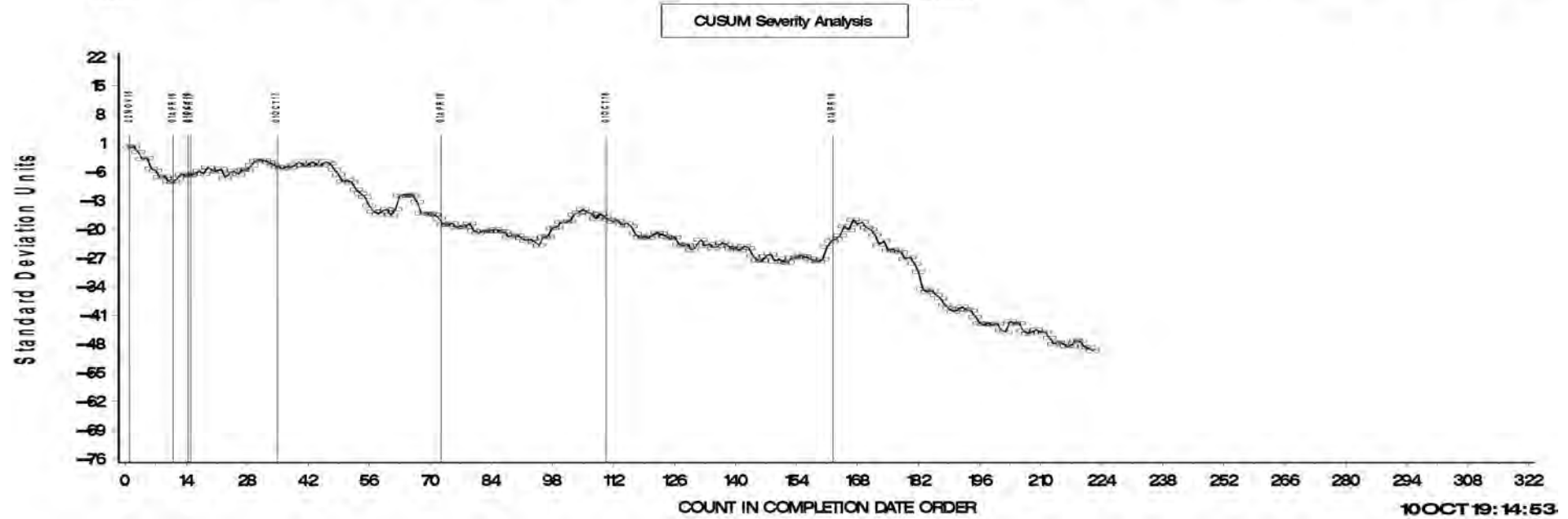
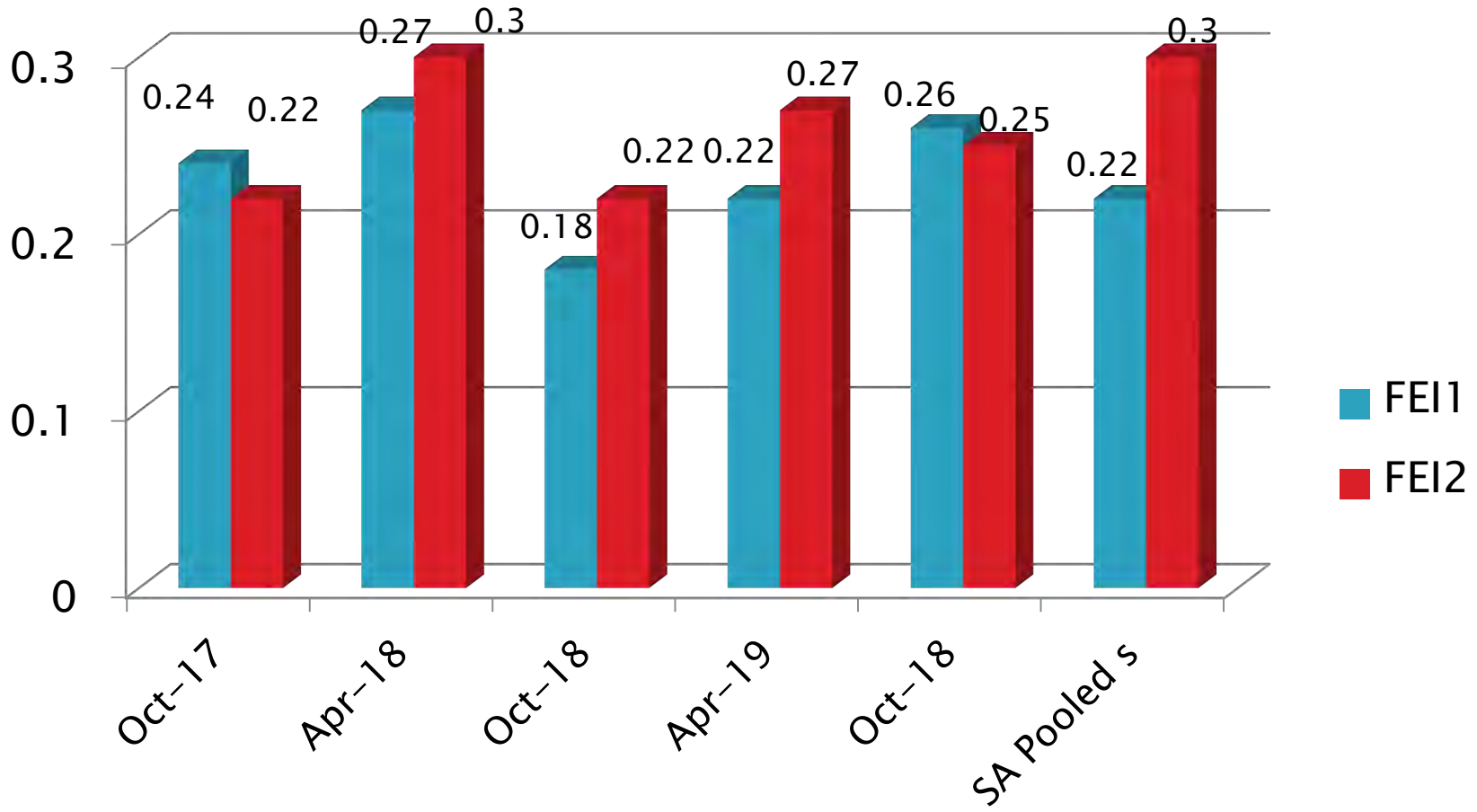
FEI FINAL RESULT PHASE II





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	4
Statistically Unacceptable Calibration Test	OC	1
Operationally Invalid Calibration Test, Lab Judgement	LC	2
Total		**7**

Sequence VIII – Failed Tests

Test Status	Number of Tests
Severe Bearing Weight Loss	1
Total	**1**

Sequence VIII – Lost Tests

Test Status	Cause	#
Invalid	Fuel Flow calibration error	1
Invalid	High Mechanical Wear	1
Totals		**2**

*Invalid and aborted tests

Sequence VIII Test Severity

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

SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

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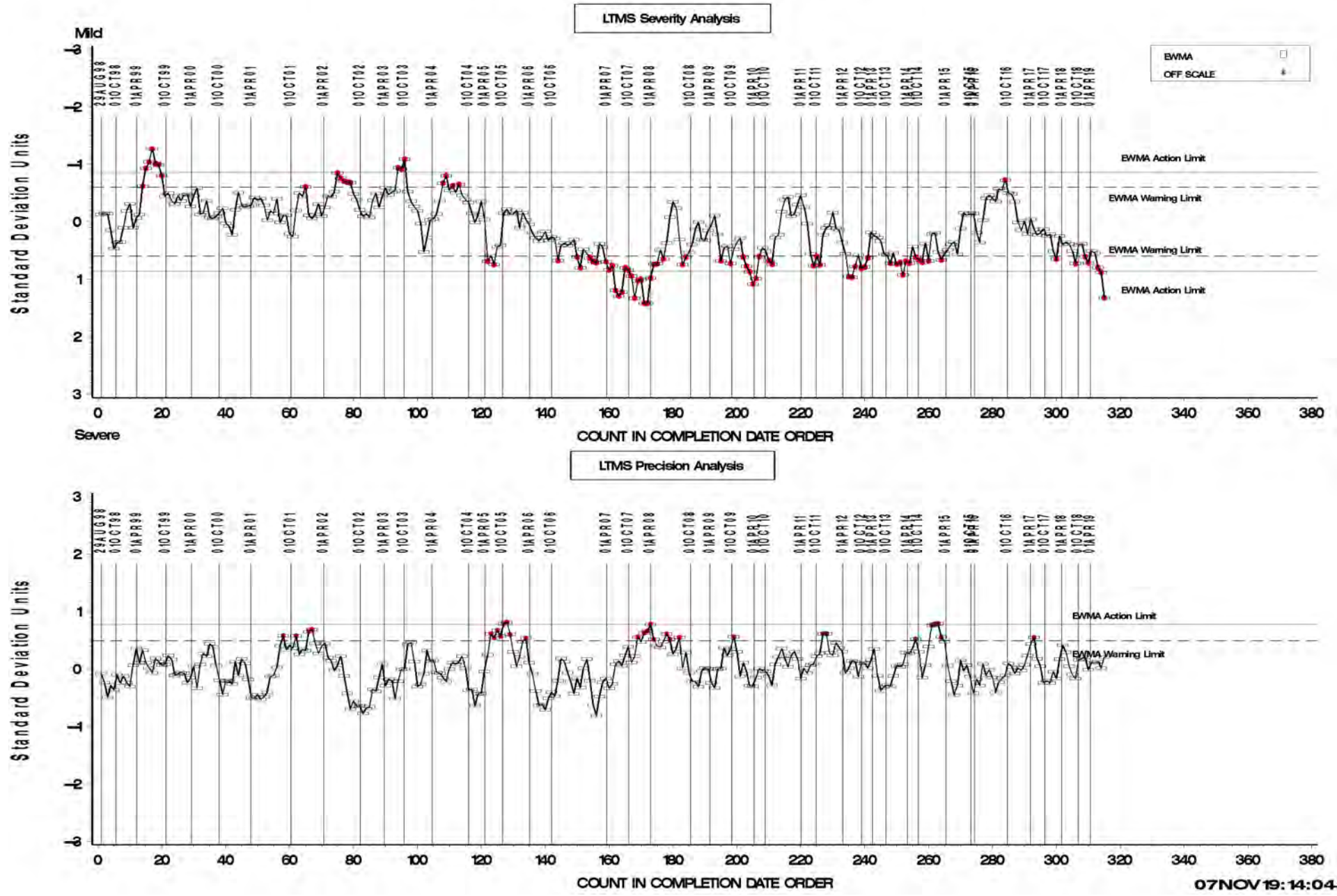
FINAL BEARING WEIGHT LOSS



SEQUENCE VIII INDUSTRY OPERATIONALLY VALID DATA

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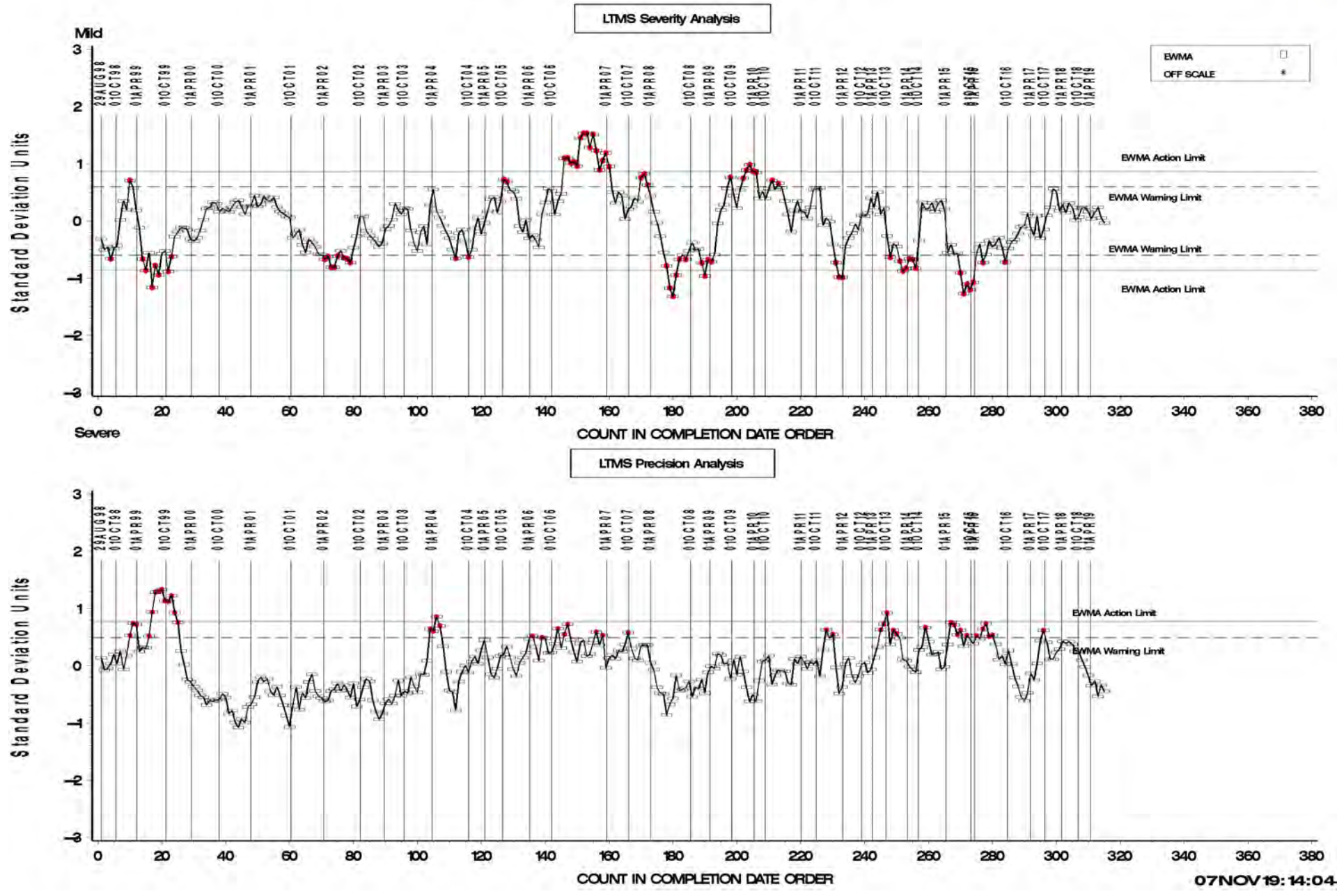
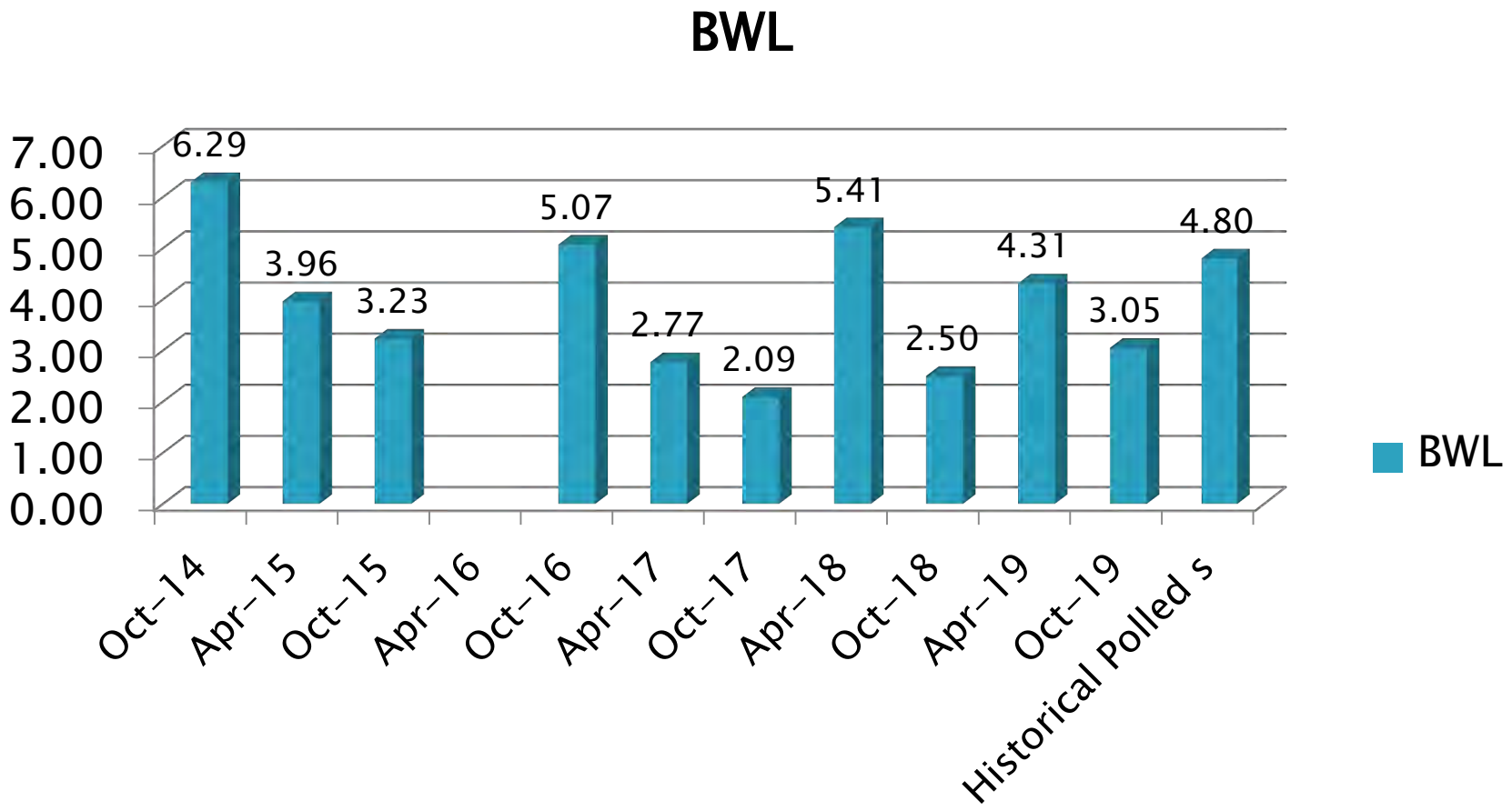
STRIPPED VIS. @ 100 DEG C

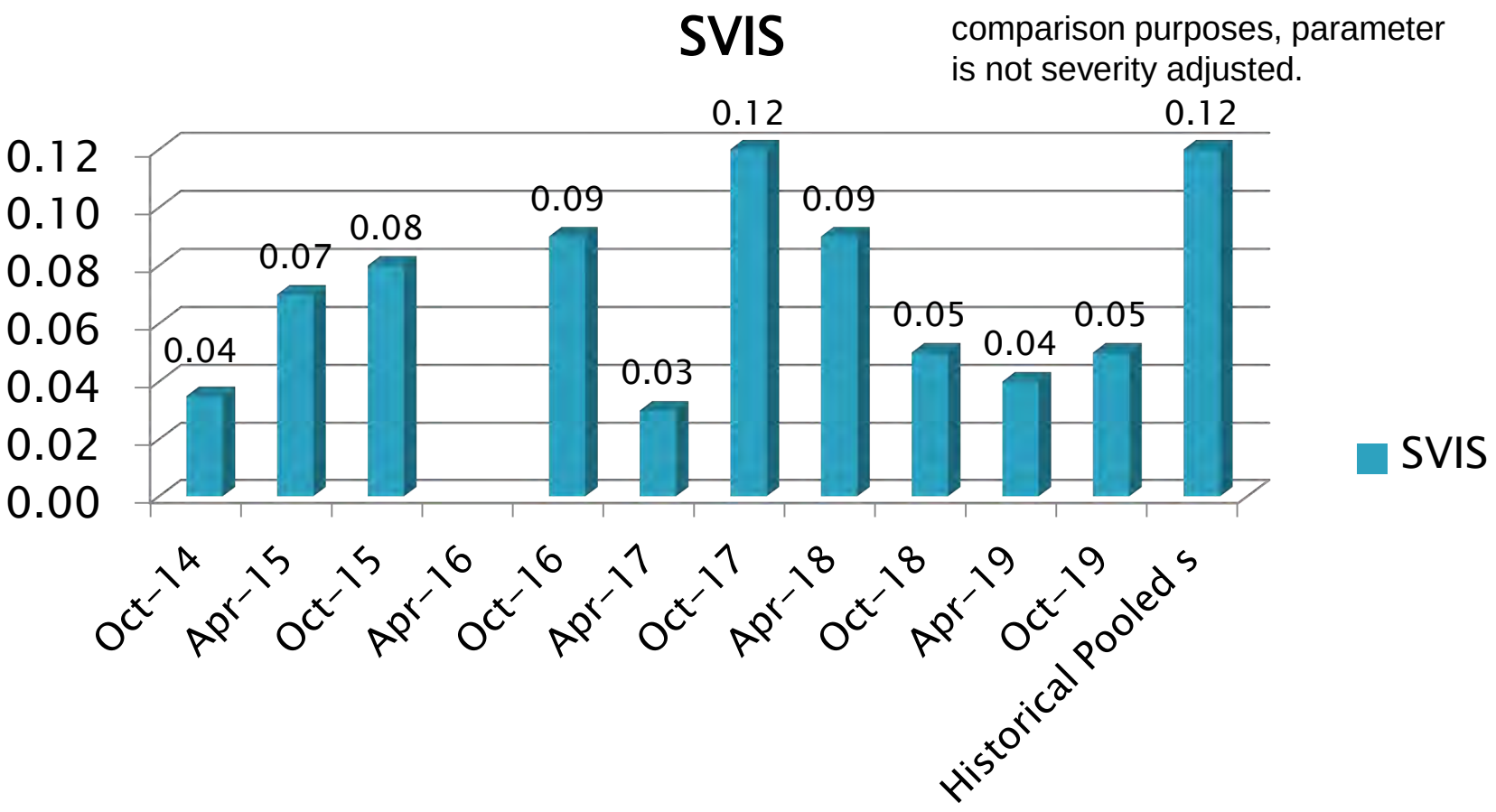


Sequence VIII Precision Estimates



Sequence VIII Precision Estimates

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



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Sequence IX

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Sequence IX Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	40
Invalid Not for Industry Statistics Test	LN	1
Aborted Calibration Test	XC	2
Acceptable Hardware Test, 2019 BB Piston prove out	AI	6
Statistically Unacceptable Calibration Test	OC	7
Acceptable Donated Test, Reference oil 224	AG	1
Engine Abandoned Calibration Test	MC	5
Not for Industry Statistics Test, different fuel	NN	1
Total		**63**

Sequence IX – Failed Tests

Test Status	Number of Tests
Mild Average Pre-ignitions	2
Ei Level 3 alarm	1
Ei Level 3, Zi level 2	1
Severe Average Pre-ignitions	3
Total	**7**

Sequence IX – Lost Tests*

Test Status	Cause	#
Invalid	Oil Contaminated from previous test	1
Aborted	Exceeded downtime limit	2
Totals		**3**

*Invalid and aborted tests

Sequence IX Test Severity

- Average number of Pre-ignitions in control.

SEQUENCE IX INDUSTRY OPERATIONALLY VALID DATA

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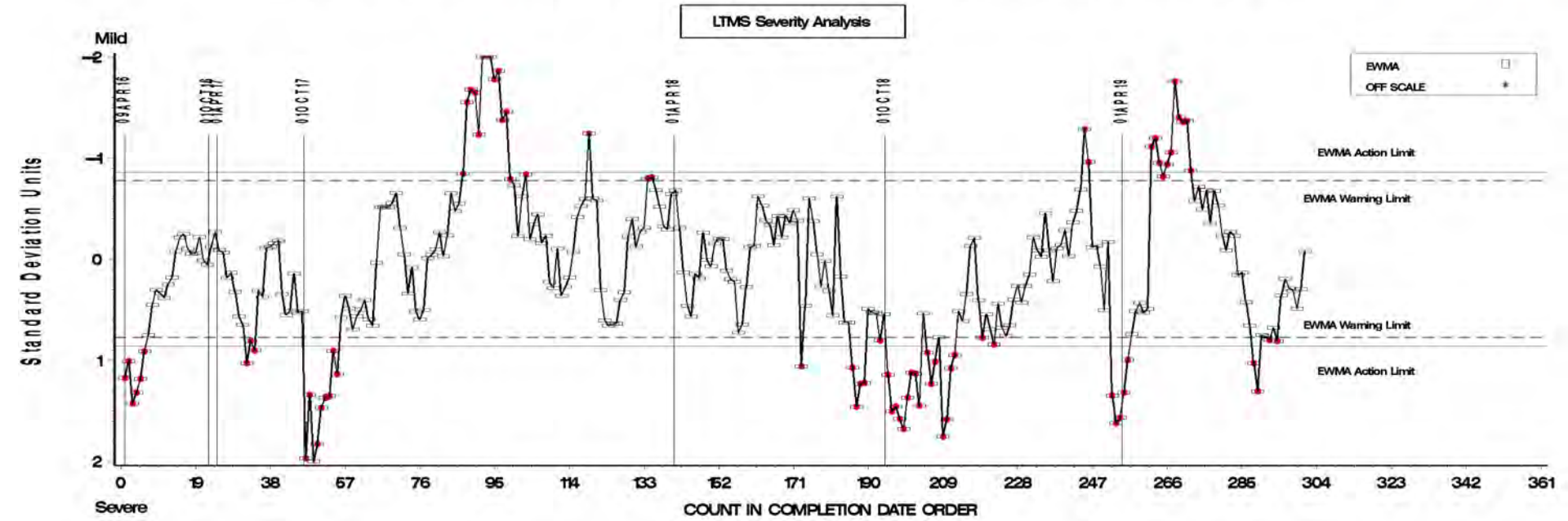
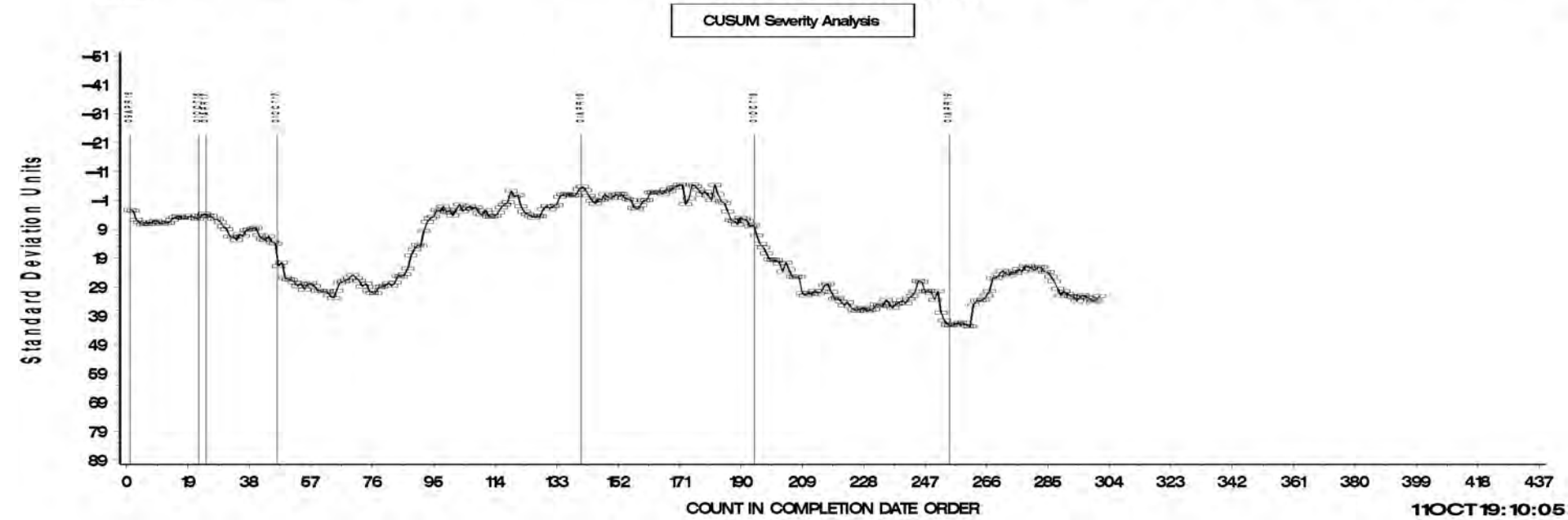
AVERAGE NUMBER OF PREIGNITIONS FROM VALID ITERATIONS





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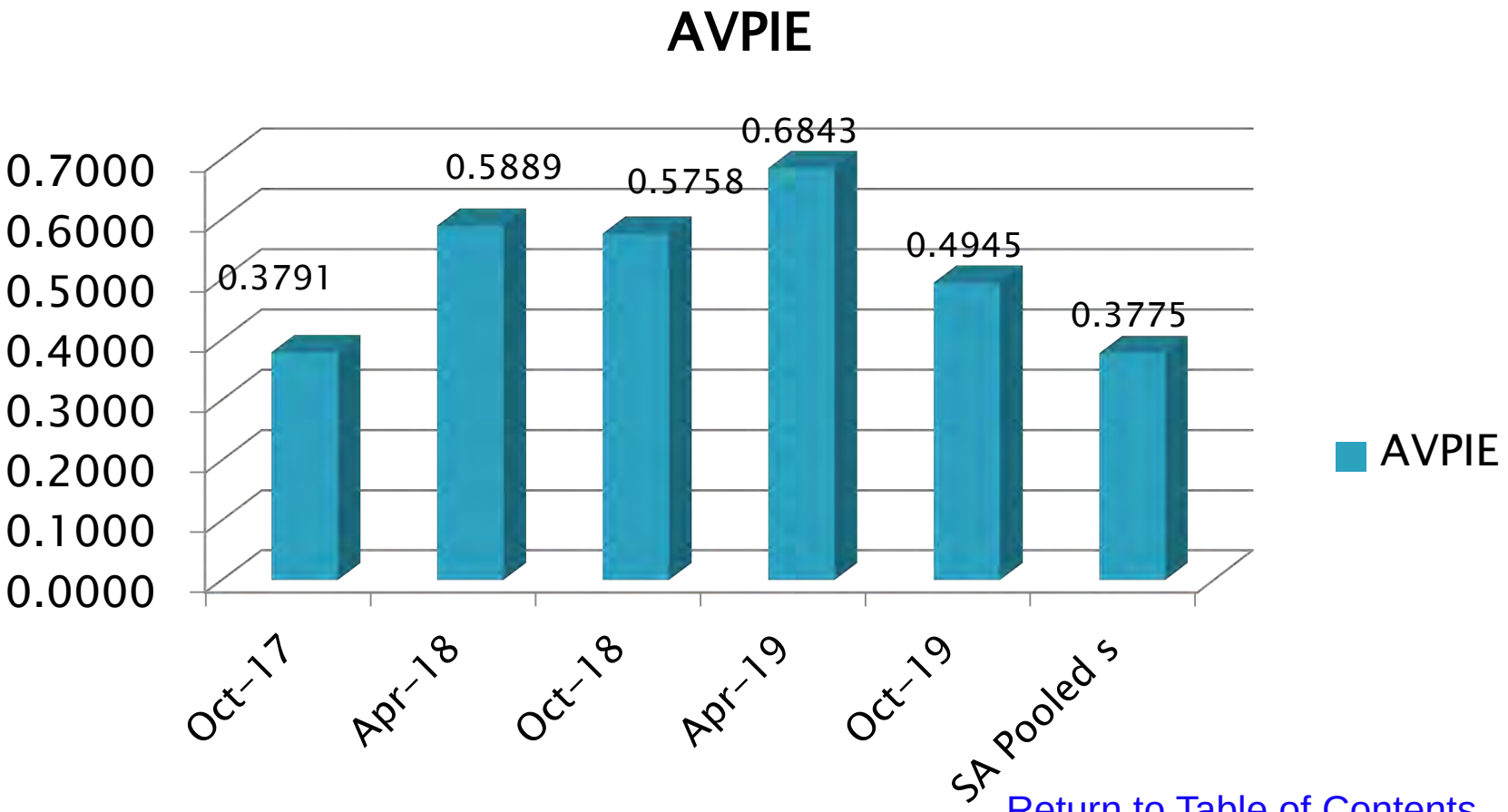
Sequence IX Precision Estimates



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Sequence X

- October 2019

Sequence X Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Statistically Unacceptable Calibration Test	OC	1
Aborted Calibration Test	XC	2
Total Number of Tests		**9**

Sequence X – Failed Tests

Test Status	Number of Tests
CHST Ei Level 3 alarm	1
Total	**1**

Sequence X – Lost Tests*

Test Status	Cause	#
Aborted	Oil Loss due to Venting	1
Aborted	Oil loss during rework	1
Totals		2

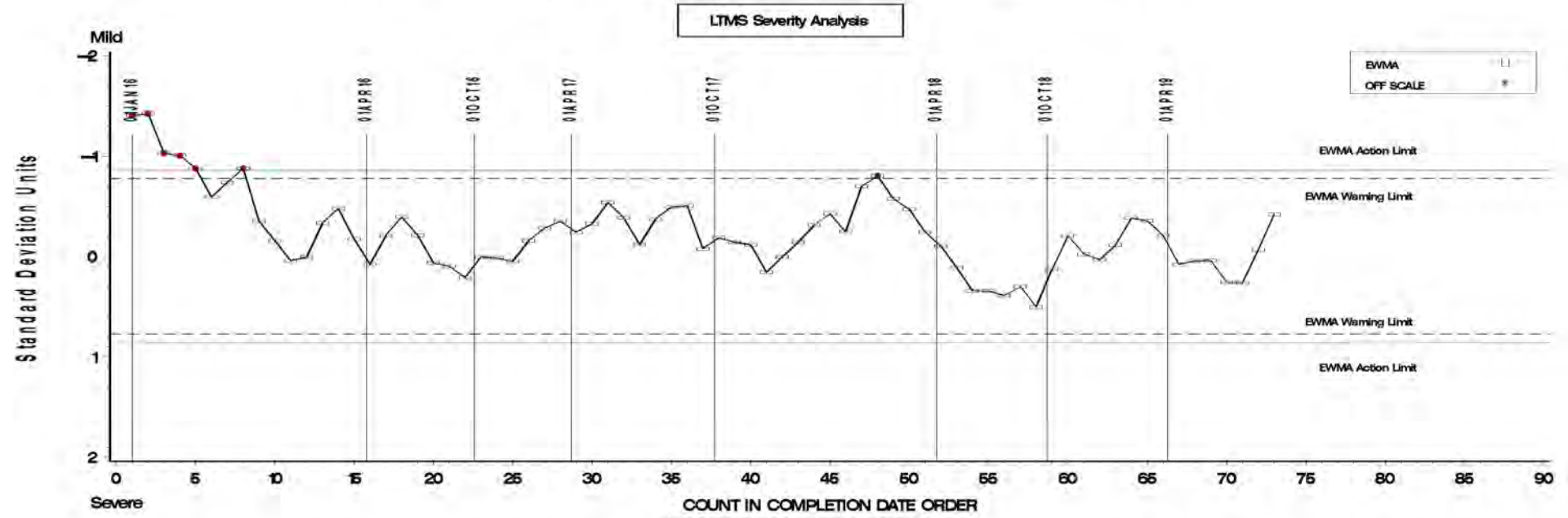
*Invalid and aborted tests

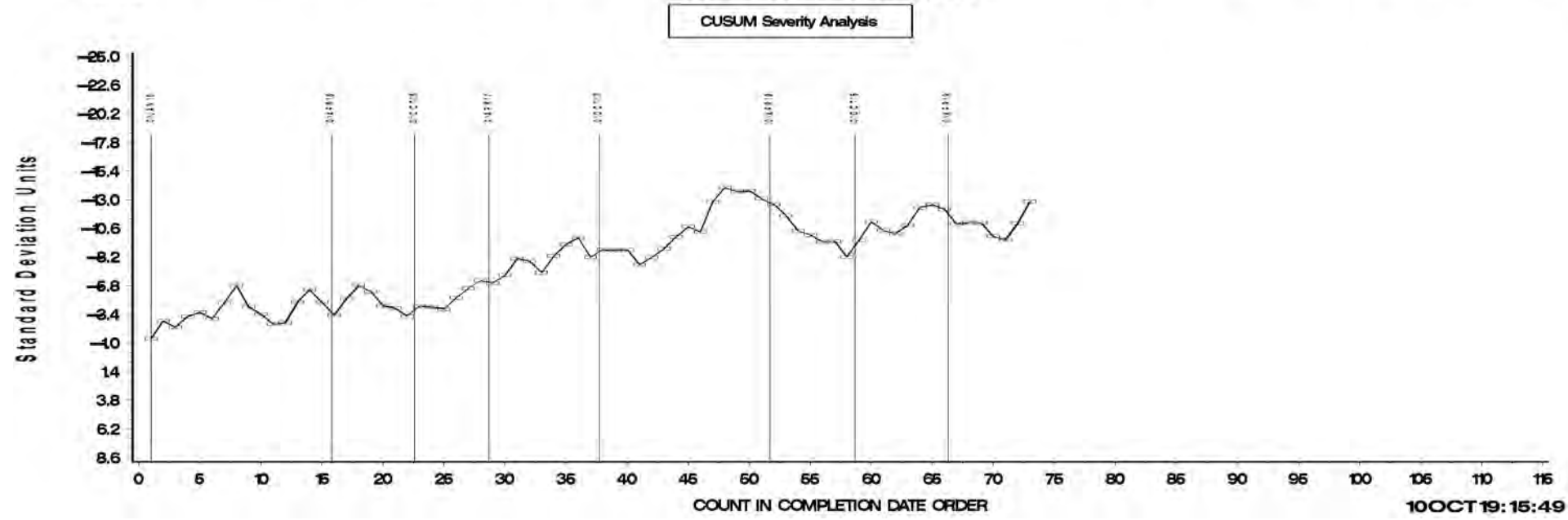
Sequence X Test Severity

- Average Chain Stretch % in control.

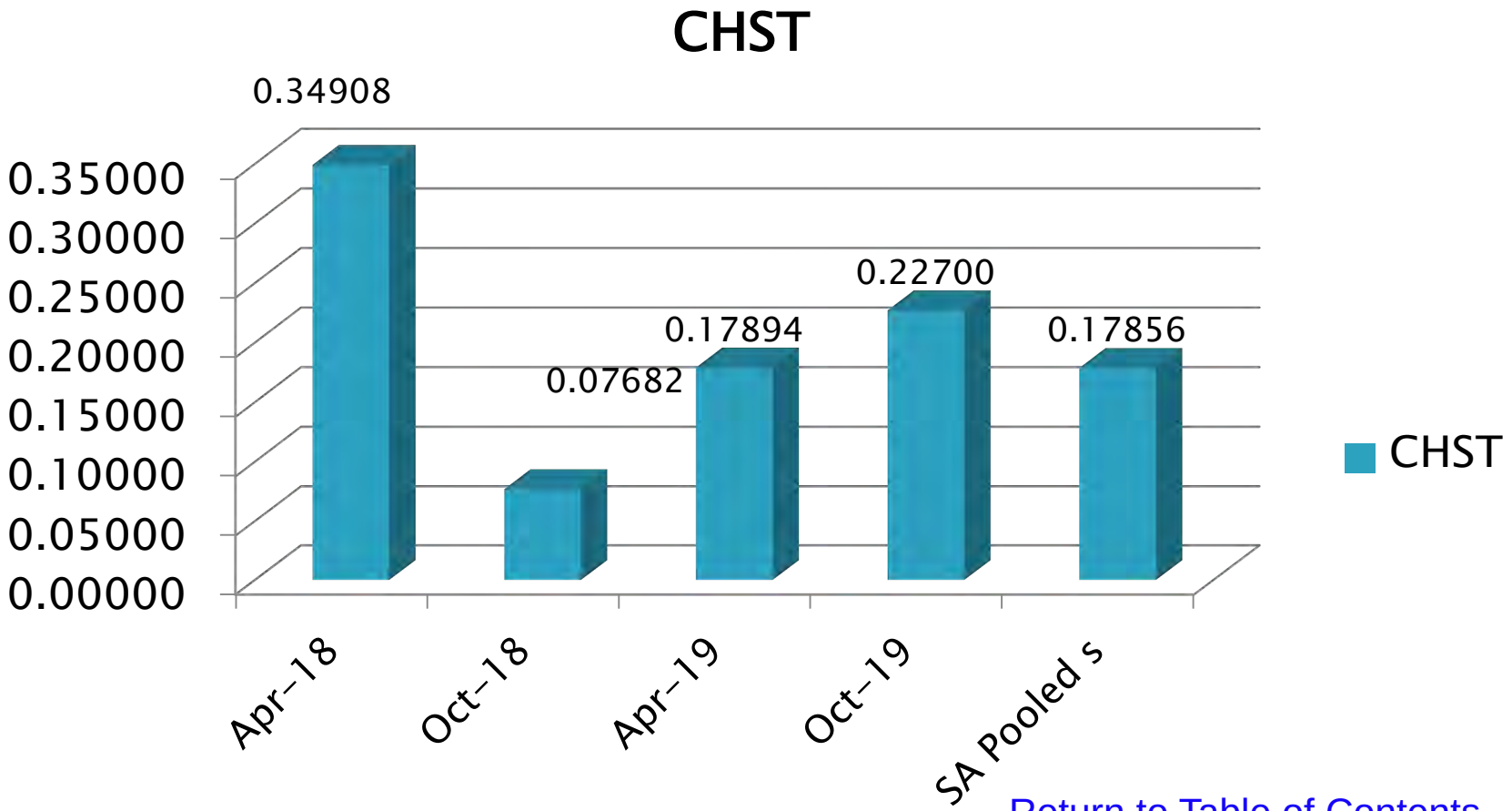
SEQUENCE X INDUSTRY OPERATIONALLY VALID DATA

END OF TEST CHAIN WEAR FINAL RESULT





Sequence X Precision Estimates



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Information Letters

- October 2019

Test Monitoring Center
http://astmtmc.cmu.edu
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Information Letters*

Test	Date	IL	Topic
IIIH	20190503	19-1	Added Appendices to address IIIH60 and IIIH70 hour tests
IIIH	20190523	19-2	Update ultrasonic cleaning fluid supplier, additional clarifications to QI calculations and identified the transformation applied to MRV results
IIIH	20190603	19-3	Added transformation note to table X1.1.
IIIH	20190918	19-4	Correction to Section 12.8 and Addition of Annex (Oxidation & Nitration)
VIE	20190405	19-2	Clarified additional break in in section 10.1.18 as it relates to unacceptable reference tests.
VIF	20190405	19-2	Clarified additional break in in section 10.1.18as it relates to unacceptable reference tests.

*Available from TMC Website

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Reference Oil Inventory

- Actions, Re-blends, Inventories and Estimated Life

Reference Oil Re-blends

- TMC 224
  - Reference oil 224 introduced this period (Seq. IX).
- TMC 300-1
  - The panel began introduction this period; 3 tests run (Seq. IVB).
- TMC 438-2
  - This re-blend is being introduced. One test completed this report period (Seq. IIIH)

Reference Oil Re-blends (cont)

- TMC 1006-2
  - This oil is being held for IVA and IVB break-in. The panel may wish to use another oil for IVB Break-in as 1006-2 can not be re-blended.
- TMC 542-4
  - The panel agreed to begin to introduce this period. One test (VIF) reported this period.

Reference Oil Re-blends (cont)

- TMC 1009-1
  - The Sequence V panel agreed to introduce this reblend for Sequence VH test. Three tests reported this period.
- TMC 1011-1
  - Reblend is now available (IVB/VH/VIF/X).

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	50	390	50	3 years
221	IX	2120	300	106	60	2.5+ years
222*	IX	1040	60	0	35	<1 year
224	IX	1026	80	847	105	4+ years
270	X	1100	15	848	30	5 years
271	X	980	25	779	35	5 years
300-1	IVB	378	5	342	24	5 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	39	811	20	5+ years
436	IIIH	1100	8	742.5	21	5+ years
438-1	IIIH	605	8.5	0	10	<1 year
438-2	IIIH	540	27.5	511.5	15	5 years
542-3	VIE/VIF	997	82	5	36	<1 Year
542-4	VIE/VIF	1100	120	781	90	3+ Years
543	VIF	1100	133	397	60	1.5 Years
544	VIE	897	0	275	54	4+ 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	71	6	5+ years
940	VH	560	18	118	24	3+ years
1006-2	IVA, VIII	5500	250	422	75	1-2 years
1009-1	VH, VIII	1100	0	1094	6	5 years
1010-1	VIE	1760	109	369	66	1.5 years
1011	IVB/VH/VIF/X	1100	195	197	130	<1 year
1011-1	IVB/VH/VIF/X	1395	0	1395	0	5+ years
1012	IVB	2200	52	1721	45	5+ years

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LTMS Deviations

- April 1, 2019 – September 30, 2019

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

- April 1, 2019 –
  September 30, 2019

Quality Index Deviations

- One Quality Index Deviation this Report Period.
  - IVB – Fuel Rail temperature (Lab A)

Quality Index Deviations

Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIH	5
IVA	30
IVB	1
VH	5
IX	1
X	2

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TMC Laboratory Visits

- April 1, 2019 –
  September 30, 2019

TMC Lab Visits

Test	Number of Labs Visited
IIIH	1
VH	2
VIE/VIF	1
X	2

Lab Visit Issues

- Seq. X
  - Exhaust backpressure and temperature probes not located properly (2 labs).

Labs have notified the TMC that these items were corrected or were corrected during the visit.

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Test Area Timelines

- April 1, 2019 –
  September 30, 2019

Test Area Timeline Additions*

Test	Date	Topic	IL
IIIH	20190510	Added IIIH60 and IIIH70 procedures to the Sequence III method.	19-1
IIIH	20190523	Additional Brulin solution for ultrasonic cleaner and corrected table 7 to show transformation applied to MRV	19-2
IIIH	20190603	Added note to Table X1.1 to show MRV has natural log transformation	19-3
IIIH	20190918	Added Annex A18 and modified Section 12.8 to address oxidation and nitration measurements	19-4
VIE	20190411	Clarified when additional break in can be conducted after an unacceptable reference	19-2
VIF	20190411	Clarified when additional break in can be conducted after an unacceptable reference	19-2

*As of 09/30/2019

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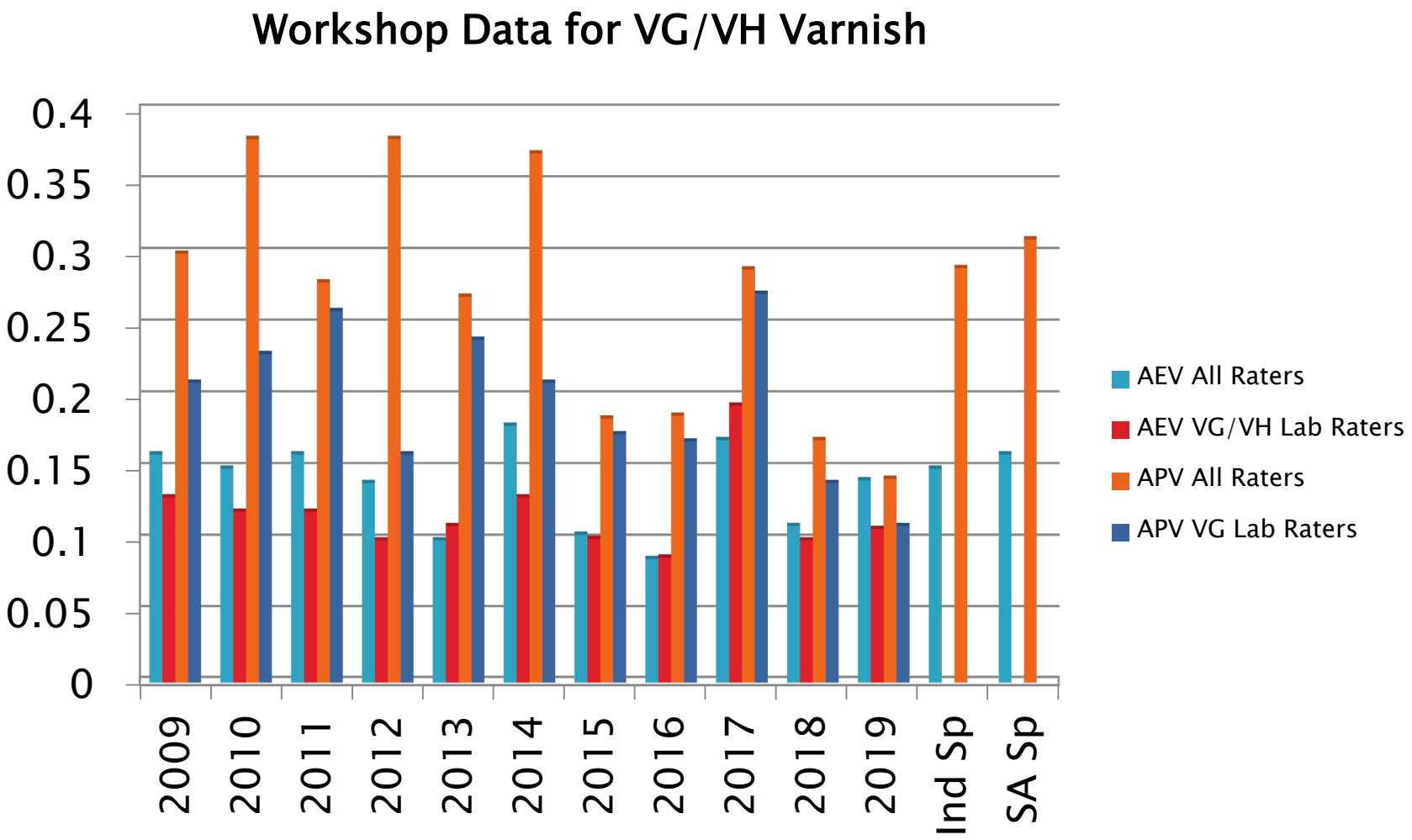
Rating Workshop Data

- 2019 Light Duty Workshop

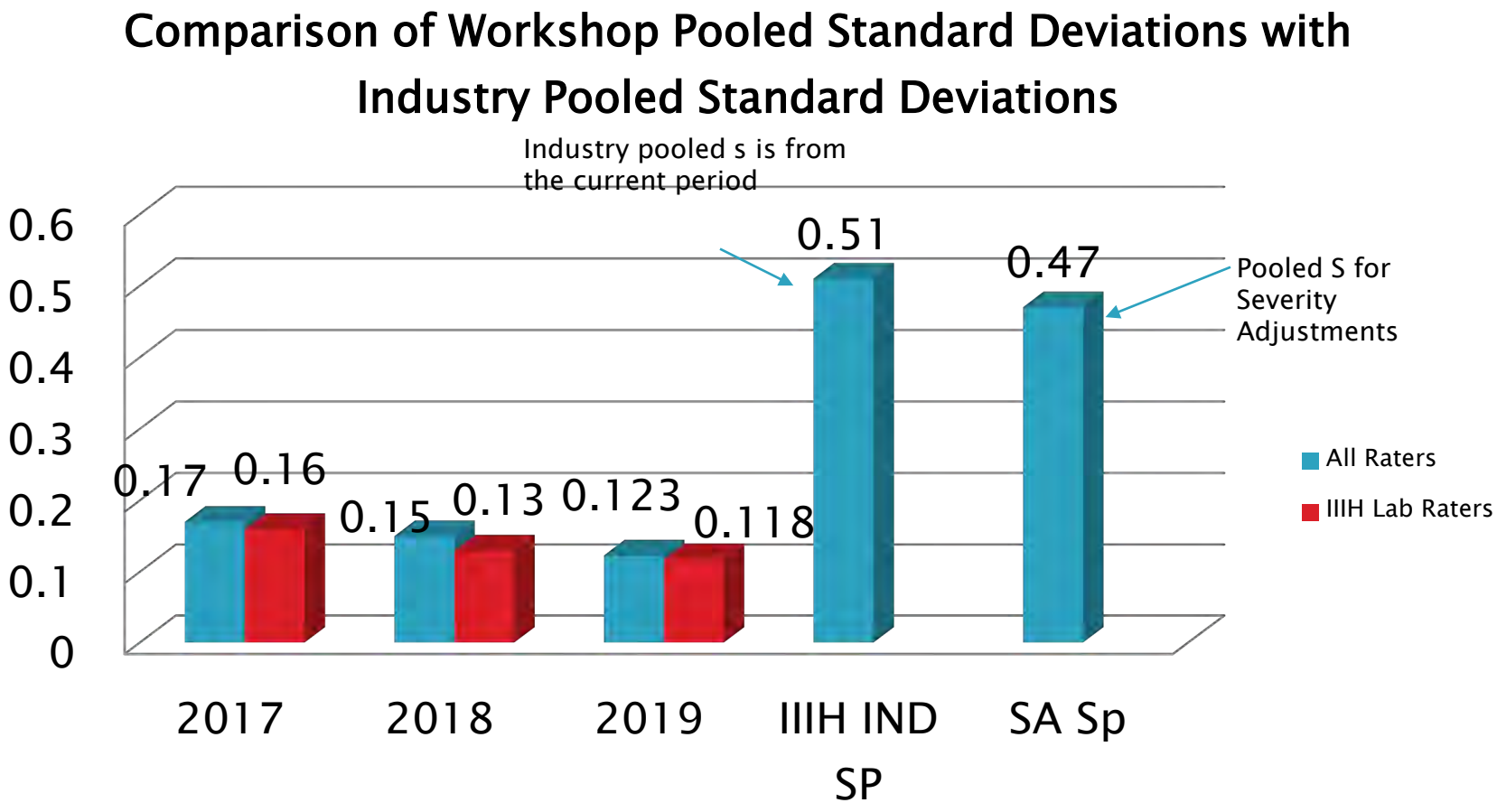
Rating Workshop Data

- Summary of Precision Data From Light Duty Rating workshops:
  - VH Average Piston and Average Engine Varnish.
  - IIIH WPD

Sequence VG/VH Precision-Rating Workshop Data



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

- www.astmtmc.cmu.edu

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