



A Program of ASTM International

Test Monitoring Center

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ASTM D02.B2 Semi-Annual Report Heavy Duty Reference Oil Testing

Spring 2018

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Heavy Duty Testing

Executive Summary

- ▶ Reference Oils
 - 832
 - Re-blend complete and available at TMC in near future.
- ▶ Test Issues
 - COAT standardized aeration enclosures built and testing ongoing.

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Calibrated Labs and Stands*

Test	Labs	Stands
1K	2	2
1N	2	5
1M-PC	1	1
1P	2	2
1R	1	1
C13	3	3
ISB	2	2
ISM	2	2
EOAT	0	0
RFWT	0	0
T-8/E	2	3
T-11	3	4
T-12/T-12A	3/3	3/3
T-13	4	5
COAT	0	0
DD13	1	1

*As of 03/31/2018

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SCOTE 1K

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1 K Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		1

1 K Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

1 K Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

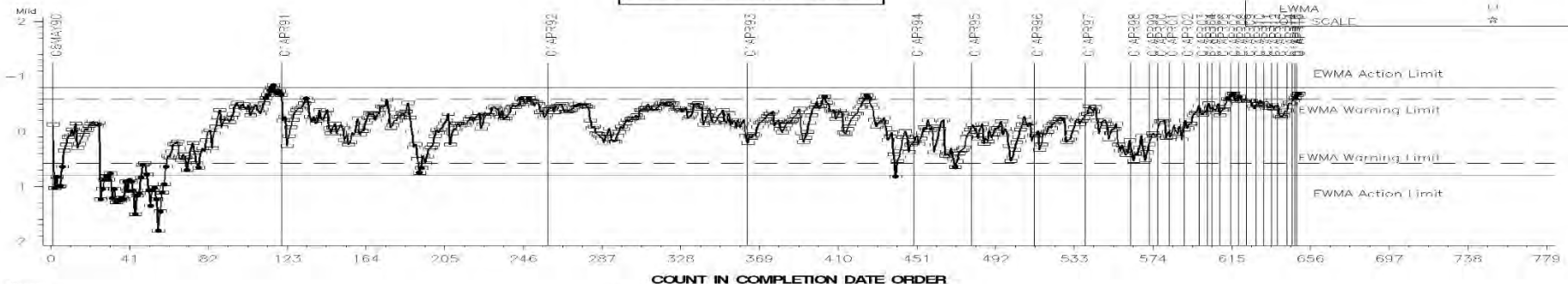
*Invalid and aborted tests

1 K Test Severity

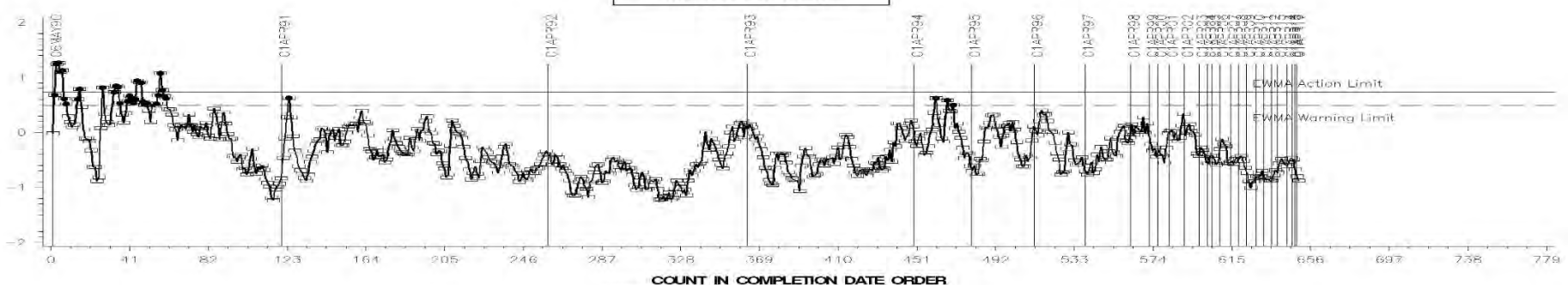
- ▶ TGF is in warning alarm in the mild direction
- ▶ BSOC is in action alarm in the mild direction
- ▶ WDK, TLHC and EOTOC are in control

FINAL TGF

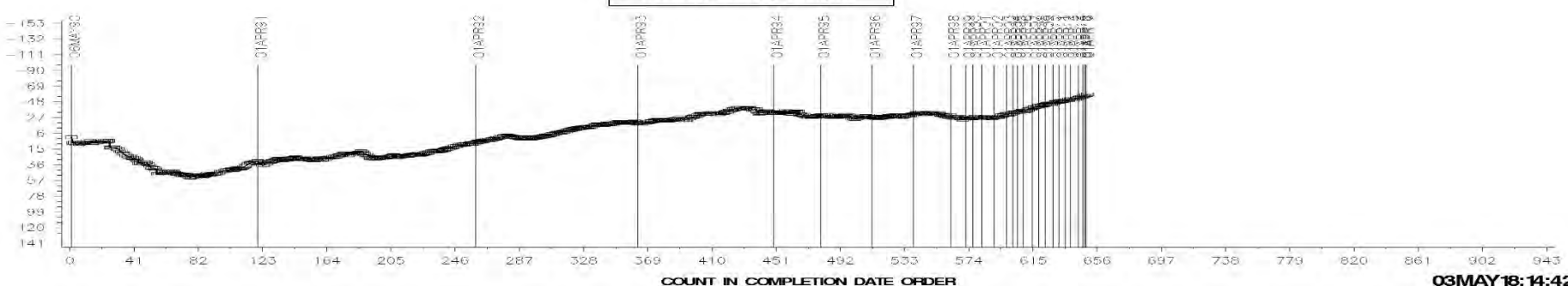
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



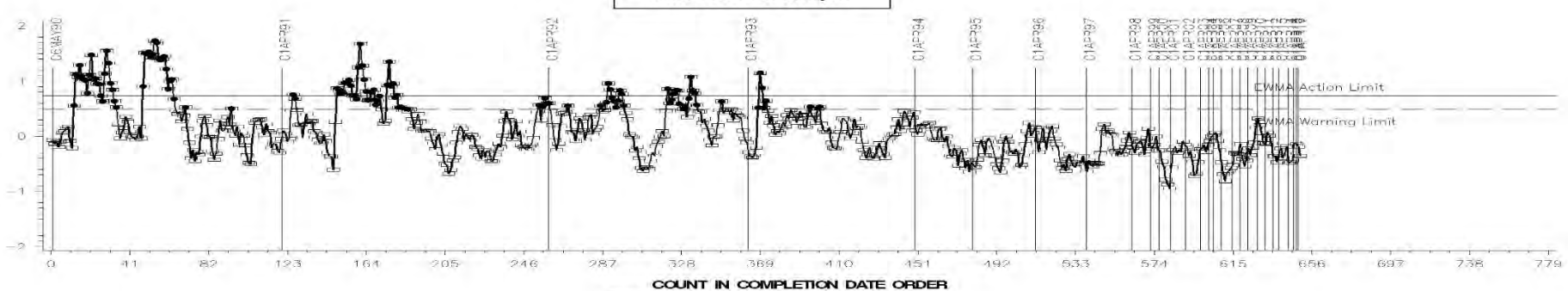
03MAY18: 14:42

FINAL Weighted Total Demerits

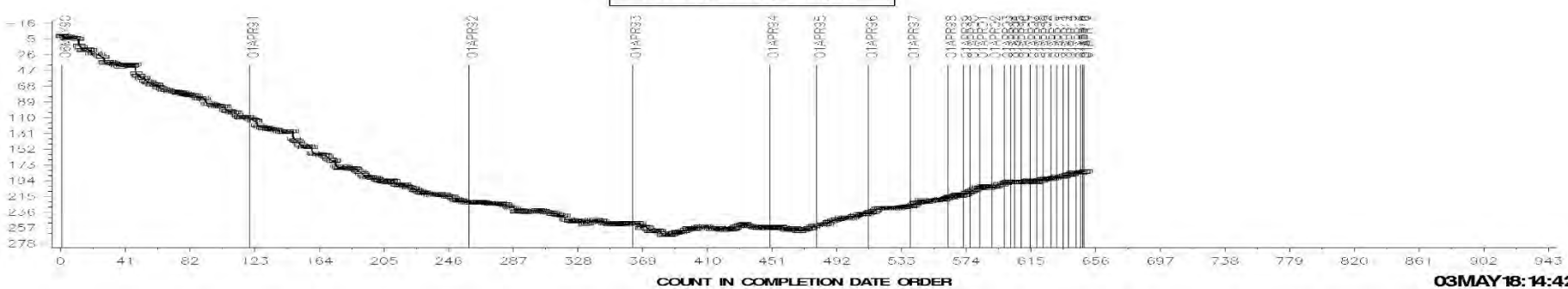
LTMS Severity Analysis



LTMS Precision Analysis



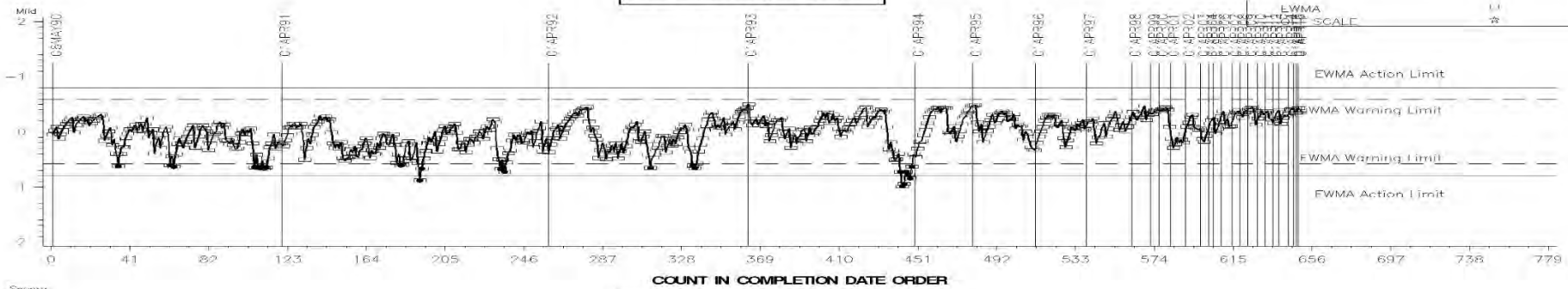
CUSUM Severity Analysis



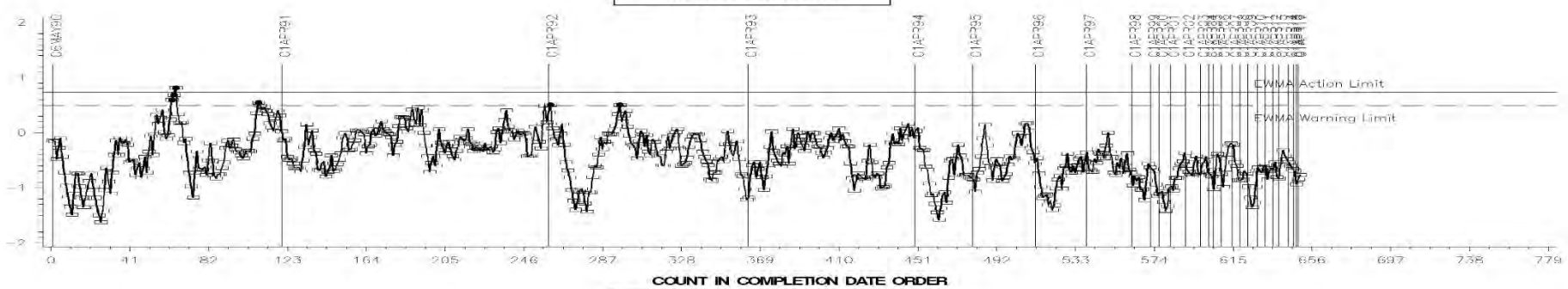
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FINAL TLHC

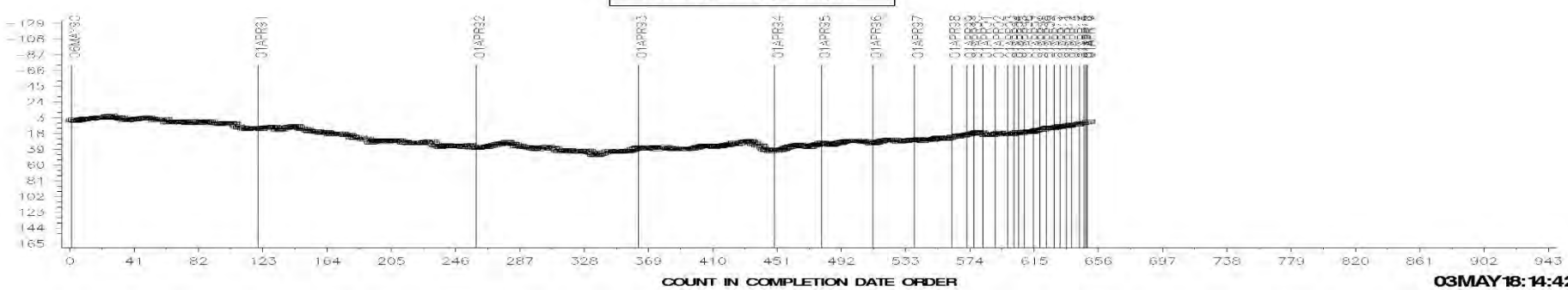
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

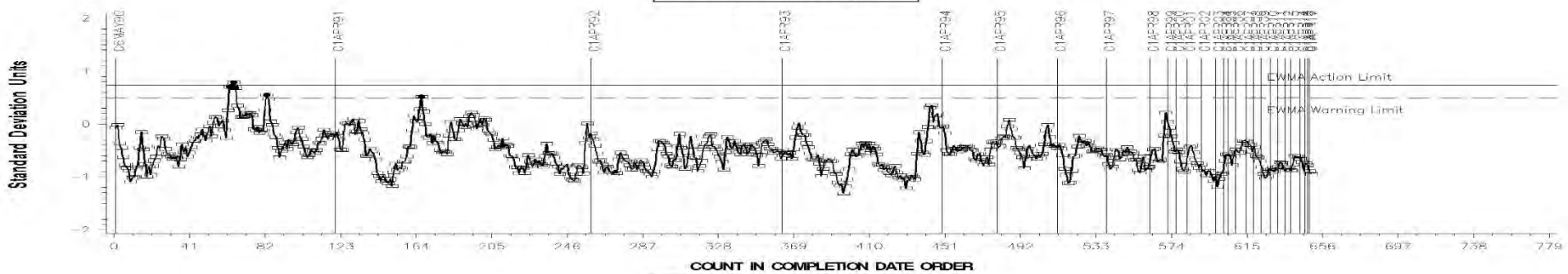


03MAY18: 14:42

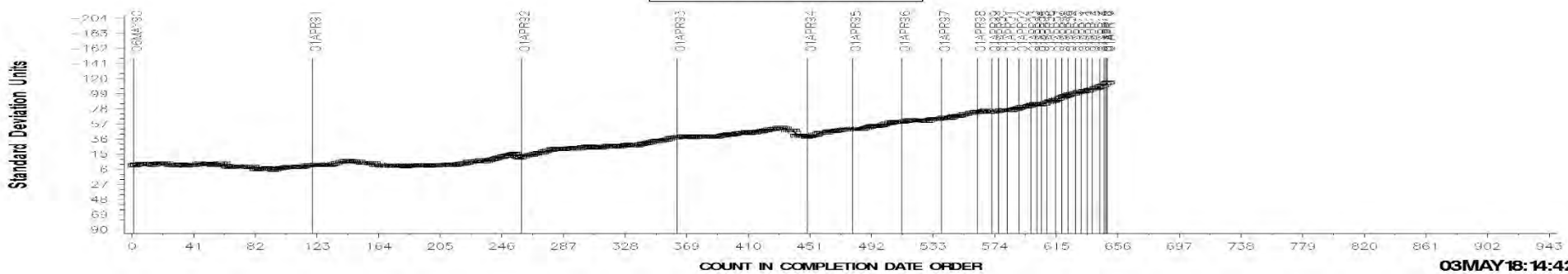
FINAL BSOC LTMS Severity Analysis



LTMS Precision Analysis



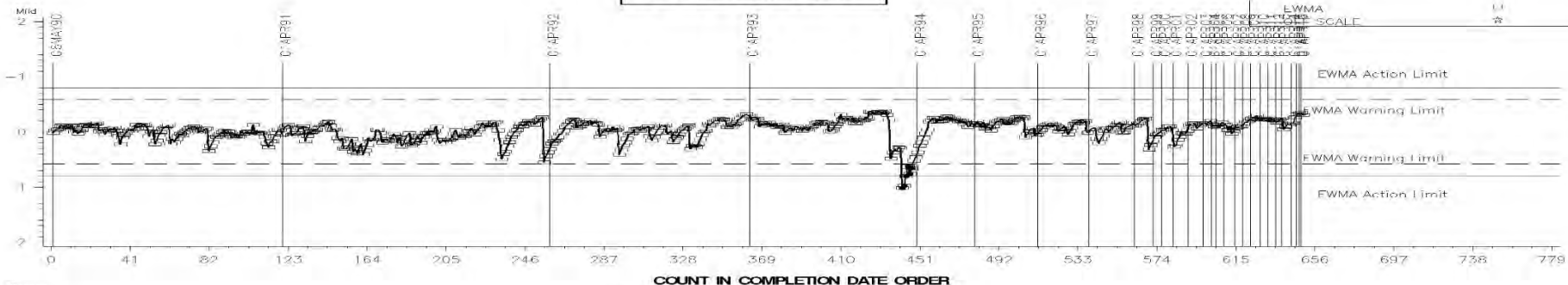
CUSUM Severity Analysis



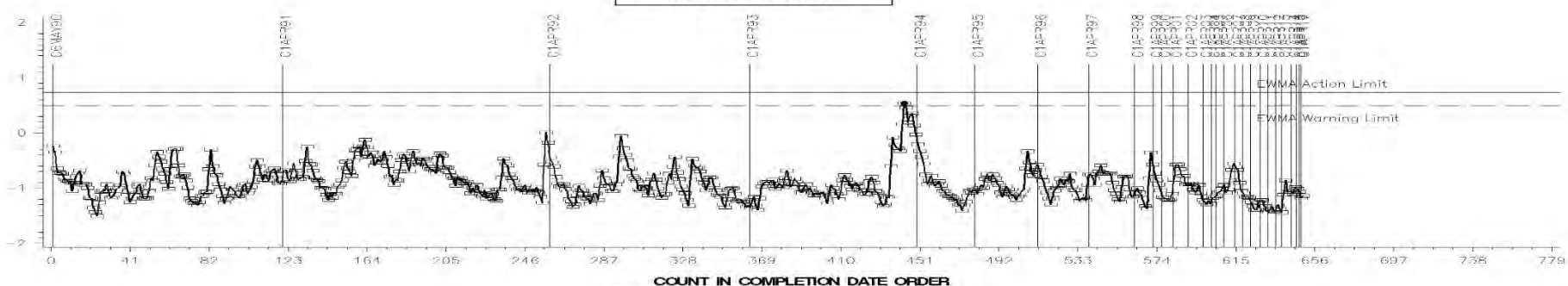
03MAY18: 14:42

FINAL EOTC

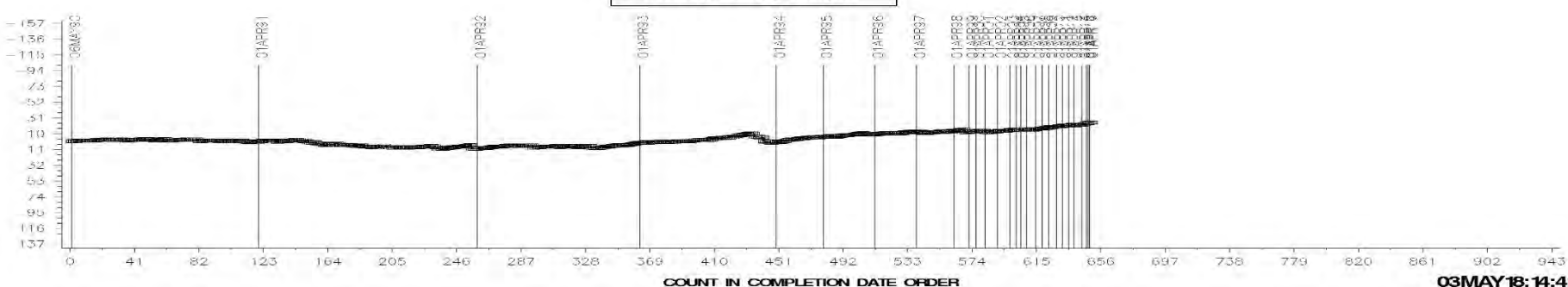
LTMS Severity Analysis



LTMS Precision Analysis

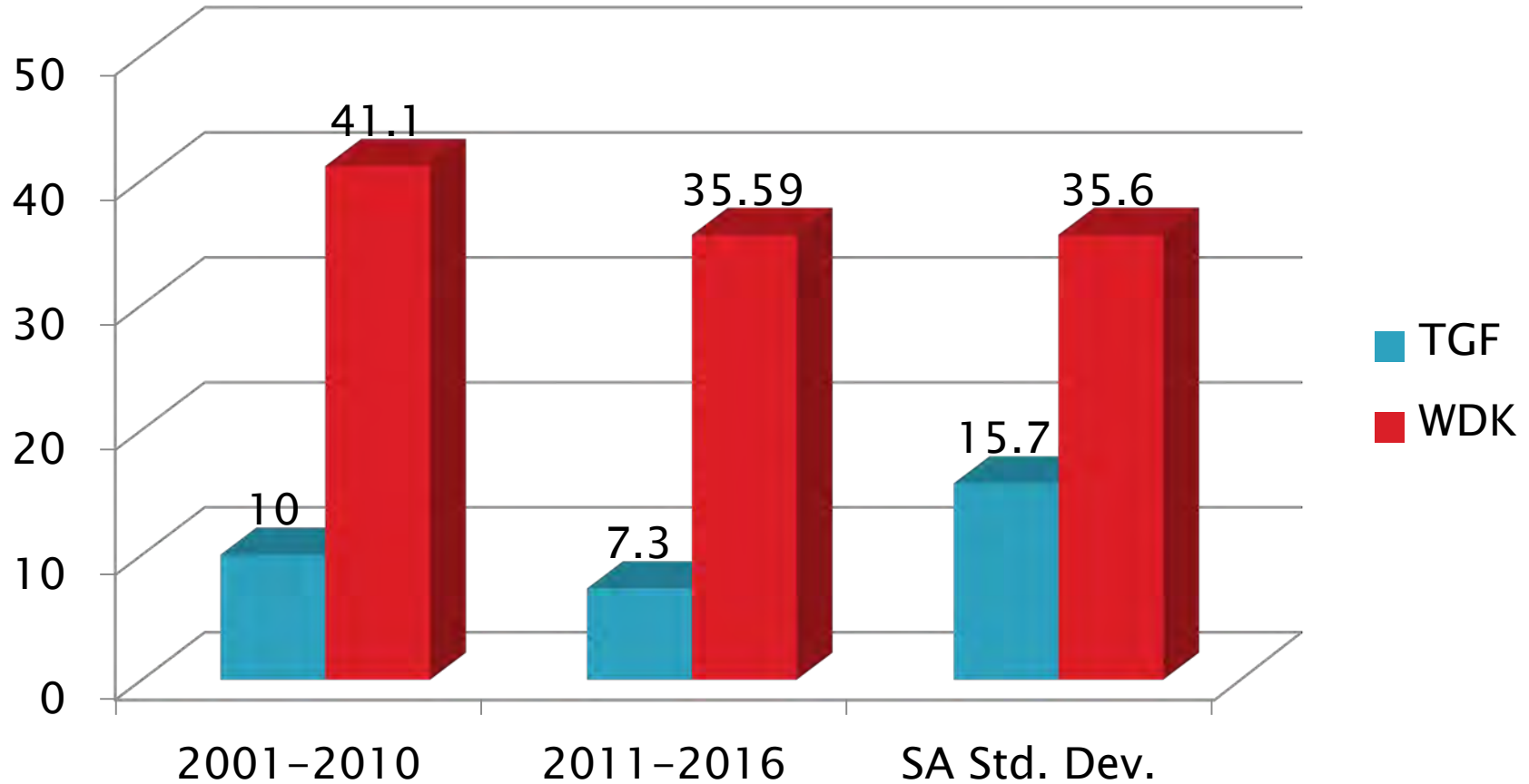


CUSUM Severity Analysis

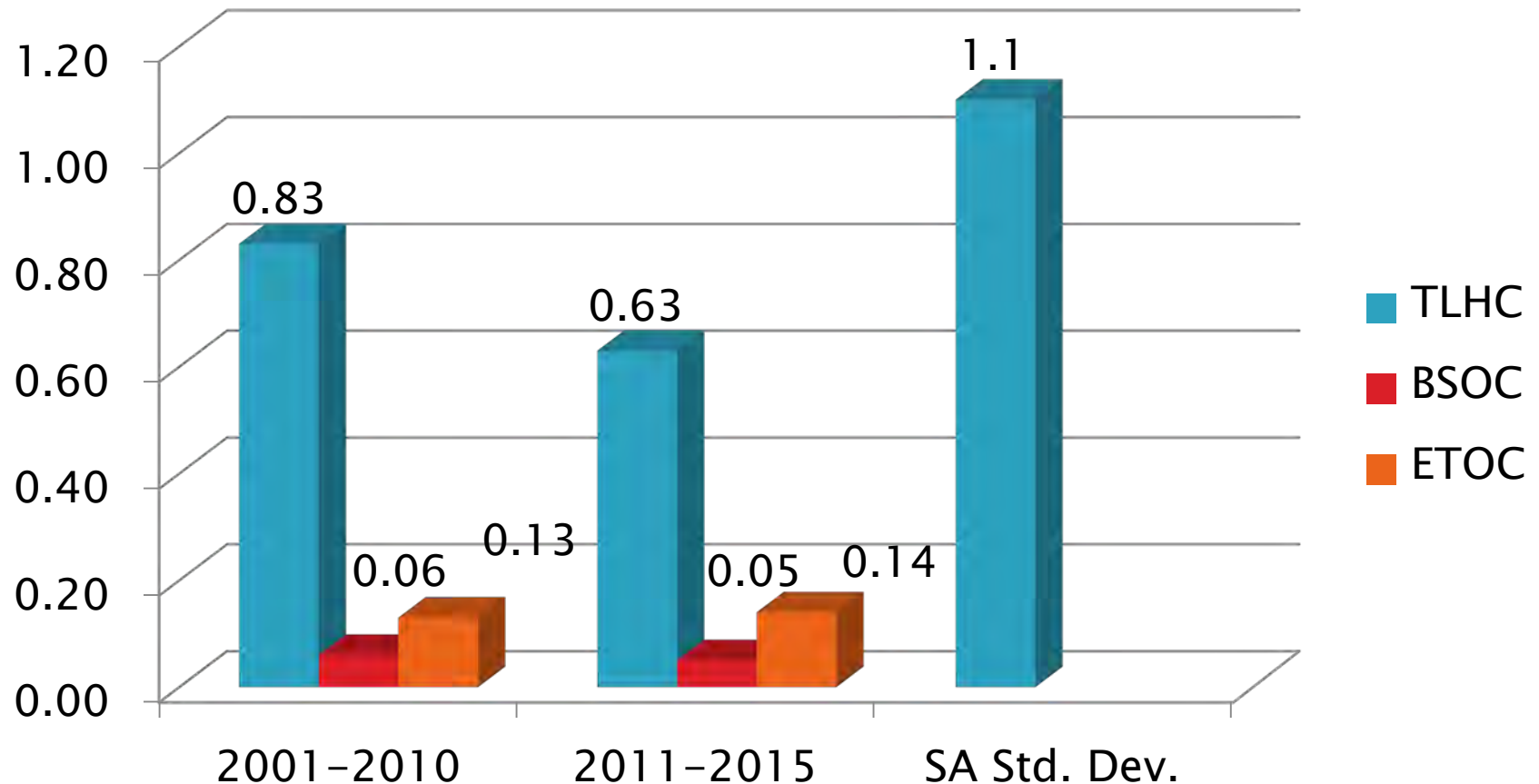


03MAY18: 14:42

1 K Precision Estimates



1 K Precision Estimates



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SCOTE 1N

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1 N Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	3
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Informational	NN	0
Total		3

1 N Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

1 N Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

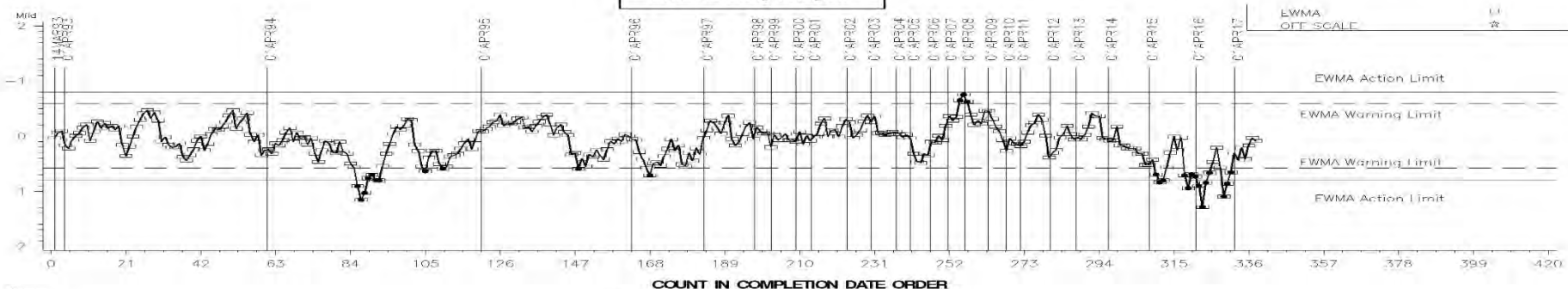
*Invalid and aborted tests

1 N Test Severity

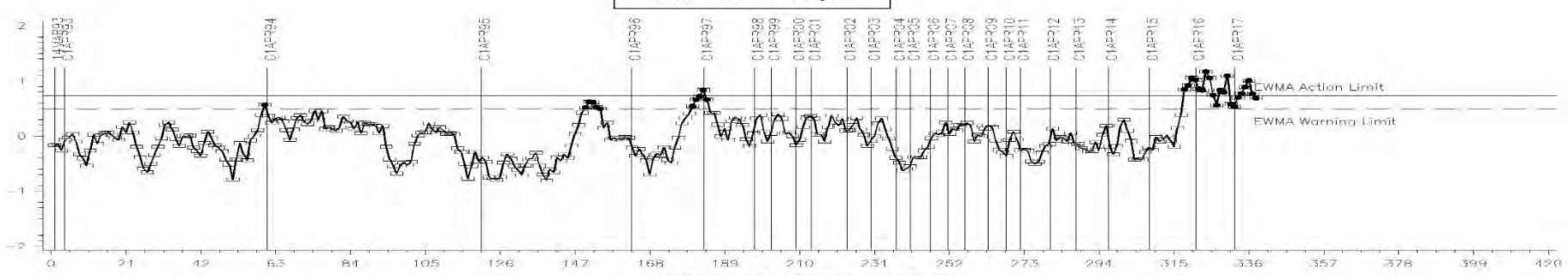
- ▶ WDN in severity action alarm mild direction.
- ▶ TGF in precision warning alarm.
- ▶ TLHC and BSOC in control
- ▶ Severity trends are being evaluated by surveillance panel

FINAL CORRECTED TGF

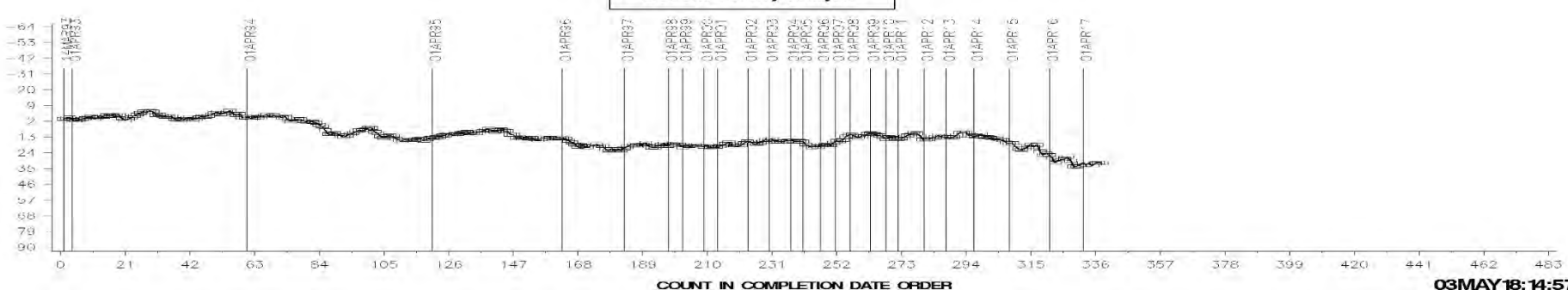
LTMS Severity Analysis



LTMS Precision Analysis



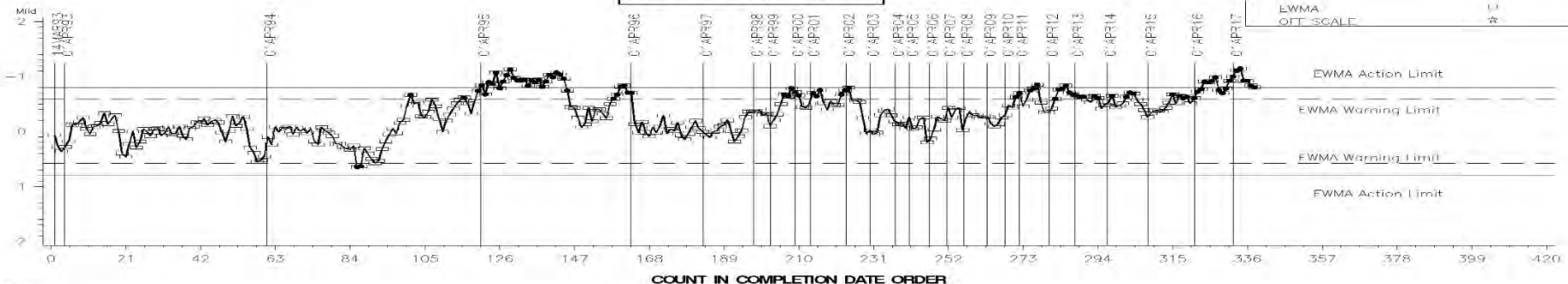
CUSUM Severity Analysis



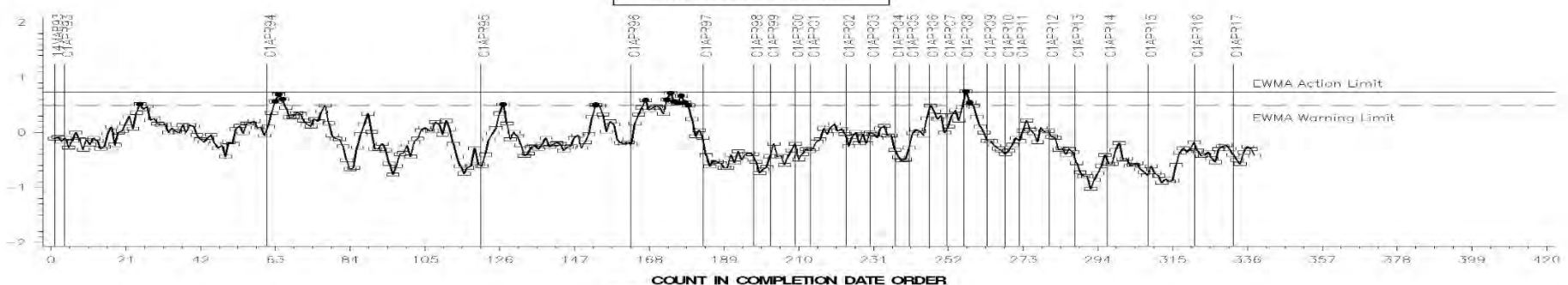
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Weighted Total Demerits

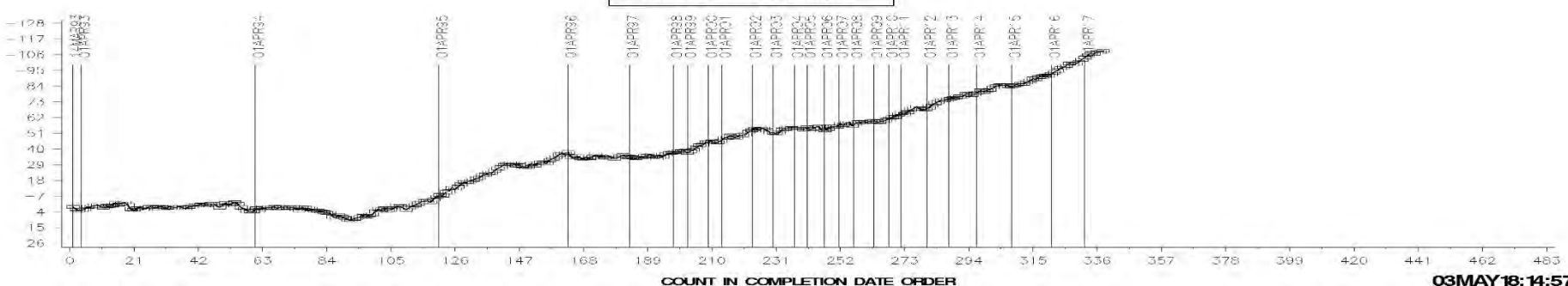
LTMS Severity Analysis



LTMS Precision Analysis



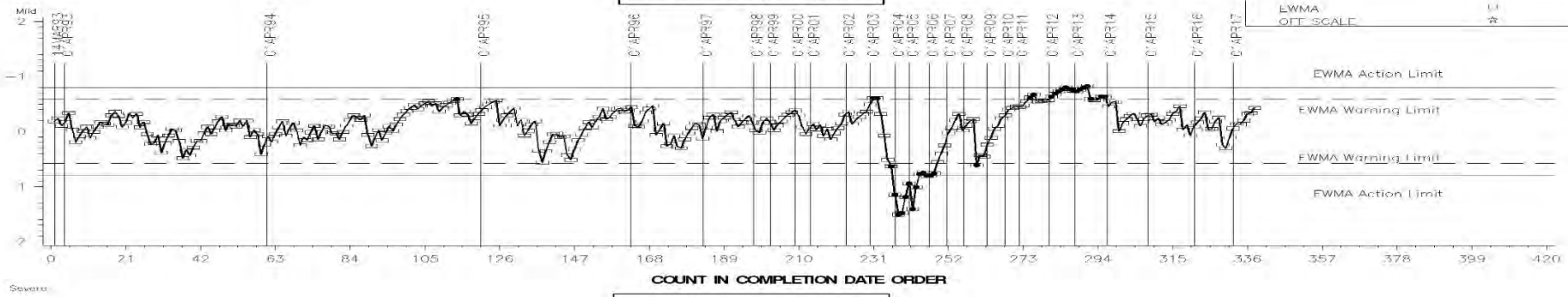
CUSUM Severity Analysis



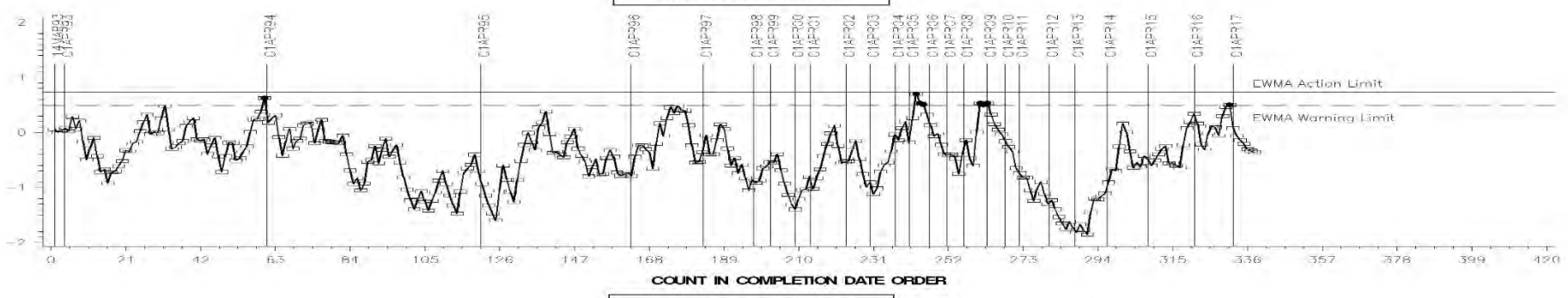
03MAY18: 14:57

Top Land Heavy Carbon

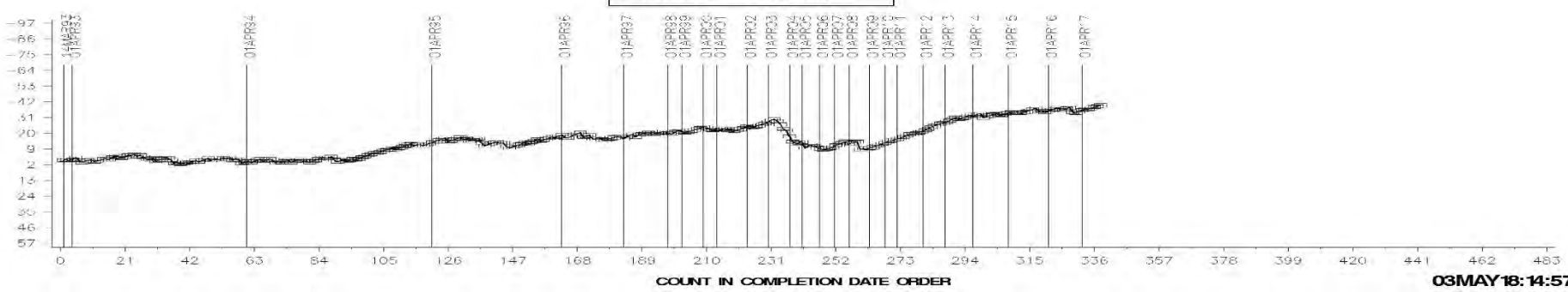
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



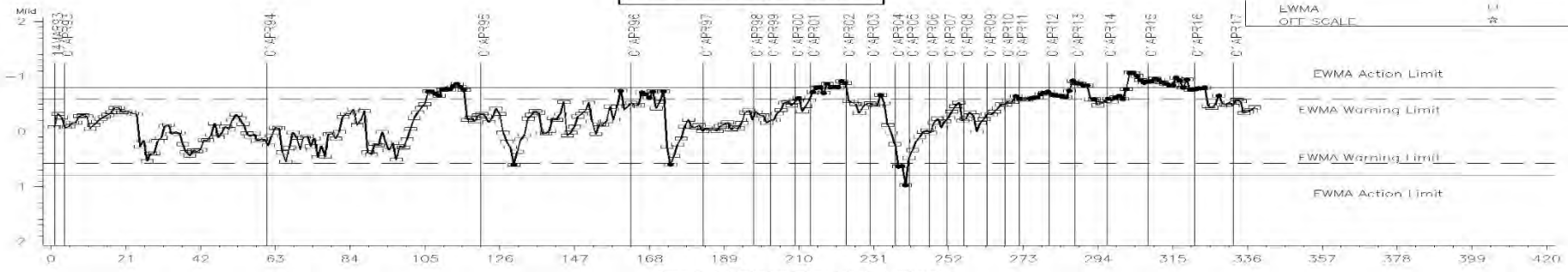
03MAY18: 14:57

CATERPILLAR 1N INDUSTRY OPERATIONAL VALID DATA



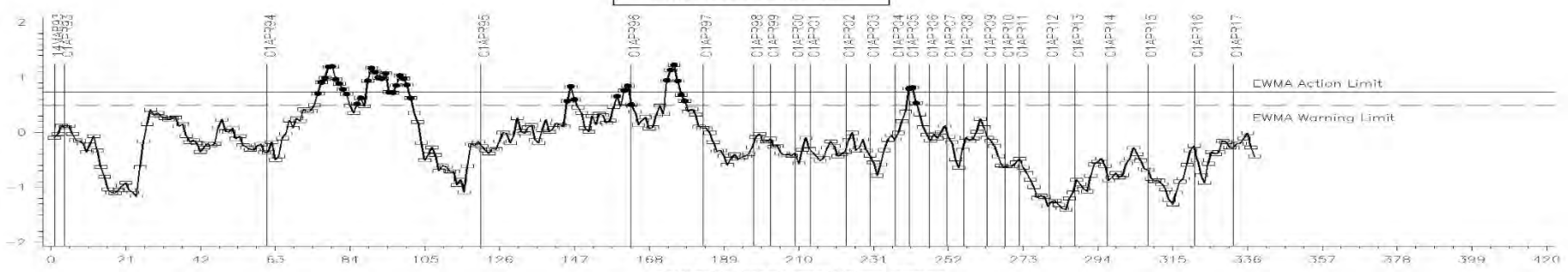
BSOC

LTMS Severity Analysis



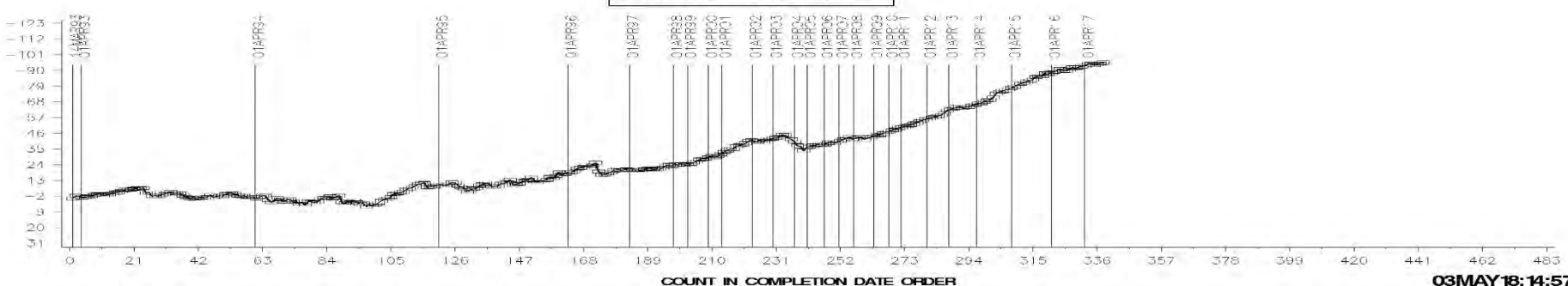
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

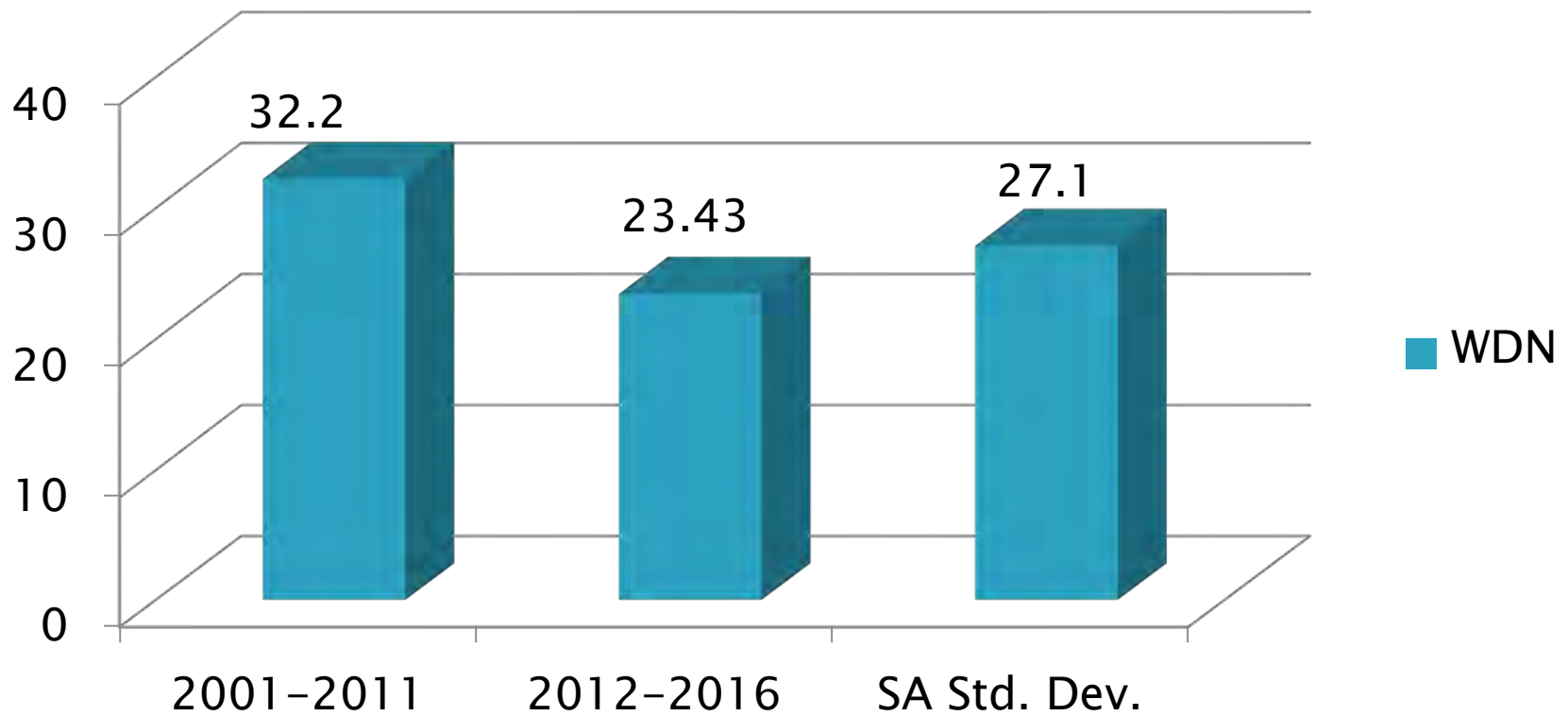


03MAY18: 14:57

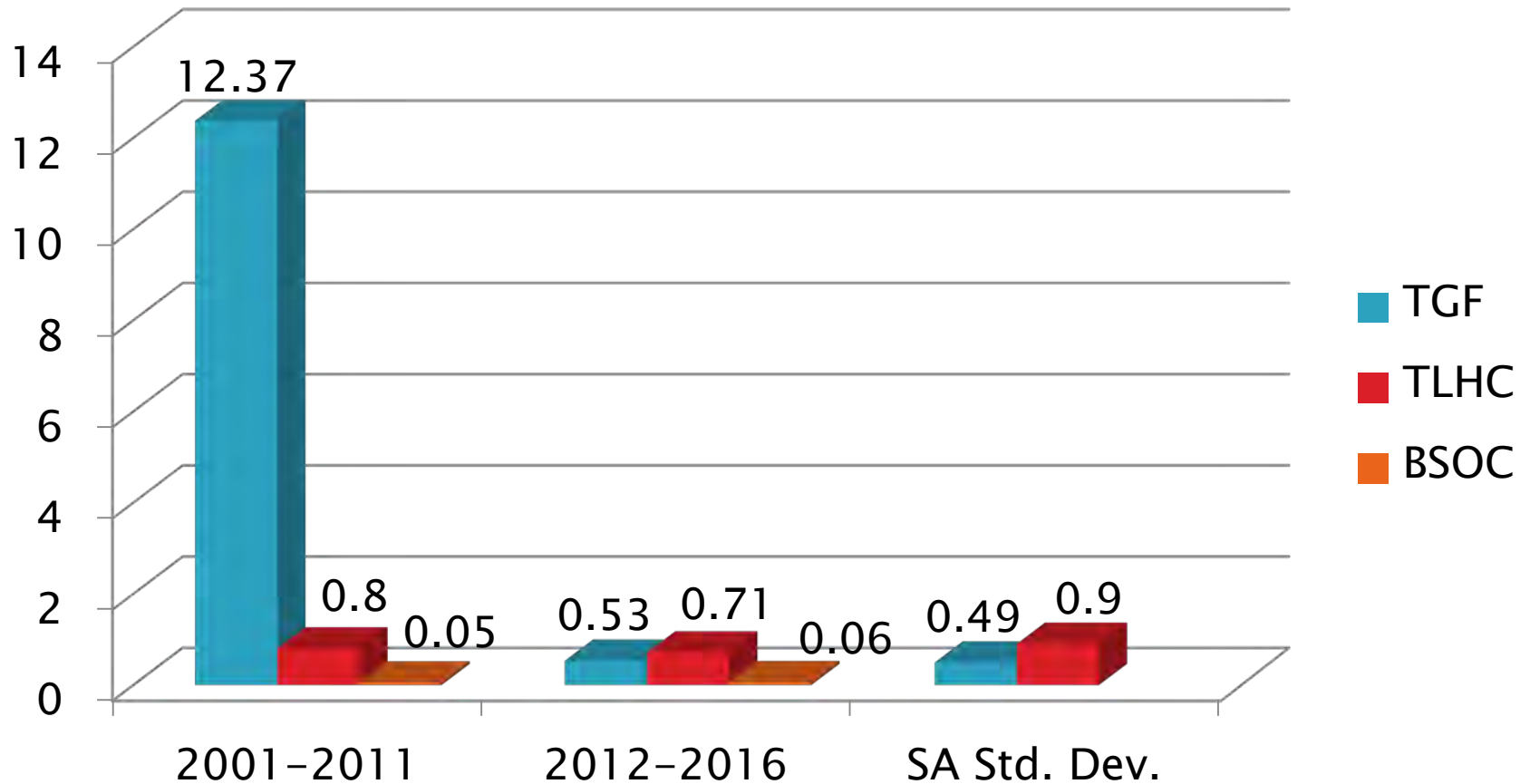


1 N Precision Estimates

WDN



1N Precision Estimates



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1 M-PC Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Total		1

1 M-PC Failed Tests

Failed Parameter	Number of Tests
No Failed Test	0
Total	0

1 M-PC Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

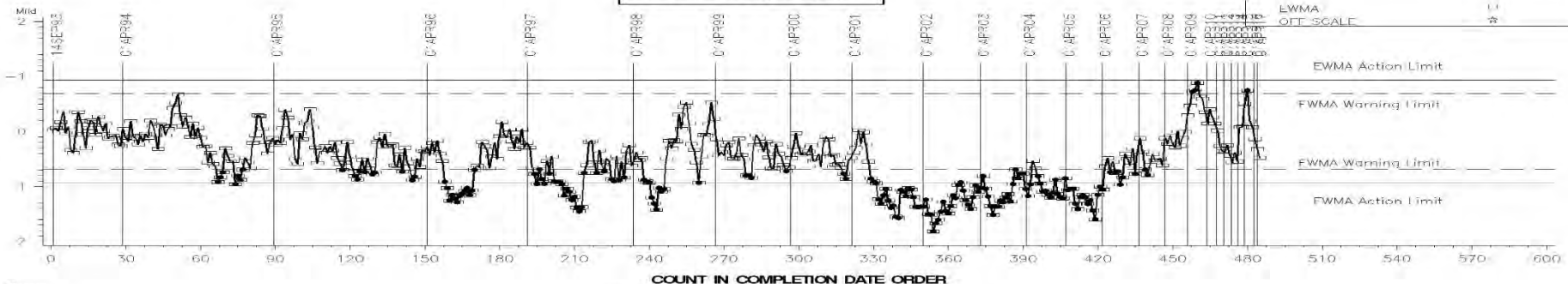
*Invalid and aborted tests

1 M-PC Test Severity

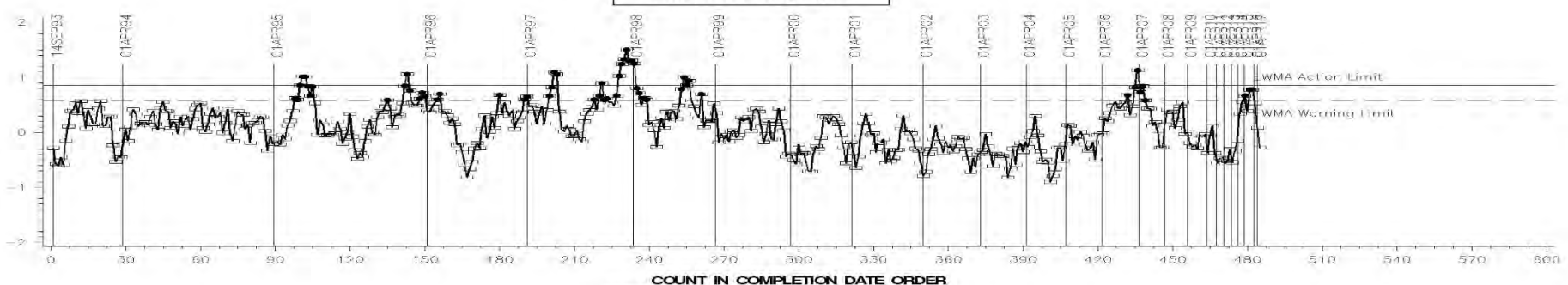
- ▶ TGF and WTD are in control.

FINAL TOP GROOVE FILLING

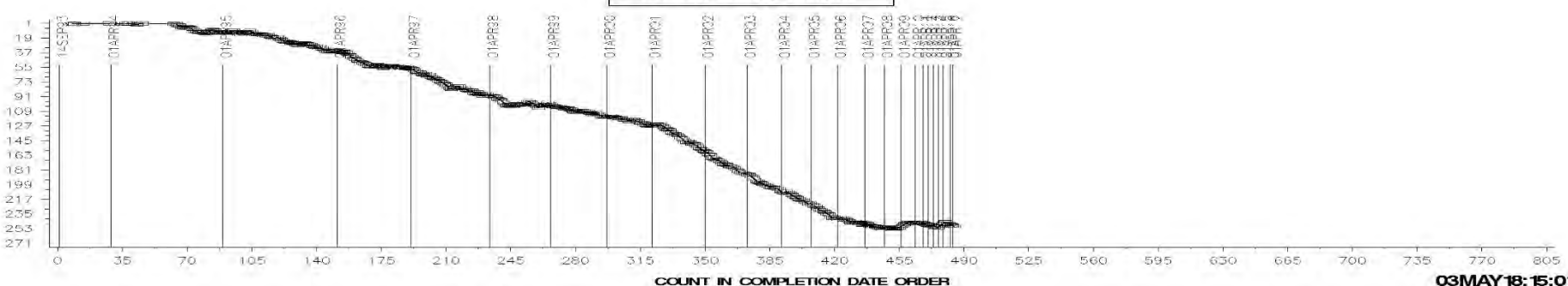
LTMS Severity Analysis



LTMS Precision Analysis



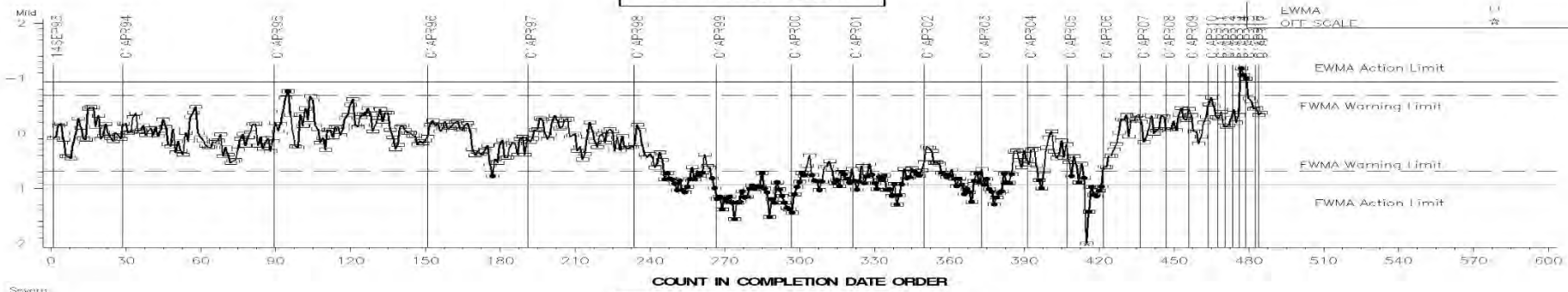
CUSUM Severity Analysis



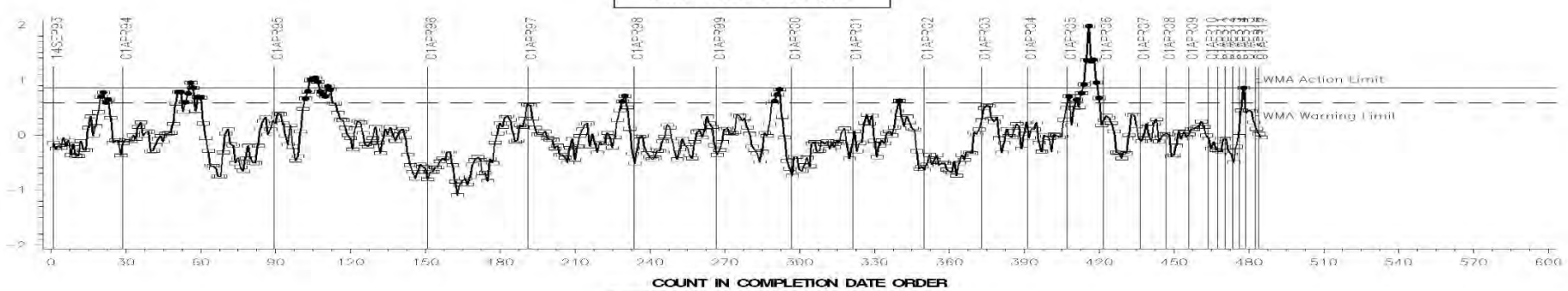
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Weighted Total Demerits

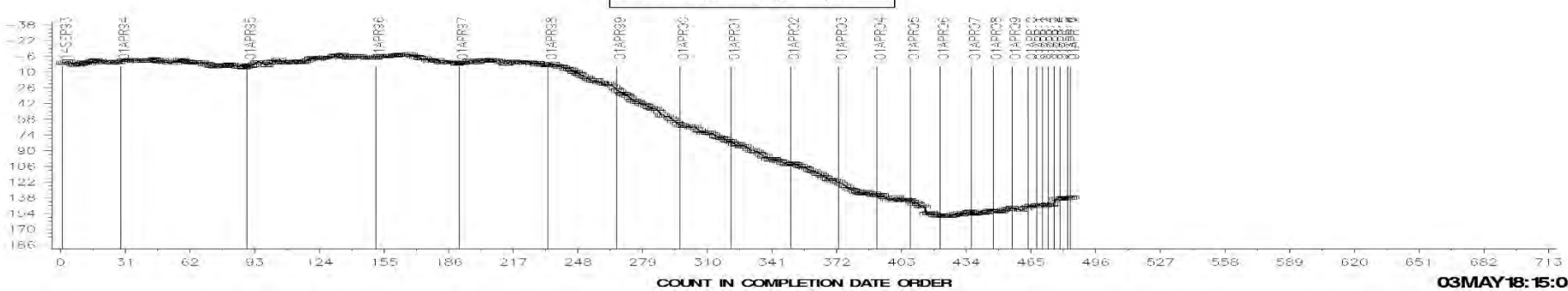
LTMS Severity Analysis



LTMS Precision Analysis

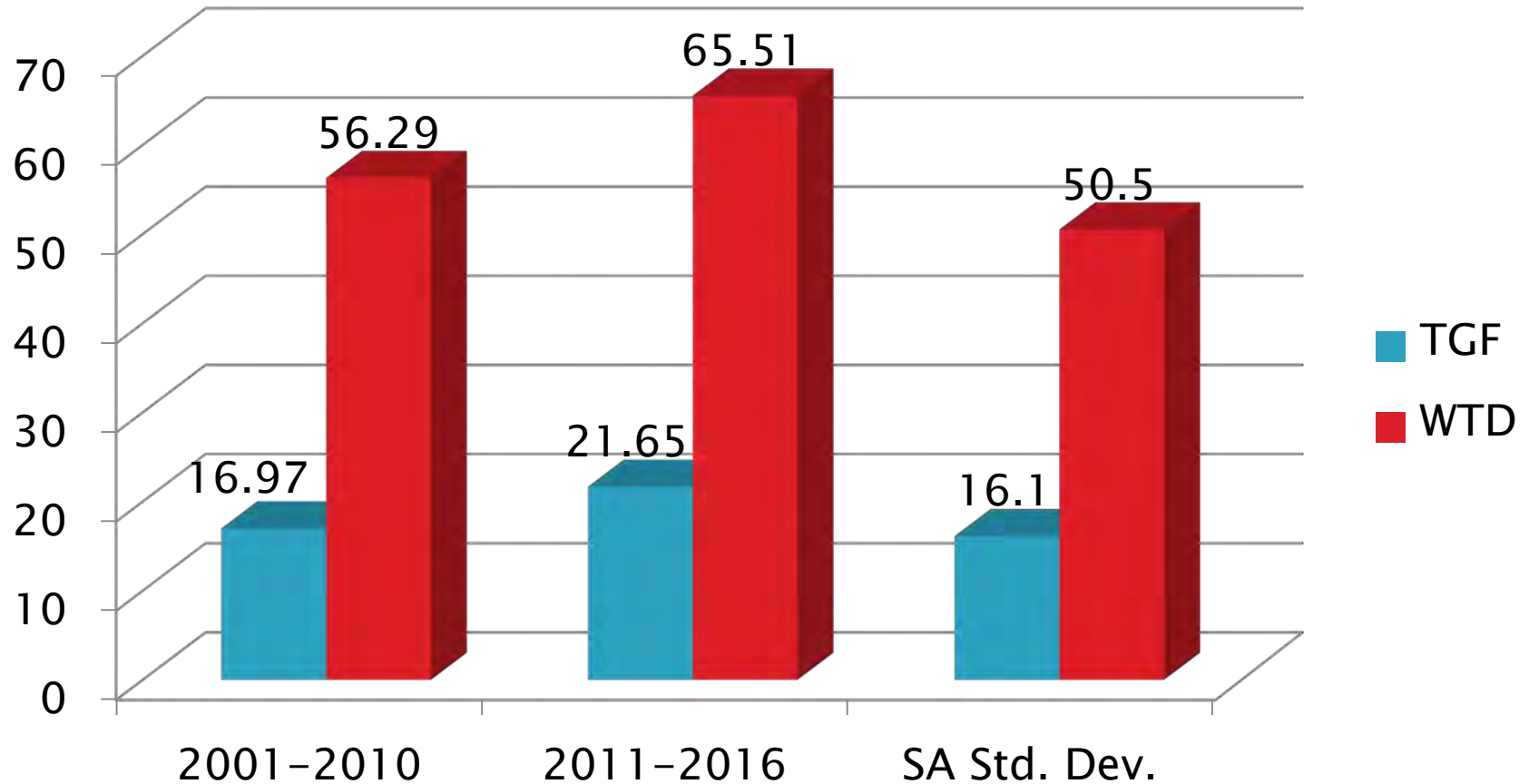


CUSUM Severity Analysis



03MAY18: 15:01

1 MPC Precision Estimates



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1P Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Donated	AG	0
Total		0

1 P Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

1P Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

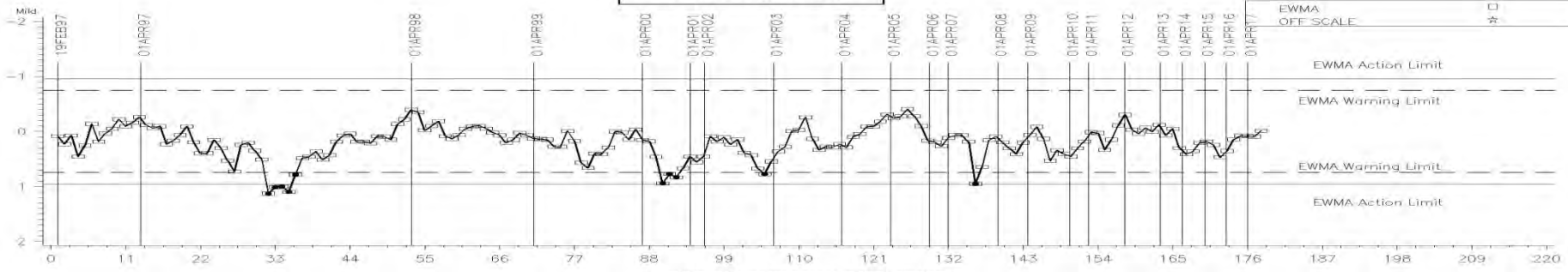
*Invalid and aborted tests

1 P Test Severity

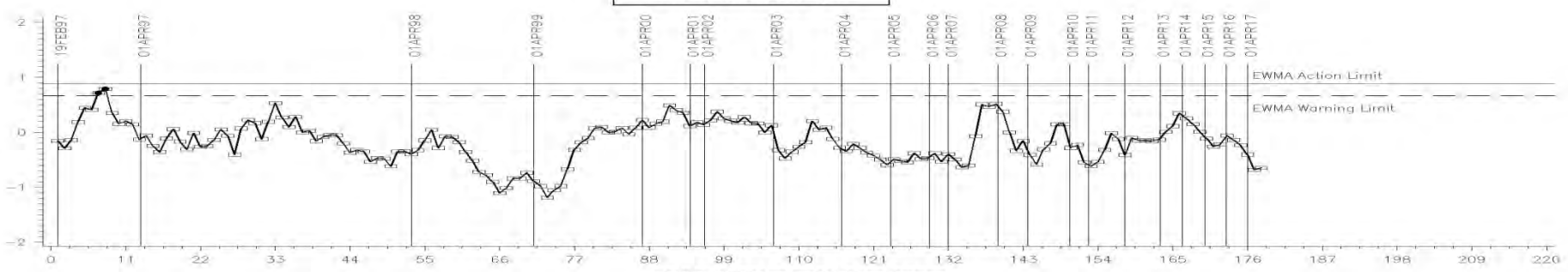
- ▶ As no 1P tests were run during this period no statement about test severity can be made.

WEIGHTED TOTAL DEMERITS

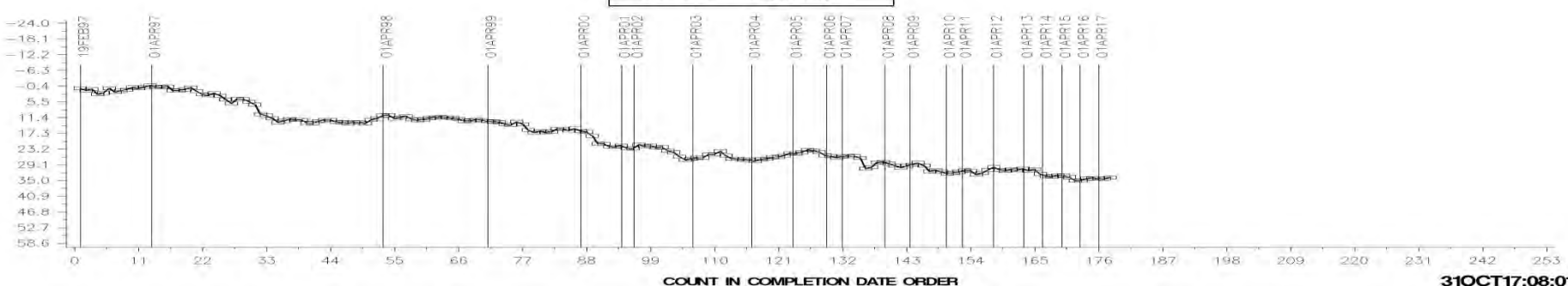
LTMS Severity Analysis



LTMS Precision Analysis



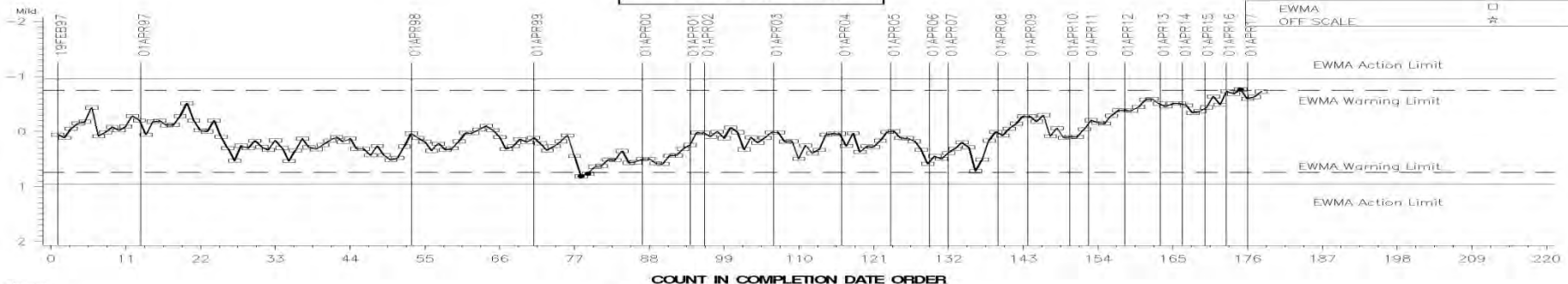
CUSUM Severity Analysis



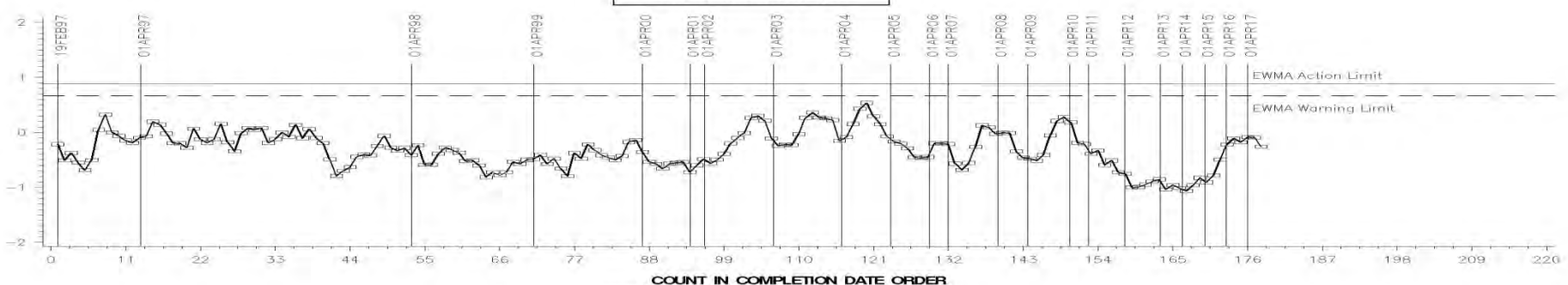
31OCT17:08:01

TOP LAND CARBON

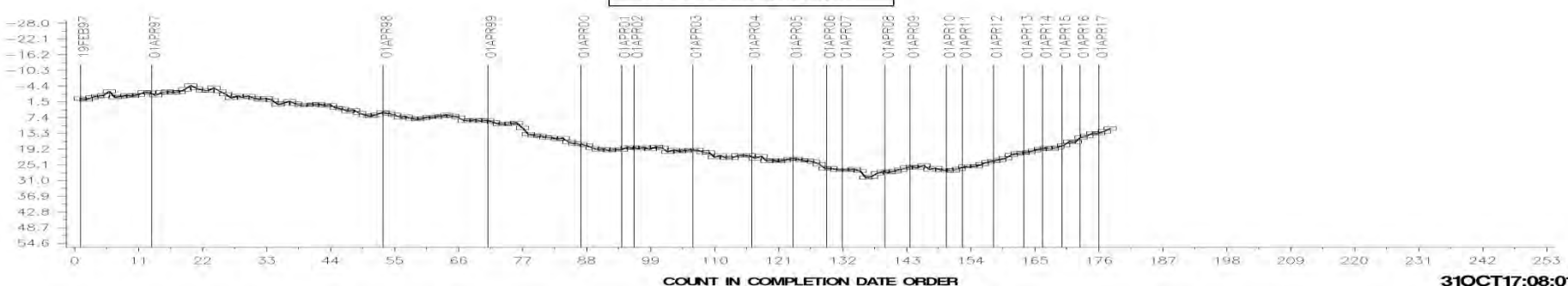
LTMS Severity Analysis



LTMS Precision Analysis



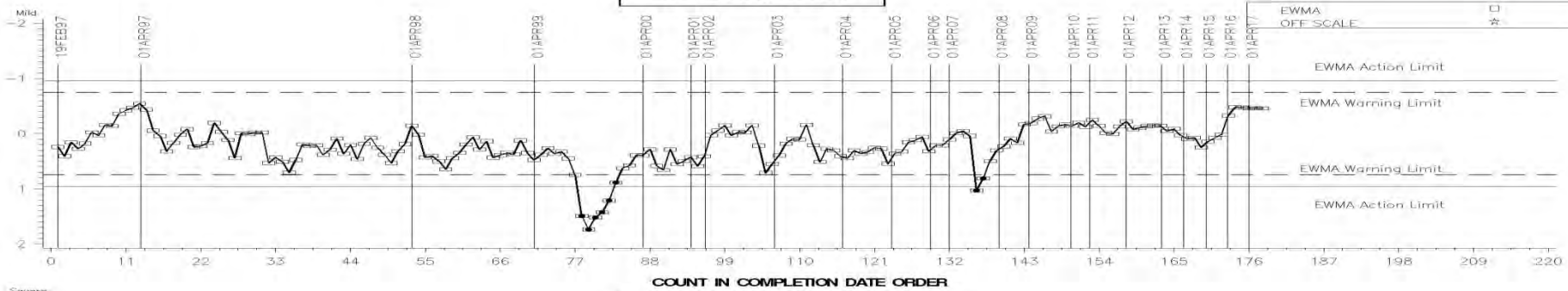
CUSUM Severity Analysis



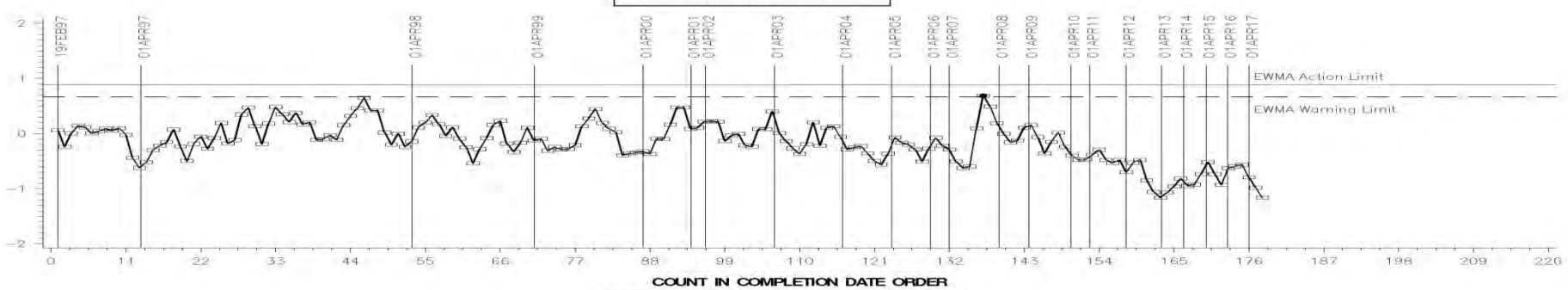
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TOP GROOVE CARBON

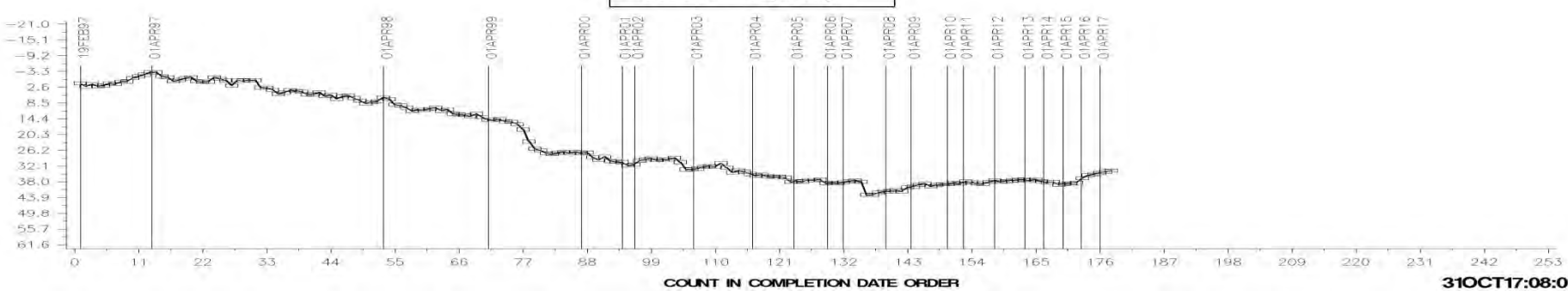
LTMS Severity Analysis



LTMS Precision Analysis



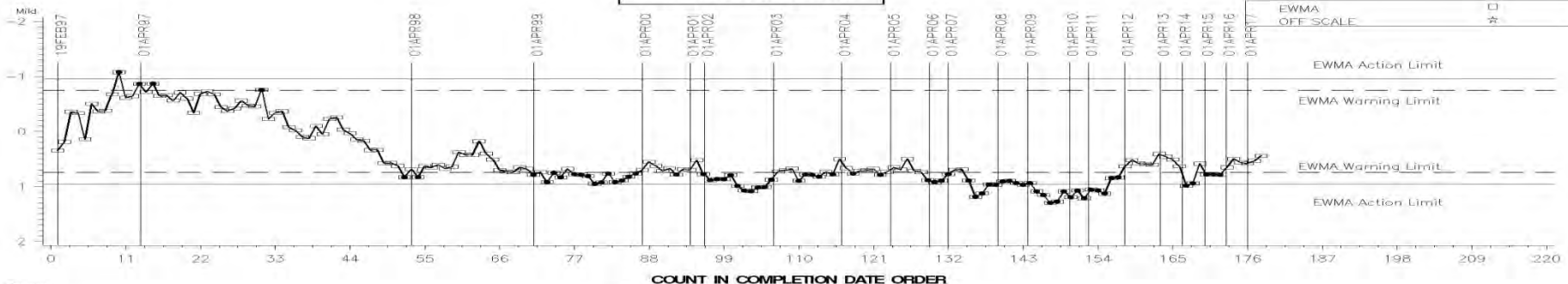
CUSUM Severity Analysis



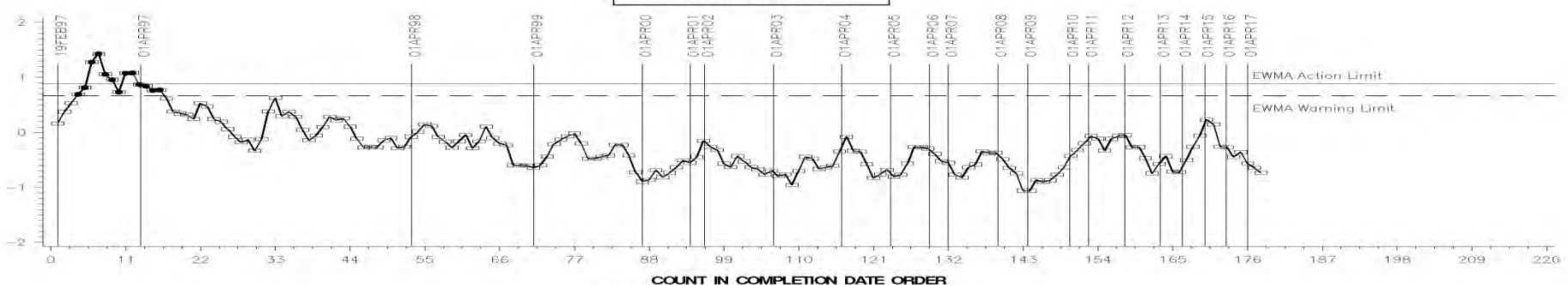
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OIL CONSUMPTION

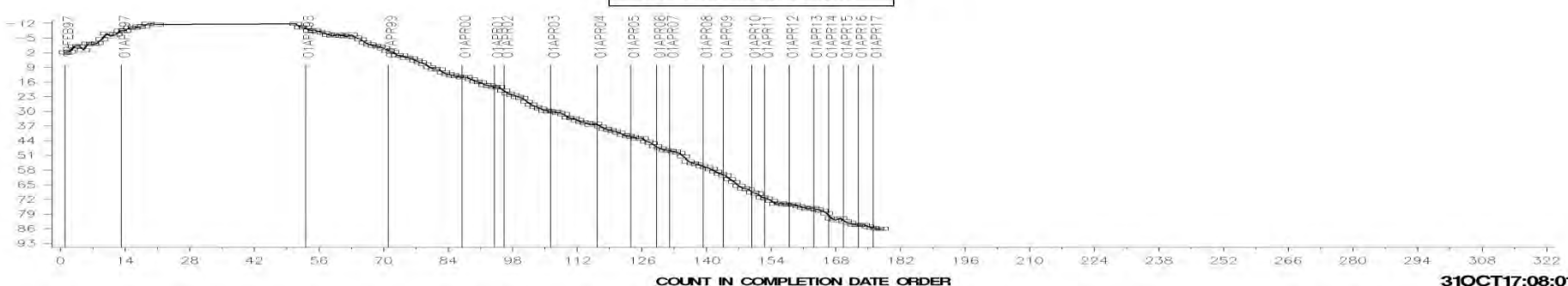
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



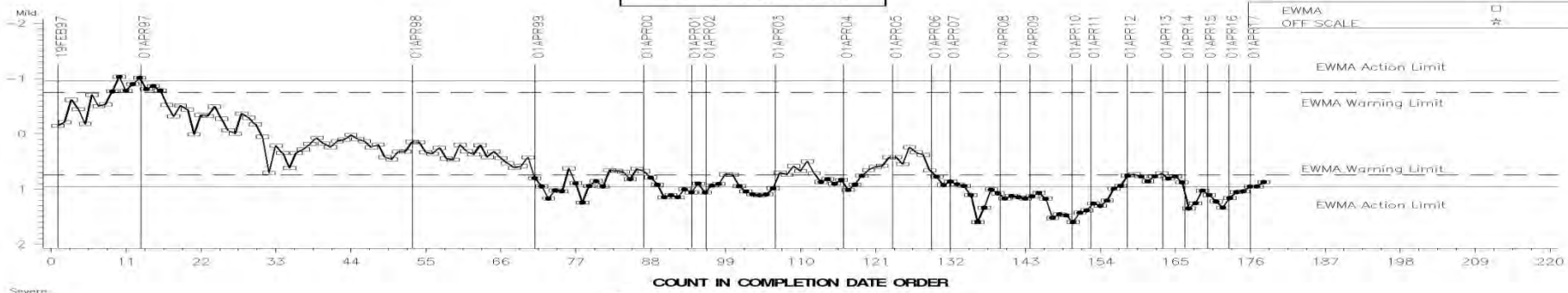
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CATERPILLAR 1P INDUSTRY OPERATIONALLY VALID DATA

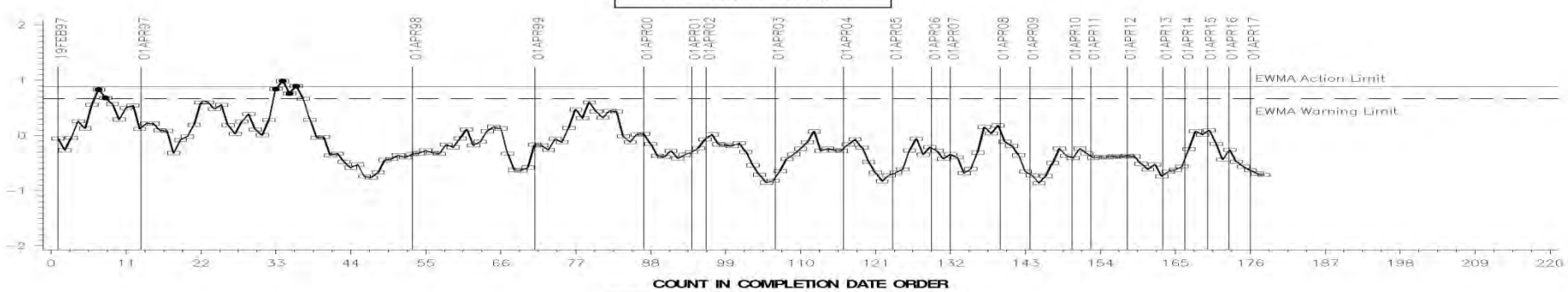


EOTOC

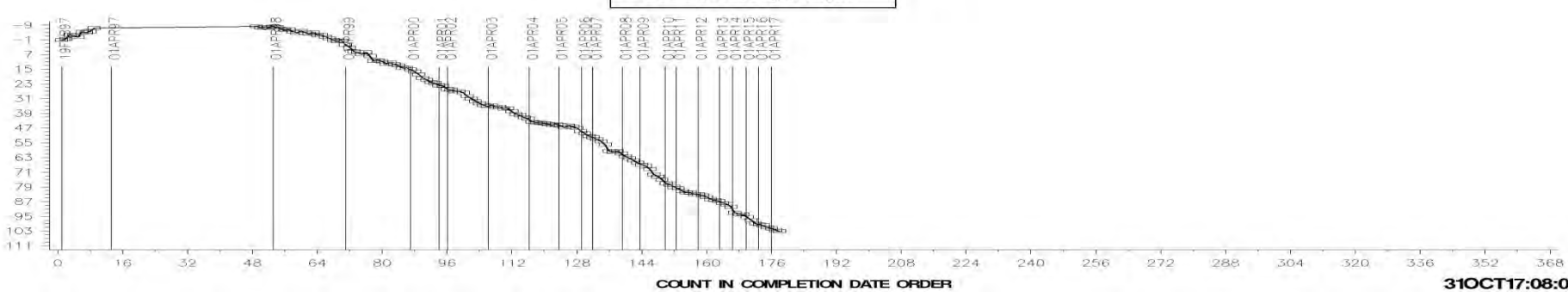
LTMS Severity Analysis



LTMS Precision Analysis



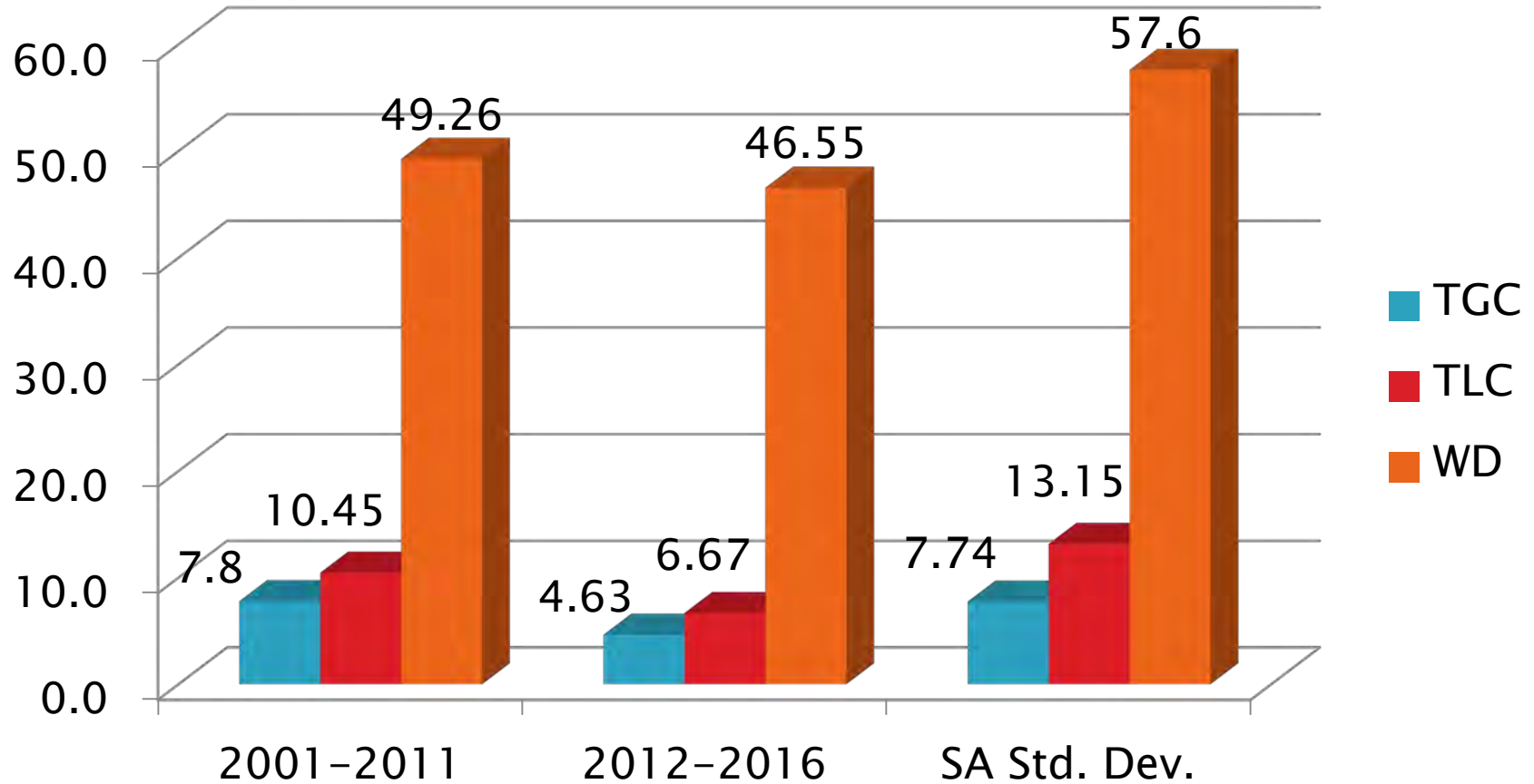
CUSUM Severity Analysis



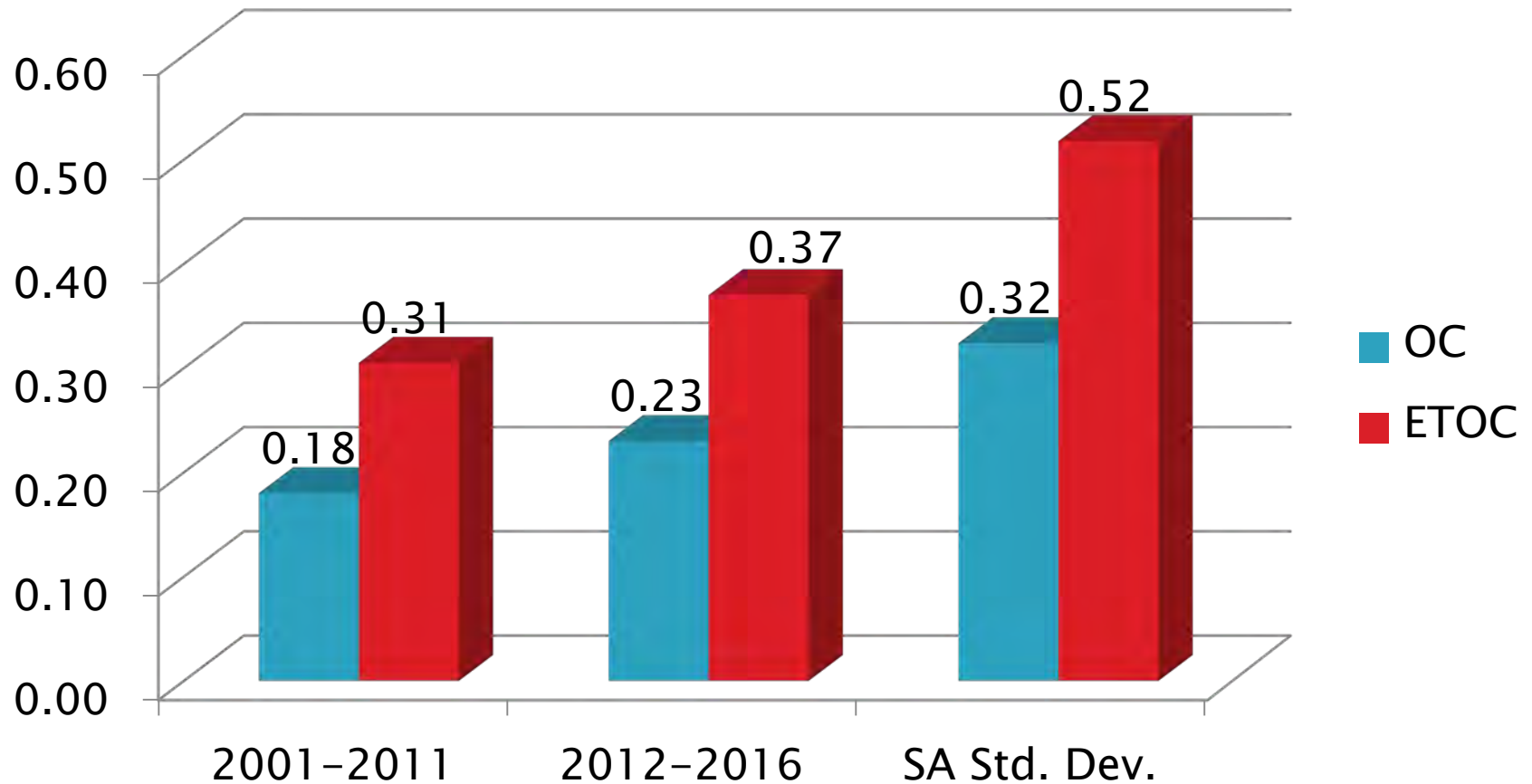
31OCT17:08:01



1P Precision Estimates



1P Precision Estimates



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SCOTE 1 R

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1 R Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		0

1 R Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

1 R Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

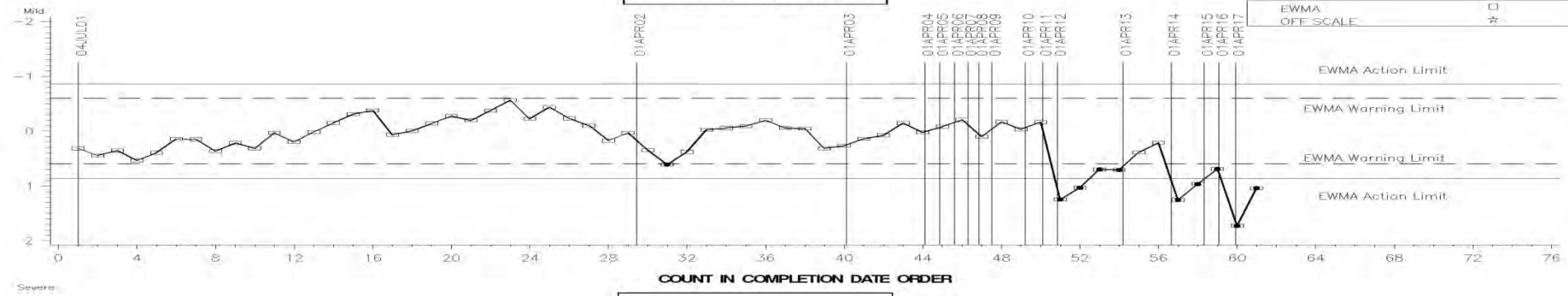
*Invalid and aborted tests

1 R Test Severity

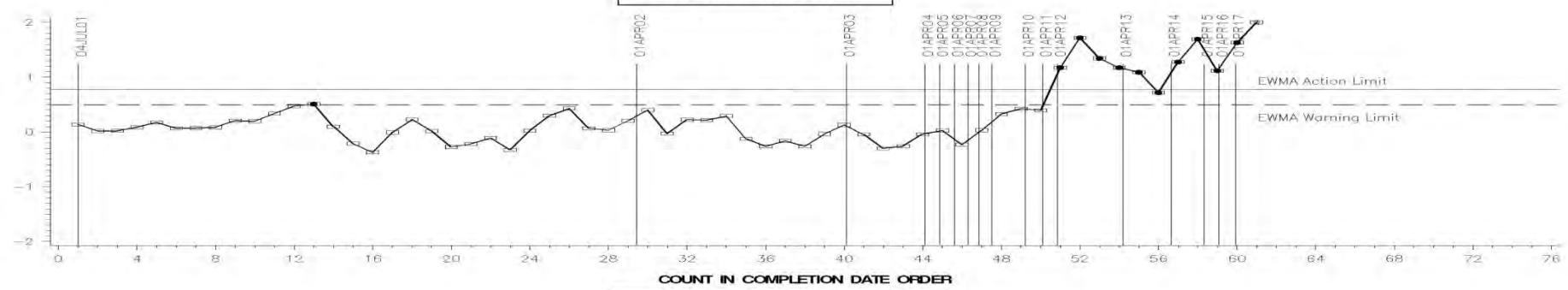
- ▶ As no 1R tests were run during this period no statement about test severity can be made.

FINAL WEIGHTED TOTAL DEMERITS (DEMERITS)

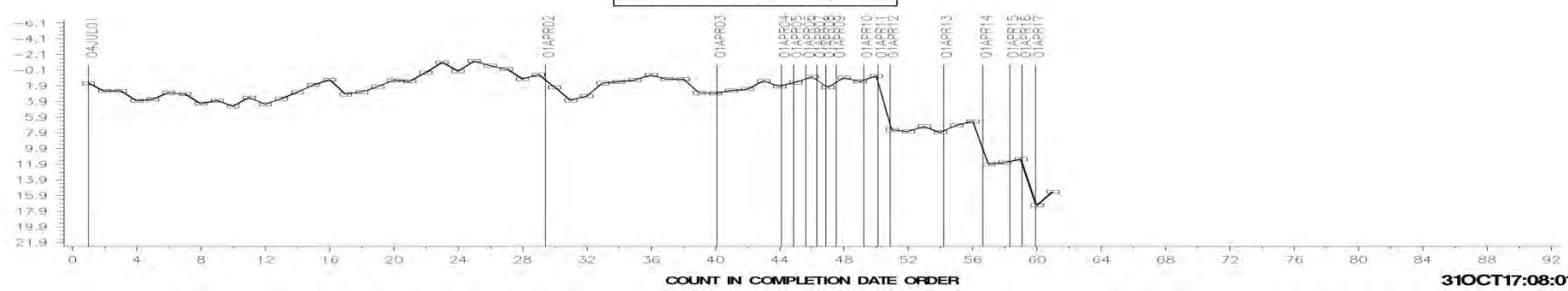
LTMS Severity Analysis



LTMS Precision Analysis



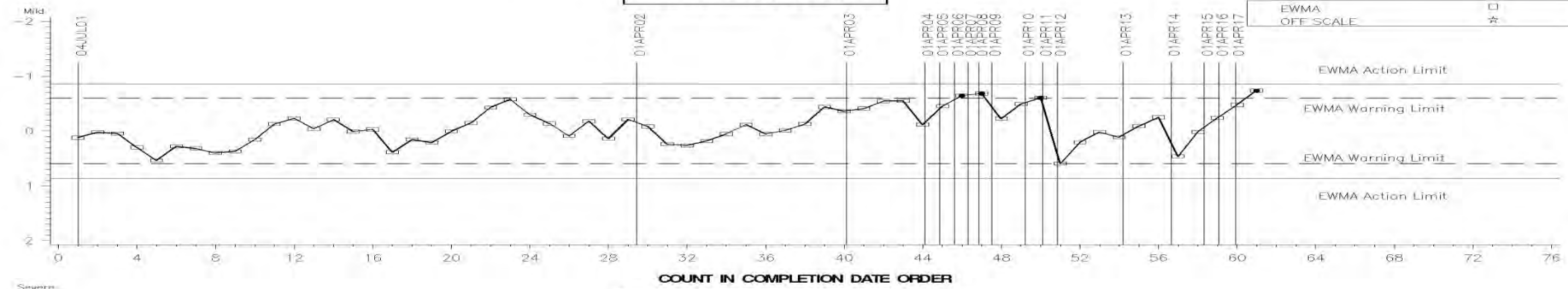
CUSUM Severity Analysis



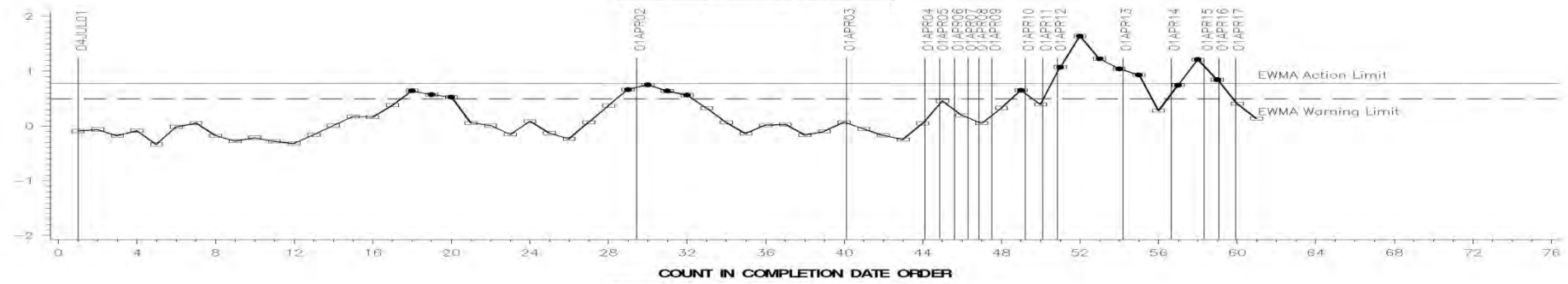
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FINAL TOP LAND CARBON (DEMERITS)

LTMS Severity Analysis



LTMS Precision Analysis



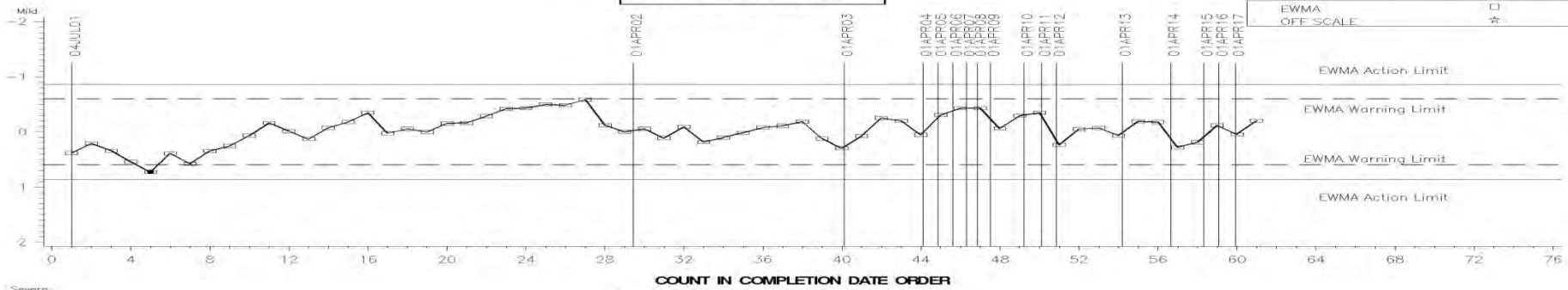
CUSUM Severity Analysis



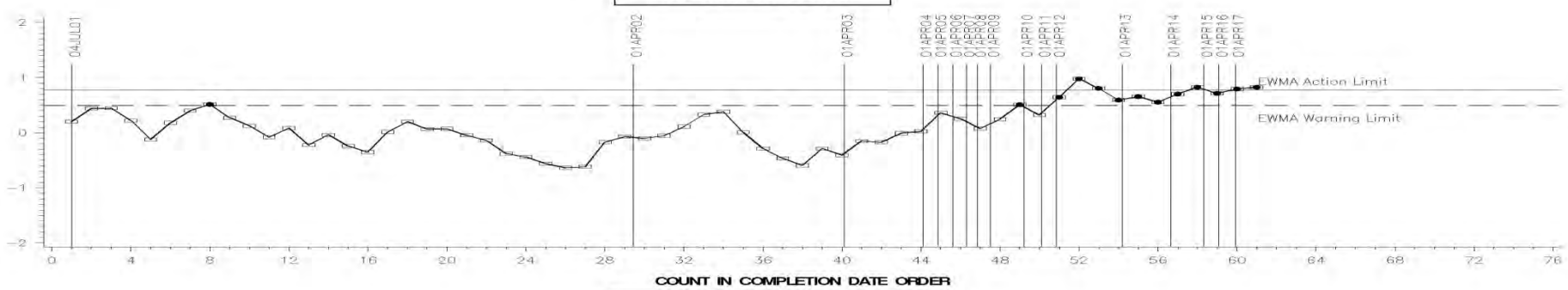
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FINAL TOP GROOVE CARBON (DEMERITS)

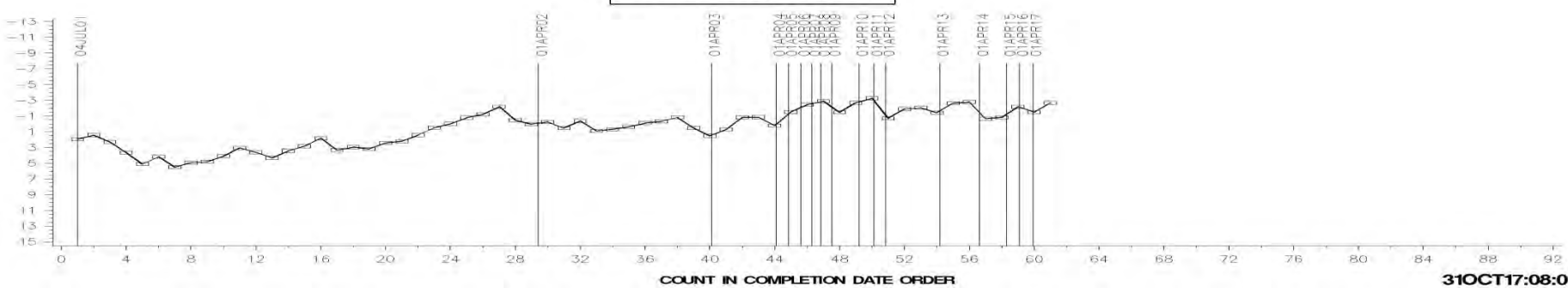
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



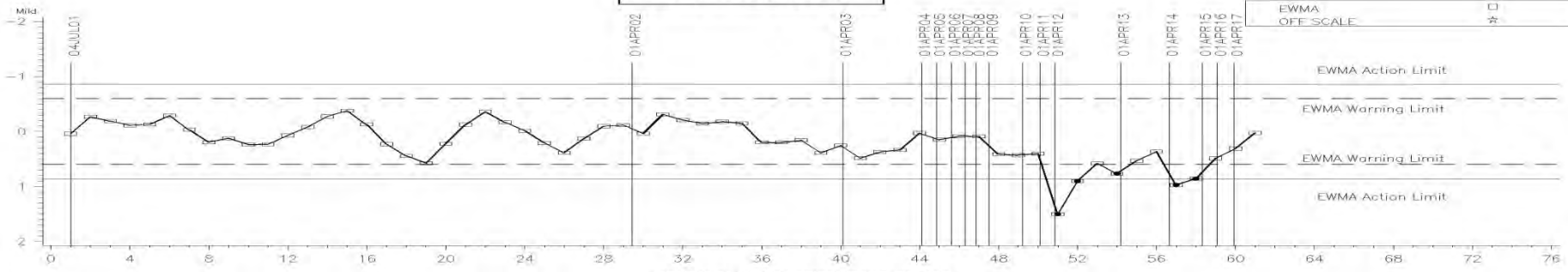
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CATERPILLAR 1R INDUSTRY OPERATIONAL VALID DATA



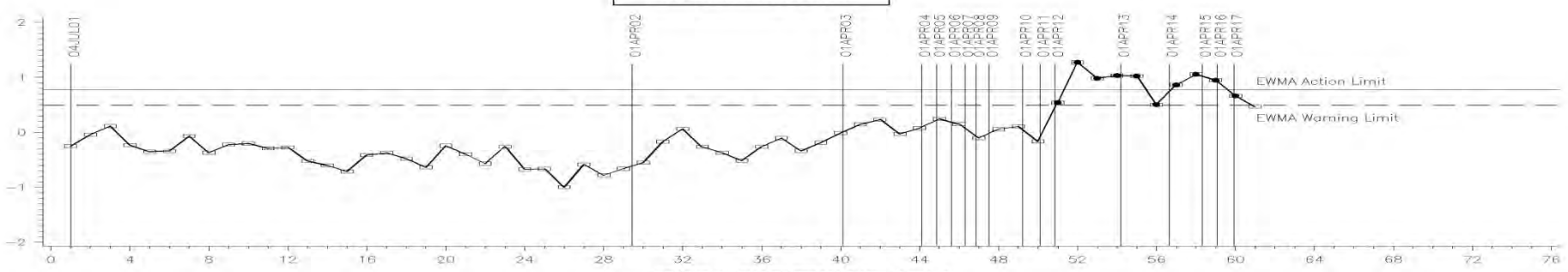
FINAL EOTOC (g/h)

LTMS Severity Analysis



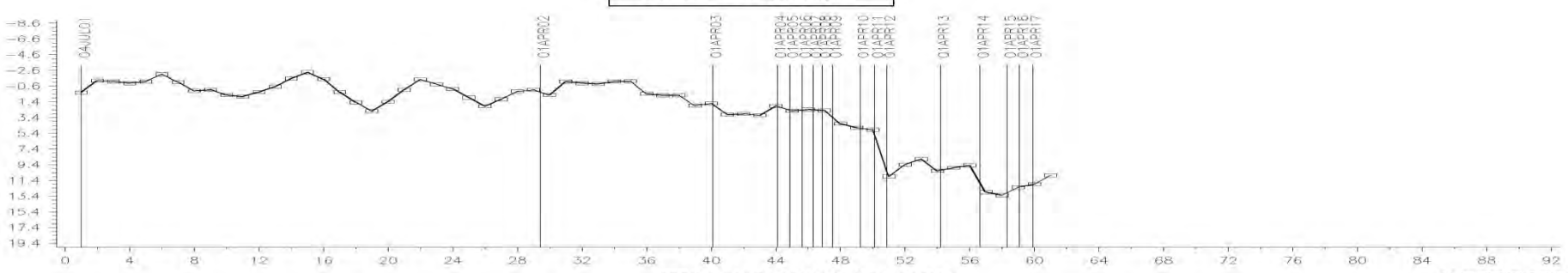
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

31OCT17:08:01

Test Monitoring Center

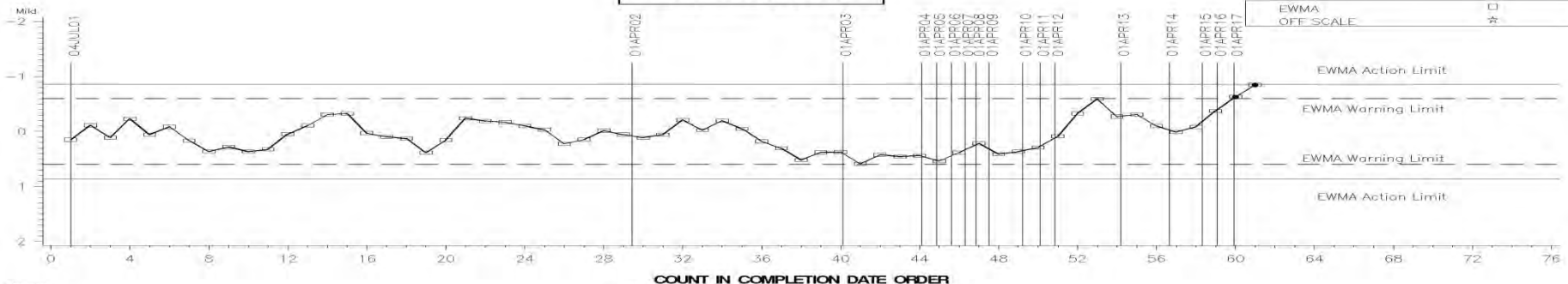
<http://astmtmc.cmu.edu>



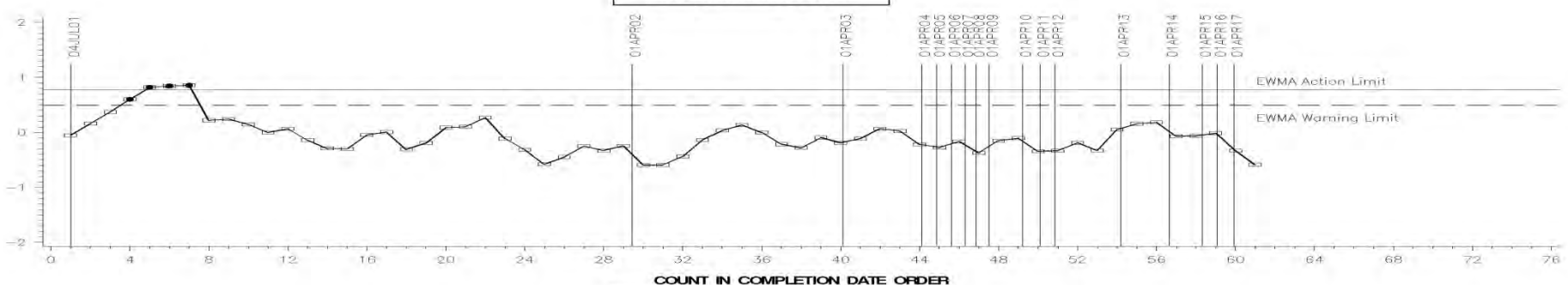
A Program of ASTM International

FINAL BOTOC

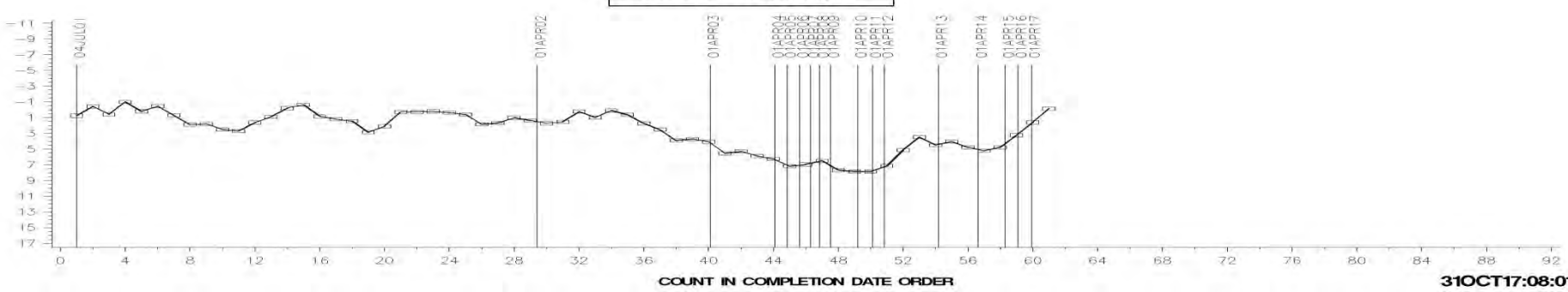
LTMS Severity Analysis



LTMS Precision Analysis

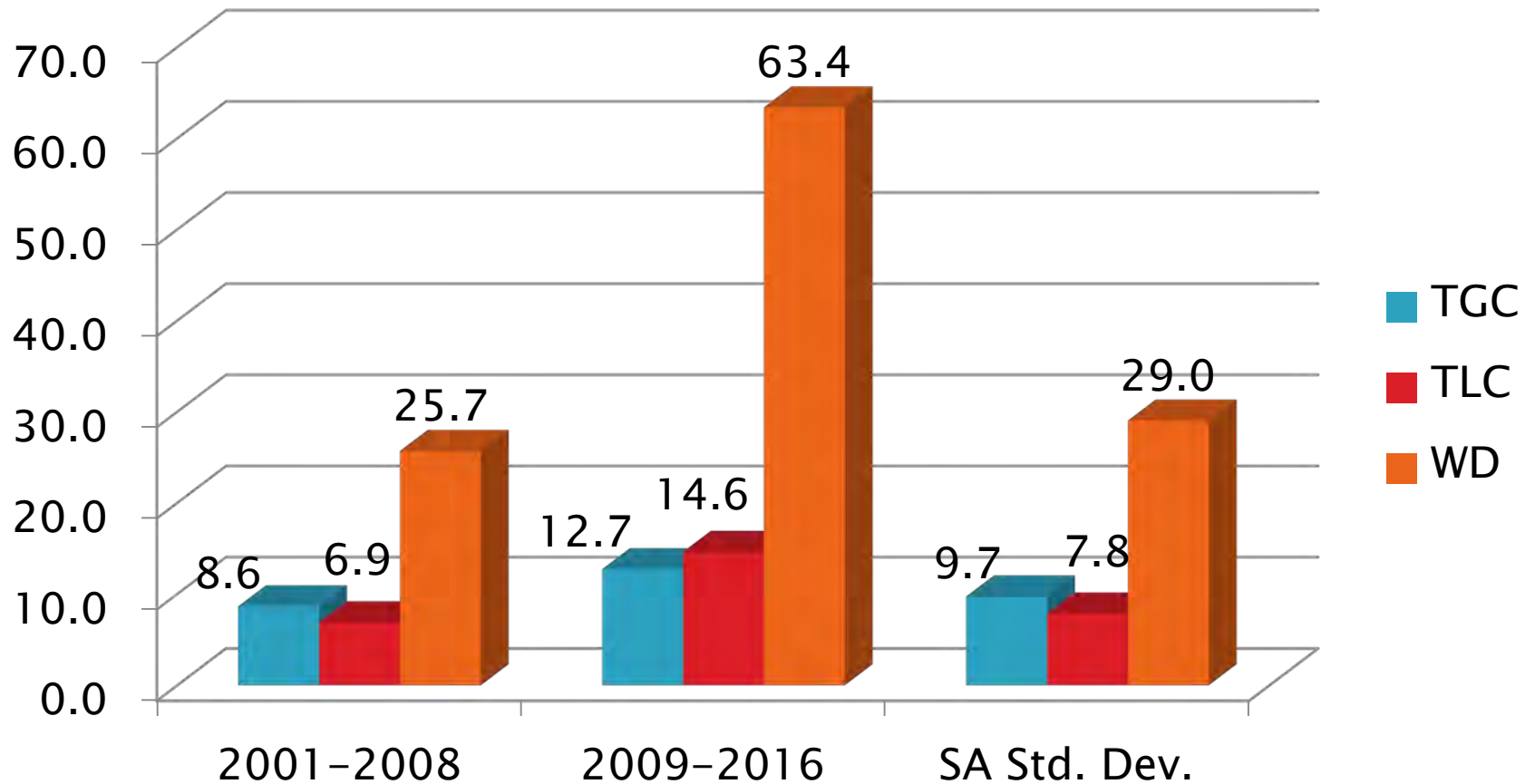


CUSUM Severity Analysis

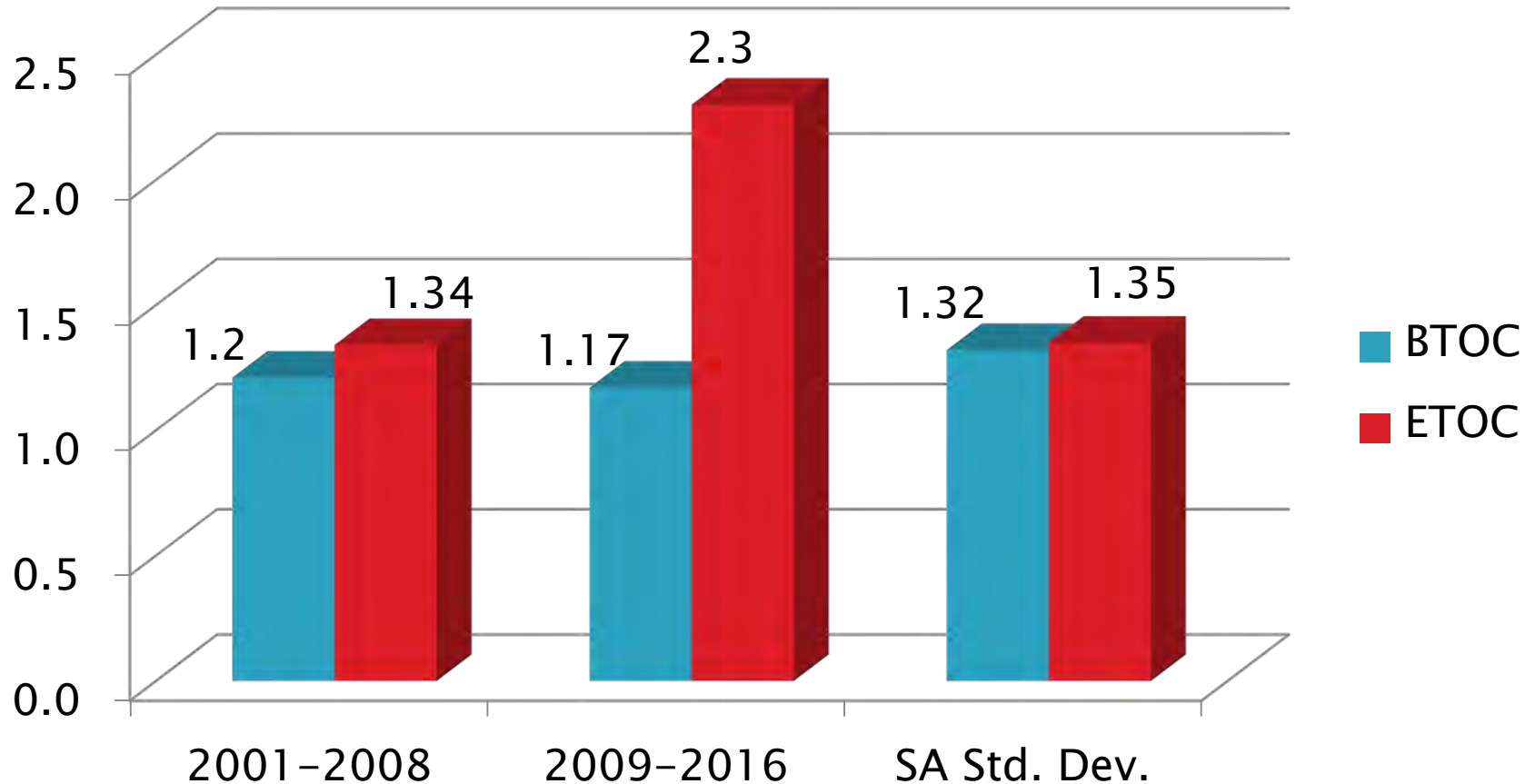


31OCT17:08:01

1R Precision Estimates



1 R Precision Estimates



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CAT C13

»» April 2018

Test Monitoring Center

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C13 Test Activity

Test Status	Validity Code	C13
Acceptable Calibration Test	AC	3
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		3

C13 Failed Tests

Failed Parameter	Number of Tests
No Failed Tests	0
Total	0

C13 Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

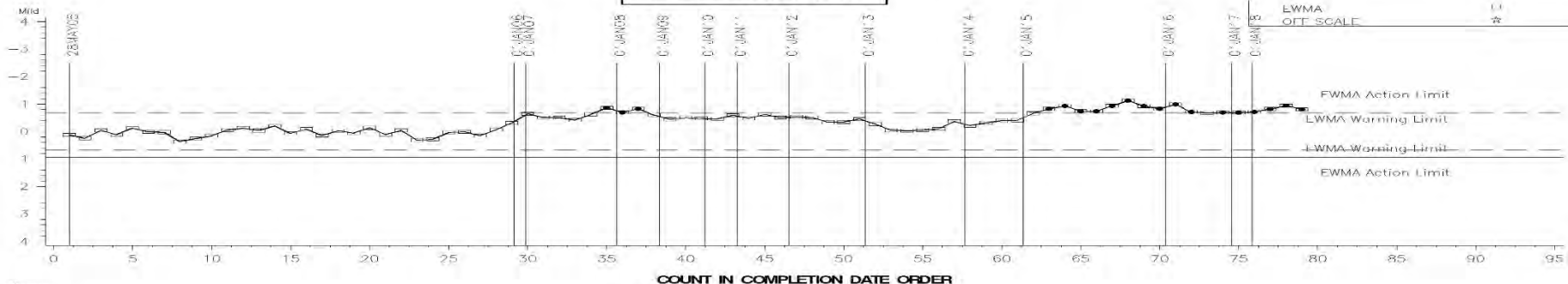
*Invalid and aborted tests

C13 Test Severity

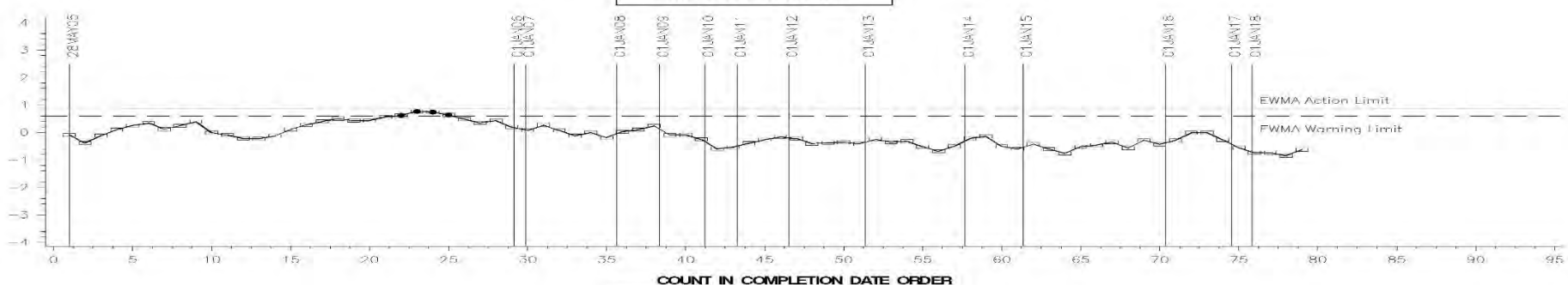
- ▶ R2TC and OC are in control
- ▶ TLC in warning alarm in the mild direction
- ▶ TGC in precision action alarm

TOP LAND CARBON AVG. — FINAL RESULT

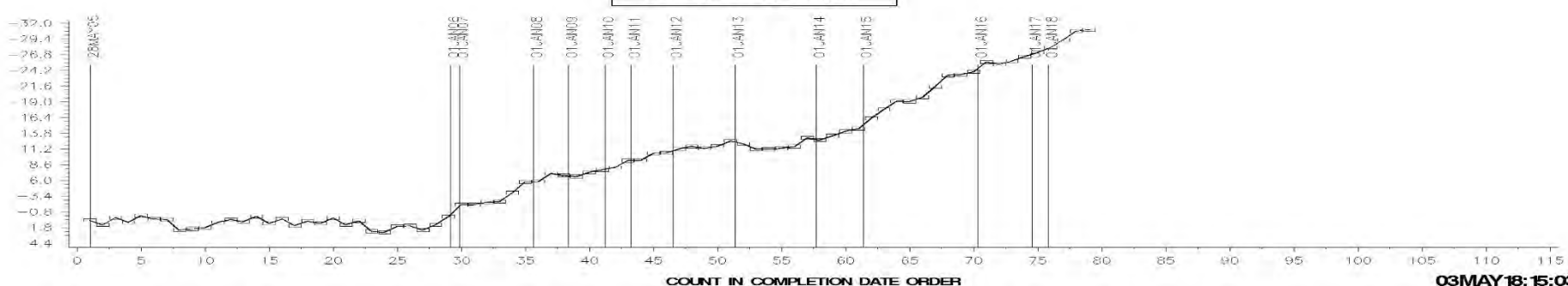
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

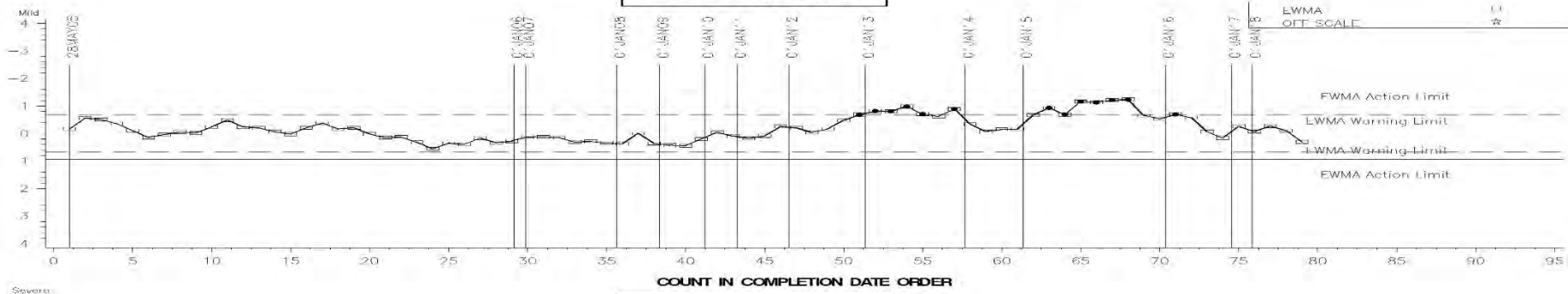


03MAY18: 15:03

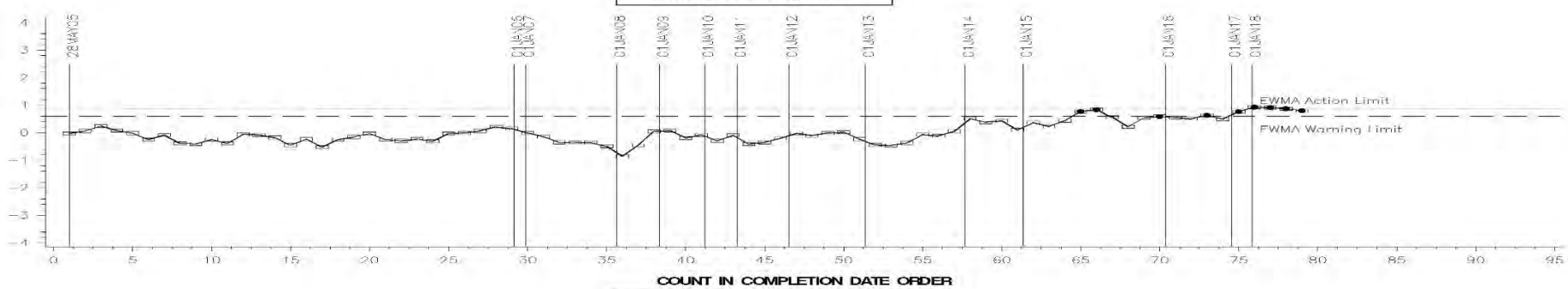
C13 INDUSTRY OPERATIONAL VALID DATA

TOP GROOVE CARBON AVG — FINAL RESULT

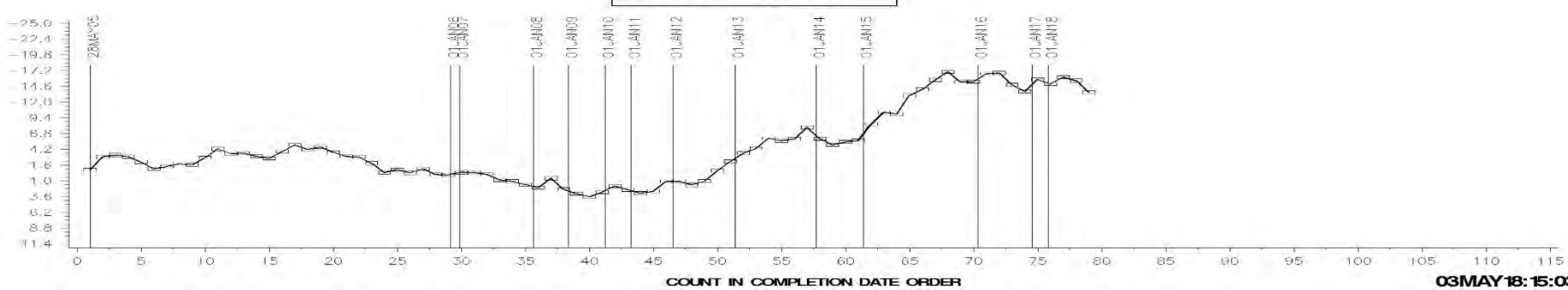
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

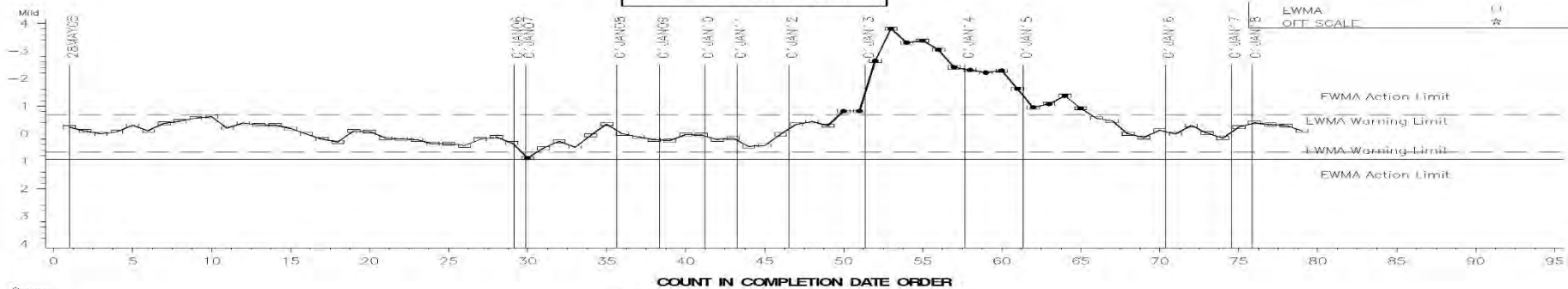


03MAY18: 15:03

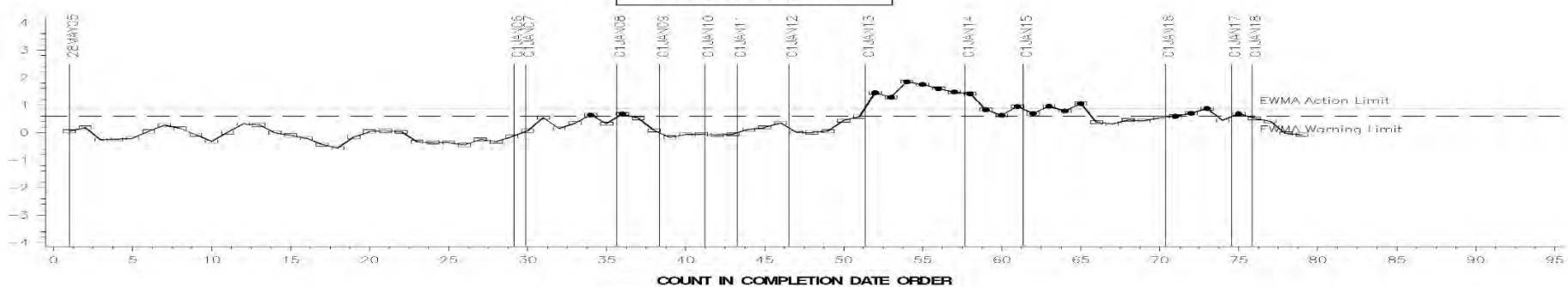
C13 INDUSTRY OPERATIONAL VALID DATA

2ND RING TOP CARBON AVG. — FINAL RESULT

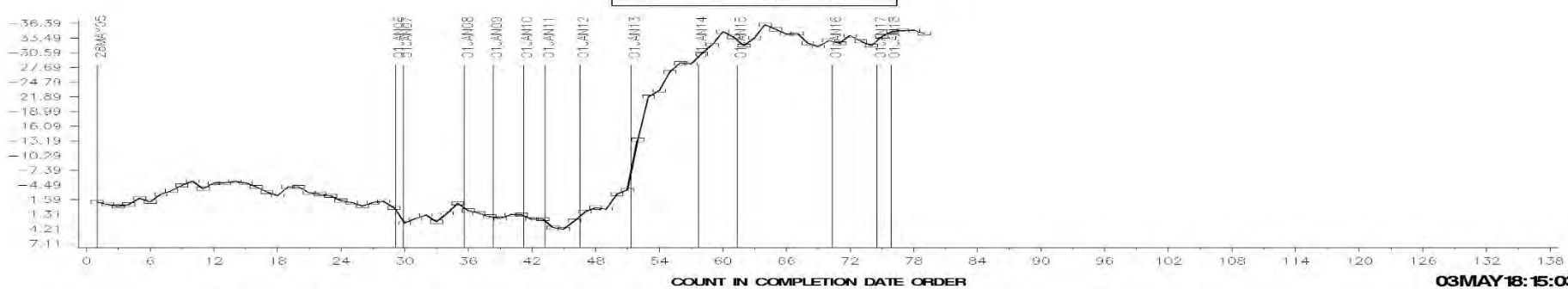
LTMS Severity Analysis



LTMS Precision Analysis



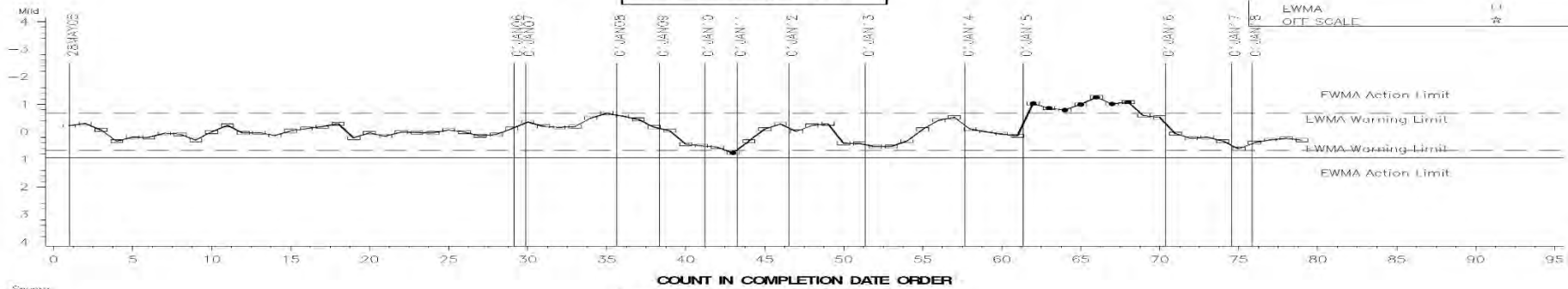
CUSUM Severity Analysis



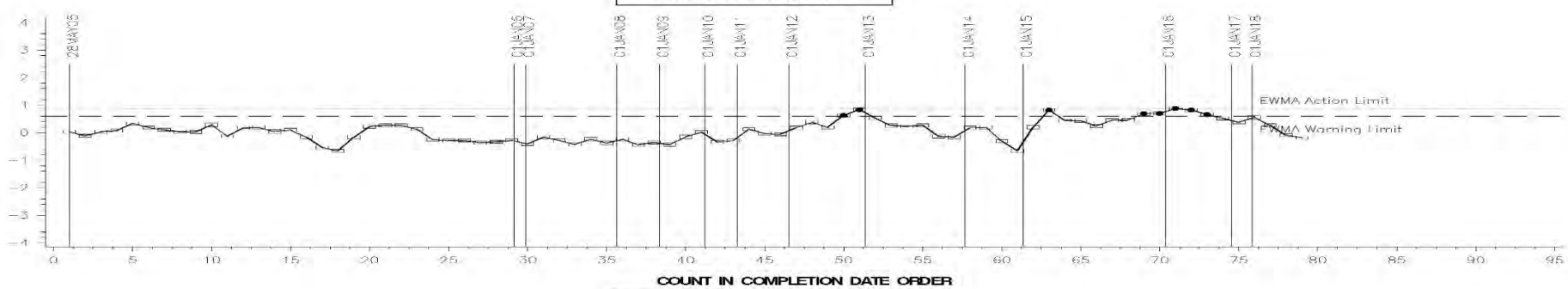
03MAY18: 15:03

OIL CONS. DELTA — FINAL RESULT

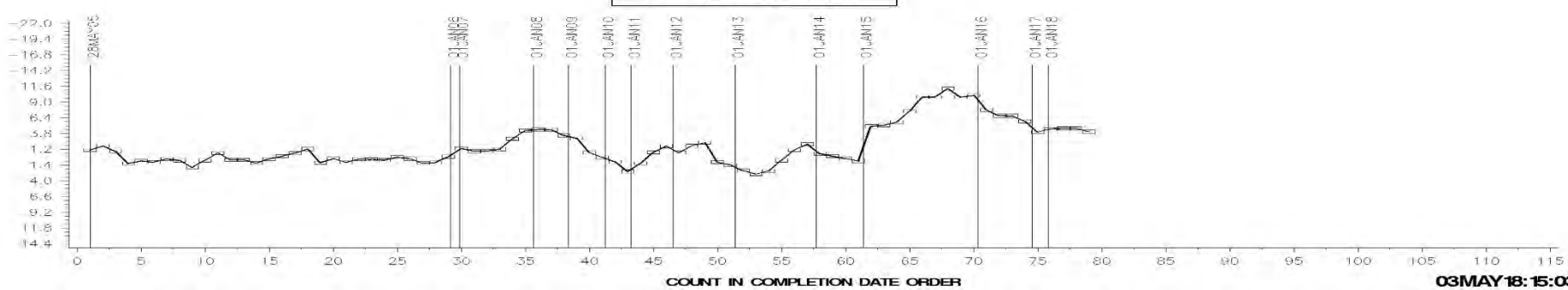
LTMS Severity Analysis



LTMS Precision Analysis

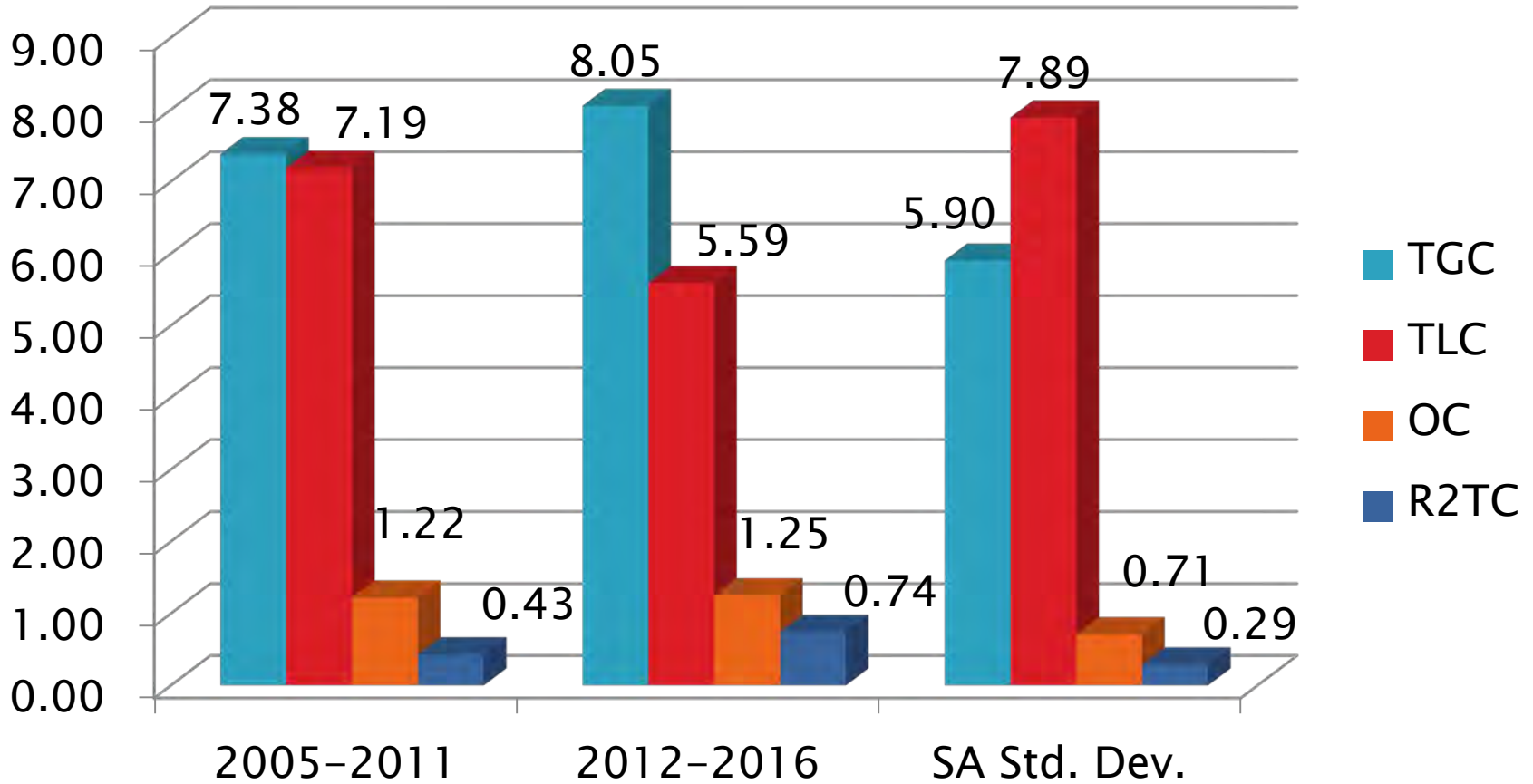


CUSUM Severity Analysis



03MAY18: 15:03

C13 Precision Estimates



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Test Monitoring Center

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C13 Oil Aeration (COAT)

»» April 2018

Test Monitoring Center

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COAT Test Activity

Test Status	Validity Code	COAT
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	2
Operationally Invalid	LC	2
Aborted	XC	1
Pending Calibration	PC	2
Hardware Approval	AI	2
Informational Run	LN	2
Total		11

COAT Failed Tests

Failed Parameter	Number of Tests
Average Aeration Mild	2
Total	2

COAT Lost Tests*

Status	Cause	#
Invalid	Bad CCP Sensor	1
Invalid	Data Acquisition Error	1
Invalid	Abnormal oil gallery pressure	2
Aborted	Data Acquisition Error	1
Total		5

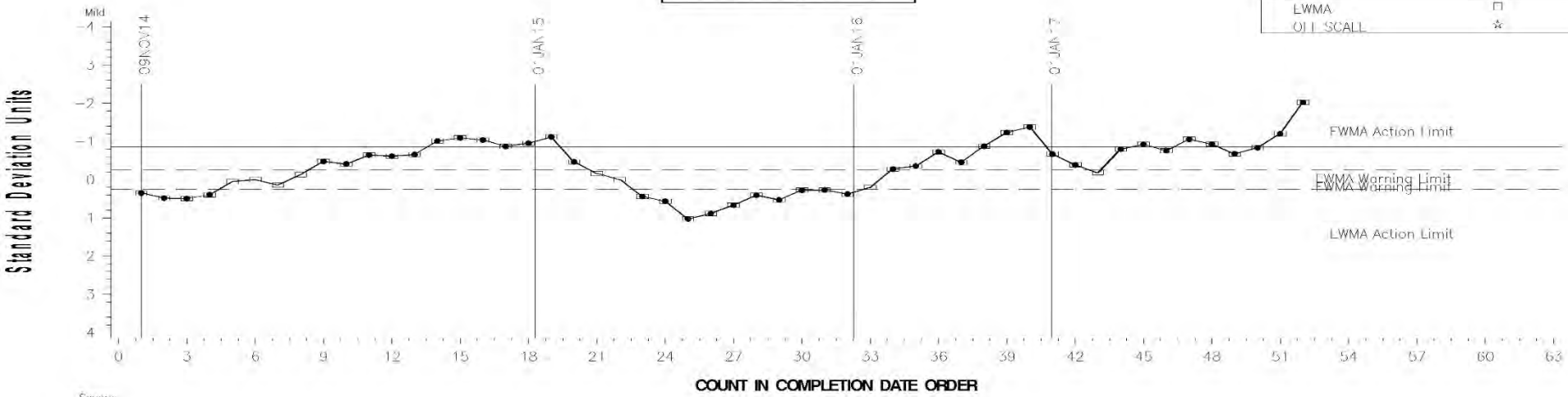
*Invalid and aborted tests

COAT Test Severity

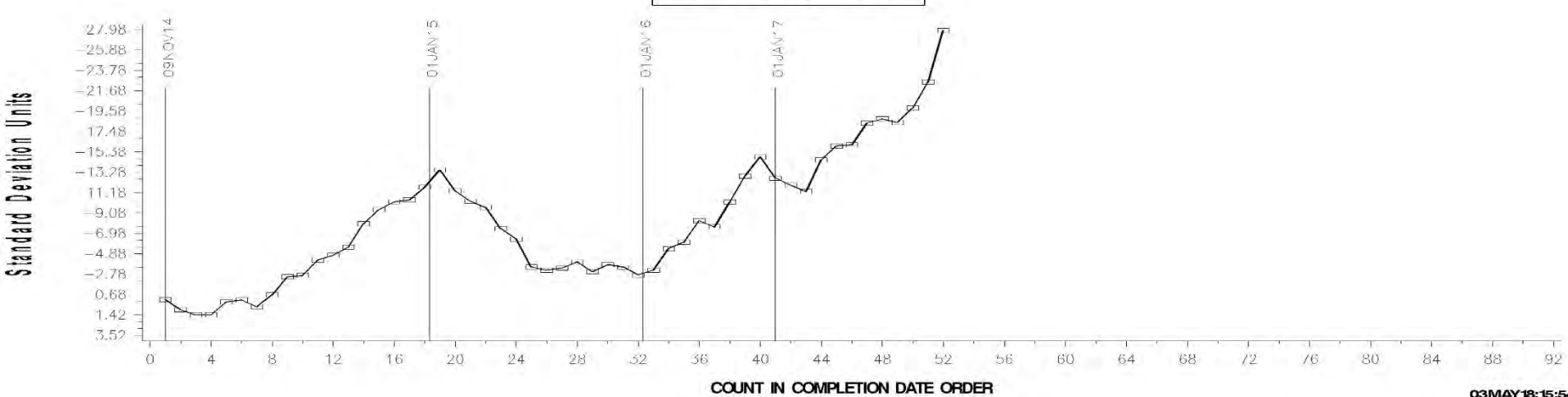
- ▶ AAVE is in action alarm (Level 2 Zi Alarm) in the mild direction.
- ▶ Test severity and precision issues being investigated by surveillance panel

FINAL AVERAGE OIL AERATION OVER TEST HOURS 40-50

LTMS Severity Analysis



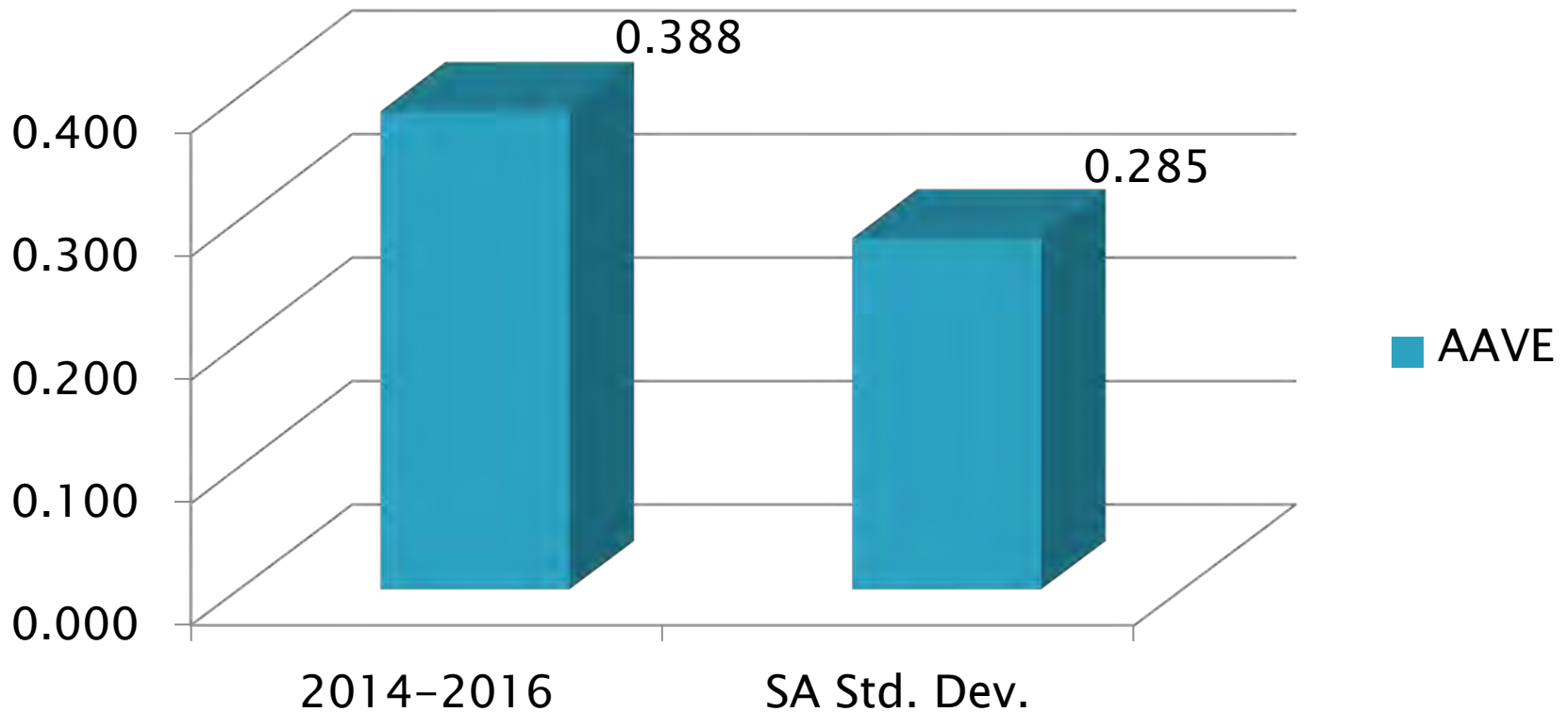
CUSUM Severity Analysis



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COAT Precision Estimates

AAVE



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Daimler DD13 Scuffing Test

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Test Monitoring Center

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DD13 Test Activity*

Test Status	Validity Code	COAT
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Pending Calibration	PC	3
Total		4

DD13 Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

DD13 Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

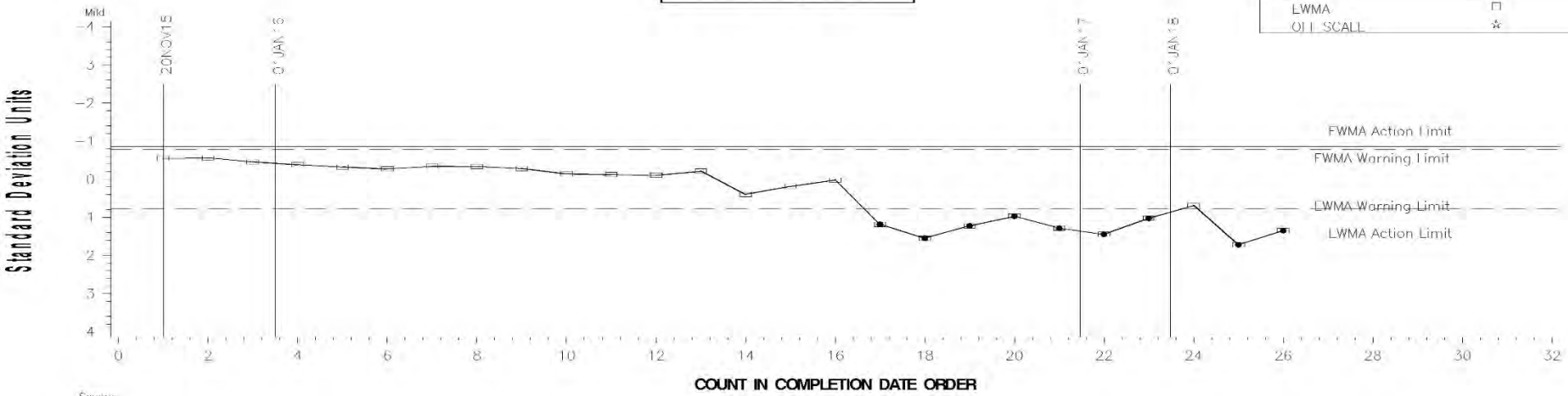
*Invalid and aborted tests

DD13 Test Severity

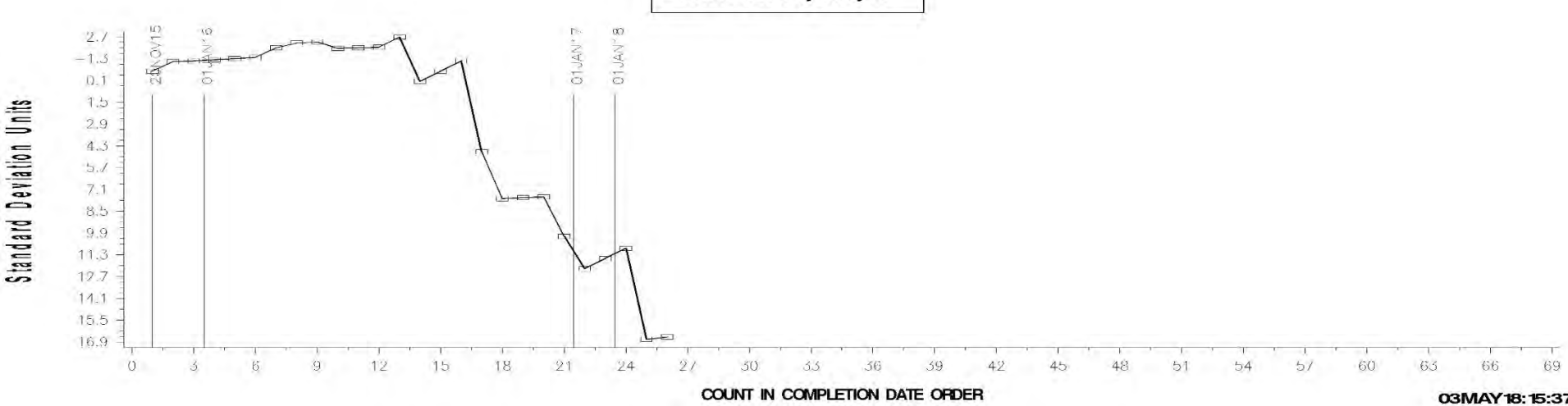
- ▶ HRS2 is in action alarm in the mild direction

FNL. ORIG. UNIT HOURS TO SCUFF

LTMS Severity Analysis



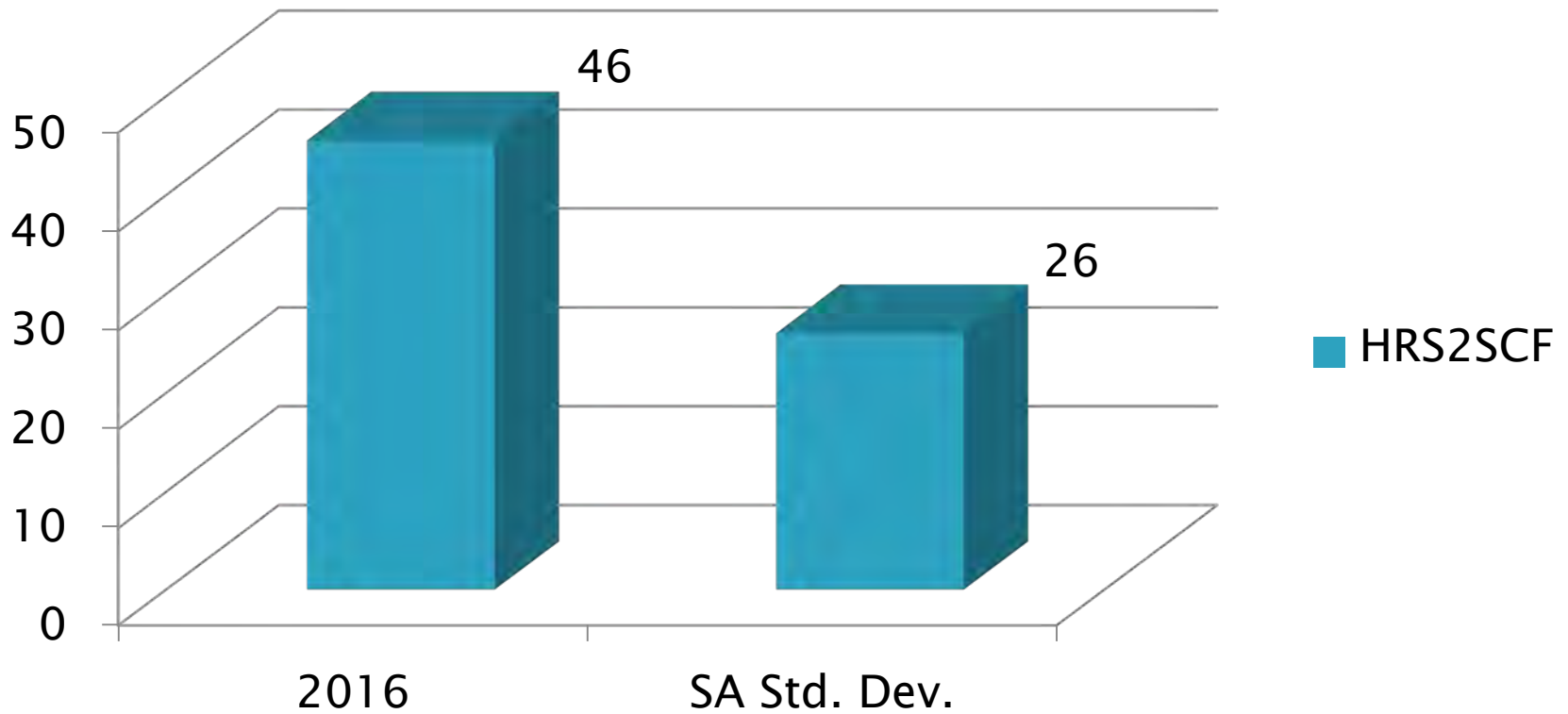
CUSUM Severity Analysis



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DD13 Precision Estimates

HRS2SCF



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Cummins ISB

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Test Monitoring Center

<http://astmtmc.cmu.edu>



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ISB Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		0

ISB Failed Tests

Failed Parameter	Number of Tests
No Failed Tests	0
Total	0

ISB Lost Tests*

Status	Cause	#
Invalid	No Invalid Tests	0
Aborted	No Aborted Tests	0
Total		0

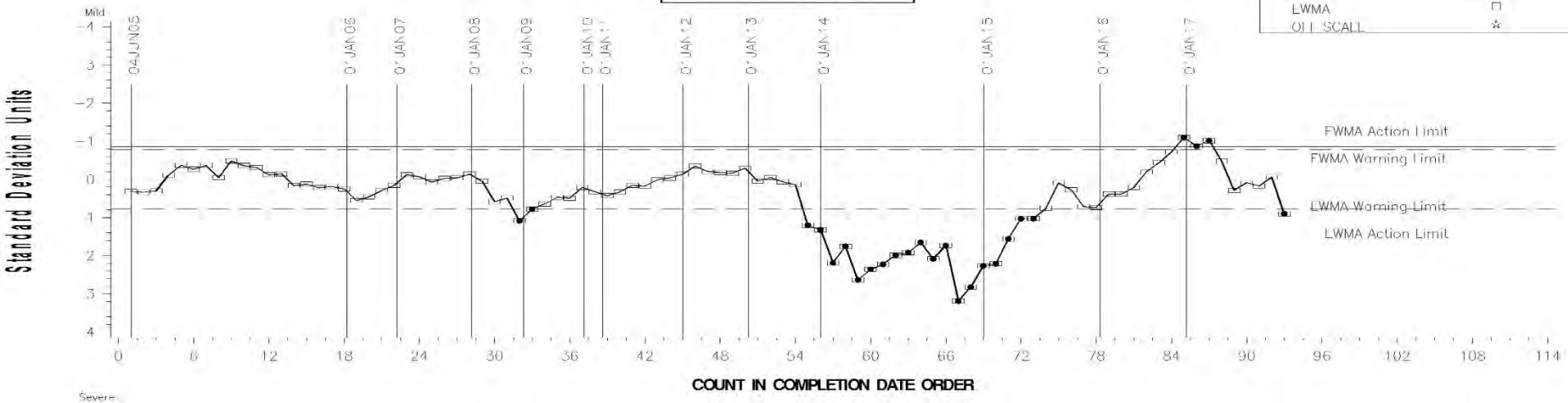
*Invalid and aborted tests

ISB Test Severity

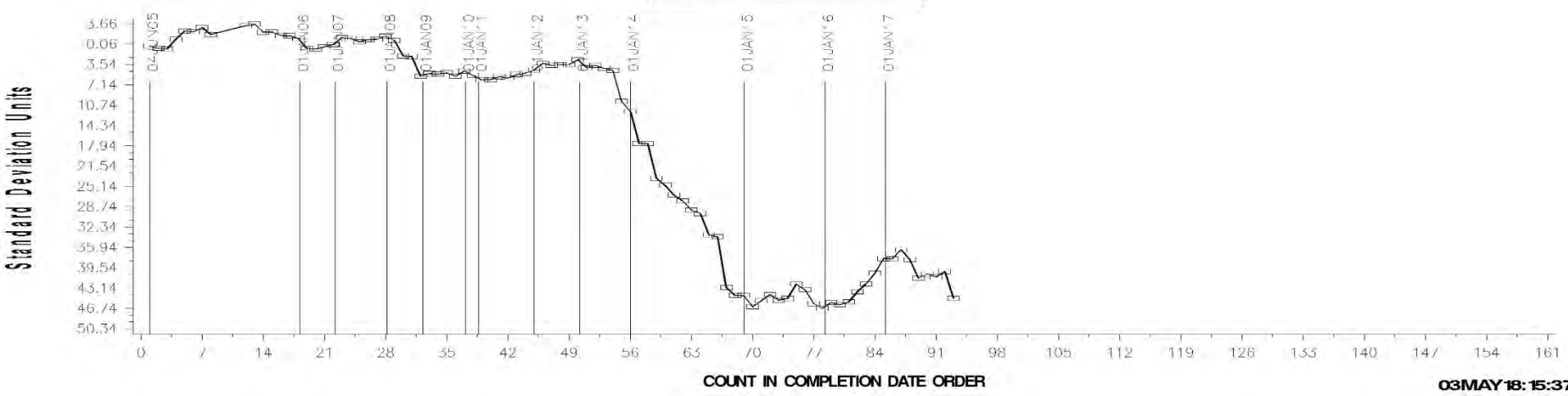
- ▶ As no ISB tests were run during this period no statement about test severity can be made.

AVERAGE CAMSHAFT WEAR

LTMS Severity Analysis



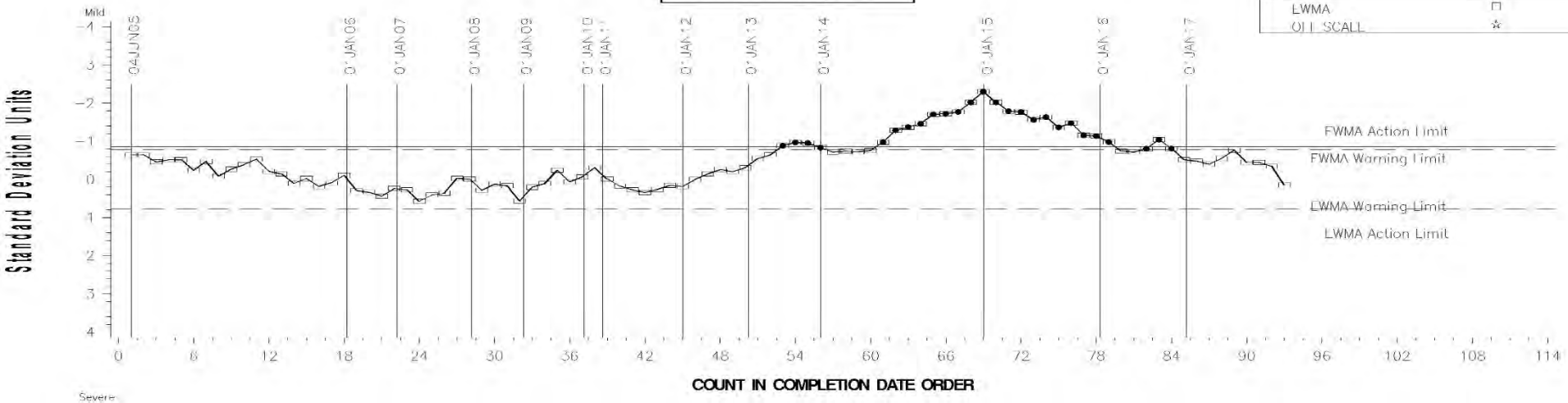
CUSUM Severity Analysis



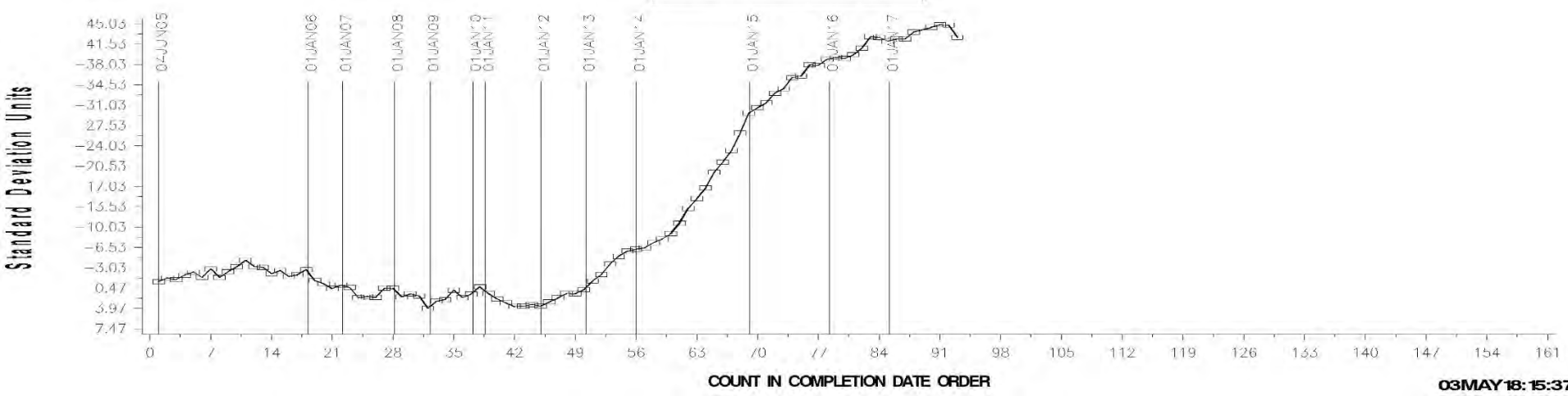
03MAY18: 15:37

AVERAGE TAPPET WEIGHT LOSS

LTMS Severity Analysis

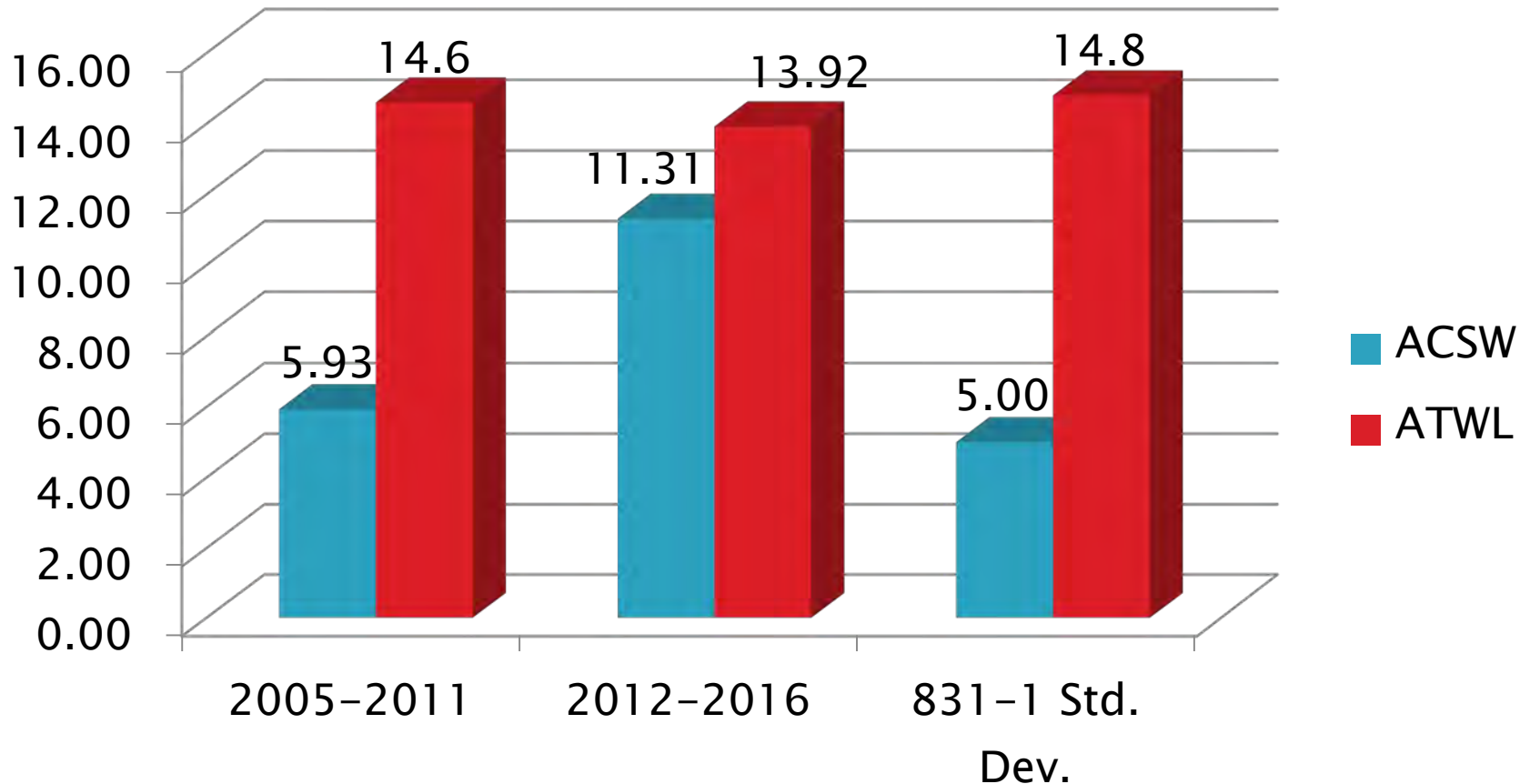


CUSUM Severity Analysis



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ISB Precision Estimates



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Cummins ISM

»» April 2018

Test Monitoring Center

<http://astmtmc.cmu.edu>



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ISM Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	1
Total		2

ISM Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

ISM Lost Tests*

Status	Cause	#
Invalid	No Invalid Tests	0
Aborted	High Oil Consumption	1
Total		1

*Invalid and aborted tests

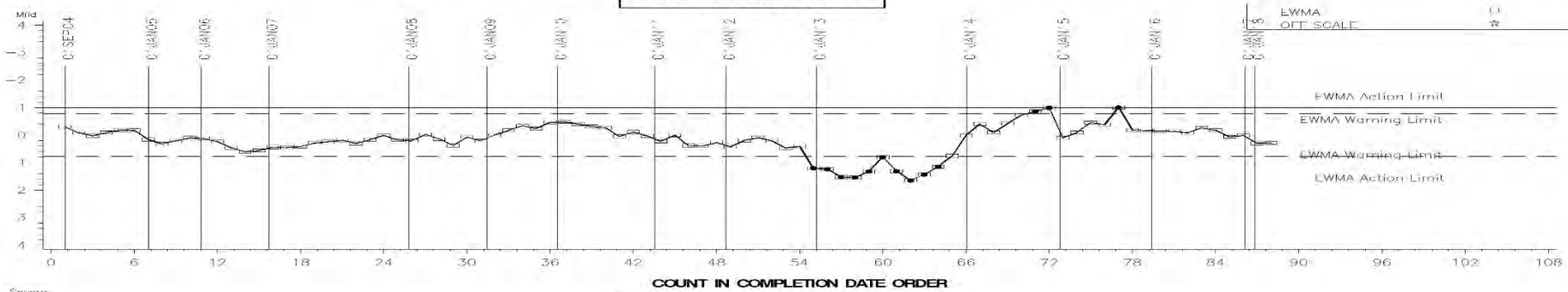
ISM Test Severity

- ▶ FPD in severity action alarm in the mild direction
- ▶ IAS, CWL and ASR are in control

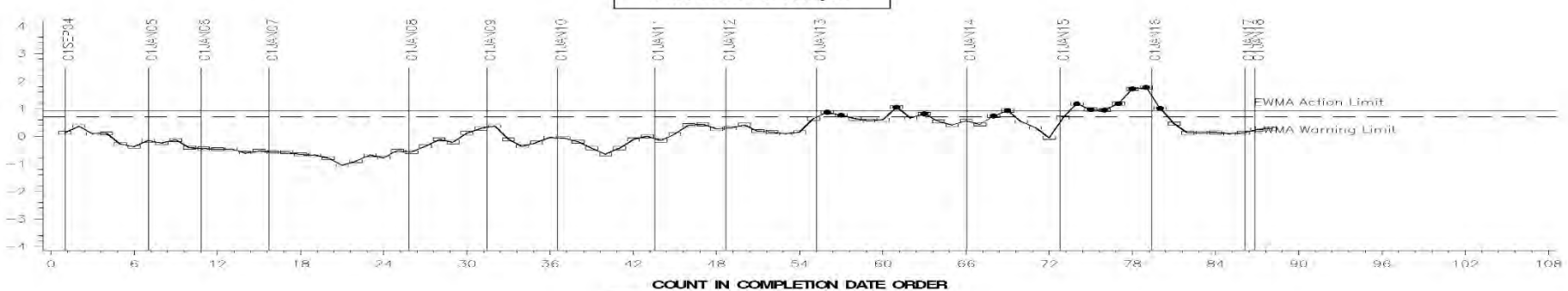
ISM INDUSTRY OPERATIONALLY VALID DATA

INJECTOR SCREW WEIGHT LOSS ADJUSTED TO 3.9% SOOT

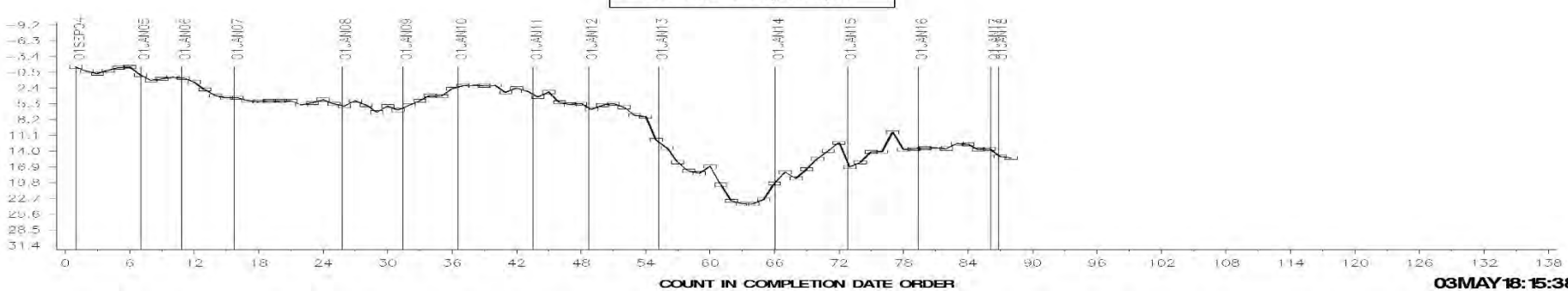
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

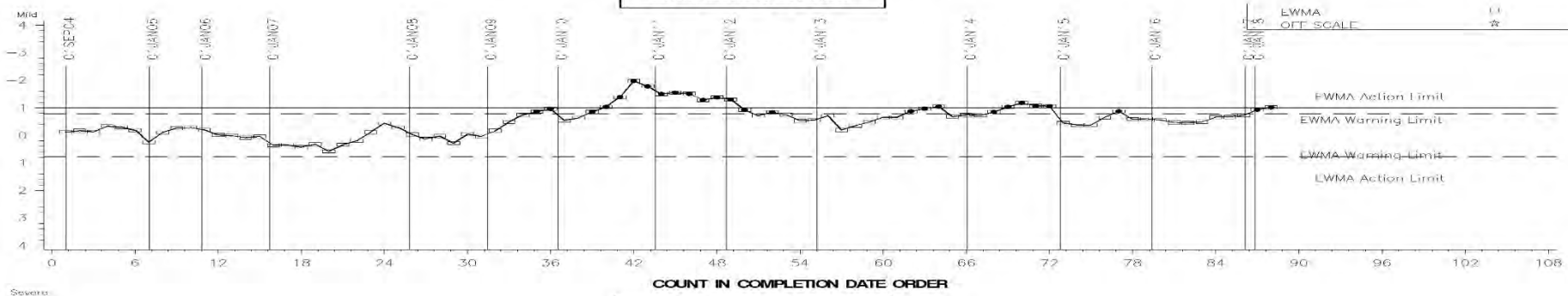


03MAY18: 15:38

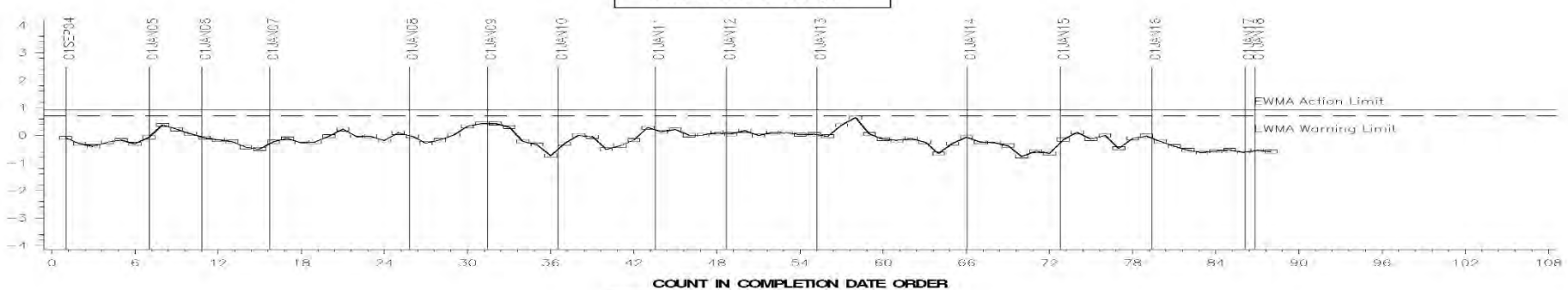
ISM INDUSTRY OPERATIONALLY VALID DATA

FILTER PLUGGING DELTA P

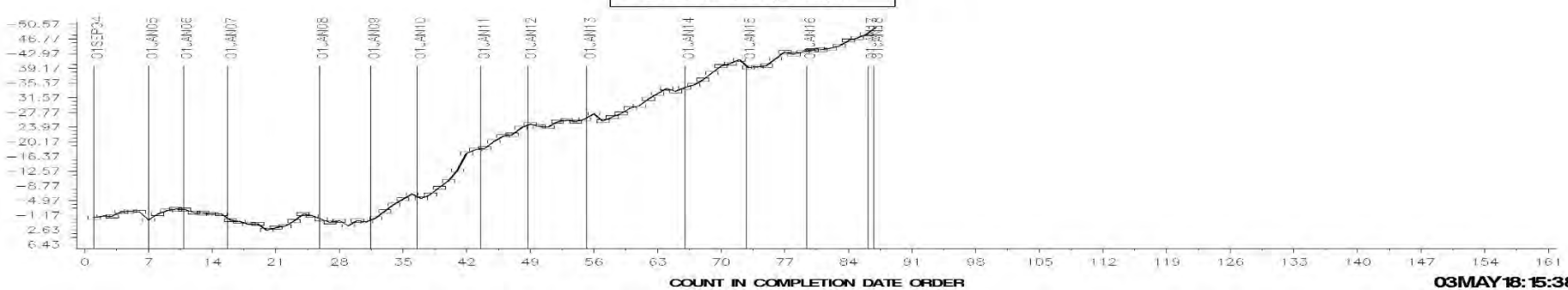
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

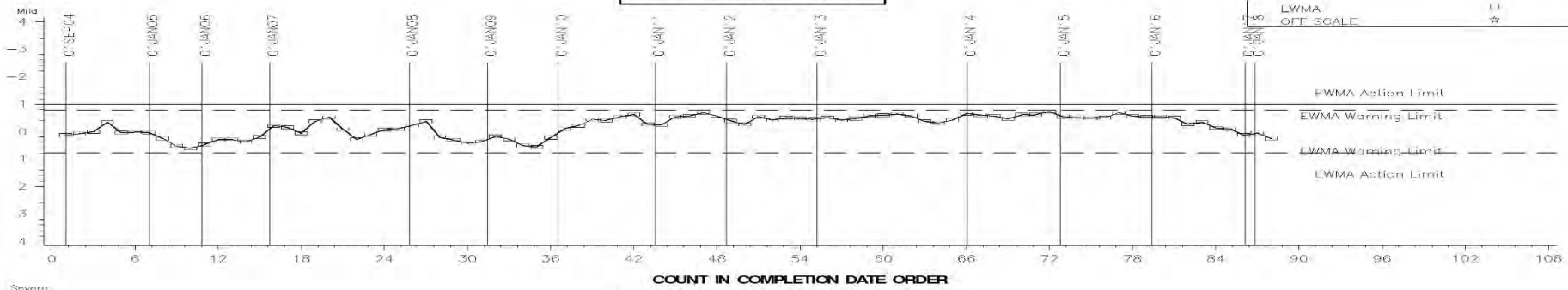


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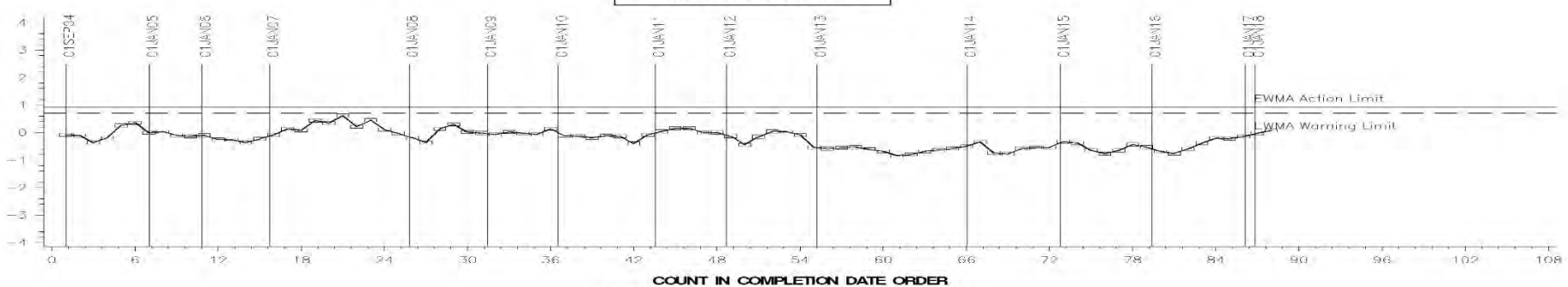
ISM INDUSTRY OPERATIONALLY VALID DATA

CROSSHEAD WEIGHT LOSS ADJUSTED TO 3.9 % SOOT

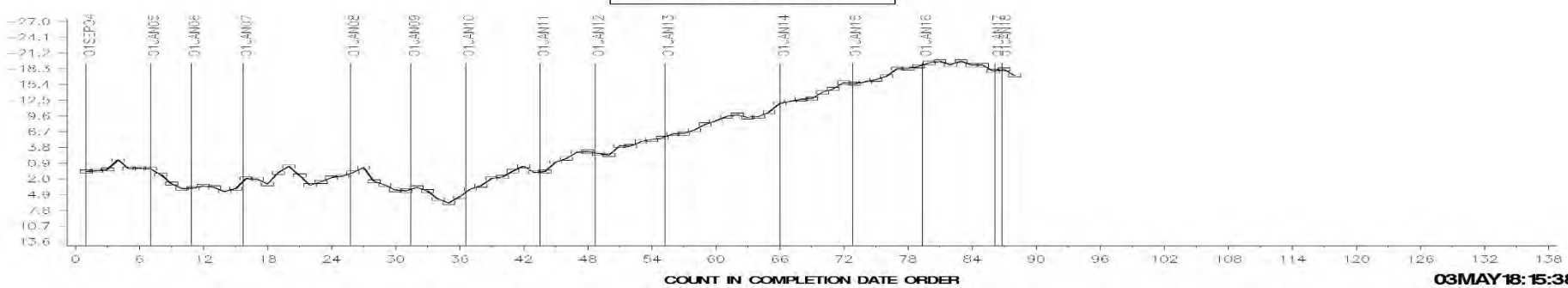
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

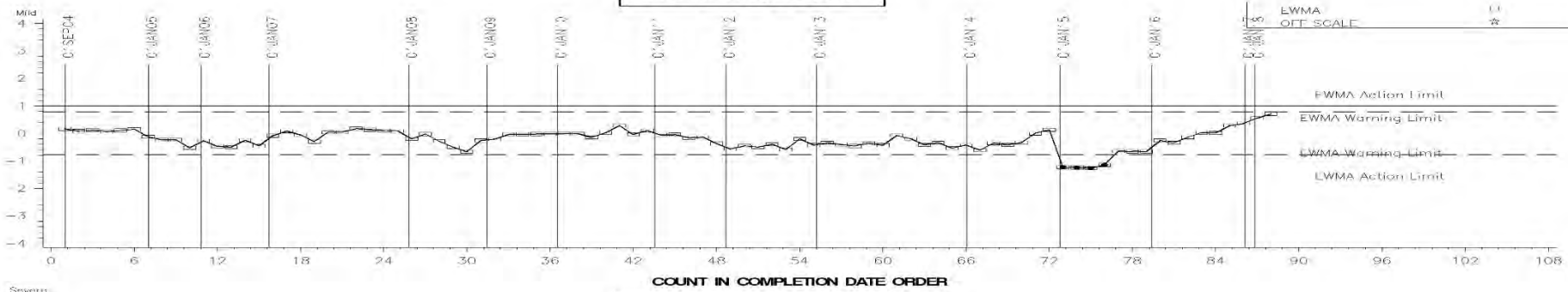


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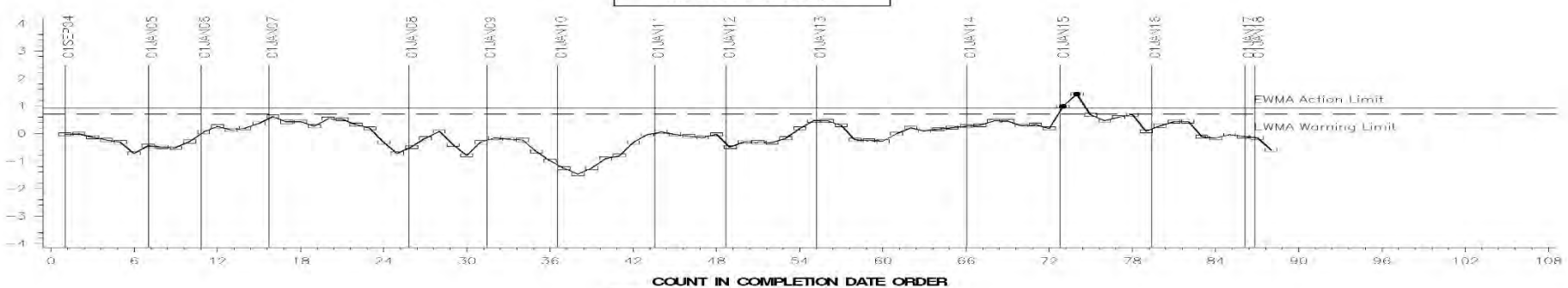
ISM INDUSTRY OPERATIONALLY VALID DATA

AVERAGE SLUDGE RATING

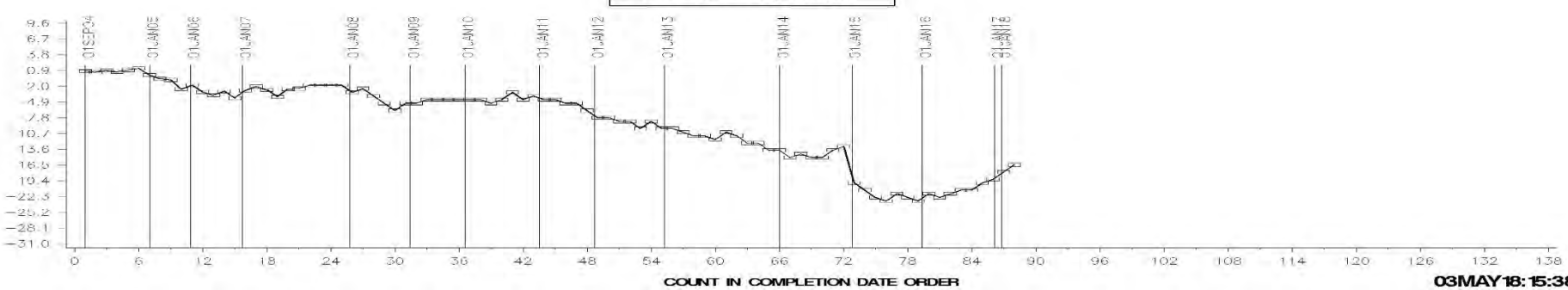
LTMS Severity Analysis



LTMS Precision Analysis

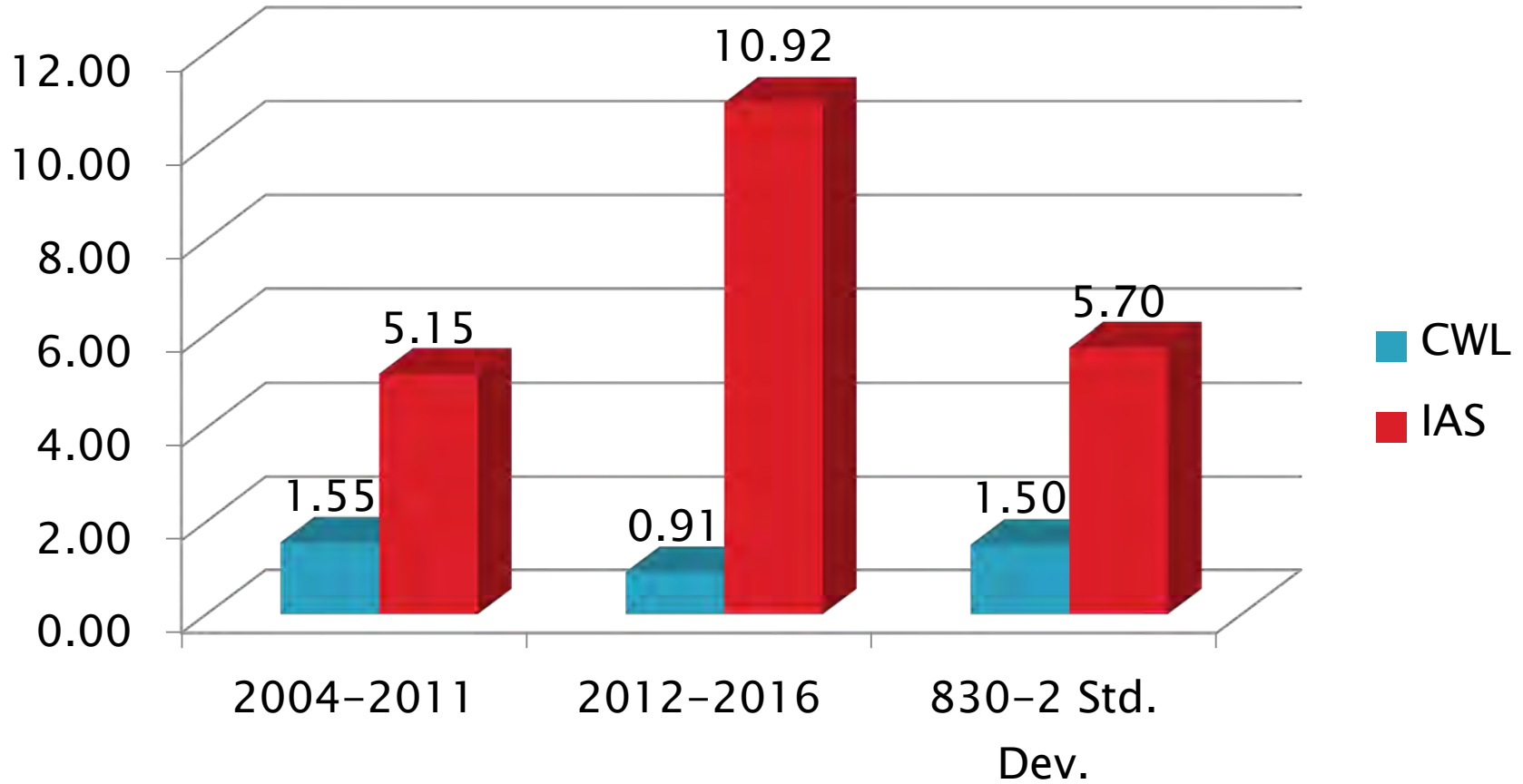


CUSUM Severity Analysis

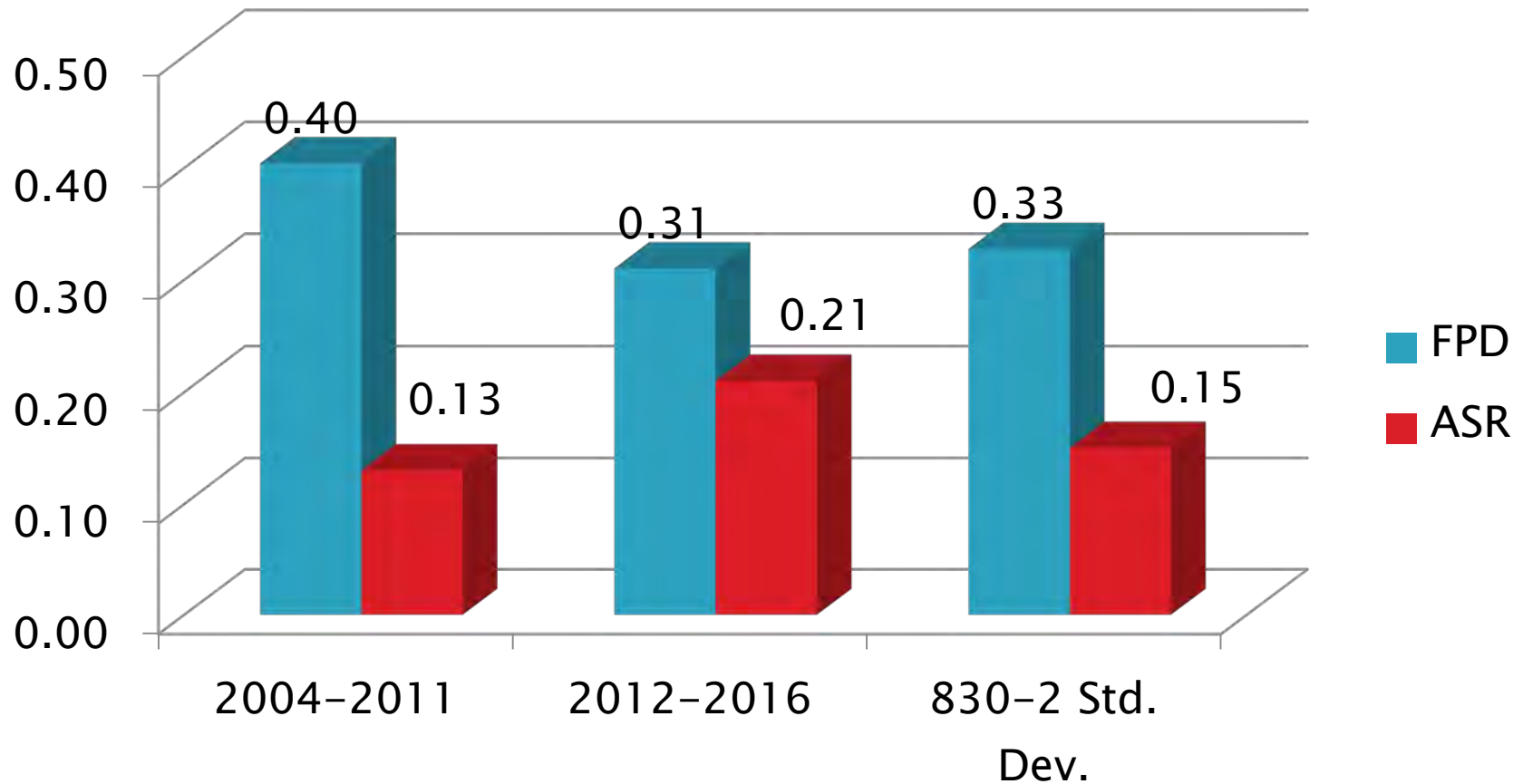


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ISM Precision Estimates



ISM Precision Estimates



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Test Monitoring Center

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EOAT

»» April 2018

EOAT Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		0

EOAT Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

EOAT Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

*Invalid and aborted tests

EOAT Test Severity

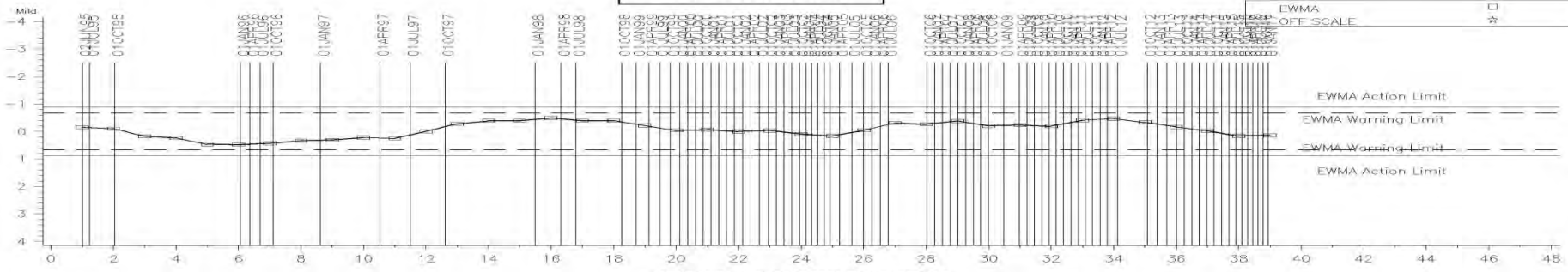
- ▶ As no EOAT tests were run during this period no statement about test severity can be made.

EOAT INDUSTRY OPERATIONAL VALID DATA

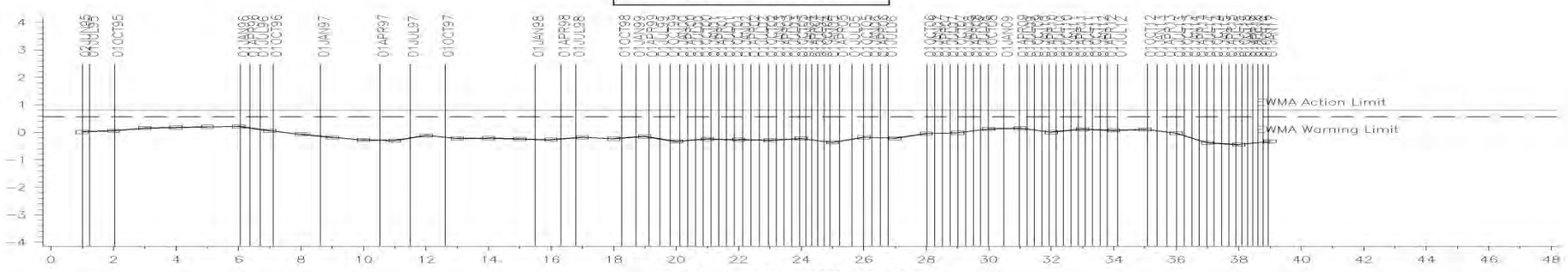


ENGINE OIL AERATION

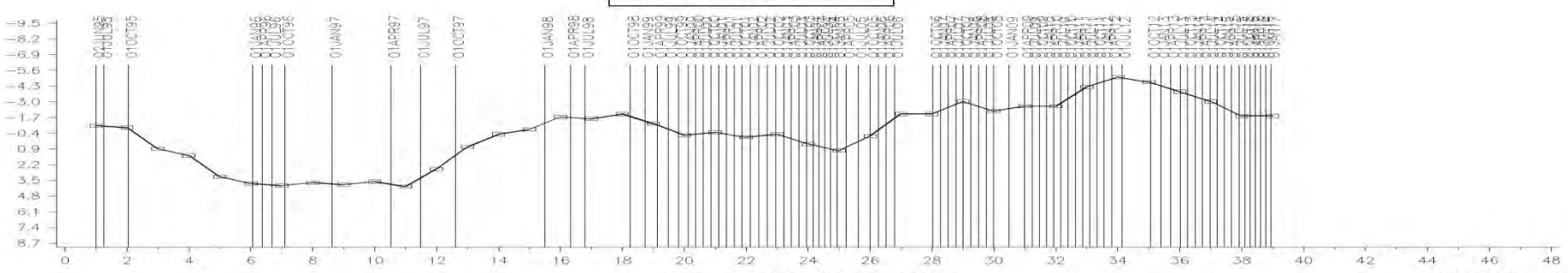
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



03NOV17: 13:49

Test Monitoring Center

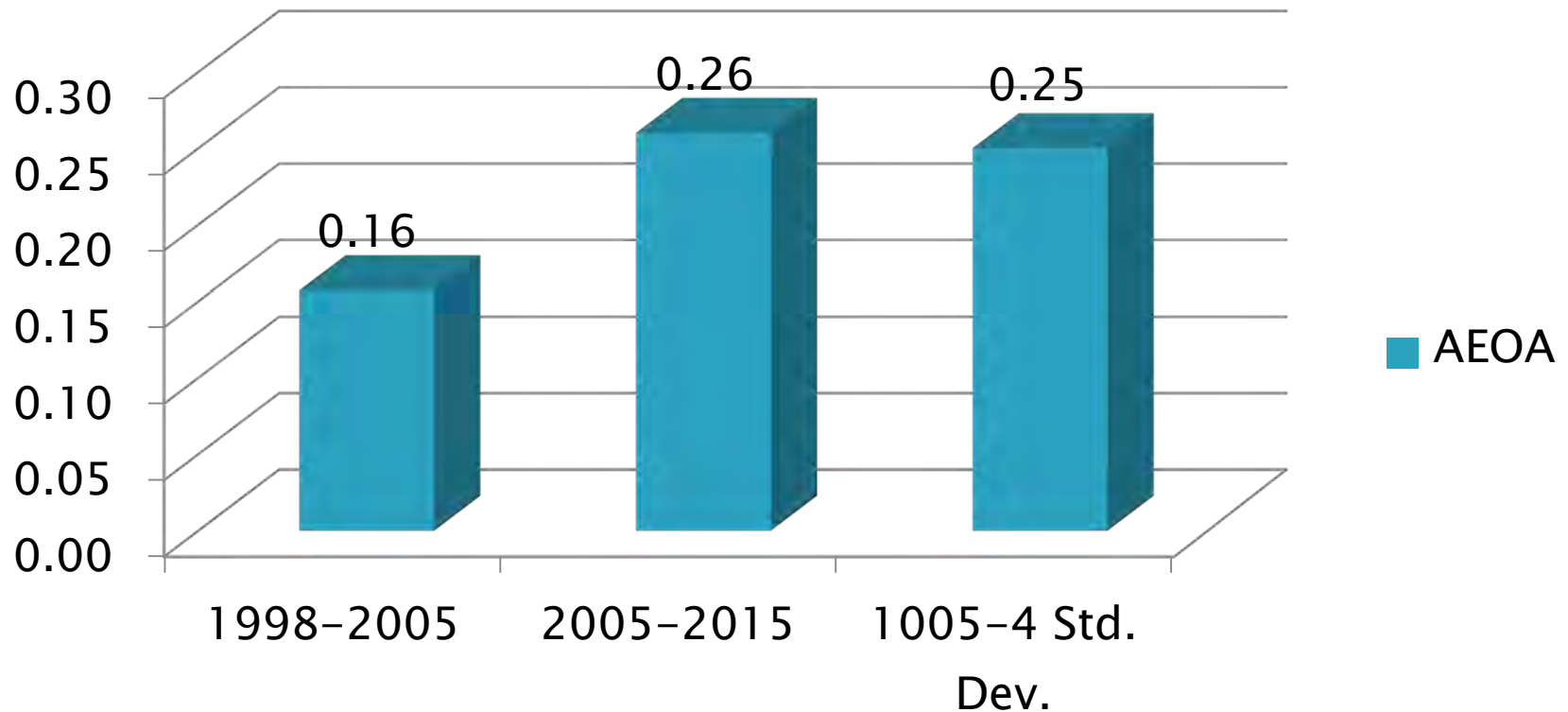
<http://astmtmc.cmu.edu>



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EOAT Precision Estimates

AEOA



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RFWT

»» April 2018

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RFWT Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		0

RFWT Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

RFWT Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

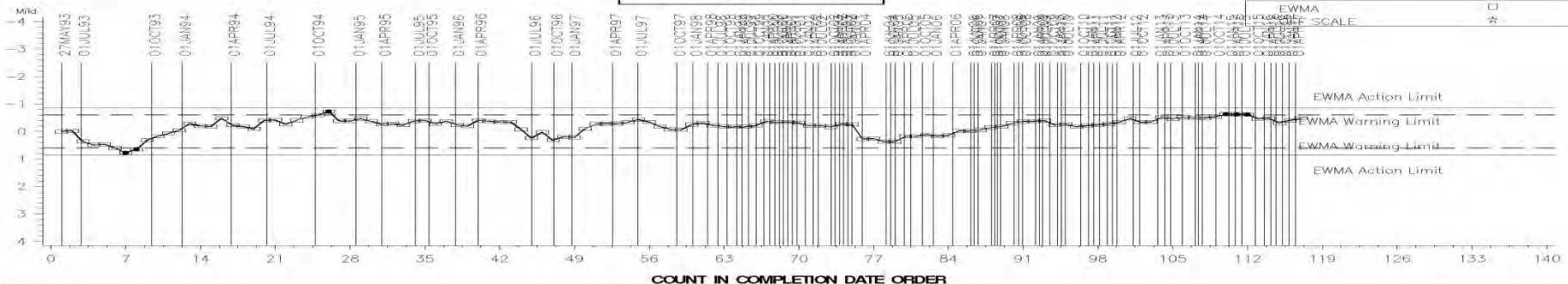
*Invalid and aborted tests

RFWT Test Severity

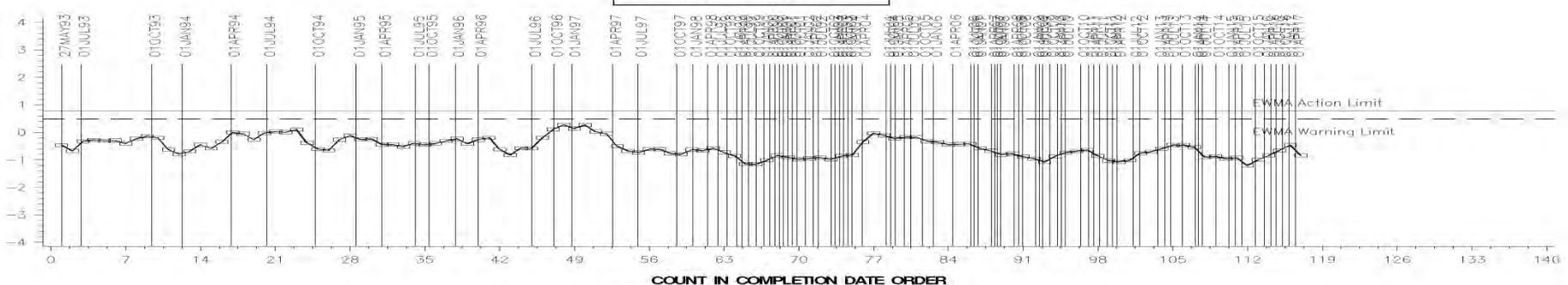
- ▶ As no RFWT tests were run during this period no statement about test severity can be made.

Average Follower Wear

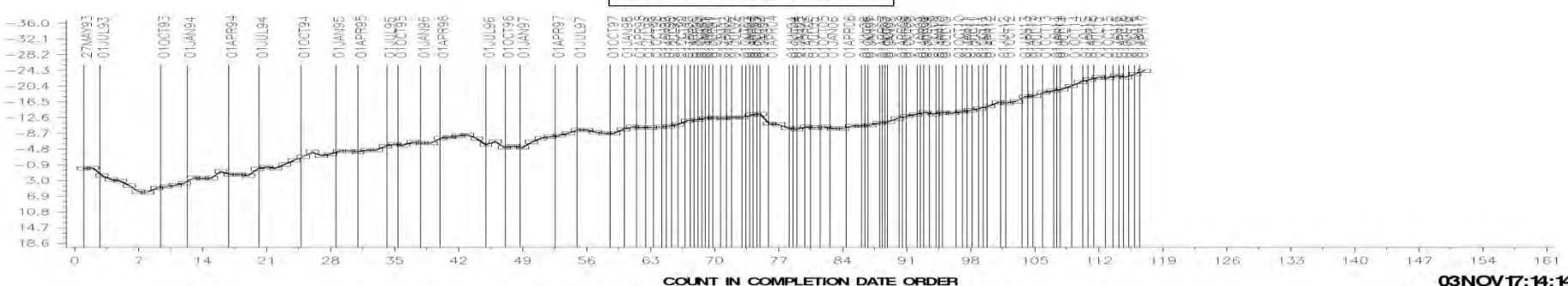
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



03NOV17:14:14

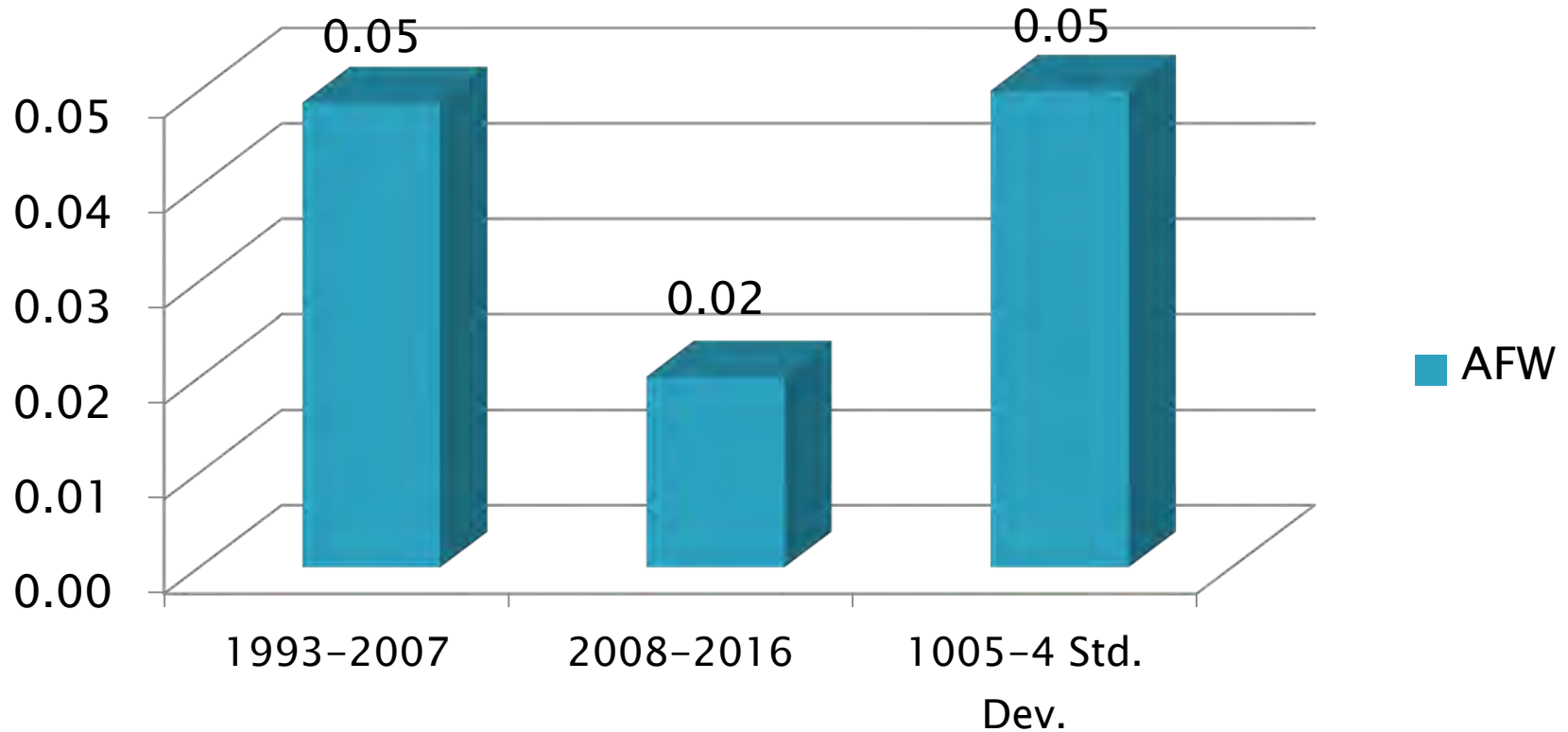
Standard Deviation Units

Standard Deviation Units

Standard Deviation Units

RFWT Precision Estimates

AFW



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Test Monitoring Center

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Mack T-8/T-8E

»» April 2018

Test Monitoring Center

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T-8/T-8E Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		1

T-8/T8-E Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

T-8/T8-E Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

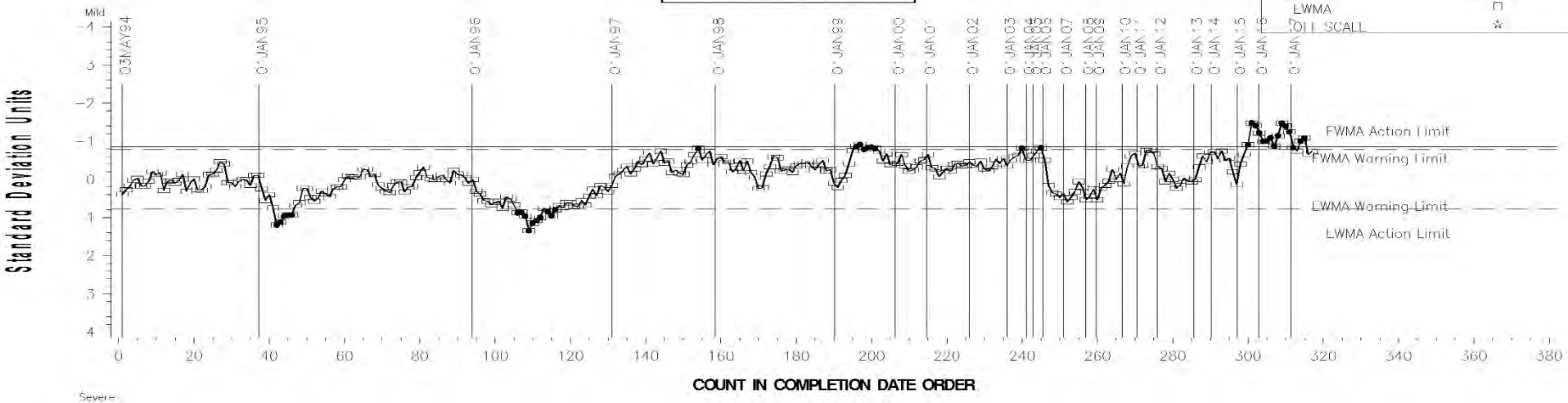
*Invalid and aborted tests

T-8/T-8E Test Severity

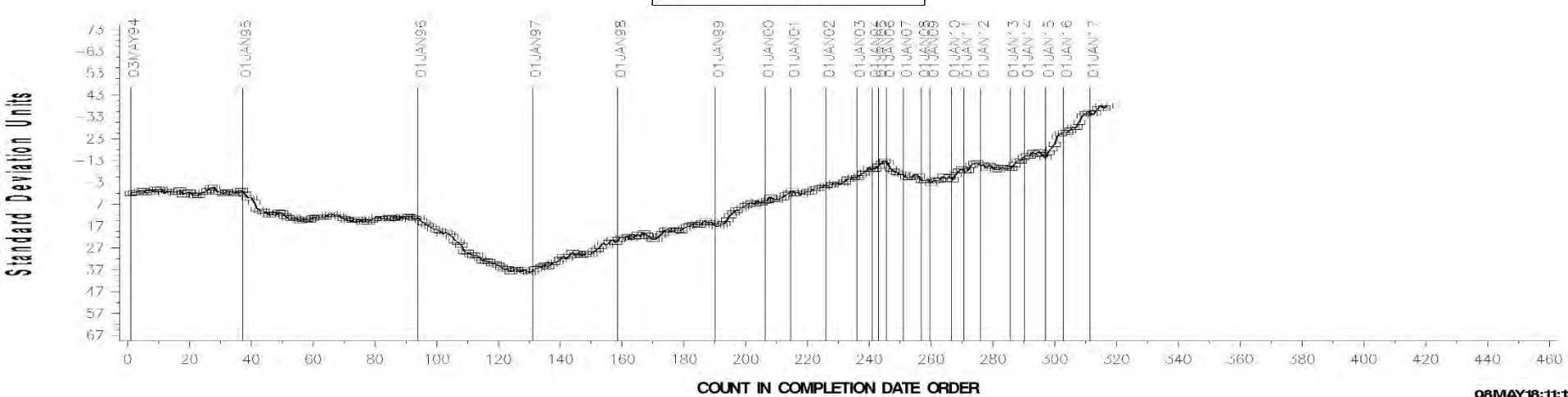
- ▶ VI38 is in severity warning alarm in mild direction.
- ▶ RV48 and RV2 are in control.

FINAL VISCOSITY INCR @ 3.8% SOOT

LTMS Severity Analysis



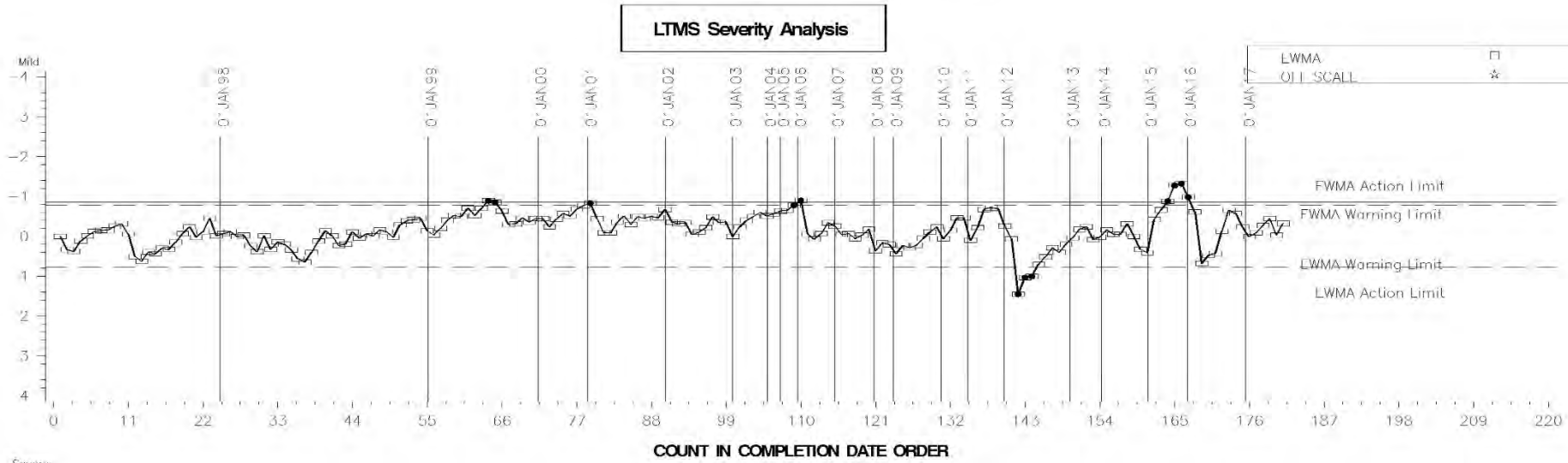
CUSUM Severity Analysis



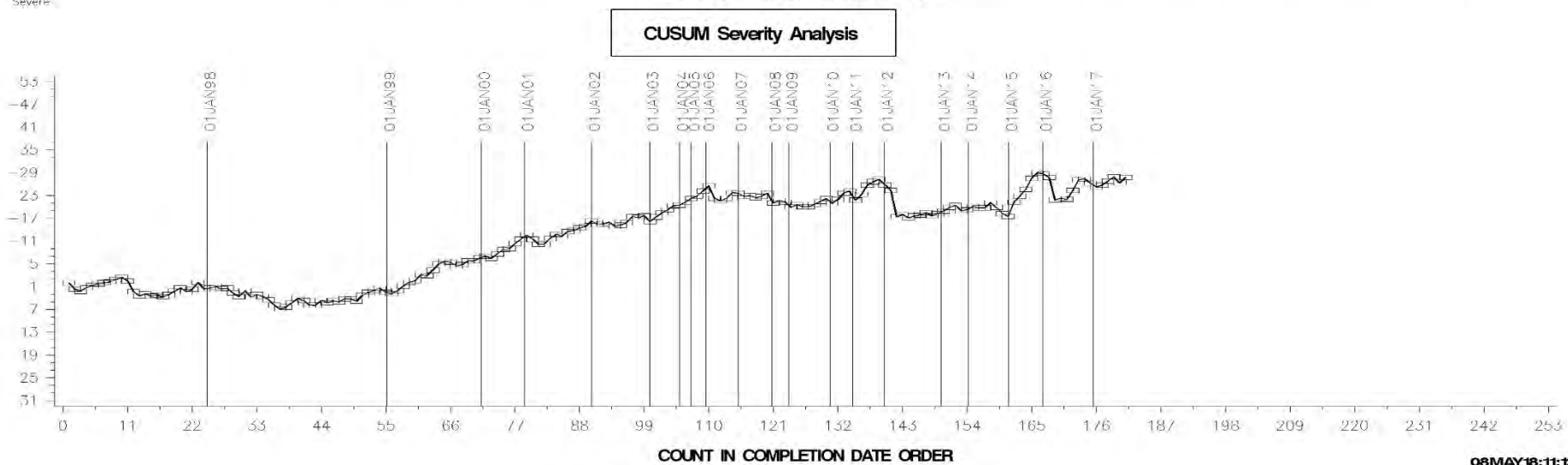
08MAY18:11:12

RELATIVE VISCOSITY @ 4.8% (50% LOSS)

Standard Deviation Units



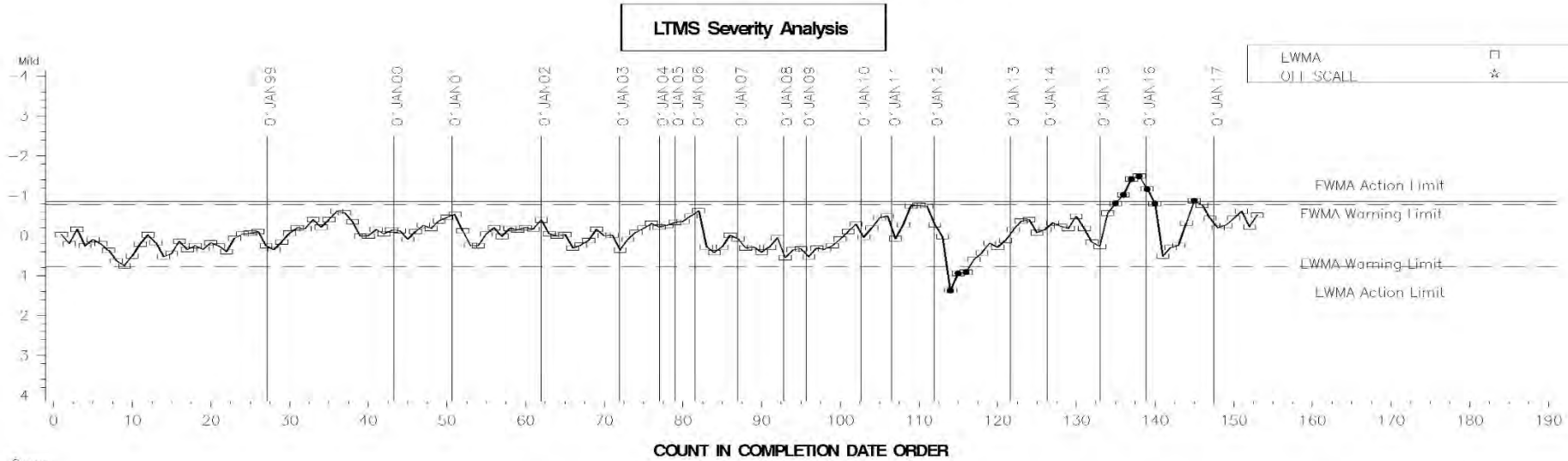
Standard Deviation Units



08MAY18:11:12

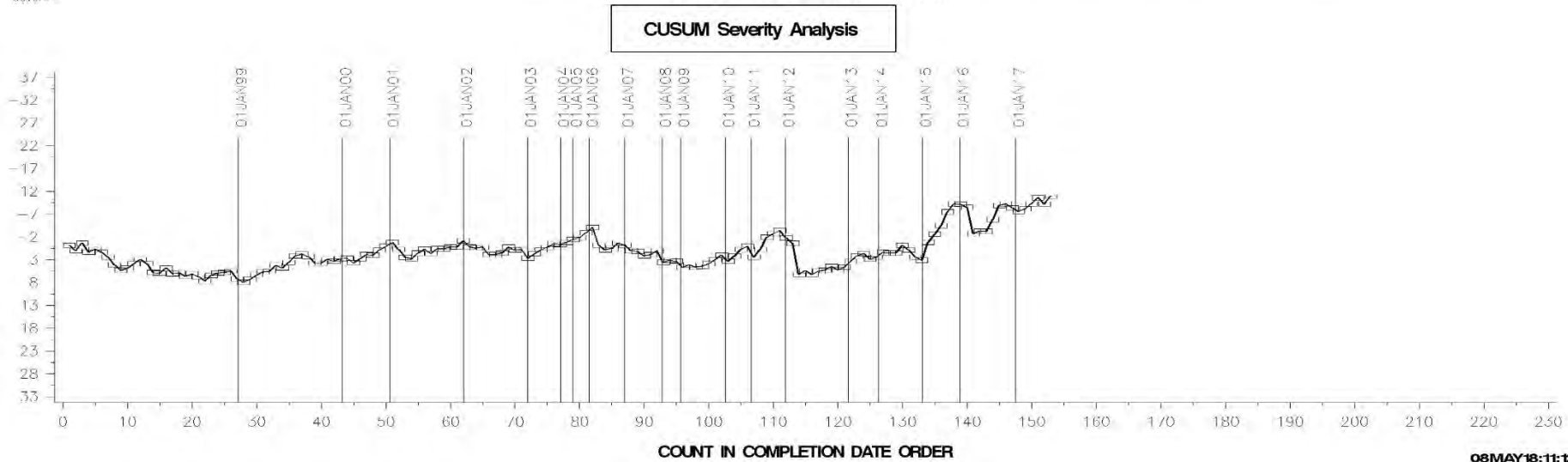
RELATIVE VISCOSITY @ 4.8% (100% LOSS)

Standard Deviation Units



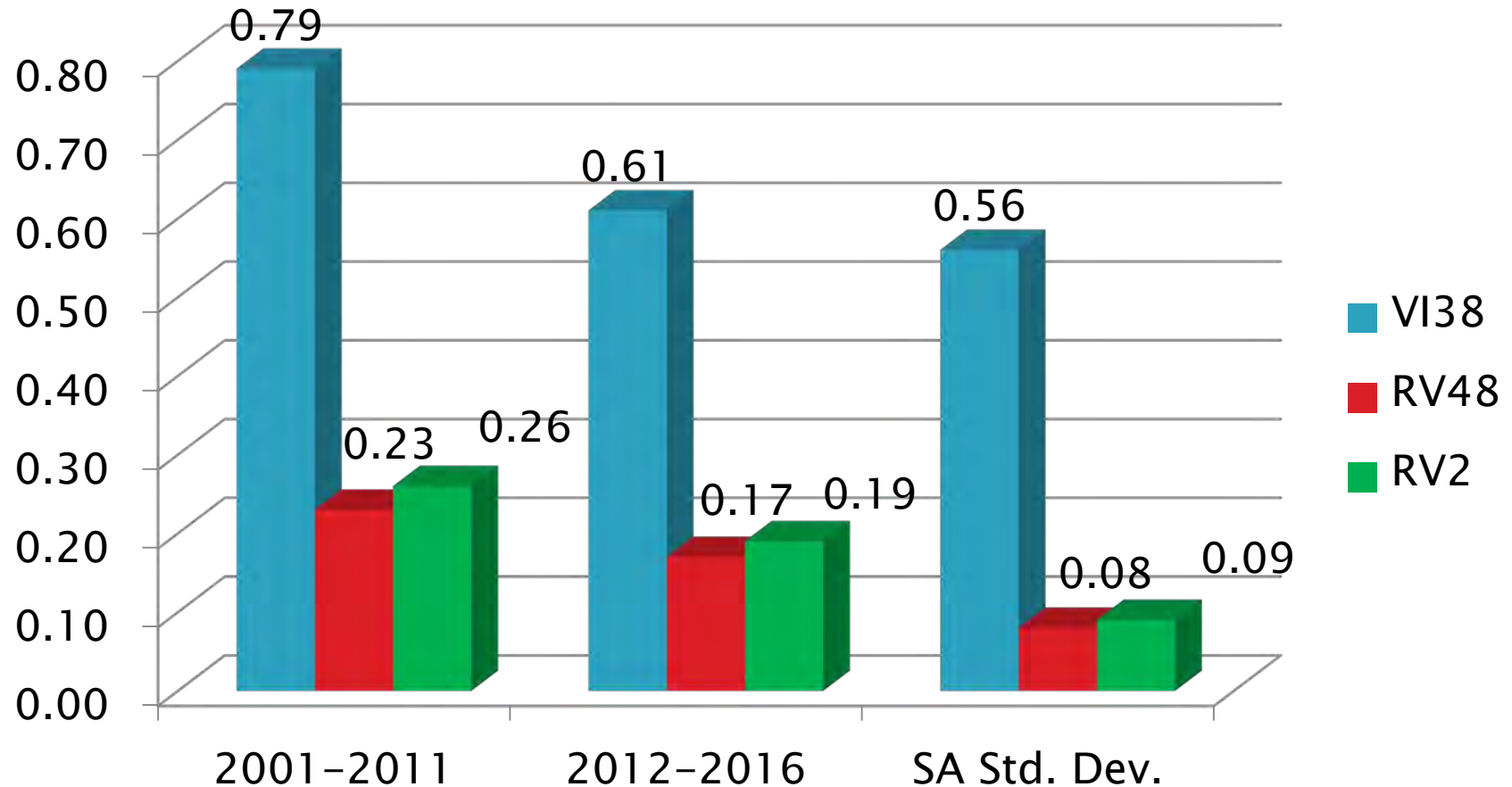
Severe

Standard Deviation Units



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T-8/E Precision Estimates



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Test Monitoring Center

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Mack T-11

»» April 2018

Test Monitoring Center

<http://astmtmc.cmu.edu>



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T-11 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	5
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Not Interpretable	MC	1
Total		6

T-11 Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

T-11 Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Not Interpretable	Did not make 12 cSt Viscosity Increase	1
Total		1

*Invalid and aborted tests

T-11 Test Severity

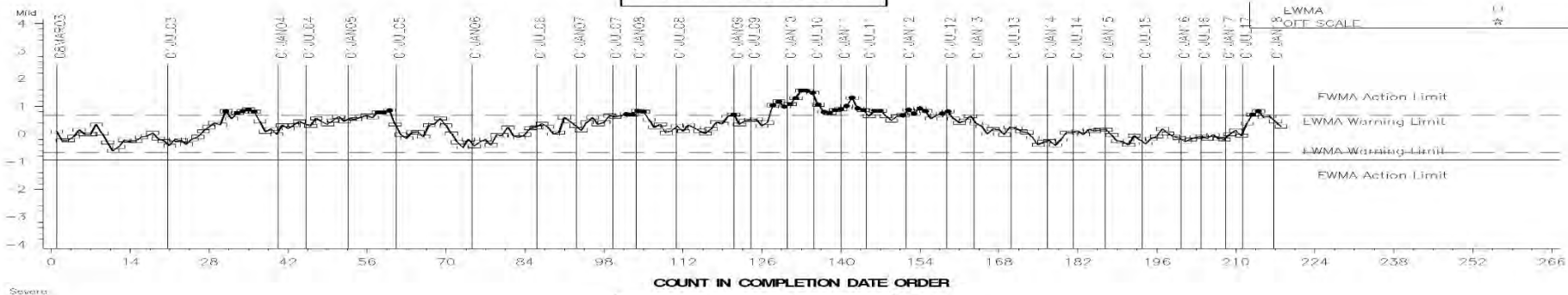
- ▶ SOOT and SOOT5 are in control.
- ▶ SOOT4 and MRV are in severity action alarm in the severe direction.
- ▶ MRV in precision action alarm.

T-11 INDUSTRY OPERATIONALY VALID DATA

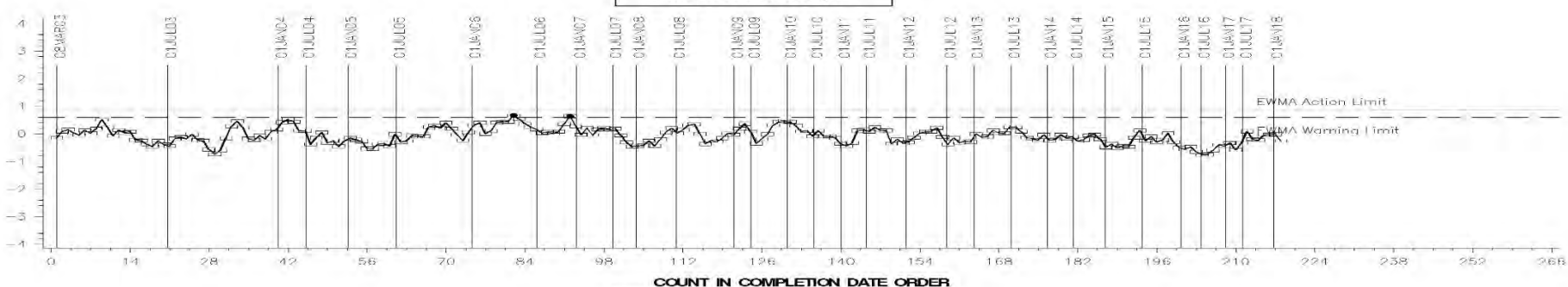


SOOT AT 12 cSt

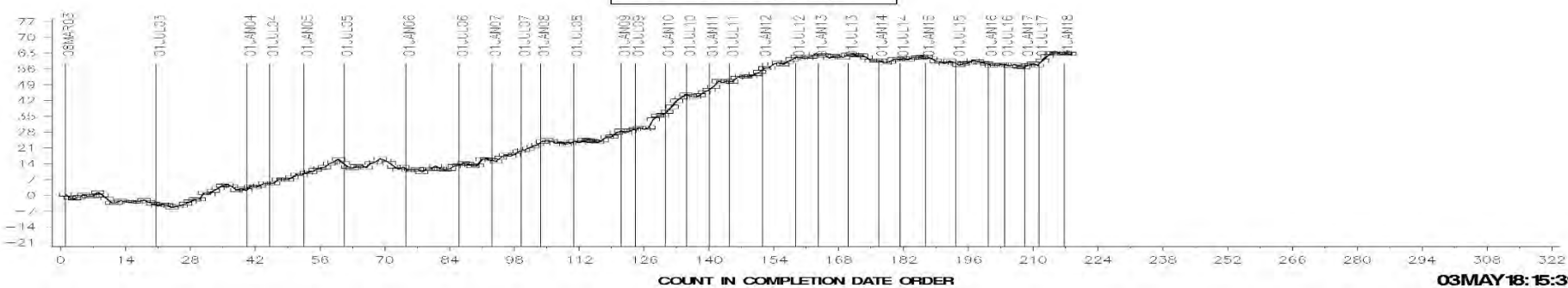
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



03MAY18: 15:39

Test Monitoring Center

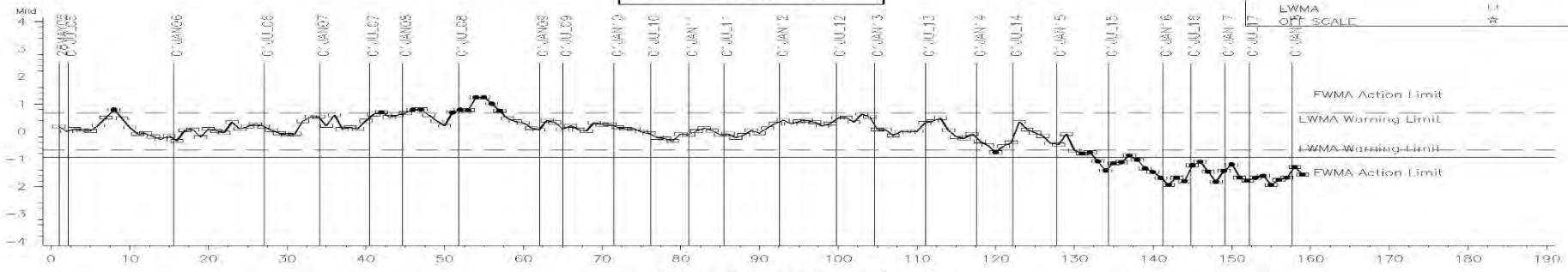
<http://astmtmc.cmu.edu>



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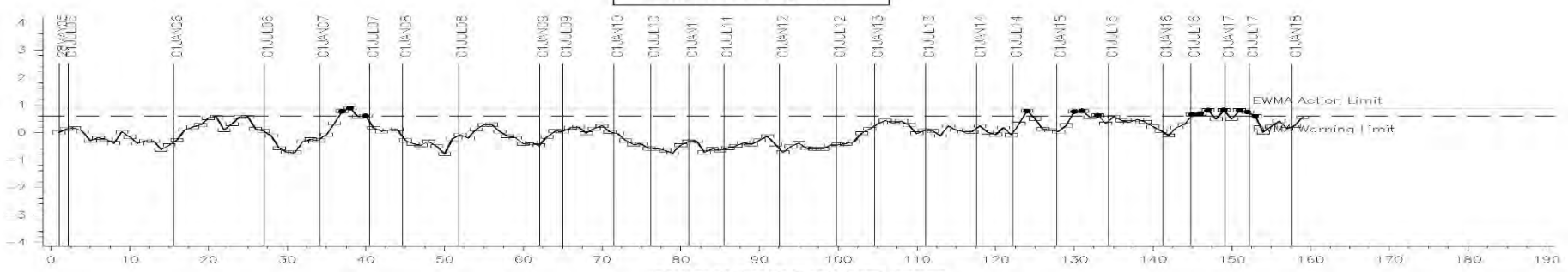
SOOT @ 4 cSt - FINAL RESULT

LTMS Severity Analysis



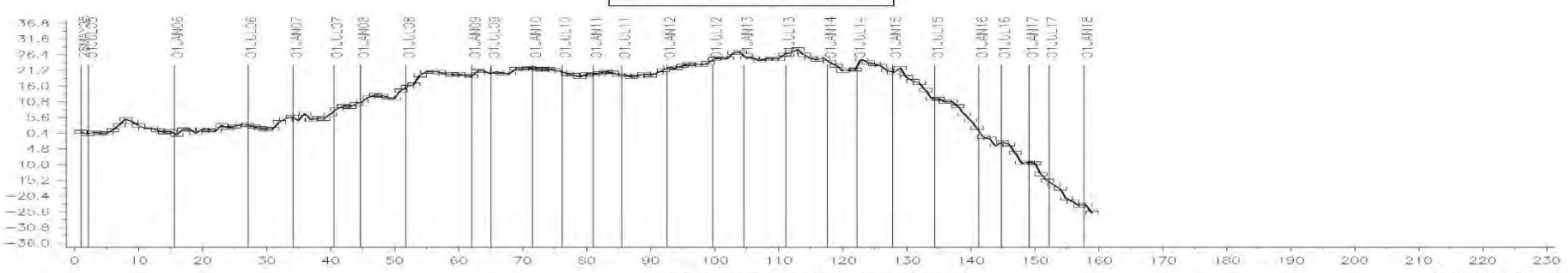
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

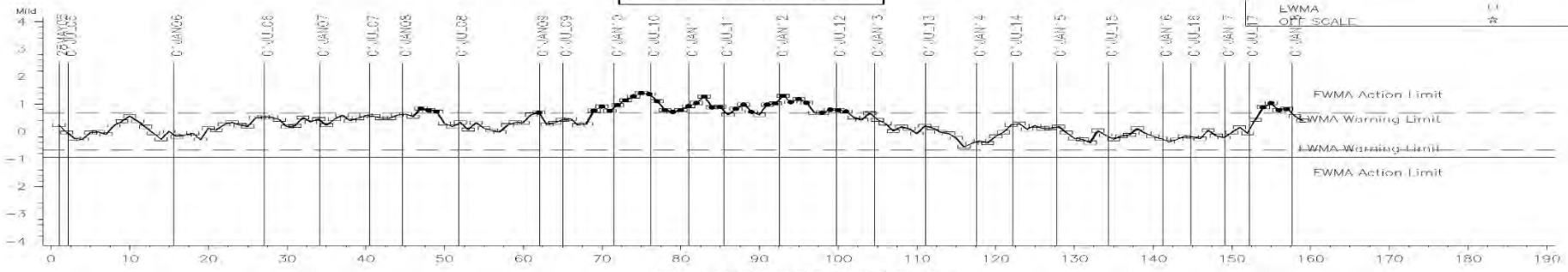
03MAY18: 15:41

T-11 INDUSTRY OPERATIONALLY VALID DATA



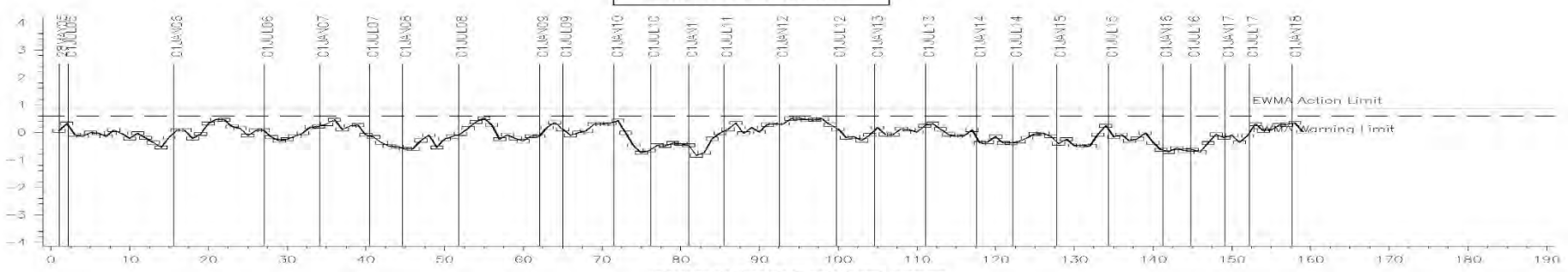
SOOT @ 15 cSt — FINAL RESULT

LTMS Severity Analysis



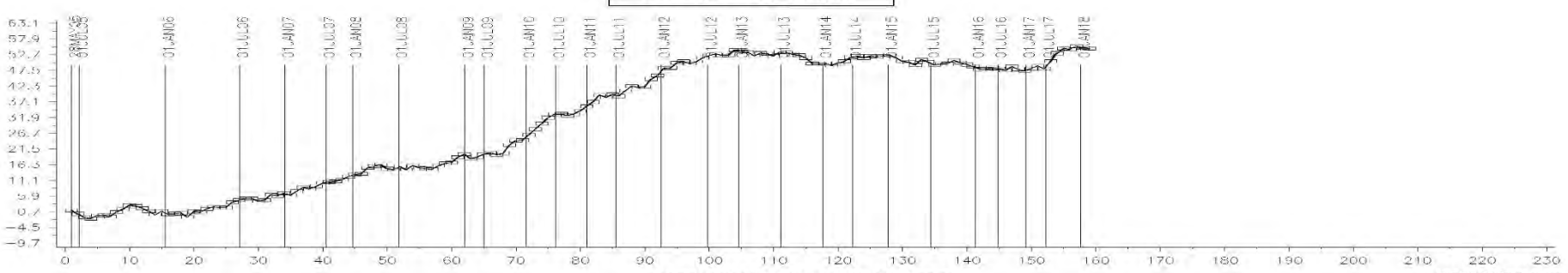
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



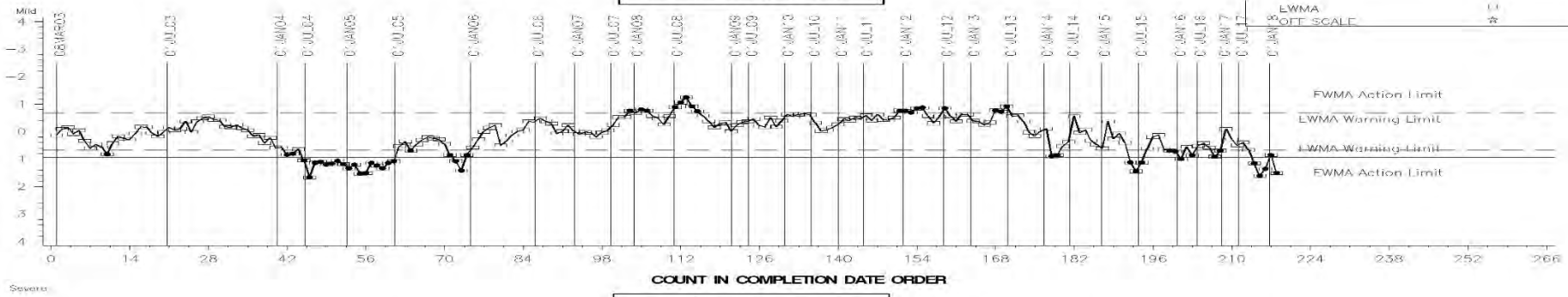
COUNT IN COMPLETION DATE ORDER

03MAY18: 15:41

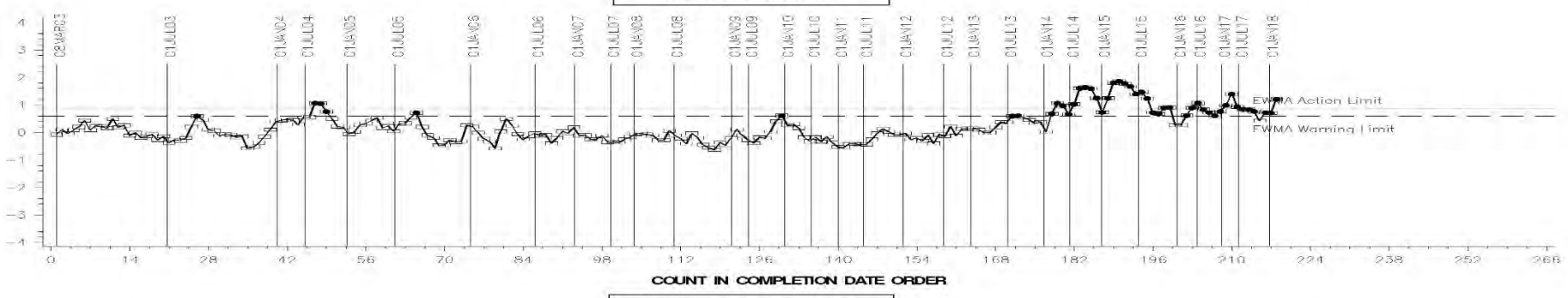


MRV VISCOSITY

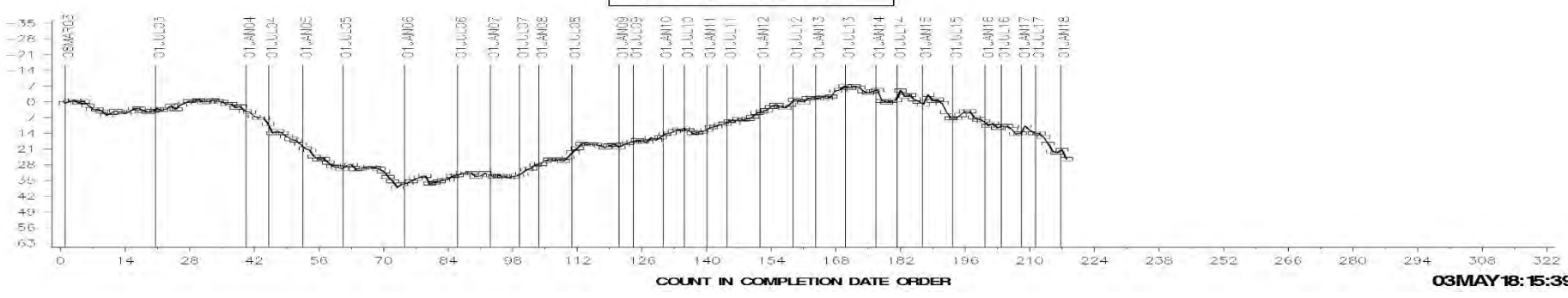
LTMS Severity Analysis



LTMS Precision Analysis

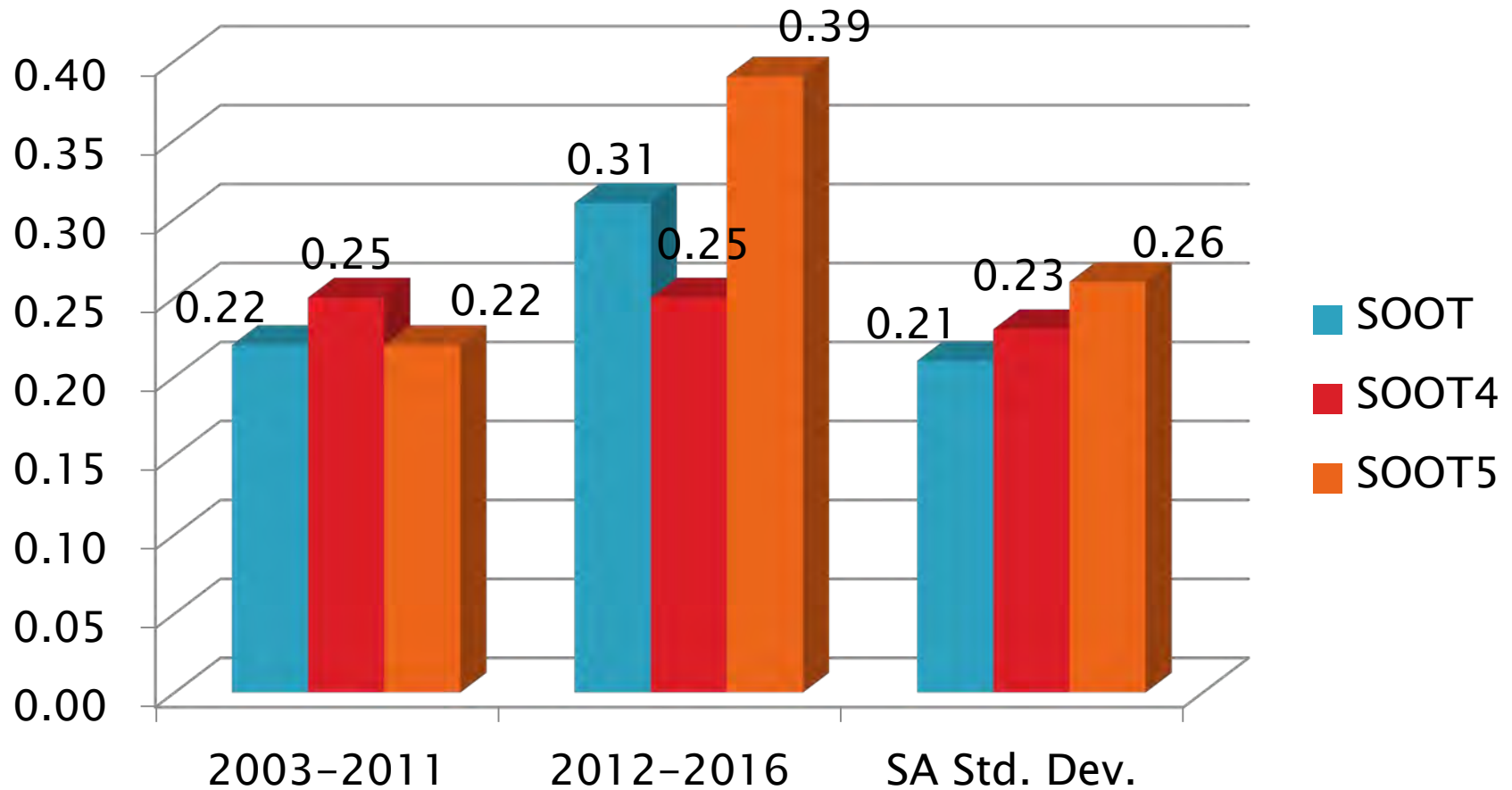


CUSUM Severity Analysis



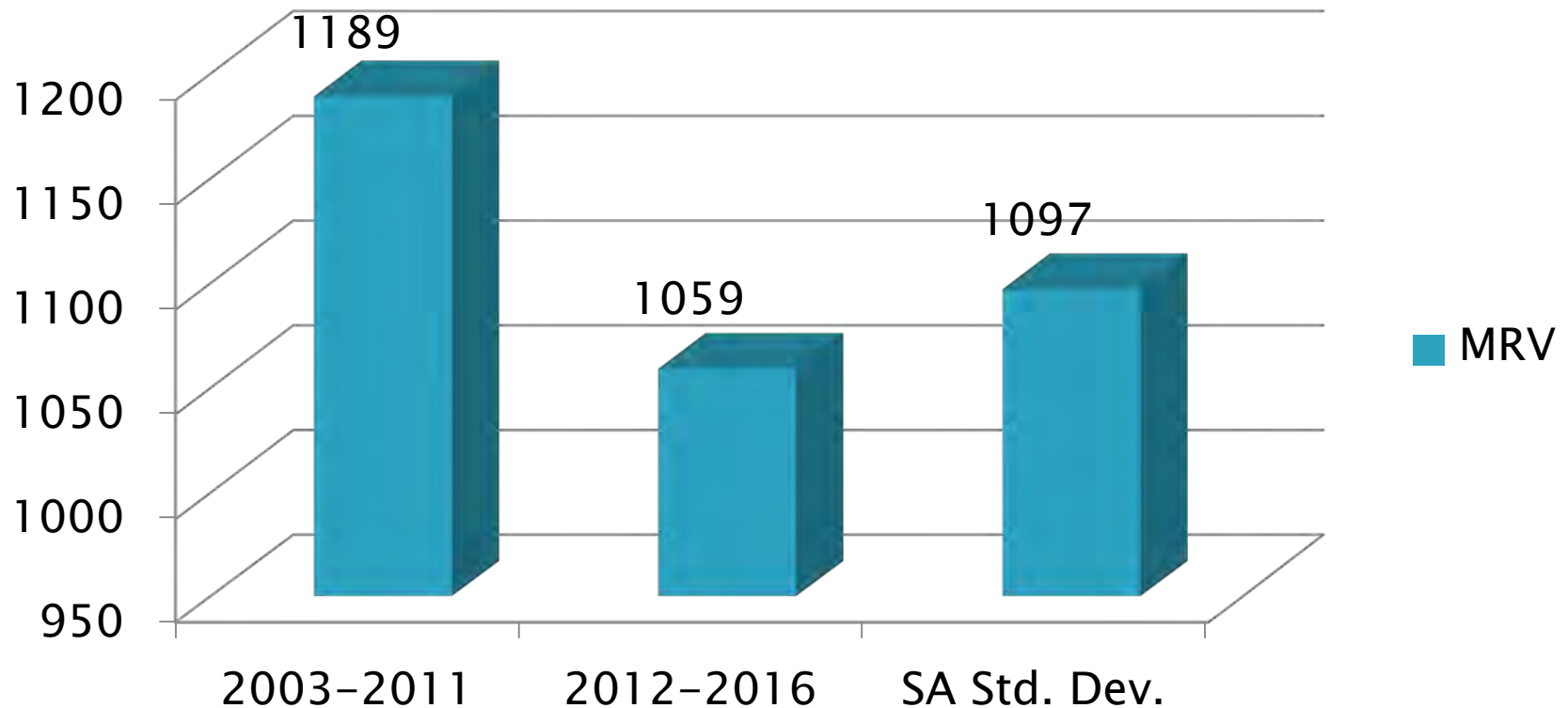
03MAY18: 15:39

T-11 Precision Estimates



T-11 Precision Estimates

MRV



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Mack T-12

»» April 2018

Test Monitoring Center

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T-12 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		1

T-12 Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

T-12 Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
Total		0

*Invalid and aborted tests

T-12 Test Severity

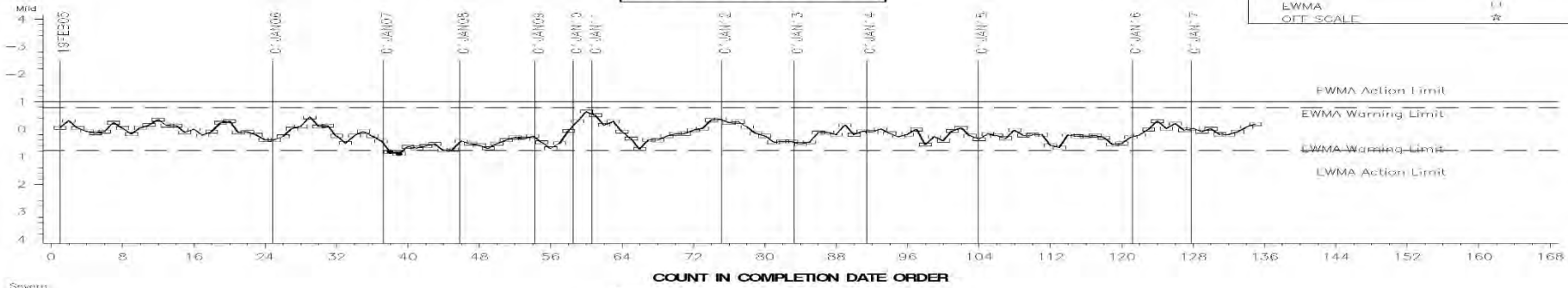
- ▶ All parameters are in control.

MACK T-12 INDUSTRY OPERATIONALLY VALID DATA

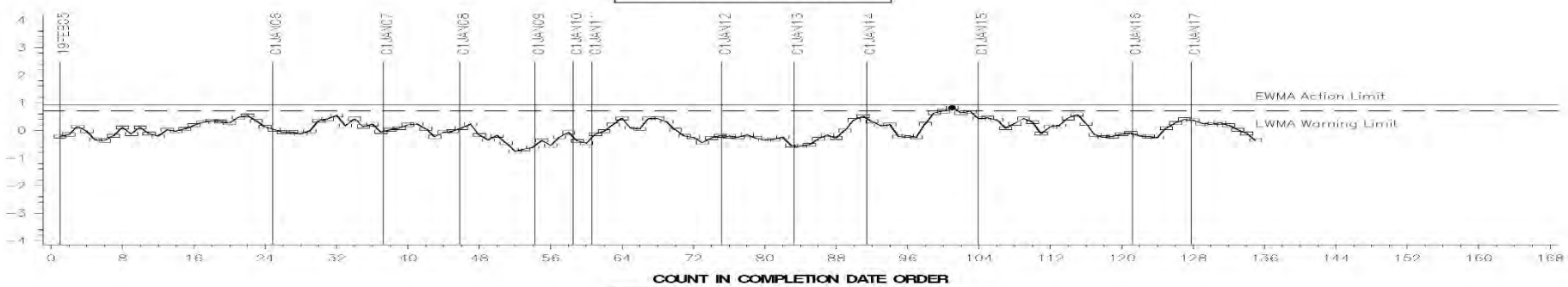


AVG. CYLINDER LINER WEAR (CLW)

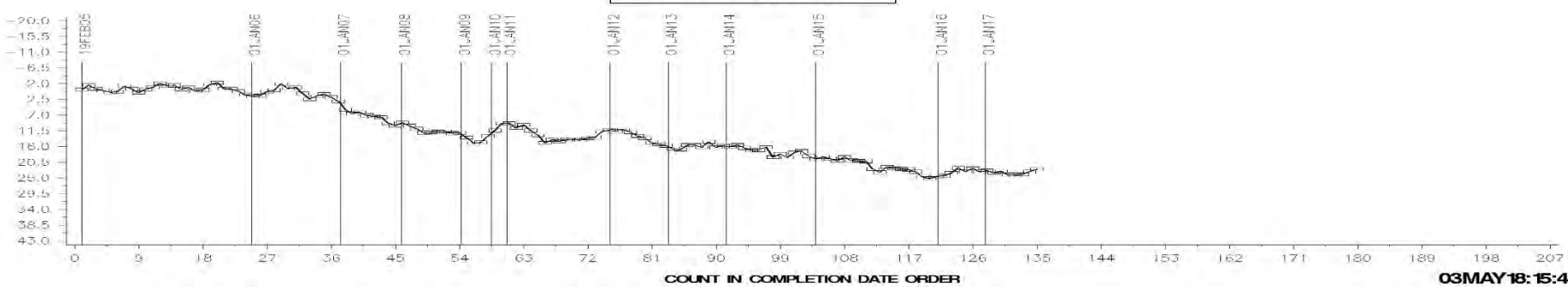
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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Test Monitoring Center

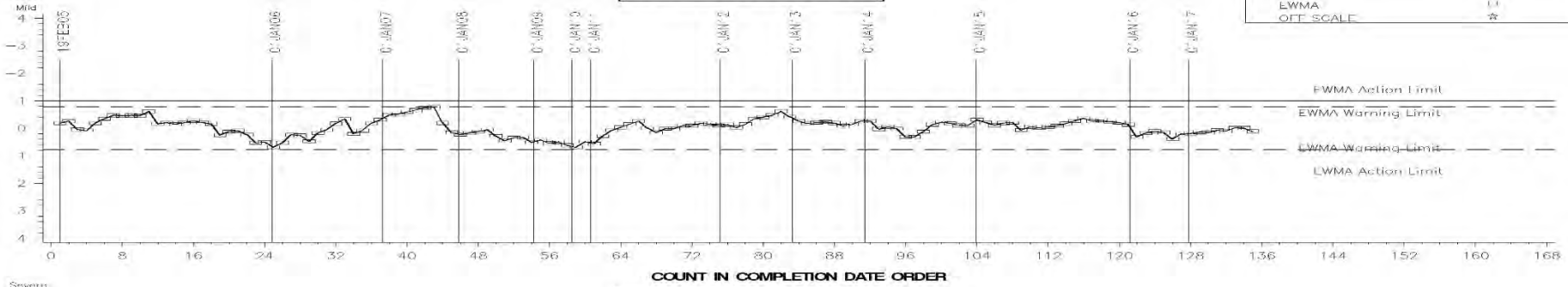
<http://astmtmc.cmu.edu>



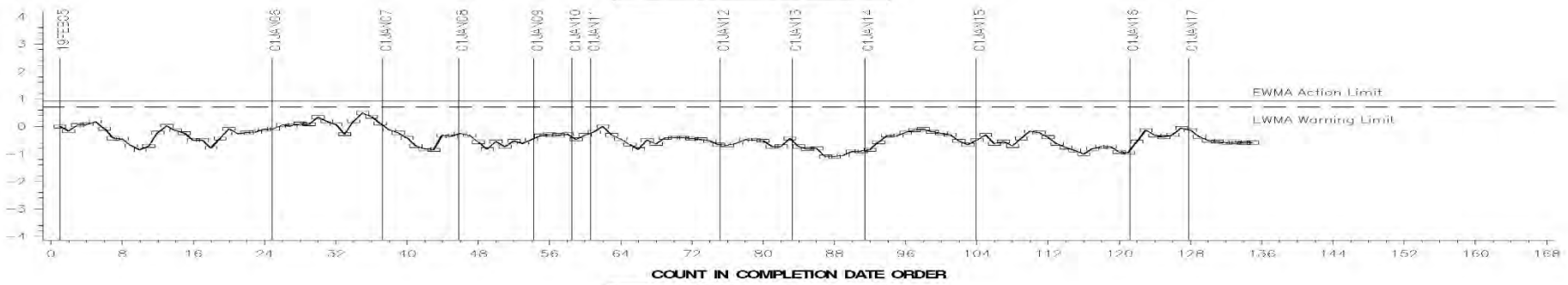
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AVG. TOP RING WEIGHT LOSS (TRWL)

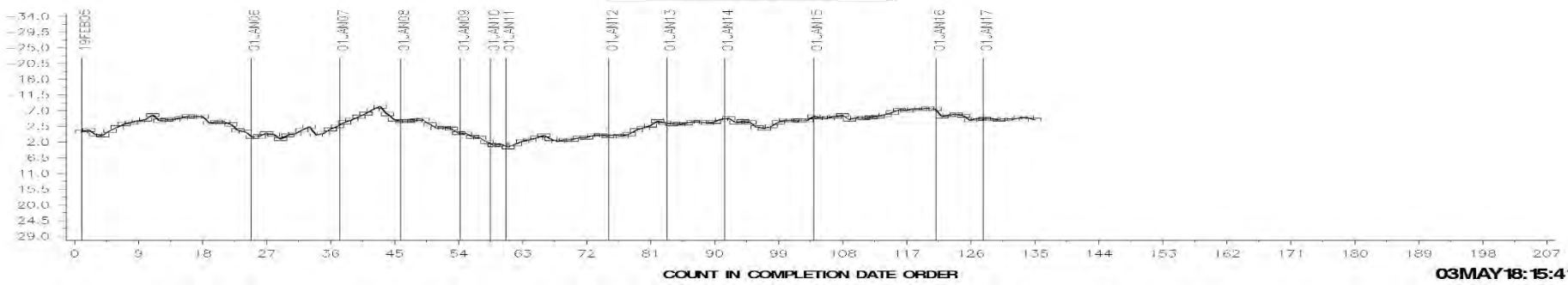
LTMS Severity Analysis



LTMS Precision Analysis

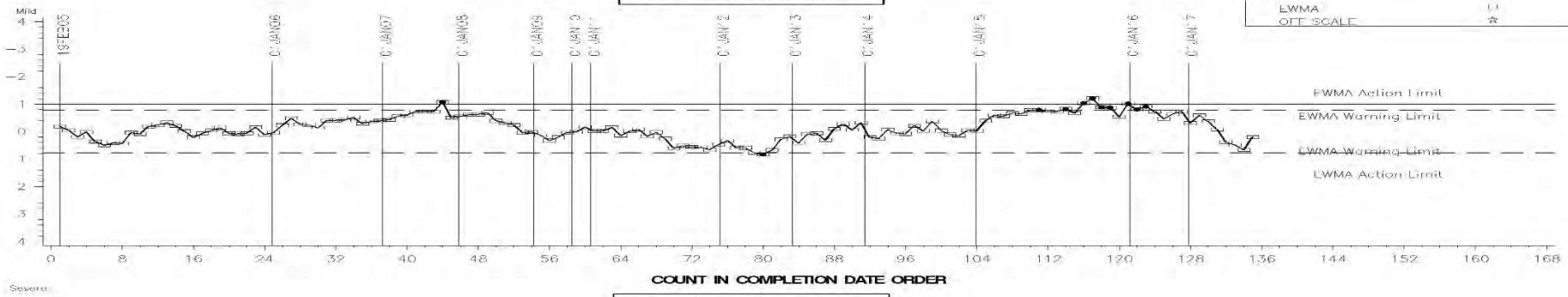


CUSUM Severity Analysis

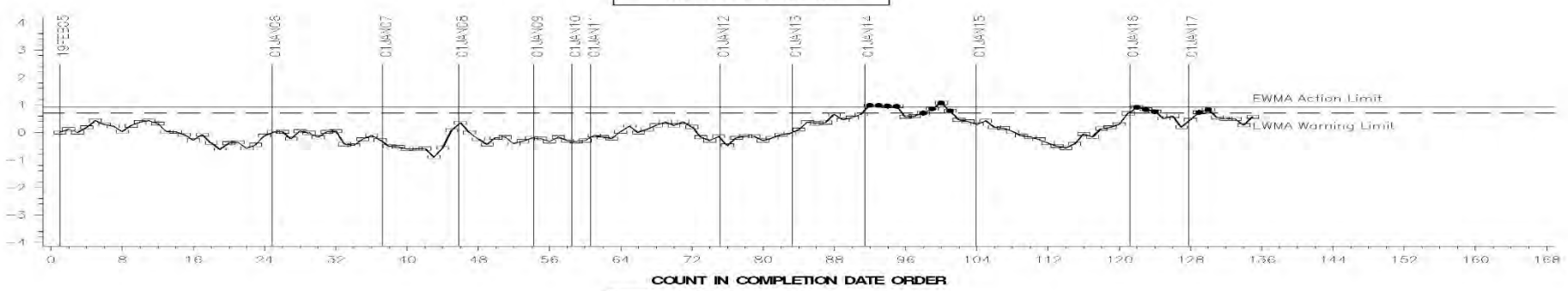


FINAL TRANS. RES. DELTA PB @ EOT

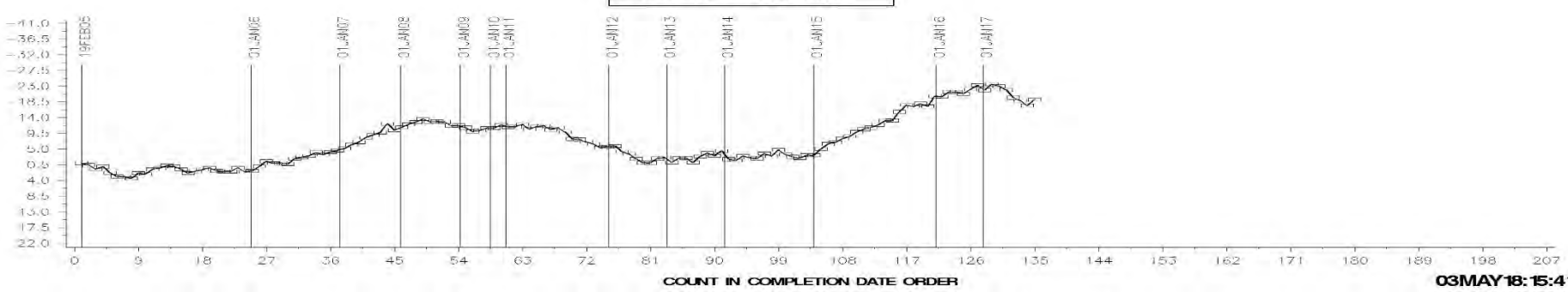
LTMS Severity Analysis



LTMS Precision Analysis



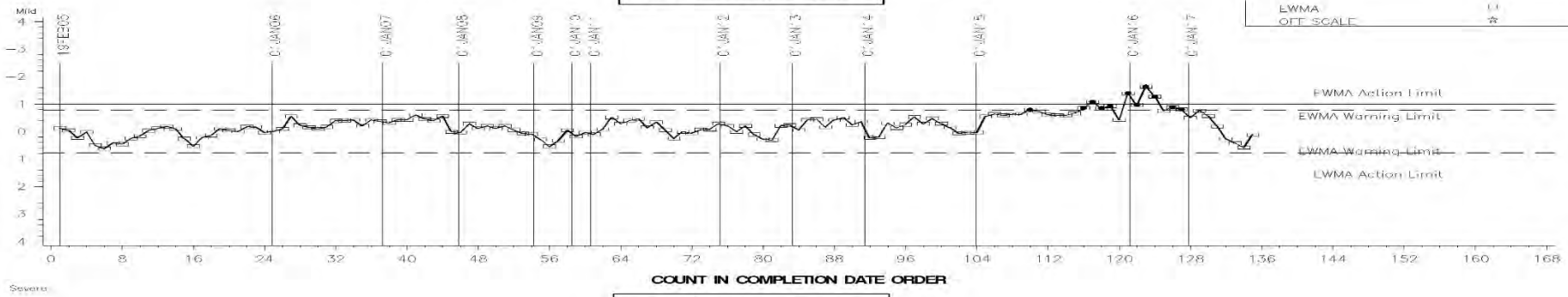
CUSUM Severity Analysis



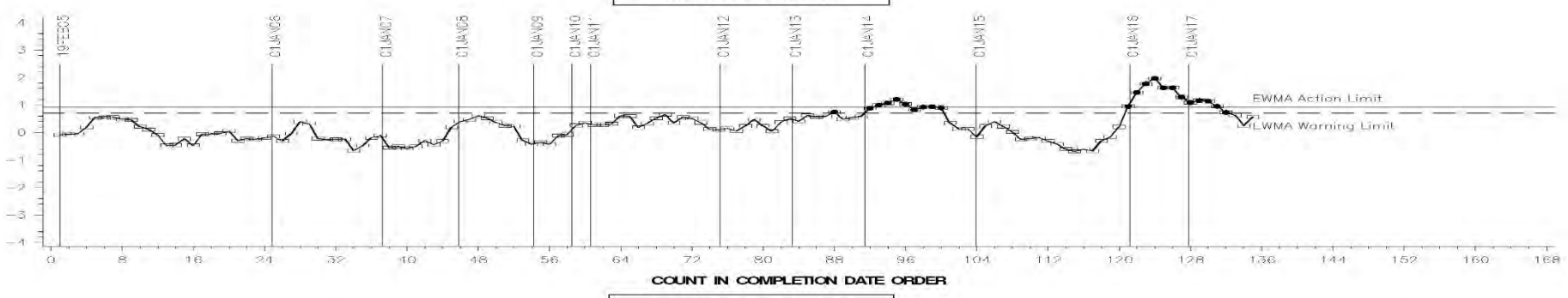
03MAY18: 15:41

FINAL TRANS. RES. DELTA PB 250-300H

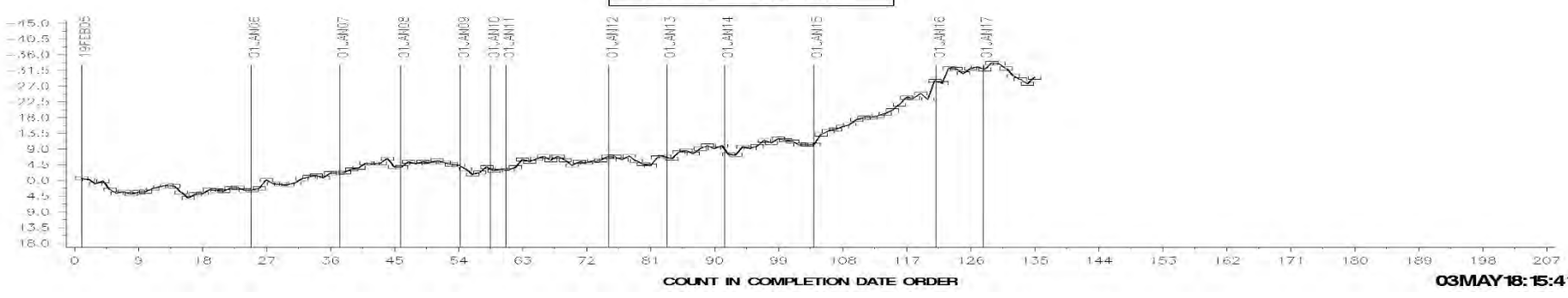
LTMS Severity Analysis



LTMS Precision Analysis



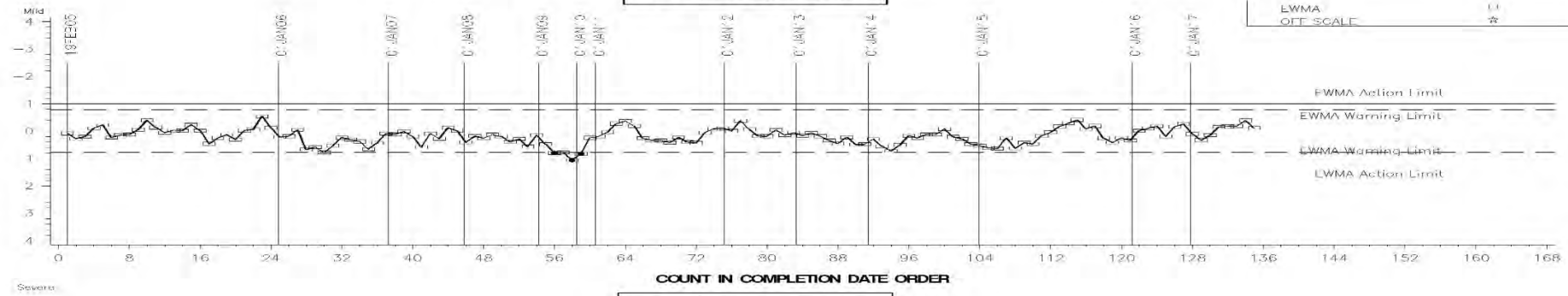
CUSUM Severity Analysis



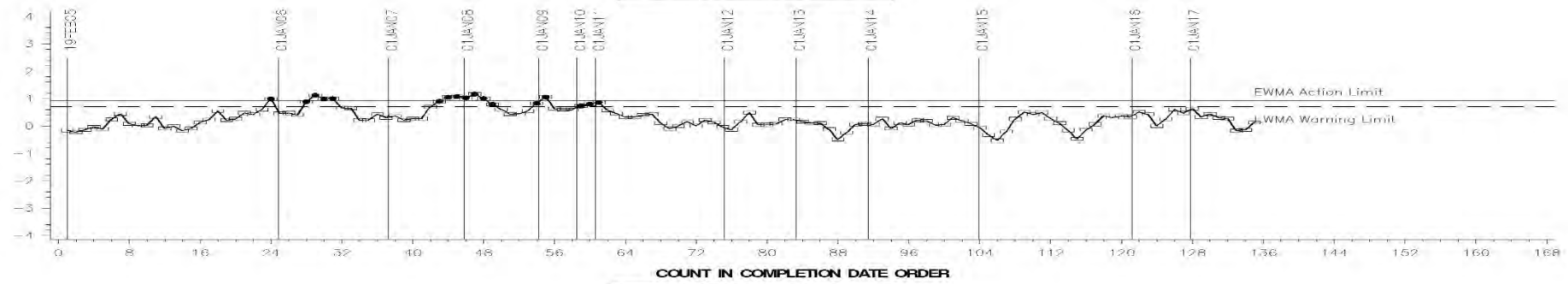
03MAY18: 15:41

FINAL TRANS. RES. OIL CONSUMPTION

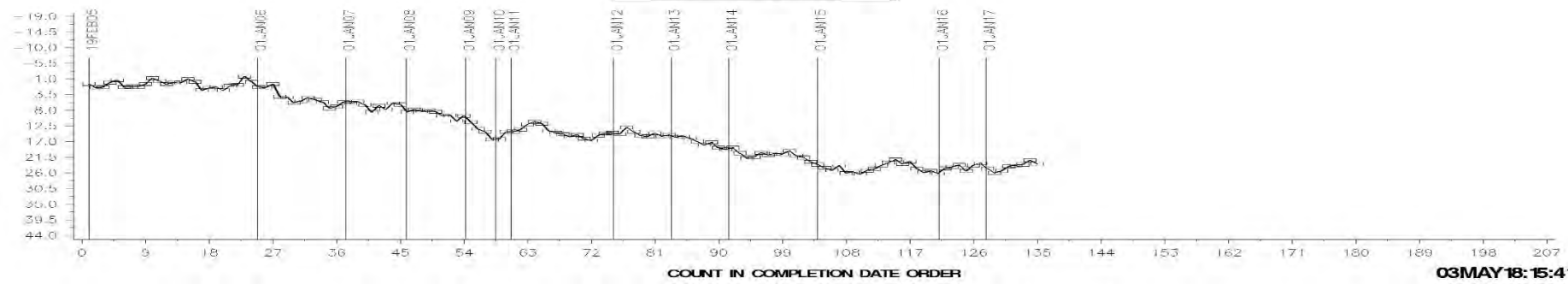
LTMS Severity Analysis



LTMS Precision Analysis

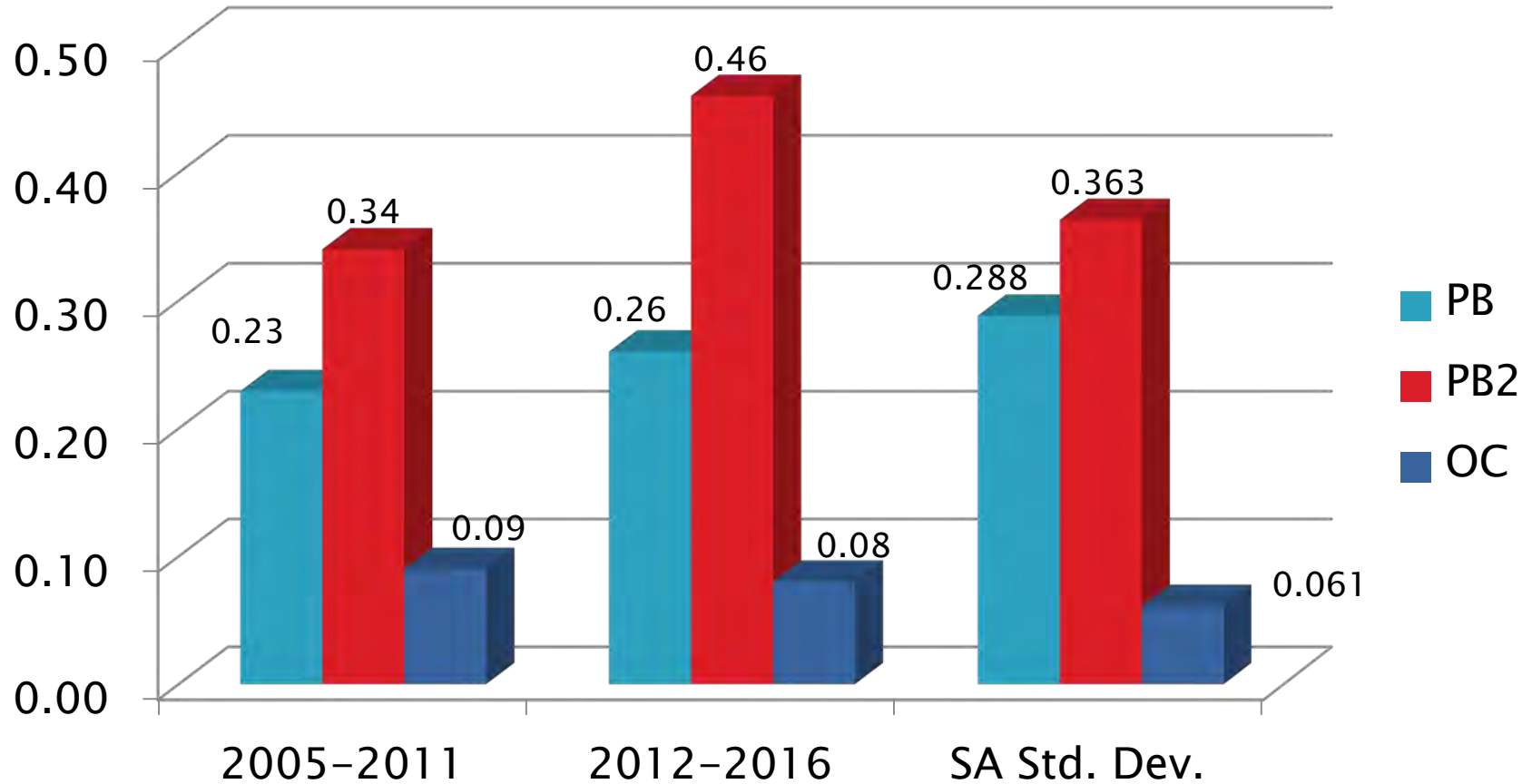


CUSUM Severity Analysis

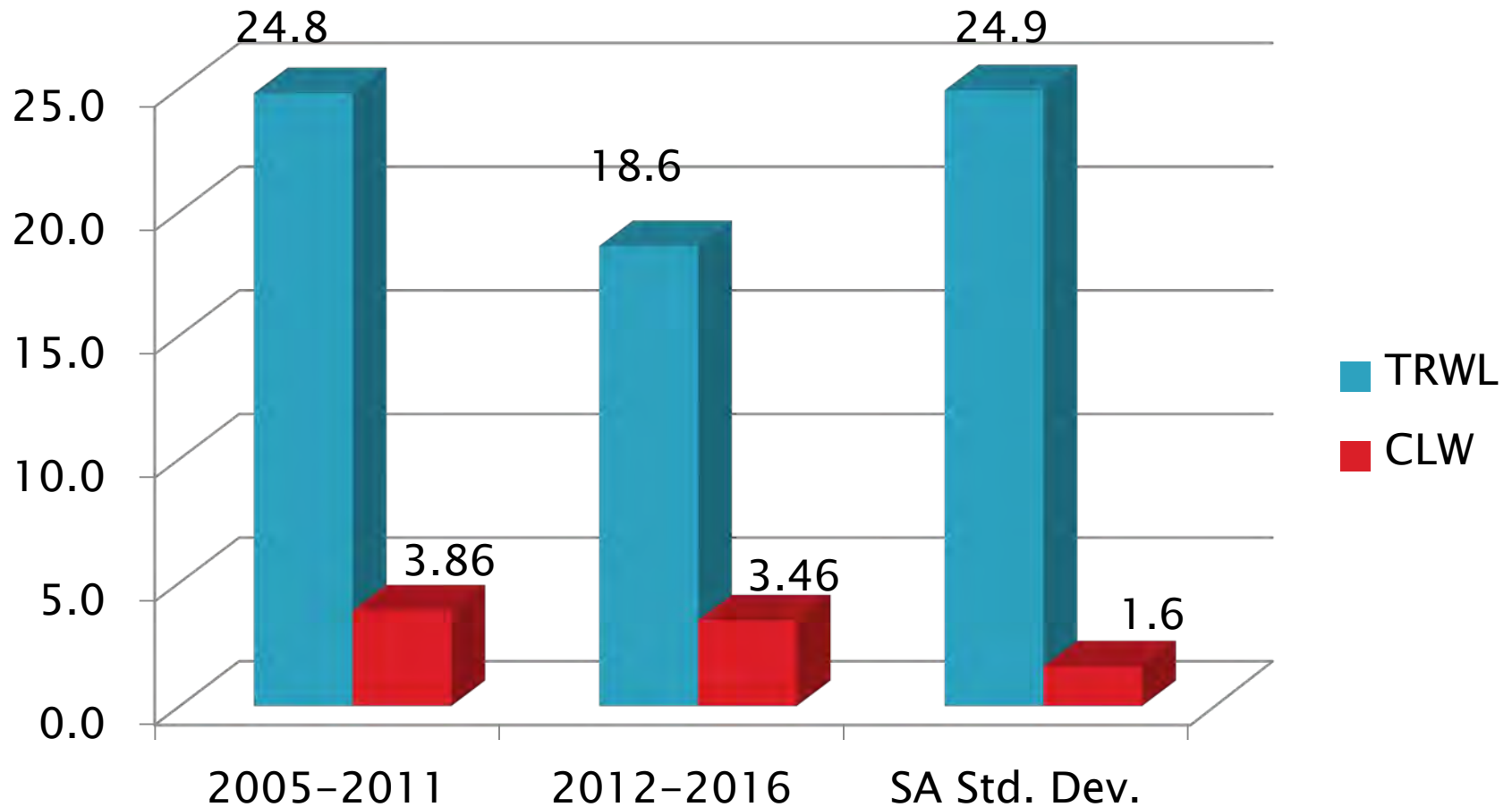


03MAY18: 15:41

T-12 Precision Estimates



T-12 Precision Estimates



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Mack T-12A

»» April 2018

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T-12A Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		1

T-12A Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

T-12A Lost Tests*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted test	0
Total		0

*Invalid and aborted tests

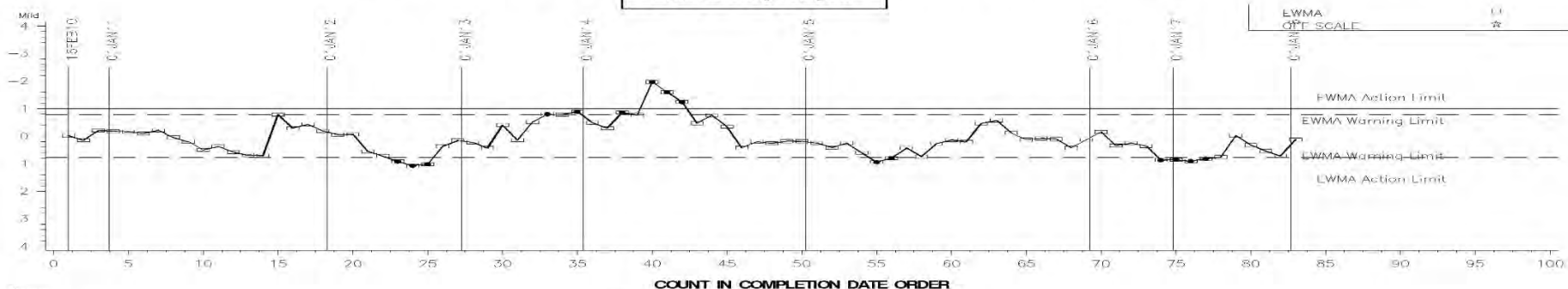
T-12A Test Severity

- ▶ MRV is in control.

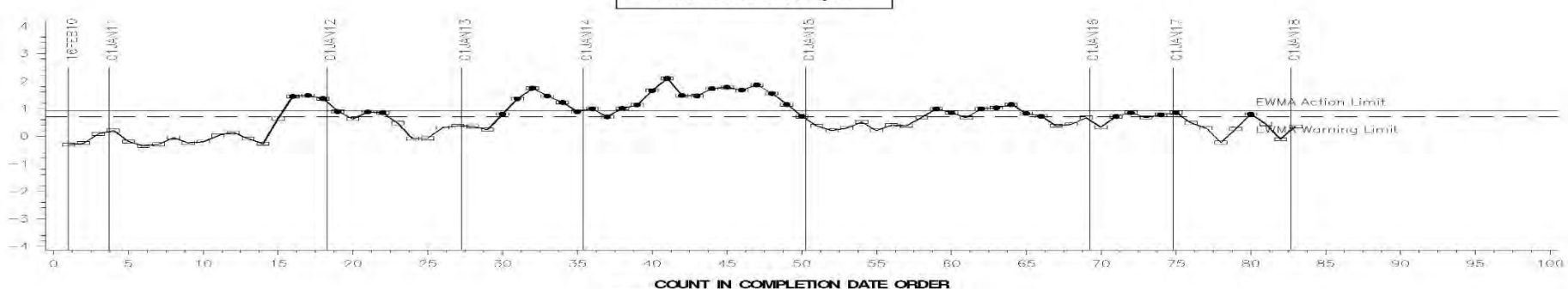
MACK T-12A INDUSTRY OPERATIONALLY VALID DATA

FINAL ORIGINAL UNIT MRV VISCOSITY [NM, SOLID, FROZEN, <, >]

LTMS Severity Analysis



LTMS Precision Analysis



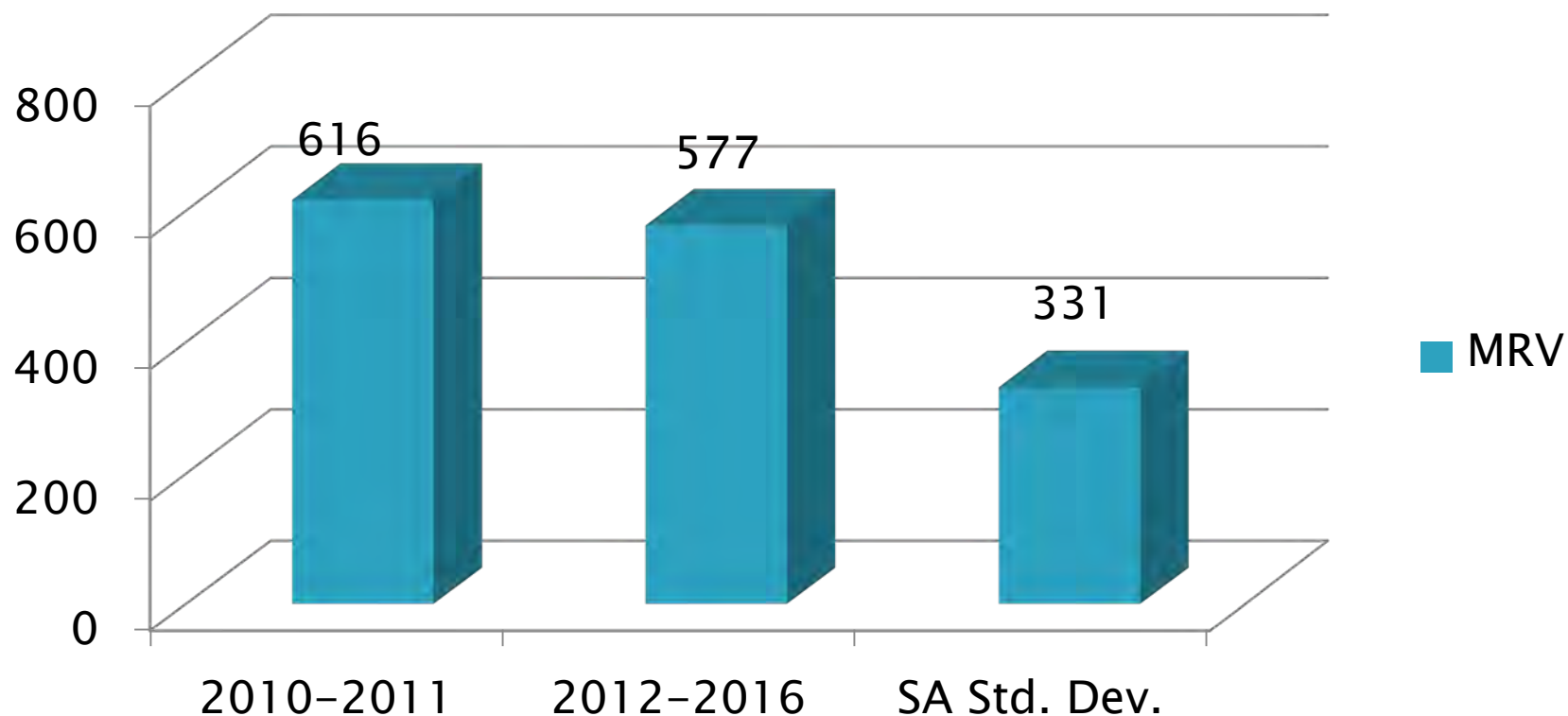
CUSUM Severity Analysis



03MAY18: 15:41

T-12A Precision Estimates

MRV



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Mack T-13

»» April 2018

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T-13 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	1
Aborted	XC	0
Total		2

T-13 Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

T-13 Lost Tests*

Status	Cause	#
Invalid	Bad Exhaust Back Pressure transducer calibration	1
Aborted	No aborted tests	0
Total		1

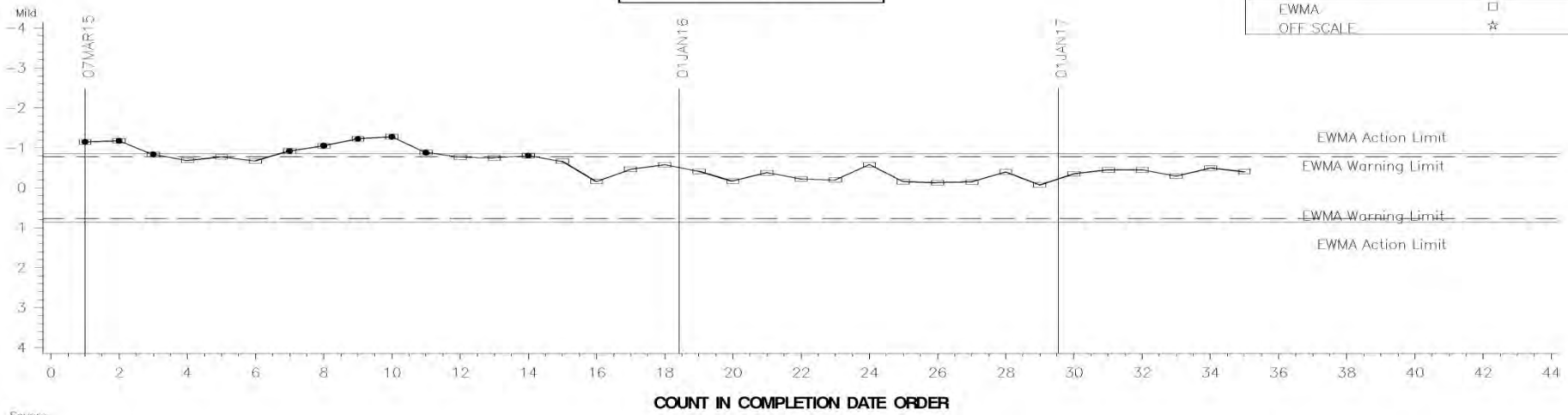
*Invalid and aborted tests

T-13 Test Severity

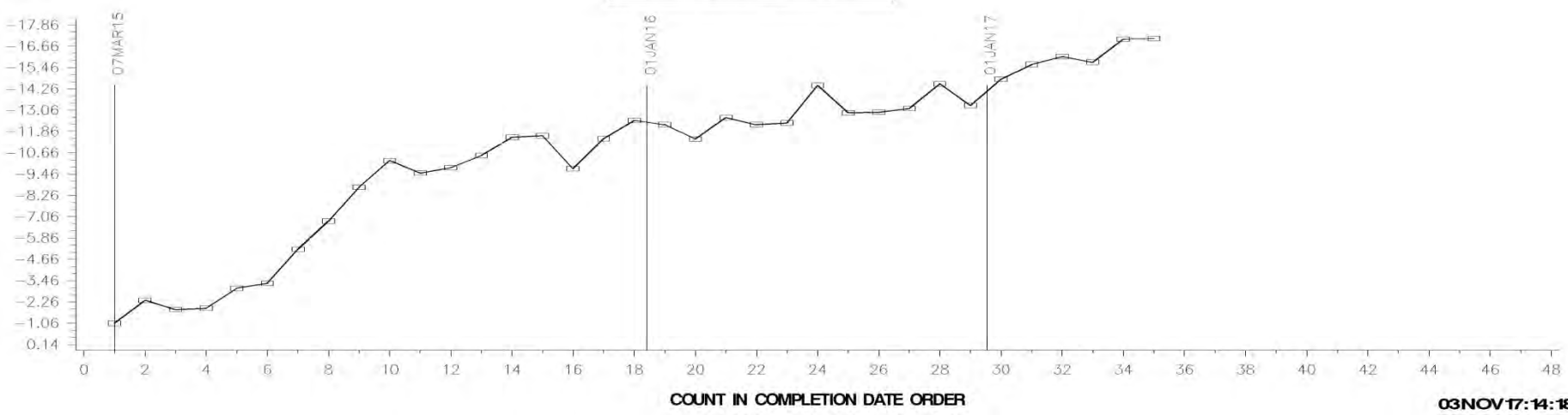
- ▶ IRPH is in control.
- ▶ KV40PC in level 2 alarm in the mild direction.

FINAL ORIGINAL PEAK HEIGHT IR AT EOT

LTMS Severity Analysis



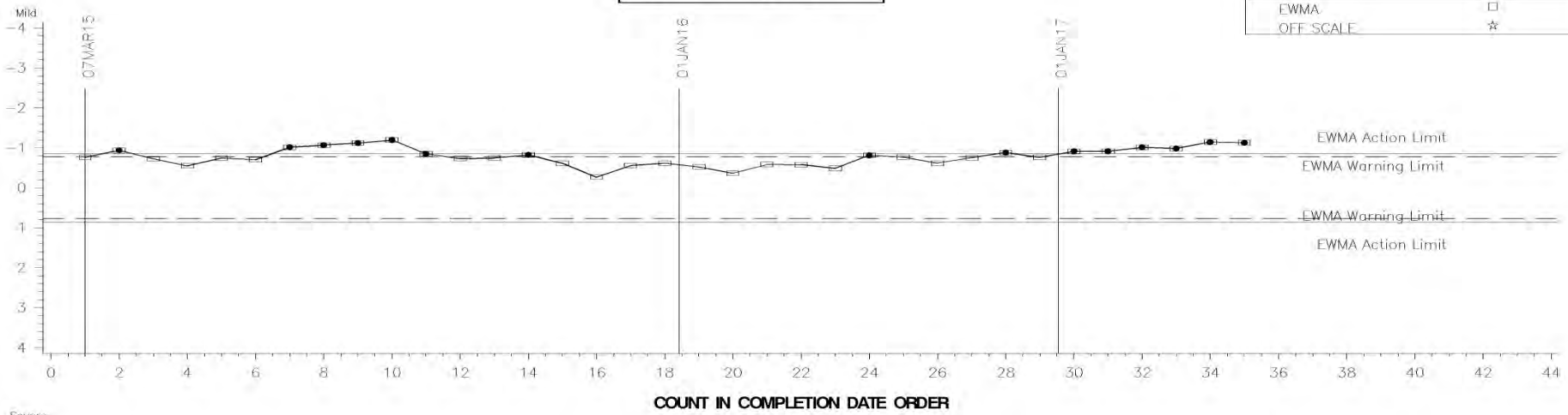
CUSUM Severity Analysis



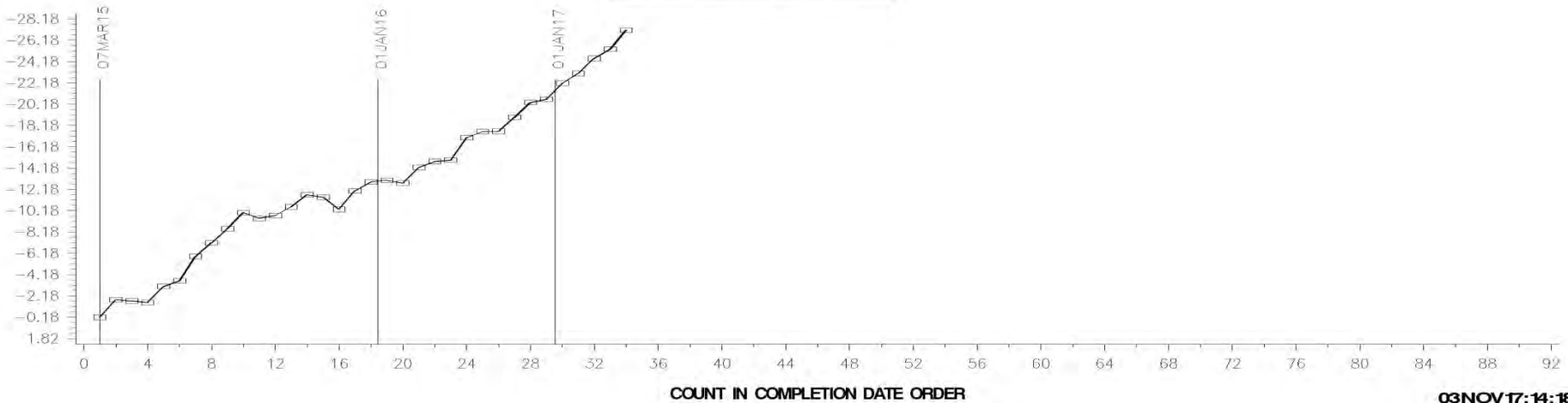
03NOV17:14:18

FNL. ORIG. UNIT KINEMATIC VISCOSITY AT 40 DEG C % CHANGE 300-360 HRS

LTMS Severity Analysis

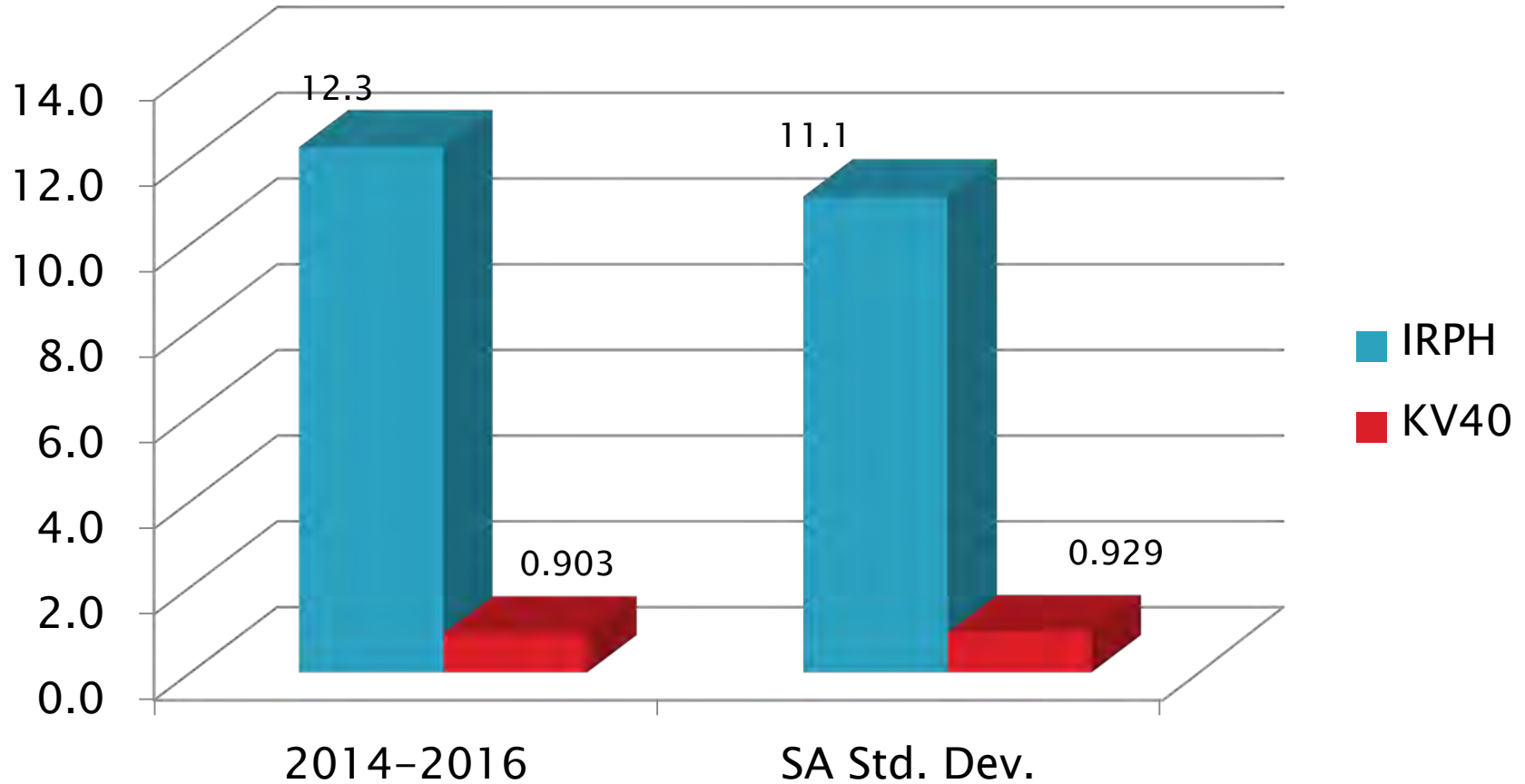


CUSUM Severity Analysis



03NOV17:14:18

T-13 Precision Estimates



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Information Letters

»» October 1, 2017 –
March 31, 2018

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Information Letters*

Test	Date	IL	Topic
ISB	10/25/2017	17-1	ISB ATWL & ACSW Correction Factors
COAT	10/31/2017	17-2	COAT Procedure Updates
ISB	12/21/2017	17-2	Adoption of a Stand Based LTMS with Severity Adjustments
C13	2/12/2018	18-1	2 nd Ring and Cylinder Liner Cleaning Procedure Change

*Available from TMC Website

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Reference Oil Inventory

»» Actions, Re-blends, Inventories
and Estimated Life

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Reference Oil Reblends

- ▶ Re-blend of 832 complete and in transit to TMC

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
809-1	1K, 1N	9134	20	2133	126	5+ years
811-2	1K, 1N	1732	20	908	60	5+ years
821-4	T-12	4495	25	2701	200	5+ years
822-2	1R, T-11	4386	140	2900	196	5+ years
823	T-13	1796	40	967	200	3 years
830-2	ISM	3786	0	115	150	2.5 years
830-3	ISM	2891	50	2841	50	5+ years
831-3	C13, ISB	972	25	61	165	1 year
831-4	C13, ISB	1699	25	1517	125	5+ years

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
832	COAT	1166	196	256	84	0.75 years
833	COAT	1152	196	71	56	0.25 year
833-1	COAT	1248	140	1102	112	5+ years
864-1	DD13	1576	150	1173	150	5+ years
866	DD13	341	25	241	0	5 years
873-2	1M-PC	1650	20	36	50	3 years
1005-4	1P, 1R, EOAT, RFWT, T-8/E	2000	0	74	30	< 0.5 years
1005-5	1P, 1R, EOAT, RFWT, T-8/E	3826	205	2412	251	3 years

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LTMS Deviations

»» October 1, 2017 –
March 31, 2018

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LTMS Deviations

- No LTMS Deviations in Current Period

Historical Count of HD LTMS Deviations

Test	LTMS Deviations
1M-PC	2
1N	2
T-8/E	2
T-10A	1
T-12	1

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Quality Index Deviations

»» October 1, 2017 –

March 31, 2018

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Quality Index Deviations

- ▶ No Quality Index Deviations during this period

Quality Index Deviations

Historical Count of HD Quality Index Deviations

Test	Qi Deviations
1P	14
1R	1
ISM	3
C13	2
T-10A	1
T-11	3
T-12	6
T-13	1
COAT	4

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TMC Laboratory Visits

»» October 1, 2017 –
March 31, 2018

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TMC Lab Visits

- ▶ 2 Labs were visited during this period

Test	Number of Labs-Number of Stands
ISB	1-2
ISM	1-1
T-8/E	1-1
T-11	1-1
T-13	1-1

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Lab Visit Issues

- ▶ ISB
 - Turbo outlet exhaust piping incorrect.
- ▶ ISM
 - No discrepancies were found.
- ▶ T8
 - No discrepancies were found.
- ▶ T11
 - No discrepancies were found.
- ▶ T12
 - No discrepancies were found.

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Test Area Timelines

»» October 1, 2017 –
March 31, 2018

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Test Area Timeline Additions*

Test	Date	IL/Memo	Topic
ISB	10/25/2017	17-1	ISB ATWL & ACSW Correction Factors
COAT	10/31/2017	17-2	COAT Procedure Updates
ISB	12/21/2017	17-2	Adoption of a Stand Based LTMS with Severity Adjustments
C13	2/12/2018	18-1	2 nd Ring and Cylinder Liner Cleaning Procedure Change

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*As of 3/31/2018

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Rating Workshop Data

»» 2017 Heavy Duty Workshop

Test Monitoring Center

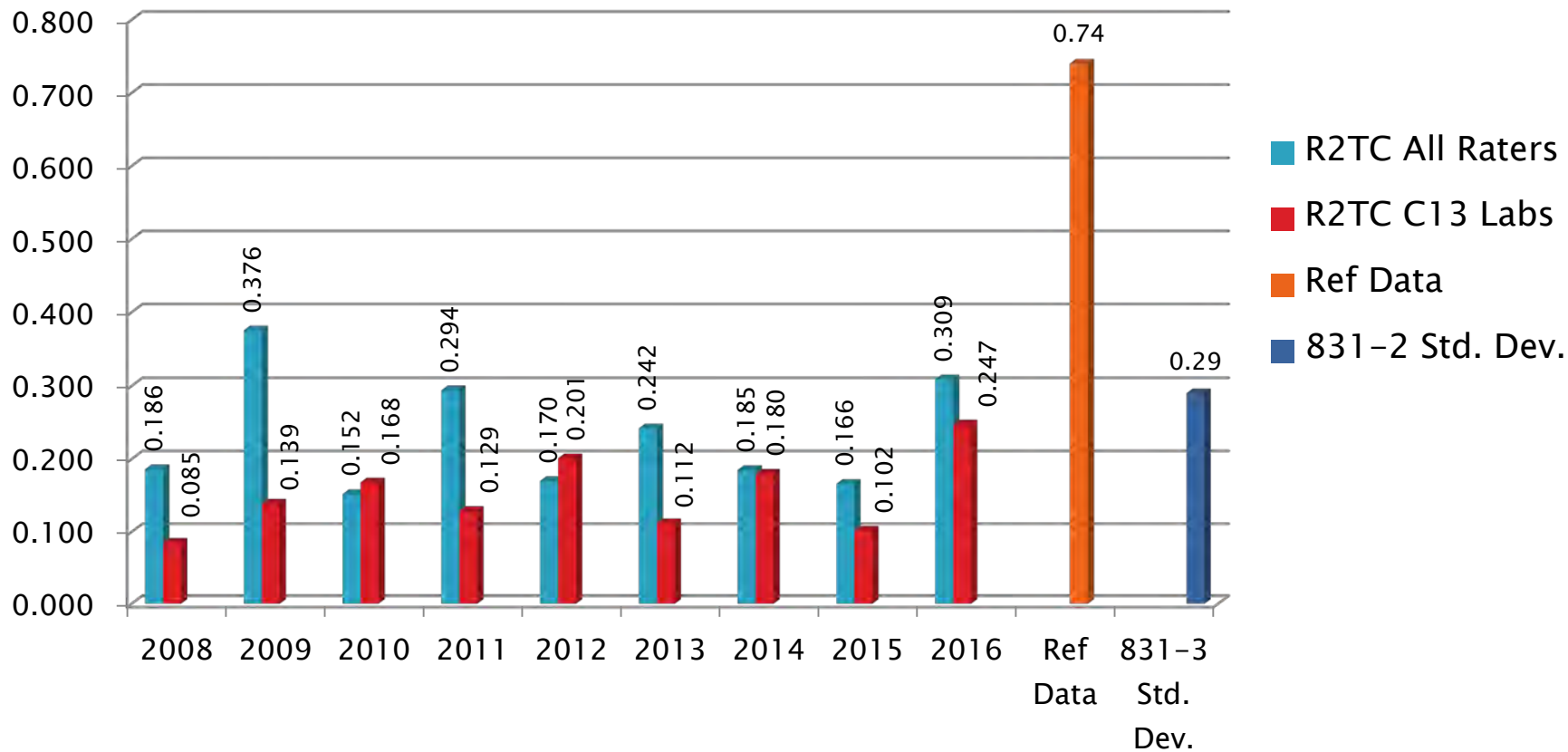
<http://astmtmc.cmu.edu>



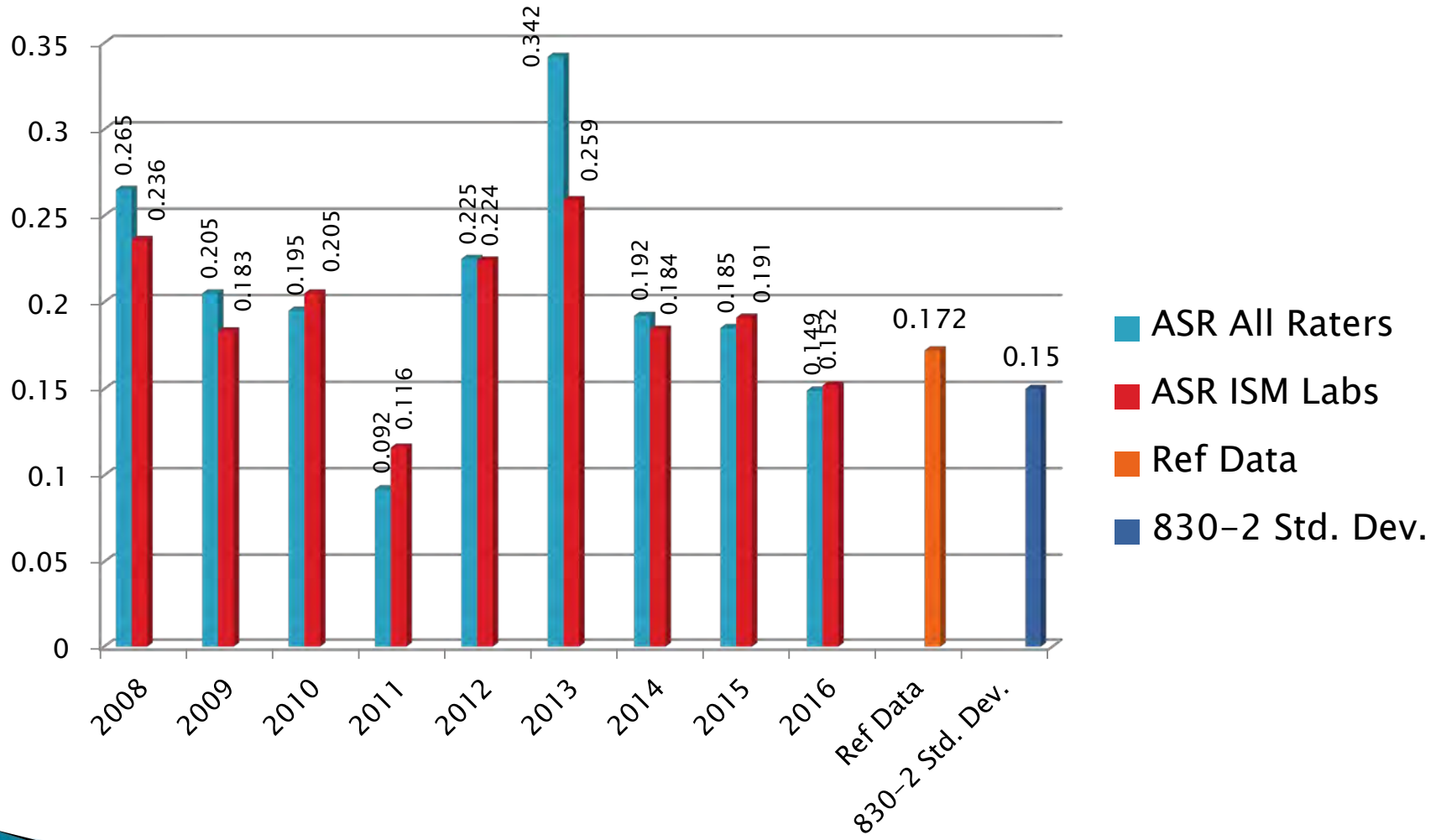
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C13 2nd Ring Carbon Precision – Rating Workshop Data

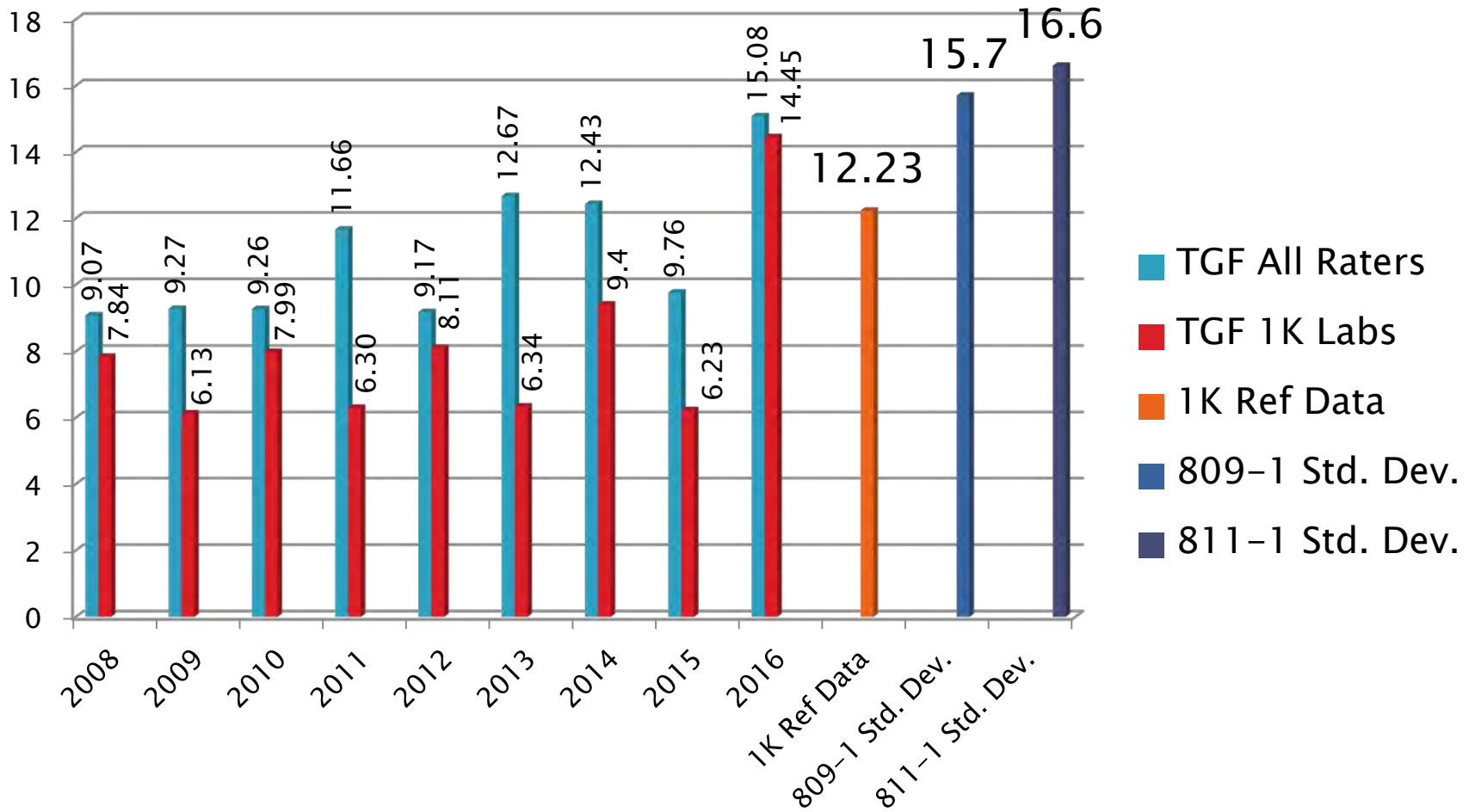
R2TC



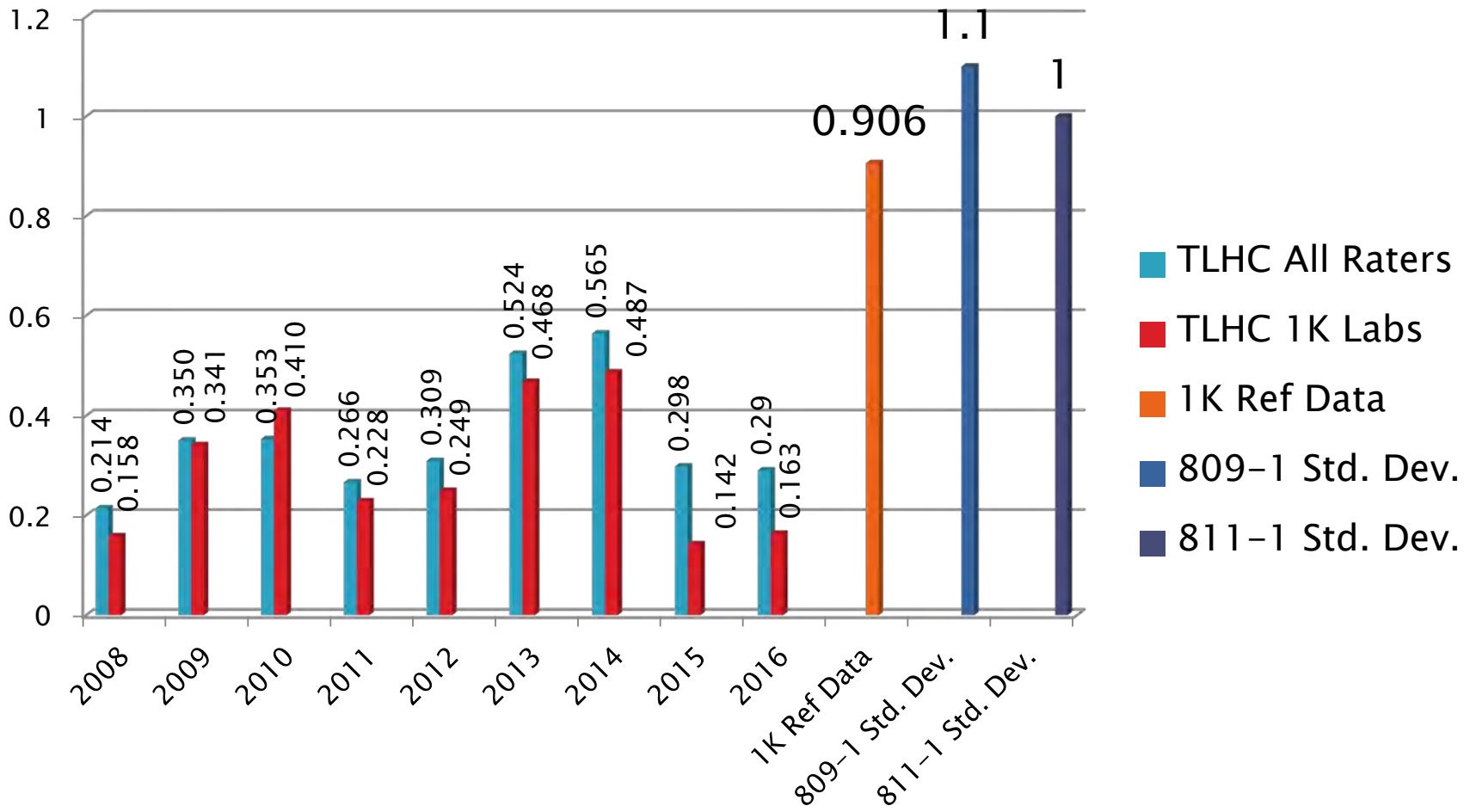
ISM Sludge Rating Precision – Rating Workshop Data



Deposit Rating Precision - Rating Workshop Data



Deposit Rating Precision - Rating Workshop Data



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Miscellaneous Information

- ▶ Available on TMC Website:
 - Oil Assignment Request and Test File Upload
 - 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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