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Test Monitoring Center

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

April 2016

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Heavy Duty Testing

Executive Summary

- ▶ Reference Oils
 - 830-2
 - ISM Reference Oil re-blend being pursued
- ▶ EOAT Surveillance Panel moved into the CAT Surveillance Panel.

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Calibrated Labs and Stands*

Test	Labs	Stands
1K	3	3
1N	4	8
1M-PC	1	1
1P	2	2
1R	1	1
C13	2	5
ISB	3	9
ISM	4	7
EOAT	1	1
RFWT	2	2
T-8/E	2	4
T-11	4	7
T-12/T-12A	4/4	11/11
T-13	5	13
COAT	3	3

*As of 03/31/2016

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SCOTE 1K

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1 K 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 K Failed Tests

Failed Parameter	Number of Tests
No failed tests	
Total	0

1 K Lost Tests*

Status	Cause	#
Aborted		0
Total		0

*Invalid and aborted tests

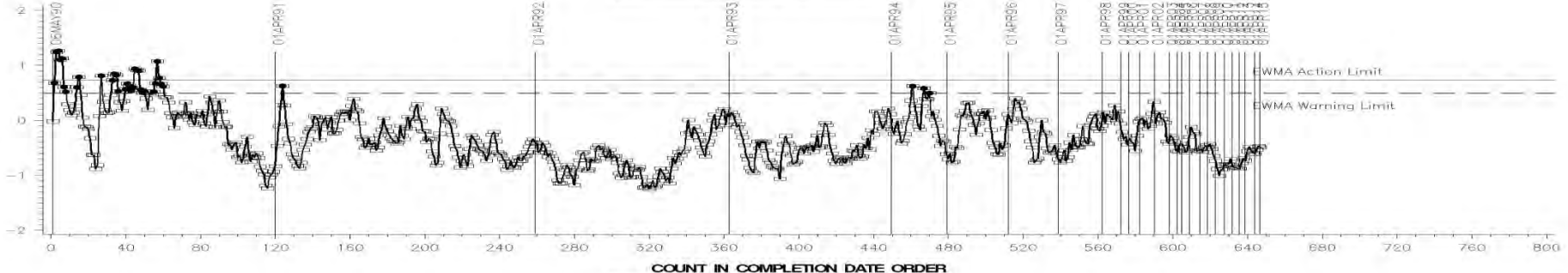
1 K Test Severity

- ▶ WDK, TGF, TLHC, ETOC are in control based on data from last period.
- ▶ TGF, TLHC and WDK
 - Within Chart Limits but near warning limit.
 - Long-term mild trend exists
- ▶ BSOC in Warning Alarm in the mild direction
 - Long-term mild trend exists
 - Nearing Action Limit

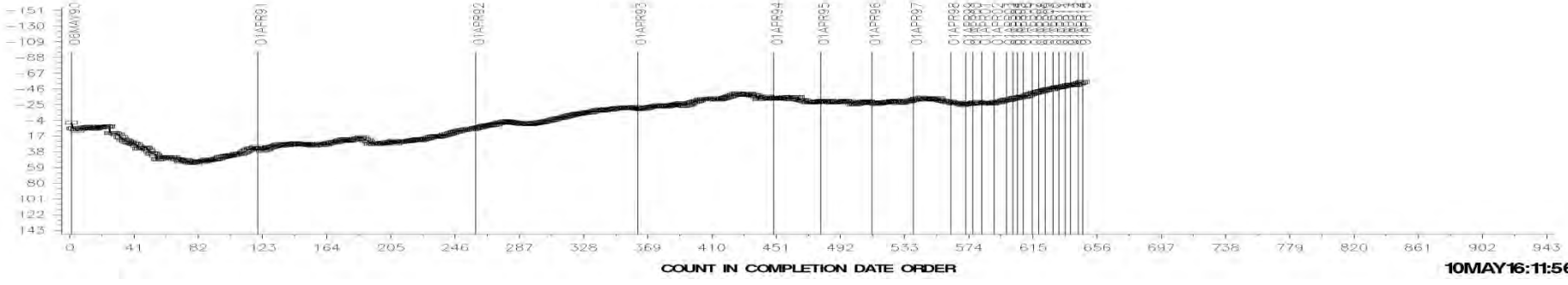
FINAL TGF LTMS Severity Analysis



LTMS Precision Analysis



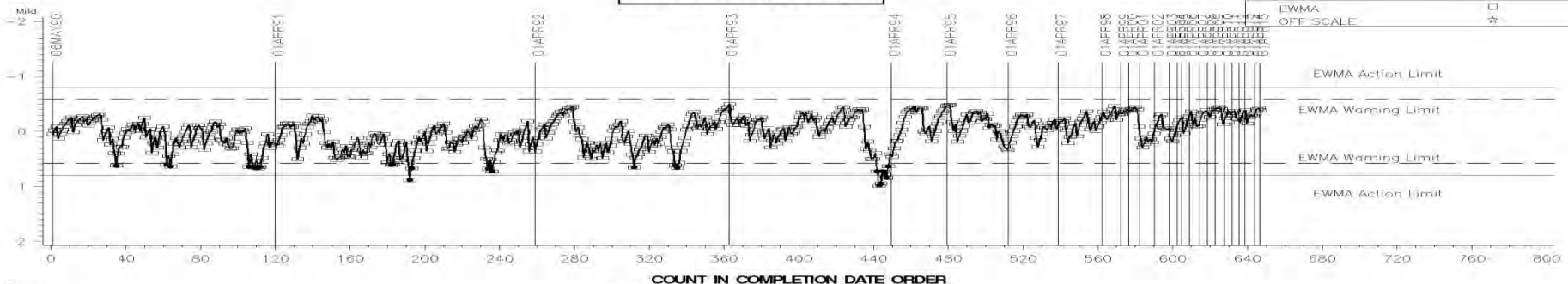
CUSUM Severity Analysis



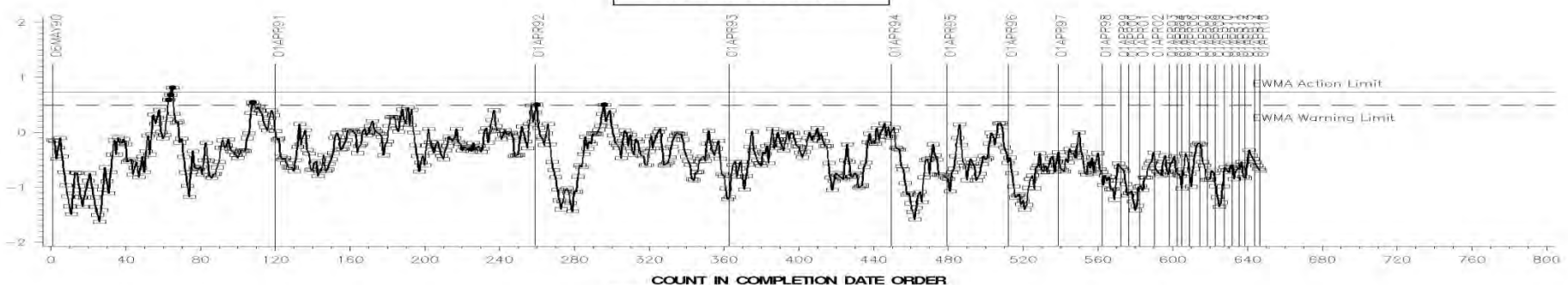
10MAY16:11:56

FINAL TLHC

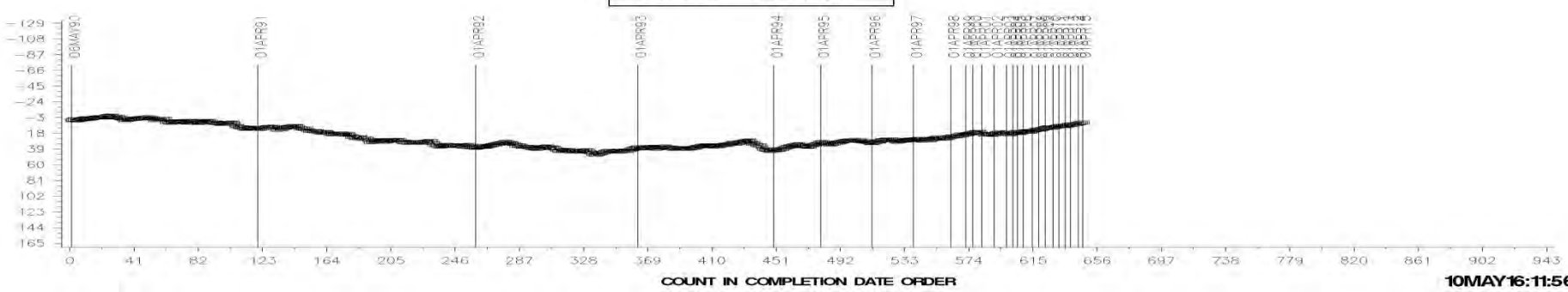
LTMS Severity Analysis



LTMS Precision Analysis



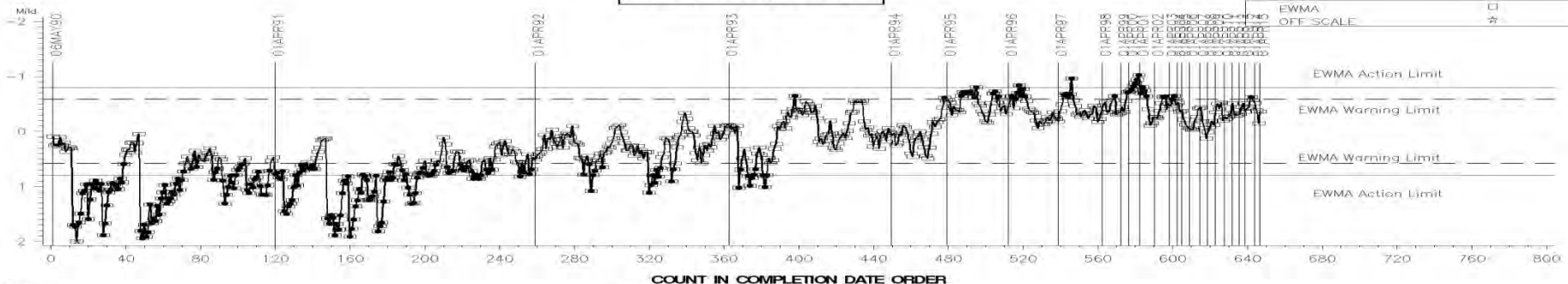
CUSUM Severity Analysis



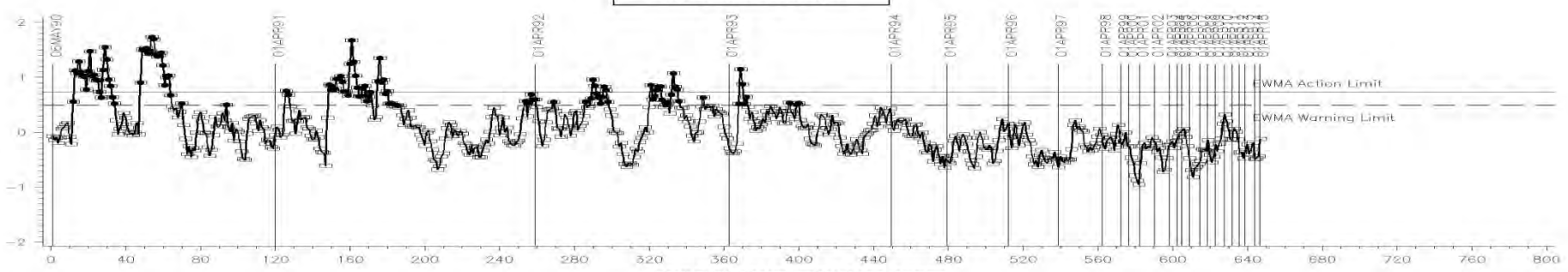
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FINAL Weighted Total Demerits

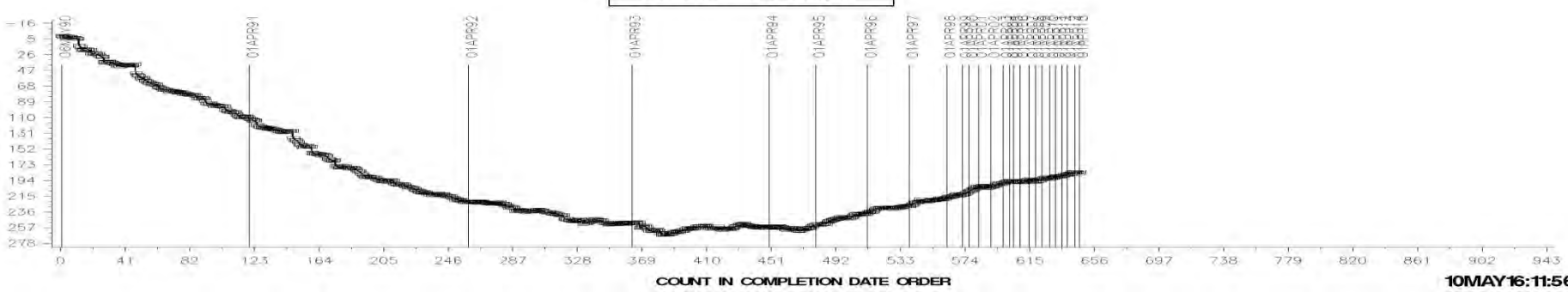
LTMS Severity Analysis



LTMS Precision Analysis



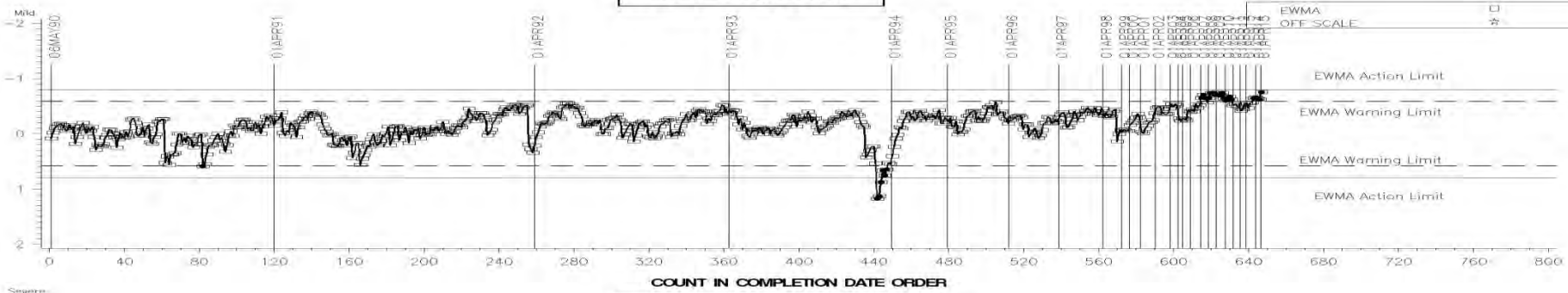
CUSUM Severity Analysis



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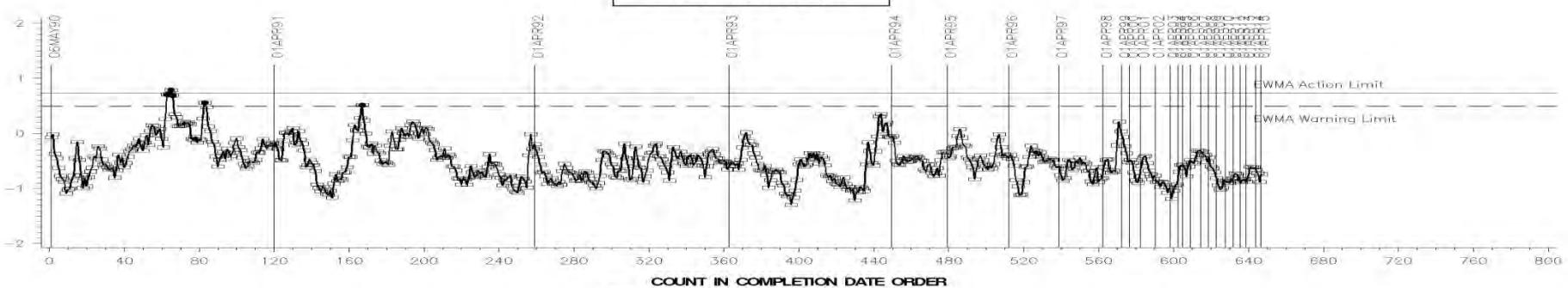
FINAL BSOC

LTMS Severity Analysis



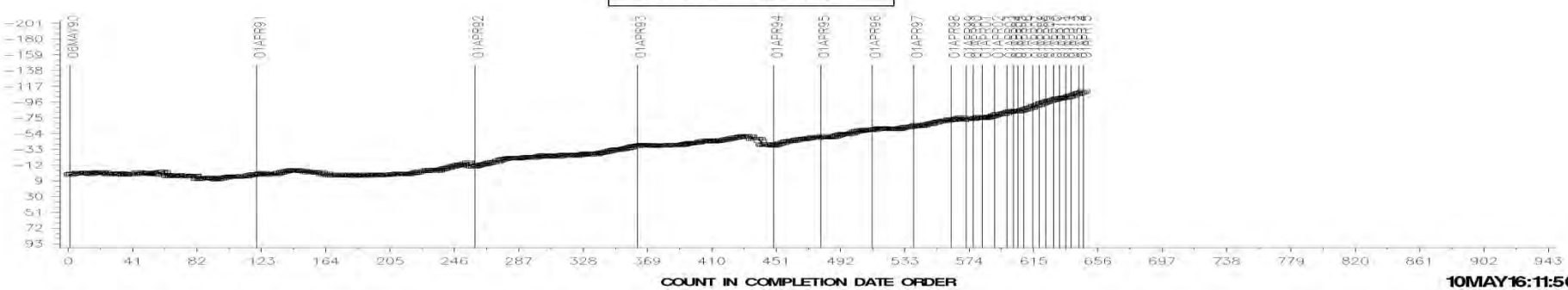
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

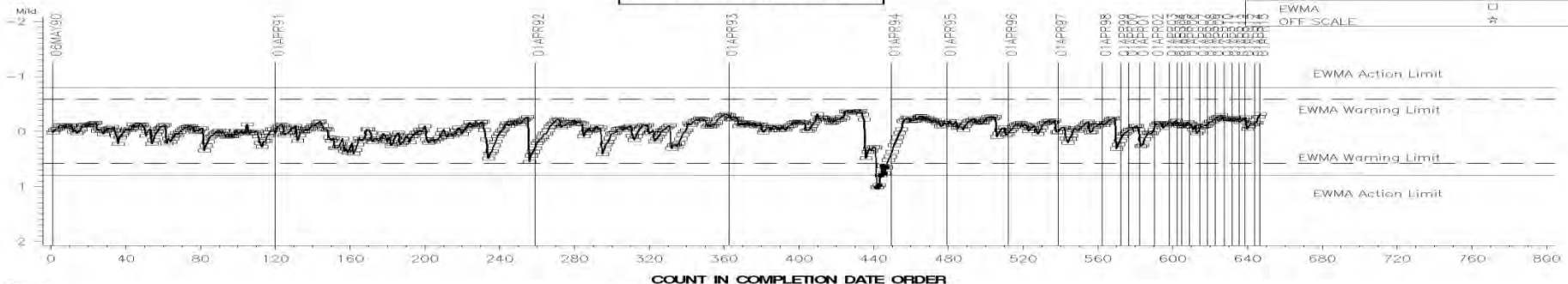
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

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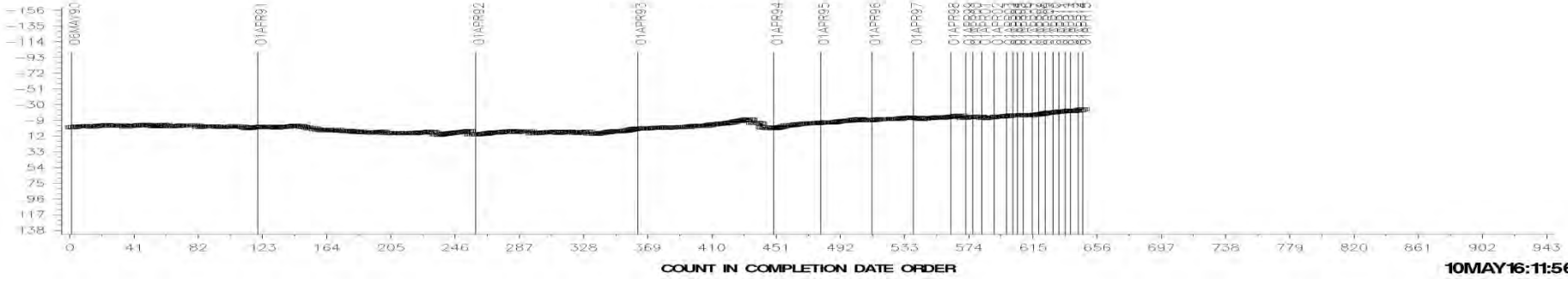
FINAL EOTC LTMS Severity Analysis



LTMS Precision Analysis

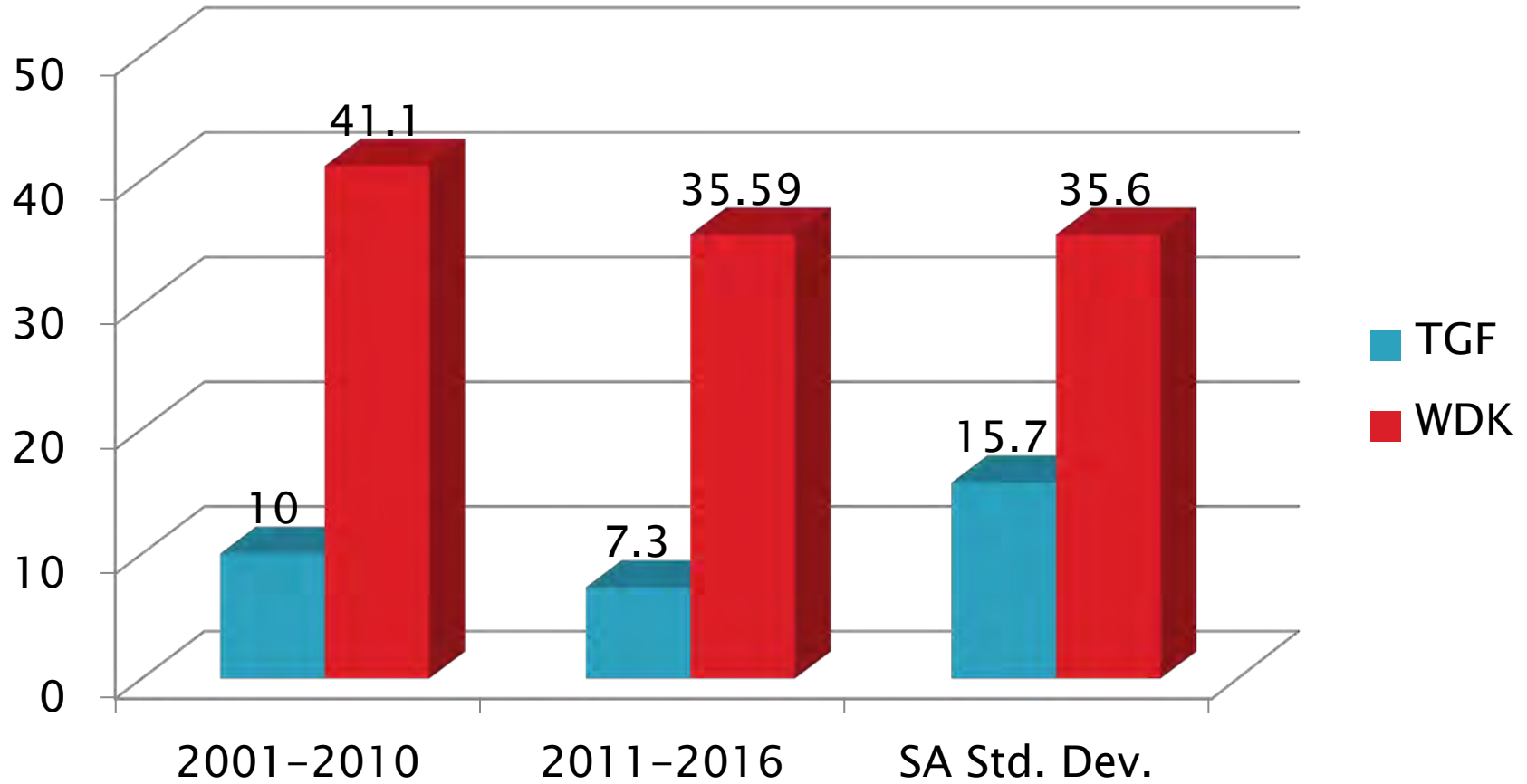


CUSUM Severity Analysis

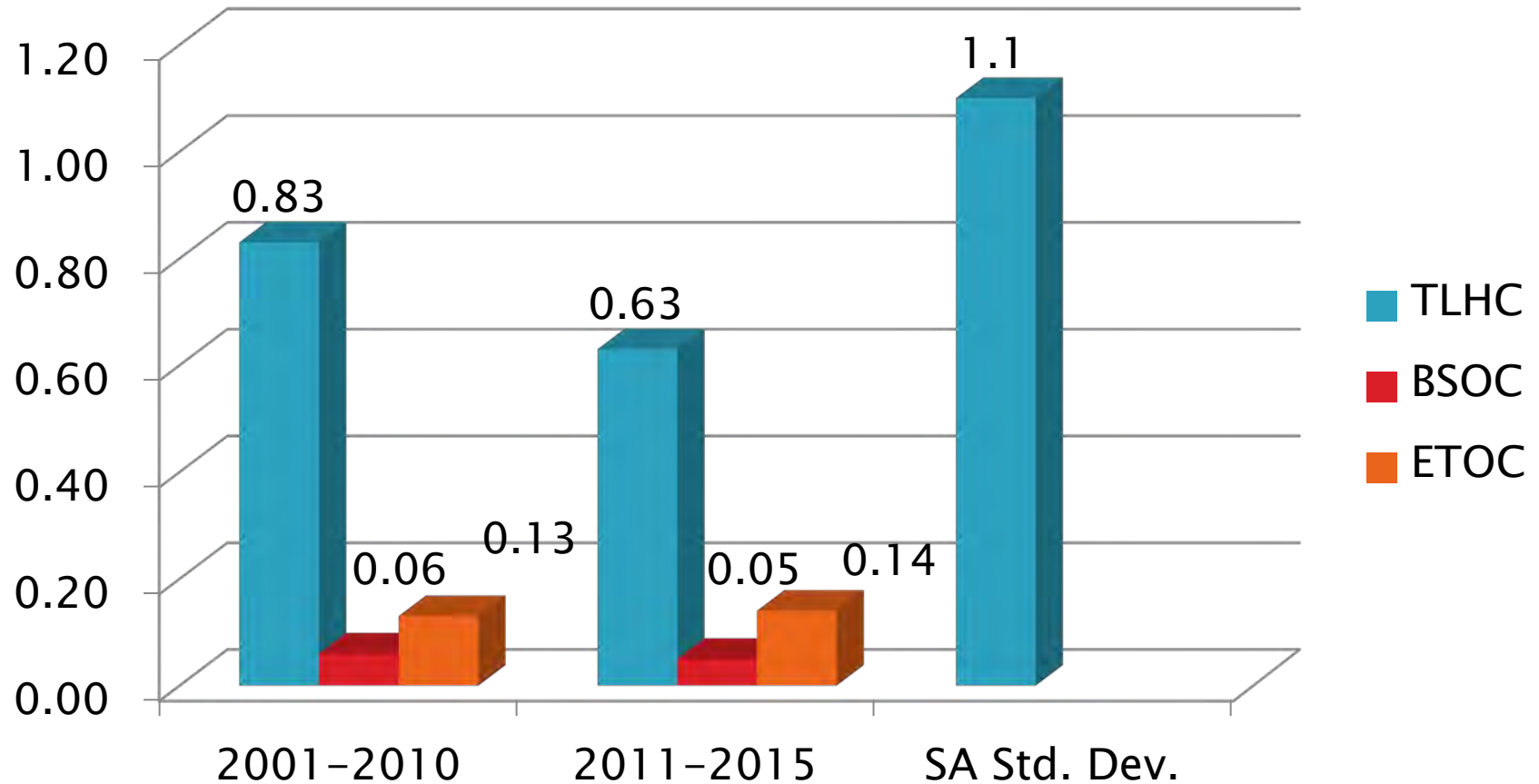


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1 K Precision Estimates



1 K Precision Estimates



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SCOTE 1 N

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1 N Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	5
Failed Calibration Test	OC	2
Operationally Invalid	LC	1
Aborted	XC	0
Total		8

1 N Failed Tests

Failed Parameter	Number of Tests
Severe Top Groove Fill	2
Total	2

1 N Lost Tests*

Status	Cause	#
Invalid	Coolant Delta Temperature Out of Spec	1
Aborted	No Aborted Tests	0
Total		1

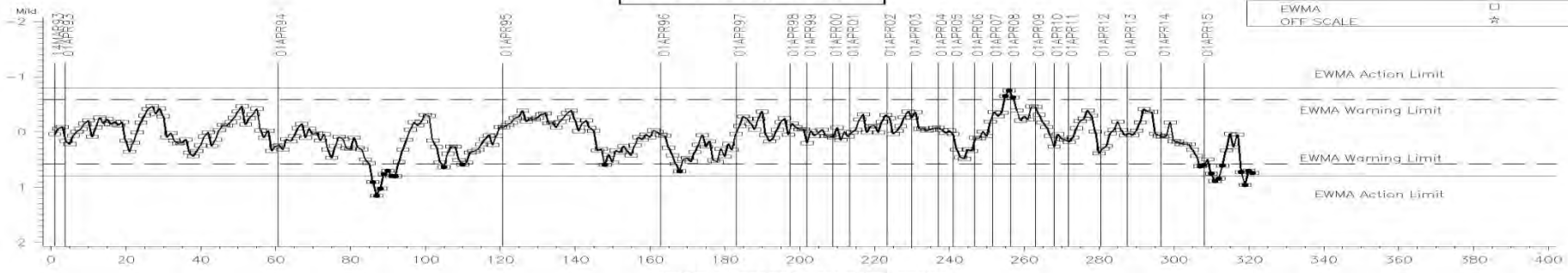
*Invalid and aborted tests

1 N Test Severity

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

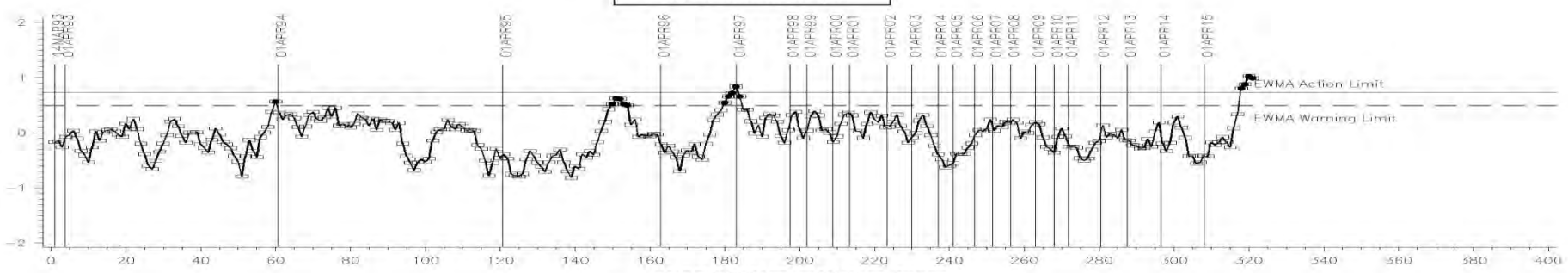
FINAL CORRECTED TGF

LTMS Severity Analysis



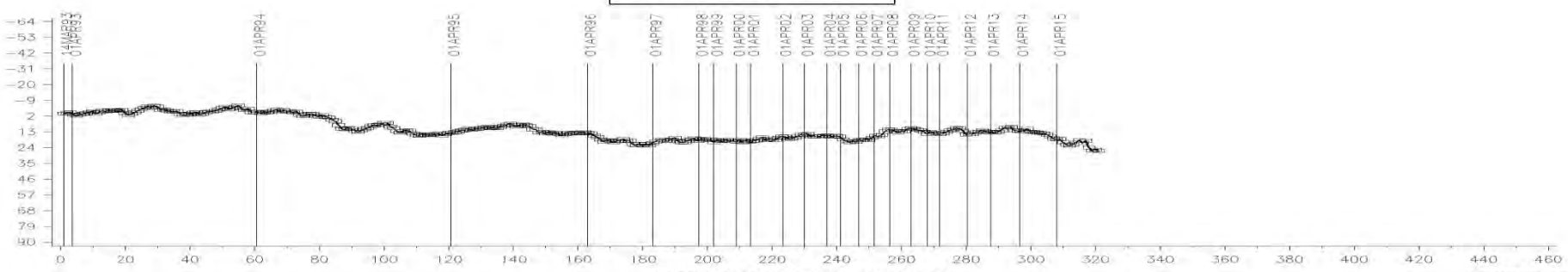
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

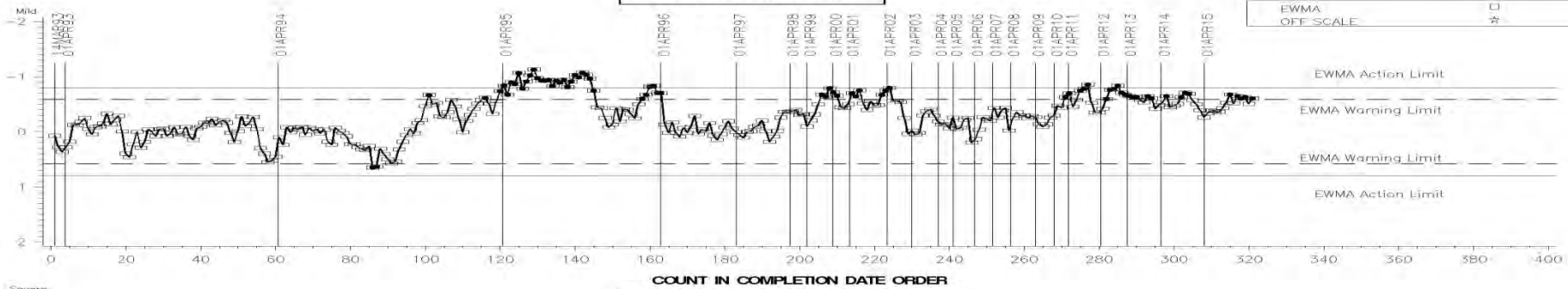


COUNT IN COMPLETION DATE ORDER

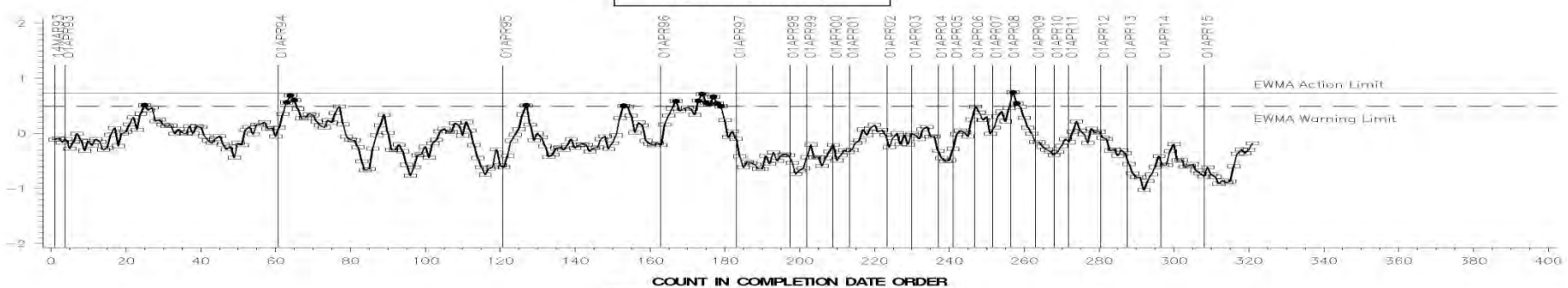
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Weighted Total Demerits

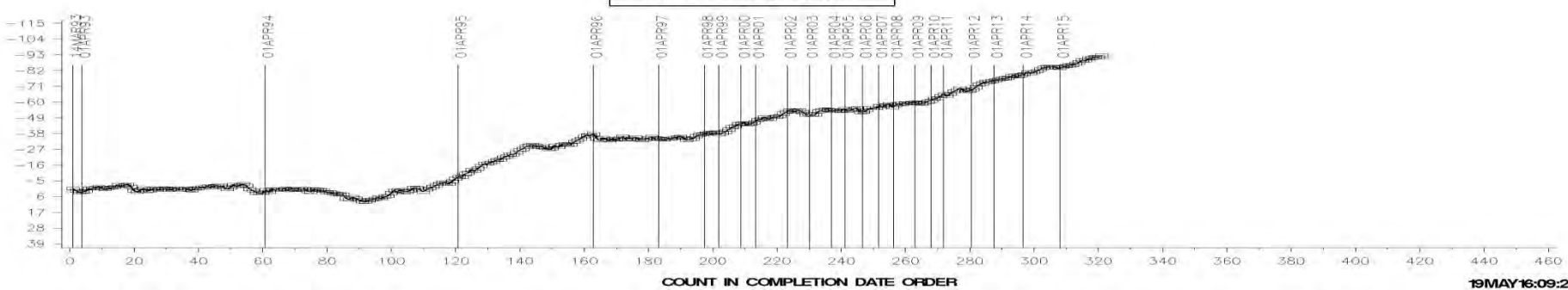
LTMS Severity Analysis



LTMS Precision Analysis



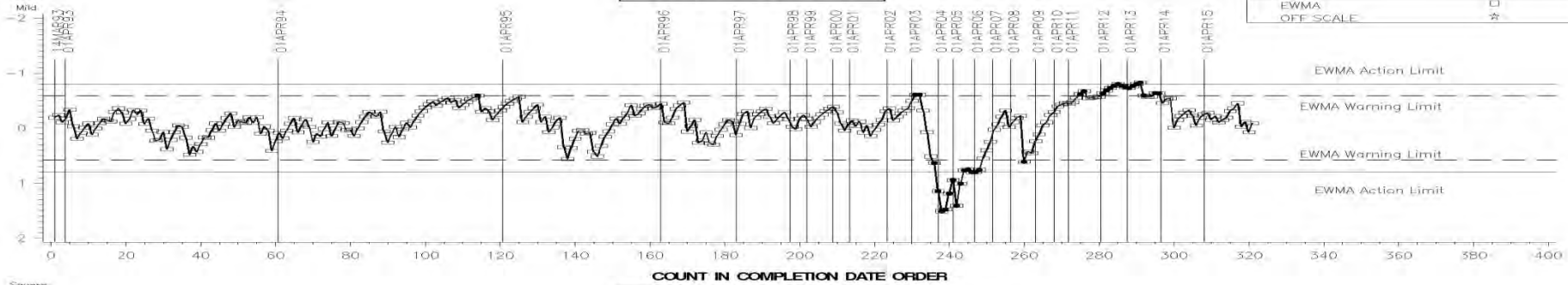
CUSUM Severity Analysis



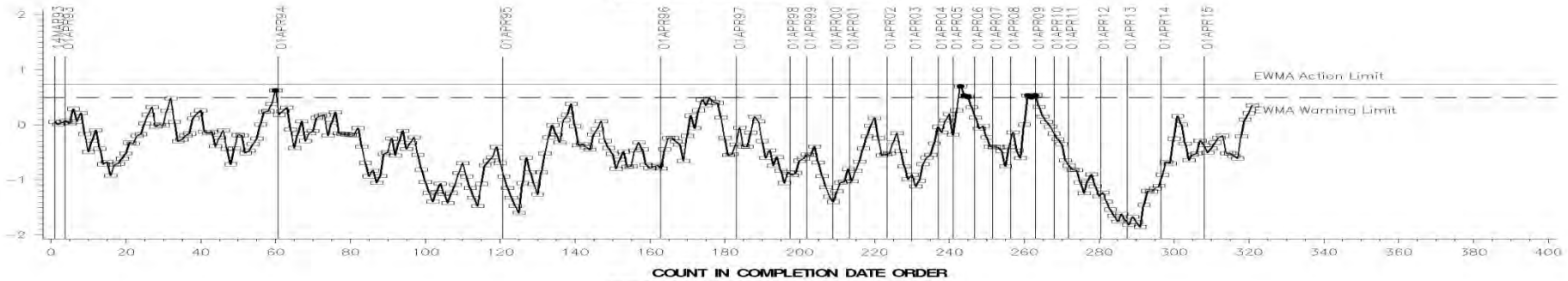
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Top Land Heavy Carbon

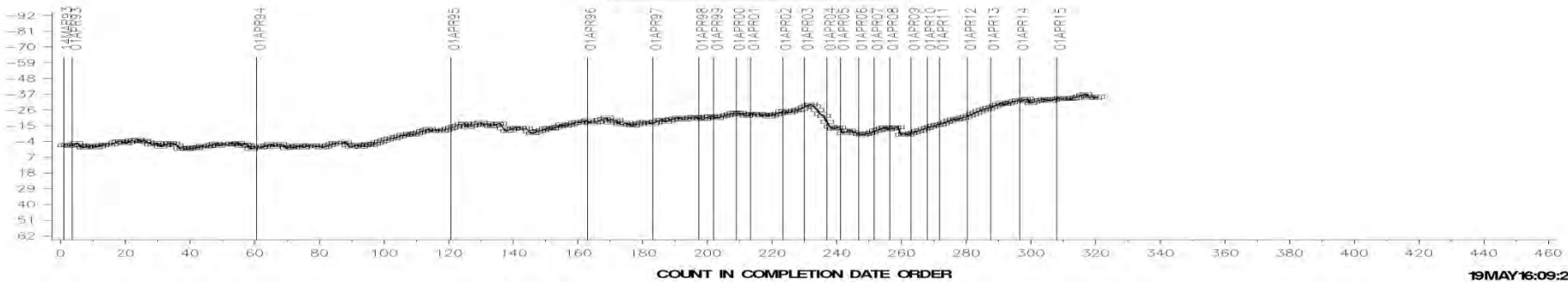
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



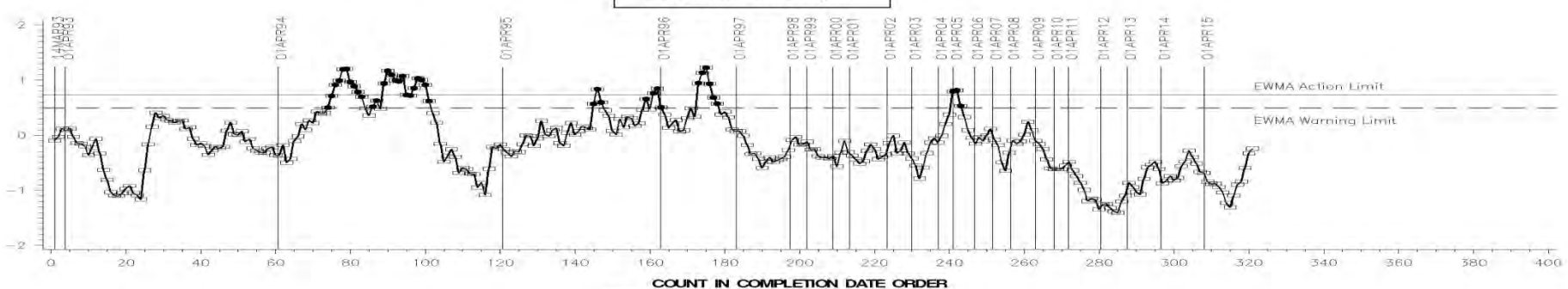
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BSOC

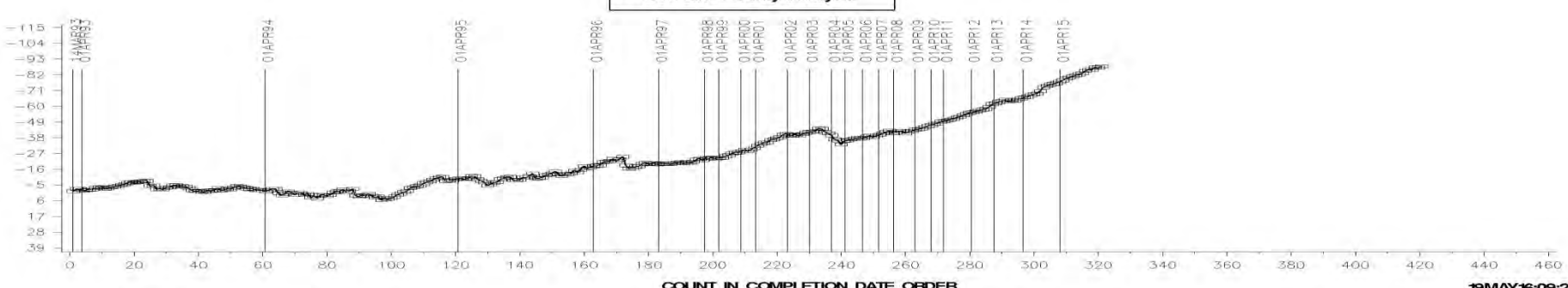
LTMS Severity Analysis



LTMS Precision Analysis



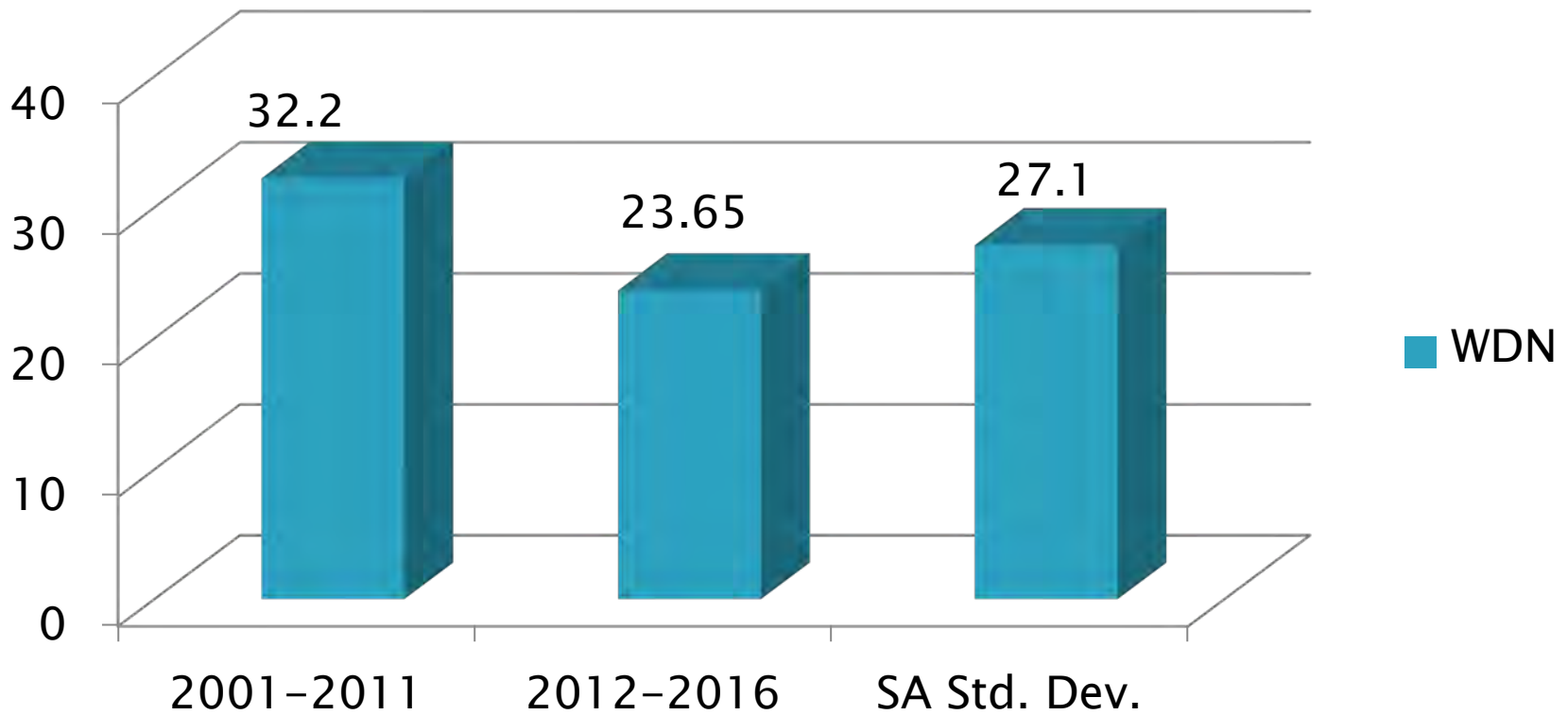
CUSUM Severity Analysis



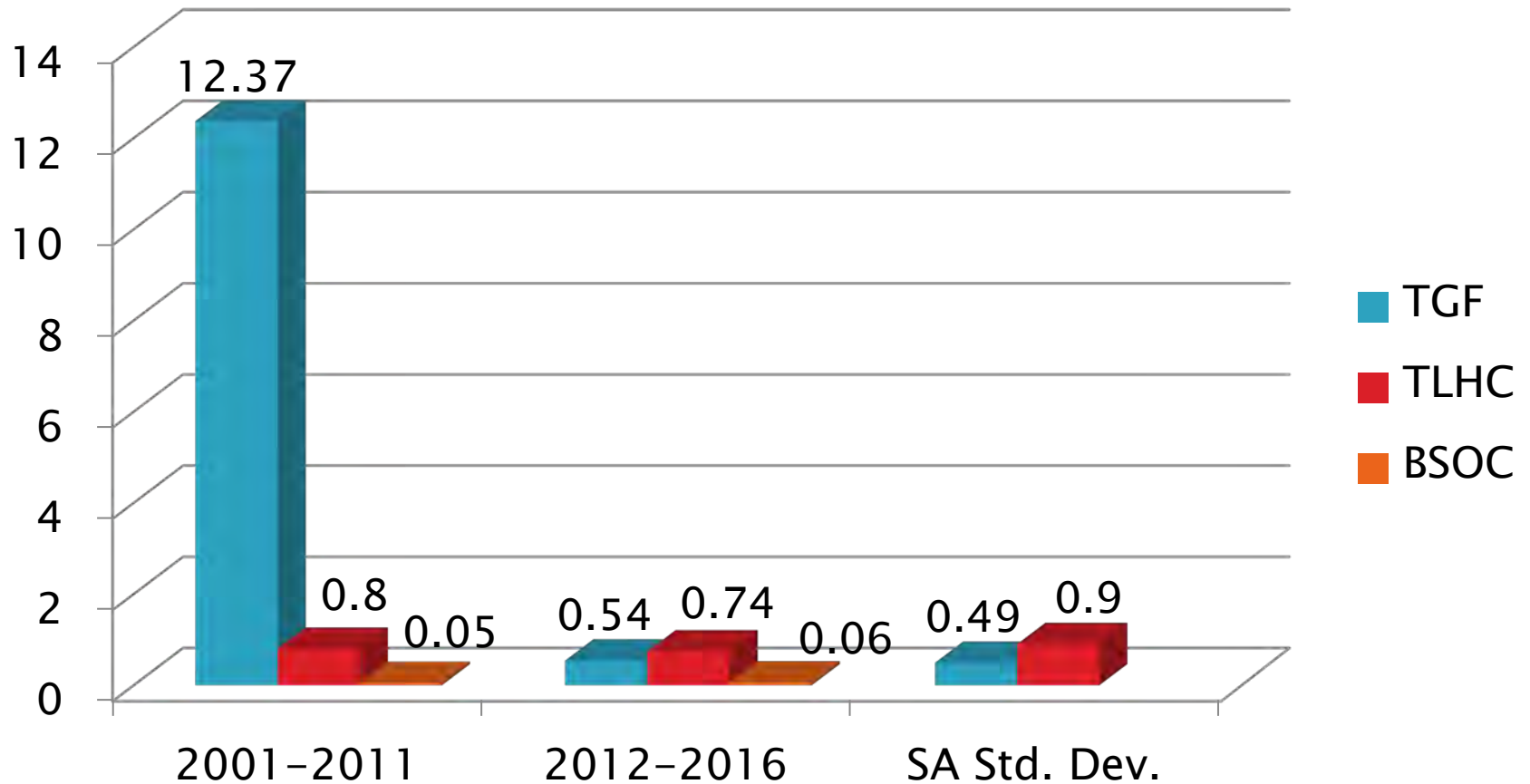
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1 N Precision Estimates

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	1
Operationally Invalid	LC	1
Total		3

1 M-PC Failed Tests

Failed Parameter	Number of Tests
Severe TGF	1
Total	1

1 M-PC Lost Tests*

Status	Cause	#
Invalid	Low Coolant Flow	1
Aborted	No Aborted Tests	0
Total		0

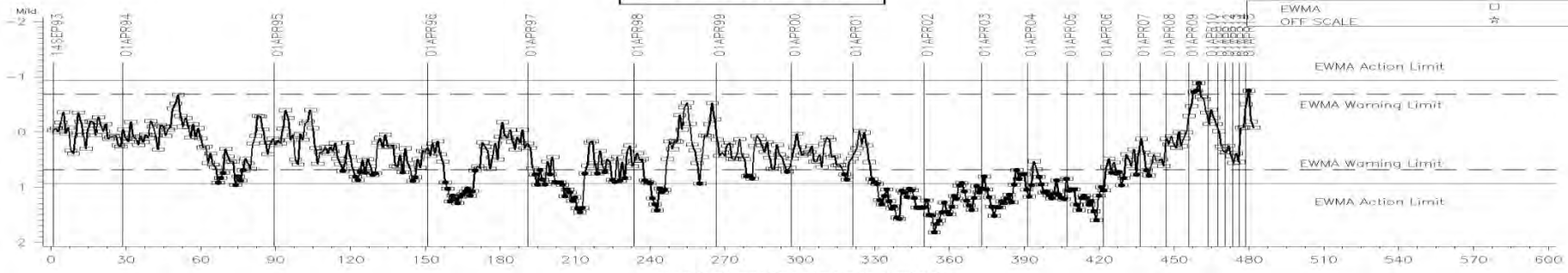
*Invalid and aborted tests

1 M-PC Test Severity

- ▶ TGF in precision warning alarm.
- ▶ WTD in control.

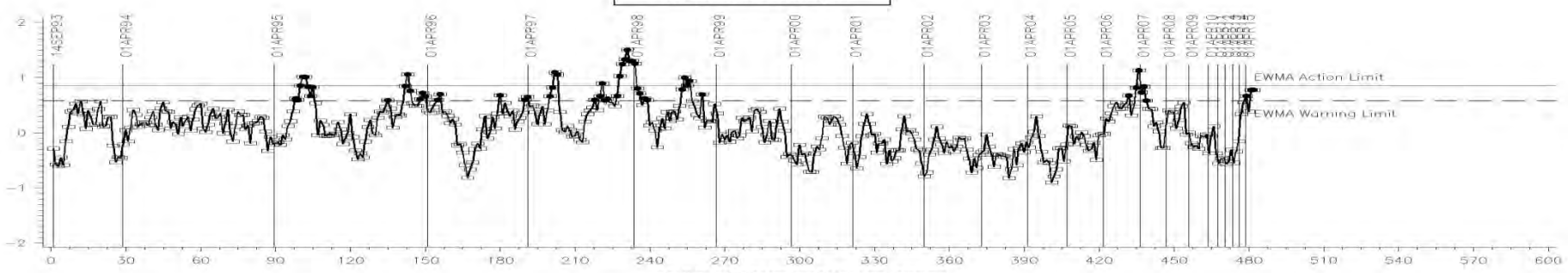
FINAL TOP GROOVE FILLING

LTMS Severity Analysis



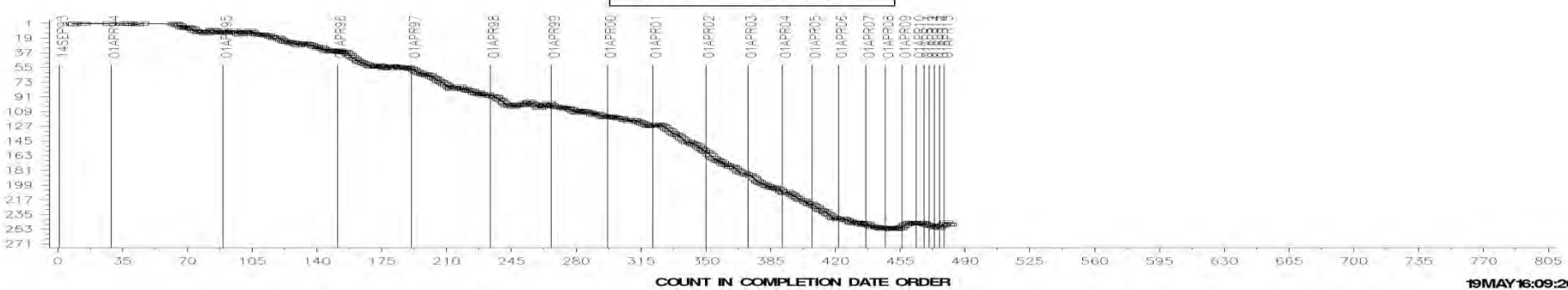
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

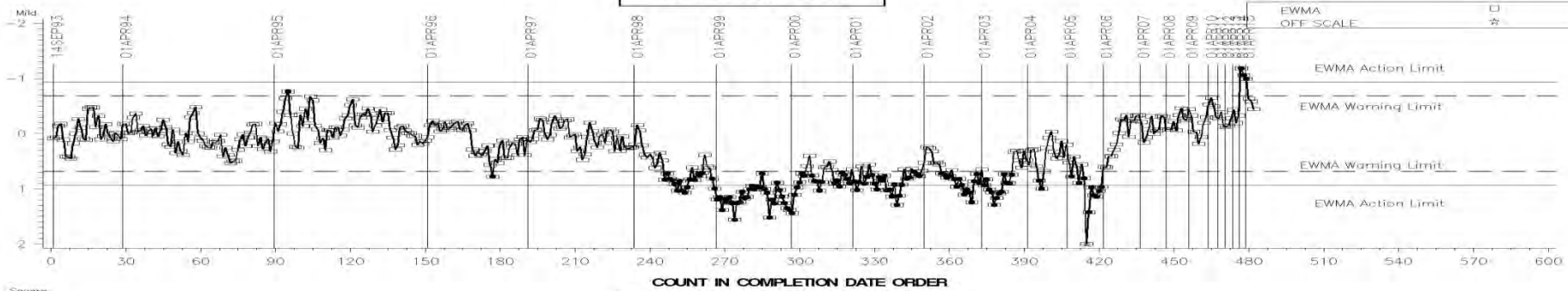


COUNT IN COMPLETION DATE ORDER

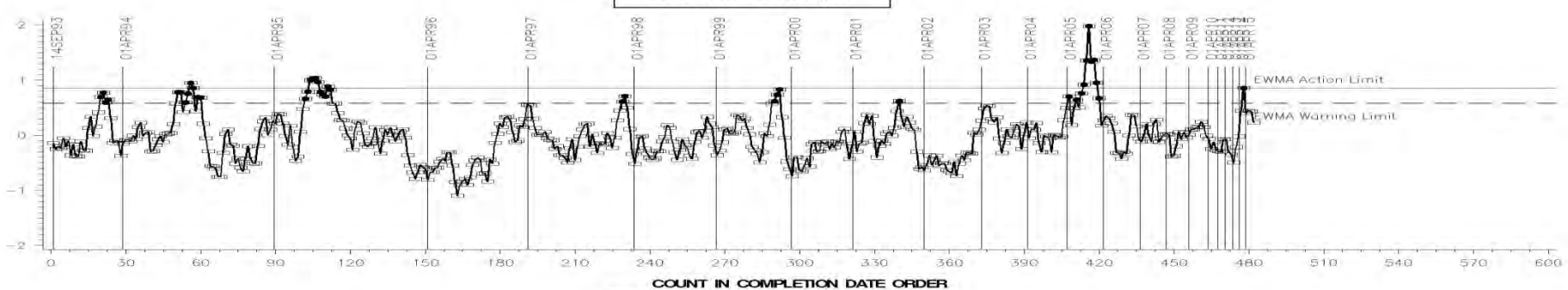
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Weighted Total Demerits

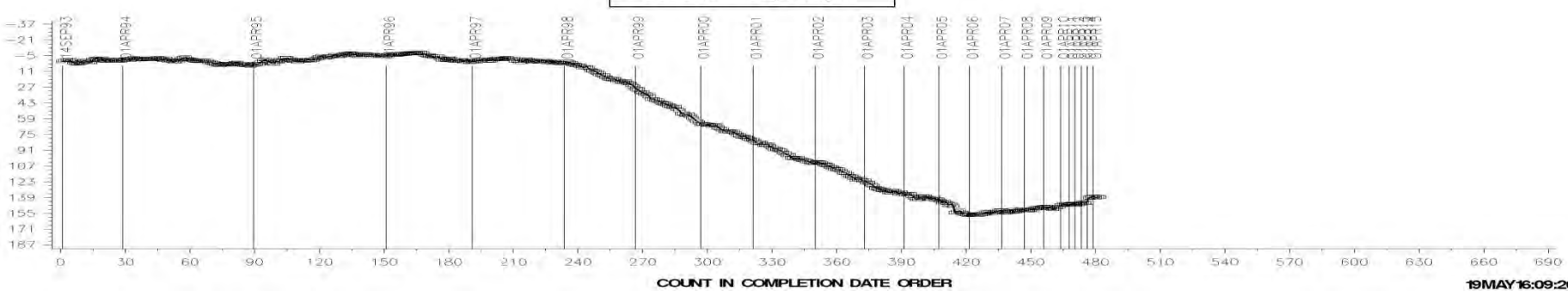
LTMS Severity Analysis



LTMS Precision Analysis

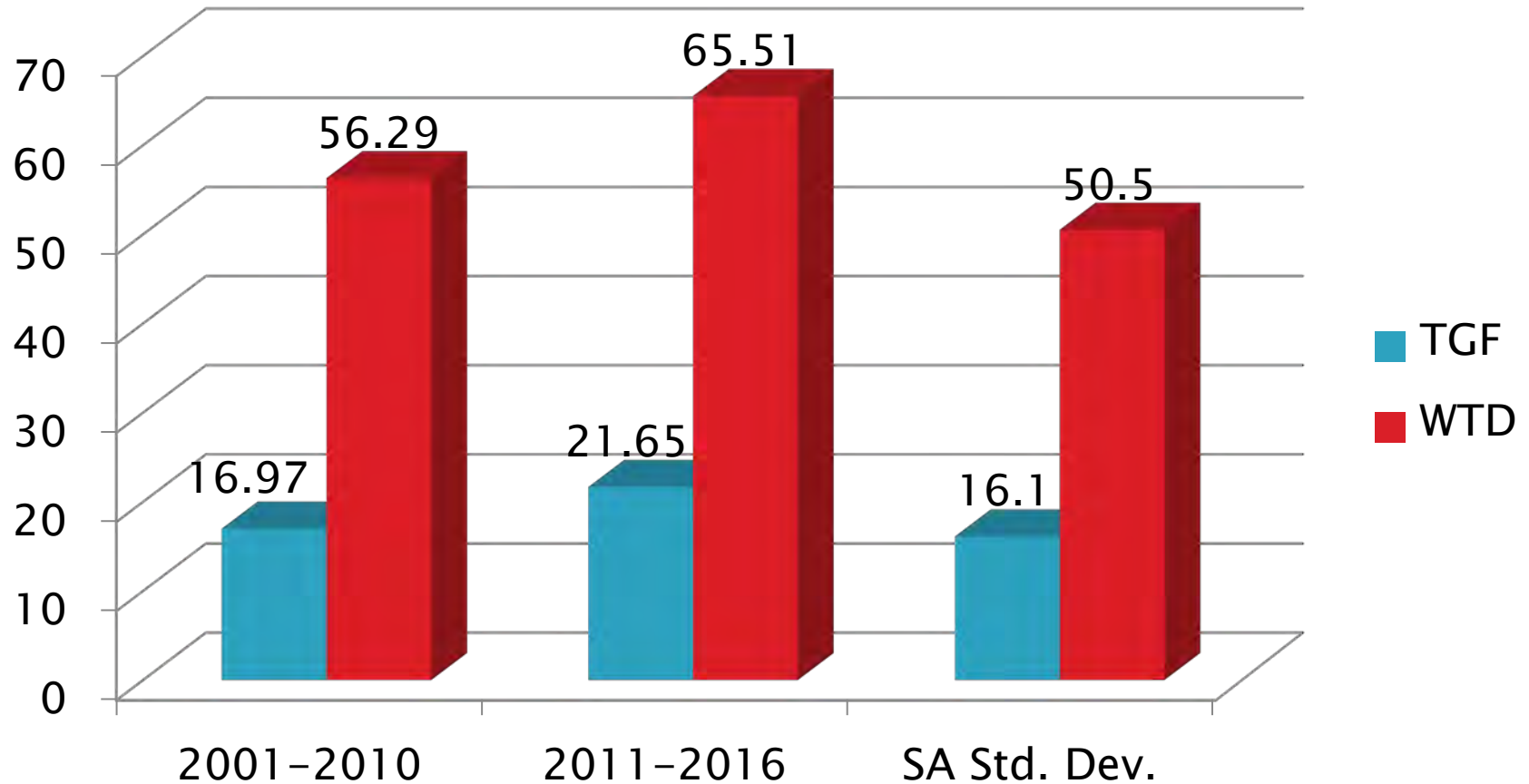


CUSUM Severity Analysis



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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

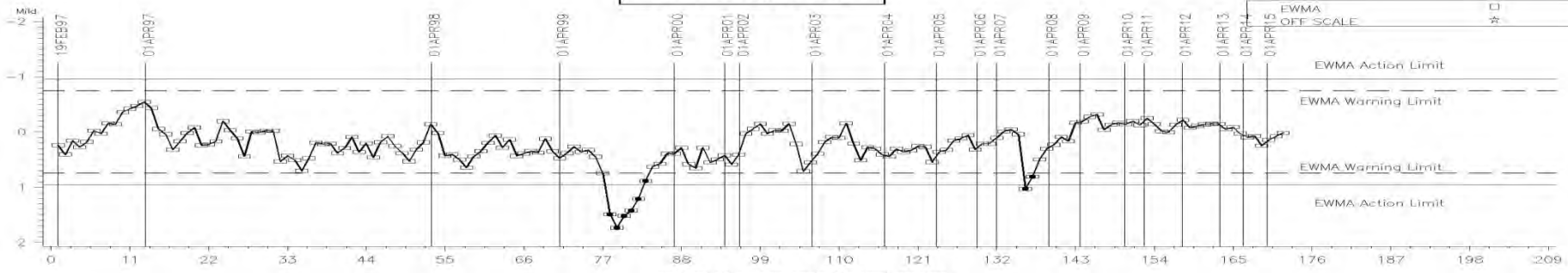
*Invalid and aborted tests

1 P Test Severity

- ▶ EOTOC is in action alarm severe direction.
- ▶ OC in warning alarm severe direction.
- ▶ TGC, TLC and WD are in control.

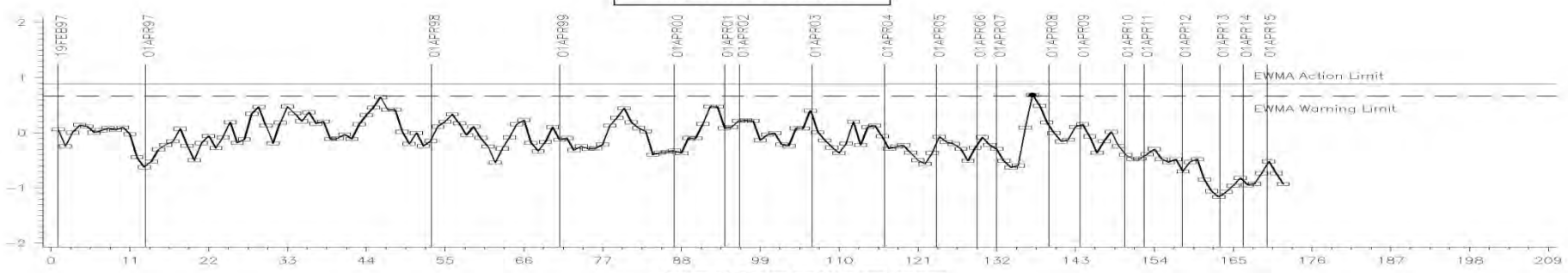
TOP GROOVE CARBON

LTMS Severity Analysis



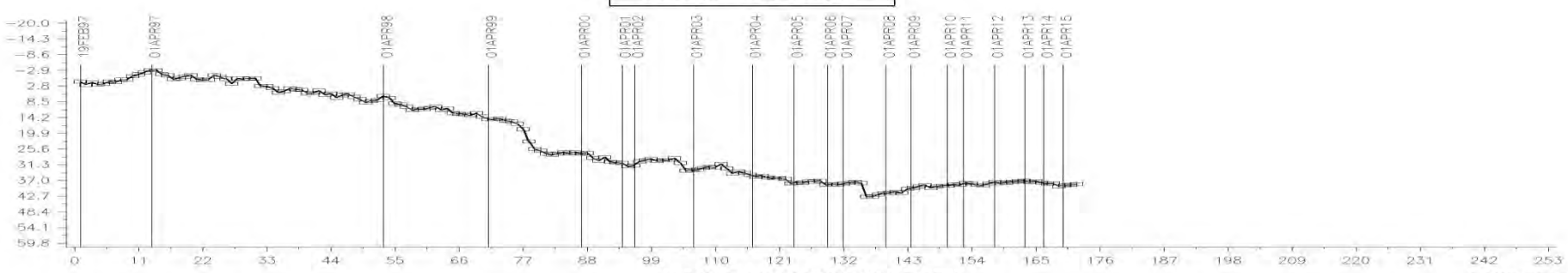
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

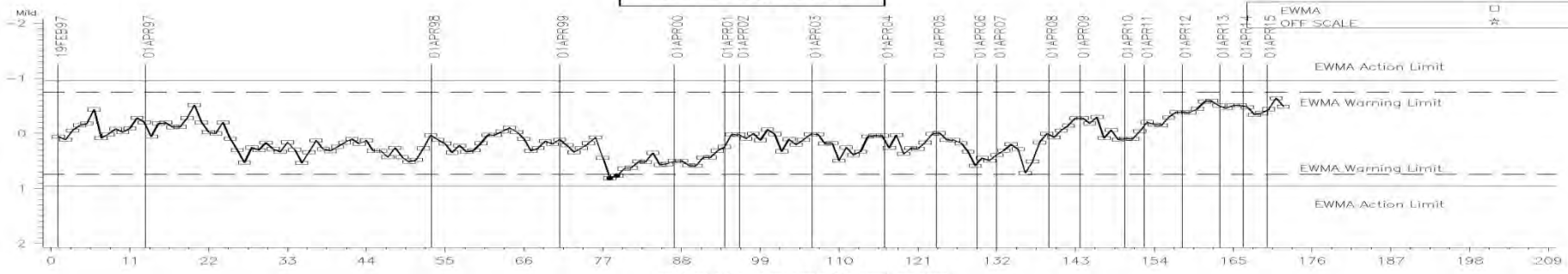


COUNT IN COMPLETION DATE ORDER

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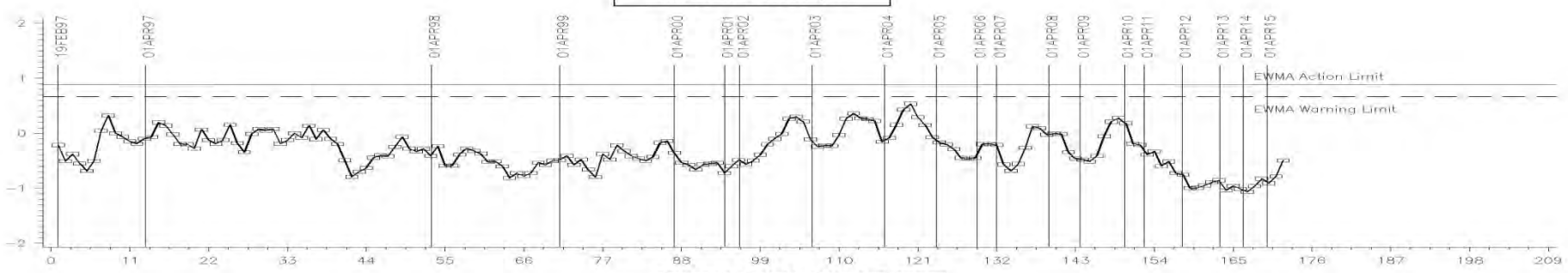
TOP LAND CARBON

LTMS Severity Analysis



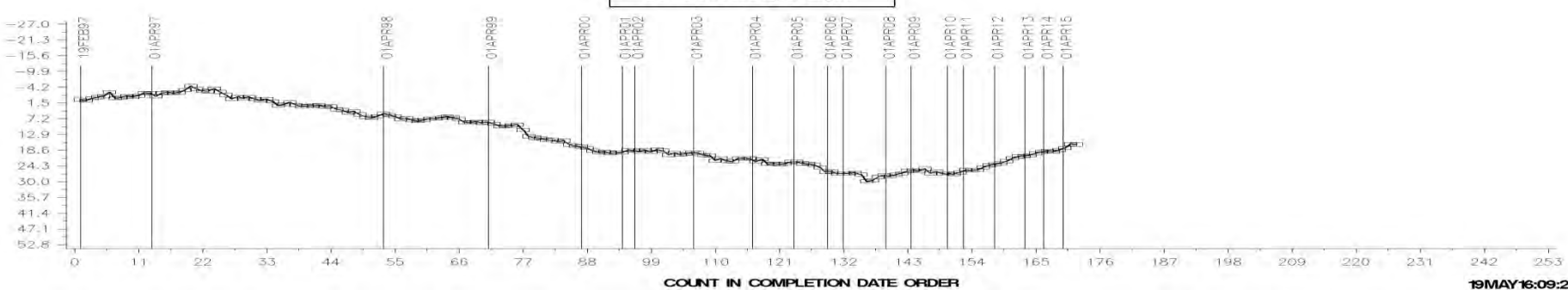
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

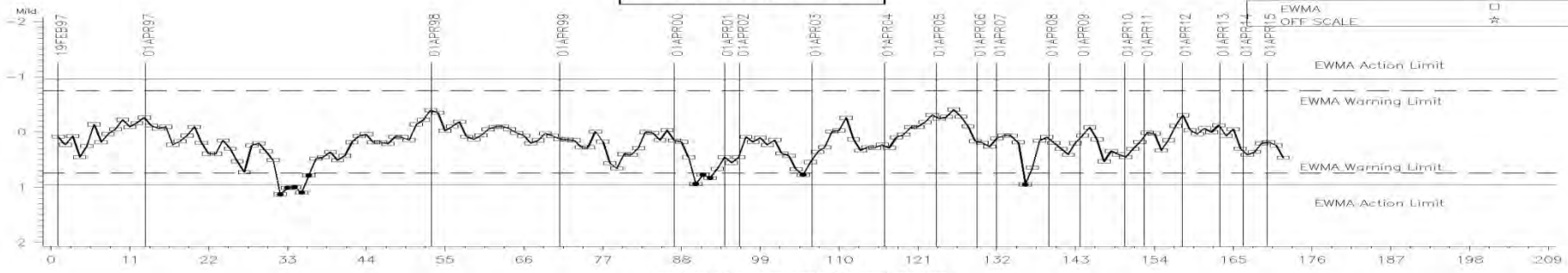
CUSUM Severity Analysis



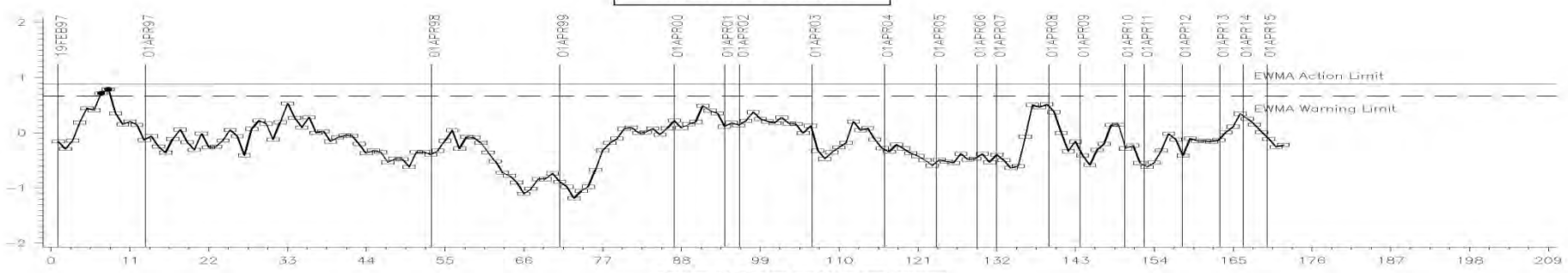
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WEIGHTED TOTAL DEMERITS

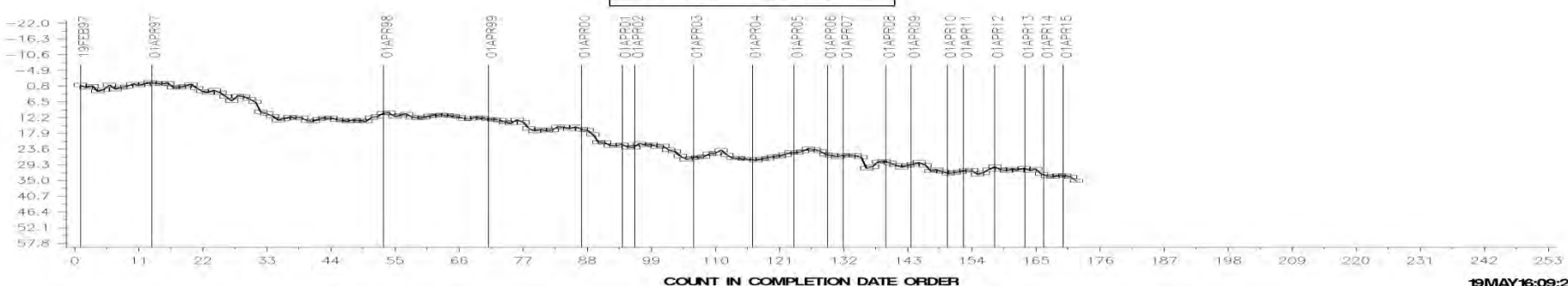
LTMS Severity Analysis



LTMS Precision Analysis



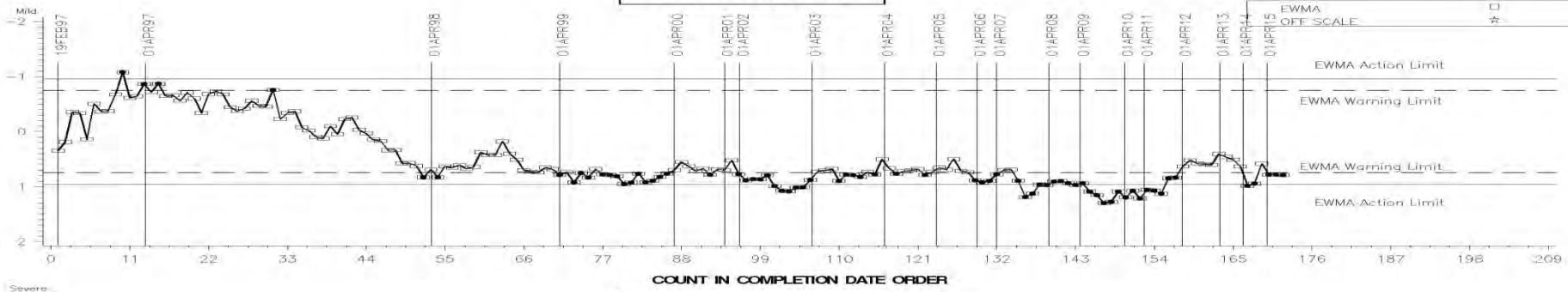
CUSUM Severity Analysis



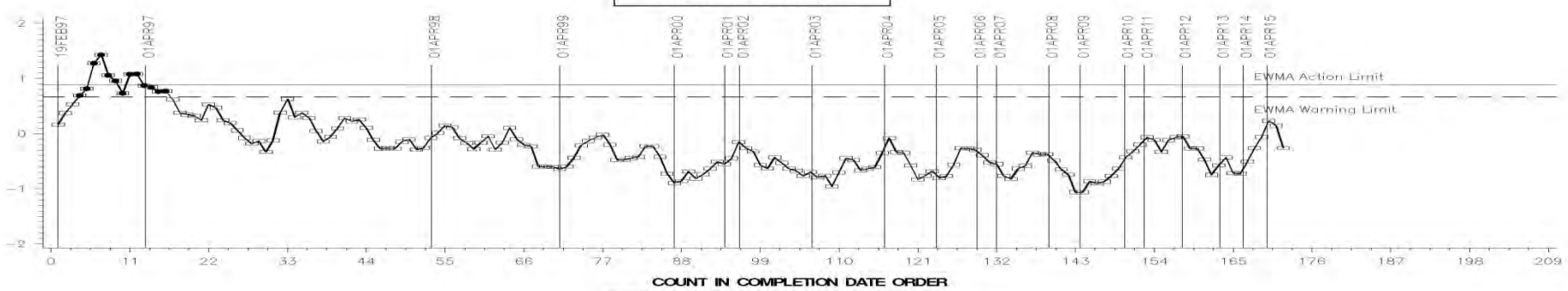
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OIL CONSUMPTION

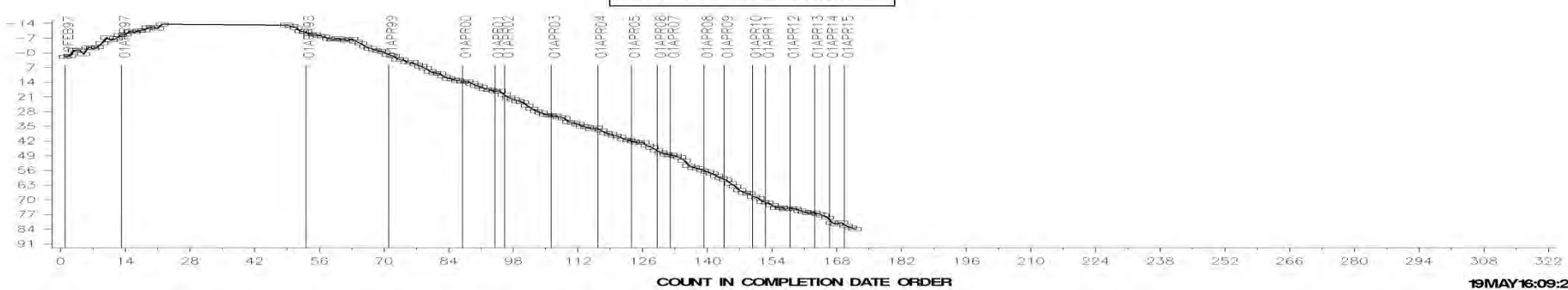
LTMS Severity Analysis



LTMS Precision Analysis



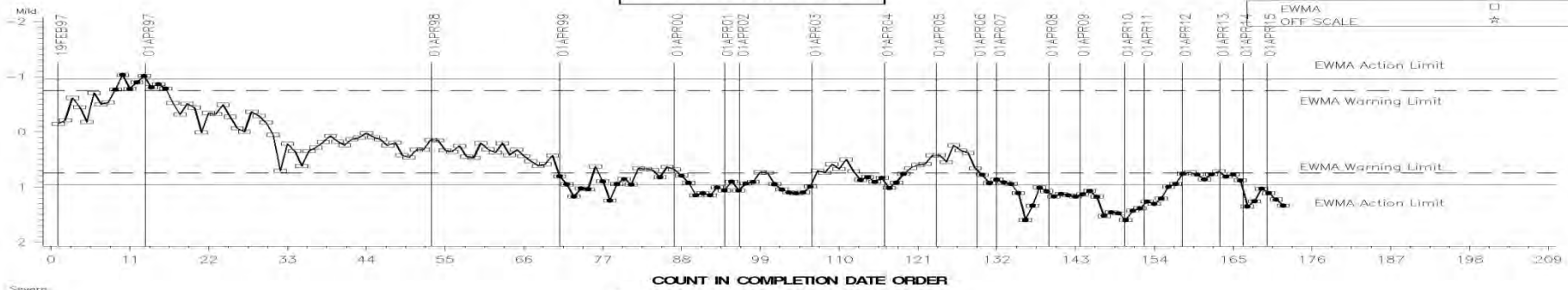
CUSUM Severity Analysis



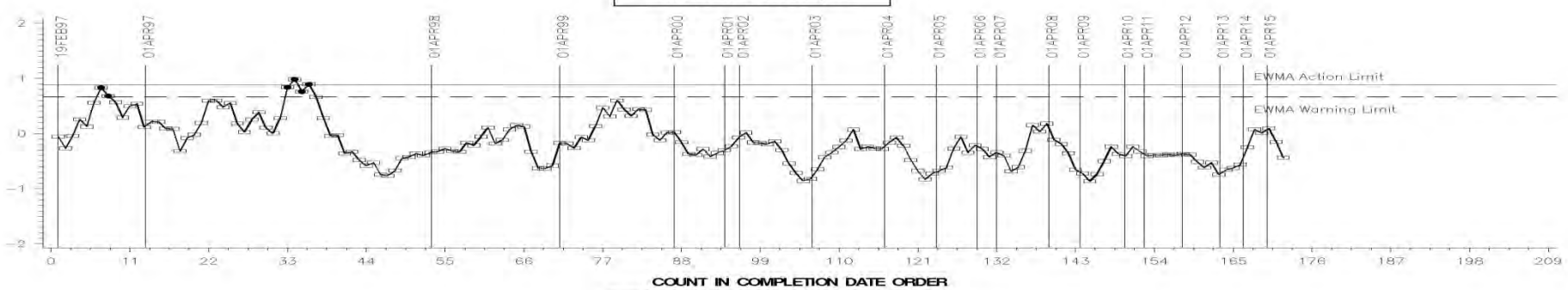
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EOTOC

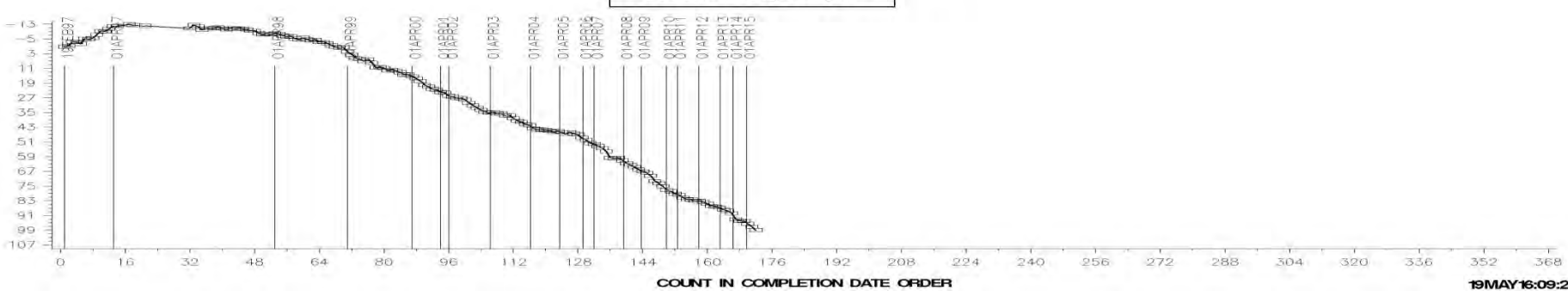
LTMS Severity Analysis



LTMS Precision Analysis

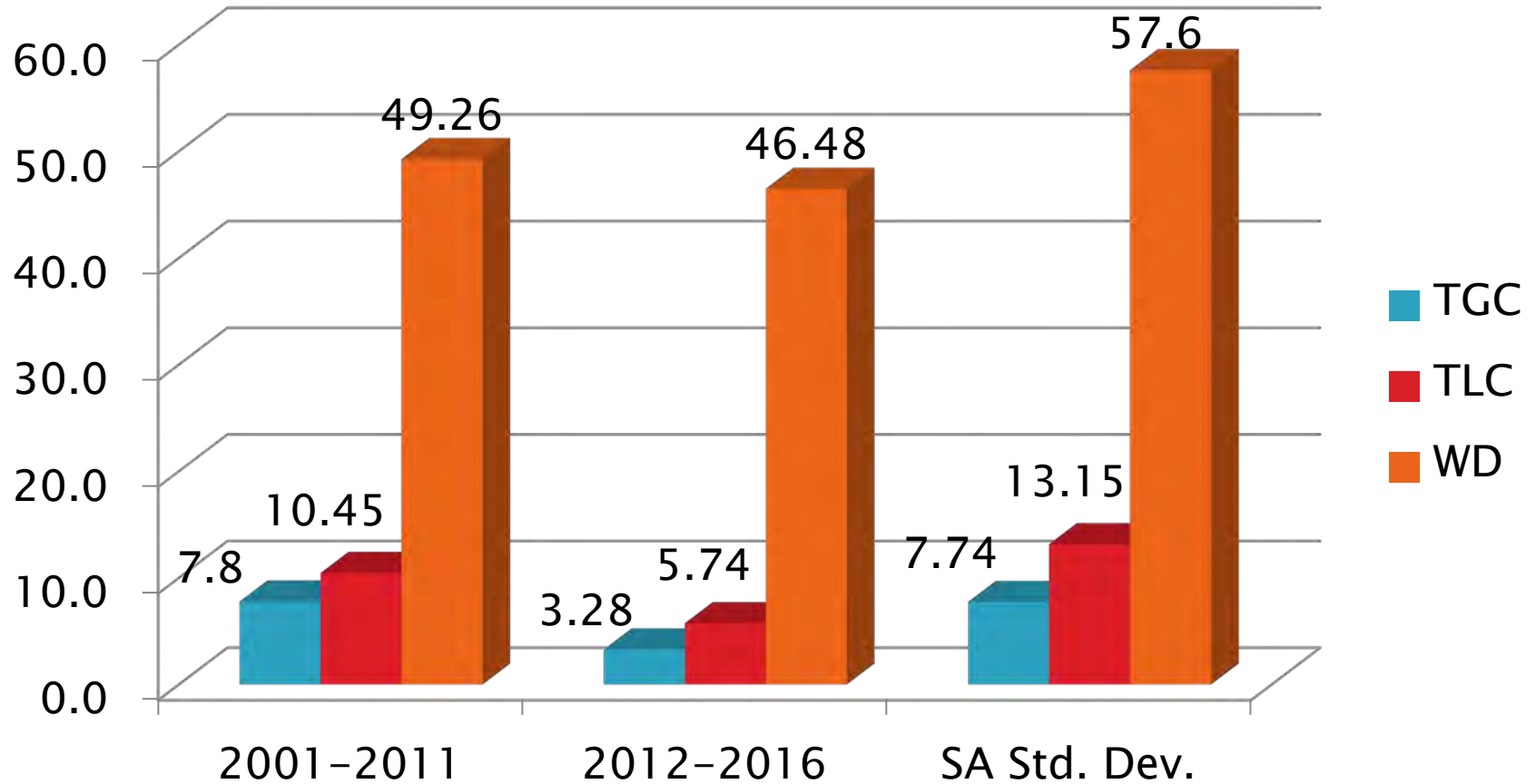


CUSUM Severity Analysis

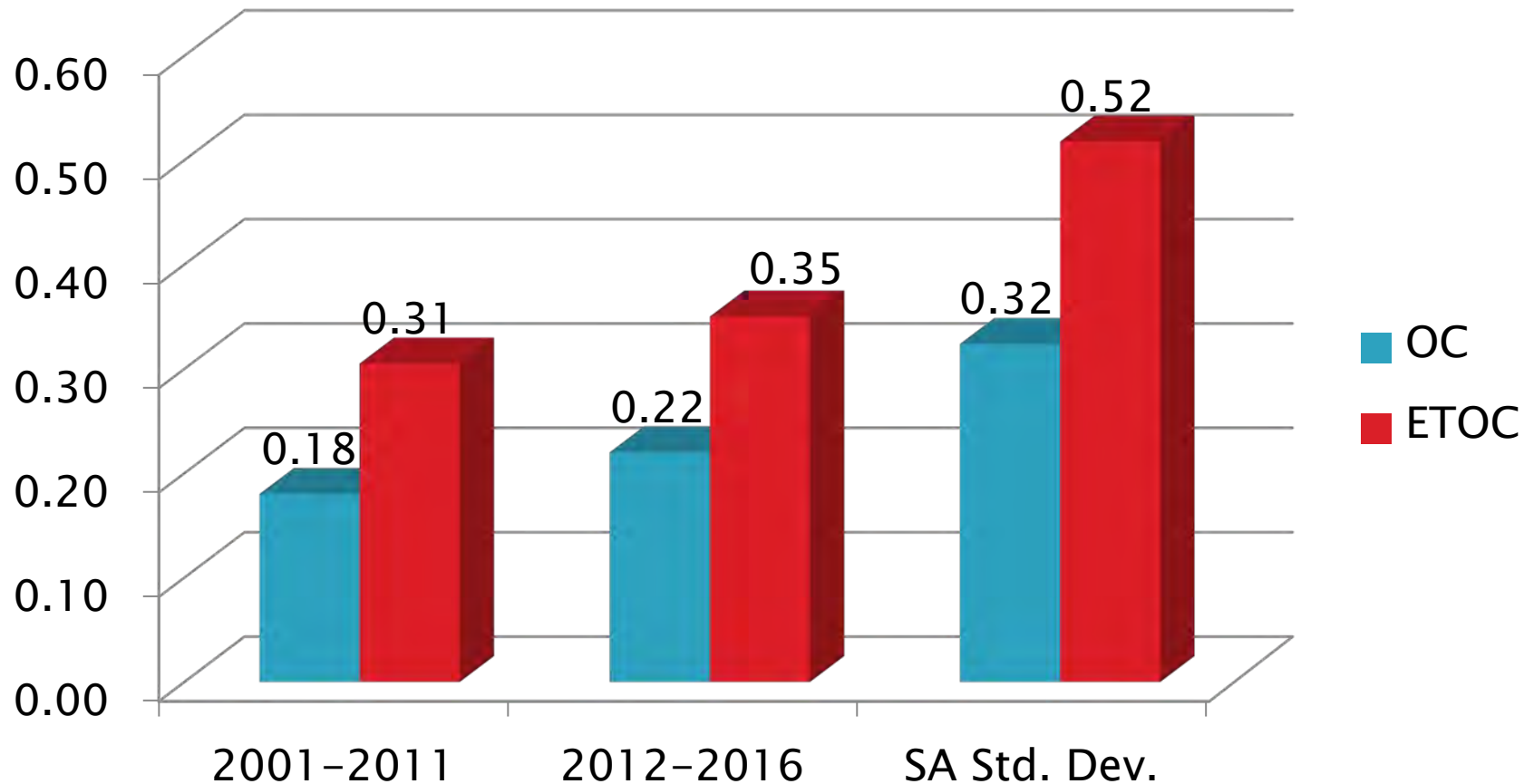


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1P Precision Estimates



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	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	1
Total		2

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	Aborted due to High Oil Consumption Concern	1
Total		1

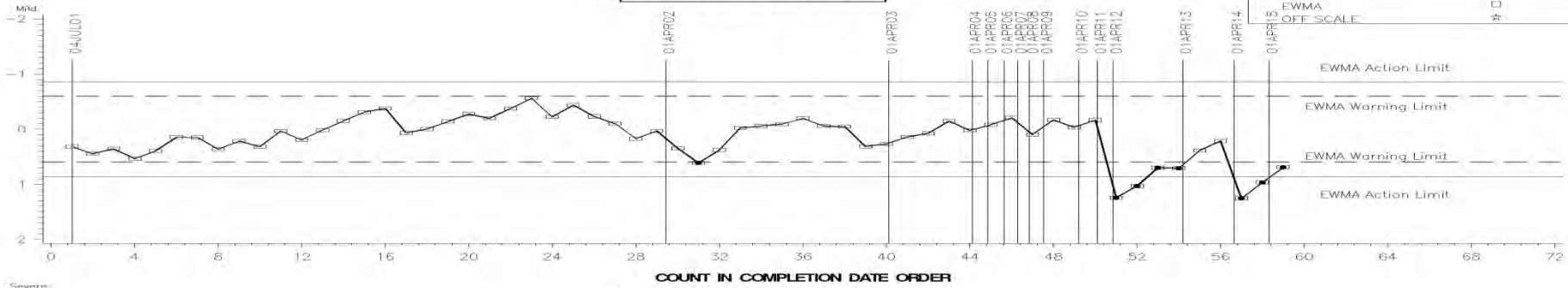
*Invalid and aborted tests

1 R Test Severity

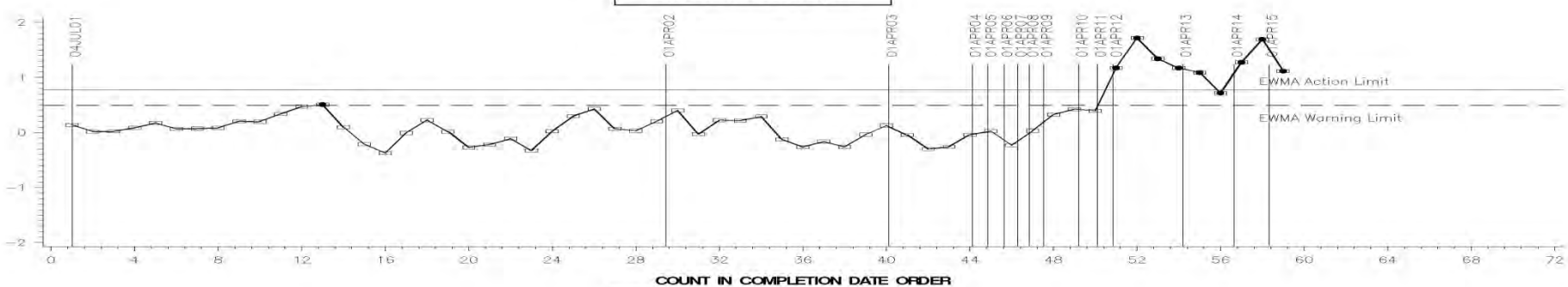
- ▶ WD in severity warning alarm severe direction
- ▶ BTOC is in control.
- ▶ WD, TGC, TLC and ETOC in precision alarm

FINAL WEIGHTED TOTAL DEMERITS (DEMERITS)

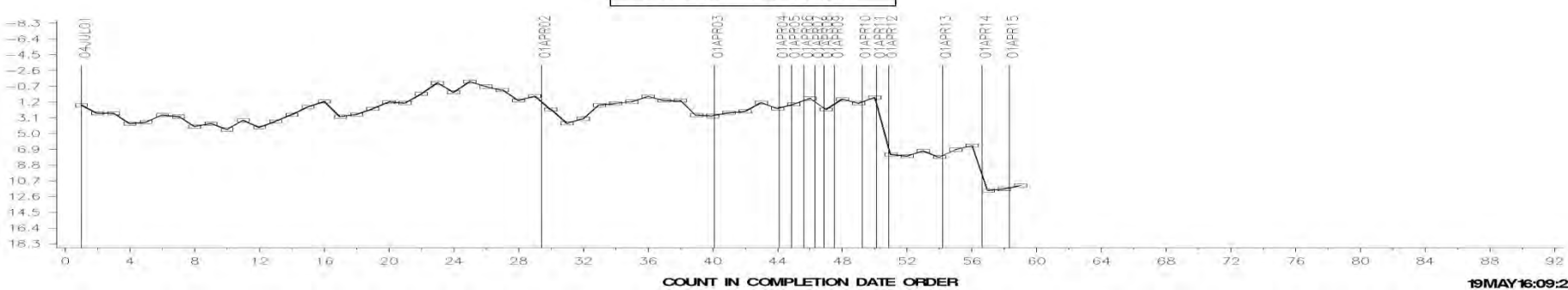
LTMS Severity Analysis



LTMS Precision Analysis



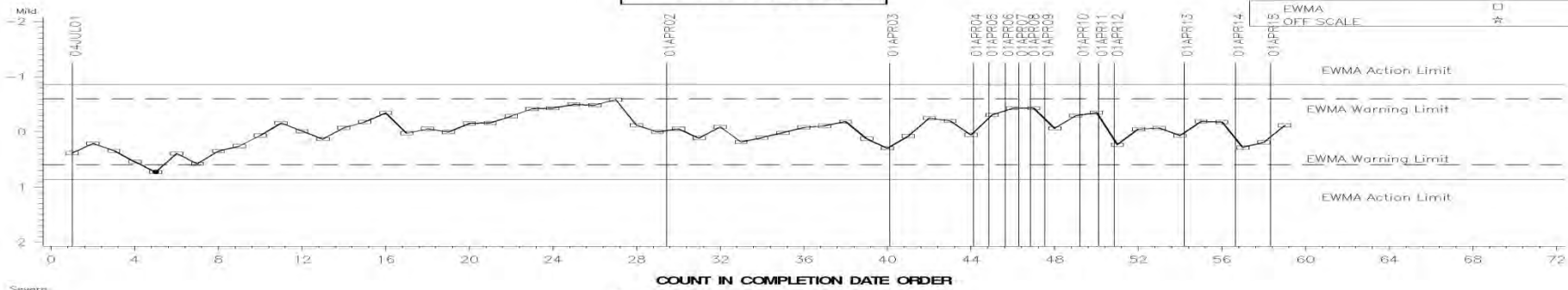
CUSUM Severity Analysis



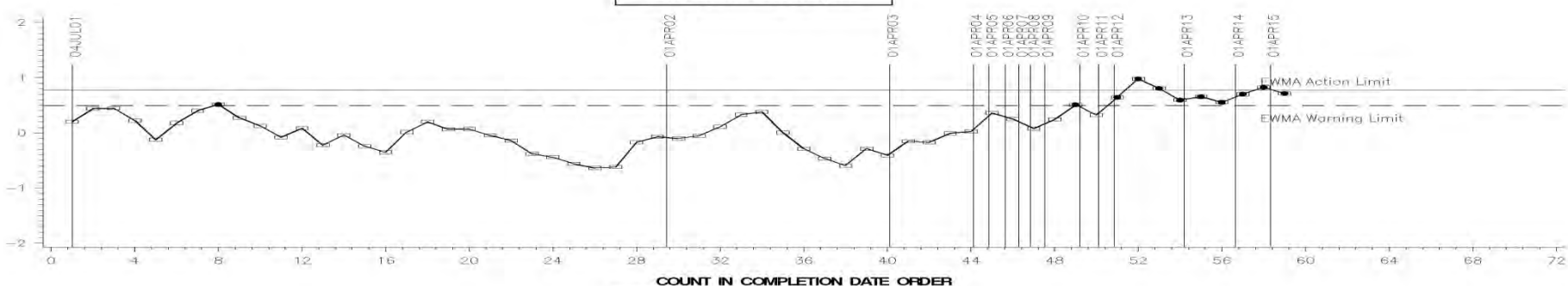
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FINAL TOP GROOVE CARBON (DEMERITS)

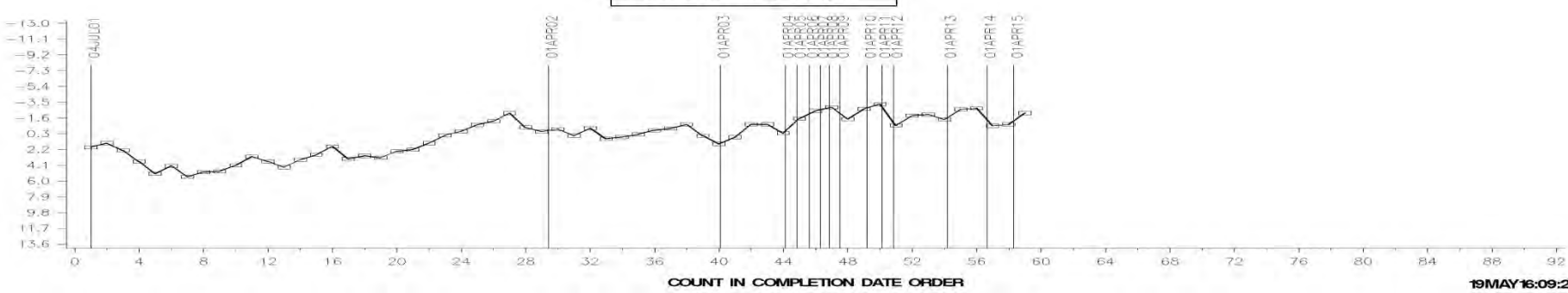
LTMS Severity Analysis



LTMS Precision Analysis



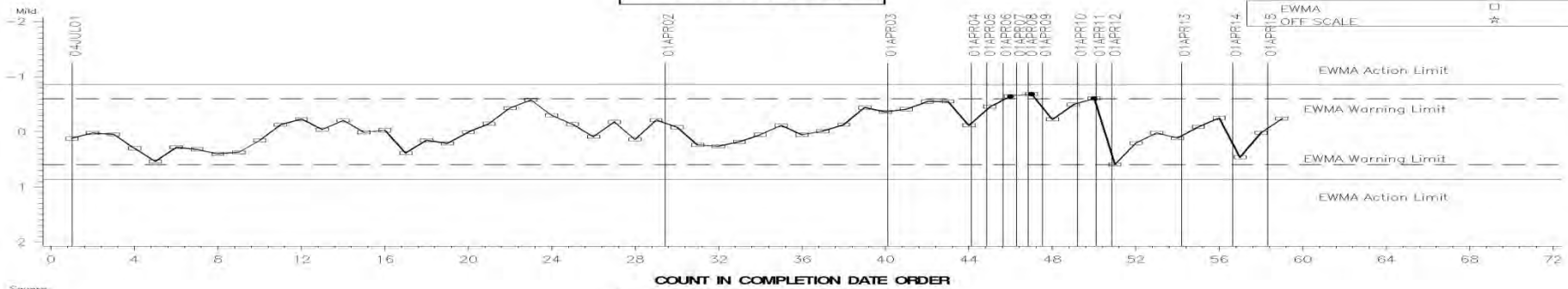
CUSUM Severity Analysis



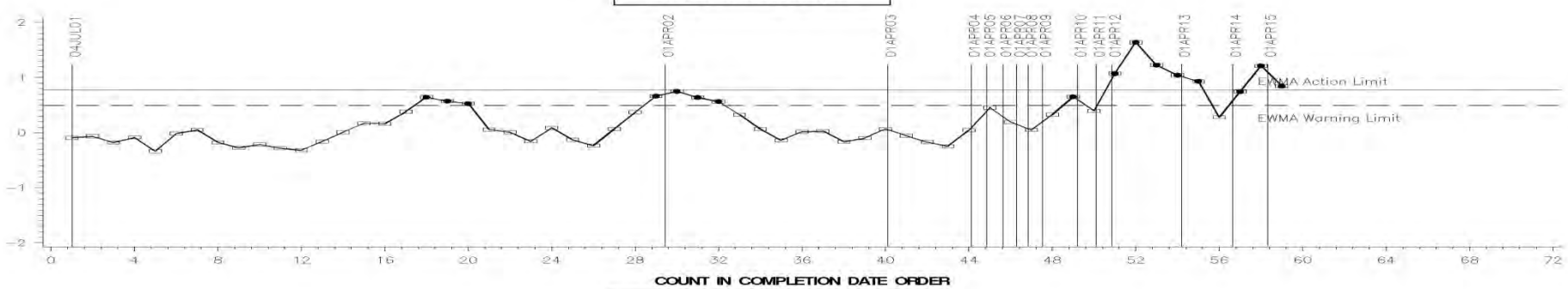
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FINAL TOP LAND CARBON (DEMERITS)

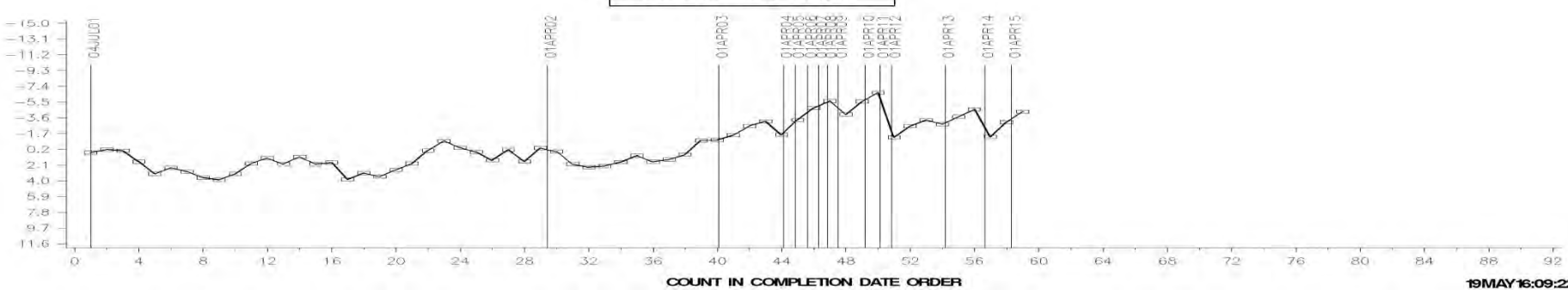
LTMS Severity Analysis



LTMS Precision Analysis



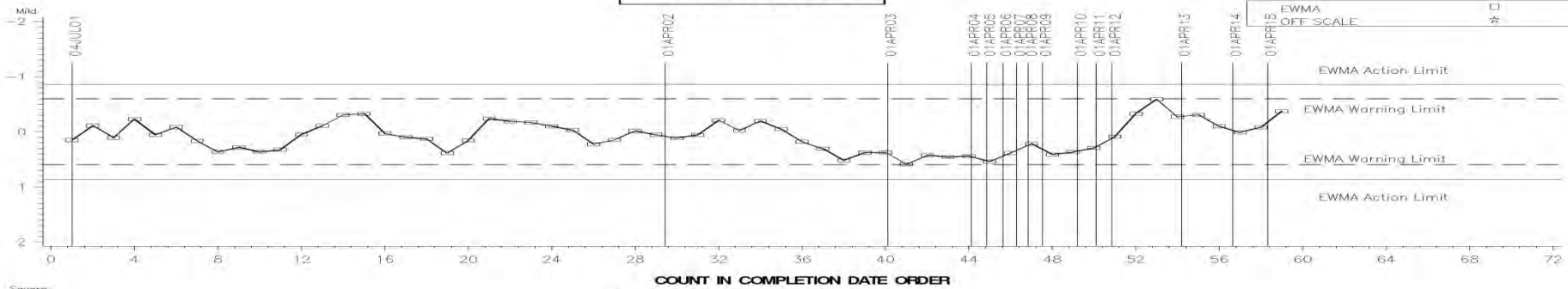
CUSUM Severity Analysis



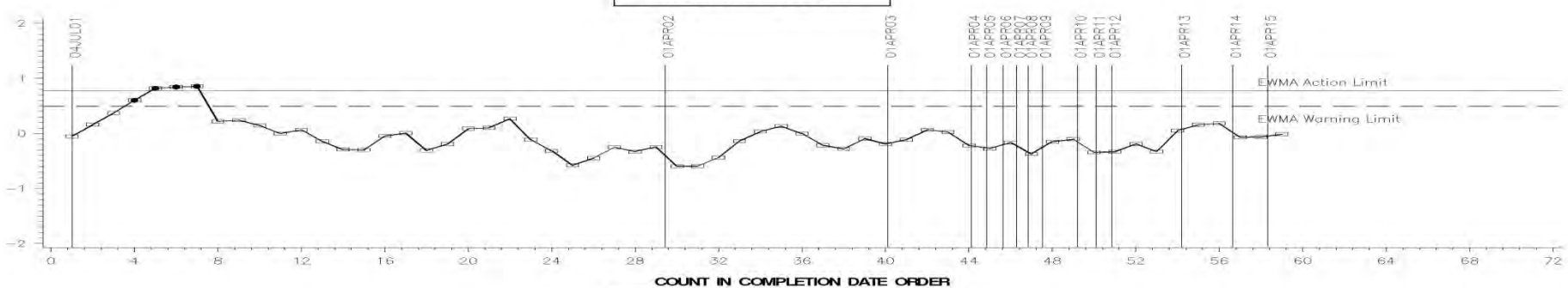
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FINAL BOTOC

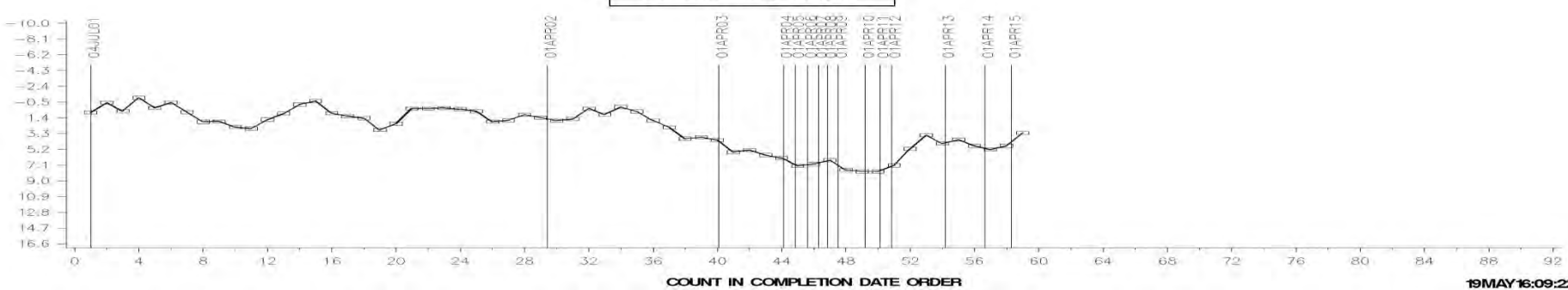
LTMS Severity Analysis



LTMS Precision Analysis



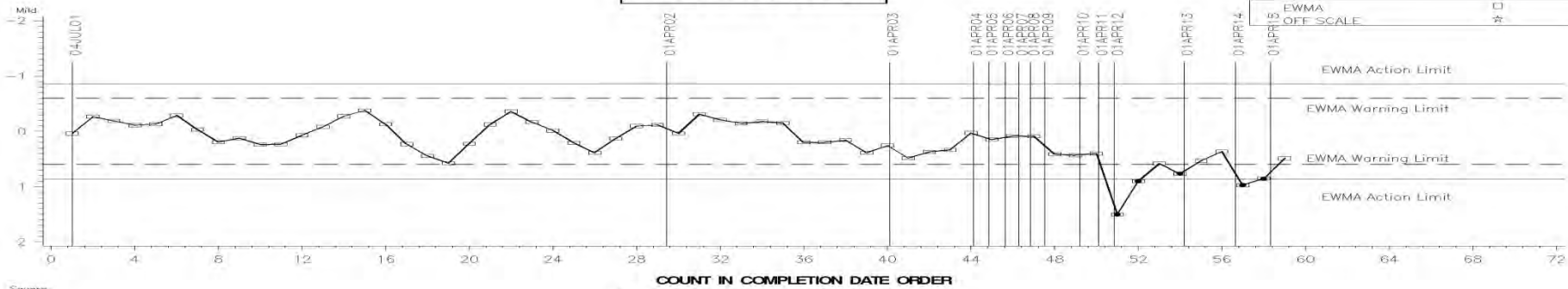
CUSUM Severity Analysis



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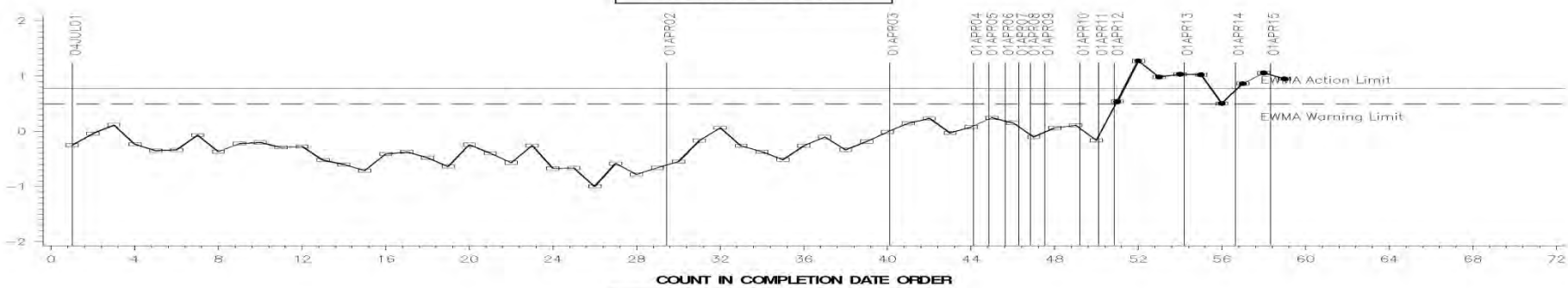
FINAL EOTC (g/h)

LTMS Severity Analysis



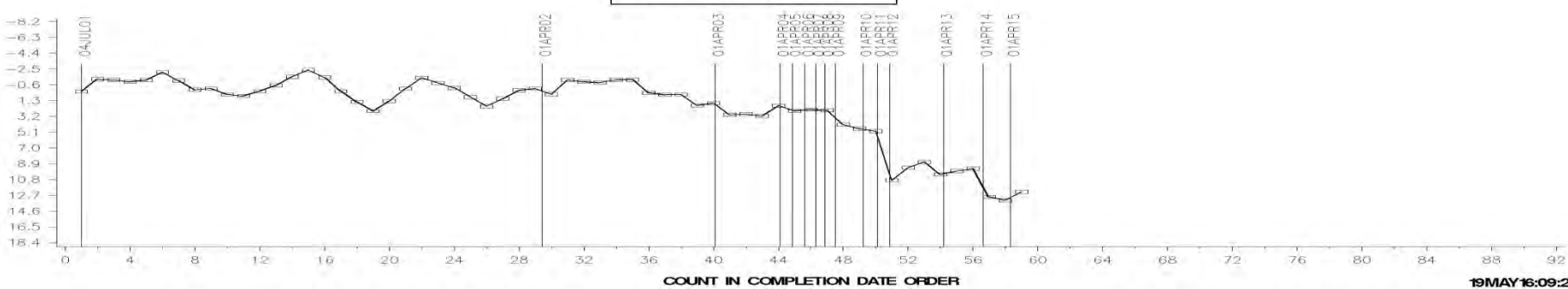
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



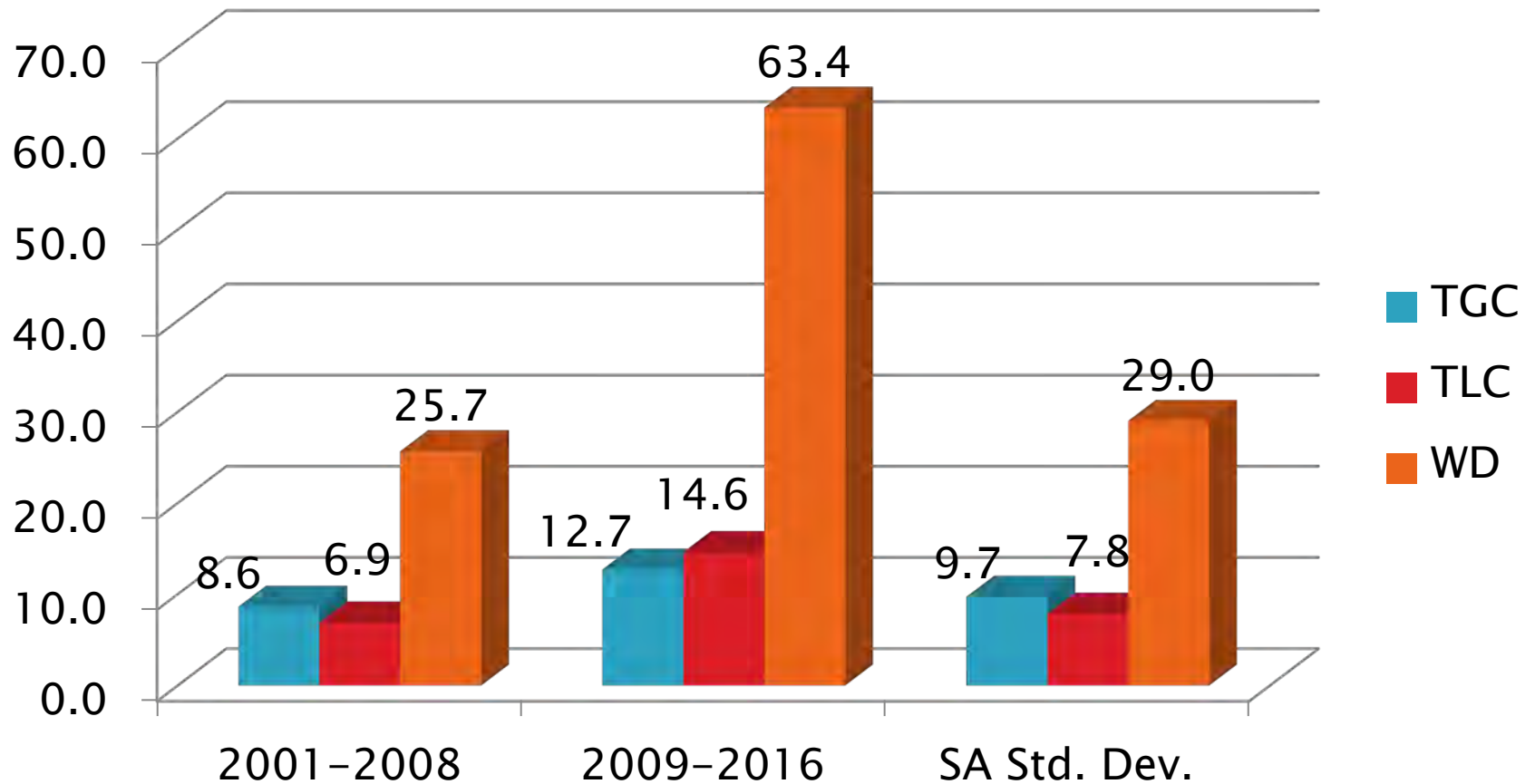
COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

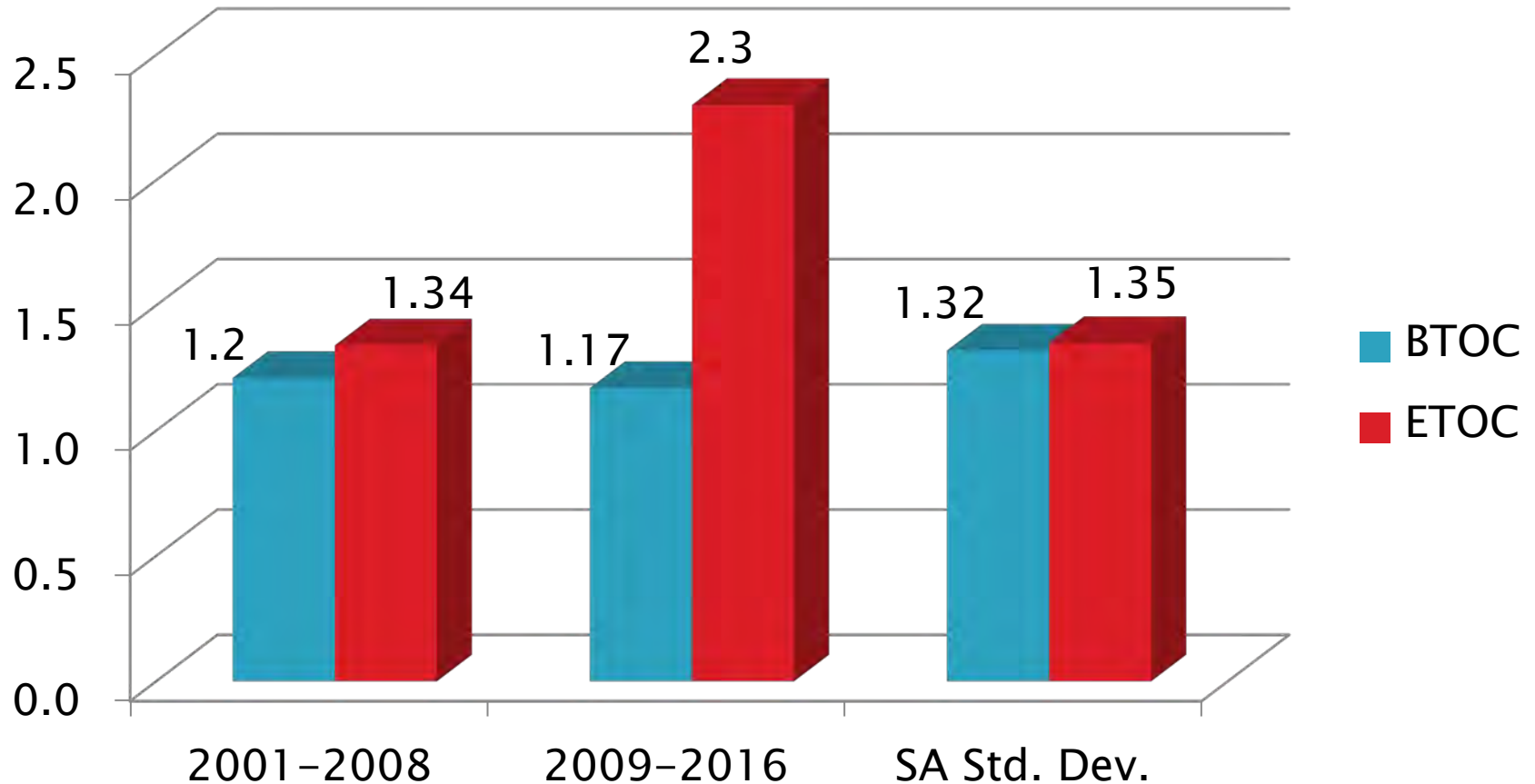


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1R Precision Estimates



1 R Precision Estimates



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CAT C13

»» April 2016

Test Monitoring Center

<http://astmtmc.cmu.edu>



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C13 Test Activity

Test Status	Validity Code	C13
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		2

C13 Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

C13 Lost Tests*

Status	Cause	#
	No invalid or aborted tests	0
Total		0

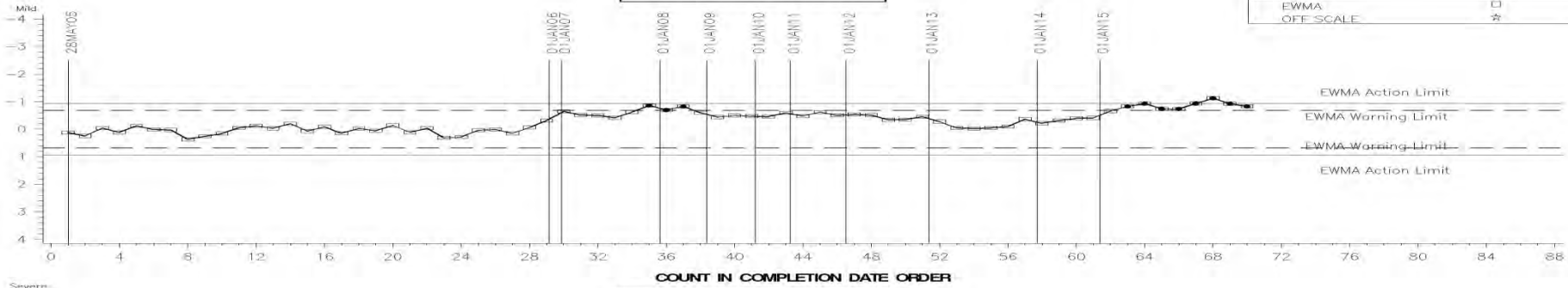
*Invalid and aborted tests

C13 Test Severity

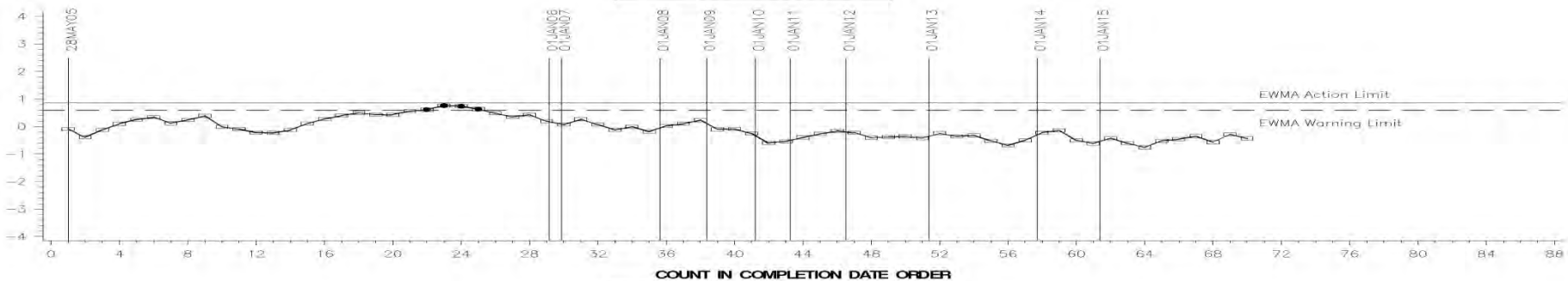
- ▶ TGC and R2TC are in control. TGC near severity warning alarm.
- ▶ OC in precision warning alarm. Near severity warning alarm
- ▶ TLC in severity warning alarm mild direction.

TOP LAND CARBON AVG. - FINAL RESULT

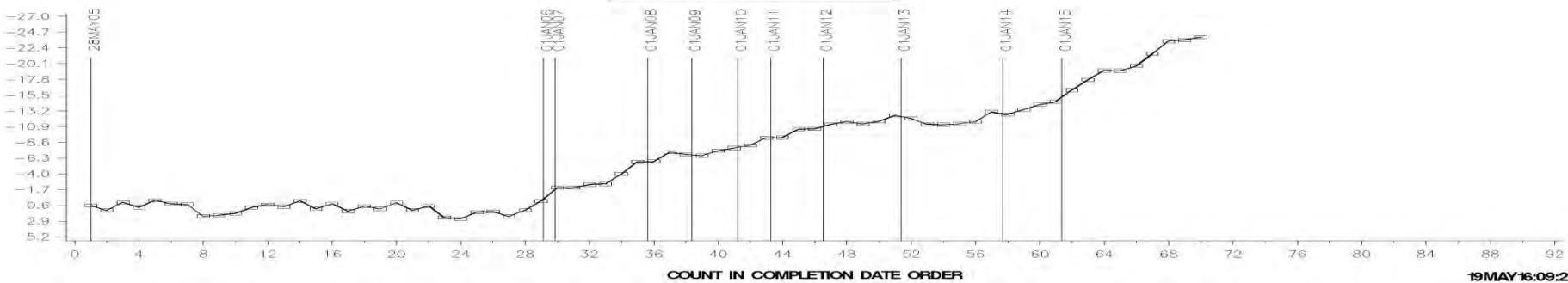
LTMS Severity Analysis



LTMS Precision Analysis



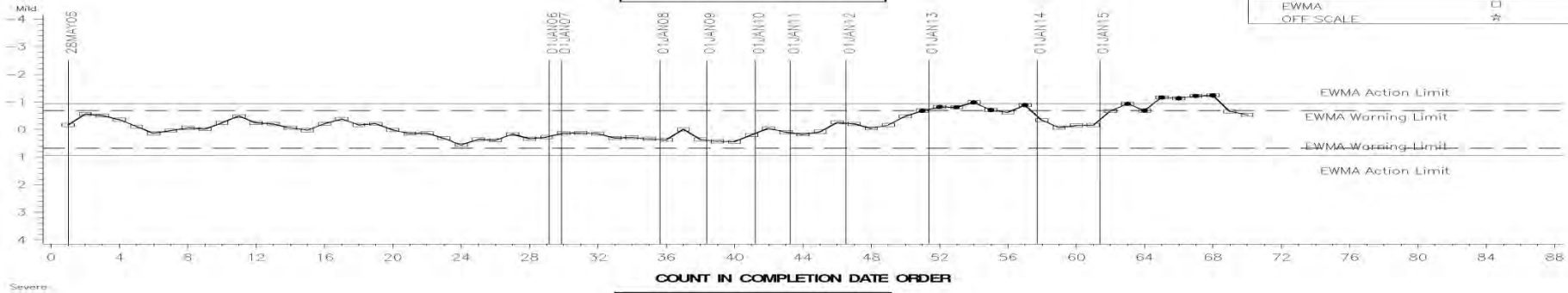
CUSUM Severity Analysis



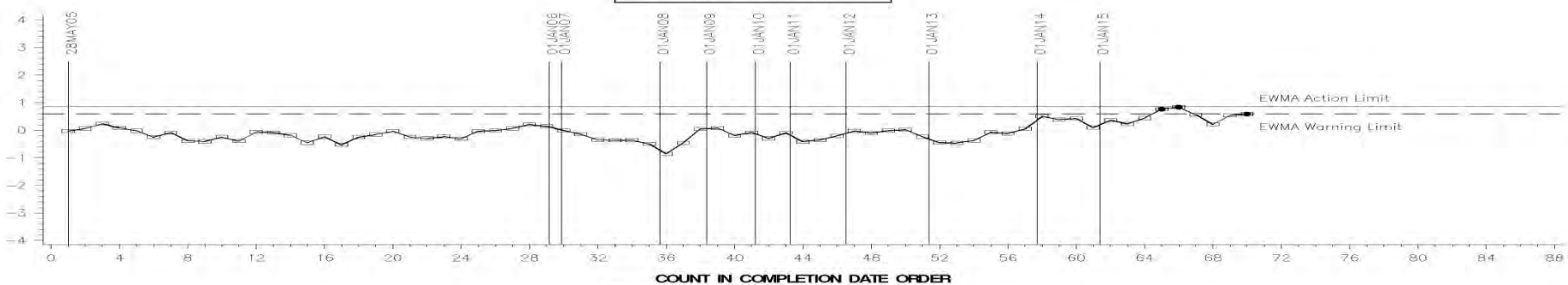
19MAY16:09:22

TOP GROOVE CARBON AVG - FINAL RESULT

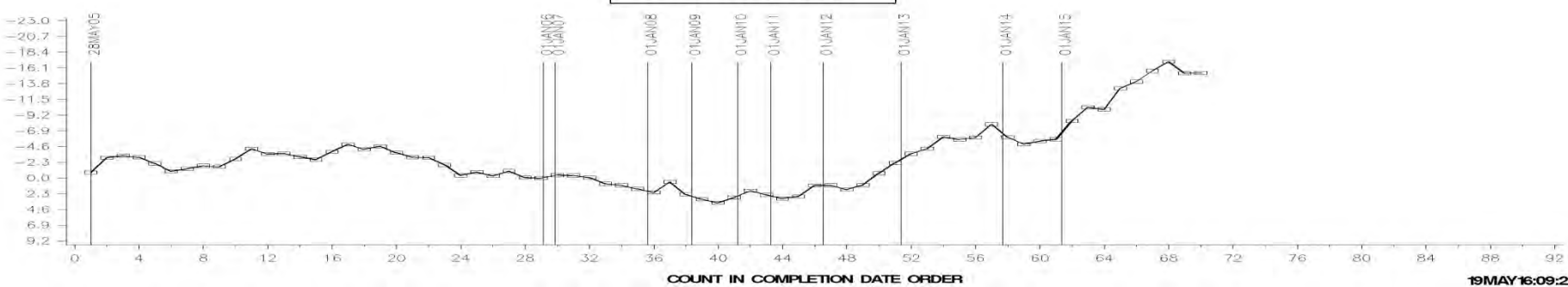
LTMS Severity Analysis



LTMS Precision Analysis



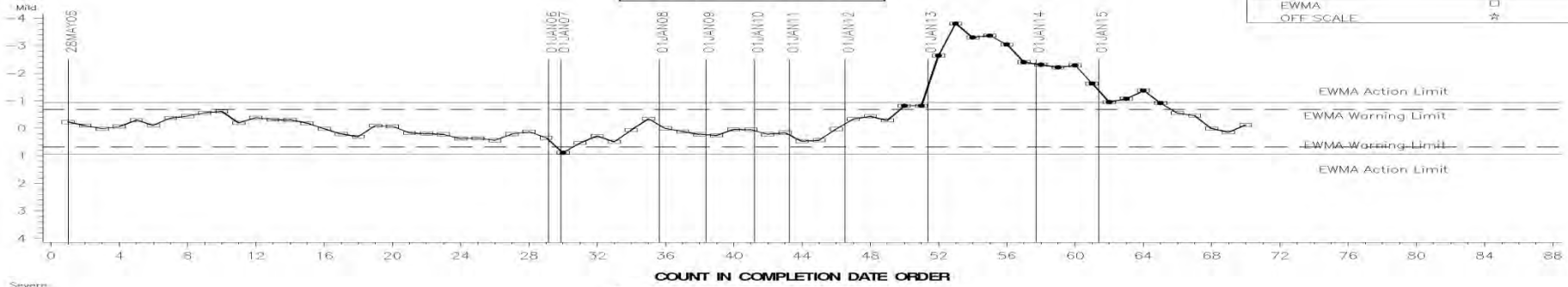
CUSUM Severity Analysis



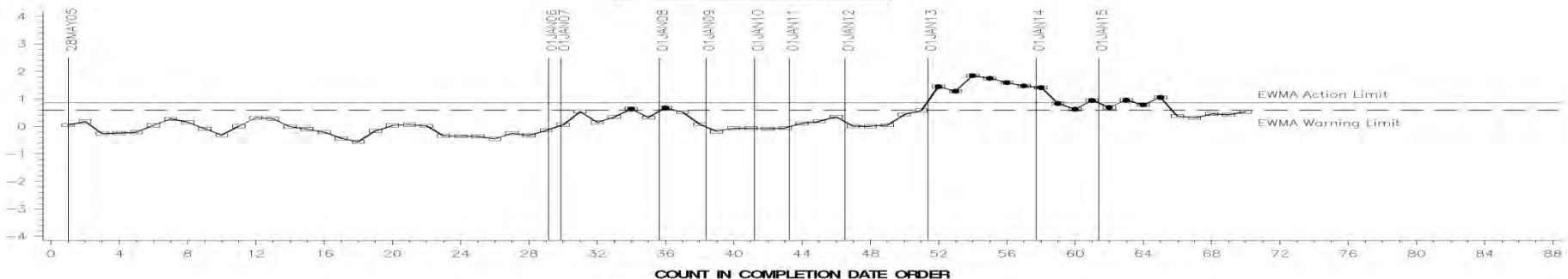
19MAY16:09:22

2ND RING TOP CARBON AVG. — FINAL RESULT

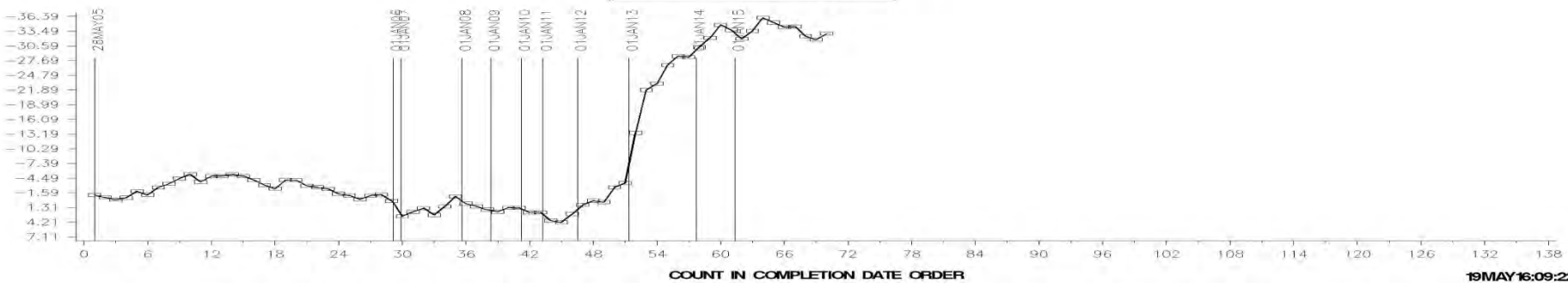
LTMS Severity Analysis



LTMS Precision Analysis



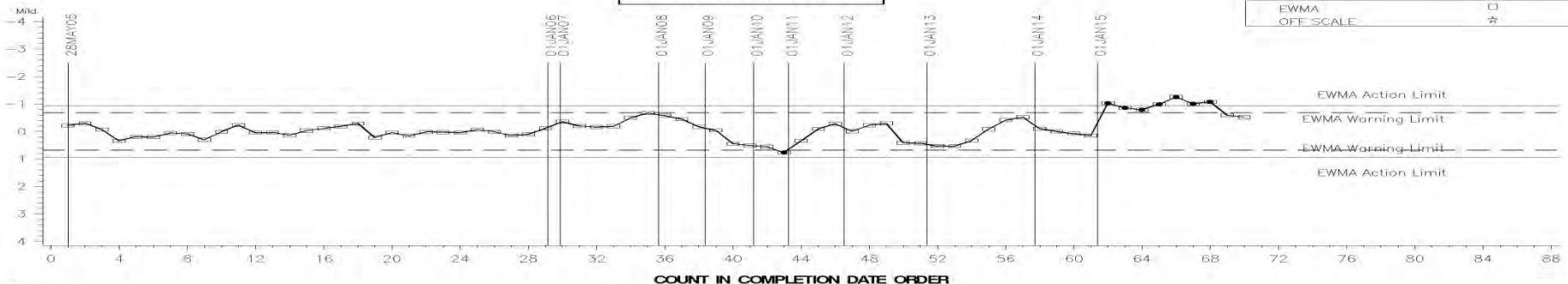
CUSUM Severity Analysis



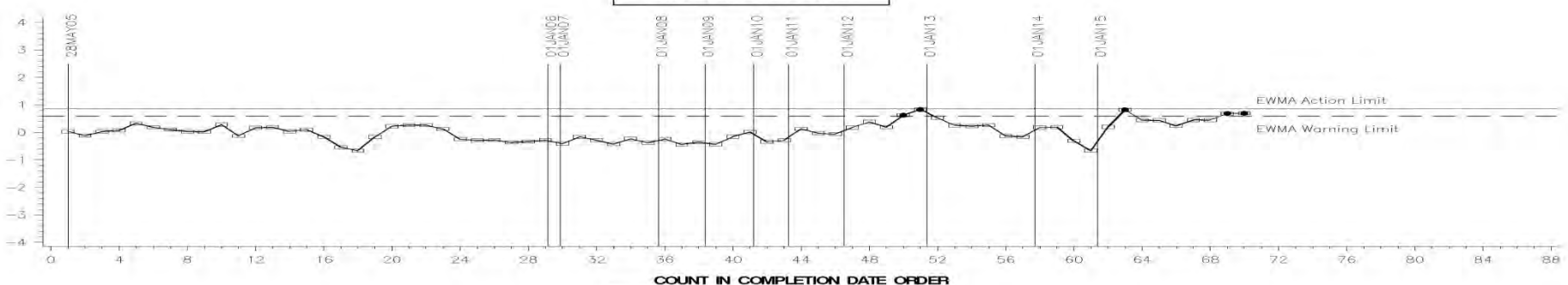
19MAY16:09:22

OIL CONS. DELTA - FINAL RESULT

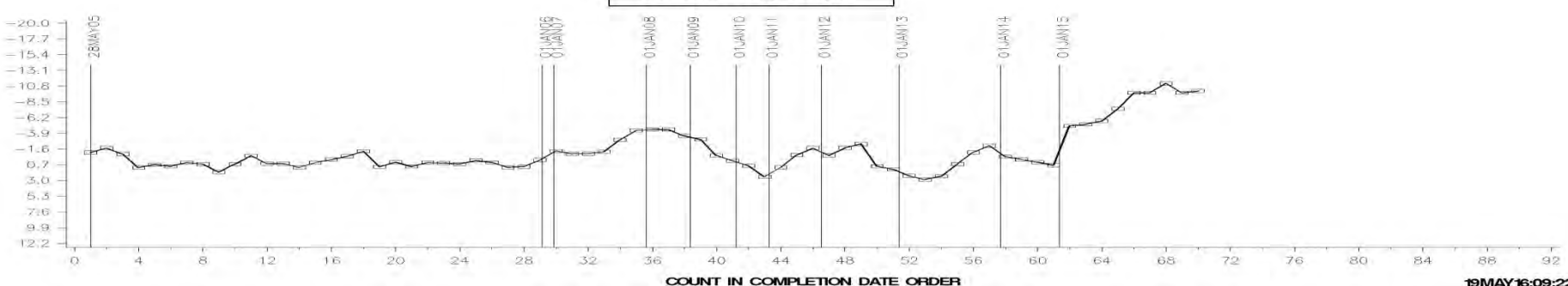
LTMS Severity Analysis



LTMS Precision Analysis

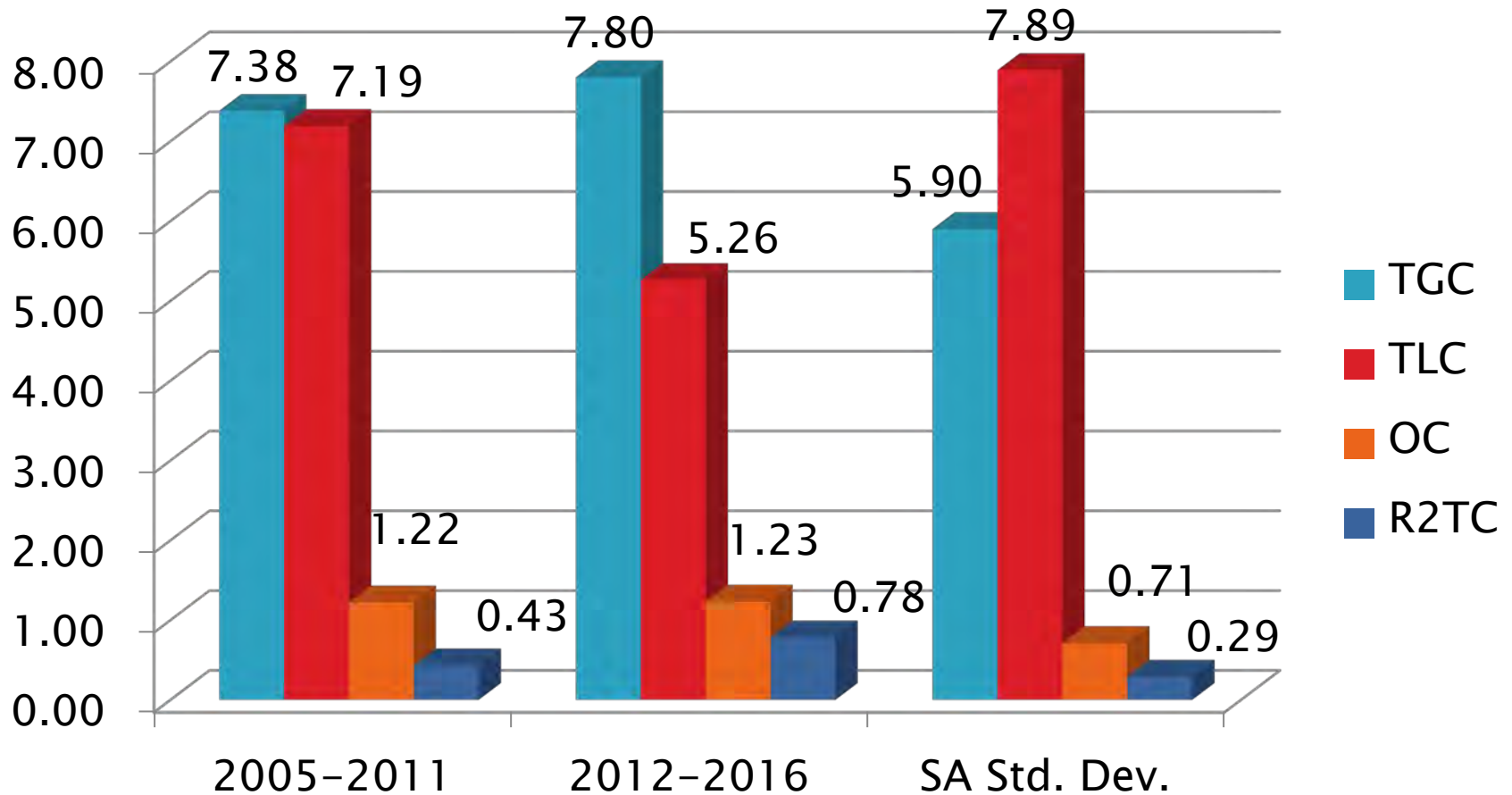


CUSUM Severity Analysis



19MAY16:09:22

C13 Precision Estimates



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Test Monitoring Center

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C13 Oil Aeration (COAT)

»» April 2016

Test Monitoring Center

<http://astmtmc.cmu.edu>



A Program of ASTM International

COAT Test Activity

Test Status	Validity Code	COAT
Acceptable Calibration Test	AC	6
Failed Calibration Test	OC	0
Operationally Invalid	LC	4
Aborted	XC	2
Donated	AG/OG/NC	11
Total		23

COAT Failed Tests

Failed Parameter	Number of Tests
No Failed Tests	0
Total	0

COAT Lost Tests*

Status	Cause	#
Invalid	Shutdown after 30 hours	1
Invalid	Micromotion software issue	2
Invalid	Bad data acquisition calibration	1
Aborted	Large Oil Leak	2
Total		6

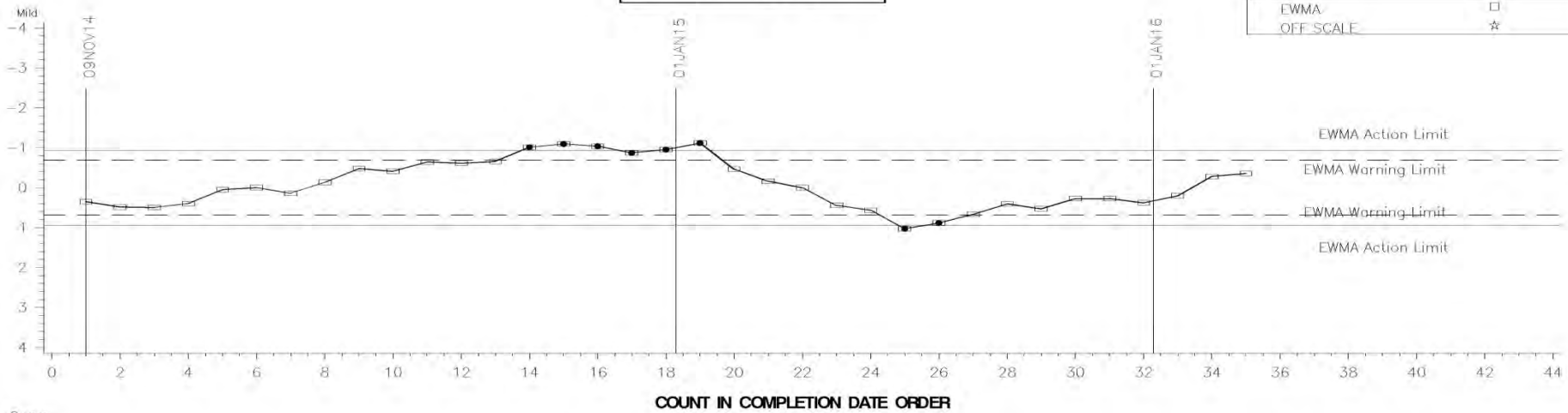
*Invalid and aborted tests

COAT Test Severity

- ▶ AAVE is in control.

AVERAGE AERATION HOURS 40 — 50

LTMS Severity Analysis



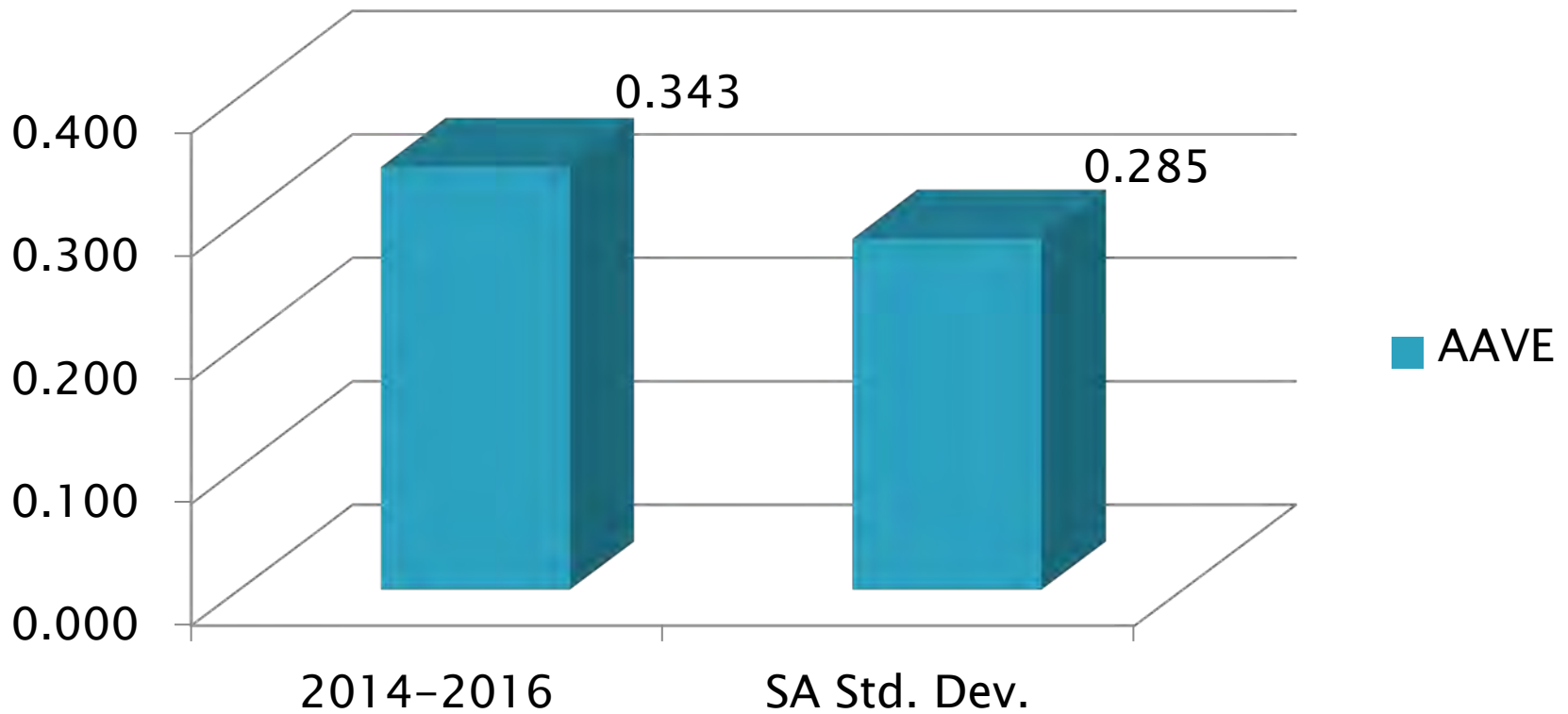
CUSUM Severity Analysis



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COAT Precision Estimates

AAVE



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Cummins ISB

»» April 2016

Test Monitoring Center

<http://astmtmc.cmu.edu>



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ISB Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	1
Operationally Invalid	LC	0
Aborted	XC	0
Total		3

ISB Failed Tests

Failed Parameter	Number of Tests
Severe ACSW	1
Total	1

ISB Lost Tests*

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

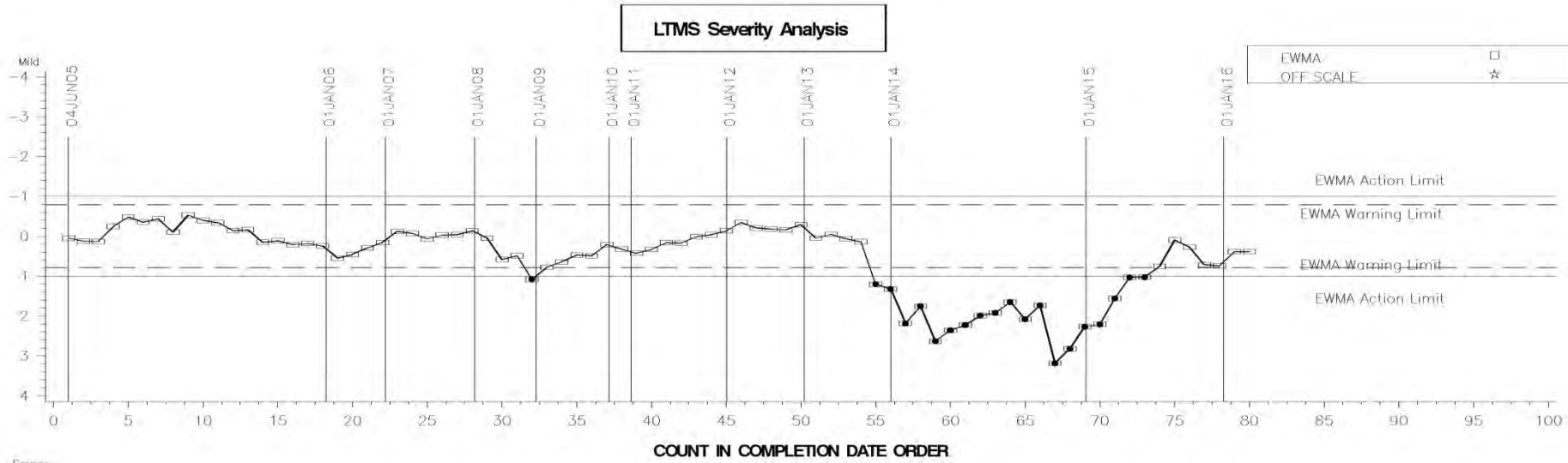
*Invalid and aborted tests

ISB Test Severity

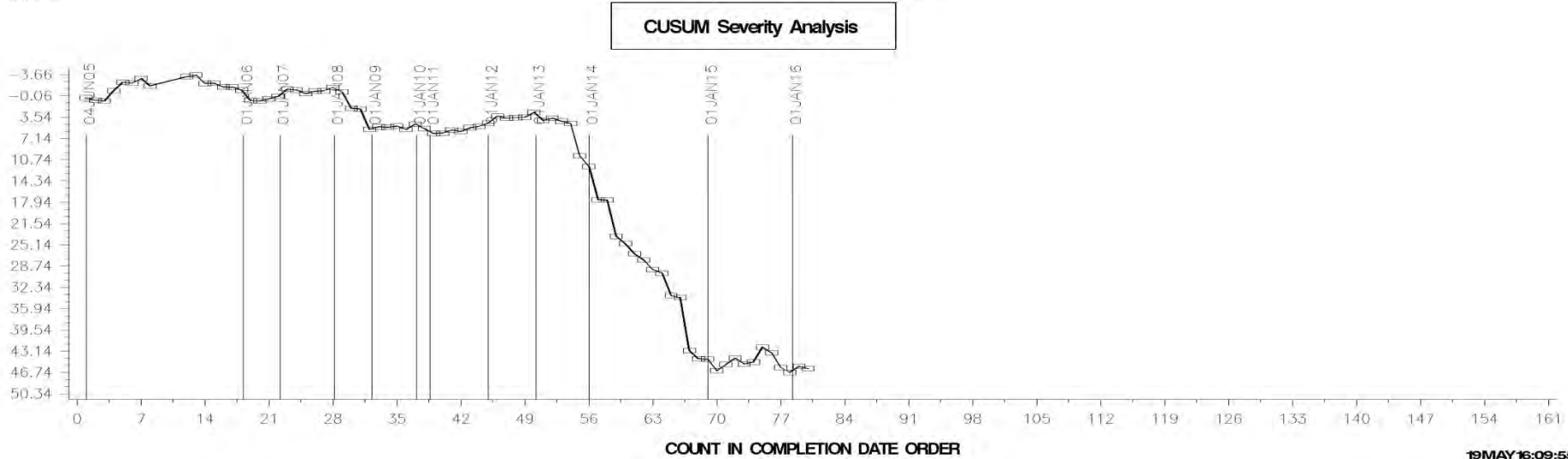
- ▶ ACSW and ATWL are in control.
- ▶ ATWL near severity warning limit mild direction. Mild severity trend may be ending.
- ▶ ACSW severe trend ending.

AVERAGE CAMSHAFT WEAR

Standard Deviation Units



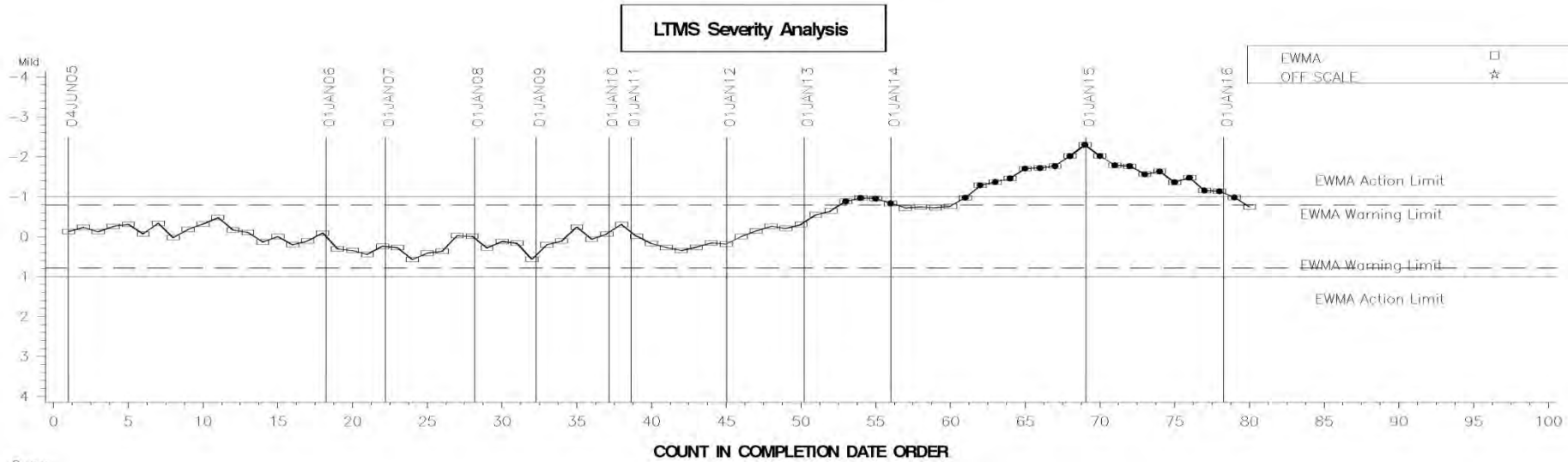
Standard Deviation Units



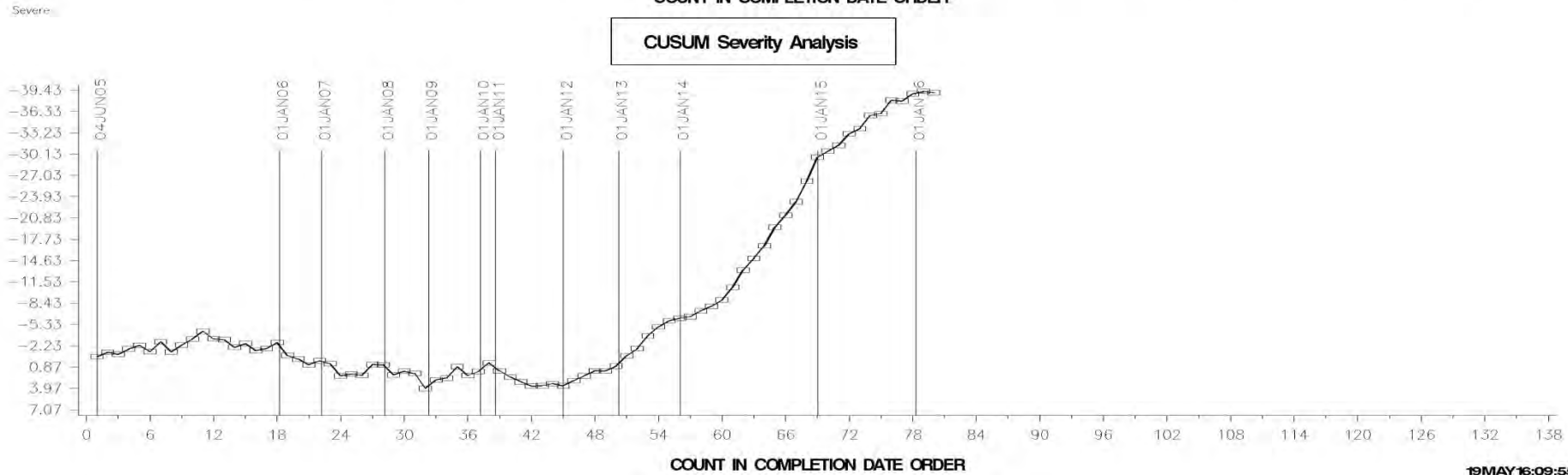
19MAY16:09:55

AVERAGE TAPPET WEIGHT LOSS

Standard Deviation Units

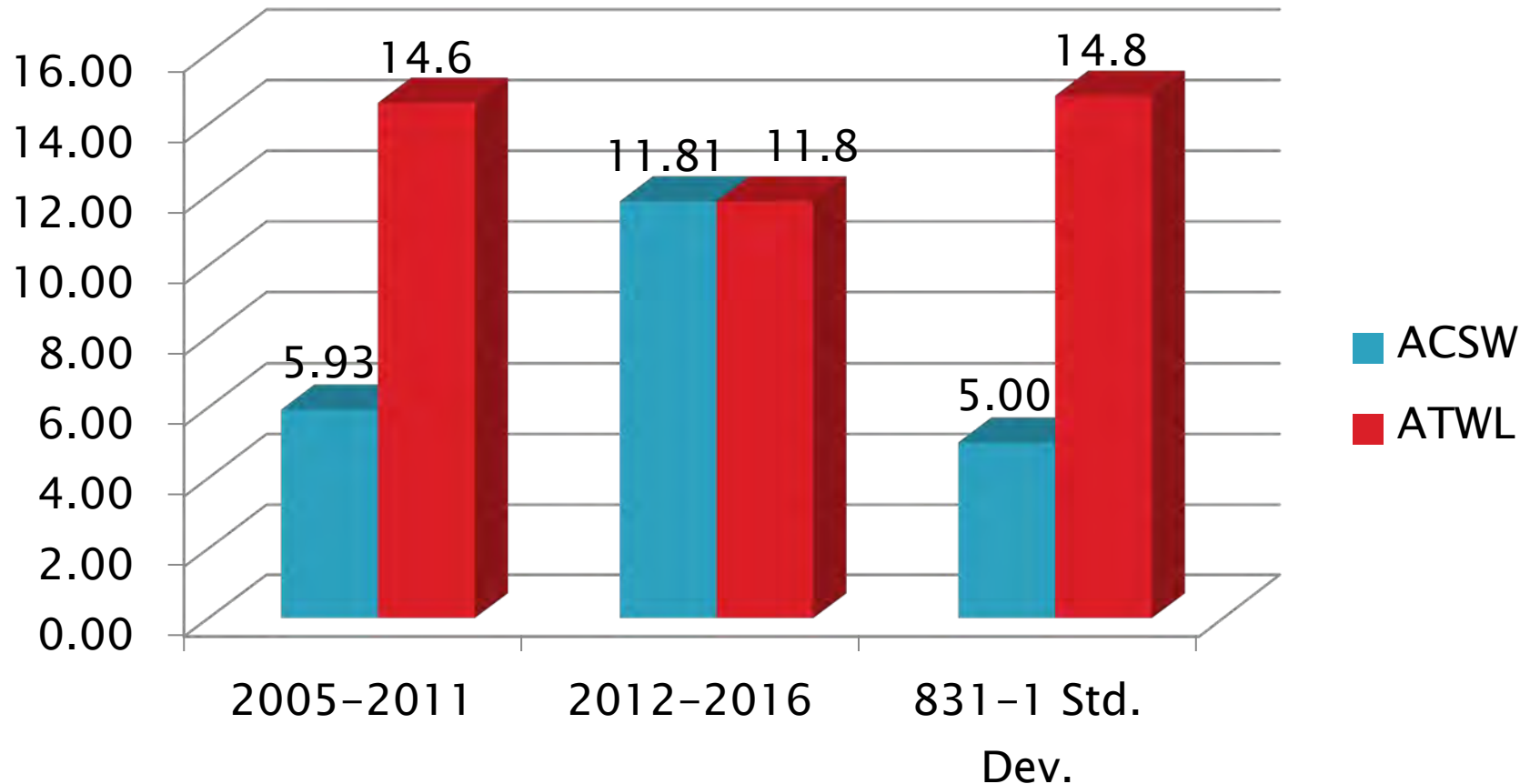


Standard Deviation Units



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ISB Precision Estimates



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Cummins ISM

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ISM Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	4
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		4

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	No Aborted Tests	0
Total		0

*Invalid and aborted tests

Test Monitoring Center

<http://astmtmc.cmu.edu>



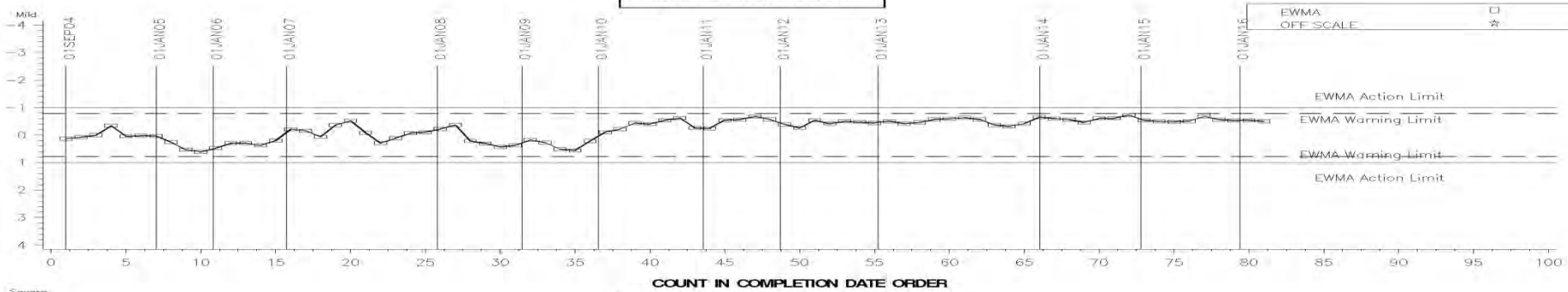
A Program of ASTM International

ISM Test Severity

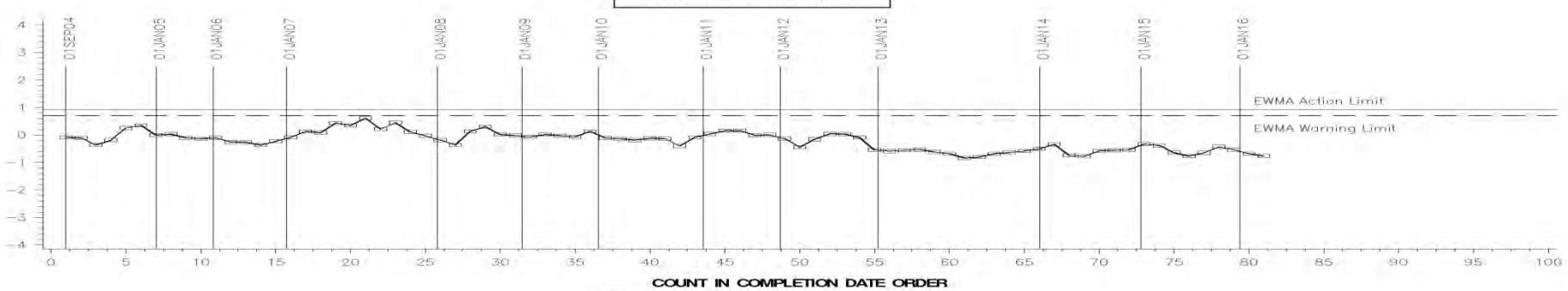
- ▶ ASR near precision warning alarm.
- ▶ CWL, FPD and IAS in control.
 - CWL trending mild and near warning alarm.
 - FPD trending mild and near warning alarm.

CROSSHEAD WEIGHT LOSS ADJUSTED TO 3.9 % SOOT

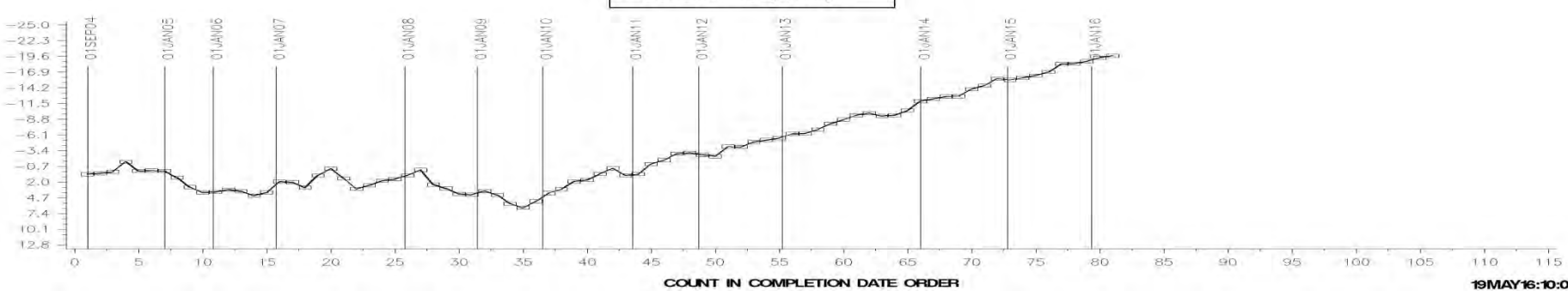
LTMS Severity Analysis



LTMS Precision Analysis



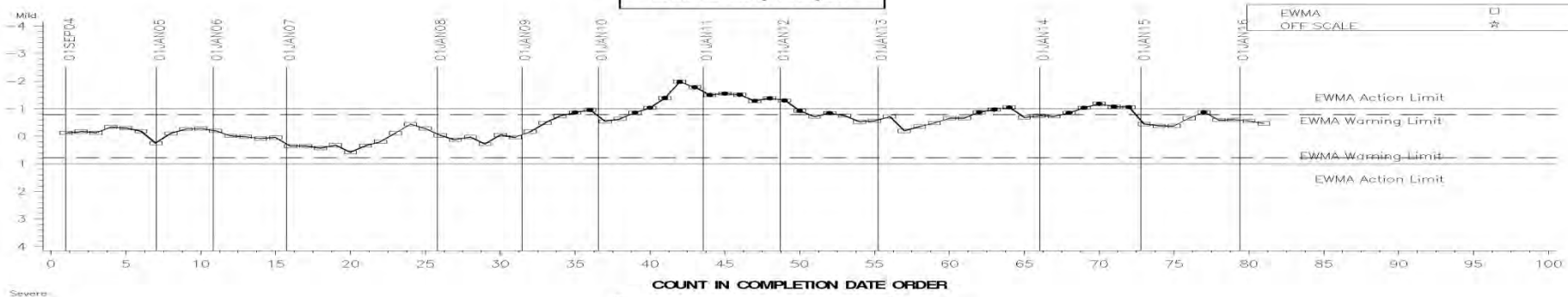
CUSUM Severity Analysis



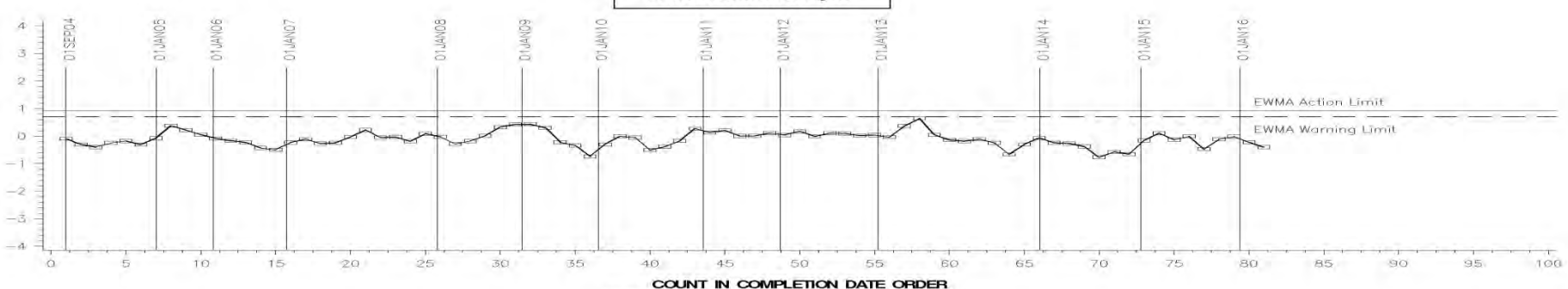
19MAY16:10:01

FILTER PLUGGING DELTA P

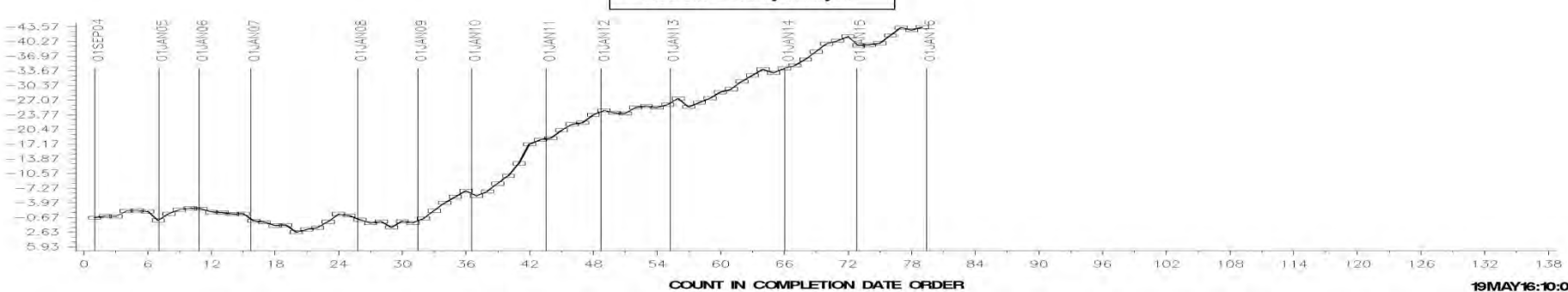
LTMS Severity Analysis



LTMS Precision Analysis



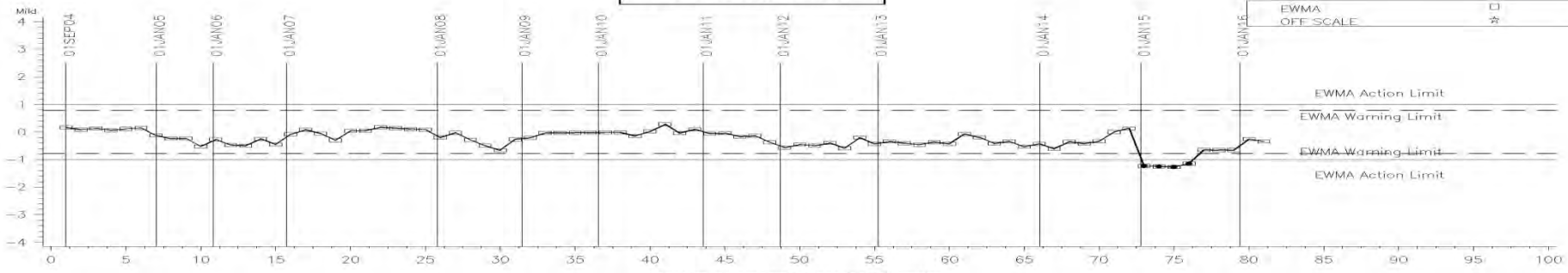
CUSUM Severity Analysis



19MAY16:10:01

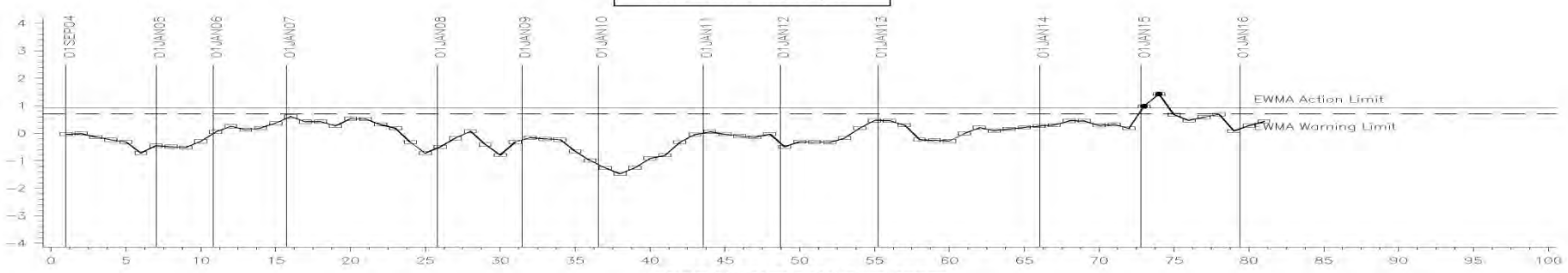
AVERAGE SLUDGE RATING

LTMS Severity Analysis



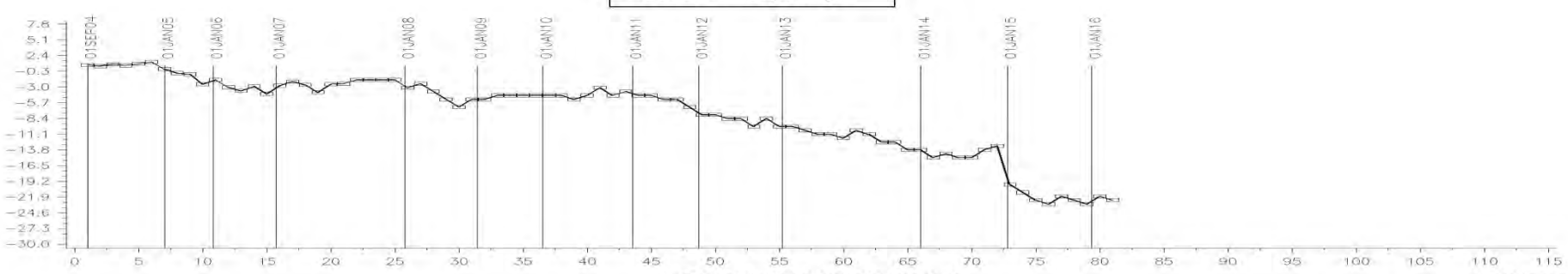
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

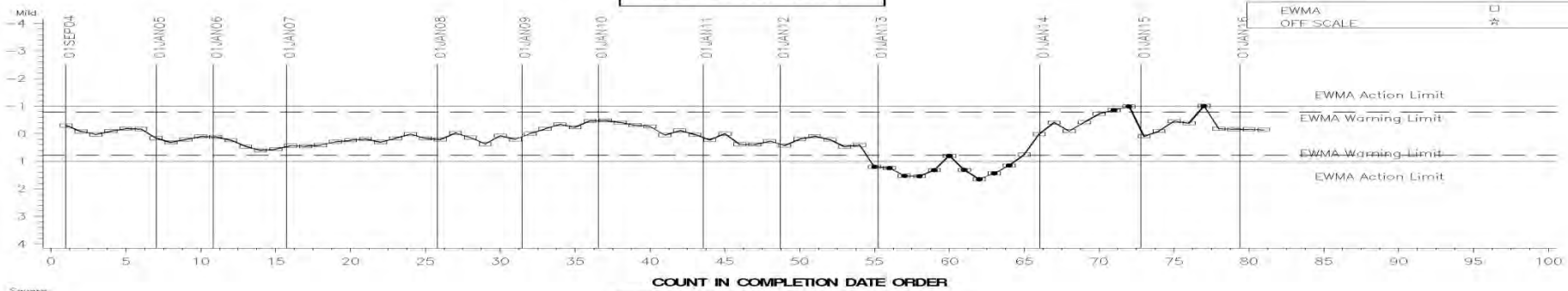


COUNT IN COMPLETION DATE ORDER

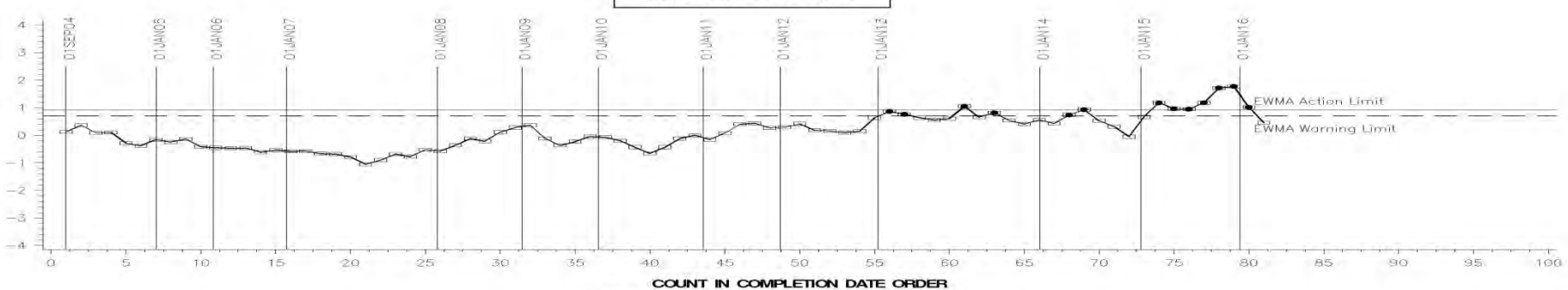
19MAY16:10:01

INJECTOR SCREW WEIGHT LOSS ADJUSTED TO 3.9% SOOT

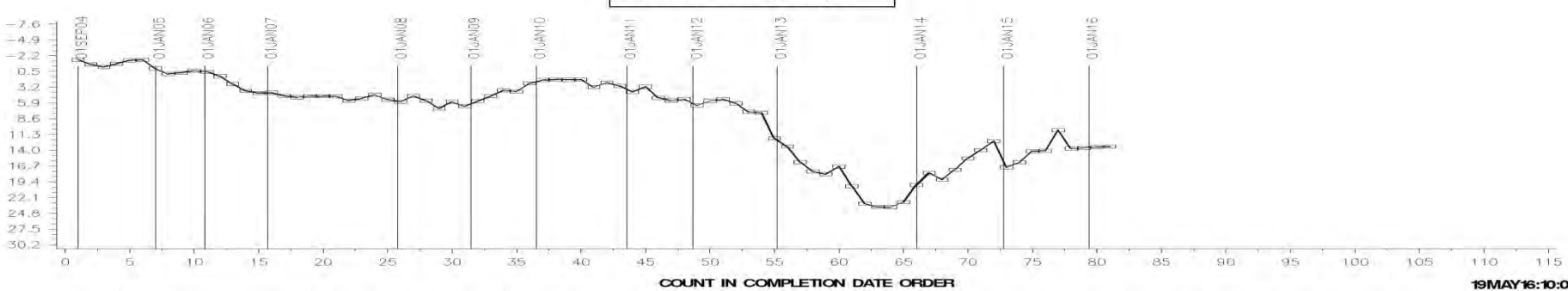
LTMS Severity Analysis



LTMS Precision Analysis

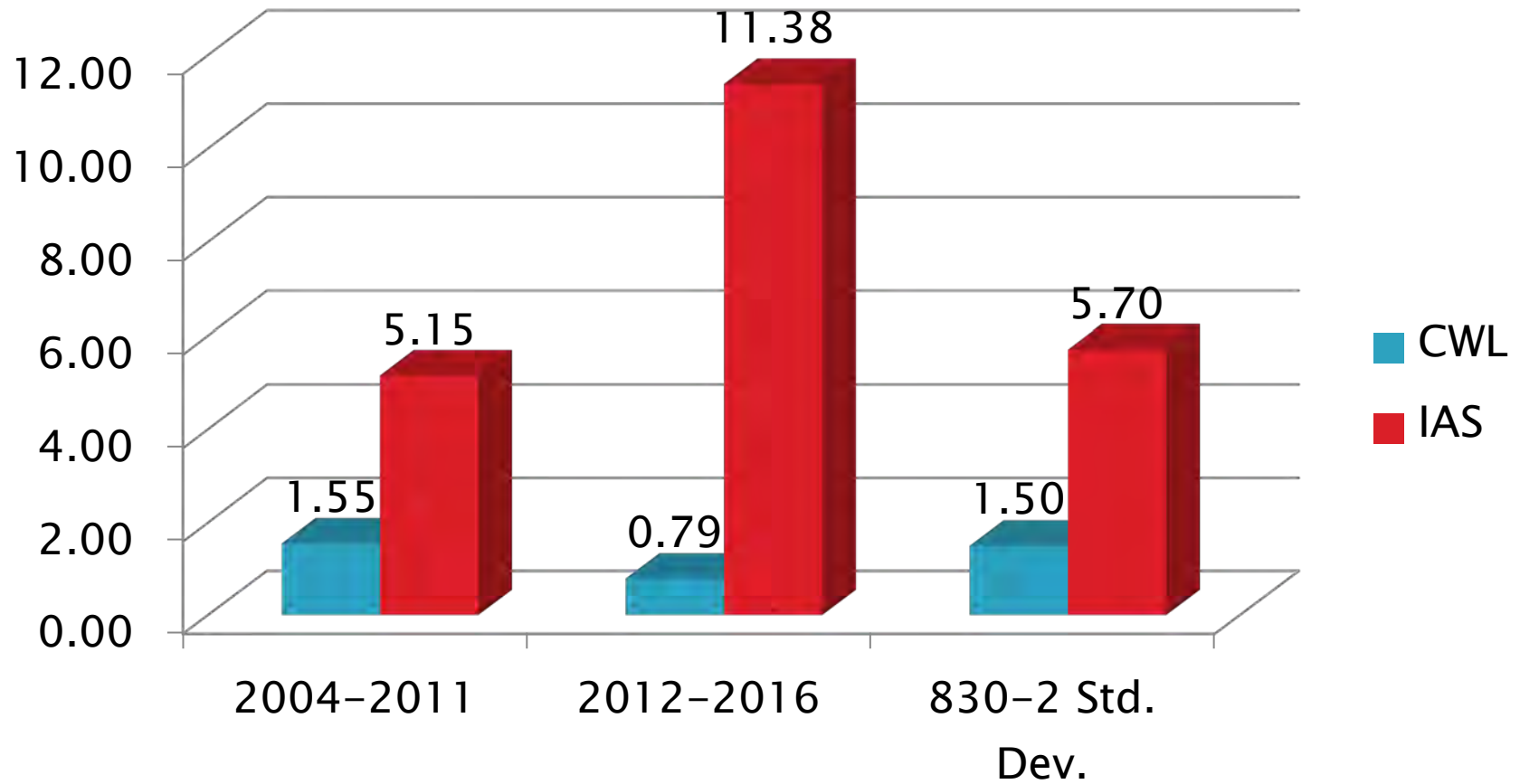


CUSUM Severity Analysis

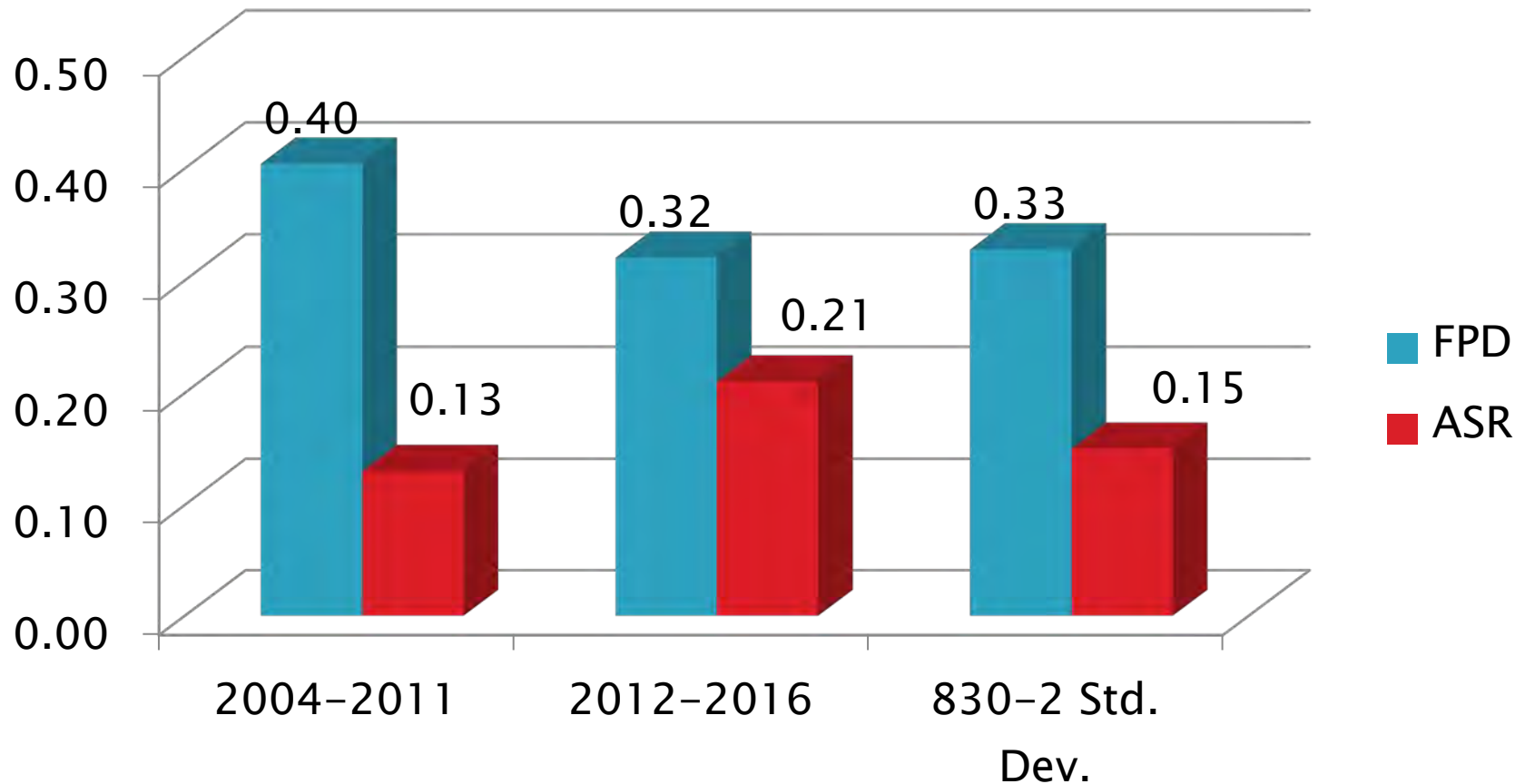


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ISM Precision Estimates



ISM Precision Estimates



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Test Monitoring Center

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EOAT

»» April 2016

Test Monitoring Center

<http://astmtmc.cmu.edu>



A Program of ASTM International

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

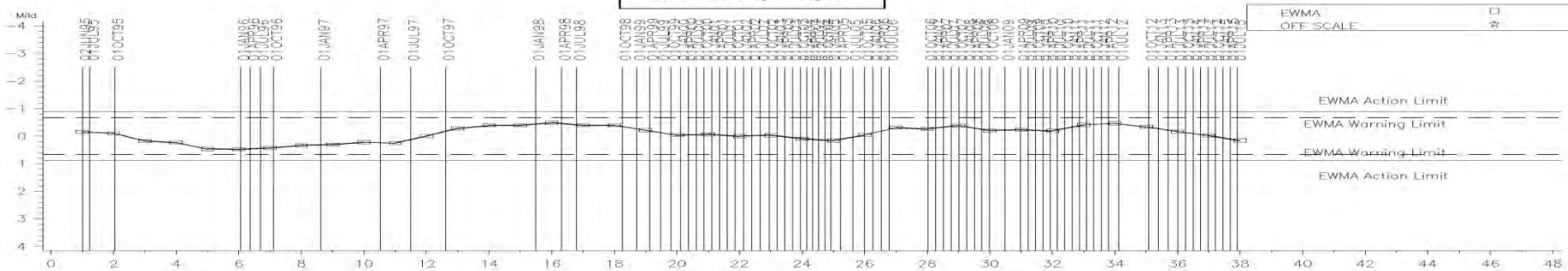
*Invalid and aborted tests

EOAT Test Severity

- ▶ As no EOAT tests were reported this period no statement about test severity or precision can be made.

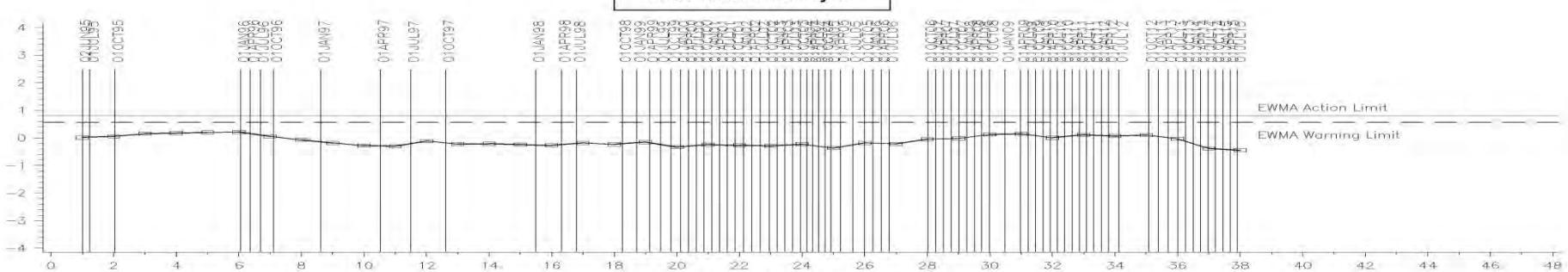
ENGINE OIL AERATION

LTMS Severity Analysis



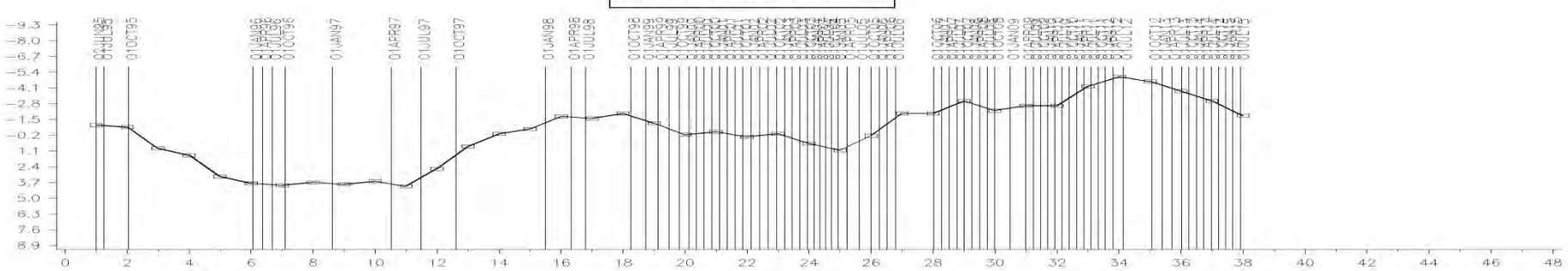
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

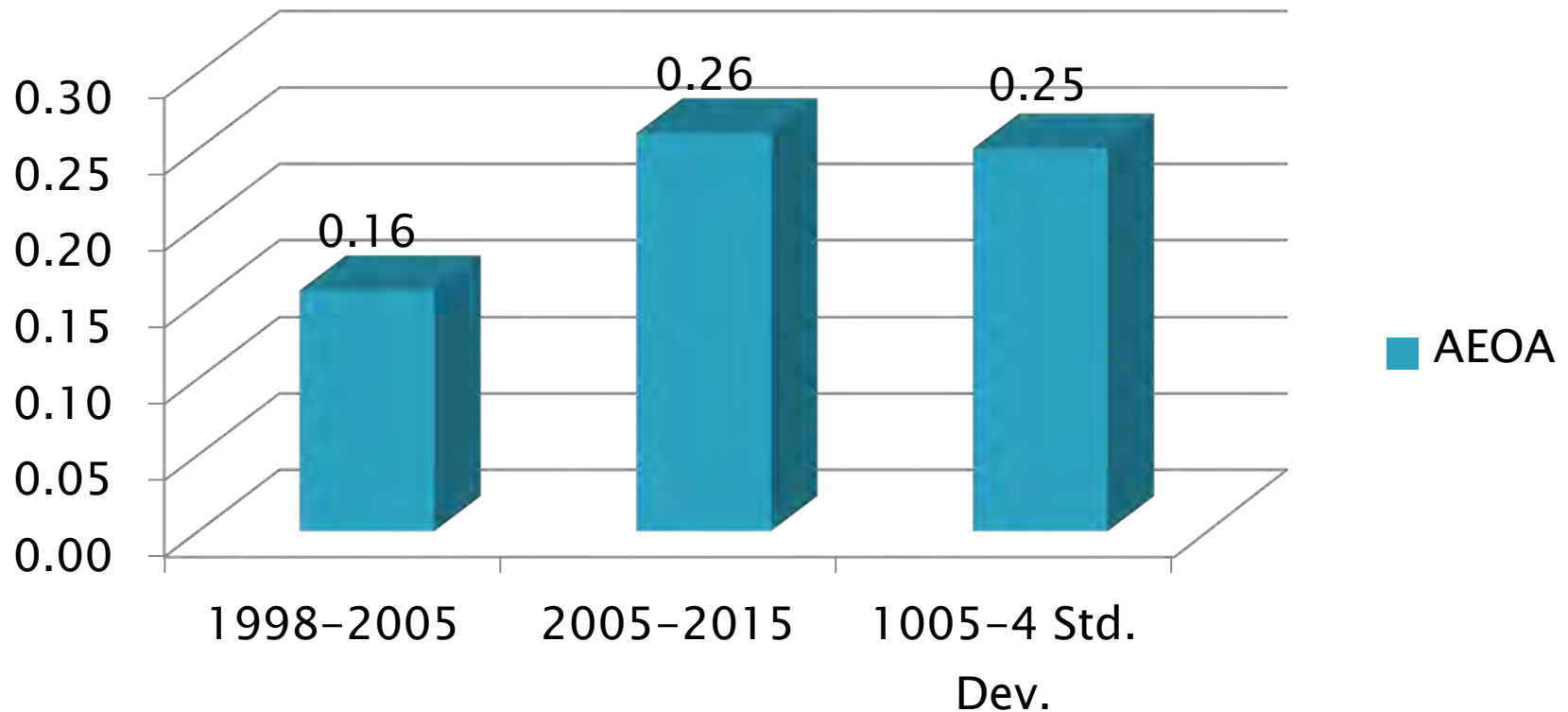


COUNT IN COMPLETION DATE ORDER

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EOAT Precision Estimates

AEOA



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Test Monitoring Center

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A Program of ASTM International

RFWT

»» April 2016

Test Monitoring Center

<http://astmtmc.cmu.edu>



A Program of ASTM International

RFWT Test Activity

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

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

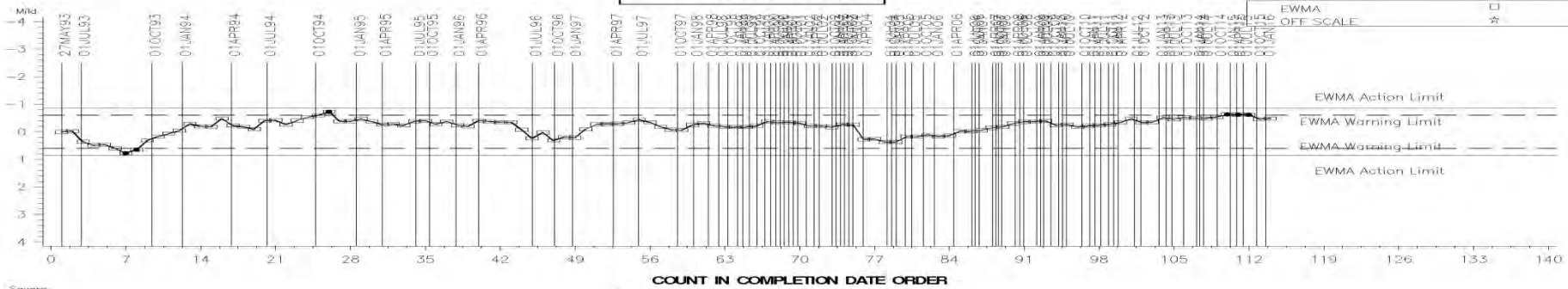
*Invalid and aborted tests

RFWT Test Severity

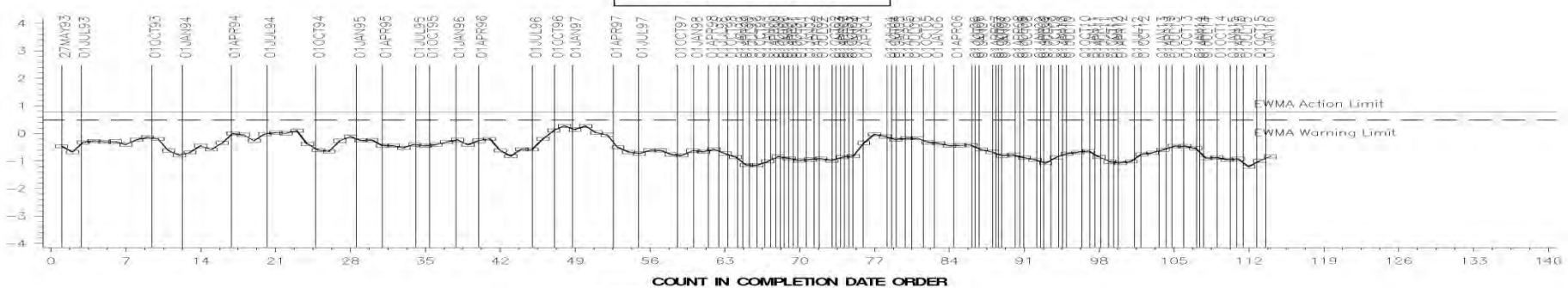
- ▶ AFW is in control but near severity warning alarm in mild direction.

Average Follower Wear

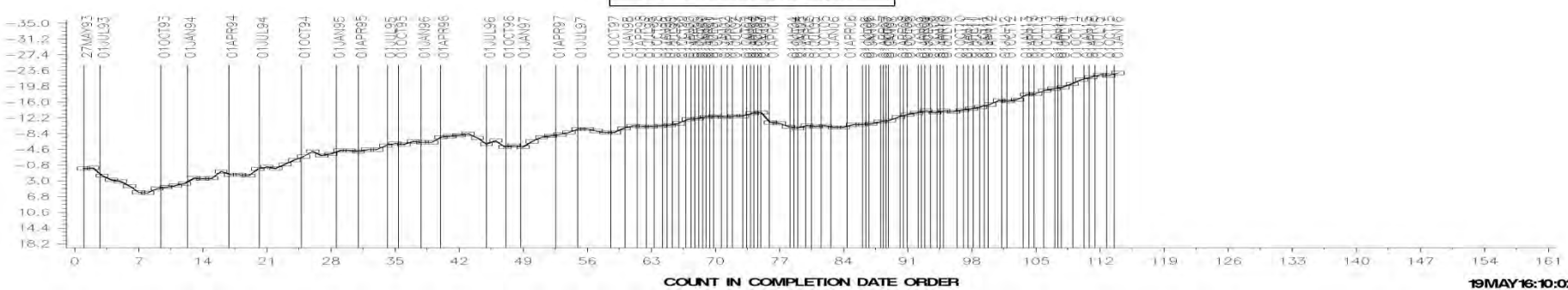
LTMS Severity Analysis



LTMS Precision Analysis



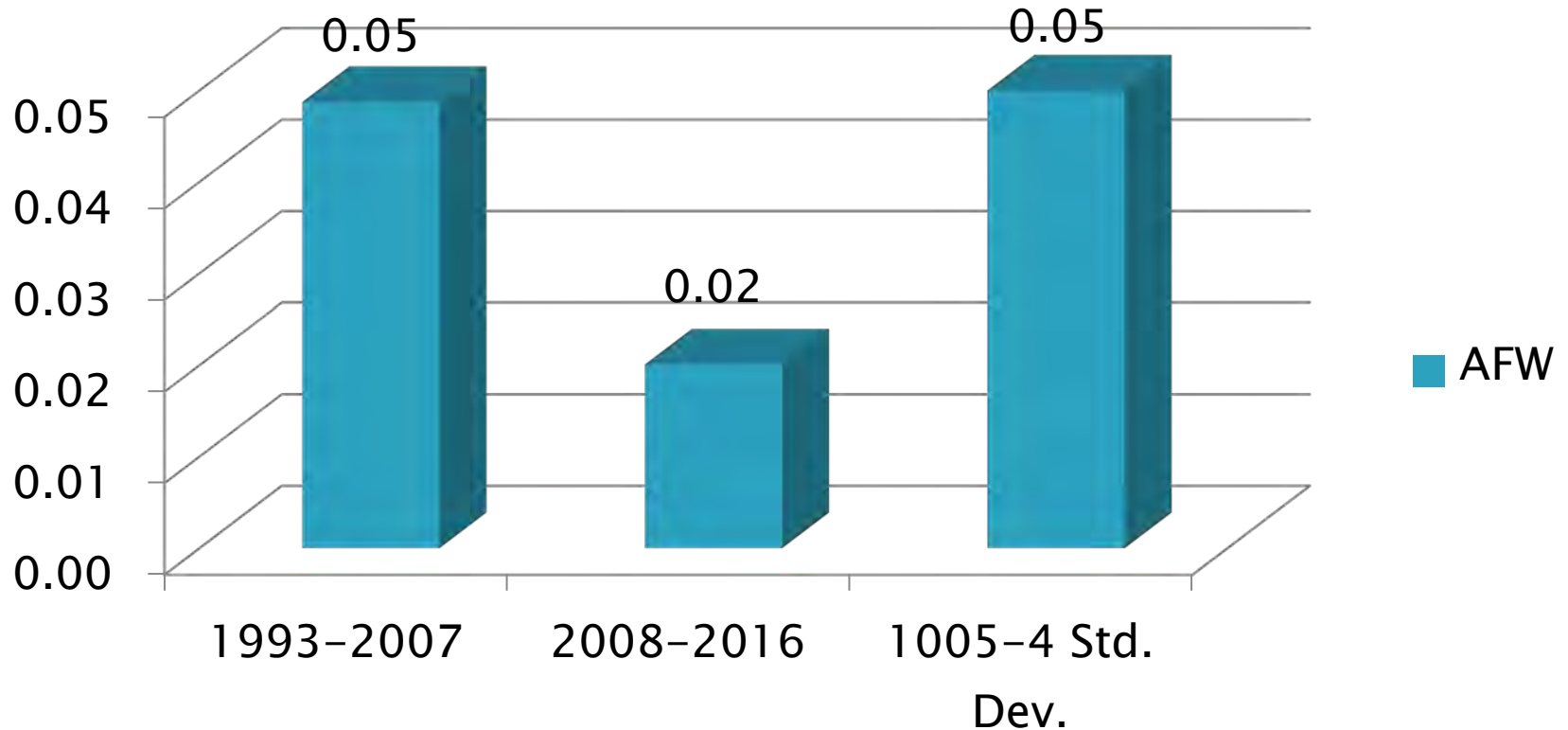
CUSUM Severity Analysis



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RFWT Precision Estimates

AFW



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Test Monitoring Center

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A Program of ASTM International

Mack T-8/T-8E

»» April 2016

Test Monitoring Center

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A Program of ASTM International

T-8/T-8E Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	1
Operationally Invalid	LC	1
Aborted	XC	1
Total		5

T-8/T8-E Failed Tests

Failed Parameter	Number of Tests
Severe RV48	1
Total	1

T-8/T8-E Lost Tests*

Status	Cause	#
Invalid	Missed soot window	1
Aborted	Injector Pump Failure	1
Total		2

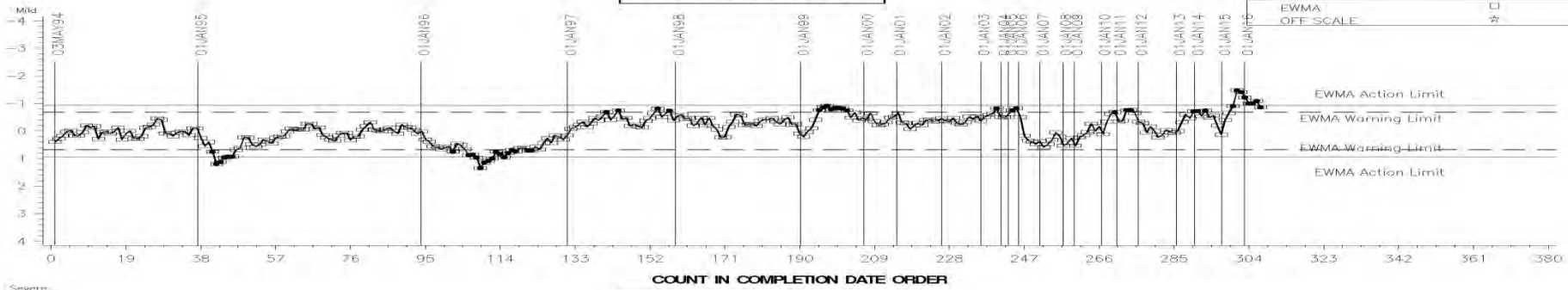
*Invalid and aborted tests

T-8/T-8E Test Severity

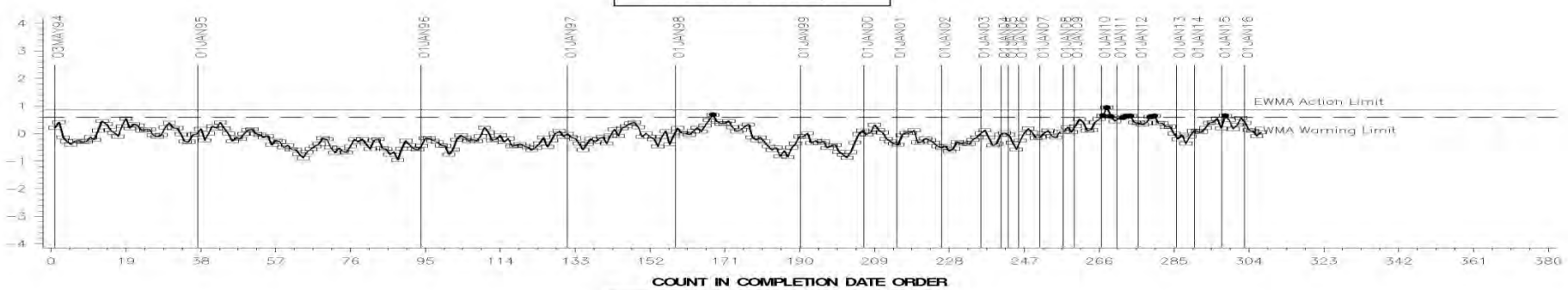
- ▶ VI38 is in severity warning alarm in mild direction.
- ▶ RV48 and RV2 in precision action alarm.

FINAL REFERENCE VISCOSITY AT 3.8% TGA SOOT LEVEL

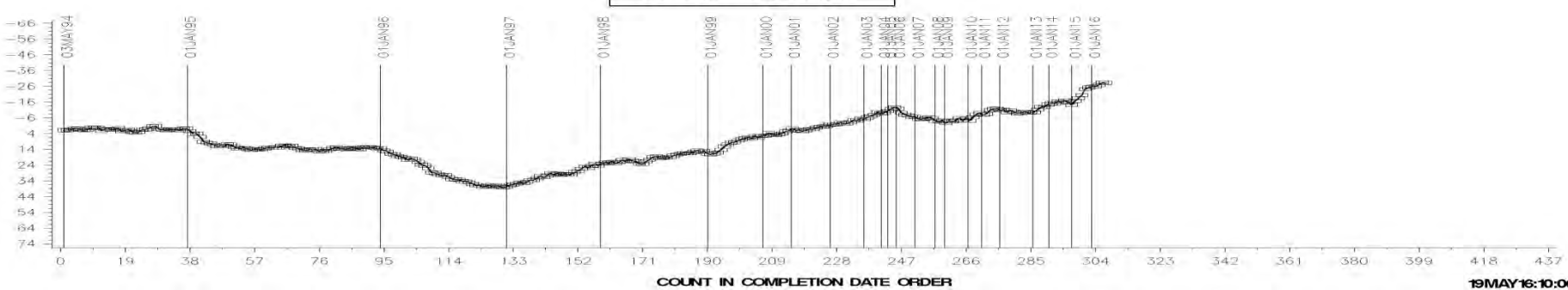
LTMS Severity Analysis



LTMS Precision Analysis



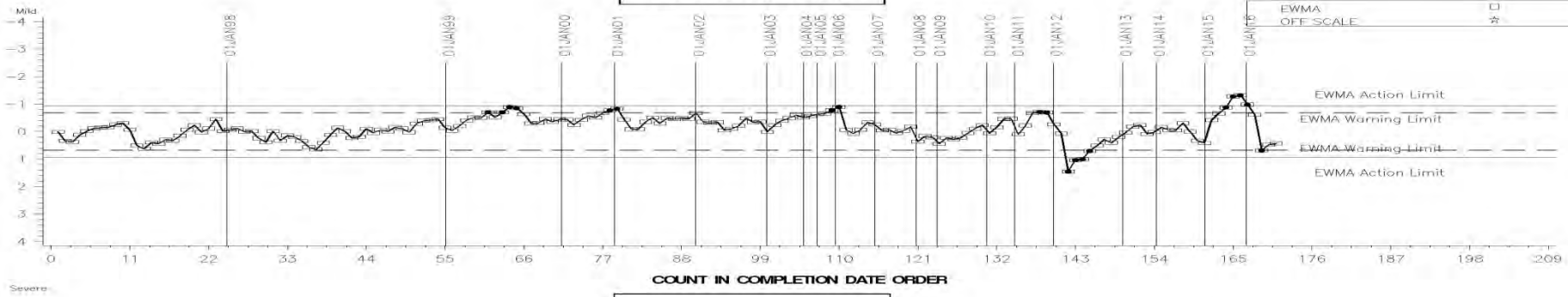
CUSUM Severity Analysis



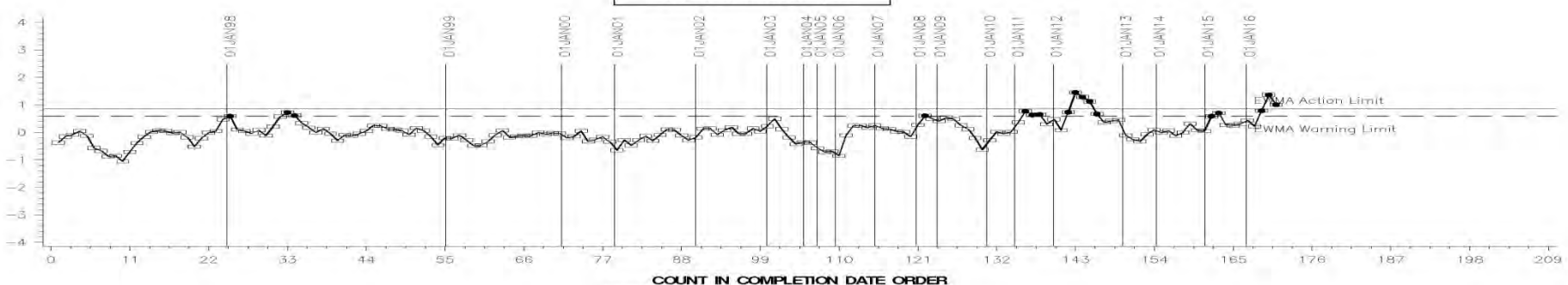
19MAY16:10:06

FINAL RELATIVE VISCOSITY (50% LOSS)

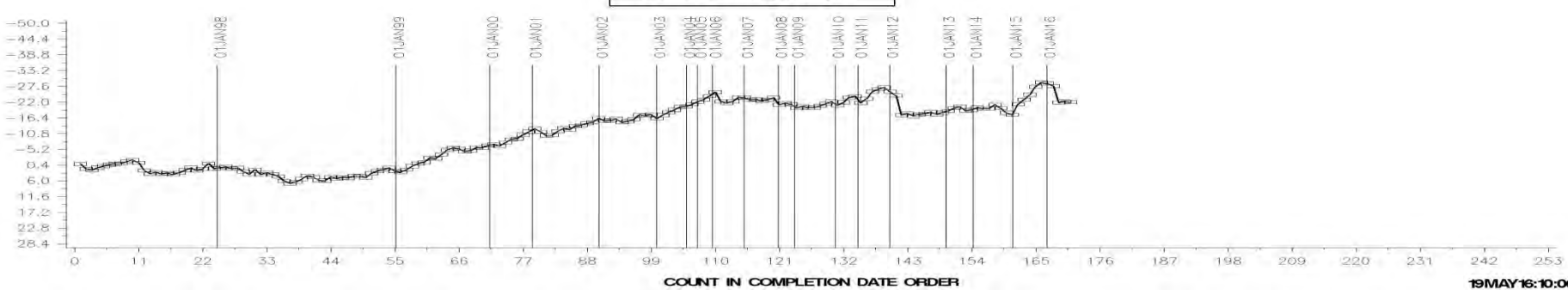
LTMS Severity Analysis



LTMS Precision Analysis



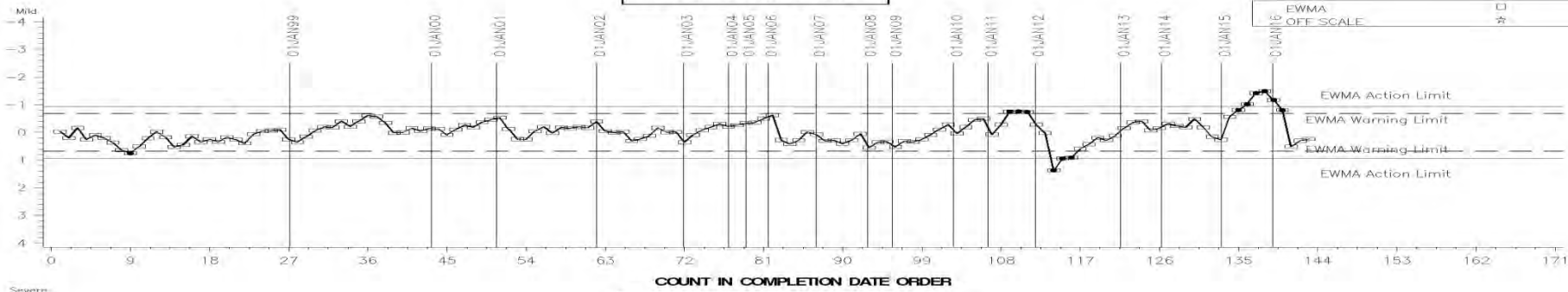
CUSUM Severity Analysis



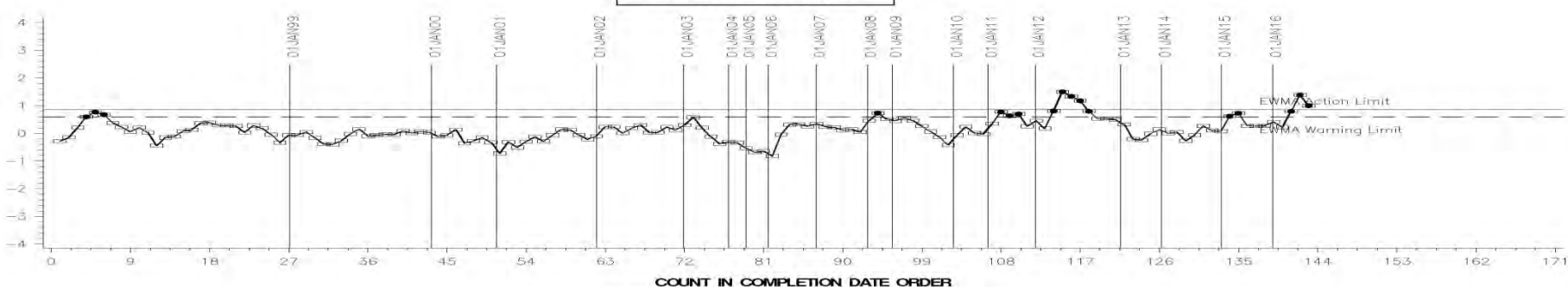
19MAY16:10:06

FINAL RELATIVE VISCOSITY (100% LOSS)

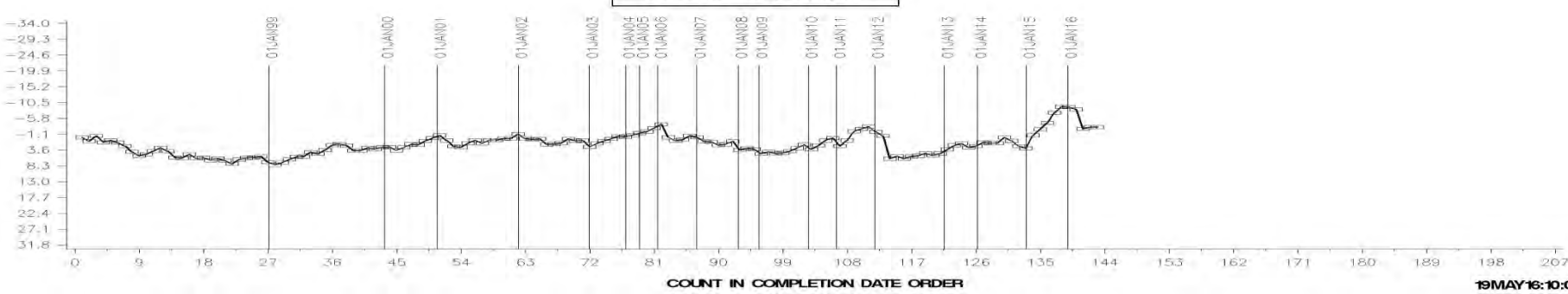
LTMS Severity Analysis



LTMS Precision Analysis

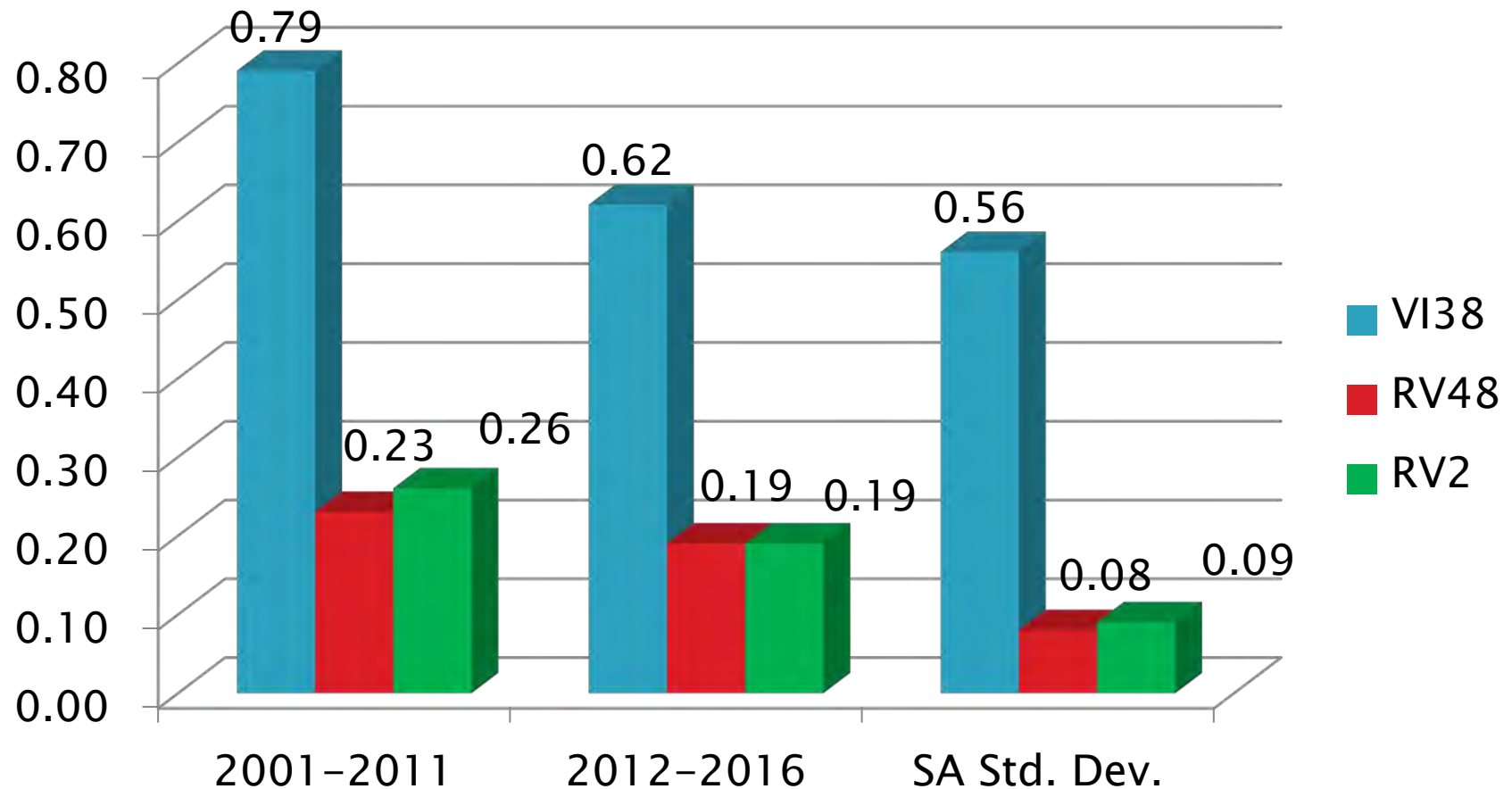


CUSUM Severity Analysis



19MAY16:10:06

T-8/E Precision Estimates



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Test Monitoring Center

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A Program of ASTM International

Mack T-11

»» April 2016

Test Monitoring Center

<http://astmtmc.cmu.edu>



A Program of ASTM International

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
Total		5

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
Total		0

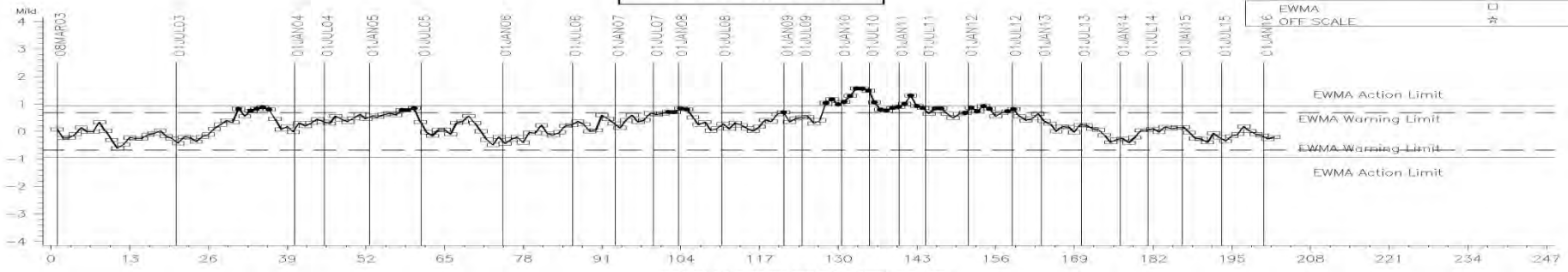
*Invalid and aborted tests

T-11 Test Severity

- ▶ SOOT and SOOT5 in control.
- ▶ SOOT4 in severity action alarm in mild direction.
- ▶ MRV in precision warning alarm.

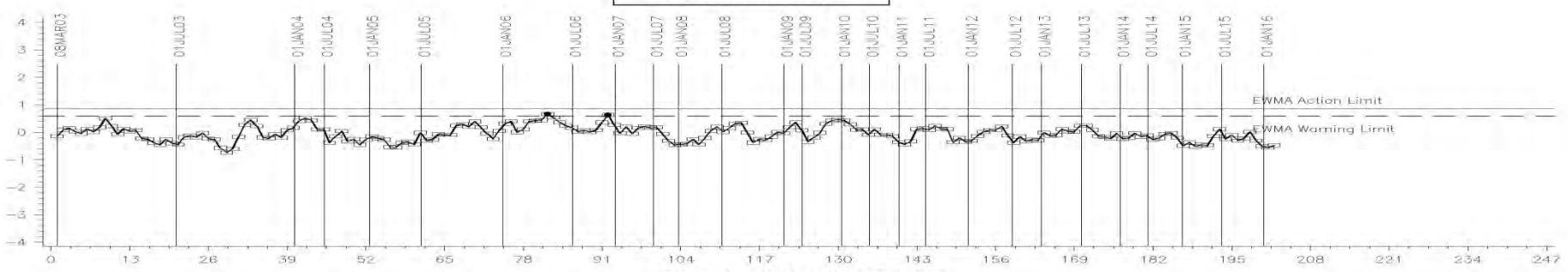
SOOT AT 12 cSt

LTMS Severity Analysis



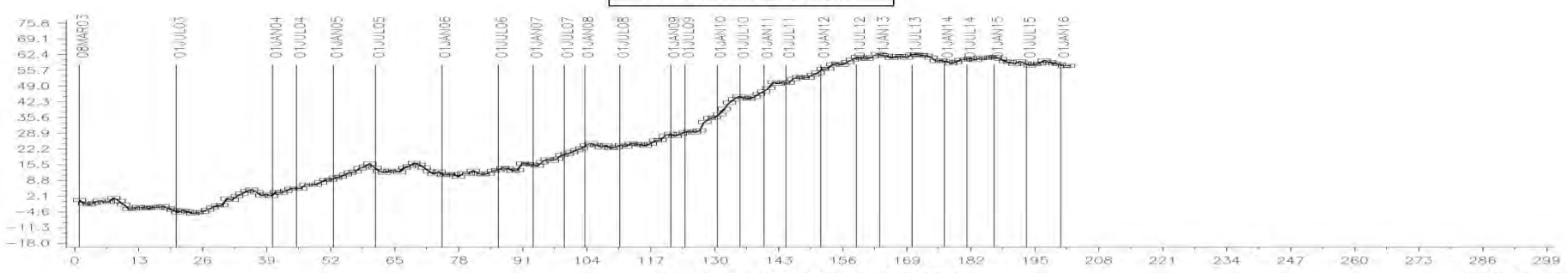
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

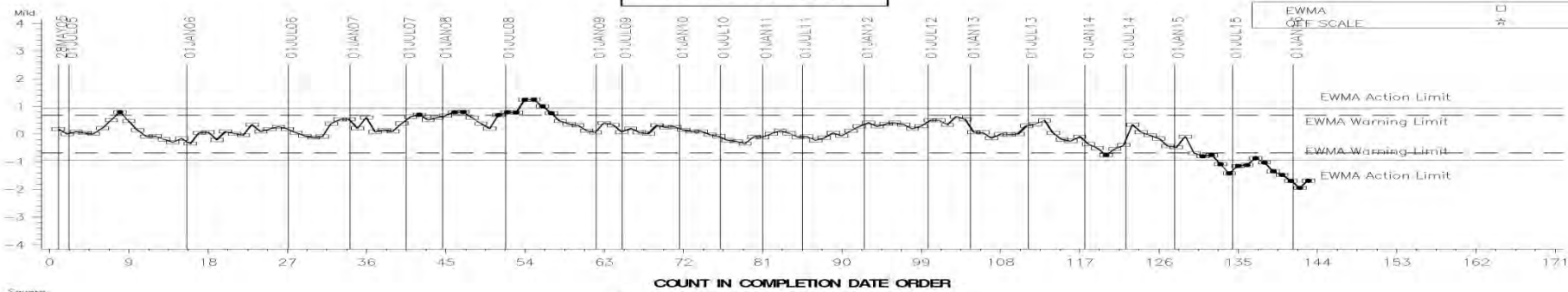


COUNT IN COMPLETION DATE ORDER

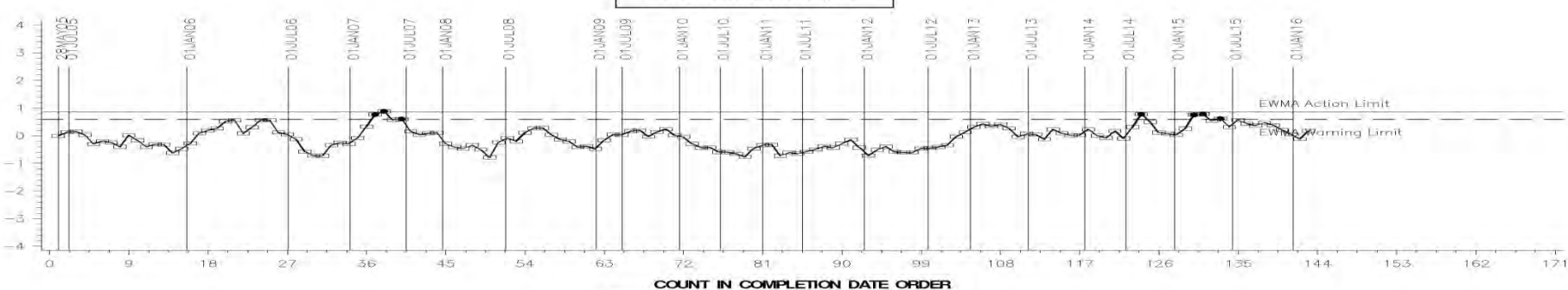
19MAY16:10:07

SOOT @ 4 cSt - FINAL RESULT

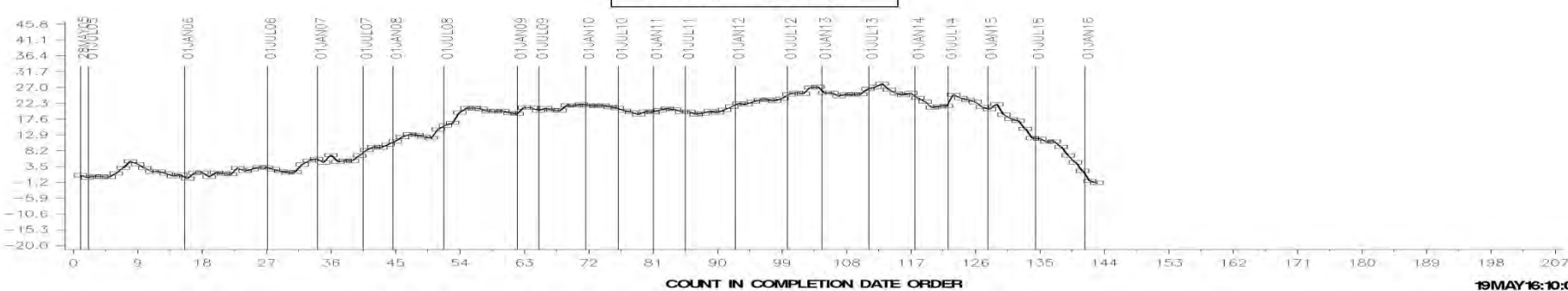
LTMS Severity Analysis



LTMS Precision Analysis



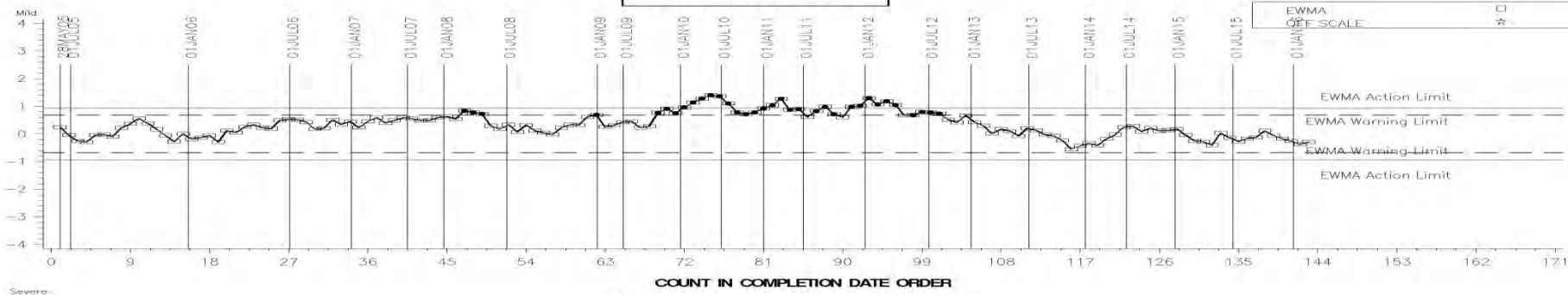
CUSUM Severity Analysis



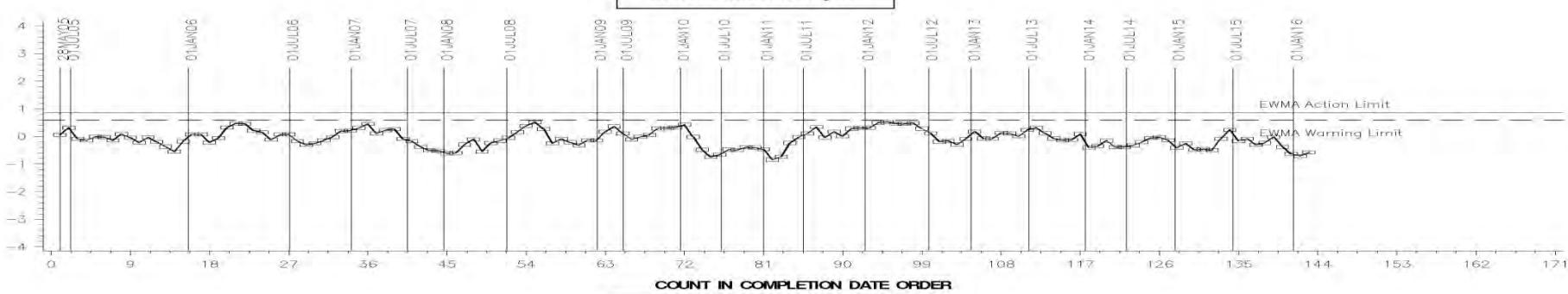
19MAY16:10:08

SOOT @ 15 cSt - FINAL RESULT

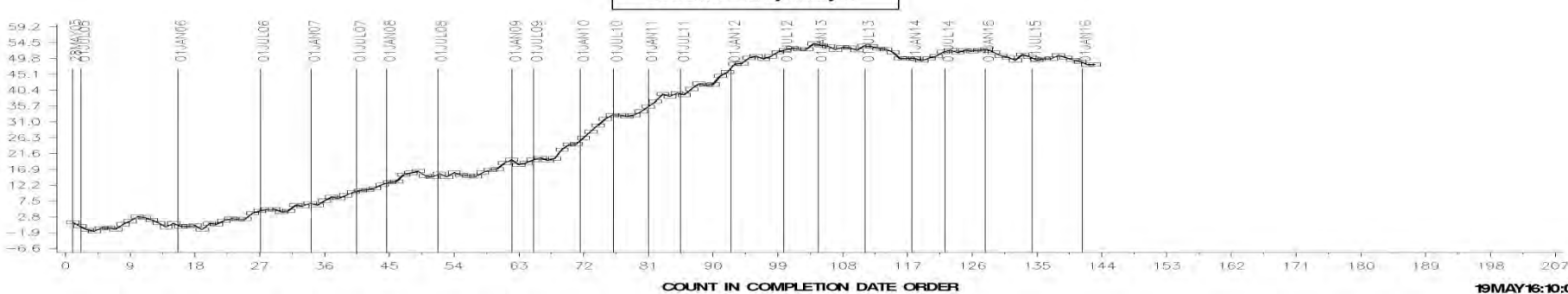
LTMS Severity Analysis



LTMS Precision Analysis



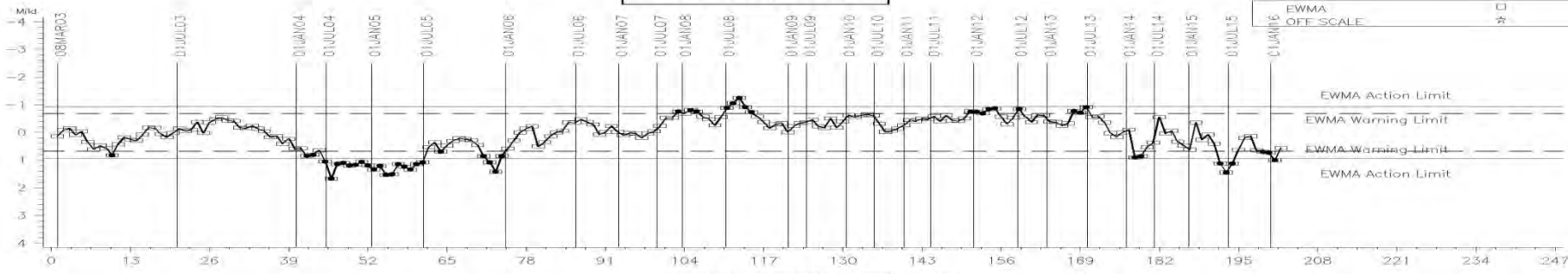
CUSUM Severity Analysis



19MAY16:10:08

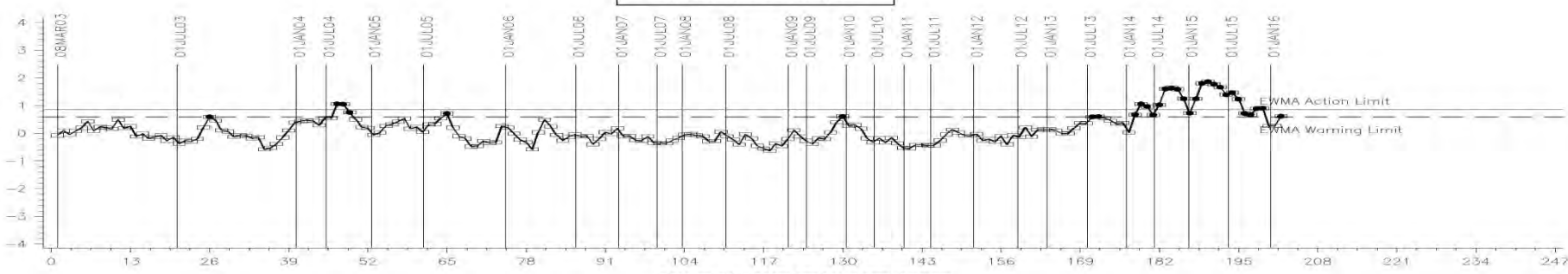
MRV VISCOSITY

LTMS Severity Analysis



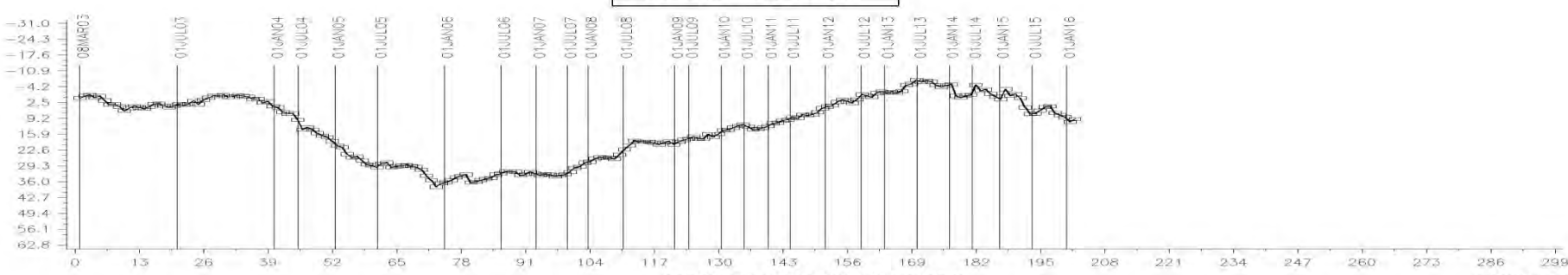
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

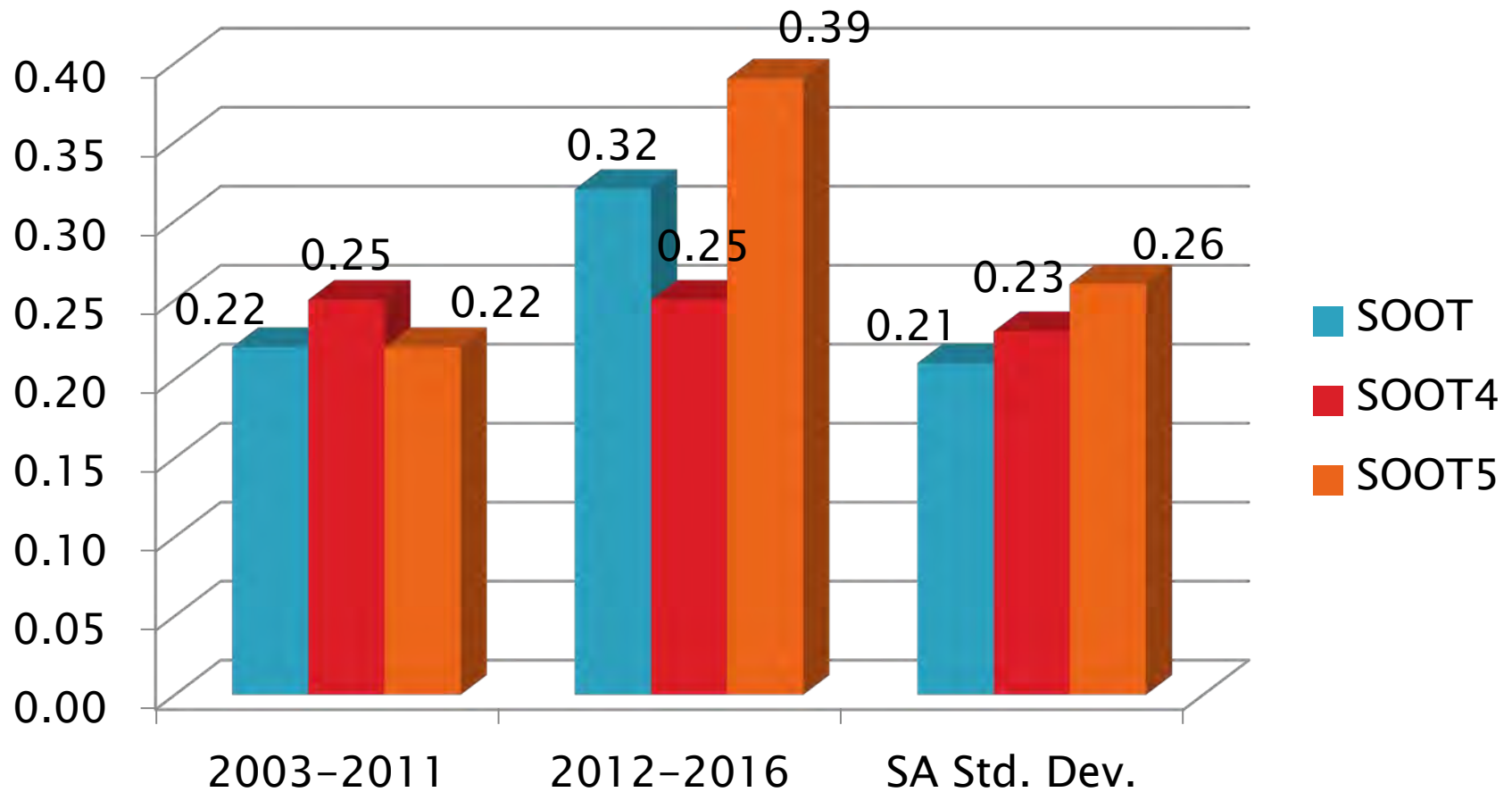
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

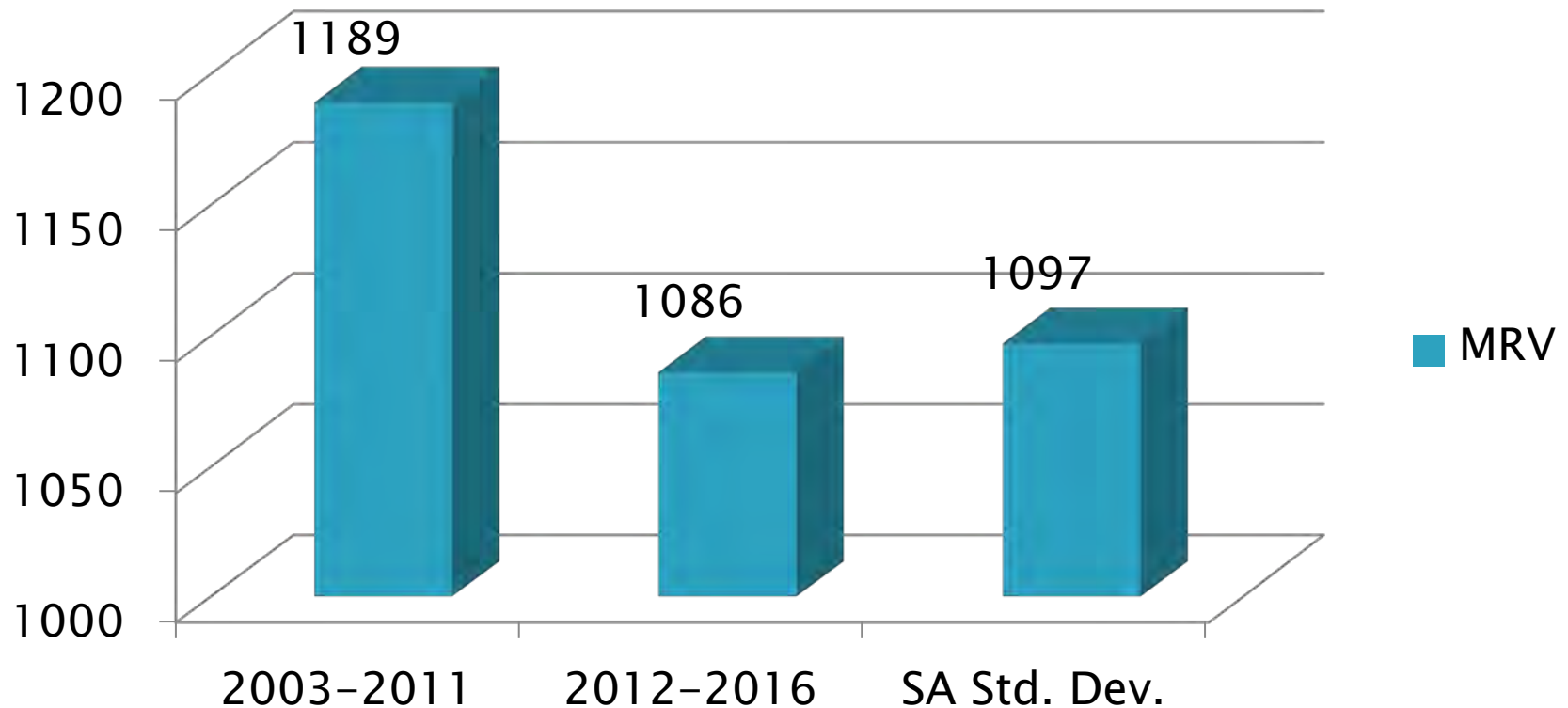
19MAY16:10:07

T-11 Precision Estimates



T-11 Precision Estimates

MRV



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Mack T-12

»» April 2016

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T-12 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Failed Calibration Test	OC/MC	3
Operationally Invalid	LC	0
Aborted	XC	2
Total		11

T-12 Failed Tests

Failed Parameter	Number of Tests
Severe CLW, PB and PB2	1
Severe PB and PB2	1
Mild PB and PB2	1
Total	3

T-12 Lost Tests*

Status	Cause	#
Aborted	Rod bearing failure during breakin	1
Aborted	Rod failure during breaking	1
Total		2

*Invalid and aborted tests

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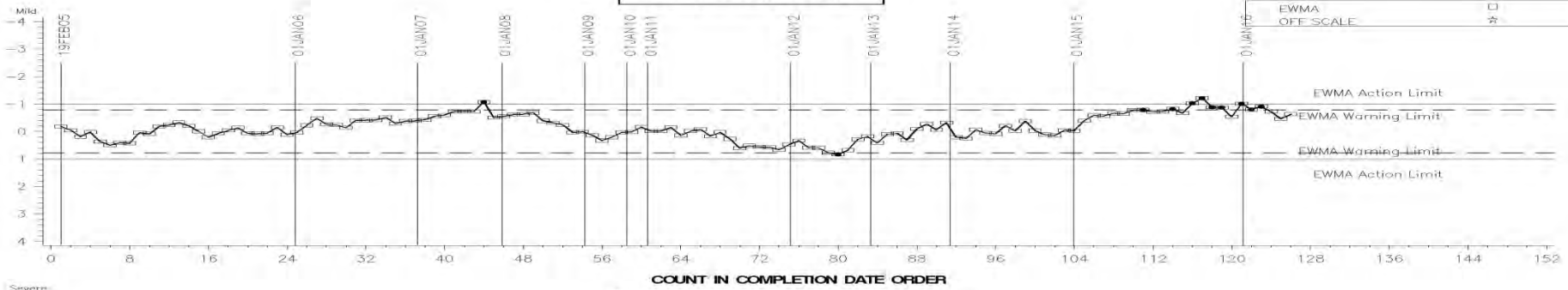
A Program of ASTM International

T-12 Test Severity

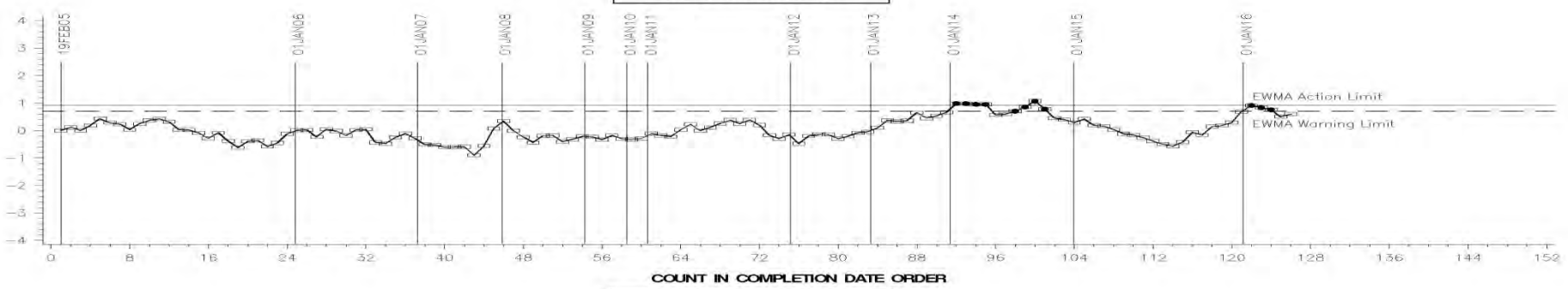
- ▶ PB, CLW, TRWL and OC parameters are in control.
- ▶ PB2 in severity warning alarm in mild direction. Also in precision action alarm.

FINAL TRANS. RES. DELTA PB @ EOT

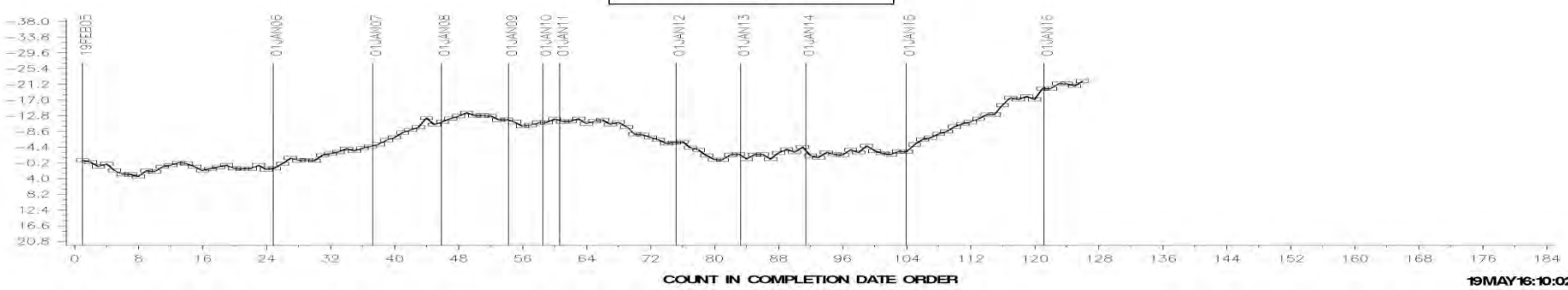
LTMS Severity Analysis



LTMS Precision Analysis



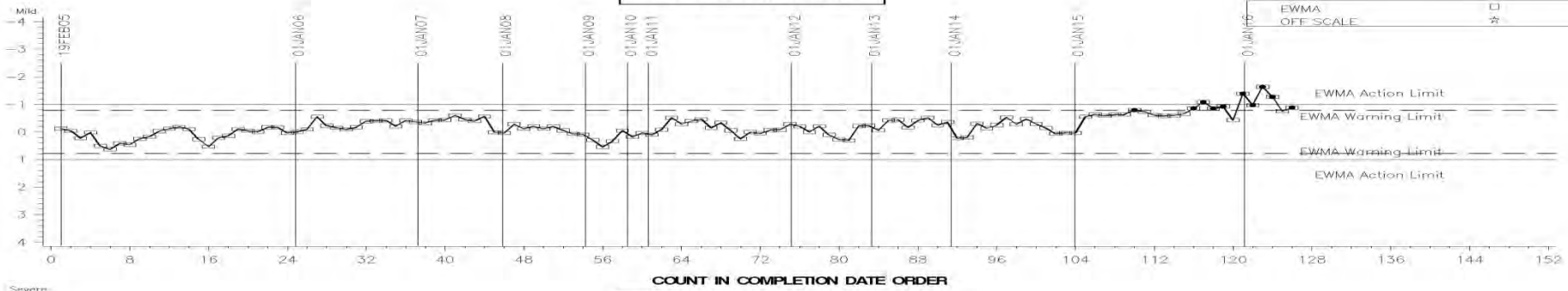
CUSUM Severity Analysis



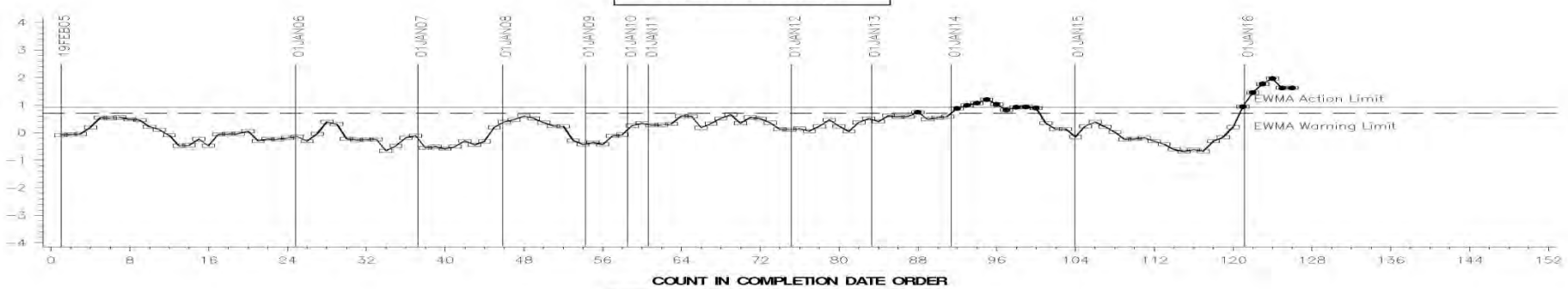
19MAY16:10:02

FINAL TRANS. RES. DELTA PB 250-300H

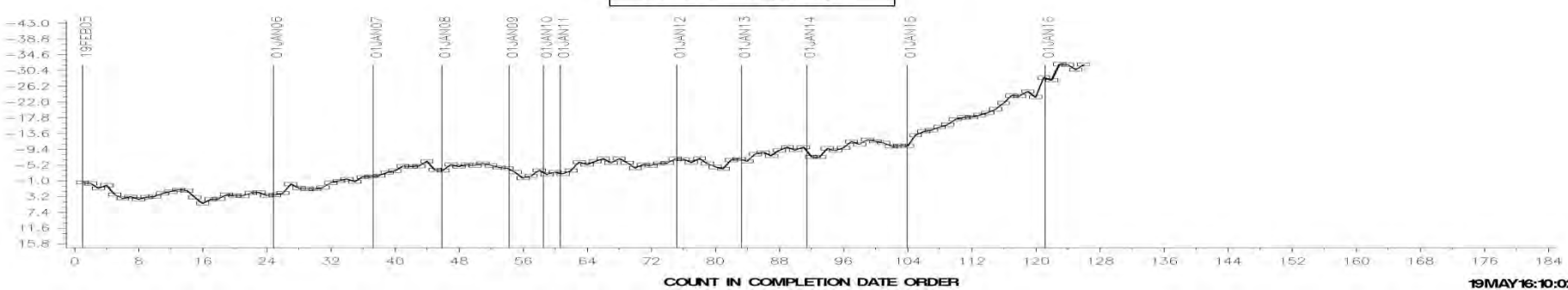
LTMS Severity Analysis



LTMS Precision Analysis



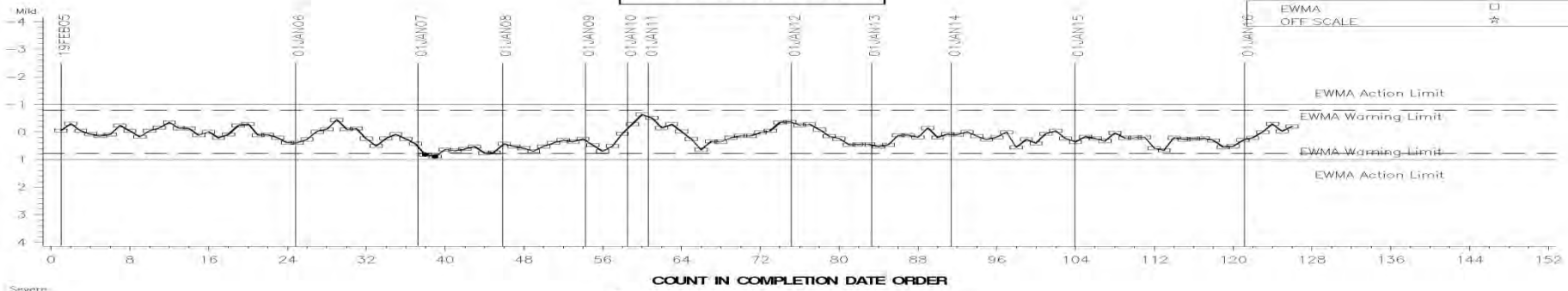
CUSUM Severity Analysis



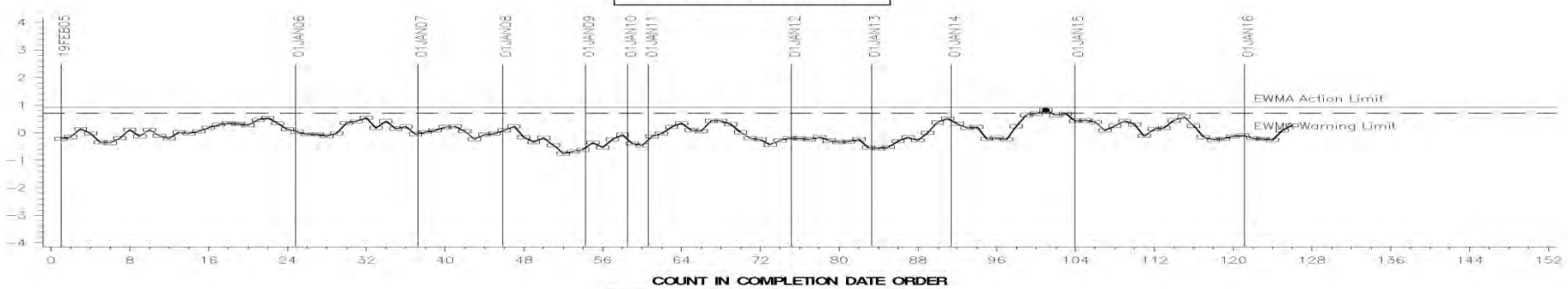
19MAY16:10:02

AVG. CYLINDER LINER WEAR (CLW)

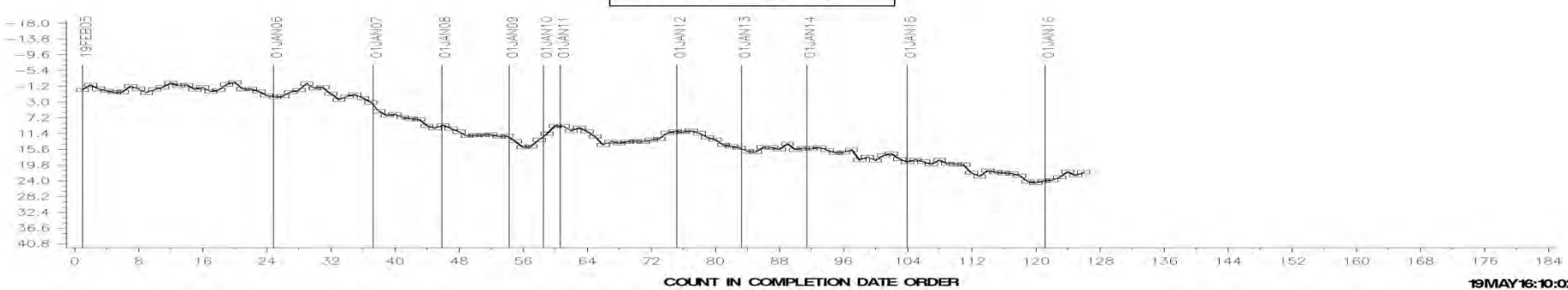
LTMS Severity Analysis



LTMS Precision Analysis



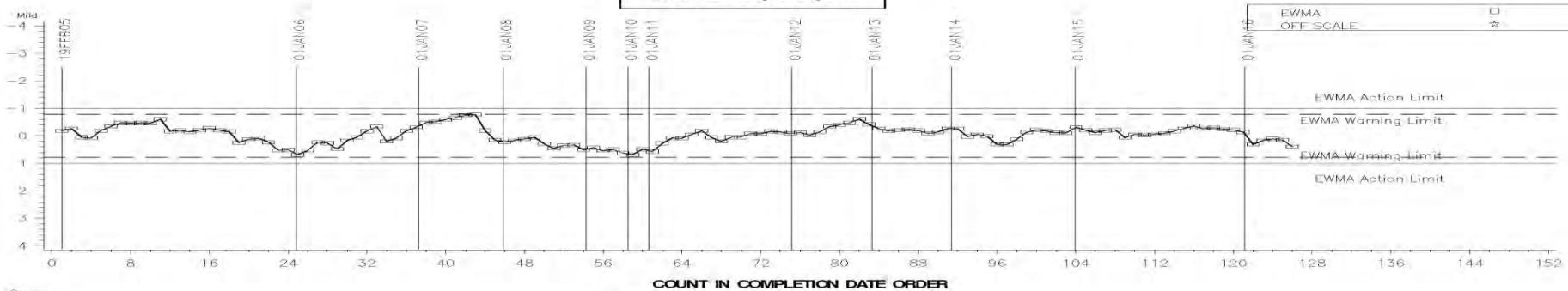
CUSUM Severity Analysis



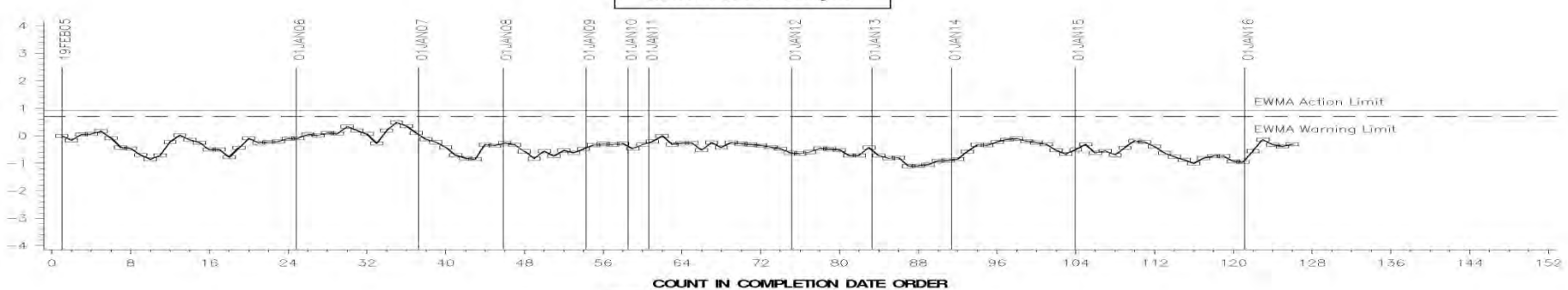
19MAY16:10:02

AVG. TOP RING WEIGHT LOSS (TRWL)

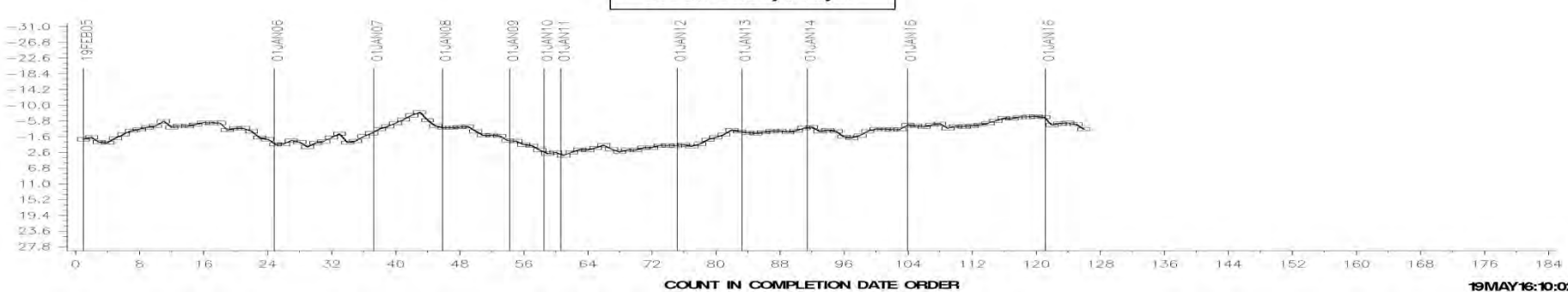
LTMS Severity Analysis



LTMS Precision Analysis



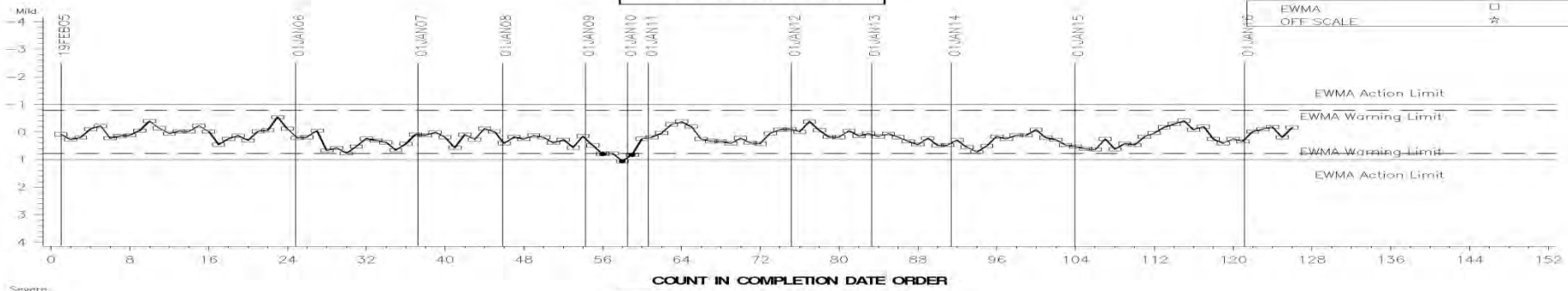
CUSUM Severity Analysis



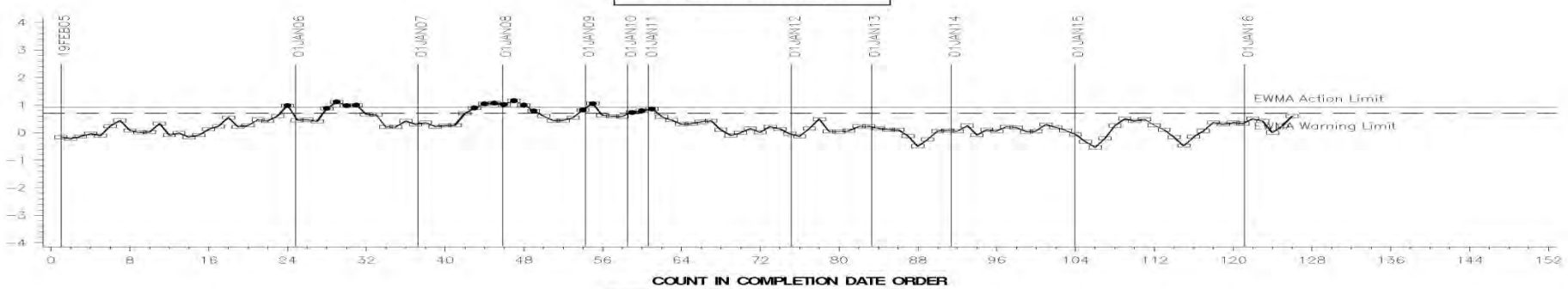
19MAY16:10:02

FINAL TRANS. RES. OIL CONSUMPTION

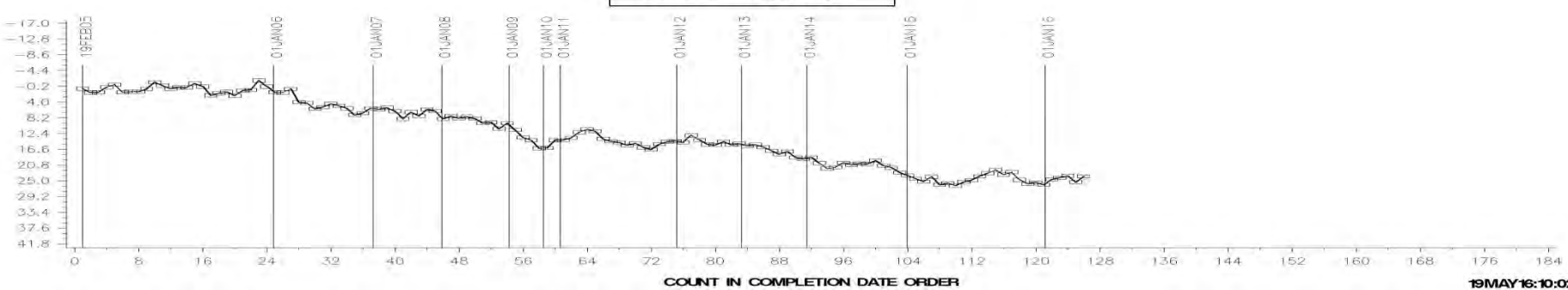
LTMS Severity Analysis



LTMS Precision Analysis

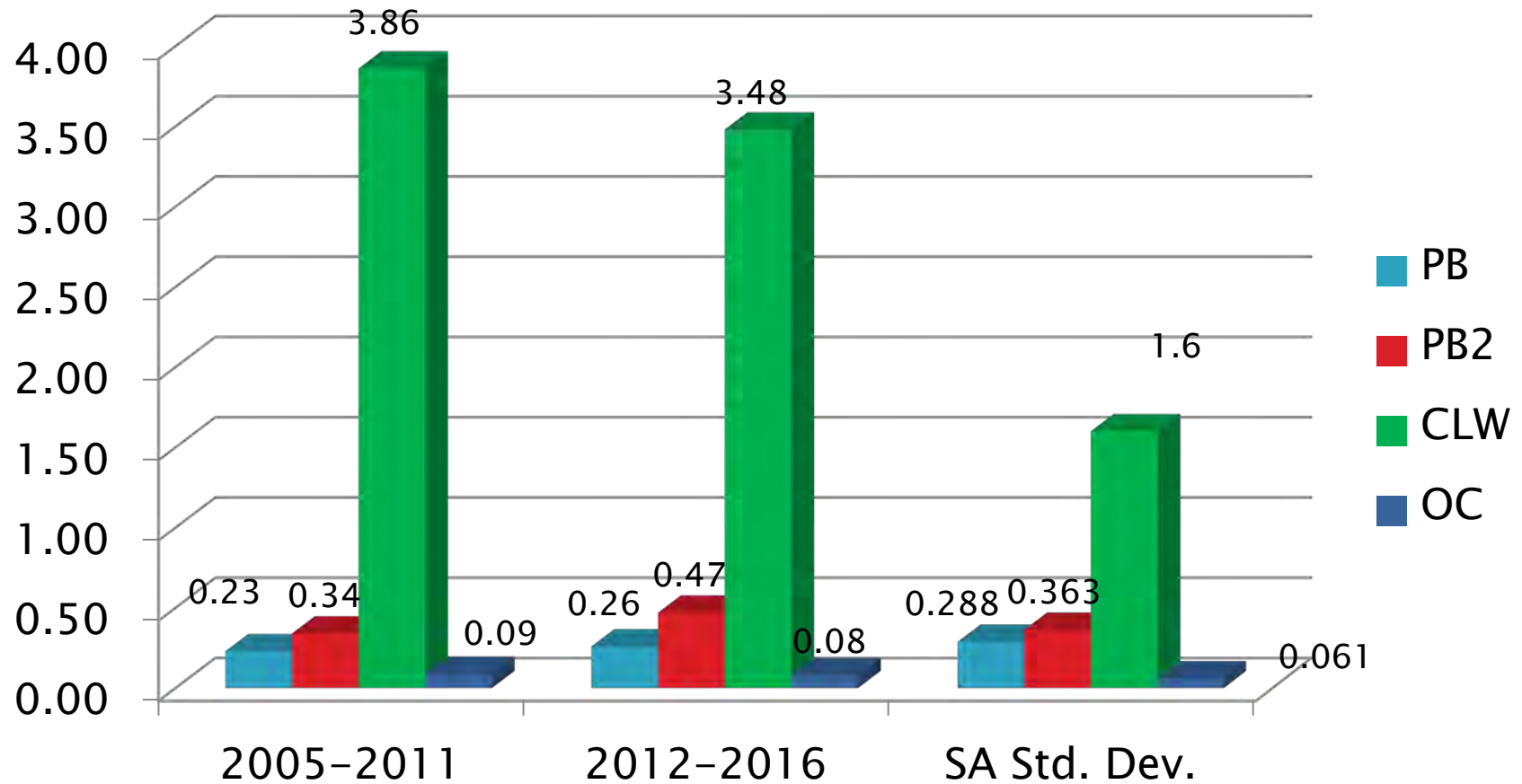


CUSUM Severity Analysis



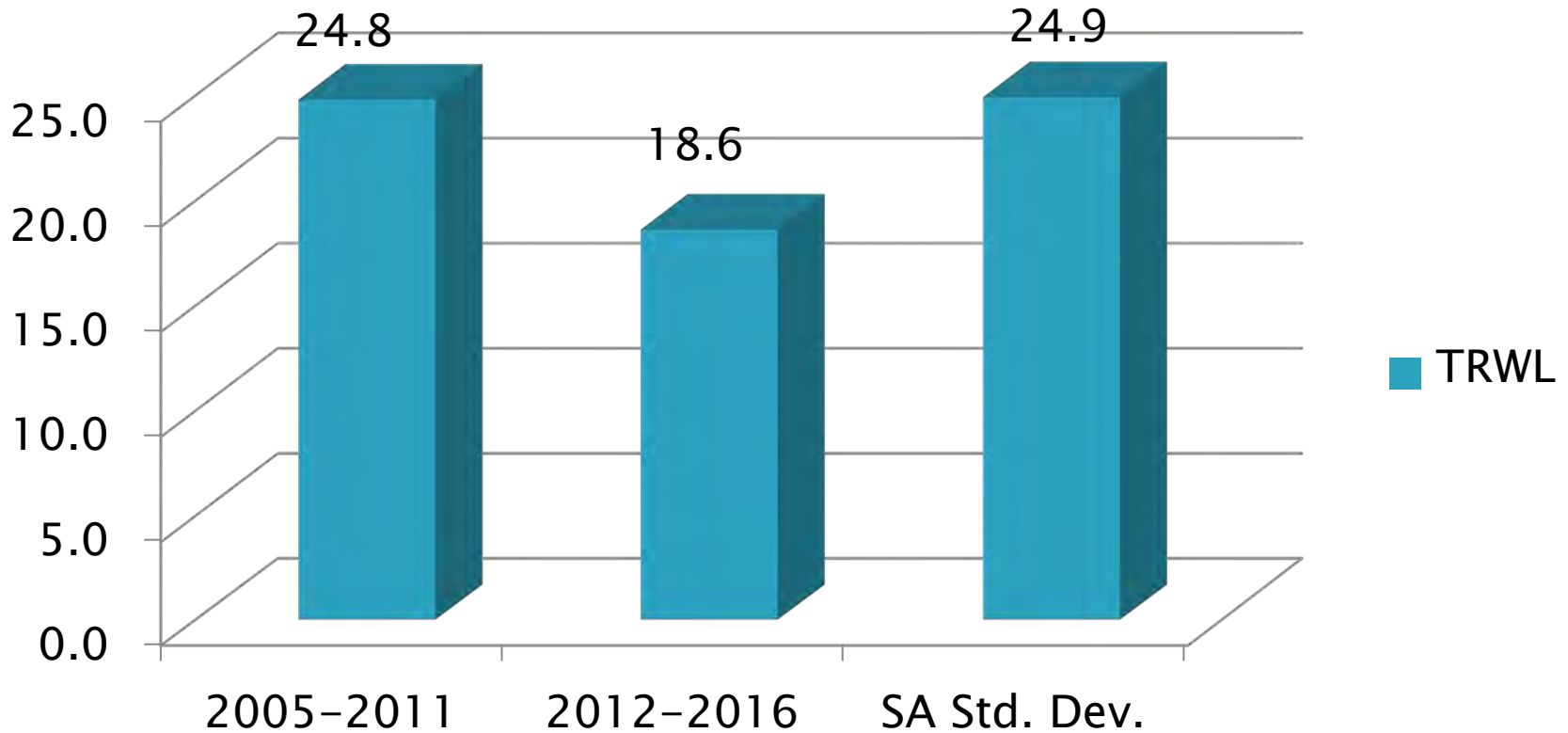
19MAY16:10:02

T-12 Precision Estimates



T-12 Precision Estimates

TRWL



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Mack T-12A

»» April 2016

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T-12A Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	9
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	2
Total		11

T-12A Failed Tests

Failed Parameter	Number of Tests
No failed tests	
Total	0

T-12A Lost Tests*

Status	Cause	#
Aborted	Rod bearing failure during breakin	1
Aborted	Rod failure during breaking	1
Total		2

*Invalid and aborted tests

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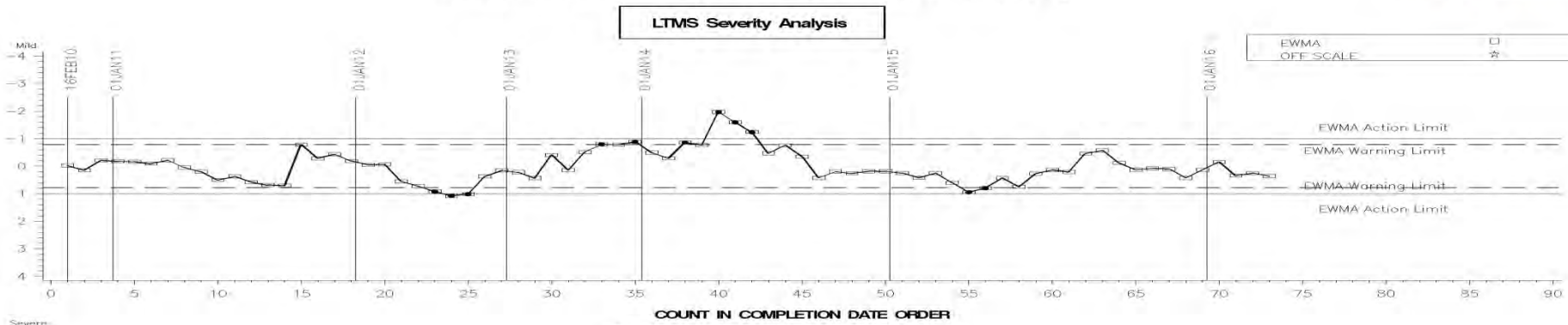
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T-12A Test Severity

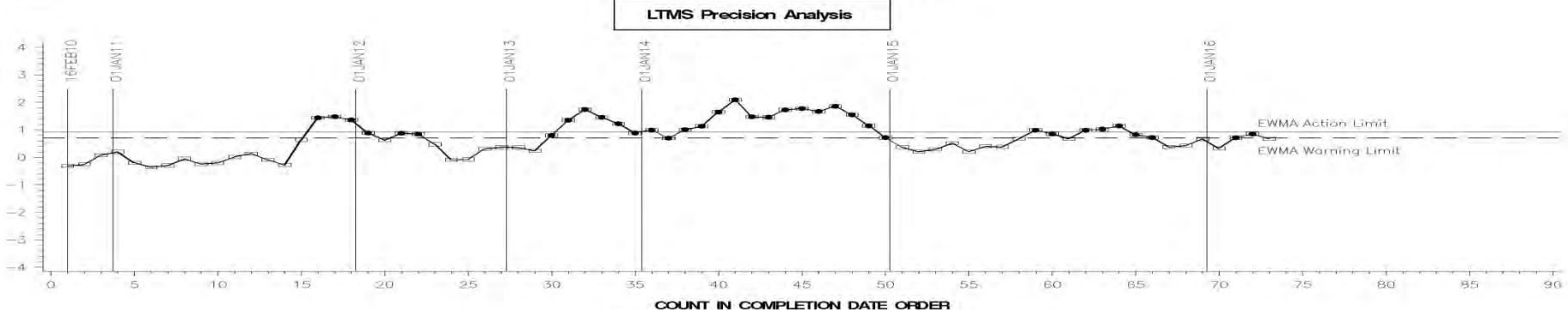
- ▶ MRV is in control.

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

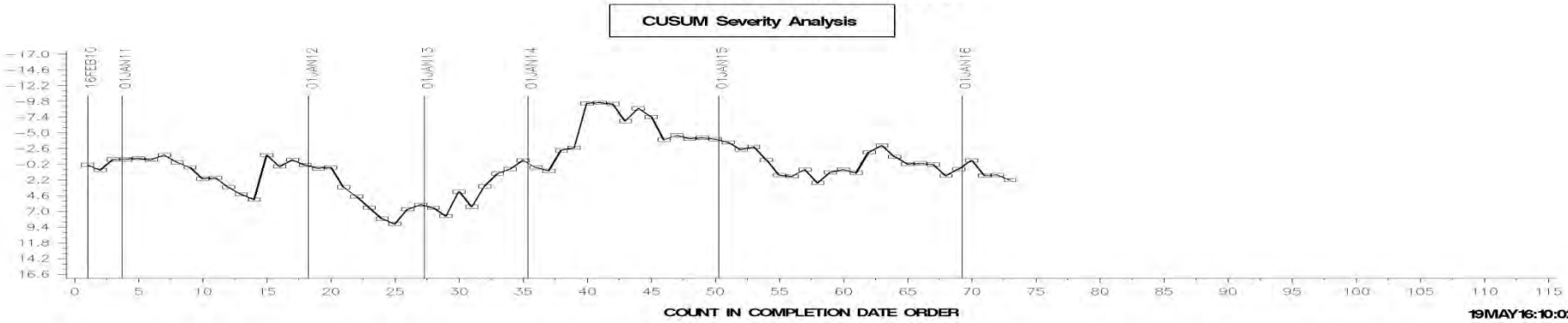
Standard Deviation Units



Standard Deviation Units



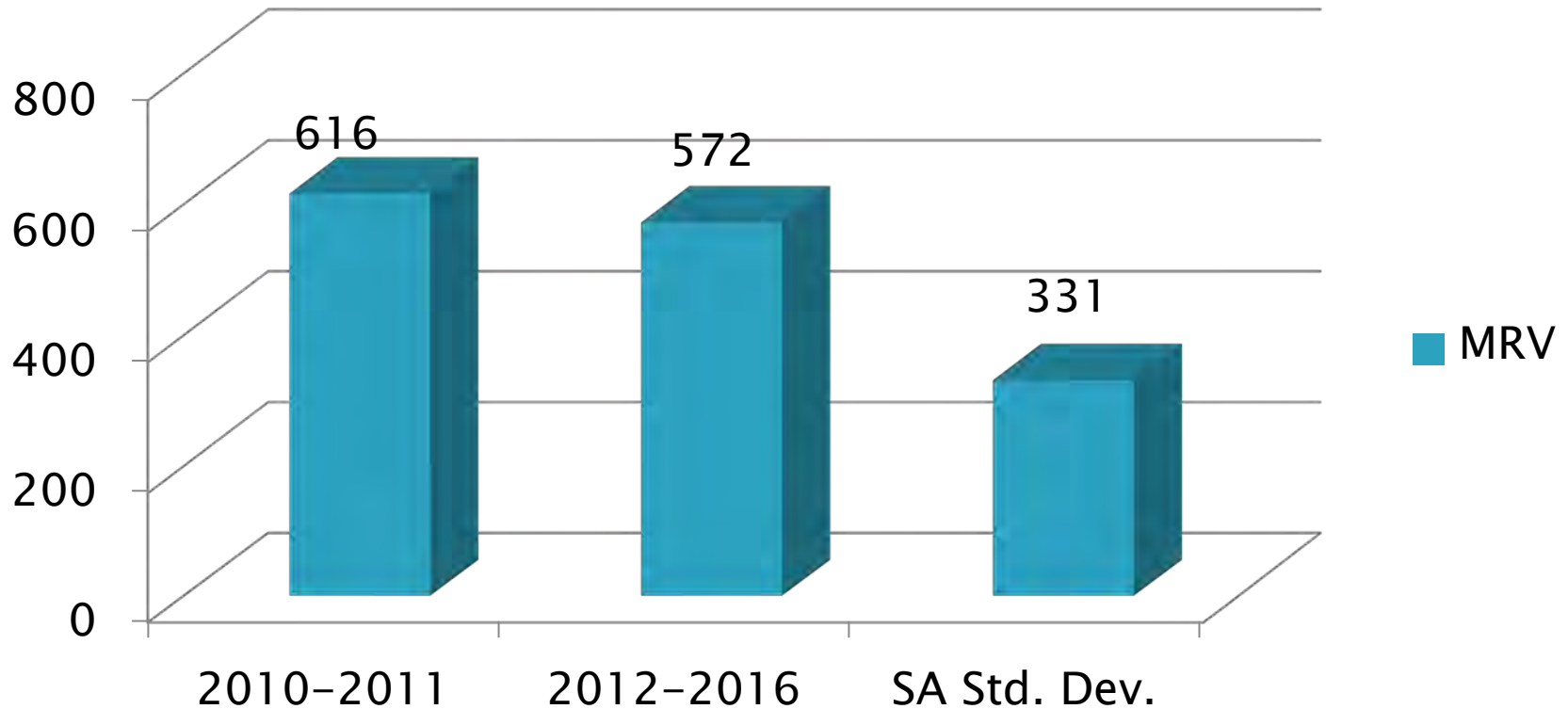
Standard Deviation Units



19MAY16:10:02

T-12A Precision Estimates

MRV



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Mack T-13

»» April 2016

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T-13 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC/NC	13
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Total		13

T-13 Failed Tests

Failed Parameter	Number of Tests
No Failed Tests	0
Total	0

T-13 Lost Tests*

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

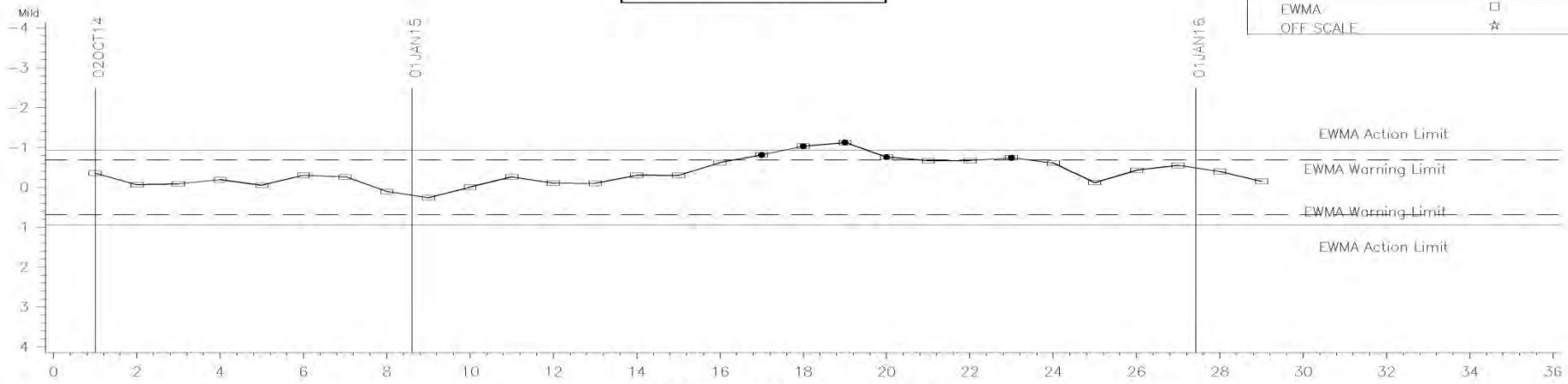
*Invalid and aborted tests

T-13 Test Severity

- ▶ IRPH and KV40PC are in control.

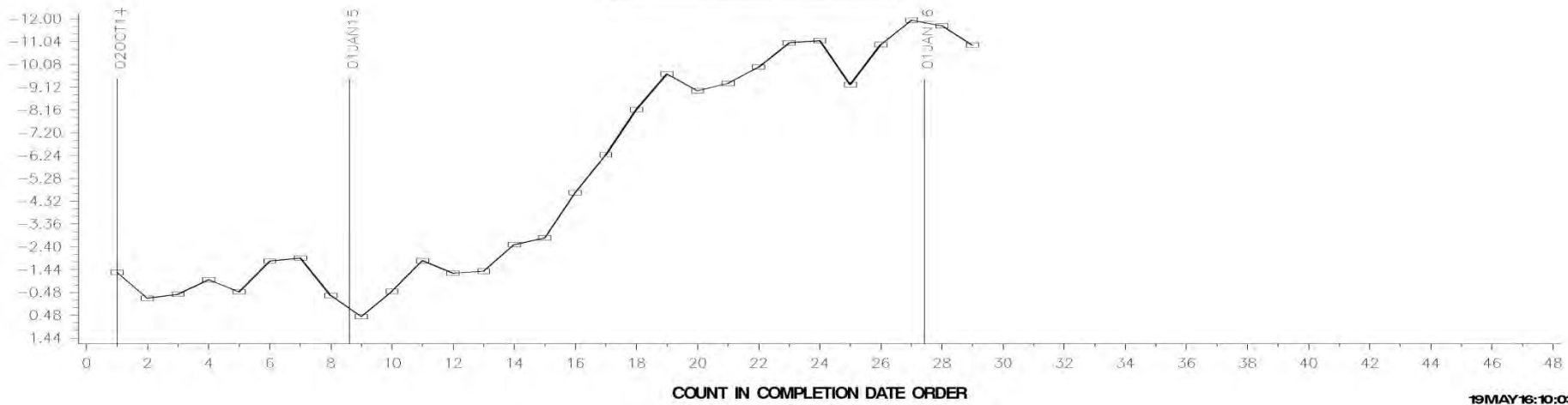
FINAL ORIGINAL PEAK HEIGHT IR AT EOT

LTMS Severity Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

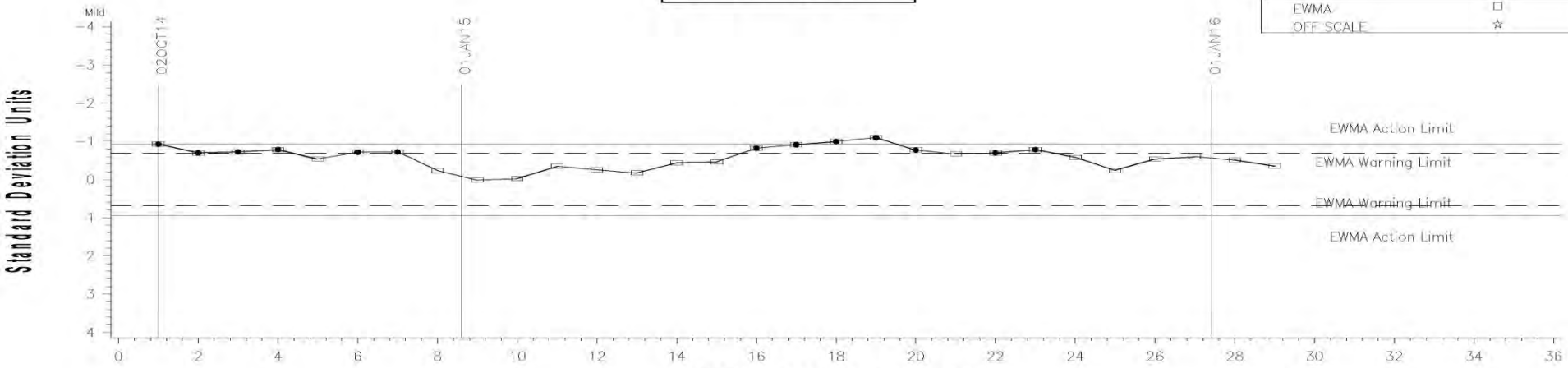


COUNT IN COMPLETION DATE ORDER

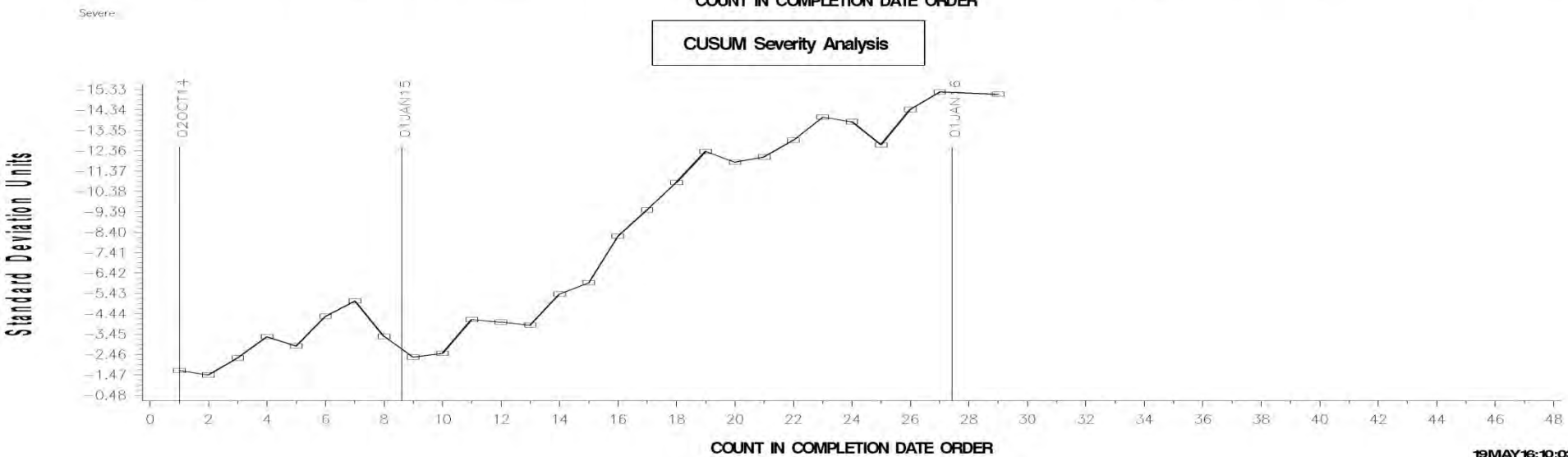
19 MAY 16: 10:03

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

LTMS Severity Analysis

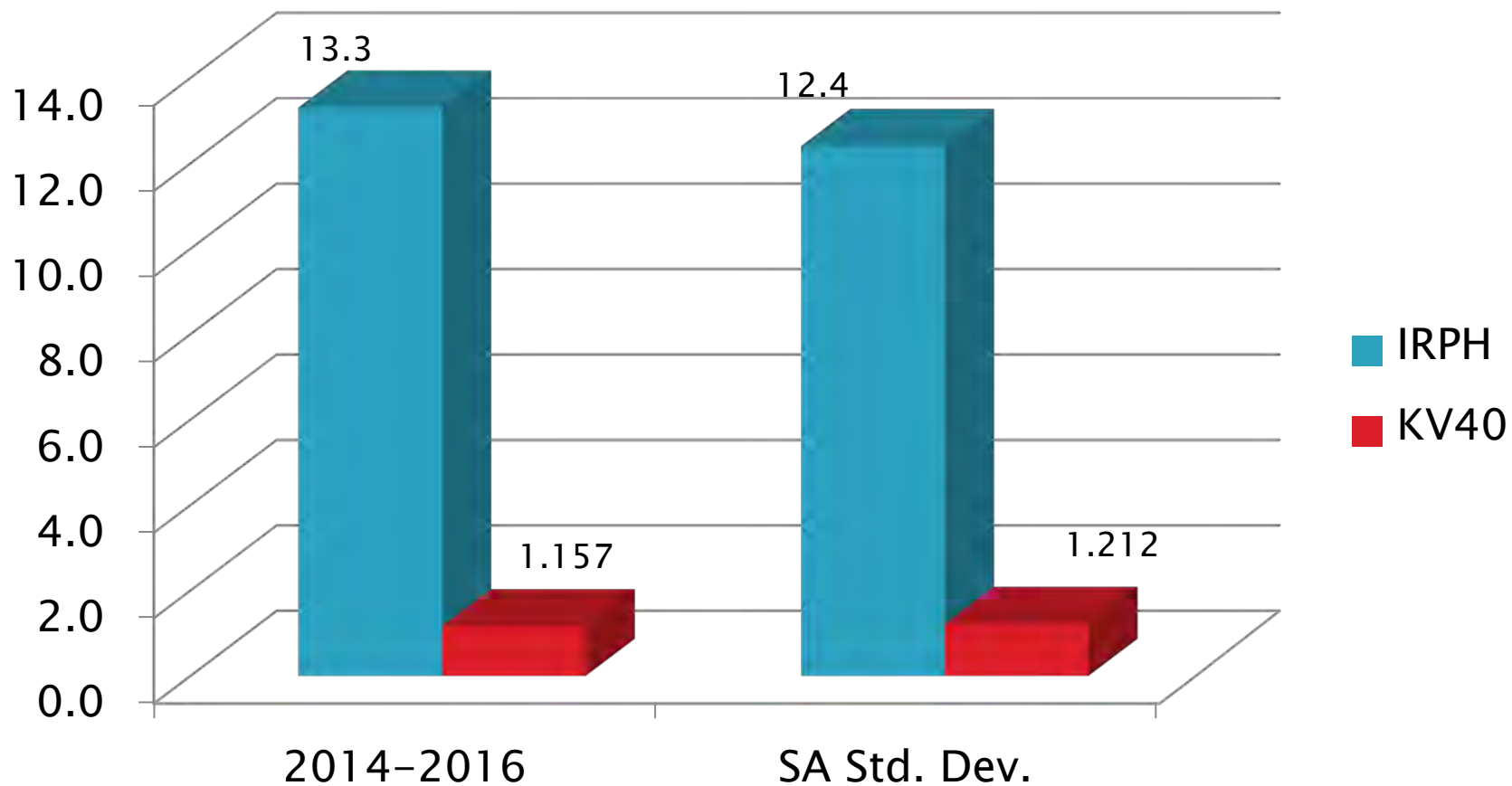


CUSUM Severity Analysis



19 MAY 16: 10:03

T-13 Precision Estimates



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Information Letters

»» October 1, 2015 –
March 31, 2016

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Information Letters*

Test	Date	IL	Topic
1N	12/28/2015	15-3	Changes to 1N Top Groove Fill Reporting
T12	3/14/2016	16-1	Updated VUYP Hardware Correction Factors and New Delta Lead Correction Factors
ISM	3/24/2016	16-1	ISM Test Number Correction

*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

- ▶ Reblend of 830-2 being pursued for ISM.

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	70	2189	146	5+ years
811-2	1K, 1N	1732	60	1001	70	5+ years
822-1	1R, T-10A, T-11	560	0	0	56	~.25 years
822-2	1R, T-10A, T-11	4386	140	3347	252	5+ years
821-3	T-12	1500	0	94	100	~.75 years
821-4	T-12	4495	300	3134	225	2.75 years
823	T-13	1796	128	1277	200	5+ years

Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
830-2	ISM	3786	100	216	300	1.5 years
831-3	C13, ISB	972	100	363	345	5+ years
873-2	1M-PC	1650	40	67	50	5+ years
1005-4	1P, 1R, EOAT, RFWT, T-8/E	2000	112	74	30	< 0.5 years
1005-5	1P, 1R, EOAT, RFWT, T-8/E	3826	260	3177	285	5+ years
832	COAT	1166	28	754	168	5+ years
833	COAT	1152	168	655	168	4.25 years

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LTMS Deviations

»» October 1, 2015 –
March 31, 2016

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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, 2015 –
March 31, 2016

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Quality Index Deviations

- ▶ C13 Qi Deviation
 - Broken fuel temperature thermocouple led to negative Qi.
- ▶ COAT Qi Deviation
 - Intake manifold temperature negative Qi due to slow controller response to weather induced drop in tower water temperature.
- ▶ COAT Qi Deviation
 - Improperly set proportional control setting led to negative Qi for micromotion sample oil pressure.

Quality Index Deviations

- ▶ COAT Qi Deviation
 - Intake manifold temperature negative QI due to erratic control.

Quality Index Deviations

Historical Count of HD Quality Index Deviations

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

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TMC Laboratory Visits

»» October 1, 2015 –
March 31, 2016

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TMC Lab Visits

- ▶ No Heavy Duty Test Lab Visits were conducted during this period.

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Test Area Timelines

»» October 1, 2015 –
March 31, 2016

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Test Area Timeline Additions*

Test	Date	Topic	IL/Memo
T12	3-02-2016	NEW OC BASED PB AND PB2 CFS INTRODUCED. CFS UPDATED FOR VUYPA/B/C HW FOR ALW, ATRWL AND OC.	16-1

*As of 9/30/2015

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Rating Workshop Data

»» 2015 Heavy Duty Workshop

Test Monitoring Center

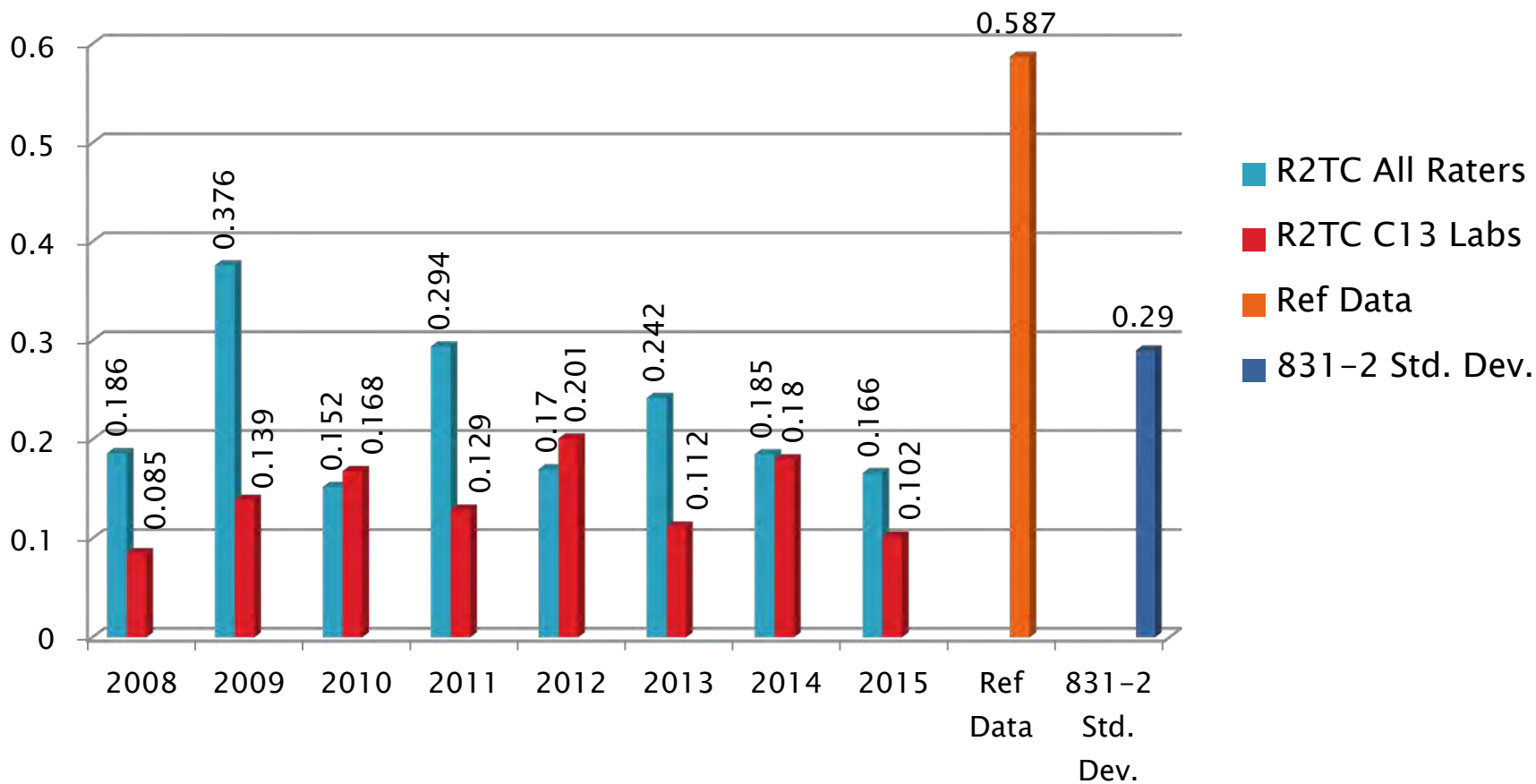
<http://astmtmc.cmu.edu>



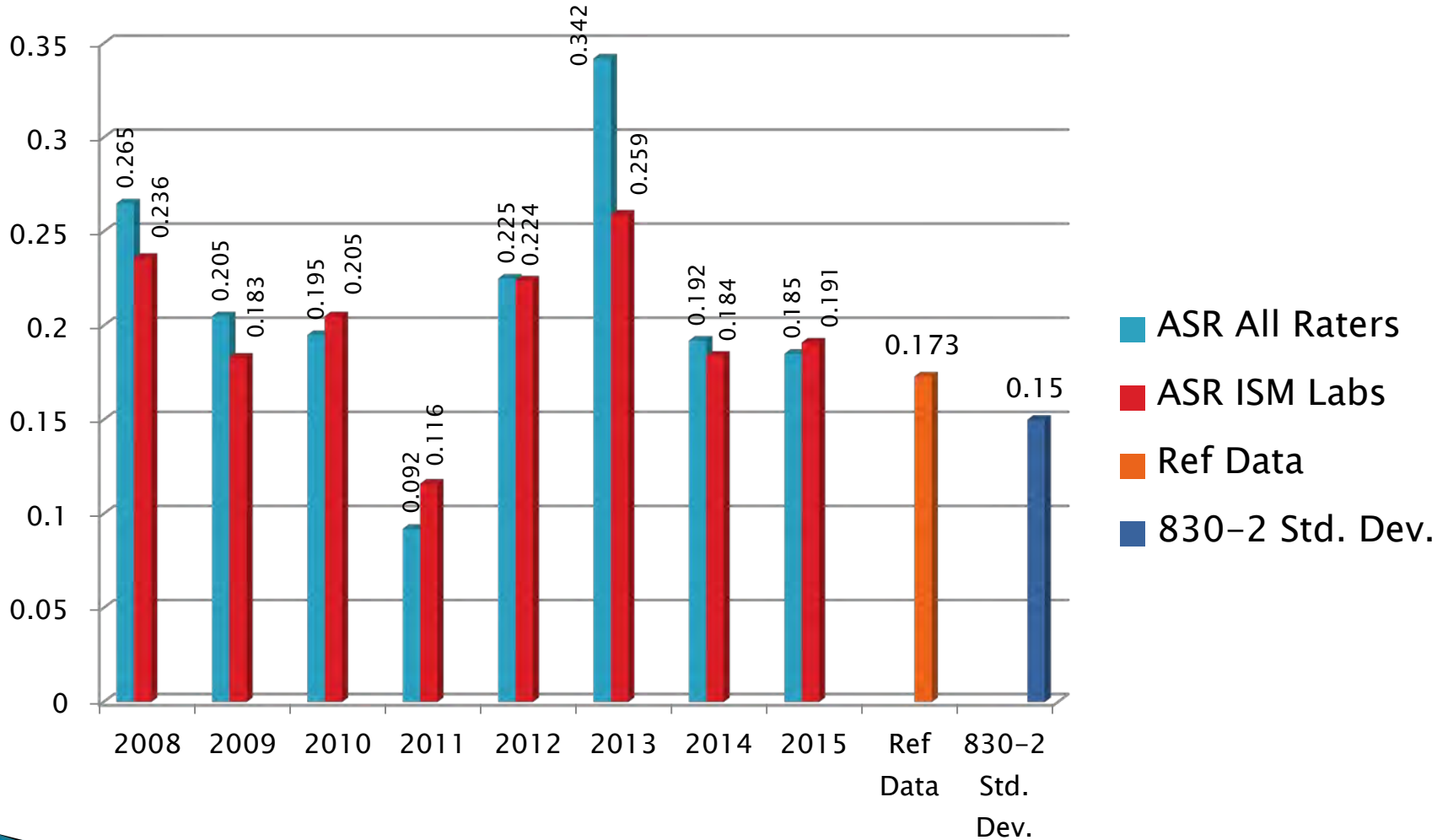
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C13 2nd Ring Carbon Precision – Rating Workshop Data

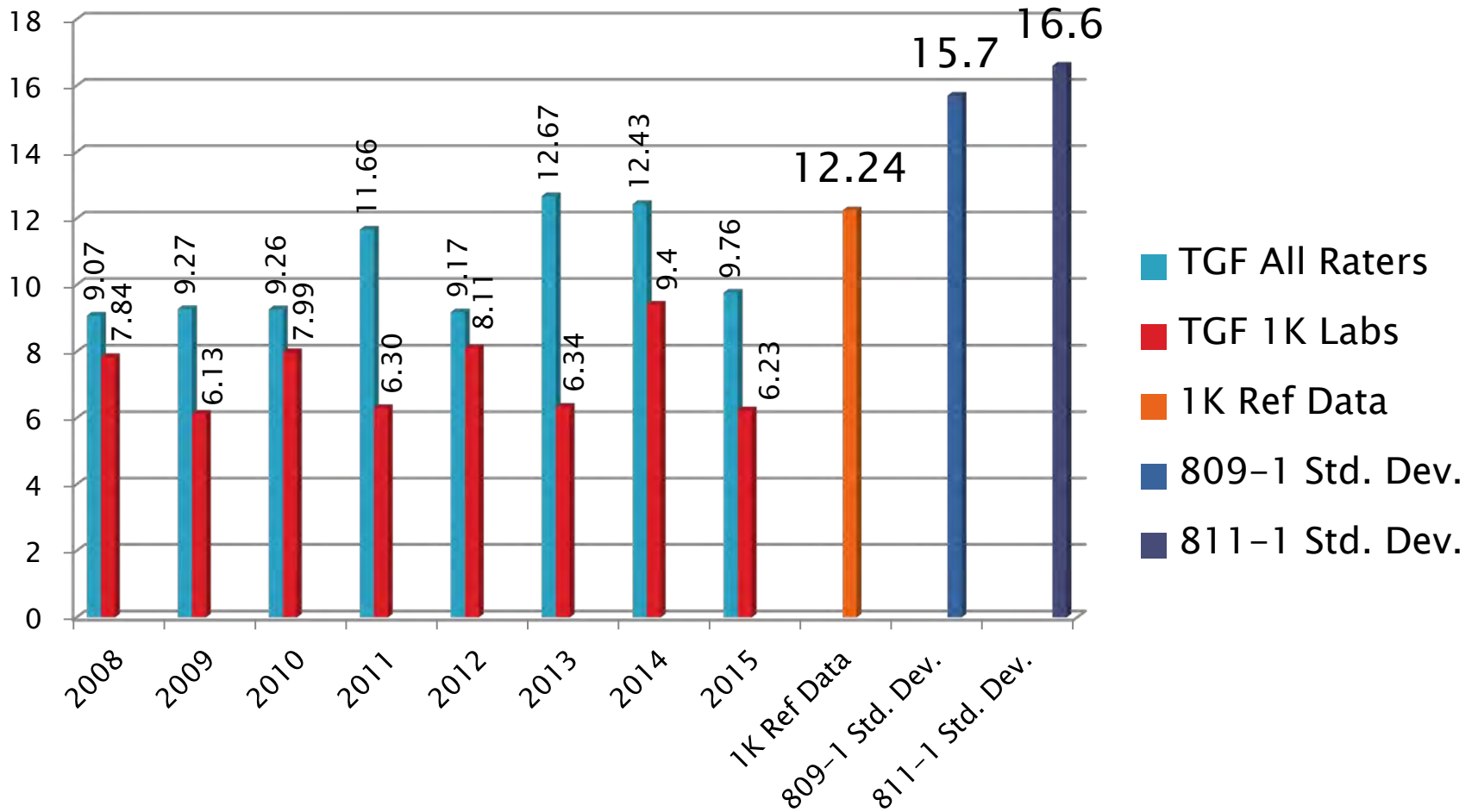
R2TC



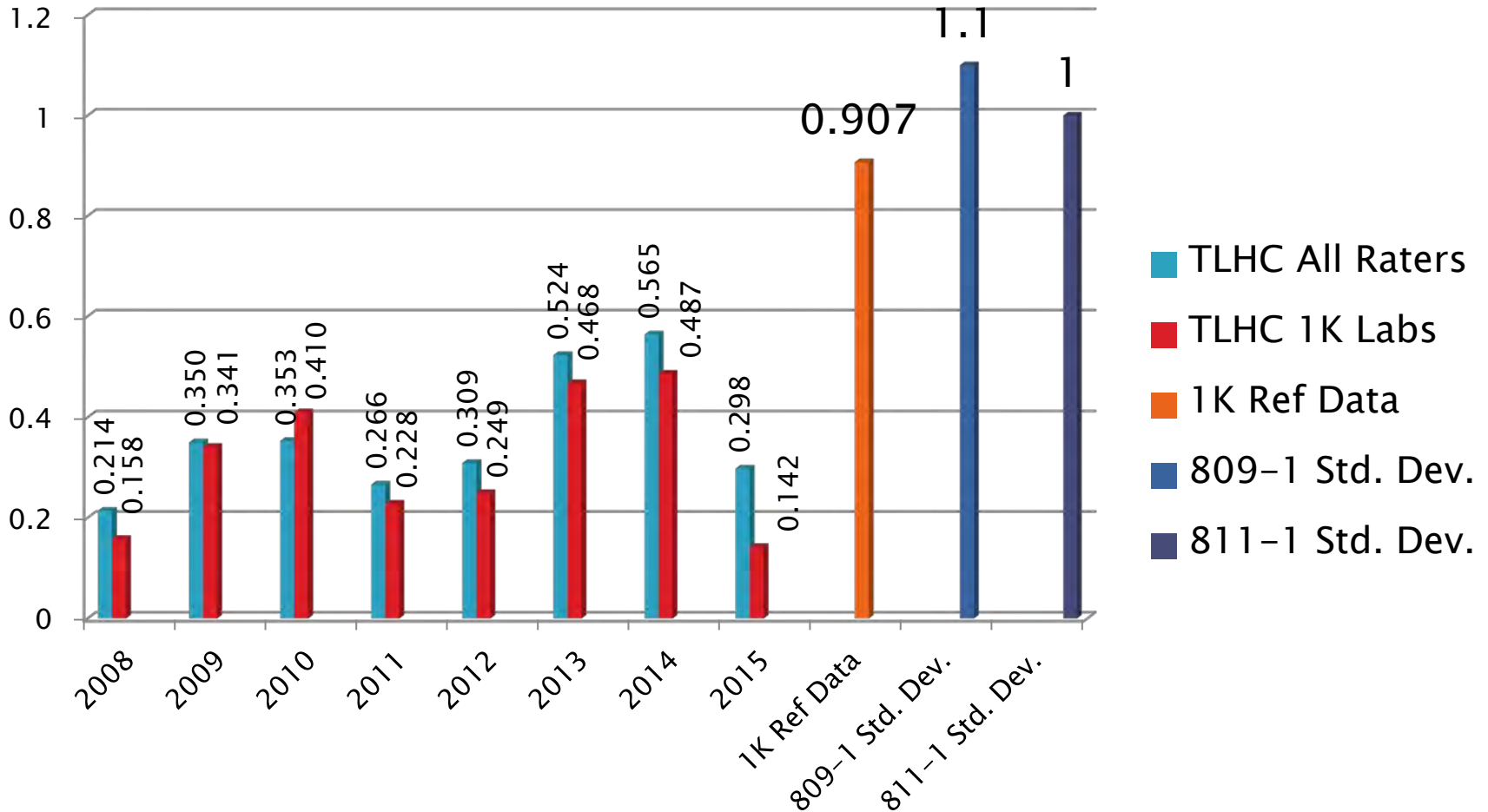
ISM Sludge Rating Precision - Rating Workshop Data



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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