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Test Monitoring Center

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

Oct 2012

Heavy Duty Testing

Executive Summary

▶ Reference Oils

- 820-3 replacement
 - New oil designated 822
- 1005-3 was reblended as 1005-4
- 821-2 was reblended as 821-3

Heavy Duty Testing

Executive Summary

- ▶ T-12
 - Correction factors implemented for all parameters due to STWN hardware
- ▶ ISB
 - Calibration period reduced from 18 to 12 months
- ▶ T-8
 - Partial rebuilds allowed without reference
- ▶ T-11
 - Full rebuilds allowed without reference

Calibrated Labs and Stands*

Test	Labs	Stands
1K	3	4
1N	4	7
1M-PC	2	2
1P	3	3
1R	1	1
C13	2	4
ISB	3	4
ISM	5	6
EOAT	1	1
RFWT	2	2
T-8/E	2	4
T-10A	1	1
T-11	4	5
T-12	4	8
T-12A	4	8

*As of 9/30/2012

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Test Activity Levels

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CAT – SCOTE Tests

Test Status	Validity Code	1K	1N	1M-PC	1P	1R
Acceptable Calibration Test	AC	2	3	2	4	1
Failed Calibration Test	OC	0	0	0	0	2
Operationally Invalid	LC	0	0	0	0	0
Aborted	XC	0	0	0	0	0
Total		2	3	2	4	3

CAT - C13 Test

Test Status	Validity Code	C13
Acceptable Calibration Test	AC	3
Failed Calibration Test	OC	1
Operationally Invalid	LC	0
Aborted	XC	0
Total		4

Cummins Tests

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

Light Duty Diesel Tests

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

Mack Tests

Test Status	Validity Code	T-8/E	T-10A	T-11	T-12	T-12A
Acceptable Calibration Test	AC	4/4	2	6	4	5
Failed Calibration Test	OC	0/0	0	0	1	0
Operationally Invalid	LC	0	0	2	1	1
Aborted	XC	2/2	0	0	3	3
Total		6	2	8	9	9

Failed Tests

Test Status	Test	Number of Tests
Mild on BTOC	1R	1
Severe on WD, TGC, TLC and ETOC	1R	1
Severe OC, Mild R2TC	C13	1
Severe PB	T12	1
Total		4

Lost Tests*

*Invalid and aborted tests

Test	Status	Cause
T-8/E	Aborted	High Oil Consumption
T-8/E	Aborted	Loss of oil charge
T-11	Invalid	Engine Failure: Water pump failure and loss of coolant
T-11	Invalid	Crankcase pressure out of spec
T-12/A	Invalid	Tight main bearing clearances and head gasket damage
T-12/A	Aborted	Cracked injector nozzle
T-12/A	Aborted	Engine valve failure
T-12/A	Aborted	Combustion leak into coolant

Test Severity

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CAT Test Severity

▶ 1K

- WDK, TLHC, ETOC are in control.
- TGF and BSOC
 - Within Chart Limits
 - Long-term mild trend continuing

- Charts shown in [Appendix 1.a.](#)

▶ 1N

- TGF, WDN, TLHC, and BSOC trending mild
- TGF, WDN, TLHC, and BSOC in alarm

- Charts shown in [Appendix 1.b.](#)

CAT Test Severity

▶ 1 M-PC

- Both parameters (TGF & WTD) are in control.

- Charts shown in [Appendix 1.c.](#)

▶ 1 P

- TGC, WD, TLC and OC are in control.
- ETOC in alarm, severe direction.
 - Continuation of long-term trend.

- Charts shown in [Appendix 1.d.](#)

CAT Test Severity

▶ 1R

- BTOC is in control but trending mild.
- WD in severity alarm, severe direction
- WD, TLC, TGC and ETOC in precision alarm

- Charts shown in [Appendix 1.e.](#)

▶ C13

- TGC and TLC are in control.
- R2TC in alarm, mild direction.
- OC is in precision alarm.

- Charts shown in [Appendix 1.f.](#)

Cummins Test Severity

▶ ISB

- Both ACSW and ATWL are in control with slight mild trends.

- Charts shown in [Appendix 1.g.](#)

▶ ISM

- All parameters in control.
 - CWL trending mild.
 - FPD mild trend may be ending.
 - ASR possibly trending severe.

- Charts shown in [Appendix 1.h.](#)

Light Duty Diesel Test Severity

▶ EOAT

- AEOA in control.

- Charts shown in [Appendix 1.i.](#)

▶ RFWT

- AFW in control.

- Charts shown in [Appendix 1.j.](#)

Mack Test Severity

- ▶ T-8/E
 - All parameters are in control.
 - Charts shown in [Appendix 1.k.](#)
- ▶ T-10A
 - MRV in severity alarm (severe) and still trending severe.
 - Charts shown in [Appendix 1.l.](#)

Mack Test Severity

▶ T-11

- All parameters within chart limits.
 - SOOT and MRV trending mild.
 - SOOT5 mild trend ending.

- Charts shown in [Appendix 1.m.](#)

▶ T-12

- All parameters within chart limits.
 - CLW and OC showing mild trend.
 - TRWL showing long-term severe trend.

- Charts shown in [Appendix 1.n.](#)

Mack Test Severity

- ▶ T-12A
 - MRV is in alarm in the severe direction.
- Charts shown in [Appendix 1.o.](#)

Test Precision

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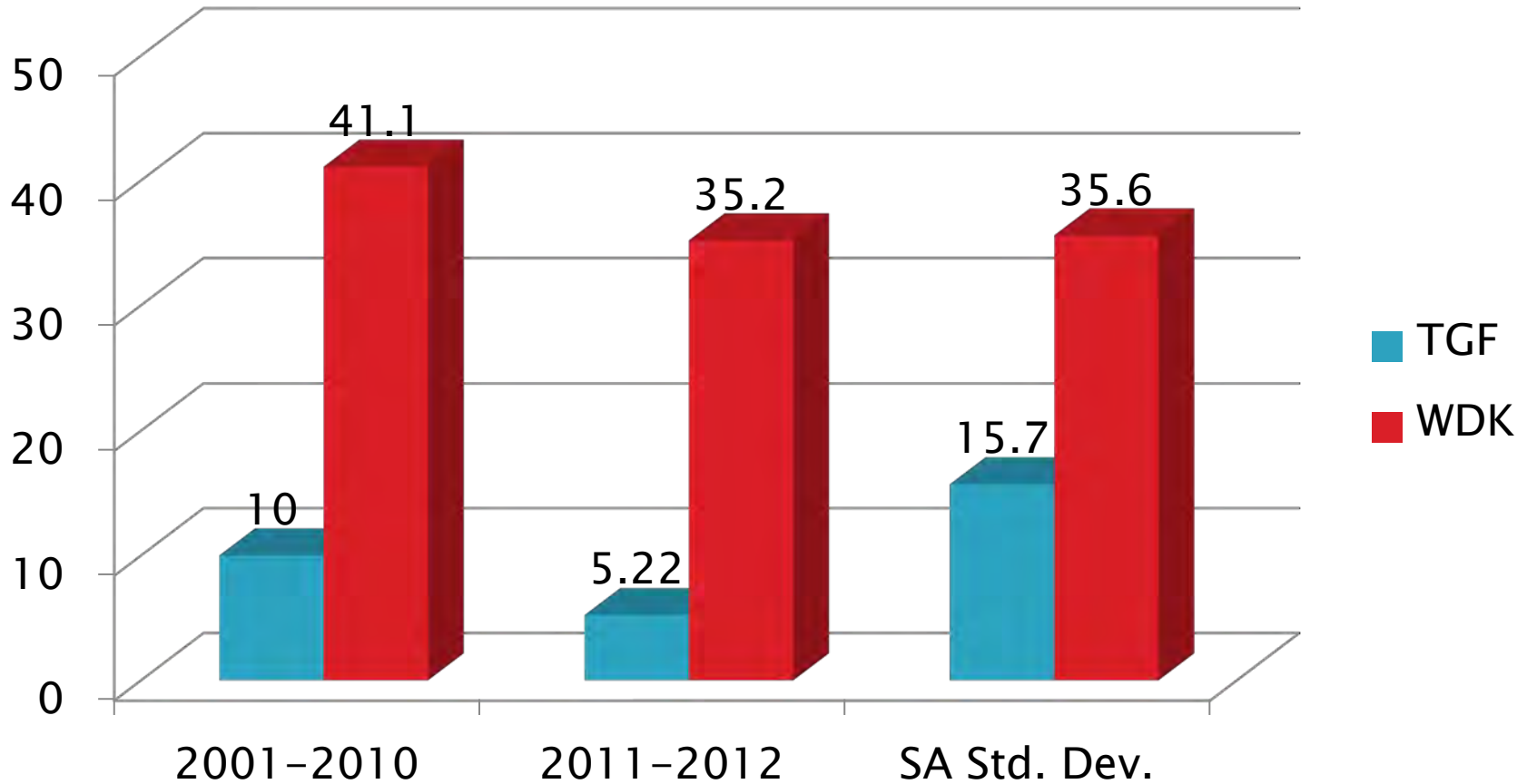


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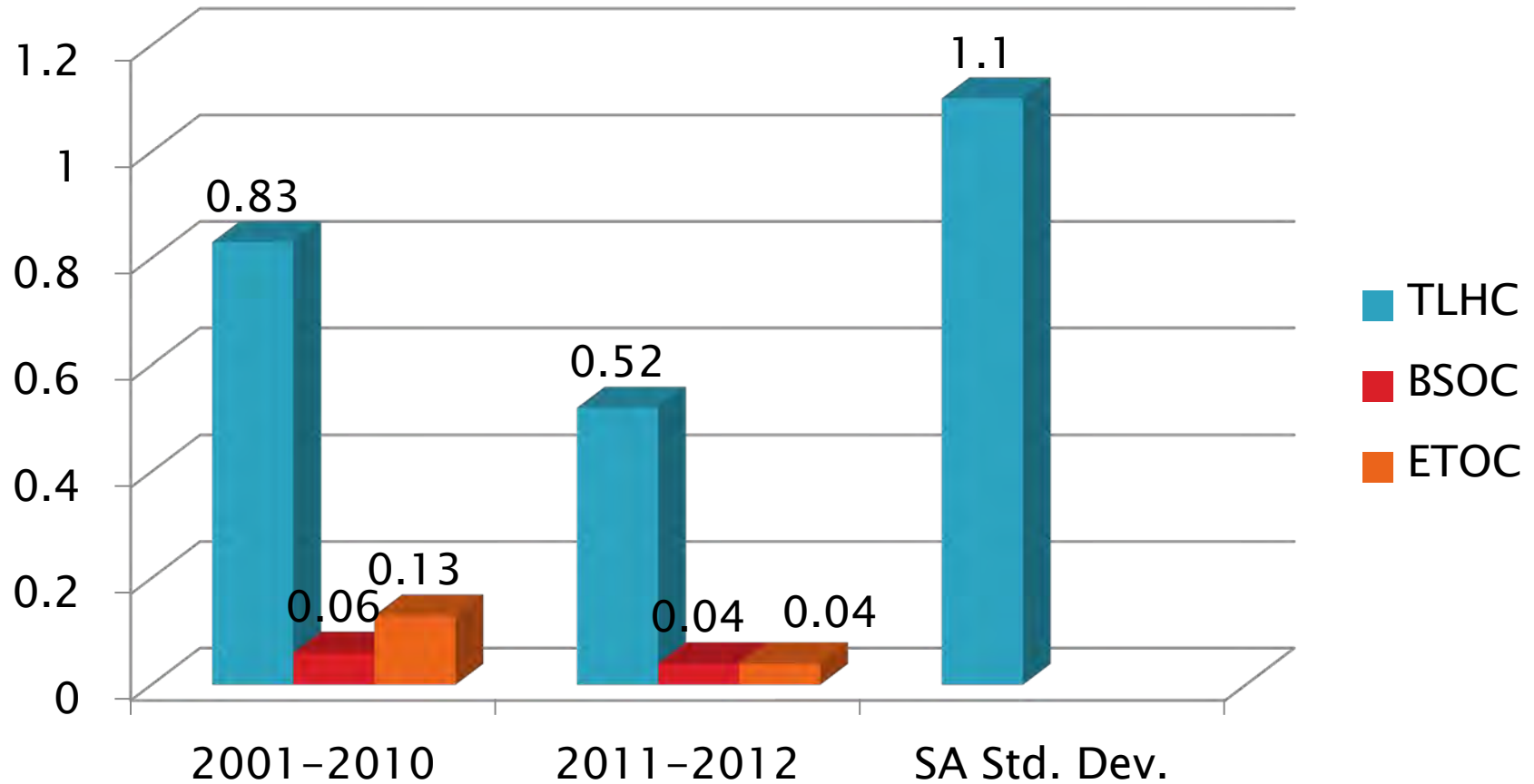
Test Precision Estimates

- ▶ Presented for years where sufficient data exist
- ▶ Precision estimates are shown with reference oil std. deviations, or where applicable, with Severity Adjustment std. deviations
- ▶ For several test types, precision estimates are not available due to low activity levels

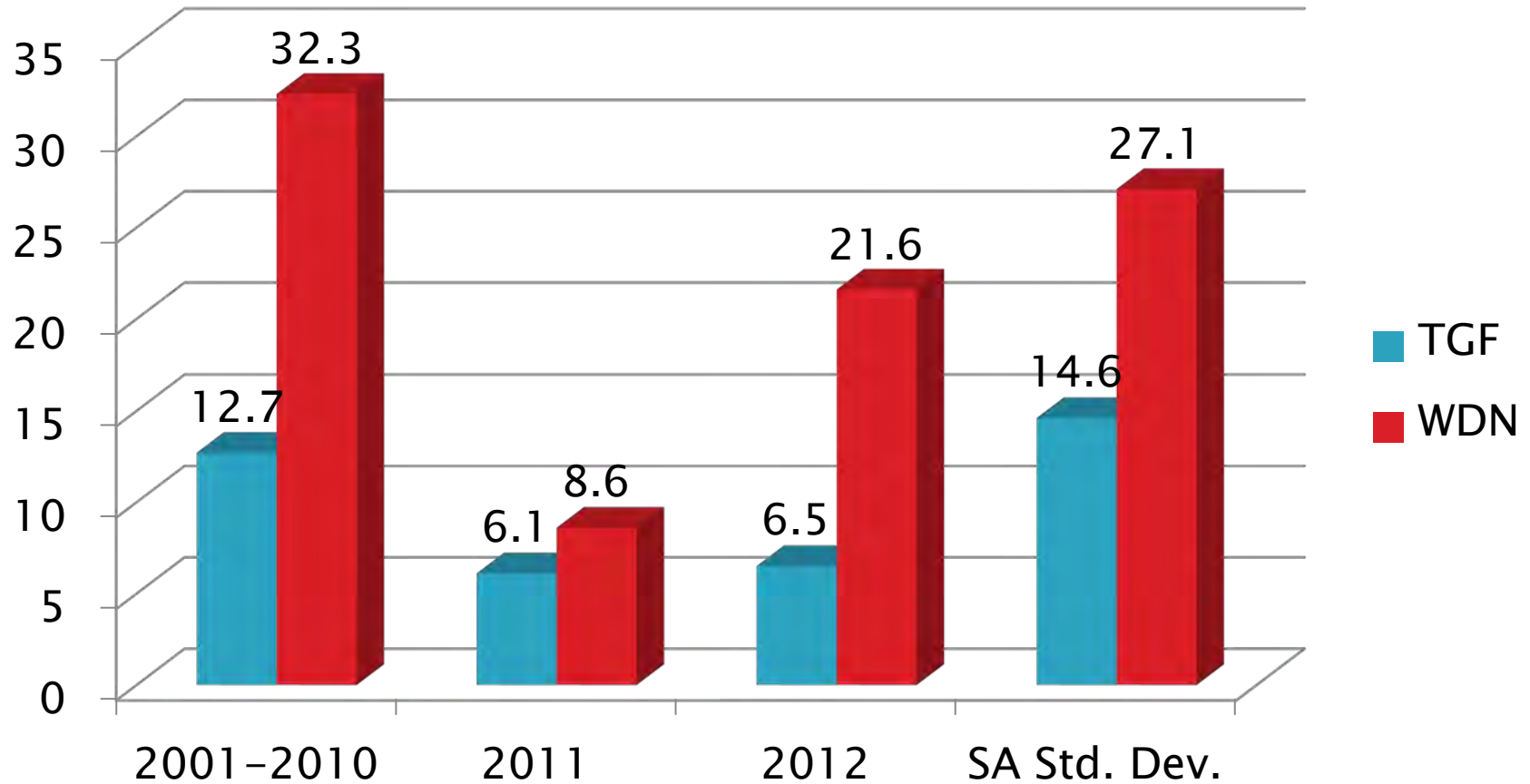
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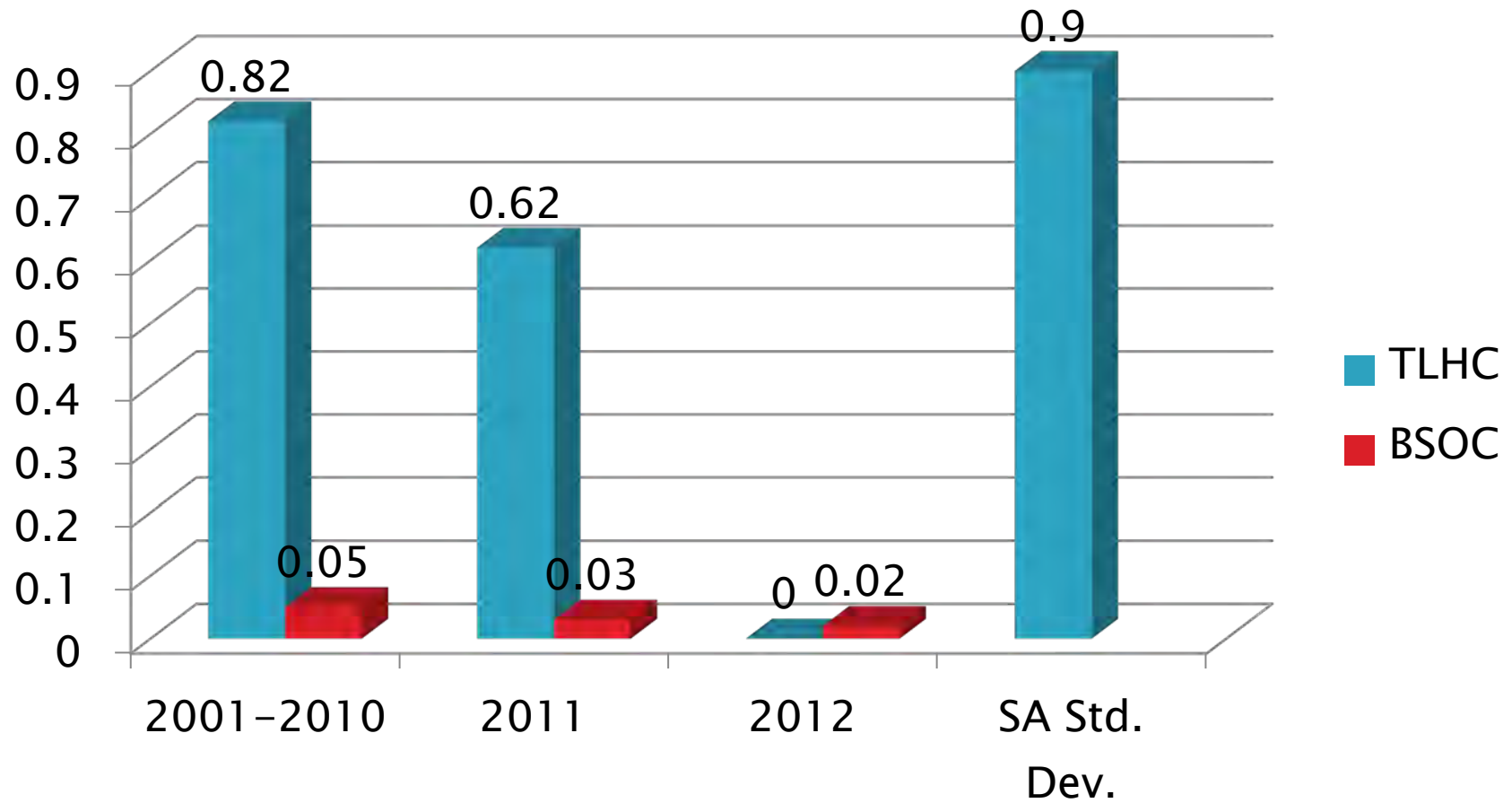
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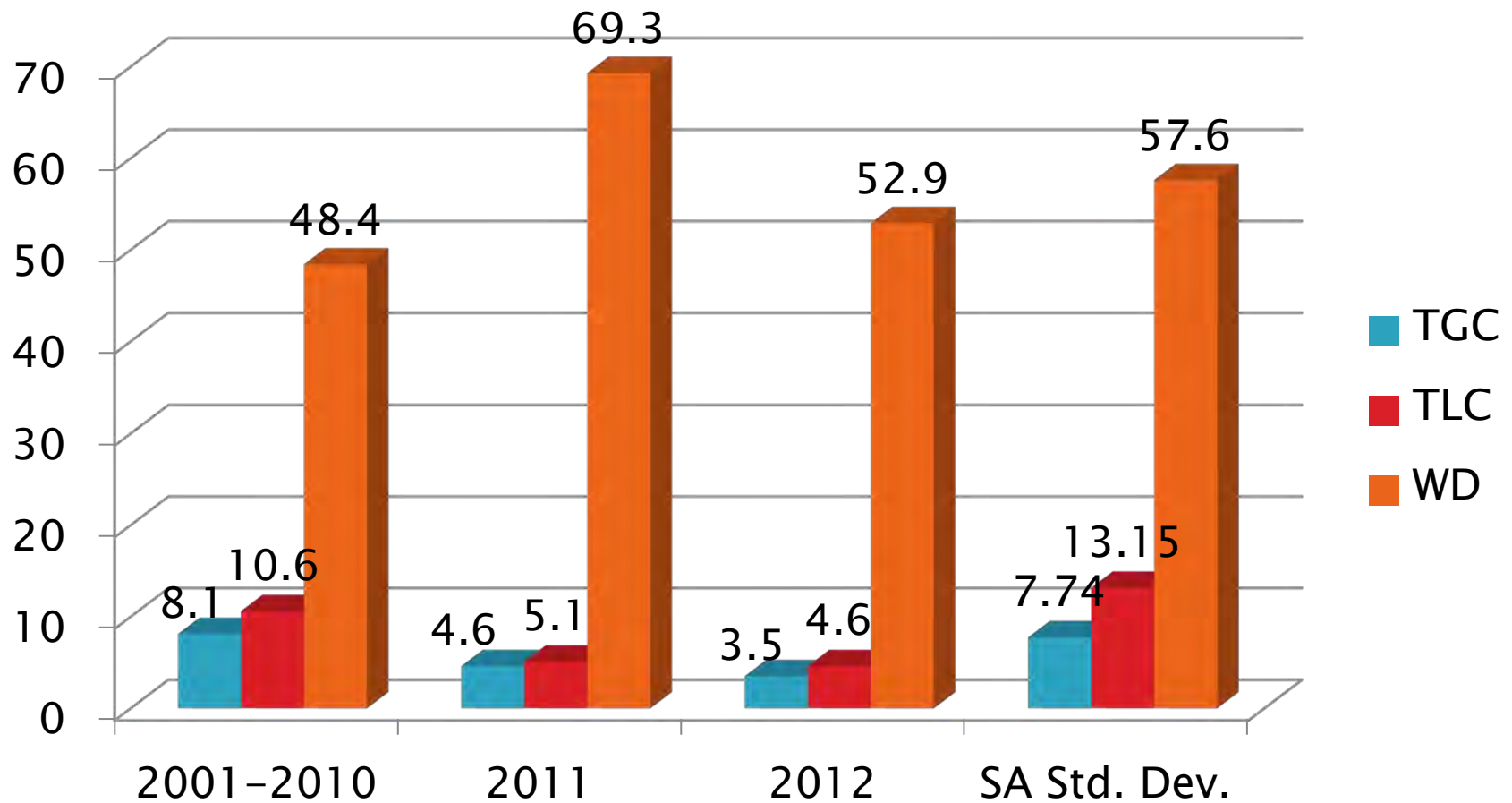
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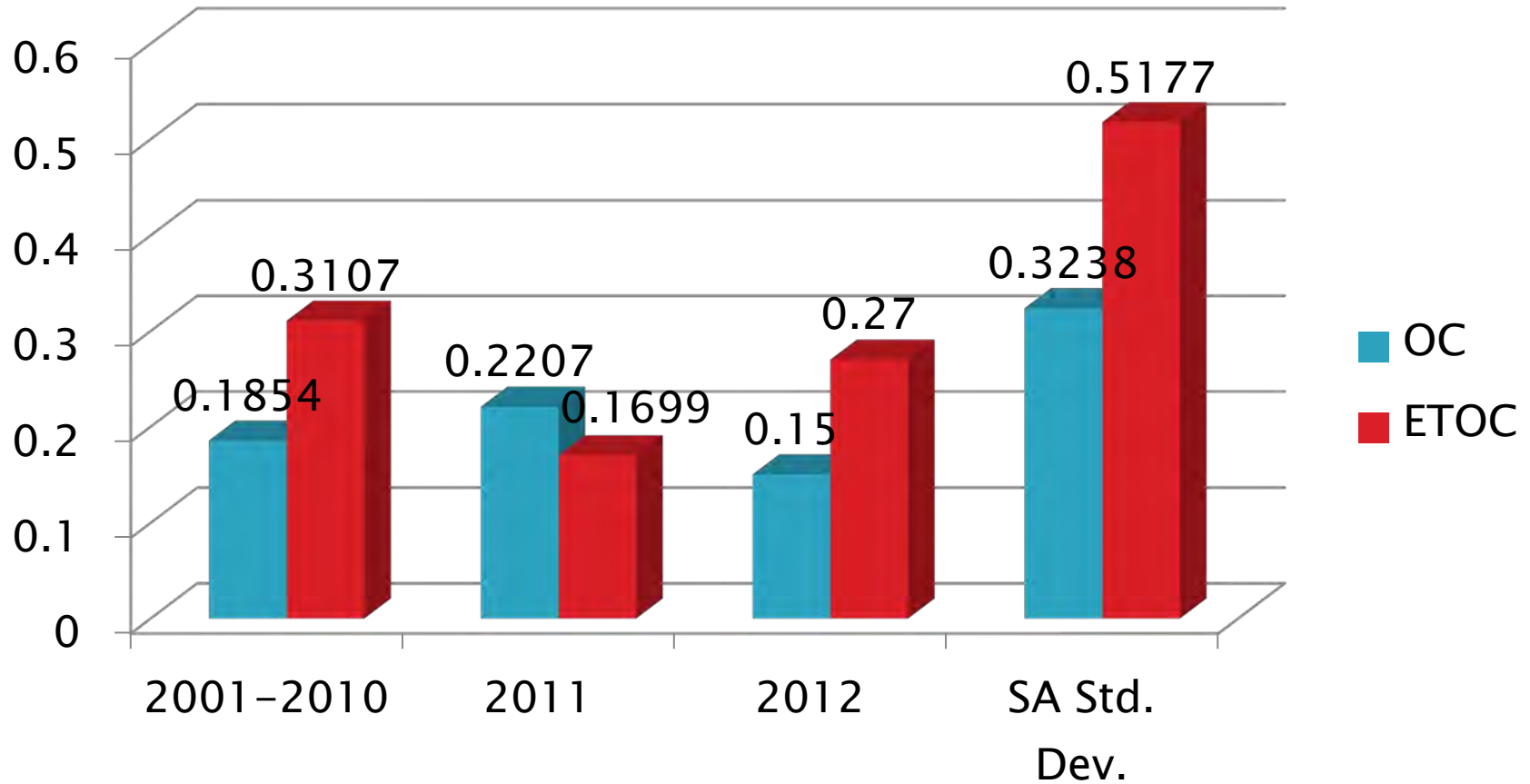
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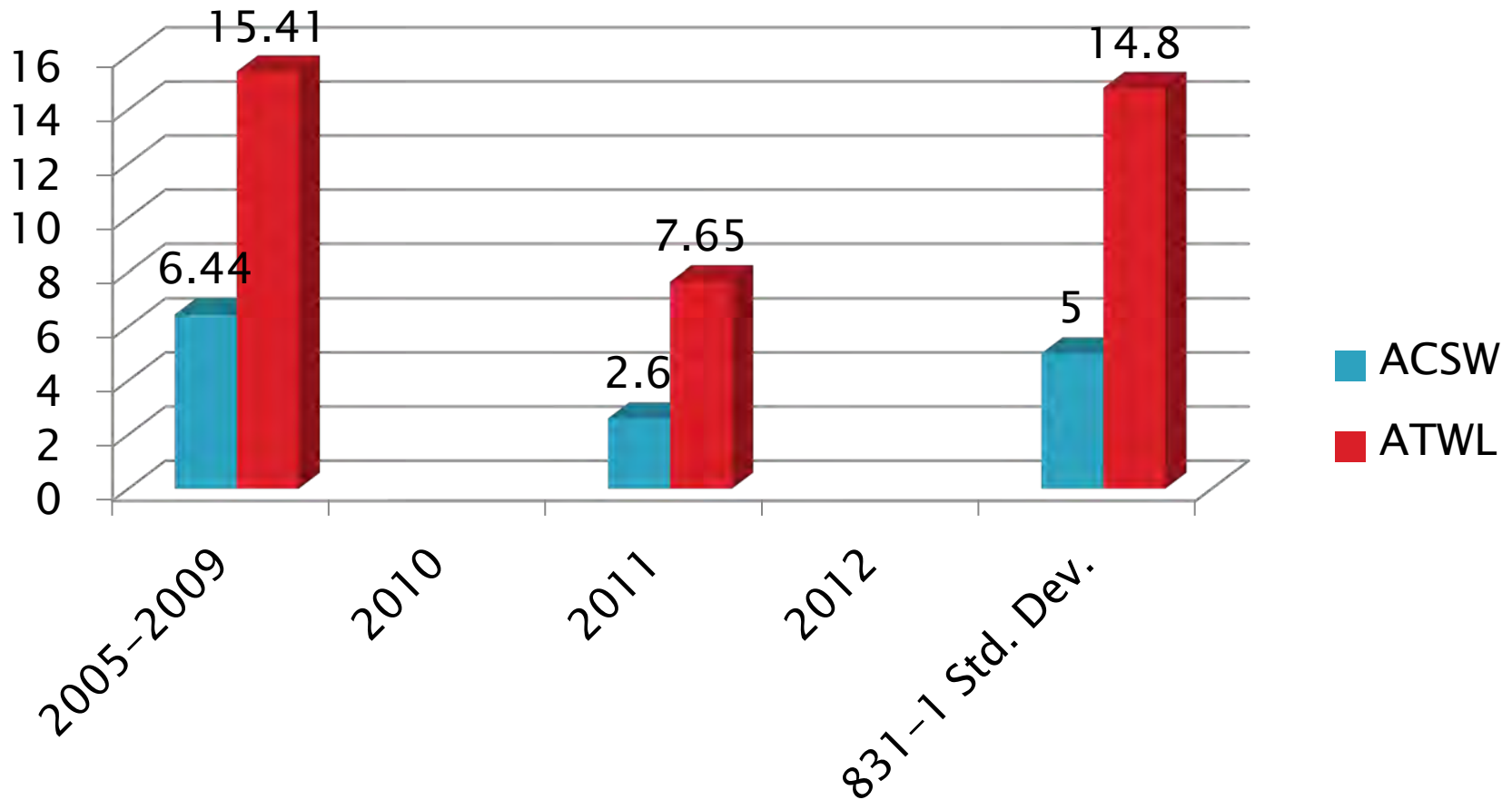
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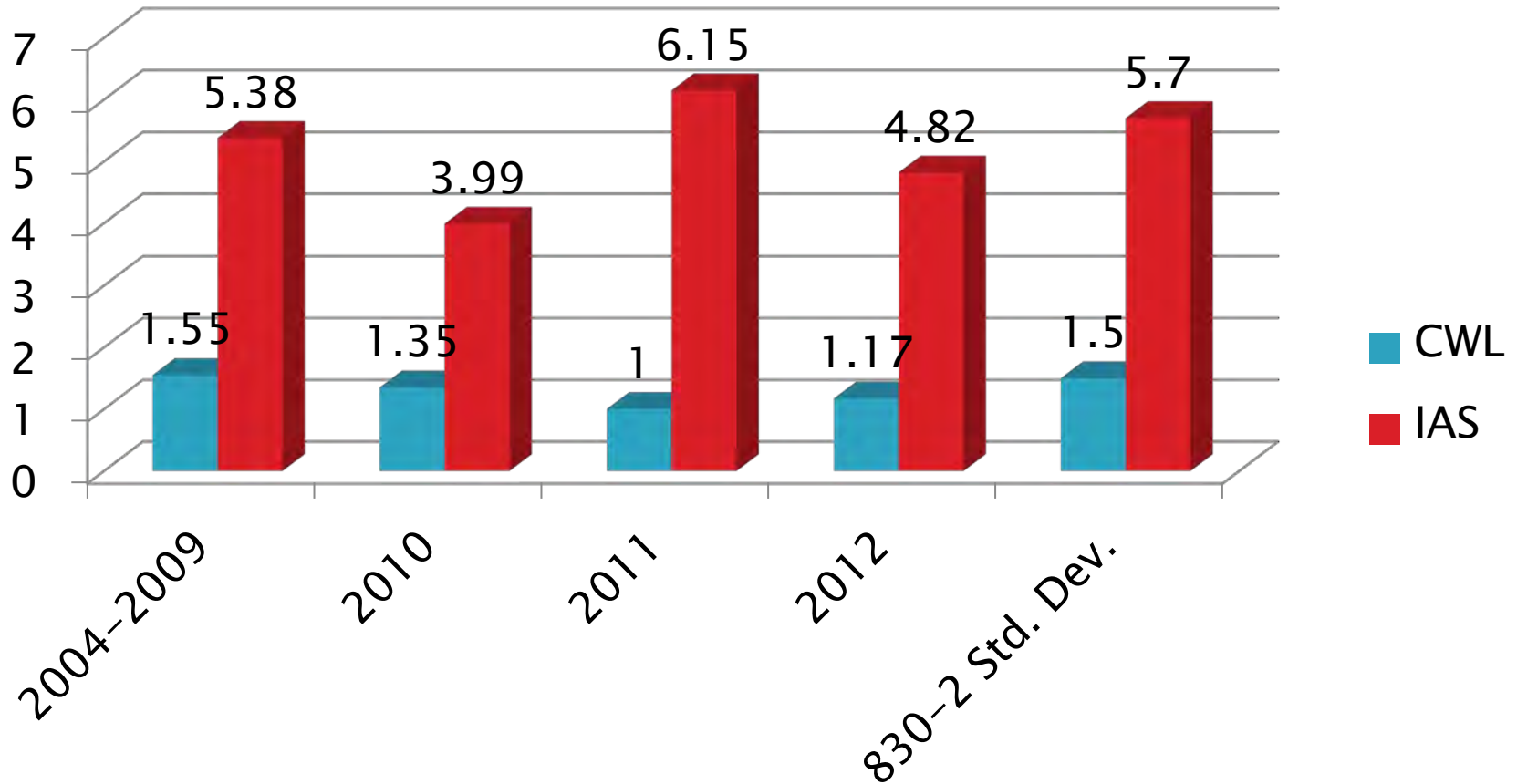
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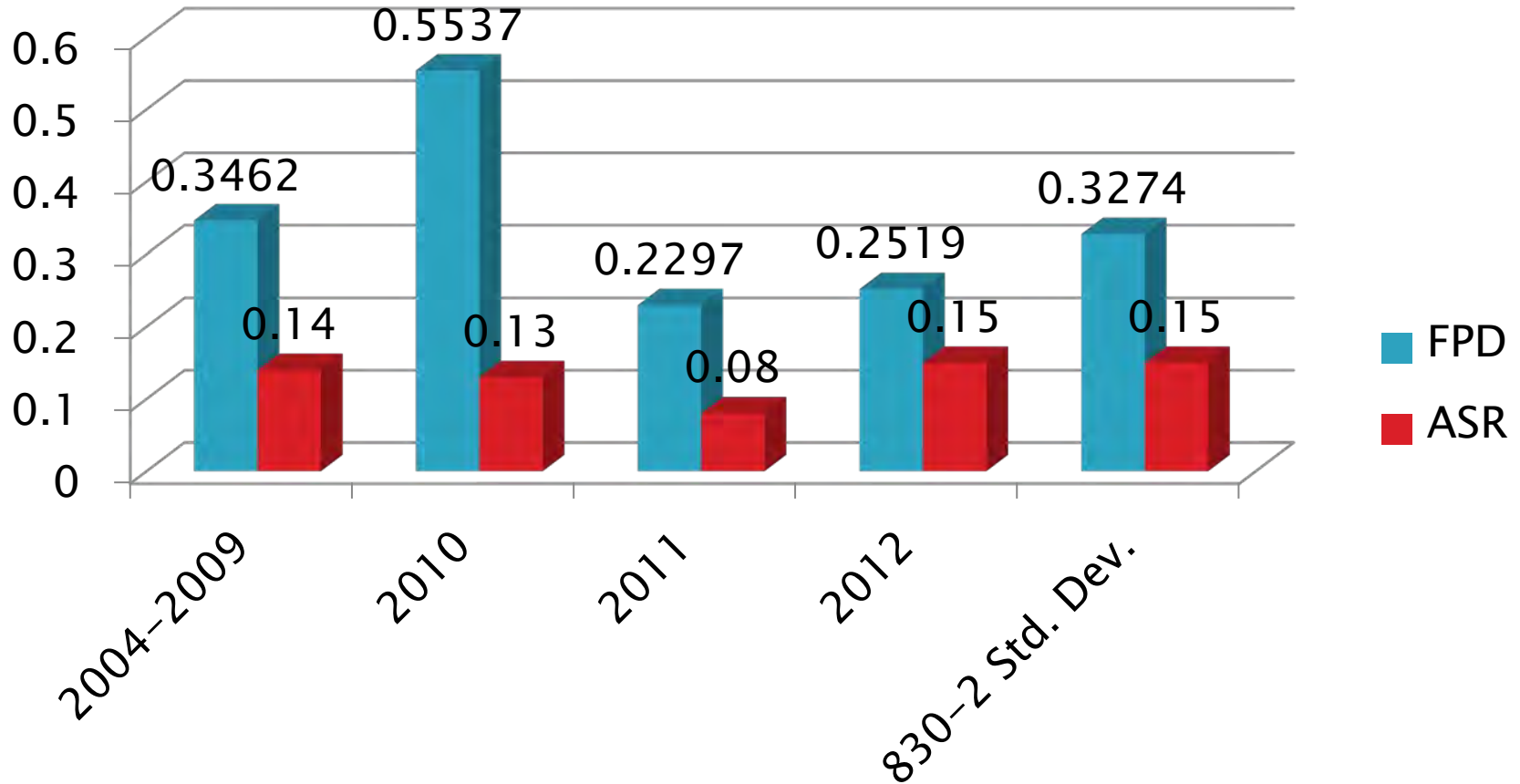
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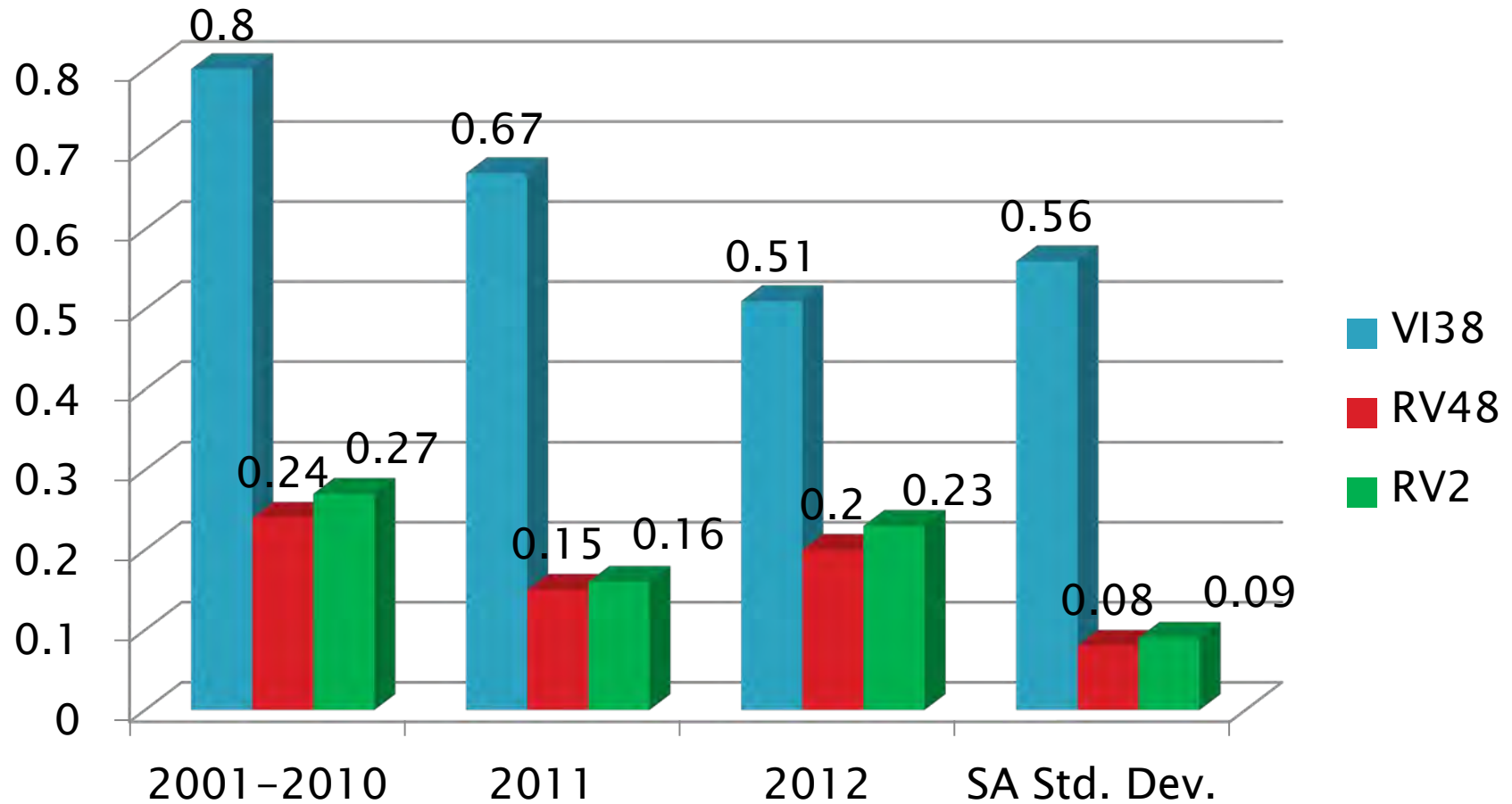
ISM Precision Estimates



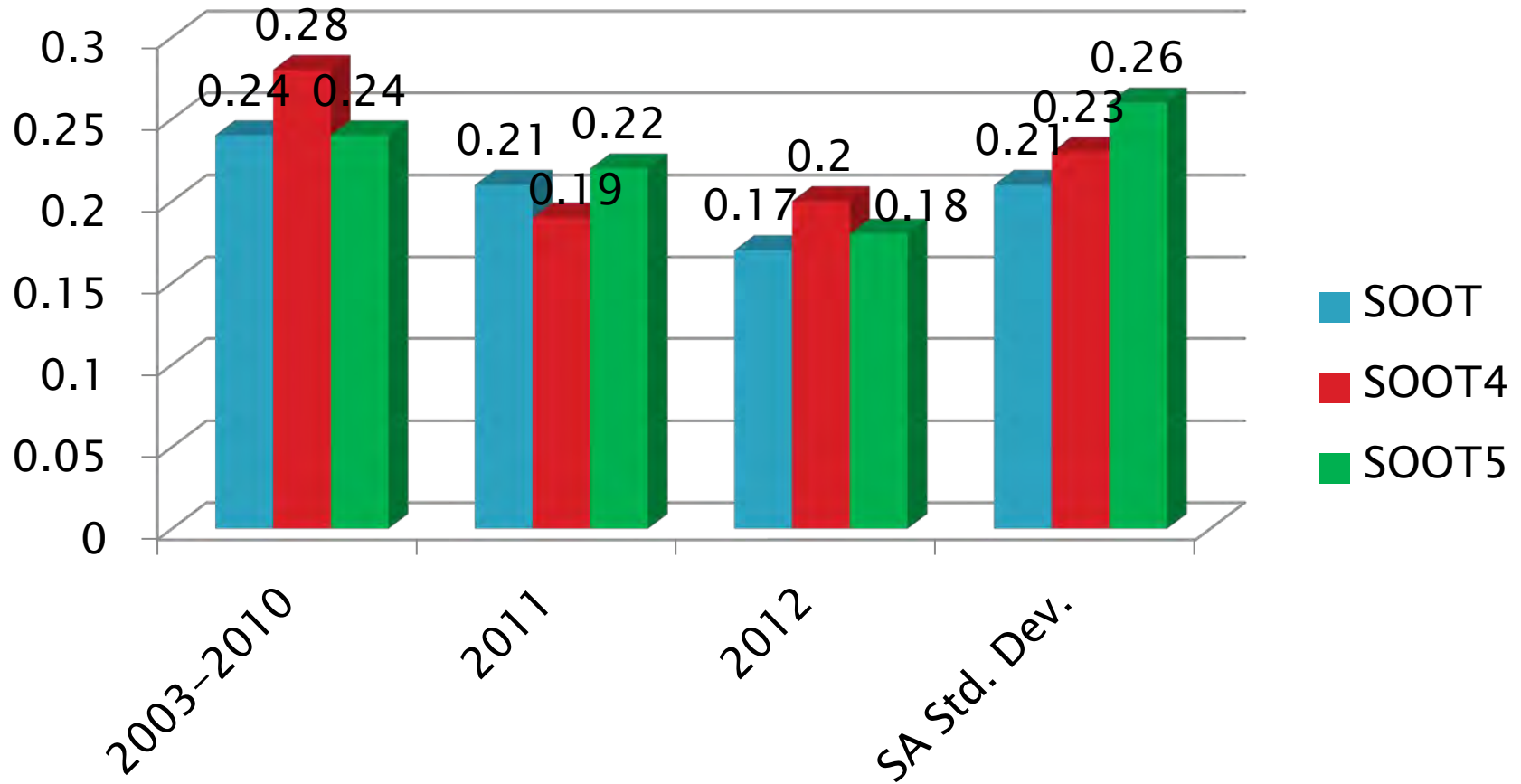
ISM Precision Estimates



T-8/E Precision Estimates

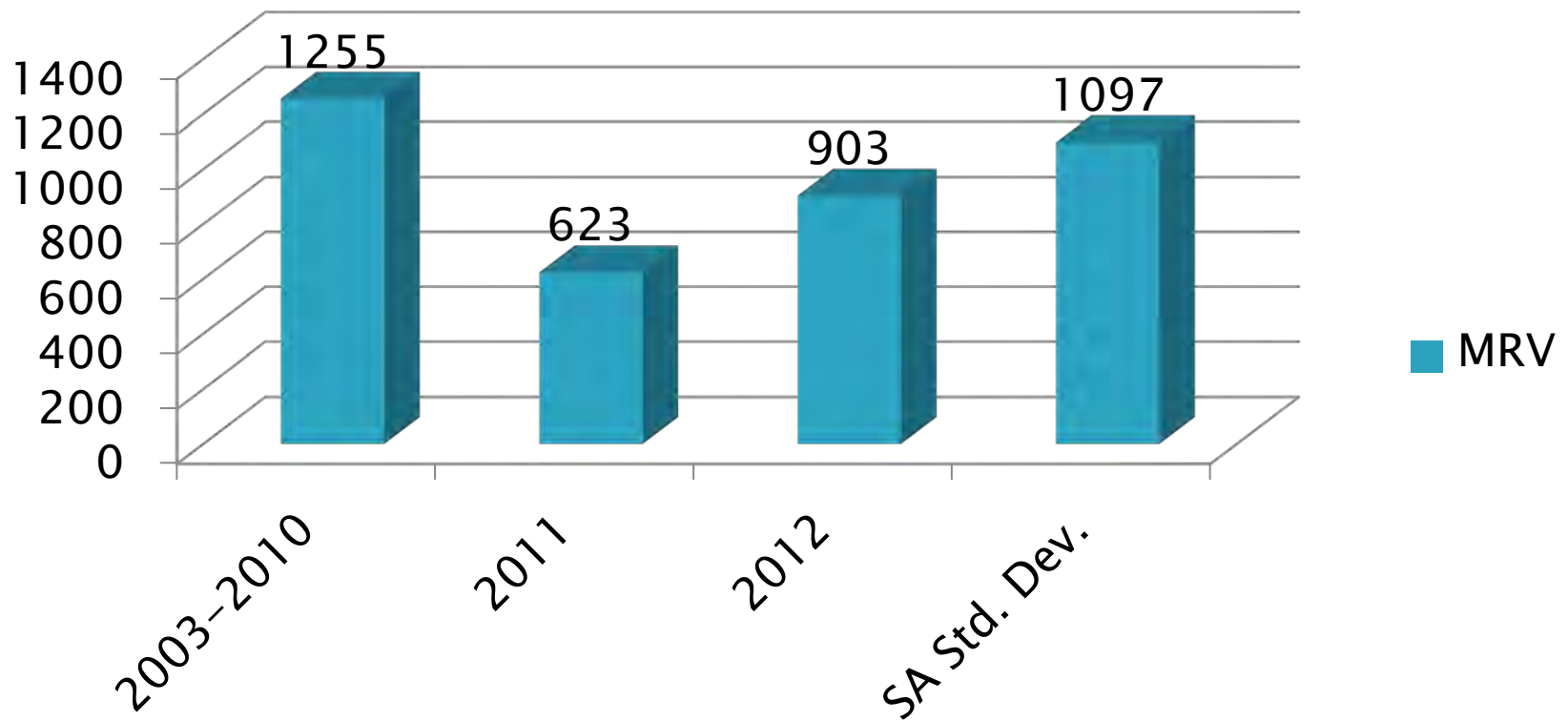


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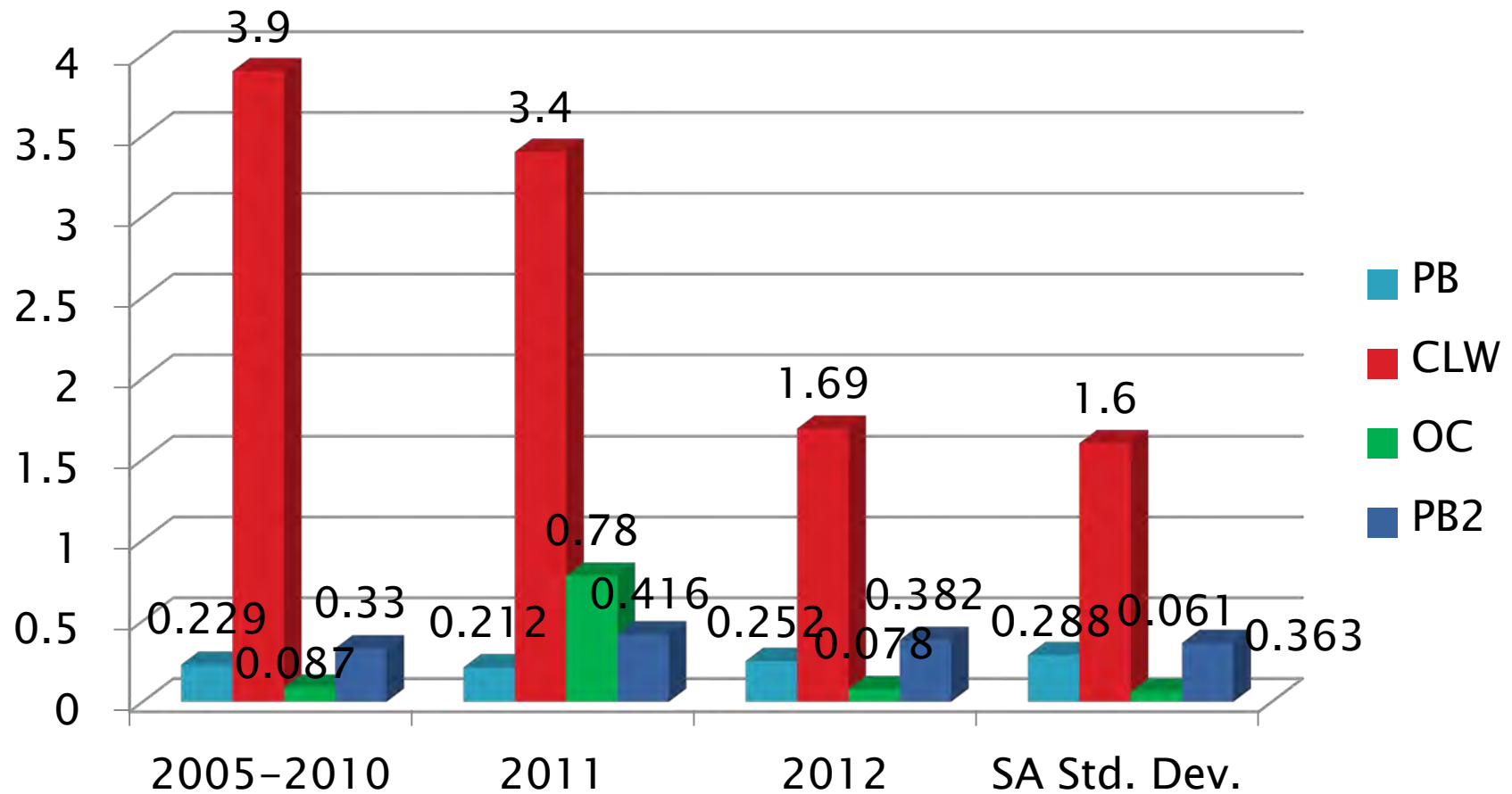


T-11 Precision Estimates

MRV

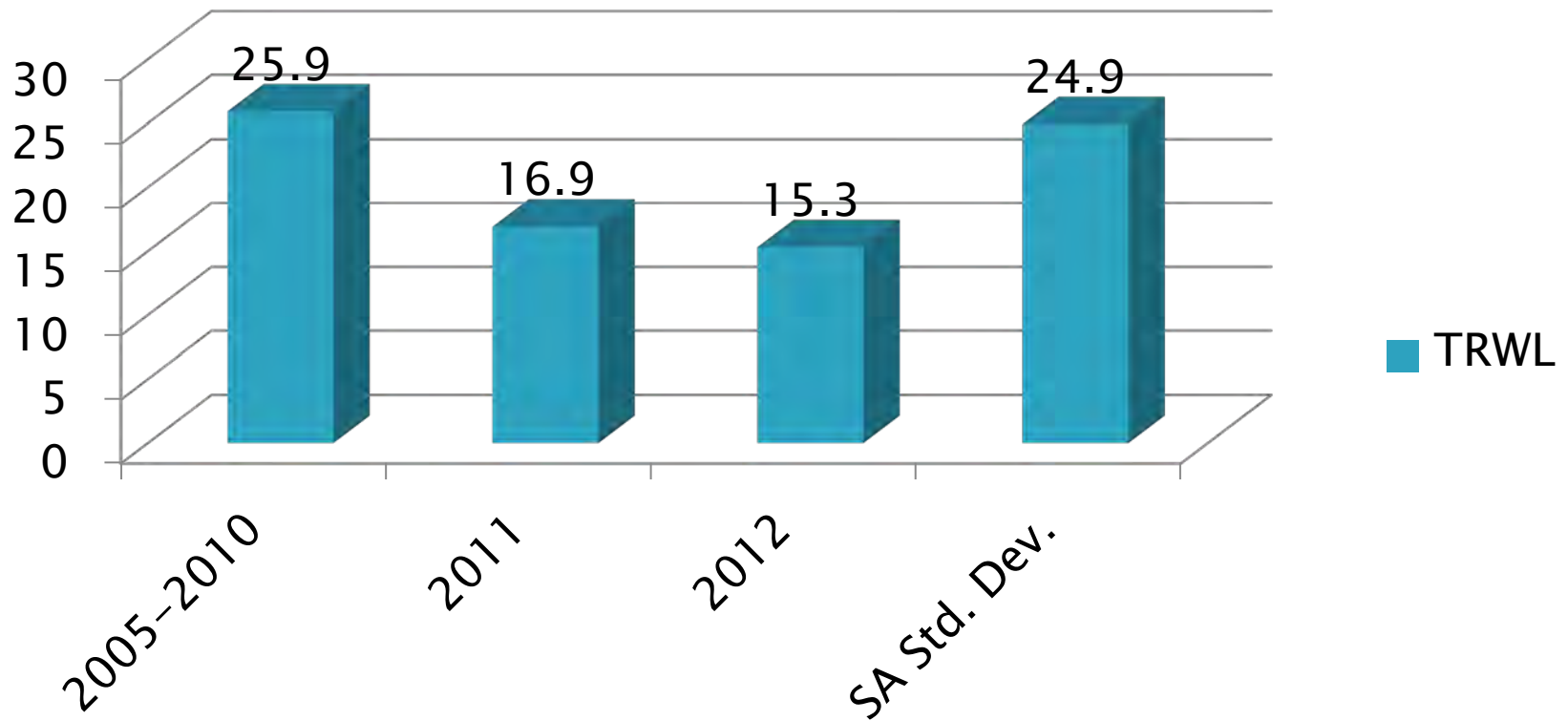


T-12 Precision Estimates



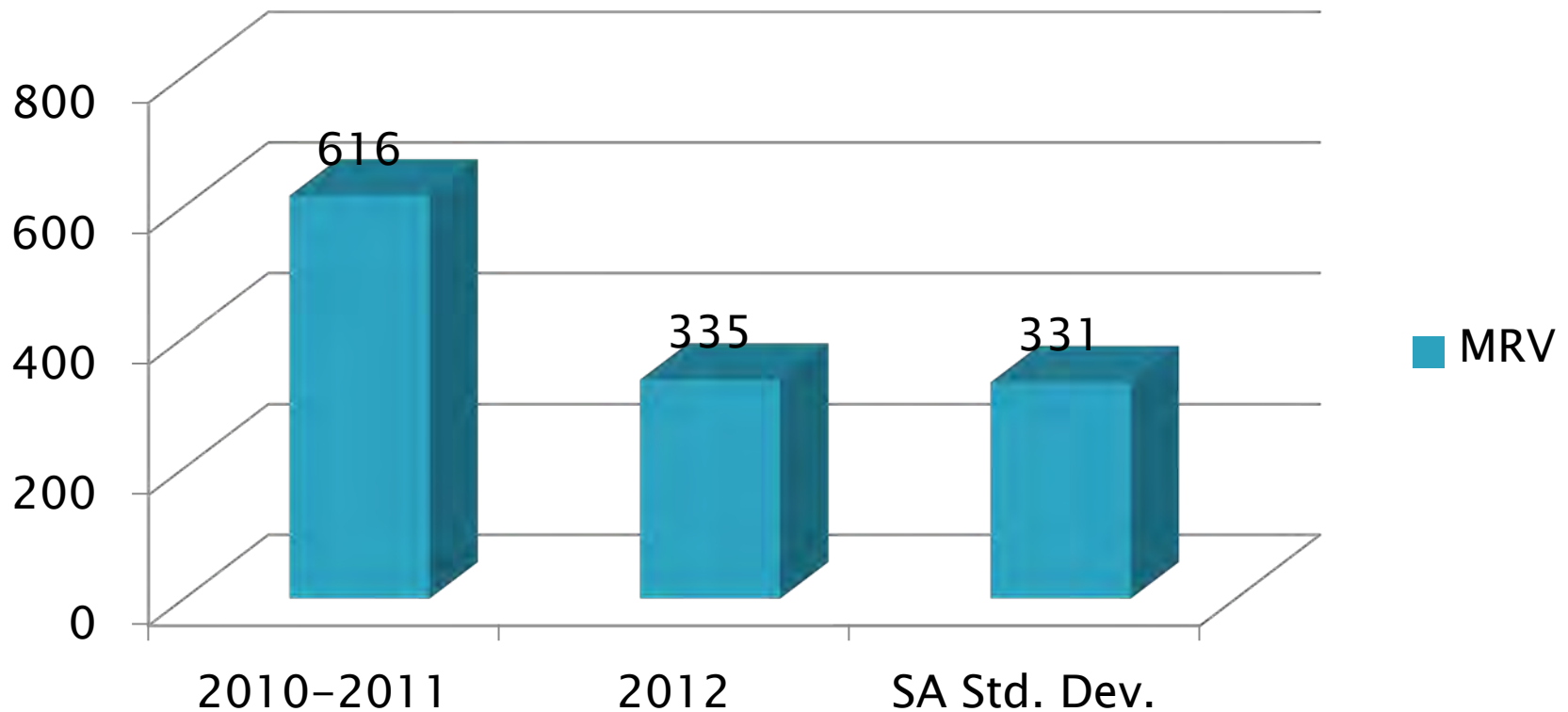
T-12 Precision Estimates

TRWL



T-12A Precision Estimates

MRV



Information Letters

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Information Letters*

Test	Date	IL	Topic
EOAT	5/17/2012	12-1	Test Specified Fuel Designation Change
T8 T11	5/18/2012	12-1 12-1	Test Specified Fuel Designation Change and Rebuild Allowances
1N 1P 1R	5/24/2012	12-1 12-1 12-1	Test Specified Fuel Designation Change
RFWT ISM	6/11/2012	12-1 12-1	Test Specified Fuel Designation Change
T12	6/18/2012	12-1	Updated STWN Hardware Correction Factors
ISB	8/30/2012	12-2	Calibration Period Change
T10/T10A	9/20/2012	12-1	Test Specified Fuel Designation 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 Re-blends

➤ T12 Oil Supply

- Need to consider acquiring more oil if T12 is not replaced by T13

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	30	2540	130	5+ years
811-2	1K, 1N	1732	10	1315	80	5+ years
820-3	1R, T-10A, T-11	2750	196	0	30	~ 1 year
822	1R, T-10A, T-11	5000	252	4748	140	5+ years
821-2	T-12	450	50	38	75	~ 1 year
821-3	T-12	1500	500	1000	225	1.8 years
830-2	ISM	3786	100	937	300	5+ years
831-1	C13, ISB	1300	160	95	200	~ .7 years
831-2	C13, ISB	880	0	880	0	5+ years
873-2	1M-PC	1650	30	218	40	5+ years
1005-3	1P, 1R, EOAT, RFWT, T-8/E	2000	520	105	342	~ 1 year
1005-4	1P, 1R, EOAT, RFWT, T-8/E	2000	0	2000	0	5+ years

LTMS Deviations

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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

Quality Index Deviations

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Quality Index Deviations

- One C13 Quality Index Deviation this period
 - Fuel Flow low
 - Caused by fault code and subsequent engine derate
 - Adequate control restored once fault was cleared

Historical Count of HD Quality Index Deviations

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

TMC Laboratory Visits

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TMC Lab Visits

Test	Number of Labs Visited
ISB	1
ISM	1
T11	1
T12	1

TMC Lab Visits

- ISB and ISM lab visits this period
 - Stands using Fleetguard Compleat EG versus specified Fleetguard Compleat PG
- T11 and T12 visits this period
 - Full instrumentation calibration before reference test not completed.

Test Area Timelines

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Test Area Timeline Additions*

Test	Date	Topic	IL
T-8/8E	20120502	PARTIAL REBUILD ALLOWANCE	12-1
T-11	20120502	NEWLY REBUILT ENGINE NO LONGER REQUIRES REFERENCE TEST	12-1
T-12	20120605	CORRECTION FACTORS UPDATED FOR ALL PARAMETERS FOR STWN HARDWARE	12-1

*As of 3/31/2012

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Additional Information



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Additional 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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Appendix 1 Heavy Duty Reference Oil Testing Control Charts October 2012

Appendix 1.a

1 K Control Charts

» Severity, Precision, and CuSum

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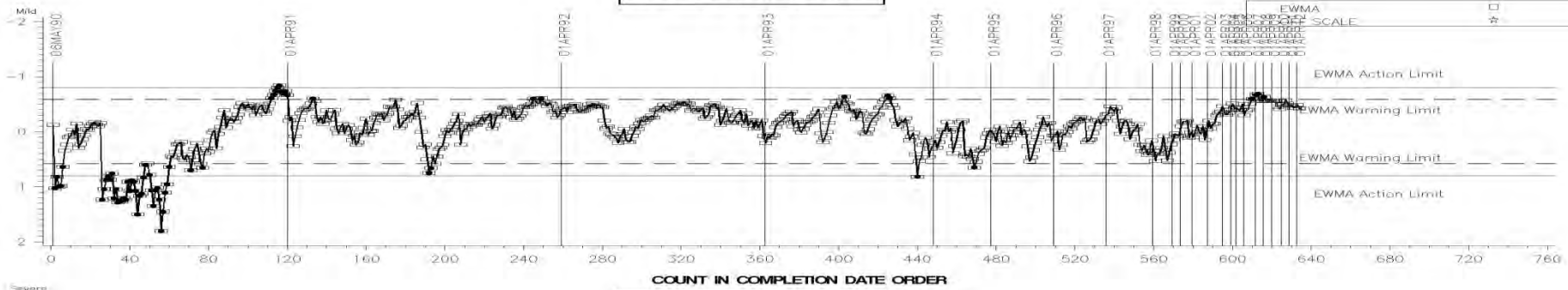
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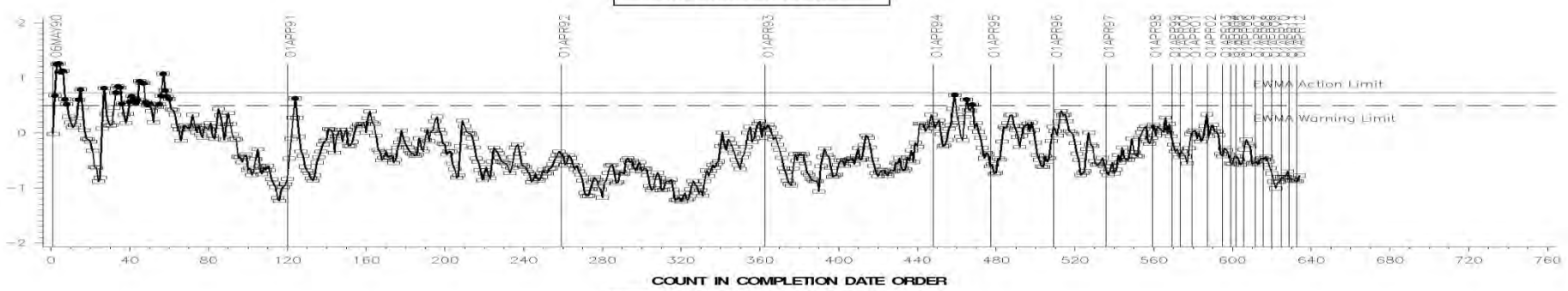
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Top Groove Fill

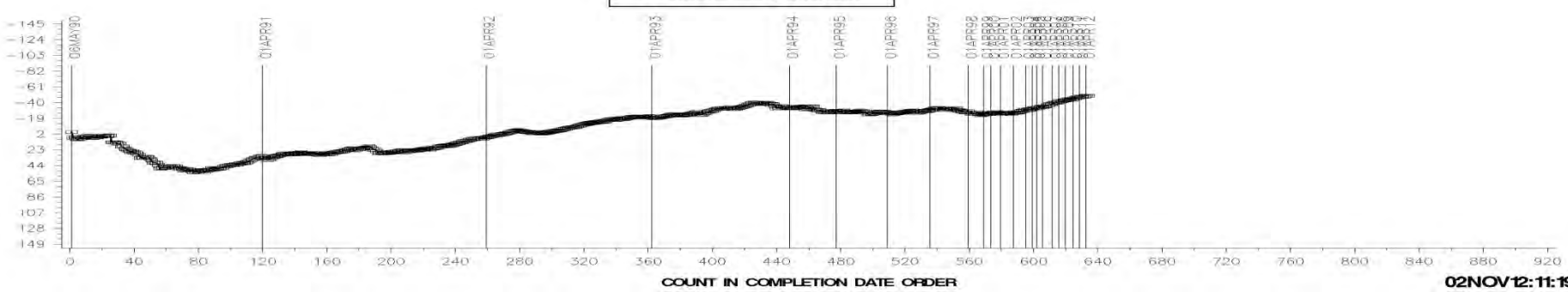
LTMS Severity Analysis



LTMS Precision Analysis



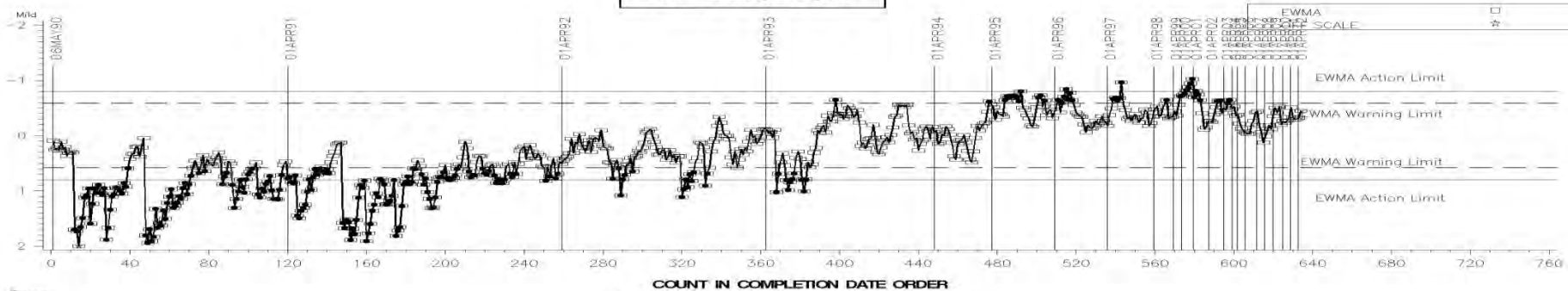
CUSUM Severity Analysis



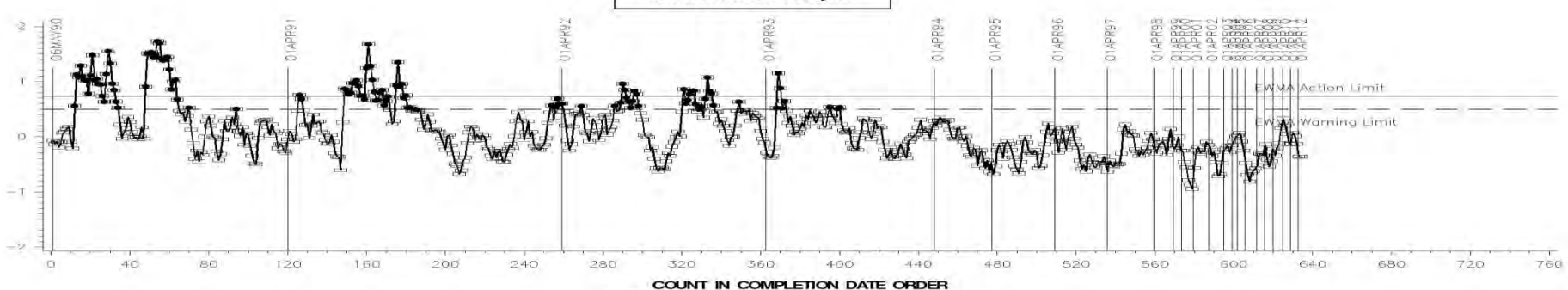
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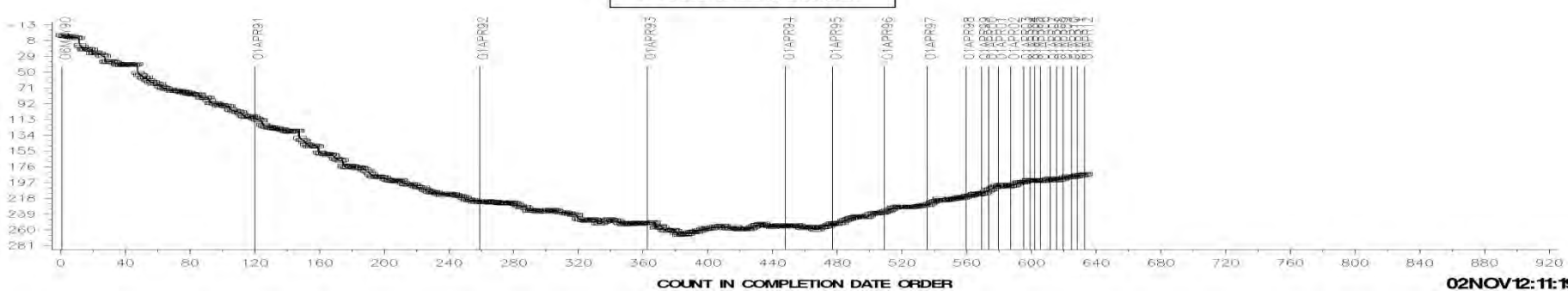
LTMS Severity Analysis



LTMS Precision Analysis



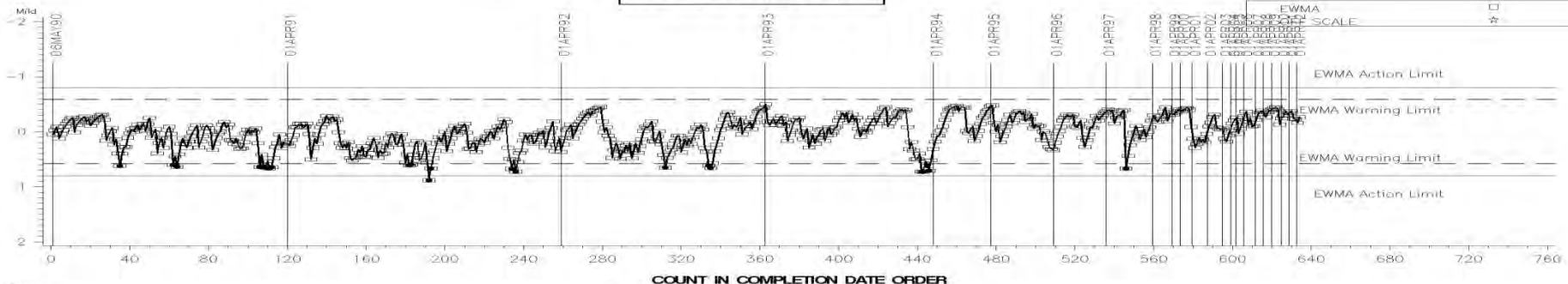
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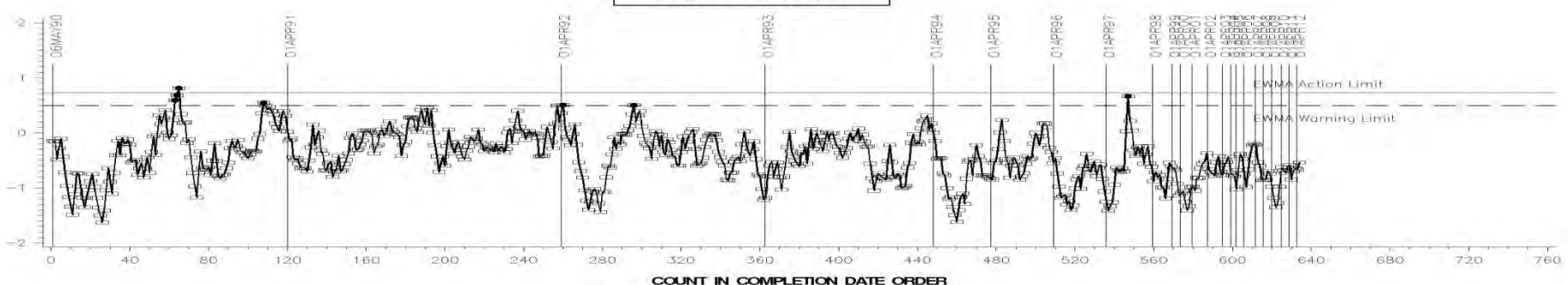
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FINAL TRANSFORMED TOP LAND HEAVY CARBON

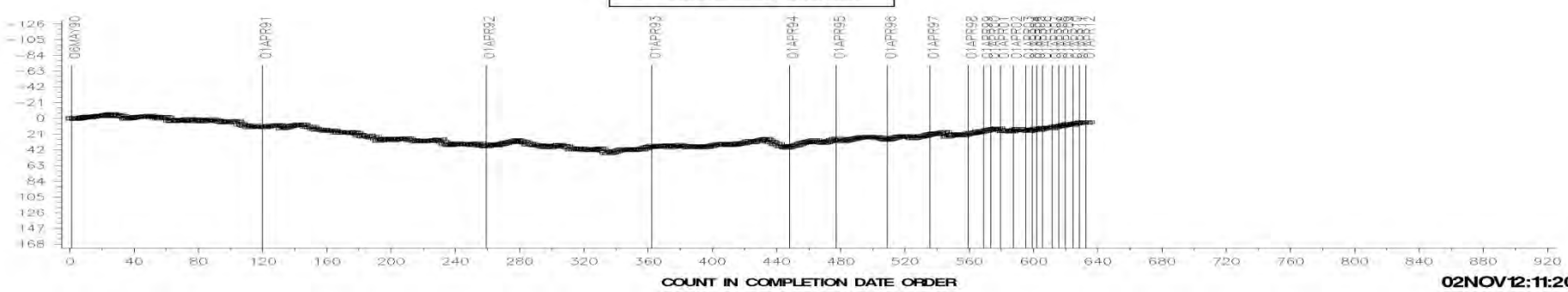
LTMS Severity Analysis



LTMS Precision Analysis



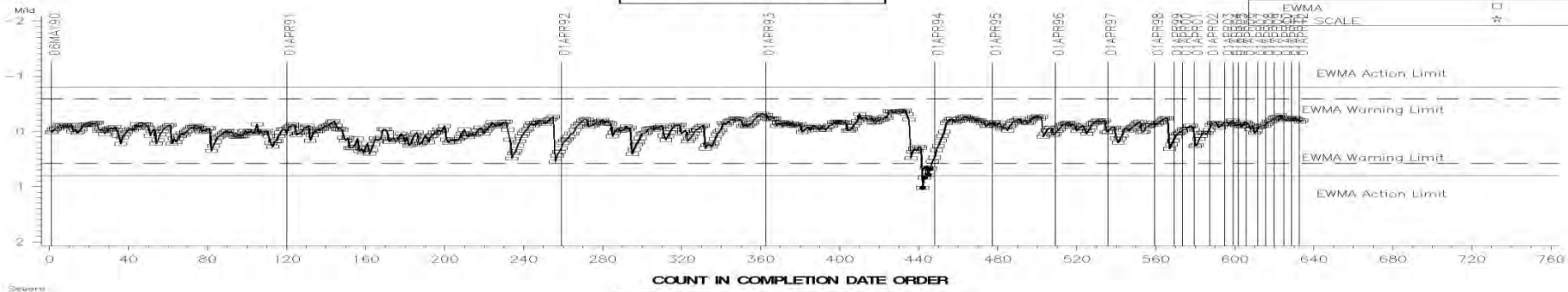
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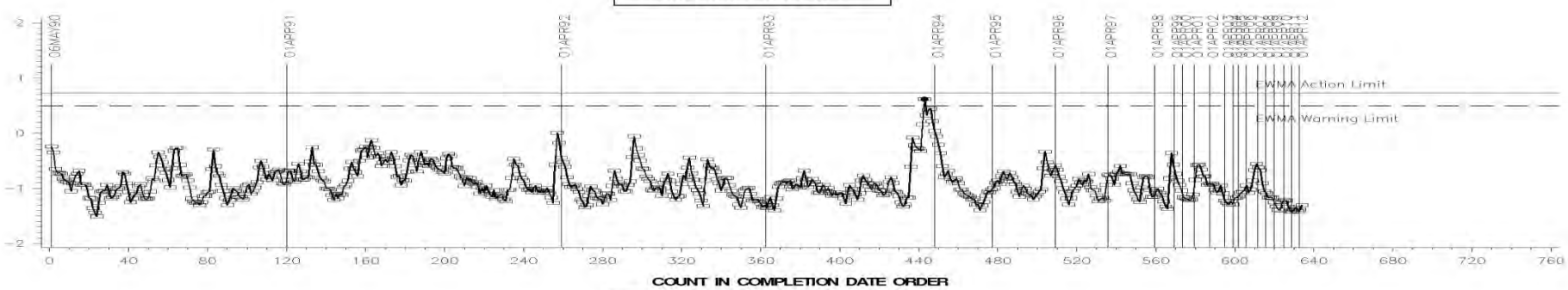
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EOTOC

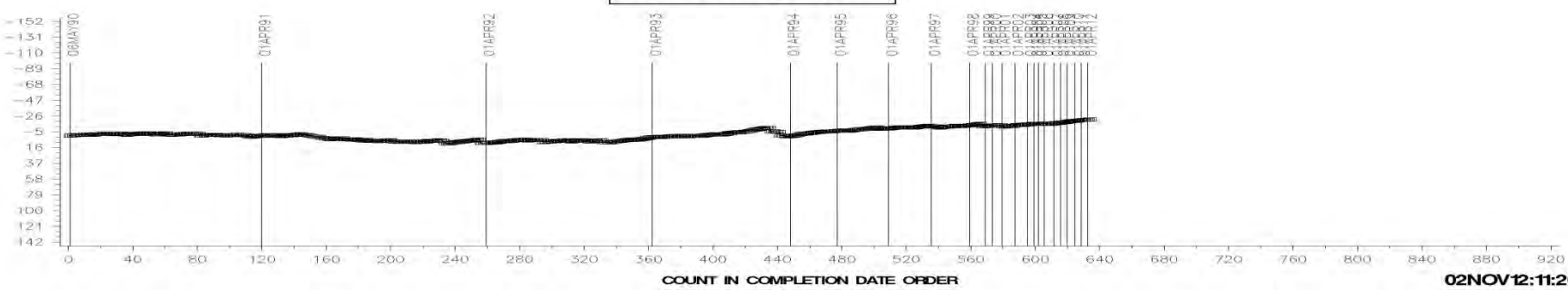
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12:11:20

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Appendix 1.b

1 N Control Charts

» Severity, Precision, and CuSum

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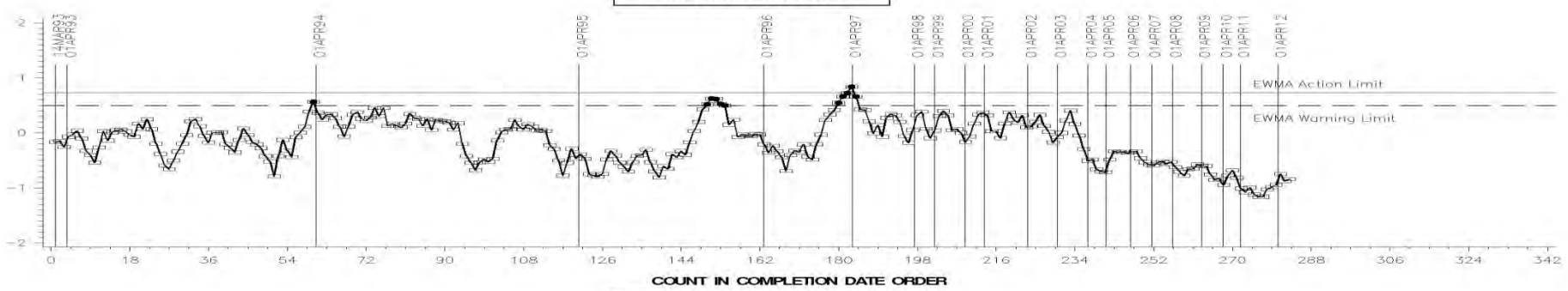
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Top Groove Fill

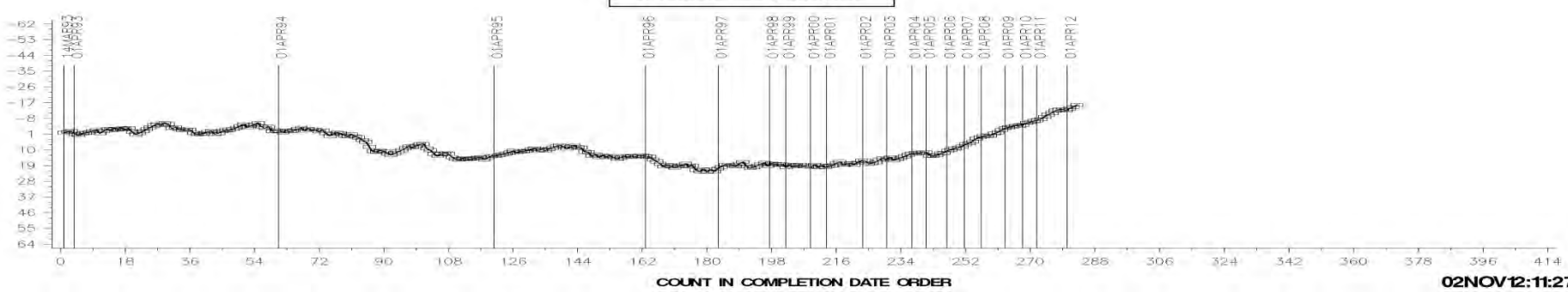
LTMS Severity Analysis



LTMS Precision Analysis



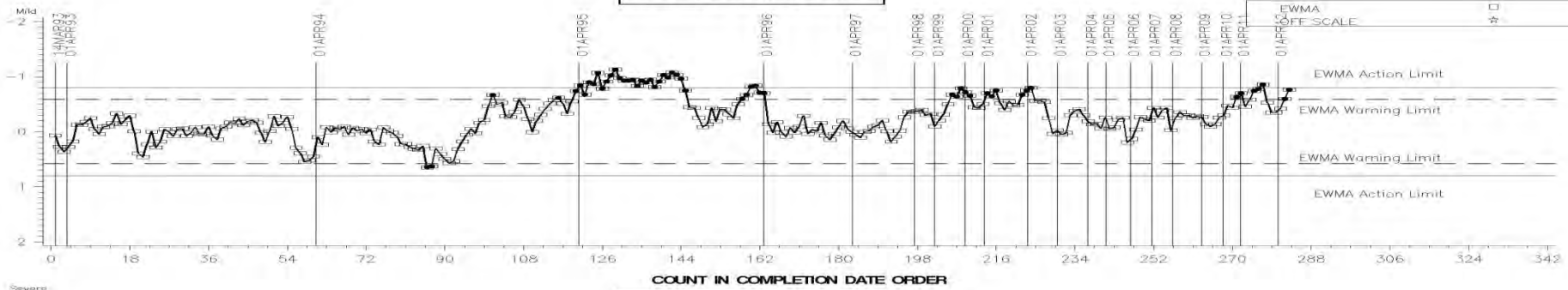
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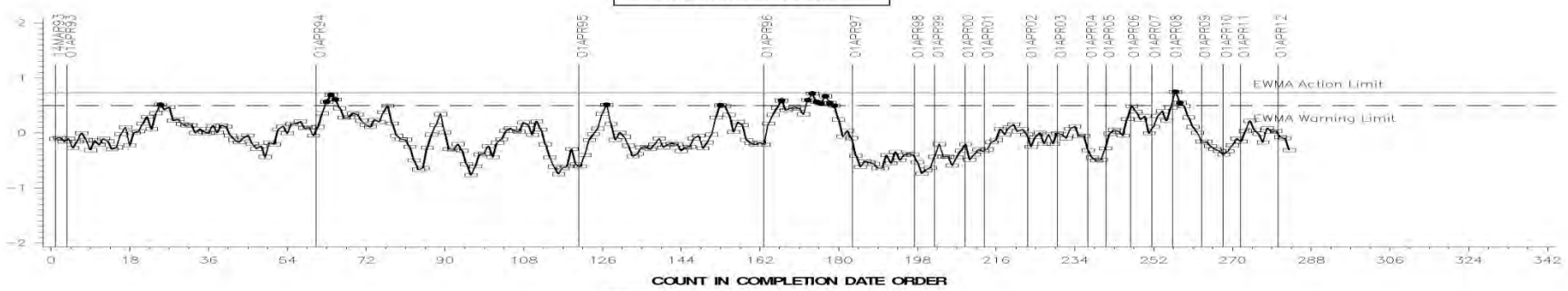
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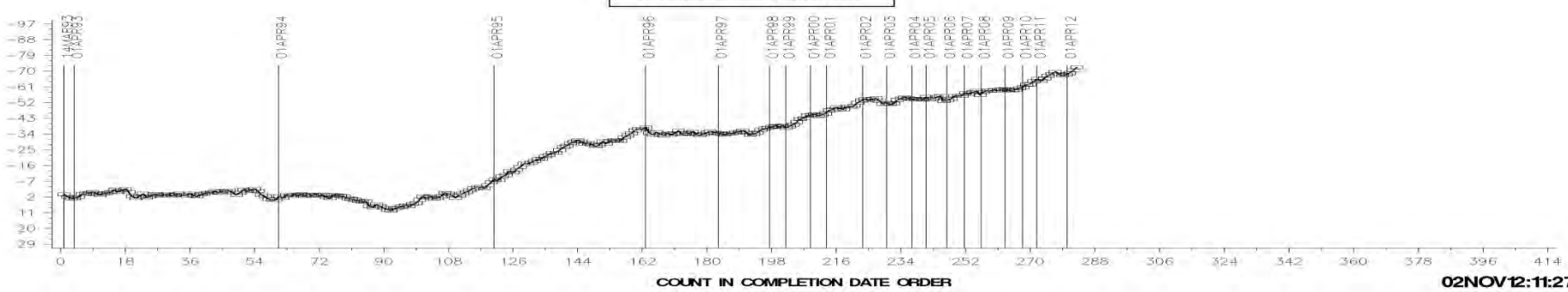
LTMS Severity Analysis



LTMS Precision Analysis



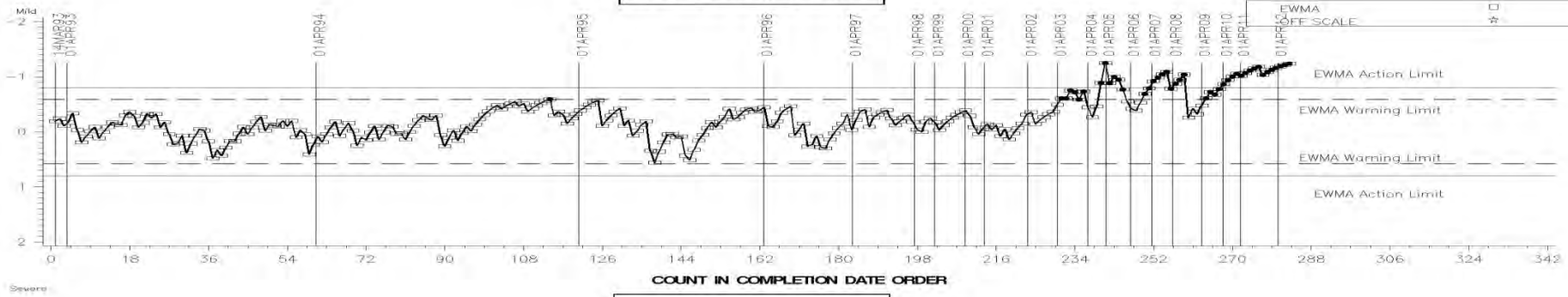
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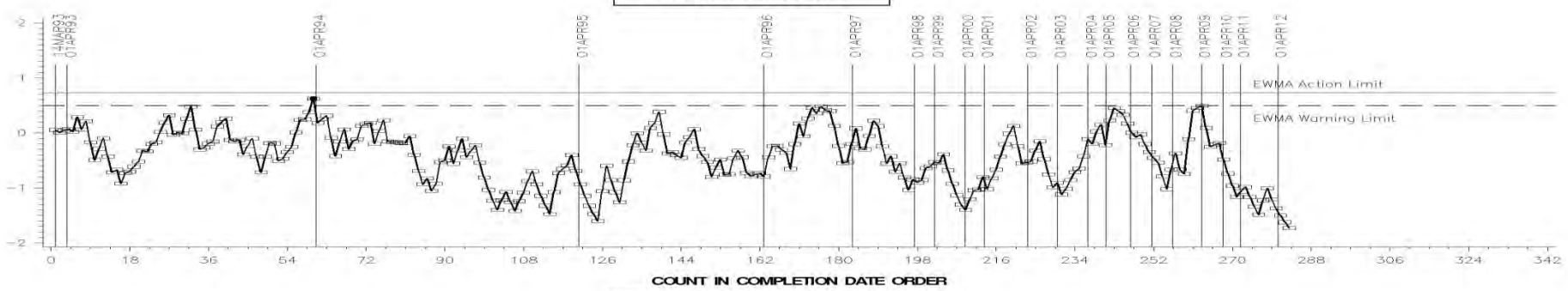
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FINAL TRANS. TOP LAND HEAVY CARBON

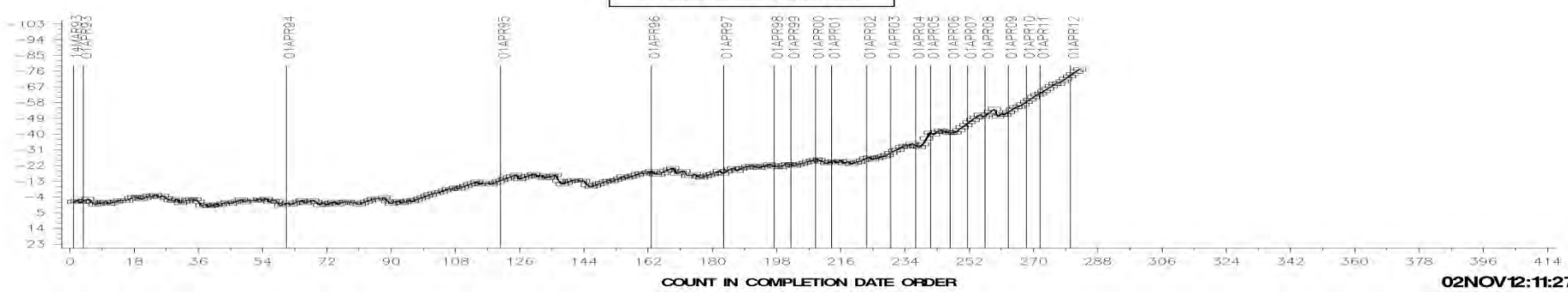
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LTMS Precision Analysis



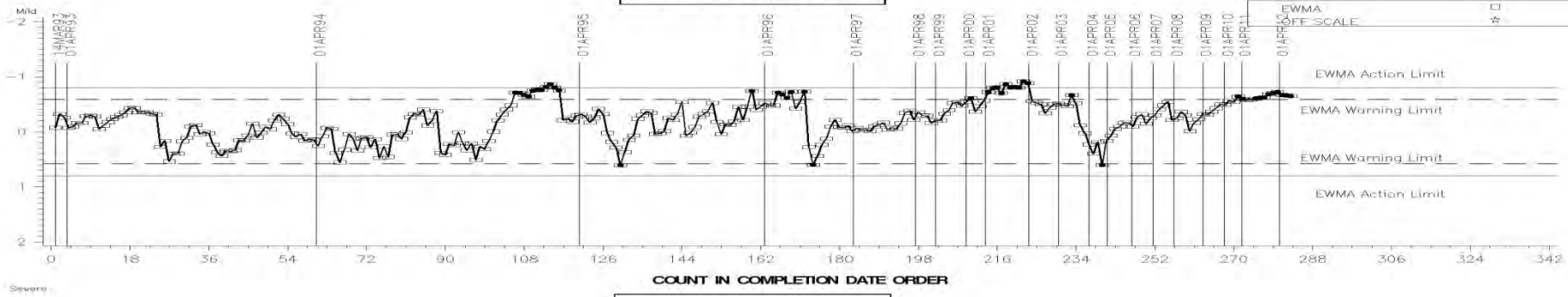
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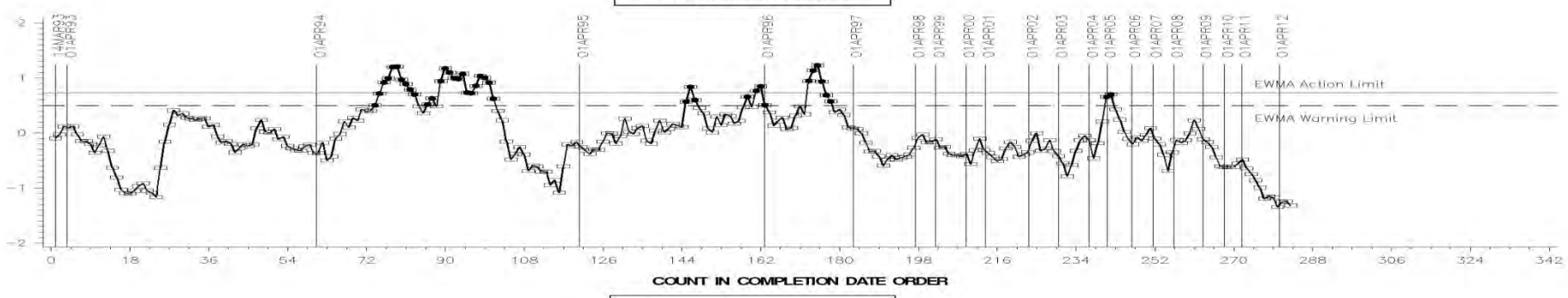
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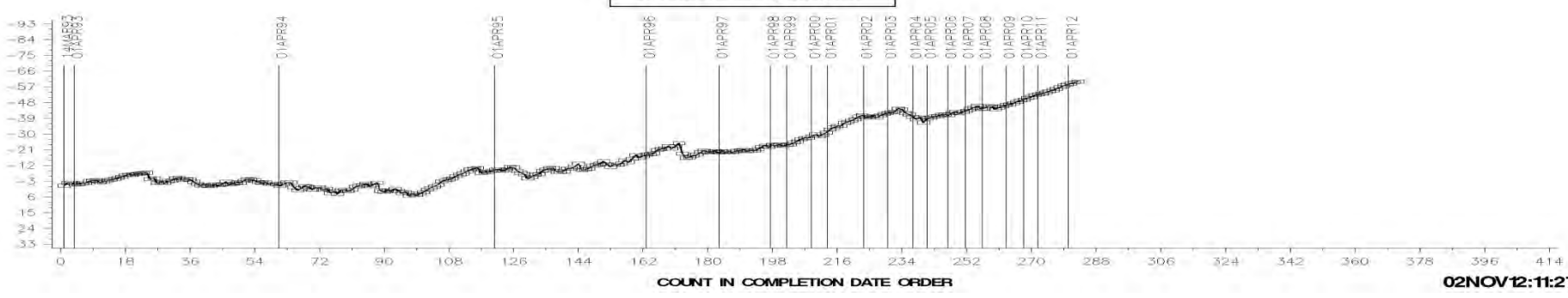
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12:11:27

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Appendix 1.c

1 M-PC Control Charts

» Severity, Precision, and CuSum

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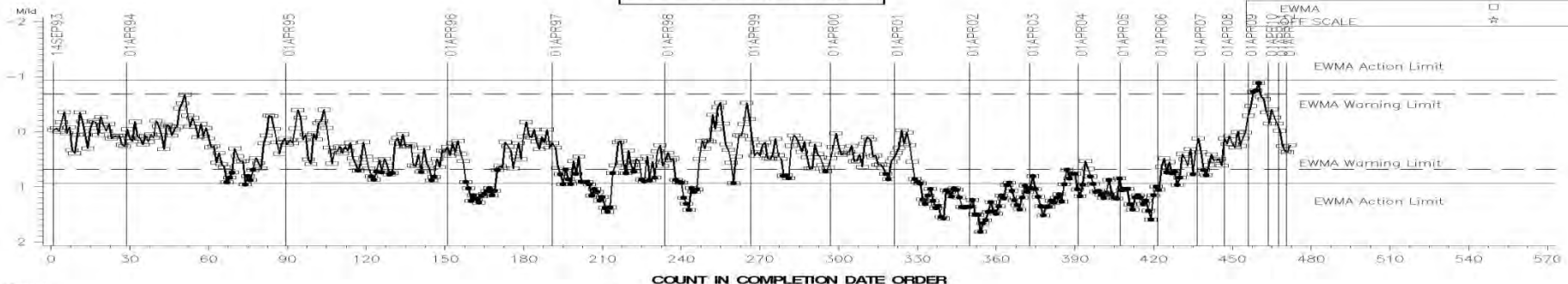
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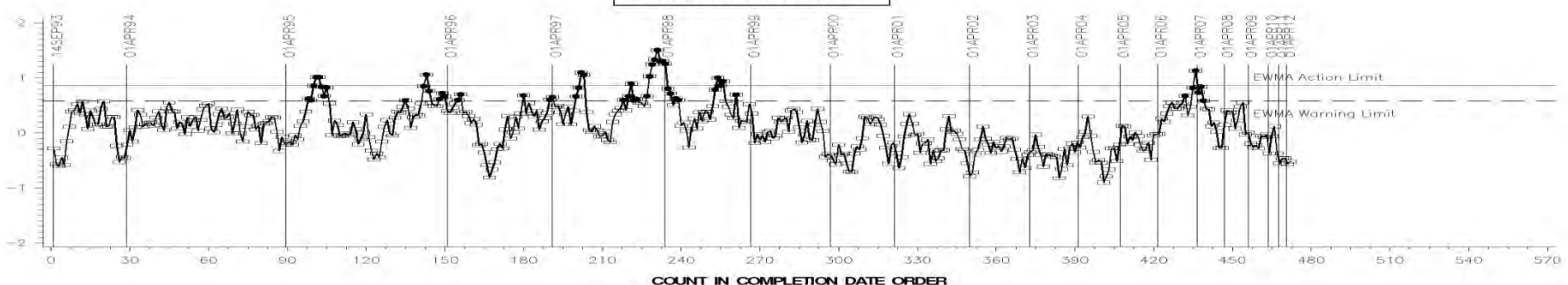
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FINAL TOP GROOVE FILLING

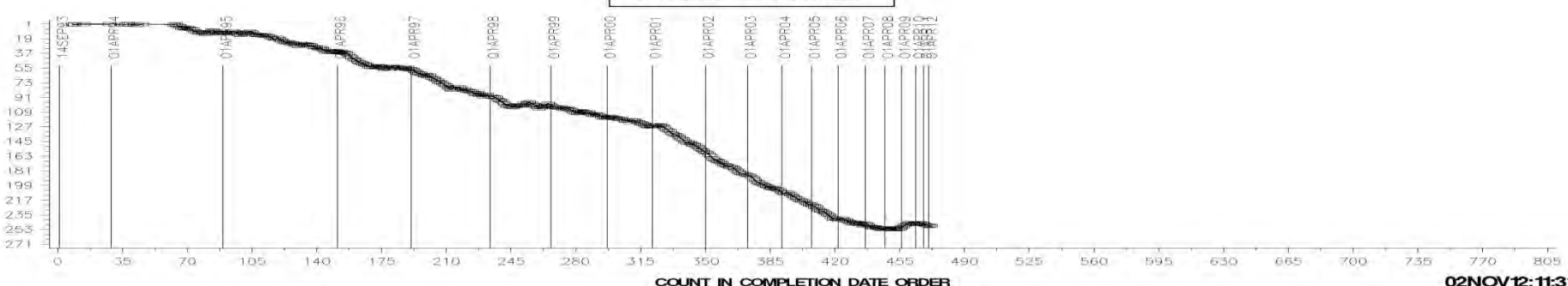
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



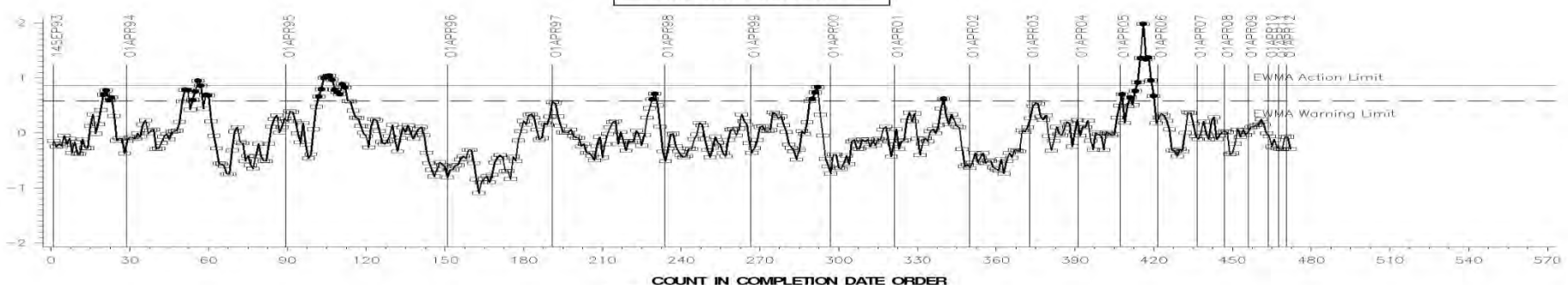
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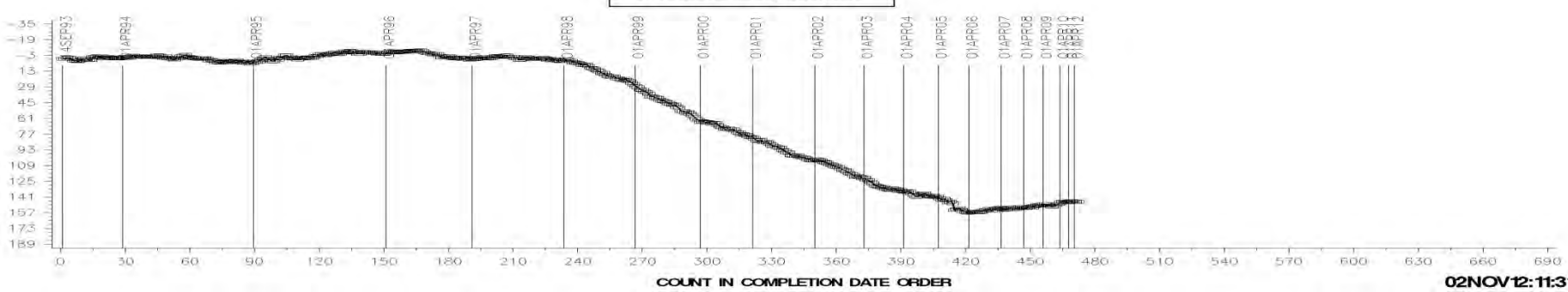
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12: 11:31

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Appendix 1.d

1 P Control Charts

» Severity, Precision, and CuSum

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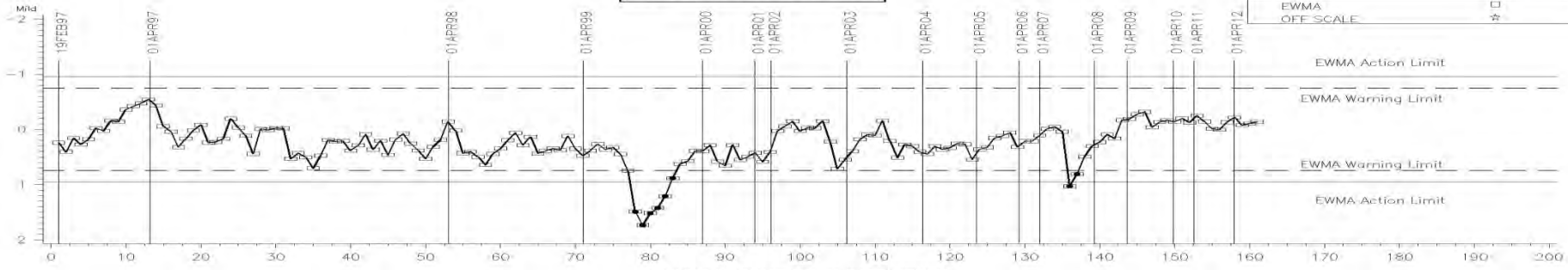
<http://astmtmc.cmu.edu>



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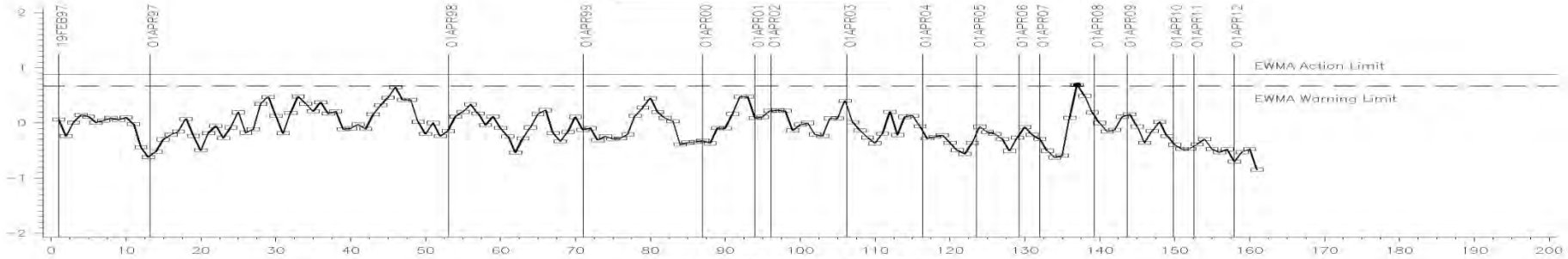
TOP GROOVE CARBON

LTMS Severity Analysis



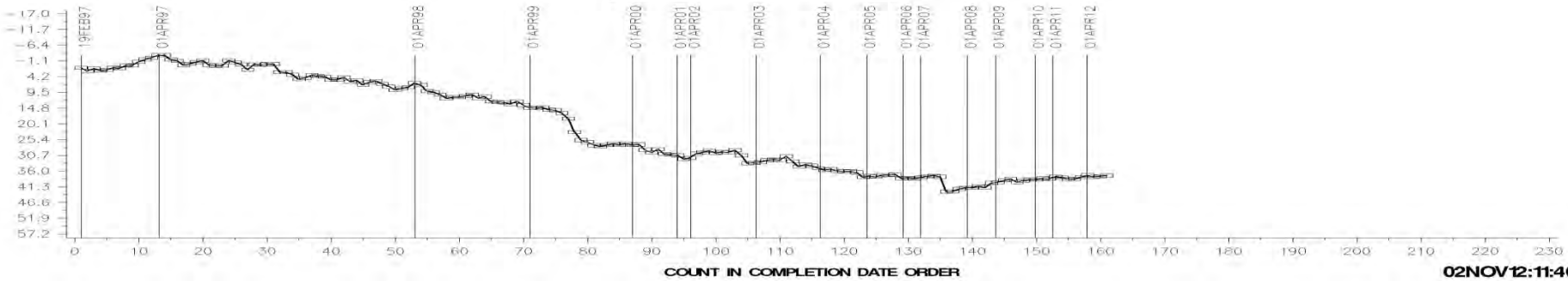
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

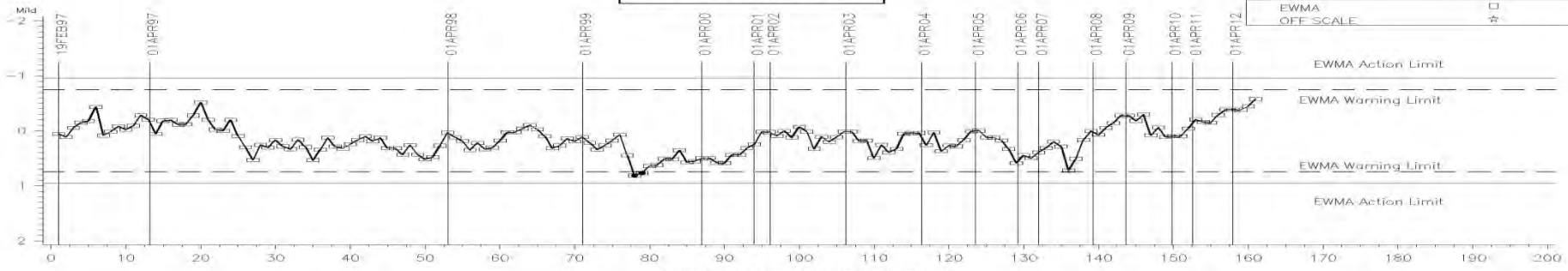


COUNT IN COMPLETION DATE ORDER

02NOV12:11:40

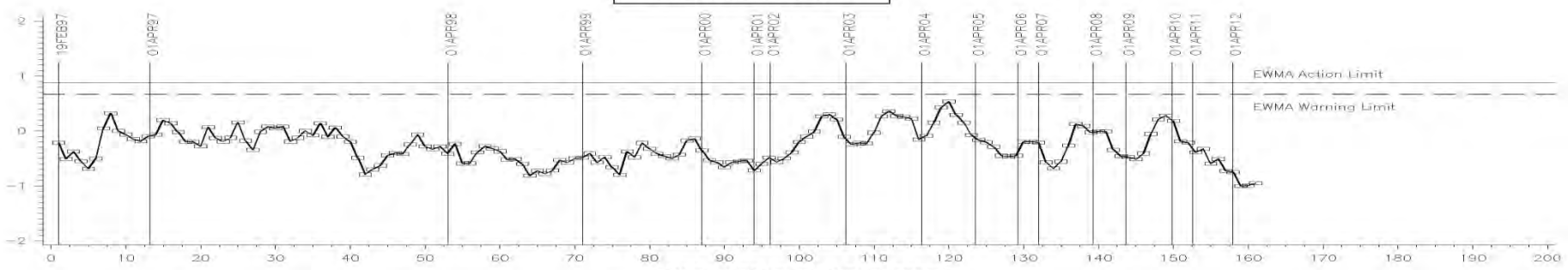
TOP LAND CARBON

LTMS Severity Analysis



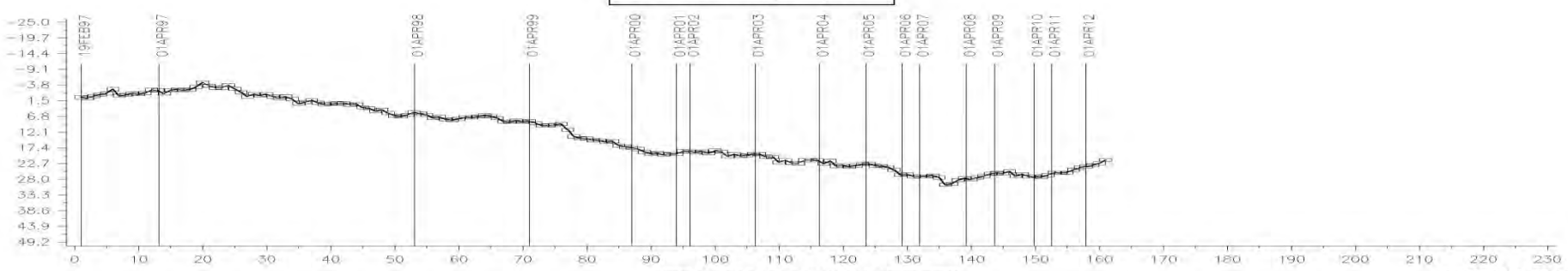
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

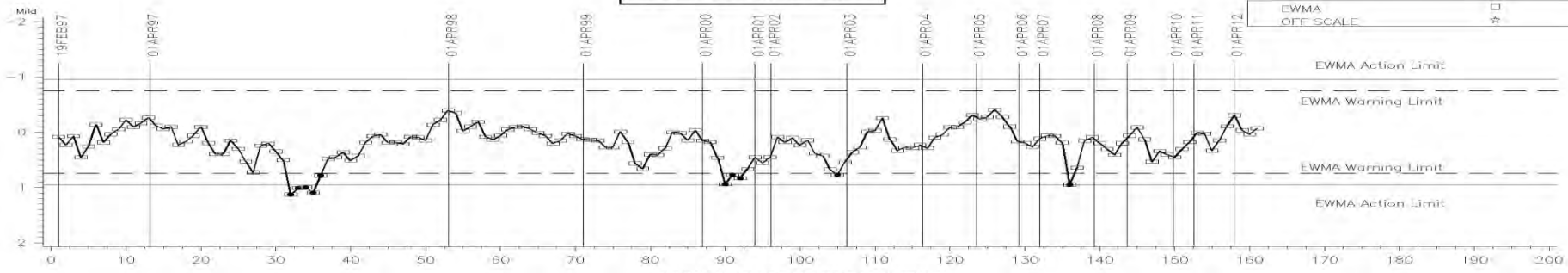


COUNT IN COMPLETION DATE ORDER

02NOV12:11:40

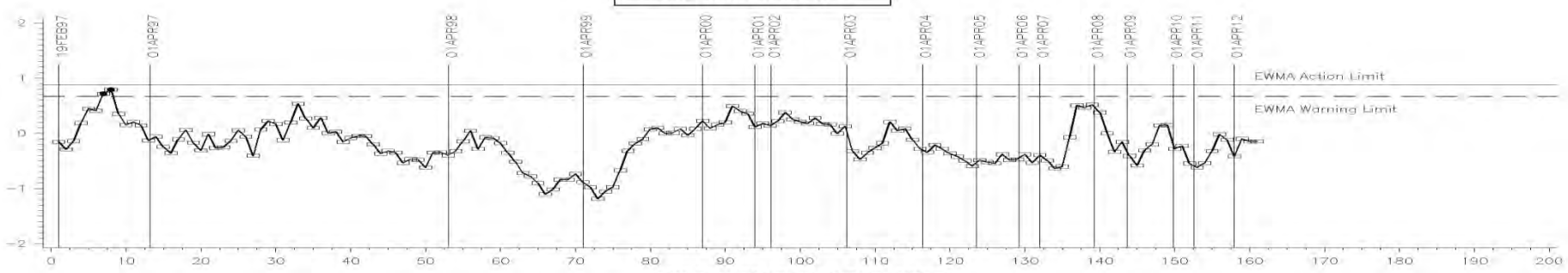
WEIGHTED TOTAL DEMERITS

LTMS Severity Analysis



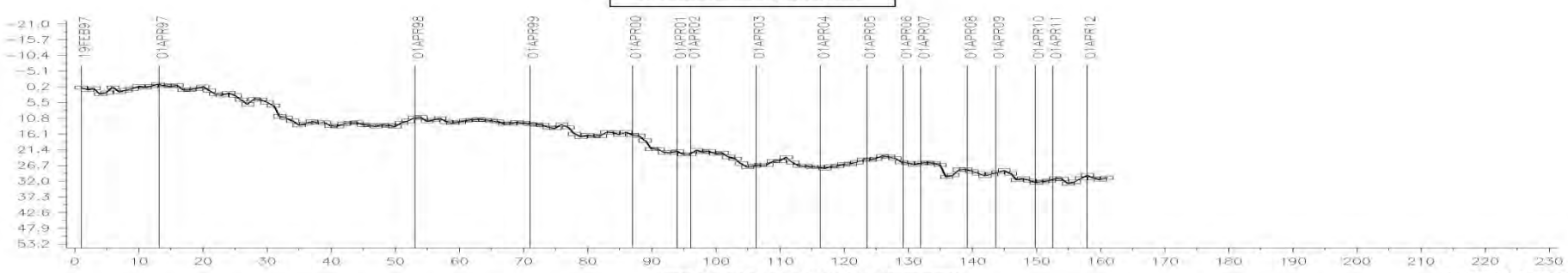
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

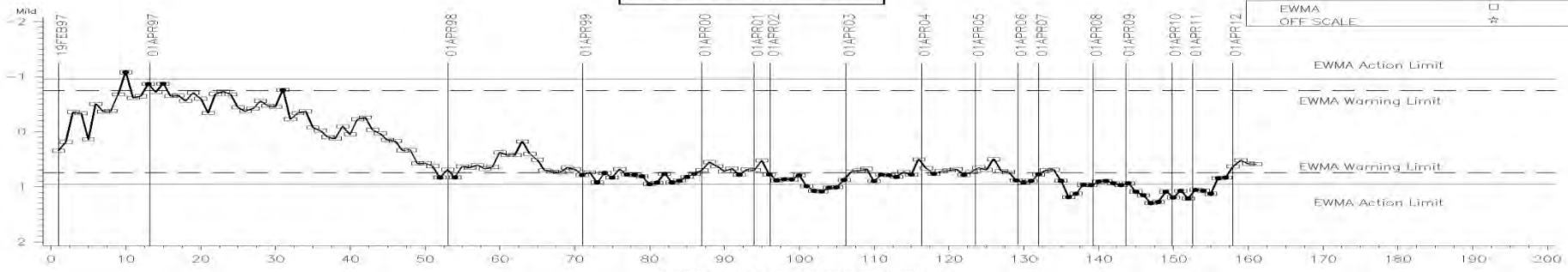


COUNT IN COMPLETION DATE ORDER

02NOV12:11:40

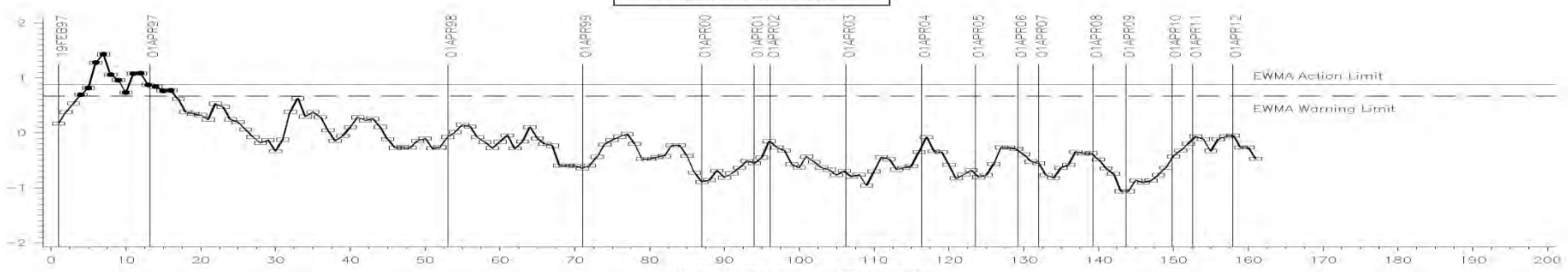
OIL CONSUMPTION

LTMS Severity Analysis



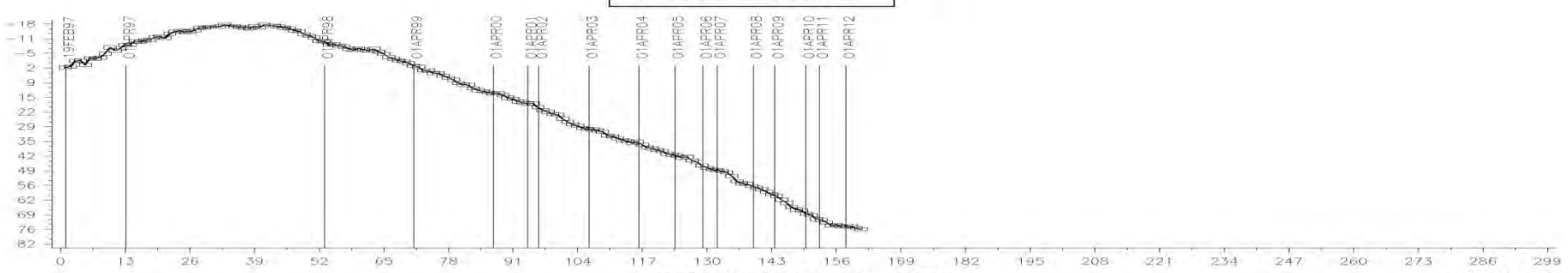
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

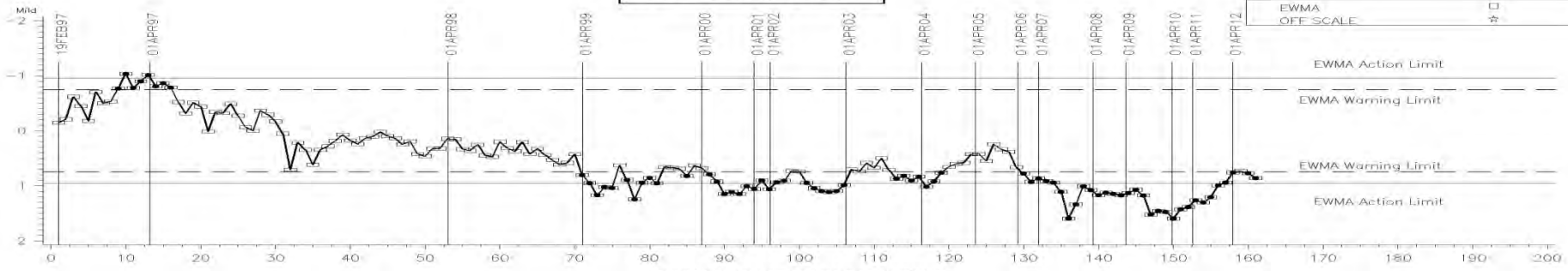
CUSUM Severity Analysis



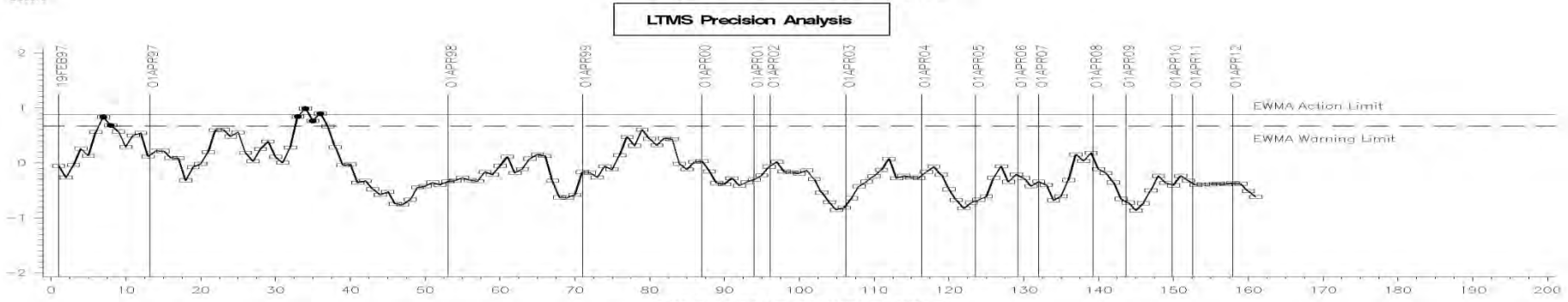
02NOV12:11:40

EOTOC

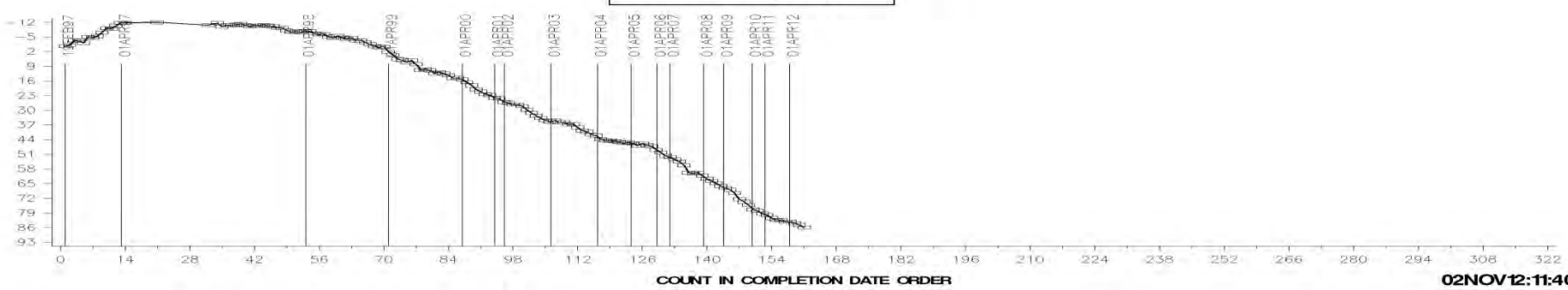
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12:11:40

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Appendix 1.e

1 R Control Charts

» Severity, Precision, and CuSum

Test Monitoring Center

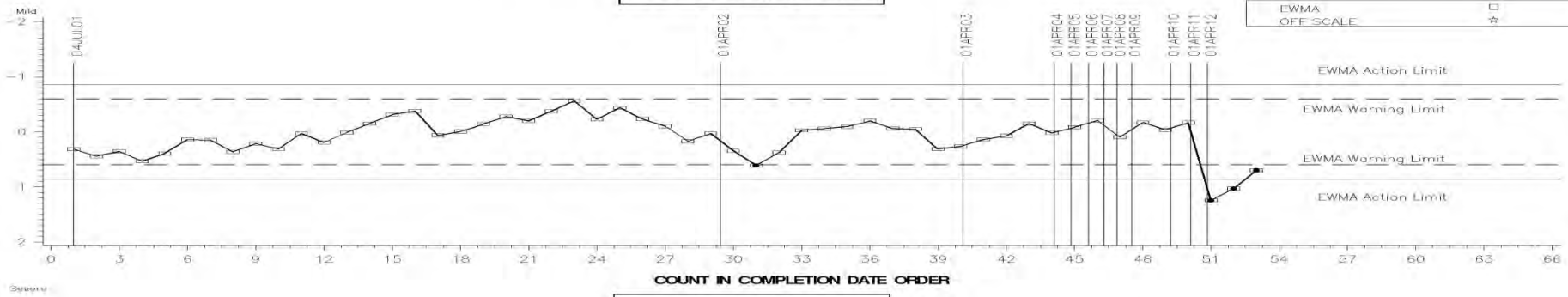
<http://astmtmc.cmu.edu>



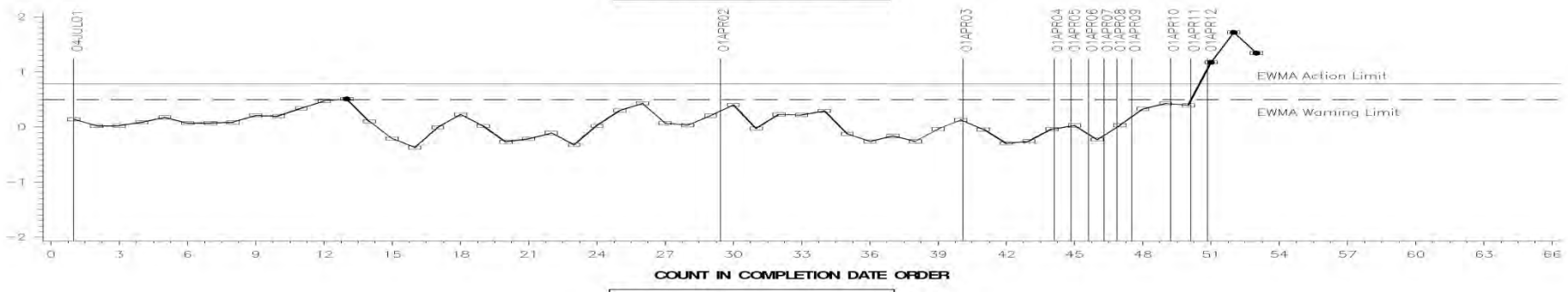
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FINAL WEIGHTED TOTAL DEMERITS (DEMERITS)

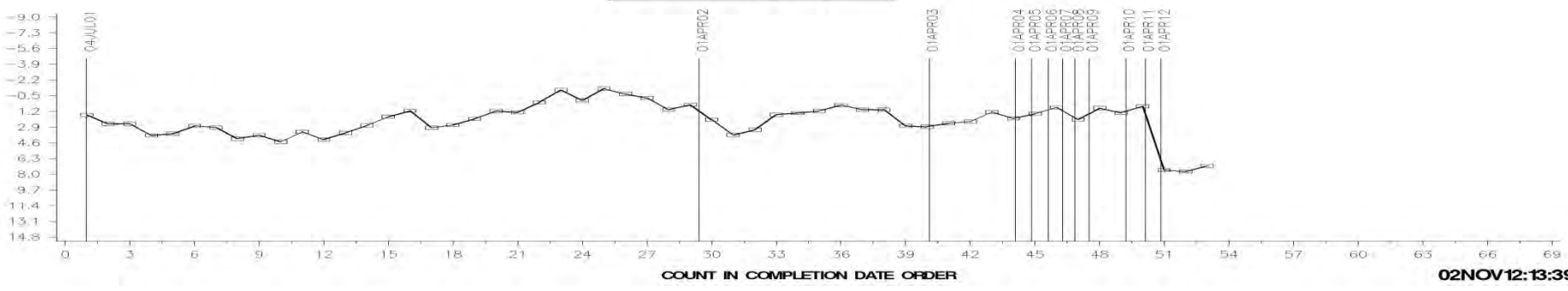
LTMS Severity Analysis



LTMS Precision Analysis



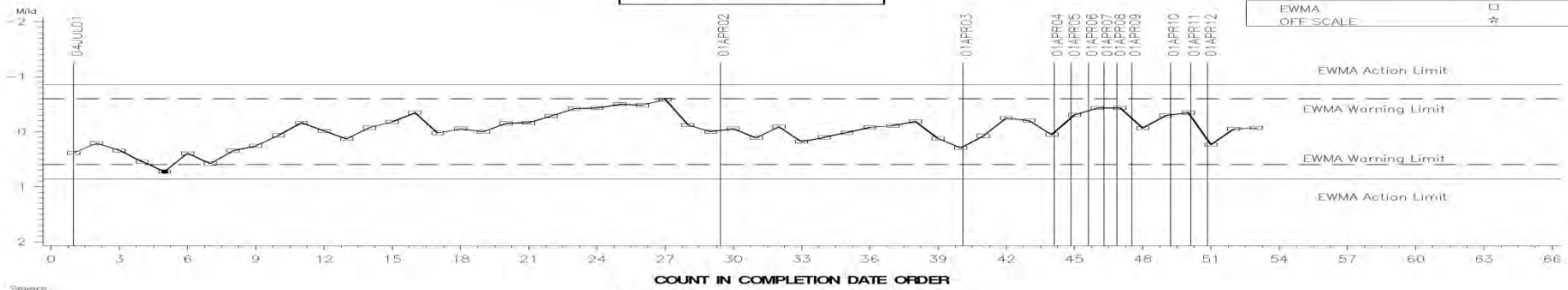
CUSUM Severity Analysis



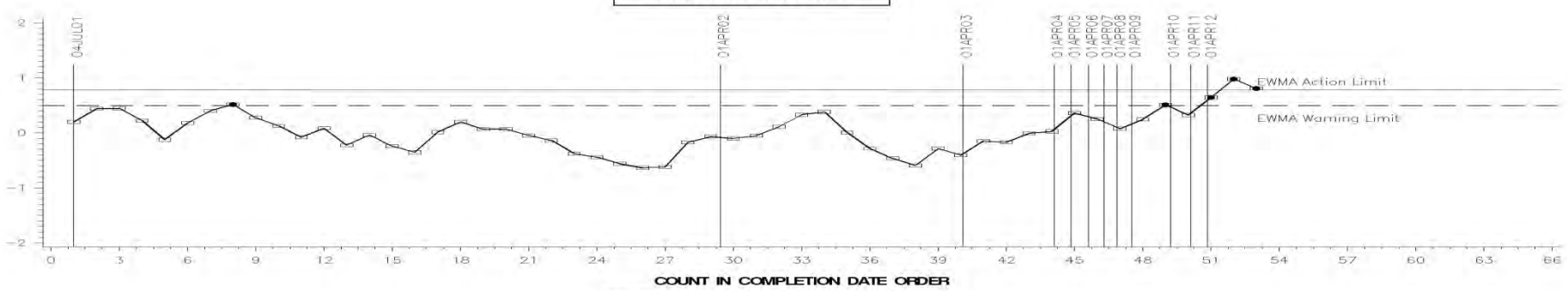
02NOV12:13:39

FINAL TOP GROOVE CARBON (DEMERITS)

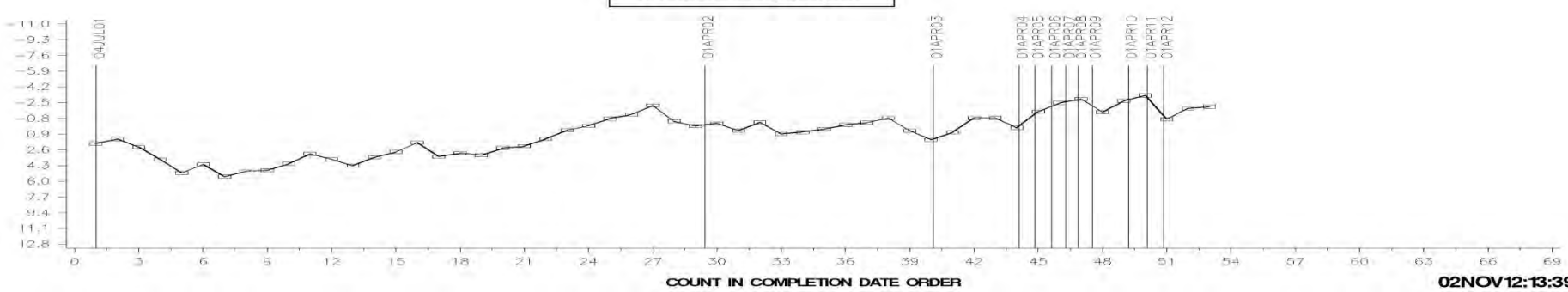
LTMS Severity Analysis



LTMS Precision Analysis



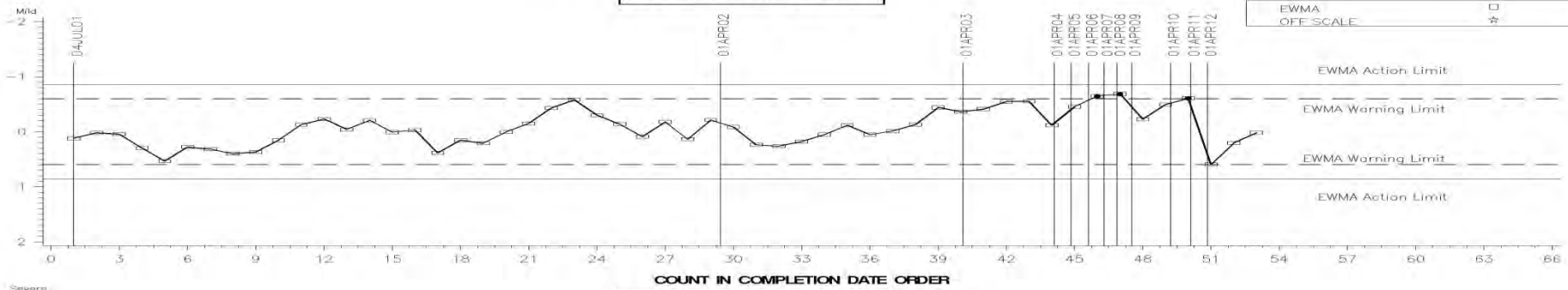
CUSUM Severity Analysis



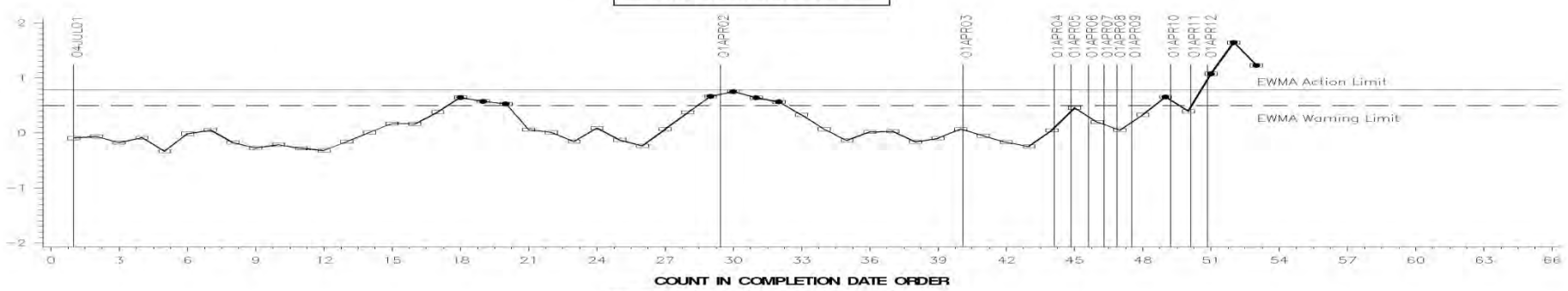
02NOV12:13:39

FINAL TOP LAND CARBON (DEMERITS)

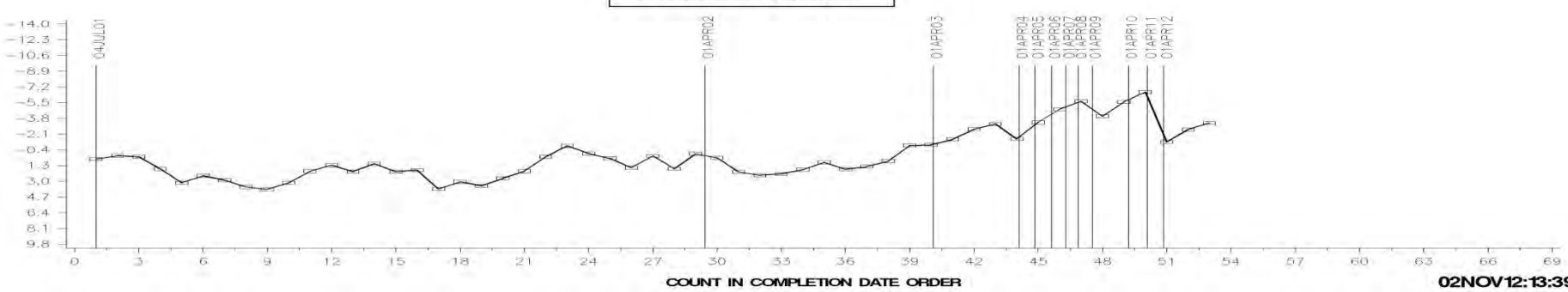
LTMS Severity Analysis



LTMS Precision Analysis



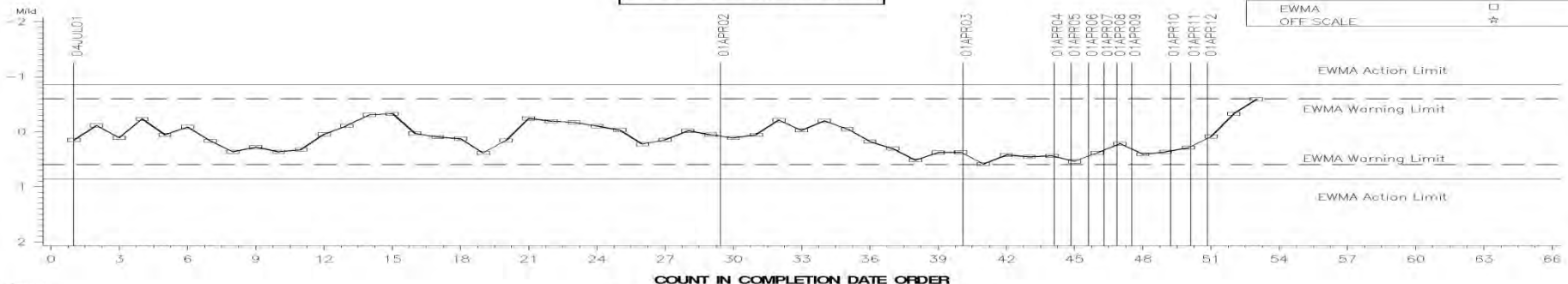
CUSUM Severity Analysis



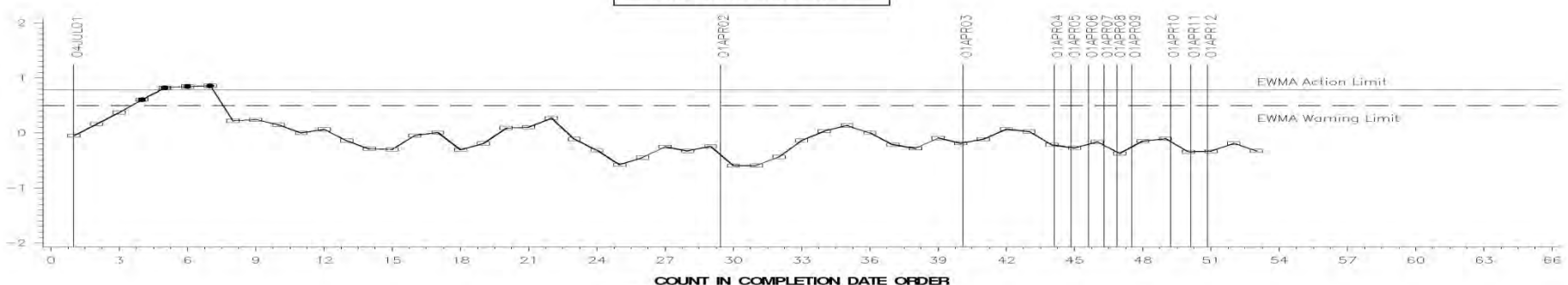
02NOV12:13:39

FINAL BOTOC

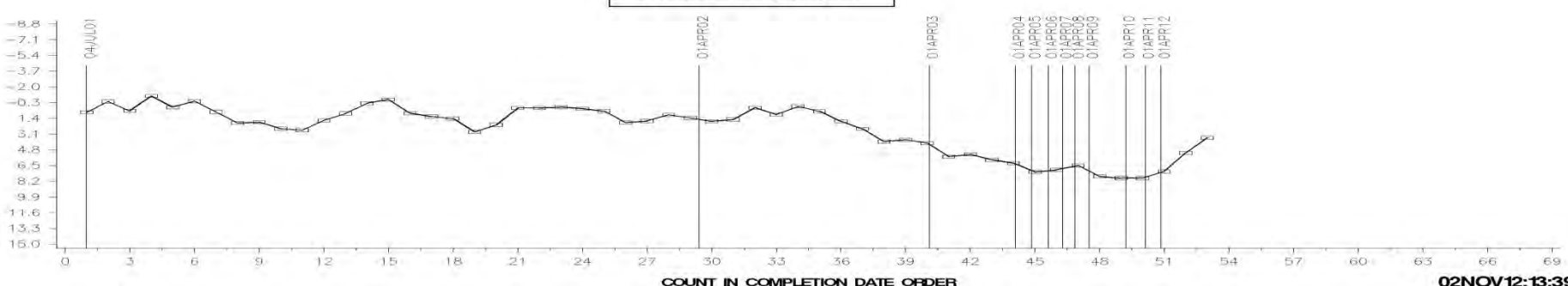
LTMS Severity Analysis



LTMS Precision Analysis



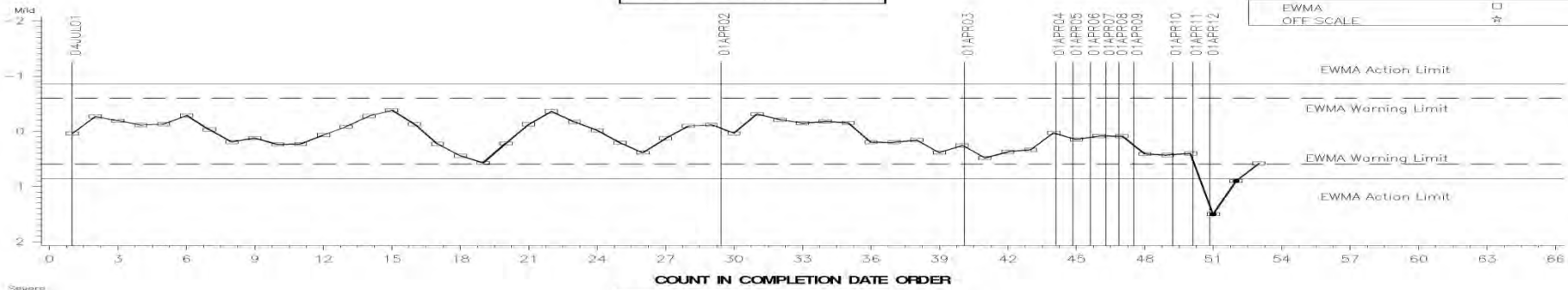
CUSUM Severity Analysis



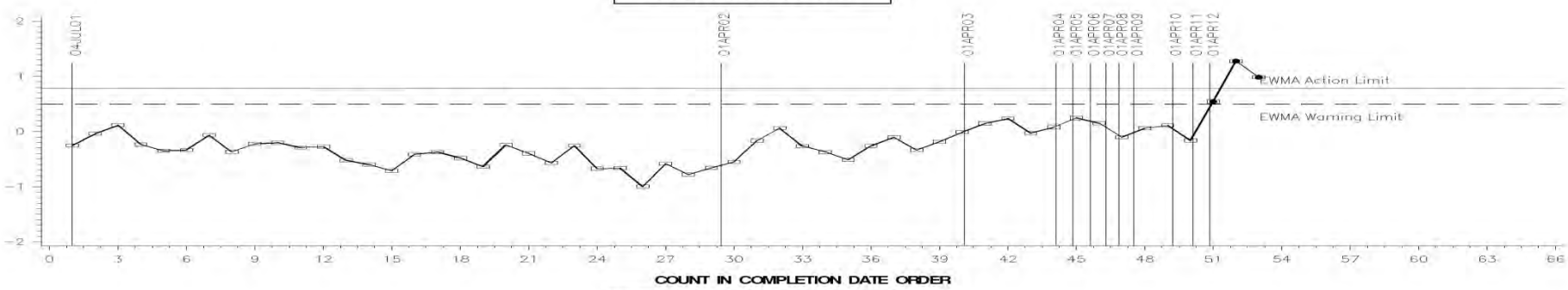
02NOV12:13:39

FINAL EOTOC (g/h)

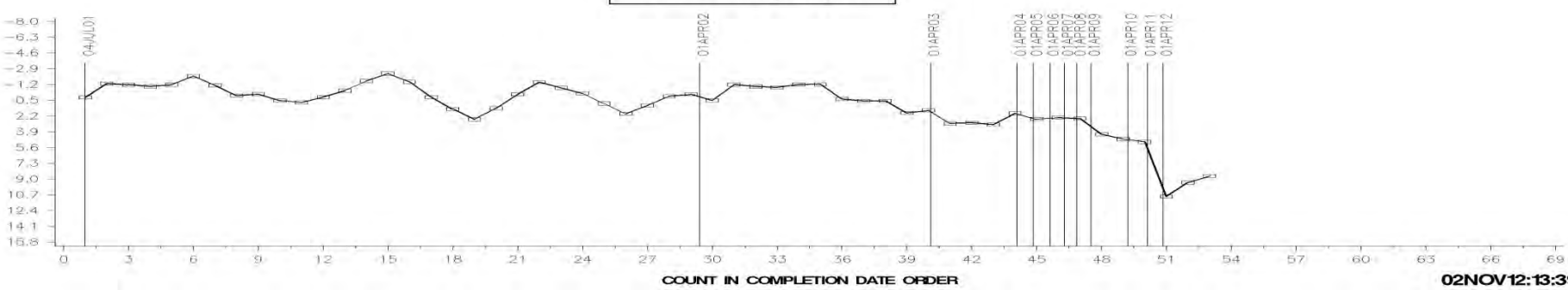
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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Appendix 1.f

C13 Control Charts

» Severity and CuSum

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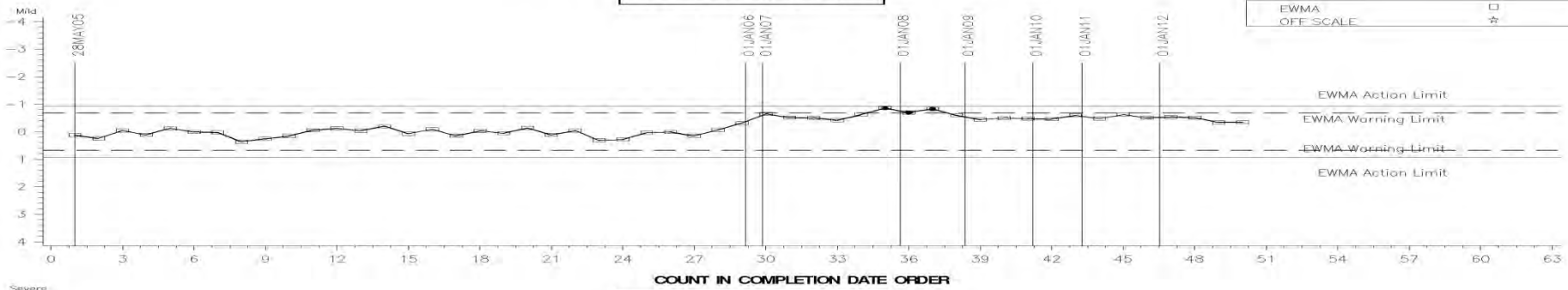


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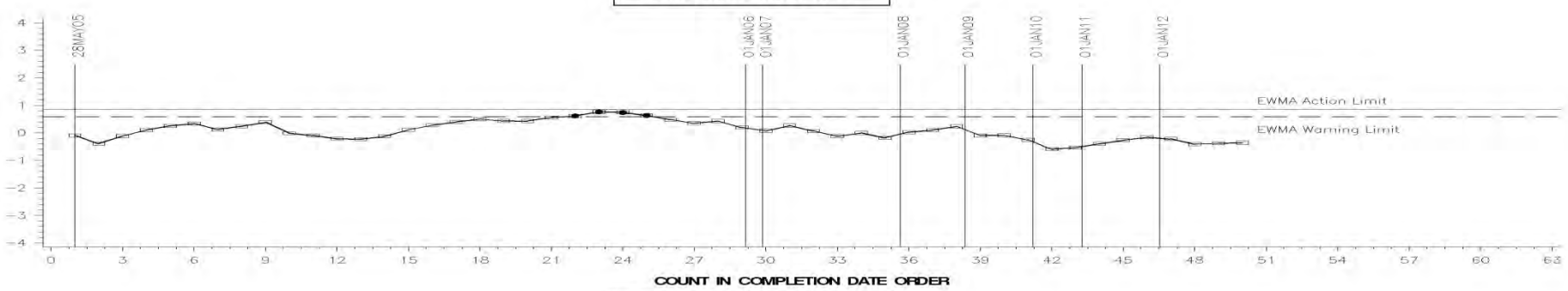
C13 INDUSTRY OPERATIONALLY VALID DATA

TOP LAND CARBON AVG. — FINAL RESULT

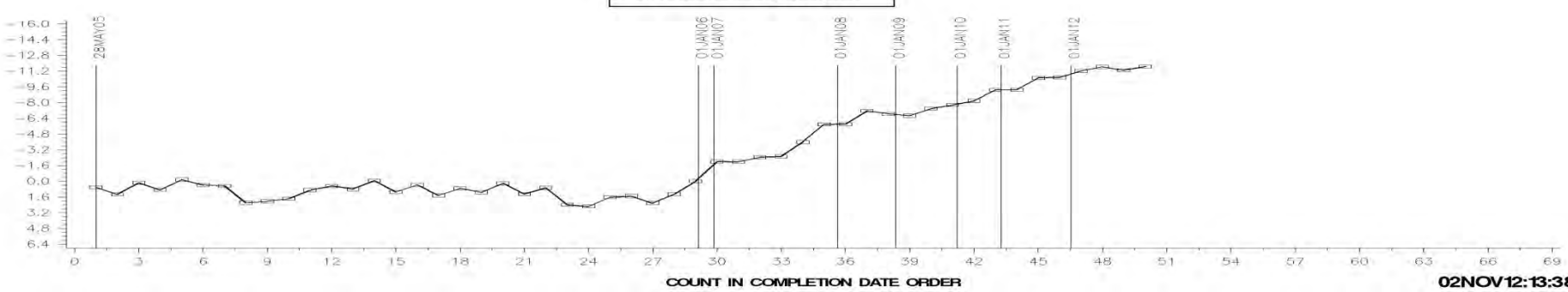
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

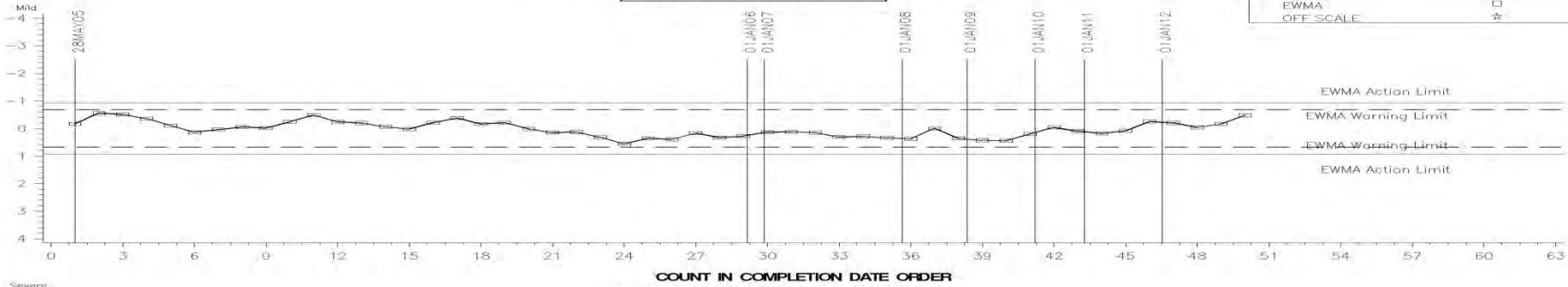


02NOV12:13:38

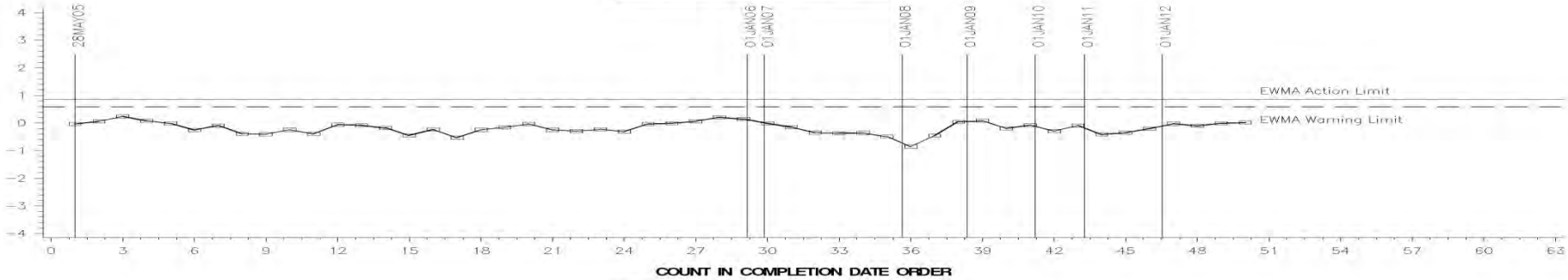
C13 INDUSTRY OPERATIONAL VALID DATA

TOP GROOVE CARBON AVG — FINAL RESULT

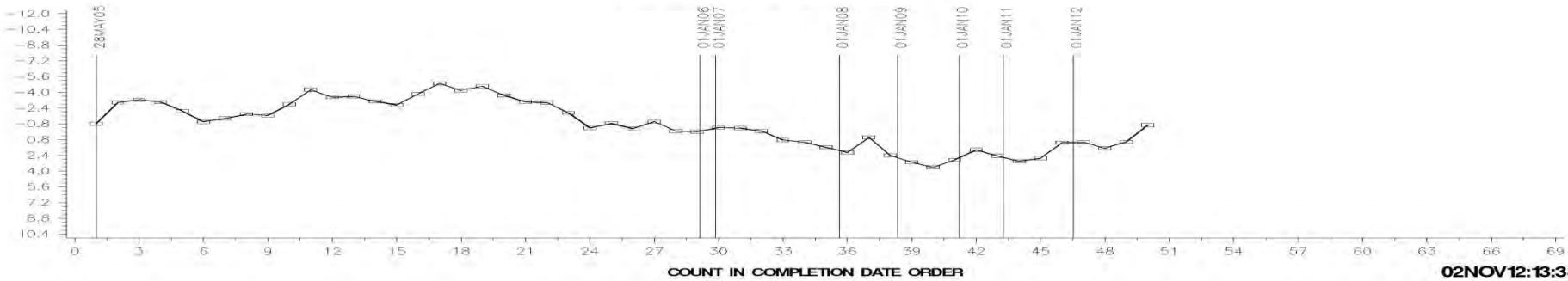
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

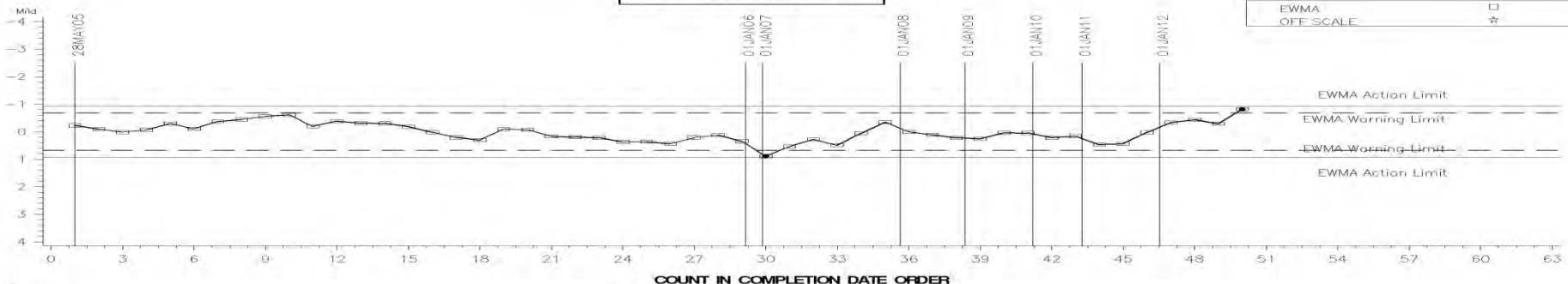


02NOV12:13:38

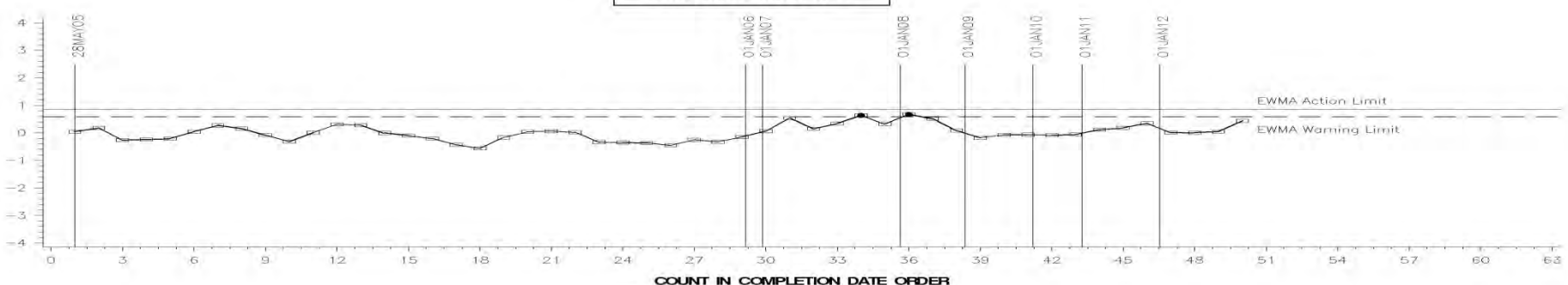
C13 INDUSTRY OPERATIONAL VALID DATA

2ND RING TOP CARBON AVG. — FINAL RESULT

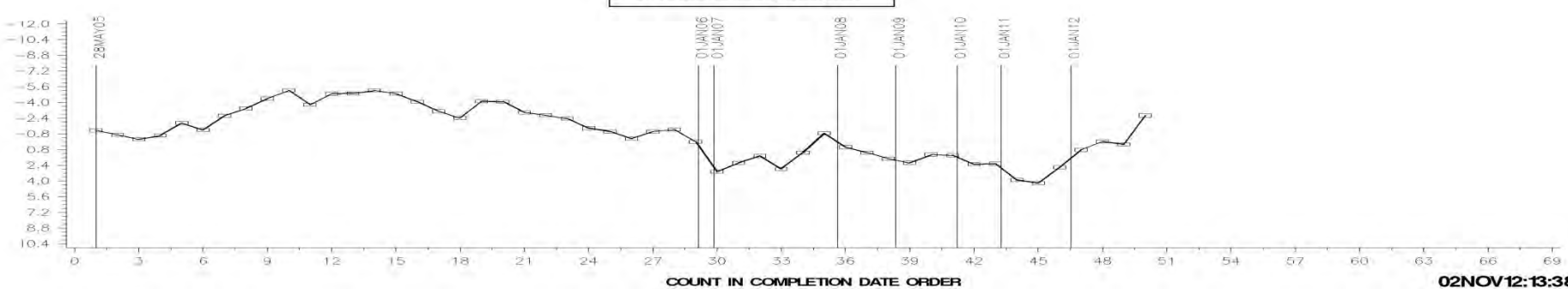
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

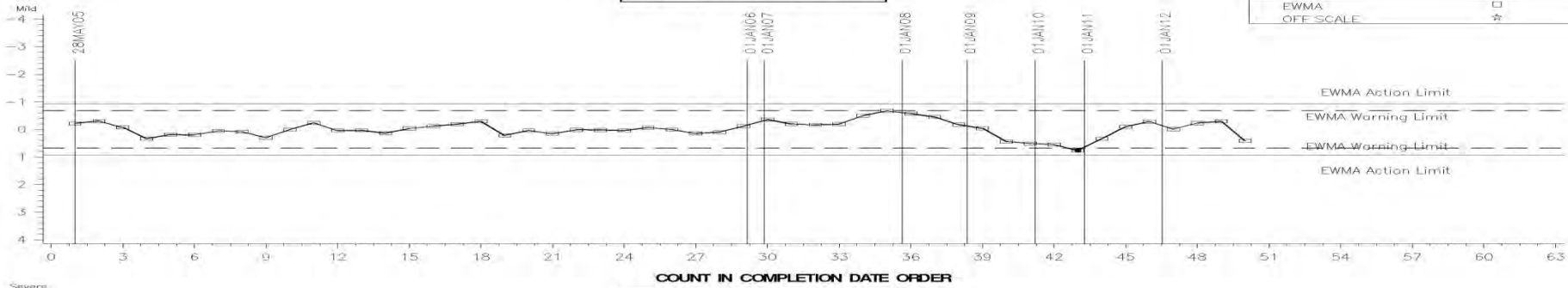


02NOV12:13:38

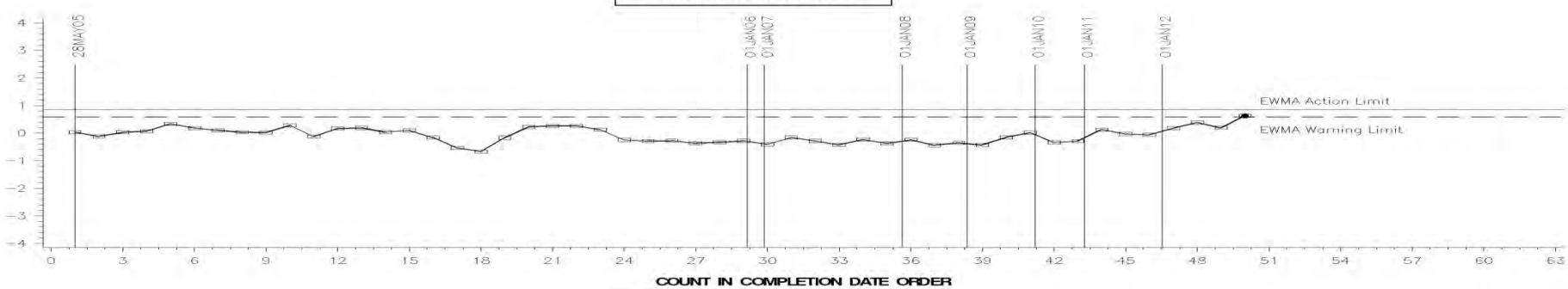
C13 INDUSTRY OPERATIONALLY VALID DATA

OIL CONS. DELTA — FINAL RESULT

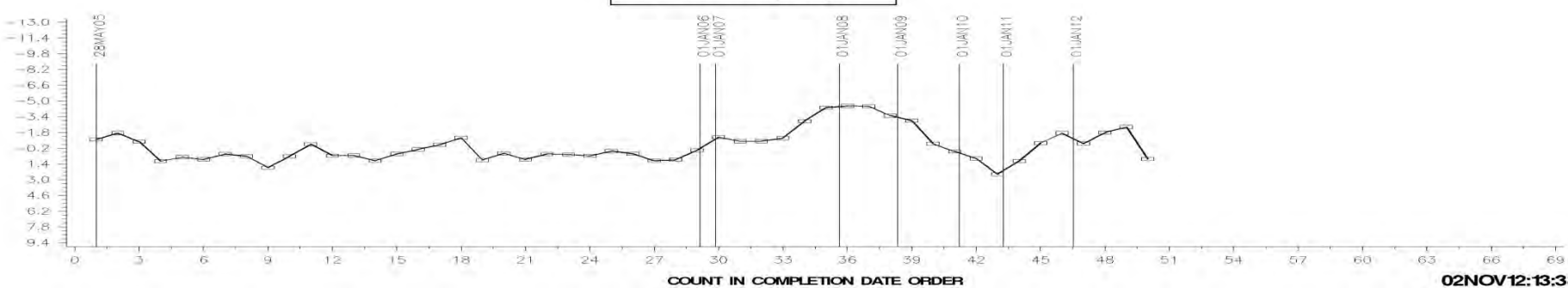
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12:13:38

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Appendix 1.g

ISB Control Charts

» Severity and CuSum

Test Monitoring Center

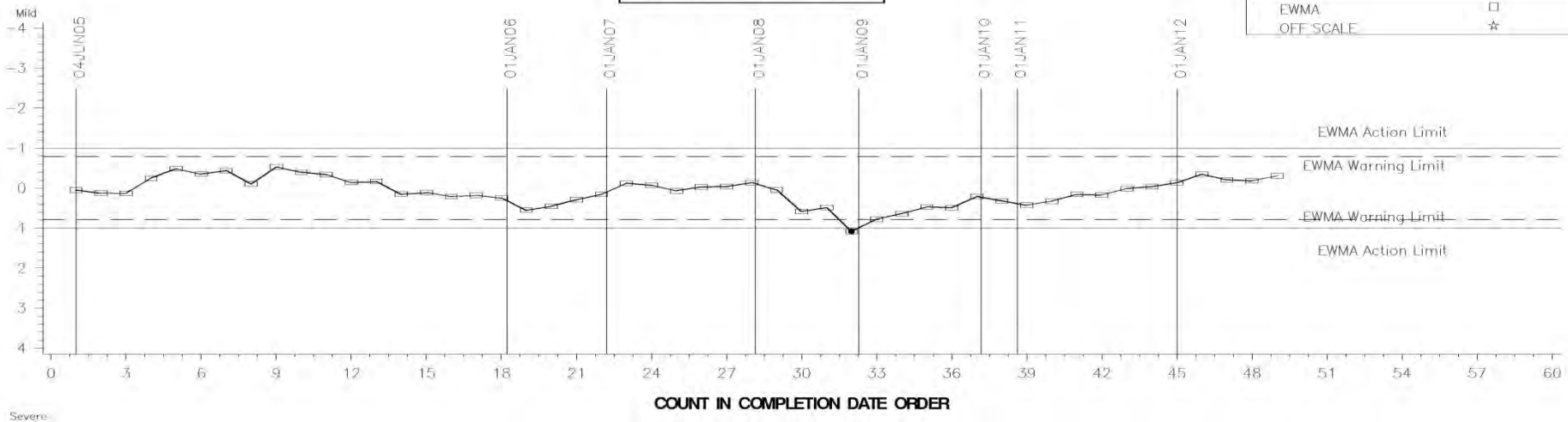
<http://astmtmc.cmu.edu>



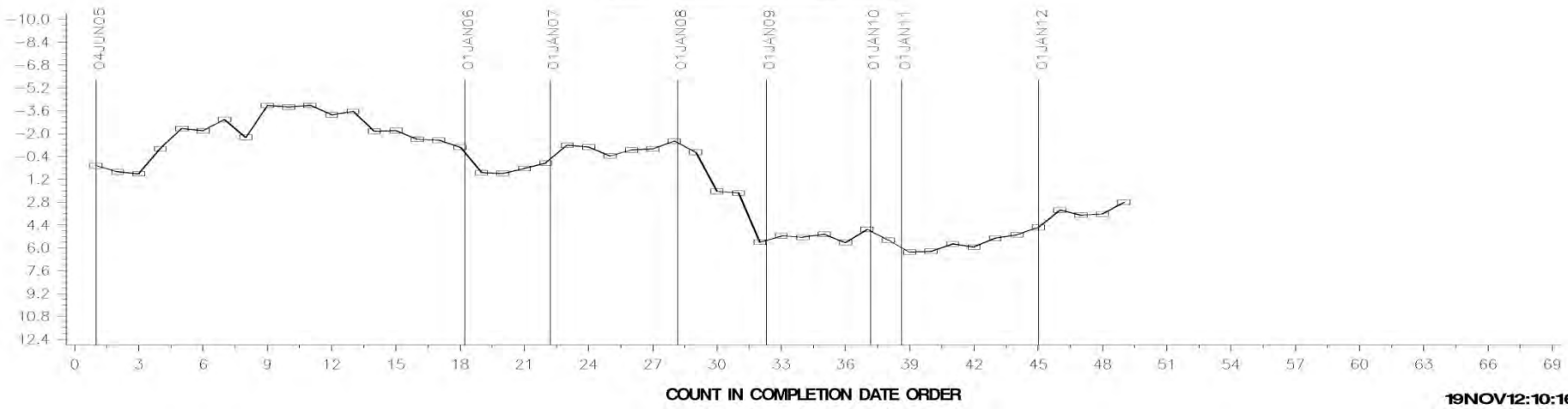
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AVERAGE CAMSHAFT WEAR

LTMS Severity Analysis



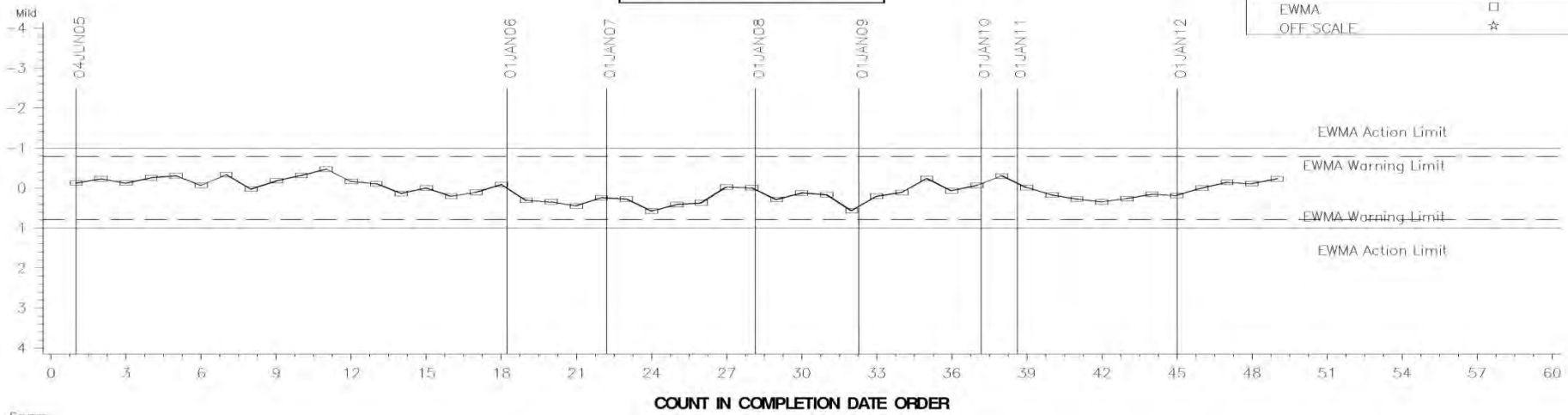
CUSUM Severity Analysis



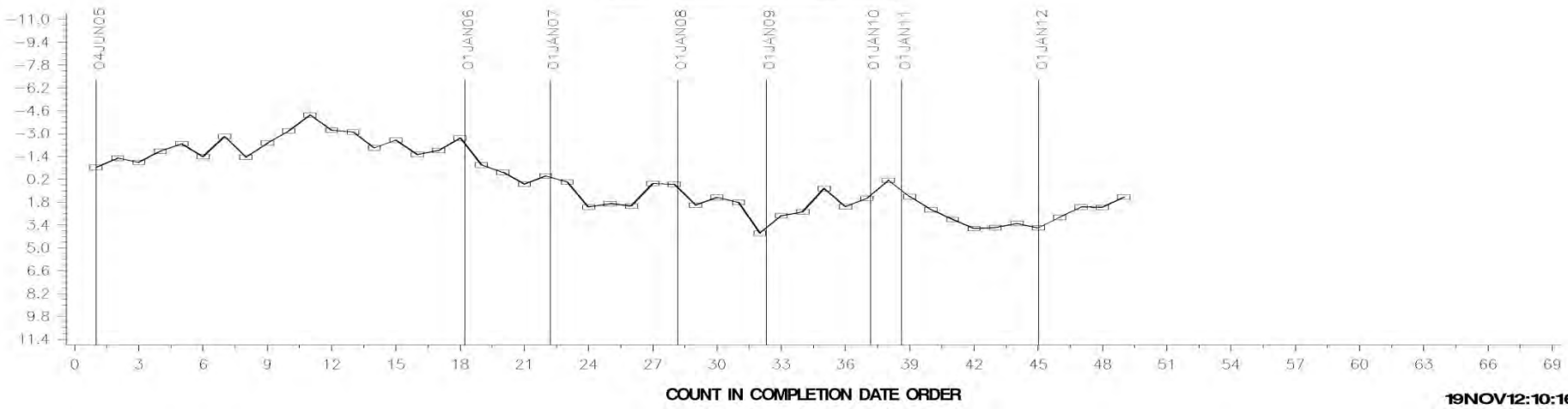
19NOV12:10:16

AVERAGE TAPPET WEIGHT LOSS

LTMS Severity Analysis



CUSUM Severity Analysis



19NOV12:10:16

[Return](#)

Appendix 1.h

ISM Control Charts

» Severity and CuSum

Test Monitoring Center

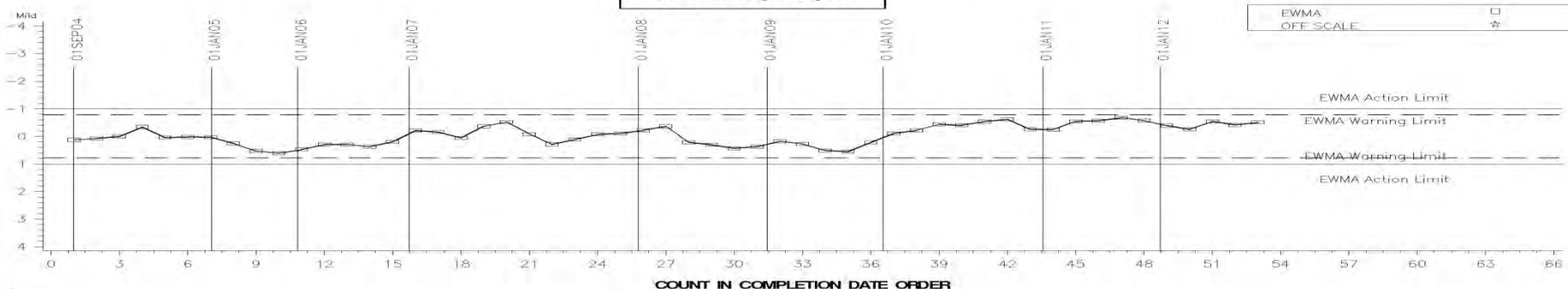
<http://astmtmc.cmu.edu>



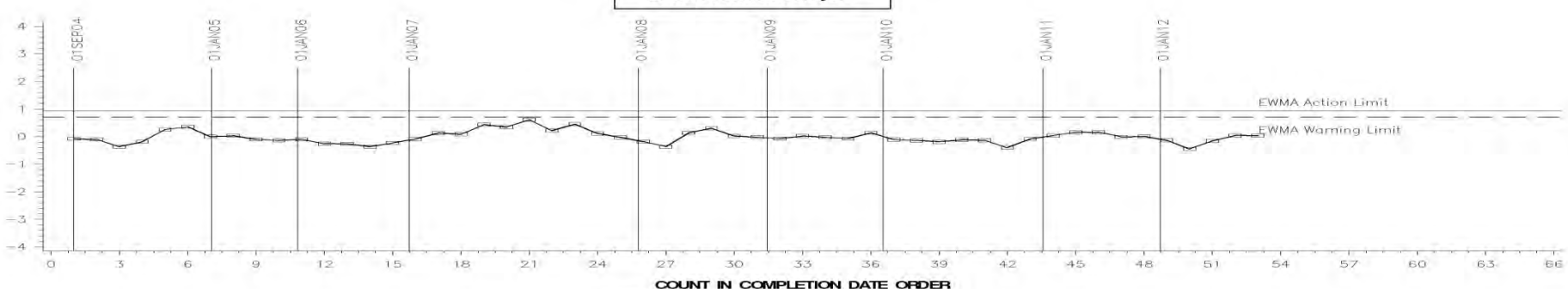
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ISM INDUSTRY OPERATIONAL VALID DATA
 CROSSHEAD WEIGHT LOSS ADJUSTED TO 3.9 % SOOT

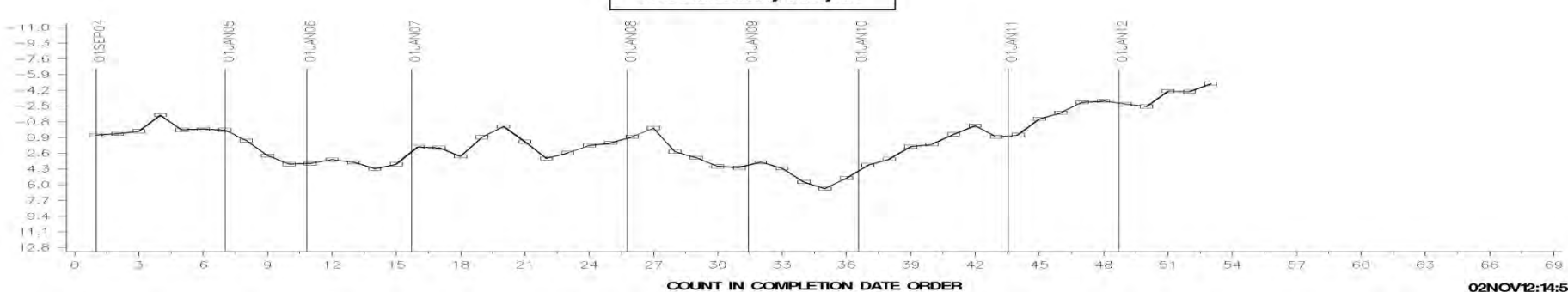
LTMS Severity Analysis



LTMS Precision Analysis



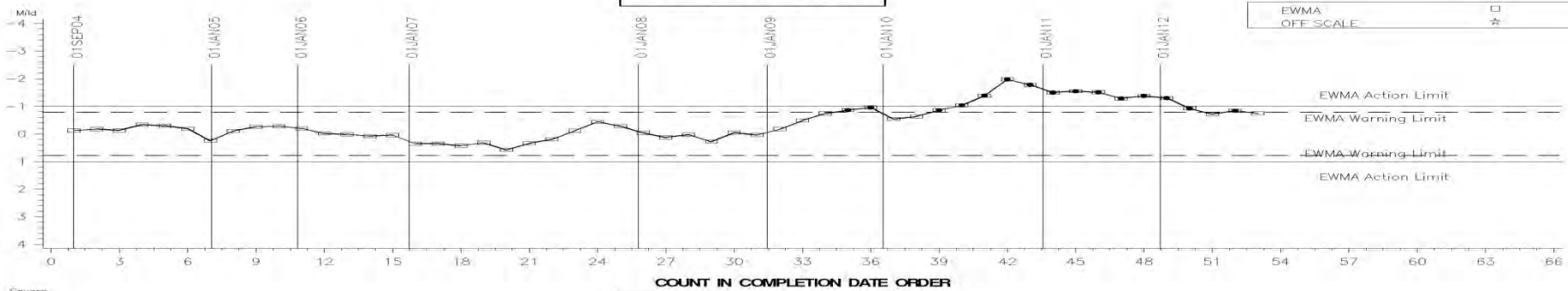
CUSUM Severity Analysis



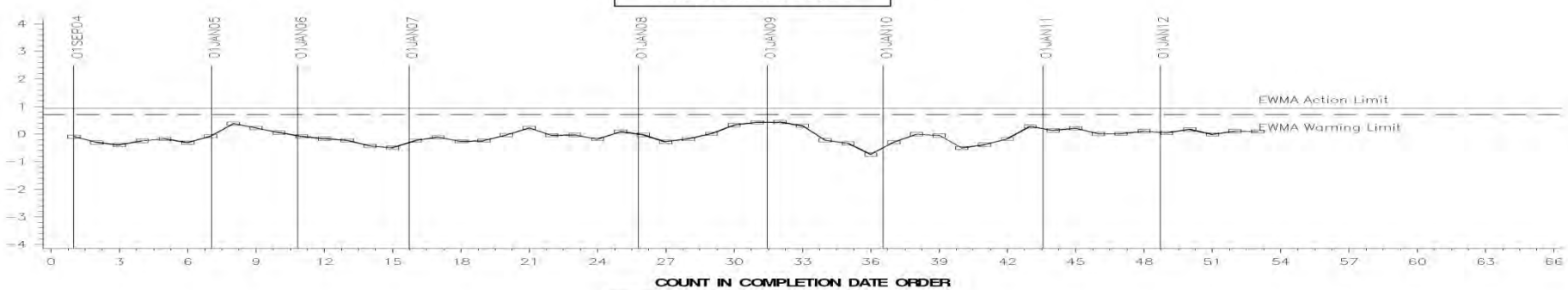
02NOV12:14:58

FILTER PLUGGING DELTA P

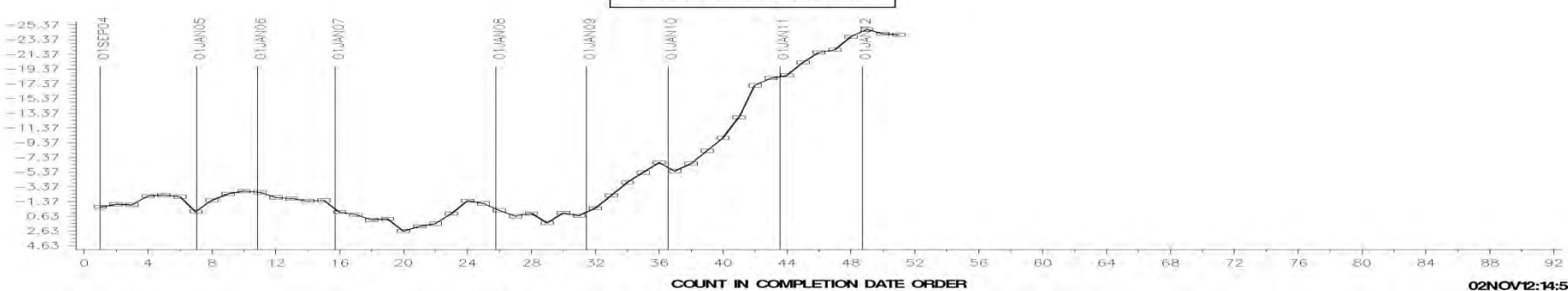
LTMS Severity Analysis



LTMS Precision Analysis



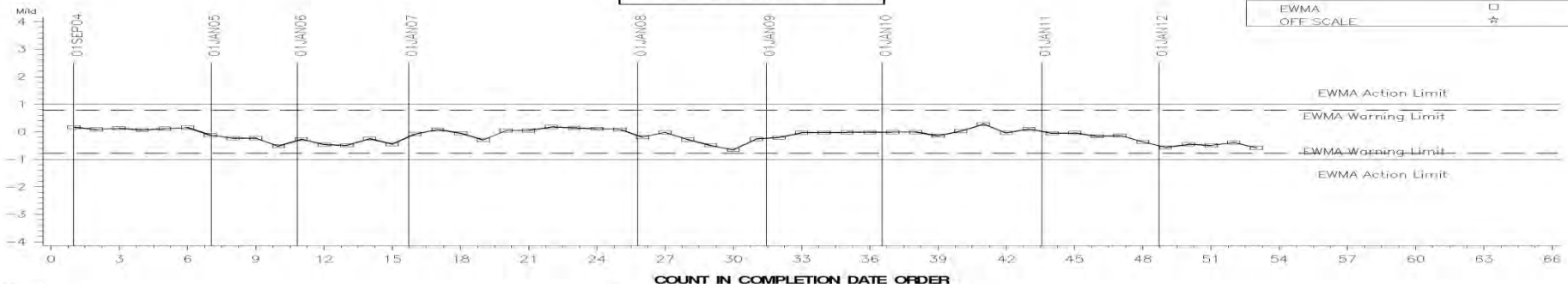
CUSUM Severity Analysis



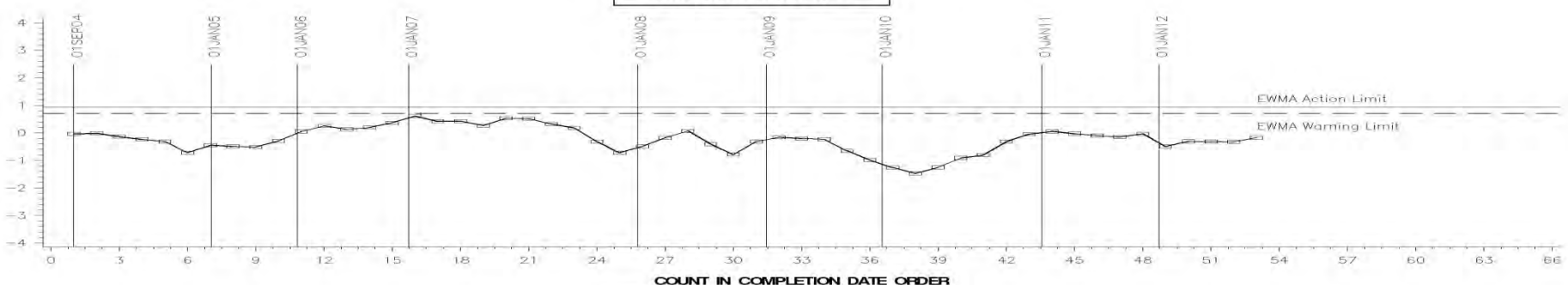
02NOV12:14:58

AVERAGE SLUDGE RATING

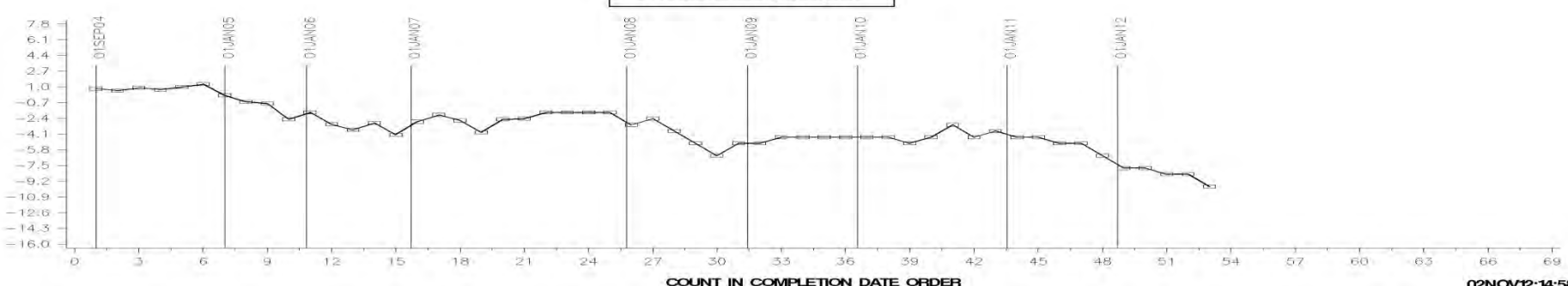
LTMS Severity Analysis



LTMS Precision Analysis

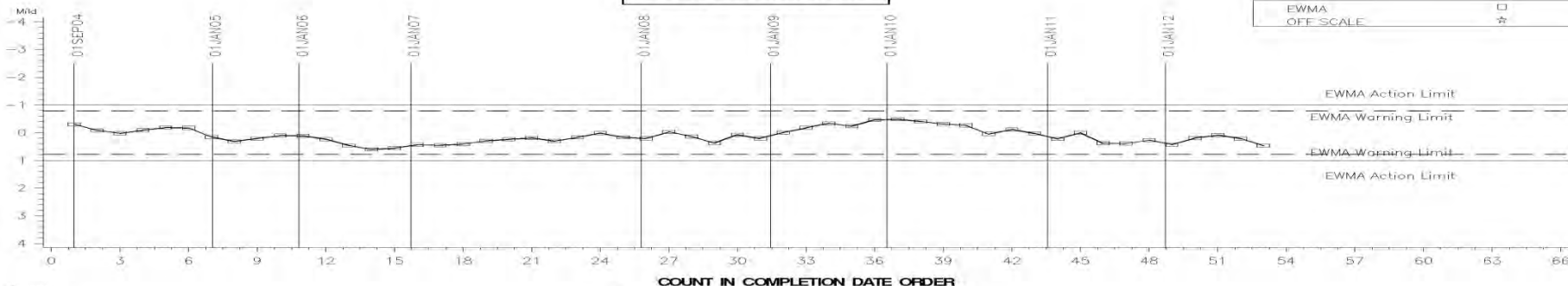


CUSUM Severity Analysis

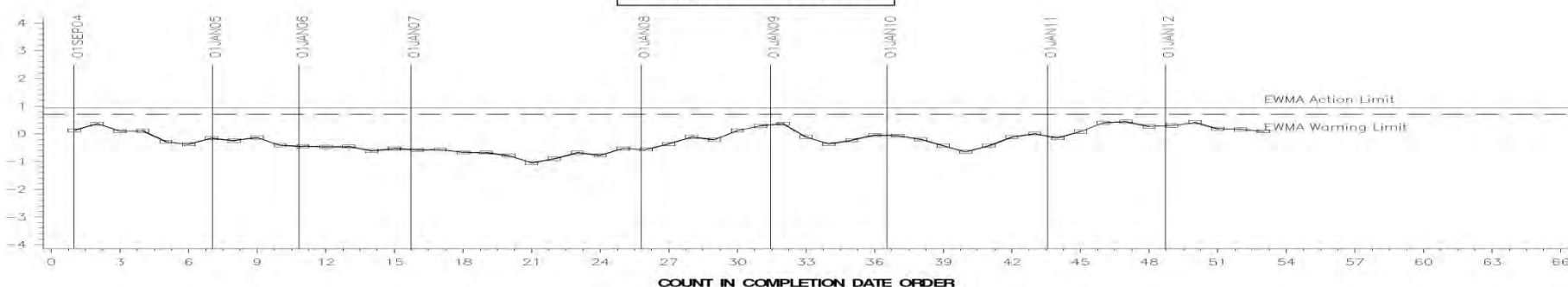


02NOV12:14:58

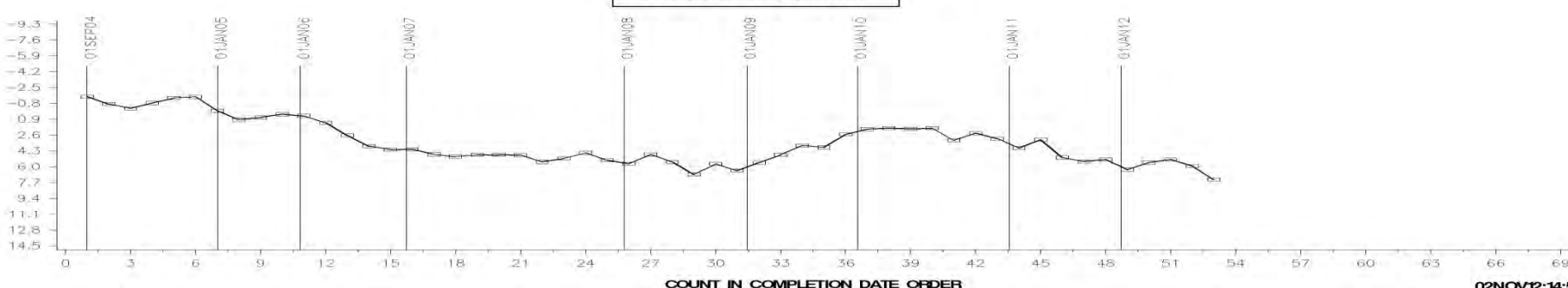
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12:14:58

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Appendix 1.i

EOAT Control Charts

» Severity, Precision, and CuSum

Test Monitoring Center

<http://astmtmc.cmu.edu>

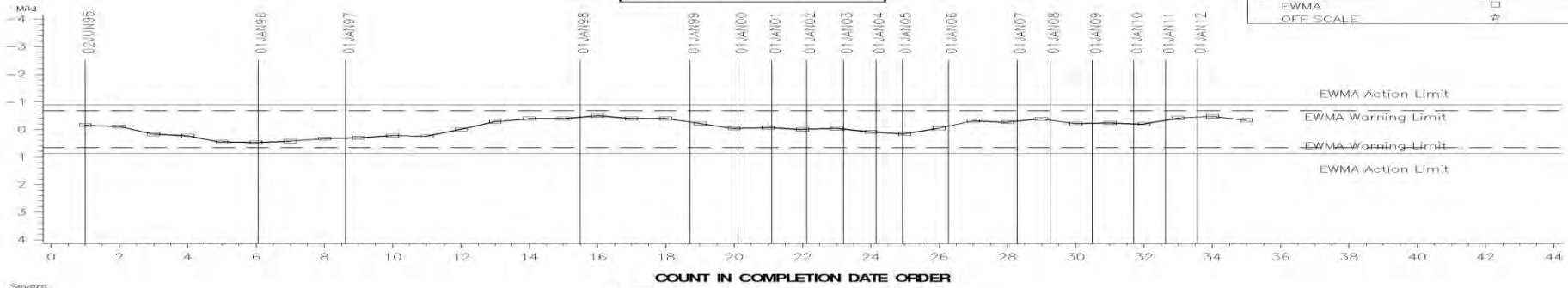


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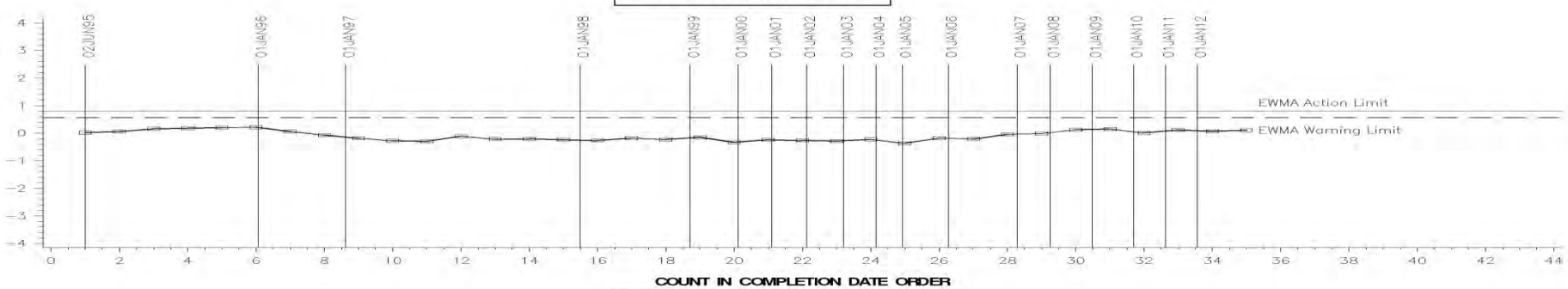
EOAT INDUSTRY OPERATIONAL VALID DATA

ENGINE OIL AERATION

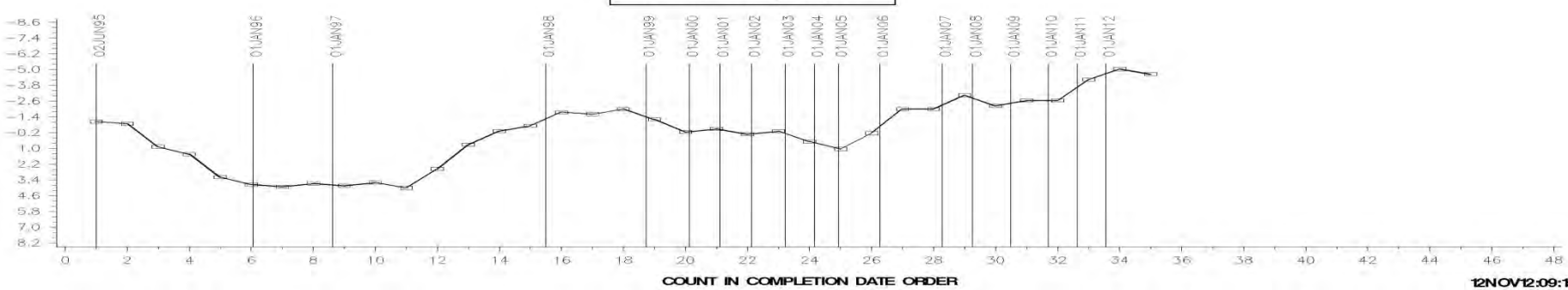
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



12NOV12:09:15

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Appendix 1.j

RFWT Control Charts

» Severity, Precision, and CuSum

Test Monitoring Center

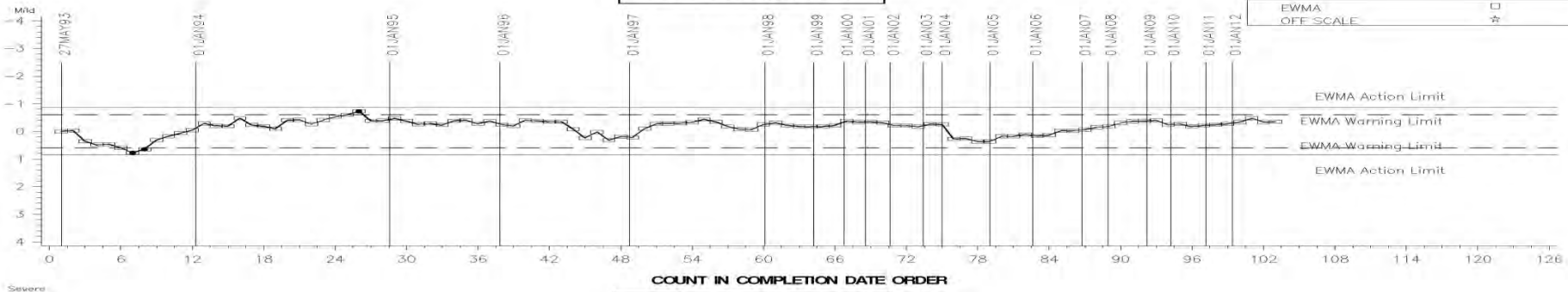
<http://astmtmc.cmu.edu>



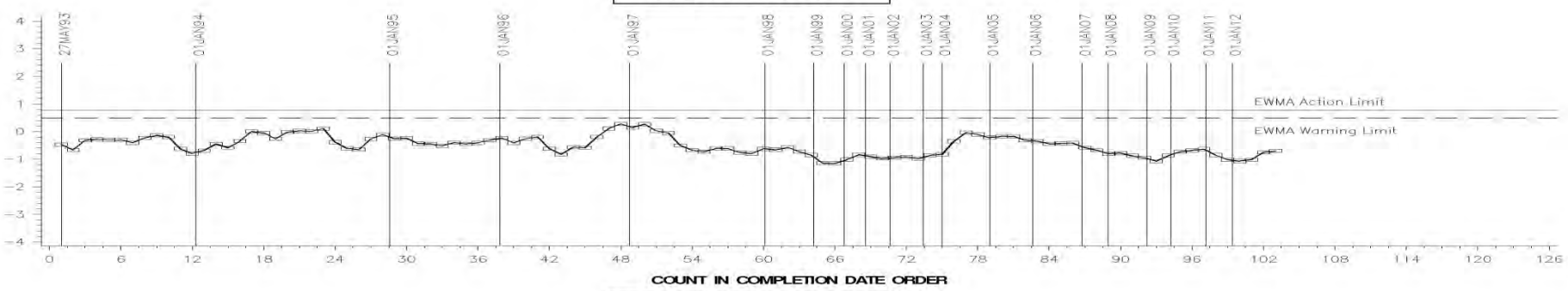
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Average Follower Wear

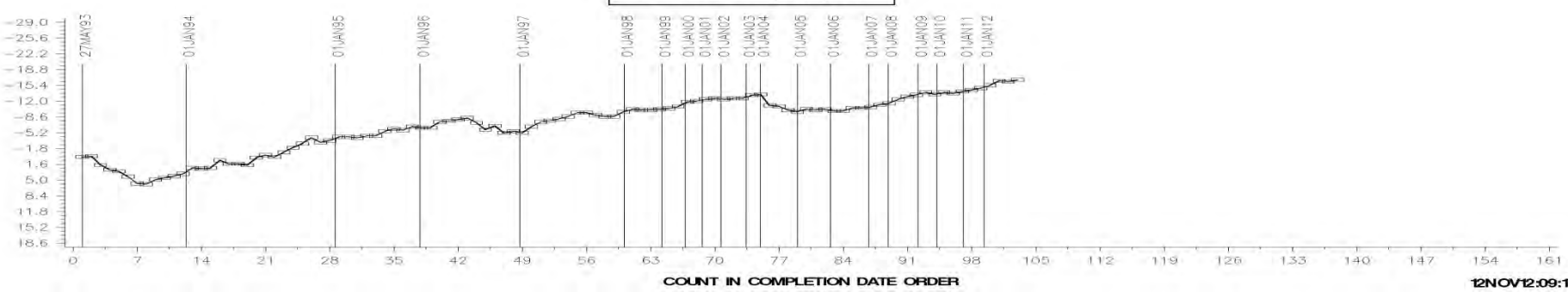
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



12NOV12:09:17

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<http://astmtmc.cmu.edu>



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Appendix 1.k

T-8/T-8E Control Charts

» Severity, Precision, and CuSum

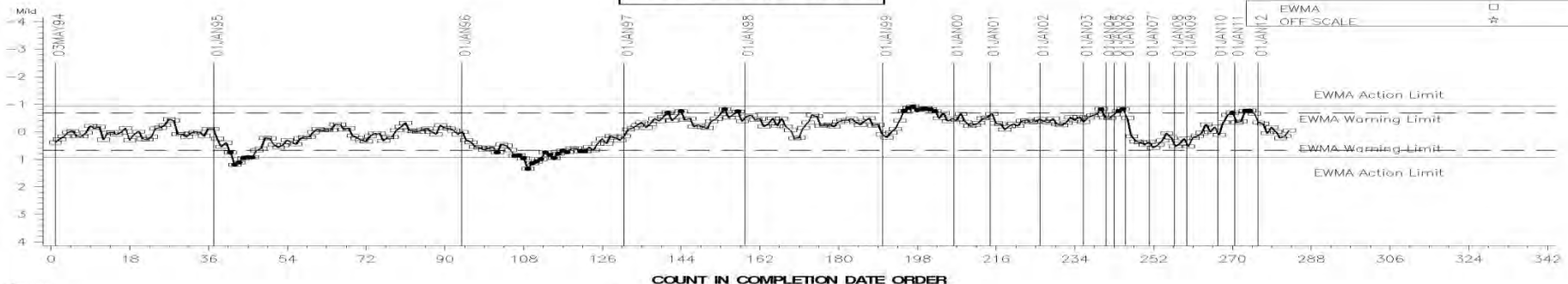
Test Monitoring Center

<http://astmtmc.cmu.edu>

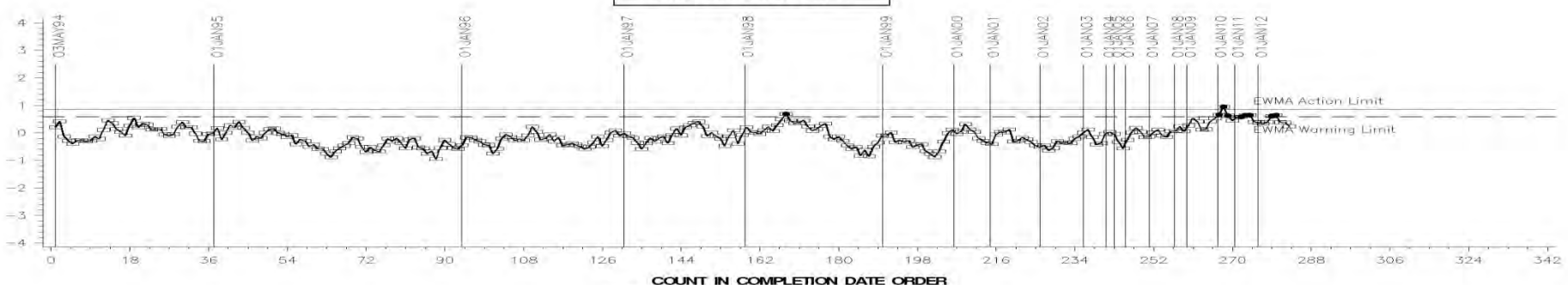


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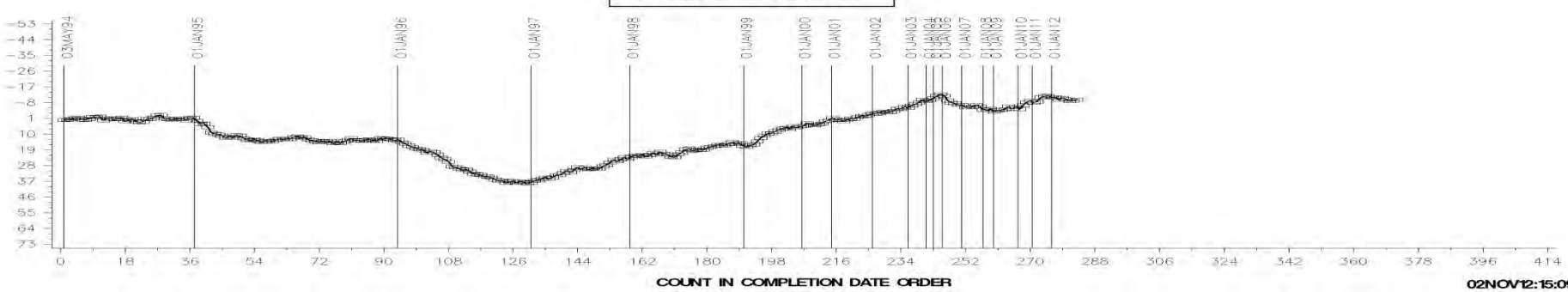
LTMS Severity Analysis



LTMS Precision Analysis

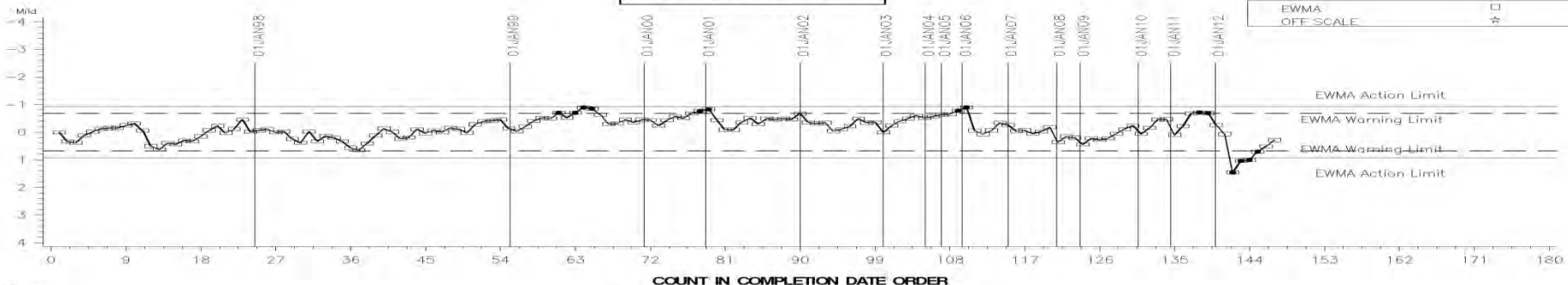


CUSUM Severity Analysis

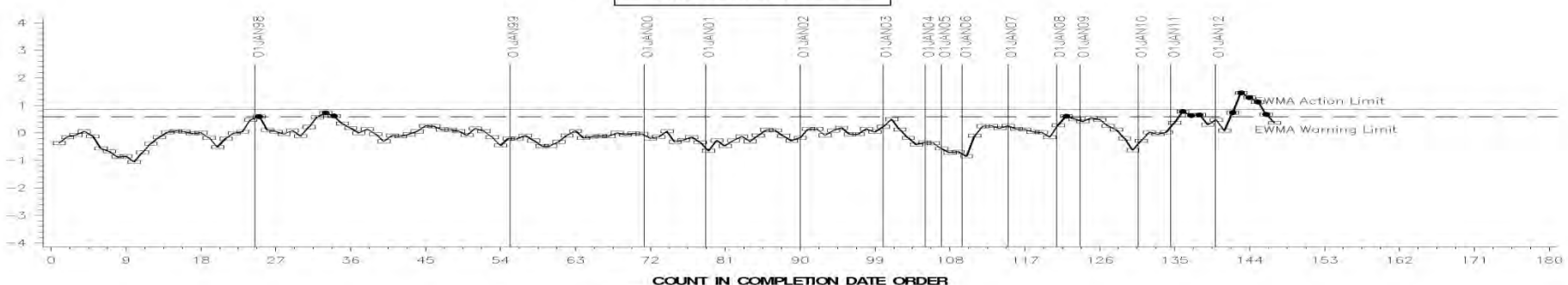


02NOV12:15:09

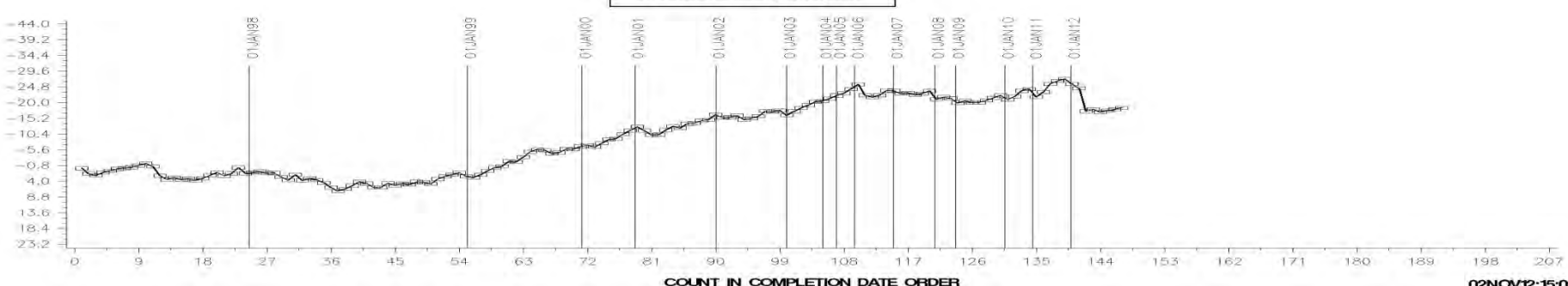
LTMS Severity Analysis



LTMS Precision Analysis

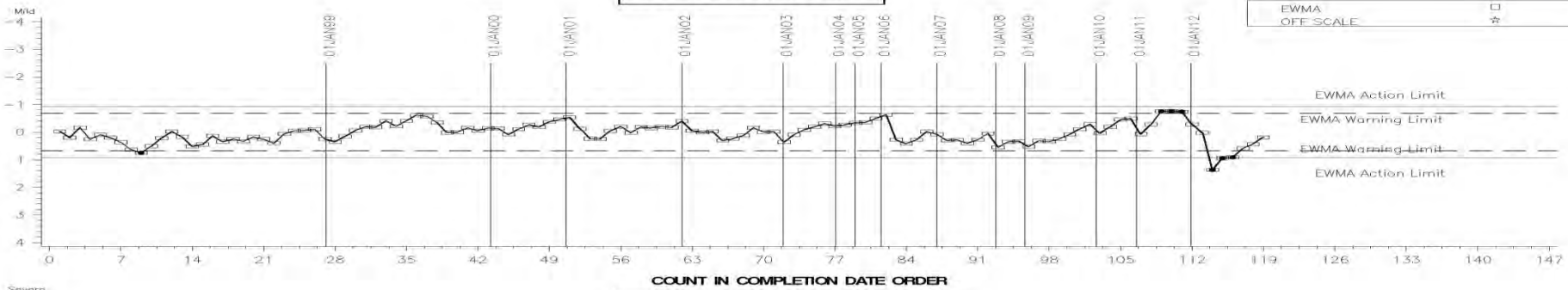


CUSUM Severity Analysis



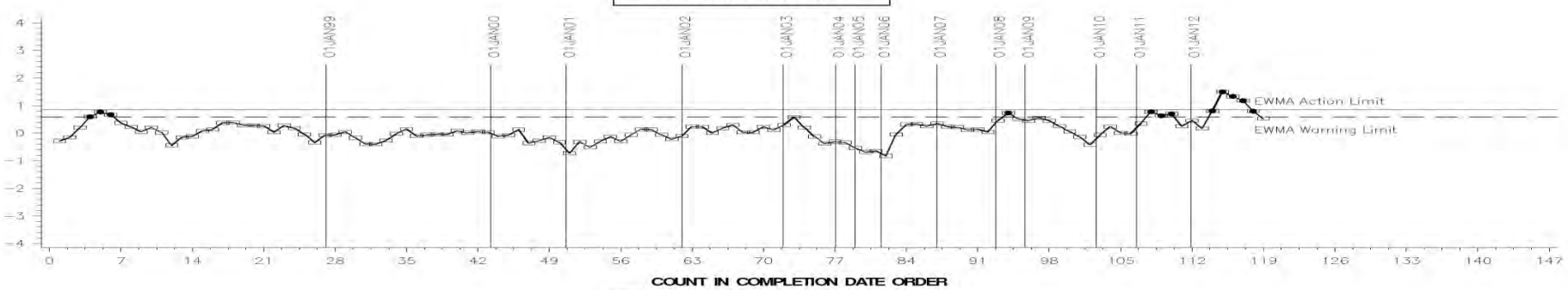
02NOV12:15:09

LTMS Severity Analysis



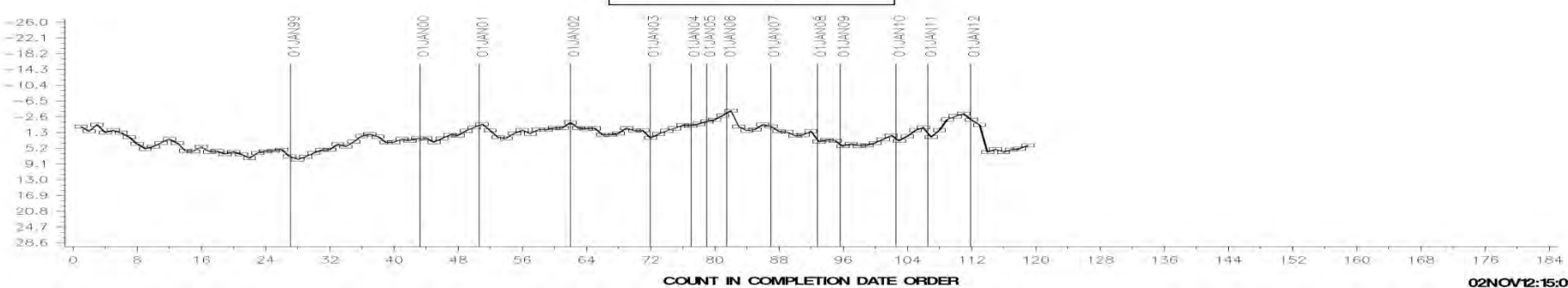
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

02NOV12:15:09

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Appendix 1.1

T-10A Control Charts

» Severity, Precision, and CuSum

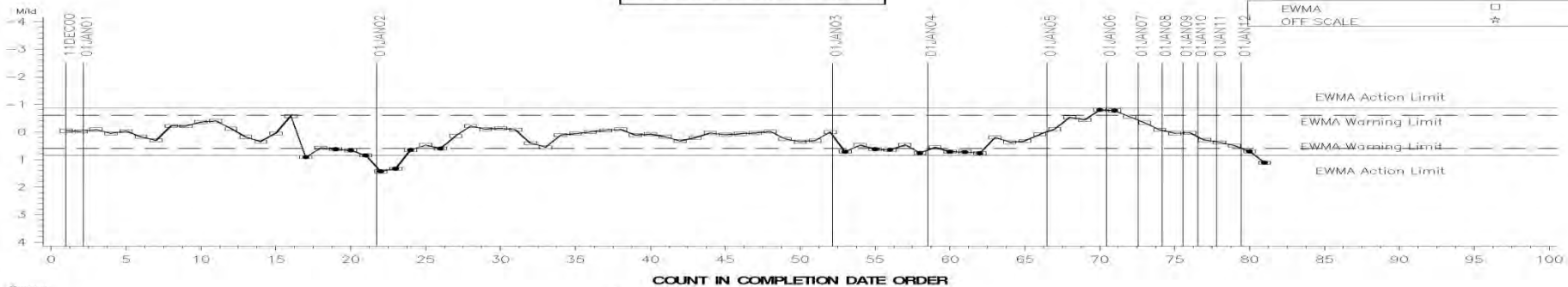
Test Monitoring Center

<http://astmtmc.cmu.edu>

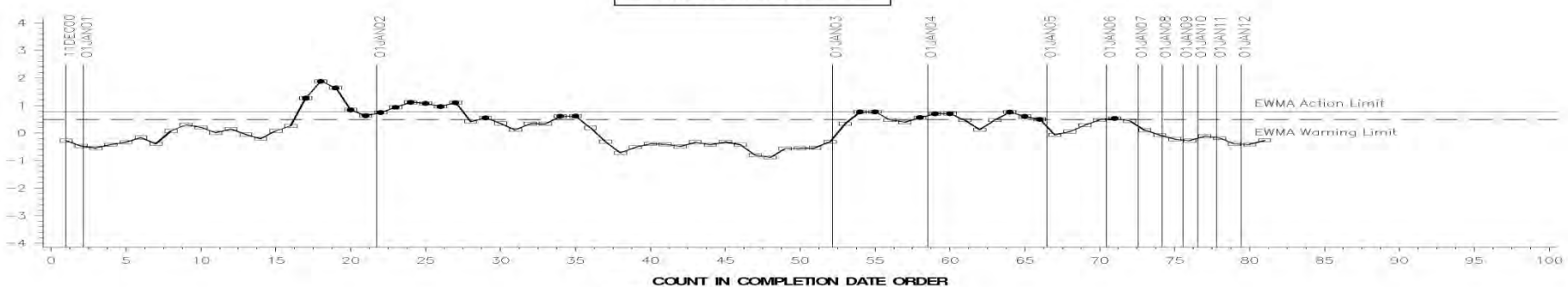


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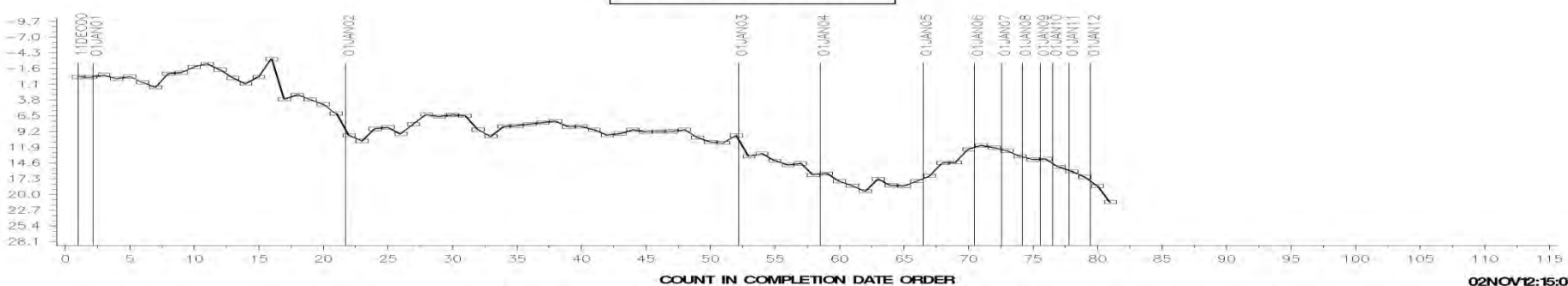
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



02NOV12:15:07

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Appendix 1.m

T-11 Control Charts

» Severity, Precision, and CuSum

Test Monitoring Center

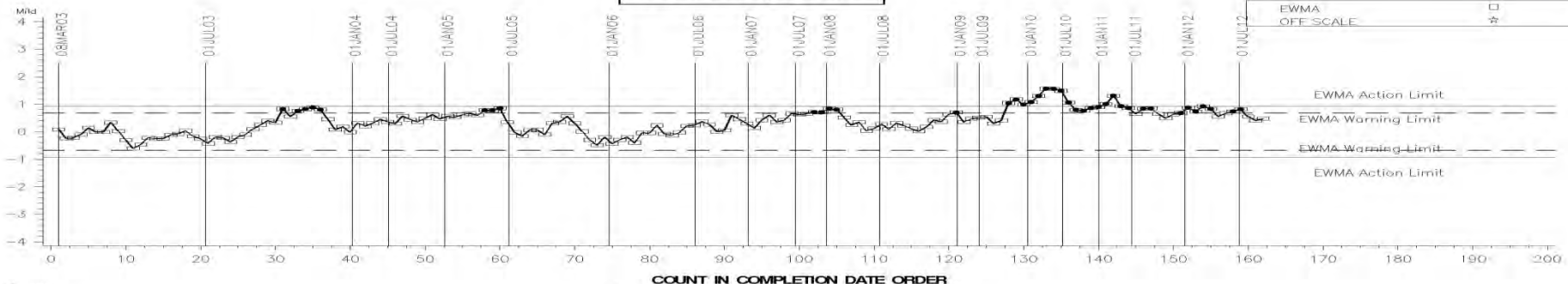
<http://astmtmc.cmu.edu>



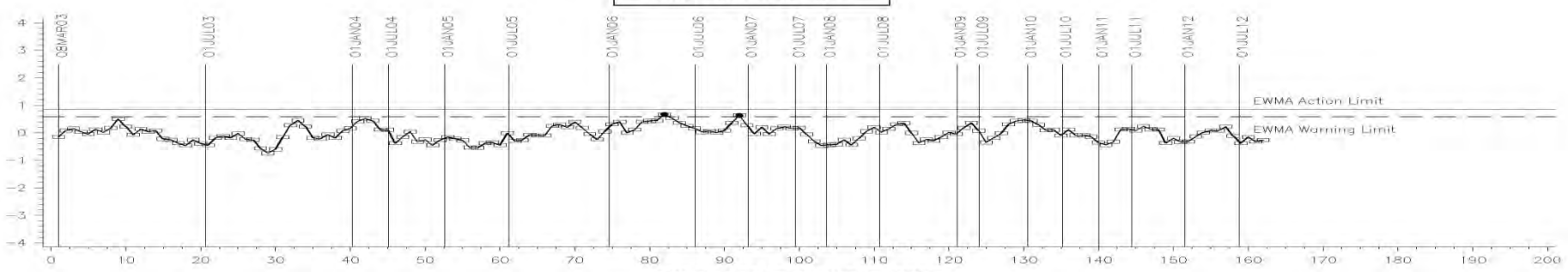
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SOOT AT 12 cSt

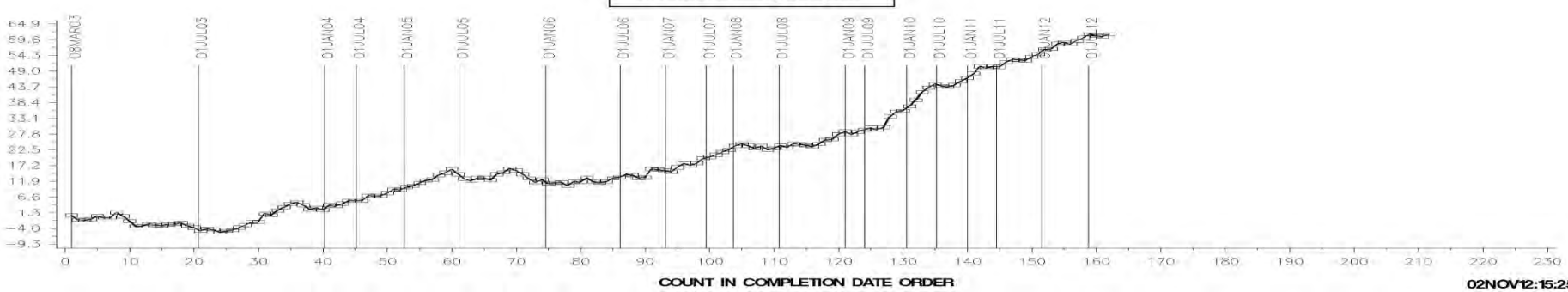
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



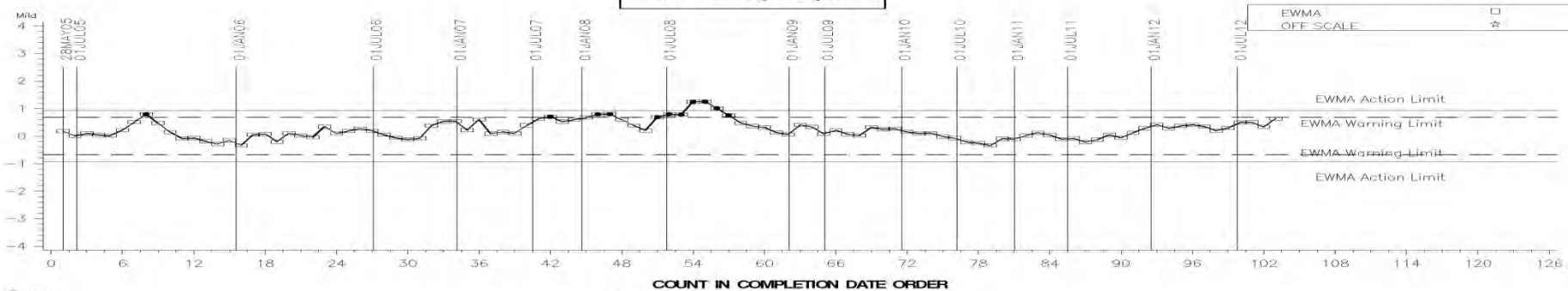
02NOV12:15:25

T-11 INDUSTRY OPERATIONAL VALID DATA

LTMSDATE <= 20121001

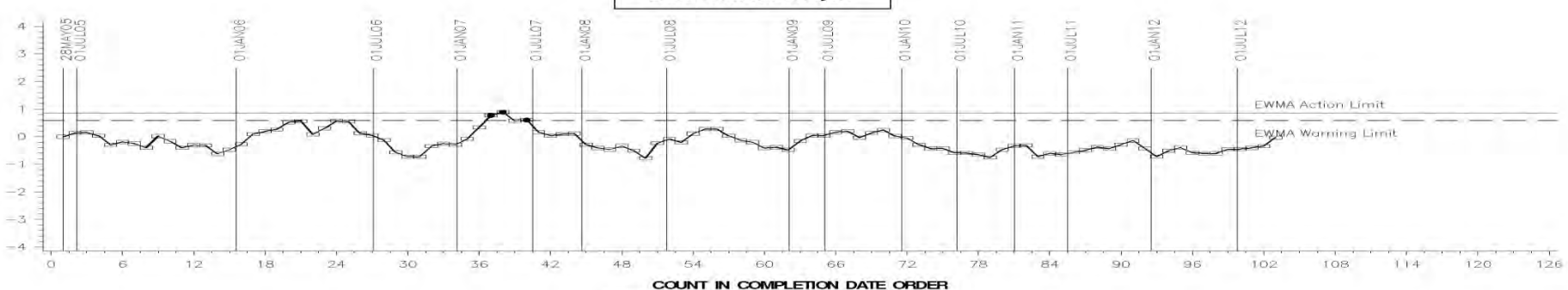
SOOT @ 4 cSt - FINAL RESULT

LTMS Severity Analysis



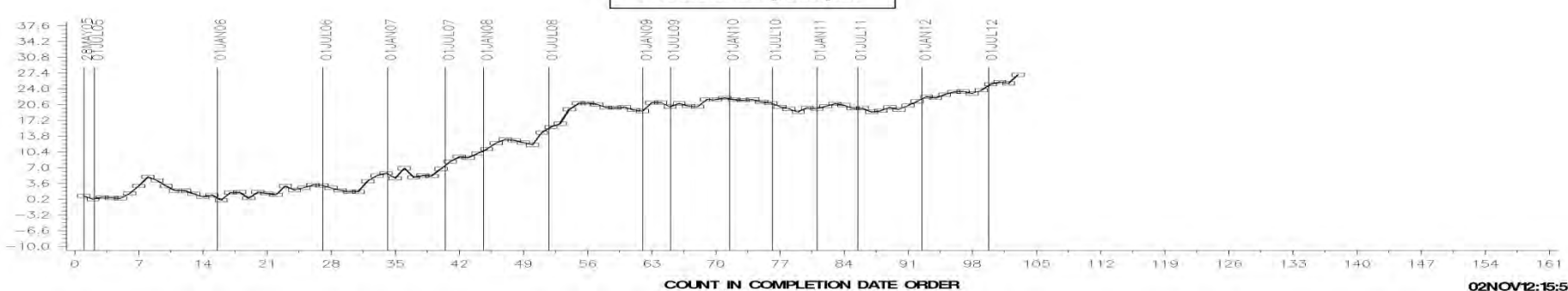
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

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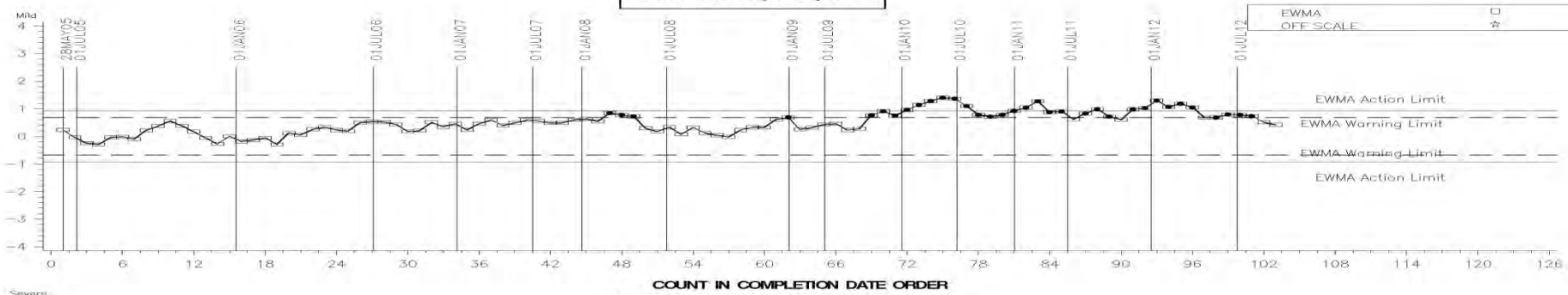
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T-11 INDUSTRY OPERATIONAL VALID DATA

LTMSDATE <= 20121001

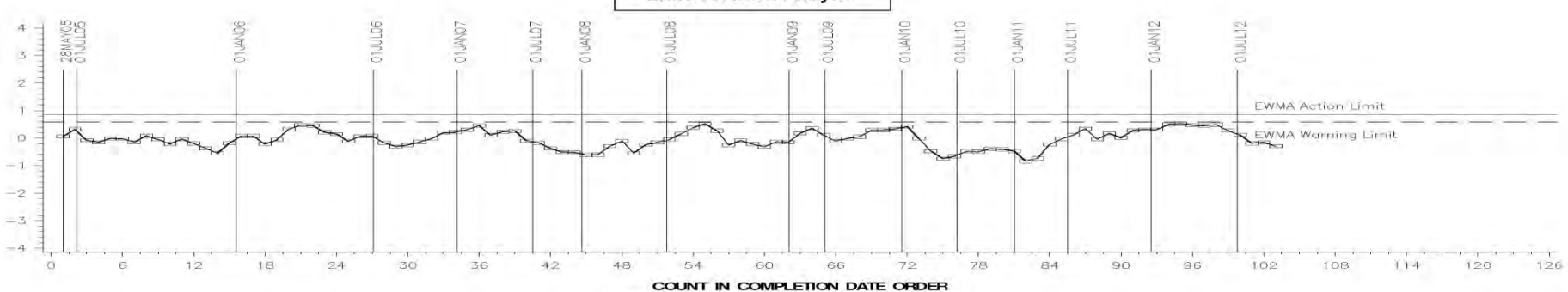
SOOT @ 15 cSt - FINAL RESULT

LTMS Severity Analysis



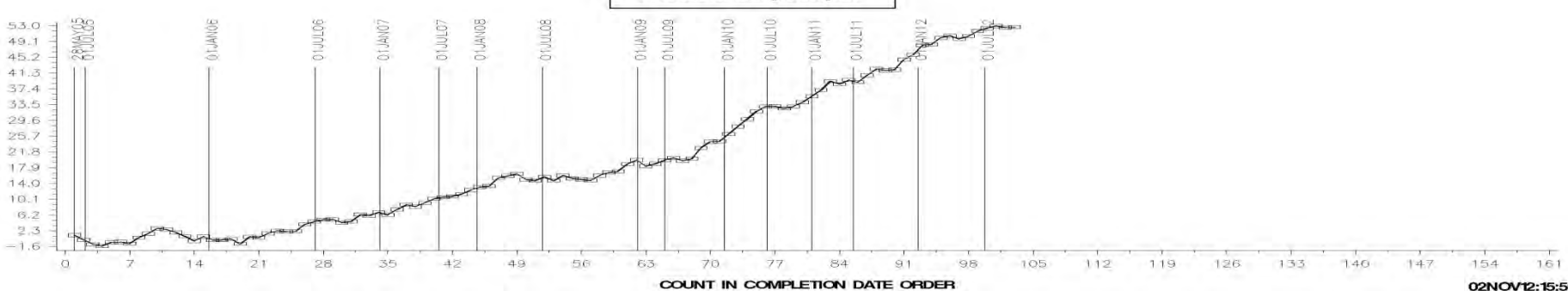
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

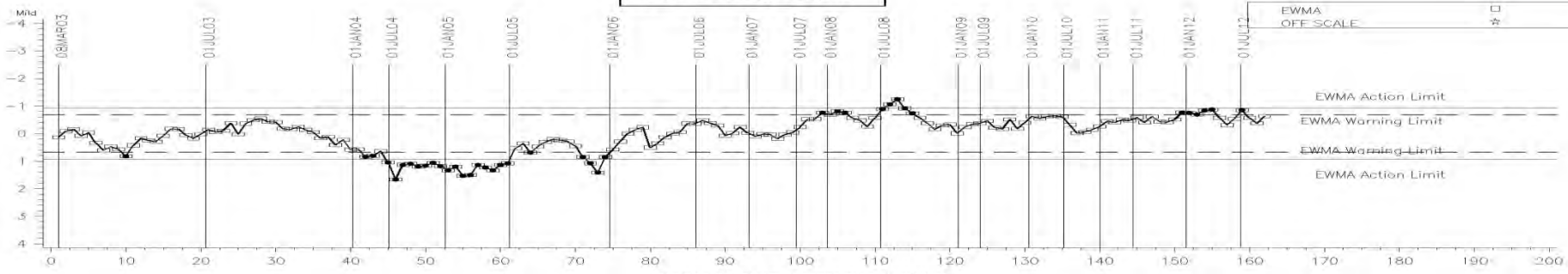


COUNT IN COMPLETION DATE ORDER

02NOV12:15:59

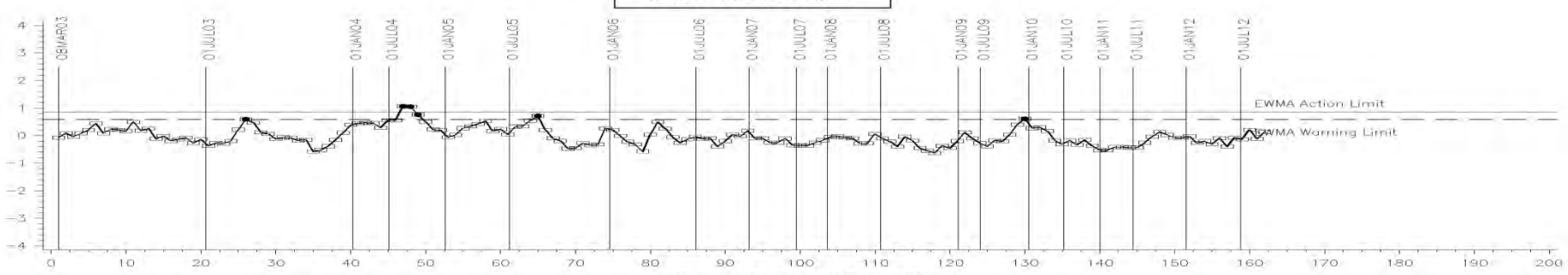
MRV VISCOSITY

LTMS Severity Analysis



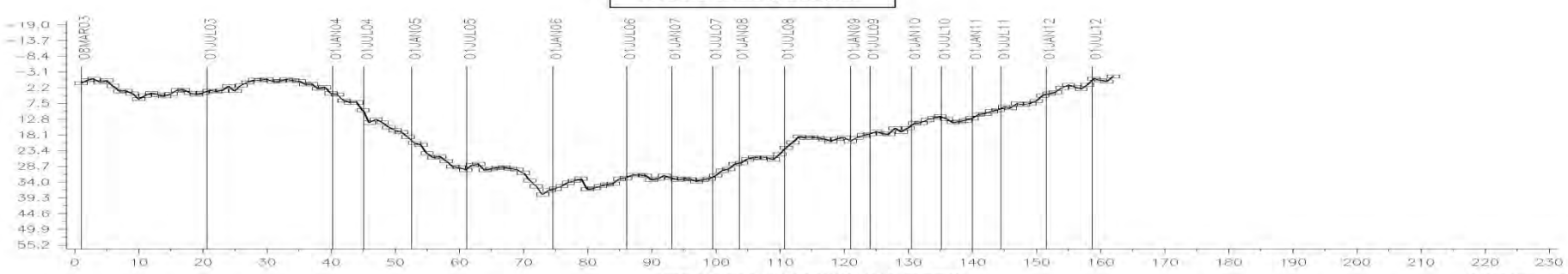
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

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Appendix 1.n

T-12 Control Charts

» Severity, Precision, and CuSum

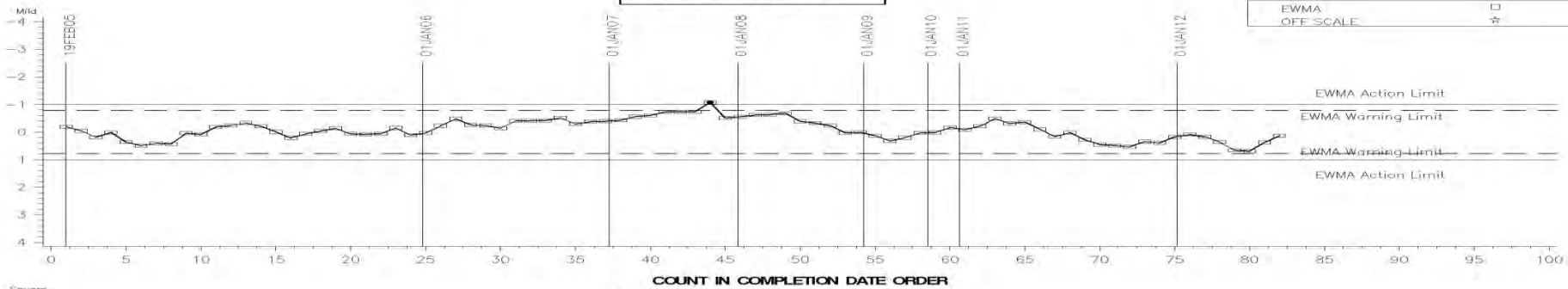
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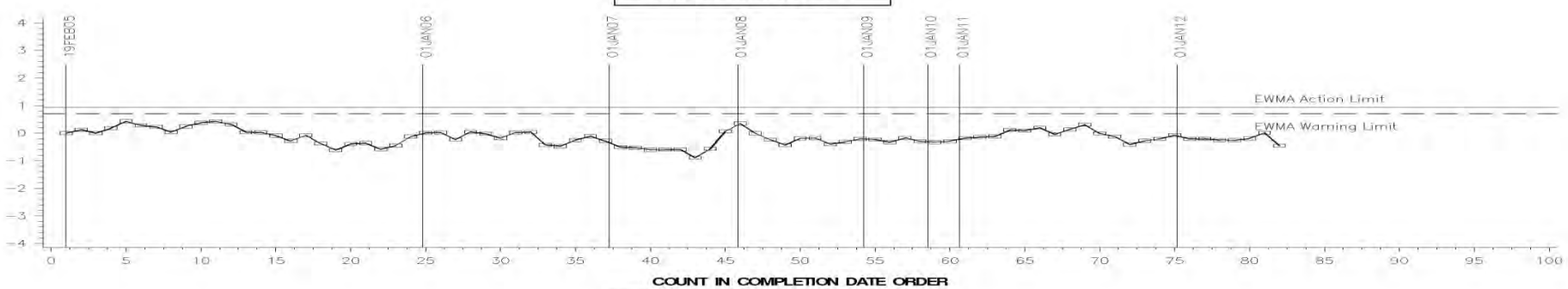


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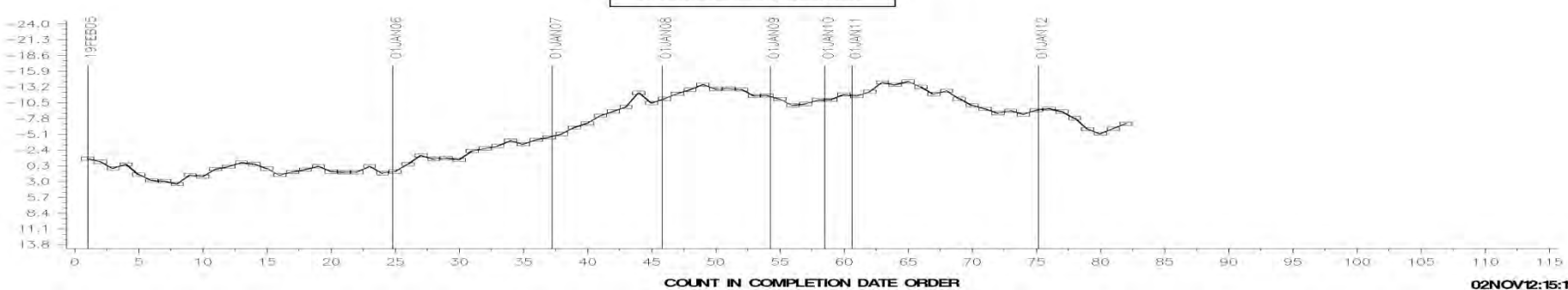
LTMS Severity Analysis



LTMS Precision Analysis



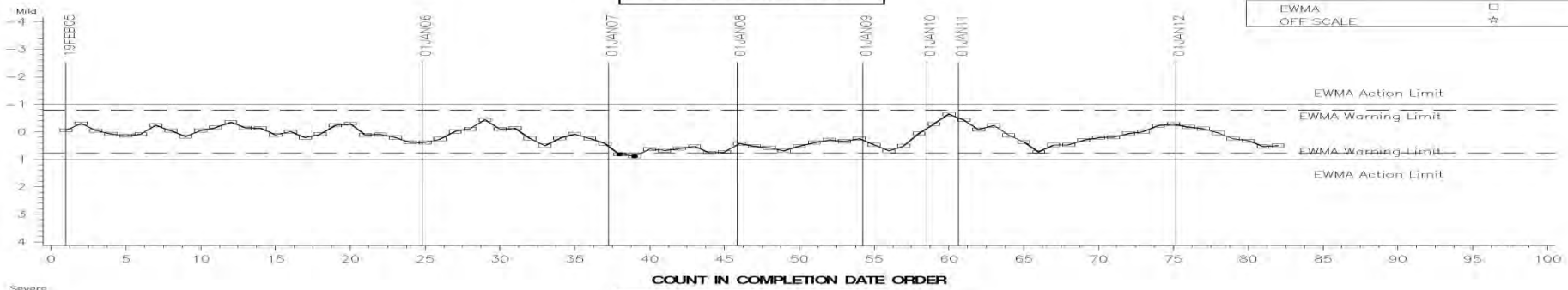
CUSUM Severity Analysis



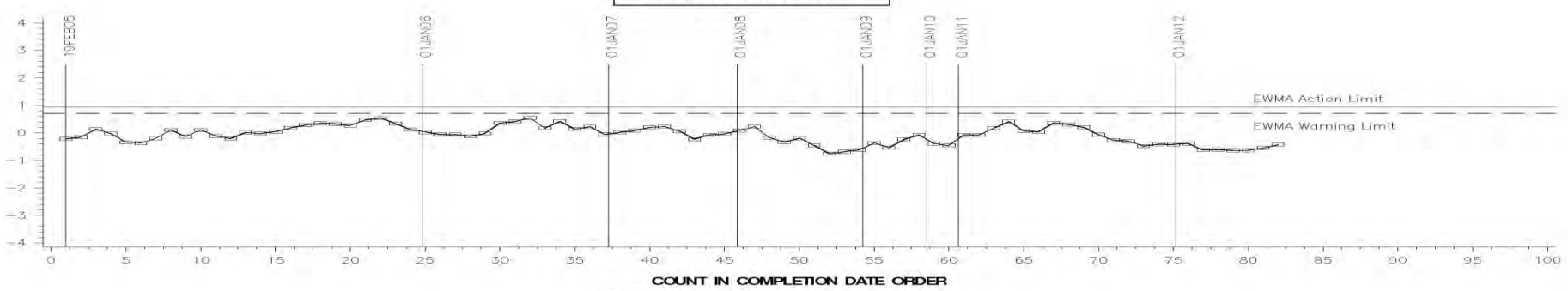
02NOV12:15:19

MACK T-12 INDUSTRY OPERATIONALLY VALID DATA
 AVG. CYLINDER LINER WEAR (CLW)

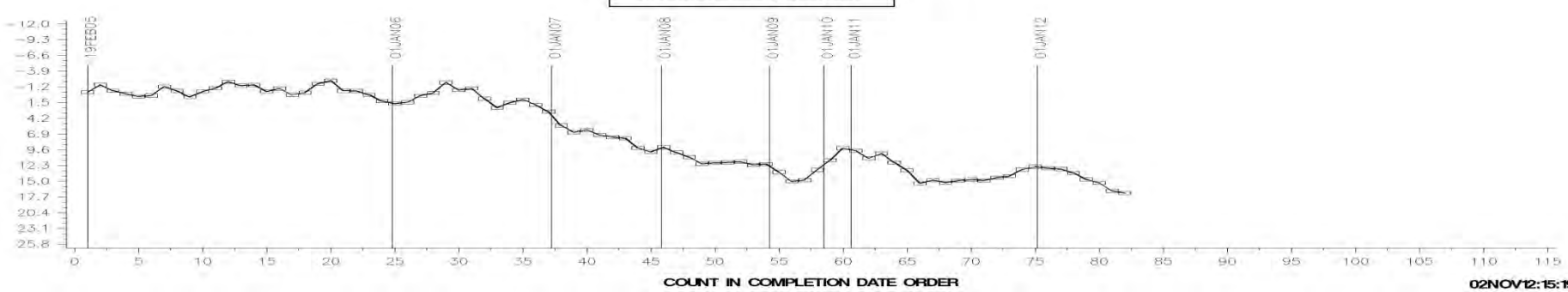
LTMS Severity Analysis



LTMS Precision Analysis



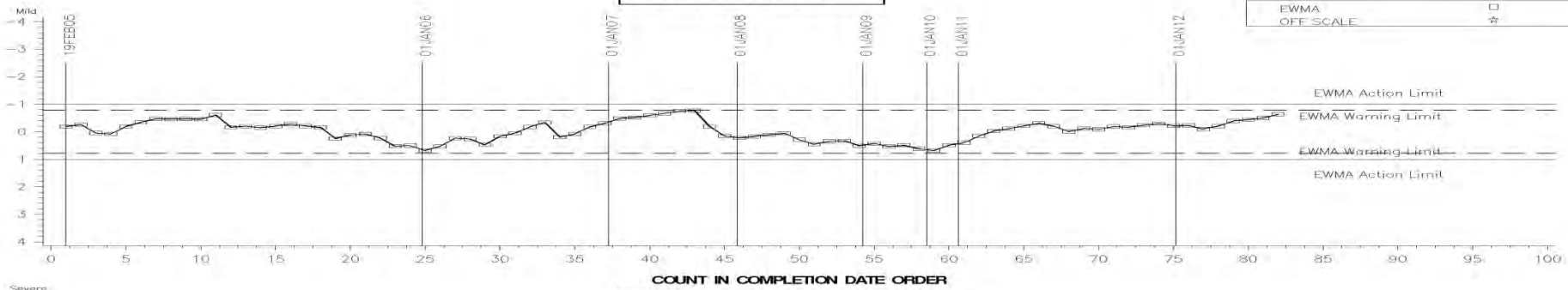
CUSUM Severity Analysis



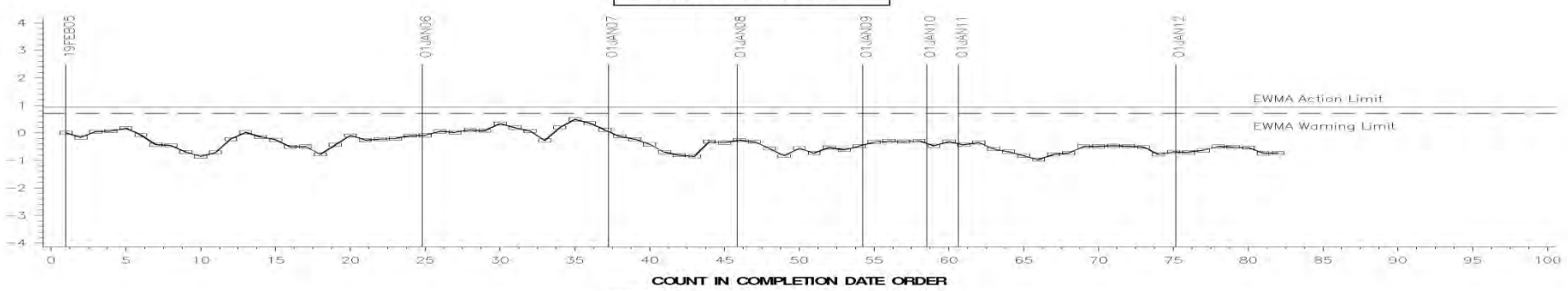
02NOV12:15:19

MACK T-12 INDUSTRY OPERATIONALY VALID DATA
 AVG. TOP RING WEIGHT LOSS (TRWL)

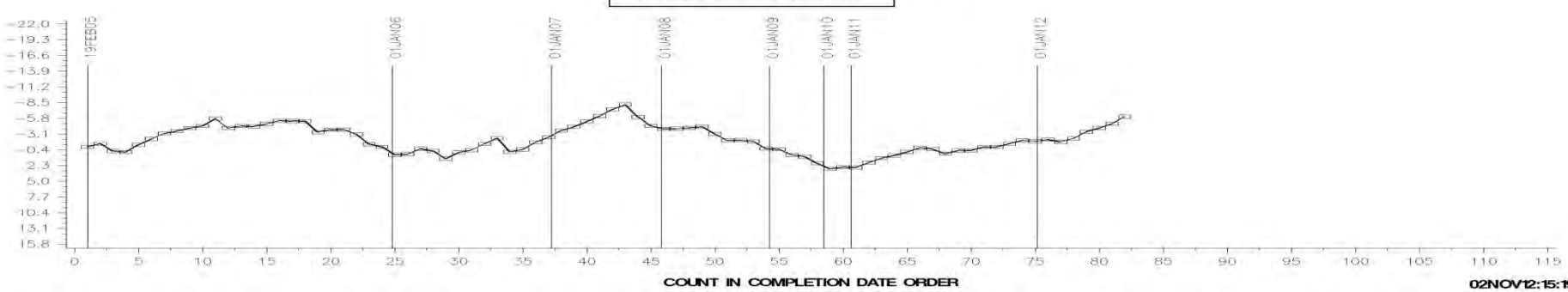
LTMS Severity Analysis



LTMS Precision Analysis



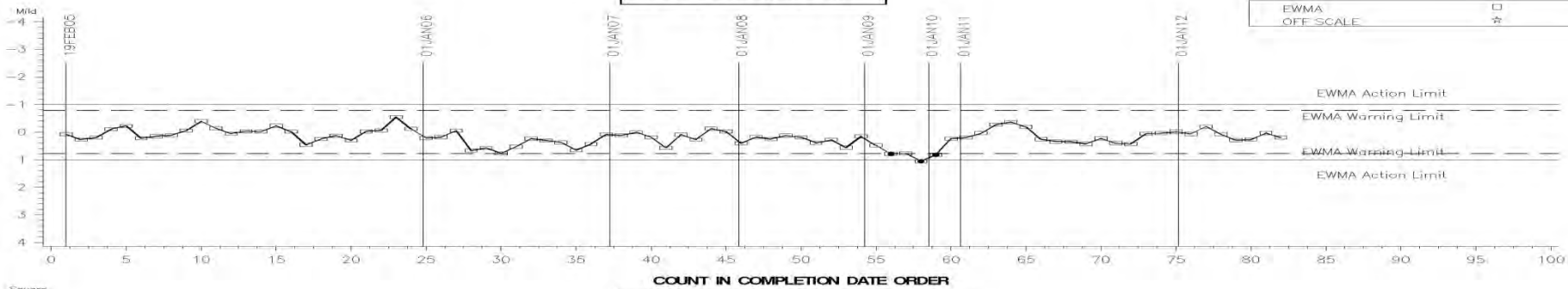
CUSUM Severity Analysis



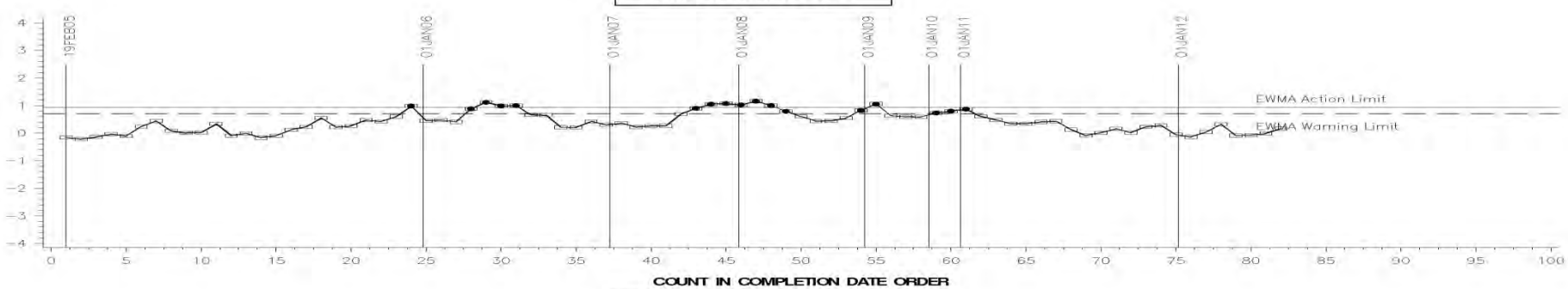
02NOV12:15:19

MACK T-12 INDUSTRY OPERATIONALLY VALID DATA
FINAL TRANS. RES. OIL CONSUMPTION

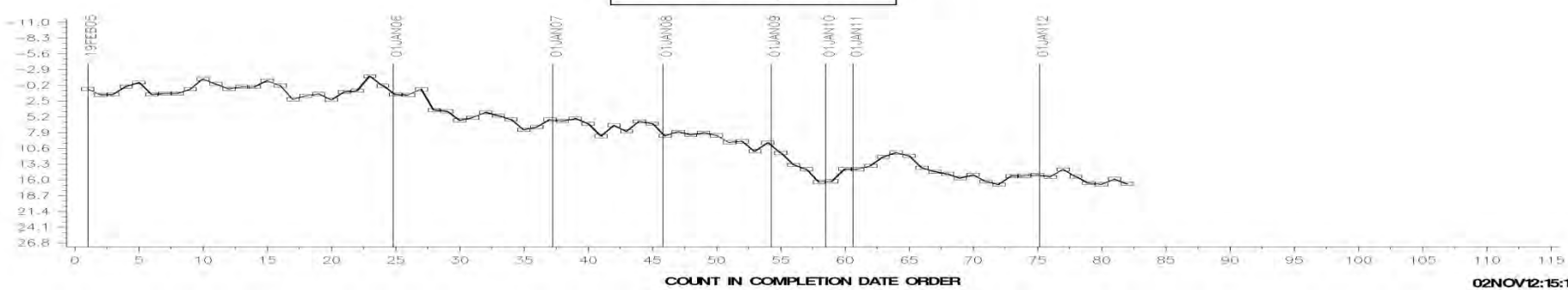
LTMS Severity Analysis



LTMS Precision Analysis

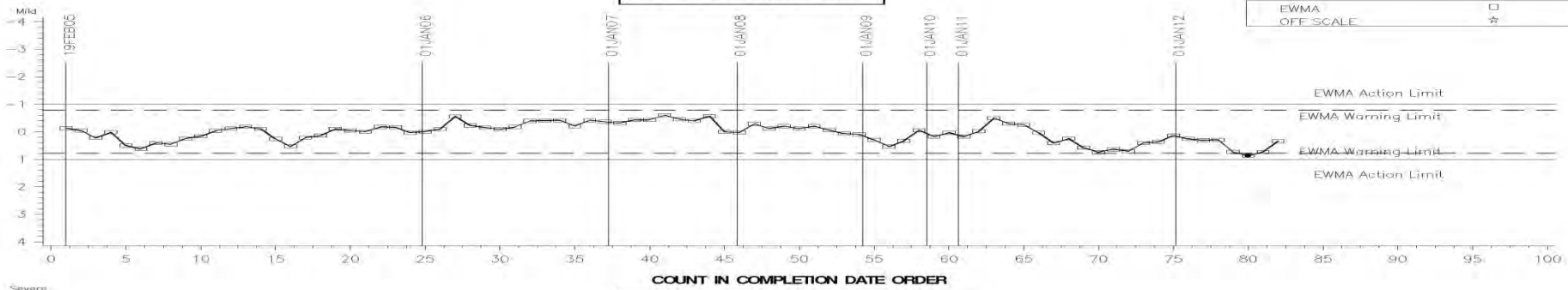


CUSUM Severity Analysis

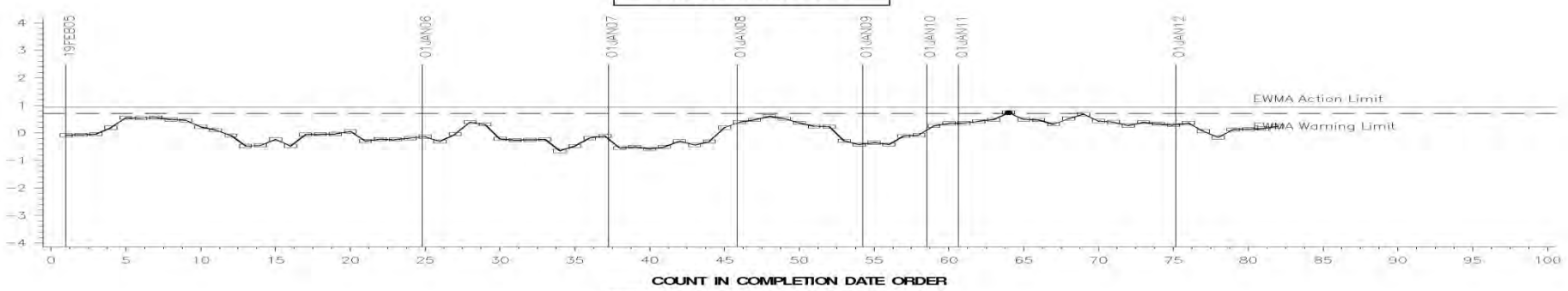


02NOV12:15:19

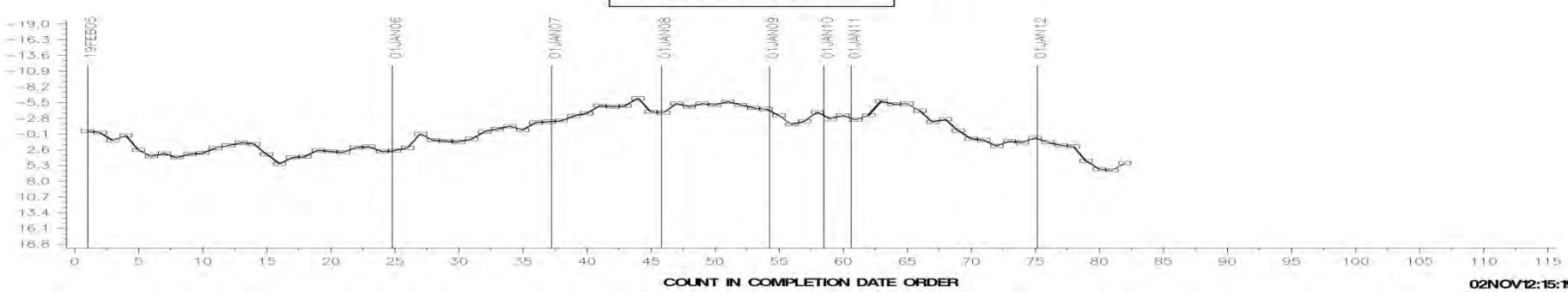
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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Appendix 1.0

T-12A Control Charts

» Severity, Precision, and CuSum

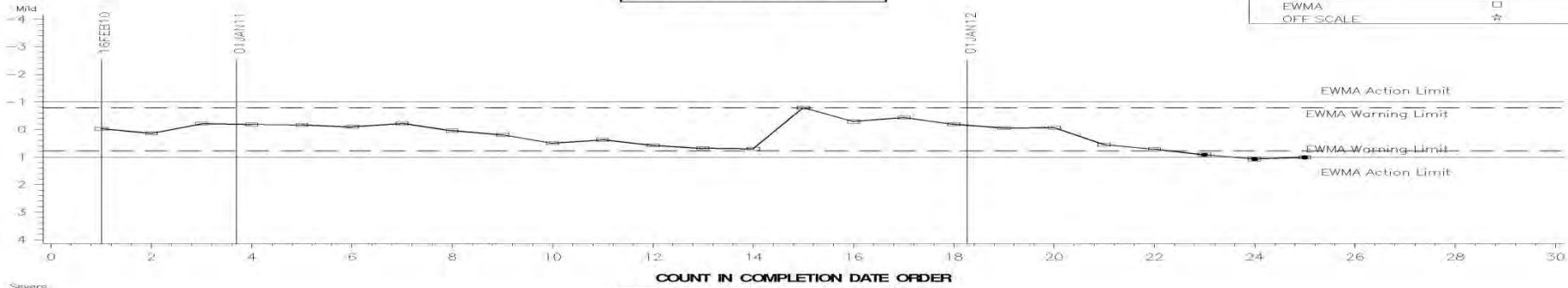
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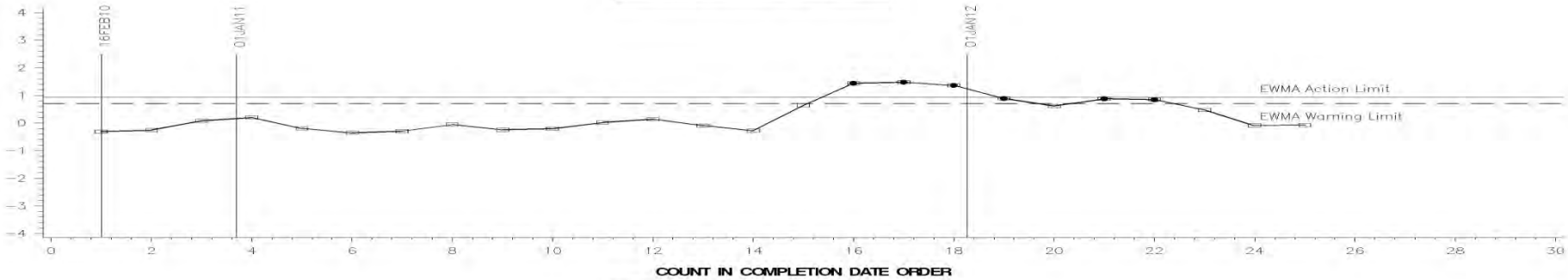


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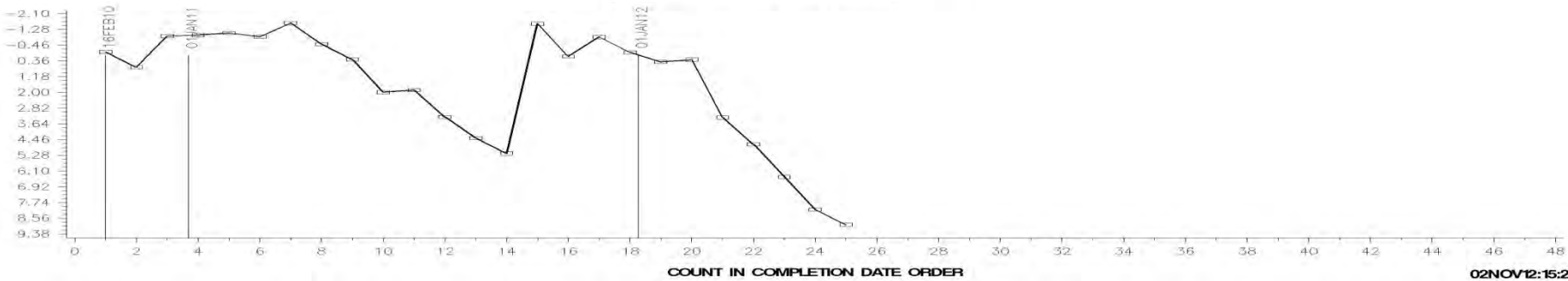
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis



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