

HEAVY-DUTY ENGINE OIL CLASSIFICATION PANEL
OF
ASTM D02.B0.02
December 6, 2022
Orlando, FL

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ACTION ITEMS

MINUTES

- 1.0 Call to order
 - 1.1 The Heavy-Duty Engine Oil Classification Panel (HDEOCP) was called to order by Chairman Shawn Whitacre at 1:32 p.m. on Tuesday, December 6, 2022, in the Oceans Ballroom 3 of the Renaissance Orlando at SeaWorld Hotel, Orlando, FL.
 - 1.2 There were **12** members present and **63** guests present. The attendance list is included as Attachment 2.
- 2.0 Agenda,
 - 2.1 The agenda circulated prior (included as Attachment 1) was not changed.
- 3.0 Minutes
 - 3.1 The June 28, 2022, minutes were approved as written.
- 4.0 Membership
 - 4.1 There were 4 membership changes. Lysie Delp of CAT replaces Hind Abi-Akar, Stephen Kirby of GM replaces Nathan Siebert, Greer Gibbons of Lubrizol replaces John Loop and Bruce Tonkel of Valvoline replaces Ed Murphy.
- 5.0 Mack/Volvo, David Brass -**Attachment 3**
 - 5.1 The T-13 will be going through a Reference oil change in the Q2-2023 from TMC 823 to TMC 823-1.
 - 5.2 Mack T-8/T-11/T12 will be transitioning to the last batch of hardware in the 2nd or 3rd Quarter of 2023. This batch will take the tests to end of life.
 - 5.3 Current usage is about 50 kits per year (T-11, T-12, T-8 combined). The current projection end of life is 5-6 years.
 - 5.4 Testing on the new T-13 Reference oil 823-1 is expected to start in April 2023.
 - 5.5 There are no concerns on reference oil availability for the Mack T-8 / T-11 / T-12 tests.
 - 5.6 Current batch for Mack T-11 / T-12 hardware is in **attachment 3 page 5**
 - 5.7 The Mack T-8 VI38 is in level 2 Zi alarm in the mild direction.
 - 5.8 The Mack T-11 SOOT4 is in the severity action alarm in severe direction, SOOT, SOOT5 and MRV are in control.

- 5.9 The Mack T-12 test has all parameters in control however, PB and PB2 are close to precision warning alarm.
- 5.10 The Volvo T-13 KV40 is in level 2 Zi alarm in the mild direction. All mild result are due to one stand that is not in use. IRPH is in control.
- 5.11 Activity is down this year with the exception of the Mack T-11

6.0 CAT- David Brass – **Attachment 4**

- 6.1 New batch of filters introduced and approved on November 22. The updated CF is 0.9310 multiplicative on average oil aeration.
- 6.2 2 new Reference oil blends will be introduced in 2023: TMC 833-2 and TMC 832-2
- 6.3 Reference oil TMC 832-1 has been temporarily suspended by the CAT SP.
- 6.4 COAT / EOAT equivalency is still being done. The SP is waiting on more data for further analyses. Funding is slowing the progress down.
- 6.5 The C13 is in severity warning alarm for TLC in the mild direction.
- 6.6 The COAT has an action alarm for AAVE in the severe direction.
- 6.7 The 1K TGF is in warning alarm in the mild direction. BSOC is in action alarm in the mild direction. All other parameters are in control.
- 6.8 The test severity for the 1N is in the warning alarm for WDN and BSOC. TFG is in precision action alarm. TLHC is in control.
- 6.9 The 1P has a severity action alarm for ETOC in the severe direction.

7.0 Cummins- Andrew Smith -**Attachment 5**

- 7.1 Inventory is low on ISB critical parts with Cams being the lowest at 10 Batch M kits.
- 7.2 New hardware is expected to arrive in January 2023.
- 7.3 Current Reference oil is expected to last 2 years. The re-blend of the new reference oil has started, and it will be introduced in the next few years.
- 7.4 Current hardware supply issues with ISB turbos are being addressed by Cummins. The labs are slowly backfilling their inventory.
- 7.5 Tappets triggered an action alarm in the mild direction. The Panel will need to review data and weigh options to reference on new hardware.
- 7.6 Both cams and tappets are getting a new batch.
- 7.7 ISM hardware status looks good, no issues to report.
- 7.8 Average sludge rating has triggered a Precision Action Limit alarm. The Panel has decided not to make changes.
- 7.9 Crosshead Weight Loss has triggered a warning alarm. Alarm will be monitored as more data is produced.
- 7.10 Oil Filter Delta Pressure has triggered a precision alarm. Alarm will be monitored as more data is produced.
- 7.11 Injector Screw weight loss has triggered a severity and precision alarm. The CF has been updated. The Labs need to re-submit data on batch G crossheads so charts can be updated.

8.0 DD13 -Robert Slocum- **Attachment 6**

- 8.1 A total of 3 reference tests were reported this year.
- 8.2 Severity for Hours to Scuff is under control.
- 8.3 There is a supply issue with main caps bolts and head bolts.
- 8.4 Current supply for Reference oil is ~ 1.5 years.

9.0 Ford VTW Task Force-Mike Deegan- **Attachment 7**

- 9.1 The MY2019 engine will be needed for one more year.
- 9.2 MY23 hardware are making its way to the labs.

- 9.3 The hardware is creating two changes from the MY2019, the oil pump is producing higher oil pressure and the fuel pressure is higher on the MY23.
 - 9.4 One engine currently available. Ford is working on sending SwRI and ECM.
 - 9.5 Ford is looking for a supplier to provide a 5w-20 reference oil.
 - 9.6 Labs are to decide when hardware has reached end of life.
 - 9.7 SwRI is currently using D975 fuel, while Intertek and Lubrizol are on PC-10. There are slight differences on test results.
 - 9.8 Update to MY23 engines is expected to come in the 3rd Quarter 2023.
- 10.0 D4485 Update- Laura B- **Attachment 8**
- 10.1 Revised limits for elastomer compatibility were approved and sent out via a D4485 information letter.
 - 10.2 Conversations between TMC, the Elastomer SP and D4485 SP Chair are ongoing. John Loop is now the point of contact for the TMC.
 - 10.3 The new standard deviation will be estimated after Q1 2023 meetings. Change will also involve a change to EOEC test report.
 - 10.4 A Ballot will be sent out Q1 2023
- 11.0 Old Business
- 11.1 No Old Business to discuss.
- 12.0 Next meetings, June 25th
- 12.1 Next meeting to be held on June 27, 2023, in Denver.
- 13.0 The meeting was adjourned at 2:38 pm.

AGENDA
D02.B0.02.1
Heavy-Duty Engine Oil Classification Panel
Tuesday, December 6, 2022 1:30pm EST
Renaissance Orlando at SeaWorld®
Orlando, Florida USA

- 1) Call to Order/Anti-trust statement**
- 2) Minutes** – Approval of Minutes from June 28, 2022 Meeting in Seattle, WA USA
- 3) Membership**
 - a) Review and update current panel membership
- 4) Surveillance Panel/Task Force Reports**
 - a) Volvo/Mack SP Report (David Brass, Infineum)
 - b) CAT SP Report (David Brass *for Jacob Goodale*, Infineum)
 - c) Cummins SP Report (Andrew Smith, Intertek)
 - d) DD13 SP Report (Robert Slocum, Lubrizol)
 - e) Ford 6.7L VTW Test TF Update (Mike Deegan, Ford)
 - f) ASTM D4485 SP Update – Annex A5 Changes (Laura Birnbaumer, Oronite)
- 5) Old Business**
 - a) EOEC Fixed limits ballot and next steps (Shawn Whitacre, Chevron)
- 6) New Business**
- 7) HDEOCP Adjournment**

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Mack/Volvo Surveillance Panel Update

HDEOCP

December 6, 2022

Key Updates

- Volvo T-13 will be going through a Reference oil change from TMC 823 to TMC 823-1 in 2nd Quarter 2023
- Mack T-8/T-11/T-12 will be transitioning into the last batch of parts before end of life (YYFZQWB) in 2nd-3rd Quarter 2023
- Current projected end of life for Mack T-12 is about 5-6 years (under current parts usage).

Surveillance Panel Meeting Updates

October 6, 2022

- Surveillance Panel successfully voted to have coordinated reference testing started before beginning of April 2023 to introduce TMC 823-1 to Volvo T-13 using Batch “C” liners.
- Surveillance Panel successfully voted to introduce Batch “D” liners to the Volvo T-13 as a rolling parts change as new kits arrive.
 - Very limited Batch “C” liners remain
- Surveillance Panel successfully voted that next reference tests will be completed on new batch of parts: **Y** *top ring*, **Y** *2nd ring*, **Y** *oil ring*, **F** *piston crown* (subgroup TBD but will exclude subgroup A), **Z** *connecting rod bearing*, **Q** *main bearing*, **W** *liner*, **B** *piston skirt*.
 - Next reference cycle will be around Q2-Q3 2023
- Surveillance Panel provided feedback to NCDT on Low Viscosity Testing in Volvo T-13

Reference Oils

Test	Reference Oil	Supply
Mack T-8	TMC 1005-5	~ 2 year supply
Mack T-11	TMC 822-2	2.5 year supply
Mack T-12	TMC 821-4	5+ year supply
Volvo T-13	TMC 823 TMC 823-1	<1 year supply 5+ year supply

Updates:

TMC 823 is almost out of supply

TMC 823-1 to be introduced in 2nd quarter 2023.

- Surveillance Panel voted to have coordinated reference testing started before beginning of April 2023

Mack T-11/T-12 Hardware

Current Parts Batches

	Mack T-11	Mack T-12
Top Ring	W	X
2 nd Ring	W	X (limiting part)
Oil Ring	W	X
Piston Crown	E (limiting part)	FsubE
Rod Bearing	Y	Y
Main Bearing	P	P
Liner	W	W
Skirt	B	B
Kits left at TEI As of Nov 30th	0	16

- Mack T-11 current parts batch has just run out at TEI

Mack T-11/T-12 Hardware

October 6, 2022 Surveillance Panel Meeting

Surveillance Panel agreed to a coordinated reference on the new batch of parts on next reference cycle in Q2-Q3 2023 for Mack T-12

Future Parts Batch (excluding parts in current kits)

	Mack T-11/T-12	Parts Available for this kit combination (before Rejects)	Projected Good Parts	Projected Available Kits
Top Ring	Y	2120	2120?	353
2 nd Ring	Y	2000	1860	310
Oil Ring	Y	2000	1920	320
Piston Crown	F (subgroup TBD)	1862 (sub A excluded)	1824	304 (limiting part)
Rod Bearing	Z	2000	1900	316
Main Bearing	Q	450 kits	360 kits	360
Liner	W	2090	1881	313
Skirt	B	1992	1892	315

- Current Purchase Rate is 50-60 kits from TEI per 12 months.
- There is currently 5-6 years of parts left at TEI for Mack T-8/T-11/T-12

Mack T-8/E

Labs	Stands	Referenced Stands
2	2	2

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	2	
Aborted	XC	1	Missed Soot Window
TOTAL		3	

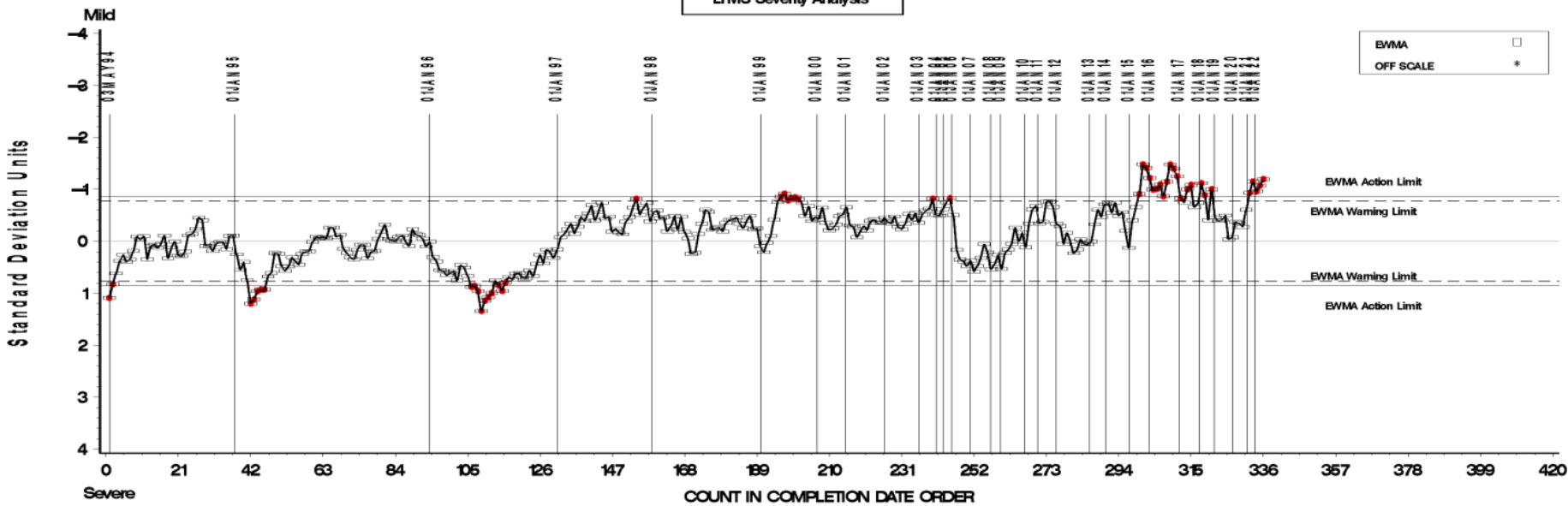
Test Severity

- VI38 is in level 2 Zi alarm in mild direction
- RV48 and RV2 are in control

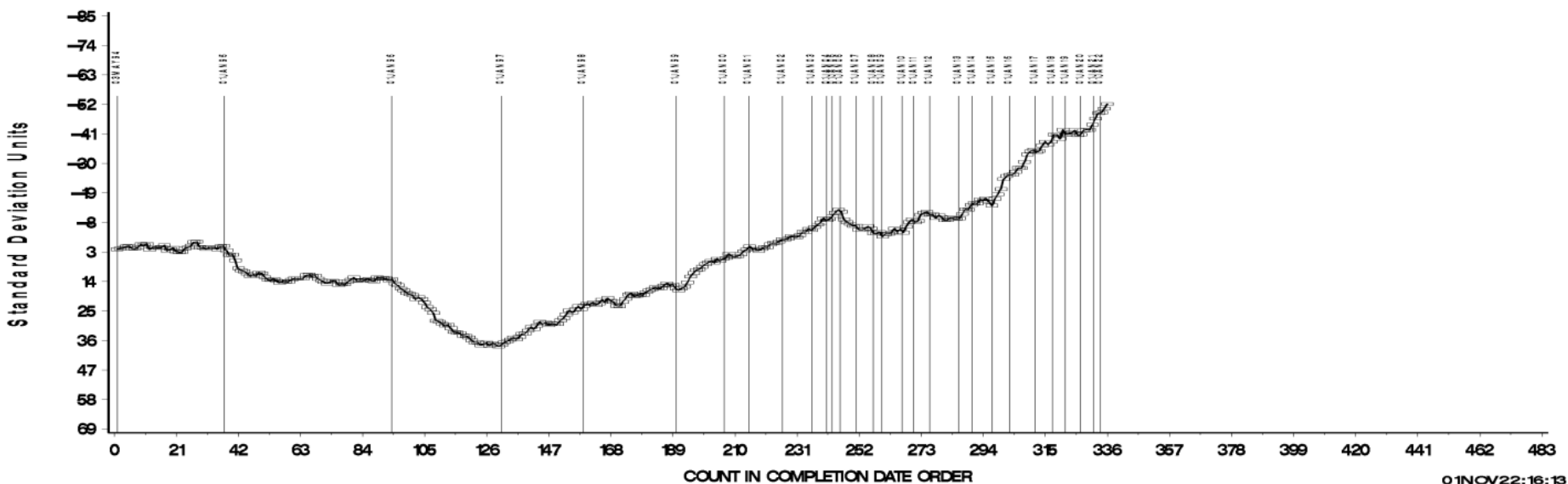
Mack T-8 Charts – VI38

Viscosity Increase @ 3.8% Soot

LTMS Severity Analysis

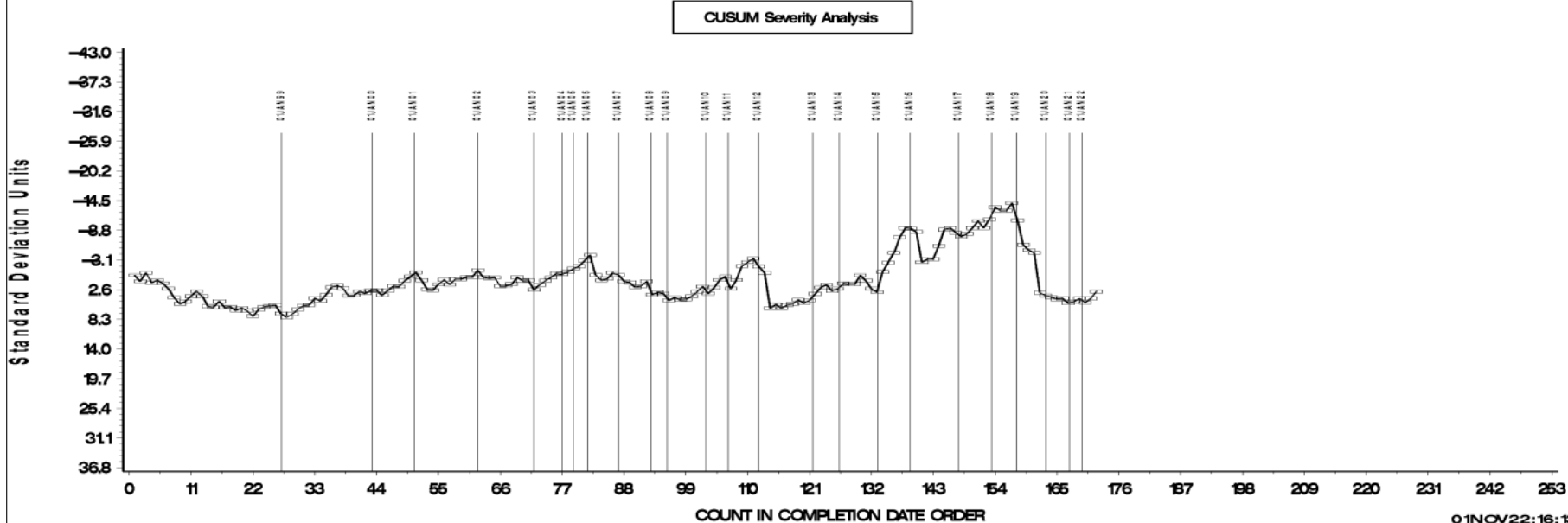
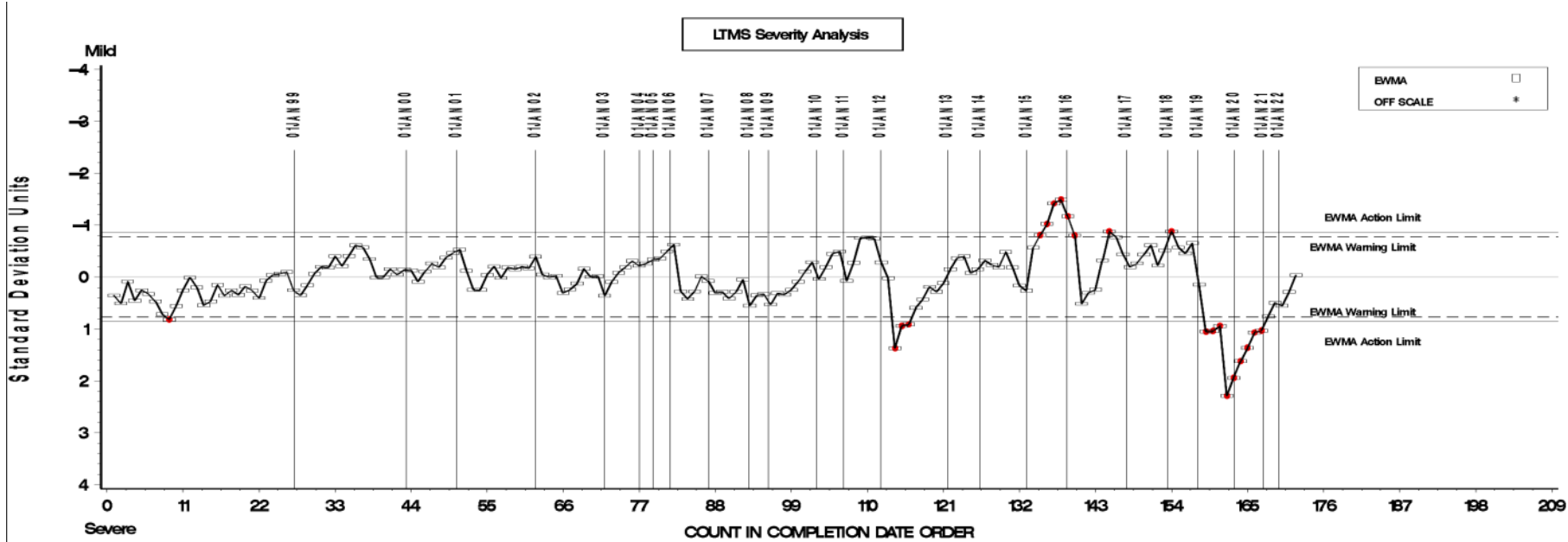


CUSUM Severity Analysis



Mack T-8 Charts – RV48

Relative Viscosity @ 4.8% Soot (100% Loss)



Mack T-11

Labs	Stands	Referenced Stands
3	5	4

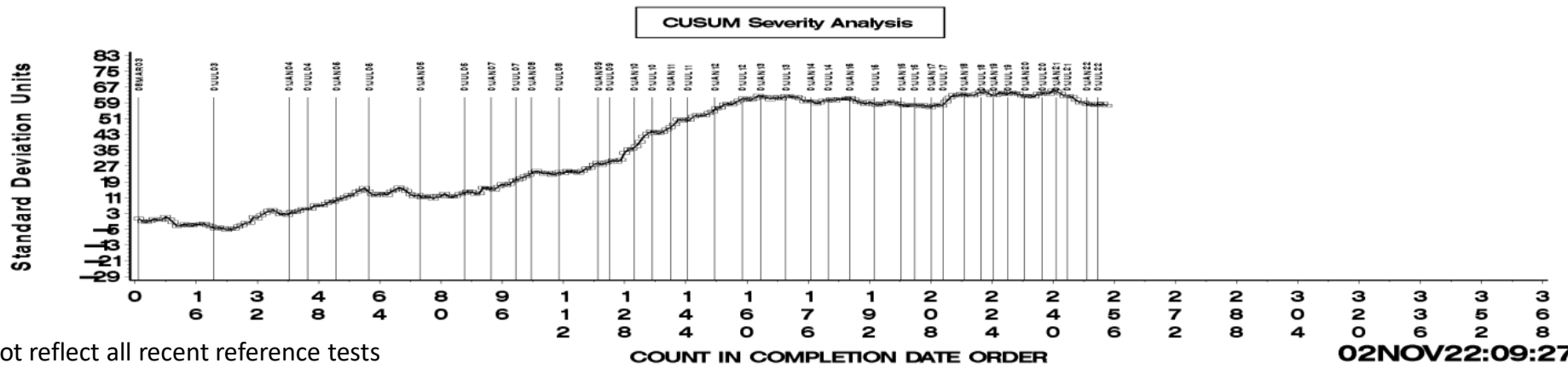
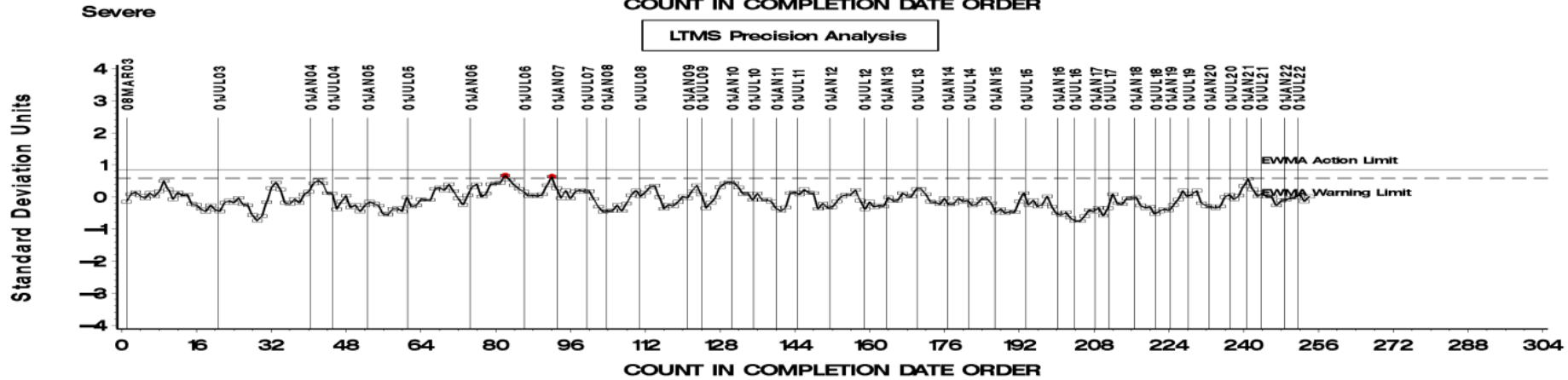
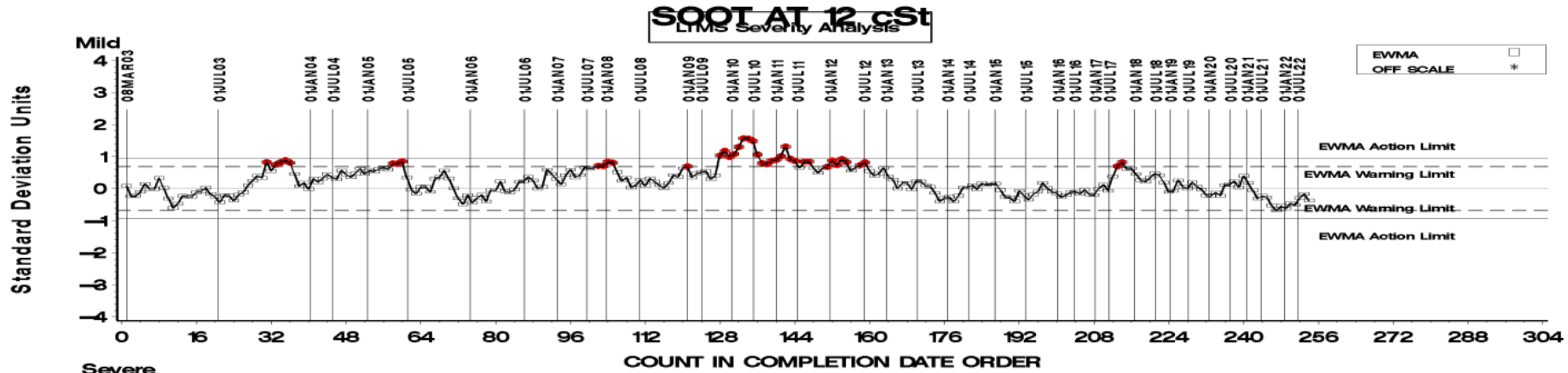
Reference Test Activity (Since June 2022)

Test Status	Validity Code	#
Acceptable Calibration Test	AC	4
TOTAL		4

Test Severity

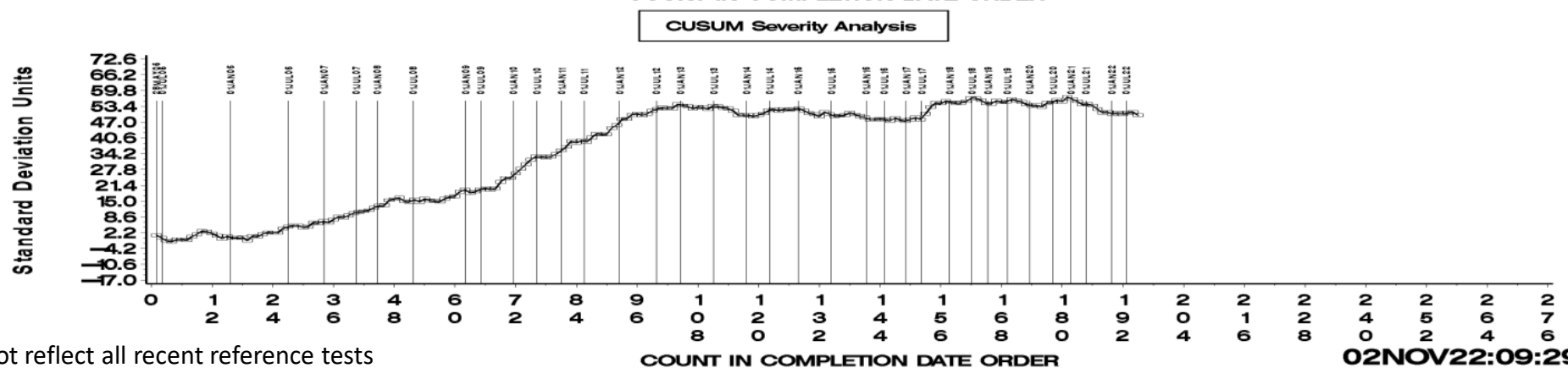
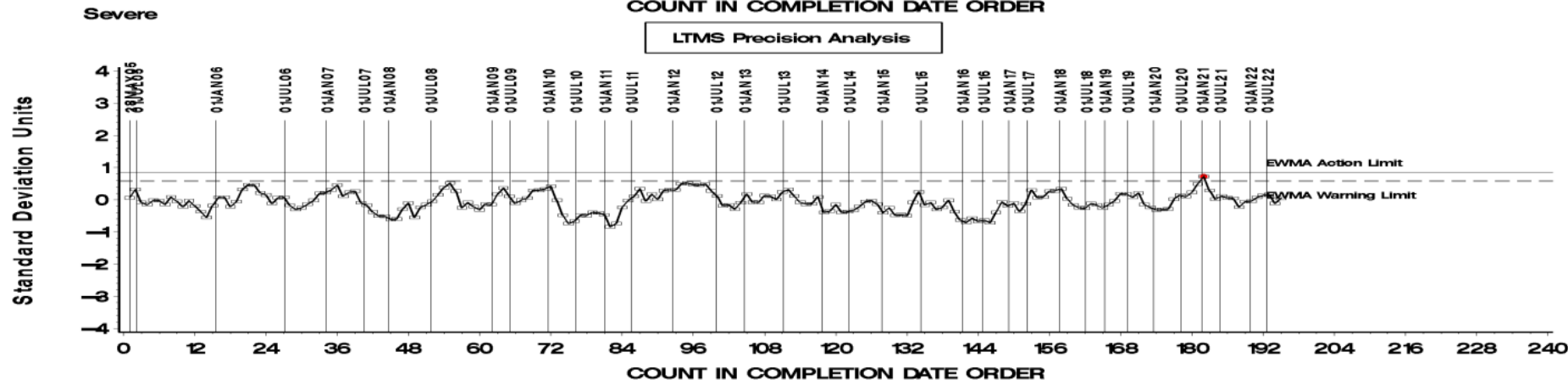
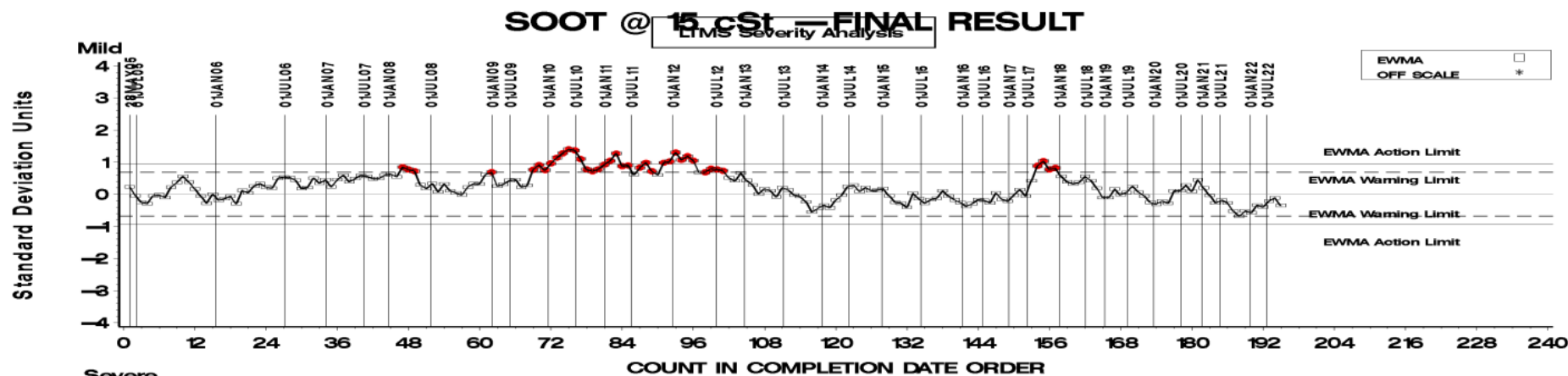
- SOOT (12 cSt), SOOT5 (15 cSt) and MRV are in control
- SOOT4 is in severity action alarm in severe direction
 - has been this way since introduction of 822-2 in 2014.
 - SOOT is critical parameter for test.

Mack T-11 Charts – SOOT



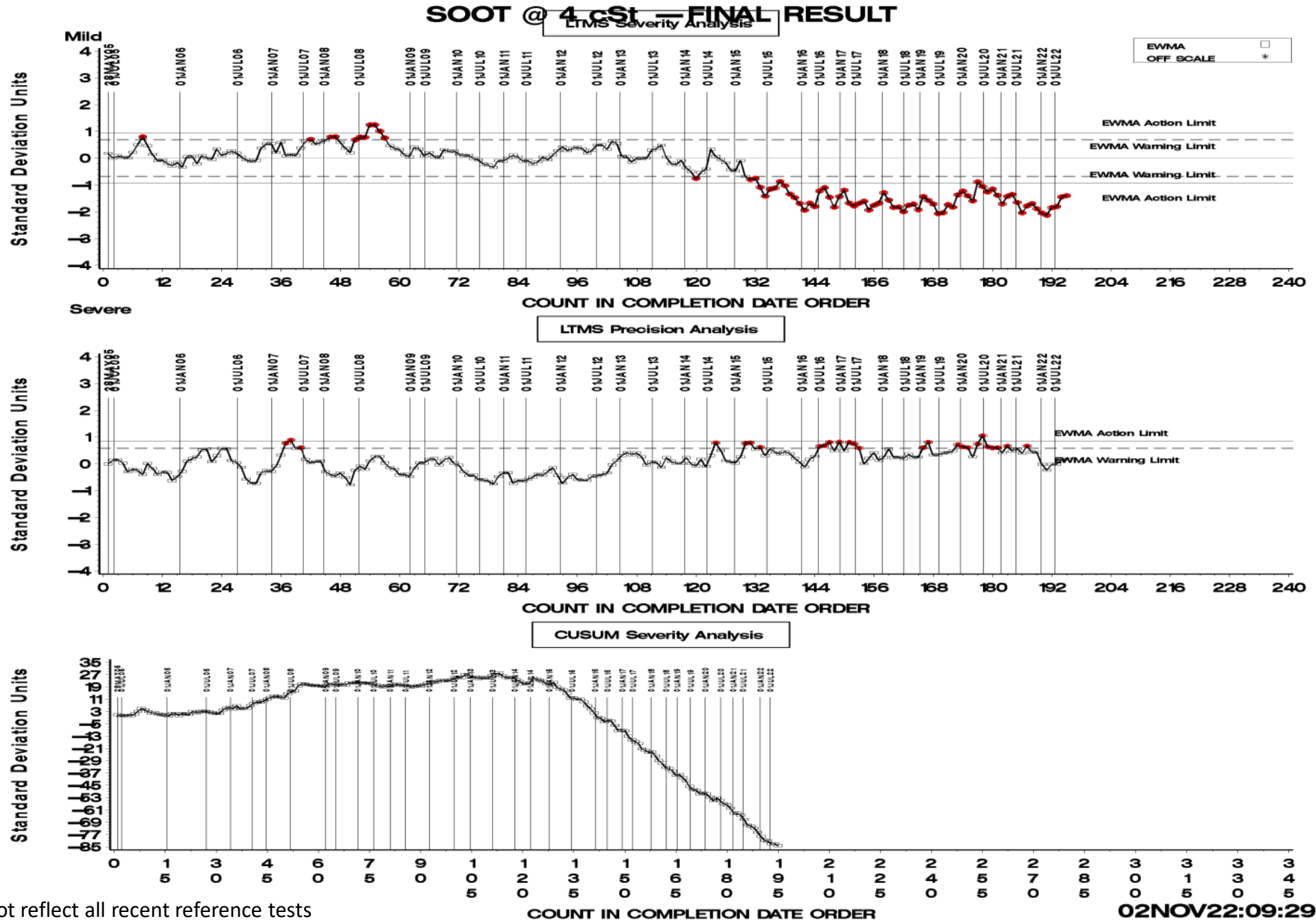
Note: charts do not reflect all recent reference tests

Mack T-11 Charts – S00T5



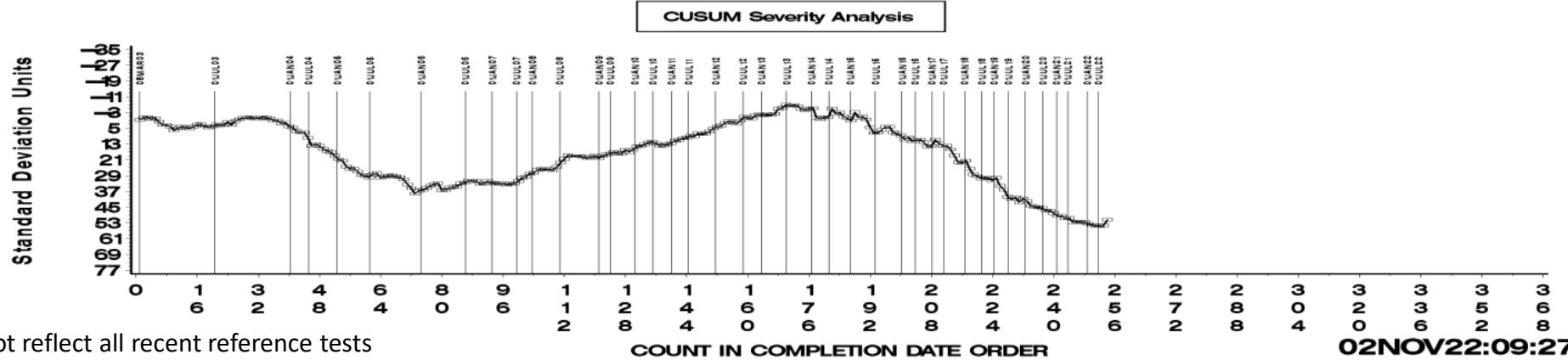
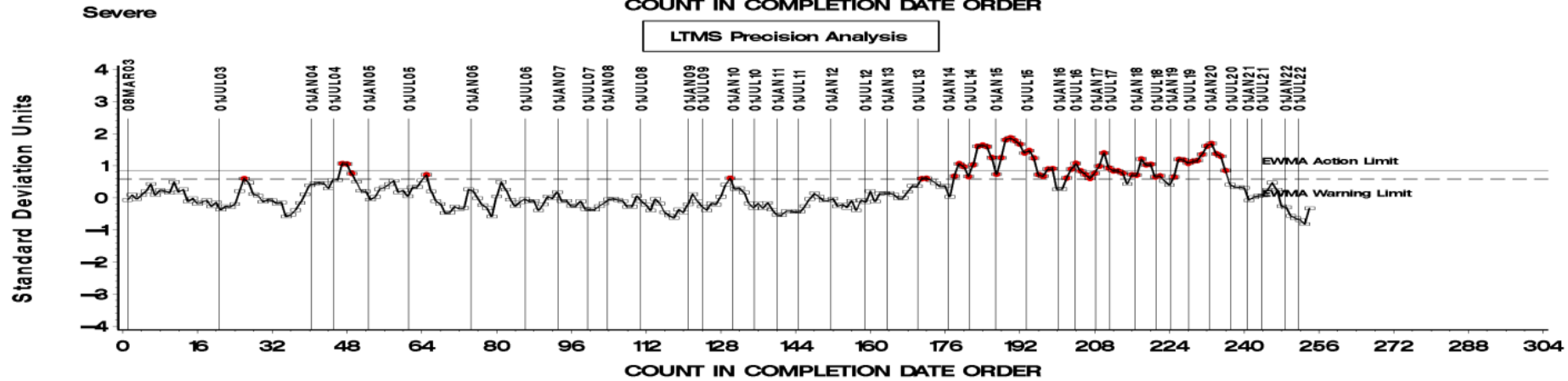
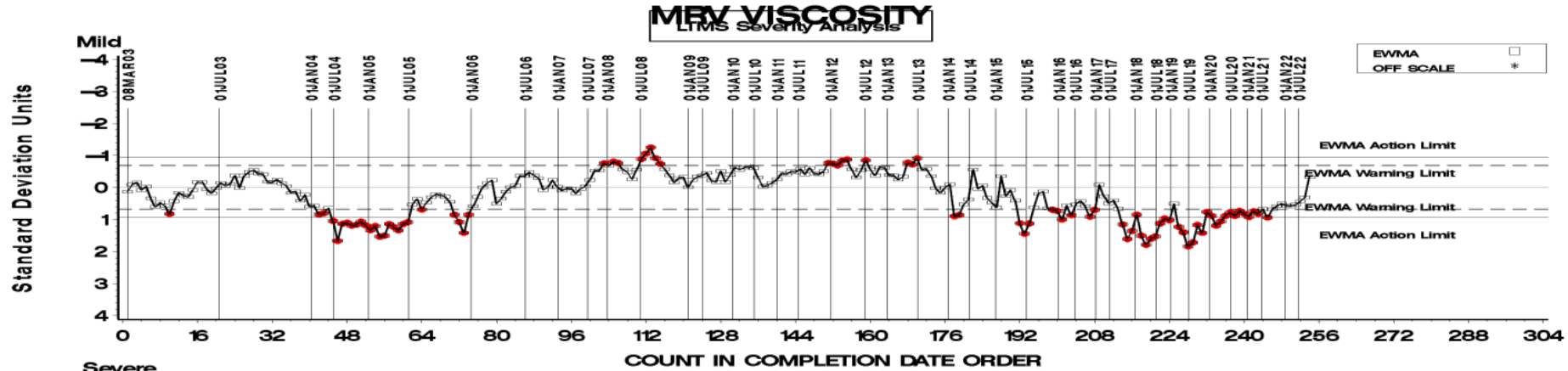
Note: charts do not reflect all recent reference tests

Mack T-11 Charts – S00T4



Note: charts do not reflect all recent reference tests

Mack T-11 Charts – MRV



Note: charts do not reflect all recent reference tests

Mack T-12

Labs	Stands	Referenced Stands
3	4	3

Reference Test Activity (Since June 2022)

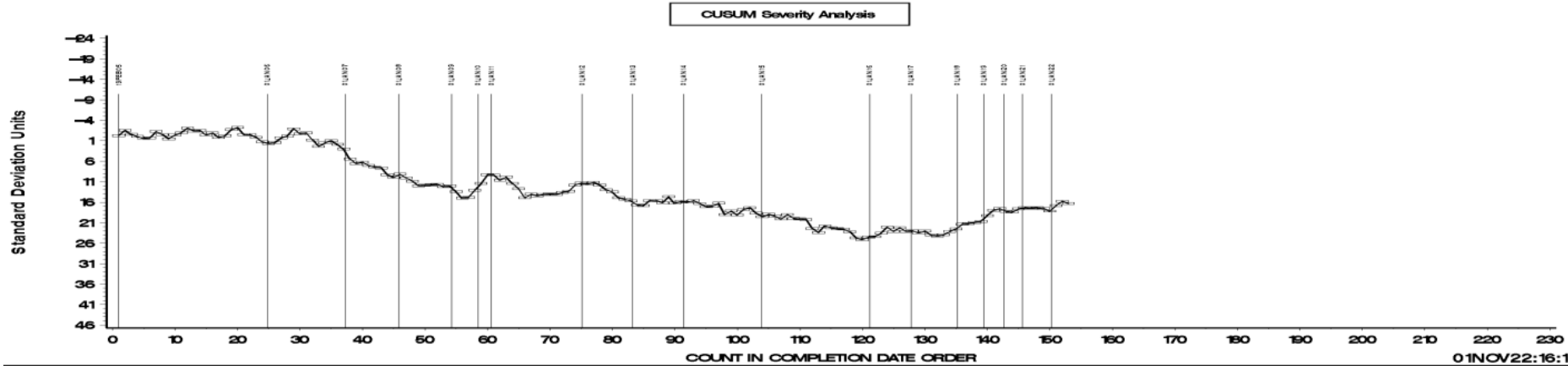
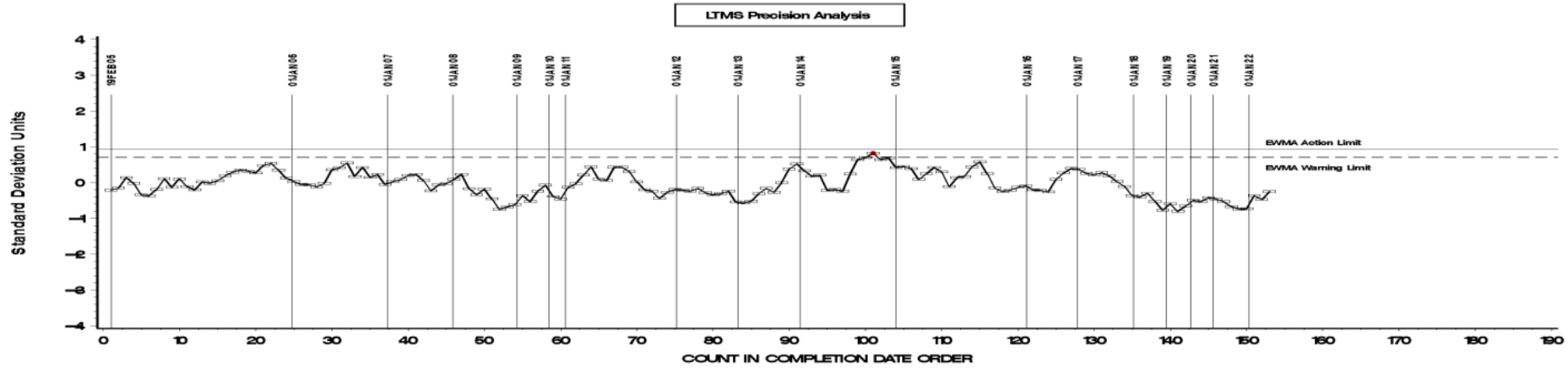
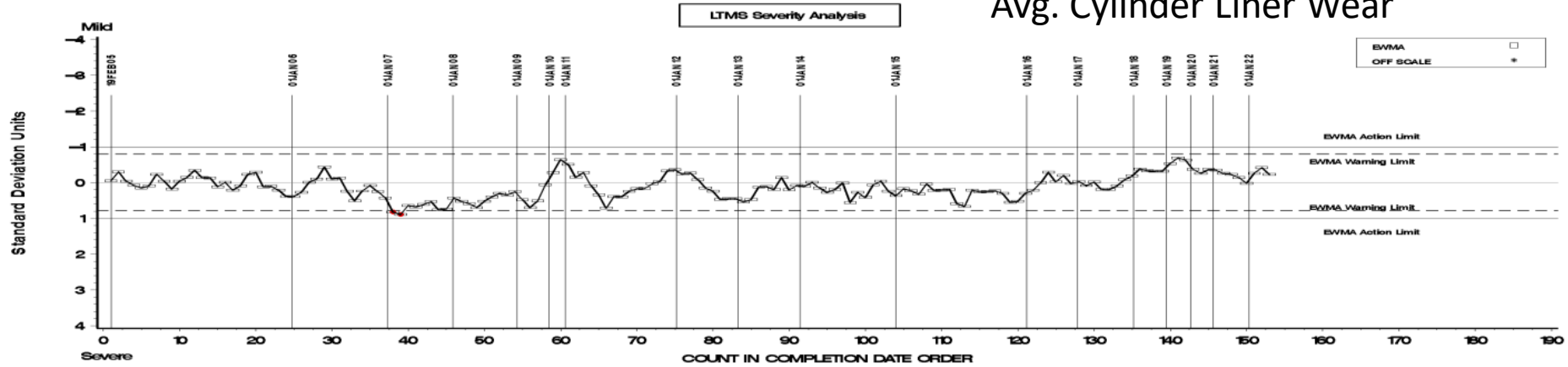
Test Status	Validity Code	#
Acceptable Calibration Test	AC	3
TOTAL		3

Test Severity

- All parameters are in control
- PB and PB2 are close to precision warning alarm

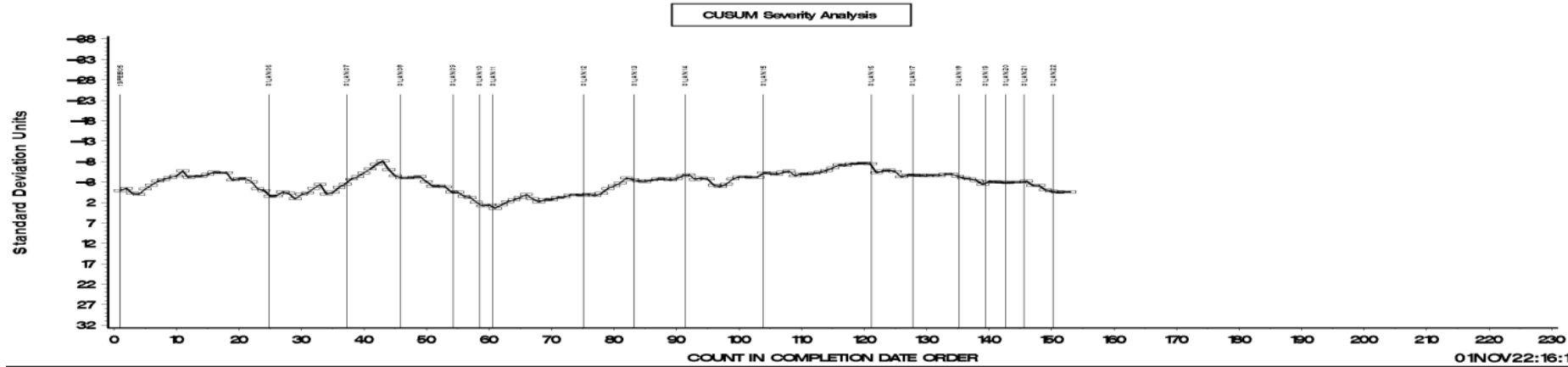
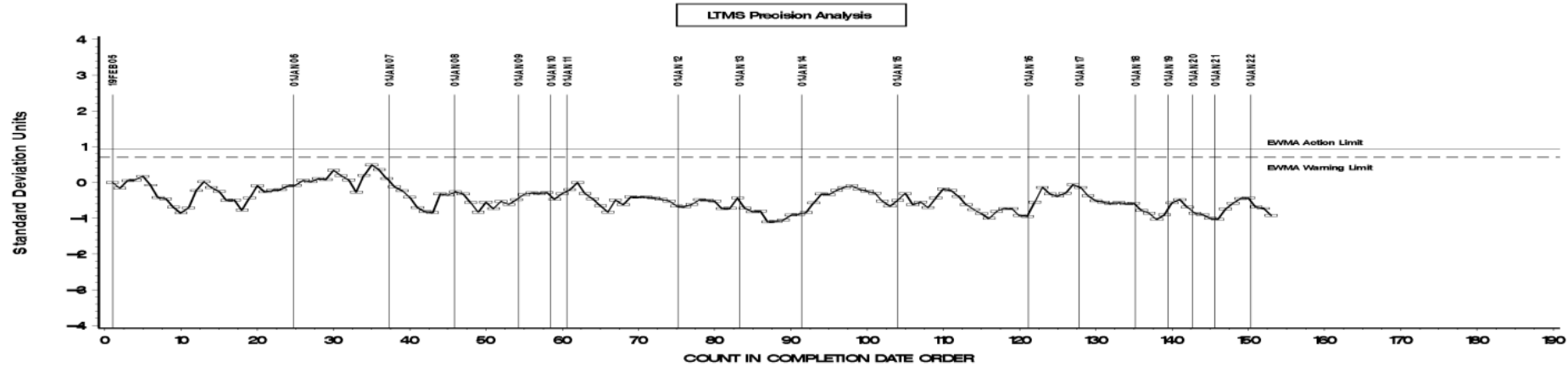
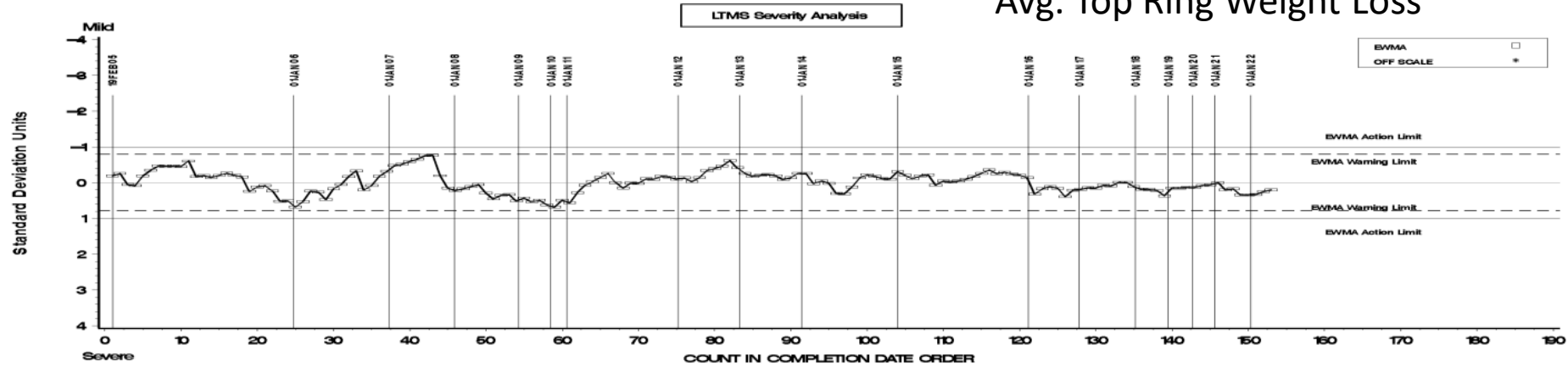
Mack T-12 Charts – CLW

Avg. Cylinder Liner Wear



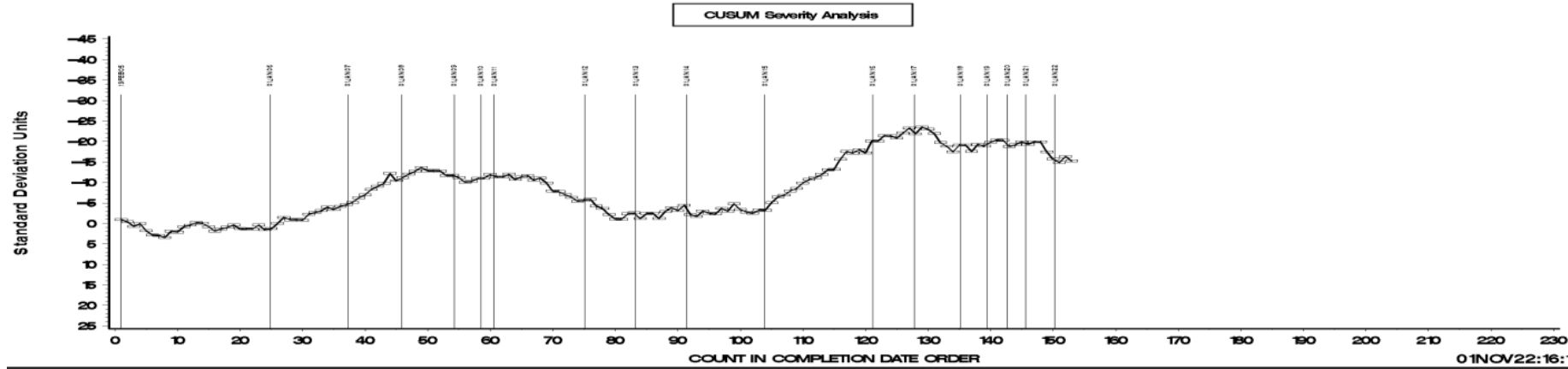
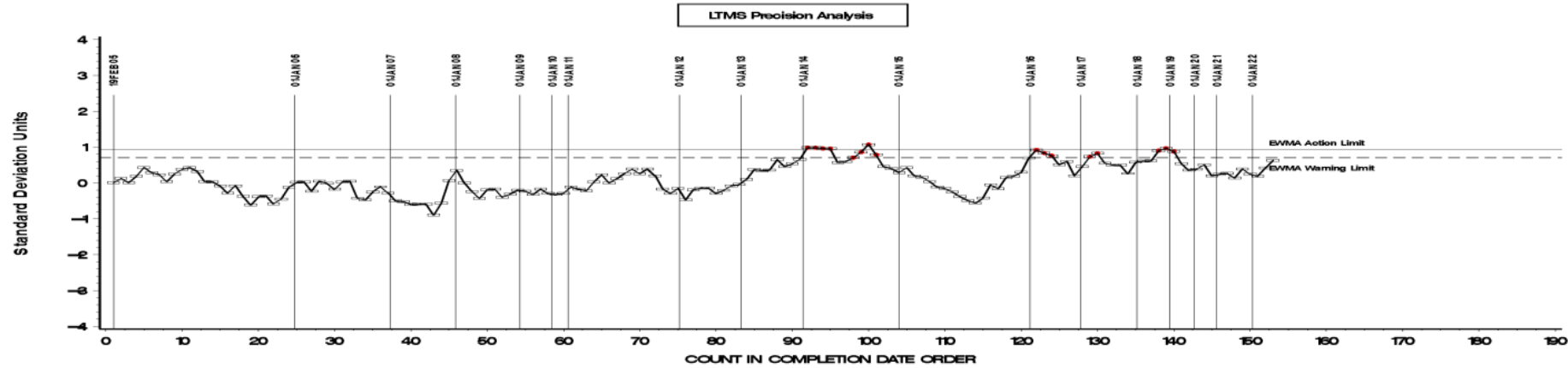
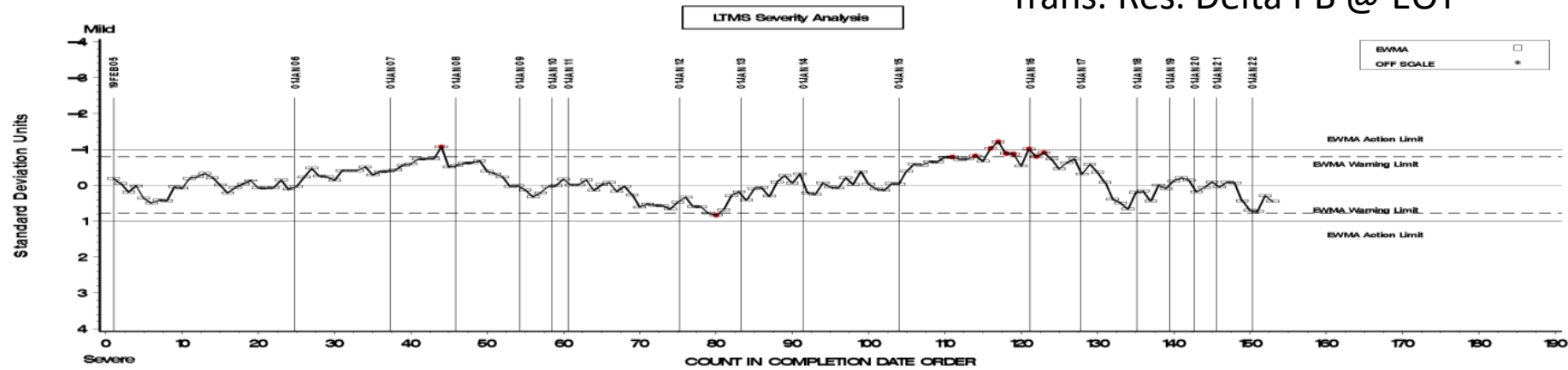
Mack T-12 Charts – TRWL

Avg. Top Ring Weight Loss



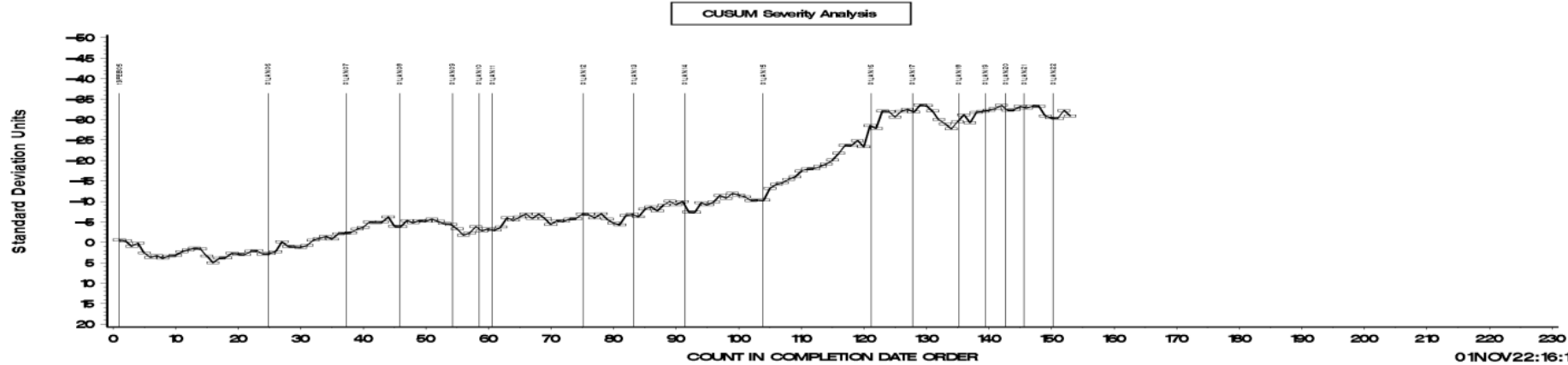
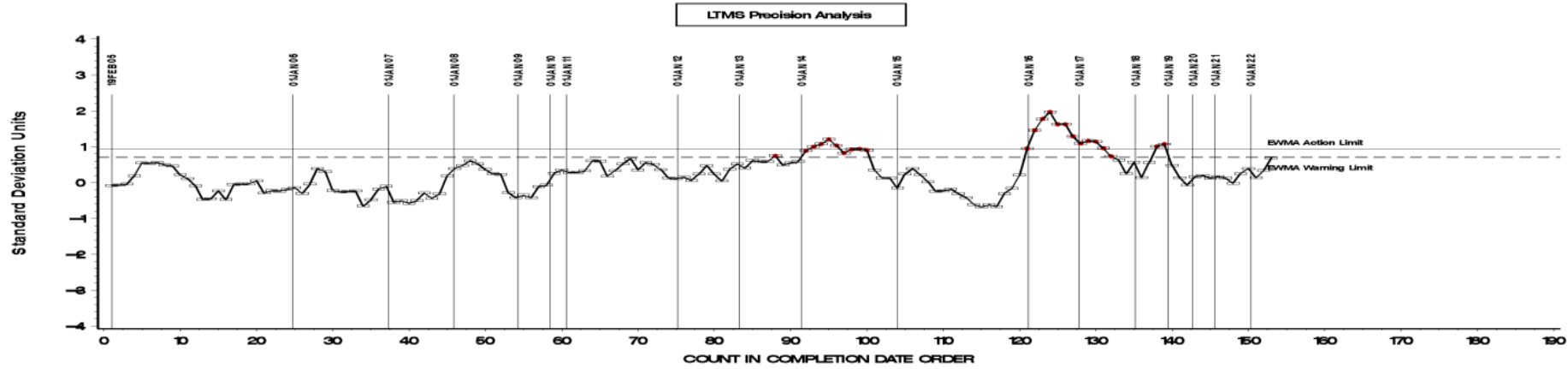
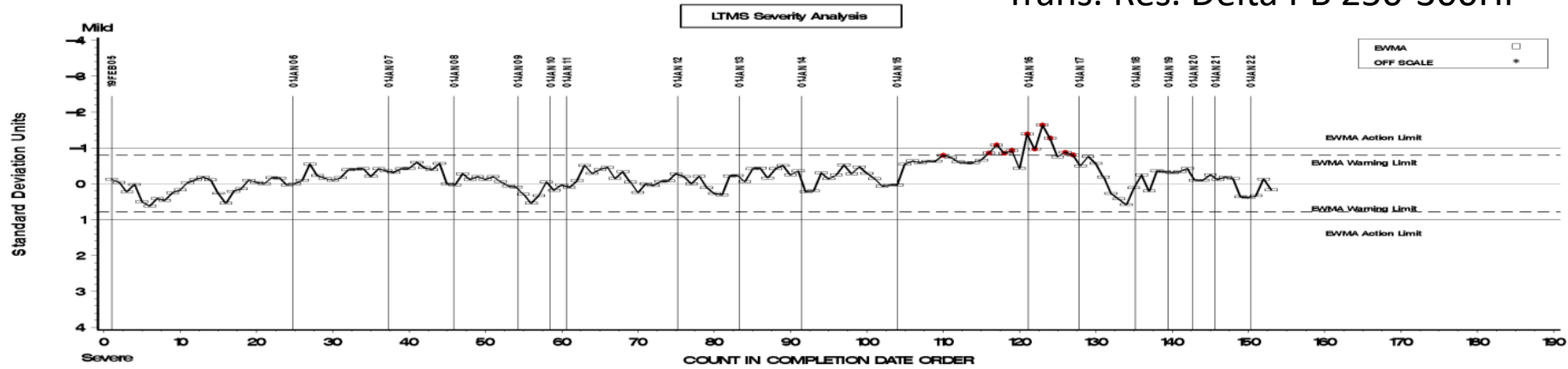
Mack T-12 Charts – PB

Trans. Res. Delta PB @ EOT



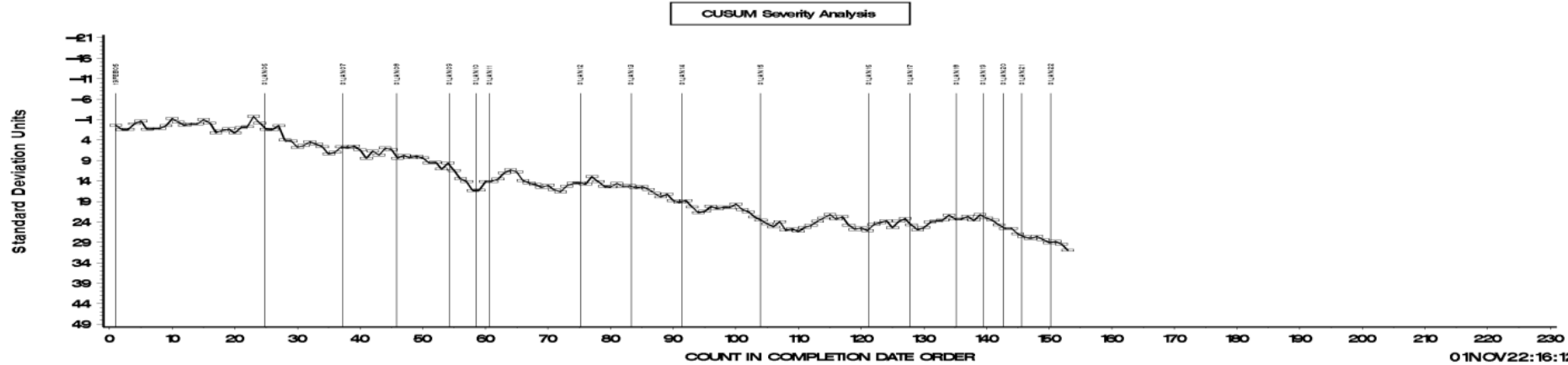
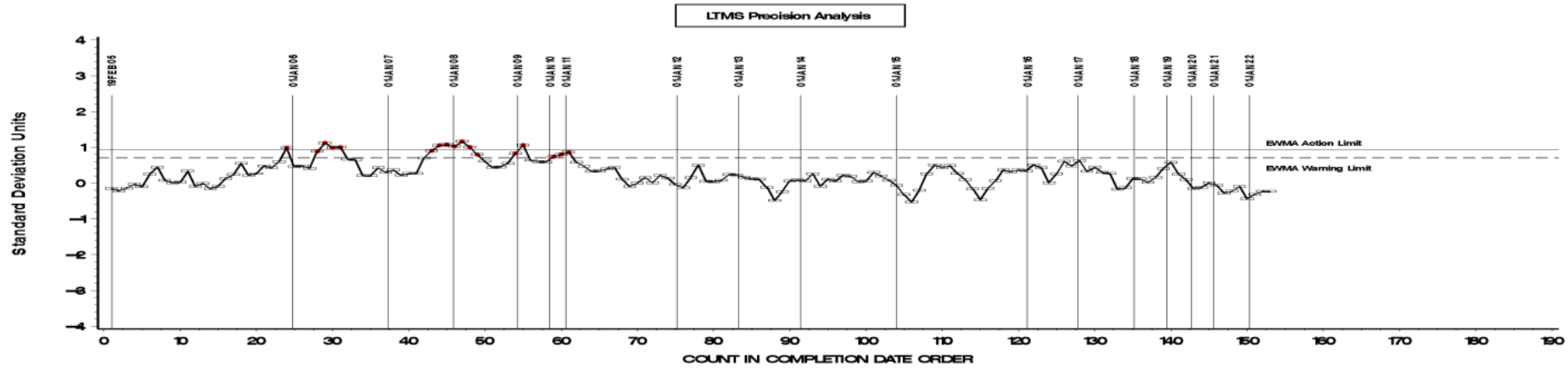
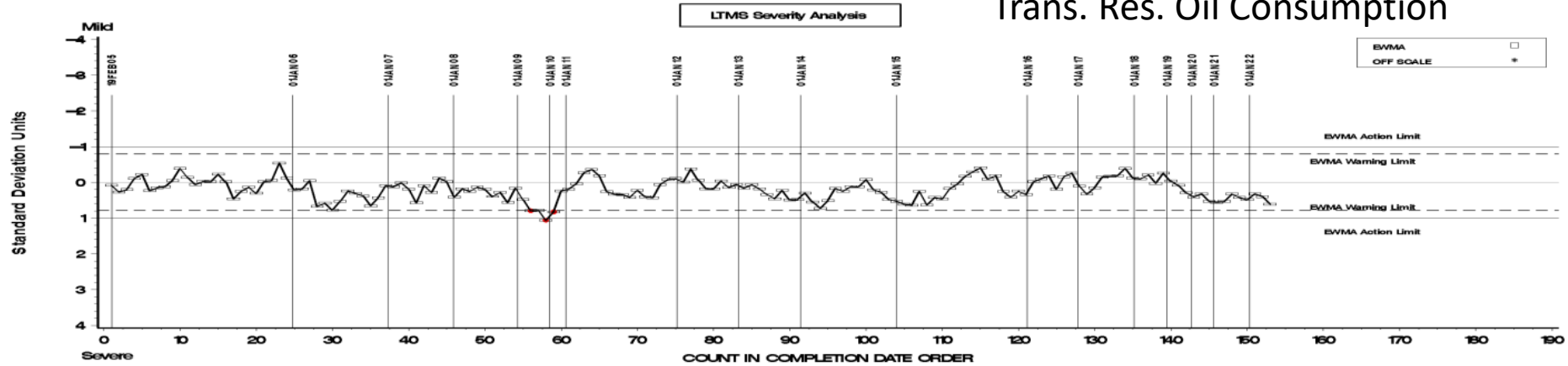
Mack T-12 Charts – PB2

Trans. Res. Delta PB 250-300Hr



Mack T-12 Charts – OC

Trans. Res. Oil Consumption



Volvo T-13

Labs	Stands	Referenced Stands
4	9	5

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause / Failed Parameter
Acceptable Calibration Test	AC	4	
Operationally Invalid	LC	1	External oil pump motor failure
Operationally Invalid	LC	1	Incorrect oil add at 252 hours
Failed Calibration Test	OC	1	IRPH Severe
TOTAL		7	

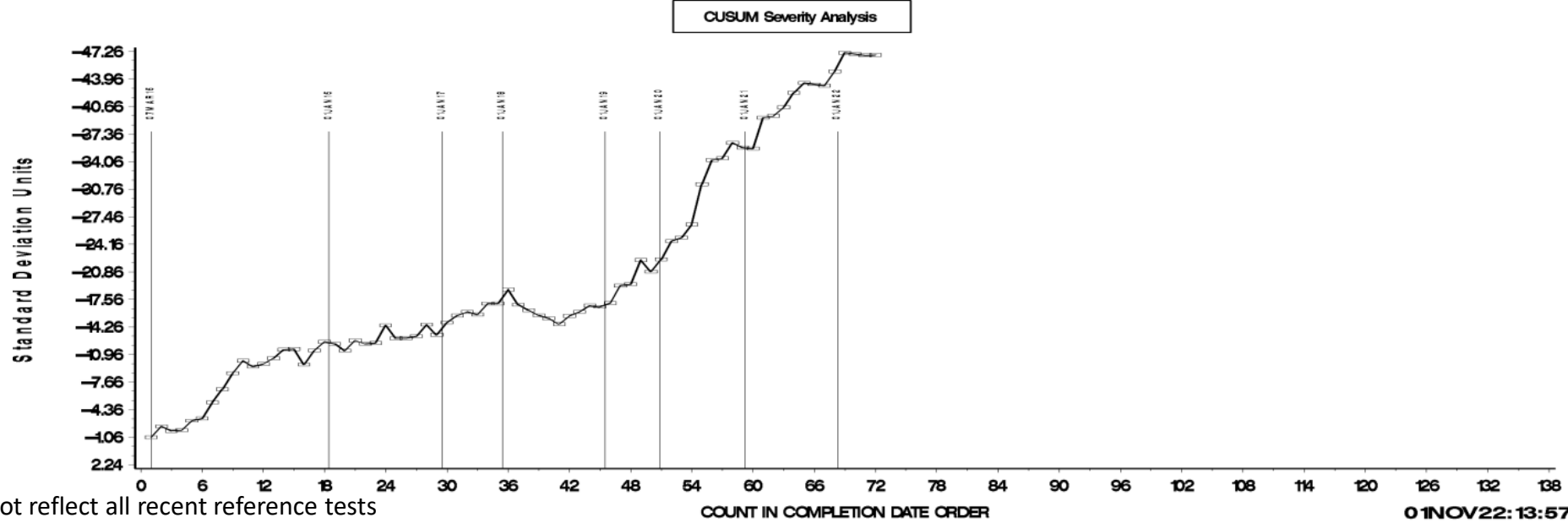
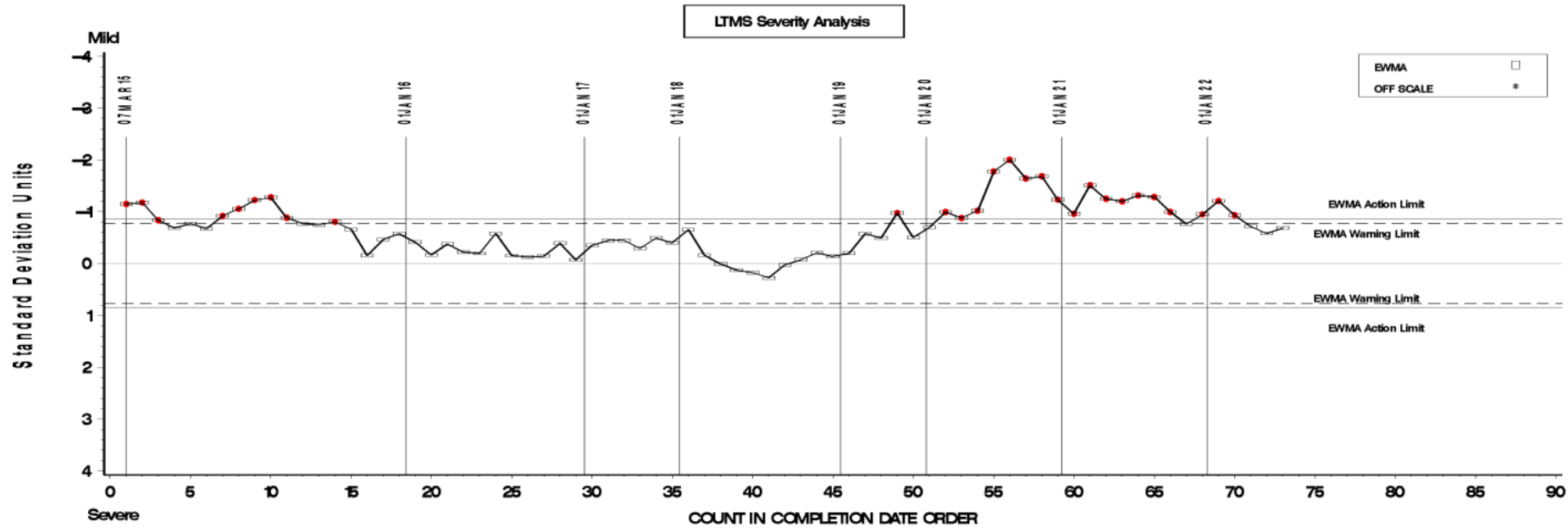
Note: All 3 non-acceptable calibration tests are from 1 stand

Test Severity

- IRPH is in control
- KV40 is in level 2 Zi alarm in the mild direction

Volvo T-13 Charts – IRPH

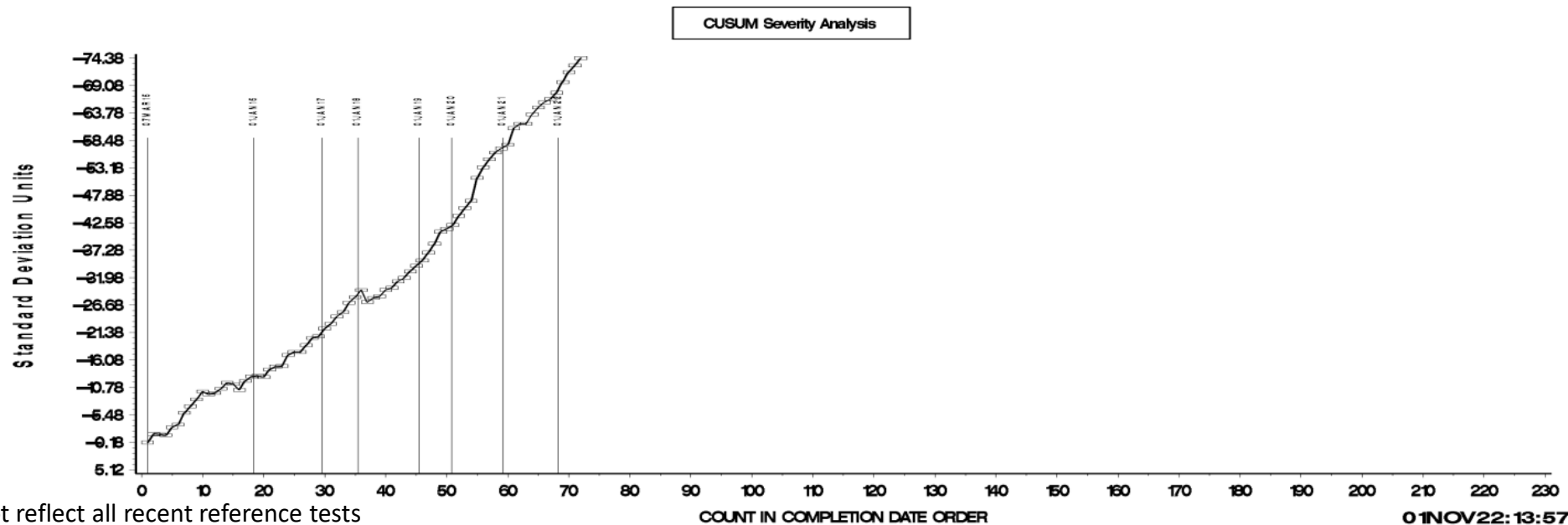
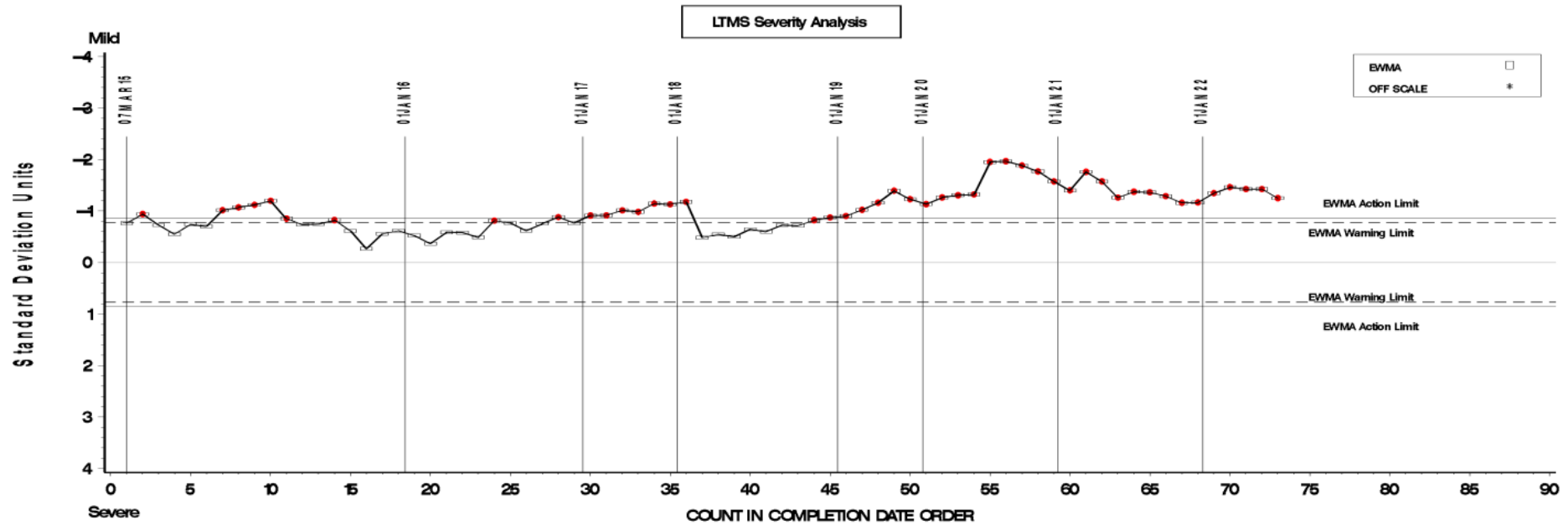
FINAL ORIGINAL PEAK HEIGHT IR AT EOT



Note: charts do not reflect all recent reference tests

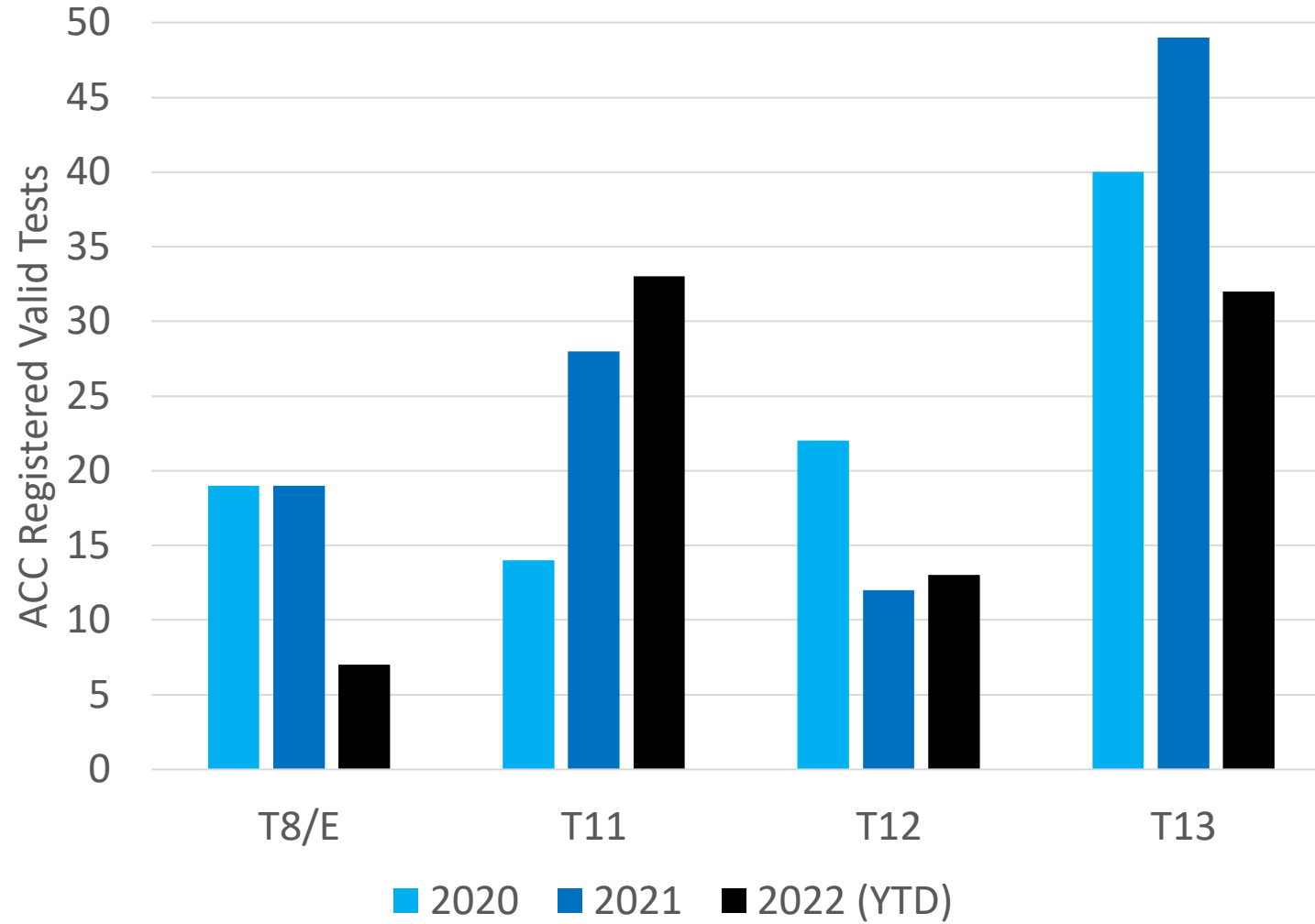
Volvo T-13 Charts – KV40

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



Note: charts do not reflect all recent reference tests

Candidate Activity



Caterpillar Surveillance Panel

HDEOCP Update

Prepared By: Jacob Goodale, S.P Chairman, December 2022

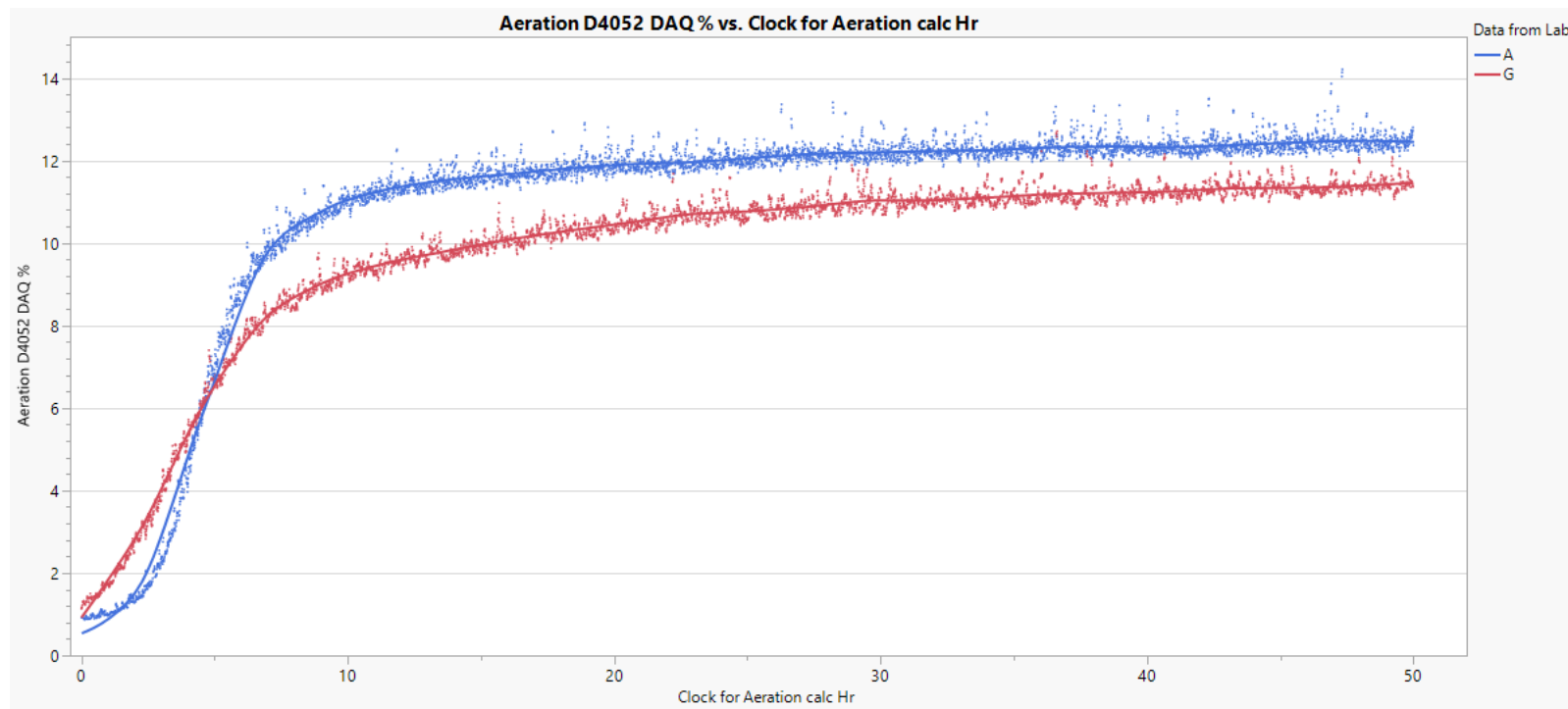
Presented By: David Brass, December 2022

Key Updates

- COAT
 - Batch B filters approved 11/18/2022
 - Updated Correction factor: 0.9310 multiplicative on average oil aeration
 - Reference oil TMC 833-2 and TMC 832-2 will be introduced as new blends in 2023
 - Reference Oil TMC 832-1 temporarily suspended by Surveillance Panel
 - Updated procedure approved by Surveillance Panel
- EOAT Equivalency
 - 2X COAT tests completed on TMC 1005-6
 - 1X COAT test to be completed December 2022 on TMC 1005-6
 - EOAT test completed on TMC 1005-6

COAT / EOAT Equivalency – TMC 1005-6 Testing

- Testing has been completed with TMC 1005-6 in the EOAT test. Result of 7.9 is on target for prior TMC 1005 versions at mean of 7.8.
- 2 tests were completed in the COAT test with uncorrected results shown below. Shape of curve is as expected for oils run in the COAT test.
- 3rd test will be completed in December 2022



Reference Oils

Test	Reference Oil	Supply
COAT	TMC 832-1	4+ Year supply
	TMC 833-1	<1 Year Supply
	TMC 833-2	5+ Year Supply
1P, 1R	TMC 1005-5	1 Year supply
1R	TMC 822-2	2.5 Year supply
1N, 1K	TMC 809-1	5+ Year supply
	TMC 811-2	5+ Year supply
C13	TMC 831-4	2 Year supply
1 M-PC	TMC 873-2	1 Year supply

Updates:

- TMC 832-1: suspended from use due to shifting severe
- TMC 832-2: to be introduced Q1-Q2023
- TMC 833-1: supply limited
- TMC 833-2: to be introduced Q1-Q2 2023

Caterpillar C13 (ASTM D7549)

Labs	Stands	Referenced Stands
2	2	2

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	1	
Failed Calibration Test	OC	1	Severe OC
TOTAL		2	

Test Severity

- TLC in severity warning alarm in the mild direction
- R2TC, TGC, OC are in control

Caterpillar COAT (ASTM D8047)

Labs	Stands	Referenced Stands
3	3	2

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	4	
Failed Calibration Test	OC	1	Average Oil Aeration Severe
Informational Run	NN	2	
Hardware Approval	NI	3	
TOTAL		10	

Test Severity

- AAVE is in action alarm in the severe direction

Caterpillar SCOTE 1K (ASTM D6750)

Labs	Stands	Referenced Stands
2	2	2

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	2	
Operationally Invalid	LC	1	Exceeded Downtime Limit
TOTAL		3	

Test Severity

- TGF is in warning alarm in the mild direction
- BSOC is in action alarm in the mild direction
- All other parameters are in control with TLHC close to warning alarm in the mild direction

Caterpillar SCOTE 1N (ASTM D6750)

Labs	Stands	Referenced Stands
3	4	2

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	4	
Failed Calibration Test	OC	1	TGF Severe
TOTAL		5	

Test Severity

- WDN and BSOC are in severity warning
- TFG is in precision action alarm
- TLHC is in control

Caterpillar SCOTE 1M-PC (ASTM D6618)

Labs	Stands	Referenced Stands
0	0	0

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	0	
TOTAL		0	

Test Severity

- No 1M-PC tests were run

Caterpillar SCOTE 1P (ASTM D6681)

Labs	Stands	Referenced Stands
1	1	1

Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	1	
TOTAL		1	

Test Severity

- TGC, TLC, WD and OC are in control
- ETOC is in severity action alarm in the severe direction

Caterpillar SCOTE 1R (ASTM D6923)

Labs	Stands	Referenced Stands
1	1	1

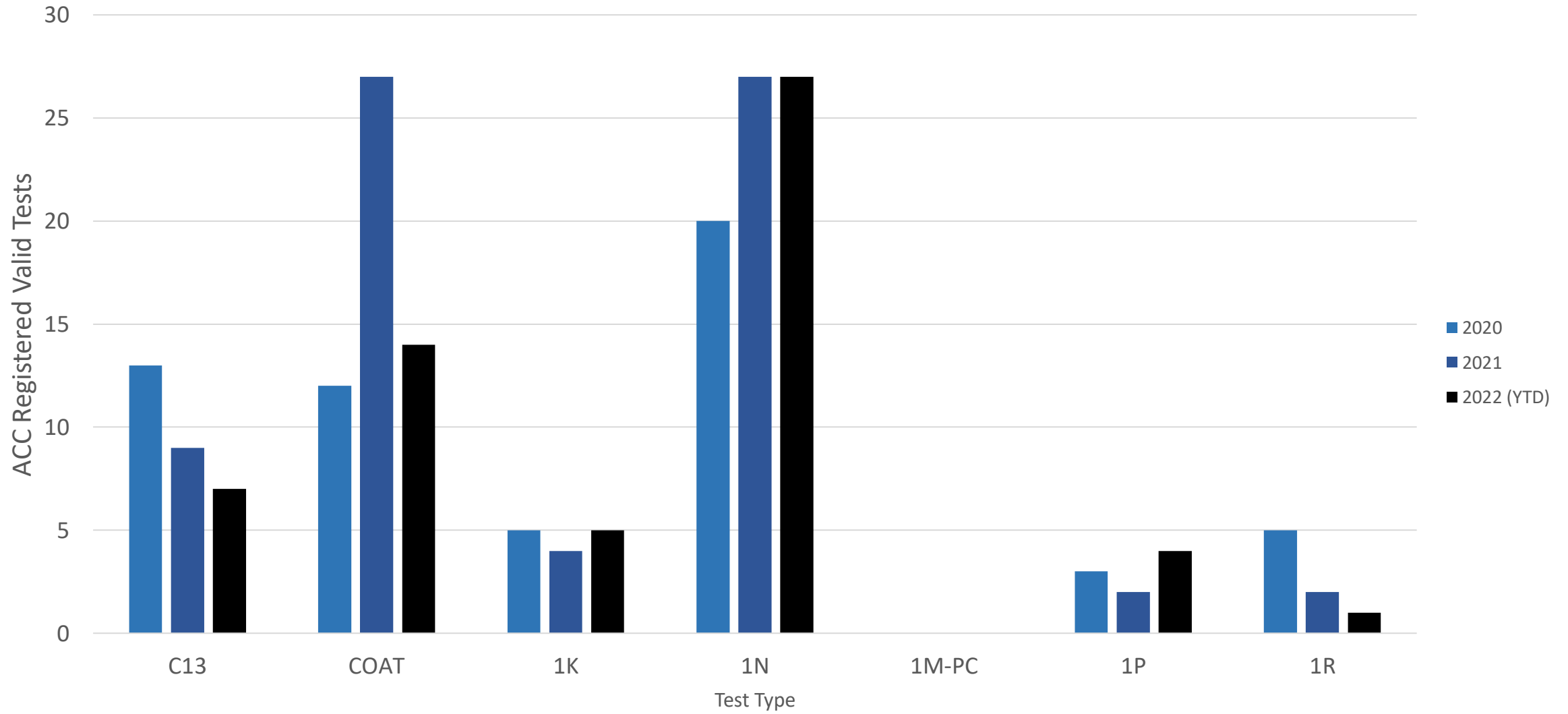
Reference Test Activity (Since June 2022)

Test Status	Validity Code	#	Cause
Acceptable Calibration Test	AC	0	
TOTAL		0	

Test Severity

- No 1R Tests run during this period

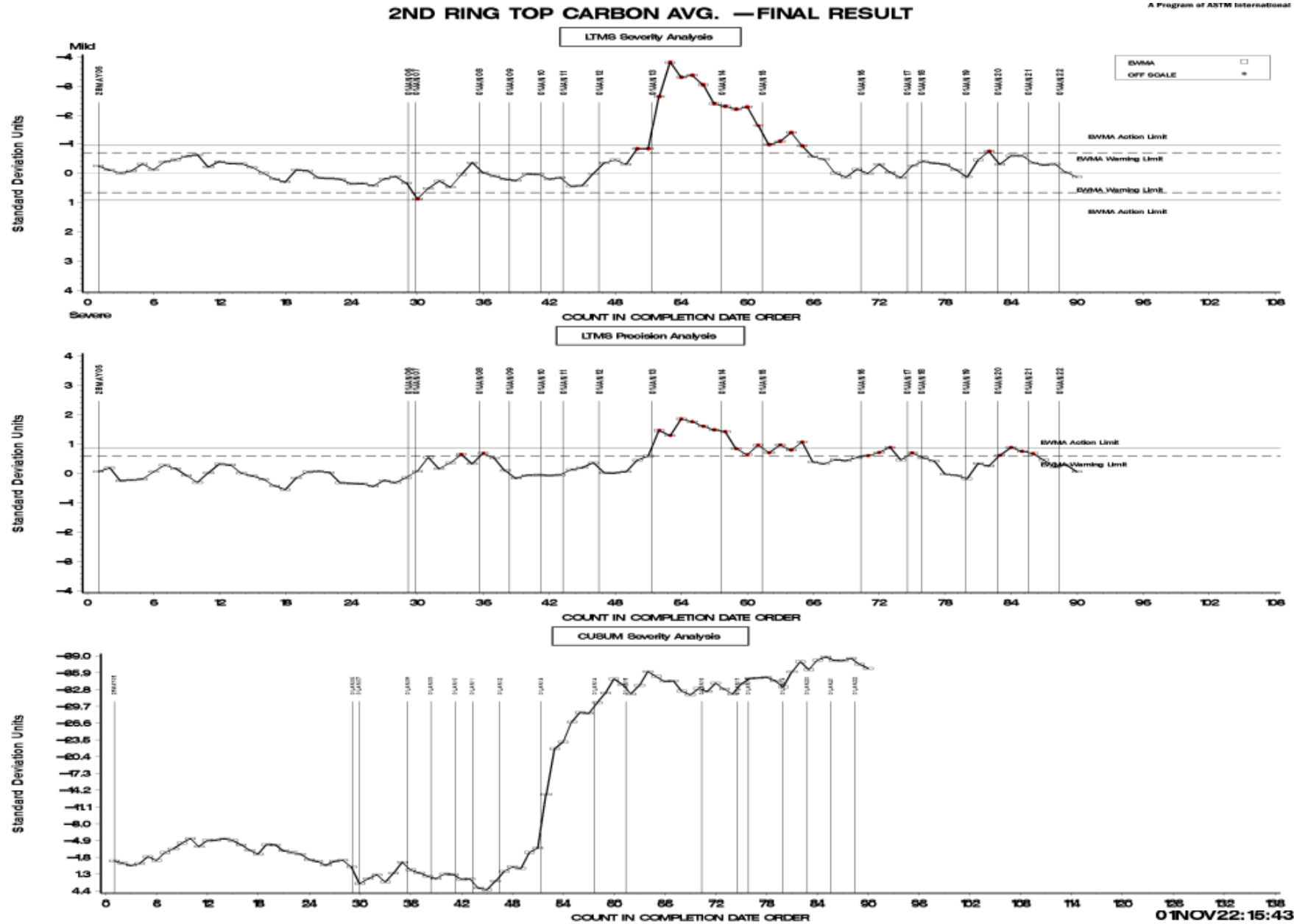
Candidate Activity



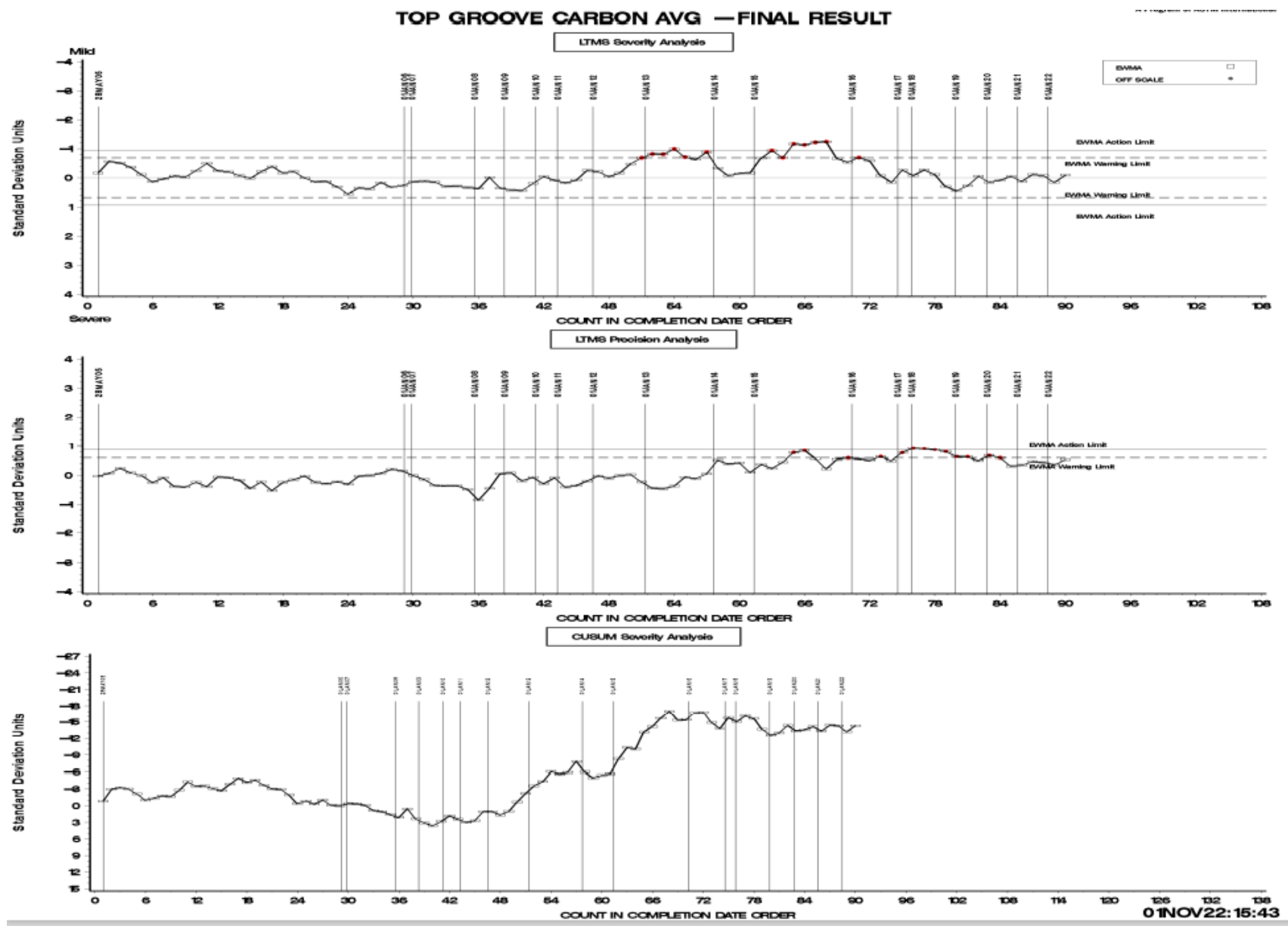
Appendix Charts

CAT C13

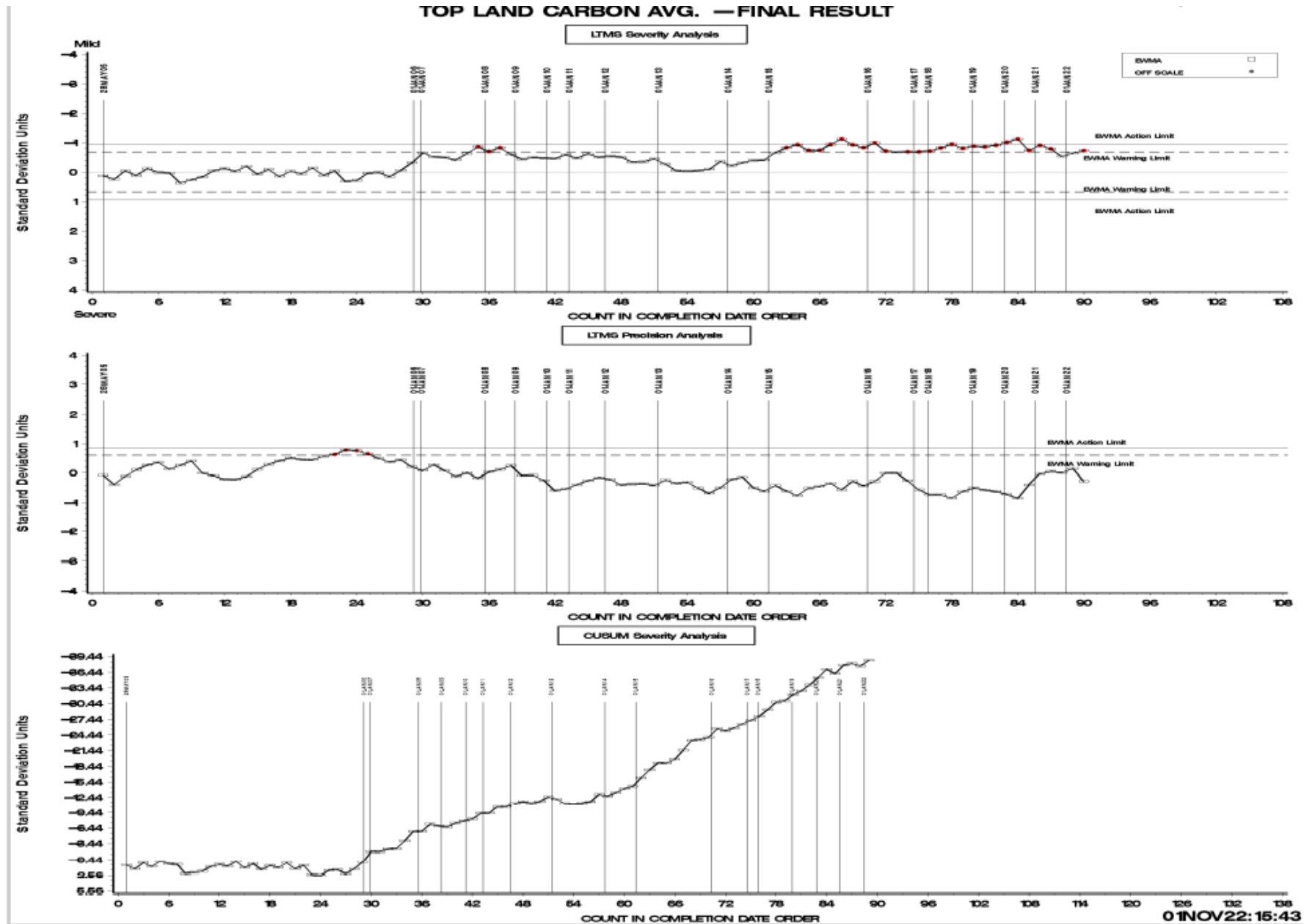
Caterpillar C13 Charts-2nd Ring Top Carbon



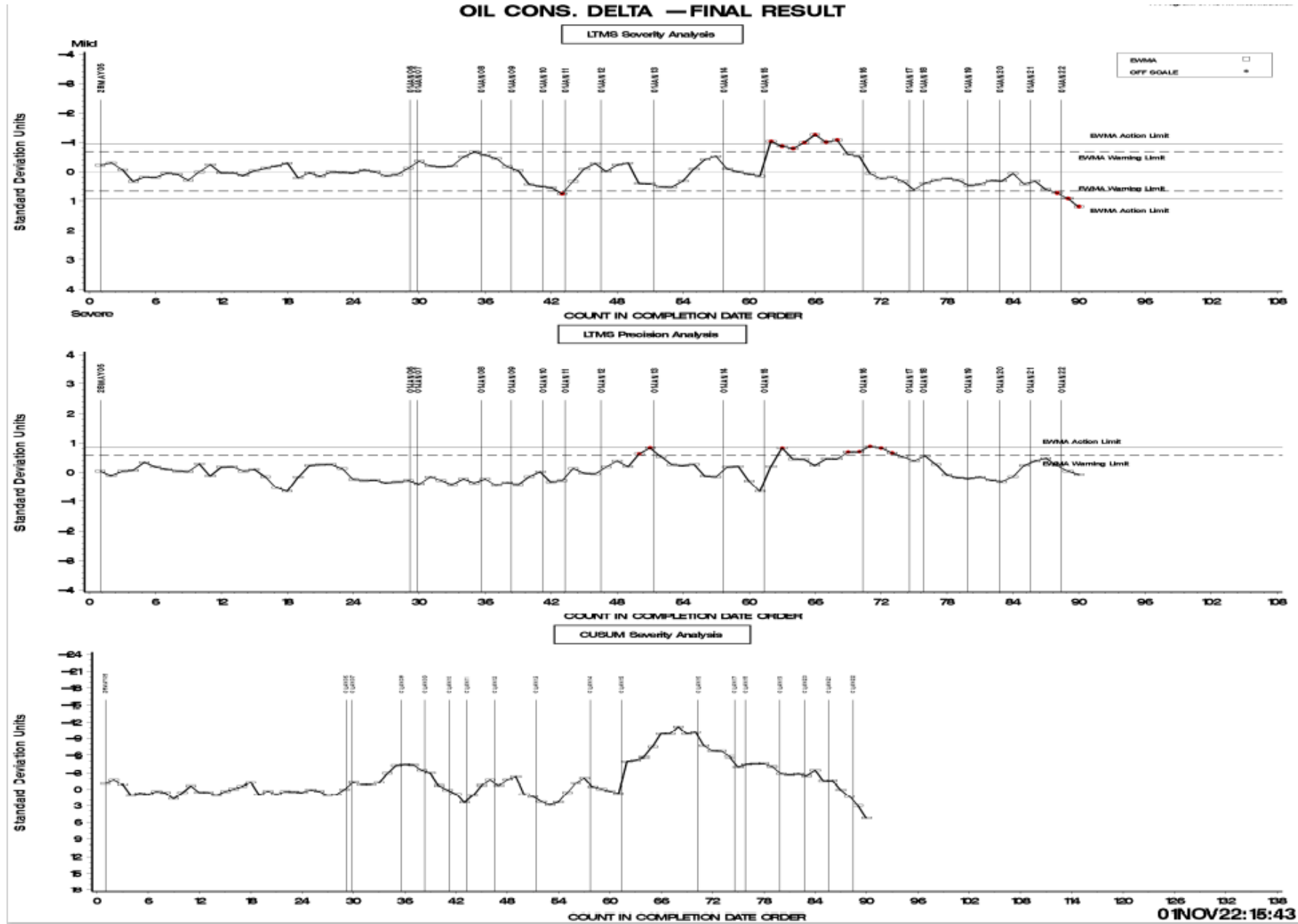
Caterpillar C13 Charts-Top Groove Carbon



Caterpillar C13 Charts- Top Land Carbon

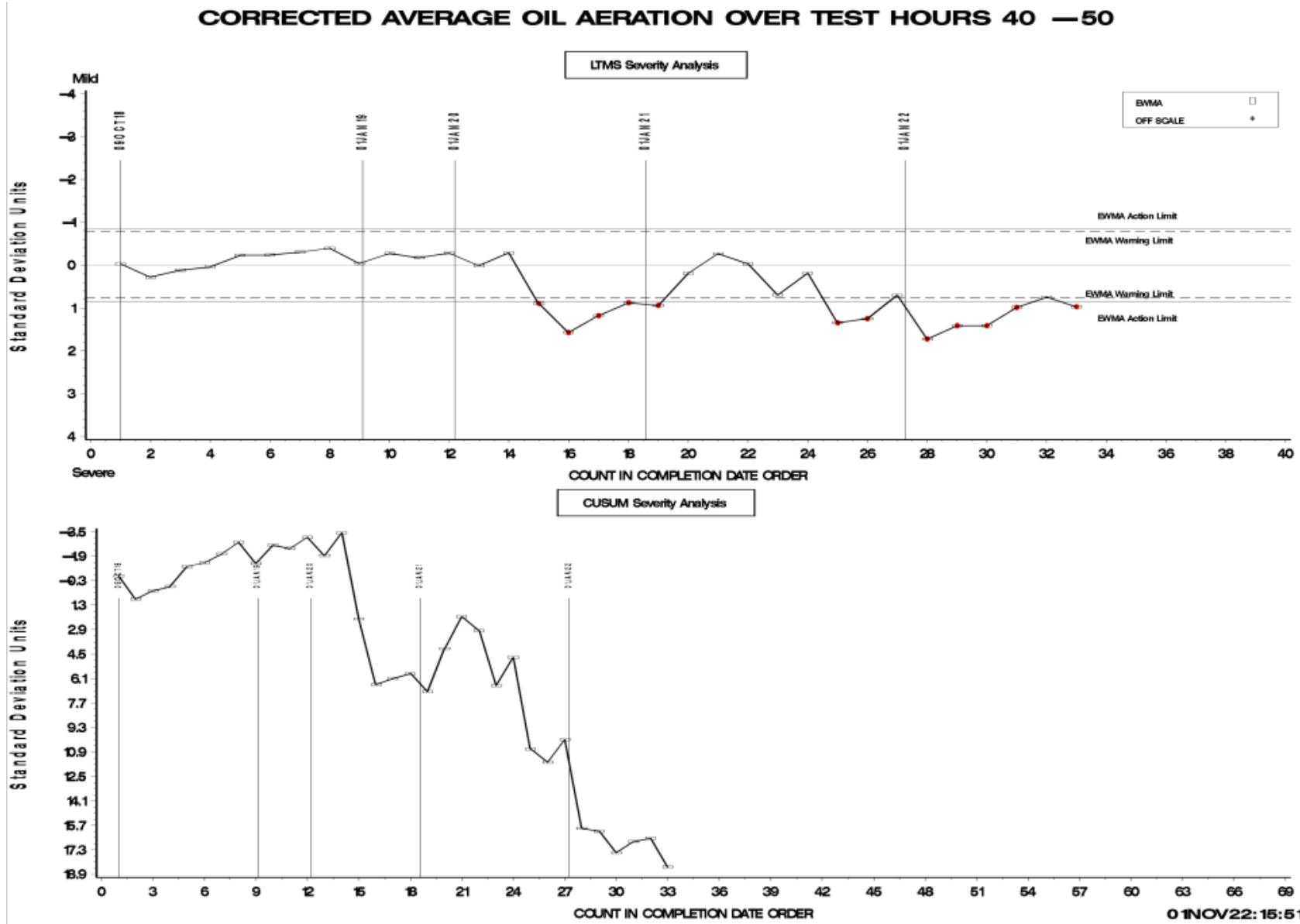


Caterpillar C13 Charts- Oil Consumption Delta



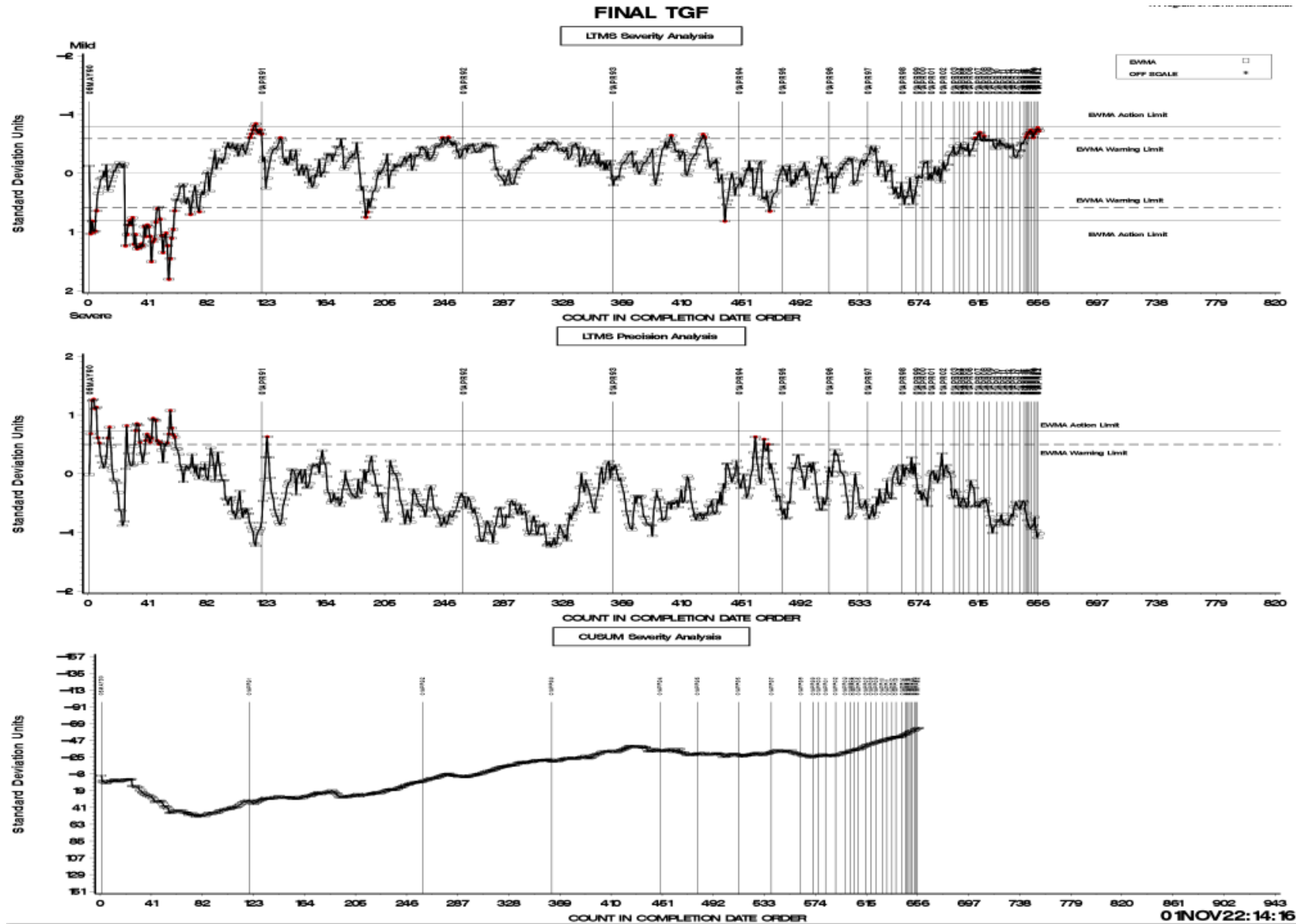
COAT

Caterpillar COAT Charts- Corrected Average Oil Aeration over Test Hours 40 - 50

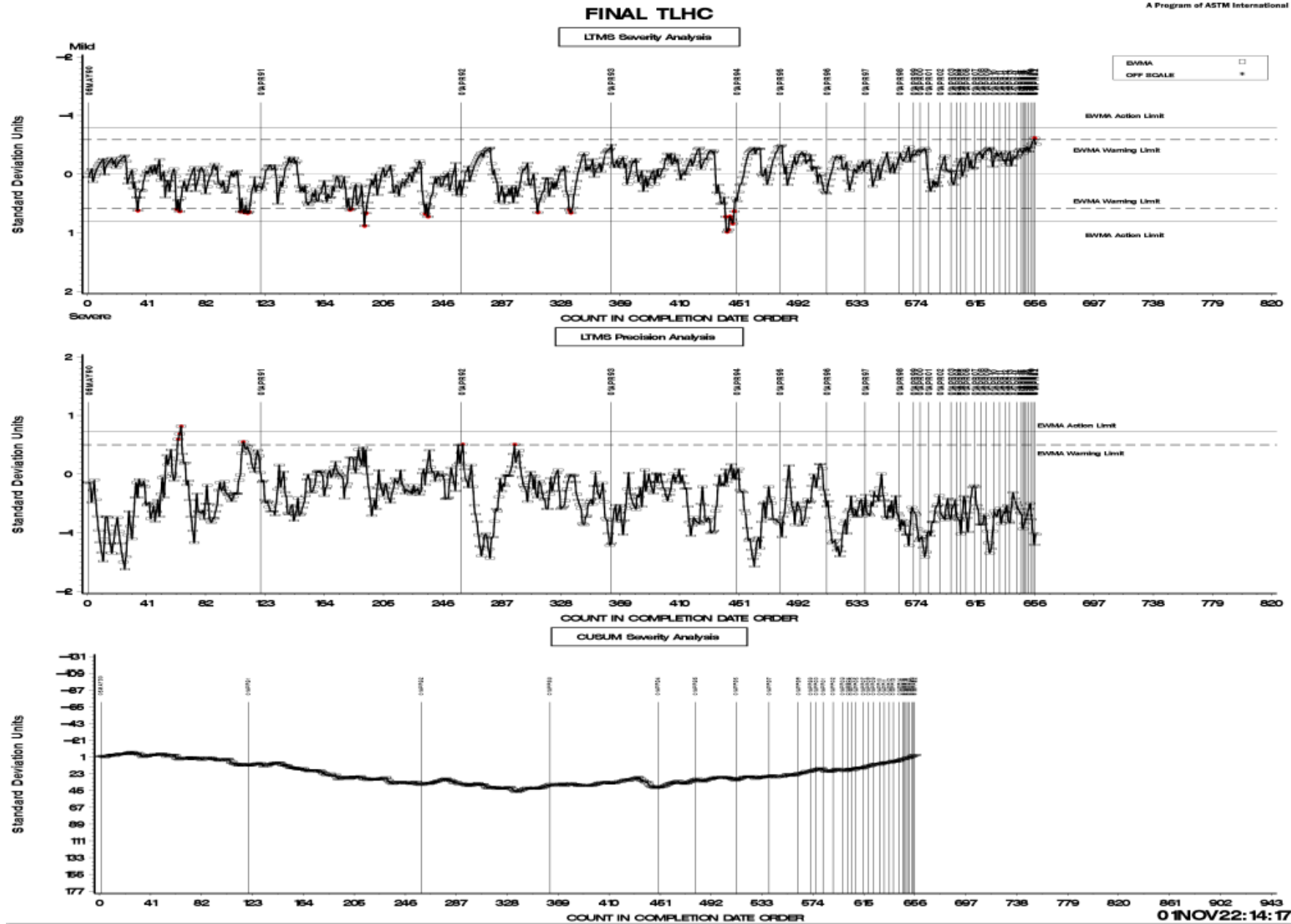


CAT 1K

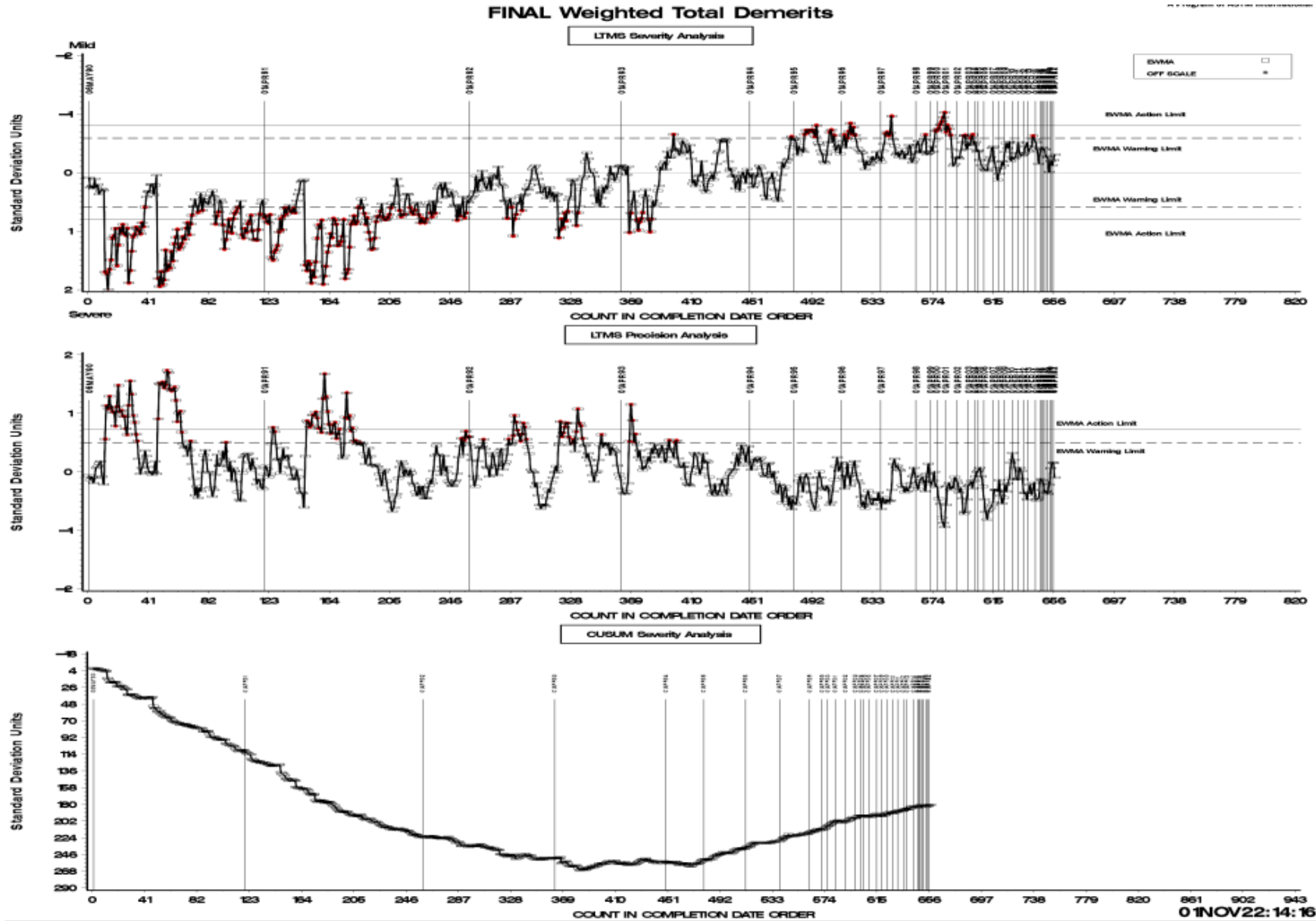
Caterpillar SCOTE 1K Charts- Final TGF



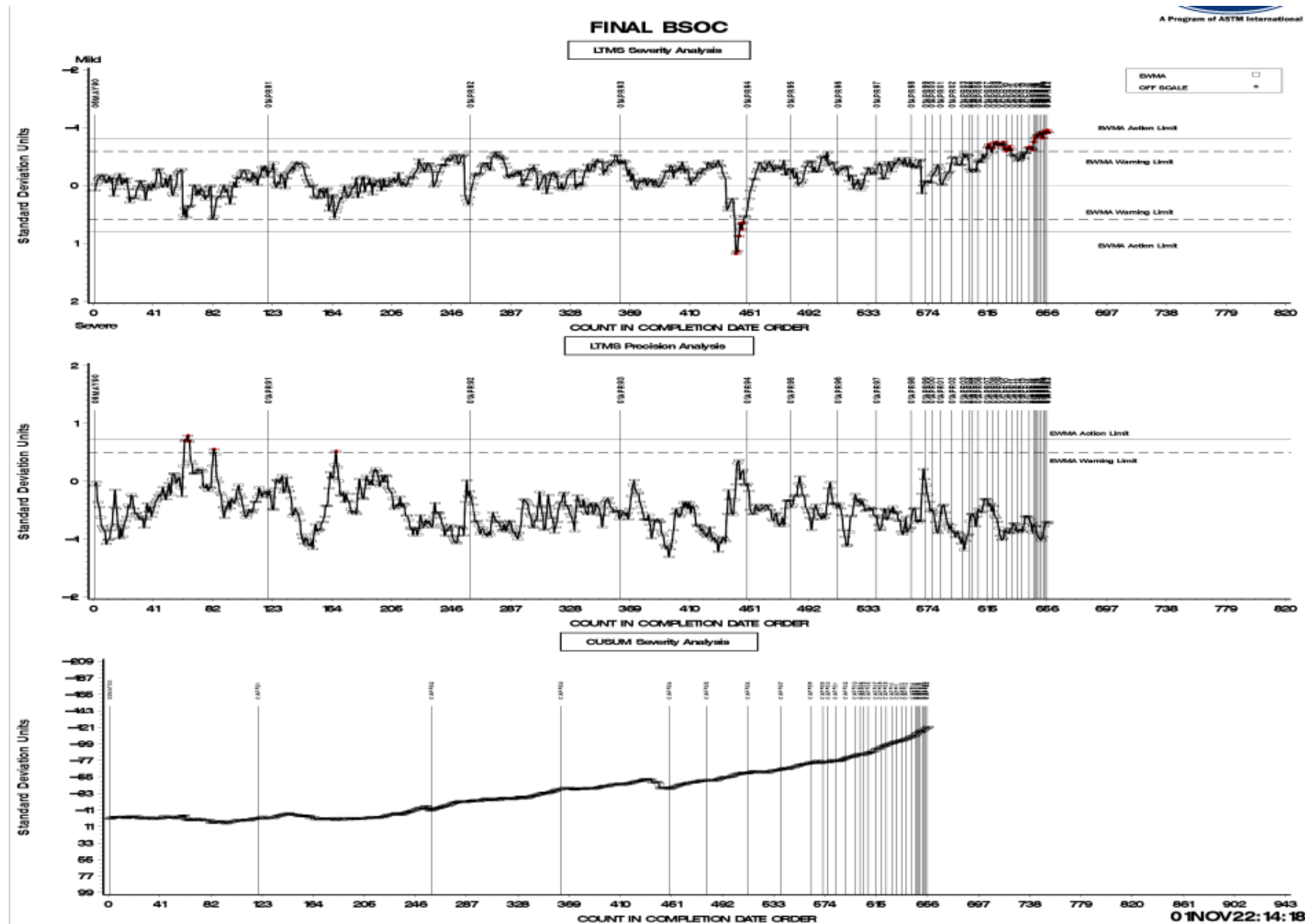
Caterpillar SCOTE 1K Charts- Final TLHC



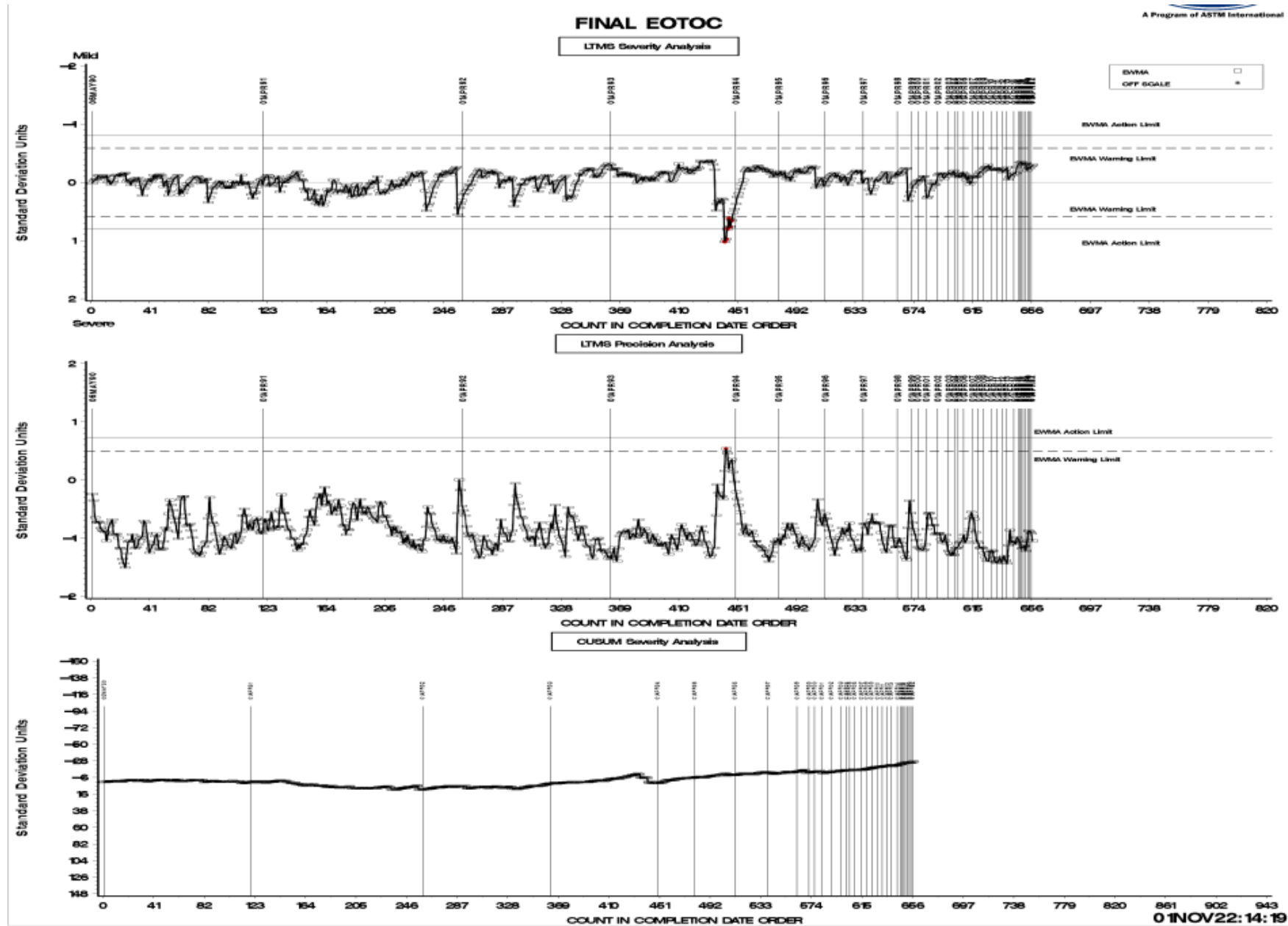
Caterpillar SCOTE 1K Charts- Final Weighted Total Demerits



Caterpillar SCOTE 1K Charts- Final BSOC

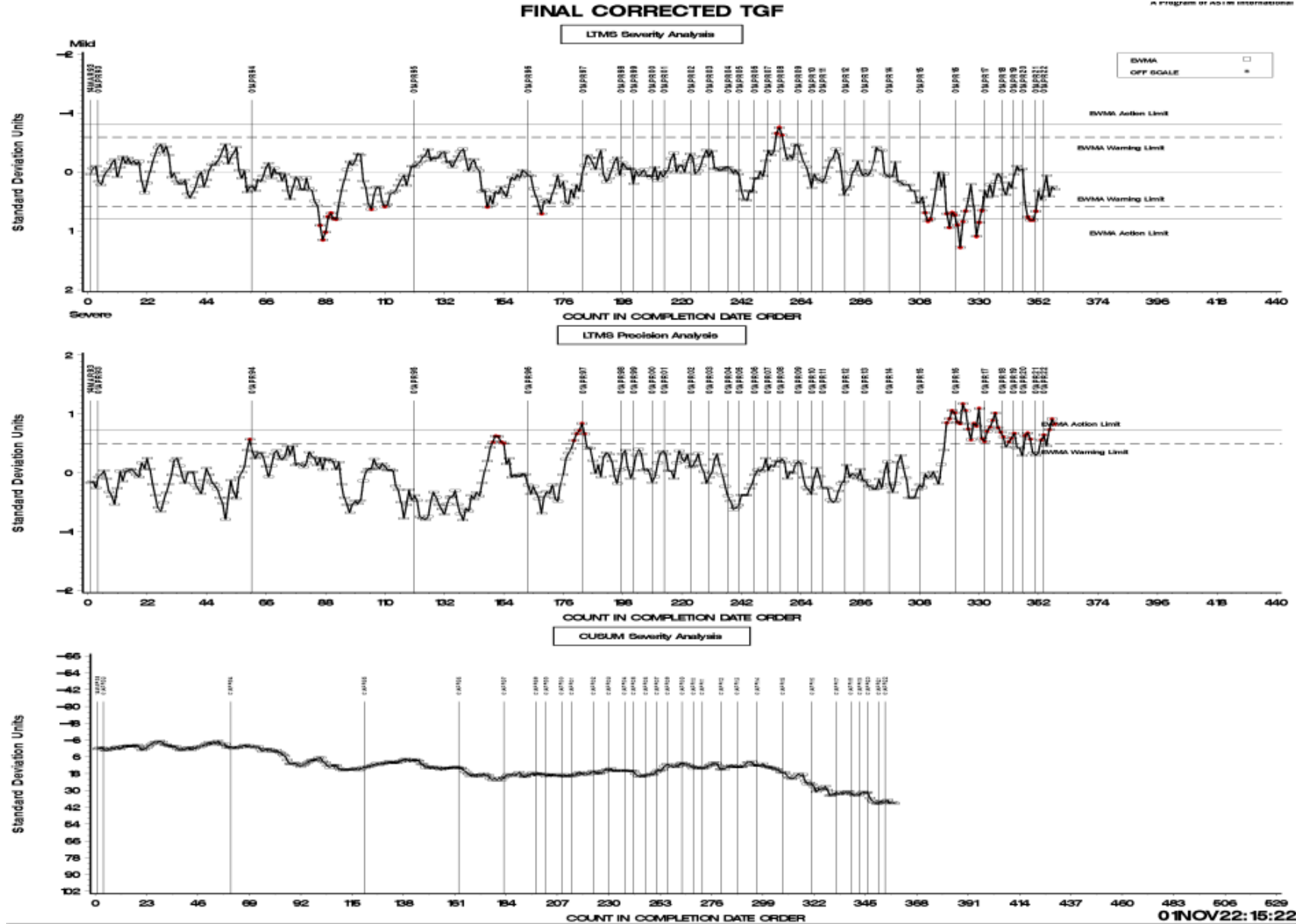


Caterpillar SCOTE 1K Charts- EOTOC

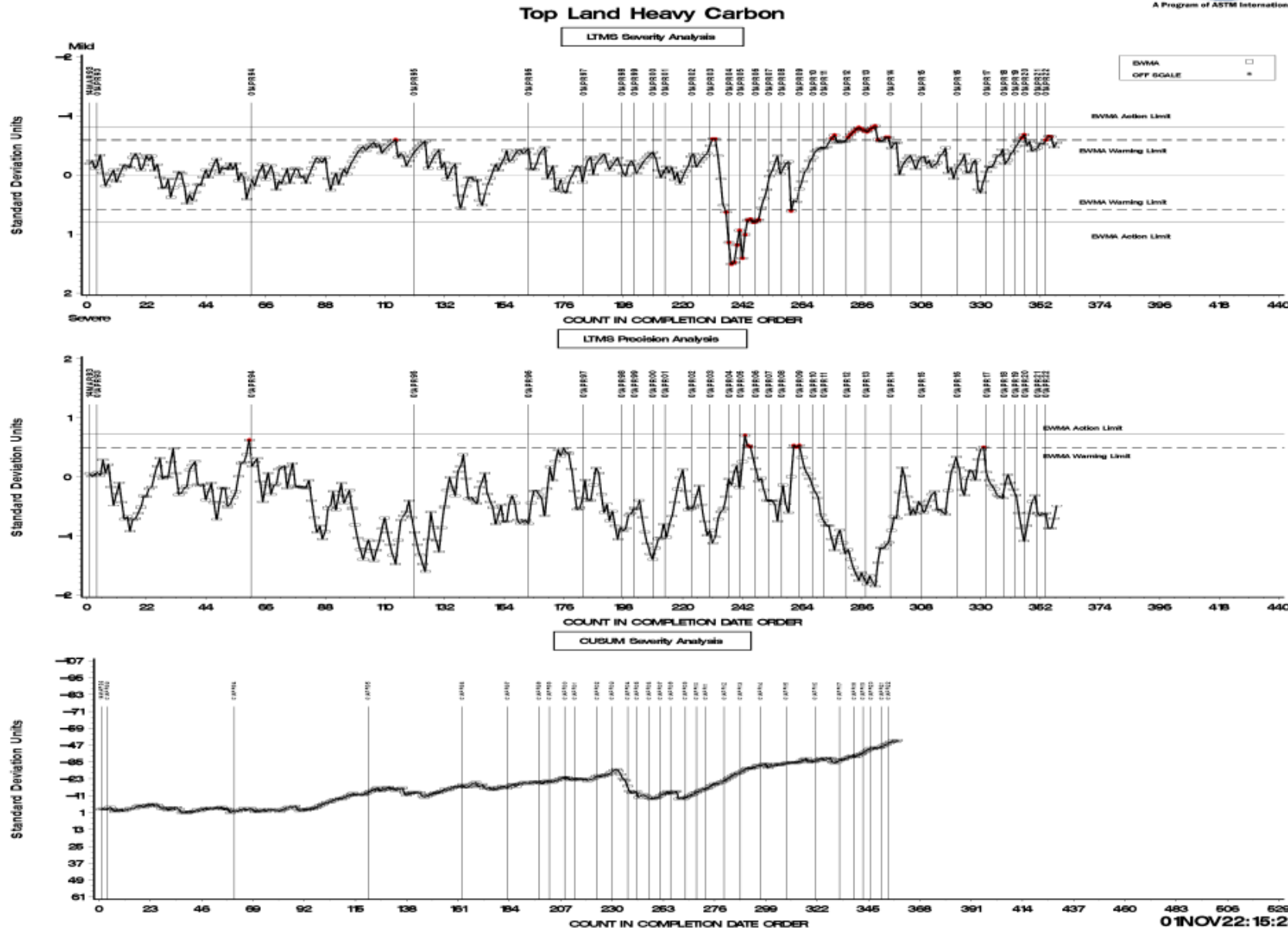


CAT 1N

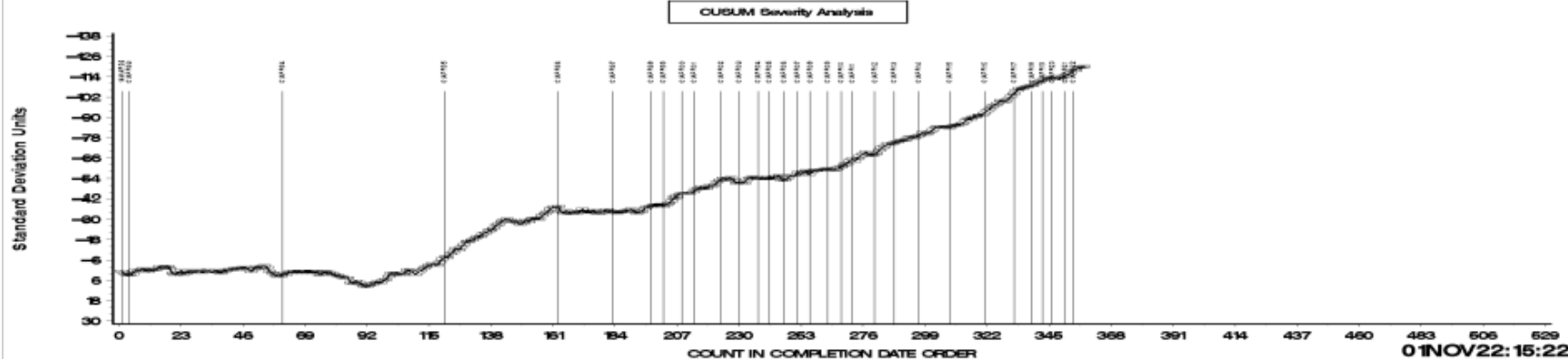
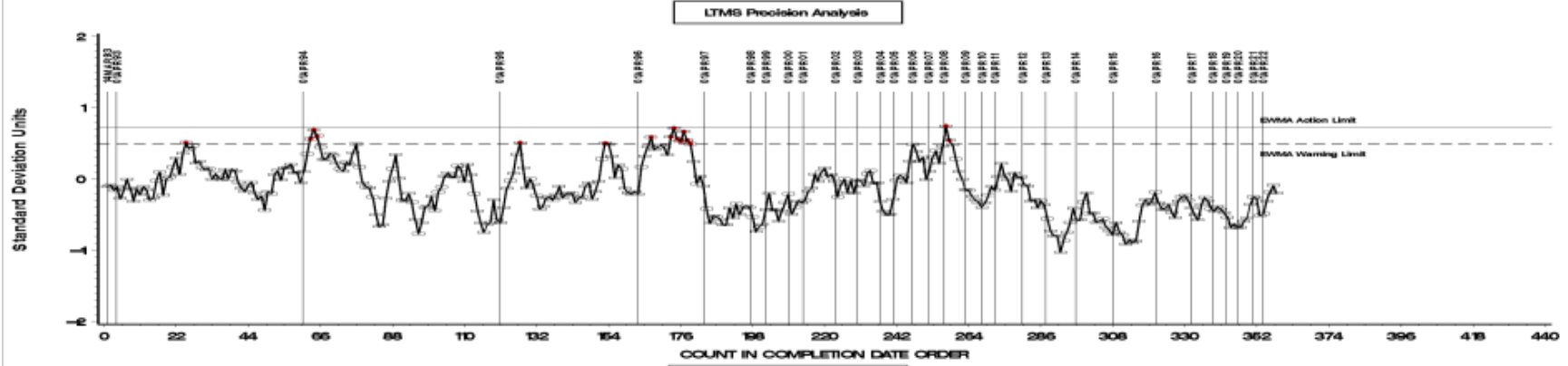
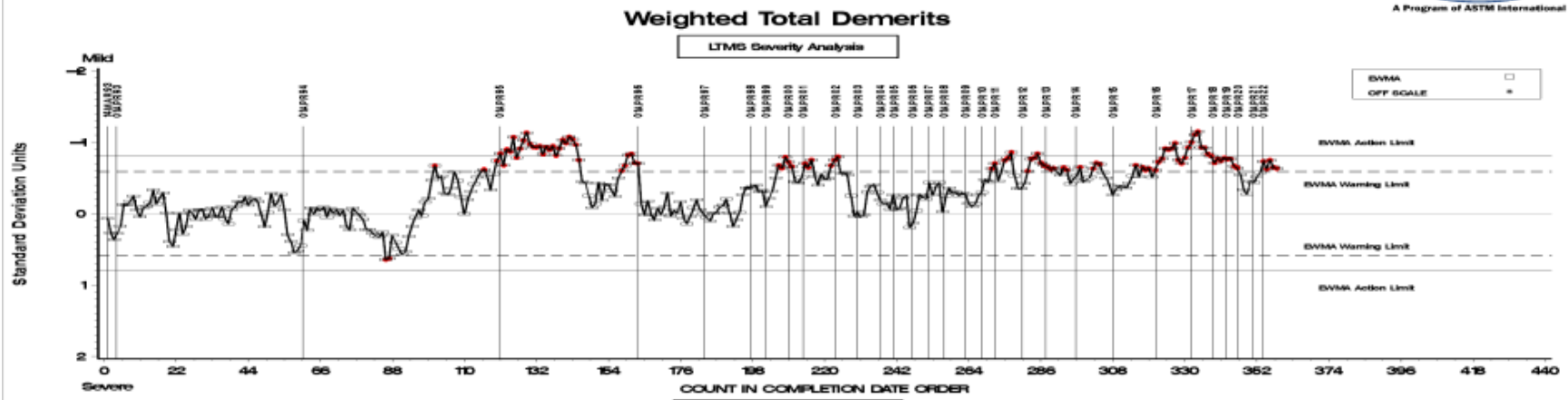
Caterpillar SCOTE 1N Charts- Final TGF



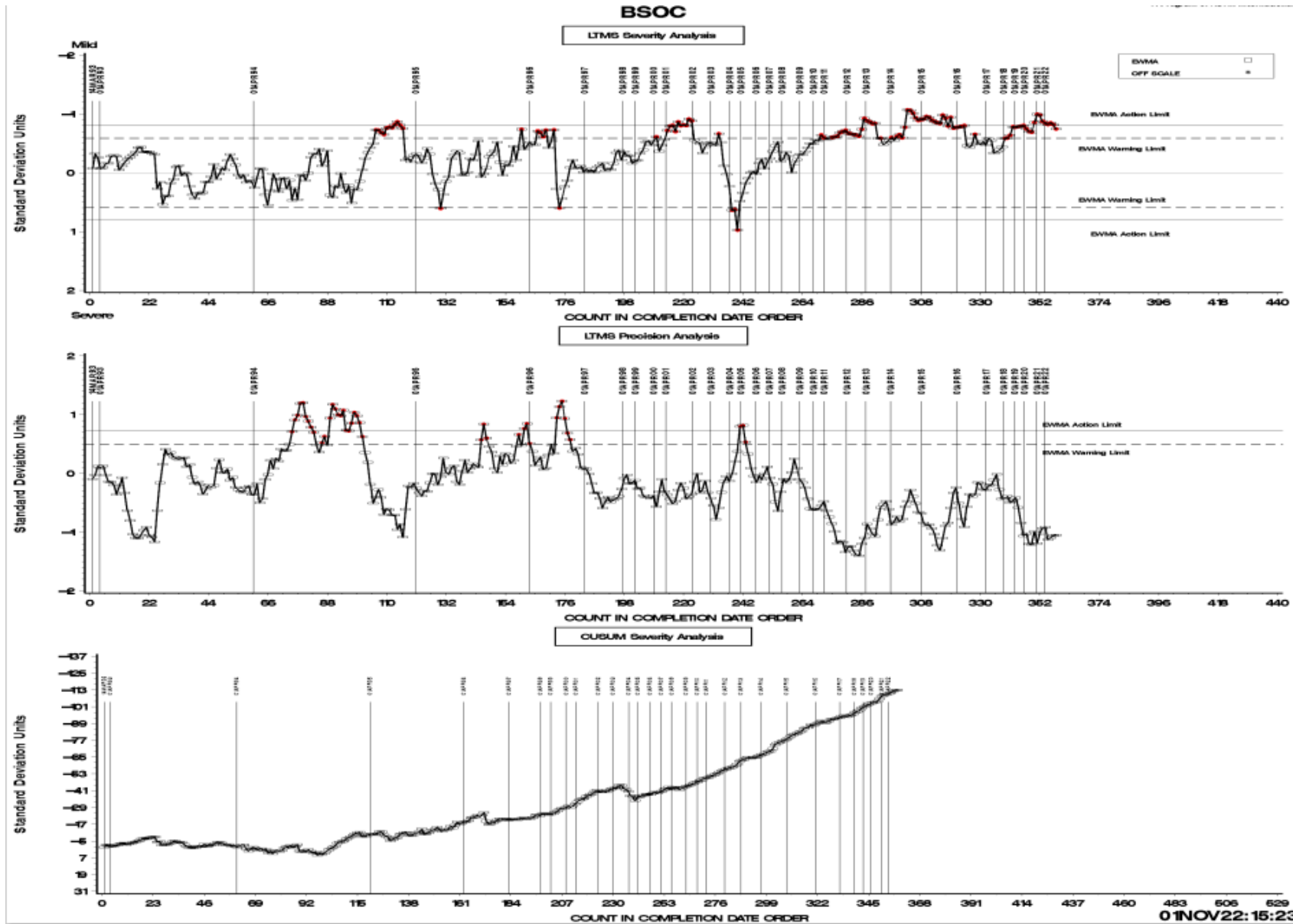
Caterpillar SCOTE 1N Charts- Top land Heavy Carbon



Caterpillar SCOTE 1N Charts- Final Weighted Total Demerits

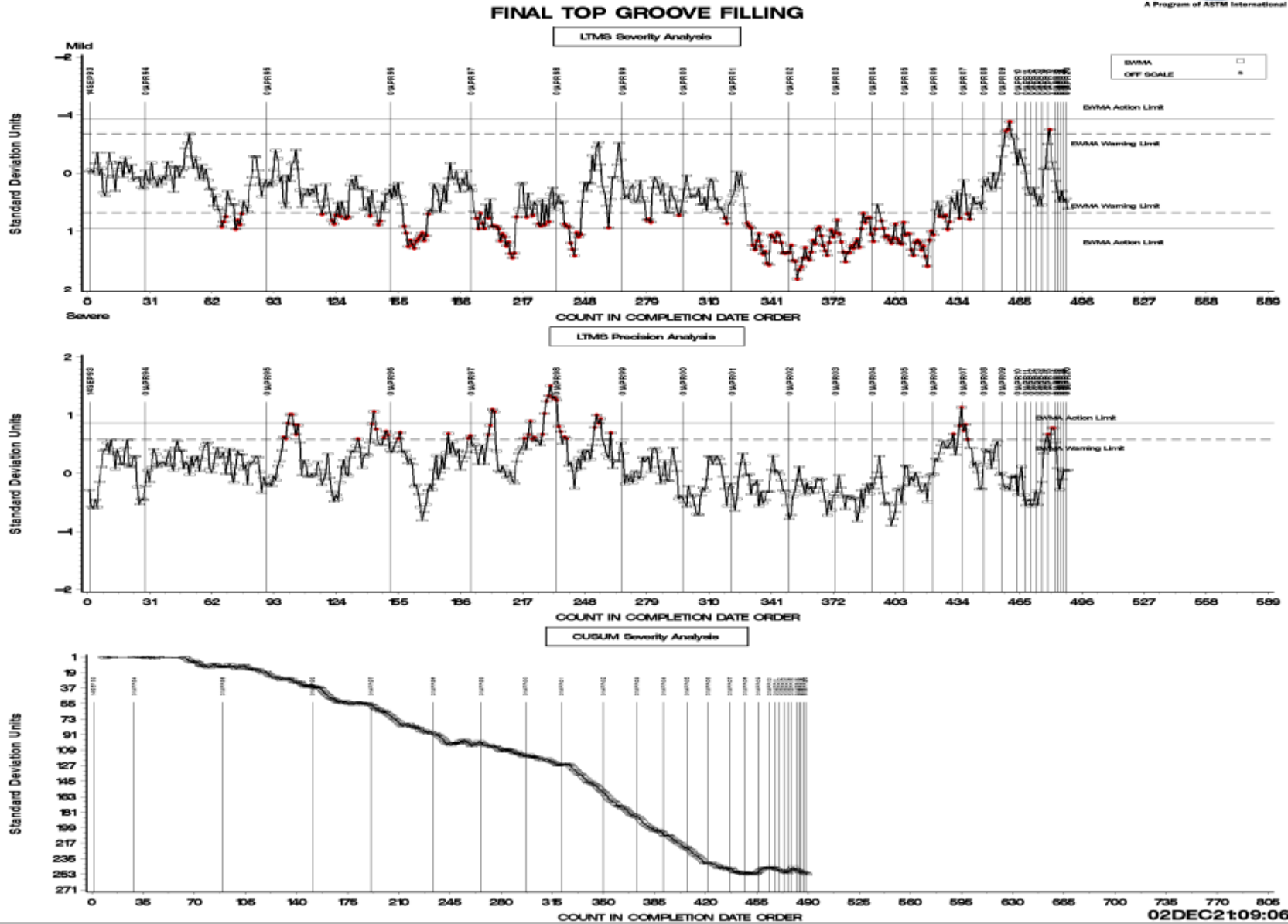


Caterpillar SCOTE 1N Charts- Final BSOC



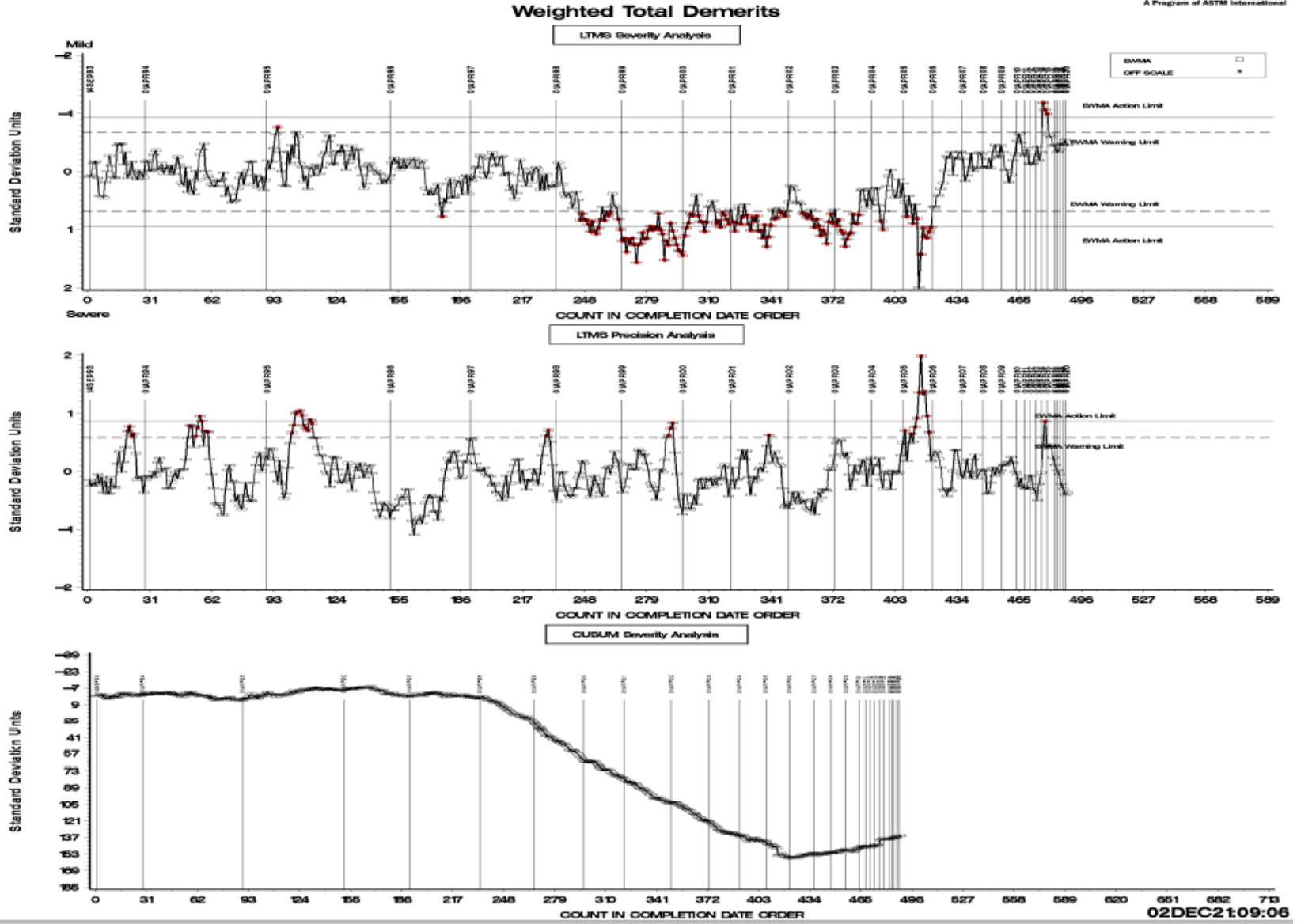
CAT 1M-PC

Caterpillar SCOTE 1M-PC Charts- Top Groove Fill



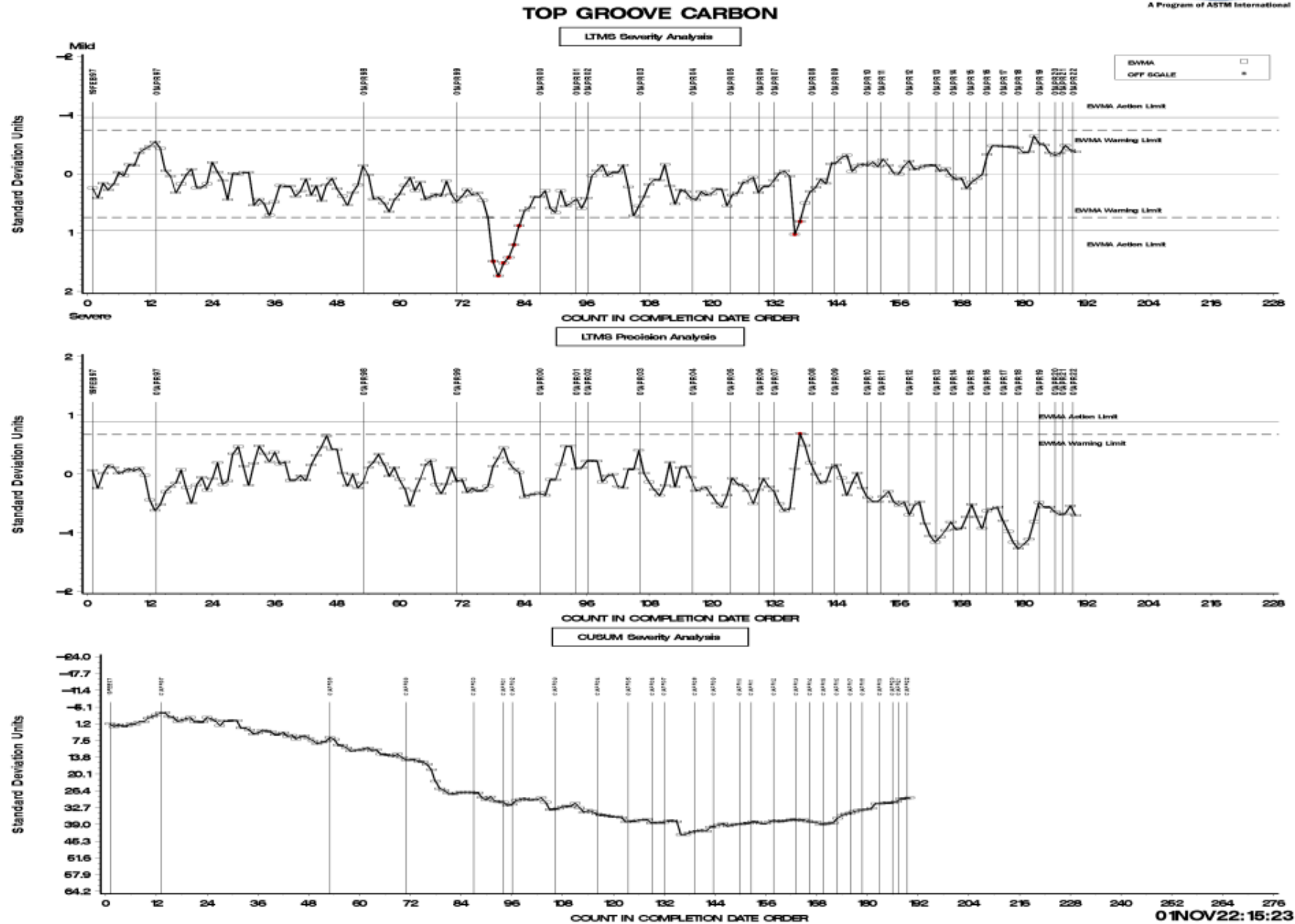
Caterpillar SCOTE 1M-PC Charts- Weighted Total Demerits

A Program of ASTM International

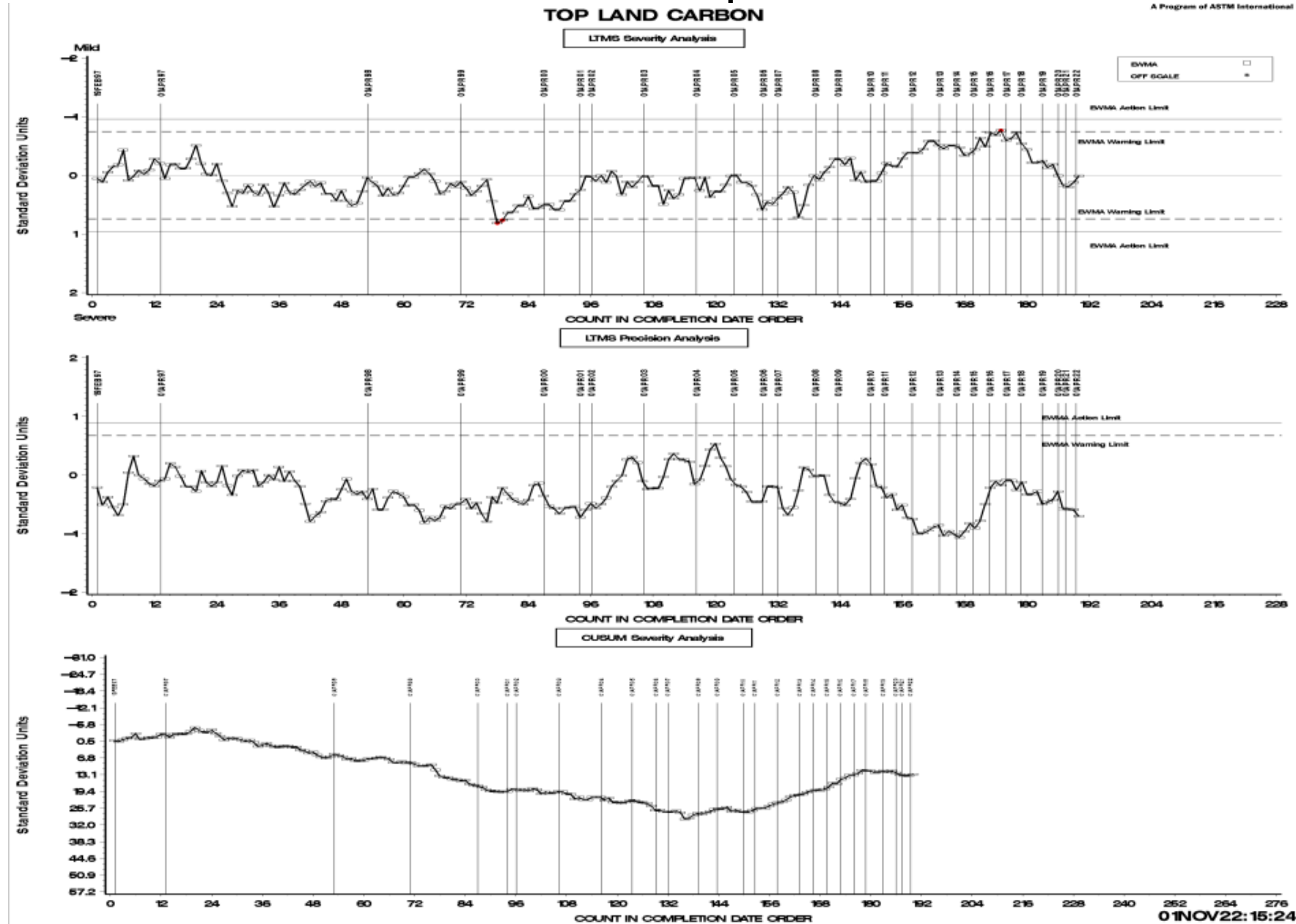


CAT 1P

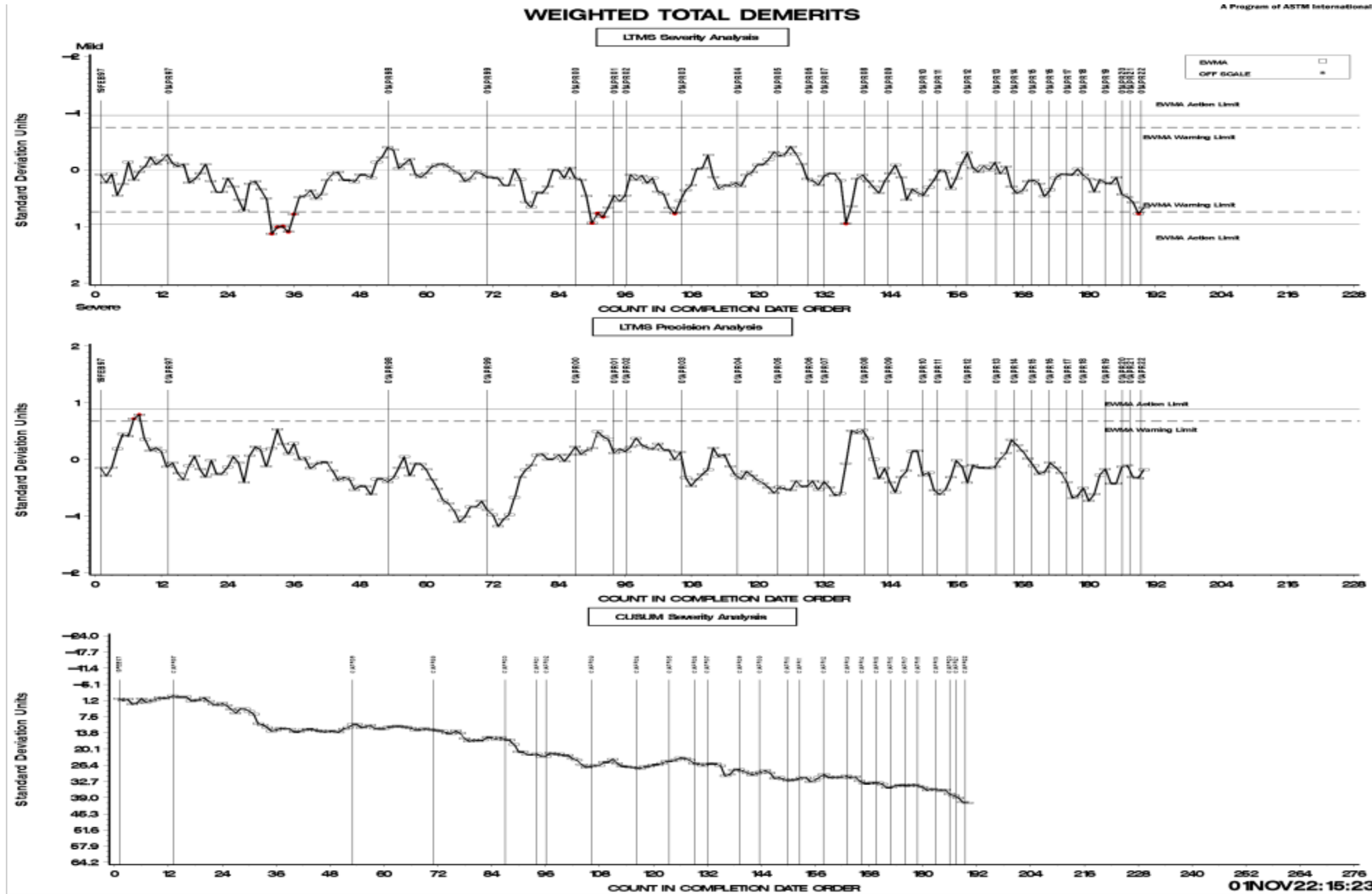
Caterpillar SCOTE 1P Charts- Top Groove Carbon



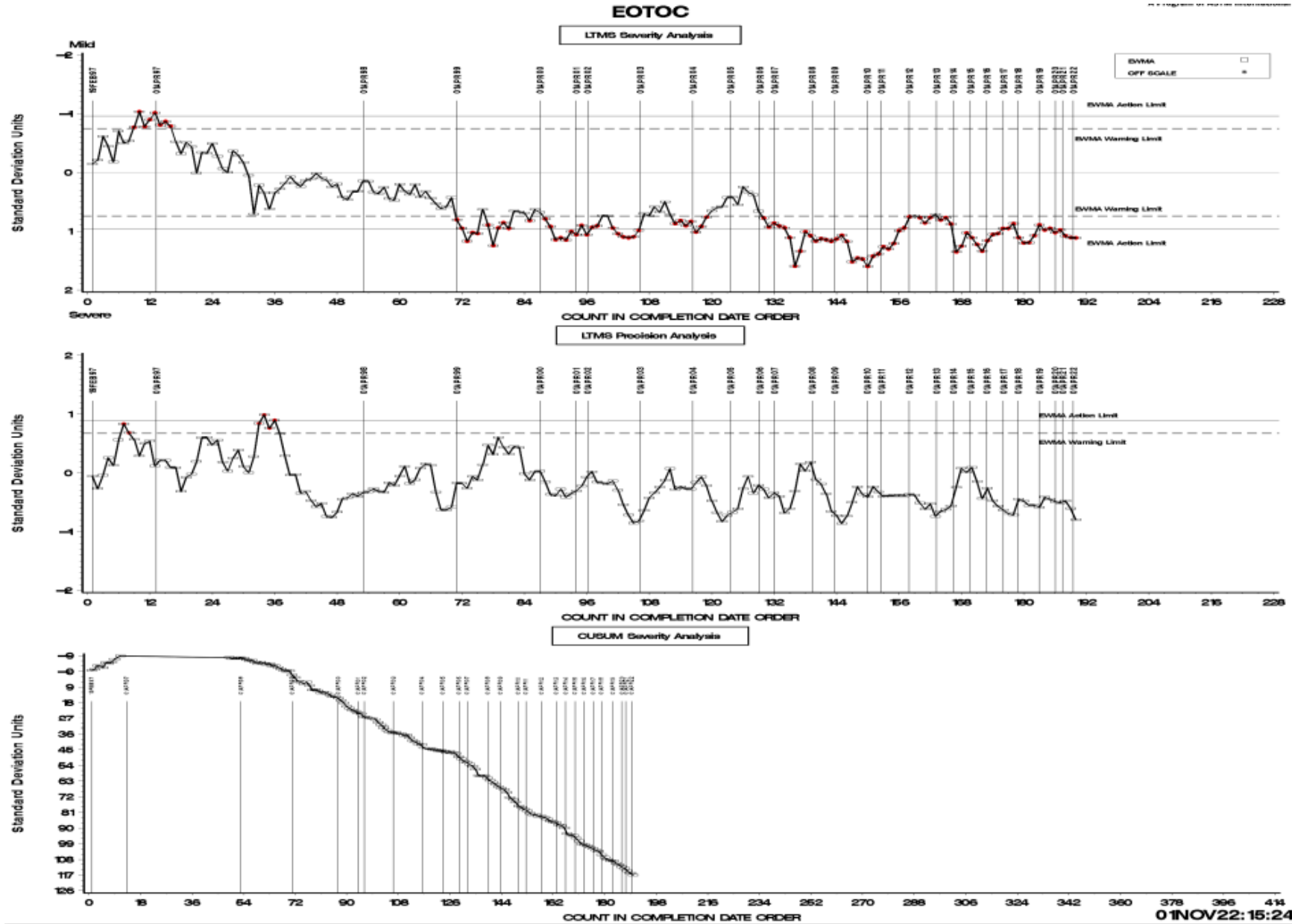
Caterpillar SCOTE 1P Charts- Top Land Carbon



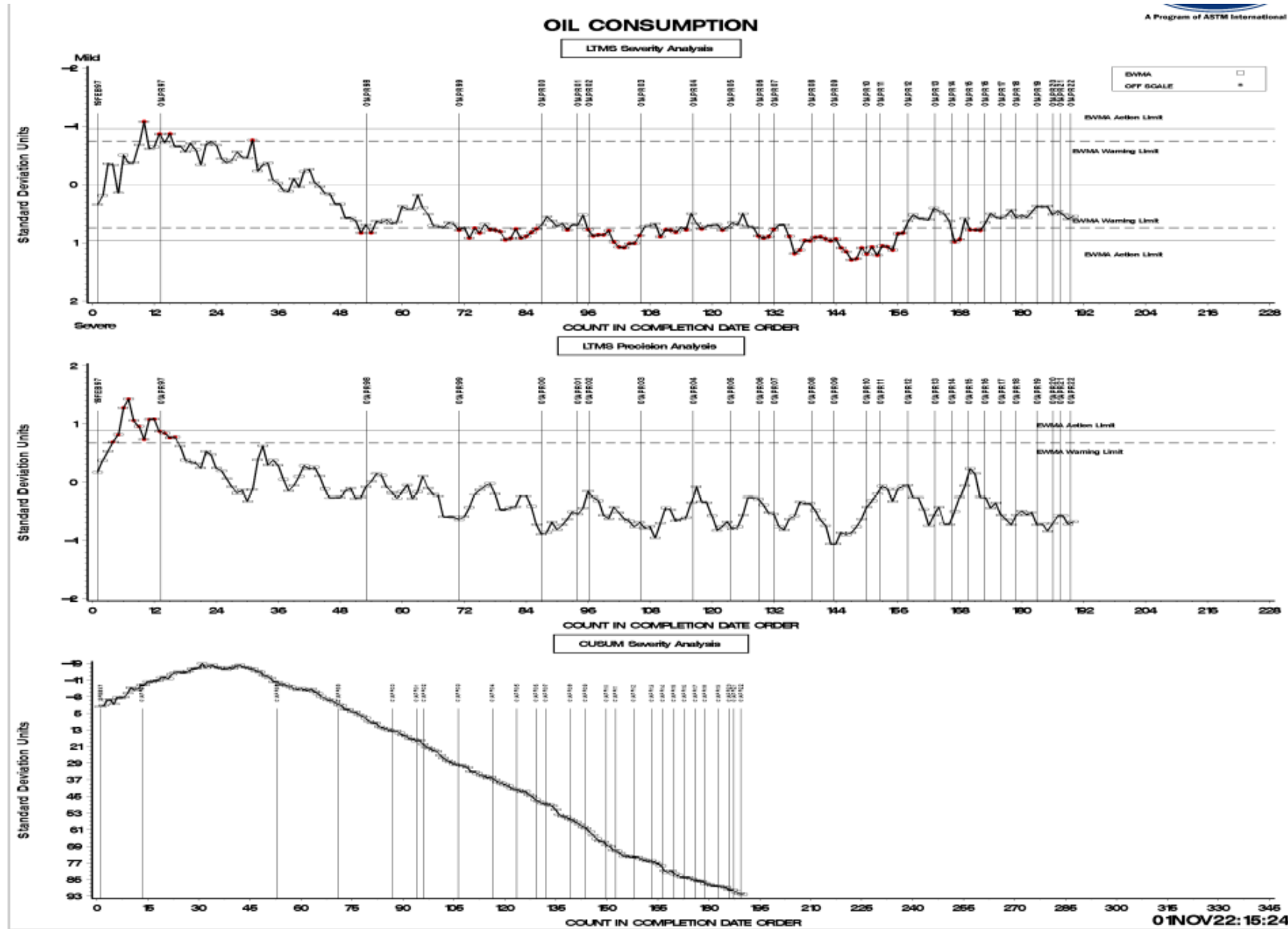
Caterpillar SCOTE 1P Charts- Weighted Total Demerits



Caterpillar SCOTE 1P Charts- EOTOC

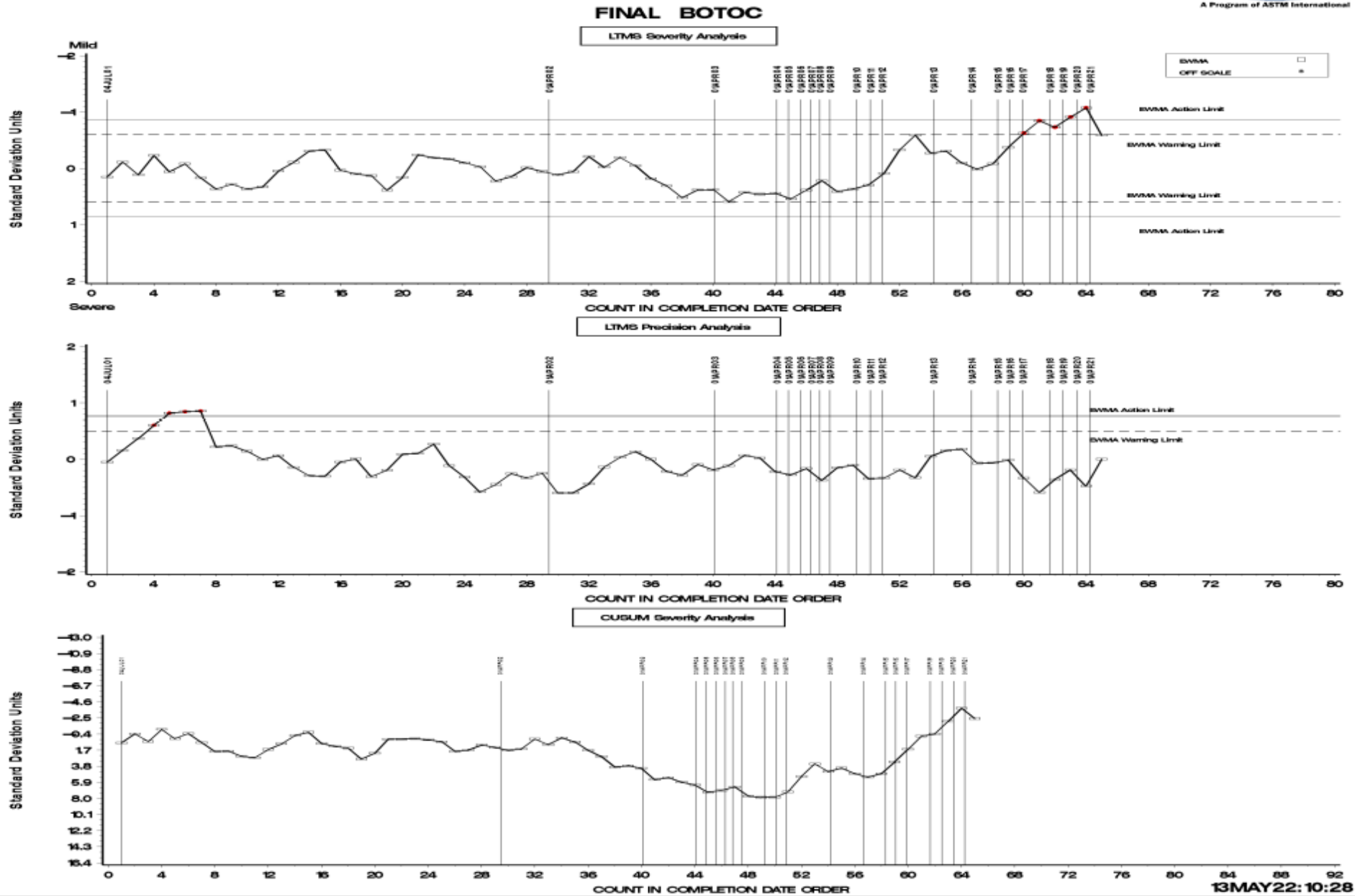


Caterpillar SCOTE 1P Charts- Oil Consumption

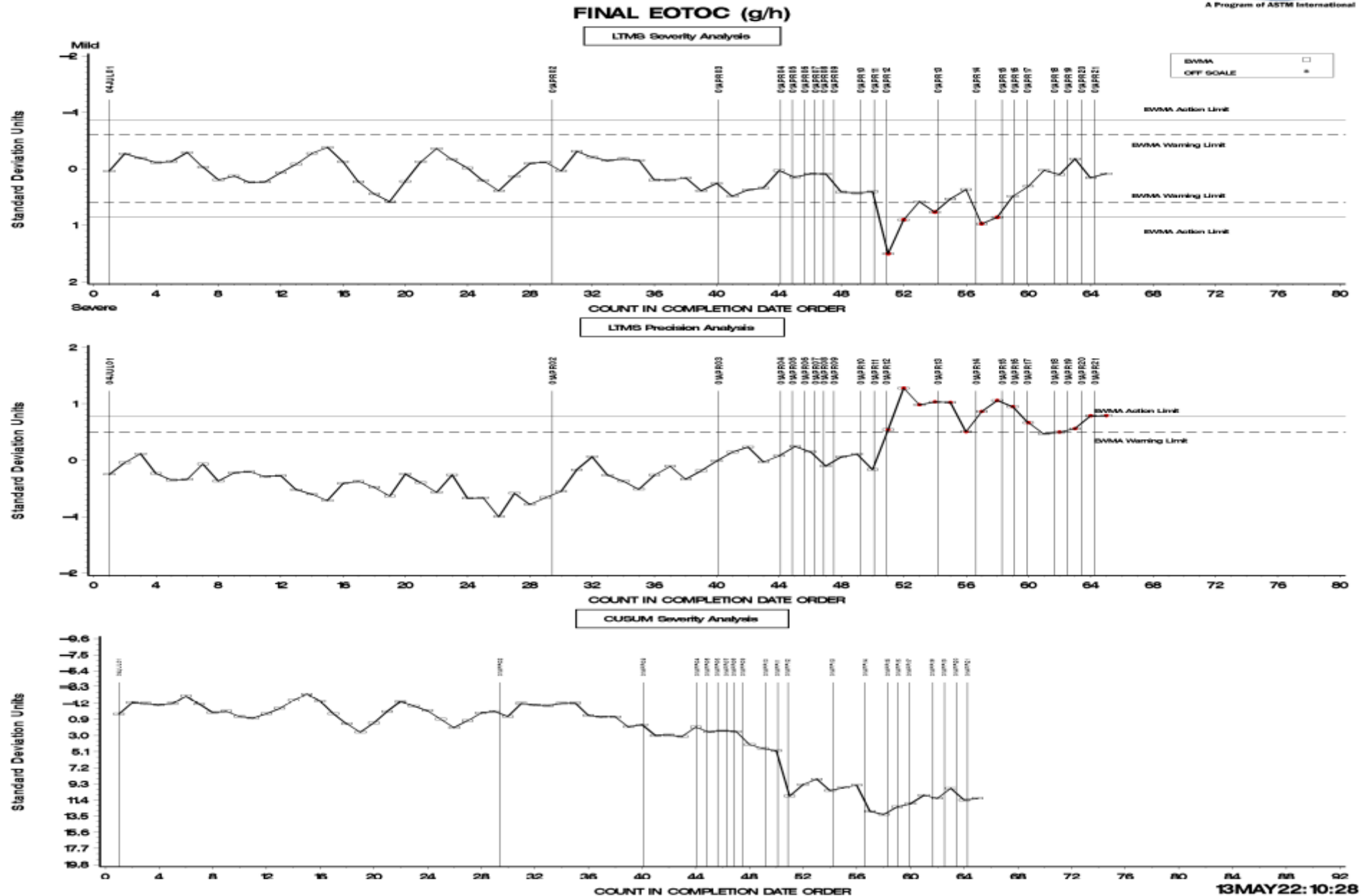


CAT 1R

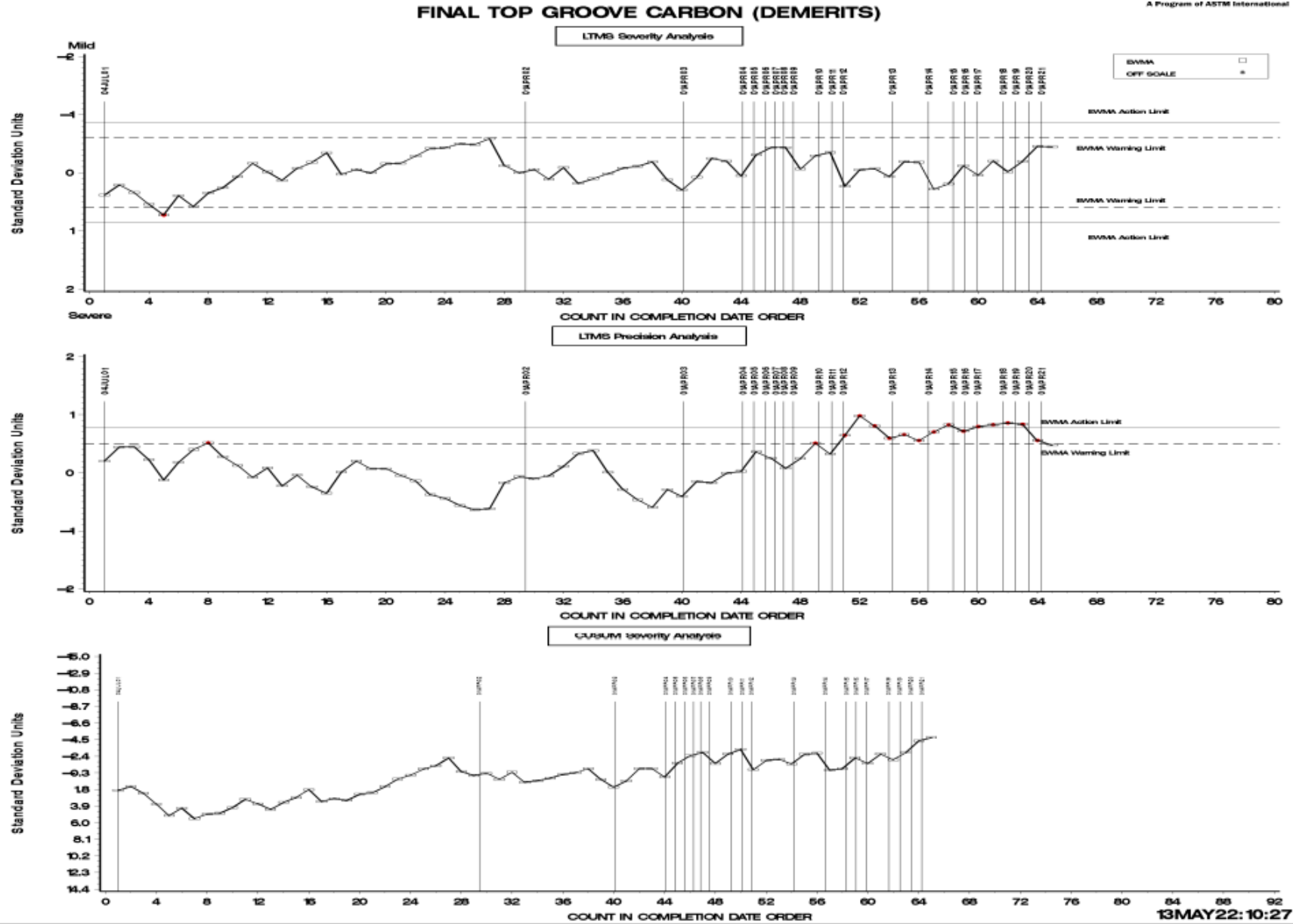
Caterpillar SCOTE 1R Charts- BOTOC



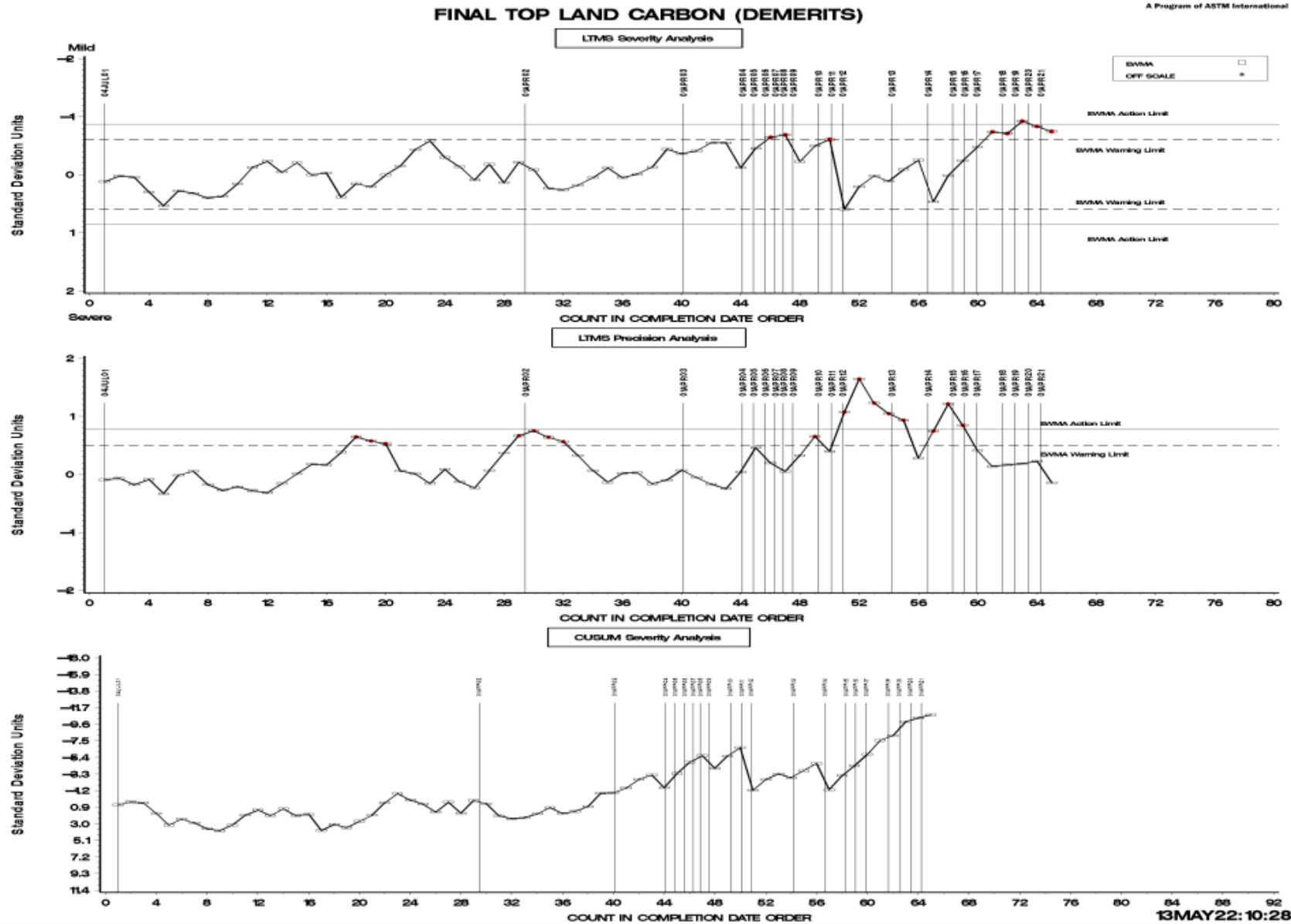
Caterpillar SCOTE 1R Charts- EOTOC



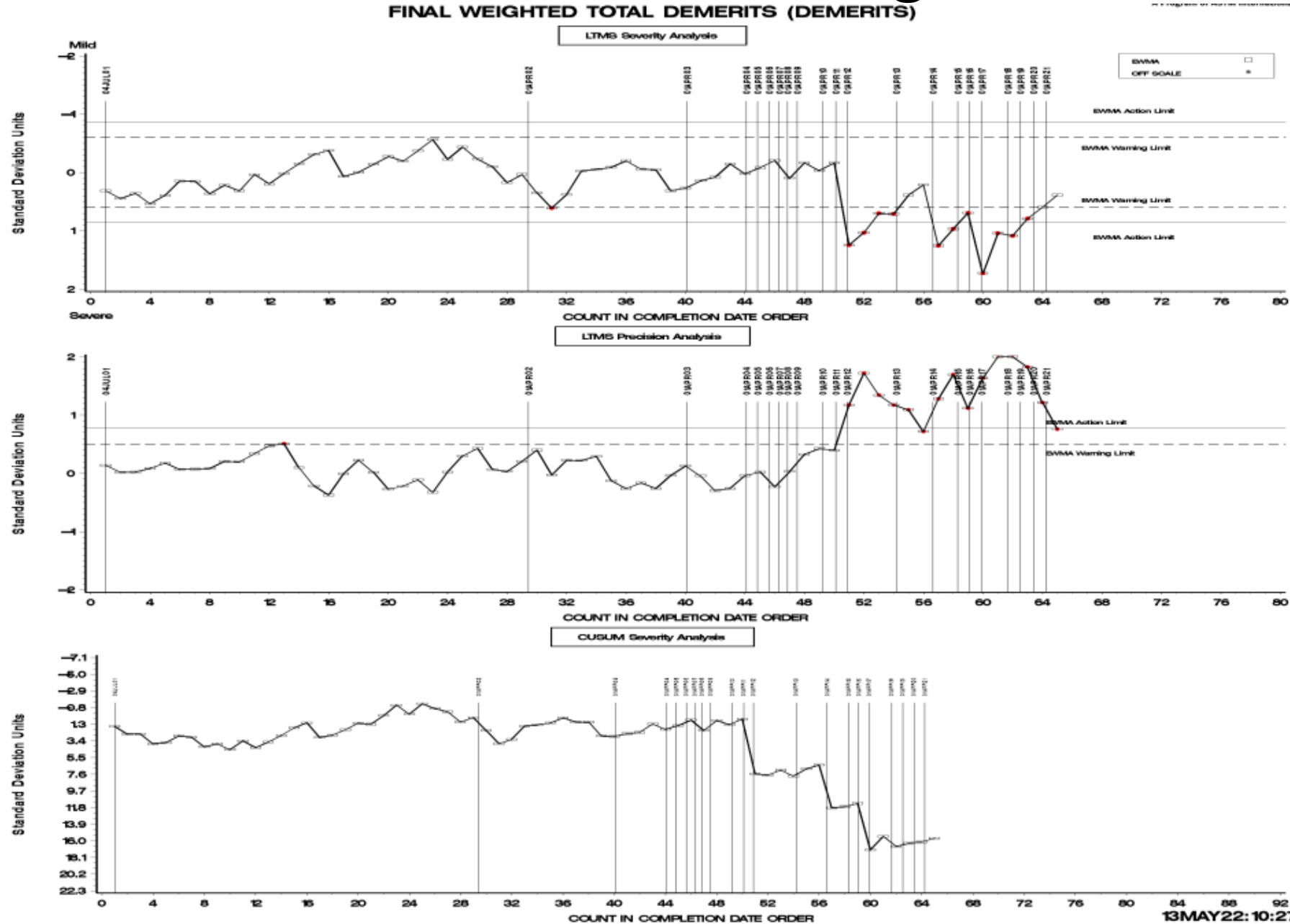
Caterpillar SCOTE 1R Charts- TGC



Caterpillar SCOTE 1R Charts- Final Top Land Carbon



Caterpillar SCOTE 1R Charts-Final Weighted Total Demerits



Cummins

ISB (ASTM D7484) ISM (ASTM D7468)

Surveillance Panel Update

December 2022

Prepared By: Andrew Smith, S.P. Chairman

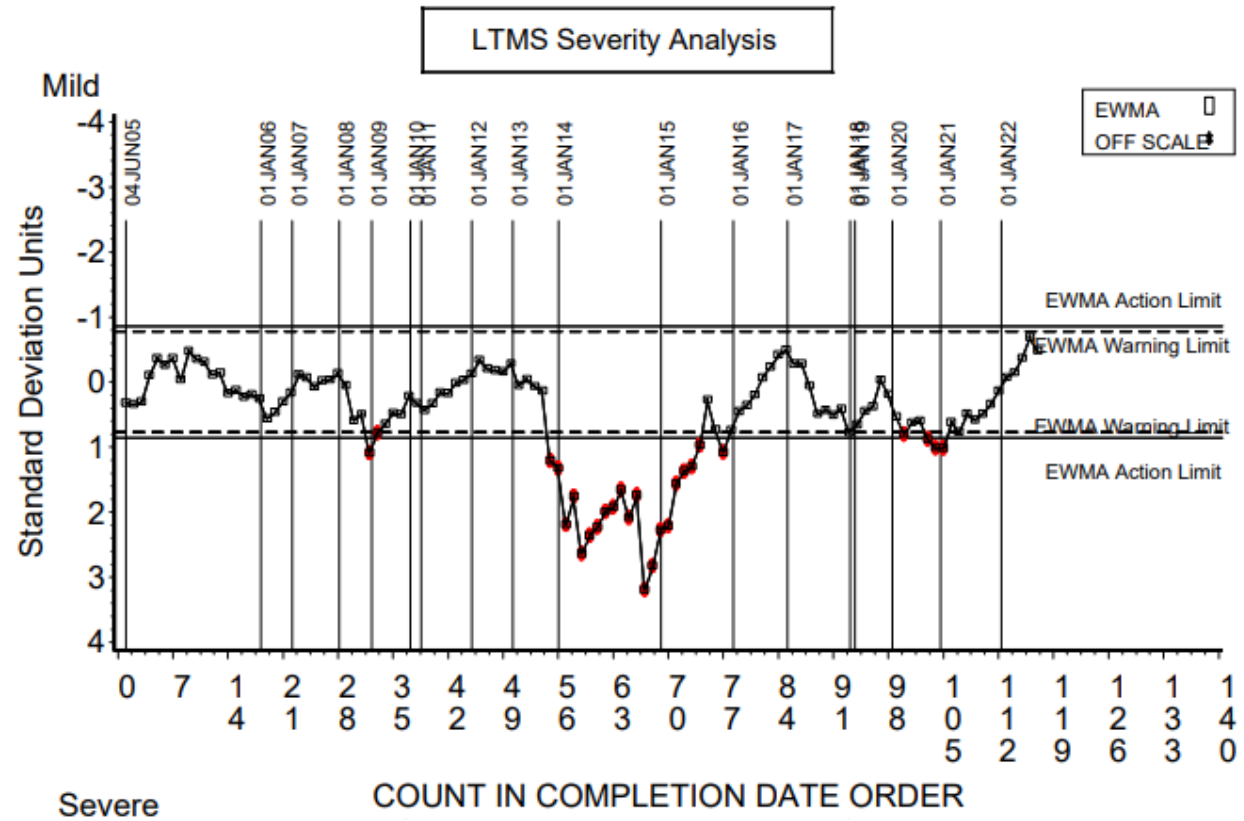
Cummins SP Report

ISB Test Status

- 4 labs, 4 tests stands are currently calibrated
- Critical Parts Inventory
 - Camshaft Batch M: 10 Kits
 - Tappets Batch F: 135 Kits
 - Crossheads Batch F: 25 Kits
 - Push Rods Batch D: 245 Kits
- Camshafts and Crossheads have been ordered by Cummins and expected to arrive January 2023
- Reference Oil Update:
 - Approximately 2 Year Supply of 831-4 and process for re-blend has started, will need to be introduced in the next couple years

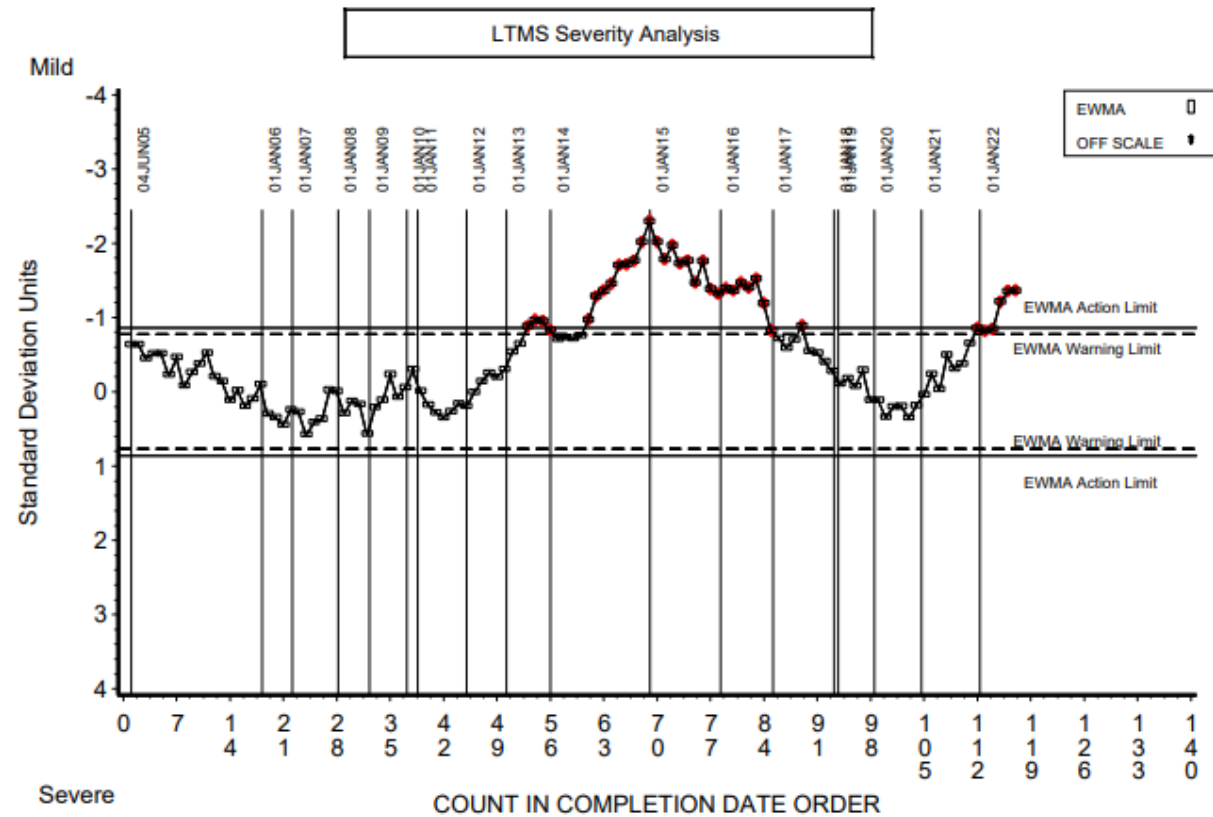
LTMS Analysis: Average Camshaft Wear

- Severity under control



LTMS Analysis: Average Tappet Weight Loss

- Severity Action Alarm
 - Panel to review data at the beginning of the year



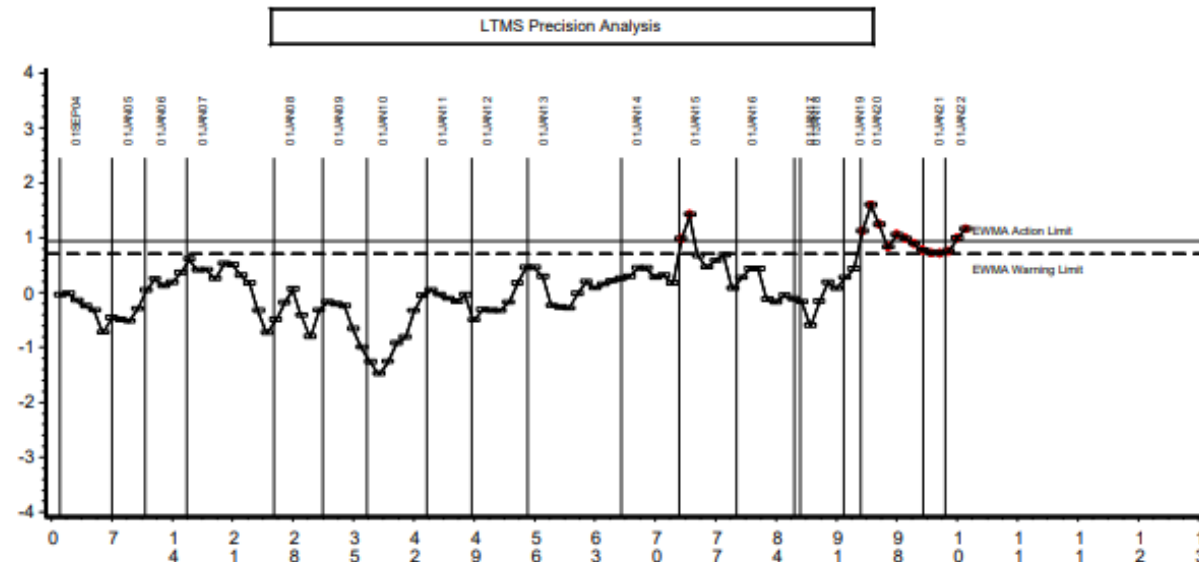
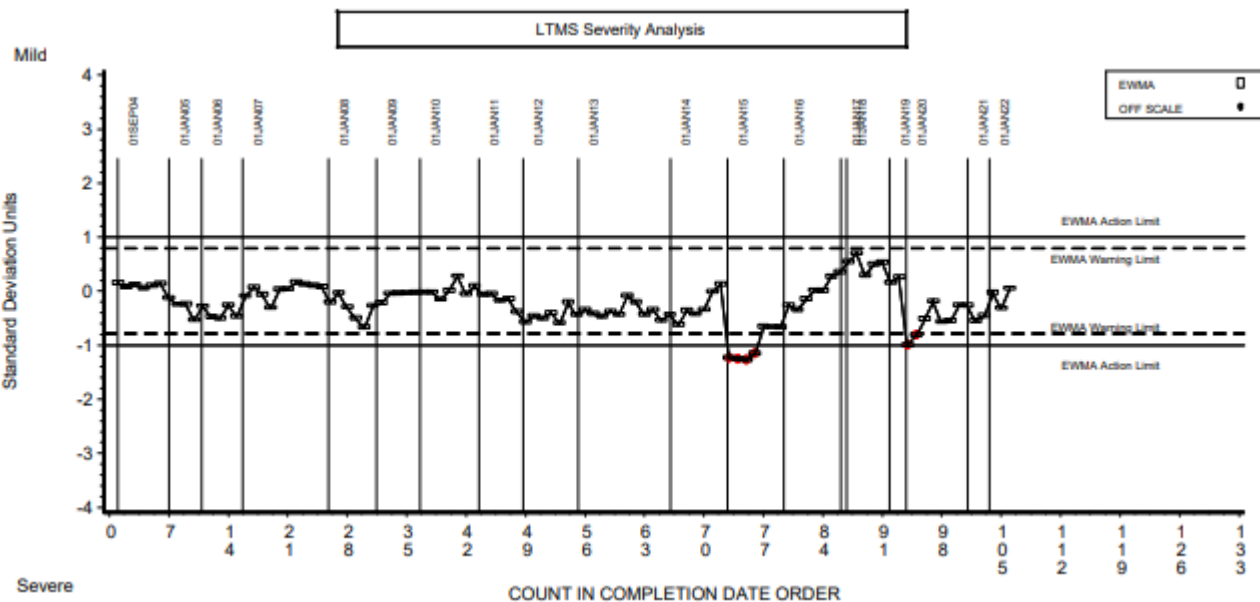
Cummins SP Report

ISM Test Status

- 4 labs, 3 tests stands are currently calibrated
- Critical Parts Inventory
 - Adjusting Screw Batch E: 177 Kits
 - Crossheads Batch G: 87 Kits
 - Push Rods Batch D: 379 Kits
 - Exhaust Valve Batch F: 116 Kits
 - Intake Valves Batch F: 102 Kits
 - Test Oil Filters 901 Media: 627 Kits
- Reference Oil Update:
 - Approximately 5 Year Supply of 830-3 at current usage rate

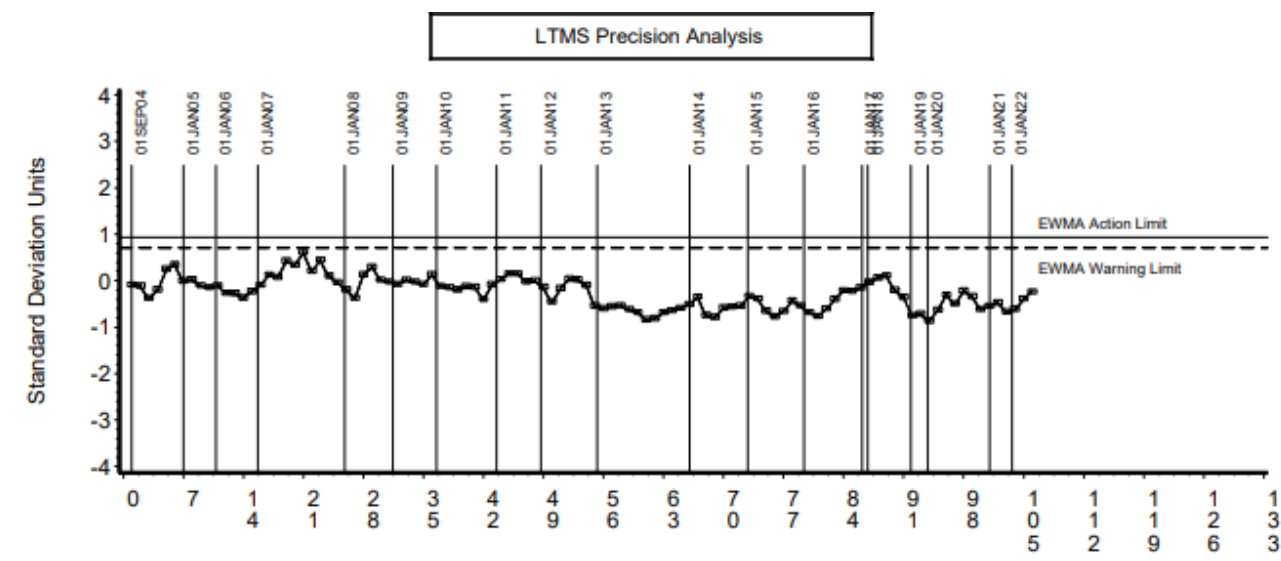
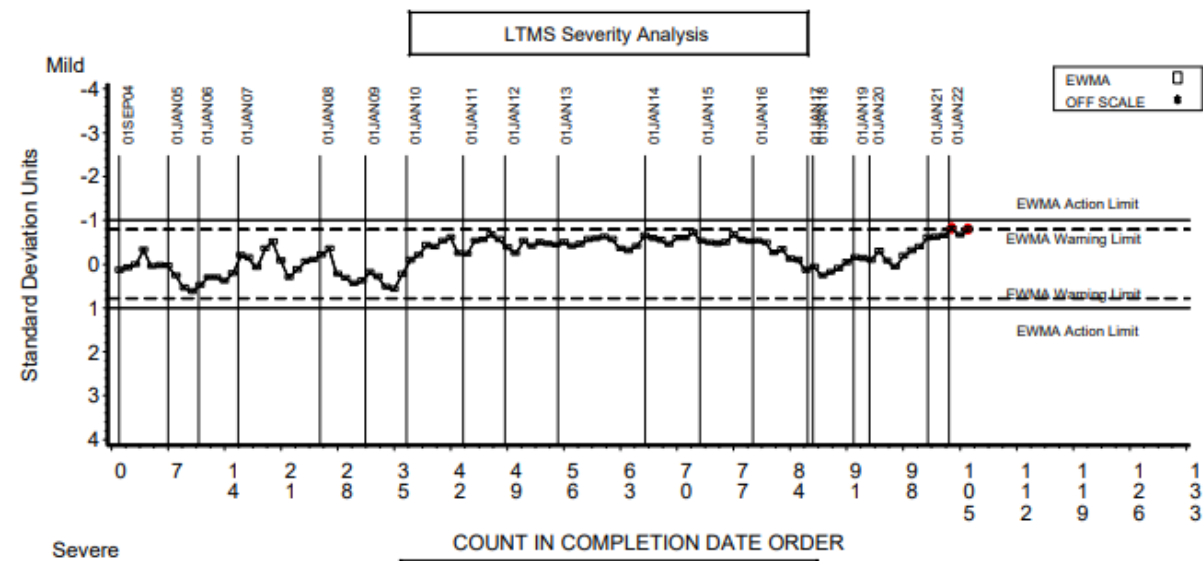
LTMS Analysis: Average Sludge Rating

- Severity under control
- Precision Action Limit
 - Panel reviewed data March 2022 with agreement to not make any changes and evaluate when more data made available, only 1 test since review



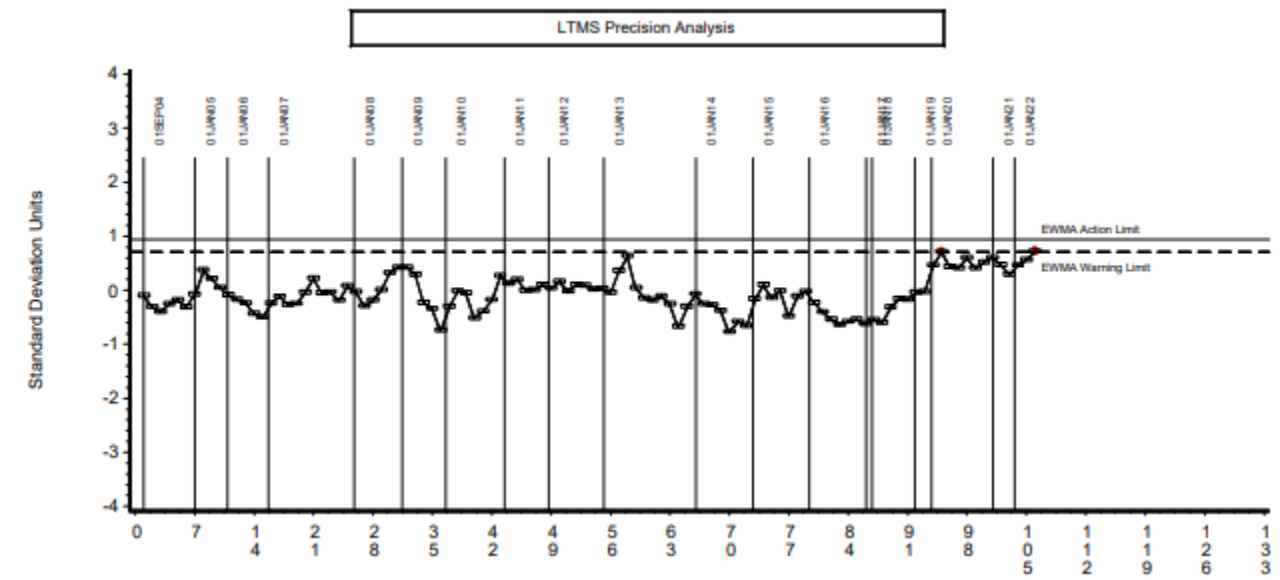
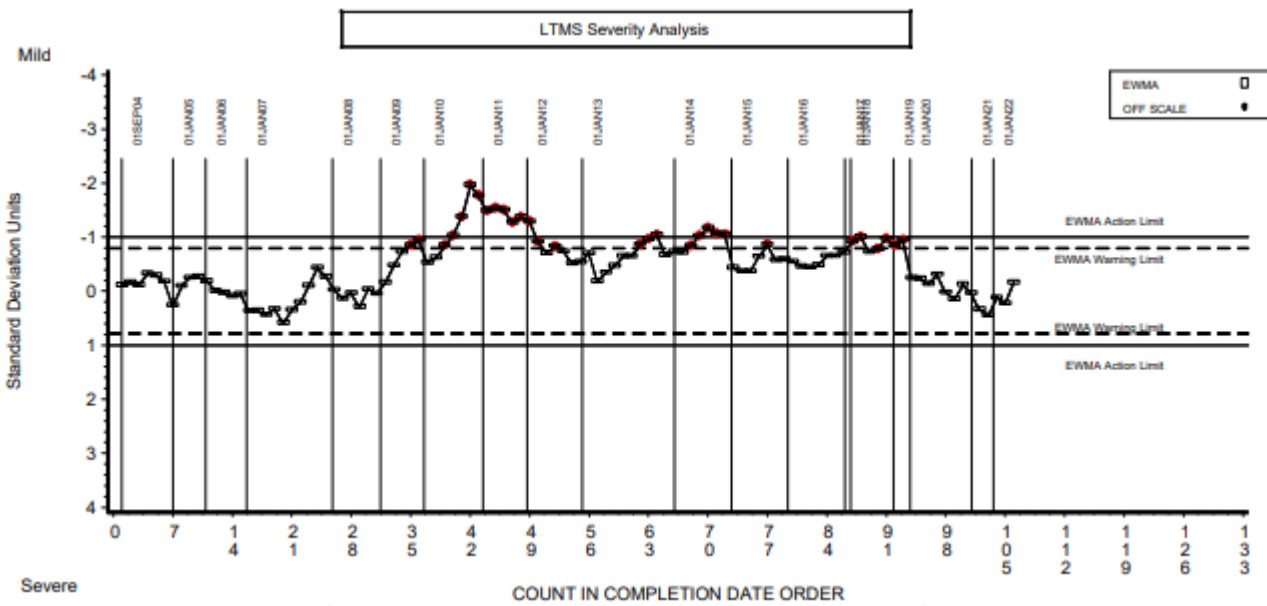
LTMS Analysis: Crosshead Weight Loss

- Severity warning alarm
 - Will be monitored as more data is produced
- Precision under control



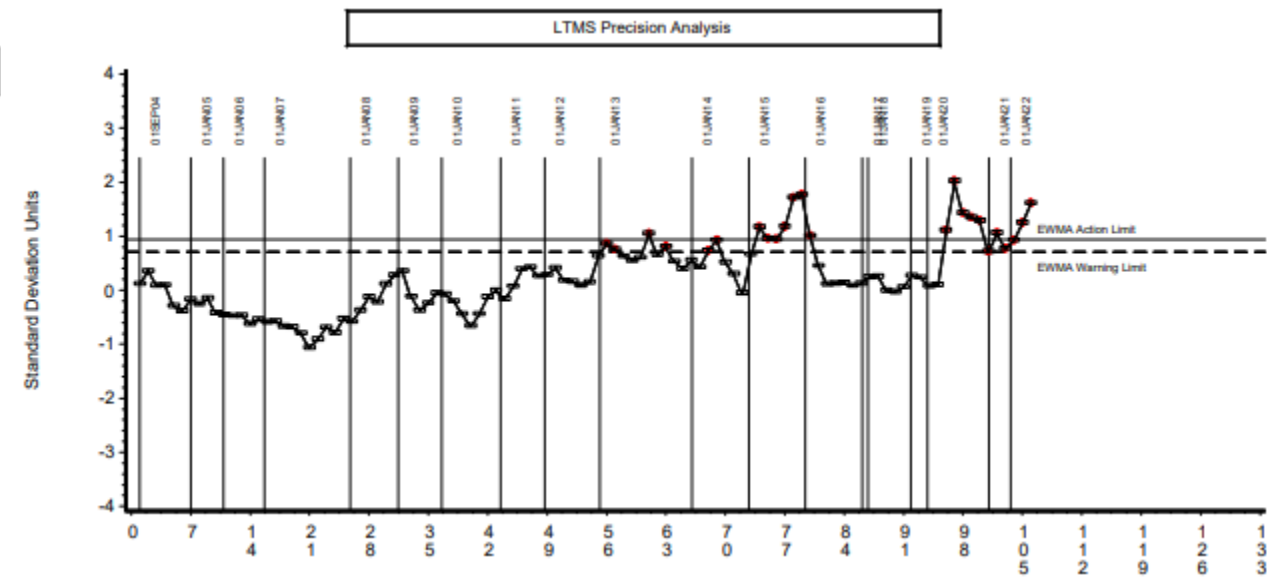
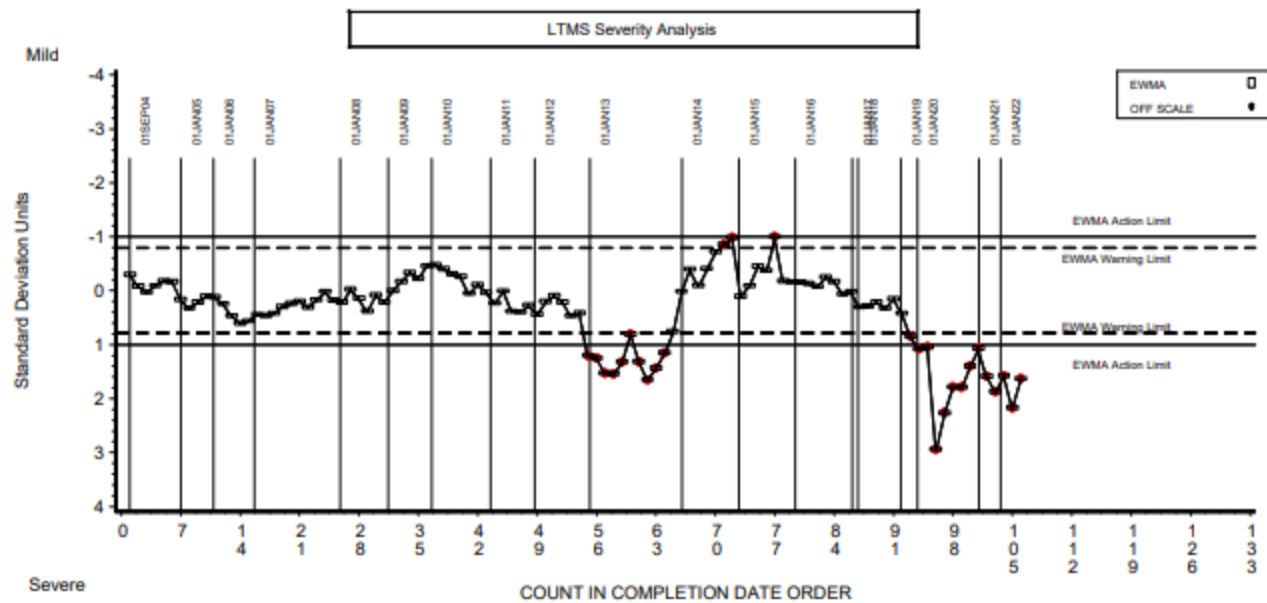
LTMS Analysis: Oil Filter Delta Pressure

- Severity under control
- Precision Warning Alarm
 - Will be monitored as more data is produced



LTMS Analysis: Injector Screw Weight Loss

- Severity and Precision Action Alarms
 - Data Reviewed March 2022 for batch G crossheads, CF was updated
 - Labs need to re-submit data on tests with batch G crossheads so charts can be updated



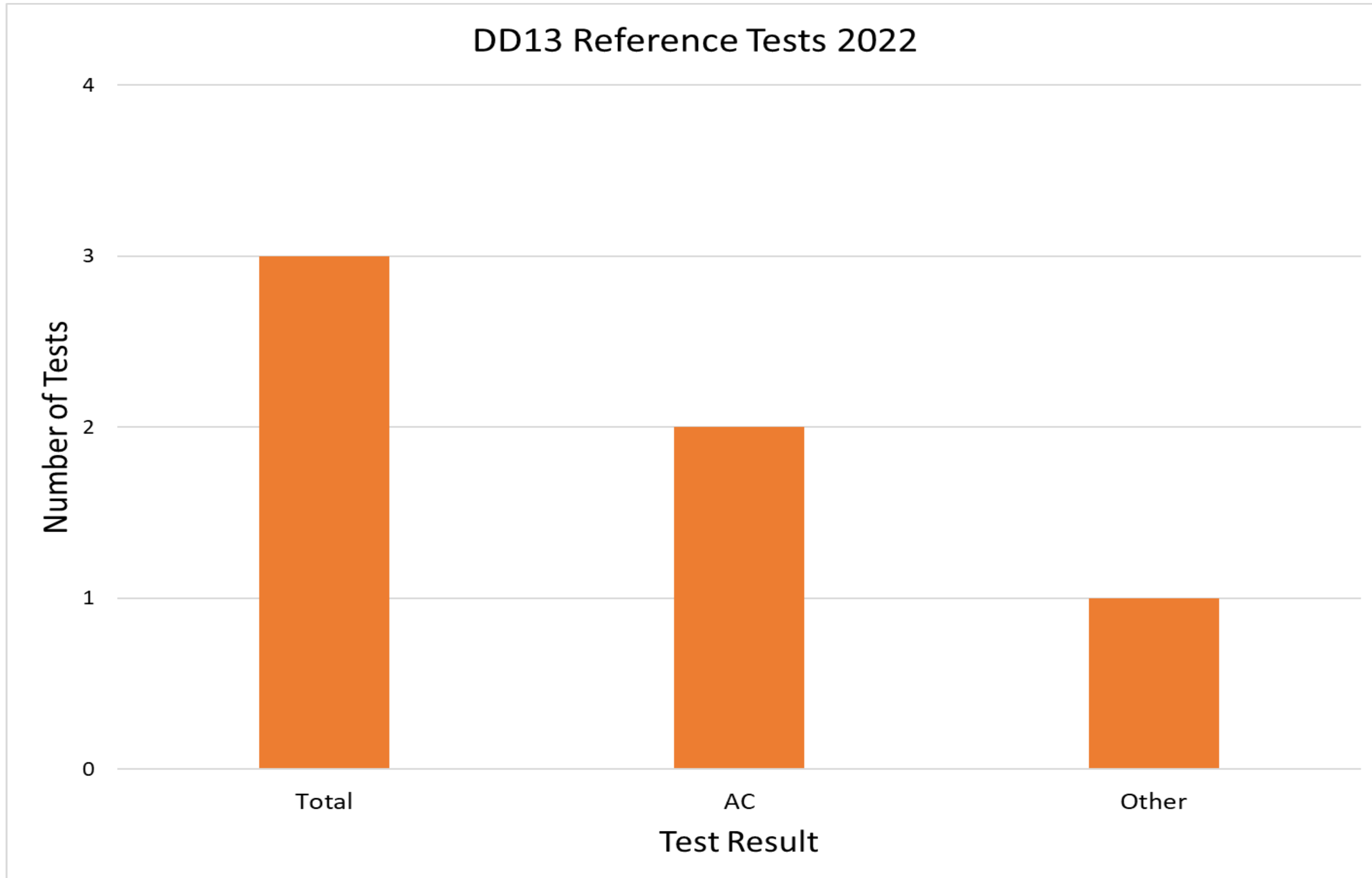
**DD13 S.P.
Annual Report, December 2022
Presentation to Subcommittee D02.B0**

Prepared By: Robert Slocum, S.P. Chair December 2022

DD13 S.P. Report Panel Activity

- R. Slocum Appointed to S.P. chair replacing Andrew Stevens
- DD13 Low Viscosity Testing:
 - Reviewed Low Viscosity Survey Results for DD13 Scuffing Test & Provided recommendation to NCDT on if any additional low viscosity prove out data points where required for the DD13 Scuffing Test.
- DD13 History & Statistical Data
 - SP helped re-assign statistician's to help review historical DD13 Scuffing Test data and provide summary to NCDT

DD13 S.P. Report Reference Test Activity

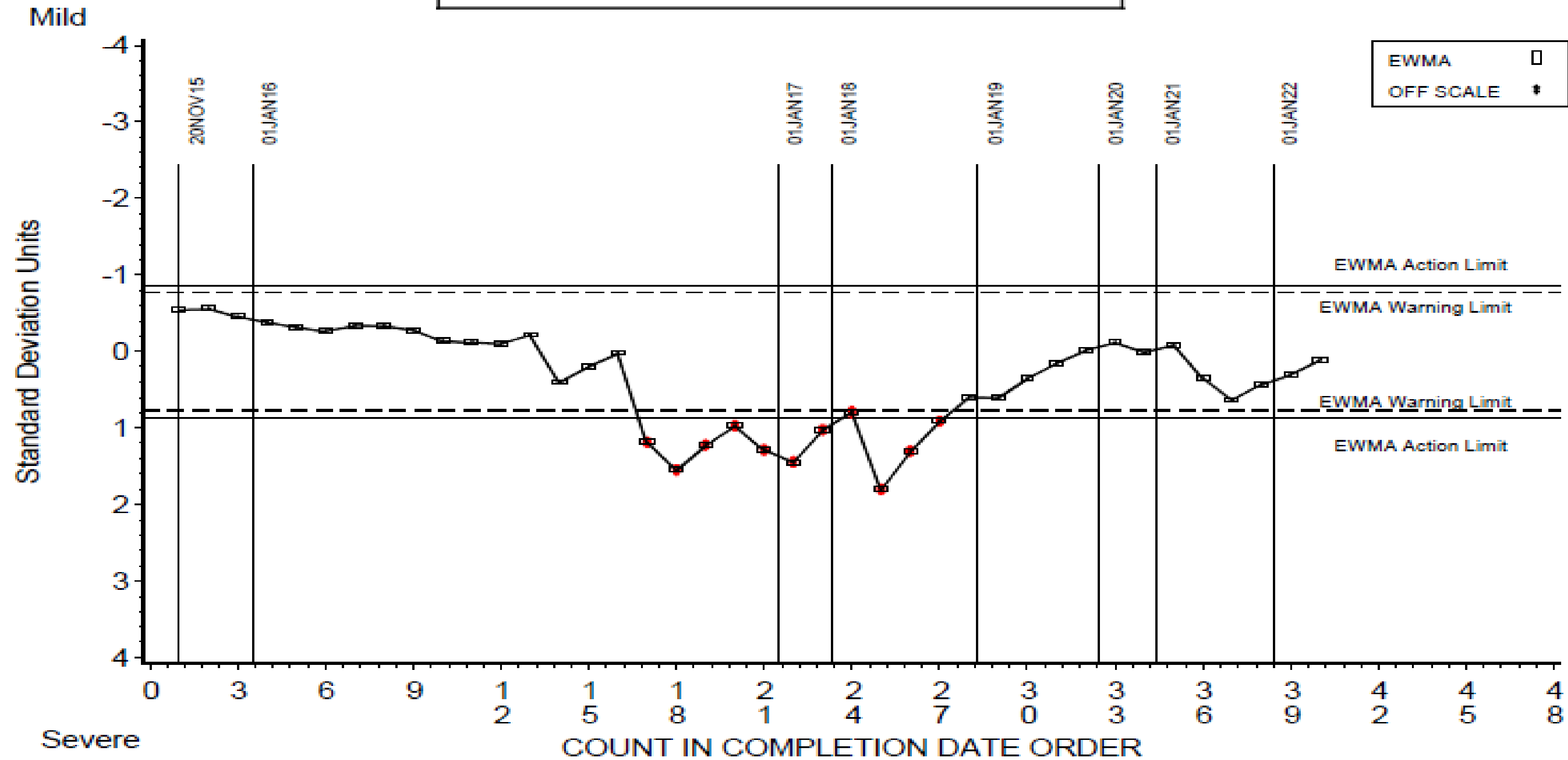


DD13 S.P. Report Industry Reference Severity Summary

DAIMLER D13 INDUSTRY OPERATIONALLY VALID DATA
FNL. ORIG. UNIT HOURS TO SCUFF

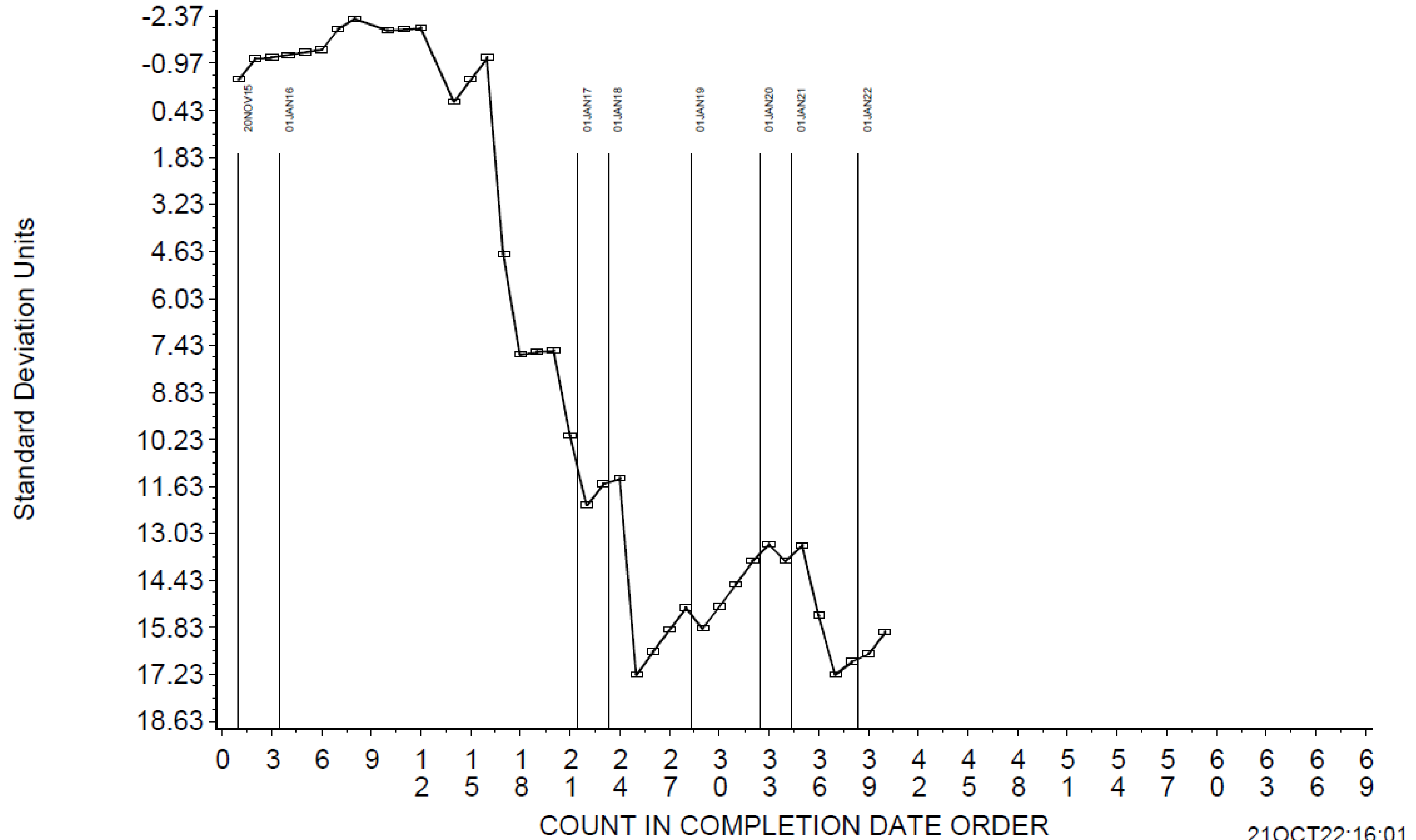


LTMS Severity Analysis



DD13 S.P. Report Industry Reference Severity Summary

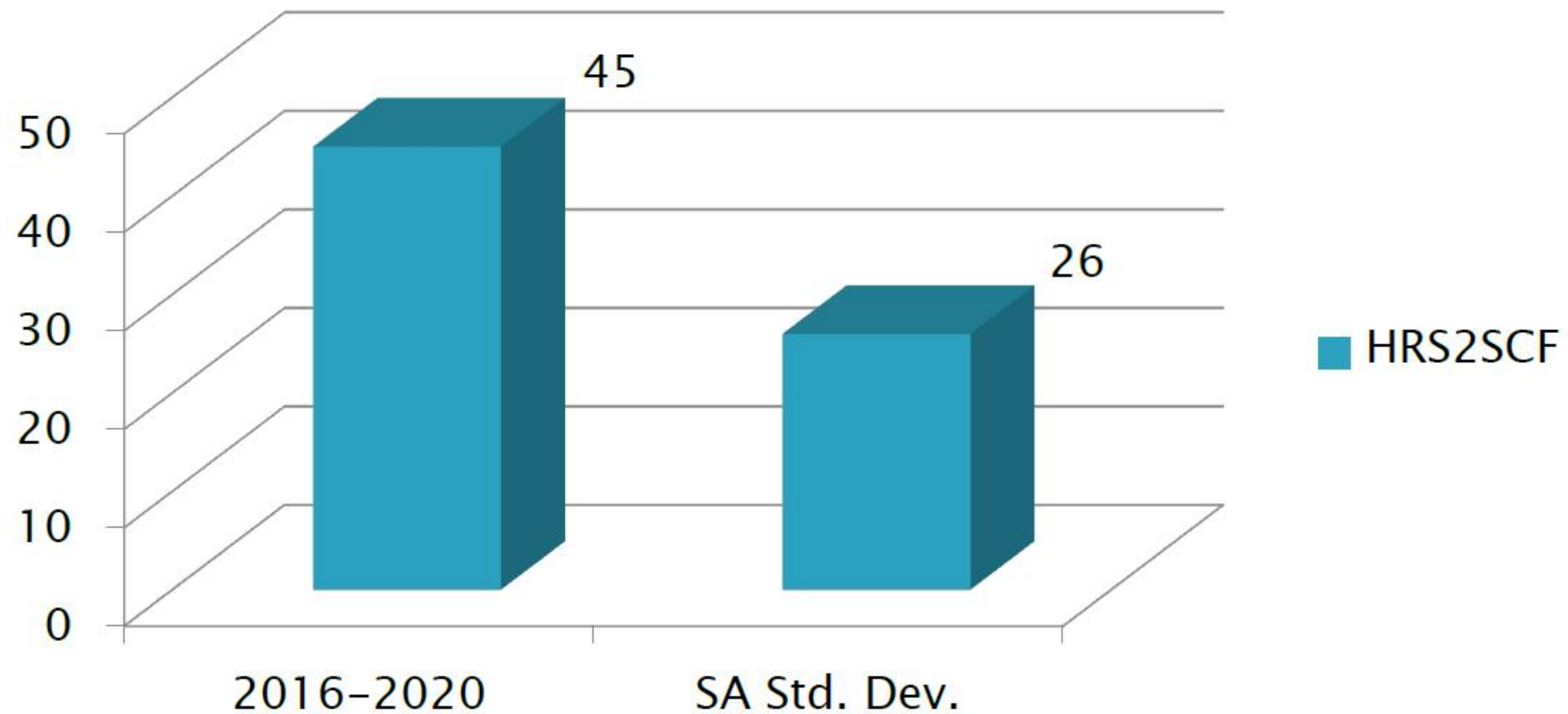
CUSUM Severity Analysis



DD13 S.P. Report

DD13 Precision Estimates

HRS2SCF



[Return to Table of Contents](#)

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



DD 13 S.P. Report Hardware

- No complete kits currently @ TEI
 - Hard time getting main cap and head bolts
- Batched parts below

Part	Batch	Quantity	Kits Remaining
Top Ring	C	2214	369
Second Ring	B	1951	325
Oil Ring	B	1391	232
Piston	B	1962	327
Liner	D	2398	400



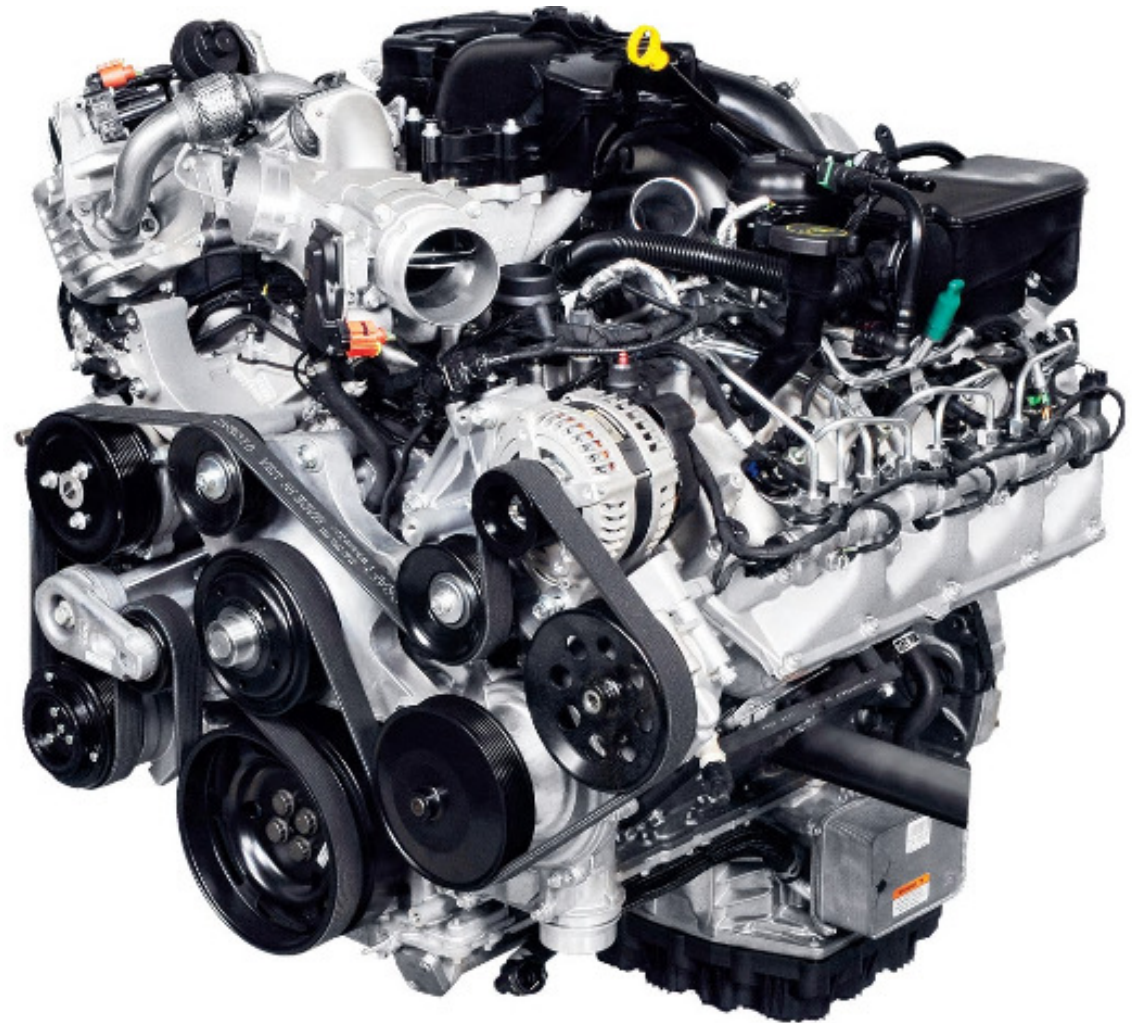
Ford 6.7L Diesel Engine Valve Train Wear (VTW) Test Update

December 2022 ASTM

Update by: Mike Deegan
FCSD SEO Lubricant TS

Additional VTW Industry Team Members:

Nick Ariemma (Lubrizol), Andrew Smith (Intertek),
Robert Warden, Jose Starling, Travis Kostan (SwRI),
Ben Maddock, Bob Campbell (Afton)



6.7L VTW Test Update

General Update:

- a. Provide confidence in MY23 Long Term Engine & Component supply- CY2040.
- b. Preliminary PM Matrix Information.
- c. Reference Test Rocker Arm Mass Loss per fuel update.
- d. PM Timing.
- e. Request other required information.

6.7L VTW Test Update

Long Term MY23 implementation:

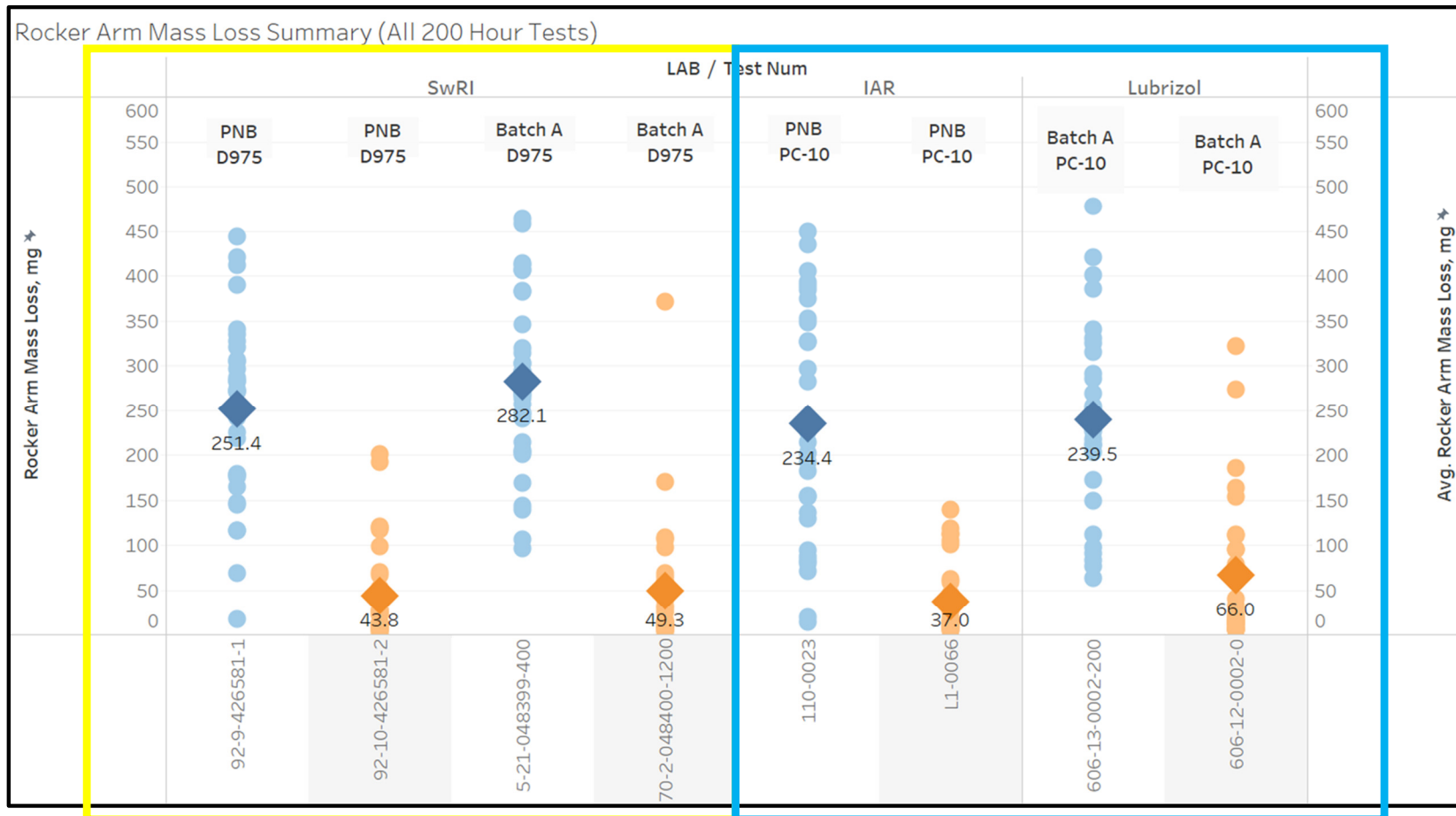
- i. MY2019 will be needed for a year.
- ii. MY23 to be scoped-3rd Qtr 2022.
 - a. Latest Hardware designed Engines and Heads enroute to Labs.
 - I. Identifying component differences and impact to test.
 - a. No changes to Critical Valvetrain components.
 - b. Valve seat and guide updates in Head Assys.
 - c. Short Block updates to steel pistons from aluminum.
 - d. Variable Displacement Oil Pump-Higher Oil Pressure than 2019.
 - e. Fuel Pump and Injectors-Higher Fuel Pressure than 2019.
 - b. Dyno kits in-process.
 - I. New Harness has provided OBD II connection. Troubleshooting of stand progressing.
- iii. Scoping plan reviewed with VTW Team with completion prior to 3rd qtr 2023 PM.
 - a. Test LWO/HWO. Validate Borderline Oil.
 - b. Determine if an xW-20 can be used as a reference oil.

6.7L VTW Test Update

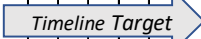
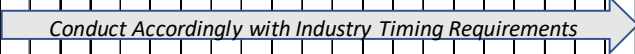
Possible changes from original PM Matrix proposal:

- Additional Test Oil to be provided. Prove out of Borderline Oil required.
- MY23 Engine required. Additional scoping tests required to verify discrimination.
- Additional Labs. Lubrizol and/or Afton based on availability of MY23's.
- Additional Stands at each lab: 2 & 2 & 1 & 1.
- Use the bookends of D975 fuel or PC10.
- Use short block up to 7-times: Lab evaluation to be done to extend short block to end of service life.
- Use turbo's 2x.
- Inclusion of BOI/VGRA.
- Evaluate for T-11 MRV, etc.

6.7L VTW Test Update



6.7L VTW Test Timing Update

FORD VTW TEST DEVELOPMENT	2022												2023												2024												2025														
	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12								
MY23 ENGINE CHANGEOVER TIMELINE	Timeline Target 																																																		
Provide two complete MY23 Engines to San Antonio Test Labs with spare cylinder heads																																																			
San Antonio Engineering Groups to Review MY 2019 / 2023 Variations with Ford																																																			
Provide Dyno Kit and ECM's							In-process @																																												
Review Scoping Test Requirements																																																			
Run Borderline Reference Oil on MY 2019 Platform																																																			
Change Over to MY 2023 Engines								Long Blocks available in November																																											
Conduct Scoping Runs on MY 2023 Engines Borderline and High Wear Reference Oils																																																			
Secure MY 2023 Engines for Precision Matrix																			Early 2nd Qtr 2023 for availability for larger																																
Review Precision Matrix Requirements with Statisticians/NCDT																																																			
Review Precision Matrix Requirements with Statisticians/NCDT																																																			
Schedule and Run Precision Matrix																			Conduct Accordingly with Industry Timing Requirements 																																
Timeline for providing MY23 engines for PC12 category.																																																			
Completed																																																			
Late																																																			

6.7L VTW Test Update



Other information request:

- Any additional information that Ford needs to provide for ASTM/API
- MOA timing

6.7L VTW Test Update

Previous Information

6.7L VTW Test Update

From D.4:

For a proposed C Category Supplement to move forward, DEOAP should consider the following items:

- a. Tests must be developed and be ASTM-approved or have made significant progress toward ASTM approval.
 - i. Ready to proceed with Precision Matrix Testing.
- b. Oils are being marketed that meet the proposed Supplement.
 - i. Approx. (200) oils on market already.
- c. Multiple technologies have been shown to meet the proposed Supplement.
 - i. Different Base Oils and Ad Pacs.
- d. There is no previous Supplement for this category (one Supplement per Category).

6.7L VTW Test Update

From D.4:

The DEOAP will work to reach consensus positions on the following questions:

- a. What is the proposed change and why is it required?
 - i. Add the Ford VTW Test.
 - ii. Excessive Valve Train Wear in Ford Durability test.
- b. What field performance issues support the need for a Supplement?
 - i. Warranty avoidance from (4) OEMs.
- c. Does data presented support the request?
 - i. See following information.
- d. When is it needed in the marketplace?
 - i. ASAP
- e. What are the potential impacts on engines and aftertreatment devices?
 - a. Improved engine (e.g.: valvetrain) durability and no impact to aftertreatment.

6.7L VTW Test Update

From D.4:

The DEOAP will work to reach consensus positions on the following questions:

- f. What are the potential impacts on consumers?
 - i. Improved durability of engines.
- g. What are the potential impacts on the environment?
 - i. No expected change to the environment
- h. Can the tests requested for the Supplement be used for the next full, new C Category?
 - i. Ford believes that it can be used for the next Category. EMA is considering.
- i. Are the requested performance tests available, or will they be available within the requested time frame, that properly evaluate the requested performance needs?
 - i. Yes, Test is available at (2) labs.
- j. Do the perceived benefits outweigh the projected costs?
 - i. Yes, warranty costs would be substantial if Ford spec oil is not used.

6.7L VTW Test Update

The OEM sponsoring each individual test shall fulfill the following requirements:

- a. Justify the need for the test and performance limits.
- b. Provide test hardware.
- c. Provide a test procedure.
- d. Provide discrimination and precision data.
- e. Provide suggested initial BOI and VGRA guidelines.
- f. Provide suggested pass/fail limits.

6.7L VTW Test Update

- This file has been updated from the DEOAP presentation to better explain Ford's request. Intent is to provide an improved test and oil type timeline based on DEOAP questions.
- General Test information:
 - Ford 1200 hour Durability Testing found the initial wear issues with ~800ppm phos oils.
 - After implementation of Ford Specification, a 600 hour durability test was implemented at external test labs.
 - Due to length of test and interest in protecting Ford engines, a 200 hour test has been developed with industry partners for ASTM implementation.
- Due to confidentiality, the additive package chemistries tested with Low Phos (~800ppm) or High Phos (1000 – 1200ppm) are not available.
- This request is also meant to ensure that an API licensed category can be implemented for addition to Owner Guides and on Motorcraft Heavy Duty Diesel engine oil labels as current CK-4 licensed oils may not protect Ford Engines.
- Current next category is not planned until 2027, Ford requests this supplement in the interim.

6.7L VTW Test Update

Initial Ford 1200hr Dyno Durability Testing Background:

- 6.7L's Valvetrain, running prototype oils showed higher wear than CJ-4 oils on Ford 1200hr Durability Engine Test.
 - **Ford Durability Test Information: (Ad Pac information not available)**
 - 1st test-FA-4, 5W-30, Low Phos-Valvetrain Failure
 - 2nd test-FA-4, 5W-30, Low Phos-Valvetrain Failure
 - 3rd test-CJ-4, 10W-30, High Phos-Valvetrain Pass
 - 4th test-FA-4 additive system with 3.5HTHS, 10W-30, Low Phos-Valvetrain Failure
 - Subsequent testing was done with CK-4, 10W-30, High Phos-Valvetrain Pass.
- Ford specification, WSS-M2C171-F1, with Phosphorus requirement between 1000 and 1200ppm implemented at same time as CK-4 licensing.

6.7L VTW Test Update

Supplement Request Test Background (cont.):

- **Incremental 600hour Ford** Durability Testing at External Labs with prototype or licensed CK-4 oils with 800ppm Phosphorus results had excessive wear.
 - Approx. 6 tests were run at different external labs.
 - Some passed, but not all.
 - Ad Pac information can not be provided.

6.7L VTW Test Update

200 hour Test Development Background:

- Ford/Lubrizol/Intertek/SwRI developed an ASTM Test Method over the past 5 years.
 - Using soot in the oil as wear mechanism.
 - Engine Test Hours targeted to 200 hours or less show visual correlation to wear in the Ford Durability Tests.
 - Average Rocker Arm Mass has shown discrimination in the testing between High Wear Oil (HWO) and Low Wear Oil (LWO).

6.7L VTW Test Development-Durability Test to VTW Test Visual Comparison

Durability Tests in 6.7L with Low Phos 5W-30 PC-11B2

Test showed excessive wear on pushrod ends and plunger tip



Example Wear from a 200 hour High Wear Oil (Low Phos) test at the Rocker Arm to Pushrod Interface



6.7L VTW Test Development: Average Rocker Arm Mass Loss

HWO – “PC11B” (shown in blue)
 3.0 HTHS-150
 800 ppm phosphorus

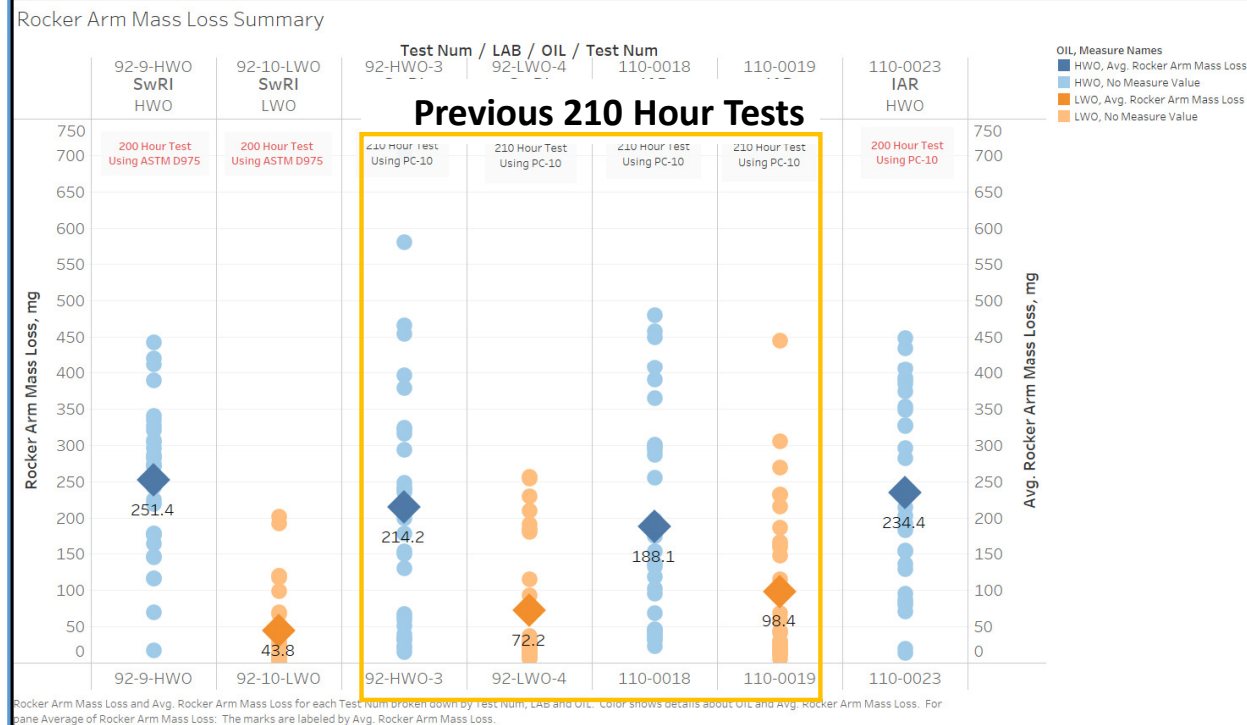
LWO – CJ-4 Factory Fill (shown in orange)
 3.5 HTHS-150
 1100 ppm phosphorus

Average Rocker Arm Mass discrimination based on:

- LWO/HWO run on latest test setup & procedure at SwRI and Intertek.
- Both labs within Soot Window Limits. Max of 6%.
- Both Labs within Operational Limits.

Statistician reviewed for Discrimination and Precision Matrix (PM) Recommendations.

- **Discrimination acceptable.**
- **A transformation may be used to Improve Discrimination.**
- **PM needs up to (20) tests for evaluation of different fuels.**



6.7L VTW 200hr Test Development Status

- Resolved Soot Window & QI Tolerances.
 - Revisit after Precision Matrix.
- Determined a Statistical Model for Rocker Arm Average Mass Loss Pass/Fail Criteria.
- Developed a Precision Matrix Proposal.
 - Task Force Implemented.
 - Different Fuels are a part of the proposed matrix.
 - Funding request to industry.
- Draft ASTM Test procedure with report forms and data dictionary have been completed.
- Potential replacement of other Valve Train Wear Tests.
 - Working with EMA.
 - Some Licensed CK-4 with existing Valve train wear tests do not appear to provide the same level of wear protection as CJ-4 provided on 6.7L engines.
- Several current WSS-M2C171-F1 approved oils have been tested and passed per proposed 115mg max Rocker Arm Mass Loss target.
 - Oils are between 1000 and 1200ppm phos.
 - 800ppm test in progress. Results pending.
- Appendix after slide 17 provides additional detail regarding the Ford VTW Test.

6.7L VTW Test Update

Additional Supplement Request Background:

- Current Ford specification, WSS-M2C171-F1, approvals exceed 200.
 - These Aftermarket oils are also CK-4 licensed.
 - Ford does not use the API Donut on its Heavy Duty Motorcraft Diesel Product.
 - A CK-4+ supplement would increase the use of API Trademark by Ford.
 - Ford has no current warranty issues.
 - There is unknown use of CK-4 oils with lower phosphorus being used in Ford Trucks.
 - Approx. Industry use of High/Low Phosphorus based CK-4 oils 80/20.

6.7L VTW Proposed Precision Matrix (PM) Test

Item	Planned Completion MMM-YY	Responsible
Finalize Draft Test Procedure	Feb-21	Ford/Labs/API
Data Dictionary	Feb-21	Ford/Labs/API
Report Forms	Feb-21	Ford/Labs/API
PM Agreement		
Critical Parts	Mar-21	Ford/Labs/TEI
Funding for (20) Tests	Mar-21	Task Force
PM Test Start	Apr-21	Labs/TEI
Review of First Row- Evaluate Fuels	May-21	All
Finalize Results	Jul-21	Statisticians
Evaluation	Aug-21	All
PM Completion	Sep-21	All
Finalize Test Procedure	Oct-21	All
Data Dictionary	Oct-21	All
Report Forms	Oct-21	All
Test accepted by API	Dec-21	

Proposed PM Test Plan-12/7/2021 with D975 (B1 & B2 Bookends)

Stand A-1	Stand A-2	Stand G-1	Stand G-2
LWO, Fuel B2	HWO, PC-10	HWO, Fuel B1	LWO, PC-10
HWO, PC-10	HWO, Fuel B1	LWO, PC-10	LWO, Fuel B2
HWO, Fuel B2	LWO, PC-10	LWO, Fuel B1	HWO, PC-10
LWO, PC-10	LWO, Fuel B1	HWO, PC-10	HWO, Fuel B2
LWO, Fuel B2	HWO, PC-10	HWO, Fuel B1	LWO, PC-10

6.7L VTW Test Update

The OEM sponsoring each individual test shall fulfill the following requirements:

- a. Justify the need for the test and performance limits.
 - i. Based on Ford Internal Dyno Testing. Other OEM information.
- b. Provide test hardware.
 - i. Hardware provided to Labs. Availability confirmed to 2027. Expectation is to provide for next Category.
- c. Provide a test procedure.
 - i. Draft ASTM Procedure provided.
- d. Provide discrimination and precision data.
 - i. Demonstrated in multiple tests. Request to run a Precision Matrix to improve.
- e. Provide suggested initial BOI and VGRA guidelines meeting CK-4.
 - i. BOI requirements similar to Table E-29 but may have little impact.
 - ii. VGRA requirements: From SAE 10W-30 to 5W-40, 10W-40, 15W-40.
- f. Provide suggested pass/fail limits.
 - i. Based on provided data as of January 2021:
 - a) Pass: 115mg or less average rocker arm weight loss.
 - ii. Intent is to change Ford Spec to performance based only and remove Phosphorus minimum.

6.7L VTW Test Update

(3) anonymous OEMs wear issues resolved with higher Phos:

- OEM 1: Top Ring and Groove-See PDF
- OEM 2: Valvetrain-Wear
- OEM 3: Valvetrain-Wear

6.7L VTW Test Next Steps

- Request a supplement to CK-4 for Ford VTW Test.
 - DEOAP consideration

6.7 VTW Test Development

QUESTIONS?

Appendix:

Additional 200hour test
information follows.



6.7L VTW Test Development: Overview

MY2019 Ford Powerstroke 6.7L V8 Diesel Engine with EGR & CCV Removed

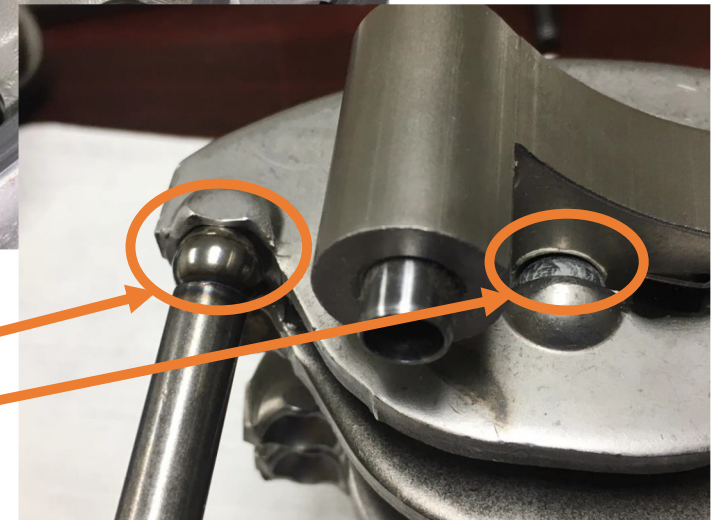
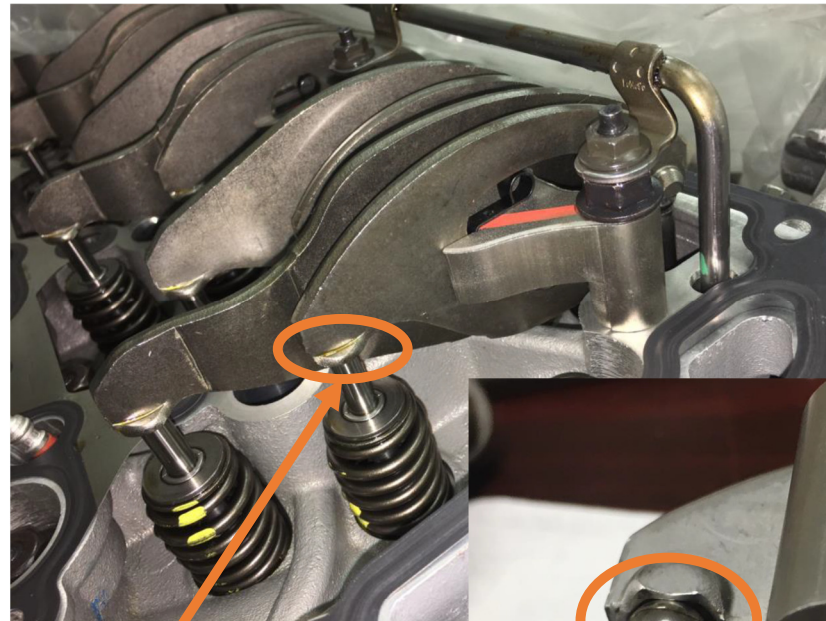
- **Test Phases**
 - Flush
 - Engine Break-In (New Engines only)
 - Flush 2 & 3
 - 200 hour test to initiate wear.
 - 1000Nm at 2800rpm.
- **Using soot as the mechanism to generate wear at Max Horsepower.**
 - Controlled by adjusting Coolant Temp Signal to PCM which in turn changes Fuel Injection Timing
 - Targets for soot loading with a maximum of 6% by End of Test (EOT).
- **14.5 kg oil charges**
 - Approximately 30 gallons of oil needed.
 - High Wear Oil (HWO)
 - Low Wear Oil (LWO)
- **Approximately 16200L (4300gal) of Diesel Fuel**
 - Evaluating PC10 & D975 Fuels to determine test sensitivity.



6.7 VTW Test Development: Overview

Focused on Average Rocker Arm Wear:

- No discrimination between oils seen on other components during prove-out testing
- Will continue to monitor other components throughout precision matrix testing

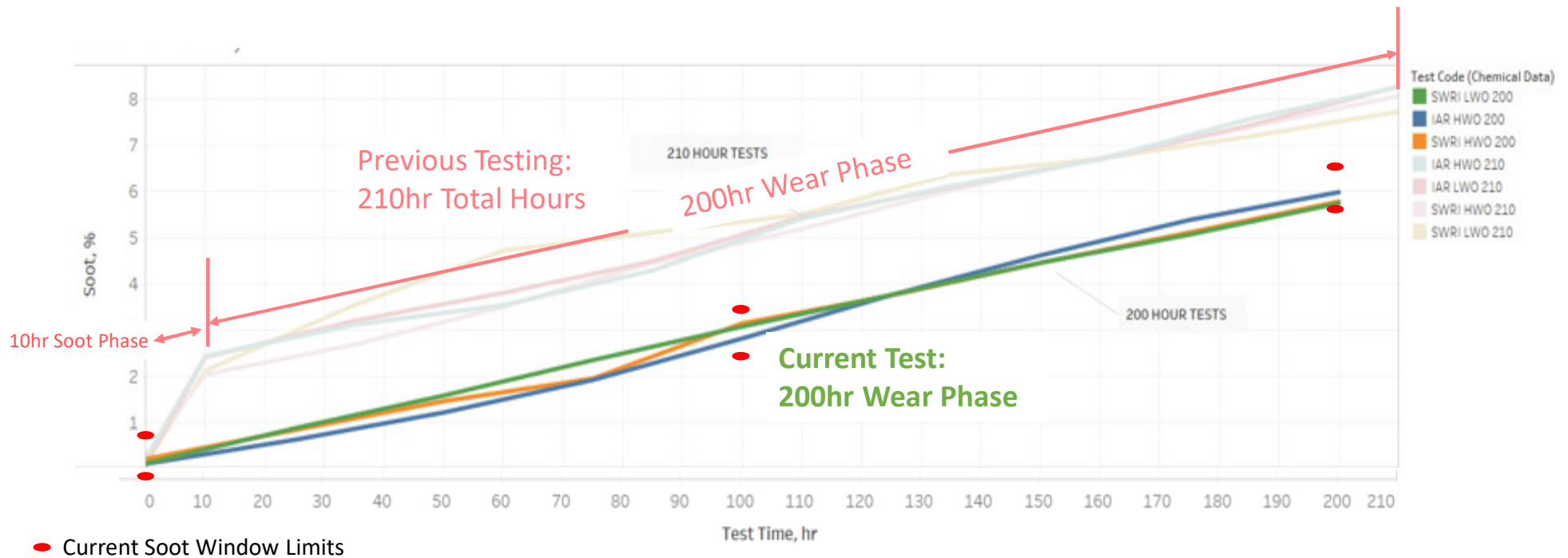


Wear locations:

- Rocker to Valve
- Rocker to Pushrod
- Rocker to Fulcrum Balls

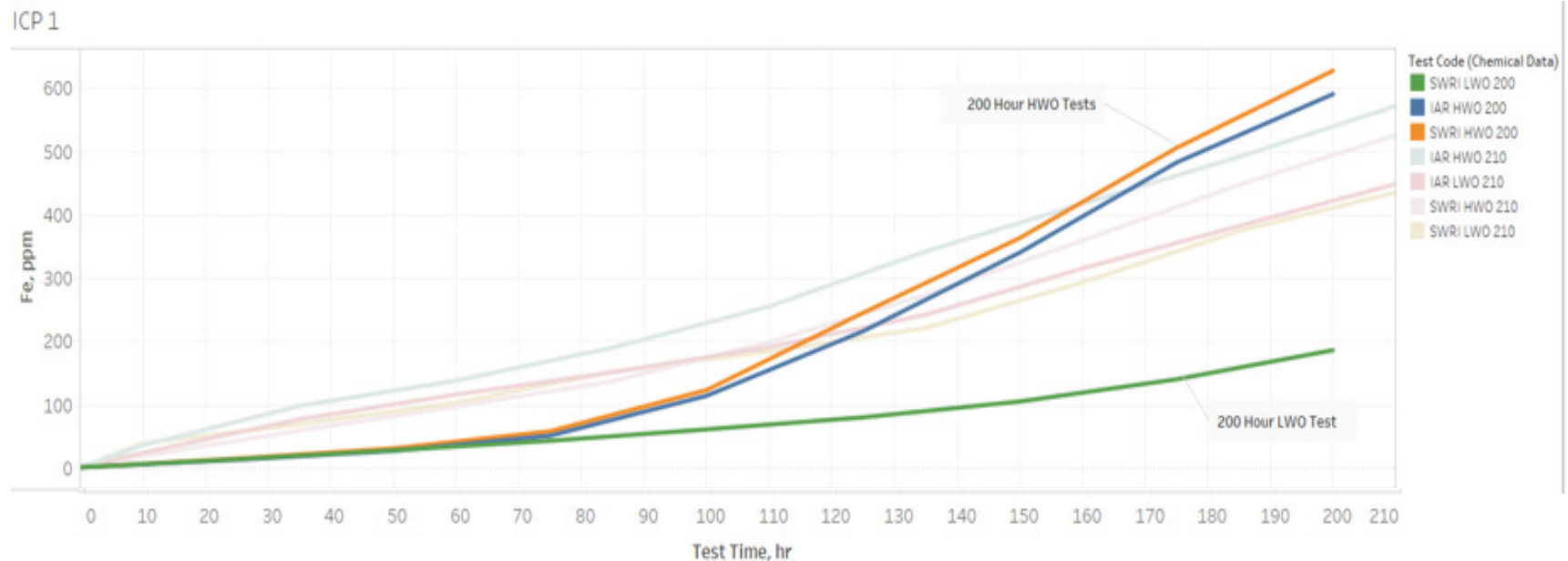
Test Development Data: Soot Content vs Test Time

- Soot content shown for the completed tests at each lab.
- Current soot window requirements shown at 0, 100, 200 hours with soot at 0%, 3%, 6% +/-0.5%.
- Ability to manage soot content via coolant temp shown.
- 25 test hour monitoring of soot necessary.



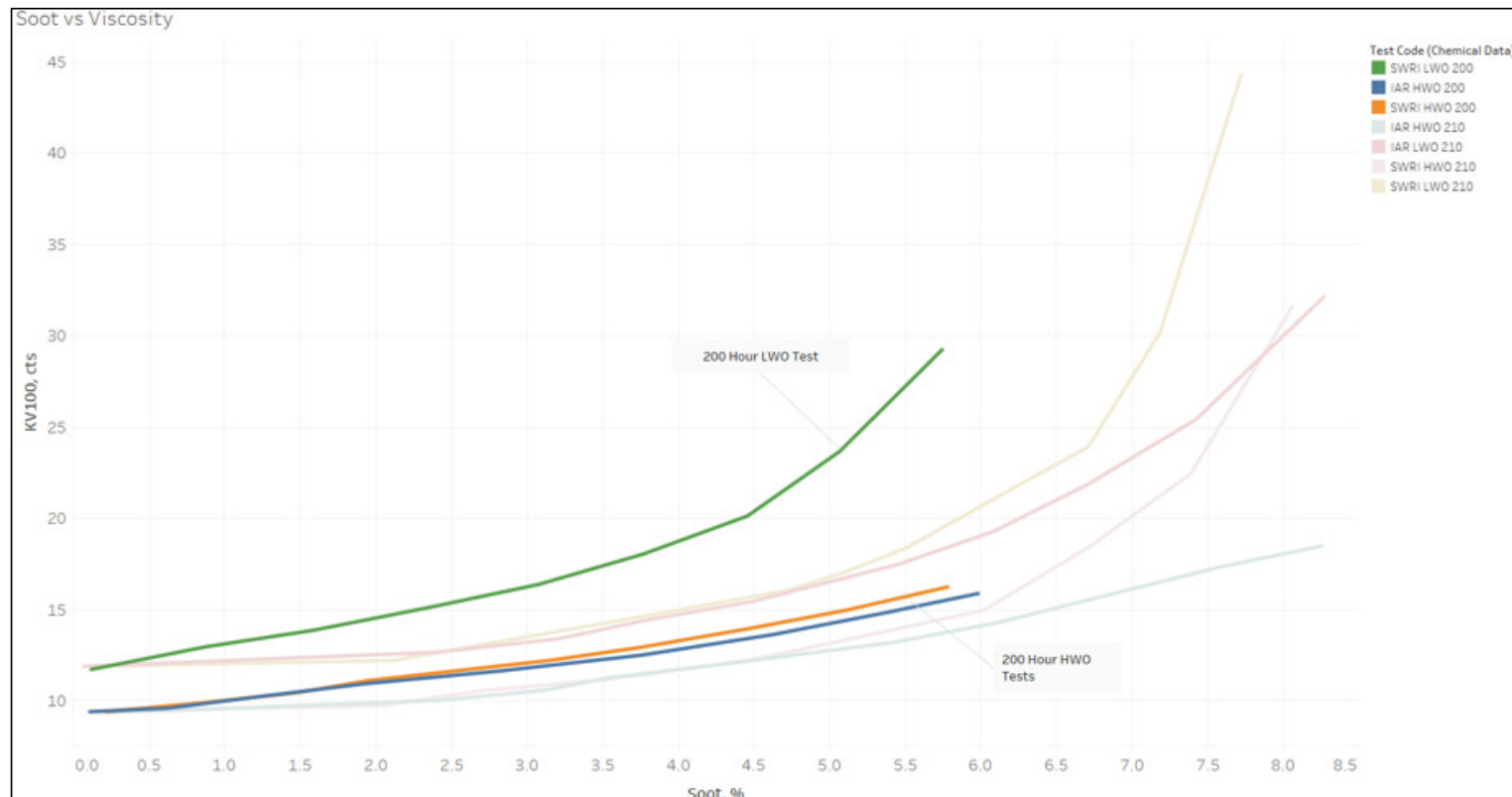
Test Development Data: Fe vs. Test Hours

- HWO EOT Fe > LWO EOT Fe
- Labs consistent with HWO & LWO Fe content.
- May be useful for predicting failure before end of test.
- Current Test shows approx. 2% Soot impacts Valvetrain Wear at ~75hrs on HWO.



Test Development Data: Soot Content vs Viscosity

- Results with regard to Oil Viscosity to % TGA Soot.
- Labs consistent with soot vs Viscosity including HWO & LWO up to ~6% soot.



ASTM D4485 Surveillance Panel Update

D02.B Heavy Duty Engine Oil Class Panel

Orlando, FL

December 6, 2022

Current Activity

- ▶ At June HDEO CP and Sub B, revised limits for the elastomer compatibility (EOEC) were approved to be sent to ballot via a D4485 Information Letter.
- ▶ These limits were incorporated into Tables 3, 4, 5 and 6.
- ▶ Annex A5 is an integral part of HD elastomer compatibility and when we tried to update that, we realized how complicated that was.
- ▶ Conversations between TMC, the Elastomer Surveillance Panel Chair and the D4485 SP Chair have been ongoing.
- ▶ A meeting of the Elastomer Compatibility SP will be scheduled in Q1 2023 to work out the new standard deviation estimates for the new reference oil, SL107, as well as to determine a schedule to keep the standard deviation estimates current.
 - ▶ This will also involve a change to the EOEC test report.