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Test Monitoring Center

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ASTM D02.B0.07 Semi-Annual Report Bench Test Monitoring

D874 (SASH), D5133 (GI), D5800 (NOACK), D6082 (HT
FOAM), D6335 (TEOST), D6417 (GC VOL), D6557 (BRT),
D6594 (HTCBT), D6794 (EOWT), D6795 (EOFT),
D7097(MTEOS), D7216 (EOEC/LDEOC) and D7528 (ROBO)

April 1, 2025 – September 30, 2025

Table of Contents

Section	Topic		
Summary Items	Executive	Reference Oil Inventories	Additional Information
Section	Topic		
Test Area Status	TEST	LABS*	STANDS*
Sulfated Ash	D874	5 (+0)	N/A
Gelation Index (GI)	D5133	8 (-1)	44 (-2)
NOACK Volatility	D5800	14 (+0)	40 (+1)
High Temp Foam	D6082	7 (+0)	9 (+0)
TEOST	D6335	8 (+1)	14 (+2)
GC Volatility	D6417	7 (+0)	12 (+2)
* Between 4/1/2025 and 9/30/2025			

Table of Contents

Section	Topic		
Test Area Status (cont.)	TEST	LABS*	STANDS*
Ball Rust Test (BRT)	D6557	5 (+0)	5 (+0)
HTCBT	D6594	9 (+0)	26 (-1)
EOWT	D6794	5 (+0)	N/A
EOFT	D6795	6 (+1)	N/A
MTEOS	D7097	11 (+0)	35 (-1)
EOEC Elast. Compat.	D7216-E	7 (-1)	N/A
LDEOC Elast. Compat.	D7216-L	9 (+2)	N/A
ROBO	D7528	6 (+0)	36 (+7)
* Between 4/1/2025 and 9/30/2025			

B0.07 Bench Testing Executive Summary

▶ D874 (Sulfated Ash)

- ▶ For the first time in several years, there was one test which failed to meet acceptance criteria for D874. Reference test results were found to be slightly mild of target this semester. No Reference Oil 92 assignments were made this semester; targets will need to be updated next year.

▶ D5133 (Gelation Index)

- ▶ One less lab and two fewer stands were calibrated this semester. Calibration testing is on-target with performance at -0.04s.

▶ D5800 (NOACK)

- ▶ Same number of labs and one additional stand calibrated this semester. Precision remained the same, but Performance has moved more severe (0.37) as compared to last semester (0.21). The last NCK2 (Procedure B) unit was removed from service so all units are now NS2 (Procedure D) or NCK25G (Procedure B) units.

B0.07 Bench Testing Executive Summary

- ▶ D6082 (High Temperature Foam)
 - ▶ No new labs added this semester. Test is still trending Severe (+0.45s).
- ▶ D6335 (TEOST)
 - ▶ One added lab and two additional stands were calibrated this semester. Performance (+0.61) has moved more severe this semester versus last semester (+0.43), but Precision improved towards target (6.27 vs 10.56).
- ▶ D6417 (GC Volatility)
 - ▶ Same number of Labs, but two added Stands this semester. Precision remains consistent and on-target, and Severity has also remained the same (slightly severe).
- ▶ D6557 (BRT)
 - ▶ All calibrations continue to be run on RO 1006 only. A reblend of RO 82 has been received by TMC and the labs are supposed to be working on additional Round Robin testing to qualify RO 86 and RO 87 on Batch E ball bearings.

B0.07 Bench Testing Executive Summary

▶ D6594 (HTCBT)

- ▶ Same number of labs, but one fewer stand was calibrated this semester. Most labs have now moved on to Batch P coupons although some labs still possess Batch O coupons. Copper and Lead results are on-target for Precision, but both showed increased Severity.

▶ D6794 (EOWT)

- ▶ No change in number of test labs. Large swings in both Precision and Severity was observed for the 0.6%, 1.0% and 2.0% water levels. TMC working with Reference Oil 79 supplier to determine if a reblend is possible.

▶ D6795 (EOFT)

- ▶ One additional lab calibrated this semester. Precision moved towards target and Severity also reduced from last semester. TMC working with Reference Oil 79 supplier to determine if a reblend is possible.

B0.07 Bench Testing Executive Summary

▶ D7097 (MTEOS)

- ▶ Same number of labs, but one fewer stand calibrated this semester. Precision regressed further to 7.59 s, and Performance (Severity) regressed moving up to 0.52s this period. All operationally valid tests this period report using Rod Batch N. Most labs have now moved to Catalyst Batch 23AB, but one calibration used Catalyst Batch 20AB. No labs used Catalyst Batch 19BA.

▶ D7216 (EOEC) / D7216 (LDEOC)

- ▶ All calibrations are using Ref Oil SL-107. Two additional labs calibrated LDEOC elastomers this semester, but one fewer lab calibrated EOEC. PC-12 has added the Hydrogenated Nitrile Butyl Rubber (HNBR) elastomer type and EOEC calibrations are being conducted by labs. EOEC has six elastomer types; LDEOC has nine elastomer types available for calibrations.

▶ D7528 (ROBO)

- ▶ Same number of labs, but seven(!) added stands semester. Precision fell further to 0.22 (target 0.15). Performance (Severity) improved to -0.25 this semester.

TABLE of CONTENTS

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D02.B0.07

TMC Monitored Tests



ASTM D 874

Sulfated Ash

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change shown in parentheses)

Test	Labs	Stands
D874	5 (+0)	N/A
*As of 9/30/2025		

D874: Sulfated Ash

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	11
Unacceptable Calibration Test	OC	1
Total		12

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 8%

April 1, 2025 – September 30, 2025

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D874: Sulfated Ash

Statistically Unacceptable Tests (OC)	No. Of Tests
Failing Calibrations (Mild)	1

- One statistically unacceptable test this report period.

April 1, 2025 – September 30, 2025

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D874: Sulfated Ash

Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets	81	78	0.07	-----
4/1/20 through 9/30/20	8	5	0.03	-0.30
10/1/20 through 3/31/21	8	5	0.02	-0.35
4/1/21 through 9/30/21	10	7	0.15	0.37
10/1/21 through 3/31/22	9	6	0.05	-0.07
4/1/22 through 9/30/22	8	6	0.06	-0.38
10/1/22 through 3/31/23	11	8	0.04	-0.71
4/1/23 through 9/30/23	10	7	0.04	-0.46
10/1/23 through 3/31/24	11	8	0.02	-0.47
4/1/24 through 9/30/24	9	7	0.04	-0.45
10/1/24 through 3/31/25	10	7	0.04	0.03
4/1/25 through 9/30/25	12	9	0.06	-0.60

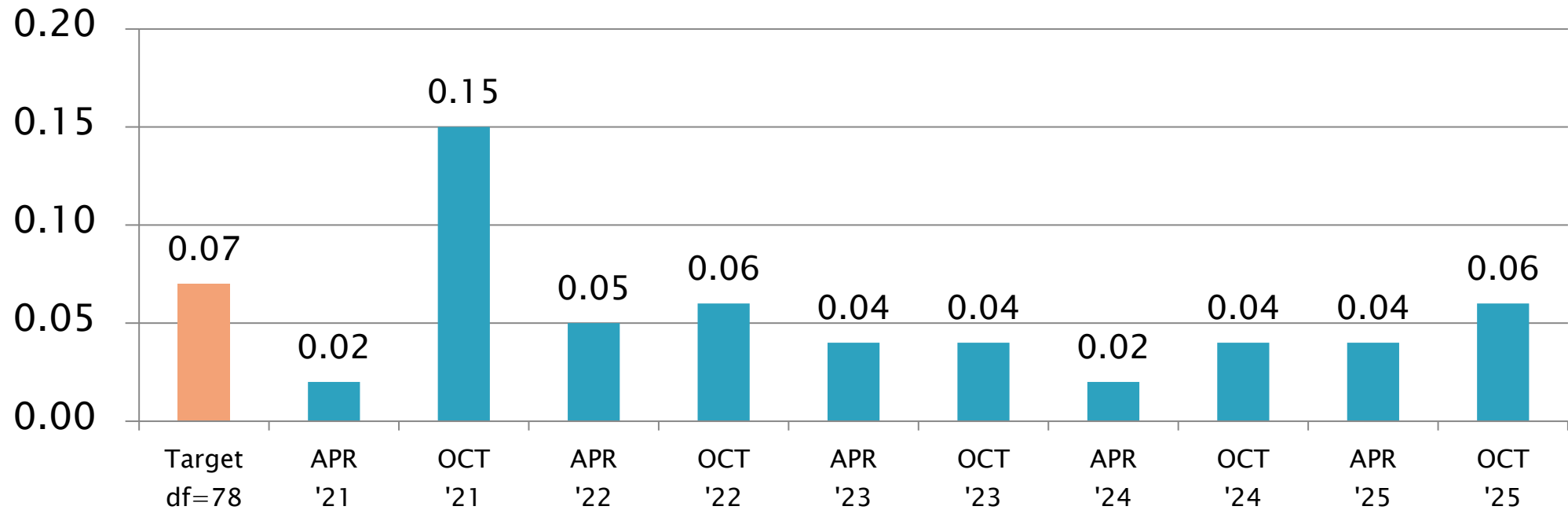
April 1, 2025 – September 30, 2025

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D874: Sulfated Ash

Sulfated Ash, mass%
Pooled s



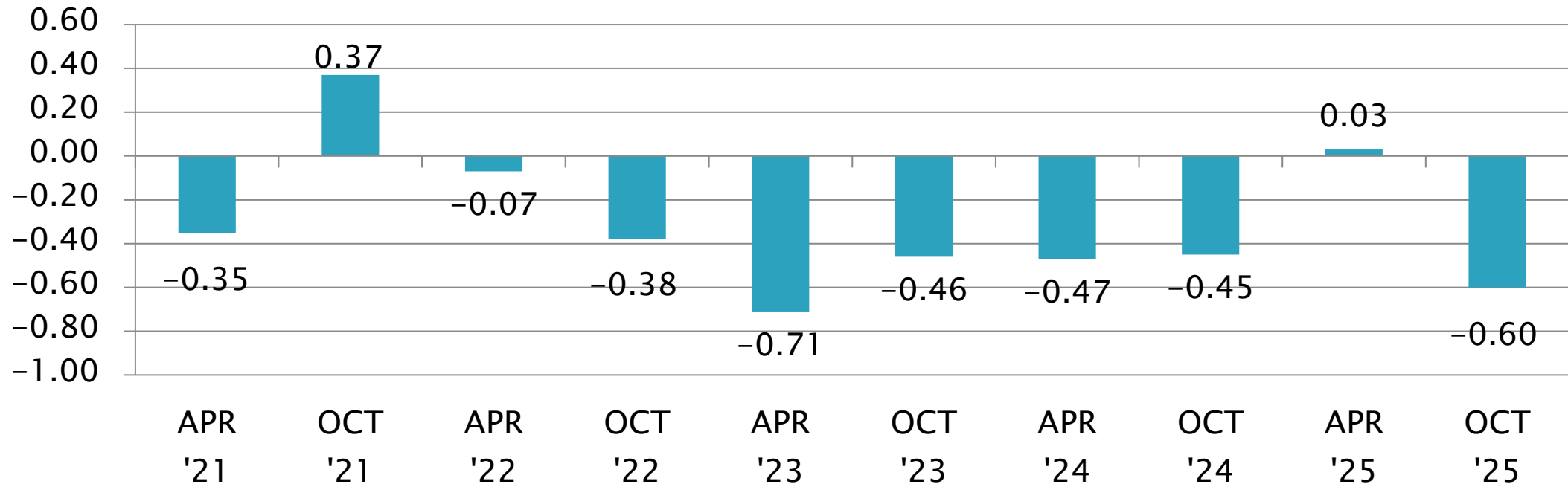
April 1, 2025 – September 30, 2025

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D874: Sulfated Ash

Sulfated Ash, mass%
Mean Δ/s



April 1, 2025 – September 30, 2025

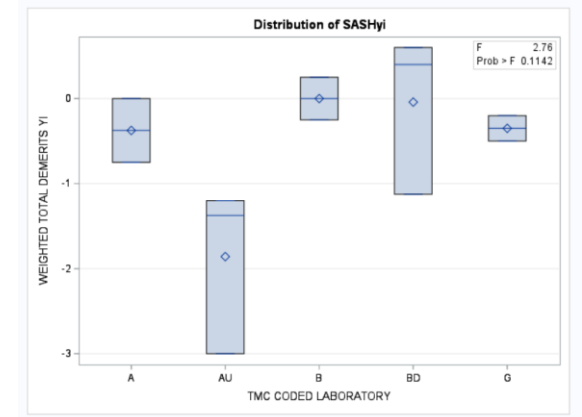
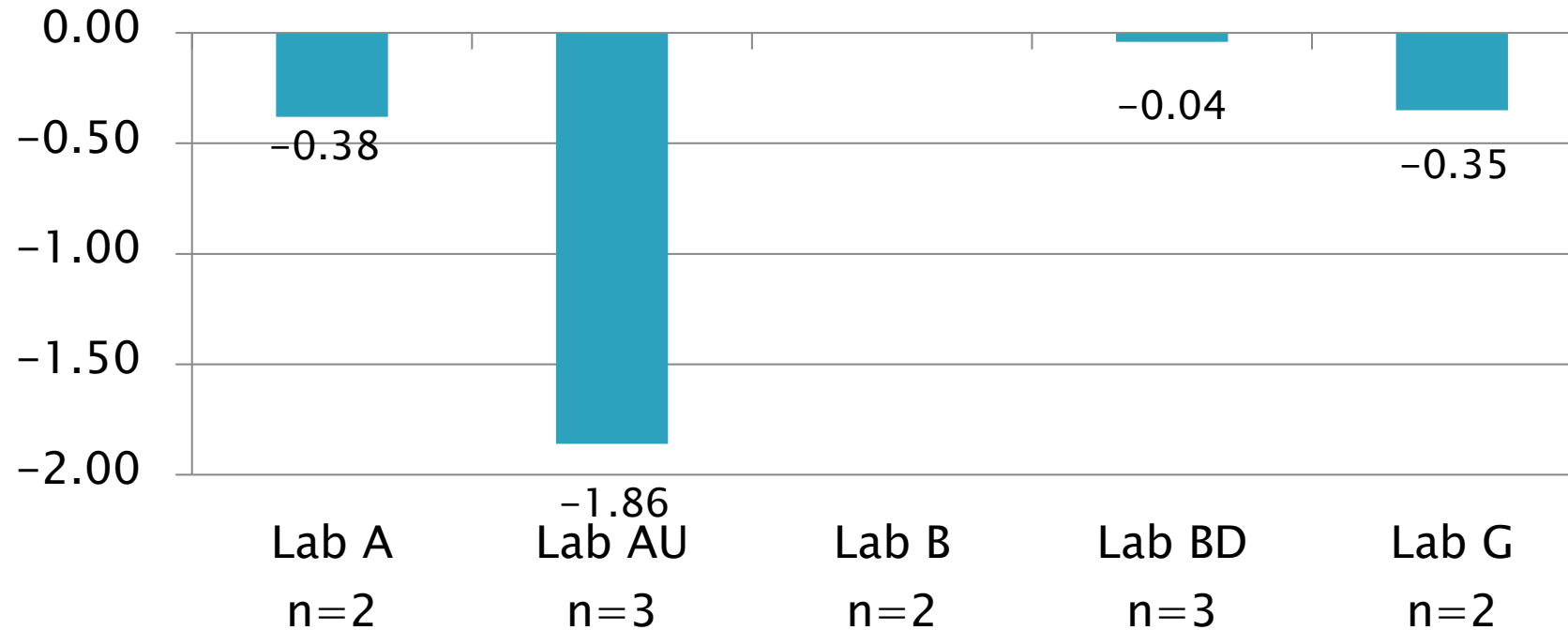
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D874: Sulfated Ash

Sulfated Ash, mass%

Mean Δ/s
0.00



April 1, 2025 – September 30, 2025

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D874 (Sulfated Ash) Status

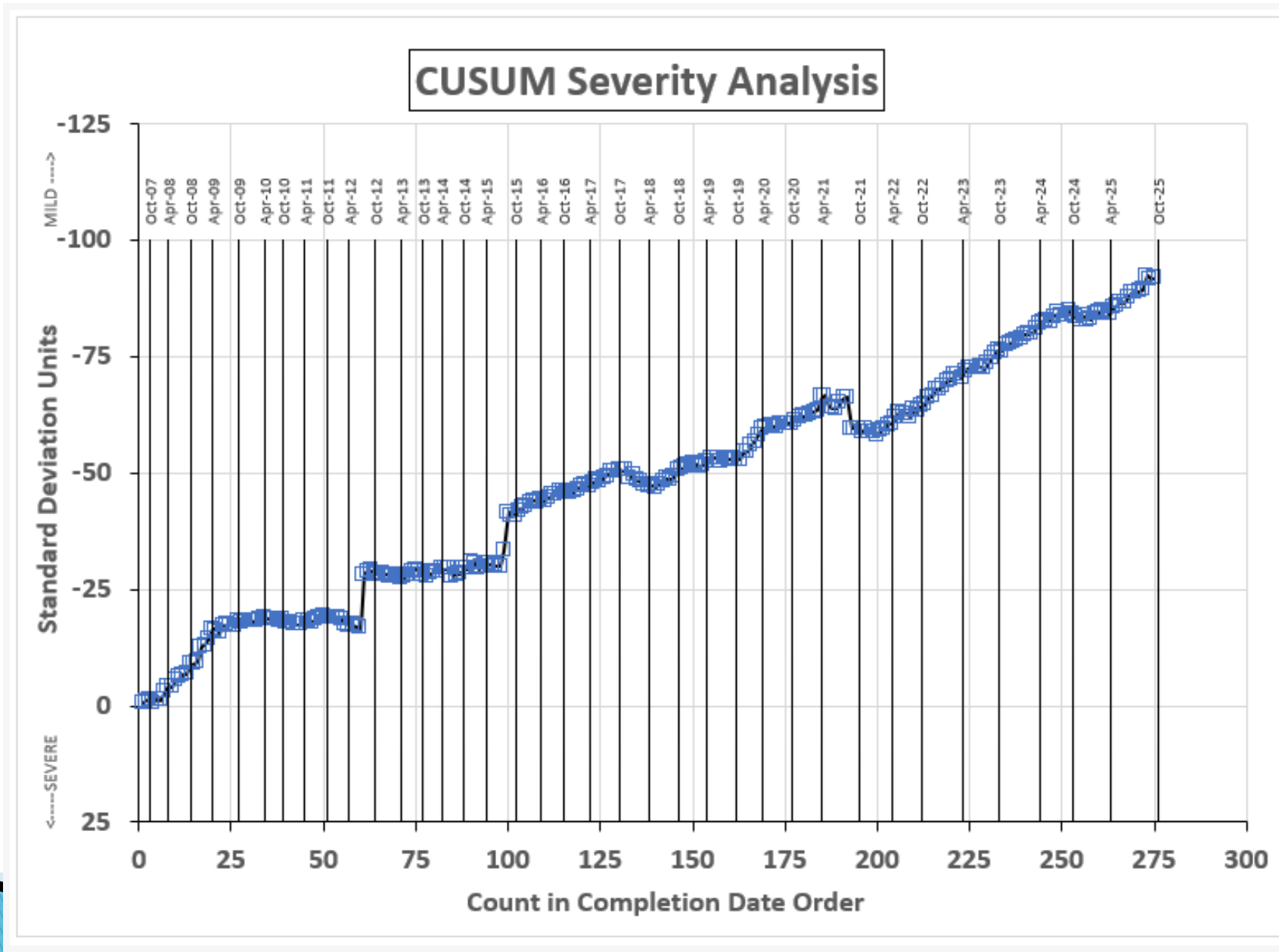
- ▶ Precision (Pooled s) regressed slightly to 0.06 this semester.
- ▶ Performance (Mean Δ/s) moved mild of target to -0.60 s.
- ▶ Labs with remaining Reference Oil 90 will be assigned until their supply is consumed (3 TESTKEYs total). TMC inventory of Reference Oil 90 is only used for fill requests for Daily QC.
- ▶ Reference Oil 92 still needs a few more runs before an update to the RO 92 targets can be made.

April 1, 2025 – September 30, 2025

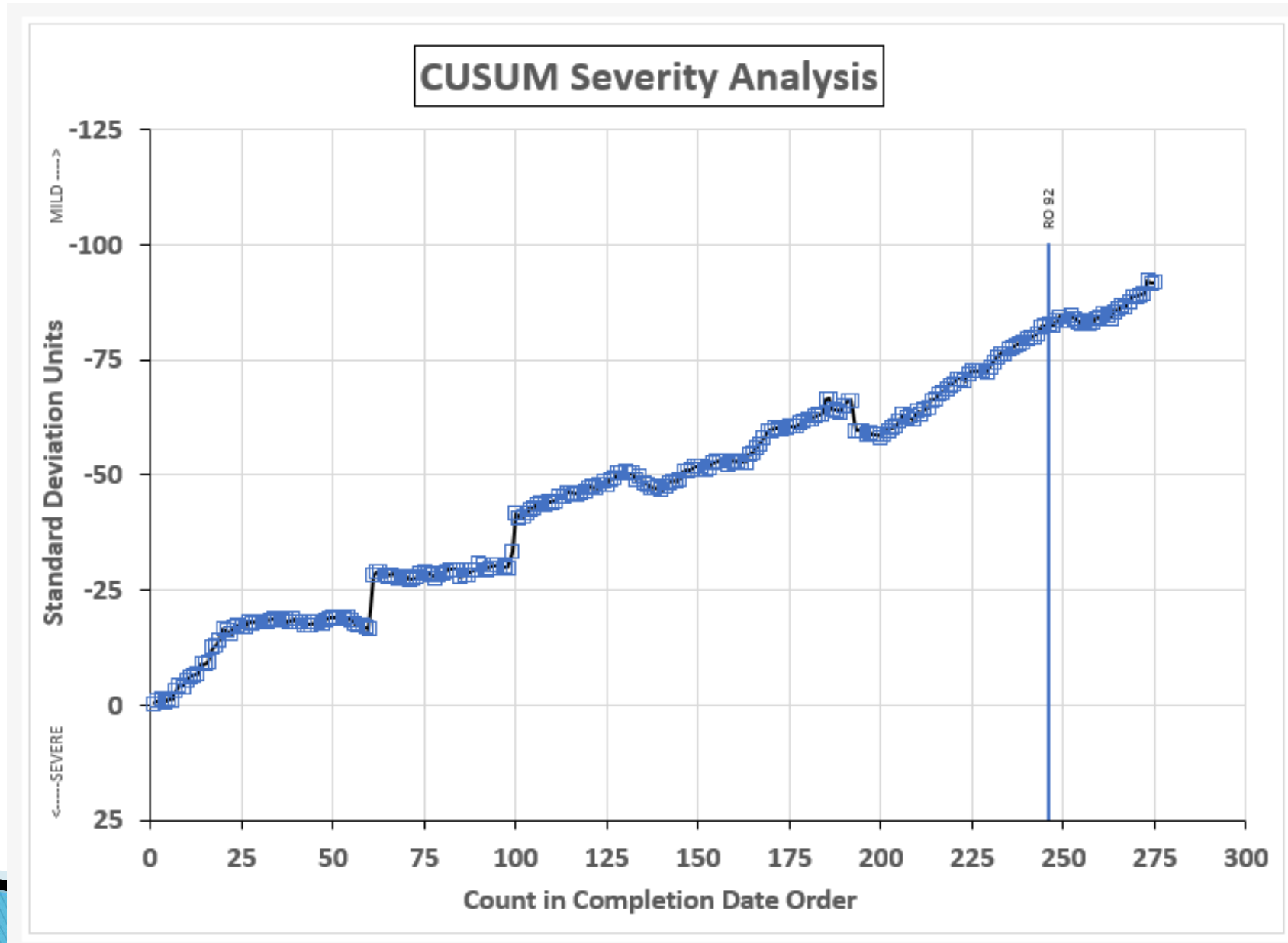
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TEST SAMPLE PERCENT SULFATED ASH

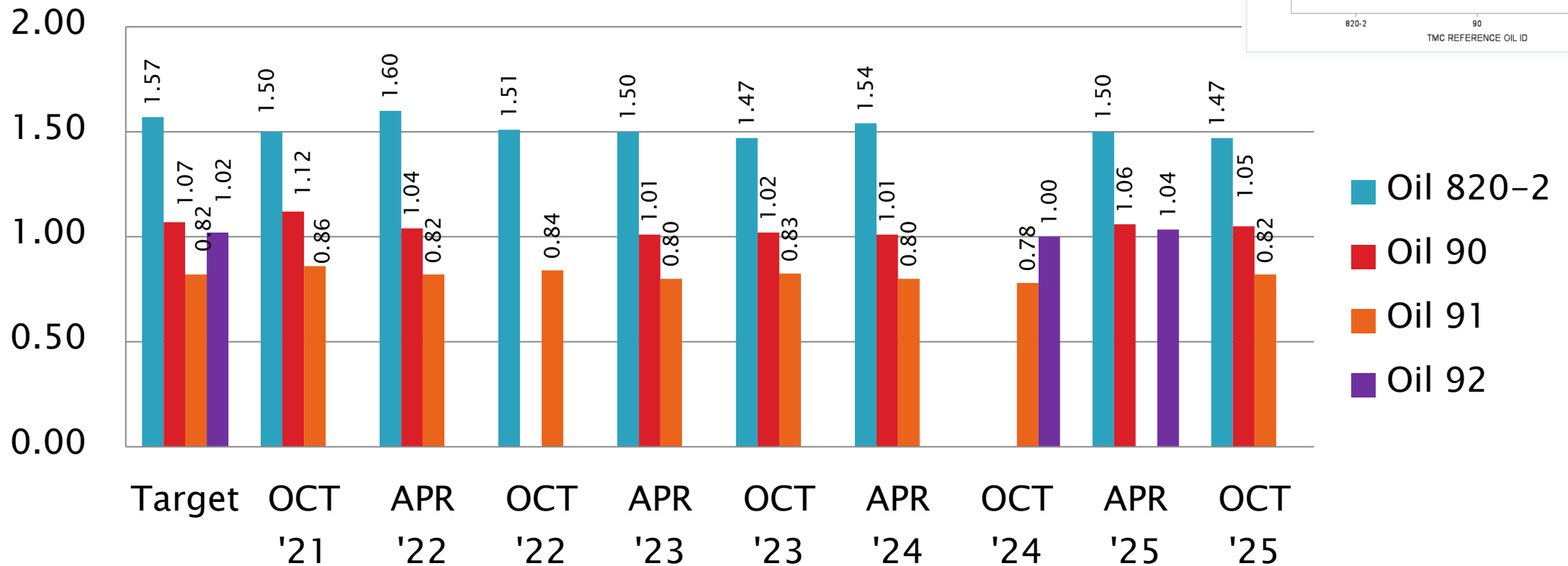
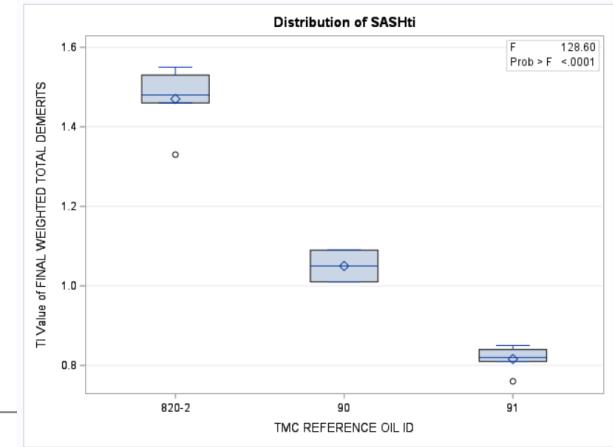


TEST SAMPLE PERCENT SULFATED ASH



D874: Sulfated Ash

Sulfated Ash, mass%
Mean



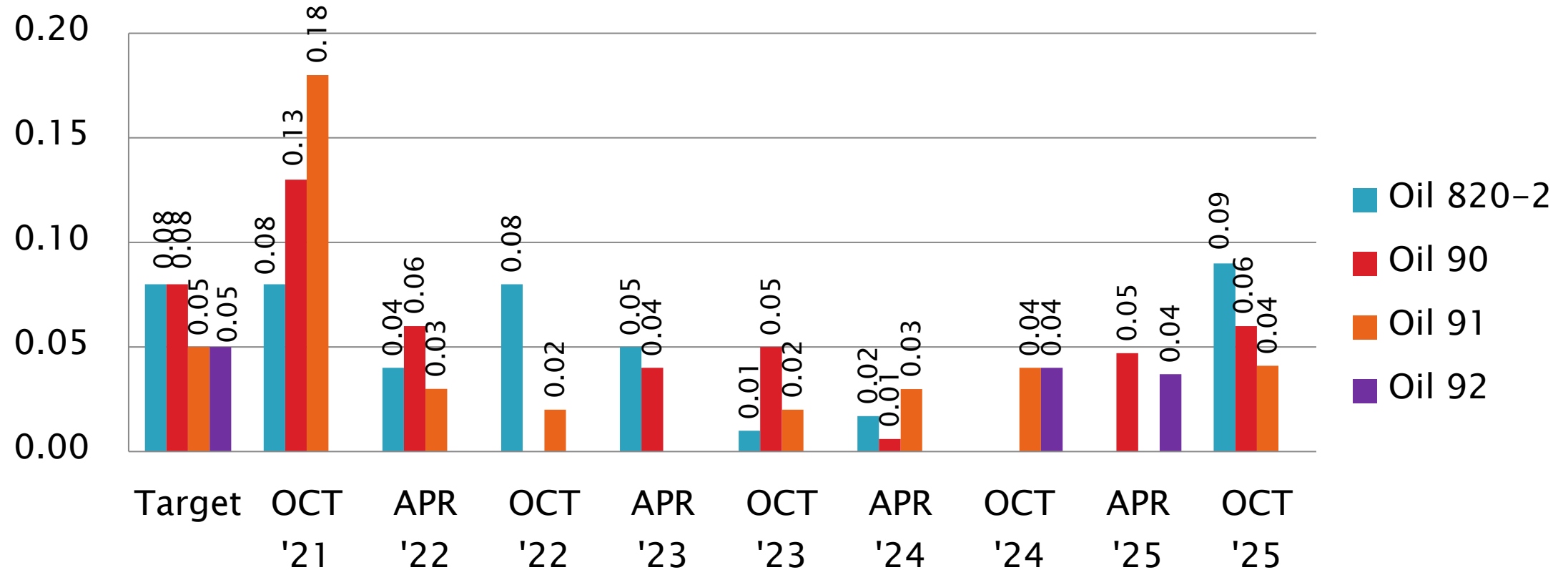
April 1, 2025 – September 30, 2025

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D874: Sulfated Ash

Sulfated Ash, mass%
Standard Deviation



April 1, 2025 – September 30, 2025

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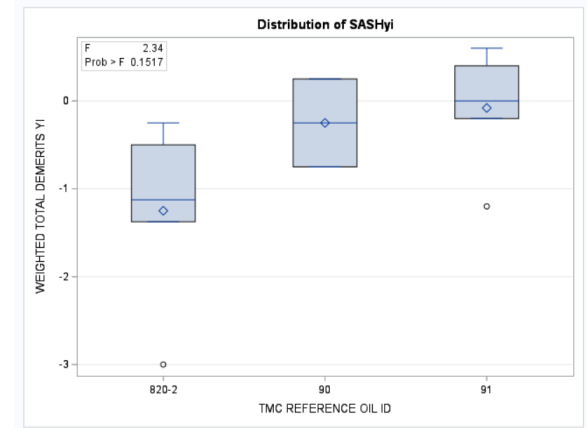
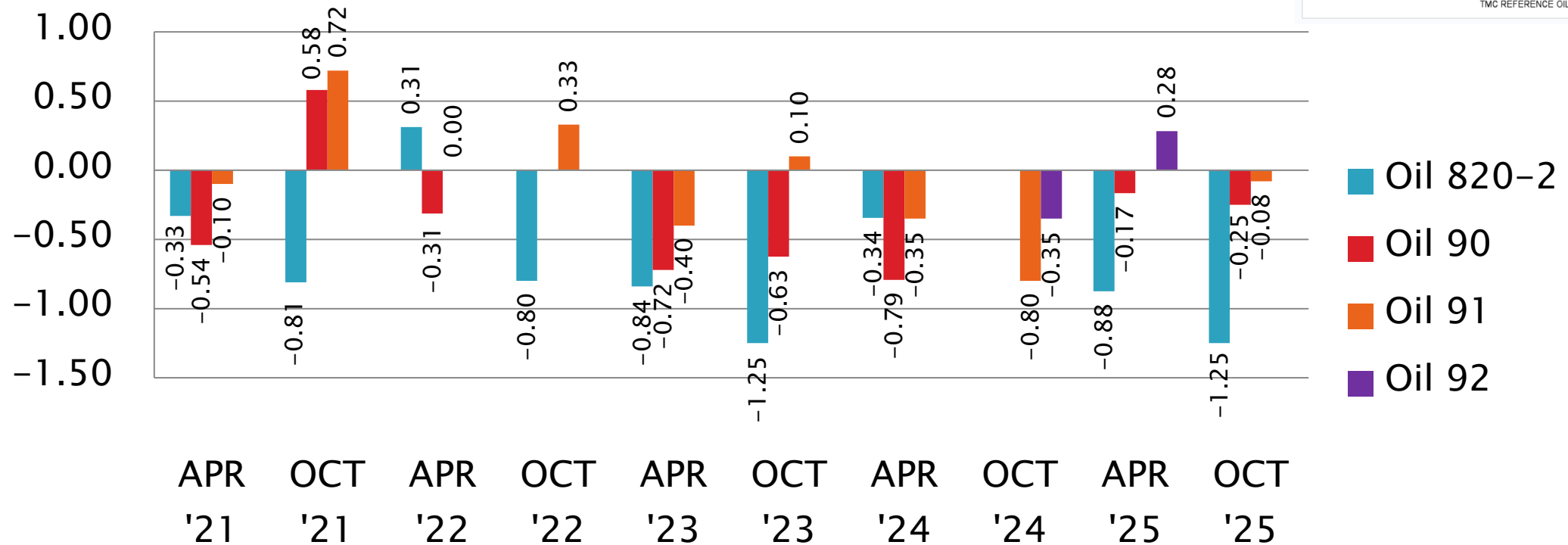


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D874: Sulfated Ash

Sulfated Ash, mass%

Mean Δ/s



[TABLE of CONTENTS](#)

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Reference Oil Inventory

D874

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
820-2	2001	D874	5.86	0.05	5+ years
90 ^B	2005	D874QC	0.9	1.3	< 6 months
91	2006	D874	2.86	0.04	5+ years
92	2020	D874	52.40	0.04	5+ years

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B TMC Inventory of Reference Oil 90 is now only used for D874QC Samples (1L sizes)

April 1, 2025 – September 30, 2025

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D02.B0.07

TMC Monitored Tests



ASTM D 5133

Gelation Index (GI)

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual Report)

Test	Labs	Stands
D5133	8 (-1)	44 (-2)
*As of 9/30/2025		

D5133: Gelation Index

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	49
Failed Calibration Test	OC	4
Operationally Invalidated by Lab	LC / LS / LN / XC / XS	1
Operationally Invalidated After Initially Reported as Valid	RC/RS	0
Acceptable Discrimination Tests	AS	19
Failed Discrimination Tests	OS	0
Informational Runs	NN / MN	0
Total		73

Number of Labs Reporting Data:	8	(previous 9)
Fail Rate of Operationally Valid Calibration Tests:	7.5%	(previous 10.1%)
Fail Rate of Operationally Valid Discrimination Tests:	0.0 %	(previous 8.3%)

April 1, 2025 – September 30, 2025

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D5133: Gelation Index

Statistically Unacceptable Calibration Tests (OC)	No. Of Tests
Gelation Index Severe	3
Gelation Index Mild	1
Total	4

- Of the FOUR “OC” tests
 - 4-1009
- One between -1.96 and -3.0 sd from target
- Three greater than $+3.0$ sd from target

April 1, 2025 – September 30, 2025

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D5133: Gelation Index

Statistically Unacceptable Discrimination Tests (OS)	No. Of Tests
Gelation Index Severe (> 7.2)	0
Total	0

- There were no Failing Discrimination Runs this Semester

April 1, 2025 – September 30, 2025

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D5133: Gelation Index

Tests Excluded From Statistics (Operationally or Otherwise)	Validity Code	No. Tests
Invalidated Runs	LC, LS, LN, RC, RS	0
Aborted Runs	XC, XS	1
Informational Runs (Acceptable Result)	NN	0
Informational Runs (Unacceptable Result)	MN	0
Total		1

- ONE Aborted Run due to Computer Failure

April 1, 2025 – September 30, 2025

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D5133: Gelation Index

Period Precision and Severity Estimates

Gelation Index	n	df	Pooled s	Mean Δ/s
Targets Updated 20201001 ¹	34	32	1.44	-----
4/1/20 through 9/30/20	52	48	2.23	-0.11
10/1/20 through 3/31/21 ²	116	113	3.74	-0.86
4/1/21 through 9/30/21	75	73	1.71	-0.20
10/1/21 through 3/31/22	61	59	1.55	-0.84
4/1/22 through 9/30/22	57	55	1.28	-0.41
10/1/22 through 3/31/23	84	80	3.83	-0.08
4/1/23 through 9/30/23	62	59	1.34	-0.21
10/1/23 through 3/31/24	57	54	1.64	-0.03
4/1/24 through 9/30/24	62	59	2.09	-0.92
10/1/24 through 3/31/25	69	66	1.81	-0.25
4/1/25 through 9/30/25	53	50	1.42	-0.04

¹Target precision based upon GIA17 and 1009 reference oils 10/1/2020

²Changed from bath to head-based monitoring scheme 10/1/2020

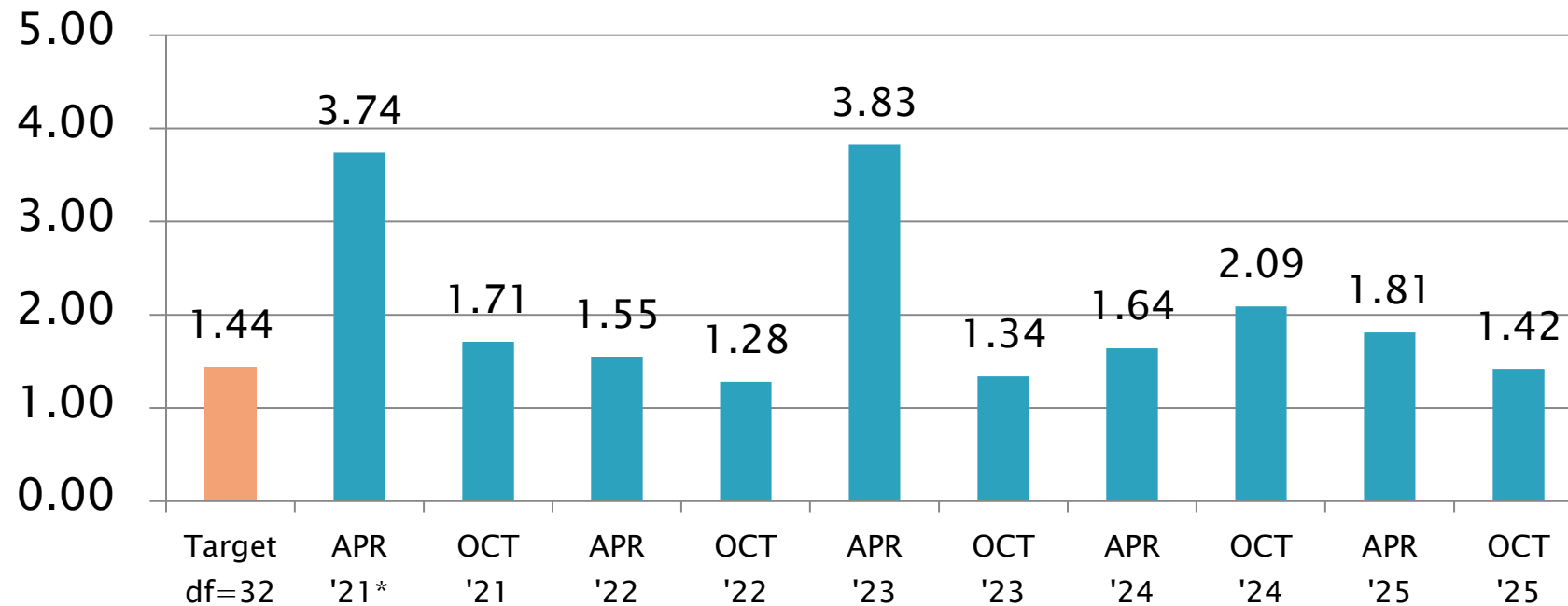
April 1, 2025 – September 30, 2025

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D5133 Precision Estimates

Gelation Index Pooled s



*Changed from bath to head-based monitoring scheme

April 1, 2025 – September 30, 2025

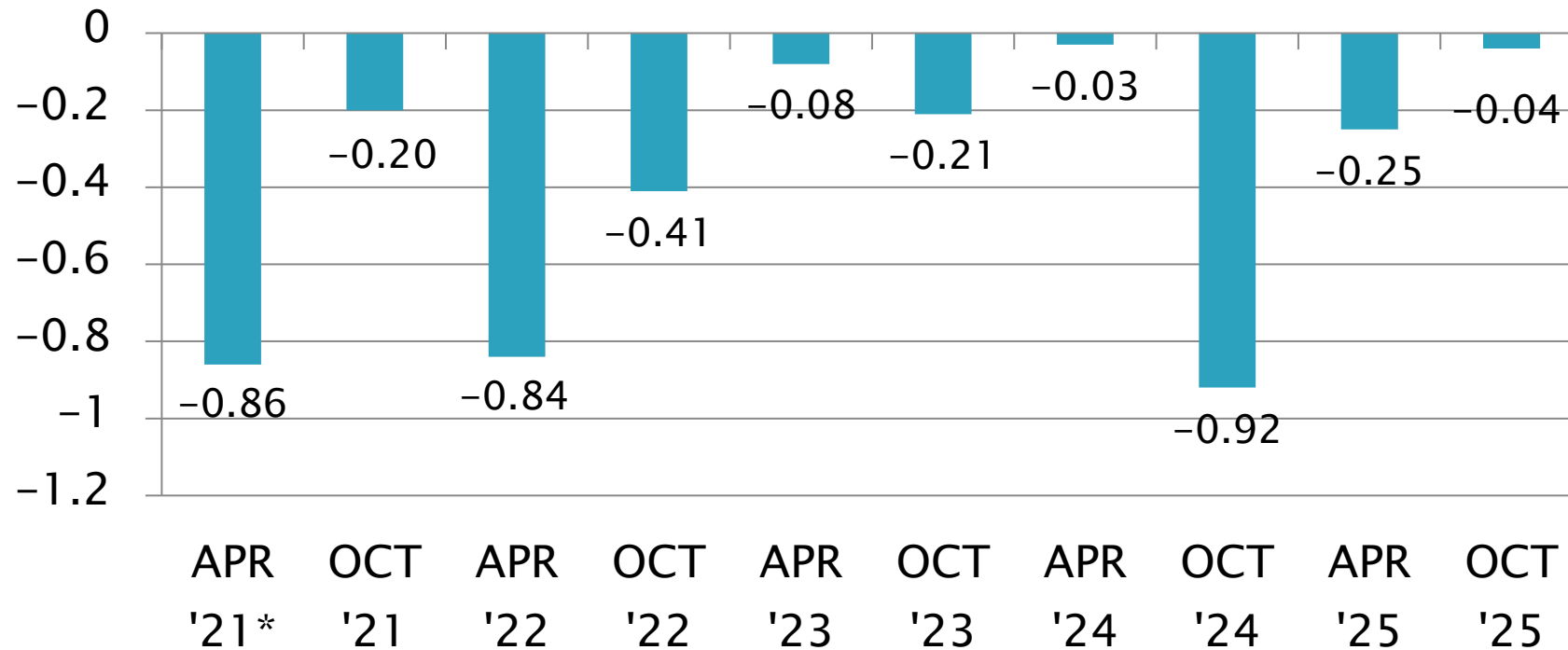
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D5133 Severity Estimates

Gelation Index

Mean Δ/s



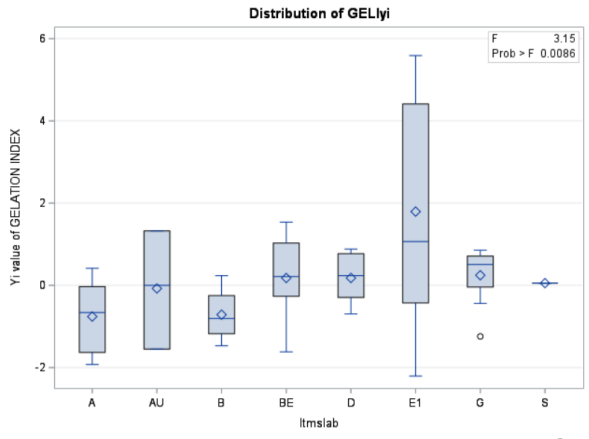
*Changed from bath to head-based monitoring scheme

April 1, 2025 – September 30, 2025

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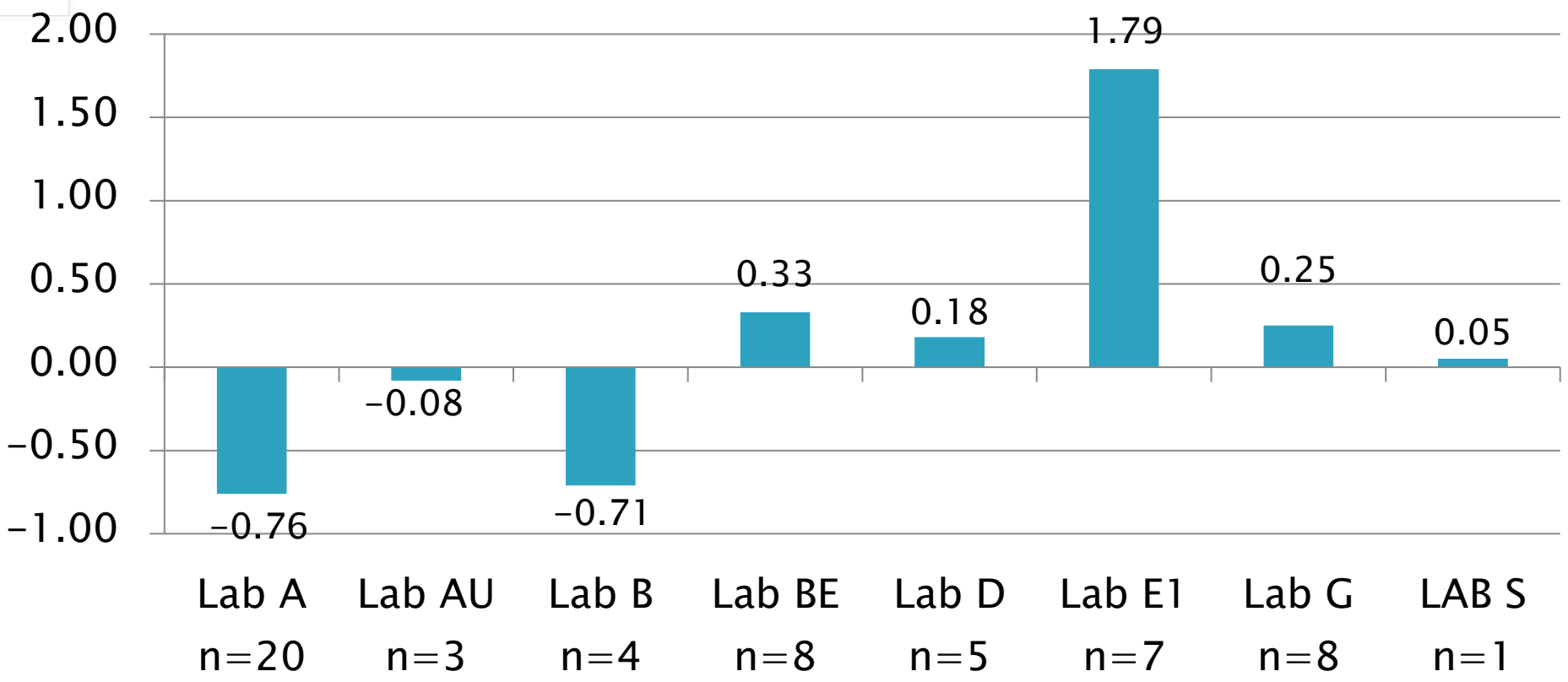


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D5133 Lab Severity Estimates

Gelation Index
Mean Δ/s



April 1, 2025 - September 30, 2025

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D5133: Gelation Index Test Status

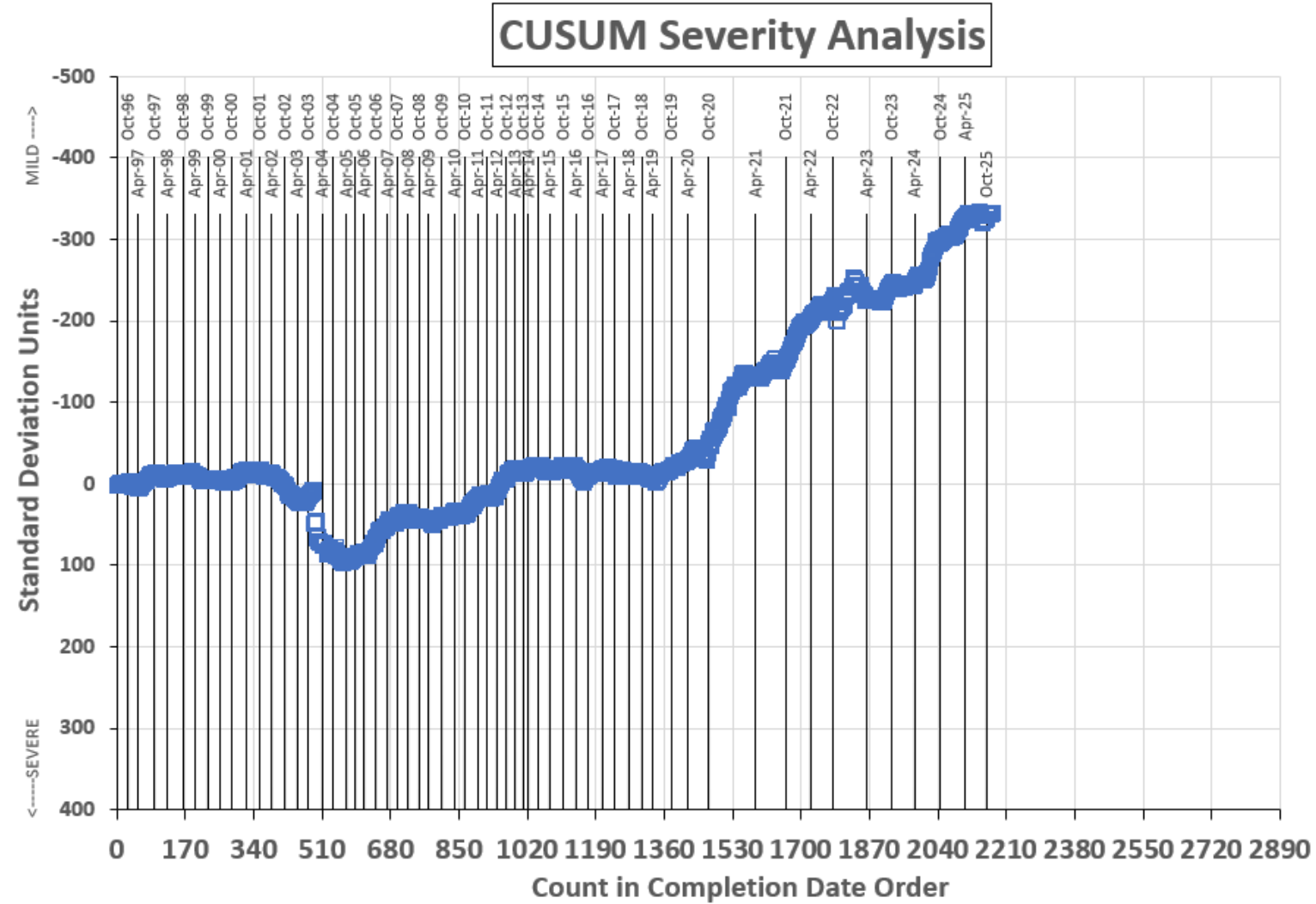
- Fail rate of operationally valid tests dropped again this semester falling to 7.5%
 - Fail rate last period was 10.1%
- No operationally valid discrimination runs failed this period
 - THREE (3) discrimination runs failed last period
- Precision (Pooled s) was 1.42, moving closer to target (1.44).
- Performance (Mean Δ/s) improved to -0.04 s showing that the testing is running on-target.

April 1, 2025 – September 30, 2025

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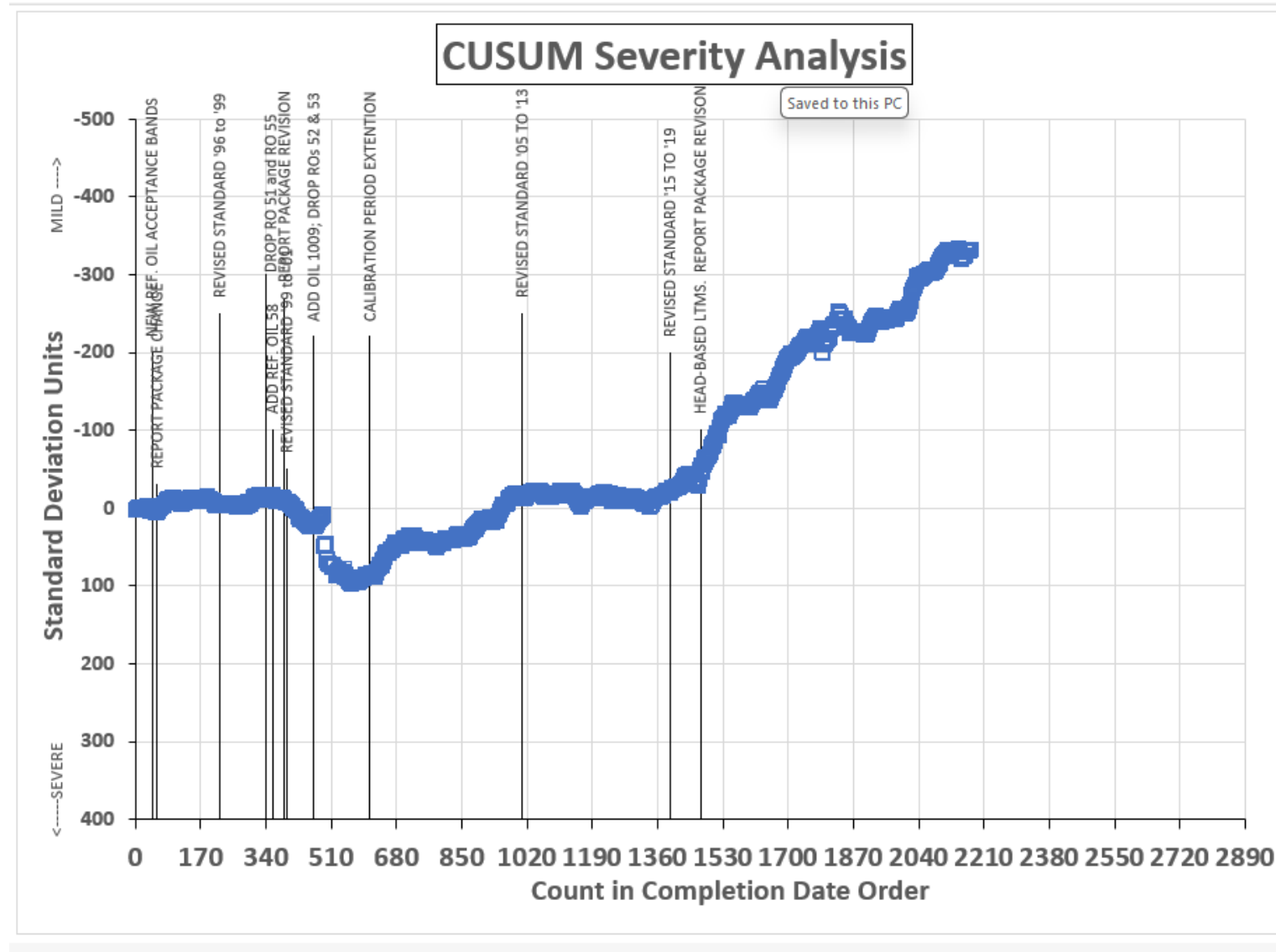


GELATION INDEX



April 1, 2025 – September 30, 2025

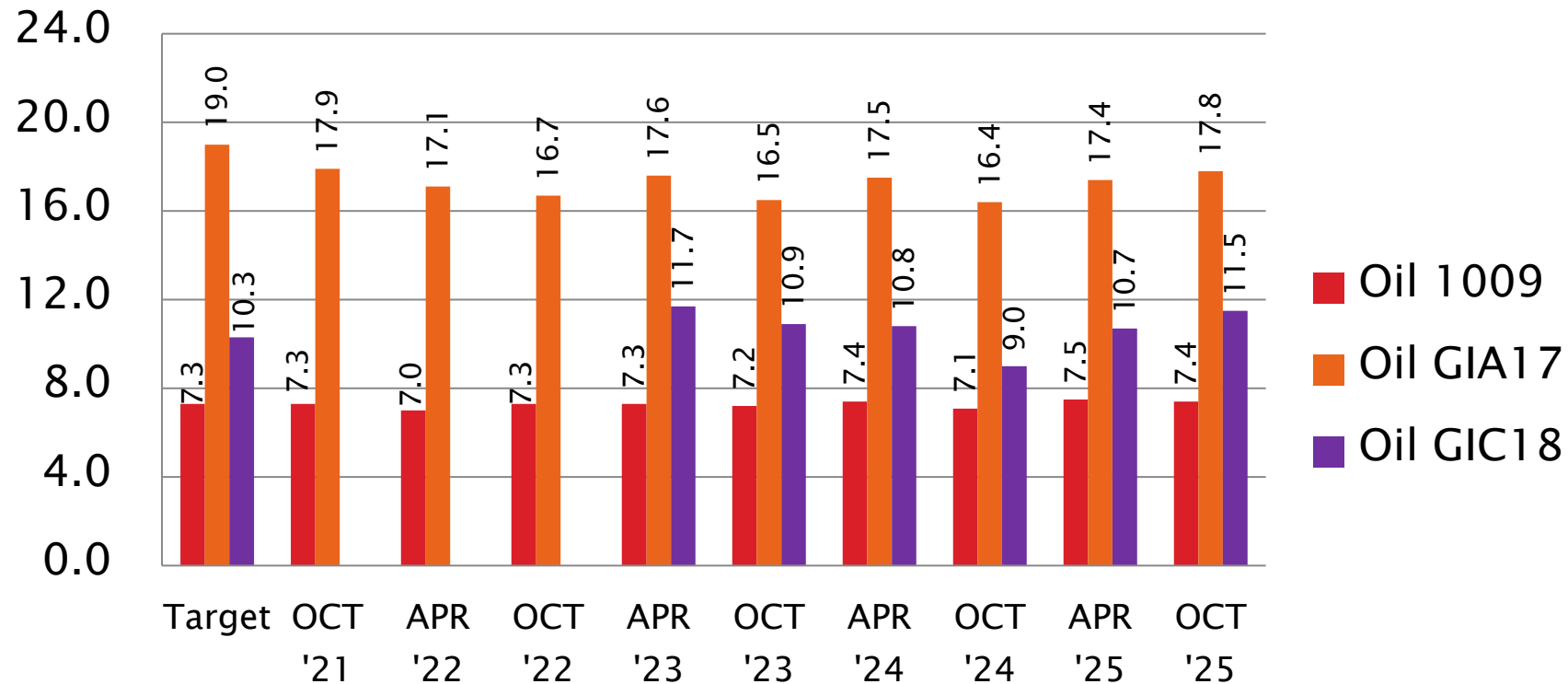
GELATION INDEX



April 1, 2025 – September 30, 2025

D5133 Performance by Oil

Gelation Index
Mean

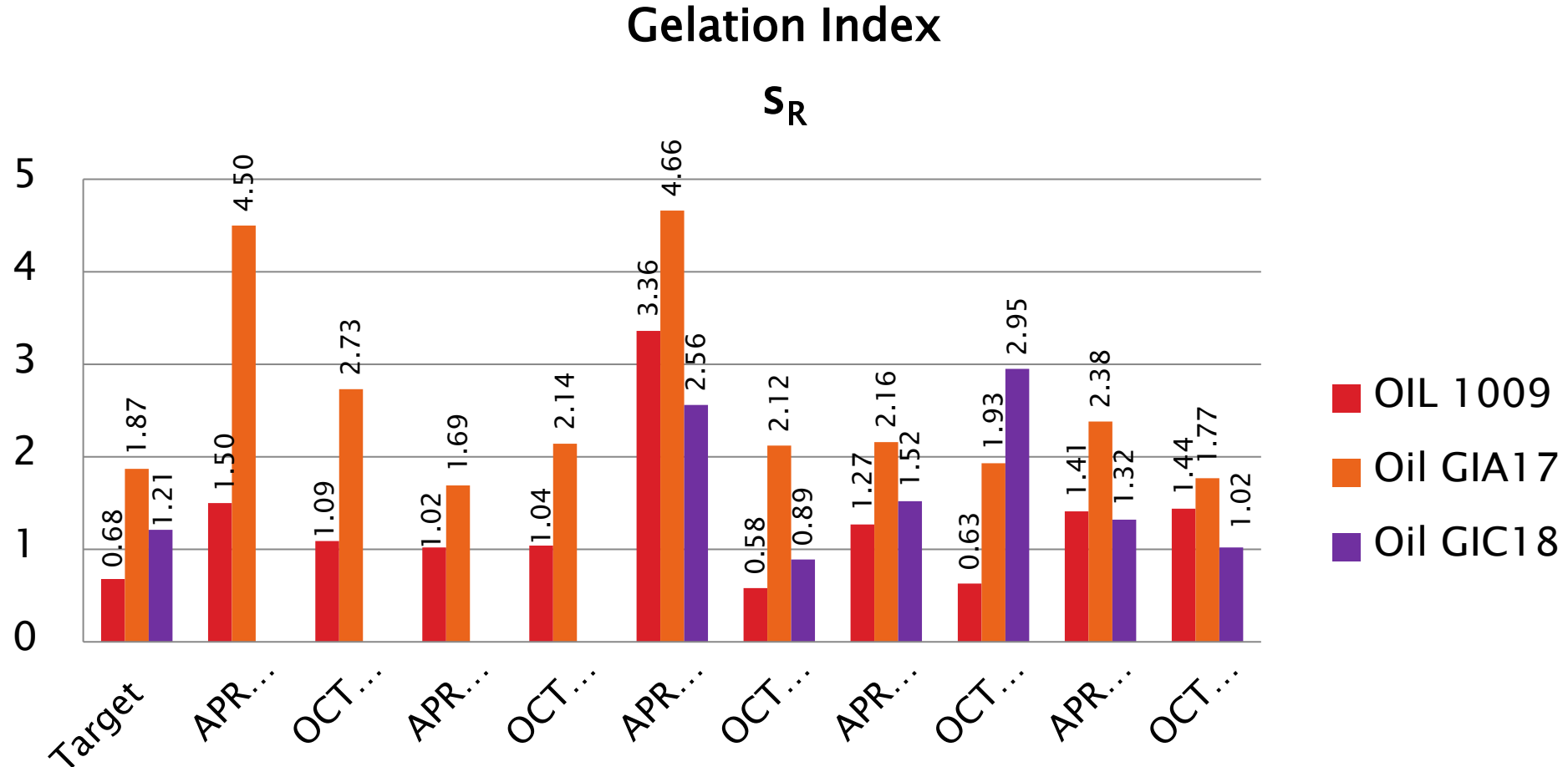


April 1, 2025 – September 30, 2025

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D5133 Performance by Oil

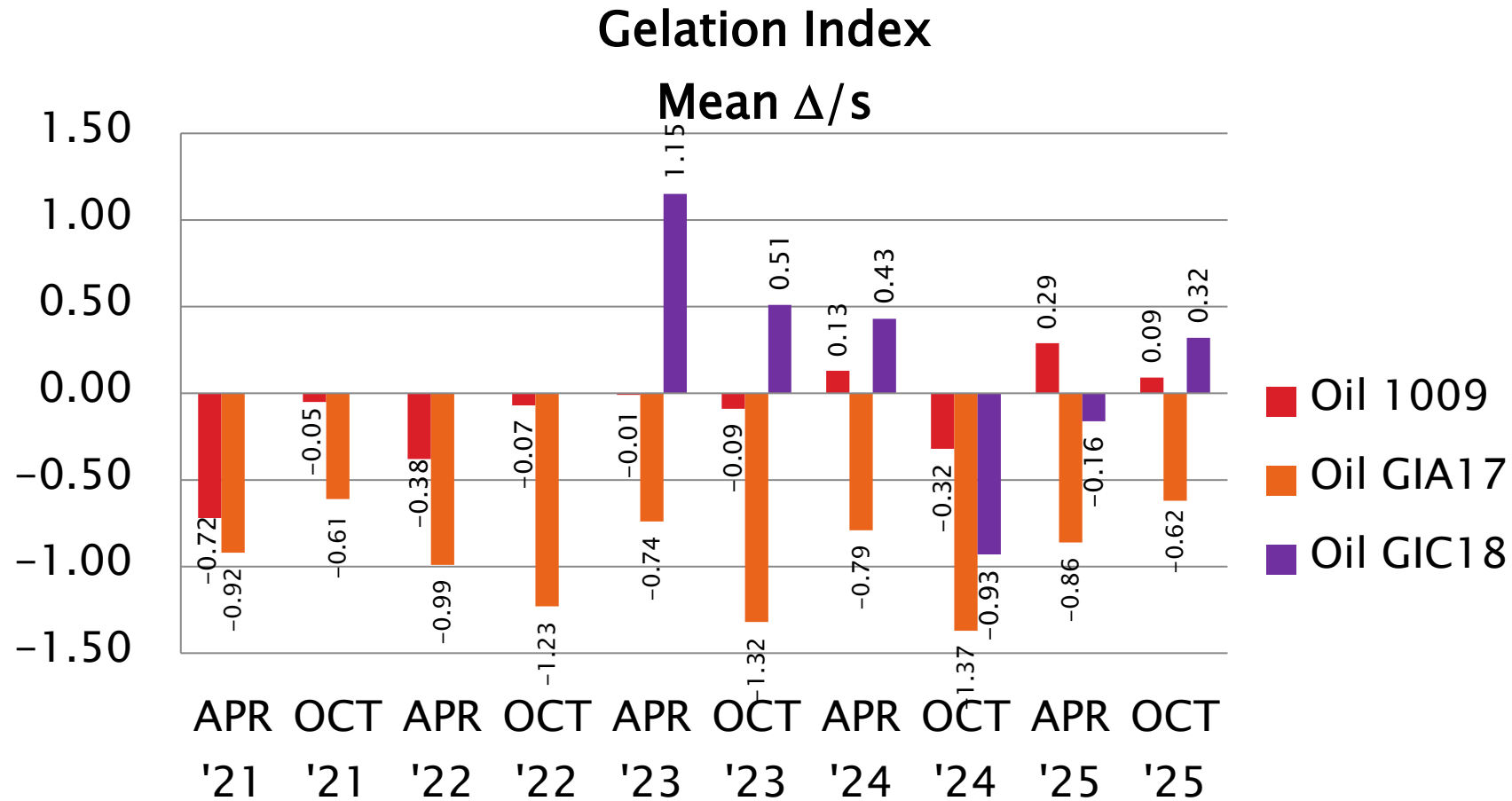


April 1, 2025 – September 30, 2025

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D5133 Performance by Oil



April 1, 2025 – September 30, 2025

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ASTM D5133 (GI): APR2025 – SEP2025 Results

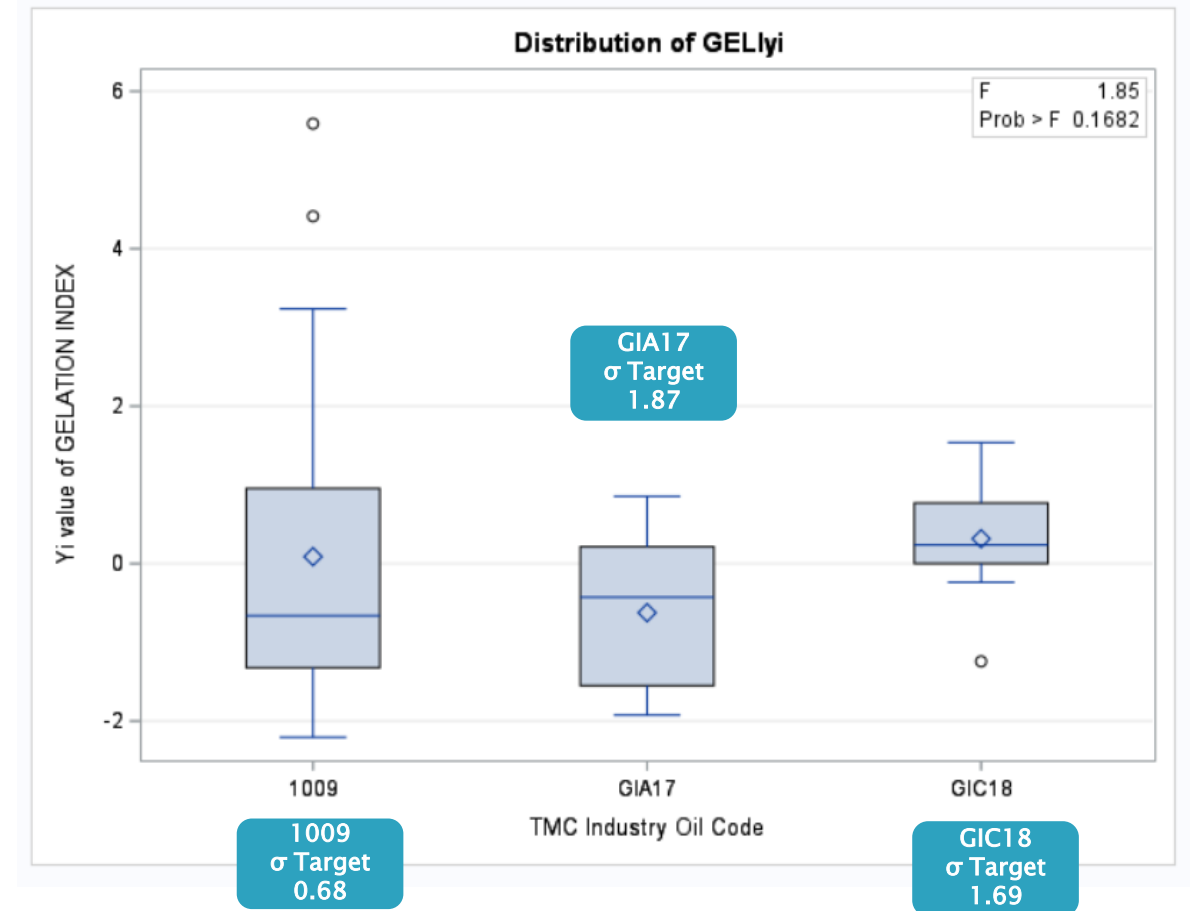
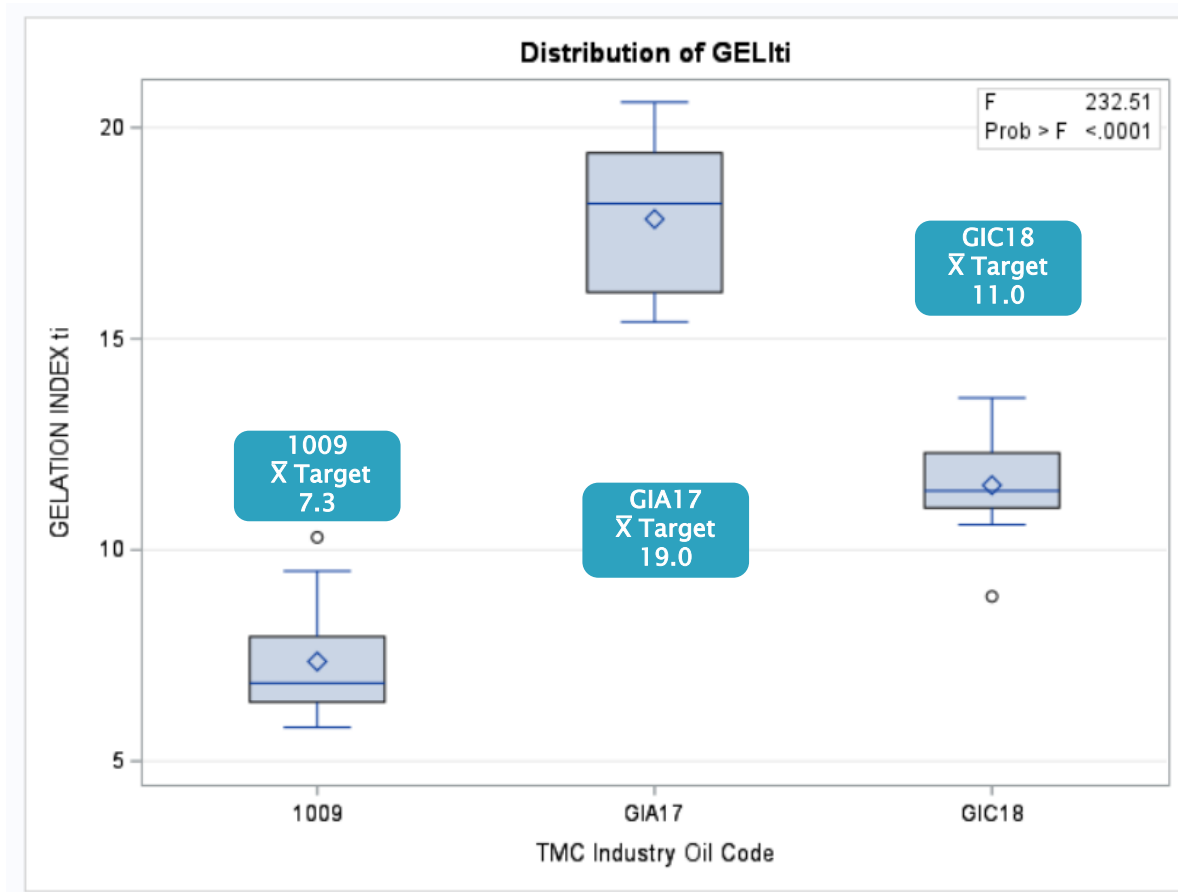


TABLE of CONTENTS

Test Monitoring Center
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Reference Oil Inventory

GI (D5133)

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
58 ^B	1998	GI	111.3	0.20	5+ years
GIA17	2017	GI	5.00	0.15	5+ years
GIC18	2018	GI	7.67	0.15	5+ years
1009	2002	GI	33.1	0.2	5+ years

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B Reference Oil 58 is used in multiple Bench Test Areas and is the Discrimination Oil in D5133 (GI)

April 1, 2025 – September 30, 2025

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D02.B0.07

TMC Monitored Tests



ASTM D 5800

NOACK Volatility

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual Report)

Test	Labs	Stands
D5800	14 (+0)	40 (+1)
*Between 4/1/2025 and 9/30/2025		

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	185
Failed Calibration Test	OC	8
Operationally Invalidated by LAB	LC	6
Operationally Invalidated by TMC	RC	0
Aborted Test	XC	0
Acceptable Shakedown Run	NN	0
Unacceptable Shakedown Run	MN	1
Total		200

Number of Labs Reporting Data: 14
Fail Rate of Operationally Valid Tests: 4.00% (last Semester 4.86%)

April 1, 2025 – September 30, 2025

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D5800: Evaporation Loss of Lubricating Oil by Noack Method

Statistically Unacceptable Tests (OC)	No. Of Tests
Ei Level 3 Alarm Mild	2
Ei Level 3 Alarm Severe	3
Zi Level 2 Alarm Severe	1
Zi Level 2 Alarm Mild	0
Zi Level 2 and Ei Level 3 Alarms, Mild	2
Zi Level 2 and Ei level 3 Alarms, SEVERE	0

- EIGHT OC tests were on SIX different rigs at SIX different labs.
- THREE operationally valid tests exceeded ± 3.0 s this period.

April 1, 2025 – September 30, 2025

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D5800: Evaporation Loss of Lubricating Oil by Noack Method

Failed (OC) Details	Procedure	Model	No. Tests
Ei Level 3 Alarm: Rig (AZ-4) Mild, too imprecise to predict SA	B	NCK25G	1
Ei Level 3 Alarm: Rig (AY-2) Mild, too imprecise to predict SA	B	NCK25G	1
Zi Level 2 Alarm: Rig (Au-2) Severe	B	NCK25G	1
Zi Level 2 (Mild) and Ei Level 3 (Mild) Alarms: Rig (D-6)	D	NS2	2
Ei Level 3 Alarm: Rig (BD-5) Severe, too imprecise to predict SA	D	NS2	2
Ei Level 3 Alarm: Rig (E1-3) Severe, too imprecise to predict SA	B	NCK25G	1
Total			8
Fail Rate of Operationally Valid Tests: 4.00%			

April 1, 2025 – September 30, 2025

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D5800: Evaporation Loss of Lubricating Oil by Noack Method

Operationally Invalid Tests (LC, RC)

Two labs had invalidated calibration runs this period

- One test was invalidated by Lab due to DAILY QC Out of Range (LC)
- Three tests were invalidated by Lab due to use of wrong oil or wrong test unit (LC)
- Two tests were invalidated by Lab due to not running DAILY QC test (LC)

Informational, Non-Blind Tests (NN,MN)

One lab ran an informational (Non-Blind) Test

- Informational Test Result was Out of Range (MN)

April 1, 2025 – September 30, 2025

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D5800: Evaporation Loss of Lubricating Oil by Noack Method

D5800 Technical Memos

No D5800 technical memos were issued by the TMC this period.

April 1, 2025 – September 30, 2025

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D5800: Evaporation Loss of Lubricating Oil by Noack Method

Period Precision and Severity Estimates

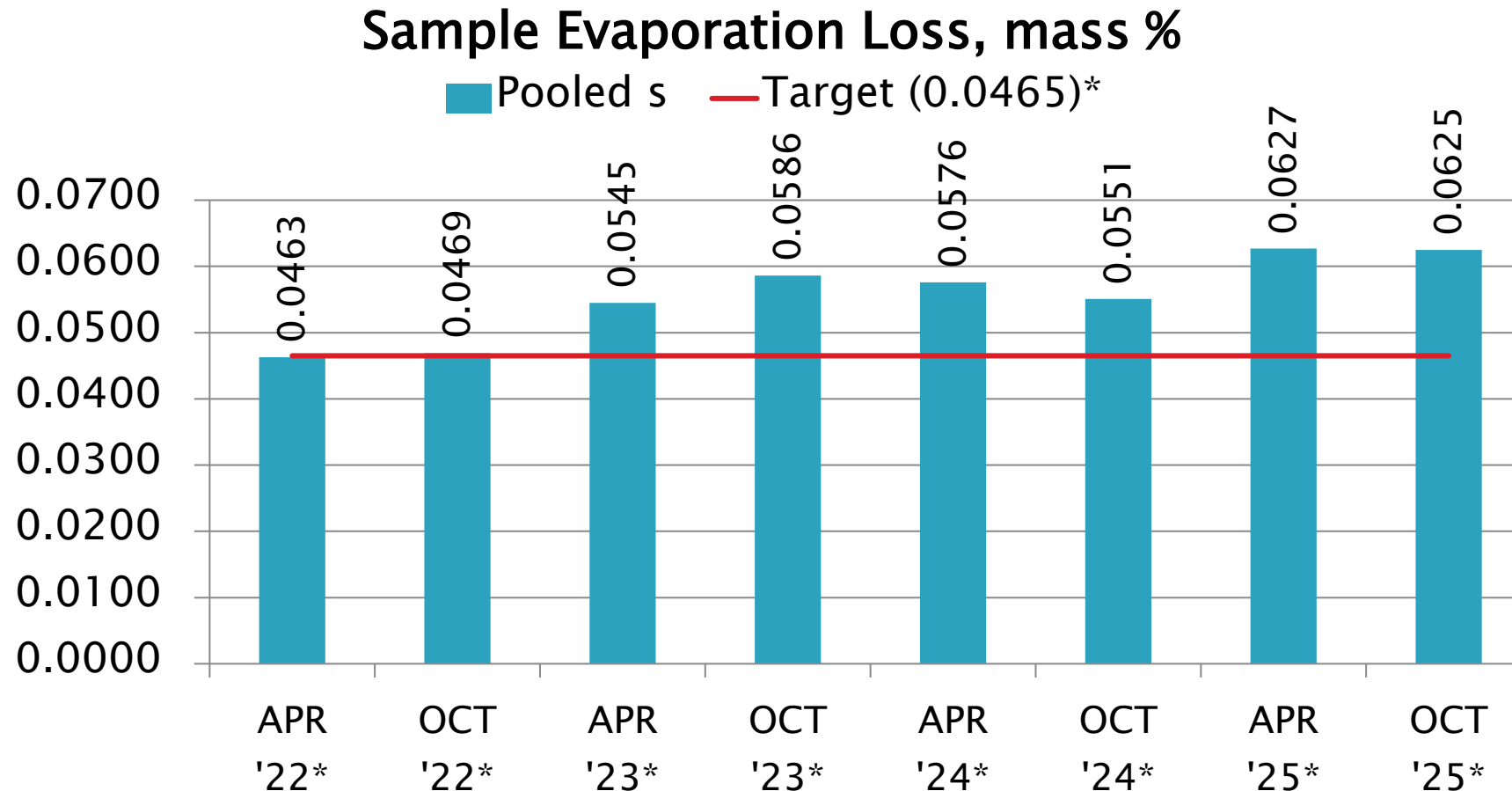
Sample Evaporation Loss, mass %	n	df	Pooled s	Mean Δ/s
Targets Effective 02/07/20 ¹	78	75	0.0465	-----
10/1/20 through 3/31/21 ¹	140	137	0.0495	0.53
4/1/21 through 9/30/21 ¹	136	133	0.0510	0.45
10/1/21 through 3/31/22 ¹	139	136	0.0463	0.24
4/1/22 through 9/30/22 ¹	136	133	0.0469	-0.10
10/1/2022 through 3/31/23 ¹	136	133	0.0545	-0.15
4/1/2023 through 9/30/23 ¹	169	166	0.0586	0.33
10/1/2023 through 3/31/24 ¹	174	171	0.0576	0.37
4/1/2024 through 9/30/24 ¹	189	187	0.0551	0.23
10/1/2024 through 3/31/25 ¹	186	183	0.0627	0.21
4/1/2025 through 9/30/25 ¹	193	190	0.0625	0.37
¹ Began monitoring natural log transformed test results on 20200207 making logarithmic scale changes for target and period precision estimates starting April 2020 report period				

April 1, 2025 – September 30, 2025

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D5800 Precision Estimates



*Began monitoring natural log transformed test results on 20200207 making logarithmic scale changes for target and period precision estimates starting April 2020 report period.

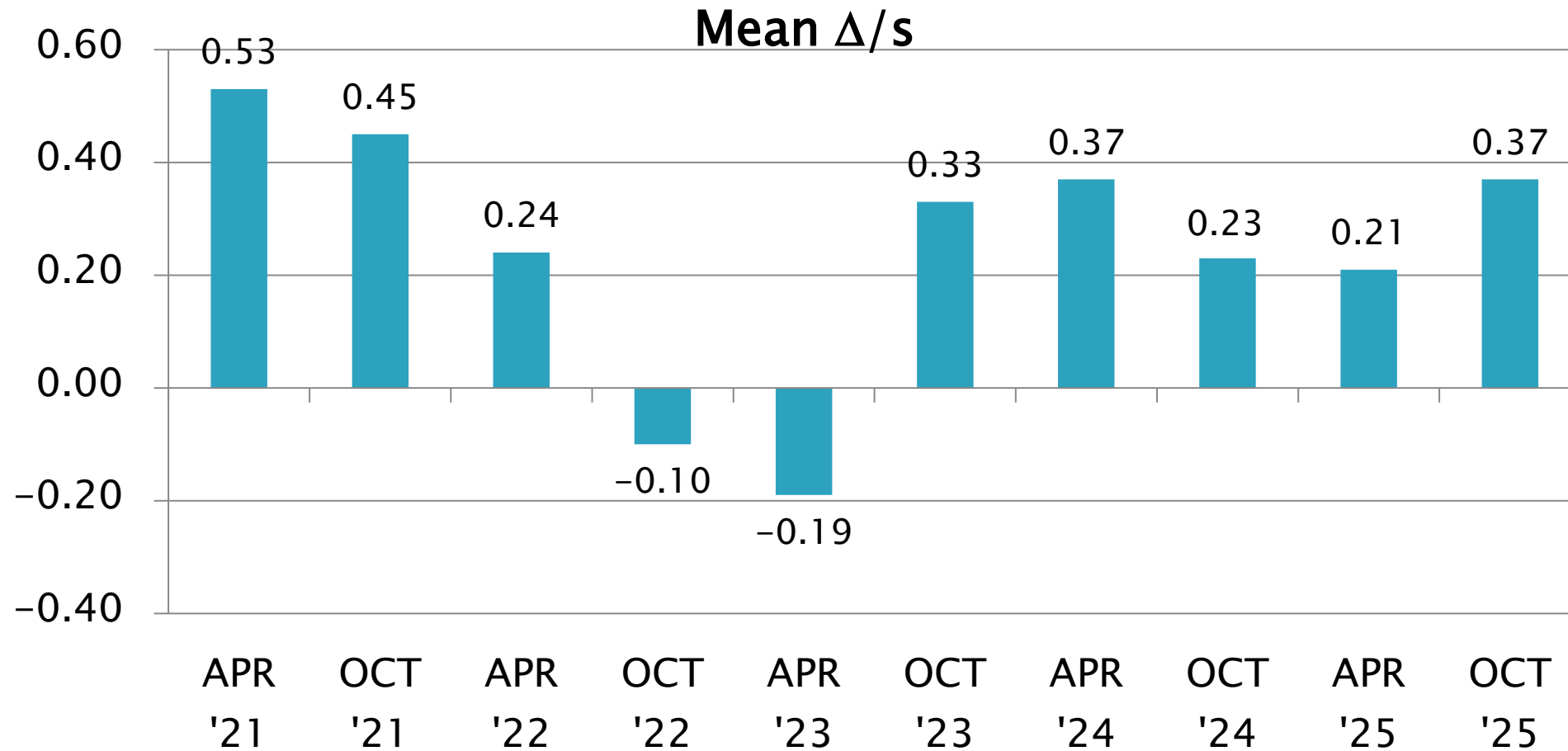
April 1, 2025 – September 30, 2025

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



D5800 Severity Estimates

Sample Evaporation Loss, mass %



April 1, 2025 – September 30, 2025

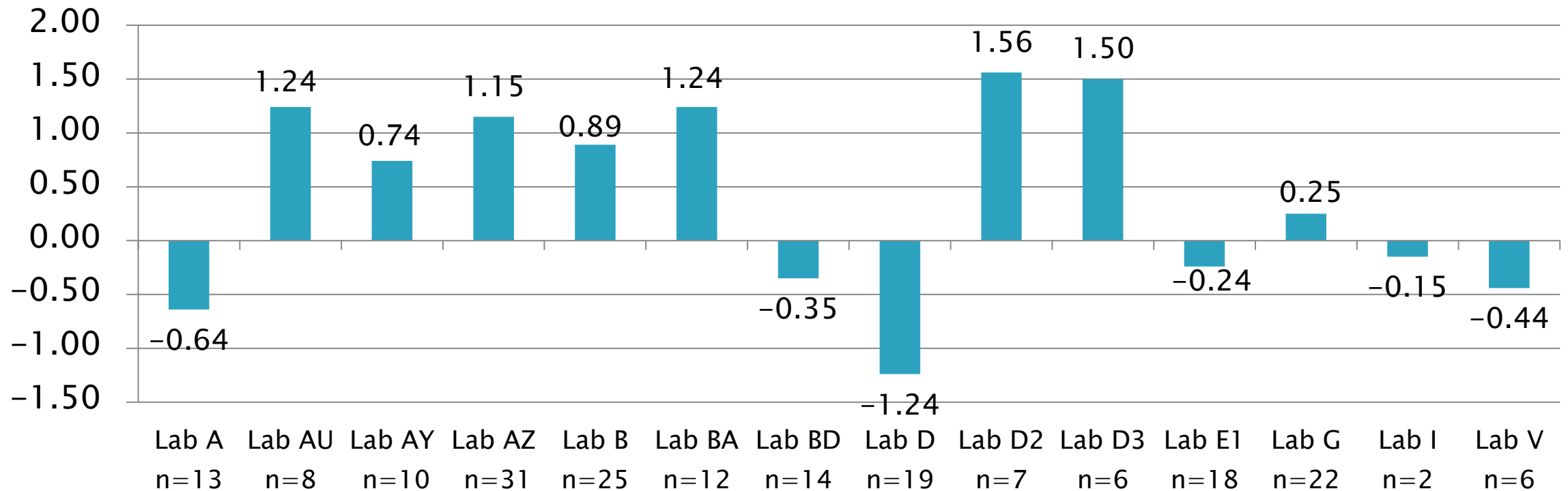
Test Monitoring Center
<https://www.astmtmc.org>



D5800 Lab Severity Estimates

Sample Evaporation Loss, mass %

Mean Δ/s



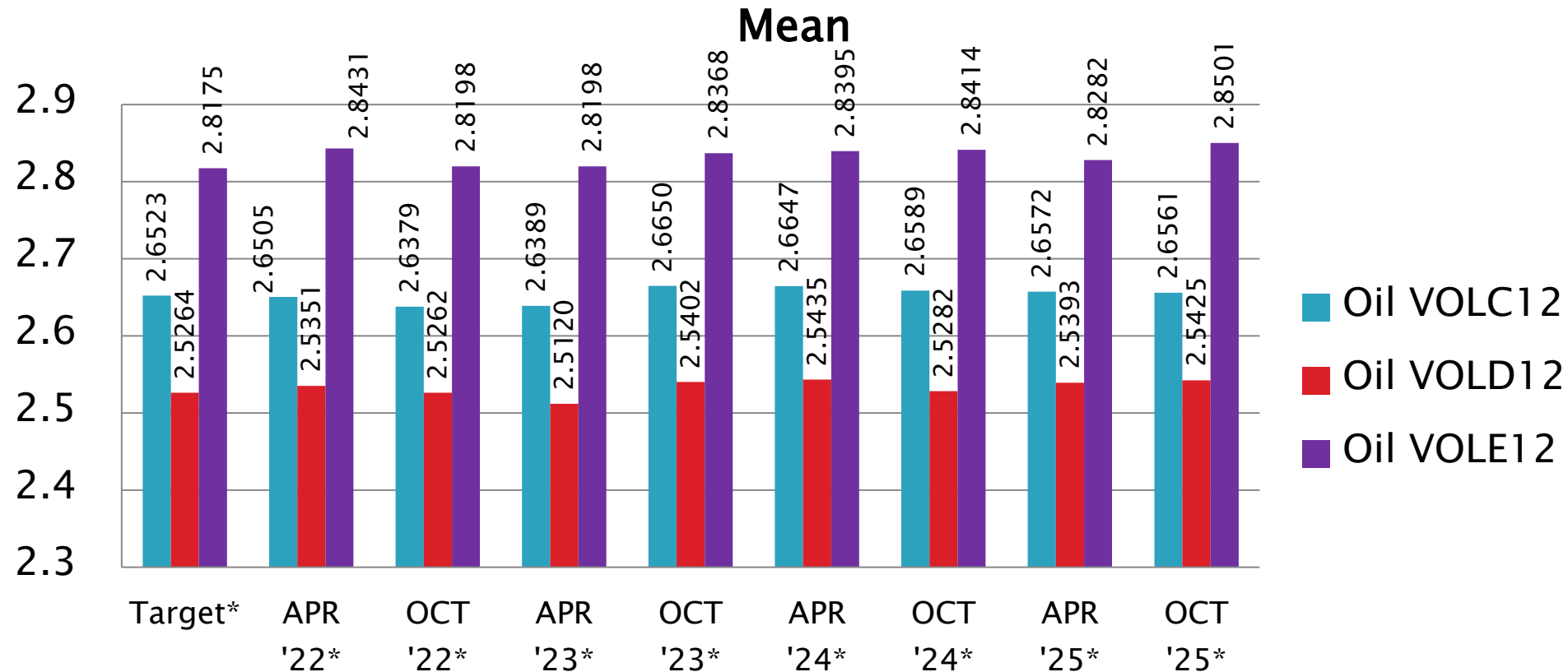
April 1, 2025 – September 30, 2025

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



D5800 Performance by Oil

Sample Evaporation Loss, mass %



*Results transformed to natural log per updated LTMS 20200207

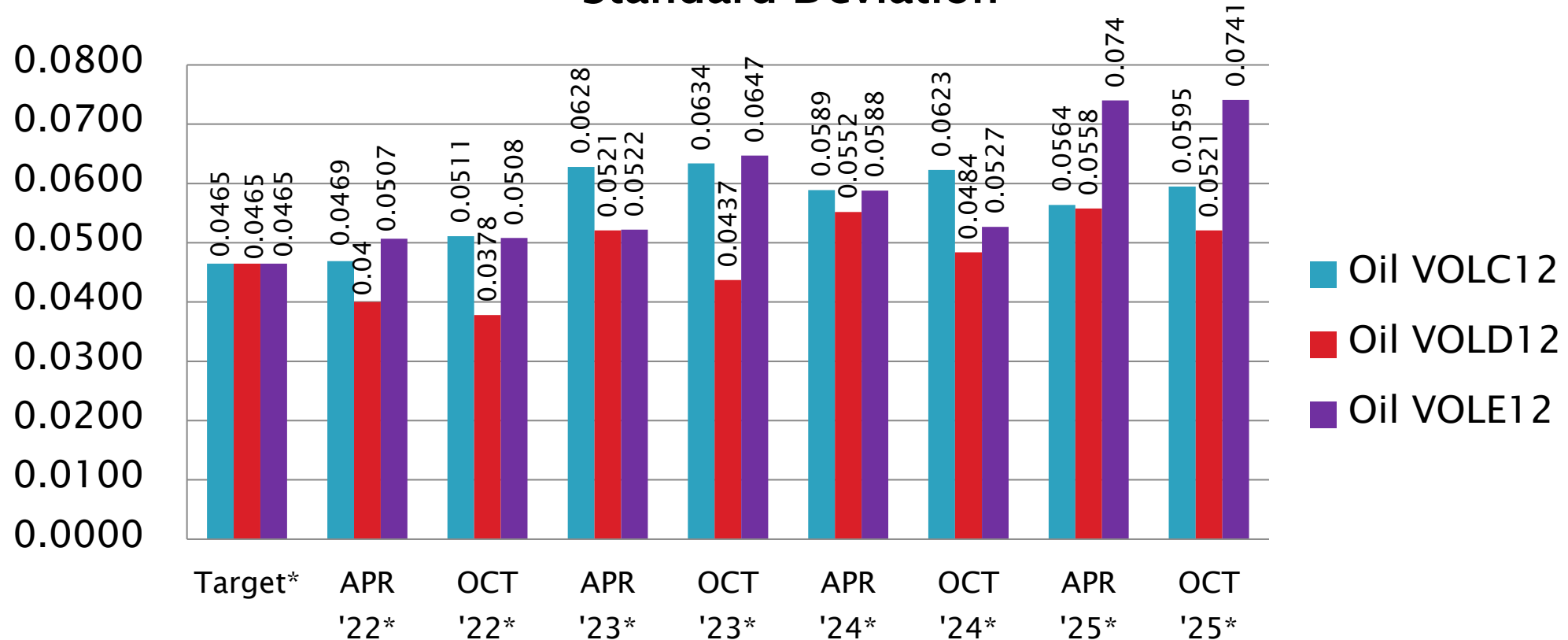
April 1, 2025 – September 30, 2025

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D5800 Performance by Oil

Sample Evaporation Loss, mass %
Standard Deviation



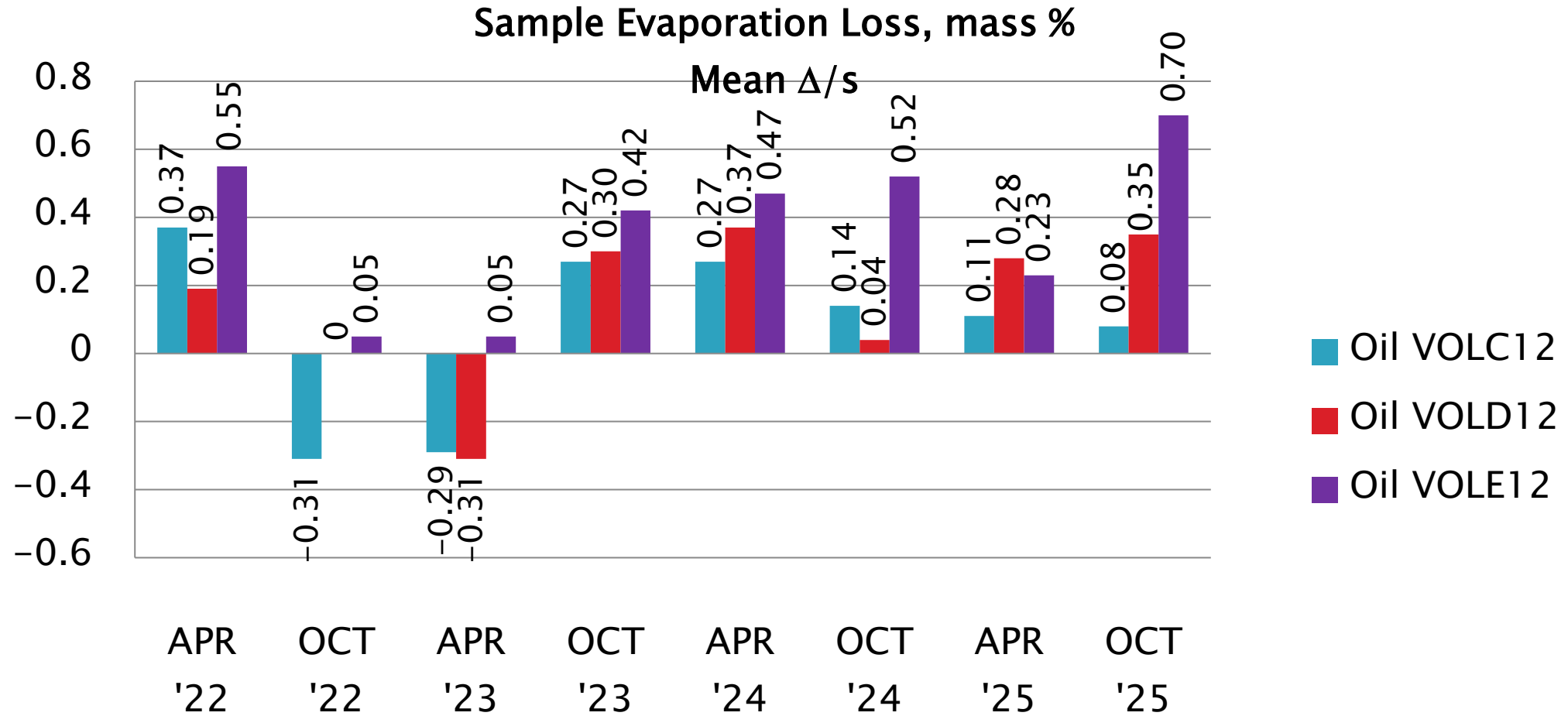
*Results transformed to natural log per updated LTMS 20200207

April 1, 2025 – September 30, 2025

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D5800 Performance by Oil



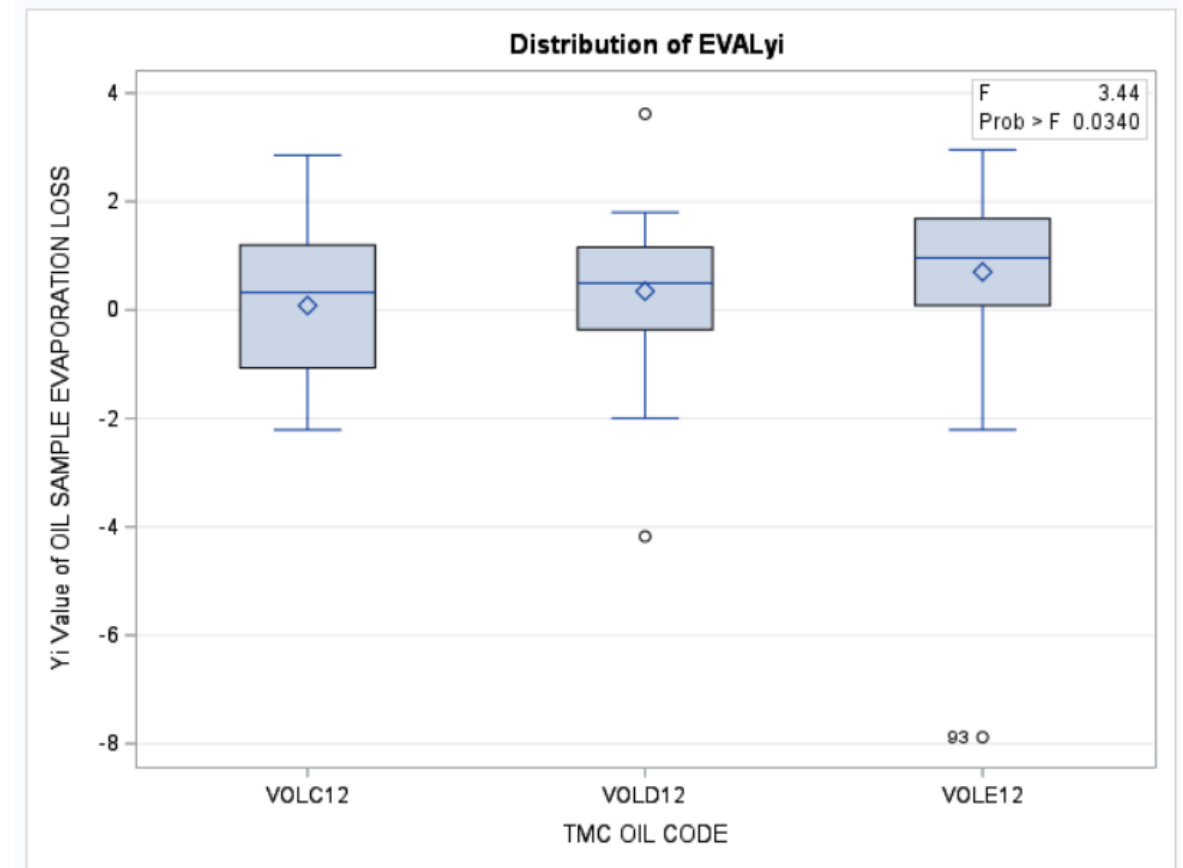
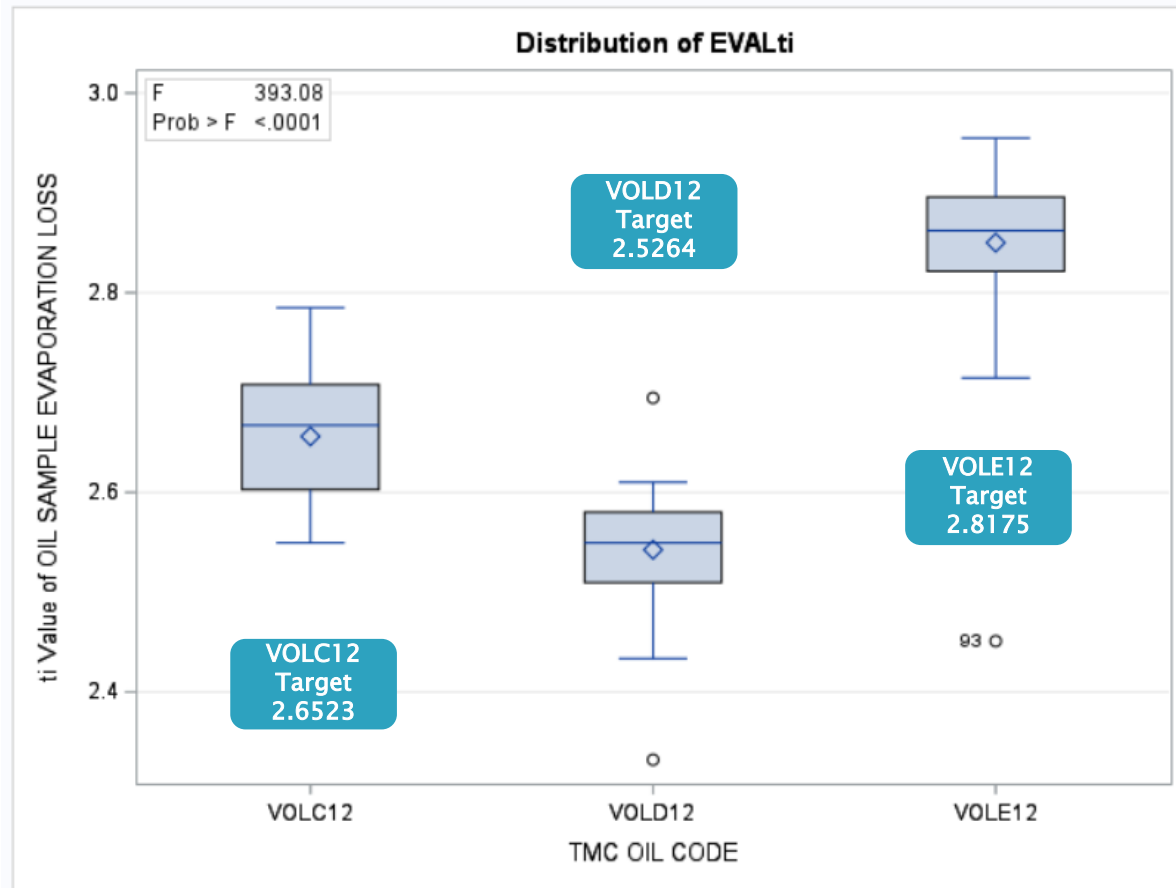
April 1, 2025 – September 30, 2025

Test Monitoring Center
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ALL

All Procedures: APR2025 – SEP2025 Results



April 1, 2025 – September 30, 2025

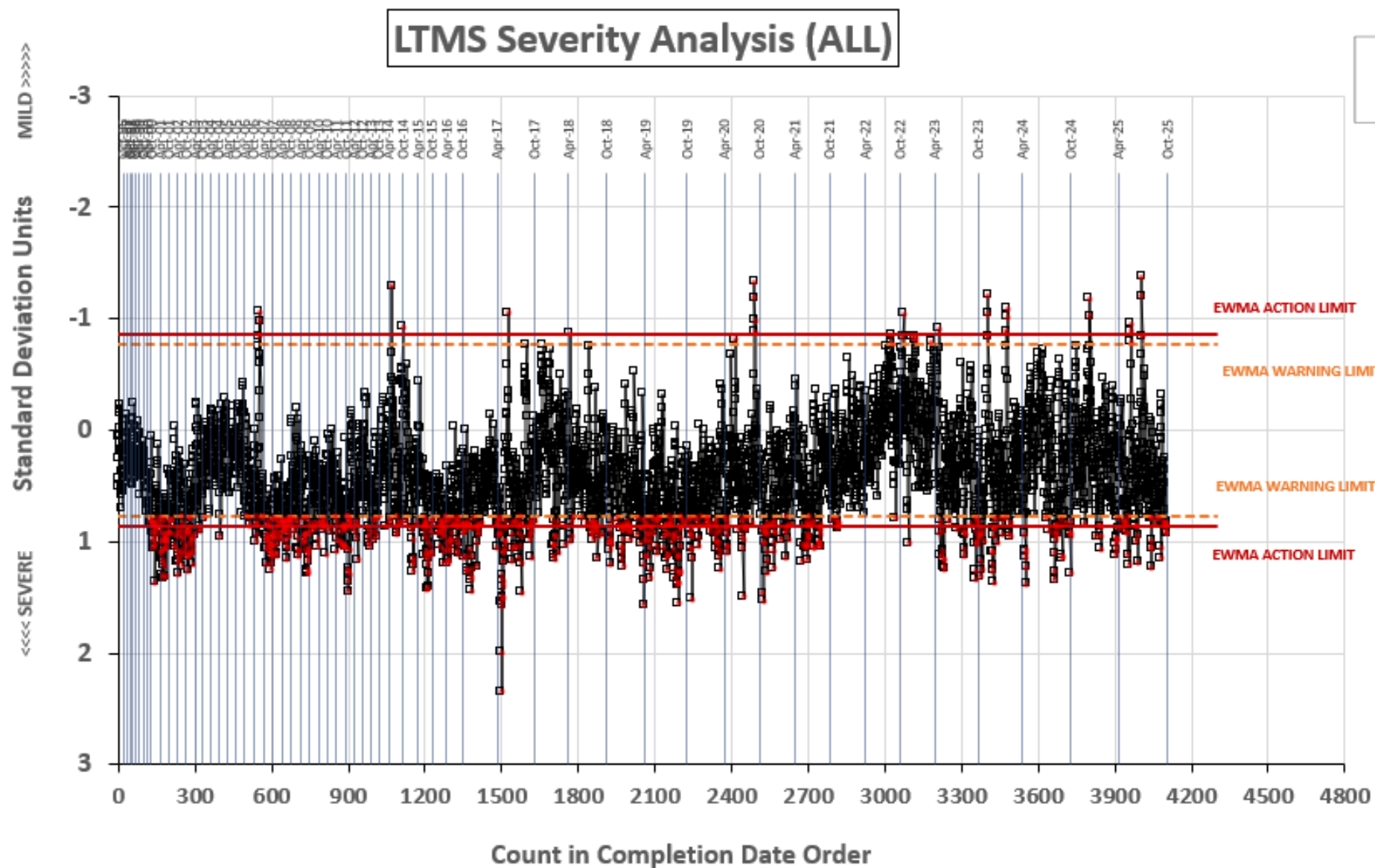
Test Monitoring Center
<https://www.astmtmc.org>



ALL

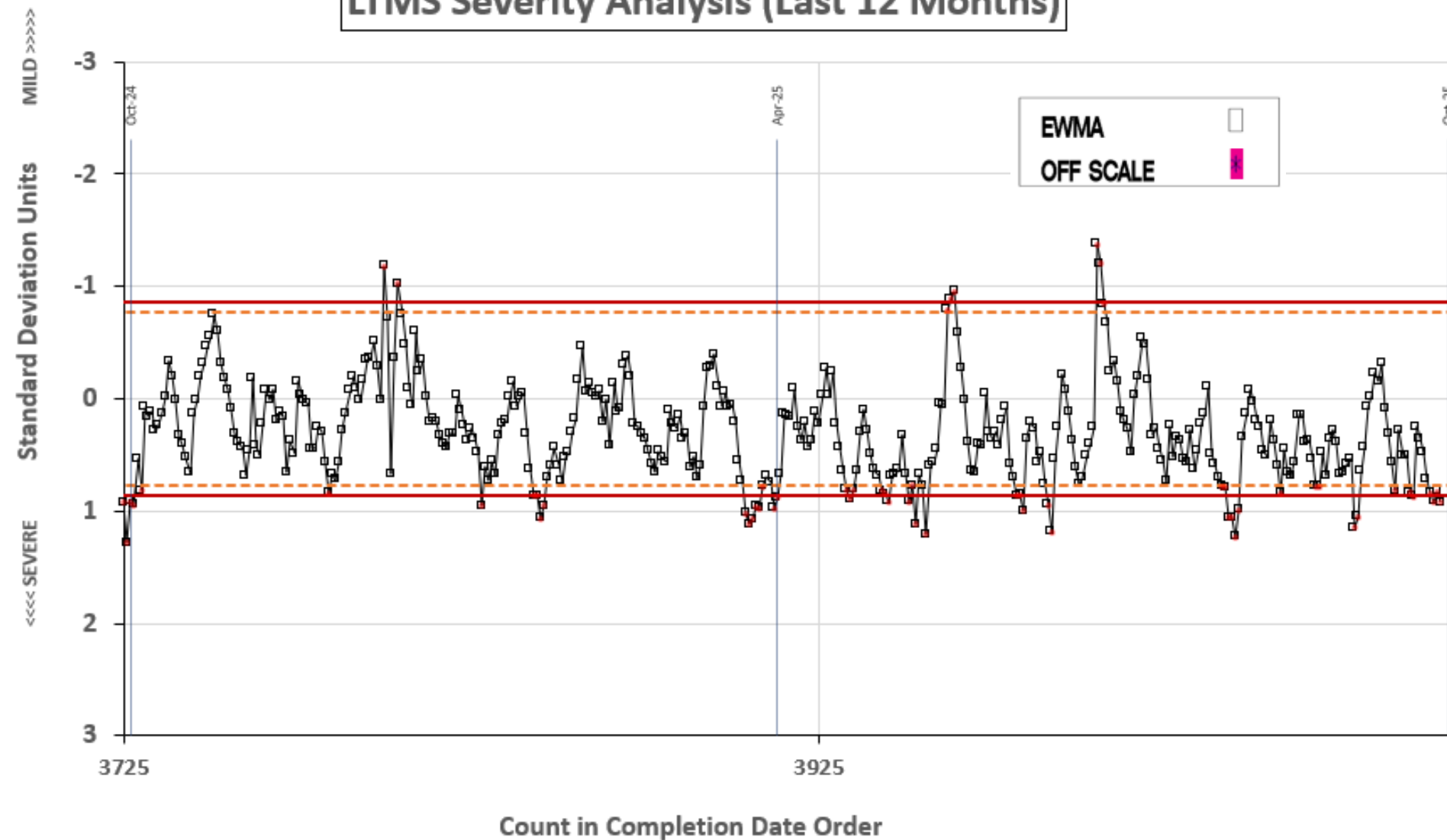
D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

EVAPORATION LOSS, MASS%



EVAPORATION LOSS, MASS%

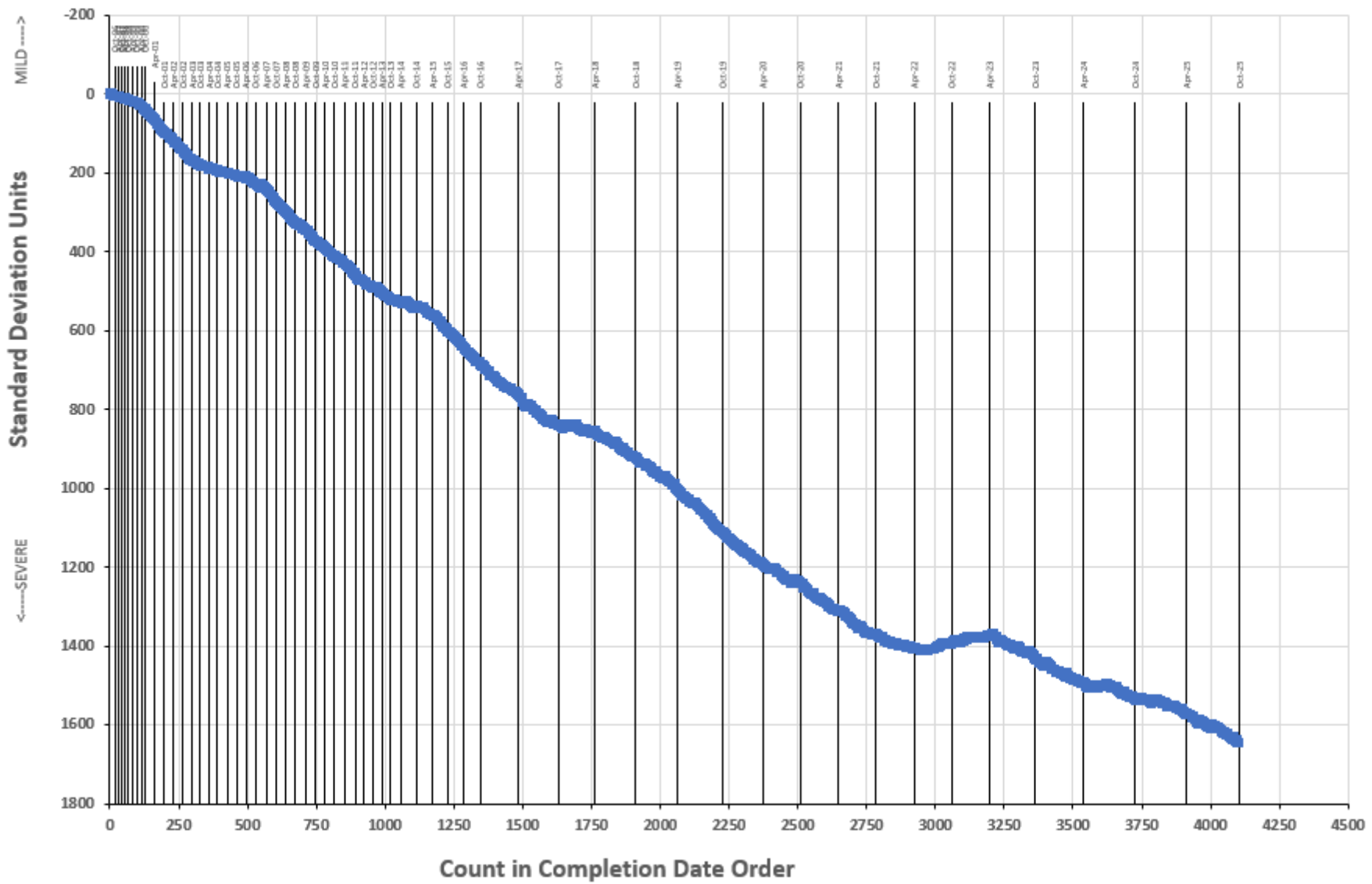
LTMS Severity Analysis (Last 12 Months)



ALL

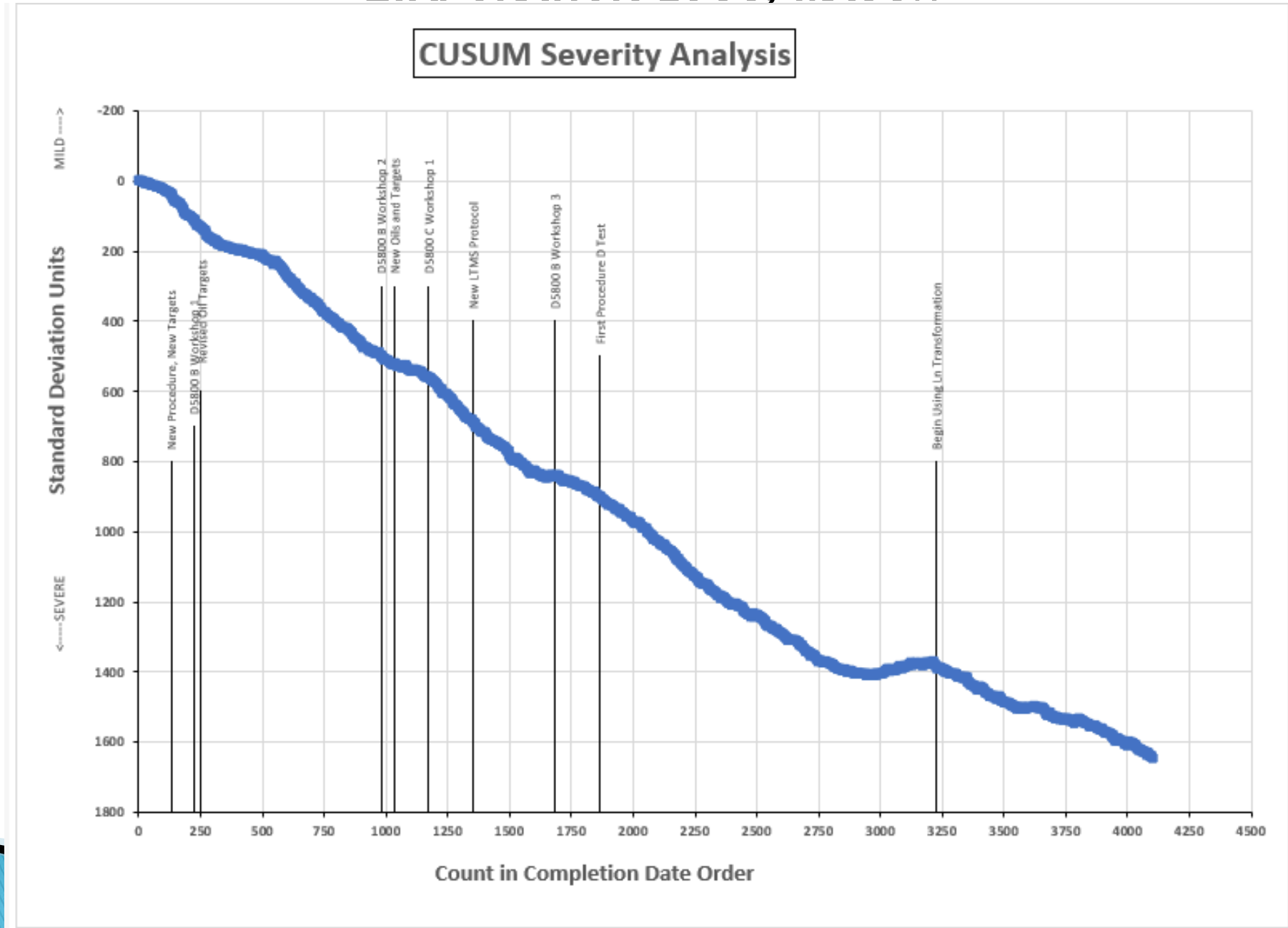
EVAPORATION LOSS, MASS%

CUSUM Severity Analysis



ALL

EVAPORATION LOSS, MASS%



D5800: Evaporation Loss of Lubricating Oil by Noack Method and Rig Model

Performance Comparison
Sample Evaporation Loss, Mass %

Model	n	df	Pooled s	Mean Δ/s
NCK2 (Procedure B)	0	0	n/a	n/a
NCK25G (Procedure B)	120	117	0.0335	1.06
NS2 (Procedure D)	73	70	0.0619	-0.76

0 (-1) Procedure B NCK2 Rig
25 (+2) Procedure B NCK25G Rigs in 10 Labs
15 (+0) Procedure D NS2 Rigs in 6 Labs

April 1, 2025 – September 30, 2025

Test Monitoring Center
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D5800: Evaporation Loss of Lubricating Oil by Noack Method: Industry Procedure B

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	116
Failed Calibration Test	OC	4
Total		120

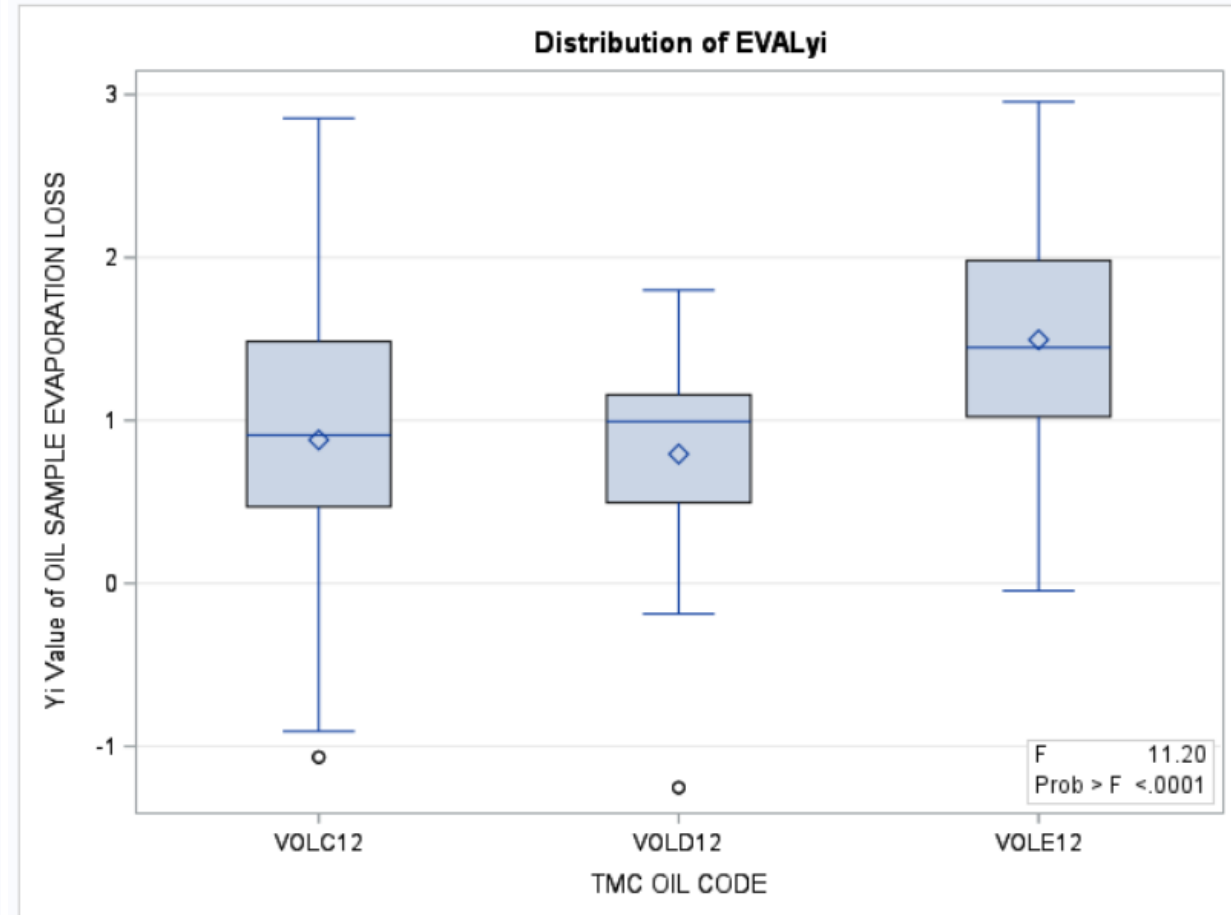
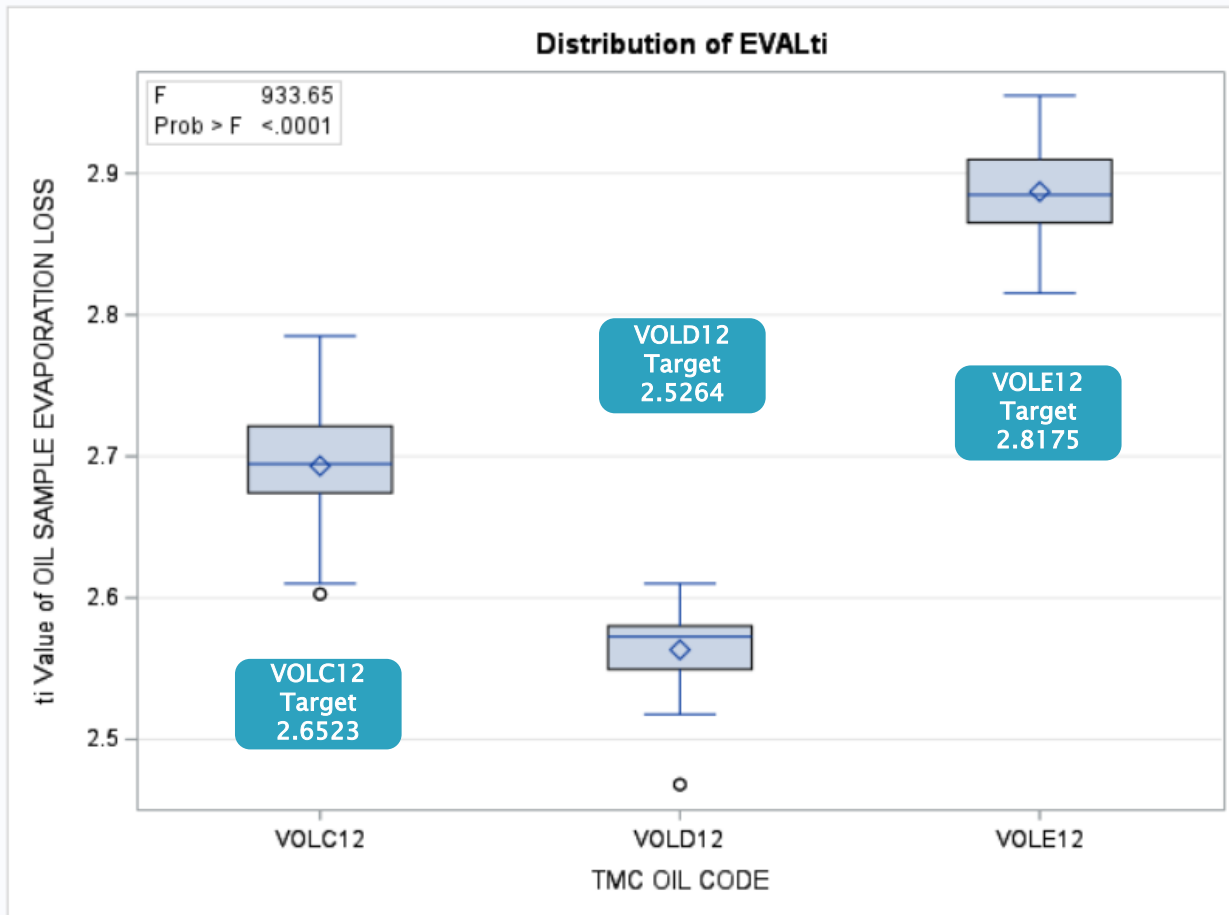
Number of Labs Reporting Data: 10
Fail Rate of Operationally Valid Tests: 3.3%

April 1, 2025 – September 30, 2025

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Procedure B: APR2025 – SEP2025 Results



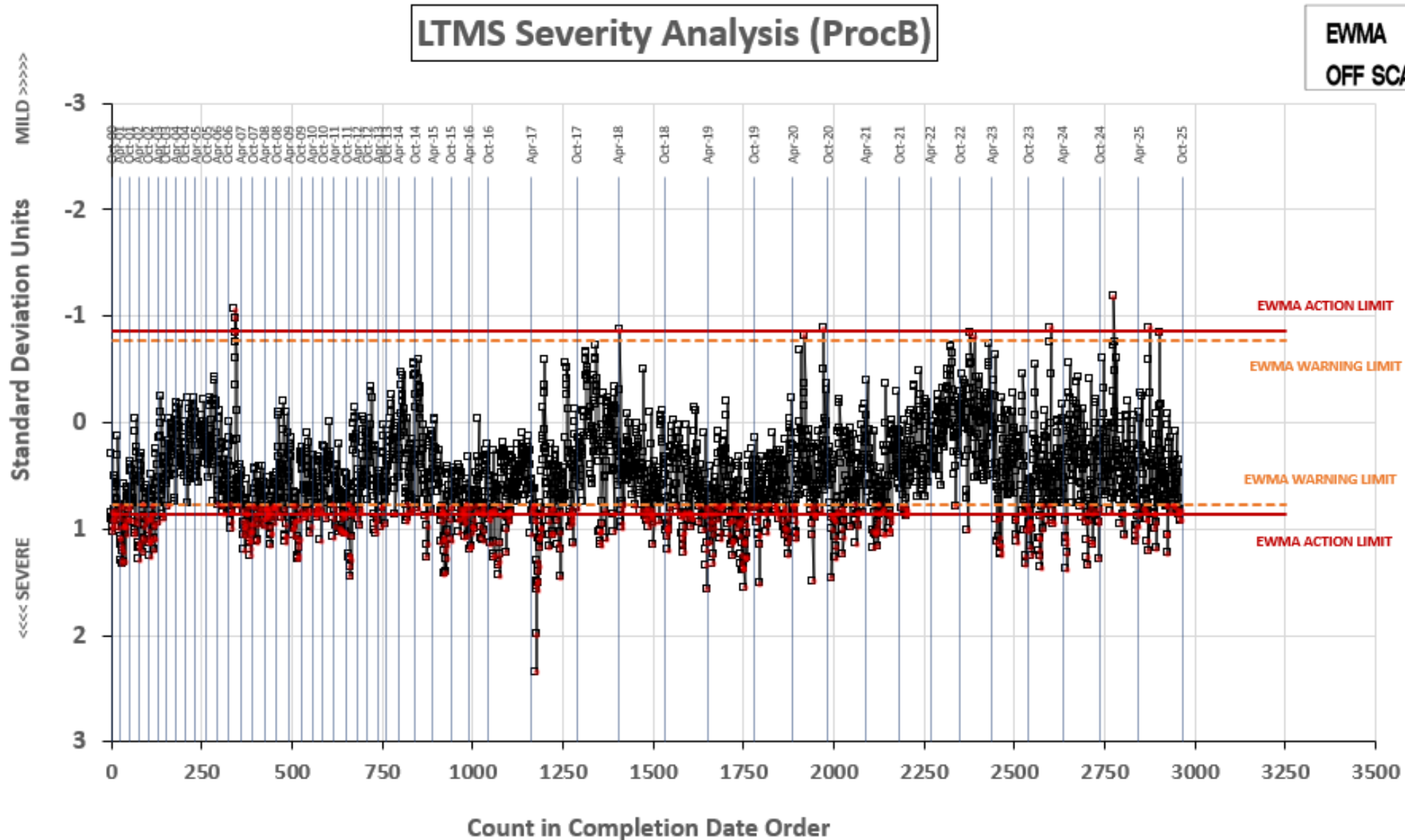
April 1, 2025 – September 30, 2025

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B only

**D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA
PROCEDURE B ONLY
EVAPORATION LOSS, MASS%**

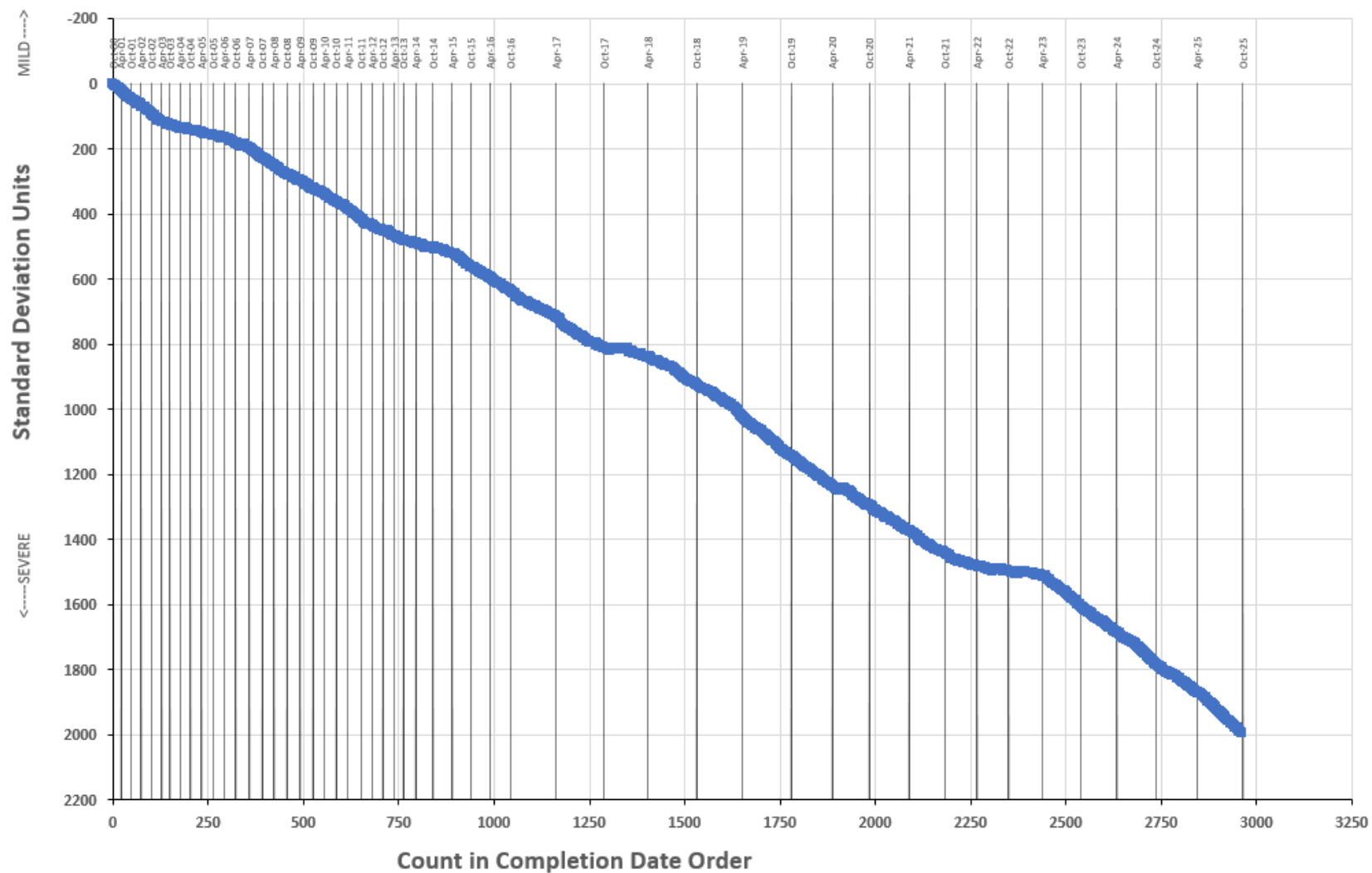


B only

**D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA
PROCEDURE B ONLY
EVAPORATION LOSS, MASS%**



Procedure B CUSUM Severity Analysis

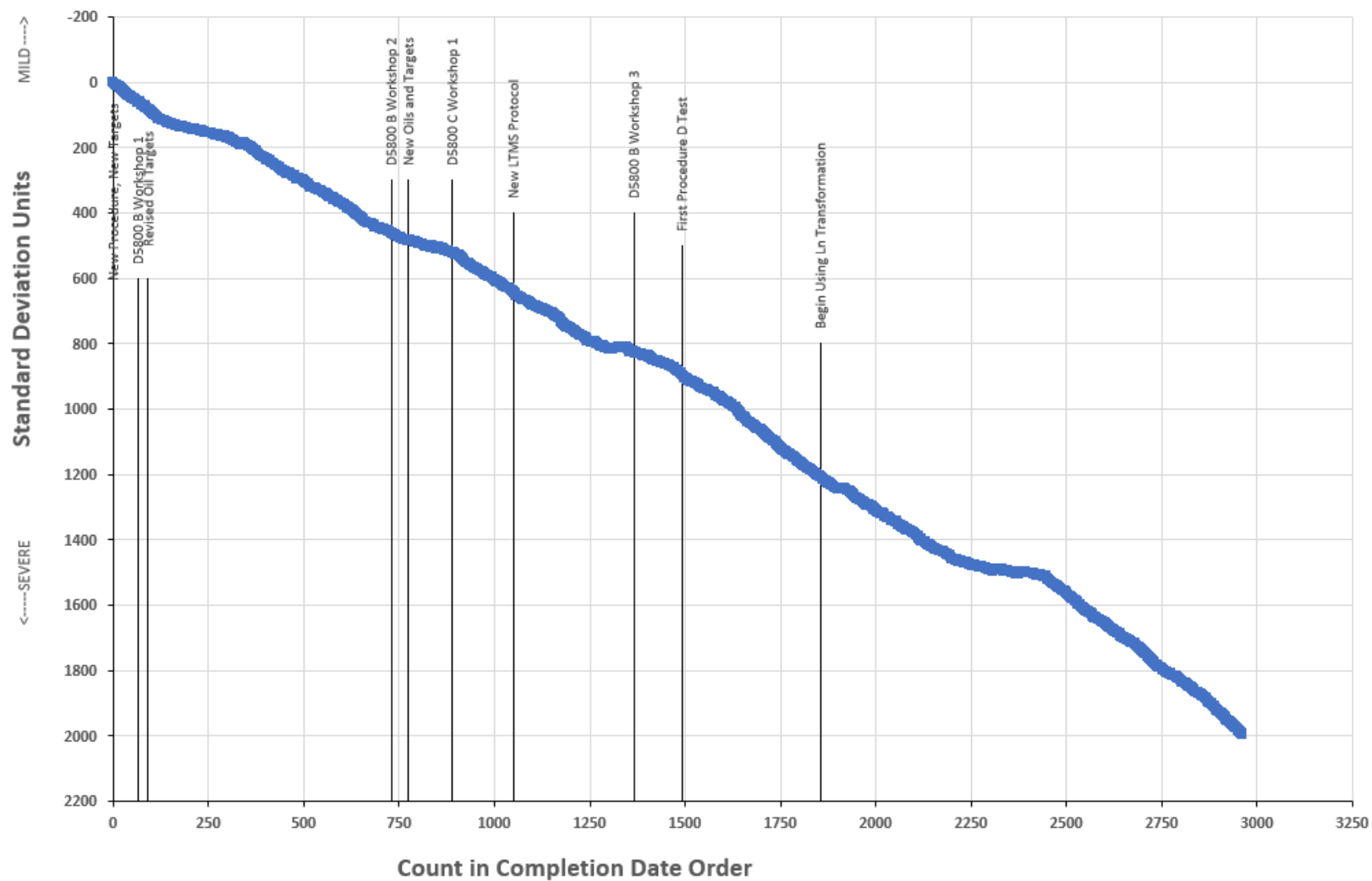


B only

**D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA
PROCEDURE B ONLY
EVAPORATION LOSS, MASS%**



Procedure B CUSUM Severity Analysis



D5800: Evaporation Loss of Lubricating Oil by Noack Method: Industry Procedure D

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	69
Failed Calibration Test	OC	4
Total		73

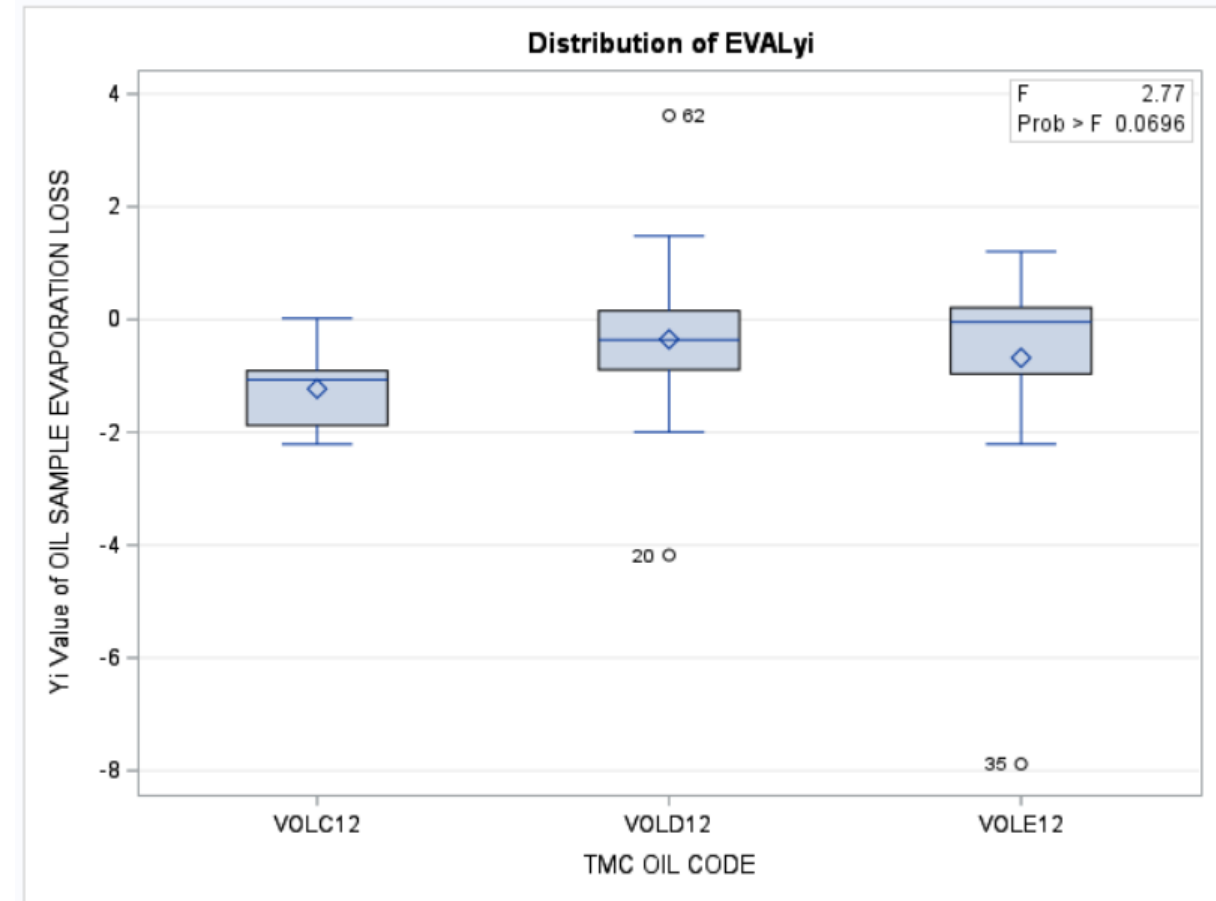
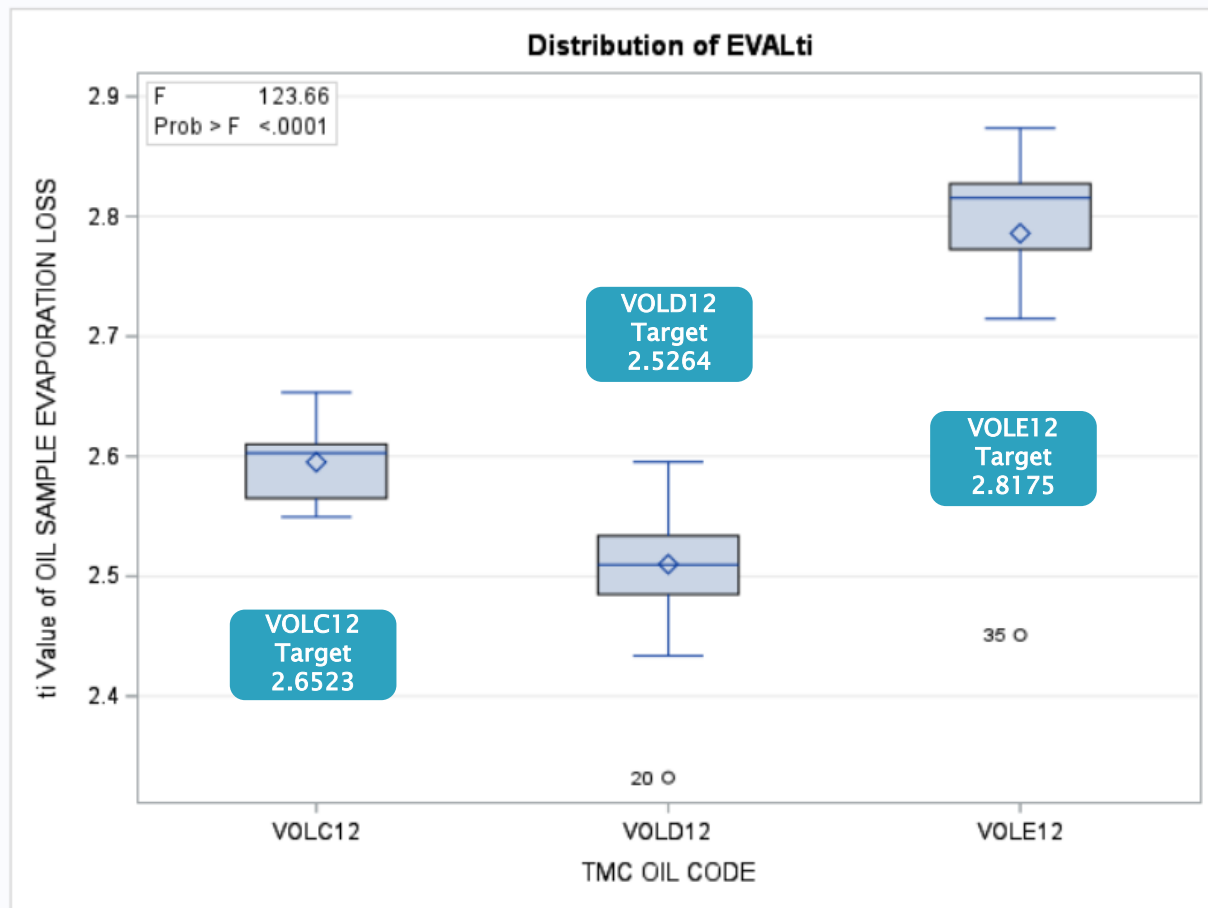
Number of Labs Reporting Data: 6
Fail Rate of Operationally Valid Tests: 5.48%

April 1, 2025 – September 30, 2025

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Procedure D: APR2025 – SEP2025 Results



April 1, 2025 – September 30, 2025

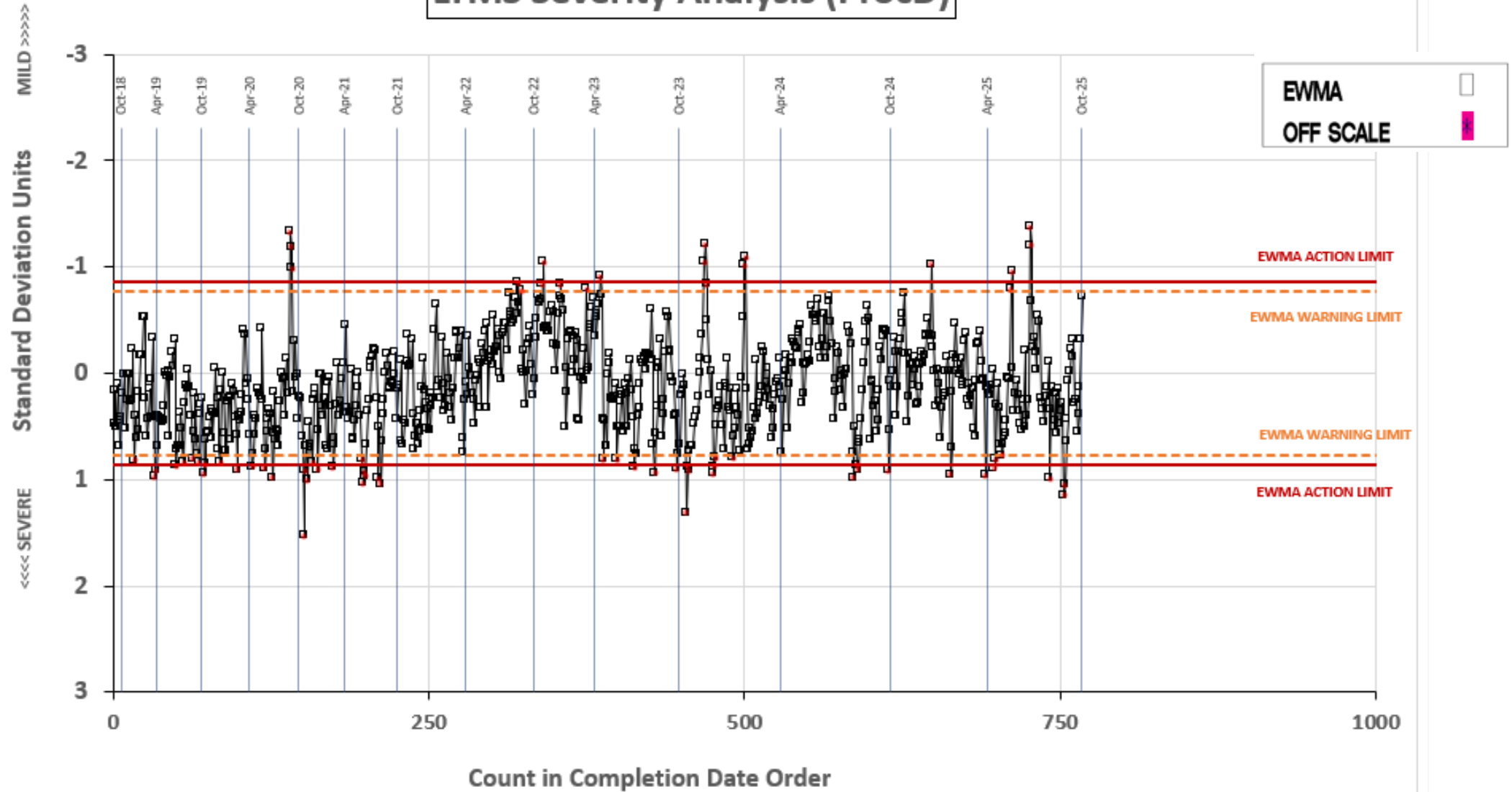
Test Monitoring Center
<https://www.astmtmc.org>



D only

Procedure D Only
EVAPORATION LOSS, MASS%

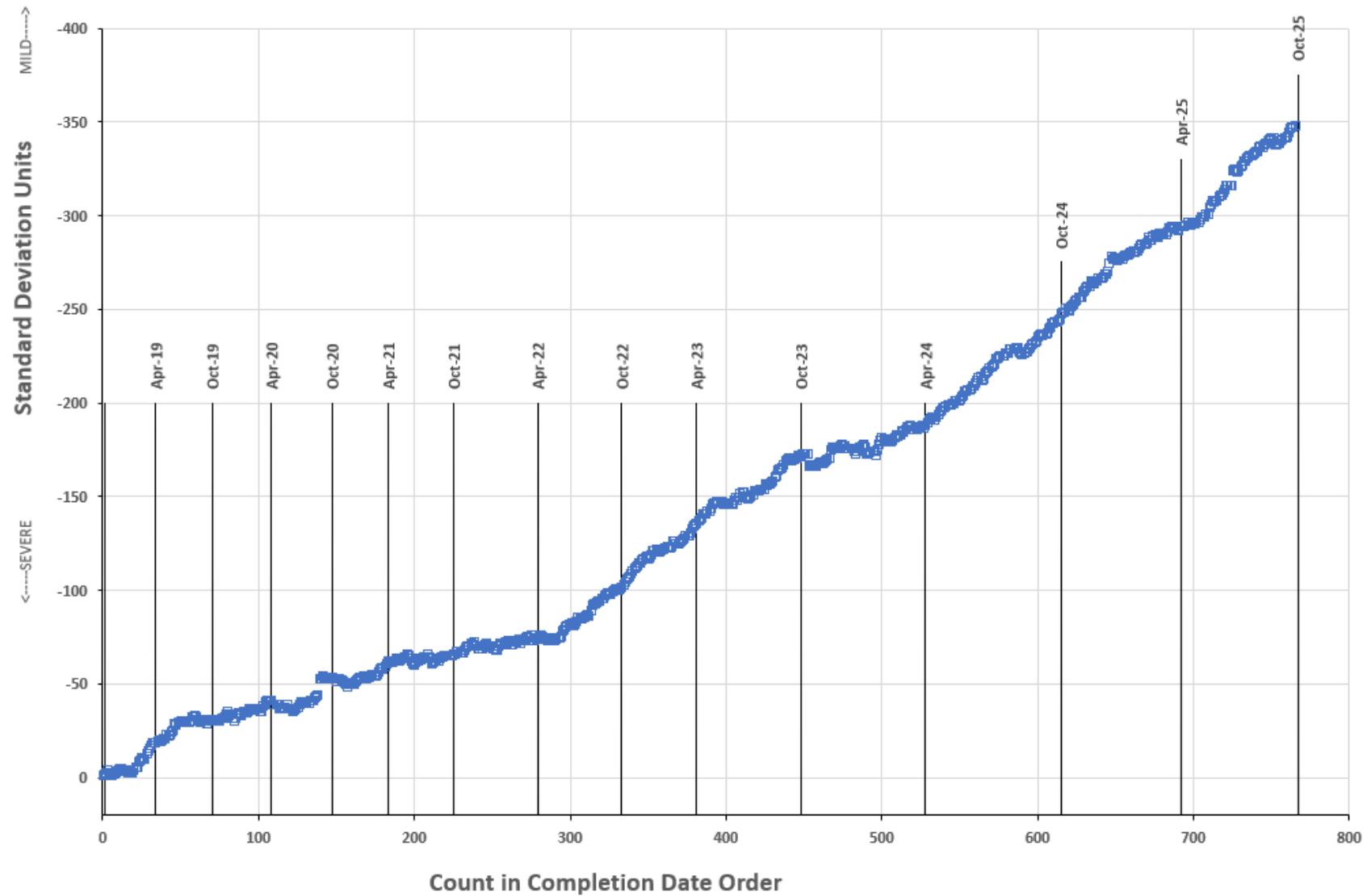
LTMS Severity Analysis (ProcD)



D only

Procedure D Only
EVAPORATION LOSS, MASS%

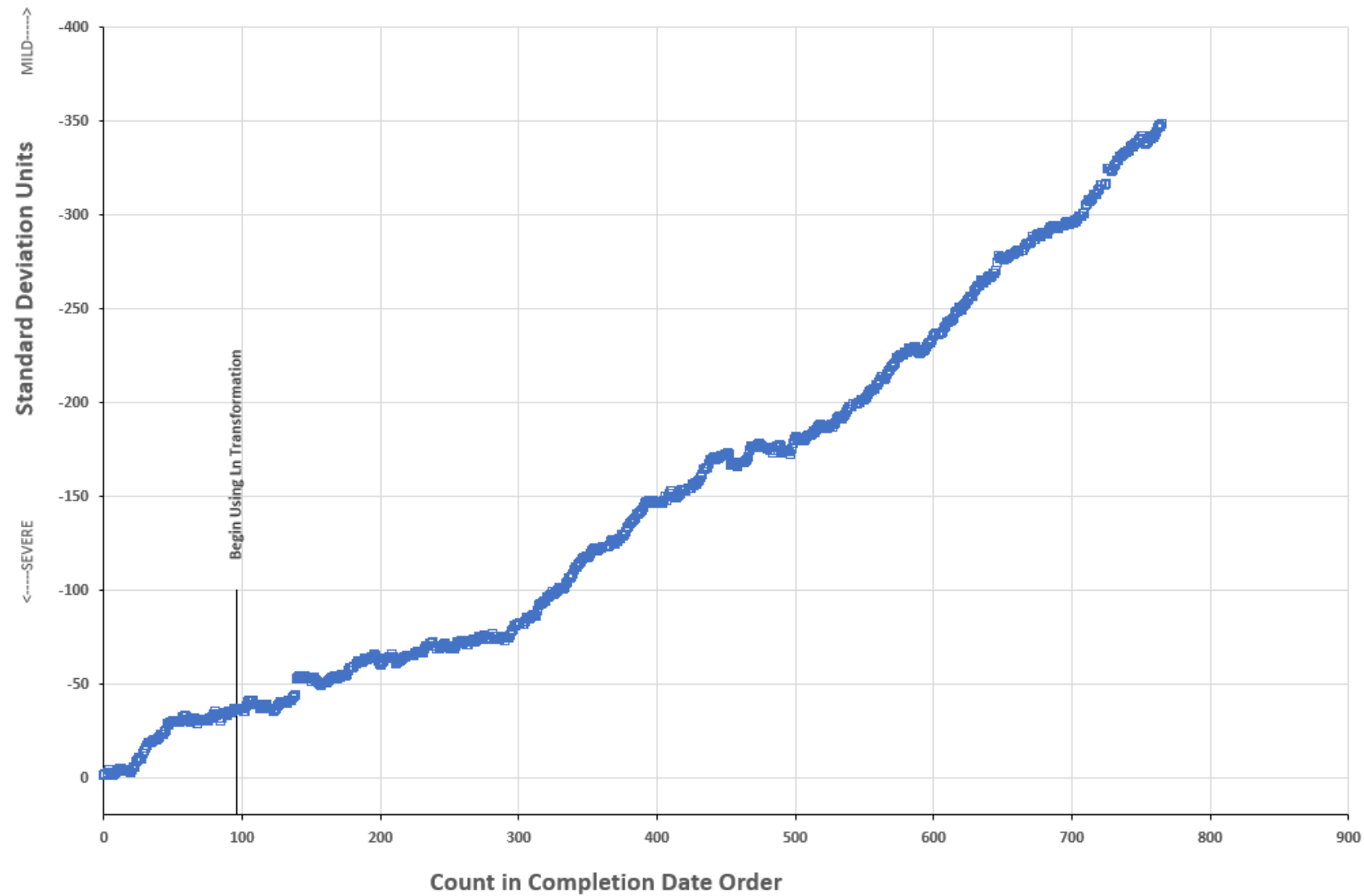
Procedure D CUSUM Severity Analysis



D only

Procedure D Only
EVAPORATION LOSS, MASS%

Procedure D CUSUM Severity Analysis



Reference Oil Inventory

D5800

Oil	Year Rec'd By TMC ⁴	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
VOLC12	2013	D5800	15.1	1.5	4 years
VOLD12	2013	D5800	13.4	1.4	4 years
VOLE12	2013	D5800	11.2	1.4	4 years
VOLD18	2018	D5800QC	464	52	5+ years

⁴ Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

April 1, 2025 – September 30, 2025

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D5800: Evaporation Loss of Lubricating Oil by Noack Method: Semester Summary

No change in Precision (Pooled s) for last two semesters (0.0627 vs 0.0625).

Performance (Mean Δ/s) continues to be severe at +0.37 s.

- Procedure B rigs continue to trend severe (+1.06 s) while Procedure D rigs continue to trend mild (-0.76s).

The last NCK2 (Proc B) was removed from service and so all calibrated instruments are either NS2 (Proc D) or NCK25G (Proc B).

TABLE of CONTENTS

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



D02.B0.07

TMC Monitored Tests



ASTM D 6082

High Temperature Foam

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6082	7 (+0)	9 (+0)
*Between 4/1/2025 and 9/30/2025		

D6082: High Temperature Foam

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	18
Failed Calibration Test	OC	1
Acceptable Discrimination Test	AS	6
Operationally Invalid, Reported as Valid	RC, RS	0
Operationally Invalid, Reported by Lab	LC, LS	0
Informational Run (Valid)	NN	1
Aborted Tests	XC, XS	1
Total		27

Number of Labs Reporting Data: 7
Fail Rate of Operationally Valid Calibration Tests: 5.3%

April 1, 2025 – September 30, 2025

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D6082: High Temperature Foam

Statistically Unacceptable Tests (OC, OS)	No. Of Tests
Foam Tendency Mild	0
Foam Tendency Severe	1
Total	1

- There was ONE statistically unacceptable calibration test this period.

April 1, 2025 – September 30, 2025

Test Monitoring Center
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D6082: High Temperature Foam

Operationally Unacceptable Tests (RC, LC, LS, XC, XS)	No. Of Tests
LC (Lab Invalid Calibration Run)	0
XC (Lab Aborted Calibration Run)	1
RC (TMC Invalidated Calibration Run)	0
XS (Lab Aborted Discrimination Run)	0
LS (Lab Invalid Discrimination Run)	0
Total	1

- There was ONE operationally invalid results this report period.

D6082: High Temperature Foam

Informational Runs (MN, NN)	No. Of Tests
Non-blind Informational run on-target, valid (NN)	1
Non-blind Informational run out of range, valid (MN)	0
Total	1

- There was one informational run this report period.

April 1, 2025 – September 30, 2025

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D6082: High Temperature Foam (Tendency)

Period Precision and Severity Estimates

Foam Tendency, ml	n	df	Pooled s	Mean Δ/s
Targets updated 20201001 ¹	18	17	9	-----
4/1/21 through 9/30/21	14	13	7	-0.48
10/1/21 through 3/31/22	13	12	7	-0.57
4/1/22 through 9/30/22	15	14	4	-0.52
10/1/22 through 3/31/23	16	15	10	-0.69
4/1/23 through 9/30/23	14	13	4	-0.68
10/1/23 through 3/31/24	19	18	10	-0.62
4/1/24 through 9/30/24	18	17	13	-0.01
10/1/24 through 3/31/25	17	16	18	0.88
4/1/25 through 9/30/25	18	17	10	0.45

¹Target precision updated to current reference oil FOAMB18

April 1, 2025 – September 30, 2025

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D6082: High Temperature Foam (Stability)

Period Precision and Severity Estimates

Foam Stability @ 1 min, ml	n	Mean	s
Current Targets	18	0.00	0.00
4/1/21 through 9/30/21	14	No non-zero occurrences	
10/1/21 through 3/31/22	13	No non-zero occurrences	
4/1/22 through 9/30/22	15	No non-zero occurrences	
10/1/22 through 3/31/23	16	No non-zero occurrences	
4/1/23 through 9/30/23	14	No non-zero occurrences	
10/1/23 through 3/31/24	19	No non-zero occurrences	
4/1/24 through 9/30/24	18	No non-zero occurrences	
10/1/24 through 3/31/25	18	No non-zero occurrences	
4/1/25 through 9/30/25	18	No non-zero occurrences	

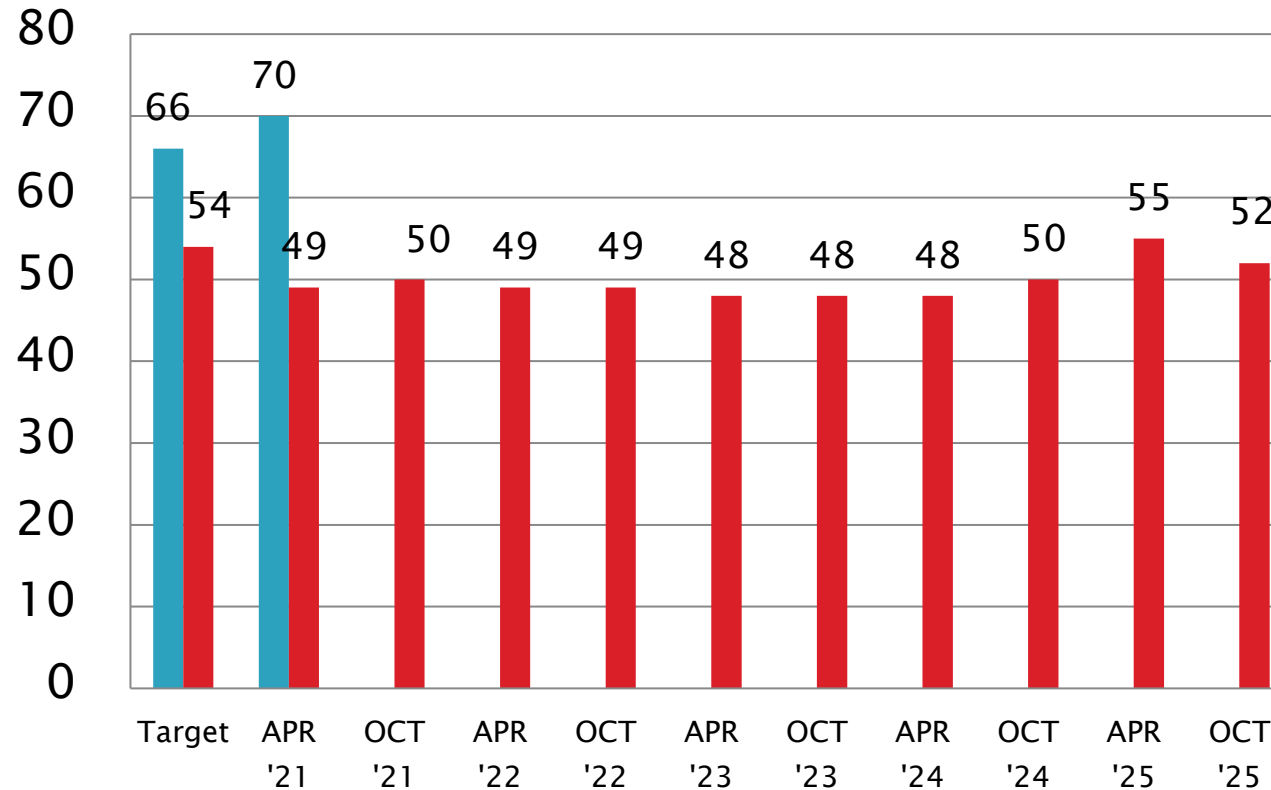
April 1, 2025 – September 30, 2025

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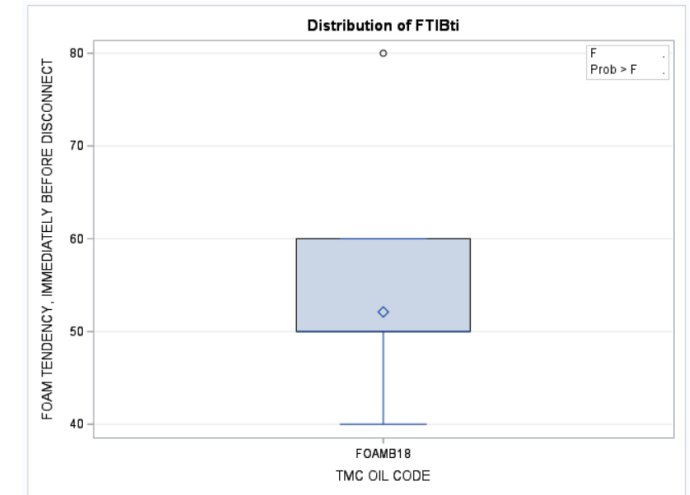


D6082 Performance by Oil

Foam Tendency, ml
Mean



Oil 1007
Oil FOAMB18



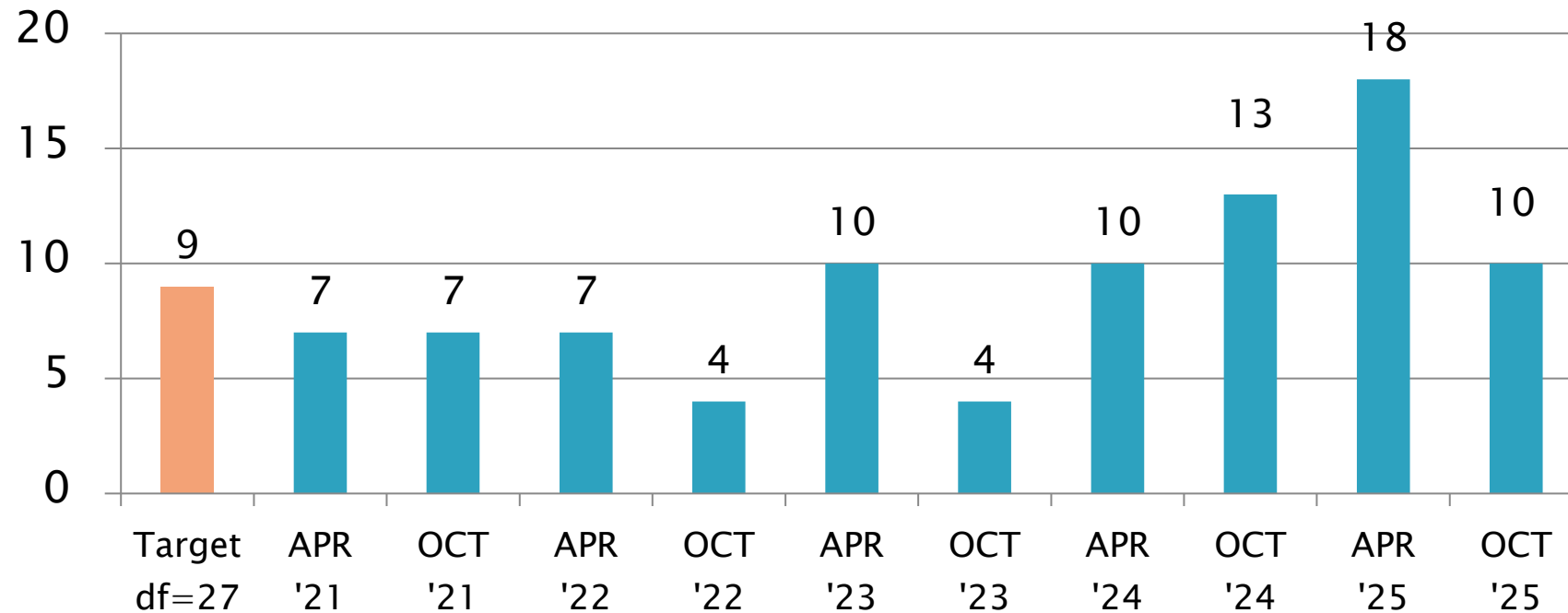
April 1, 2025 – September 30, 2025

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D6082: High Temperature Foam

Foam Tendency, ml
Pooled s



April 1, 2025 – September 30, 2025

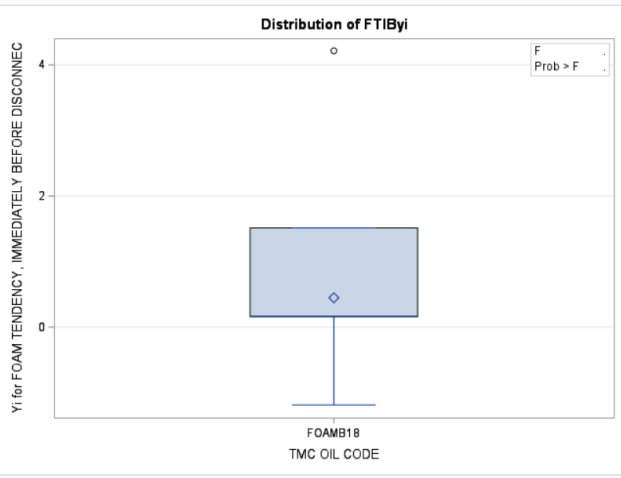
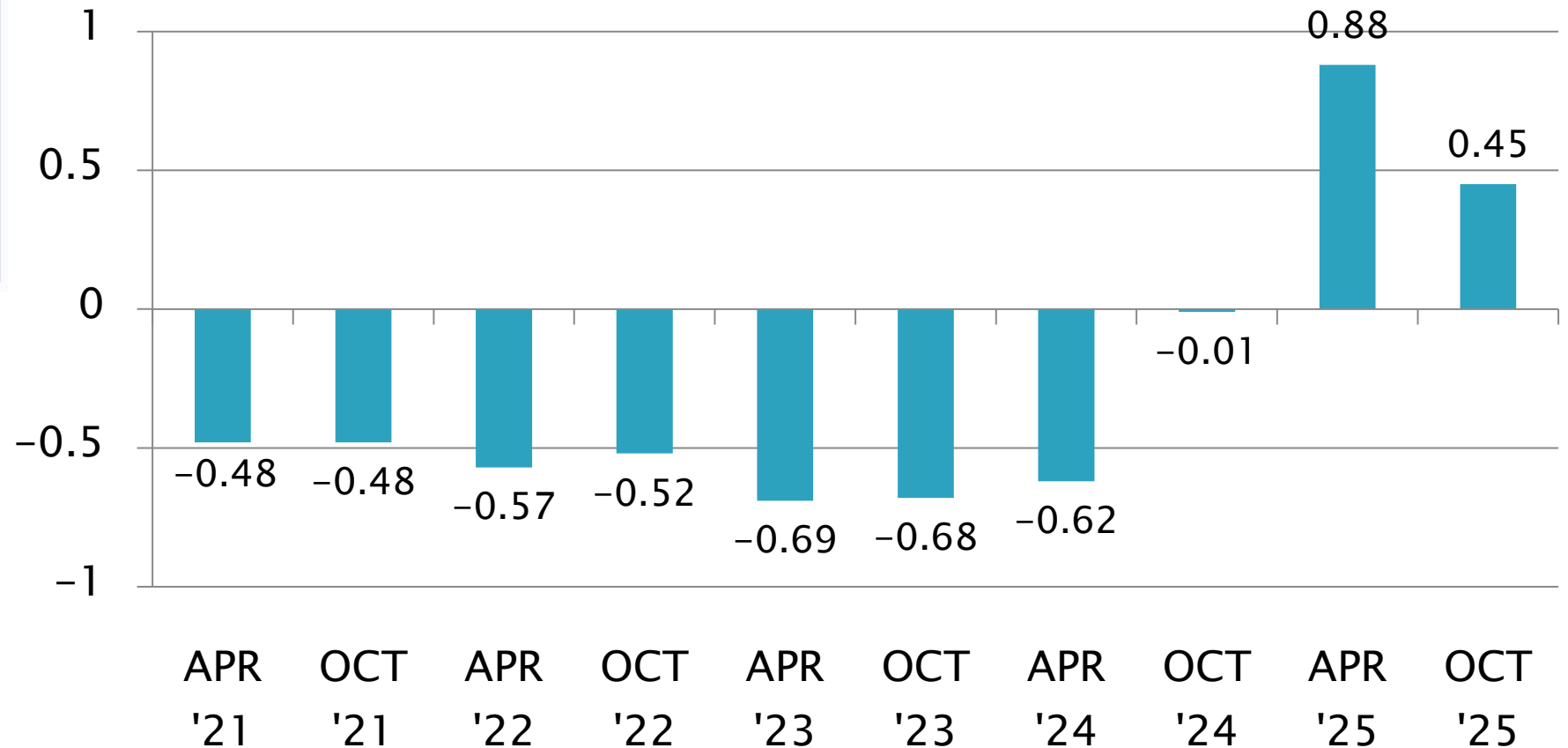
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D6082: High Temperature Foam

Foam Tendency, ml
Mean Δ/s



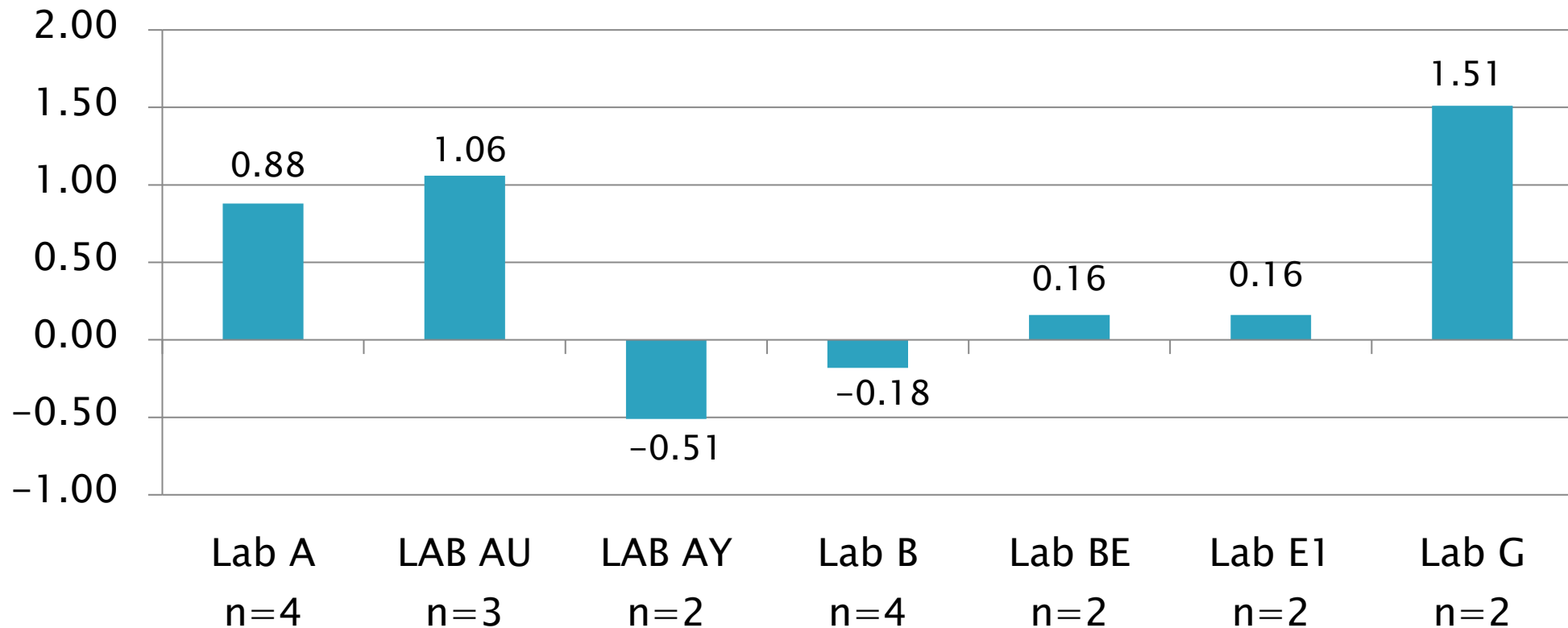
April 1, 2025 – September 30, 2025

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D6082: High Temperature Foam

Current Period Severity Estimates by Lab
Foam Tendency, ml



April 1, 2025 - September 30, 2025

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D6082: High Temperature Foam Status

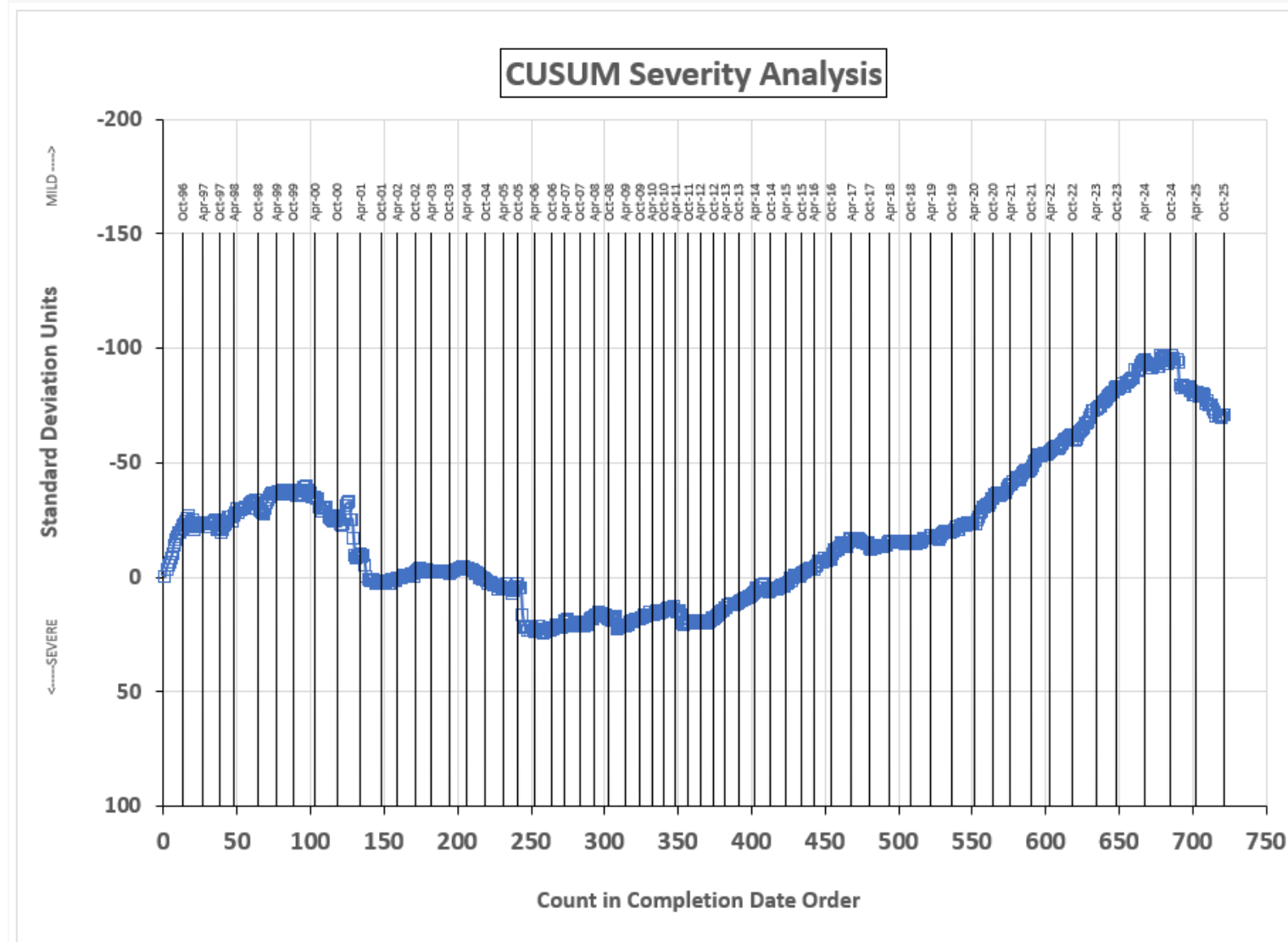
- ▶ Foam Tendency Precision (Pooled s) has improved (to 10) this semester. Previous semester Precision was 18.
- ▶ Performance (Mean Δ/s) has moved to a less severe position at +0.45s.
- ▶ No non-zero occurrences of Foam Stability
- ▶ No discrimination runs (on TMC oil 66) failed this semester.

April 1, 2025 – September 30, 2025

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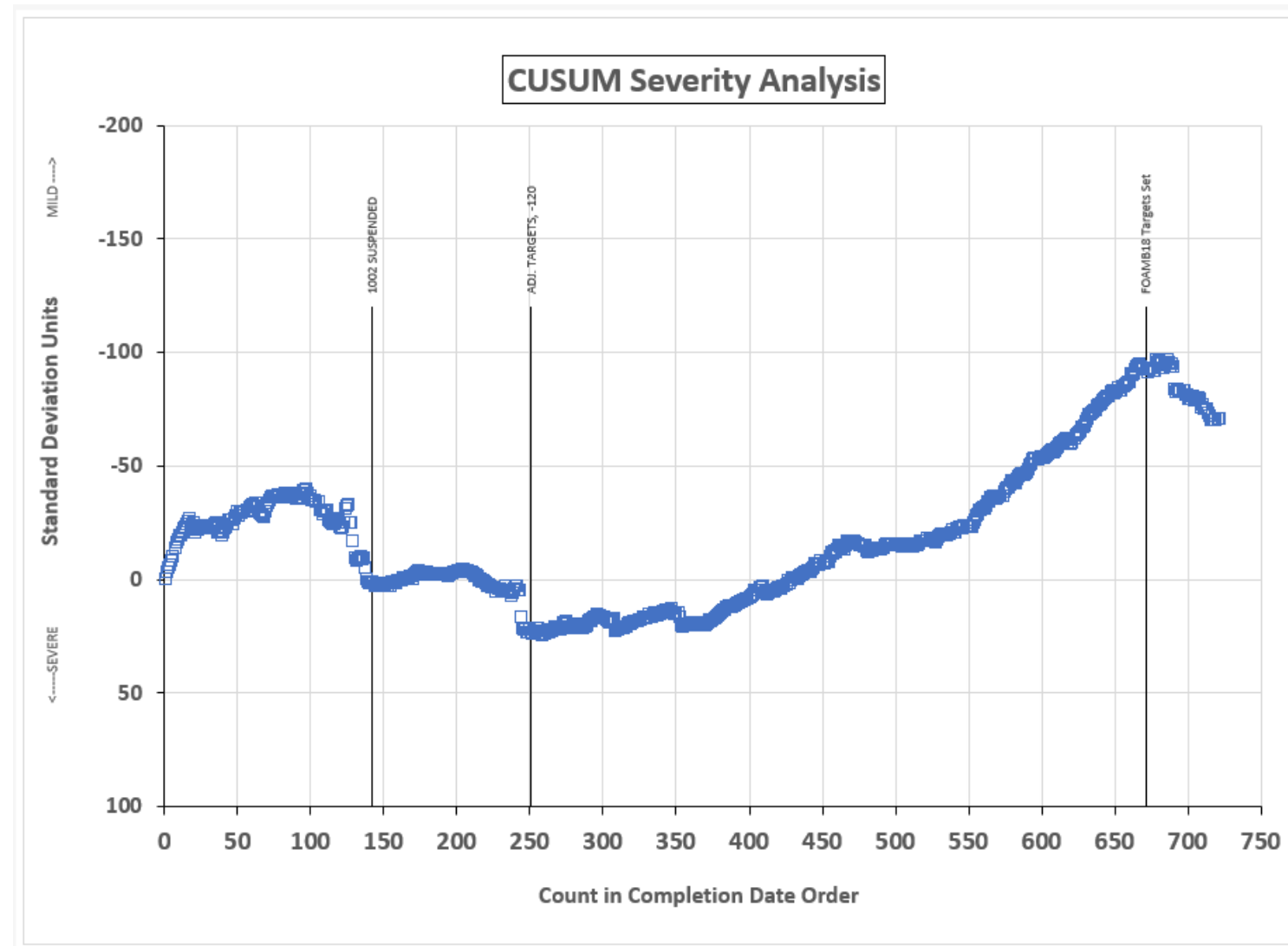


FOAM TENDENCY



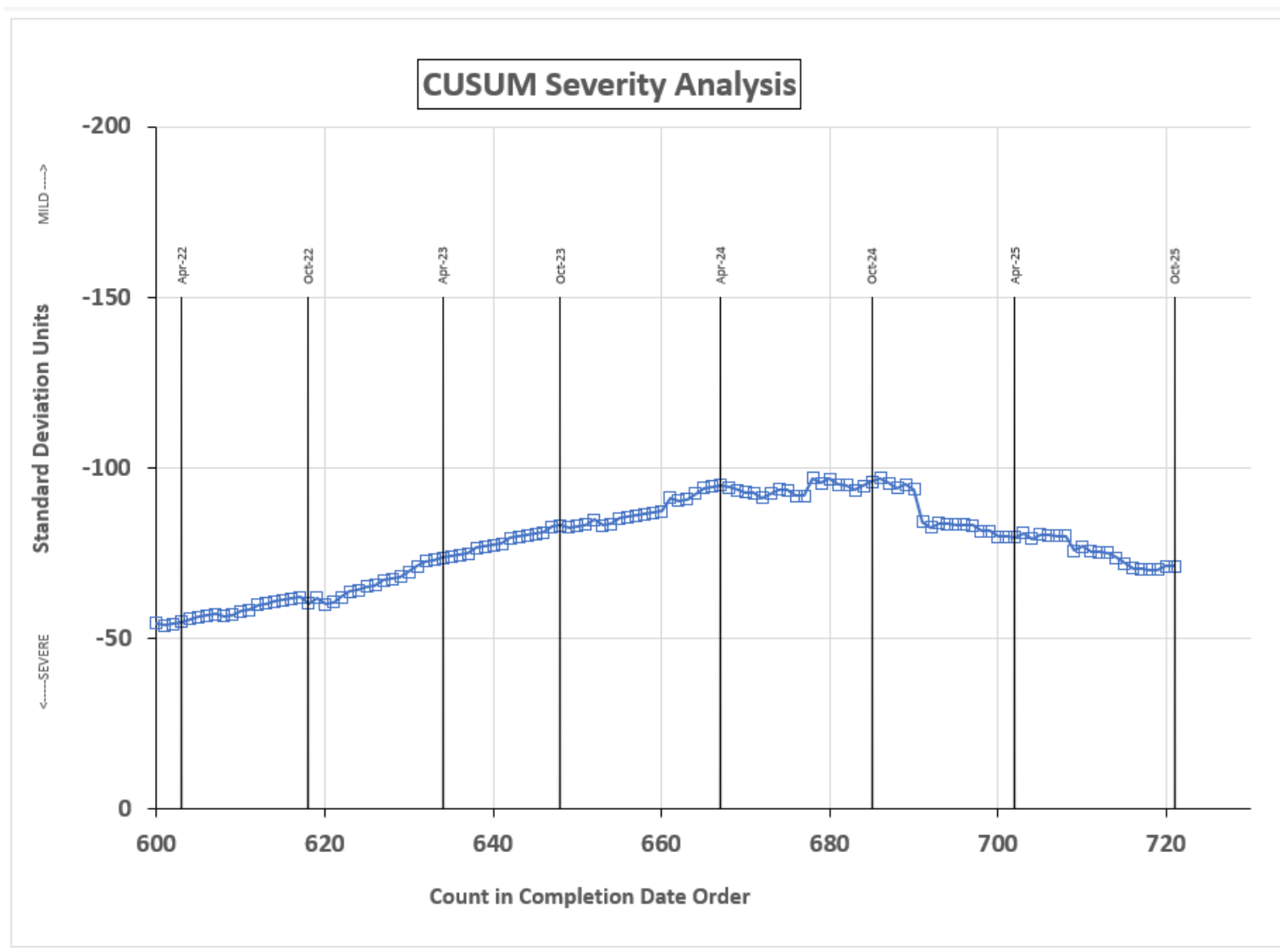
April 1, 2025 – September 30, 2025

FOAM TENDENCY



April 1, 2025 – September 30, 2025

Last 120 Data Points
FOAM TENDENCY



[TABLE of CONTENTS](#)

Reference Oil Inventory

D6082

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
FOAMB18	2018	D6082	65.6	1.58	5+ years
66	2002	D6082	65.3	1.00	5+ years

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B D874QC Samples (1L sizes) could quickly deplete Reference Oil 90 availability.

April 1, 2025 – September 30, 2025

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D02.B0.07

TMC Monitored Tests



ASTM D 6335

TEOST

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6335	8 (+1)	14 (+2)
*As of 9/30/2025		

D6335: Deposits by TEOST-33C

Test Status	Validity Code	No. Tests
Acceptable Calibration Tests	AC	29
Failed Calibration Tests	OC	1
Operationally Invalid or Aborted by Lab	LC, XC	2
Informational Run (Test Result In Range)	NN	6
Informational Run (Test Result Out of Range)	MN	2
Donated Industry Runs (Ref Oil 75-2 Round Robin)	NG, NN	19
Total		59

Number of Labs Reporting Data: 8 (7 Labs Last Period)
Fail Rate of Operationally Valid Tests: 3.3% (27.6% Last Period)

April 1, 2025 – September 30, 2025

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D6335: Deposits by TEOST-33C

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Severe	1
Total Deposits Mild	0
Total	1
Operationally Invalid Tests (LC, XC)	No. Of Tests
XC: Lab Invalidated Run (thermocouple at wrong depth)	1
XC: Lab Aborted Run (rod pre-weight not recorded)	1
Total	2

- RO reblend 75-2 approved for use with current RO 75-1 acceptance range.

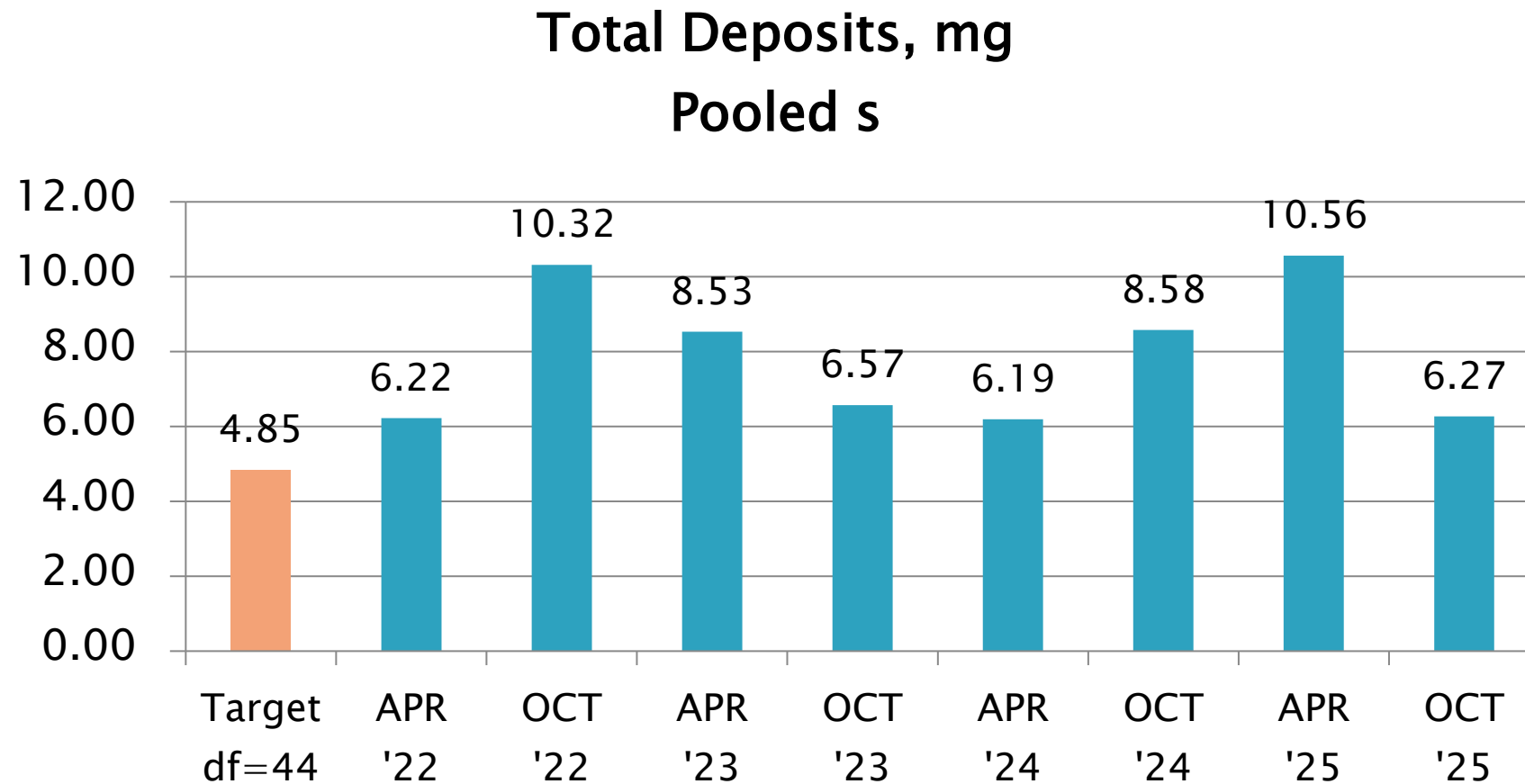
D6335: Deposits by TEOST-33C

Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Updated Targets 20201001 ¹	46	44	4.85	-----
4/1/21 through 9/30/21	31	28	8.27	-0.36
10/1/21 through 3/31/22	27	25	6.22	0.55
4/1/22 through 9/30/22	29	27	10.32	0.80
10/1/22 through 3/31/23	35	33	8.53	0.84
4/1/23 through 9/30/23	30	28	6.57	0.03
10/1/23 through 3/31/24	34	32	6.19	0.63
4/1/24 through 9/30/24	41	39	8.58	0.84
10/1/24 through 3/31/25	29	27	10.56	0.43
4/1/25 through 9/30/25	30	27	6.27	0.61

¹Target precision updated to include only current oils 75-1 and 435-2

D6335 Precision Estimates

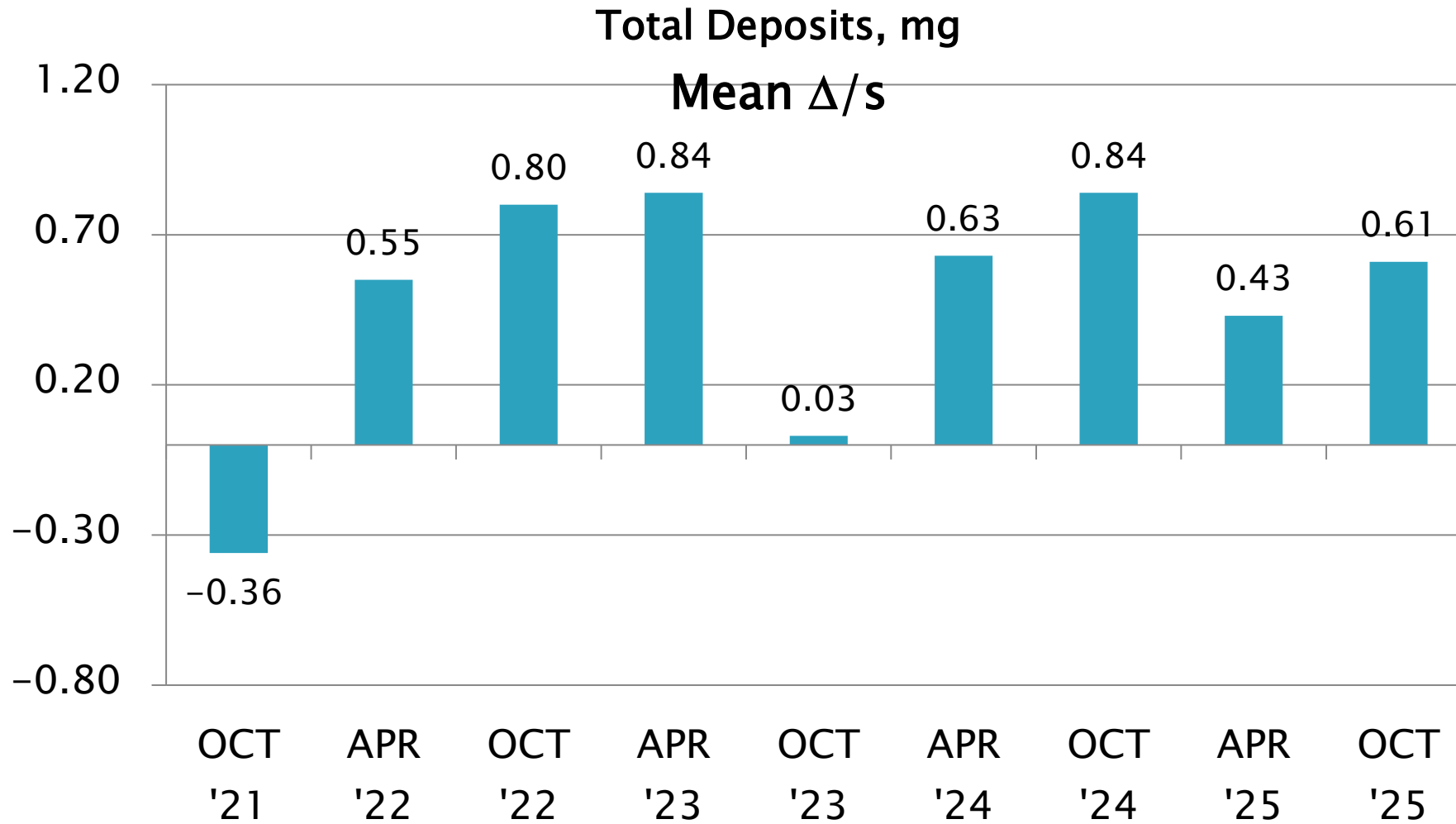


April 1, 2025 – September 30, 2025

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D6335 Severity Estimates

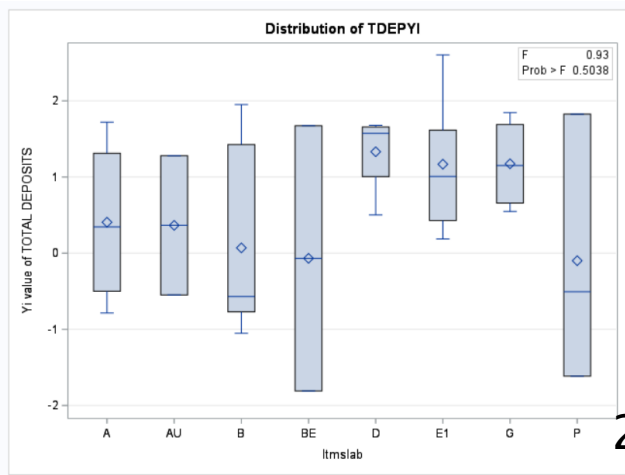


April 1, 2025 – September 30, 2025

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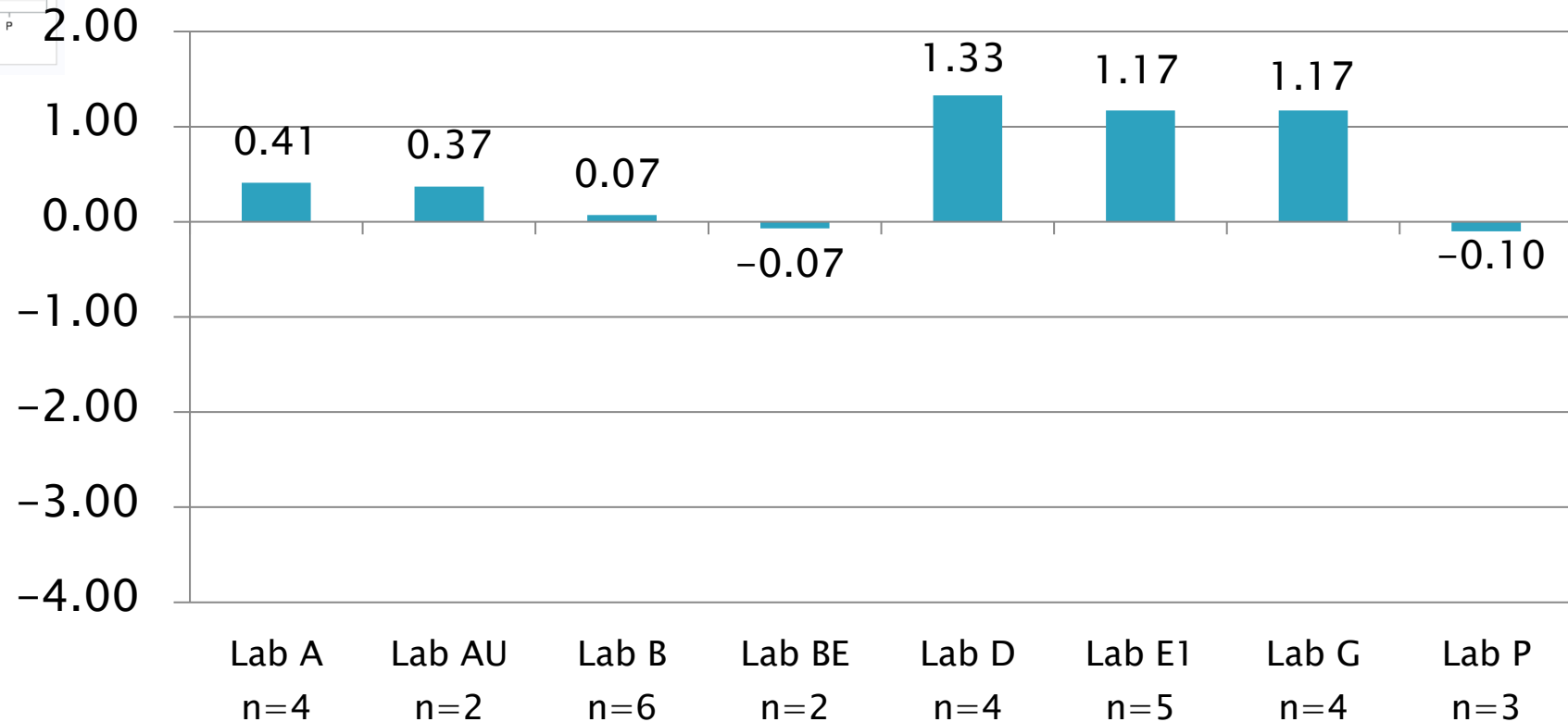
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D6335 Lab Severity Estimates

Total deposits, mg

Mean Δ/s



April 1, 2025 – September 30, 2025

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D6335: Deposits by TEOST-33C Status

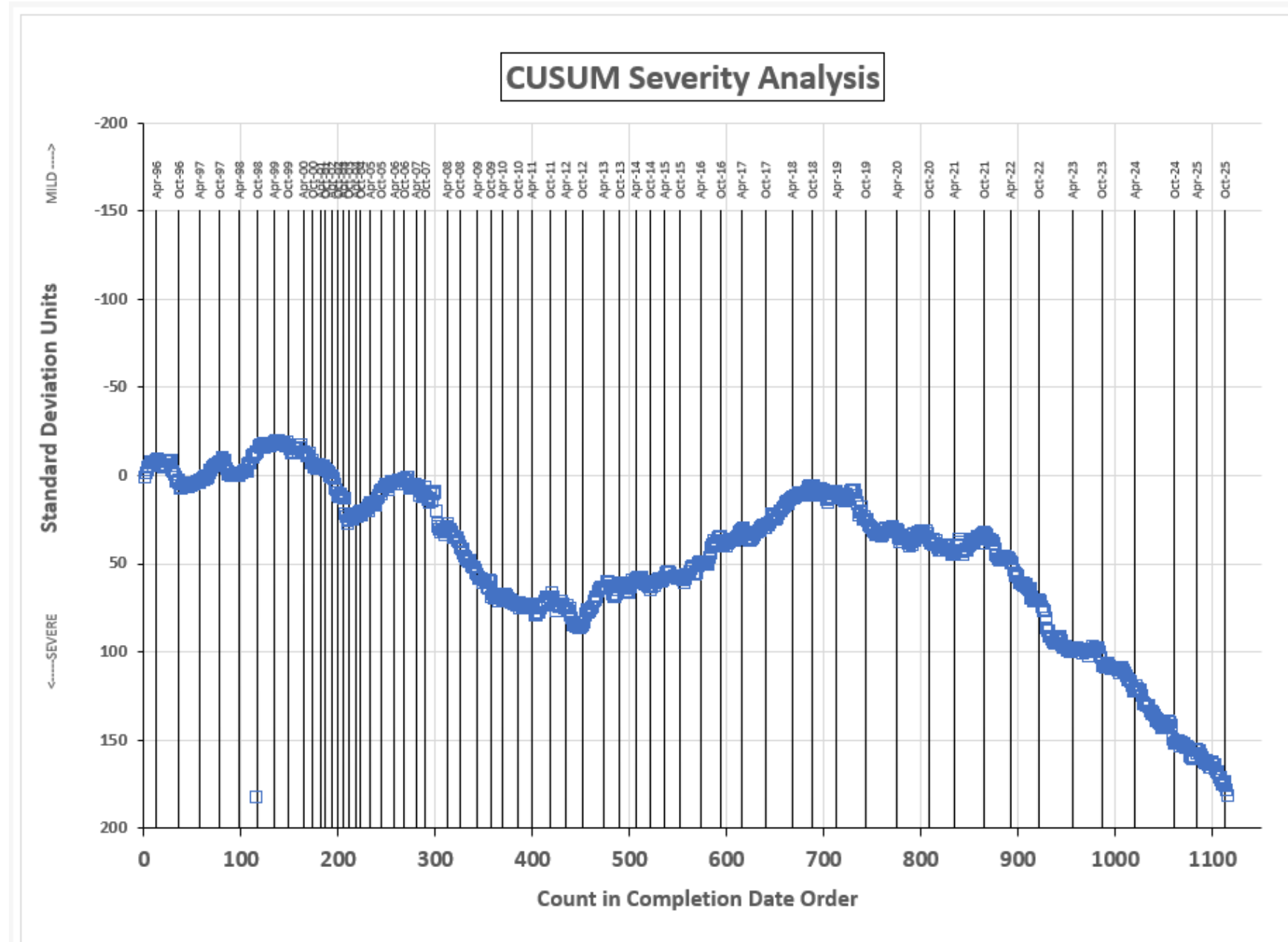
- Precision (Pooled s) improved towards target this semester (6.27s vs 10.56s)
- Performance (Mean Δ/s) regressed this this period moving to 0.61 (0.43 last semester)
- Fail rate decreased significantly to 3.3% this semester, last semester fail rate was 27.6%.
- All tests this period report used Rod Batch N.
- Reblend RO 75-2 has replaced batch 75-1. Surveillance Panel voted to carry-forward the existing acceptance range for 75-2, although round robin data is available to adjust the RO 75-2 targets if needed. RO 75-1 TESTKEYs will be assigned to consume inventories remaining at the labs.

April 1, 2025 – September 30, 2025

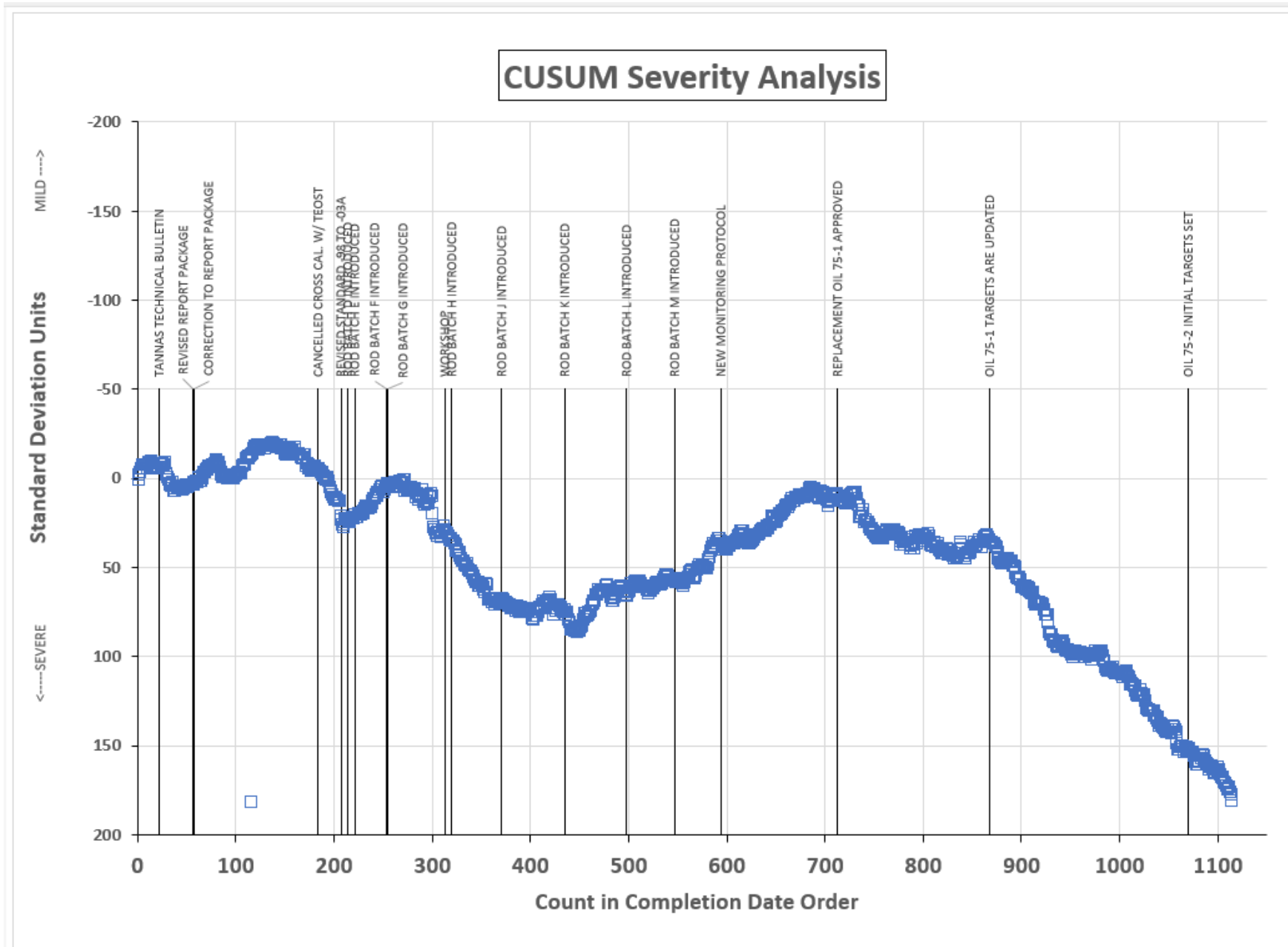
Test Monitoring Center
<https://www.astmtmc.org>

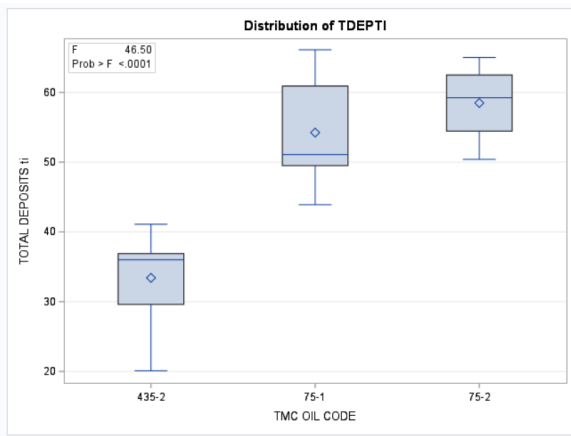


TOTAL DEPOSITS MG



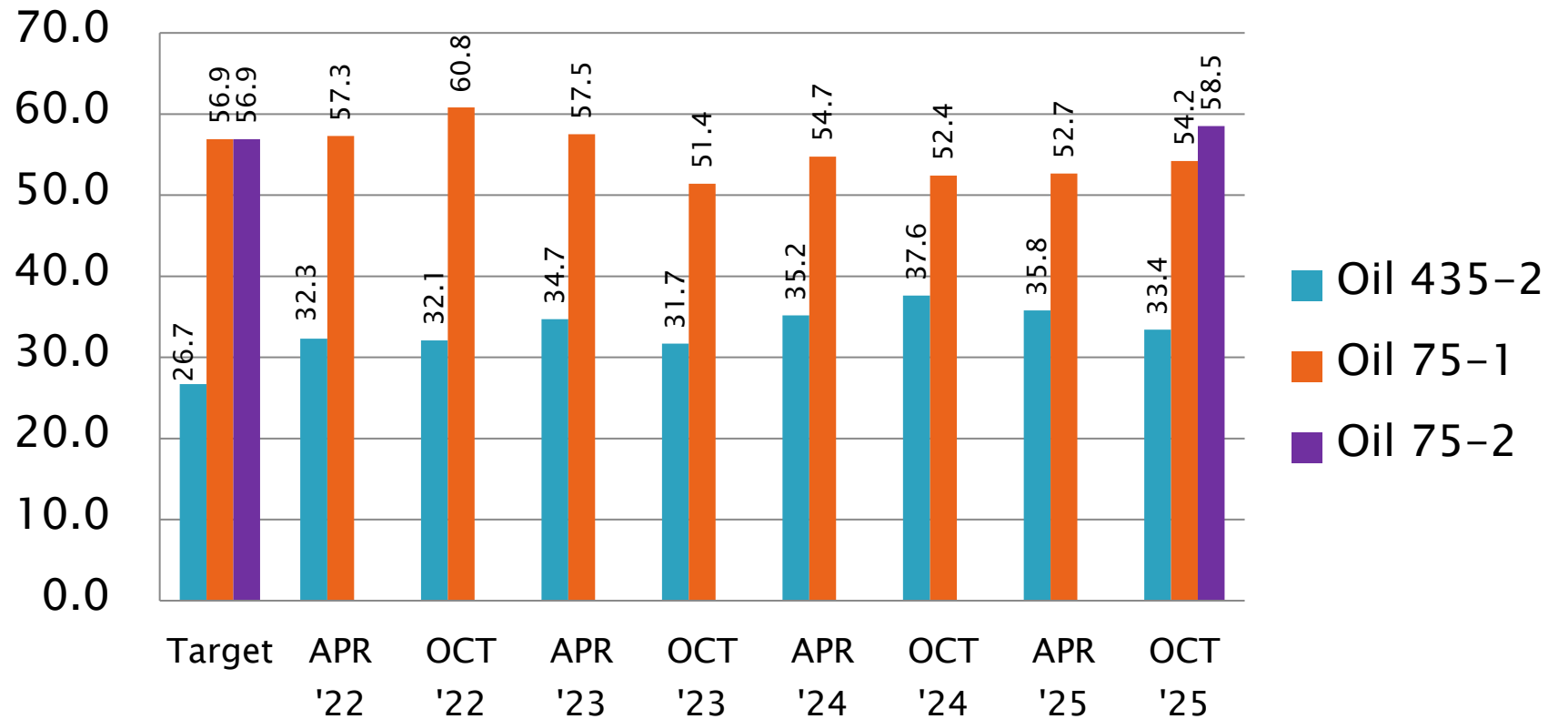
TOTAL DEPOSITS MG





D6335 Performance by Oil

Total Deposits, mg
Mean

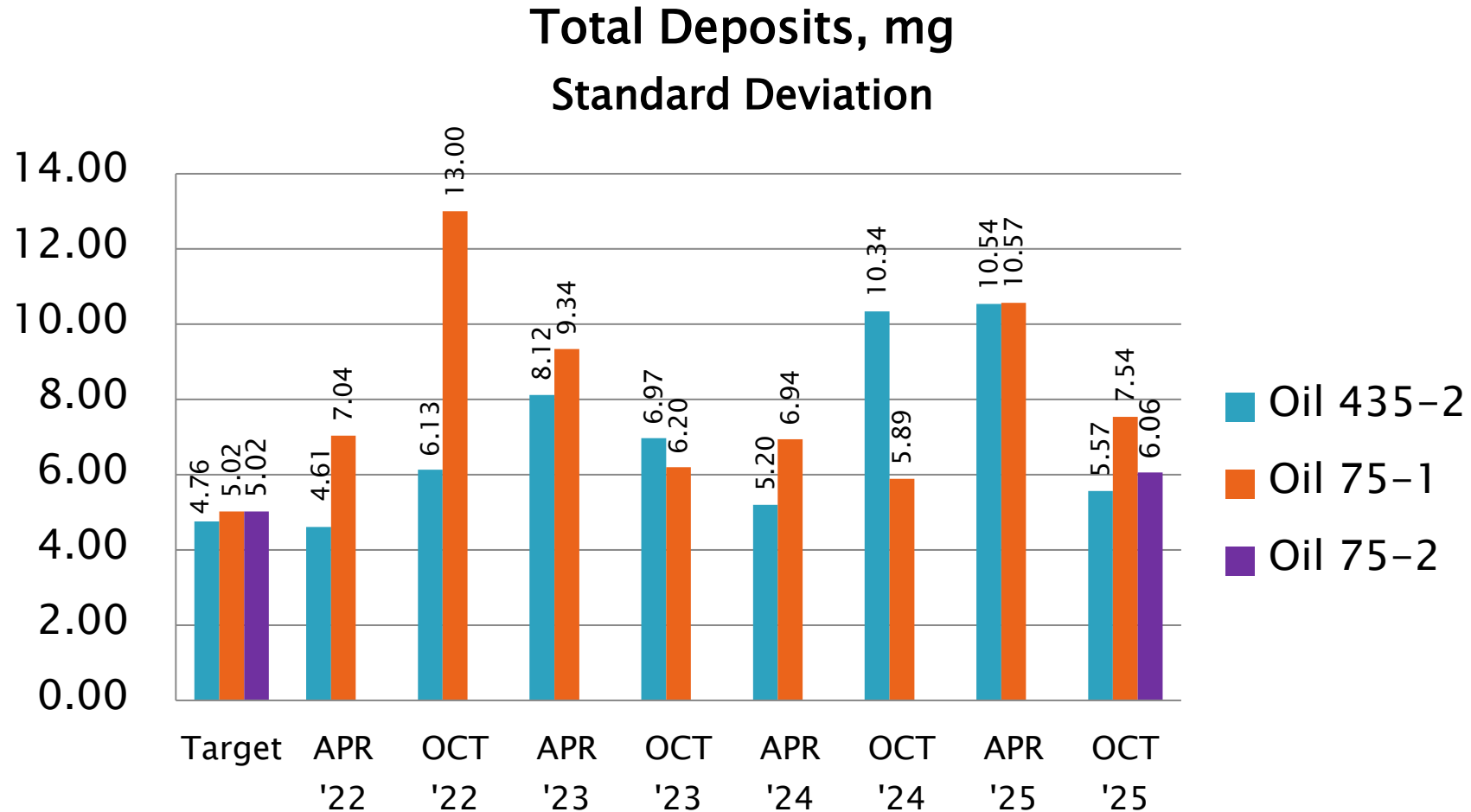


April 1, 2025 – September 30, 2025

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D6335 Performance by Oil



April 1, 2025 – September 30, 2025

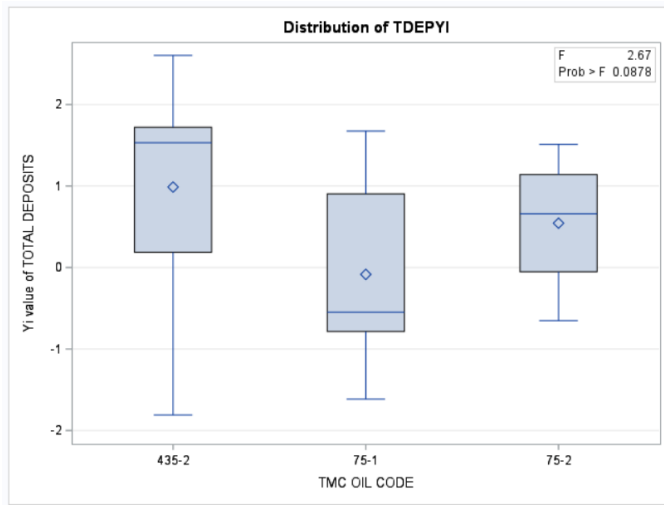
Test Monitoring Center
<https://www.astmtmc.org>



D6335 Performance by Oil

Total Deposits, mg

Mean Δ/s



2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
-0.25
-0.50
-0.75

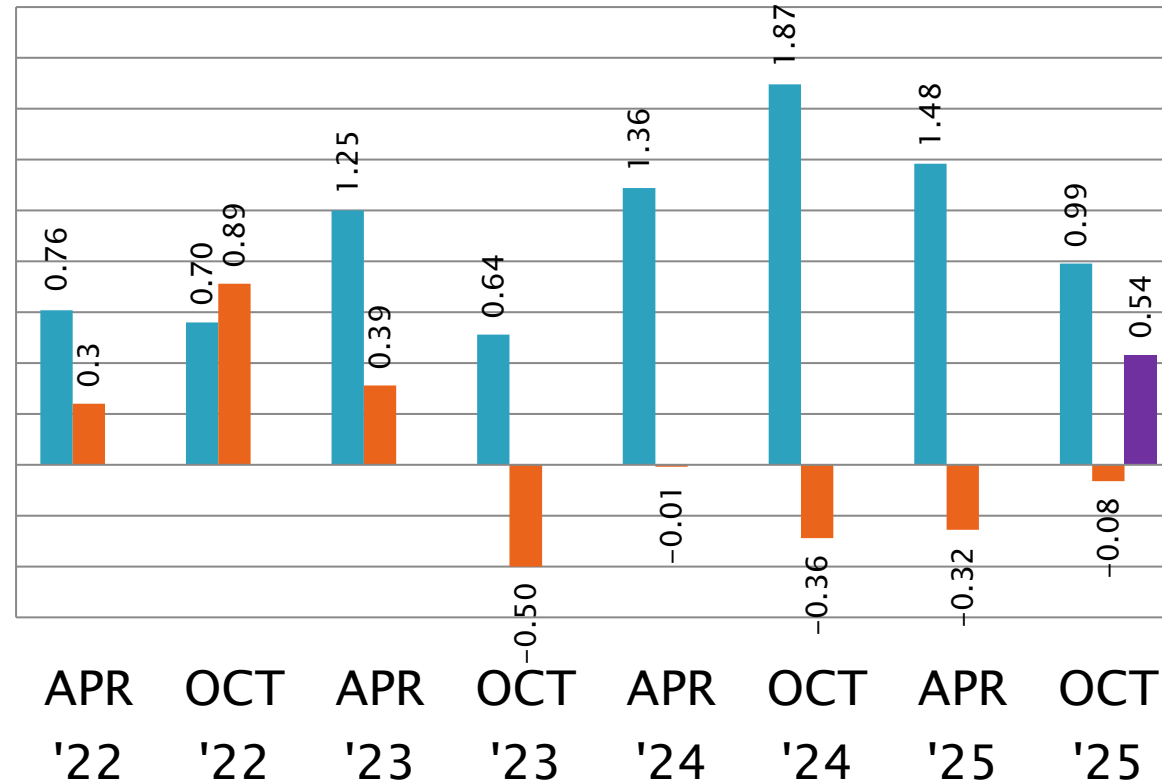


TABLE of CONTENTS

Test Monitoring Center
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Reference Oil Inventory

TEOST

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
75-2	2024	TEOST	5.48	1.38	4 years
435-2 ^B	2010	TEOST	31.50	0.23	5+ years

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B Multi-test oil; estimated aliquot reserved for bench testing.

April 1, 2025 – September 30, 2025

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



D02.B0.07

TMC Monitored Tests



ASTM D 6417

April 1, 2025 – September 30, 2025

D6417 Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6417	7 (+0)	12 (+2)
*Between 4/1/2025 and 9/30/2025		

D6417: Estimation of Engine Oil Volatility by Capillary GC

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	21
Failed Calibration Test	OC	0
Total		21

Number of Labs Reporting Data: 7
Fail Rate of Operationally Valid Tests: 0.0%

April 1, 2025 – September 30, 2025

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



D6417: Estimation of Engine Oil Volatility by Capillary GC

Statistically Unacceptable Tests (OC)	No. Of Tests
Volatility Loss Mild	0
Volatility Loss Severe	0

Operationally Invalid Tests (LC)	No. Of Tests
Daily QC was out of range (Severe)	0

- No D6417 TMC technical updates were issued this report period.

D6417: Estimation of Engine Oil Volatility by Capillary GC

Period Precision and Severity Estimates

Area % Volatized @ 371°C	n	df	Pooled s	Mean Δ/s
Initial Selected Oils from RR	54	51	0.39	-----
4/1/21 through 9/30/21	17	14	0.39	-0.28
10/1/21 through 3/31/22	20	17	0.51	0.13
4/1/22 through 9/30/22	19	16	0.48	-0.67
10/1/22 through 3/31/23	18	15	0.43	0.41
4/1/23 through 9/30/23	16	13	0.34	-0.02
10/1/23 through 3/31/24	18	15	0.27	0.25
4/1/24 through 9/30/24	20	17	0.40	-0.02
10/1/24 through 3/31/25	20	17	0.43	-0.16
4/1/25 through 9/30/25	21	18	0.32	-0.16

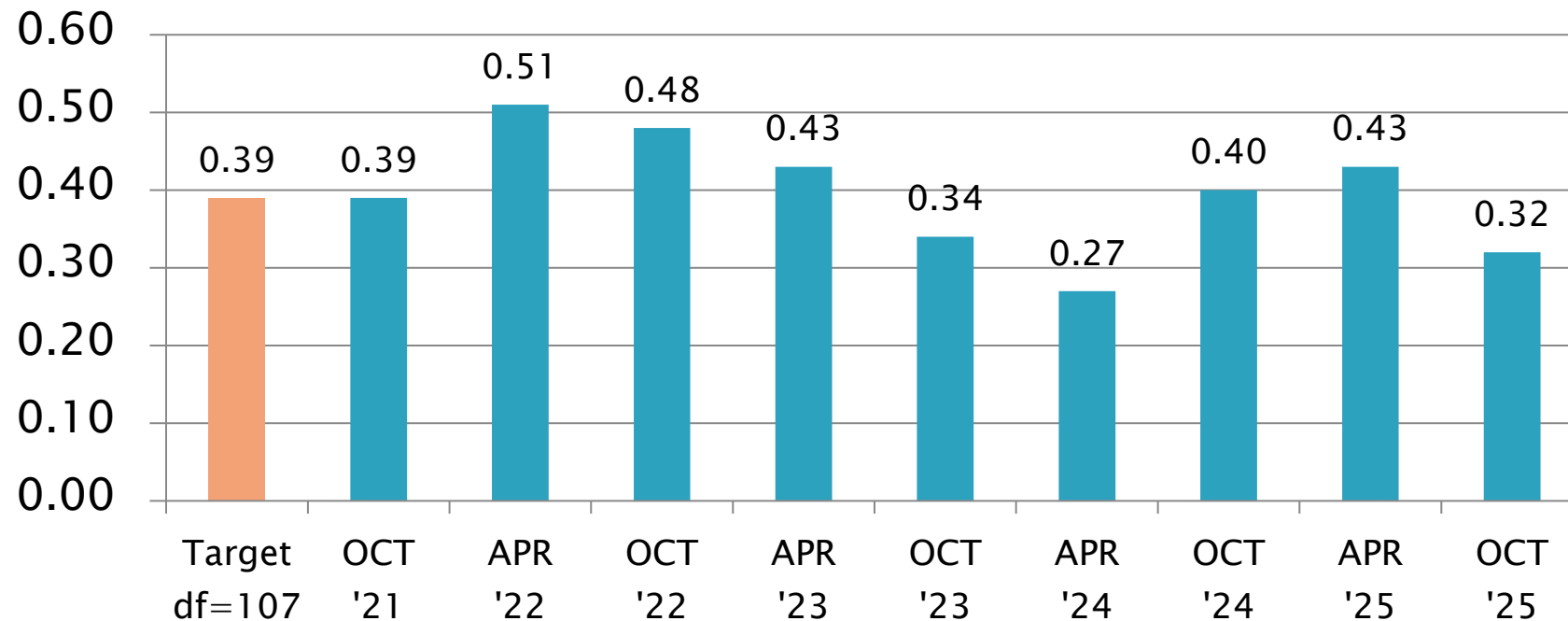
April 1, 2025 – September 30, 2025

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



D6417 Precision Estimates

Area % Volatized @ 371°C
Pooled s



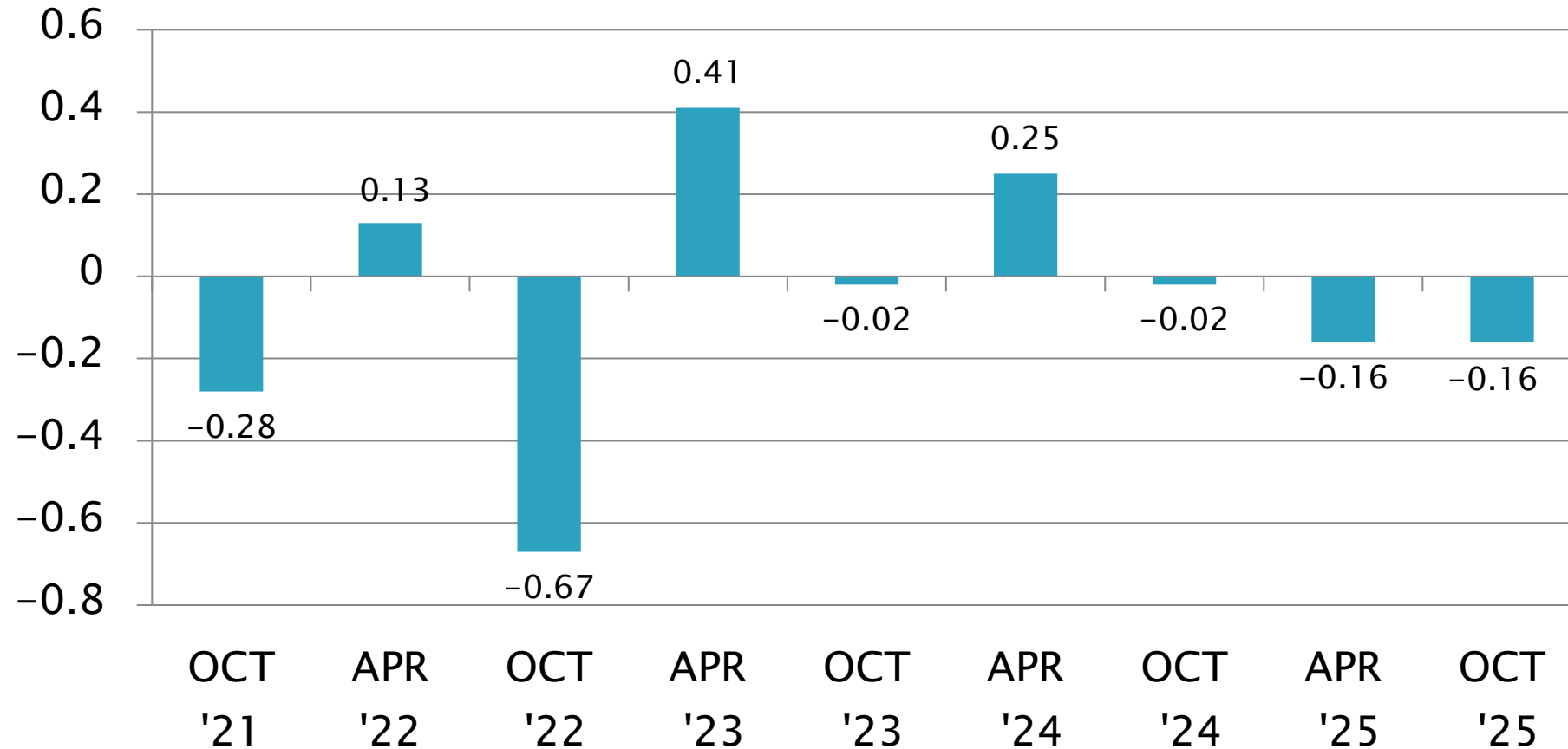
April 1, 2025 – September 30, 2025

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



D6417 Severity Estimates

Area % Volatized @ 371°C
Mean Δ/s



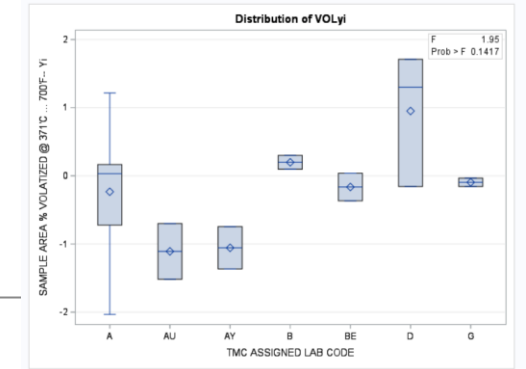
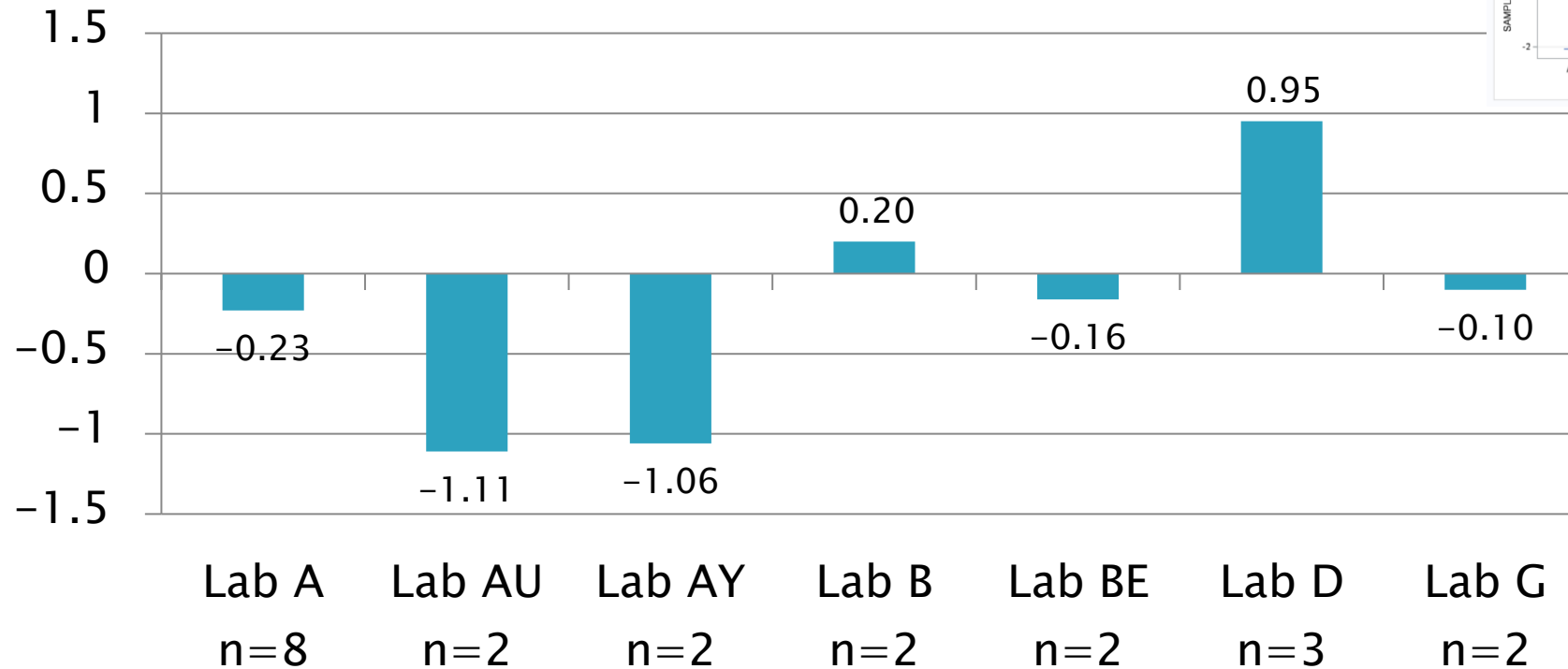
April 1, 2025 – September 30, 2025

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



D6417 Lab Severity Estimates

Area % Volatized @ 371°C
Mean Δ/s

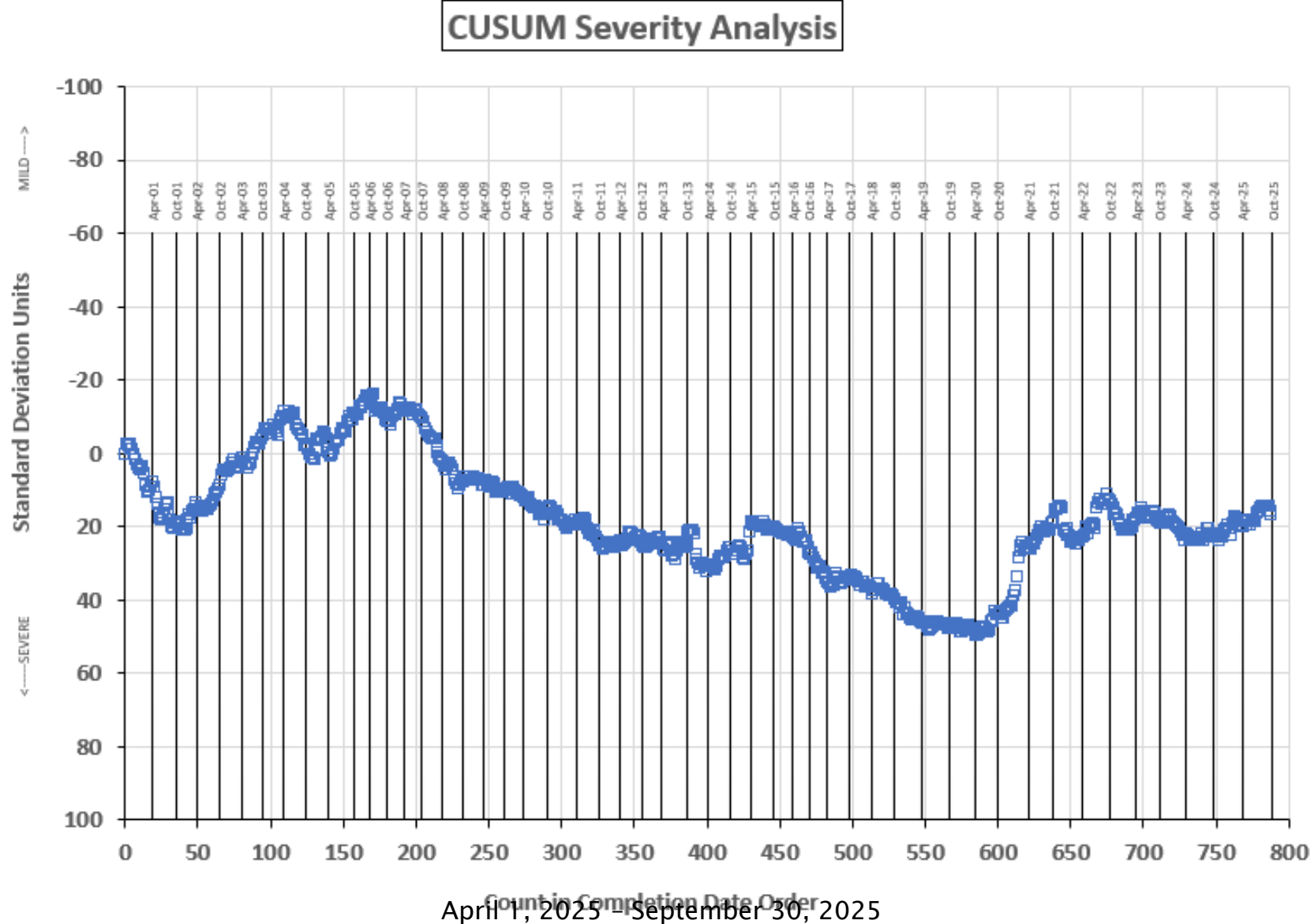


April 1, 2025 – September 30, 2025

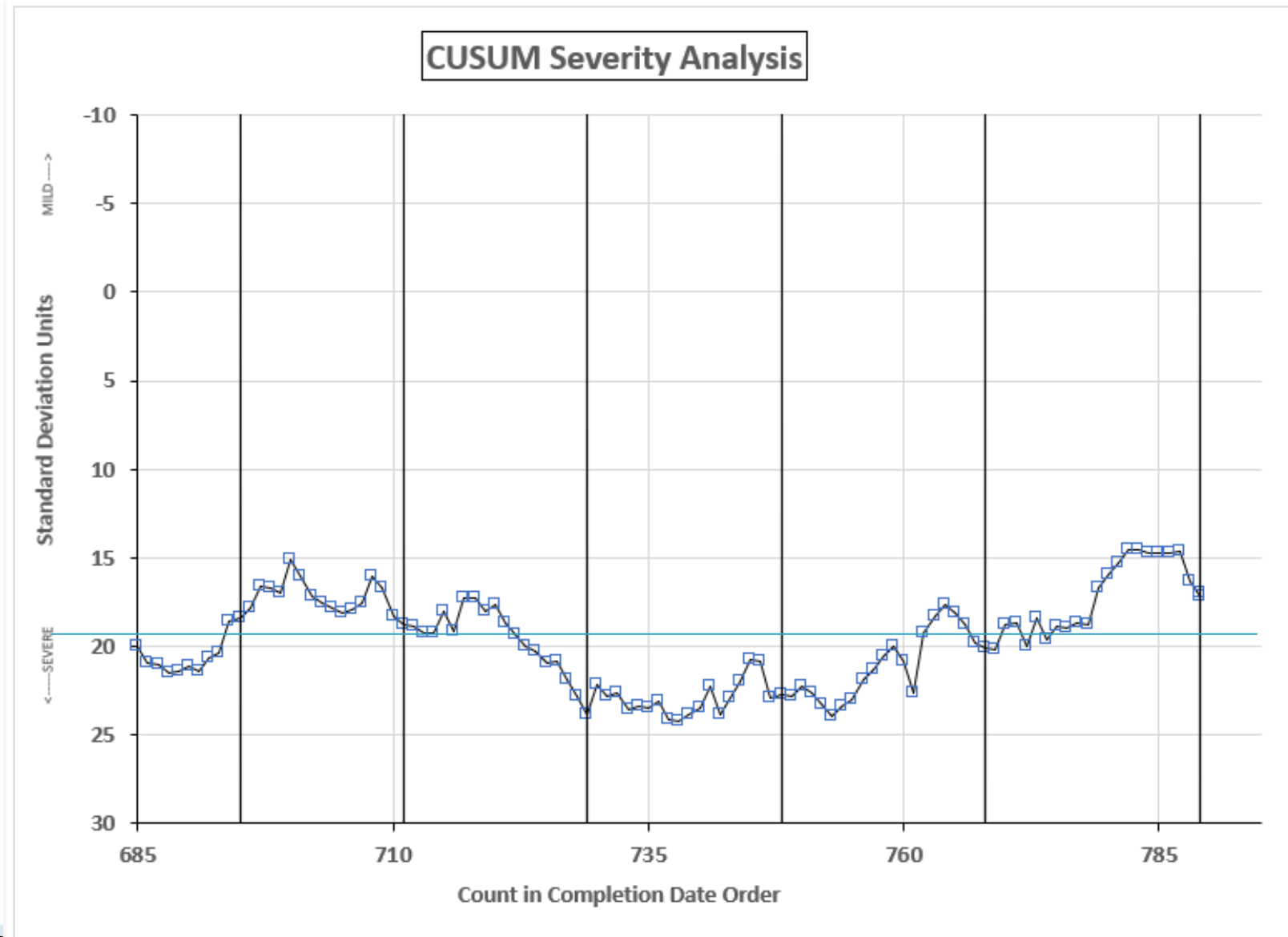
Test Monitoring Center
<https://www.astmtmc.org>



SAMPLE AREA % VOLATIZED



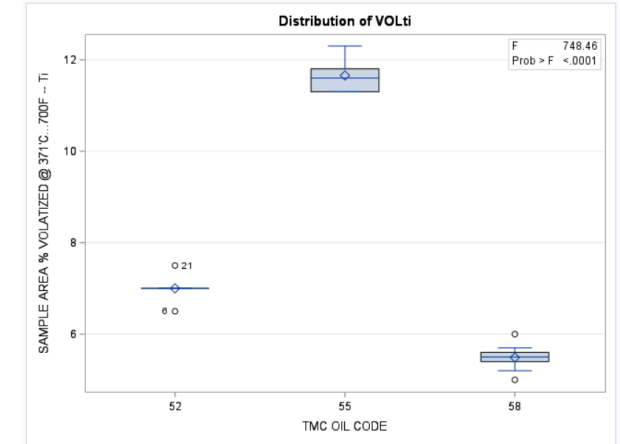
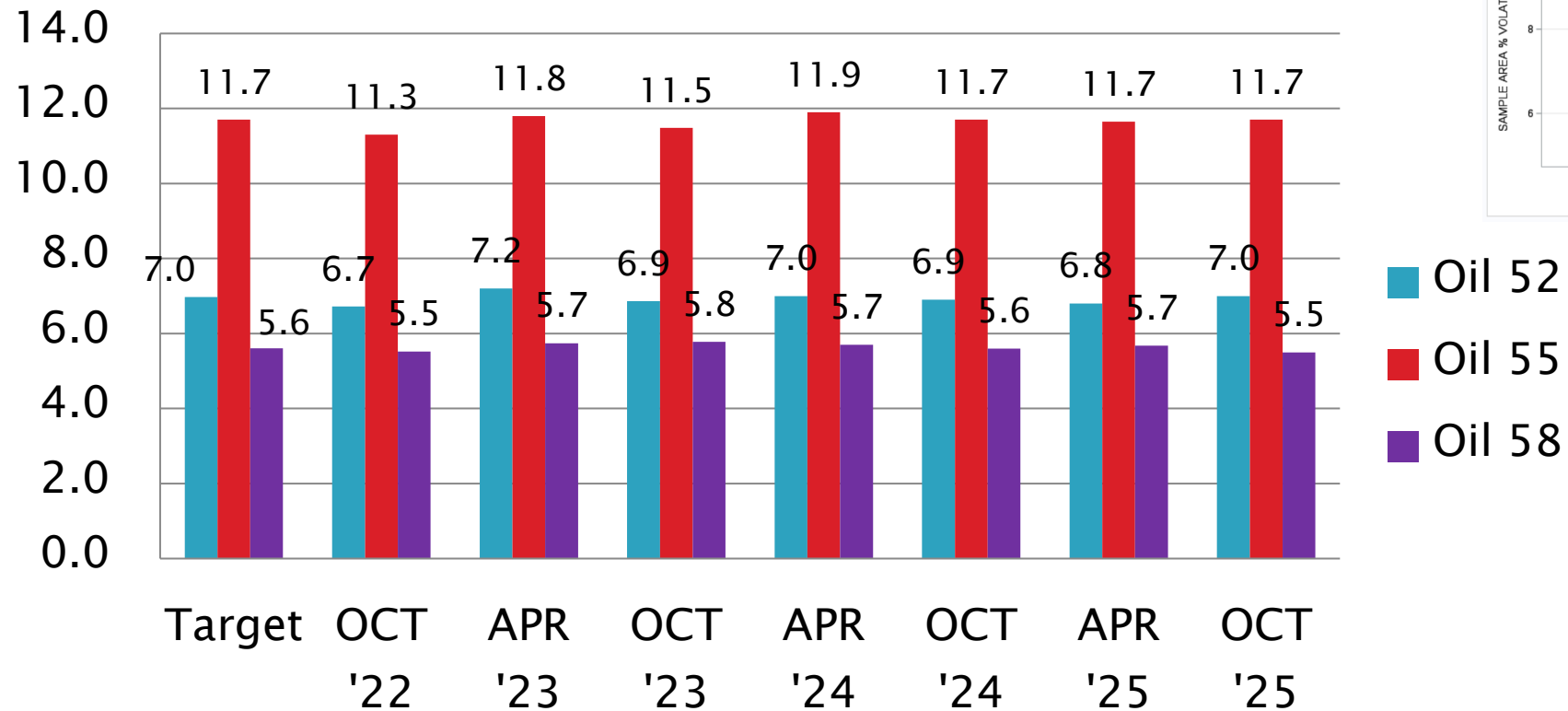
D6417 VOLATILITY BY GC INDUSTRY OPERATIONALLY VALID DATA
LAST 90 Points
SAMPLE AREA % VOLATIZED



April 1, 2025 - September 30, 2025

D6417 Performance by Oil

Area % Volatized @ 371°C
Mean



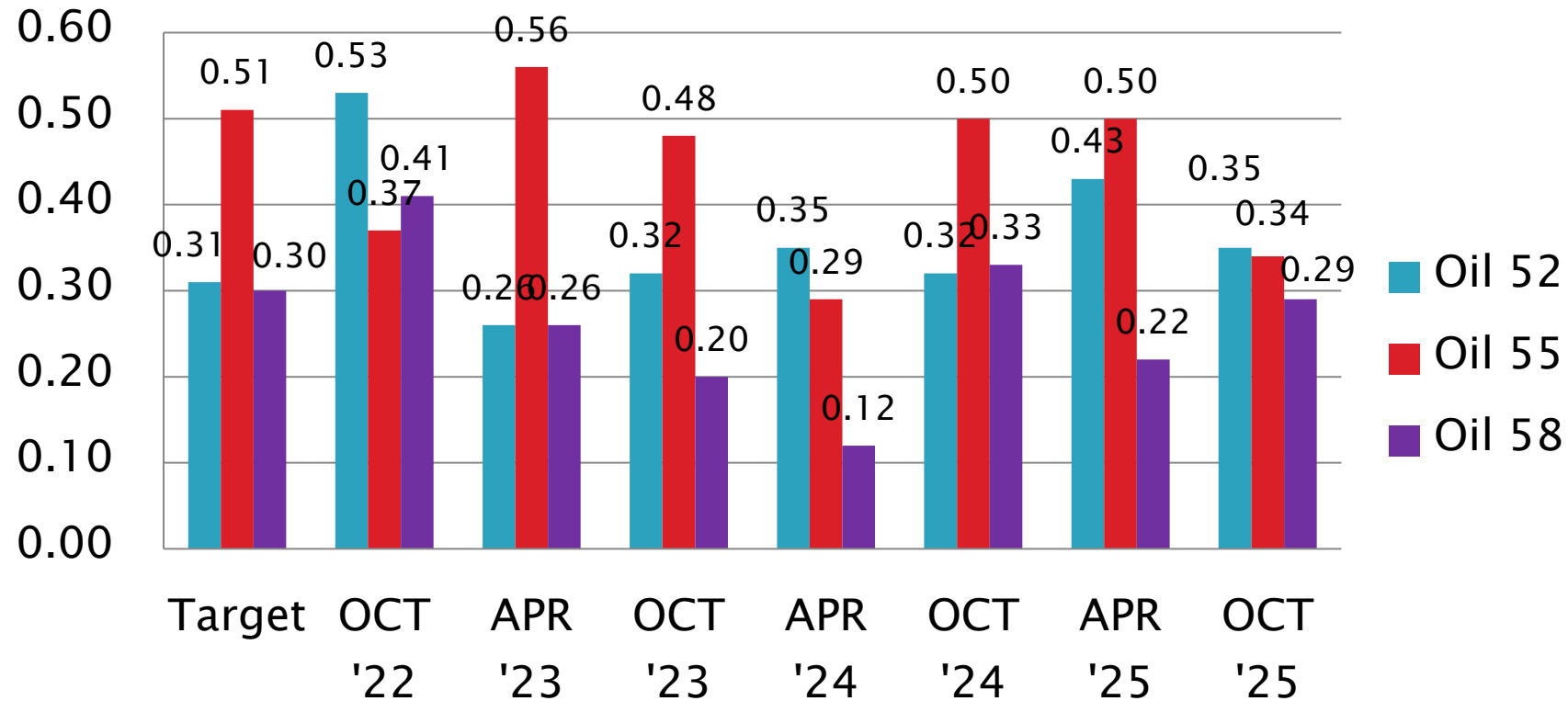
April 1, 2025 – September 30, 2025

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



D6417 Performance by Oil

Area % Volatized @ 371°C
Standard Deviation



April 1, 2025 – September 30, 2025

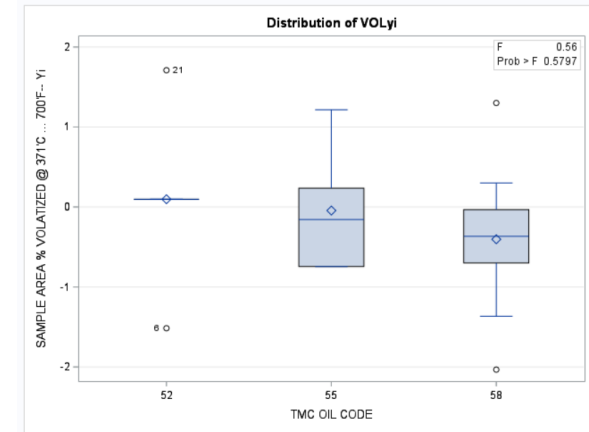
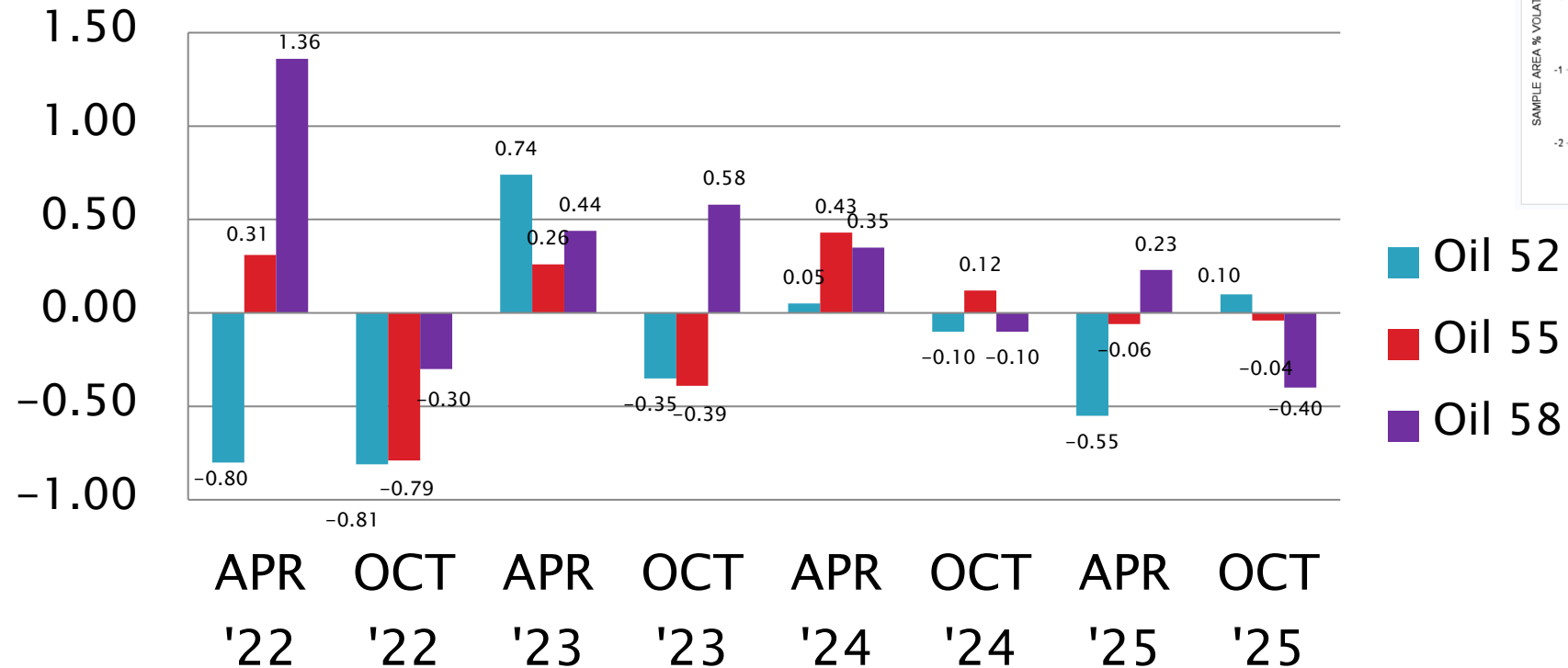
Test Monitoring Center
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D6417 Performance by Oil

Area % Volatized @ 371°C
Mean Δ /s



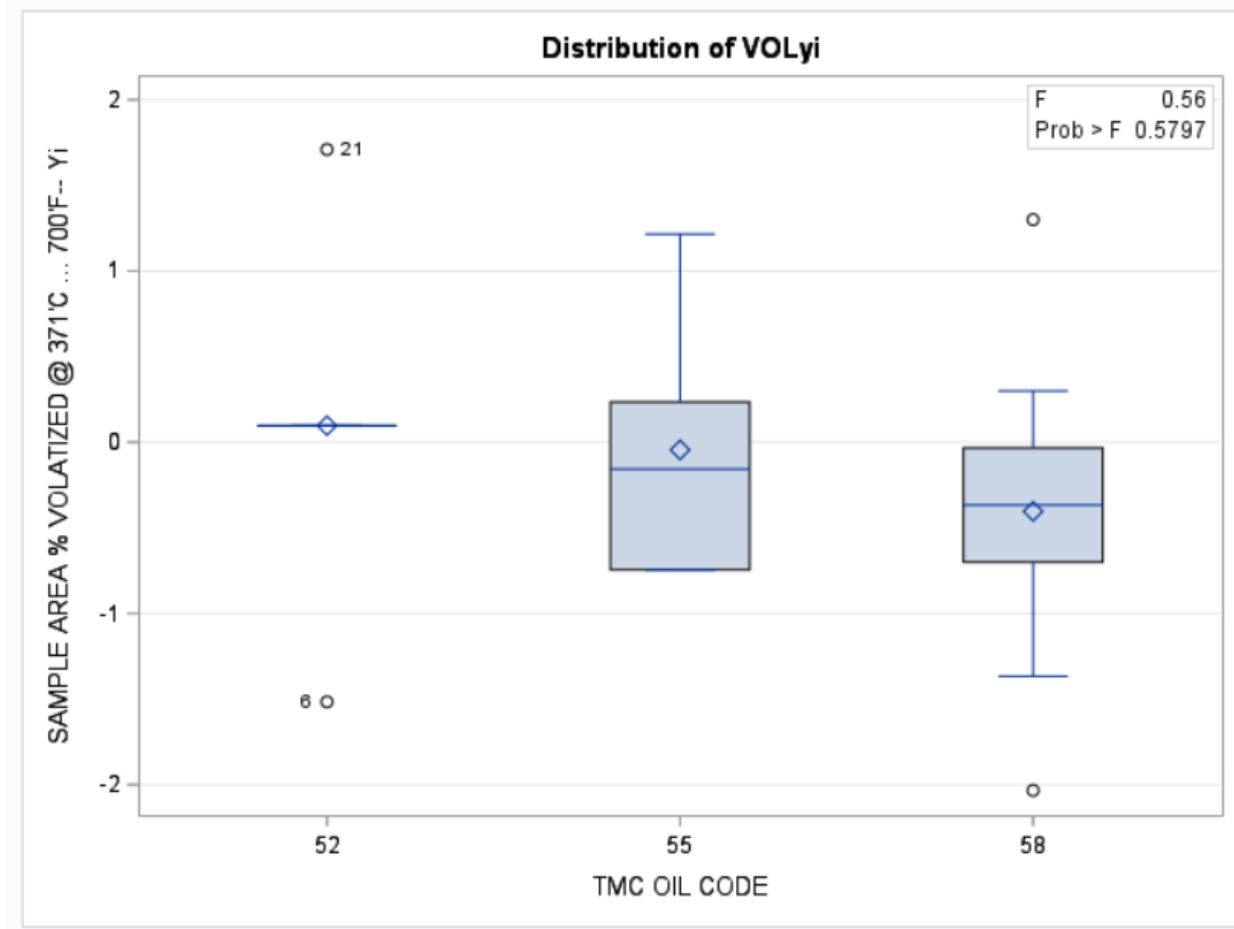
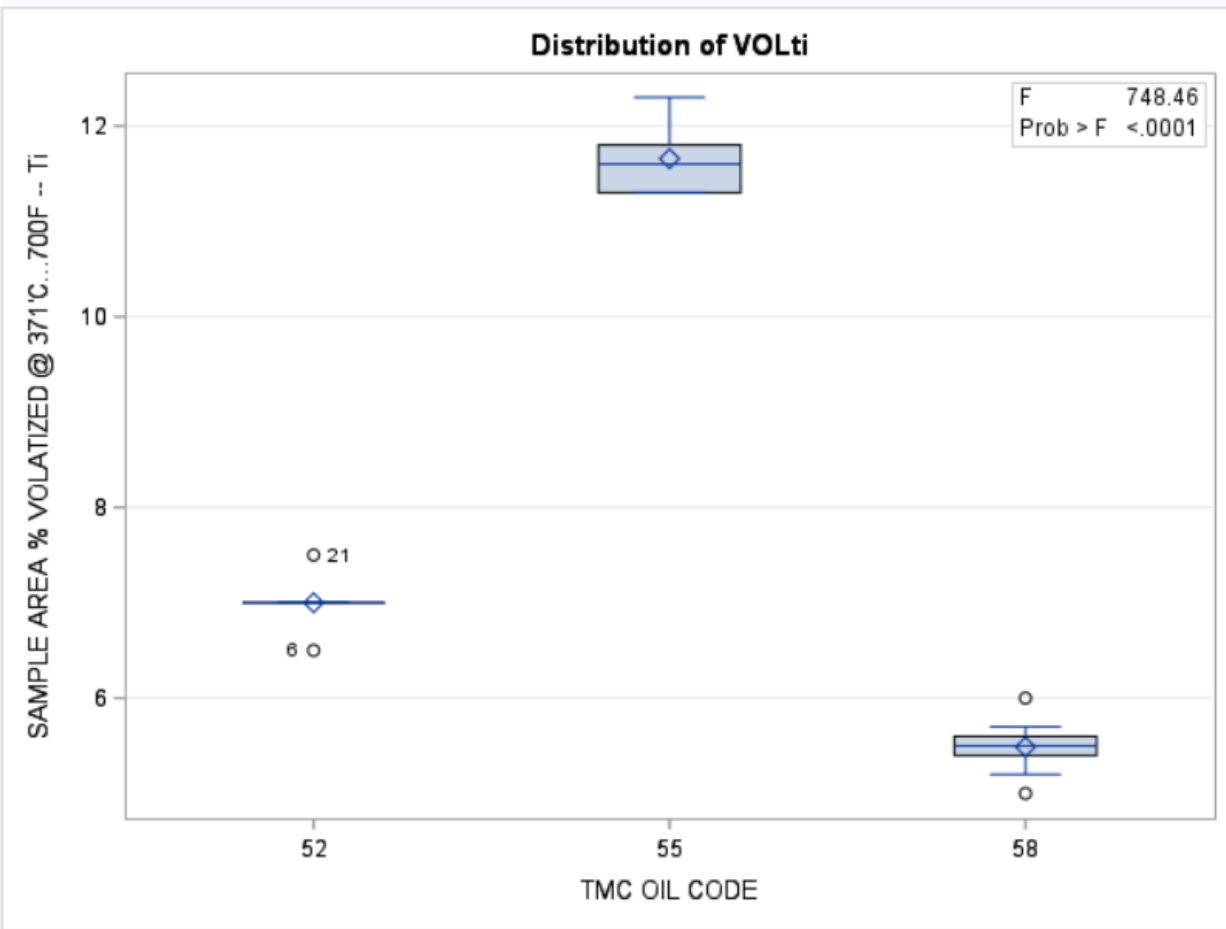
April 1, 2025 – September 30, 2025

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D6417 Performance by Oil



April 1, 2025 – September 30, 2025

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D6417: Estimation of Engine Oil Volatility by Capillary GC Status

- ▶ Precision (Pooled s) continues to be remarkably consistent and on target (again) this past semester.
- ▶ Performance (Mean Δ/s) is the same as last semester (-0.16) and is still near target.
- ▶ CUSUM severity continuing to be relatively flat this semester

TABLE of CONTENTS

Test Monitoring Center
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Reference Oil Inventory

D6417

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
52 ^B	1995	D6417	59.37	<0.01	5+ years
55	1995	D6417	65.89	<0.01	5+ years
58	1998	D6417, D6417QC	111.3	0.2	5+ years

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B Reference Oil 58 is used in multiple Bench Test Areas.

April 1, 2025 – September 30, 2025

Test Monitoring Center
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D02.B0.07

TMC Monitored Tests



ASTM D 6557

Ball Rust Test (BRT)

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6557	5 (+0)	5 (+0)
*As of 9/30/2025		

BRT Test Activity*

Test Status	Validity Code	Number of Tests
Acceptable Calibration Test	AC	177
Failed Calibration Test	OC	1
Operationally Invalid	LC, RC, LS, RS	4
Aborted Run	XC, XS	1
Shakedown Run (Result Within Acceptance Band)	NN	0
Shakedown Run (Result Outside Acceptance Band)	MN	0
Total		183

- 5 labs reported data

April 1, 2025 – September 30, 2025

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



BRT Failed Tests

Failed Parameter (OC)	Number of Tests
Severe (low) Average Gray Value	1
Mild (high) Average Gray Value	0
Total	1

RO 82-1

RO 86

RO 87

RO 1006

One Severe Test

April 1, 2025 – September 30, 2025

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



BRT Failed Tests (OC) by Lab

Failed Parameter	LTMS Lab					#
	A	B	D	G	L	
Severe Average Gray Value	0	0	1	0	0	1
Mild Average Gray Value	0	0	0	0	0	0
Total	0	0	1	0	0	1

April 1, 2025 – September 30, 2025

Test Monitoring Center
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BRT Lost Tests*

Failed Parameter (LC, RC, XC)	Number of Tests
Temperature Control Issues (LC)	2
Shaker Tabel Failure (LC)	1
Testing Time Error (LC)	1
Aborted due to loss of power (XC)	1
Total	5

*Invalid (LC, RC) and Aborted (XC) calibration tests

April 1, 2025 – September 30, 2025

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



BRT Lost Tests by Lab

Cause	LTMS Lab					#
	A	B	D	G	L	
Temperature Control Issues (LC)	0	0	0	2	0	2
Shaker Tabel Failure (LC)	0	0	0	1	0	1
Testing Time Error (LC)	0	0	0	1	0	1
Aborted due to loss of power (XC)	0	0	1	0	0	1
Total	0	0	1	4	0	5

April 1, 2025 – September 30, 2025

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



BRT (D6557) Rust Protection Test

Period Precision and Severity Estimates

Average Gray Value	n	df	Pooled s	Mean Δ/s
10/1/21 through 3/31/22	141	138	16.28	0.12
4/1/22 through 9/30/22	154	151	21.10	-0.29
10/1/22 through 3/31/23	165	162	15.56	-0.17
4/1/23 through 9/30/23	171	168	17.56	0.34
10/1/23 through 3/31/24	183	179	13.75	0.32
4/1/24 through 9/30/24	166	162	14.41	-0.07
10/1/24 through 3/31/25	170	168	7.90	-0.61
4/1/25 through 9/30/25	177	176	3.63	-0.63

*Period statistics for all Valid Reference Oil Results (pooled)

April 1, 2025 – September 30, 2025

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D6557: Ball Rust Test Status

- ▶ Calibration tests continue to be run only on Reference Oil 1006 (High Reference Oil).
- ▶ Ball Bearing Batch E was round-robin tested in RO's 1006 and 82-1 to determine if it could be a replacement for current Ball Bearing Batch D. Data supported the replacement and Batch E Ball Bearings are now available for use in the BRT with no change from the current Acceptance Bands for Reference Oils 1006 and 82-1. A follow-up Round Robin with RO's 86 and 87 with Ball Bearing Batch E is currently underway.

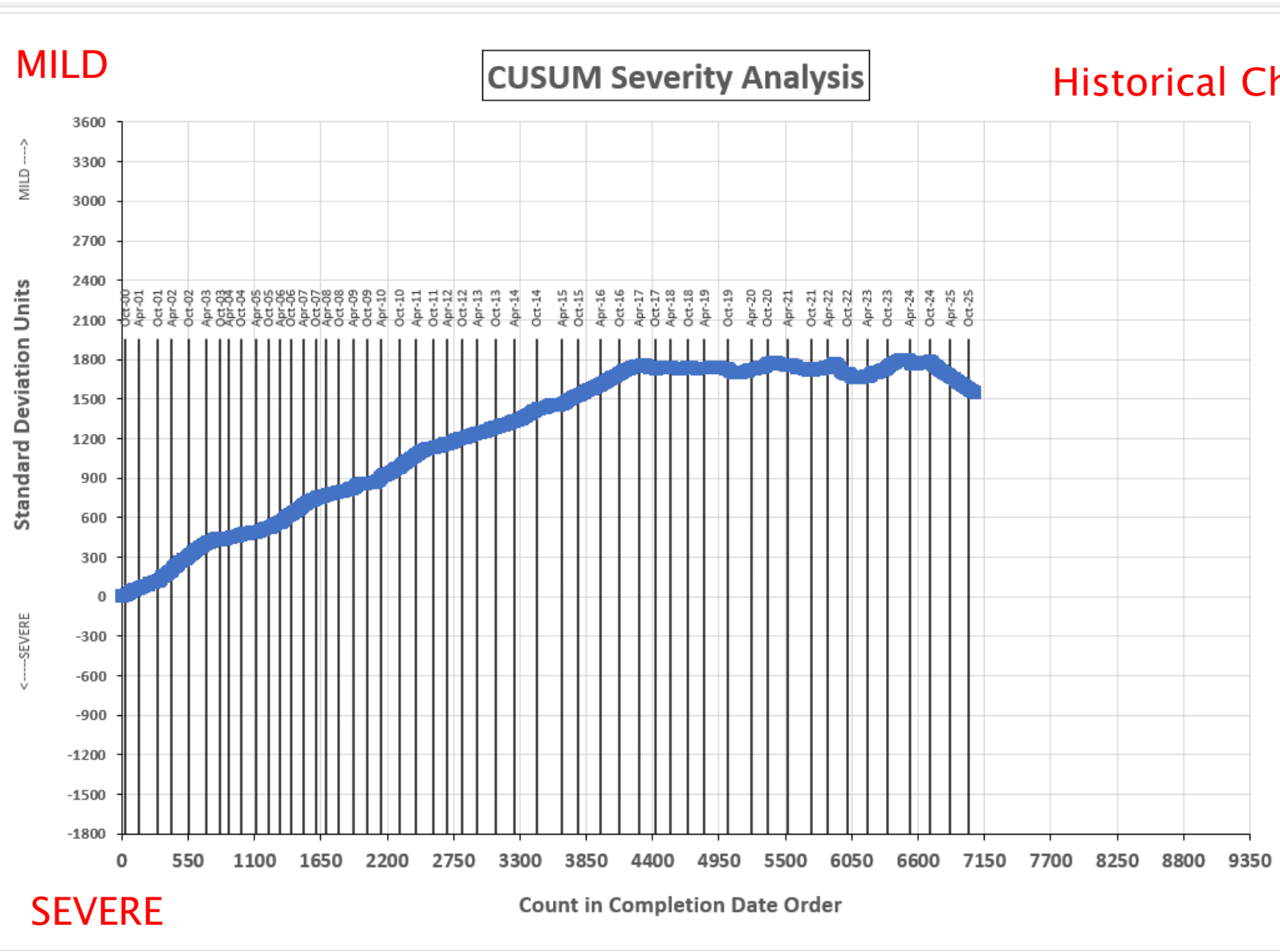
April 1, 2025 – September 30, 2025

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

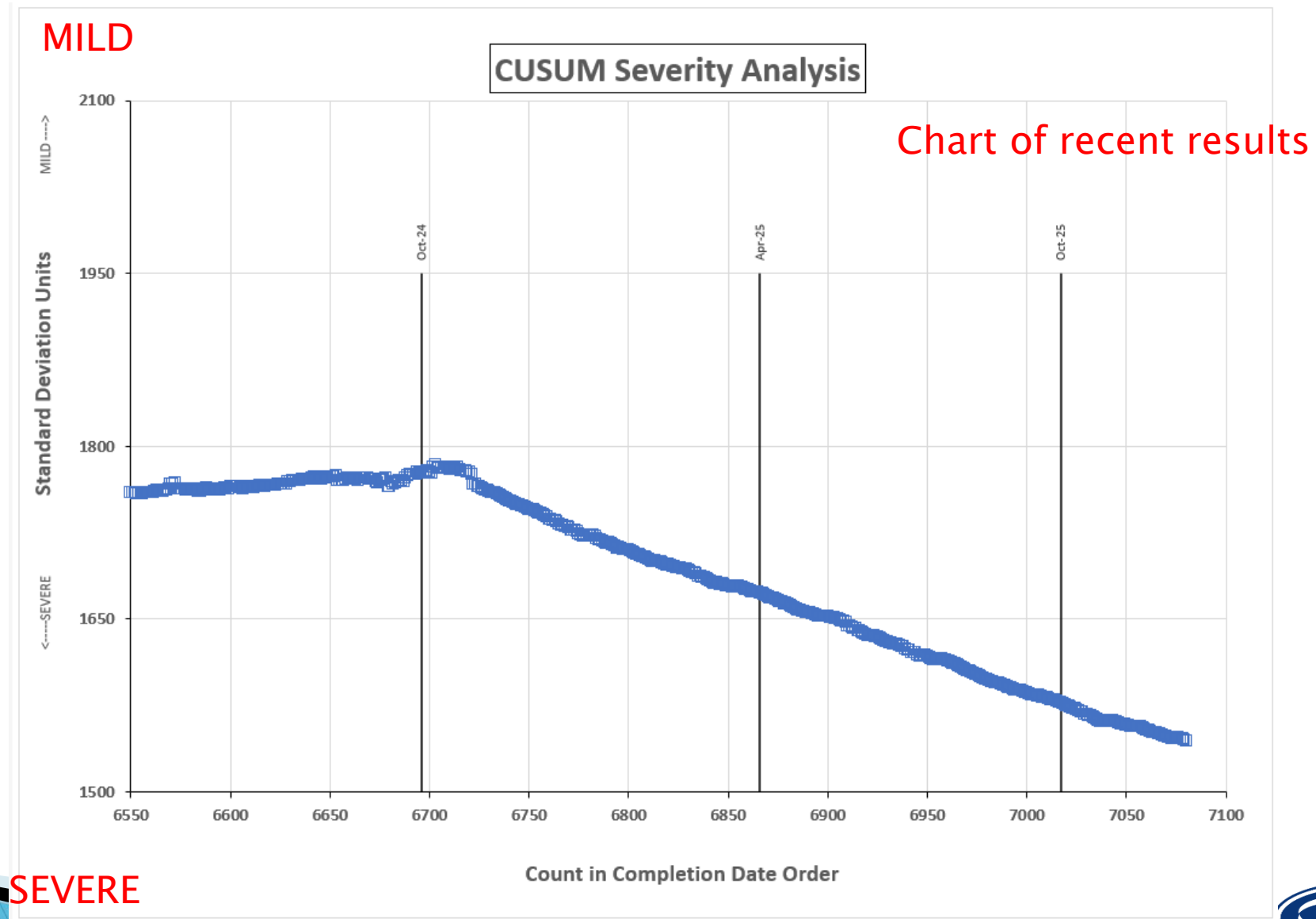


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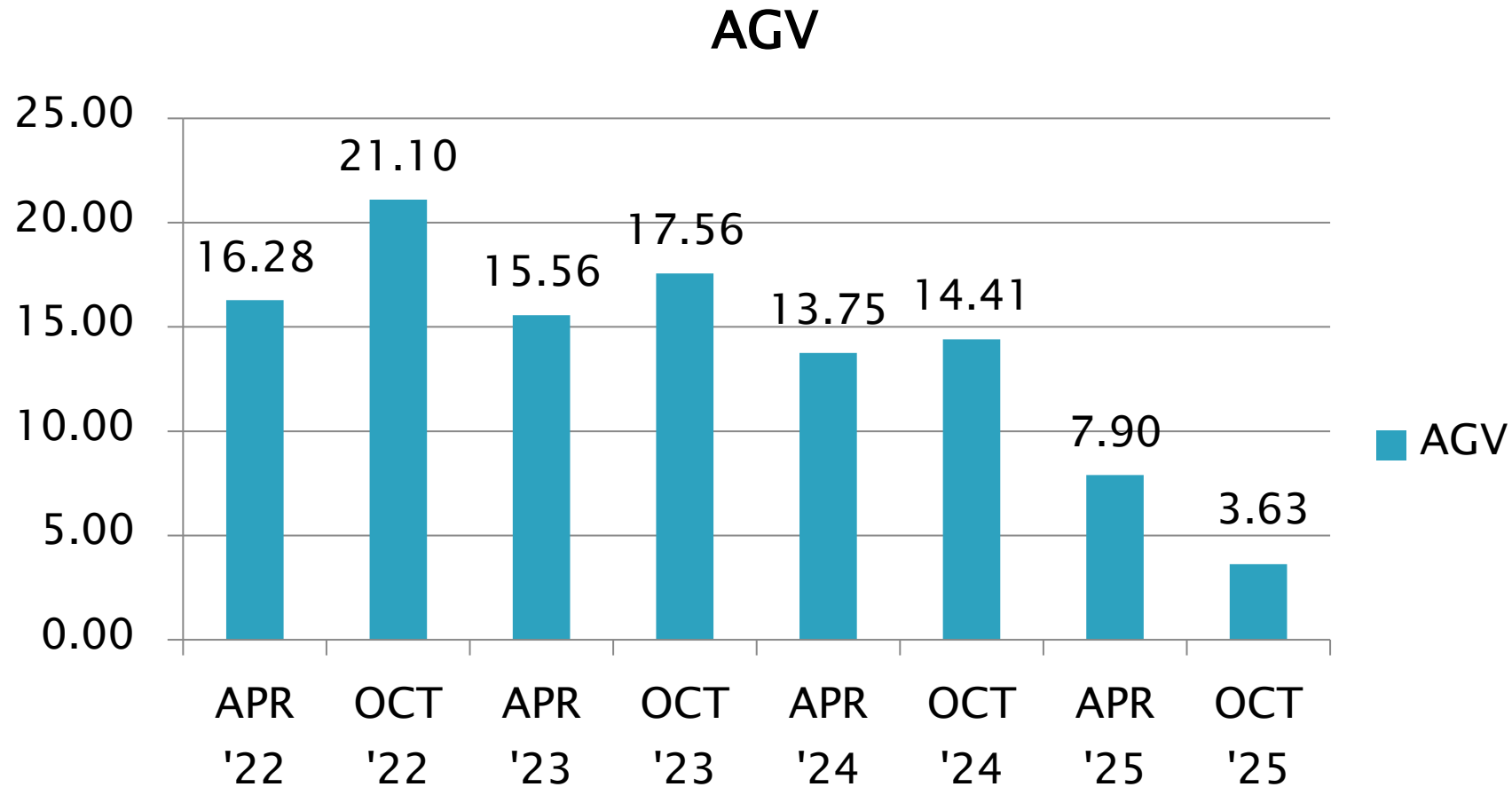
REFERENCE AVERAGE GRAY VALUE



BALL RUST TEST INDUSTRY OPERATIONALLY VALID DATA
Last 500 Points
REFERENCE AVERAGE GRAY VALUE



BRT Precision (Pooled s) Estimates

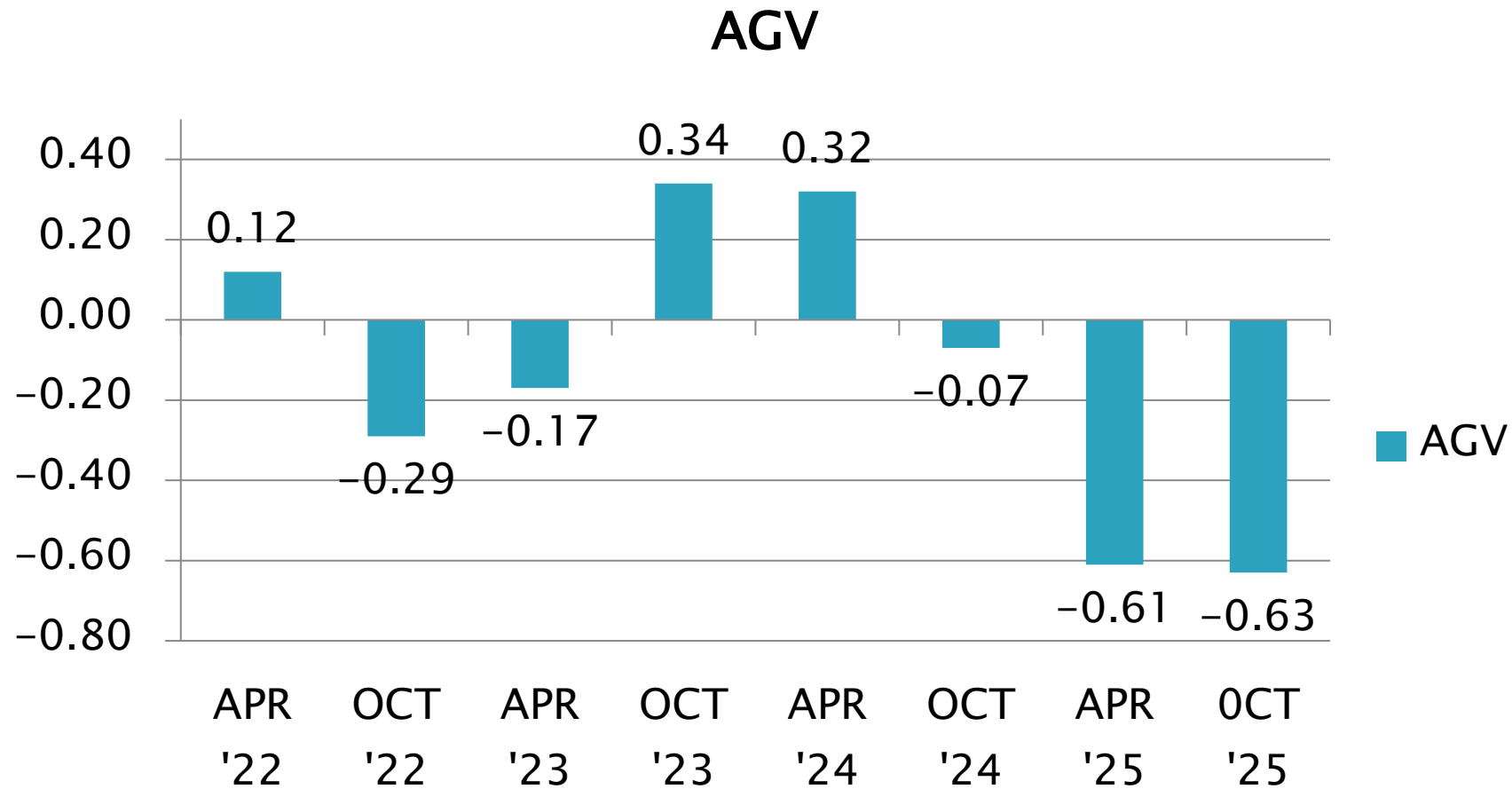


April 1, 2025 – September 30, 2025

Test Monitoring Center
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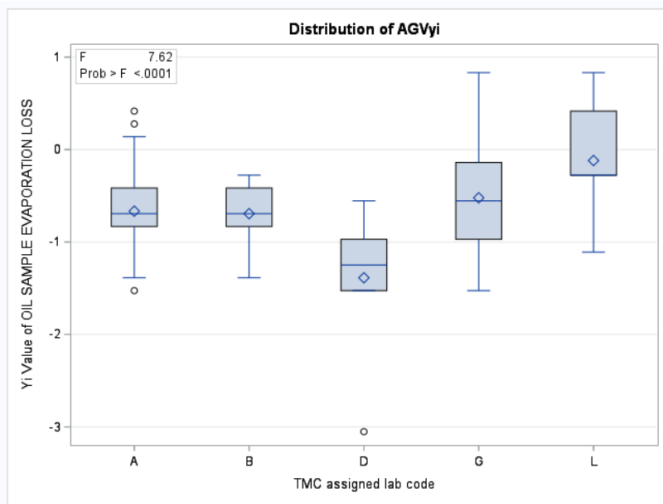
BRT Performance (Mean Δ/s) Estimates



April 1, 2025 – September 30, 2025

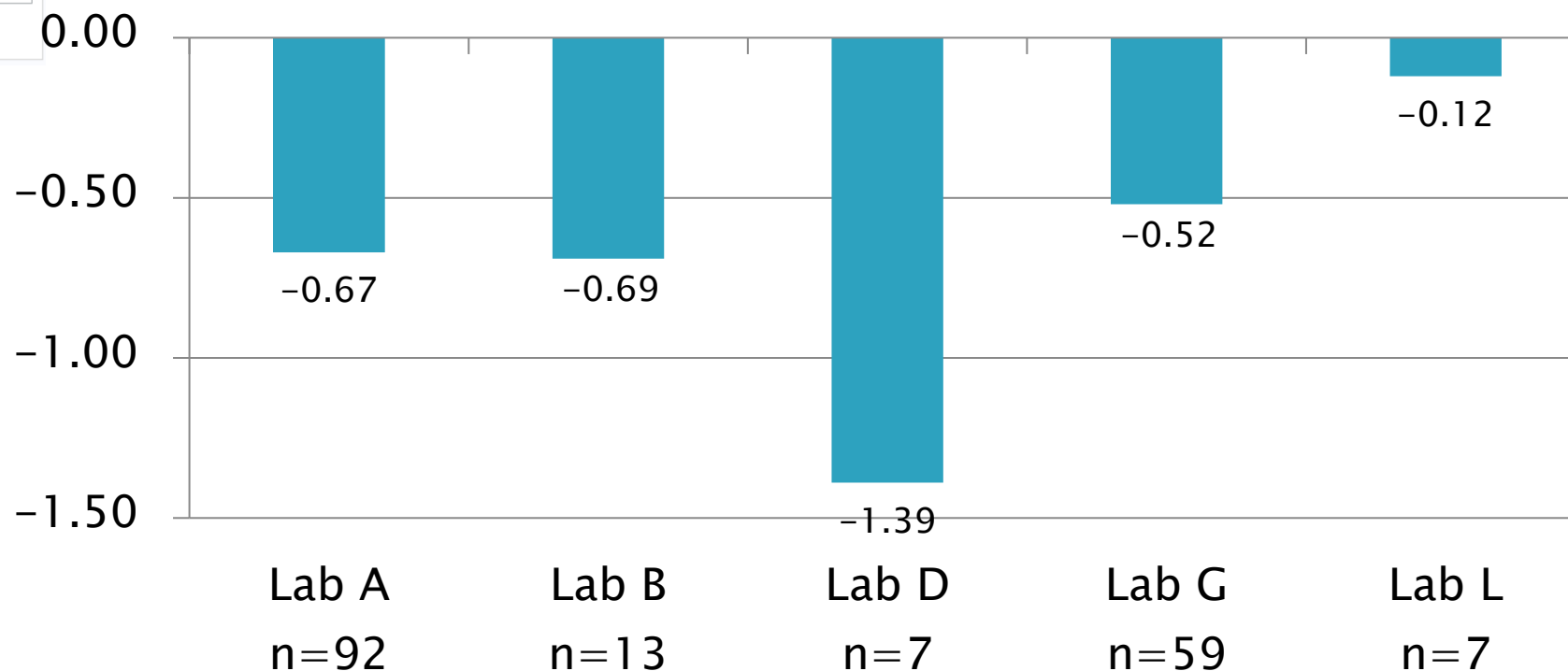
Test Monitoring Center
<https://www.astmtmc.org>





BRT Lab Severity Estimates

AGV
Mean Δ/s



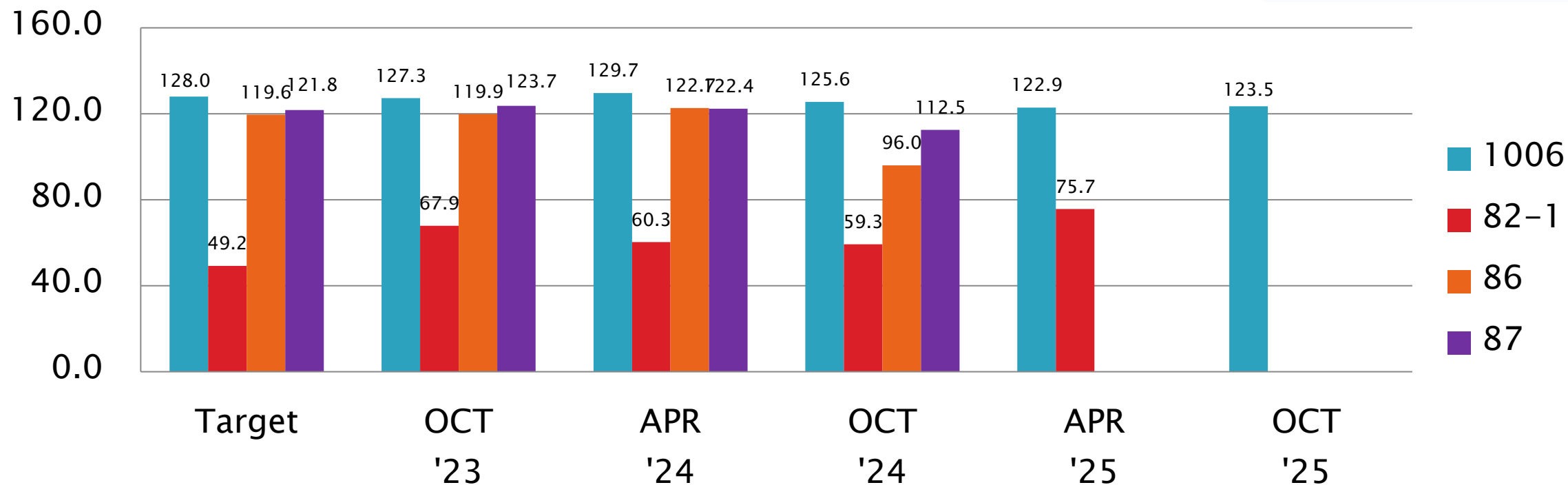
April 1, 2025 – September 30, 2025

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



BRT Performance by OIL

Average Gray Value Mean



April 1, 2025 – September 30, 2025

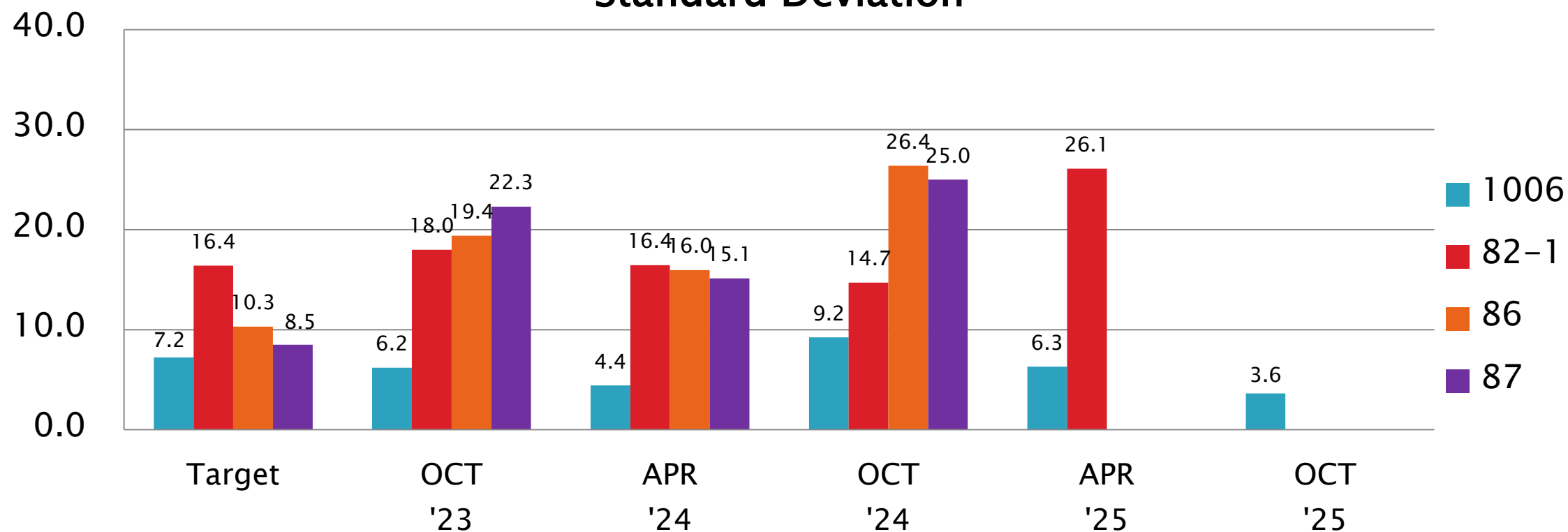
Test Monitoring Center
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BRT Performance by OIL

Average Gray Value
Standard Deviation

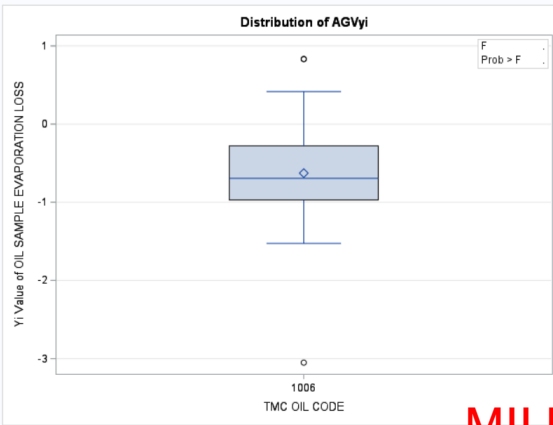


April 1, 2025 – September 30, 2025

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BRT Performance by OIL



MILD

2.00

1.00

0.00

-1.00

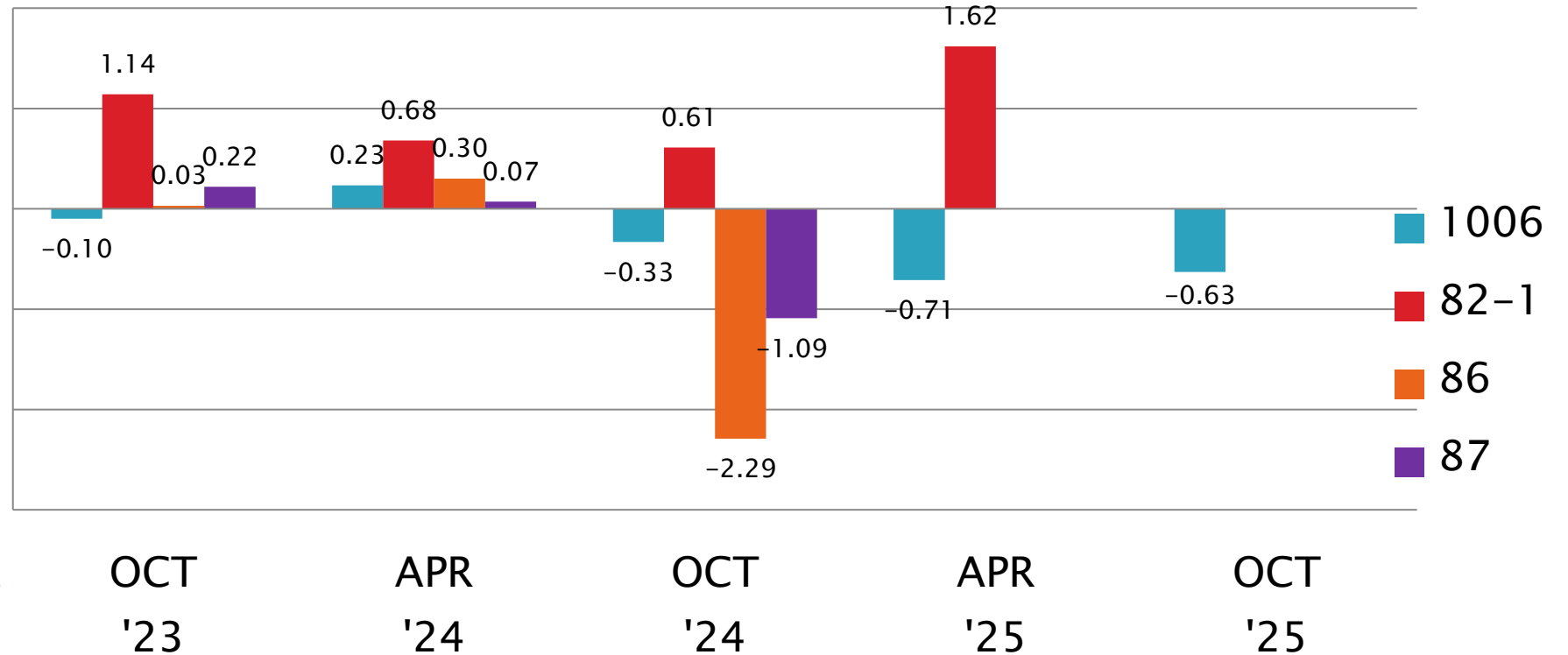
-2.00

-3.00

SEVERE

Average Gray Value

MEAN Δ/s



April 1, 2025 – September 30, 2025

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



Information Letters & Memos*

No new information letters or memos this semester.

Test	Date	IL / Memo	Topic

*Available from TMC Website

April 1, 2025 – September 30, 2025

[TABLE of CONTENTS](#)

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



Reference Oil Inventory Estimated Life

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Total Assignments ¹ made over Semester	Estimated Life
1006	24.20	2.15	177	5+ years
82-1	0.5	0.0	0	< 1 year
86	49.0	0.0	0	5+ years
87	92.9	0.0	0	5+ years

¹– Includes Informational (i.e. “Shakedown”) run assignments

D02.B0.07

TMC Monitored Tests



ASTM D 6594

High Temperature Corrosion Bench Test (HTCBT)

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report in parentheses)

Test	Labs	Stands
D6594	9 (+0)	26 (-1)
*As of 9/30/2025		

HTCBT Test Activity*

Test Status	Validity Code	Number of Tests
Acceptable Calibration Test	AC	204
Failed Calibration Test	OC	22
Operationally Invalid, by lab	LC	3
Calibration Test Aborted	XC	8
Informational Test Aborted	XN	1
Information Run in Range	NN	4
Information Run out of Range	MN	12
Total		254

April 1, 2025 – September 30, 2025

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



HTCBT Failed Tests

Failed Parameter (OC)	Number of Tests
Lead Concentration Severe	11
Lead Concentration Mild	0
Copper Concentration Severe	6
Copper Concentration Mild	3
Lead and Copper Concentrations (both) Severe	2
Total	22

NOTE: Of the 22 failing tests
13 (59%) were on runs with 1005-5 Reference Oil
9 (41%) were on runs with 44-5 Reference Oil

April 1, 2025 – September 30, 2025

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



HTCBT Failed Tests by Lab

Failed Parameter (OC)	LTMS Lab										#
	A	L	G	I	V	BB	BC	B	P	BE	
Lead Concentration Severe	1	0	3	3	2	0	0	0	1	1	11
Lead Concentration Mild	0	0	0	0	0	0	0	0	0	0	0
Copper Concentration Severe	2	0	1	0	2	0	0	0	0	1	6
Copper Concentration Mild	0	0	3	0	0	0	0	0	0	0	3
Lead and Copper Concentrations (both) Severe	0	0	1	0	1	0	0	0	0	0	2
Totals	3	0	8	3	5	0	0	0	1	2	22

April 1, 2025 – September 30, 2025

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



HTCBT Lost Tests*

Status (LC, XC, LN, XN)	Cause	#
Invalid Calibration (LC)	Lab invalidated due to Air Supply Issues	2
Invalid Calibration (LC)	Lab invalidated due to Sample Contamination	1
Aborted Calibration (XC)	Test stopped because of Temperature Control Issue	2
Aborted Calibration (XC)	Test stopped because of Power Failure	4
Aborted Calibration (XC)	Test stopped because of Bath Temperature Control Issue	1
Aborted Calibration (XC)	Test stopped because of Sample Contamination	1
Aborted Non-Blind (XN)	Test stopped because of Air Leak	1
Total		12

*Invalid or Aborted calibration tests

April 1, 2025 – September 30, 2025

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



HTCBT Lost Tests by Lab

Failed Parameter (LC, XC, XN)	LTMS Lab										#
	A	L	G	I	V	BB	BC	B	P	BE	
Air Supply Issues (LC)	0	0	2	0	0	0	0	0	0	0	2
Sample Contamination (LC)	0	0	0	0	0	0	0	0	1	0	1
Temperature Control Issue (XC)	0	0	2	0	0	0	0	0	0	0	2
Power Failure (XC)	4	0	0	0	0	0	0	0	0	0	4
Bath Temperature Control Issue (XC)	1	0	0	0	0	0	0	0	0	0	1
Sample Contamination (XC)	0	0	0	0	0	0	0	1	0	0	1
Air Leak (XN)	0	1	0	0	0	0	0	0	0	0	1
Total	5	1	4	0	0	0	0	1	1	0	12

April 1, 2025 – September 30, 2025

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



HTCBT Test Status

- ▶ Most labs now using Batch P coupons although a few labs continue to test with Batch O coupons.
- ▶ Few TESTKEYs of Reference Oil 44-4 remaining at labs. Most labs now using Reference Oil 44-5.
- ▶ Same number of labs calibrated this semester, but one fewer stand was calibrated this semester

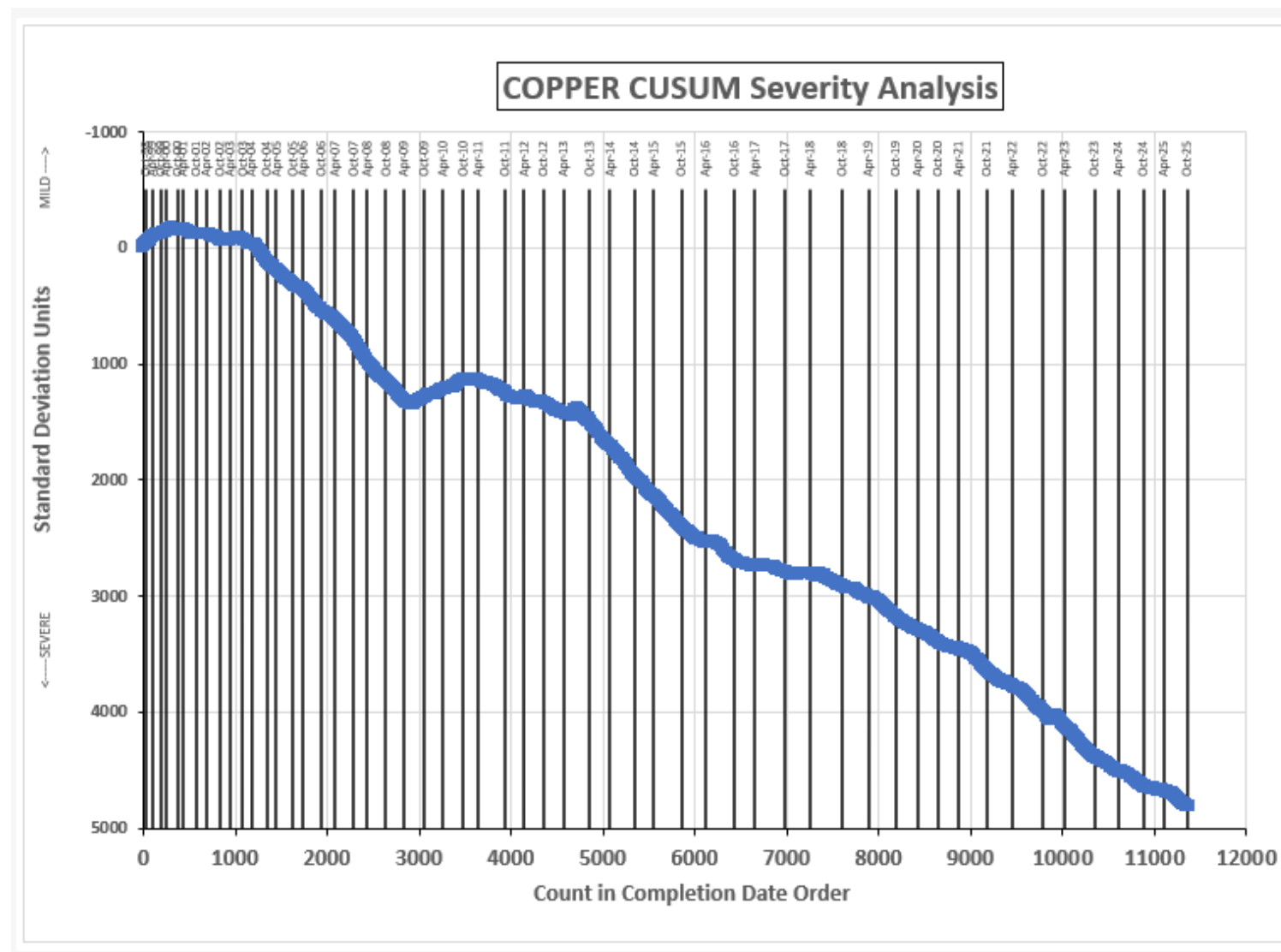
April 1, 2025 – September 30, 2025

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COPPER CHANGE (ppm)

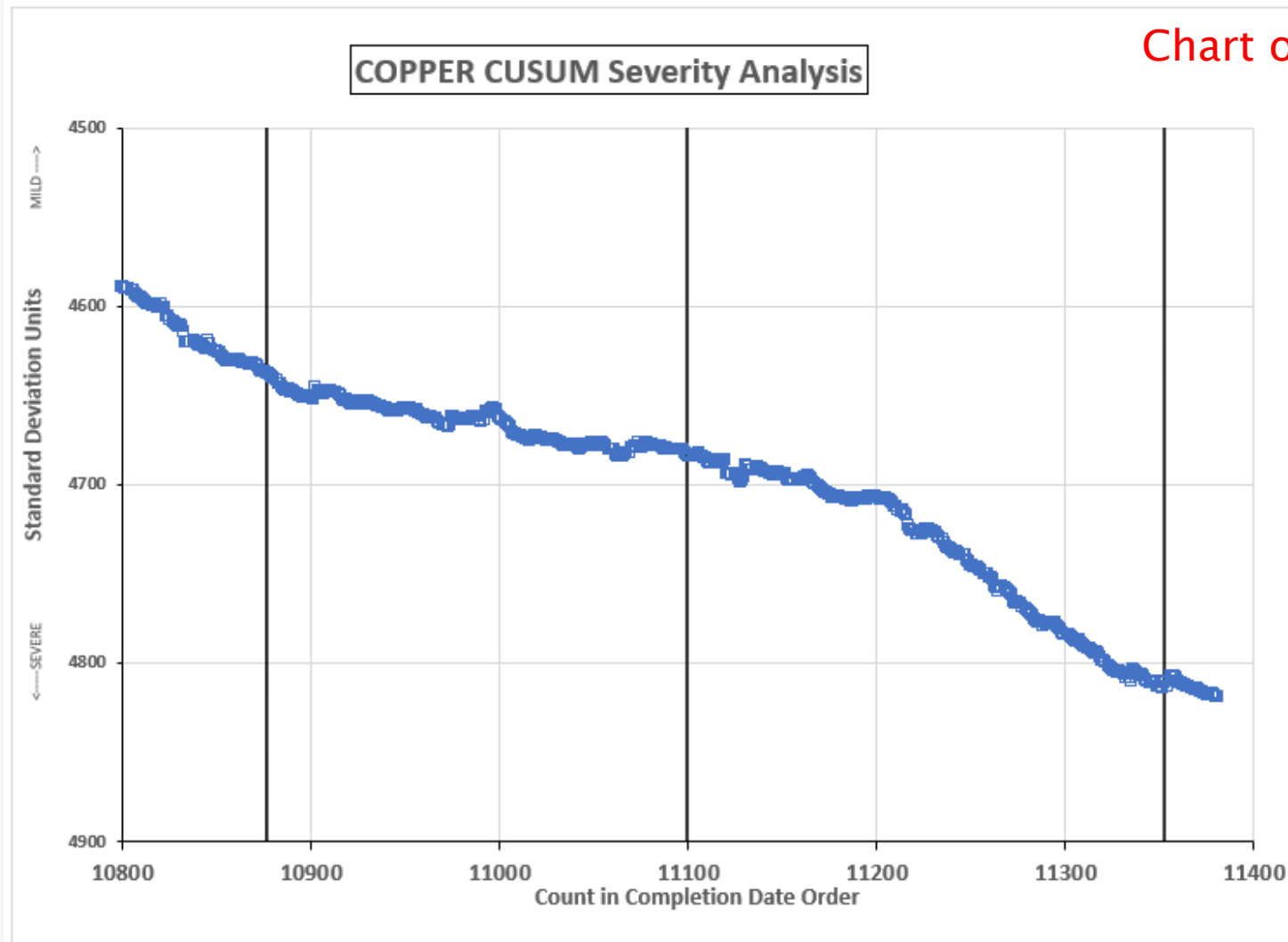


April 1, 2025 – September 30, 2025

Test Monitoring Center
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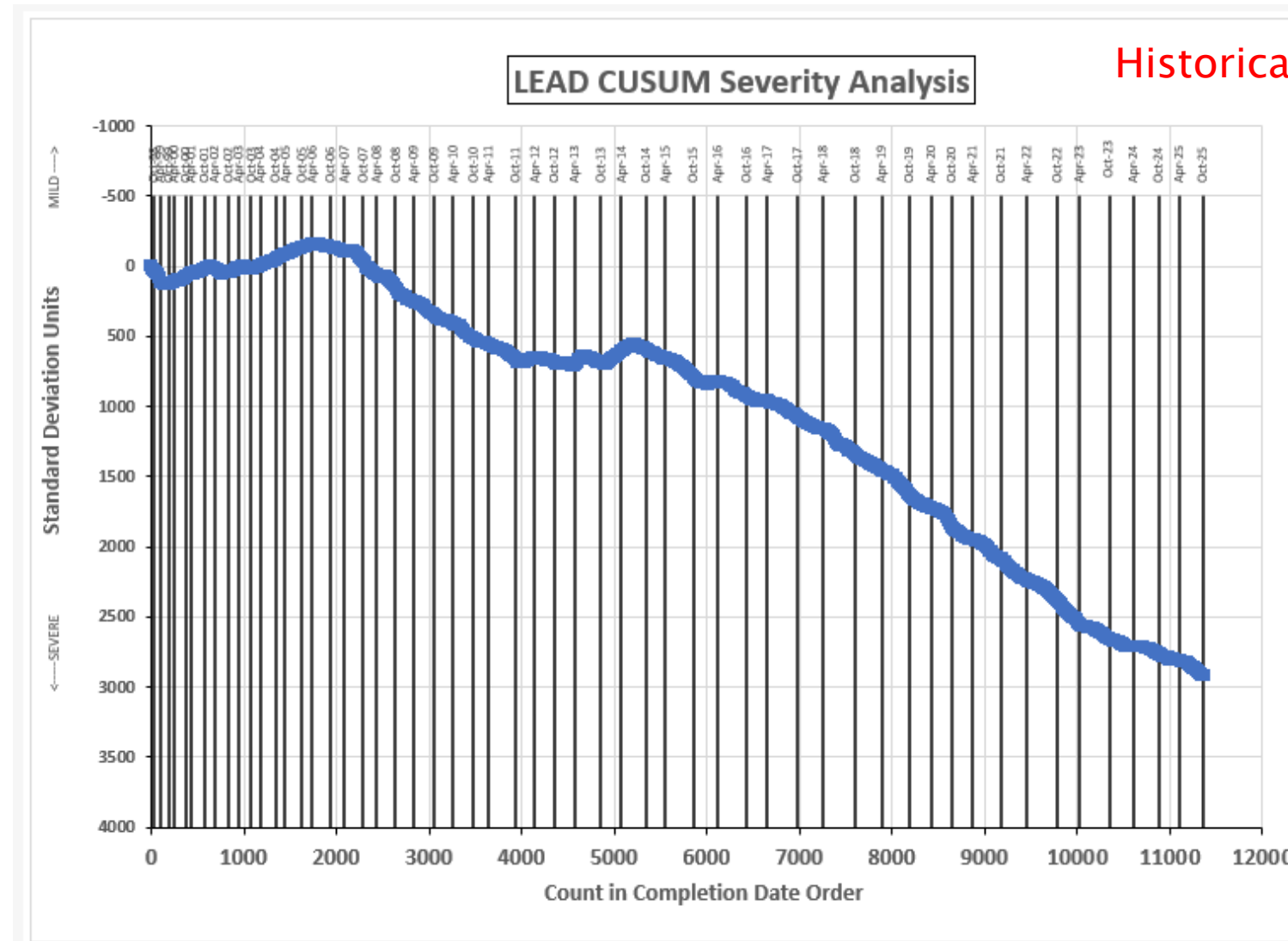
HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
LAST 600 DATA POINTS
COPPER CHANGE (ppm)

Chart of recent results



April 1, 2025 - September 30, 2025

LEAD CHANGE (ppm)

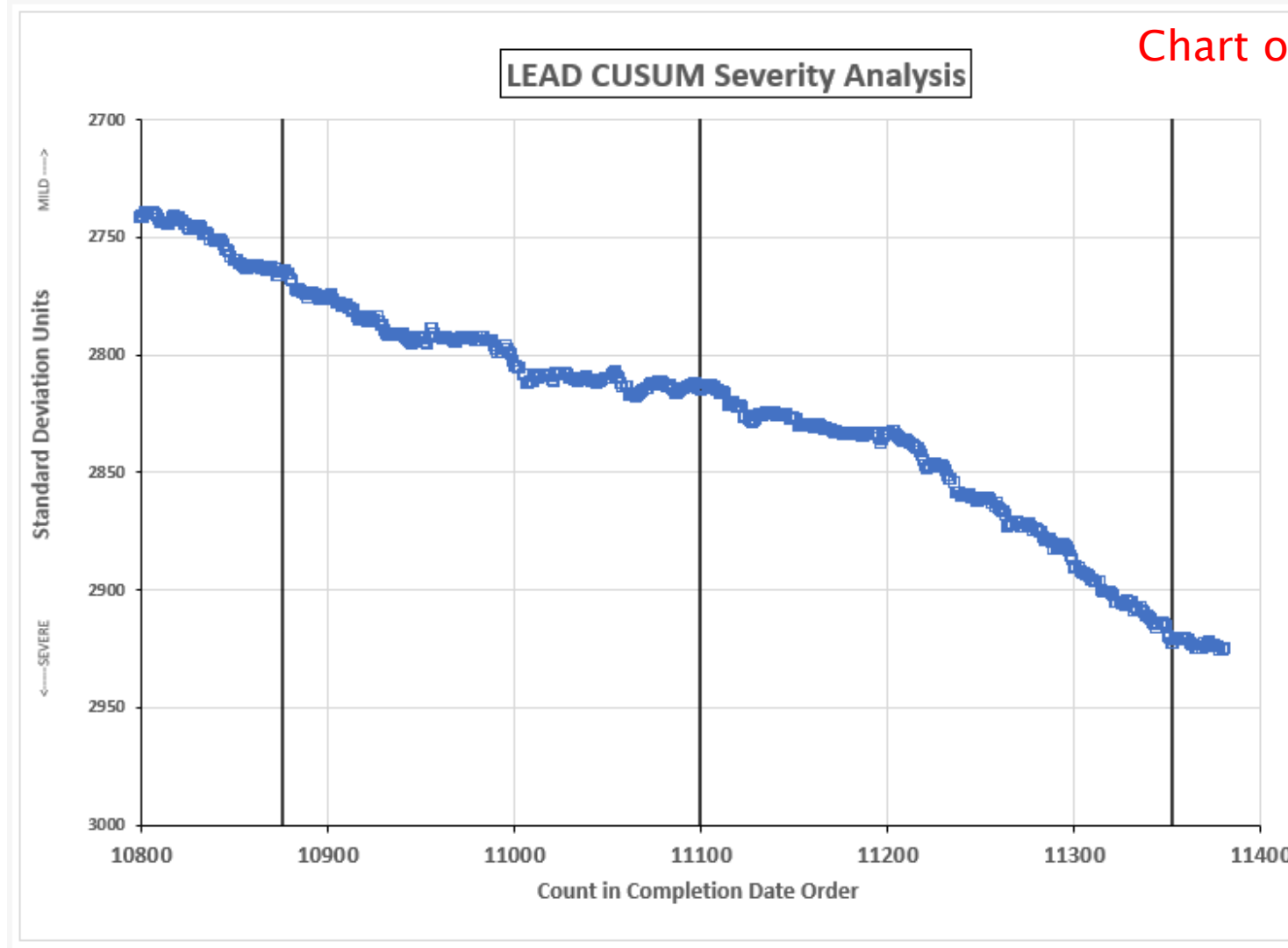


Historical Chart

April 1, 2025 – September 30, 2025

HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
LAST 600 DATA POINTS
LEAD CHANGE (ppm)

Chart of recent results



April 1, 2025 - September 30, 2025

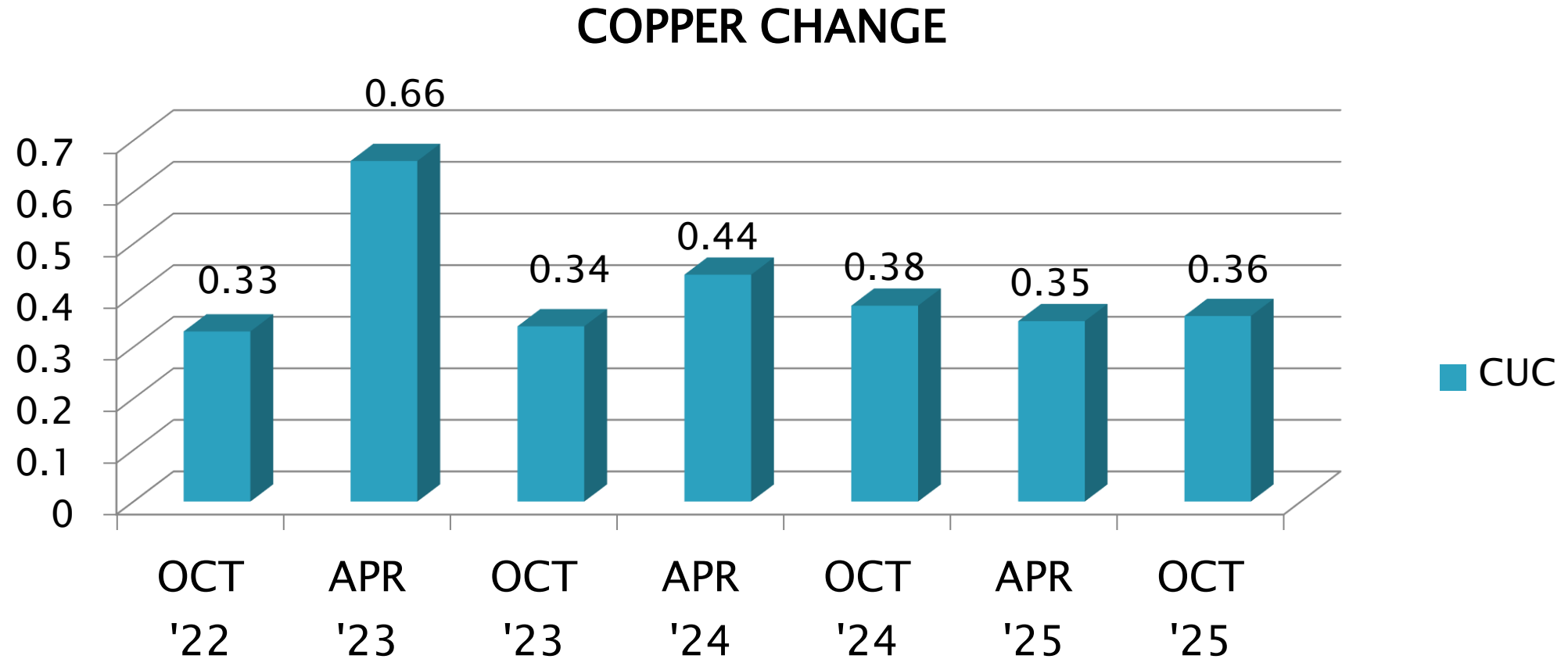
HTCBT (D6594): High Temperature Corrosion Bench Test

Period Precision and Severity Estimates: Copper Change

Date Range	n	df	Pooled s	Mean Δ/s
10/1/21 through 3/31/22	305	302	0.31	0.53
4/1/22 through 9/30/22	306	303	0.33	0.63
10/1/22 through 3/31/23	263	260	0.66	0.57
4/1/23 through 9/30/23	296	293	0.34	0.87
10/1/23 through 3/31/24	287	284	0.44	0.39
4/1/24 through 9/30/24	244	241	0.38	0.53
10/1/24 through 3/31/25	250	248	0.35	0.23
4/1/25 through 9/30/25	226	223	0.36	0.52

*Period statistics for all Valid Reference Oil Results (pooled)

HTCBT Precision (Pooled s) Estimates



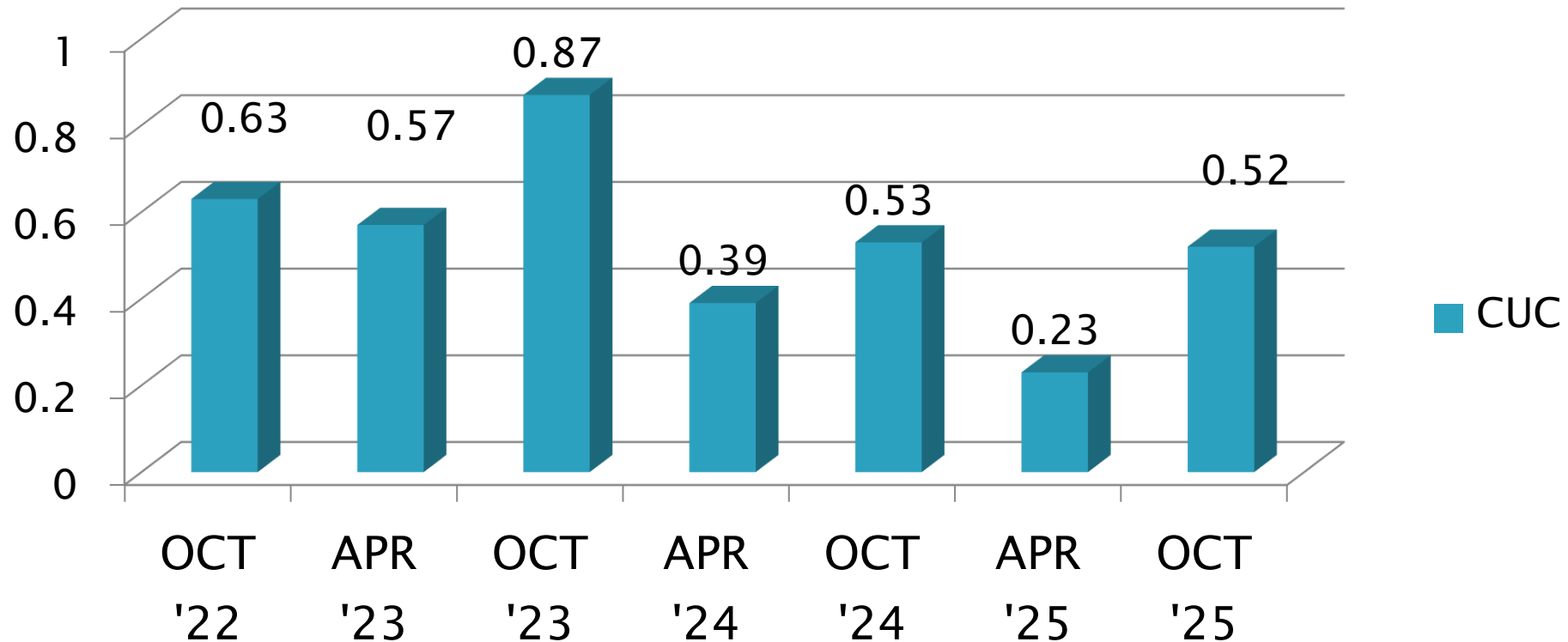
April 1, 2025 – September 30, 2025

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



HTCBBT Performance (mean Δ/s) Estimates

COPPER CHANGE



April 1, 2025 – September 30, 2025

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



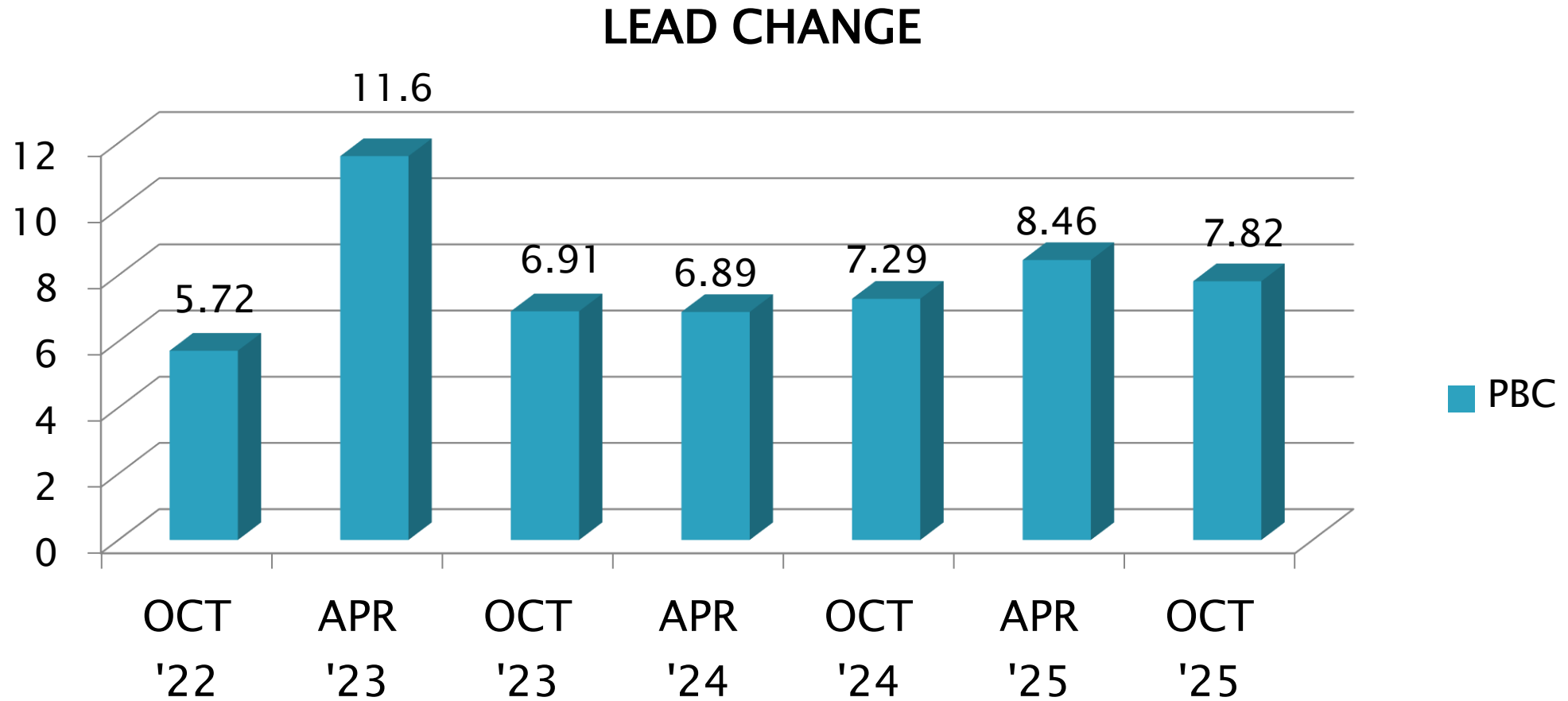
HTCBT (D6594): High Temperature Corrosion Bench Test

Period Precision and Severity Estimates: Lead Change

Average Gray Value	n	df	Pooled s	Mean Δ/s
10/1/21 through 3/31/22	305	302	8.20	0.55
4/1/22 through 9/30/22	306	303	5.72	0.43
10/1/22 through 3/31/23	263	260	11.6	0.69
4/1/23 through 9/30/23	296	293	6.91	0.31
10/1/23 through 3/31/24	287	284	6.89	0.20
4/1/24 through 9/30/24	244	241	7.29	0.20
10/1/24 through 3/31/25	250	248	8.46	0.24
4/1/25 through 9/30/25	226	223	7.82	0.41

*Period statistics for all Valid Reference Oil Results (pooled)

HTCBT Precision (Pooled s) Estimates

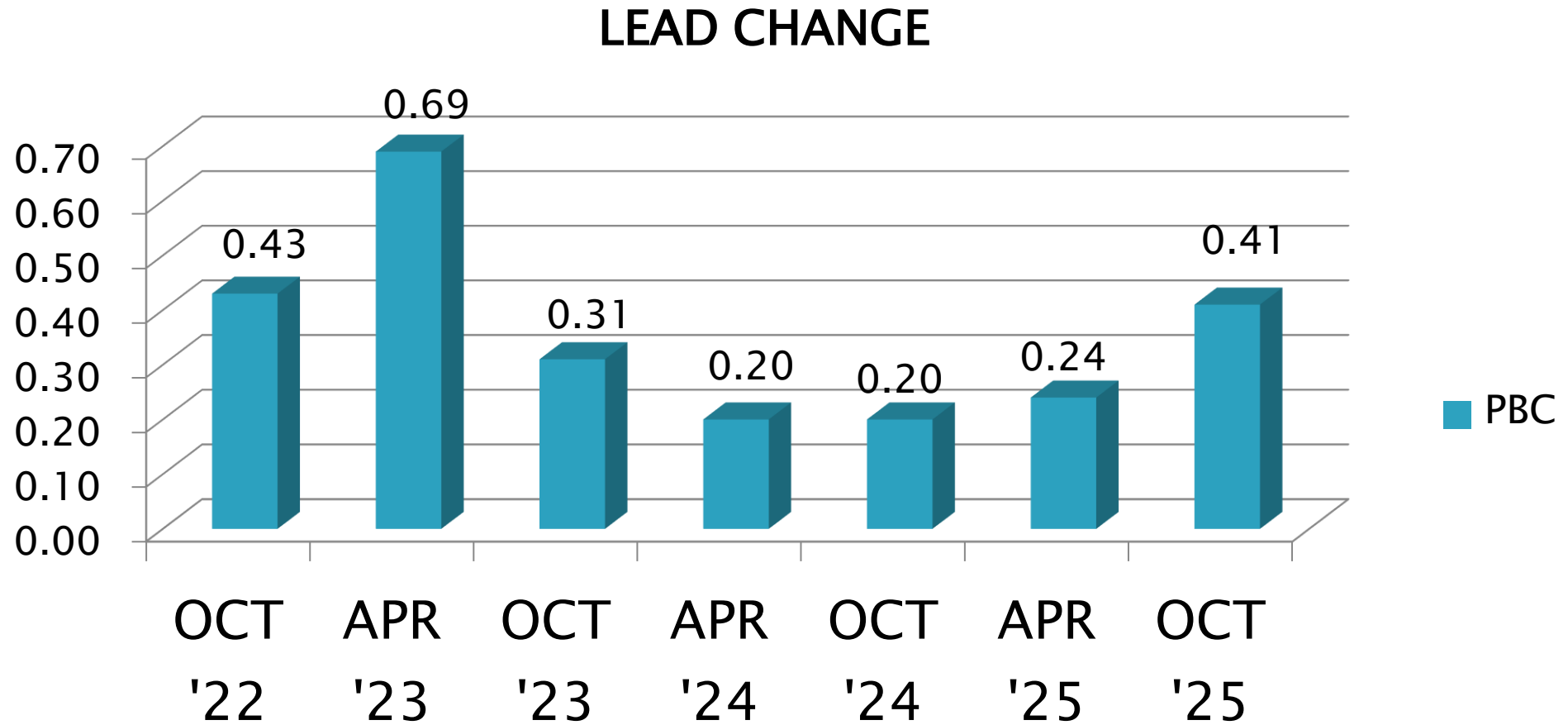


April 1, 2025 – September 30, 2025

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<https://www.astmtmc.org>



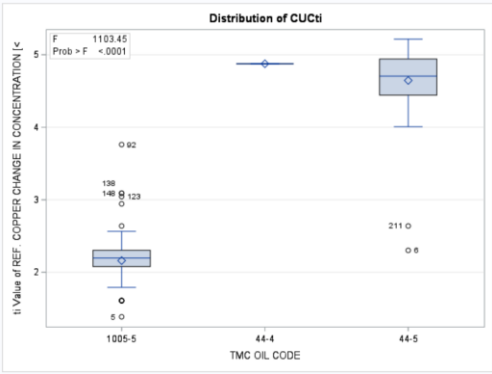
HTCBBT Performance (mean Δ/s) Estimates



April 1, 2025 – September 30, 2025

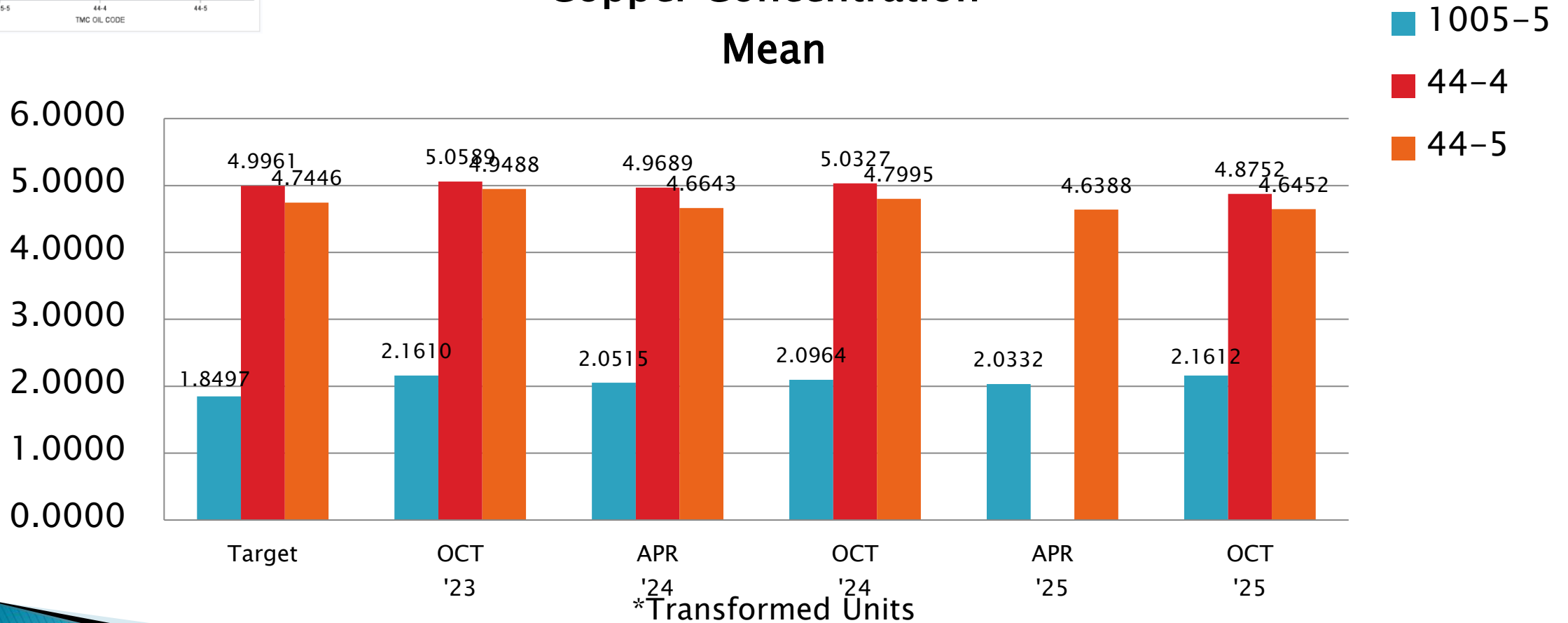
Test Monitoring Center
<https://www.astmtmc.org>





HTCBT Performance by OIL

Copper Concentration* Mean



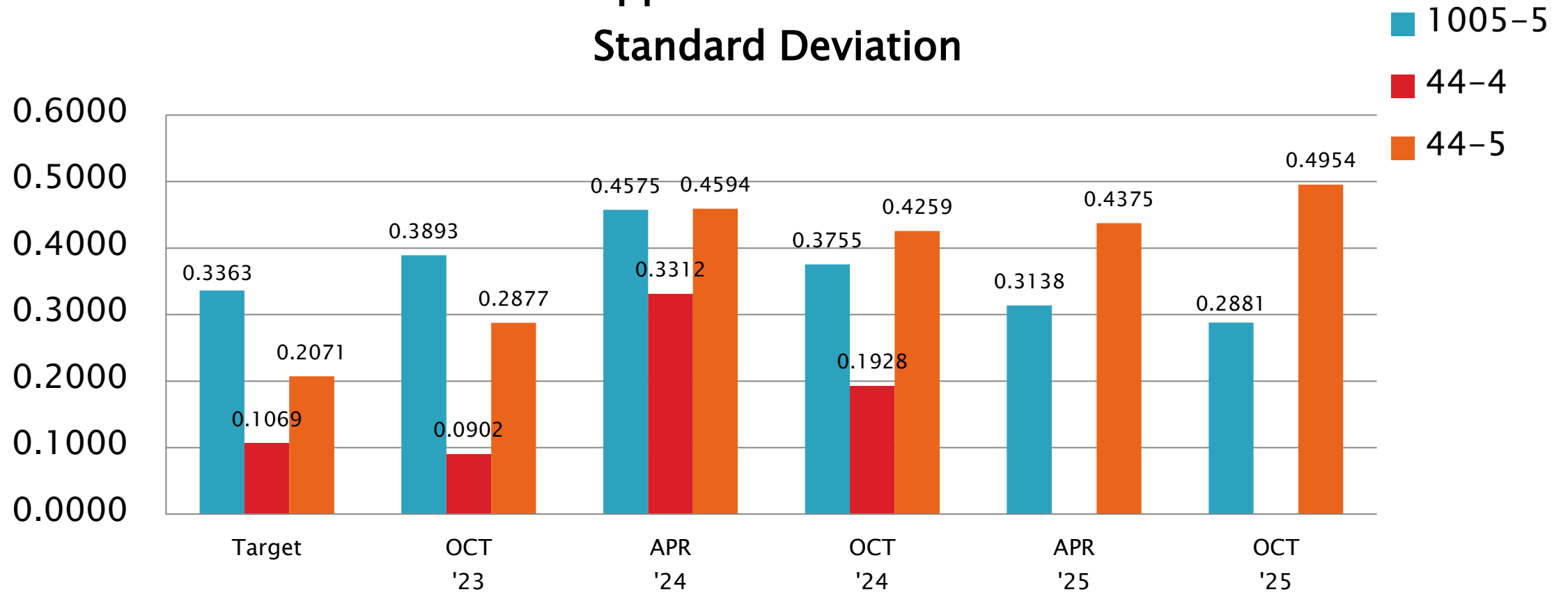
April 1, 2025 – September 30, 2025

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



HTCBT Performance by OIL

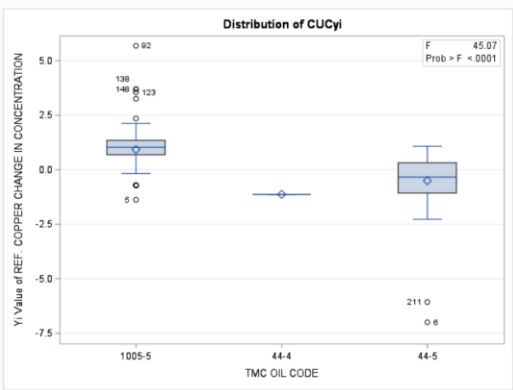
Copper Concentration Standard Deviation



April 1, 2025 – September 30, 2025

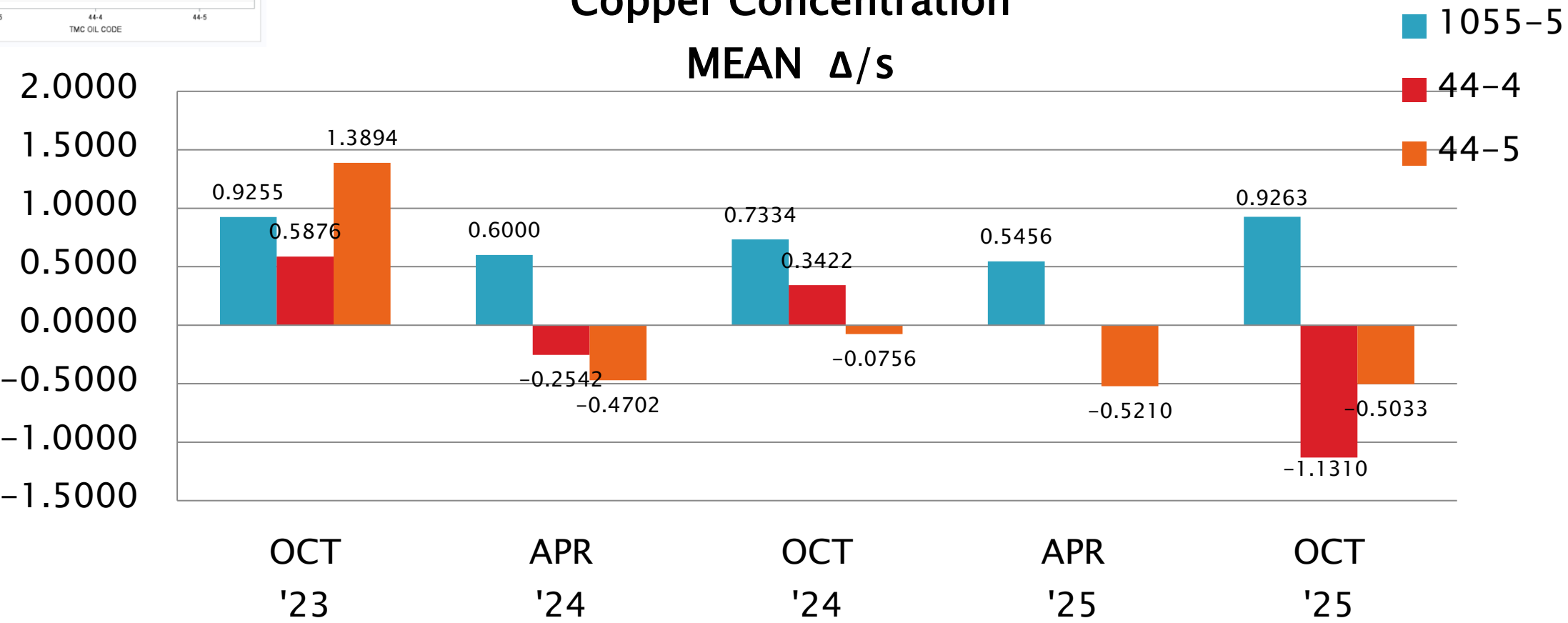
Test Monitoring Center
<https://www.astmtmc.org>





HTCBT Performance by OIL

Copper Concentration MEAN Δ/s



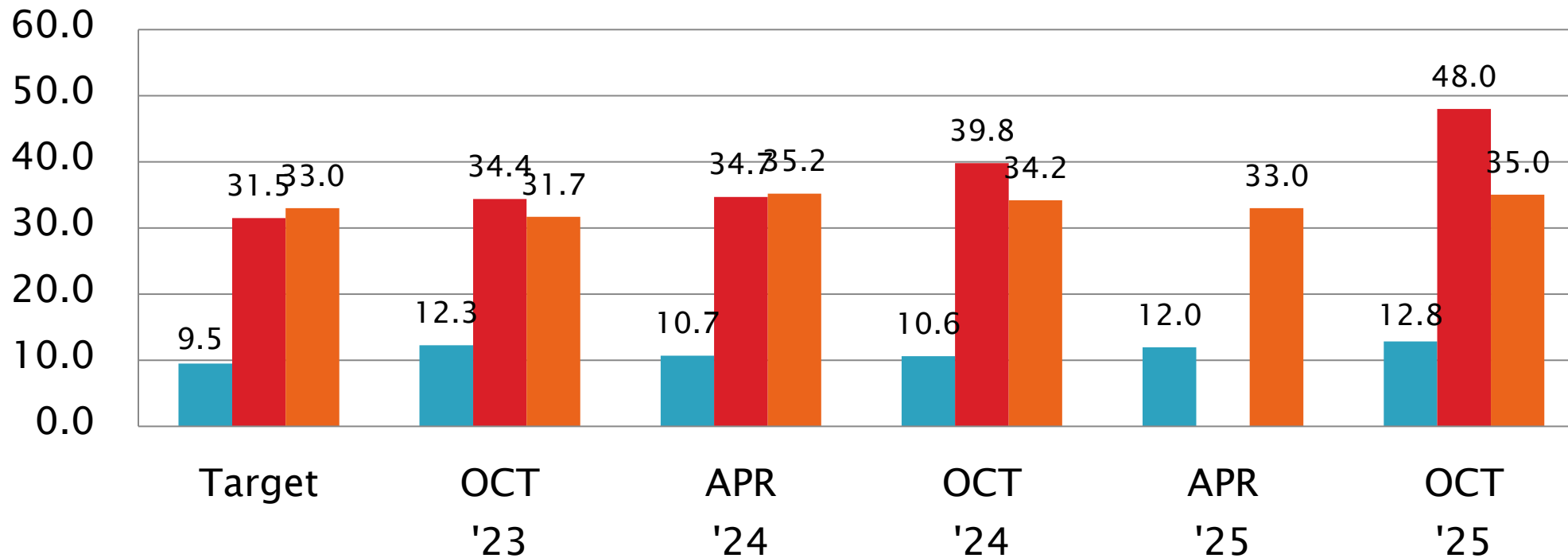
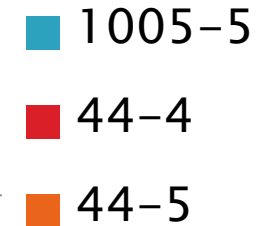
April 1, 2025 – September 30, 2025

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



HTCBT Performance by OIL

Lead Concentration Mean



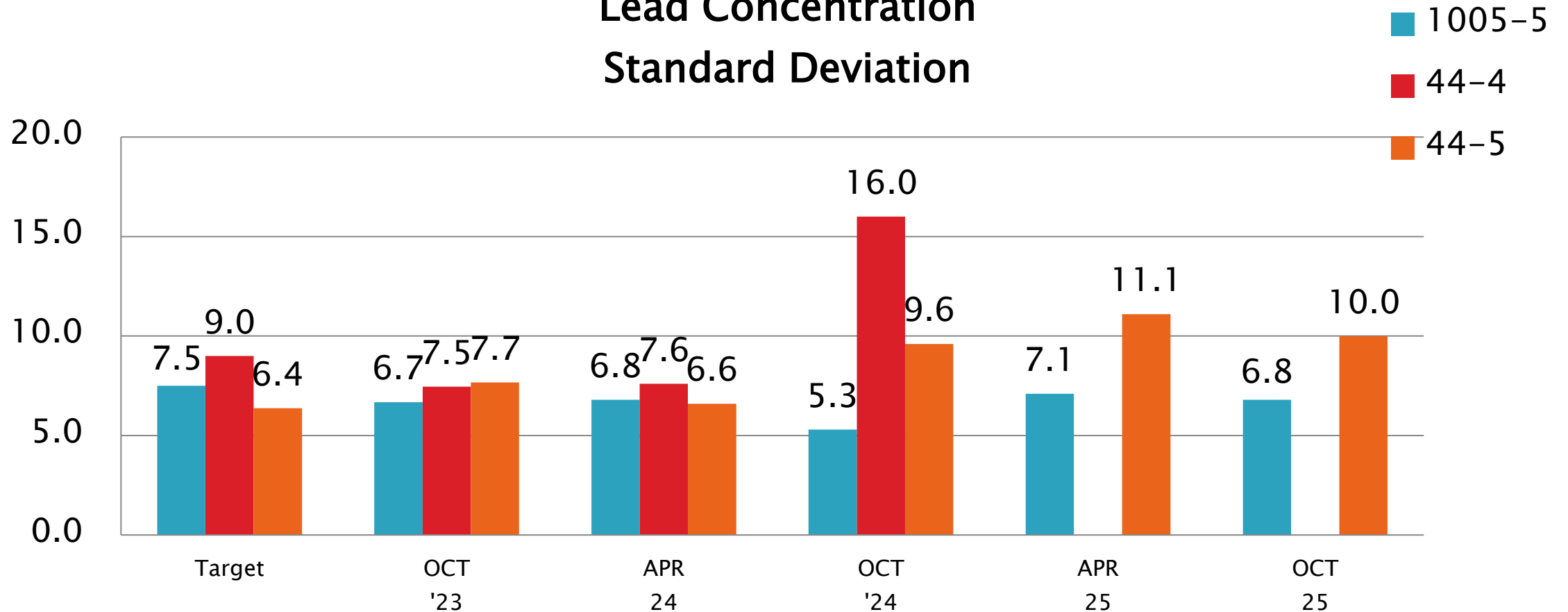
April 1, 2025 – September 30, 2025

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



HTCBT Performance by OIL

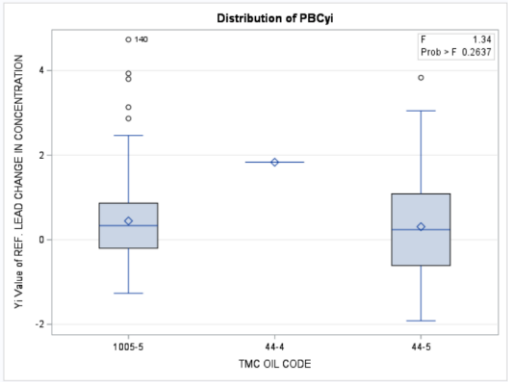
Lead Concentration
Standard Deviation



April 1, 2025 – September 30, 2025

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

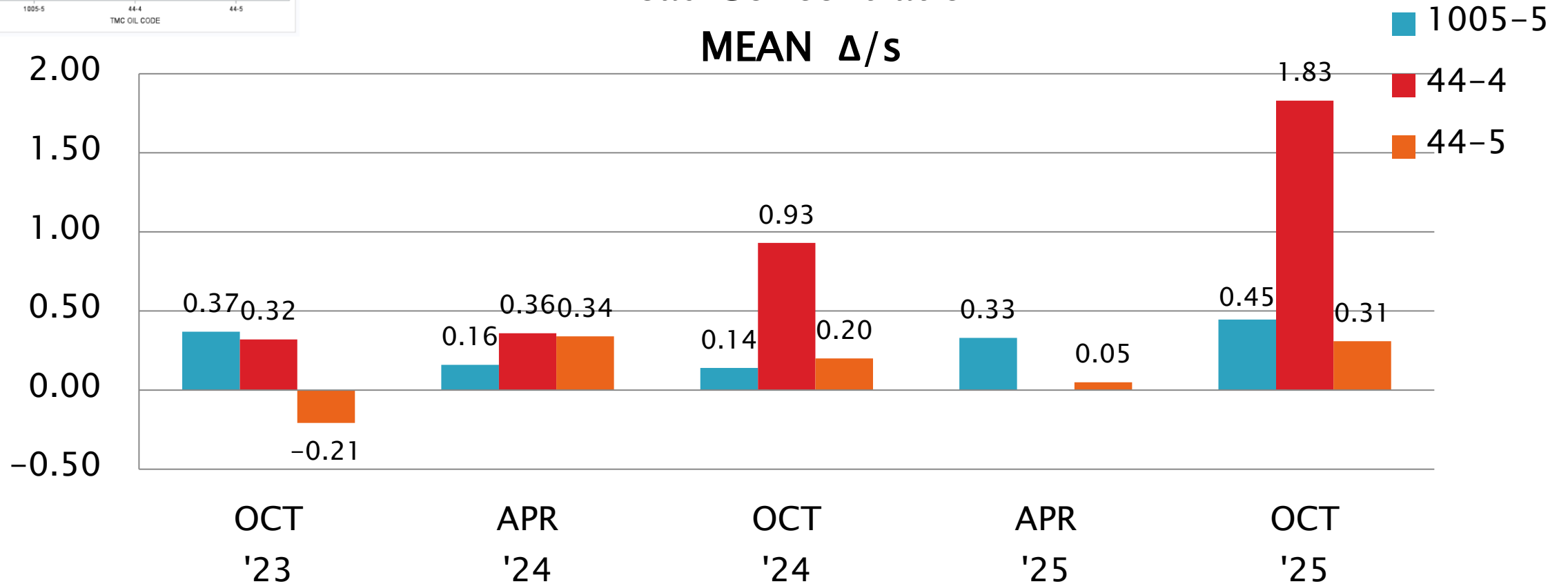




HTCBT Performance by OIL

Lead Concentration

MEAN Δ/s

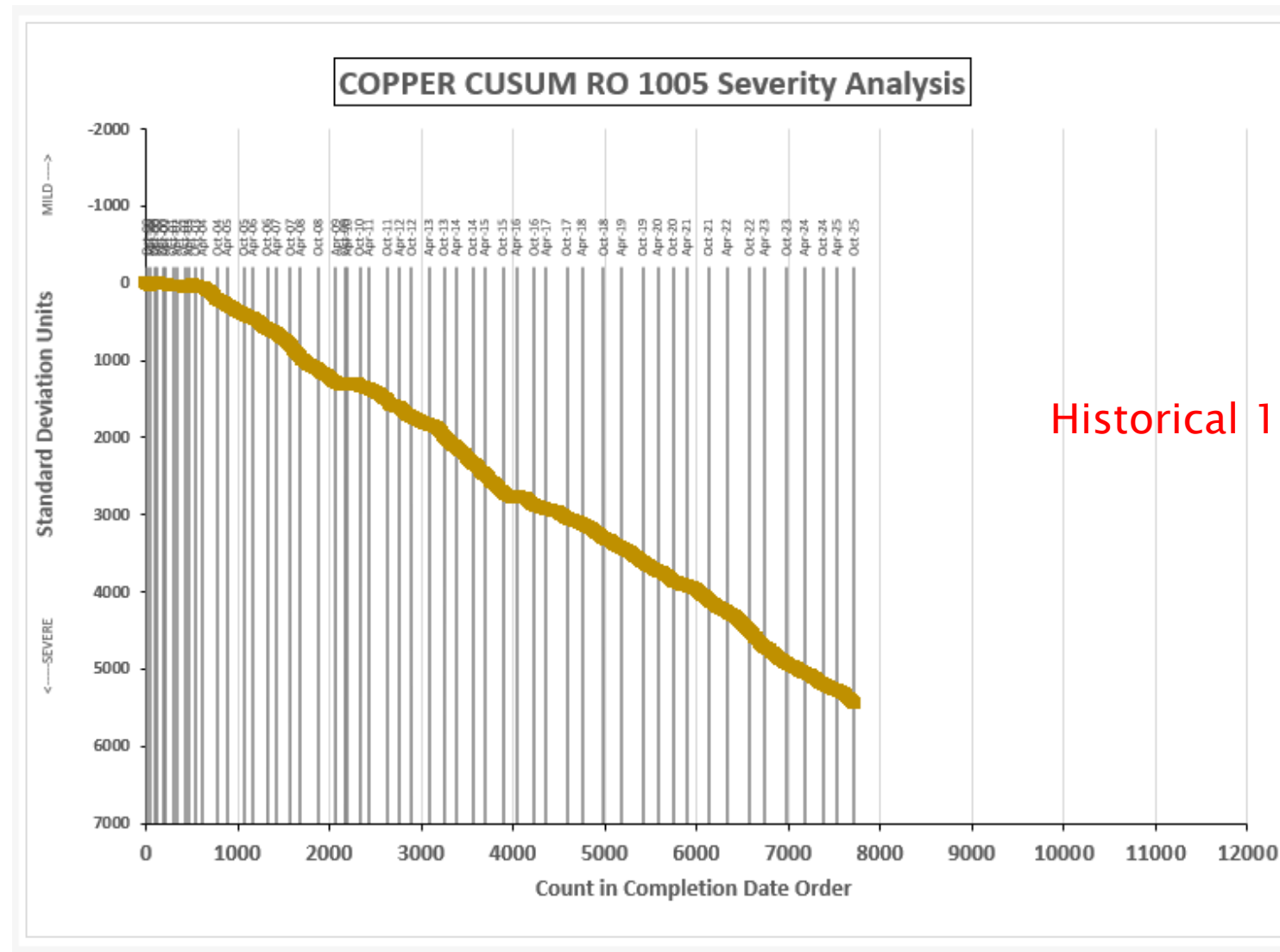


April 1, 2025 – September 30, 2025

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



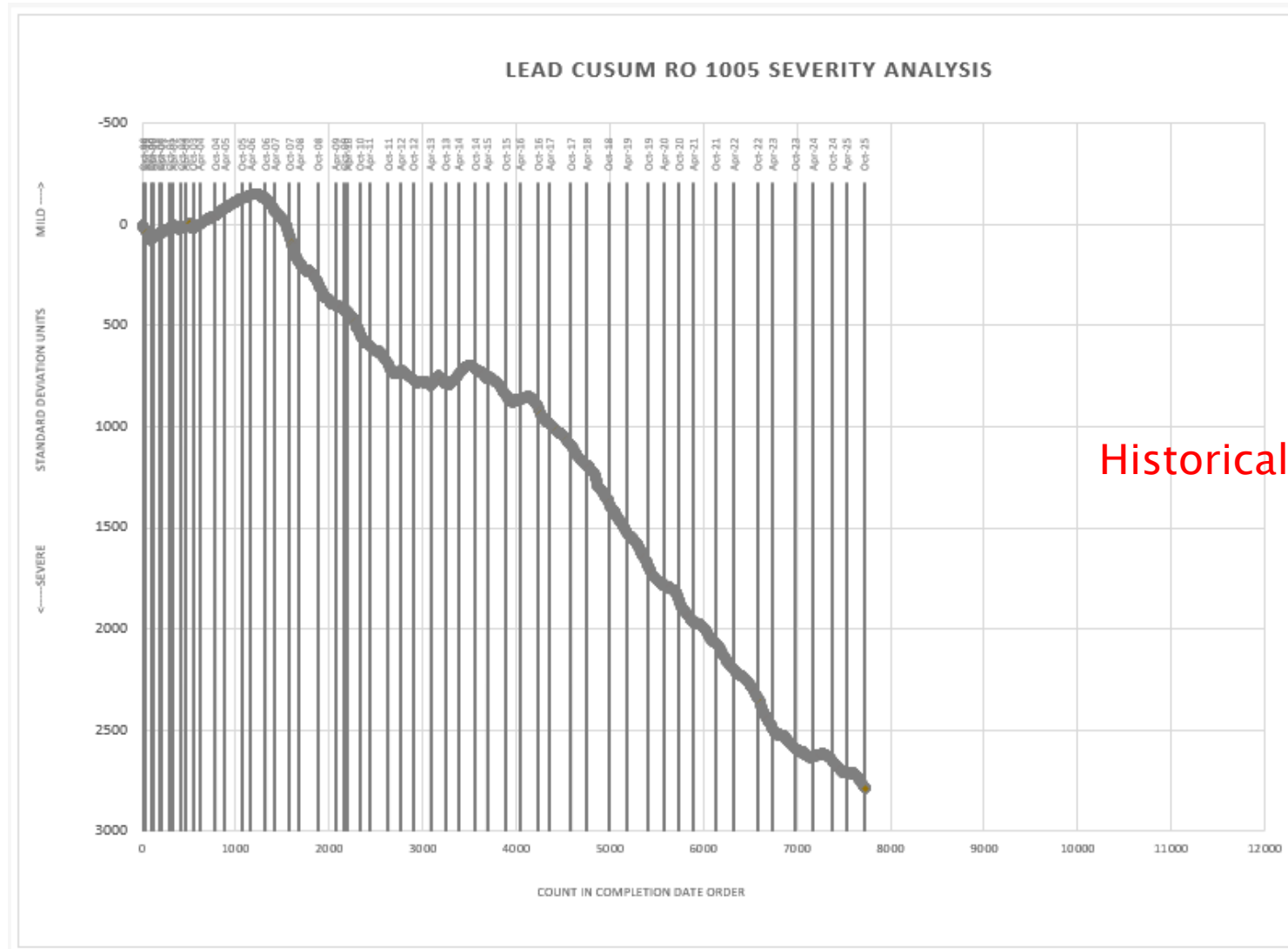
HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
Oil 1005 →x Only
COPPER CHANGE (ppm)



Historical 1005-x Chart

April 1, 2025 - September 30, 2025

HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
Oil 1005 →x Only
LEAD CHANGE (ppm)



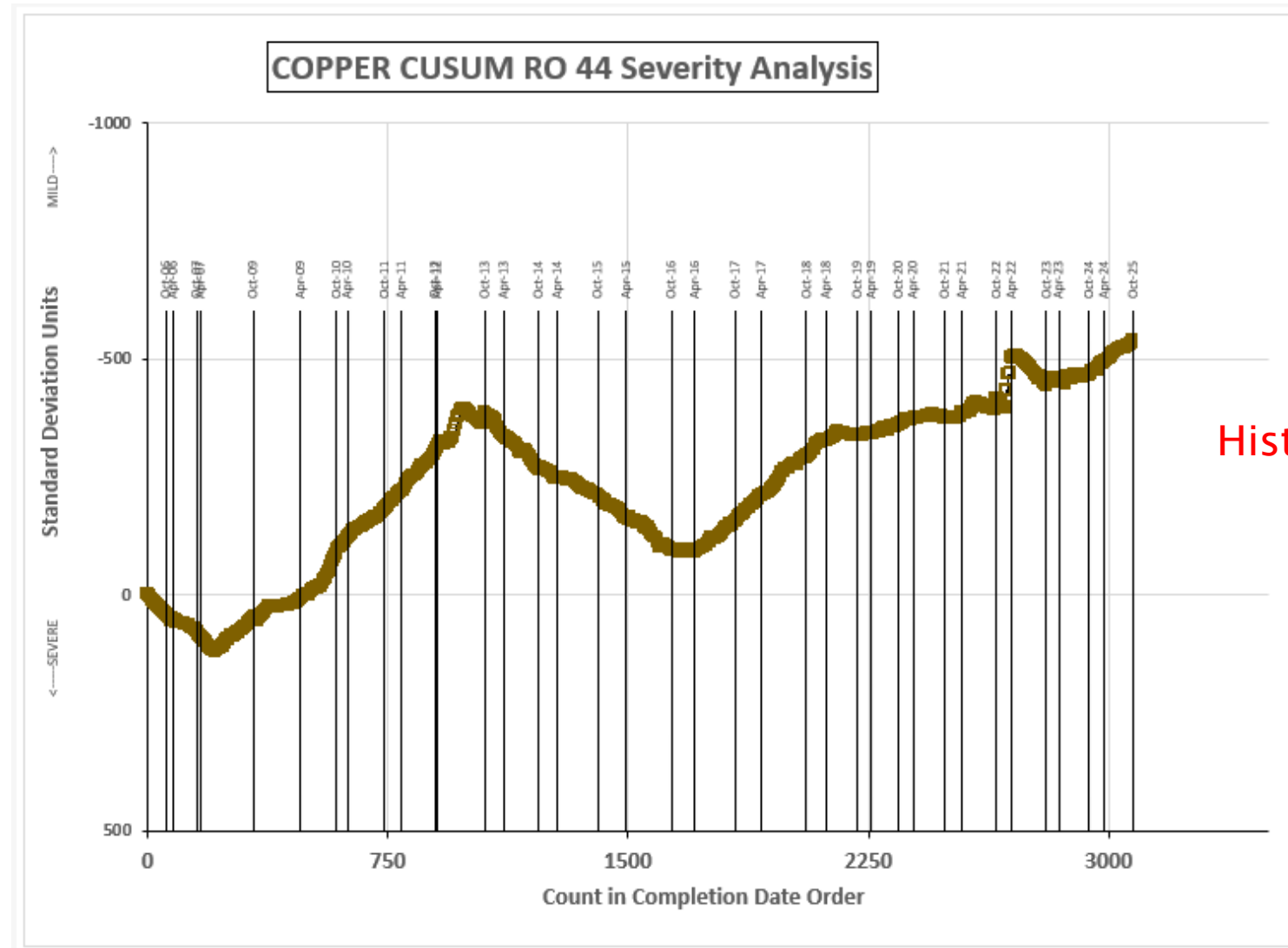
Historical 1005-x Chart

April 1, 2025 – September 30, 2025

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



HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
Oil 44 →x Only
COPPER CHANGE (ppm)

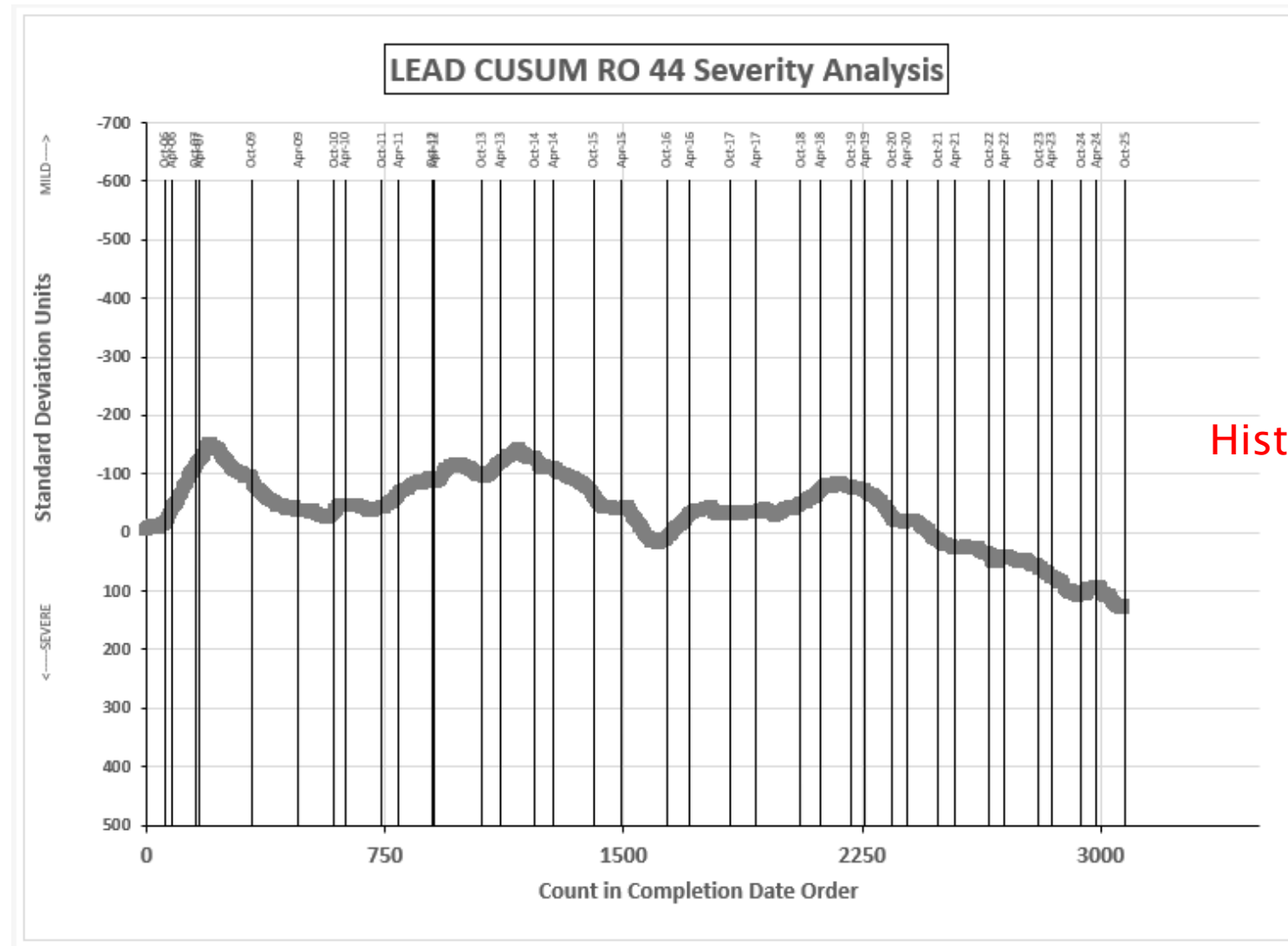


Historical 44-x Chart

April 1, 2025 – September 30, 2025

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





Historical 44-x Chart

Information Letters and Memos*

Test	Date	IL/Memo	Topic
HTCBT			

No new Information Letters or Memos issued this semester.

*Available from TMC Website

April 1, 2025 – September 30, 2025

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



Reference Oil Inventory Estimated Life

D6594

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Lab Assignments Made	Estimated Life
44-5	42.2	3.1	189	5+ year
1005-5	17.4 (Reserved drum - Additional oil available at the TMC)	6.0	76	5+ year

TABLE of CONTENTS

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



D02.B0.07

TMC Monitored Tests



ASTM D 6794

Engine Oil Water Tolerance (EOWT)

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6794	5 (+0)	N/A
*As of 9/30/2025		

- 7 labs reported data

EOWT Test Activity by Treat Rate

Test Status	Validity Code	Number of Tests by Water Treat Rate				Total
		0.6%	1.0%	2.0%	3.0%	
Acceptable Calibration Test	AC	175	175	180	175	705
Failed Calibration Test	OC	4	6	3	2	15
Acceptable Information Run	NN	2	7	6	4	19
Unacceptable Information Run	MN	4	2	2	4	12
Invalid Calibration Test	LC, RC	3	2	1	1	7
Aborted Calibration Test	XC	0	0	0	0	0
Aborted Informational Test	XN	0	0	0	3	3
Total		188	192	192	189	761

April 1, 2025 – September 30, 2025

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



EOWT Test Activity by Reference Oil*

Test Status	Validity Code	Number of Tests by Reference Oil		Total
		77-3	79	
Acceptable Calibration Test	AC	353	352	705
Failed Calibration Test	OC	7	8	15
Acceptable Informational Test	NN	6	13	19
Unacceptable Informational Test	MN	10	2	12
Invalid Calibration Test	LC, RC	4	3	7
Aborted Calibration Test	XC	0	0	0
Aborted Informational Test	XN	3	0	3
Total		383	378	

- No Informational runs requested this semester

April 1, 2025 – September 30, 2025

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



EOWT Failed Tests

Failed Parameter (OC)	Number of Tests				Total
	0.6%	1.0%	2.0%	3.0%	
Severe Change in Flowrate	1	5	0	1	7
Mild Change in Flowrate	3	1	3	1	8
Total	4	6	3	2	15

April 1, 2025 – September 30, 2025

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



EOWT Failed Tests by Lab

Failed Parameter (OC)	LTMS Lab							#
	A	B	BE	G	I	L	V	
Severe Change in Flowrate	2	N/A	0	0	0	2	3	7
Mild Change in Flowrate	7	N/A	0	0	0	1	0	8
Total	9	N/A	0	0	0	3	3	15

April 1, 2025 – September 30, 2025

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



EOWT Lost Calibration Tests*

Cause	Number of Tests				#
	0.6%	1.0%	2.0%	3.0%	
INCORRECT WATER LEVEL (RC)	1	1	1	1	4
INCORRECT OIL USED (LC)	1	1	0	0	2
FILTERING ISSUE (LC)	1	0	0	0	1
Total	3	2	1	1	7

*Invalid (LC,RC) and Aborted (XC) calibration tests

April 1, 2025 – September 30, 2025

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



D6794: EOWT

Period Precision and Severity Estimates

Change in Filtration Rate	H ₂ O %	n	df	Pooled s	Mean Δ/s
4/1/25 through 9/30/25	ALL	720	718	4.63	0.17
4/1/25 through 9/30/25	0.6	179	177	5.37	0.26
4/1/25 through 9/30/25	1.0	181	179	4.30	-0.19
4/1/25 through 9/30/25	2.0	183	181	3.97	0.47
4/1/25 through 9/30/25	3.0	177	175	3.14	0.13

April 1, 2025 – September 30, 2025

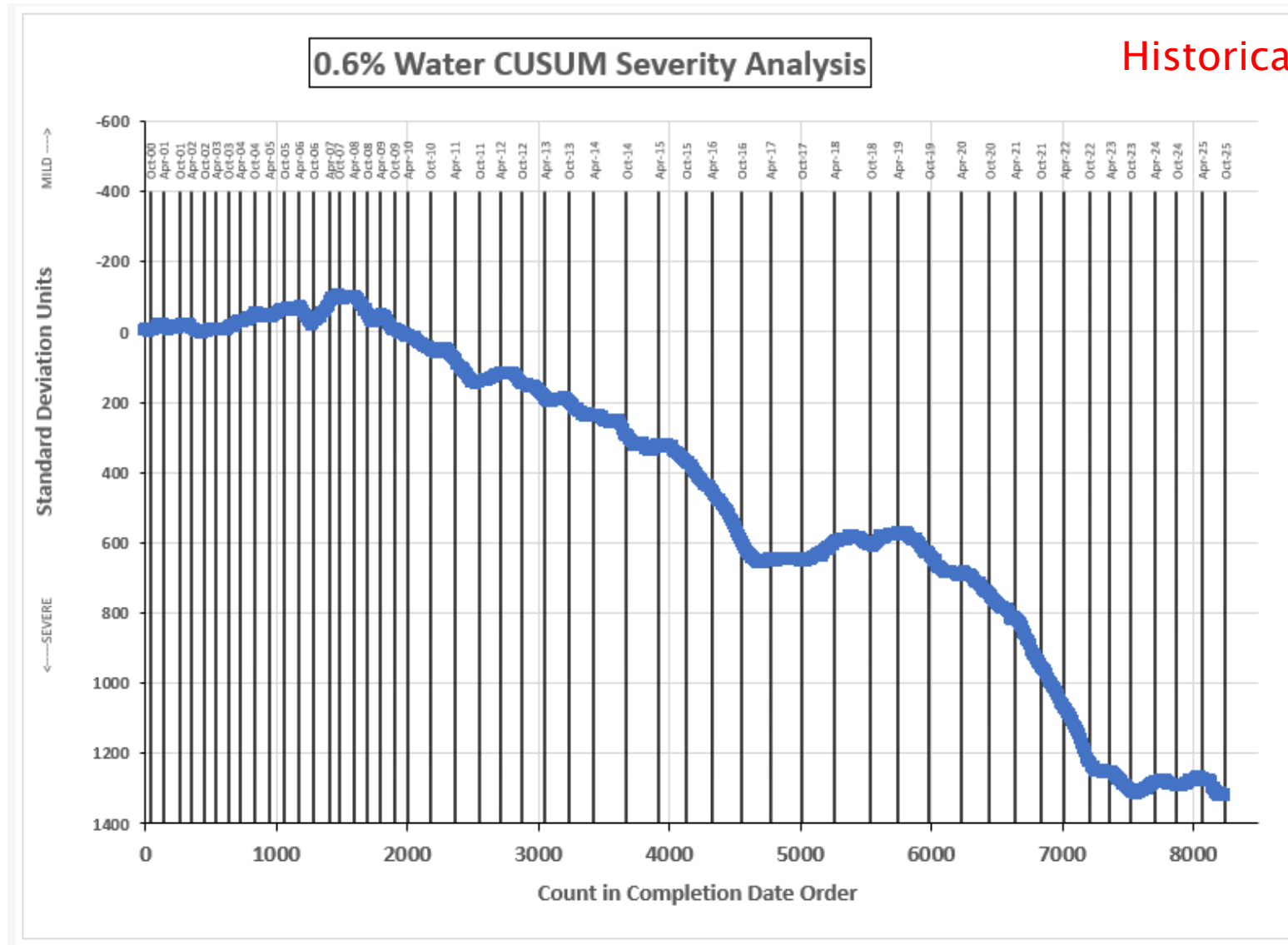
Test Monitoring Center
<https://www.astmtmc.org>



EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 0.6% Water Treat Rate
20 —25 ML CHANGE IN FLOWRATE AVG.



Historical Chart



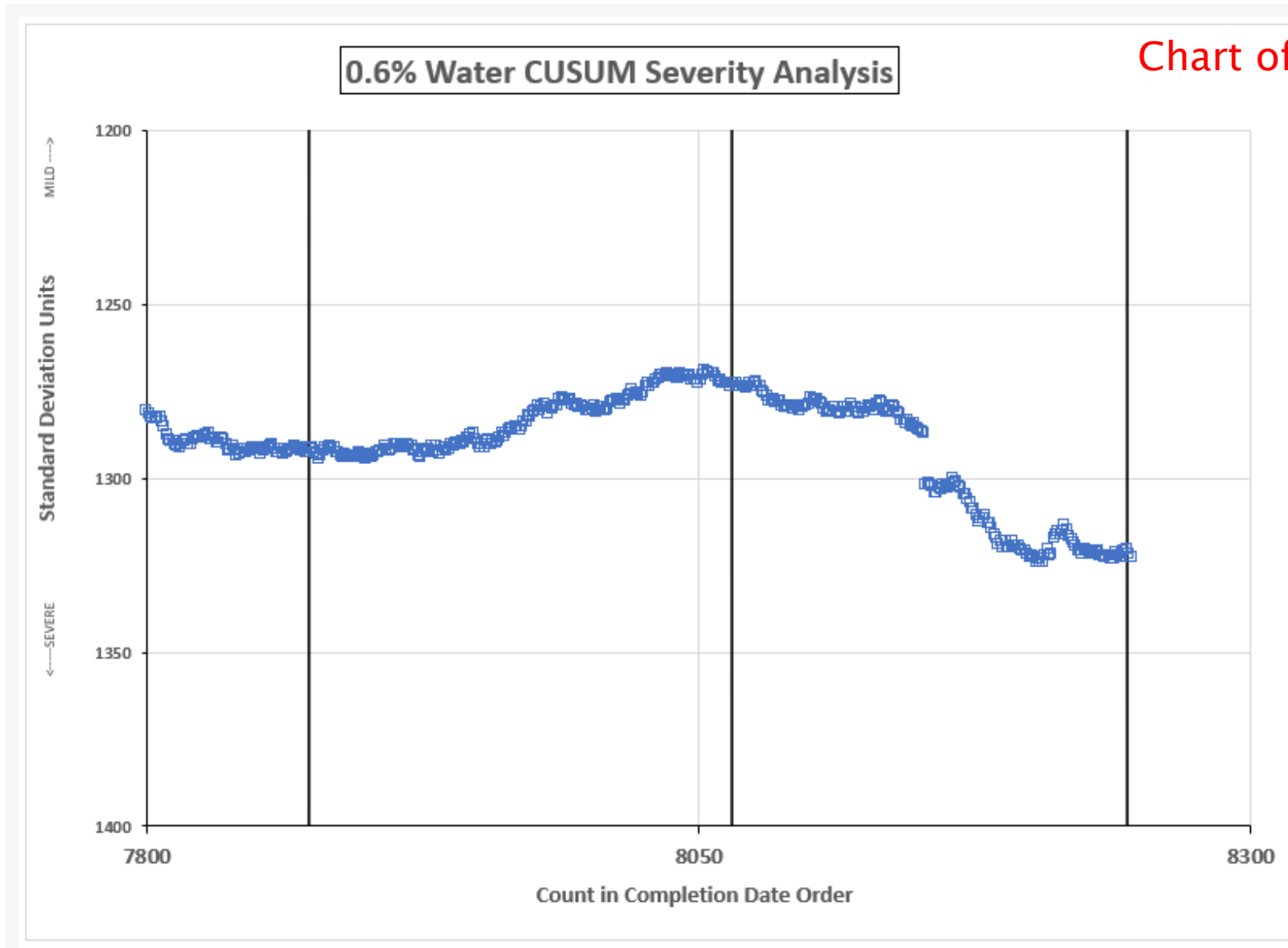
April 1, 2025 – September 30, 2025

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



EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 0.6% Water Treat Rate (Last 400 Data Points)
20 —25 ML CHANGE IN FLOWRATE AVG.

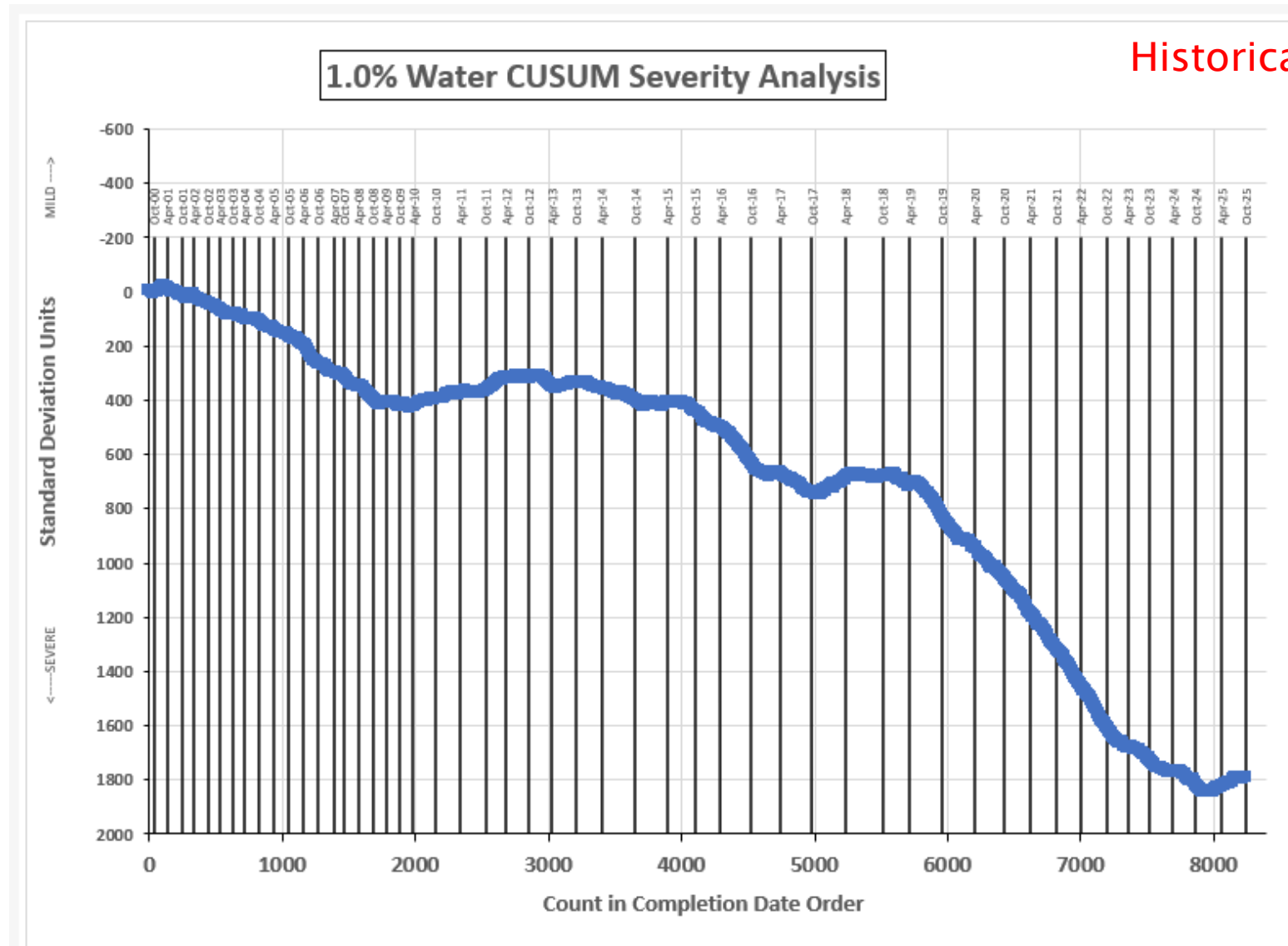
Chart of recent results



April 1, 2025 – September 30, 2025

EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 1.0% Water Treat Rate
20 —25 ML CHANGE IN FLOWRATE AVG.

Historical Chart



April 1, 2025 – September 30, 2025

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

EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 1.0% Water Treat Rate (Last 400 Data Points)
20 —25 ML CHANGE IN FLOWRATE AVG.

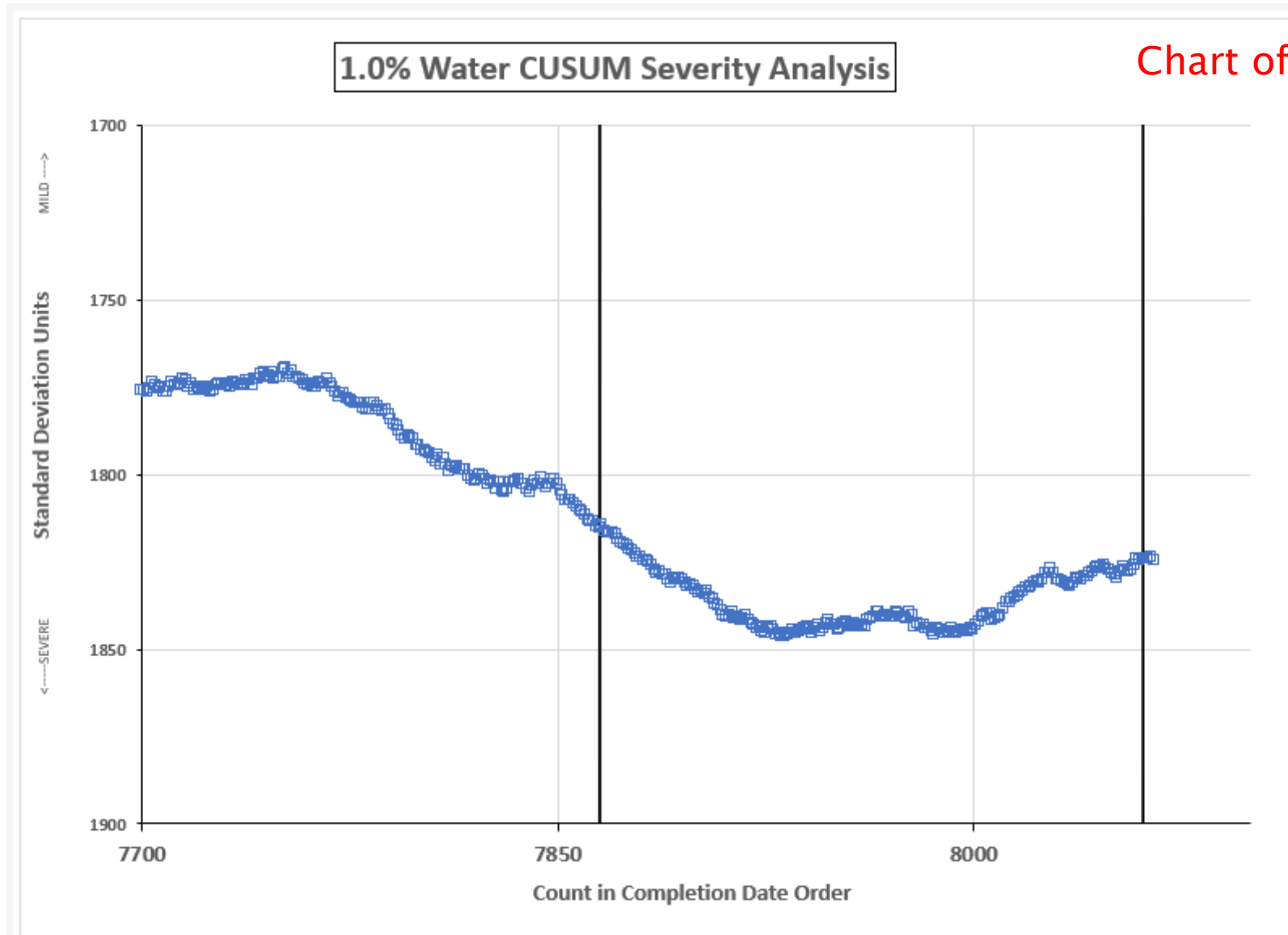


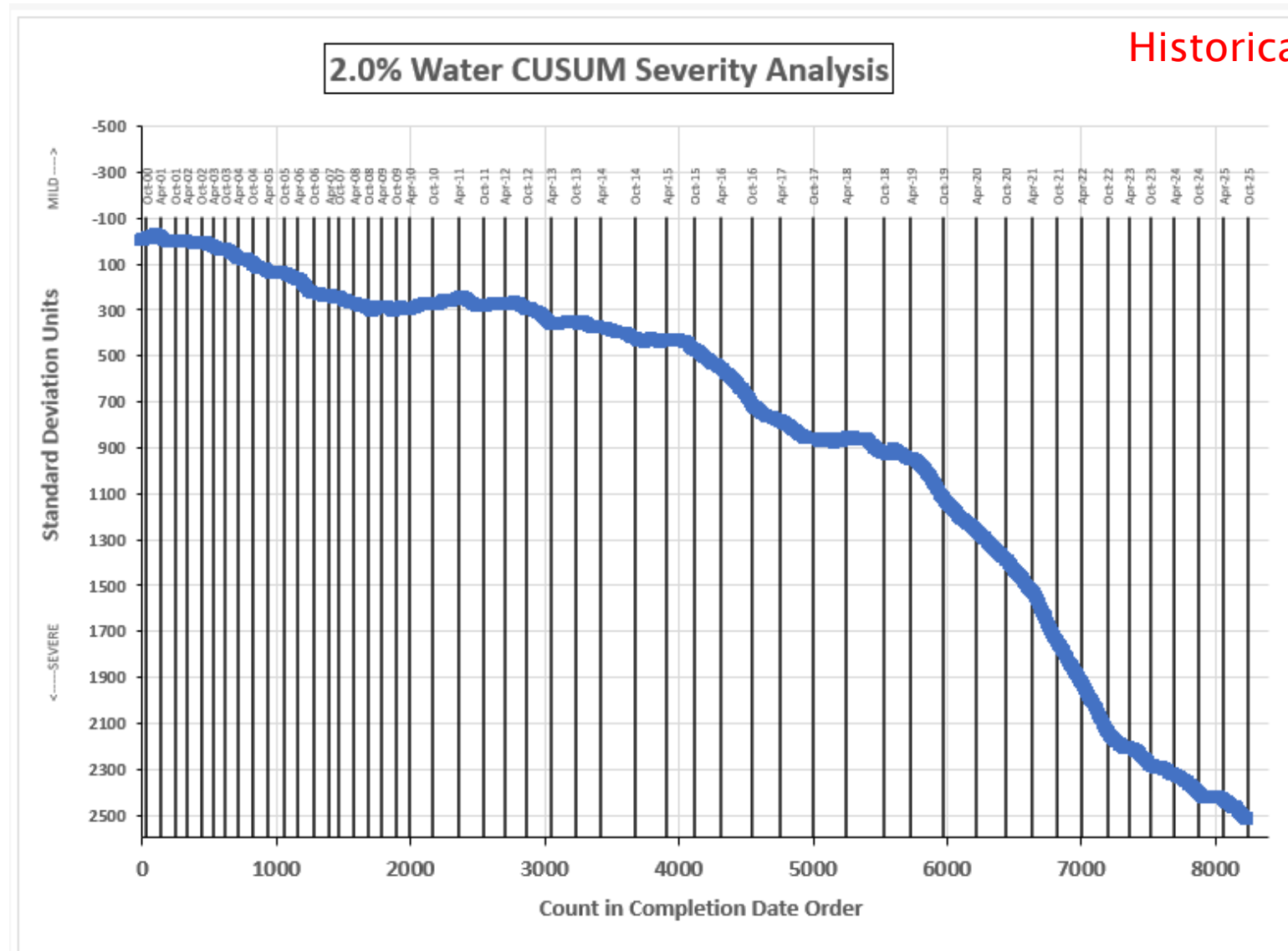
Chart of recent results

April 1, 2025 – September 30, 2025

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

EWOT INDUSTRY OPERATIONALLY VALID DATA
CFA 2.0% Water Treat Rate
20 —25 ML CHANGE IN FLOWRATE AVG.

Historical Chart

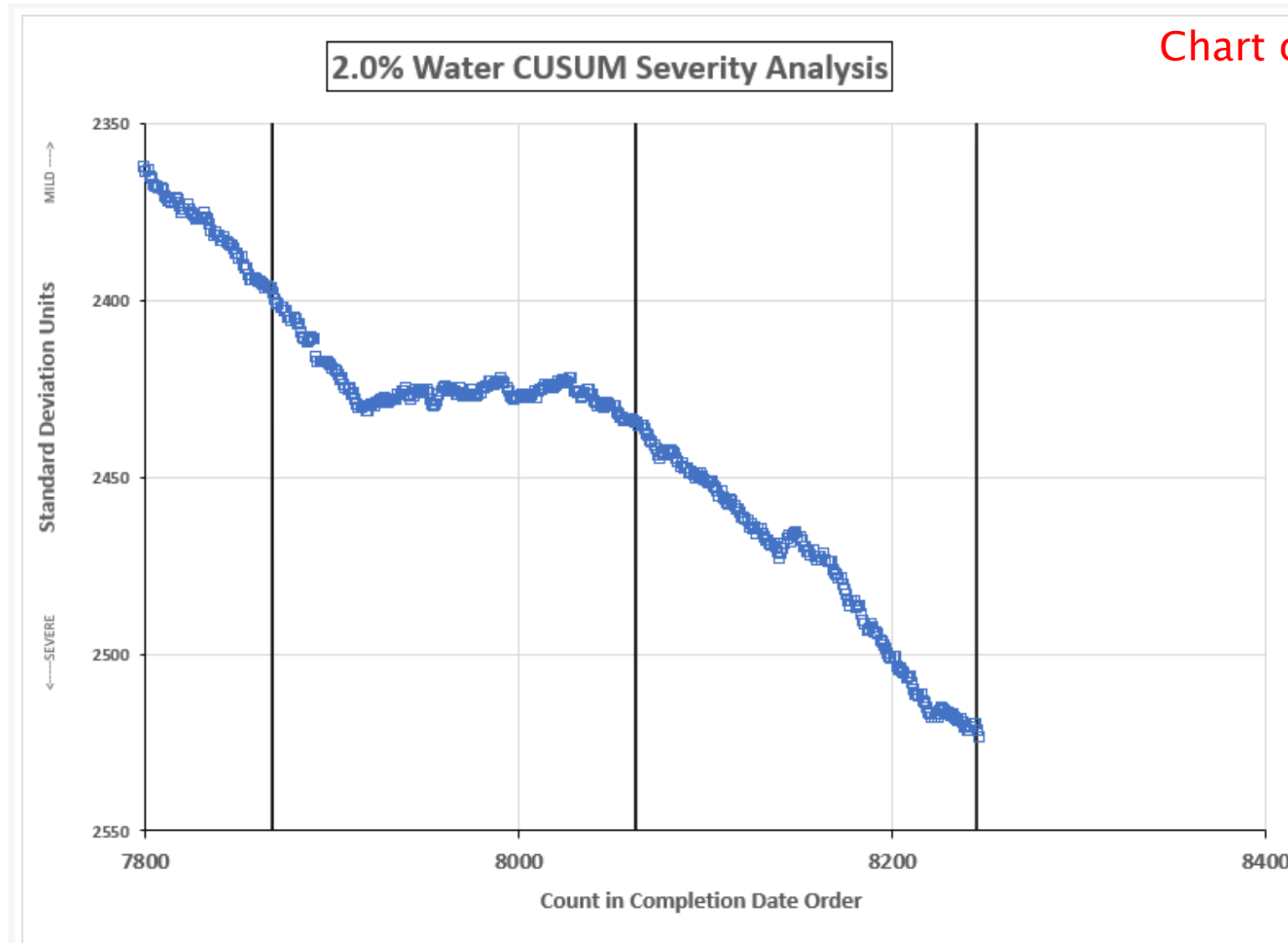


April 1, 2025 – September 30, 2025

EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 2.0% Water Treat Rate (Last 400 Data Points)
20 —25 ML CHANGE IN FLOWRATE AVG.



Chart of recent results



April 1, 2025 – September 30, 2025

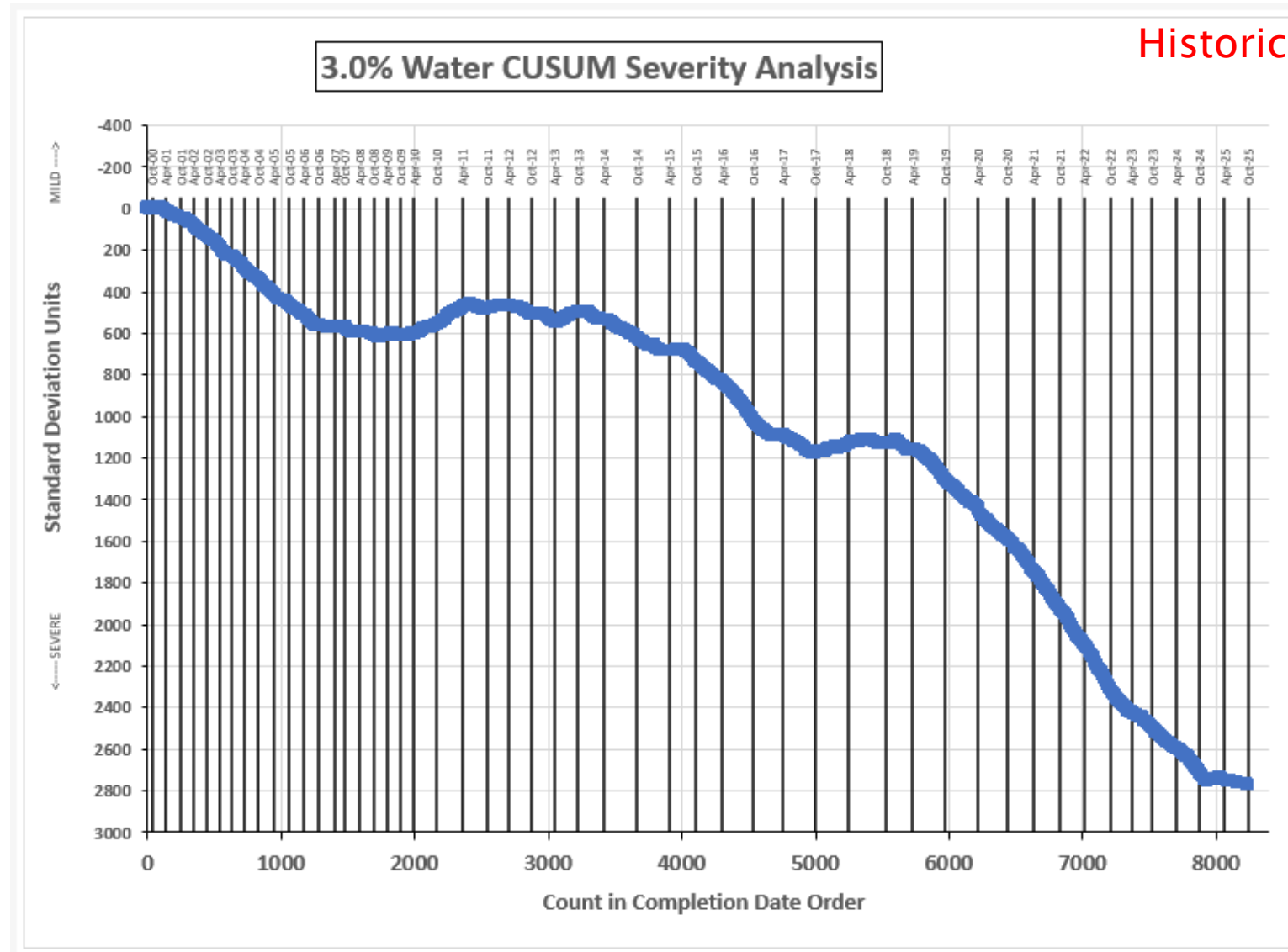
Test Monitoring Center
<https://www.astmtmc.org>



EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 3.0% Water Treat Rate
20 —25 ML CHANGE IN FLOWRATE AVG.



Historical Chart



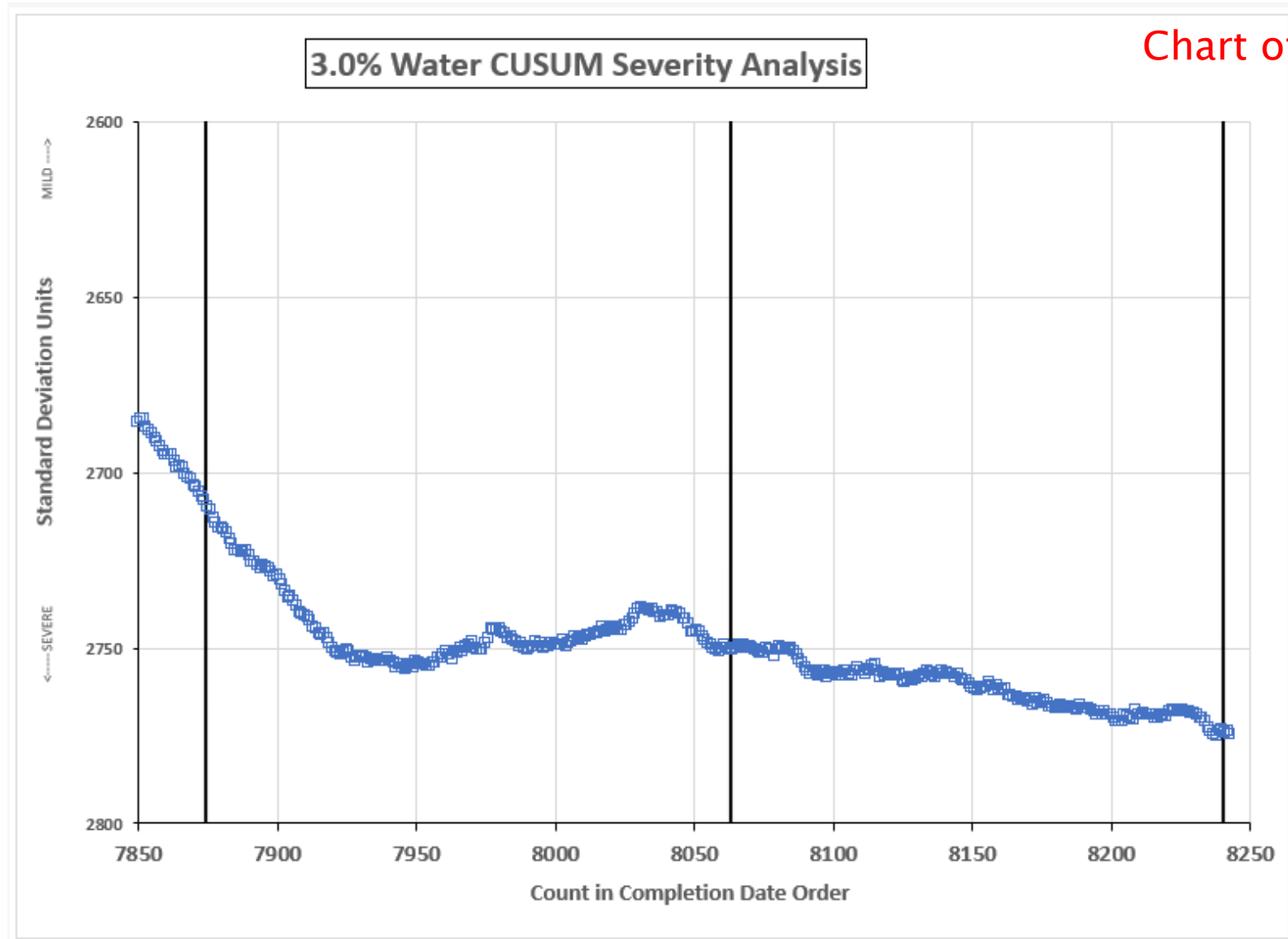
April 1, 2025 – September 30, 2025

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



EOWT INDUSTRY OPERATIONALLY VALID DATA
CFA 3.0% Water Treat Rate (Last 400 Data Points)
20 —25 ML CHANGE IN FLOWRATE AVG.

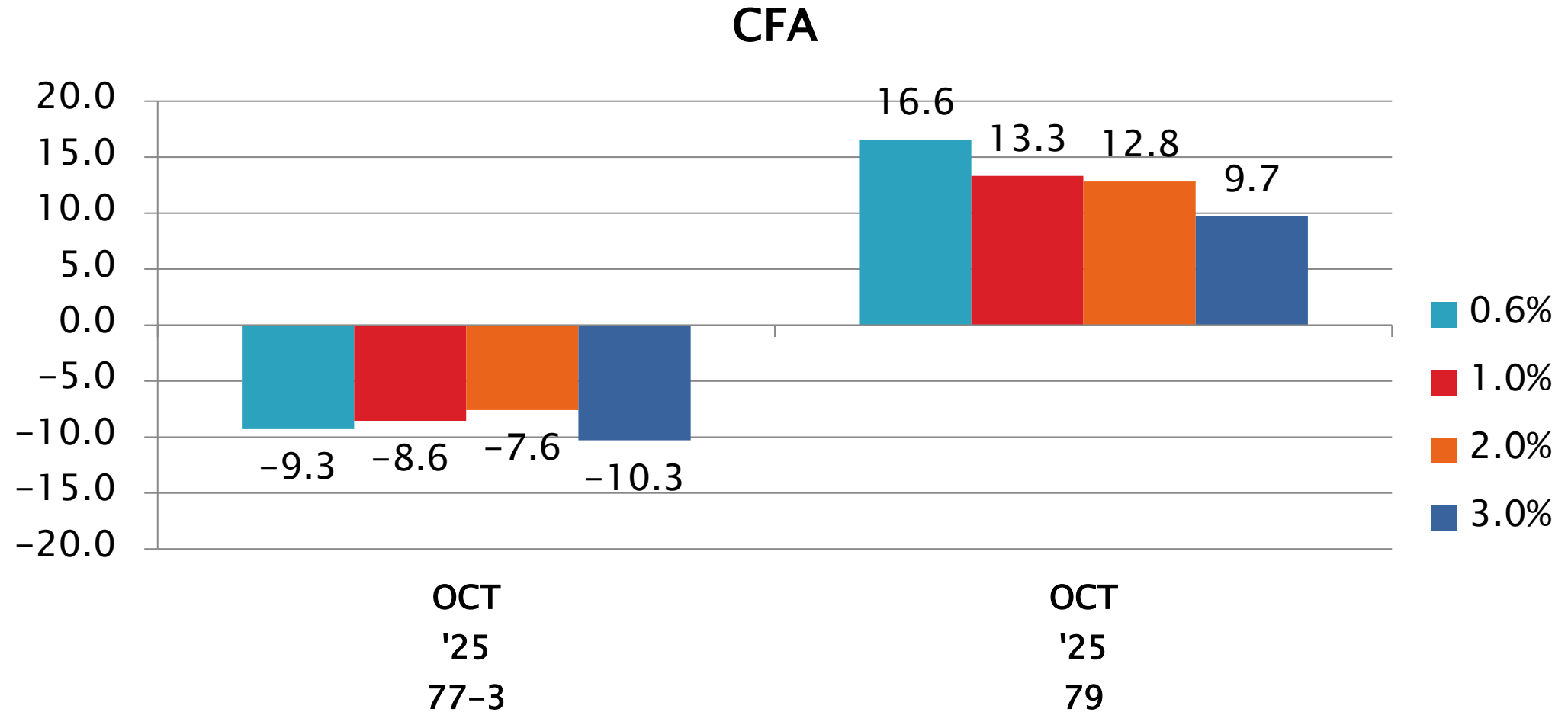
Chart of recent results



April 1, 2025 – September 30, 2025

Test Monitoring Center
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EOWT MEAN CFA's (%) by Reference Oil



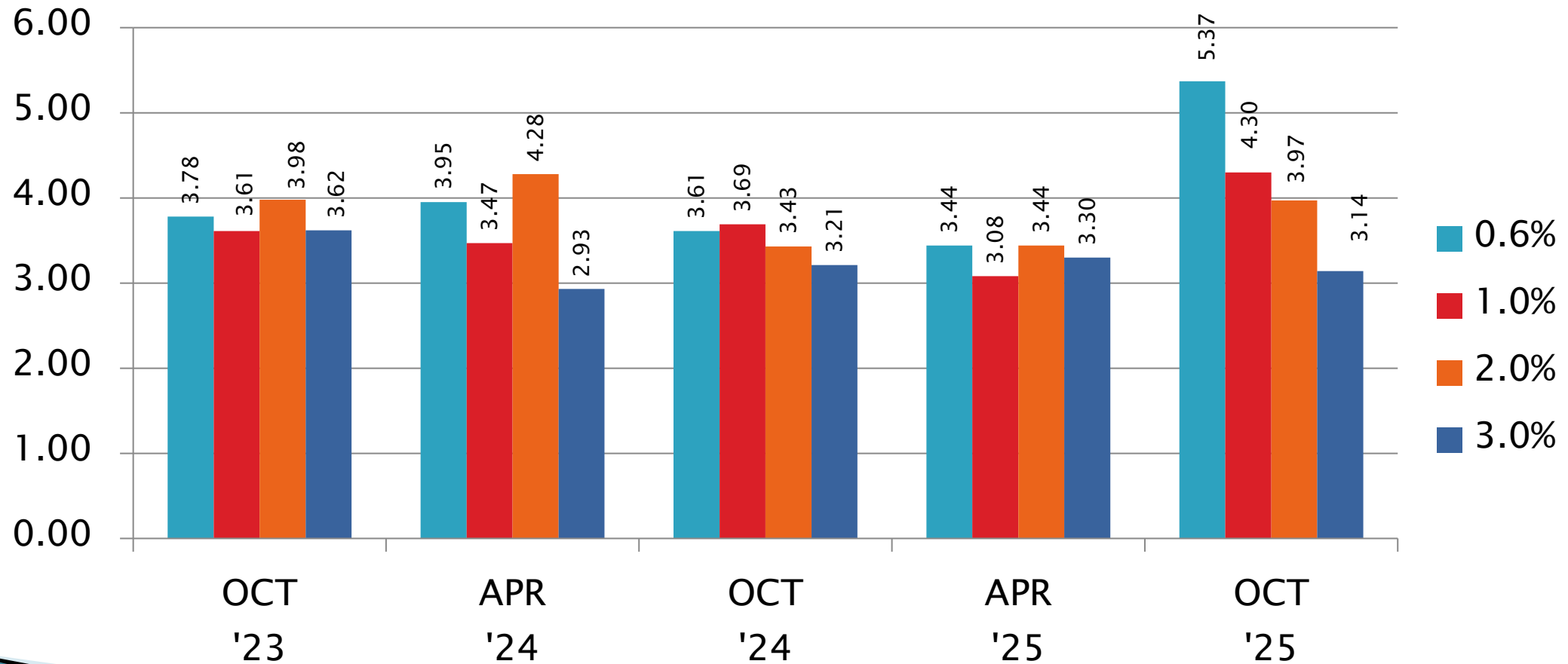
April 1, 2025 - September 30, 2025

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



EOWT Precision (Pooled s) Estimates

CFA

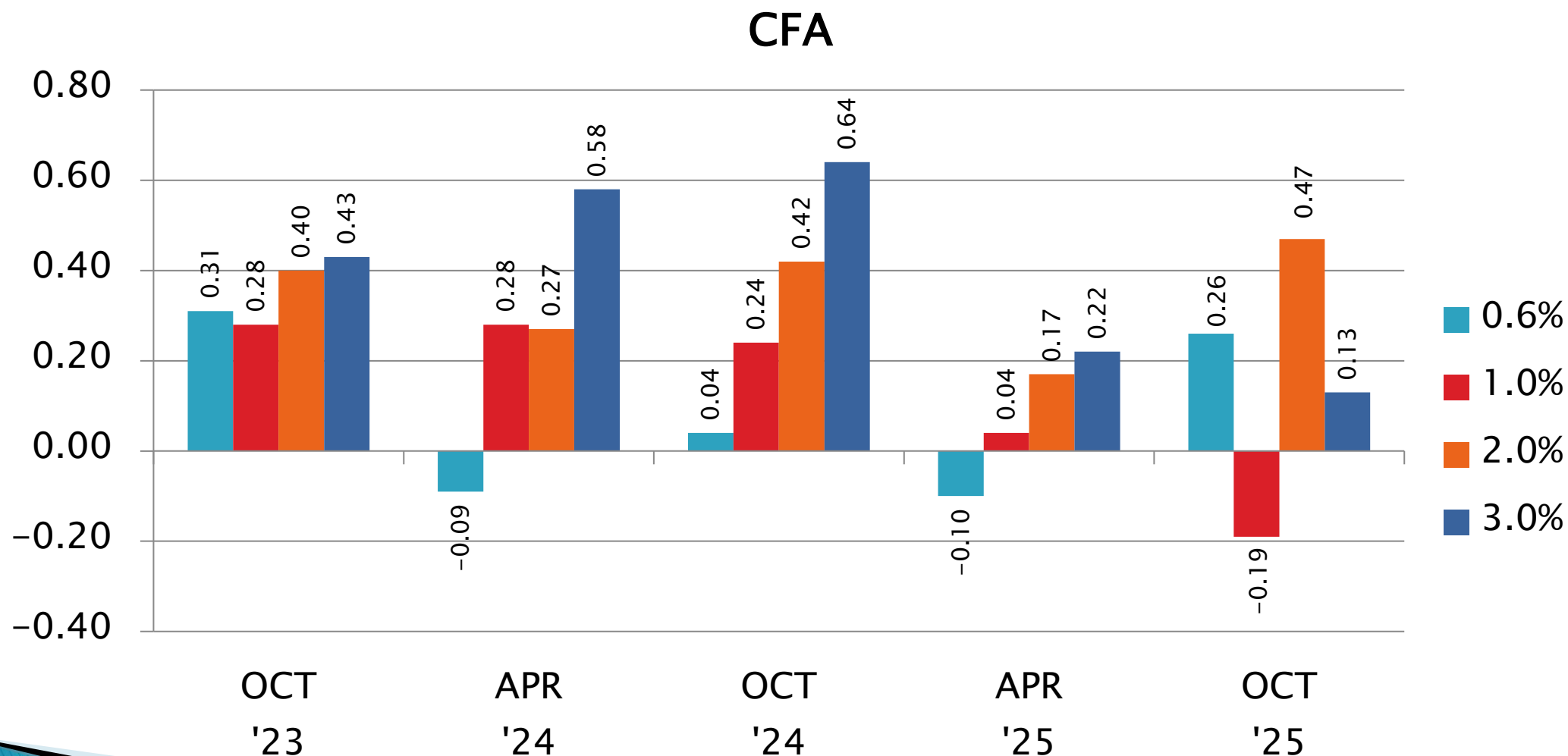


April 1, 2025 – September 30, 2025

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



EOWT Performance (Mean Δ/s) Estimates

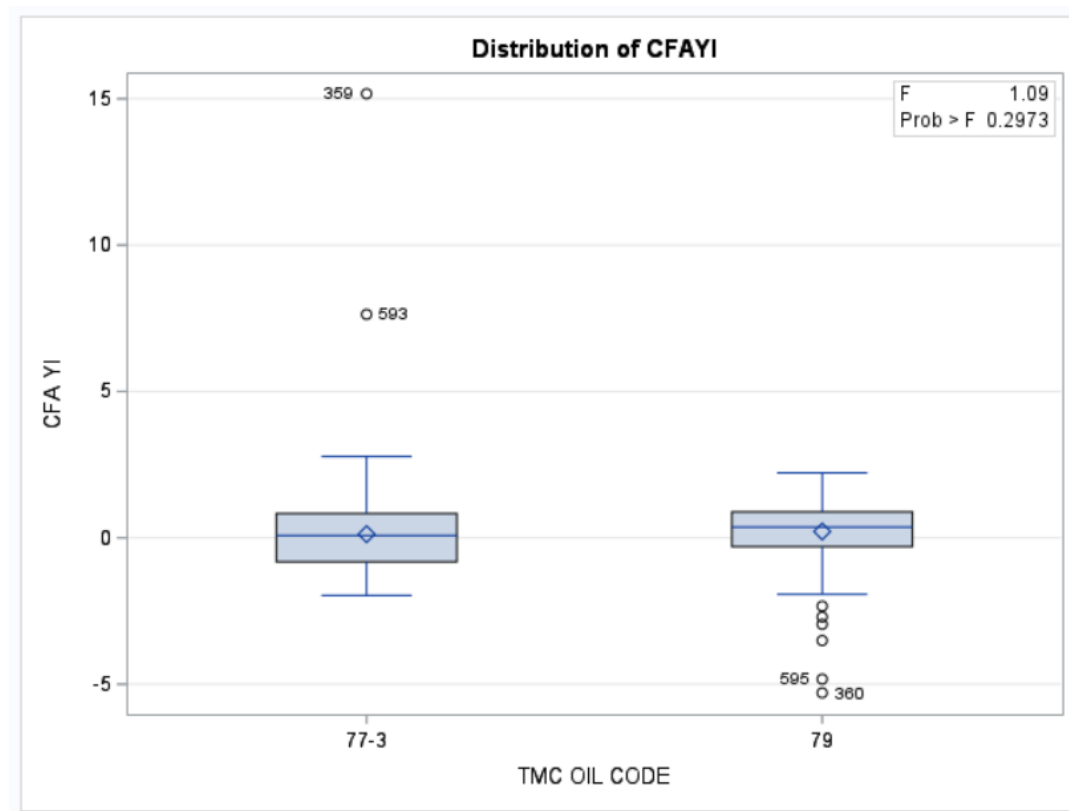
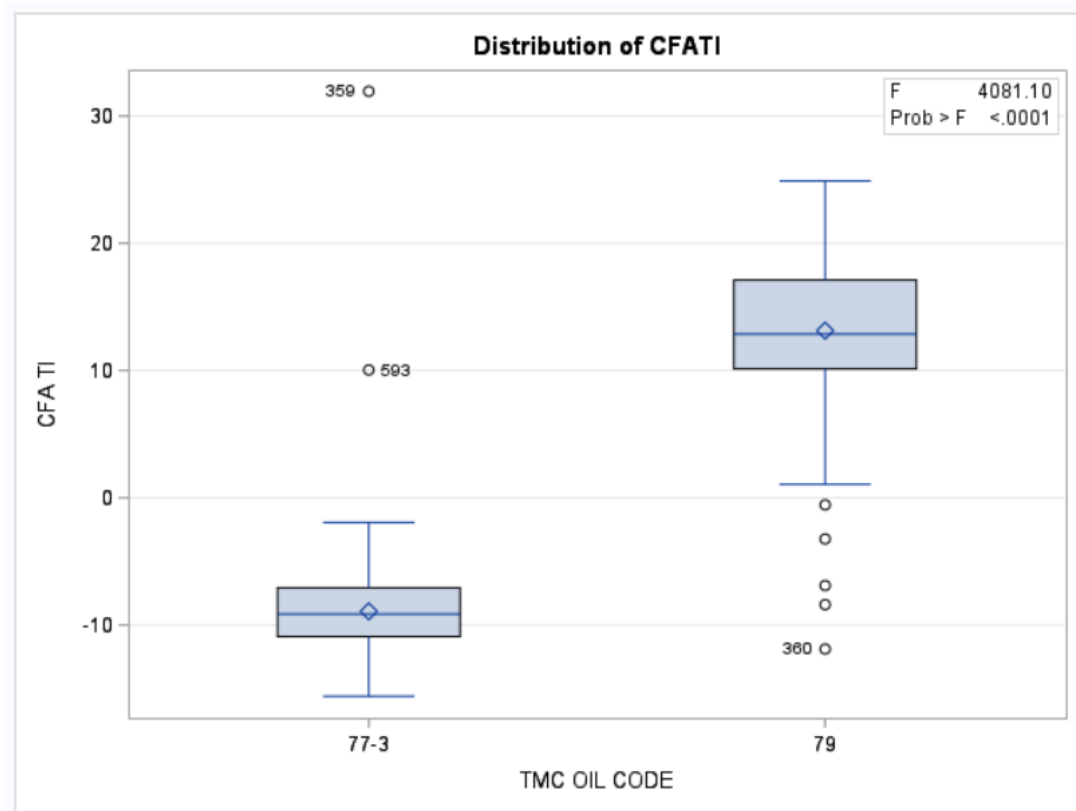


April 1, 2025 – September 30, 2025

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



EOWT Results by Reference Oil: All Water Levels

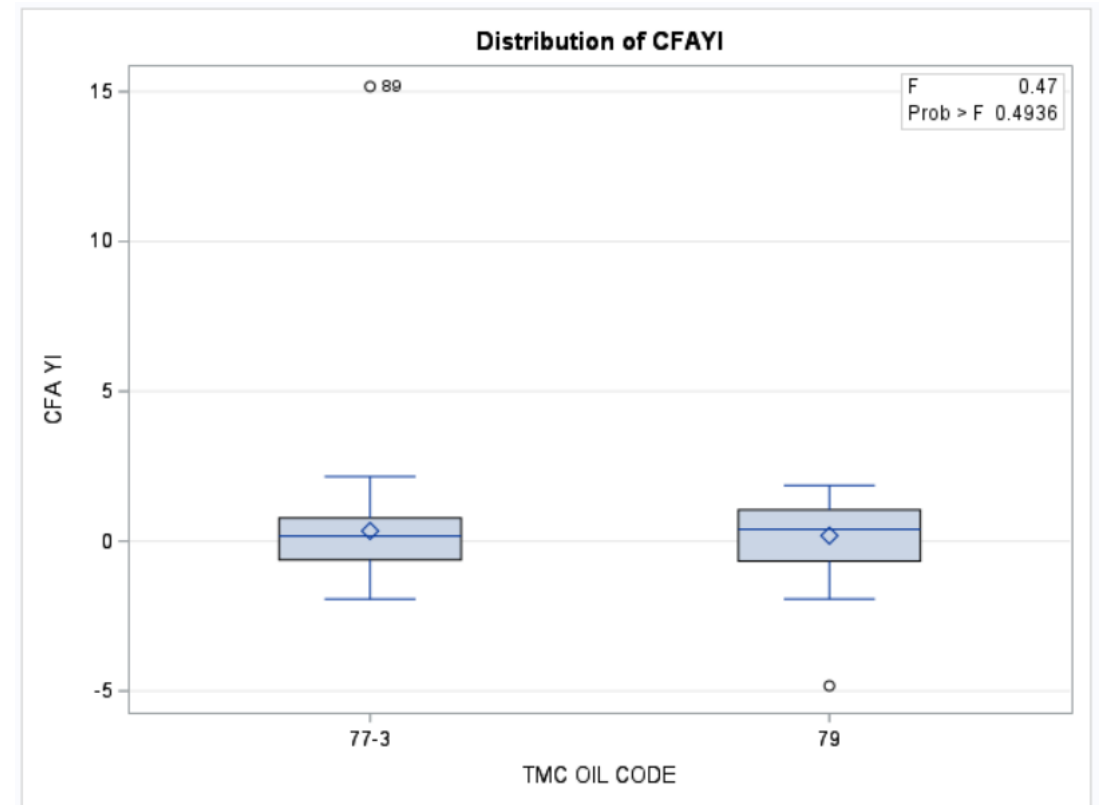
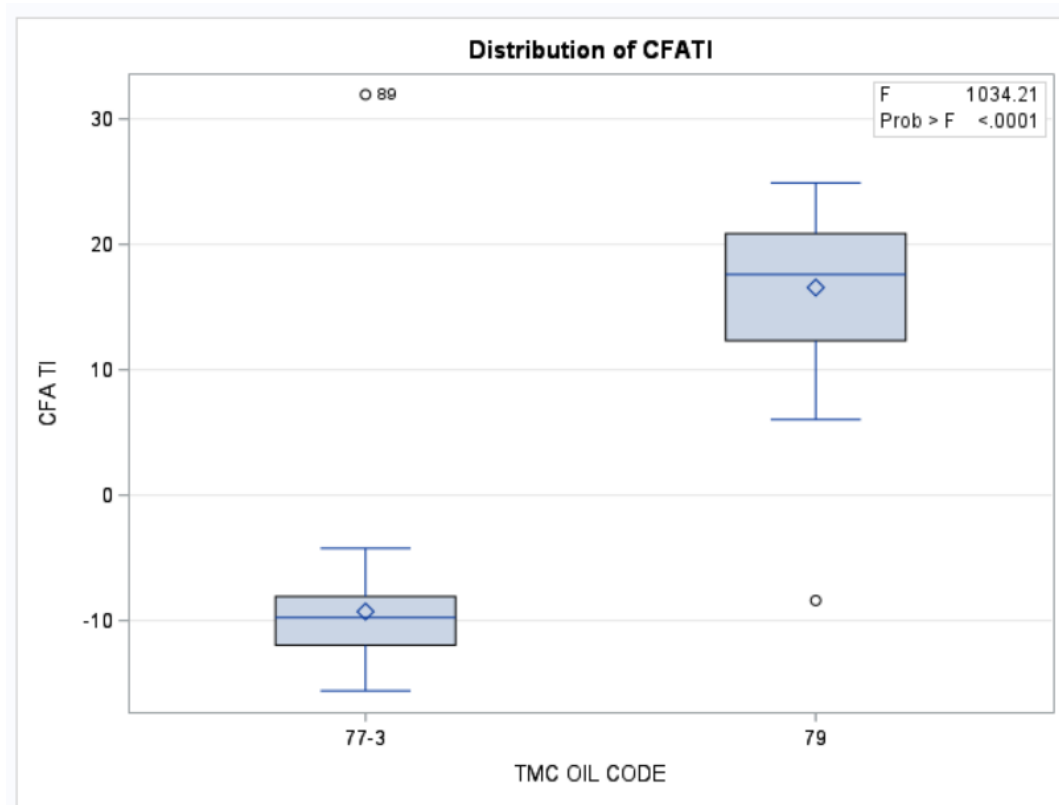


April 1, 2025 – September 30, 2025

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



EOWT 0.6% Results by Reference Oil

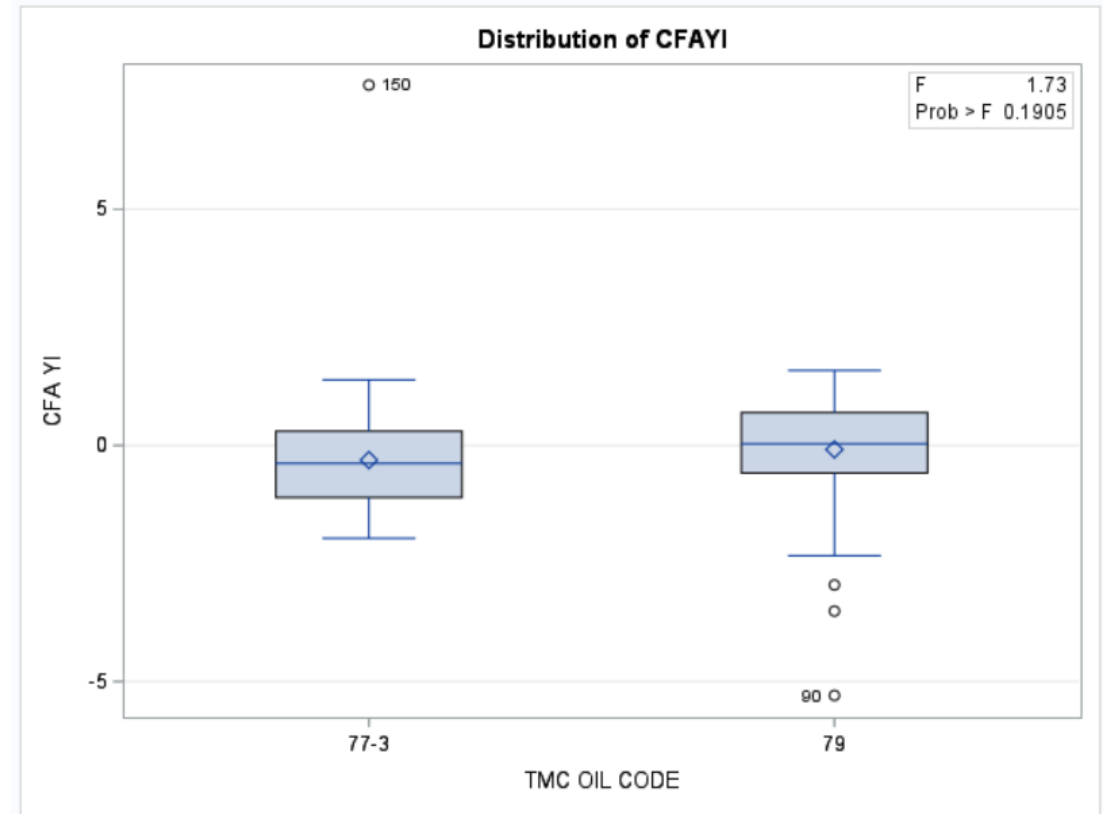
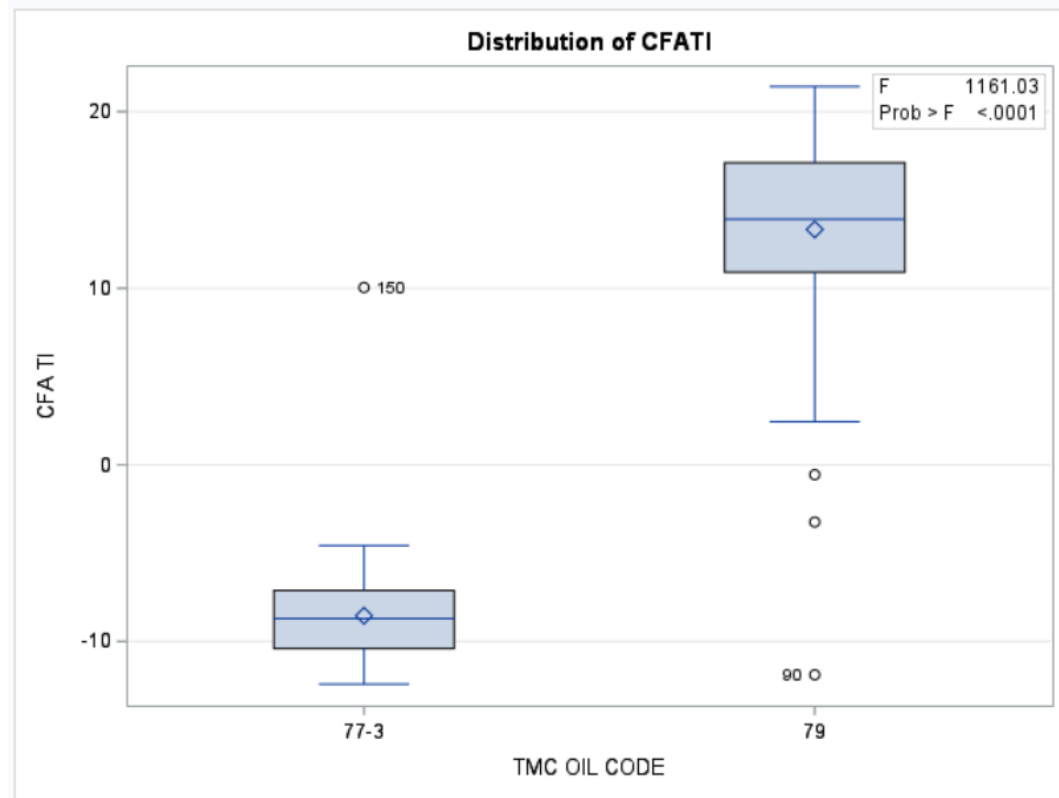


April 1, 2025 – September 30, 2025

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



EOWT 1.0% Results by Reference Oil

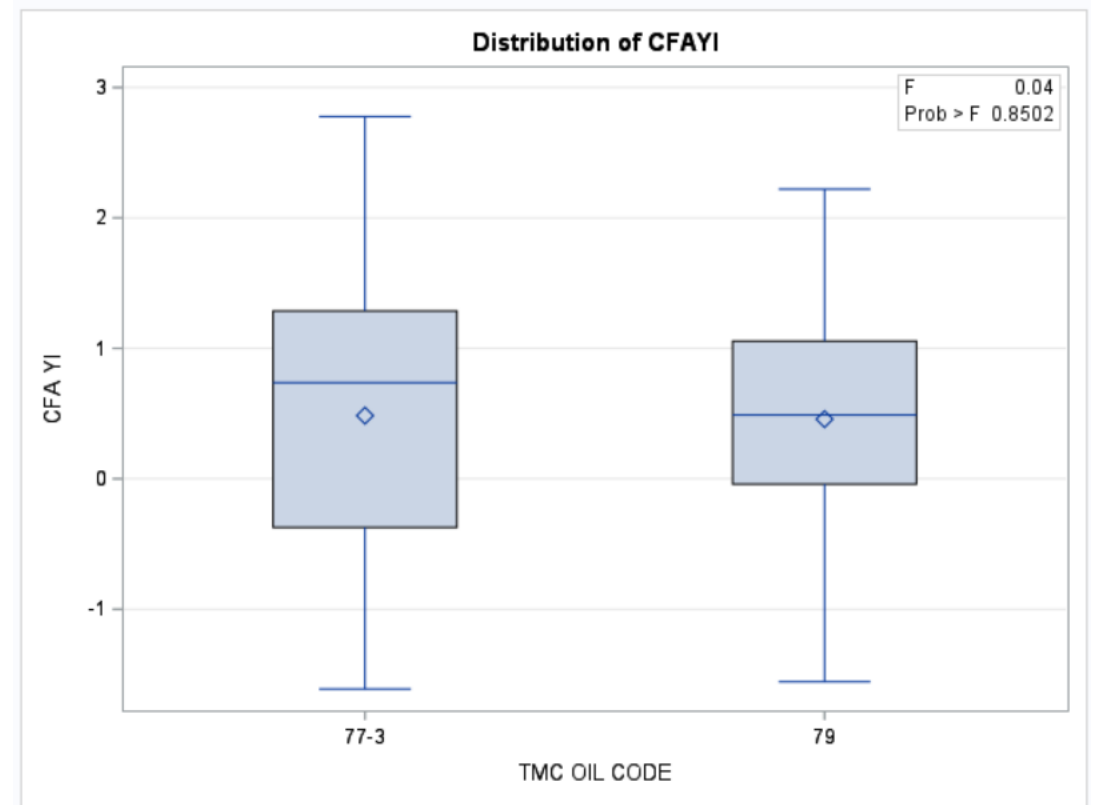
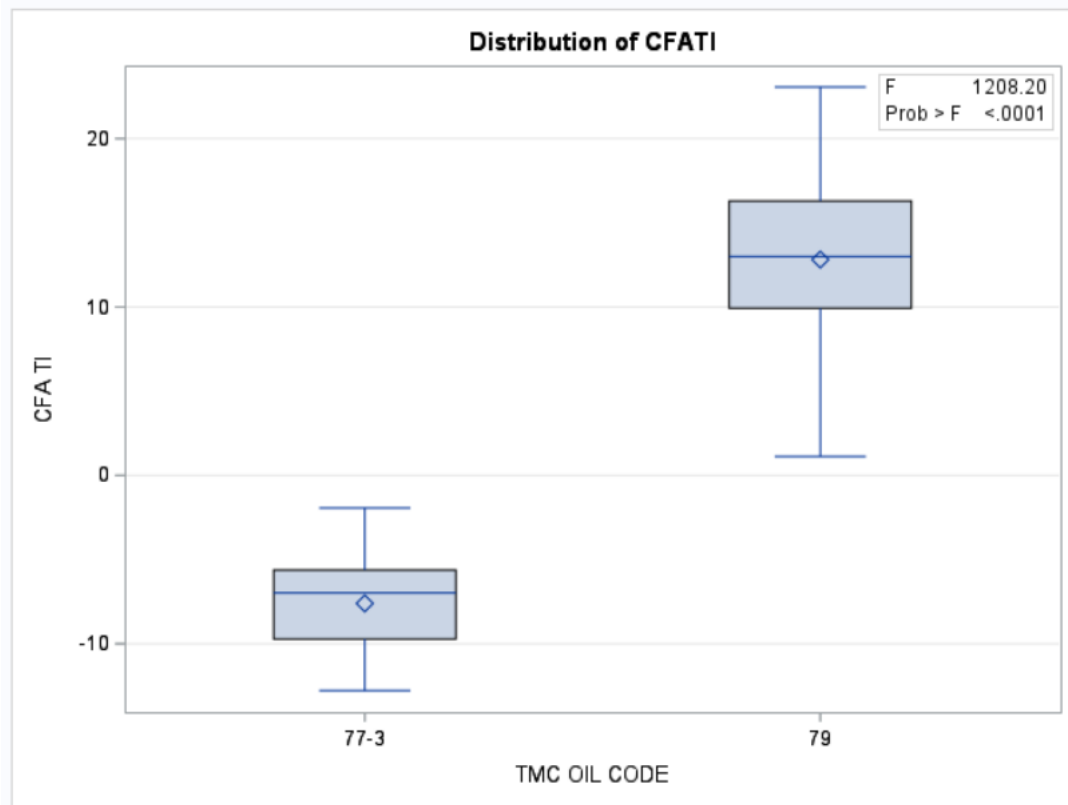


April 1, 2025 – September 30, 2025

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



EOWT 2.0% Results by Reference Oil

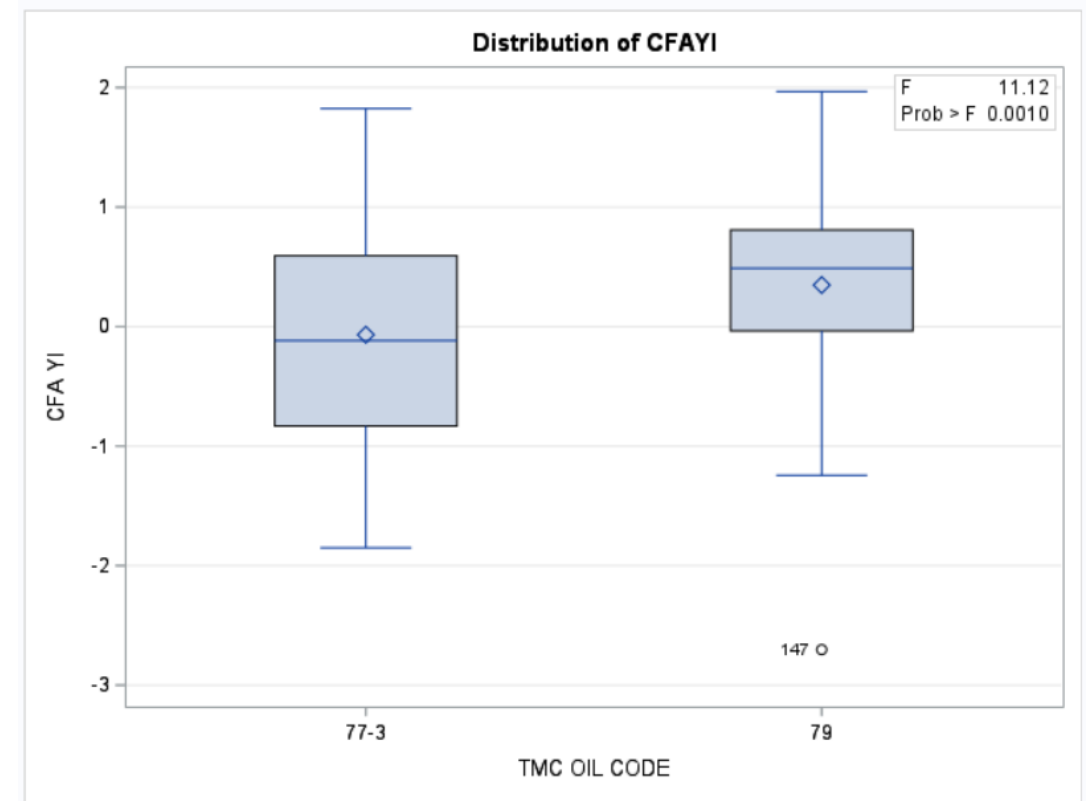
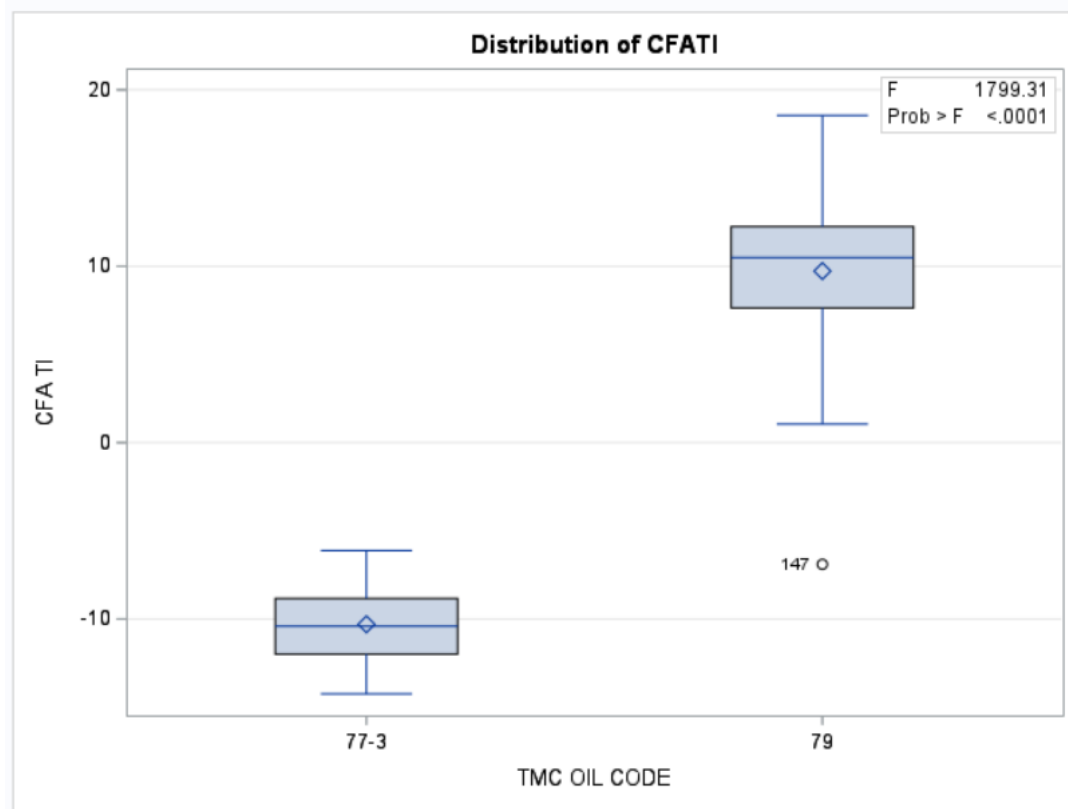


April 1, 2025 – September 30, 2025

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



EOWT 3.0% Results by Reference Oil



April 1, 2025 – September 30, 2025

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



Information Letters*

Test	Date	IL	Topic
			No new information letters this period.

*Available from TMC Website

April 1, 2025 – September 30, 2025

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



EOWT Test Status

- ▶ Poorer Precision was found in the 0.6, 1.0 and 2.0 water treat rates as well as large movements in their Severity (severe in 0.6 & 2.0; mild in 1.0).
- ▶ TMC is working with Reference Oil 79 supplier to determine if a reblend is possible.
 - Reference Oil 79 is also used in the EOFT and is the single Reference Oil for that Bench Test.

April 1, 2025 – September 30, 2025

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



Reference Oil Inventory Estimated Life

EOWT & EOFT

Oil	TMC Inventory (gallons)	TEST	Total Assignments made over Semester	Volume of Samples Assigned (Gallons)	Estimated Life ¹
77-3	315	EOWT	392	35	3 years
79	31.7	EOWT	393	35	6 months
		EOFT	152	11.6	

1 –Based upon Sample Assignment Rate from past 6 months.

TABLE of CONTENTS

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



D02.B0.07

TMC Monitored Tests



ASTM D 6795

Engine Oil Filterability Test (EOFT)

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6795	6 (+1)	N/A
*As of 9/30/2025		

- 7 labs reported data

EOFT Test Activity*

Test Status	Validity Code	Number of Tests
Acceptable Calibration Test	AC	154
Failed Calibration Test	OC	0
Invalid Calibration Test	LC	0
Acceptable Informational Run	NN	3
Unacceptable Informational Run	MN / XN	2
Total		159

- 100% Acceptable Calibration (AC) Testing Rate
 - 7 labs reported data this semester

April 1, 2025 – September 30, 2025

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



EOFT Failed Tests

Failed Parameter	Number of Tests
Change in Flow Average (CIFA) Severe	0
Change in Flow Average (CIFA) Mild	0
Total	0

April 1, 2025 – September 30, 2025

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



EOFT Failed Tests by Lab

Failed Parameter	LTMS Lab							#
	A	B	BE	G	I	L	V	
Change in Flow Average (CIFA) Severe	0	N/A	0	0	0	0	0	0
Change in Flow Average (CIFA) Mild	0	N/A	0	0	0	0	0	0
Totals	0	N/A	0	0	0	0	0	0

April 1, 2025 – September 30, 2025

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



EOFT Lost Tests*

Status	Cause	No. of Tests
Invalid (L,R)	Oven Temperature Issue	0
Aborted (X)		0
Total		0

*Invalid and aborted calibration tests

April 1, 2025 – September 30, 2025

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



EOFT Information/Shakedown Tests

Informational / Non-blind Results	Number of Tests
Informational / Non-blind Test Result In-Range (NN)	3
Informational / Non-blind Test Result Severe (MN)	1
Informational / Non-blind Test Result Mild (MN)	1
Total	5

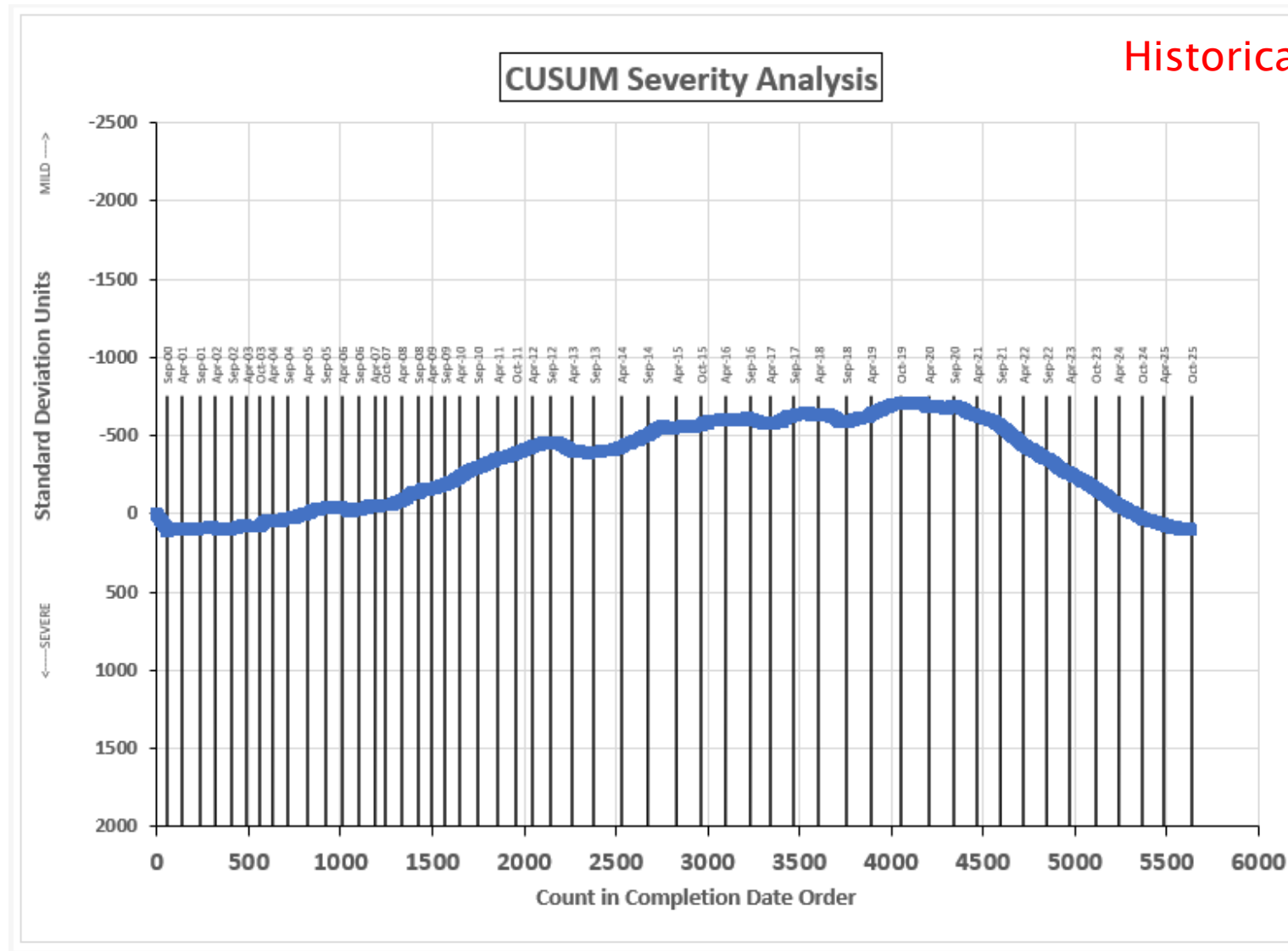
April 1, 2025 – September 30, 2025

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



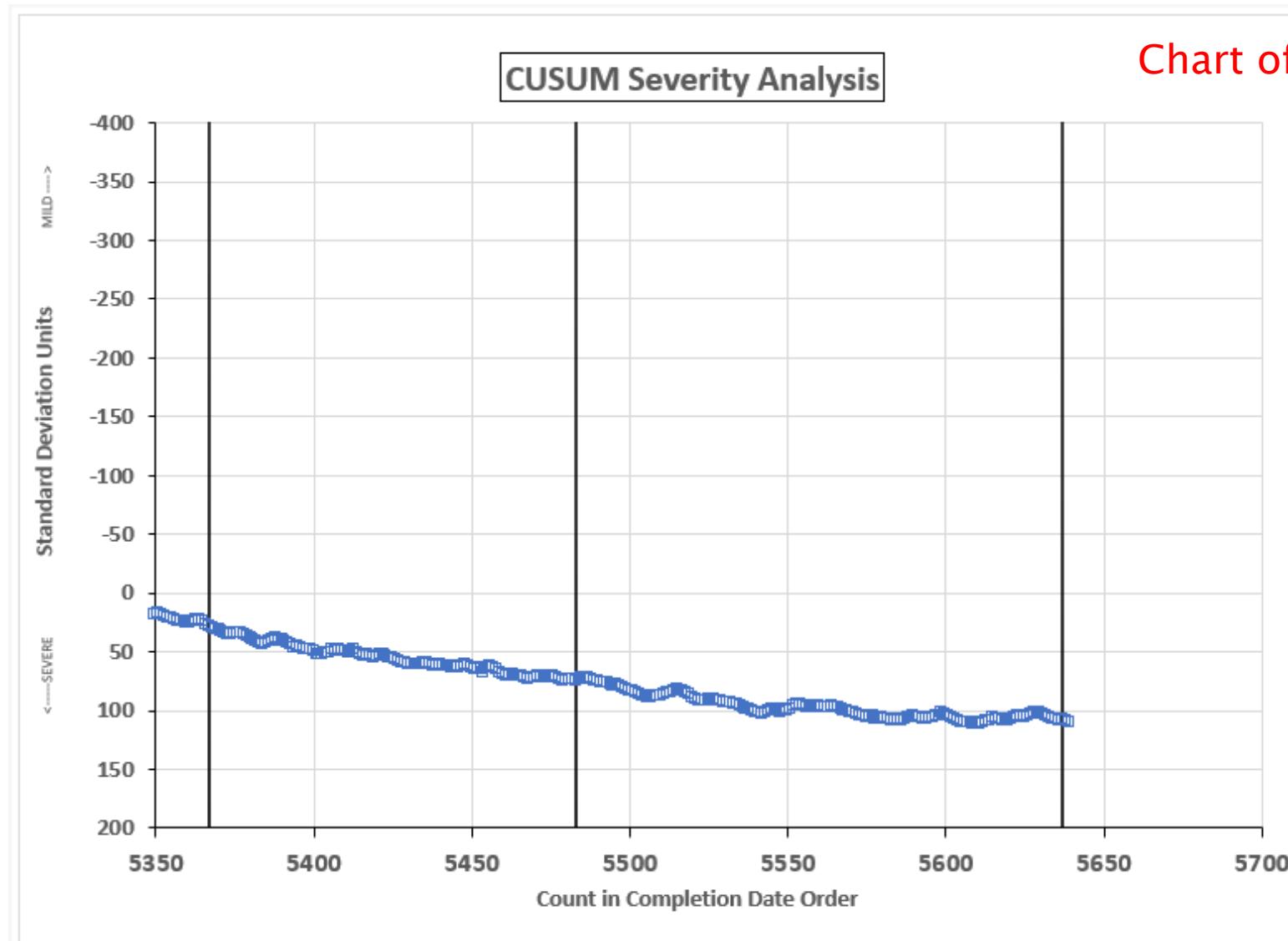
20 —25 ML CHANGE IN FLOWRATE AVERAGE (%)

Historical Chart



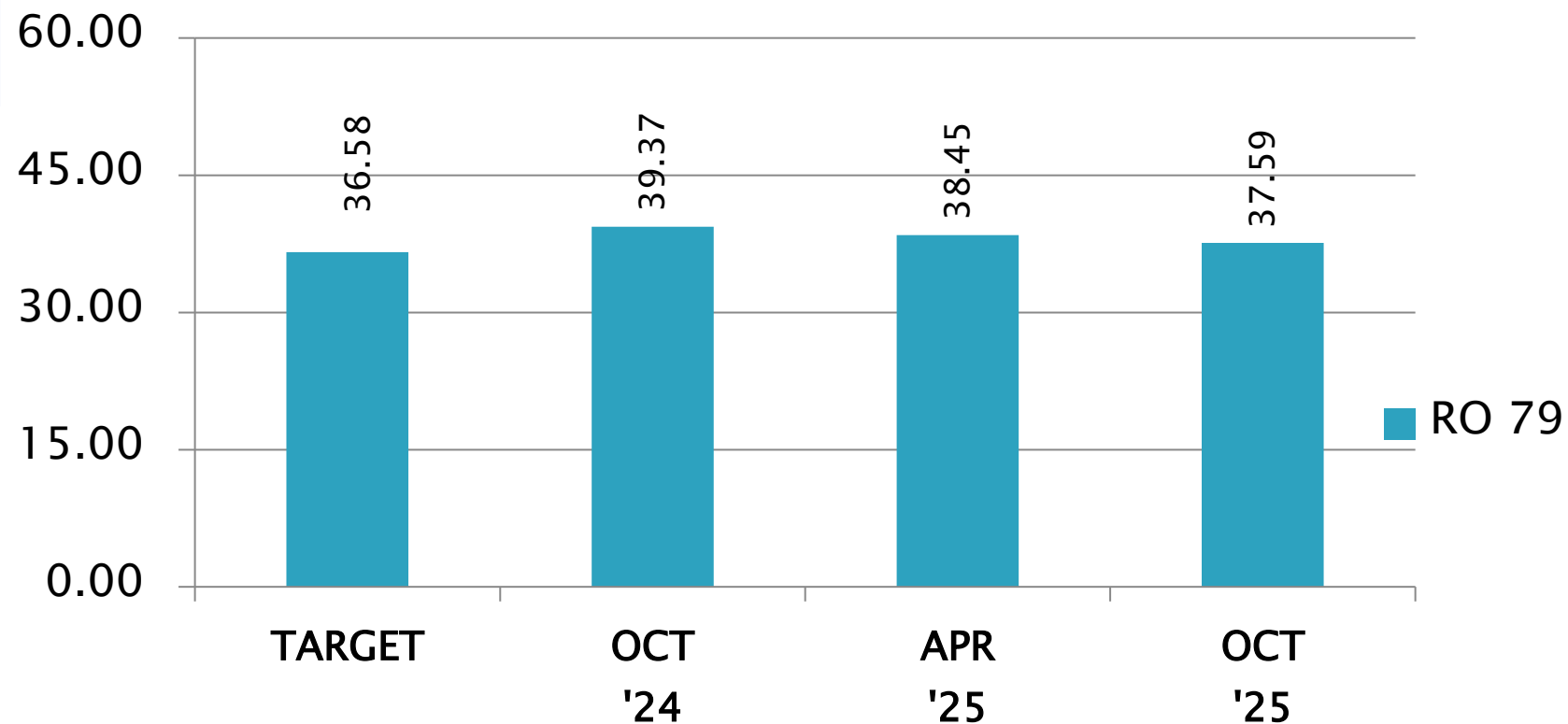
EOFT INDUSTRY OPERATIONALLY VALID DATA
Last 250 Data Points
20 —25 ML CHANGE IN FLOWRATE AVERAGE (%)

Chart of recent results

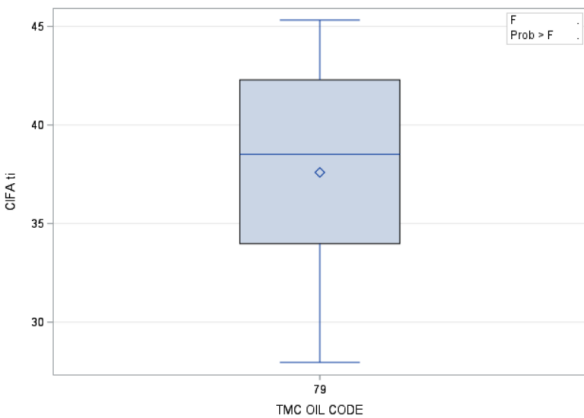


EOFT MEAN CFA's (%)

CFA



Distribution of CIFAti



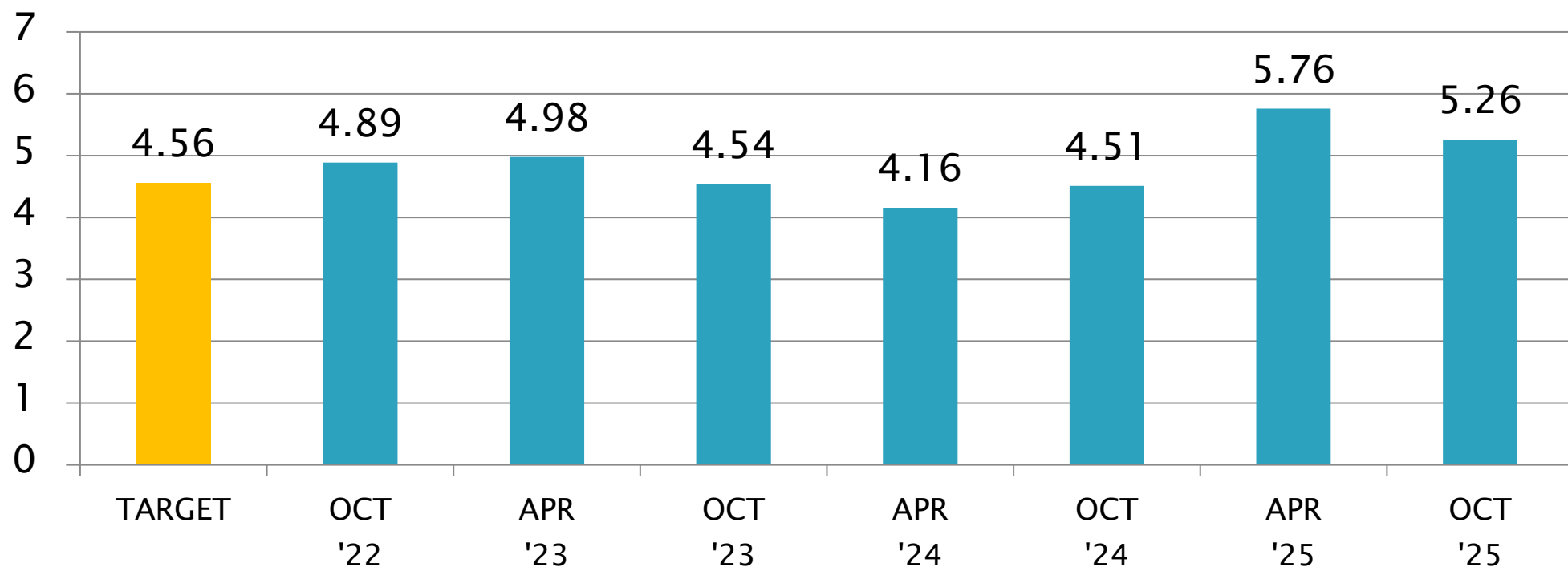
April 1, 2025 – September 30, 2025

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



EOFT Precision Estimates

CIFA
Pooled s

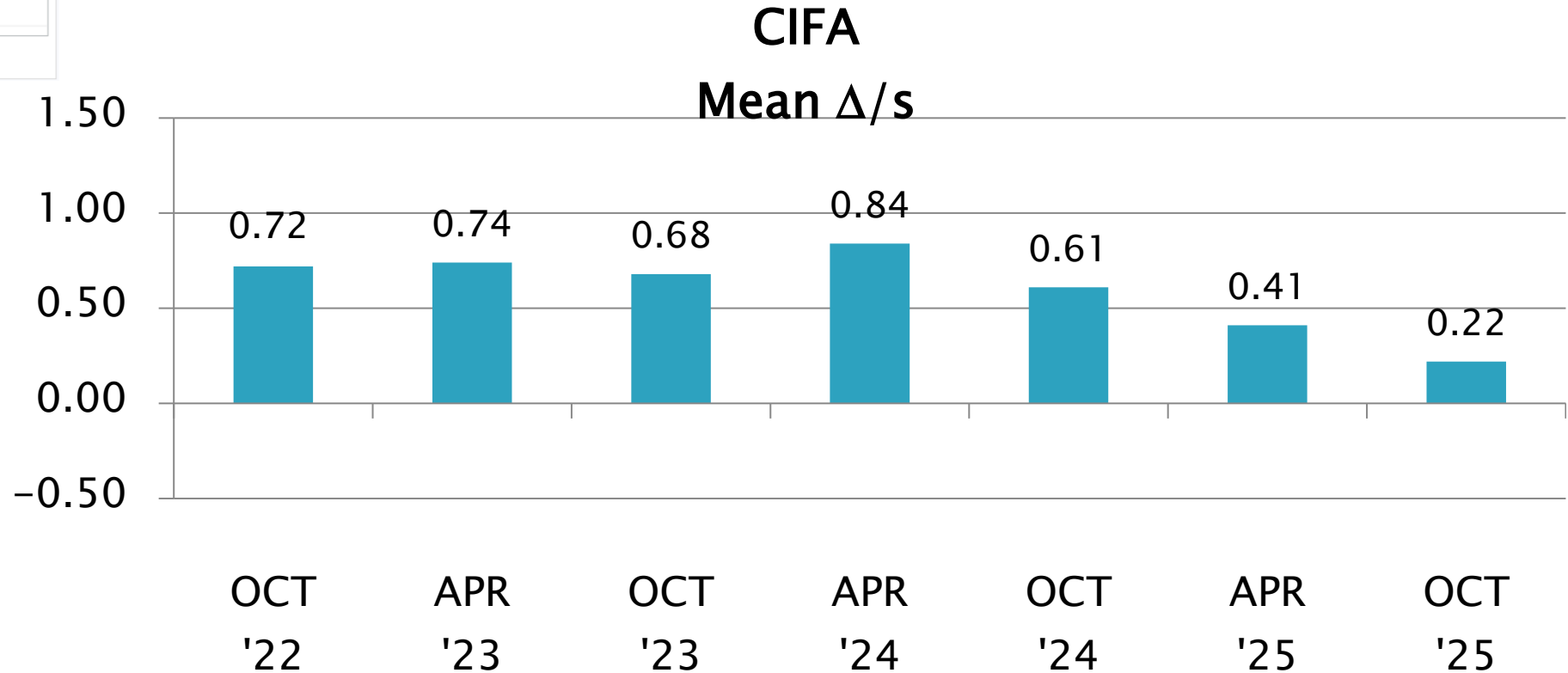


April 1, 2025 – September 30, 2025

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



EOFT Severity Estimates



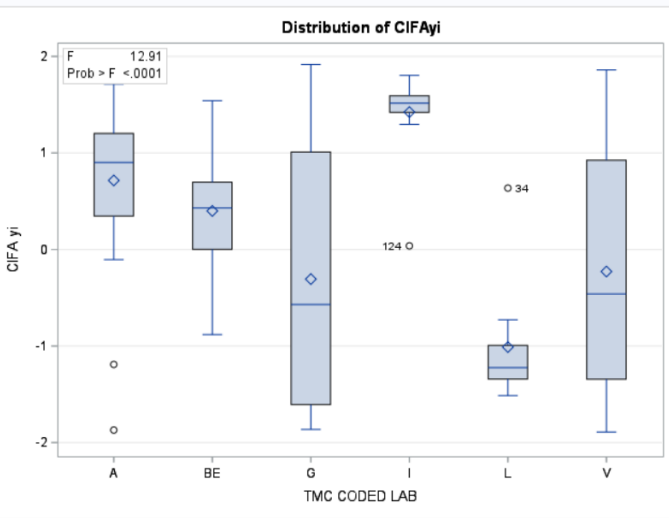
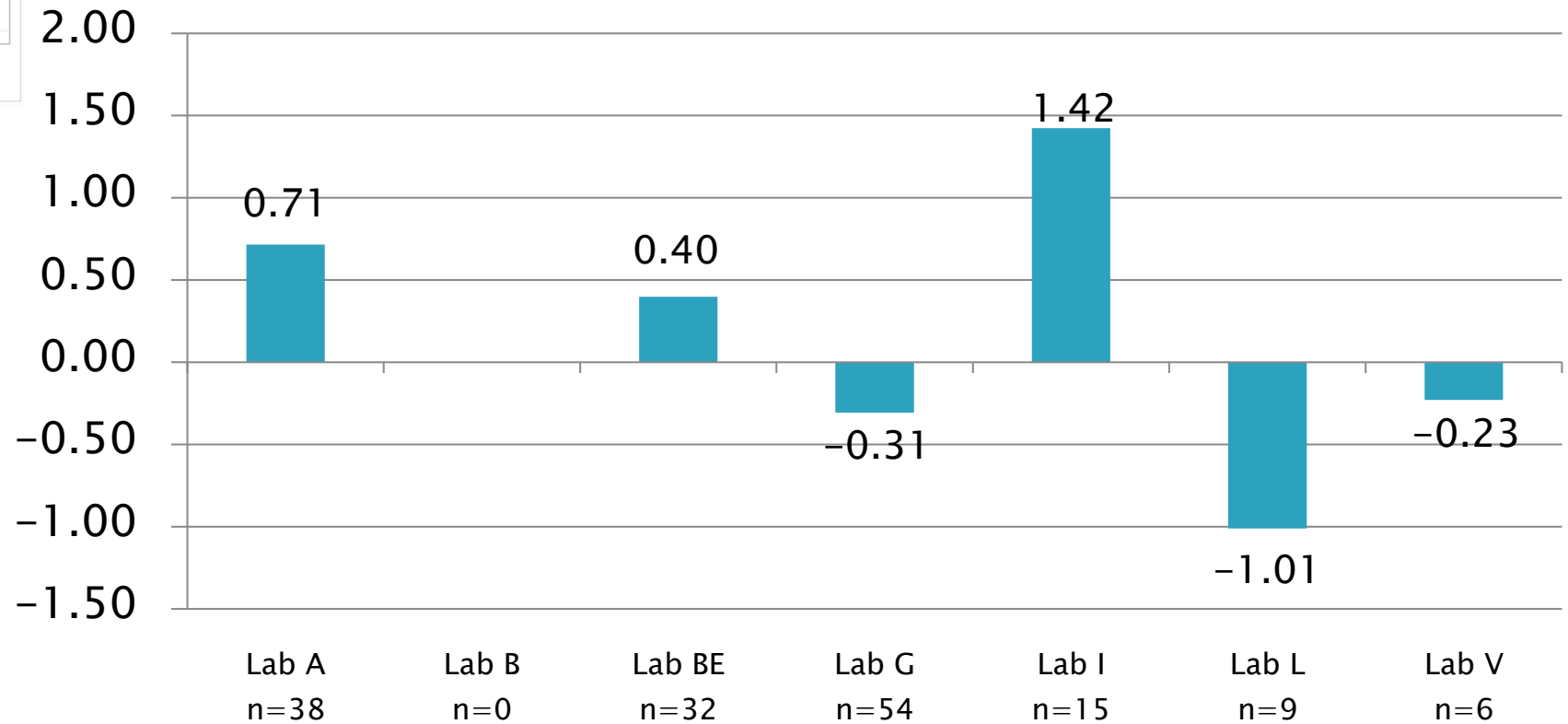
April 1, 2025 – September 30, 2025

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



EOFT Lab Severity Estimates

CIFA
Mean Δ/s



April 1, 2025 – September 30, 2025

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



Information Letters*

Test	Date	IL	Topic
			No new information letters this period.

*Available from TMC Website

April 1, 2025 – September 30, 2025

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



EOFT Test Status

- ▶ One new lab became calibrated this semester.
- ▶ Change in Flow Average (CIFA) continues to trend severe although CUSUM slope appears to be leveling off this semester.
- ▶ Precision (Pooled s) abated slightly to 5.26 s.
- ▶ Performance (Mean Δ/s) reduced for the second semester to 0.22 s.

April 1, 2025 – September 30, 2025

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



Reference Oil Inventory Estimated Life

EOWT & EOFT

Oil	TMC Inventory (gallons)	TEST	Total Assignments made over Semester	Volume of Samples Assigned (Gallons)	Estimated Life ¹
77-3	315	EOWT	392	35	3 years
79	31.7	EOWT	393	35	6 months
		EOFT	152	11.6	

1 –Based upon Sample Assignment Rate from past 6 months.

TABLE of CONTENTS

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



D02.B0.07

TMC Monitored Tests



ASTM D 7097

Medium High Temperature TEOST (MTEOS)

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D7097	11 (+0)	35 (-1)
*As of 9/30/2025		

D7097: Deposits by MTEOS

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	65
Failed Calibration Test	OC	7
Operationally Invalidated by Lab	LC	1
Operationally Invalidated by TMC	RC	0
Operationally Invalid (Aborted)	XC	2
Acceptable Informational Run	NN	0
Unacceptable Informational Run	MN	2
Total		77

Number of Labs Reporting Data: 11 (+0)
Fail Rate of Operationally Valid Tests: 9.7% (11.1% last period)

April 1, 2025 – September 30, 2025

Test Monitoring Center
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D7097: Deposits by MTEOS

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Severe	6
Total Deposits Mild	1
Total	7

FOUR Labs had OC results.
THREE Severe fails and ONE Mild fail on RO 434-3
THREE Severe fails on RO 432.

April 1, 2025 – September 30, 2025

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



D7097: Deposits by MTEOS

Summary of Invalid Tests

Operationally Invalid Tests (LC, RC, XC)	Validity Code	No. Of Tests
Aborted by Lab due to Air Flow issue	XC	1
Aborted by Lab due to Temperature Control issue	XC	1
Invalidated by Lab due to issue with pump	LC	1
Total		3

April 1, 2025 – September 30, 2025

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



D7097: Deposits by MTEOS

Summary of Informational Tests

Informational / Non-blind Tests (NN, MN)	Validity Code	No. Of Tests
Informational run, Deposits in Range	NN	0
Informational run, Deposits not in Range (Severe)	MN	2
Informational run, Deposits not in Range (Mild)	MN	0
Total		2

April 1, 2025 – September 30, 2025

Test Monitoring Center
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D7097: Deposits by MTEOS

Period Precision and Severity Estimates

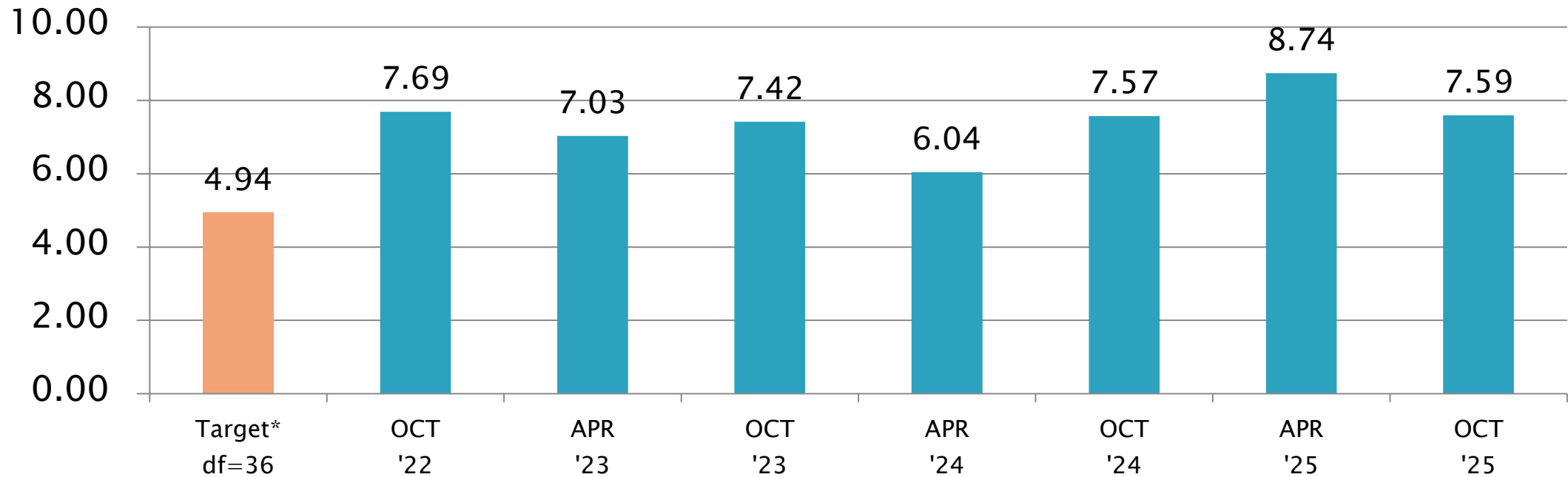
Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets 9/30/2021 ¹	38	36	4.94	-----
10/1/20 through 3/31/21	101	99	8.40	0.17
4/1/21 through 9/30/21	81	78	7.25	-0.02
10/1/21 through 3/31/22	75	73	8.86	0.18
4/1/22 through 9/30/22	77	75	7.69	0.69
10/1/22 through 3/31/23	67	65	7.03	0.41
4/1/22 through 9/30/23	74	71	7.42	0.31
10/1/23 through 3/31/24	65	62	6.04	0.19
4/1/24 through 9/30/24	76	73	7.57	0.43
10/1/24 through 3/31/25	72	70	8.74	0.31
4/1/25 through 9/30/25	72	70	7.59	0.52

¹Target precision updated to reference oils 432 and 434-3 preliminary

D7097 Precision Estimates

Total Deposits, mg

Pooled s



*Target precision updated to reference oils 432 and 434-3 preliminary

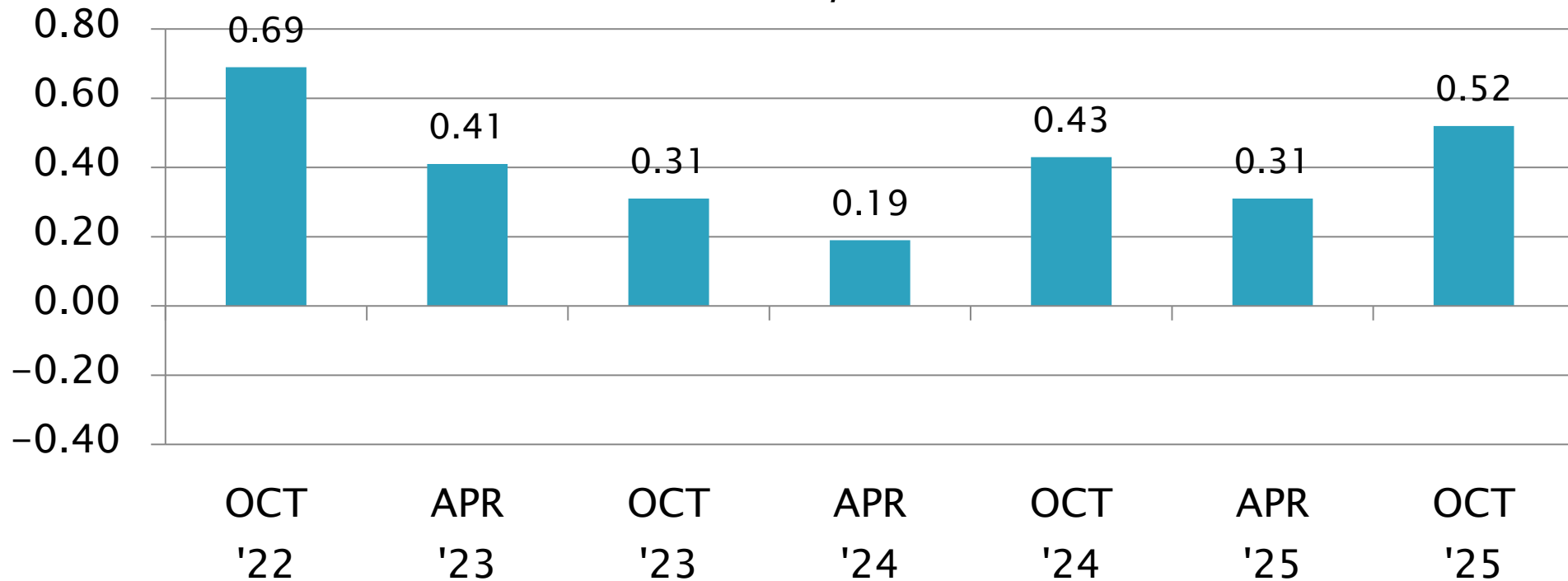
April 1, 2025 – September 30, 2025

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D7097 Severity Estimates

Total Deposits, mg
Mean Δ/s



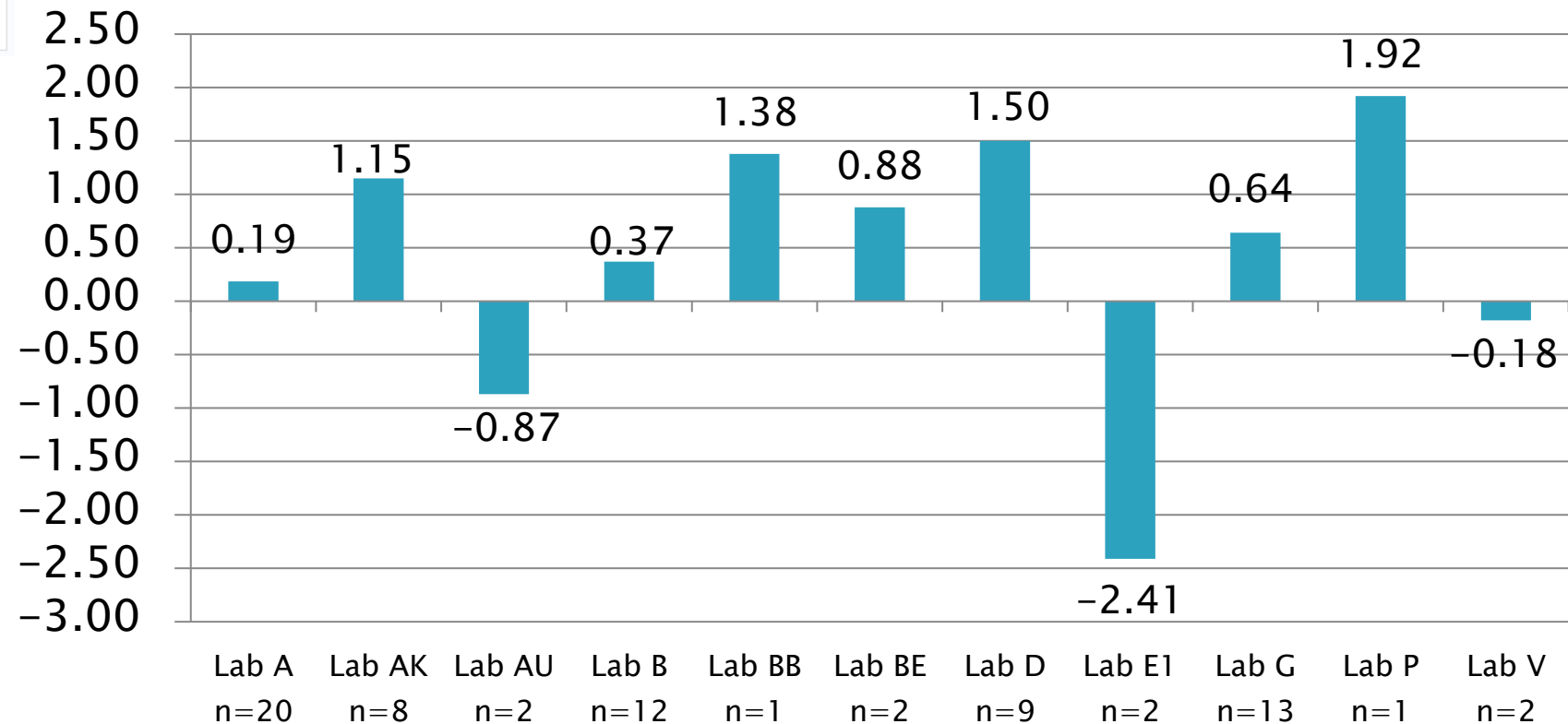
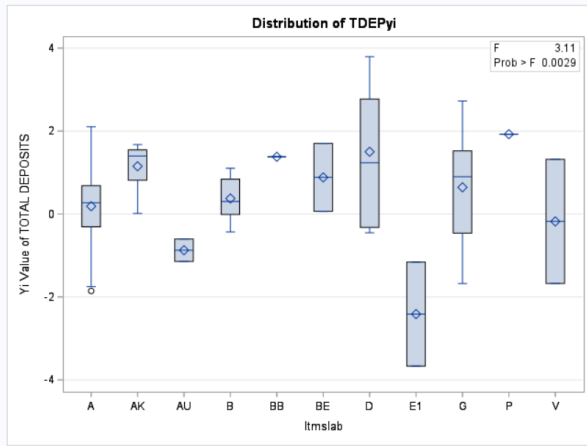
April 1, 2025 – September 30, 2025

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D7097 Lab Severity Estimates

Total Deposits, mg
Mean Δ/s



April 1, 2025 – September 30, 2025

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D7097: Deposits by MTEOS

- ▶ Precision (Pooled s) regressed further to 7.59s this reporting period
- ▶ Performance (Mean Δ/s) has regressed, moving from 0.31s back up to 0.52s this semester.
- ▶ All 72 operationally valid tests this period report using Rod Batch N.
- ▶ Most operationally valid calibration tests this period report using Catalyst Batch 23AB (n=71). Only one test used Catalyst Batch 20AB (n=1).
 - No runs used Catalyst Batch 19BA this semester

April 1, 2025 – September 30, 2025

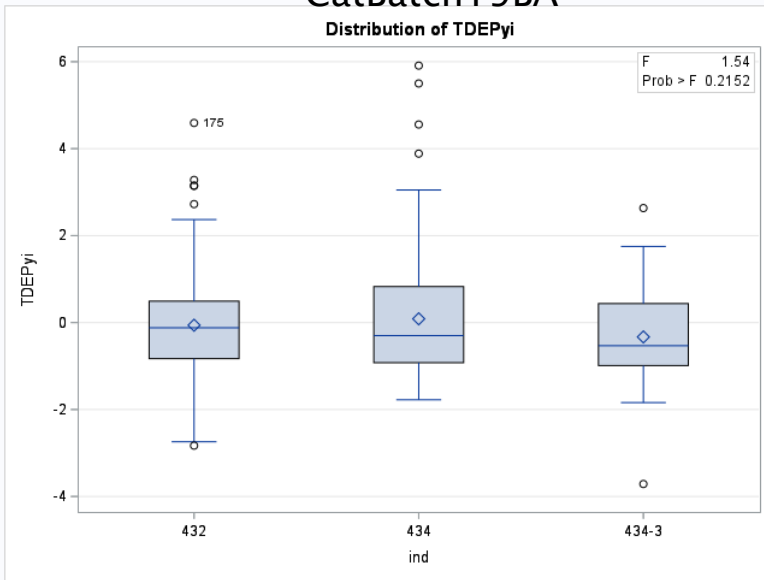
Test Monitoring Center
<https://www.astmtmc.org>



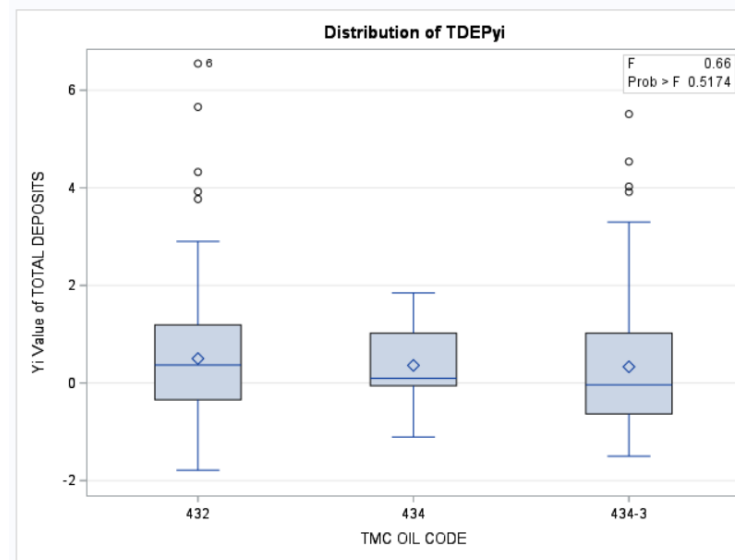
D7097: Deposits by MHT TEOST

- ▶ No new runs on catalyst batch 19BA this semester
 - Total Runs and Yi statistic for batch 19BA remain at n=349, $Y_i = -0.02$.
- ▶ Only 1 new run on catalyst batch 20AB (total n=323). Performance (Y_i) unchanged at 0.42s.
- ▶ Newest catalyst batch 23AB now has 203 runs. Performance (Y_i) settling in on 0.44s.
 - 0.44 $Y_i =$ OCT '25; $Y_i = 0.44$ APR '25; $Y_i = 0.53$ OCT '24; $Y_i = 1.39$ APR '24

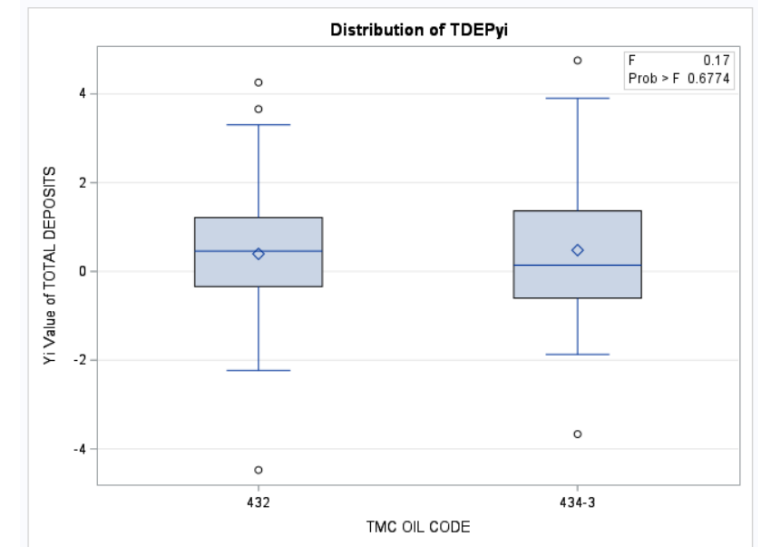
CatBatch19BA



CatBatch20AB



CatBatch23AB



April 1, 2025 – September 30, 2025

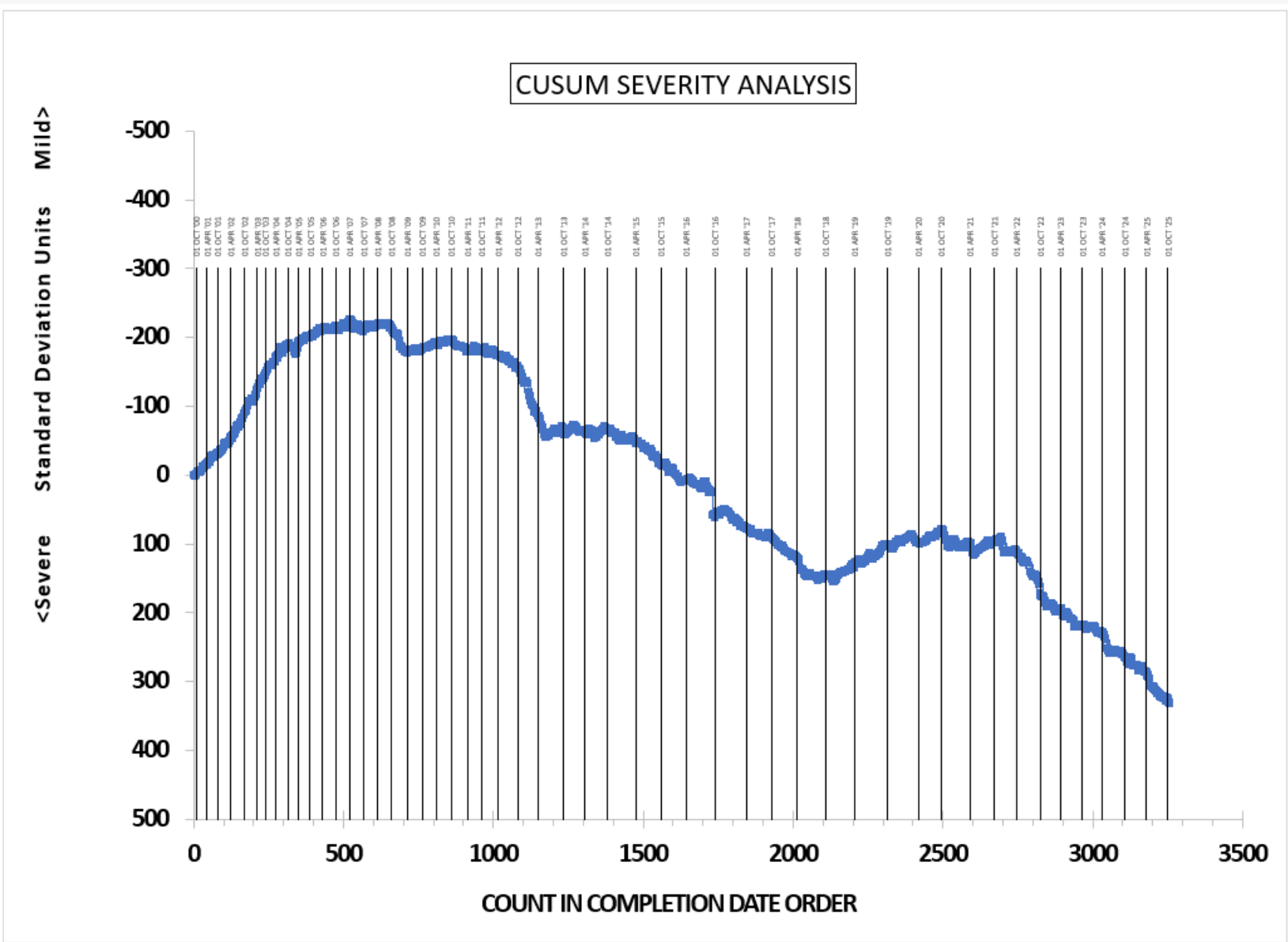
Test Monitoring Center
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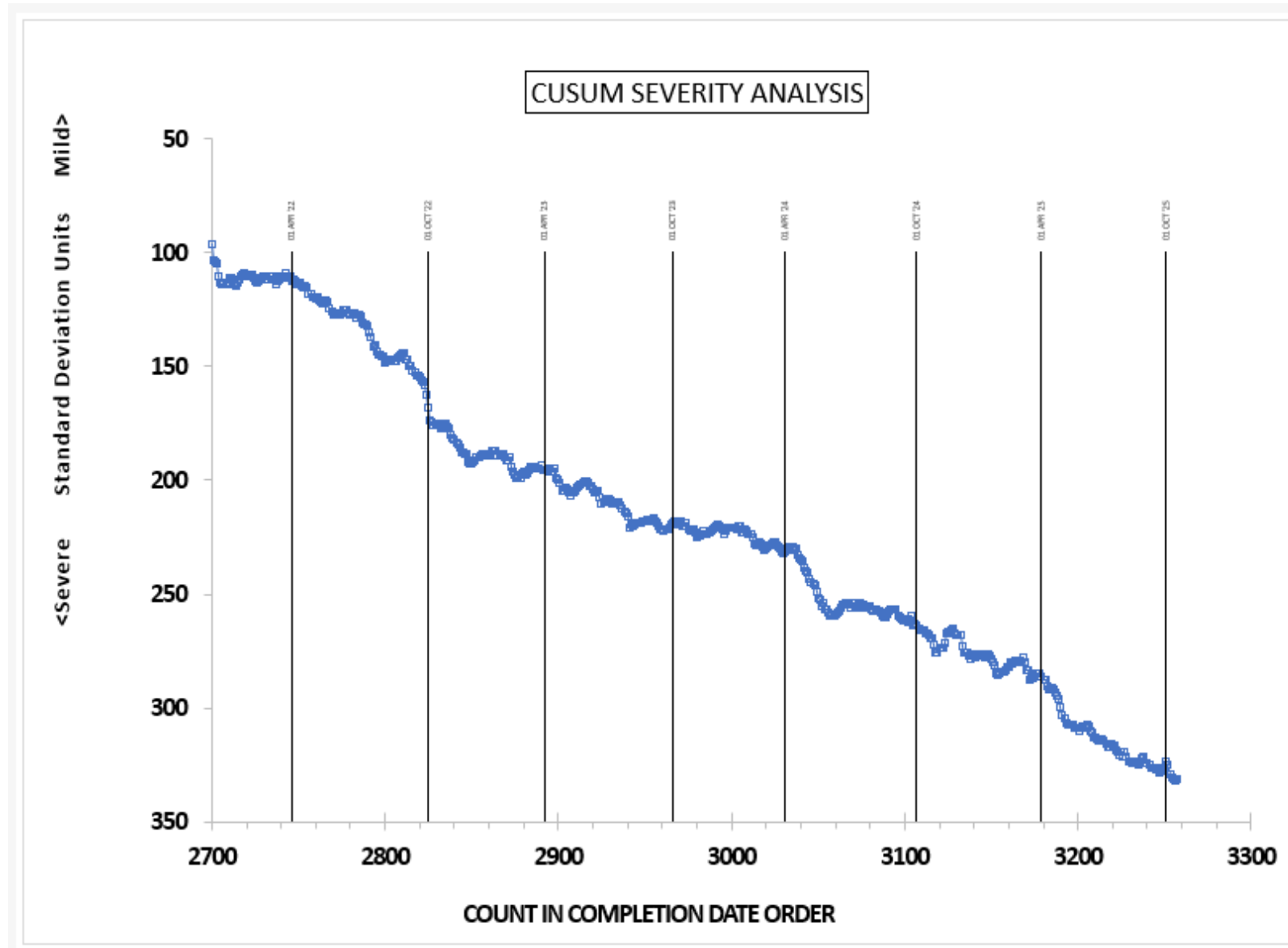
MHT-4 TEOST INDUSTRY OPERATIONALLY VALID DATA

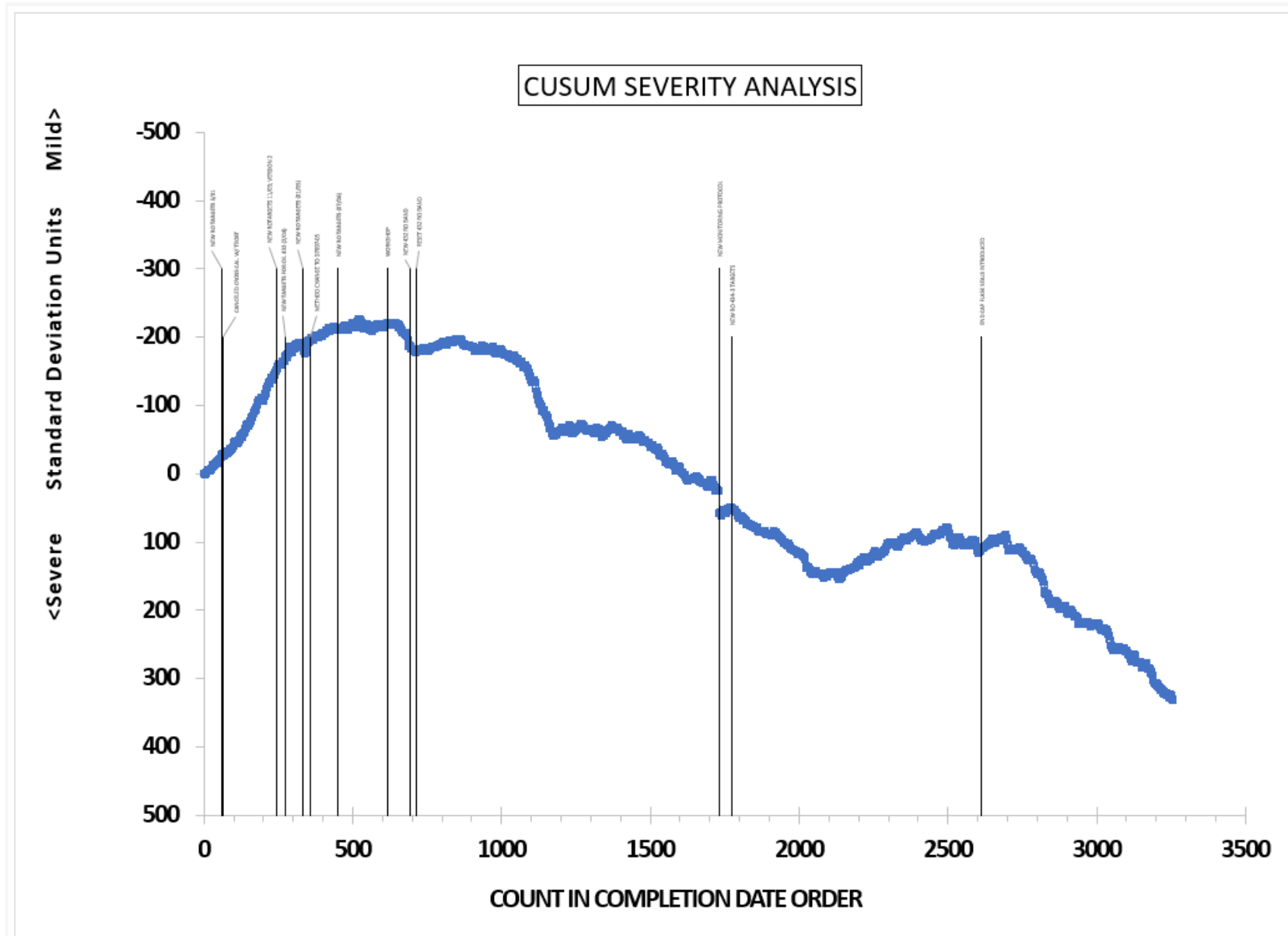


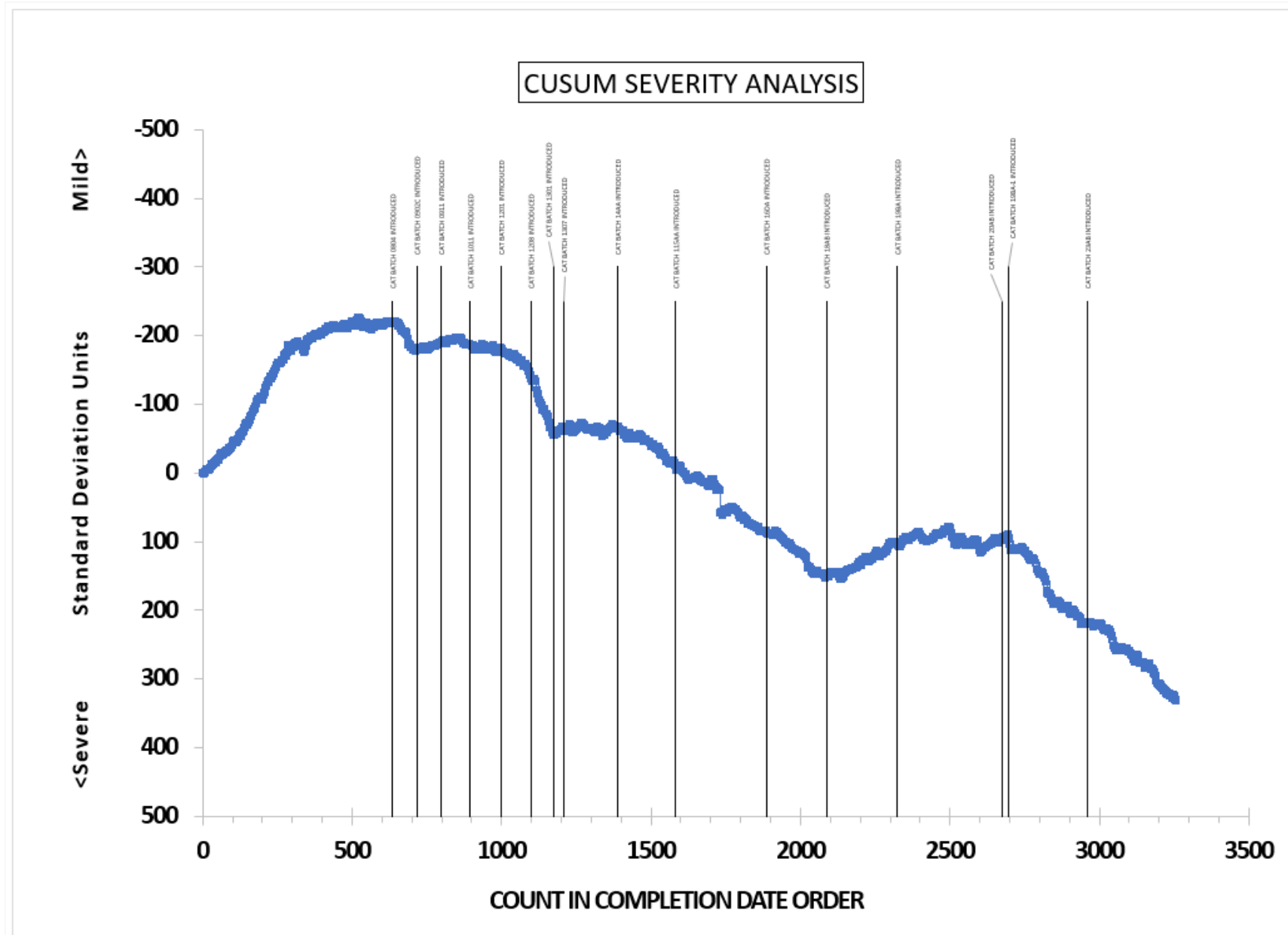
TOTAL DEPOSITS MG

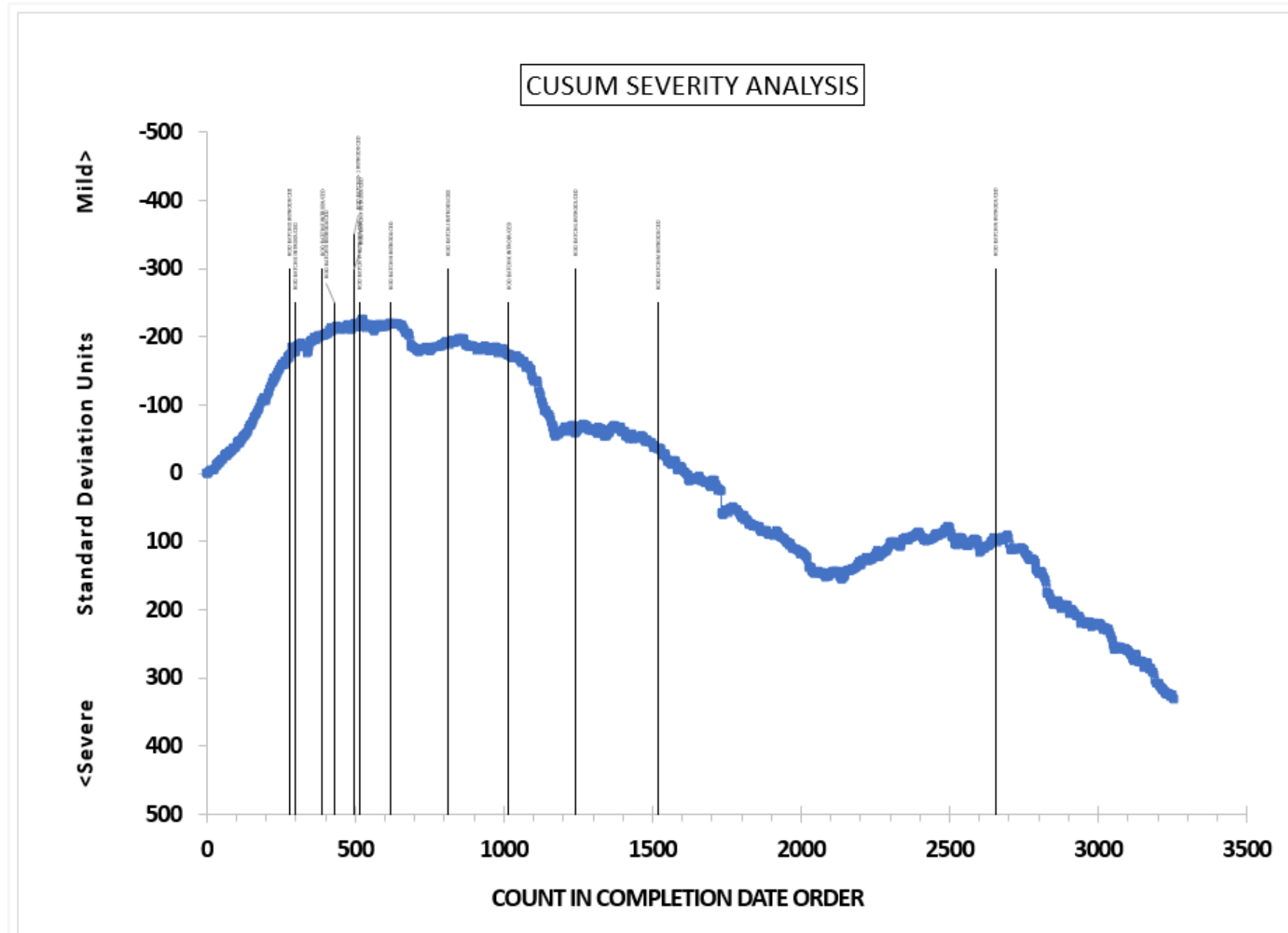


MHT-4 TEOST INDUSTRY OPERATIONALLY VALID DATA
Last 500 Points
TOTAL DEPOSITS MG



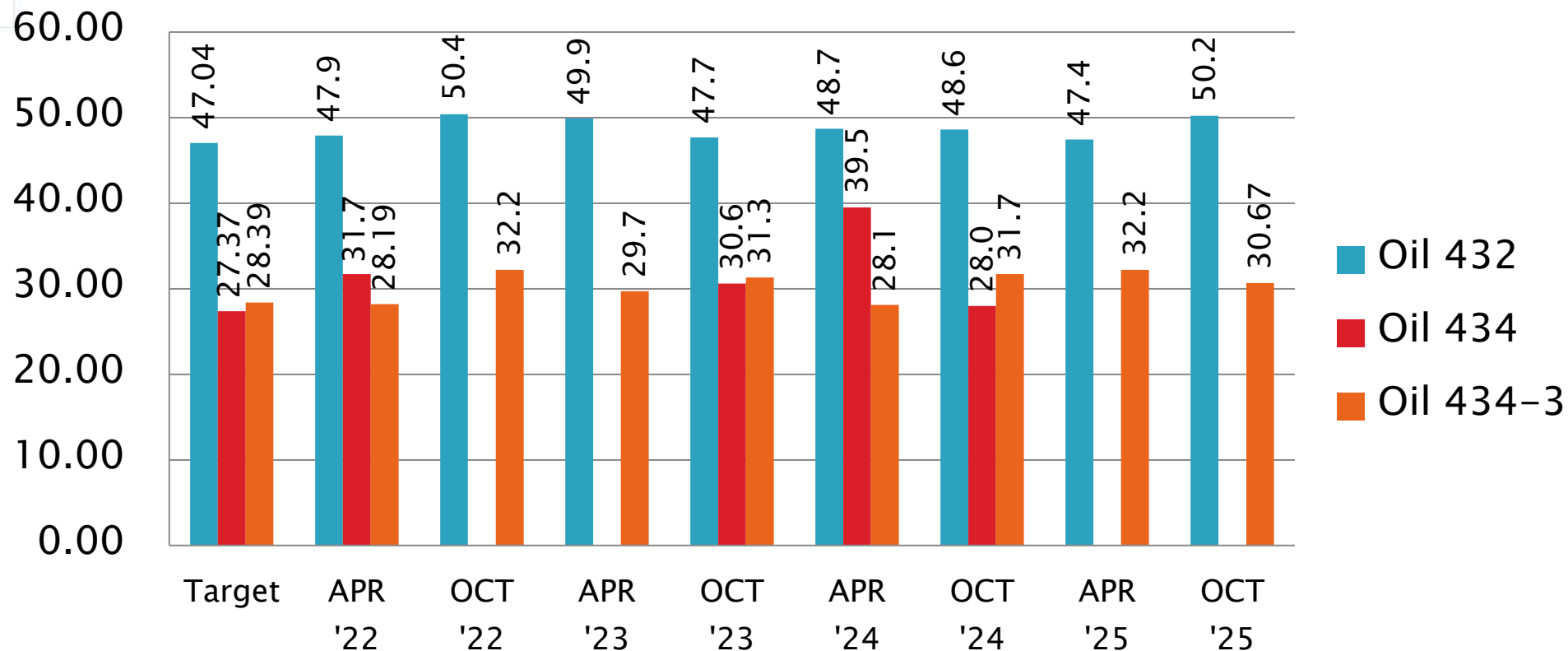
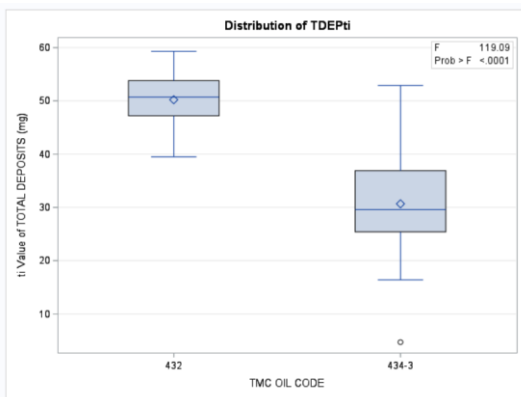






D7097 Performance by Oil

Total Deposits, mg
Mean



*Only a single RO 434 run for APR'24 and OCT'24.

April 1, 2025 – September 30, 2025

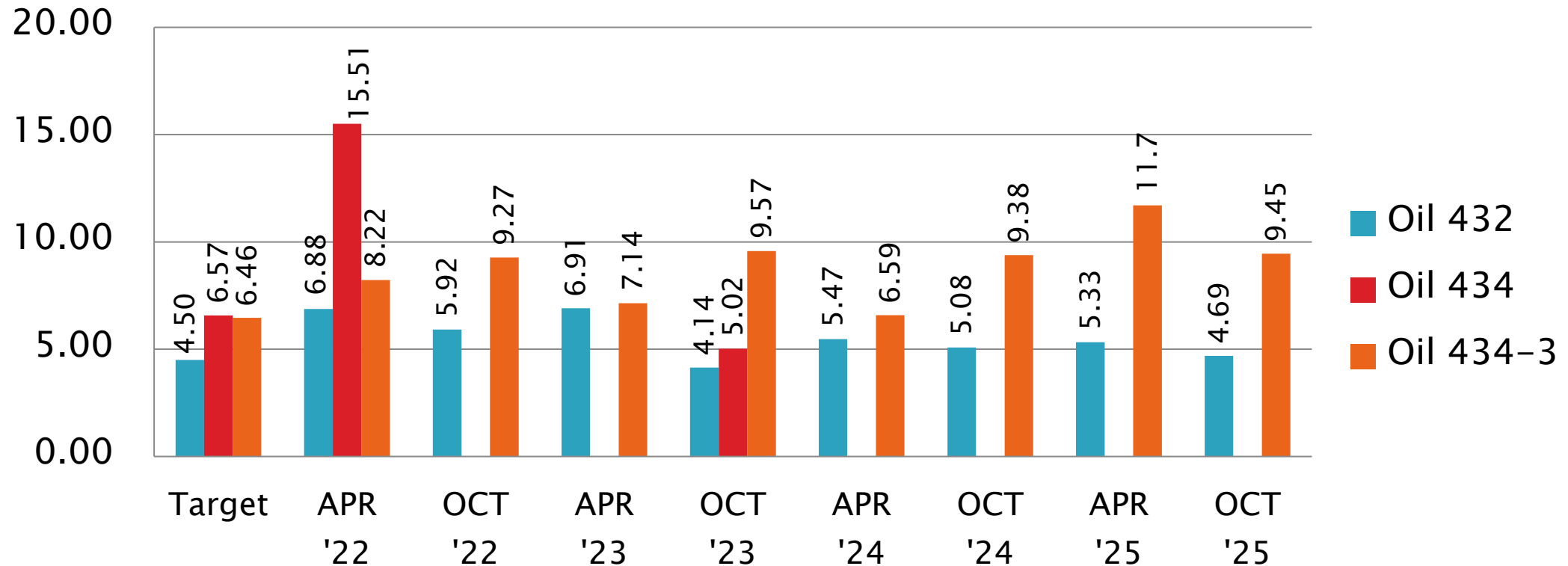
Test Monitoring Center
<https://www.astmtmc.org>



D7097: Deposits by MHT TEOST

Total Deposits, mg

S_R



*Only single RO 434 runs. No StDEV result available for APR'24 and OCT'24.

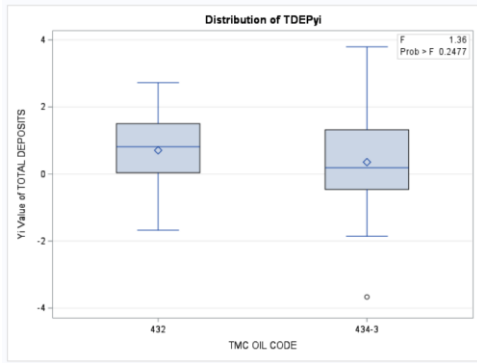
April 1, 2025 - September 30, 2025

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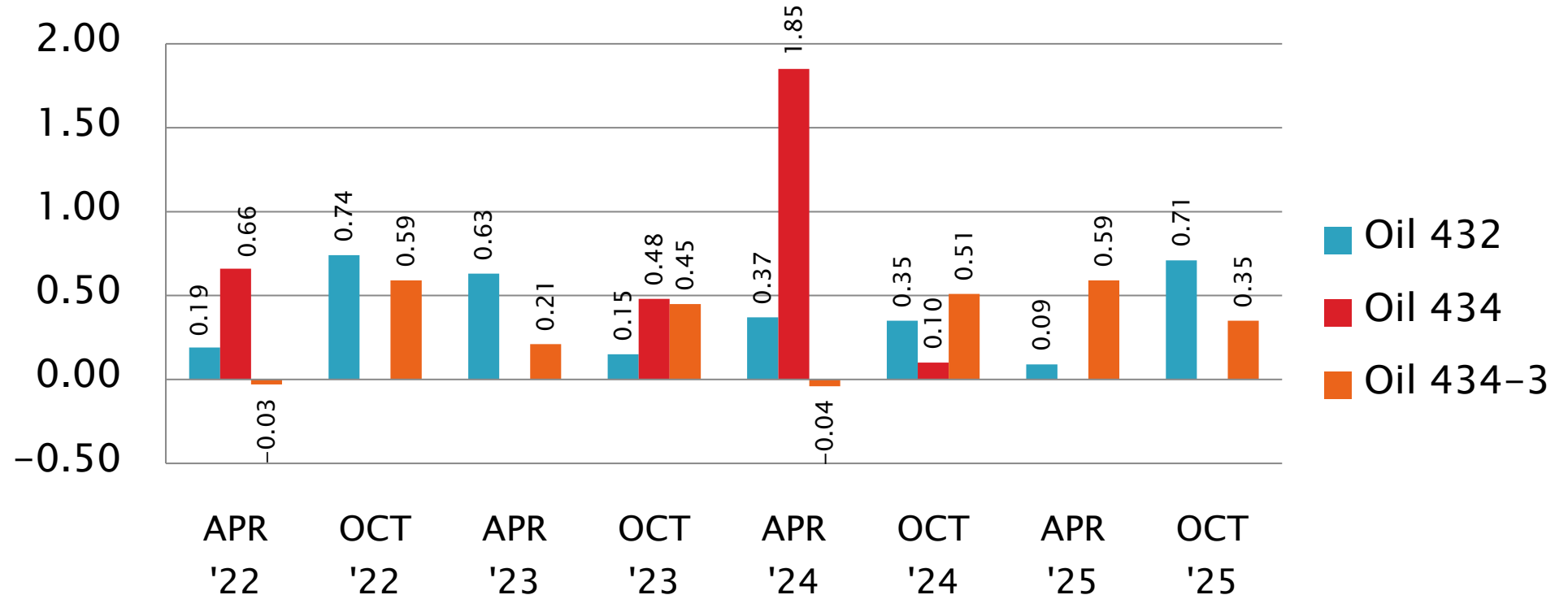


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D7097: Deposits by MHT TEOST



Total Deposits, mg
Mean Δ/s



*Only a single RO 434 run for APR'24 and OCT'24.

[TABLE of CONTENTS](#)

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Reference Oil Inventory

MTEOS

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
432	1998	MTEOS	100.80	0.18	5+ years
434-3 ^B	2017	MTEOS	7.50	4.28	1.0 year

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B Multi-test oil; estimated supply of drum reserved for bench testing – other drums available.

April 1, 2025 – September 30, 2025

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D02.B0.07

TMC Monitored Tests



ASTM D 7216

Engine Oil Elastomer Compatibility (EOEC/LDEOC)

April 1, 2025 – September 30, 2025



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Test Monitoring Center

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ASTM Reference Testing Semi-Annual Report D7216 EOEC

April 1, 2025 – September 30, 2025

ASTM D 7216

Engine Oil Elastomer Compatibility

EOEC (Heavy-Duty)	
OHT PART NUMBER	BATCH CODE*
OHTEOEC-NBR-A	34
OHTEOEC-ACM-B	34
OHTEOEC-FKM-A	32
OHTEOEC-MAC-A	26
OHTLDEOC-VMQ1-A	43
OHTLDEOC-HNBR-A	1
OHTEOEC-FKM2-A	new

* As of 20251106

Calibrated Labs and Stands¹

(change since last Semi-Annual report)

Test	Labs	Stands
D7216 EOEC	7 ² (-1)	N/A
¹ As of 9/30/2025		
² Not all elastomer types were run at each lab		

EOEC Test Activity*

Test Status		FKM	NBR	ACM	VMQ	MAC	HNBR	FKM2	Total
LABS BATHS		7 36	7 21	7 31	7 32	7 34	3 9	6 12	
Acceptable Calibration Test	AC	80	90	80	76	71	17	0	414
Failed Calibration Test	OC	1	0	0	2	1	1	0	5
Operationally Invalid, by lab	LC	1	3	6	2	4	1	0	17
Operationally Invalid, by TMC	RC	0	0	0	0	0	0	0	0
Aborted	XC	0	0	0	0	0	0	0	0
Acceptable Informational Run	NN	0	0	0	0	0	2	30	2
Unacceptable Informational Run	MN	0	0	0	0	0	0	0	0
Total		82	93	86	80	76	21	30	438
FKM2 totals not included in Overall Summary Totals									

April 1, 2025 – September 30, 2025

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EOEC Failed Calibration Tests*

Cause	Elastomer	No. of Tests
HARDNESS (MILD)		0
HARDNESS (SEVERE)		0
ELONGATION (MILD)	VMQ	1
ELONGATION (SEVERE)		0
VOLUME CHANGE (MILD)		0
VOLUME CHANGE (SEVERE)		0
TENSILE STRENGTH (MILD)	FKM, VMQ	2
TENSILE STRENGTH (SEVERE)	MAC	1
VOLUME (Mild), HARDNESS (Severe)	HNBR	1
Total		5

* FIVE failing calibration tests from TWO different labs

April 1, 2025 – September 30, 2025

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EOEC Lost Tests*

Validity	Cause	No. of Tests
LC	Bath Temperature Issue	16
LC	Wrong Elastomer Used	1
Total		17

*Invalid (LC,RC) and Aborted (XC) calibration tests

April 1, 2025 – September 30, 2025

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EOEC Test Severity

Fluoroelastomer (FKM)

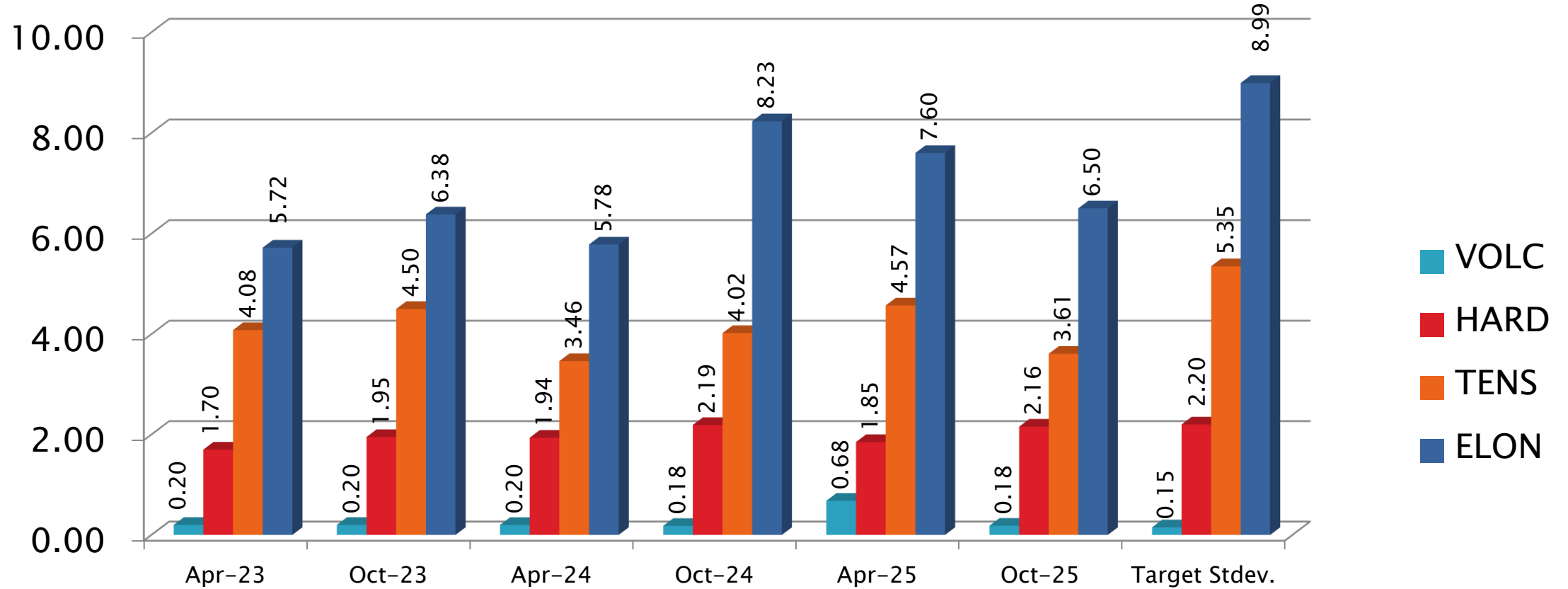
Parameter	Period Mean Δ /s	Status
Volume Change	-0.0259	On Target
Points Hardness Change	0.1951	Slightly Severe
Tensile Strength Change	0.2680	Slightly Severe
Elongation Change	-0.6998	Mild

April 1, 2025 – September 30, 2025

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EOEC Precision (Pooled s) Estimates: Fluoroelastomer



April 1, 2025 - September 30, 2025

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EOEC Precision Estimates by Lab: FKM

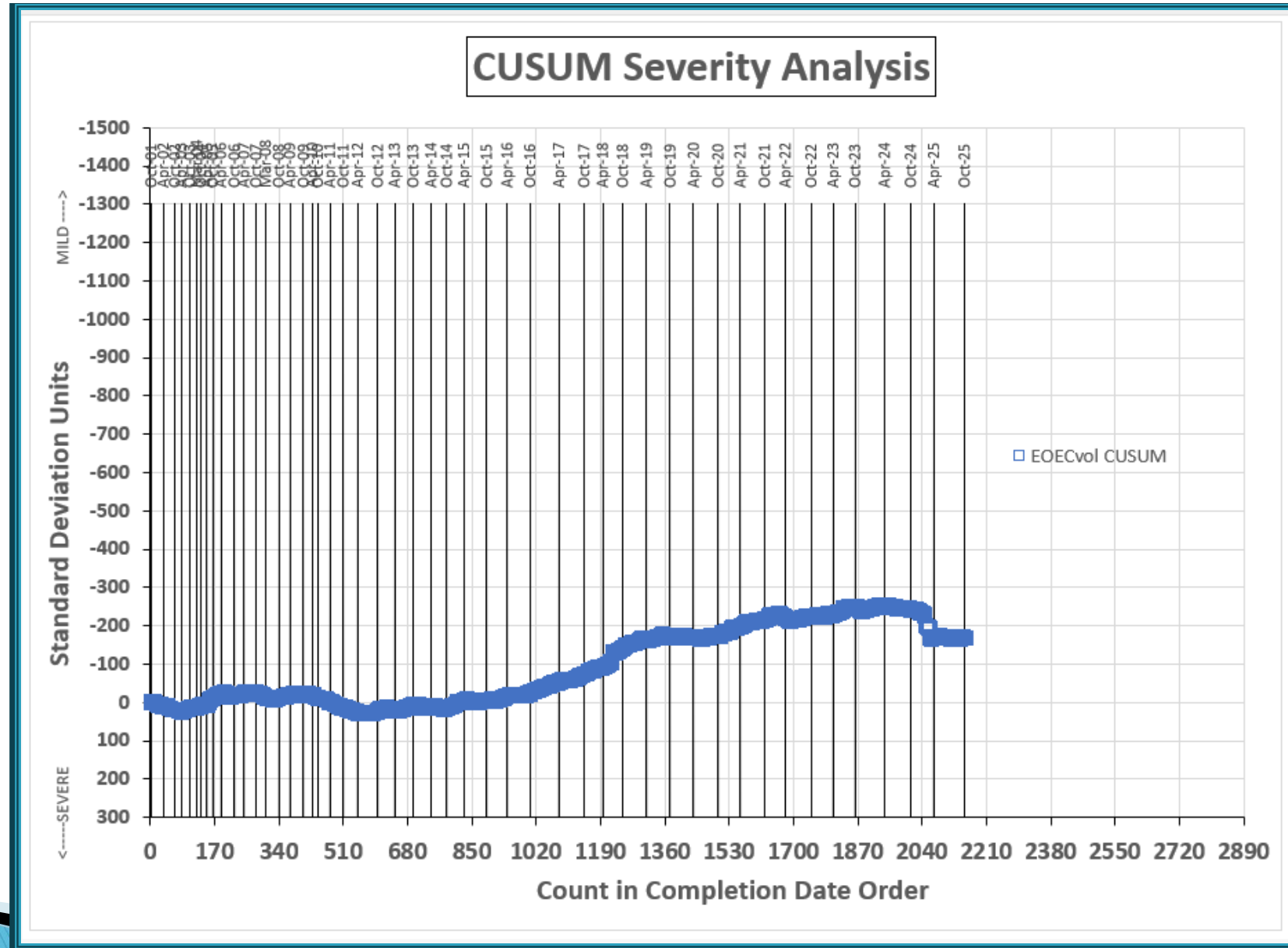
Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	22	9	0	18	13	8	2	9
Volume	Mean	0.4927	0.3789		0.5106	0.42846	0.2900	0.3850	0.3589
	Pooled s	0.1171	0.1565		0.1976	0.2653	0.1264	0.0495	0.1374
	Mean /s	0.3563	-0.4129		0.4767	-0.0779	-1.0135	-0.3716	-0.5480
Hardness	Mean	8.9091	7.8889		6.0556	9.0000	8.7500	10.00	11.44
	Pooled s	1.4445	0.6009		2.1549	1.0000	1.8323	0	1.1304
	Mean /s	0.3950	-0.0687		-0.9020	0.4364	0.3227	0.8909	1.5475
Tensile Strength	Mean	-70.54	-70.64		-70.278	-66.08	-68.80	-69.05	-73.41
	Pooled s	1.8157	1.3343		3.8230	2.2316	6.6095	0.7778	1.3308
	Mean /s	0.1465	0.1263		0.1948	0.9800	0.4710	0.4243	-0.3909
Elongation	Mean	-68.03	-65.46		-57.97	-60.52	-68.18	-59.75	-73.94
	Pooled s	2.5142	3.0709		6.8431	1.5975	3.8451	1.0607	2.119
	Mean /s	-1.0625	-0.7759		0.0565	-0.2272	-1.0784	-0.1413	-1.720

April 1, 2025 – September 30, 2025

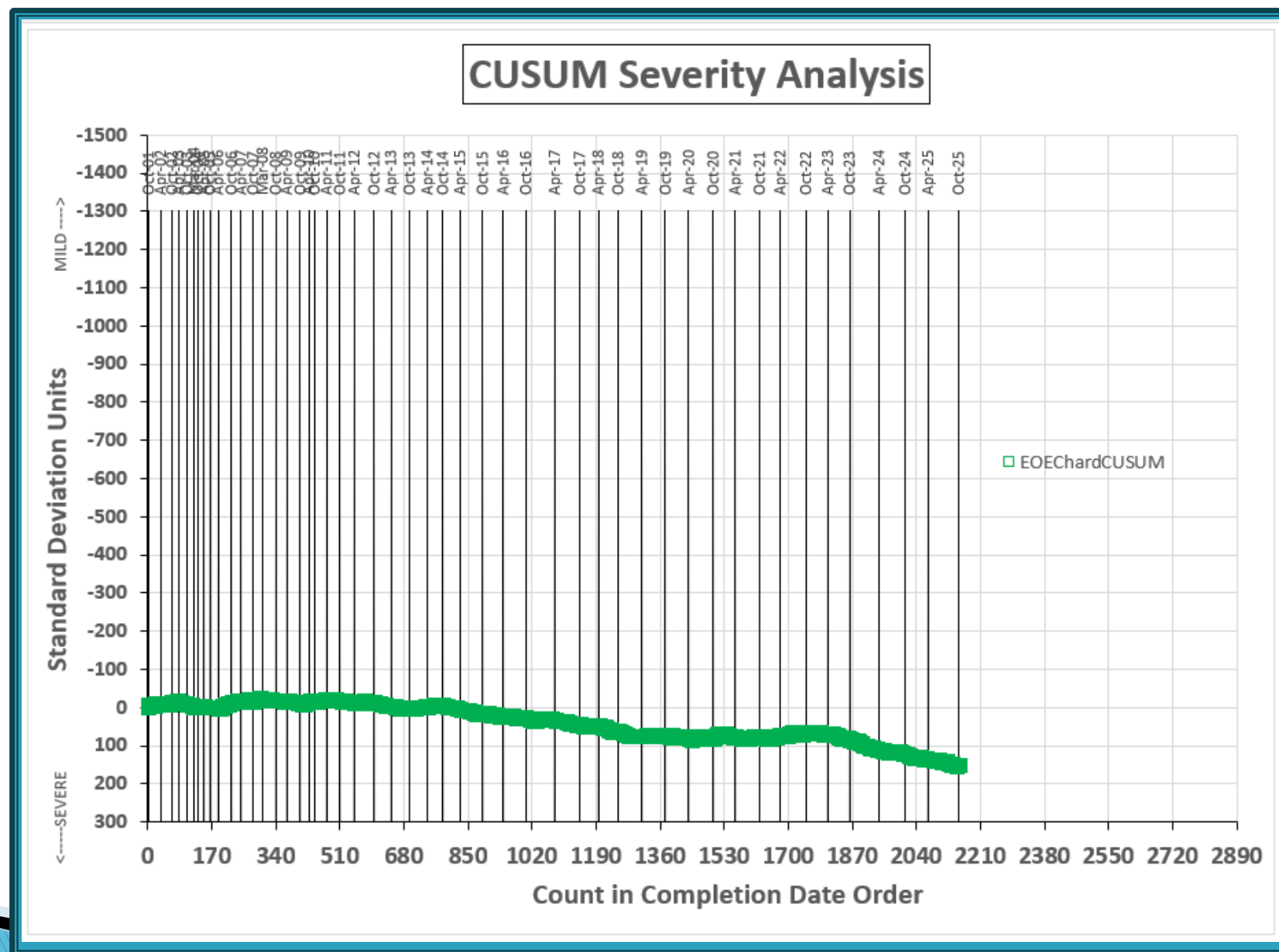
Test Monitoring Center
<https://www.astmtmc.org>



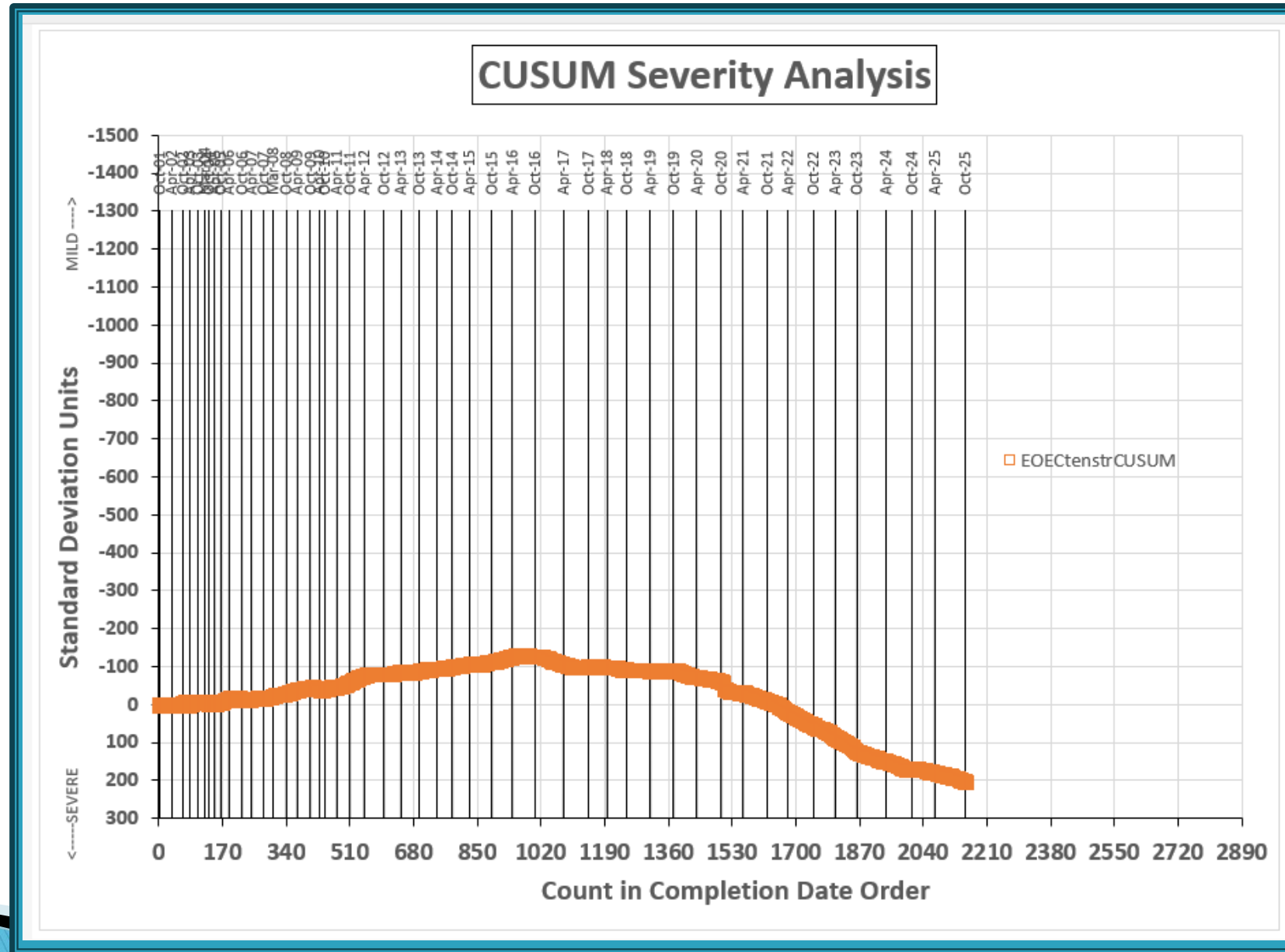
FLUOROELASTOMER VOLUME CHANGE CORRECTED AVERAGE



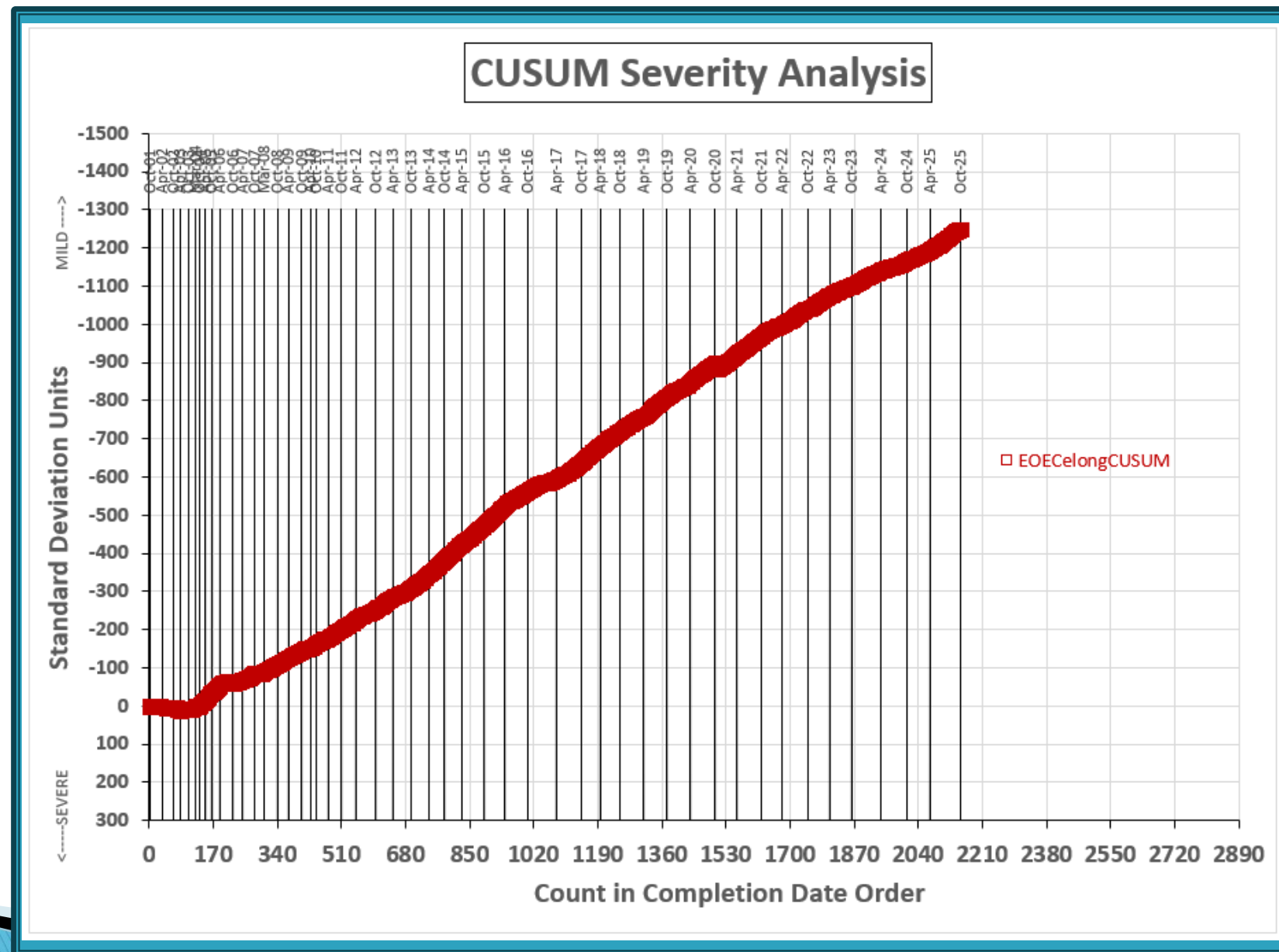
FLUOROELASTOMER PTS HARDNESS CHANGE CORRECTED AVG



FLUROELASTOMER TENS STRENGTH CHANGE CORRECTED AVG



FLUOROELASTOMER ELONGATION CHANGE CORRECTED AVG



EOEC Test Severity

Nitrile (NBR)

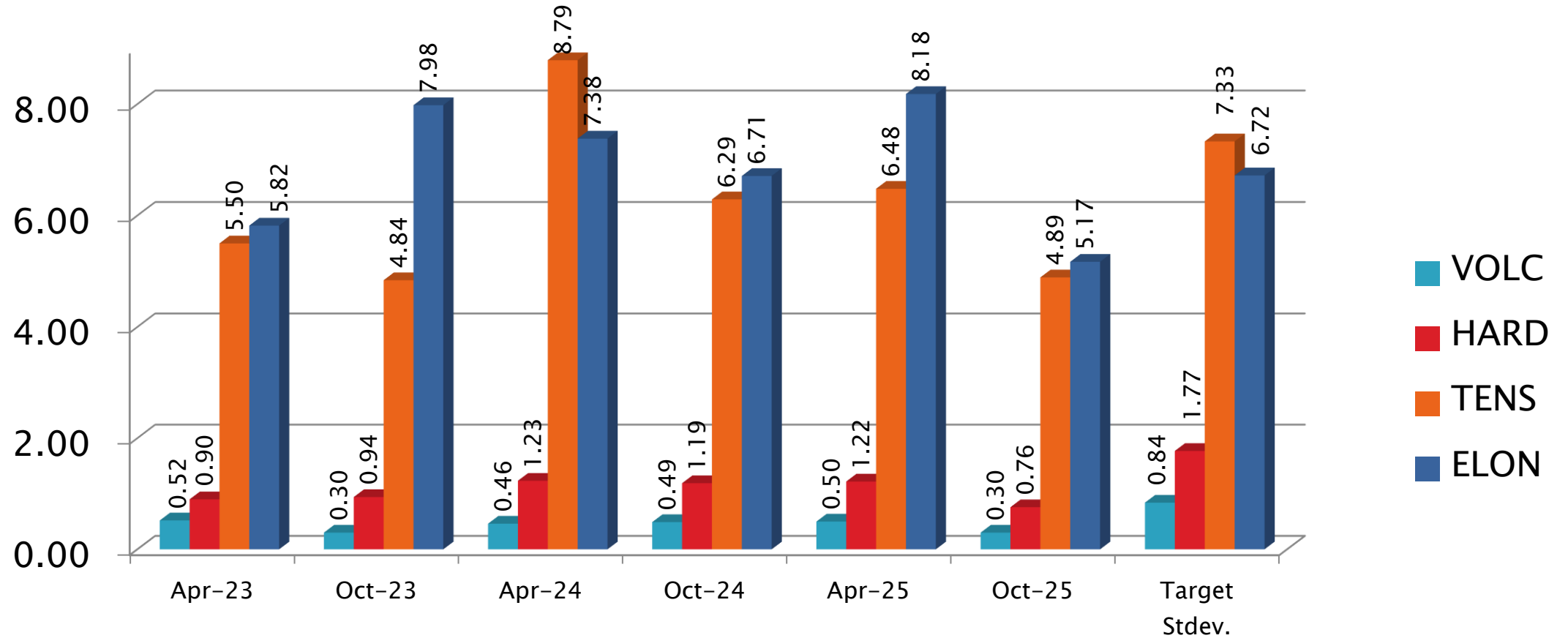
Parameter	Period Mean Δ/s	Status
Volume Change	-0.0288	On Target
Points Hardness Change	1.0126	Severe
Tensile Strength Change	-1.2973	Mild
Elongation Change	0.1321	Slightly Mild

April 1, 2025 – September 30, 2025

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EOEC Precision Estimates – Nitrile



April 1, 2025 – September 30, 2025

Test Monitoring Center
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EOEC Precision Estimates by Lab: NBR

Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	28	10	0	16	15	9	4	8
Volume	Mean	1.6325	1.6980		1.7225	1.9340	1.6989	1.6800	1.6438
	Pooled s	0.1949	0.1393		0.3138	0.5042	0.1732	0.1685	0.2679
	Mean /s	-0.1280	-0.0500		-0.0208	0.2310	-0.0489	-0.0714	-0.1146
Hardness	Mean	3.6071	4.6000		3.3125	3.5333	3.3333	3.7500	3.5000
	Pooled s	0.5669	0.6992		0.7042	0.7432	0.8666	0.9574	0.5345
	Mean /s	1.0040	1.5650		0.8376	0.9623	0.8493	1.0847	0.9435
Tensile Strength	Mean	-3.7143	-8.8400		-10.92	-5.5533	-4.0333	-6.4250	-11.41
	Pooled s	4.2159	3.1387		5.5739	2.5247	3.5224	2.7122	2.3967
	Mean /s	-0.8887	-1.5880		-1.8724	-1.1396	-0.9322	-1.2585	-1.9389
Elongation	Mean	-32.16	-37.40		-28.46	-33.90	-32.01	-34.42	-35.99
	Pooled s	3.4622	4.1537		7.7721	3.4637	1.5752	1.3647	4.8354
	Mean /s	0.2270	-0.5521		0.7788	-0.0322	0.2498	-0.1094	-0.3419

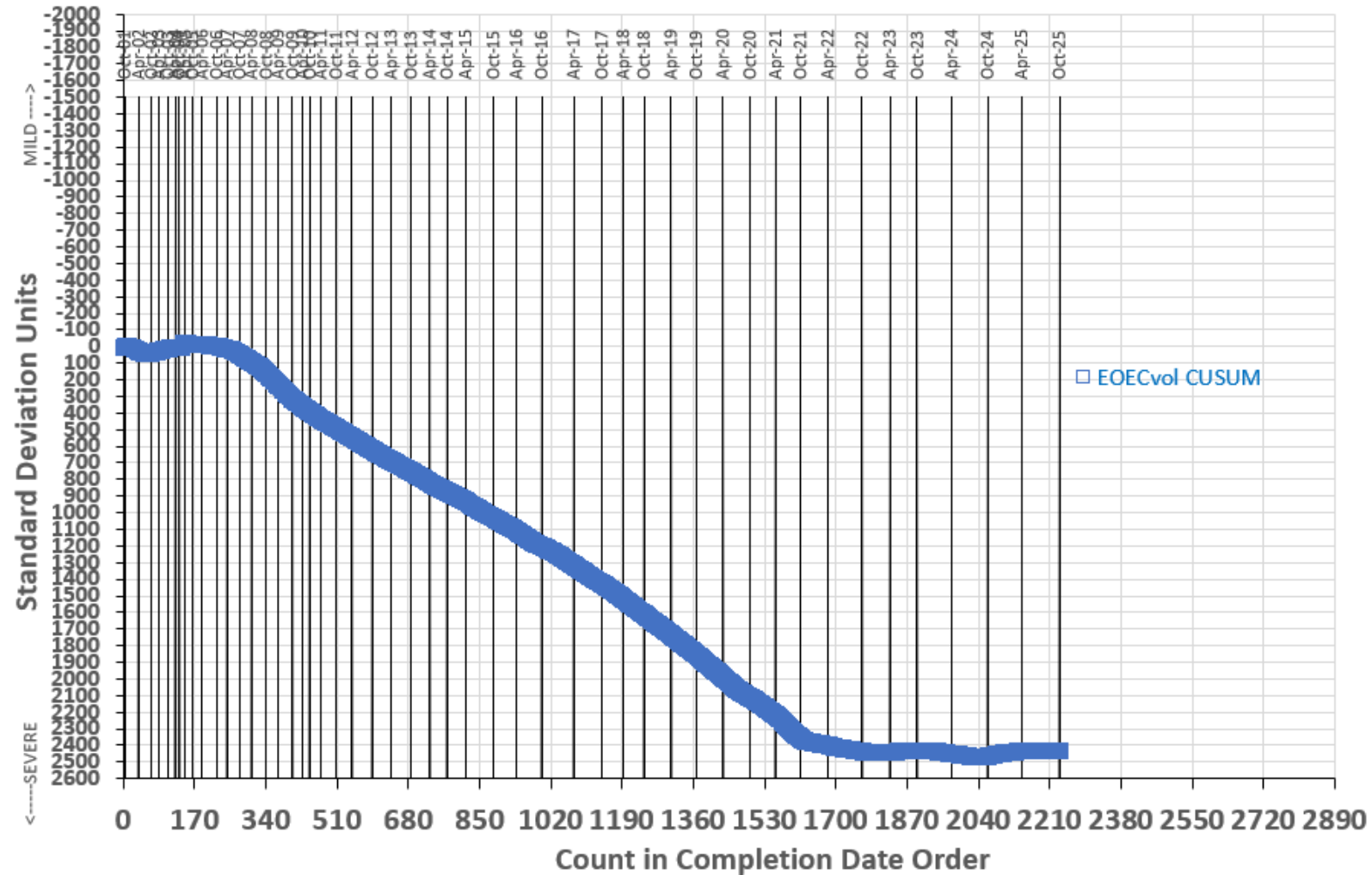
April 1, 2025 – September 30, 2025

Test Monitoring Center
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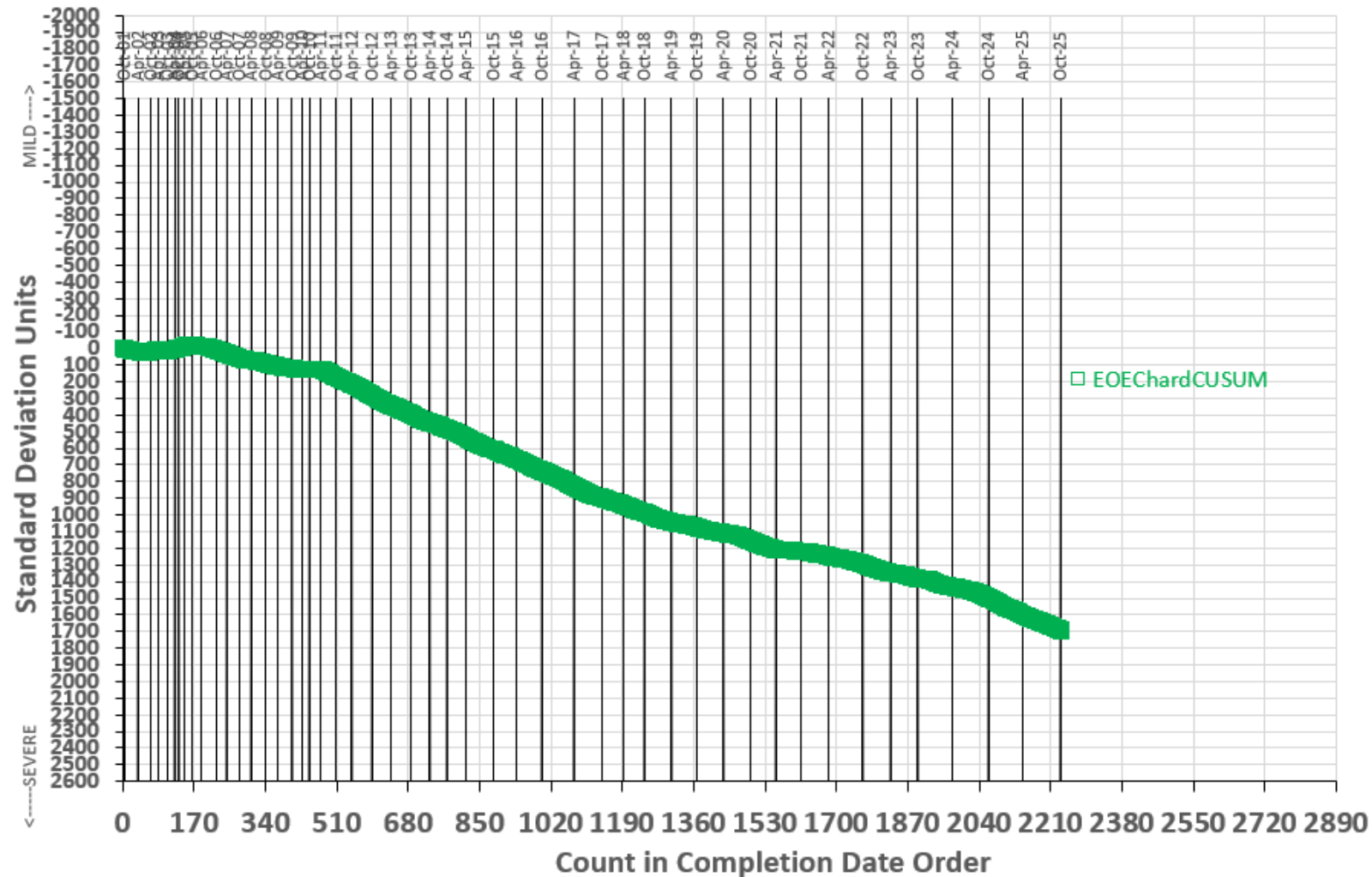
REFERENCE NITRILE VOLUME CHANGE CORRECTED AVERAGE

CUSUM Severity Analysis



REFERENCE NITRILE PTS HARD CHANGE CORRECTED AVG

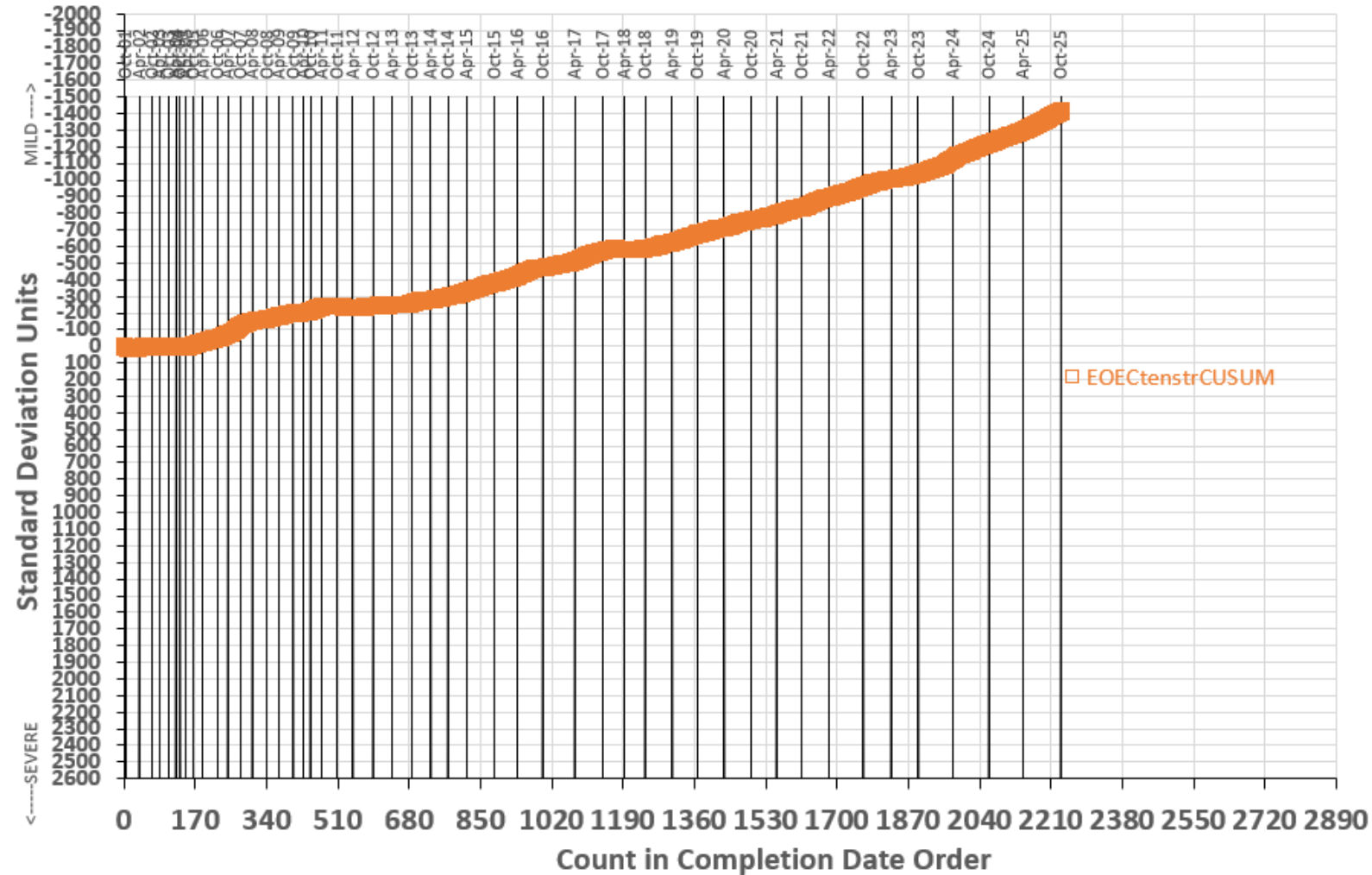
CUSUM Severity Analysis



□ EOEChardCUSUM

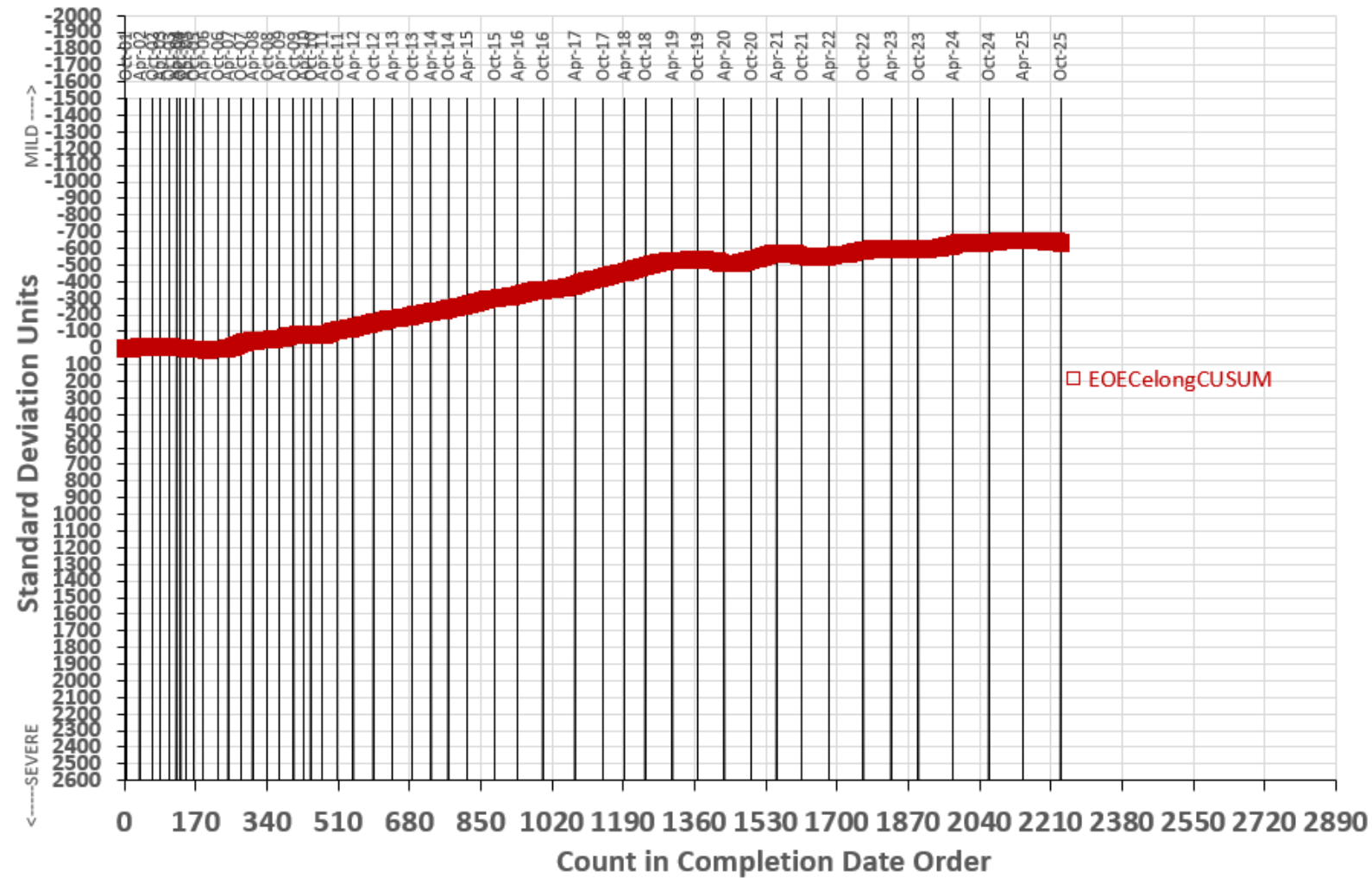
REF NITRILE TENS STRENGTH CHANGE CORRECTED AVG

CUSUM Severity Analysis



REF NITRILE ELONGATION CHANGE CORRECTED AVERAGE

CUSUM Severity Analysis



EOEC Test Severity

Polyacrylate (ACM)

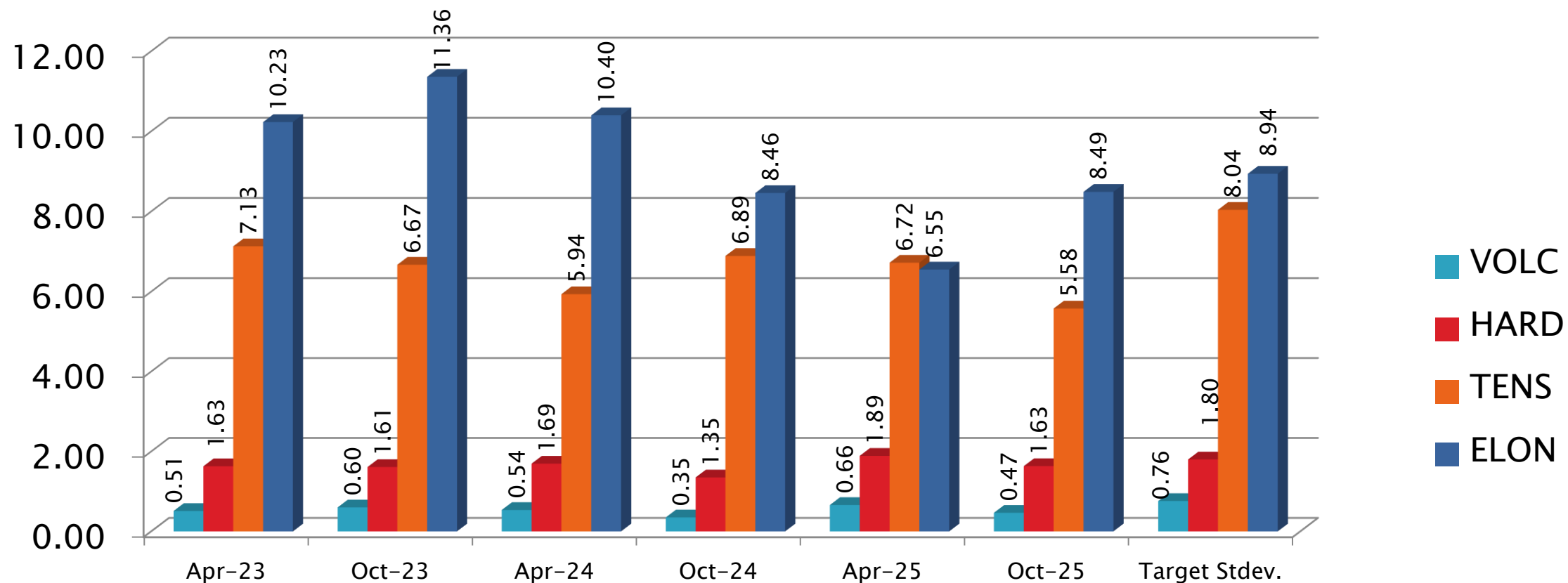
Parameter	Period Mean Δ/s	Status
Volume Change	1.5500	Very Severe
Points Hardness Change	-0.6194	Mild
Tensile Strength Change	0.4697	Severe
Elongation Change	0.5203	Severe

April 1, 2025 – September 30, 2025

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



EOEC Precision Estimates – Polyacrylate



April 1, 2025 – September 30, 2025

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



EOEC Precision Estimates by Lab: ACM

Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	22	9	0	18	13	8	3	7
Volume	Mean	1.2277	1.3767		1.4078	1.7769	1.0412	1.6000	1.3243
	Pooled s	0.2803	0.3280		0.5671	0.5892	0.1912	0.1778	0.4013
	Mean /s	1.3523	1.5482		1.5892	2.0749	1.1069	1.8421	1.4793
Hardness	Mean	-1.8636	-1.2222		-0.4444	-0.7692	-0.5000	0.3333	-2.4286
	Pooled s	0.8335	1.3944		2.3319	1.3634	1.4142	1.1547	0.9759
	Mean /s	-1.0298	-0.6735		-0.2414	-0.4218	-0.2722	0.1907	-1.3437
Tensile Strength	Mean	6.2955	5.6222		-1.1611	6.2538	4.2000	7.7000	3.5286
	Pooled s	3.9769	3.6605		7.3081	2.5382	5.9869	0.9539	2.9482
	Mean /s	0.7382	0.6545		-0.1891	0.7331	0.4776	0.9129	0.3941
Elongation	Mean	-18.29	-17.74		-16.97	-20.70	-18.15	-18.20	-13.96
	Pooled s	8.5300	4.2928		12.61	7.0480	7.1542	1.4526	4.5672
	Mean /s	0.4798	0.5409		0.6266	0.2103	0.4955	0.4899	0.9645

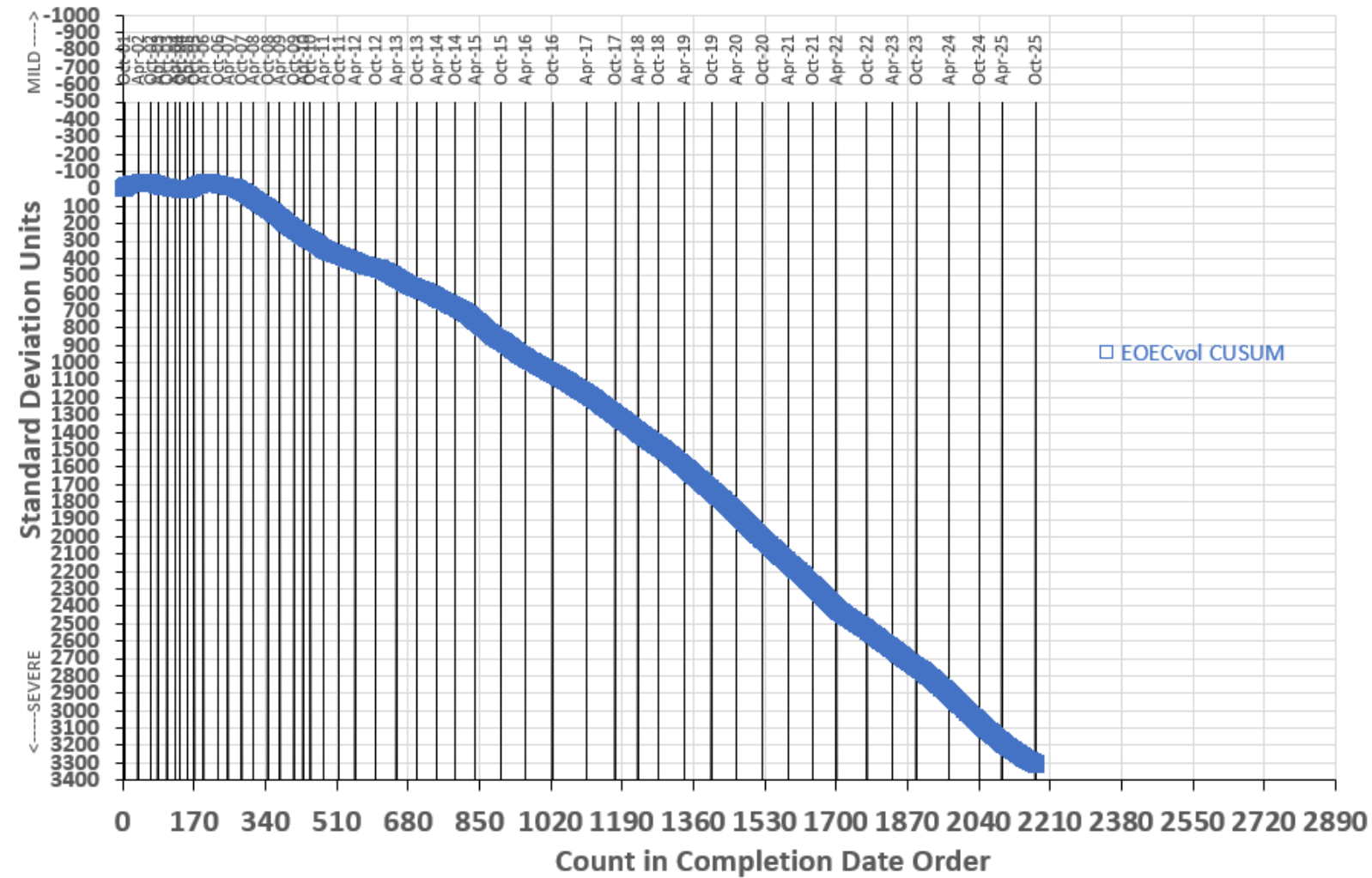
April 1, 2025 – September 30, 2025

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



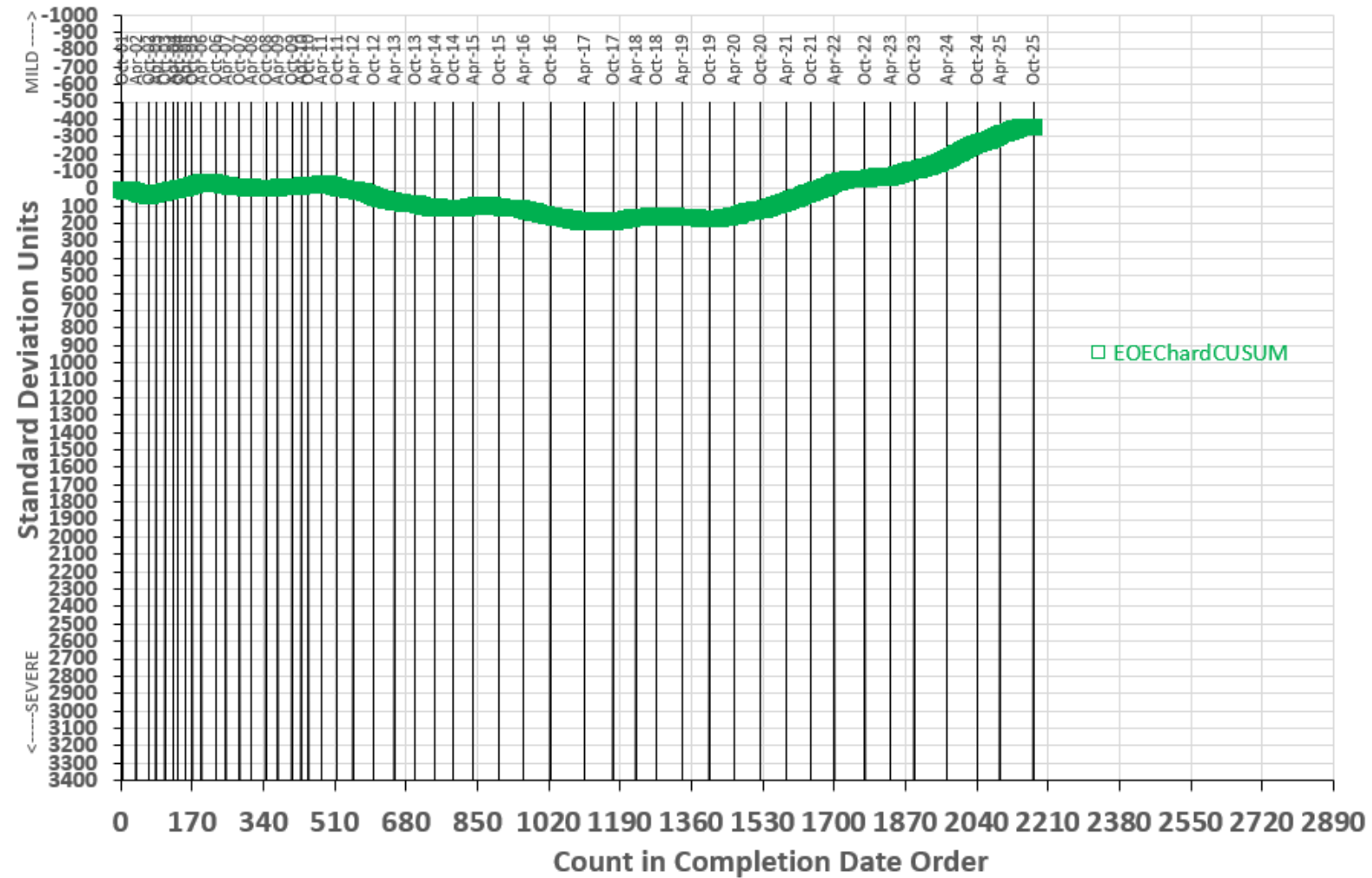
REFERENCE POLYACRYLATE VOLUME CHANGE CORRECTED AVG

CUSUM Severity Analysis

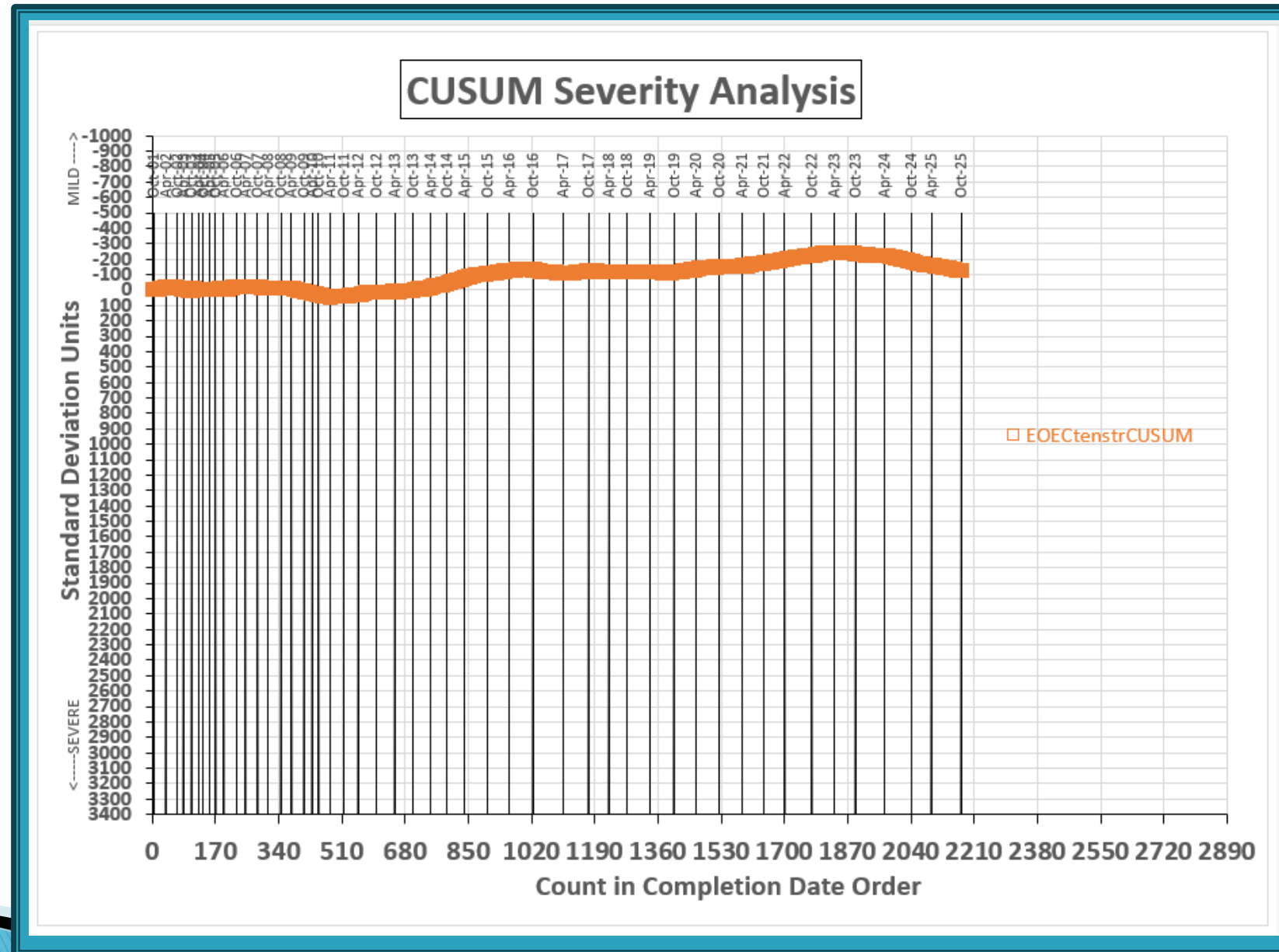


REF POLYACRYLATE PTS HARD CHANGE CORRECTED AVG

CUSUM Severity Analysis

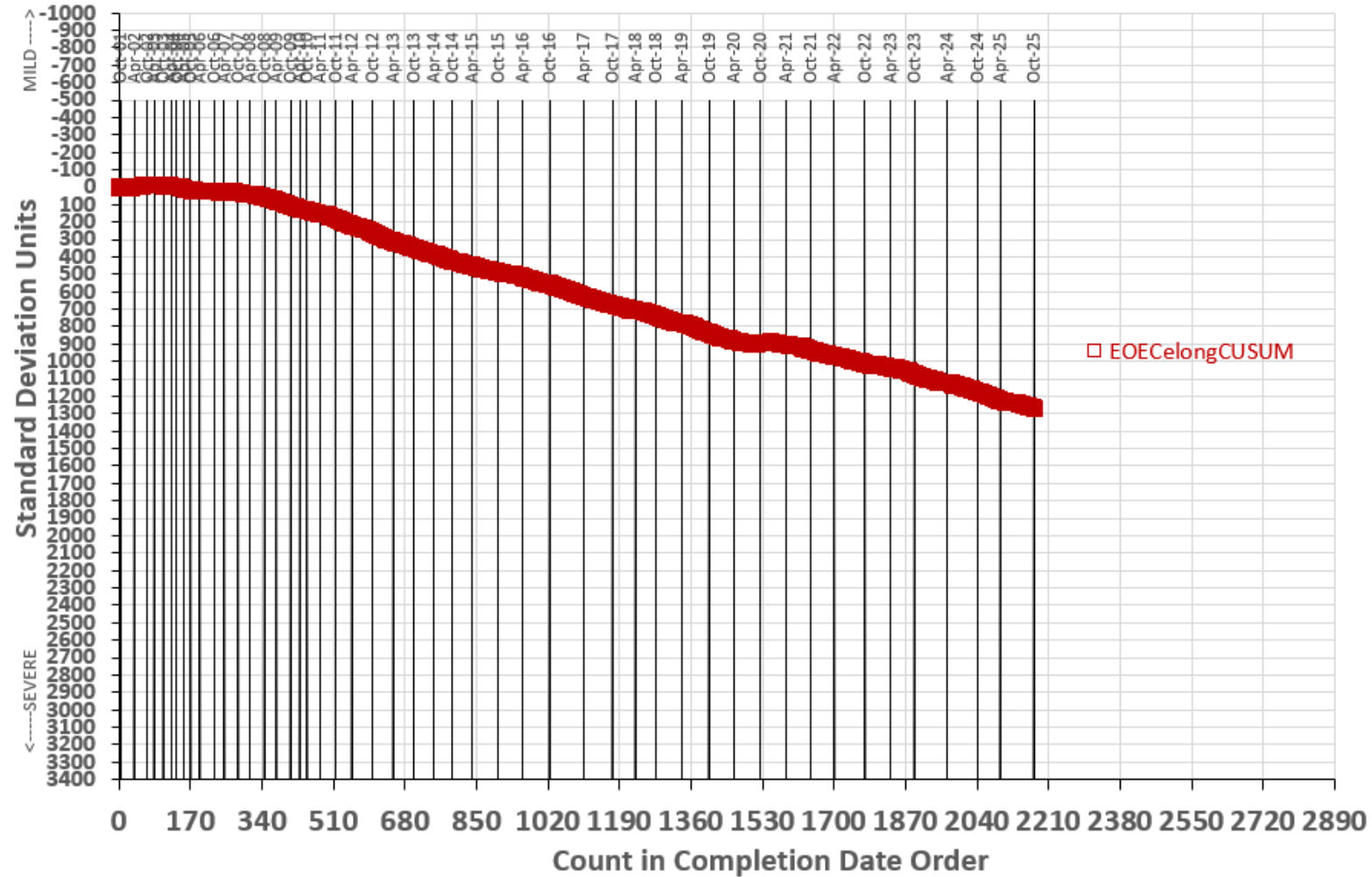


REF POLYACRYLATE TENS STRNGTH CHANGE CORRECTED AVG



REF POLYACRYLATE ELONGATION CHANGE CORRECTED AVG

CUSUM Severity Analysis



EOEC Test Severity

Silicone (VMQ)

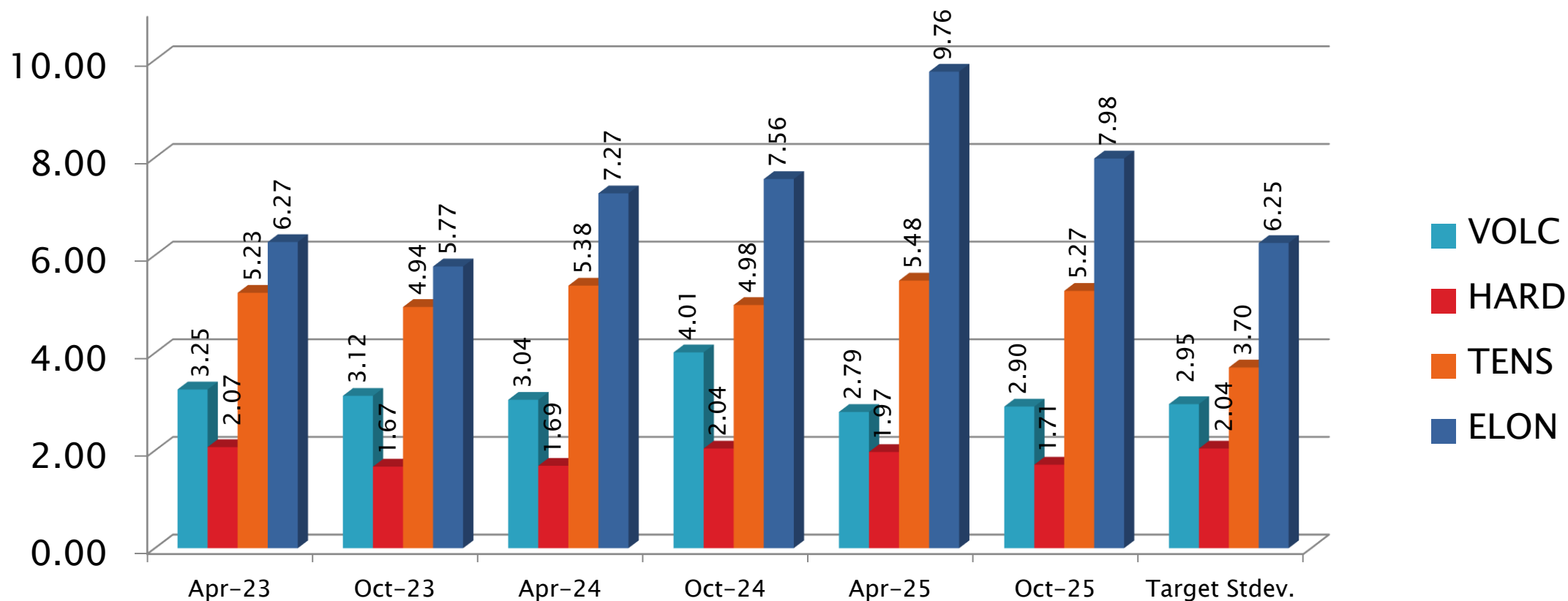
Parameter	Period Mean Δ/s	Status
Volume Change	0.6841	Severe
Points Hardness Change	-0.3643	Mild
Tensile Strength Change	0.1930	Slightly Severe
Elongation Change	0.1433	Slightly Severe

April 1, 2025 – September 30, 2025

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EOEC Precision Estimates – Silicone



April 1, 2025 – September 30, 2025

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EOEC Precision Estimates by Lab: VMQ

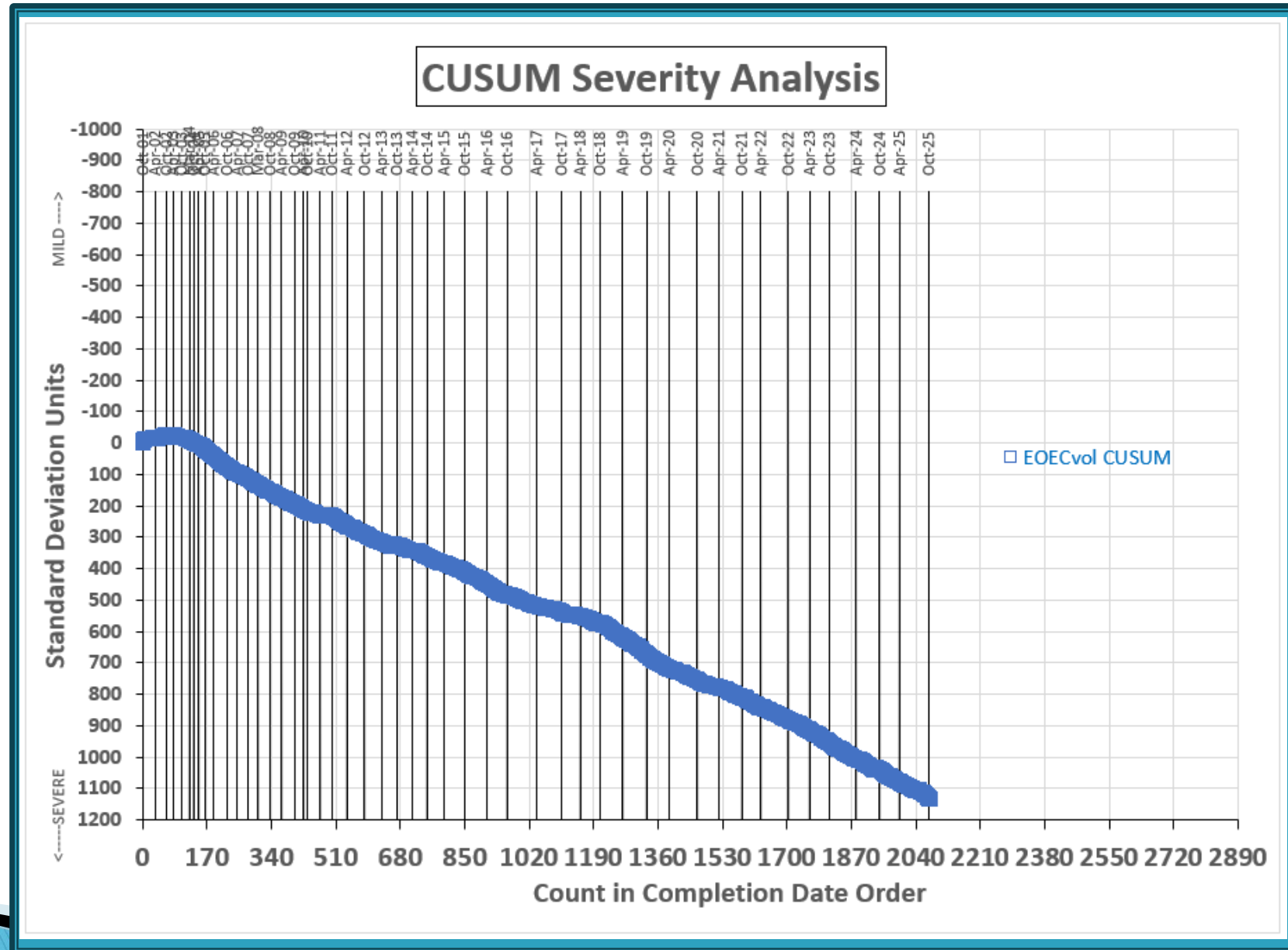
Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	22	9	0	18	11	8	2	8
Volume	Mean	34.10	34.06		37.31	30.94	31.68	35.00	34.32
	Pooled s	0.9359	0.9372		3.7692	1.2953	1.0066	1.9728	1.1990
	Mean /s	0.6541	0.6414		1.7418	-0.4160	-0.1665	0.9576	0.7297
Hardness	Mean	-23.55	-22.22		-22.78	-22.27	-18.88	-24.50	-22.00
	Pooled s	1.0108	0.9718		1.4371	0.9045	0.6409	0.7071	1.0690
	Mean /s	-0.9144	-0.2658		-0.5381	-0.2906	1.3750	-1.3824	-0.1569
Tensile Strength	Mean	-33.86	-30.07		-35.14	-34.67	-27.24	-41.25	-30.81
	Pooled s	4.4876	3.3015		4.6465	5.3284	-4.1241	3.60692	5.2537
	Mean /s	-0.0295	0.9955		-0.3769	-0.2494	1.7601	-2.0811	0.7939
Elongation	Mean	-26.43	-25.28		-20.37	-26.31	-19.61	-30.20	-22.89
	Pooled s	6.3973	6.6687		10.98	5.8654	4.0895	4.9497	8.2409
	Mean /s	-0.2588	-0.0748		0.7109	-0.2399	0.8312	-0.8624	0.3076

April 1, 2025 – September 30, 2025

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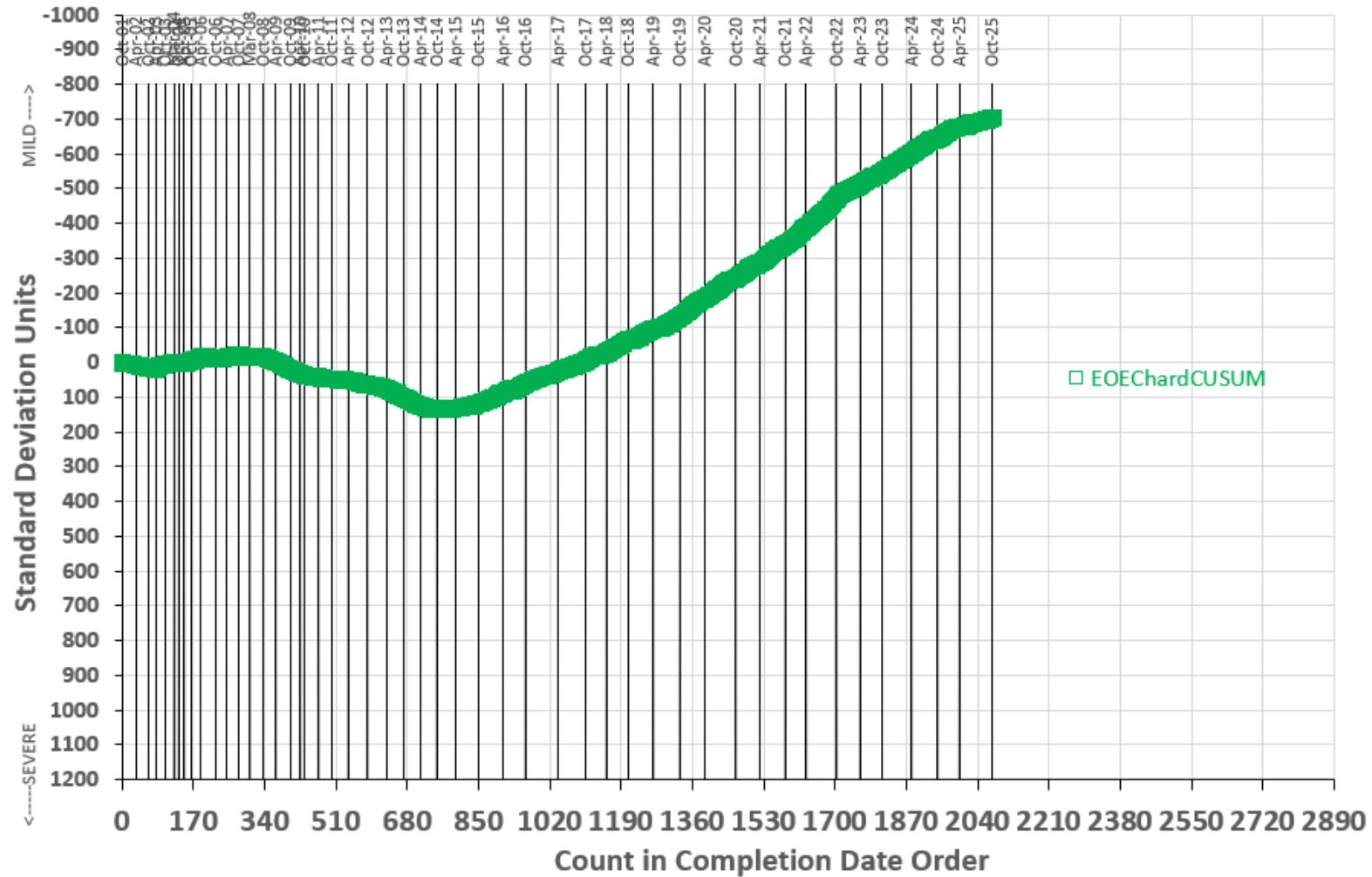


REFERENCE SILICON VOLUME CHANGE CORRECTED AVG



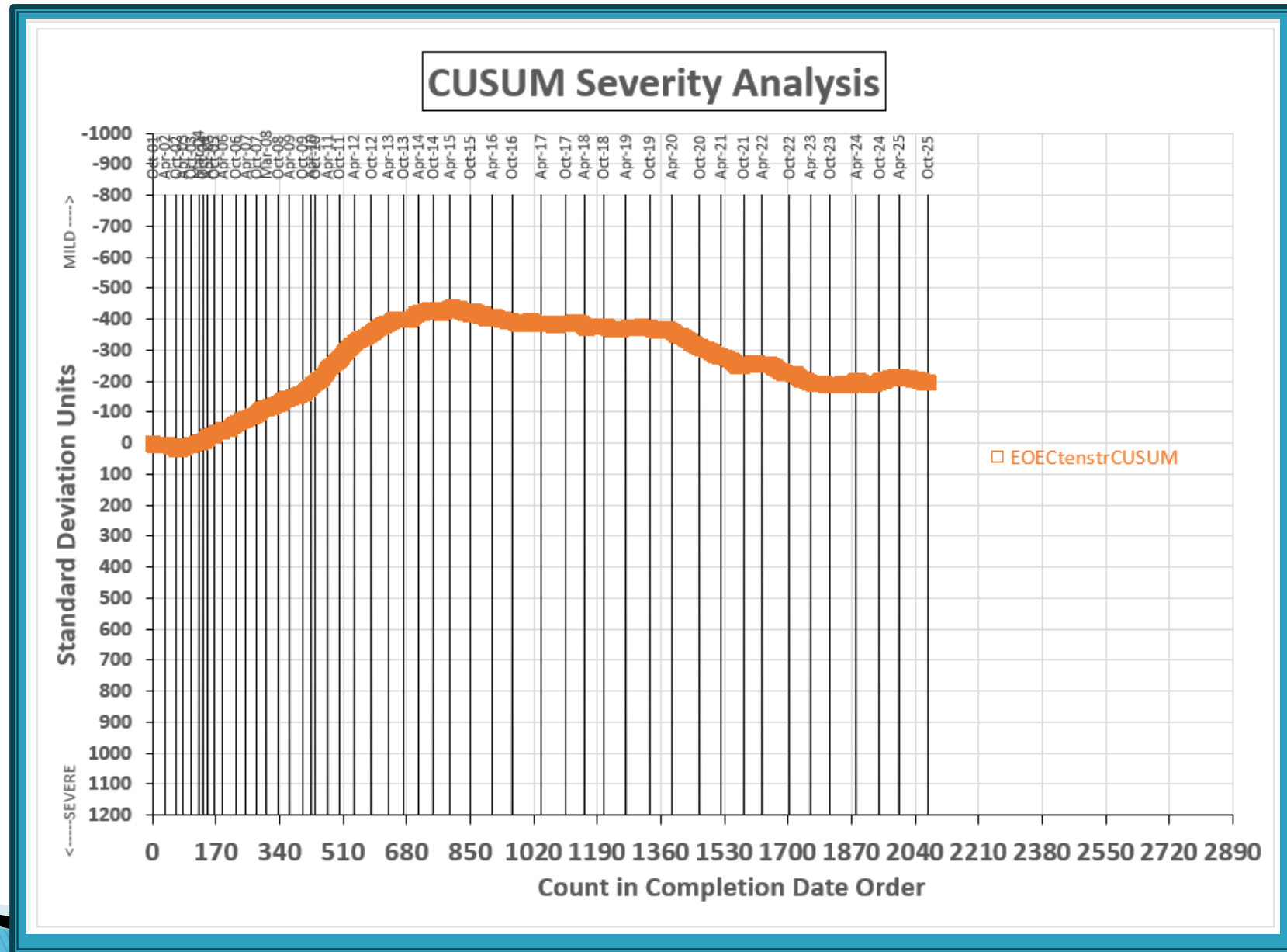
REFERENCE SILICON PTS HARD CHANGE CORRECTED AVG

CUSUM Severity Analysis



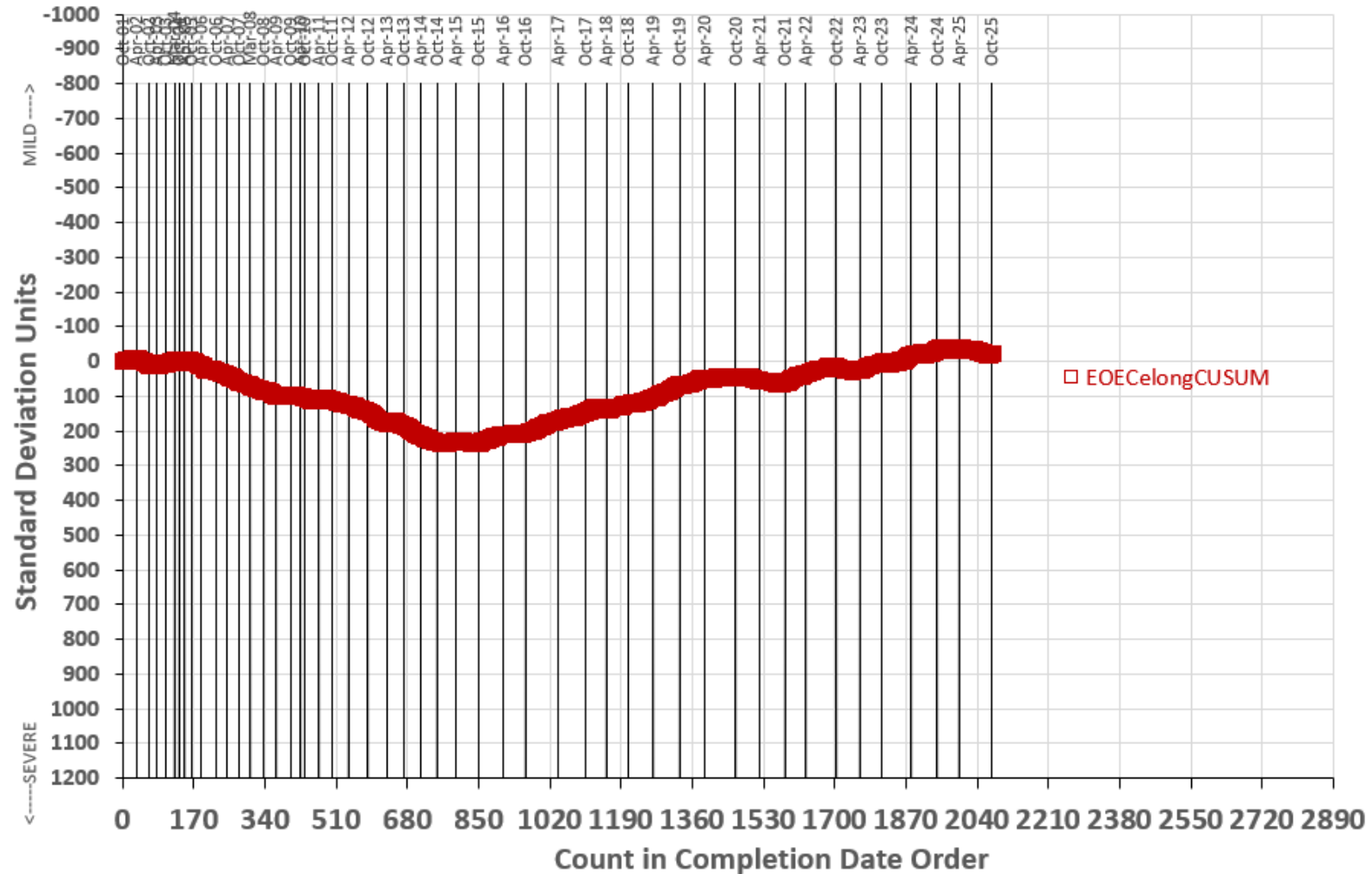
□ EOEChardCUSUM

REF SILICON TENSILE STRENGTH CHANGE CORRECTED AVG



REF SILICON ELONGATION CHANGE CORRECTED AVG

CUSUM Severity Analysis



EOEC Test Severity

Ethylene Acrylate “VAMAC” (MAC)

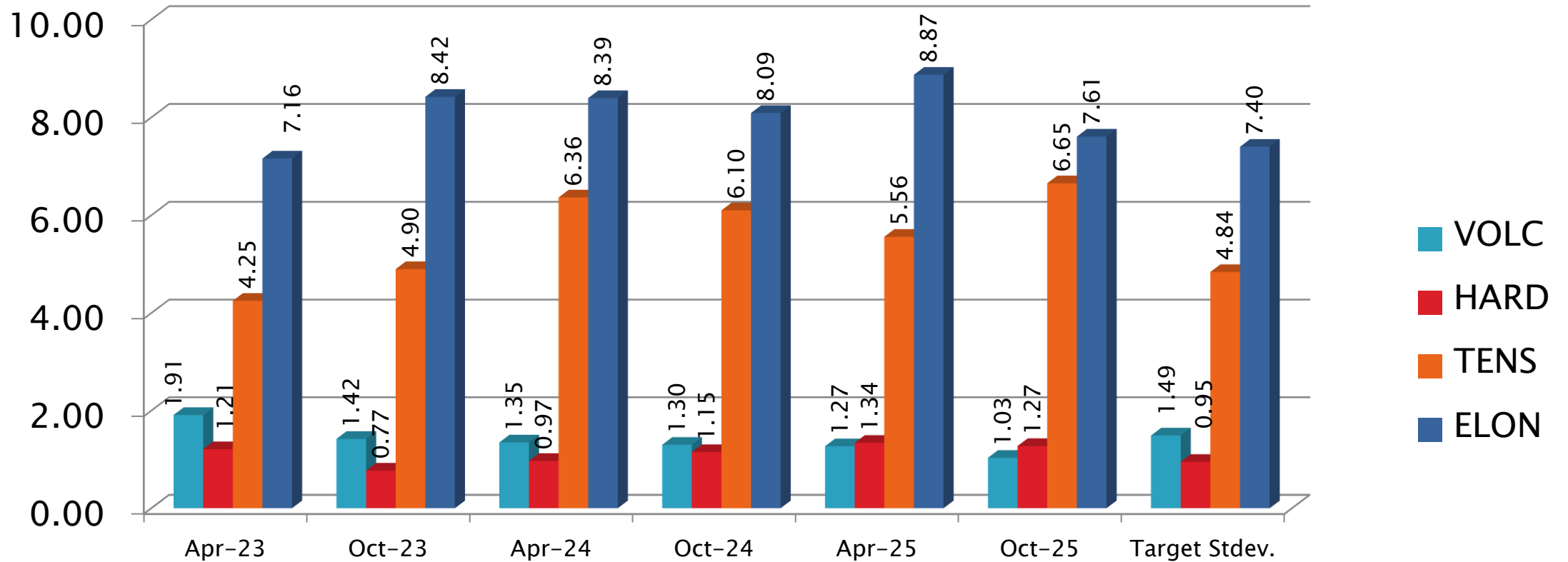
Parameter	Period Mean Δ/s	Status
Volume Change	0.1083	Slightly Severe
Points Hardness Change	-0.7520	Mild
Tensile Strength Change	0.6286	Severe
Elongation Change	0.1526	Slightly Severe

April 1, 2025 – September 30, 2025

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EOEC Precision Estimates – VAMAC



April 1, 2025 – September 30, 2025

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EOEC Precision Estimates by Lab: MAC

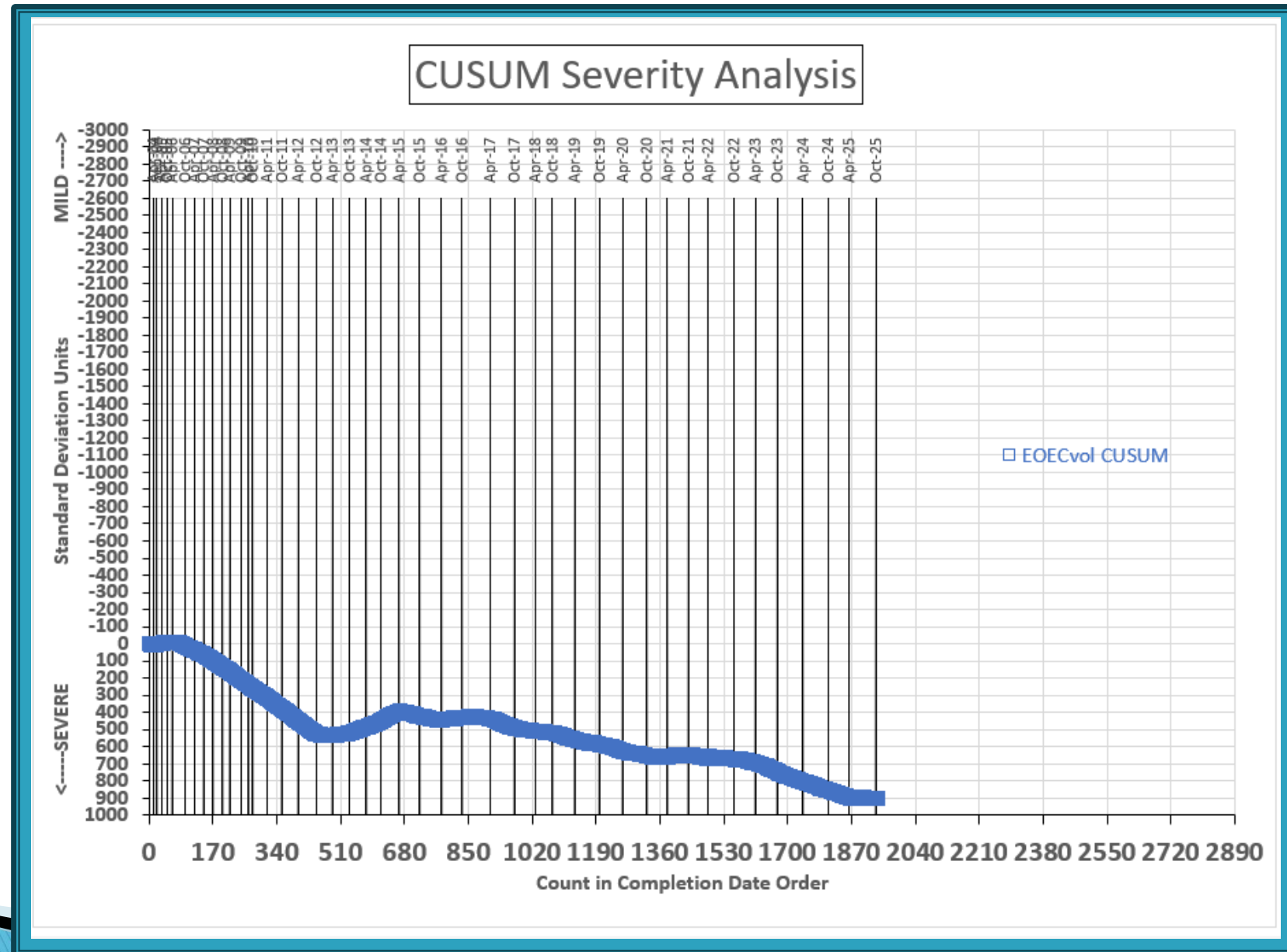
Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	23	9	0	15	12	7	1	5
Volume	Mean	18.40	18.64		19.56	19.06	18.07	19.33	17.53
	Pooled s	0.8669	0.2176		1.3033	0.9260	0.1282		0.3981
	Mean /s	-0.0957	0.0664		0.6841	0.3518	-0.3174	0.5302	-0.6779
Hardness	Mean	-8.8696	-9.1111		-7.7333	-7.7500	-6.5714	-9.0000	-8.0000
	Pooled s	0.9197	0.9280		1.2799	1.2154	0.5345		1.2247
	Mean /s	-1.4627	-1.7170		-0.2667	-0.2842	0.9564	-1.6000	-0.5474
Tensile Strength	Mean	-10.53	-14.92		-18.62	-8.4667	-8.5143	-15.50	-10.42
	Pooled s	3.2870	3.6245		9.3211	6.6135	2.5641		2.5460
	Mean /s	0.9907	0.0843		-0.6798	1.4180	1.4082	-0.0351	1.0145
Elongation	Mean	-31.67	-37.63		-35.43	-38.33	-30.06	-33.00	-26.78
	Pooled s	5.0890	5.0224		12.44	4.0545	2.3950		4.6917
	Mean /s	0.4467	-0.3613		-0.0631	-0.4559	0.6625	0.2649	1.1054

April 1, 2025 – September 30, 2025

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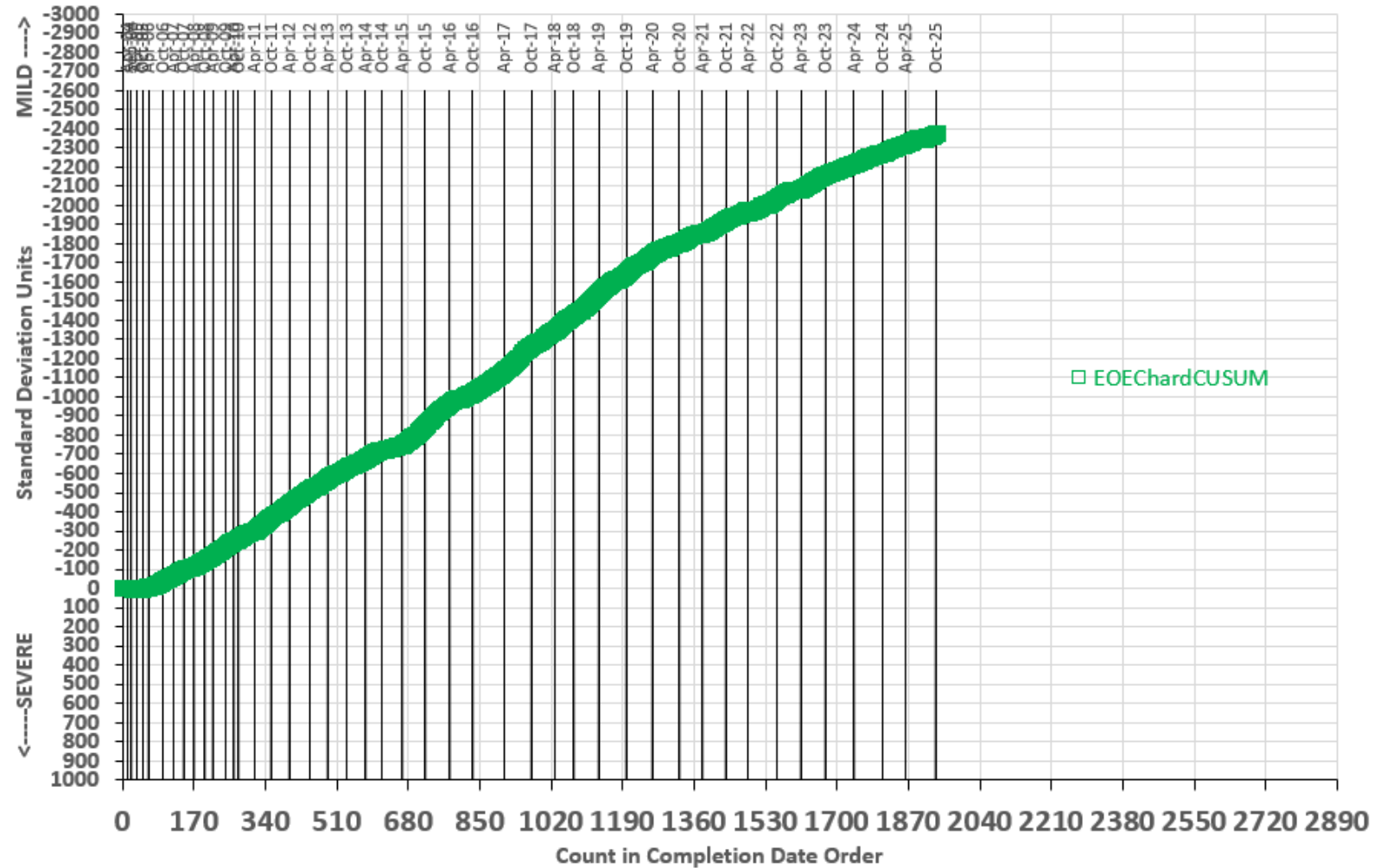


REFERENCE VAMAC G VOLUME CHANGE CORRECTED AVERAGE



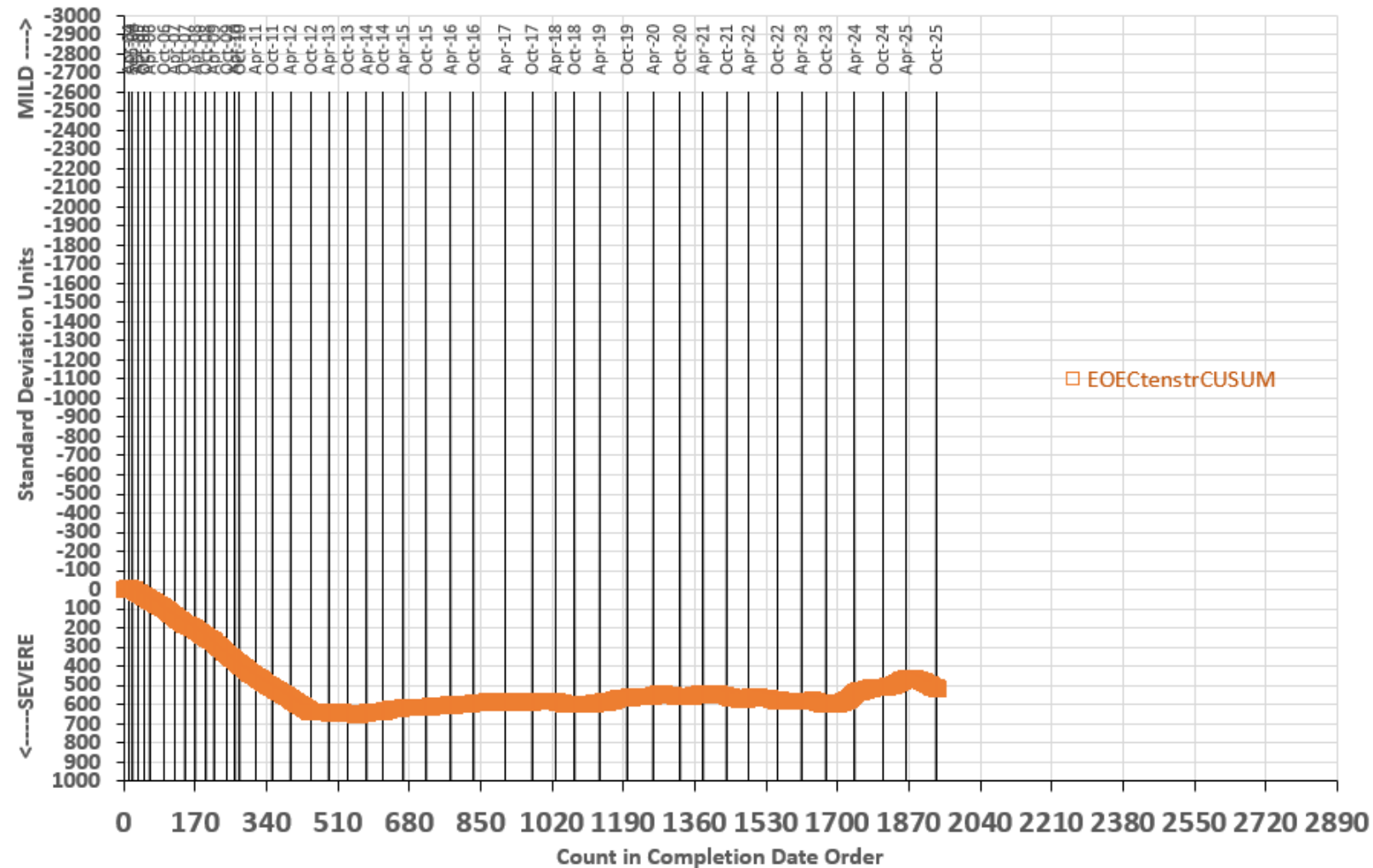
REF VAMAC G POINTS HARDNESS CHANGE CORRECTED AVG

CUSUM Severity Analysis



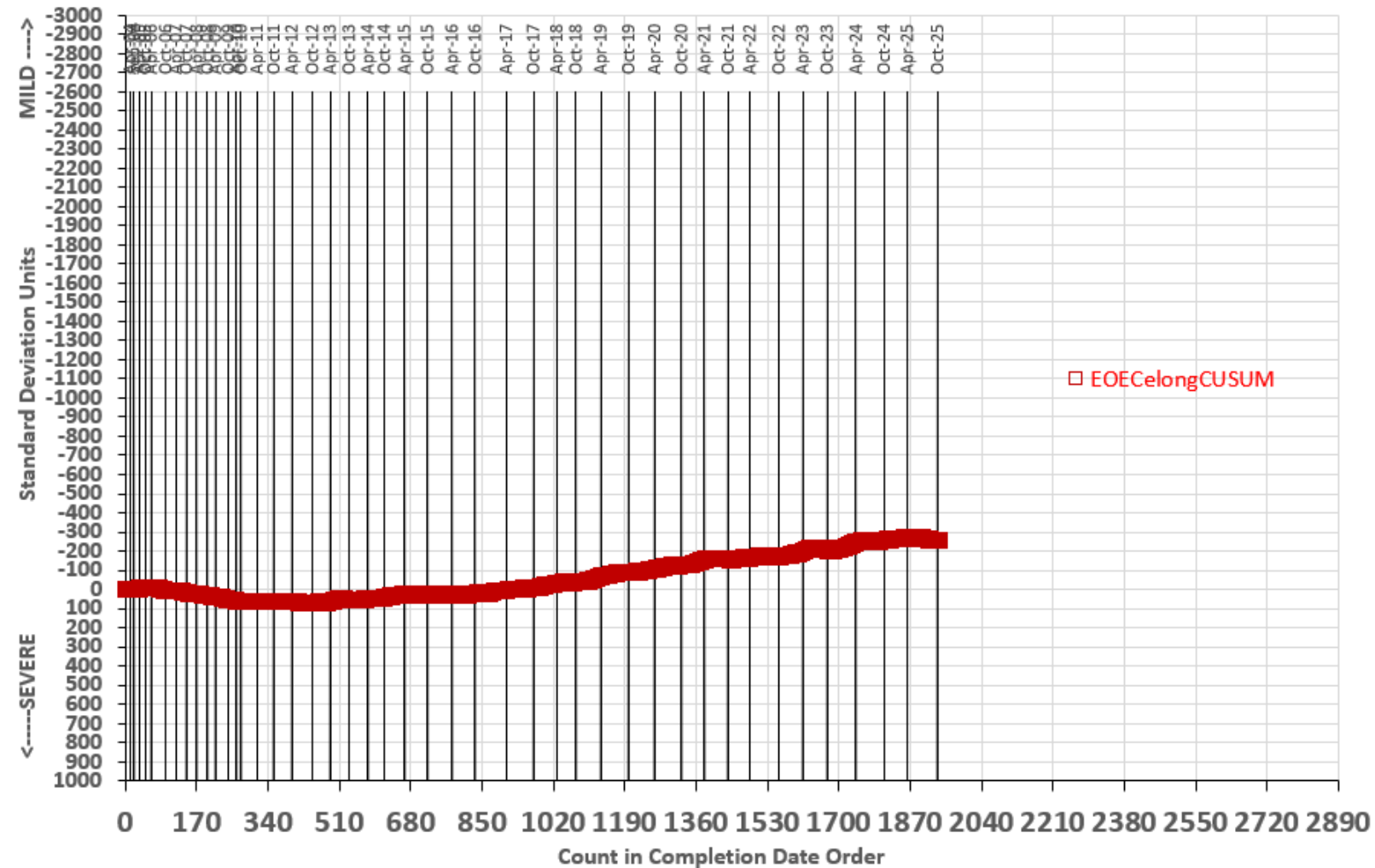
REF VAMAC G TENSILE STRENGTH CHANGE CORRECTED AVG

CUSUM Severity Analysis



REF VAMAC G ELONGATION CHANGE CORRECTED AVG

CUSUM Severity Analysis



EOEC Test Severity

Hydrogenated NBR (HNBR)

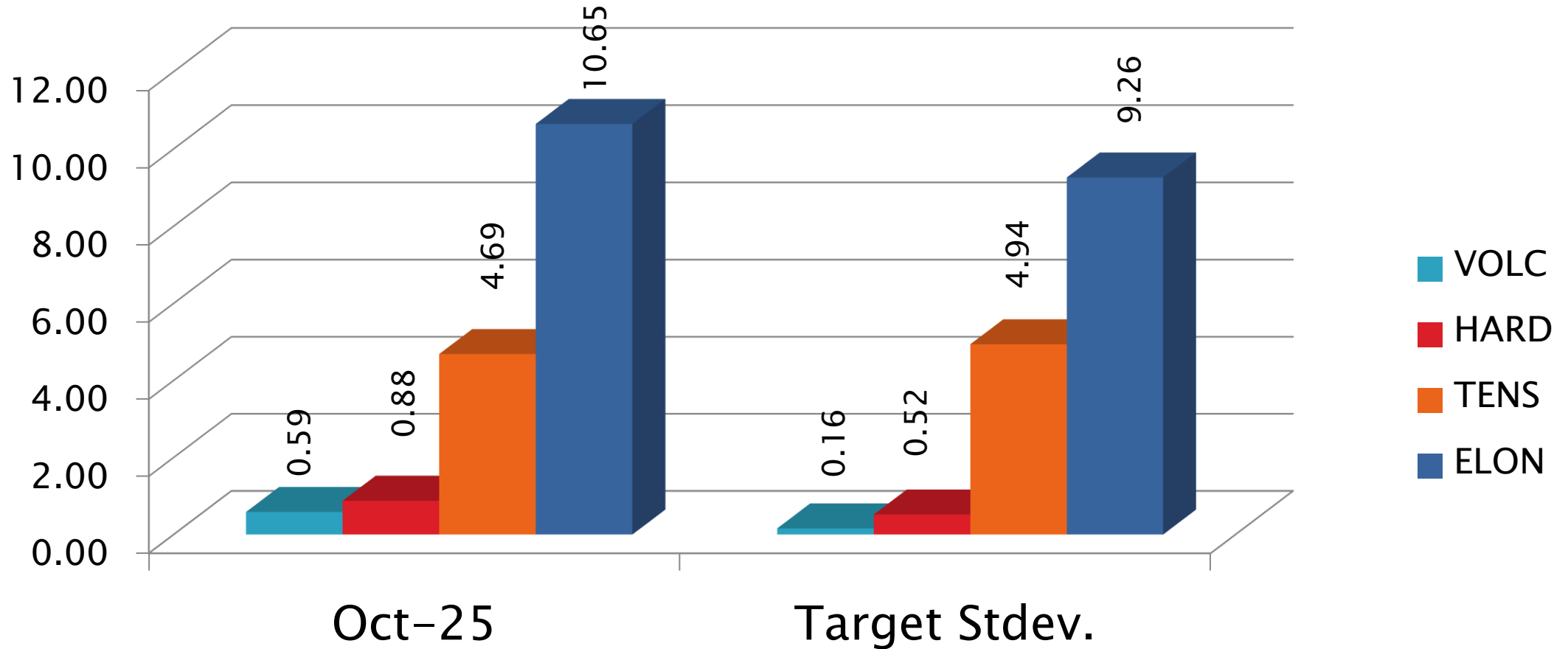
Parameter	Period Mean Δ/s	Status
Volume Change	-0.0243	On Target
Points Hardness Change	-0.2842	Mild
Tensile Strength Change	-0.0882	Slightly Mild
Elongation Change	0.1814	Severe

April 1, 2025 – September 30, 2025

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EOEC Precision Estimates – Hydrogenated NBR



April 1, 2025 – September 30, 2025

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EOEC Precision Estimates by Lab: HNBR

Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	7	6	0	5	0	0	0	0
Volume	Mean	3.9729	4.3350		4.0900				
	Pooled s	0.9167	0.1544		0.2521				
	Mean /s	-0.9821	1.2812		-0.2500				
Hardness	Mean	-1.5714	-2.0000		-1.8000				
	Pooled s	1.2724	0.6325		0.4472				
	Mean /s	0.1126	-0.7115		-0.3270				
Tensile Strength	Mean	5.2000	6.3500		11.54				
	Pooled s	1.8520	2.7414		6.8723				
	Mean /s	-0.5223	-0.2895		0.7611				
Elongation	Mean	0.4714	-1.9333		18.11				
	Pooled s	3.7907	3.9170		11.01				
	Mean /s	-0.2590	-0.5187		1.1894				

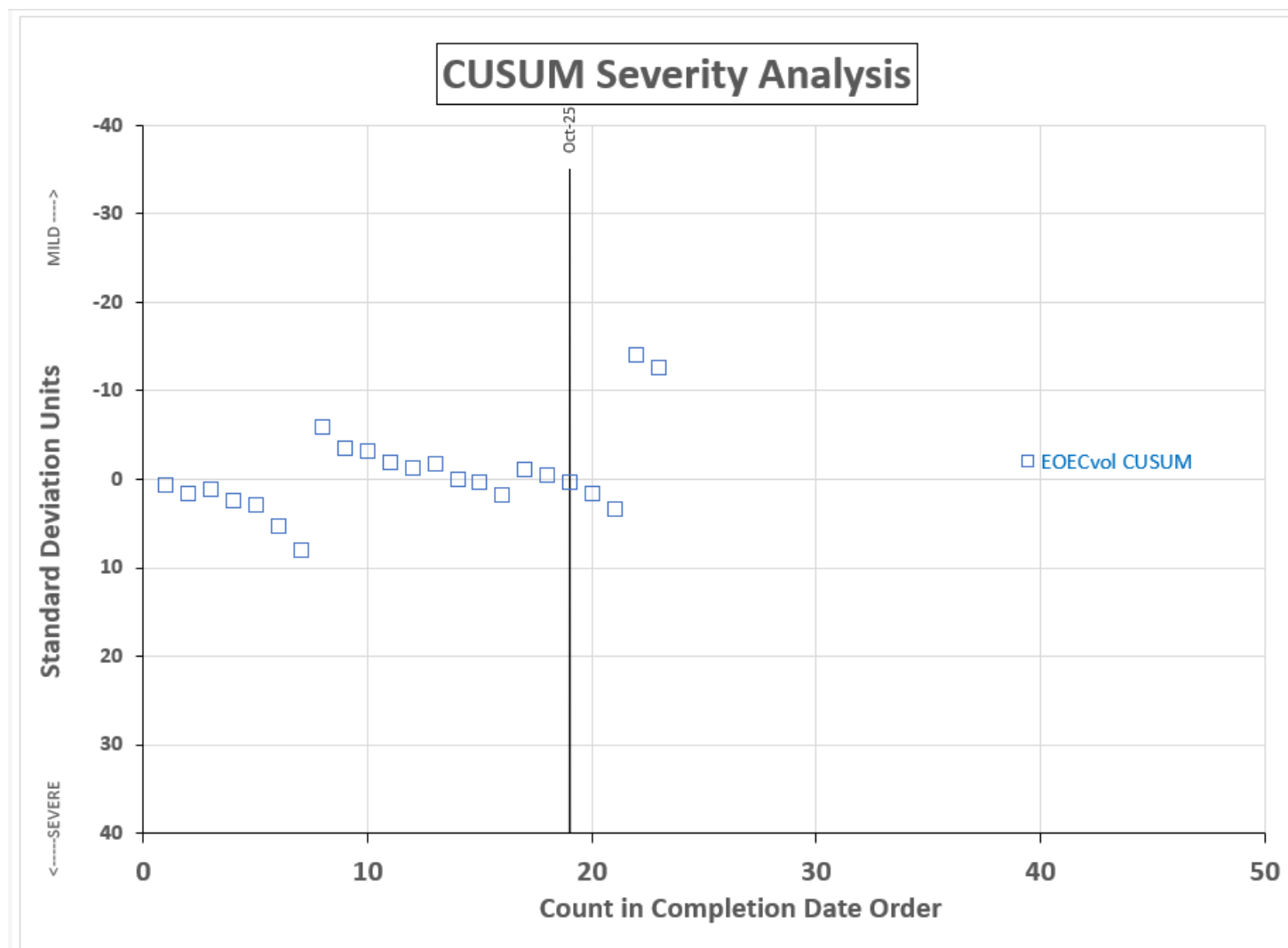
April 1, 2025 – September 30, 2025

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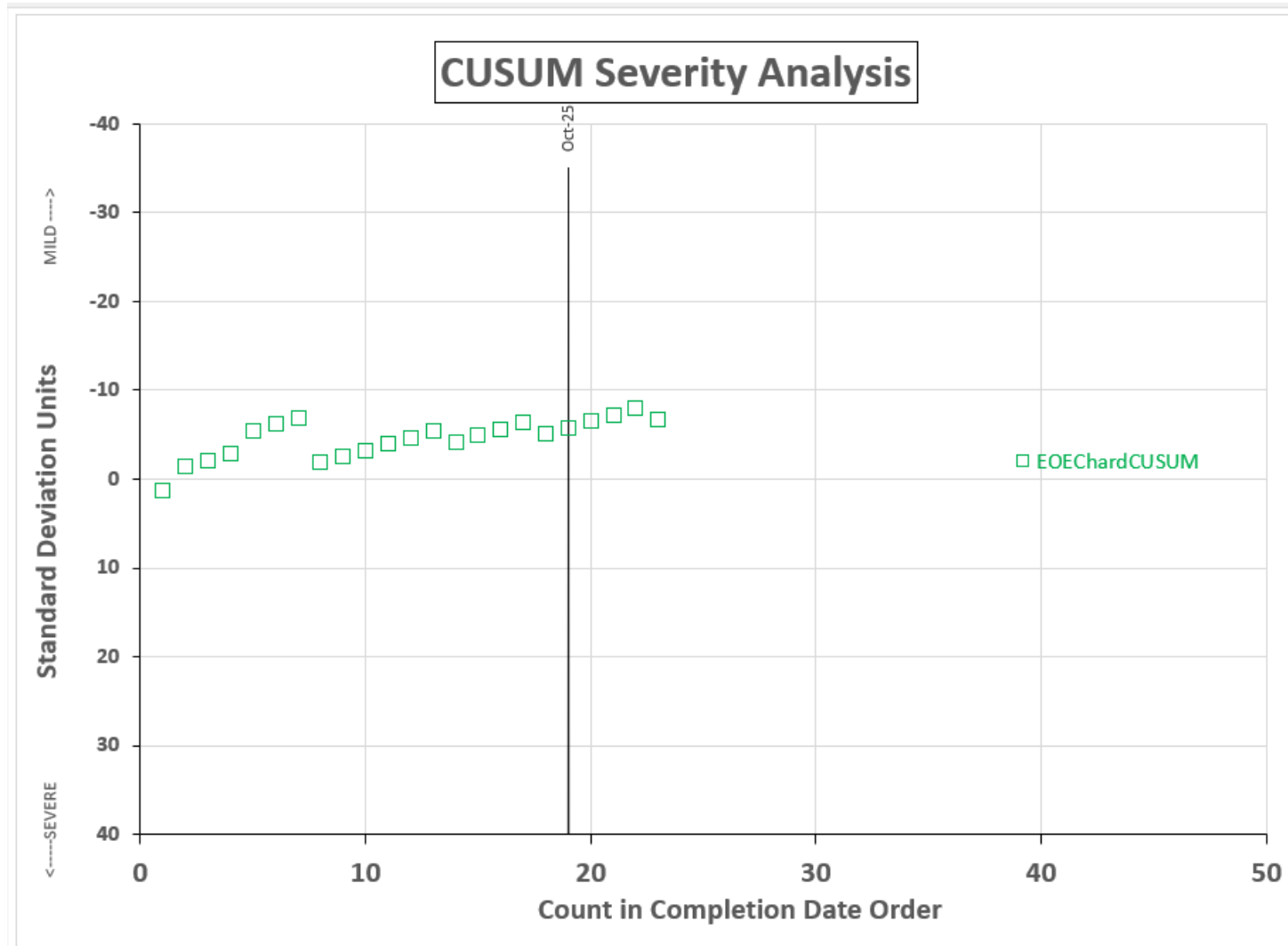
EOEC - HYDROGENATED NITRILE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE HNITRILE VOLUME CHANGE CORRECTED AVERAGE



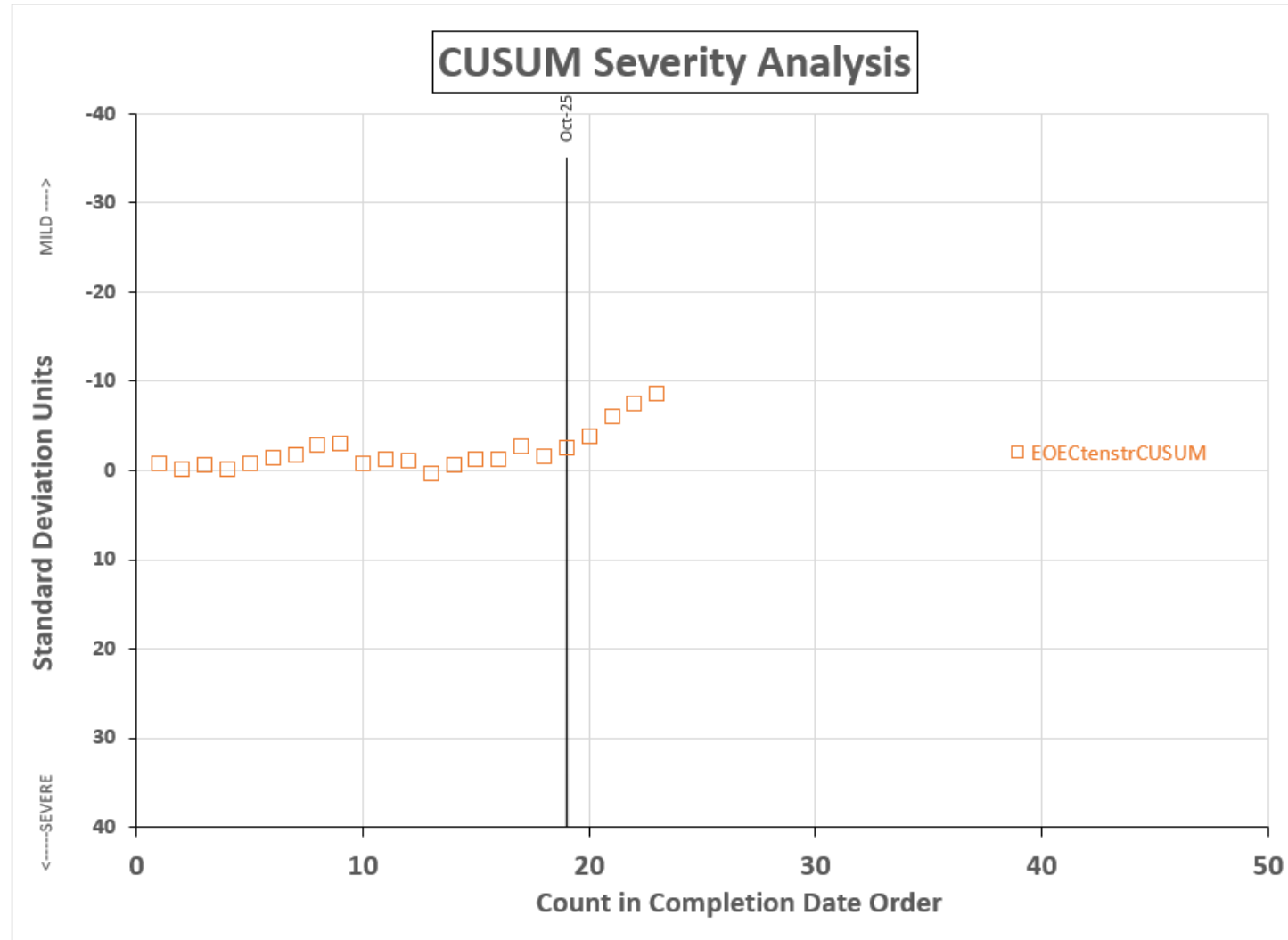
EOEC - HYDROGENATED NITRILE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE HY NITRILE PTS HARD CHANGE CORRECTED AVG



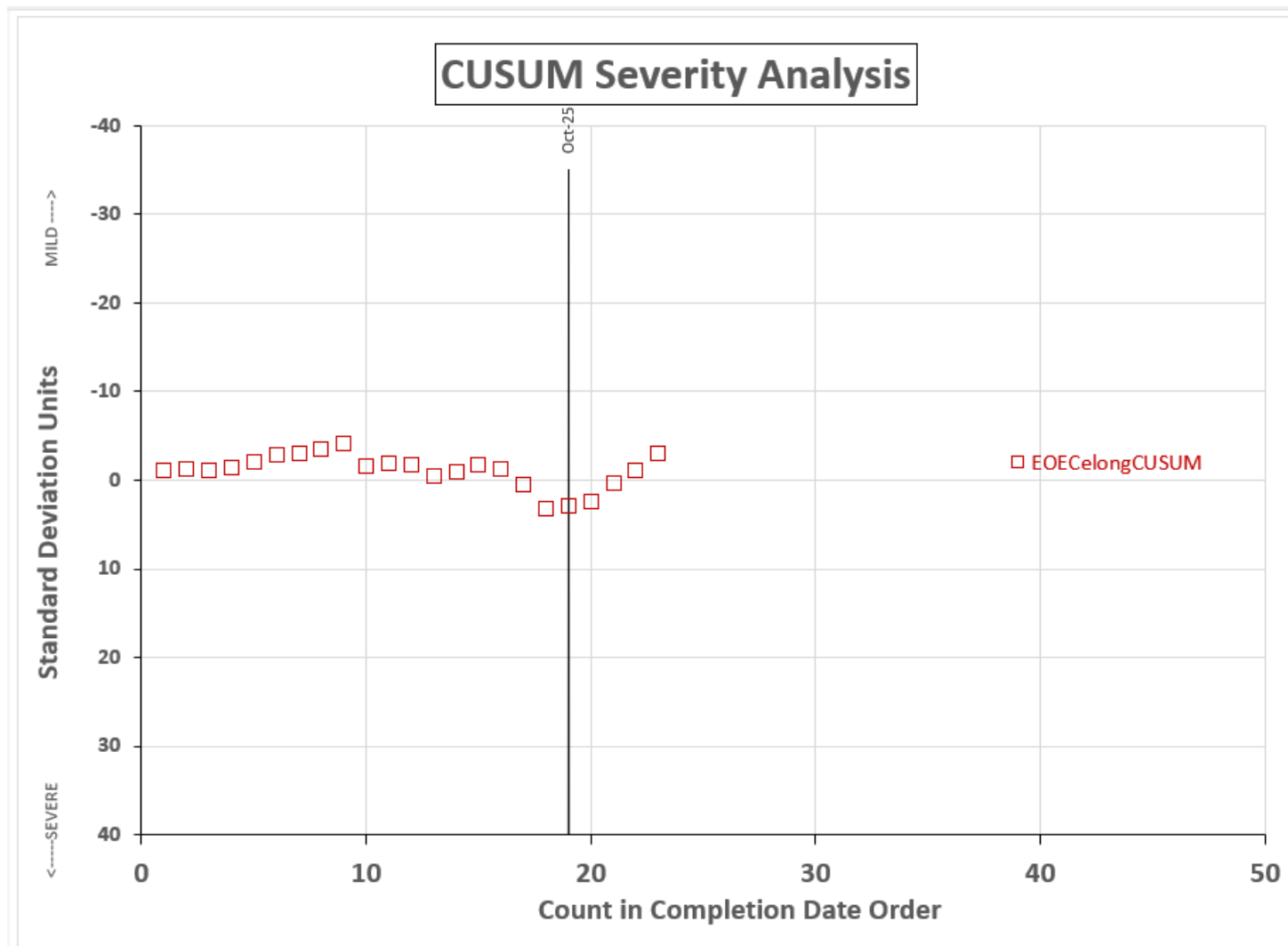
EOEC - HYDROGENATED NITRILE INDUSTRY OPERATIONALLY VALID DATA

REF HYD NITRILE TENS STRENGTH CHANGE CORRECTED AVG



EOEC - HYDROGENATED NITRILE INDUSTRY OPERATIONALLY VALID DATA

REF HY NITRILE ELONGATION CHANGE CORRECTED AVERAGE



Information Letters & Technical Updates*

No new information letters or technical updates were released this semester.

Test	Date	IL or Memo Number	Topic
EOEC			

*Available from TMC Website

April 1, 2025 – September 30, 2025

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Reference Oil Inventory Estimated Life

EOEC & LDEOC

Oil	TMC Inventory Gallons	Gallons Shipped Past 6 Months	Estimated Life ^C
SL107 ^{A, B}	881	321	1.5 years

^A TMC Inventory is used across several test methods

^B SL107 has fully replaced oil 1006; Oil 1006 is no longer used as an EOEC Reference Fluid

^C Use Rate of SL107 has accelerated due to addition of five new Elastomers to D7216:
FOUR: ILSAC GF-7
ONE: PC-12

[TABLE of CONTENTS](#)

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ASTM Reference Testing Semi-Annual Report D7216 LDEOC

October 1, 2024 to March 31, 2025

ASTM D 7216

Engine Oil Elastomer Compatibility

LDEOC (Light-Duty)	
OHT PART NUMBER	BATCH CODE*
OHTLDEOC-HNBR1-A	34
OHTLDEOC-FKM1-A	31
OHTLDEOC-ACM1-B	27
OHTLDEOC-VMQ1-A	43
OHTLDEOC-AEM1-B	33
OHTLDEOC-ACM2-A	3
OHTLDEOC-AEM2-A	3
OHTLDEOC-FKM3-A	2
OHTLDEOC-AEM3-A	3

* As of 20250403

LDEOC Test Activity

Test Status		Ethylene Acrylate	Fluoroelast.	Nitrile	Polyacrylate	Silicone	Total
LABS BATHS		8 32	8 29	9 20	8 29	9 37	
Acceptable Calibration Test	AC	61	67	67	63	74	332
Failed Calibration Test	OC	2	2	2	0	2	8
Operationally Invalid, by lab	LC	2	2	3	3	2	12
Operationally Invalid, by TMC	RC	0	1	0	1	0	2
Aborted	XC	0	1	0	0	1	2
Acceptable Informational Run	NN	0	0	1	0	0	1
Unacceptable Informational Run	MN	0	0	0	0	0	0
Total		65	73	73	67	79	357

April 1, 2025 – September 30, 2025

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LDEOC Test Activity

Test Status		Ethylene Acrylate 2	Ethylene Acrylate 3	Fluoroelast.3	Polyacrylate2	Total
		LABS BATHS	8 39	8 39	7 37	
Acceptable Calibration Test	AC	82	78	69	80	309
Failed Calibration Test	OC	4	1	1	3	9
Operationally Invalid, by lab	LC	0	1	0	1	2
Operationally Invalid, by TMC	RC	0	1	0	0	1
Aborted	XC	1	0	1	0	2
Acceptable Informational Run	NN	0	0	0	1	1
Unacceptable Informational Run	MN	0	0	0	0	0
Total		87	81	71	85	324

April 1, 2025 – September 30, 2025

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Calibrated Labs and Stands¹

(change shown in parentheses)

Test	Labs	Stands
D7216 LDEOC	9 ² (+2)	N/A

¹ As of 9/30/2025

² Not all Elastomer Types were run at each lab

LDEOC Failing Calibration (OC) Tests

Cause	Elastomer	#
TENSILE STRENGTH (SEVERE)	1-AEM1, 1-NBR1, 1-ACM2, 1-VMQ1	4
TENSILE STRENGTH (MILD)	3-AEM2, 1-ACM2	4
VOLUME (MILD)	1-AEM1, 1-FKM1	2
VOLUME (SEVERE)	1-NBR1	1
HARDNESS (MILD)	1-FKM3, 1-VMQ1	2
HARDNESS (SEVERE)	1-AEM2, 1-AEM3, 1FKM1	3
VOL/TENS (SEVERE), HARD (MILD)	1-ACM2	1
Total		17

There were SEVENTEEN failing LDEOC Calibration Tests reported this period from EIGHT different labs.

April 1, 2025 – September 30, 2025

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LDEOC Lost Tests

Validity	Cause	No. of Tests
LC	BATH TEMPERATURE/POWER OUTAGE	13
LC	WRONG ELASTOMER TESTED	1
XC	ABORTED: BATH TEMPERATURE ISSUE	5
XC	WRONG ELASTOMER TESTED	2
RC	INCORRECT RUN TIME	1
RC	WRONG ELASTOMER TESTED	2
Total		24

*Invalid (LC,RC) and Aborted (XC) calibration tests

April 1, 2025 – September 30, 2025

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LDEOC Test Severity

Ethylene Acrylate (AEM1)

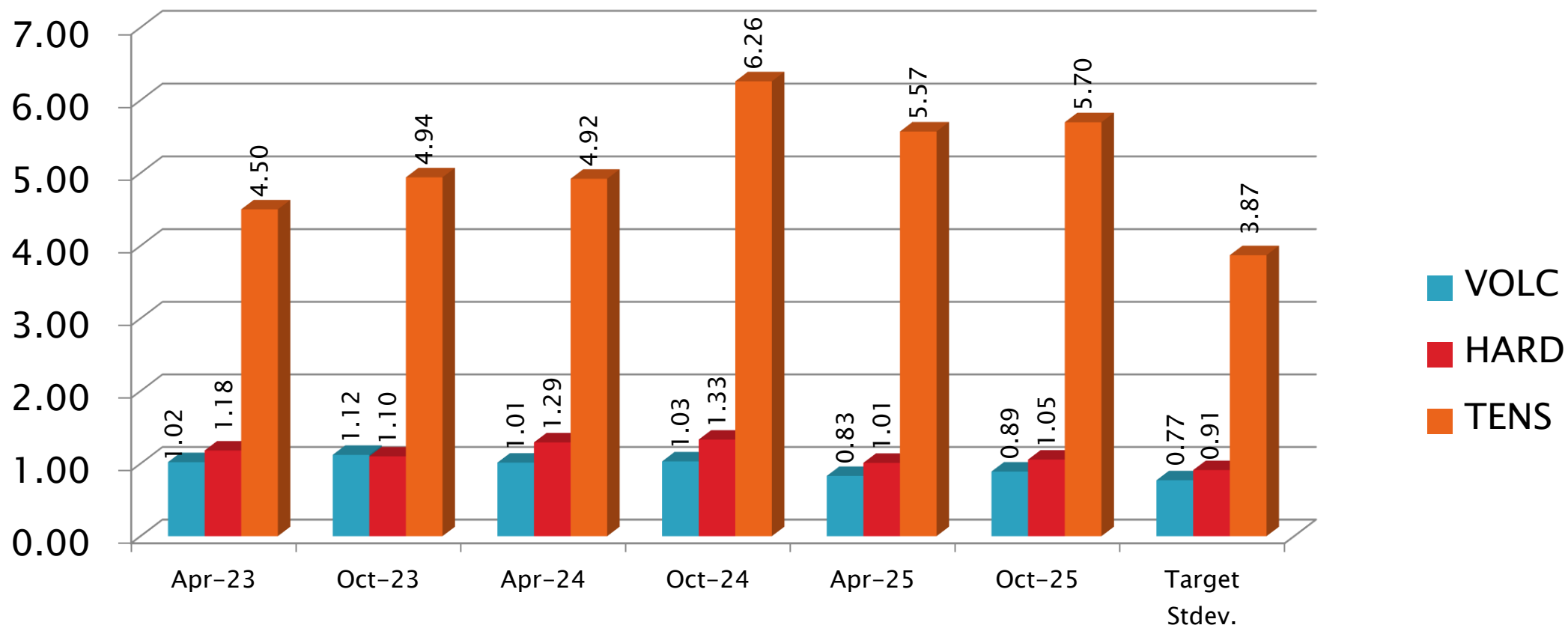
Parameter	Period Mean Δ/s	Status
Volume Change	-0.8580	Mild
Points Hardness Change	0.9417	Severe
Tensile Strength Change	-0.0380	On-Target

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Ethylene Acrylate



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: AEM1

Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	19	6	2	19	8	3	2	4
Volume	Mean	22.99	23.17	24.20	24.38	23.61	23.40	23.67	22.25
	Pooled s	0.2469	0.2861	0.3111	0.6823	1.2154	0.09713	0.6505	0.4576
	Mean /s	-1.5687	-1.3377	0.0000	0.2386	-0.7662	-1.0433	-0.6883	-2.5292
Hardness	Mean	-12.32	-11.50	-11.50	-11.74	-11.12	-11.67	-11.50	-13.00
	Pooled s	0.8201	1.5166	2.1213	1.0976	0.3536	0.5774	0.7071	0.8165
	Mean /s	0.4552	1.3516	1.3516	1.0914	1.7637	1.1685	1.3516	-0.2967
Tensile Strength	Mean	-16.95	22.13	-20.10	-17.81	-12.55	-19.30	-15.75	-11.72
	Pooled s	3.6593	3.3140	2.2627	7.6115	4.0497	3.4598	0.4950	4.1040
	Mean /s	-0.0291	-1.3678	-0.8424	-0.2508	1.1085	-0.6356	0.2817	1.3217

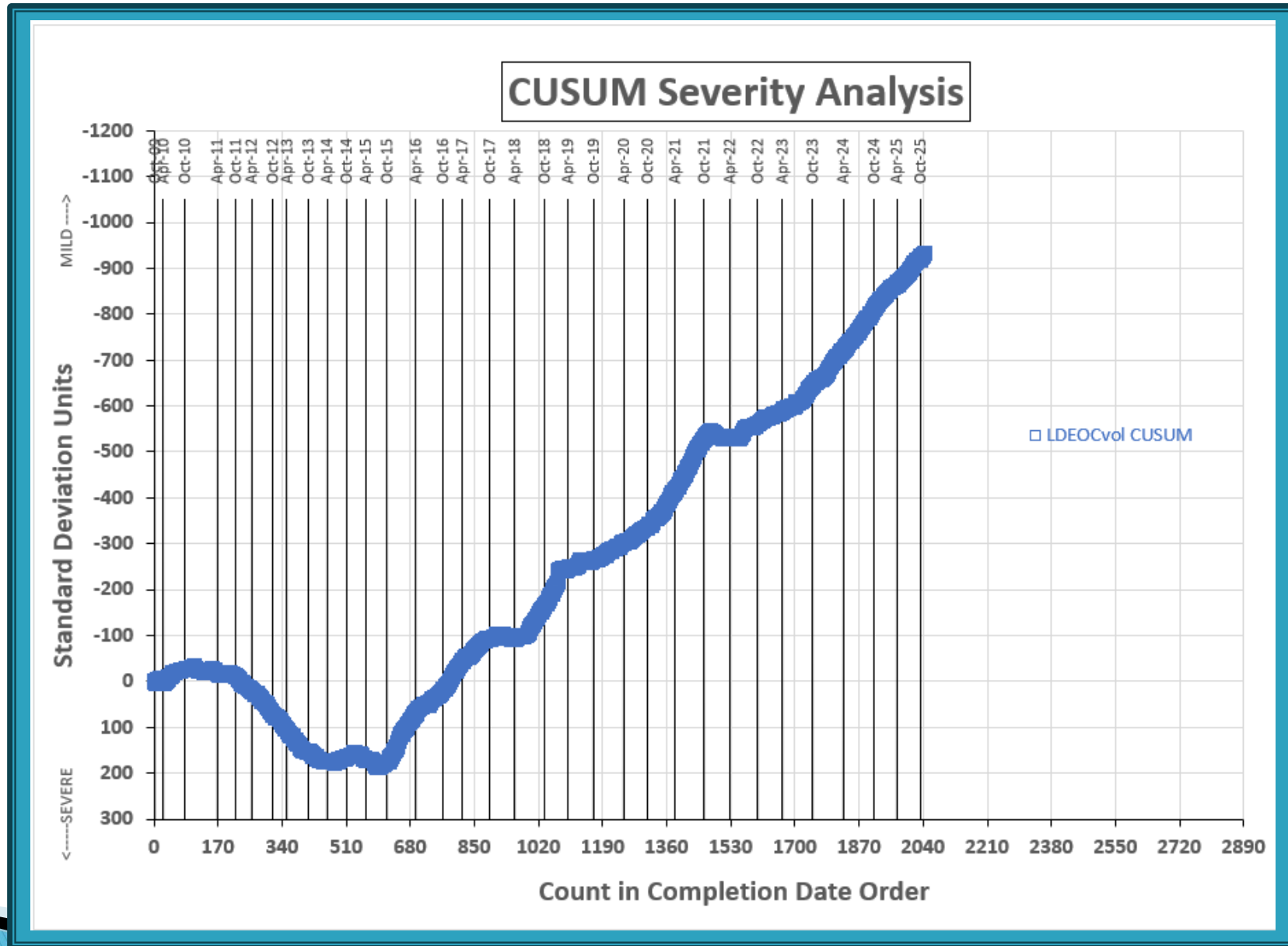
April 1, 2025 – September 30, 2025

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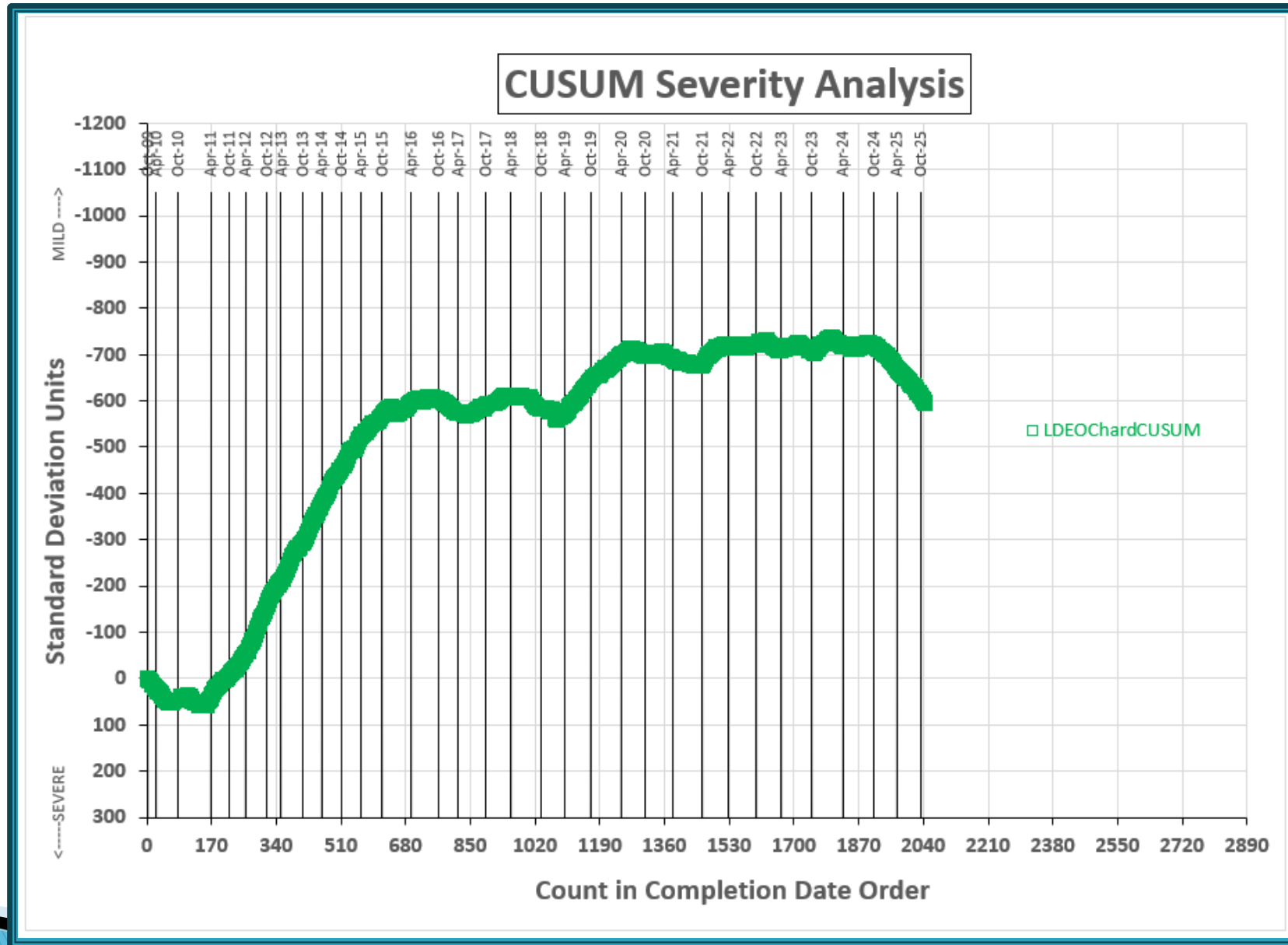
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE VOLUME CHANGE FINAL



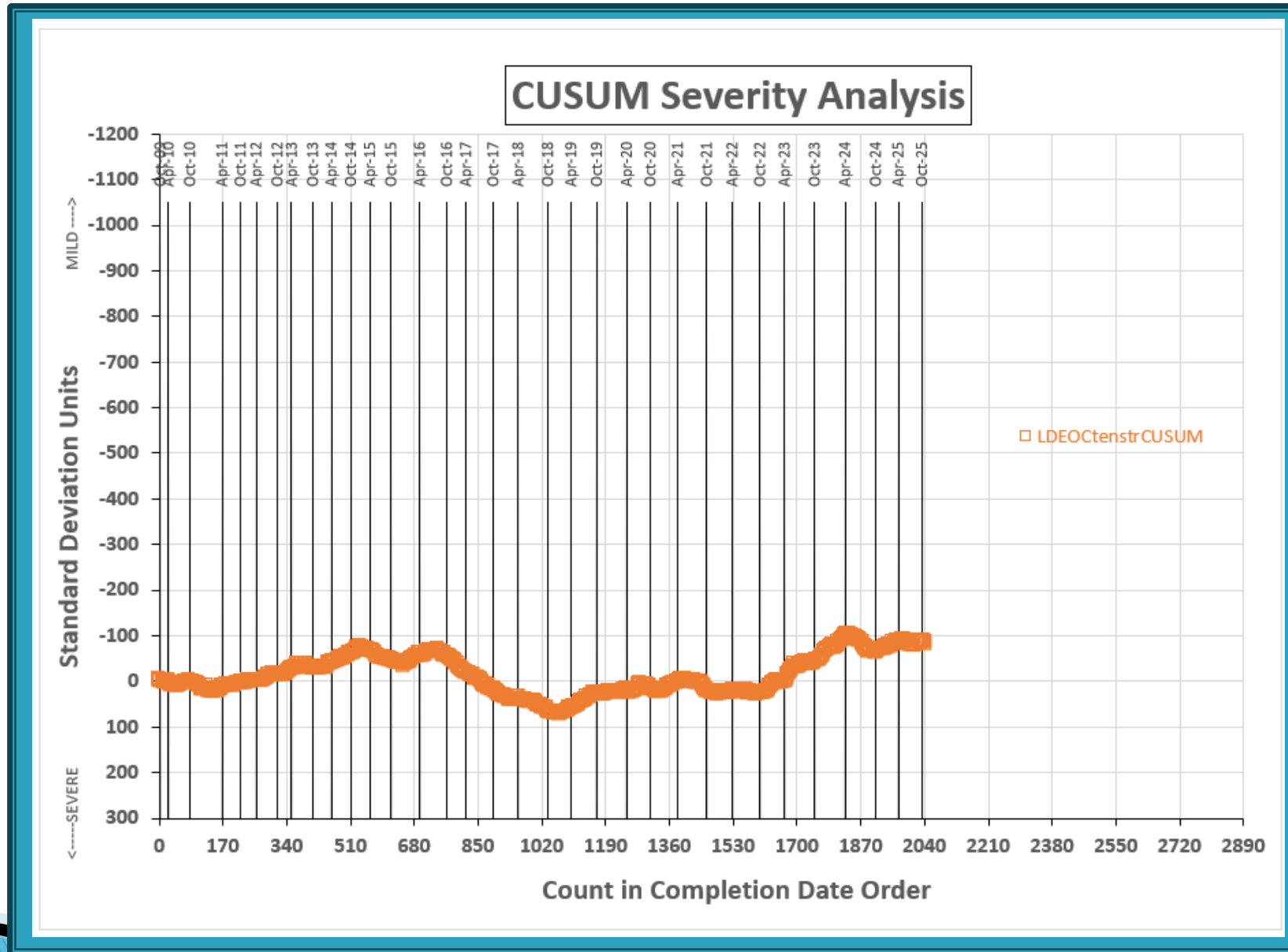
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Ethylene Acrylate (AEM2)

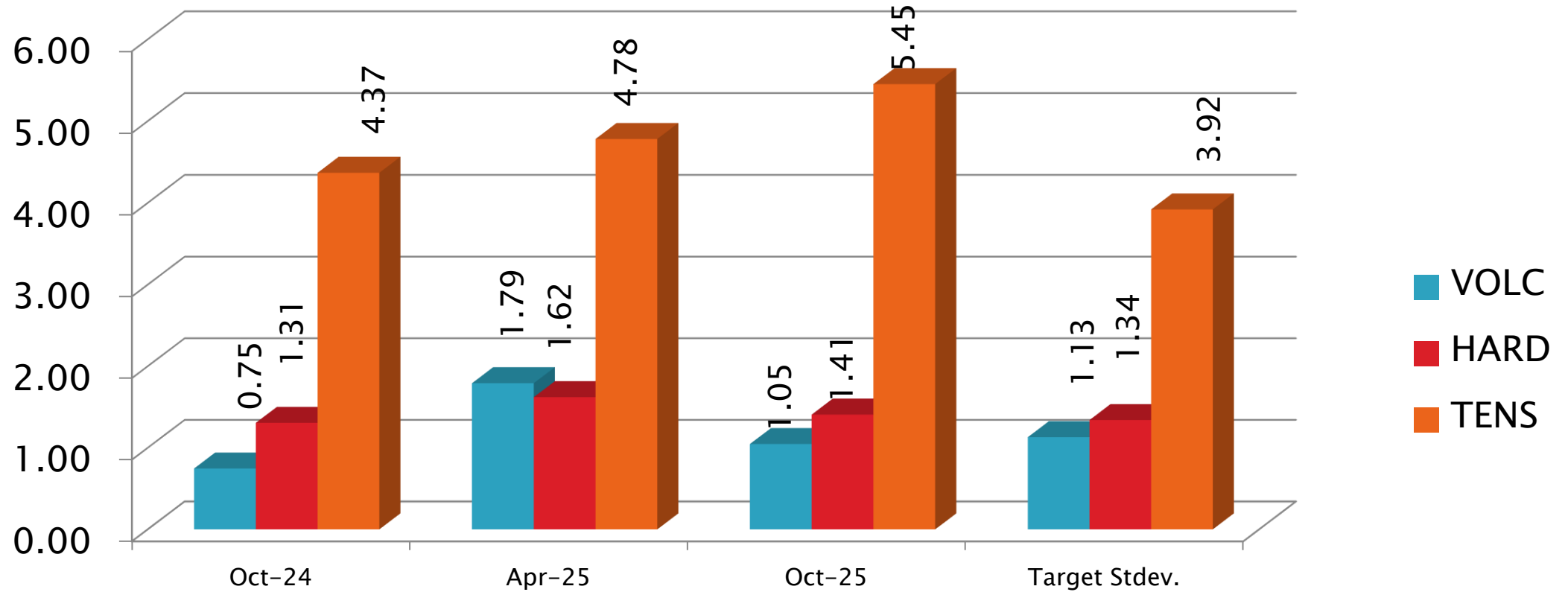
Parameter	Period Mean Δ/s	Status
Volume Change	0.2444	Severe
Points Hardness Change	-0.3700	Mild
Tensile Strength Change	0.6065	Severe

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Ethylene Acrylate 2



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: AEM2

Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	34	8	1	24	4	5	2	8
Volume	Mean	20.89	21.36	22.09	22.25	21.67	19.76	21.00	20.41
	Pooled s	0.4308	1.0923		1.0735	0.7223	0.4619	0.2616	0.6299
	Mean /s	-0.0781	0.3330	0.9823	1.1250	0.6084	-1.0761	0.0133	-0.5066
Hardness	Mean	-9.0294	-7.2500	-12.00	-8.0417	-7.2500	-6.4000	-7.0000	-8.1250
	Pooled s	0.9370	1.1650		1.4885	0.5000	0.8944	0.0000	0.9910
	Mean /s	-0.9473	0.3806	-3.1642	-0.2102	0.3806	1.0149	0.5672	-0.2724
Tensile Strength	Mean	-37.95	-41.56	-35.70	-41.42	-42.92	-31.10	-37.95	-44.08
	Pooled s	3.0048	5.7694		6.2501	4.8010	5.0907	3.8890	4.1403
	Mean /s	1.0350	0.1142	1.6097	0.1503	-0.2334	2.7832	1.0357	-0.5268

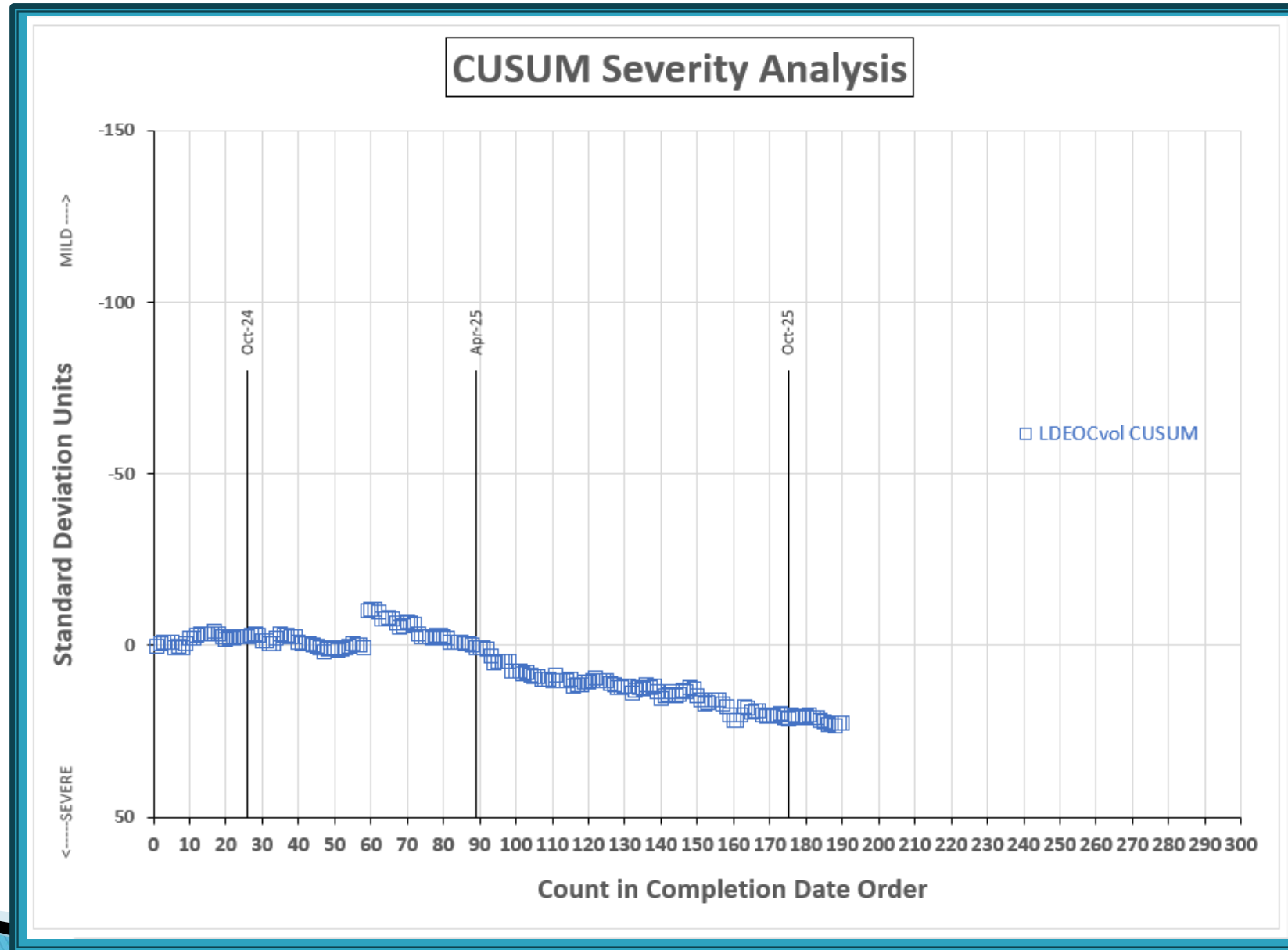
April 1, 2025 – September 30, 2025

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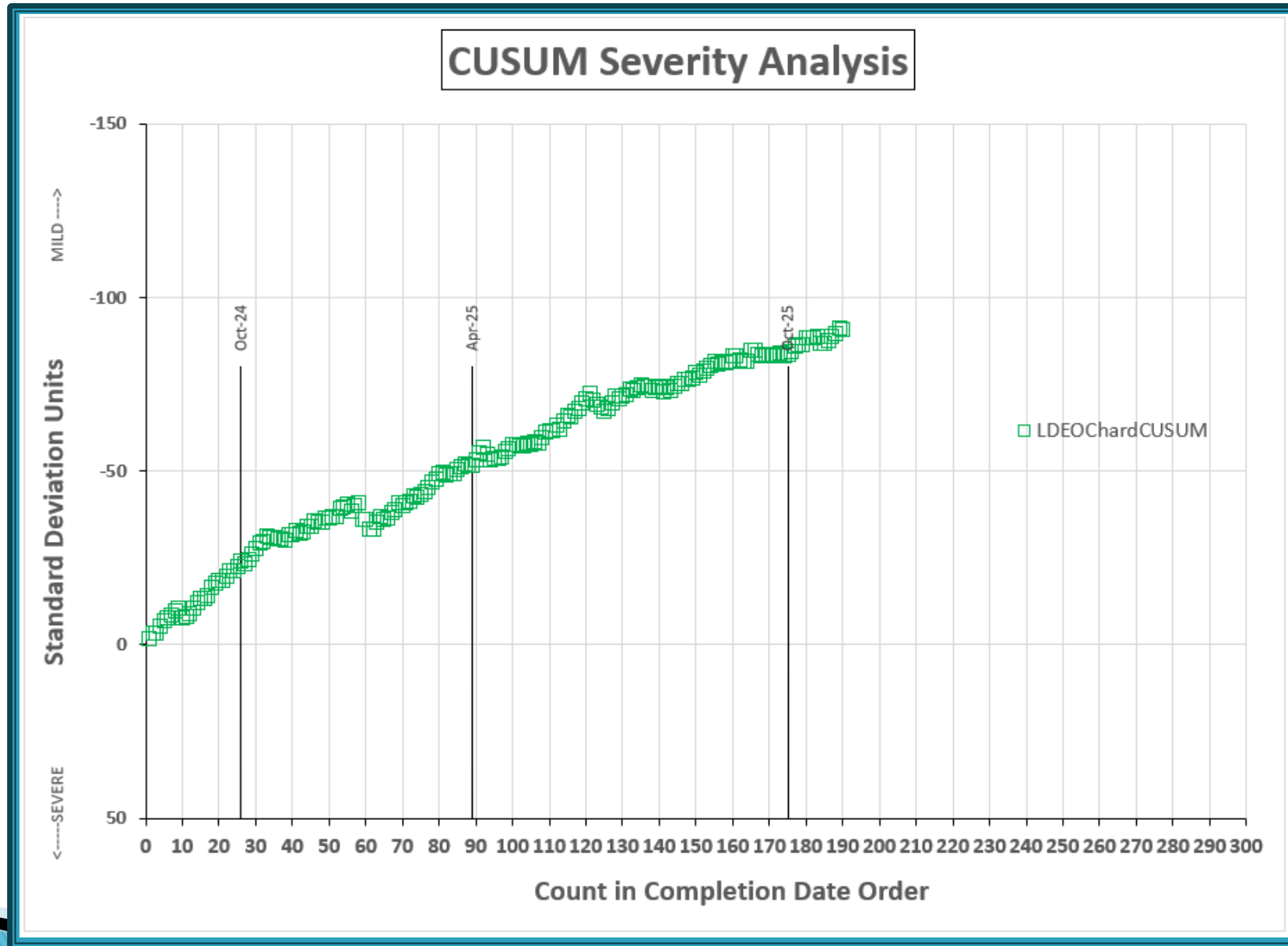
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE-2 VOLUME CHANGE FINAL



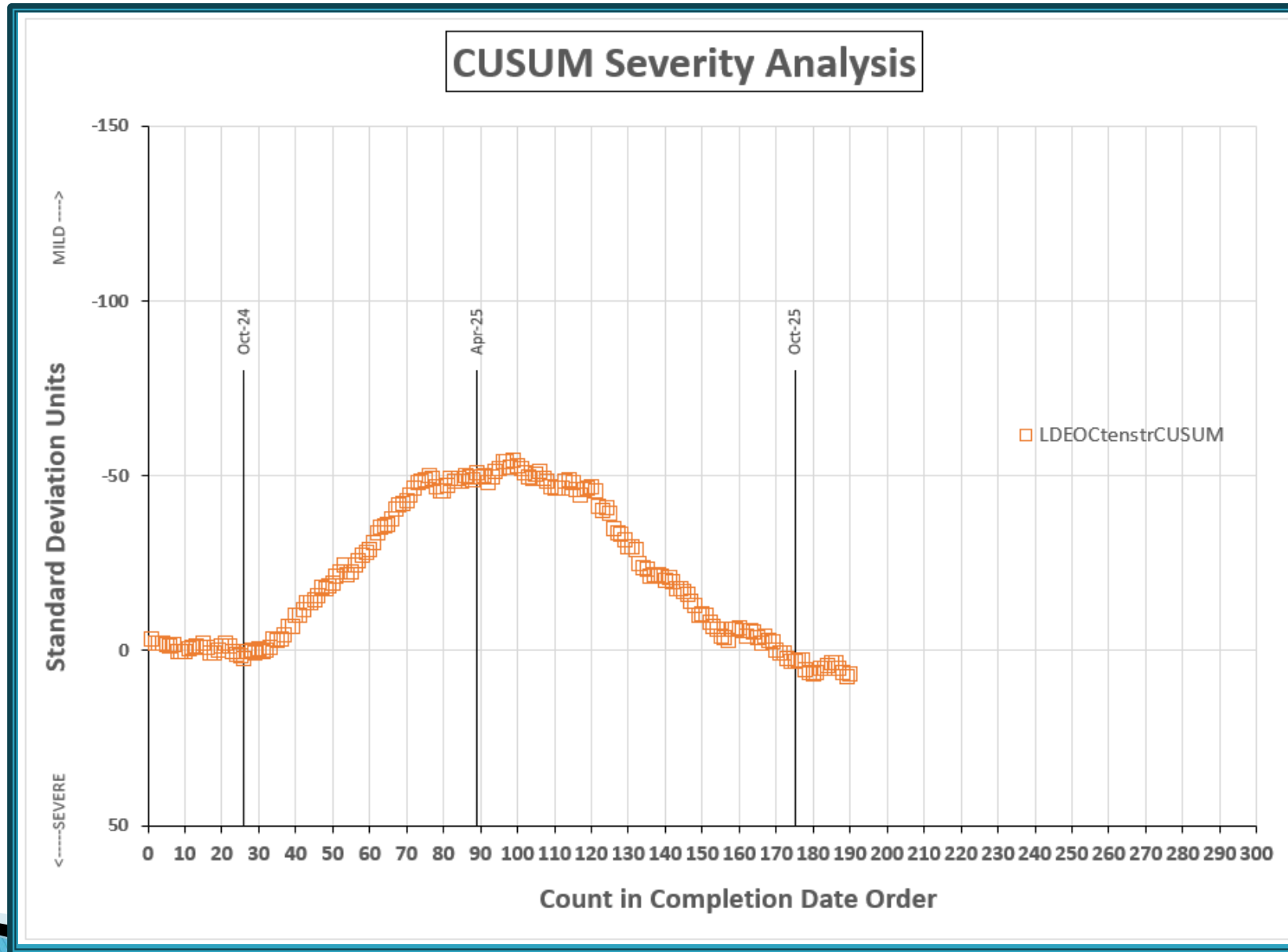
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE-2 HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE-2 TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Ethylene Acrylate (AEM3)

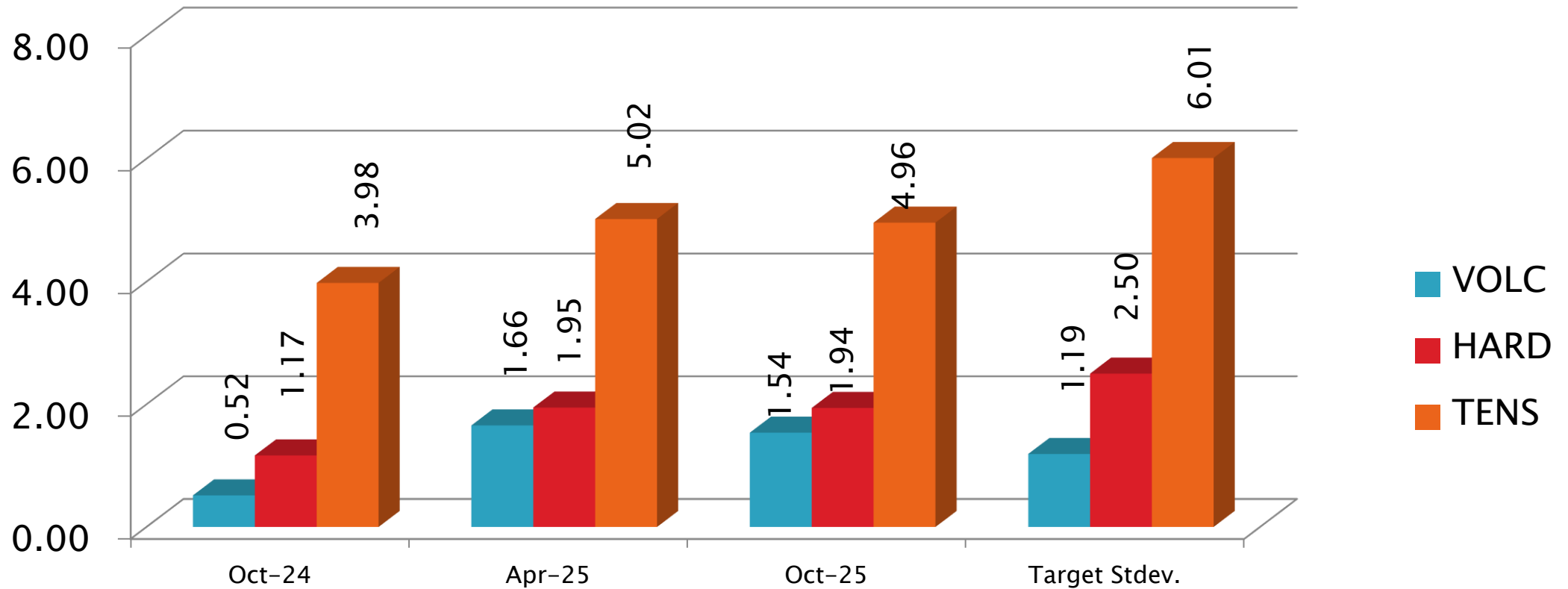
Parameter	Period Mean Δ/s	Status
Volume Change	0.4959	Severe
Points Hardness Change	0.4393	Severe
Tensile Strength Change	-1.161	Very Mild

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Ethylene Acrylate 3



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: AEM3

Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	33	8	1	22	4	3	1	7
Volume	Mean	8.8233	8.6300	8.7800	9.2741	9.6600	8.0400	7.3200	8.2343
	Pooled s	2.0884	0.1681		1.1792	0.3819	0.3559		0.3434
	Mean /s	0.4566	0.2941	0.4202	0.8354	1.1597	-0.2017	-0.8067	-0.0384
Hardness	Mean	-0.0909	1.6250	-2.0000	1.2727	0.7500	1.3333	3.0000	0.8571
	Pooled s	1.8769	1.0607		2.2293	1.2583	1.1547		1.4639
	Mean /s	0.1396	0.8260	-0.6240	0.6851	0.4760	0.7093	1.3760	0.5189
Tensile Strength	Mean	-46.79	-47.29	-44.50	-43.01	-38.90	-39.13	-46.20	-47.74
	Pooled s	3.1282	2.8083		6.3914	3.5926	2.2679		4.1605
	Mean /s	-1.4349	-1.5171	-1.0532	-0.8059	-0.1215	-0.1603	-1.3361	-1.5928

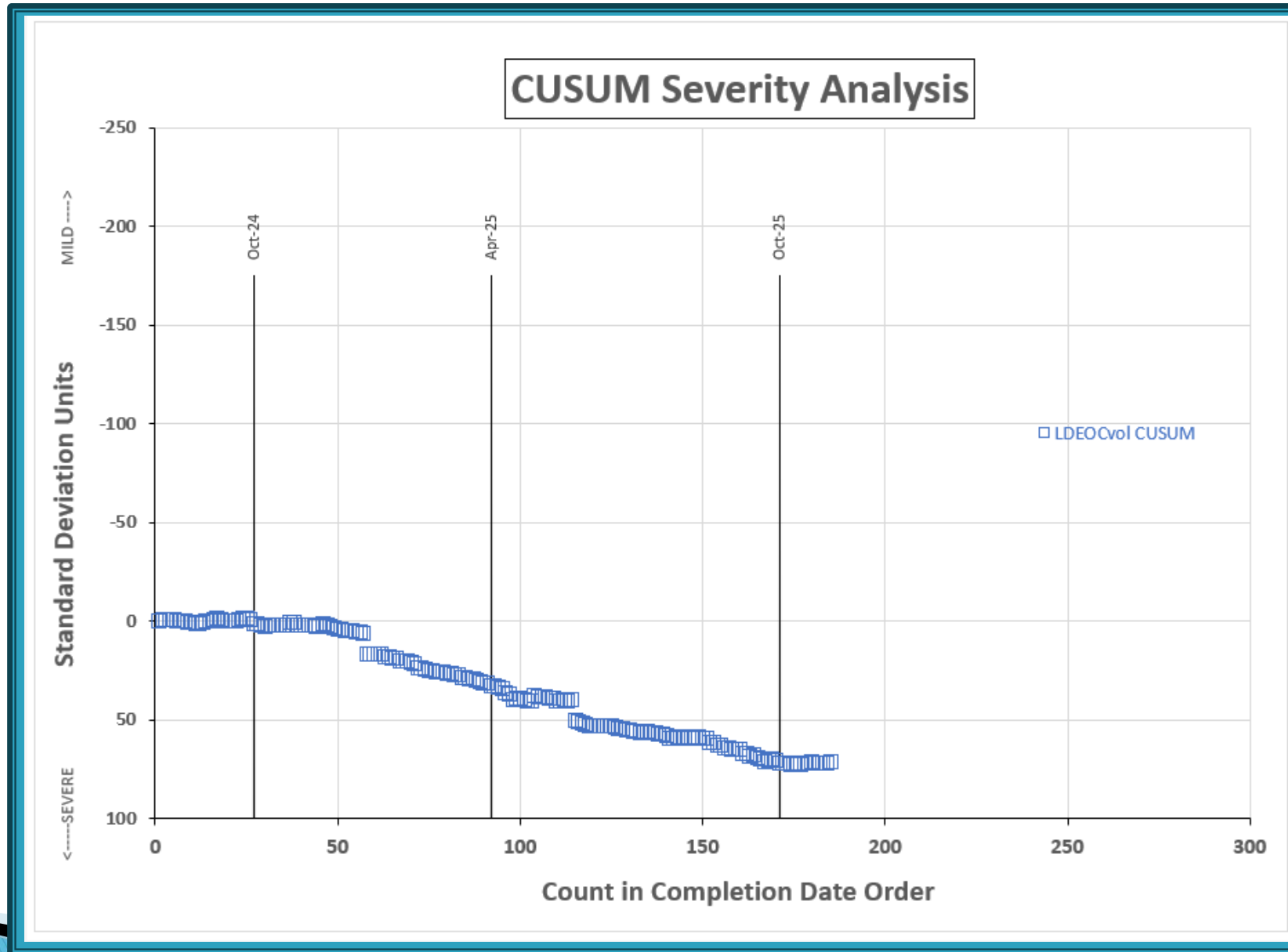
April 1, 2025 – September 30, 2025

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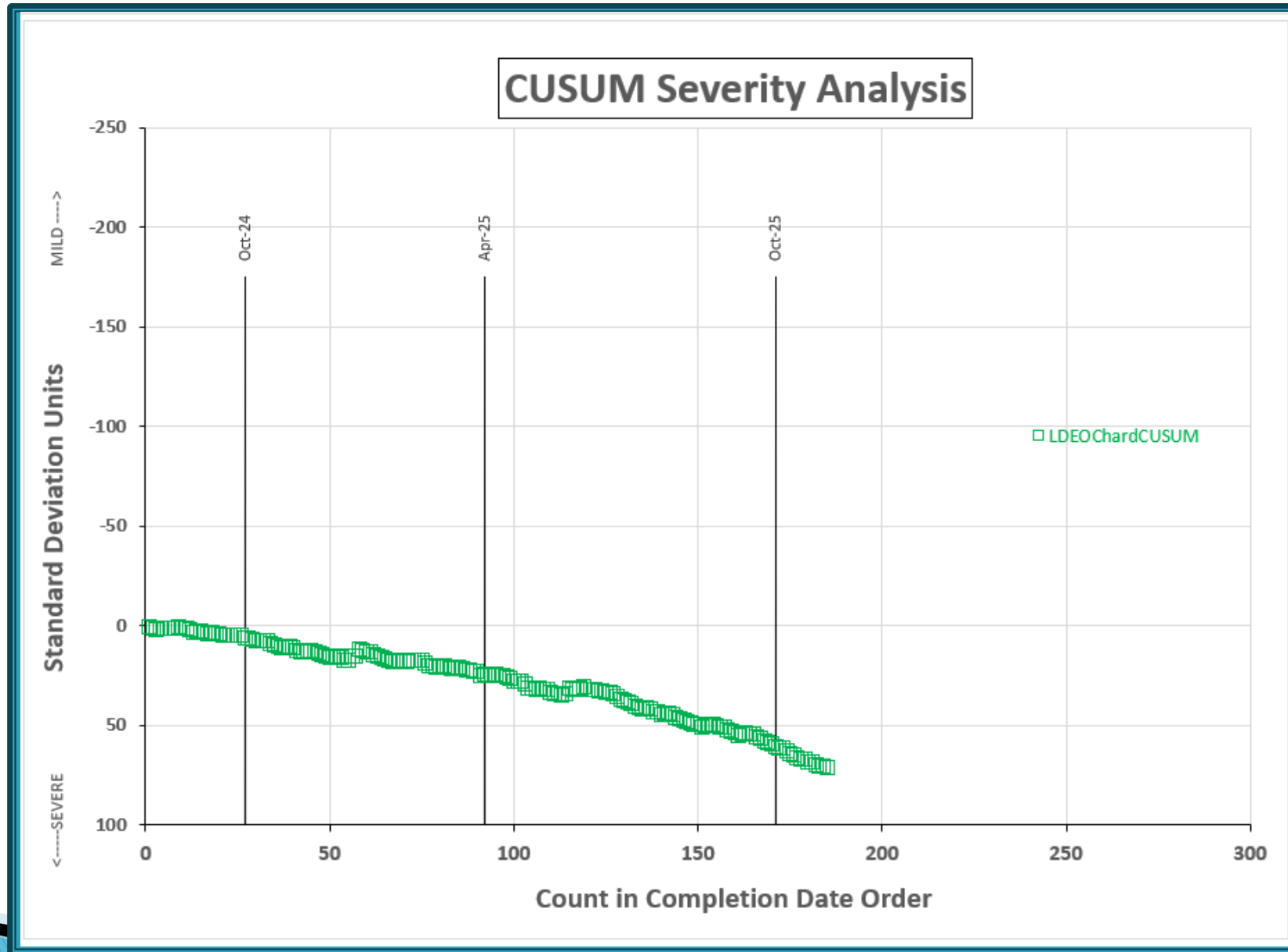
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE-3 VOLUME CHANGE FINAL



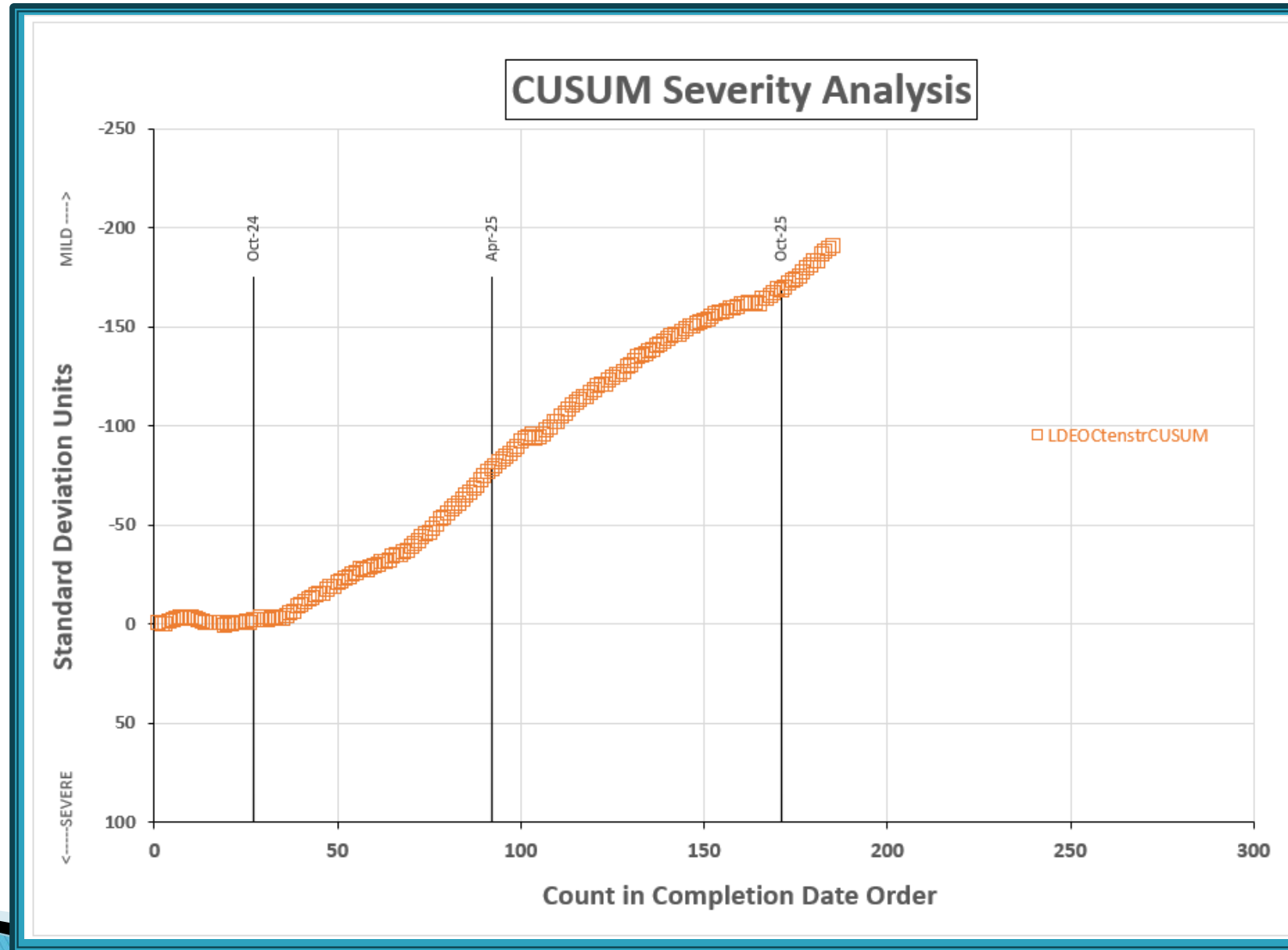
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE-3 HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

ETHYLENE ACRYLATE-3 TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Fluoroelastomer (FKM1)

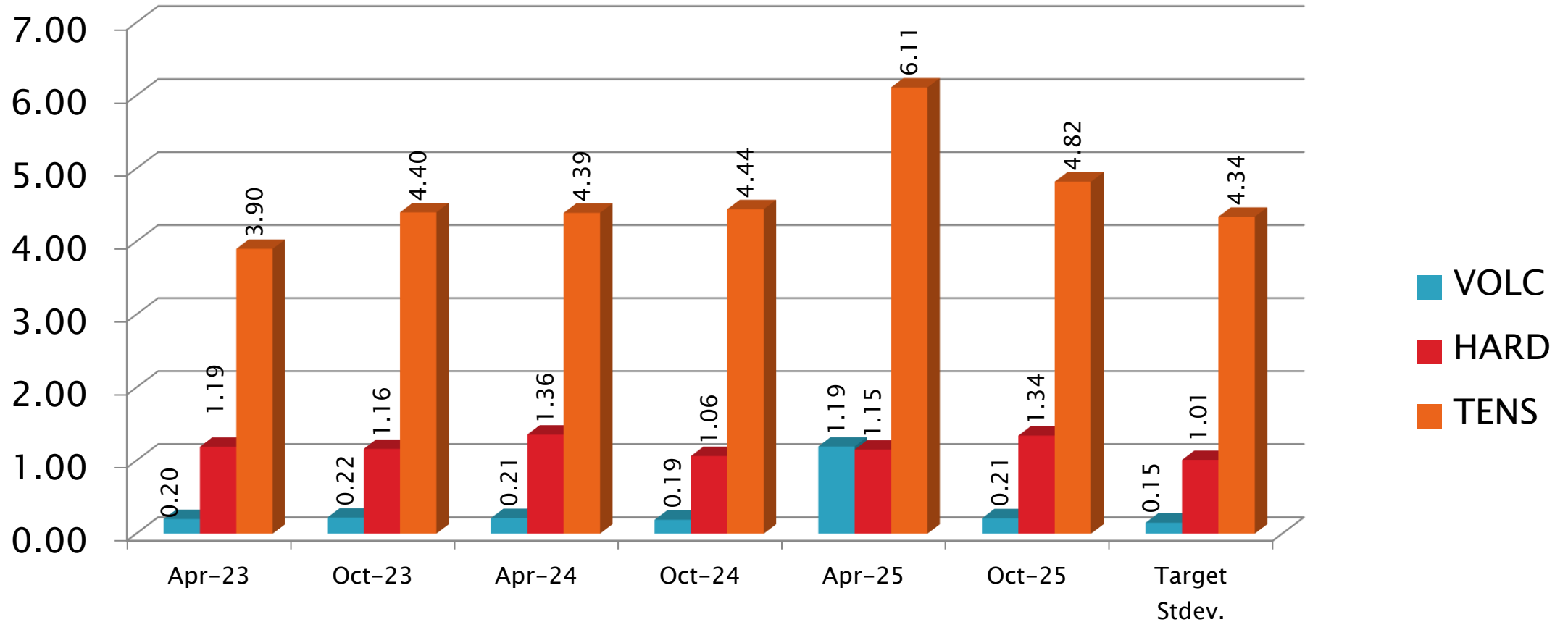
Parameter	Period Mean Δ/s	Status
Volume Change	-0.5990	Very Mild
Points Hardness Change	0.0445	On-Target
Tensile Strength Change	0.2661	Slightly Severe

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Fluoroelastomer



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: FKM1

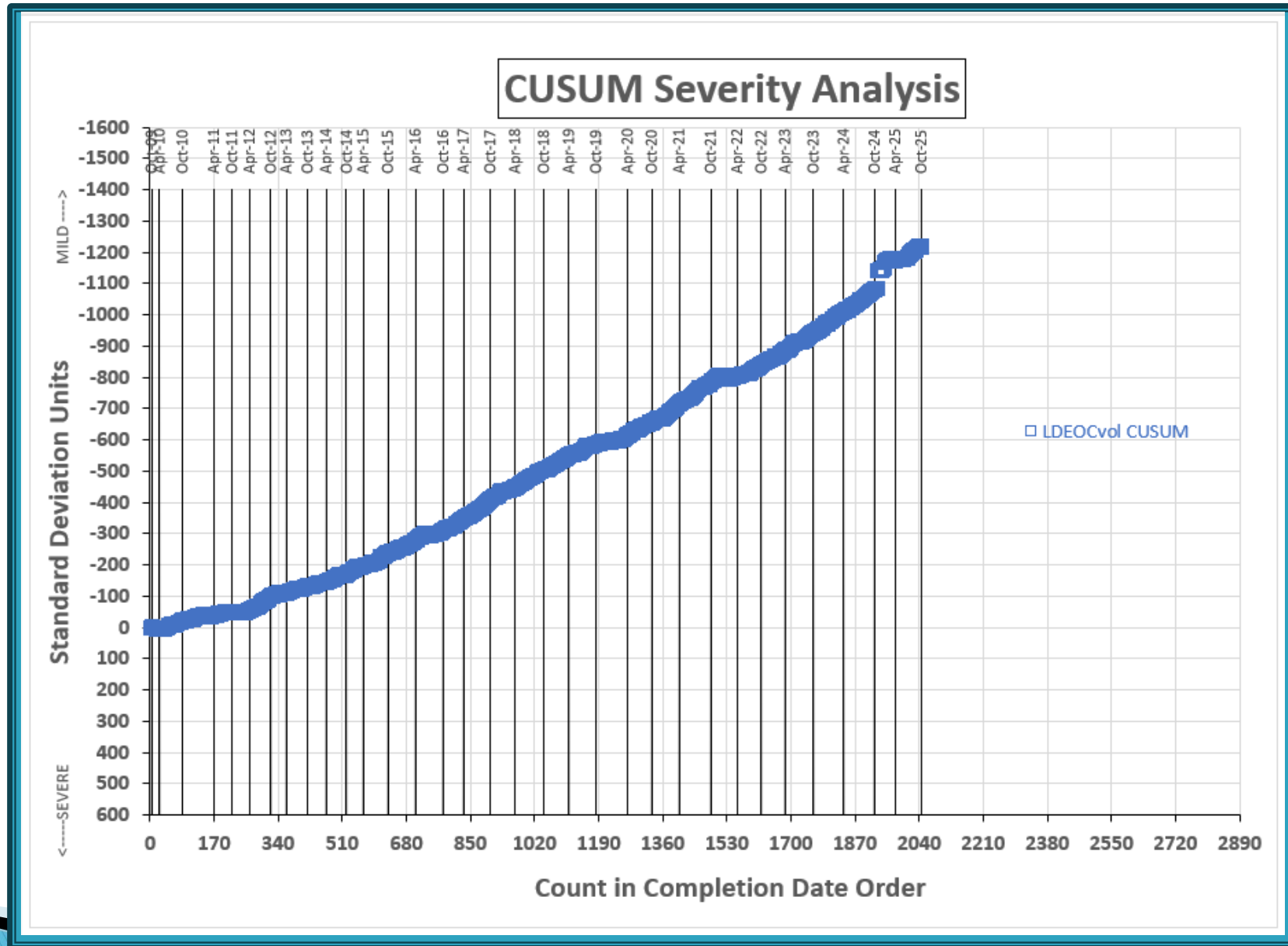
Test Parameter	Statistic	LTMS Lab*							
		A	B	BB	G	I	L	P	V
	n=	18	7	3	22	8	4	3	4
Volume	Mean	0.6217	0.4786	0.4033	0.6309	0.7250	0.4375	0.5000	0.5100
	Pooled s	0.1315	0.0667	0.2219	0.2058	0.3798	0.1295	0.1967	0.1163
	Mean /s	-0.3889	-1.3429	-1.8444	-0.3273	0.3000	-1.1617	-1.2000	-1.1333
Hardness	Mean	4.2222	3.4286	4.6667	3.3182	4.7500	5.2500	4.6667	6.5000
	Pooled s	0.6468	0.9759	1.5275	-0.7741	1.0351	1.8930	0.5774	0.5774
	Mean /s	0.1210	-0.6648	0.5616	1.2741	0.6436	1.1386	0.5611	2.3762
Tensile Strength	Mean	-56.82	-57.69	-58.33	-54.83	-52.54	-61.60	-51.33	-62.95
	Pooled s	2.9339	1.8881	3.1086	4.8020	5.7149	6.4550	0.5132	1.3626
	Mean /s	0.1331	-0.0658	-0.2151	0.5928	1.1204	-0.9677	1.3518	-1.2788

April 1, 2025 – September 30, 2025

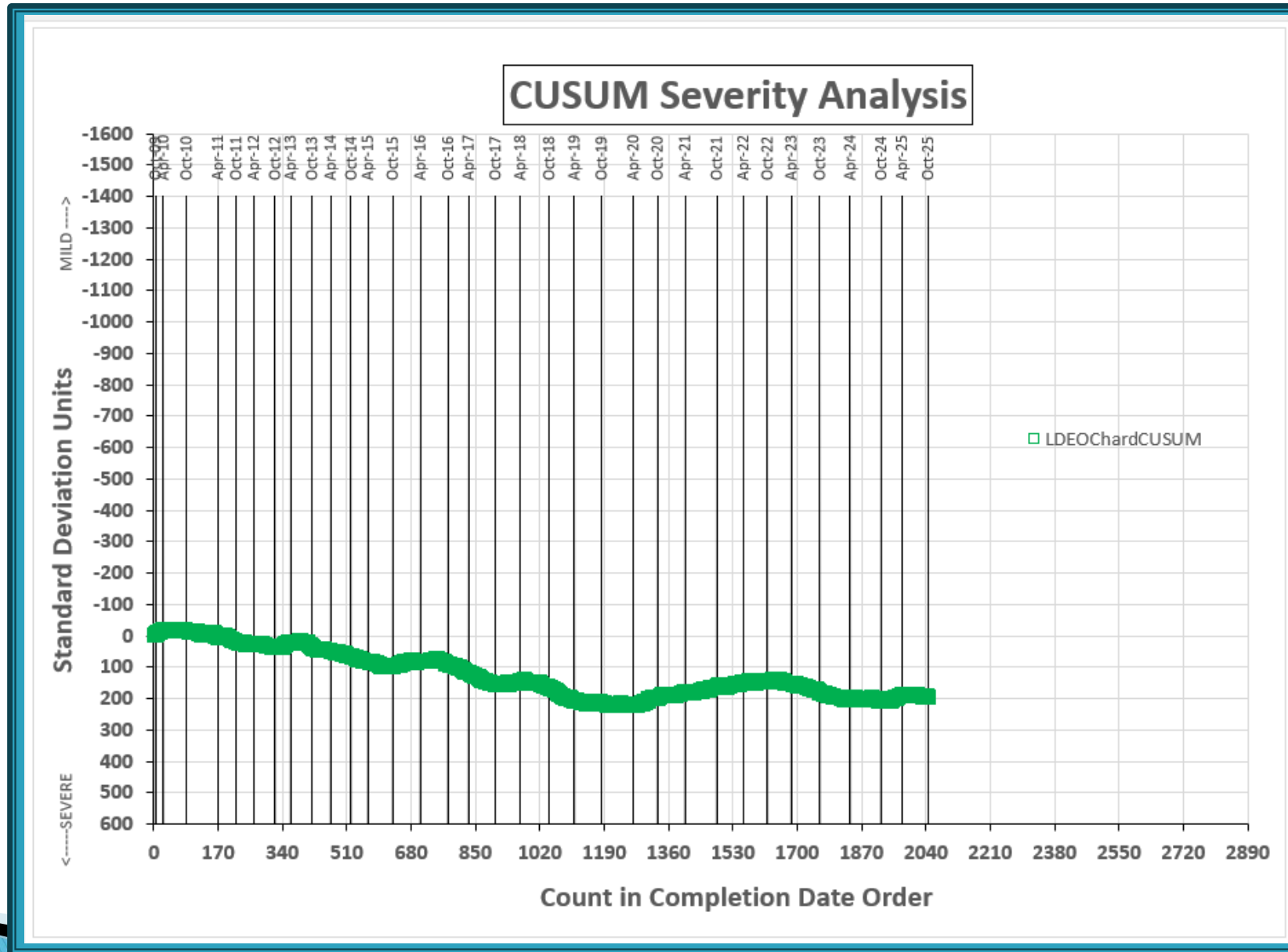
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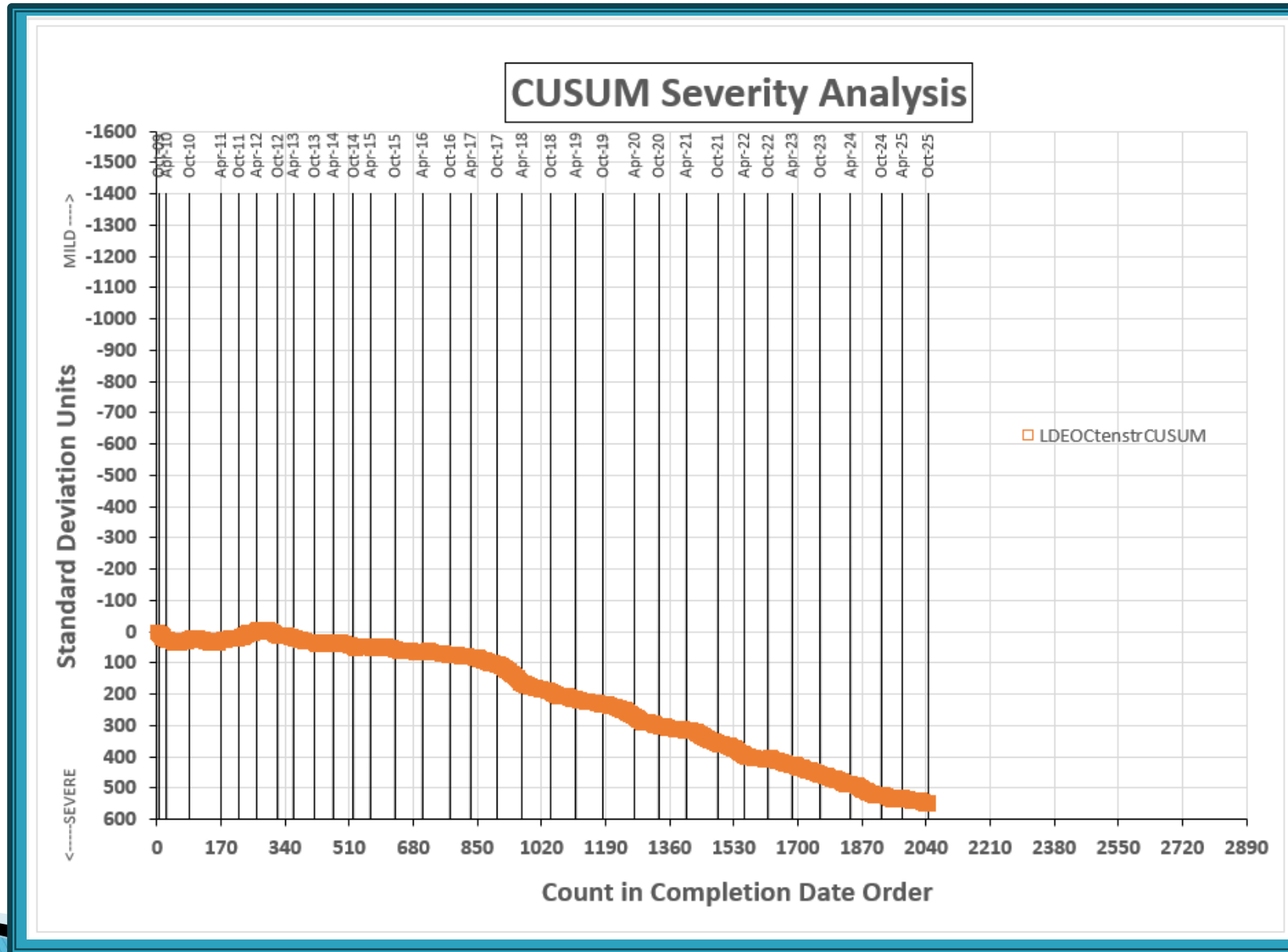
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA FLUOROELASTOMER VOLUME CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA FLUOROELASTOMER HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA FLUOROELASTOMER TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Fluoroelastomer (FKM3)

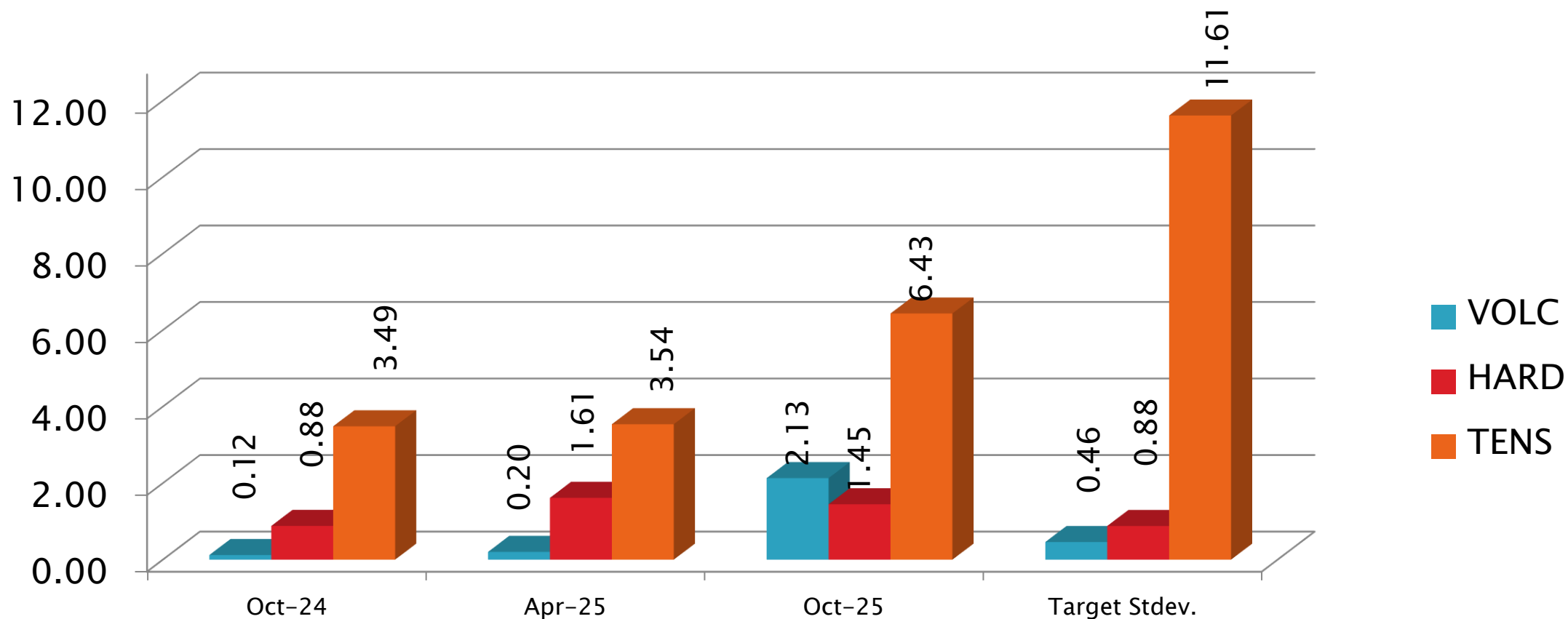
Parameter	Period Mean Δ/s	Status
Volume Change	0.5550	Severe
Points Hardness Change	0.2957	Severe
Tensile Strength Change	-0.5287	Mild

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Fluoroelastomer3



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: FKM3

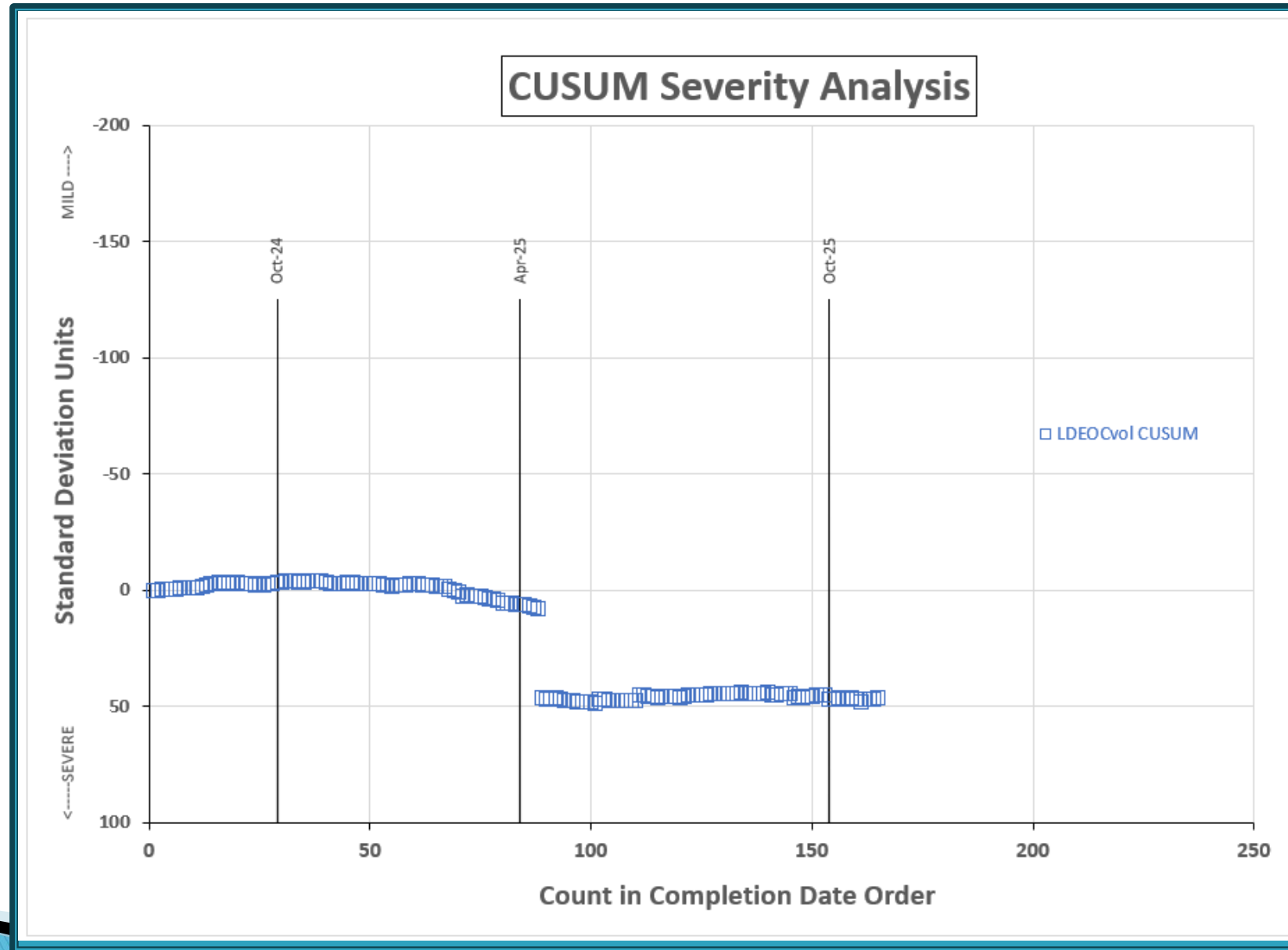
Test Parameter	Statistic	LTMS Lab*							
		A	B	BB	G	I	L	P	V
	n=	28	7	1	20	4	2	0	8
Volume	Mean	0.7886	0.7329	1.4500	1.5780	0.7275	0.6650		0.7038
	Pooled s	0.1485	0.1414		3.9924	0.1578	0.0071		0.1302
	Mean /s	0.1056	-0.0373	1.5217	1.8000	-0.0489	-0.1848		-0.1005
Hardness	Mean	4.1786	4.5714	5.0000	3.7500	3.5000	4.5000		5.5000
	Pooled s	0.7724	0.7868		2.2682	1.0000	0.7071		0.5345
	Mean /s	0.2029	0.6494	1.1364	-0.2841	-0.5682	0.5682		1.7045
Tensile Strength	Mean	-57.85	-59.66	-67.80	-53.48	-52.45	-60.80		-56.38
	Pooled s	3.0255	1.8100		9.6028	5.4885	1.9800		5.4484
	Mean /s	-0.6422	-0.7982	-1.4996	-0.2657	-0.1774	-0.8966		-0.5155

April 1, 2025 – September 30, 2025

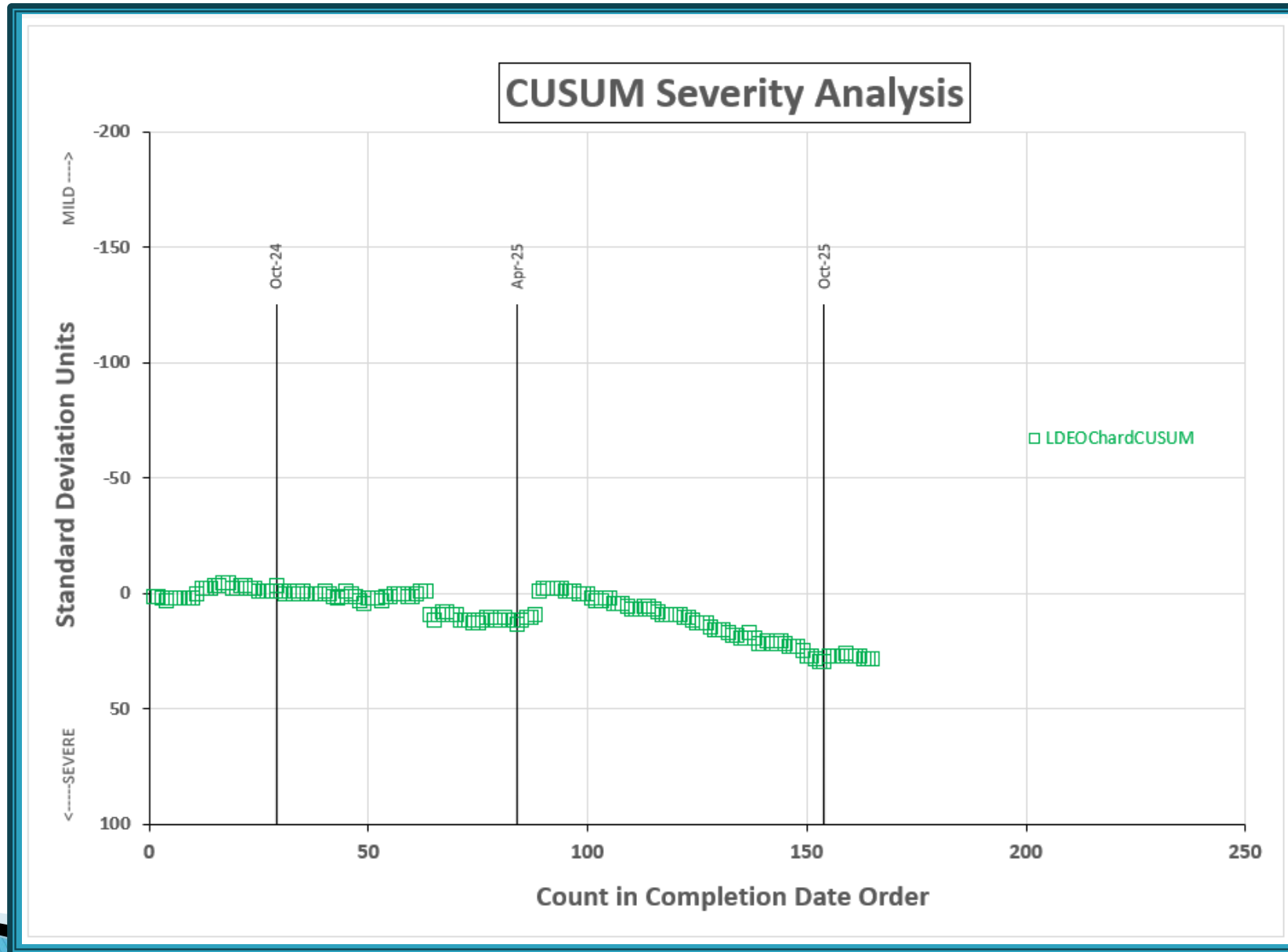
Test Monitoring Center
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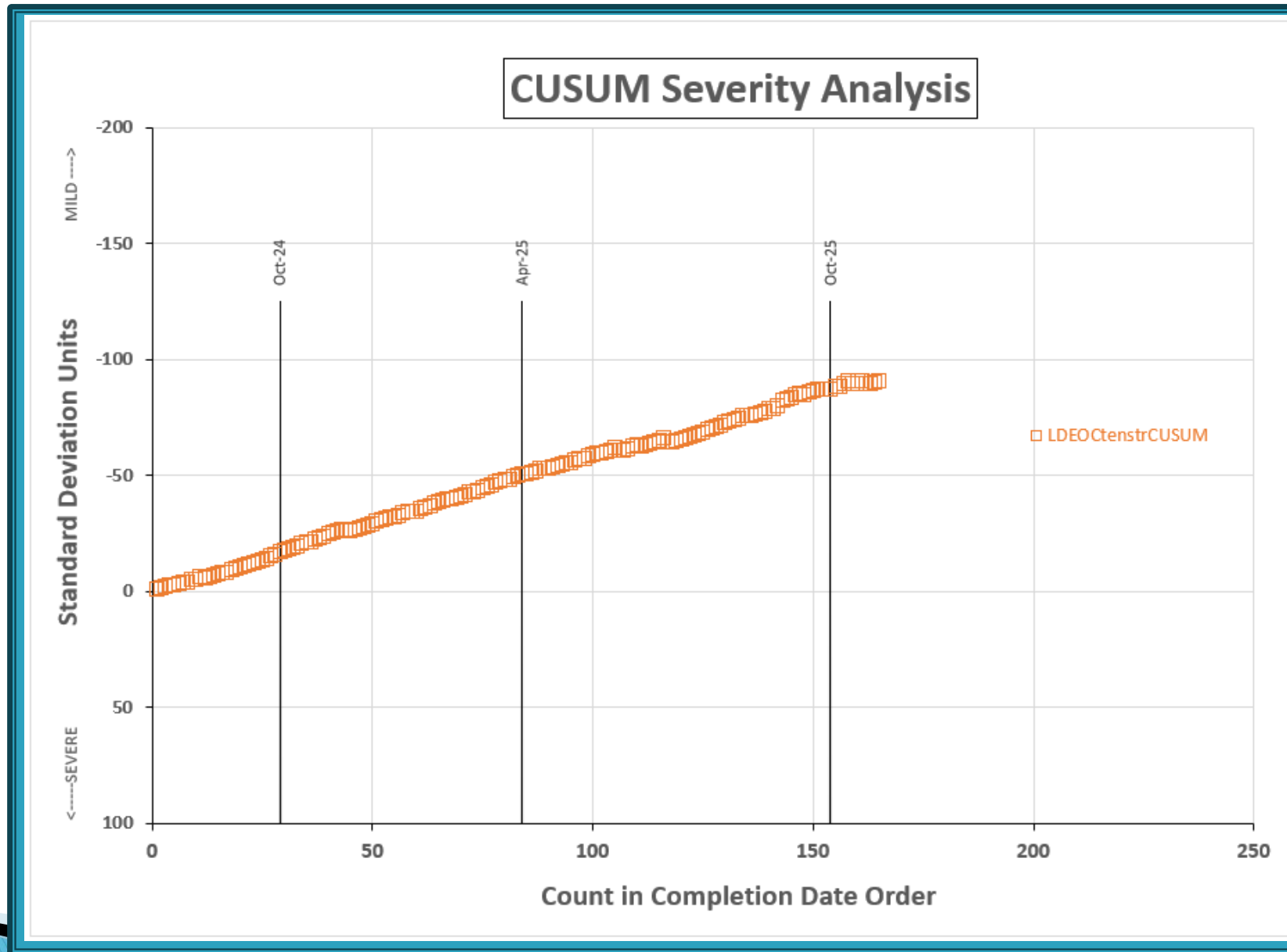
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA FLUOROELASTOMER-3 VOLUME CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA FLUOROELASTOMER-3 HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA FLUOROELASTOMER-3 TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Nitrile (NBR1)

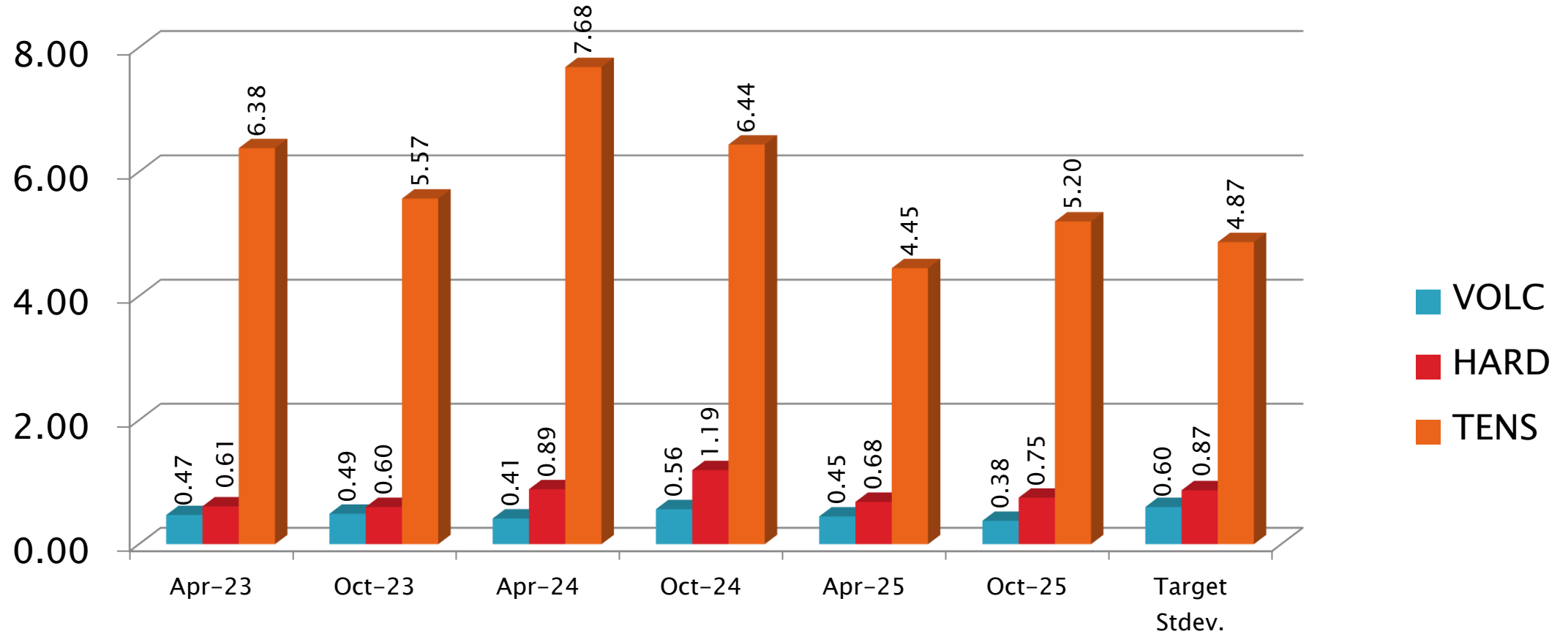
Parameter	Period Mean Δ/s	Status
Volume Change	1.6722	Very Severe
Points Hardness Change	-0.6760	Mild
Tensile Strength Change	-0.8551	Mild

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Nitrile



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: NBR1

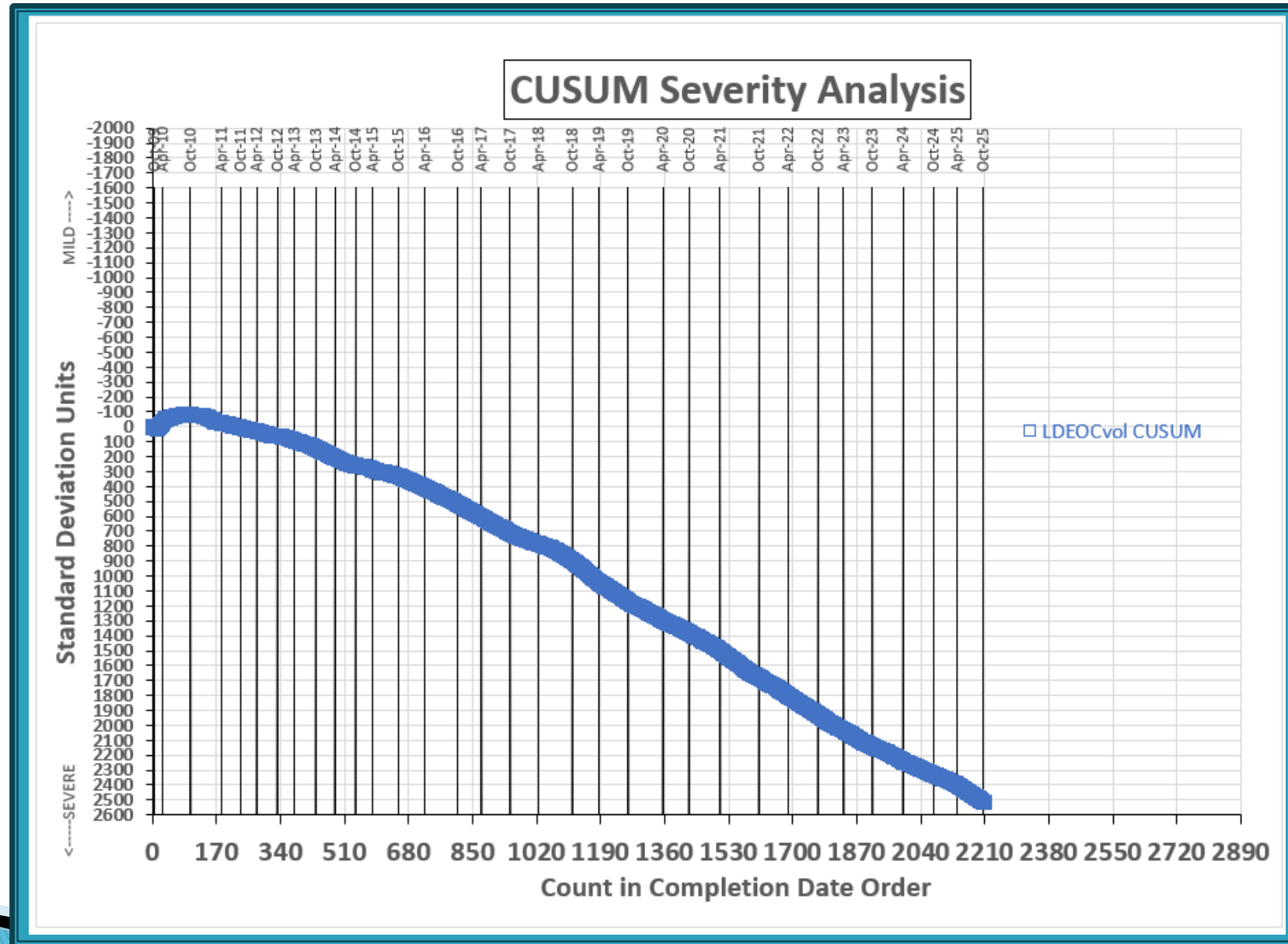
Test Parameter	Statistic	LTMS Lab								
		A	B	BB	G	I	K	L	P	V
	n=	19	7	2	20	8	1	3	3	6
Volume	Mean	1.4332	1.4157	0.7250	1.4320	1.0050	1.4300	1.0900	1.1267	1.3267
	Pooled s	0.3326	0.1493	0.4738	0.2985	0.5850		0.1664	0.2483	0.3711
	Mean /s	1.5883	1.8262	0.6750	1.8533	1.1417	1.8500	1.2833	1.3444	1.6778
Hardness	Mean	-1.7895	-0.5714	-2.0000	-2.1000	-2.0000	-1.0000	-2.0000	-1.6667	-1.6667
	Pooled s	0.7133	0.9759	0.0000	0.4472	0.5345		0.0000	1.1547	0.5164
	Mean /s	-0.7005	0.6995	-0.9425	-1.0575	-0.9425	0.2069	-0.9425	-0.5594	-0.5594
Tensile Strength	Mean	1.1789	3.4429	-5.3000	3.1300	1.6500	-0.1000	3.1333	2.4667	-0.6333
	Pooled s	3.8521	2.8195	5.2326	7.8779	2.5829		2.1502	1.0017	3.2259
	Mean /s	-0.9838	-0.5189	-2.3142	-0.5832	-0.8871	-1.2464	-0.5825	-0.7194	-1.3559

April 1, 2025 – September 30, 2025

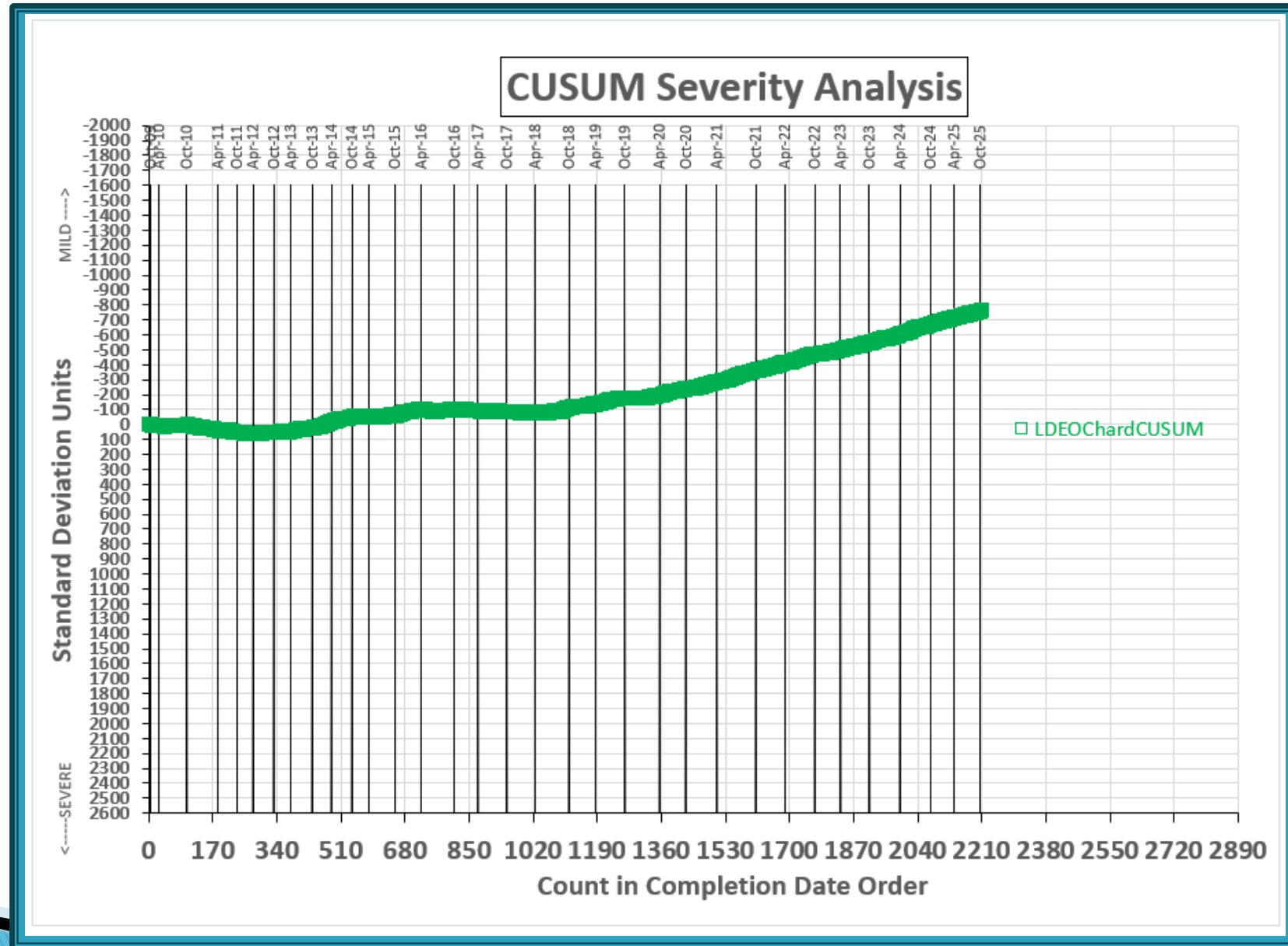
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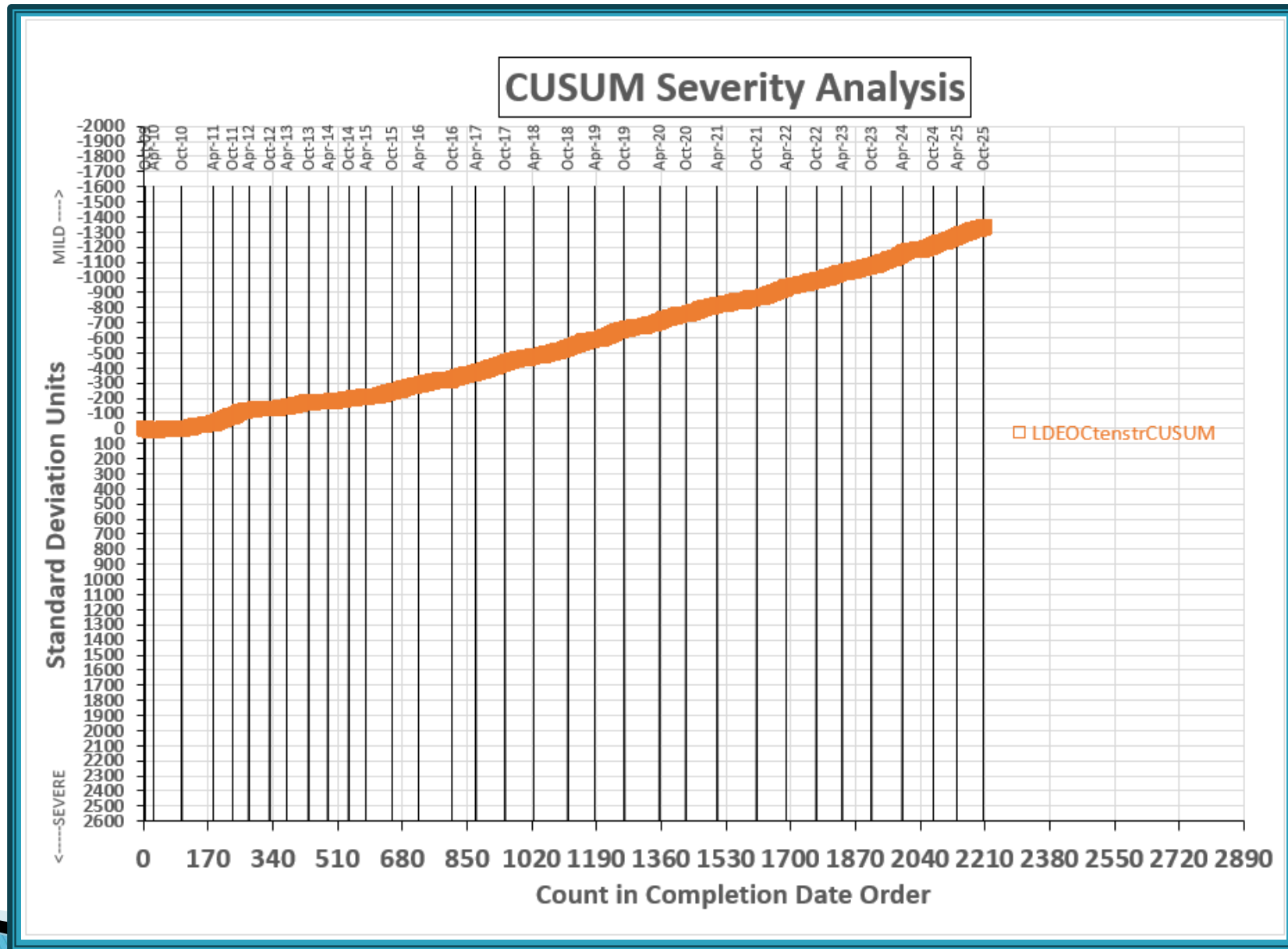
REFERENCE NITRILE VOLUME CHANGE FINAL



REF NITRILE POINTS HARDNESS CHANGE AVERAGE



REF NITRILE TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Polyacrylate (ACM1)

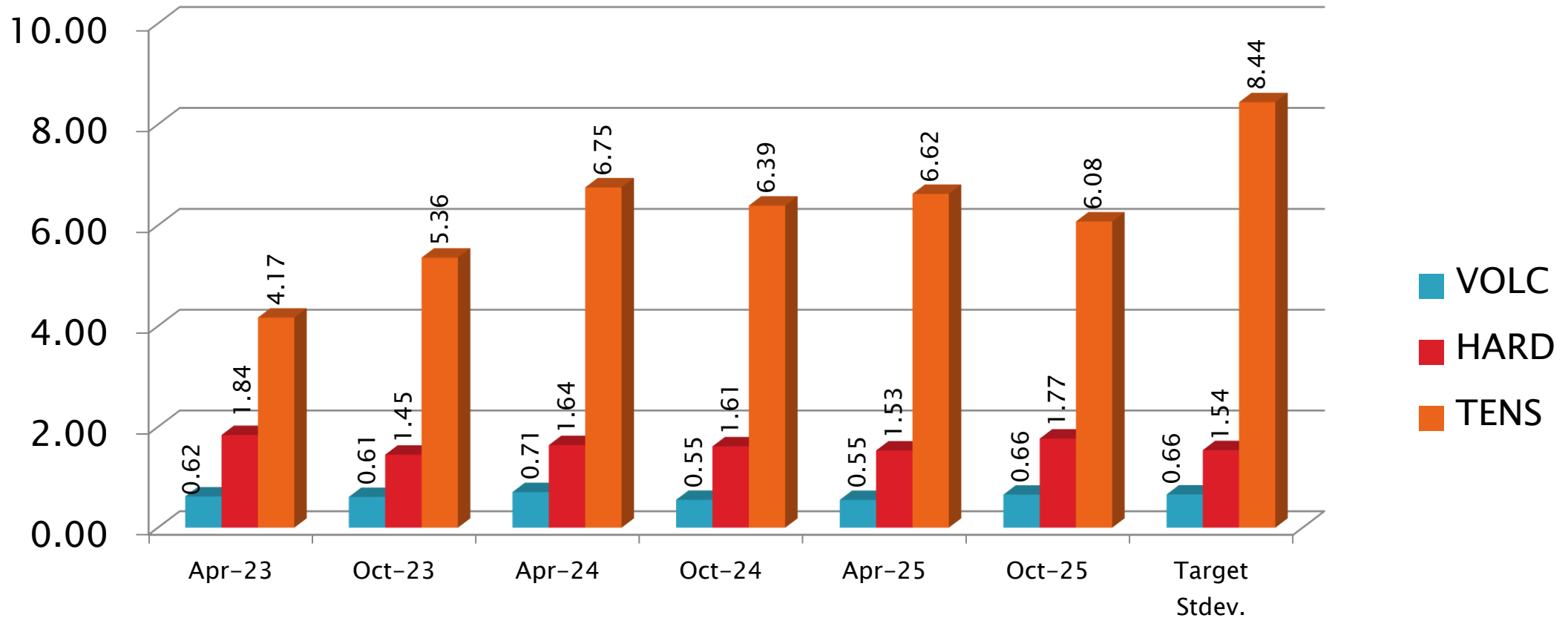
Parameter	Period Mean Δ/s	Status
Volume Change	-0.3213	Mild
Points Hardness Change	-1.1417	Very Mild
Tensile Strength Change	-0.5884	Mild

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Polyacrylate



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: ACM1

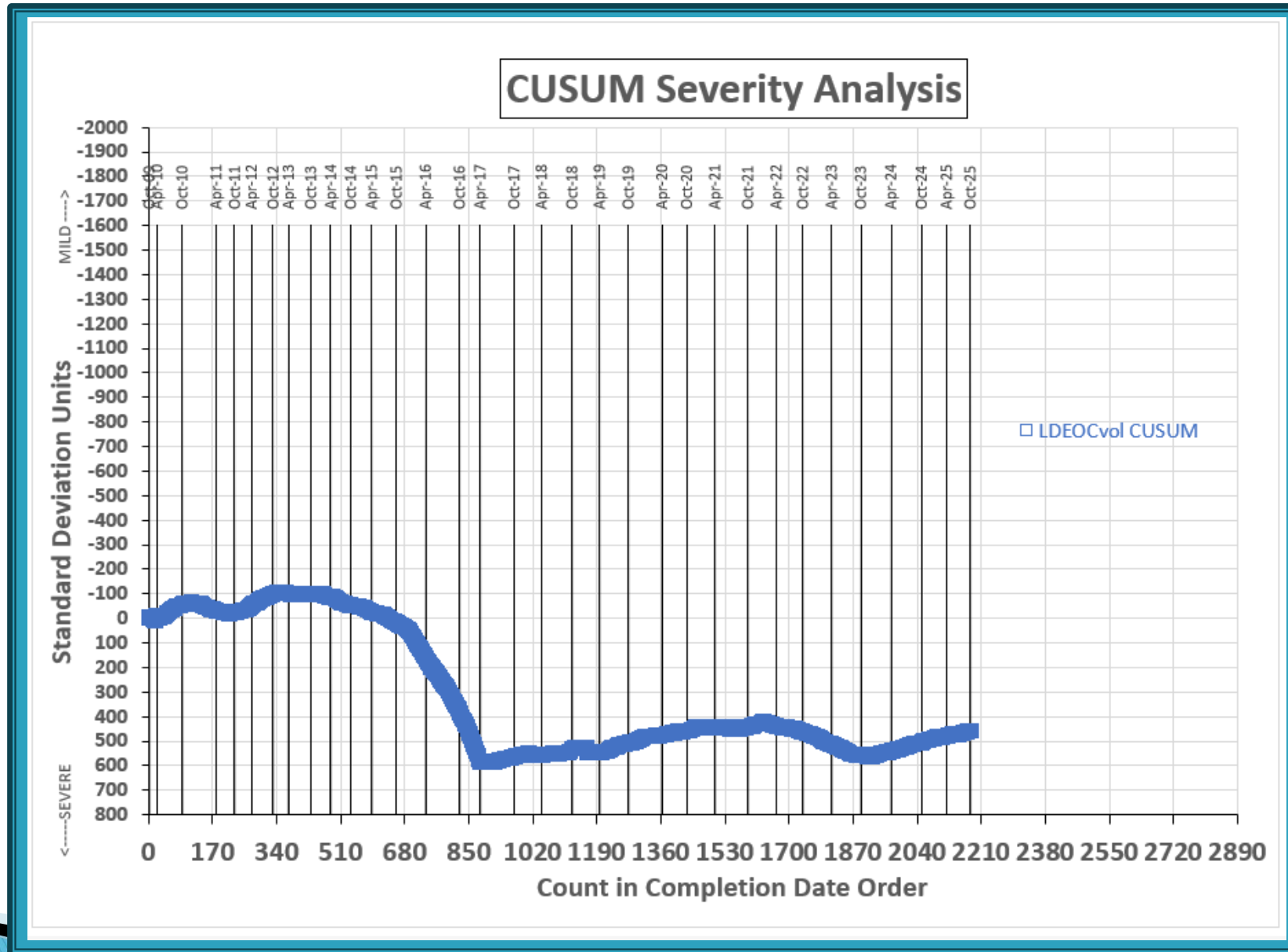
Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	L	P	V
	n=	16	7	2	21	8	3	3	3
Volume	Mean	1.7300	1.6857	0.5850	1.9776	2.0950	2.0333	2.0167	1.5667
	Pooled s	0.6325	0.3460	0.3323	0.7382	0.7199	0.3436	0.2517	0.2255
	Mean /s	-0.4848	-0.5519	-2.2197	-0.1097	0.0682	-0.0253	-0.0505	-0.7323
Hardness	Mean	-3.0000	-1.5714	-3.5000	-1.5714	-1.5000	-0.6667	0.3333	-4.0000
	Pooled s	0.7303	0.9759	0.7071	2.2928	1.0690	1.5275	0.5774	0.0000
	Mean /s	-1.8117	-0.8840	-2.1364	-0.8840	-0.8377	-0.2965	0.3528	-2.4610
Tensile Strength	Mean	1.5688	0.7714	-2.5000	-7.5619	-0.1750	-3.1000	-5.3000	3.2000
	Pooled s	4.7791	3.0550	3.8184	4.8625	6.6663	3.0806	3.4641	1.8682
	Mean /s	-0.1198	-0.2143	-0.6019	-1.2016	-0.3264	-0.6730	-0.9336	0.0735

April 1, 2025 – September 30, 2025

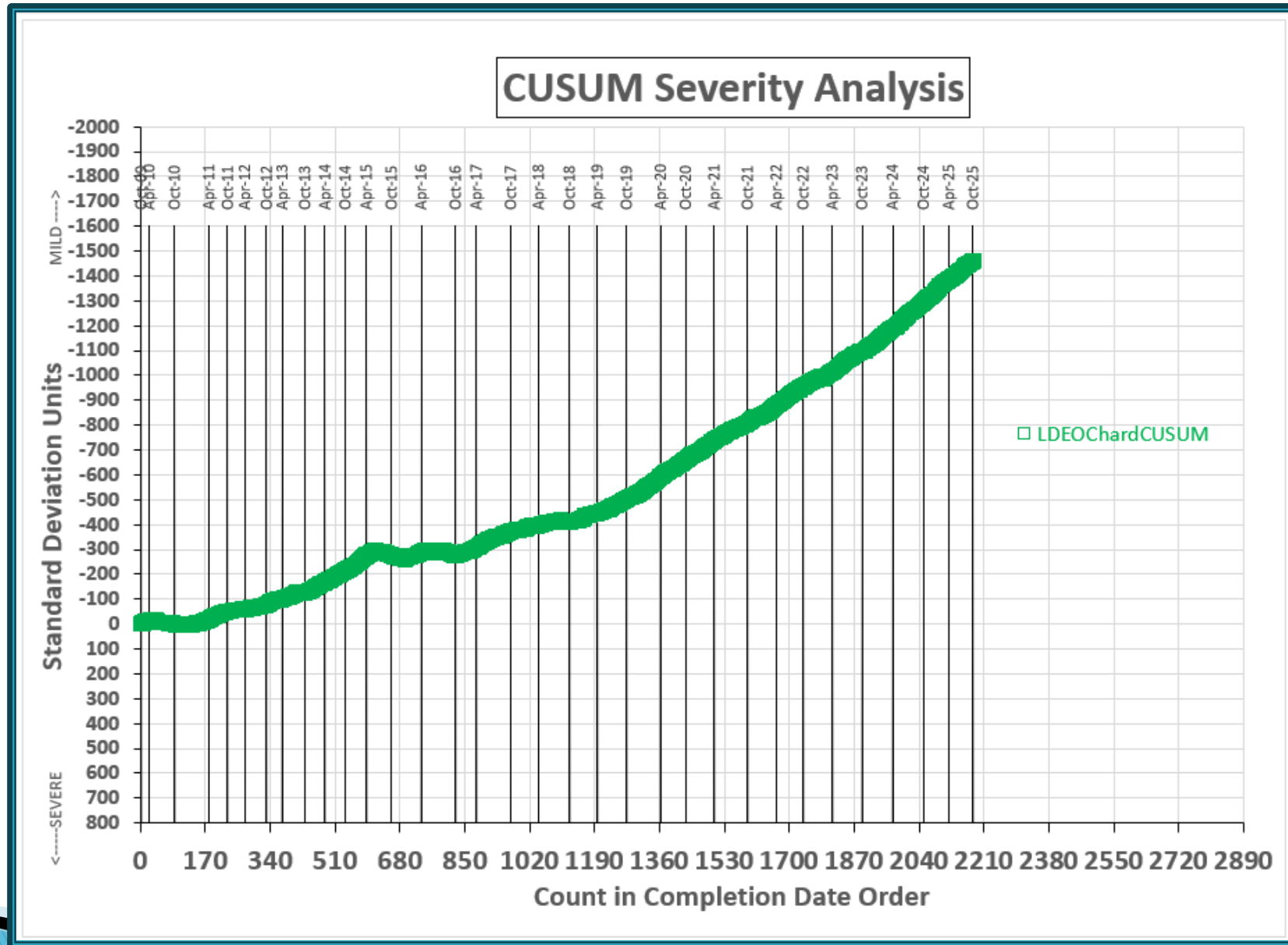
Test Monitoring Center
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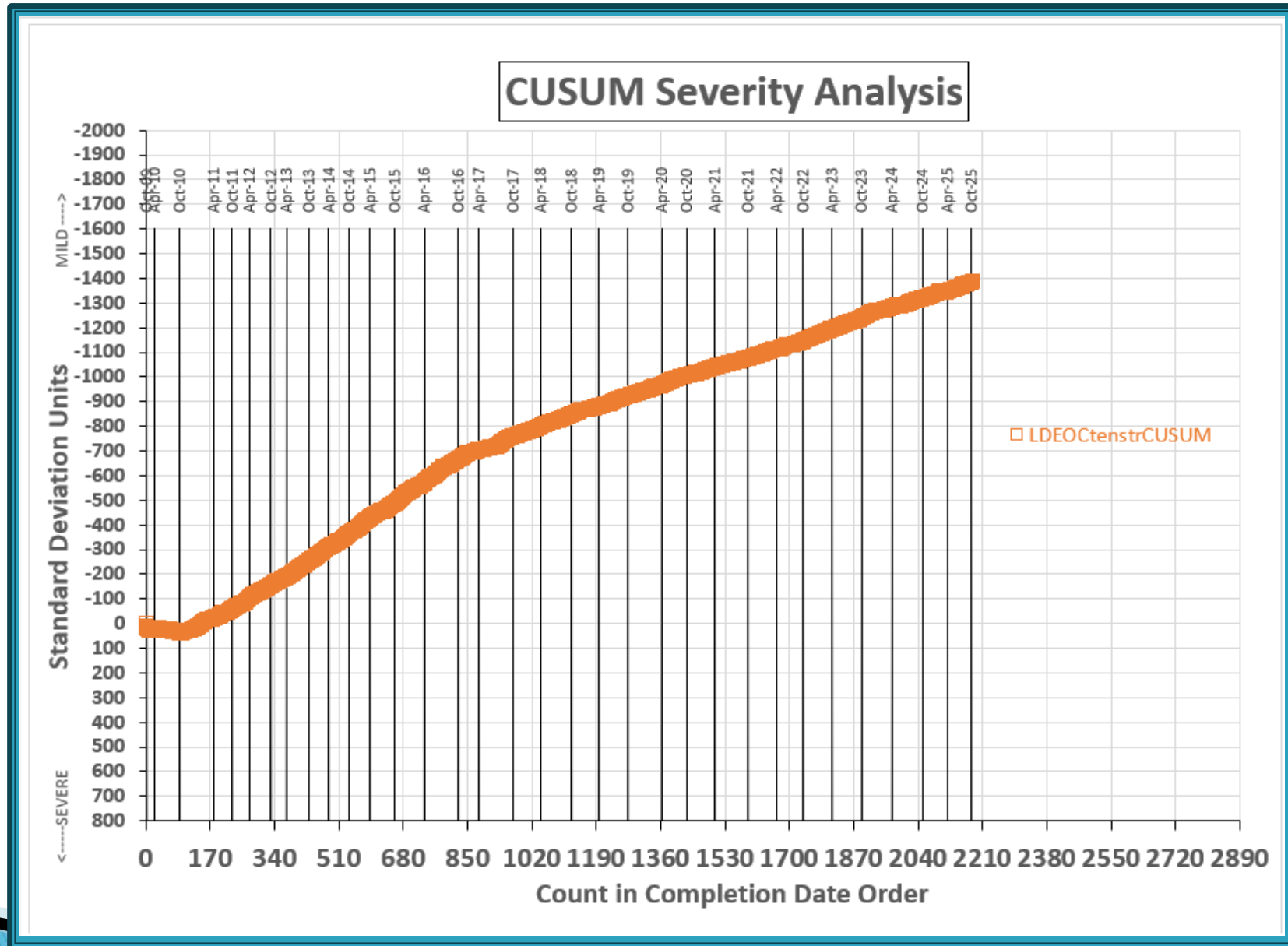
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA POLYACRYLATE VOLUME CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA POLYACRYLATE HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA POLYACRYLATE TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Polyacrylate (ACM2)

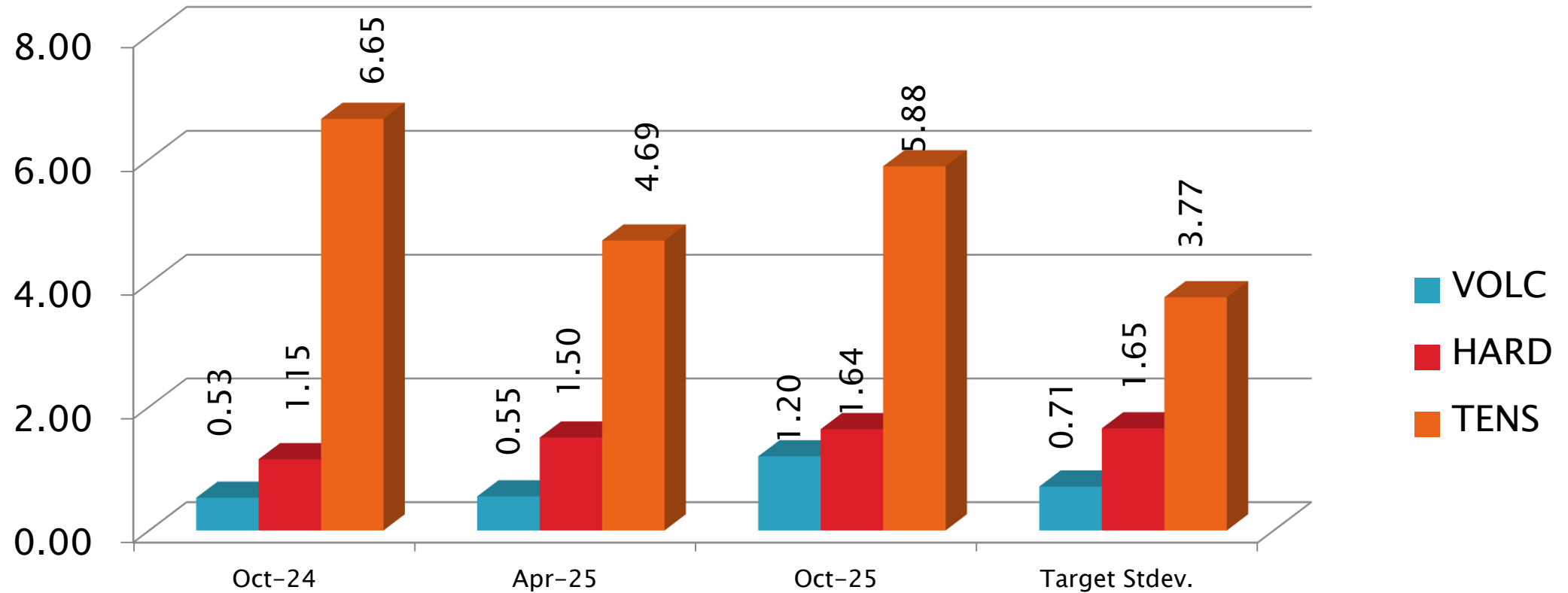
Parameter	Period Mean Δ/s	Status
Volume Change	1.5062	Very Severe
Points Hardness Change	-1.3474	Very Mild
Tensile Strength Change	-0.0972	Mild

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Polyacrylate2



April 1, 2025 – September 30, 2025

Test Monitoring Center
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LDEOC Precision Estimates by Lab: ACM2

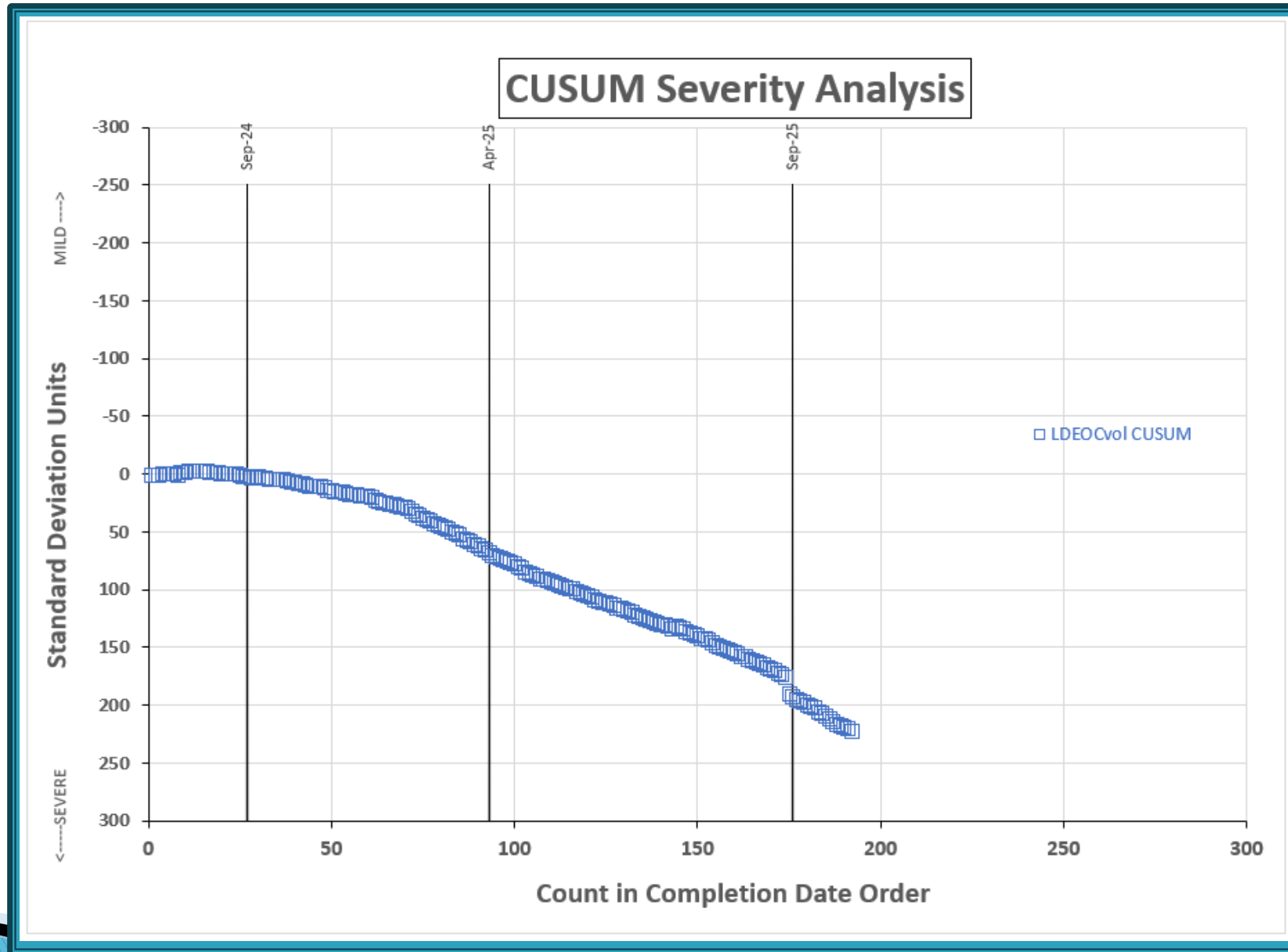
Test Parameter	Statistic	LTMS Lab							
		A	B	BB	G	I	K	L	V
	n=	34	9	1	22	5	1	3	8
Volume	Mean	11.93	11.96	11.27	11.98	13.95	12.42	11.47	11.61
	Pooled s	0.2156	0.2897		0.8149	4.4269		0.0416	0.4222
	Mean /s	1.3780	1.4288	0.4507	1.4545	4.2254	2.0704	0.7277	0.9261
Hardness	Mean	-5.2353	-3.8889	-6.0000	-3.3182	-3.6000	-4.0000	-2.6667	-4.5000
	Pooled s	0.8549	1.4530		1.9120	2.8810		0.5774	0.5345
	Mean /s	-1.9062	-1.0902	-2.3697	-0.7444	-0.9152	-1.1576	-0.3495	-1.4606
Tensile Strength	Mean	-14.26	-16.80	-19.50	-11.49	-20.16	-17.60	-12.80	-16.96
	Pooled s	3.4001	4.8660		7.2824	10.47		2.0000	4.8624
	Mean /s	-0.0413	-0.7162	-1.4324	0.6921	-1.6074	-0.9284	0.3448	-0.7593

April 1, 2025 – September 30, 2025

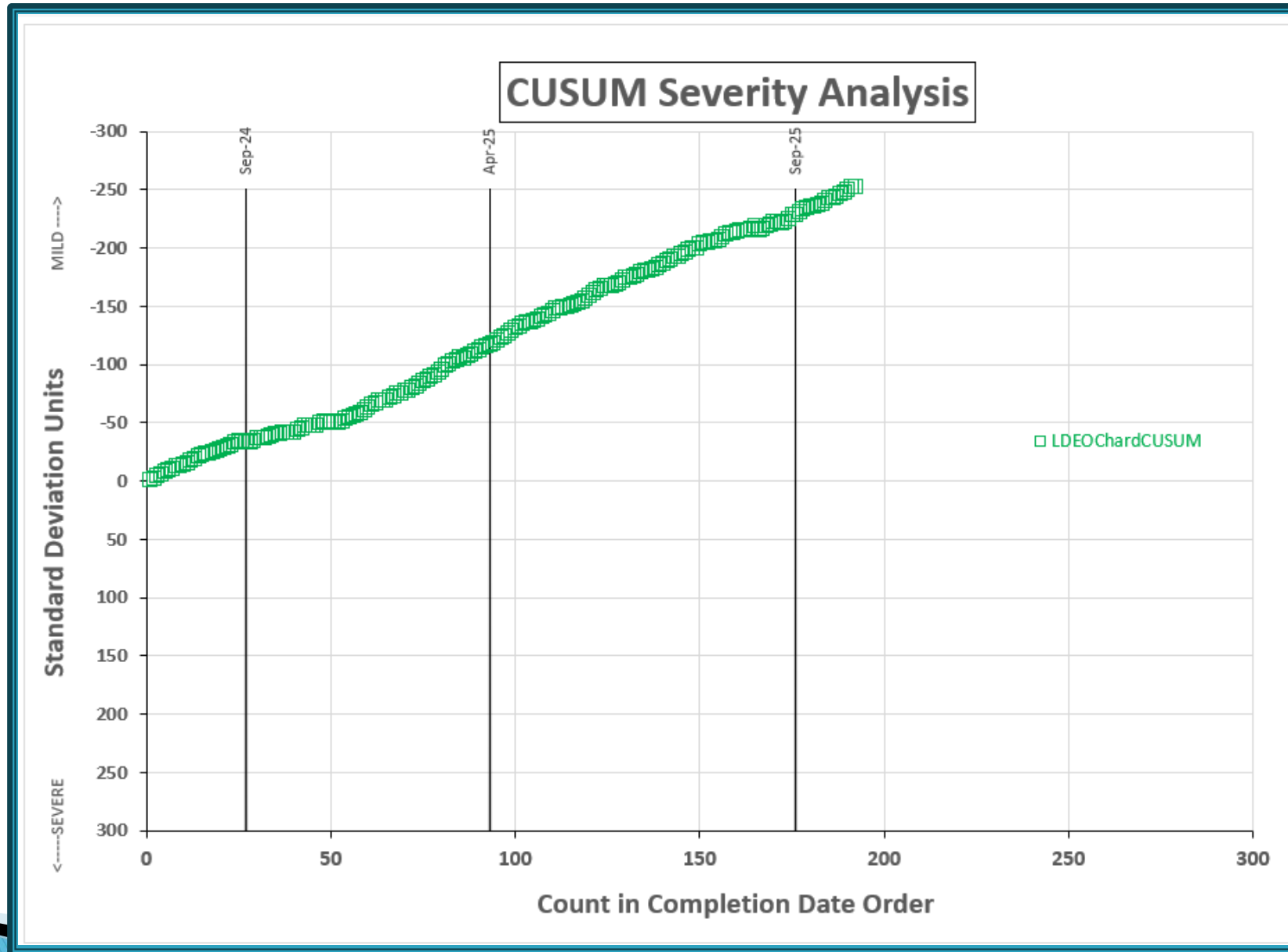
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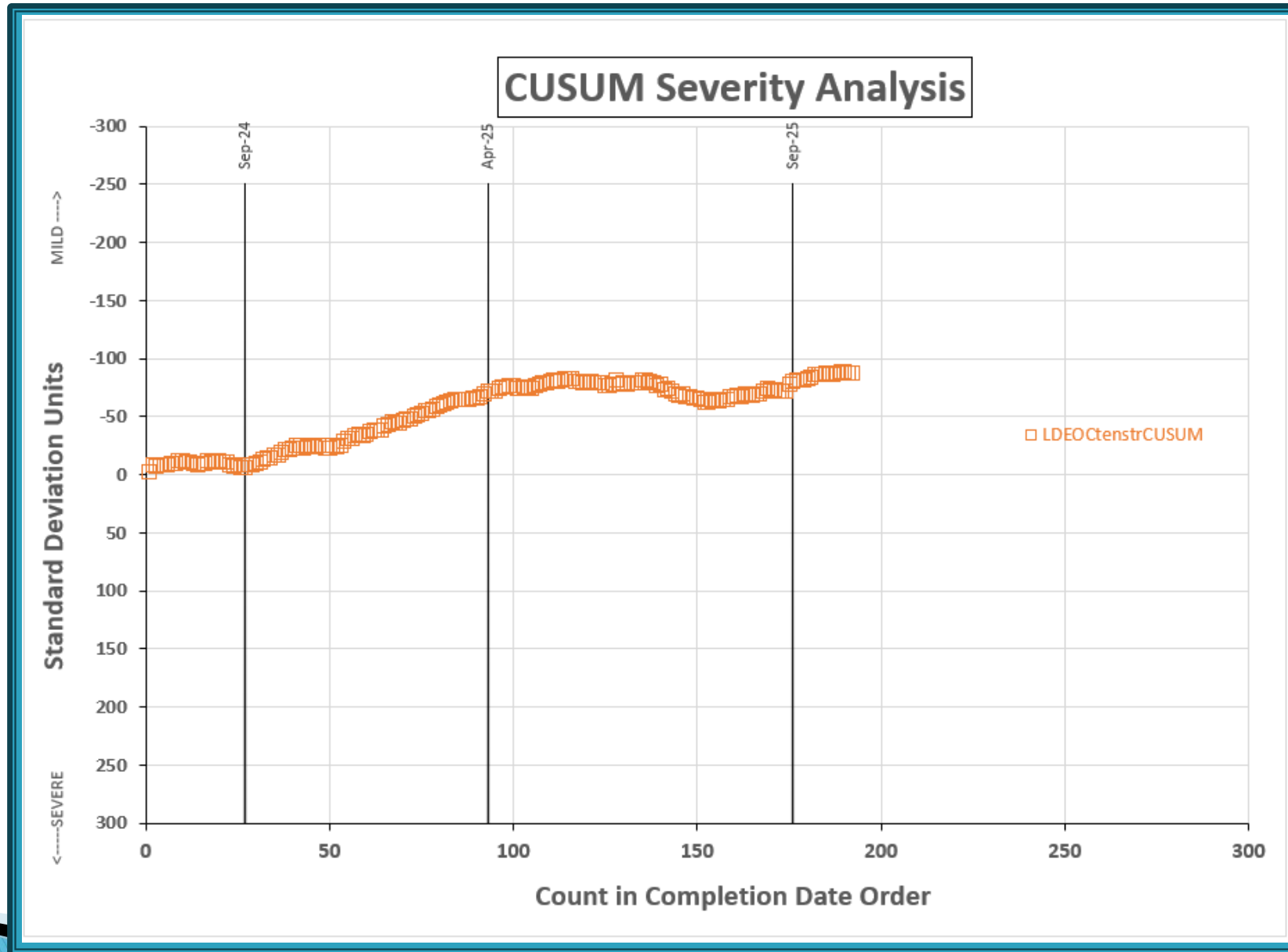
LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA POLYACRULATE-2 VOLUME CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA POLYACRYLATE-2 HARDNESS CHANGE FINAL



LDEOC – ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA POLYACRYLATE-2 TENSILE STRENGTH CHANGE FINAL



LDEOC Test Severity

Silicone (VMQ1)

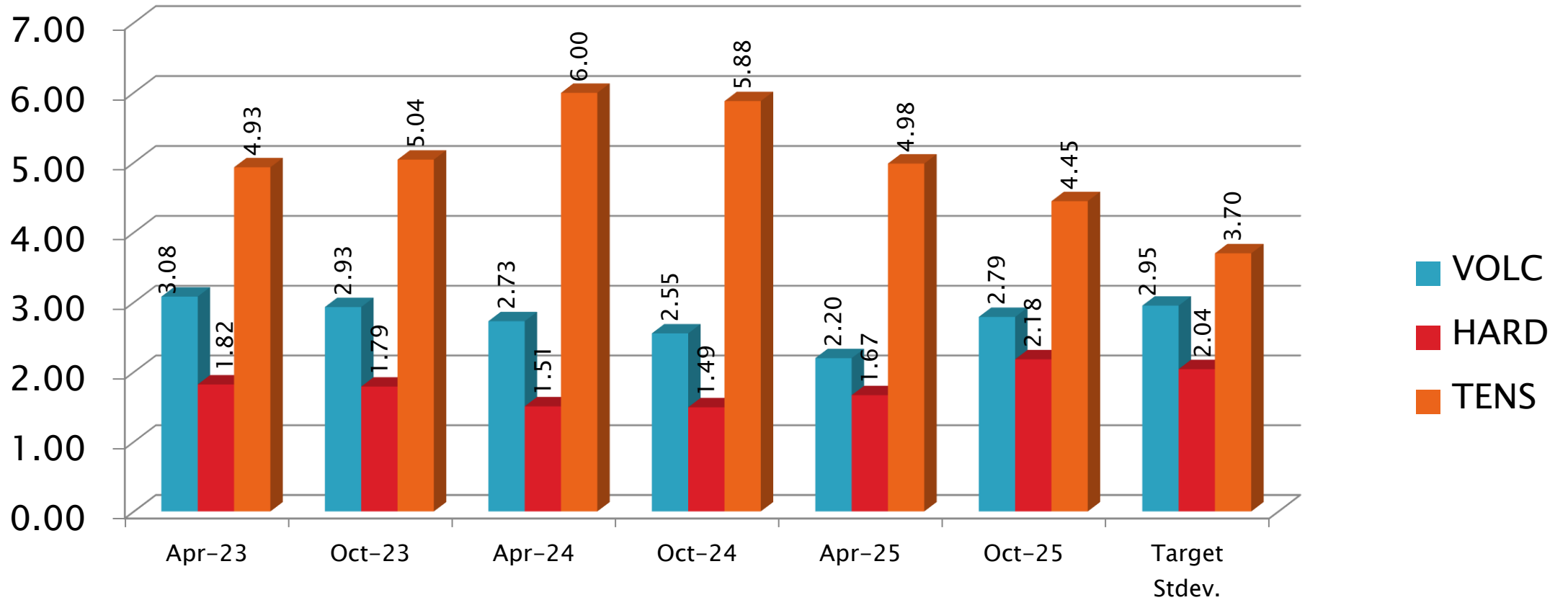
Parameter	Period Mean Δ /s	Status
Volume Change	0.7417	Severe
Points Hardness Change	-0.2407	Mild
Tensile Strength Change	0.0640	On-Target

April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates – Silicone



April 1, 2025 – September 30, 2025

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LDEOC Precision Estimates by Lab: VMQ1

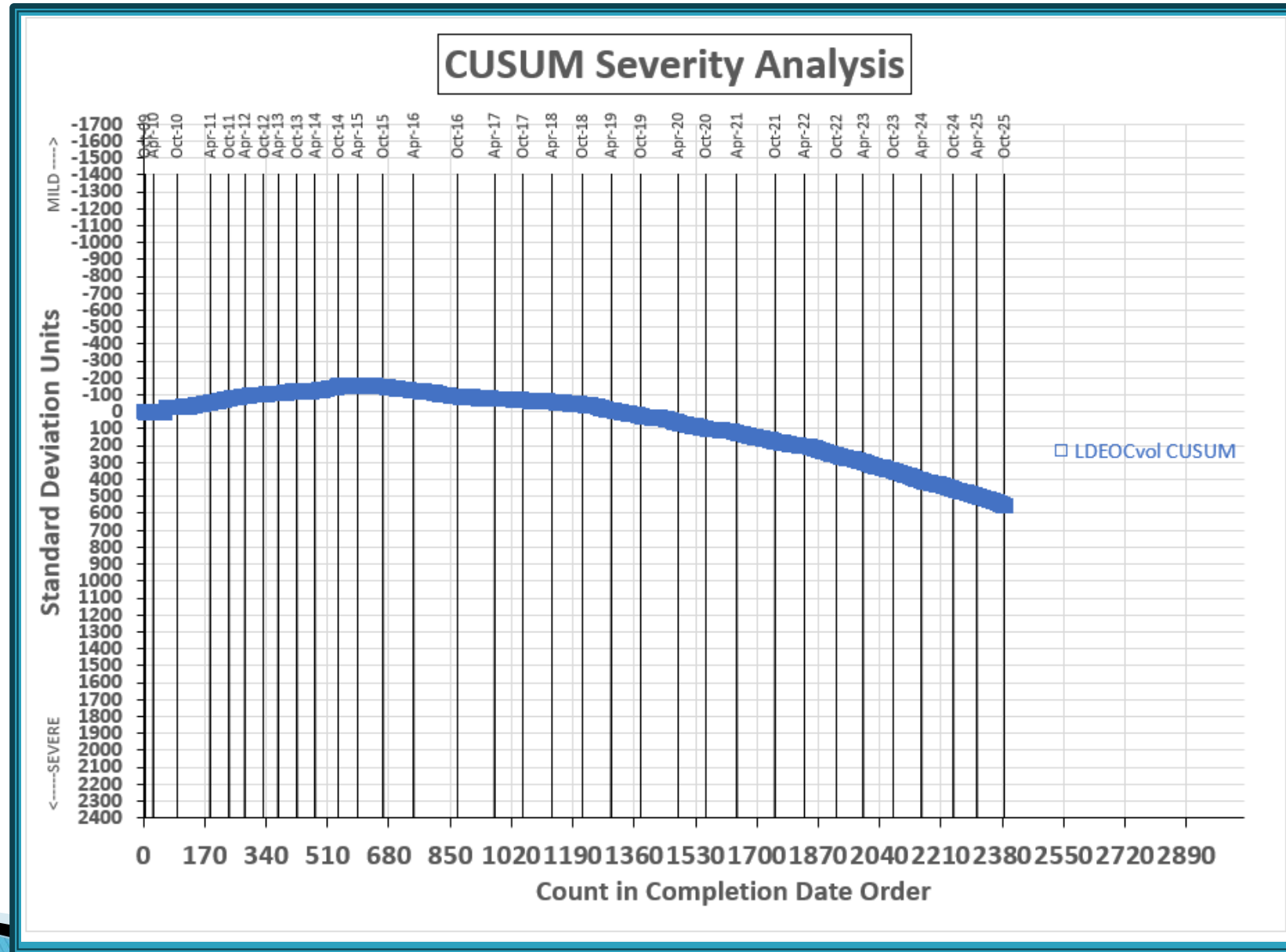
Test Parameter	Statistic	LTMS Lab								
		A	B	BB	G	I	K	L	P	V
	n=	19	8	3	21	11	1	3	3	7
Volume	Mean	34.39	33.94	29.86	37.41	30.54	36.44	32.67	34.67	33.81
	Pooled s	0.6411	0.5408	1.7365	1.7563	1.2742		2.0522	0.7448	2.8236
	Mean /s	0.7534	0.5987	-0.7819	1.7748	-0.5510	1.4475	0.1706	0.8475	0.5574
Hardness	Mean	-24.00	-21.75	-16.67	-22.62	-21.73	-18.00	-18.00	-24.00	-21.00
	Pooled s	0.8819	1.1650	2.3094	1.5322	0.6467		0.0000	0.0000	1.8257
	Mean /s	-1.1372	-0.0343	2.4575	-0.4603	-0.0232	1.8039	1.8039	-1.1373	0.3333
Tensile Strength	Mean	-33.85	-30.68	-35.47	-35.10	-32.11	-45.40	-29.07	-36.37	-31.43
	Pooled s	2.7508	3.4112	4.9602	5.1685	3.8679		1.9858	0.6028	4.3786
	Mean /s	-0.0277	0.8311	-0.4640	-0.3649	0.4435	-3.1486	1.2658	-0.7072	0.6274

April 1, 2025 – September 30, 2025

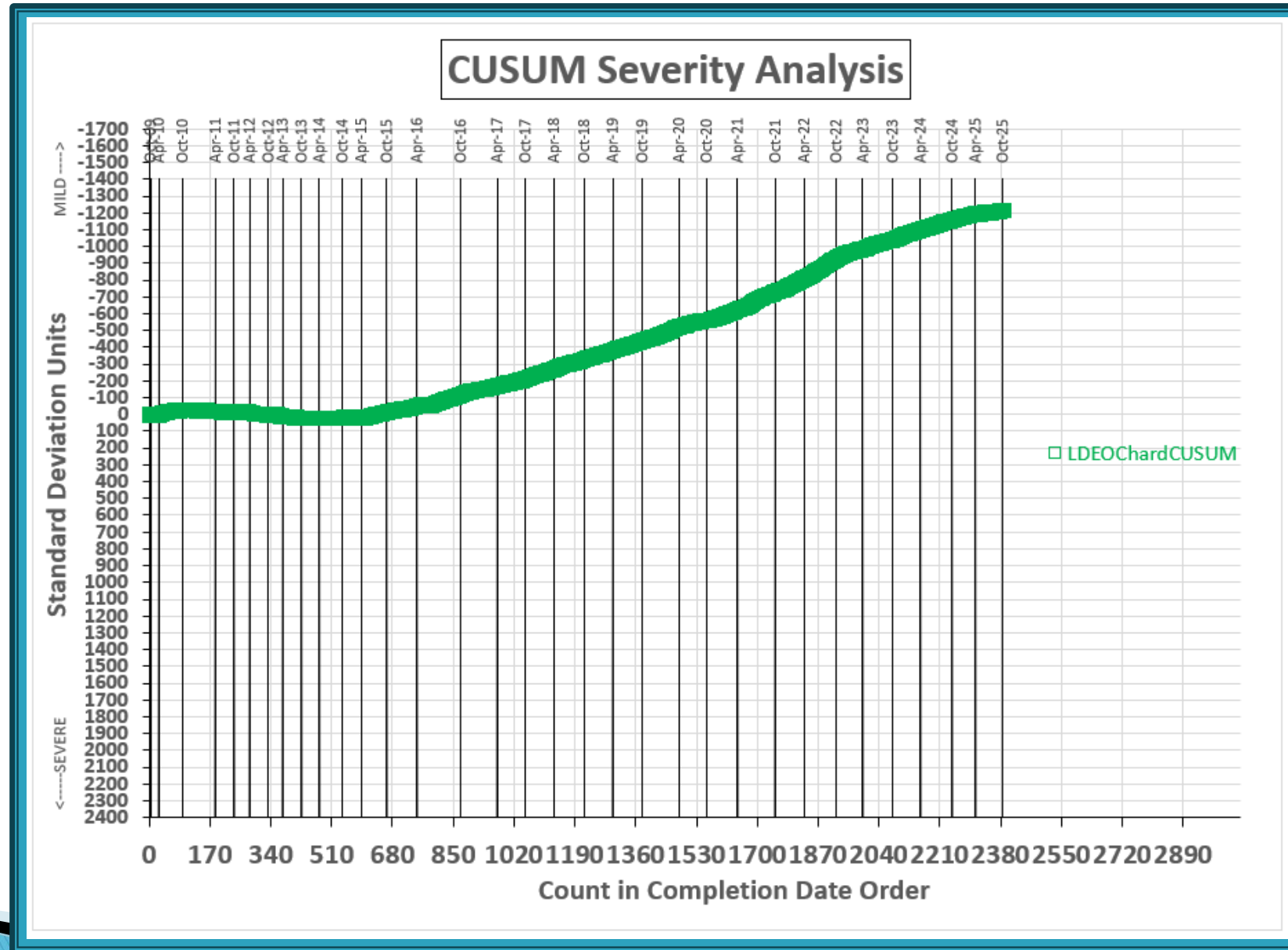
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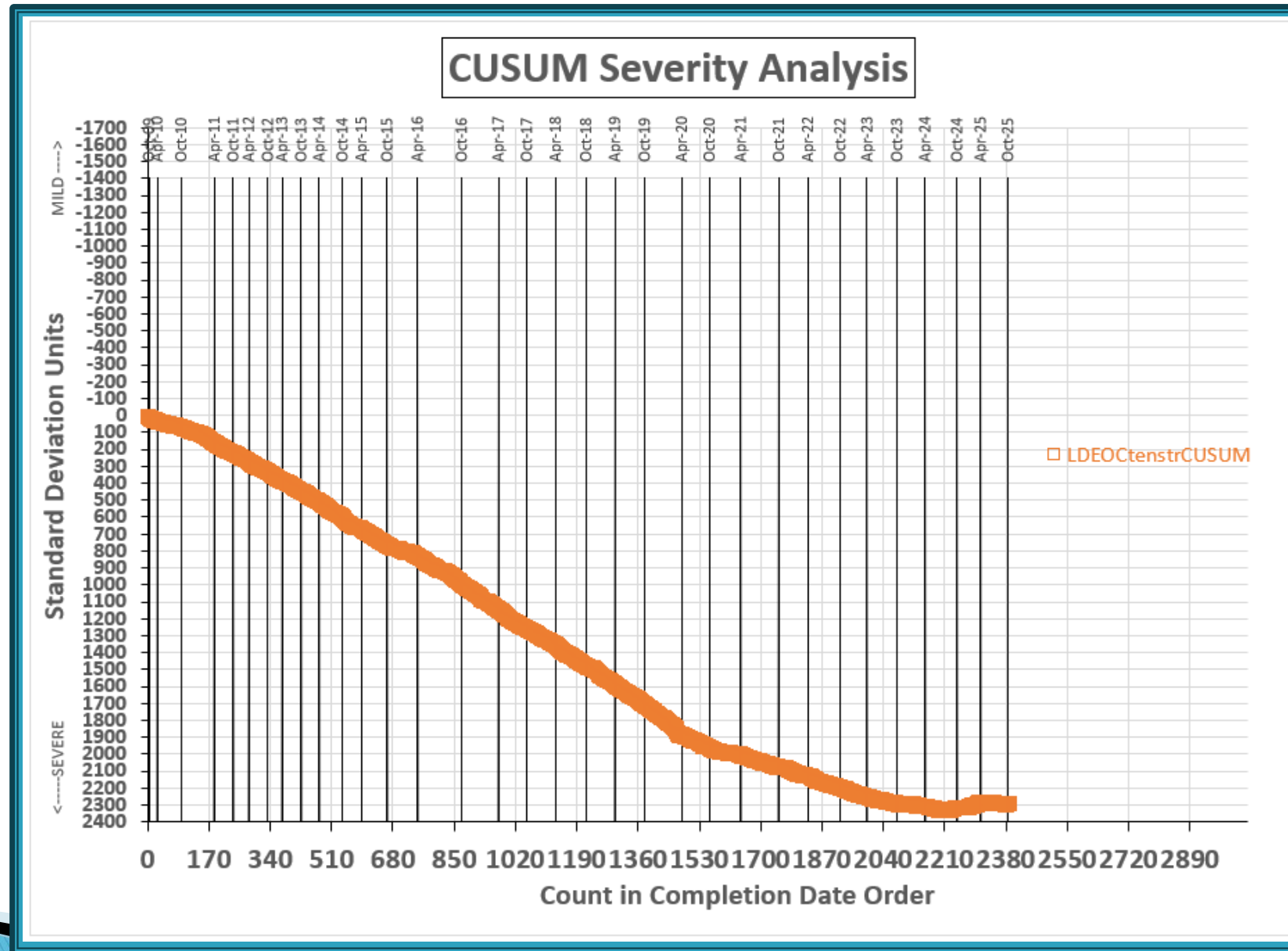
REFERENCE SILICON VOLUME CHANGE FINAL



REFERENCE SILICON POINTS HARDNESS FINAL



REF SILICON TENSILE STRENGTH CHANGE FINAL



Information Letters & Technical Updates*

Test	Date	IL or Memo Number	Topic
LDEOC	20250425	25-1	AMCM1 Batch 27 Volume Change Correction Factor

*Available from TMC Website

April 1, 2025 – September 30, 2025

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Reference Oil Inventory Estimated Life

EOEC & LDEOC

Oil	TMC Inventory Gallons	Gallons Shipped Past 6 Months	Estimated Life ^C
SL107 ^{A, B}	881	321	1.5 years

^A TMC Inventory is used across several test methods

^B SL107 has fully replaced oil 1006; Oil 1006 is no longer used as an EOEC Reference Fluid

^C Use Rate of SL107 has accelerated due to addition of five new Elastomers to D7216:
FOUR: ILSAC GF-7
ONE: PC-12

[TABLE of CONTENTS](#)

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D02.B0.07

TMC Monitored Tests



ASTM D 7528

ROBO

April 1, 2025 – September 30, 2025

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D7528	6 (+0)	36 (+7)
*As of 9/30/2025		

D7528: Oxidation by ROBO

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	121
Failed Calibration Test	OC	16
Lab Reported Calibration Test as Operationally Invalid	LC	2
Calibration Test Aborted by Lab	XC	5
Calibration Test Declared Operationally Invalid by TMC	RC	1
Total		145

Number of Labs Reporting Data: 6
Fail Rate of Operationally Valid Tests: 11.7% (8.2% last period)

April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

Statistically Unacceptable Tests (OC)	No. Of Tests
Natural Log (MRV Viscosity) Severe	9
Natural Log (MRV Viscosity) Mild	7
Total	16

April 1, 2025 – September 30, 2025

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D7528: ROBO Failed Tests by Lab

Failed Parameter	LTMS Lab					Number of Tests
	A	AM	AQ	B	G	
Natural Log (MRV Viscosity) Severe	1	1	2	3	2	9
Natural Log (MRV Viscosity) Mild	4	0	0	0	3	7
Total	5	1	2	3	5	16

- TWELVE different units from FIVE different labs reported failing calibration tests

April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

Operationally Invalid (LC, RC) or Aborted (XC) Calibration Tests

Test Status	Cause	No. of Tests
Invalidated by Lab (LC)	Issues with the NO2 Feed	1
Invalidated by Lab (LC)	High Volatiles	1
Invalidated by TMC (RC)	Yield Stress NOT <35 Pa (and not RO 434-3)	1
Aborted Test (XC)	Issues with Vacuum	3
Aborted Test (XC)	Sample lost (spill)	1
Aborted Test (XC)	Insufficient volume of sample for MRV test	1
Totals		8

April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

Period Precision and Severity Estimates

Natural Log (MRV Viscosity)	n	df	Pooled s	Mean Δ/s
Targets Updated 20211021 ¹	80	77	0.1551	-----
4/1/21 through 9/30/21	116	110	0.1992	-0.37
10/1/21 through 3/31/22	106	102	0.2103	-0.36
4/1/22 through 9/30/22	105	101	0.1868	-0.06
10/1/22 through 3/31/23	94	91	0.2000	0.11
4/1/23 through 9/30/23	103	100	0.1990	-0.11
10/1/23 through 3/31/24	91	88	0.1741	-0.12
4/1/24 through 9/30/24	92	88	0.1893	-0.72
10/1/24 through 3/31/25	97	94	0.1957	-0.37
4/1/25 through 9/30/25	137	134	0.2264	-0.25

¹Updated targets to include latest primary reference oils 434-3, 435-1 and 436

April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

NO ₂ Delivery Mechanism	Number of Total Tests	Number Of AC Tests	Pass Rate (%)	Number of Labs	Number of Rigs	LAB ID's
Dilute	56	52	92.9	2	18	G, AM
Liquid	81	69	85.2	5	18	A, AQ, B, BC, G
BOTH (Totals)	137	121	88.3	6*	36	A, AM, AQ, B, BC, G

*One lab is conducting tests with both NO₂ delivery methods.

April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

Precision, Performance (Mean Δ/s) by Lab and NO₂ Delivery Mechanism

NO ₂ Delivery		Ref Oil 434-3	Ref Oil 435-1	Ref Oil 436	TOTAL
Dilute	No. of Runs	13	30	13	56
	Mean	10.7753	10.9986	10.2776	10.7794
	Pooled s	0.2031	0.1834	0.1543	0.1820
	Mean Δ/s	-0.30	-0.21	-0.42	-0.28
Liquid	No. of Runs	22	41	18	81
	Mean	10.7107	11.0163	10.3604	10.7876
	Pooled s	0.2973	0.2537	0.1861	0.2537
	Mean Δ/s	-0.77	-0.12	0.22	-0.22
BOTH	No. of Runs	35	71	31	137
	Mean	10.7347	11.0088	10.3257	10.7842
	Pooled s	0.2648	0.2254	0.1757	0.2264
	Mean Δ/s	-0.59	-0.16	-0.05	-0.25

April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

Period Performance (Mean Δ/s) by Lab and NO₂ Delivery Mechanism

NO ₂ Delivery Mechanism	LAB A (all L)	LAB AM (all D)	LAB AQ (all L)	LAB B (all L)	LAB BC (all L)	LAB G (mix)
Dilute	n = 0	n = 4	n = 0	n = 0	n = 0	n = 52
	N/A	0.33	N/A	N/A	N/A	-0.33
Liquid	n = 45	n = 0	n = 6	n = 15	n = 1	n = 14
	-0.77	N/A	1.61	0.53	-1.13	0.01
BOTH	n = 45	n = 4	n = 6	n = 15	n = 1	n = 66
	-0.77	0.33	1.61	0.53	-1.13	-0.26

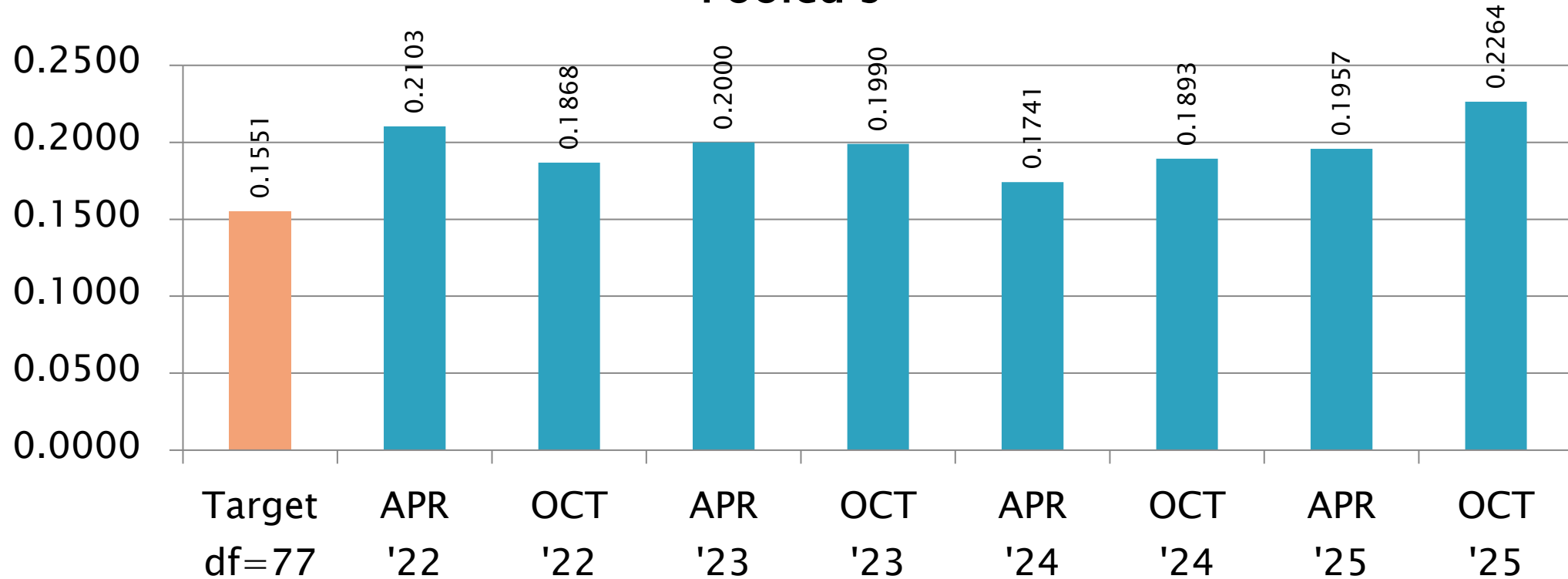
April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO

Natural Log (MRV Viscosity) Pooled s

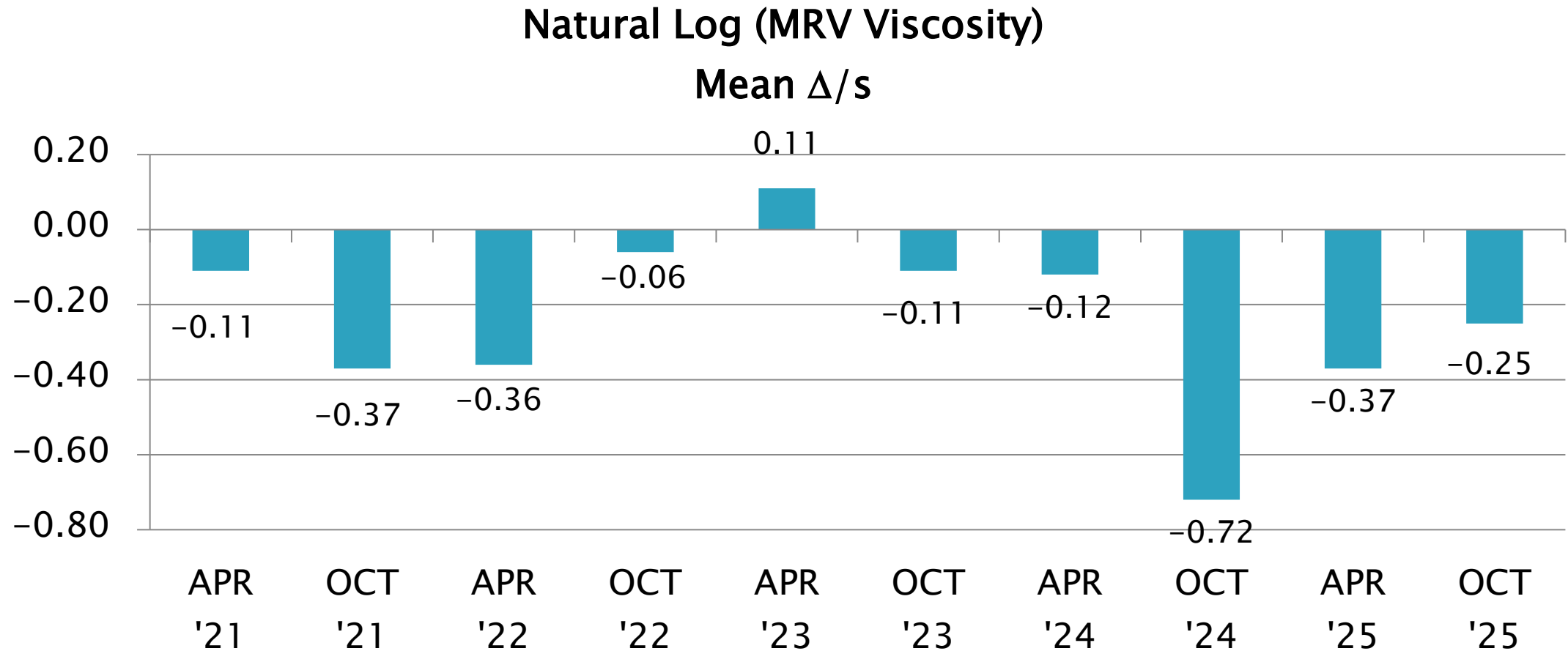


April 1, 2025 – September 30, 2025

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D7528: Oxidation by ROBO



April 1, 2025 – September 30, 2025

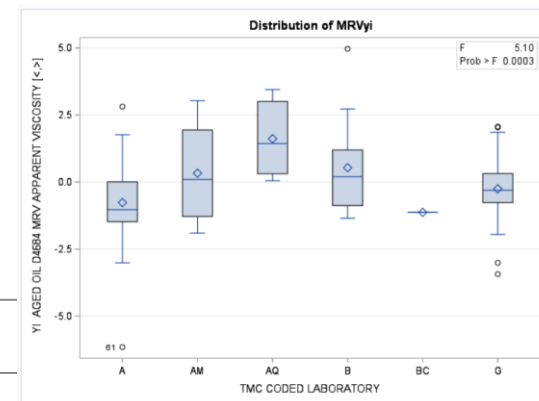
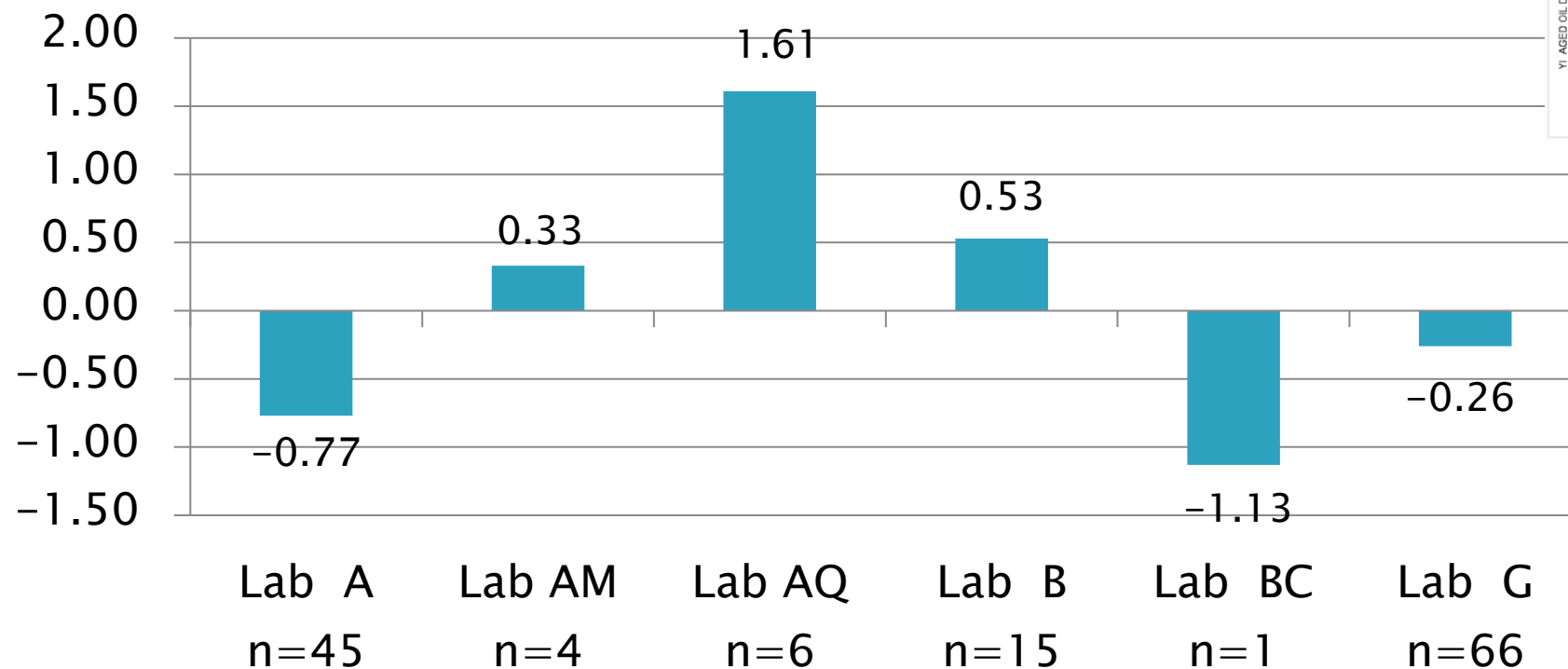
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D7528: Oxidation by ROBO

Natural Log (MRV Viscosity)

Mean Δ/s



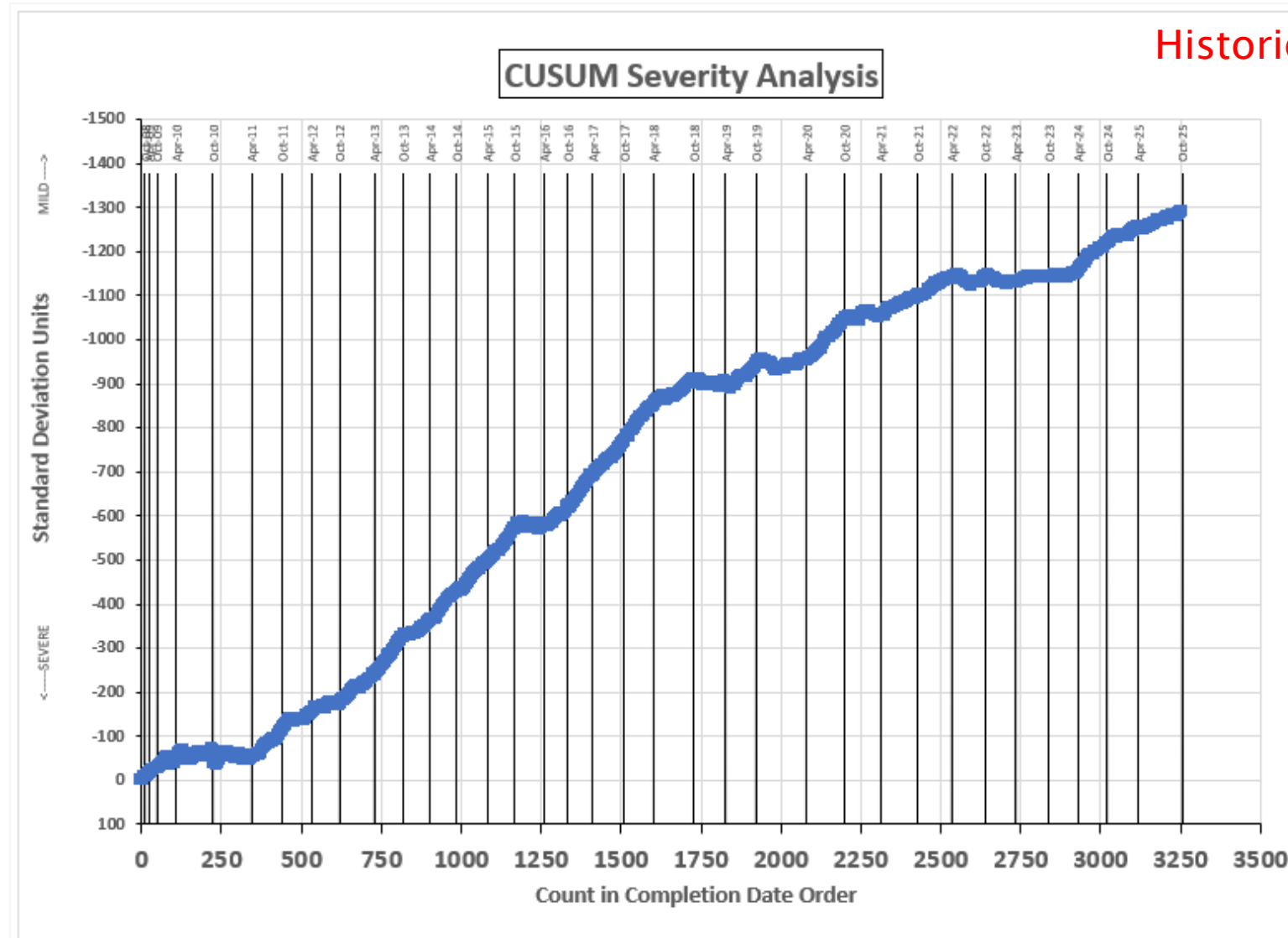
April 1, 2025 – September 30, 2025

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AGED OIL MRV APPARENT VISCOSITY

Historical Chart



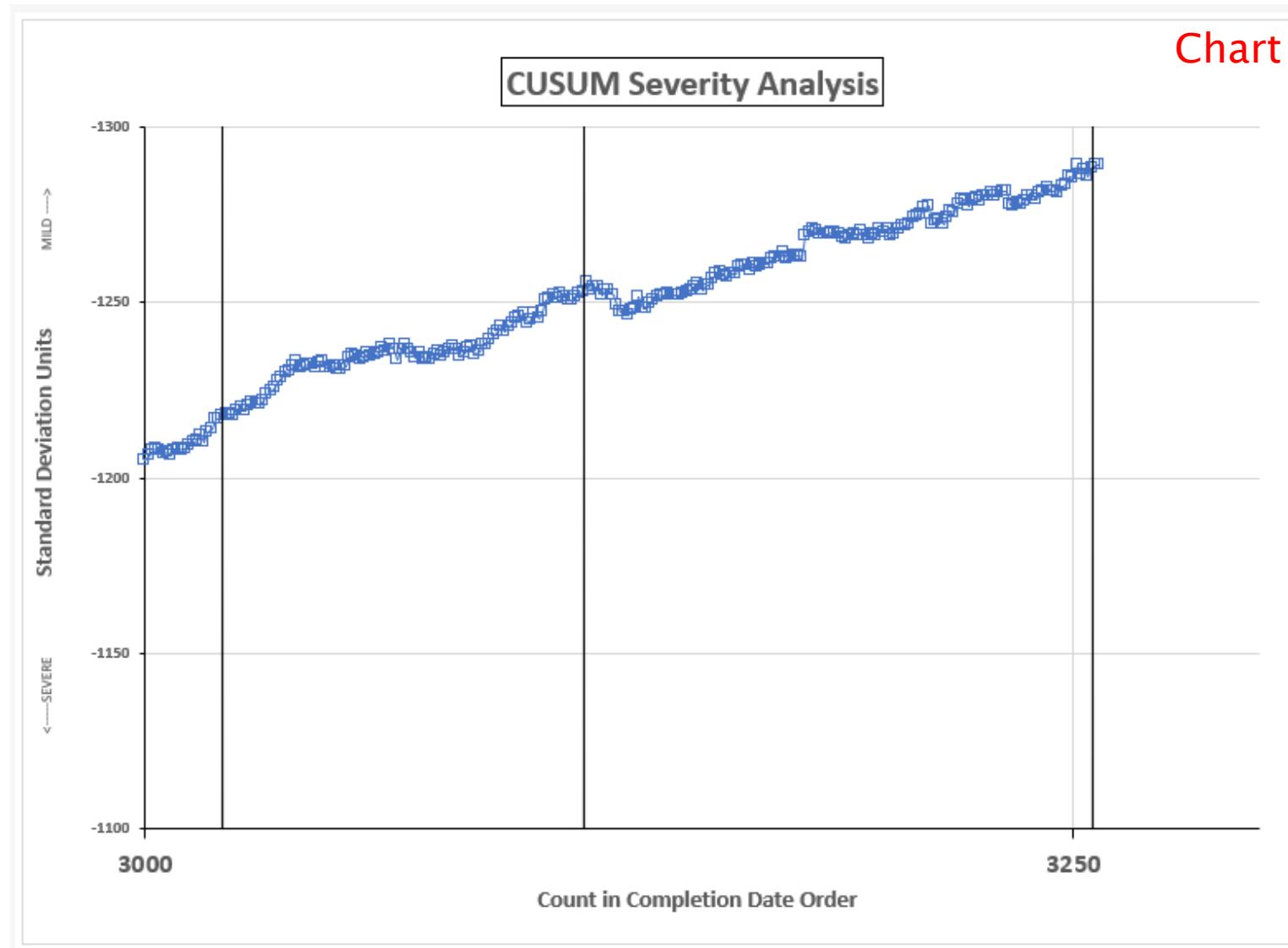
April 1, 2025 - September 30, 2025

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Last 200 Data Points

AGED OIL MRV APPARENT VISCOSITY

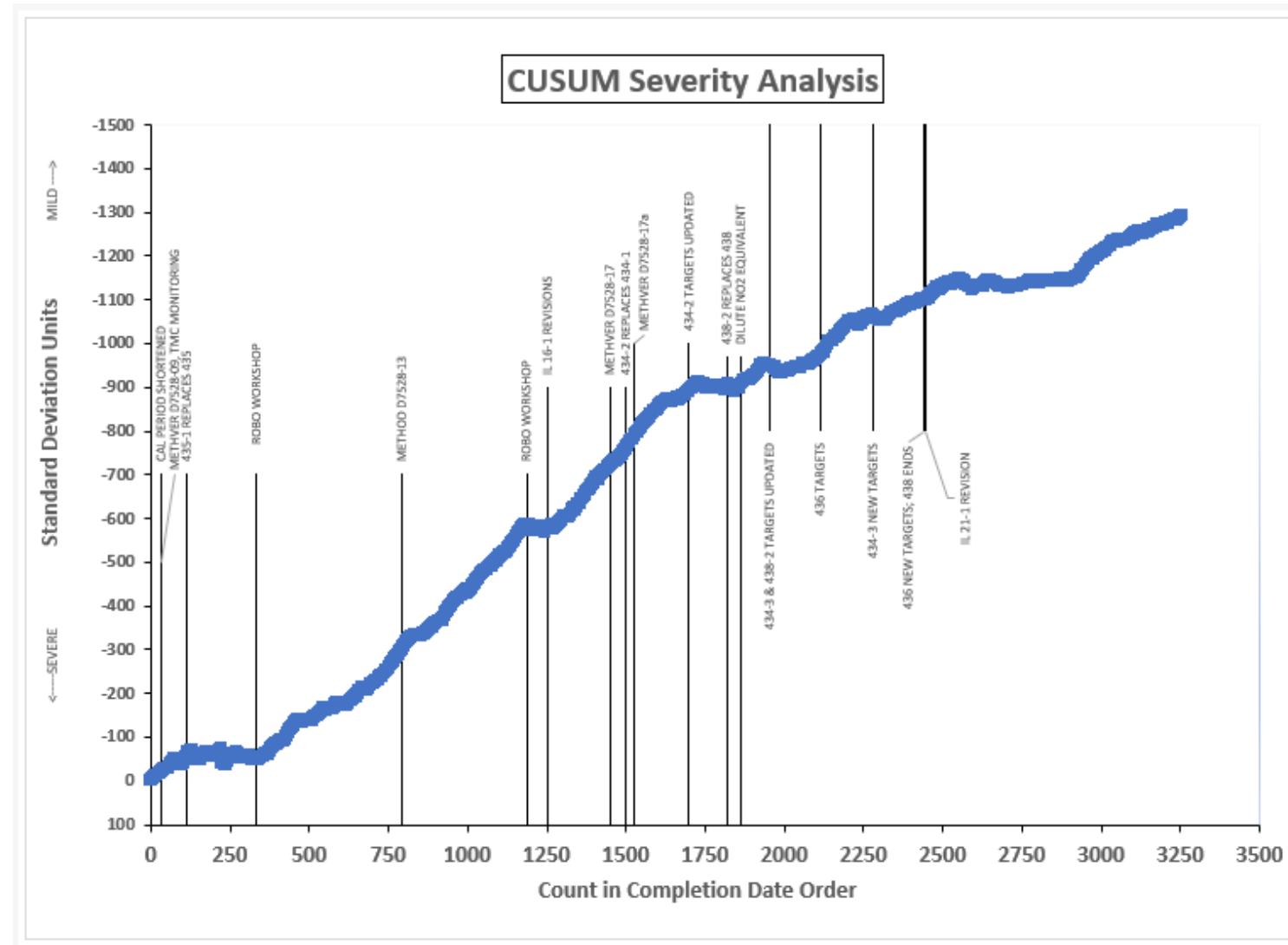
Chart of recent results



April 1, 2025 - September 30, 2025

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

AGED OIL MRV APPARENT VISCOSITY



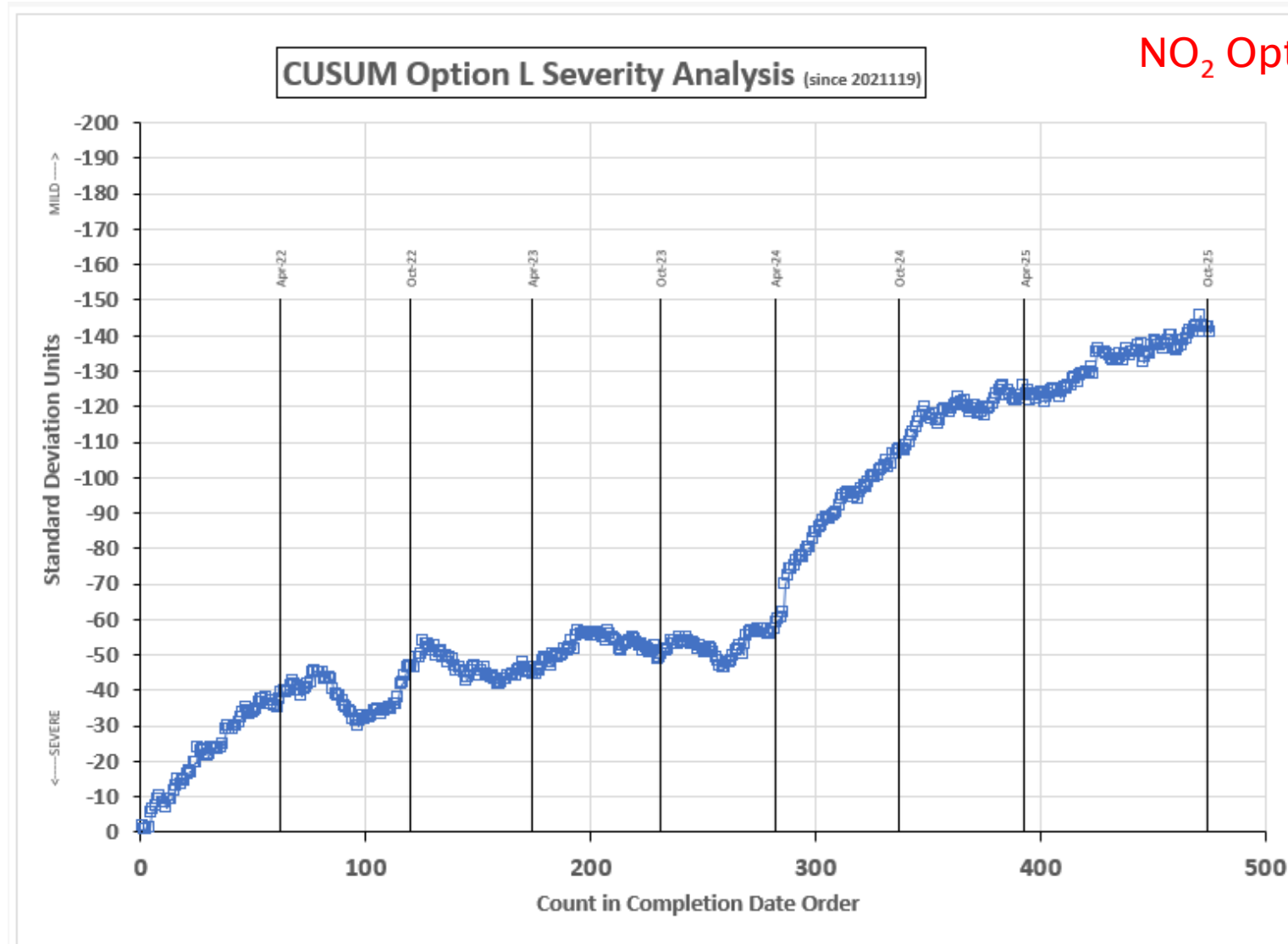
April 1, 2025 – September 30, 2025

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ROBO TEST INDUSTRY OPERATIONALLY VALID DATA
NO₂ Option L ONLY
AGED OIL MRV APPARENT VISCOSITY



NO₂ Option L Chart



April 1, 2025 - September 30, 2025

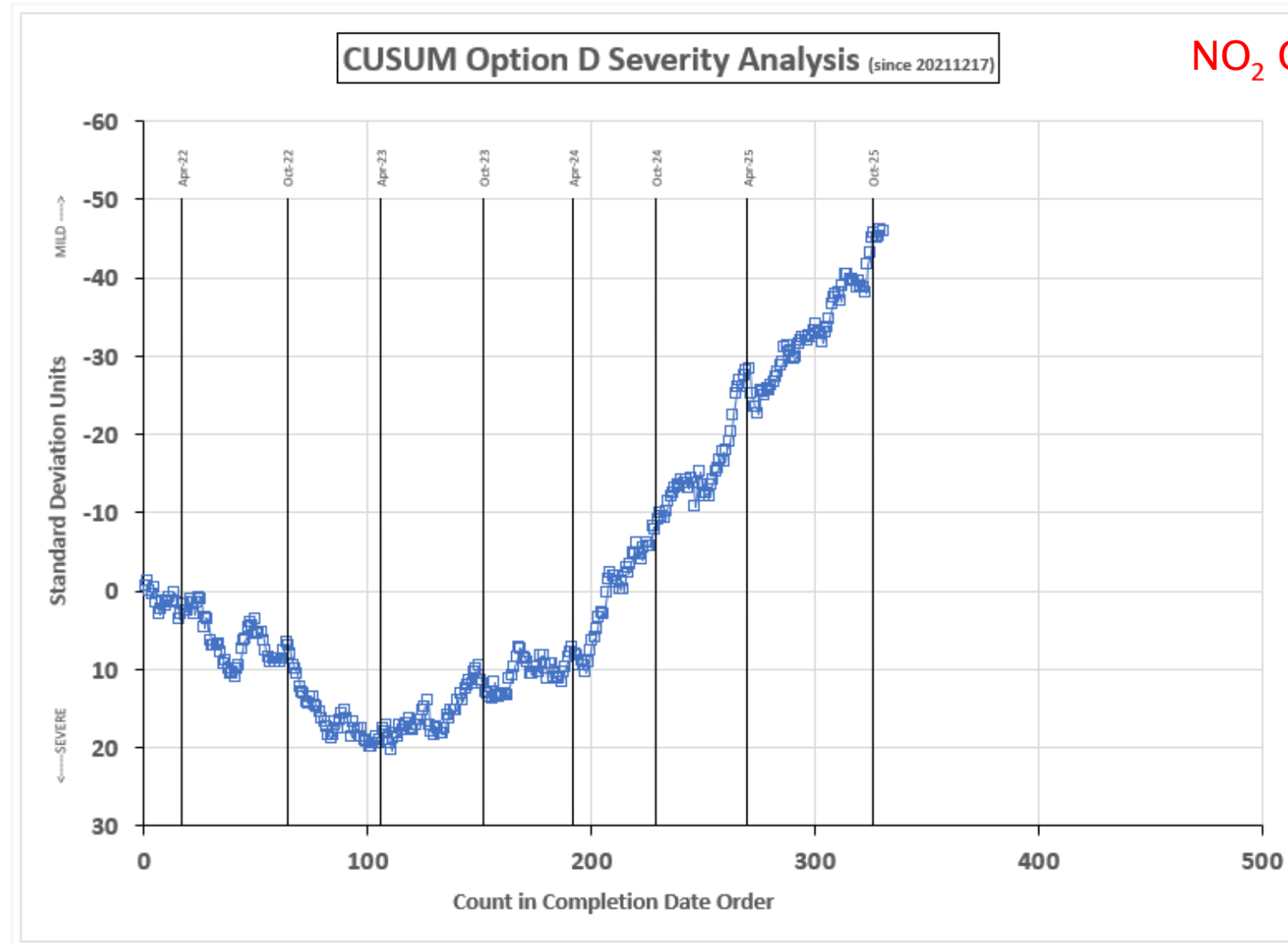
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ROBO TEST INDUSTRY OPERATIONALLY VALID DATA
NO₂ Option D ONLY
AGED OIL MRV APPARENT VISCOSITY



NO₂ Option D Chart



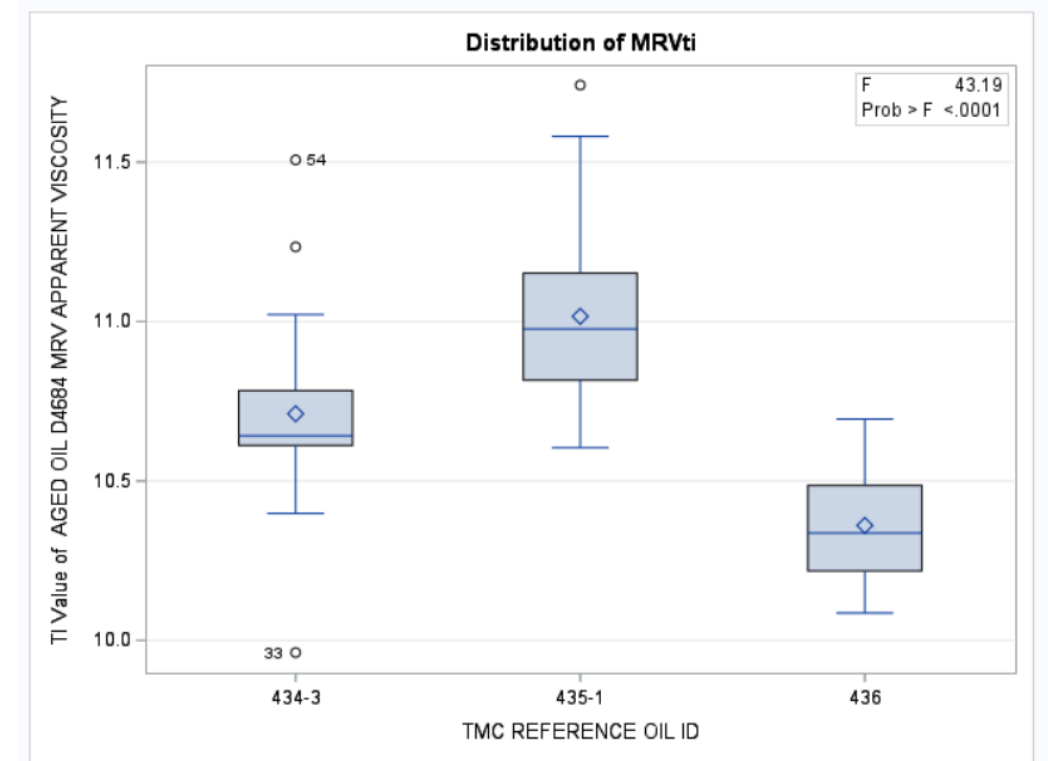
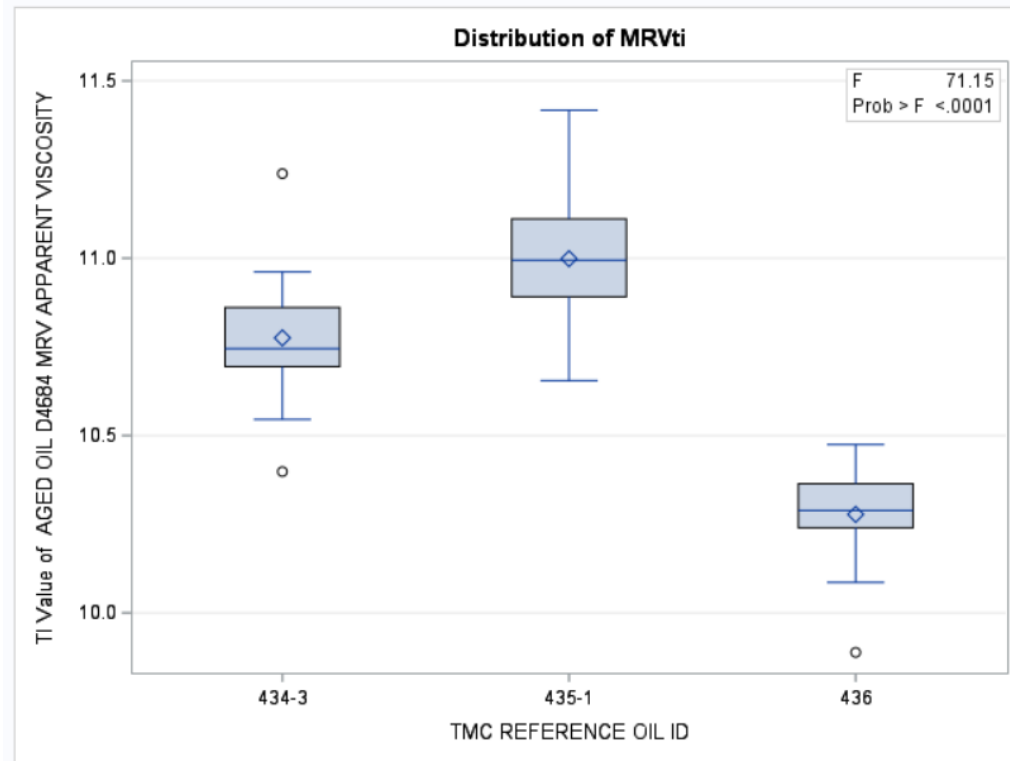
April 1, 2025 - September 30, 2025

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Means by Reference Oil, NO2 Delivery

D (left) and L (right)



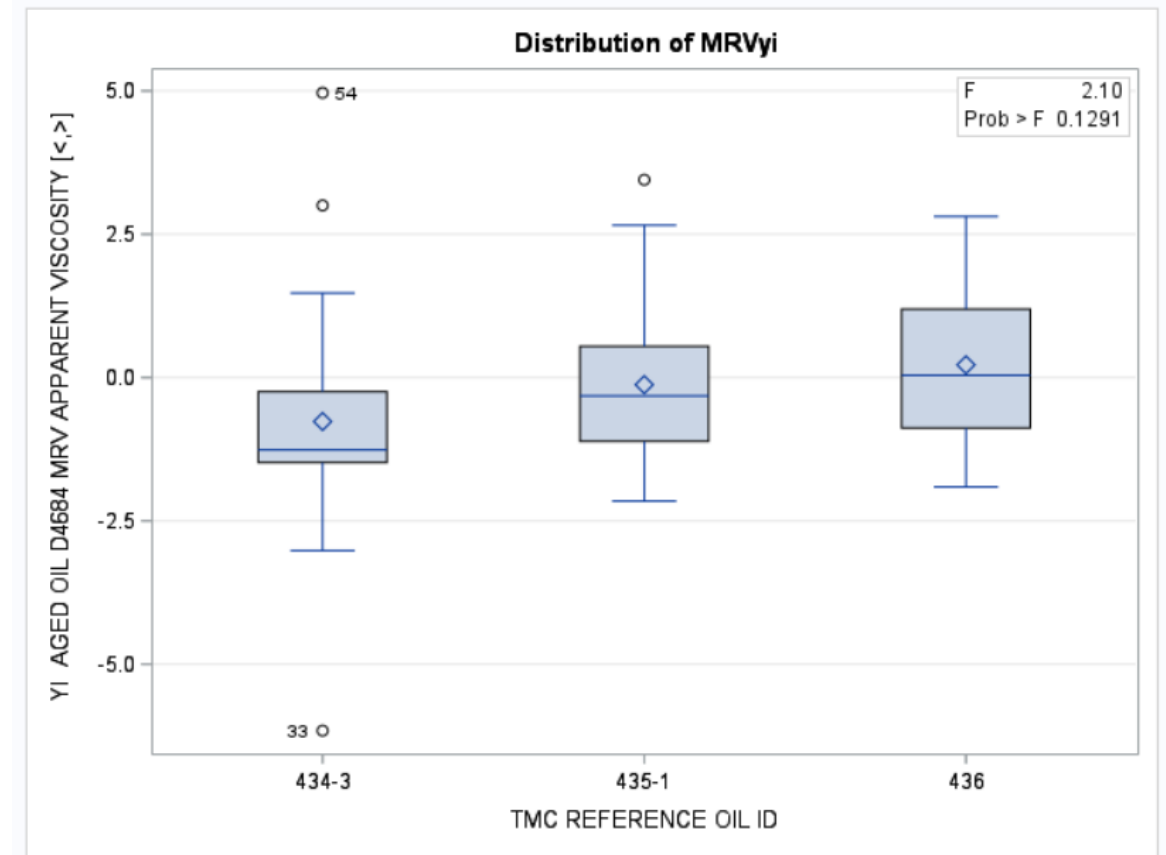
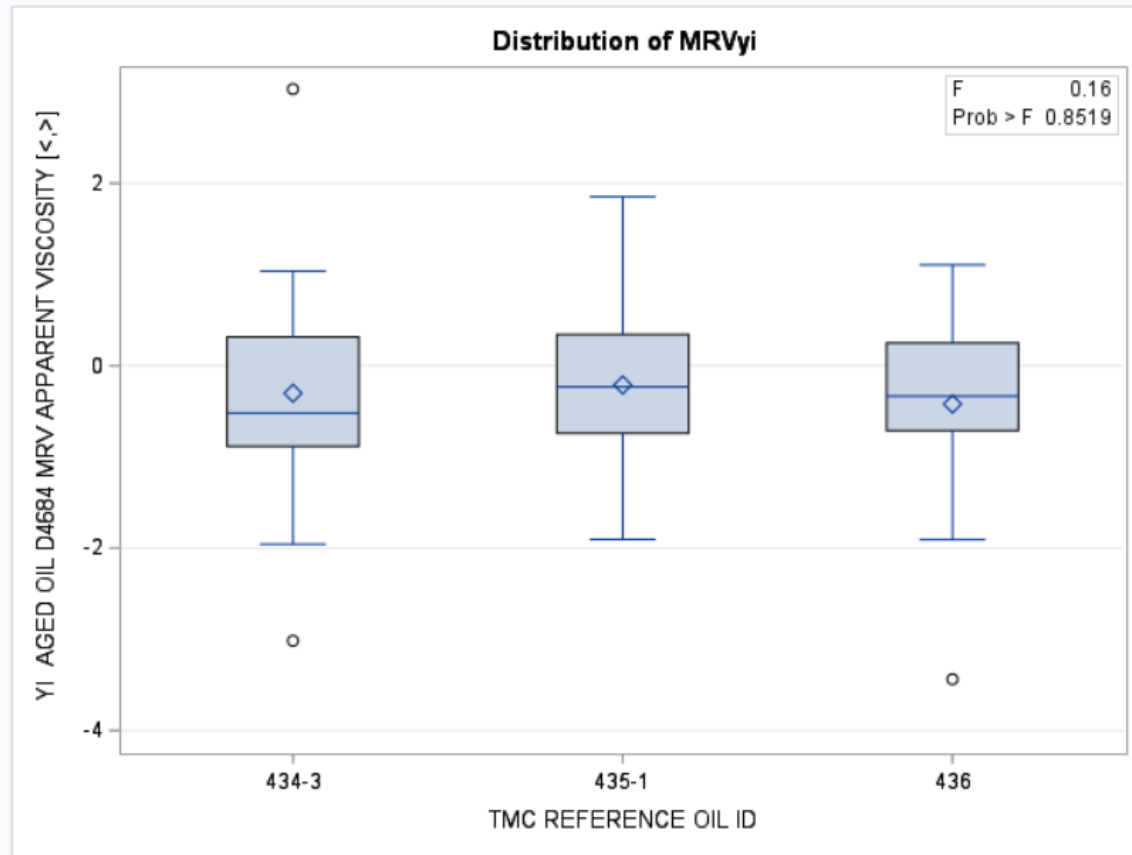
April 1, 2025 – September 30, 2025

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Performance by Ref Oil, NO2 Delivery

D (left) and L (right)



April 1, 2025 – September 30, 2025

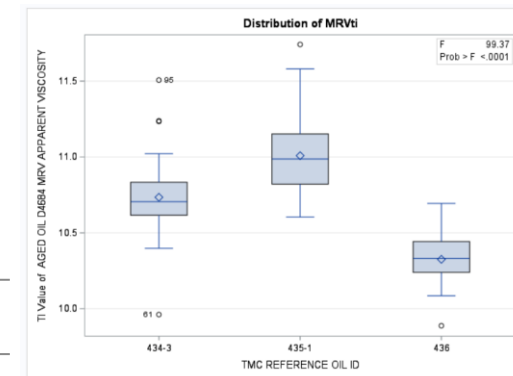
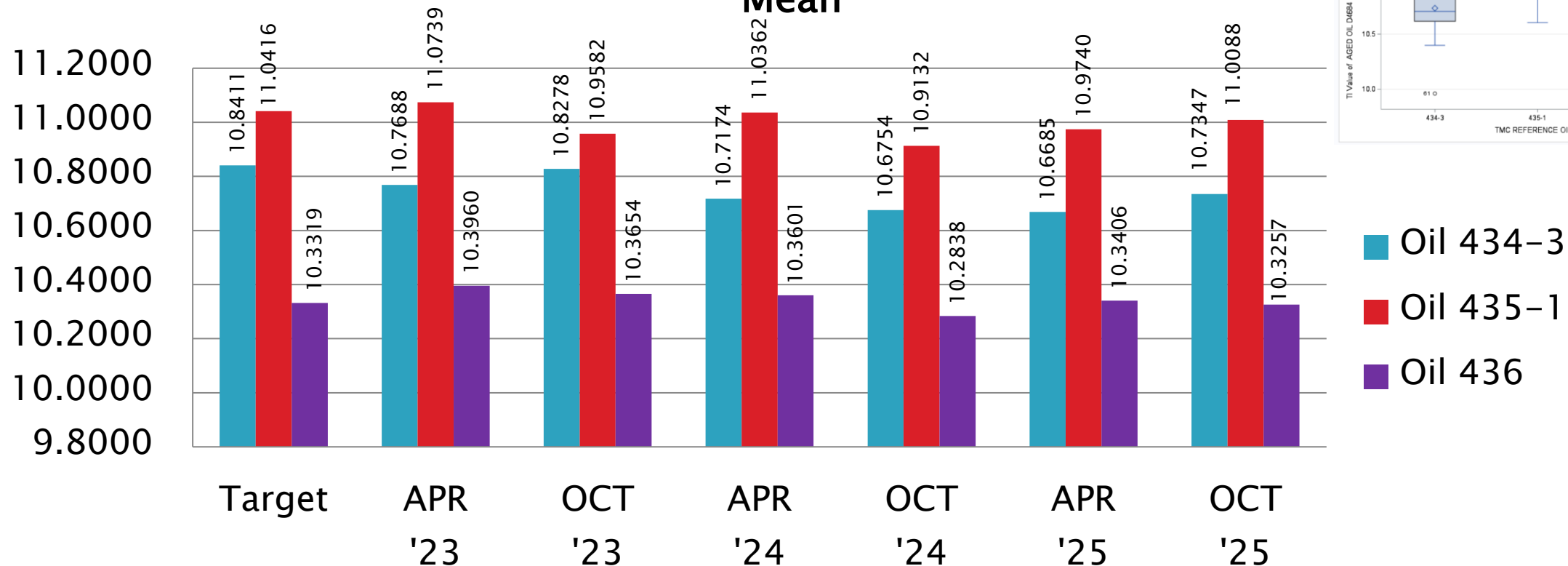
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D7528: Oxidation by ROBO

Natural Log (MRV Viscosity)

Mean



April 1, 2025 – September 30, 2025

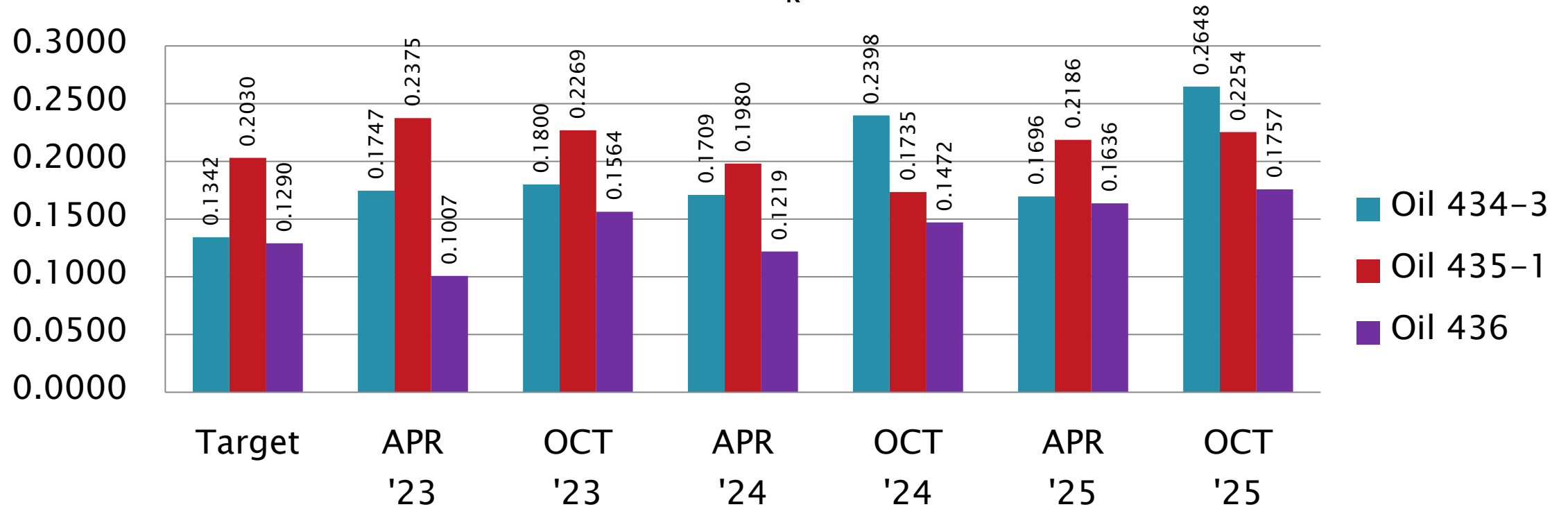
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D7528: Oxidation by ROBO

Natural Log (MRV Viscosity)

S_R



April 1, 2025 – September 30, 2025

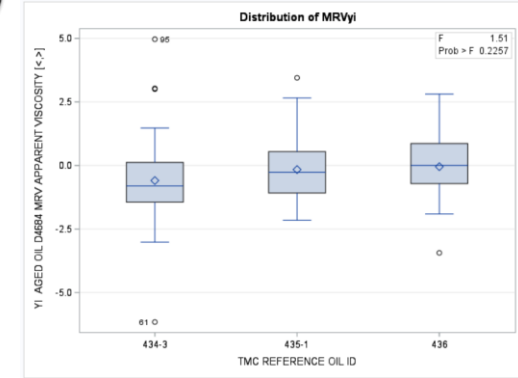
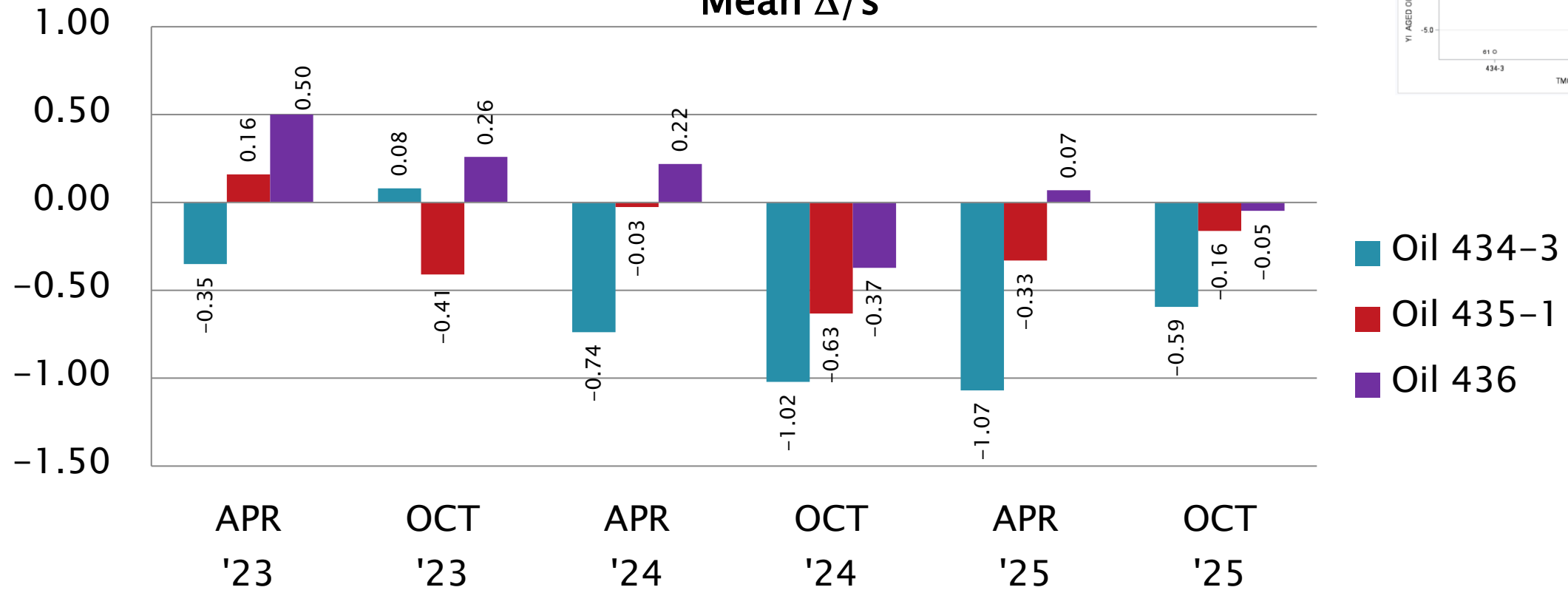
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D7528: Oxidation by ROBO

Natural Log (MRV Viscosity)

Mean Δ/s



D7528: Oxidation by ROBO

- ▶ Precision (Pooled s) regressed to 0.23 this semester.
- ▶ Severity (Mean Δ/s) has moved to -0.25, continuing to move closer to target.
- ▶ CUSUM plot for NO₂ delivery method (D = dilute) is trending mild (overall), but with a couple of severe runs early and late in the semester.
- ▶ CUSUM plot for NO₂ delivery method (L = liquid) is showing an overall mild trend, but not to the extent that method L is showing.

April 1, 2025 – September 30, 2025

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Reference Oil Inventory

ROBO

Oil	Year Rec'd By TMC ^A	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
434-3 ^B	2017	ROBO	7.50	4.28	1.5 years
435-1	2008	ROBO	21.1	8.13	1.5 years
436 ^B	2014	ROBO	26.3	2.91	5+ years

^A Integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

^B Multi-test oil; estimated aliquot reserved for bench testing.

TABLE of CONTENTS

Test Monitoring Center
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Reference Oil Inventory



As of 9/30/2025

Reference Oil Inventory: November 2025

Original Blend	Section	Oil	Tests	Year	Blend Quantity	TMC Inventory	Estimated Life
44	BENCH	44-5	D6594	2022	54	42.2	> 5
52	BENCH	52	D6417	1995	100	59.37	> 5
55	BENCH	55	D6417	1995	100	65.89	> 5
58	BENCH	58	D6417, D6417QC, GI	1998	159	111.3	> 5
66	BENCH	66	D6082	2002	108	65.3	> 5
75	BENCH	75-2	TEOST	2024	8	5.48	4
77	BENCH	77-3	EOWT	2015	900	315	3
79	BENCH	79	EOFT, EOWT	2014	1026	31.7	0.5
82	BENCH	82-1	BRT	2008	10	0.5	not assigned
86	BENCH	86	BRT	2017	54	49	not assigned
87	BENCH	87	BRT	2017	98	92.9	not assigned
90	BENCH	90	D874QC	2005	49.5	0.9	QC Only
91	BENCH	91	D874	2006	5	2.86	> 5
92	BENCH	92	D874	2020	52	52.4	> 5
432	BENCH	432	MTEOS	1998	207	100.8	> 5
434	BENCH	434-3	MTEOS, ROBO	2017	55	7.5	1.0
435	BENCH	435-1	ROBO	2008	55	21.1	1.5
435	BENCH	435-2	TEOST	2010	550	31.5	> 5
436	BENCH	436	ROBO	2014	55	26.3	> 5
820	BENCH	820-2	D874	2001	55	5.86	> 5
1005	BENCH	1005-5	D6594	2015	55	17.4	3
1006	BENCH	1006	BRT	1996	55	24.2	> 5
1009	BENCH	1009	GI	2002	55	33.1	> 5
FOAMB18	BENCH	FOAM18B	D6082	2018	102	65.6	> 5
GIA17	BENCH	GIA17	GI	2017	10	5.00	> 5
GIC18	BENCH	GIC18	GI	2018	10	7.67	> 5
SL107	BENCH	SL107	EOEC, LDEOC	2019	3868	881	1.5
VOLC12	BENCH	VOLC12	D5800	2013	55	15.1	4
VOLD12	BENCH	VOLD12	D5800	2013	55	13.4	4
VOLD18	BENCH	VOLD18	D5800QC	2018	1092	464	> 5
VOLE12	BENCH	VOLE12	D5800	2012	55	11.2	4

TABLE of CONTENTS

Test Monitoring Center
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Additional Information

Additional Information

- ▶ Available on the TMC's Website:
 - Lubricant Test Monitoring System (LTMS) Document
 - CUSUM Severity Plots
 - Reference Data, Period Statistics and Timelines
 - Information Letters and Technical Memos
 - Report Forms & Data Dictionaries
 - Online Store, and more...

- ▶ www.astmtmc.org

TABLE of CONTENTS

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





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