A Program of ASTM International

Test Monitoring Center

https://www.astmtmc.org

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, 2023 – September 30, 2023

Table of Contents

Section	Topic		
Summary Items	Executive	Reference Oil Inventories	Additional Information
Test Area Status	TEST	LABS*	STANDS*
Sulfated Ash	D874	5 (+0)	N/A
Gelation Index (GI)	D5133	9 (+0)	52 (–3)
NOACK Volatility	D5800	14 (+3)	36 (+11)
High Temp Foam	D6082	7 (+0)	8 (+0)
TEOST	D6335	9 (+1)	13 (+0)
GC Volatility	D6417	6 (–1)	8 (–1)
* Between 4/1/203 and 9/30/2023			

Table of Contents

Section	Topic		
Test Area Status (cont.)	TEST	LABS*	STANDS*
Ball Rust Test (BRT)	D6557	5 (+0)	5 (+0)
HTCBT	D6594	10 (+0)	30 (+0)
EOWT	D6794	6 (+0)	N/A
EOFT	D6795	6 (+0)	N/A
MTEOS	D7097	10 (+0)	41 (+5)
EOEC Elast. Compat.	D7216-E	6 (+0)	N/A
LDEOC Elast. Compat.	D7216-L	7 (-1)	N/A
ROBO	D7528	5 (+0)	30 (+1)
* Between 4/1/2023 and 9/30/2023			

B0.07 Bench Testing Executive Summary

- D874 (Sulfated Ash)
- For the fourth consecutive 6-month period, there were no tests which failed to meet acceptance criteria for D874. Reference test results continue trending mild and new Reference Oil 92 is in the process of replacing Oil 90 which is not available as a reblend.
- D5133 (Gelation Index)
- Nine labs are running GI, same as last period, but three units fell out of calibration this period. GIC18, a new Reference Oil with a performance target close to the Pass/Fail limit of 12, collected 30+ runs (from 7 different labs) and is ready for reassessment / confirmation of reference oil test targets.
- D5800 (NOACK)
- Two new labs and one former lab brought eleven stands into calibration this period. CUSUM slope turned back towards SEVERE after being MILD in the previous semester.

B0.07 Bench Testing Executive Summary

- D6082 (High Temperature Foam)
- For the fourth consecutive 6-month period, there were no tests which failed to meet acceptance criteria for HT Foam calibration testing.
- D6335 (TEOST)
- Test fail rate improved to 13.3% after being at 20% last semester. Precision is also improving, and Performance is on-target (0.03 s).
- D6417 (GC Volatility)
- One less test lab (6) reported data this semester and no failing Calibration Runs in this period for the eight instruments.
- D6557 (BRT)
- Average Gray Value (AGV) has returned to a slightly mild trend this semester after a severe run over the last two periods. But overall, CUSUM has been relatively “flat” for the past six years (since April 2017).

B0.07 Bench Testing Executive Summary

- D6594 (HTCBT)
- New Chairperson for HTCBT Surveillance Panel has been identified. New Reference Oil 44-5 completed 30+ tests and is now ready for target confirmation/reassessment evaluation. Only 2.6 gallons of Reference Oil 44-4 remain. Reblend Oil 44-5 is now available as a replacement for 44-4. Test severity issues have abated and a significantly fewer number of Calibration Run fails occurred this semester.
- D6794 (EOWT)
- Change in Flowrate Average (CIFA) continues to trend severe for all water treat rates. Slight abatement of the severe trend observed in last semester has ended.
- D6795 (EOFT)
- Change in Flow Average (CIFA) is trending severe with a very consistent CUSUM slope over the past three years.

B0.07 Bench Testing Executive Summary

- D7097 (MTEOS)
  - Precision regressed slightly moving to 7.42 s, whereas Performance continued to improve moving from 0.41 s down to 0.31 s this period. Most operationally valid tests this period report using Rod Batch N and Catalyst Batch 20AB, although one test used Catalyst Batch 23AB. No labs used Catalyst Batch 19BA.
- D7216 (EOEC/LDOEC)
  - No tests on Ref Oil 1006 as all testing has moved to Ref Oil SL-107. Surveillance Panel has agreed to resume Adjustment Factors for EOEC. Several labs participated in Round Robin tests of ACM1 batch 25 vs batch 26 to understand what would be the result of returning to a previous manufacturing method for the Polyacrylate elastomer. TMC will officially monitor the EOEC/LDEOC bench tests, adding a section to LTMS. And new elastomer types will be added to LDEOC (GF-7) and EOEC (PC-12) within the next year.
- D7528 (ROBO)
  - Precision continues to stay around 0.20 and about 0.05 units higher than target (0.15). Performance returned to mild (-0.11) but has been close to "zero" for the past three semesters. CUSUM severity plot shows a third consecutive period of relatively 'flat' CUSUM after many periods of trending Mild. Two labs did not report any runs this period.

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 874

Sulfated Ash

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change shown in parentheses)

Test	Labs	Stands
D874	5 (+0)	N/A
*As of 9/30/2023		

D874: Sulfated Ash

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	10
Total		**10**

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 0%

D874: Sulfated Ash

Statistically Unacceptable Tests (OC)	No. Of Tests
No Failed tests	0

- No operationally invalid or statistically unacceptable tests this report period.

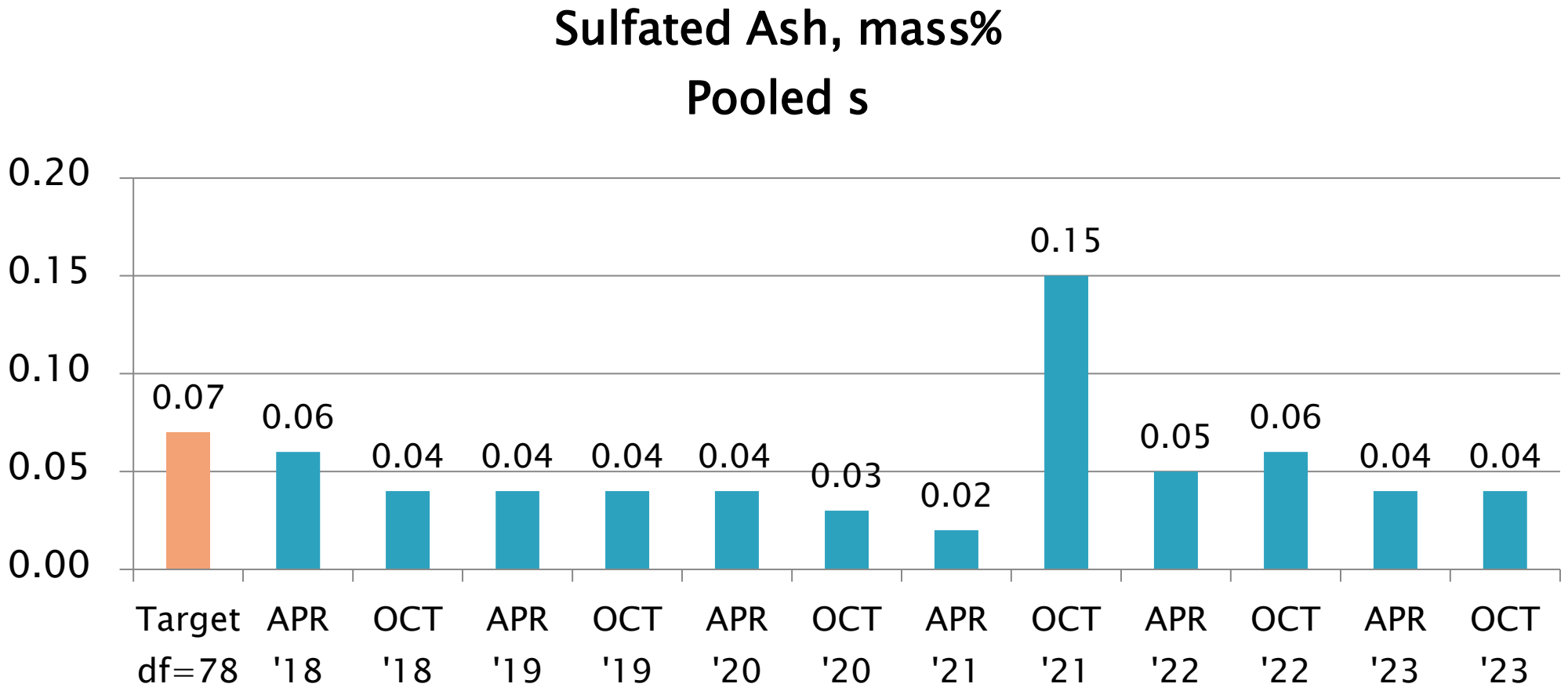
D874: Sulfated Ash

Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets	81	78	0.07	-----
10/1/18 through 3/31/19	8	5	0.04	-0.33
4/1/19 through 9/30/19	8	5	0.04	-0.18
10/1/19 through 3/31/20	7	4	0.04	-0.71
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

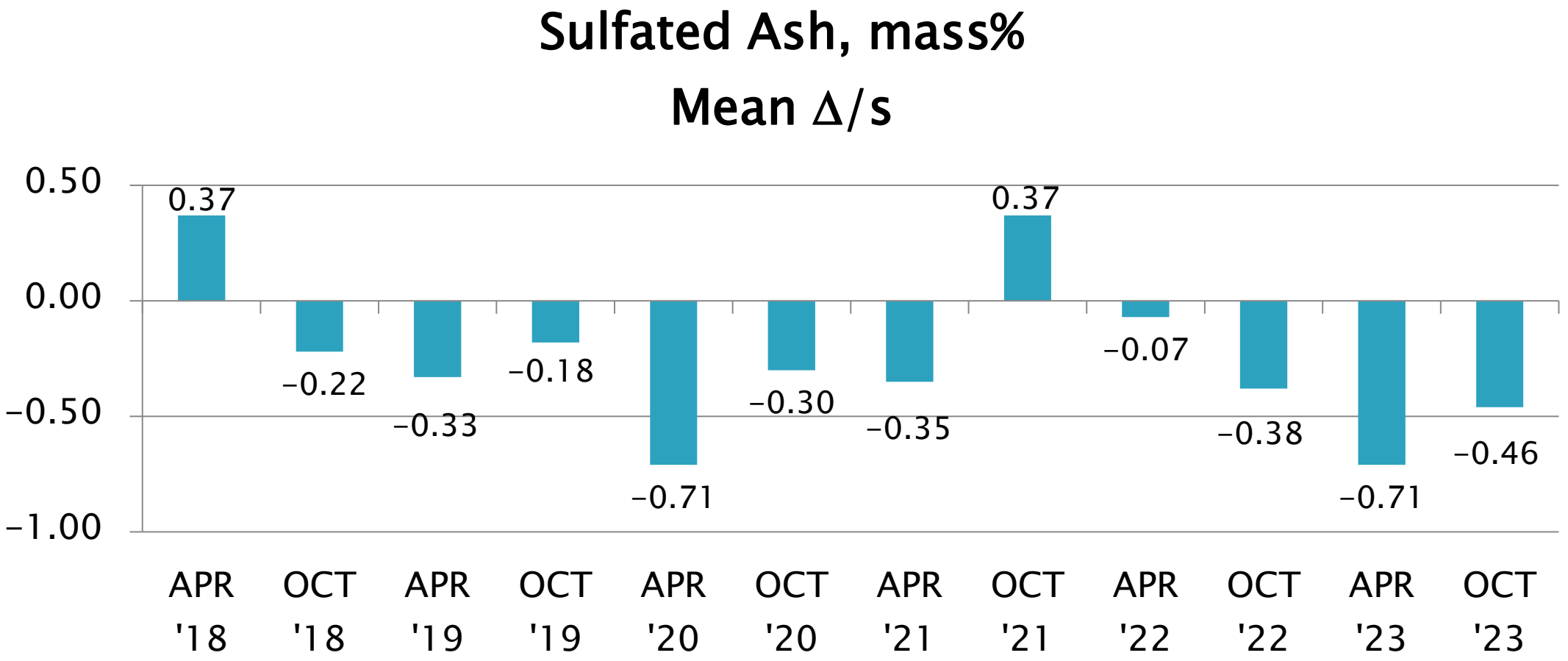
Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

D874: Sulfated Ash



Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

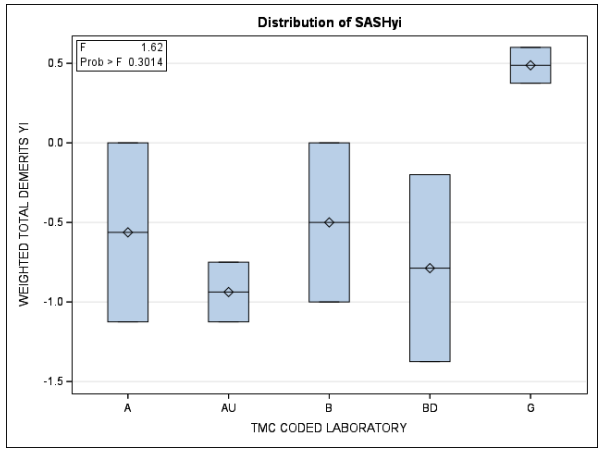
D874: Sulfated Ash



April 1, 2023 – September 30, 2023

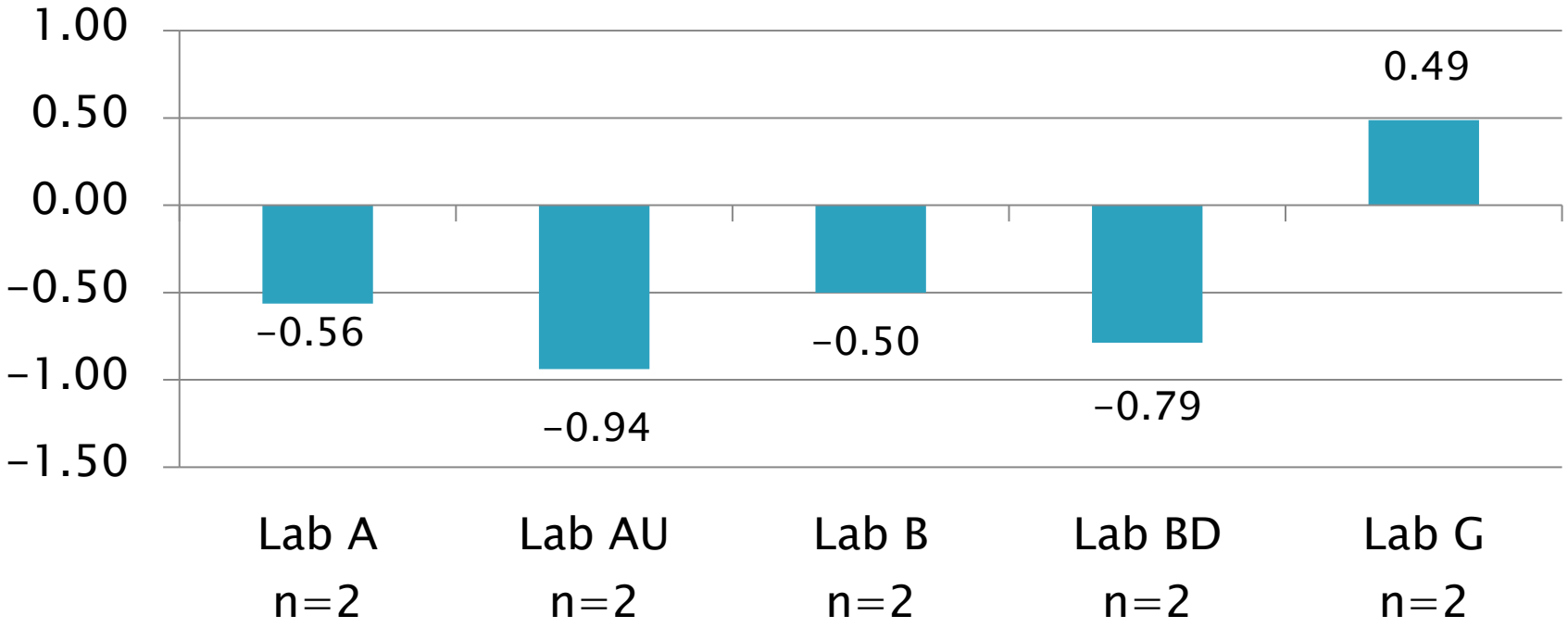
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D874: Sulfated Ash



Sulfated Ash, mass%

Mean Δ/s



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

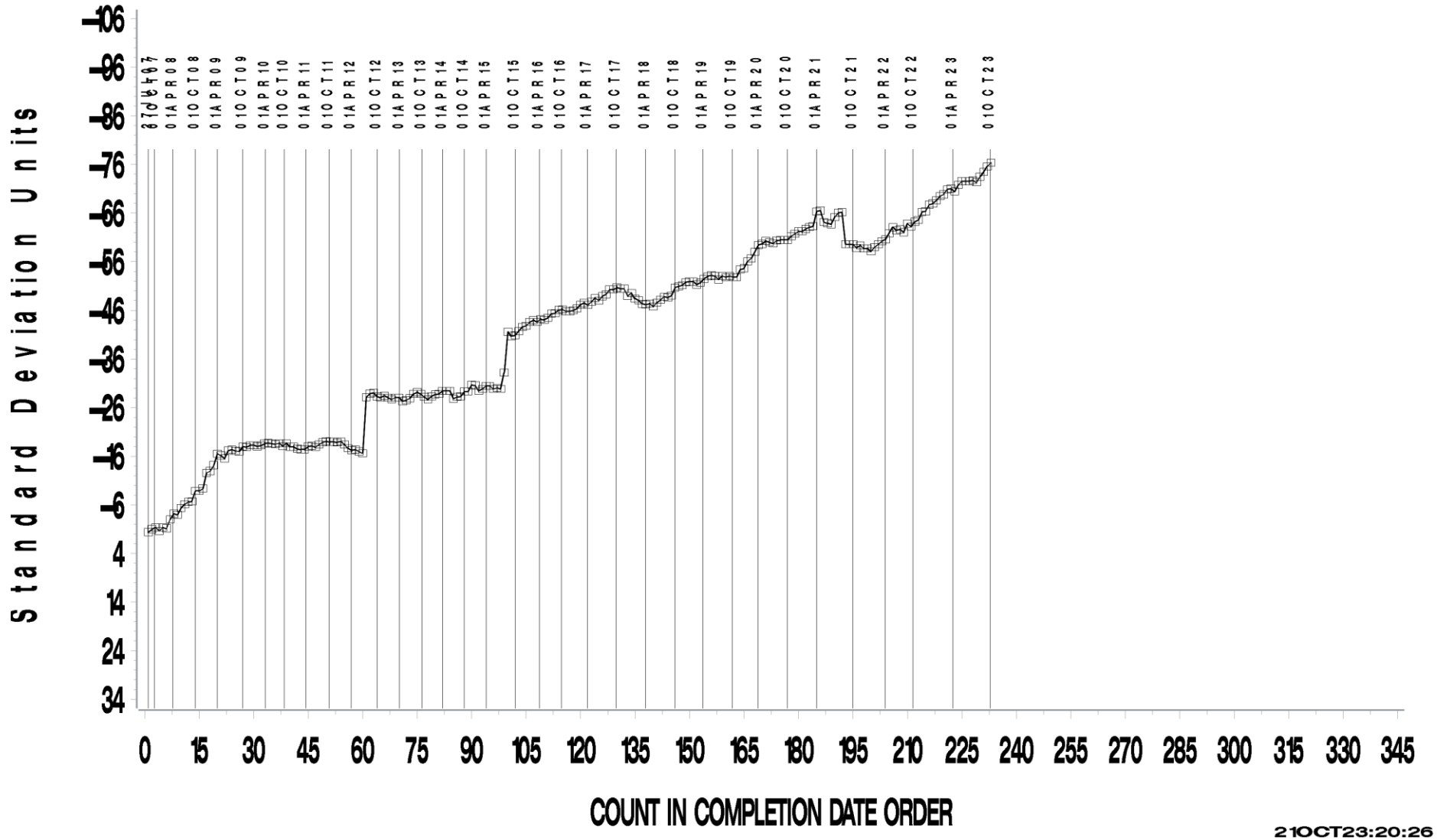
D874 (Sulfated Ash) Status

- Precision (Pooled s) is identical to the previous period (0.04) and is in line with most historical estimates
- Performance (Mean Δ/s) has improved to -0.46 s
- Only 2.5 gallons of Reference Oil 90 available.
  - Reference Oil 92 is currently running a Round Robin with goal of replacing Oil 90
  - Both Oil 90 and Oil 92 have a Sulfated Ash of approximately 1.0%

D874 INDUSTRY OPERATIONALLY VALID DATA

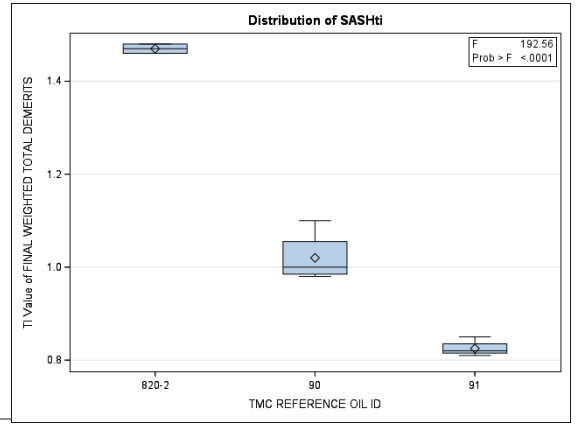
TEST SAMPLE PERCENT SULFATED ASH

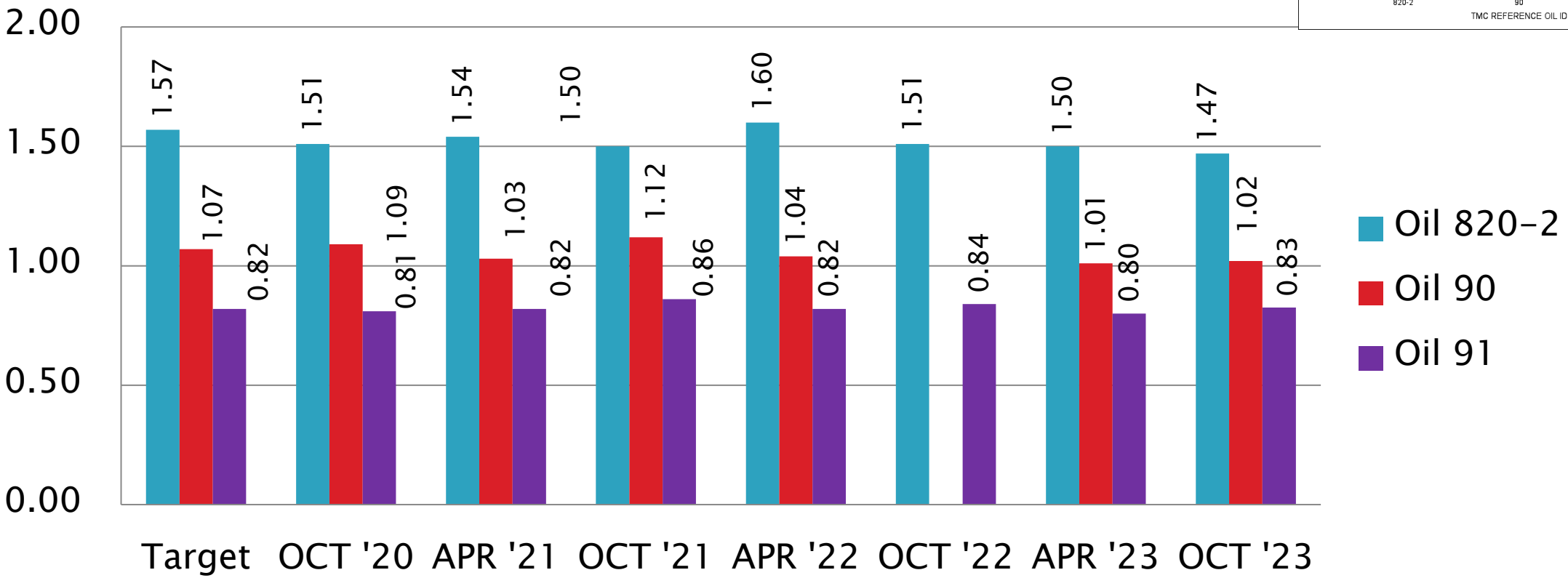
CUSUM Severity Analysis



21OCT23:20:26

D874: Sulfated Ash

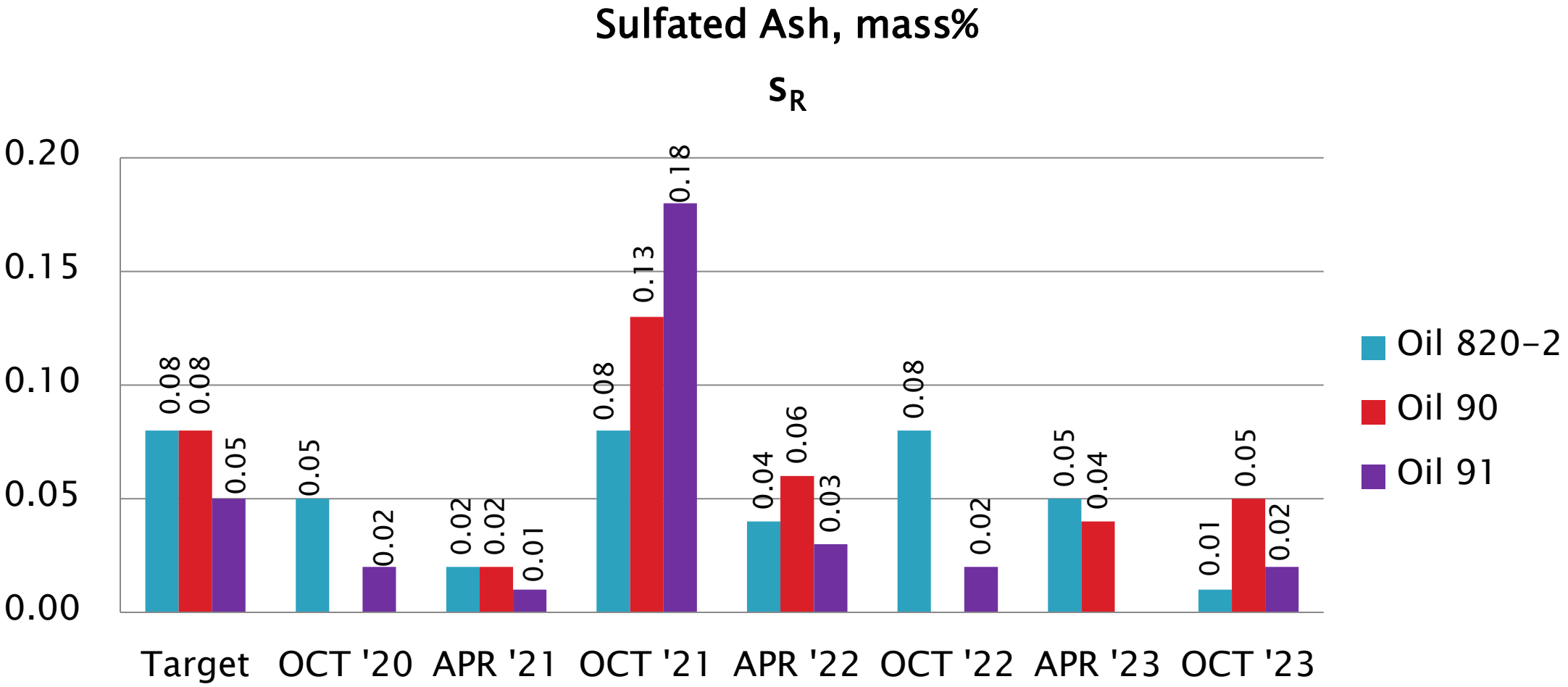




April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

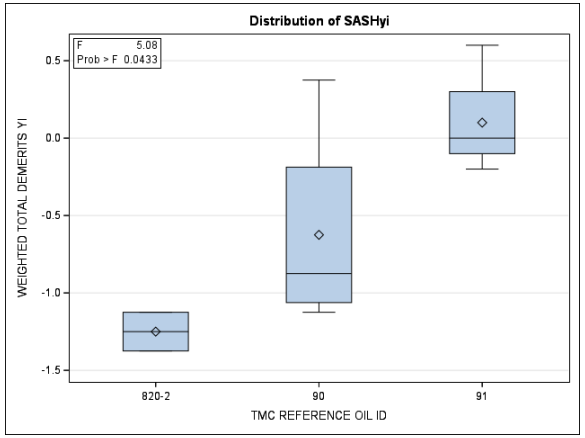
D874: Sulfated Ash



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D874: Sulfated Ash



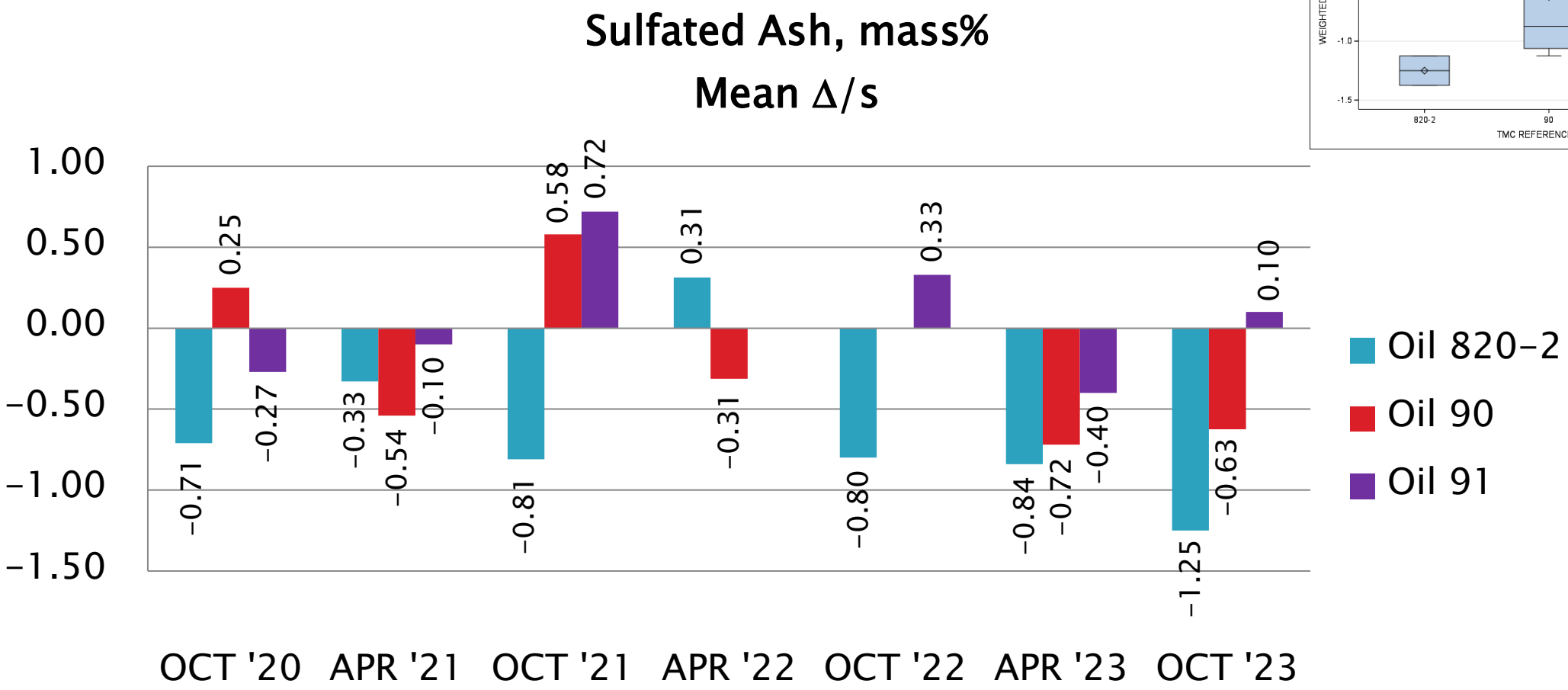


TABLE of CONTENTS

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D02.B0.07
TMC Monitored Tests

ASTM D 5133

Gelation Index (GI)

April 1, 2023 – September 30, 2023

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

A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual Report)

Test	Labs	Stands
D5133	9 (+0)	52 (-3)
*As of 9/30/2023		

D5133: Gelation Index

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	57
Failed Calibration Test	OC	5
Operationally Invalidated by Lab	LC / LS / XC / XS	0
Operationally Invalidated After Initially Reported as Valid	RC/RS	0
Acceptable Discrimination Tests	AS	18
Failed Discrimination Tests	OS	0
Informational Runs	NN / MN	9
Total		**89**

Number of Labs Reporting Data: 9 (previous 9)
Fail Rate of Operationally Valid Calibration Tests: 8.8% (previous 17%)
Fail Rate of Operationally Valid Discrimination Tests: 0% (previous 15%)

Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

D5133: Gelation Index

Statistically Unacceptable Calibration Tests (OC)	No. Of Tests
Gelation Index Severe	0
Gelation Index Mild	5
Total	**5**

- Of the Five "OC" tests
  - 0-GIC18
  - 5-GIA17
  - 0-1009
- Three between -1.96 and -3.0 s from target
- One greater than -3.0 s from target

D5133: Gelation Index

Statistically Unacceptable Discrimination Tests (OS)	No. Of Tests
Gelation Index Severe	0
Gelation Index Mild	0
Total	**0**

- There were no (zero) Failing Discrimination Runs

D5133: Gelation Index

Tests Excluded From Statistics (Operationally or Otherwise)	Validity Code	No. Tests
Invalidated Runs	LC, LS, RC, RS	0
Aborted Runs	XC, XS	0
Informational Runs (Acceptable Result)	NN	7
Informational Runs (Unacceptable Result)	MN	2
Total		**9**

- No (zero) Invalidated or Aborted runs this period
- Nine requests for Informational (non-blind) runs

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	-----
10/1/18 through 3/31/19	27	24	1.65	0.13
4/1/19 through 9/30/19	47	44	1.40	-0.25
10/1/19 through 3/31/20	41	37	2.45	-0.24
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

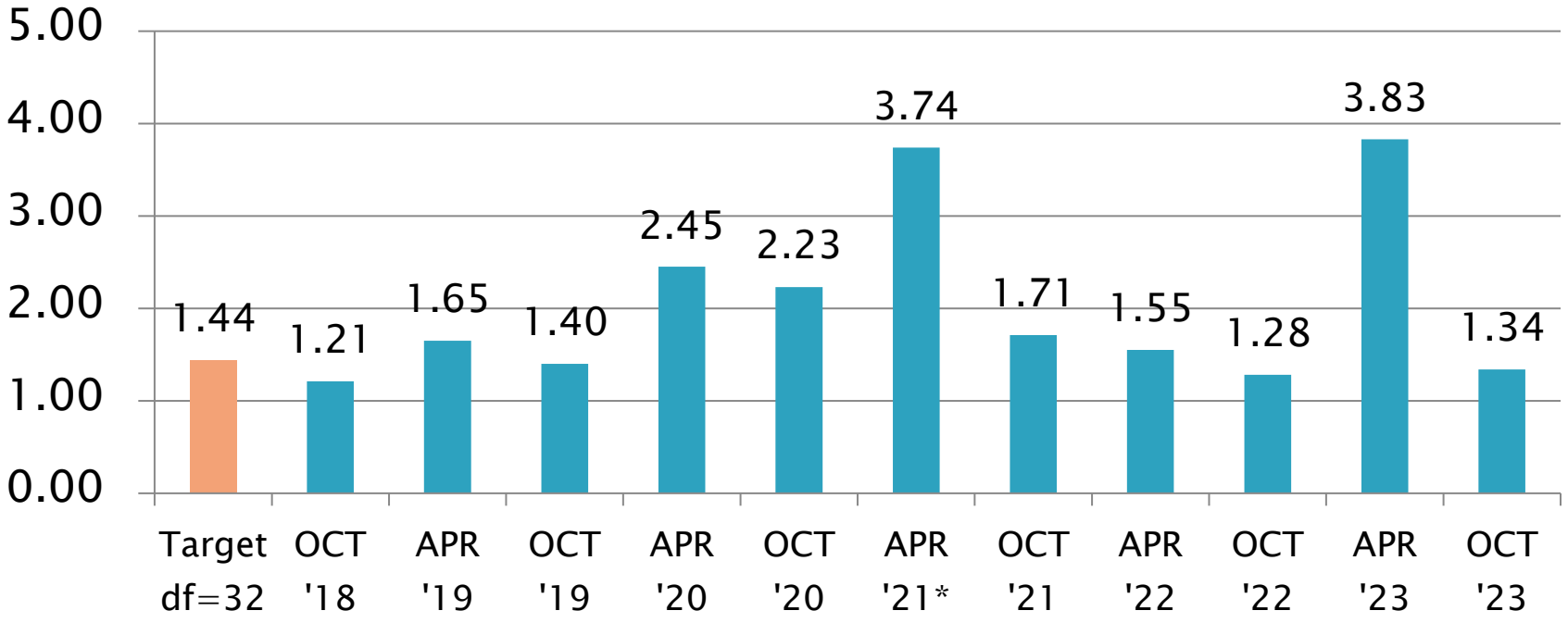
[1]Target precision updated to current reference oils GIA17 and 1009 only
[2]Changed from bath to head-based monitoring scheme 10/1/20

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D5133 Precision Estimates

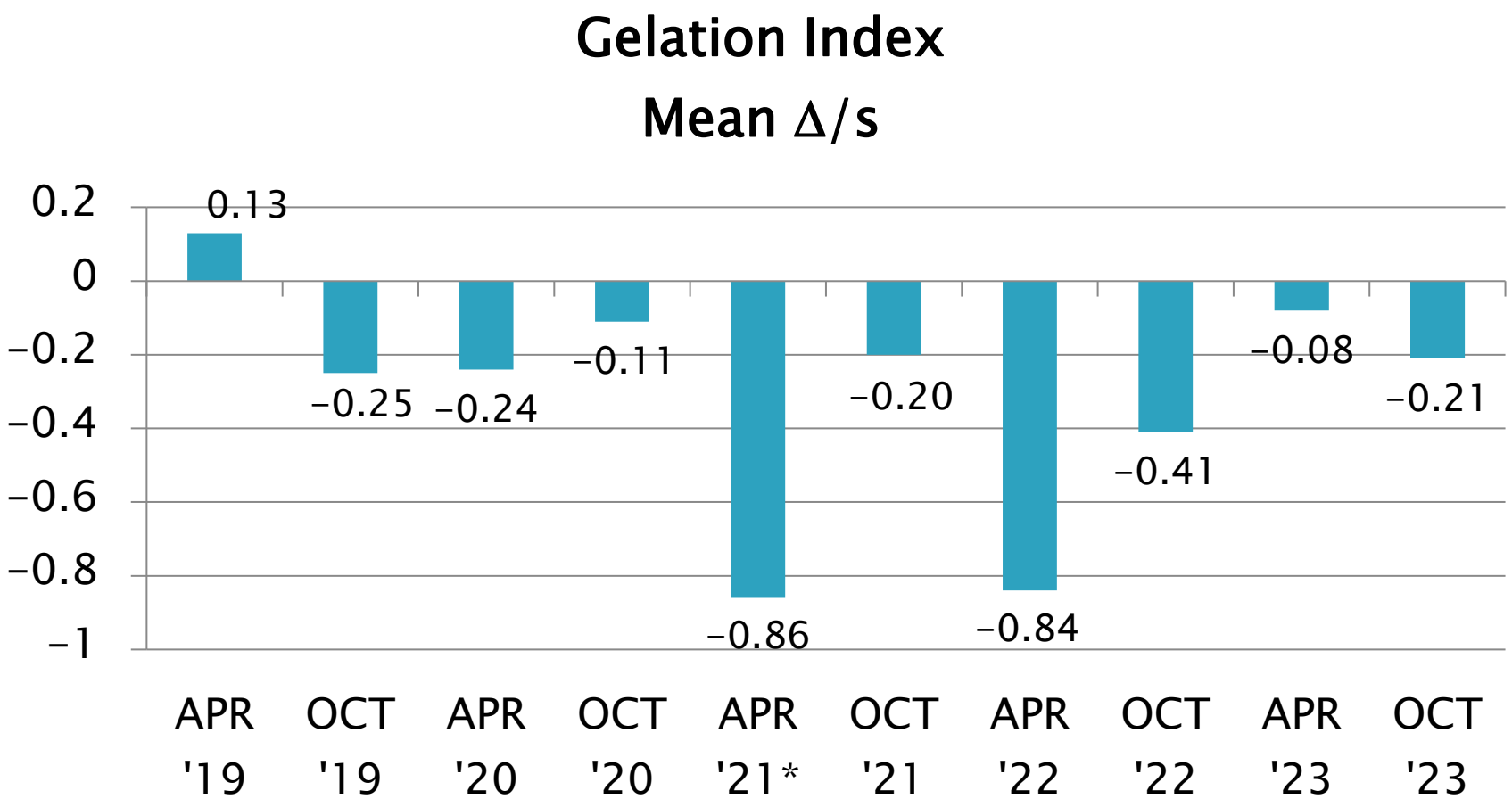
Gelation Index

Pooled s



*Changed from bath to head-based monitoring scheme

D5133 Severity Estimates



*Changed from bath to head-based monitoring scheme

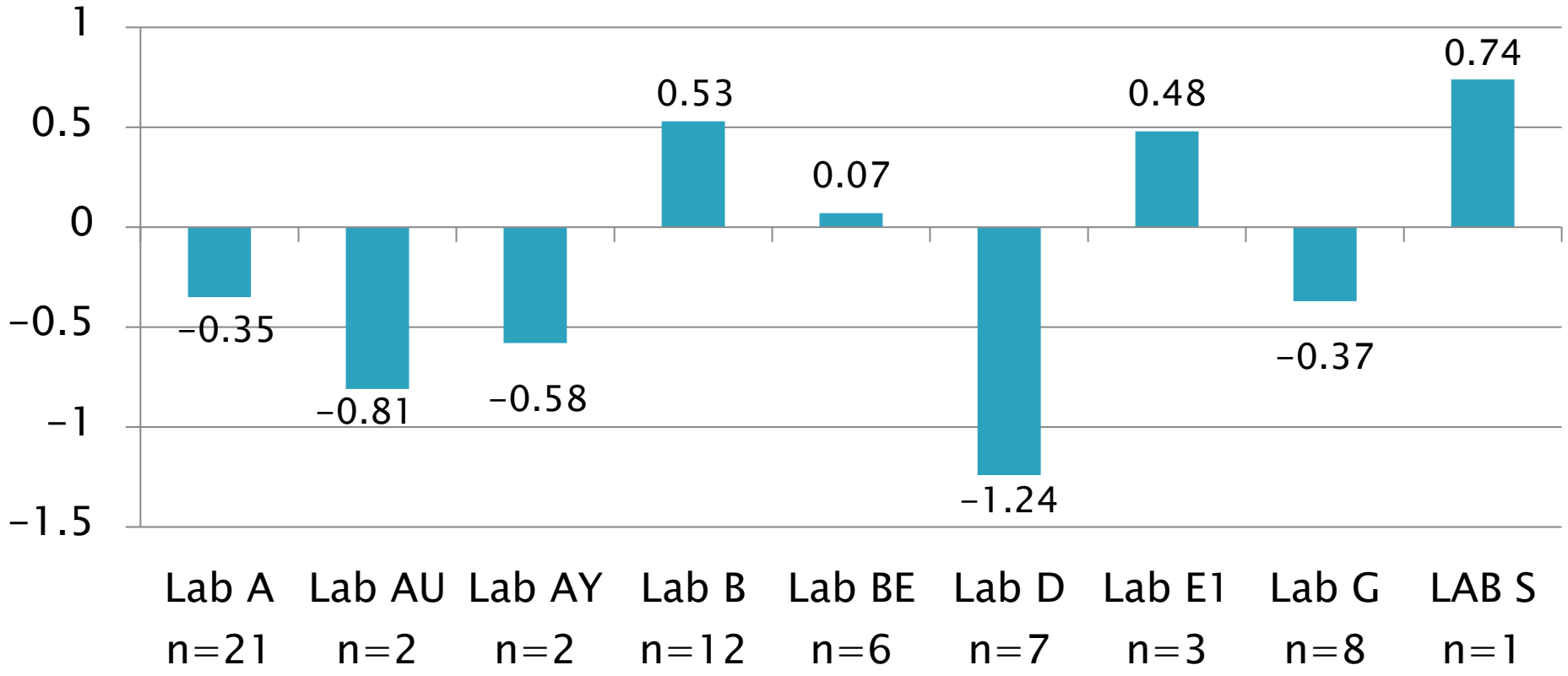
April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D5133 Lab Severity Estimates

Gelation Index

Mean Δ/s



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D5133: Gelation Index

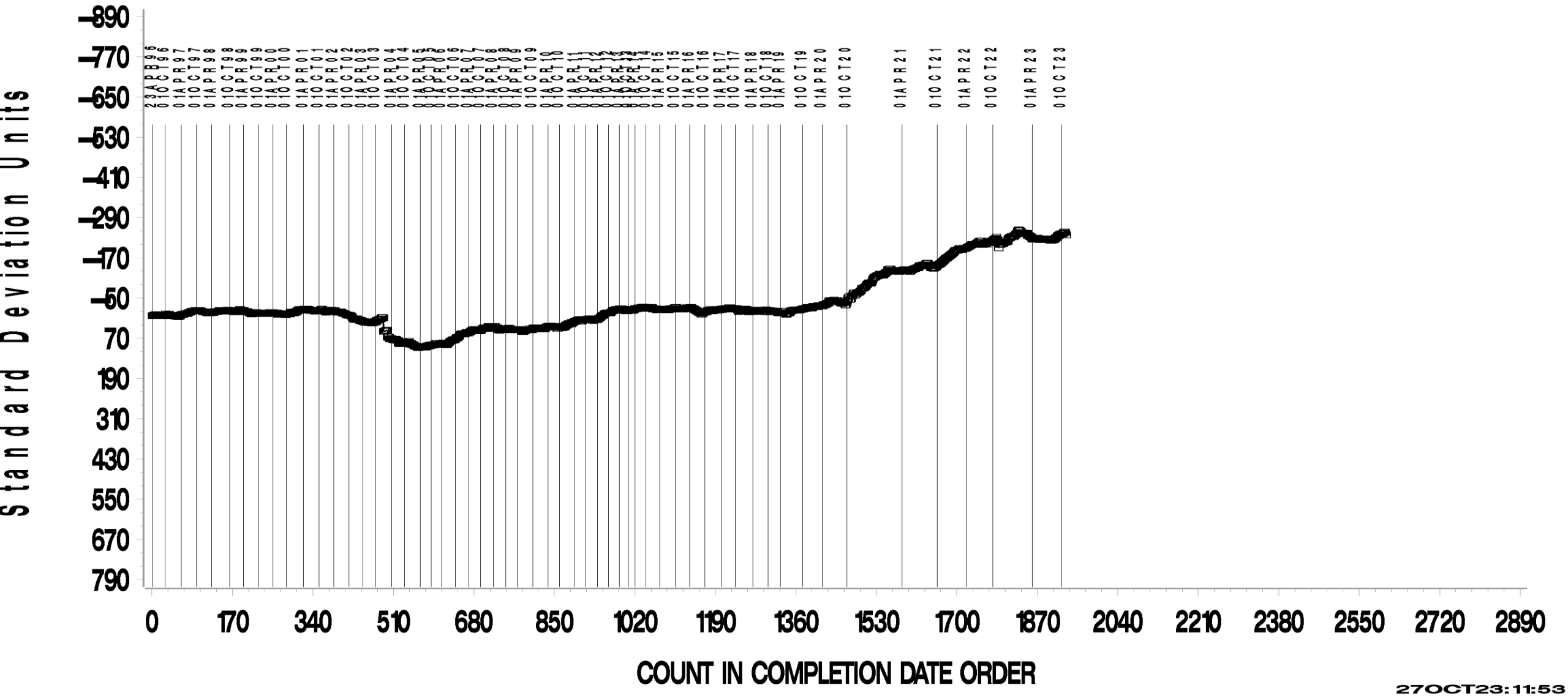
- Fail rate of operationally valid tests improved to 8.8% this period
  - Fail rate last period was 17%
    - No (zero) operationally valid discrimination runs failed this period
- Precision (Pooled s) returned to target after poor precision last semester
- Performance (Mean Δ/s) is -0.21 s, slightly more mild than last period
- Reference Oil GIC18 has now been included in calibration testing for two semesters
  - Twenty-nine GIC18 tests were completed this semester (7 Labs)
  - GIC18 targets will be revisited now that >30 test have been completed
    - GIC18 replaced RO 58 which was reclassified as a discrimination oil

D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

GELATION INDEX

CUSUM Severity Analysis



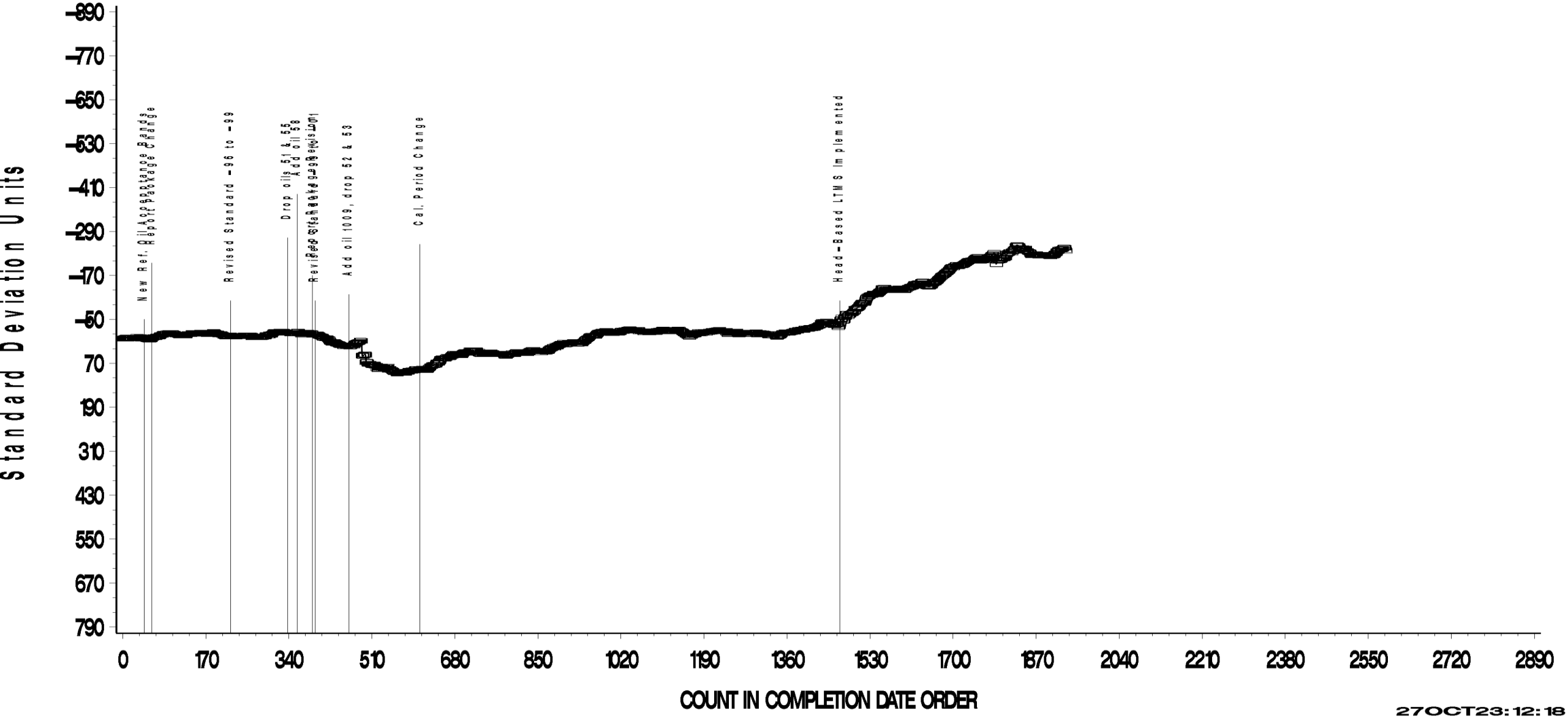
27OCT23:11:53

D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

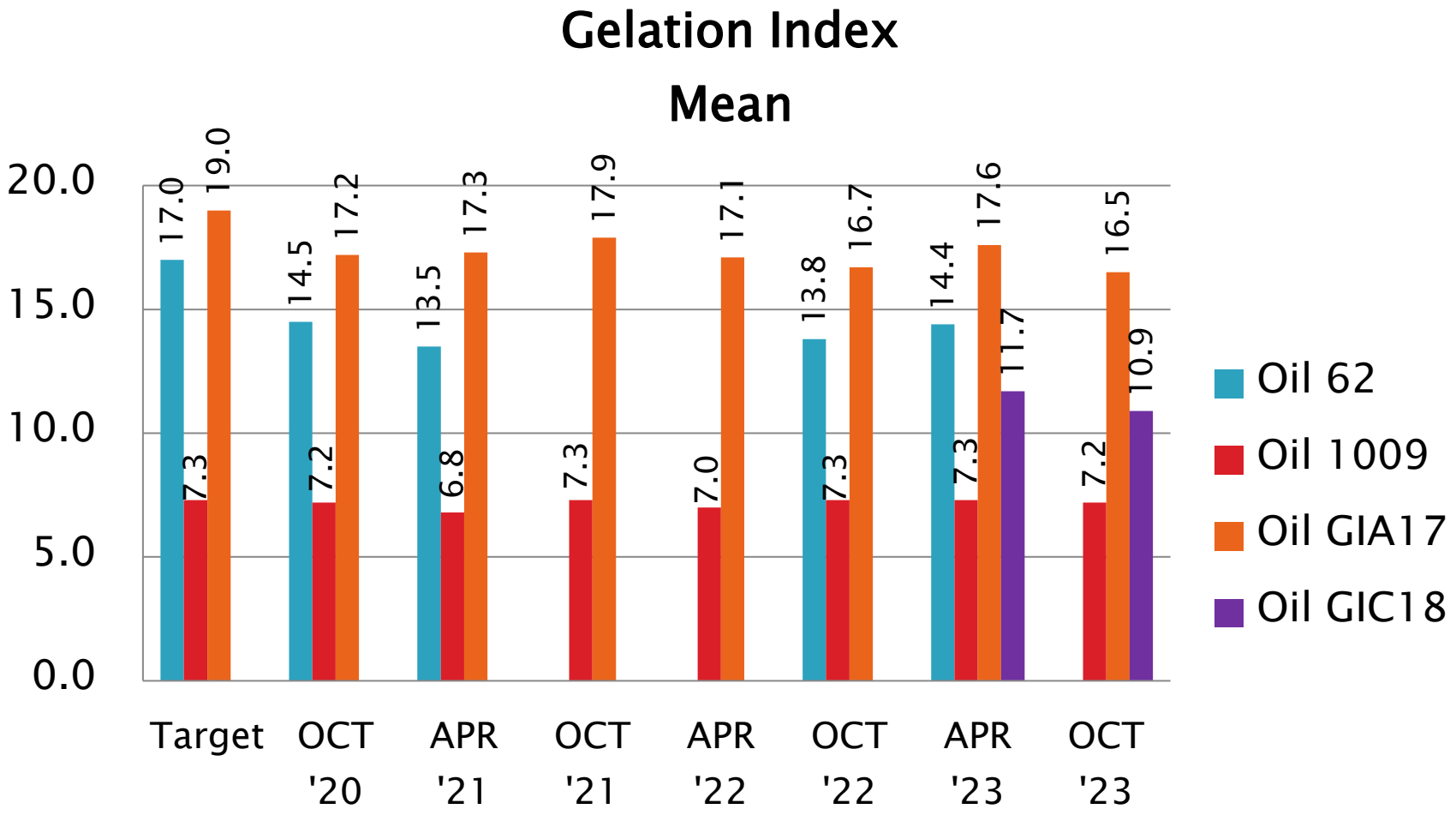
GELATION INDEX

CUSUM Severity Analysis



27OCT23:12:18

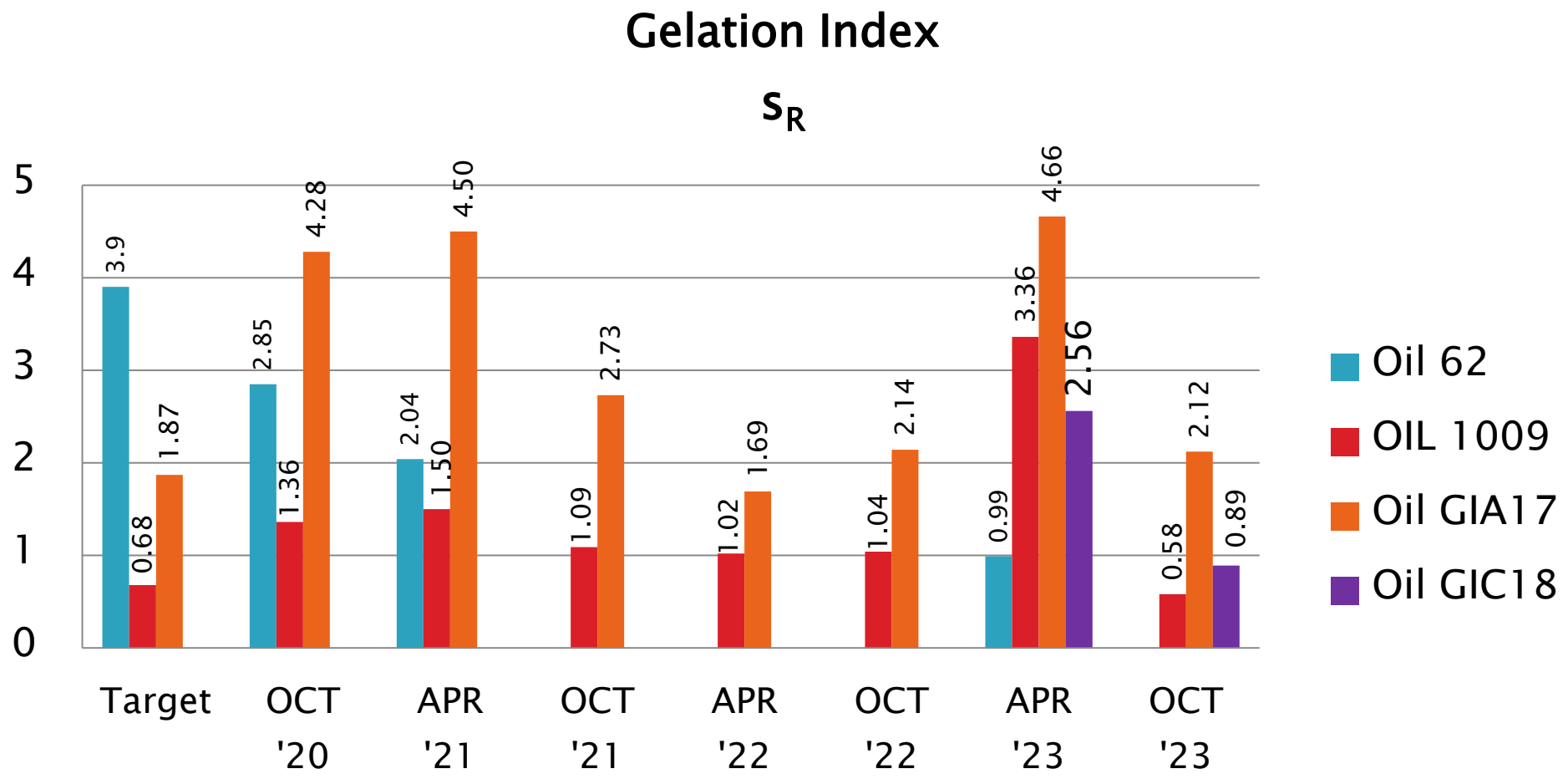
D5133 Performance by Oil



April 1, 2023 – September 30, 2023

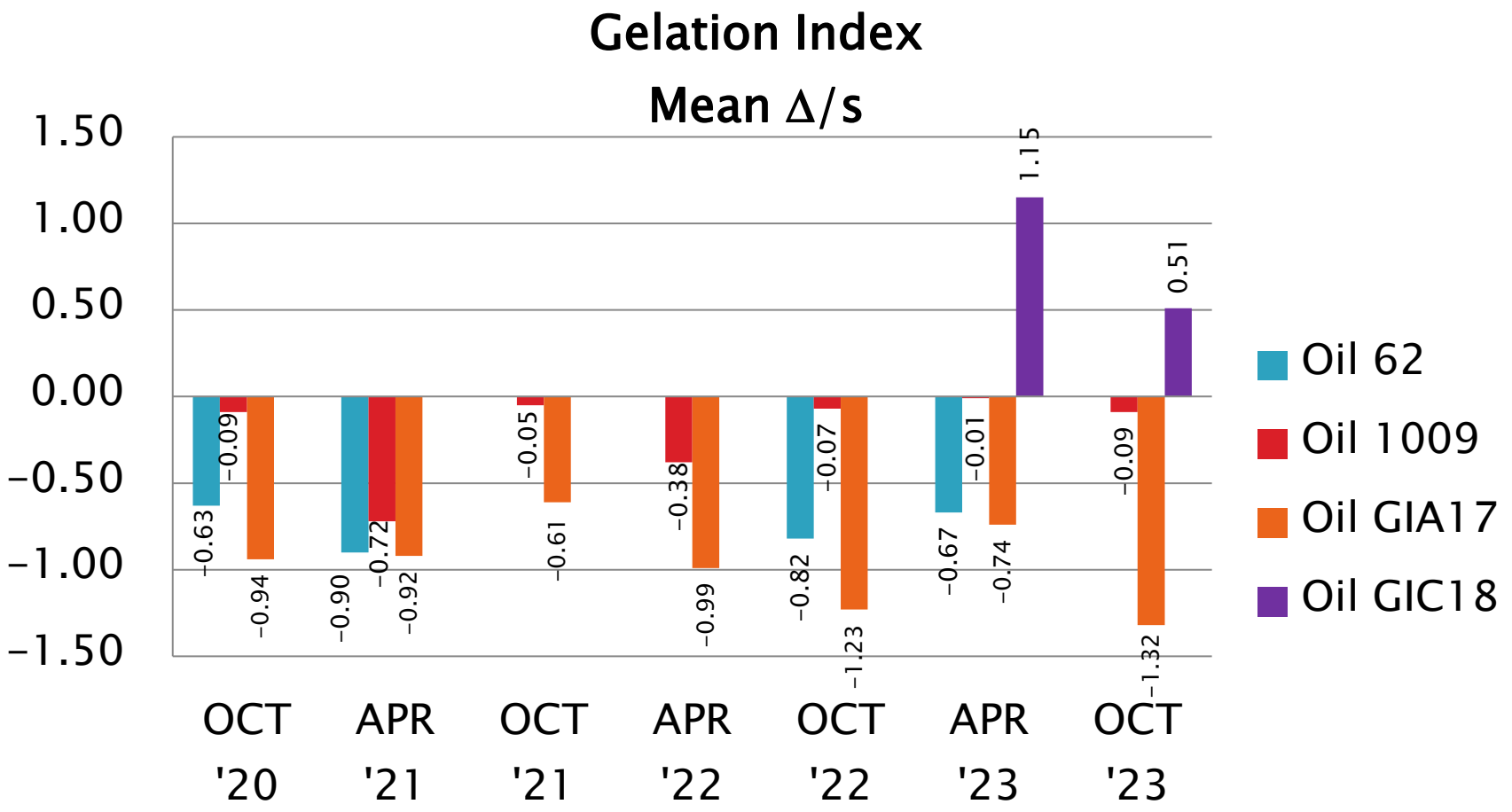
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D5133 Performance by Oil



April 1, 2023 – September 30, 2023

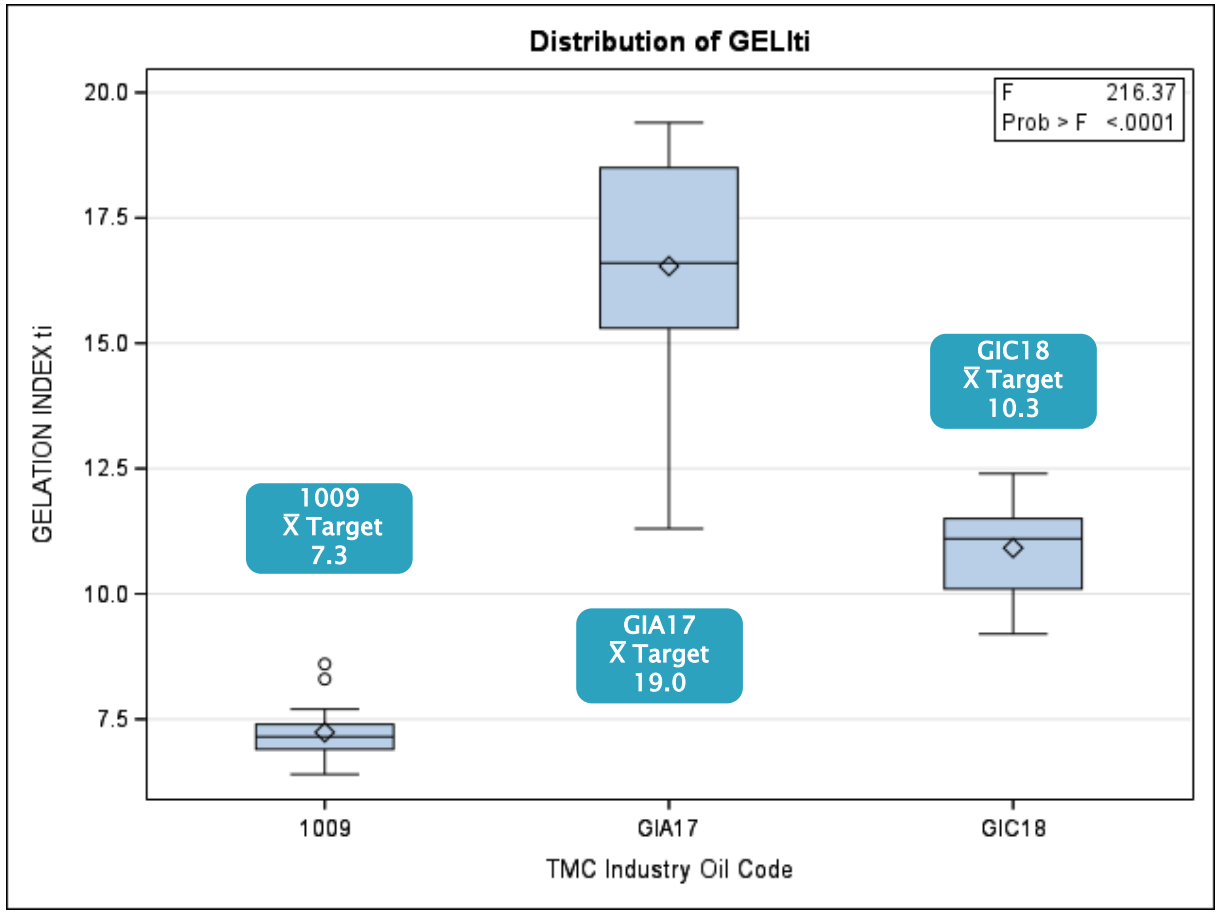
D5133 Performance by Oil



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

ASTM D5133 (GI): Apr23 – Sept23 Results



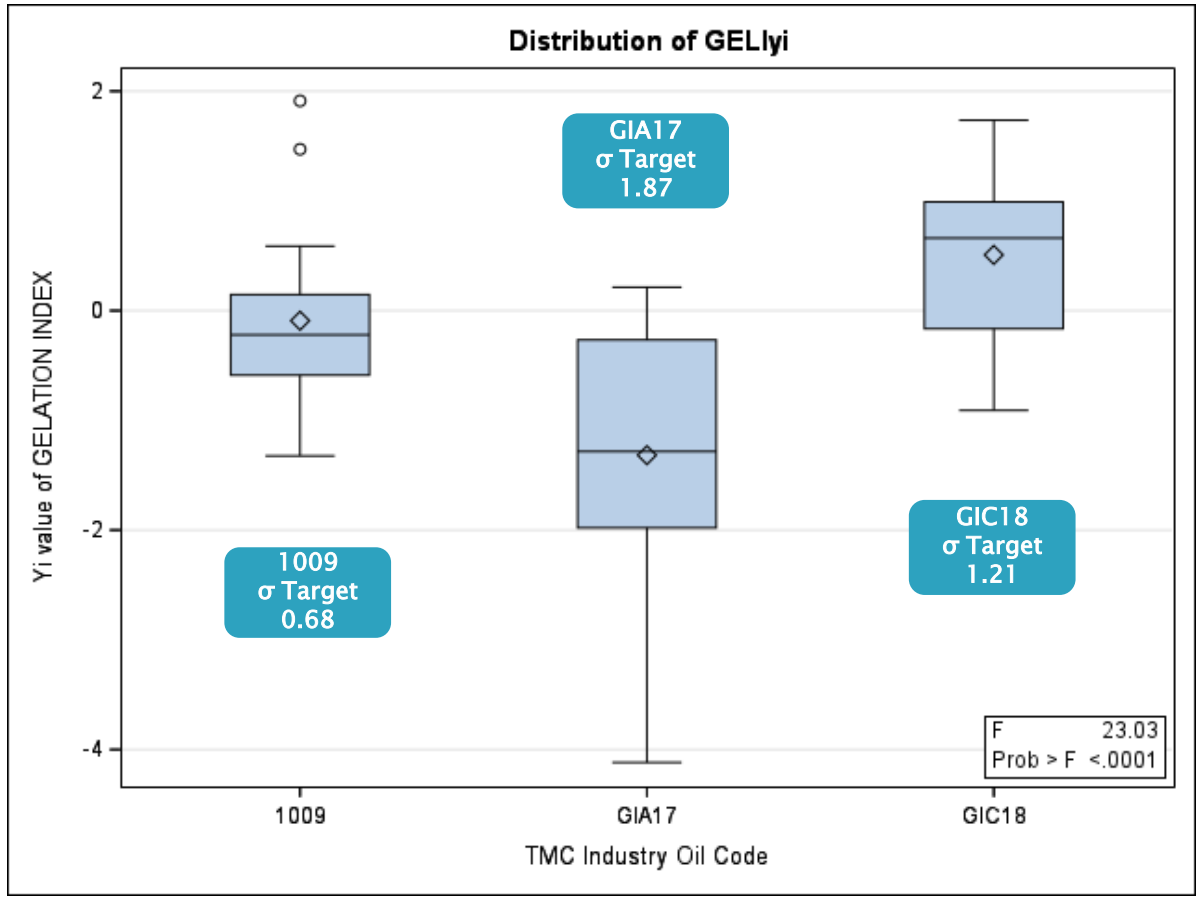


TABLE of CONTENTS

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D02.B0.07
TMC Monitored Tests

ASTM D 5800

NOACK Volatility

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual Report)

Test	Labs	Stands
D5800	14 (+3)	36 (+11)

*Between 4/1/2023 and 9/30/2023

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	151
Failed Calibration Test	OC	18
Operationally Invalidated by Lab	LC	5
Acceptable Shakedown Run	NN	2
Unacceptable Shakedown Run	MN	1
Total		**177**

Number of Labs Reporting Data: 14
Fail Rate of Operationally Valid Tests: 10.65%

April 1, 2023 – September 30, 2023

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Statistically Unacceptable Tests (OC)	No. Of Tests
Ei Level 3 Alarm Mild	4
Ei Level 3 Alarm Severe	3
Zi Level 2 Severity Alarm Severe	11

- The 18 OC tests were on seven different rigs at seven labs.
- Two operationally valid tests exceeded ±3.0 s this period.

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Failed (OC) Details	Procedure	Model	No. Tests
Zi Level 2 Alarm: Rig (BD4*) Severe	B	NCK25G	7
Zi Level 2 Alarm: Rig (AY2) Severe	B	NCK25G	3
Zi Level 2 Alarm: Rig (AZ1) Severe	B	NCK25G	1
Ei Level 3 Alarm Mild & Severe: Rig (D5) too imprecise to predict SA	D	NS2	2
Ei Level 3 Alarm Mild: Rig (AY2) too imprecise to predict SA	B	NCK25G	1
Ei Level 3 Alarm Mild & Severe: Rig (A17) too imprecise to predict SA	D	NS2	2
Ei Level 3 Alarm Severe: Rig (G7) too imprecise to predict SA	B	NCK25G	1
Ei Level 3 Alarm Mild: Rig (V4) too imprecise to predict SA	D	NS2	1
Total			**18**
Fail Rate of Operationally Valid Tests: 10.65%			
*Owner of Unit BD4 has removed this Rig from LTMS monitoring			

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Operationally Invalid Tests (LC)

Five operationally invalid calibration runs were reported this period

- Test was invalidated due to Power Outage
- Test invalidated when determined test ran beyond 60 minutes
- Test invalidated by TMC because no Daily QC was run with Calibration
- Test invalidated by lab when cleaning material found in orifice after completion
- Test invalidated when lab determined that wrong oil was run

D5800 Technical Memos

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

D5800: Evaporation Loss of Lubricating Oil by Noack Method

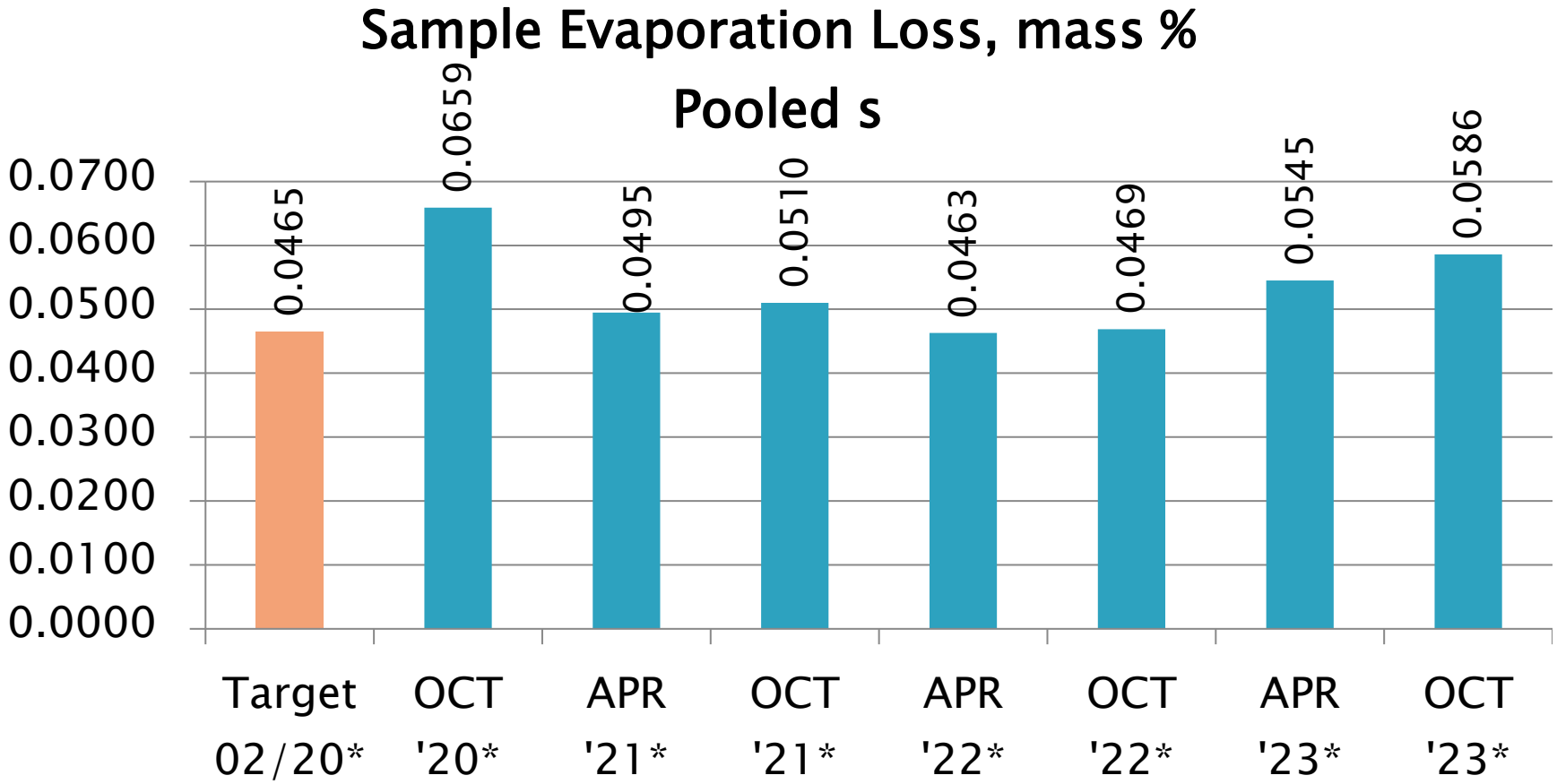
Period Precision and Severity Estimates

Sample Evaporation Loss, mass %	n	df	Pooled s	Mean Δ/s
Targets Effective 02/07/20[1]	78	75	0.0465	-----
4/1/19 through 9/30/19	164	161	0.81	0.65
10/1/19 through 3/31/20[1]	146	143	0.0503	0.54
4/1/20 through 9/30/20[1]	136	133	0.0659	0.35
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

[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

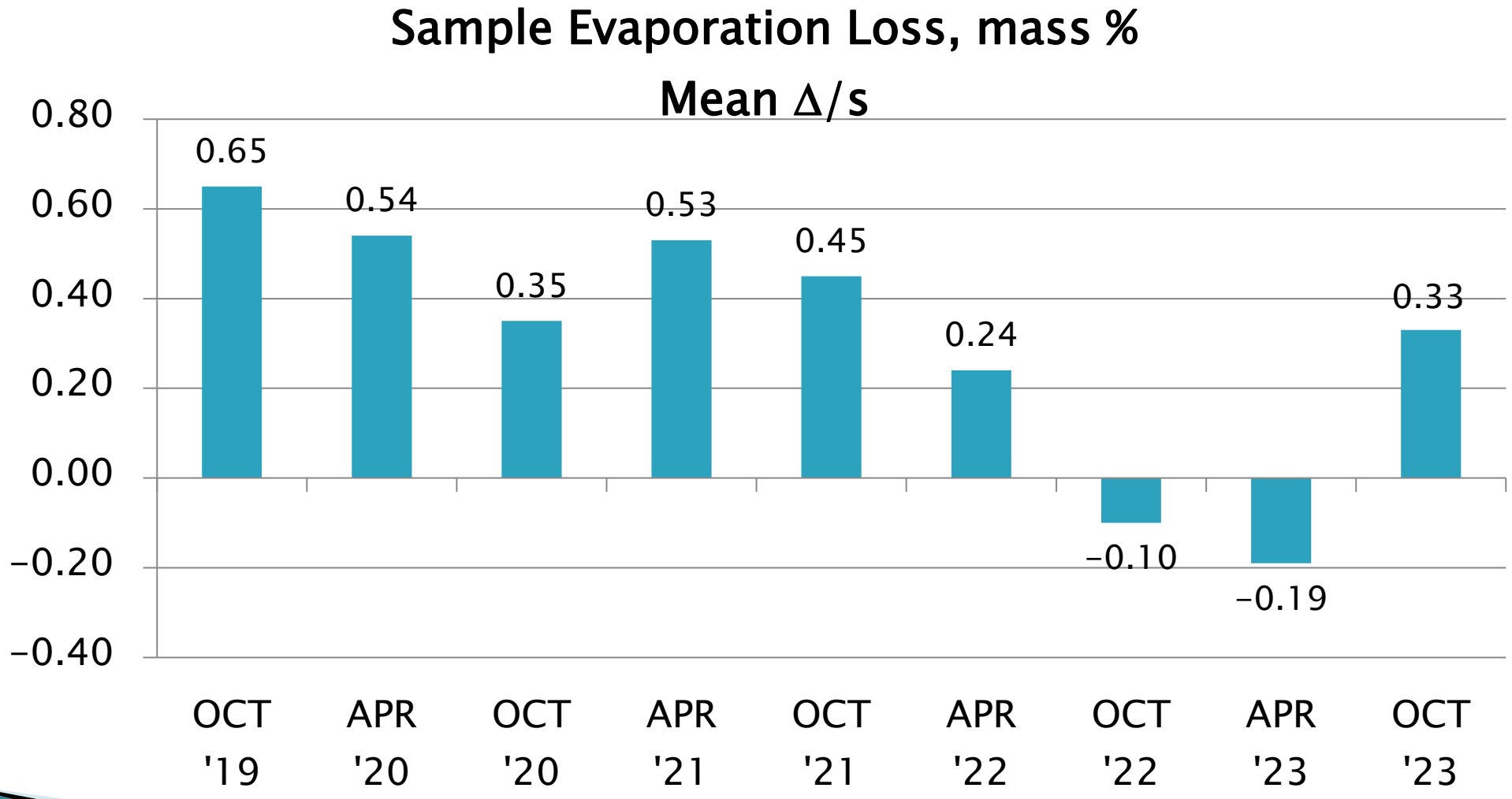
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

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.

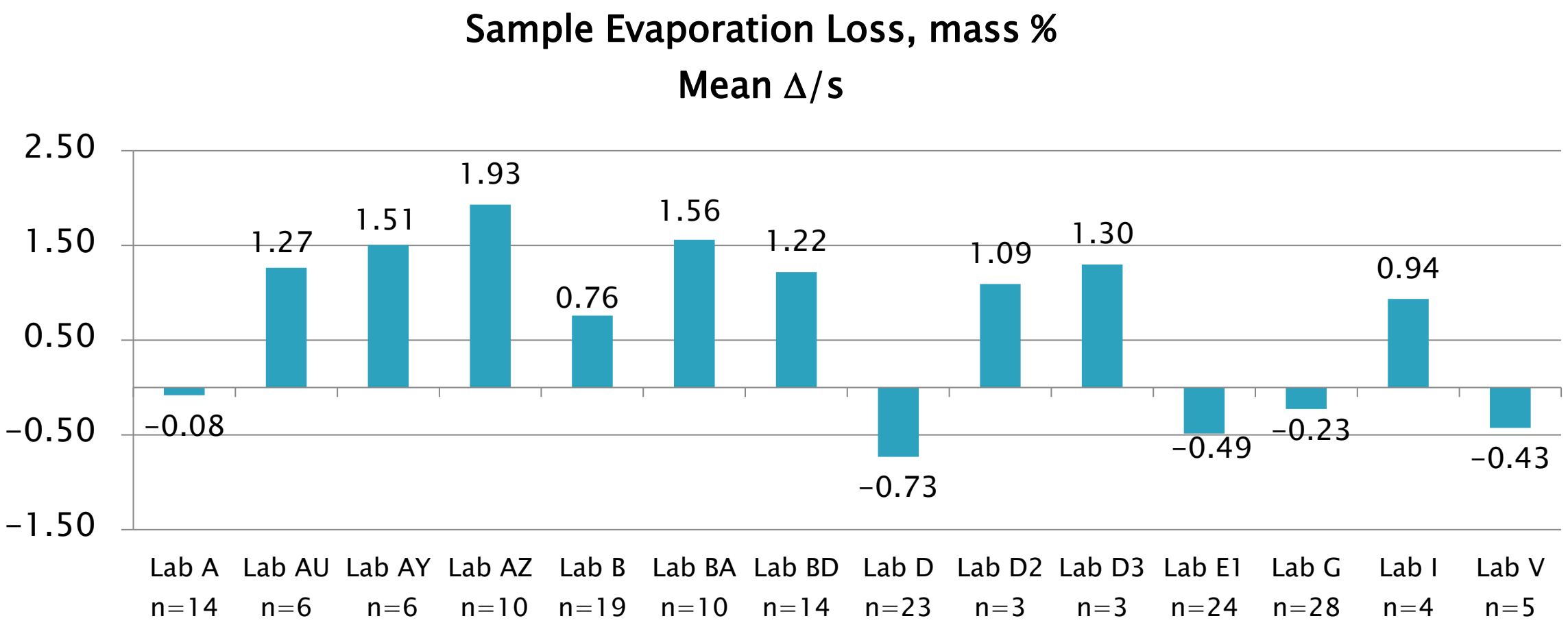
D5800 Severity Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

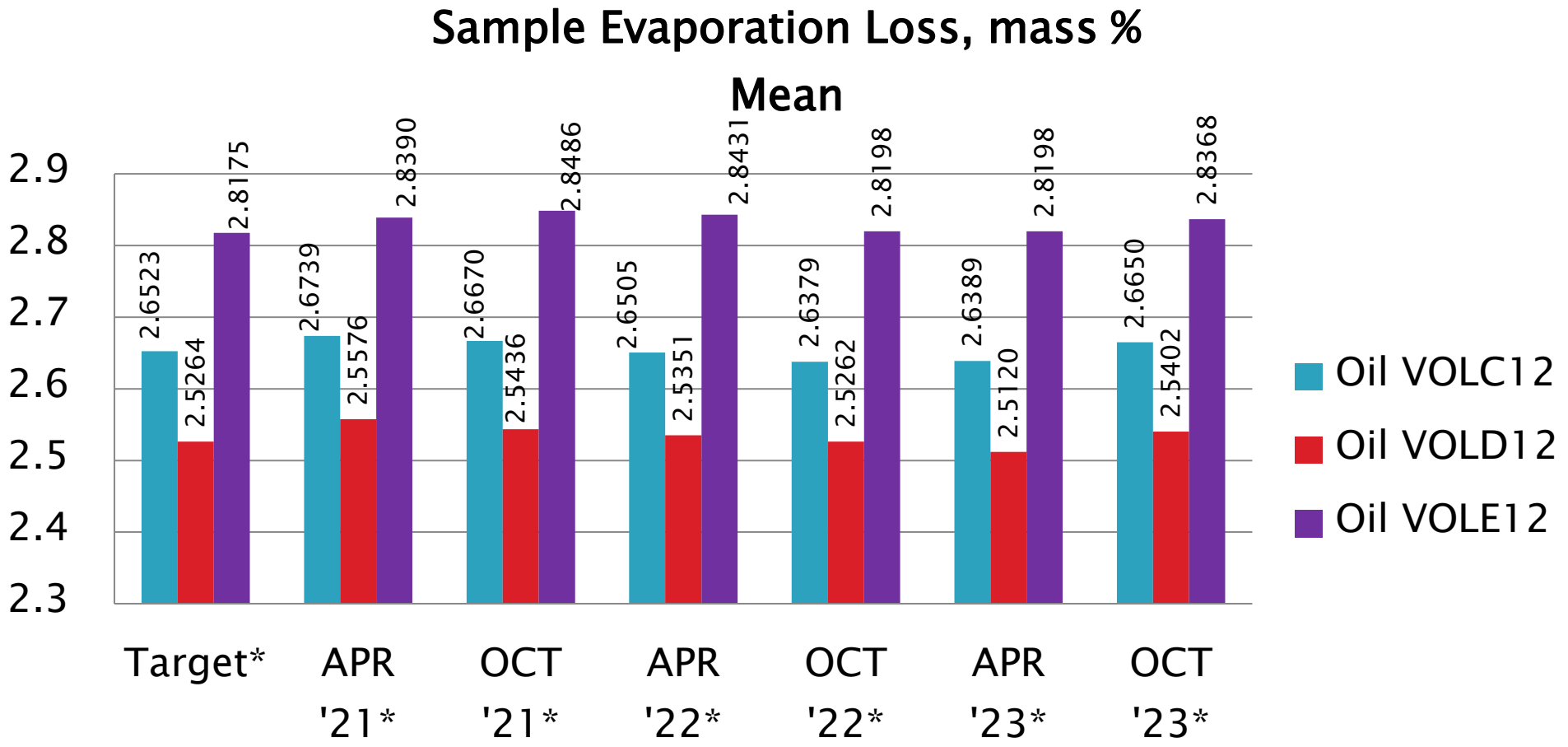
D5800 Lab Severity Estimates



April 1, 2023 – September 30, 2023

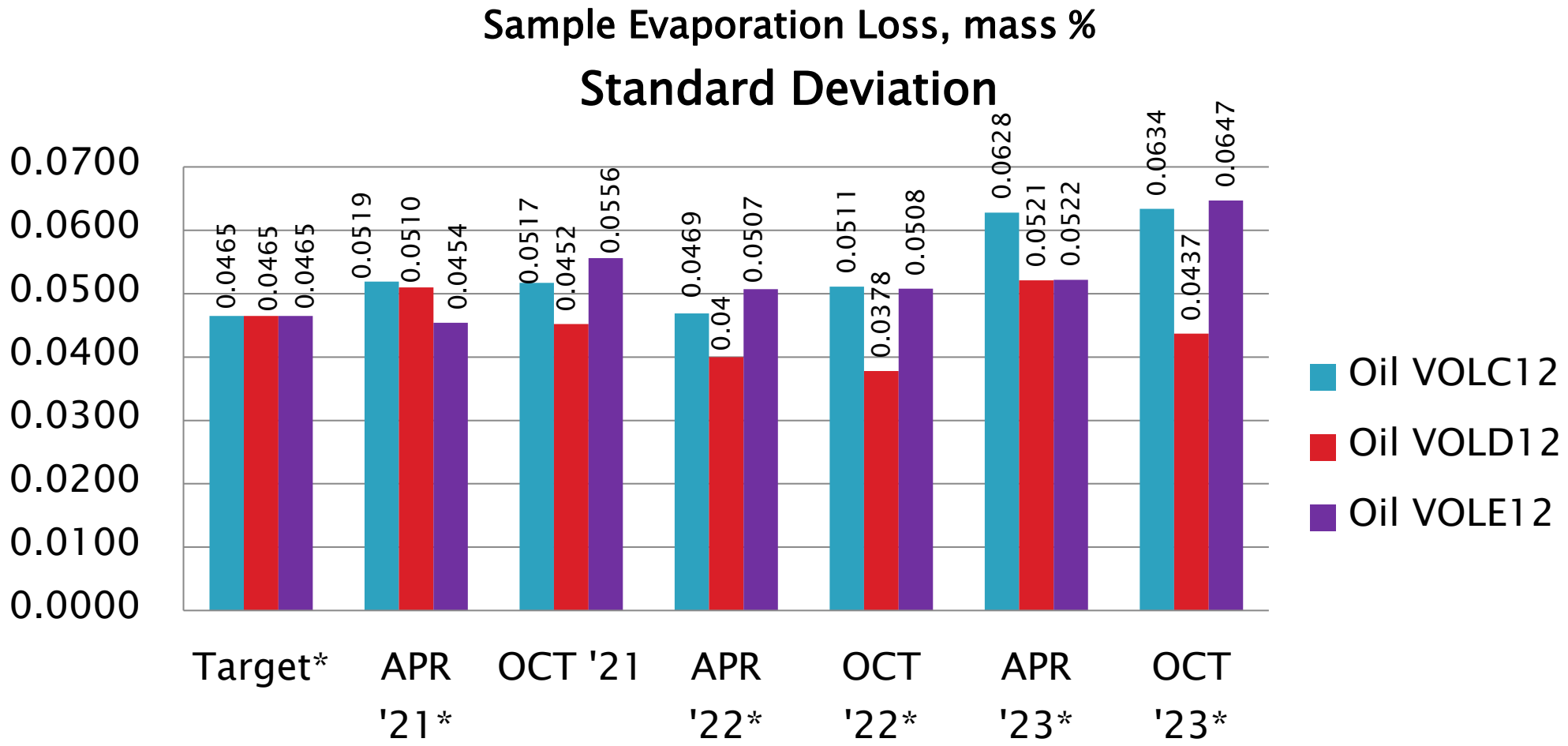
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D5800 Performance by Oil



*Results transformed to natural log per updated LTMS 20200207

D5800 Performance by Oil

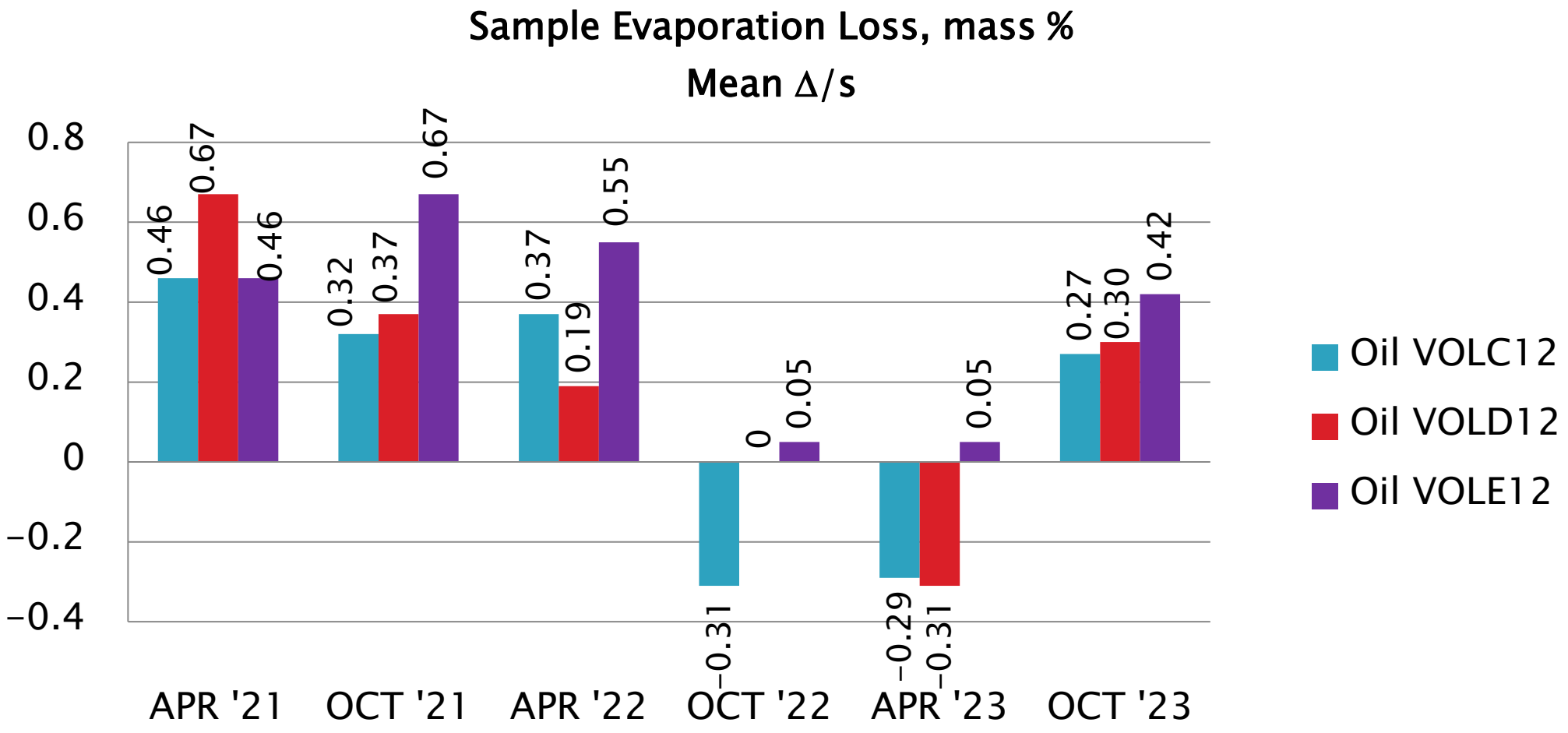


*Results transformed to natural log per updated LTMS 20200207

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D5800 Performance by Oil

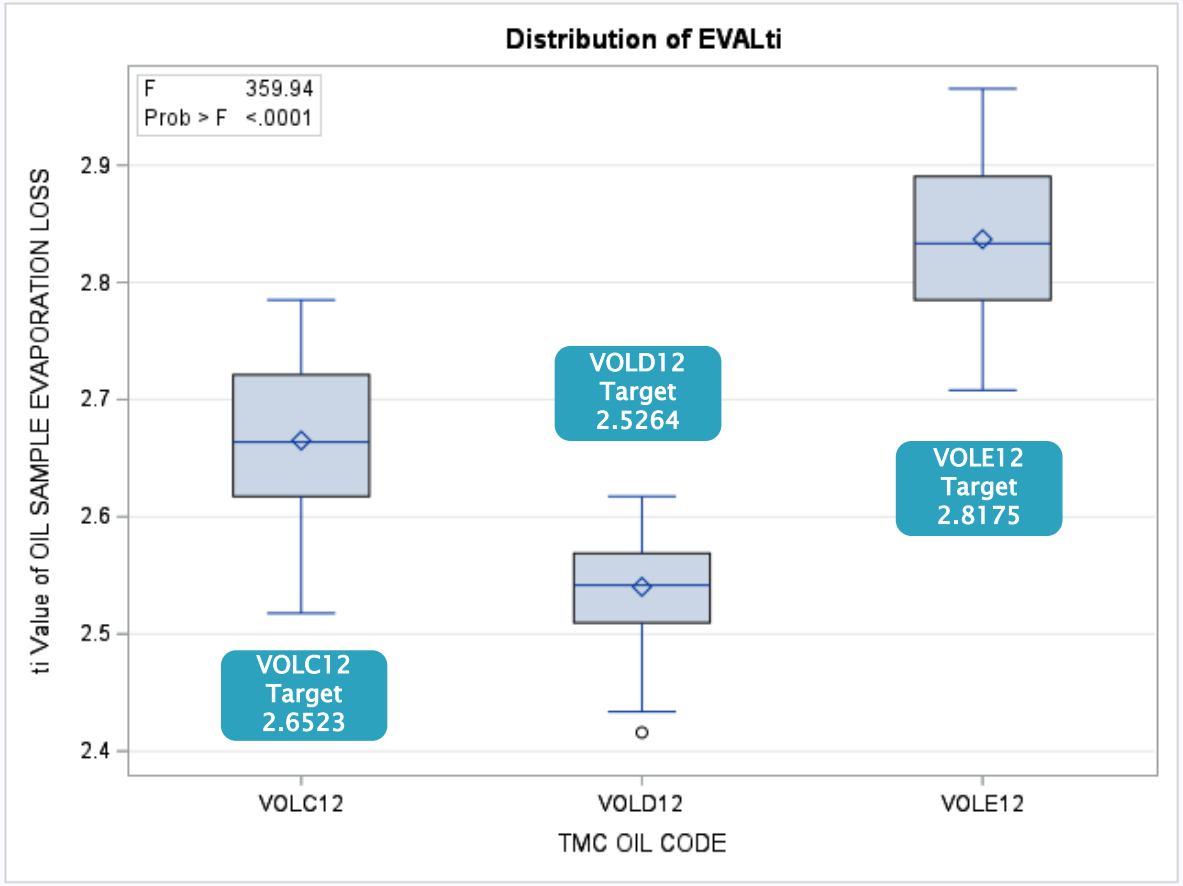


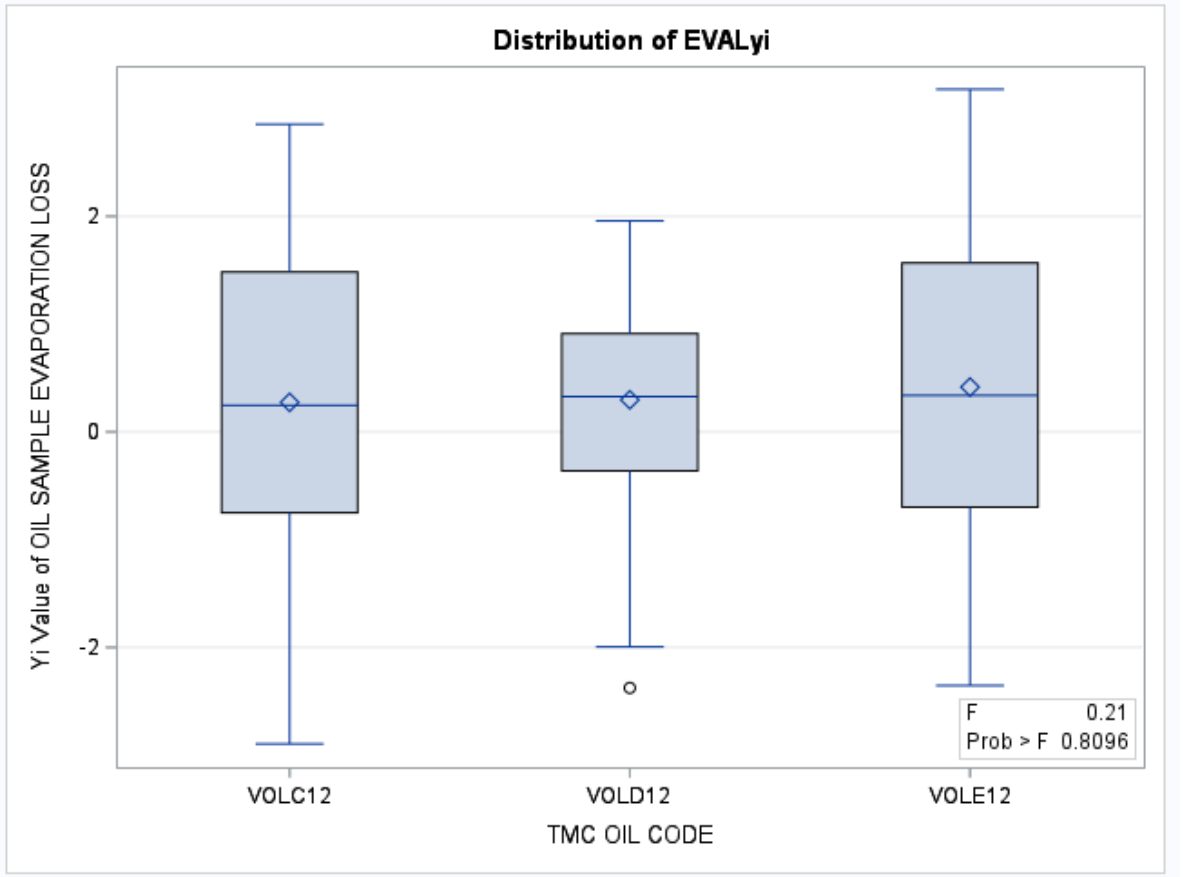
April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

ALL

All Procedures: Apr23 – Sept23 Results

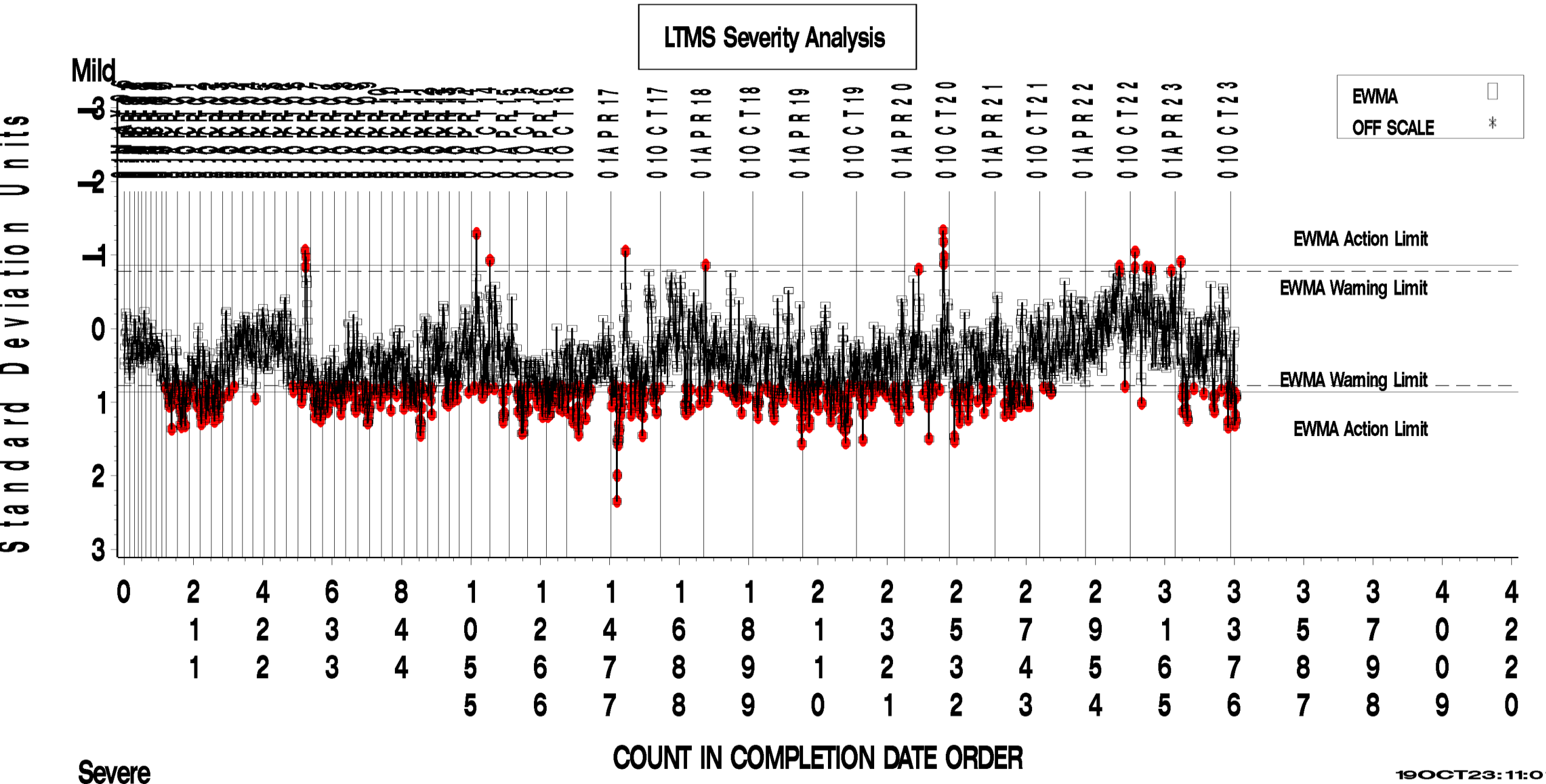




D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

ALL

EVAPORATION LOSS, MASS%

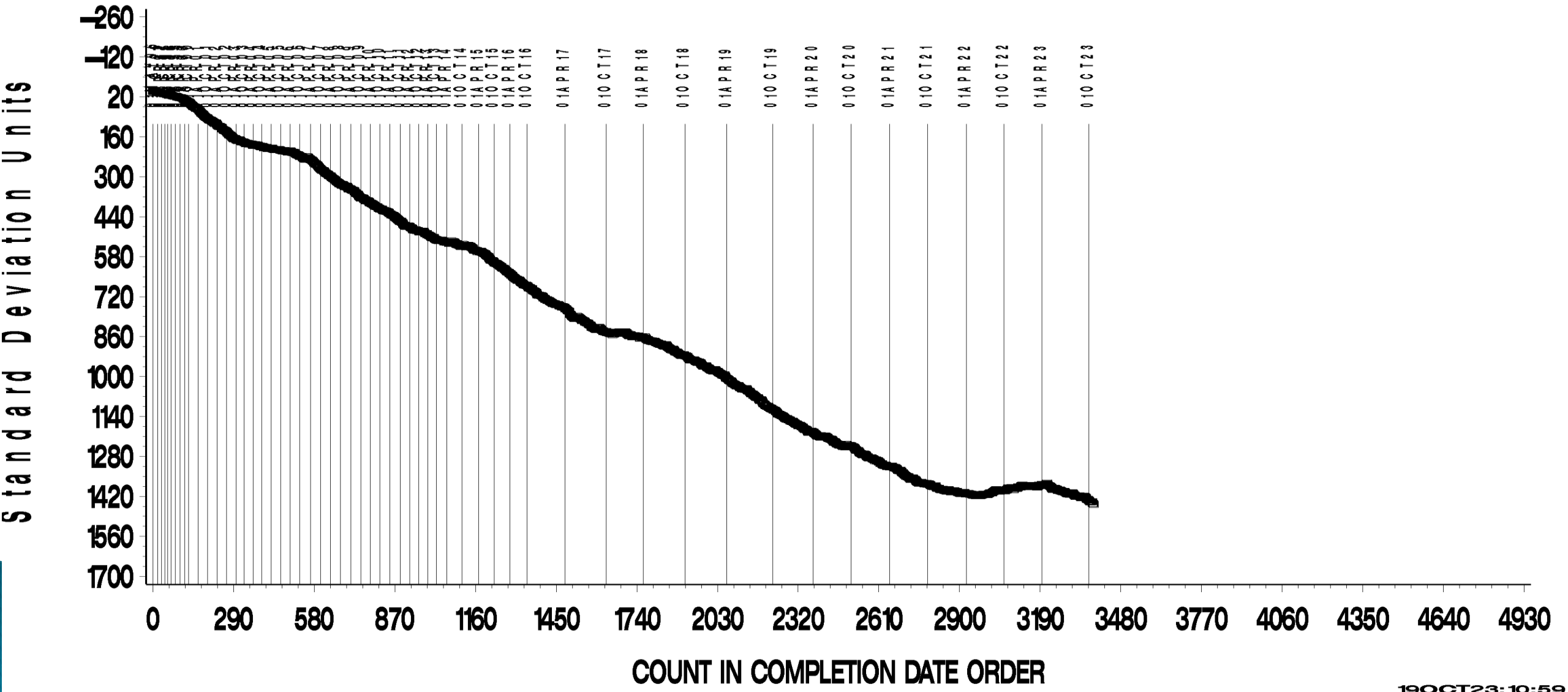


D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

ALL

EVAPORATION LOSS, MASS%

CUSUM Severity Analysis



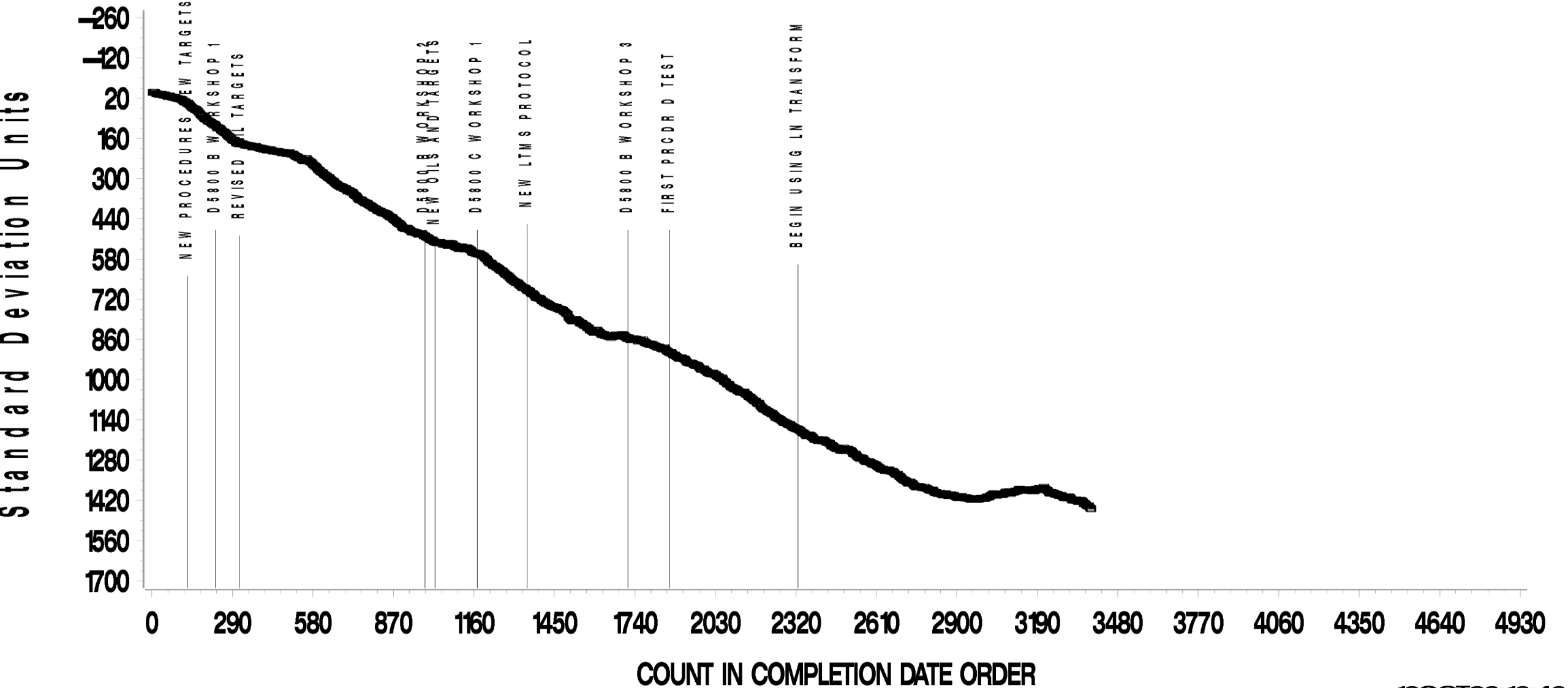
19OCT23:10:59

D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

ALL

EVAPORATION LOSS, MASS%

CUSUM Severity Analysis



19OCT23:16:46

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

Performance Comparison
Sample Evaporation Loss, Mass %

Procedure	n	df	Pooled s	Mean Δ/s
Procedure B (NCK2, NCK25G)	102	99	0.0476	0.92
Procedure D (NS2)	67	64	0.0460	-0.56

Model	n	df	Pooled s	Mean Δ/s
NCK2 (B)	5	2	0.0079	-0.28
NCK25G (B)	97	94	0.0465	0.98
NS2 (D)	67	64	0.0460	-0.56

1 (+0) Procedure B NCK2 Rig
22 (+7) Procedure B NCK25G Rigs
13 (+4) Procedure D NS2 Rigs

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

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

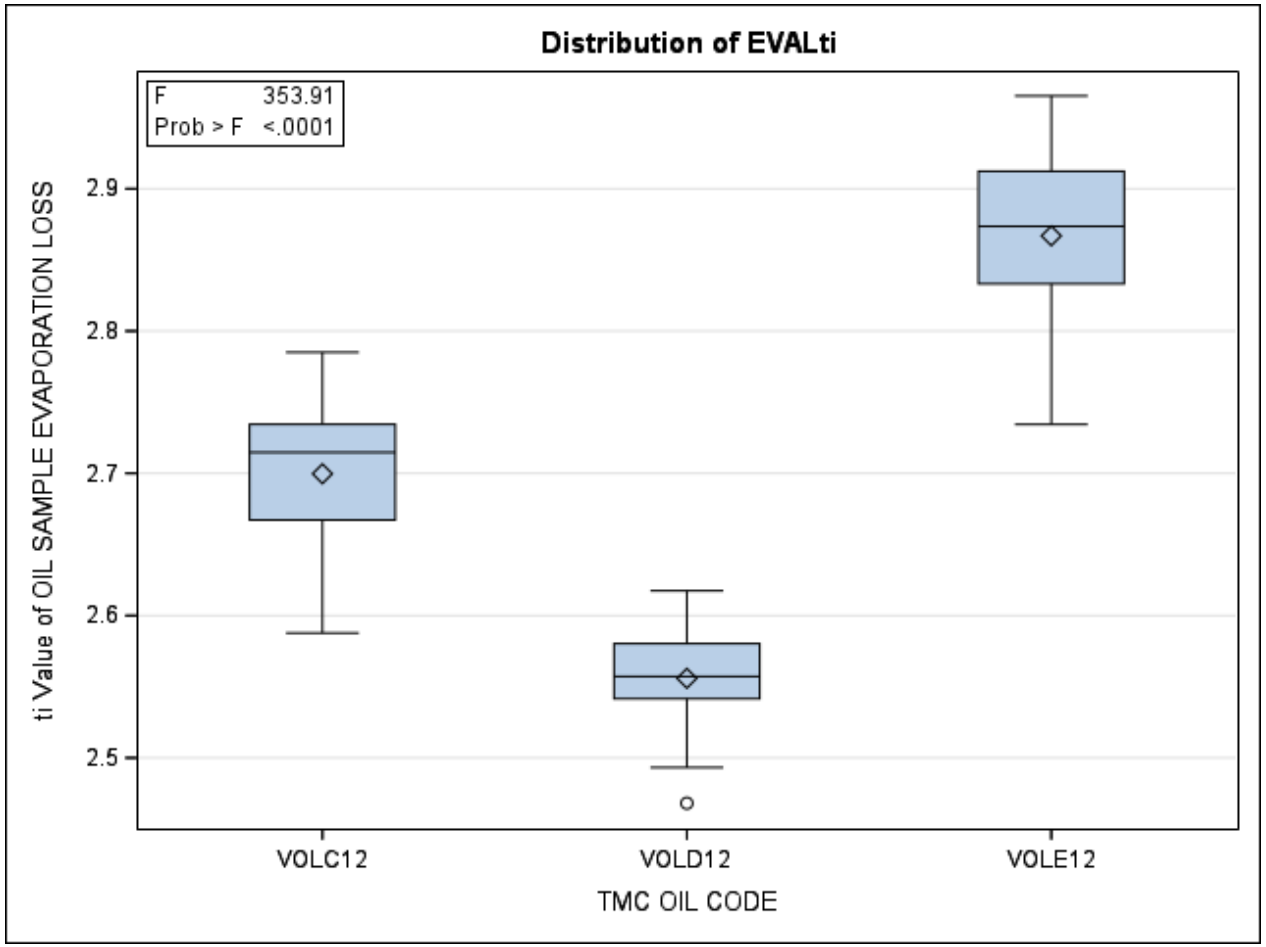
Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	89
Failed Calibration Test	OC	13
Total		**102**

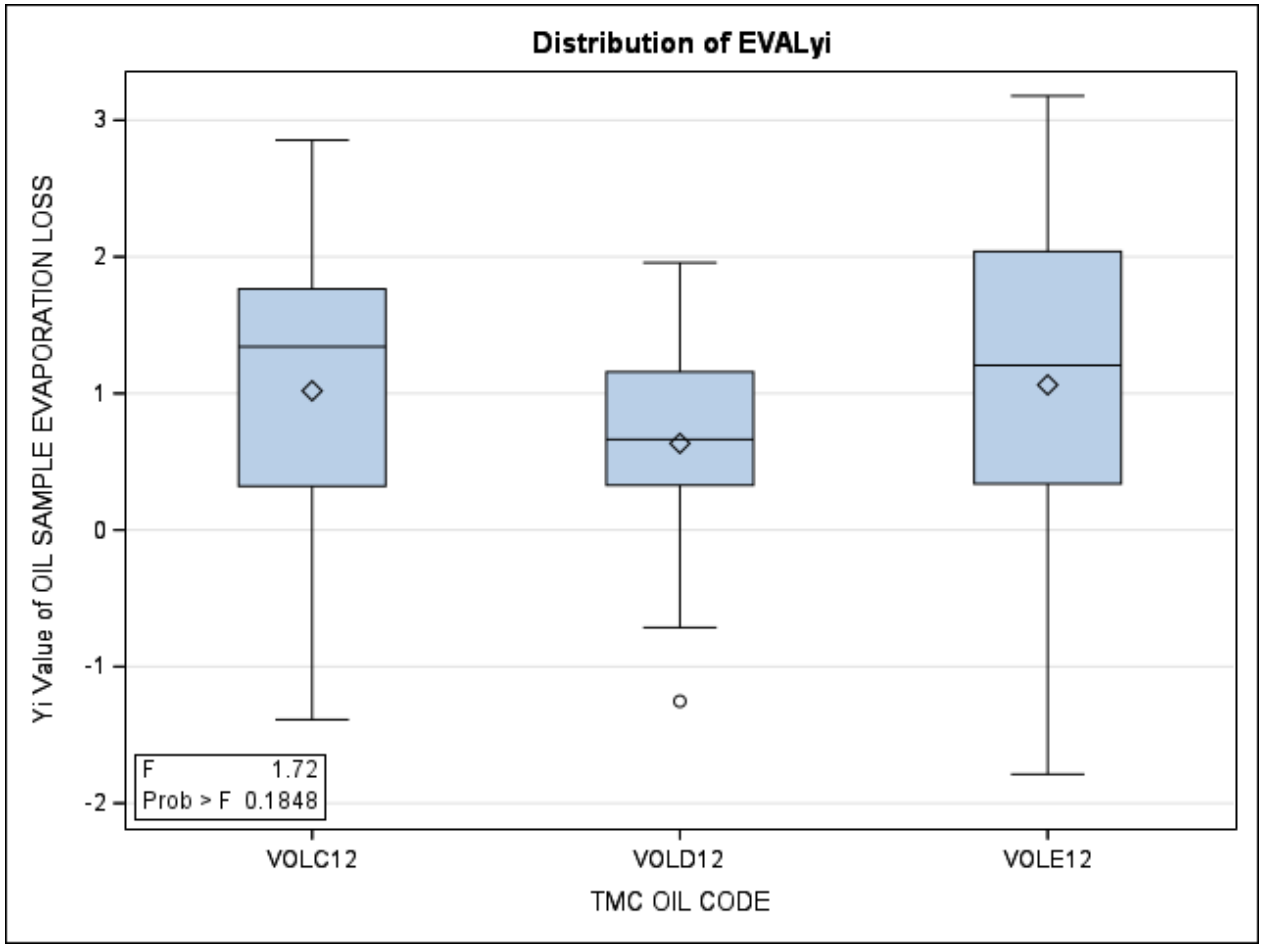
Number of Labs Reporting Data: 11
Fail Rate of Operationally Valid Tests: 12.7%

April 1, 2023 – September 30, 2023

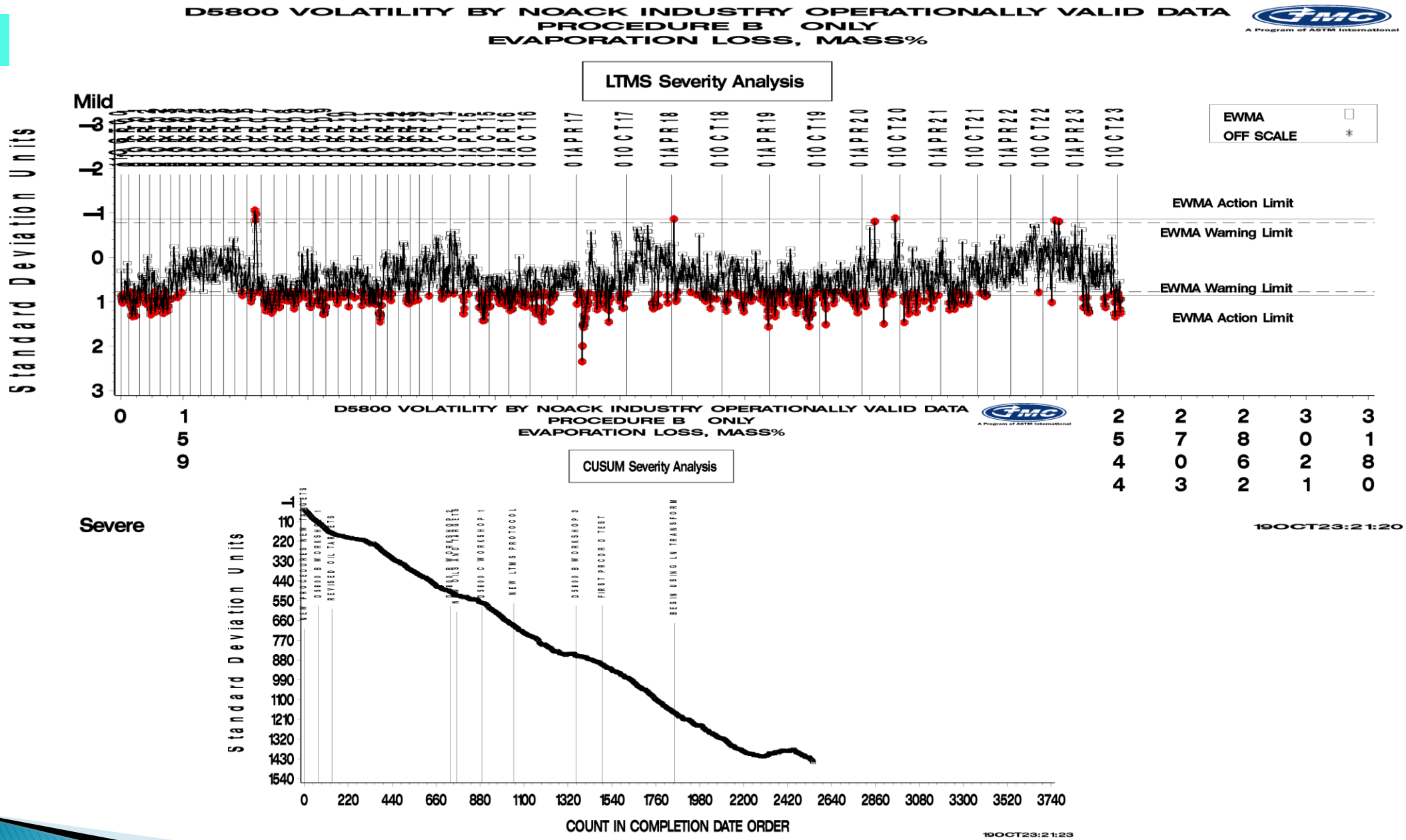
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Procedure B: Apr23 – Sept23 Results





B only



Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

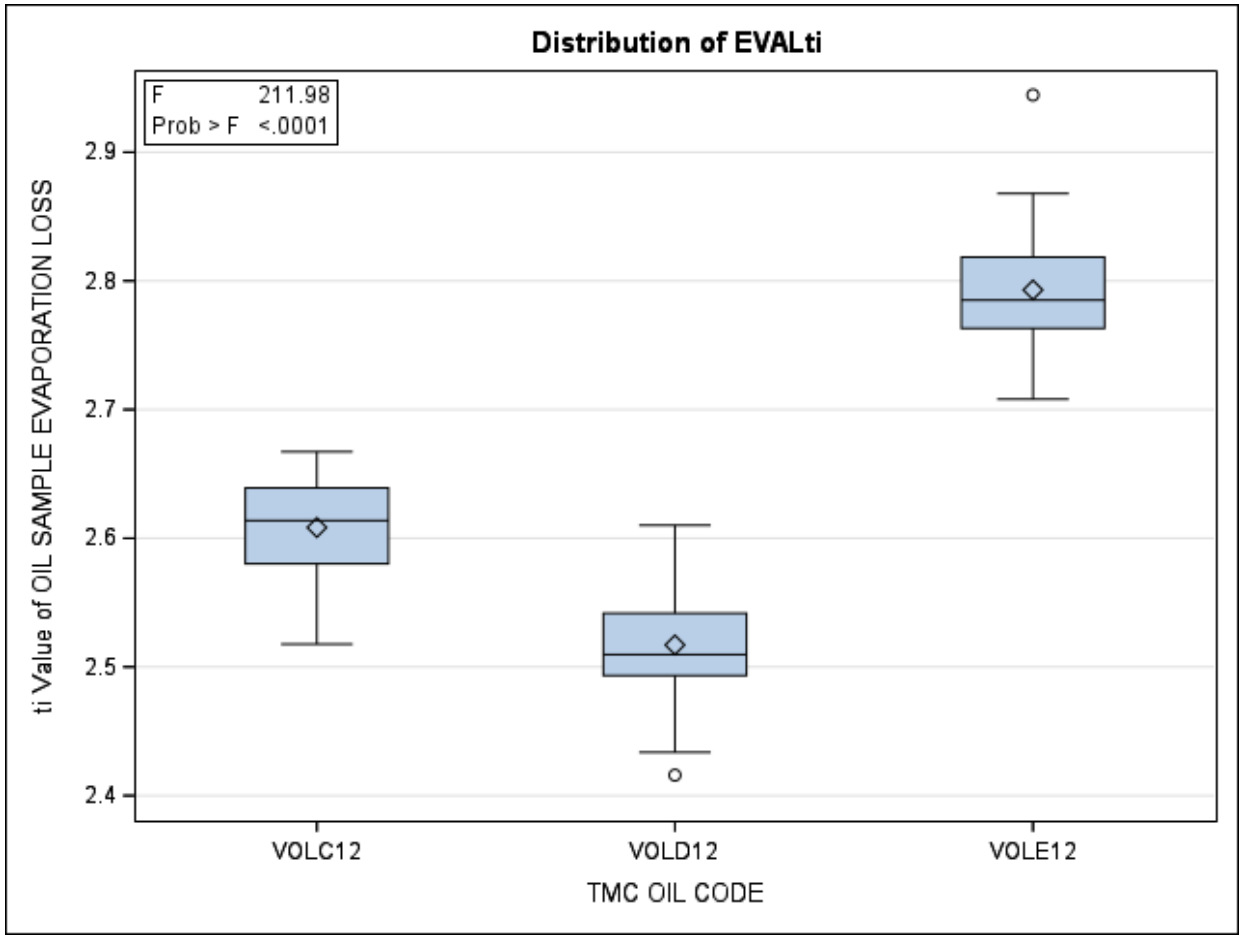
D5800: Evaporation Loss of Lubricating Oil by Noack Method: Industry Procedure D (NS2)

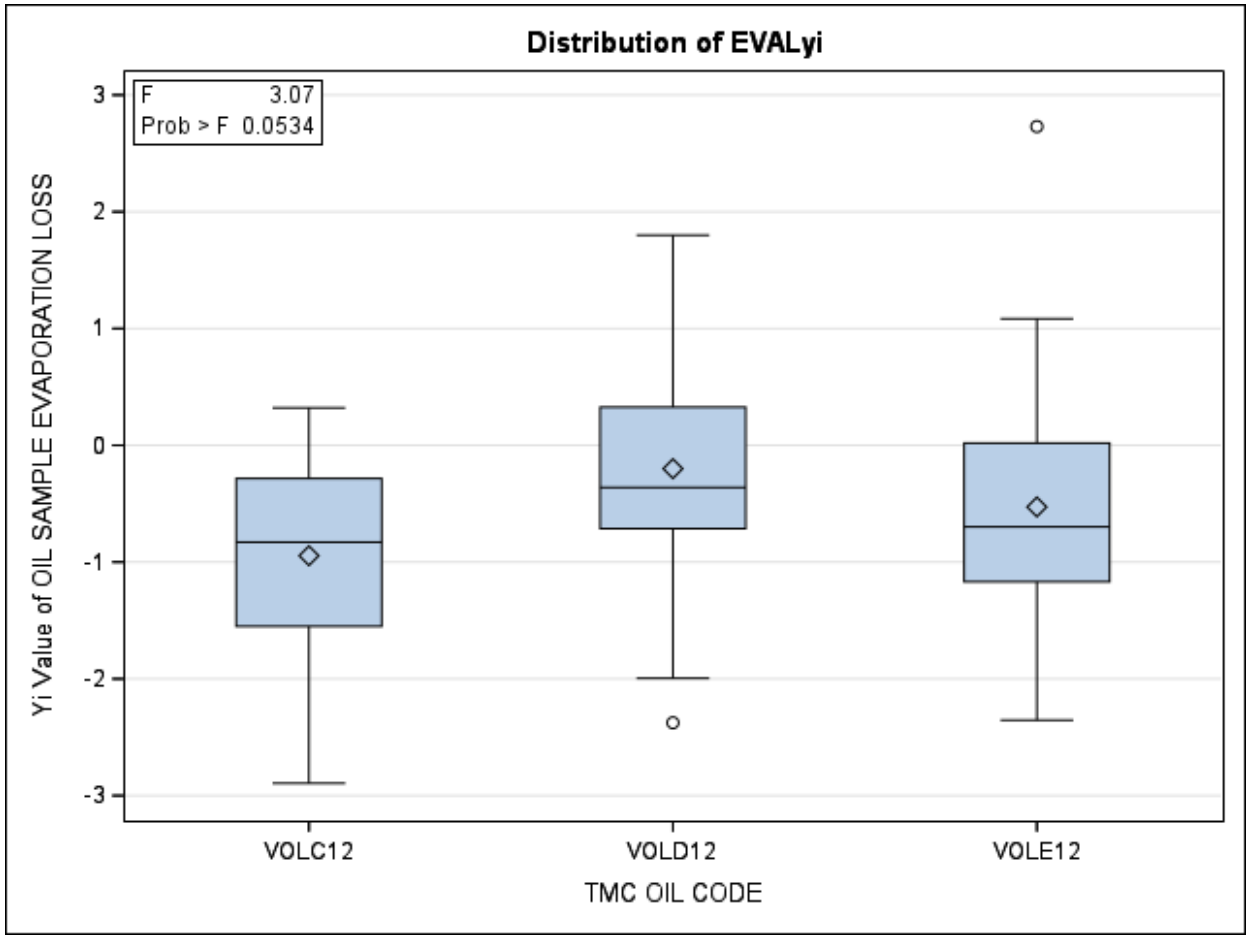
Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	62
Failed Calibration Test	OC	5
Total		**67**

Number of Labs Reporting Data: 6
Fail Rate of Operationally Valid Tests: 7.5%

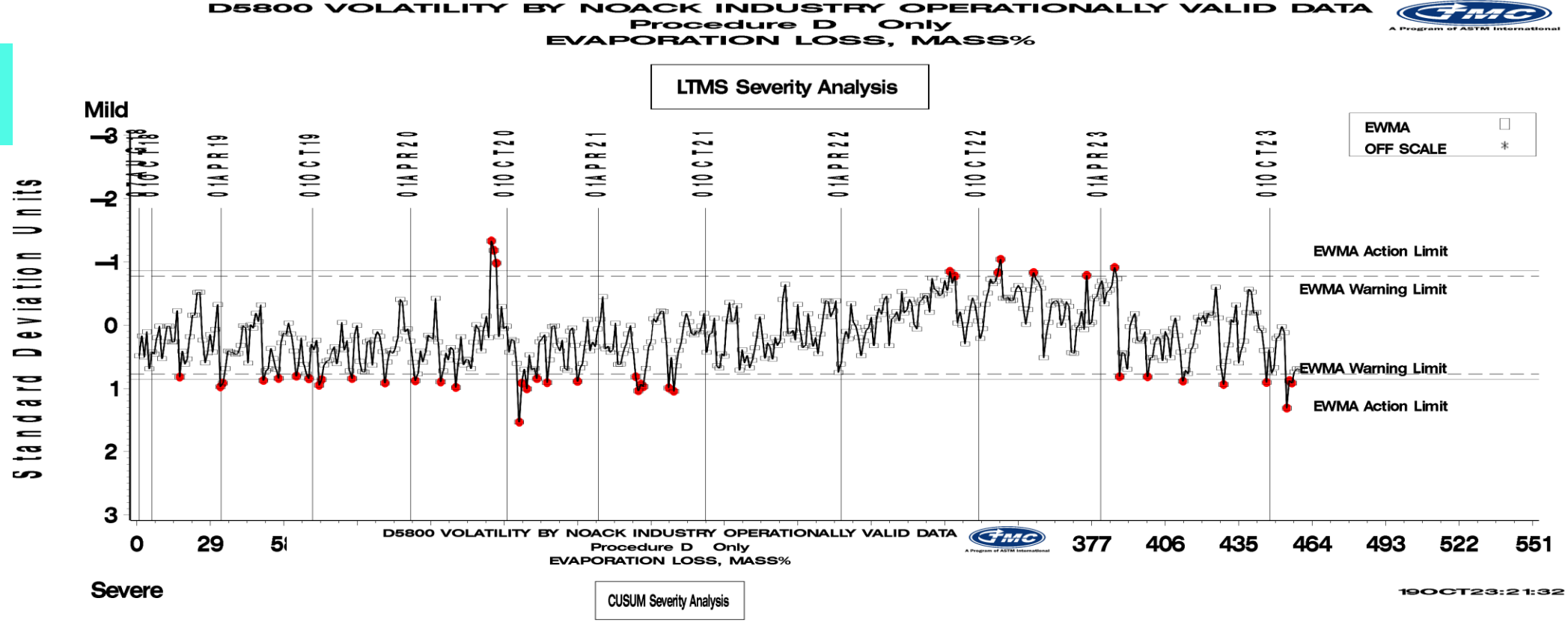
Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

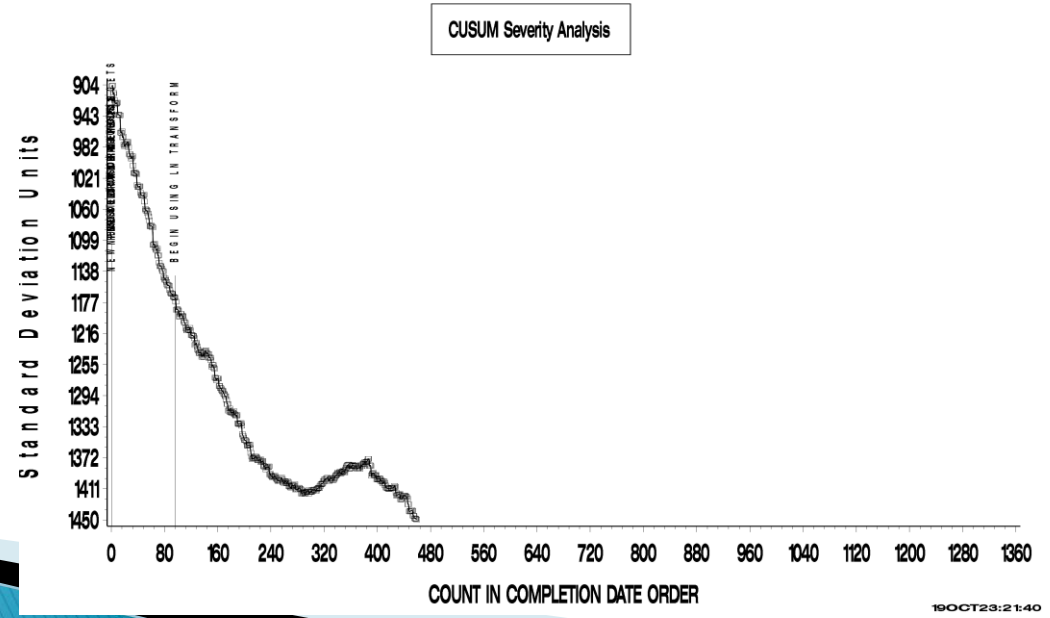
Procedure D (NS2): Apr23 – Sept23 Results





D only (NS2)





Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

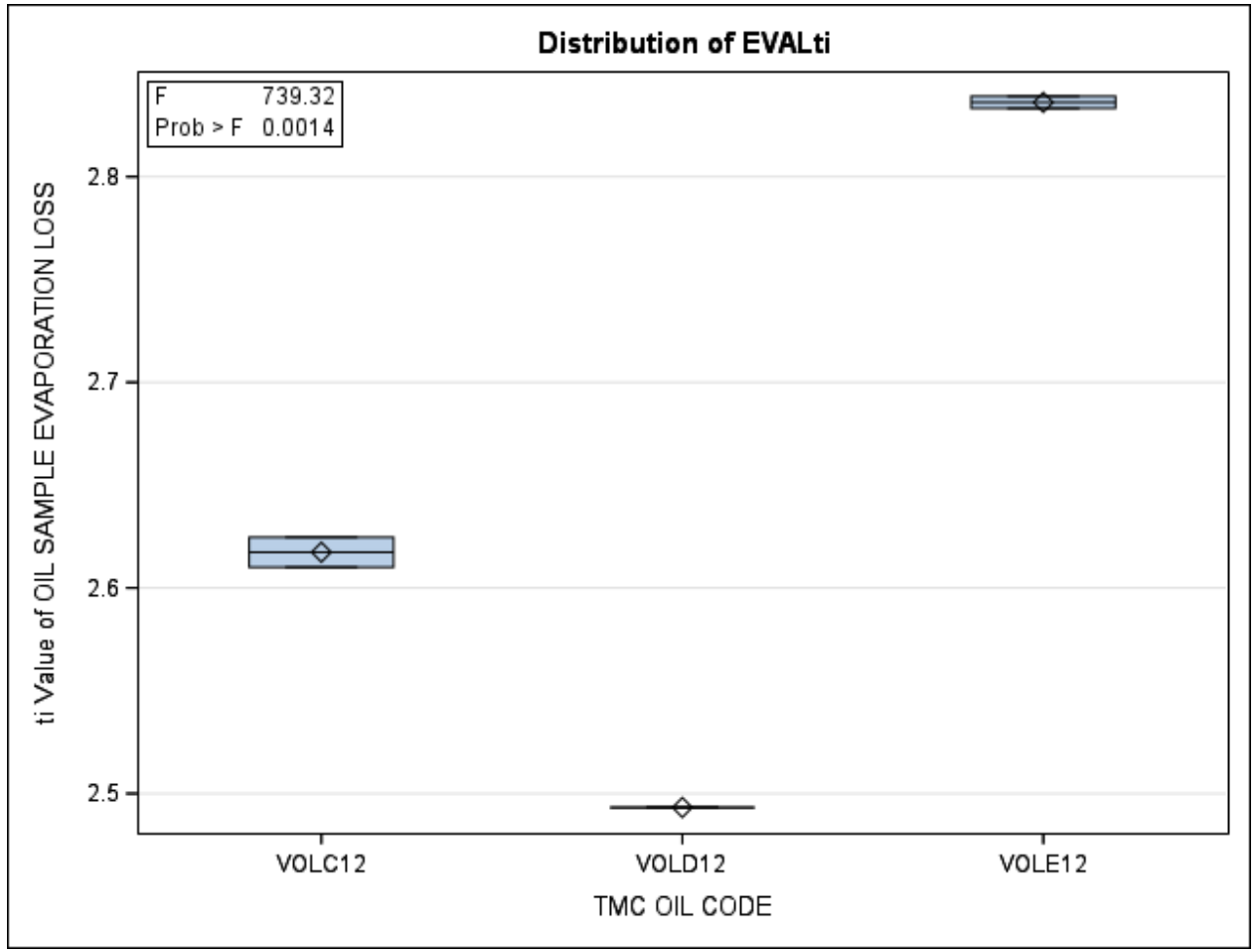
D5800: Evaporation Loss of Lubricating Oil by Noack Method: Industry Model NCK2

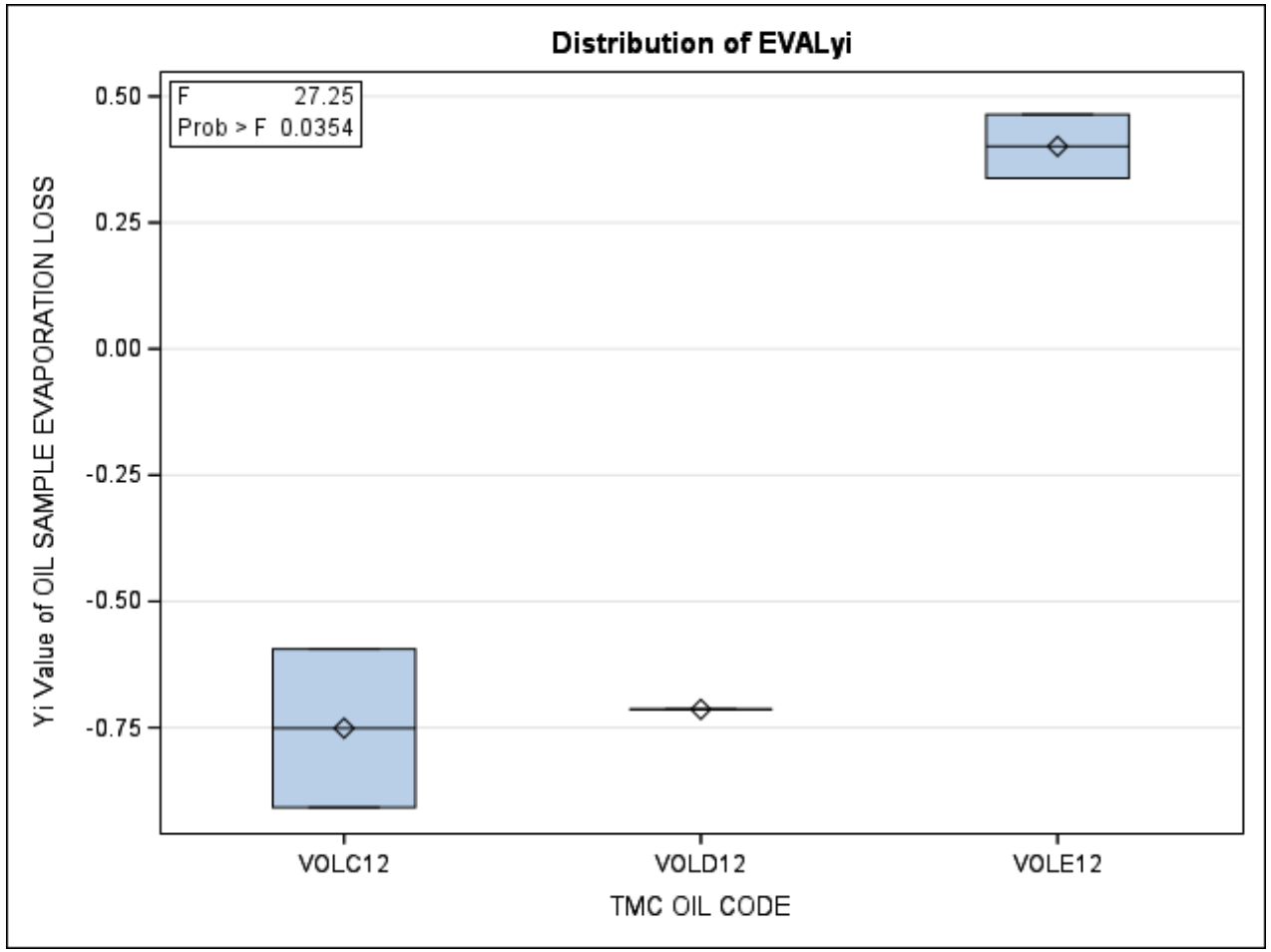
Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	5
Failed Calibration Test	OC	0
Total		**5**

Number of Labs Reporting Data: 1
Fail Rate of Operationally Valid Tests: 0.0 %

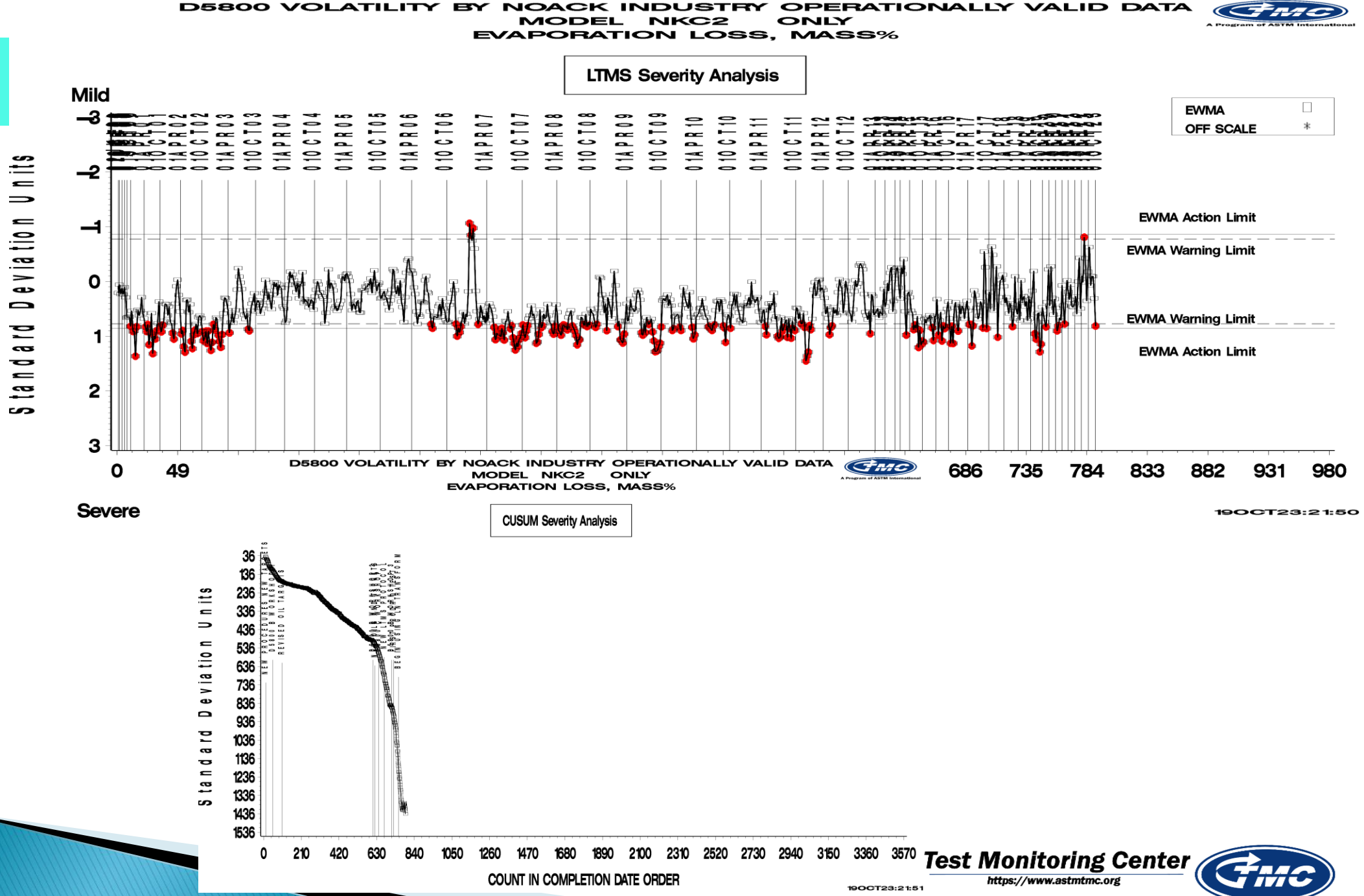
Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

MODEL NCK2: Apr23 – Sept23 Results





NCK2 only


D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA
MODEL NKC2 ONLY
EVAPORATION LOSS, MASS%
LTMS Severity Analysis
Mild
Severe
Standard Deviation Units
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
0 49 686 735 784 833 882 931 980
19OCT23:21:50
CUSUM Severity Analysis
Standard Deviation Units
36 136 236 336 436 536 636 736 836 936 1036 1136 1236 1336 1436 1536
0 210 420 630 840 1050 1260 1470 1680 1890 2100 2310 2520 2730 2940 3150 3360 3570
COUNT IN COMPLETION DATE ORDER
19OCT23:21:51
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

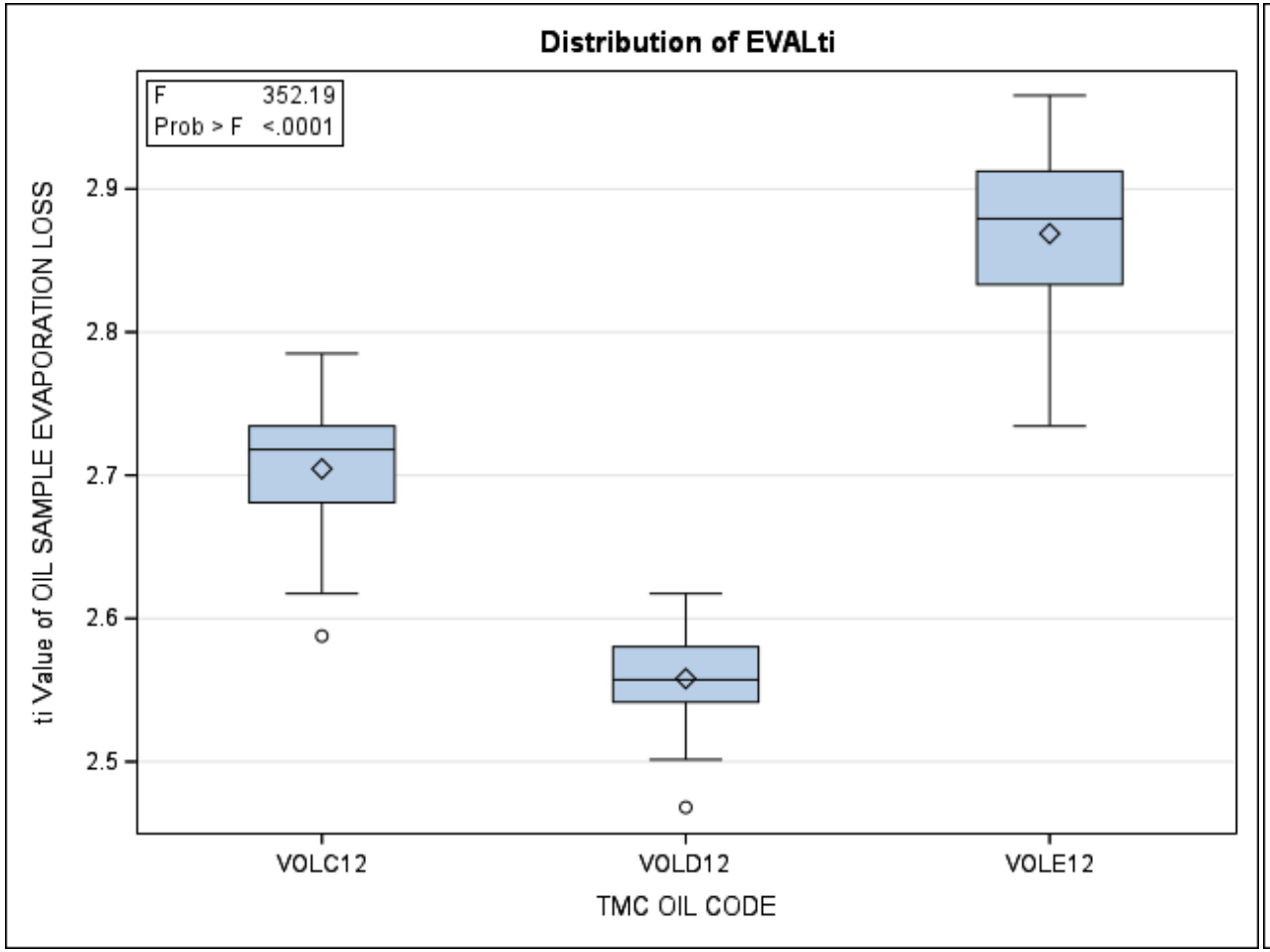
D5800: Evaporation Loss of Lubricating Oil by Noack Method: Industry Model NCK25G

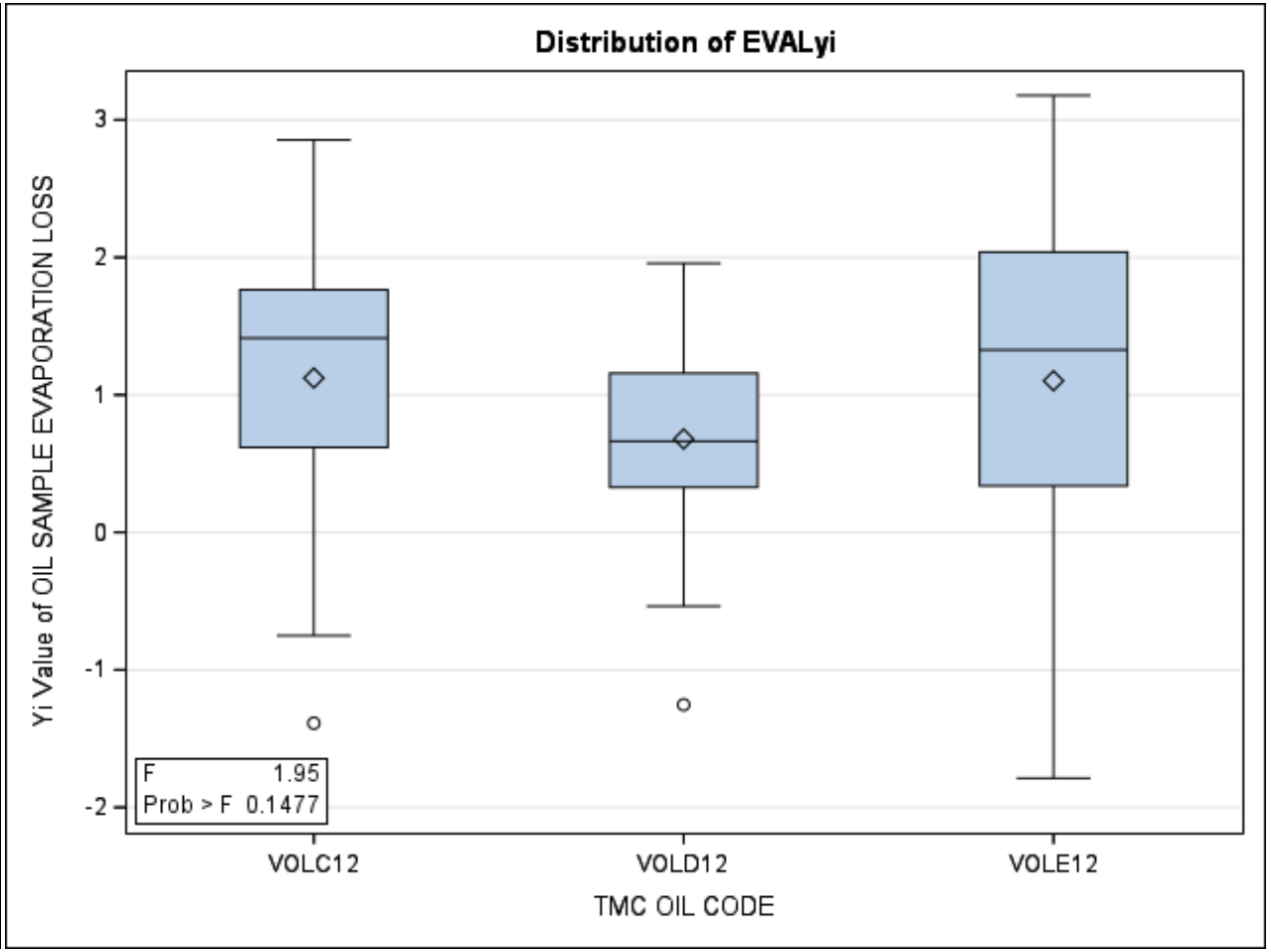
Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	84
Failed Calibration Test	OC	13
Total		**97**

Number of Labs Reporting Data: 11
Fail Rate of Operationally Valid Tests: 13.4 %

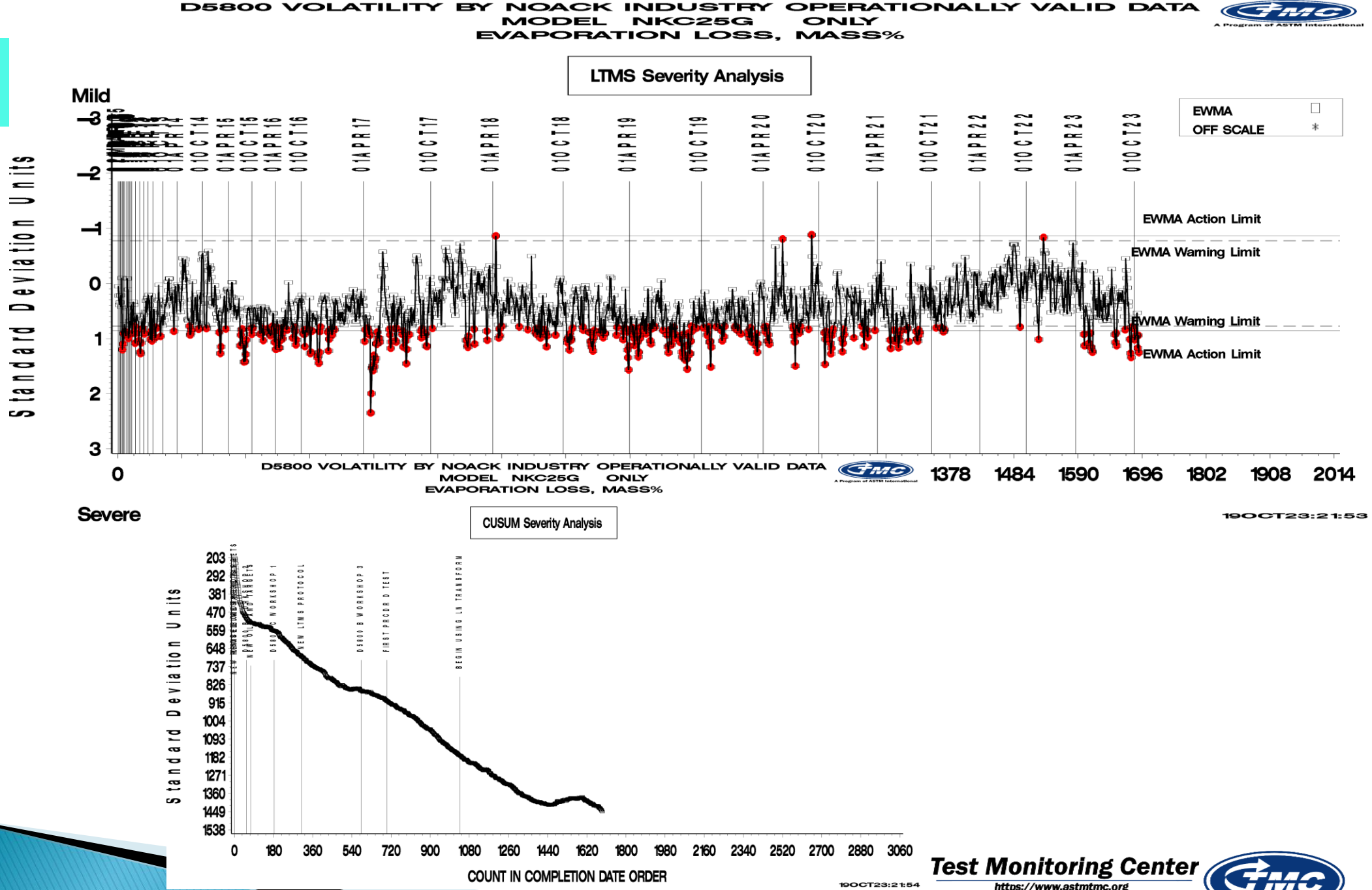
Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

MODEL NCK25G: Apr23 – Sept23 Results





NCK25
G only



Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

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

Precision (Pooled s) moved slightly further from target this semester as former and new labs returned to monitoring and reported several failing calibration attempts.

Performance (Mean Δ/s) returned towards a severe path at +0.33 s after being mild (at −0.15 s) the previous semester.

- Procedure B rigs continue to trend severe (0.98 s) while Procedure D rigs continue to trend mild (−0.56 s).

CUSUM plot once again turned towards severe as has been the observed trend for many years (except last semester). This is due to severe test results from both Procedure B and D units in the last six months. The industry EWMA Control Chart had several Severe Warning Alarms last semester (and continues to have alarms this semester).

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 6082

High Temperature Foam

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6082	7 (+0)	8 (+0)

*Between 4/1/2023 and 9/30/2023

D6082: High Temperature Foam

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	14
Acceptable Discrimination Test	AS	7
Operationally Invalid, Reported as Valid	RC, RS	1
Operationally Invalid, Reported by Lab	LC, LS	7
Informational Run (Valid)	NN	2
Aborted Tests	XC, XS	2
Total		**33**

Number of Labs Reporting Data: 7
Fail Rate of Operationally Valid Calibration Tests: 0%

D6082: High Temperature Foam

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

- All severe oil discrimination runs (on TMC oil 66) reported this period demonstrated acceptable discrimination.
  - Discrimination runs are not evaluated for overall period precision or severity due to poor test precision above 100 ml foam tendency.
- There were no statistically unacceptable results this report period.

D6082: High Temperature Foam

Operationally Unacceptable Tests (RS, LC, LS, XC, XS)	No. Of Tests
No Option A (RS; Originally reported as Valid)	1
No Option A (XC, XS; Lab reported as Invalid)	2
Hose Leak (LC, LS)	5
Diffuser Issue (LS)	1
Temperature (Heater) Issue (LS)	1
Total	**10**

- There were ten operationally invalid results this report period.

D6082: High Temperature Foam

Informational Runs (MN, NN)	No. Of Tests
Non-blind Informational run on-target and valid (NN)	2
Non-blind Informational run invalid (MN)	0
Total	**2**

- There were two valid Informational results this report period.

D6082: High Temperature Foam

Period Precision and Severity Estimates

Foam Tendency, ml	n	df	Pooled s	Mean Δ/s
Targets updated 20201001[1]	18	17	9	-----
10/1/18 through 3/31/19	14	13	12	-0.07
4/1/19 through 9/30/19	14	12	12	-0.18
10/1/19 through 3/31/20	15	13	10	-0.23
4/1/20 through 9/30/20	13	11	8	-0.85
10/1/20 through 3/31/21	12	10	7	-0.48
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

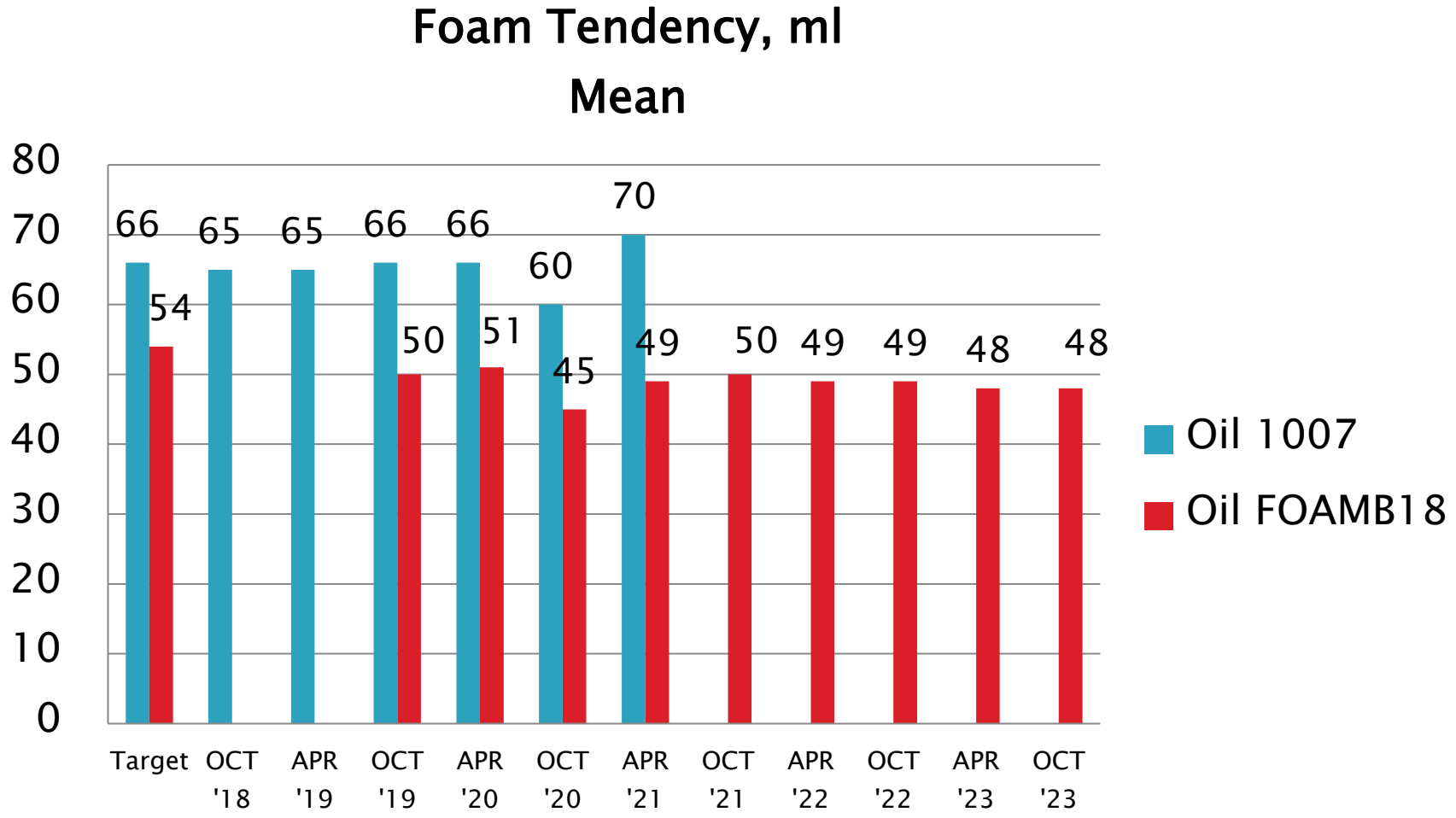
[1]Target precision updated to current reference oil FOAMB18

D6082: High Temperature Foam

Period Precision and Severity Estimates

Foam Stability @ 1 min, ml	n	Mean	s
Current Targets	18	0.00	0.00
10/1/18 through 3/31/19	14	No non-zero occurrences	
4/1/19 through 9/30/19	14	No non-zero occurrences	
10/1/19 through 3/31/20	15	No non-zero occurrences	
4/1/20 through 9/30/20	13	No non-zero occurrences	
10/1/20 through 3/31/21	12	No non-zero occurrences	
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	

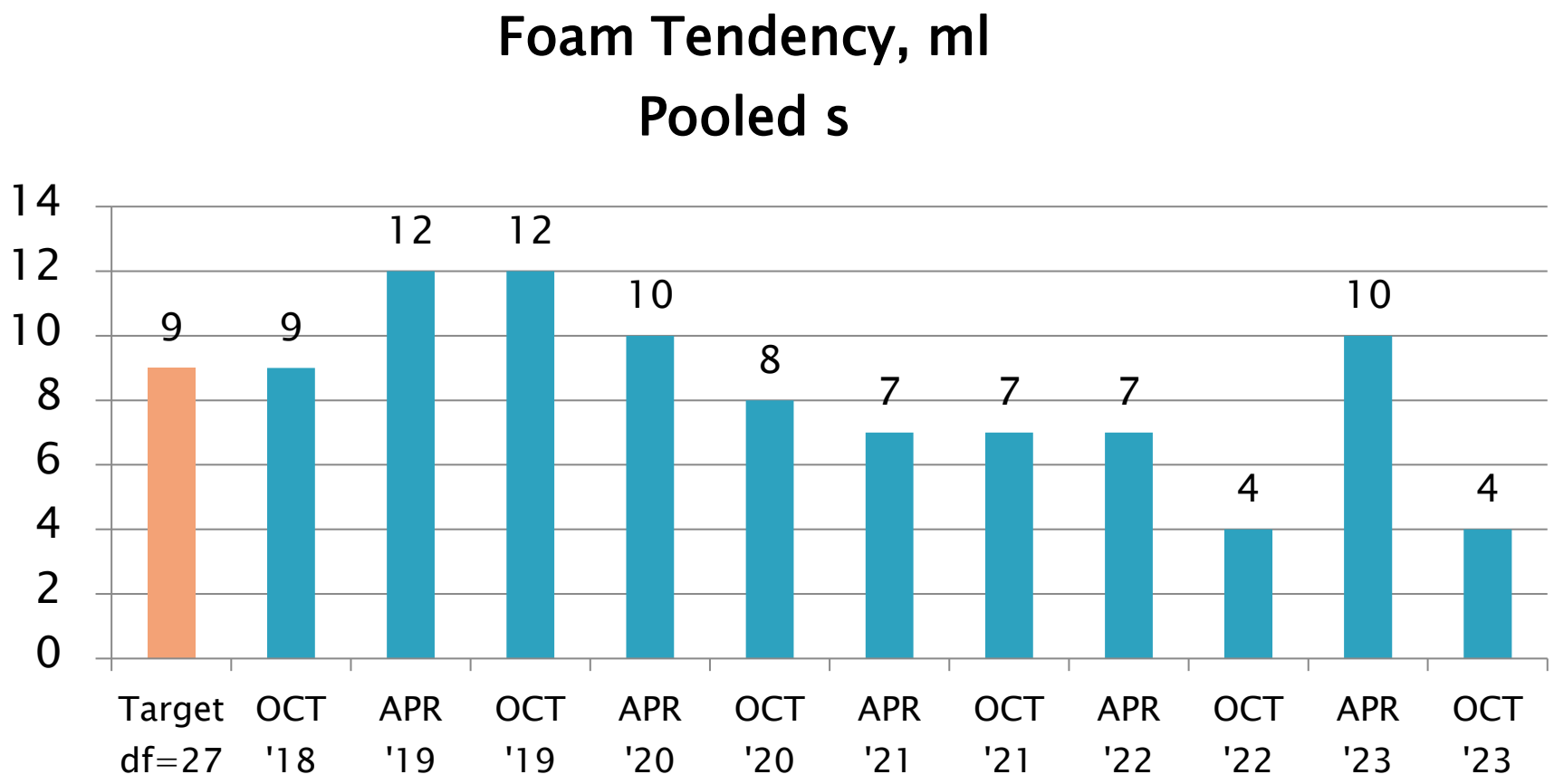
D6082 Performance by Oil



April 1, 2023 – September 30, 2023

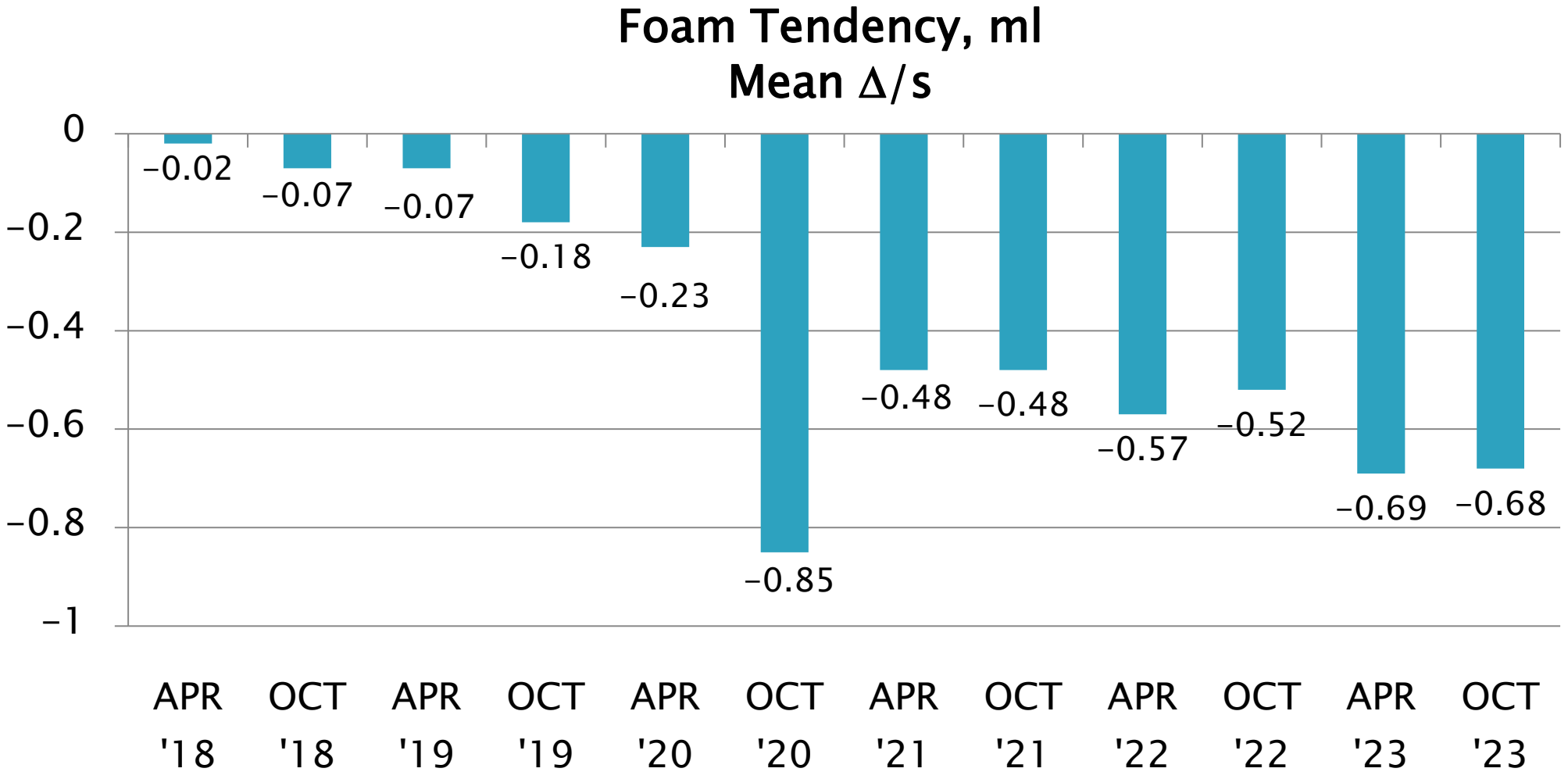
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6082: High Temperature Foam



Test Monitoring Center
https://www.astmtmc.org
TMC
A Program of ASTM International

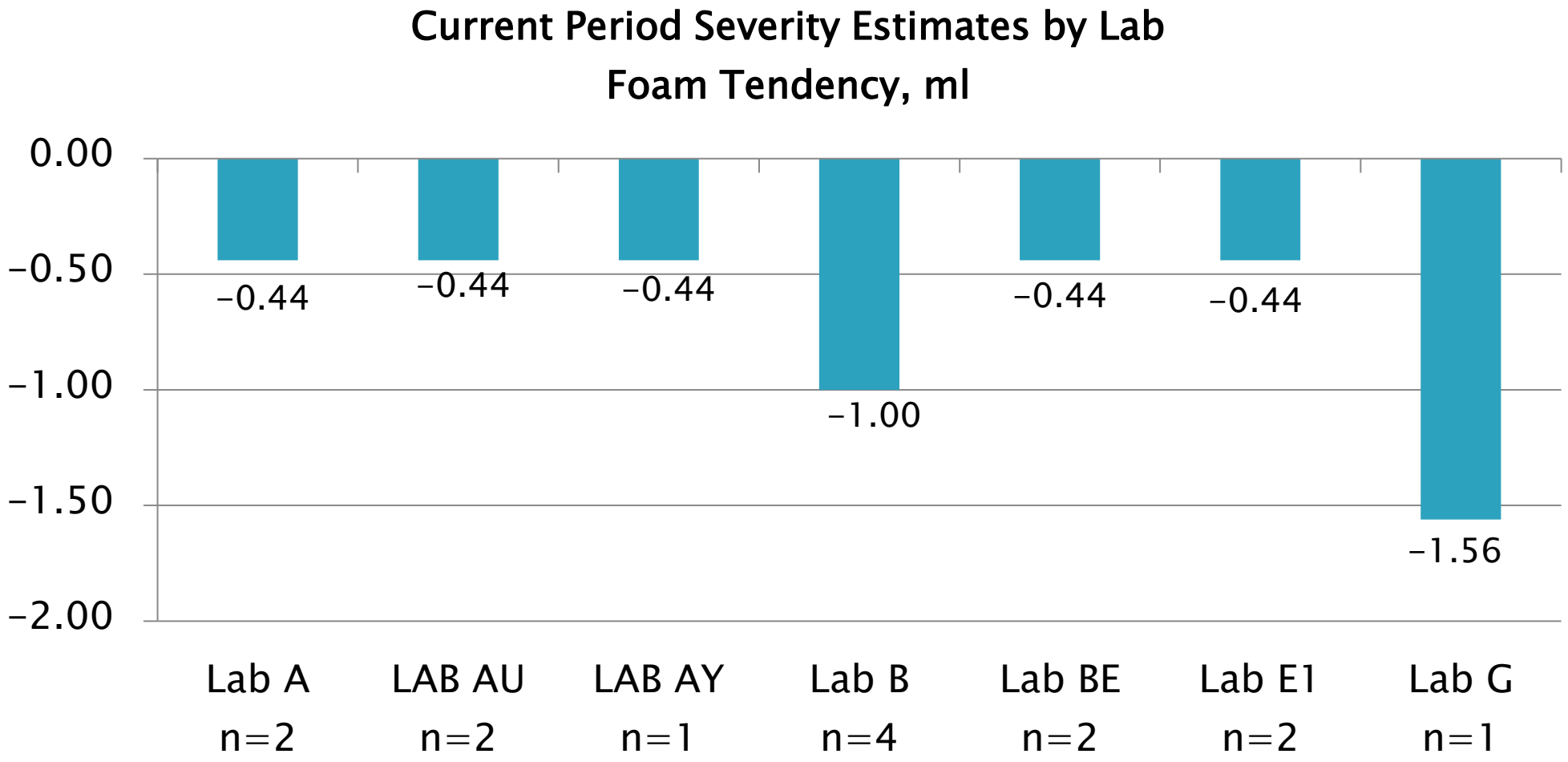
D6082: High Temperature Foam



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6082: High Temperature Foam



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6082: High Temperature Foam

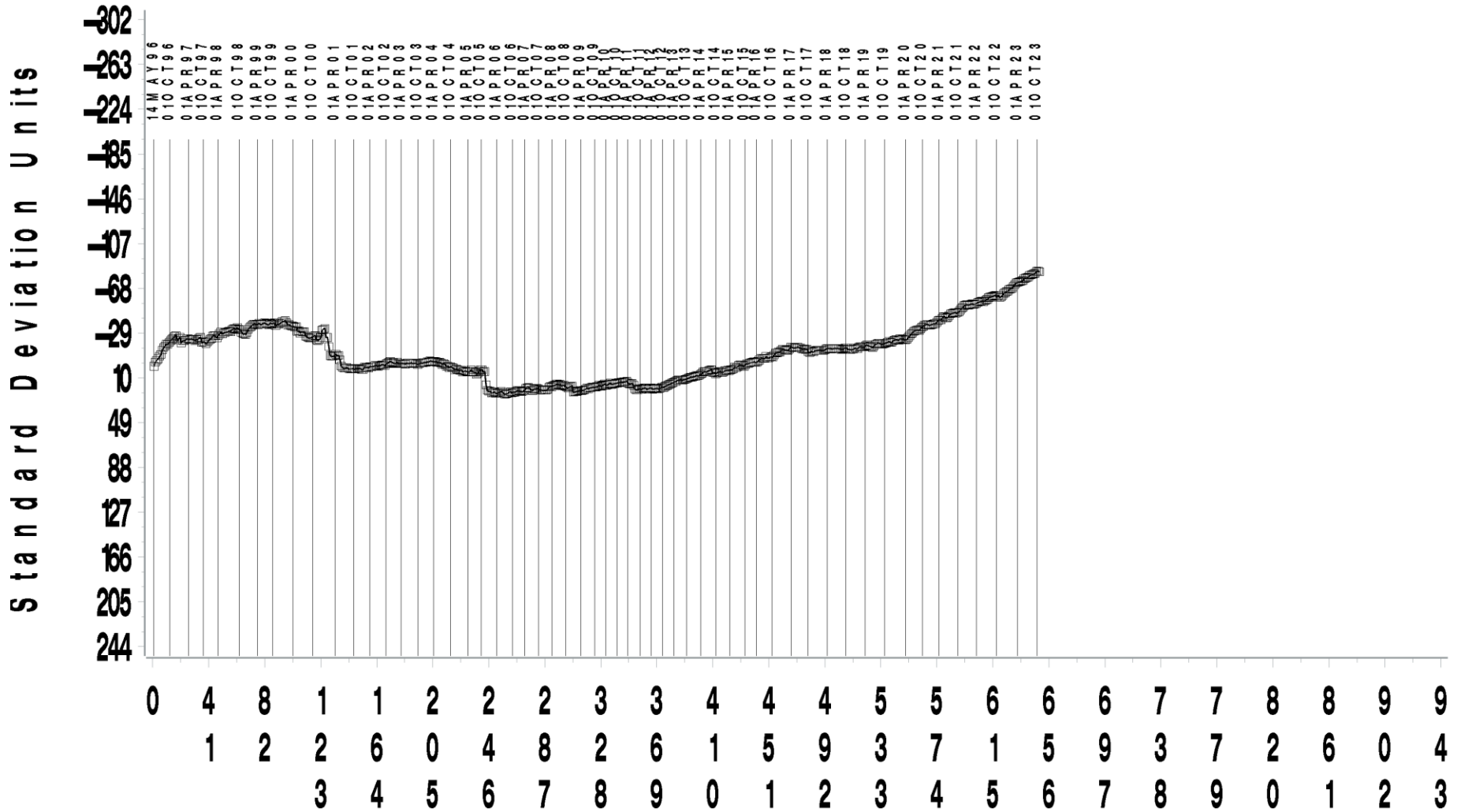
- Foam Tendency Precision (Pooled s) has improved over last period
  - All reference tests were conducted on reference oil FOAMB18.
- Performance (Mean Δ/s) remains mild at -0.68 s and constant with last semester (-0.69 s)
  - Fifth consecutive period of -0.5+ s mild performance with FOAMB18.
    - Target performance, set on 18 runs in a RR, may need revisited.
- No non-zero occurrences of Foam Stability
- All seven severe oil discrimination runs (on TMC oil 66) demonstrated acceptable discrimination on foam tendency (>100 ml).

D6082 HIGH TEMPERATURE FOAM INDUSTRY OPERATIONALLY VALID DA

A Program of ASTM International

FOAM TENDENCY

CUSUM Severity Analysis



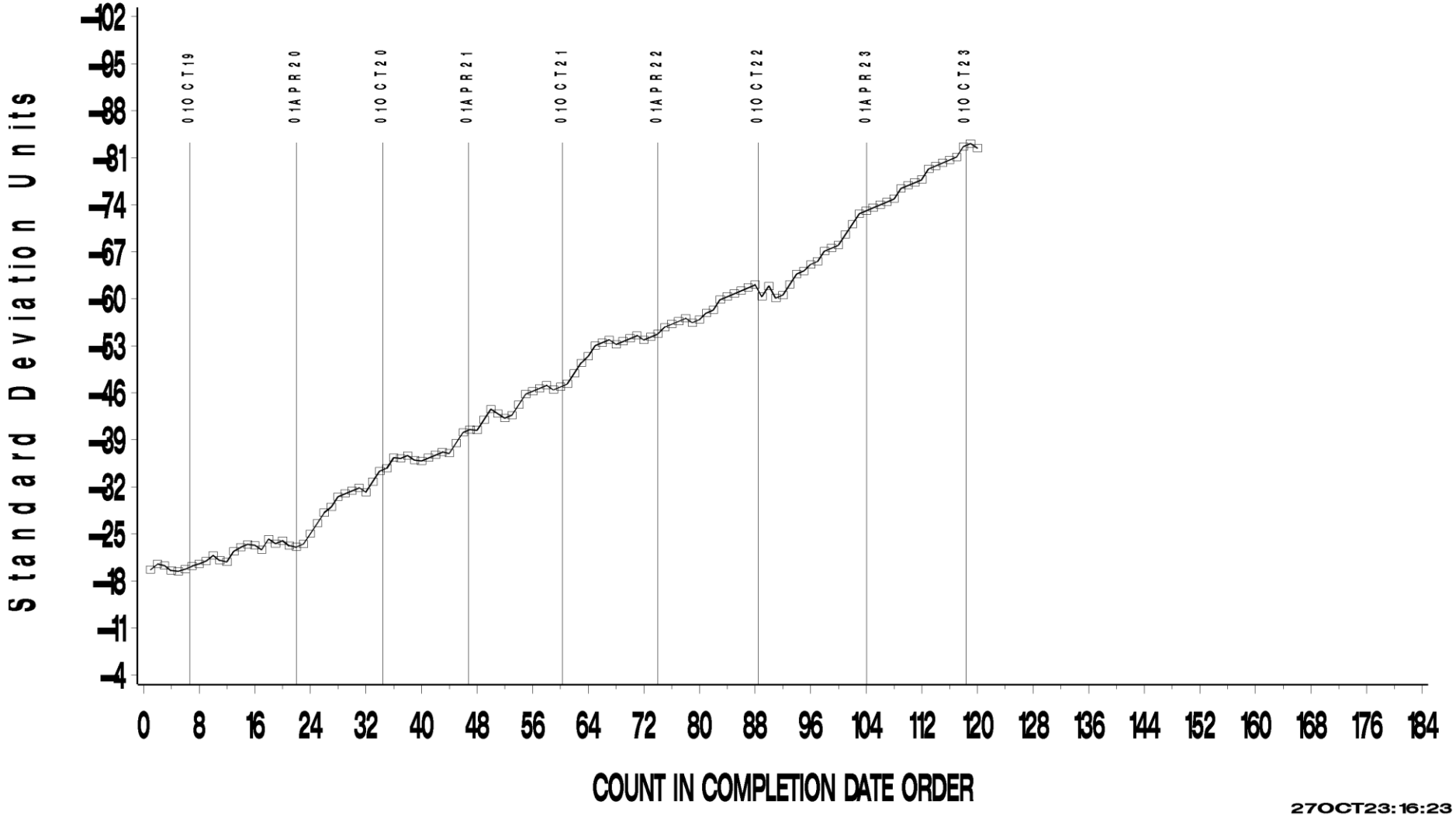
27OCT23:16:20

D6082 HIGH TEMPERATURE FOAM INDUSTRY OPERATIONALLY VALID DA

Last 120 Data Points

FOAM TENDENCY

CUSUM Severity Analysis



27OCT23:16:23

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 6335

TEOST

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6335	9 (+1)	13 (+0)
*As of 9/30/2023		

D6335: Deposits by TEOST-33C

Test Status	Validity Code	No. Tests
Acceptable Calibration Tests	AC	26
Failed Calibration Tests	OC	4
Operationally Invalidated by Lab	LC	1
Total		**31**

Number of Labs Reporting Data: 9 (8 Labs Last Period)
Fail Rate of Operationally Valid Tests: 13.3% (20.0% Last Period)

D6335: Deposits by TEOST-33C

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Severe	2
Total Deposits Mild	2
Total	**4**
Operationally Invalid Tests (LC, RC, XC)	**No. Of Tests**
NO2 Leak	1
Total	**1**

- Four statistically failing calibration runs this semester
  - Two mild results, both on RO 75-1 (two different labs)
  - Two severe results, both on RO 435-2 (two different labs)
- One operationally invalid test reported this period.
  - Discovered NO2 leak after conclusion of the test.
- No new Information Letters or Memos in the past year

D6335: Deposits by TEOST-33C

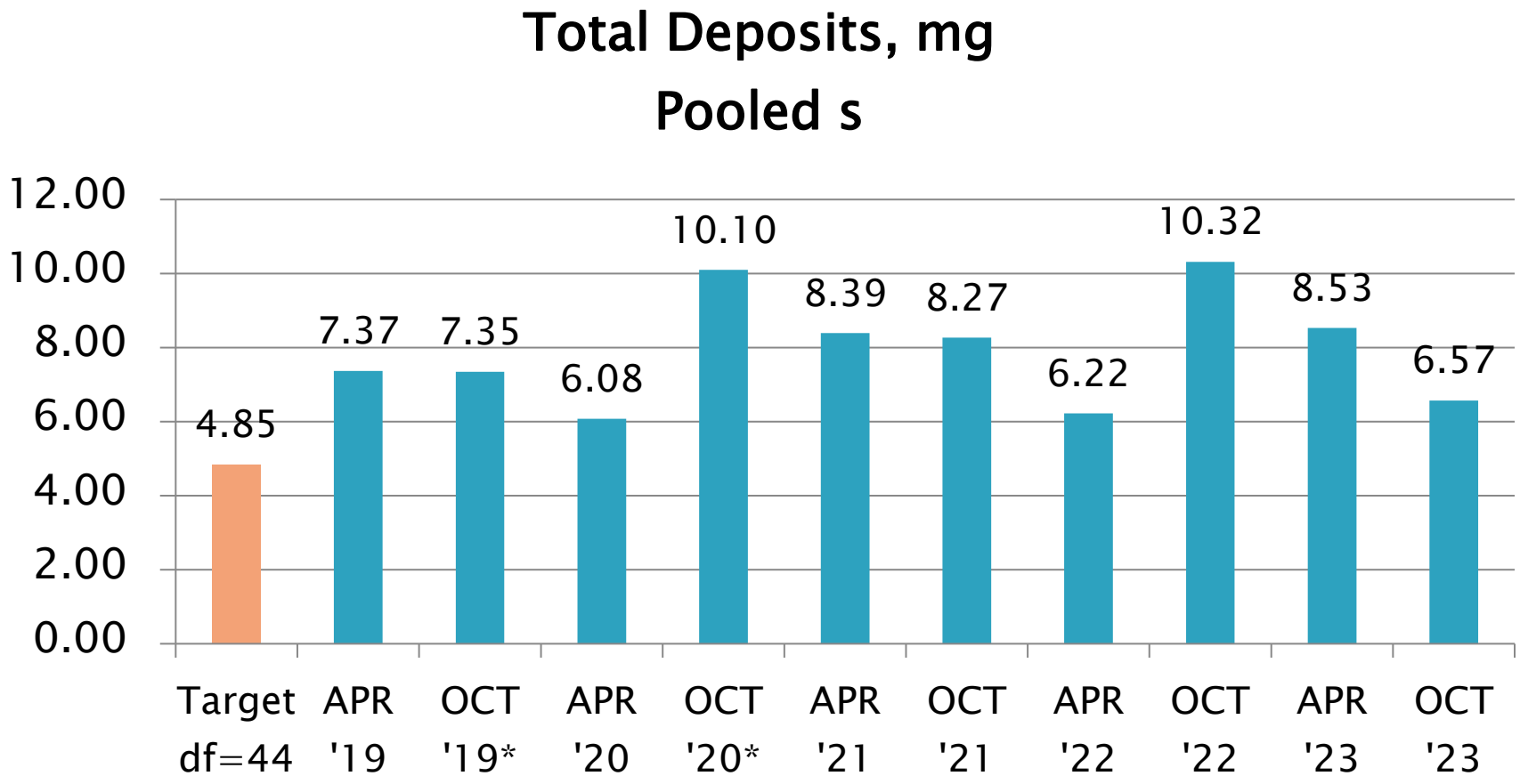
Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Updated Targets 20201001[1]	46	44	4.85	-----
4/1/17 through 9/30/19[2]	30	28	12.66	0.47
4/1/17 through 9/30/19[2]	26	24	7.35	-0.23
10/1/19 through 3/31/20	32	30	6.08	0.28
4/1/20 through 9/30/20[3]	33	30	11.44	0.02
4/1/20 through 9/30/20[3]	26	23	10.10	-0.02
10/1/20 through 3/31/21	26	23	8.39	0.42
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

[1]Target precision updated to include only current oils 75-1 and 435-2
[2]Four consecutive OC results on same rig included and excluded.
[3]Rig with six OC results included and excluded.

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

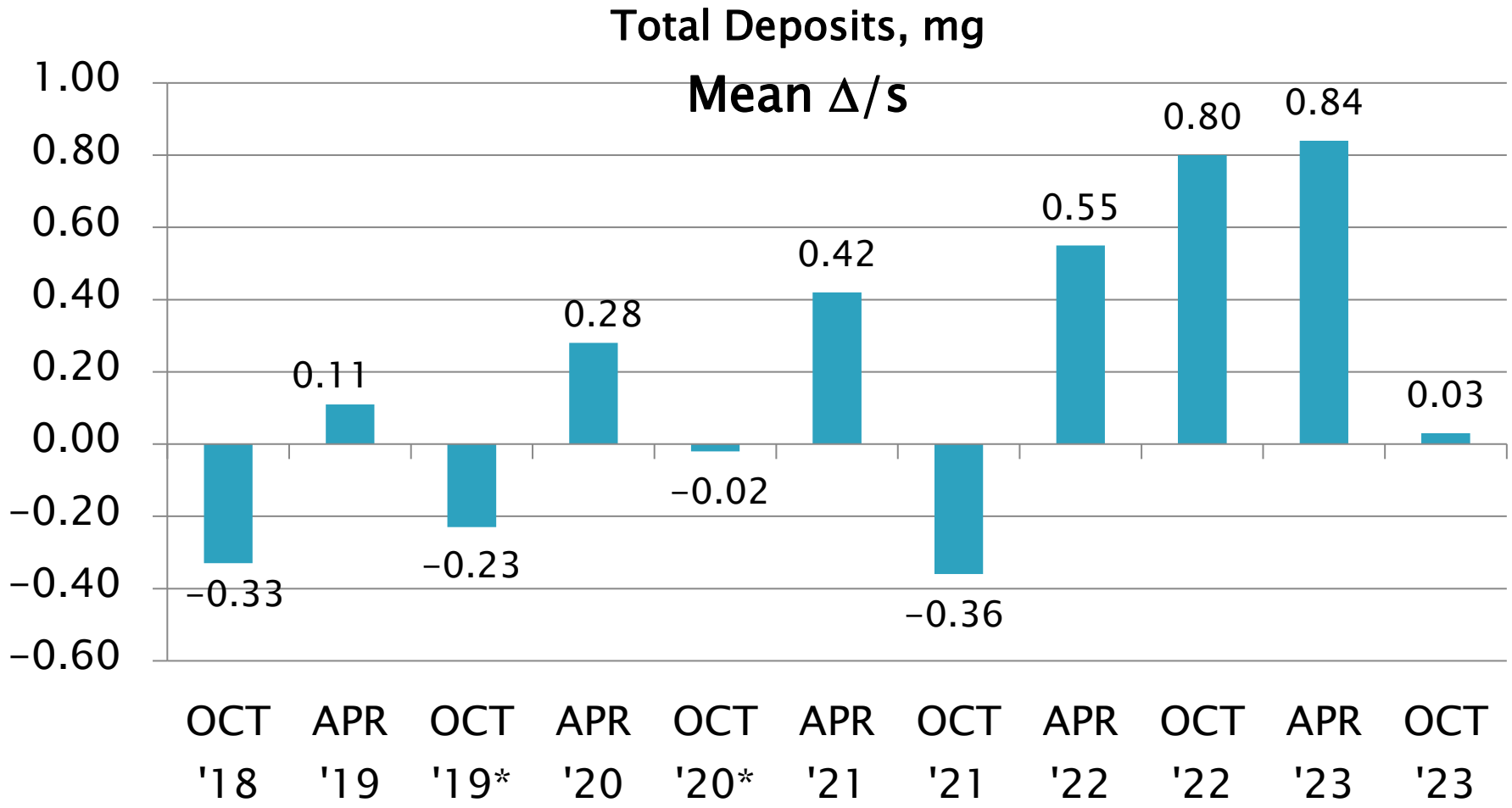
D6335 Precision Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

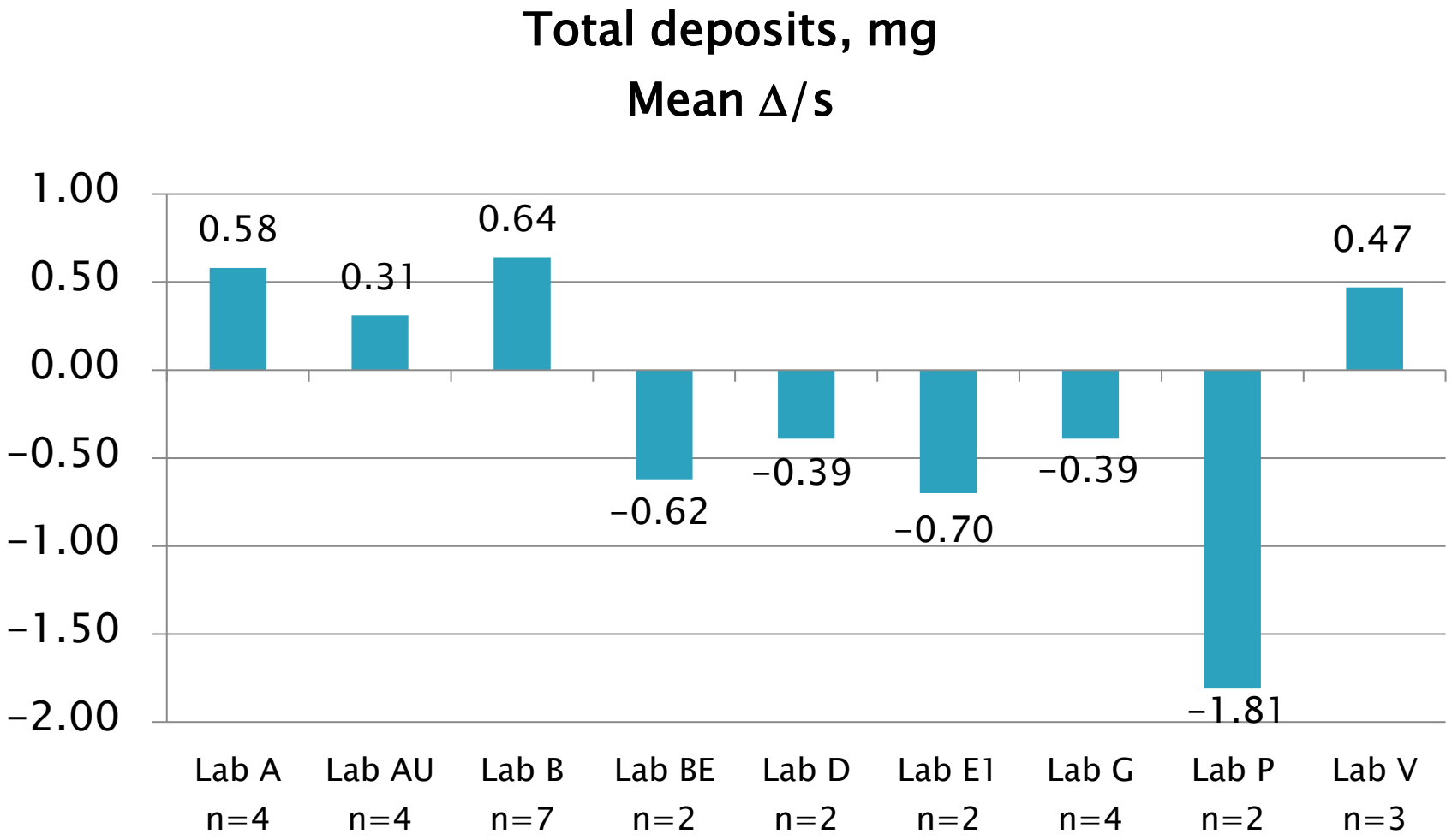
D6335 Severity Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6335 Lab Severity Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6335: Deposits by TEOST-33C

- Precision (Pooled s) continues to move back towards target for the third consecutive period
  - 6.57 OCT ’23; 8.53 APR ’23; 10.32 OCT ‘22
  - REF Oil 75 is no longer available for testing
- Performance (Mean Δ/s) has improved to 0.03 s this period (0.84 and 0.80 s last two periods)
- Fail rate fell to 13.3% on tests reported as operationally valid
  - Fail rate improved after hitting 20% last reporting period.
- All tests this period report using Rod Batch M (n=3) or N (n=27).

TEOST —33C INDUSTRY OPERATIONALLY VALID DATA

TOTAL DEPOSITS MG

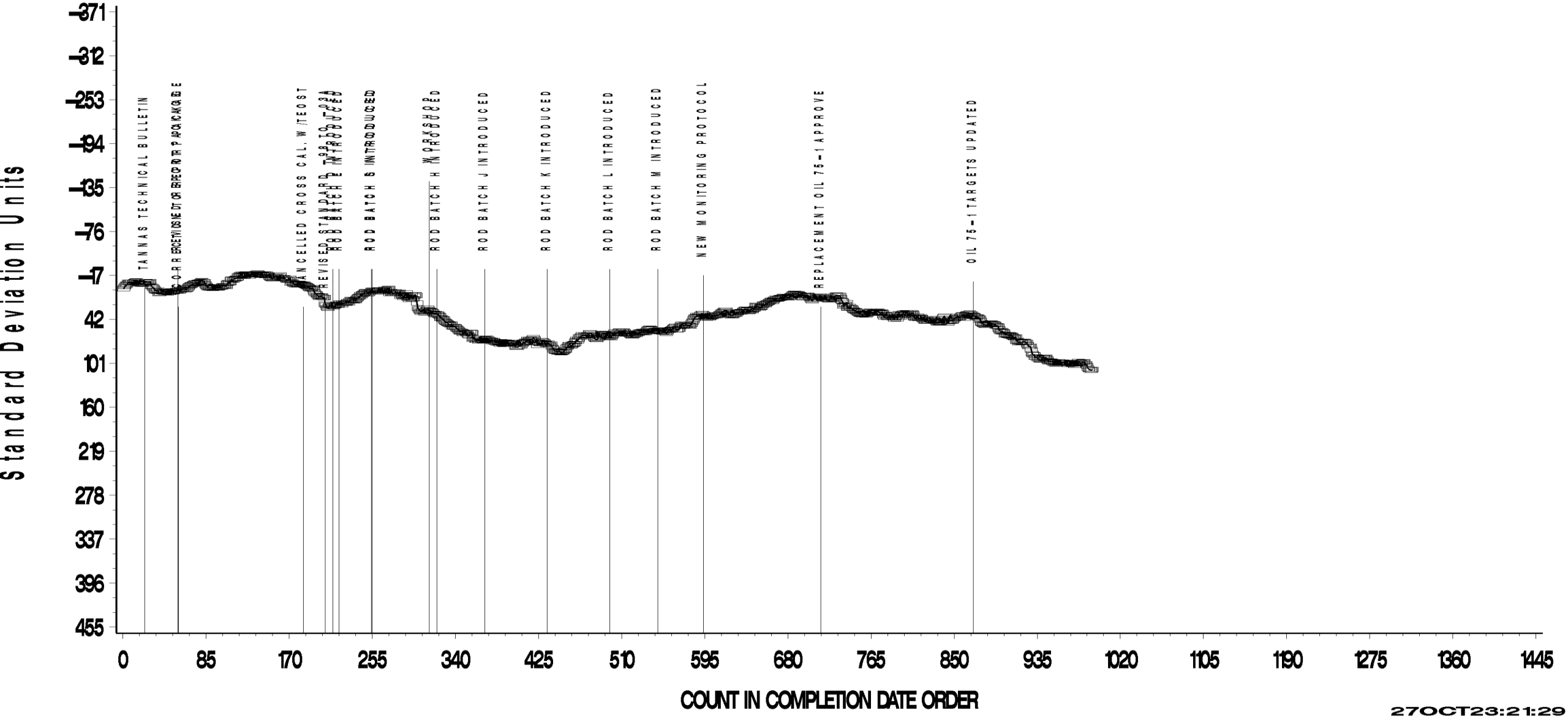
CUSUM Severity Analysis

27OCT23:21:27

TEOST—33C INDUSTRY OPERATIONALLY VALID DATA

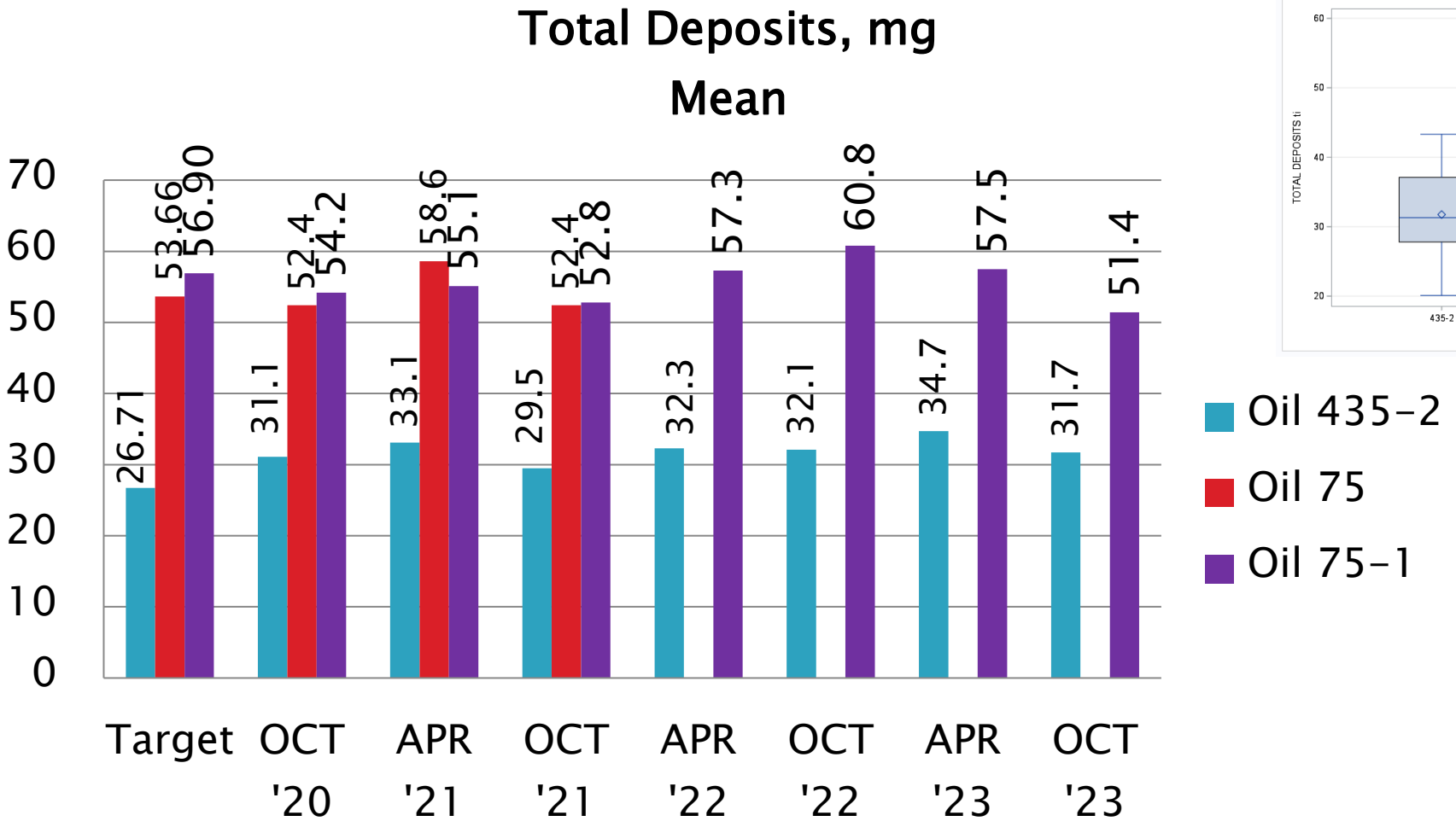
TOTAL DEPOSITS MG

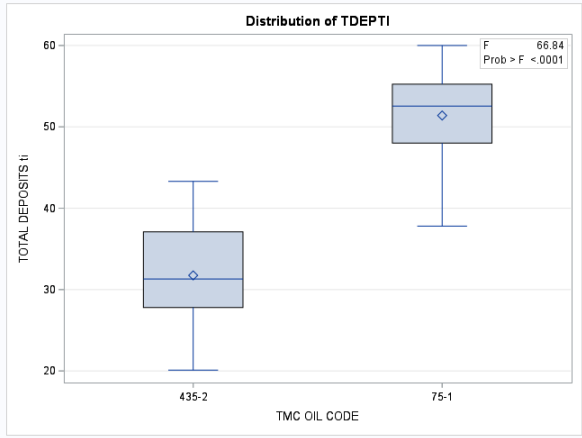
CUSUM Severity Analysis



27OCT23:21:29

D6335 Performance by Oil

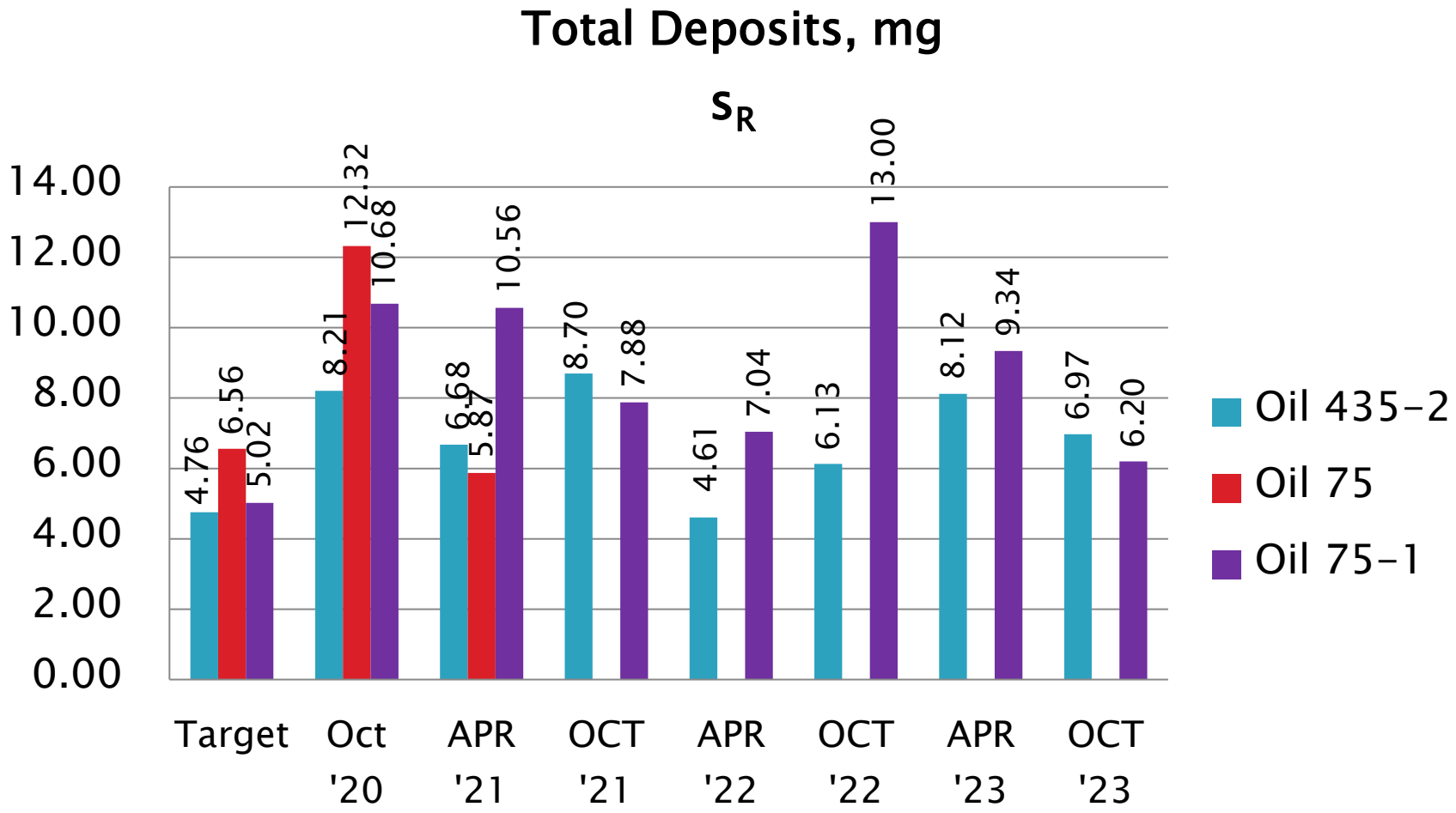




April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

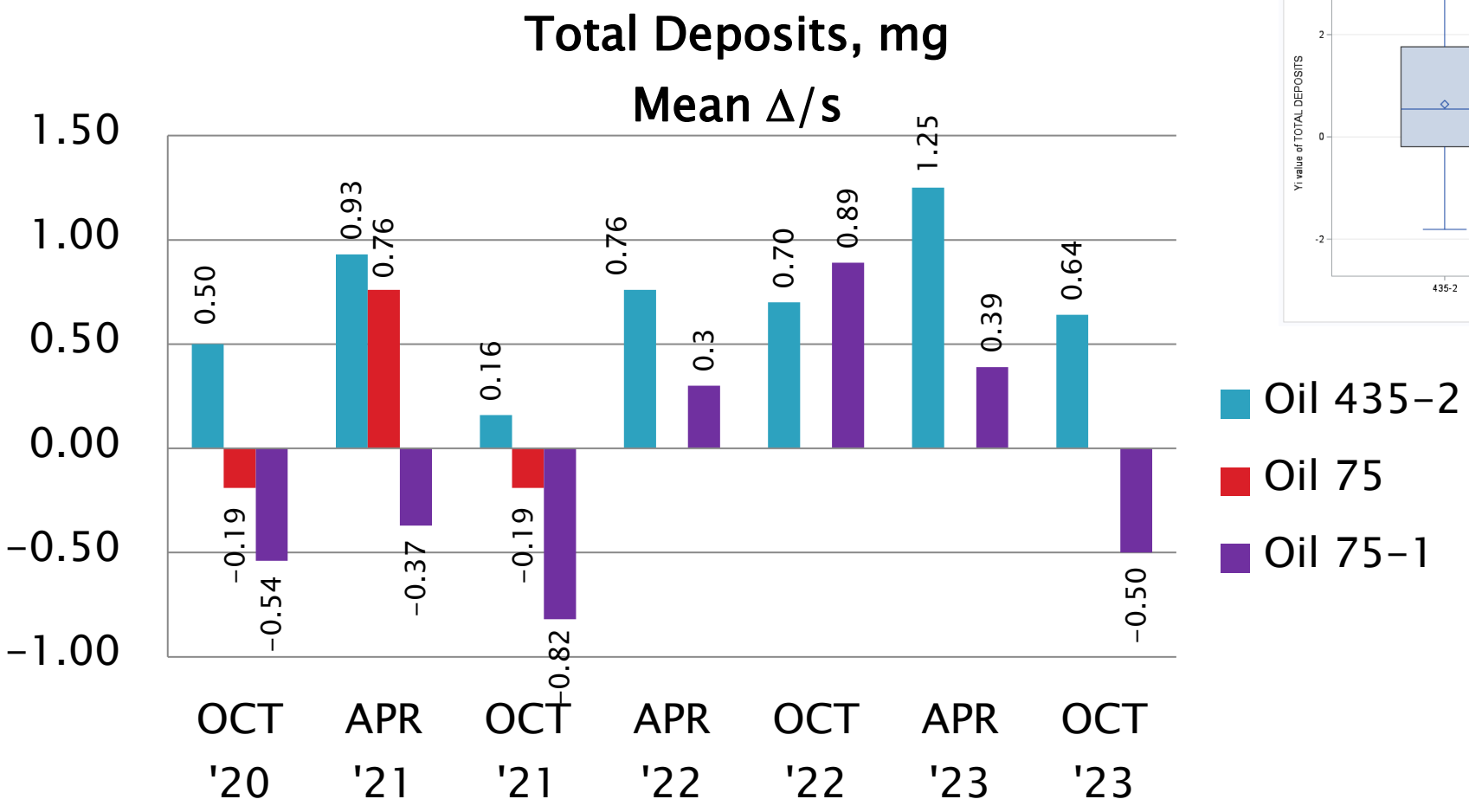
D6335 Performance by Oil



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6335 Performance by Oil



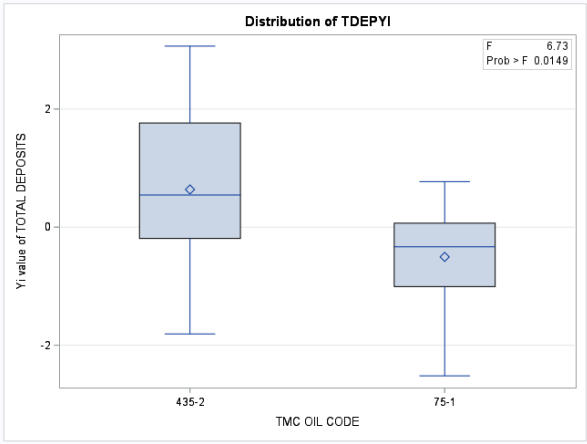


TABLE of CONTENTS

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D02.B0.07
TMC Monitored Tests

» ASTM D 6417

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6417	6 (–1)	8 (–1)

*Between 4/1/2023 and 9/31/2023

D6417: Estimation of Engine Oil Volatility by Capillary GC

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	16
Failed Calibration Test	OC	0
Total		**16**

Number of Labs Reporting Data: 7
Fail Rate of Operationally Valid Tests: 0%

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)	1

- There were no statistically invalid tests reported this period.
- There was one operationally invalid test reported this period.
- No D6417 TMC technical updates were issued this report period.

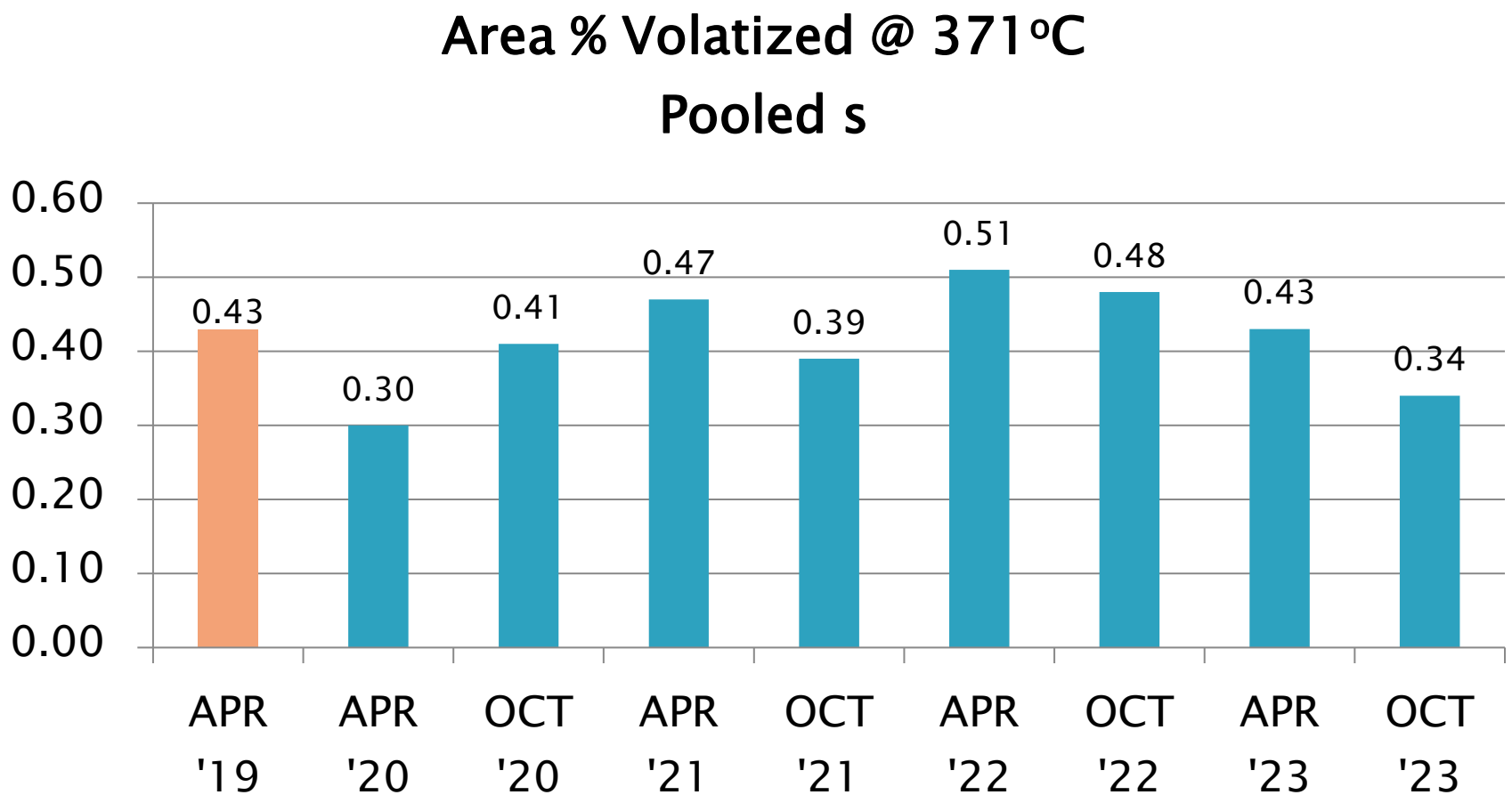
D6417: Estimation of Engine Oil Volatility by Capillary GC

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	-----
10/1/19 through 3/31/20	17	14	0.30	0.09
4/1/20 through 9/30/20*	16	13	0.41	-0.34
4/1/20 through 9/30/20*	14	11	0.31	0.01
10/1/20 through 3/31/21*	21	18	0.47	-0.81
10/1/20 through 3/31/21*	19	16	0.37	-0.43
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

*Period statistics with two mild results from rigs D5/D6 included and excluded (operational problem suspected but lab never confirmed)

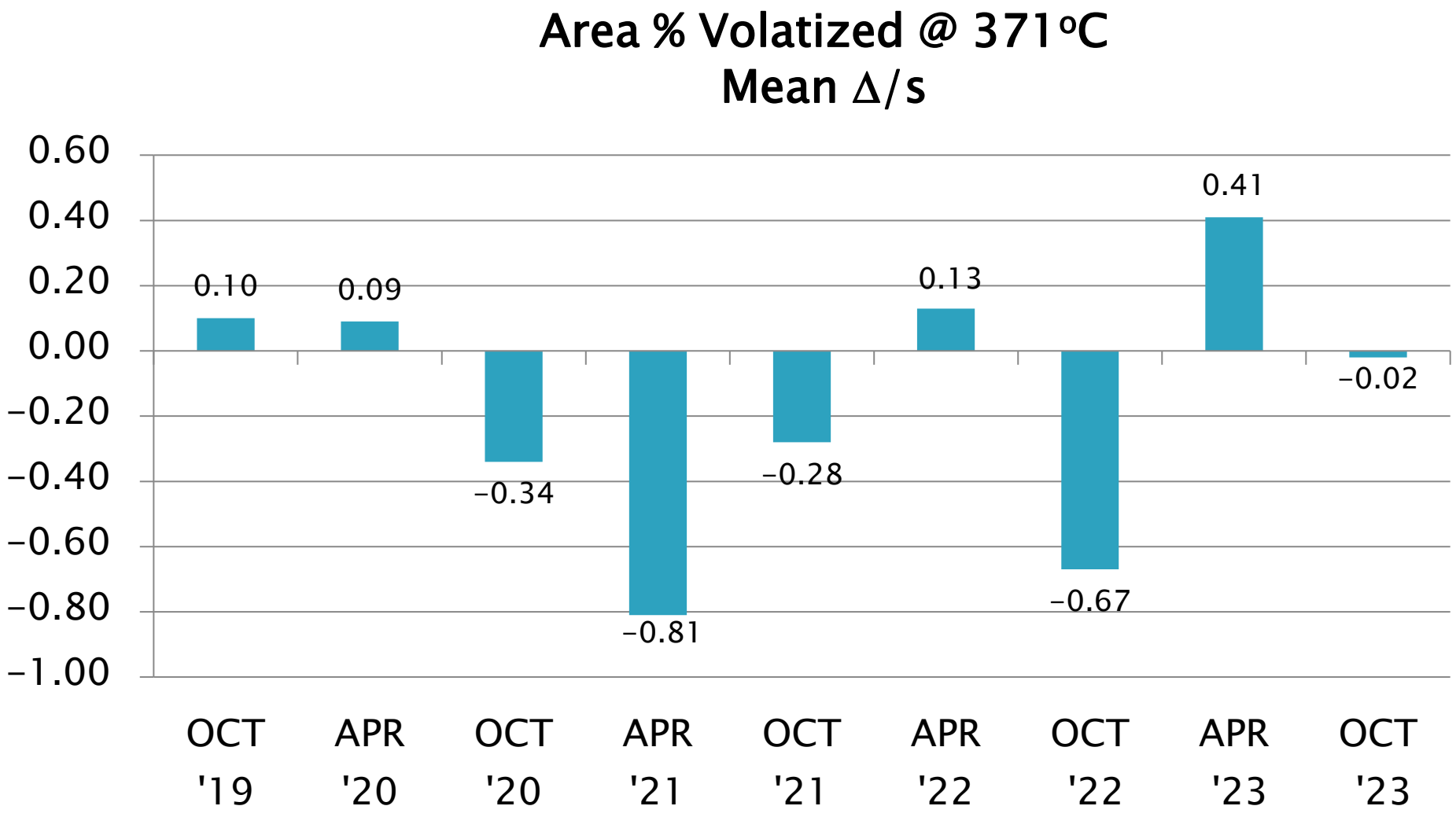
D6417 Precision Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

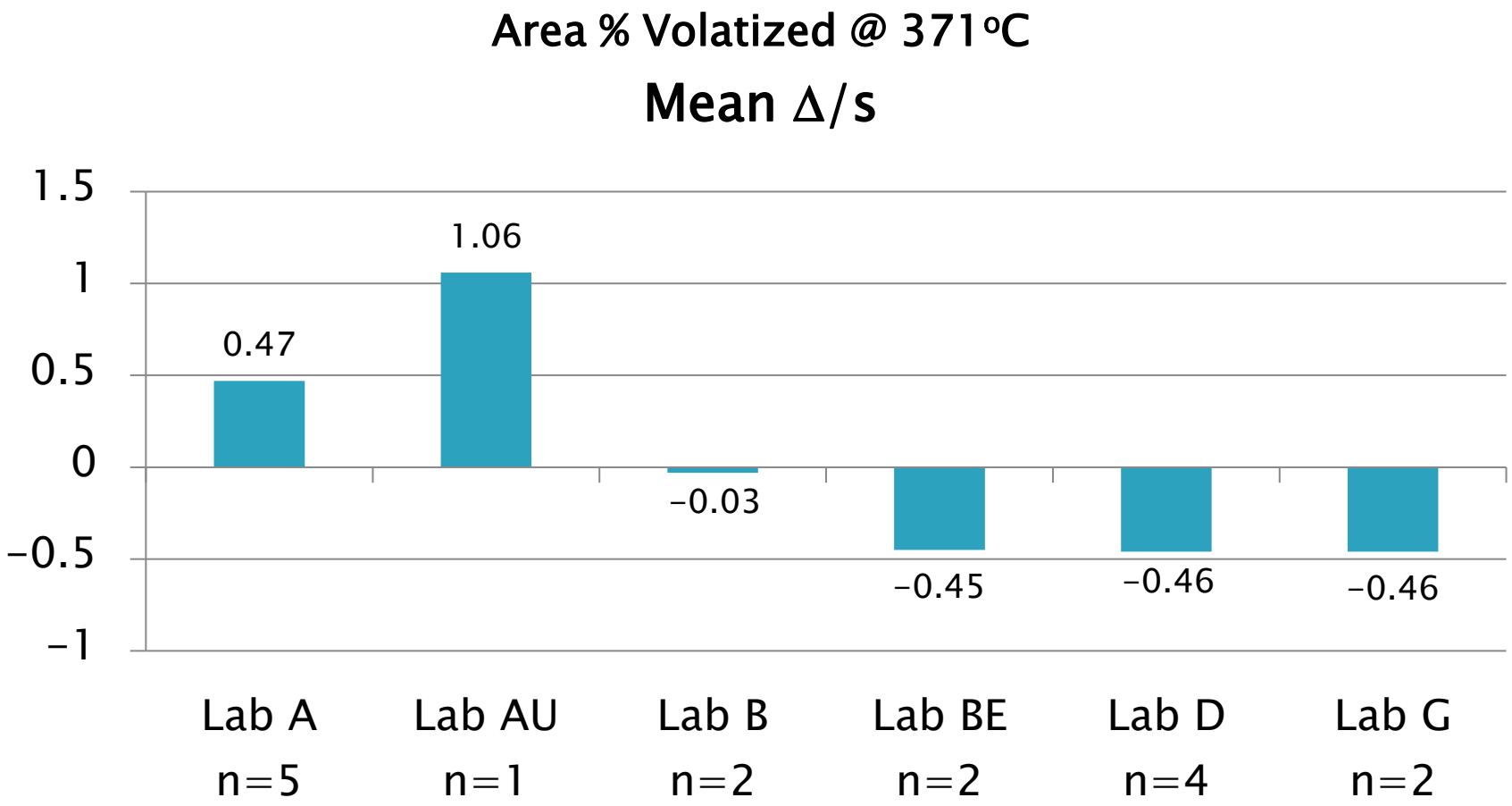
D6417 Severity Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6417 Lab Severity Estimates



April 1, 2023 – September 30, 2023

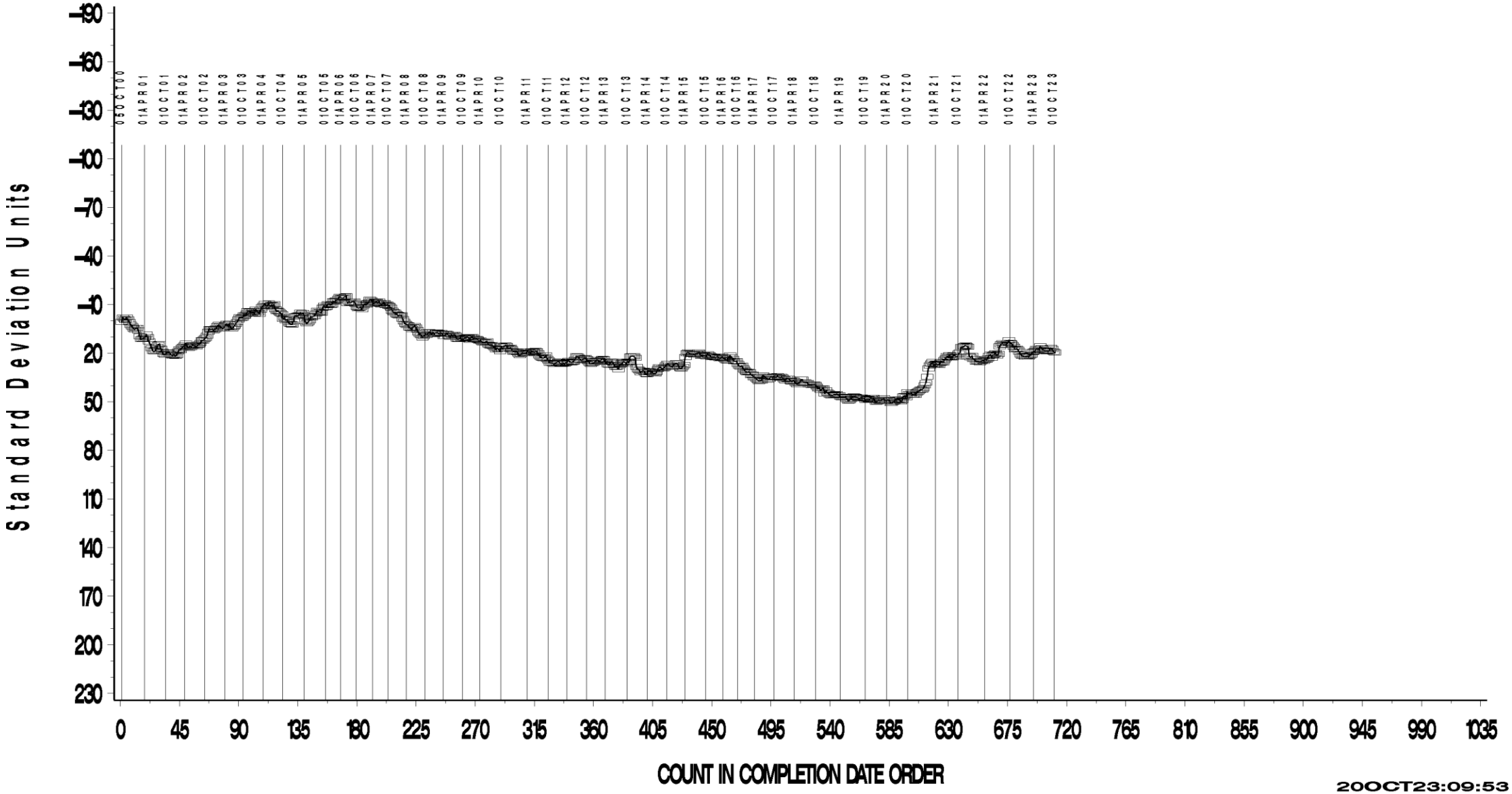
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D6417 VOLATILITY BY GC INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

SAMPLE AREA % VOLATIZED

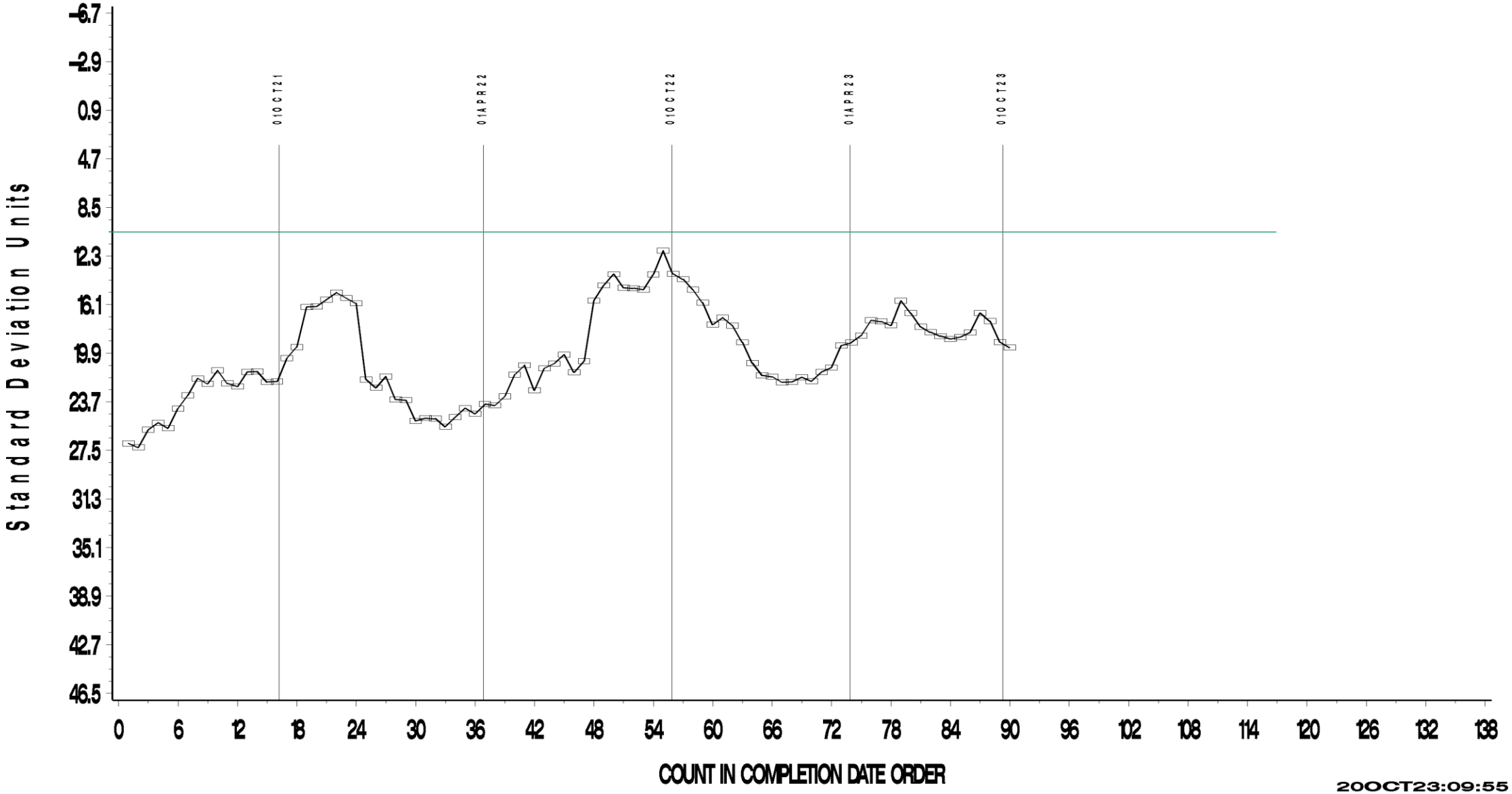
CUSUM Severity Analysis



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

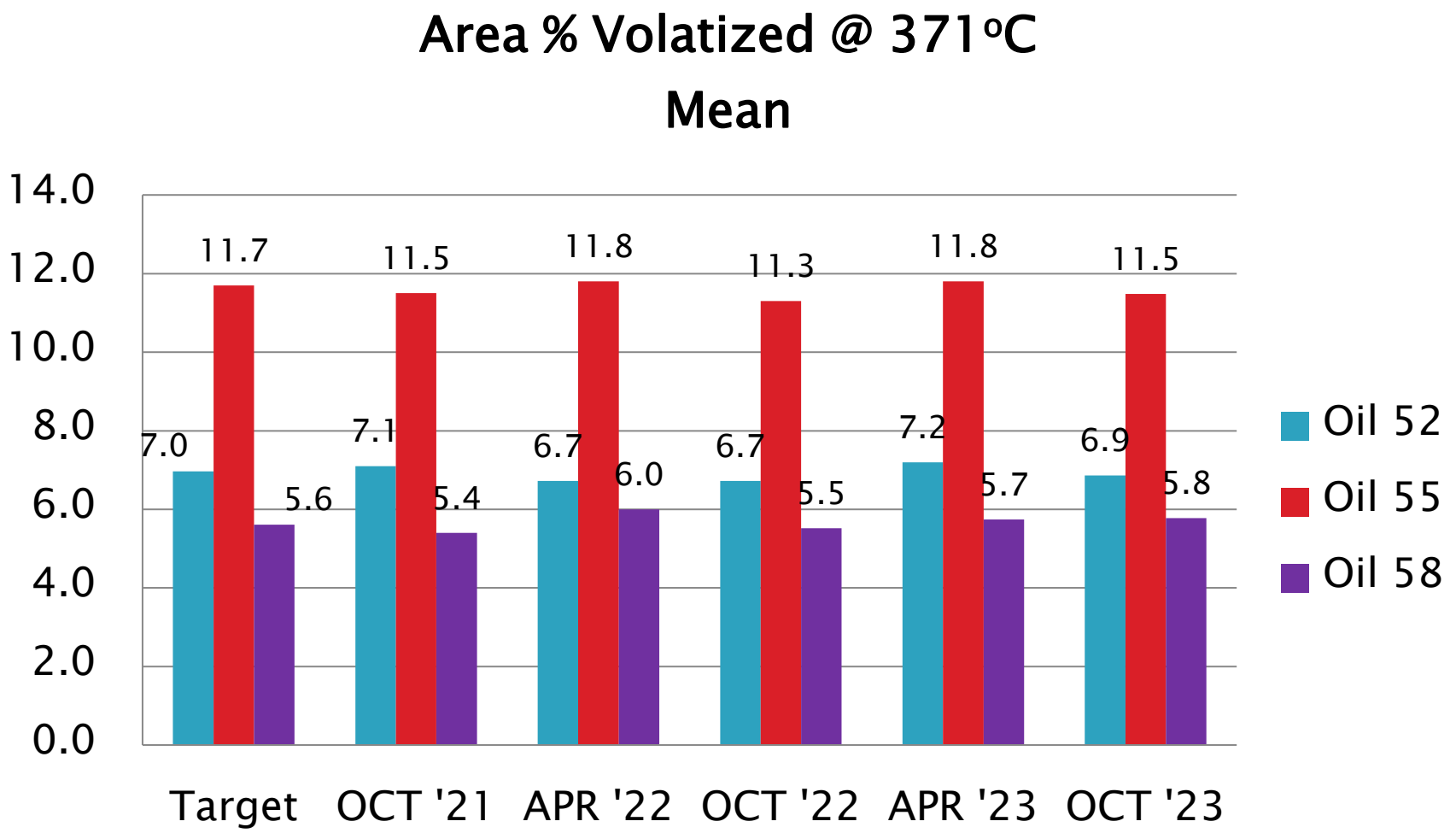
A Program of ASTM International

CUSUM Severity Analysis



20OCT23:09:55

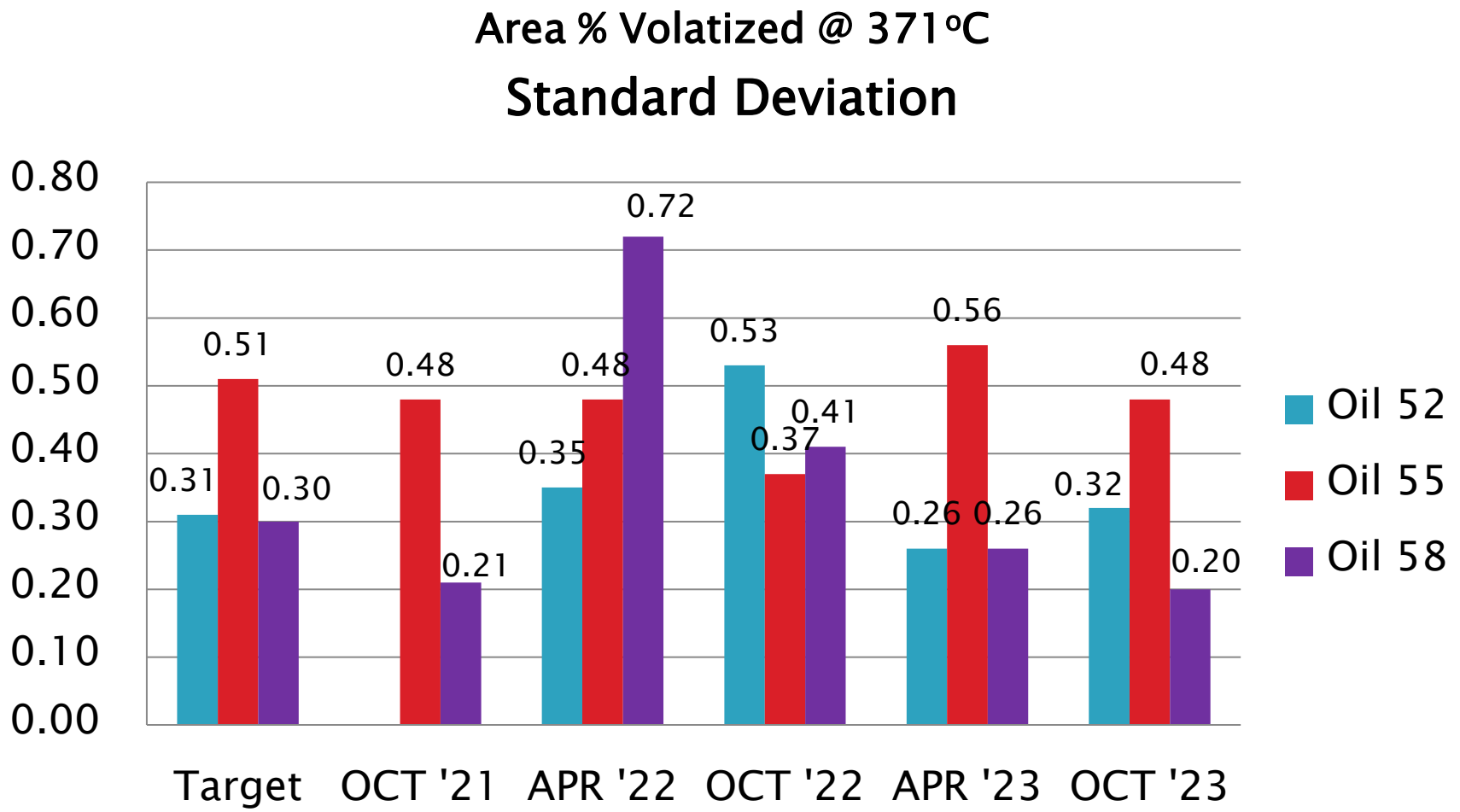
D6417 Performance by Oil



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

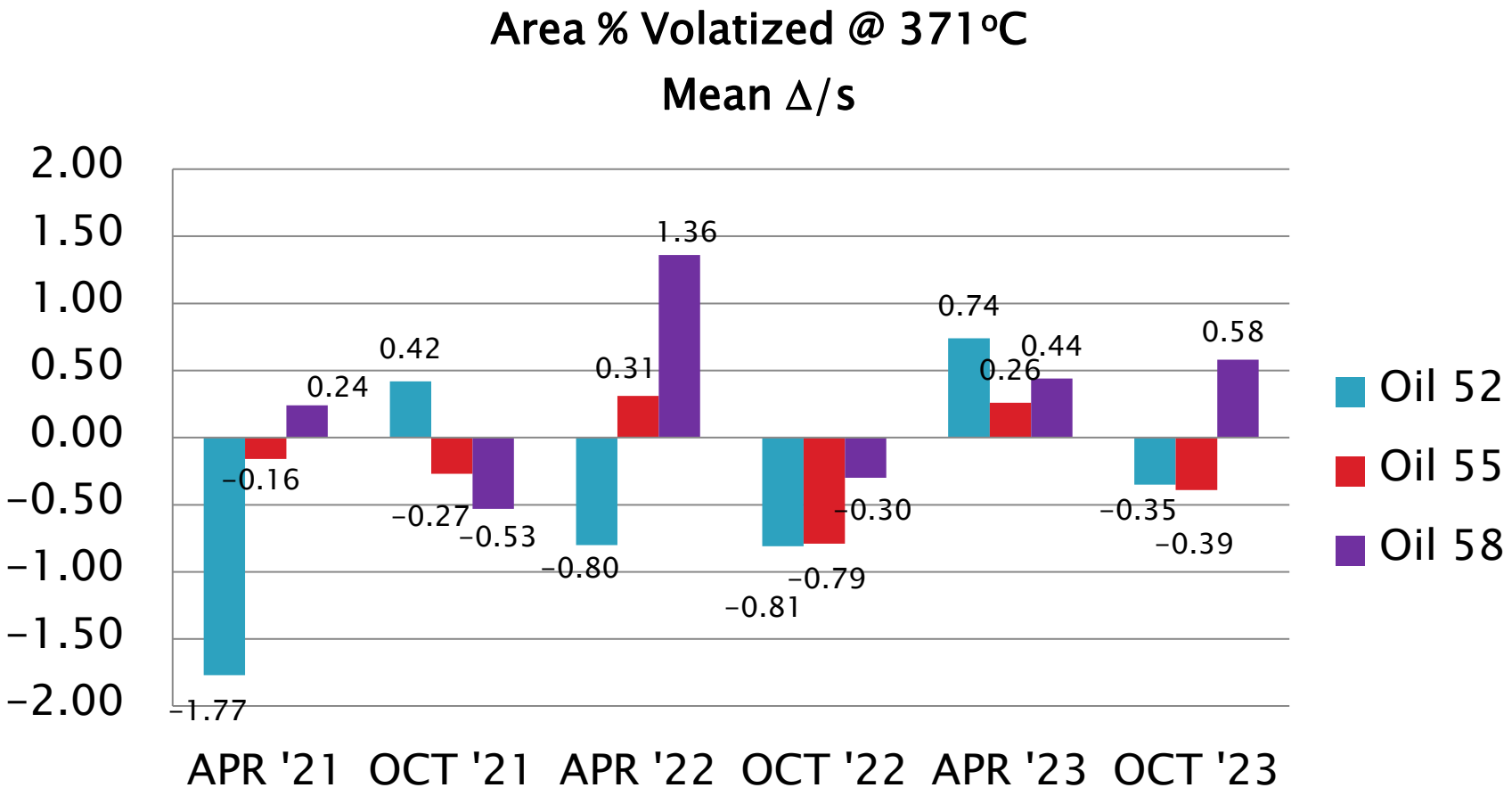
D6417 Performance by Oil



April 1, 2023 – September 30, 2023

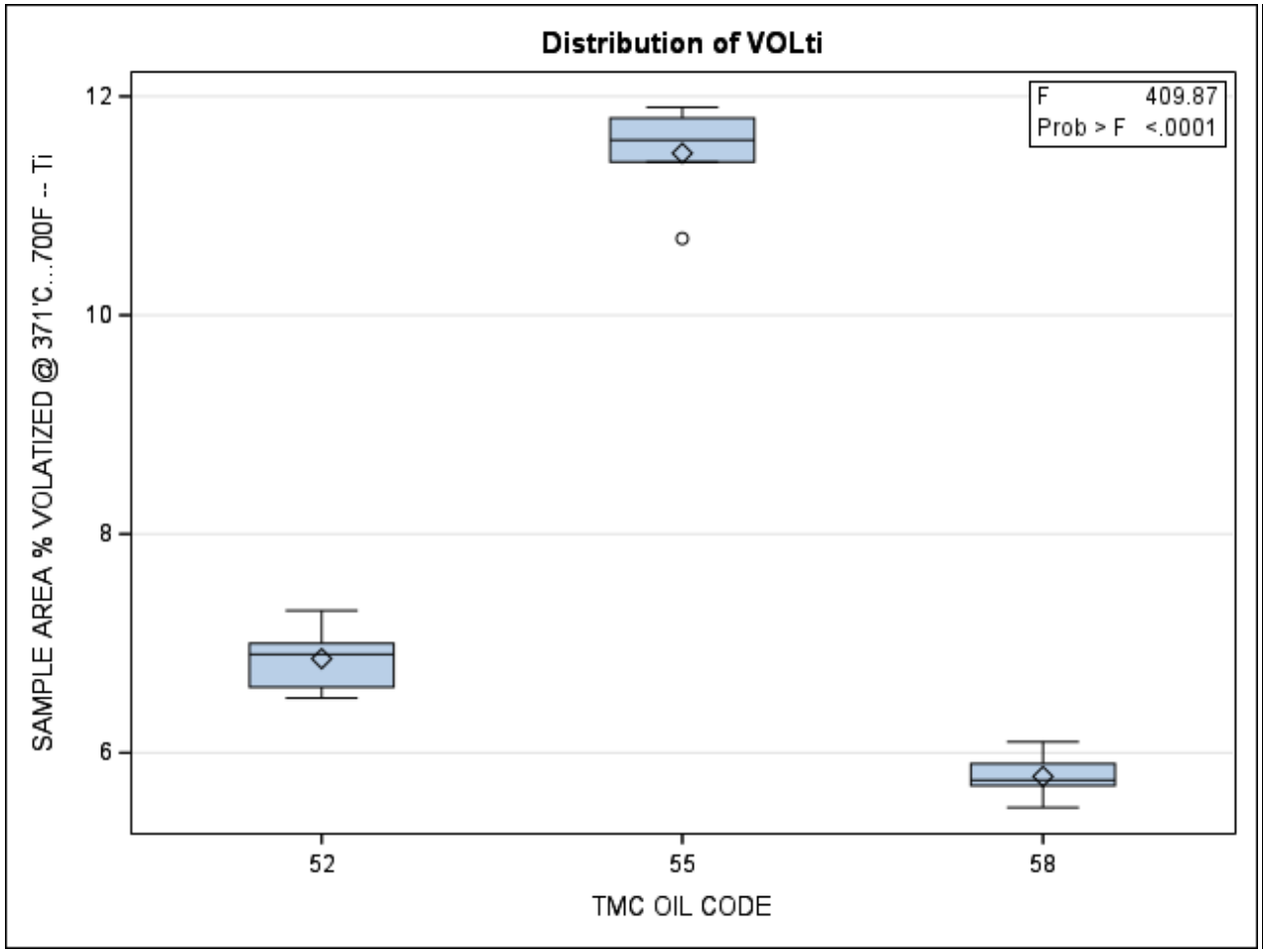
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

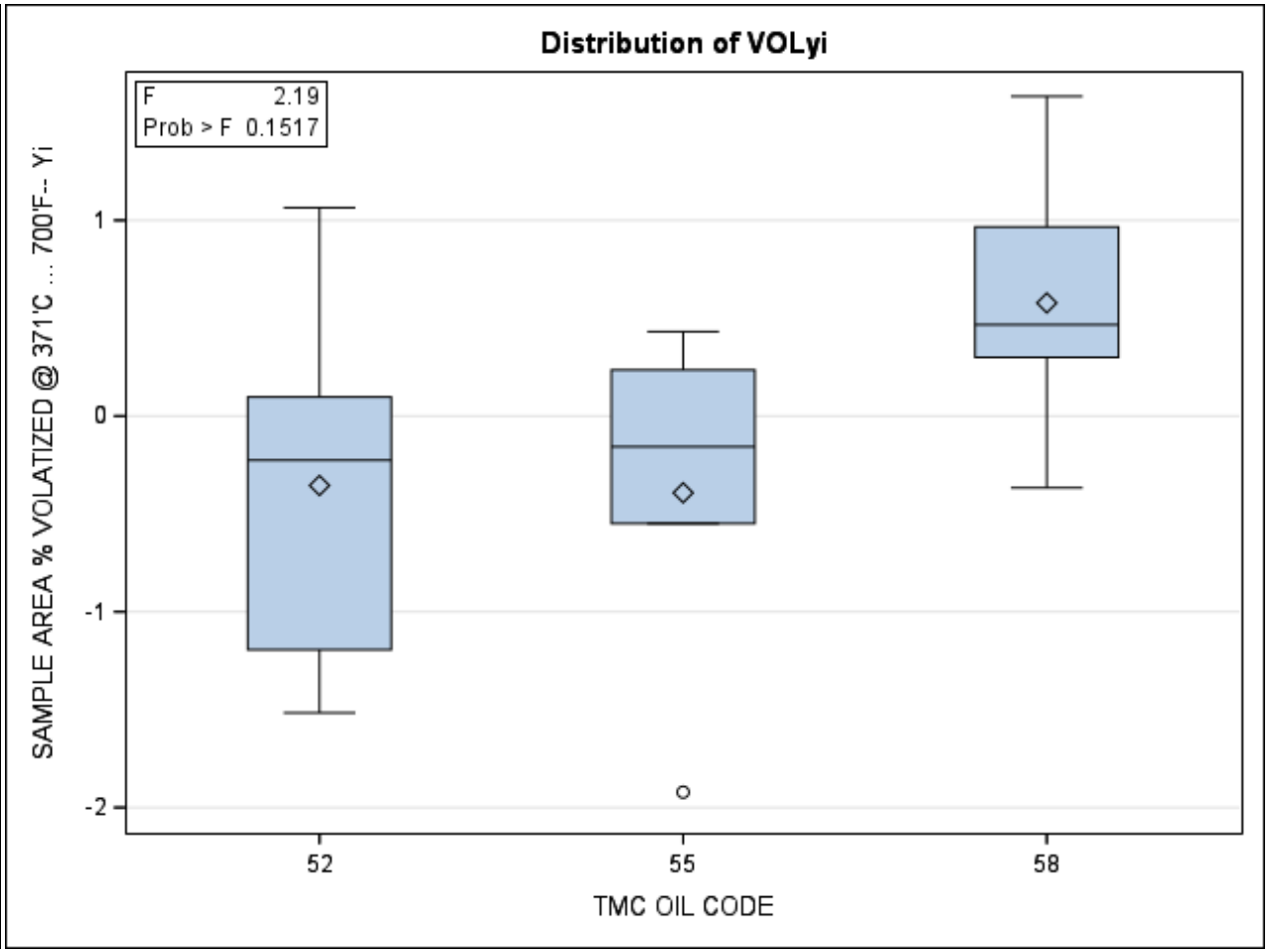
D6417 Performance by Oil



April 1, 2023 – September 30, 2023

D6417 Performance by Oil





D6417: Estimation of Engine Oil Volatility by Capillary GC

- Precision (Pooled s) continues to be remarkably consistent.
- Performance (Mean Δ/s) is “on target” after being slightly severe in prior reporting period.
- CUSUM severity plot continues to circle around CUSUM value of 19.7 and remaining very flat with no long-term directional trends.

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 6557

Ball Rust Test (BRT)

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6557	5 (+0)	5 (+0)
*As of 9/30/2023		

BRT Test Activity*

Test Status	Validity Code	Number of Tests
Acceptable Calibration Test	AC	158
Failed Calibration Test	OC	11
Operationally Invalid, by Lab	LC	1
Aborted Calibration Run	XC	1
Operationally Invalid, by TMC	RC	1
Acceptable Shakedown Run	NN	1
Total		**172**

- 5 labs reported data

BRT Failed Tests

Failed Parameter (OC)	Number of Tests
Severe (low) Average Gray Value	7
Mild (high) Average Gray Value	4
Total	**11**

RO 1006: One Severe Test
RO 82-1: One Severe Test
RO 82-1: Four Mild Tests
RO 86: Four Severe Tests
RO 87: One Severe Test

BRT Failed Tests (OC) by Lab

Failed Parameter	LTMS Lab					#
	A	B	D	G	L	
Severe Average Gray Value	0	0	3	4	0	7
Mild Average Gray Value	0	0	1	3	0	4
Total	0	0	4	7	0	11

BRT Lost Tests*

Failed Parameter (LC, RC, XC)	Number of Tests
Acid Injector Malfunction (LC)	1
Air Flow Rate Out of Specification (RC)	1
Acid Injector Malfunction (XC)	1
Total	**3**

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

BRT Lost Tests by Lab

Cause	LTMS Lab					#
	A	B	D	G	L	
Air Flow Rate	0	0	0	1	0	1
Acid Injector Malfunction	1	0	1	0	0	2
Total	**1**	**0**	**1**	**1**	**0**	**3**

BRT Test Severity

- Average Gray Value (AGV) has returned to a slightly mild trend this semester after a severe run over the last two periods. But overall, CUSUM has been relatively “flat” for the past six years (since April 2017).

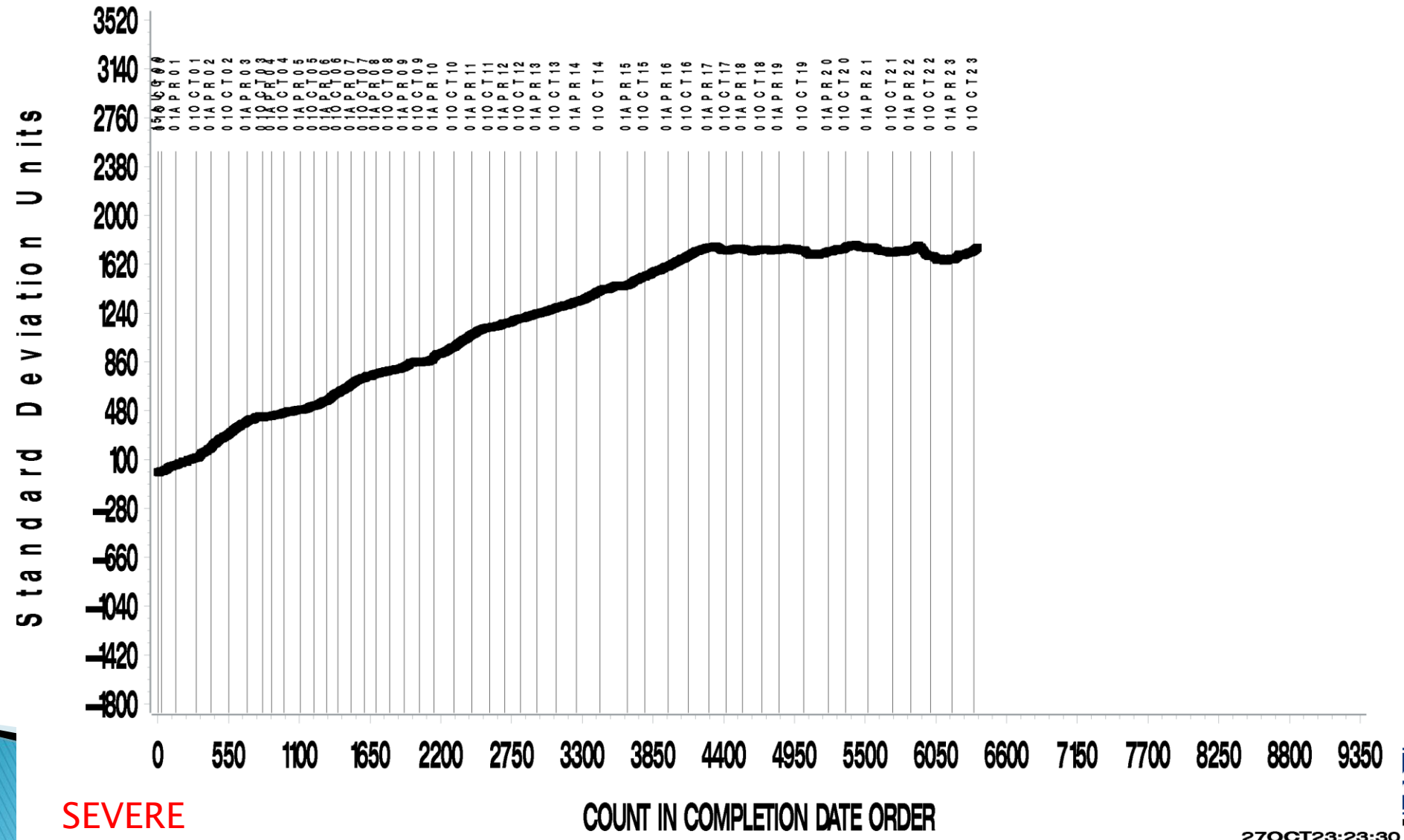
BALL RUST TEST INDUSTRY OPERATIONALLY VALID DATA

REFERENCE AVERAGE GRAY VALUE

MILD

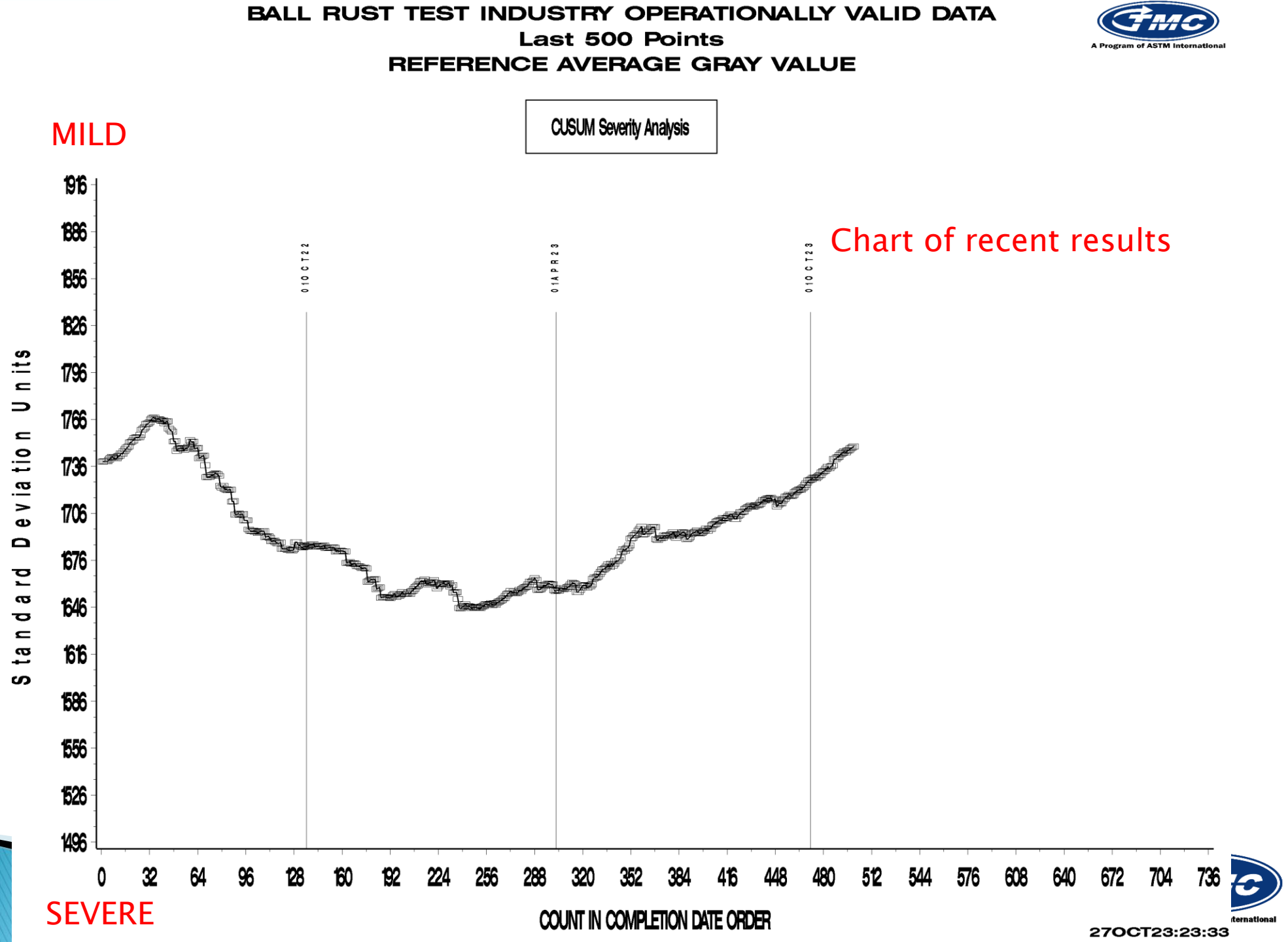
CUSUM Severity Analysis

Historical Chart



SEVERE

27OCT23:23:30


BALL RUST TEST INDUSTRY OPERATIONALLY VALID DATA
Last 500 Points
REFERENCE AVERAGE GRAY VALUE
A Program of ASTM International
CUSUM Severity Analysis
MILD
Chart of recent results
Standard Deviation Units
1916
1886
1856
1826
1796
1766
1736
1706
1676
1646
1616
1586
1556
1526
1496
01OCT22
01APR23
01OCT23
0
32
64
96
128
160
192
224
256
288
320
352
384
416
448
480
512
544
576
608
640
672
704
736
SEVERE
COUNT IN COMPLETION DATE ORDER
27OCT23:23:33

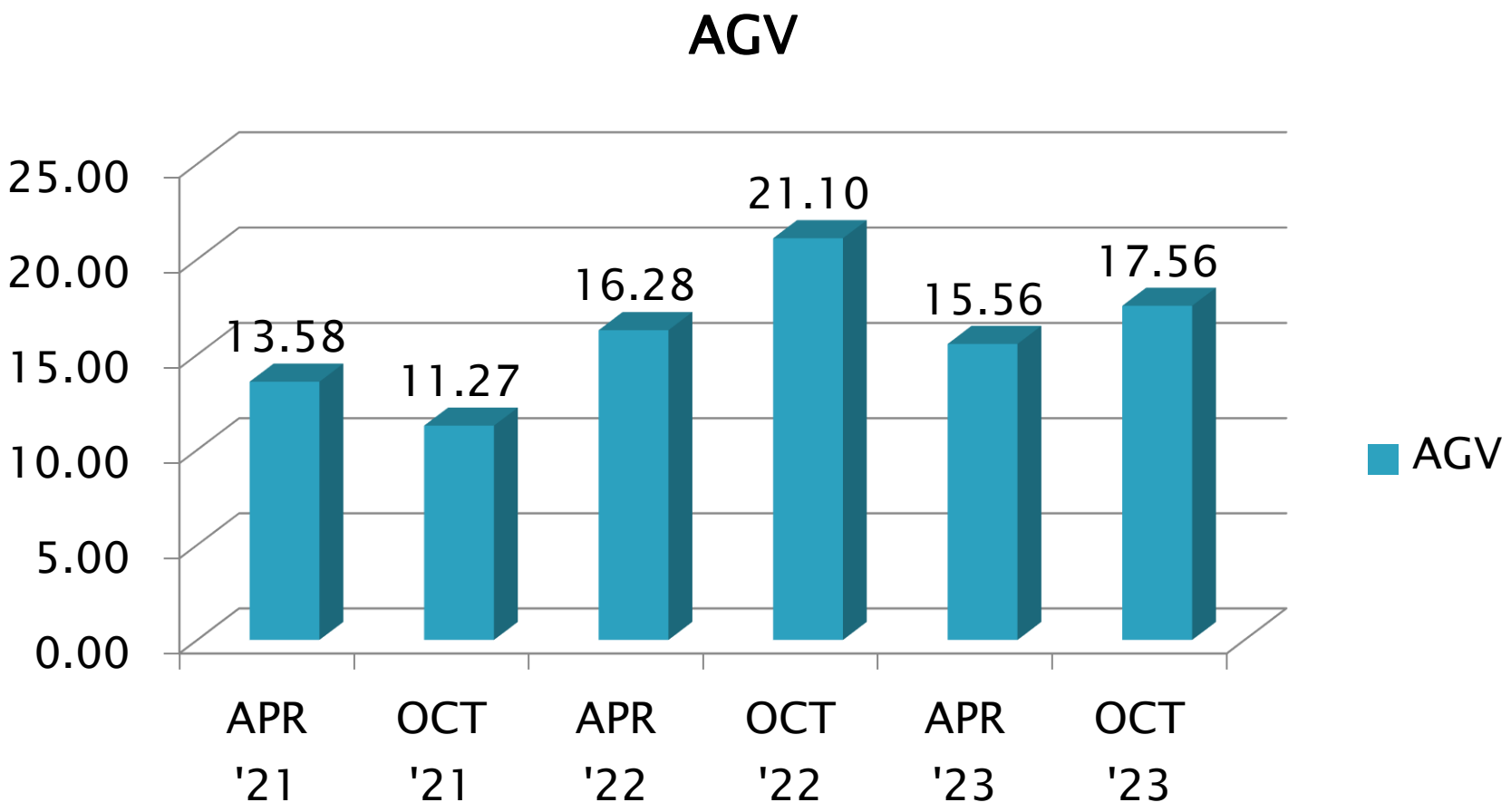
BRT (D6557) Rust Protection Test

Period Precision and Severity Estimates

Average Gray Value	n	df	Pooled s	Mean Δ/s
10/1/20 through 3/31/21	171	168	13.58	-0.01
4/1/21 through 9/30/21	191	188	11.27	-0.20
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

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

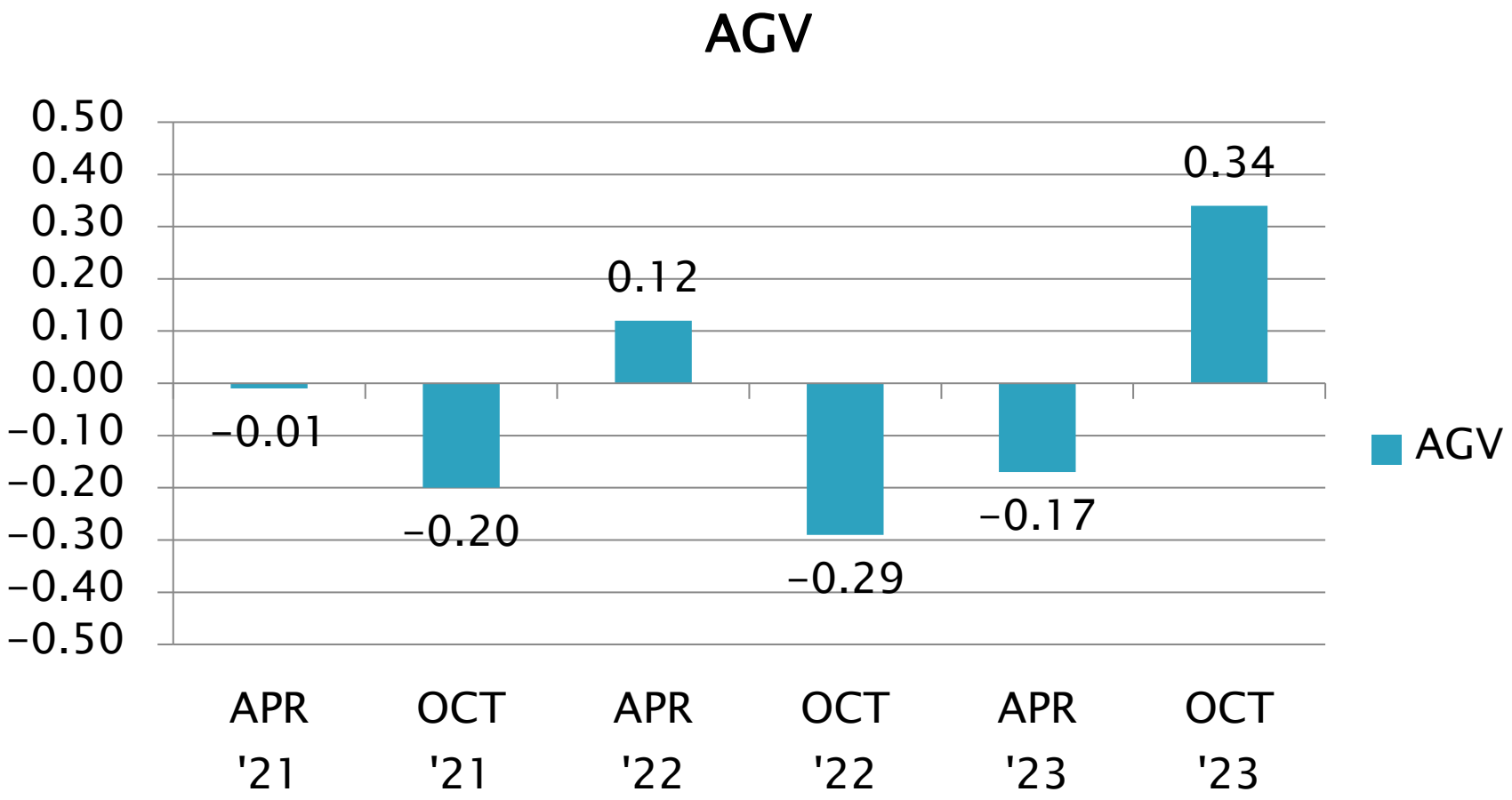
BRT Precision (Pooled s) Estimates



April 1, 2023 – September 30, 2023

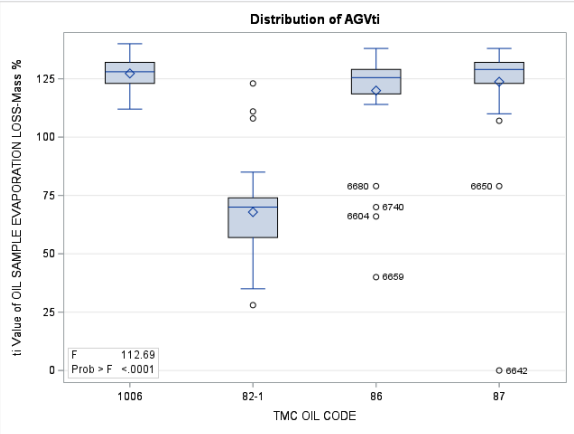
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

BRT Performance (Mean Δ/s) Estimates

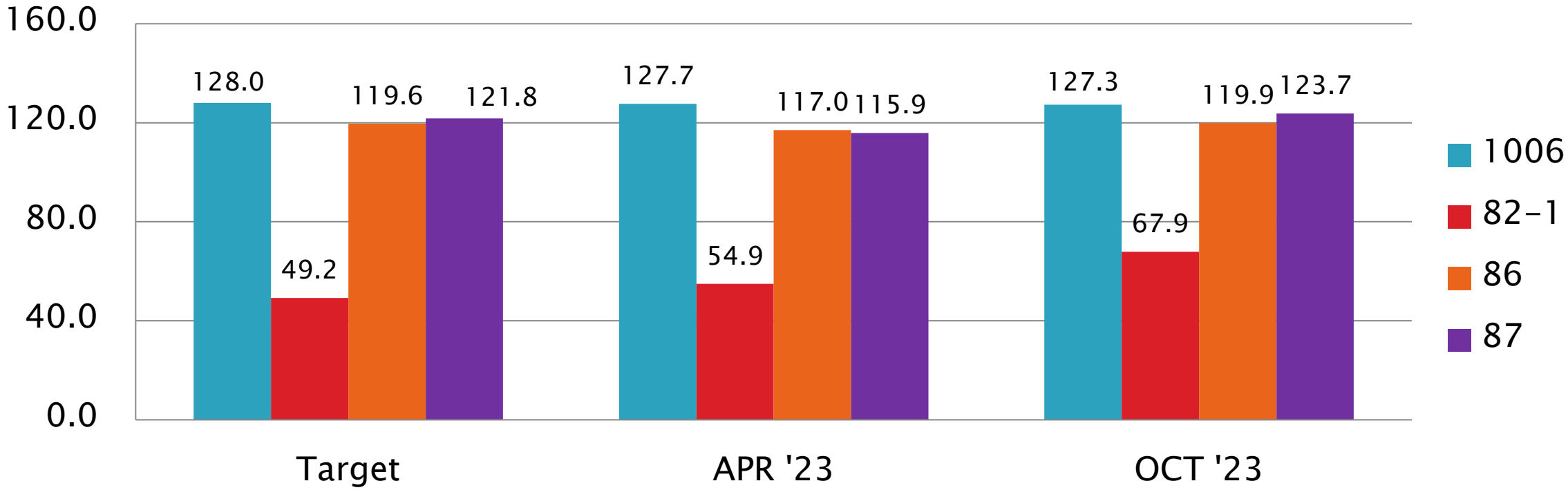


April 1, 2023 – September 30, 2023

BRT Performance by OIL



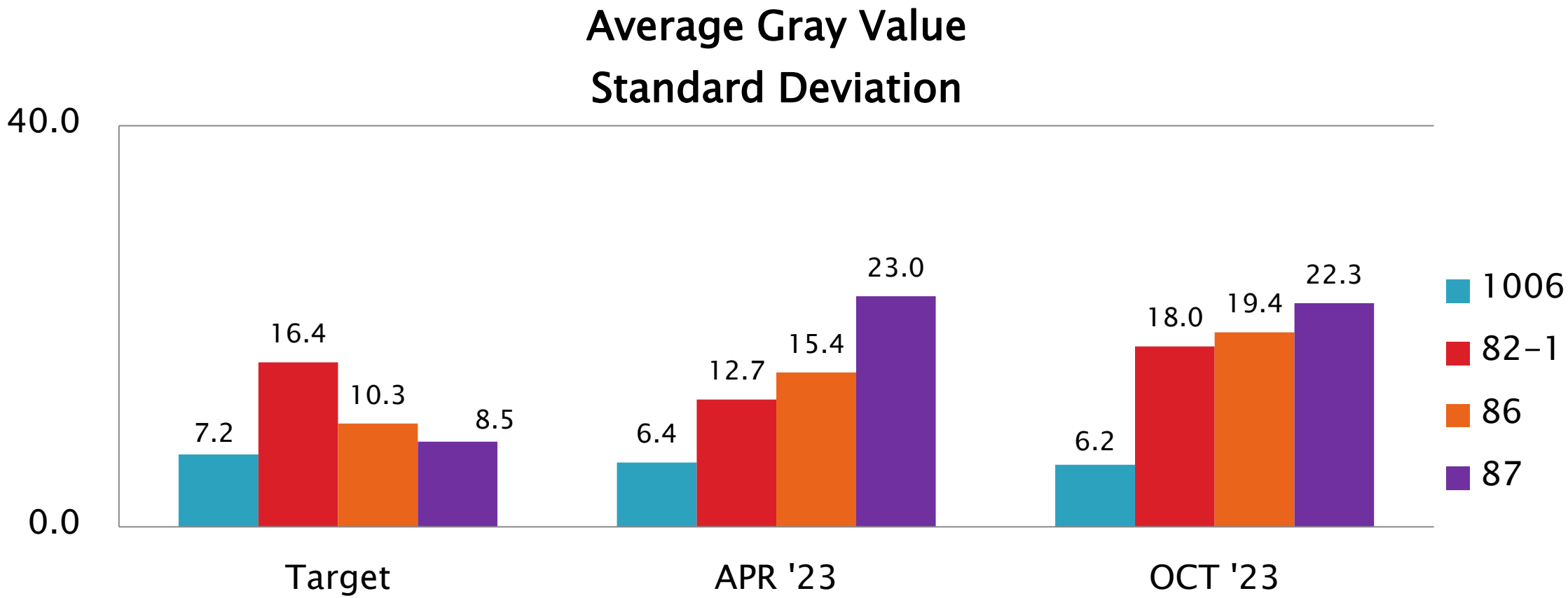
Average Gray Value
Mean



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

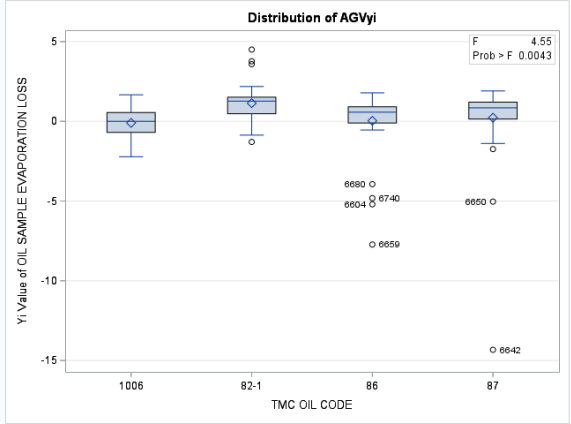
BRT Performance by OIL



April 1, 2023 – September 30, 2023

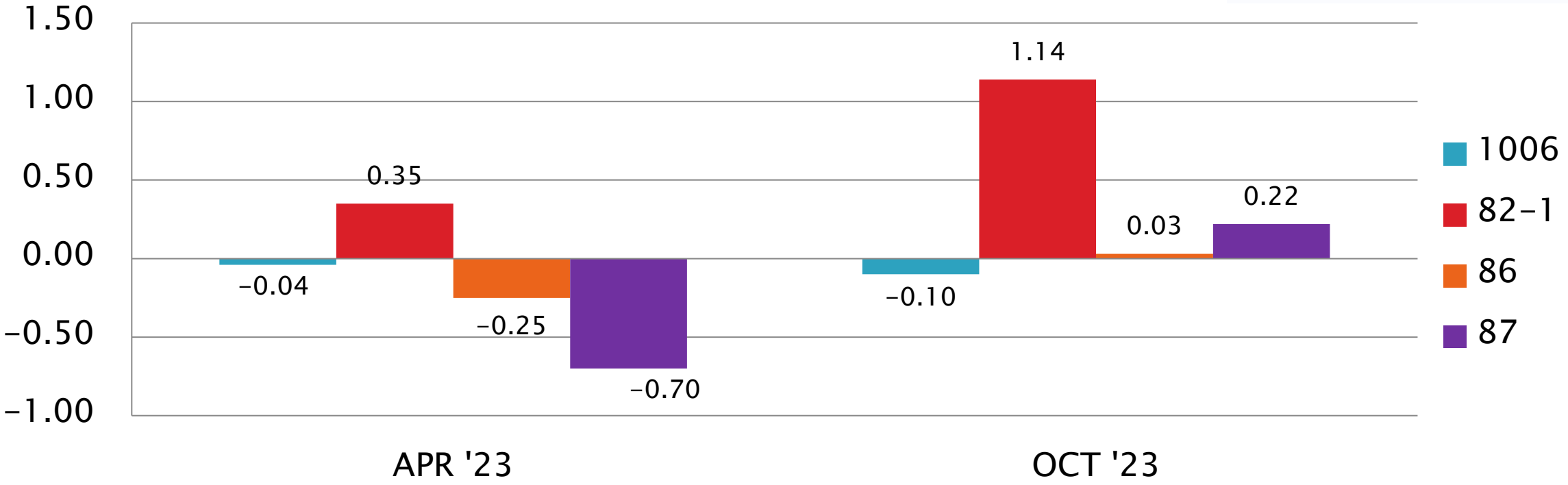
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

BRT Performance by OIL



Average Gray Value

MEAN Δ/s



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Information Letters*

Test	Date	IL	Topic
			No new information letters this period.

*Available from TMC Website

Reference Oil Inventory Estimated Life

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Total Assignments made over Semester	Estimated Life
1006	29.3	0.4	43	5+ years
82-1	1.9	0.4	45	2.5 years
86	49.6	0.5	44	5+ years
87	93.4	0.5	42	5+ years

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 6594

High Temperature Corrosion Bench Test (HTCBT)

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report in parentheses)

Test	Labs	Stands
D6594	10 (+0)	30 (+0)
*As of 9/30/2023		

HTCBT Test Activity*

Test Status	Validity Code	Number of Tests
Acceptable Calibration Test	AC	279
Failed Calibration Test	OC	17**
Operationally Invalid, by lab	LC	6
Aborted Calibration Test	XC	1
Acceptable Shakedown Run	NN	2
Unacceptable Shakedown Run	MN	0
Total		**305**

10 labs reported data
**down 6 from previous semester

*April 1, 2023 – September 30, 2023

HTCBT Failed Tests

Failed Parameter	Number of Tests
Lead Concentration Severe	6
Lead Concentration Mild	1
Copper Concentration Severe	9
Copper Concentration Mild	1
Lead and Copper Concentrations (both) Severe	0
Lead and Copper Concentrations (both) Mild	0
Total	**17**

NOTE: Of the 17 failing tests, 5 (29%) were on runs with 44-5 Reference Oil

HTCBT Failed Tests by Lab

Failed Parameter	LTMS Lab										#
	A	L	G	I	V	BB	BC	B	P	BE	
Lead Concentration Severe	0	0	0	4	1	0	1	0	0	0	6
Lead Concentration Mild	0	0	1	0	0	0	0	0	0	0	1
Copper Concentration Severe	2	0	1	4	1	0	0	0	0	1	9
Copper Concentration Mild	0	0	0	0	1	0	0	0	0	0	1
Lead & Copper Concentrations Severe	0	0	0	0	0	0	0	0	0	0	0
Lead & Copper Concentrations Mild	0	0	0	0	0	0	0	0	0	0	0
Total	**2**	**0**	**2**	**8**	**3**	**0**	**1**	**0**	**0**	**1**	**17**

HTCBT Lost Tests*

Status (LC, XC)	Cause	#
Invalid	Temperature Bath / Heater Malfunction	2
Invalid	Air Flow Malfunction	4
Aborted	Temperature Bath / Heater Malfunction	1
Total	*Invalid or Aborted calibration tests	**7**

HTCBT Lost Tests by Lab

Failed Parameter (LC, XC)	LTMS Lab										#
	A	L	G	I	V	BB	BC	B	P	BE	
Temperature Bath / Heater Malfunction	2	0	0	1	0	0	0	0	0	0	3
Air Flow Malfunction	4	0	0	0	0	0	0	0	0	0	4
Total	**6**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**7**

HTCBT Test Status

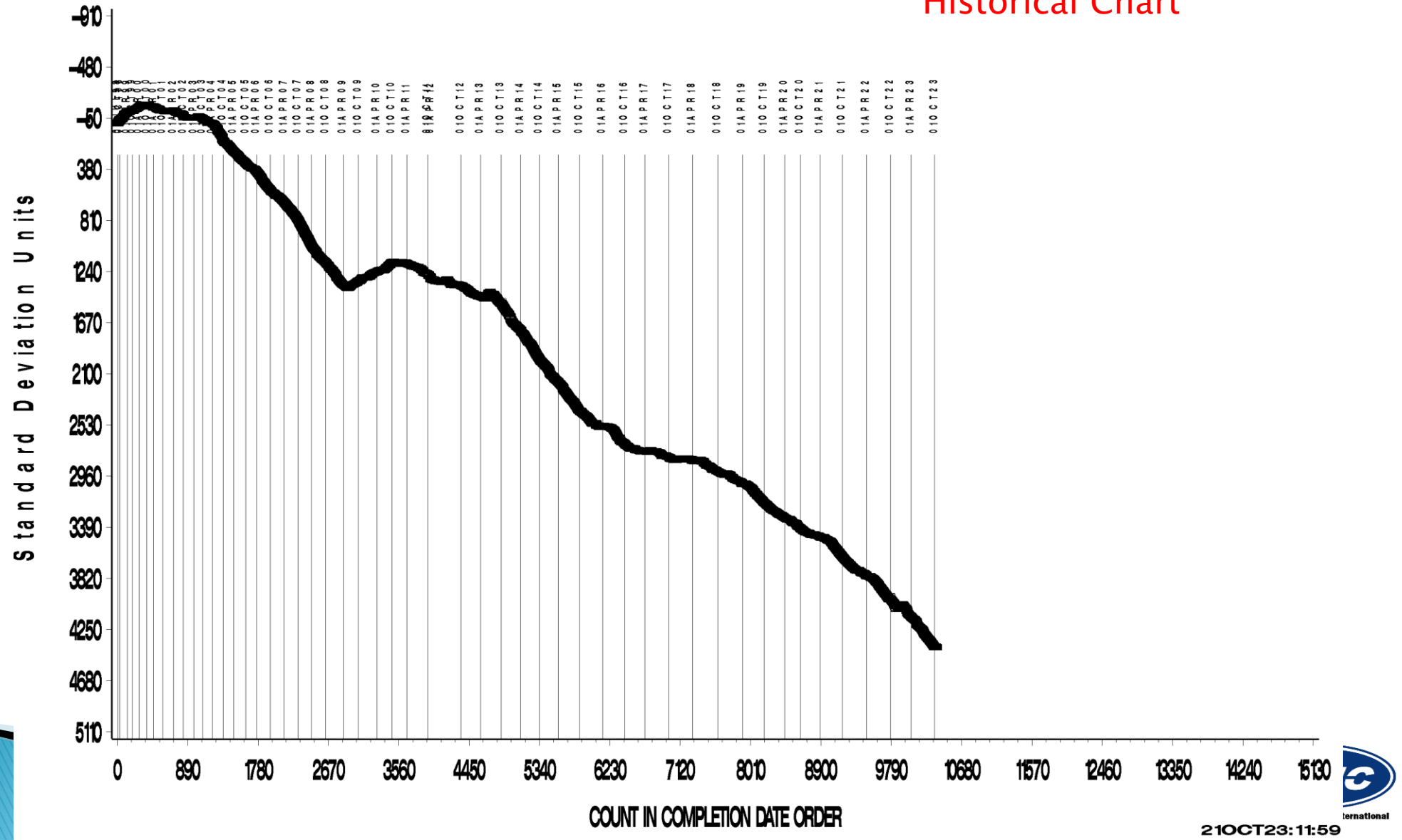
- New Chairperson for HTCBT Surveillance Panel has been identified: Jared Cavaliere
- New Reference Oil 44-5 has completed over 30 Valid tests since its initial introduction and is now ready for target and Pass/Fail analyses
- Only 2.6 gallons of Reference Oil 44-4 remain
- Test severity issues have abated and a significantly fewer number of Calibration Run fails occurred this semester.

HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA

COPPER CHANGE (ppm)

CUSUM Severity Analysis

Historical Chart



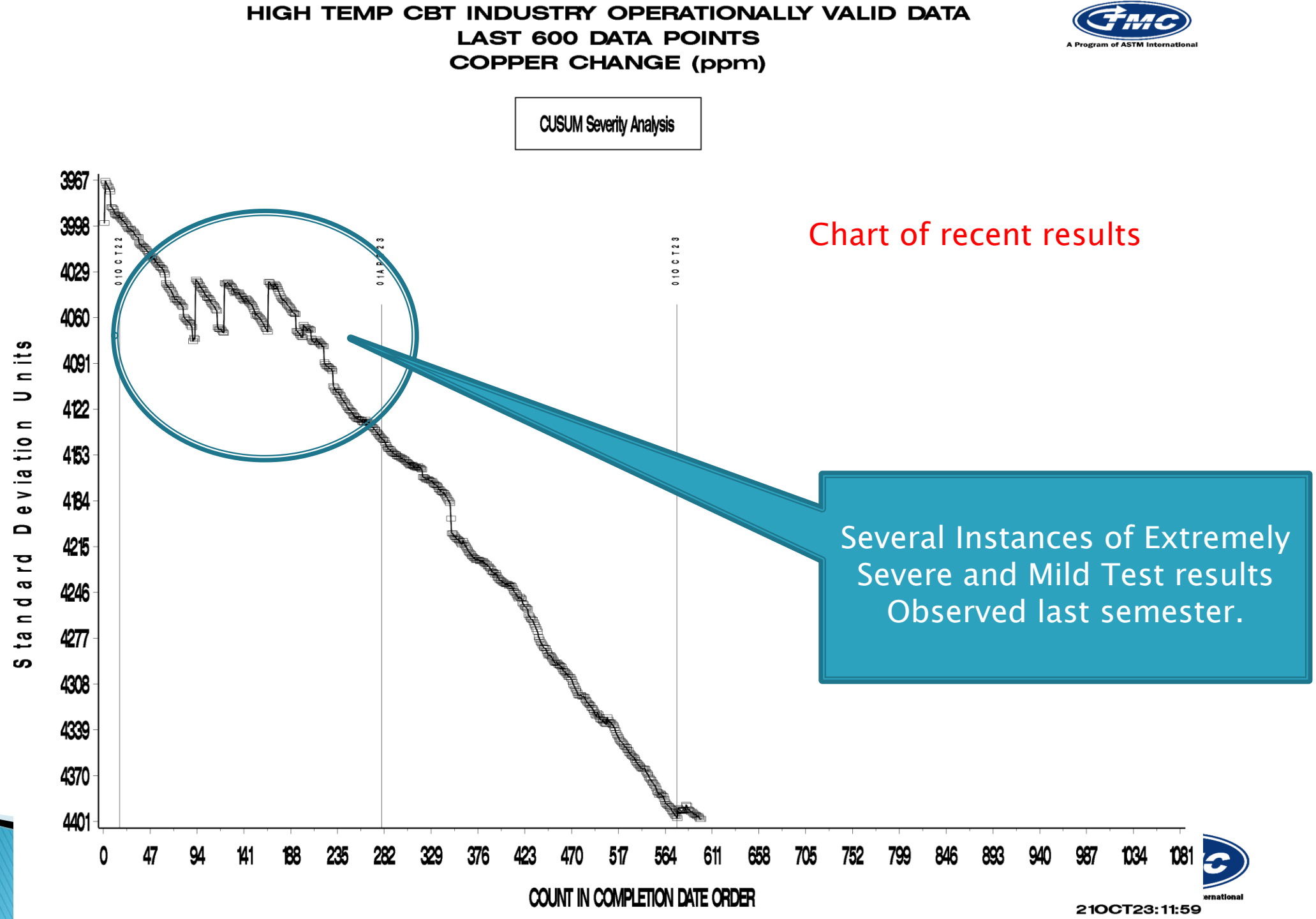


Chart of recent results

Several Instances of Extremely Severe and Mild Test results Observed last semester.

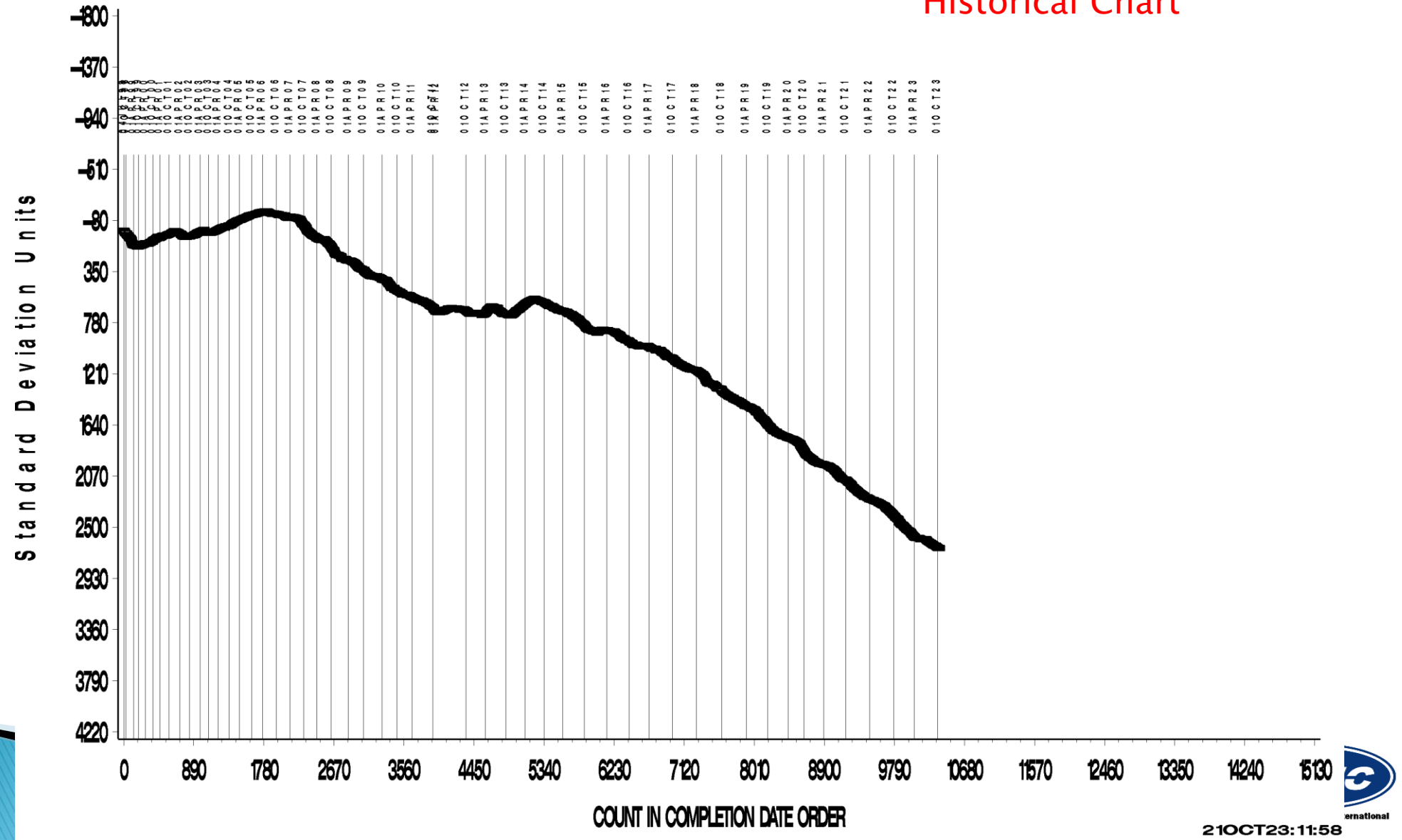
HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA

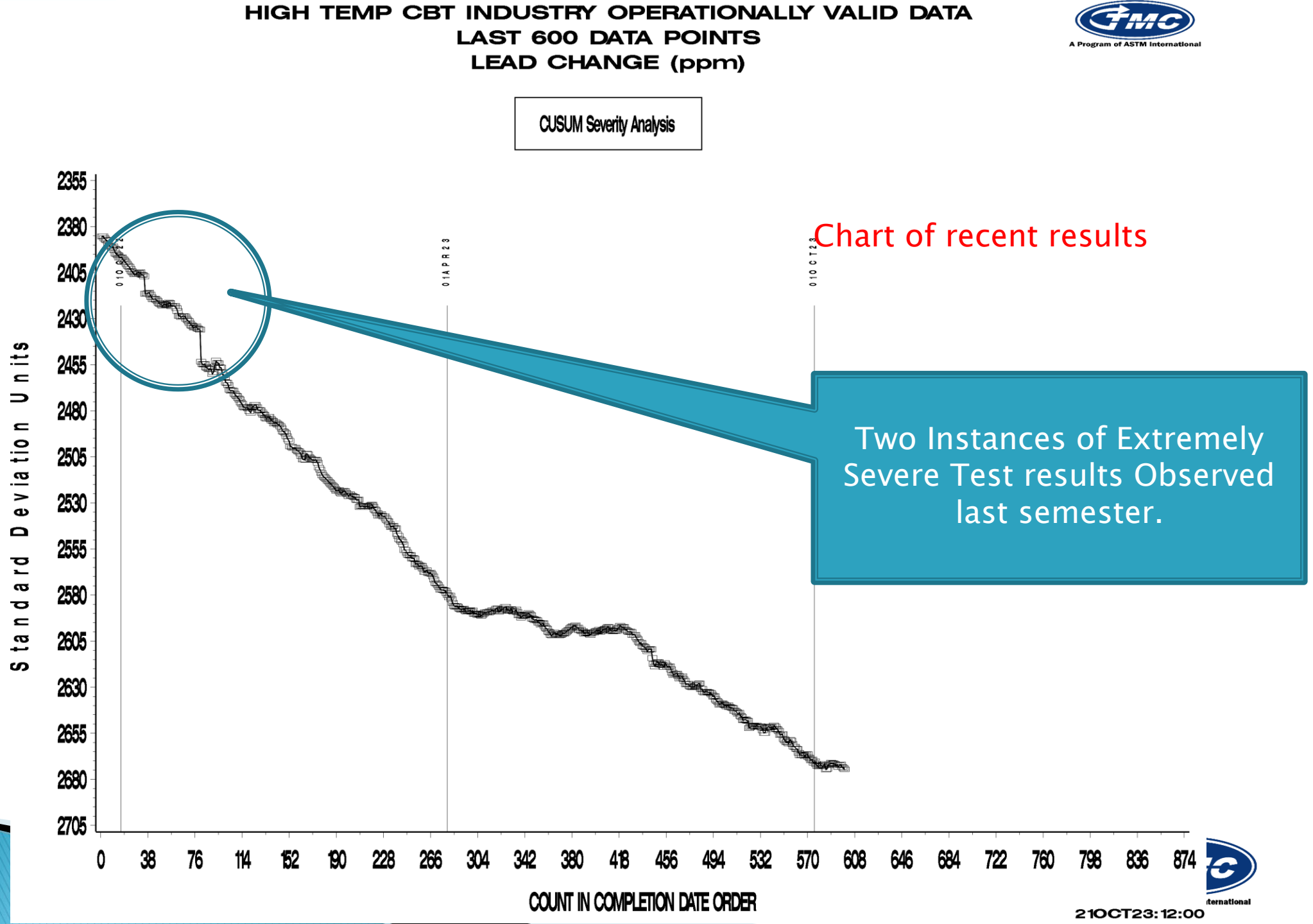
A Program of ASTM International

LEAD CHANGE (ppm)

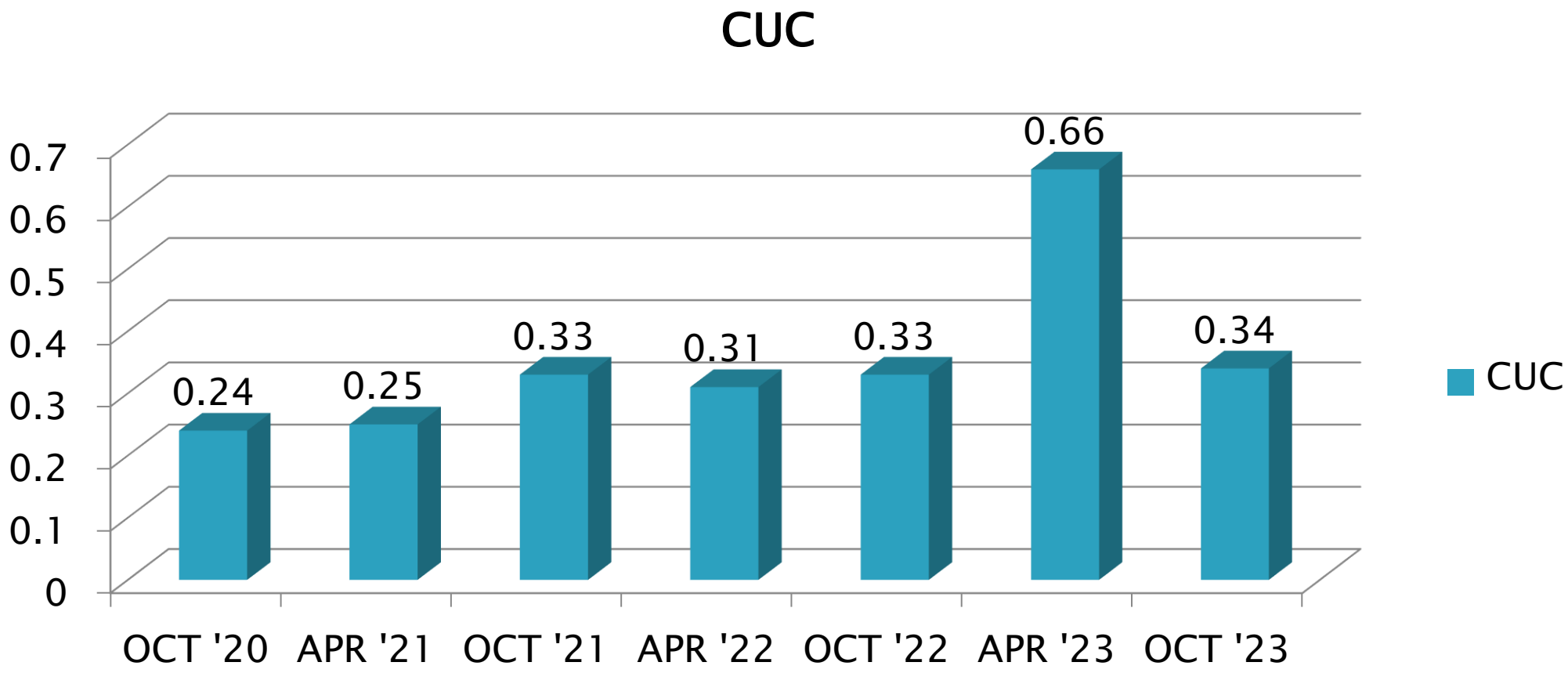
CUSUM Severity Analysis

Historical Chart



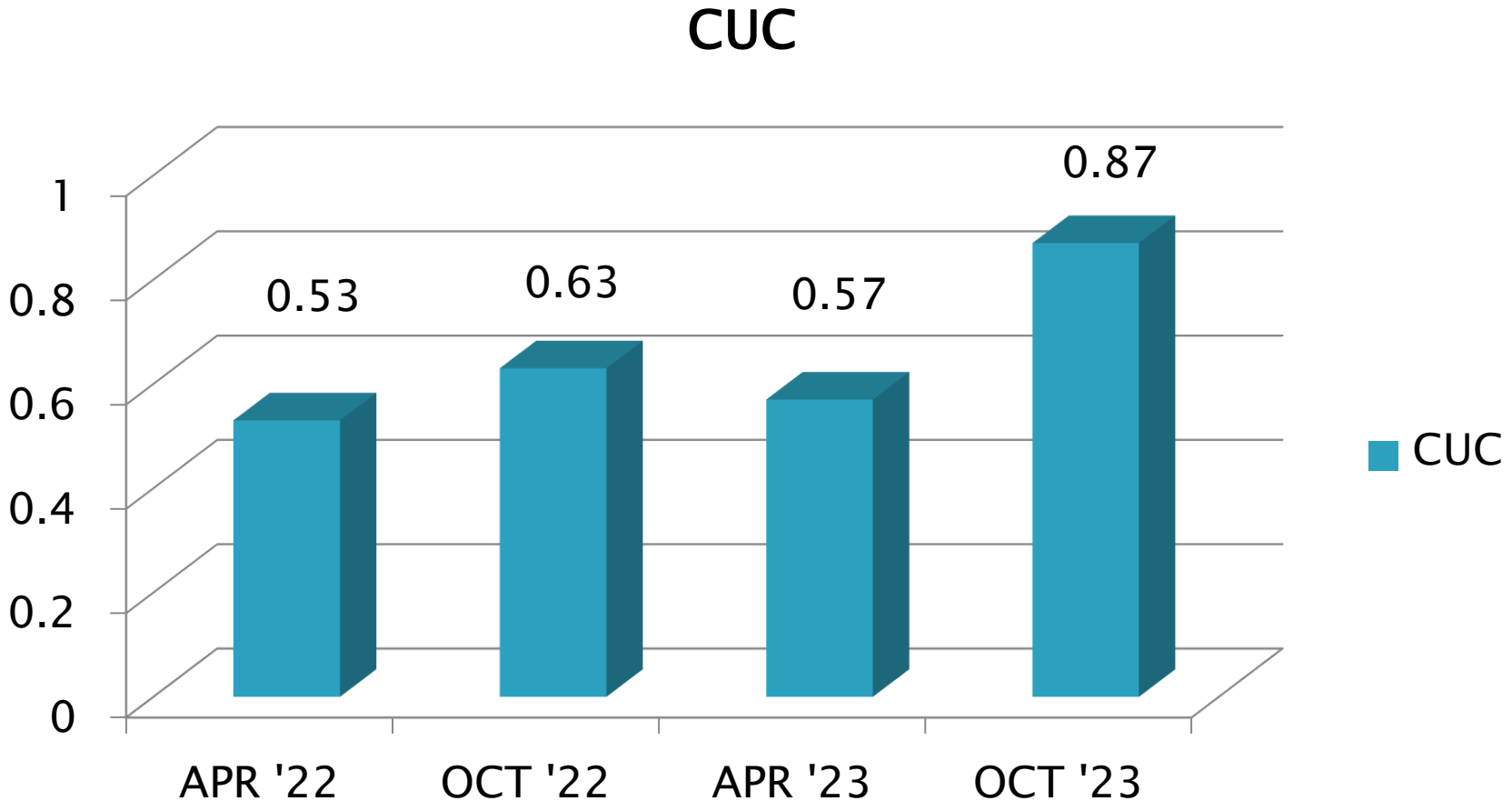

HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
LAST 600 DATA POINTS
LEAD CHANGE (ppm)
CUSUM Severity Analysis
Standard Deviation Units
2355
2380
2405
2430
2455
2480
2505
2530
2555
2580
2605
2630
2655
2680
2705
01APR23
01OCT23
0
38
76
114
152
190
228
266
304
342
380
418
456
494
532
570
608
646
684
722
760
798
836
874
COUNT IN COMPLETION DATE ORDER
Chart of recent results
Two Instances of Extremely Severe Test results Observed last semester.
21OCT23:12:00

HTCBT Precision (Pooled s) Estimates



CUC Standard Deviation results closer to target this semester.

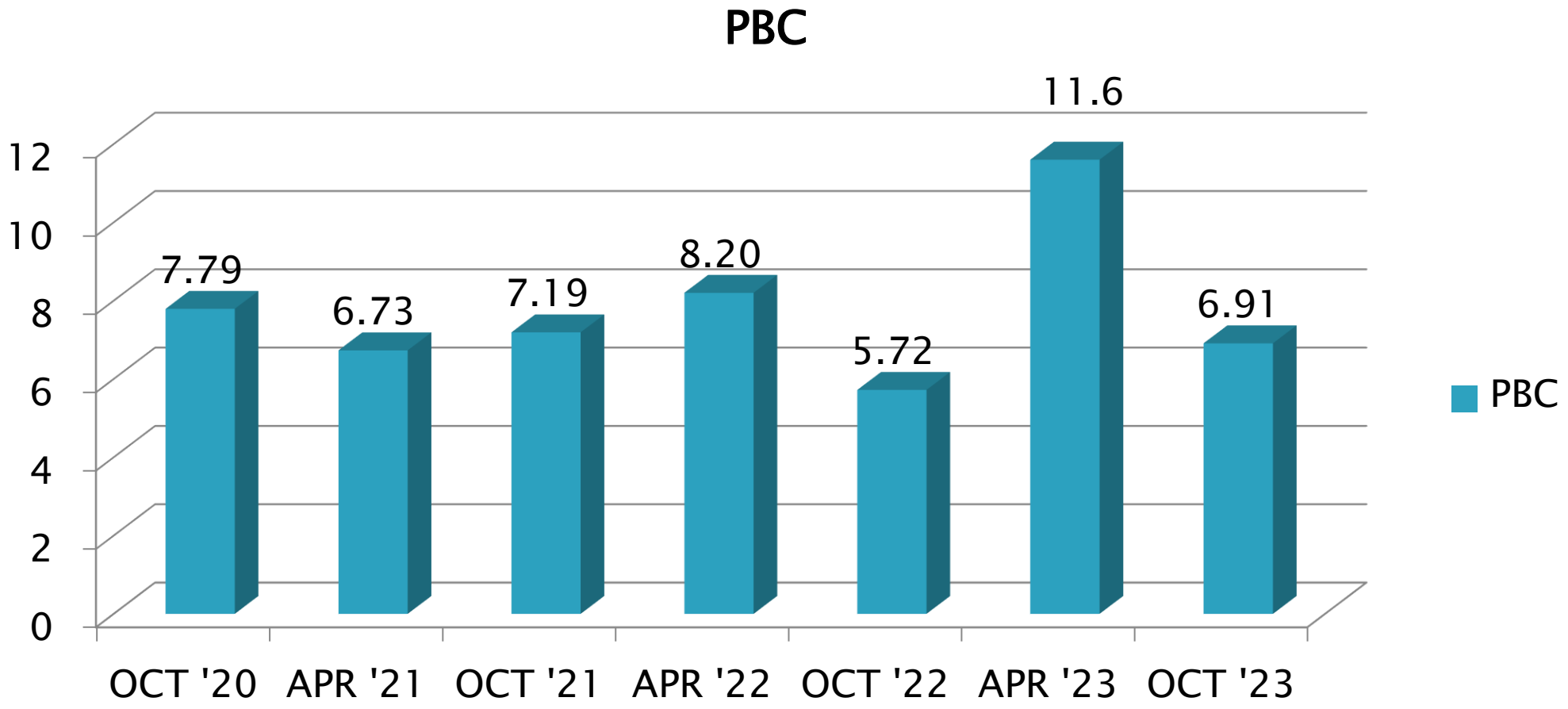
HTCBT Performance (mean Δ/s) Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

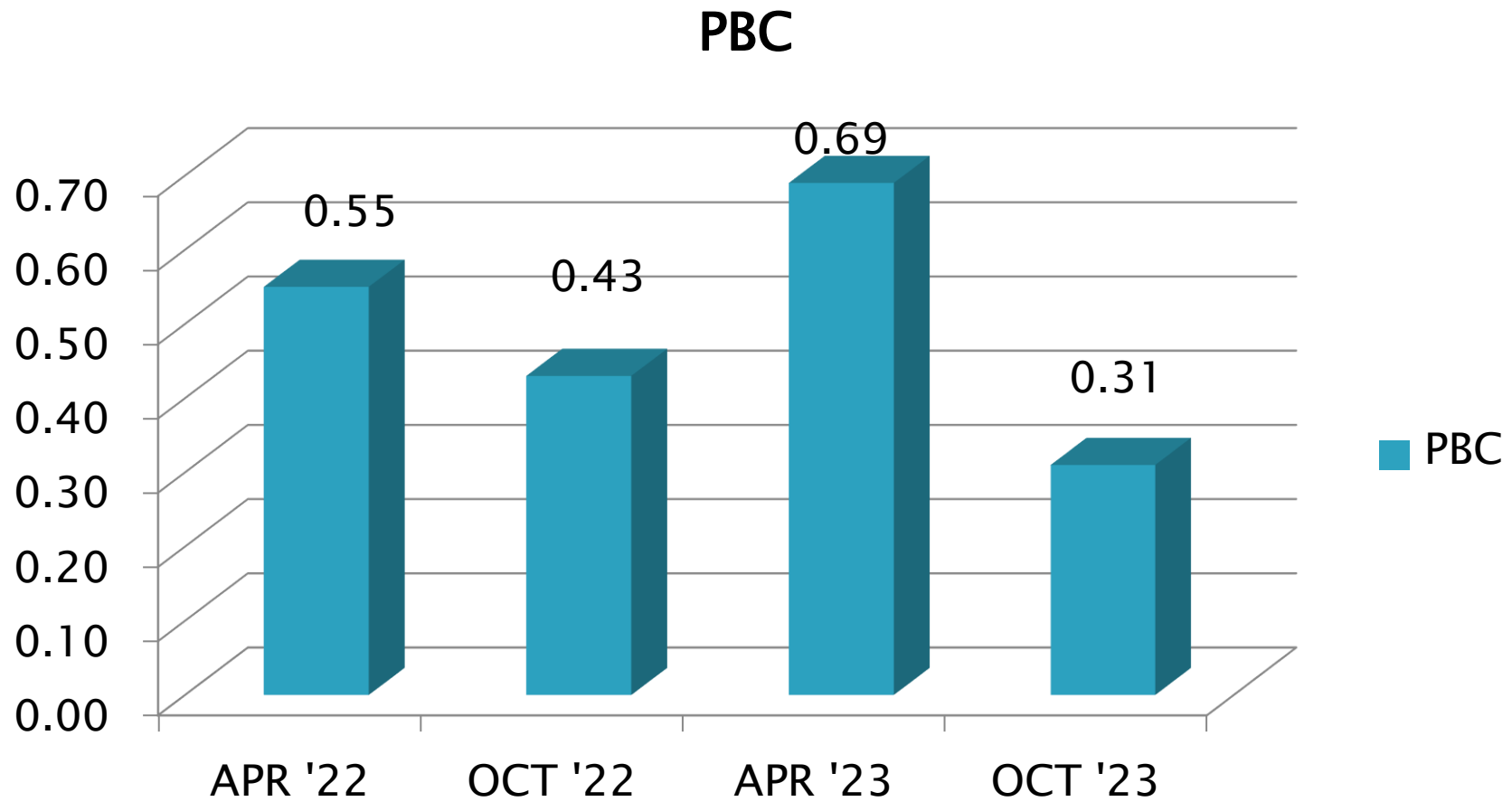
HTCBT Precision (Pooled s) Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

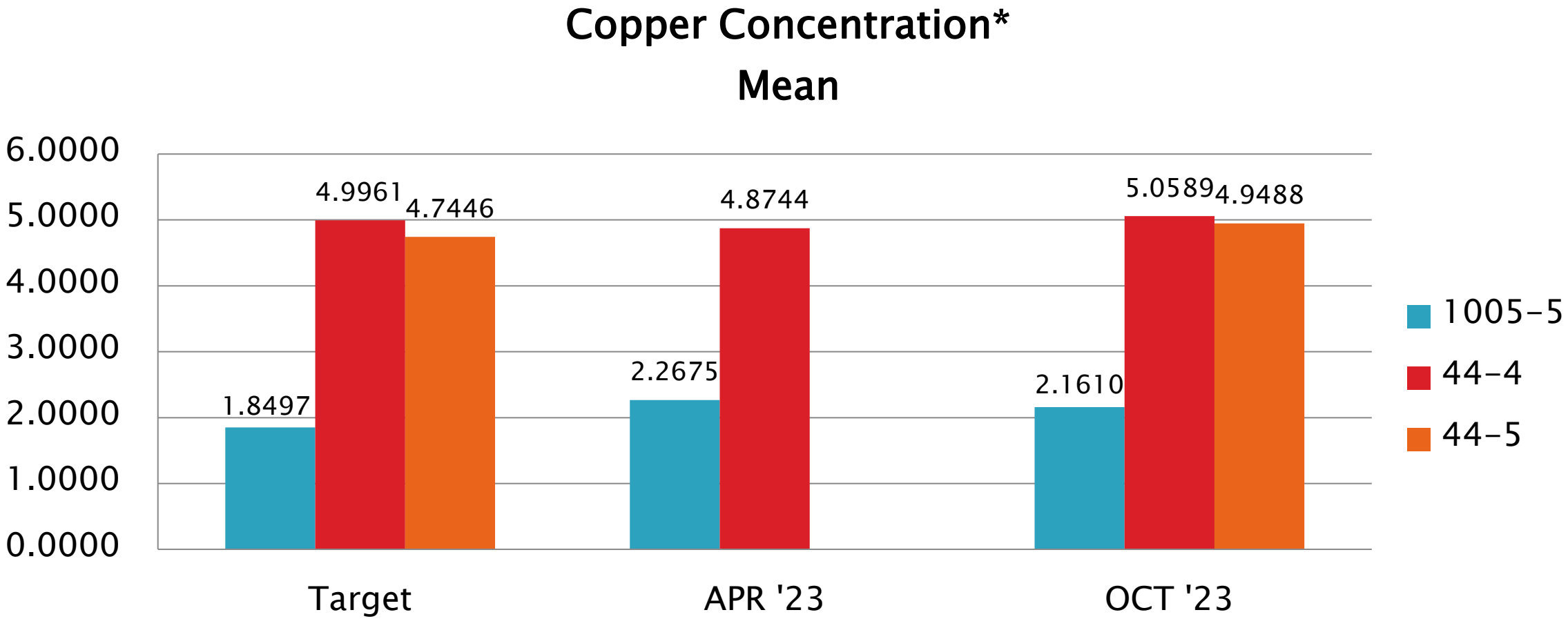
HTCBT Performance (mean Δ/s) Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

HTCBT Performance by OIL

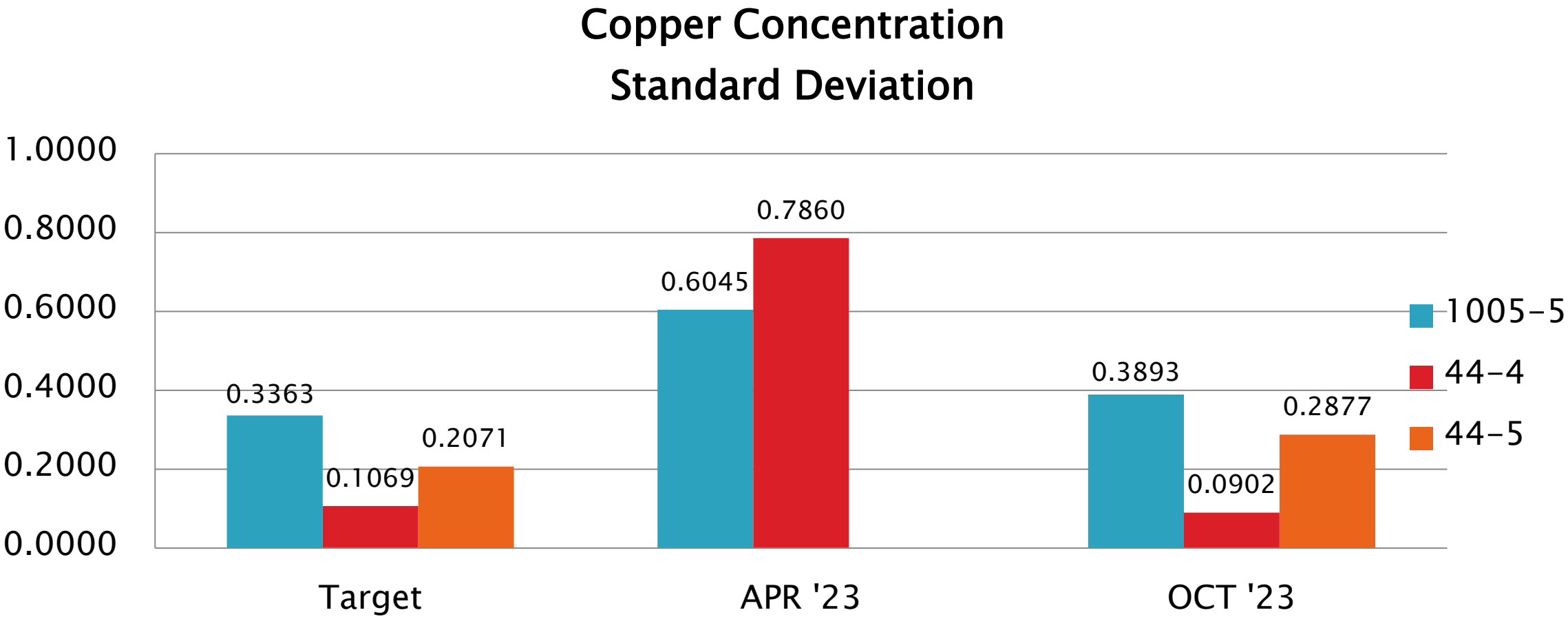


*Transformed Units

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

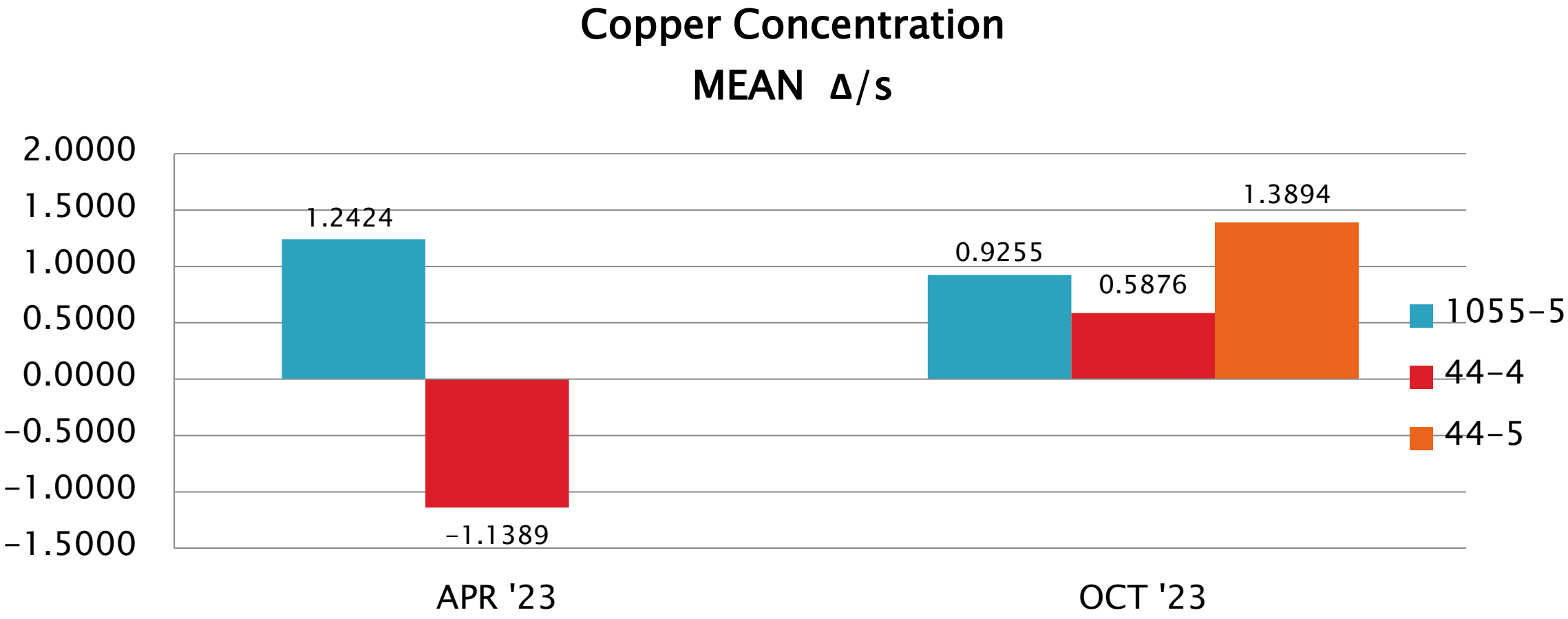
HTCBT Performance by OIL



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

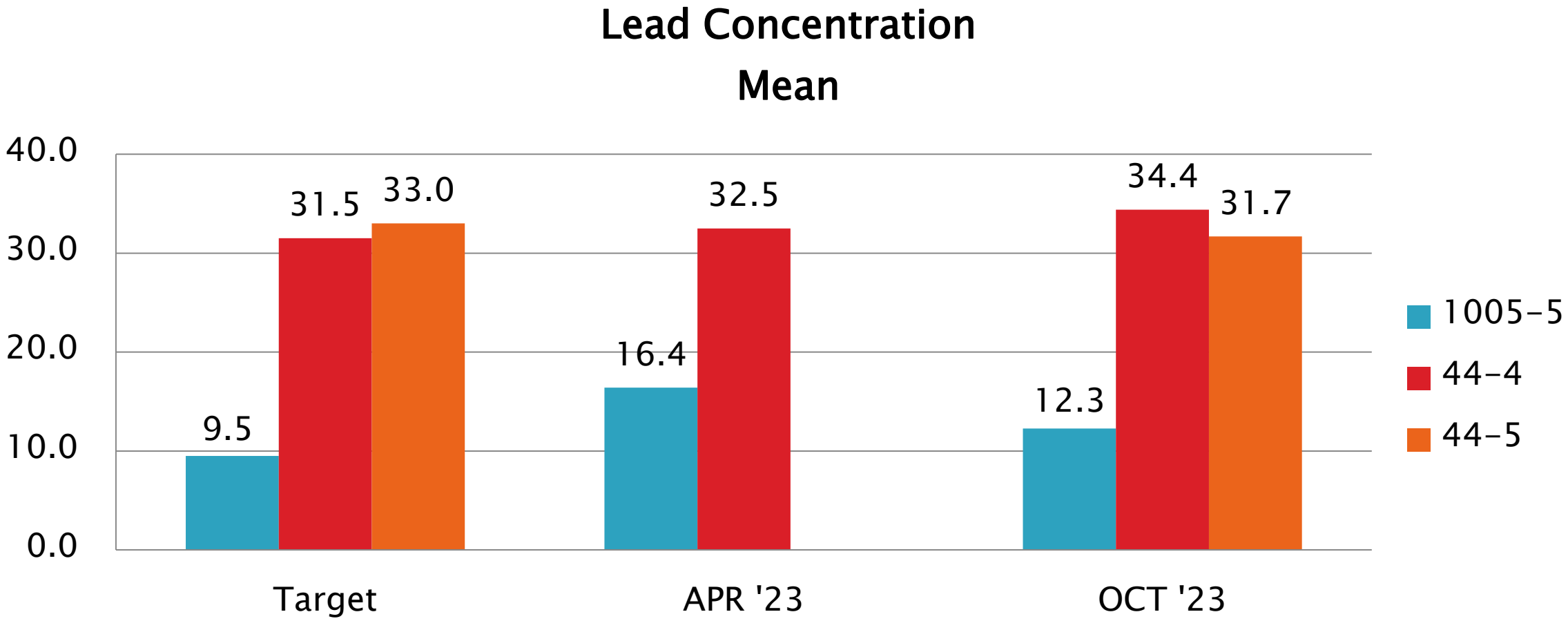
HTCBT Performance by OIL



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

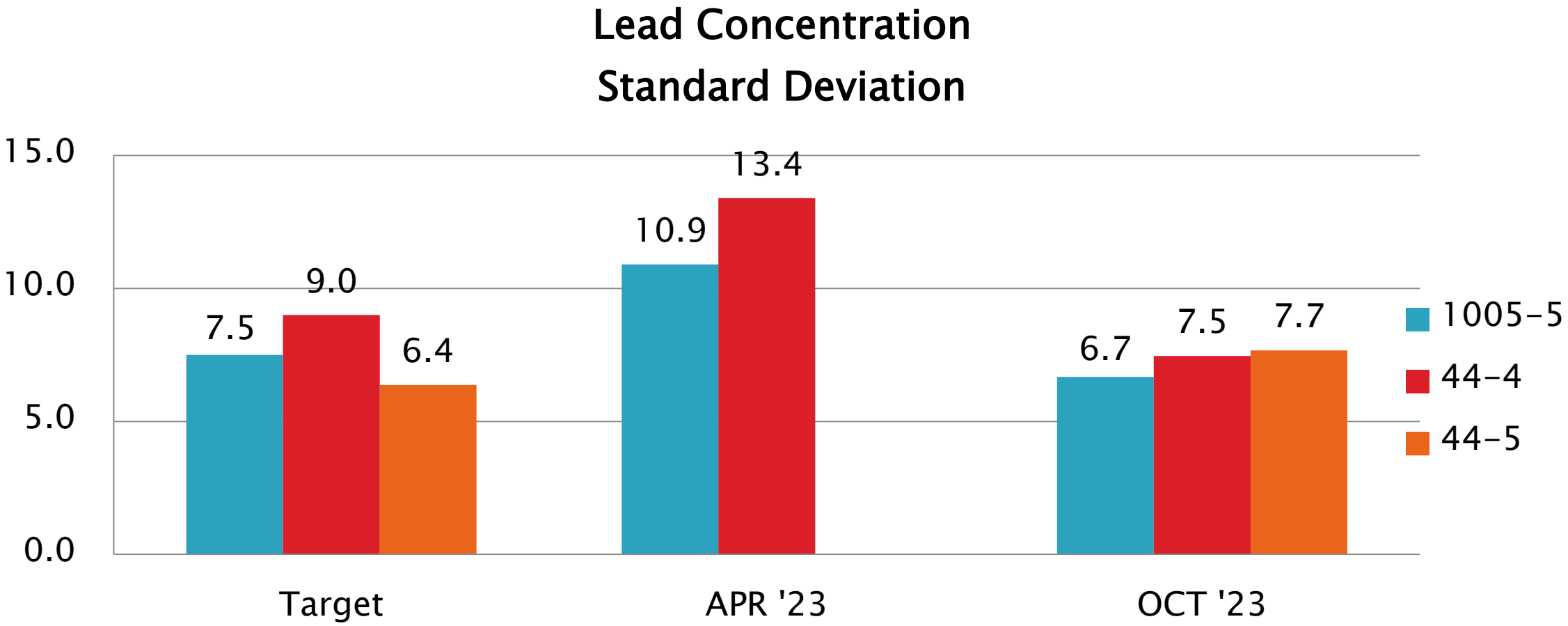
HTCBT Performance by OIL



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

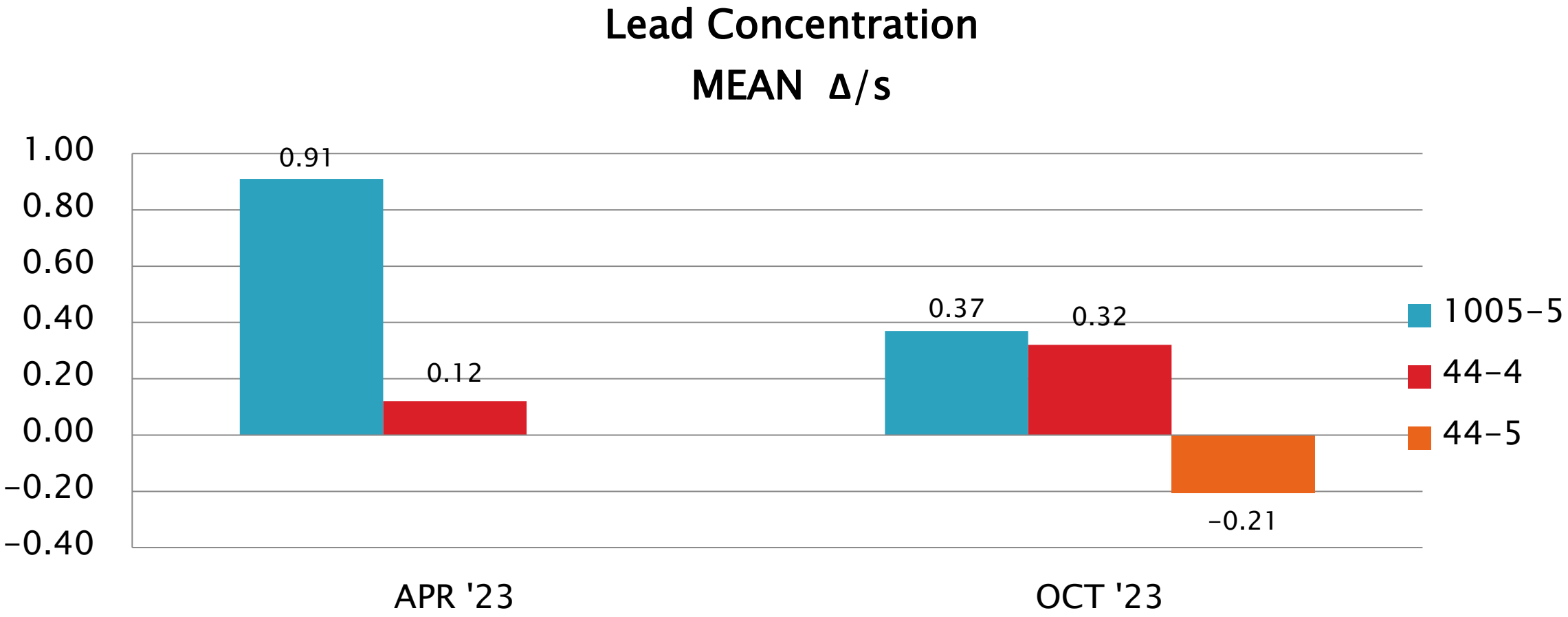
HTCBT Performance by OIL



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

HTCBT Performance by OIL



April 1, 2023 – September 30, 2023

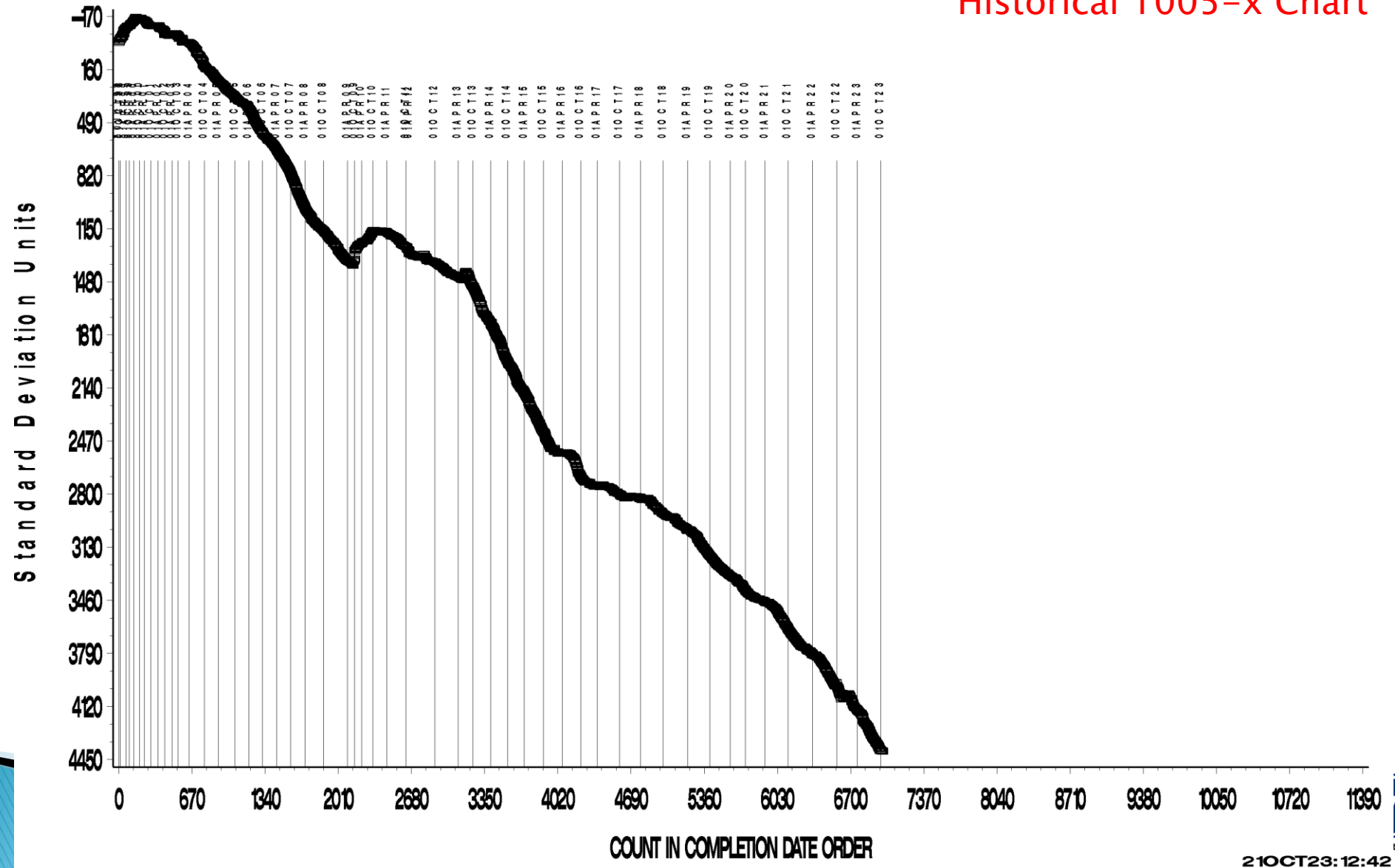
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

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

A Program of ASTM International

CUSUM Severity Analysis

Historical 1005-x Chart

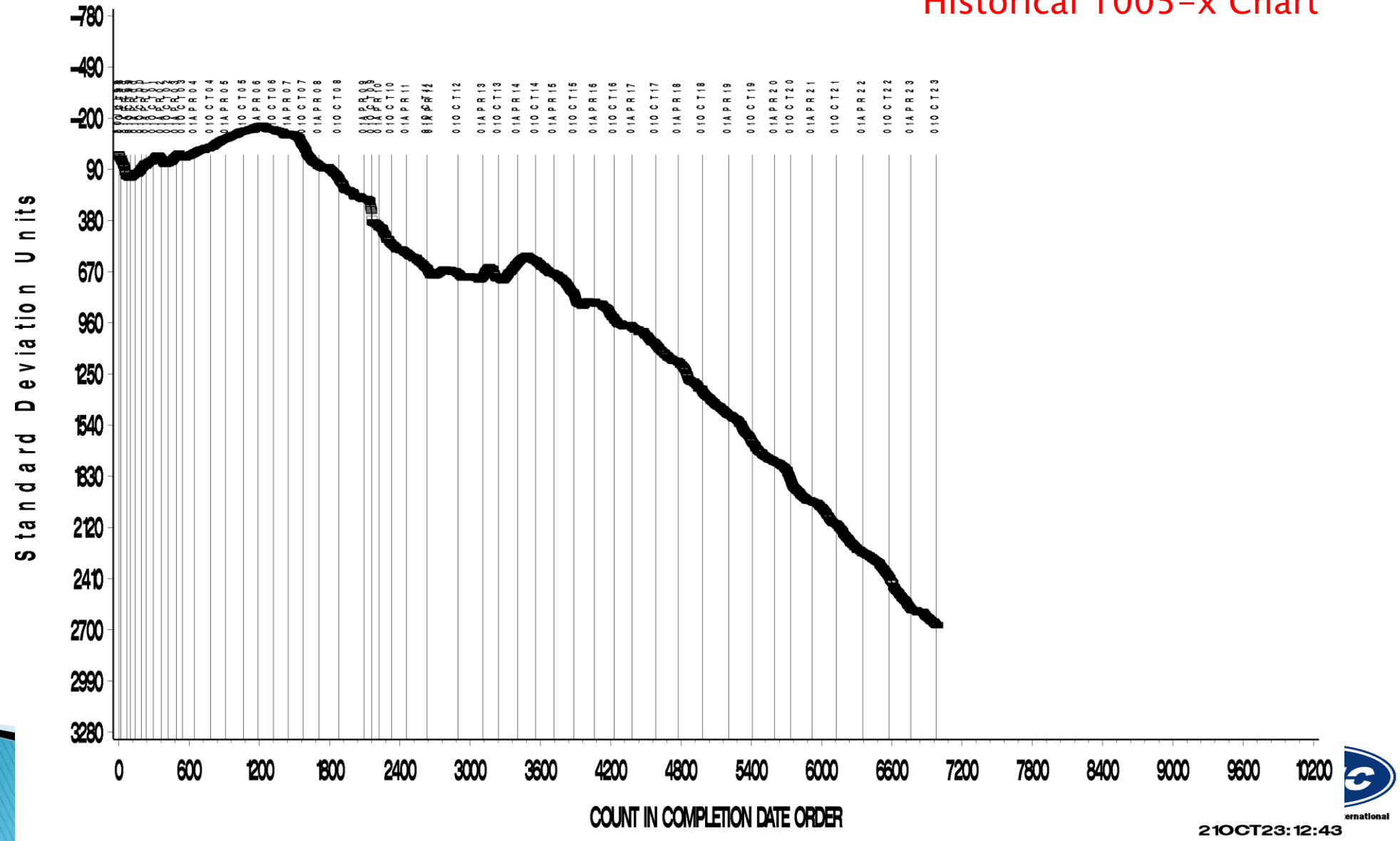


21OCT23:12:42

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

CUSUM Severity Analysis

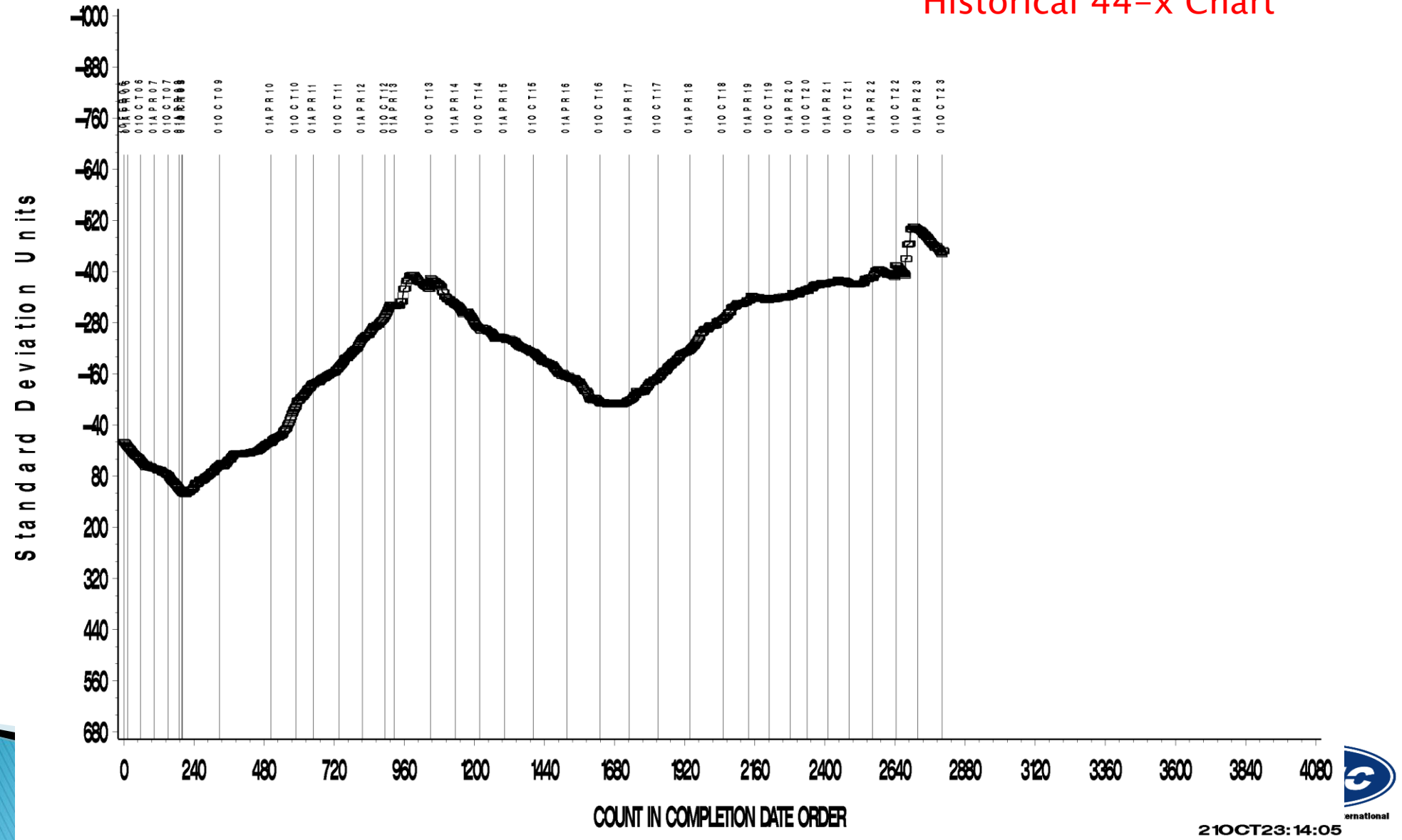
Historical 1005-x Chart



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

CUSUM Severity Analysis

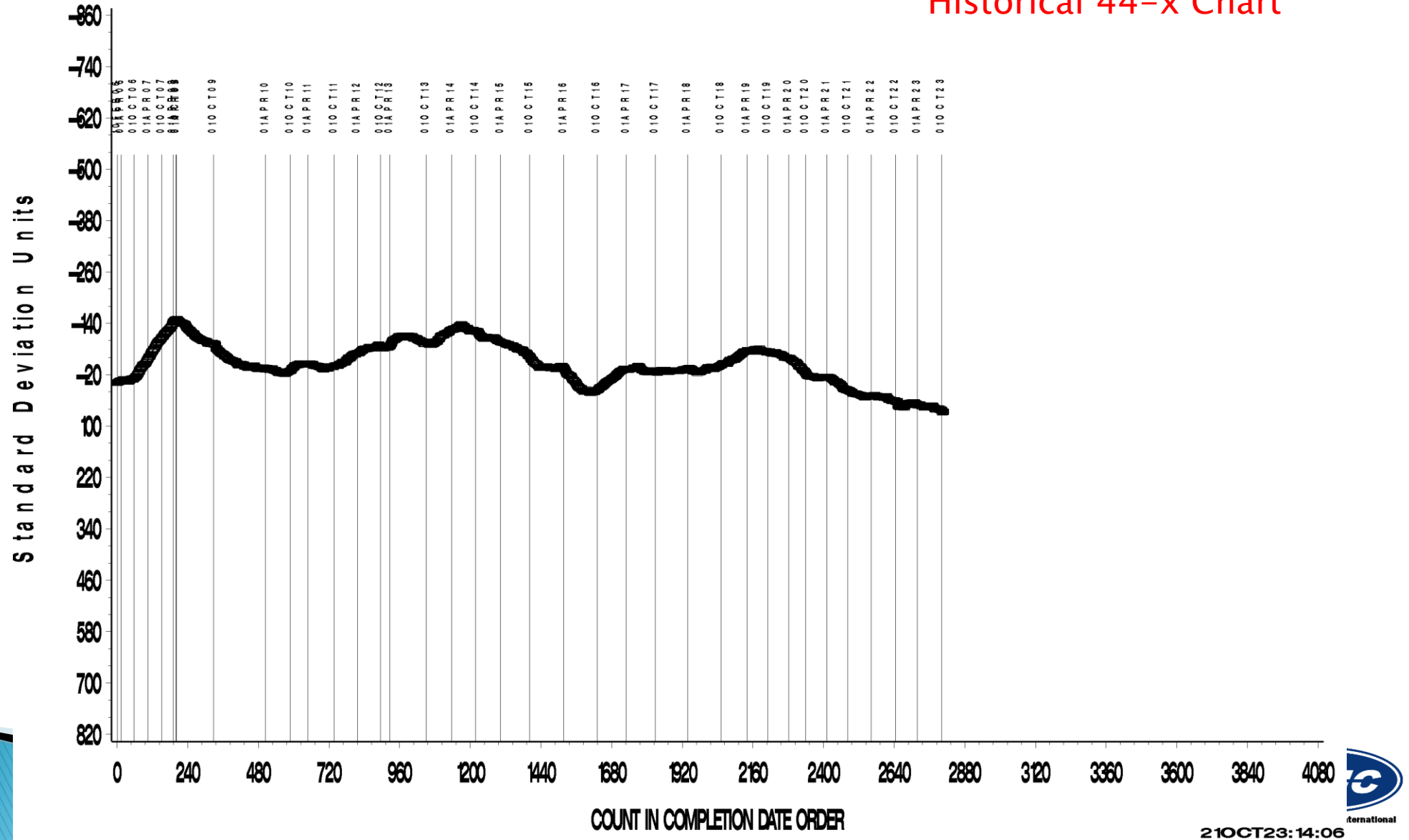
Historical 44-x Chart



HIGH TEMP CBT INDUSTRY OPERATIONALLY VALID DATA
Oil 44 –x Only
LEAD CHANGE (ppm)

CUSUM Severity Analysis

Historical 44-x Chart



Information Letters*

Test	Date	IL	Topic
			No information letters this period.

*Available from TMC Website

Update on Oil 44-5 (November 7, 2023)

- Reference Oil 44-5 has completed 49 valid HTCBT Tests
  - 16 Initial runs

Parameter	Target (Mean)	STDEV	Maximum	Minimum
Copper Change	4.7446*	0.2071*	172 ppm	77 ppm
Lead Change	33 ppm	6.367	45 ppm	20 ppm

  - 33 Reference Oil Assignment Runs

Parameter	Target (Mean)	STDEV	Maximum not selected	Minimum not selected
Copper Change	4.8666*	0.4124*	291 ppm	58 ppm
Lead Change	32.52 ppm	8.292	48 ppm	17 ppm

* Natural Log Transformed Parameter

Update on Oil 44-5 (November 10, 2023)

- Reference Oil 44-5 has completed 49 valid HTCBT Tests
  - All 49 Valid HTCBT Results

Parameter	Target (Mean)	STDEV	Maximum Proposed**	Minimum Proposed**
Copper Change	4.8268*	0.3608*	253 ppm	62 ppm
Lead Change	32.67 ppm	7.652	47 ppm	18 ppm

* Natural Log Transformed Parameter

** Surveillance Panel considering this Acceptance Range for RO 44-5

Reference Oil Inventory Estimated Life

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Lab Assignments Made	Estimated Life
44-4	2.6	1.1	53	<1 year
44-5	52	1.0	35	>5 year
1005-5	43.25 (Reserved drum – Additional oil available at the TMC)	6.65	212	>5 years

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 6794

Engine Oil Water Tolerance (EOWT)

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6794	6 (+0)	N/A
*As of 9/30/2023		

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	156	157	156	158	627
Failed Calibration Test	OC	0	0	1	0	1
Acceptable Information Run	NN	0	0	0	0	0
Unacceptable Information Run	MN	0	0	0	0	0
Invalid Calibration Test	LC, RC	2	1	2	1	6
Aborted Calibration Test	XC	1	1	1	1	4
Total		**159**	**159**	**160**	**160**	**638**

- 6 labs reported data

EOWT Test Activity by Reference Oil*

Test Status	Validity Code	Number of Tests by Reference Oil		Total
		77-3	79	
Acceptable Calibration Test	AC	307	320	627
Failed Calibration Test	OC	0	1	1
Acceptable Informational Test	NN	0	0	0
Unacceptable Informational Test	MN	0	0	0
Invalid Calibration Test	LC, RC	2	4	6
Aborted Calibration Test	XC	2	2	4
Total		**311**	**327**	**638**

- No Informational runs requested this semester

EOWT Failed Tests

Failed Parameter (OC)	Number of Tests				Total
	0.6%	1.0%	2.0%	3.0%	
Severe Change in Flowrate	0	0	1	0	0
Mild Change in Flowrate	0	0	0	0	0
Total	**0**	**0**	**1**	**0**	**1**

EOWT Failed Tests by Lab

Failed Parameter (OC)	LTMS Lab						#
	A	B	BE	G	I	L	
Severe Change in Flowrate	1	0	0	0	0	0	1
Mild Change in Flowrate	0	0	0	0	0	0	0
Total	**1**	**0**	**0**	**0**	**0**	**0**	1

EOWT Lost Calibration Tests*

Cause	Number of Tests				#
	0.6%	1.0%	2.0%	3.0%	
Blender Issue	1	1	1	1	4
Air Pressure Issue	1	0	1	0	2
Total	2	1	2	1	6

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

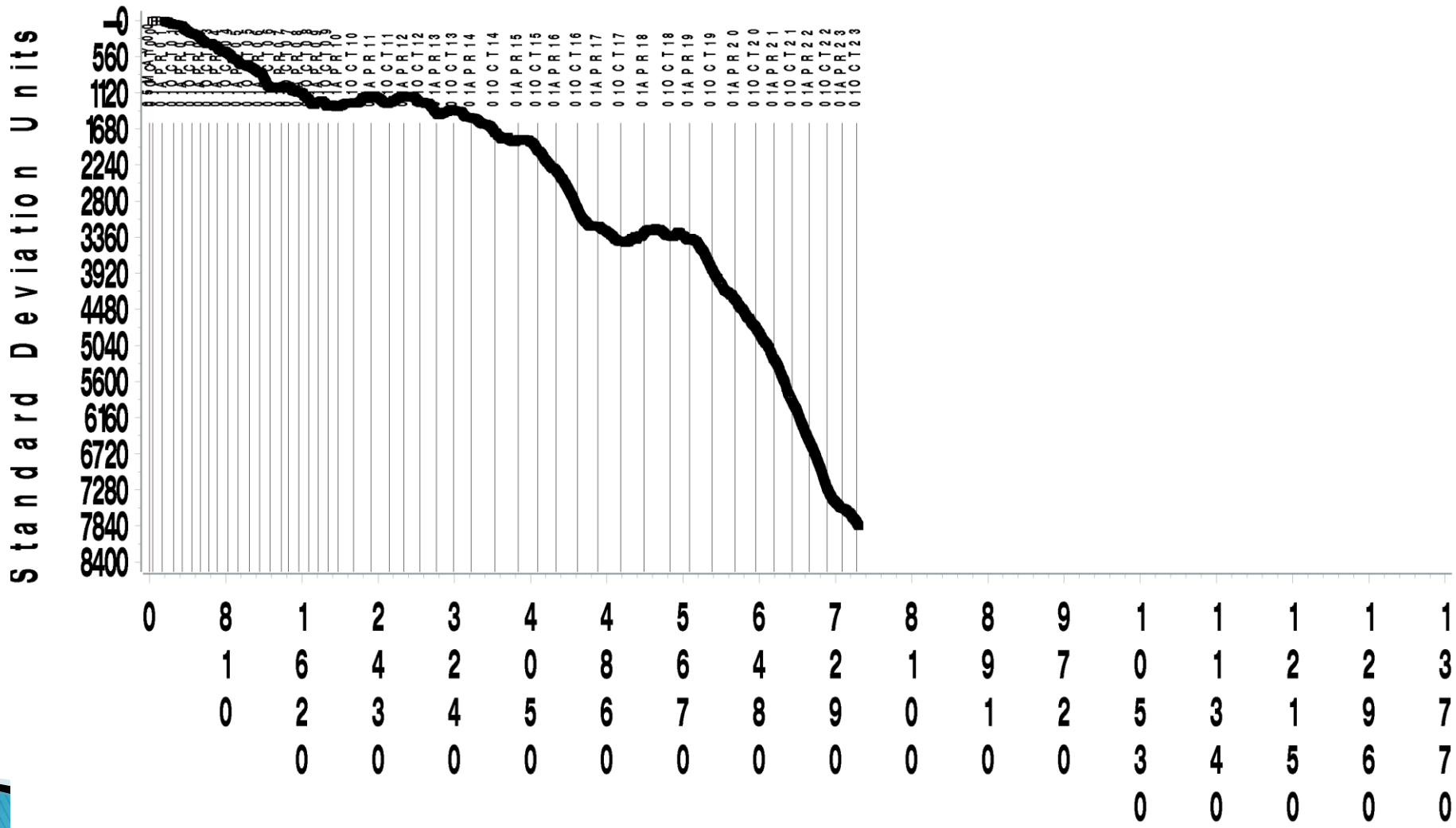
EOWT Test Severity

- Change in Flowrate Average (CIFA) continues to trend severe for all water treat rates. Slight abatement of the severe trend observed in last semester has ended.

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

CUSUM Severity Analysis

Historical Chart



28OCT23:13:20

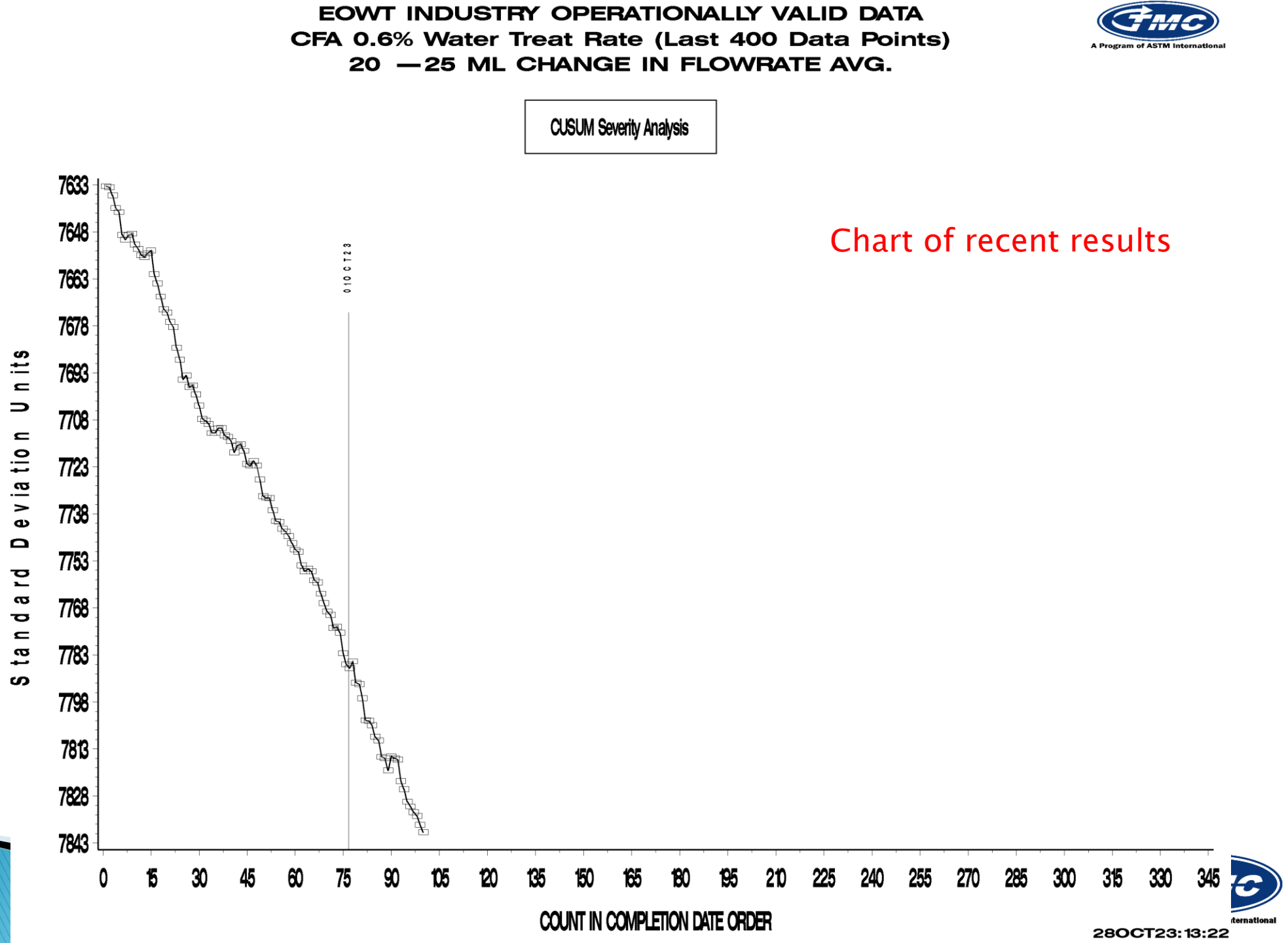
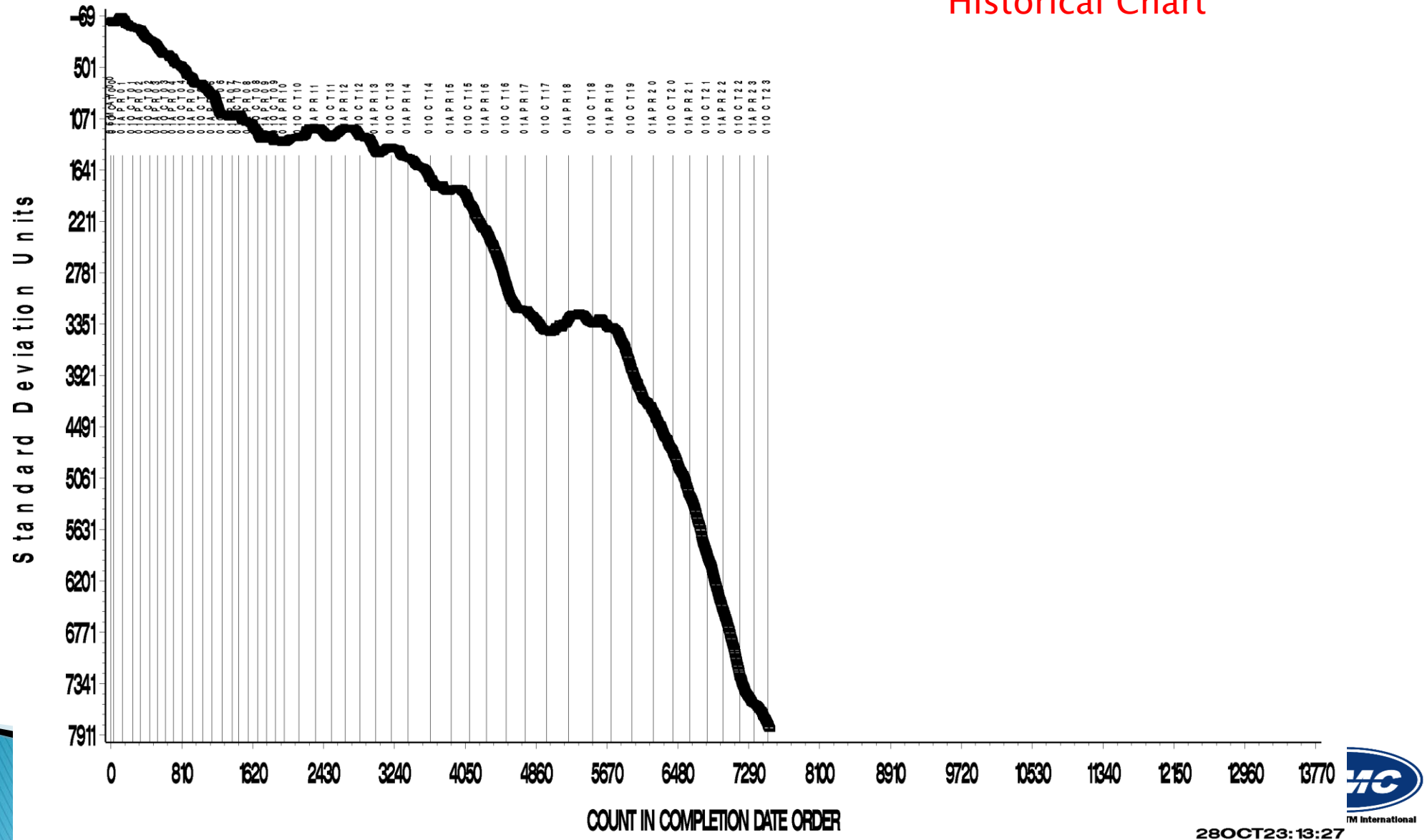


Chart of recent results

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

CUSUM Severity Analysis

Historical Chart



28OCT23:13:27

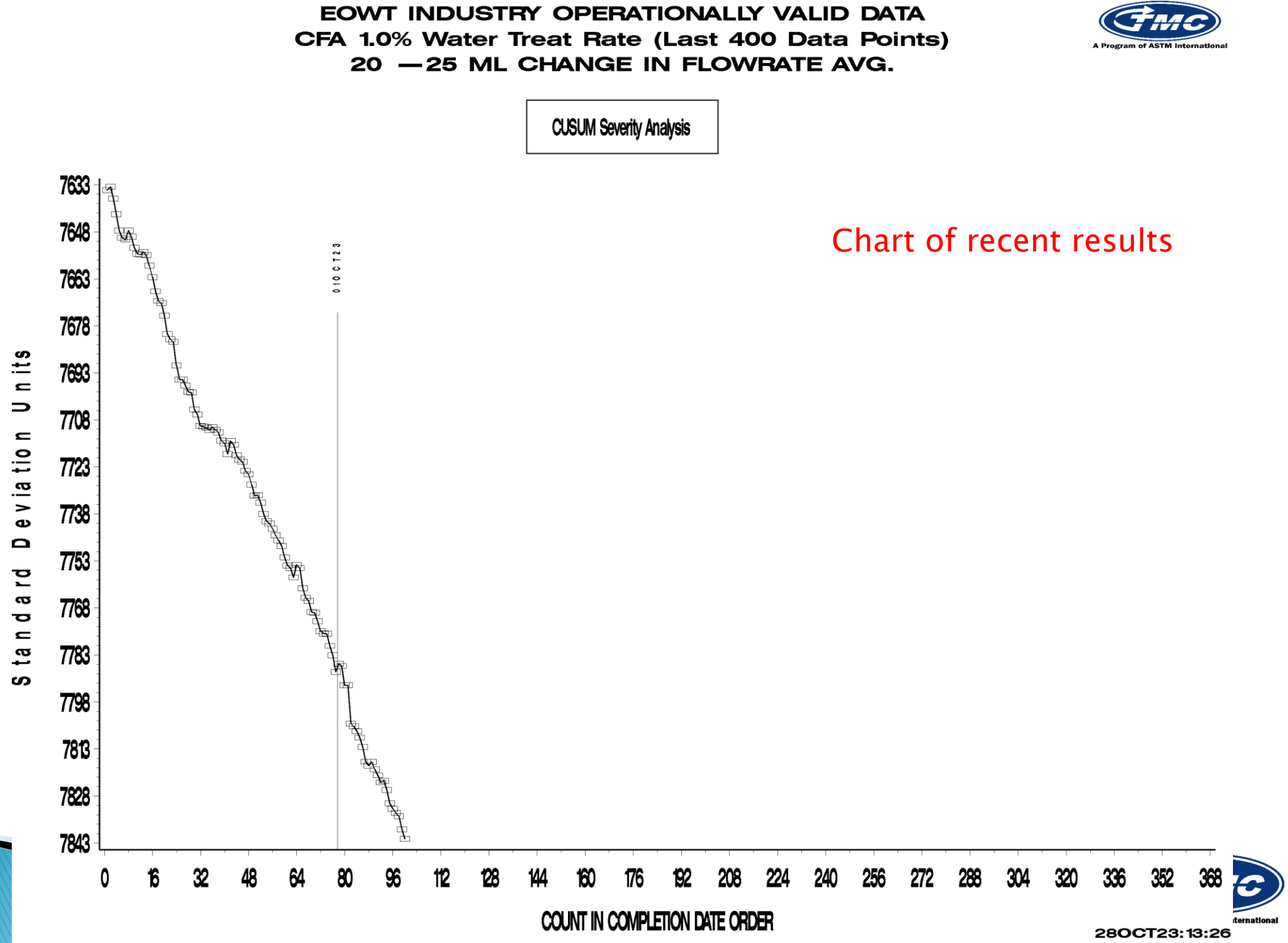
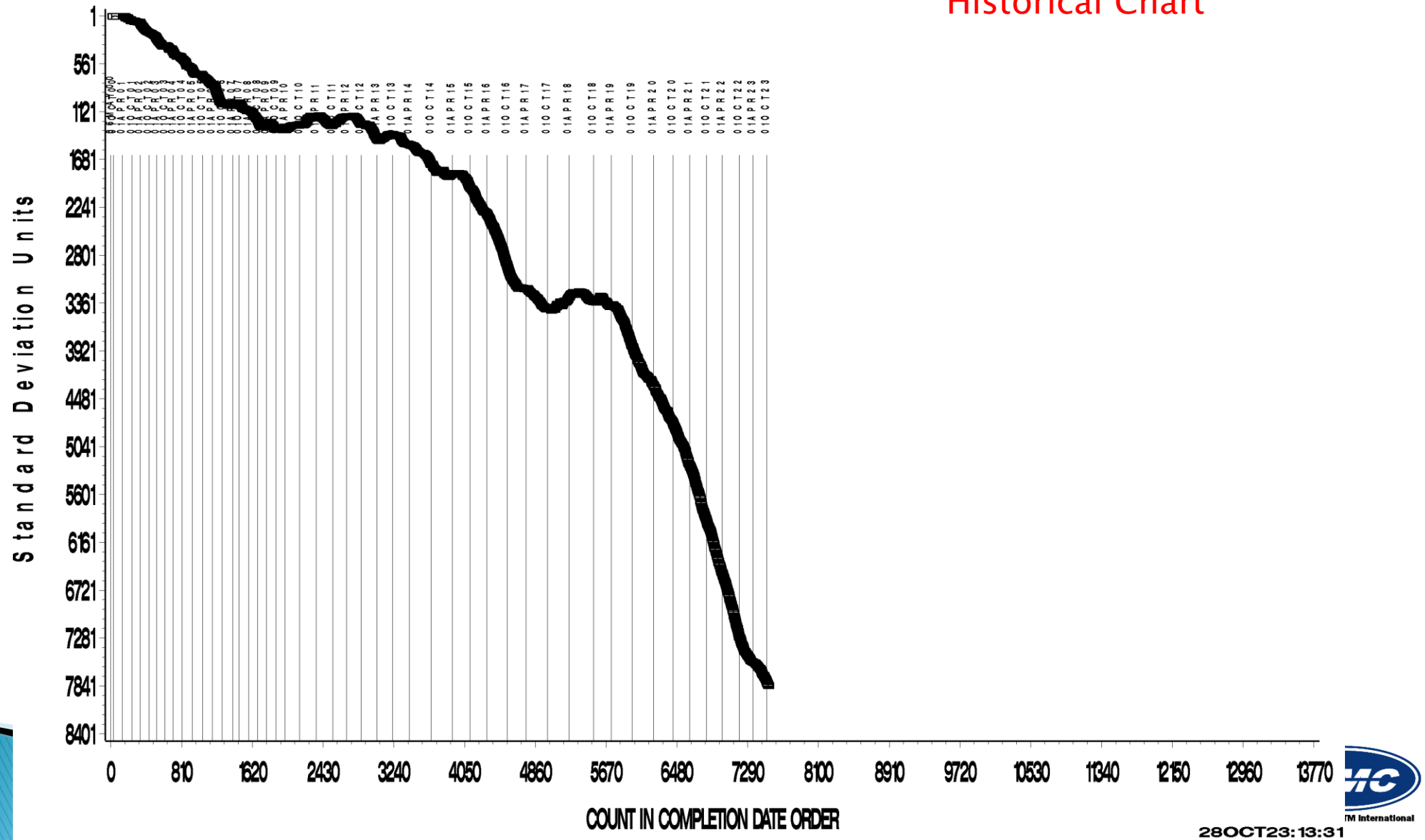


Chart of recent results

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

CUSUM Severity Analysis

Historical Chart



28OCT23:13:31

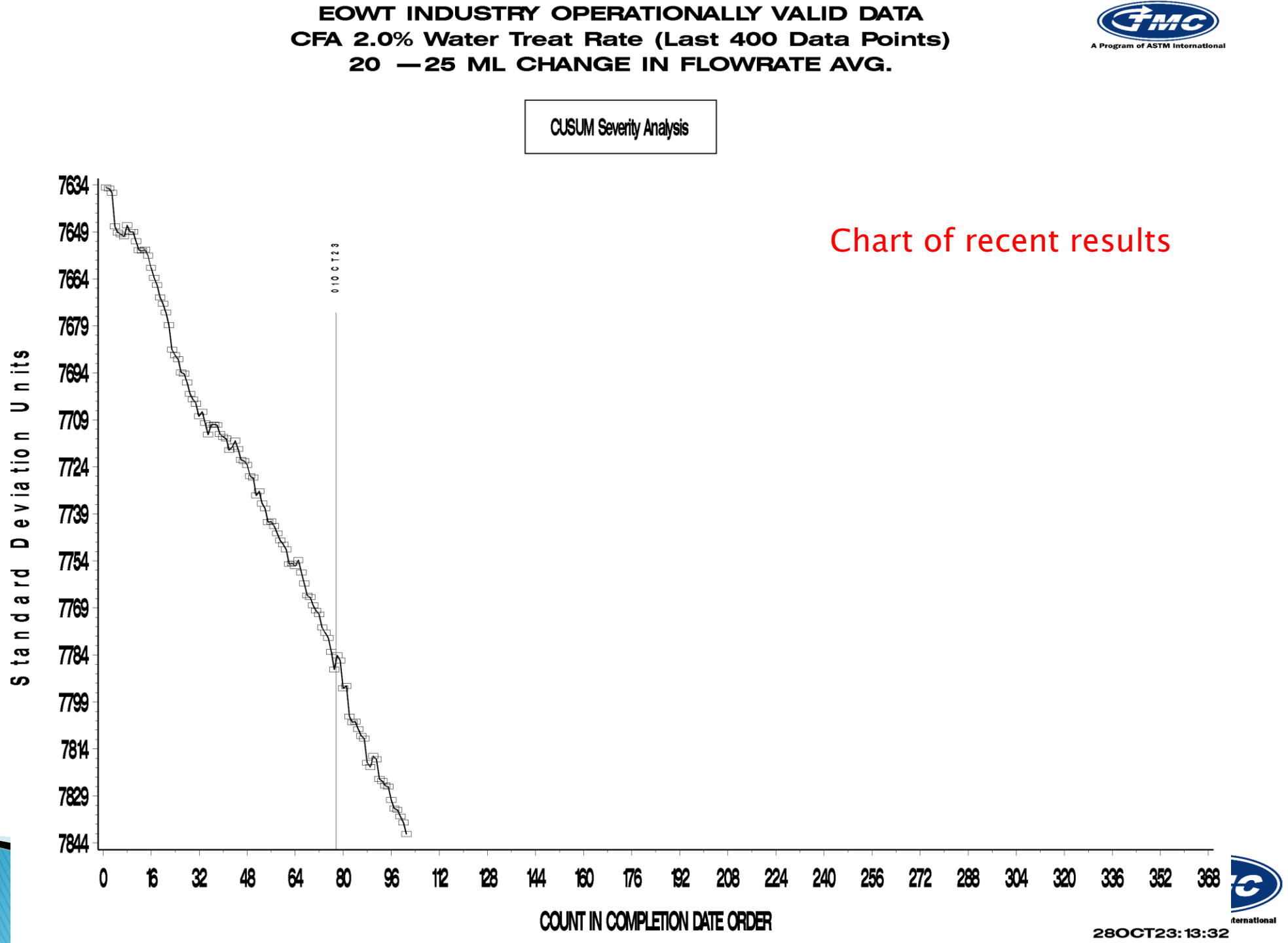
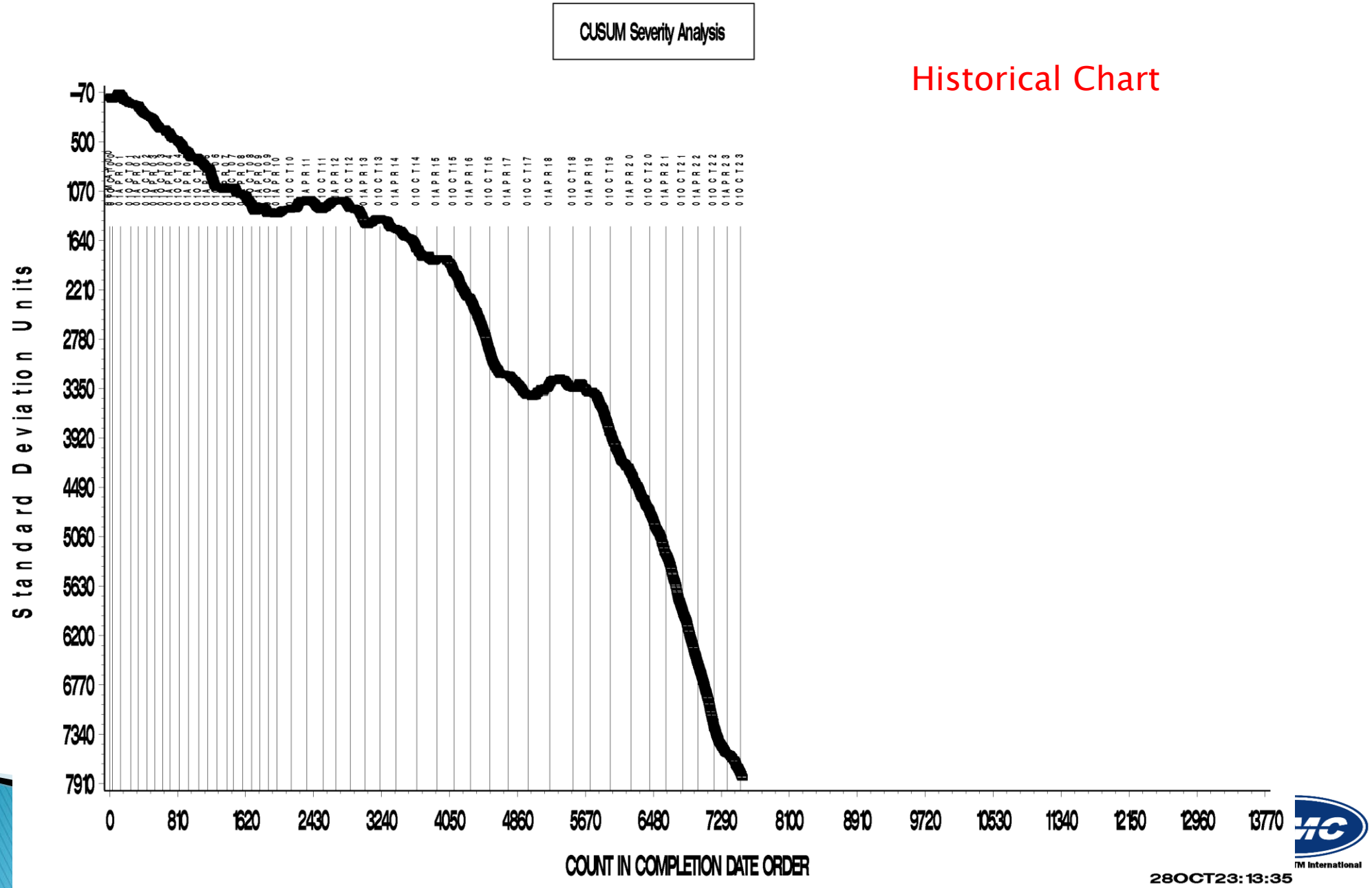


Chart of recent results

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



Historical Chart

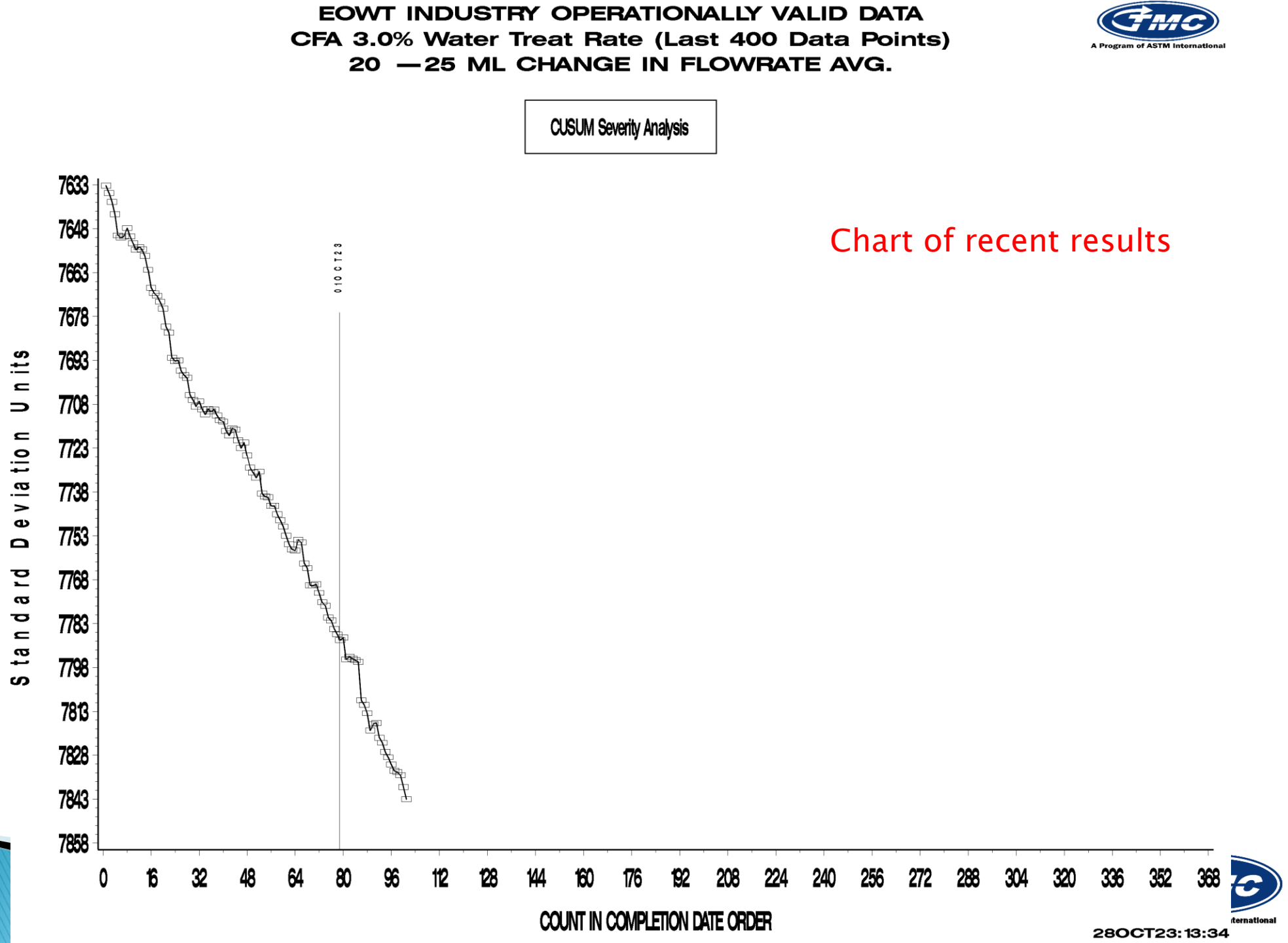
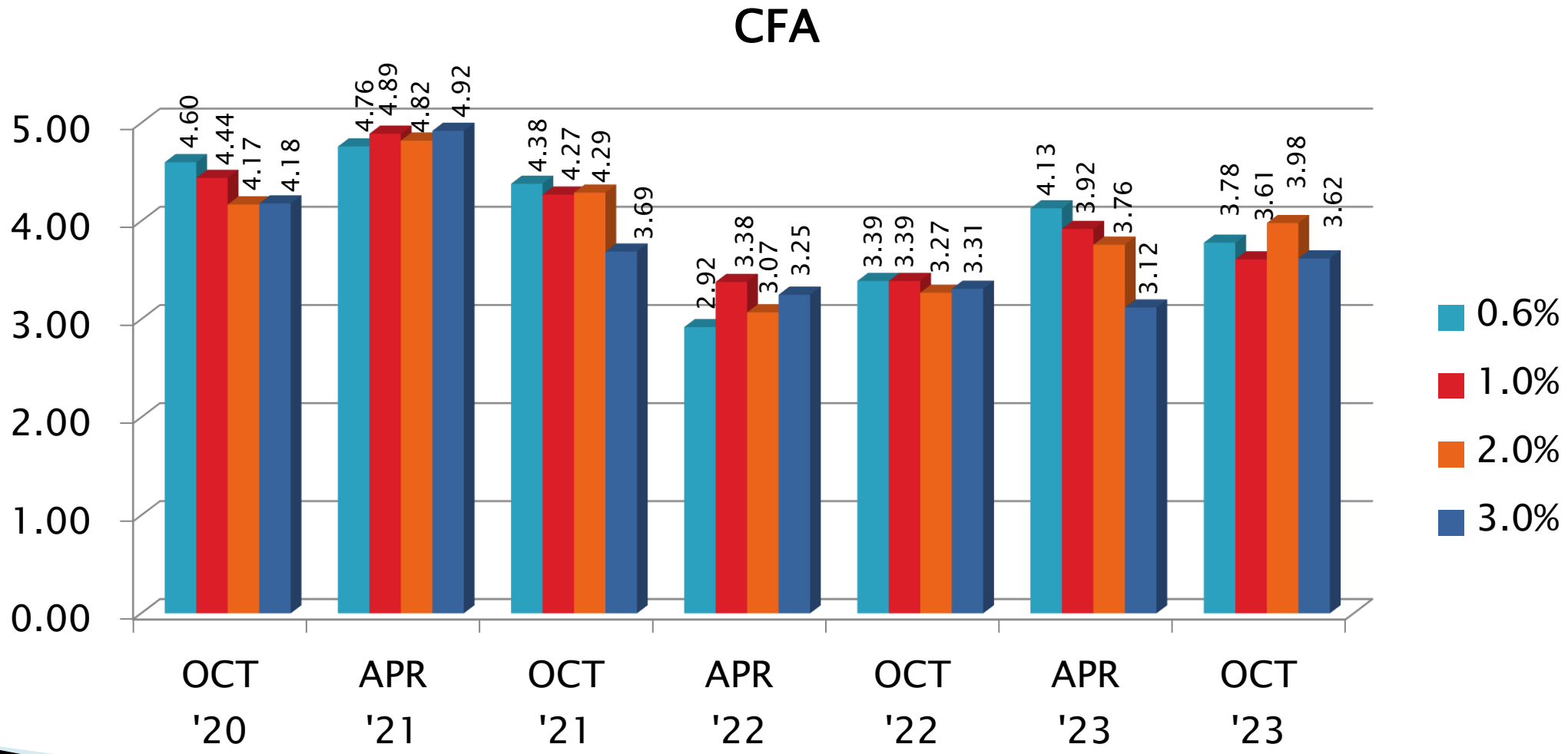


Chart of recent results

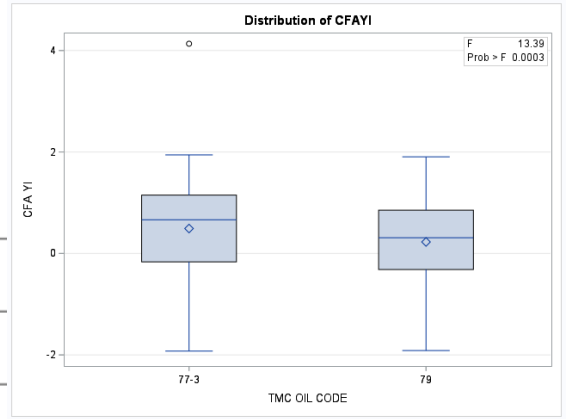
EOWT Precision (Pooled s) Estimates

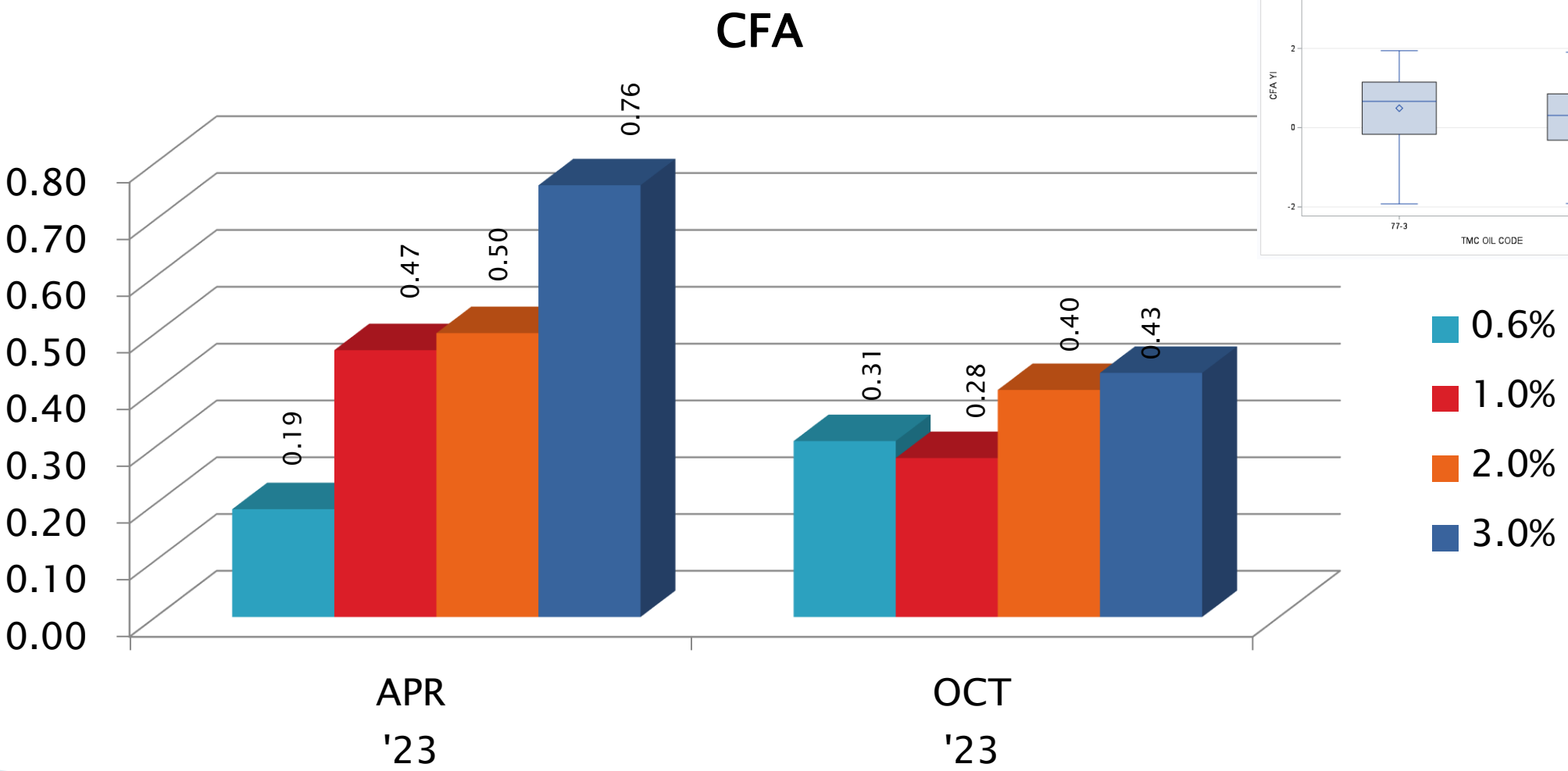


April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

EOWT Performance (Mean Δ/s) Estimates

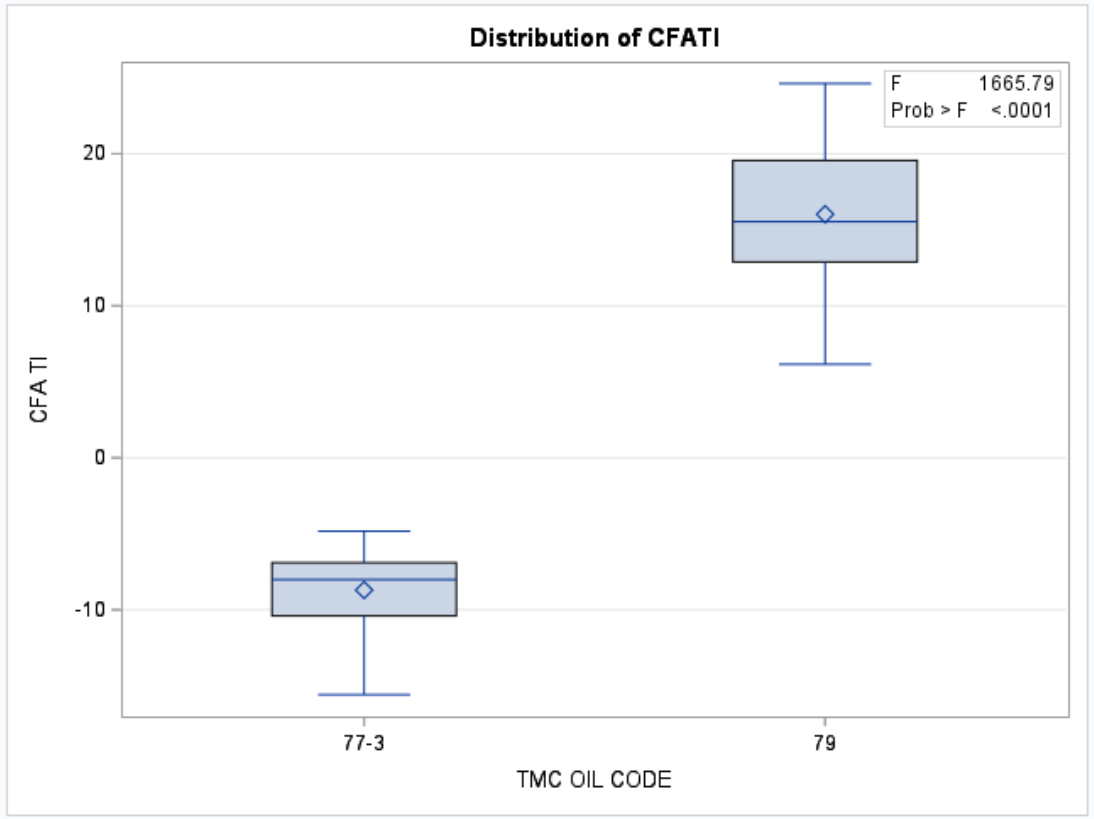


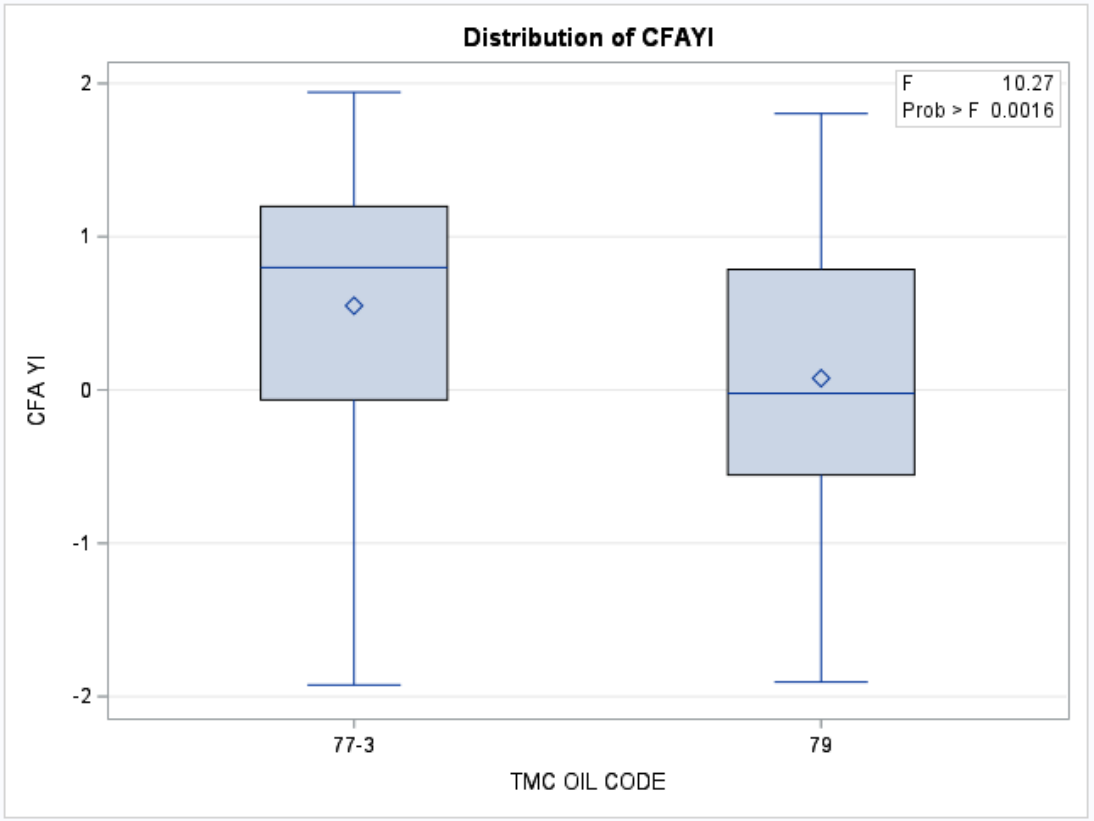


April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

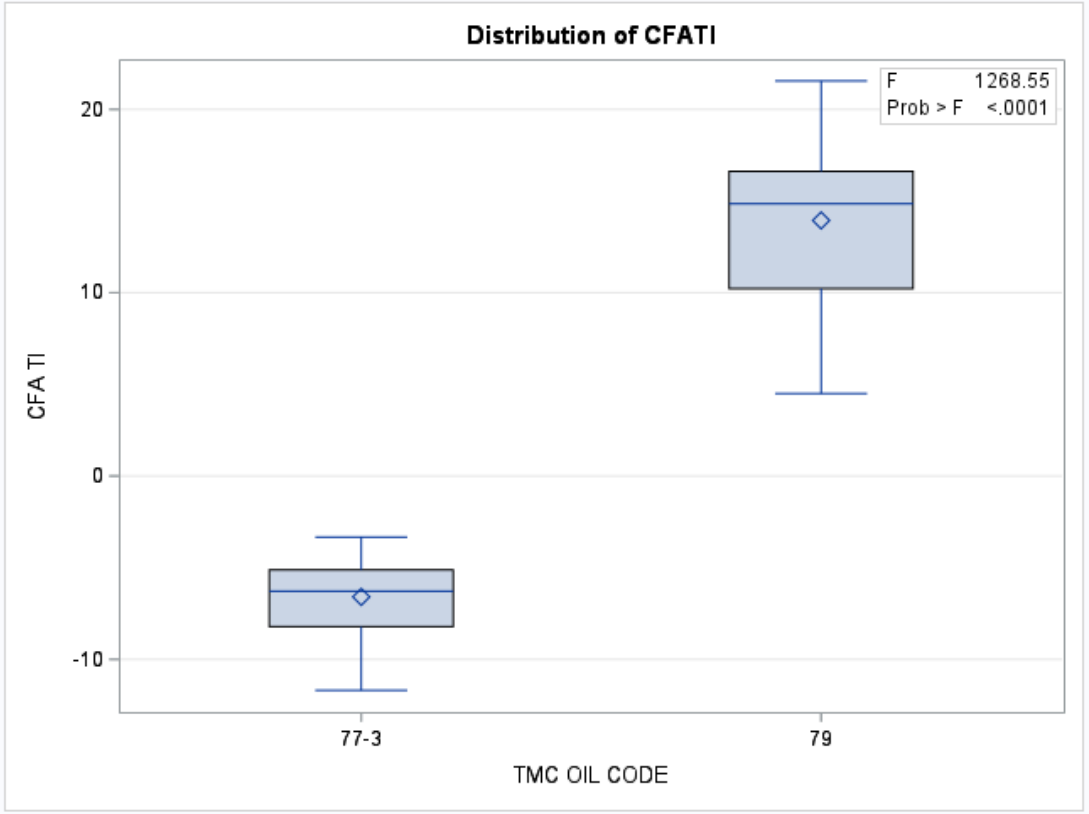
EOWT 0.6% Results by Reference Oil

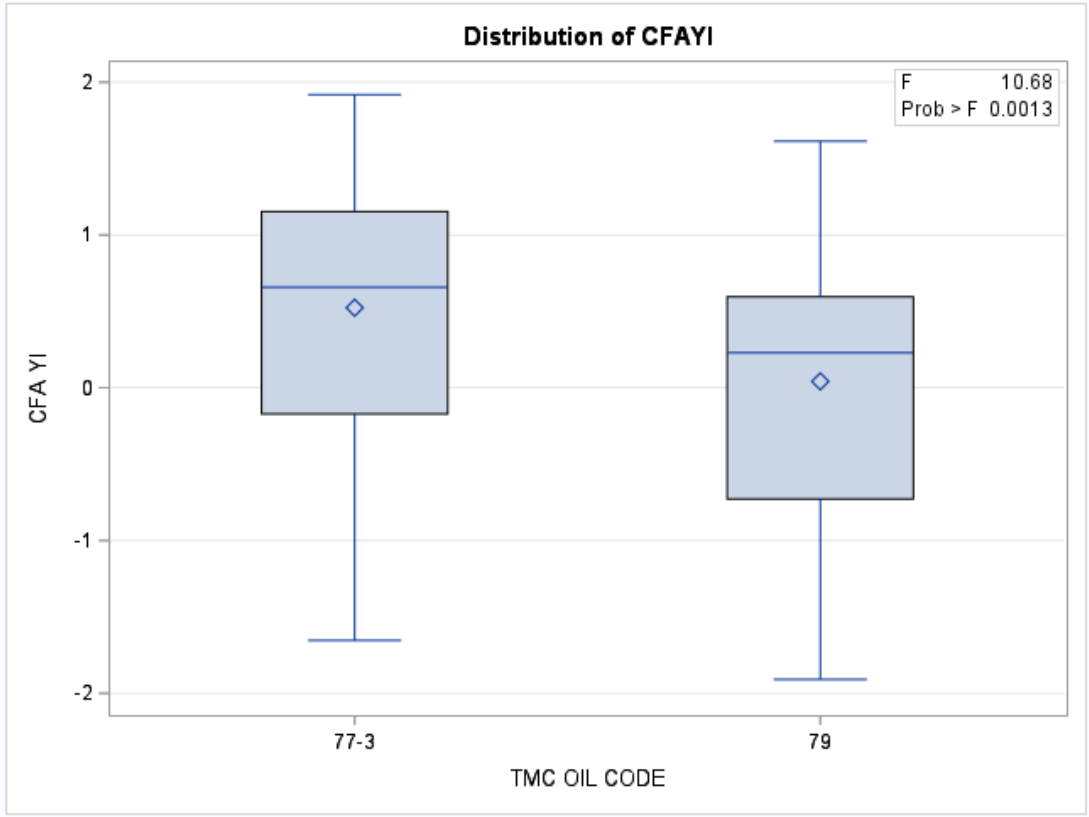




April 1, 2023 – September 30, 2023

EOWT 1.0% Results by Reference Oil

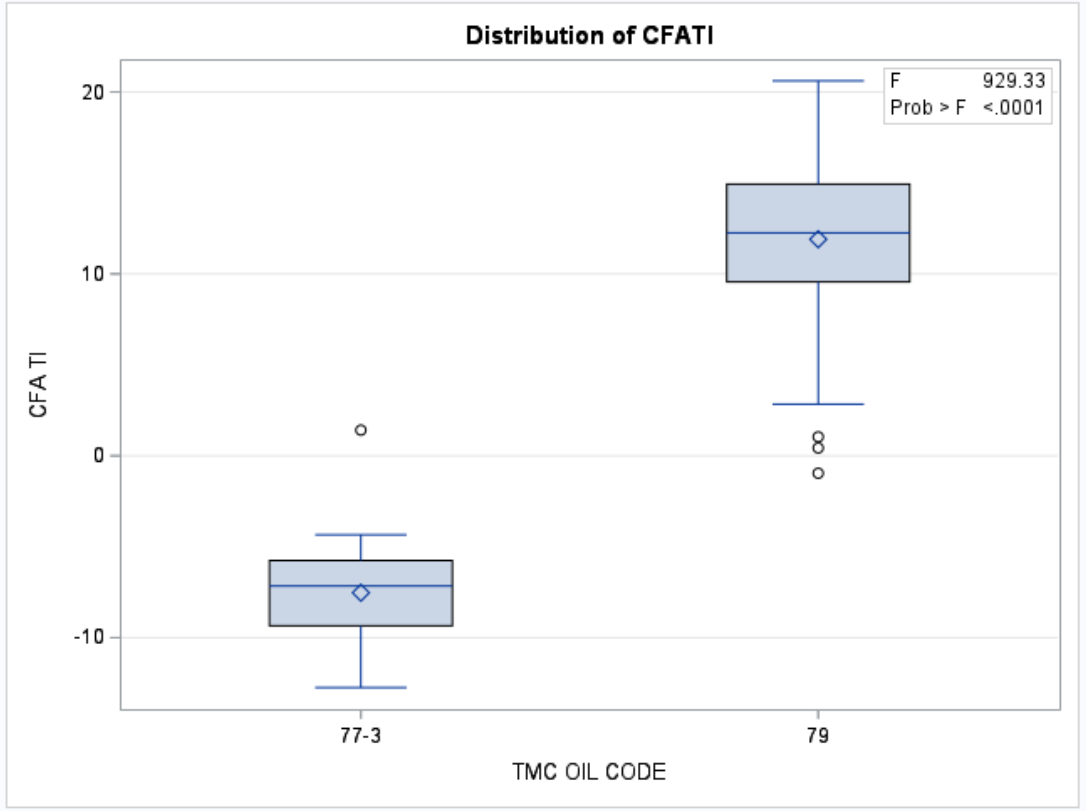


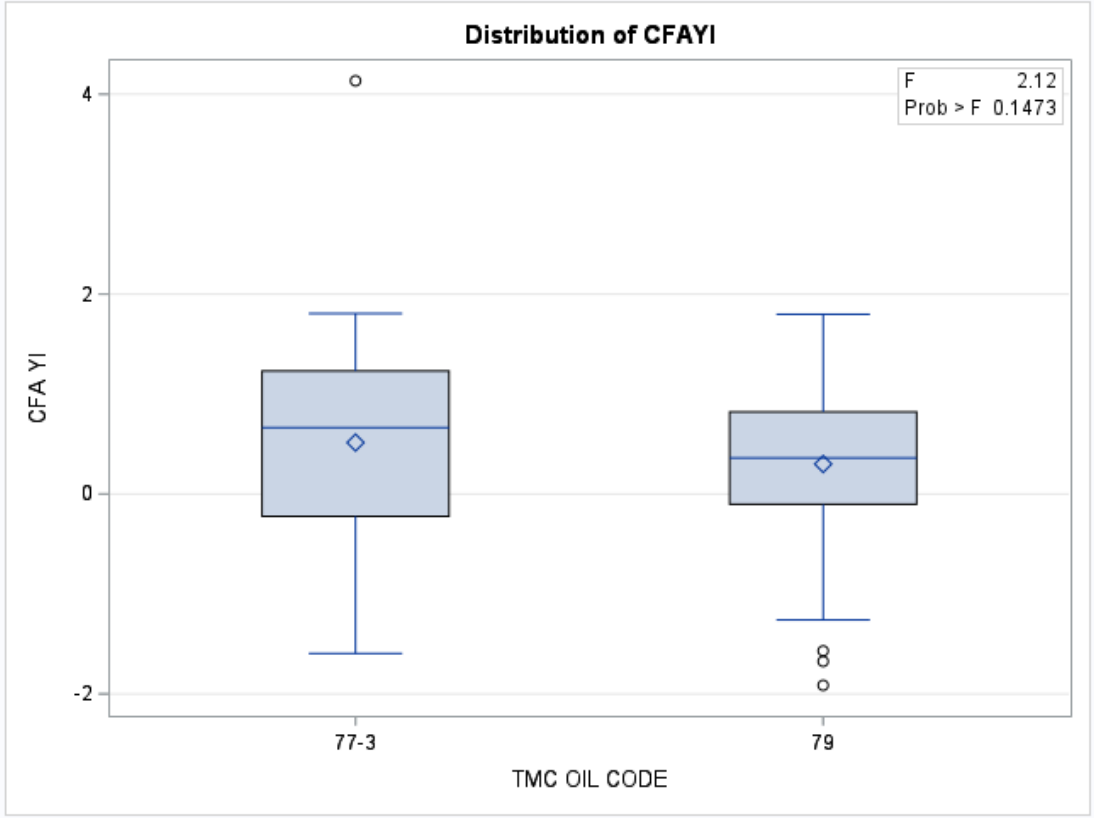


April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

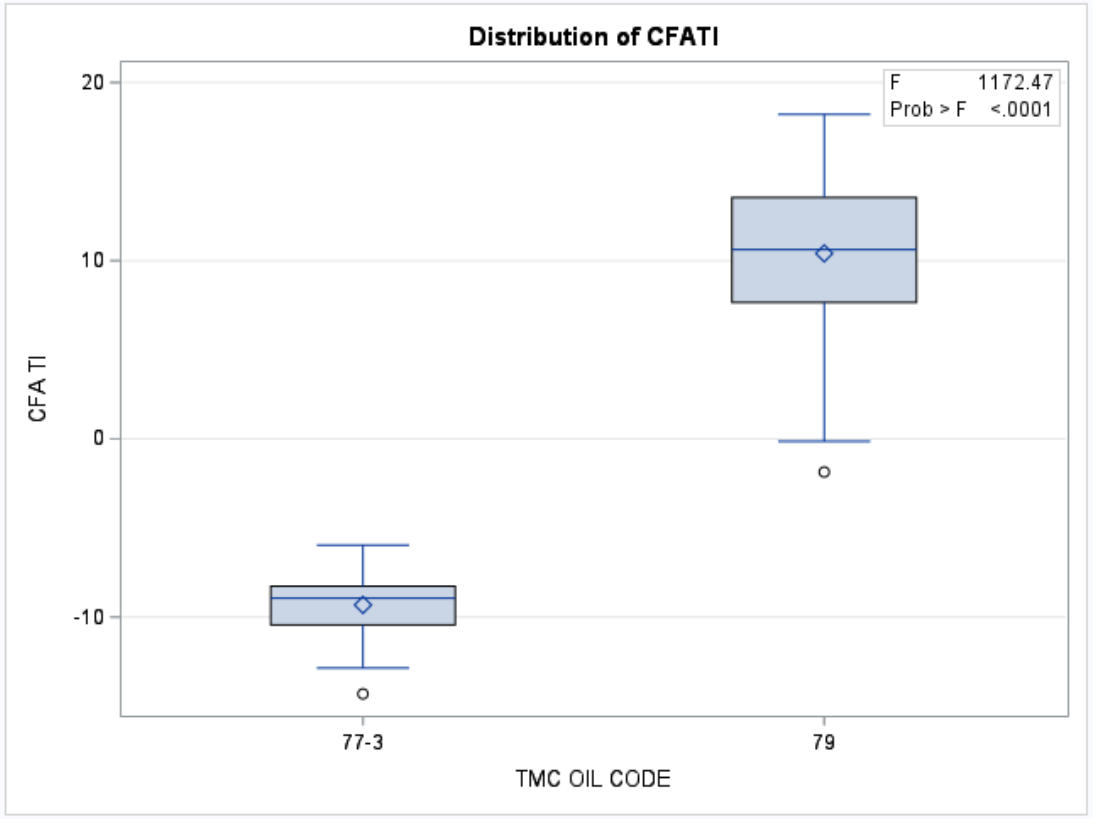
EOWT 2.0% Results by Reference Oil

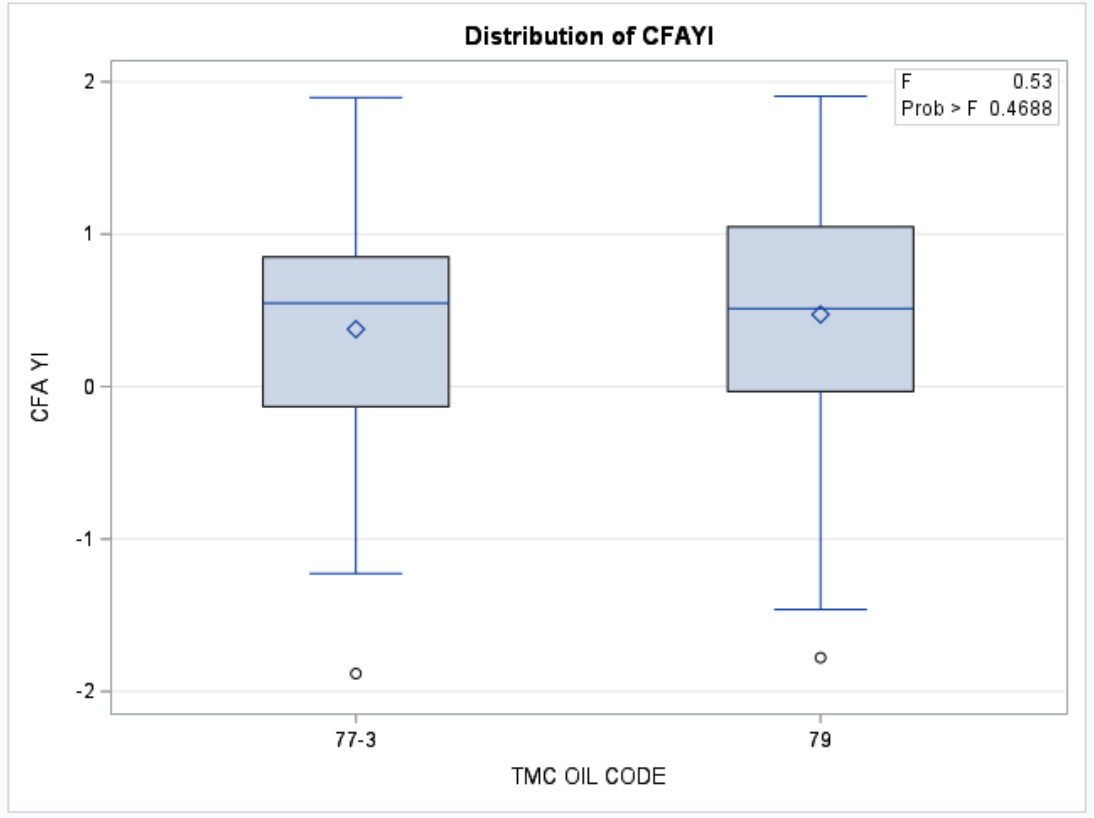




April 1, 2023 – September 30, 2023

EOWT 3.0% Results by Reference Oil





April 1, 2023 – September 30, 2023

Information Letters*

Test	Date	IL	Topic
			No new information letters this period.

*Available from TMC Website

Reference Oil Inventory Estimated Life EOWT

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Lab Assignments Made Last 6 Months	Estimated Life*
77-3	436.7	28.8	320	5+ years
79**	200.8	39.4	320	3 years

* Based upon Sample Shipping Rate from past 6 months.
** RO 79 is also used in EOFT

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 6795

Engine Oil Filterability Test (EOFT)

April 1, 2023 – September 30, 2023

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

A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D6795	6 (+0)	N/A
*As of 9/30/2023		

EOFT Test Activity*

Test Status	Validity Code	Number of Tests
Acceptable Calibration Test	AC	138
Failed Calibration Test	OC	1
Aborted Calibration Test	XC	0
Acceptable Shakedown Run	NN	0
Unacceptable/Aborted Shakedown Run	MN / XN	0
Total		**139**

- 99.3% Acceptable Calibration (AC) Testing Rate
  - 6 labs reported data this semester

EOFT Failed Tests

Failed Parameter	Number of Tests
Change in Flow Average (CIFA) Severe	0
Change in Flow Average (CIFA) Mild	1
Total	**1**

- Only one calibration fail this semester.

EOFT Failed Tests by Lab

Failed Parameter	LTMS Lab						#
	A	B	G	I	L	BE	
Change in Flow Average (CIFA) Severe	0	0	0	0	0	0	0
Change in Flow Average (CIFA) Mild	0	0	1	0	0	0	1
Totals	**0**	**0**	**1**	**0**	**0**	**0**	**1**

EOFT Lost Tests*

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

*Invalid and aborted calibration tests

EOFT Information/Shakedown Tests

Informational / Shakedown Results	Number of Tests
None	0
Total	**0**

EOFT Test Severity

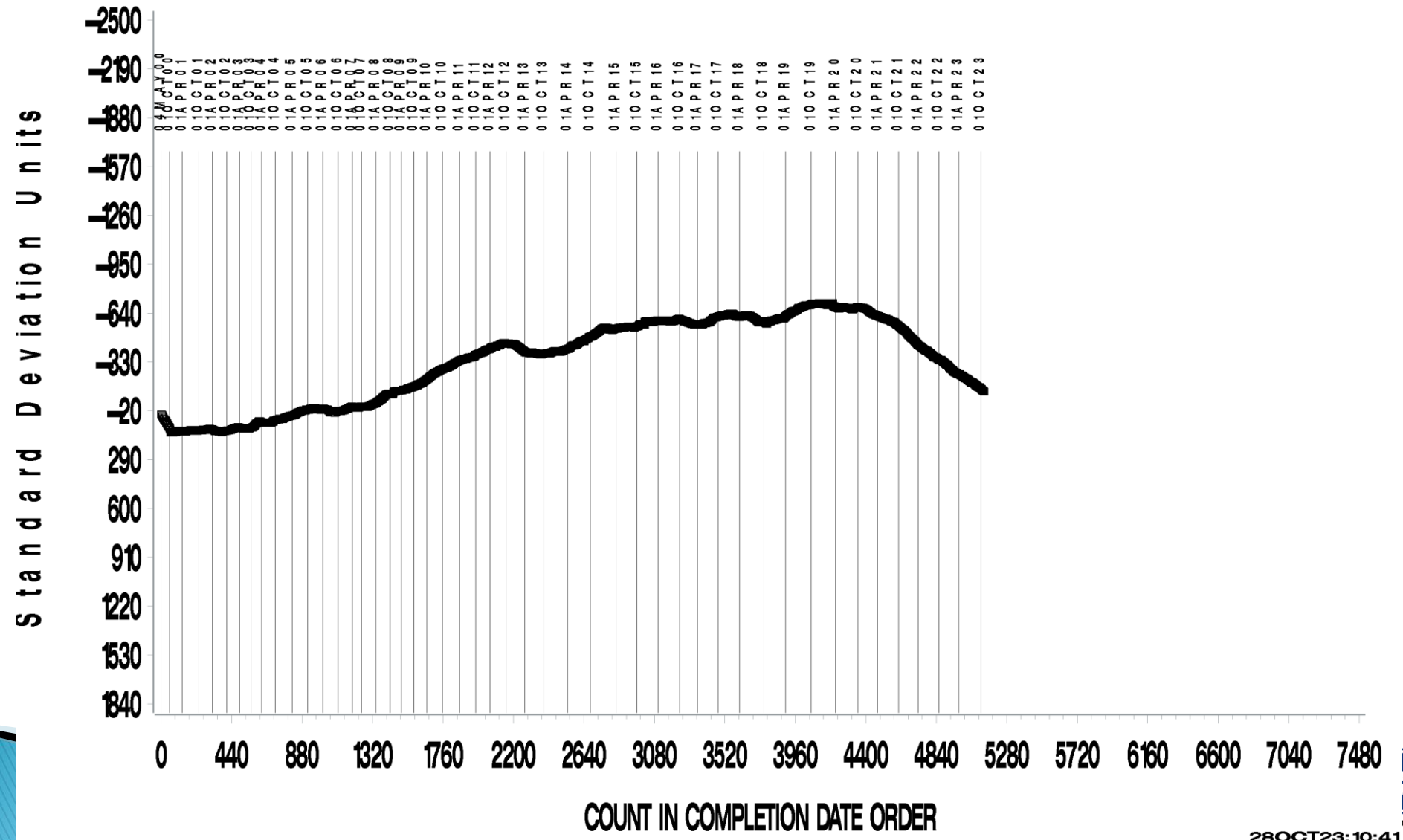
- Change in Flow Average (CIFA) is trending severe with a very consistent CUSUM slope over the past three years.

EOFT INDUSTRY OPERATIONALLY VALID DATA

20 —25 ML CHANGE IN FLOWRATE AVERAGE (%)

CUSUM Severity Analysis

Historical Chart



28OCT23:10:41

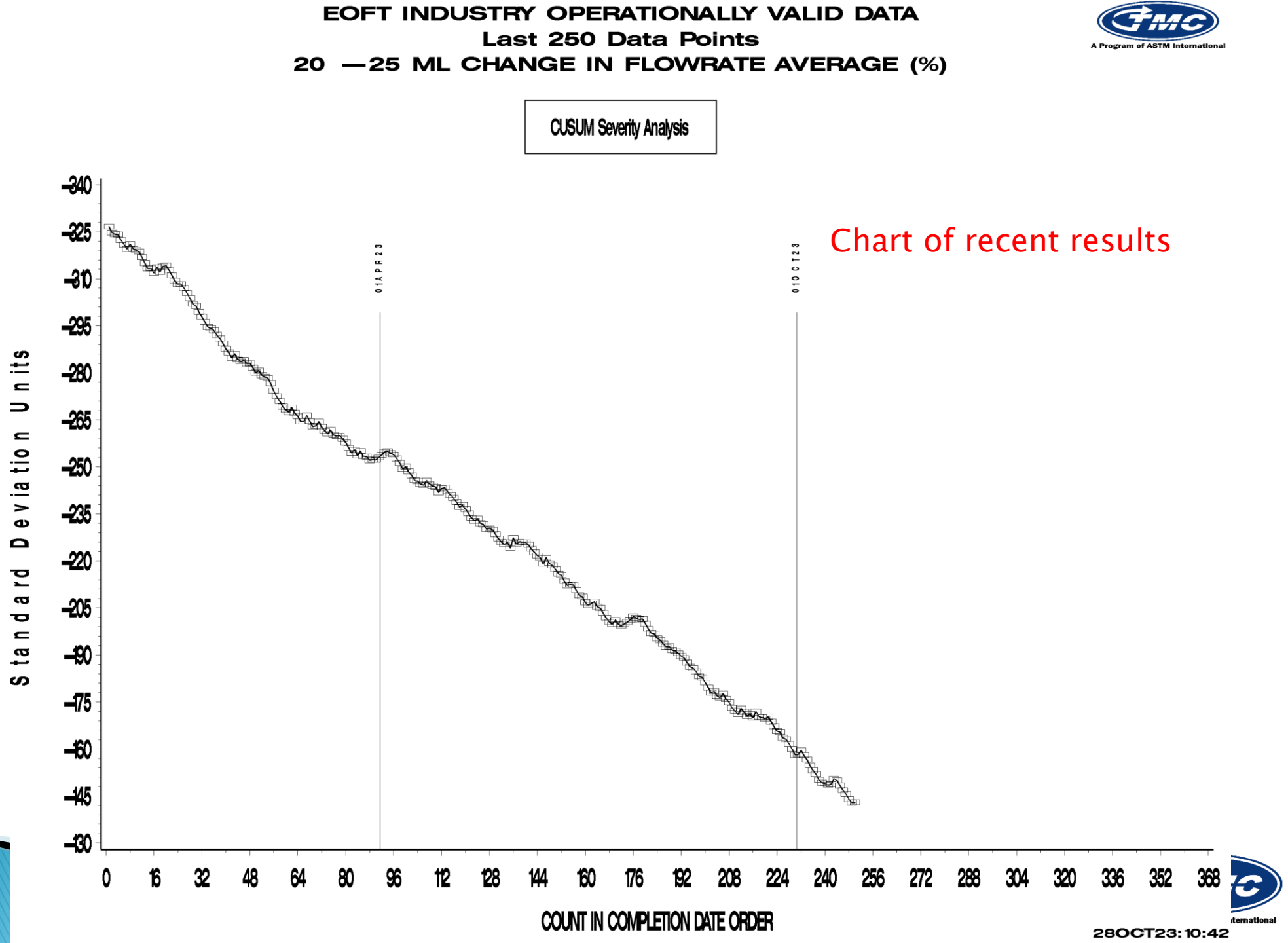
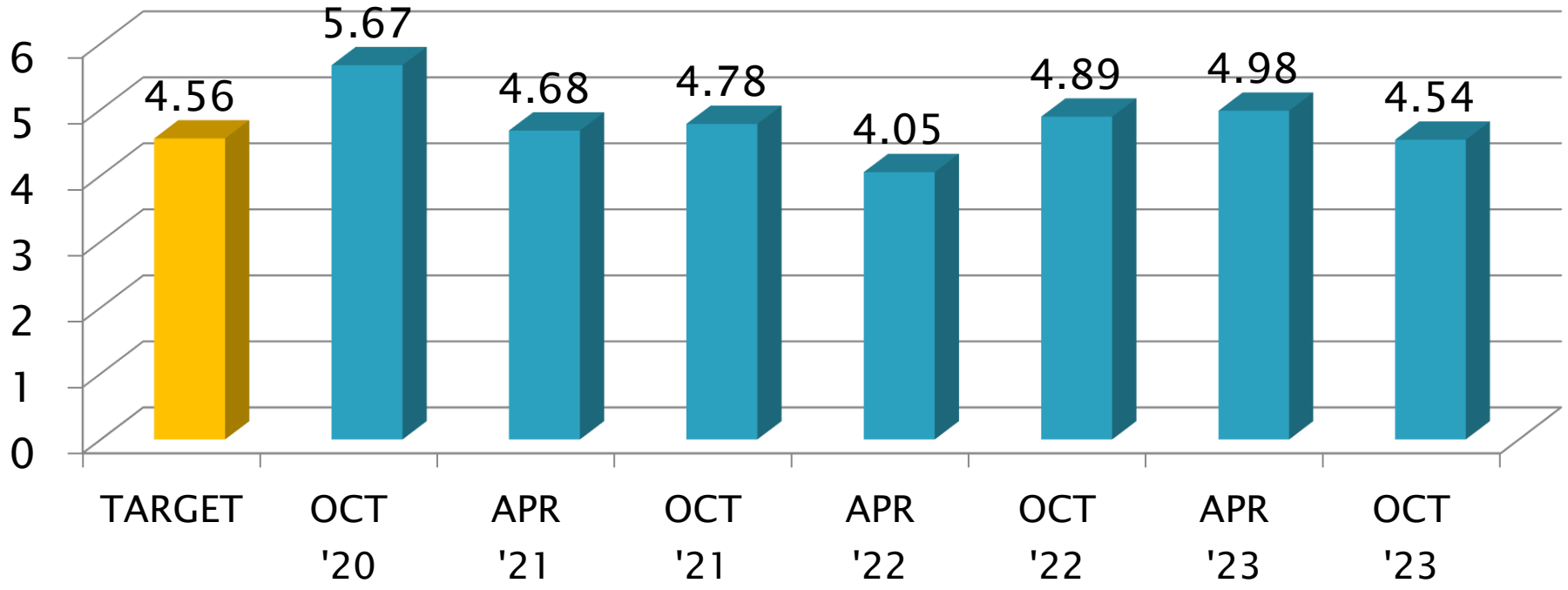


Chart of recent results

EOFT Precision Estimates

CIFA

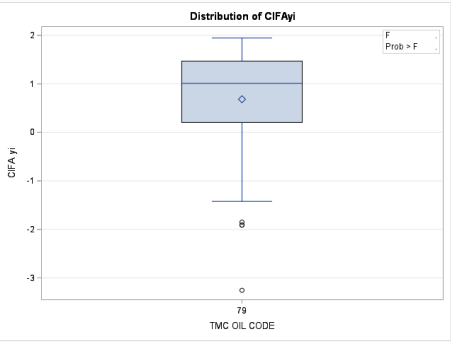
Pooled s

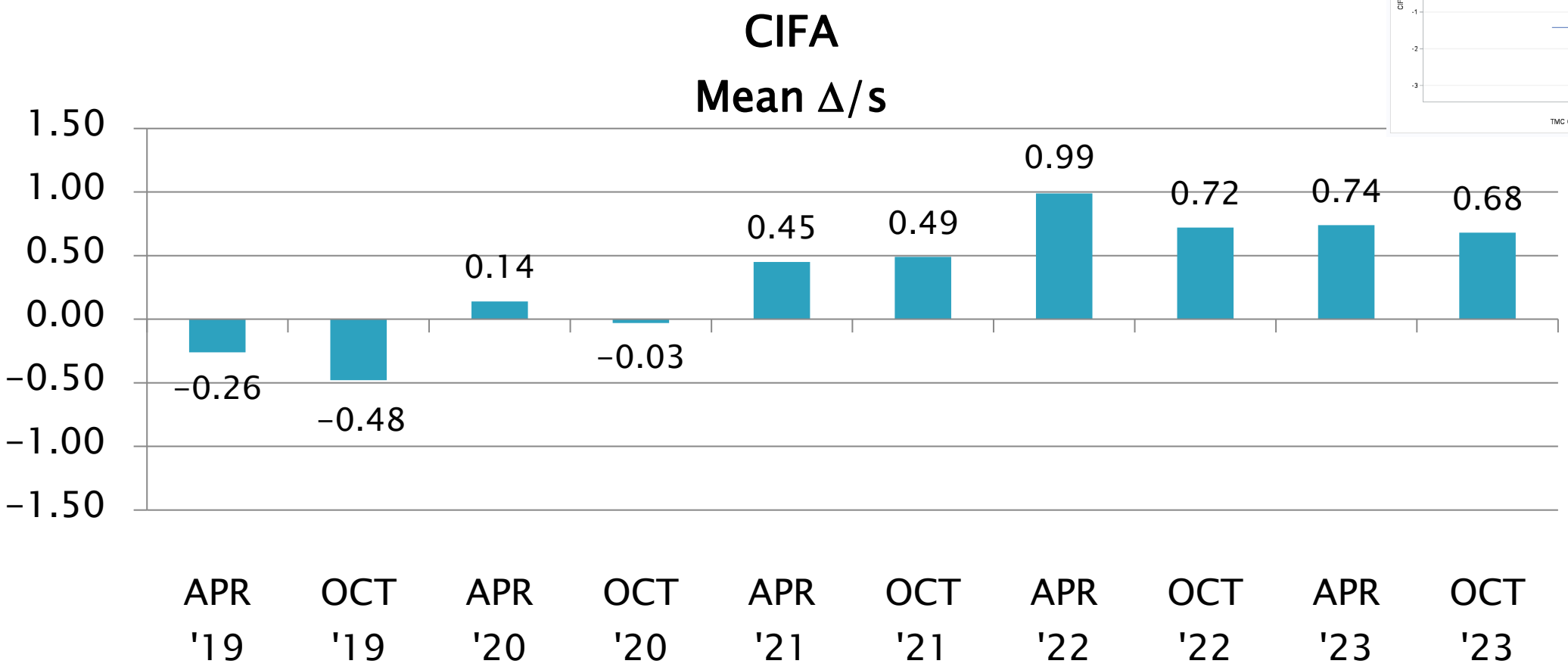


April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

EOFT Severity Estimates

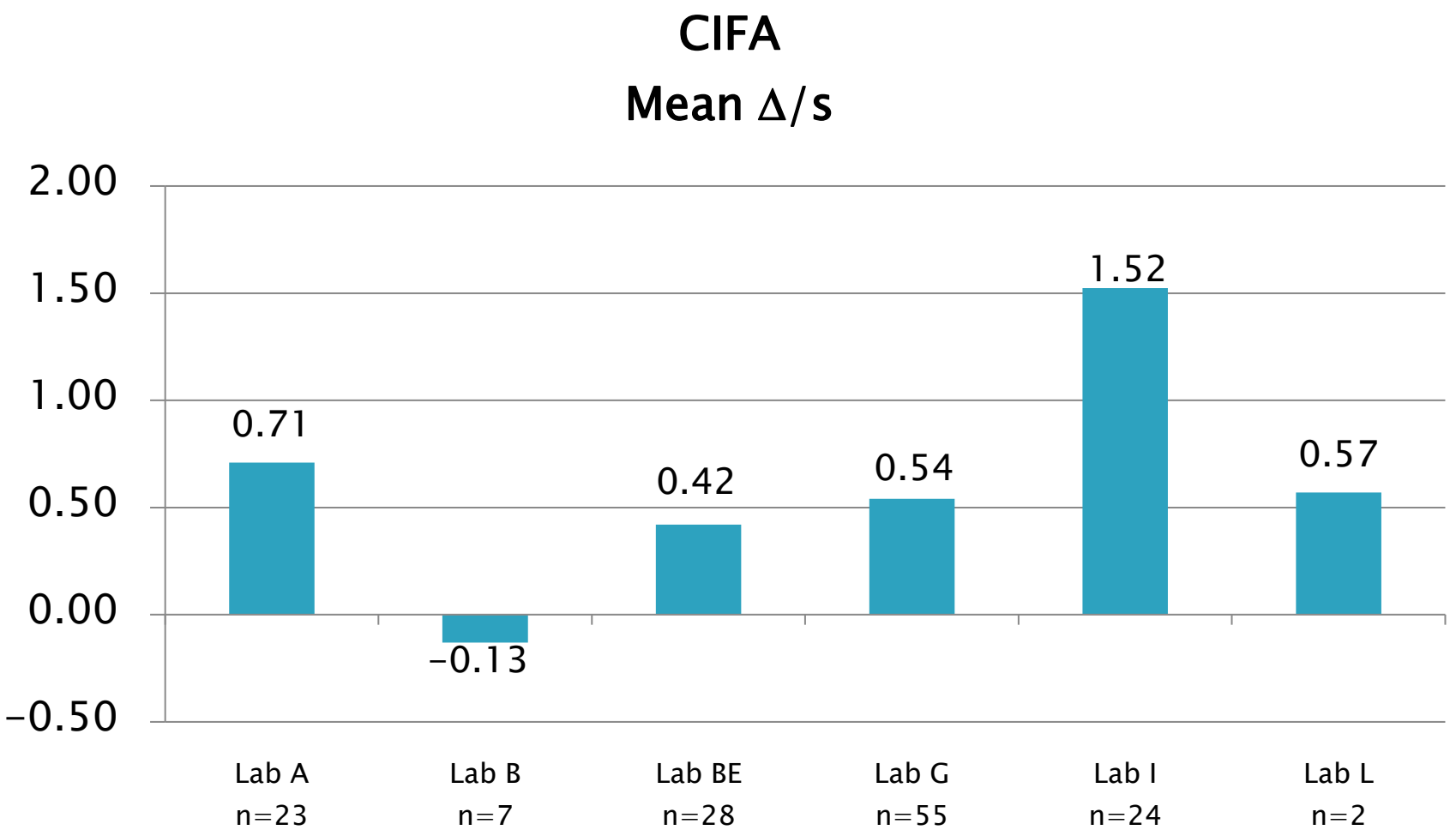




April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

EOFT Lab Severity Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Information Letters*

Test	Date	IL	Topic
			No new information letters this period.

*Available from TMC Website

Reference Oil Inventory Estimated Life EOFT

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Lab Assignments Made Last 6 Months	Estimated Life
79*	200.8	39.4	134	3 years

* RO 79 is also used in EOWT Bench Test

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 7097

Medium High Temperature TEOST (MTEOS)

October 1, 2022 – March 31, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D7097	10 (+0)	41 (+5)
*As of 9/30/2023		

D7097: Deposits by MTEOS

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	69
Failed Calibration Test	OC	5
Operationally Invalidated by Lab	LC	1
Operationally Invalid (Aborted)	XC	1
Acceptable Informational Run	NN	1
Unacceptable Informational Run	MN	1
Total		**78**

Number of Labs Reporting Data: 10 (+0)
Fail Rate of Operationally Valid Tests: 6.8%

D7097: Deposits by MTEOS

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Severe	5
Total Deposits Mild	0
Total	**5**

Three Labs had OC results.

D7097: Deposits by MTEOS
Summary of Invalid Tests

Operationally Invalid Tests (LC, XC)	Validity Code	No. Of Tests
Pump Issue	XC	1
Initial Rod Weight not Recorded	LC	1
Total		**2**

D7097: Deposits by MTEOS
Summary of Informational Tests

Informational / Shakedown Tests (NN, MN)	Validity Code	No. Of Tests
Shakedown run, Deposits in Range	NN	1
Shakedown run, Deposits not in Range (Severe)	MN	1
Total		**2**

D7097: Deposits by MTEOS

Period Precision and Severity Estimates

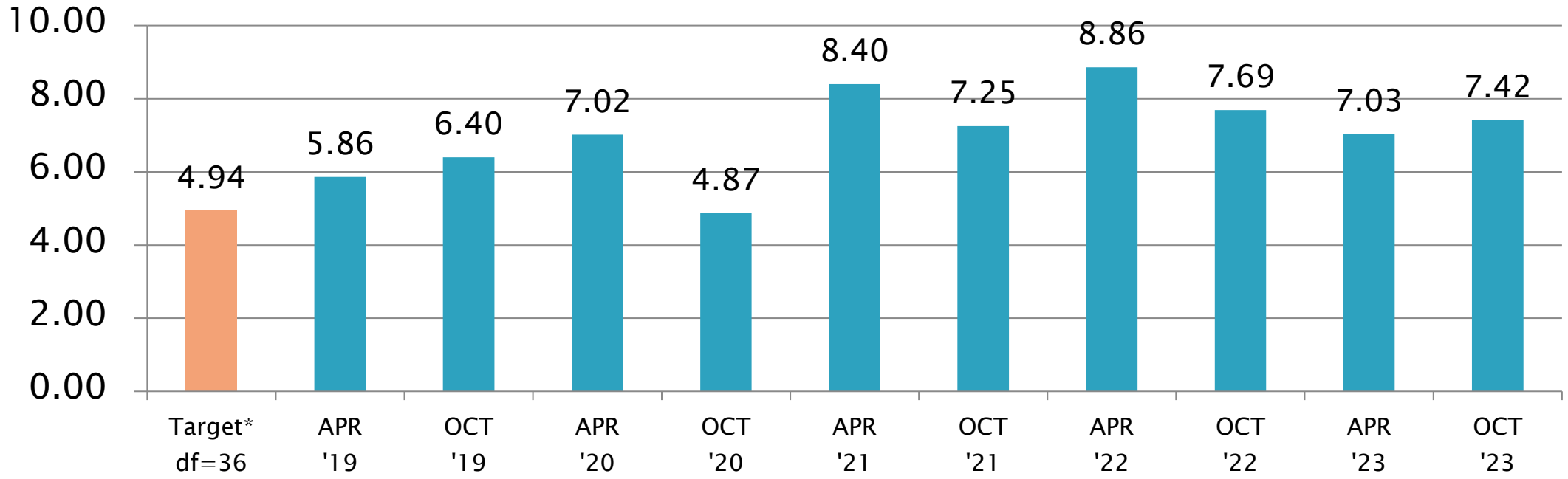
Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets 9/30/2021[1]	38	36	4.94	-----
10/1/18 through 3/31/19	97	95	5.86	-0.14
4/1/19 through 9/30/19	109	107	6.40	-0.30
10/1/19 through 3/31/20	103	101	7.02	-0.02
4/1/20 through 9/30/20	72	70	4.87	-0.22
10/1/20 through 3/31/21	101	99	8.40	0.17
4/1/21 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

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

D7097 Precision Estimates

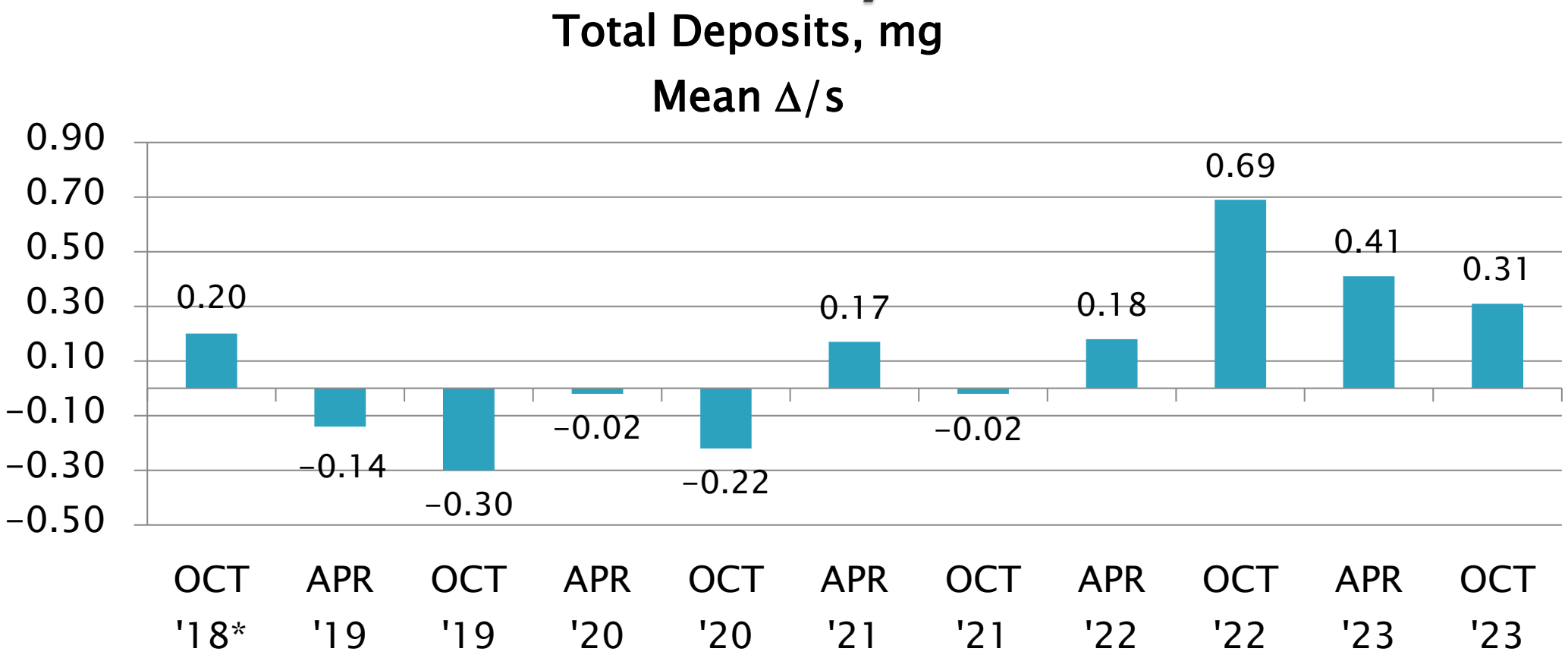
Total Deposits, mg

Pooled s



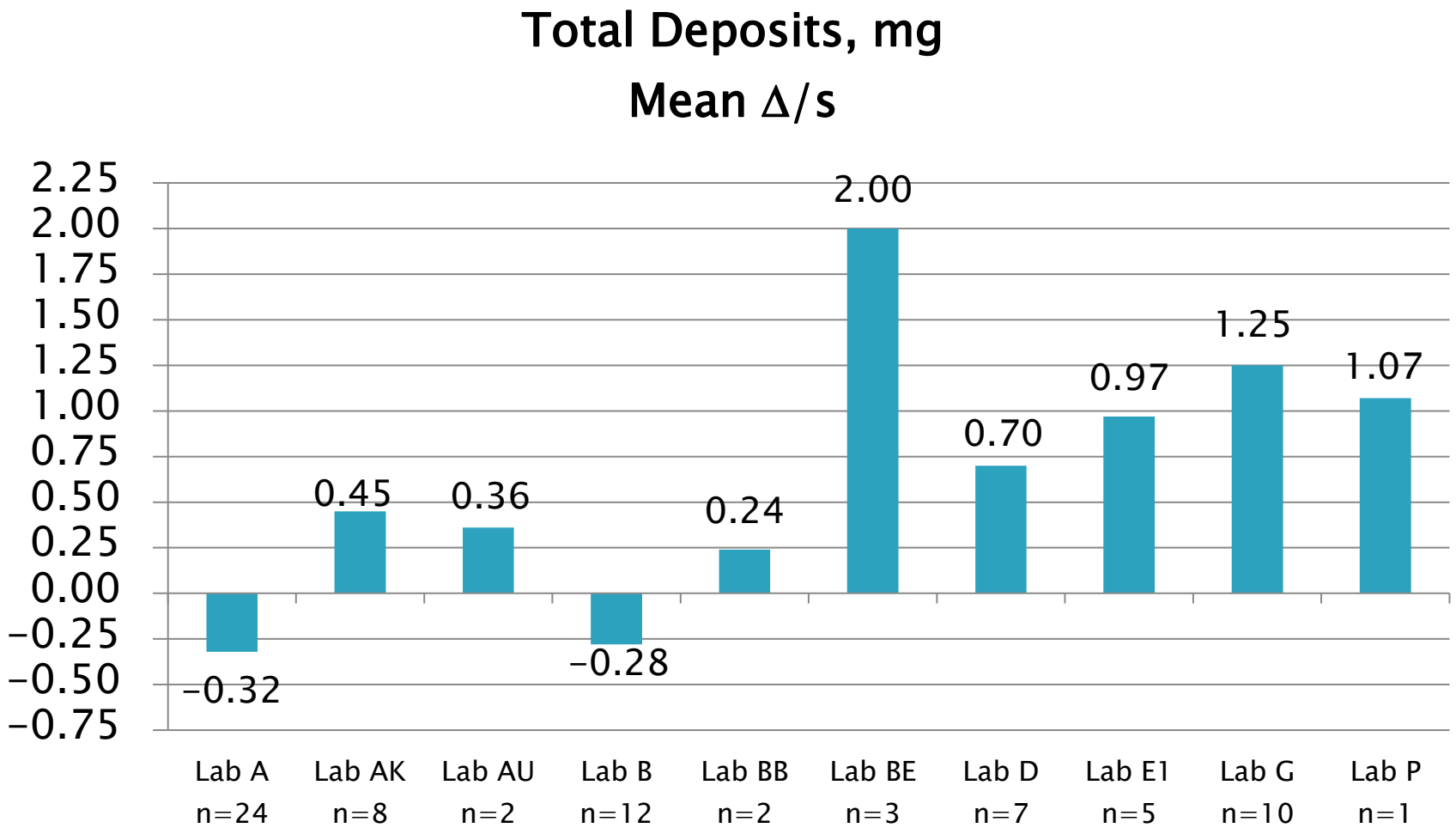
*Target precision updated to reference oils 432 and 434-3 preliminary

D7097 Severity Estimates



*One severe OC test from instrument G5 excluded (8.9 s)

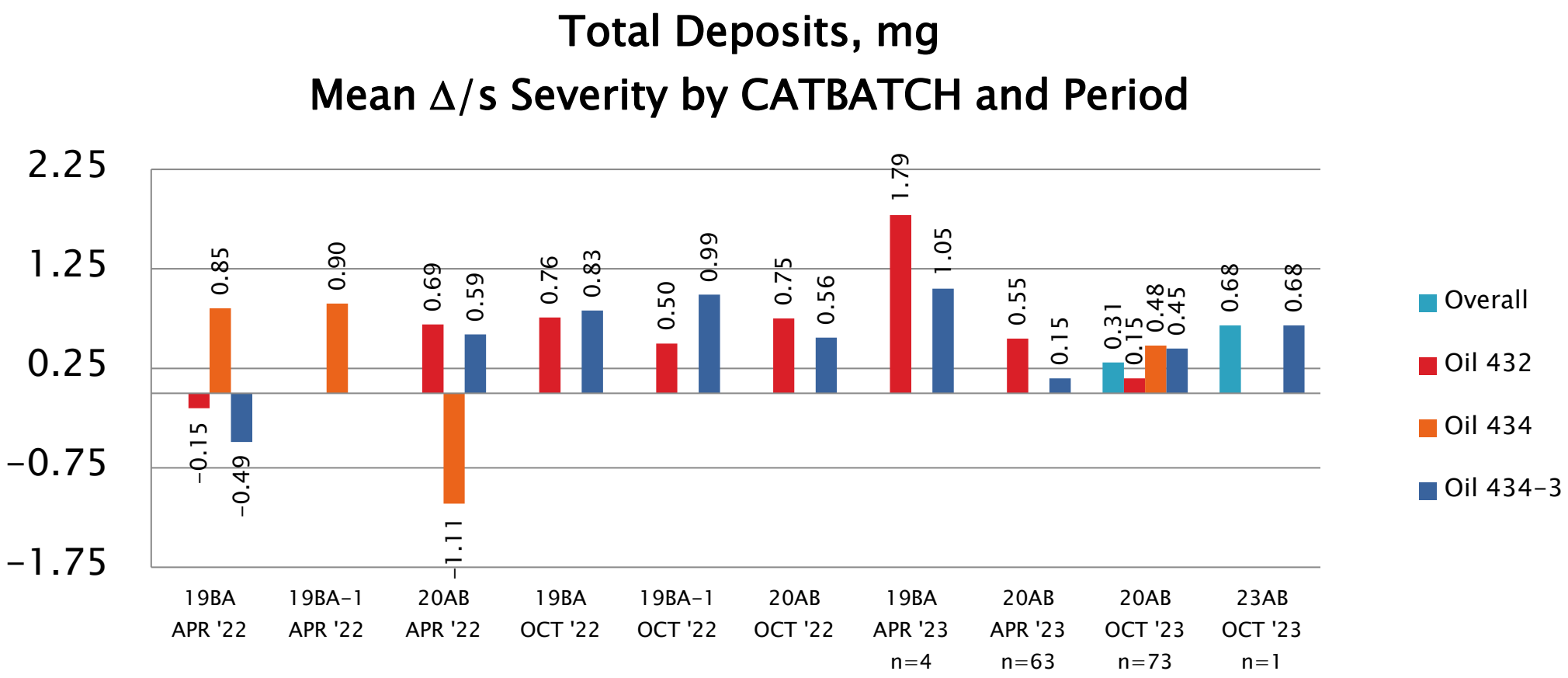
D7097 Lab Severity Estimates



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D7097: Deposits by MTEOS



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

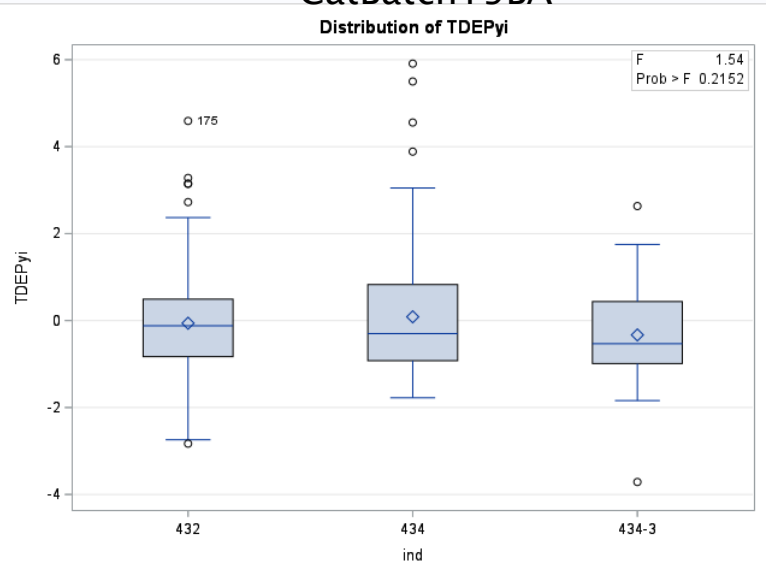
D7097: Deposits by MTEOS

- Precision (Pooled s) regressed slightly moving to 7.42 s this reporting period
- Performance (Mean Δ/s) continued to improve, moving from 0.41 s down to 0.31 s
- All operationally valid tests this period report using Rod Batches M (n=1) or N (n=73).
- Most operationally valid calibration tests this period report using Catalyst Batch 20AB (n=73)
  - The use of Catalyst Batch 23AB (n=1) started this semester
  - No runs used Catalyst Batch 19BA this semester

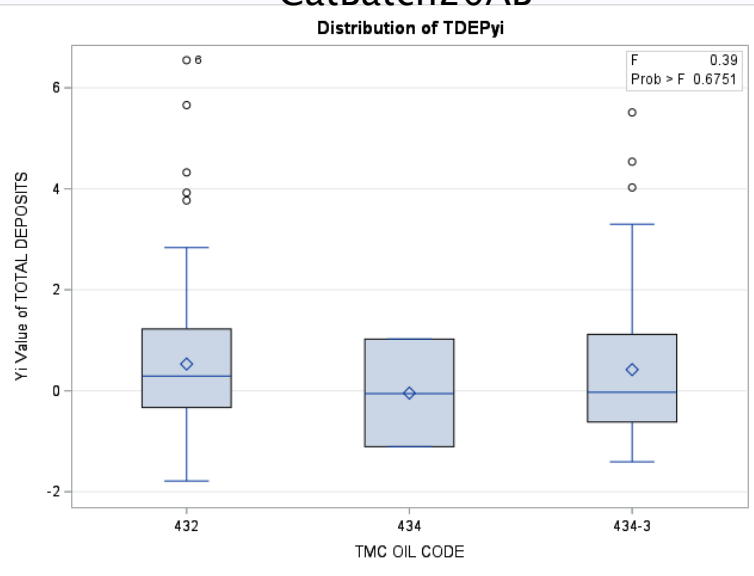
D7097: Deposits by MHT TEOST

- No new runs on catalyst batch 19BA this semester
  - Total Runs and Yi statistic for batch 19BA remain at n=348, Yi = -0.02.
- Severity on catalyst batch 20AB (n=233) appears to be slightly severe of target for oils 432, 434 and 434-3 (Yi = 0.48), but continuing to improve from previous reports (Yi = 0.65 OCT '22, Yi = 0.54 APR '23)
- New catalyst batch 23AB started with one run on RO 434-3. (n=1, Yi=0.68)

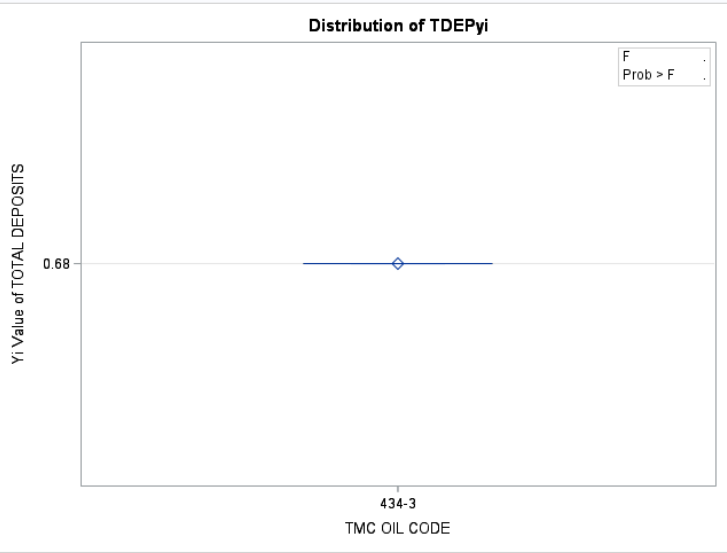
CatBatch19BA



CatBatch20AB



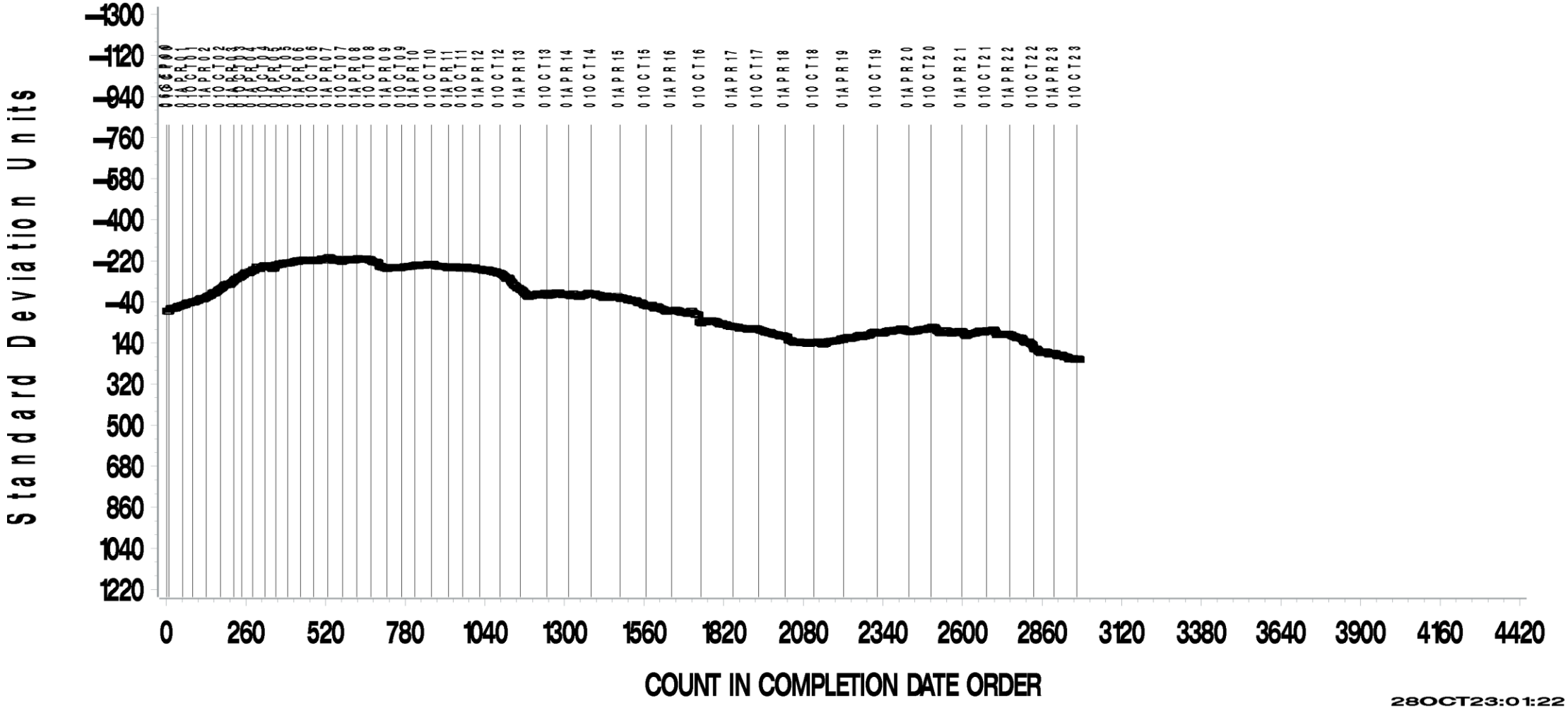
CatBatch23AB



MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA

TOTAL DEPOSITS MG

CUSUM Severity Analysis

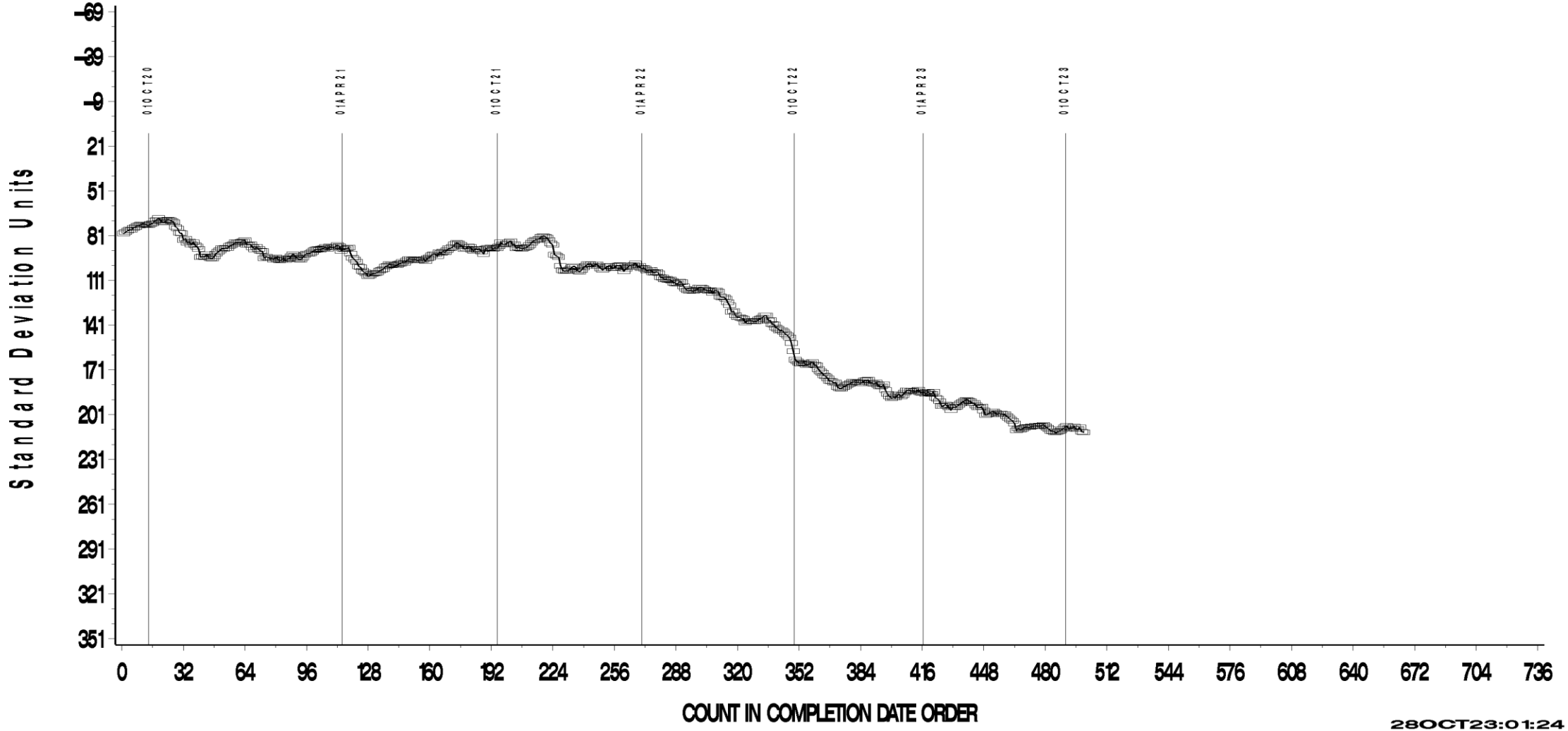


28OCT23:01:22

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

A Program of ASTM International

CUSUM Severity Analysis



28OCT23:01:24

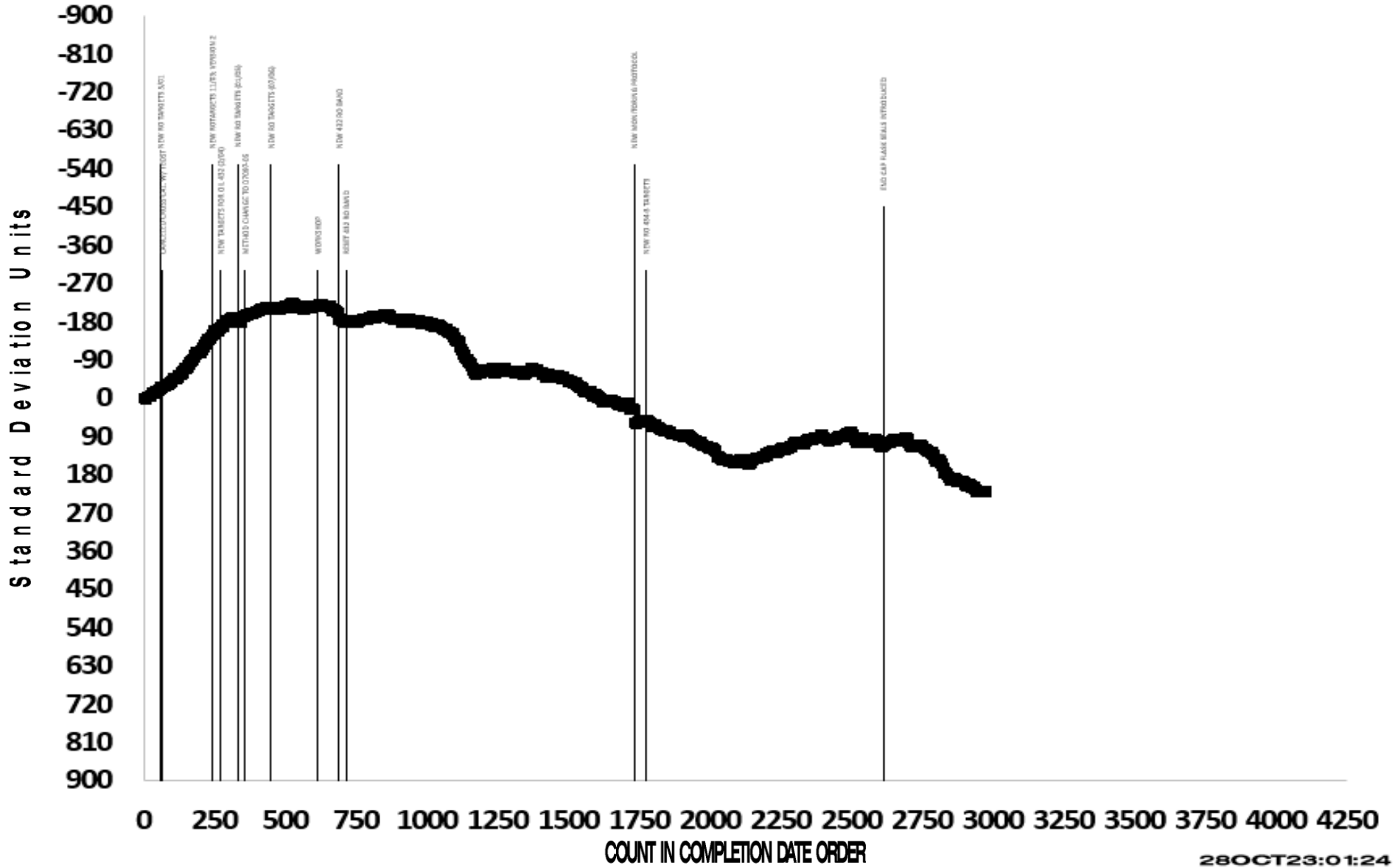
MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA

SEVERITY DATES

TOTAL DEPOSITS MG

A Program of ASTM International

CUSUM Severity Analysis



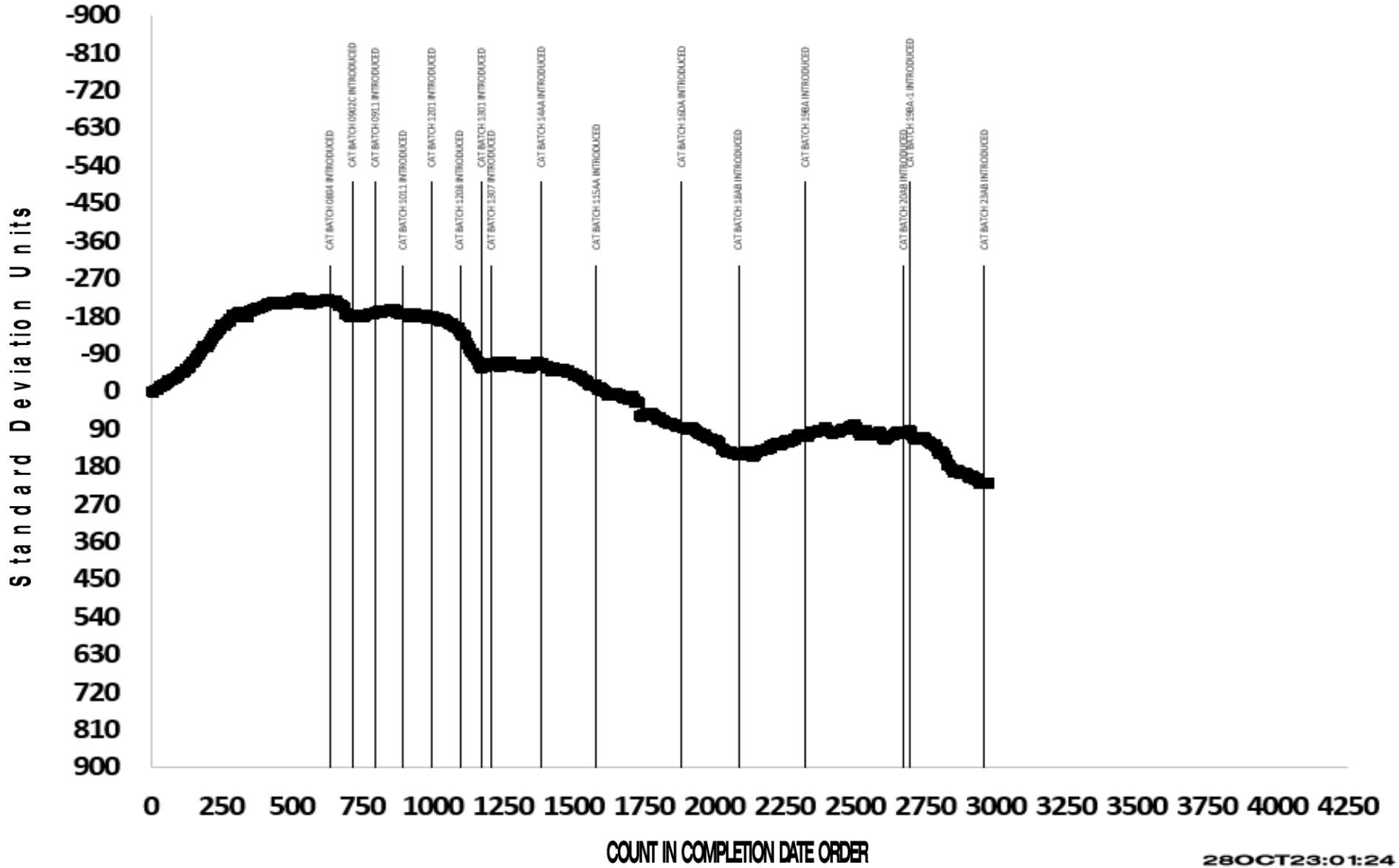
28OCT23:01:24

MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA

CATALYST BATCH

TOTAL DEPOSITS MG

CUSUM Severity Analysis



28OCT23:01:24

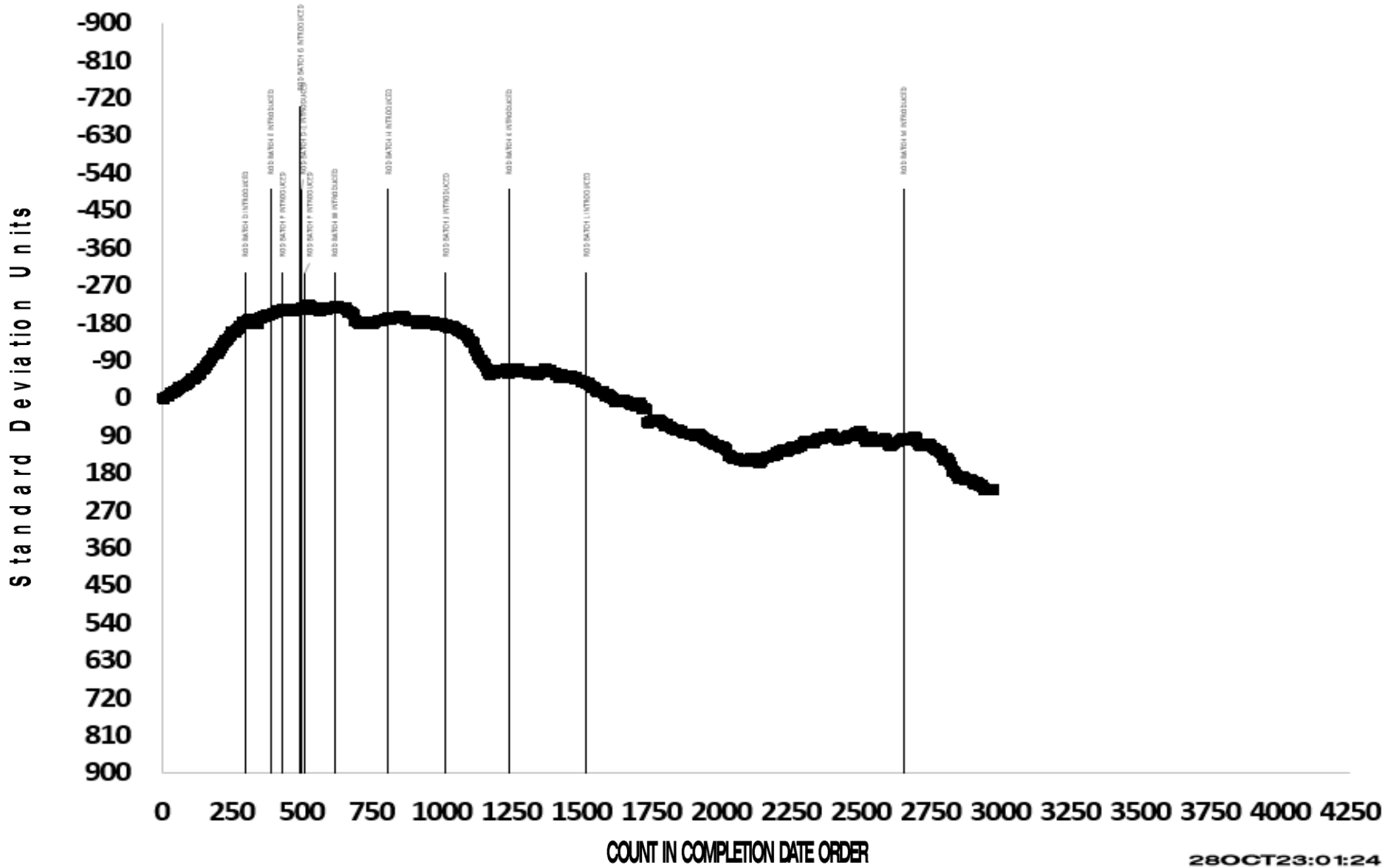
MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA

ROD BATCH

TOTAL DEPOSITS MG

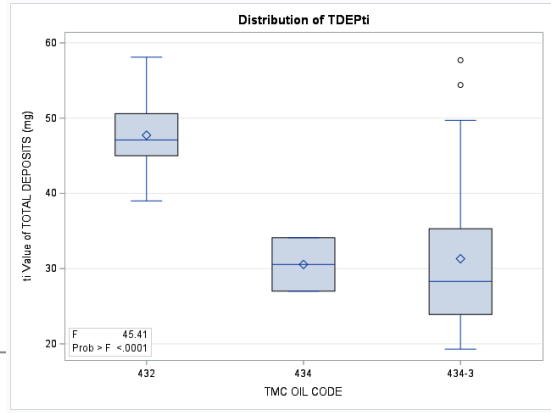
A Program of ASTM International

CUSUM Severity Analysis

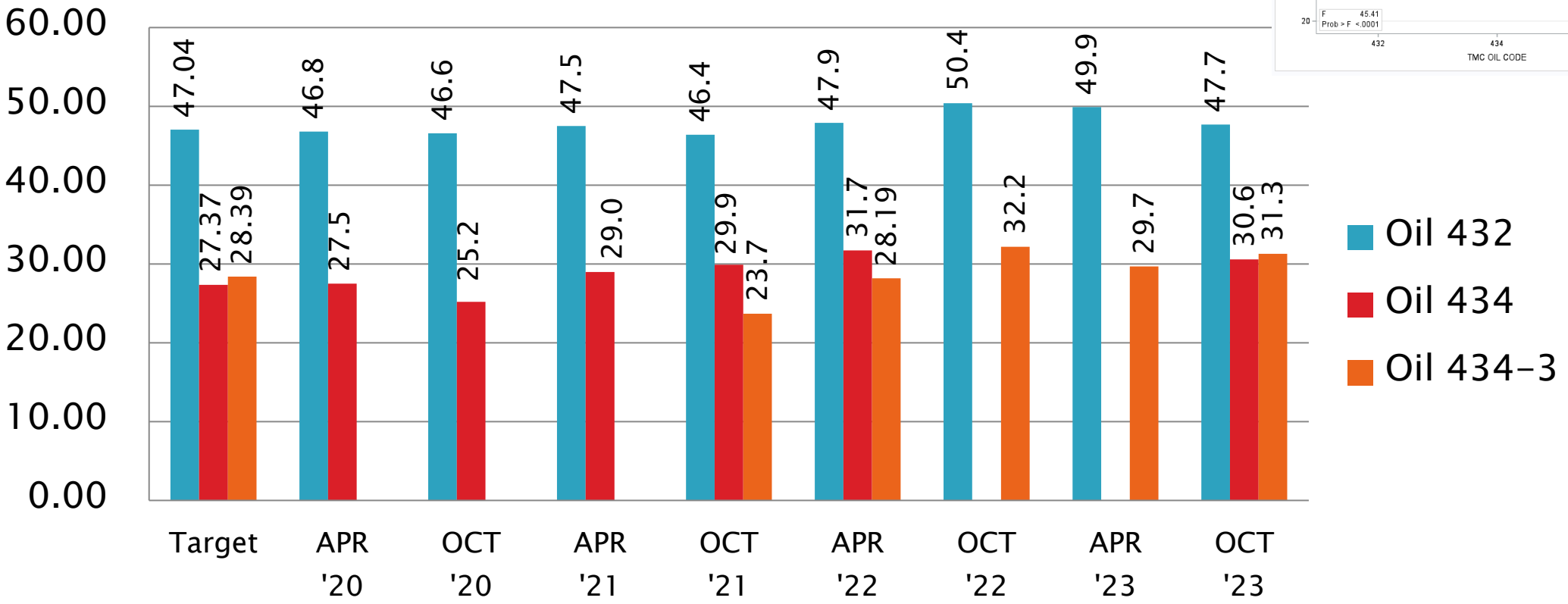


28OCT23:01:24

D7097 Performance by Oil



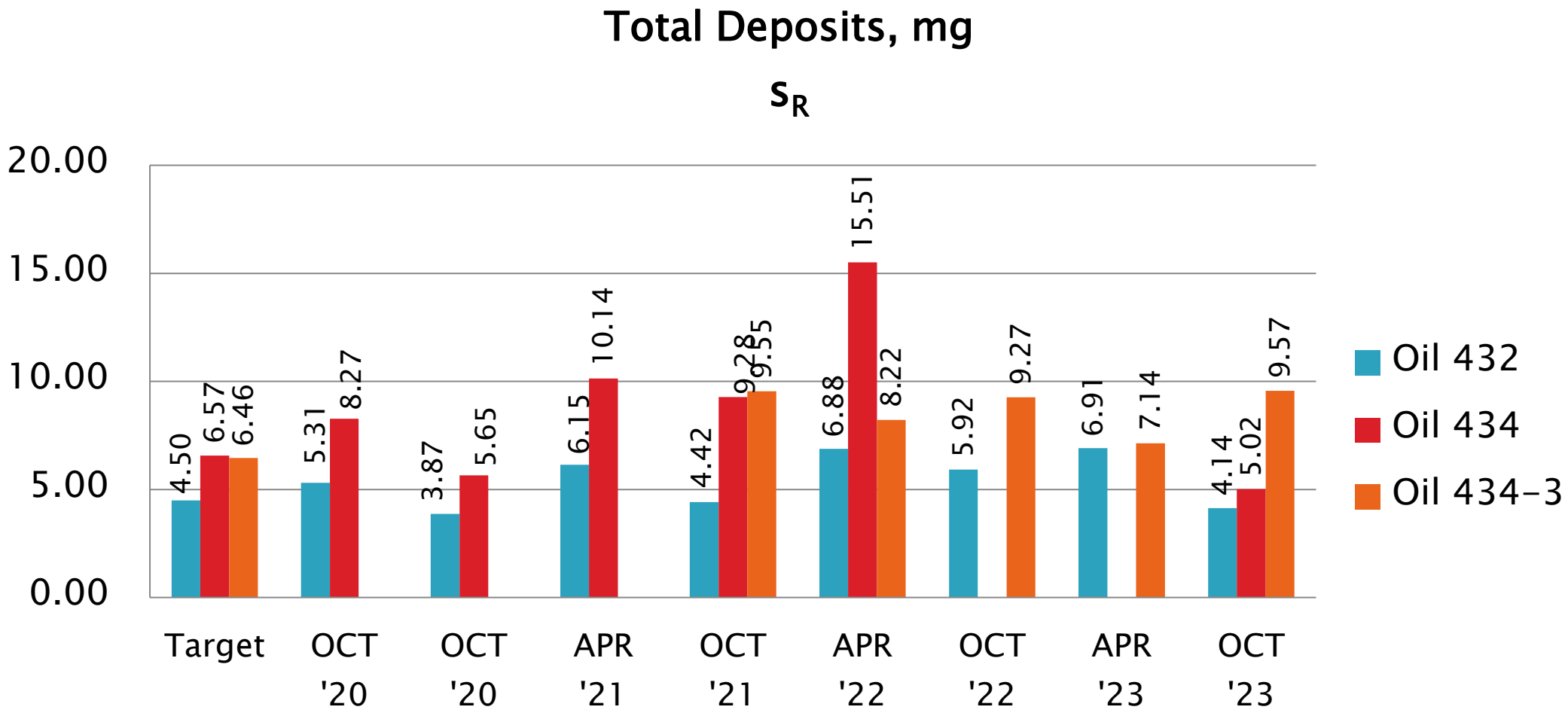
Total Deposits, mg
Mean



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

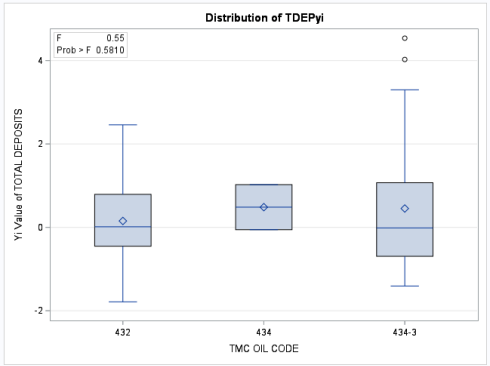
D7097: Deposits by MHT TEOST



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D7097: Deposits by MHT TEOST



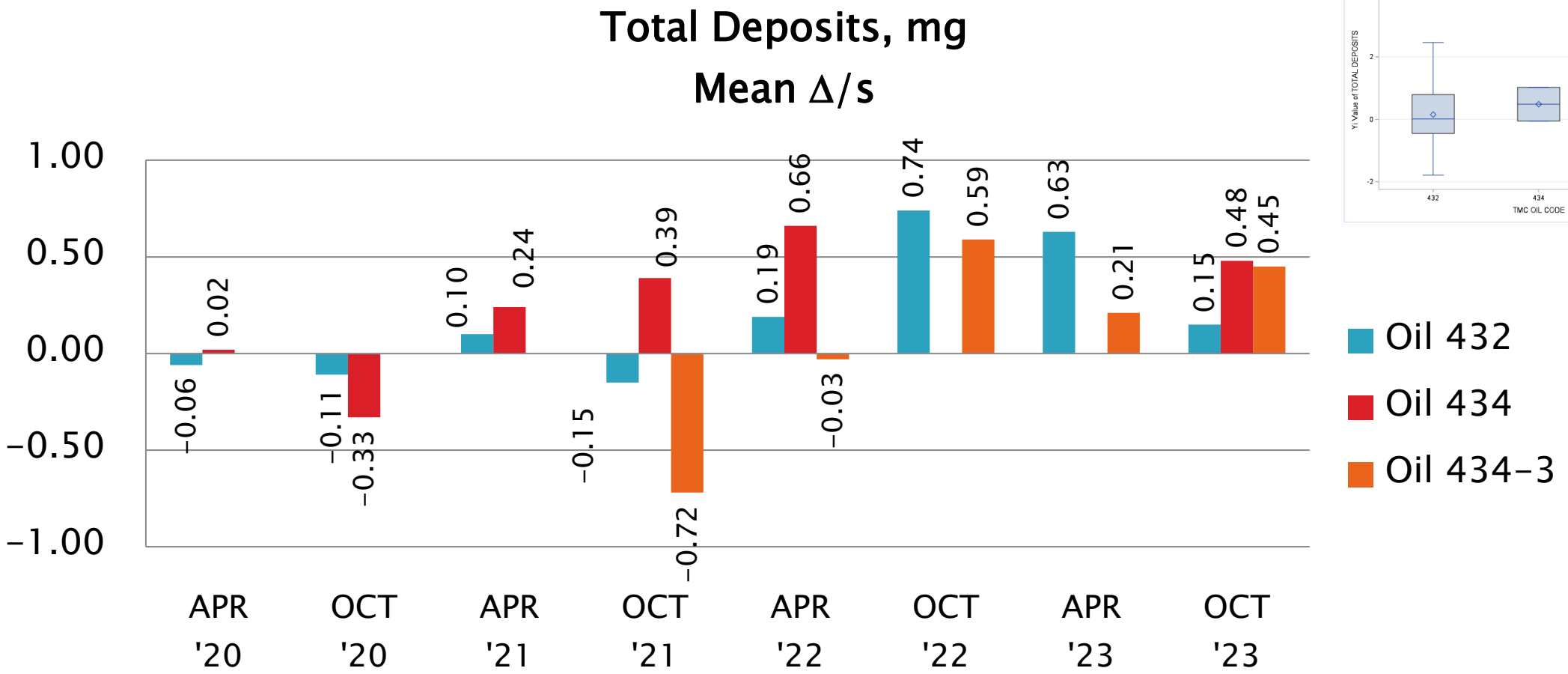


TABLE of CONTENTS

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D02.B0.07
TMC Monitored Tests

ASTM D 7216

Engine Oil Elastomer Compatibility (EOEC/LDEOC)

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

ASTM Reference Testing Semi-Annual Report D7216 EOEC

April 1, 2023 – September 30, 2023

ASTM D 7216

Engine Oil Elastomer Compatibility (EOEC/HDEOC)

OHT CURRENT ELASTOMER BATCH CODES FOR ASTM D7216
AS OF: 10/3/2023

EOEC (PC 9)	
OHT PART NUMBER	BATCH CODE
OHTPC9-NBR-1	30
OHTPC9-ACM-2	31
OHTPC9-FKM-1	30
OHTPC9-MAC-1	24

LDEOC (J2643)	
OHT PART NUMBER	BATCH CODE
OHTJ2643-HNBR-1	31
OHTJ2643-FKM-1	29
OHTJ2643-ACM-2	26
OHTJ2643-VMQ-1	41
OHTJ2643-AEM-2	30

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D7216 EOEC	6 (+0)	N/A
*As of 9/30/2023		

EOEC Test Activity*

Test Status		Fluoroelast.	Nitrile	Polyacrylate	Silicone	Ethylene Acrylate	Total
	LABS	6	6	6	6	6	
Acceptable Calibration Test	AC	56	62	56	52	58	284
Failed Calibration Test	OC	2	3	1	0	0	6
Operationally Invalid, by lab	LC	0	0	0	1	1	2
Operationally Invalid, by TMC	RC	0	0	0	0	0	0
Aborted	XC	0	1	2	0	0	3
Total		**58**	**66**	**59**	**53**	**59**	**295**

April 1, 2023 – September 30, 2023

EOEC Failed Calibration Tests*

Cause	Elastomer	No. of Tests
Elongation Change (MILD)	EOECP	1
Elongation Change (MILD)	EOECN	3
Volume Change (MILD)	EOECF	2
Total		**6**

* Six failing calibration tests from three different labs

EOEC Lost Tests*

Validity	Cause	No. of Tests
XC	Power Outage (EOECN, EOECP)	2
XC	System Error (EOECP)	1
LC	Lab Aborted Test (EOECS)	1
LC	SOT Data Missing (EOECV)	1
Total		**5**

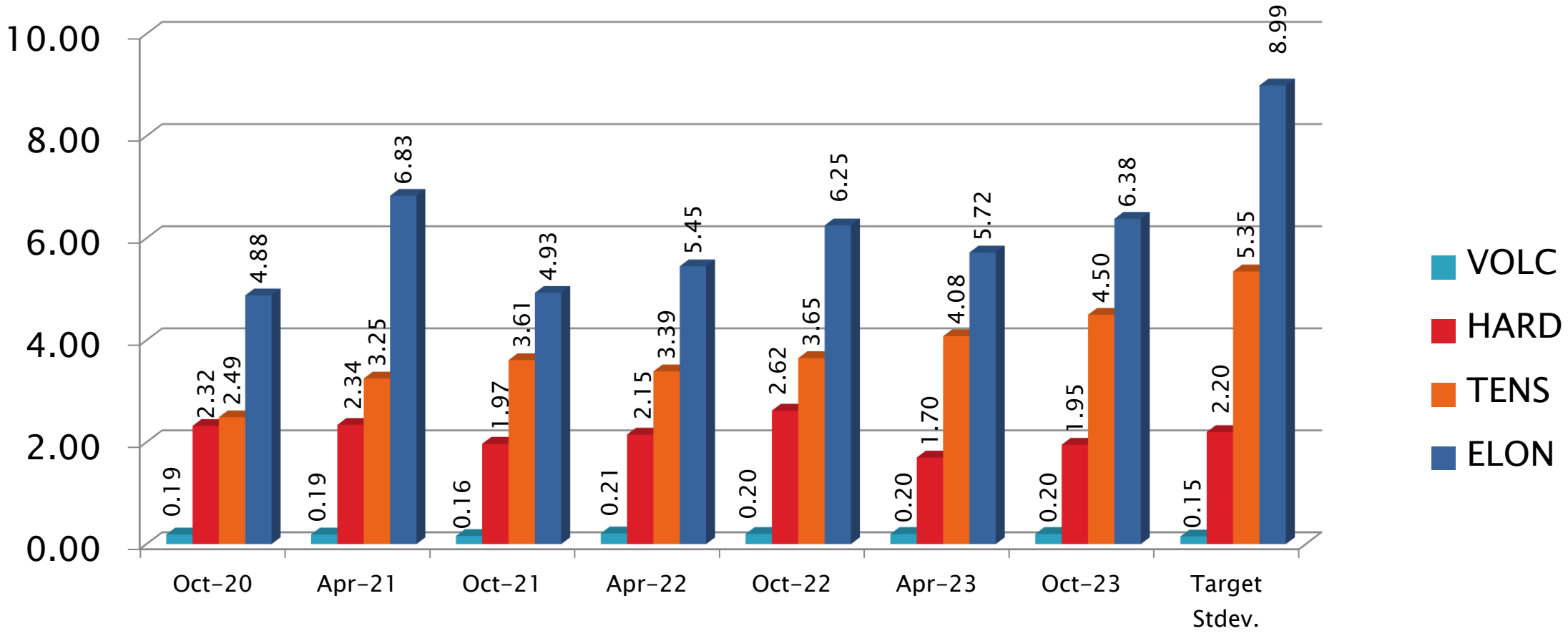
*Invalid and aborted calibration tests

EOEC Test Severity

Fluoroelastomer (FKM)

Parameter	Period Mean Δ/s	Status
Volume Change	-0.38	Mild
Points Hardness Change	0.24	Slightly Severe
Tensile Strength Change	0.63	Severe
Elongation Change	-0.44	Mild

EOEC Precision (Pooled s) Estimates: Fluoroelastomer



EOEC Precision Estimates by Lab: FKM

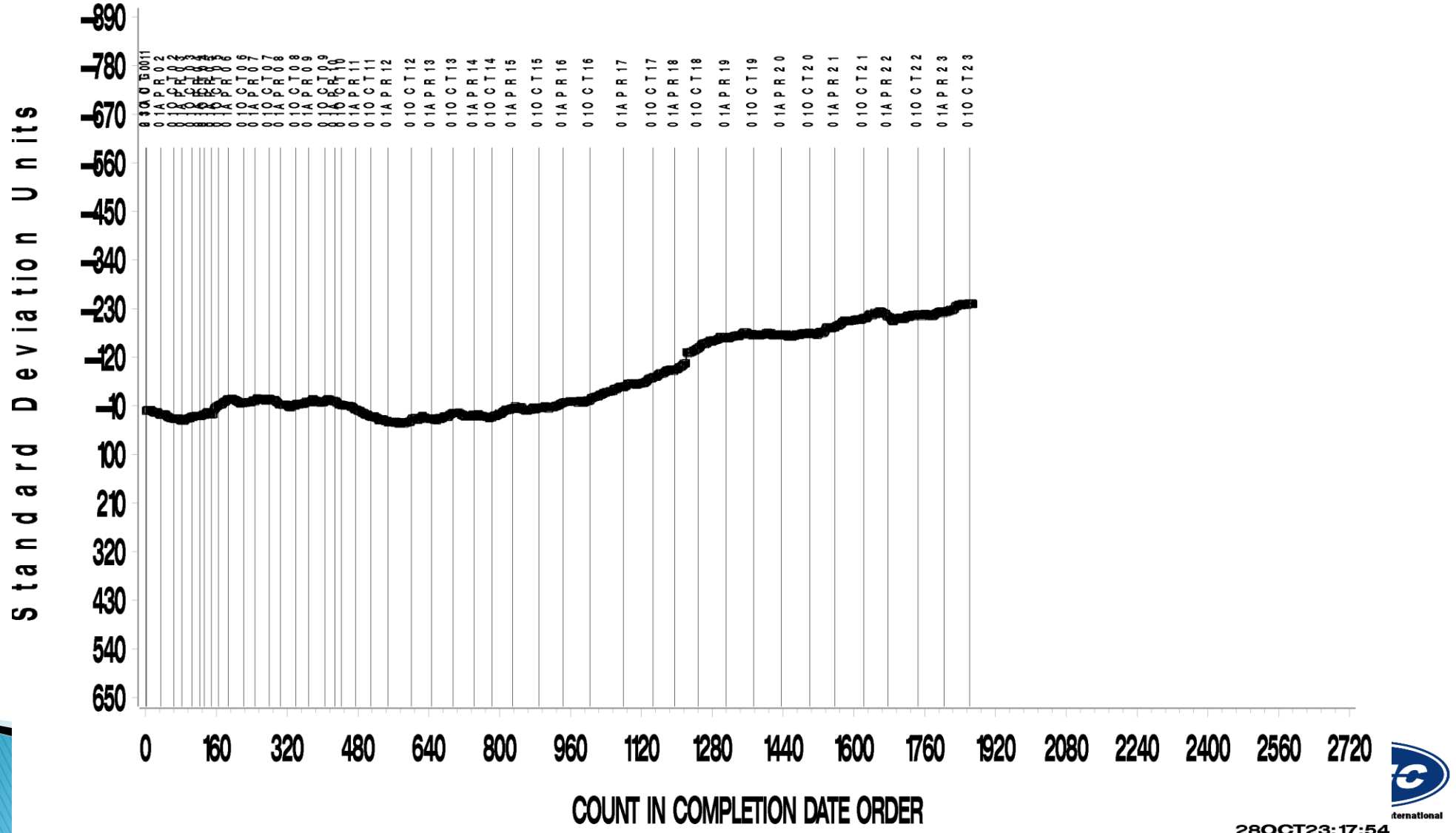
Test Parameter	Statistic	LTMS Lab					
		A	B	G	I	L	P
	n=	22	4	19	8	2	3
Volume	Mean	0.3459	0.3700	0.4153	0.4650	0.0700	0.4633
	Pooled s	0.1556	0.1283	0.1759	0.3516	0.2404	0.01528
	Mean /s	-0.6357	-0.4730	-0.1671	0.1689	-2.500	0.1577
Hardness	Mean	9.5455	10.2500	6.7368	8.2500	9.500	11.000
	Pooled s	0.6710	0.9574	2.0503	1.1650	0.7071	1.000
	Mean /s	0.6843	1.0045	-0.5923	0.0955	0.06636	1.3455
Tensile Strength	Mean	-71.7363	-70.625	-63.1789	-66.750	-70.550	-68.700
	Pooled s	1.6800	1.2420	3.6233	2.5360	0.3536	1.9519
	Mean /s	-0.0778	0.1299	1.5217	0.8542	0.1439	0.4897
Elongation	Mean	-67.4909	-60.525	-57.8210	-61.200	-67.550	-56.8667
	Pooled s	2.7198	12.2655	5.5131	1.7567	0.07071	2.0033
	Mean /s	-1.0023	1.3643	0.6132	-0.0303	-1.0089	0.1795

EOEC — FLUOROELASTOMER INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

FLUOROELASTOMER VOLUME CHANGE CORRECTED AVERAGE

CUSUM Severity Analysis



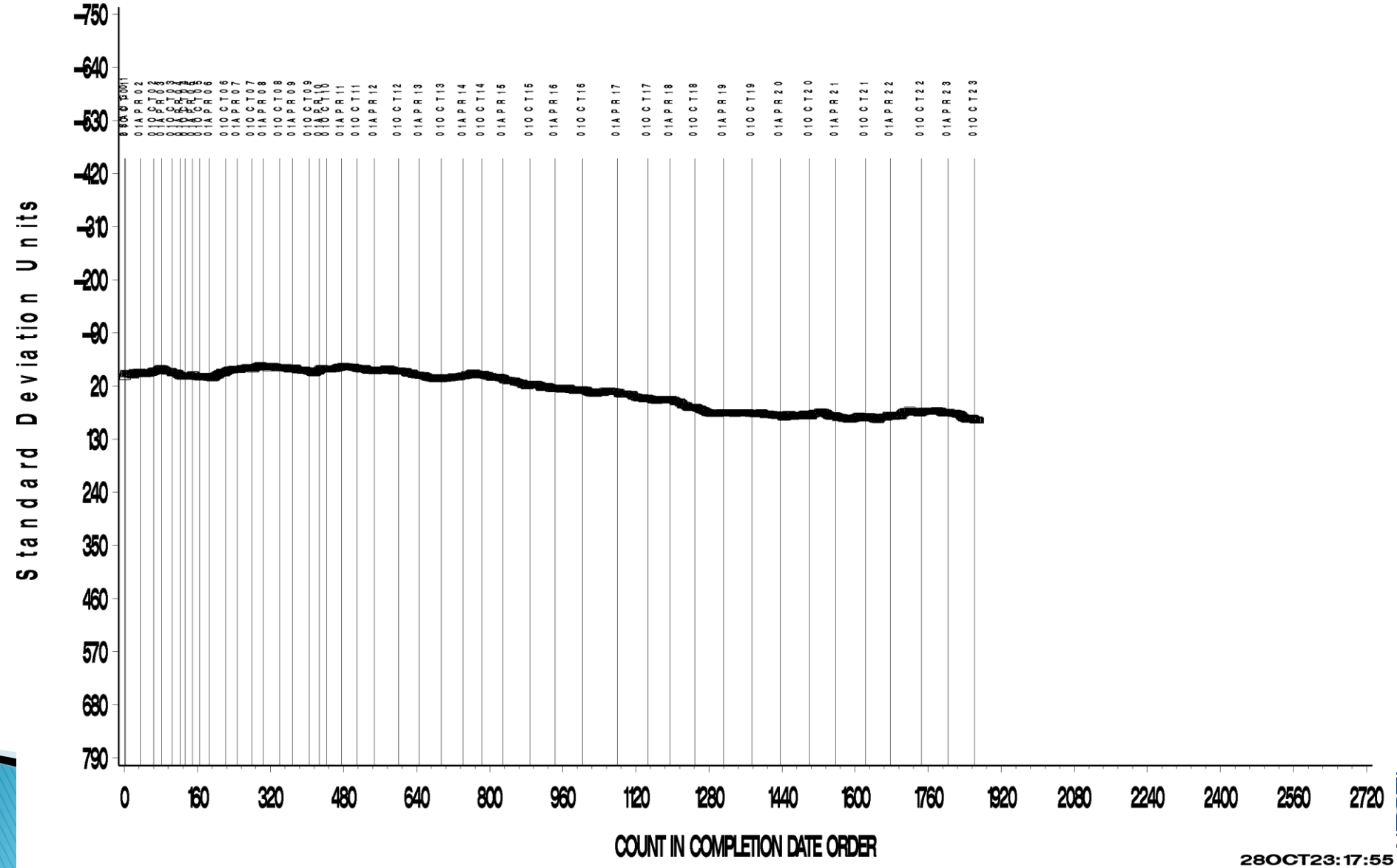
28OCT23:17:54

EOEC — FLUOROELASTOMER INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

FLUOROELASTOMER PTS HARDNESS CHANGE CORRECTED AVG

CUSUM Severity Analysis

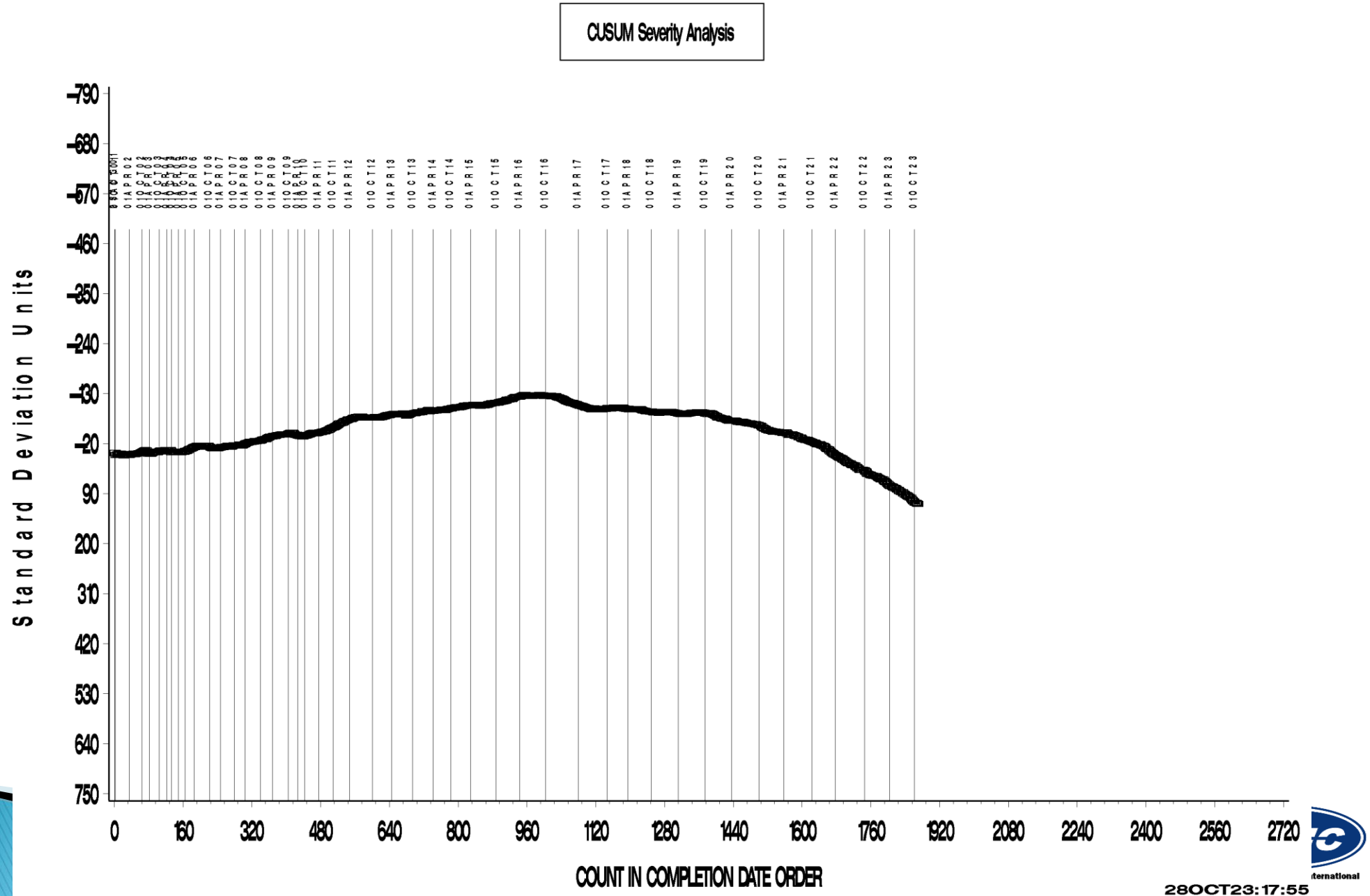


28OCT23:17:55

EOEC — FLUOROELASTOMER INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

FLUOROELASTOMER TENS STRENGTH CHANGE CORRECTED AVG

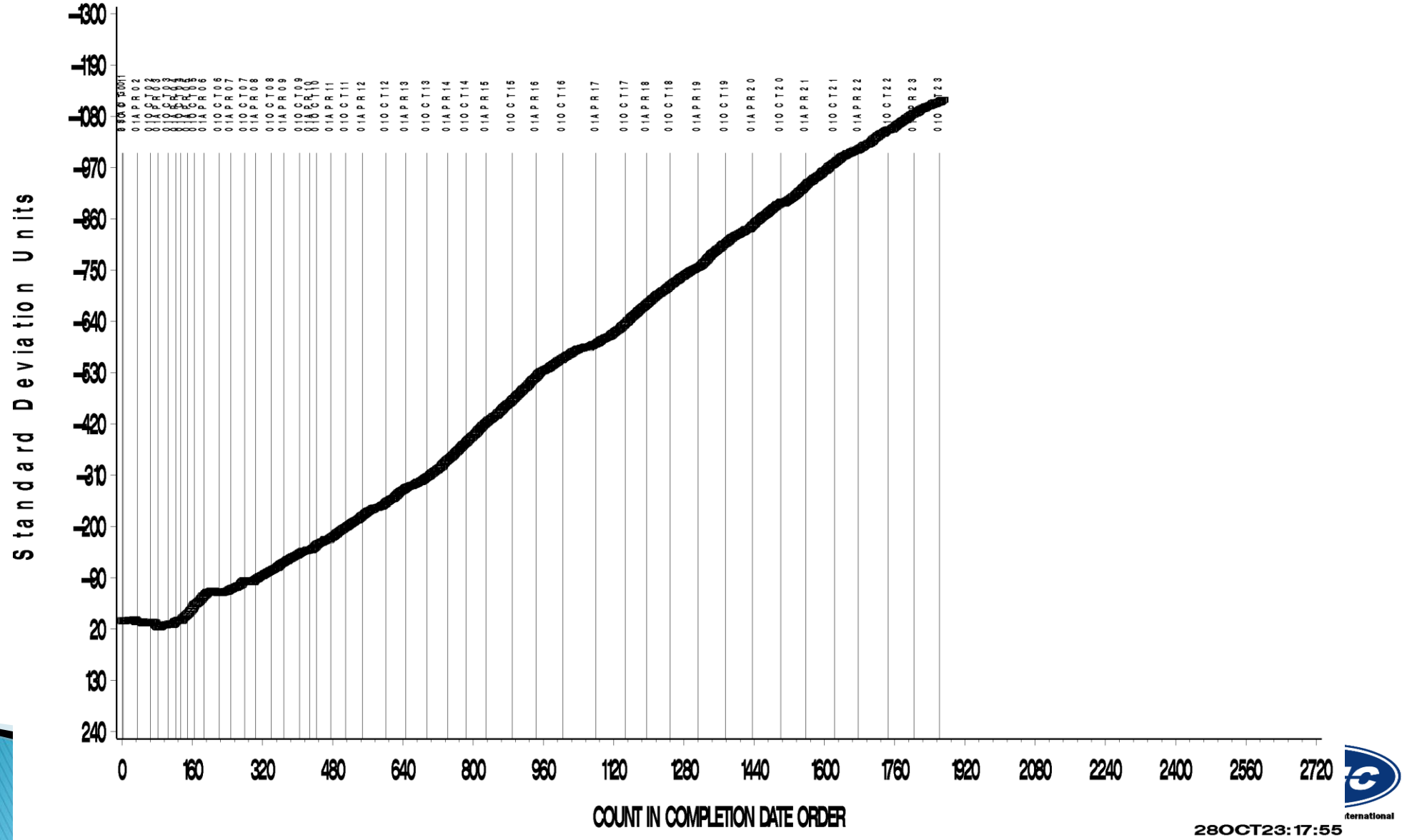


EOEC — FLUOROELASTOMER INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

FLUOROELASTOMER ELONGATION CHANGE CORRECTED AVG

CUSUM Severity Analysis



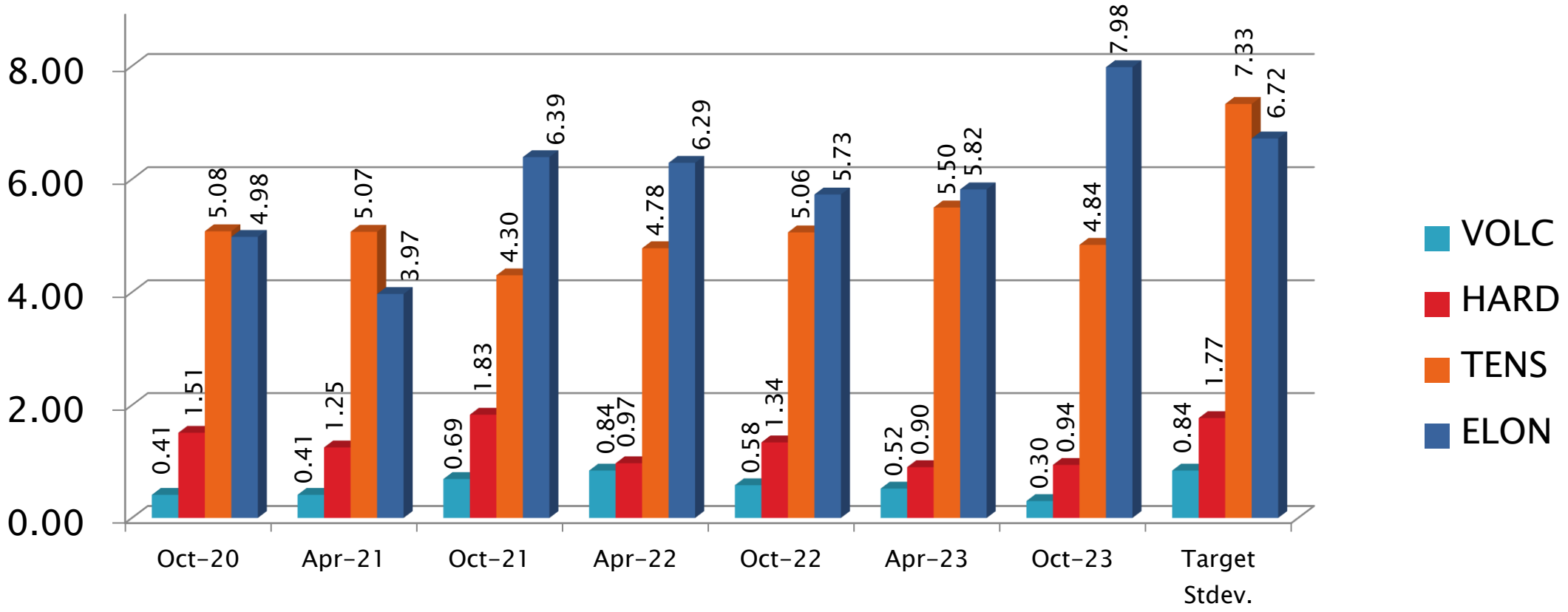
28OCT23:17:55

EOEC Test Severity

Nitrile (NBR)

Parameter	Period Mean Δ/s	Status
Volume Change	-0.13	Slightly Mild
Points Hardness Change	0.54	Severe
Tensile Strength Change	-0.47	Mild
Elongation Change	-0.01	On-target

EOEC Precision Estimates – Nitrile



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

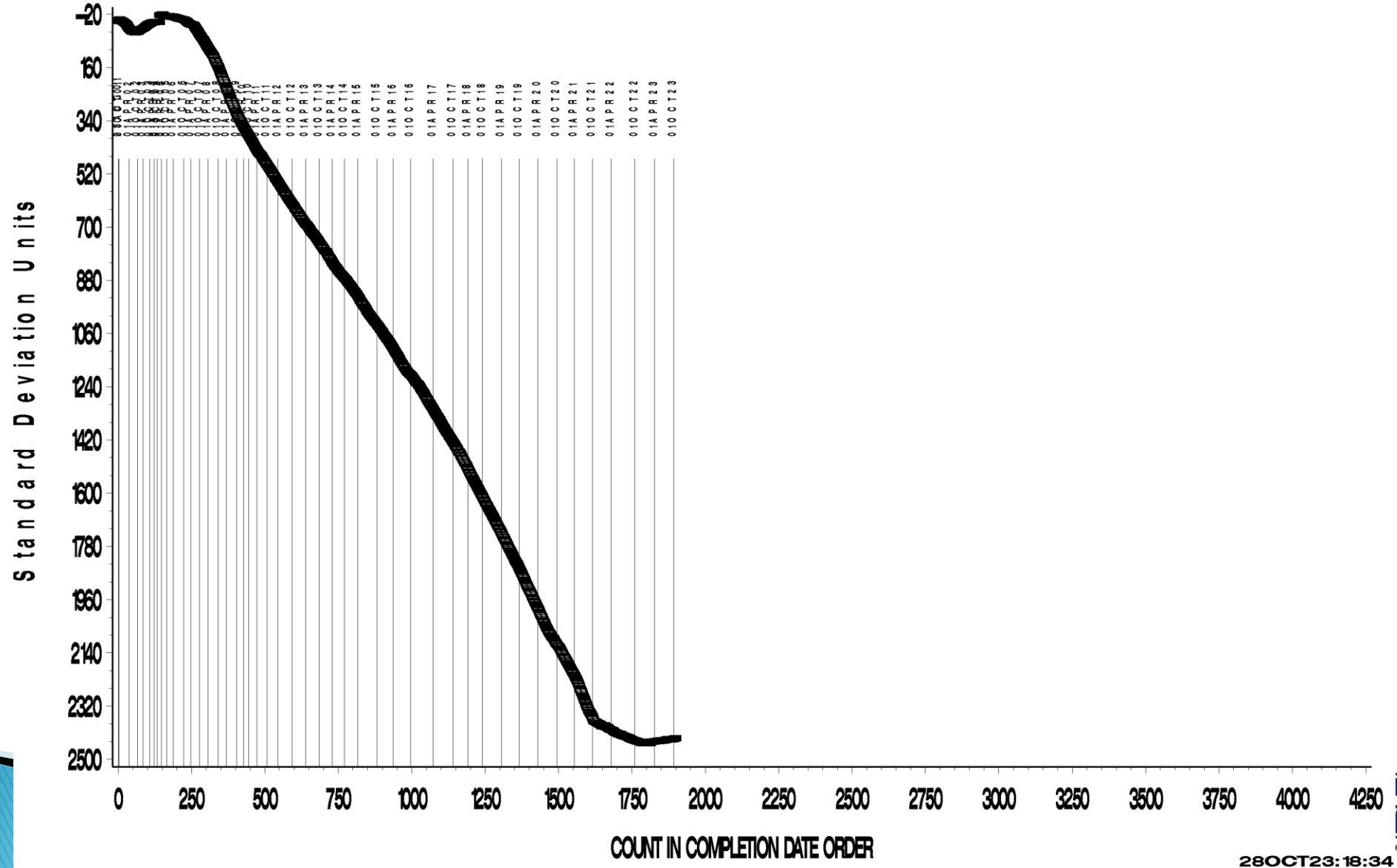
EOEC Precision Estimates by Lab: NBR

Test Parameter	Statistic	LTMS Lab					
		A	B	G	I	L	P
	n=	26	5	18	9	3	4
Volume	Mean	1.5027	1.7380	1.5500	1.7978	2.3300	1.7700
	Pooled s	0.1182	0.1450	0.2837	0.3361	0.5458	0.2165
	Mean /s	-0.2825	-0.0024	-0.2262	0.0688	0.7024	0.03571
Hardness	Mean	2.5769	4.0000	2.6667	2.8889	2.6667	3.0000
	Pooled s	0.9021	0	1.0290	0.9280	0.5774	0.8165
	Mean /s	0.4220	1.2260	0.4727	0.5982	0.4727	0.6610
Tensile Strength	Mean	0.3384	-3.8400	-0.6056	-0.3000	-0.53333	-3.6500
	Pooled s	3.4192	2.4643	7.5524	2.9176	2.1008	2.6338
	Mean /s	-0.3358	-0.9059	-0.4646	-0.4229	-0.4548	-0.8800
Elongation	Mean	-31.7077	-50.860	-31.8167	-34.5778	-33.0667	-33.2500
	Pooled s	3.0133	7.8656	10.1334	4.3286	2.7755	3.5218
	Mean /s	0.2950	-2.5550	0.2788	-0.1321	0.0928	0.0655

EOEC — NITRILE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE NITRILE VOLUME CHANGE CORRECTED AVERAGE

CUSUM Severity Analysis

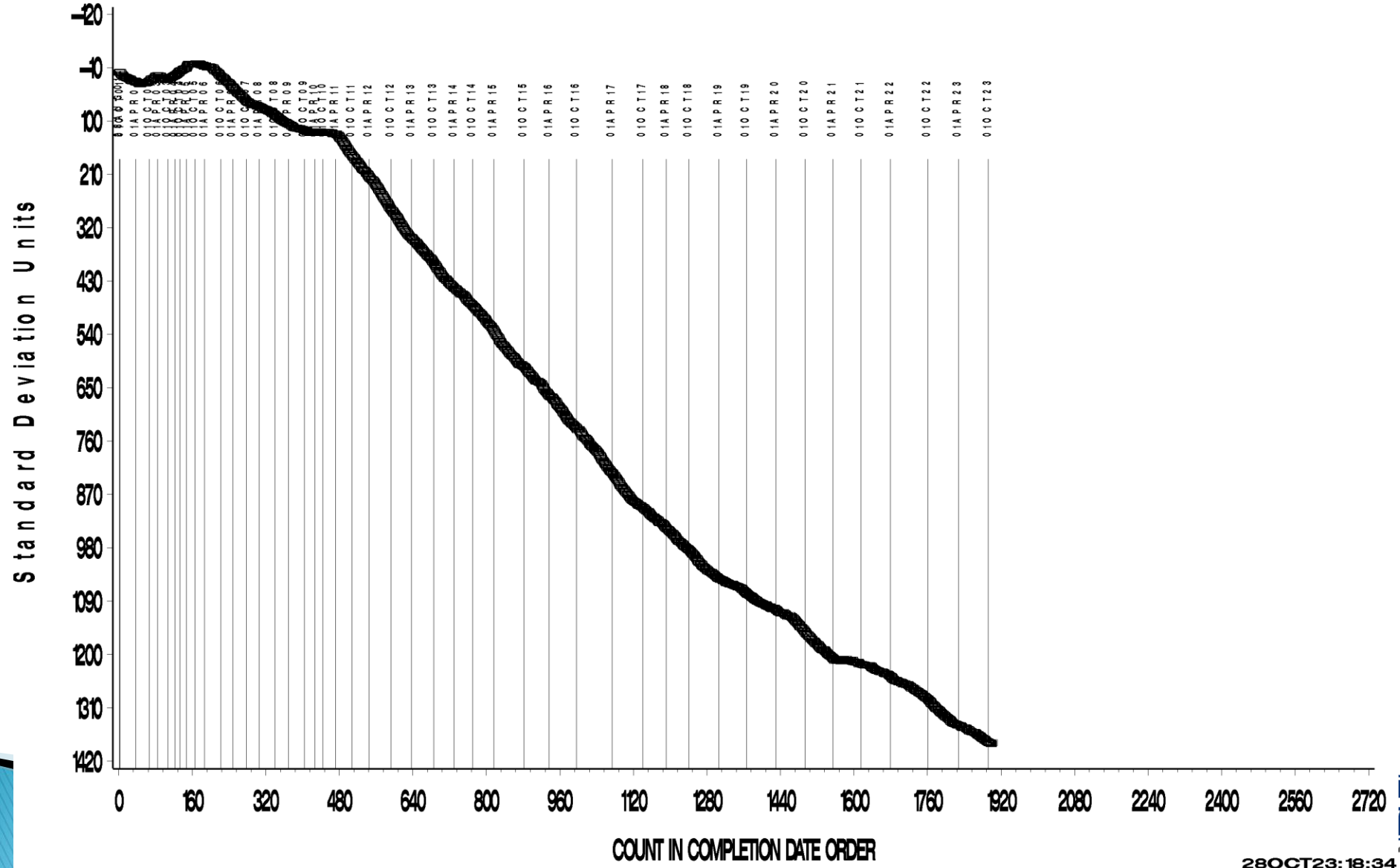


28OCT23:18:34

EOEC —NITRILE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE NITRILE PTS HARD CHANGE CORRECTED AVG

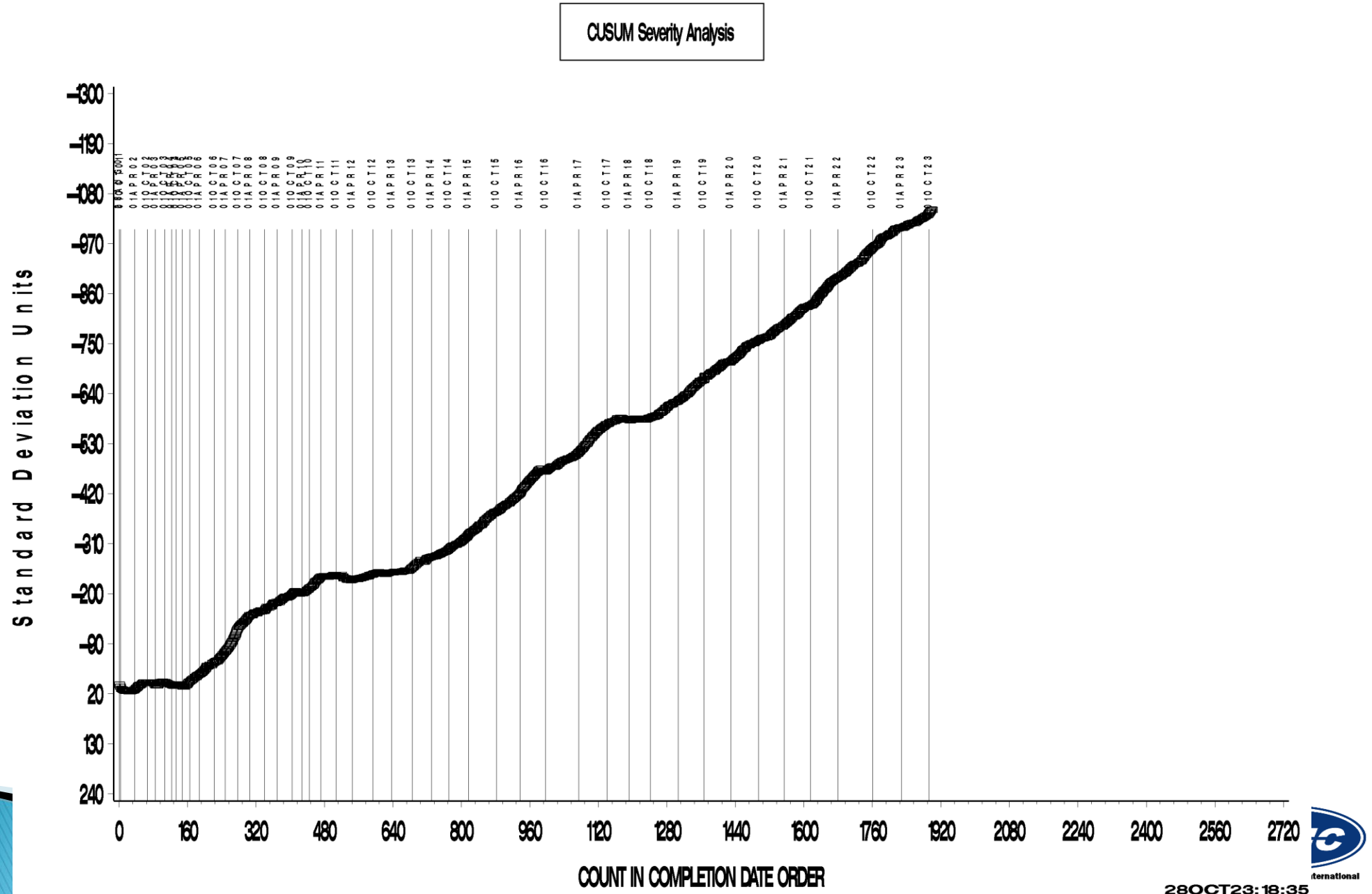
CUSUM Severity Analysis



28OCT23:18:34

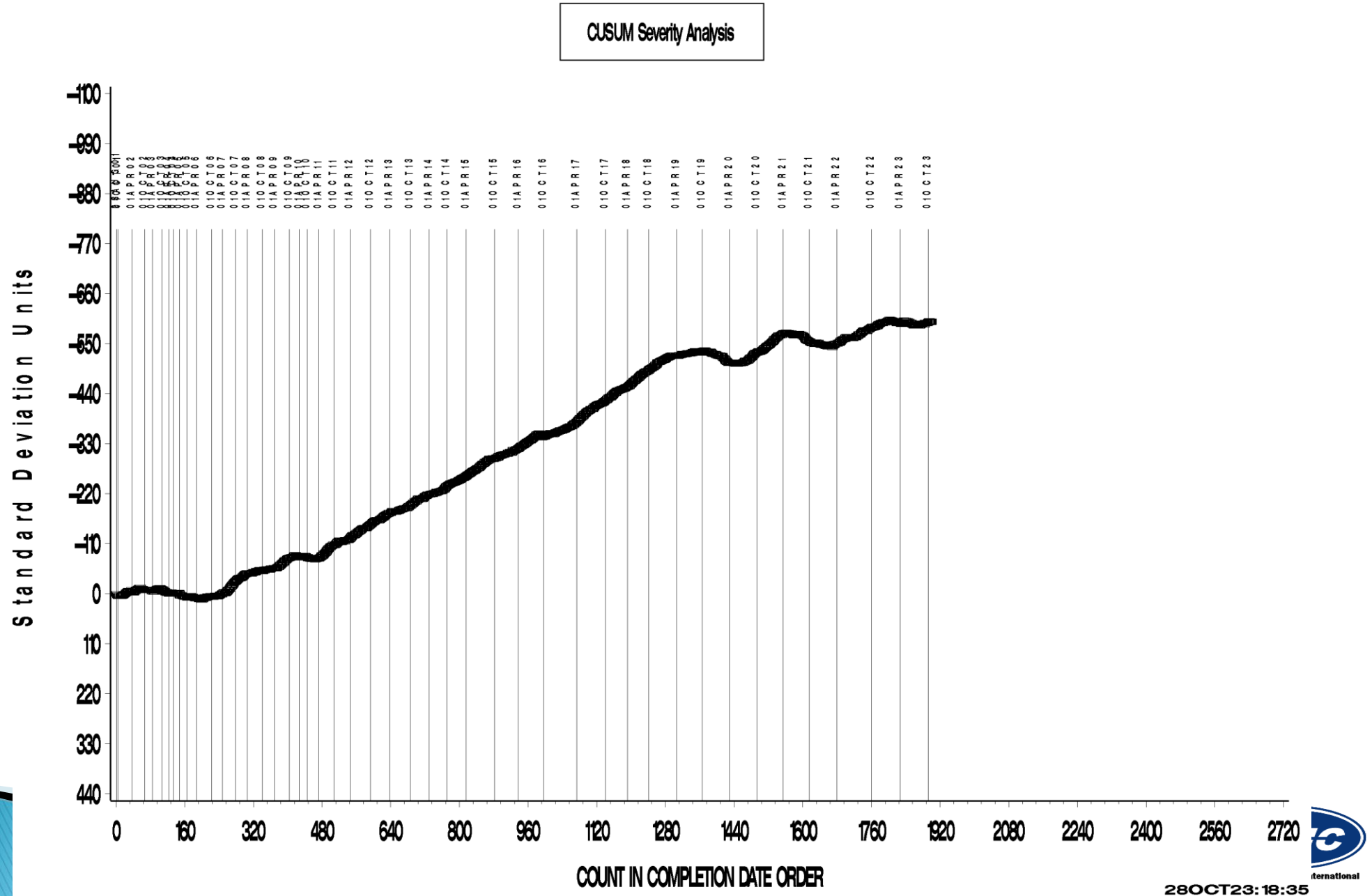
EOEC —NITRILE INDUSTRY OPERATIONALLY VALID DATA

REF NITRILE TENS STRENGTH CHANGE CORRECTED AVG



EOEC —NITRILE INDUSTRY OPERATIONALLY VALID DATA

REF NITRILE ELONGATION CHANGE CORRECTED AVERAGE

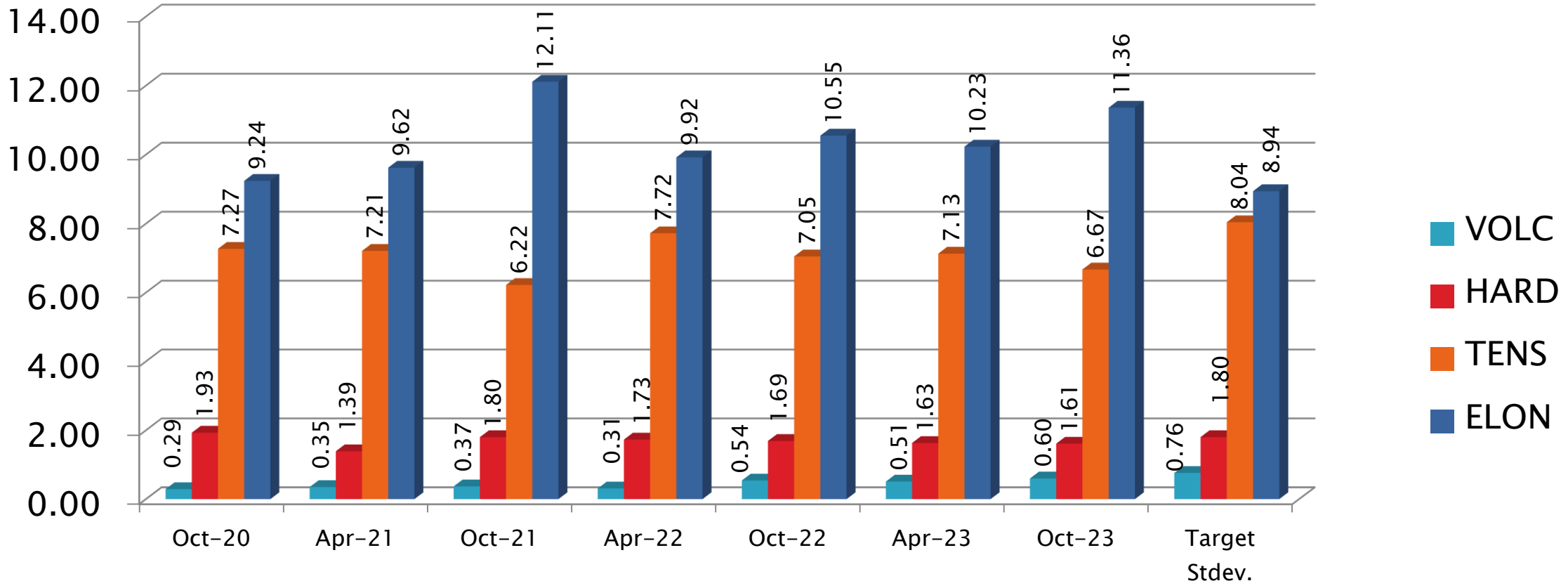


EOEC Test Severity

Polyacrylate (ACM)

Parameter	Period Mean Δ/s	Status
Volume Change	1.80	Severe
Points Hardness Change	-0.67	Mild
Tensile Strength Change	0.06	On-target
Elongation Change	0.60	Severe

EOEC Precision Estimates – Polyacrylate



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

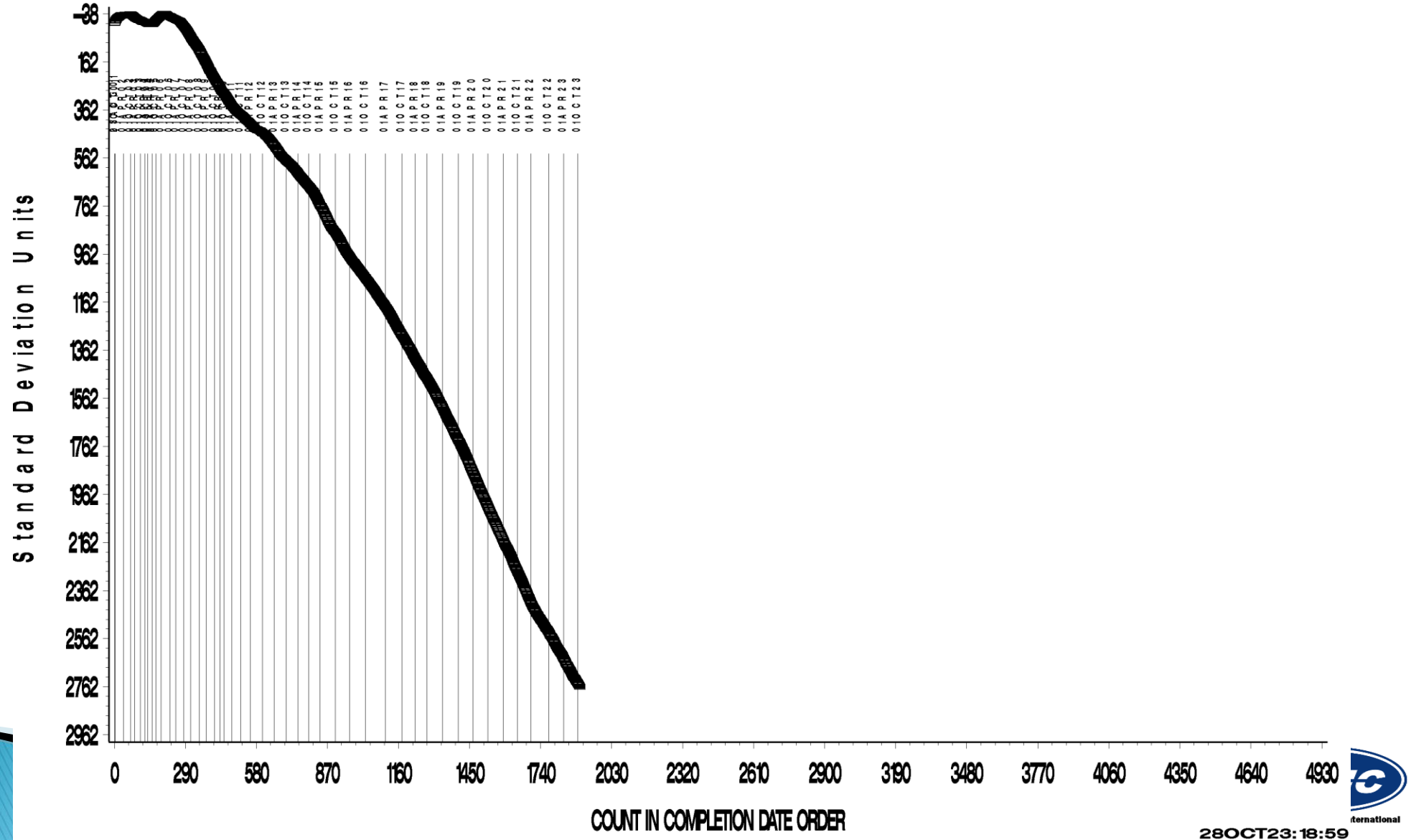
EOEC Precision Estimates by Lab: ACM

Test Parameter	Statistic	LTMS Lab					
		A	B	G	I	L	P
	n=	21	5	17	9	2	3
Volume	Mean	1.6219	1.4760	1.2635	2.0844	0.8750	1.9233
	Pooled s	0.1642	0.0483	0.9097	0.3677	0.2192	0.1607
	Mean /s	1.8709	1.6790	1.3993	2.4795	0.8882	2.2675
Hardness	Mean	-2.2857	-0.6000	-1.2352	0.1111	0.0000	0.6667
	Pooled s	0.7171	0.8944	1.9212	1.1667	1.4142	1.5275
	Mean /s	-1.2643	-0.3278	-0.6807	0.0673	0.0056	0.3759
Tensile Strength	Mean	0.3984	-3.4600	-0.8471	0.1778	-4.1000	9.2333
	Pooled s	2.7952	3.8811	7.7941	8.4711	1.2728	0.8386
	Mean /s	0.3029	-0.4751	-0.1501	-0.0227	-0.5547	1.1036
Elongation	Mean	-13.8429	-23.680	-16.7882	-21.9111	-18.7000	-16.8333
	Pooled s	7.4844	23.7932	12.5097	9.0145	0.8485	3.9551
	Mean /s	0.9773	-0.1230	0.6478	0.0748	0.4340	0.6428

EOEC —POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

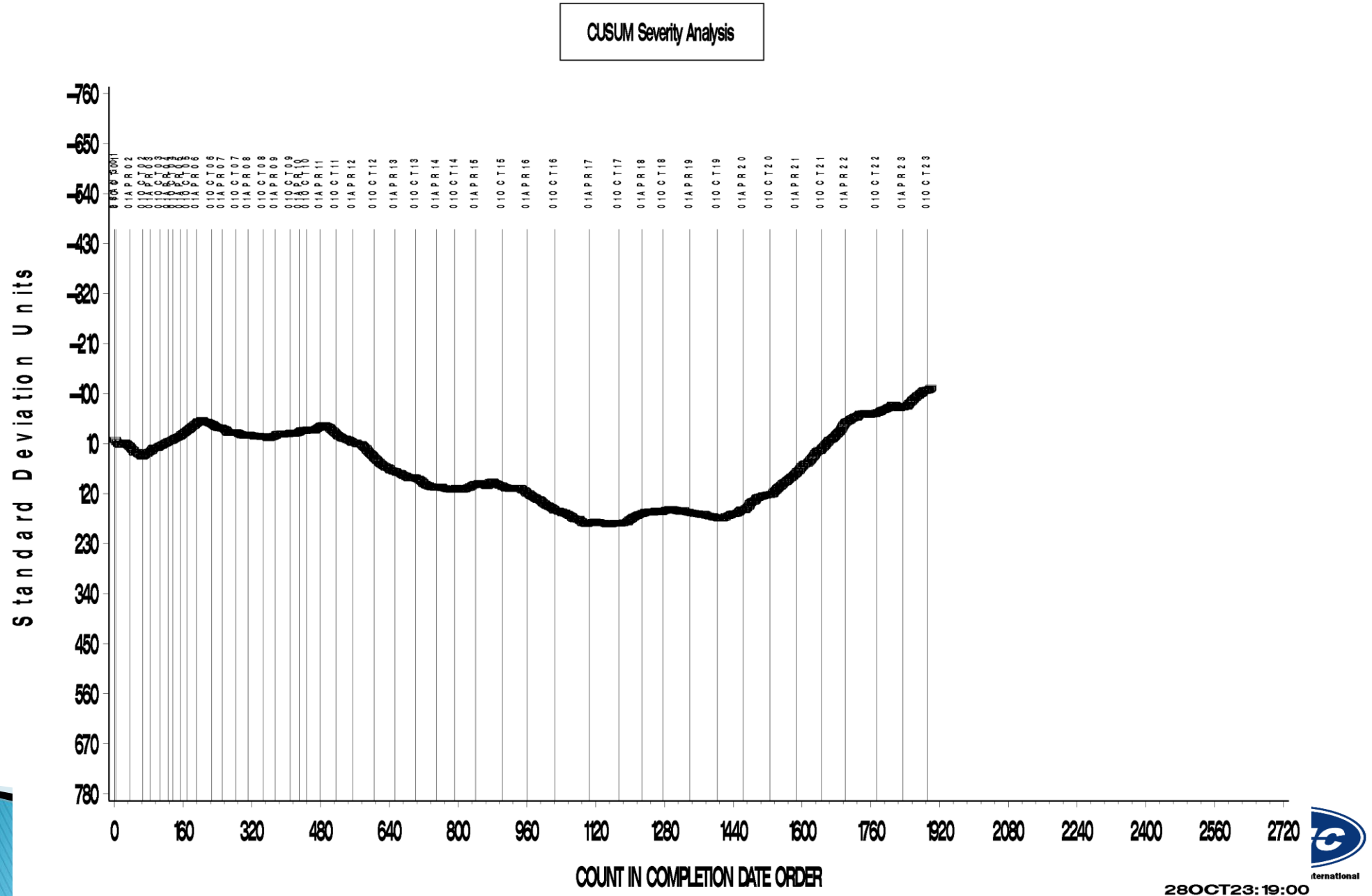
REFERENCE POLYACRYLATE VOLUME CHANGE CORRECTED AVG

CUSUM Severity Analysis



EOEC —POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REF POLYACRYLATE PTS HARD CHANGE CORRECTED AVG



28OCT23:19:00

EOEC —POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

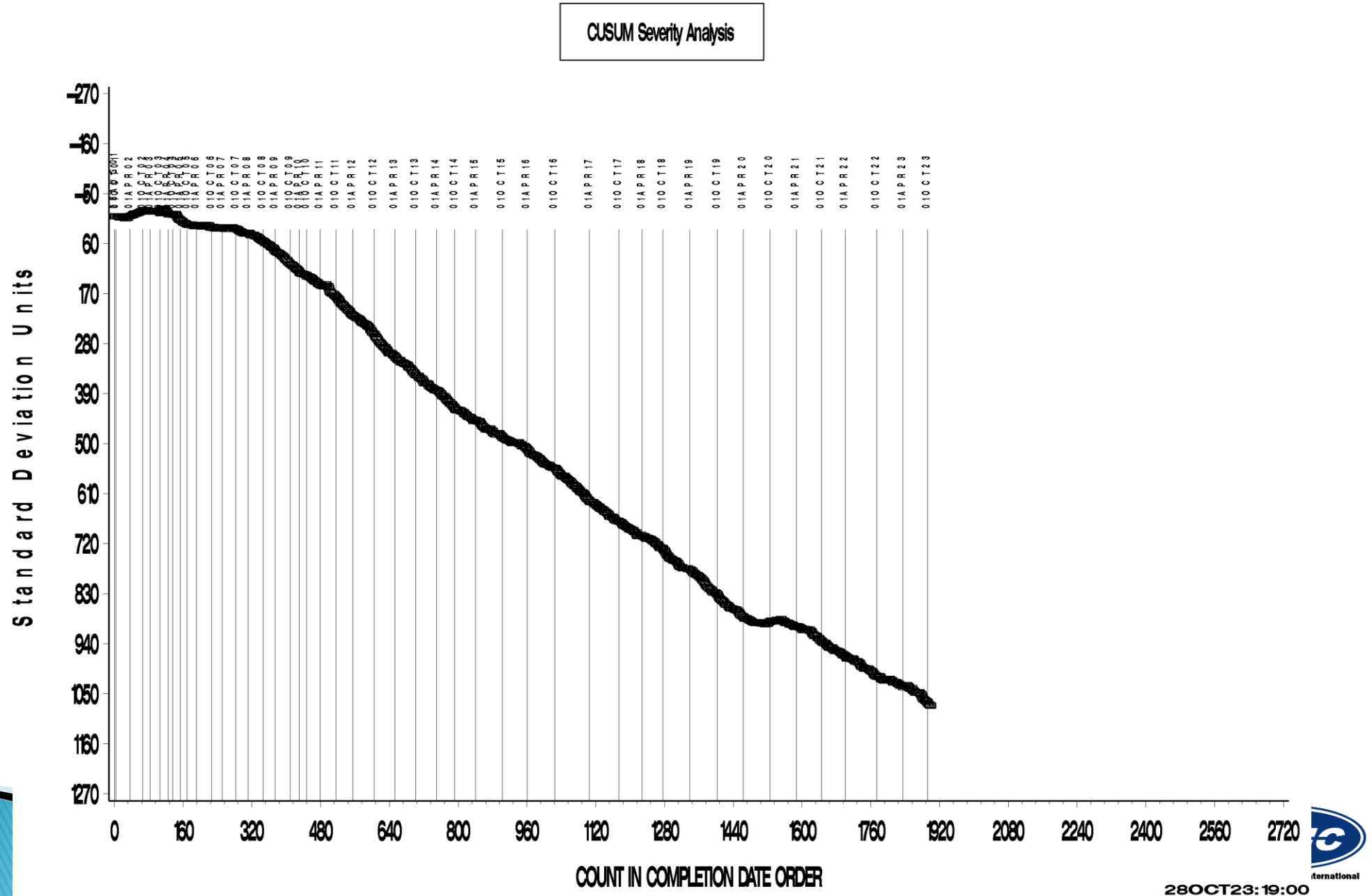
REF POLYACRYLATE TENS STRNGTH CHANGE CORRECTED AVG

CUSUM Severity Analysis

28OCT23:19:00

EOEC —POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REF POLYACRYLATE ELONGATION CHANGE CORRECTED AVG

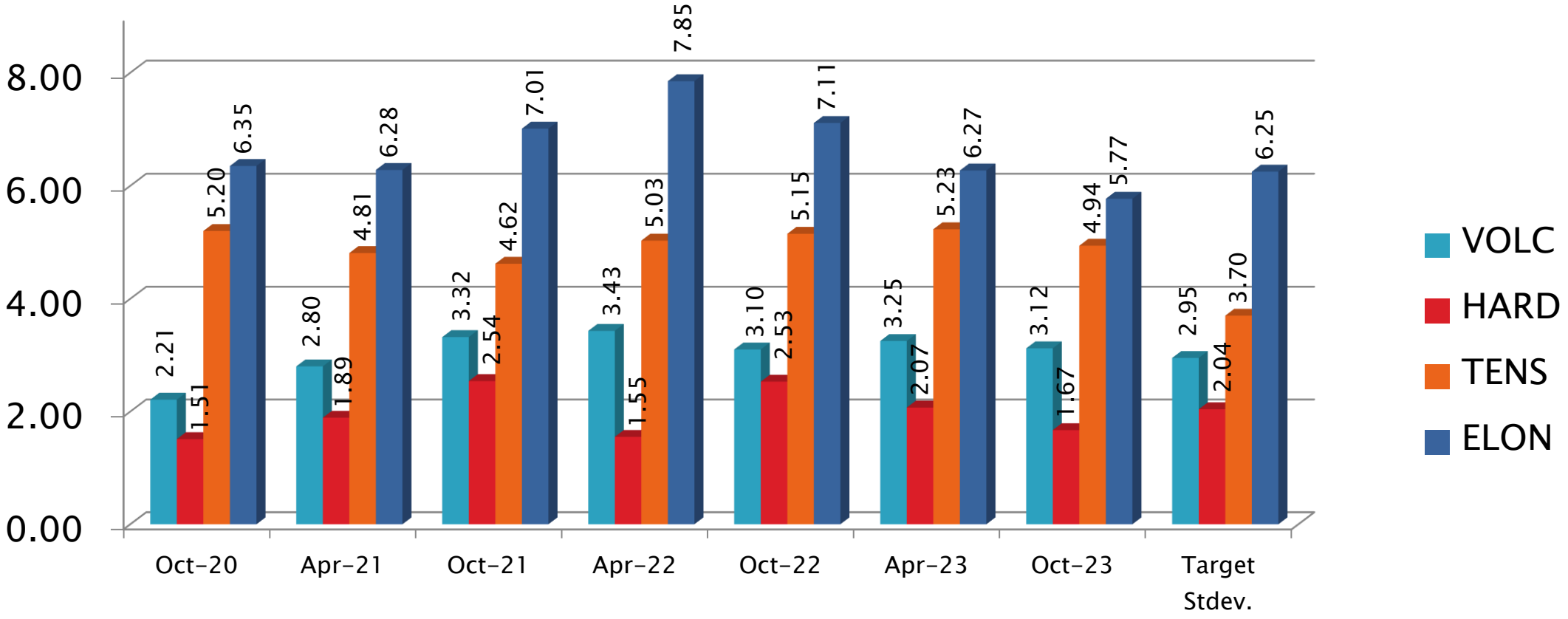


EOEC Test Severity

Silicone (VMQ)

Parameter	Period Mean Δ/s	Status
Volume Change	0.75	Severe
Points Hardness Change	-0.66	Mild
Tensile Strength Change	0.17	Slightly Severe
Elongation Change	-0.38	Mild

EOEC Precision Estimates – Silicone



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

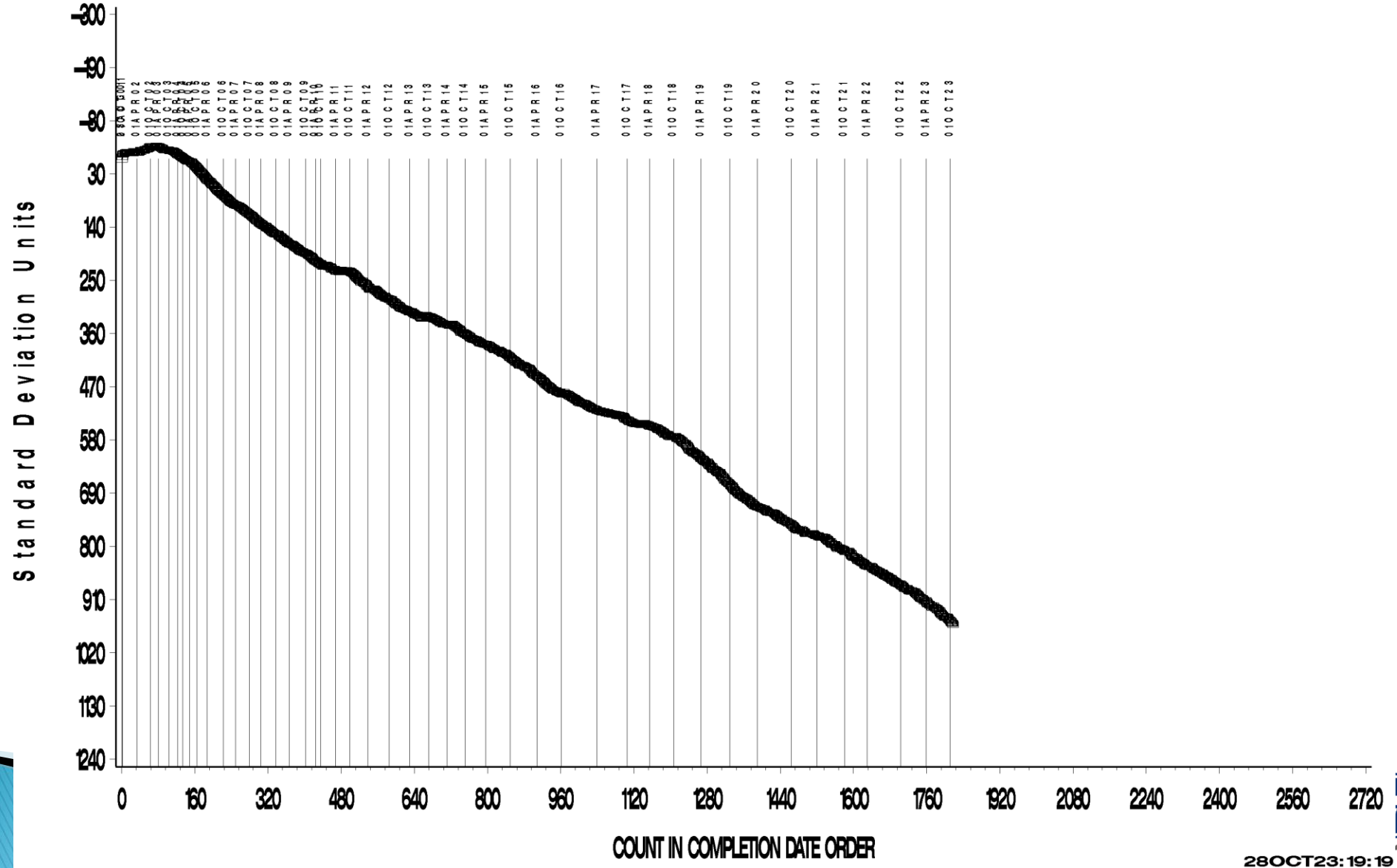
EOEC Precision Estimates by Lab: VMQ

Test Parameter	Statistic	LTMS Lab					
		A	B	G	I	L	P
	n=	18	4	20	6	2	2
Volume	Mean	33.5811	34.0825	36.2275	31.6417	31.6950	34.5450
	Pooled s	0.6935	1.0820	4.2439	0.9233	0.5020	0.1768
	Mean /s	0.4783	0.6483	1.3754	-0.1791	-0.1610	0.8051
Hardness	Mean	-23.9444	-22.750	-22.9500	-22.3333	-18.5000	-23.0000
	Pooled s	1.2113	0.9574	1.6376	0.8165	0.7071	0
	Mean /s	-1.1100	-0.5245	-0.6225	-0.3202	1.5588	-0.6471
Tensile Strength	Mean	-31.8722	-30.175	-33.8300	-34.9000	-33.4000	-37.7500
	Pooled s	4.2315	4.0877	6.2269	1.8526	1.1314	0.9192
	Mean /s	0.5075	0.9662	-0.0216	-0.3108	0.0945	-1.0810
Elongation	Mean	-25.5611	-29.400	-29.1050	-26.4500	-19.7000	-27.5500
	Pooled s	4.1416	6.2193	7.1499	3.4355	1.8385	1.6263
	Mean /s	-0.1202	-0.7344	-0.6872	-0.2624	0.8176	-0.4384

EOEC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE SILICON VOLUME CHANGE CORRECTED AVG

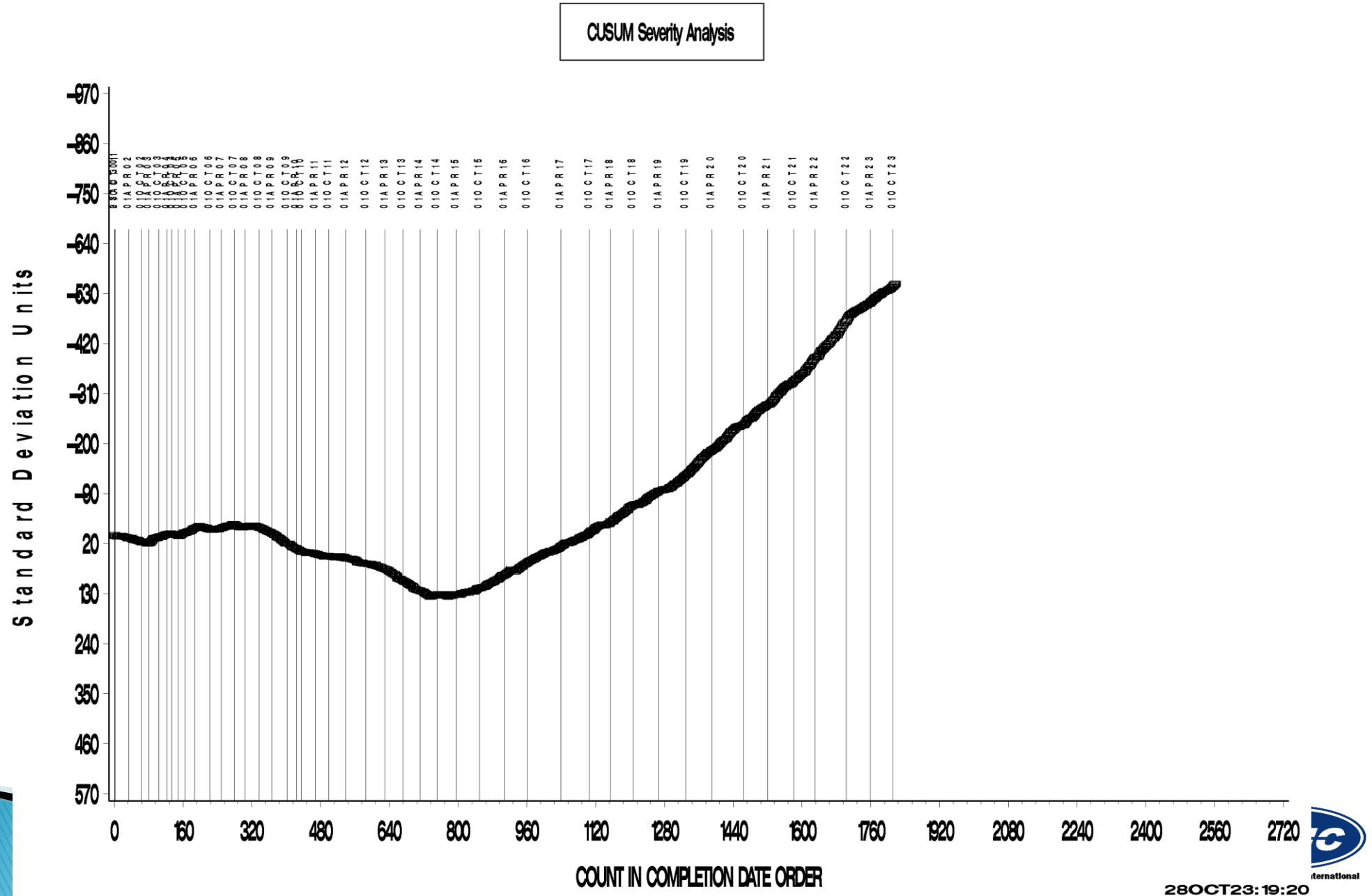
CUSUM Severity Analysis



28OCT23:19:19

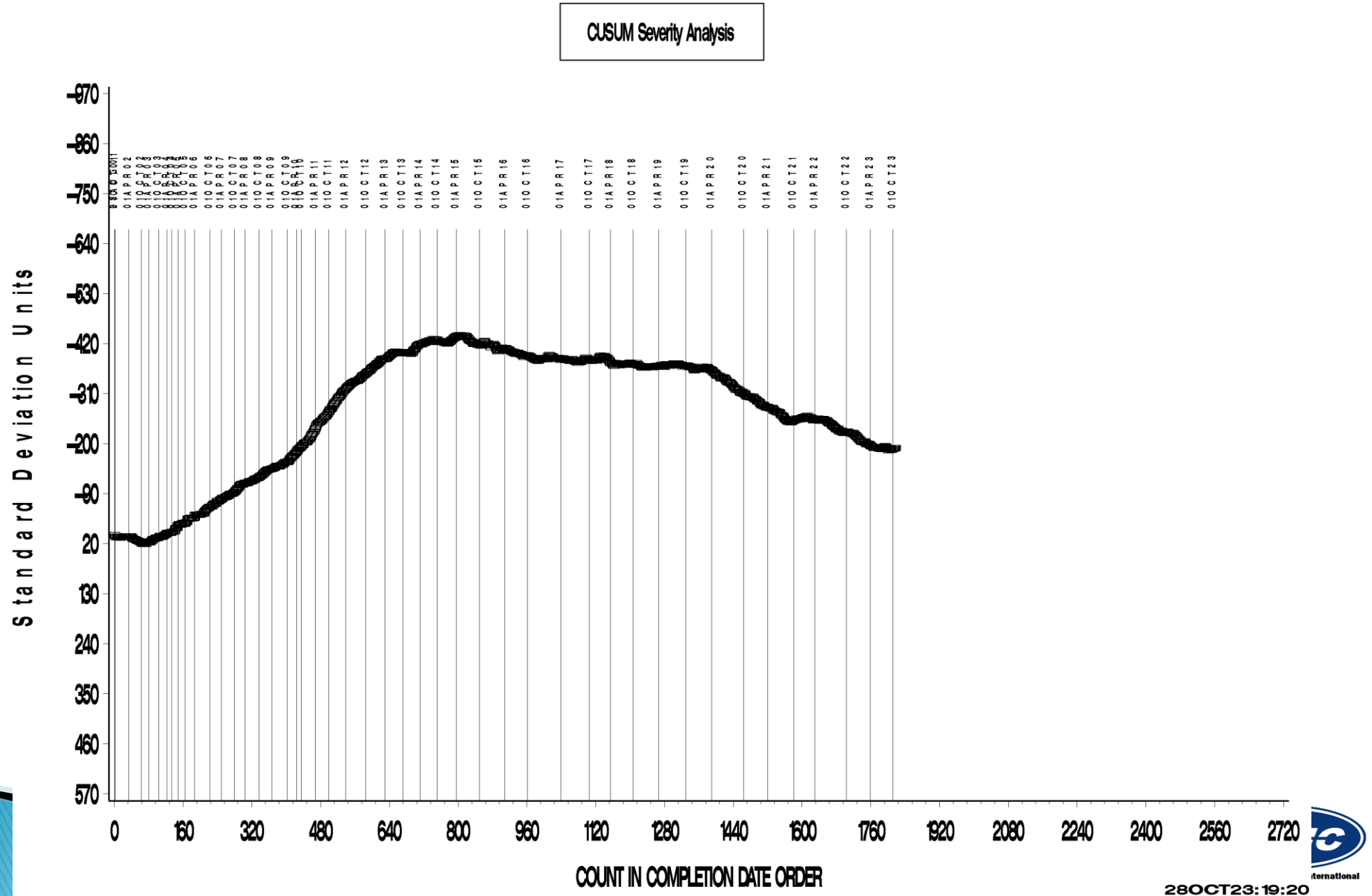
EOEC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE SILICON PTS HARD CHANGE CORRECTED AVG



EOEC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

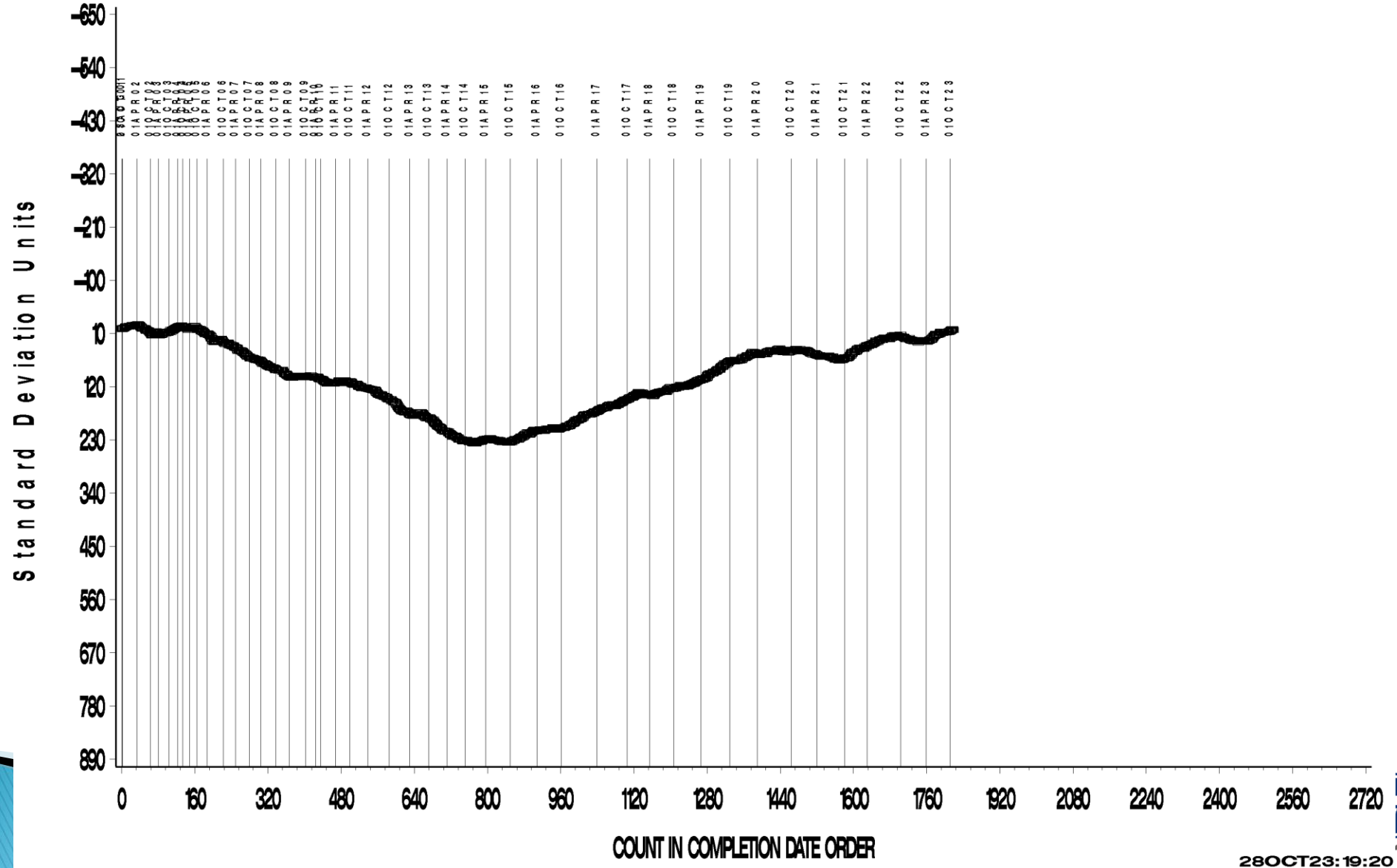
REF SILICON TENSILE STRENGTH CHANGE CORRECTED AVG



EOEC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

REF SILICON ELONGATION CHANGE CORRECTED AVG

CUSUM Severity Analysis



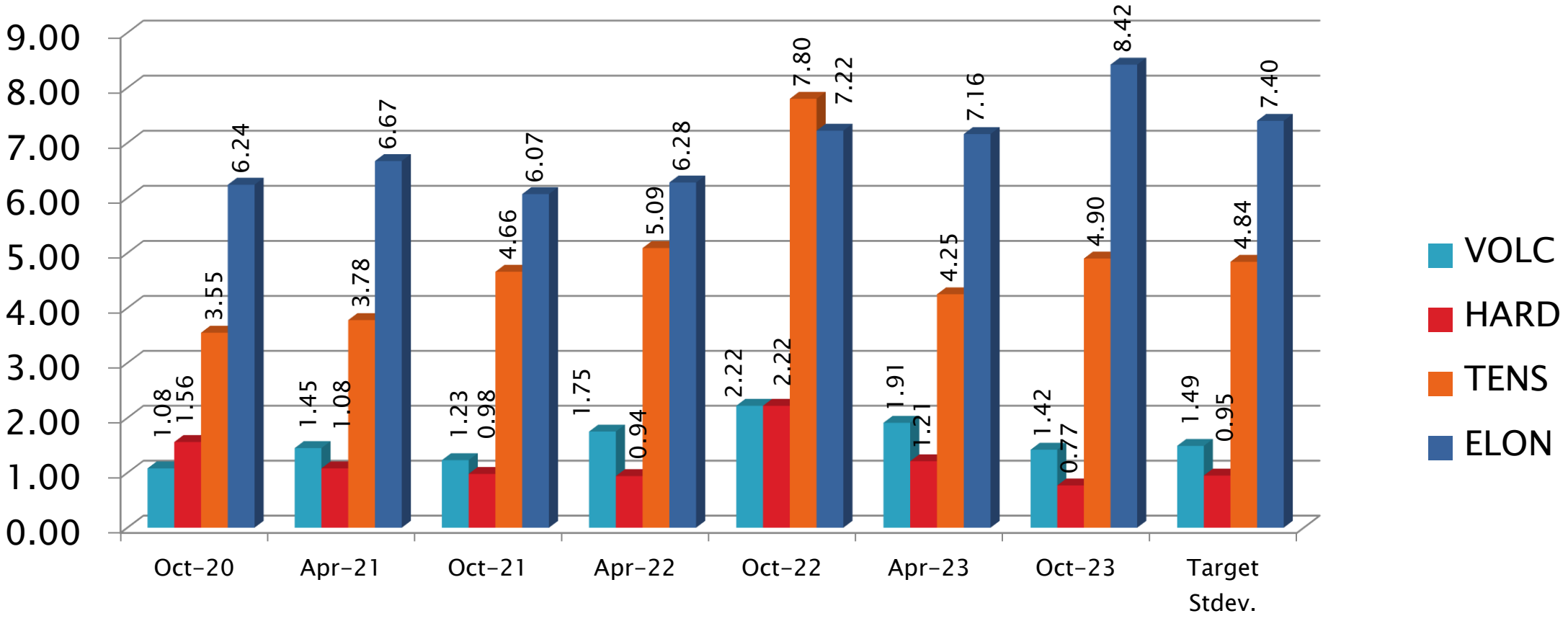
28OCT23:19:20

EOEC Test Severity

Ethylene Acrylate "VAMAC" (MAC)

Parameter	Period Mean Δ/s	Status
Volume Change	0.85	Severe
Points Hardness Change	-1.31	Very Mild
Tensile Strength Change	0.33	Severe
Elongation Change	-0.15	Slightly Mild

EOEC Precision Estimates – VAMAC



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

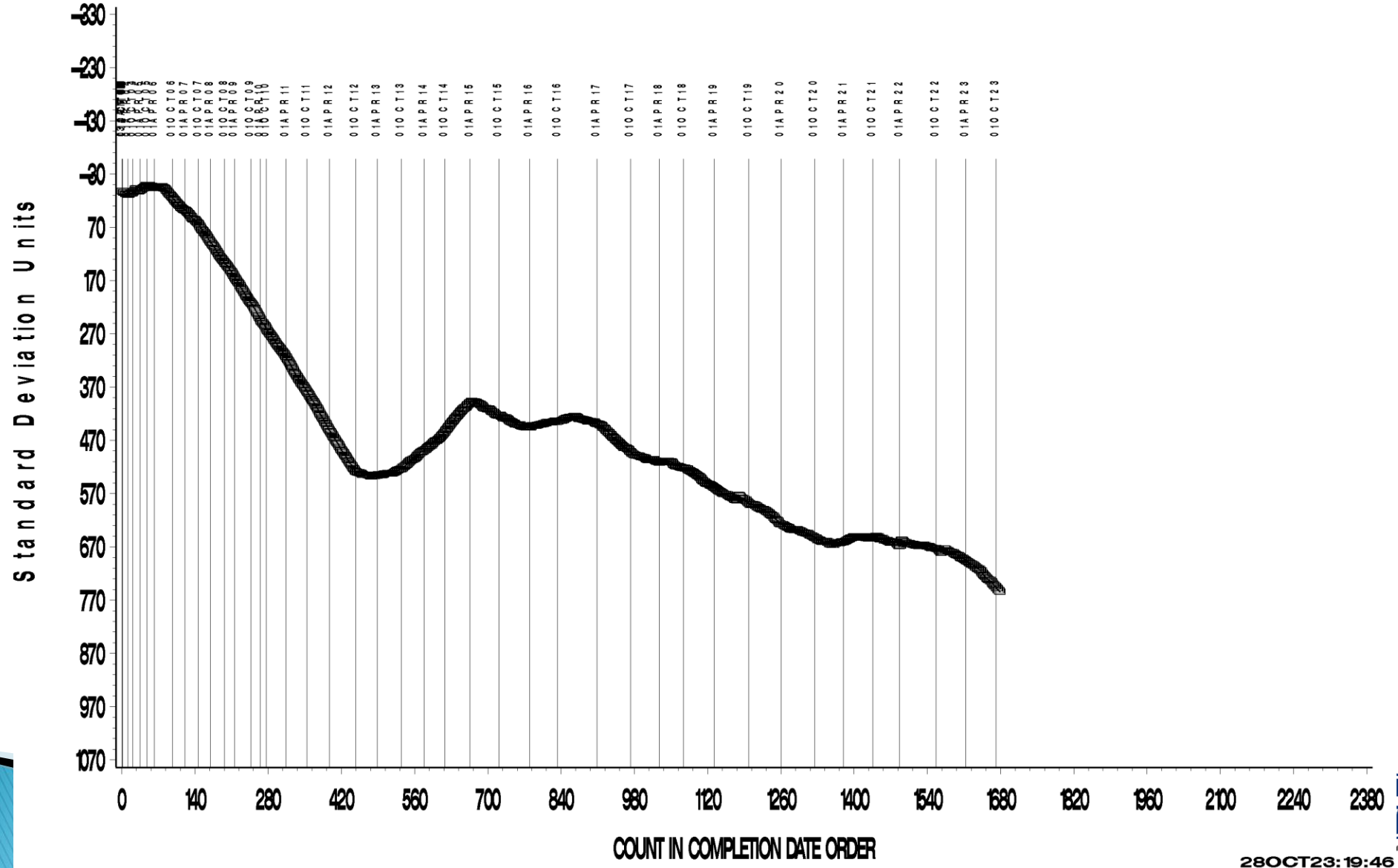
EOEC Precision Estimates by Lab: MAC

Test Parameter	Statistic	LTMS Lab					
		A	B	G	I	L	P
	n=	23	4	18	9	3	1
Volume	Mean	18.8157	19.6625	21.5028	19.6144	17.5567	21.1300
	Pooled s	0.3477	0.7043	0.8728	0.9261	0.0651	0
	Mean /s	0.1850	0.7533	1.9884	0.7211	-0.6600	1.7383
Hardness	Mean	-8.8696	-9.0000	-8.7222	-8.6667	-7.3333	-9.0000
	Pooled s	0.7570	0	0.6691	0.7071	1.1547	0
	Mean /s	-1.4627	-1.6000	-1.3076	-1.2491	0.1544	-1.6000
Tensile Strength	Mean	-13.8304	-14.350	-12.3333	-14.4667	-18.3667	-13.3000
	Pooled s	2.9925	2.8443	6.9375	5.1976	2.1502	0
	Mean /s	0.3098	0.2025	0.6191	0.1784	-0.6274	0.4194
Elongation	Mean	-32.1174	-37.575	-38.7333	-40.1889	-36.2333	-35.5000
	Pooled s	4.6701	11.9355	11.0888	6.8679	2.6951	0
	Mean /s	0.3841	-0.3534	-0.5099	-0.7066	-0.1721	-0.0730

EOEC — ETHYLENEACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE VAMAC G VOLUME CHANGE CORRECTED AVERAGE

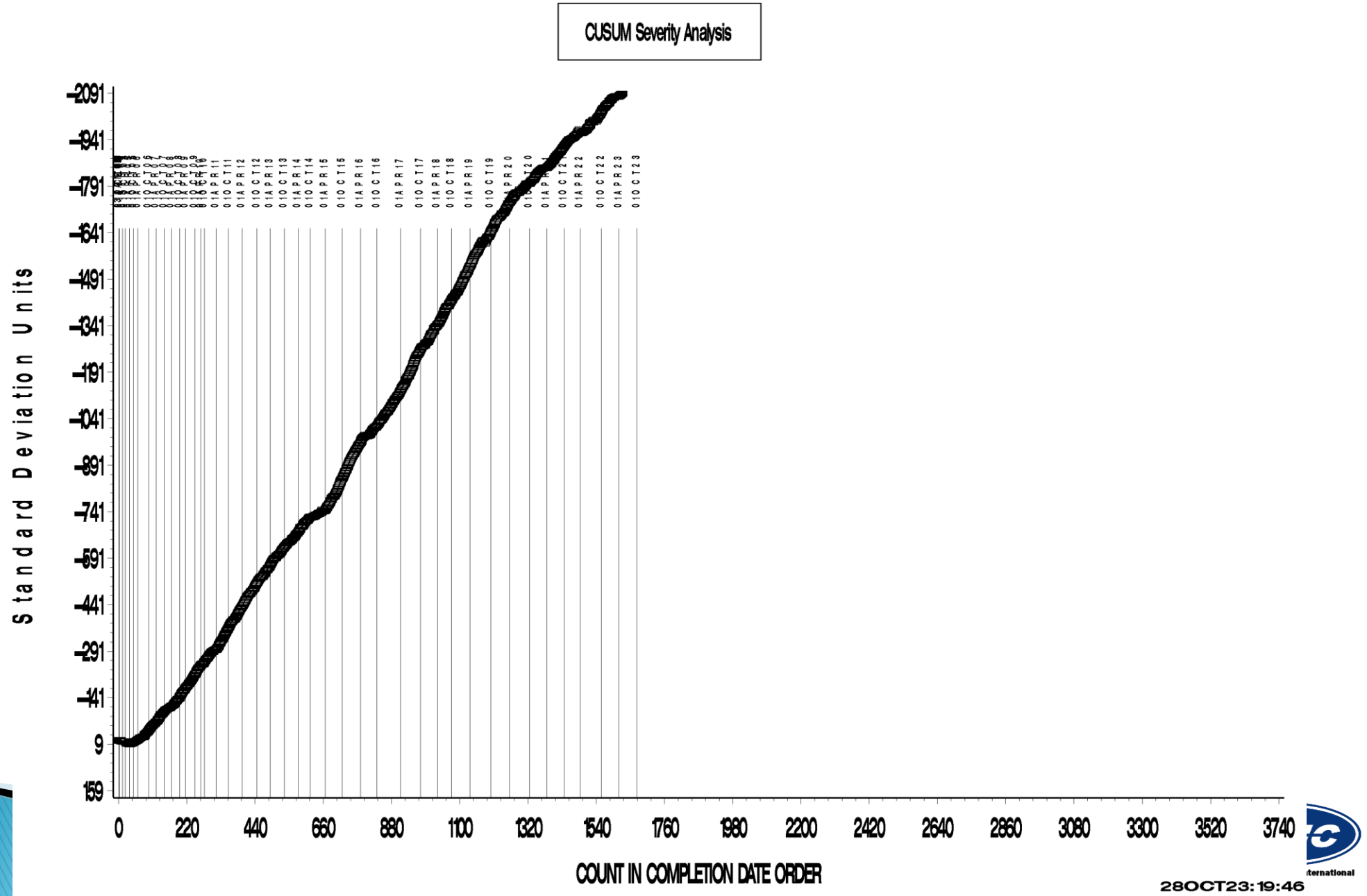
CUSUM Severity Analysis



28OCT23:19:46

EOEC — ETHYLENEACRYLATE INDUSTRY OPERATIONALLY VALID DATA

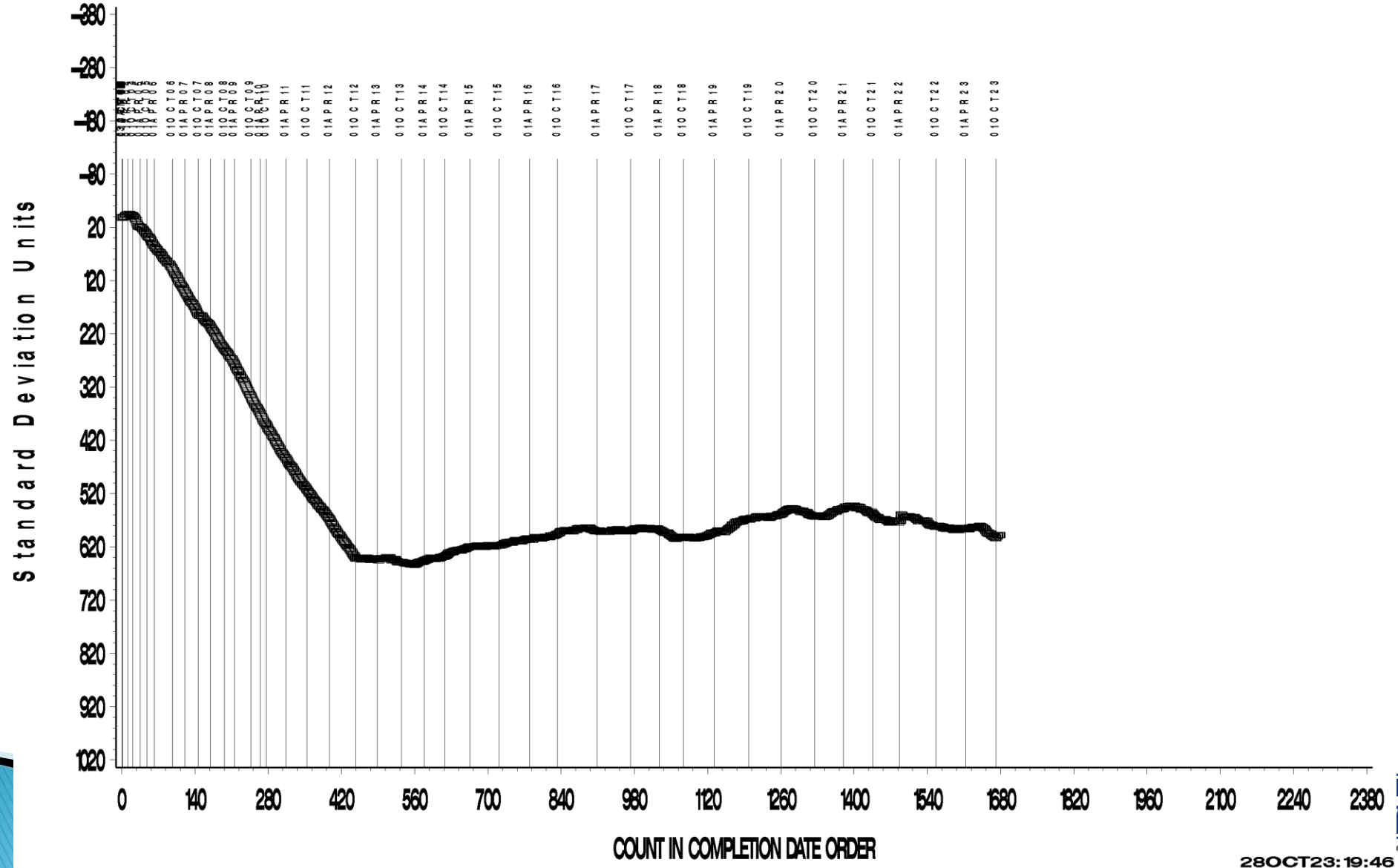
REF VAMAC G POINTS HARDNESS CHANGE CORRECTED AVG



EOEC —ETHYLENEACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REF VAMAC G TENSILE STRENGTH CHANGE CORRECTED AVG

CUSUM Severity Analysis

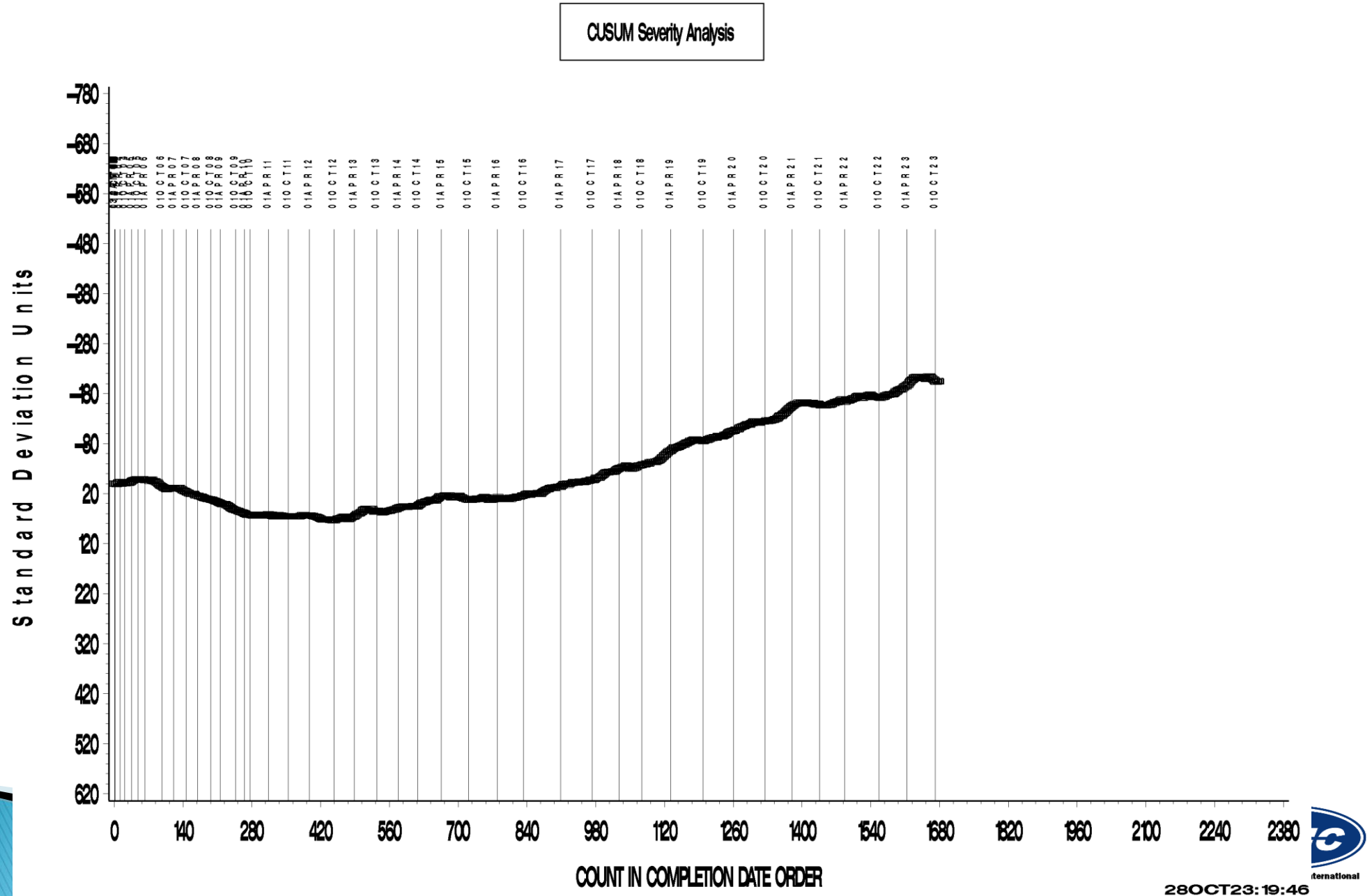


28OCT23:19:46

EOEC — ETHYLENEACRYLATE INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

REF VAMAC G ELONGATION CHANGE CORRECTED AVG



Information Letters & Technical Updates*

Test	Date	IL or Memo Number	Topic
LDEOC	20230615	IL23-001*	Implementation of Industry Correction Factor (ICF) to the Volume Change result for Batch Code ACM1-26 (-3.40).

*Available from TMC Website

Reference Oil Inventory Estimated Life EOEC/LDEOC

Oil	TMC Inventory Gallons	Gallons Shipped Past 12 Months	Estimated Life[C]
SL107[A, B]	1971	203	3.4 years

[A]TMC Inventory is used across several test methods
[B]SL107 has fully replaced oil 1006; Oil 1006 is no longer used as EOEC/LDEOC Reference Fluid
[C]Additional Elastomer types will be added to new lubricant categories ILSAC GF-7 and PC-12 (HDEO) which will have an impact on Estimated Lifetime availability of SL107.

TABLE of CONTENTS

ASTM Reference Testing Semi-Annual Report D7216 LDEOC

April 1, 2023 to September 30, 2023

ASTM D 7216

Engine Oil Elastomer Compatibility (EOEC/LDEOC)

OHT CURRENT ELASTOMER BATCH CODES FOR ASTM D7216
AS OF: 10/3/2023

EOEC (PC 9)	
OHT PART NUMBER	BATCH CODE
OHTPC9-NBR-1	30
OHTPC9-ACM-2	31
OHTPC9-FKM-1	30
OHTPC9-MAC-1	24

LDEOC (J2643)	
OHT PART NUMBER	BATCH CODE
OHTJ2643-HNBR-1	31
OHTJ2643-FKM-1	29
OHTJ2643-ACM-2	26
OHTJ2643-VMQ-1	41
OHTJ2643-AEM-2	30

LDEOC Test Activity*

Test Status		Ethylene Acrylate	Fluoroelast.	Nitrile	Polyacrylate	Silicone	Total
LABS		7	7	7	7	7	
Acceptable Calibration Test	AC	75	75	77	75	83	**385**
Failed Calibration Test	OC	3	0	0	1	1	**5**
Operationally Invalid, by lab	LC	0	0	0	0	0	**0**
Operationally Invalid, by TMC	RC	0	0	0	0	0	**0**
Aborted	XC	2	1	1	0	2	**6**
Total		**80**	**76**	**78**	**76**	**86**	396

* April 1, 2023 – September 30, 2023

Calibrated Labs and Stands*

(change shown in parentheses)

Test	Labs	Stands
D7216 LDEOC	7 (–1)	N/A
*As of 9/30/2023		

* April 1, 2023 – September 30, 2023

LDEOC Failing Calibration (OC) Tests*

Validity	Cause	#
OC	Tensile Strength Mild (LDEOCA)	2
OC	Volume Change Mild (LDOECA, LDEOCS)	2
OC	Hardness Change Mild (LDEOCP)	1
Total		**5**

There were five failing LDEOC Calibration Tests reported this period from three different labs.

* April 1, 2023 – September 30, 2023

LDEOC Lost Tests*

Validity	Cause	No. of Tests
XC	Aborted, System Error (LDEOCA, LDEOCS)	2
XC	Lost Sample (LDEOCA, LDEOCS, LDEOCF)	3
XC	Aborted, Power Outage (LDEOCN)	1
Total		**6**

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

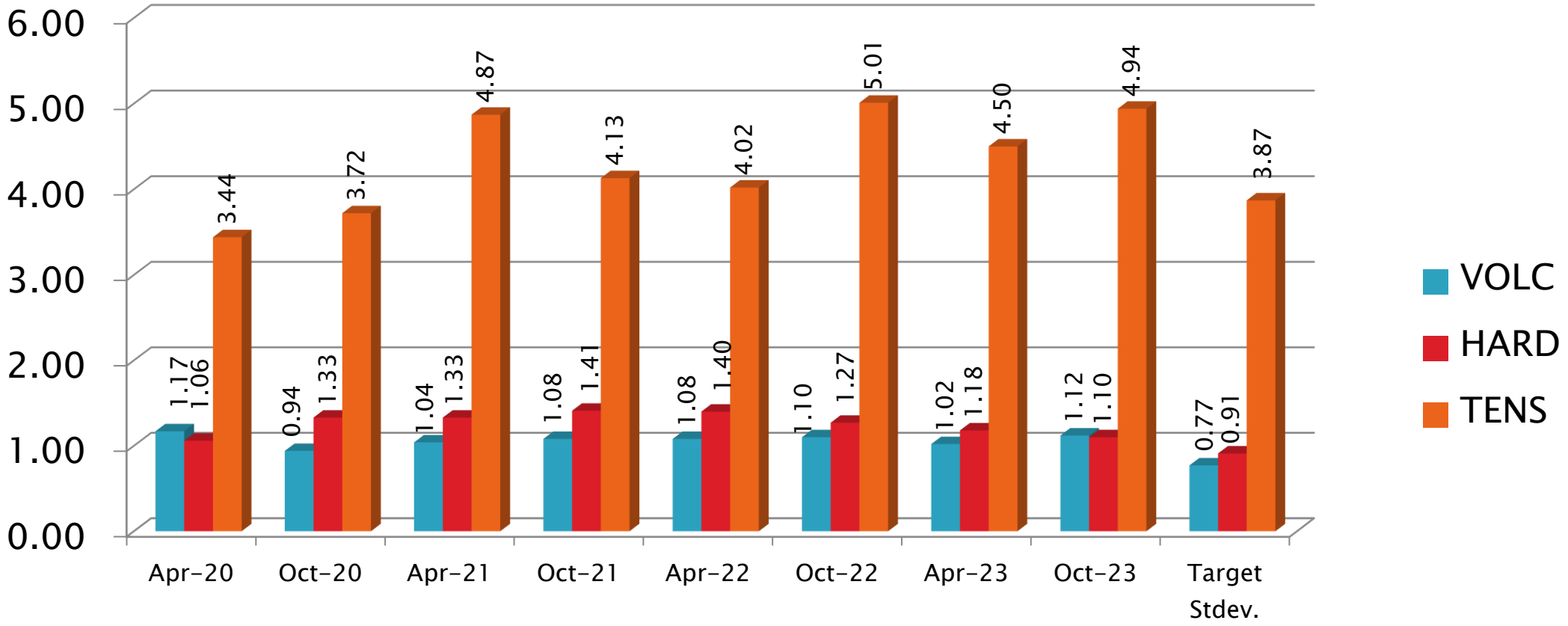
* April 1, 2023 – September 30, 2023

LDEOC Test Severity

Ethylene Acrylate (AEM1)

Parameter	Period Mean Δ/s	Status
Volume Change	-0.67	Mild
Points Hardness Change	0.01	On-Target
Tensile Strength Change	-0.51	Mild

LDEOC Precision Estimates – Ethylene Acrylate



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

LDEOC Precision Estimates by Lab: AEM1

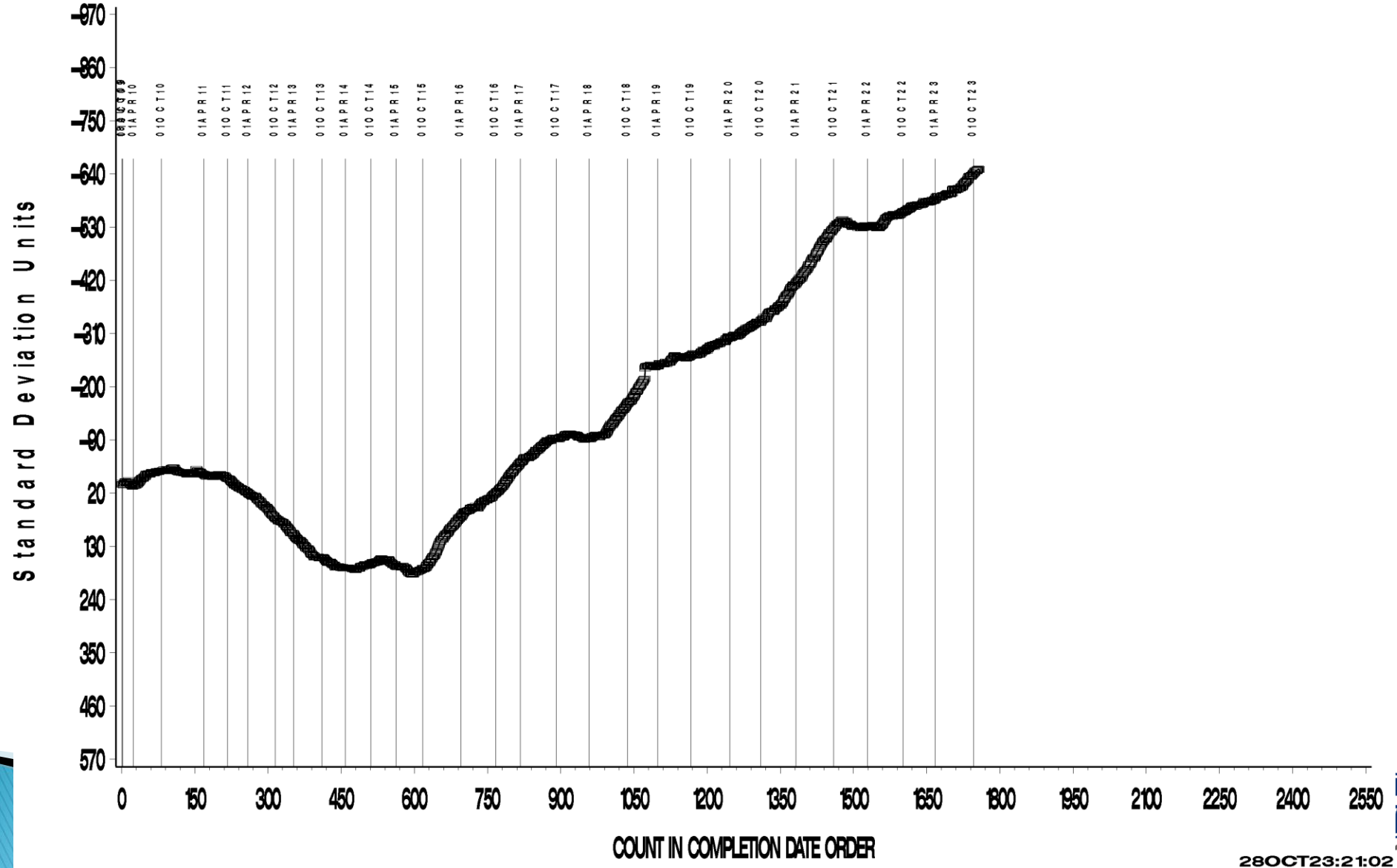
Test Parameter	Statistic	LTMS Lab						
		A	B	G	I	L	P	V
	n=	31	2	23	15	3	1	3
Volume	Mean	23.1184	23.750	24.3839	24.1320	22.8233	23.6900	22.6867
	Pooled s	0.4574	0.3748	1.4058	1.01958	0.8221	0	0.6735
	Mean /s	-1.4047	-0.6039	0.2388	-0.0883	-1.7879	-0.6623	-1.9654
Hardness	Mean	-13.1613	-12.500	-12.4348	-12.4667	-11.000	-13.0000	-13.3333
	Pooled s	0.7788	3.5355	1.1211	1.0601	0	0	0.5774
	Mean /s	-0.4739	0.2527	0.3244	0.2894	1.9011	-0.2967	-0.6630
Tensile Strength	Mean	-19.6613	-18.100	-19.6957	-16.7733	-12.000	-25.600	-19.1333
	Pooled s	4.2837	0.2828	5.7281	4.5598	3.0000	0	1.5503
	Mean /s	-0.7290	-0.3256	-0.7379	0.01723	1.2506	-2.264	-0.5926

LDEOC —ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

REF ETH ACRYLATE VOLUME CHANGE FINAL

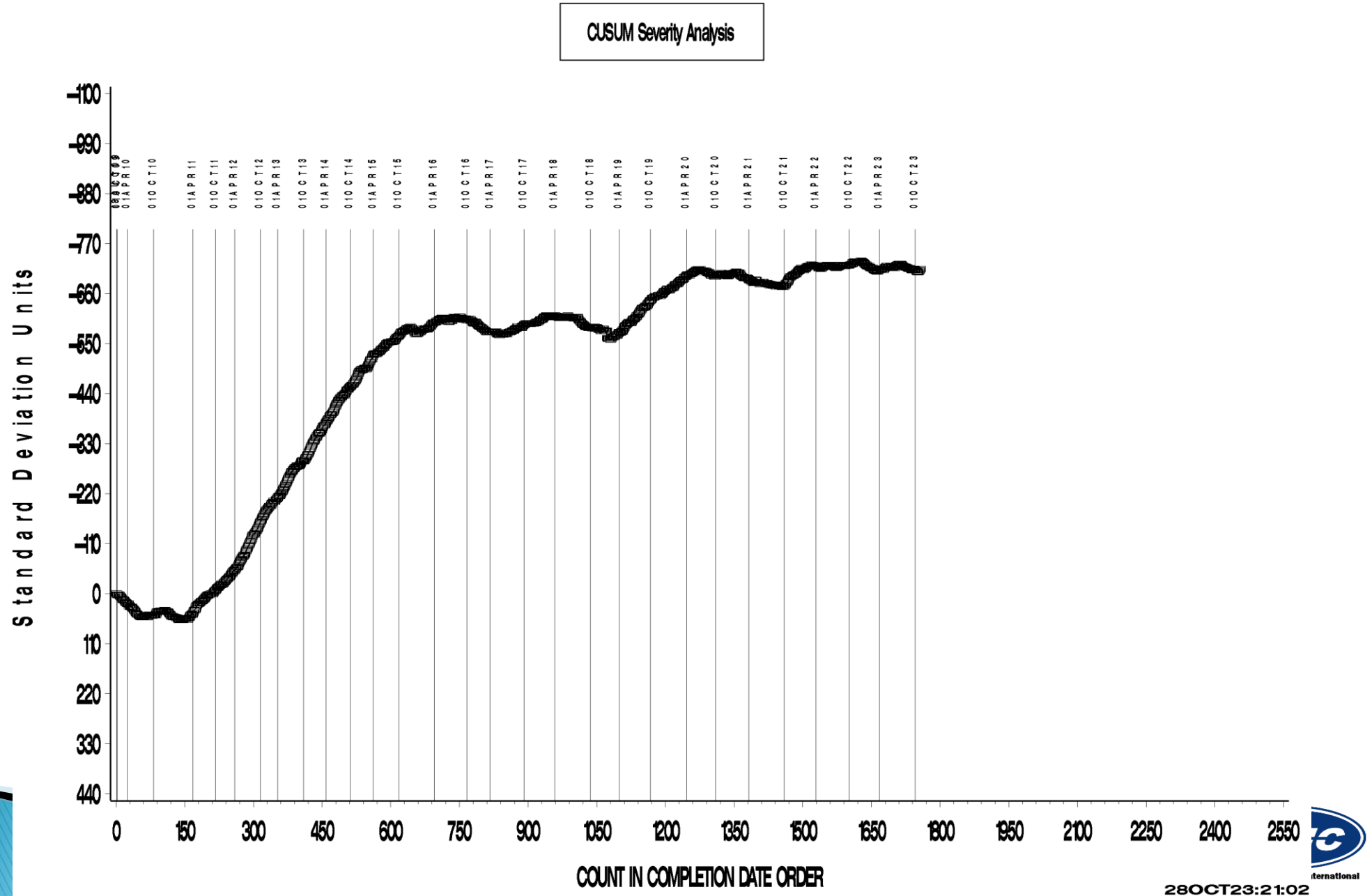
CUSUM Severity Analysis



28OCT23:21:02

LDEOC —ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

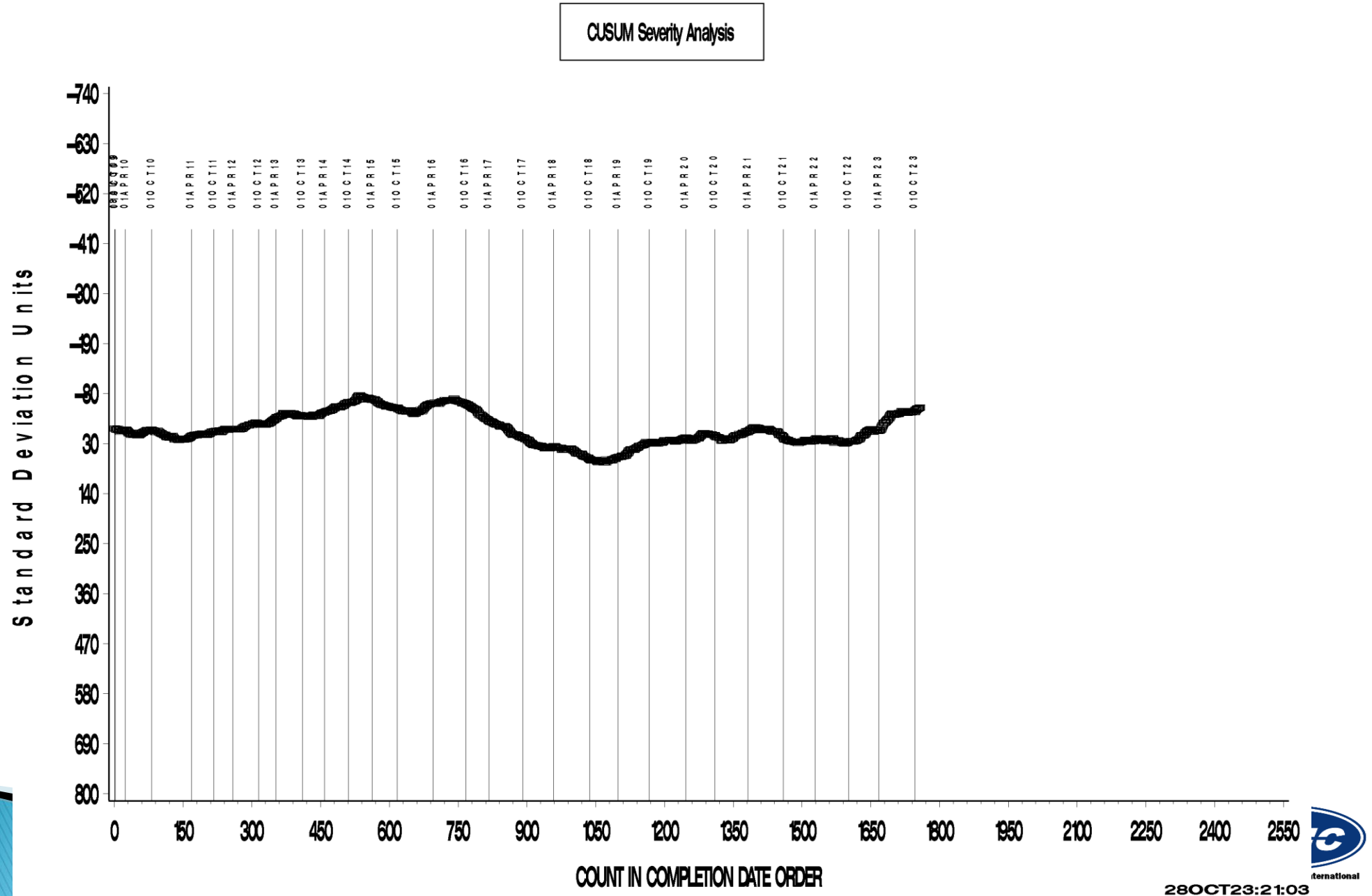
REF ETH ACRYLATE POINTS HARDNESS CHANGE FINAL



LDEOC —ETHYLENE ACRYLATE INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

REF ETH ACRYLATE TENSILE STRENGTH CHANGE FINAL



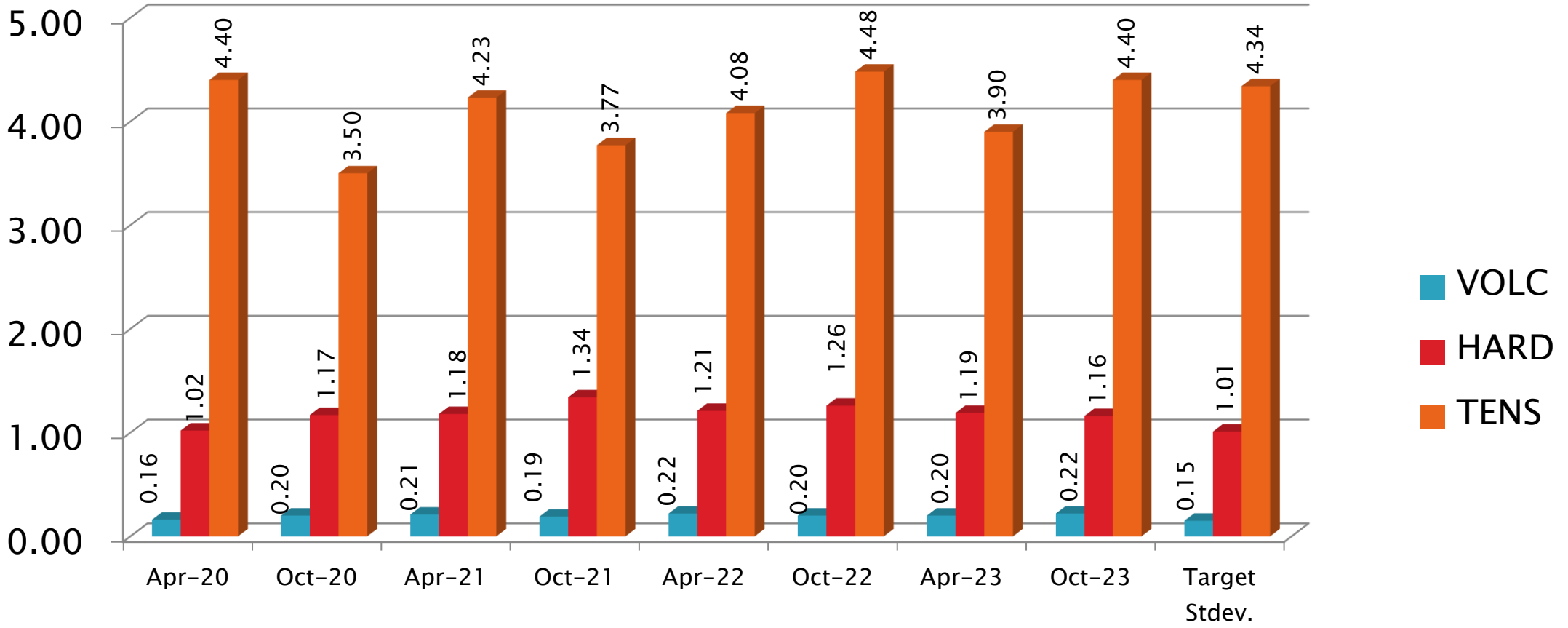
28OCT23:21:03

LDEOC Test Severity

Fluoroelastomer (FKM1)

Parameter	Period Mean Δ/s	Status
Volume Change	-0.71	Mild
Points Hardness Change	0.38	Severe
Tensile Strength Change	0.45	Severe

LDEOC Precision Estimates – Fluoroelastomer



*One 1006 reference oil result not included in this table

April 1, 2023 – September 30, 2023

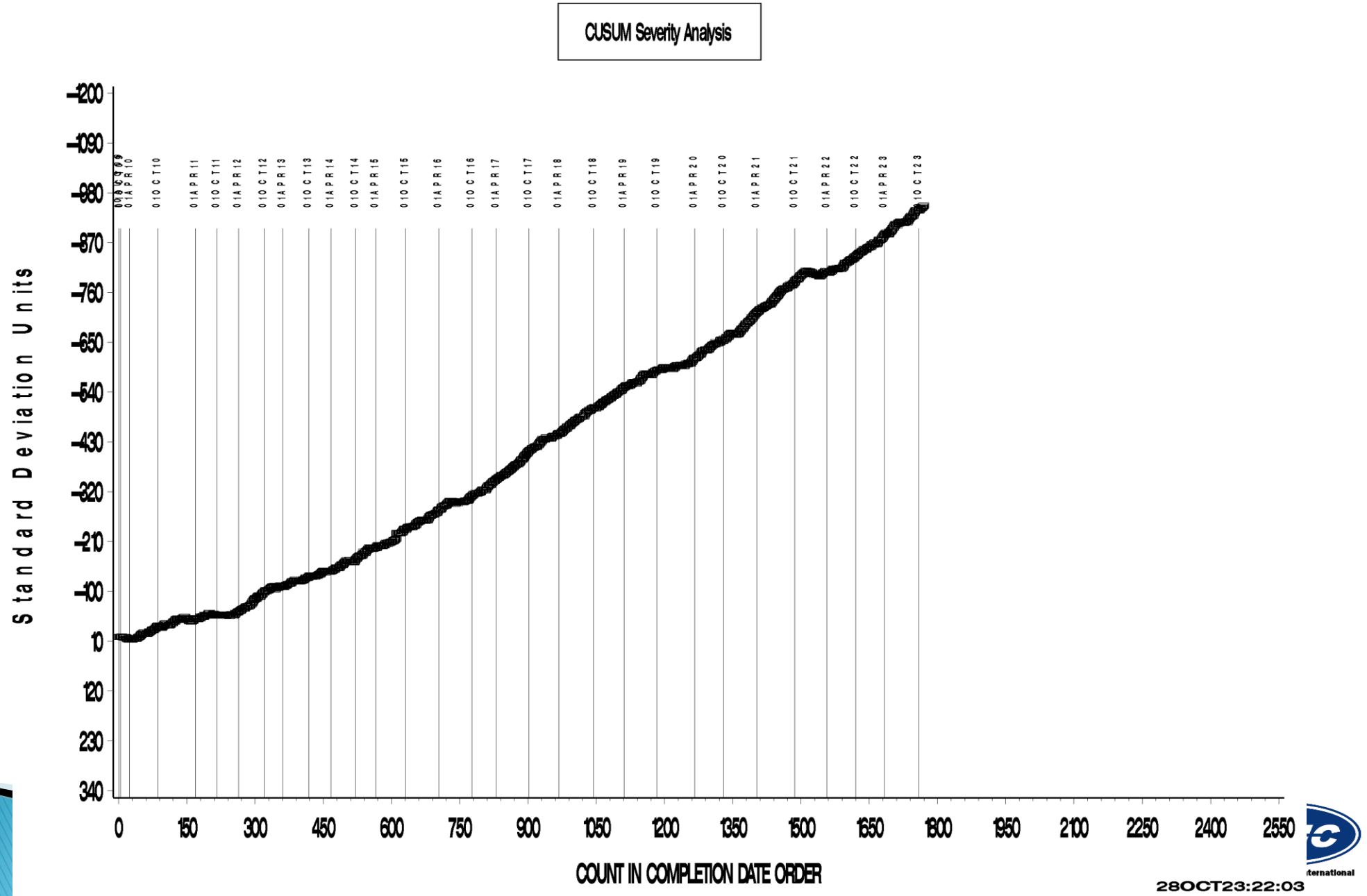
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

LDEOC Precision Estimates by Lab: FKM1

Test Parameter	Statistic	LTMS Lab						
		A	B	G	I	L	P	V
	n=	26	2	24	15	3	1	4
Volume	Mean	0.5131	0.3900	0.5767	0.7567	0.5400	0.64	0.3600
	Pooled s	0.1221	0.0707	0.1972	0.3069	0.0866	0	0.0906
	Mean /s	-1.1128	-1.9333	-0.6889	0.5111	-0.9333	-0.2667	-2.133
Hardness	Mean	4.6538	5.5000	3.7500	4.8667	4.000	4.000	6.2500
	Pooled s	0.6895	0.7071	1.3909	0.7432	1.000	0	0.5000
	Mean /s	0.5484	1.3861	-0.3465	0.7591	-0.0990	-0.0990	2.1287
Tensile Strength	Mean	-58.2308	-58.1000	-52.7667	-51.5067	-60.900	-56.200	-62.825
	Pooled s	2.2819	0.5657	3.6575	1.8359	1.7059	0	1.9363
	Mean /s	-0.1914	-0.1613	1.0676	1.3579	-0.8064	0.2765	-1.2500

A Program of ASTM International

REF FLUOROELASTOMER VOLUME CHANGE FINAL



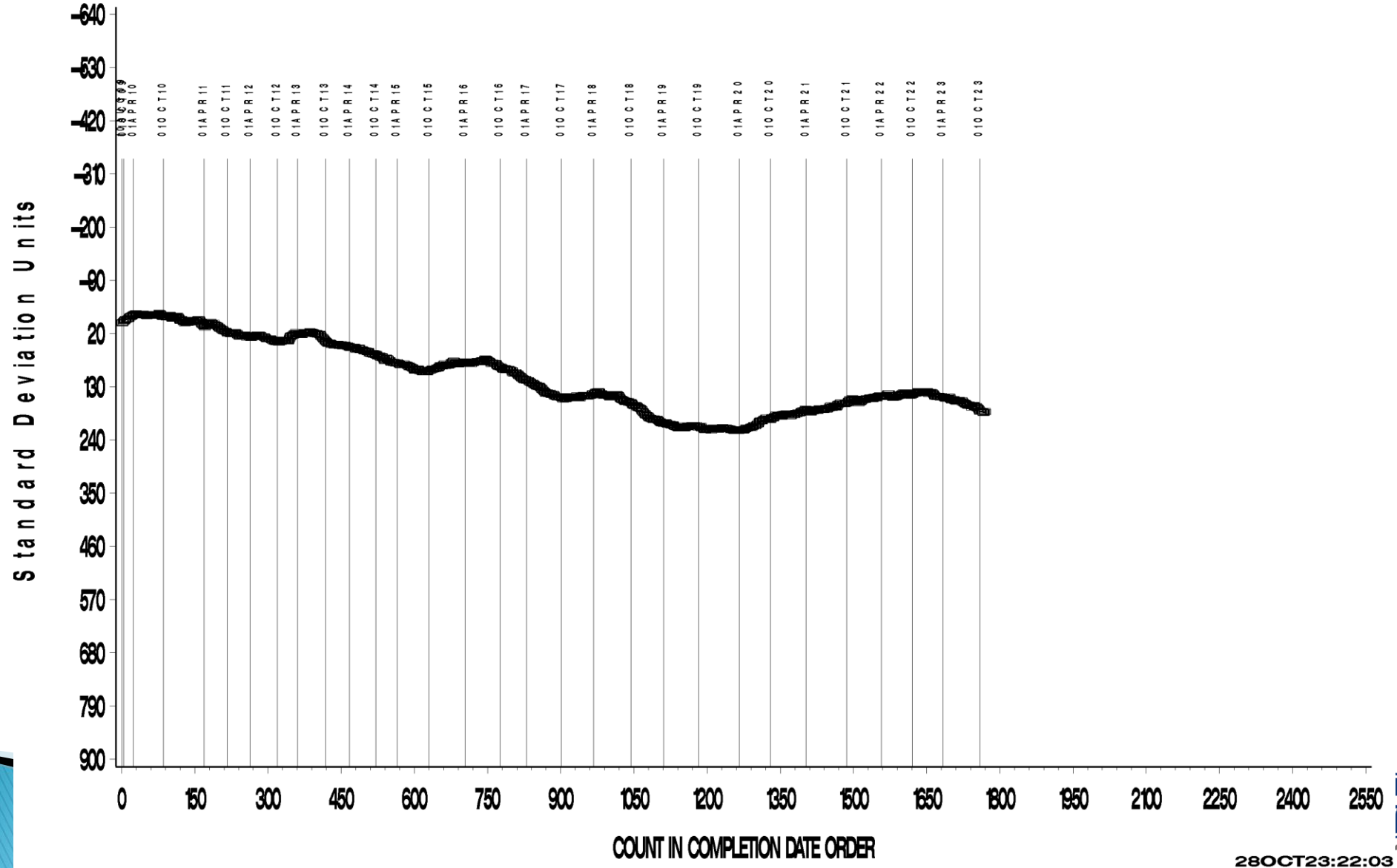
28OCT23:22:03

LDEOC — FLUOROELASTOMER INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

REF FLUORO POINTS HARDNESS CHANGE FINAL

CUSUM Severity Analysis

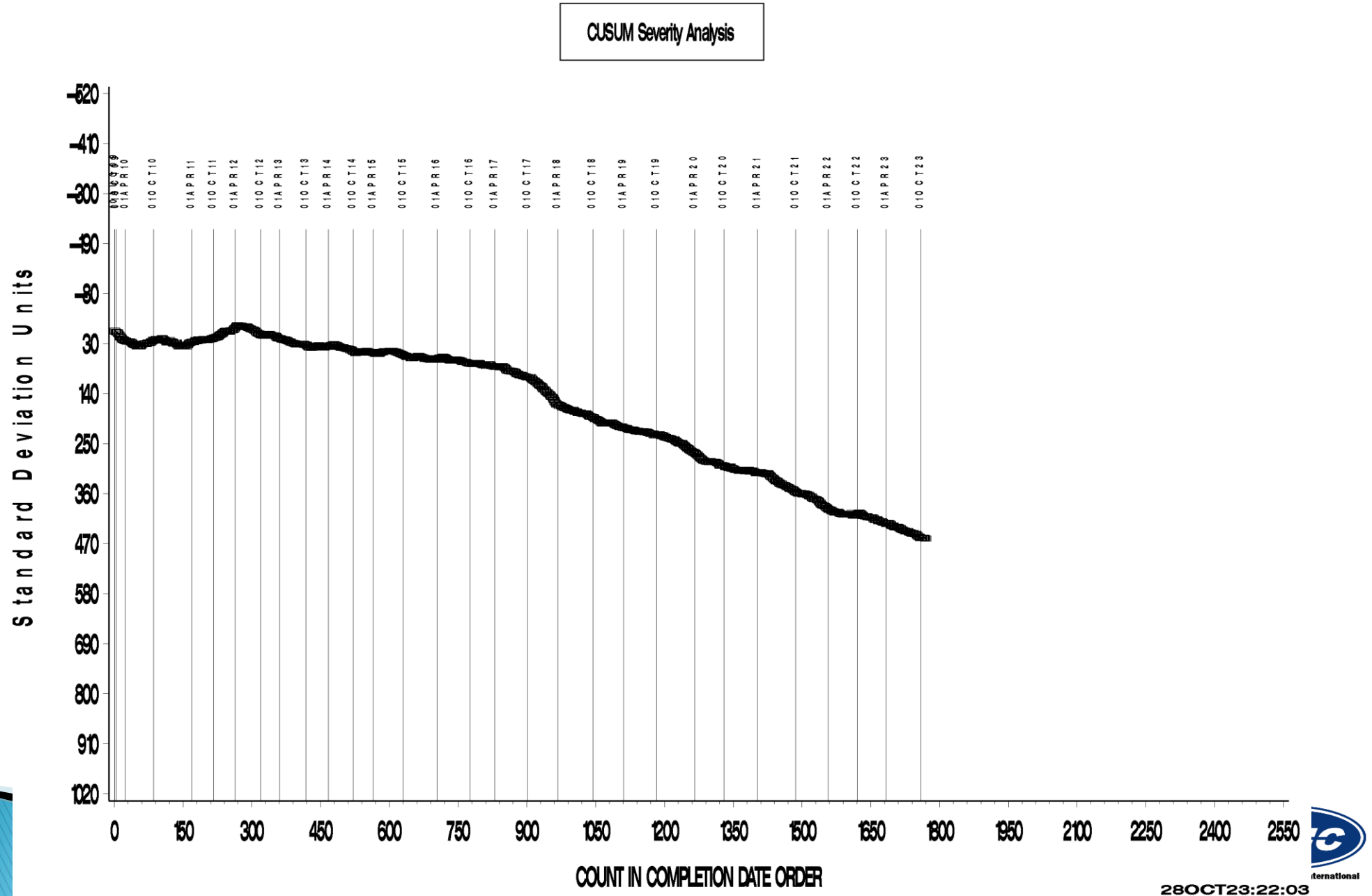


28OCT23:22:03

LDEOC —FLUOROELASTOMER INDUSTRY OPERATIONALLY VALID DATA

A Program of ASTM International

REF FLUORO TENSILE STRENGTH CHANGE AVERAGE



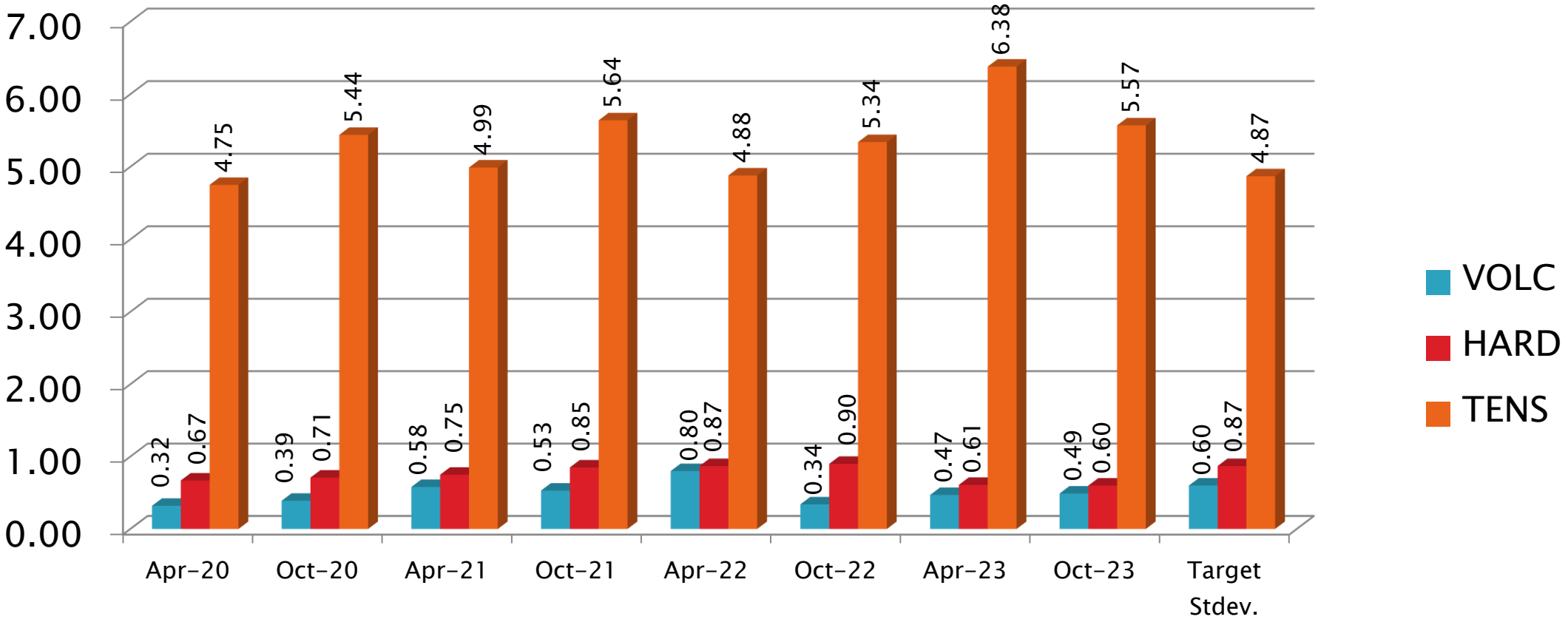
28OCT23:22:03

LDEOC Test Severity

Nitrile (NBR1)

Parameter	Period Mean Δ/s	Status
Volume Change	1.41	Severe
Points Hardness Change	-0.61	Mild
Tensile Strength Change	-0.56	Mild

LDEOC Precision Estimates – Nitrile

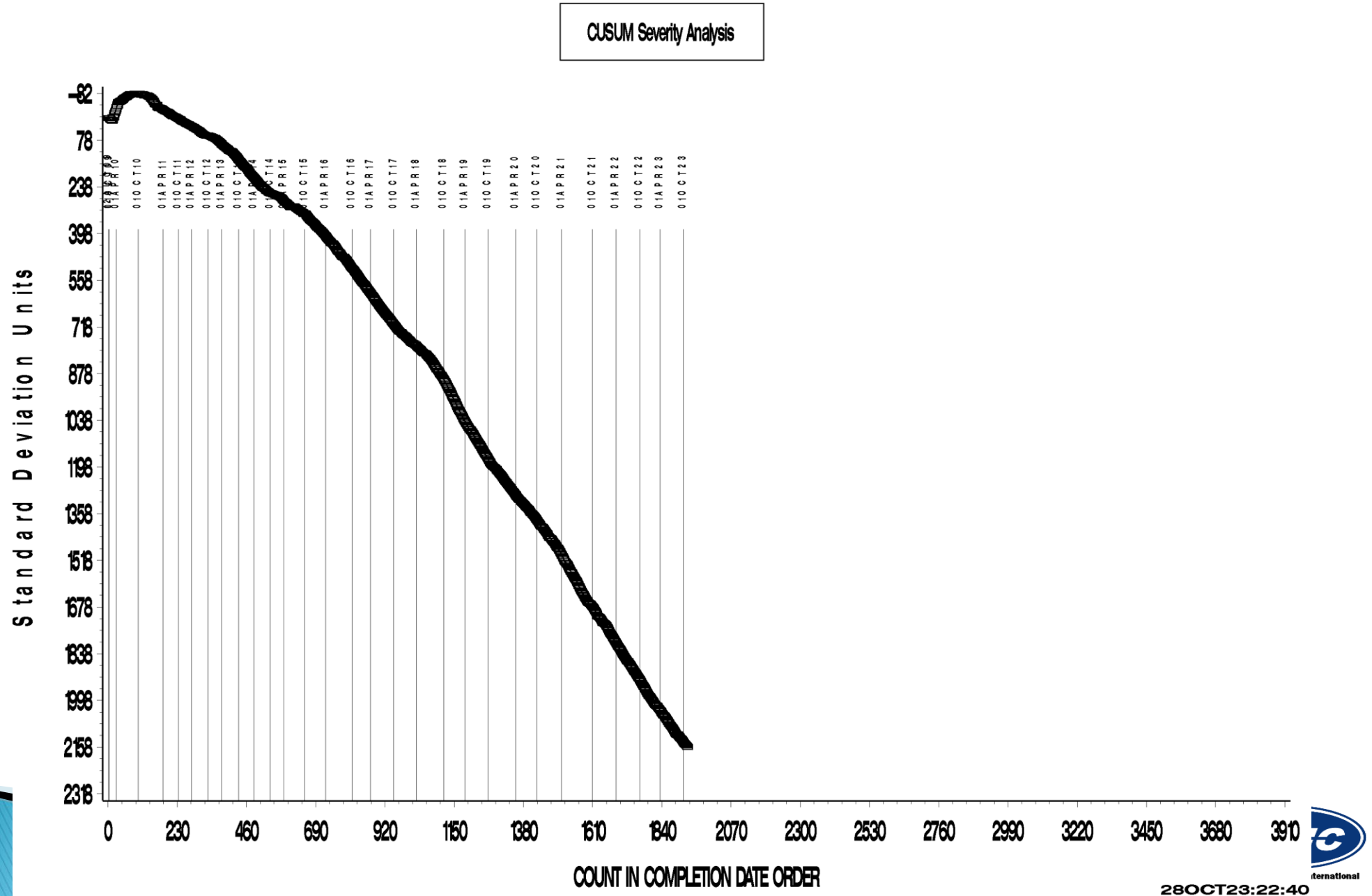


LDEOC Precision Estimates by Lab: NBR1

Test Parameter	Statistic	LTMS Lab						
		A	B	G	I	L	P	V
	n=	26	2	23	16	3	2	5
Volume	Mean	1.1981	1.0400	1.0961	1.2250	1.1667	1.1500	1.1700
	Pooled s	0.0830	0.0424	0.6895	0.6769	0.1686	0.2546	0.2189
	Mean /s	1.4635	1.2000	1.2935	1.5083	1.4111	1.3833	1.4167
Hardness	Mean	-1.8846	-1.000	-1.9130	-1.4375	-1.000	-1.000	-1.8000
	Pooled s	0.4315	0	0.7332	0.5123	0	0	0.4472
	Mean /s	-0.8099	0.2069	-0.8426	-0.2960	0.2069	0.2029	-0.7126
Tensile Strength	Mean	1.6038	7.5000	5.3565	2.1000	-1.000	8.6000	4.1200
	Pooled s	3.5071	1.8385	8.2999	2.7503	3.6756	2.627	3.1839
	Mean /s	-0.8965	0.3142	-0.1260	-0.7947	-1.4312	0.5400	-0.3799

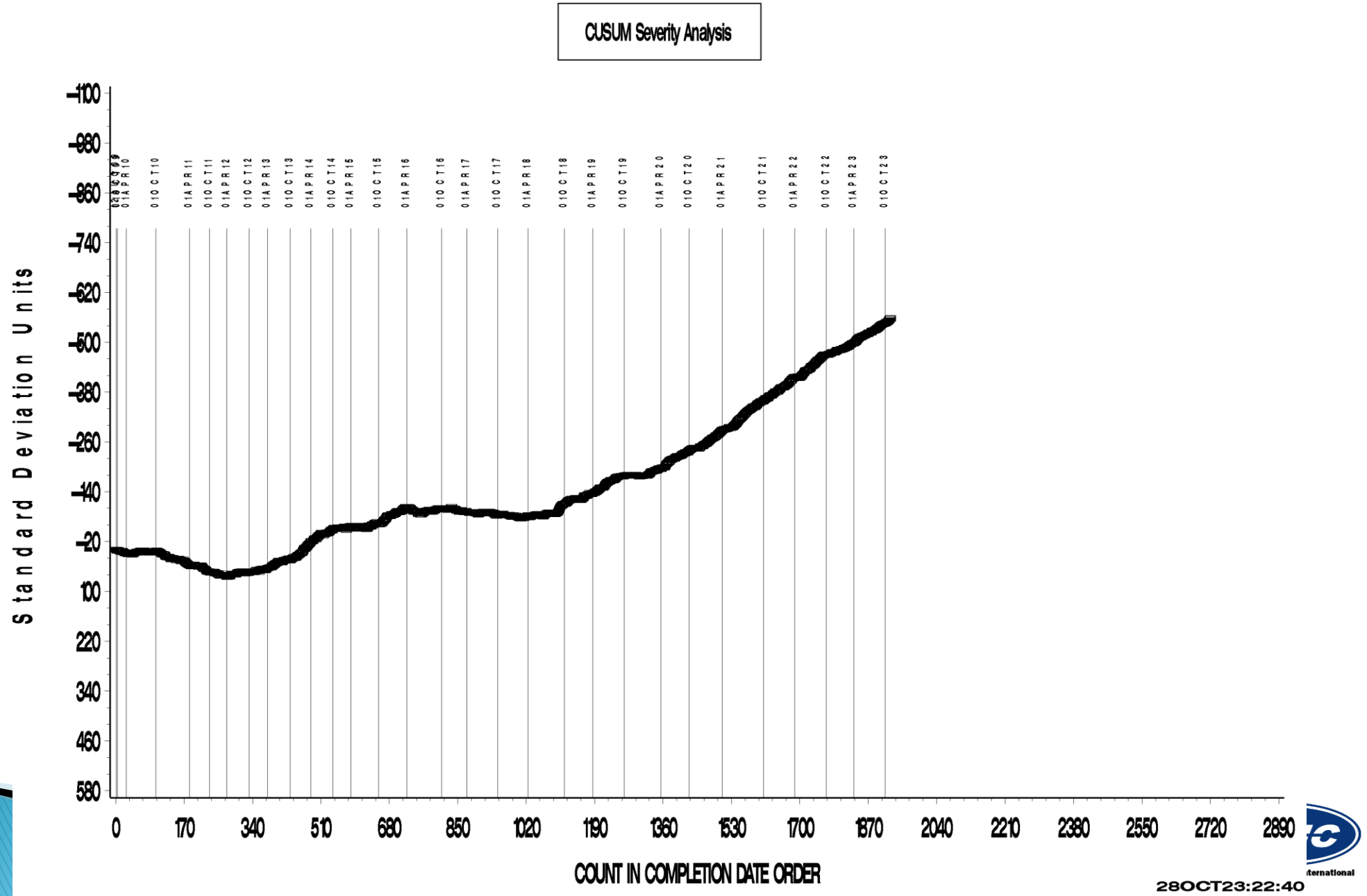
LDEOC —NITRILE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE NITRILE VOLUME CHANGE FINAL



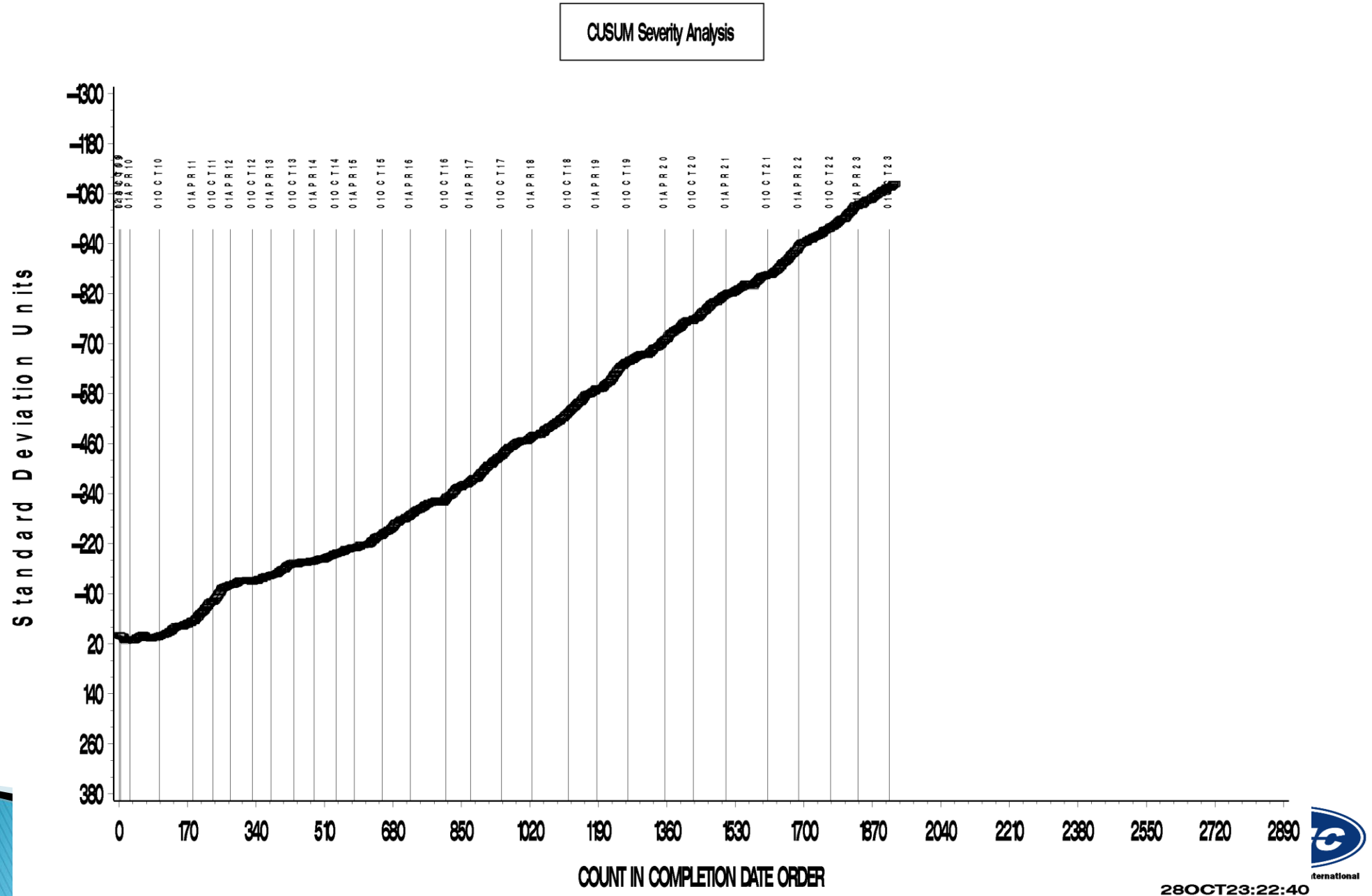
LDEOC —NITRILE INDUSTRY OPERATIONALLY VALID DATA

REF NITRILE POINTS HARDNESS CHANGE AVERAGE



LDEOC —NITRILE INDUSTRY OPERATIONALLY VALID DATA

REF NITRILE TENSILE STRENGTH CHANGE FINAL

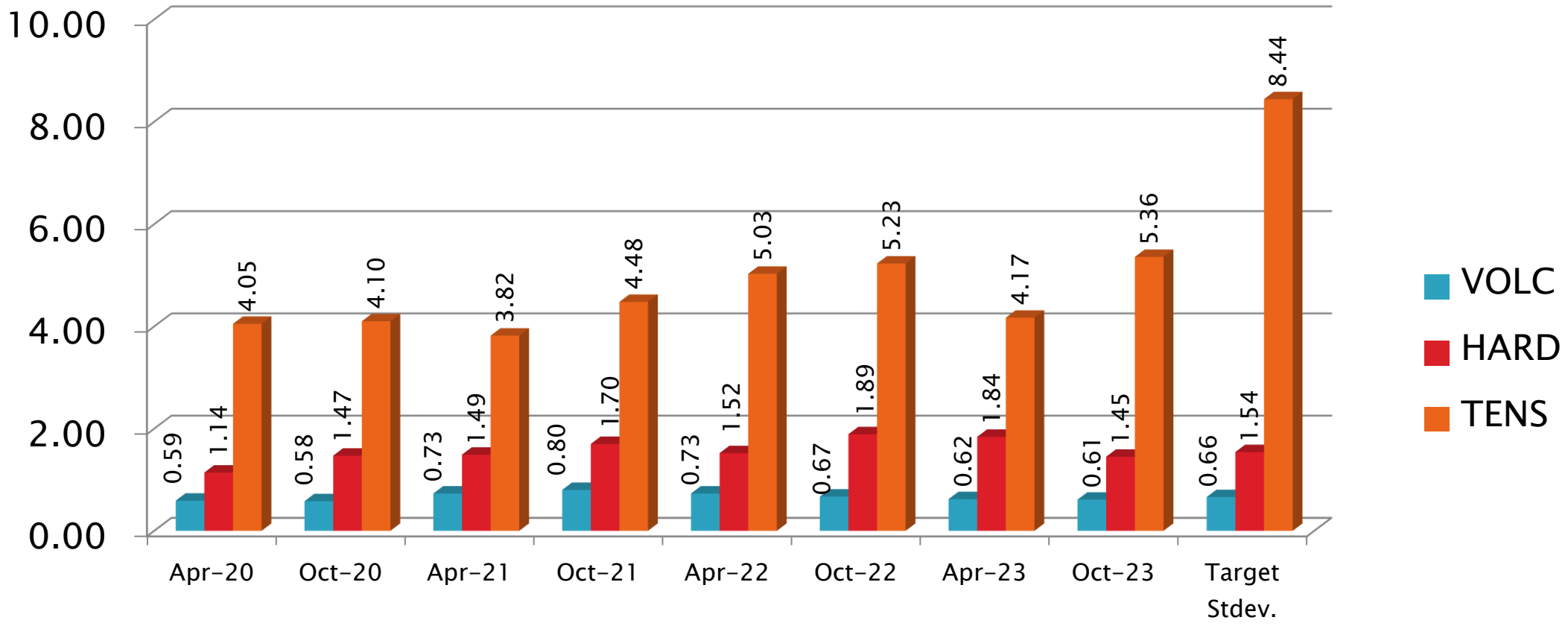


LDEOC Test Severity

Polyacrylate (ACM1)

Parameter	Period Mean Δ/s	Status
Volume Change	0.59	Severe
Points Hardness Change	-1.12	Mild
Tensile Strength Change	-0.56	Mild

LDEOC Precision Estimates – Polyacrylate



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

LDEOC Precision Estimates by Lab: ACM1

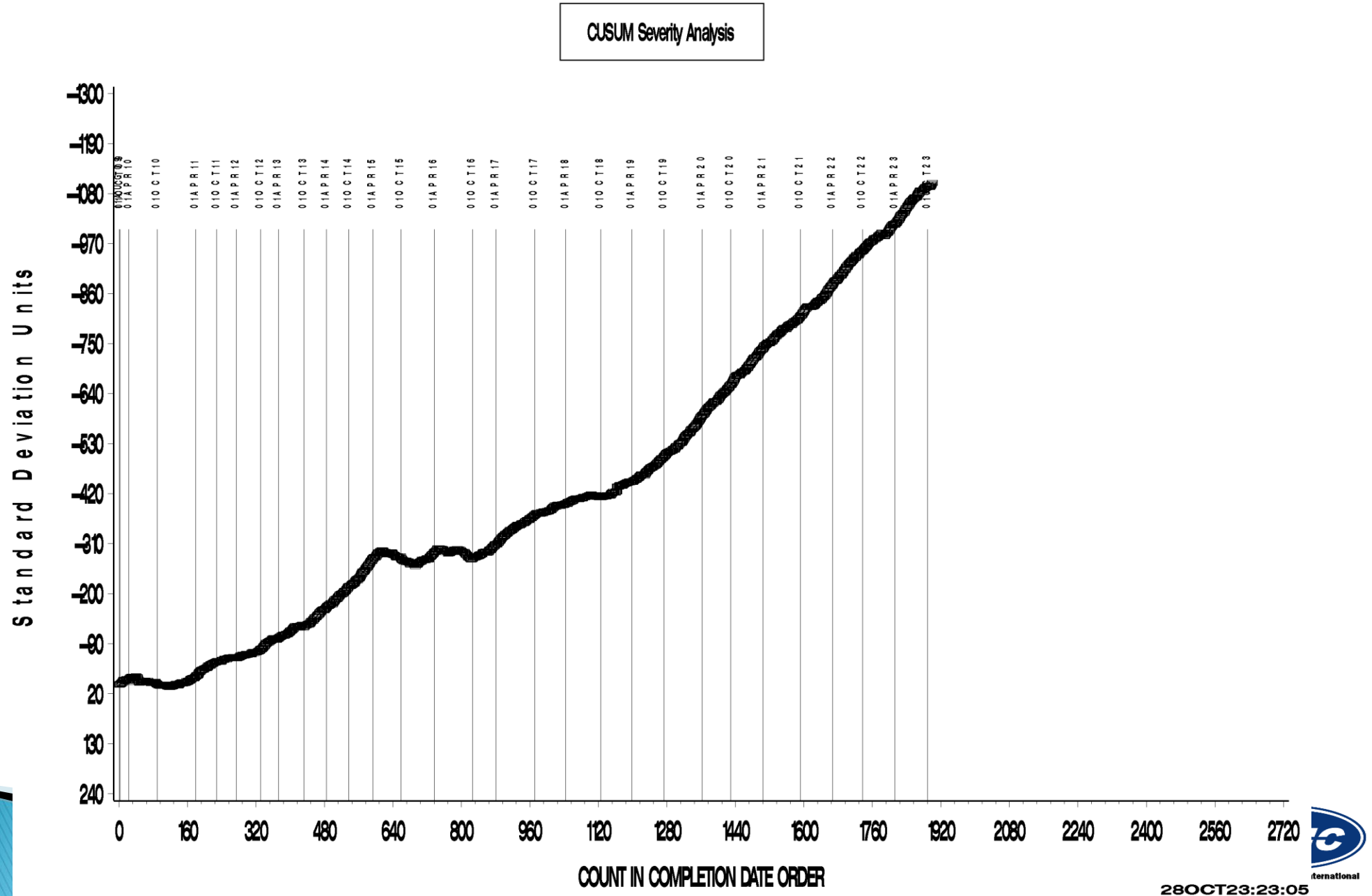
Test Parameter	Statistic	LTMS Lab						
		A	B	G	I	L	P	V
	n=	27	3	22	15	3	1	5
Volume	Mean	2.3256	2.6333	2.3850	2.9380	2.3667	2.6800	1.6860
	Pooled s	0.1747	0.2272	0.6938	0.7980	0.1665	0	0.2797
	Mean /s	0.4175	0.8838	0.5076	1.3454	0.4798	0.9545	-0.5515
Hardness	Mean	-2.5926	-2.6667	-1.8636	-0.8667	-0.3333	0.000	-2.8000
	Pooled s	1.0834	2.5166	1.4895	1.0601	1.1547	0.000	0.8367
	Mean /s	-1.5471	-1.5952	-1.0738	-0.4264	-0.0801	0.1364	-1.6818
Tensile Strength	Mean	-0.2185	-4.9333	-3.4727	-3.0867	-3.1333	-4.7000	-1.1000
	Pooled s	4.1519	3.4122	7.9385	3.0232	1.7243	0	2.9640
	Mean /s	-0.3316	-0.8902	-0.7171	-0.6715	-0.6769	-0.8626	-0.4360

LDEOC — POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REF POLYACRYLATE VOLUME CHANGE FINAL

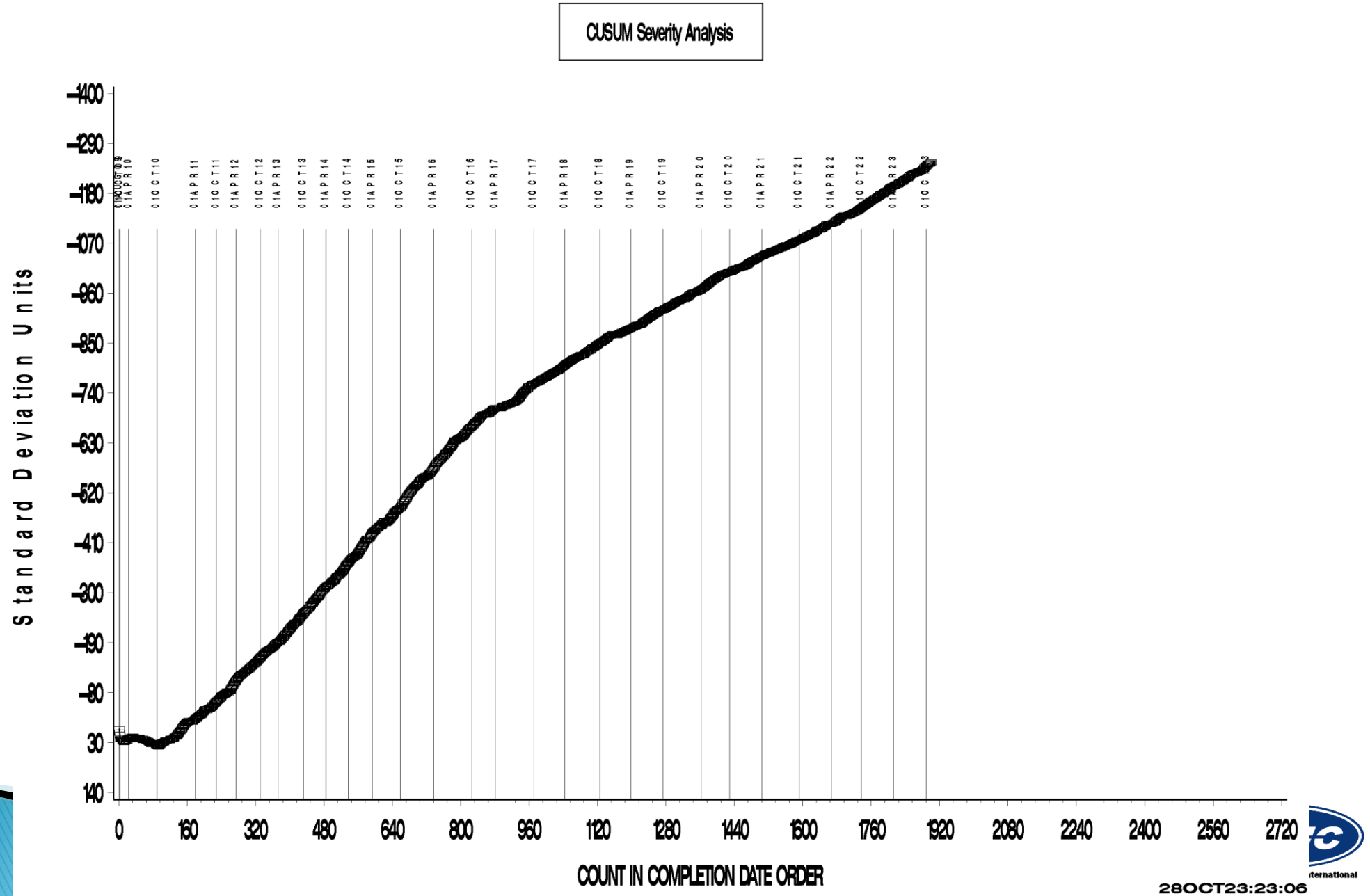
LDEOC — POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REF POLYACRYLATE POINTS HARDNESS CHG FINAL



LDEOC — POLYACRYLATE INDUSTRY OPERATIONALLY VALID DATA

REF POLYACRYLATE TENSILE STRENGTH CHG FINAL

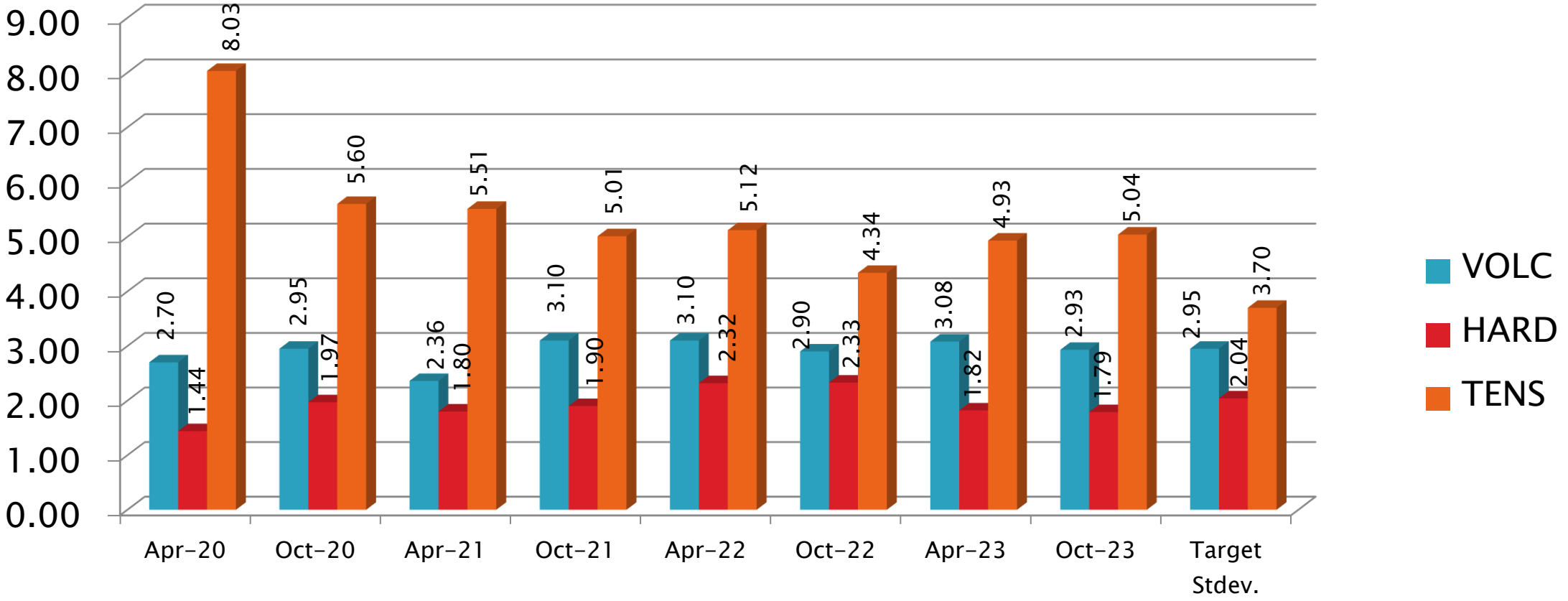


LDEOC Test Severity

Silicone (VMQ1)

Parameter	Period Mean Δ/s	Status
Volume Change	0.63	Severe
Points Hardness Change	-0.66	Mild
Tensile Strength Change	0.48	Severe

LDEOC Precision Estimates – Silicone



April 1, 2023 – September 30, 2023

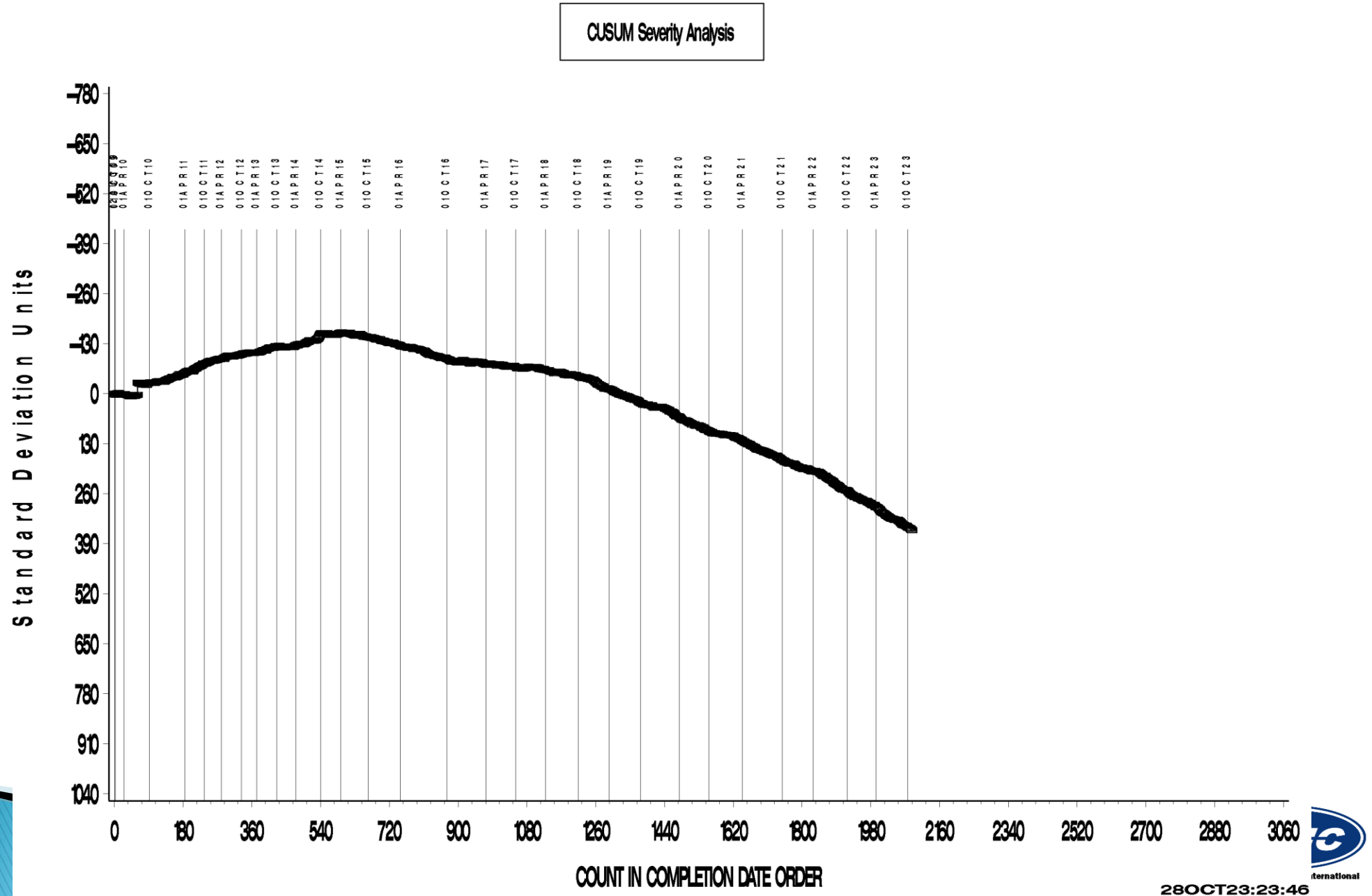
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

LDEOC Precision Estimates by Lab: VQM1

Test Parameter	Statistic	LTMS Lab						
		A	B	G	I	L	P	V
	n=	34	2	23	15	3	2	5
Volume	Mean	33.7256	34.1300	37.9873	30.3300	30.4900	32.8750	32.1520
	Pooled s	0.6272	0.1980	1.6865	0.9640	1.3685	1.0111	0.7674
	Mean /s	0.5273	0.6644	1.9720	-0.6237	-0.5695	0.2390	-0.0061
Hardness	Mean	-23.9411	-22.5000	-23.4091	-21.6000	-17.3333	-23.000	-23.000
	Pooled s	1.0714	0.7071	1.4027	1.2421	0.5774	0	0
	Mean /s	-1.1084	-0.4020	-0.8476	0.03921	2.1307	-0.6471	-0.6471
Tensile Strength	Mean	-31.7088	-24.1500	-33.6455	-32.6400	-31.3667	-35.7500	-26.4400
	Pooled s	4.5266	1.6263	6.0233	3.5292	5.3985	2.0506	2.7619
	Mean /s	0.5517	2.5946	0.0283	0.3000	0.6441	-0.5405	1.9757

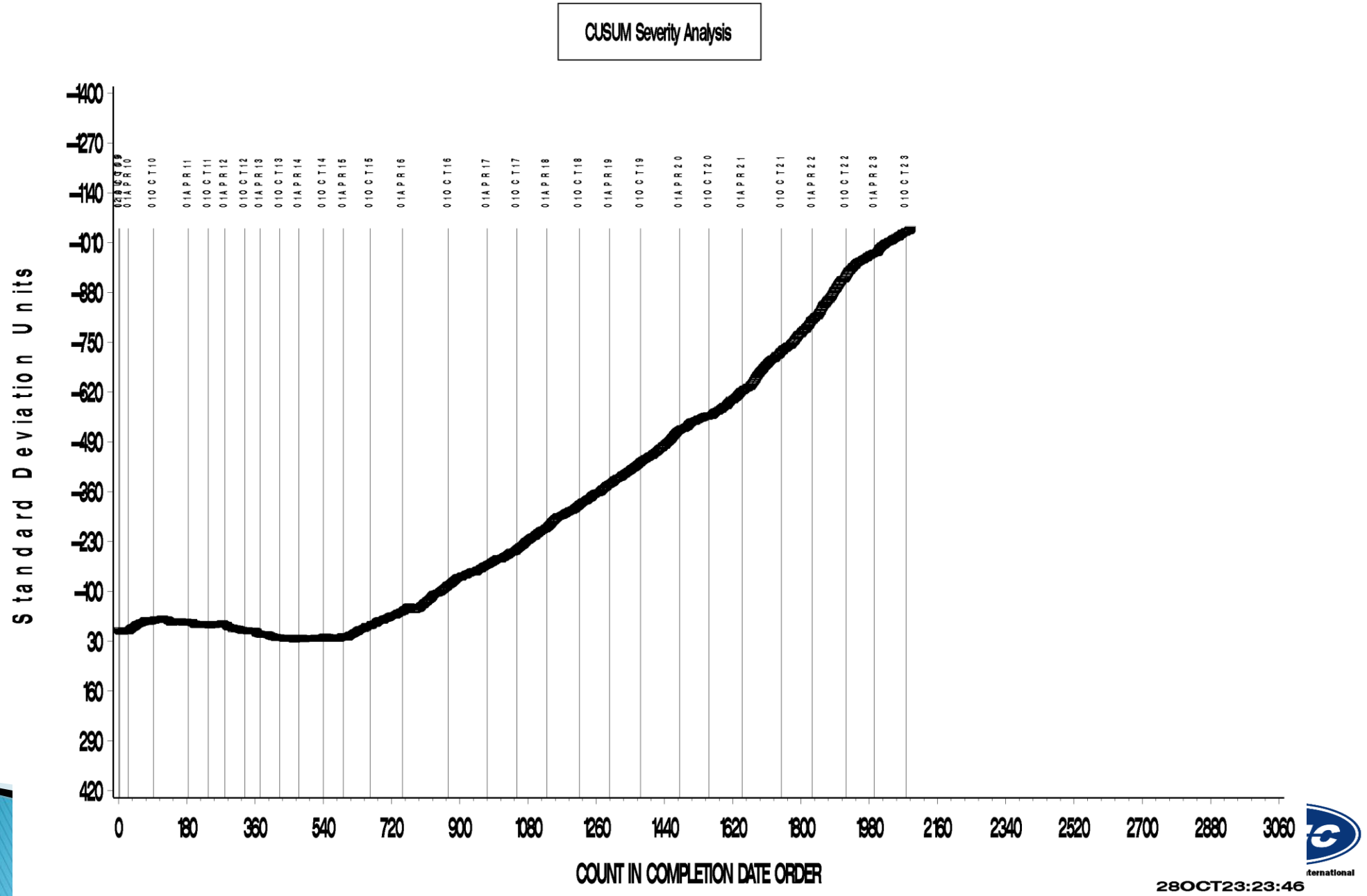
LDEOC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE SILICON VOLUME CHANGE FINAL



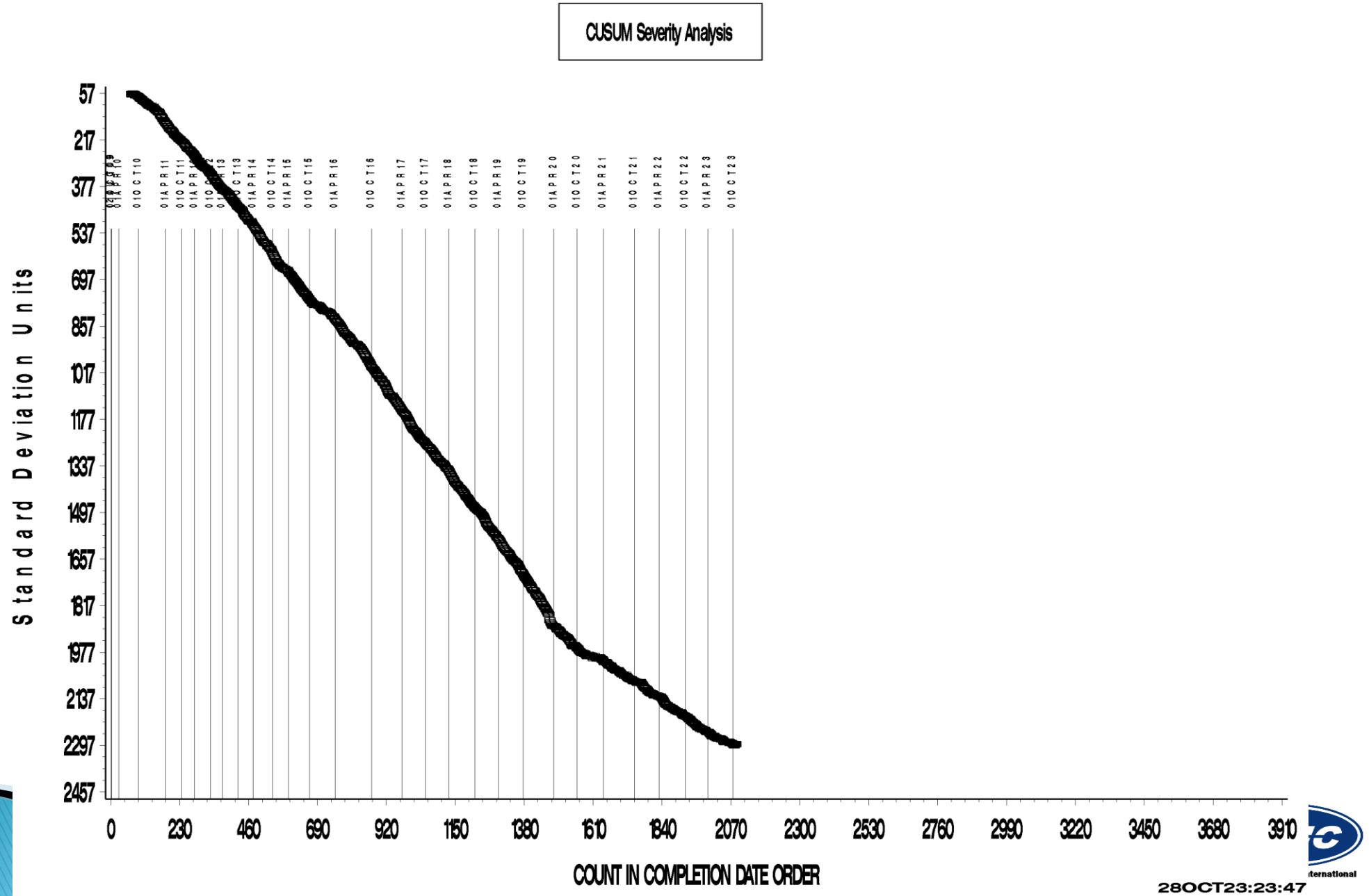
LDEOC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

REFERENCE SILICON POINTS HARDNESS FINAL



LDEOC —SILICONE INDUSTRY OPERATIONALLY VALID DATA

REF SILICON TENSILE STRENGTH CHANGE FINAL



Information Letters & Technical Updates*

Test	Date	IL or Memo Number	Topic
LDEOC	20230615	IL23-001*	Implementation of Industry Correction Factor (ICF) to the Volume Change result for Batch Code ACM1-26 (-3.40).

*Available from TMC Website

Reference Oil Inventory Estimated Life EOEC/LDEOC

Oil	TMC Inventory Gallons	Gallons Shipped Past 12 Months	Estimated Life[C]
SL107[A, B]	1971	203	3.4 years

[A]TMC Inventory is used across several test methods
[B]SL107 has fully replaced oil 1006; Oil 1006 is no longer used as EOEC/LDEOC Reference Fluid
[C]Additional Elastomer types will be added to new lubricant categories ILSAC GF-7 and PC-12 (HDEO) which will have an impact on Estimated Lifetime availability of SL107.

TABLE of CONTENTS

D02.B0.07
TMC Monitored Tests

ASTM D 7528

ROBO

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Calibrated Labs and Stands*

(change since last Semi-Annual report)

Test	Labs	Stands
D7528	5 (+0)	30 (+1)
*As of 9/30/2023		

D7528: Oxidation by ROBO

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	91
Failed Calibration Test	OC	12
Operationally Invalidated by Lab	LC, XC	2
Operationally Invalidated After Initially Reported as Valid	RC	1
Total		**106**

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 11.6%

D7528: Oxidation by ROBO

Statistically Unacceptable Tests (OC)	No. Of Tests
Natural Log (MRV Viscosity) Severe	7
Natural Log (MRV Viscosity) Mild	5
Total	**12**

- Information Letter 21-1 was issued 3 November 2021 and added an option to use dilute nitrogen dioxide in air

D7528: ROBO Failed Tests by Lab

Failed Parameter	LTMS Lab					Number of Tests
	A	BC	AQ	G	AM	
Natural Log (MRV Viscosity) Severe	5	0	0	2	0	7
Natural Log (MRV Viscosity) Mild	4	0	0	1	0	5
Total	**9**	**0**	**0**	**3**	**0**	**12**

- Eight different units from two different labs reported failing calibration tests

D7528: Oxidation by ROBO

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

Test Status	Cause	No. of Tests
Invalidated by Lab (LC)	Pump Issue	1
Invalidated by TMC (RC)	Yield stress >35kPa (Not RO 434-3)	1
Aborted Test (XC)	NO2 Pump Issue	1
Totals		**3**

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	-----
10/1/18 through 3/31/19	100	96	0.2738	0.04
4/1/19 through 9/30/19	95	91	0.2492	-0.32
10/1/19 through 3/31/20	158	153	0.2723	-0.10
4/1/20 through 9/30/20	119	113	0.2264	-0.76
10/1/20 through 3/31/21	113	108	0.3188	-0.11
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

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

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	46	44	95.7	2	15	G,AM
Liquid	57	47	82.5	4	15	A,AQ,BC,G
BOTH (Totals)	**103**	**91**	**88.3**	**5***	**30**	**A, AM, AQ, BC, G**

*One lab is conducting tests with both NO_2 delivery methods.

D7528: Oxidation by ROBO

Precision, Performance (Mean Δ/s) by Lab and NO_2 Delivery Mechanism

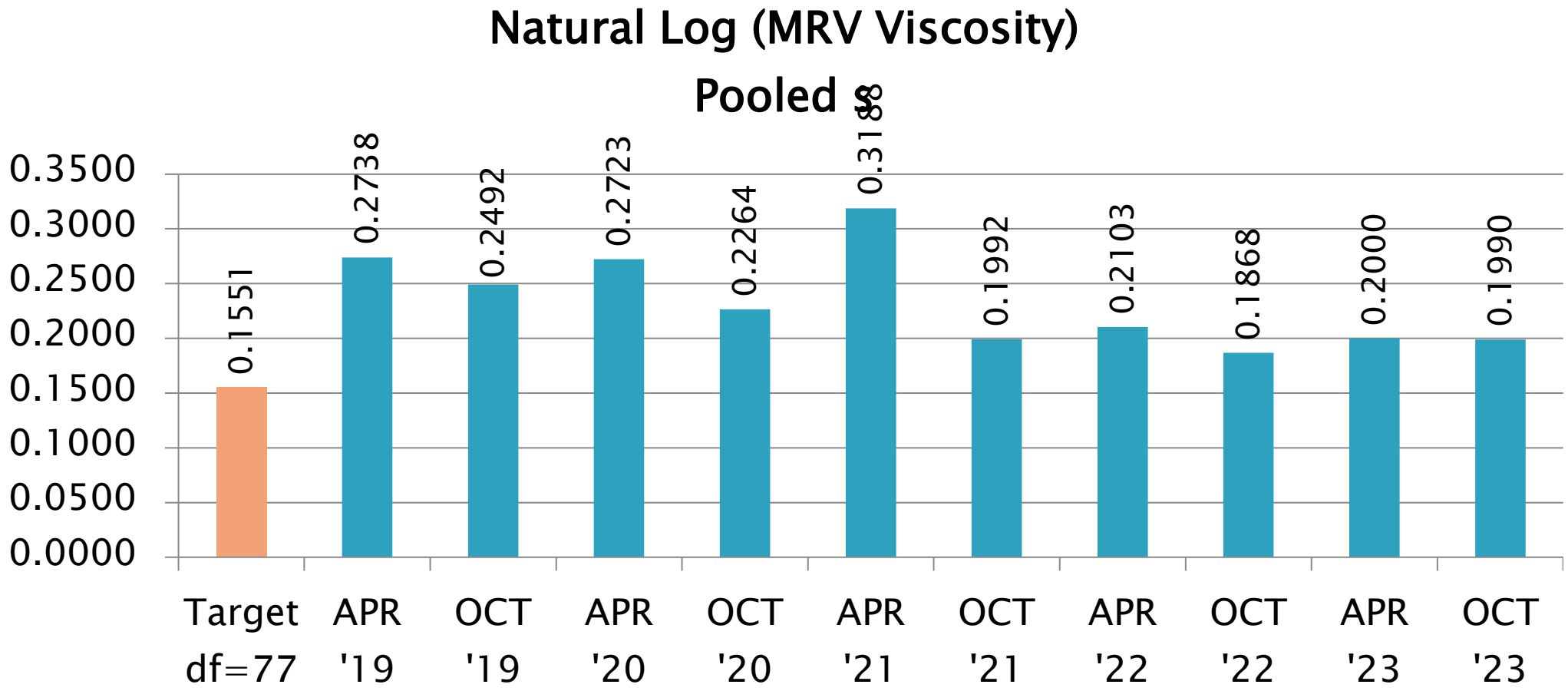
NO_2 Delivery		Reference Oil 434-3	Reference Oil 435-1	Reference Oil 436	TOTAL
Dilute	No. of Runs	10	21	15	46
	Mean	10.8617	10.9632	10.3049	10.7265
	Pooled s	0.1759	0.1600	0.1410	0.1577
	Mean Δ/s	0.32	-0.39	-0.21	-0.17
Liquid	No. of Runs	15	29	13	57
	Mean	10.8052	10.9547	10.4352	10.7969
	Pooled s	0.1852	0.2679	0.1484	0.2258
	Mean Δ/s	-0.09	-0.43	0.80	-0.06
BOTH	No. of Runs	25	50	28	103
	Mean	10.8288	10.9582	10.3654	10.8487
	Pooled s	0.1800	0.2269	0.1564	0.1990
	Mean Δ/s	0.07	-0.41	0.26	-0.11

D7528: Oxidation by ROBO

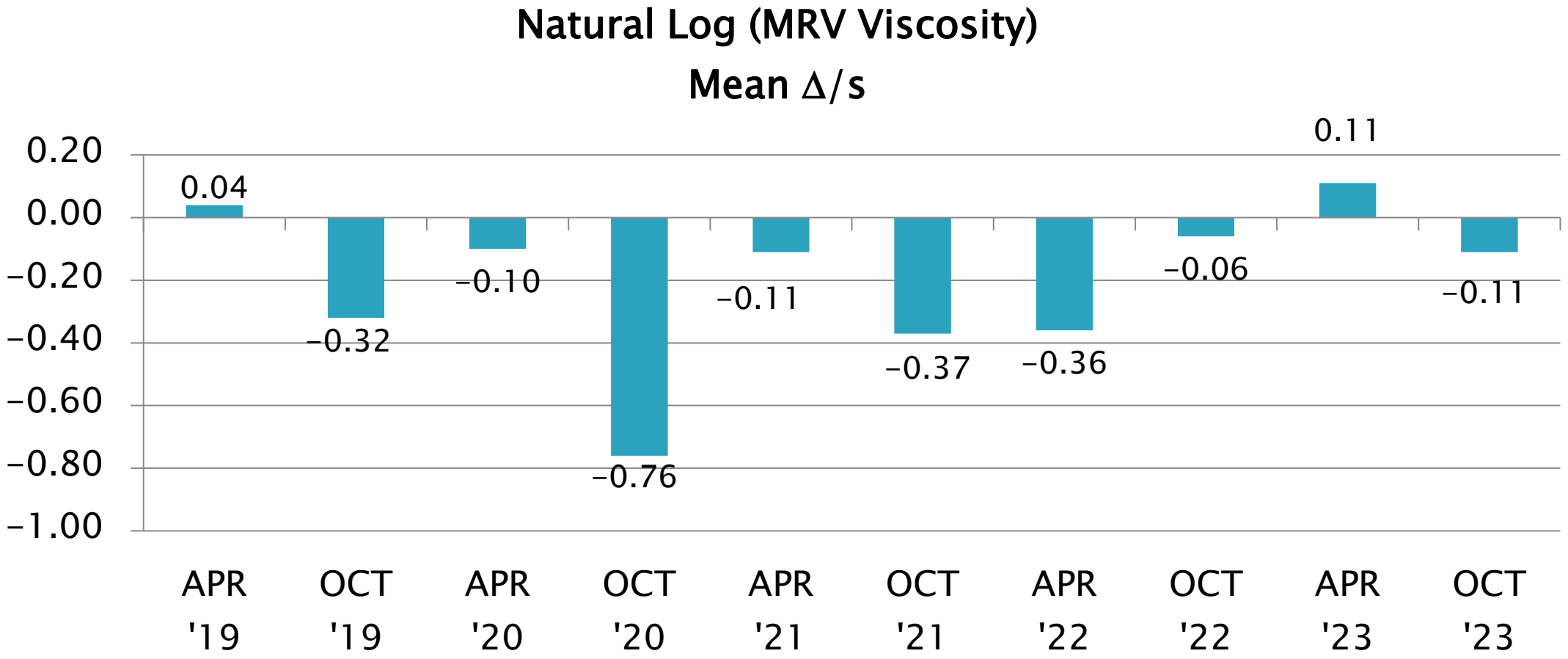
Period Performance (Mean Δ/s) by Lab and NO_2 Delivery Mechanism

NO_2 Delivery Mechanism	LAB A (all L)	LAB AM (all D)	LAB AQ (all L)	LAB BC (all L)	LAB G (mix)
Dilute	n = 0	n = 8	n = 0	n = 0	n = 38
	N/A	-0.47	N/A	N/A	-0.11
Liquid	n = 39	n =0	n = 5	n = 1	n = 12
	0.07	N/A	0.02	-1.57	-0.38
BOTH	**n = 39**	**n = 8**	**n =5**	**n = 1**	**n = 50**
	0.07	**-0.47**	**0.02**	**-1.57**	**-0.18**

D7528: Oxidation by ROBO



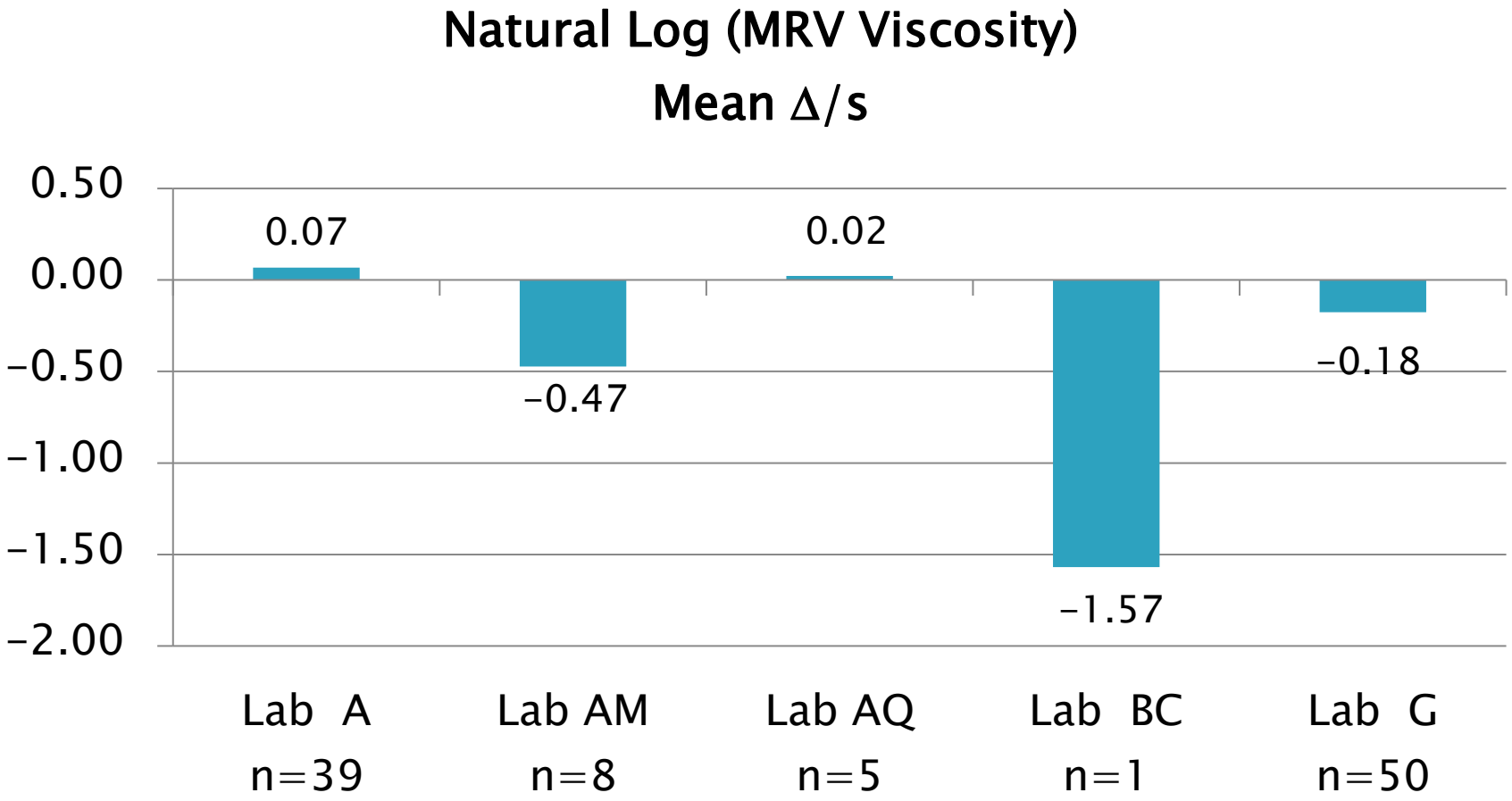
D7528: Oxidation by ROBO



April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D7528: Oxidation by ROBO



April 1, 2023 – September 30, 2023

D7528: Oxidation by ROBO

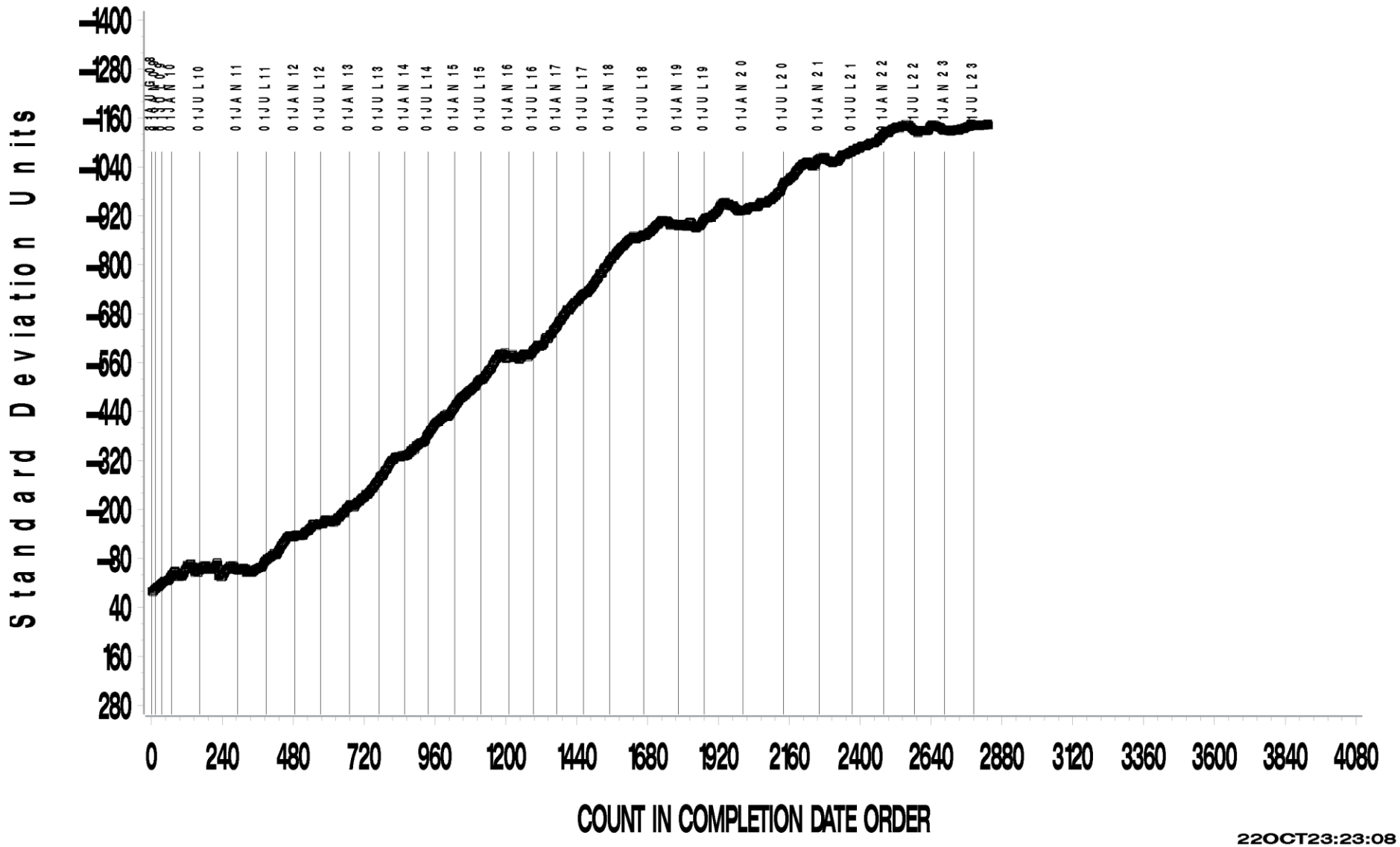
- Precision (Pooled s) continues to stay around 0.20 and about 0.05 units higher than target (0.15).
- Severity (Mean Δ/s) has returned to mild (-0.11) but has been close to "zero" for the past three semesters
- CUSUM severity plot shows a third consecutive period of relatively 'flat' CUSUM after many periods of trending Mild.
- Two labs did not report any runs this period

ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

AGED OIL MRV APPARENT VISCOSITY

CUSUM Severity Analysis

Historical Chart



22OCT23:23:08

ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

Last 200 Data Points

AGED OIL MRV APPARENT VISCOSITY

CUSUM Severity Analysis

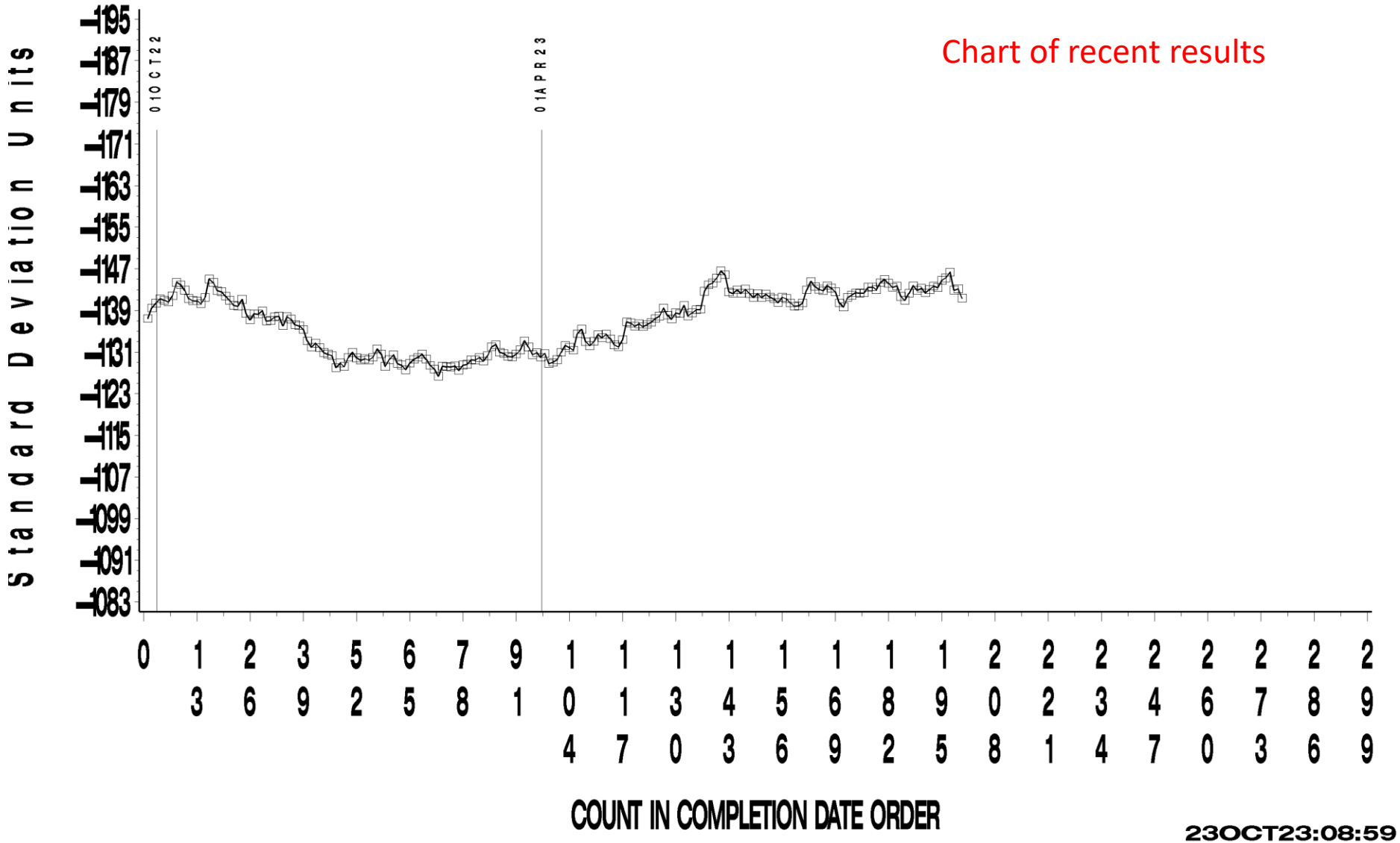


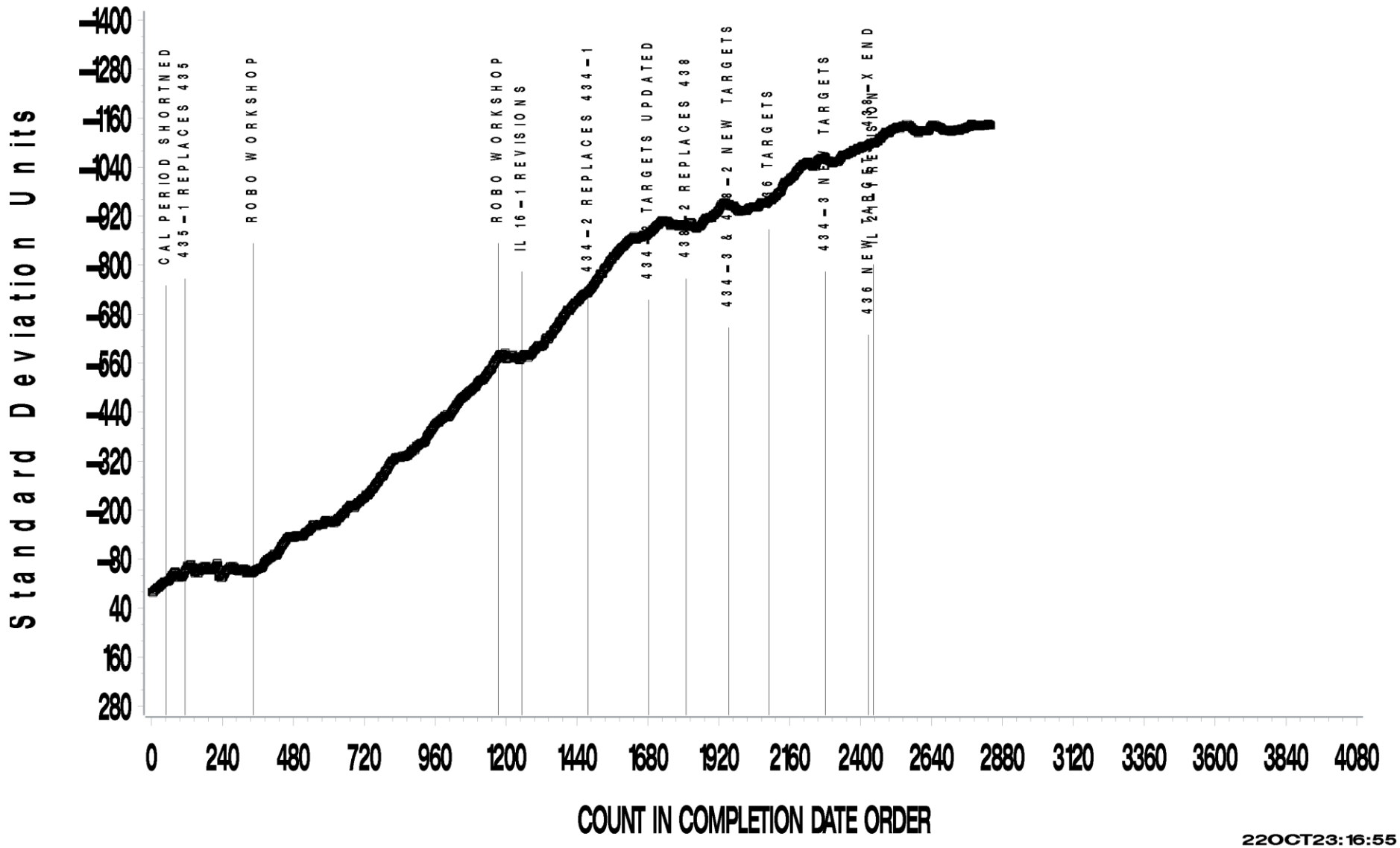
Chart of recent results

23OCT23:08:59

ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

AGED OIL MRV APPARENT VISCOSITY

CUSUM Severity Analysis



22OCT23:16:55

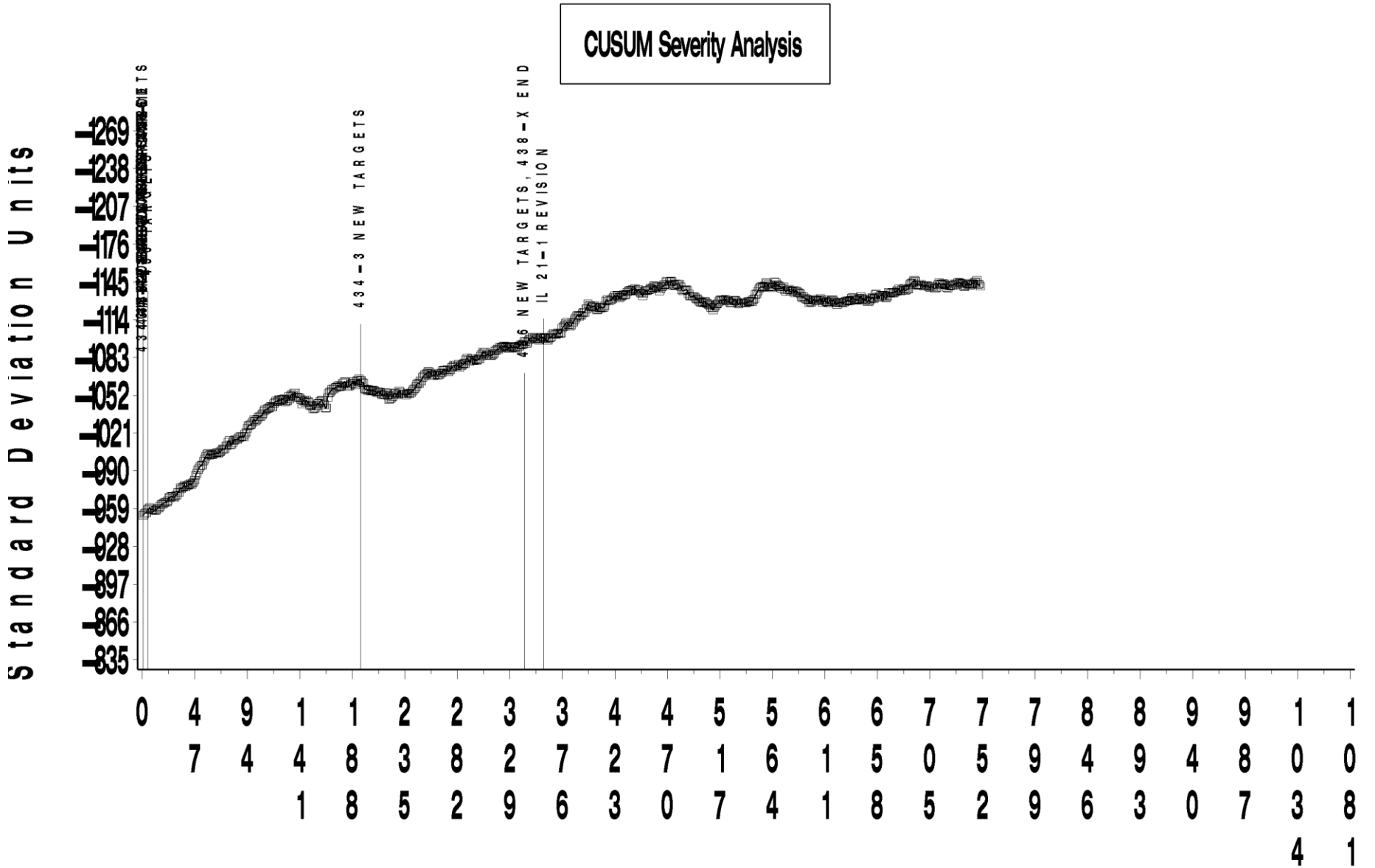
ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

Last 750 Data Points

AGED OIL MRV APPARENT VISCOSITY

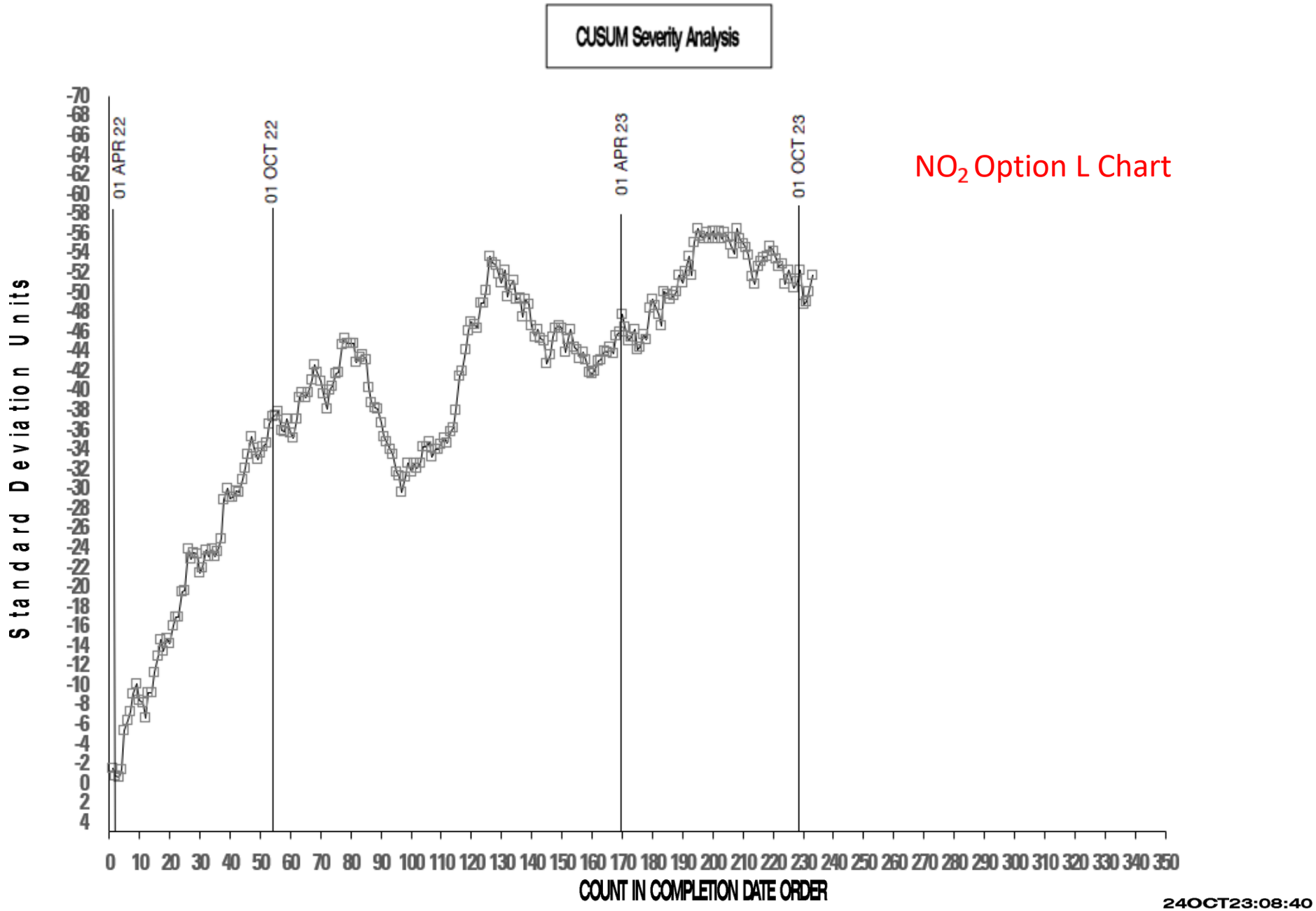
A Program of ASTM International

CUSUM Severity Analysis



23OCT23:08:57

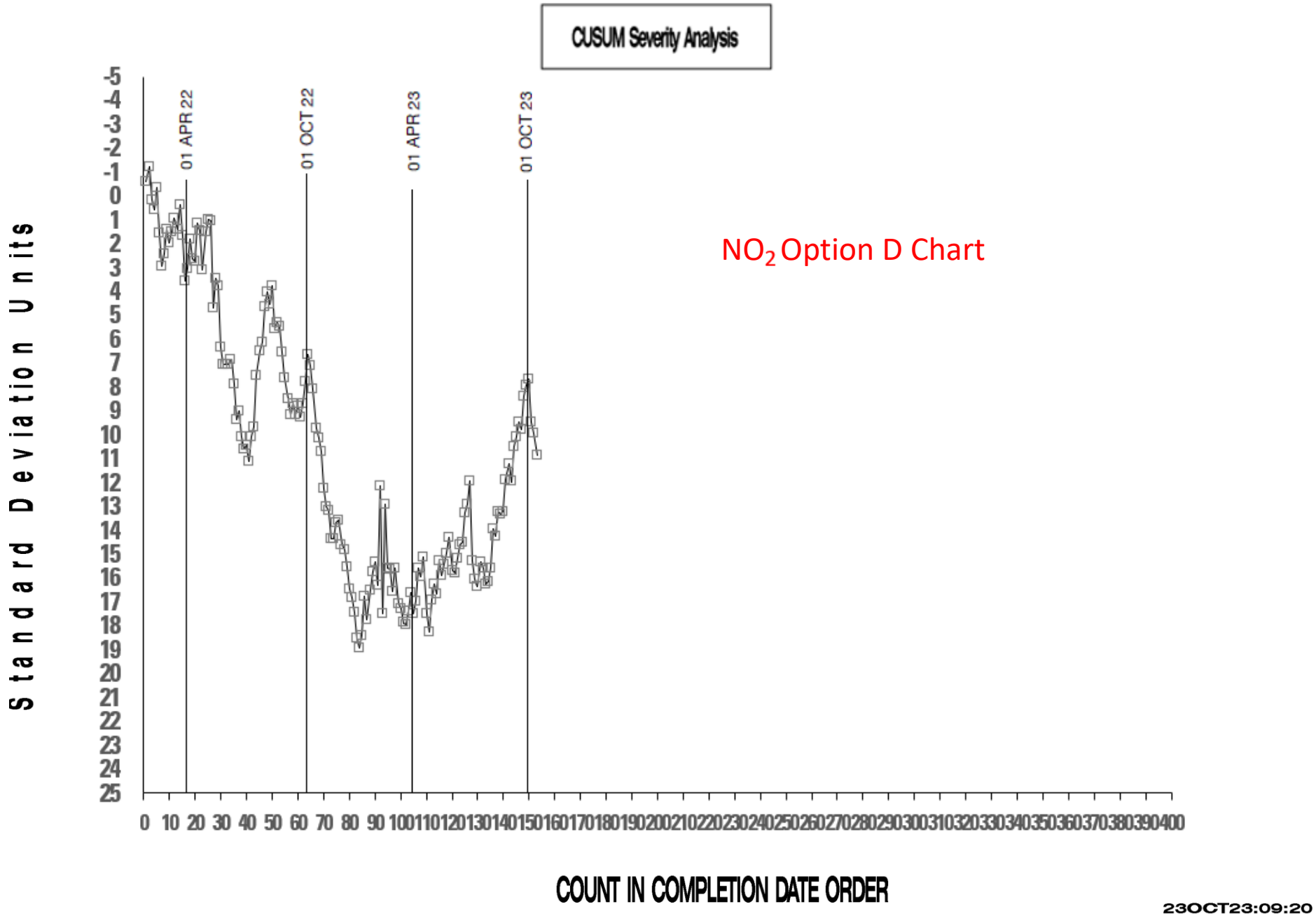
ROBO TEST INDUSTRY OPERATIONALLY VALID DATA
NO2 Option L ONLY
AGED OIL MRV APPARENT VISCOSITY



NO_2 Option L Chart

24OCT23:08:40

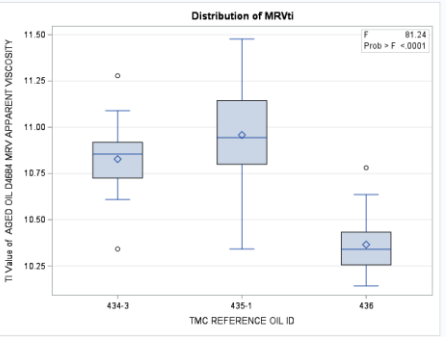
ROBO TEST INDUSTRY OPERATIONALLY VALID DATA
NO2 Option D ONLY
AGED OIL MRV APPARENT VISCOSITY

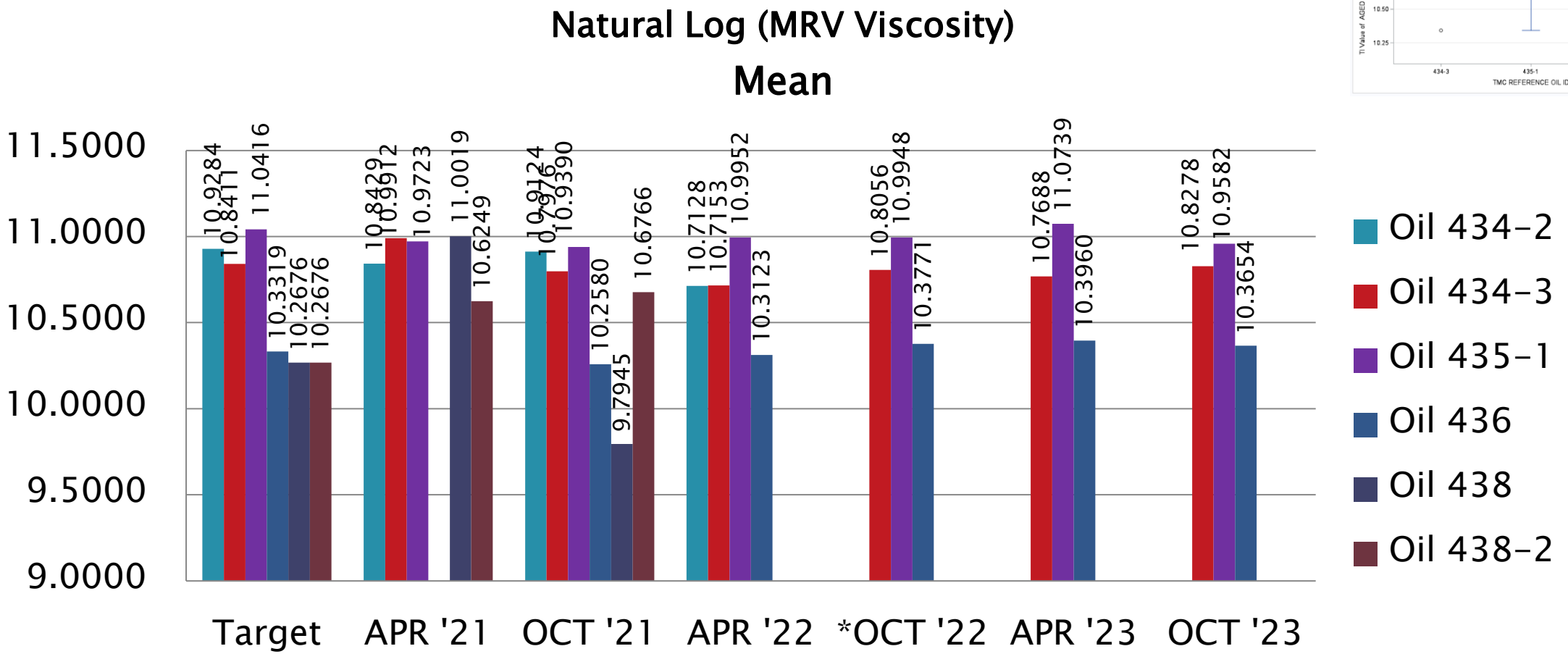


NO_2 Option D Chart

23OCT23:09:20

D7528: Oxidation by ROBO



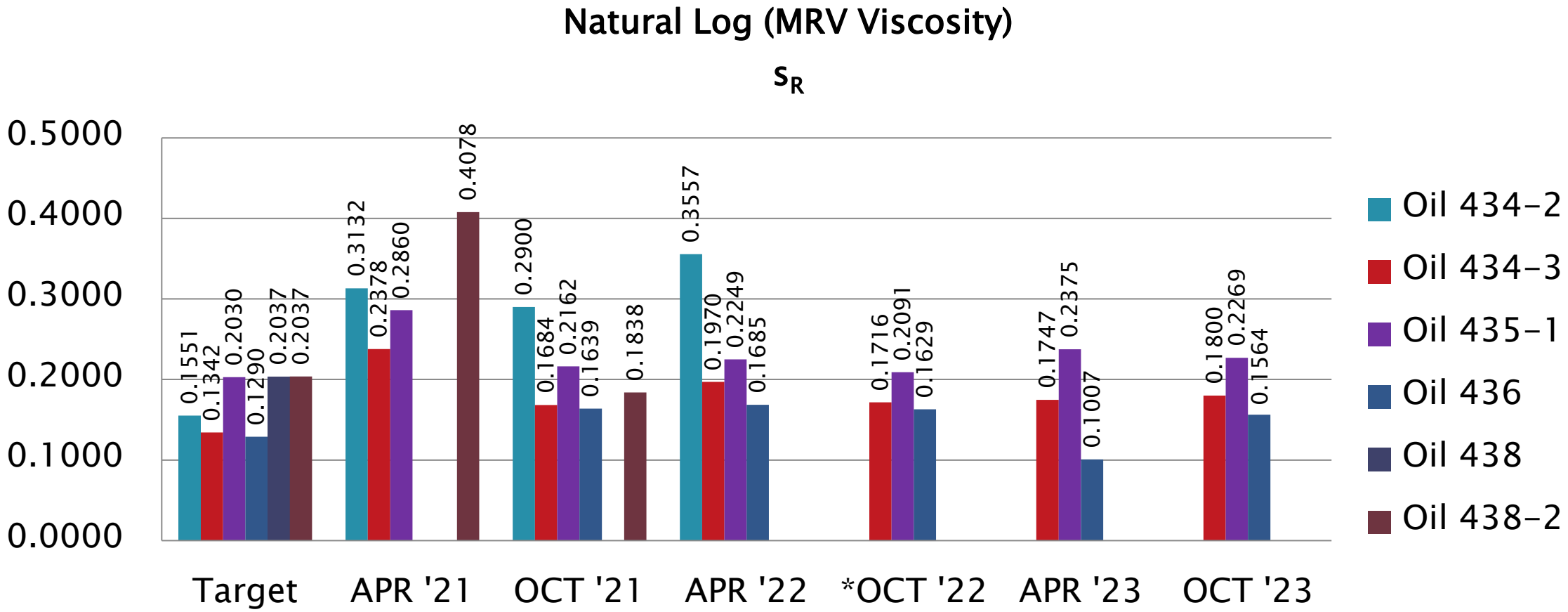


* SINGLE OIL 434-2 RUN NOT INCLUDED IN THIS ANALYSIS

April 1, 2023 – September 30, 2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D7528: Oxidation by ROBO

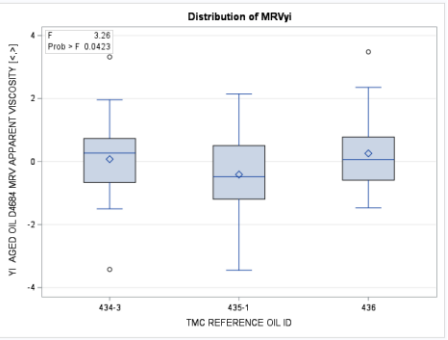


* SINGLE OIL 434-2 RUN NOT INCLUDED IN THIS ANALYSIS

April 1, 2023 – September 30, 2023

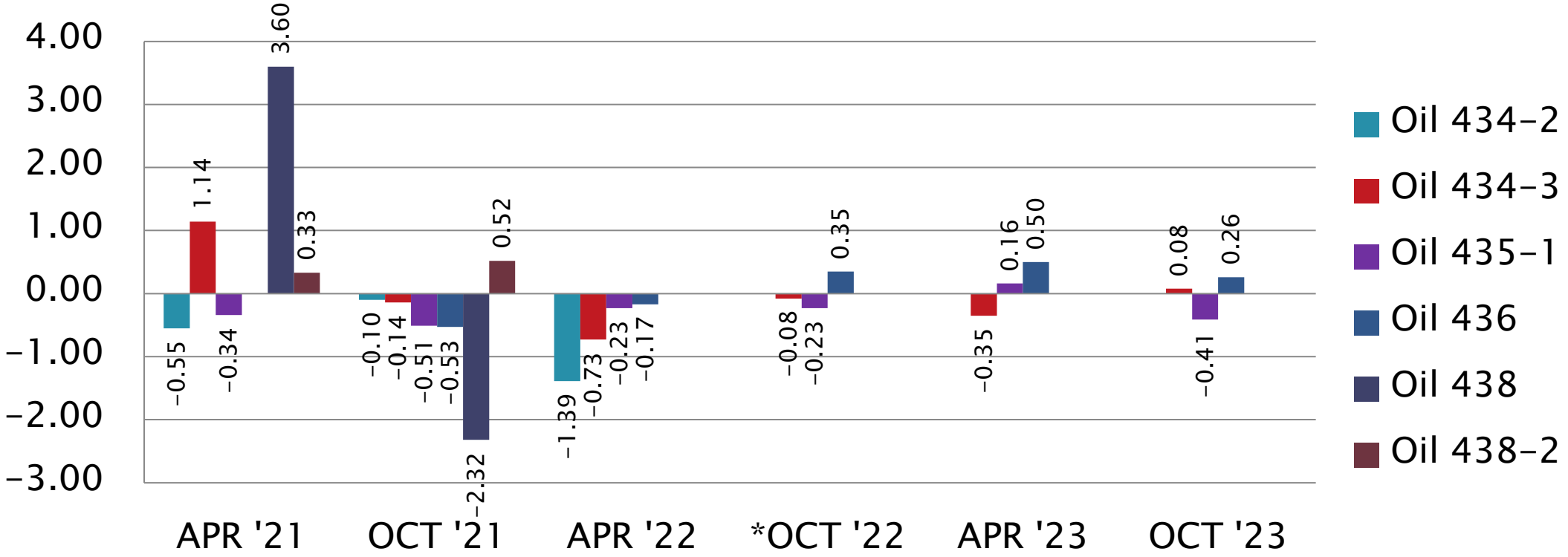
Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

D7528: Oxidation by ROBO



Natural Log (MRV Viscosity)

Mean Δ/s



* SINGLE OIL 434-2 RUN NOT INCLUDED IN THIS ANALYSIS

TABLE of CONTENTS

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Reference Oil Inventory

As of 9/30/2023

Test Monitoring Center
https://www.astmtmc.org
A Program of ASTM International

Reference Oil Inventory

D5800

Oil	Year Rec'd By TMC[A]	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
VOLC12	2013	D5800	21.9	1.3	5+ years
VOLD12	2013	D5800	19.9	1.4	5+ years
VOLE12	2013	D5800	17.8	1.4	5+ years
VOLD18	2018	D5800QC	622	84	5+ years

[A] The integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

Reference Oil Inventory

D6417 & GI

Oil	Year Rec'd By TMC[A]	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
52	1995	D6417	59.39	<0.01	5+ years
55	1995	D6417	65.91	<0.01	5+ years
58	1998	D6417, D6417QC, GI	110.66	0.34	5+ years
GIA17	2017	GI	5.95	0.25	5+ years
GIC18	2018	GI	8.53	0.17	5+ years
1009	2002	GI	33.94	1.63	5+ years

[A] The integrity of TMC reference oils is confirmed annually by analytical QC testing of chemical and physical properties.

Reference Oil Inventory

TEOST, MTEOS & ROBO

Oil	Year Rec'd By TMC[A]	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
432	1998	MTEOS	101.76	0.14	5+ years
75-1	2016	TEOST	2.04	0.56	1.5 years
435-2[B]	2010	TEOST	30.67	3.93	5+ years
434-3[B]	2017	TEOST/ROBO	22.81	2.19	5+ years
435-1	2008	ROBO	51.25	3.75	5+ years
436[B]	2014	ROBO	36.97	1.83	5+ years

[A]The 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.

Reference Oil Inventory

D6082 & D874

Oil	Year Rec'd By TMC[A]	Tests	TMC Inventory, gallons	Gallons Shipped last 6 months	Estimated Life
FOAMB18	2018	D6082	71.06	7.24	5+ years
66	2002	D6082	68.25	3.65	5+ years
820-2	2001	D874	5.50	0.03	5+ years
90[B]	2005	D874/D874QC	4.39	2.51	1.5 years
91	2006	D874	3.10	0.03	5+ years
92	2020	D874	52.63	0.19	5+ years

[A] The 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.

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	436.8	EOWT	320	25.8	5+ years
79	201.0	EOWT	320	25.8	2.7 years
		EOFT	134	10.8	

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

Reference Oil Inventory Estimated Life

D6594

Oil	TMC Inventory (gallons)	Quantity Shipped in last 6 months (gallons)	Lab Assignments Made	Estimated Life
44-4	2.6	1.1	53	<1 year
44-5	52	1.0	35	>5 year
1005-5	43.25 (Reserved drum – Additional oil available at the TMC)	6.65	212	>5 years

Reference Oil Inventory Estimated Life

EOEC & LDEOC

Oil	TMC Inventory Gallons	Gallons Shipped Past 6 Months	Estimated Life[C]
SL107[A, B]	1971	203	3.7 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 will accelerate due to addition of new Elastomers for ILSAC GF-7 Category

TABLE of CONTENTS

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

A Program of ASTM International