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

D6417, D5800, D6335 (TEOST), D7097 (MTEOS), D5133 (GI), D6082, D874 and D7528 (ROBO)

October 2013

B0.07 Bench Testing Executive Summary

- D6417 (Volatility by GC)
  - Degraded precision
    - Less precise than target precision
  - Performance 0.17 s severe

- D5800 (Volatility by Noack)
  - Precision comparable to prior period and to target precision
  - Three severe results on same instrument biasing precision and severity
  - Long-term severe trend with increase in severity since 01JUL06

  - Oil 52 continues to perform severe (0.96 s)
    - Since 4/1/2009, 33 of 38 statistically failing tests were severe fails on oil 52

  - Surveillance Panel is working to address severity issue
    - Operational survey issued to participating labs 2012
    - Teleconferences held
    - Workshop January 2013
    - **Round robin for new reference oils completed and replacement oils selected**
      - **New reference oils introduced coincident with start of next TMC report period**

B0.07 Bench Testing
Executive Summary

- D5133 (Gelation Index)
  - Improved precision
    - More precise than target precision
  - Performance 0.17 s severe
  - No issues

B0.07 Bench Testing Executive Summary

- D6335 (TEOST-33C)
  - Targets updated 4/15/13 to include ~50% calibration data and ~50% RR data
  - Precision (Pooled s) is less precise than prior period
    - Less precise than the NEW target precision
  - Performance (Mean Δ/s) is on target
- D7097 (MHT-4 TEOST)
- Precision (Pooled s) is comparable to prior period
  - Less precise than target precision
- Performance (Mean Δ/s) is 0.19 s severe
  - Unusually severe performance on severe oil 432
    - Coincident with catalyst batch 1208, but improves with introduction of batch 1307
    - Significant lab performance differences observed

B0.07 Bench Testing Executive Summary

- D6082 (High Temperature Foam)
  - More precise than target precision
  - Performance -0.32 s mild
  - All operationally valid discrimination runs demonstrated acceptable discrimination

- D874 (Sulfated Ash)
  - More precise than target precision
  - Performance -0.12 s mild
  - No issues

B0.07 Bench Testing
Executive Summary

- D7528 (ROBO)
  - Less precise than target, but more precise than prior report period
  - Performance –0.94 s mild
    - **Significantly more mild than prior periods!**
    - All three reference oils continue to perform mild
    - Only one lab of seven on target, overall
      - One lab 1 s severe
      - Five labs 1 s or more mild

Calibrated Labs and Stands*

Test	Labs	Stands
D6417	5	7
D5800	6	12
D5133 (GI)	4	6
D6335 (TEOST)	5	7
D7097 (MTEOS)	7	31
D6082	4	5
D874	3	---
D7528 (ROBO)	5	13

*As of 9/30/2013

D02.B0.07
TMC Monitored Tests

- April 1, 2013 –
  September 30, 2013

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D6417: Estimation of Engine Oil Volatility by Capillary GC

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	16
Failed Calibration Test	OC	1
Operationally Invalidated by Lab	LC, XC	1
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		**18**

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 6%

D6417: Estimation of Engine Oil Volatility by Capillary GC

Statistically Unacceptable Tests (OC)	No. Of Tests
Volatility Loss Mild	1
Volatility Loss Severe	0

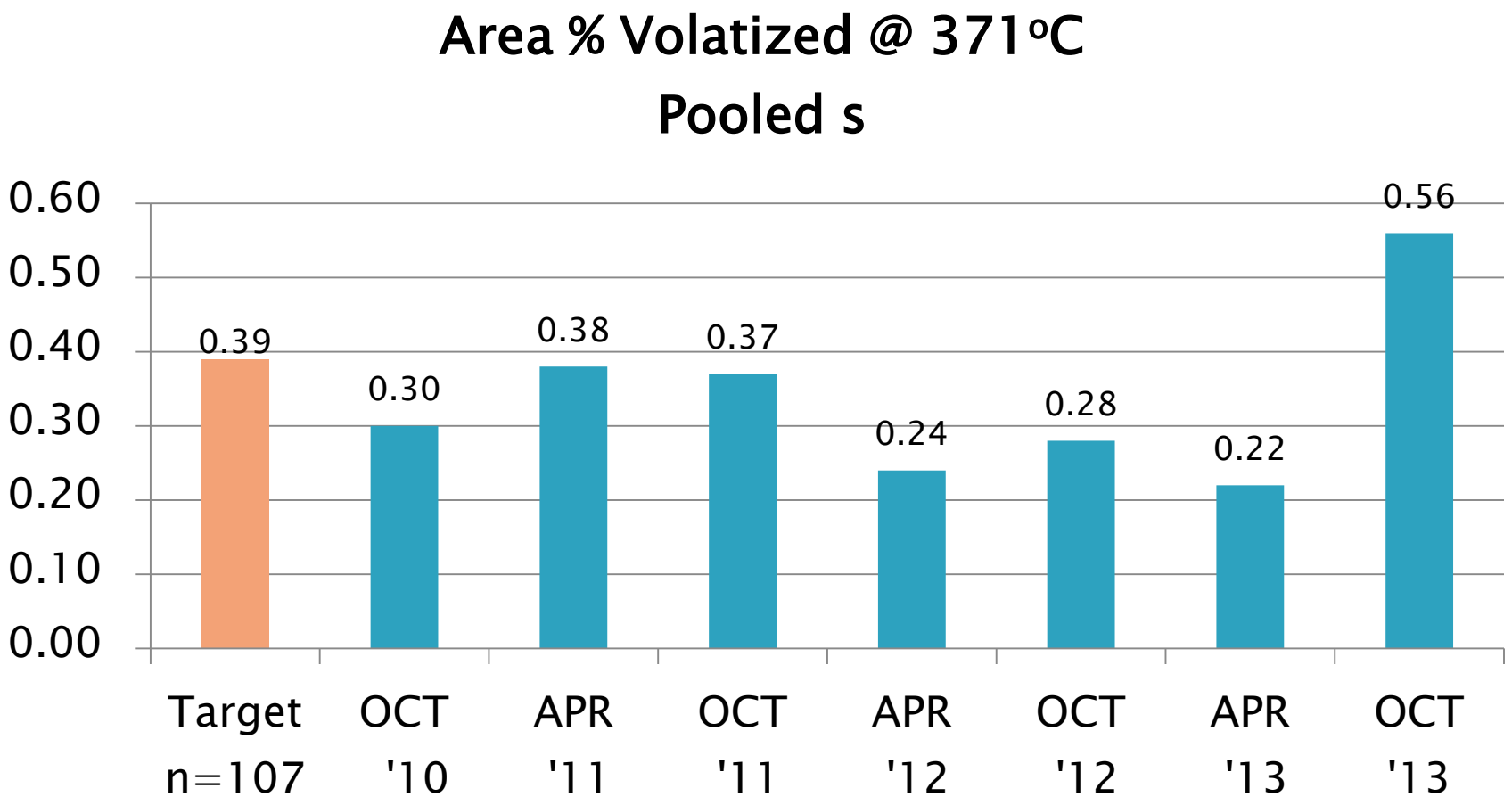
- Reasons for Operationally Invalid Tests:
  - 1 test with incorrect QC check sample (LC)
- No TMC technical updates issued this period

D6417: Estimation of Engine Oil Volatility by Capillary GC

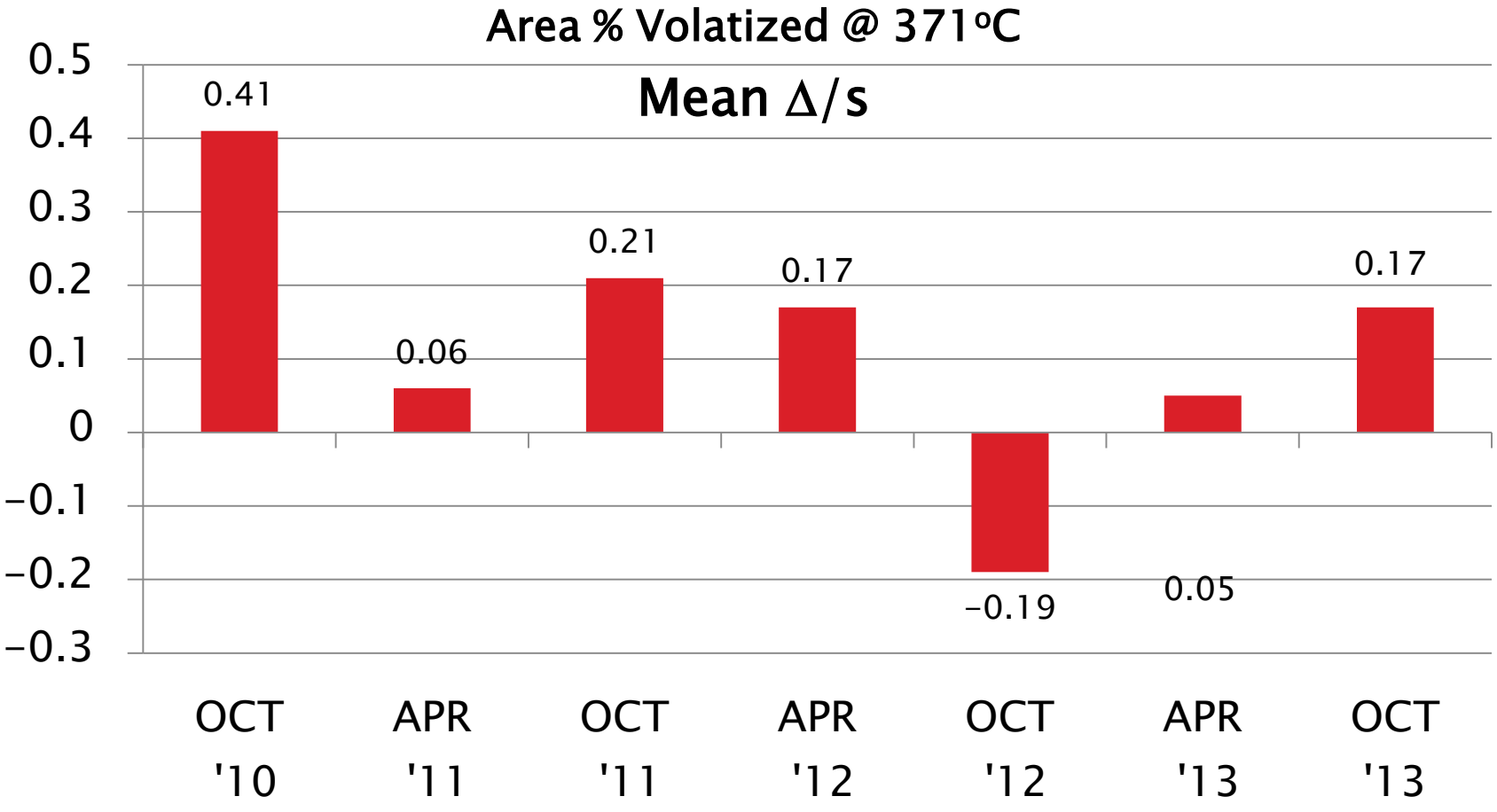
Period Precision and Severity Estimates

Area % Volatized @ 371°C	n	df	Pooled s	Mean Δ/s
Initial Selected Oils from RR	54	51	0.39	-----
4/1/10 through 9/30/10	16	13	0.30	0.41
10/1/10 through 3/31/11	20	17	0.38	0.06
4/1/11 through 9/30/11	16	13	0.37	0.21
10/1/11 through 3/31/12	14	11	0.24	0.17
4/1/12 through 9/30/12	15	12	0.28	-0.19
10/1/12 through 3/31/13	14	11	0.22	0.05
4/1/13 through 9/30/13	17	14	0.56	0.17

D6417 Precision Estimates



D6417 Severity Estimates

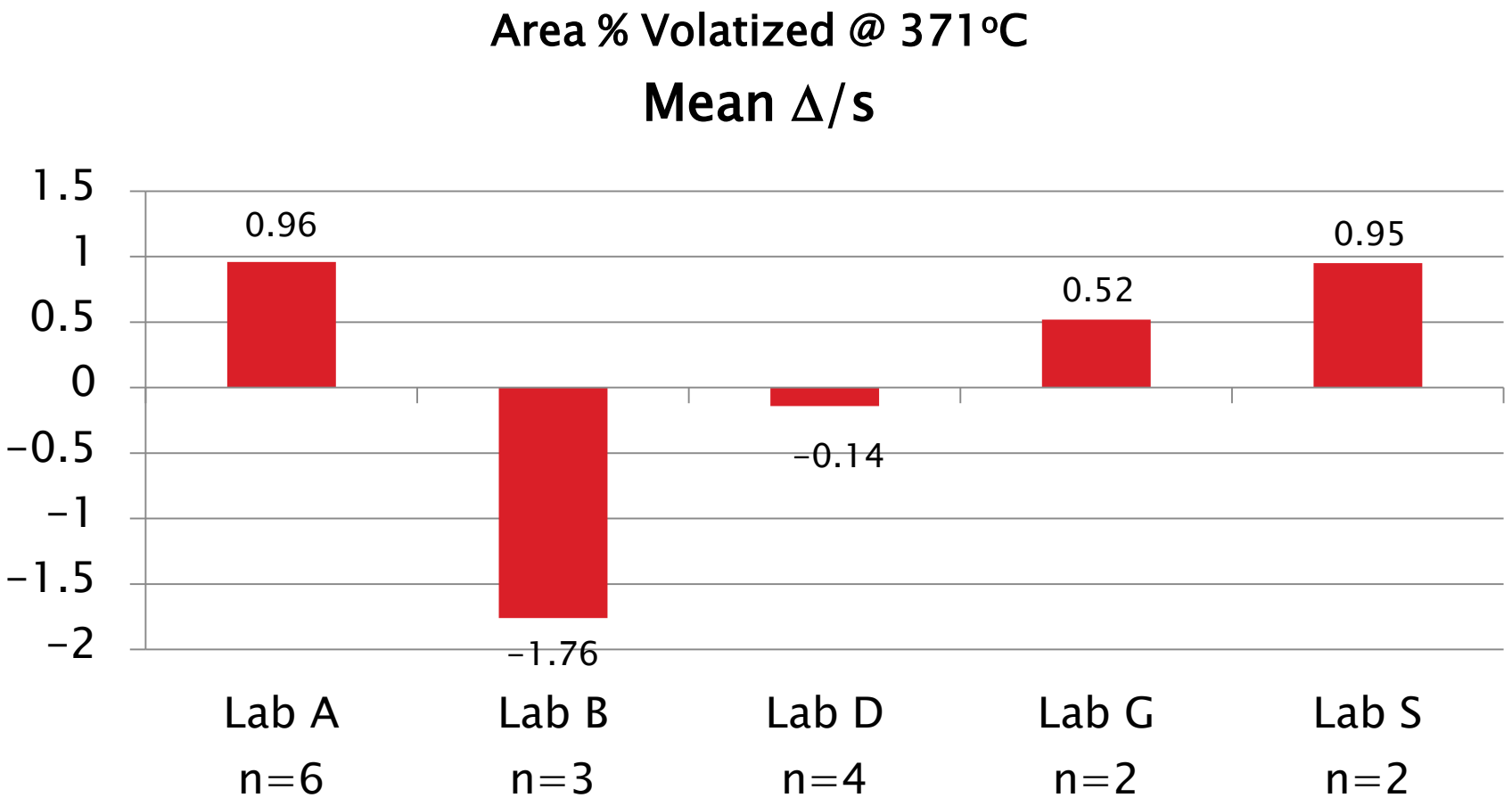


D6417: Estimation of Engine Oil Volatility by Capillary GC

Current Period Severity Estimates by Lab
Area % Volatized @ 371°C

	n	Mean Δ/s
Lab A	6	0.96
Lab B	3	-1.76
Lab D	4	-0.14
Lab G	2	0.52
Lab S	2	0.95

D6417 Lab Severity Estimates



D6417: Estimation of Engine Oil Volatility by Capillary GC

- Precision (Pooled s) is degraded
  - Less precise than the target precision
- Performance (Mean Δ/s) is slightly severe (0.17 s)
- Severity plot shows overall nearly on-target performance since the 01OCT11 timeline

D6417 VOLATILITY BY GC INDUSTRY OPERATIONALLY VALID DATA

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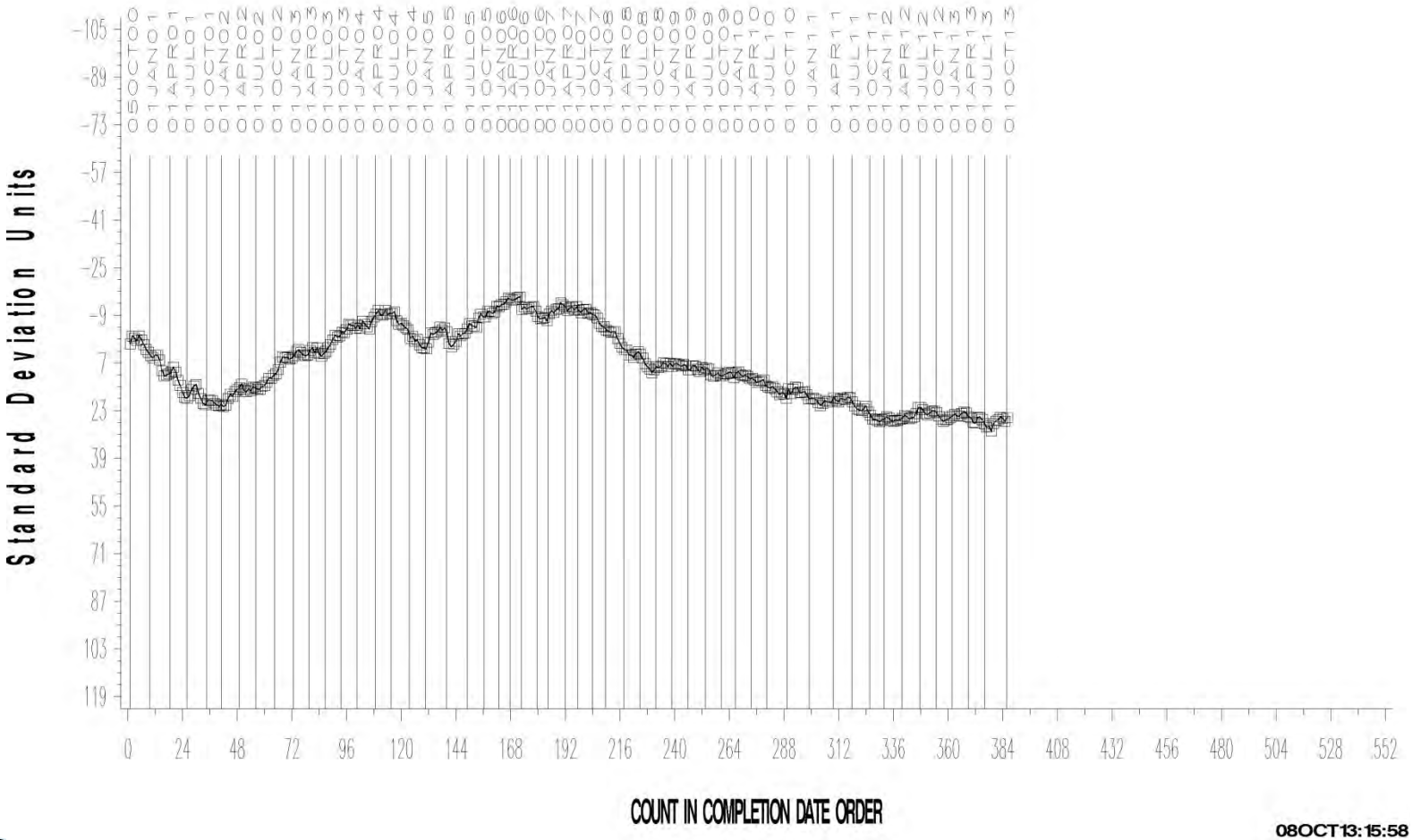
SAMPLE AREA % VOLATIZED

CUSUM Severity Analysis



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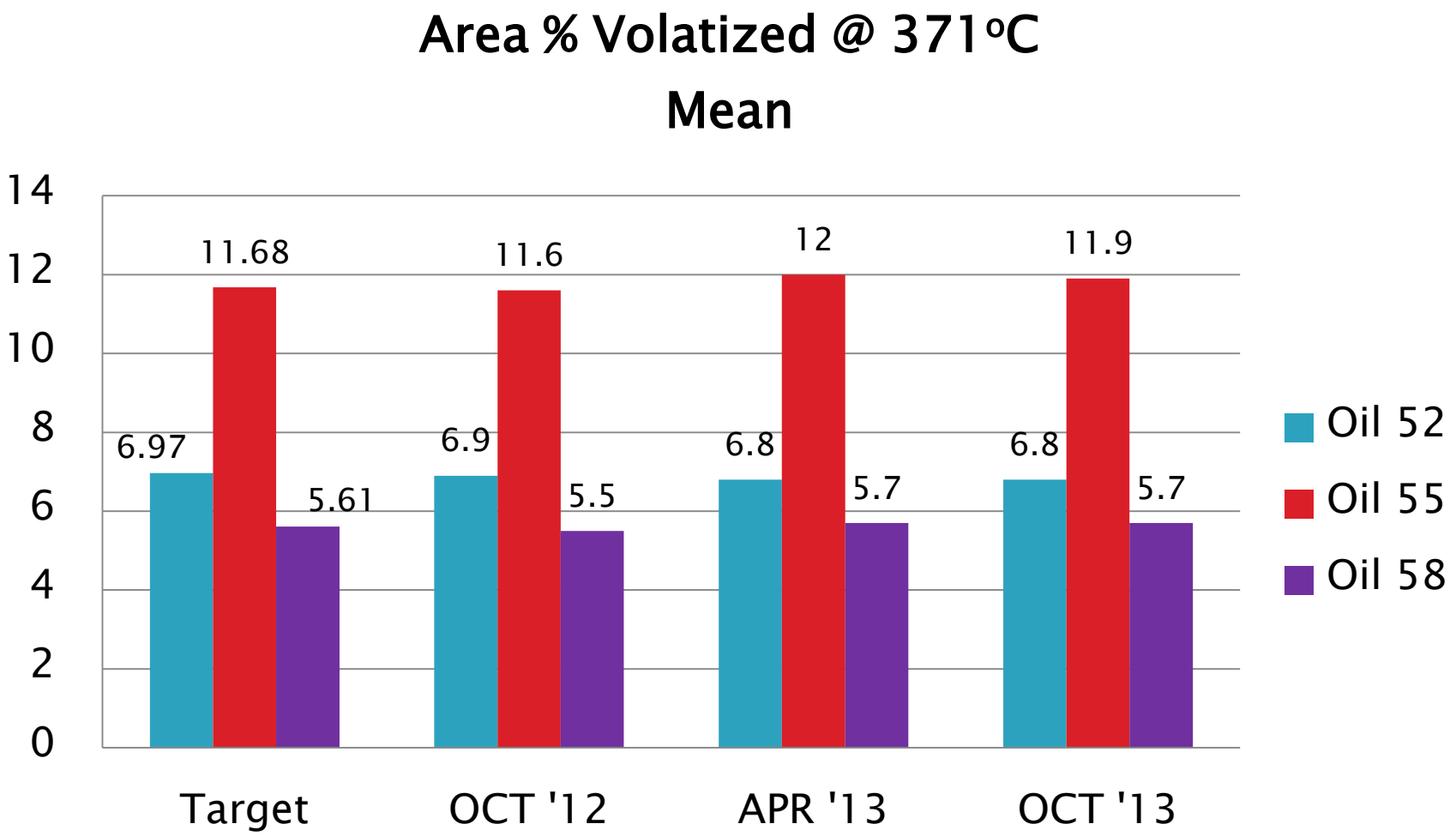
D6417: Estimation of Engine Oil Volatility by Capillary GC

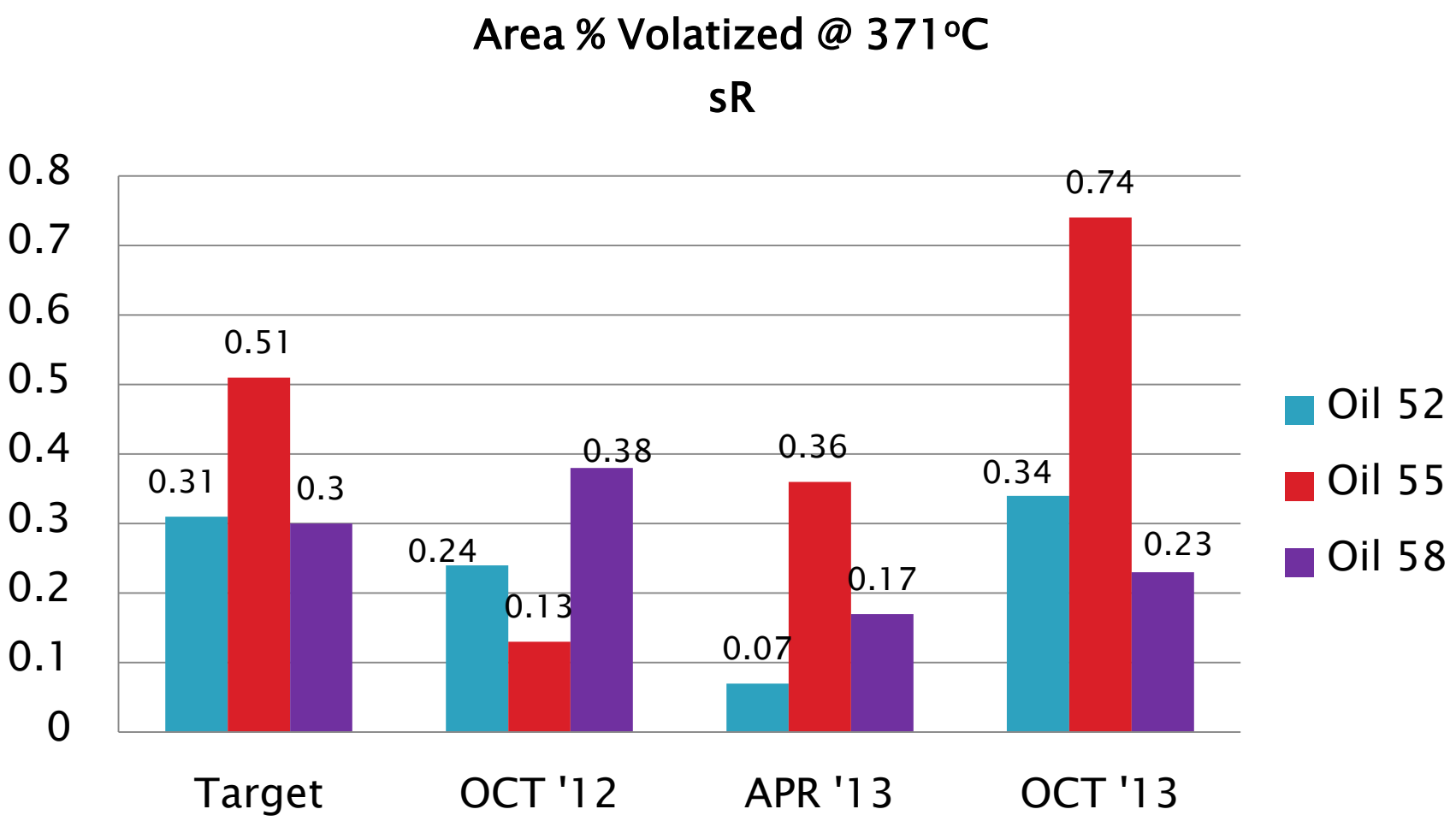
Area % Volatized @ 371°C
Performance by Oil

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 - 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
52	18	6.97	0.31	6	6.9	0.24	-0.12	5	6.8	0.07	-0.55	4	6.8	0.34	-0.47
55	18	11.68	0.51	4	11.6	0.13	-0.25	4	12.0	0.36	0.63	8	11.9	0.74	0.36
58	18	5.61	0.30	5	5.5	0.38	-0.23	5	5.7	0.17	0.19	5	5.7	0.23	0.37

D6417 Performance by Oil



D6417 Performance by Oil



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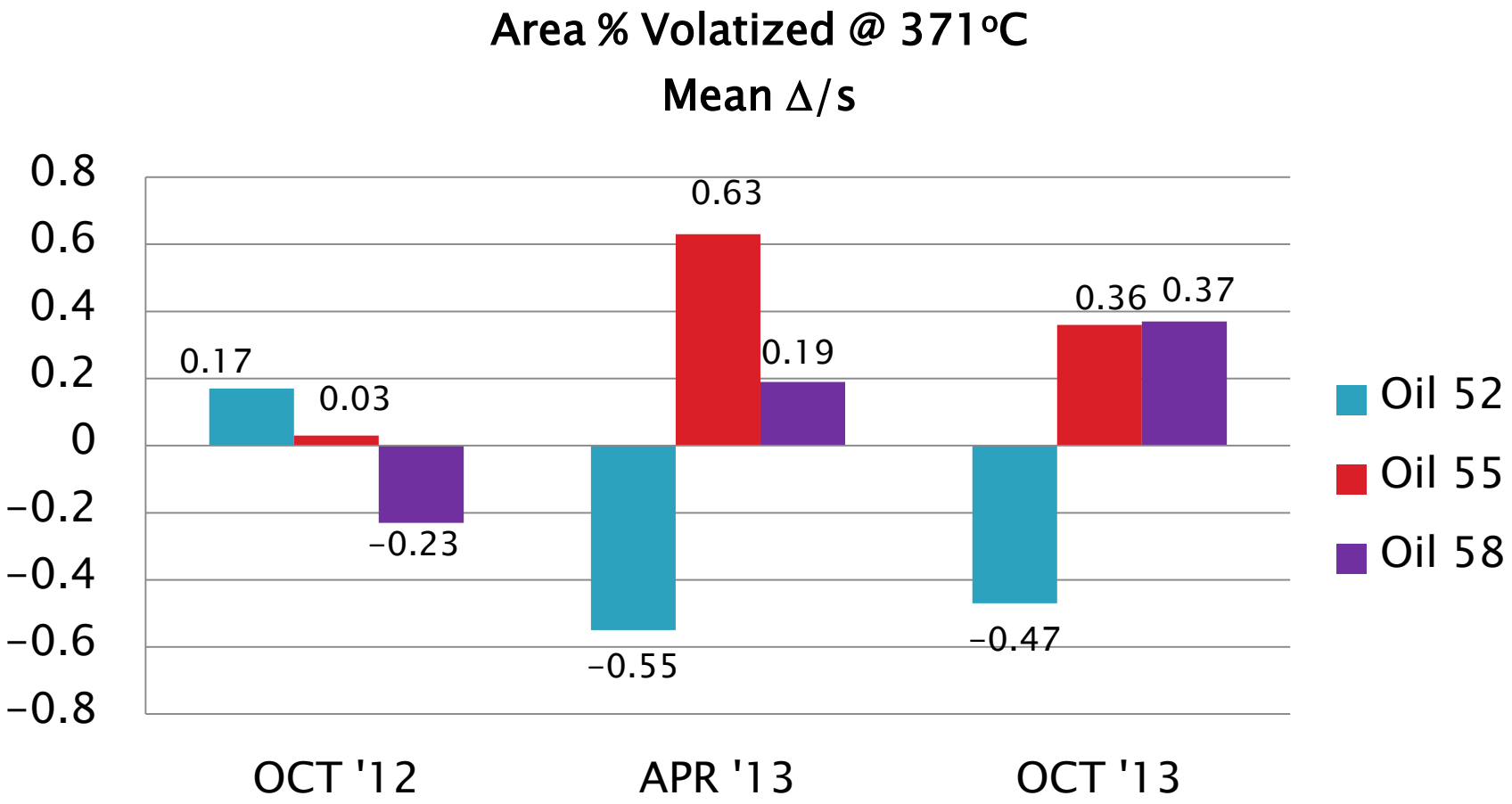
D6417 Performance by Oil



Return to Executive Summary

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	27
Failed Calibration Test	OC	3
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC, MC	1
Round Robin Tests (New Oils)	AG, RG	108
Decoded for Shakedown	NN	2
Total		**141**

Number of Labs Reporting Data: 8
Fail Rate of Operationally Valid Tests: 10%

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Statistically Unacceptable Tests (OC)	No. Of Tests
Evaporation Loss Mild	0
Evaporation Loss Severe	3

- Three consecutive severe fails on one instrument
  - Lab A, Instrument 5
  - One fail each on oils 52, 55 and 58
  - No passing runs on instrument this period.
  - All reported as operationally valid (OC)

D5800: Evaporation Loss of Lubricating Oil by Noack Method

- No operationally invalid tests reported this period but one severe fail result excluded from statistics
  - new instrument with no prior passing runs.

- Reference oils replaced shortly after end of report period based on extensive round robin by participating labs using all TMC calibrated instruments.

D5800: Evaporation Loss of Lubricating Oil by Noack Method

- One TMC Technical Update was issued just *after* the end of the report period:
  - TMC Memo 13-049, Issued October 4, 2013
    - New Reference Oils, Effective September 17, 2013
    - Replaced referenced oils 52, 55 and 58 with oils VOLC12, VOLD12, VOLE12, with new performance targets and acceptance bands

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
Current Targets 7/21/2003	102	99	0.70	-----
10/1/10 through 3/31/11	34	31	0.76	0.49
4/1/11 through 9/30/11	39	36	0.59	0.77
10/1/11 through 3/31/12	32	29	0.78	0.54
4/1/12 through 9/30/12	33	30	0.67	0.56
10/1/12 through 3/31/13	33	30	0.79	0.43
4/1/13 through 9/30/13*	30	27	0.72	0.58
4/1/13 through 9/30/13*	27	24	0.46	0.31

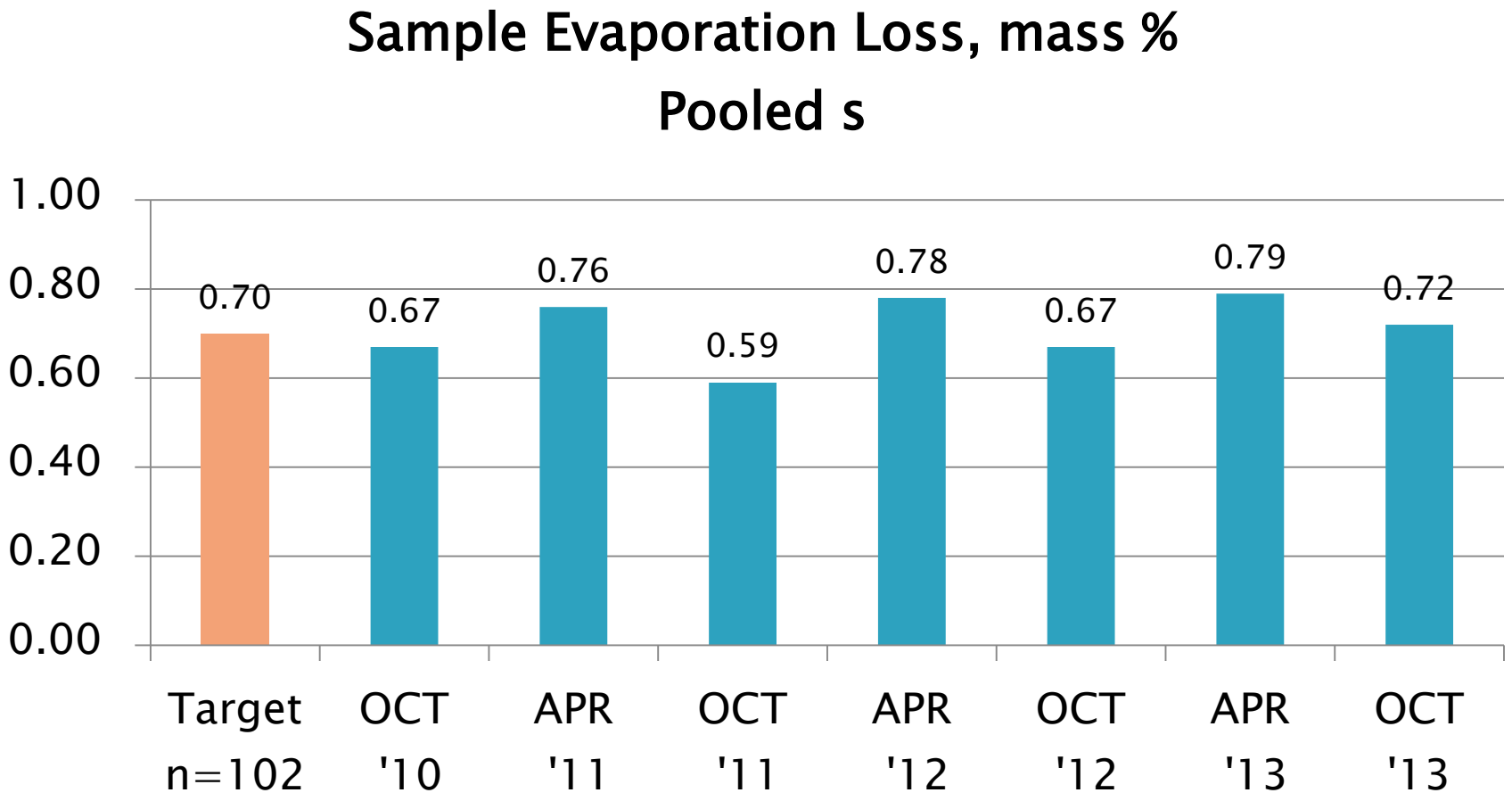
*Period statistics with 3 severe results on same instrument included and excluded

D5800: Evaporation Loss of Lubricating Oil by Noack Method

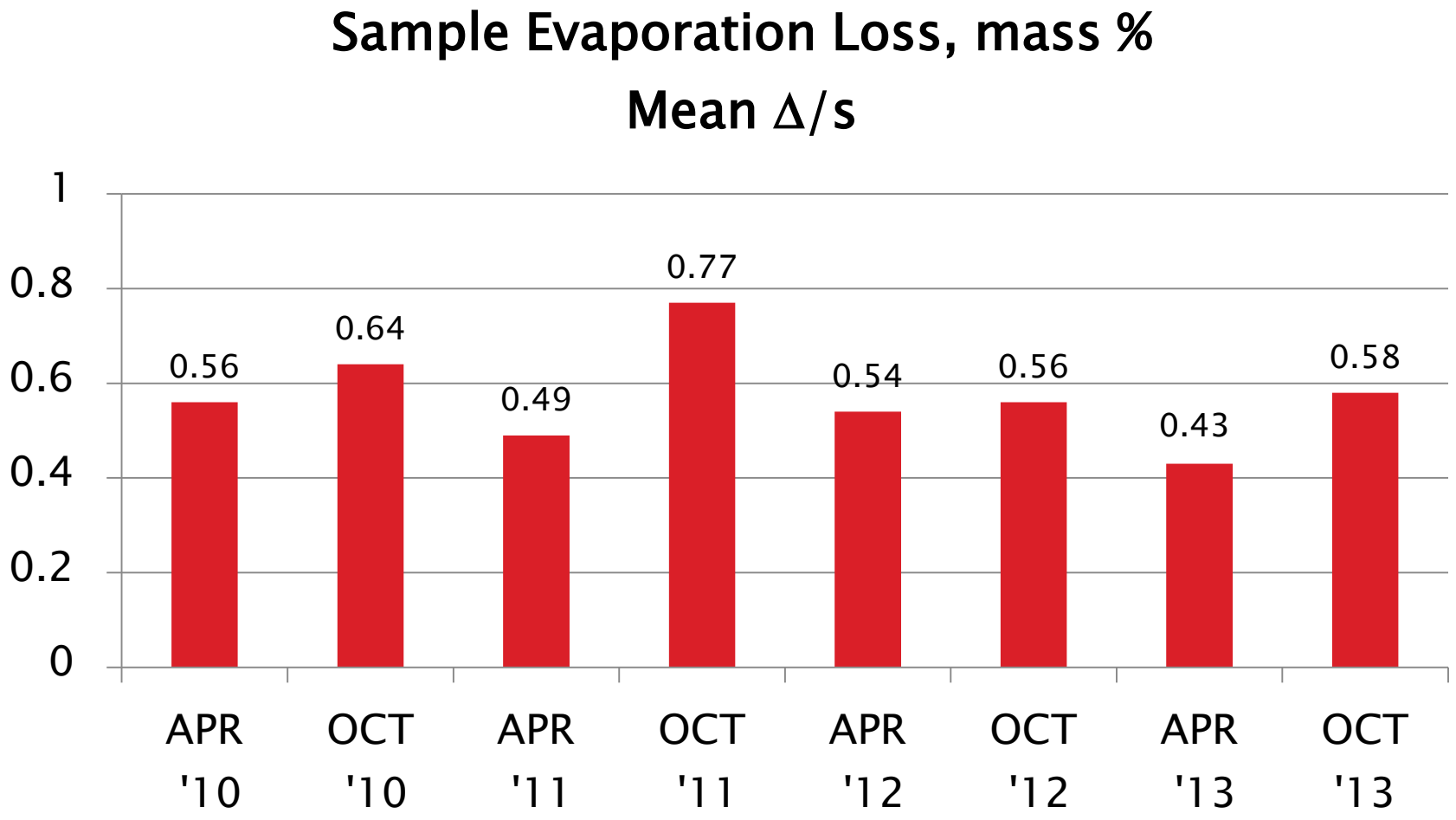
Performance Comparison by Procedure
Sample Evaporation Loss, Mass %

	n	df	Pooled s	Mean Δ/s
Procedure B	24	21	0.74	0.63
Procedure C	6	3	0.83	0.39

D5800 Precision Estimates



D5800 Severity Estimates

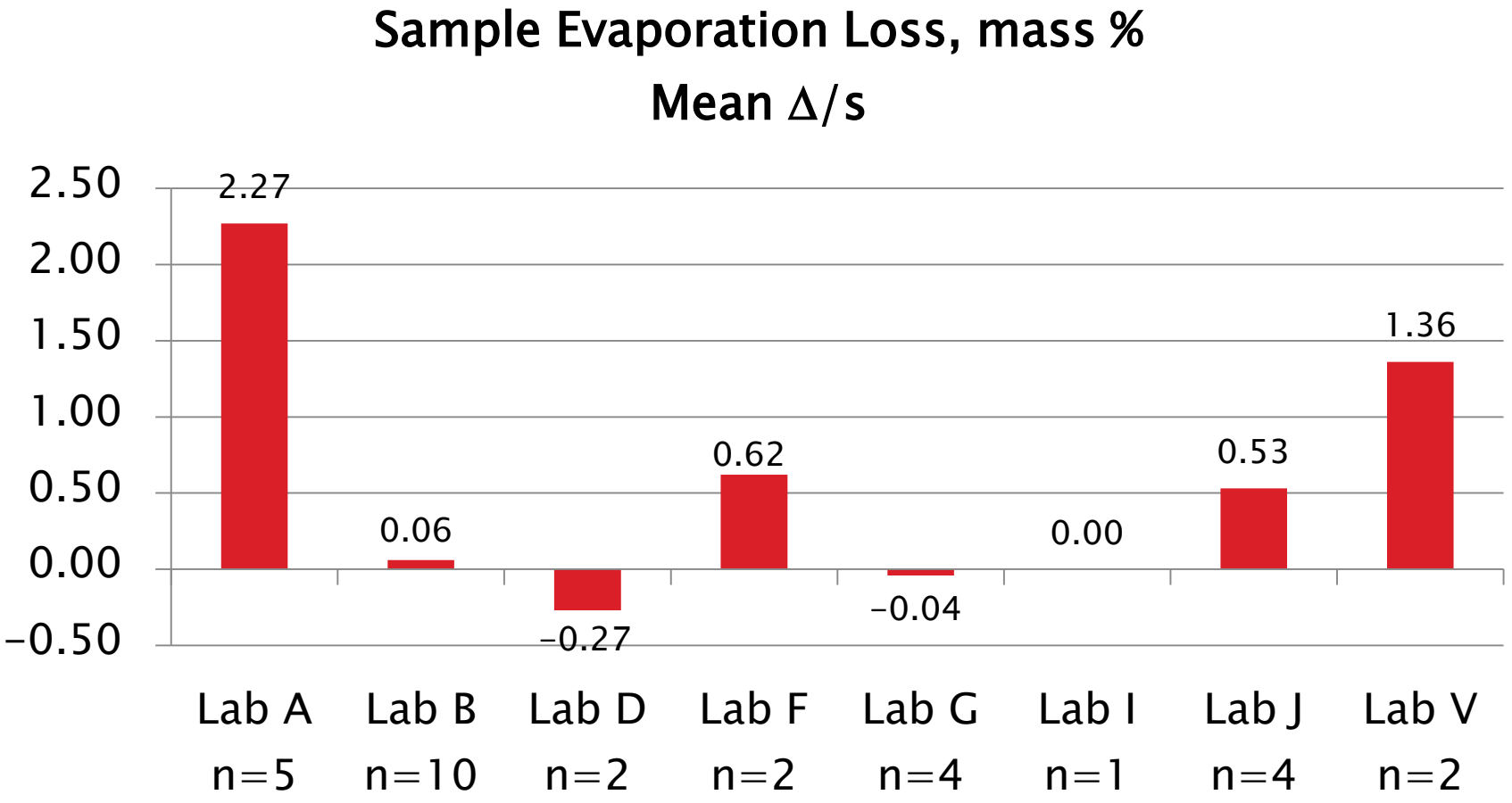


D5800: Evaporation Loss of Lubricating Oil by Noack Method

Current Period Severity Estimates by Lab
Sample Evaporation Loss, mass %

	n	Mean Δ/s
Lab A	5	2.27
Lab B	10	0.06
Lab D	2	-0.27
Lab F	2	0.62
Lab G	4	-0.04
Lab I	1	0.00
Lab J	4	0.53
Lab V	2	1.36

D5800 Lab Severity Estimates



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D5800: Evaporation Loss of Lubricating Oil by Noack Method

- All three statistically failing results this period were unexplained fails on one instrument (Lab A, Instrument 5)
- Precision (Pooled s) is comparable to prior period and to target
  - Improves significantly with instrument A5 results excluded
- Performance (Mean Δ/s) is 0.58 s severe
  - 0.31 s severe with instrument A5 results excluded
- Severity plot shows unexplained long-term severe trend since 01JUL06 timeline
- Since 4/1/2009, 33 of 38 statistically failing tests were on oil 52
  - All severe of acceptance bands

D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

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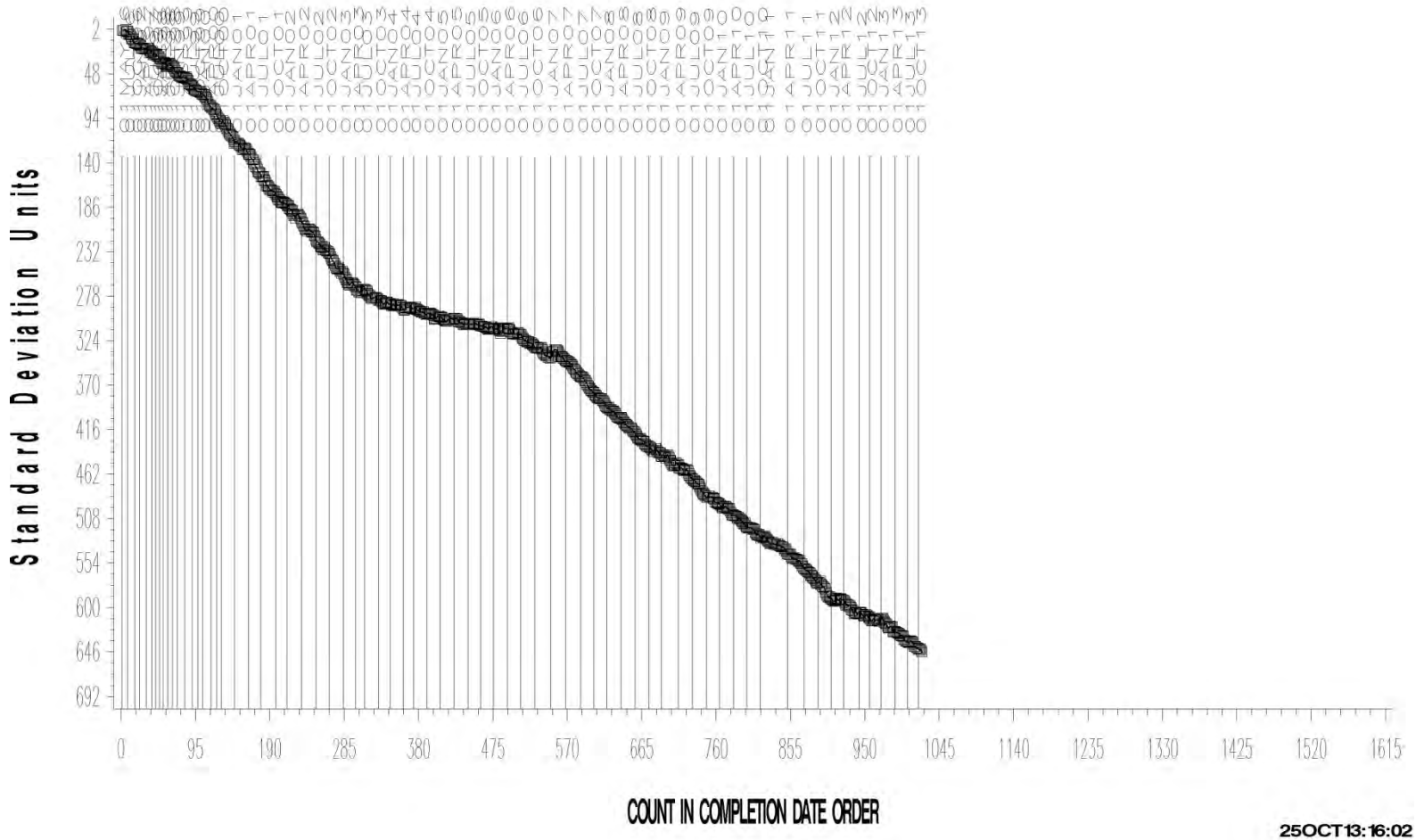
EVAPORATION LOSS, MASS%

CUSUM Severity Analysis



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D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

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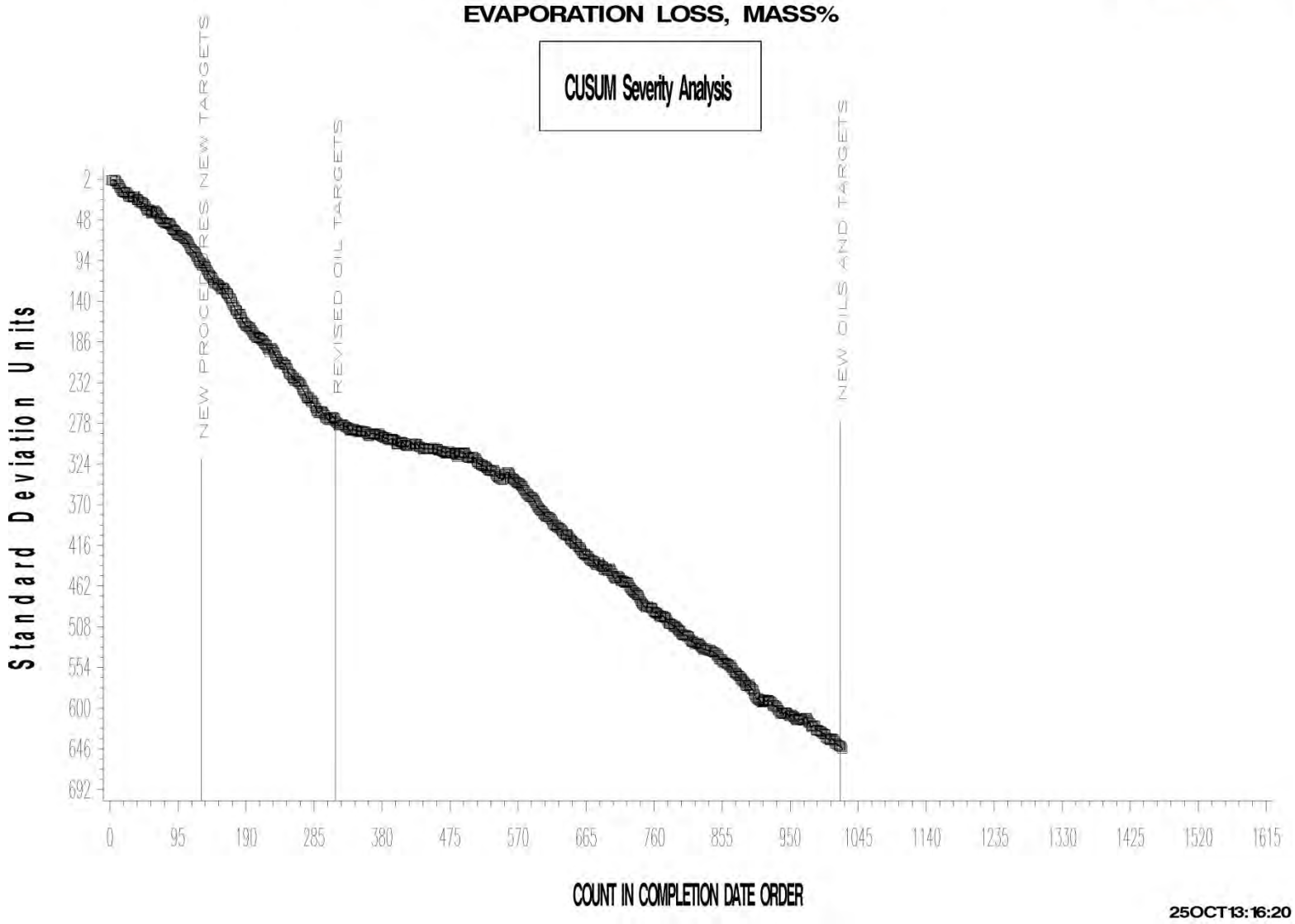
EVAPORATION LOSS, MASS%



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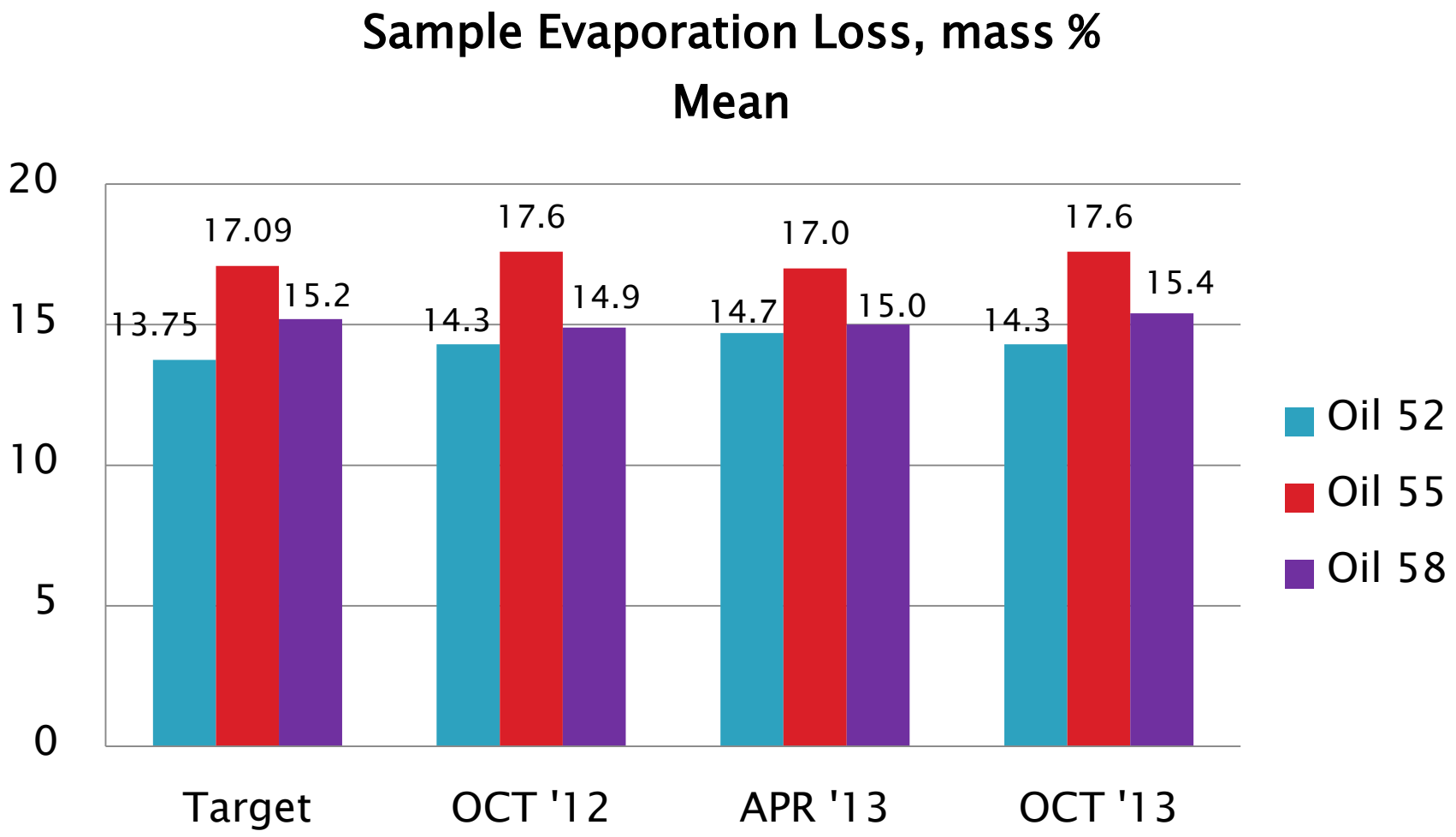
D5800: Evaporation Loss of Lubricating Oil by Noack Method

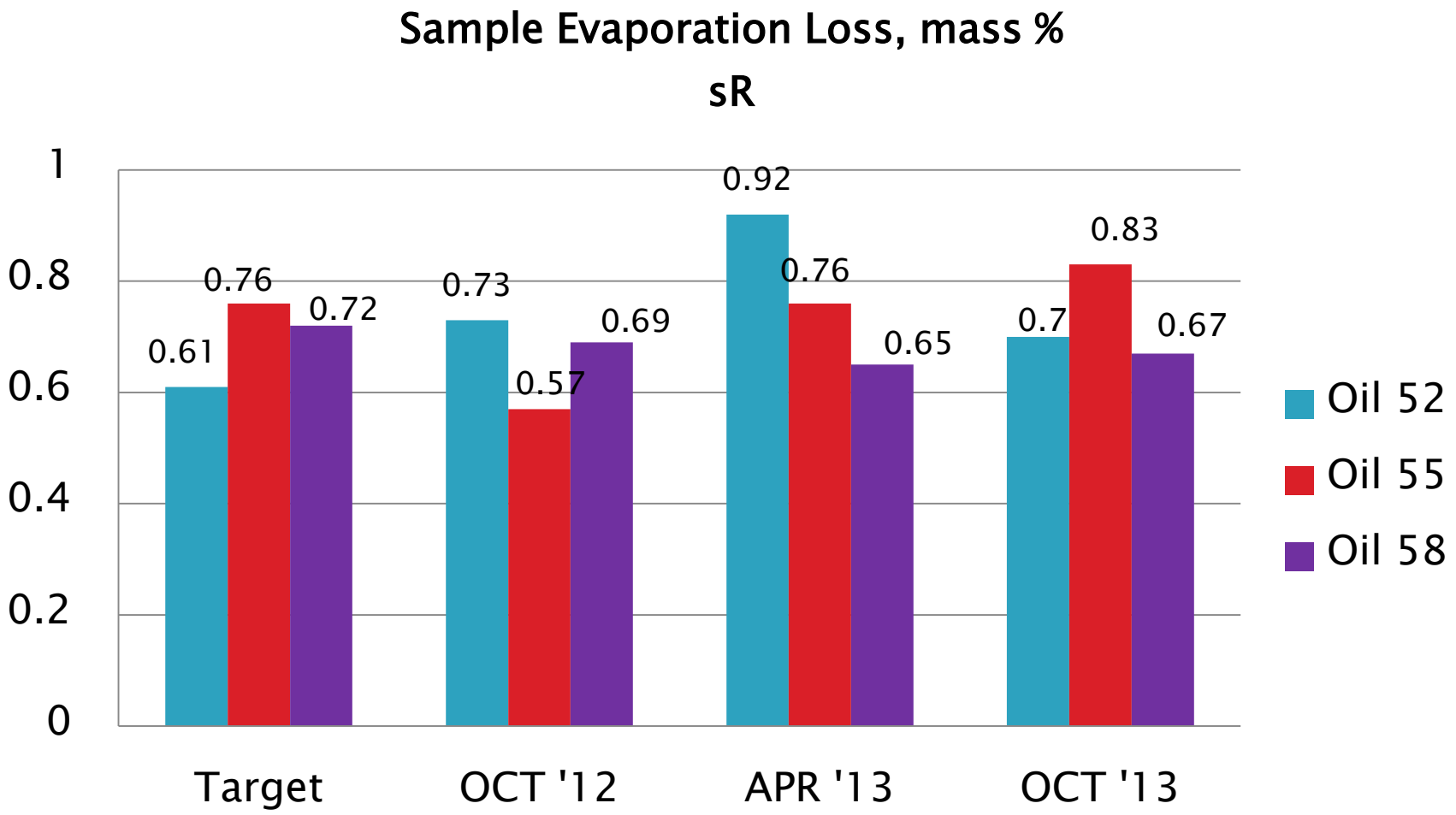
Sample Evaporation Loss, mass %
Performance by Oil

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 – 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
52	33	13.75	0.61	14	14.3	0.73	0.98	12	14.7	0.92	1.49	9	14.3	0.70	0.96
55	32	17.09	0.76	12	17.6	0.57	0.66	10	17.0	0.76	-0.12	7	17.6	0.83	0.61
58	37	15.20	0.72	7	14.9	0.69	-0.46	11	15.0	0.65	-0.23	14	15.4	0.67	0.32

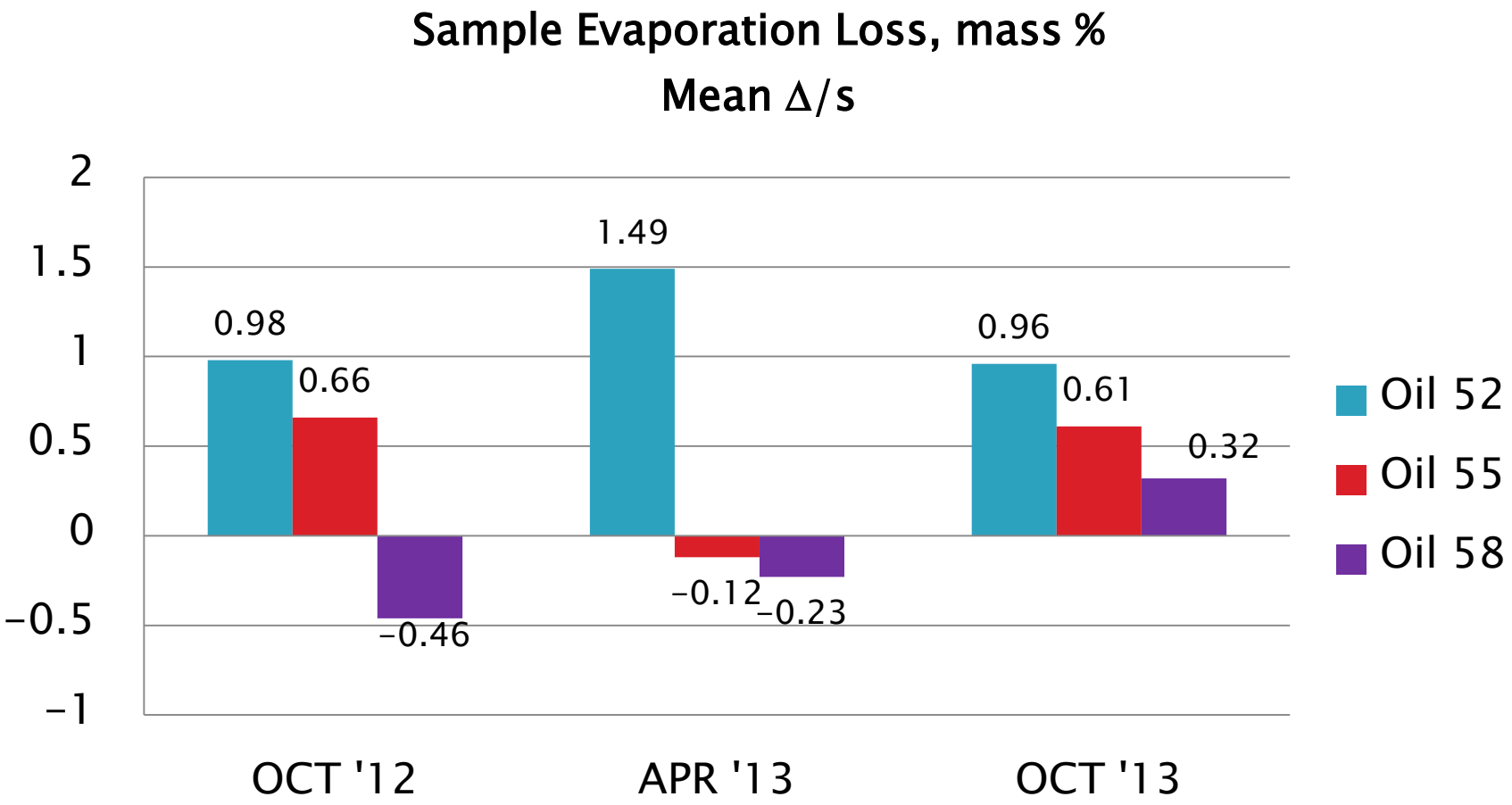
D5800 Performance by Oil



D5800 Performance by Oil



D5800 Performance by Oil



Return to Executive Summary

D5133: Gelation Index

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	18
Failed Calibration Test	OC	1
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	3
Total		**22**

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

D5133: Gelation Index

Statistically Unacceptable Tests (OC)	No. Of Tests
Gelation Index Mild	0
Gelation Index Severe	1

- Reasons for Operationally Invalid Tests:
  - 1 test had not run a recent internal instrument calibration (RC)
  - 2 tests (same instrument) found to have inaccurate thermocouple readings (RC)

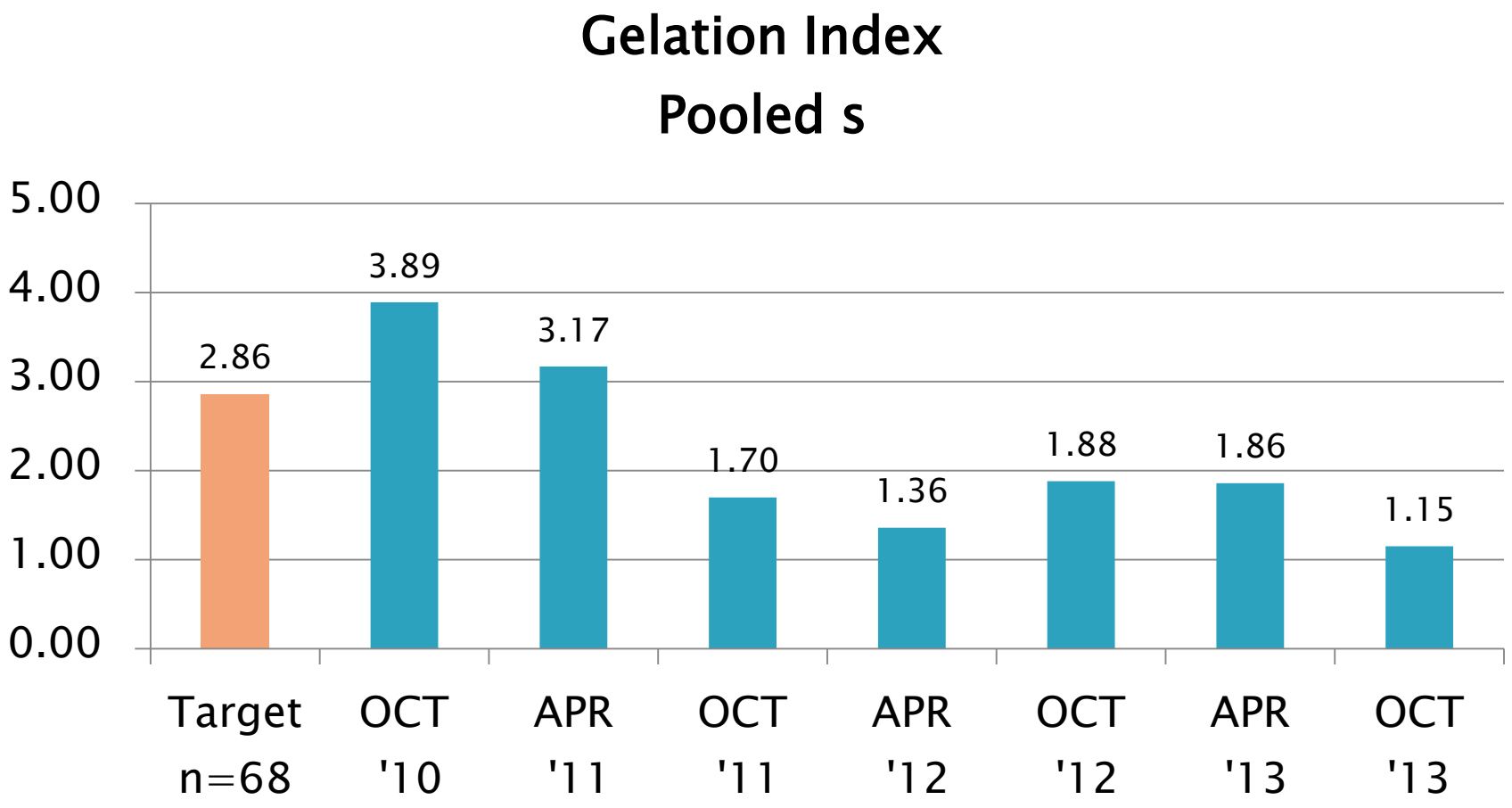
- One TMC technical update issued this period
  - Memo 13-048, 9/25/13, Updated Test Method

D5133: Gelation Index

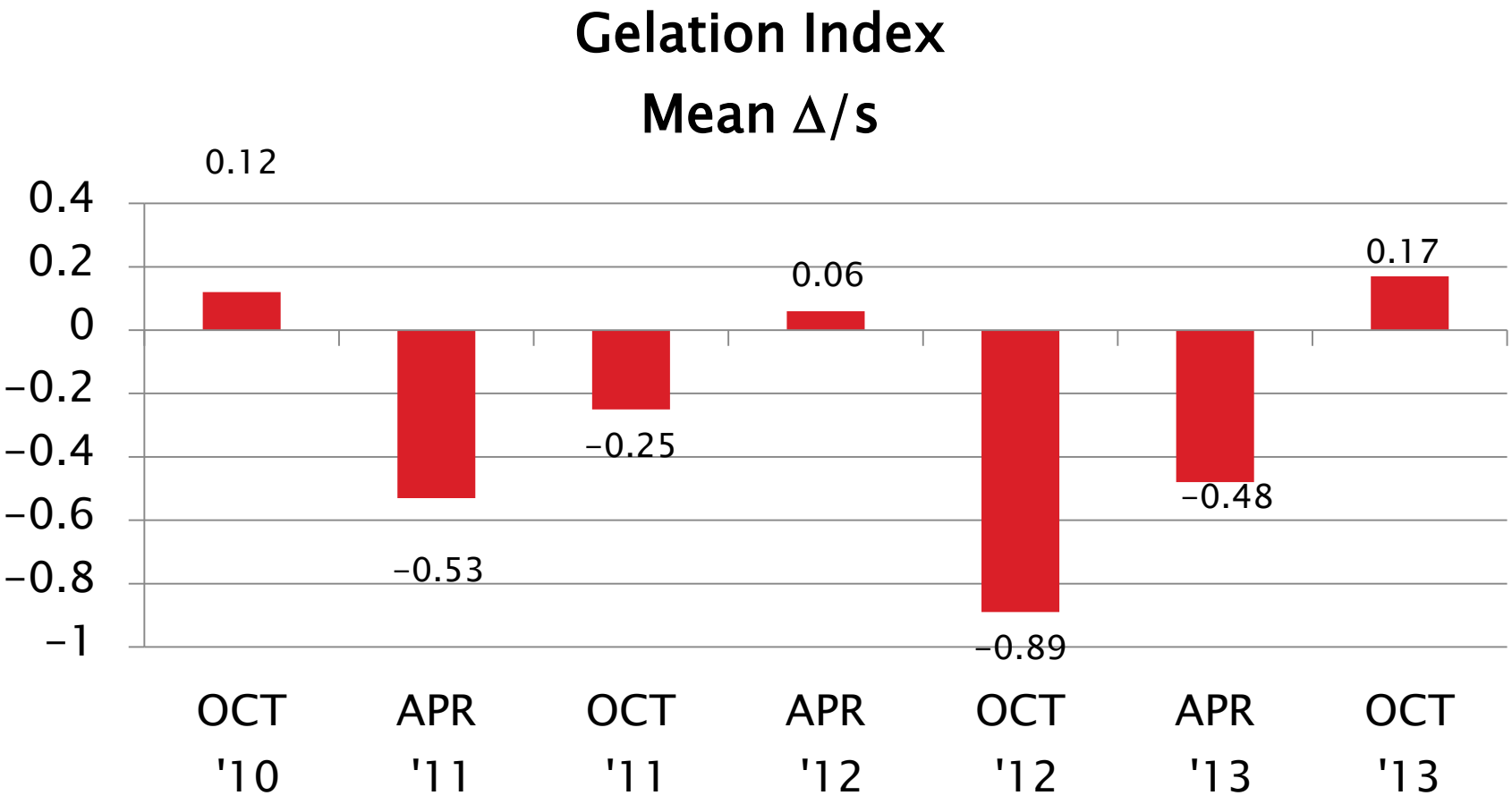
Period Precision and Severity Estimates

Gelation Index	n	df	Pooled s	Mean Δ/s
Current Targets 7/15/2003	68	65	2.86	-----
4/1/10 through 9/30/10	24	21	3.89	0.12
10/1/10 through 3/31/11	33	30	3.17	-0.53
4/1/11 through 9/30/11	23	20	1.70	-0.25
10/1/11 through 3/31/12	24	21	1.36	0.06
4/1/12 through 9/30/12	24	21	1.88	-0.89
10/1/12 through 3/31/13	22	19	1.86	-0.48
4/1/13 through 9/30/13	19	16	1.15	0.17

D5133 Precision Estimates



D5133 Severity Estimates



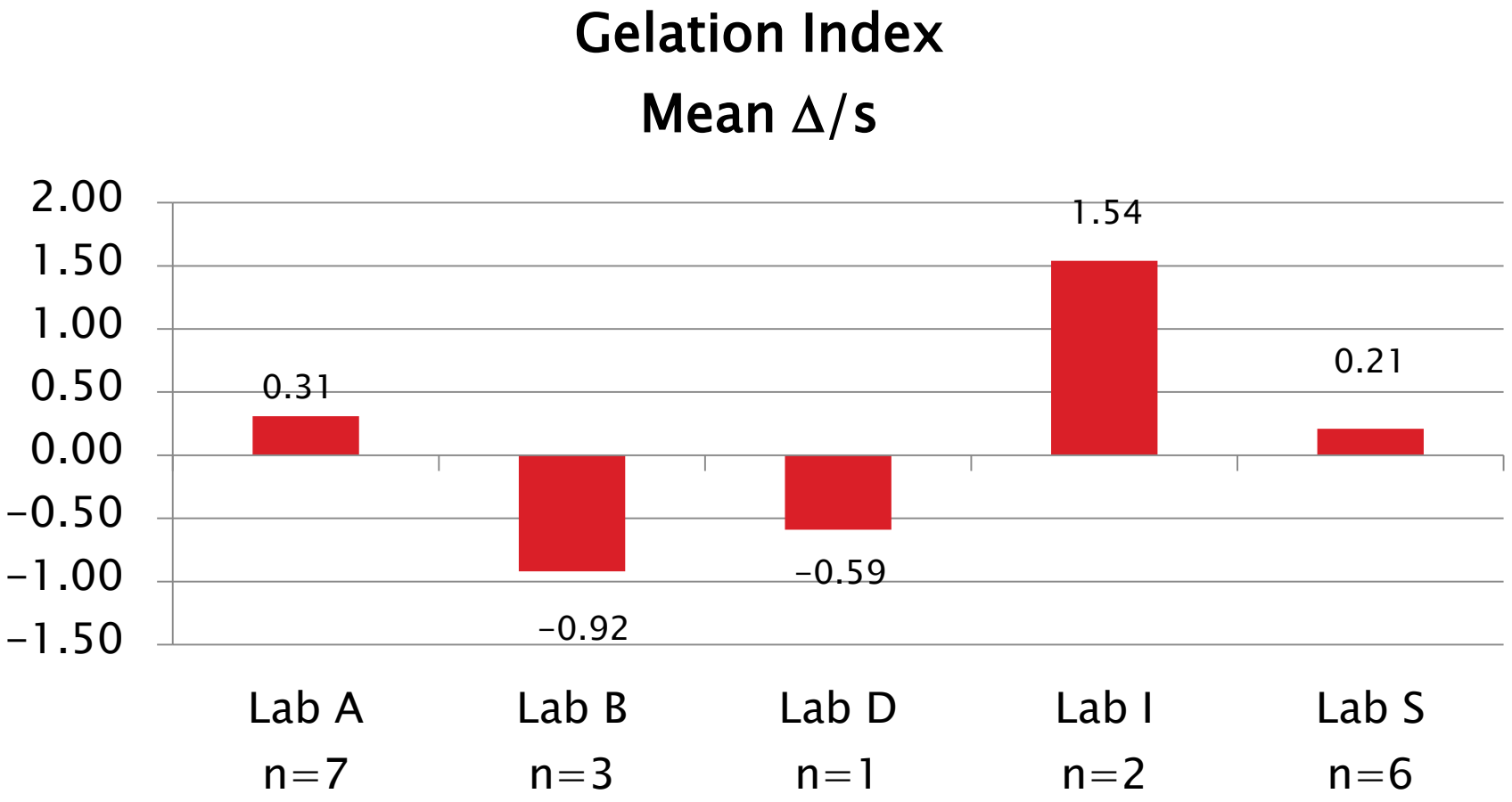
D5133: Gelation Index

Current Period Severity Estimates by Lab

Gelation Index

	n	Mean Δ/s
Lab A	7	0.31
Lab B	3	-0.92
Lab D	1	-0.59
Lab I	2	1.54
Lab S	6	0.21

D5133 Lab Severity Estimates



D5133: Gelation Index

- Precision (Pooled s) is more precise than prior period
  - More precise than target precision
- Performance (Mean Δ/s) is 0.17 s severe

D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA

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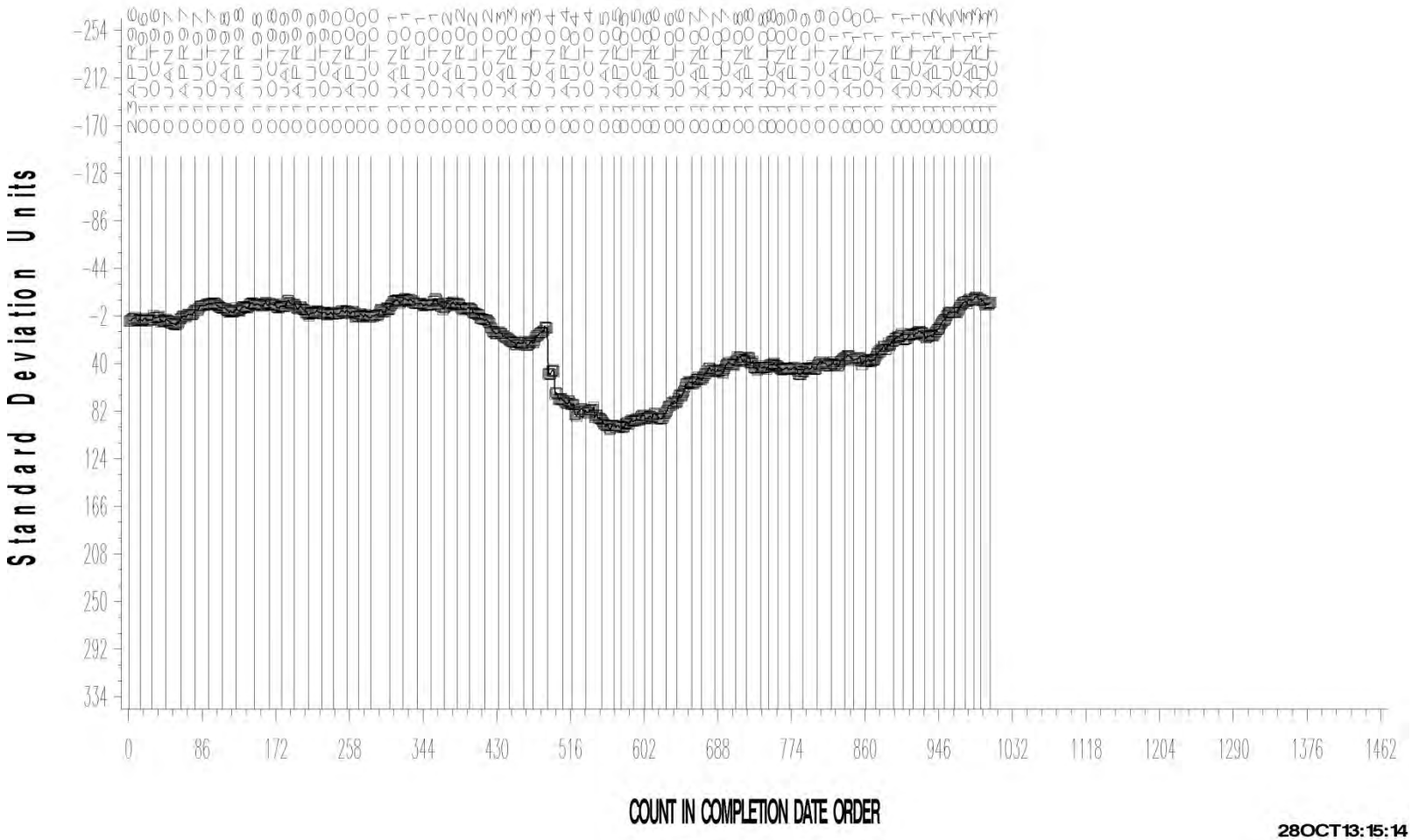
GELATION INDEX

CUSUM Severity Analysis



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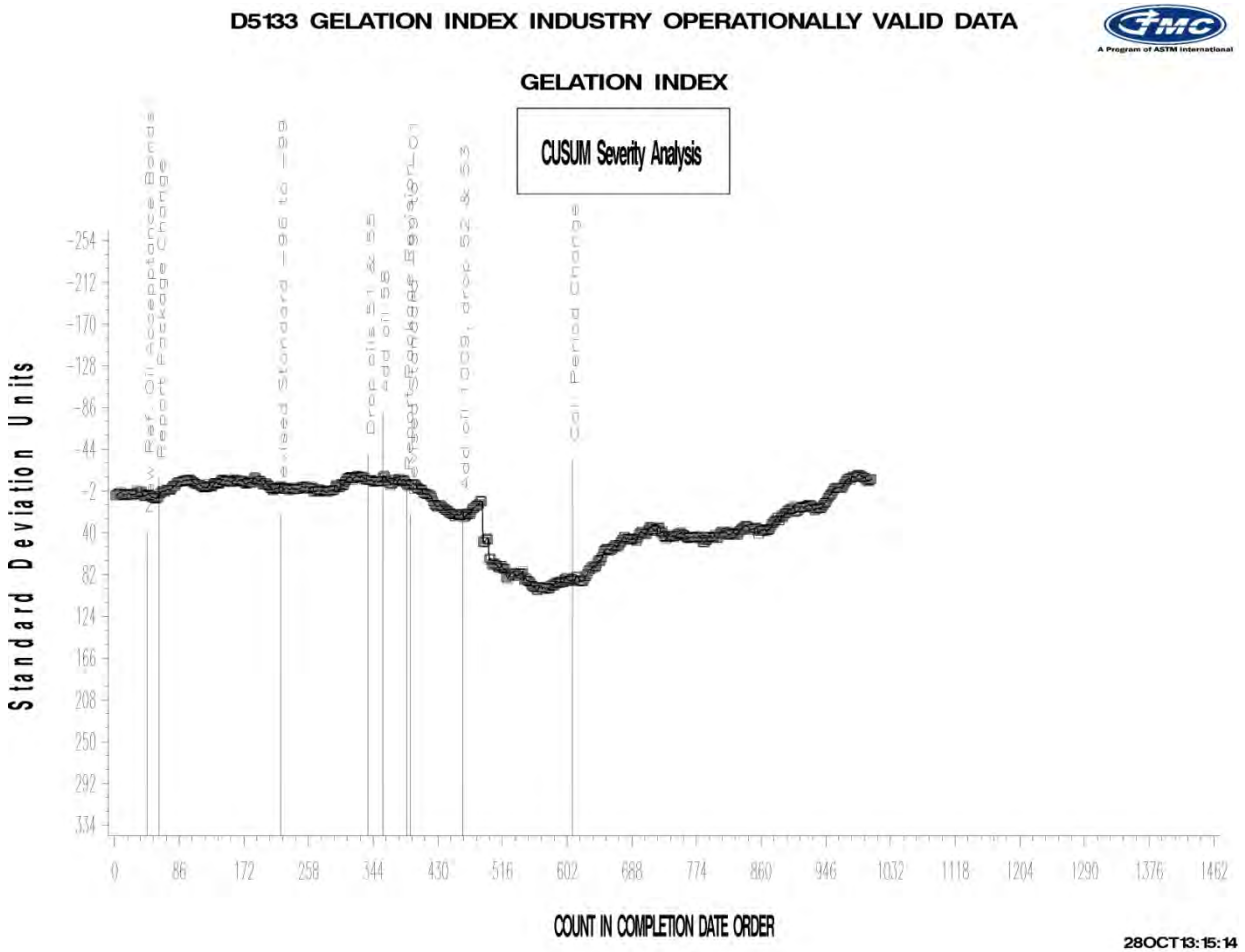
D5133: Gelation Index



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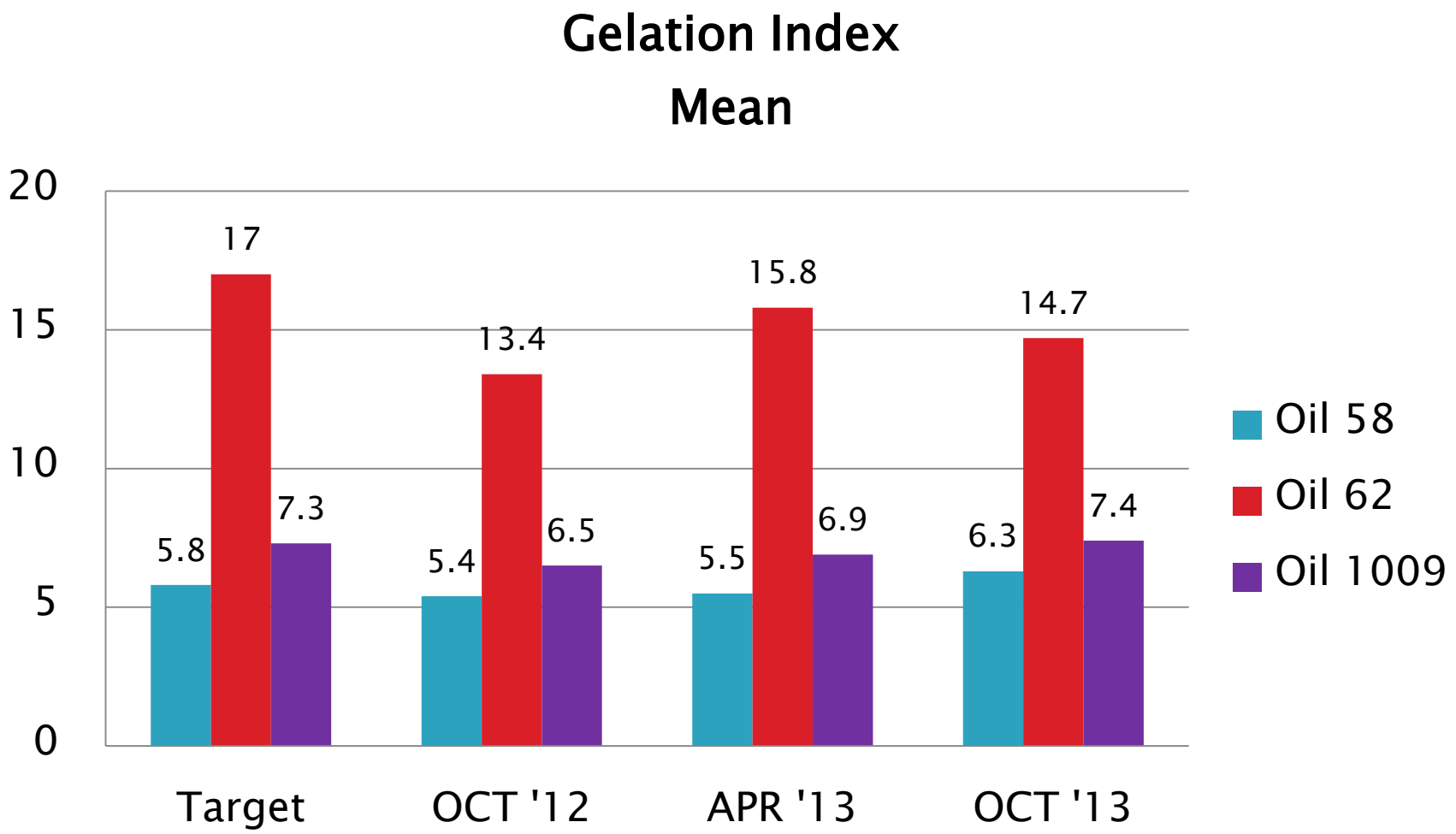
D5133 Performance by Oil

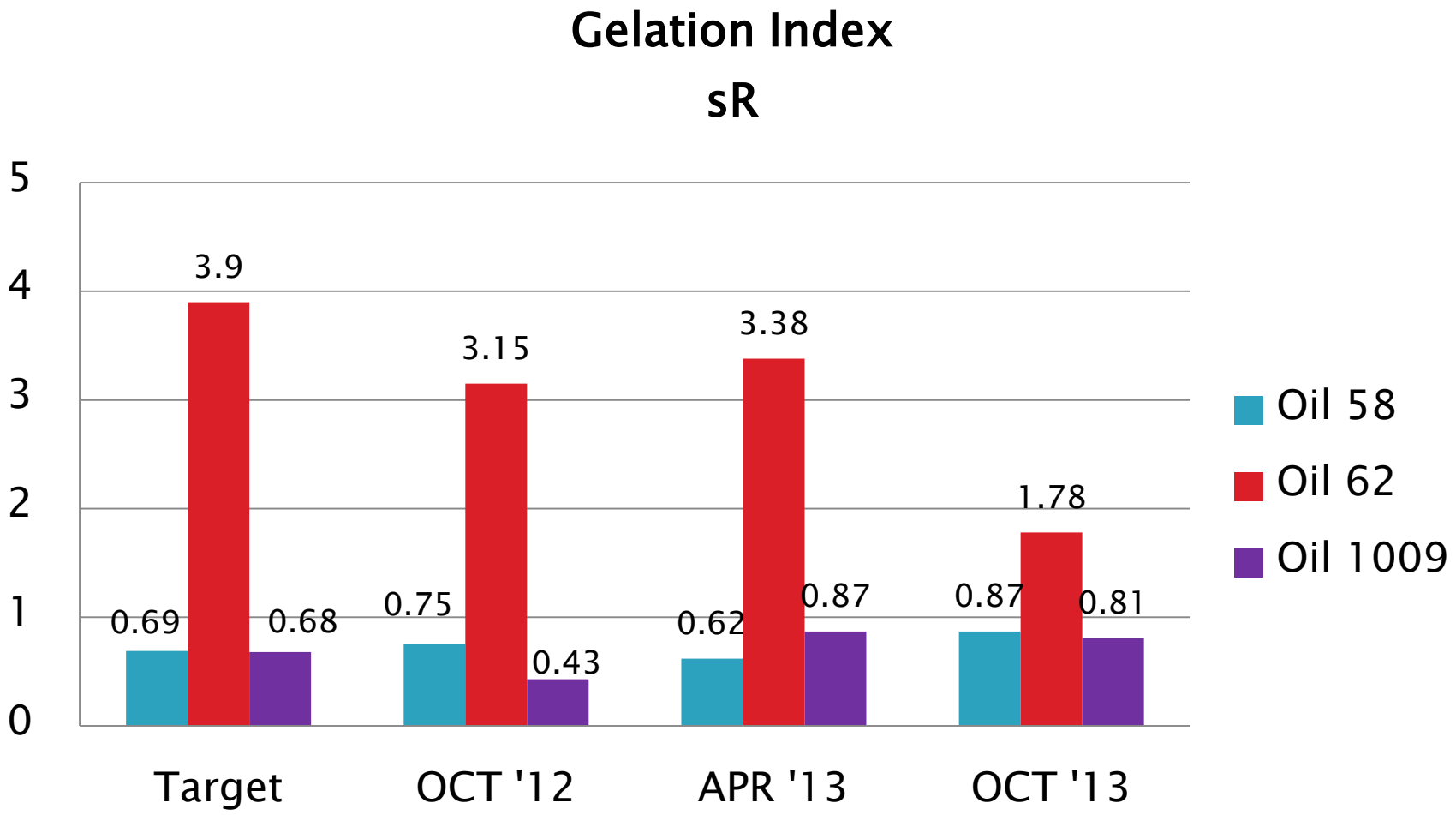
Gelation Index
Performance by Oil

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 – 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
58	17	5.8	0.69	8	5.4	0.75	-0.60	7	5.5	0.62	-0.43	6	6.3	0.87	0.75
62	35	17.0	3.90	8	13.4	3.15	-0.92	6	15.8	3.38	-0.30	5	14.7	1.78	-0.59
1009	16	7.30	0.68	8	6.5	0.43	-1.14	9	6.9	0.87	-0.64	8	7.4	0.81	0.20

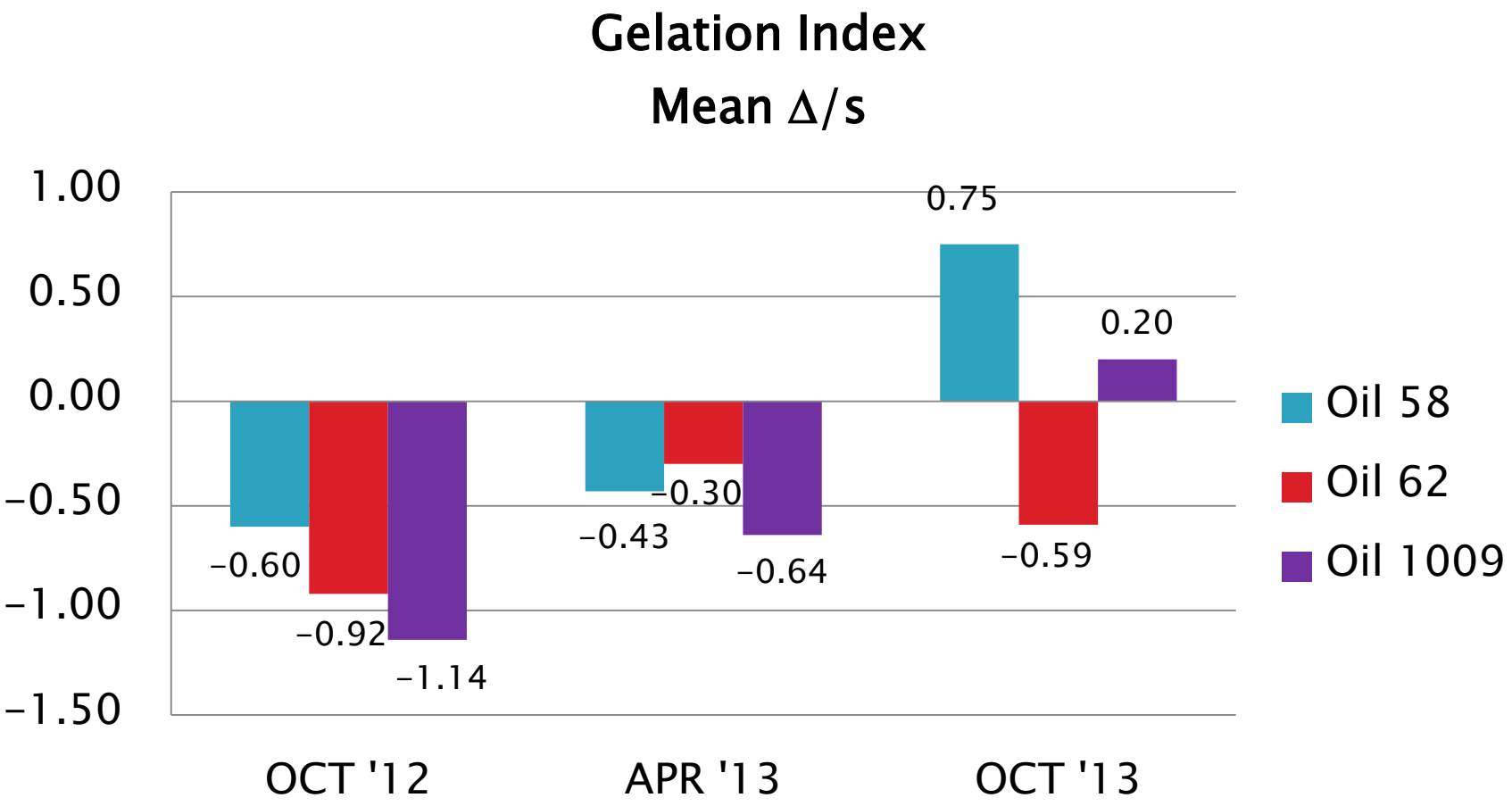
D5133 Performance by Oil



D5133 Performance by Oil



D5133 Performance by Oil



Return to Executive Summary

D6335: Deposits by TEOST-33C

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	14
Failed Calibration Test	OC	3
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		**17**

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 18%

D6335: Deposits by TEOST-33C

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Mild	2
Total Deposits Severe	1

- No operationally invalid tests reported this period

- One mild and one severe fail on same instrument (not consecutive)

D6335: Deposits by TEOST-33C

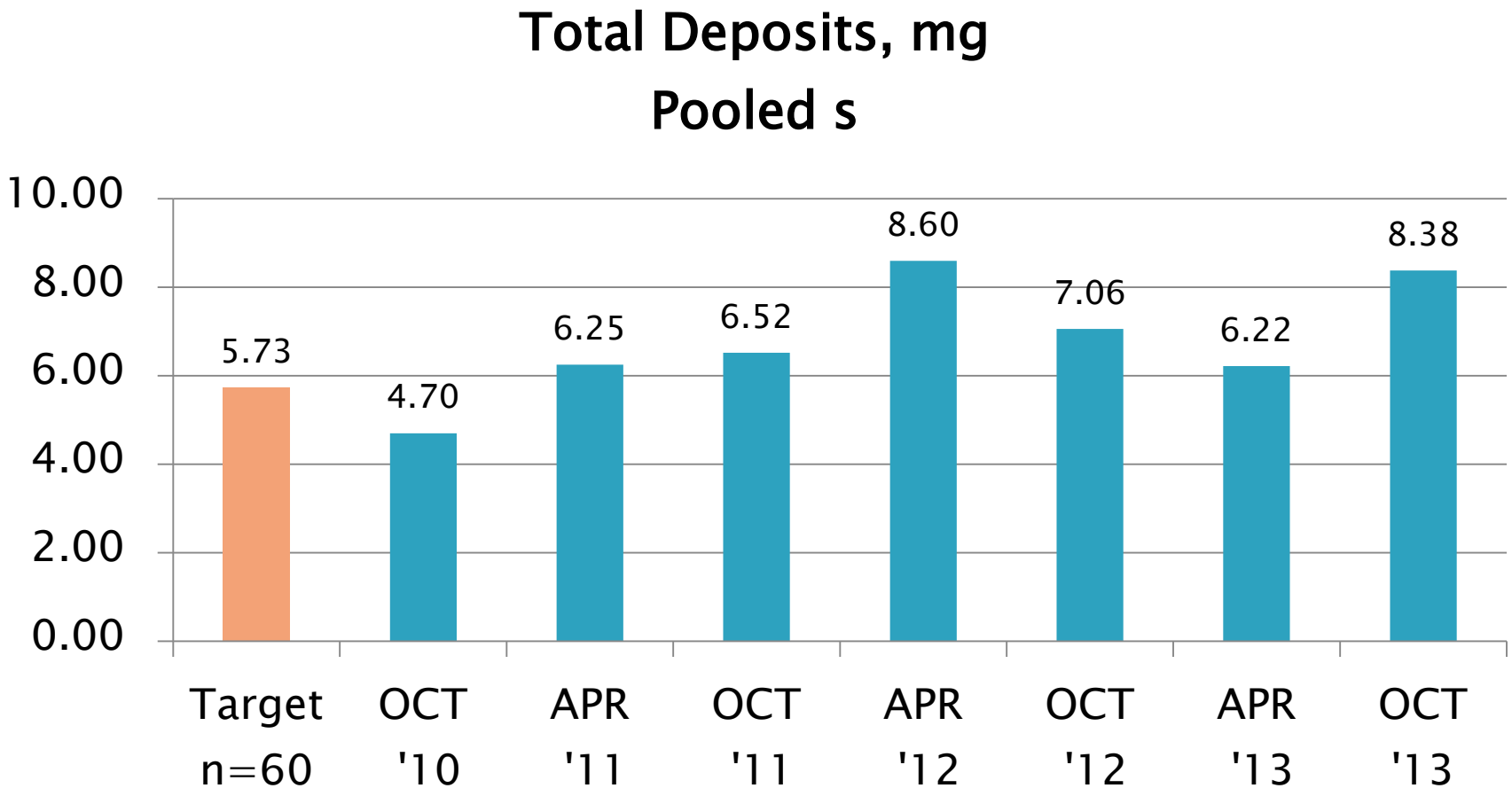
- One TMC Technical Update was issued at the start of the report period:
  - TMC Memo 13-018, Issued April 10, 2013
    - Revised Reference Oil Targets Effective April 15, 2013
    - Targets were initially set by a RR but updated this period to include additional calibration data per surveillance panel approval.

D6335: Deposits by TEOST-33C

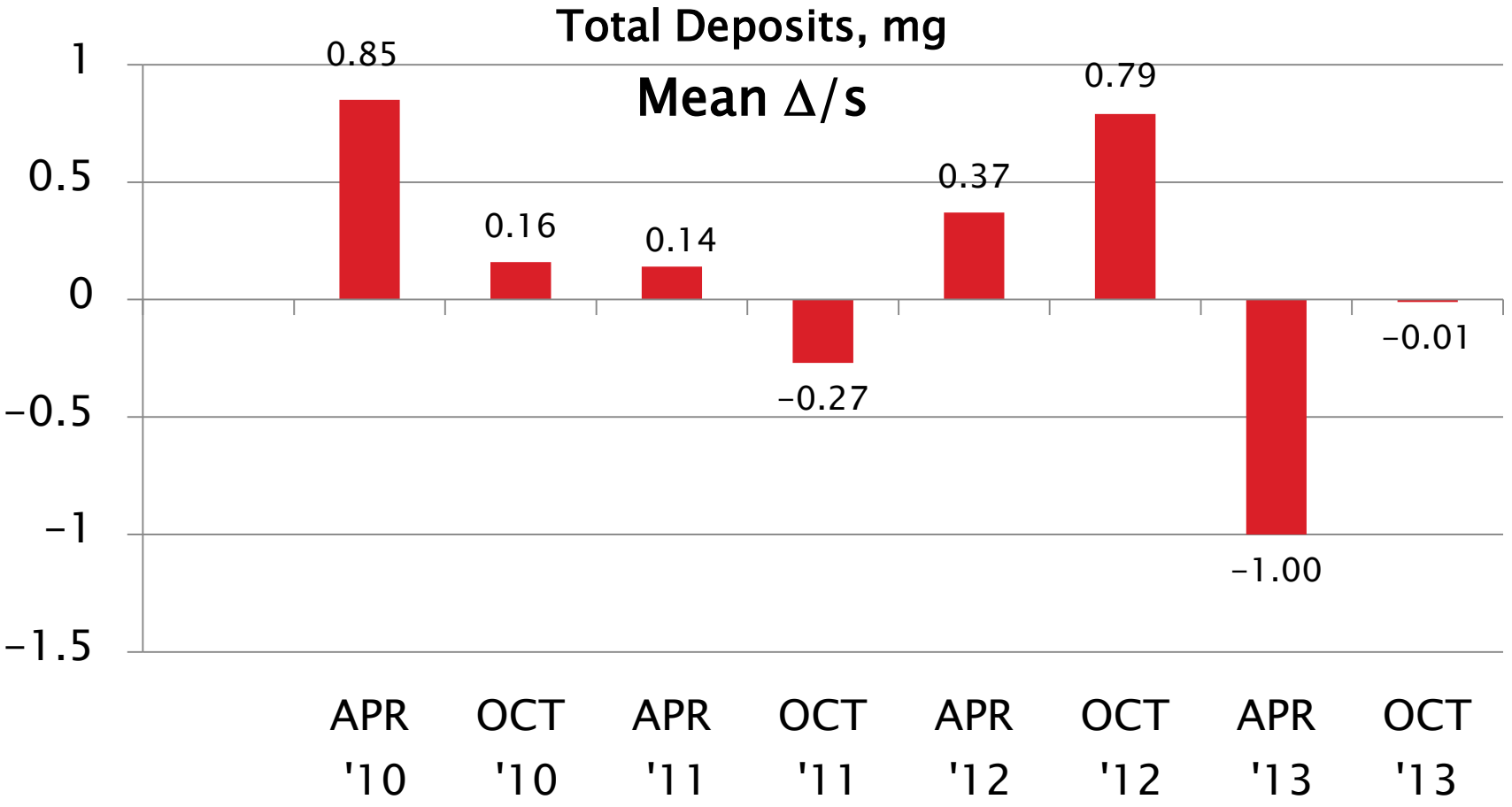
Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Updated Targets 20130415	60	58	5.73	-----
4/1/10 through 9/30/10	16	12	4.70	0.16
10/1/10 through 3/31/11	14	10	6.25	0.14
4/1/11 through 9/30/11	19	15	6.52	-0.27
10/1/11 through 3/31/12	16	12	8.60	0.37
4/1/12 through 9/30/12	18	15	7.06	0.79
10/1/12 through 3/31/13	22	20	6.22	-1.00
4/1/13 through 9/30/13	17	15	8.38	-0.01

D6335 Precision Estimates



D6335 Severity Estimates

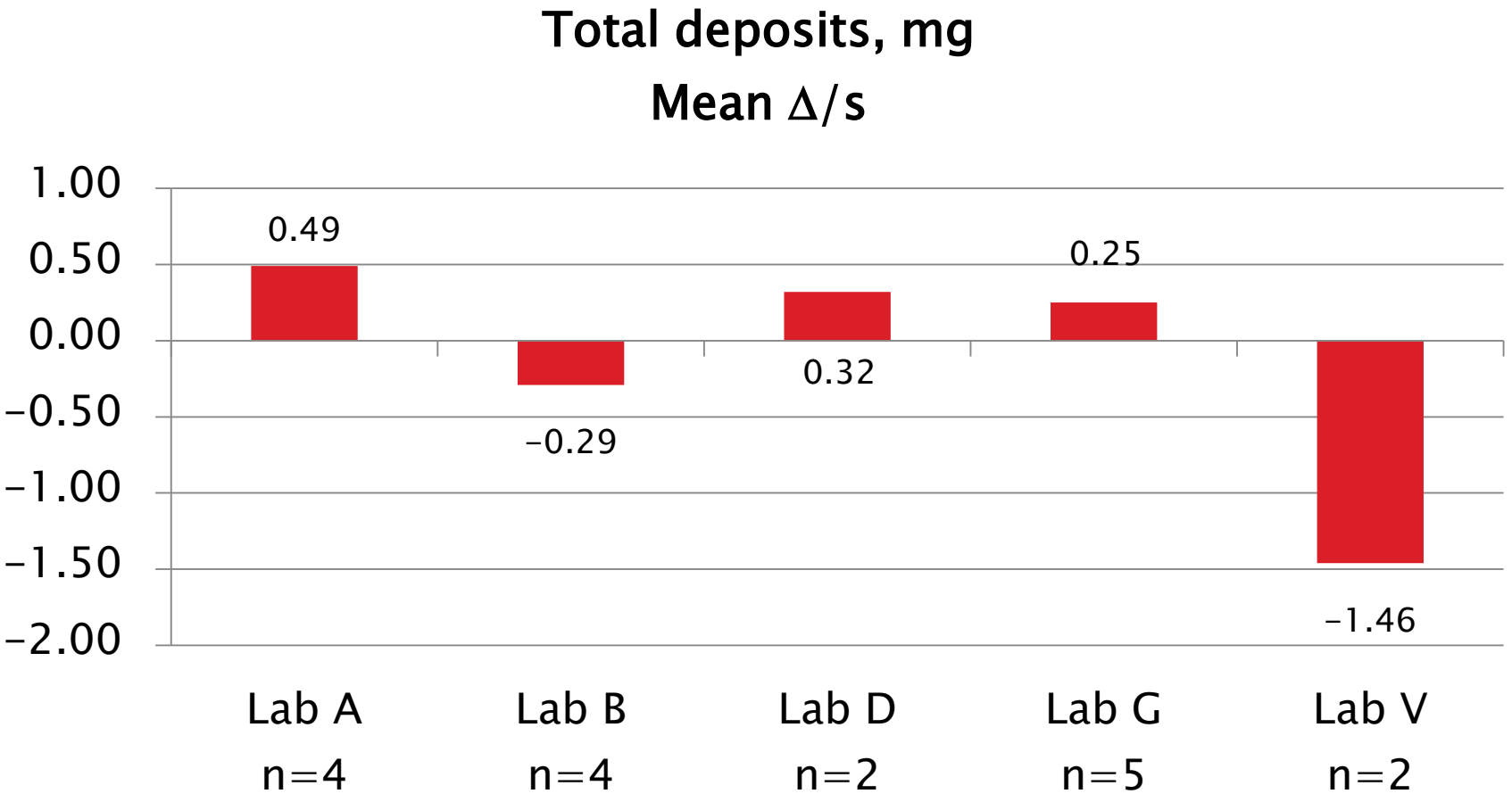


D6335: Deposits by TEOST-33C

Current Period Severity Estimates by Lab
Total Deposits, mg

	n	Mean Δ/s
Lab A	4	0.49
Lab B	4	-0.29
Lab D	2	0.32
Lab G	5	0.25
Lab V	2	-1.46

D6335 Lab Severity Estimates



Test Monitoring Center
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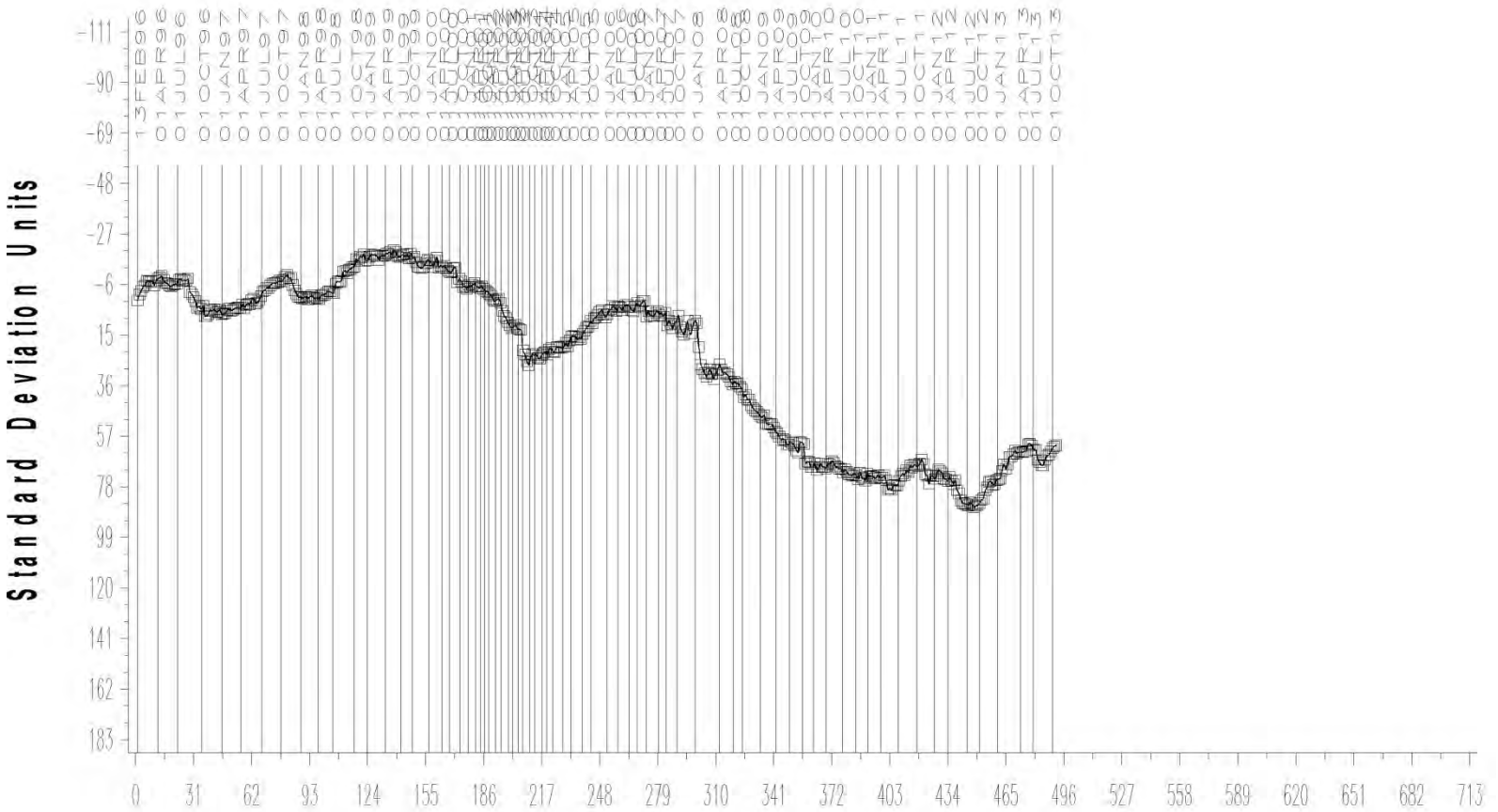
D6335: Deposits by TEOST-33C

- Precision (Pooled s) is less precise than prior periods
  - Less precise than NEW target precision
  - One test 3 s severe, another 4 s mild (different labs)
- Performance (Mean Δ/s) is on target
  - Individual Δ/s results calculated using targets that were in place at time of each test was run
  - Lab G, Instrument 2 has two fails reported as operationally valid; same instrument had a series of RC fails last period traced back to a bad thermocouple
- All tests this period report using Rod Batch K

TEOST—33C INDUSTRY OPERATIONALLY VALID DATA

TOTAL DEPOSITS MG

CUSUM Severity Analysis



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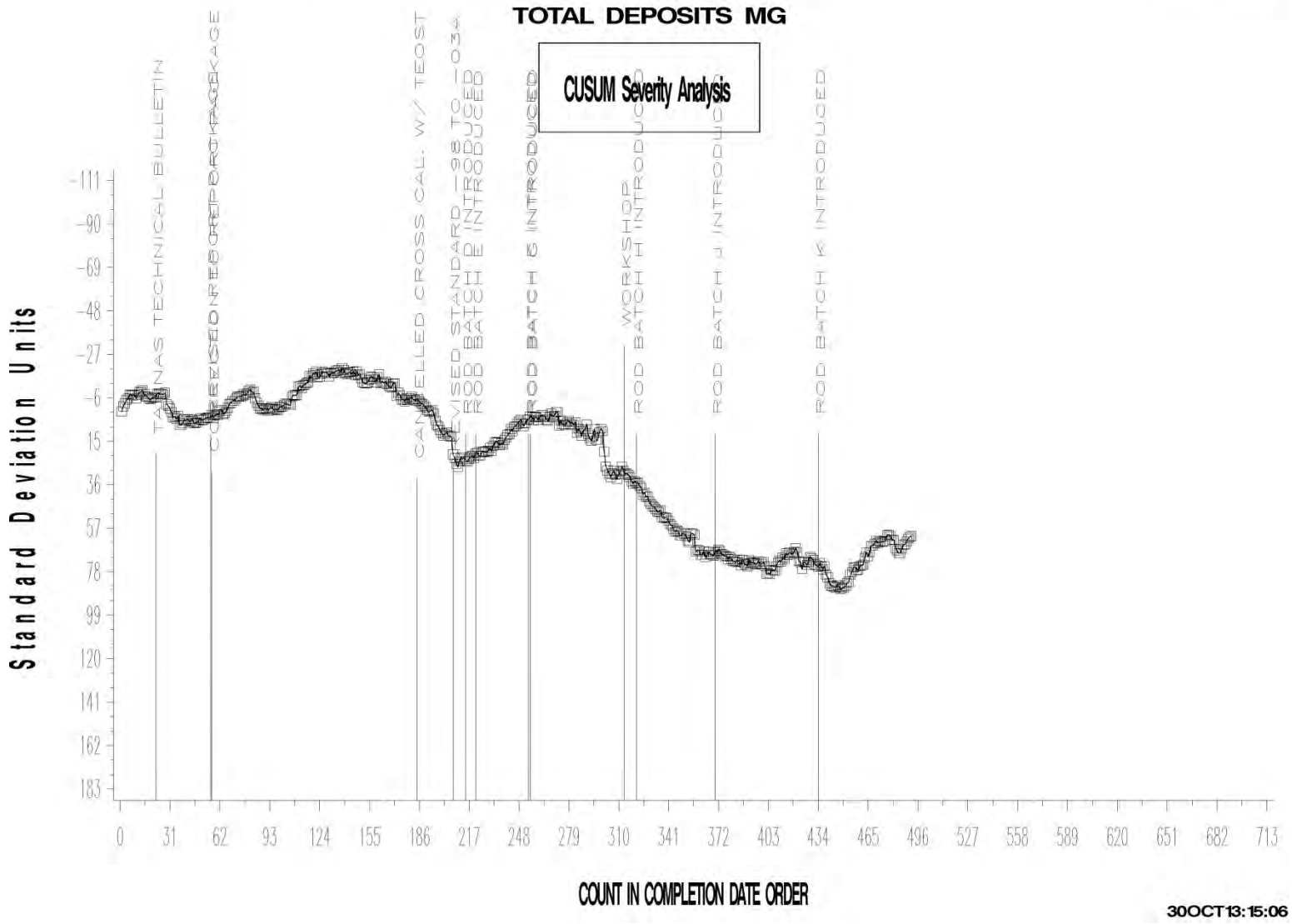
TEOST–33C INDUSTRY OPERATIONALLY VALID DATA



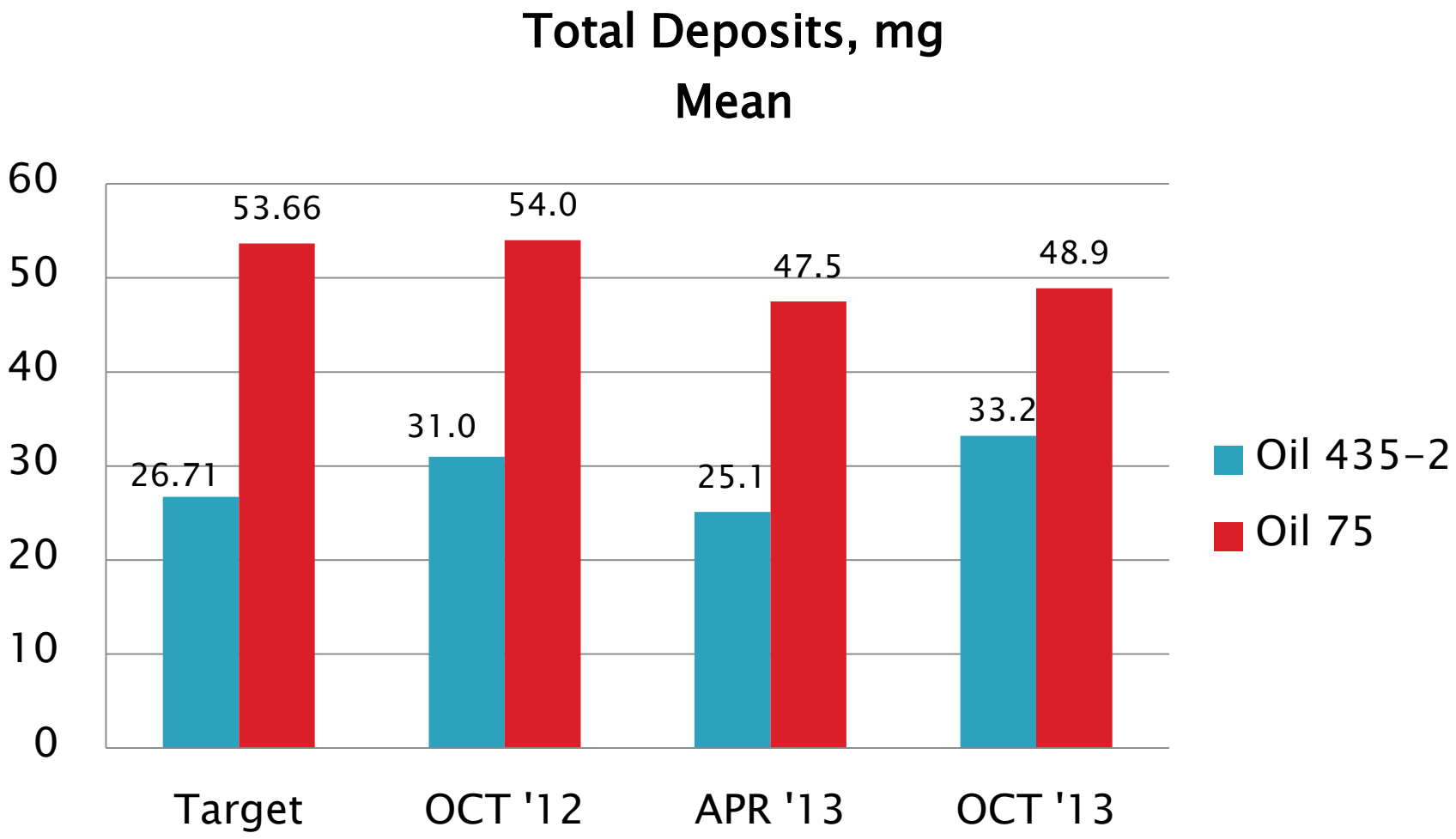
30OCT13:15:06

D6335 Performance by Oil

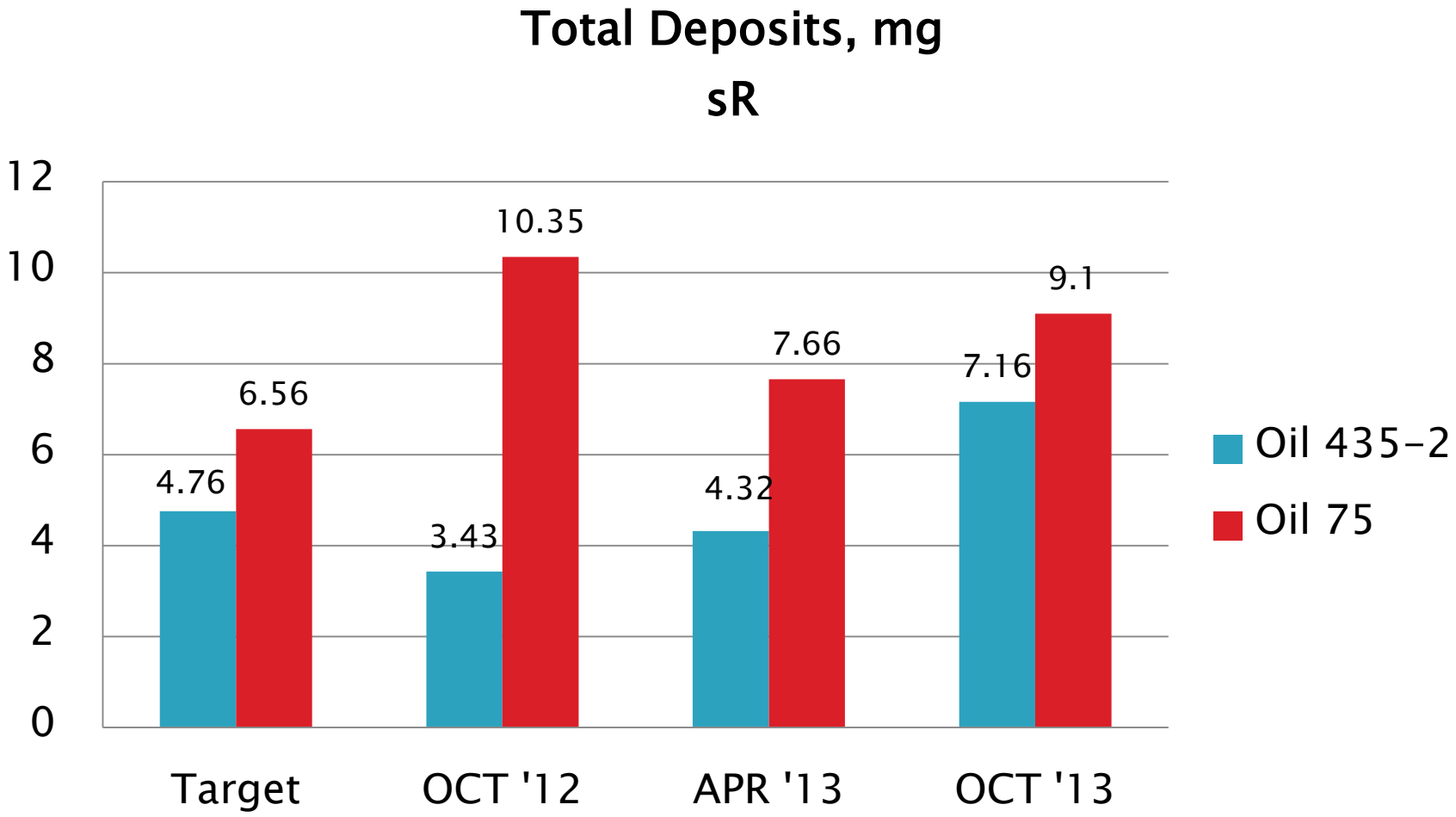
Total Deposits, mg
Performance by Oil

	Targets 20130415			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 – 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
435-2	30	26.71	4.76	10	31.0	3.43	1.43	11	25.1	4.32	-0.65	7	33.2	7.16	1.00
75	30	53.66	6.56	7	54.0	10.35	-0.21	11	47.5	7.66	-1.35	10	48.9	9.10	-0.72

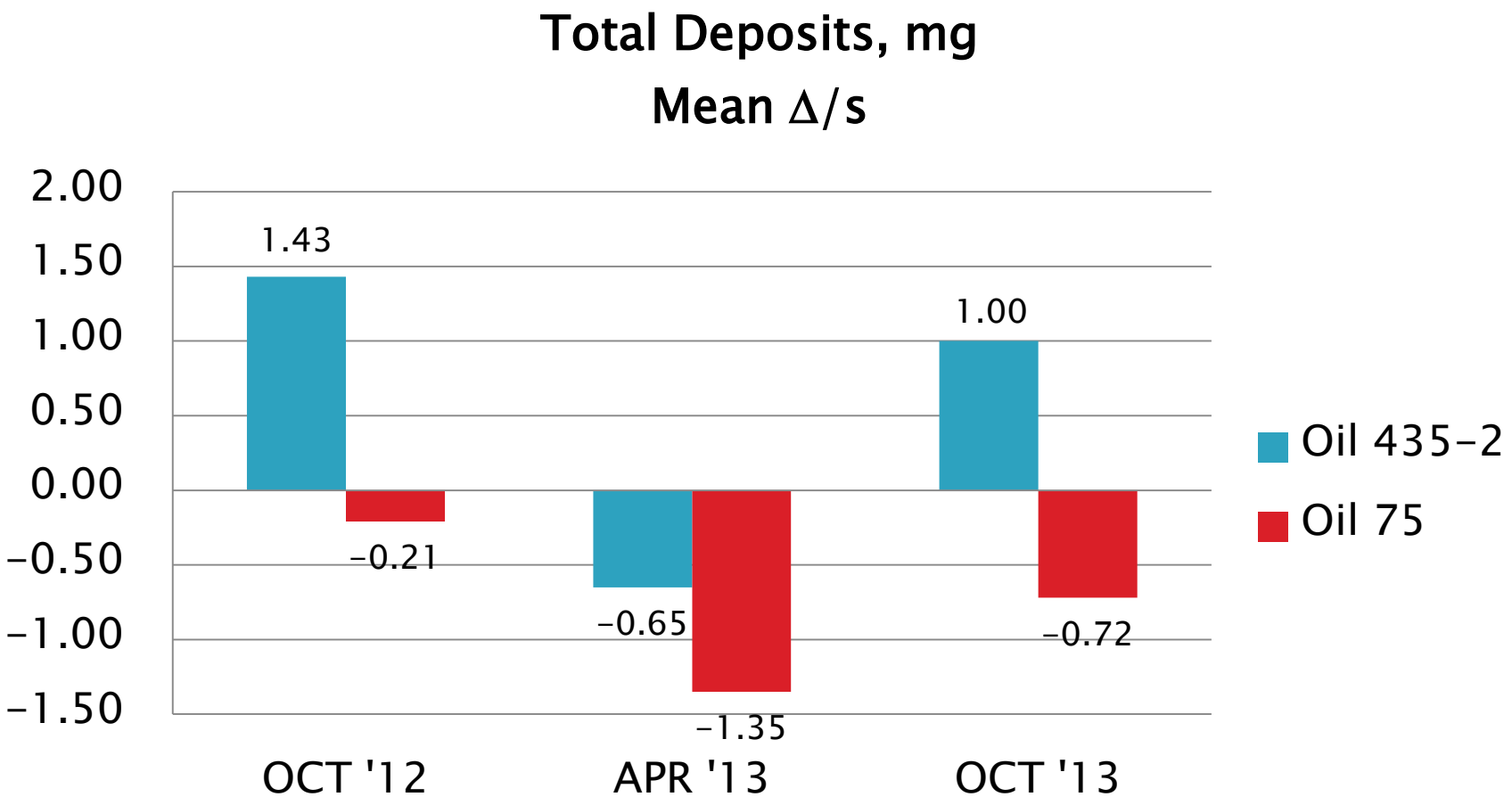
D6335 Performance by Oil



D6335 Performance by Oil



D6335 Performance by Oil



Return to Executive Summary

D7097: Deposits by MHT TEOST

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	72
Failed Calibration Test	OC	13
Operationally Invalidated by Lab	LC, XC	5
Operationally Invalidated After Initially Reported as Valid	RC	3
Donated Industry Info Runs	AG, OG, XG	11
Non-blind Shakedown Run	NN	9
Total		**113**

Number of Labs Reporting Data: 7

Fail Rate of Operationally Valid Tests: 15%

D7097: Deposits by MHT TEOST

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Mild	5
Total Deposits Severe	8

- Eight operationally invalid calibration tests this period:
  - One incorrect thermocouple depth (LC)
  - Three using invalidated catalyst batch 1301 (RC)
  - Four aborted with incorrect catalyst weight (XC)

- CATBATCH 1208 found to bias severe on oil 432
- CATBATCH 1301 found to bias mild on oil 434

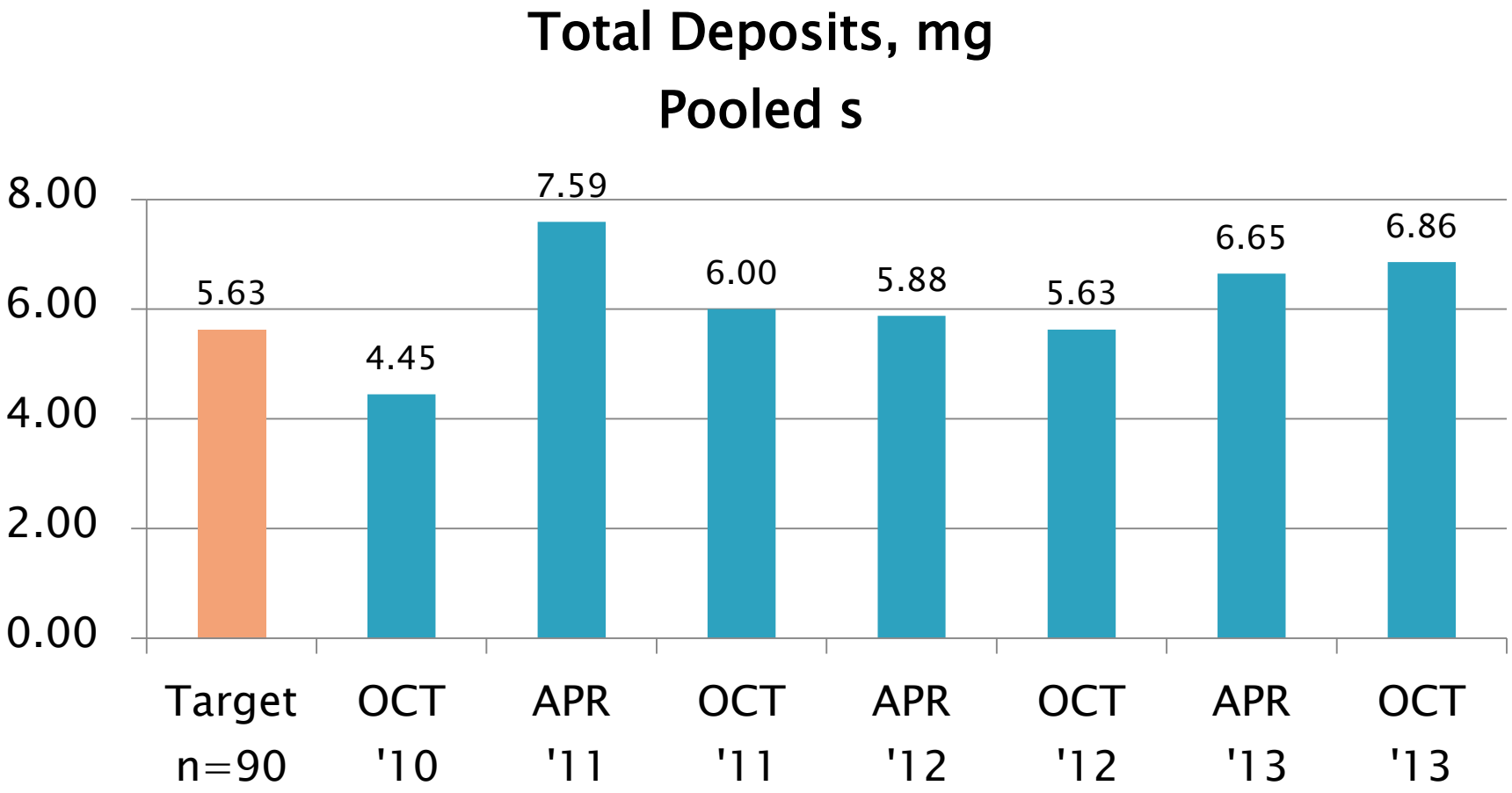
- No TMC technical updates issued this period
  - Industry notified of catalyst batch issues

D7097: Deposits by MHT TEOST

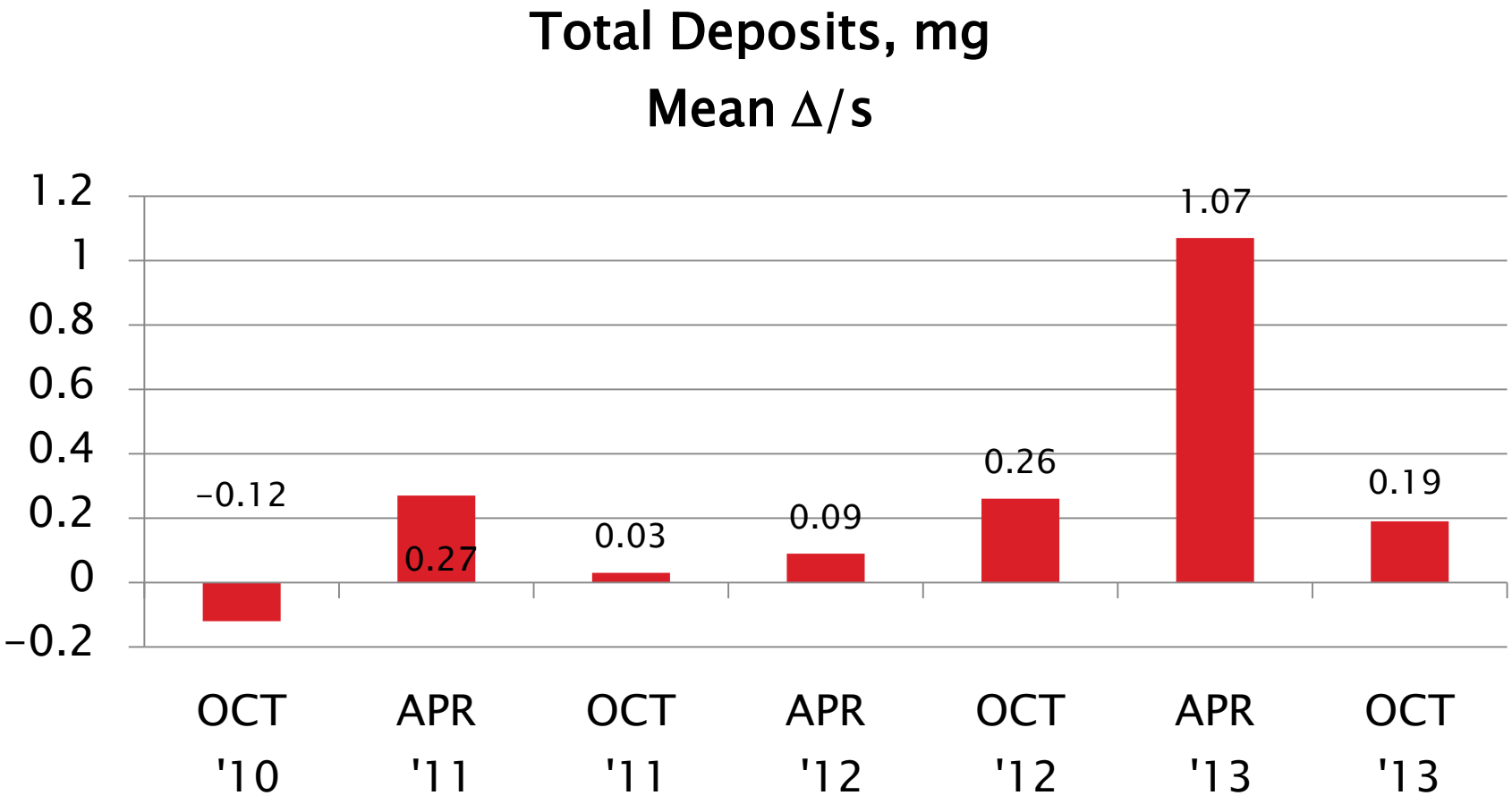
Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets 7/31/2006	90	87	5.63	-----
4/1/10 through 9/30/10	55	52	4.45	-0.12
10/1/10 through 3/31/11	55	52	7.59	0.27
4/1/11 through 9/30/11	46	43	6.00	0.03
10/1/11 through 3/31/12	56	54	5.88	0.09
4/1/12 through 9/30/12	65	62	5.63	0.26
10/1/12 through 3/31/13	68	66	6.65	1.07
4/1/13 through 9/30/13	85	83	6.86	0.19

D7097 Precision Estimates



D7097 Severity Estimates

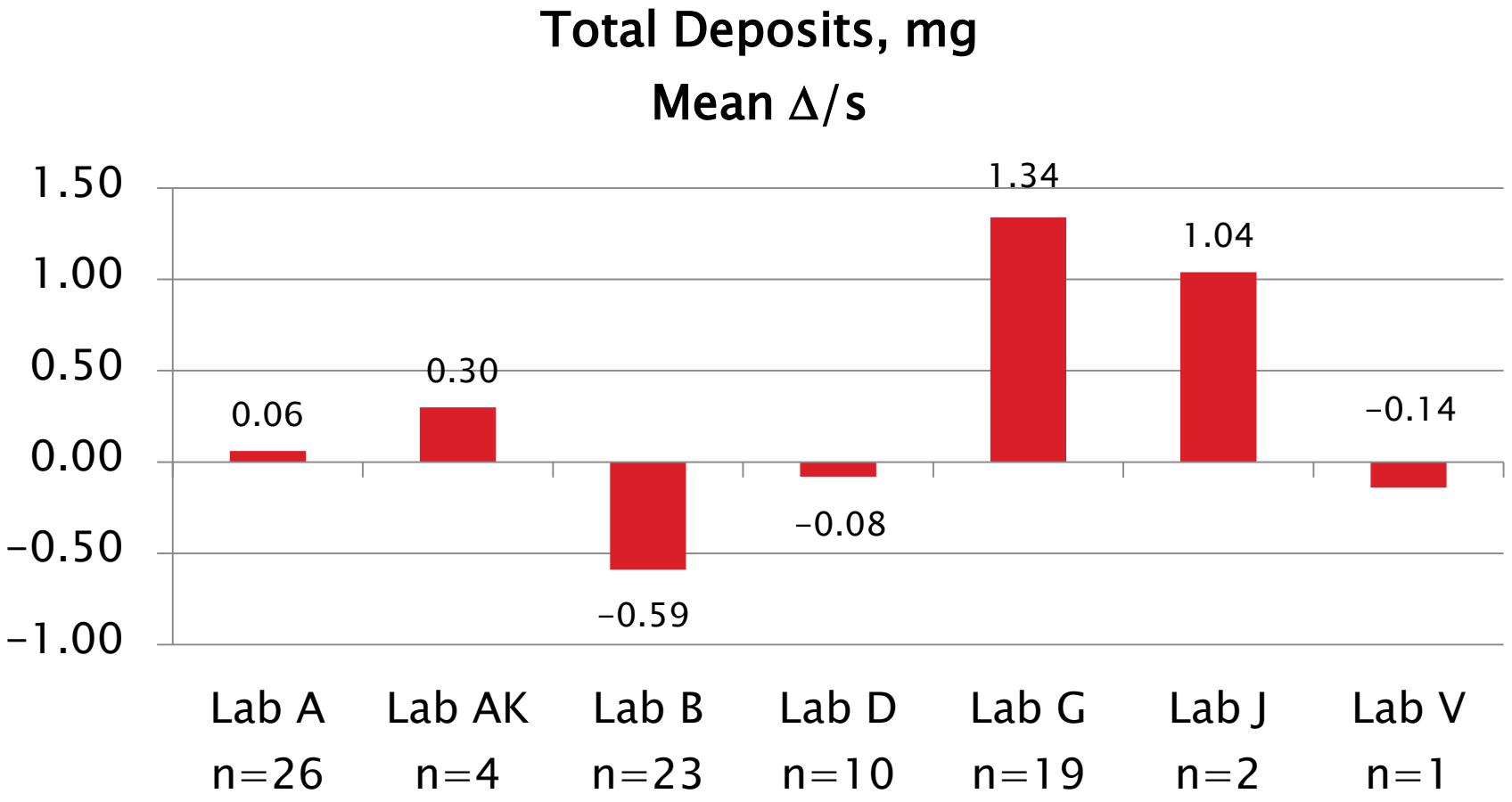


D7097: Deposits by MHT TEOST

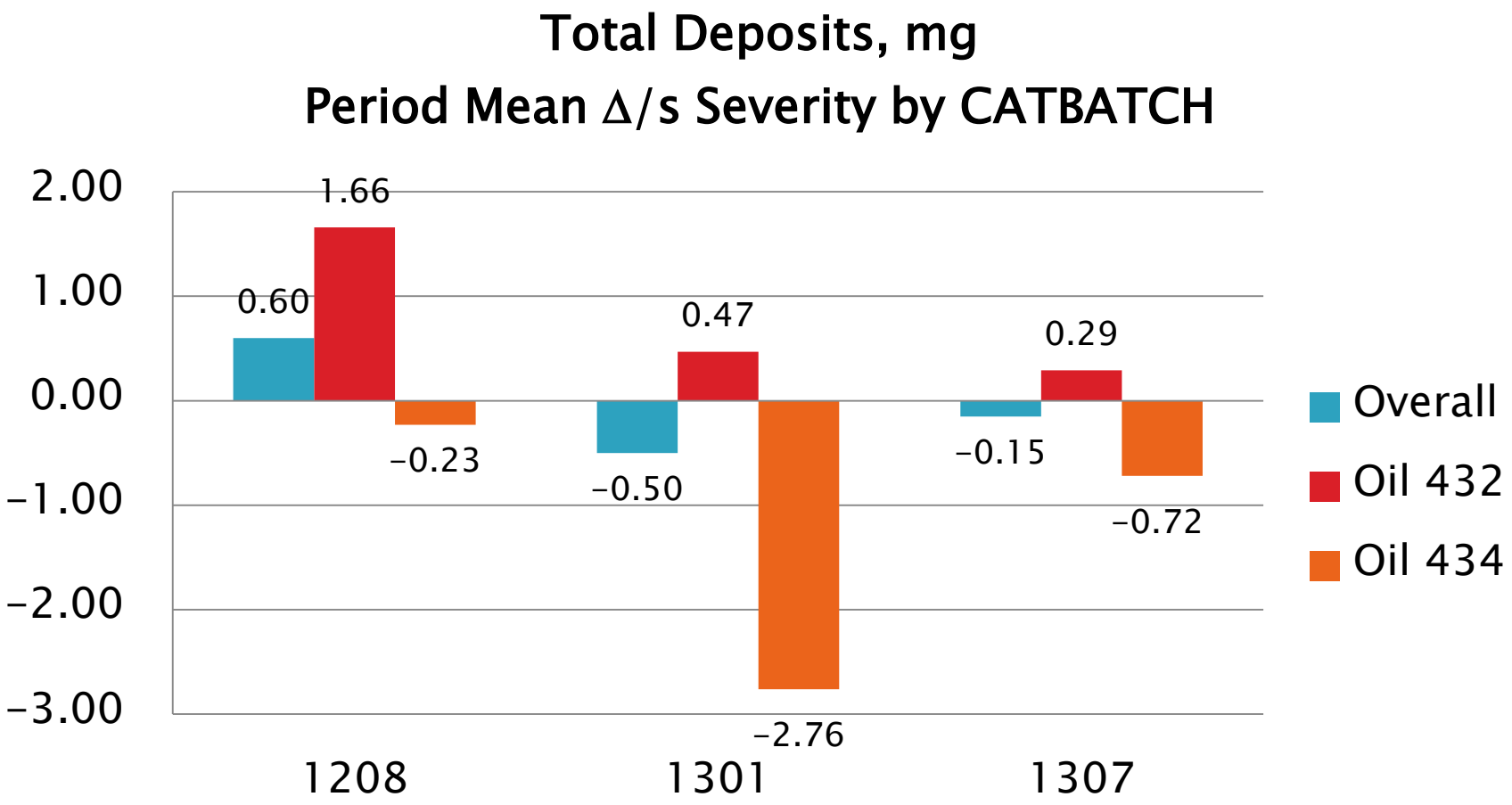
Current Period Severity Estimates by Lab
Total Deposits, mg

	n	Mean Δ/s
Lab A	26	0.06
Lab AK	4	0.30
Lab B	23	-0.59
Lab D	10	-0.08
Lab G	19	1.34
Lab J	2	1.04
Lab V	1	-0.14

D7097 Lab Severity Estimates



D7097: Deposits by MHT TEOST



D7097: Deposits by MHT TEOST

- Precision (Pooled s) is comparable to prior period
  - Less precise than target precision
- Performance (Mean Δ/s) is 0.19 s severe
- All completed tests this period report using Rod Batch K
- All completed tests this period report using Catalyst Batches 1208, 1301 or 1307
  - Some donated runs on experimental batch of 1307

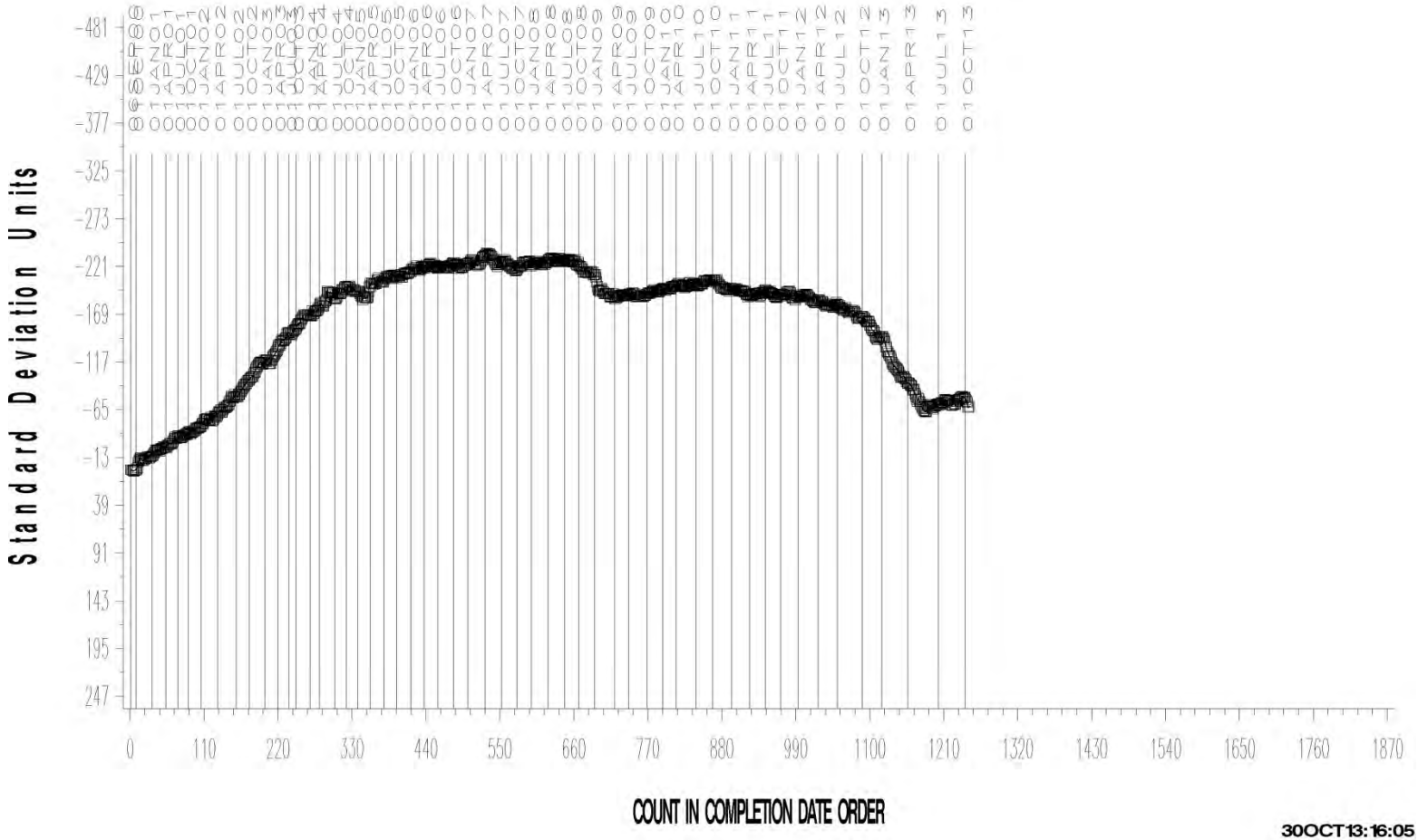
D7097: Deposits by MHT TEOST

- CUSUM severity plot shows severe trend starting just after the 01OCT12 timeline
  - Coincident with the introduction of catalyst batch 1208, with leveling again when all labs switched to batch 1307
  - Significant lab performance differences also observed
  - Considerable effort by industry to resolve catalyst related severity issues in test monitoring, resulting in an improved catalyst qualification protocol

MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA

TOTAL DEPOSITS MG

CUSUM Severity Analysis



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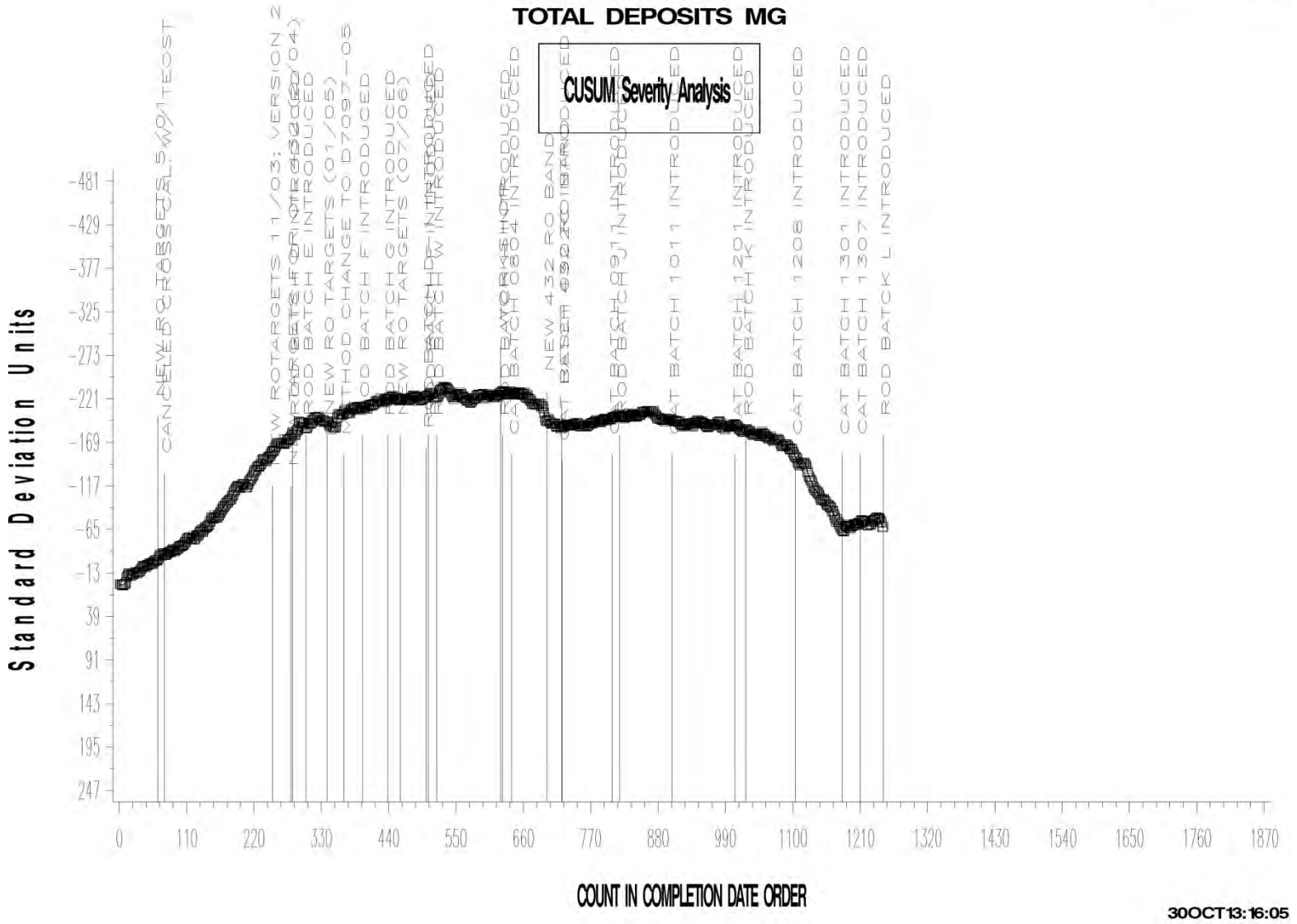
MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA



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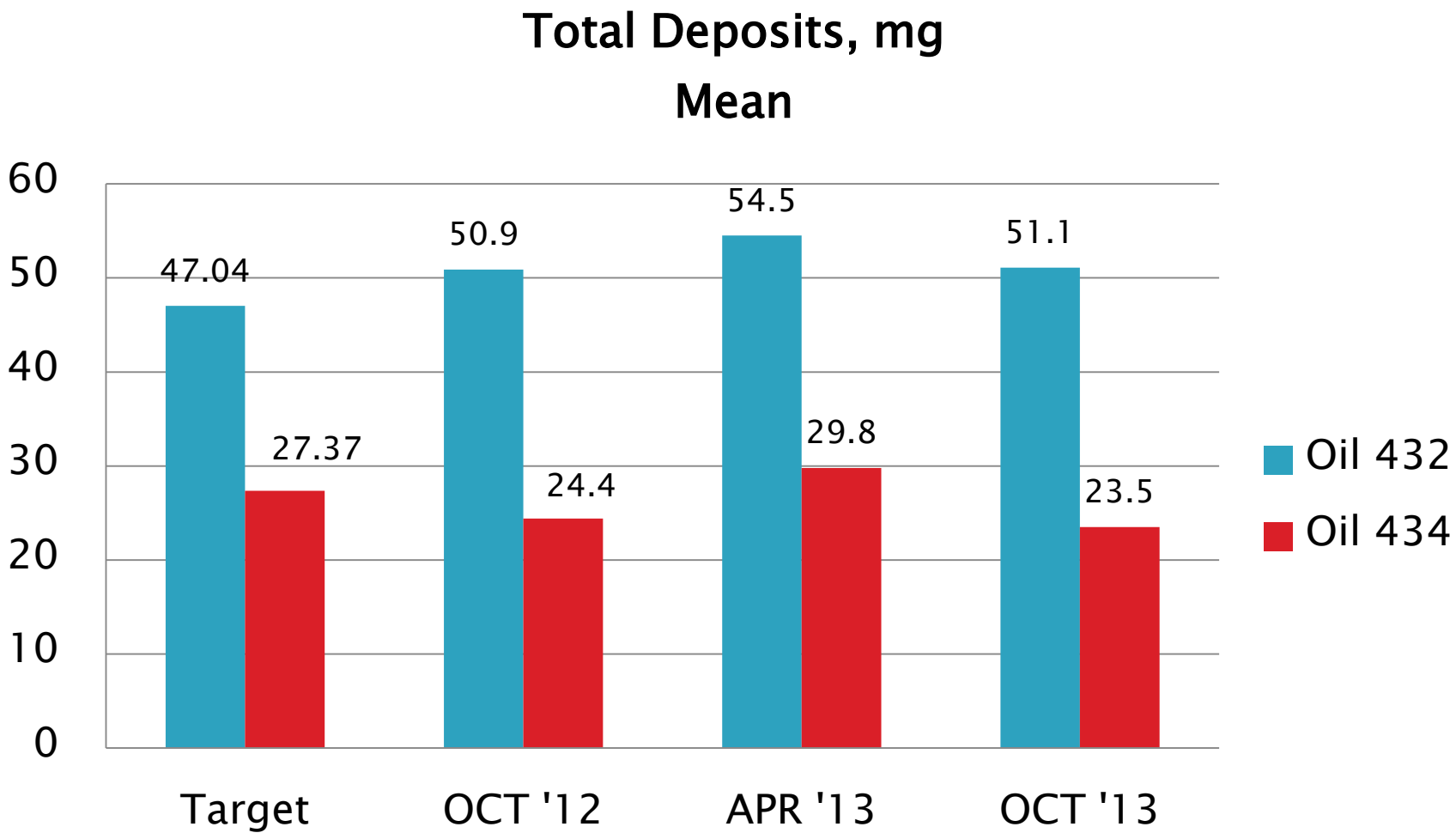
D7097 Performance by Oil

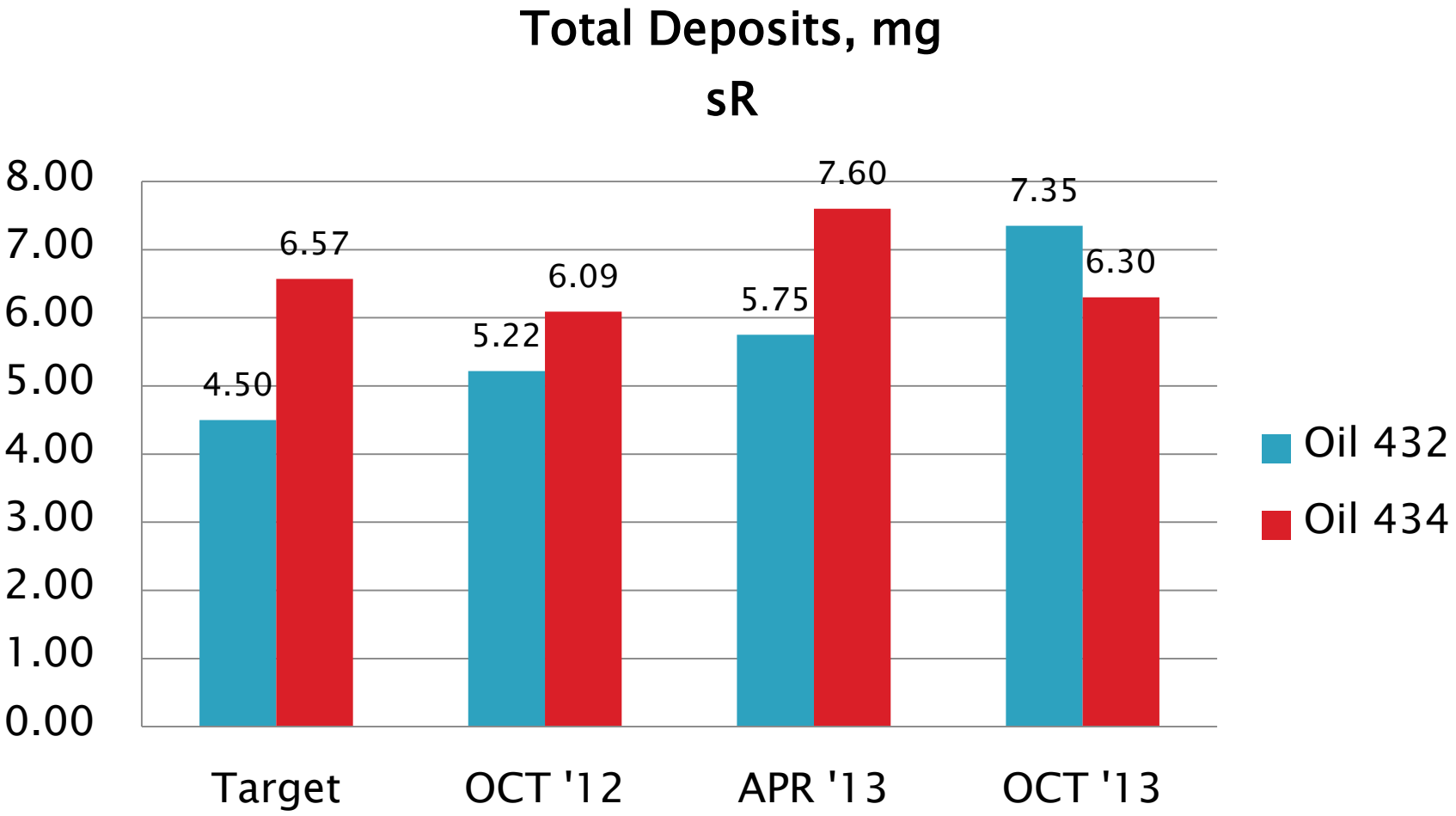
Total Deposits, mg
Performance by Oil

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 – 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
432	30	47.04	4.50	35	50.9	5.22	0.86	37	54.5	5.75	1.65	44	51.1	7.35	0.91
434	30	27.37	6.57	29	24.4	6.09	-0.45	31	29.81	7.60	0.37	41	23.5	6.30	-0.58

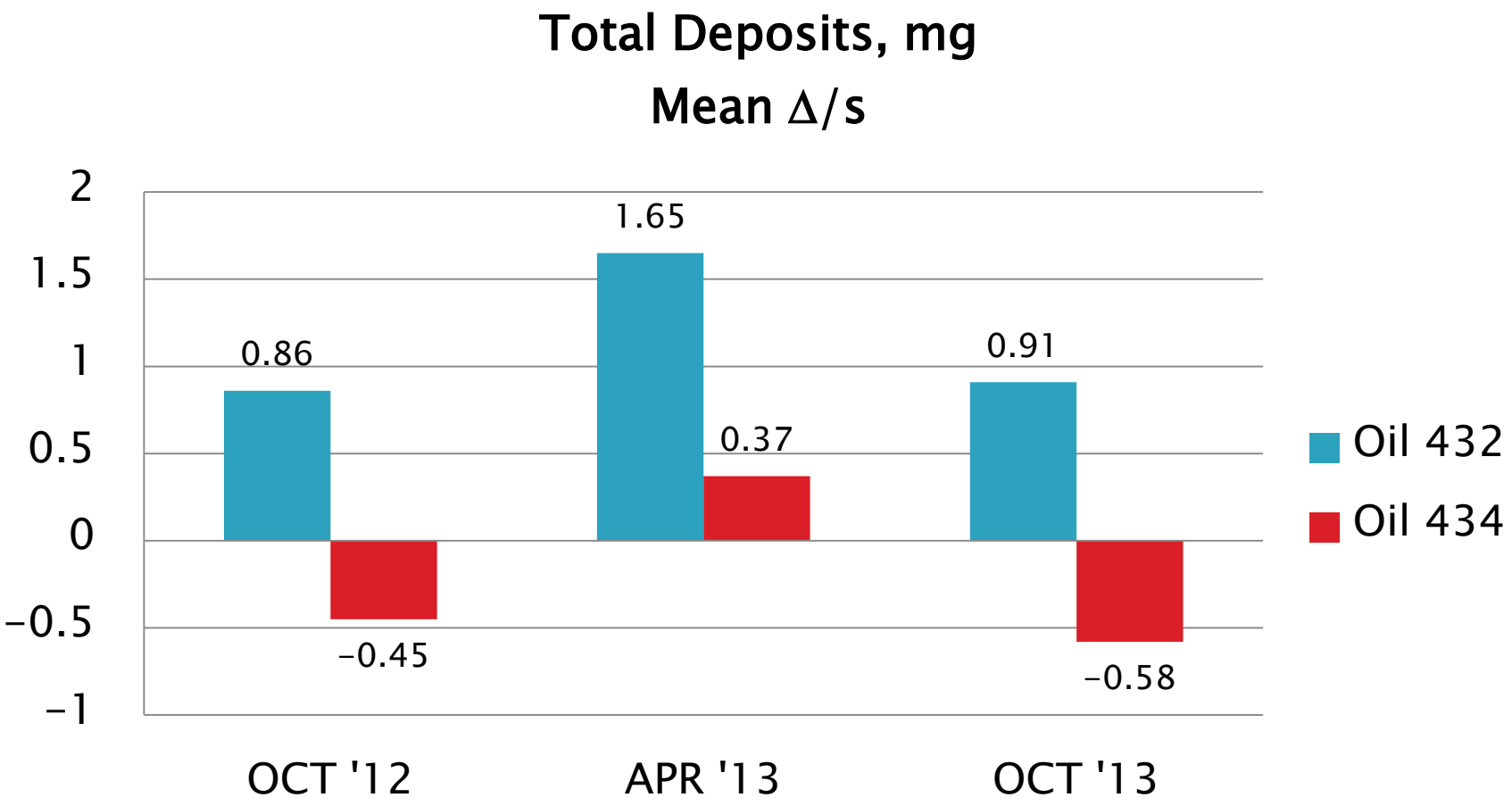
D7097 Performance by Oil



D7097: Deposits by MHT TEOST



D7097: Deposits by MHT TEOST



Return to Executive Summary

D6082: High Temperature Foam

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	9
Acceptable Discrimination Test	AS	4
Failed Calibration Test	OC	0
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		**13**

Number of Labs Reporting Data: 4
Fail Rate of Operationally Valid Tests: 0%

D6082: High Temperature Foam

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

- No Operationally invalid test reported this period

- All operationally valid discrimination runs reported this period could discriminate oil 66 as a GF-5/SN failing oil for Foam Tendency

- No TMC technical updates issued this period

D6082: High Temperature Foam

Period Precision and Severity Estimates Oil 1007

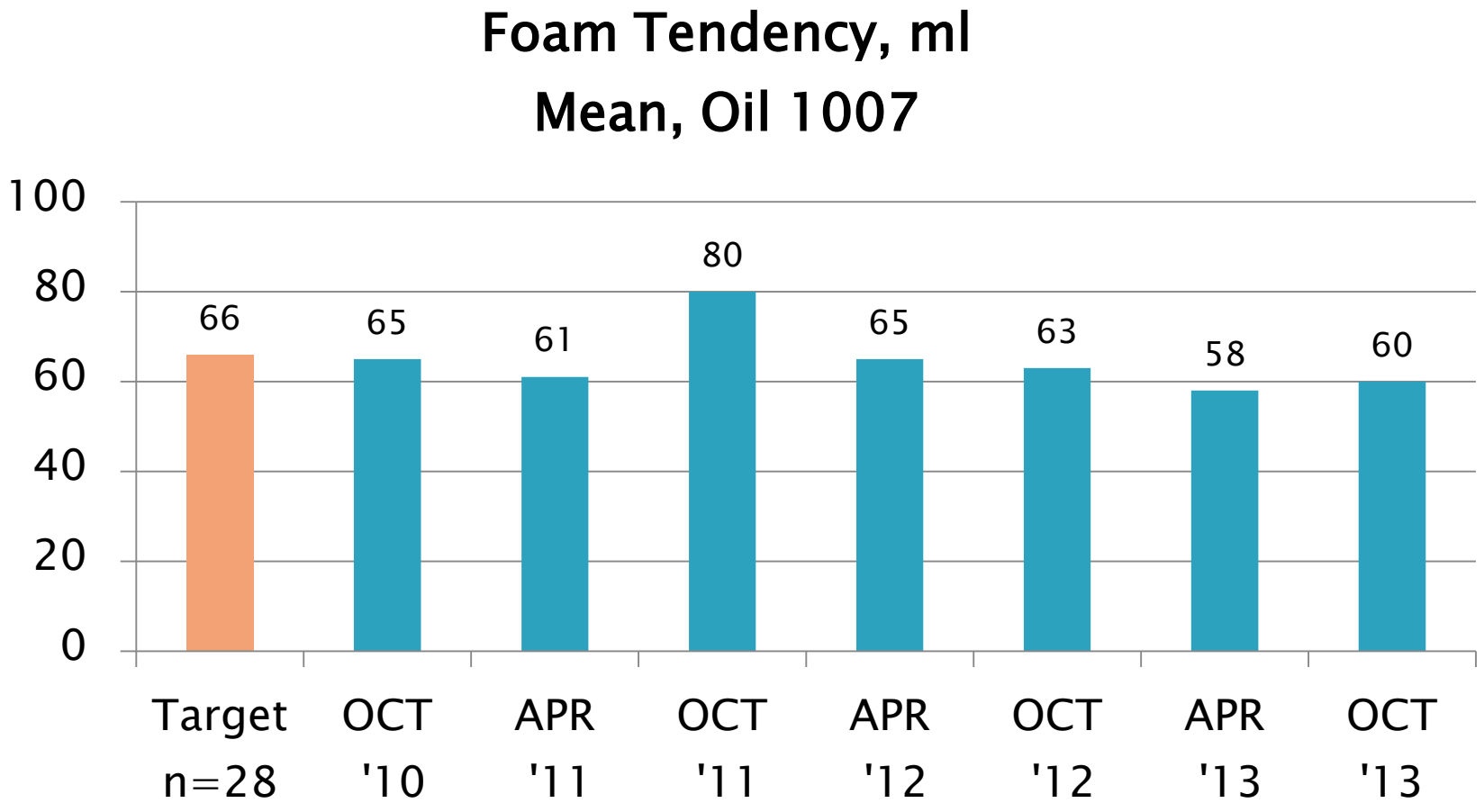
Foam Tendency, ml	n	Mean	Pooled s	Mean Δ/s
Current Targets	28	65.71	19.28	-----
4/1/10 through 9/30/10	8	65	16	-0.05
10/1/10 through 3/31/11	8	61	10	-0.25
4/1/11 through 9/30/11	9	80	26	0.74
10/1/11 through 3/31/12	8	65	13	-0.05
4/1/12 through 9/30/12	9	63	13	-0.14
10/1/12 through 3/31/13	8	58	10	-0.45
4/1/13 through 9/30/13	9	60	7	-0.32

D6082: High Temperature Foam

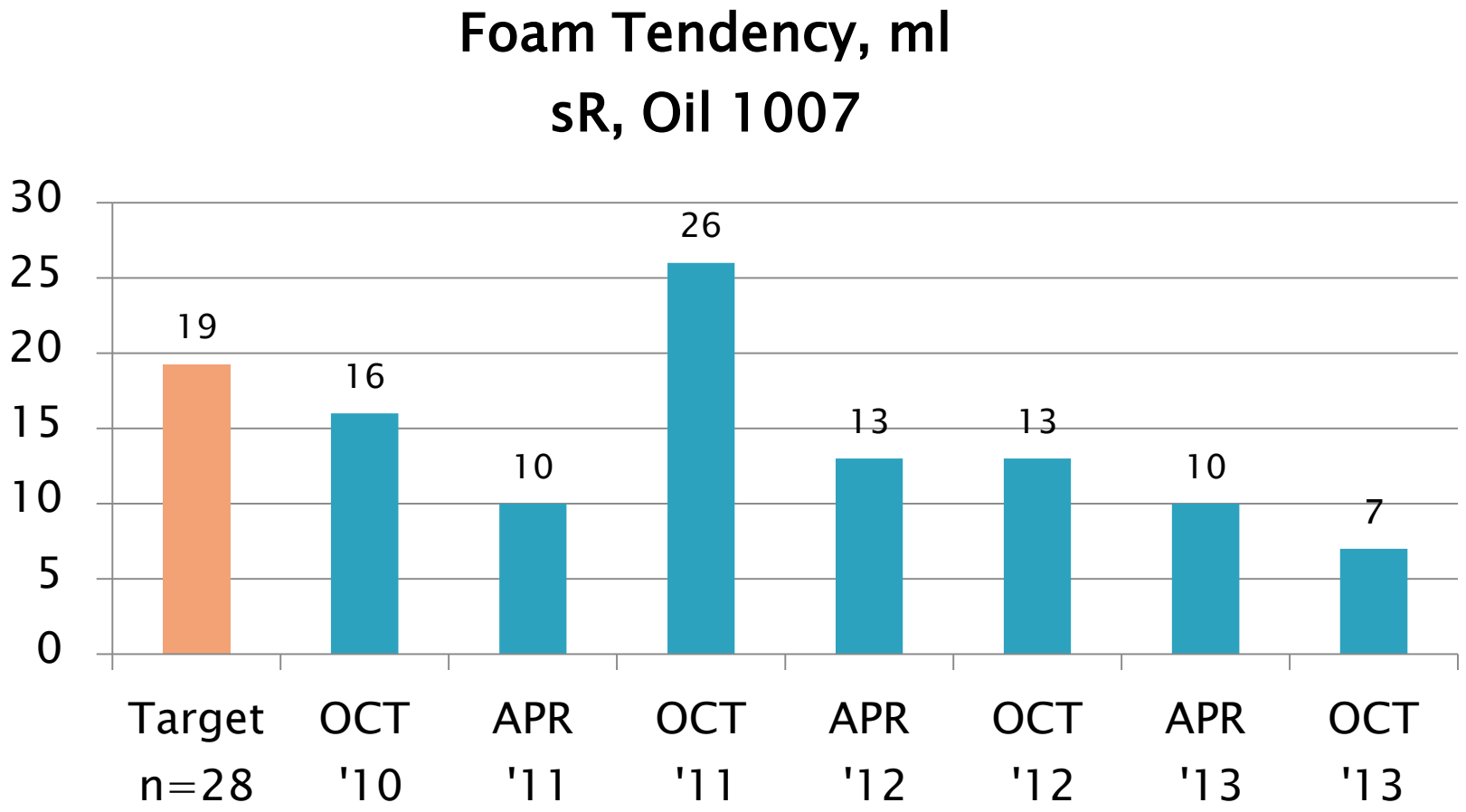
Period Precision and Severity Estimates Oil 1007

Foam Stability @ 1 min, ml	n	Mean	s
Current Targets	28	0.00	19.28
4/1/10 through 9/30/10	8	No non-zero occurrences	
10/1/10 through 3/31/11	8	No non-zero occurrences	
4/1/11 through 9/30/11	9	No non-zero occurrences	
10/1/11 through 3/31/12	8	No non-zero occurrences	
4/1/12 through 9/30/12	9	No non-zero occurrences	
10/1/12 through 3/31/13	8	No non-zero occurrences	
4/1/13 through 9/30/13	9	No non-zero occurrences	

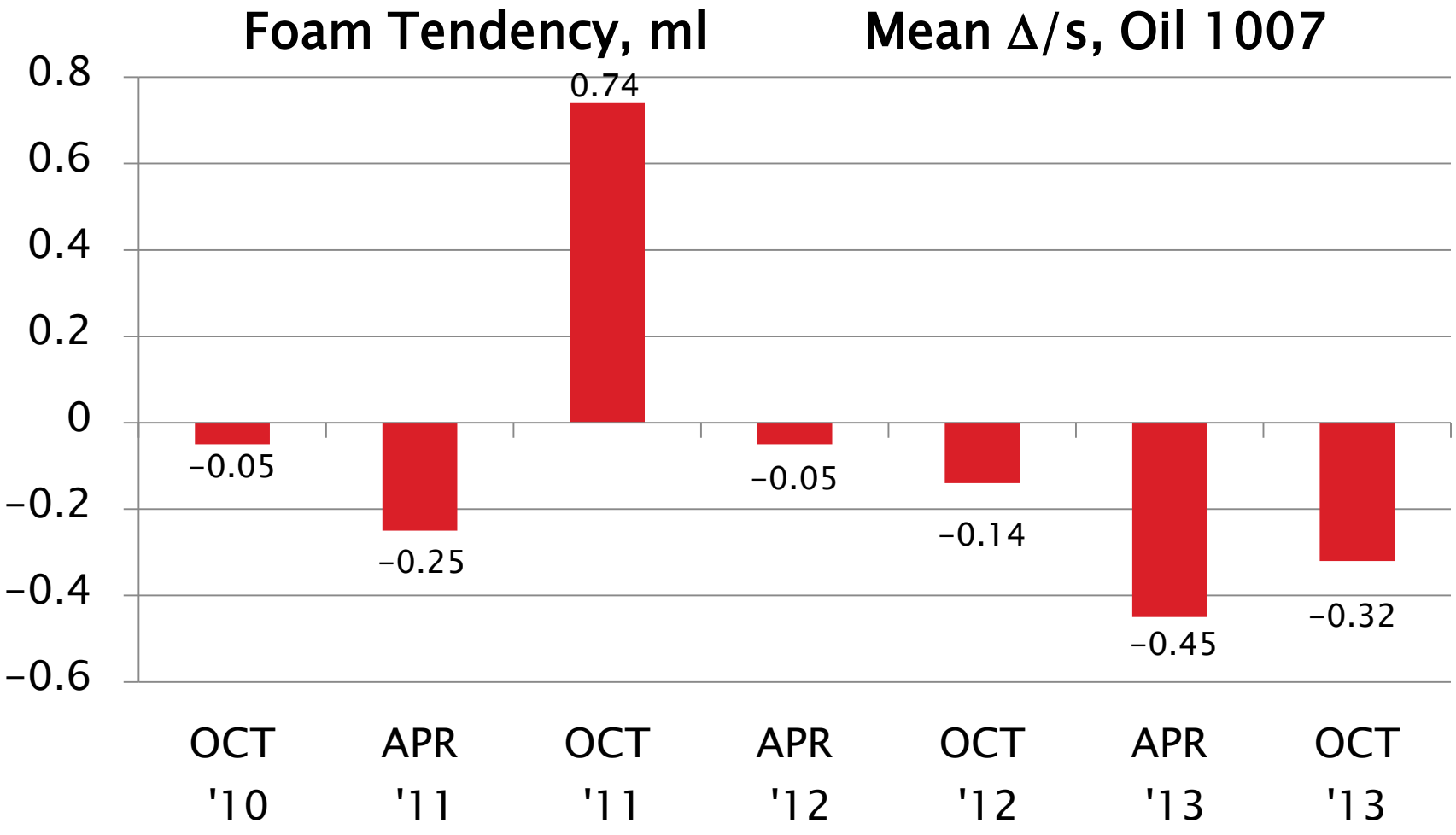
D6082: High Temperature Foam



D6082: High Temperature Foam



D6082: High Temperature Foam



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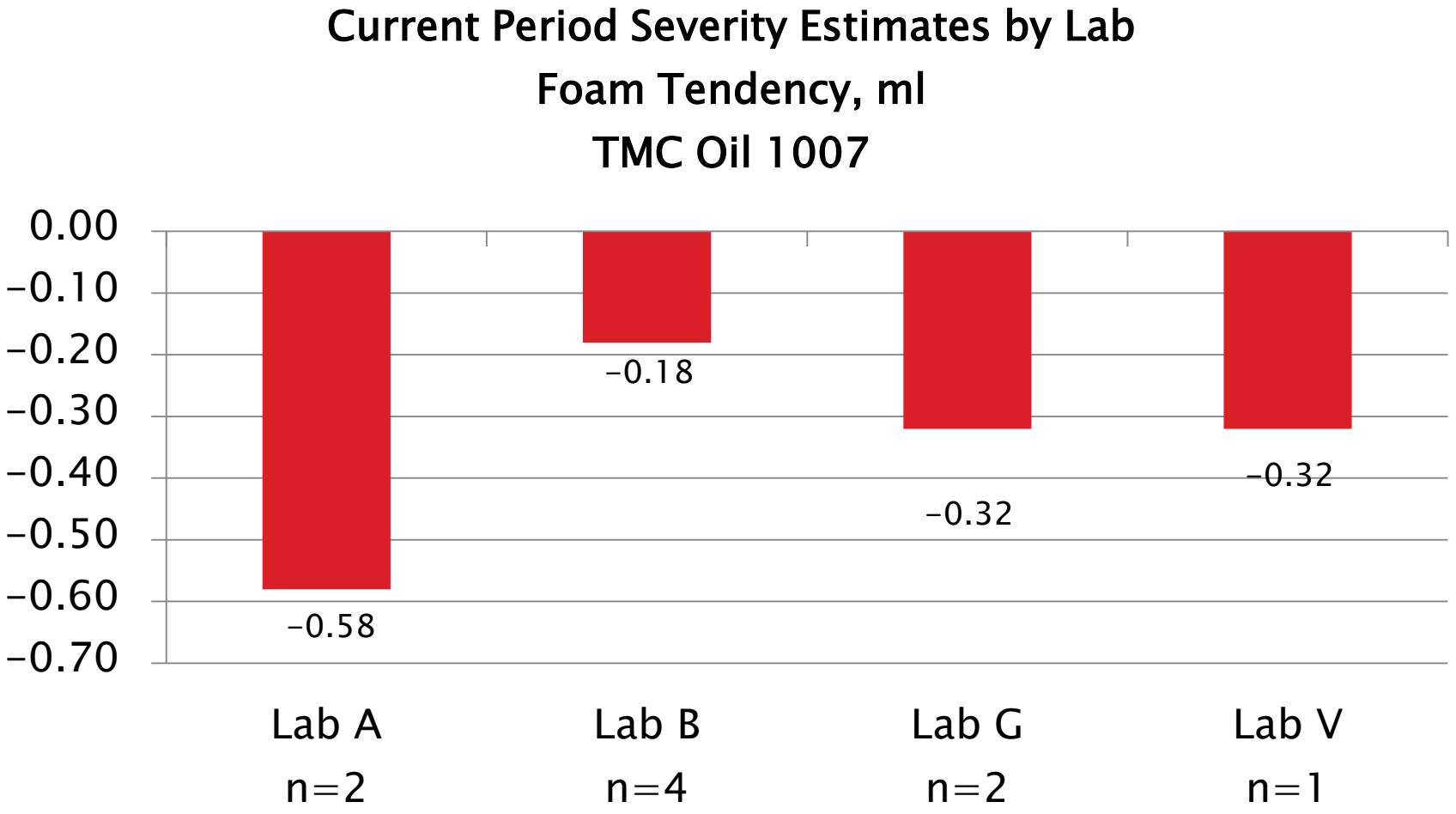
D6082: High Temperature Foam

Current Period Severity Estimates by Lab
Foam Tendency, ml
TMC Oil 1007

	n	Mean Δ/s
Lab A	2	-0.58
Lab B	4	-0.18
Lab G	2	-0.32
Lab V	1	-0.32

D6082: High Temperature Foam



D6082: High Temperature Foam

- Foam Tendency Precision (Pooled s) is more precise than prior period
  - More precise than target precision
- Performance (Mean Δ/s) is -0.32 s mild
- No non-zero occurrences of Foam Stability
- All operationally valid discrimination runs demonstrated acceptable discrimination

D6082 HIGH TEMPERATURE FOAM INDUSTRY OPERATIONALLY VALID DATA

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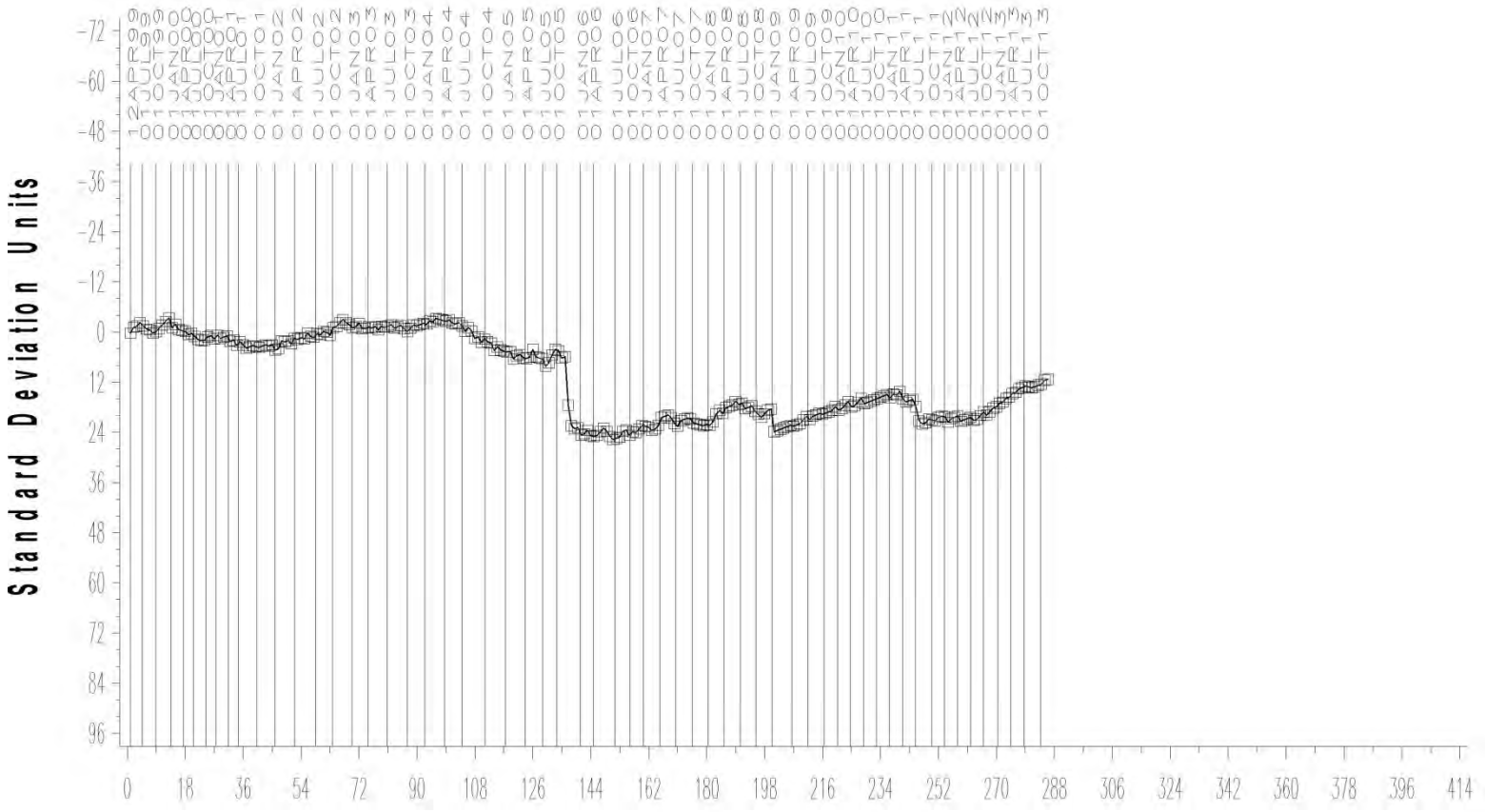
IND='1007'

FOAM TENDENCY

CUSUM Severity Analysis



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D6082: High Temperature Foam

Foam Tendency, ml
Performance by Oil

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 – 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
1007	28	65	19	9	63	13	-0.14	8	58	10	-0.45	9	60	7	-0.32

Return to Executive Summary

D874: Sulfated Ash

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	6
Failed Calibration Test	OC	0
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		**6**

Number of Labs Reporting Data: 3
Fail Rate of Operationally Valid Tests: 0%

D874: Sulfated Ash

Statistically Unacceptable Tests (OC)	No. Of Tests
Sulfated Ash Mild	0
Sulfated Ash Severe	0

- No operationally or statistically invalid tests reported this period

- One TMC technical update issued this period
  - Memo 13-047, 8/14/13, Updated Test Method

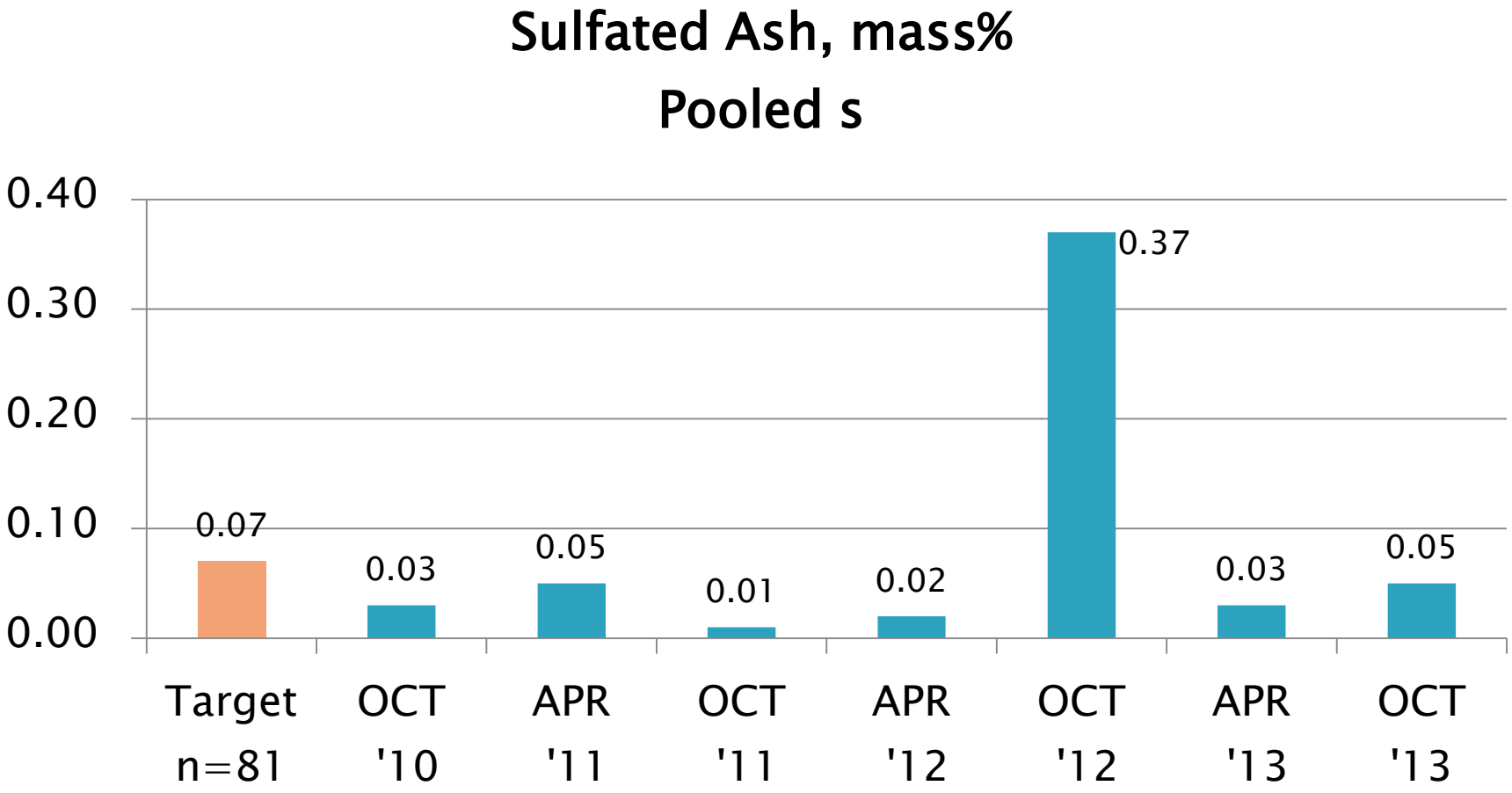
D874: Sulfated Ash

Period Precision and Severity Estimates

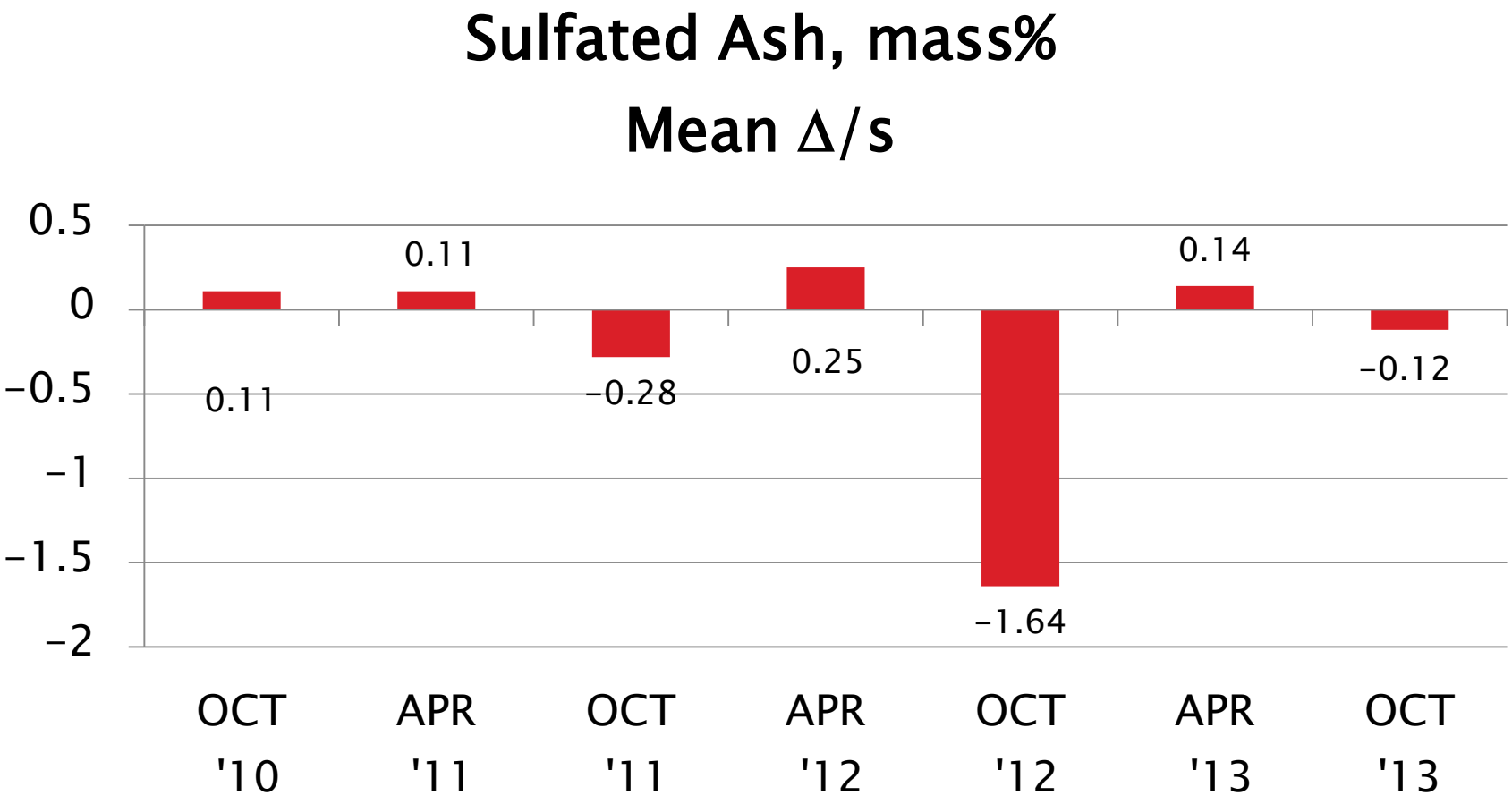
Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets	81	78	0.07	-----
4/1/10 through 9/30/10	5	2	0.03	0.11
10/1/10 through 3/31/11	6	3	0.05	0.11
4/1/11 through 9/30/11	6	3	0.01	-0.28
10/1/11 through 3/31/12	6	4	0.02	0.25
4/1/12 through 9/30/12*	7	4	0.37	-1.64
4/1/12 through 9/30/12*	6	3	0.04	0.01
10/1/12 through 3/31/13	7	4	0.03	0.14
4/1/13 through 9/30/13	6	3	0.05	-0.12

*Period statistics with and without extreme result included

D874: Sulfated Ash



D874: Sulfated Ash

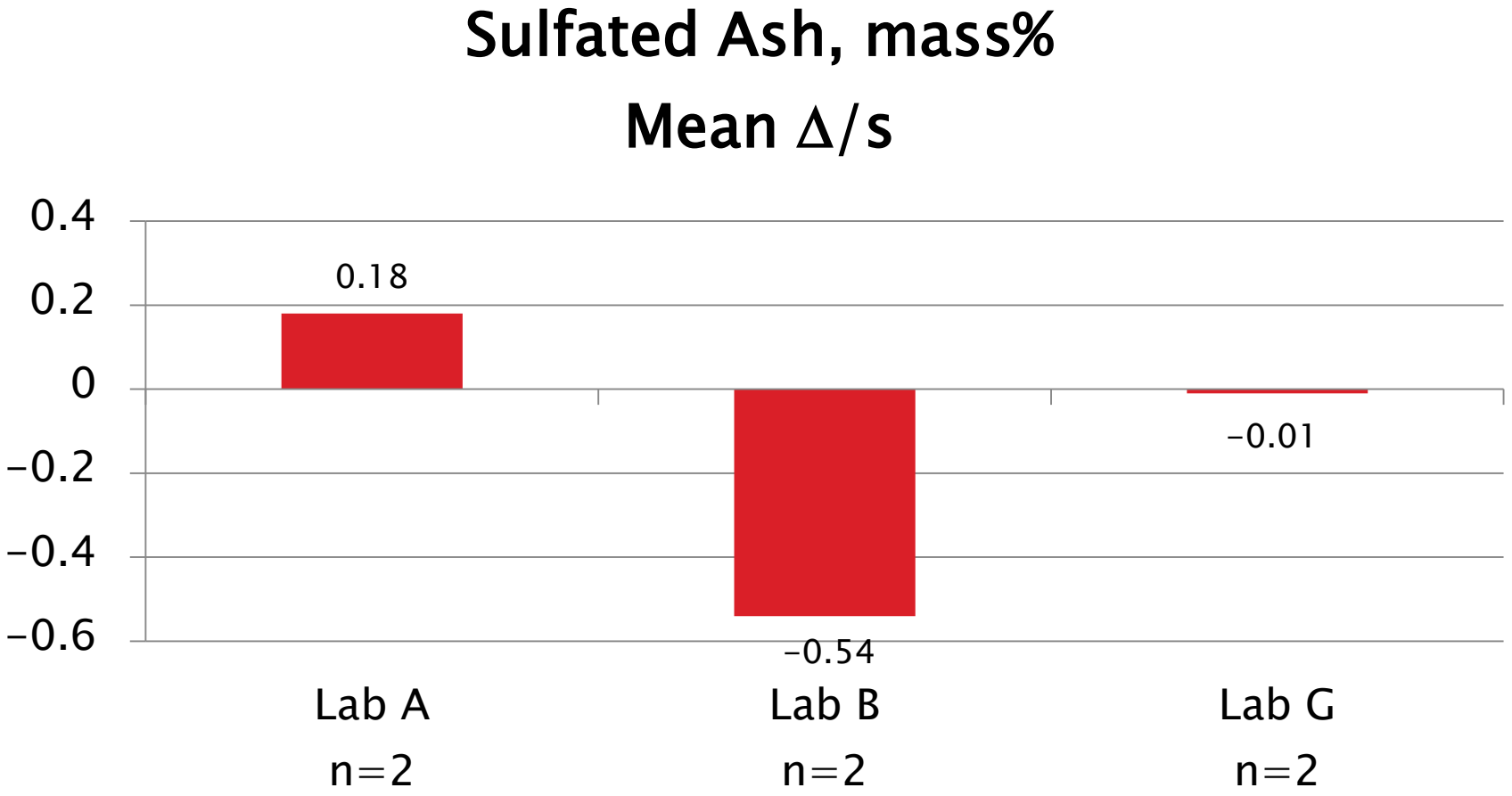


D874: Sulfated Ash

Current Period Severity Estimates by Lab
Sulfated Ash, mass%

	n	Mean Δ/s
Lab A	2	0.18
Lab B	2	-0.54
Lab G	2	-0.01

D874: Sulfated Ash



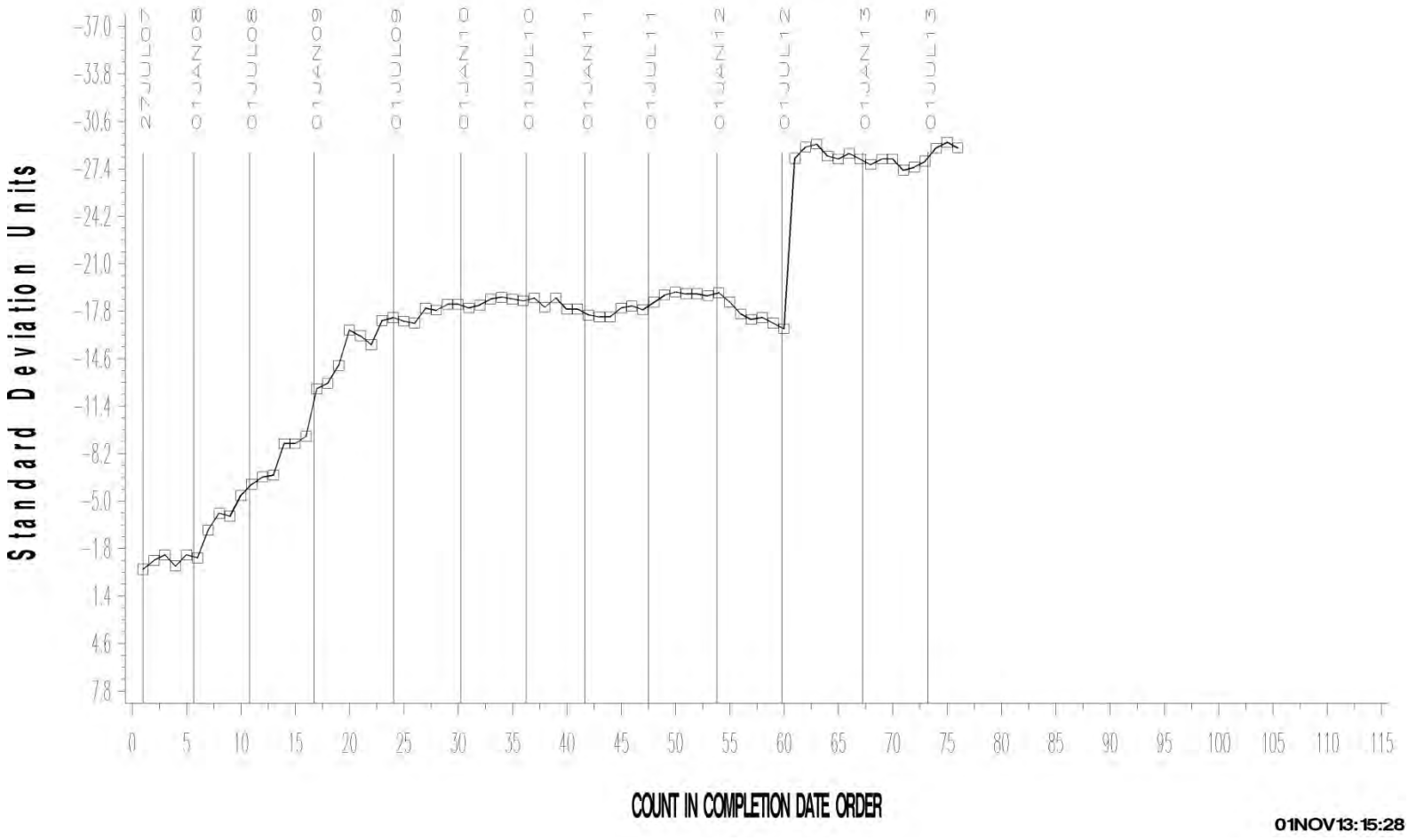
D874: Sulfated Ash

- Precision (Pooled s) is comparable to prior period
  - More precise than target precision
- Performance (Mean Δ/s) is -0.12 s mild

D874 INDUSTRY OPERATIONALLY VALID DATA

TEST SAMPLE PERCENT SULFATED ASH

CUSUM Severity Analysis



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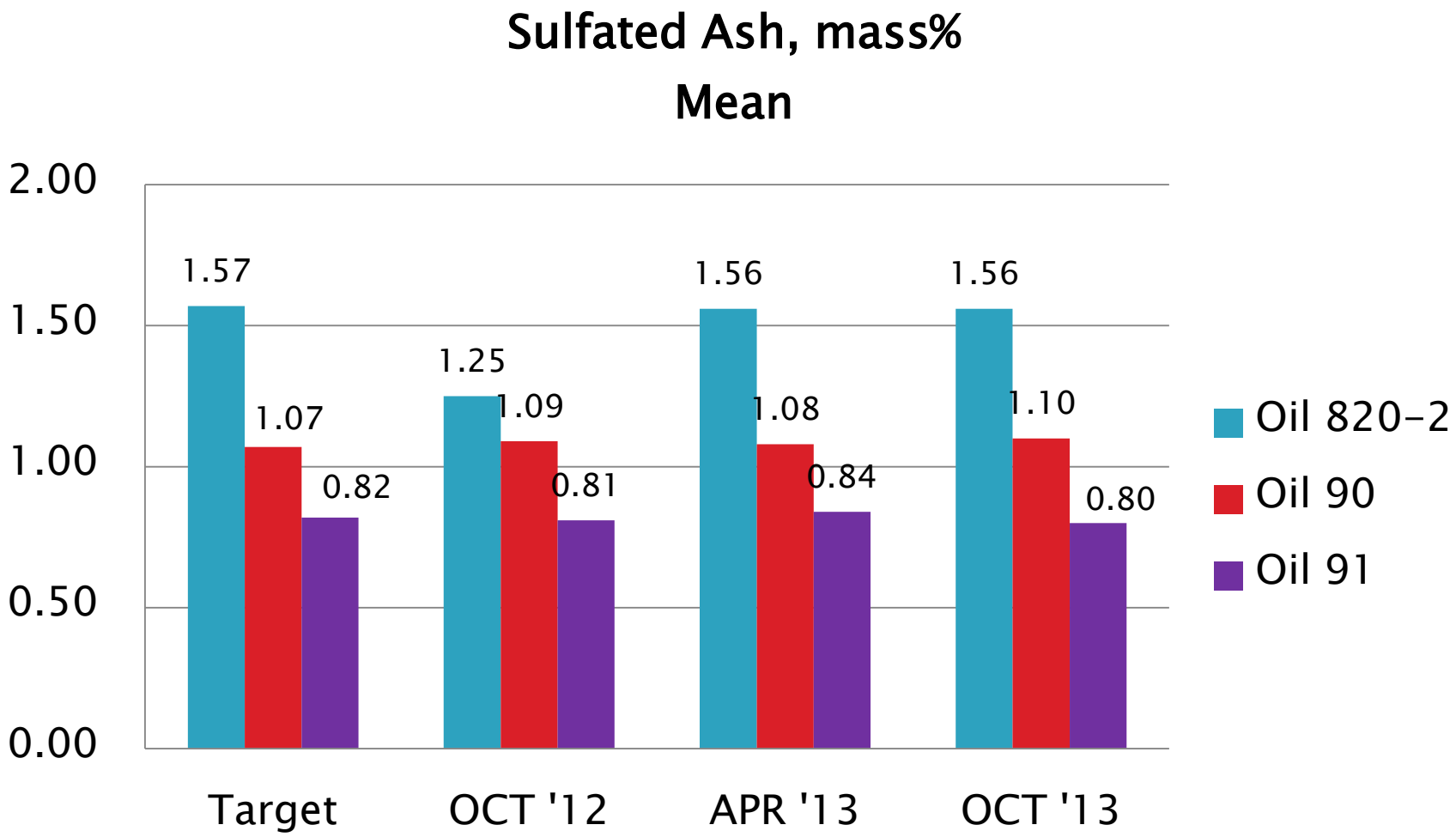
D874: Sulfated Ash

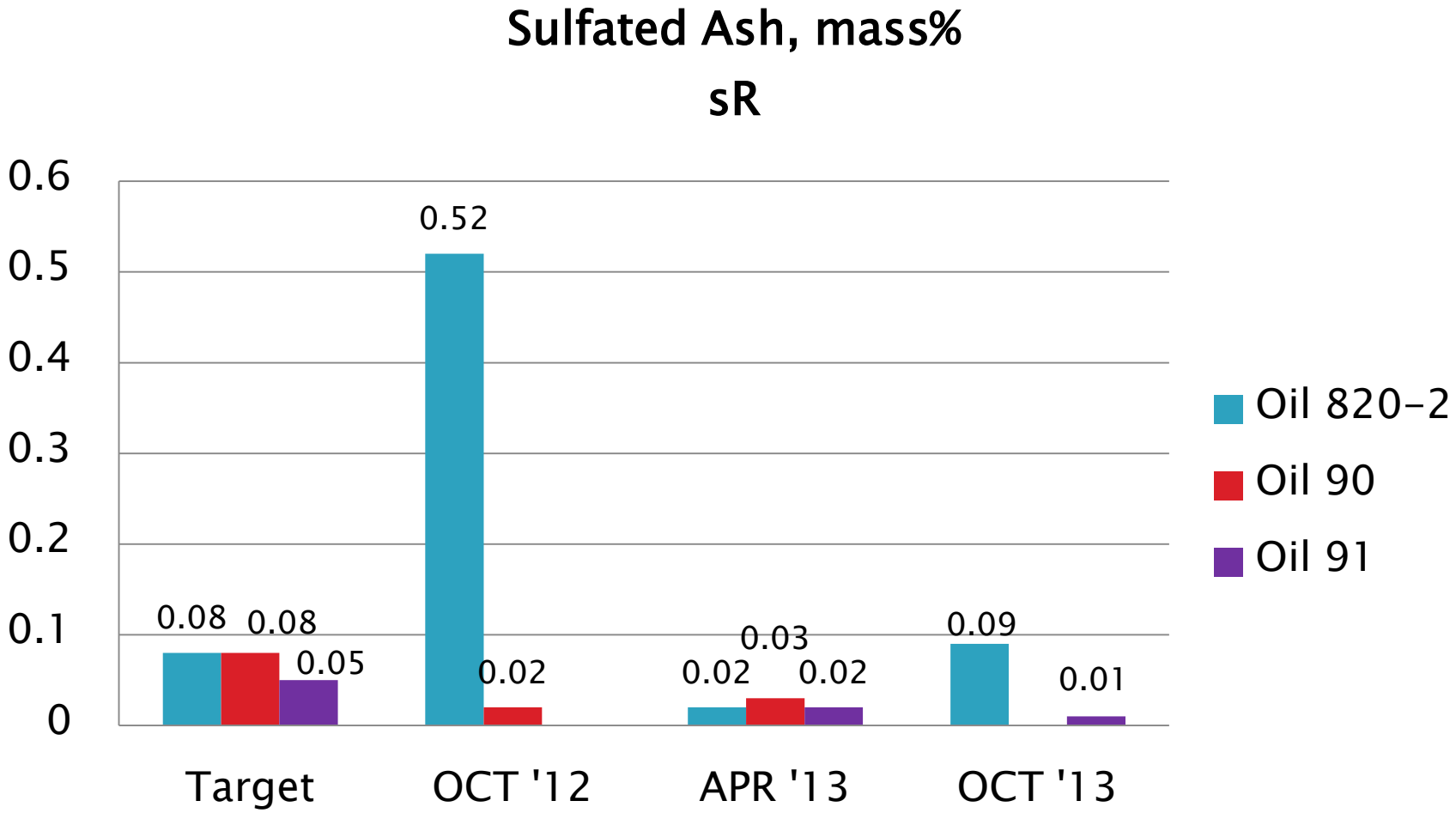
Performance by Oil
Sulfated Ash, mass%

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 – 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
820-2	27	1.57	0.08	3	1.25	0.52	-3.96	2	1.56	0.02	-0.19	2	1.56	0.09	-0.06
90	27	1.07	0.08	3	1.09	0.02	0.21	3	1.08	0.03	0.12	1	1.10	---	0.38
91	27	0.82	0.05	1	0.81	----	-0.20	2	0.84	0.02	0.50	3	0.80	0.01	-0.33

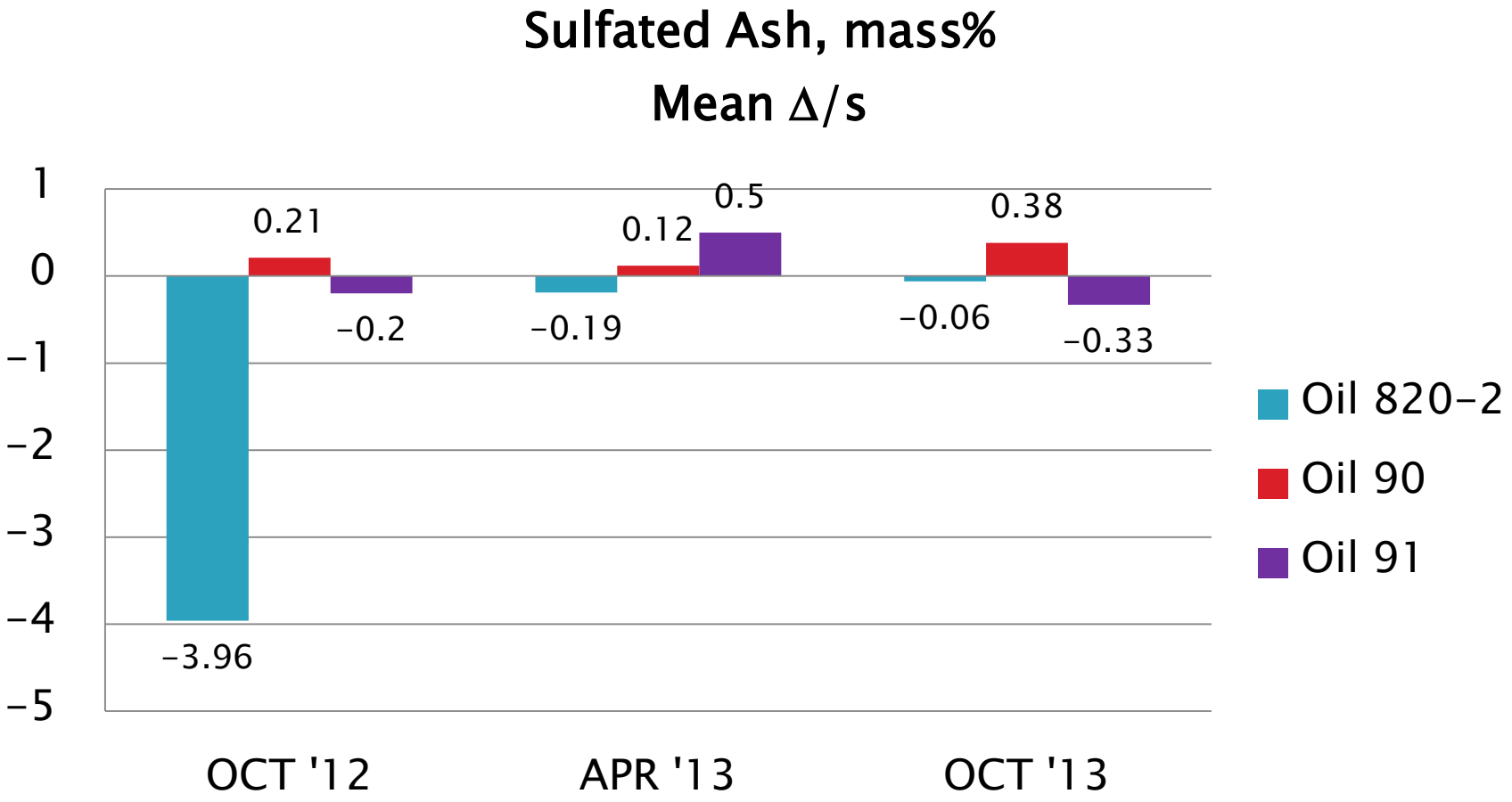
D874: Sulfated Ash



D874: Sulfated Ash



D874: Sulfated Ash



Return to Executive Summary

D7528: Oxidation by ROBO

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	70
Failed Calibration Test	OC	20
Operationally Invalidated by Lab	LC, XC	13
Operationally Invalidated After Initially Reported as Valid	RC	0
Non-reference shakedown, excluded from statistics	NN	4
Total		**107**

Number of Labs Reporting Data: 8
Fail Rate of Operationally Valid Tests: 22%

D7528: Oxidation by ROBO

Operationally Invalid Tests

- 2 tests: Incorrect VCV setting (LC, XC)
- 2 test: Vacuum system failure (LC)
- 2 tests: Stirrer failure (LC)
- 2 tests: NO_2 leak or flow problem (XC)
- 3 tests: Hood fail or excessive draft (LC, XC)
- 1 test: Power failure (XC)
- 1 test: Unexplained high EOT volatiles (XC)

D7528: Oxidation by ROBO

Statistically Unacceptable Tests (OC)	No. Of Tests
Natural Log (MRV Viscosity) Mild	19
Natural Log (MRV Viscosity) Severe	1

- One TMC technical update issued this period
  - Memo 13-046, 8/14/13, Updated Test Method

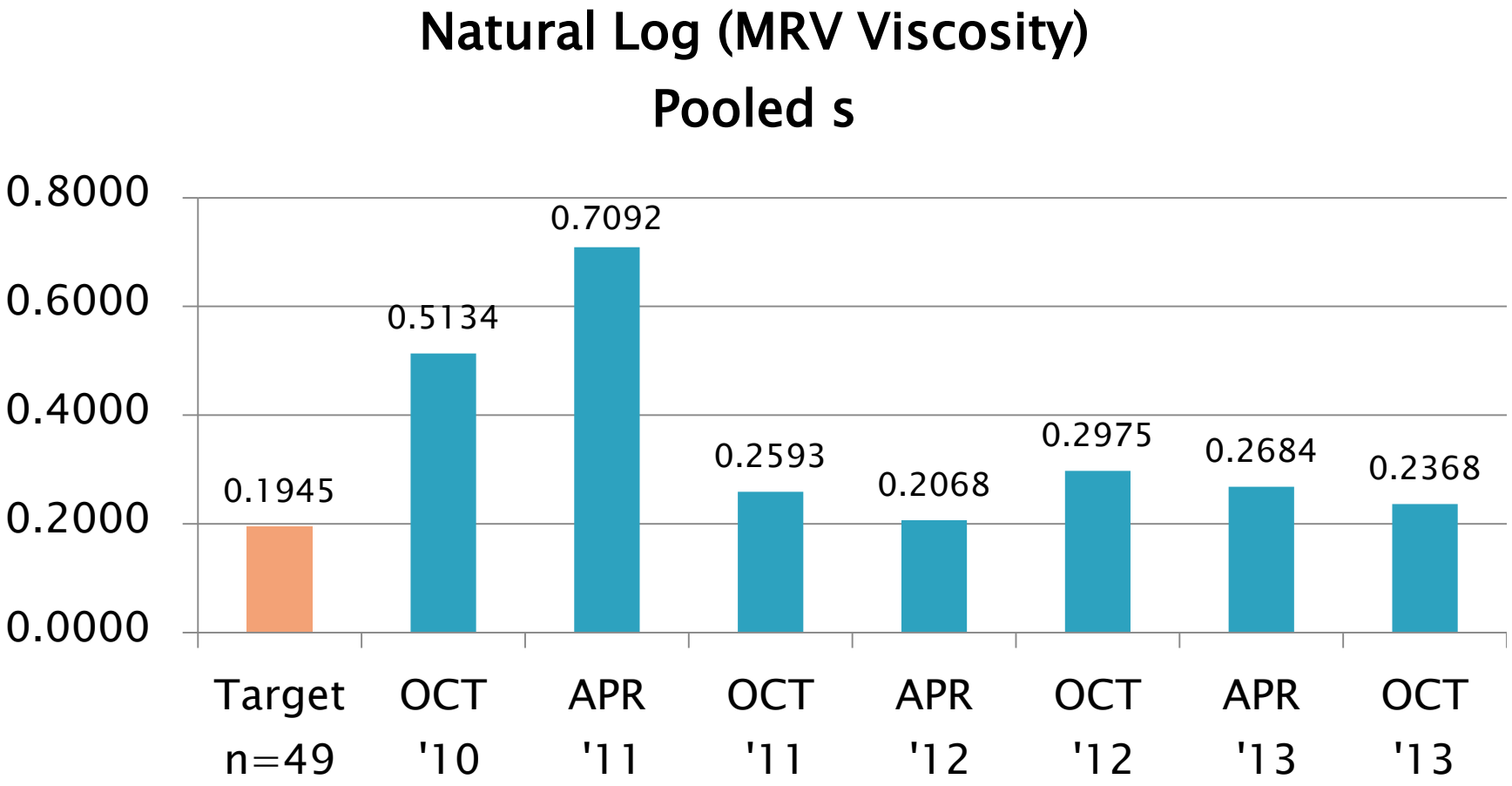
D7528: Oxidation by ROBO

Period Precision and Severity Estimates

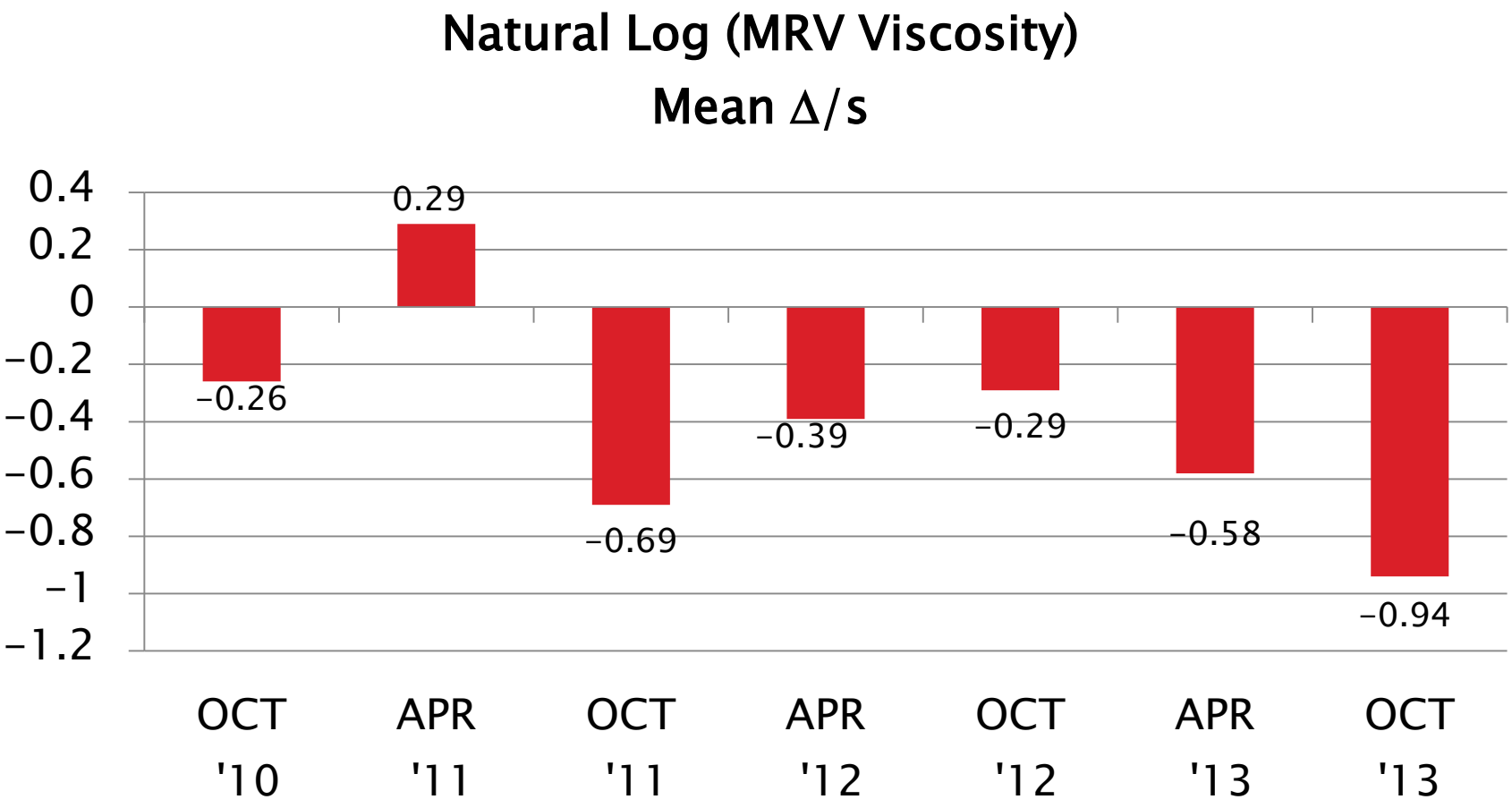
Natural Log (MRV Viscosity)	n	df	Pooled s	Mean Δ/s
Current Targets	49	46	0.1945	-----
4/1/10 through 9/30/10	114	110	0.5134	-0.26
10/1/10 through 3/31/11*	121	118	0.7092	0.29
10/1/10 through 3/31/11*	120	117	0.4628	0.05
4/1/11 through 9/30/11	96	92	0.2593	-0.69
10/1/11 through 3/31/12	93	90	0.2068	-0.39
4/1/12 through 9/30/12	86	83	0.2975	-0.29
10/1/12 through 3/31/13	109	106	0.2684	-0.58
4/1/13 through 9/30/13	90	87	0.2368	-0.94

*Period statistics with and without extreme result included

D7528: Oxidation by ROBO



D7528: Oxidation by ROBO



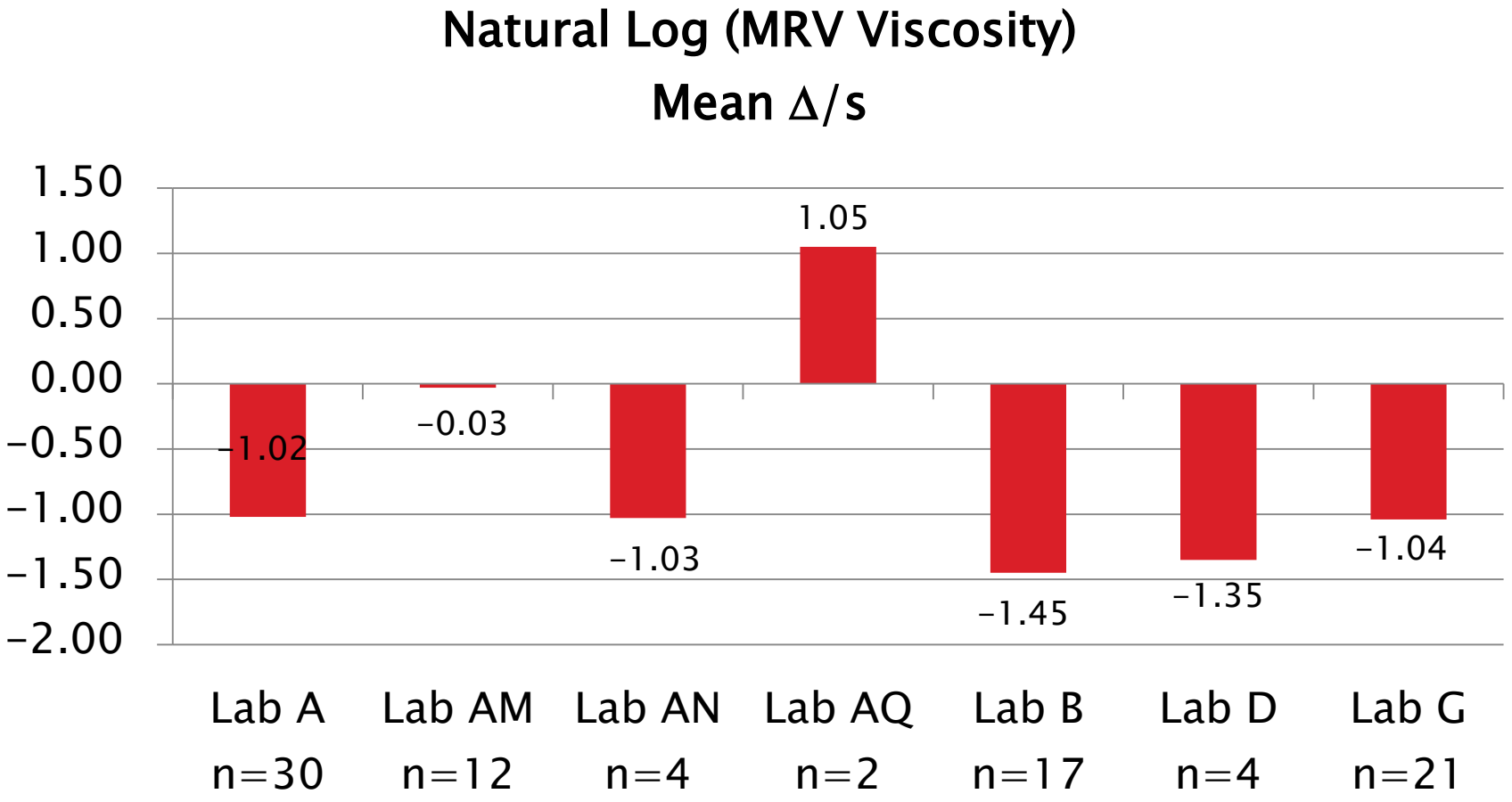
D7528: Oxidation by ROBO

Current Period Severity Estimates by Lab Natural Log (MRV Viscosity)

	n	Mean Δ/s
Lab A	30	-1.02
Lab AM	12	-0.03
Lab AN	4	-1.03
Lab AQ	2	1.05
Lab B	17	-1.45
Lab D	4	-1.35
Lab G	21	-1.04

Lab AS reported only shakedown runs this period

D7528: Oxidation by ROBO



D7528: Oxidation by ROBO

- Precision (Pooled s) is more precise than prior period
  - Less precise than target precision

- Performance (Mean Δ/s) is -0.94 s mild
  - Significant increase in overall mild performance
  - All three reference oils continue to perform mild
  - Only one lab on target, overall
    - One lab 1 s severe
    - Five labs 1 s or more mild

ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

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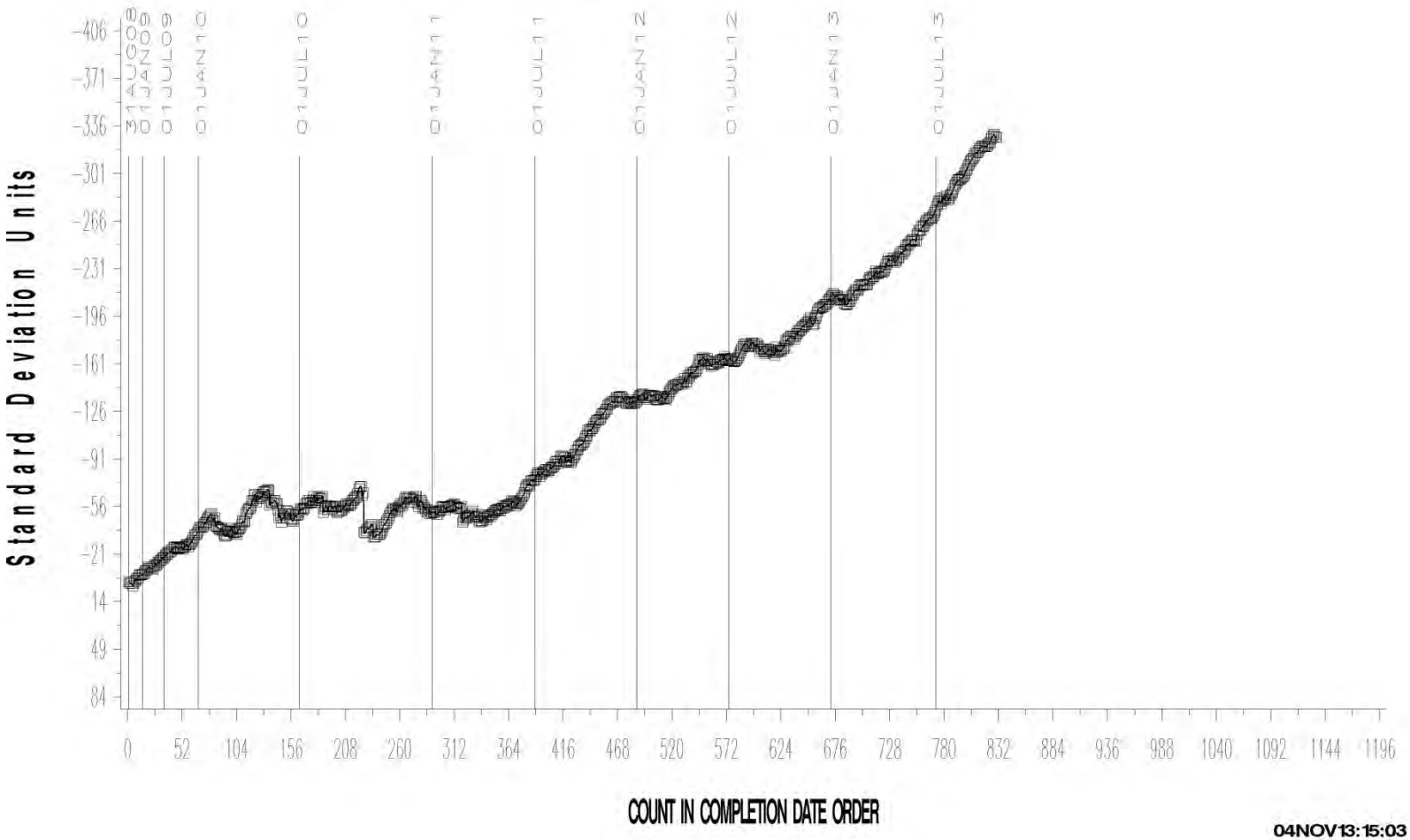
AGED OIL MRV APPARENT VISCOSITY

CUSUM Severity Analysis



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Test Monitoring Center

http://astmtmc.cmu.edu

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ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

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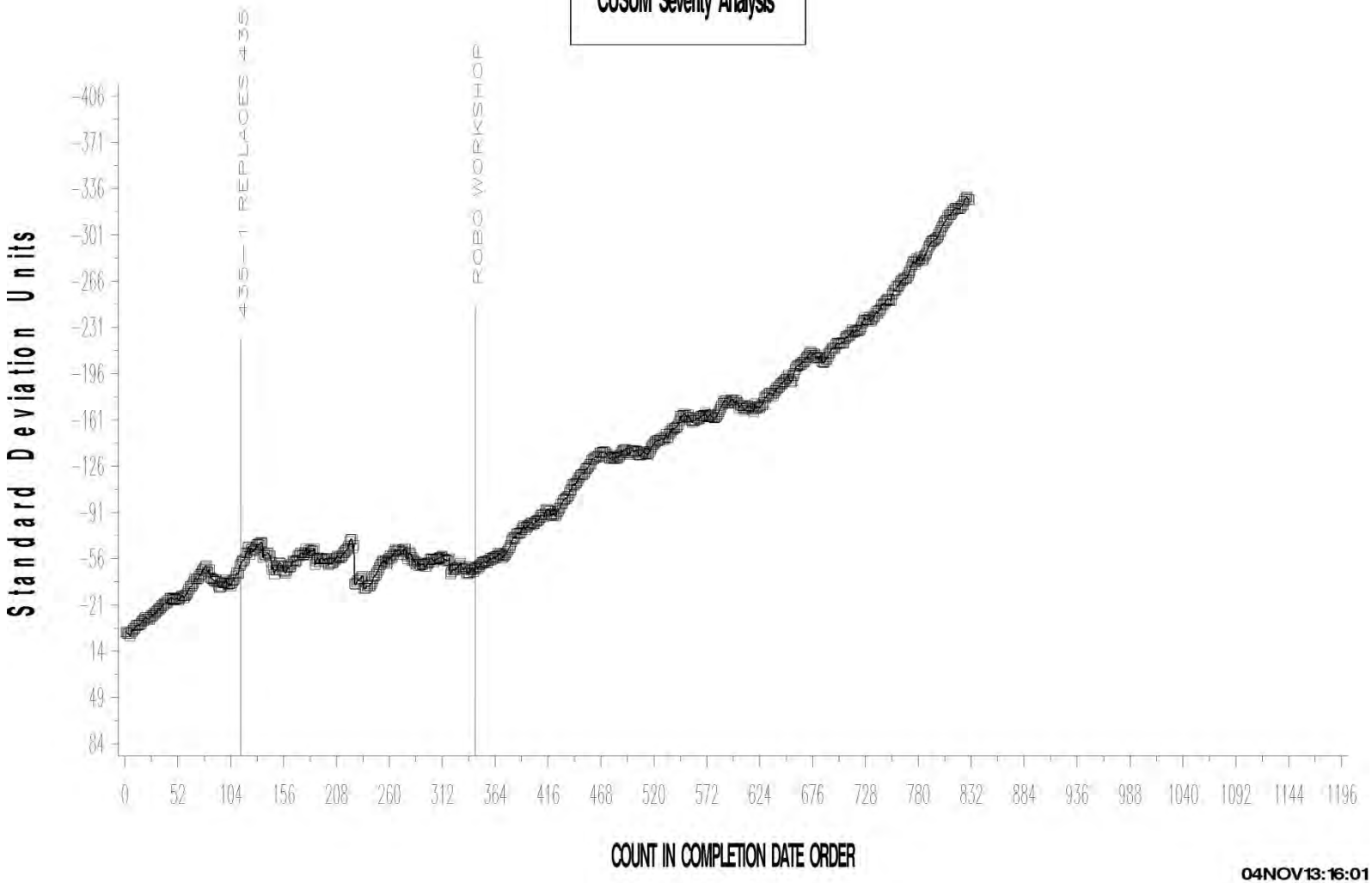
AGED OIL MRV APPARENT VISCOSITY

CUSUM Severity Analysis



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Test Monitoring Center

http://astmtmc.cmu.edu

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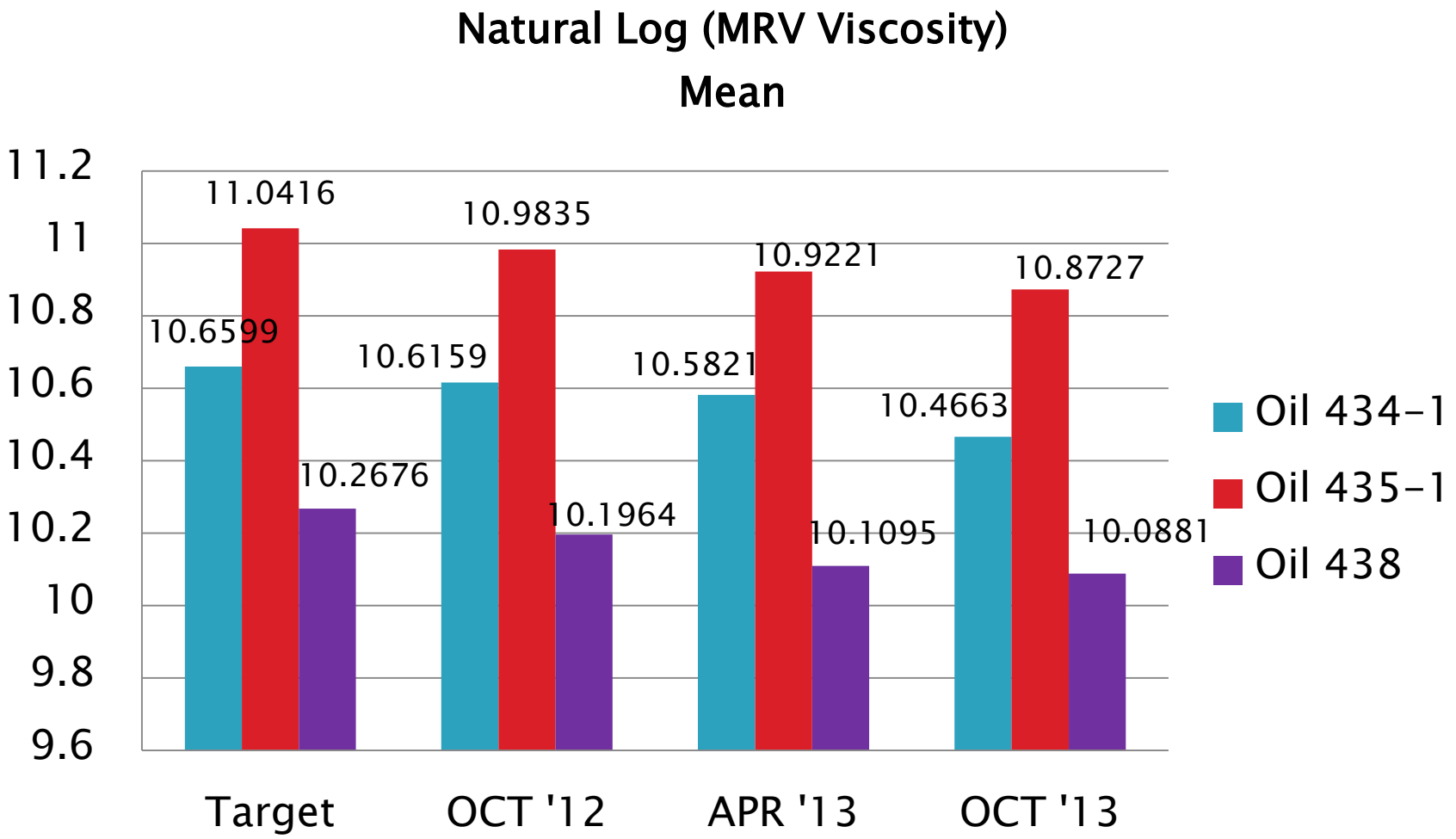
D7528: Oxidation by ROBO

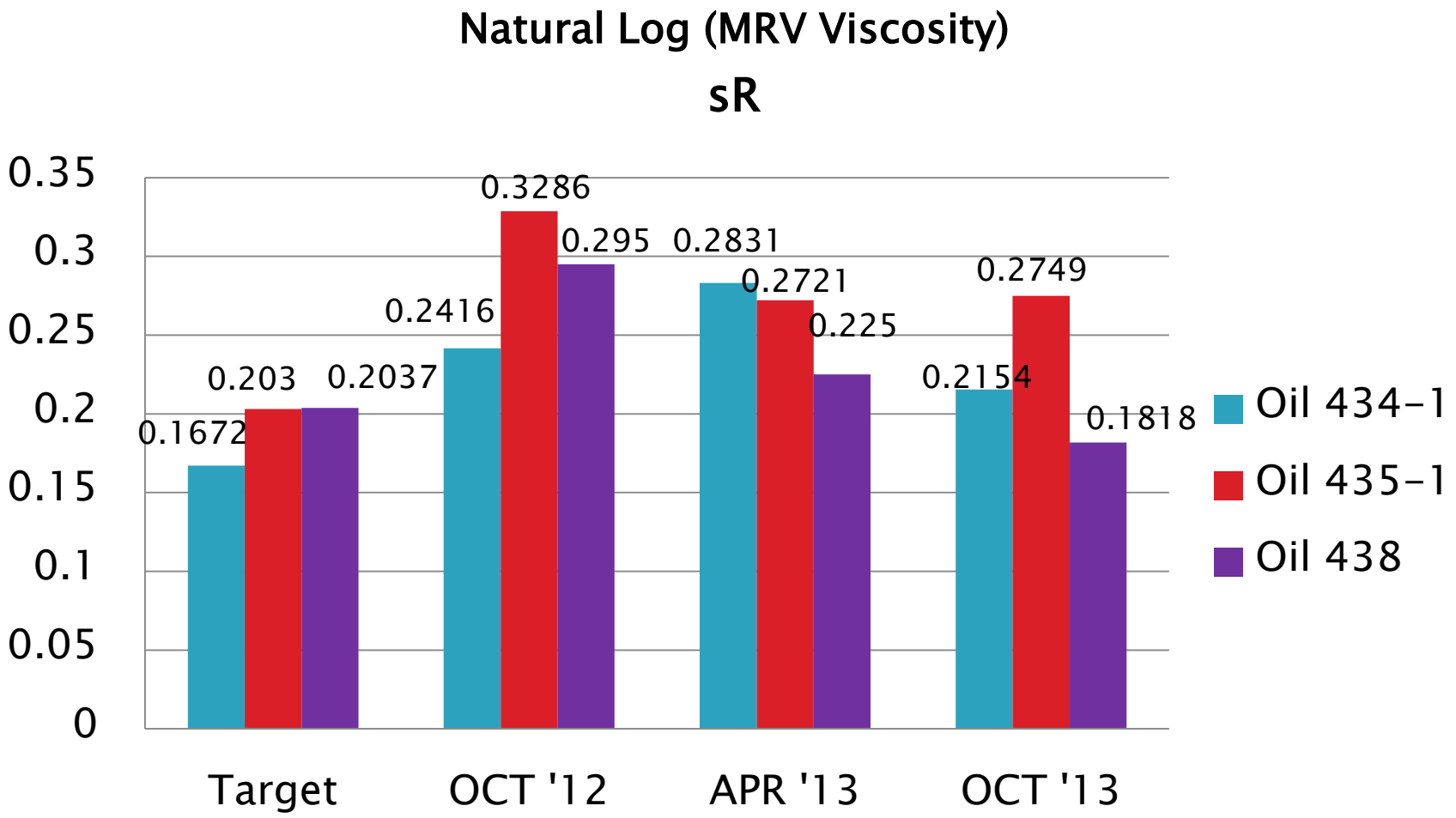
Performance by Oil
Natural Log (MRV Viscosity)

	Targets			4/1/12 - 9/30/12				10/1/12 - 3/31/13				4/1/13 - 9/30/13			
Oil Code	n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
434-1	13	10.6599	0.1672	26	10.6159	0.2416	-0.26	39	10.5821	0.2831	-0.47	27	10.4663	0.2154	-1.16
435-1	22	11.0416	0.2030	41	10.9835	0.3286	-0.29	50	10.9221	0.2721	-0.59	40	10.8727	0.2749	-0.83
438	14	10.2676	0.2037	19	10.1964	0.2950	-0.35	20	10.1095	0.2250	-0.78	23	10.0881	0.1818	-0.88

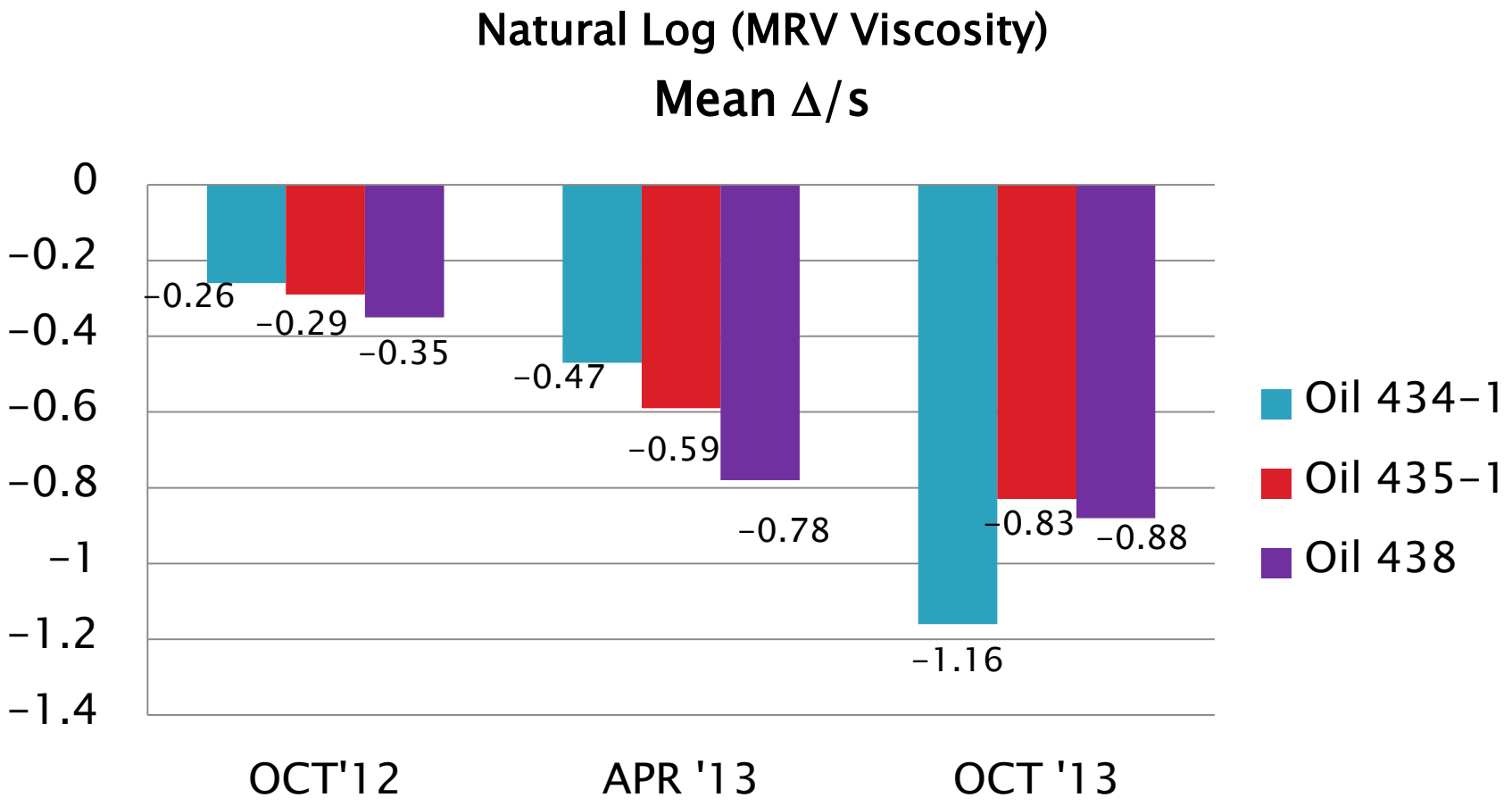
D7528: Oxidation by ROBO



D7528: Oxidation by ROBO



D7528: Oxidation by ROBO



Return to Executive Summary

Non-monitored Bench Tests

- **D6922 Homogeneity and Miscibility**
  - The TMC distributes six D6922 reference oils.
  - The TMC does not collect reference data or monitor test results for this test at this time.
  - **Oils rec'd by TMC 2002 – 2003**
    - **Formulations are 11 years old now**
    - **Should section or panel consider updating?**

- **D7563 Emulsification**
  - The TMC distributes two D7563 reference oils.
  - The TMC does not collect reference data or monitor test results for this test at this time.

Reference Oil Inventory

- As of 9/30/2013

Reference Oil Inventory

D5800, D6417, GI

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
VOLC12	D5800	53.3	1.7
VOLD12	D5800	53.3	1.7
VOLE12	D5800	53.3	1.7
52	D6417	62.1	0.7
55	D6417	66.2	1.9
58	D6417, GI	110.4	1.2
62	GI	1.4	0.1
1009*	GI	52.9	----

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

Reference Oil Inventory

TEOST, MTEOS & ROBO

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
432	MTEOS	113.1	1.6
434	MTEOS	4.7	0.5
75	TEOST	5.7	1.0
435-2*	TEOST	45.8	----
434-1*	ROBO	10.4	----
435-1*	ROBO	40.4	----
438*	ROBO	21.8	----

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

Reference Oil Inventory

D6082 & D874

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
1007	D6082	14.2	3.4
66	D6082	90.1	1.7
820-2	D874	10.3	0.0
90	D874	31.7	3.5
91	D874	4.1	0.0

Reference Oil Inventory

Obsolete or Development Oils

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
51*	Obsolete Vol. & GI	94.6	0.0
53*	Obsolete Vol. & GI	96.8	0.0
54*	Obsolete Vol.	97.8	0.0
71	Obsolete TEOST	4 Samples	0.0
71-1	Obsolete TEOST	12 Samples	0.0
72	Obsolete TEOST	2 Samples	0.0
72-1	Obsolete TEOST	4 Samples	0.0
433*	Obsolete MTEOS	3.9	0.0

*Test development oil; holding for instructions from Surveillance Panel

Reference Oil Inventory

Obsolete or Development Oils

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
83*	Obsolete ROBO	47.3	0.0
84*	Obsolete ROBO	3.3	0.0
85*	Obsolete ROBO	3.3	0.0
435	Obsolete ROBO	7 Samples	0.0
VOL12A	Obsolete D5800 RR (never used)	55	0.0
VOL12B	Obsolete D5800 RR (not selected)	53.2	1.0

*Test development oil; holding for instructions from Surveillance Panel

Reference Oil Inventory

D6922 Homogeneity & Miscibility Oils

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
HMA	H&M	153.4	5.3
HMB	H&M	161.6	5.3
HMC	H&M	143.4	5.3
HMD	H&M	151.2	5.3
HME	H&M	137.2	5.3
HMF	H&M	159.7	5.3

Reference Oil Inventory

D7563 Emulsion Retention Oils

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
EM2	Emulsion	8.7	0.0
EM2-1	Emulsion	25.0	0.0
EM5	Emulsion	8.7	0.0
EM5-1	Emulsion	25.0	0.0

Reference Oil Shipping Aliquots

Test	Quantity
D6417	1 ml
D6417QC	118 ml
D5800	100 ml
GI	25 ml
MTEOS	17 ml
TEOST	125 ml
D6082	525 ml
D874	32 ml
D874QC	1000 ml
ROBO	300 ml
ROBOQC	1000 ml
H&M	1000 ml
D7563	1000 ml

Additional Information

Additional Information

- Available on the TMC's Website:
  - CUSUM Severity Plots
  - Reference Data, Period Statistics and Timelines
  - Information Letters and Technical Memos
  - Report Forms & Data Dictionaries
  - Online Store, and more…

- www.astmtmc.cmu.edu

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