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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)

April 2013

B0.07 Bench Testing Executive Summary

- D6417 (Volatility by GC)
  - More precise than target, on-target performance, no issues

- D5800 (Volatility by Noack)
  - Slightly less precise than target, performance 0.43 s severe
  - Long-term severe trend with increase in severity since 01JUL06

  - Oil 52 continues to perform quite severe (1.49 s)
    - Since 4/1/2009, 32 of 35 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 and ongoing
    - Workshop held January 2013
    - Round robin for new reference oils is underway
      - Testing targeted to complete June 30

B0.07 Bench Testing Executive Summary

- D5133 (Gelation Index)
  - More precise than target, performance -0.48 s mild
  - 4 of 5 labs mild, 1 lab on-target
- D6335 (TEOST-33C)
  - Less precise than target but better than prior periods
  - Performance -1.00 s mild
  - Reference oil targets and acceptance bands updated shortly after end of this report period to include ~50% calibration data
- D7097 (MHT-4 TEOST)
  - Less precise than target precision, performance 1.07 s severe
  - Unusually severe performance overall, especially on severe oil 432
    - Coincident with new catalyst batch 1208, but not necessarily dependent; inconclusive correlation of severity with catalyst batch
    - Significant lab performance differences observed

B0.07 Bench Testing Executive Summary

- D6082 (High Temperature Foam)
  - More precise than target precision
  - Performance –0.45 s mild
  - All operationally valid discrimination runs demonstrated acceptable discrimination

- D874 (Sulfated Ash)
  - More precise than target precision
  - Performance 0.14 s severe
  - No issues

B0.07 Bench Testing Executive Summary

- D7528 (ROBO)
  - Less precise than target, but more precise than prior report period
  - Performance -0.58 s mild
    - All three reference oils continue to perform mild

Calibrated Labs and Stands*

Test	Labs	Stands
D6417	5	7
D5800	6	14
D5133 (GI)	3	6
D6335 (TEOST)	5	6
D7097 (MTEOS)	7	27
D6082	3	4
D874	3	---
D7528 (ROBO)	7	18

*As of 3/31/2013

D02.B0.07
TMC Monitored Tests

- October 1, 2012 –
  March 31, 2013

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D6417: Estimation of Engine Oil Volatility by Capillary GC

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

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

D6417: Estimation of Engine Oil Volatility by Capillary GC

- No operationally invalid tests reported this period
- No statistically unacceptable tests reported this period
- No TMC technical updates issued this period

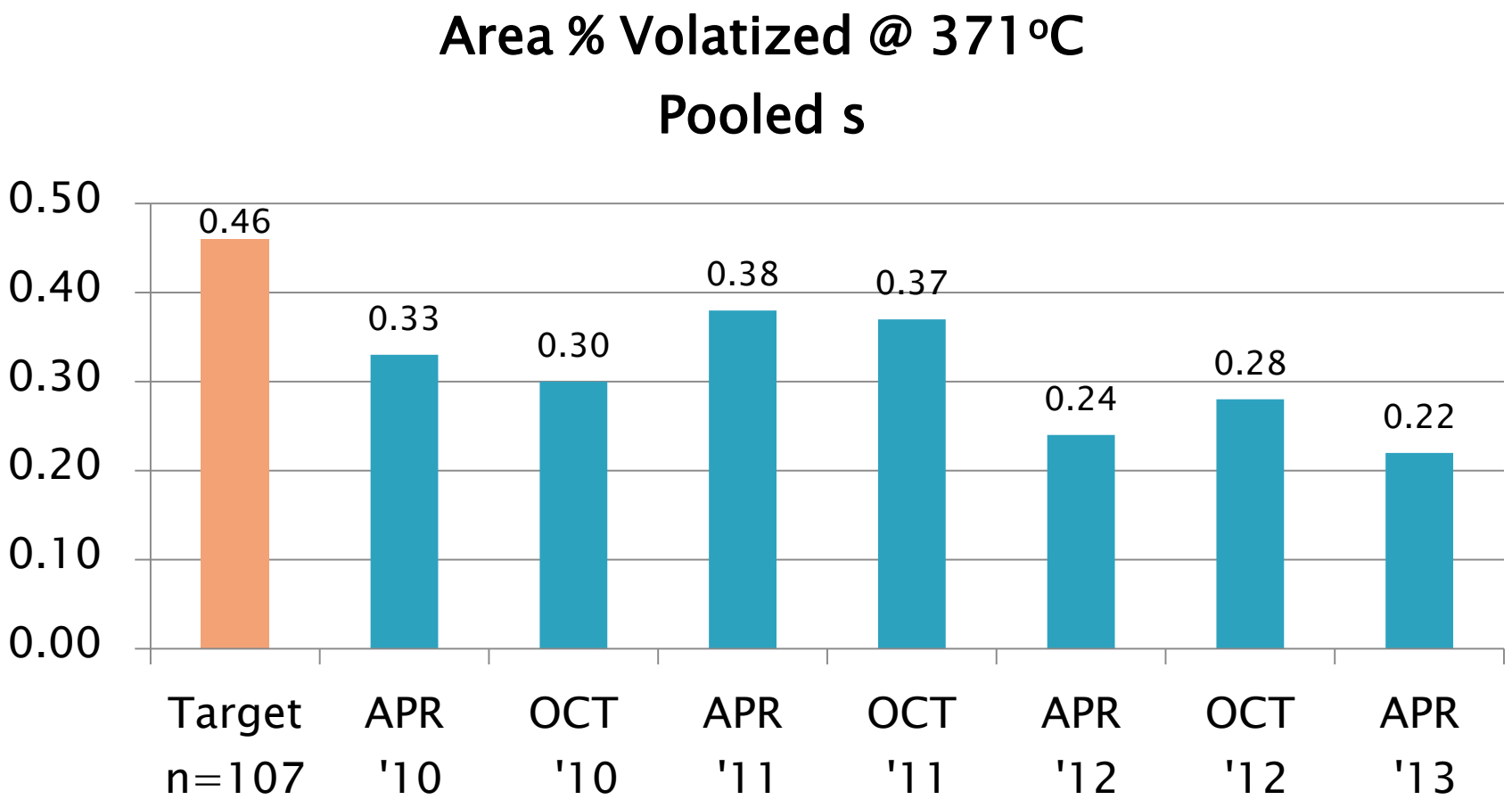
D6417: Estimation of Engine Oil Volatility by Capillary GC

Period Precision and Severity Estimates

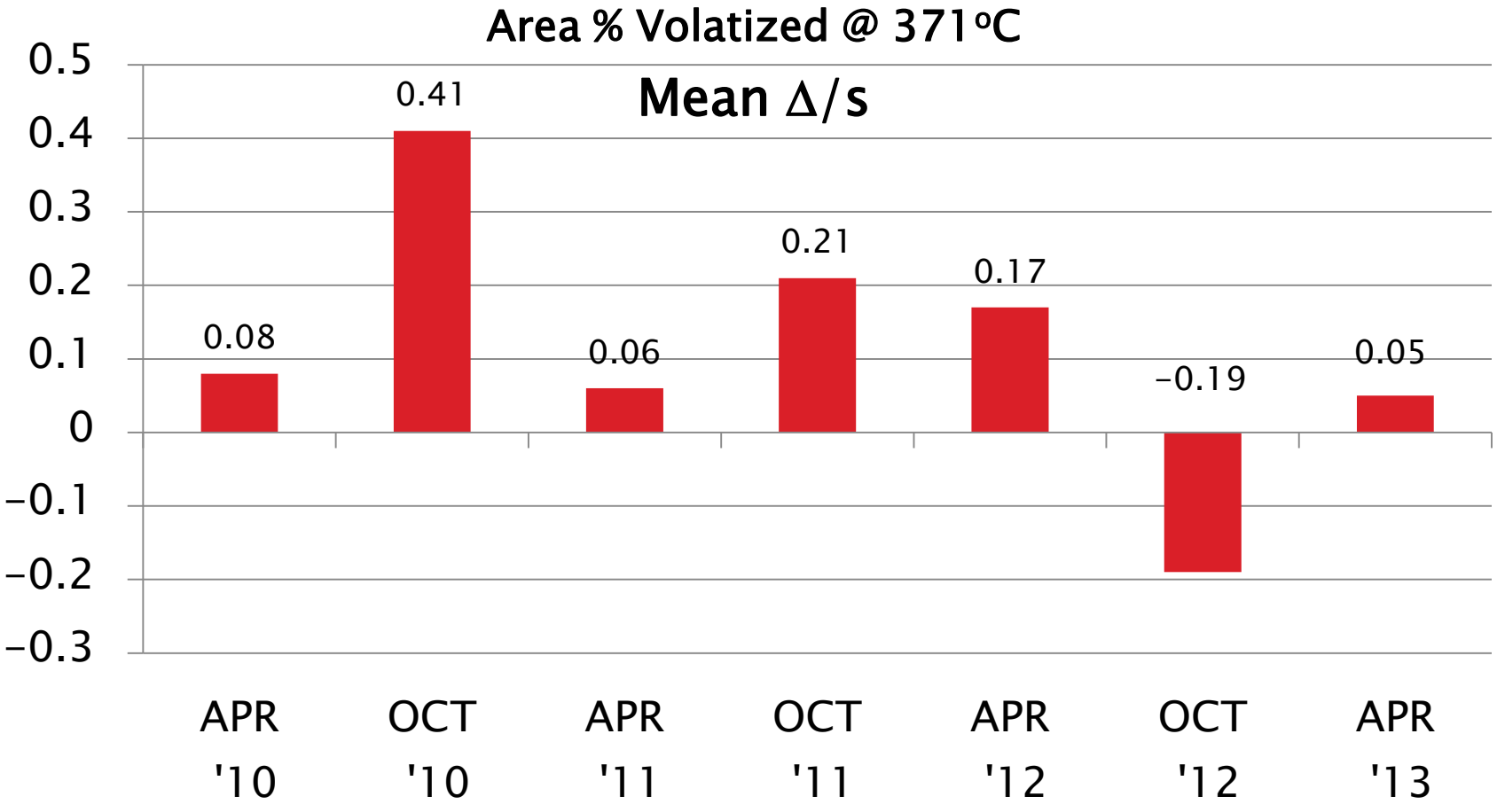
Area % Volatized @ 371°C	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	107	101	0.46	-----
10/1/09 through 3/31/10	13	10	0.33	0.08
4/1/10 through 9/30/10	16	13	0.30	0.41
10/1/10 through 3/31/11	20	17	0.38	0.06
4/1/11 through 9/30/11	16	13	0.37	0.21
10/1/11 through 3/31/12	14	11	0.24	0.17
4/1/12 through 9/30/12	15	12	0.28	-0.19
10/1/12 through 3/31/13	14	11	0.22	0.05

Return

D6417 Precision Estimates



D6417 Severity Estimates

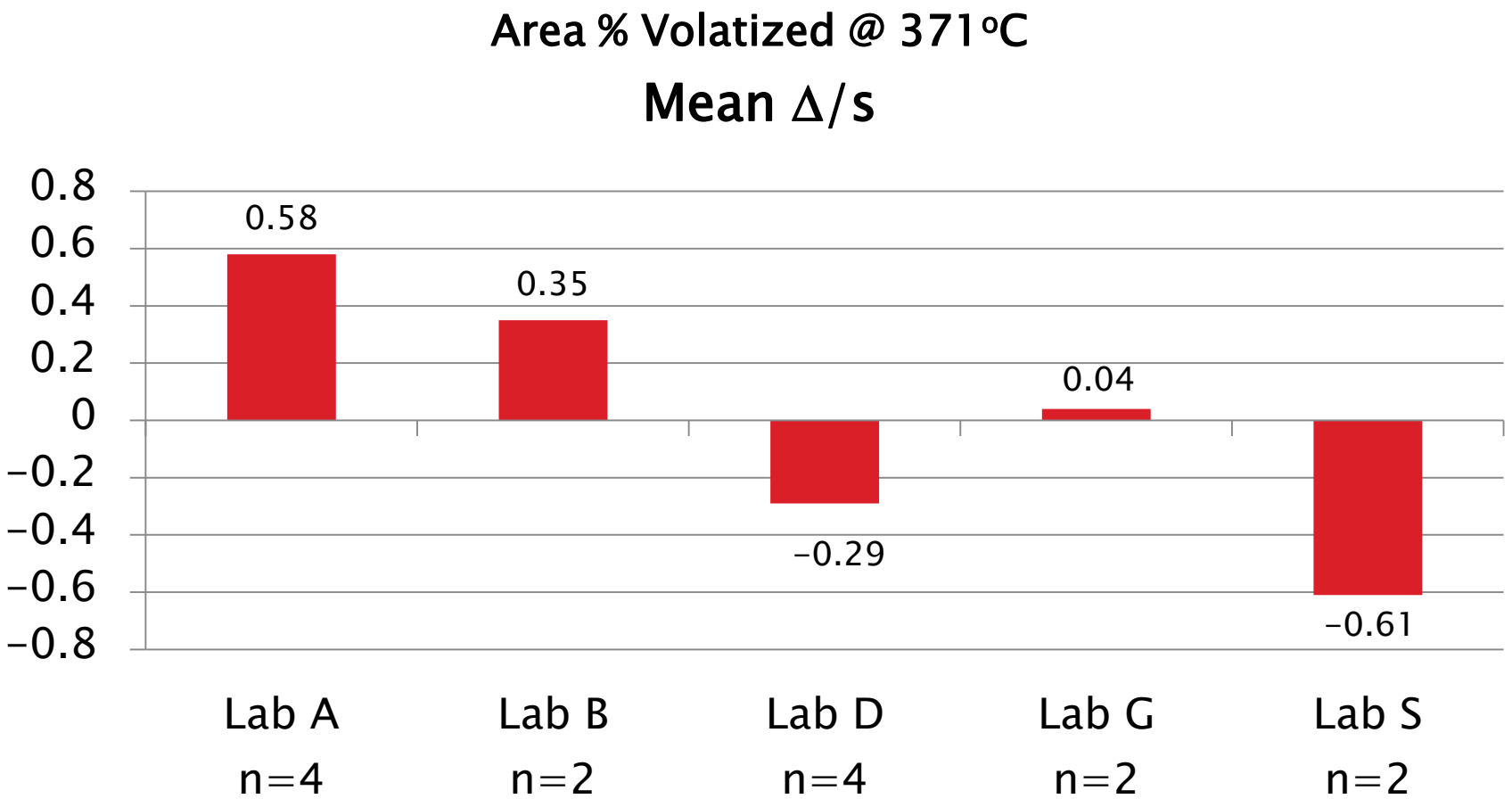


D6417: Estimation of Engine Oil Volatility by Capillary GC

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

	n	Mean Δ/s
Lab A	4	0.58
Lab B	2	0.35
Lab D	4	-0.29
Lab G	2	0.04
Lab S	2	-0.61

D6417 Lab Severity Estimates



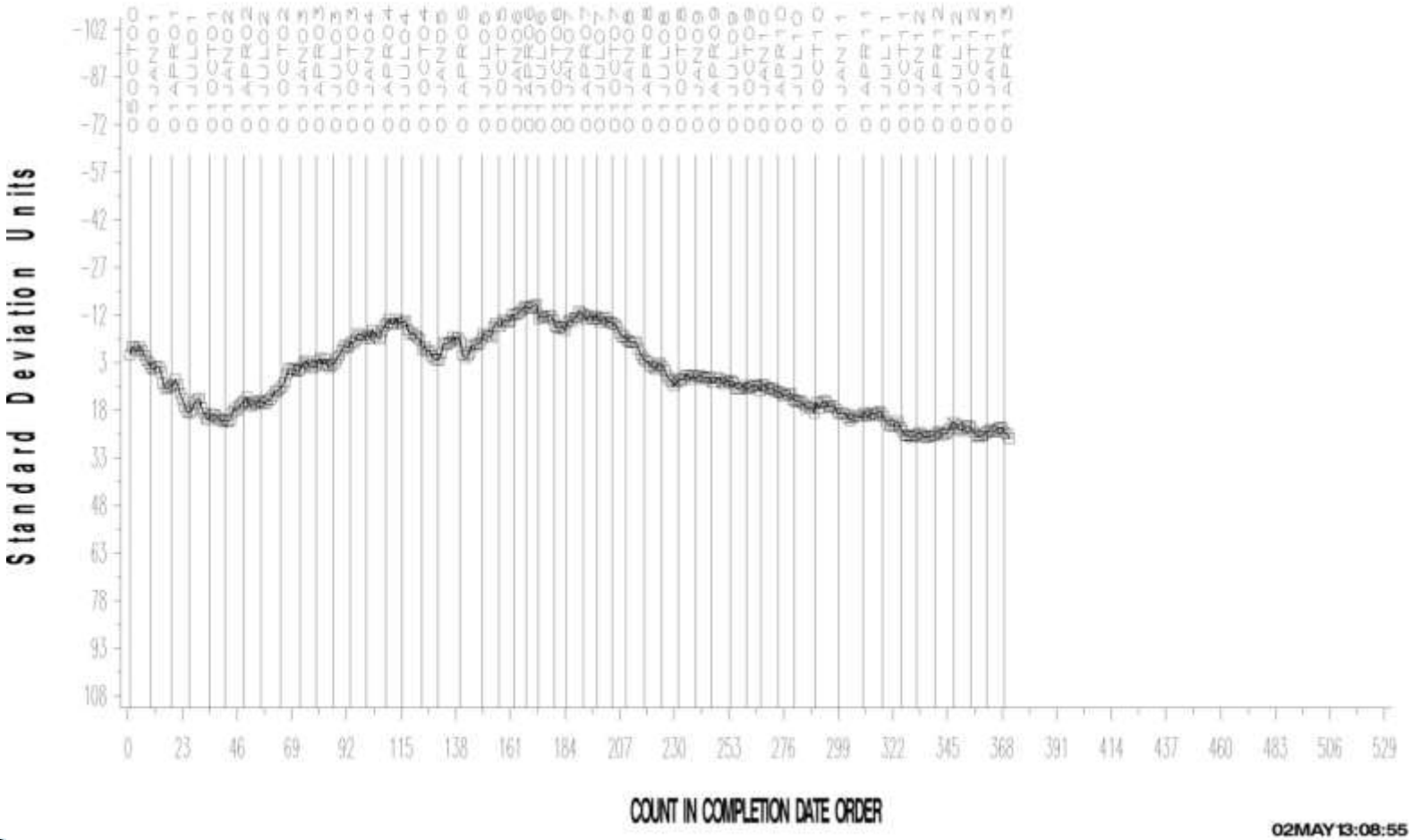
D6417: Estimation of Engine Oil Volatility by Capillary GC

- Precision (Pooled s) is comparable to prior two periods
  - More precise than the target precision
- Performance (Mean Δ/s) is on target (0.05 s)
- Severity plot shows overall nearly on-target performance since the 01OCT11 timeline

D6417 VOLATILITY BY GC INDUSTRY OPERATIONALLY VALID DATA

SAMPLE AREA % VOLATIZED

CUSUM Severity Analysis



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Return

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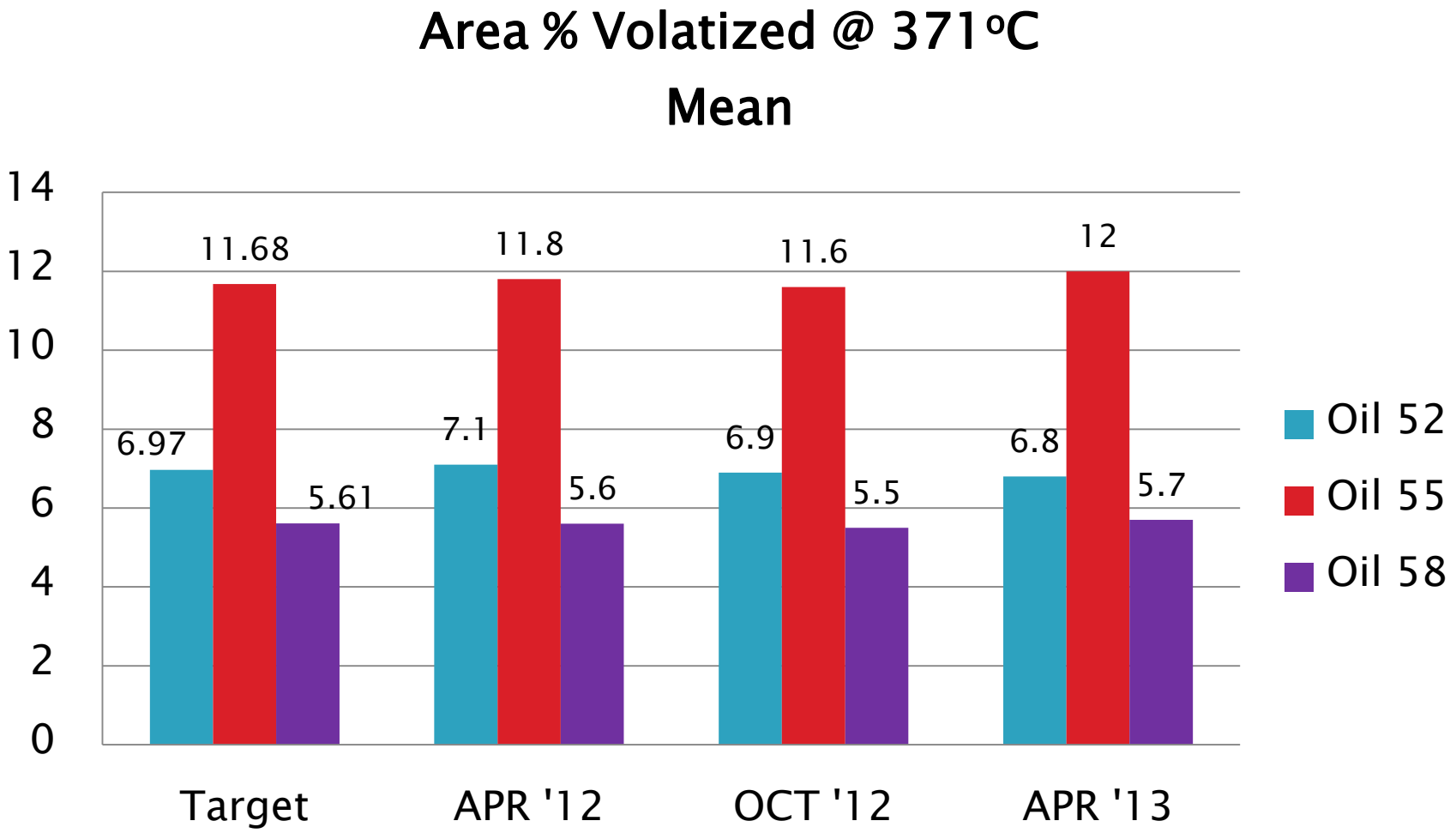
D6417: Estimation of Engine Oil Volatility by Capillary GC

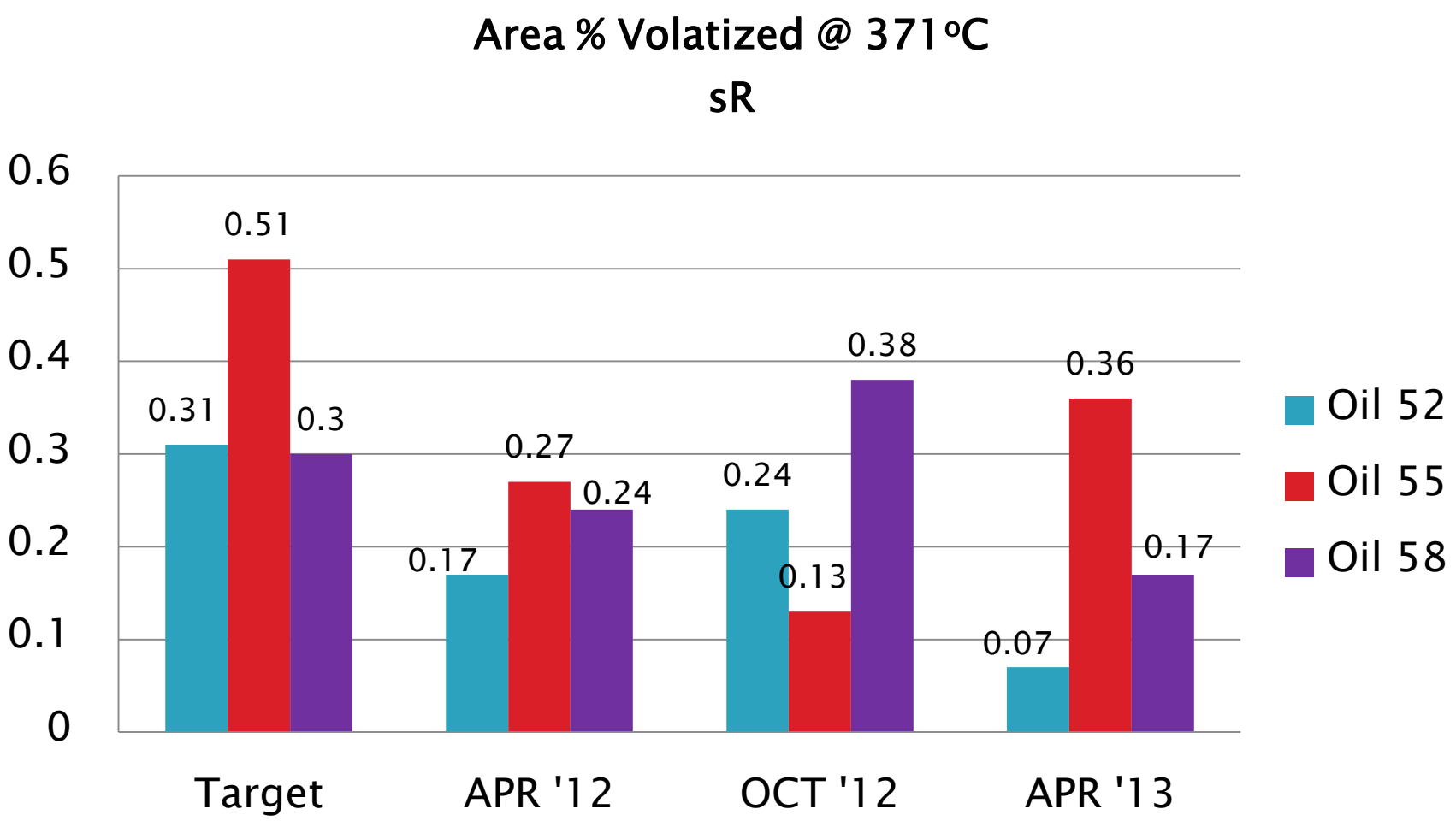
Area % Volatized @ 371°C
Performance by Oil

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	3	7.1	0.17	0.42	6	6.9	0.24	-0.12	5	6.8	0.07	-0.55
55	18	11.68	0.51	6	11.8	0.27	0.17	4	11.6	0.13	-0.25	4	12.0	0.36	0.63
58	18	5.61	0.30	5	5.6	0.24	0.03	5	5.5	0.38	-0.23	5	5.7	0.17	0.19

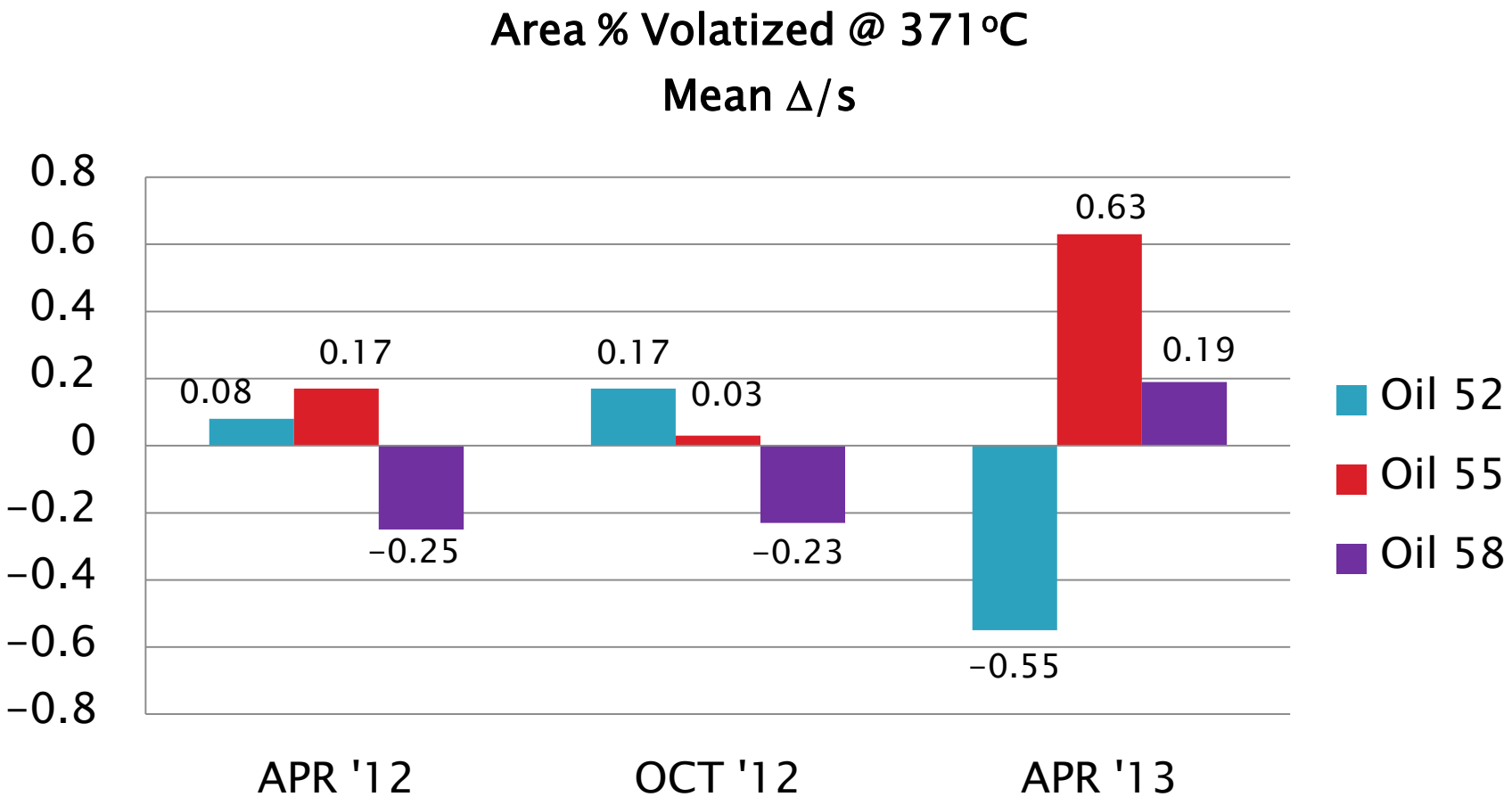
D6417 Performance by Oil



D6417 Performance by Oil



D6417 Performance by Oil



D5800: Evaporation Loss of Lubricating Oil by Noack Method

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	28
Failed Calibration Test	OC	5
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		**33**

Number of Labs Reporting Data: 6
Fail Rate of Operationally Valid Tests: 15%

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Statistically Unacceptable Tests (OC)	No. Of Tests
Evaporation Loss Mild	0
Evaporation Loss Severe	5

- Five severe OC tests on oil 52
- Seven passing AC tests on oil 52 this period

D5800: Evaporation Loss of Lubricating Oil by Noack Method

- No operationally invalid tests reported this period
- No TMC technical updates issued 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
Current Targets 7/21/2003	102	99	0.70	-----
10/1/09 through 3/31/10	35	32	0.69	0.56
4/1/10 through 9/30/10	34	31	0.67	0.64
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

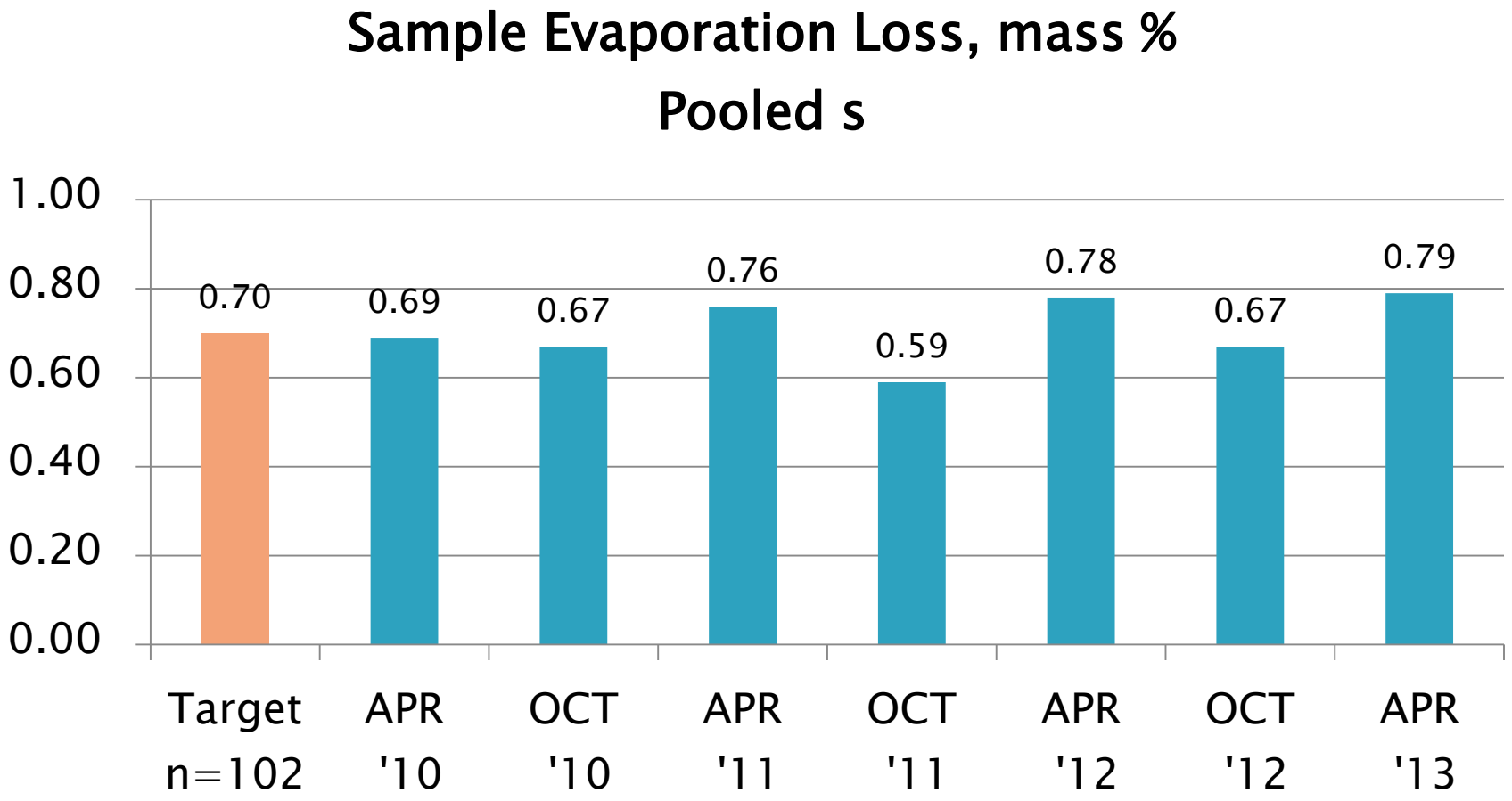
Return

D5800: Evaporation Loss of Lubricating Oil by Noack Method

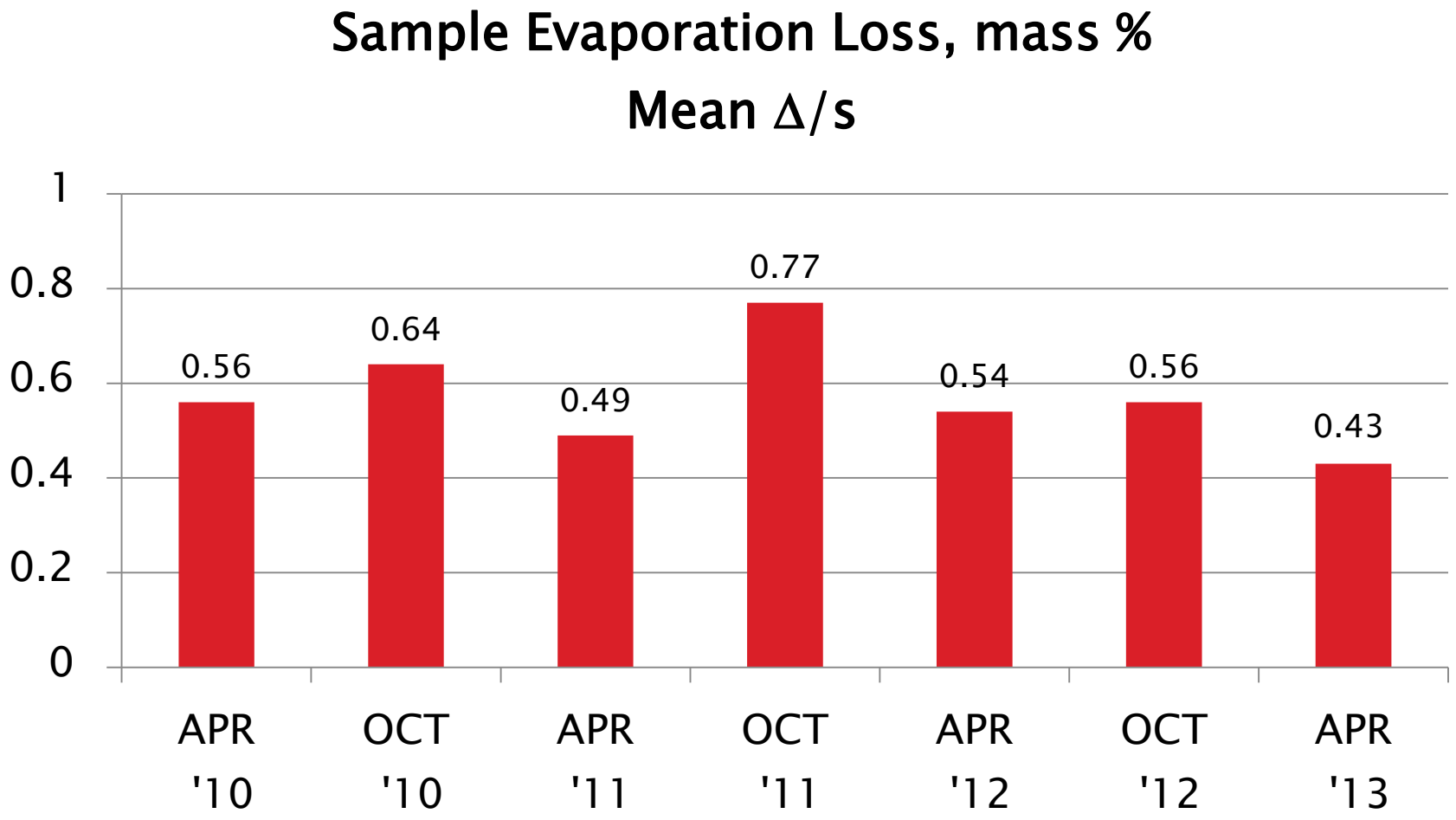
Performance Comparison by Procedure
Sample Evaporation Loss, Mass %

	n	df	Pooled s	Mean Δ/s
Procedure B	30	27	0.78	0.56
Procedure C	3	1	1.20	-0.84

D5800 Precision Estimates



D5800 Severity Estimates

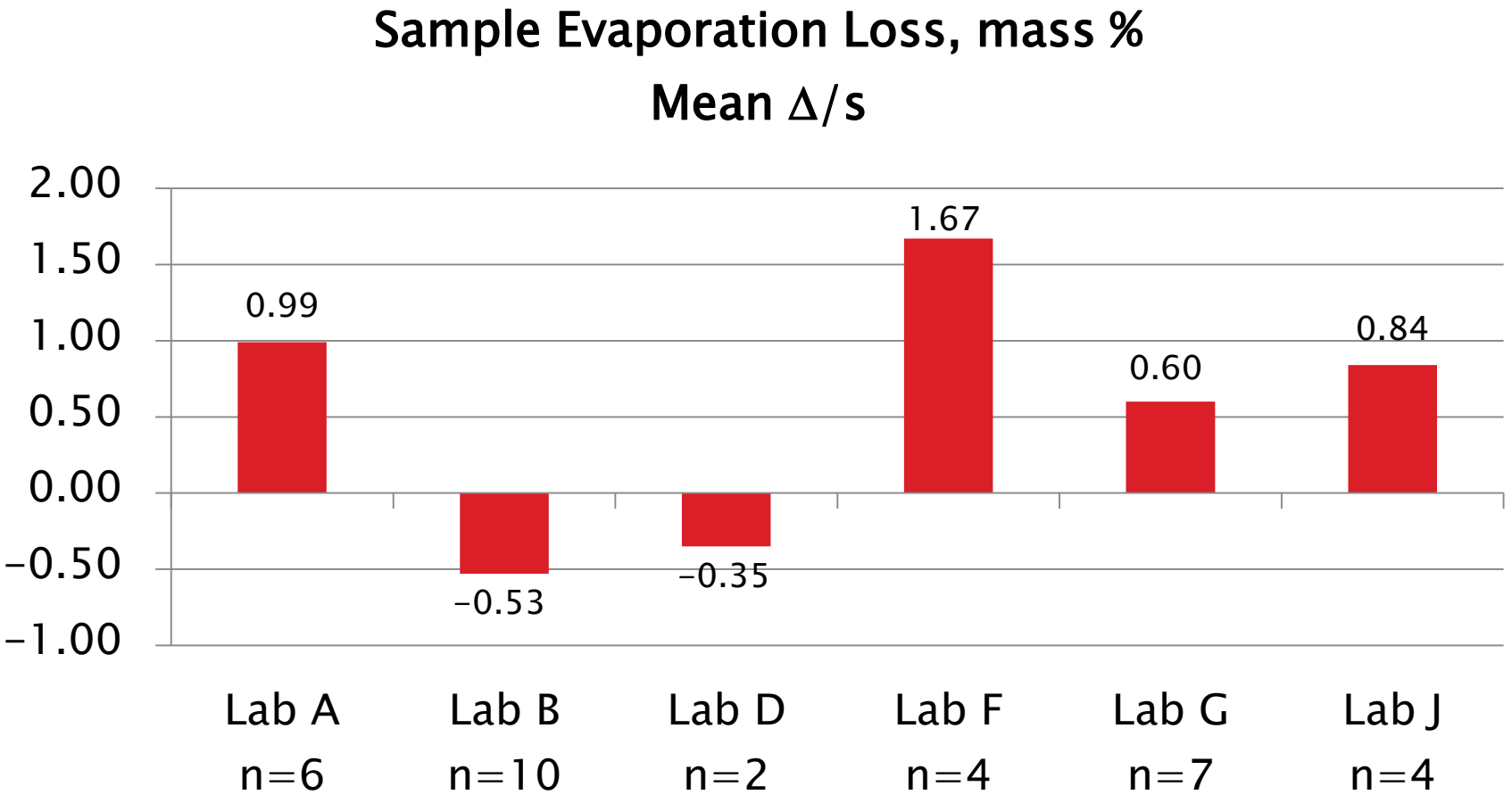


D5800: Evaporation Loss of Lubricating Oil by Noack Method

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

	n	Mean Δ/s
Lab A	6	0.99
Lab B	10	-0.53
Lab D	2	-0.35
Lab F	4	1.67
Lab G	7	0.60
Lab J	4	0.84

D5800 Lab Severity Estimates



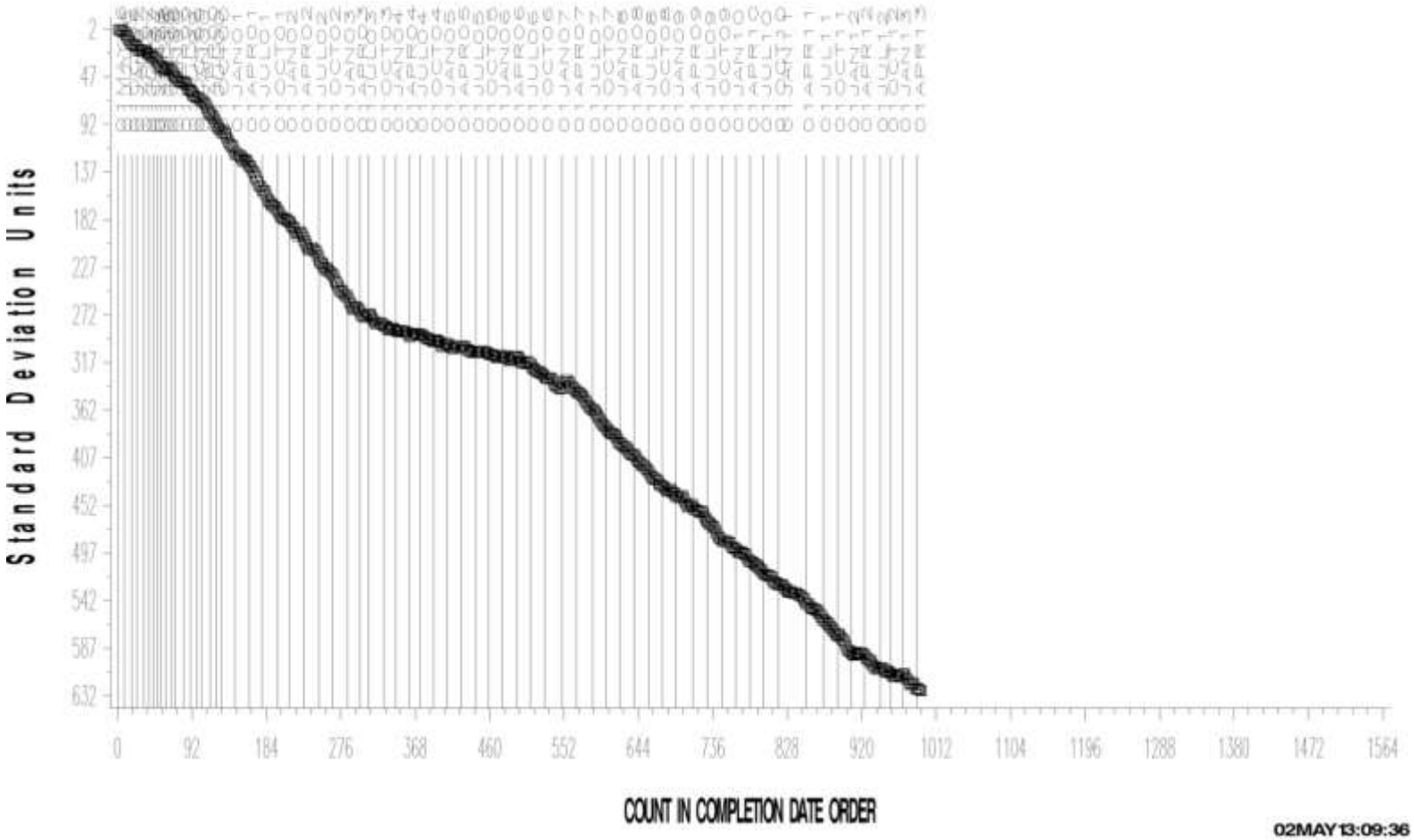
D5800: Evaporation Loss of Lubricating Oil by Noack Method

- Precision (Pooled s) is less precise than prior period
  - Less precise than the target precision
- Performance (Mean Δ/s) is 0.43 s severe
- Severity plot shows unexplained long-term severe trend since 01JUL06 timeline
- All five statistically failing results this period were on oil 52
  - Also had seven passing results on oil 52
- Since 4/1/2009, 32 of 35 statistically failing tests were on oil 52
  - All severe of acceptance bands

D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

EVAPORATION LOSS, MASS%

CUSUM Severity Analysis



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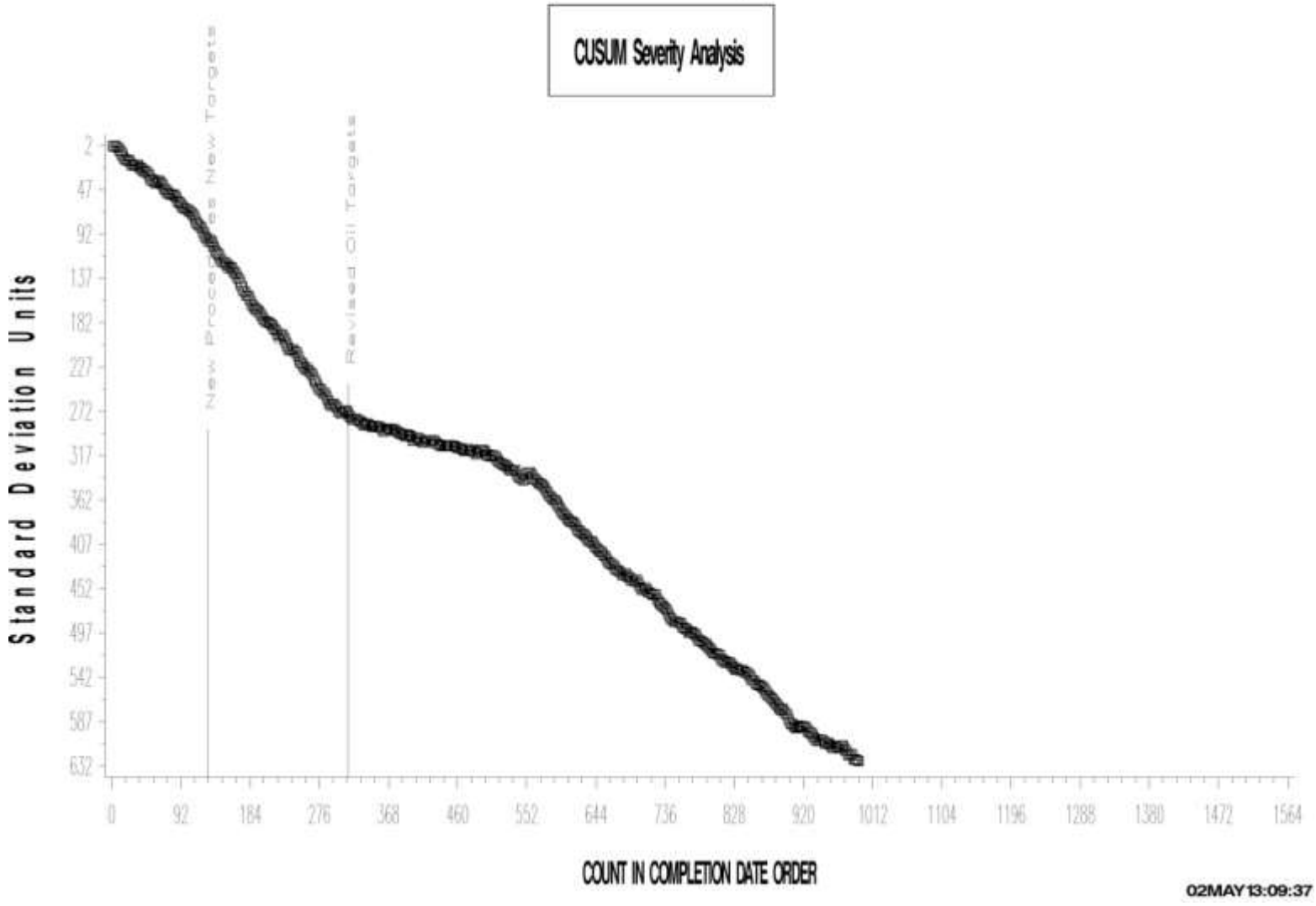
D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

EVAPORATION LOSS, MASS%



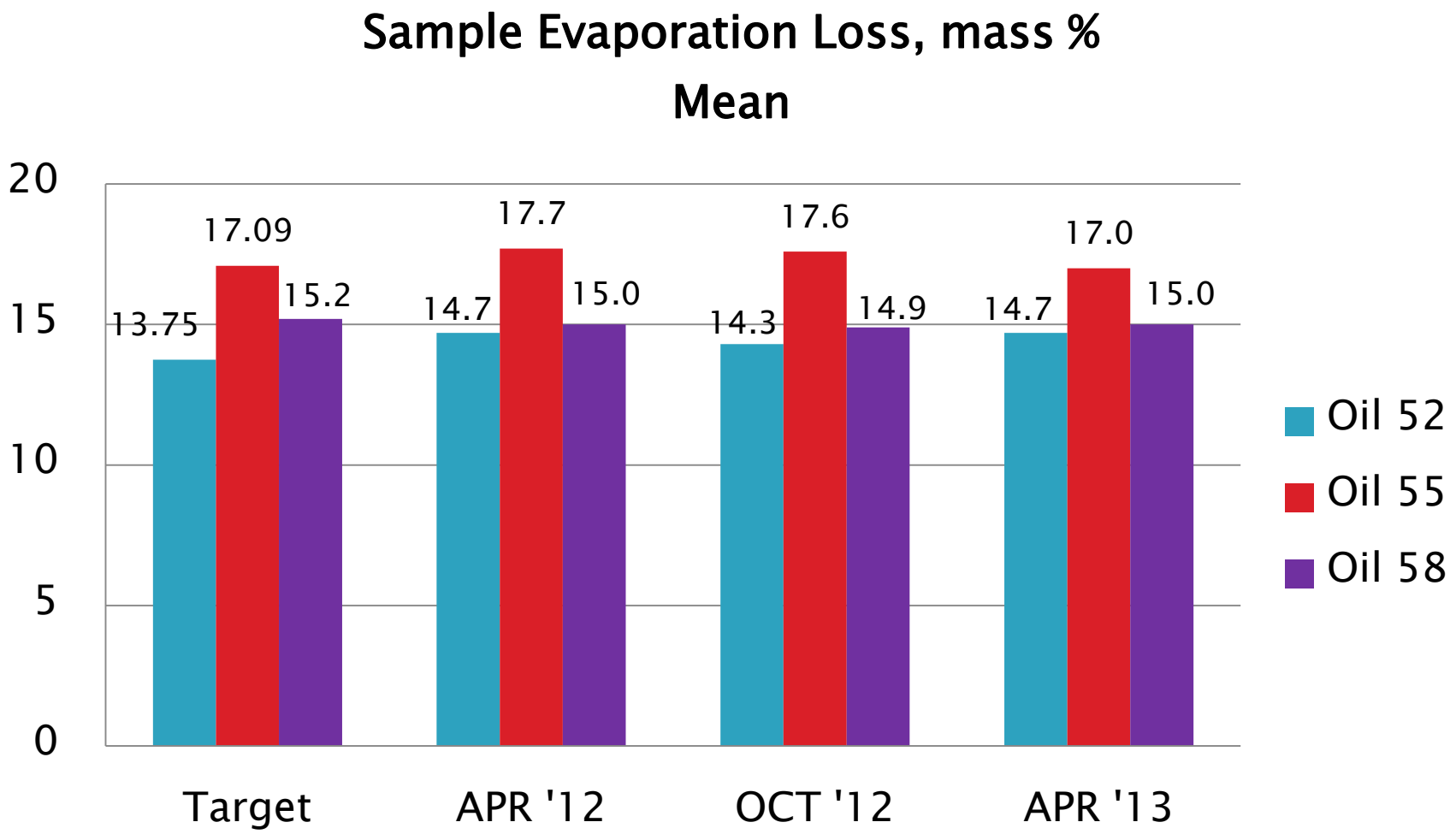
Return

D5800: Evaporation Loss of Lubricating Oil by Noack Method

Sample Evaporation Loss, mass %
Performance by Oil

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	9	14.7	0.84	1.52	14	14.3	0.73	0.98	12	14.7	0.92	1.49
55	32	17.09	0.76	9	17.7	0.78	0.76	12	17.6	0.57	0.66	10	17.0	0.76	-0.12
58	37	15.20	0.72	14	15.0	0.74	-0.24	7	14.9	0.69	-0.46	11	15.0	0.65	-0.23

D5800 Performance by Oil



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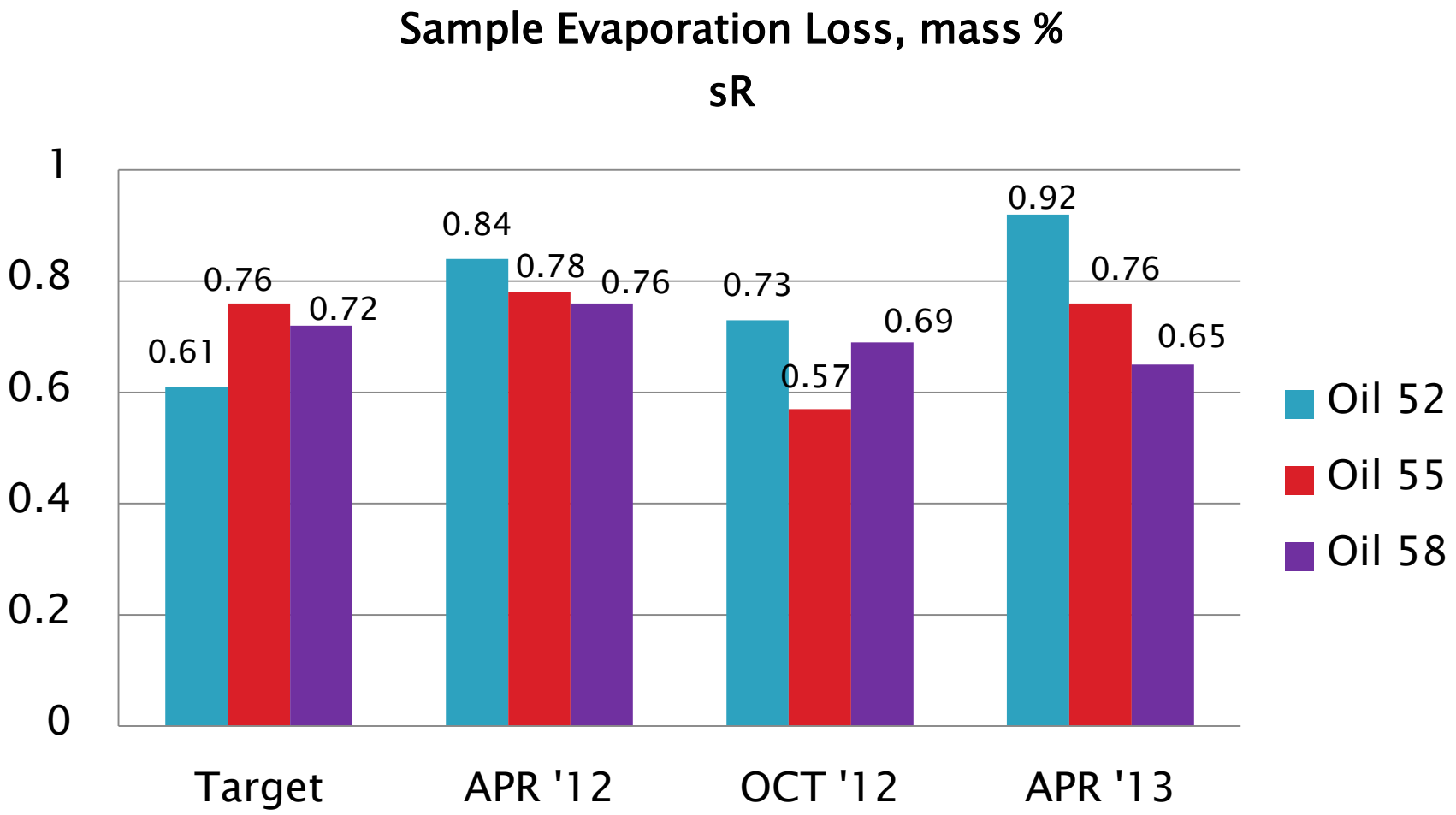
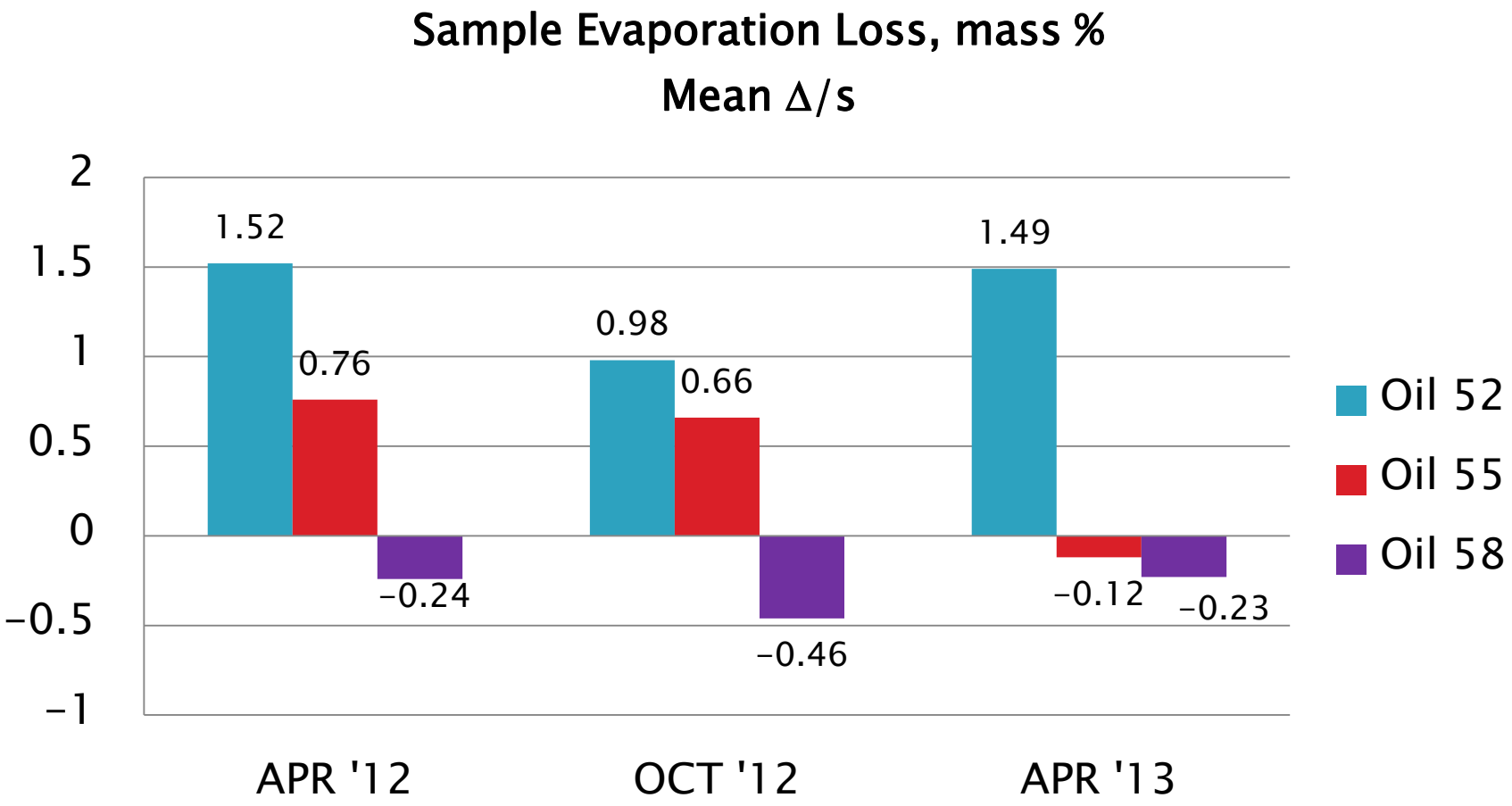
D5800 Performance by Oil



D5800 Performance by Oil



D5133: Gelation Index

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	20
Failed Calibration Test	OC	2
Operationally Invalidated by Lab	LC, XC	1
Operationally Invalidated After Initially Reported as Valid	RC	1
Total		**24**

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 9%

D5133: Gelation Index

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

- Reasons for Operationally Invalid Tests:
  - 1 test used incorrect program profile (XC)
  - 1 test had excessive bath vibration (RC)

- No TMC technical updates issued this period

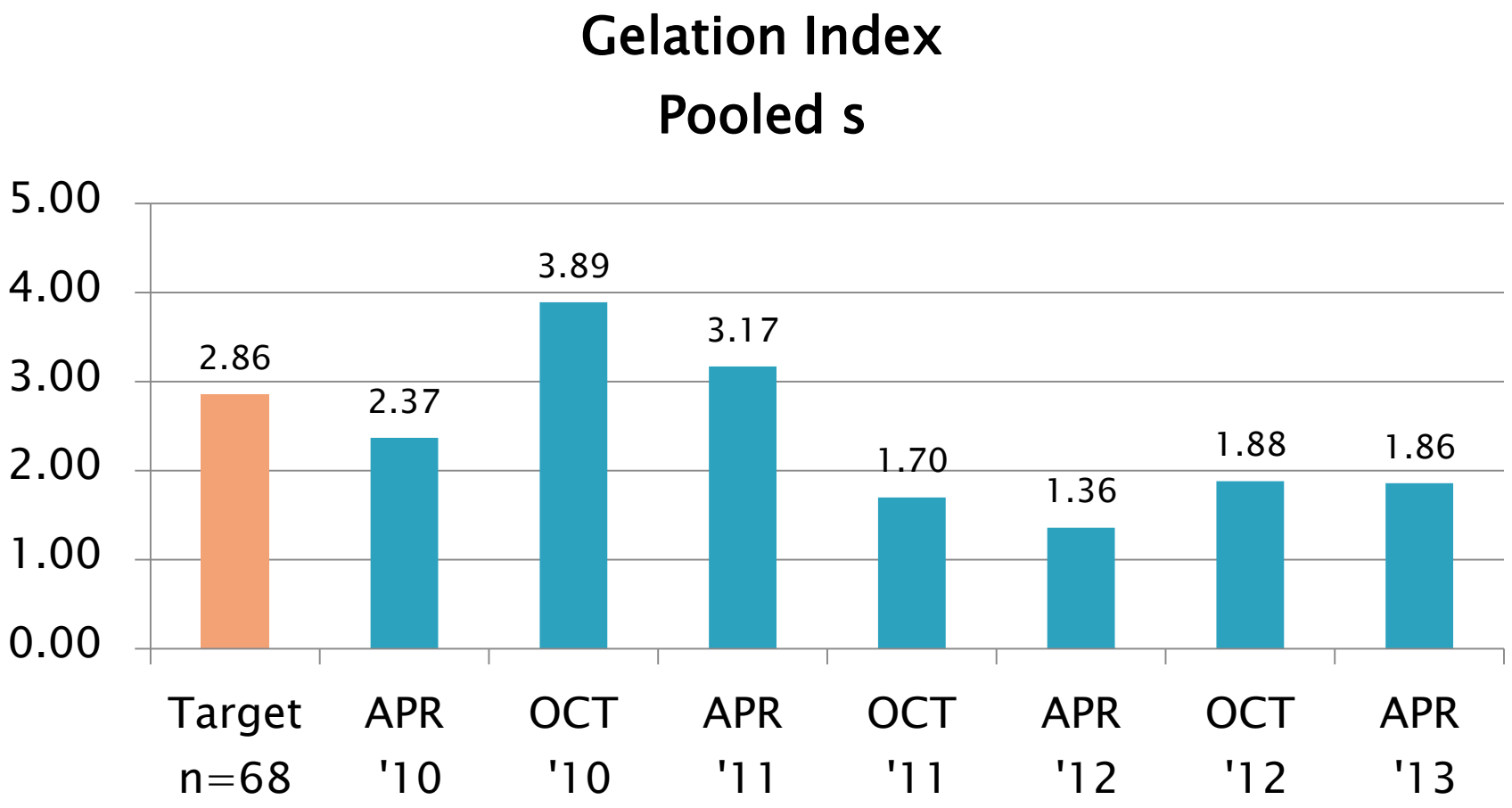
D5133: Gelation Index

Period Precision and Severity Estimates

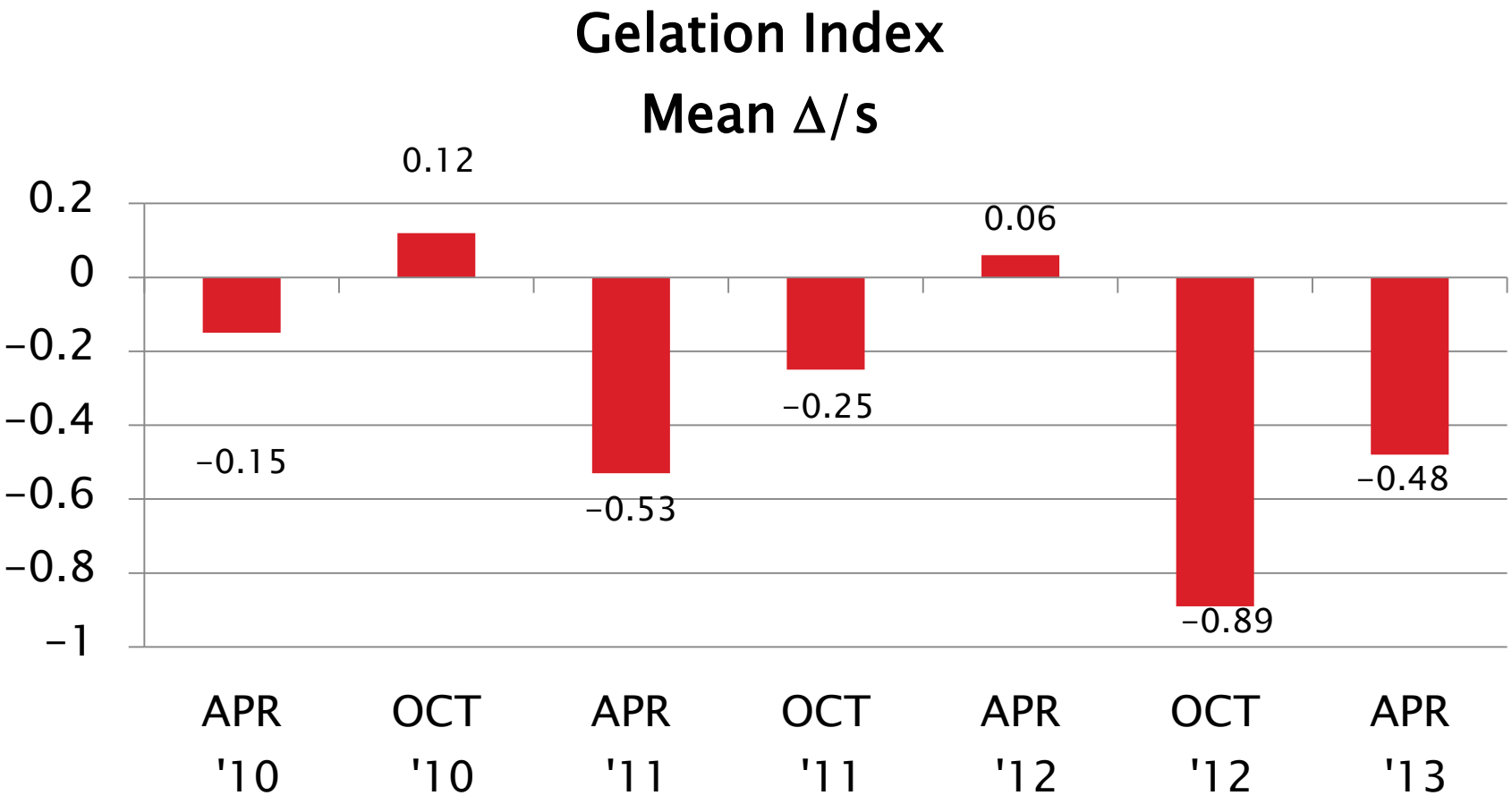
Gelation Index	n	df	Pooled s	Mean Δ/s
Current Targets 7/15/2003	68	65	2.86	-----
10/1/09 through 3/31/10	31	28	2.37	-0.15
4/1/10 through 9/30/10	24	21	3.89	0.12
10/1/10 through 3/31/11	33	30	3.17	-0.53
4/1/11 through 9/30/11	23	20	1.70	-0.25
10/1/11 through 3/31/12	24	21	1.36	0.06
4/1/12 through 9/30/12	24	21	1.88	-0.89
10/1/12 through 3/31/13	22	19	1.86	-0.48

Return

D5133 Precision Estimates



D5133 Severity Estimates



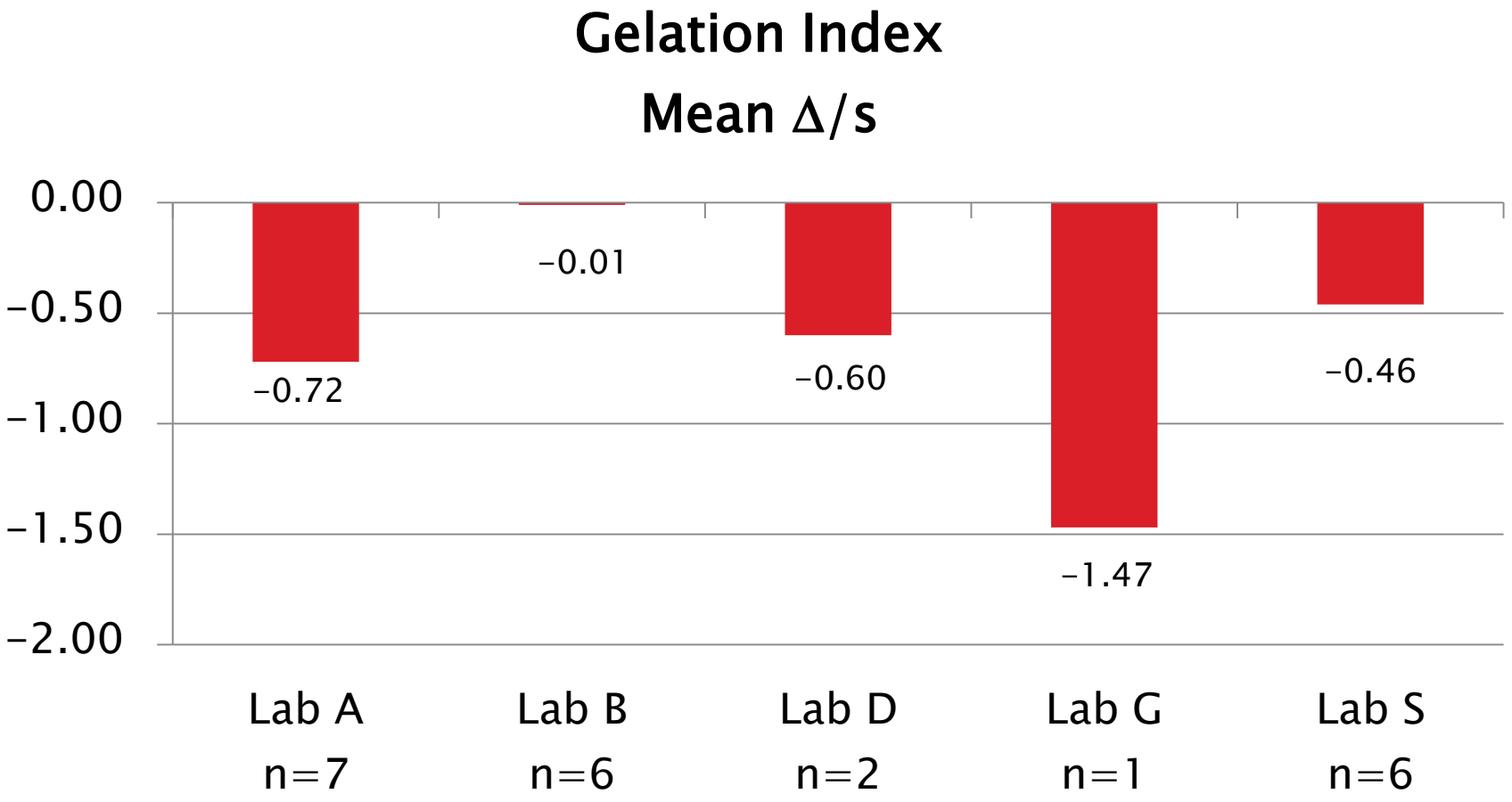
D5133: Gelation Index

Current Period Severity Estimates by Lab

Gelation Index

	n	Mean Δ/s
Lab A	7	-0.72
Lab B	6	-0.01
Lab D	2	-0.60
Lab G	1	-1.47
Lab S	6	-0.46

D5133 Lab Severity Estimates



D5133: Gelation Index

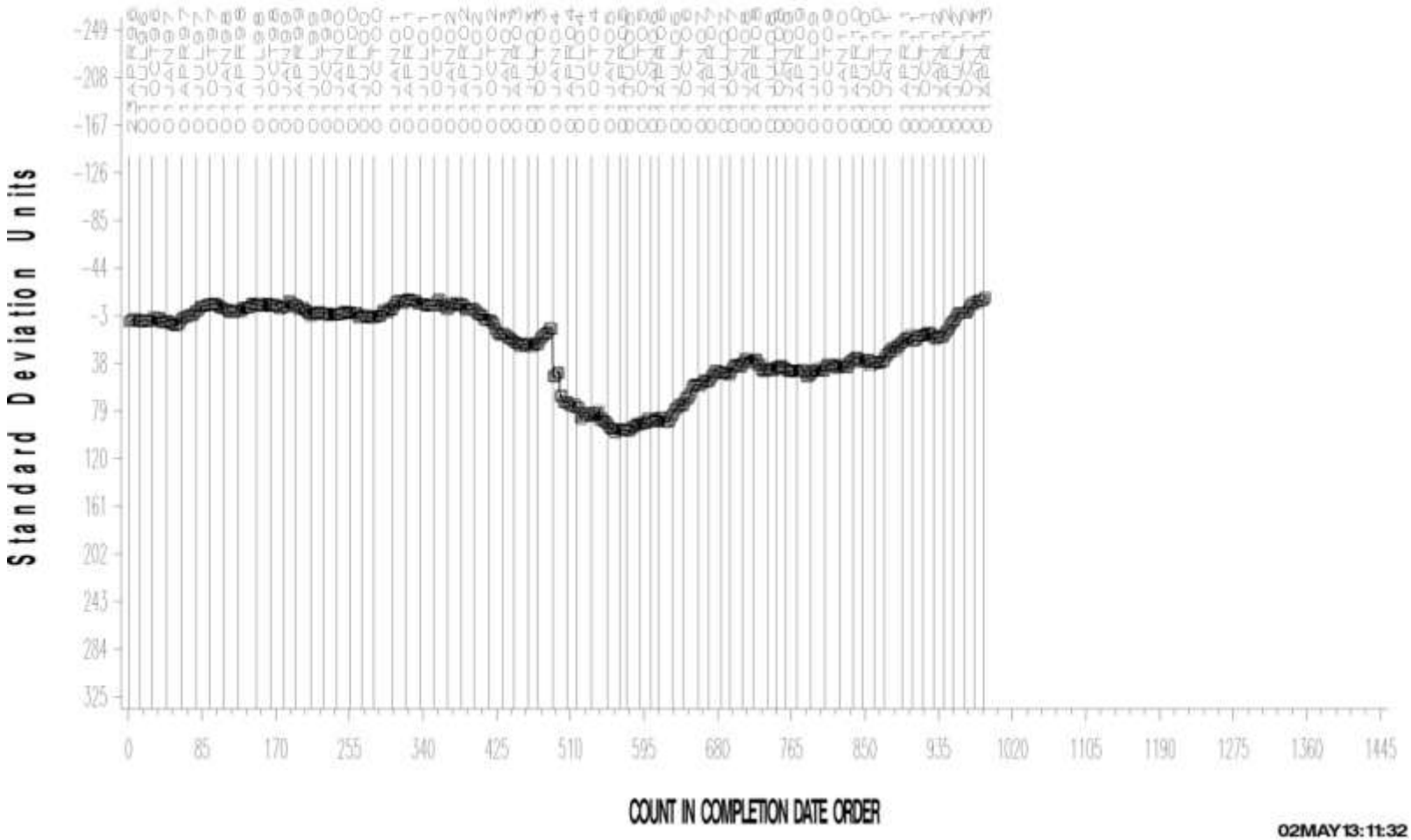
- Precision (Pooled s) is comparable to prior period
  - More precise than target precision

- Performance (Mean Δ/s) is -0.48 s mild
  - Four of five labs mild to some extent
  - One lab on-target

D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA

GELATION INDEX

CUSUM Severity Analysis



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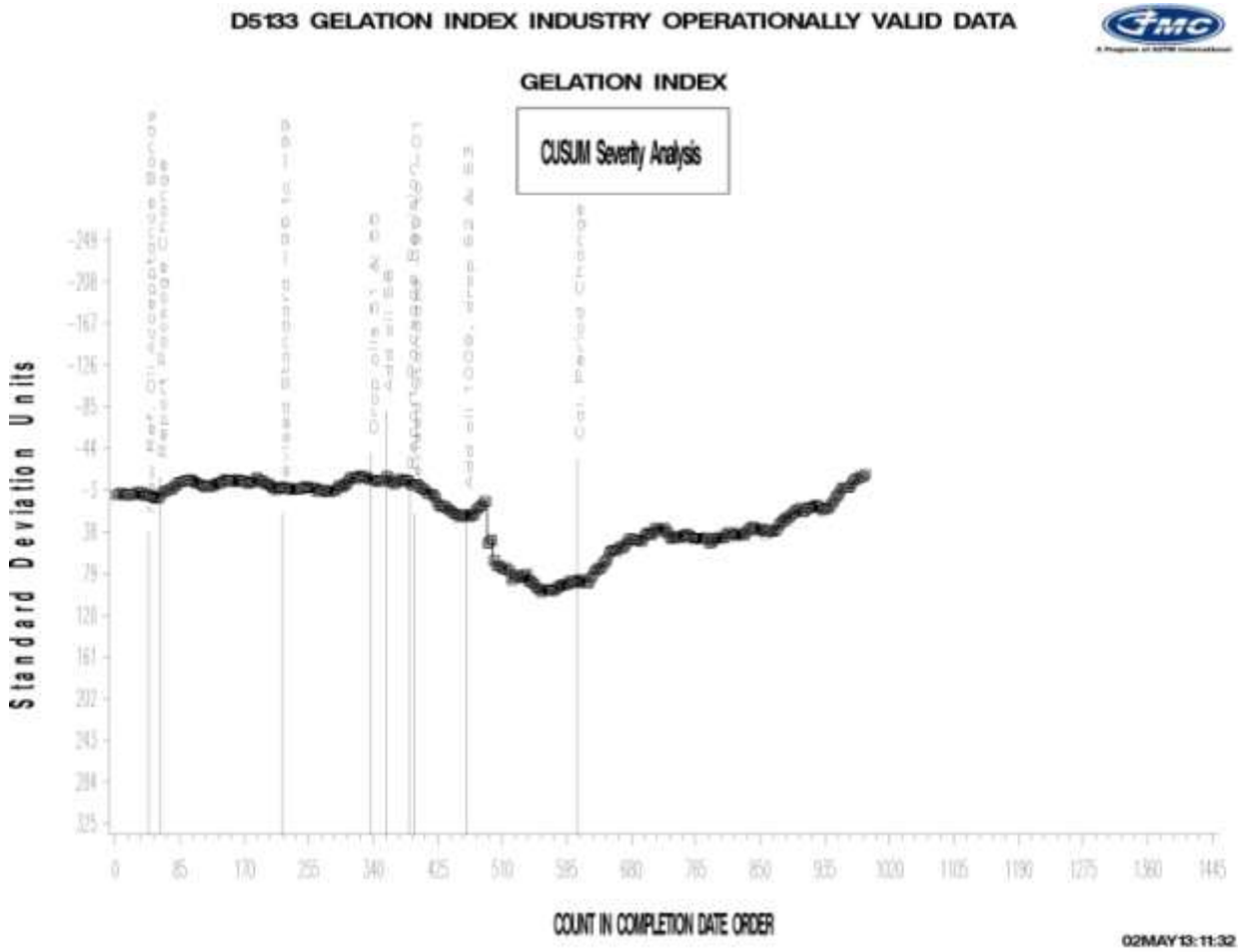
D5133: Gelation Index

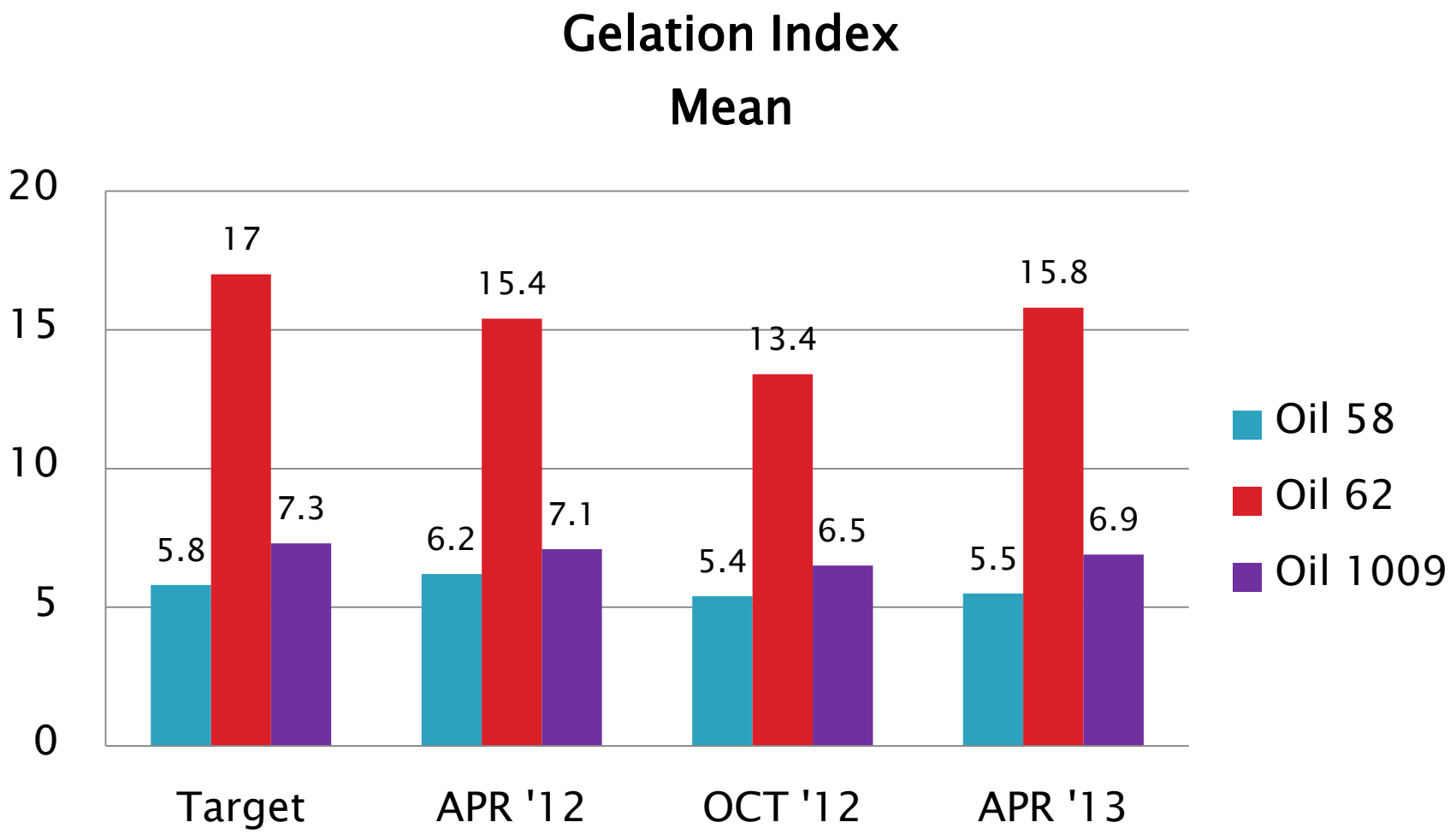


D5133 Performance by Oil

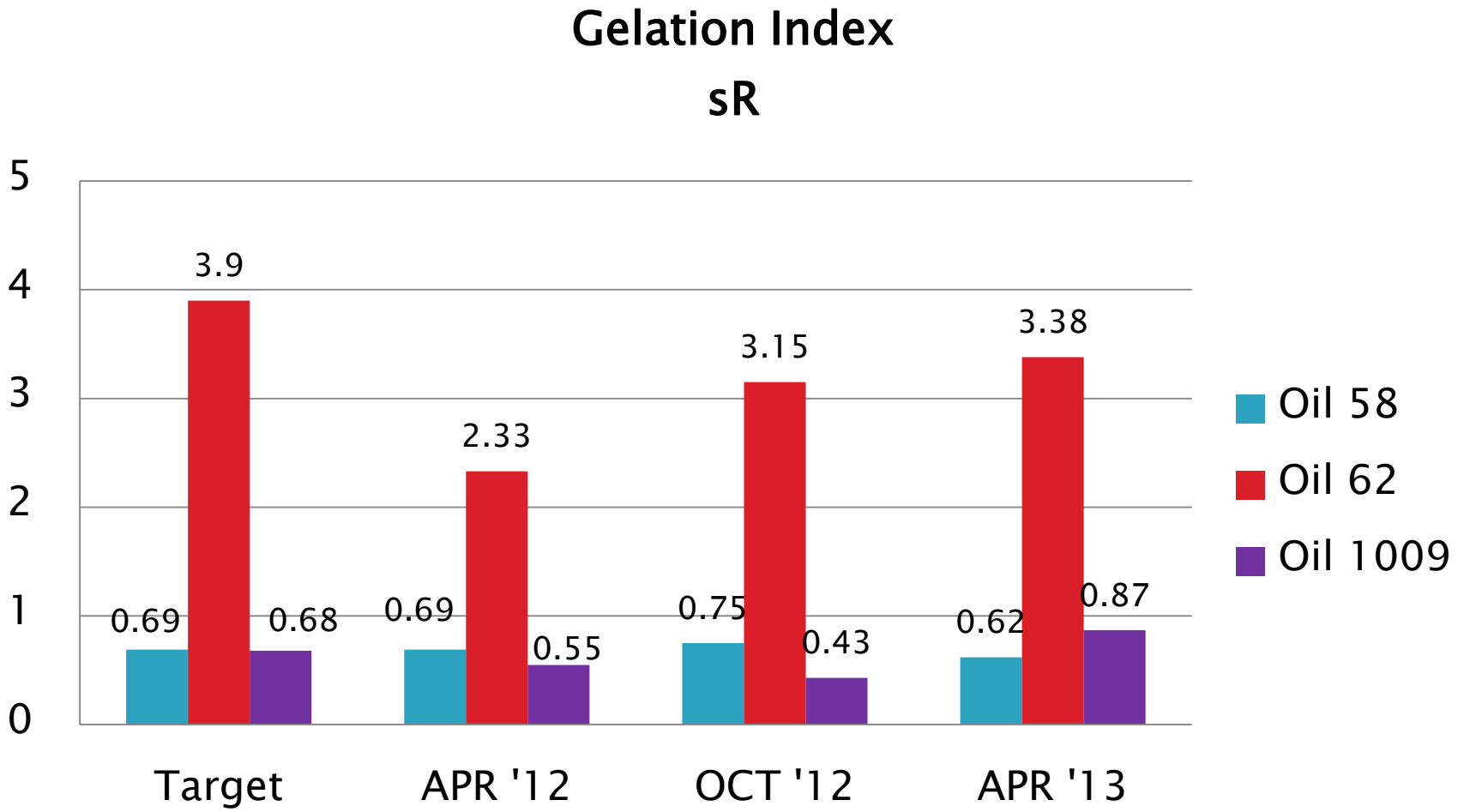
Gelation Index
Performance by Oil

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	10	6.2	0.69	0.61	8	5.4	0.75	-0.60	7	5.5	0.62	-0.43
62	35	17.0	3.90	7	15.4	2.33	-0.40	8	13.4	3.15	-0.92	6	15.8	3.38	-0.30
1009	16	7.30	0.68	7	7.1	0.55	-0.25	8	6.5	0.43	-1.14	9	6.9	0.87	-0.64

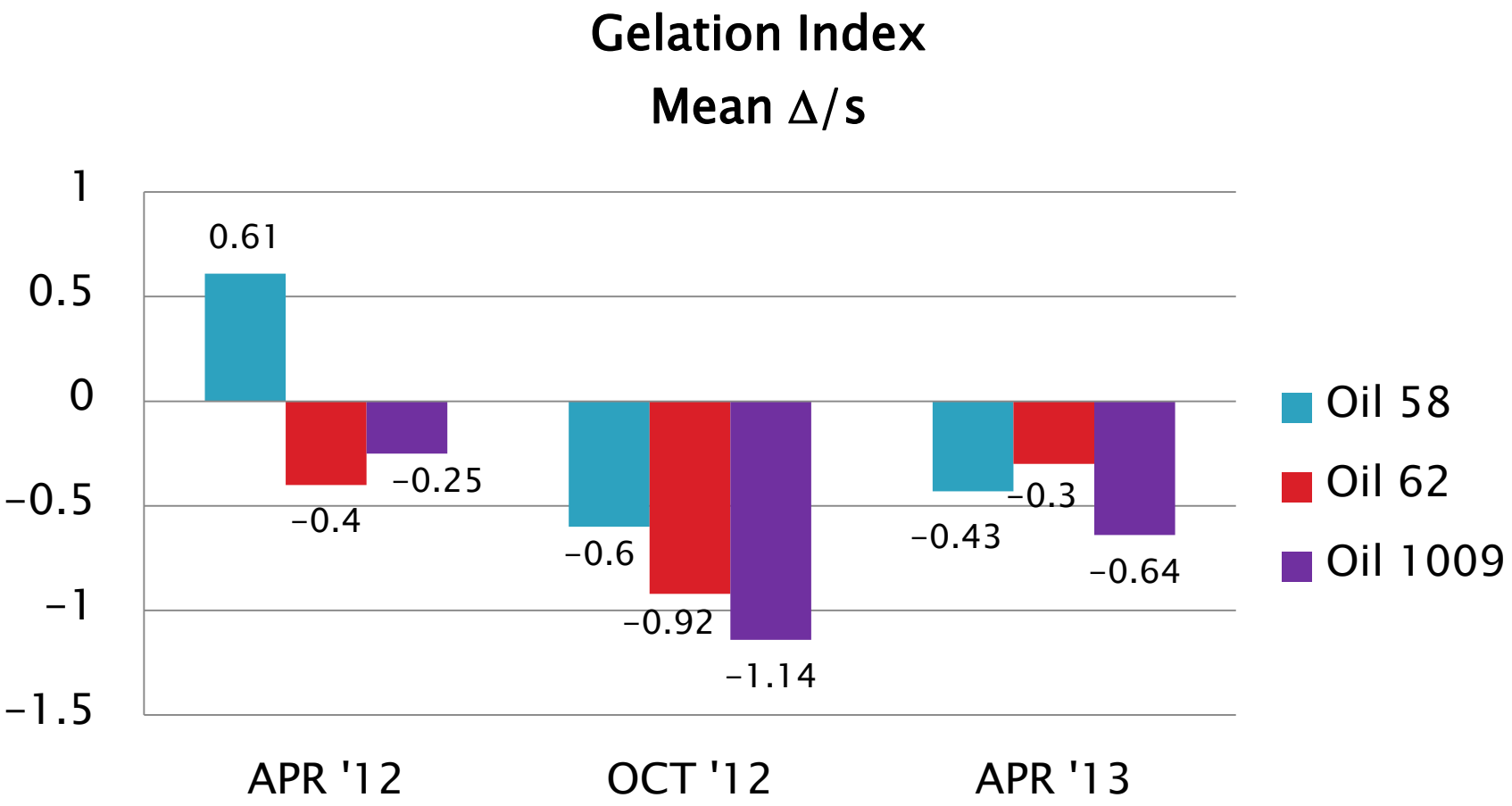
D5133 Performance by Oil



D5133 Performance by Oil



D5133 Performance by Oil



D6335: Deposits by TEOST-33C

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	17
Failed Calibration Test	OC	5
Operationally Invalidated by Lab	LC, XC	2
Operationally Invalidated After Initially Reported as Valid	RC	4
Non-blind Shakedown Runs	NN	4
Total		**32**

Number of Labs Reporting Data: 5
Fail Rate of Operationally Valid Tests: 23%

D6335: Deposits by TEOST-33C

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

- Three consecutive mild fails on one instrument
  - Lab A, Instrument 3
  - All reported as operationally valid (OC)

- Six operationally invalid test this period
  - One bad thermocouple (RC)
  - One incorrect thermocouple depth (LC)
  - Three incorrect power setting (RC)
  - One heater failure (XC)

D6335: Deposits by TEOST-33C

Period Precision and Severity Estimates

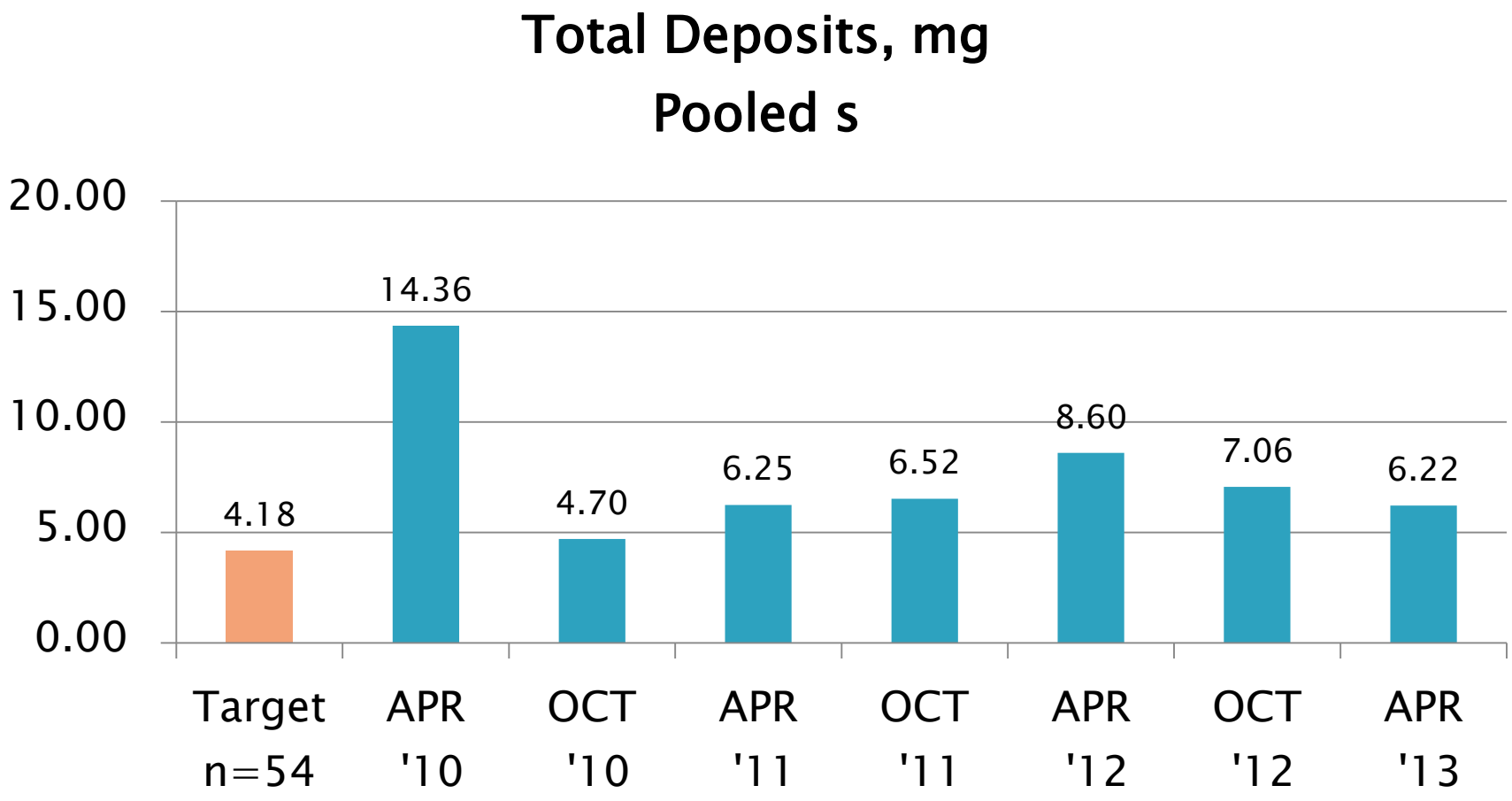
Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Initial Round Robin Targets	54	52	4.18	-----
10/1/09 through 3/31/10	12	8	14.36	0.85
4/1/10 through 9/30/10	16	12	4.70	0.16
10/1/10 through 3/31/11	14	10	6.25	0.14
4/1/11 through 9/30/11	19	15	6.52	-0.27
10/1/11 through 3/31/12	16	12	8.60	0.37
4/1/12 through 9/30/12	18	15	7.06	0.79
10/1/12 through 3/31/13	22	20	6.22	-1.00

Return

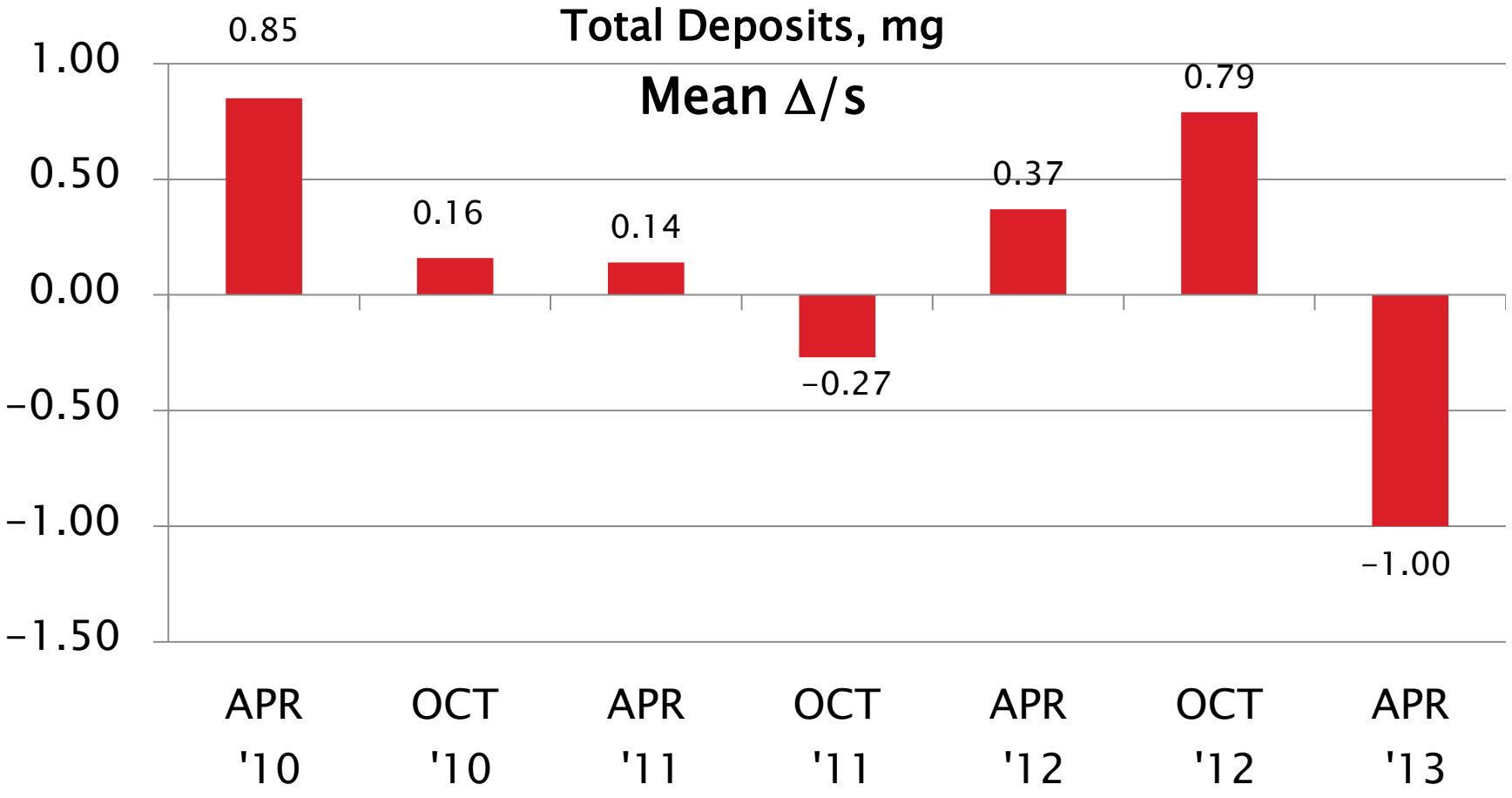
D6335: Deposits by TEOST-33C

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

D6335 Precision Estimates



D6335 Severity Estimates



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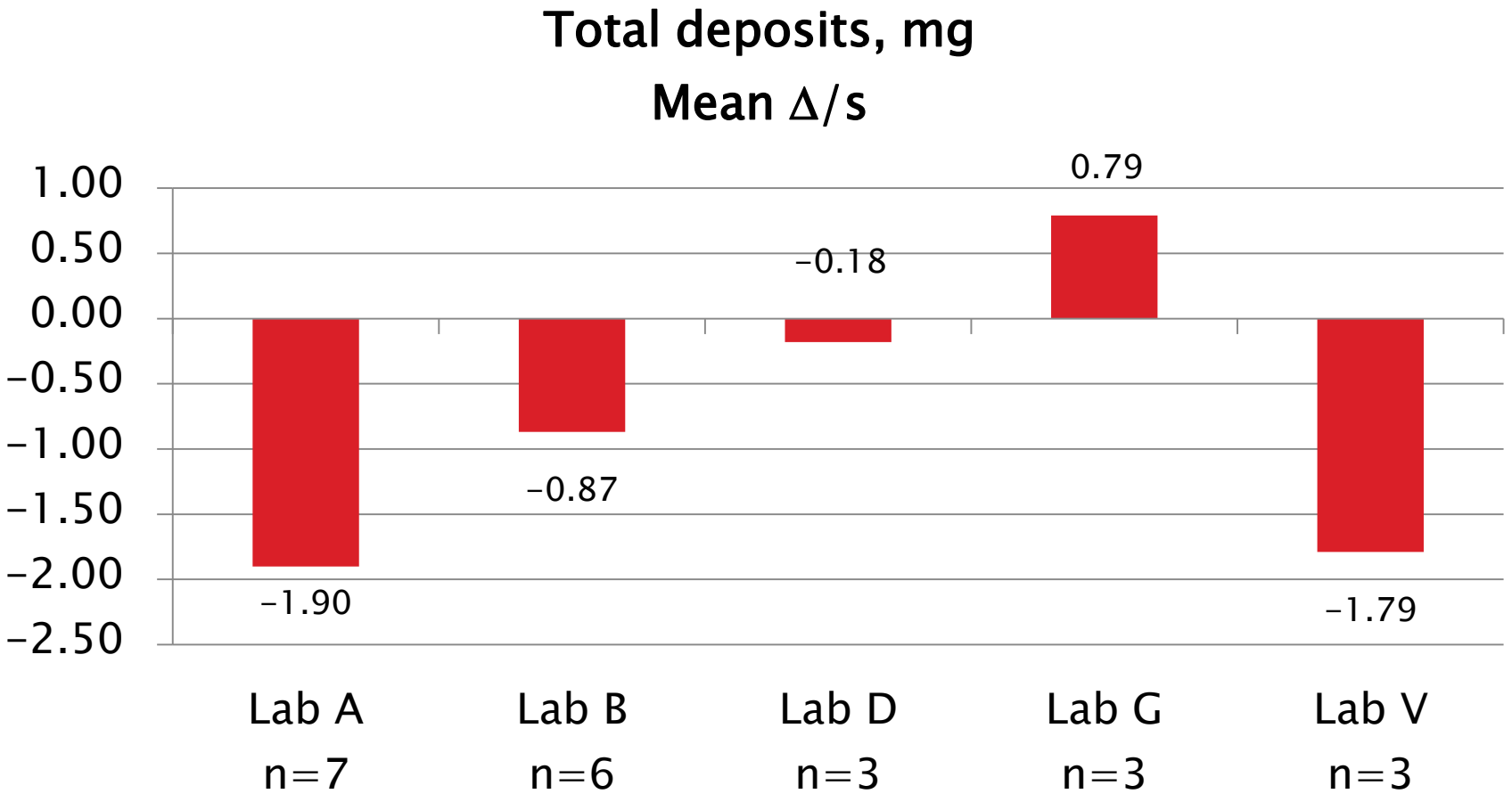
D6335: Deposits by TEOST-33C

Current Period Severity Estimates by Lab
Total Deposits, mg

	n	Mean Δ/s
Lab A	7	-1.90
Lab B	6	-0.87
Lab D	3	-0.18
Lab G	3	0.79
Lab V	3	-1.79

D6335 Lab Severity Estimates



Test Monitoring Center
http://astmtmc.cmu.edu
A Program of ASTM International

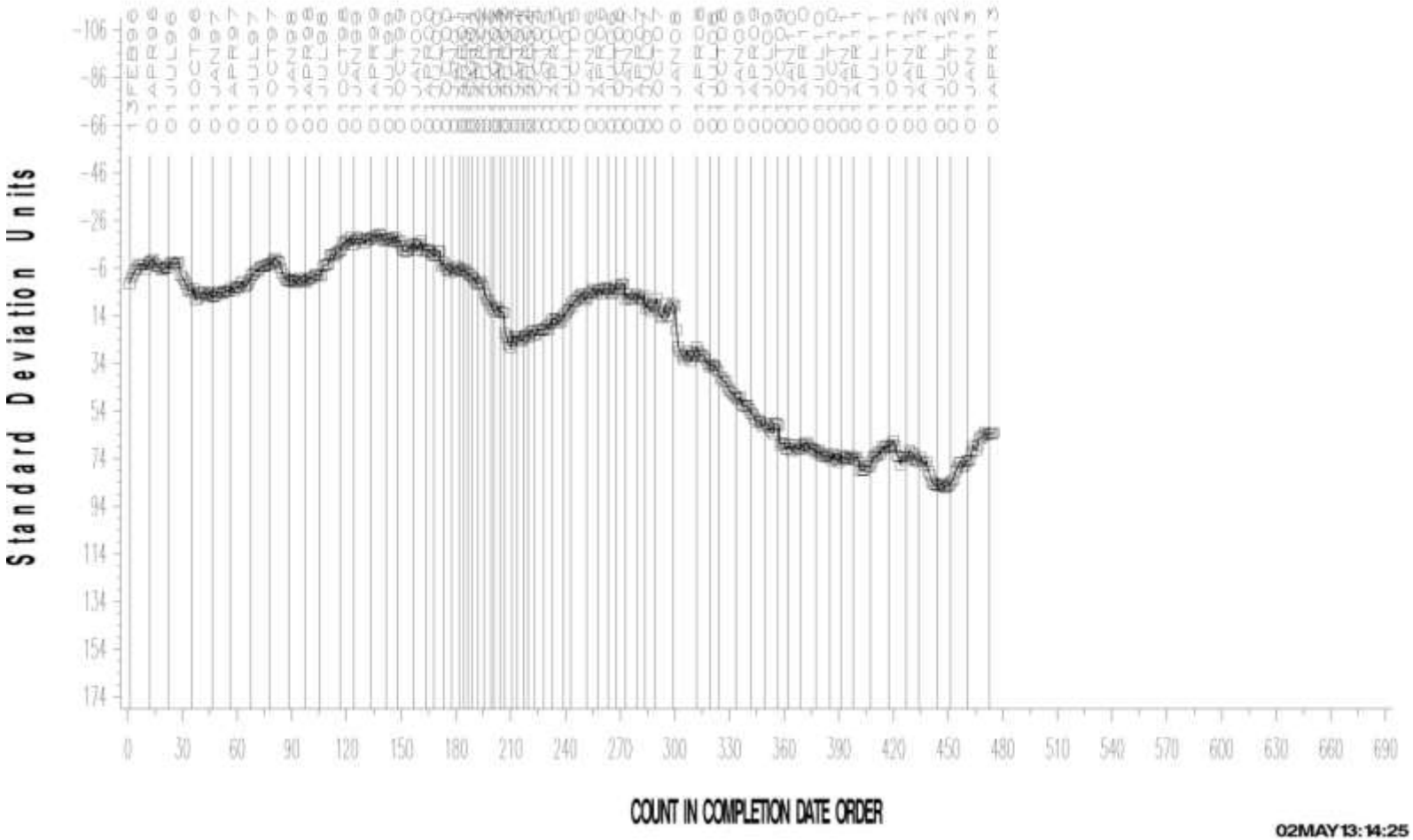
D6335: Deposits by TEOST-33C

- Precision (Pooled s) is more precise than prior periods
  - Remains less precise than target precision
- Performance (Mean Δ/s) is -1.00 s mild
  - Three results more than 3 s from target
    - -3.4 s mild, Lab V (OC), Oil 435-2
    - -3.2 s mild, Lab A (OC), Oil 75
    - -3.1 s mild, Lab A (OC), Oil 75
      - Lab A had 3 consecutive fails on same instrument
  - Lab G, Instrument 2 had a series of failing runs initially reported as operationally valid but traced back to an incorrect power setting (all RC).
- All tests this period report using Rod Batch J or K

TEOST—33C INDUSTRY OPERATIONALLY VALID DATA

TOTAL DEPOSITS MG

CUSUM Severity Analysis



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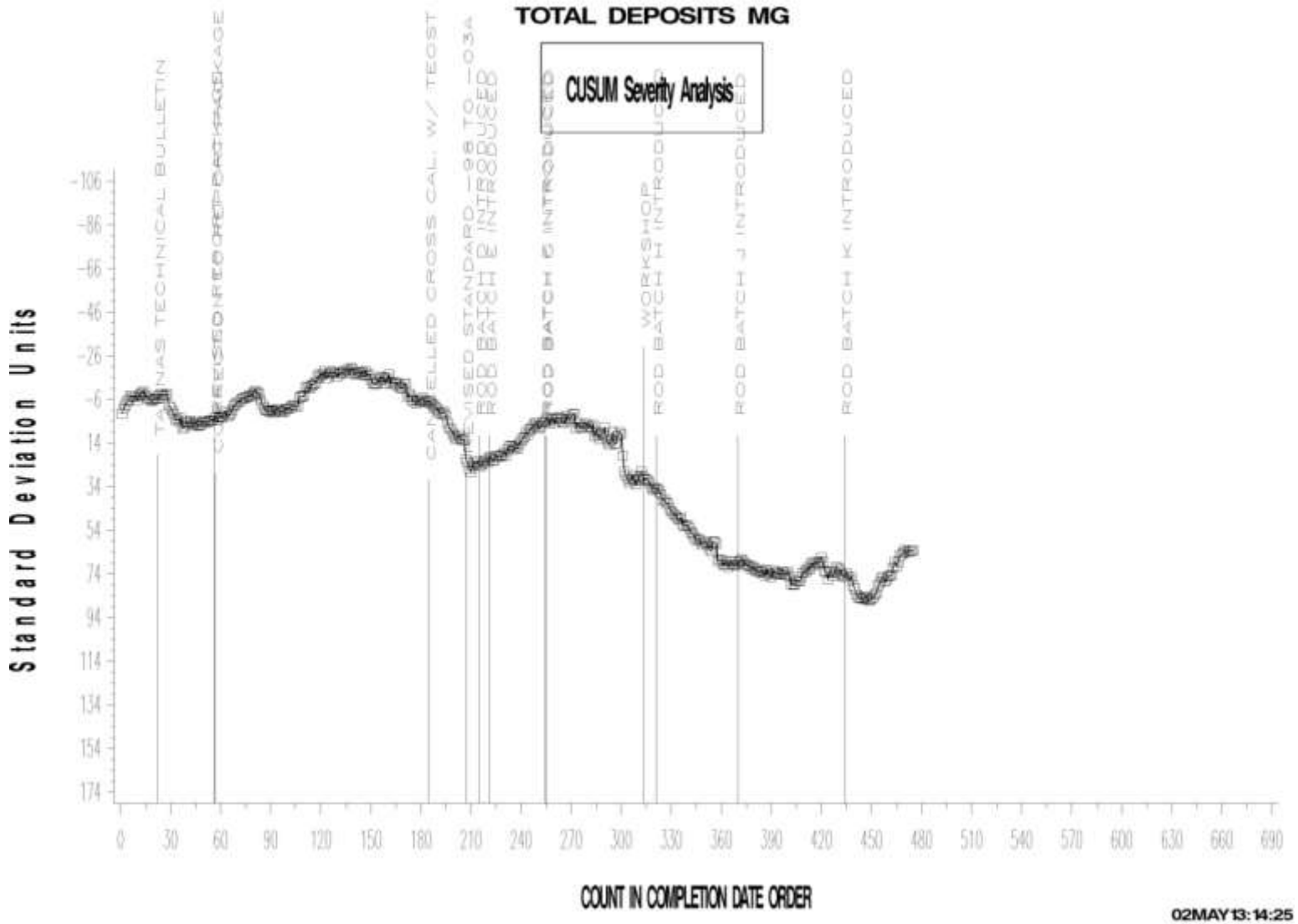
TEOST–33C INDUSTRY OPERATIONALLY VALID DATA

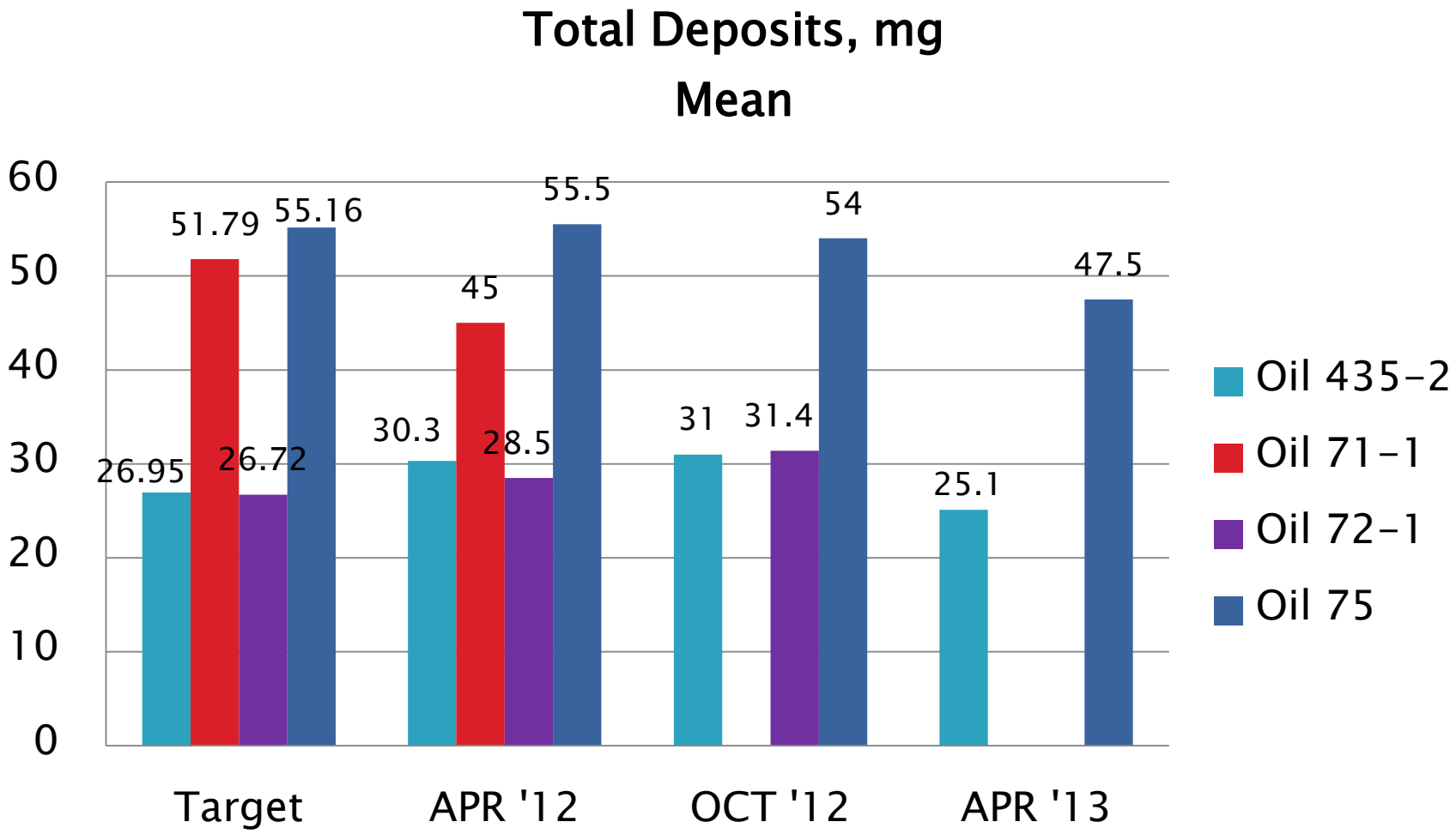


D6335 Performance by Oil

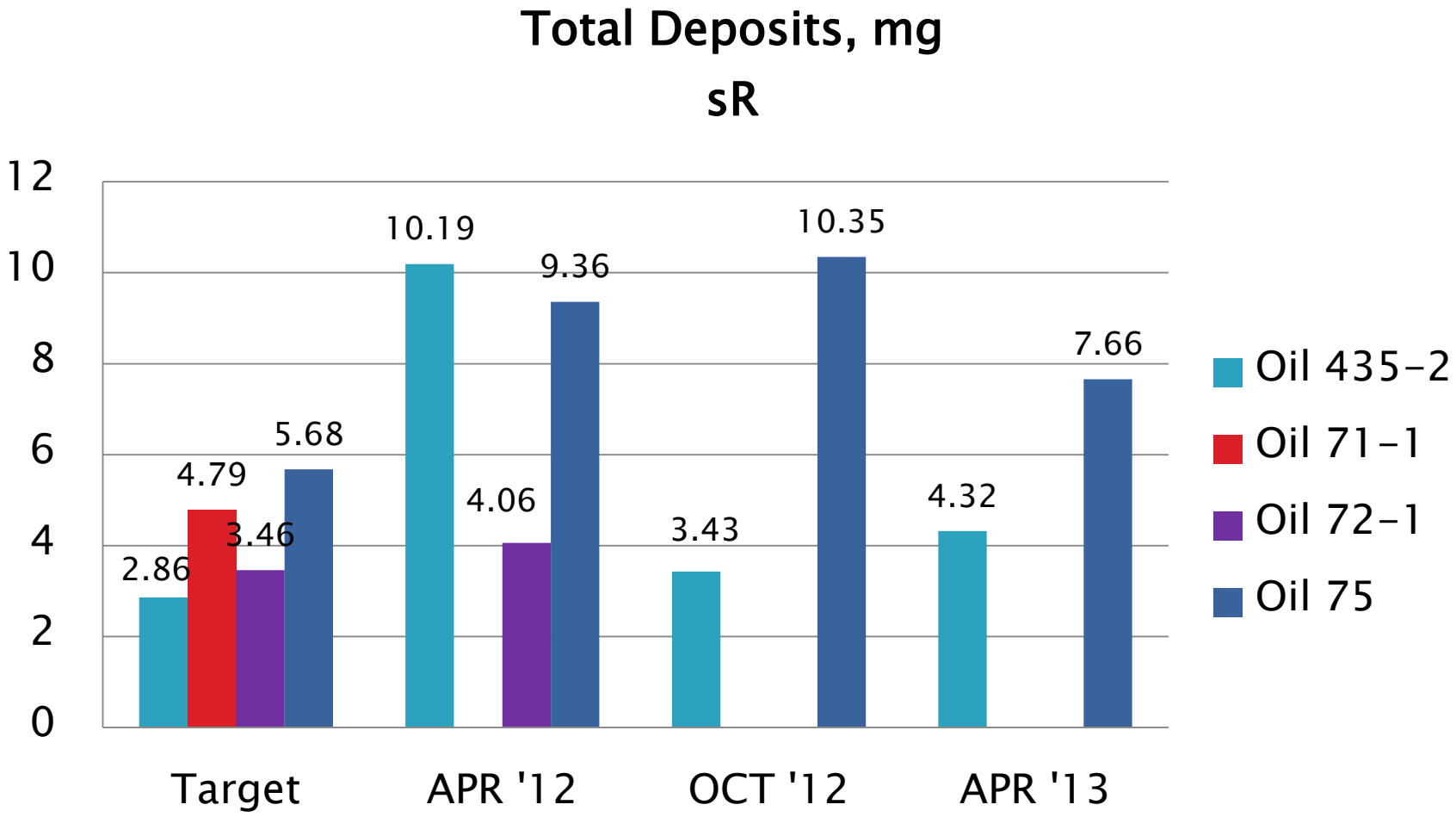
Total Deposits, mg
Performance by Oil

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	15	26.95	2.86	4	30.3	10.19	1.18	10	31.0	3.43	1.43	11	25.1	4.32	-0.65
71-1	27	51.79	4.79	1	45.0	-----	-1.42	0	-----	-----	-----	----	-----	-----	-----
72-1	27	28.72	3.46	4	28.5	4.06	0.52	1	31.4	-----	1.36	----	-----	-----	-----
75	14	55.16	5.68	7	55.5	9.36	0.06	7	54.0	10.35	-0.21	11	47.5	7.66	-1.35

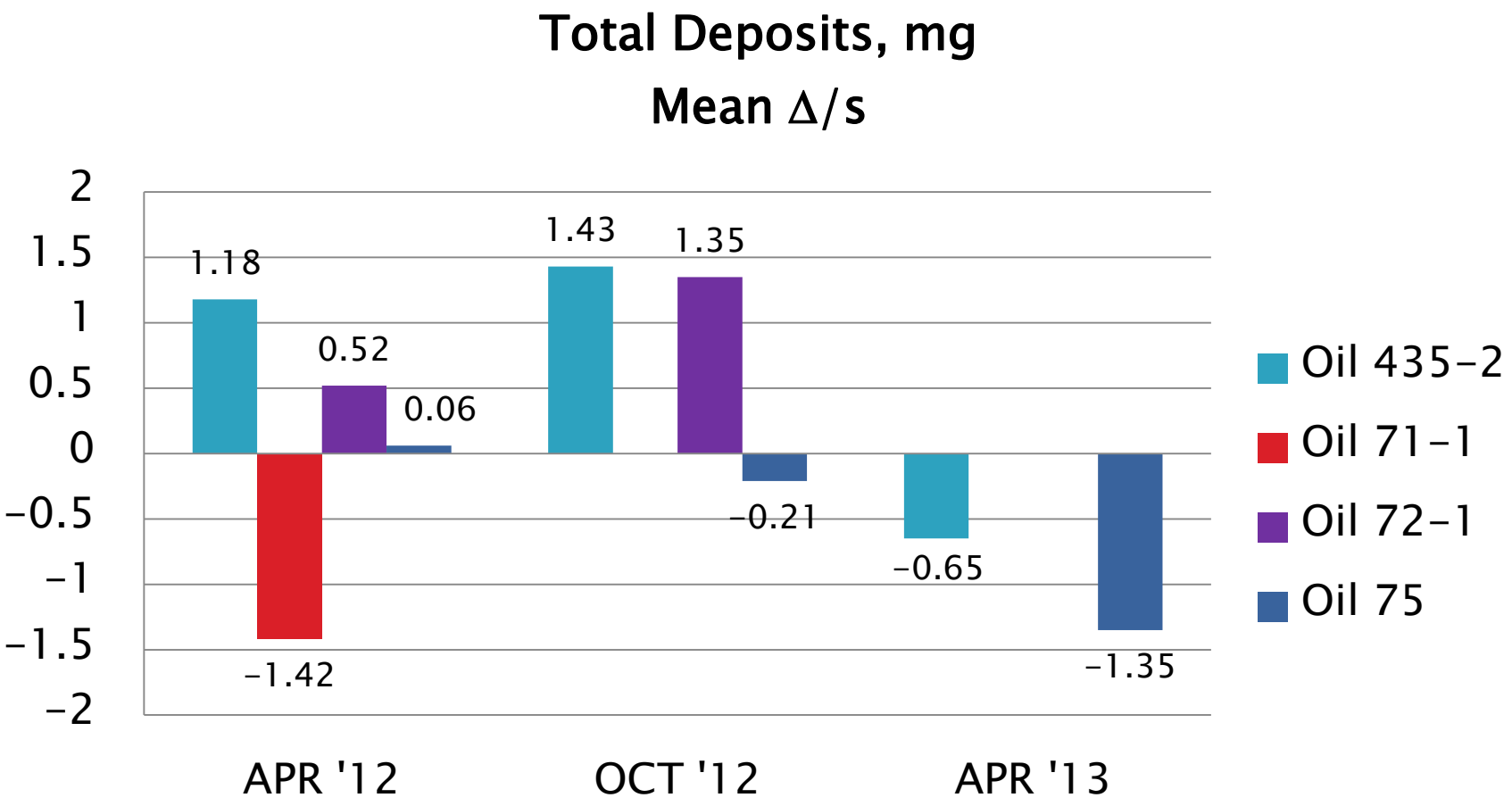
D6335 Performance by Oil



D6335 Performance by Oil



D6335 Performance by Oil



D7097: Deposits by MHT TEOST

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	55
Failed Calibration Test	OC	13
Operationally Invalidated by Lab	LC, XC	3
Operationally Invalidated After Initially Reported as Valid	RC	2
Non-blind Shakedown Run	NN	1
Total		**74**

Number of Labs Reporting Data: 7
Fail Rate of Operationally Valid Tests: 19%

D7097: Deposits by MHT TEOST

Statistically Unacceptable Tests (OC)	No. Of Tests
Total Deposits Mild	0
Total Deposits Severe	13

- Five operationally invalid tests this period:
  - Two sample weight off-spec (RC)
  - One sample leak (LC)
  - One airflow off-spec (LC)
  - One aborted due to power failure (XC)

- 11 of 13 severe failing results on severe oil 432
  - Multiple labs and instruments
  - 26 passing tests on 432

- No TMC technical updates issued this period

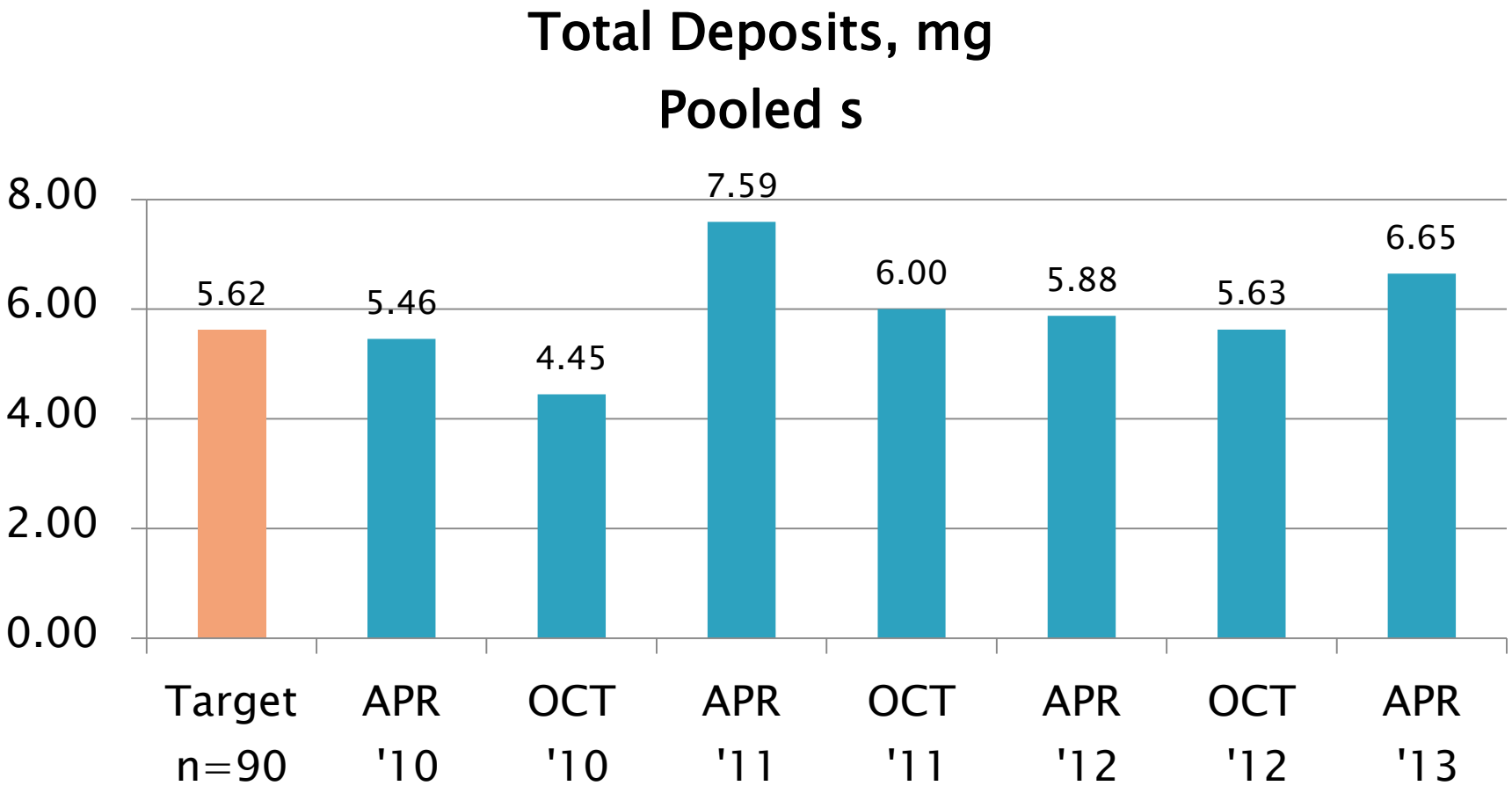
D7097: Deposits by MHT TEOST

Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets 7/31/2006	90	87	5.62	-----
10/1/09 through 3/31/10	43	40	5.46	-0.19
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

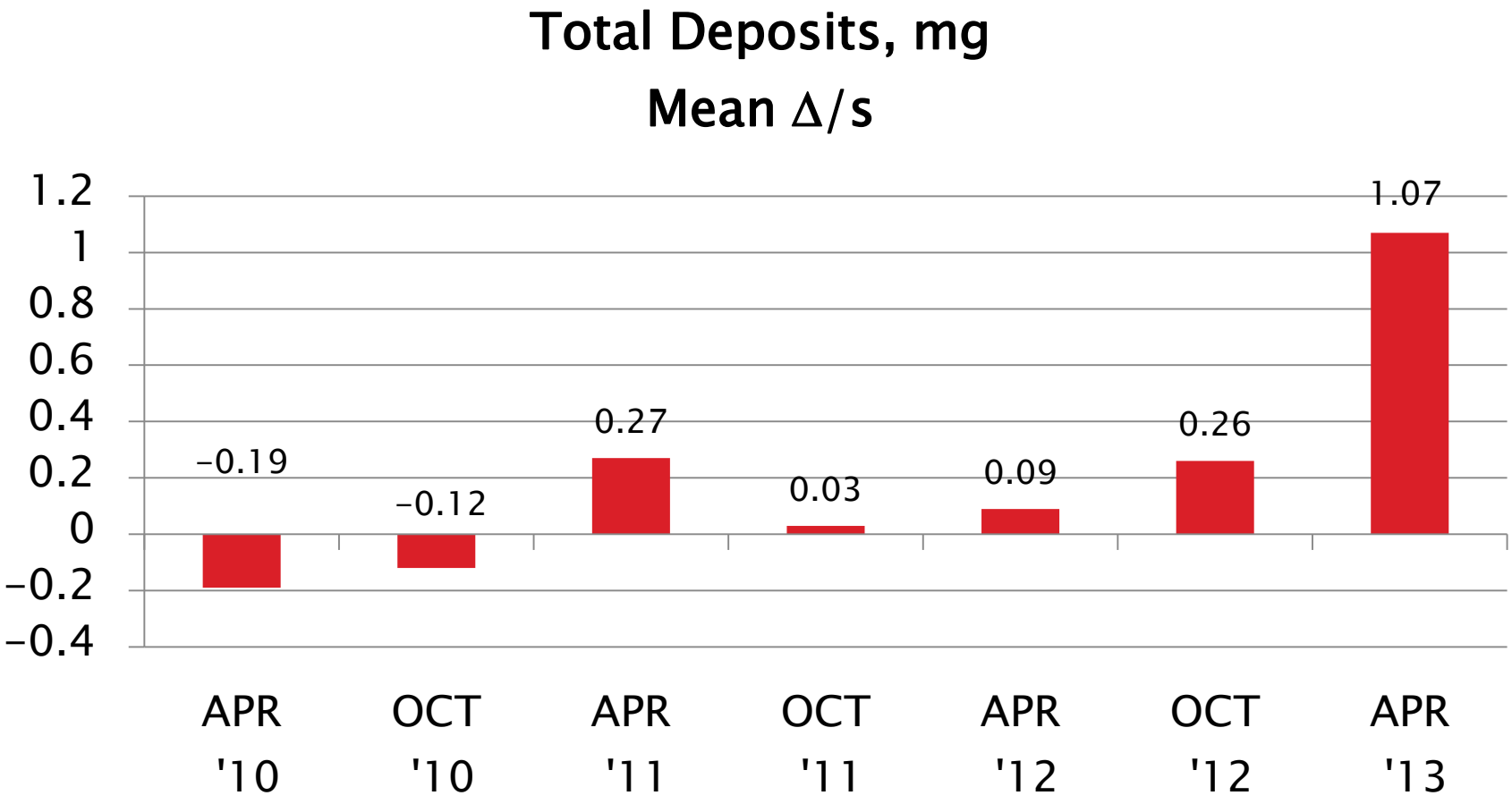
Return

D7097 Precision Estimates



Test Monitoring Center
http://astmtmc.cmu.edu
A Program of ASTM International

D7097 Severity Estimates

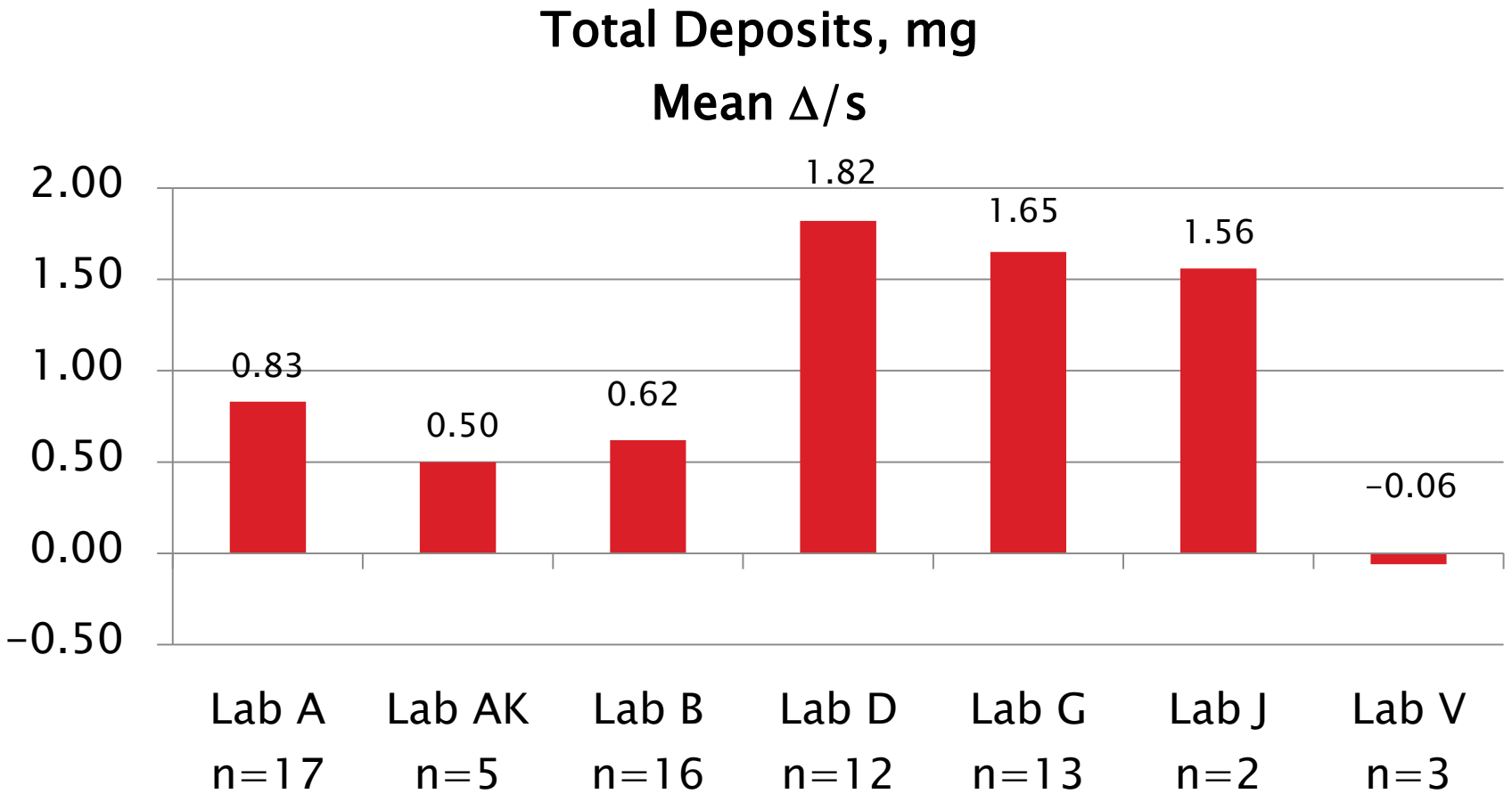


D7097: Deposits by MHT TEOST

Current Period Severity Estimates by Lab
Total Deposits, mg

	n	Mean Δ/s
Lab A	17	0.83
Lab AK	5	0.50
Lab B	16	0.62
Lab D	12	1.82
Lab G	13	1.65
Lab J	2	1.56
Lab V	3	-0.06

D7097 Lab Severity Estimates



D7097: Deposits by MHT TEOST

- Precision (Pooled s) is less precise than prior period
  - Less precise than target precision
- Performance (Mean Δ/s) is exceptionally severe at 1.07 s severe
- All tests this period report using Rod Batch J or K
- All tests this period report using Catalyst Batch 1201 or 1208

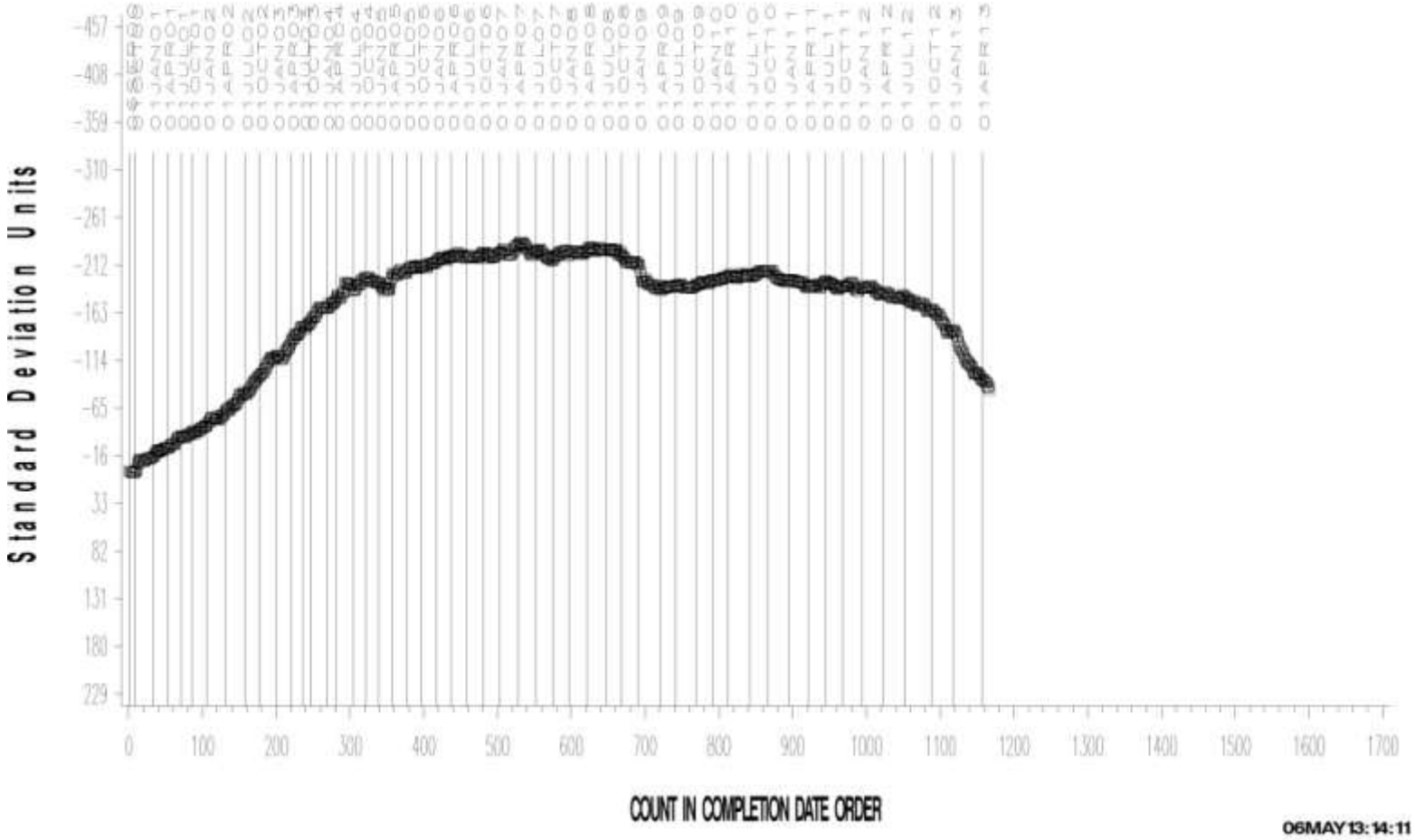
D7097: Deposits by MHT TEOST

- CUSUM severity plot shows severe trend starting just after the 01OCT12 timeline
  - Unusually severe performance overall this period, especially on oil 432 (1.65 s severe compared to 0.37 s on oil 434)
    - Appears coincident with the introduction of new catalyst batch 1208, but not necessarily dependent; inconclusive correlation of severity with catalyst batch
    - Significant lab performance differences also observed

MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA

TOTAL DEPOSITS MG

CUSUM Severity Analysis



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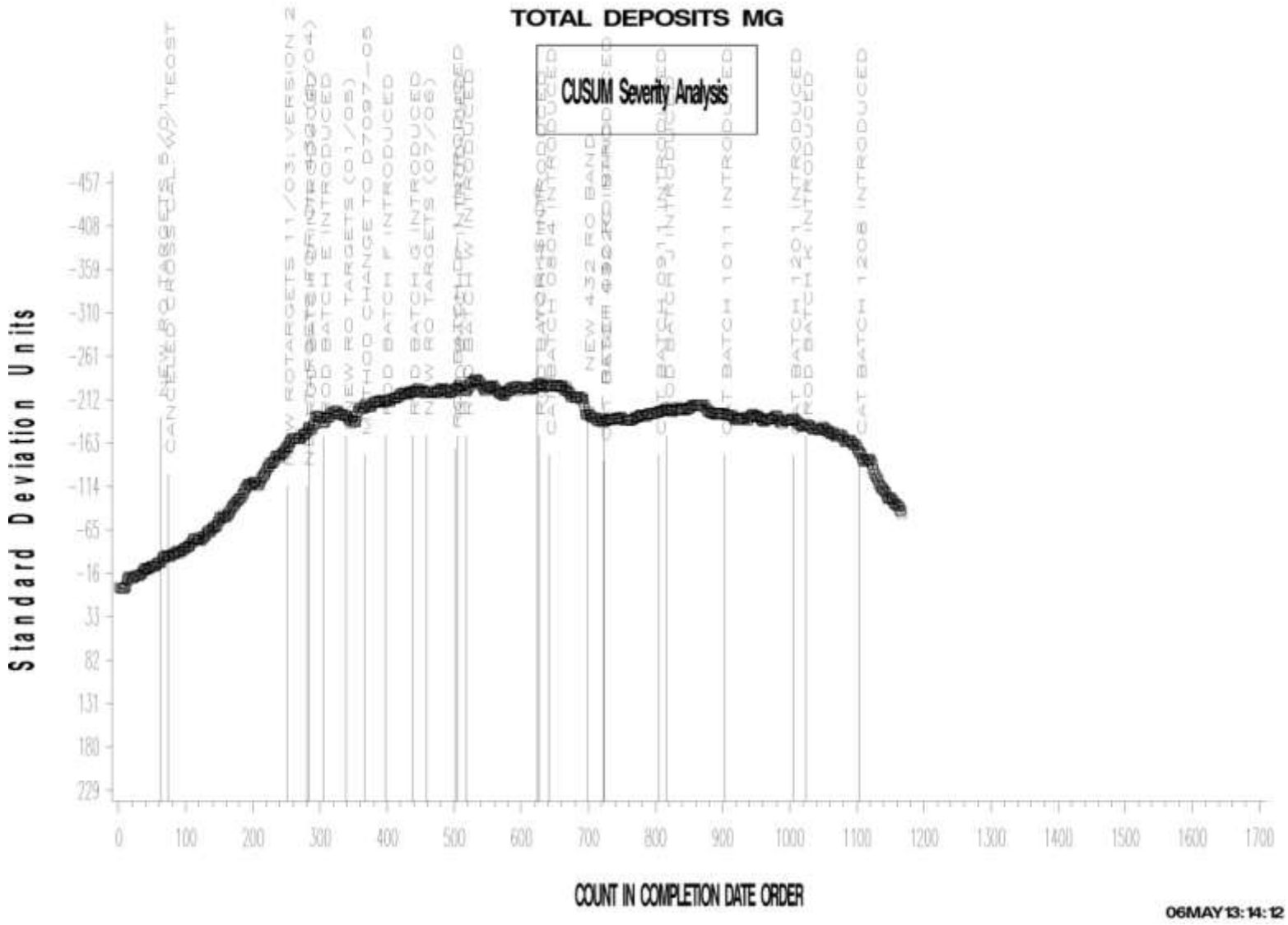
Return

MHT—4 TEOST INDUSTRY OPERATIONALLY VALID DATA



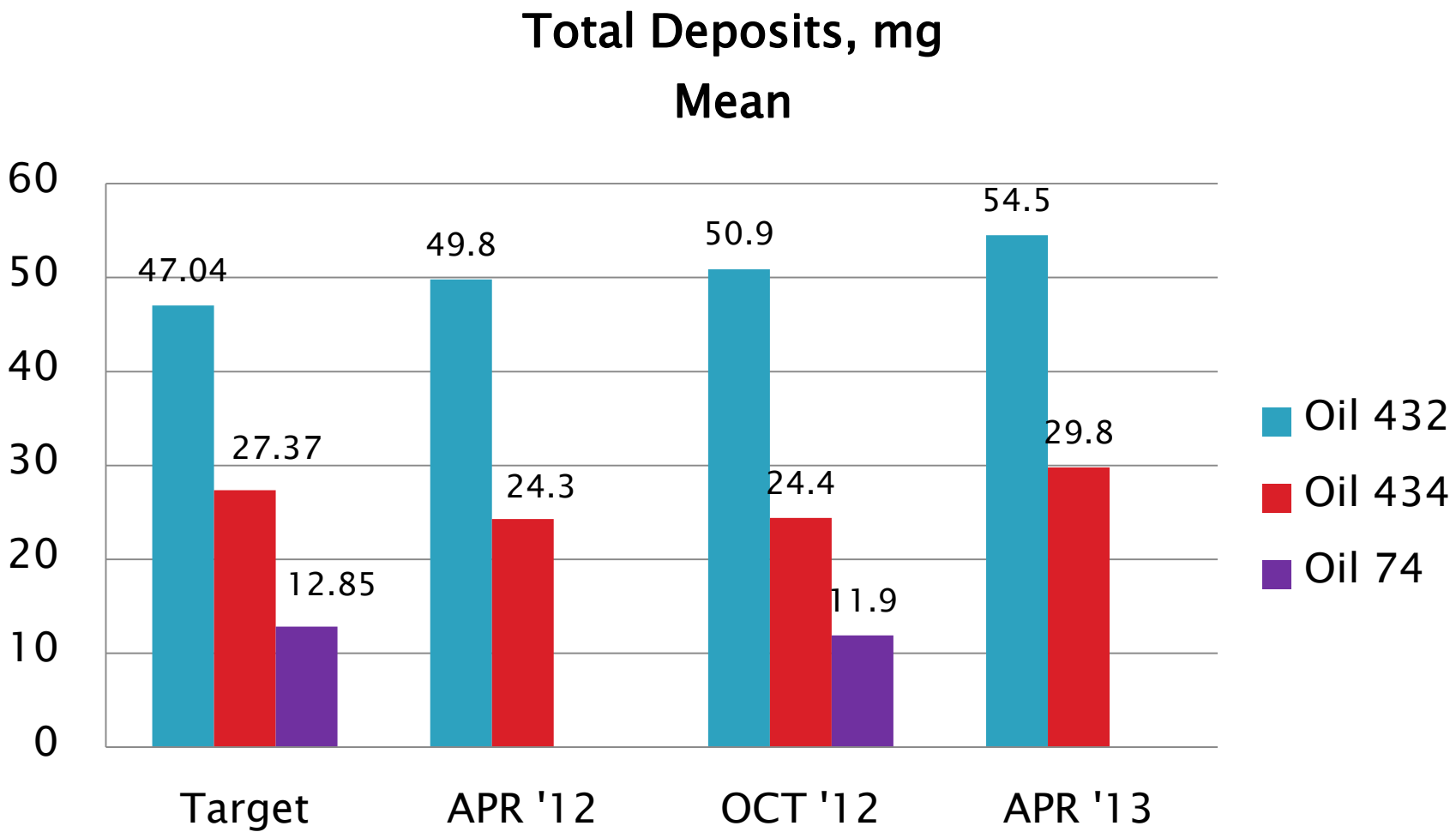
Return

D7097 Performance by Oil

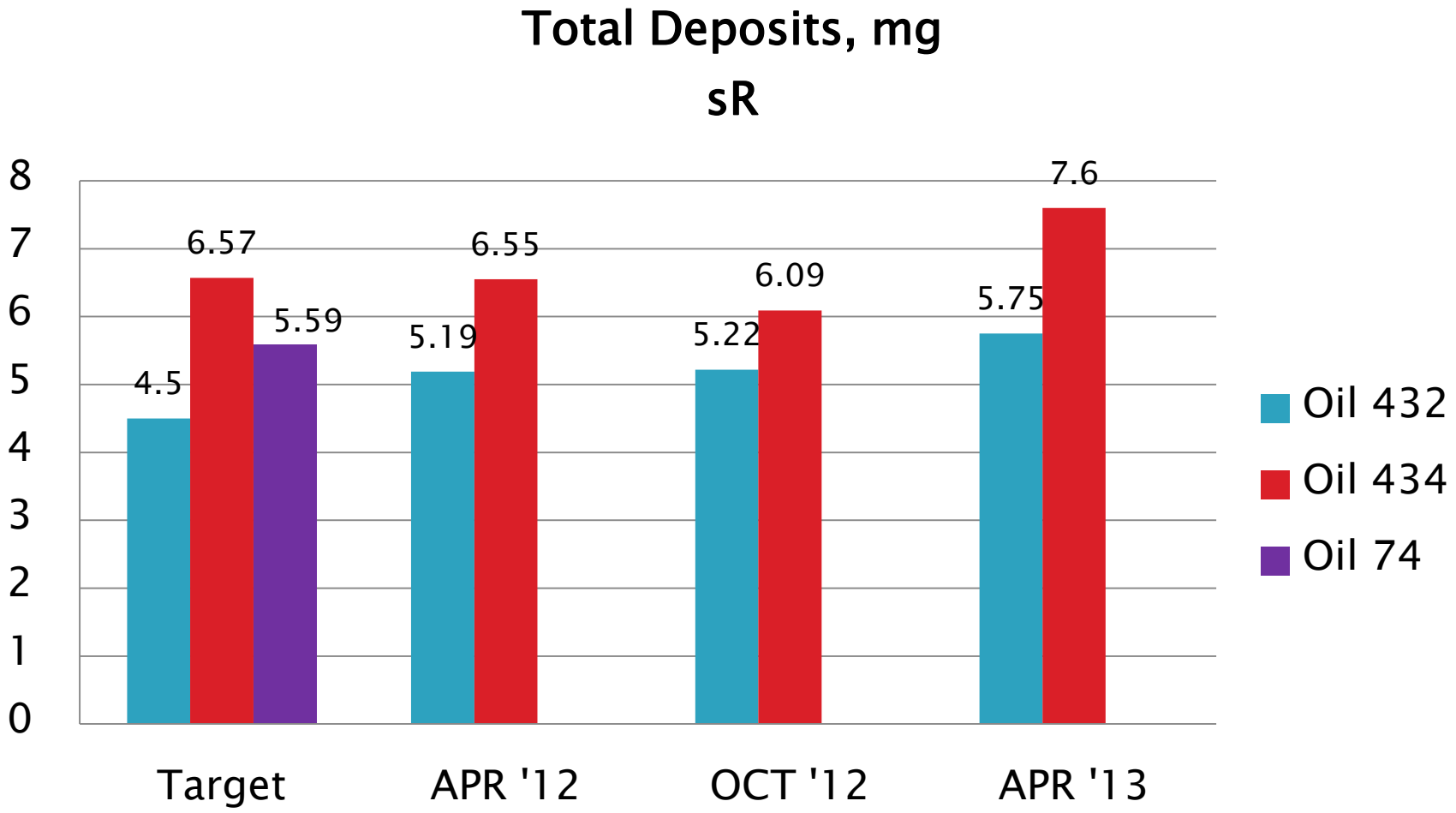
Total Deposits, mg
Performance by Oil

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	29	49.8	5.19	0.61	35	50.9	5.22	0.86	37	54.5	5.75	1.65
434	30	27.37	6.57	27	24.3	6.55	-0.46	29	24.4	6.09	-0.45	31	29.81	7.60	0.37
74	30	12.85	5.59	--	-----	-----	-----	1	11.9	-----	-0.17	--	-----	-----	-----

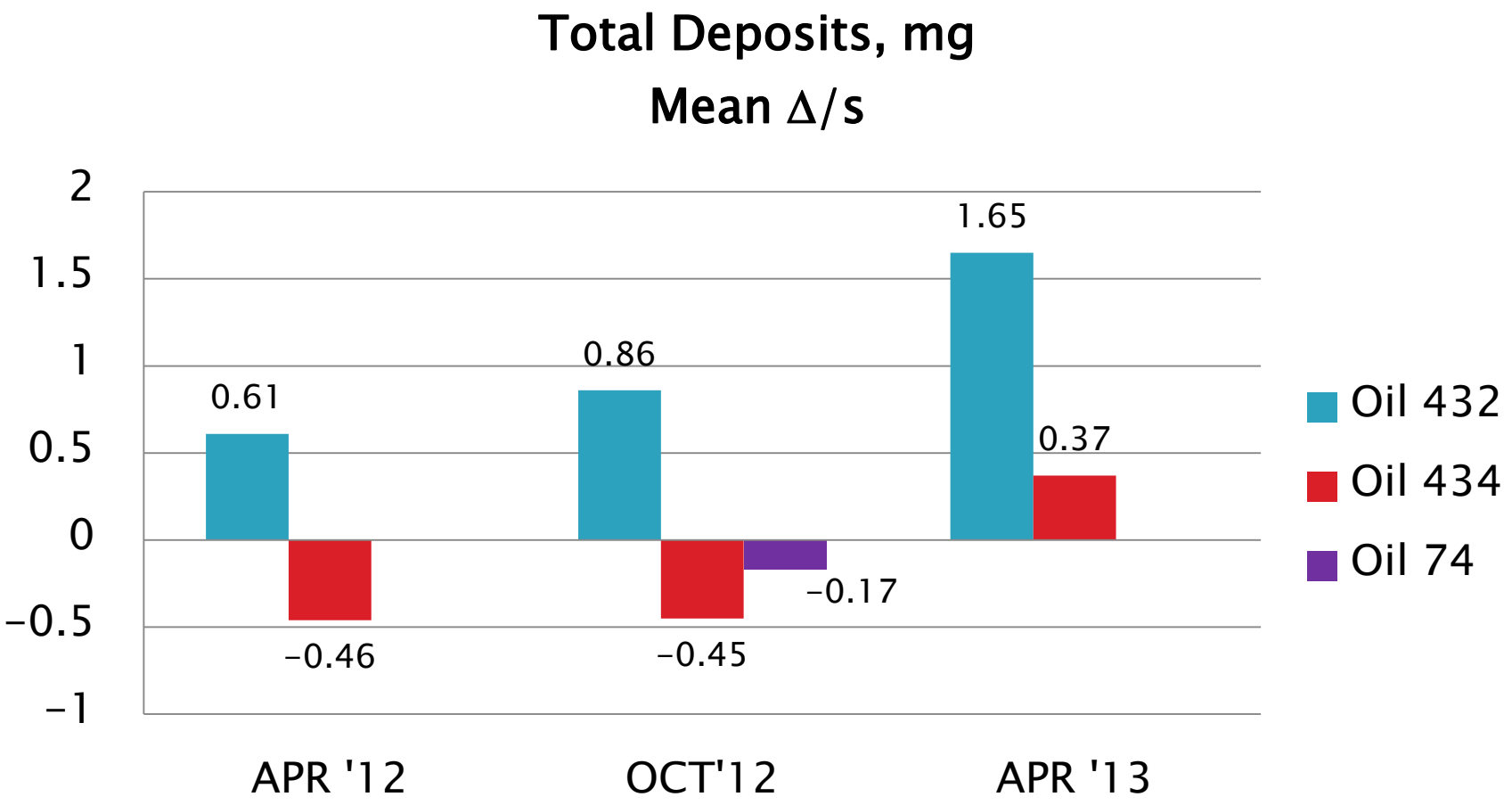
D7097 Performance by Oil



D7097: Deposits by MHT TEOST



D7097: Deposits by MHT TEOST



D6082: High Temperature Foam

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	8
Acceptable Discrimination Test	AS	3
Failed Calibration Test	OC	0
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		11

Number of Labs Reporting Data: 3
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	-----
10/1/09 through 3/31/10	8	59	10	-0.38
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

Return

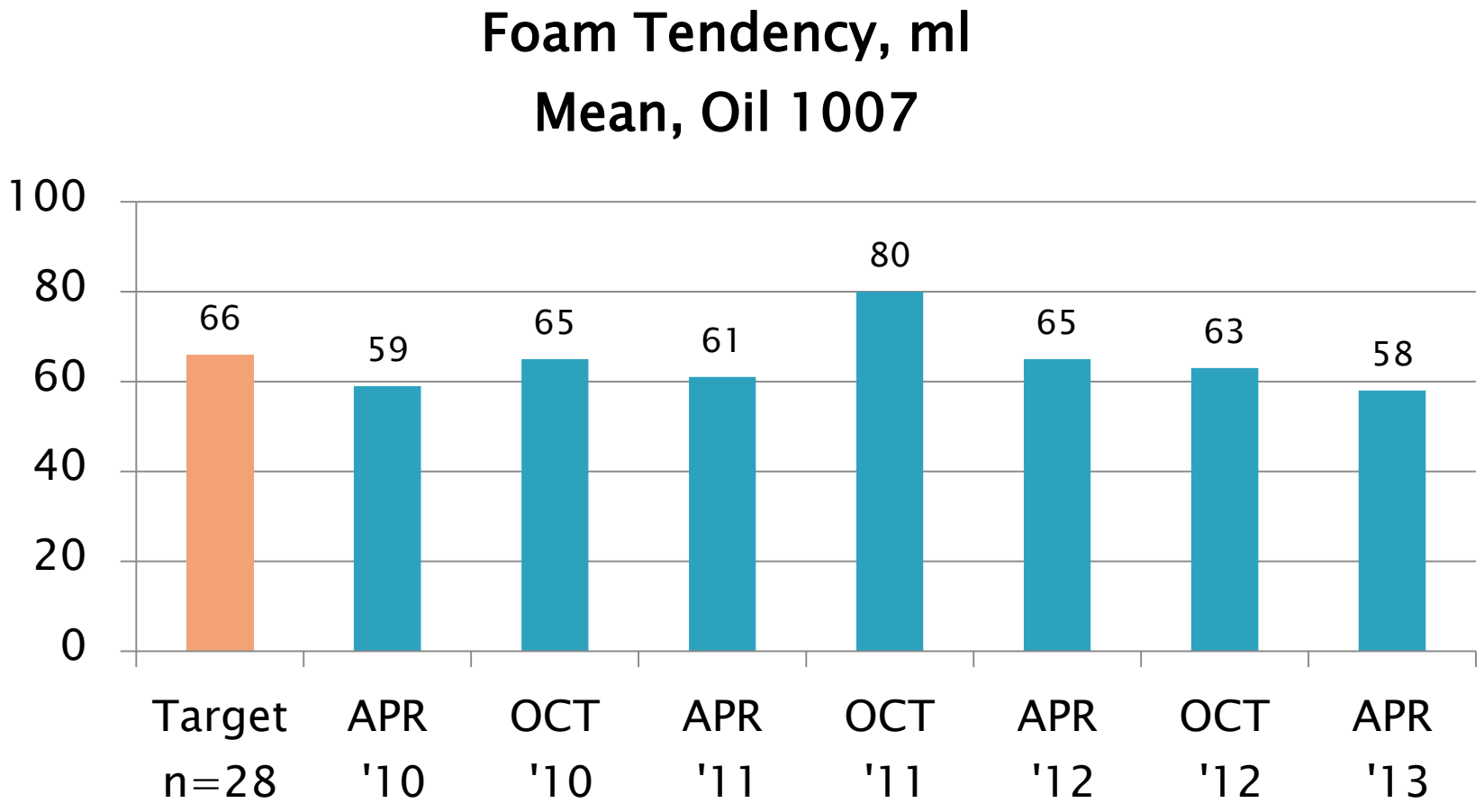
D6082: High Temperature Foam

Period Precision and Severity Estimates Oil 1007

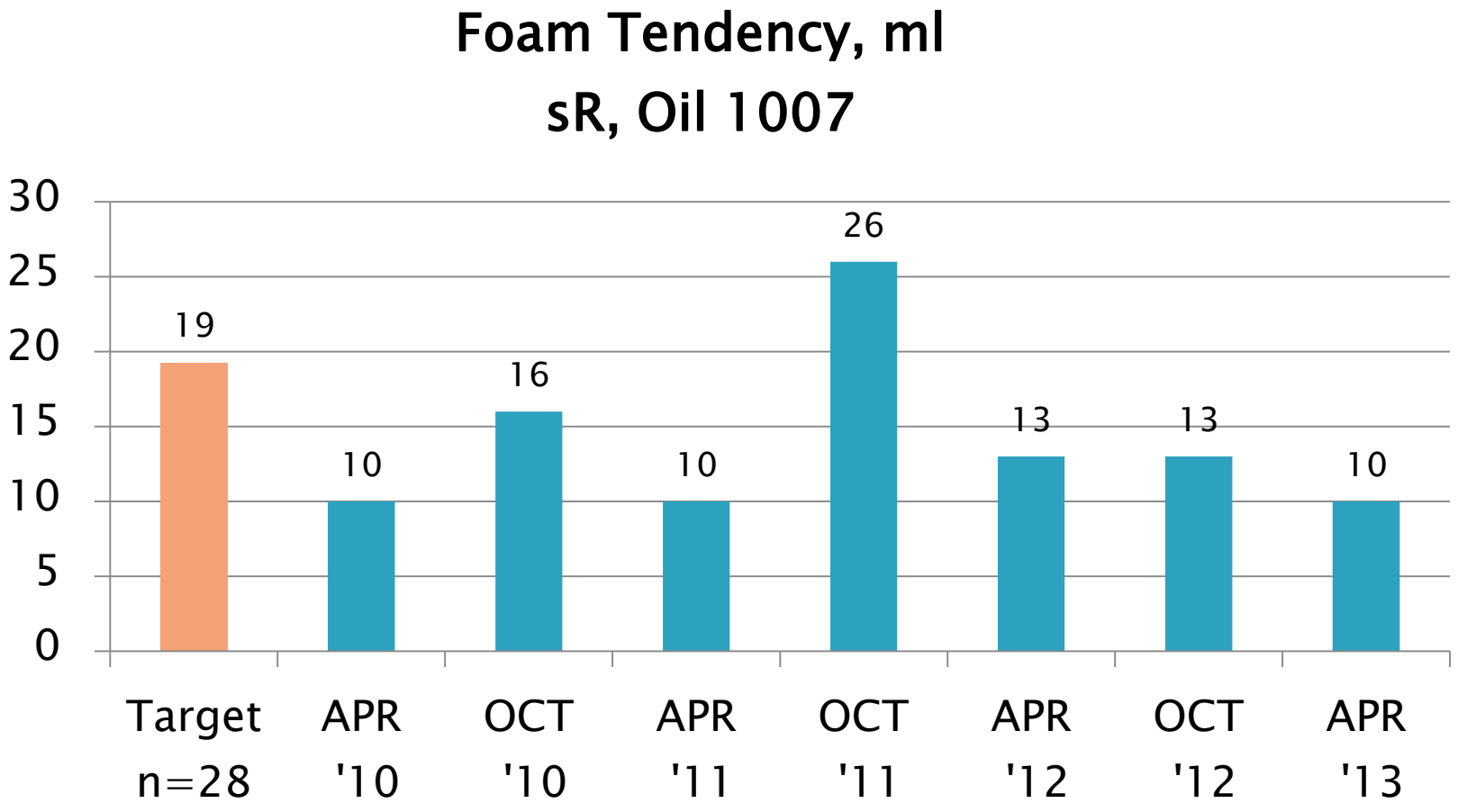
Foam Stability @ 1 min, ml	n	Mean	s
Current Targets	28	0.00	19.28
10/1/09 through 3/31/10	8	No non-zero occurrences	
4/1/10 through 9/30/10	8	No non-zero occurrences	
10/1/10 through 3/31/11	8	No non-zero occurrences	
4/1/11 through 9/30/11	9	No non-zero occurrences	
10/1/11 through 3/31/12	8	No non-zero 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	

Return

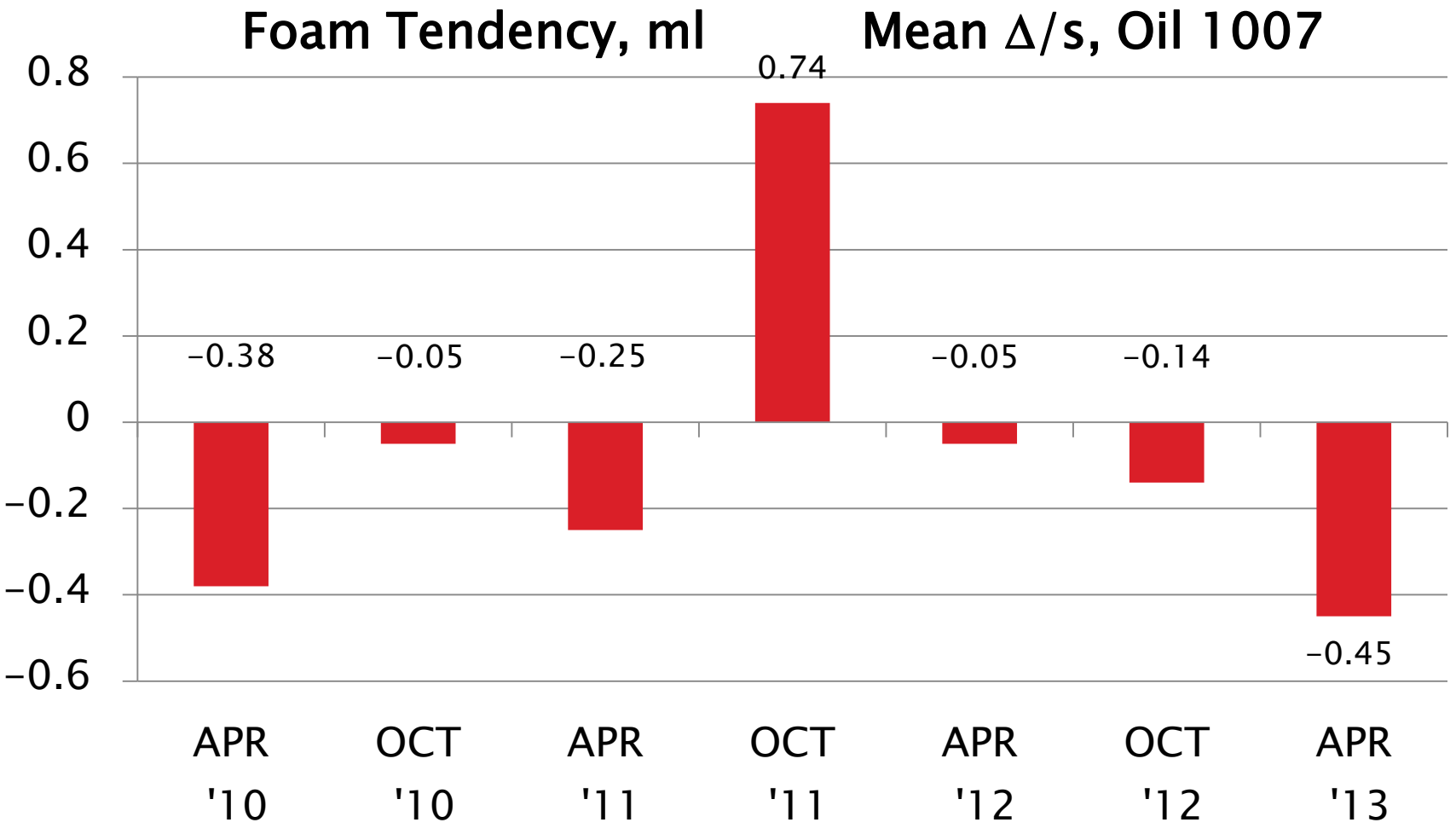
D6082: High Temperature Foam



D6082: High Temperature Foam



D6082: High Temperature Foam

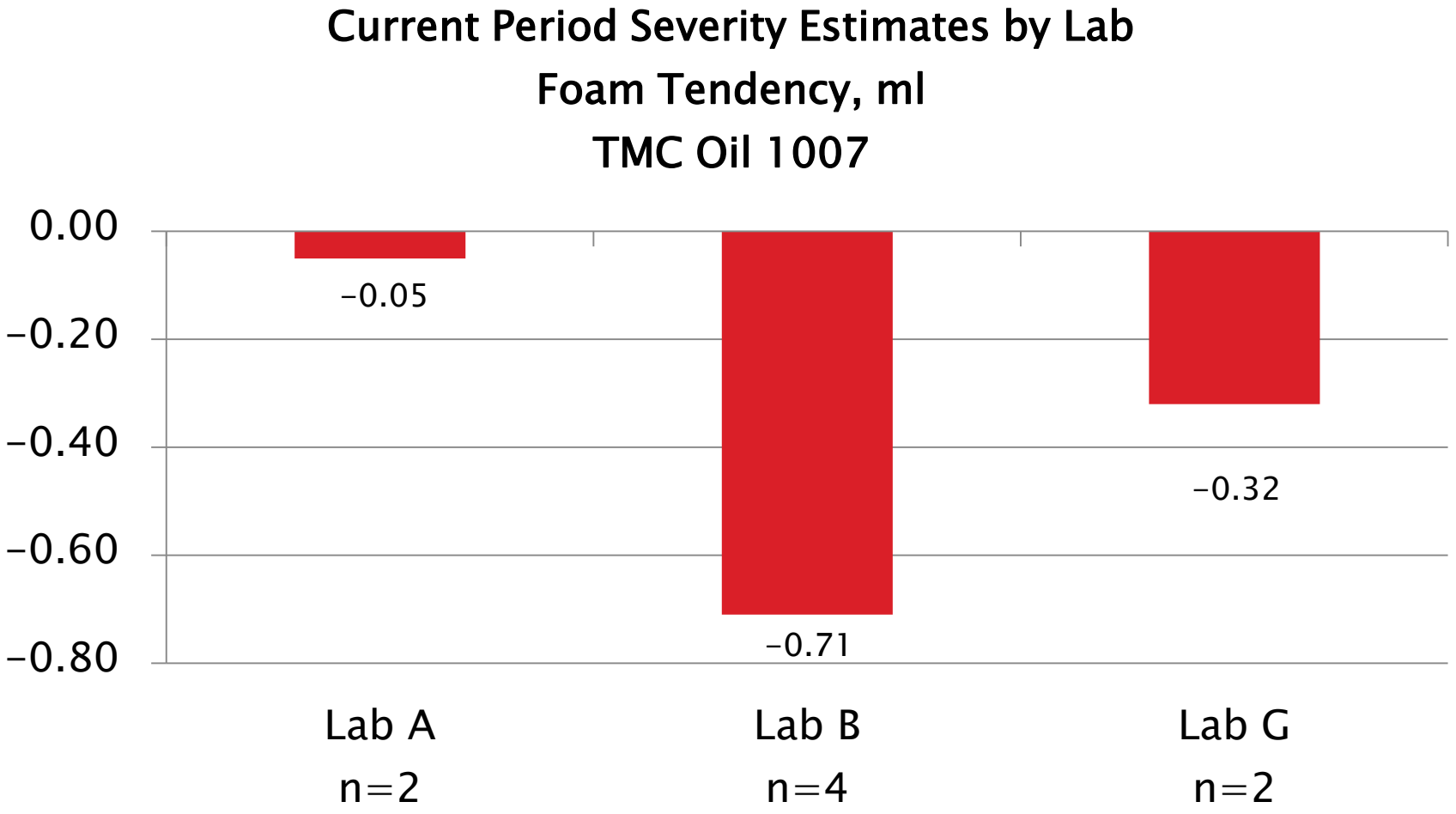


D6082: High Temperature Foam

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

	n	Mean Δ/s
Lab A	2	-0.05
Lab B	4	-0.71
Lab G	2	-0.32

D6082: High Temperature Foam



D6082: High Temperature Foam

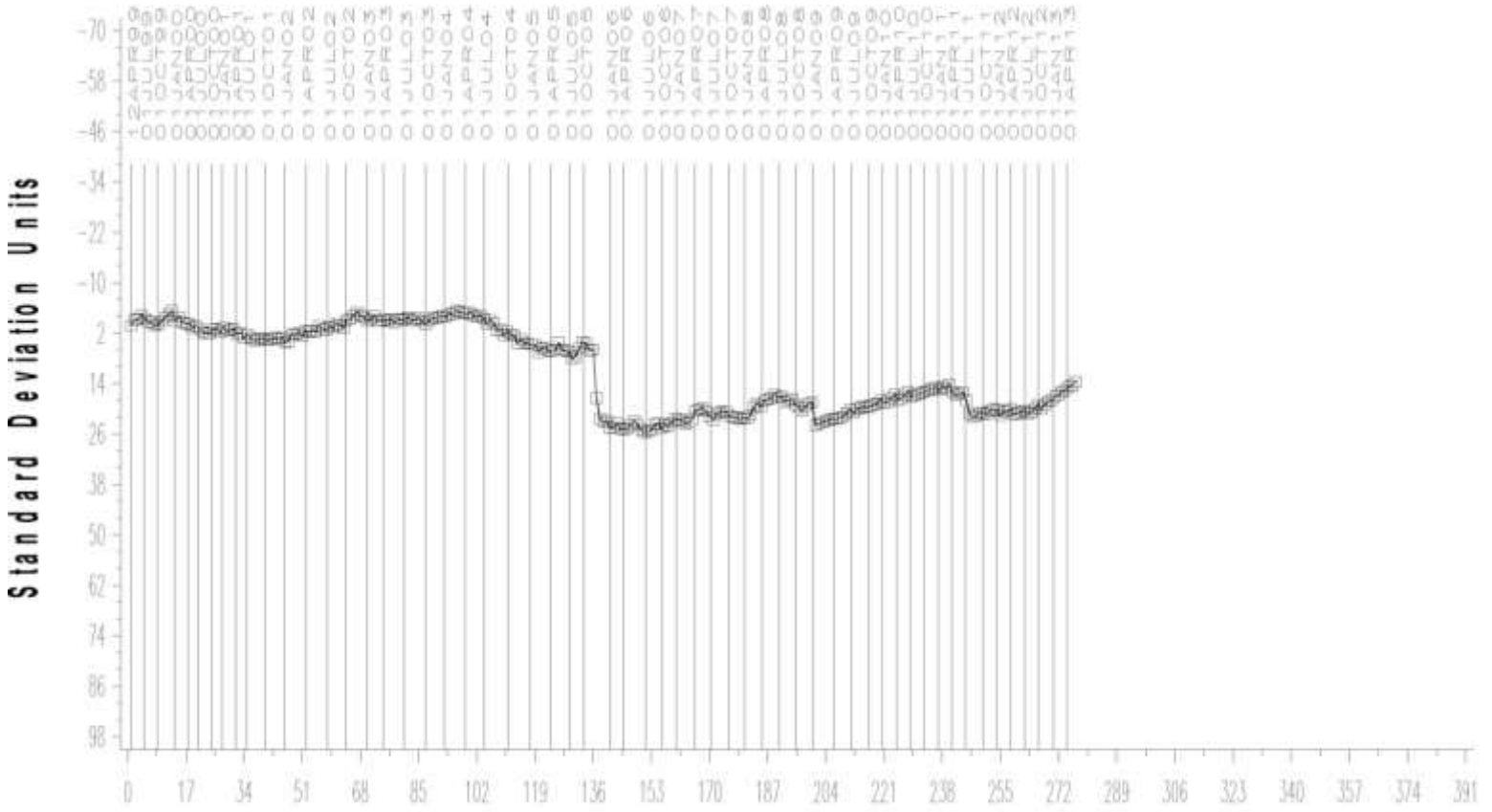
- Foam Tendency Precision (Pooled s) is more precise than prior period
  - More precise than target precision
- Performance (Mean Δ/s) is -0.45 s mild
- No non-zero occurrences of Foam Stability
- All operationally valid discrimination runs demonstrated acceptable discrimination

D6082 HIGH TEMPERATURE FOAM INDUSTRY OPERATIONALLY VALID DATA

IND='1007'

FOAM TENDENCY

CUSUM Severity Analysis



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D6082: High Temperature Foam

Foam Tendency, ml
Performance by Oil

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	8	65	13	-0.05	9	63	13	-0.14	8	58	10	-0.45

D874: Sulfated Ash

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	7
Failed Calibration Test	OC	0
Operationally Invalidated by Lab	LC, XC	0
Operationally Invalidated After Initially Reported as Valid	RC	0
Total		**7**

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 TMC technical updates issued this period

D874: Sulfated Ash

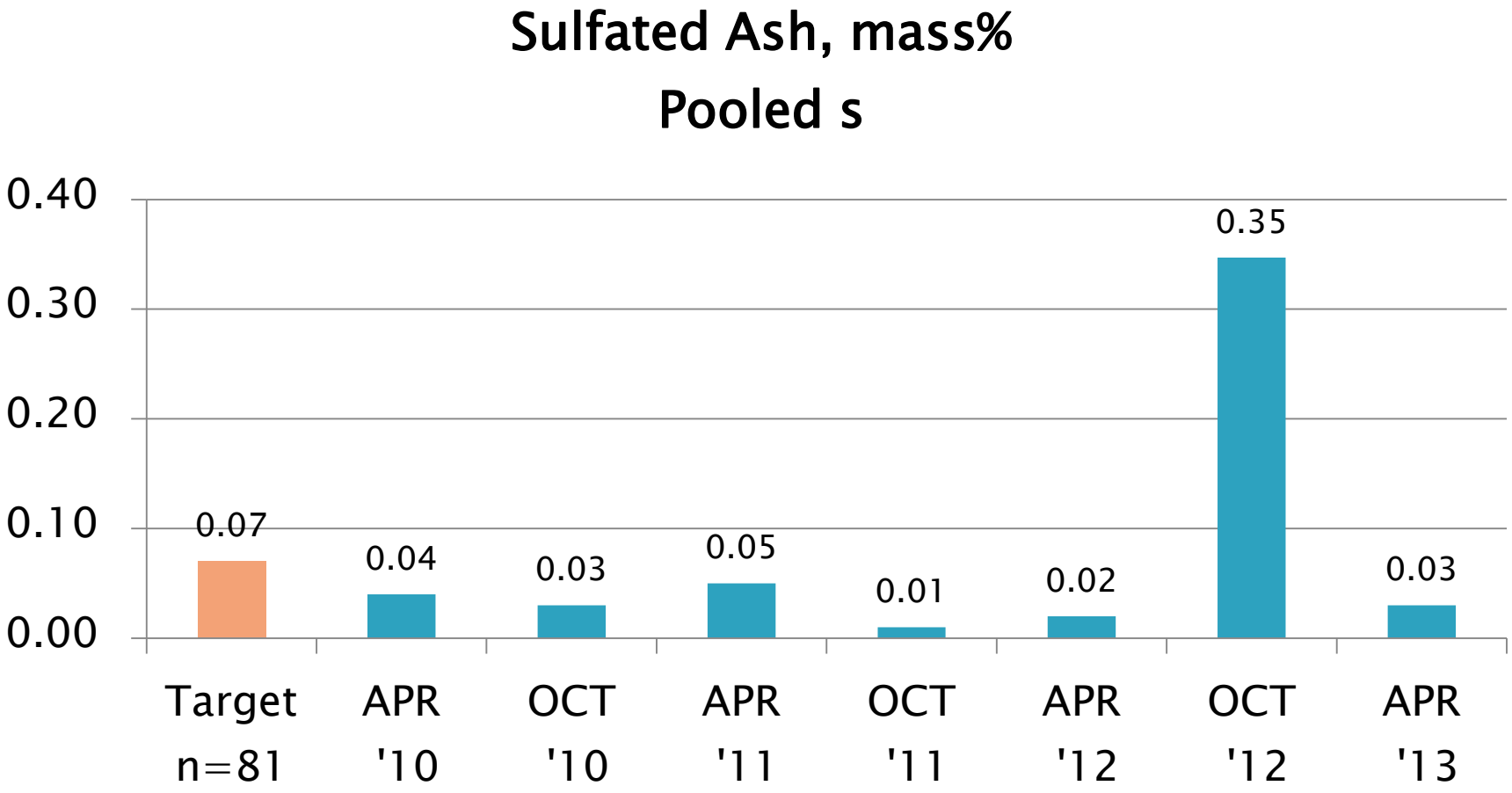
Period Precision and Severity Estimates

Total Deposits, mg	n	df	Pooled s	Mean Δ/s
Current Targets	81	79	0.07	-----
10/1/09 through 3/31/10	7	4	0.04	-0.23
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

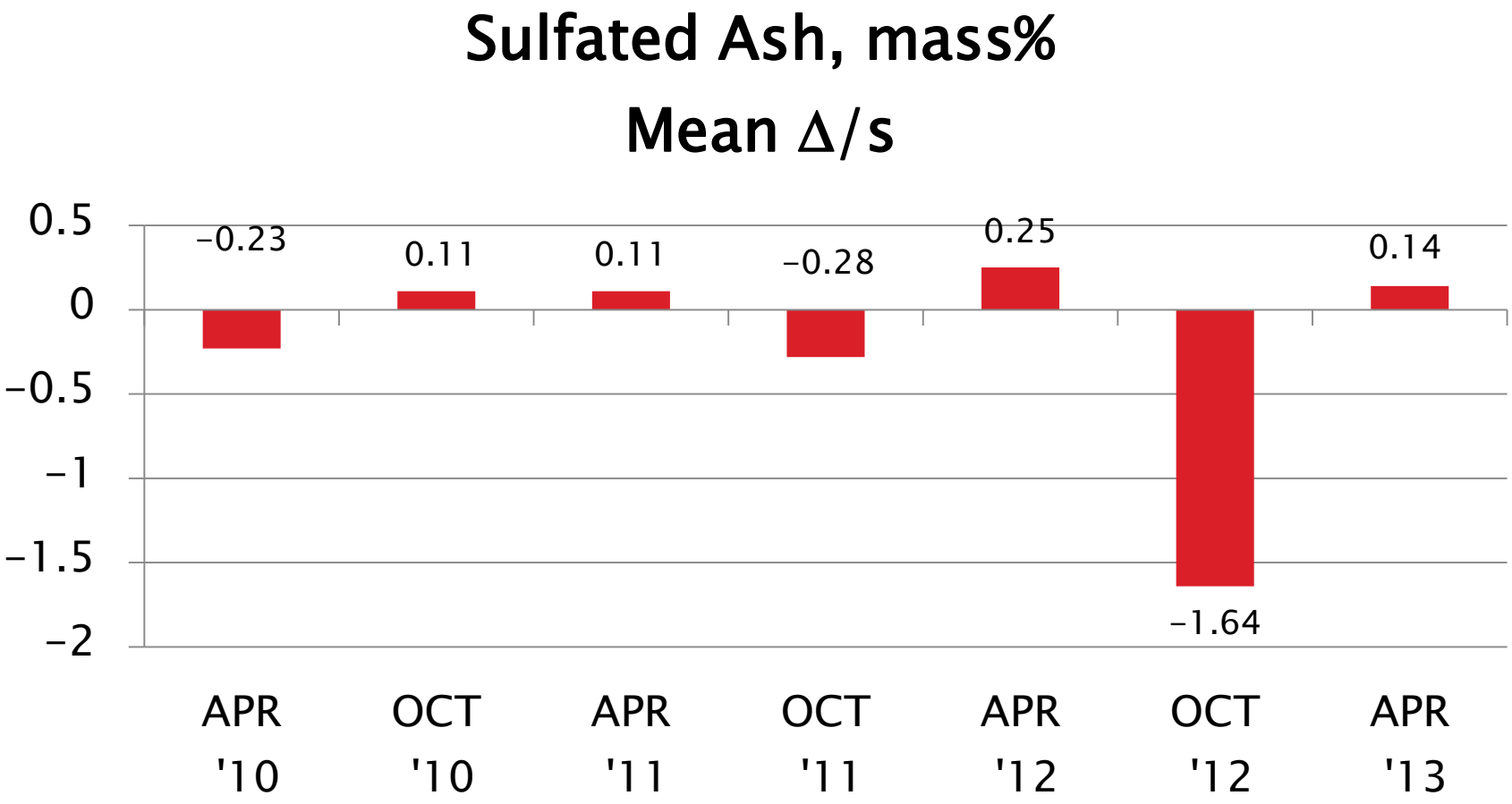
*Period statistics with and without extreme result included

Return

D874: Sulfated Ash



D874: Sulfated Ash

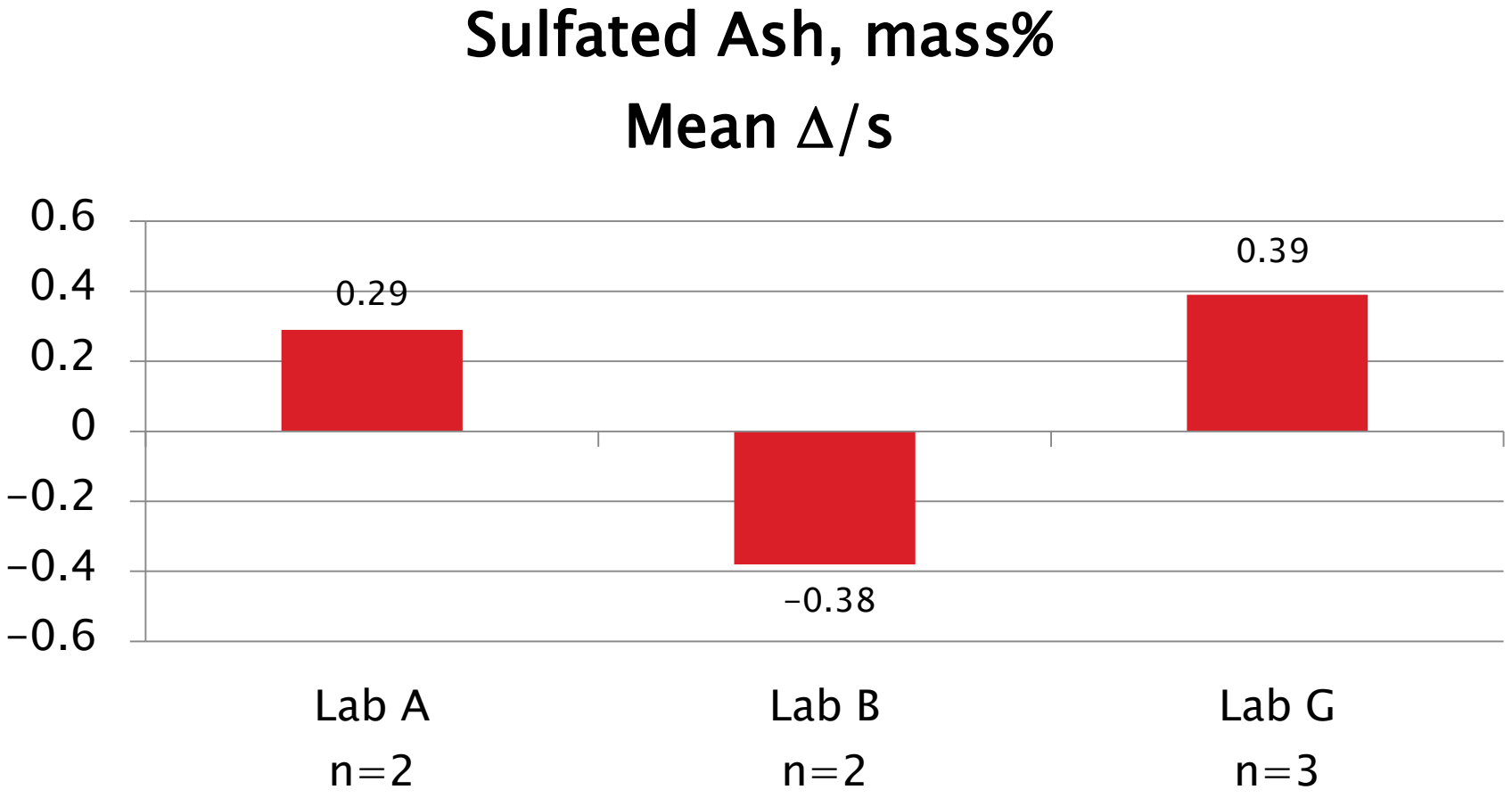


D874: Sulfated Ash

Current Period Severity Estimates by Lab
Sulfated Ash, mass%

	n	Mean Δ/s
Lab A	2	0.29
Lab B	2	-0.38
Lab G	3	0.39

D874: Sulfated Ash



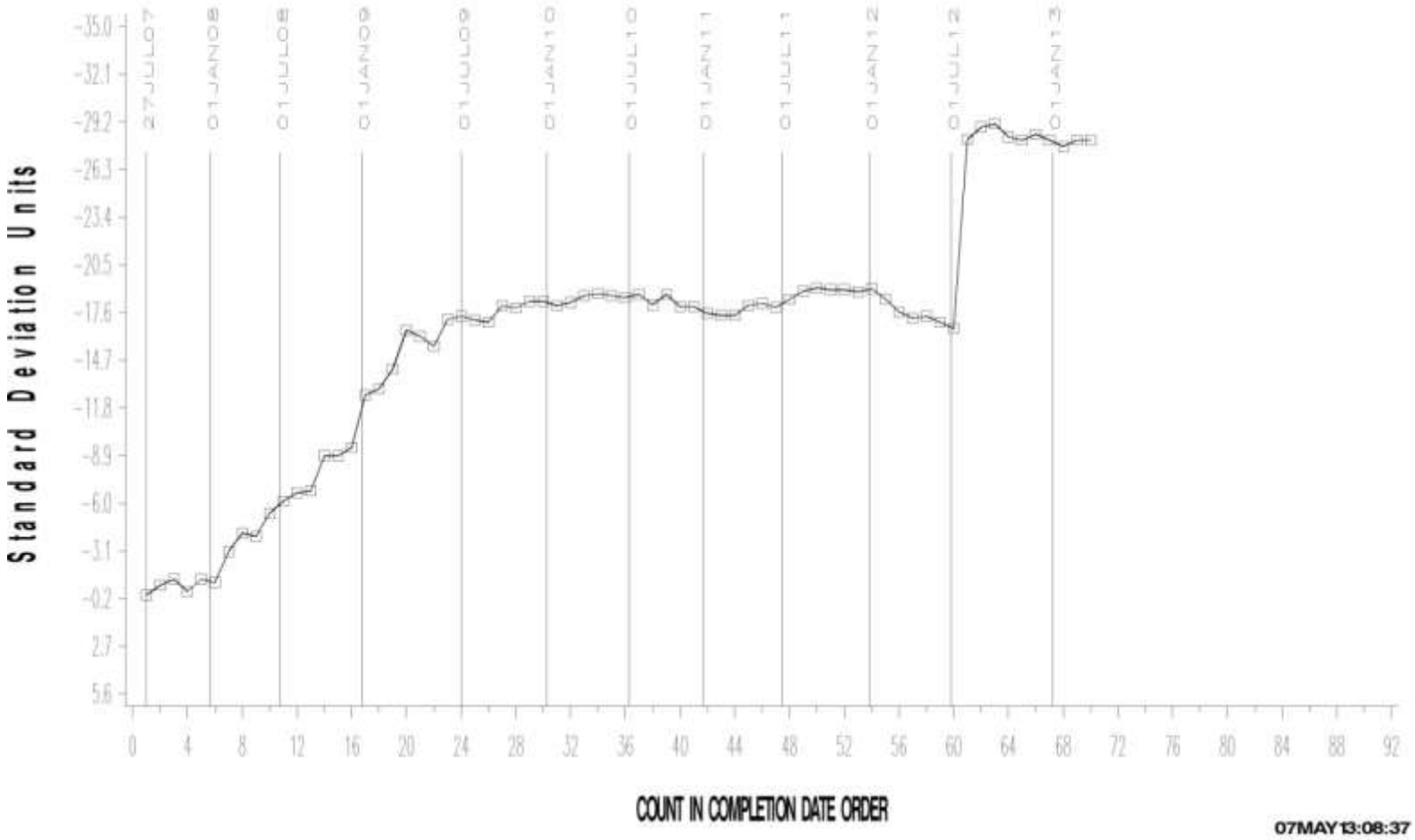
D874: Sulfated Ash

- Precision (Pooled s) is comparable to prior period
  - More precise than target precision
- Performance (Mean Δ/s) is 0.14 s severe

D874 INDUSTRY OPERATIONALLY VALID DATA

TEST SAMPLE PERCENT SULFATED ASH

CUSUM Severity Analysis



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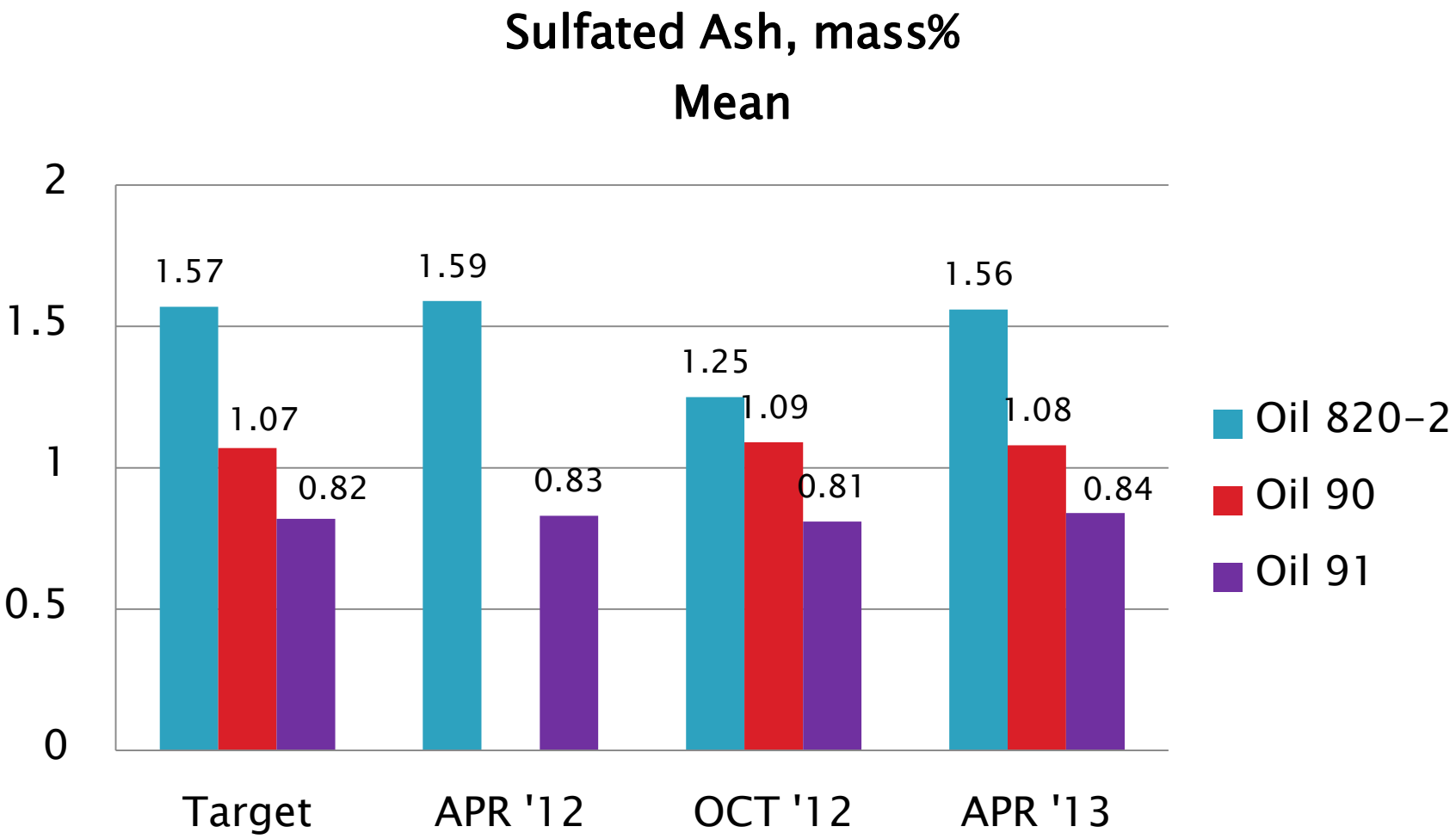
D874: Sulfated Ash

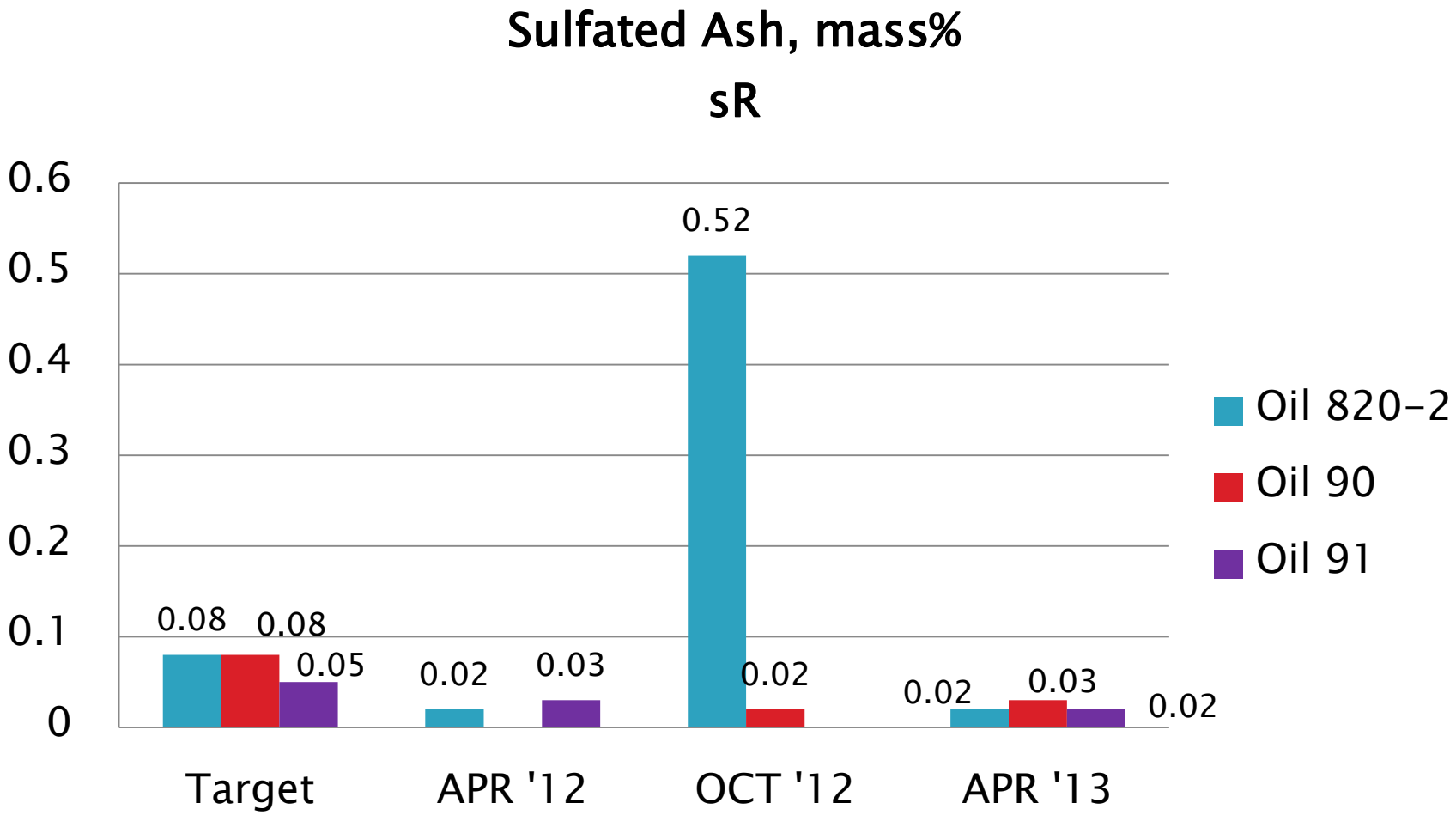
Performance by Oil
Sulfated Ash, mass%

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	1.59	0.02	0.29	3	1.25	0.52	-3.96	2	1.56	0.02	-0.19
90	27	1.07	0.08	--	----	----	----	3	1.09	0.02	0.21	3	1.08	0.03	0.12
91	27	0.82	0.05	3	0.83	0.03	0.20	1	0.81	----	-0.20	2	0.84	0.02	0.50

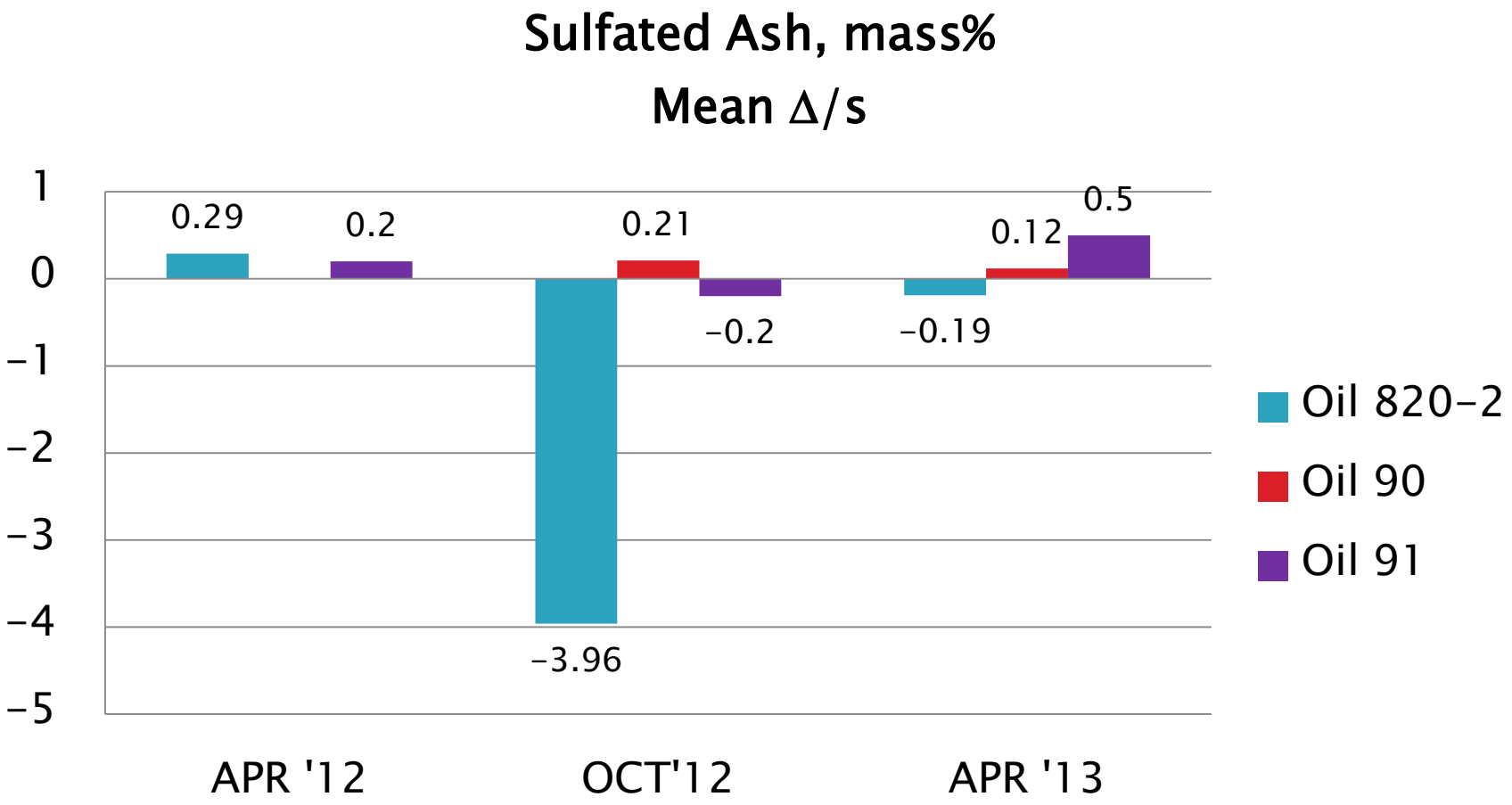
D874: Sulfated Ash



D874: Sulfated Ash



D874: Sulfated Ash



D7528: Oxidation by ROBO

Test Status	Validity Code	No. Tests
Acceptable Calibration Test	AC	90
Failed Calibration Test	OC	19
Operationally Invalidated by Lab	LC, XC	21
Operationally Invalidated After Initially Reported as Valid	RC	5
Non-reference shakedown, excluded from statistics		0
Total		**135**

Number of Labs Reporting Data: 9
Fail Rate of Operationally Valid Tests: 17%

D7528: Oxidation by ROBO

Operationally Invalid Tests

- 1 test: Incorrect VCV setting (LC)
- 14 tests: Vacuum system failure (XC, LC, RC)
- 2 tests: Stirrer failure (XC, RC)
- 2 tests: Power failure (XC)
- 1 test: Thermocouple problem (LC)
- 5 tests: NO_2 leak or flow problem (XC, LC)
- 1 Test: Unexplained high EOT volatiles (RC)

D7528: Oxidation by ROBO

Statistically Unacceptable Tests (OC)	No. Of Tests
Natural Log (MRV Viscosity) Mild	14
Natural Log (MRV Viscosity) Severe	5

- No TMC technical updates issued this period

D7528: Oxidation by ROBO

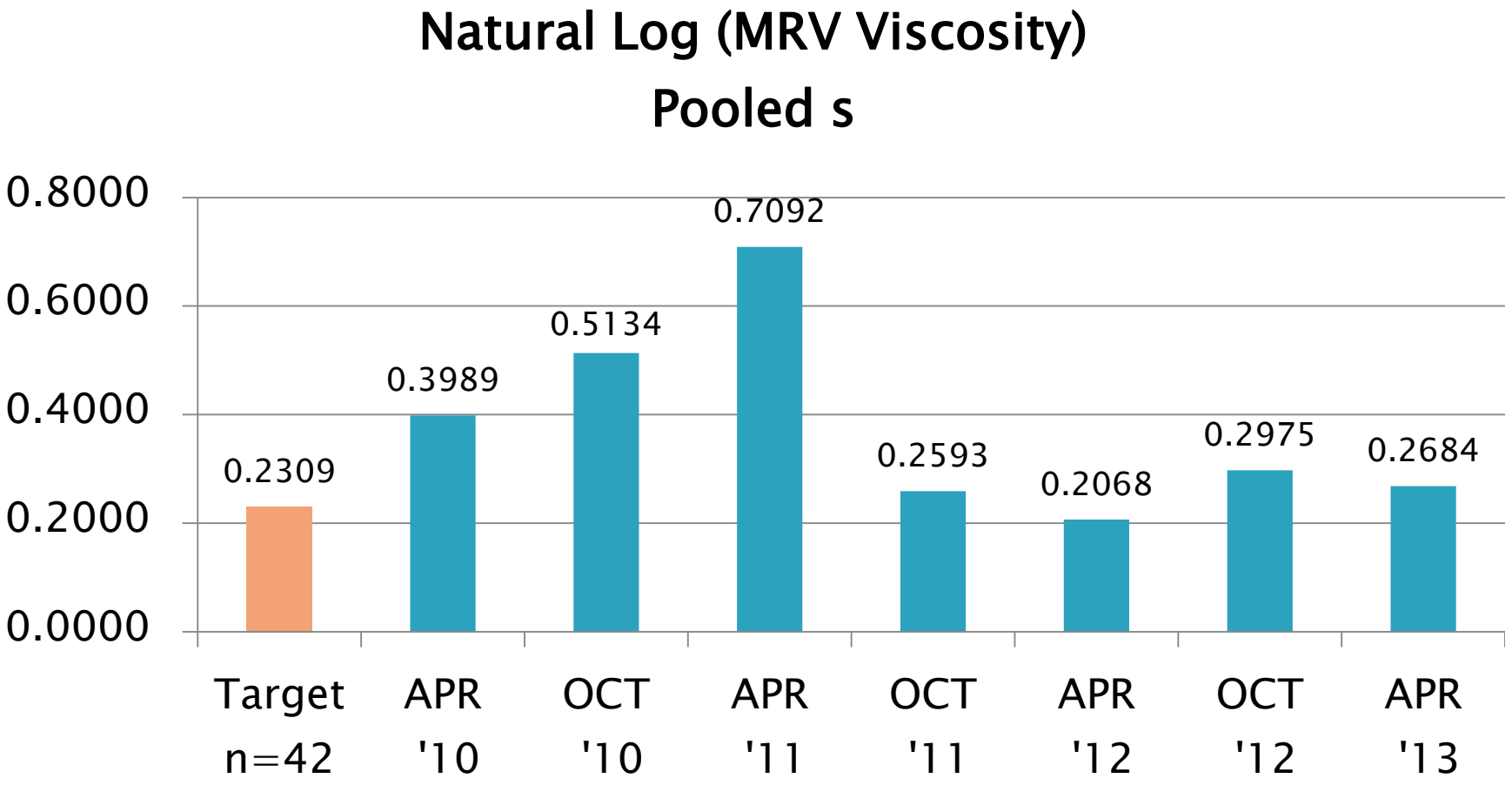
Period Precision and Severity Estimates

Natural Log (MRV Viscosity)	n	df	Pooled s	Mean Δ/s
Current Targets	42	39	0.2309	-----
10/1/09 through 3/31/10	59	56	0.3989	-0.24
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

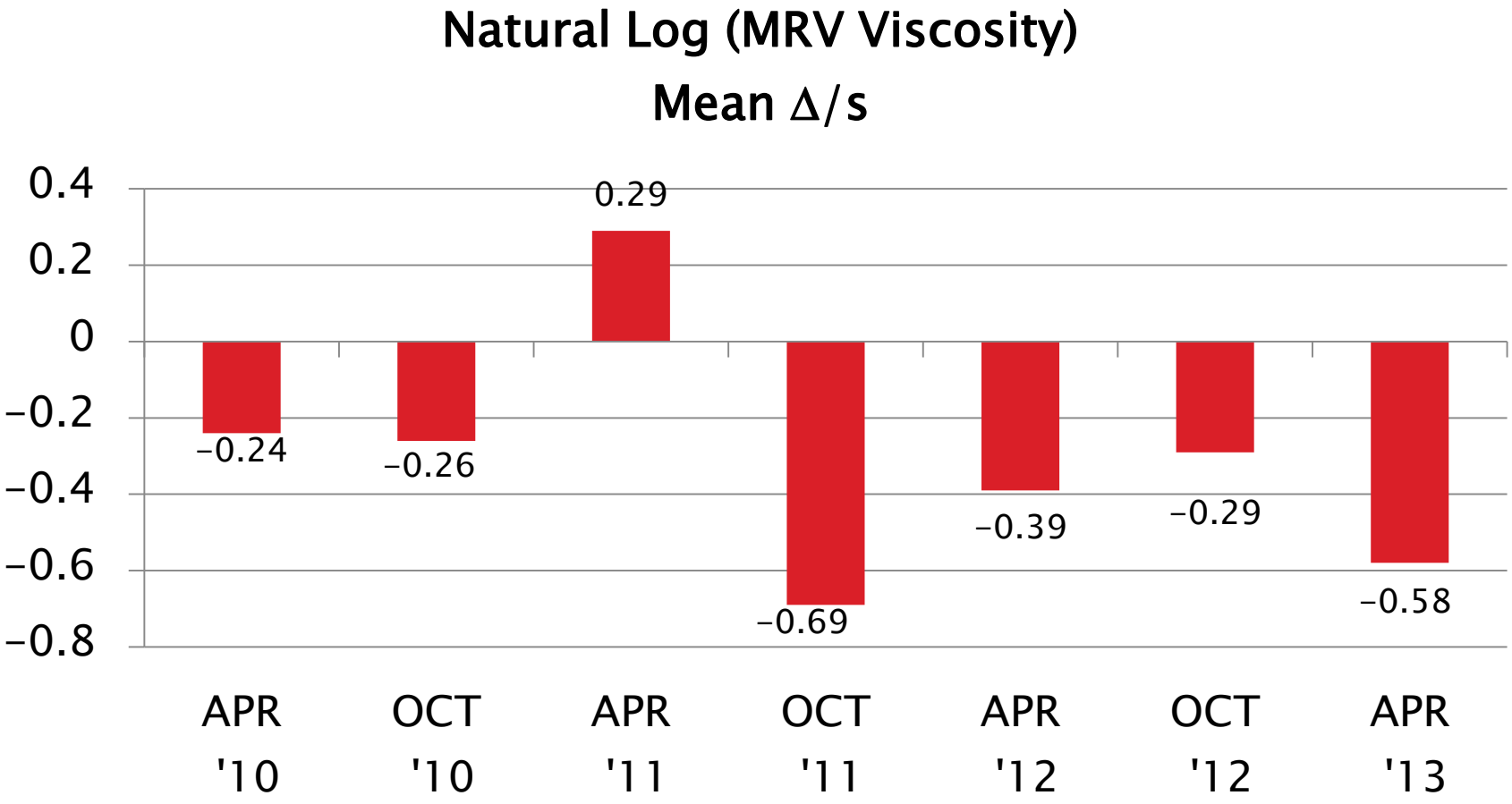
*Period statistics with and without extreme result included

Return

D7528: Oxidation by ROBO



D7528: Oxidation by ROBO

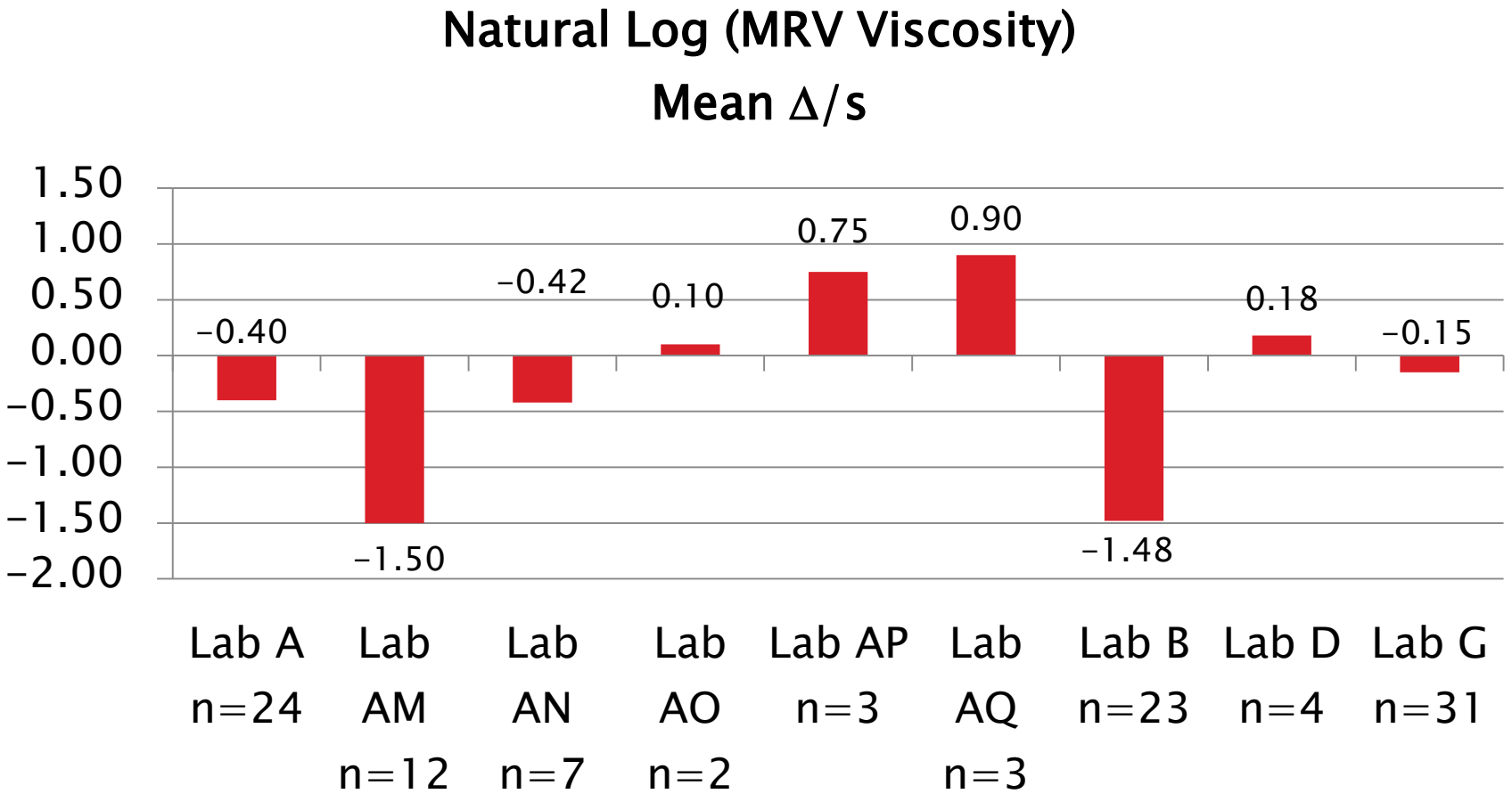


D7528: Oxidation by ROBO

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

	n	Mean Δ/s
Lab A	24	-0.40
Lab AM	12	-1.50
Lab AN	7	-0.42
Lab AO	2	0.10
Lab AP	3	0.75
Lab AQ	3	0.90
Lab B	23	-1.48
Lab D	4	0.18
Lab G	31	-0.15

D7528: Oxidation by ROBO



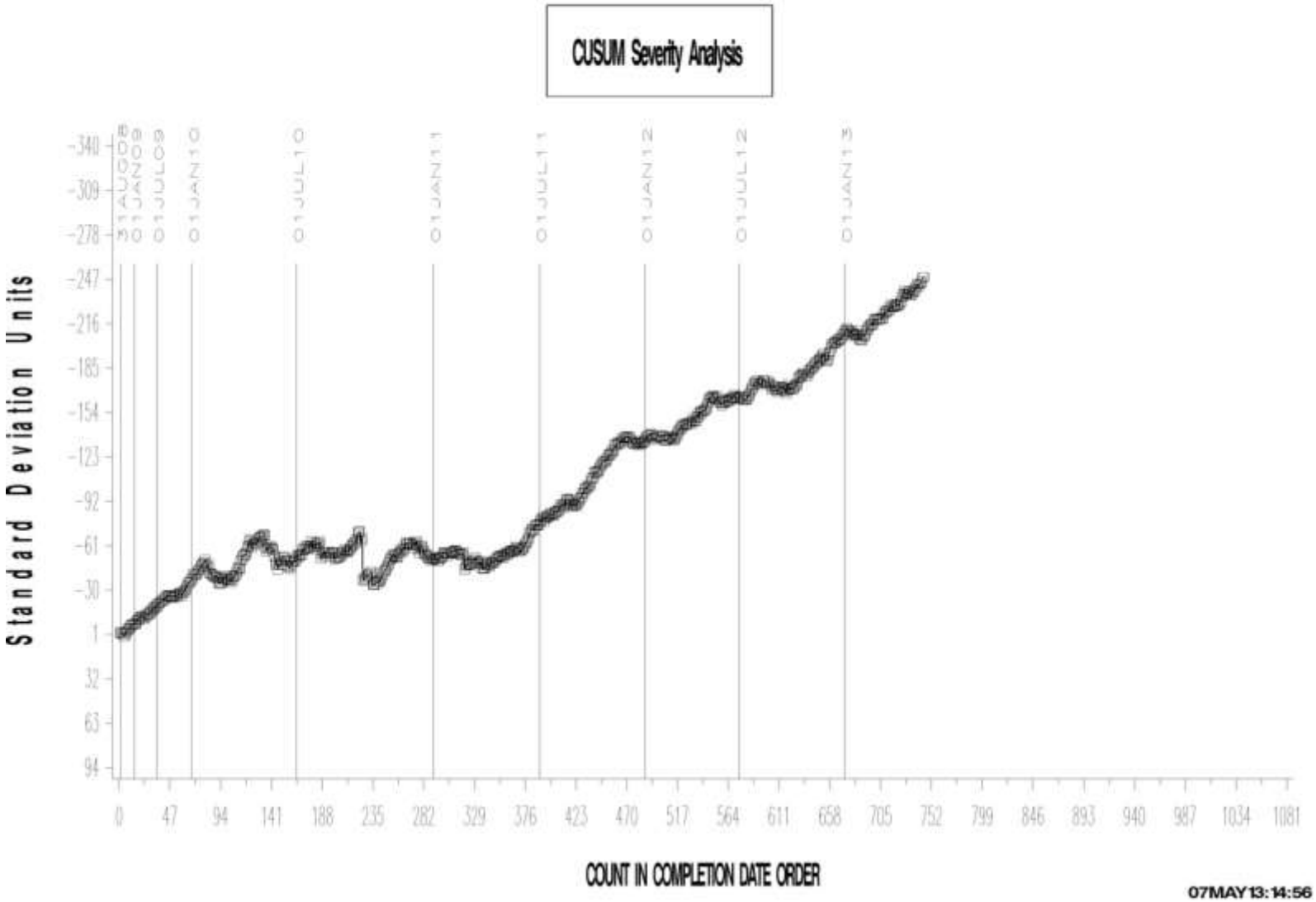
D7528: Oxidation by ROBO

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

- Performance (Mean Δ/s) is -0.58 s mild
  - All three reference oils continue to perform mild

ROBO TEST INDUSTRY OPERATIONALLY VALID DATA

AGED OIL MRV APPARENT VISCOSITY



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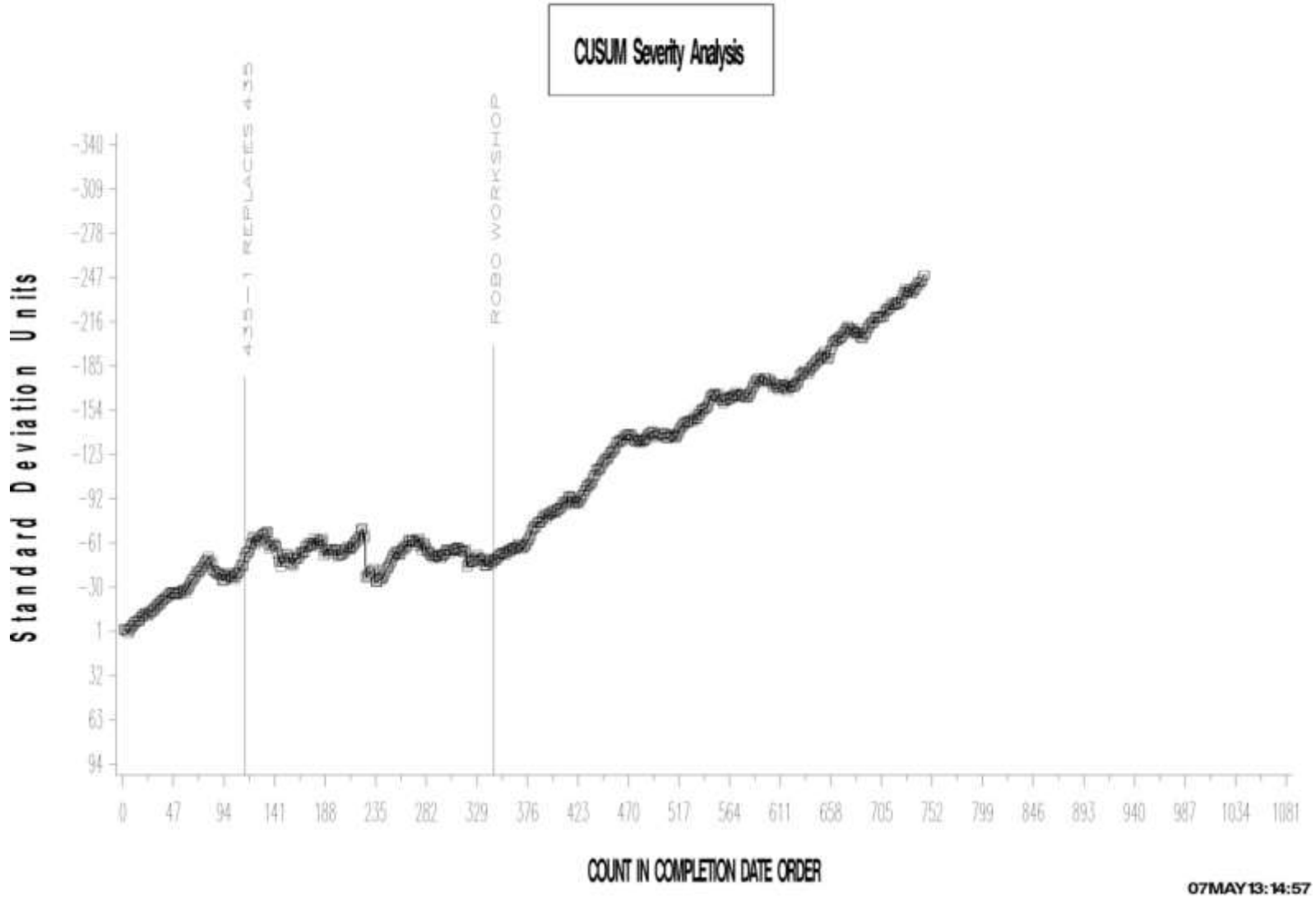

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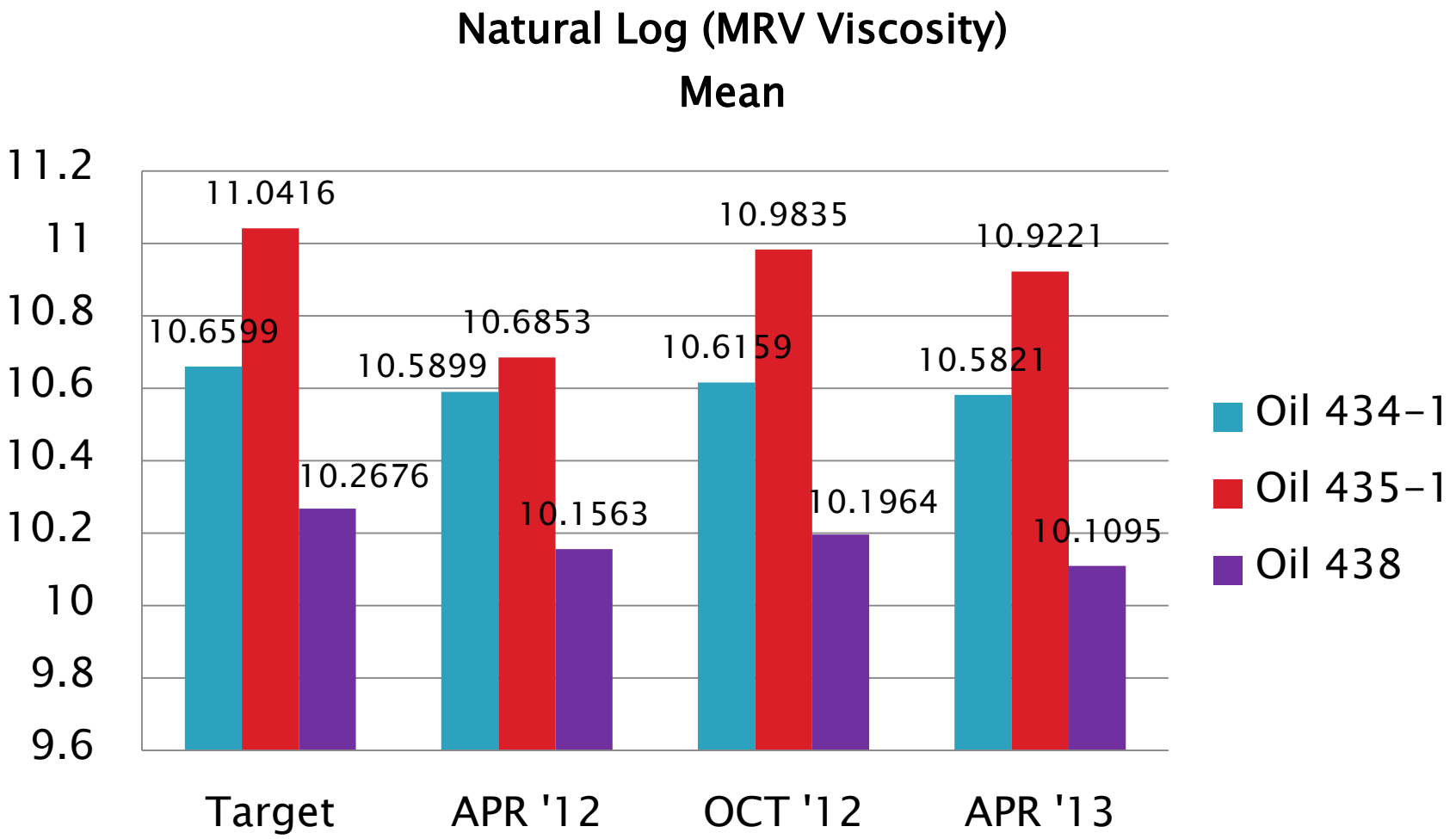
D7528: Oxidation by ROBO

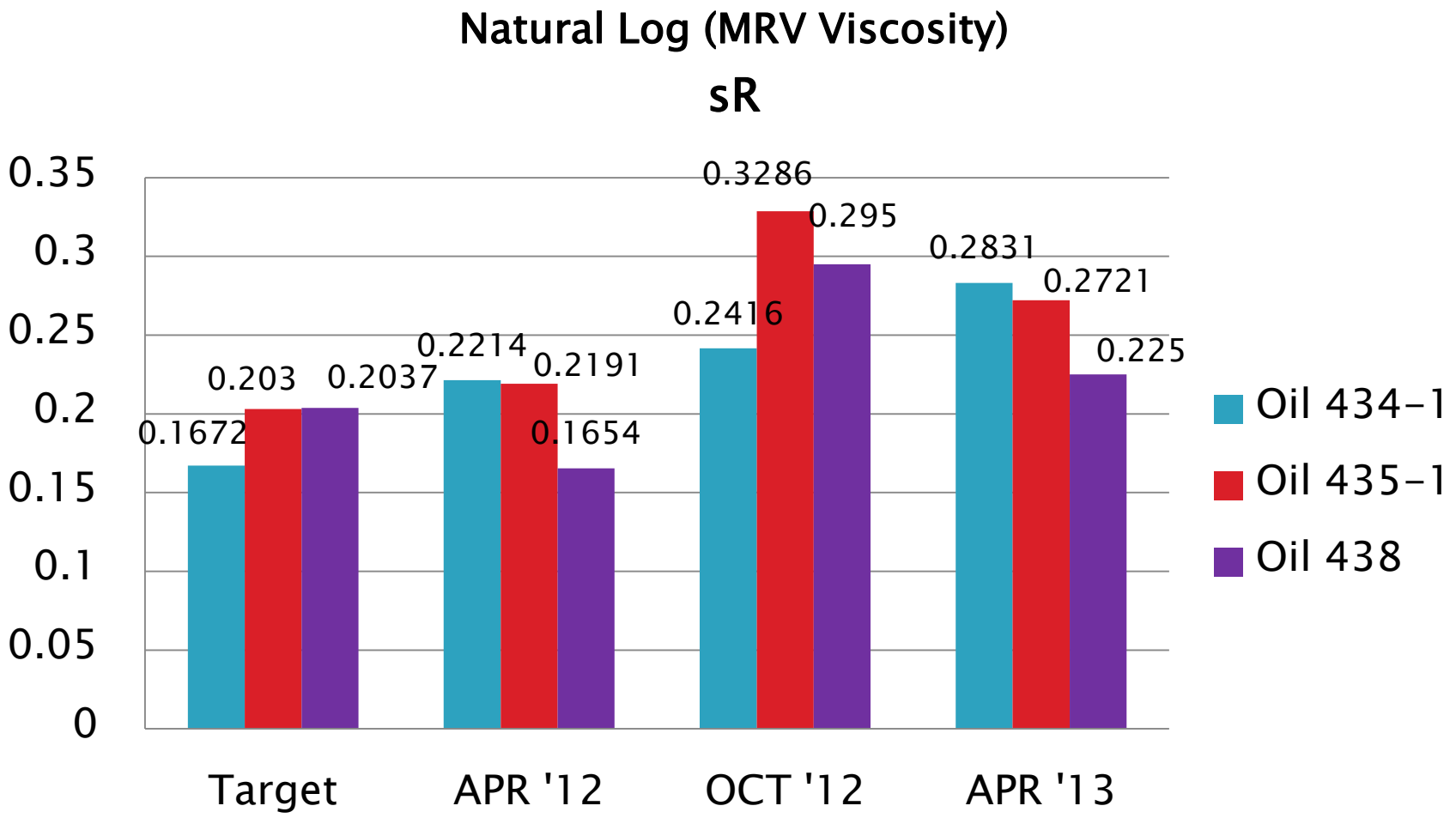
Performance by Oil
Natural Log (MRV Viscosity)

	Targets			10/1/11 - 3/31/12				4/1/12 - 9/30/12				10/1/12 - 3/31/13			
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	10.5899	0.2214	-0.42	26	10.6159	0.2416	-0.26	39	10.5821	0.2831	-0.47
435-1	22	11.0416	0.2030	42	10.6853	0.2191	-0.28	41	10.9835	0.3286	-0.29	50	10.9221	0.2721	-0.59
438	14	10.2676	0.2037	25	10.1563	0.1654	-0.55	19	10.1964	0.2950	-0.35	20	10.1095	0.2250	-0.78

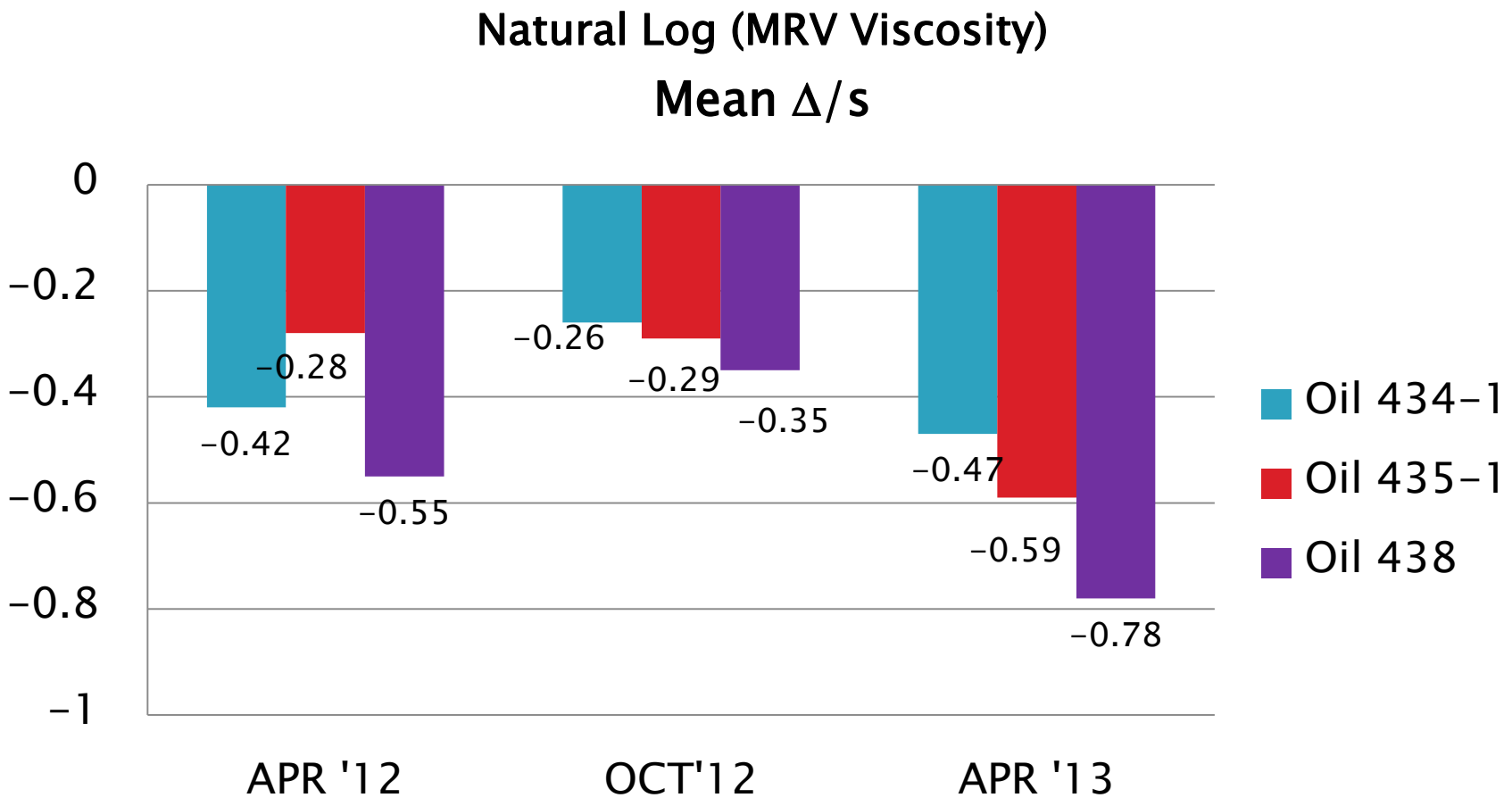
D7528: Oxidation by ROBO



D7528: Oxidation by ROBO



D7528: Oxidation by ROBO



Non-monitored Bench Tests

- **D6922 Homogeneity and Miscibility**
  - The TMC distributes six reference oils for D6922 testing.
  - The TMC does not collect reference data or monitor test results for this test at this time.

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

Reference Oil Inventory

- As of 3/31/2013

Reference Oil Inventory

D6417, D5800, GI, TEOST & ROBO

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
52	D6417, D5800	62.2	0.7
55	D6417, D5800	67.4	0.9
58	D6417, D5800, GI	111.1	0.8
62	GI	1.5	0.1
1009*	GI	53.0	----
75	TEOST	6.4	0.9
435-2*	TEOST	46.2	----
434-1*	ROBO	16.8	----
435-1*	ROBO	51.4	----
438*	ROBO	26.4	----

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

Reference Oil Inventory

MTEOS, D6082 & D874

Oil	Tests	TMC Inventory, gallons	Gallons Shipped last 12 months
432	MTEOS	114.5	0.5
434	MTEOS	1.0	0.4
1007	D6082	17.1	3.2
66	D6082	92.0	0.7
820-2	D874	10.3	0.0
90	D874	34.1	2.9
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
74	Obsolete MTEOS	0.2	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	D5800 RR	55	0.0
VOL12B	Current D5800 RR	54.4	0.6
VOL12C	Current D5800 RR	54.4	0.6
VOL12D	Current D5800 RR	54.4	0.6
VOL12E	Current D5800 RR	54.4	0.6

*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	157.6	5.3
HMB	H&M	161.6	5.3
HMC	H&M	147.6	5.3
HMD	H&M	155.4	5.3
HME	H&M	141.4	5.3
HMF	H&M	163.9	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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