A Program of ASTM International

Test Monitoring Center

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MEMORANDUM: 10-010

DATE: June 7, 2010

TO: Messrs. Ted Selby and Mark Devlin, Co-Chairs ASTM D02.B0.07

FROM: Tom Schofield

SUBJECT: TMC Bench Reference Test Monitoring Semiannual Report
From October 1, 2009, through March, 31, 2010, for Test Areas
D6417, D5800, D6335 (TEOST), D7097 (MTEOS), D5133 (GI), D6082,
D874 and D7528 (ROBO)

I respectfully submit the TMC's ASTM D02.B07 Bench Reference Test Monitoring Semiannual Report for Test Areas D6417, D5800, D6335 (TEOST), D7097 (MTEOS), D5133 (GI), D6082 D874 and D7528 (ROBO), with statistical summaries broken down by test area (Attachment 1).

Calibration testing precision and severity are monitored by comparing a recent period of reference test performance to "target" performance (as determined by the surveillance panels), and to performance over previous periods. The TMC monitors test precision by a pooled standard deviation (pooled s), and test severity by mean Δ/s ("mean delta over s"), where:

Pooled s = Standard deviation pooled across labs and reference oils
(i.e., The pooled precision of the test this period in standard deviations.)
Δ/s = [(Single Test Result) - (Reference Oil's Target Mean Performance)] / (R.O.'s Target Precision)
(i.e., "How many standard deviations from the target mean is this test?")
Mean Δ/s = [Σ (Δ/s)] / n (across reference oils and labs, and over a period of time)
(i.e., "On average, how many standard deviations from the target mean are <u>all</u> the operationally valid calibration tests for each period?")

Note that the period severity estimates (mean Δ/s) can be averaged across oils of different performance levels because the individual test results used to calculate mean Δ/s have all been normalized into standard deviations (Δ/s) for each corresponding reference oil. Using a pooled s for estimating precision simplifies the interpretation of precision across all reference oil performance levels. These two calculations (pooled s and mean Δ/s) allow all calibration performance levels to be combined into overall period precision and severity estimates for each test type, providing a means to compare current test performance (precision and severity) to target performance and to prior periods. Individual oil targets, and current performance summaries by oil, are also reported (Attachments 2 and 3).

The tables in Attachment 1, comparing current and previous period precision and severity, have become too large to conveniently show all prior report periods. Some of the oldest period comparison periods have been eliminated to keep the information succinct and relevant.

The blind lab codes in this report are cross-referenced, as they were in previous reports. That is, in this report, Lab A represents the same lab in each section, which is the same as Lab A in previous reports, and should remain the same lab in future reports.

All operationally valid test data and severity plots are available on the TMC's website. Please contact the TMC if you require further information.

Attachments

c: D02.B07 Bench Test Mailing List
F. Farber, TMC
J. Clark, TMC
ftp://ftp.astmtmc.cmu.edu/docs/bench/bo7semiannualreports/mem10-010.pdf

Distribution: Email

Attachment 1

ASTM Test Monitoring Center

Semiannual Report

ASTM D02.B07 Bench Reference Test Monitoring
From October 1, 2009 through March 31, 2010

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

D6417: Estimation of Engine Oil Volatility by Capillary Gas Chromatography

MONITORED TESTING STATUS

Table 1 summarizes the reference tests reported to the TMC this period (6 labs reporting):

TABLE 1

	No. of Tests
Statistically Acceptable and Operationally Valid	13
Operationally Valid but Failed Acceptance Criteria	0
Operationally Invalid (initially reported as)	0
Operationally Invalid (after informed of failing calibration)	0
Total	**13**

Fail Rate of Operationally Valid Tests: 0.0%

Table 2 is a breakdown of the statistically unacceptable tests.

TABLE 2

Reason for Fail	No. of Tests
Area % Volatized @ 371°C Severe	0
Area % Volatized @ 371°C Mild	0

PRECISION AND SEVERITY

Table 3 shows the current Industry precision and severity for the Sample Area % Volatized @ 371°C test parameter for all operationally valid tests for the report period. (First TMC calibration test completed 10/5/00.)

TABLE 3

Area % Volatized @ 371°C	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	107	101	0.46	-----
4/1/06 through 9/30/06	12	9	0.45	0.36
10/1/06 through 3/31/07	12	9	0.54	-0.17
4/1/07 through 9/30/07	12	9	0.31	0.22
10/1/07 through 3/31/08	14	11	0.29	0.84
4/1/08 through 9/30/08	14	11	0.34	0.54
10/1/08 through 3/31/09	14	11	0.23	-0.10
4/1/09 through 9/30/09	15	12	0.34	0.23
10/1/09 through 3/31/10	13	10	0.33	0.08

Table 4 shows the current severity for the Sample Area % Volatized @ 371°C parameter for each lab for all operationally valid tests for the report period.

TABLE 4

	n	Mean Δ/s
Lab A	4	0.59
Lab B	2	0.21
Lab D	1	-1.52
Lab G	2	0.43
Lab H	2	-0.16
Lab S	2	-0.39

INDUSTRY PERFORMANCE

D6417 reference testing precision, as measured by pooled s, is nearly the same as the previous report period and remains more precise than the target precision (Table 3). Overall performance is on-target at 0.08 standard deviations. Severity is represented graphically in Figure 1 showing nearly on-target performance since the 01OCT08 timeline.

TMC MEMORANDA

There were no TMC technical updates issued this report period for the D6417 test method.

D5800: Evaporation Loss of Lubricating Oils by the Noack Method

MONITORED TESTING STATUS

Table 5 summarizes the reference tests reported to the TMC this period (8 labs reporting):

TABLE 5

	No. of Tests
Statistically Acceptable and Operationally Valid	32
Operationally Valid but Failed Acceptance Criteria	3
Operationally Invalid (initially reported as)	1
Operationally Invalid (after informed of failing calibration)	0
Total	**36**

Fail Rate of Operationally Valid Tests: 8.6%

The explanation for the operationally invalid test is failure to maintain test temperature.

Table 6 is a breakdown of the statistically unacceptable tests.

TABLE 6

Reason for Fail	No. of Tests
Sample Evaporation Loss Severe	3*
Sample Evaporation Loss Mild	0

*3 severe results on oil 52

PRECISION AND SEVERITY

Table 7 shows the current Industry precision and severity for the Sample Evaporation Loss test parameter for all operationally valid tests for the report period. (First calibration test completed 5/1/96.)

TABLE 7

Sample Evaporation Loss, mass %	n	df	Pooled s	Mean Δ/s
New Targets Effective 7/21/2003	102	99	0.70	-----
4/1/07 through 9/30/07	36	33	0.50	0.92
10/1/07 through 3/31/08	34	31	0.50	0.75
4/1/08 through 9/30/08	36	33	0.54	0.82
10/1/08 through 3/31/09	36	33	0.84	0.51
4/1/09 through 9/30/09	36	33	0.56	0.88
10/1/09 through 3/31/10	35	32	0.69	0.56

*Period statistics with and without a single unusually mild result (-5.51 s) included

Table 8 shows statistical comparisons by procedure for all operationally valid tests for the report period.

TABLE 8

Sample Evaporation Loss, mass %	n	df	Pooled s	Mean Δ/s
Procedure A	0	0	---	---
Procedure B	31	28	0.69	0.50
Procedure C	4	1	0.14	1.03

D5800: Evaporation Loss of Lubricating Oils by the Noack Method, continued

Table 9 shows the current severity for the Sample Evaporation Loss parameter for each lab for all operationally valid tests for the report period.

TABLE 9

	n	Mean Δ/s
Lab A	5	0.75
Lab B	8	0.28
Lab D	2	0.67
Lab F	4	0.36
Lab G	6	0.31
Lab H	3	1.66
Lab I	2	0.39
Lab J	5	0.66

INDUSTRY PERFORMANCE

D5800 reference testing precision, as measured by pooled s, is less precise than the previous period, and is about the same as the target precision. Overall performance remains severe this period with all eight participating labs performing severe. Severity is graphically represented in Figures 2A and 2B. Figure 2A shows a clear long-term severe trend with an unexplained increase in severity since the 01JUL06 timeline.

Table 8 compares the procedures for the period. There were no Procedure A calibration tests reported and four Procedure C calibration tests reported this period.

TMC MEMORANDA

There were no TMC technical updates issued this report period for the D5800 test method.

D5133: Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature Scanning Technique (Gelation Index or GI)

MONITORED TESTING STATUS

Table 10 summarizes the reference tests reported to the TMC this period (7 labs reporting):

TABLE 10
Reference Tests

	No. of Tests
Statistically Acceptable and Operationally Valid	30
Operationally Valid but Failed Acceptance Criteria	1
Operationally Invalid (initially reported as)	1
Operationally Invalid (after informed of failing calibration)	0
Total	**32**

Fail Rate of Operationally Valid Tests: 3.2%

The explanation for the operationally invalid test is data acquisition failure.

Table 11 is a breakdown of the statistically unacceptable tests.

TABLE 11

Reason for Fail	No. of Tests
Gelation Index Mild	0
Gelation Index Severe	1

PRECISION AND SEVERITY

Table 12 shows the current Industry precision and severity for the Gelation Index test parameter for all operationally valid tests for the report period. (First calibration test completed 4/20/96.)

TABLE 12

Gelation Index	n	df	Pooled s	Mean Δ/s
Revised Targets Effective 20030715 (Oils 58 & 62 targets unchanged, added oil 1009, dropped oils 52 & 53)	68	65	2.86	-----
10/1/05 through 3/31/06	22	19	3.09	-0.16
4/1/06 through 9/30/06	29	26	3.76	-0.46
10/1/06 through 3/31/07	29	26	3.23	-0.68
4/1/07 through 9/30/07	24	21	3.35	-0.28
10/1/07 through 3/31/08	26	23	4.13	-0.31
4/1/08 through 9/30/08	27	24	3.54	0.18
10/1/08 through 3/31/09	24	21	2.32	0.10
4/1/09 through 9/30/09	33	30	2.79	-0.10
10/1/09 through 3/31/10	31	28	2.37	-0.15

D5133: Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature Scanning Technique (Gelation Index or GI), continued

Table 13 shows the current severity for the Gelation Index for each lab for all operationally valid tests for the report period.

TABLE 13

	n	GI Mean Δ/s
Lab A	6	-0.10
Lab B	4	0.73
Lab D	2	-0.22
Lab G	3	-1.09
Lab H	2	-1.31
Lab I	7	0.59
Lab S	7	-0.69

INDUSTRY PERFORMANCE

D5133 reference testing is more precise, as measured by pooled s, compared to last period and is more precise than the target precision. Overall performance has a slight mild bias. Severity is graphically represented in Figures 3A and 3B showing nearly on-target performance.

Ten tests this period were more than 1 s mild, and six tests were 1 s or more severe, with only one test falling outside the acceptance bands.

TMC MEMORANDA

There were no TMC technical updates issued this report period for the D5133 test method.

D6335: High Temperature Deposits by Thermo-Oxidation Engine Oil Simulation Test (TEOST)

MONITORED TESTING STATUS

Table 14 summarizes the reference tests reported to the TMC this period (5 labs reporting):

TABLE 14

	No. of Tests
Statistically Acceptable and Operationally Valid	9
Operationally Valid but Failed Acceptance Criteria	3
Operationally Invalid (initially reported as)	3
Operationally Invalid (after informed of failing calibration)	0
Total	**15**

Fail Rate of Operationally Valid Tests: 25%

The explanations for the three operationally invalid tests are an improper power setting, a power failure during run and a calibration was started on the wrong instrument and aborted.

Table 15 is a breakdown of the statistically unacceptable tests.

TABLE 15

Reason for Fail	No. of Tests
Total Deposits Mild	0
Total Deposits Severe	3*

*2 severe results on 71 and 1 on 71-1

PRECISION AND SEVERITY

Table 16 shows the current Industry precision and severity for the Total Deposits test parameter for all operationally valid tests for the report period. (First calibration test completed 2/13/96.)

TABLE 16

Total Deposits	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	54	52	4.18	-----
10/1/06 through 3/31/07*	12	10	8.66	0.14
10/1/06 through 3/31/07*	11	9	5.67	-0.45
4/1/07 through 9/30/07*	10	8	9.59	0.43
4/1/07 through 9/30/07*	9	7	8.08	-0.11
10/1/07 through 3/31/08	22	20	9.65	0.92
4/1/08 through 9/30/08	15	13	6.99	0.20
10/1/08 through 3/31/09	18	16	4.90	0.98
4/1/09 through 9/30/09*	14	10	8.24	0.32
4/1/09 through 9/30/09*	13	9	3.71	0.68
10/1/09 through 3/31/10*	12	8	14.36	0.85
10/1/09 through 3/31/10*	11	7	6.46	0.18

*Period statistics with and without a single very severe result included

D6335: TEOST, continued

Table 17 shows the current severity for the Total Deposits parameter for each lab for all operationally valid tests in the report period.

TABLE 17

	n	Mean Δ/s
Lab A	5	1.56
Lab B	3	1.72
Lab D	1	-1.40
Lab G	2	-0.03
Lab V	1	-1.28

INDUSTRY PERFORMANCE

Reference testing precision, as measured by pooled s, is significantly worsened compared the previous report period and compared to target precision (Table 16). Performance is severe at 0.85 s. Severity is graphically represented in Figure 4 (attached) with an overall severe trend since the 01APR08 timeline.

However, one result reported this period was 8.23 s severe of target (Lab A, Oil 71-1), contributing significantly to the very poor precision and the severe overall performance. The bottom row in Table 16 shows the period statistics with this result excluded. With the exclusion, precision improves to 6.46 mg total deposits, and the overall performance estimate becomes 0.18 s severe of targets. Fail rate on tests reported as operationally valid is exceptionally high this period at 25%.

Even excluding the very severe result this period, precision is worsening rather significantly for the first time since our workshop in April 2008. This raises concerns that the test may be drifting back to the poor precision observed prior to the most recent workshop. It is also evident that this test produces occasional extreme results, both mild and severe, that are considered to be operationally valid by the reporting labs, and with a frequency more than would be classified as a rare event.

All tests this period are reported as using Rod Batch H.

Oils 71 and 72 have virtually run out at the TMC, so replacement oils 71-1 and 72-1 were introduced last period.

TMC MEMORANDA

There were no TMC technical updates issued this report period for the D6335 test method.

D7097: Determination of Moderately High Temperature Piston Deposits by Thermo-oxidation Engine Oil Simulation Test (MTEOS or MHT-4 TEOST)

MONITORED TESTING STATUS

Table 18 summarizes the reference tests reported to the TMC this period (6 labs reporting):

TABLE 18

	No. of Tests
Statistically Acceptable and Operationally Valid	40
Operationally Valid but Failed Acceptance Criteria	3
Operationally Invalid (initially reported as)	2
Operationally Invalid (after informed of failing calibration)	0
Total	**45**

Fail Rate of Operationally Valid Tests: 7.0%

The explanations for the two operationally invalid tests are a sample leak into the volatiles vial and an incorrect power setting.

Table 19 is a breakdown of the statistically unacceptable tests.

TABLE 19

Reason for Fail	No. of Tests
Total Deposits Mild	2
Total Deposits Severe	1

PRECISION AND SEVERITY

Table 20 shows the current Industry precision and severity for the Total Deposits test parameter for all operationally valid tests for the report period. (First calibration test completed 9/6/00.)

TABLE 20

Total Deposits	n	df	Pooled s	Mean Δ/s
Updated Targets Effective 7/31/06	90	87	5.62	-----
10/1/06 through 3/31/07	47	44	7.53	-0.17
4/1/07 through 9/30/07	48	45	7.68	0.32
10/1/07 through 3/31/08	46	43	7.41	-0.21
4/1/08 through 9/30/08	46	43	6.09	0.01
10/1/08 through 3/31/09	53	50	5.25	0.73
4/1/09 through 9/30/09	48	45	4.35	-0.08
10/1/09 through 3/31/10	43	40	5.46	-0.19

D7097: Determination of Moderately High Temperature Piston Deposits by Thermo-oxidation Engine Oil Simulation Test (MTEOS or MHT-4 TEOST)

Table 21 shows the current severity for the Total Deposits parameter for each lab for all operationally valid tests in the report period.

TABLE 21

	n	Mean Δ/s
Lab A	13	-0.20
Lab AK	3	0.93
Lab B	7	-0.57
Lab D	6	-0.42
Lab G	13	-0.08
Lab V	1	-0.68

INDUSTRY PERFORMANCE

D7097 reference testing overall precision, as measured by pooled s, is less precise compared to the prior report period and is comparable to the target precision. Overall performance this period is slightly mild of targets.

The MTEOS severity is graphically represented in Figures 5A & 5B, with Figure 5B showing when the new performance targets were implemented, when the monitored test method was changed and when new rod batches are introduced.

All operationally valid tests reported this period were run using rod batch H, and all but five operationally valid tests are reported as using catalyst batch 0902C; five late in the period report using catalyst batch 0911.

By Email ballot, the panel agreed to phase out TMC oil 74 as an MTEOS reference oil. The TMC is permitted to use up any blind coded inventory already shipped for TMC calibration assignments, but the TMC has been directed to stop shipping additional samples of oil 74. See TMC Memoranda, below.

TMC MEMORANDA

There was one TMC technical update issued this report period for the D7097 test method:

TMC Memo 10-001, January 29, 2010, Subject: Phase-Out of Reference Oil 74

D6082: High Temperature Foaming Characteristics of Lubricating Oils

MONITORED TESTING STATUS

Table 22 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 22

	No. of Tests
Statistically Acceptable and Operationally Valid	8
Operationally Valid but Failed Acceptance Criteria	0
Operationally Invalid (initially reported as)	0
Operationally Invalid (after informed of failing calibration)	0
Total	**8**

Fail Rate of Operationally Valid Tests: 0.0%

In addition to the calibration tests, there were three discrimination oil tests reported this period; all met the acceptance criteria for the discrimination oil.

TMC 1007 PRECISION AND SEVERITY

Tables 23 and 24 show the current industry precision and severity for the Foam Tendency and Foam Stability test parameters for all operationally valid tests on oil 1007 for the report period. (First calibration test on TMC 1007 completed 4/12/99.)

TABLE 23

1007 Foam Tendency, ml	n	Mean	s	Mean Δ/s
Initial Round Robin Study (targets)	28	65.71	19.28	-----
10/1/06 through 3/31/07	9	61	12	-0.26
4/1/07 through 9/30/07	10	63	18	-0.16
10/1/07 through 3/31/08	10	64	16	-0.13
4/1/08 through 9/30/08	10	65	16	-0.05
10/1/08 through 3/31/09*	11	72	34	0.31
10/1/08 through 3/31/09*	10	62	10	-0.21
4/1/09 through 9/30/09	10	61	10	-0.26
10/1/09 through 3/31/10	8	59	10	-0.38

*Period statistics with and without extreme results included.

D6082: High Temperature Foaming Characteristics of Lubricating Oils, continued

Note that TMC reference oil 1007 has a Foam Stability (one minute after disconnect) target mean performance of zero ml and a target precision (standard deviation) of zero ml. A negative (mild) result for this parameter is unlikely and a severity estimate for any positive result would be indeterminate in standard deviations (Δ/s). Therefore, for Foam Stability, only a count of non-zero occurrences is noted to flag any severity trends.

TABLE 24

1007 Foam Stability @ 1 min., ml	n	Mean	s
Initial Round Robin Study	28	0.00	0.00
10/1/06 through 3/31/07	9	No non-zero occurrences	
4/1/07 through 9/30/07	10	No non-zero occurrences	
10/1/07 through 3/31/08	10	No non-zero occurrences	
4/1/08 through 9/30/08	10	No non-zero occurrences	
10/1/08 through 3/31/09	11	No non-zero occurrences	
4/1/09 through 9/30/09	10	No non-zero occurrences	
10/1/09 through 3/31/10	8	No non-zero occurrences	

Table 25 shows the current 1007 severity for the monitored result parameter for each lab for all operationally valid tests reported for the report period.

TABLE 25
TMC 1007

	n	Foam Tendency Mean Δ/s
Lab A	2	0.21
Lab B	4	-0.45
Lab G	2	-0.84

INDUSTRY PERFORMANCE

The D6082 Foam Tendency precision, as measured by standard deviation (s) on TMC oil 1007, is the same as last report period, and is significantly more precise than the target precision. Overall Foam Tendency performance remains somewhat mild of target. There were no non-zero occurrences of Foam Stability on 1007 suggesting Foam Stability precision is as expected. Foam Tendency severity is graphically represented in Figure 6.

All operationally valid discrimination tests reported this period meet the acceptance criteria (that is, all reporting labs could discriminate oil 66 as a GF-4/SM failing oil for Foam Tendency).

Lab I has stopped calibrating D6082 with the TMC, so there are now three labs and four instruments in the monitoring system.

TMC MEMORANDA

There were no TMC technical updates issued this report period for the D6082 test method.

D874 Sulfated Ash from Lubricating Oils and Additives

MONITORED TESTING STATUS

Table 26 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 26
Reference Tests

	No. of Tests
Statistically Acceptable and Operationally Valid	7
Operationally Valid but Failed Acceptance Criteria	0
Operationally Invalid (initially reported as)	0
Operationally Invalid (after informed of failing calibration)	0
Total	**7**

Fail Rate of Operationally Valid Tests: 0.0%

Table 27 is a breakdown of the statistically unacceptable tests.

TABLE 27

Reason for Fail	No. of Tests
Sulfated Ash Mild	0
Sulfated Ash Severe	0

PRECISION AND SEVERITY

Table 28 shows the current Industry precision and severity for the Sulfated Ash Mass % test parameter for all operationally valid tests for the report period. (First calibration test completed 7/27/07.)

TABLE 28

Gelation Index	n	df	Pooled s	Mean Δ/s
Initial Round Robin Targets	81	79	0.07	-----
4/1/07 through 9/30/07	2	1	0.01	-0.50
10/1/07 through 3/31/08	5	2	0.11	-0.41
4/1/08 through 9/30/08	6	3	0.04	-0.62
10/1/08 through 3/31/09	6	3	0.07	-1.23
4/1/09 through 9/30/09	7	4	0.03	-0.41
10/1/09 through 3/31/10	7	4	0.04	-0.23

Table 29 shows the current severity for Sulfated Ash Mass % for each lab for all operationally valid tests for the report period.

TABLE 29

	n	Mean Δ/s
Lab A	3	-0.47
Lab B	2	-0.04
Lab G	2	-0.08

D874 Sulfated Ash from Lubricating Oils and Additives, continued

INDUSTRY PERFORMANCE

D874 precision, as measured by pooled s, is more precise than the target precision and performance is slightly mild of targets. Severity is graphically represented in Figure 7.

TMC MEMORANDA

There were no TMC technical updates issued this report period for the D874 test method.

D7528 Bench Oxidation of Engine Oils by ROBO Apparatus

MONITORED TESTING STATUS

Table 30 summarizes the reference tests reported to the TMC this period (8 labs reporting):

TABLE 30
Reference Tests

	No. of Tests
Statistically Acceptable and Operationally Valid	46
Operationally Valid but Failed Acceptance Criteria	13
Operationally Invalid (initially reported as)	12
Operationally Invalid (after informed of failing calibration)	4*
Total	**75**

Fail Rate of Operationally Valid Tests: 22.0%

*Eleven additional tests were reported as operationally valid but were on rigs that either had not previously achieved calibrated status to begin with, or had a changed VCV set position and had trouble re-calibrating on the second runs resulting in another change to the VCV set position. These results were excluded from the overall statistical estimates for this period.

The explanations for the sixteen operationally invalid tests are:

- Vacuum system leaks, failures and design flaws, and one airflow disruption all at one lab: (six tests total at lab Q while trying to calibrate two new rigs; lab Q eventually redesigned the vacuum system and has successfully calibrated both rigs)
- Vacuum pump failure and vacuum drop (two tests)
- Test sample consumed before end of test, required VCV adjustment (one test)
- Reactor temperature ranged out of specification (one test)
- Problems with NO_2 flow (three tests)
- Heating mantle failure (one test)
- Incorrect vacuum valve adjustment (two tests)

An additional 25 donated tests were reported on oil 435-1 (concurrent runs with 435); 22 of those tests were used to set preliminary targets and bands on 435-1, to replace 435.

Table 31 is a breakdown of the statistically unacceptable calibration tests.

TABLE 31

Reason for Fail	No. of Tests
MRV Viscosity Mild	9
MRV Viscosity Severe	4

PRECISION AND SEVERITY

Note: A Box-Cox analysis of the initial round robin study suggested that mathematical transform of the MRV Viscosity test parameter was suggested to better normalize the data distribution. A natural log (ln) transformation is applied to each MRV viscosity test result before any statistical analyses are performed.

Table 32 shows the current Industry precision and severity for the transformed MRV viscosity test parameter for all operationally valid tests for the report period. (The first calibration test, completed August 31, 2008, was given retroactive calibrated status as part of a round robin study.)

TABLE 32

Natural Log (MRV Viscosity)	n	df	Pooled s	Mean Δ/s
Initial Round Robin Targets	42	39	0.2309	-----
8/31/08 through 3/31/09	22	19	0.2302	-0.47
4/1/09 through 9/30/09	26	23	0.1872	-0.58
10/1/09 through 3/31/10	59	56	0.3989	-0.24

Table 33 shows the current severity for the transformed MRV Viscosity for each lab for all operationally valid tests for the report period.

TABLE 33

	n	Mean Δ/s
Lab A	17	-0.43
Lab AM	4	-0.54
Lab AN	1	0.67
Lab AO	2	-0.83
Lab B	12	-1.24
Lab D	7	2.49
Lab G	12	-0.73
Lab Q	4	0.58

INDUSTRY PERFORMANCE

ROBO precision, as measured by pooled s, is less precise than the target precision and performance is slightly mild of targets at -0.24 s. Severity is graphically represented in Figure 8. The plot shows the large variability in the results, with a number of very severe tests partially offsetting a number of quite mild tests.

BACKGROUND NOTES ON INDUSTRY PERFORMANCE ESTIMATES

On October 9, 2009, the ROBO surveillance panel agreed to shorten the calibration period from 100 days or 25 runs (test starts) to 50 days or 15 runs (test starts). This was made retroactive for rigs that were calibrated at that time. Therefore, the shortened reference period affected rigs with date completed 20090806 and later, and the frequency of calibration testing has increased as of October 9, 2009.

D7528 Bench Oxidation of Engine Oils by ROBO Apparatus, continued

Labs must calibrate new rigs by passing two consecutive blind reference oil tests. Also, if the vacuum pump is changed or the vacuum control valve (VCV) set position is changed after calibrated status is attained, the lab must recalibrate with two passing tests, as if it were a new rig. Once the operation of a rig is established as calibrated, and the VCV set position is not changed, subsequent audits require only periodic one-test calibrations.

Reference oil 435 is nearly depleted; a study on reblend oil 435-1 was completed during this period, and on April 8, 2010 the panel agreed to replace reference oil 435 with 435-1 with new targets and acceptance bands. However, the 435-1 aged oil MRV performance is generally considered to be milder than is optimal. Because of this, the TMC has been asked to pursue another reblend, preferably with somewhat more severe mean performance on aged oil MRV.

TMC MEMORANDA

There was one TMC technical update issued this report period for the D7528 test method:

Email from Tom Schofield, October 12, 2009, Subject: ROBO TMC Calibration New Requirements (Shortened Rig Calibration Period)

D6922 Determination of Homogeneity and Miscibility in Automotive Engine Oils

The TMC distributes six reference oils for D6922 testing. The TMC does not collect data or monitor any test results for this test at this time.

REFERENCE OIL SUPPLIES

There is adequate supply of B0.07 Bench Test reference oils on hand at the TMC. Tables 34A – 34C list the bench test reference oils currently on hand at the TMC.

Table 34A
Current Reference Oils

Oil	For Tests	Quantity Left (gallons)	Quantity Used Last 12 Months (gallons)
52	D6417, D5800	64.2	0.8
55	D6417, D5800	69.3	0.7
58	D6417, D5800, GI	120.4	1.0
62	GI	1.9	0.3
66	D6082 (Discrimination)	94.9	1.5
71-1	TEOST	1.0	0.8
72-1	TEOST	0.6	1.0
90	D874 & D874 Daily Check	39.9	4.1
91	D874	4.6	0.1
**432	MTEOS	Adequate Supply	-----
**434	MTEOS	Adequate	-----
**820-2	D874	Adequate	-----
*1007	D6082	Est. 20	-----
**1009	GI	Adequate	-----
*434-1	ROBO	Adequate	-----
*435-1	ROBO	Adequate	-----
*438	ROBO	Adequate	-----

*One drum of oil is set aside for bench calibration testing; the TMC has a larger supply of this oil.
**Five gallon aliquot set aside for bench testing; hard to get an inventory reading on amount set aside.

REFERENCE OIL SUPPLIES, continued

Table 34B
Obsolete or Test Development Reference Oils

Oil	For Tests	Quantity Left (gallons)	Quantity Used Last 12 Months (gallons)
^51	Obsolete Vol. & GI	94.6	0.0
^53	Obsolete Vol. & GI	96.8	0.0
^54	Obsolete Volatility	97.8	0.0
71	Obsolete TEOST	4 Samples	-----
72	Obsolete TEOST	2 Samples	-----
74	Obsolete MTEOS	0.2	0.1
^83	Obsolete ROBO (RR)	47.3	0.0
^84	Obsolete ROBO (RR)	3.3	0.0
^85	Obsolete ROBO (RR)	3.3	0.0
^**433	Obsolete MTEOS	Adequate Supply	-----
435	Obsolete ROBO	13 Samples	-----

^Not selected as reference oil; TMC holding for further instructions from Surveillance Panel.
**Five gallon aliquot set aside for bench testing; hard to get an inventory reading on amount set aside.

Table 34C
Homogeneity and Miscibility Reference Oils

Oil	For Tests	Quantity Left (gallons)	Quantity Used Last 12 Months (gallons)
HMA	H&M (D6922)	179.7	5.5
HMB	H&M (D6922)	183.7	5.5
HMC	H&M (D6922)	169.7	5.5
HMD	H&M (D6922)	177.5	5.8
HME	H&M (D6922)	163.2	5.0
HMF	H&M (D6922)	186.0	5.0

Shipping aliquots are:

D6417	1 ml
D6417QC	118 ml
D5800	100 ml
GI	25 ml
MTEOS	17 ml
TEOST	125 ml
D6082	525 ml
D874	32 ml
ROBO	300 ml
ROBOQC	950 ml
H&M	950 ml

MISCELLANEOUS

The TMC posts monitored bench test calibration data on the TMC web sit. Lab identifications are coded on the TMC's web site as they are on the previous pages of this report. Also posted are statistics, CUSUM plots, reporting forms, flatfile templates, data dictionaries and data from various round-robin matrix programs. The TMC encourages all interested parties to access and download the data, statistics and plots for individual studies and analyses. Likewise, you are encouraged to access the web site to download the most recent test reporting formats and data dictionaries. The TMC's web site address is www.astmtmc.cmu.edu.

All currently monitored bench test data dictionaries and report form packages have been beta tested by the ASTM Data Communications Committee (DCC) and approved for electronic data transfer. Please contact Tom Schofield at (412) 365-1011 for more information.

Figure 1

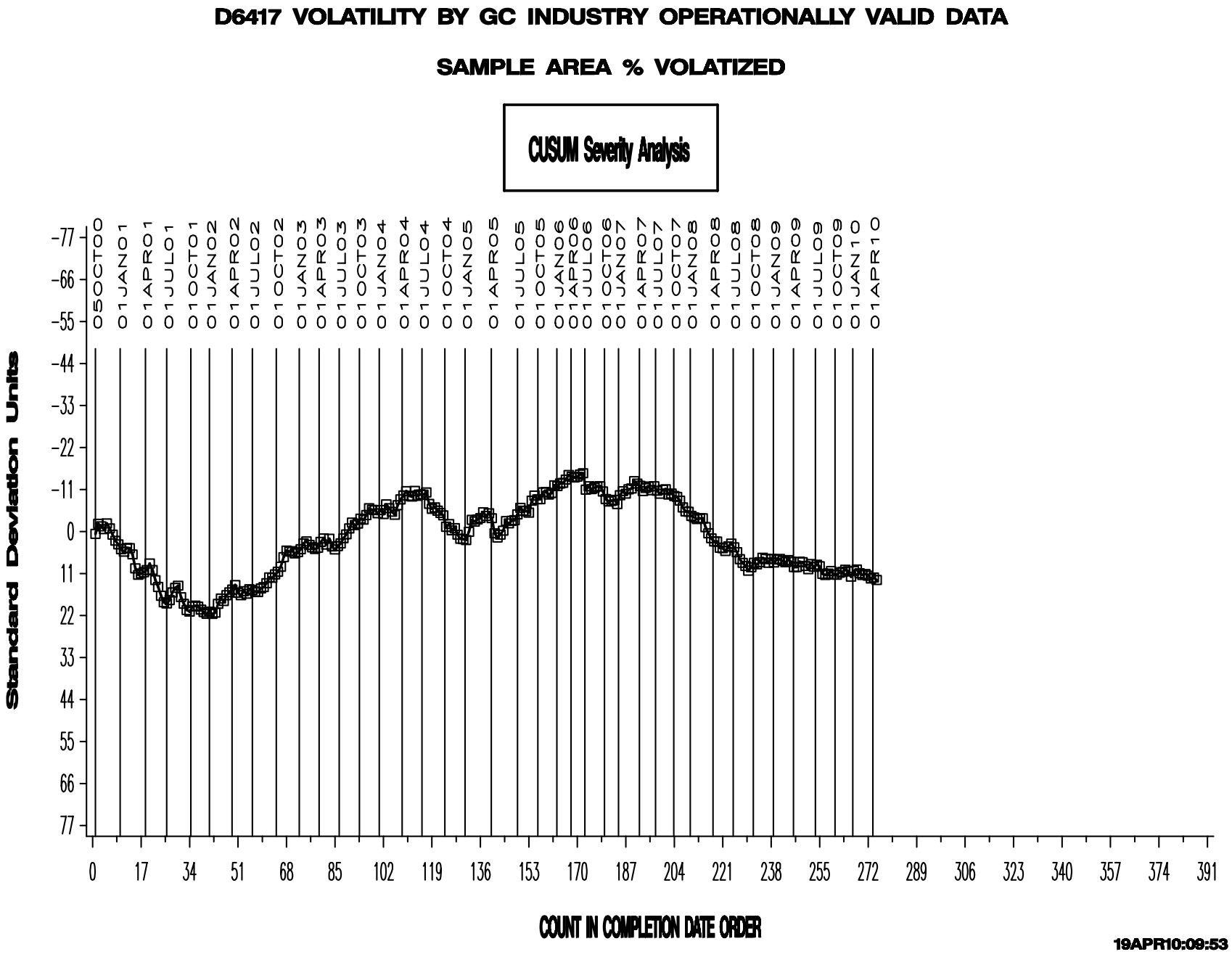

D6417 VOLATILITY BY GC INDUSTRY OPERATIONALLY VALID DATA
SAMPLE AREA % VOLATIZED
CUSUM Severity Analysis
Standard Deviation Units
-77
-66
-55
-44
-33
-22
-11
0
11
22
33
44
55
66
77
05OCT00
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
01JUL02
01OCT02
01JAN03
01APR03
01JUL03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
01JUL08
01OCT08
01JAN09
01APR09
01JUL09
01OCT09
01JAN10
01APR10
0
17
34
51
68
85
102
119
136
153
170
187
204
221
238
255
272
289
306
323
340
357
374
391
COUNT IN COMPLETION DATE ORDER
19APR10:09:53

Figure 2A

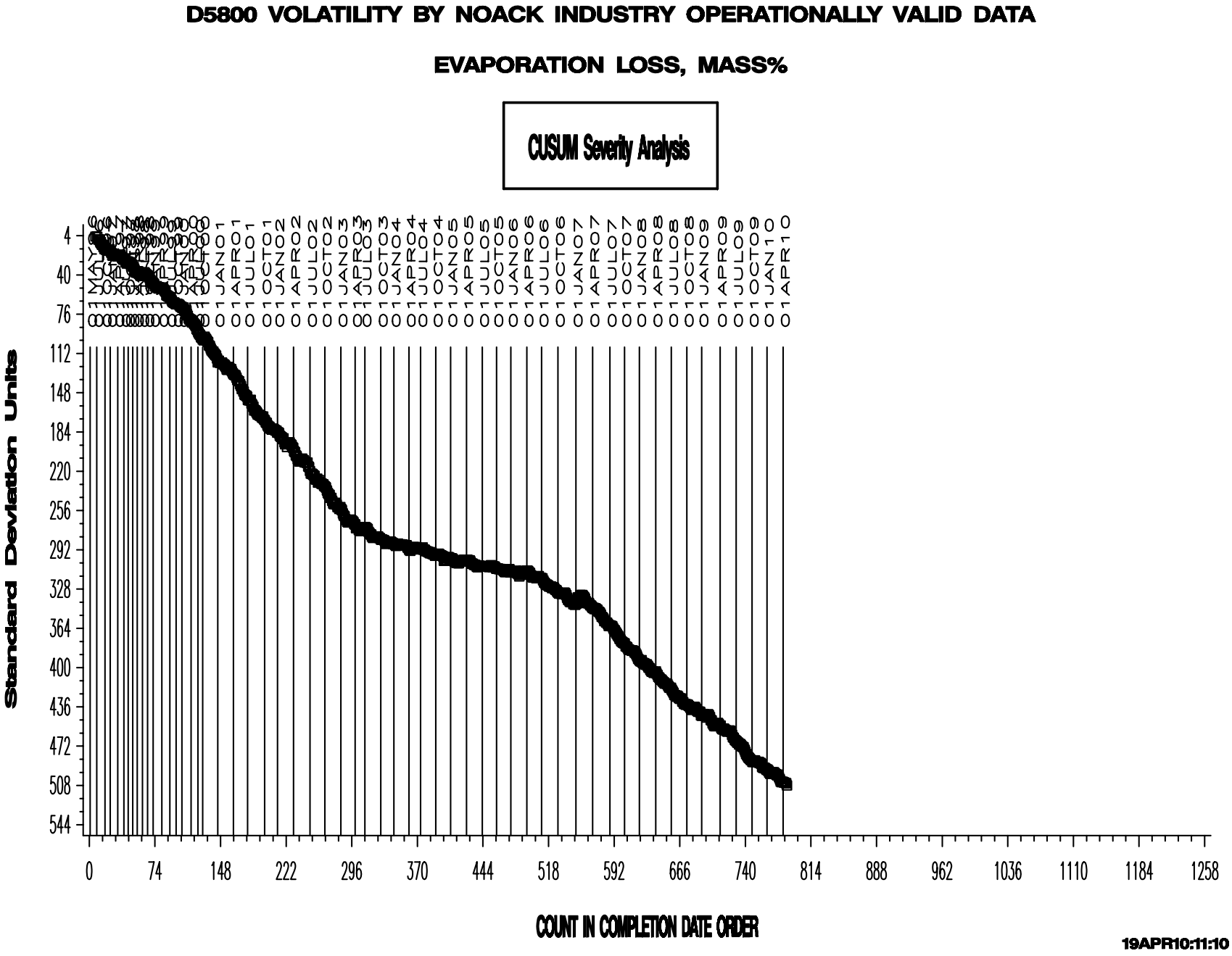

D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA
EVAPORATION LOSS, MASS%
CUSUM Severity Analysis
Standard Deviation Units
4
40
76
112
148
184
220
256
292
328
364
400
436
472
508
544
0
74
148
222
296
370
444
518
592
666
740
814
888
962
1036
1110
1184
1258
COUNT IN COMPLETION DATE ORDER
19APR10:11:10

Figure 2B

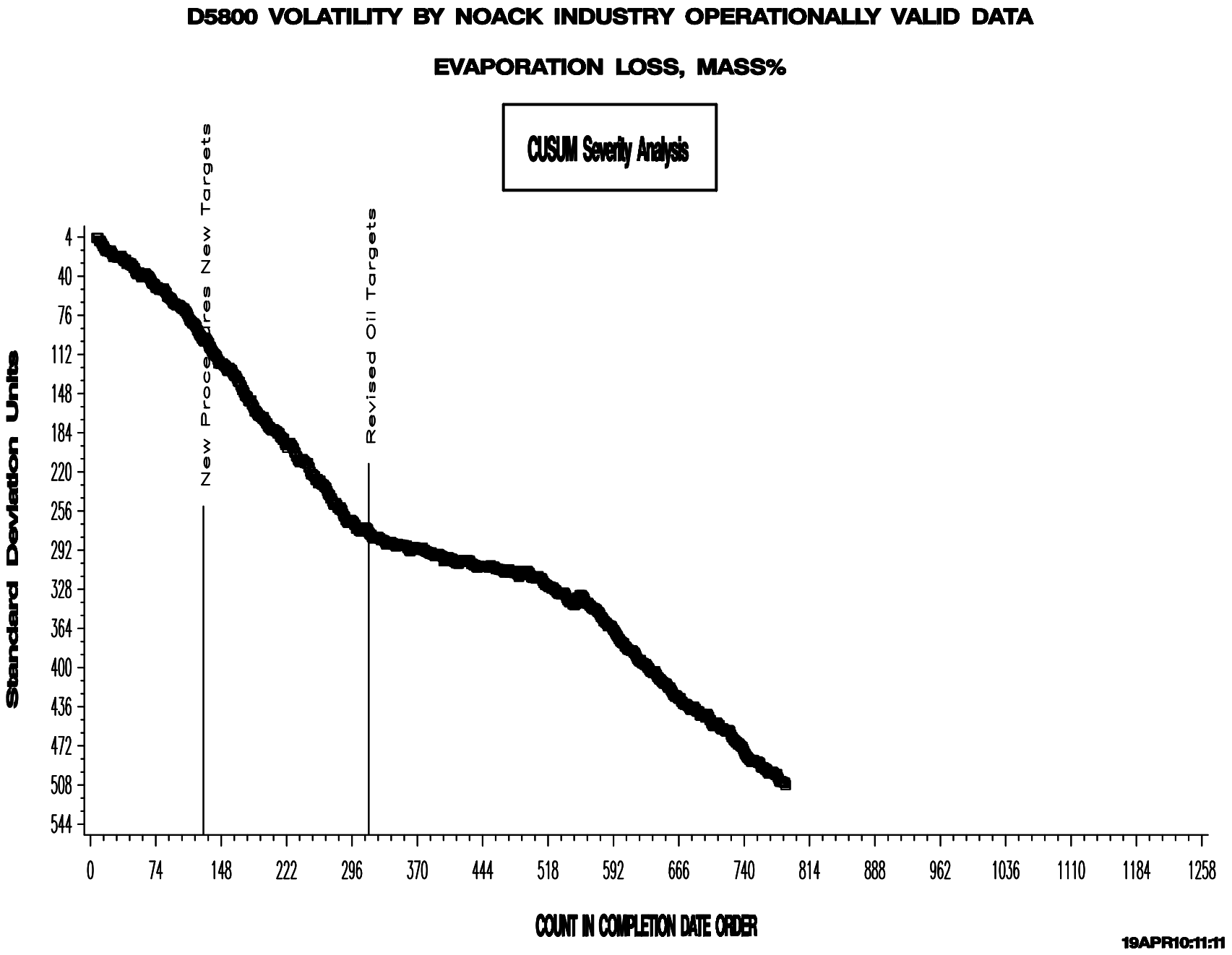

D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA
EVAPORATION LOSS, MASS%
CUSUM Severity Analysis
New Procedures New Targets
Revised Oil Targets
Standard Deviation Units
4
40
76
112
148
184
220
256
292
328
364
400
436
472
508
544
0
74
148
222
296
370
444
518
592
666
740
814
888
962
1036
1110
1184
1258
COUNT IN COMPLETION DATE ORDER
19APR10:11:11

Figure 3A

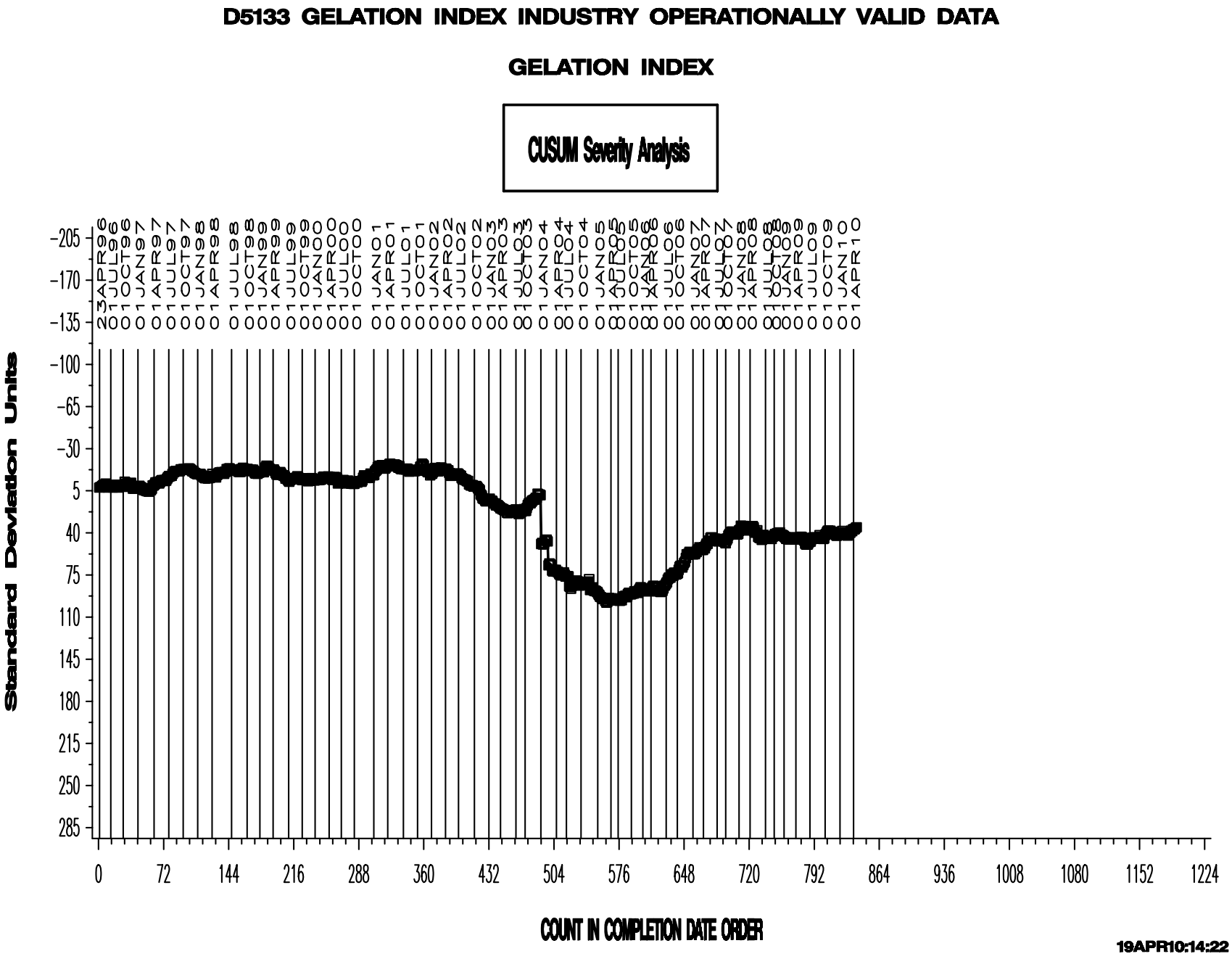

D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA
GELATION INDEX
CUSUM Severity Analysis
Standard Deviation Units
-205
-170
-135
-100
-65
-30
5
40
75
110
145
180
215
250
285
0
72
144
216
288
360
432
504
576
648
720
792
864
936
1008
1080
1152
1224
COUNT IN COMPLETION DATE ORDER
19APR10:14:22

Figure 3B

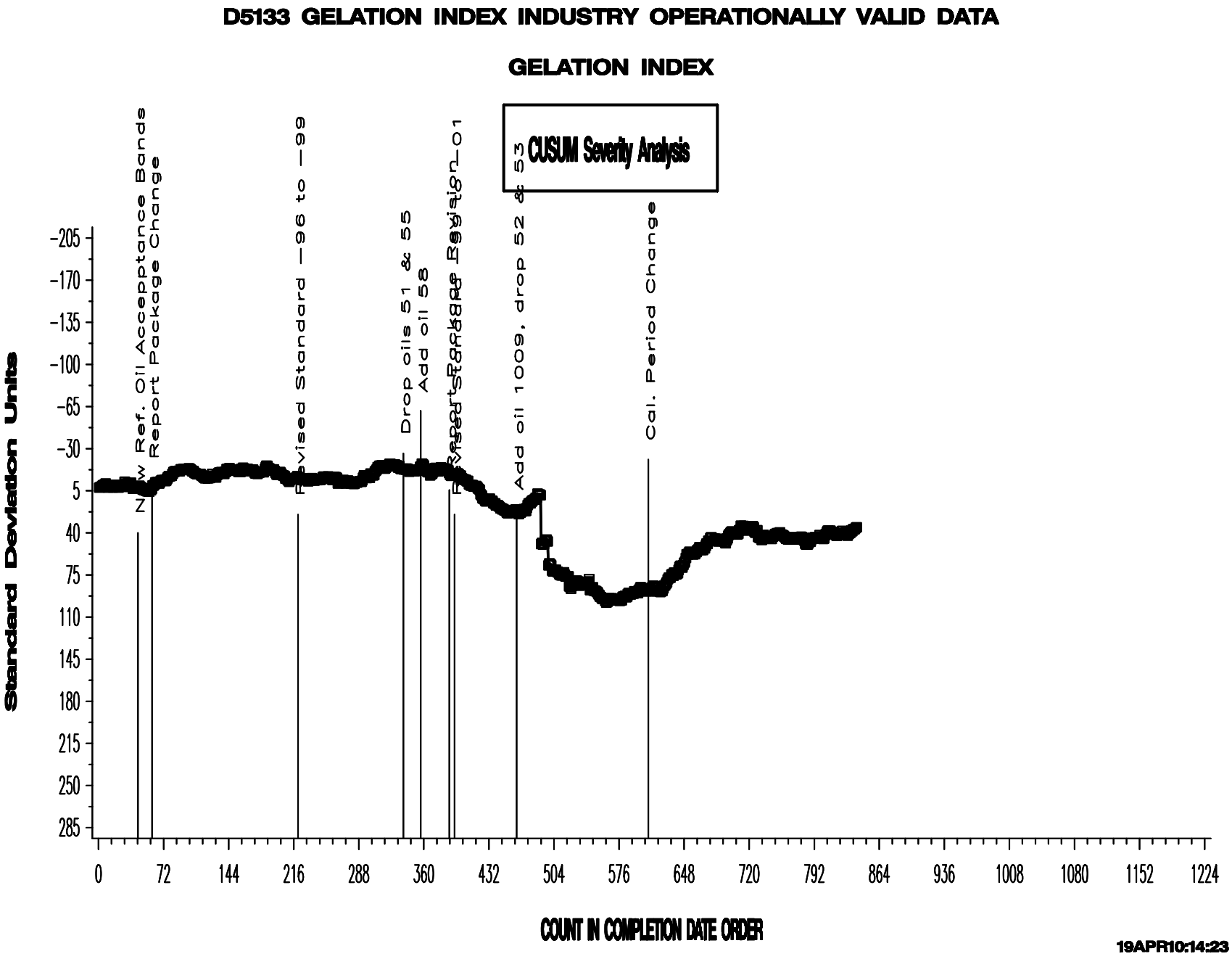

D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA
GELATION INDEX
CUSUM Severity Analysis
New Ref. Oil Acceptance Bands
Report Package Change
Revised Standard -96 to -99
Drop oils 51 & 55
Add oil 58
Report Package Revision 01
Add oil 1009, drop 52 & 53
Cal. Period Change
Standard Deviation Units
-205
-170
-135
-100
-65
-30
5
40
75
110
145
180
215
250
285
0
72
144
216
288
360
432
504
576
648
720
792
864
936
1008
1080
1152
1224
COUNT IN COMPLETION DATE ORDER
19APR10:14:23

Figure 4

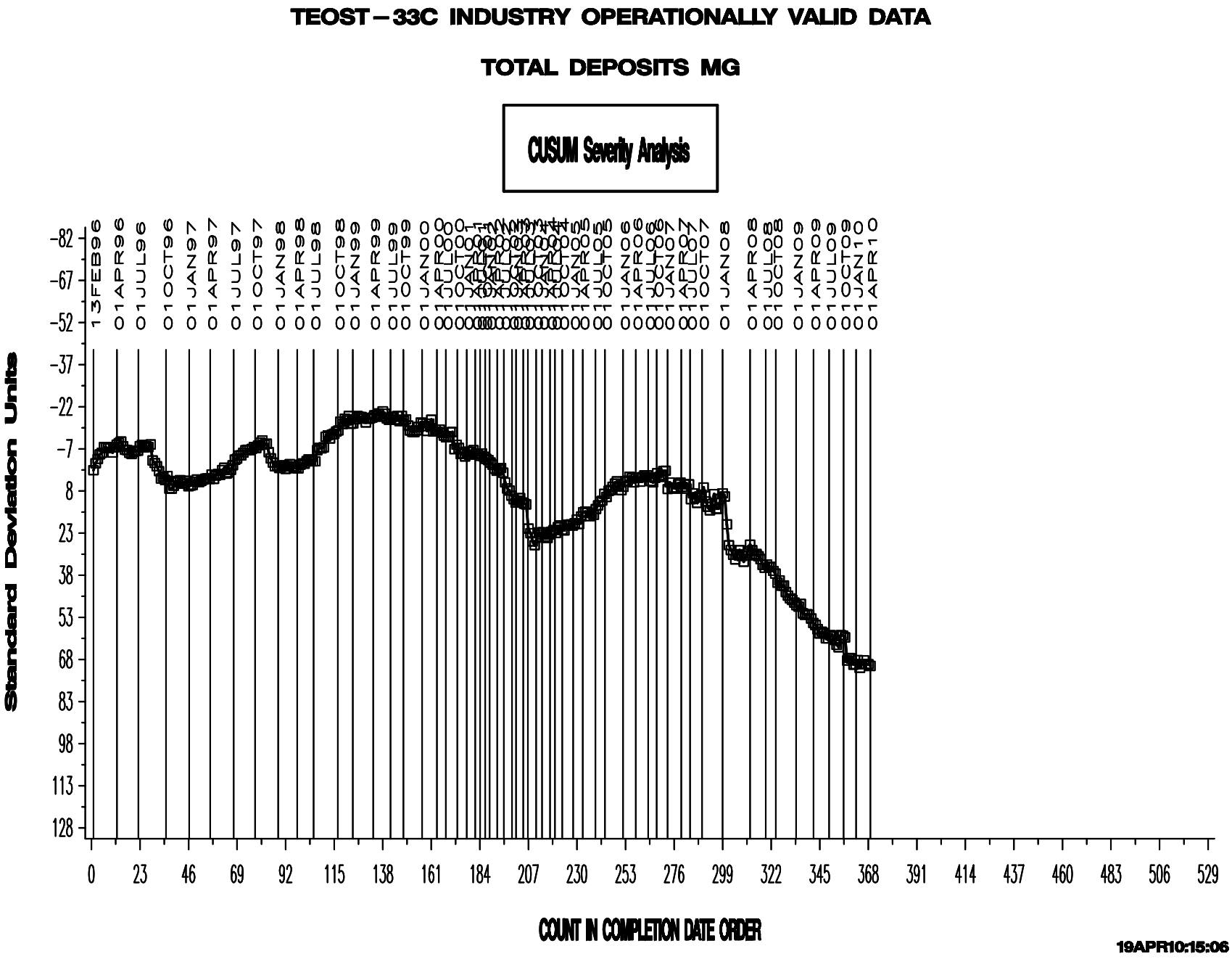

TEOST—33C INDUSTRY OPERATIONALLY VALID DATA
TOTAL DEPOSITS MG
CUSUM Severity Analysis
Standard Deviation Units
-82
-67
-52
-37
-22
-7
8
23
38
53
68
83
98
113
128
13FEB96
01APR96
01JUL96
01OCT96
01JAN97
01APR97
01JUL97
01OCT97
01JAN98
01APR98
01JUL98
01OCT98
01JAN99
01APR99
01JUL99
01OCT99
01JAN00
01APR08
01JUL08
01OCT08
01JAN09
01APR09
01JUL09
01OCT09
01JAN10
01APR10
0
23
46
69
92
115
138
161
184
207
230
253
276
299
322
345
368
391
414
437
460
483
506
529
COUNT IN COMPLETION DATE ORDER
19APR10:15:06

Figure 5A

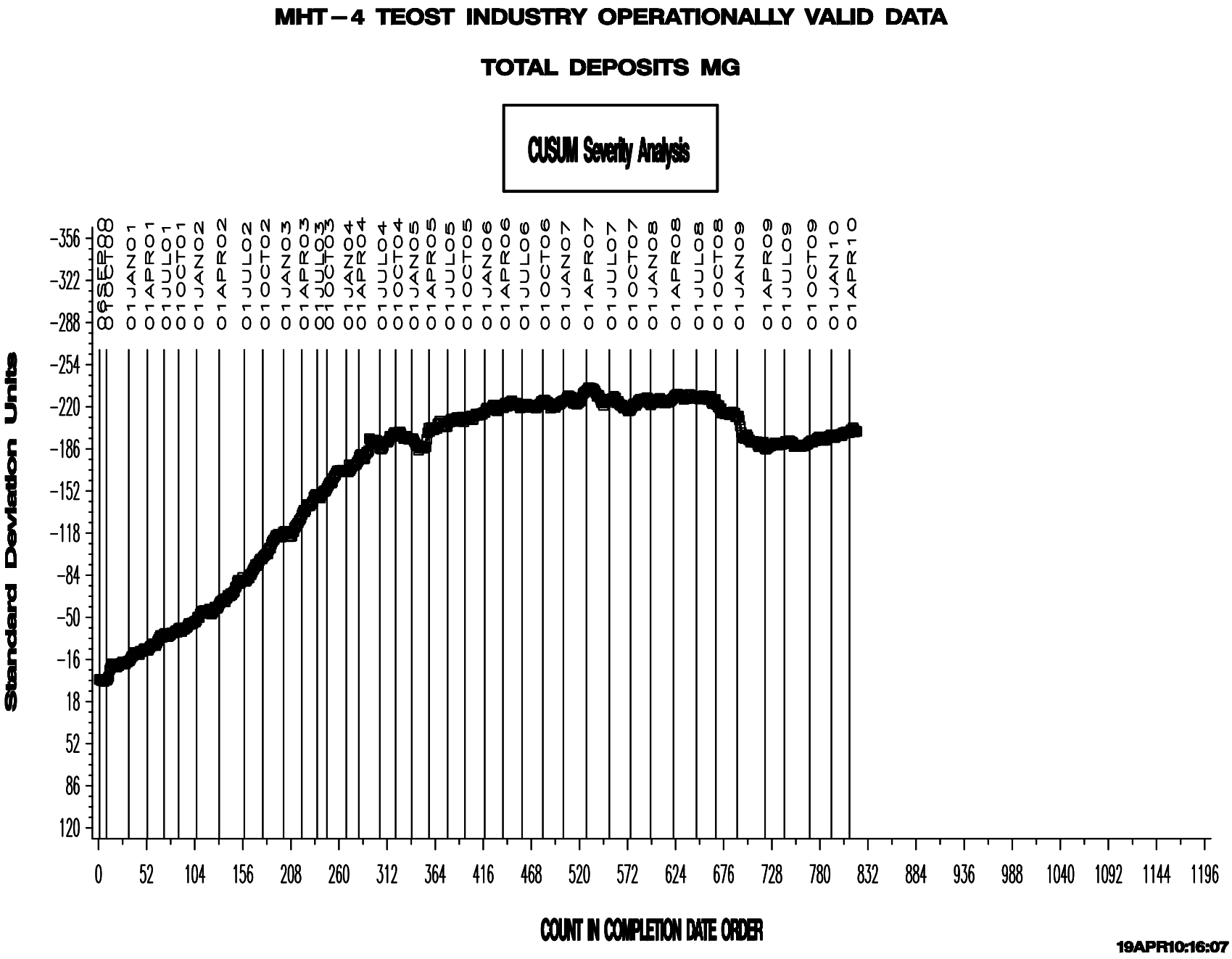

MHT–4 TEOST INDUSTRY OPERATIONALLY VALID DATA
TOTAL DEPOSITS MG
CUSUM Severity Analysis
Standard Deviation Units
-356
-322
-288
-254
-220
-186
-152
-118
-84
-50
-16
18
52
86
120
06SEP88
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
01JUL02
01OCT02
01JAN03
01APR03
01JUL03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
01JUL08
01OCT08
01JAN09
01APR09
01JUL09
01OCT09
01JAN10
01APR10
0
52
104
156
208
260
312
364
416
468
520
572
624
676
728
780
832
884
936
988
1040
1092
1144
1196
COUNT IN COMPLETION DATE ORDER
19APR10:16:07

Figure 5B

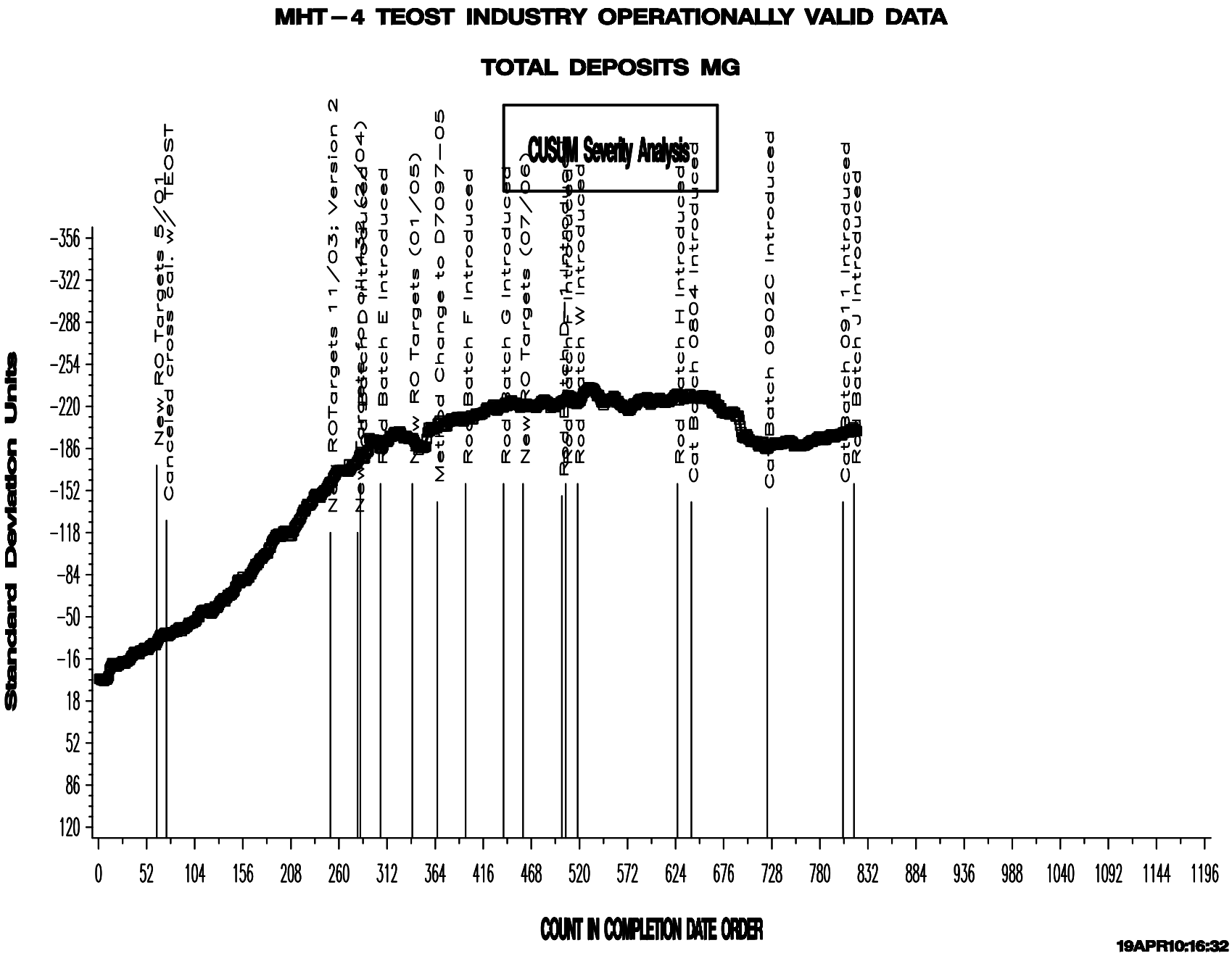
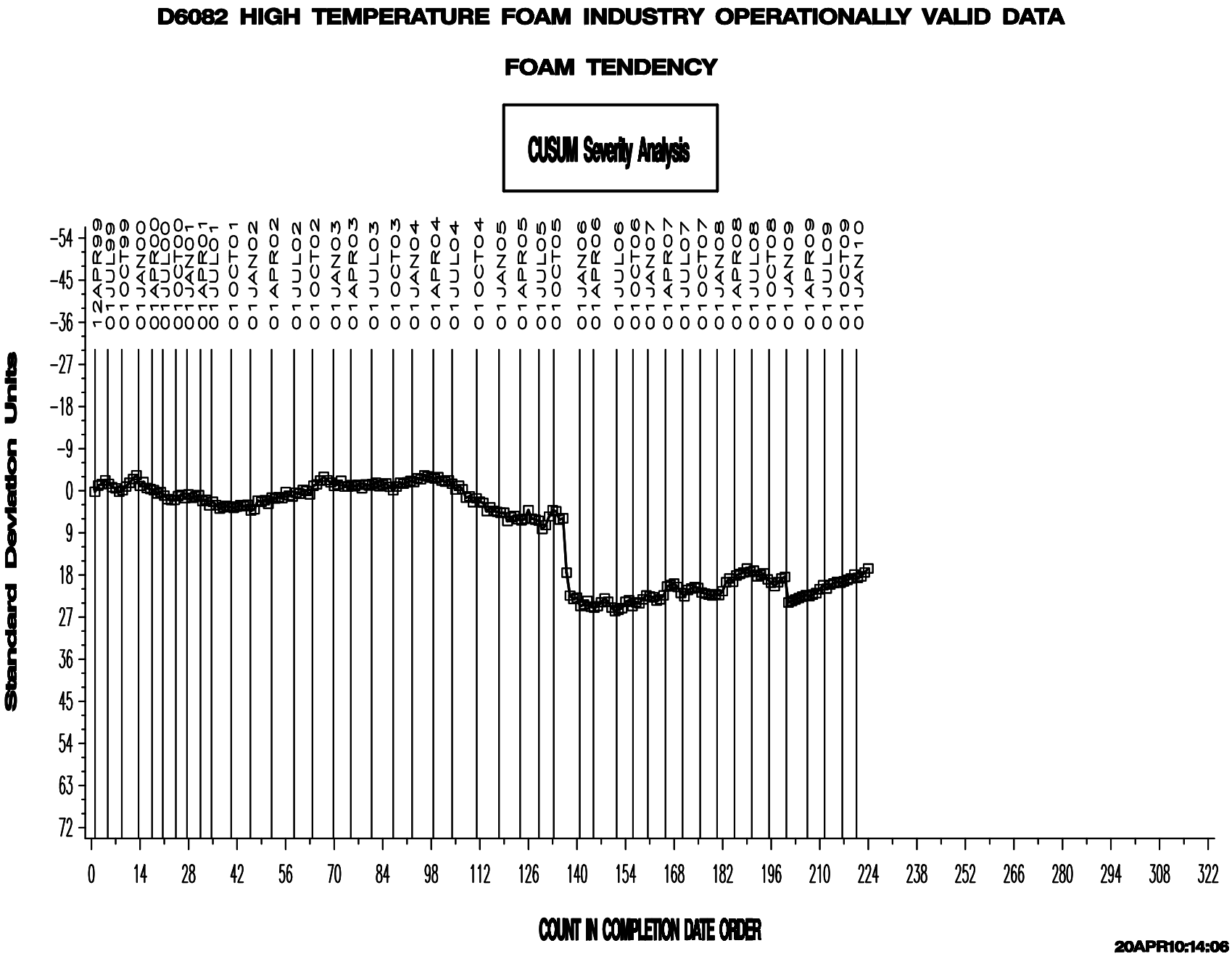

MHT–4 TEOST INDUSTRY OPERATIONALLY VALID DATA
TOTAL DEPOSITS MG
CUSUM Severity Analysis
Standard Deviation Units
-356
-322
-288
-254
-220
-186
-152
-118
-84
-50
-16
18
52
86
120
0
52
104
156
208
260
312
364
416
468
520
572
624
676
728
780
832
884
936
988
1040
1092
1144
1196
COUNT IN COMPLETION DATE ORDER
19APR10:16:32

Figure 6


D6082 HIGH TEMPERATURE FOAM INDUSTRY OPERATIONALLY VALID DATA
FOAM TENDENCY
CUSUM Severity Analysis
Standard Deviation Units
-54
-45
-36
-27
-18
-9
0
9
18
27
36
45
54
63
72
12APR99
01JUL99
01OCT99
01JAN00
01APR00
01JUL00
01OCT00
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
01JUL02
01OCT02
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01APR09
01JUL09
01OCT09
01JAN10
0
14
28
42
56
70
84
98
112
126
140
154
168
182
196
210
224
238
252
266
280
294
308
322
COUNT IN COMPLETION DATE ORDER
20APR10:14:06

Figure 7

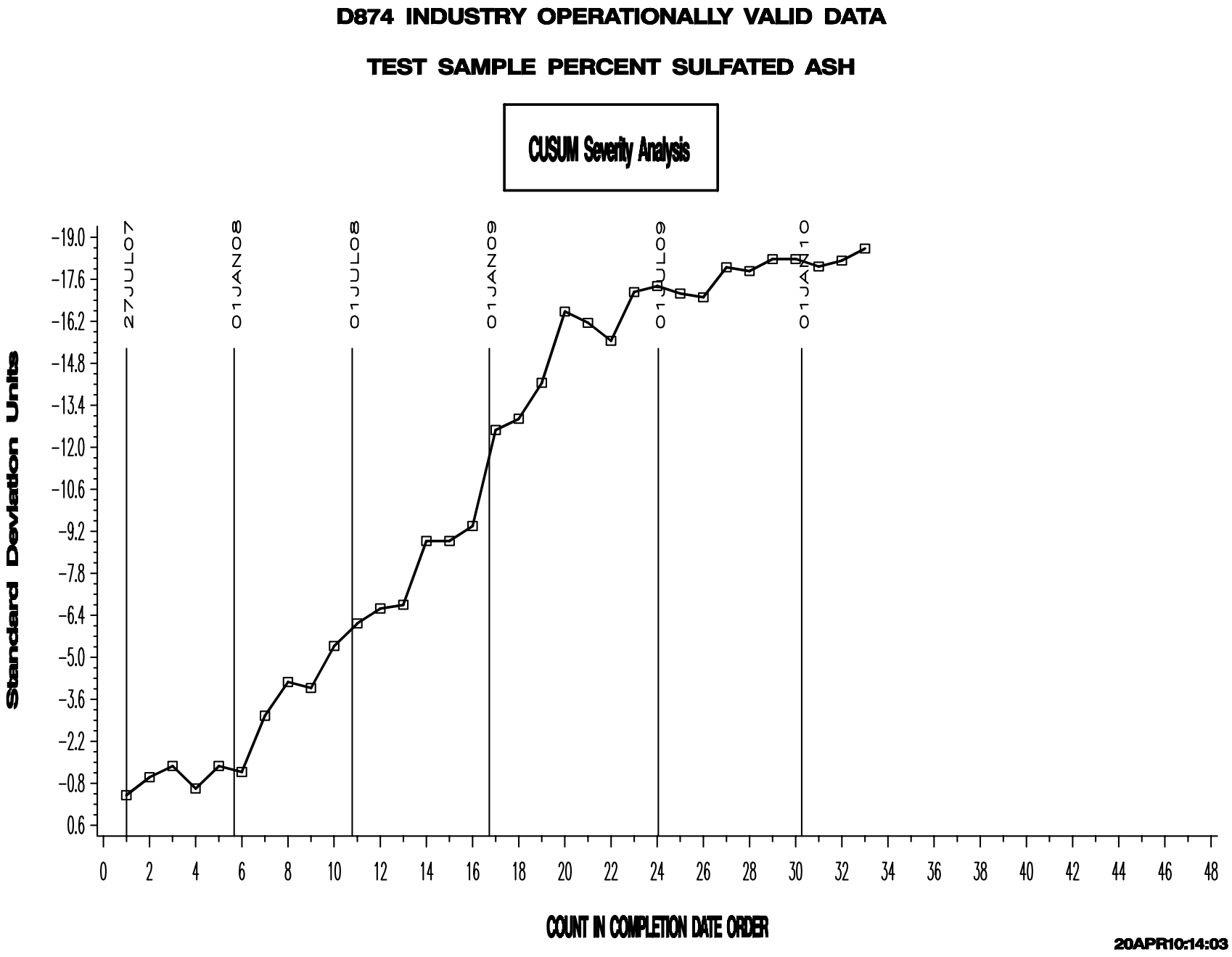
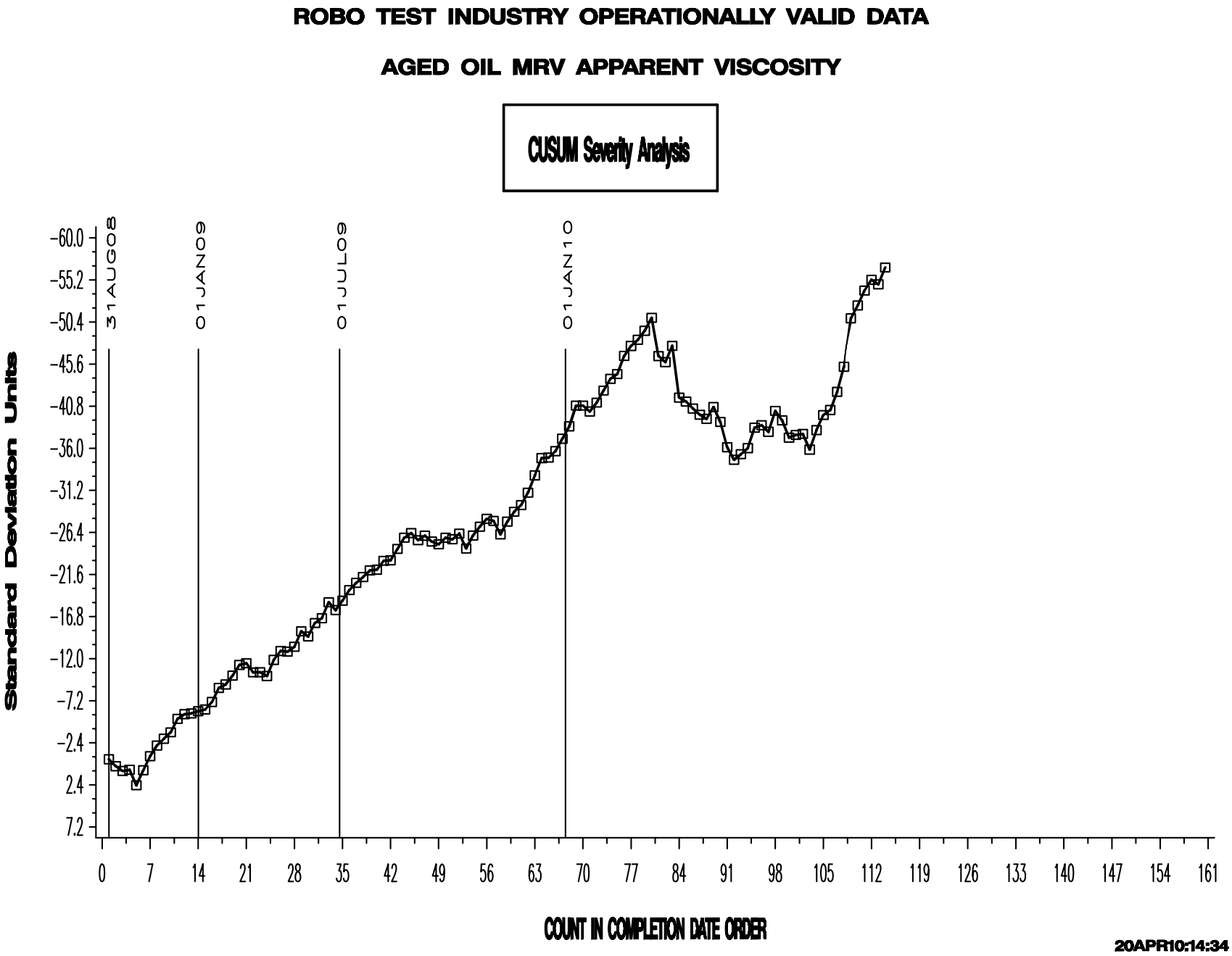

D874 INDUSTRY OPERATIONALLY VALID DATA
TEST SAMPLE PERCENT SULFATED ASH
CUSUM Severity Analysis
Standard Deviation Units
-19.0
-17.6
-16.2
-14.8
-13.4
-12.0
-10.6
-9.2
-7.8
-6.4
-5.0
-3.6
-2.2
-0.8
0.6
27JUL07
01JAN08
01JUL08
01JAN09
01JUL09
01JAN10
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
COUNT IN COMPLETION DATE ORDER
20APR10:14:03

Figure 8


ROBO TEST INDUSTRY OPERATIONALLY VALID DATA
AGED OIL MRV APPARENT VISCOSITY
CUSUM Severity Analysis
Standard Deviation Units
-60.0
-55.2
-50.4
-45.6
-40.8
-36.0
-31.2
-26.4
-21.6
-16.8
-12.0
-7.2
-2.4
2.4
7.2
31AUG08
01JAN09
01JUL09
01JAN10
0
7
14
21
28
35
42
49
56
63
70
77
84
91
98
105
112
119
126
133
140
147
154
161
COUNT IN COMPLETION DATE ORDER
20APR10:14:34

TMC Monitored Bench Tests
Reference Oil Test Targets and Acceptance Bands

						Acceptance Bands *	
						95%	
Test	**Oil Code**	**Parameter**	**n**	**Mean**	**sR**	**Lower**	**Upper**
D6417	52	area % volatility loss	18	6.97	0.31	6.4	7.6
	55	area % volatility loss	18	11.68	0.51	10.7	12.7
	58	area % volatility loss	18	5.61	0.30	5.0	6.2
D5800	52	mass % volatility loss	33	13.75	0.61	12.6	14.9
	55	mass % volatility loss	32	17.09	0.76	15.6	18.6
	58	mass % volatility loss	37	15.20	0.72	13.8	16.6
TEOST by D6335	71	Total Deposit wt. (mg)	27	51.79	4.79	42.4	61.2
	71-1	Total Deposit wt. (mg)	27	51.79	4.79	42.4	61.2
	72	Total Deposit wt. (mg)	27	26.72	3.46	19.9	33.5
	72-1	Total Deposit wt. (mg)	27	26.72	3.46	19.9	33.5
MTEOS by D7097	74	Total Deposit wt. (mg)	30	12.85	5.59	1.9	23.8
	432	Total Deposit wt. (mg)	30	47.04	4.50	38.2	55.9
	434	Total Deposit wt. (mg)	30	27.37	6.57	14.5	40.2
GI by D5133	58	Gelation Index	17	5.8	0.69	4.4	7.2
	62	Gelation Index	35	17.0	3.90	9.4	24.6
	1009	Gelation Index	16	7.3	0.68	6.0	8.6
D6082 (HT FOAM)	1007	Tendency (ml)	28	66	19	29	103
	1007	Stability (ml)	28	0	0	0	0
D6082 (HT FOAM)	66	Tendency (ml)	--	-----	-----	>100	-----
	66	Stability (ml)	--	-----	-----	0	0
D874	90	mass % Sulfated Ash	27	1.07	0.08	0.91	1.23
	91	mass % Sulfated Ash	27	0.82	0.05	0.72	0.92
	820-2	mass % Sulfated Ash	27	1.57	0.08	1.40	1.73
ROBO D7528	434-1	ln MRV, ln(mPa-s)	13	10.6599 (42612)	0.1672	10.3322 (30706)	10.9875 (59130)
	435	ln MRV, ln(mPa-s)	15	11.4895 (97685)	0.2932	11.0021 (60000)	12.0642 (173546)
	435-1	ln MRV, ln(mPa-s)	22	11.0416 (62420)	0.20295	10.7048 (44570)	11.4394 (92910)
	438	ln MRV, ln(mPa-s)	14	10.2676 (28785)	0.2037	9.8683 (19308)	10.6669 (42912)

Attachment 3

TMC Monitored Bench Tests – Individual Reference Oil Statistics
(Operationally Valid Tests Only)

Test	Oil Code	Parameter	Targets			10/1/08 - 3/31/09				4/1/09 - 9/30/09				10/1/09 - 3/31/10			
			n	Mean	sR	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s	n	Mean	sR	Mean Δ/s
D6417	52	Area % Volatized	18	6.97	0.31	6	7.0	0.22	-0.01	4	7.0	0.17	0.18	5	6.9	0.27	-0.16
	55	Area % Volatized	18	11.68	0.51	4	11.4	0.21	-0.65	4	12.0	0.39	0.73	6	11.8	0.38	0.20
	58	Area % Volatized	18	5.61	0.30	4	5.7	0.28	0.30	7	5.6	0.37	-0.03	2	5.7	0.28	0.30
D5800	52	% volatility loss	33	13.75	0.61	13	14.5	0.68	1.28	16	14.6	0.50	1.32	12	14.4	0.79	1.13
**	55	% volatility loss	32	17.09	0.76	10	17.1	1.01	0.00	15	17.5	0.63	0.59	9	17.5	0.61	0.60
	58	% volatility loss	37	15.20	0.72	13	15.3	0.84	0.13	5	15.4	0.53	0.31	14	15.2	0.65	0.05
TEOST	71	Deposit wt. (mg)	27	51.79	4.79	10	56.6	4.38	1.01	6	52.4	11.51	0.13	4	55.9	9.40	0.86
(D6335)	71-1	Deposit wt. (mg)		51.79	4.79	---	---	---	---	1	46.4	--	-1.13	3	61.1	26.11	1.94
	72	Deposit wt. (mg)	27	26.72	3.46	8	30.0	5.50	0.94	4	29.8	2.22	0.89	2	24.8	3.61	-0.54
	72-1	Deposit wt. (mg)		26.72	3.46					3	28.2	0.85	0.42	3	29.1	2.15	0.68
MTEOS	432	Deposit wt. (mg)	30	47.04	4.50	17	60.0	6.05	2.87	19	48.4	5.16	0.29	12	45.7	4.07	-0.29
(D7097)	434	Deposit wt. (mg)	30	27.37	6.57	21	26.2	5.76	-0.18	13	26.1	4.05	-0.20	17	27.6	7.32	0.04
***	74	Deposit wt. (mg)	30	12.85	5.59	15	10.4	3.01	-0.43	16	10.5	3.42	-0.42	14	10.8	3.45	-0.37
GI	58	Gelation Index	17	5.8	0.69	6	6.2	0.51	0.51	14	5.9	0.98	0.19	11	6.1	0.90	0.38
(D5133)	62	Gelation Index	35	17.0	3.90	10	18.3	3.52	0.33	11	16.6	4.68	-0.09	8	14.3	4.59	-0.70
****	1009	Gelation Index	16	7.30	0.68	8	7.0	0.26	-0.48	8	6.9	0.40	-0.62	12	7.1	0.49	-0.28
D6082	1007	Tendency (ml)	28	65	19	11	72	34	0.31	10	61	10	-0.26	8	59	10	-0.38
D874	820-2	Sulfated Ash m%	27	1.57	0.08	1	1.40	--	-2.12	3	1.59	0.01	0.25	1	1.57	---	0.00
	90	Sulfated Ash m%	27	1.07	0.08	2	1.04	0.01	-0.44	2	0.91	0.04	-2.00	3	1.05	0.06	-0.21
	91	Sulfated Ash m%	27	0.82	0.05	3	0.75	0.08	-1.47	2	0.83	0.03	0.20	3	0.80	0.01	-0.33
ROBO	434-1	ln (MRV Vis)	13	10.6599	0.1672	8	10.5971	0.1692	-0.38	7	10.5242	0.1288	-0.81	11	10.7927	0.2007	0.79
	435	ln (MRV Vis)	15	11.4895	0.2932	9	11.3553	0.3078	-0.46	11	11.3302	0.1960	-0.54	43	11.3003	0.4272	-0.65
	438	ln (MRV Vis)	14	10.2676	0.2037	5	10.1330	0.1101	-0.66	8	10.1778	0.2144	-0.44	5	10.4582	0.4591	0.94