Test Monitoring Center
6555 Penn Avenue
Pittsburgh, PA 15206-4489
(412) 365-1000

MEMORANDUM: 06-027

DATE: May 30, 2006

TO: Mr. Ted Selby, Co-Chair ASTM D02.B0.07
Mr. Mark Devlin, Co-Chair ASTM D02.B0.07

FROM: Tom Schofield & Scott Parke

SUBJECT: TMC Bench Reference Test Monitoring Semiannual Report
From October 1, 2005 through March 31, 2006

We respectfully submit the TMC's ASTM D02.B07 Bench Reference Test Monitoring Semiannual Report, 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, where:

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

Notice that the period severity estimates (mean Δ/s) can be pooled across oils of different performance levels because the individual test results used to calculate mean Δ/s have all been normalized into (target) standard deviations (Δ/s) for each corresponding reference oil. Using a pooled s for precision simplifies the interpretation of precision across all reference oil performance levels. These two calculations (pooled s and mean Δ/s) allow us to combine all calibration performance levels for each period into single 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 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. (The initial TMC PCEOCP Bench Test Report, of November 8, 1996, did not cross reference the labs.)

Beginning with the report period April 1, 2001 through September 30, 2001, we are reporting on consecutive six-month intervals for all test areas, rather than one-year intervals for some test areas and six-month for others. For more information on this decision, please refer to the TMC's web page:

ftp://ftp.astmtmc.cmu.edu/docs/bench/bo7semiannualreports/mem01-143.pdf

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
J. Zalar (TMC)
ftp://ftp.astmtmc.cmu.edu/docs/bench/bo7semiannualreports/mem06-027.pdf

Distribution: Email

Attachment 1

ASTM Test Monitoring Center

Semiannual Report

ASTM D02.B07 Bench Reference Test Monitoring
From October 1, 2005 through March 31, 2006

D6417: Estimation of Engine Oil Volatility by Capillary Gas Chromatography

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	11
Operationally Valid but Failed Acceptance Criteria	0
Operationally Invalid (initially reported as)	0
Operationally Invalid (after informed of failing calibration)	0
Total	**11**

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

INDUSTRY PERFORMANCE

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 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	-----
10/1/02 through 3/31/03	15	12	0.39	-0.47
4/1/03 through 9/30/03	14	11	0.36	-0.45
10/1/03 through 3/31/04	15	12	0.50	-0.42
4/1/04 through 9/30/04	15	12	0.40	0.28
10/1/04 through 3/31/05	16	13	0.46	-0.04
4/1/05 through 9/30/05	17	14	0.61	-0.21
10/1/05 through 3/31/06	11	8	0.23	-0.58

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	-1.44
Lab B	1	0.24
Lab D	1	-0.03
Lab G	2	-0.62
Lab H	1	0.63
Lab S	2	-0.10

PRECISION AND SEVERITY

D6417 calibration testing precision is improved compared to the previous six-month period and is better than the target precision. Overall performance is mild of targets. Severity is represented graphically in Figure 1 with a fairly consistent mild trend noted. Severity is unusually mild this period, and is strongly influenced by Lab A's reporting of four mild tests ranging from -0.7s to -2.0s.

Lab B, which had reported a series of very erratic results last period, reported only a single TMC calibration result this period, and that result was only slightly severe of target.

The fail rate this period is unusually good. There were no operationally invalid or statistically unacceptable tests reported this period. The fail rates for the prior two periods were 18.8% and 17.6%.

TMC MEMORANDA

There was one TMC technical memo issued this report period for the D6417 test method:

Memo 06-005; February 1, 2006; Use of TMC 58 as Daily QC Check Sample

D5800: Evaporation Loss of Lubricating Oils by the Noack Method

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	33
Operationally Valid but Failed Acceptance Criteria	1
Operationally Invalid (initially reported as)	1
Operationally Invalid (after informed of failing calibration)	0
Total	**35**

Fail Rate of Operationally Valid Tests: 2.9%

Table 6 is a breakdown of the statistically unacceptable tests.

TABLE 6

Reason for Fail	No. of Tests
Sample Evaporation Loss Severe	1
Sample Evaporation Loss Mild	0

INDUSTRY PERFORMANCE

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
Initial Round Robin Study	180	175	0.51	-----
New Targets Effective 9/26/00	178	175	0.56	-----
4/1/02 through 9/30/02	35	32	0.79	1.00
10/1/02 through 3/31/03	34	31	0.63	1.03
New Targets Effective 7/15/2003	102	99	0.70	-----
4/1/03 through 9/30/03	29	26	0.70	0.44
10/1/03 through 3/31/04	32	29	0.64	0.29
4/1/04 through 9/30/04	30	27	0.64	0.24
10/1/04 through 3/31/05	35	32	0.69	0.11
4/1/05 through 9/30/05	34	31	0.55	0.23
10/1/05 through 3/31/06	34	31	0.74	0.07

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	2	0	---	-0.46
Procedure B	29	26	0.75	0.18
Procedure C	3	1	0.92	-0.72

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	7	-0.19
Lab B	6	1.23
Lab D	2	-0.11
Lab F	6	0.40
Lab G	4	-1.44
Lab H	2	0.45
Lab I	3	0.87
Lab J	4	-0.92

PRECISION AND SEVERITY

Effective September 26, 2000, the TMC began monitoring the three Noack procedures under the revised D5800 test method. Revised reference oil targets and acceptance bands for all three current reference oils (52, 55 and 58), based on 18-months of TMC reference data, became effective July 15, 2003.

Overall precision has worsened for the report period and is slightly worse than the target precision. Overall performance is nearly on target (slight severe bias). Severity is graphically represented in Figures 2A and 2B. Figure 2B better illustrates improvement in the severity trend following the revised oil targets timeline. Table 8 compares the procedures for the period; with only two Procedure A tests and three procedure C tests reported this period it is hard to make any significant comparisons. There is insufficient data to make a precision evaluation on Procedure A this period.

Failure rates for tests reported to the TMC as operationally valid but evaluated as statistically unacceptable have dropped from a range of 15.2% - 25.7% for the five report periods prior to the revised targets, down to 0.0% to 5.7% for the last five periods. Figure 2B shows a fairly regular overall severe bias since oil targets were last revised.

TMC MEMORANDA

There were no TMC technical memos 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)

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	19
Operationally Valid but Failed Acceptance Criteria	3
Operationally Invalid (initially reported as)	1
Operationally Invalid (after informed of failing calibration)	0
Total	**23**

Fail Rate of Operationally Valid Tests: 13.6%

Table 11 is a breakdown of the statistically unacceptable tests.

TABLE 11

Reason for Fail	No. of Tests
Gelation Index Mild	3
Gelation Index Severe	0

INDUSTRY PERFORMANCE

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 20011024 (Oils 52, 53 & 62 targets unchanged, added oil 58)	1	120	3.29	-----
10/1/01 through 3/31/02	3	26	4.76	-0.02
*4/1/02 through 9/30/02	3	28	2.15	0.43
*10/1/02 through 3/31/03	2	25	2.02	0.59
Revised Targets Effective 20030715 (Oils 58 & 62 targets unchanged, added oil 1009, dropped oils 52 & 53)	[illegible]	65	2.86	-----
4/1/03 through 9/30/03	2	22	2.30	0.06
10/1/03 through 3/31/04	3	34	5.86	1.73
4/1/04 through 9/30/04	2	24	3.05	0.40
10/1/04 through 3/31/05	3	31	2.51	0.40
4/1/05 through 9/30/05	2	19	3.44	-0.17
10/1/05 through 3/31/06	2	19	3.09	-0.16

*Excludes one data point as a rare event (for details, see the TMC's semiannual report for that period).

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	7	-0.13
Lab B	1	0.74
Lab D	2	-0.01
Lab G	2	-0.82
Lab H	2	0.57
Lab I	4	0.11
Lab S	4	-0.84

PRECISION AND SEVERITY

Effective July 15, 2003, new D5133 reference oils, targets and acceptance bands were implemented for TMC calibration monitoring. Oils 52 and 53 were dropped and oil 1009 was introduced using performance targets derived from an industry round-robin (targets for oils 58 & 62 continue without revision). Current GI reference oils are 58, 62 & 1009.

Effective March 8, 2006, TMC instrument calibration periods changed from 90-days to 60-days, and a 480-day head calibration period was introduced, for all successful calibrations completed March 8, 2006, or later (see TMC Technical Memo 06-004).

Overall precision has improved compared to last period but remains worse than target precision. Overall testing continues to perform somewhat mild of targets at about the same level as last period. Severity is graphically represented in Figures 3A and 3B with a slight overall mild trend for the last two periods.

Lab S reported two consecutive results on the same instrument this period where both results were unacceptably mild. As of this writing the lab has not yet run a third calibration on the instrument in question. Normally, two consecutive failing results would suggest an operational problem, but the lab has not reported either test as operationally invalid or suggested any operational problems with the instrument. Therefore the two results remain in the TMC period statistics as operationally valid but failing to meet the acceptance criteria. (Update: Lab S has reported that they will be upgrading the instrument software before attempting another TMC calibration.)

TMC MEMORANDA

There was one TMC technical memo issued this report period for the D5133 test method:

Memo 06-004, February 1, 2006: TMC Instrument Calibration Period Change and New Head Calibration Period

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

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	13
Operationally Valid but Failed Acceptance Criteria	1
Operationally Invalid (initially reported as)	0
Operationally Invalid (after informed of failing calibration)	4
Total	**18**

Fail Rate of Operationally Valid Tests: 7.1%

Table 15 is a breakdown of the statistically unacceptable tests.

TABLE 15

Reason for Fail	No. of Tests
Total Deposits Mild	1
Total Deposits Severe	0

INDUSTRY PERFORMANCE

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	-----
10/1/02 through 3/31/03	5	3	5.44	0.50
4/1/03 through 9/30/03*	5	3	3.84	1.33
10/1/03 through 3/31/04	7	5	7.61	-0.56
4/1/04 through 9/30/04	5	3	3.89	-0.63
10/1/04 through 3/31/05	10	8	6.30	-0.32
4/1/05 through 9/30/05	11	9	4.13	-0.73
10/1/05 through 3/31/06	14	12	4.96	-0.29

*Statistics with extreme result excluded (8.58 s severe)

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	3	-0.67
Lab B	4	0.76
Lab G	4	-0.62
Lab I	2	-1.19
Lab V	1	-0.23

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

PRECISION AND SEVERITY

Overall precision has worsened this period with overall testing performance slightly mild of targets. Severity is graphically represented in Figure 4 (attached) with an overall mild trend since about October 2003. Of the 14 operationally valid tests reported this period, 12 tests were reported using Rod Batch E, 1 test used Rod Batch F, and 1 test used Rod Batch G. This period is the first with calibration tests reported from Rod Batches F or G.

Last period we saw some rather distinct and consistent performance differences between Labs A, B and G (the only labs reporting operationally valid tests last period). The labs also reported to the TMC increasing problems with rust in the rod cores. It was surmised, after conferring with the labs and the rod supplier, that, perhaps, the different methods being used by the labs to clean the rods before testing were biasing test results. The instrument manufacturer was quick to emphasize that the test method be followed explicitly with regards to pre-test rod cleaning and preparation. The TMC does not see the distinct lab performance differences this period as we saw last period. The calibration test results are decidedly more random around the oil targets, with each of the three labs (A, B and G) reporting both mild and severe results over this period.

However, of concern this period is that a full 22% of the tests reported this period (4 of 18) were reported initially as operationally valid, but changed to operationally invalid only after being informed of a failing TMC calibration result. (The four results are from three labs and three different instruments; two of the four were results from the same lab on the same instrument run eight days apart.)

TMC MEMORANDA

There were no TMC technical memos 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)

STATUS

Table 18 summarizes the reference tests reported to the TMC this period (5 labs reporting):

TABLE 18

	No. of Tests
Statistically Acceptable and Operationally Valid	36
Operationally Valid but Failed Acceptance Criteria	4
Operationally Invalid (initially reported as)	2
Operationally Invalid (after informed of failing calibration)	1
Total	**43**

Fail Rate of Operationally Valid Tests: 10.0%

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	2

INDUSTRY PERFORMANCE

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 6/1/01	80	76	5.40	-----
10/1/01 through 3/31/02	44	40	6.56	-0.44
4/1/02 through 9/30/02	47	43	6.74	-0.80
10/1/02 through 3/31/03	42	38	6.77	-0.78
4/1/03 through 9/30/03	27	23	6.02	-0.83
Updated Targets Effective 2/18/04	50	46	4.92	-----
10/1/03 through 3/31/04	35	31	9.40	-0.69*
4/1/04 through 9/30/04	40	36	7.29	-0.55
Updated Targets Effective 1/12/05	30	27	3.42	-----
10/1/04 through 3/31/05	36	31	5.15	-0.11**
Updated Targets Effective 6/30/05	42	39	4.60	-----
4/1/05 through 9/30/05	39	36	6.36	-0.17**
10/1/05 through 3/31/06	40	37	6.68	-0.26

*New oil performance targets and acceptance bands were implemented twice during the period; severity is estimated using the targets that were in effect at the time each test was reported.

** New oil performance targets and acceptance bands were implemented during the period; severity is estimated using the targets that were in effect at the time each test was reported.

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	14	-1.02
Lab B	10	-0.23
Lab D	6	0.44
Lab G	10	0.35

Lab V reported a single test that was operationally invalid.

PRECISION AND SEVERITY

Effective 20050519 the monitored labs began using the D7097-05 test method for TMC calibrations (moving from the previous "Version 2" test method). No significant severity shift is observed for this transition, nor was one expected as the two procedures are operationally very similar.

Reference oil targets and acceptance bands were updated effective 20050630 based on all operationally valid TMC calibration data reported through 20050608 and using Rod Batch E parts.

Overall precision has worsened slightly compared to last report period, and is worse than the newest target precision. Overall performance is mild of targets.

The MTEOS severity trend 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; note the introduction of Rod Batch F at the very start of this report period. Figure 5A shows the period severity with an overall mild slope.

Attachment 3A shows the variability of oil 434 to be consistently greater than the target precision for the three report periods since the oil was introduced (target s_R is 5.57 mg Total Deposits while the s_R for the last three periods have been 8.17, 7.07 and 9.10 mg Total Deposits). The performance targets and acceptance bands for all three current reference oils were set with sample sizes well under a statistically rigorous 30 results. The panel may wish to consider updating reference oil targets and acceptance bands.

TMC MEMORANDA

There were no TMC technical memos issued this report period for the MTEOS test method.

D6082: High Temperature Foaming Characteristics of Lubricating Oils

D6082 Monitoring Historical and Statistical References Affecting the Statistical Estimates in This Report

In June 2000, the High Temperature Foam Surveillance Panel had given approval for the TMC to stop collecting data for Total Volume Increase.

On June 18, 2001, the section agreed to suspend the use of the severe performing TMC oil 1002 as a D6082 reference oil due to ongoing calibration precision and severity problems with that oil and on June 17, 2002 the section voted to discontinue the use of 1002 altogether.

On July 21, 2003 a severe performing "discrimination oil", TMC oil 66, was introduced to the monitoring system to be run by each participating lab once every six-months to show that each lab can discriminate a GF-3/SL passing oil (foam tendency) from a failing oil in the D6082 test method. The first discrimination test using oil 66 was completed on August 13, 2003. Because of apparent poor reproducibility of the D6082 test method on severe performing oils (greater than 100 ml foam tendency) in general, it was agreed that oil 66 discrimination results would not be statistically summarized by the TMC other than a count of the tests that do and don't meet the acceptance criteria.

On March 28, 2006 the performance targets for oil 1007 were adjusted slightly by rounding the targets from a precision of 0.01 ml to 1 ml; this adjustment slightly changed the acceptance bands on oil 1007 (see TMC technical memo 06-08).

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.

STATUS

Table 22 summarizes the reference tests reported to the TMC this period (4 labs reporting):

TABLE 22

	No. of Tests
Statistically Acceptable and Operationally Valid	9
Operationally Valid but Failed Acceptance Criteria	2
Operationally Invalid (initially reported as)	0
Operationally Invalid (after informed of failing calibration)	0
Total	**11**

Fail Rate of Operationally Valid Tests: 18.2%

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

D6082: High Temperature Foaming Characteristics of Lubricating Oils, continued

TMC 1007 INDUSTRY PERFORMANCE

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	-----
4/1/02 through 9/30/02	12	62.5	14.22	-0.17
10/1/02 through 3/31/03	11	62.7	17.52	-0.15
4/1/03 through 9/30/03	12	65.8	9.96	0.01
10/1/03 through 3/31/04	12	62.5	10.55	-0.17
4/1/04 through 9/30/04	13	72.3	15.89	0.34
10/1/04 through 3/31/05	12	72.9	16.30	0.37
4/1/05 through 9/30/05	10	62.0	25.30	-0.19
10/1/05 through 3/31/06*	**11**	**102**	**70**	**1.87**
10/1/05 through 3/31/06*	**9**	**74**	**19**	**0.45**

*Period statistics with and without two extreme results included.

TABLE 24

1007 Foam Stability @ 1 min., ml	n	Mean	s	
Initial Round Robin Study	28	0.00	0.00	
4/1/02 through 9/30/02	12	No non-zero occurrences		
10/1/02 through 3/31/03	11	No non-zero occurrences		
4/1/03 through 9/30/03	12	No non-zero occurrences		
10/1/03 through 3/31/04	12	No non-zero occurrences		
4/1/04 through 9/30/04	13	No non-zero occurrences		
10/1/04 through 3/31/05	12	No non-zero occurrences		
4/1/05 through 9/30/05	10	No non-zero occurrences		
10/1/05 through 3/31/06	11	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	3	2.30
Lab B	4	0.87
Lab G	2	-0.56
Lab I	2	5.67

PRECISION AND SEVERITY

There were two tests reported this period as operationally valid, from two different labs, which were exceptionally severe. One test was 11.6 s severe (Lab I) and the other was 4.9 s severe (Lab A) of the target mean for TMC reference oil 1007. Even more unusual is that the tests were completed only a day apart, and were reported to the TMC consecutively on the same day. The tests were immediately noted as highly unusual and even alarming, and the TMC immediately investigated the oil being used for any performance changes. A sample from one of the tests was returned to the TMC and confirmed to be the correct oil with no evidence of contamination, and fresh drum samples taken at the TMC showed no contamination, degradation or other problems with the oil. Indeed, other D6082 tests using oil 1007, reported prior to the two severe results, were passing calibrations just fine, and the two labs in question followed up with passing calibrations. As of this writing there have been nine subsequent calibration tests reported on TMC 1007, and all were passing calibrations. So, it is unclear exactly what the problem was with those two particular tests, but it does not appear to be a result of any problem with reference oil 1007. It is interesting to note that the Foam Stability 1-Minute After Air Disconnect for both tests were reported to be zero, implying that the exceptional amount of observed kinetic foam had completely collapsed after one minute without air agitation. The labs have found no explanation or reason to disqualify the tests as operationally invalid, so the results remain in the period statistics as operationally valid but statistically unacceptable. Because the two results so strongly influence the period performance estimates, the period results in Table 23 are presented both with and without the two results included for comparison.

Foam Tendency precision on 1007 is exceptionally poor with the two extremely severe results included in the period statistics, but the period precision is comparable to the target precision when those two results are excluded from the period data set of test results. Overall performance is exceptionally severe when the two questionable results are included, and only somewhat severe when they are excluded. 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; note the plot is increasingly more variable after the 01APR05 timeline indicating poorer precision last period, and the two extremely severe results are distinctly obvious in the current period.

All 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).

TMC MEMORANDA

There was one TMC technical memo issued this report period for the D6082 test method:

Memo 06-08, March 27, 2006: Revised Reference Oil Targets and Acceptance Bands

D6922 Standard Test Method for 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.

D874-00 Standard Test Method for Sulfated Ash from Lubricating Oils and Additives

As reported last period, the TMC was approached by Joe Franklin on behalf of the ASTM D02.B0 Heavy Duty Classification Panel to monitor the D874 Sulfated Ash Test. Preliminary discussions held between the TMC and Joe Franklin about oils and monitoring proposed that a daily QC check oil will be introduced (to be run with each set of candidate tests) as well as quarterly calibration audits using TMC blind reference oils (similar to D5800 and D6417 monitoring).

Last period, the following progress had been reported for this project:

- A daily check oil has been identified and received by TMC and has been screened to determine SAsh performance.

- Seven potential current TMC engine tests reference oils have been identified; suppliers of the seven oils have given their permission to screen; samples have been sent to screen for SAsh performance. If any of these oils are selected, the corresponding surveillance panels' that control the oils will be asked for permission to partition a small aliquot at the TMC for D874 monitoring.

- The TMC created several potential report form versions for approval by a surveillance panel, along with questions on how test is to be monitored and how we will establish target performance of reference oils. The TMC is waiting for a response (a surveillance panel is not yet formed). The biggest question to resolve now, for TMC monitoring purposes, is how many runs will be required to calibrate (single or duplicate?).

- Eric Olsen has volunteered to chair a D874 calibration monitoring surveillance panel under D02.B07. A surveillance panel has not yet been formed.

There has been no additional progress to report. The TMC is waiting for directions and guidance from a surveillance panel on this project concerning exactly how the test is to be monitored, how data is to be reported and which reference oils are to be used.

D6557: Ball Rust Test (BRT)

Note that, for BRT, a positive Δ/s is mild, not severe (a higher AGV result is considered to be a more mild result while a lower AGV result is considered to be a more severe result.)

STATUS

Table 26 summarizes the reference tests reported to the TMC this period (4 labs reporting):

TABLE 26

	No. of Tests
Statistically Acceptable and Operationally Valid	97
Statistically Unacceptable and Operationally Valid	1
Operationally Invalid	3
Aborted	1
Total	**102**

Fail Rate of Operationally Valid Tests: 1%

Table 27 summarizes the reasons for failing, operationally invalid and aborted reference tests this period:

TABLE 27

Lab	Status	Reason	No. of Tests
G	Failed	Average Gray Value Severe (Oil 1006)	1
	Op. Invalid	Bad Flow Meter	1
		Power Failure	1
		Shaker Table Failure	1
	Aborted	Pump Syringe Stopped	1

INDUSTRY PERFORMANCE

Table 28 shows the current Industry precision and severity for the Average AGV test parameter for all operationally valid tests for the report period. (First calibration test completed 8/15/00.)

TABLE 28

Average AGV	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	48	44	9.43	-----
8/15/00 - 9/30/00	28	25	10.50	0.38
10/1/00 - 3/31/01	112	109	8.48	0.42
4/1/01 - 9/30/01	156	153	8.90	0.36
10/1/01 - 3/31/02	116	113	12.46	0.67
4/1/02 - 9/30/02	138	135	11.38	0.76
10/1/02 - 3/31/03	143	140	7.76	0.69
4/1/03 - 9/30/03	119	116	10.95	0.27
10/1/03 - 3/31/04	71	68	10.21	0.14
4/1/04 - 9/30/04	97	94	7.25	0.25
10/1/04 - 3/31/05	127	124	8.29	0.18
4/1/05 - 9/30/05	103	100	10.43	0.28
10/01/05 - 3/31/06	98	95	8.38	0.39

D6557: Ball Rust Test (BRT), continued

Table 29 shows the current severity for the Average AGV parameter for each lab for all operationally valid tests for the report period.

TABLE 29

	n	Mean Δ/s
Lab A	42	-0.064
Lab B	12	0.558
Lab D	3	1.262
Lab G	41	0.744

PRECISION AND SEVERITY

Precision as measured by pooled s has improved (lower pooled s) from last period and is comparable to previous periods. Overall industry severity is mild of target this period. Severity is graphically represented in Figure 7 (attached).

INFORMATION LETTERS

No information letters were issued this report period.

Engine Oil Filterability Test (EOFT)

STATUS

Table 30 summarizes the reference tests reported to the TMC this period (3 labs reporting).

TABLE 30

	No. of Tests
Statistically Acceptable and Operationally Valid	90
Statistically Unacceptable and Operationally Valid	1
Operationally Invalid	1
Total	**92**

Fail Rate of Operationally Valid Tests: 1%

Table 31 is a breakdown of the statistically unacceptable tests.

TABLE 31

Lab	Status	Reason	No. of Tests
A	Failed	Average % Change in Flow Mild (Oil 78)	1
	Op. Invalid	Spilled Sample	1

INDUSTRY PERFORMANCE

Table 32 shows the current Industry precision and severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.)

TABLE 32

Average % CIF	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	24	22	5.76	-----
5/4/00 - 9/30/00	53	51	7.47	1.64
10/1/00 - 3/31/01	79	78	4.79	0.30
4/1/01 - 9/30/01	103	102	6.69	-0.08
10/1/01 - 3/31/02	84	83	5.67	-0.06
4/1/02 - 9/30/02	89	88	5.38	0.11
10/1/02 - 3/31/03	81	80	4.16	-0.27
4/1/03 - 9/30/03	71	70	3.70	0.02
10/1/03 - 3/31/04	66	65	8.68	-0.54
4/1/04 - 9/30/04	86	85	7.87	-0.13
10/1/04 - 3/31/05	105	104	6.58	-0.30
4/1/05 - 9/30/05	98	97	6.74	-0.37
10/1/05 - 3/31/06	91	90	6.14	-0.05

Table 33 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period.

Engine Oil Filterability Test (EOFT), continued

TABLE 33

	n	Mean Δ/s
Lab A	29	-0.850
Lab B	24	0.242
Lab G	38	0.377

PRECISION AND SEVERITY

Precision as measured by pooled s is similar to last period and is comparable to previous periods. Overall industry severity is on target. Severity is graphically represented in Figure 8 (attached).

At this time, only TMC 78 is being assigned as TMC calibration oil. Based on current usage rates, there is less than a one year supply of reference oil 78. Reference oil 78-1 has been procured and assigned to assess its severity compared to reference oil 78. Initial indications are that 78-1 is significantly more severe than 78.

INFORMATION LETTERS

There was no information letters issued this report period.

Engine Oil Water Tolerance Test (EOWT):

STATUS

Table 34 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 34

	No. of Tests per Water Treat Level				
	0.6%	1.0%	2.0%	3.0%	Total
Statistically Acceptable and Operationally Valid	110	107	108	107	432
Statistically Unacceptable and Operationally Valid	0	0	0	1	1
Operationally Invalid	0	0	0	0	0
Total	110	107	108	108	433
Fail Rate of Operationally Valid Tests	0%	0%	0%	1%	<1%

Table 35 is a breakdown of the statistically unacceptable test.

TABLE 35

Reason for Fail	No. of Tests
Change in Flow Severe (oil 77)	1

INDUSTRY PERFORMANCE

Table 36 shows the current Industry severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.) Overall industry severity as measured by mean Δ/s shows test run at a water treat level of 0.6% to be on target. Severity is severe of target for water treat levels of 1.0% and 2.0%. Historically and currently, tests run at a water treat level of 3.0% are the most severe compared to the other water treat levels. Severity is graphically represented in Figure 9, 10, 11 and 12 (attached).

TABLE 36

	Average % Change in Flow							
	0.6%		1.0%		2.0%		3.0%	
	n	Mean Δ/s	n	Mean Δ/s	n	Mean Δ/s	n	Mean Δ/s
Initial Round Robin (targets)	24	-----	24	-----	24	-----	24	-----
05/4/00 through 9/30/00	34	-0.04	33	0.12	31	-0.07	31	0.23
10/1/00 through 3/31/01	101	-0.17	99	-0.19	100	-0.16	100	-0.01
04/1/01 through 9/30/01	123	0.05	115	0.26	114	0.22	114	0.34
10/1/01 through 3/31/02	88	-0.05	89	0.02	89	-0.02	89	0.31
04/1/02 through 9/30/02	102	0.18	105	0.25	103	0.09	103	0.56
10/1/02 through 3/31/03	89	-0.08	89	0.25	89	0.11	89	0.50
04/1/03 through 9/30/03	93	0.01	94	0.17	93	0.17	93	0.55
10/1/03 through 3/31/04	90	-0.23	88	0.17	92	0.33	92	0.52
04/1/04 through 9/30/04	108	-0.13	106	0.13	107	0.24	107	0.56
10/1/04 through 3/31/05	113	-0.05	114	0.21	115	0.29	115	0.61
04/1/05 through 9/30/05	118	-0.13	117	0.24	121	0.09	121	0.45
10/1/05 through 3/31/06	110	-0.06	107	0.32	108	0.28	108	0.48

Table 37 shows the current Industry precision for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.) Precision as measured by pooled s is comparable to previous periods.

TABLE 37

	Average % Change in Flow							
	0.6%		1.0%		2.0%		3.0%	
	df	Pooled s	df	Pooled s	df	Pooled s	df	Pooled s
Initial Round Robin (targets)	22	5.93	22	5.81	22	7.08	22	5.79
05/4/00 through 9/30/00	32	6.25	31	6.98	29	5.63	30	5.71
10/1/00 through 3/31/01	99	5.61	97	5.85	98	6.25	96	5.71
04/1/01 through 9/30/01	121	6.28	113	5.79	112	6.57	120	6.46
10/1/01 through 3/31/02	86	6.12	87	7.20	87	5.75	87	5.82
04/1/02 through 9/30/02	100	4.50	103	4.30	101	3.76	106	4.69
10/1/02 through 3/31/03	87	4.86	87	3.42	87	5.77	87	5.09
04/1/03 through 9/30/03	92	3.89	93	3.64	91	3.66	92	3.29
10/1/03 through 3/31/04	88	5.12	86	3.89	90	5.03	88	3.74
04/1/04 through 9/30/04	107	5.72	105	4.69	106	5.01	108	4.50
10/1/04 through 3/31/05	111	6.18	113	5.64	114	5.96	111	5.08
04/1/05 through 9/30/05	116	5.11	115	4.15	119	4.46	117	3.89
10/1/05 through 3/31/06	108	6.02	105	4.66	106	5.48	106	4.26

Table 38 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period. The data suggests that the three labs have three different severity levels across all water treat levels.

TABLE 38

	Average % Change in Flow							
	0.6%		1.0%		2.0%		3.0%	
	n	Mean Δ/s	n	Mean Δ/s	n	Mean Δ/s	n	Mean Δ/s
Lab A	45	-0.83	42	-0.27	43	-0.30	43	0.03
Lab B	27	-0.29	27	0.11	27	-0.16	27	0.20
Lab G	38	1.03	38	1.13	38	1.23	38	1.19

Reference Oils

Based on current usage rates, there is less than a one year supply of reference oil 78. Reference oil 78-1 has been procured and assigned to assess its severity compared to reference oil 78. Initial indications are that 78-1 is significantly more severe than 78.

INFORMATION LETTERS

There was no information letters issued this report period.

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 or Scott Parke at (412) 365-1036.

REFERENCE OIL SUPPLIES

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

Table 34A

Oil	For Tests	Quantity Left (gallons)	Quantity Used Last 12 Months (gallons)
^51	Obsolete Vol. & GI	94.6	0.0
52	D6417, D5800	67.6	1.0
^53	Obsolete Vol. & GI	96.8	0.0
^54	Obsolete Volatility	97.8	0.0
55	D6417, D5800	72.5	1.1
^57	Old Volatility Candidate	51.2	0.0
58	D6417, D5800, GI	124.0	2.3
62	GI	1.6	0.2
66	D6082 (Discrimination)	99.5	2.4
71	TEOST	3.3	0.7
72	TEOST	3.3	0.7
74	MTEOS	2.0	0.2
77	EOWT	65.7	42.6
78	EOFT, EOWT	0.3	44.9
78-1	EOFT, EOWT	260.8	14.2
^80	BRT Candidate	26.5	0.0
81	BRT	16.4	0.9
82	BRT	8.7	0.4
90	D874 Daily Check	49.5	0.0
**432	MTEOS	Adequate	-----
^**433	Obsolete MTEOS	Adequate	-----
**434	MTEOS	Adequate	-----
1006	BRT	41.6	0.4
*1007	D6082	Est. 24	-----
**1009	GI	Adequate	-----

^Not selected as reference oil; TMC holding for further instructions from Surveillance Panel.
*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

Oil	For Tests	Quantity Left (gallons)	Quantity Used Last 12 Months (gallons)
HMA	H&M (D6922)	193.8	7.0
HMB	H&M (D6922)	197.8	7.0
HMC	H&M (D6922)	183.8	7.0
HMD	H&M (D6922)	191.8	7.0
HME	H&M (D6922)	176.8	7.0
HMF	H&M (D6922)	199.5	7.0

Shipping aliquots are:

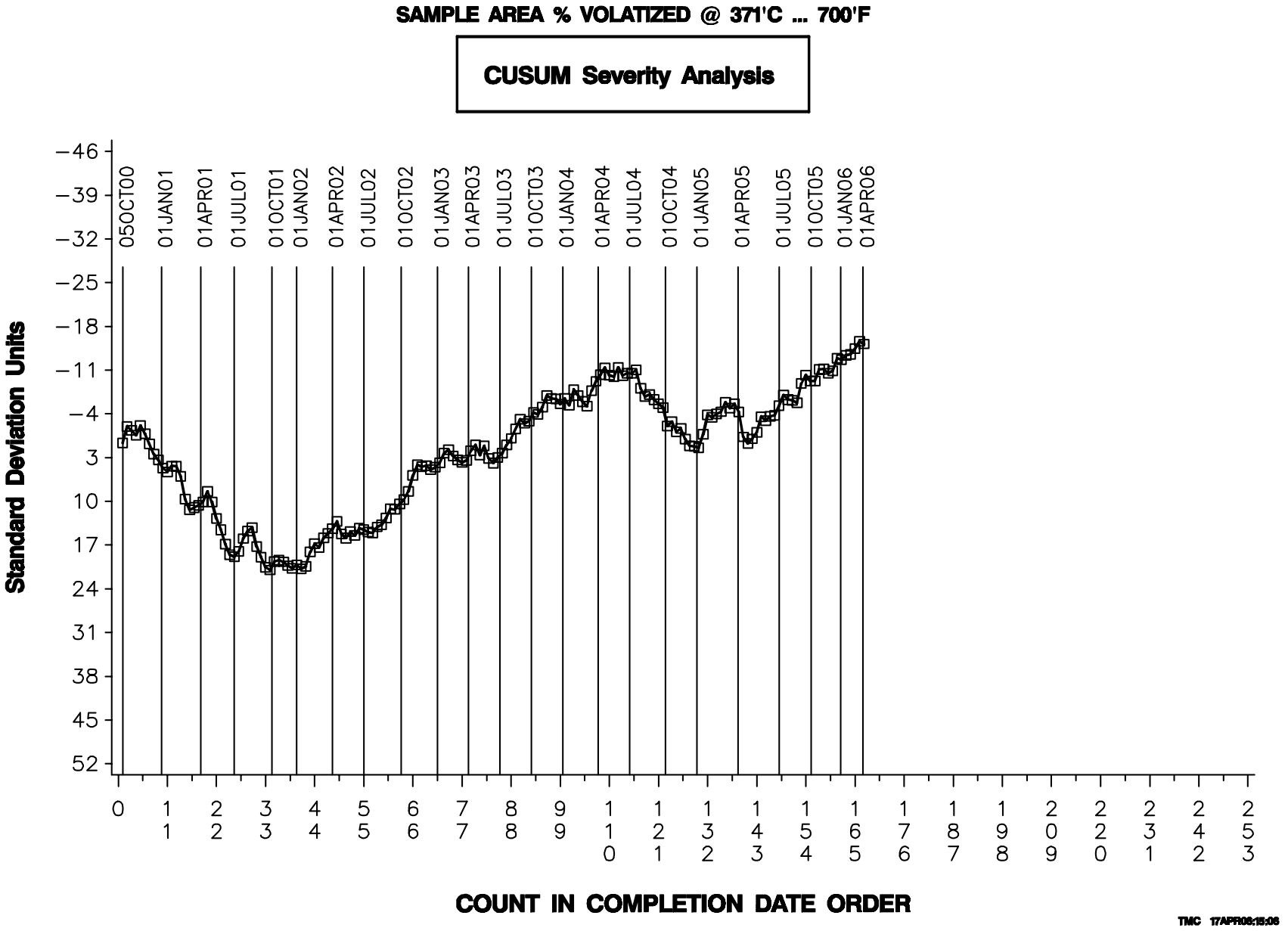
D6417	1 ml
D5480	4 ml
D5800	100 ml
GI	25 ml
MTEOS	17 ml
TEOST	125 ml
D6082	525 ml
H&M	950 ml
EOFT	290 ml
EOWT	290 ml
BRT	30 ml

MISCELLANEOUS

The TMC posts monitored bench test calibration data on the Internet. Selected parameters from all operationally valid reference tests are posted on the TMC's World-Wide-Web page in real time. 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 or Rich Grundza at (412) 365-1031 for more information.

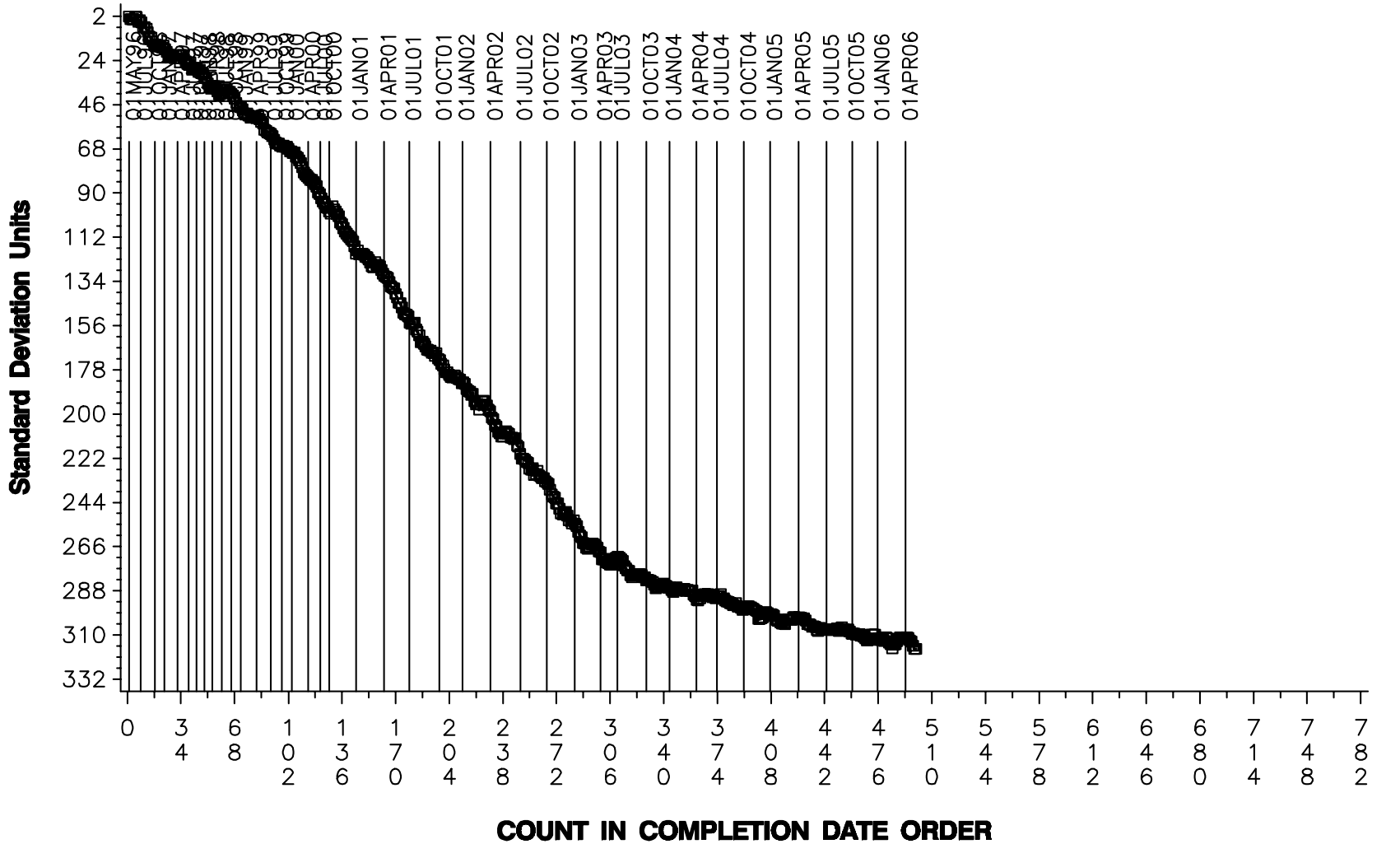
D6417 VOLATILITY BY GC INDUSTRY OPERATIONALLY VALID DATA



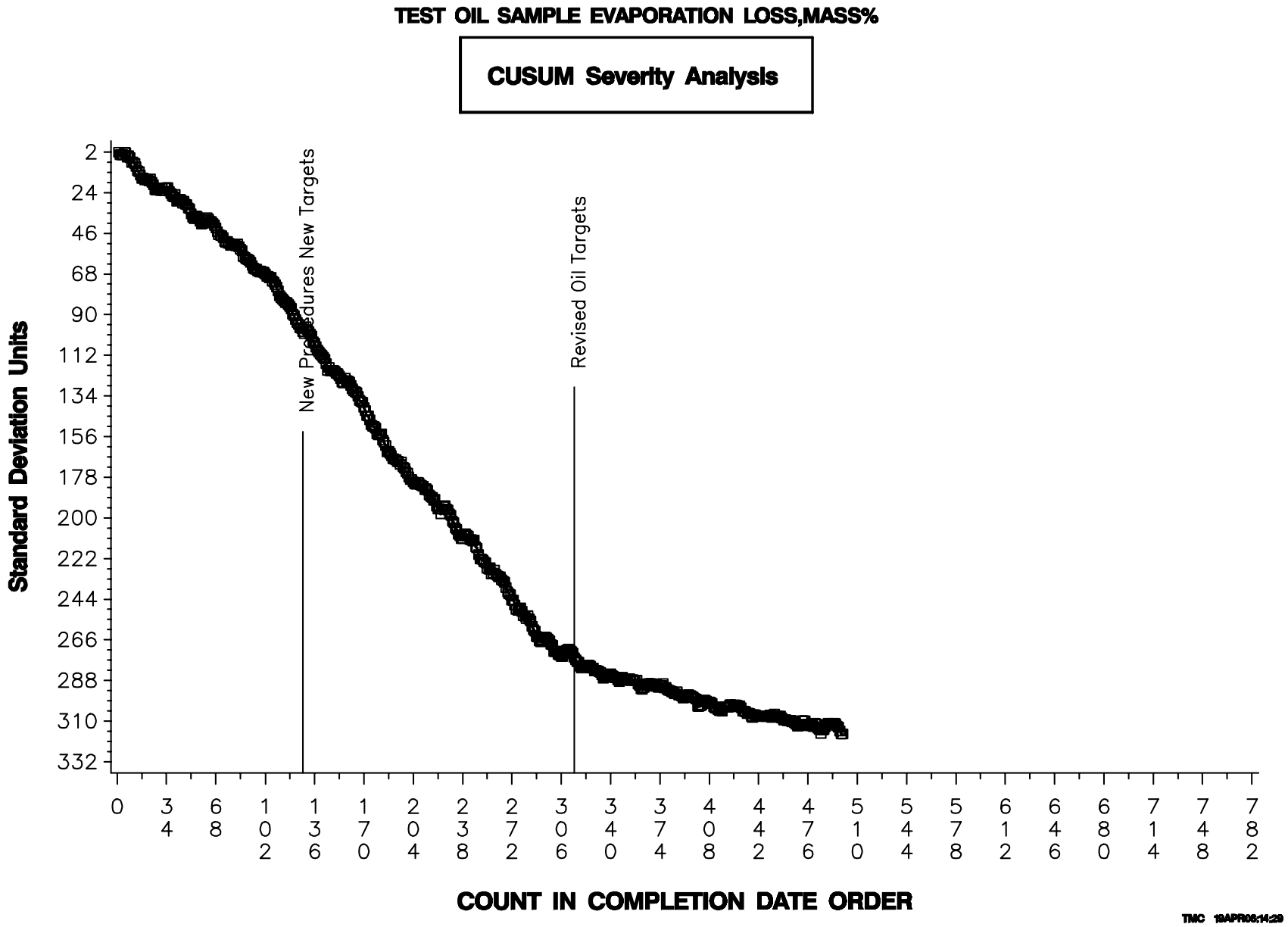
D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA

TEST OIL SAMPLE EVAPORATION LOSS,MASS%

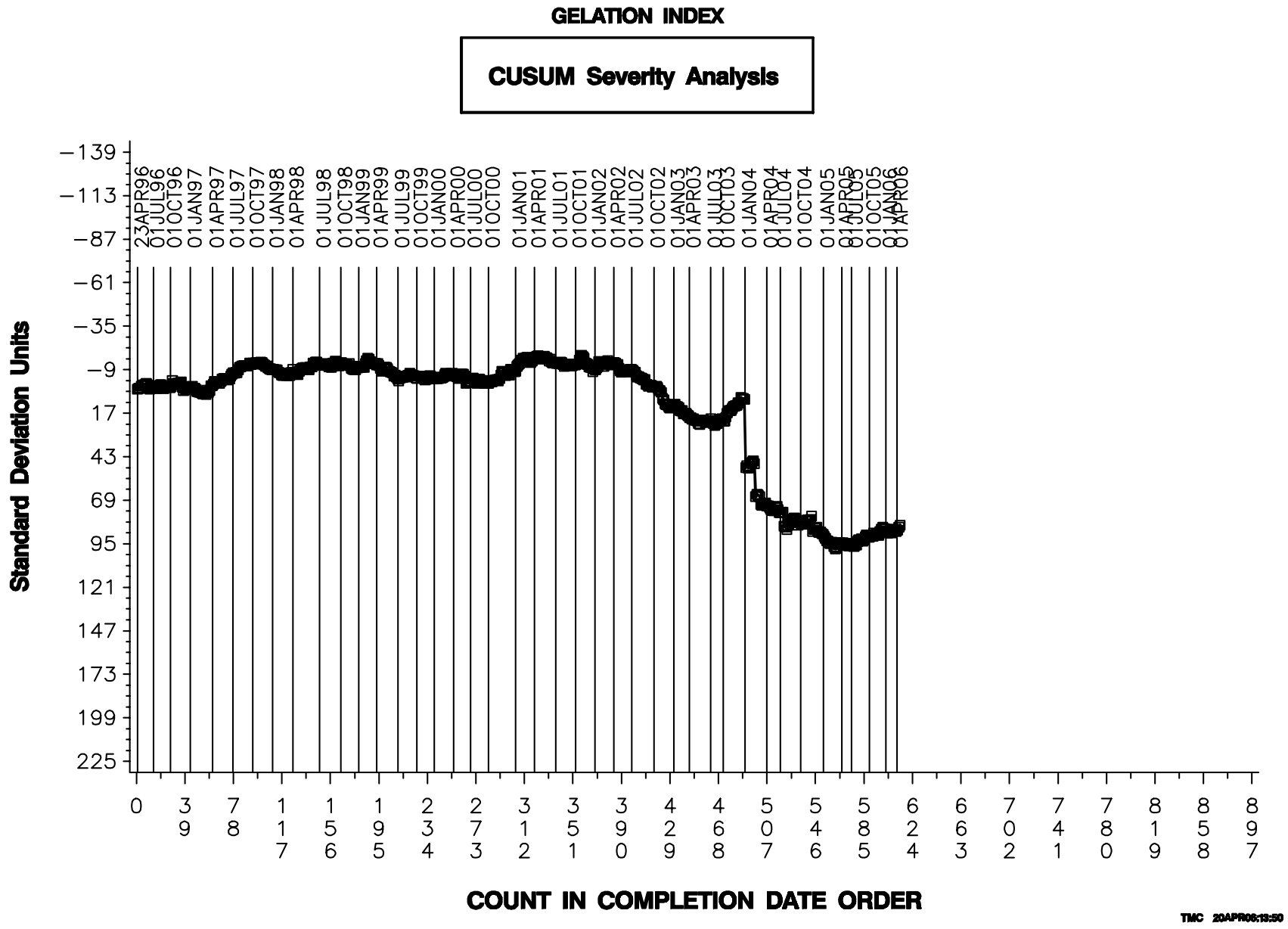
CUSUM Severity Analysis



D5800 VOLATILITY BY NOACK INDUSTRY OPERATIONALLY VALID DATA



D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA



D5133 GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA

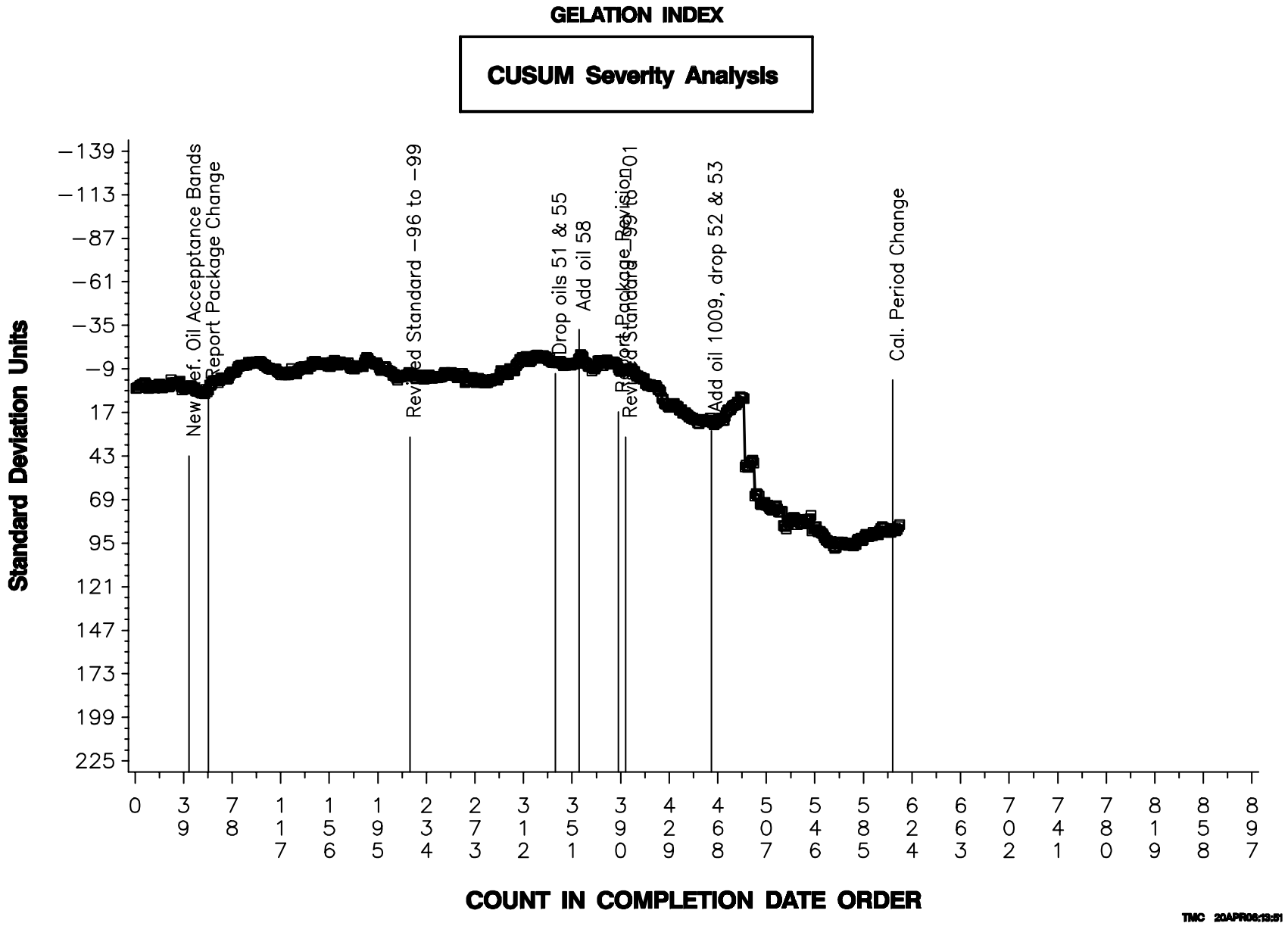


Figure 4

TEOST – 33C INDUSTRY OPERATIONALLY VALID DATA

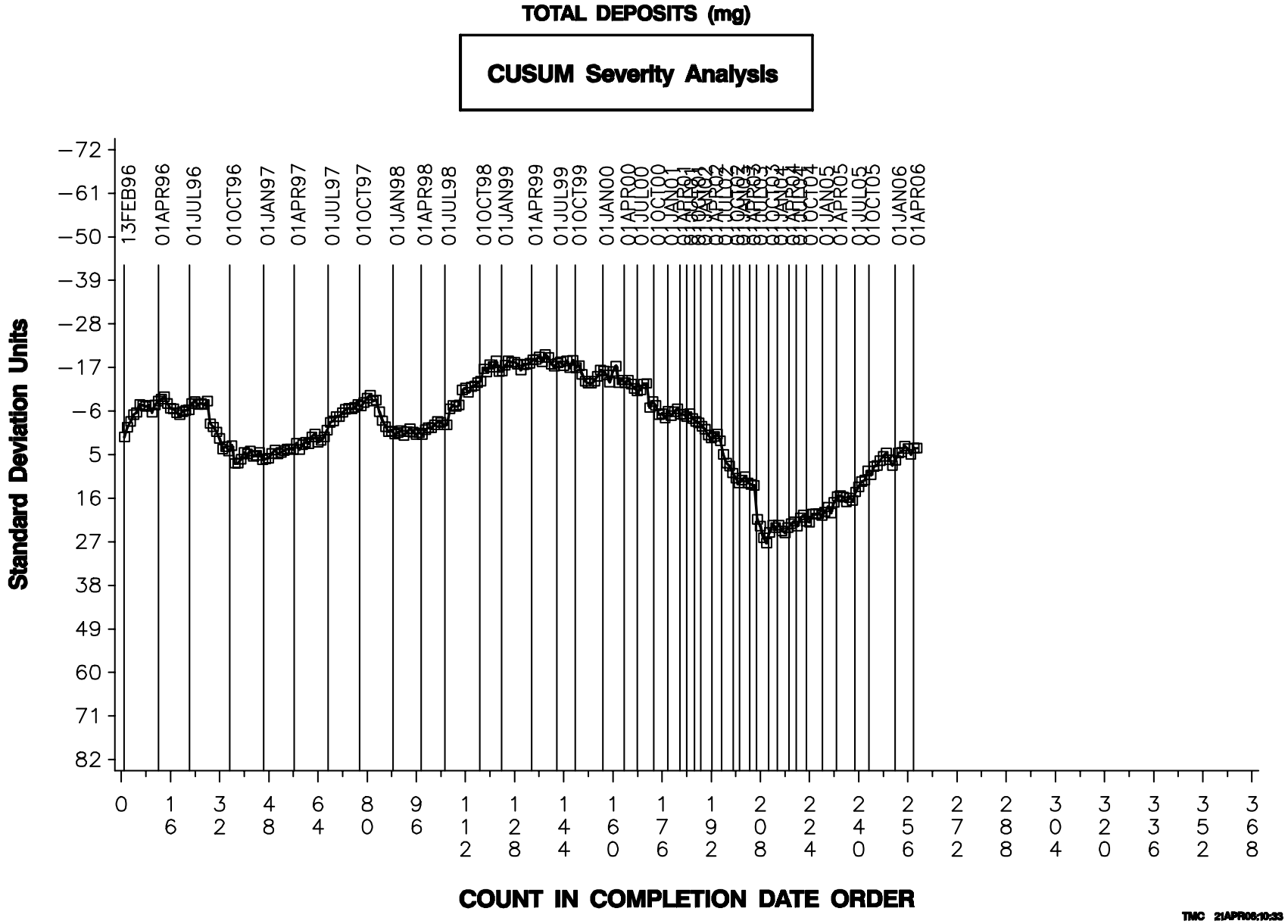


Figure 5A

MHT−4 TEOST INDUSTRY OPERATIONALLY VALID DATA

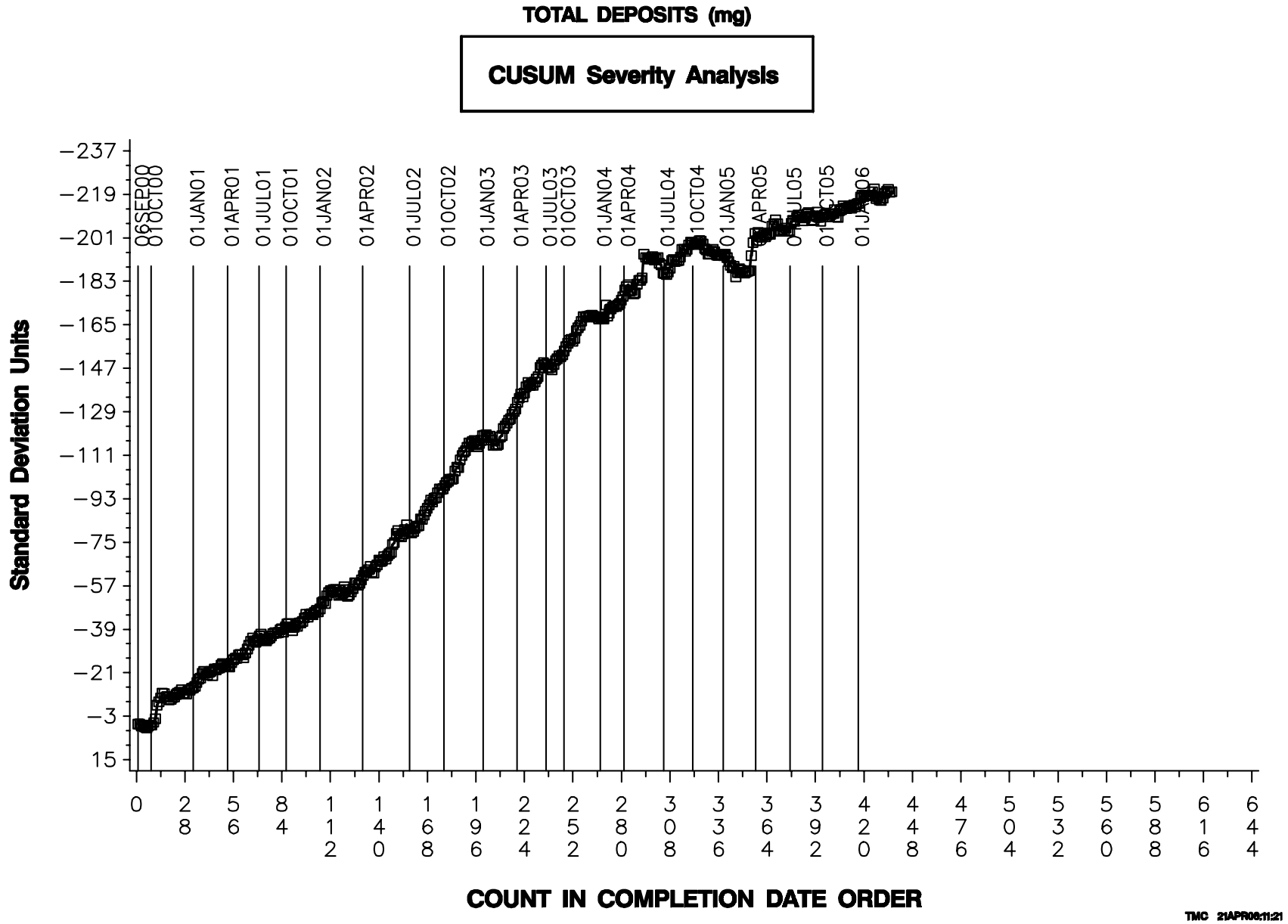
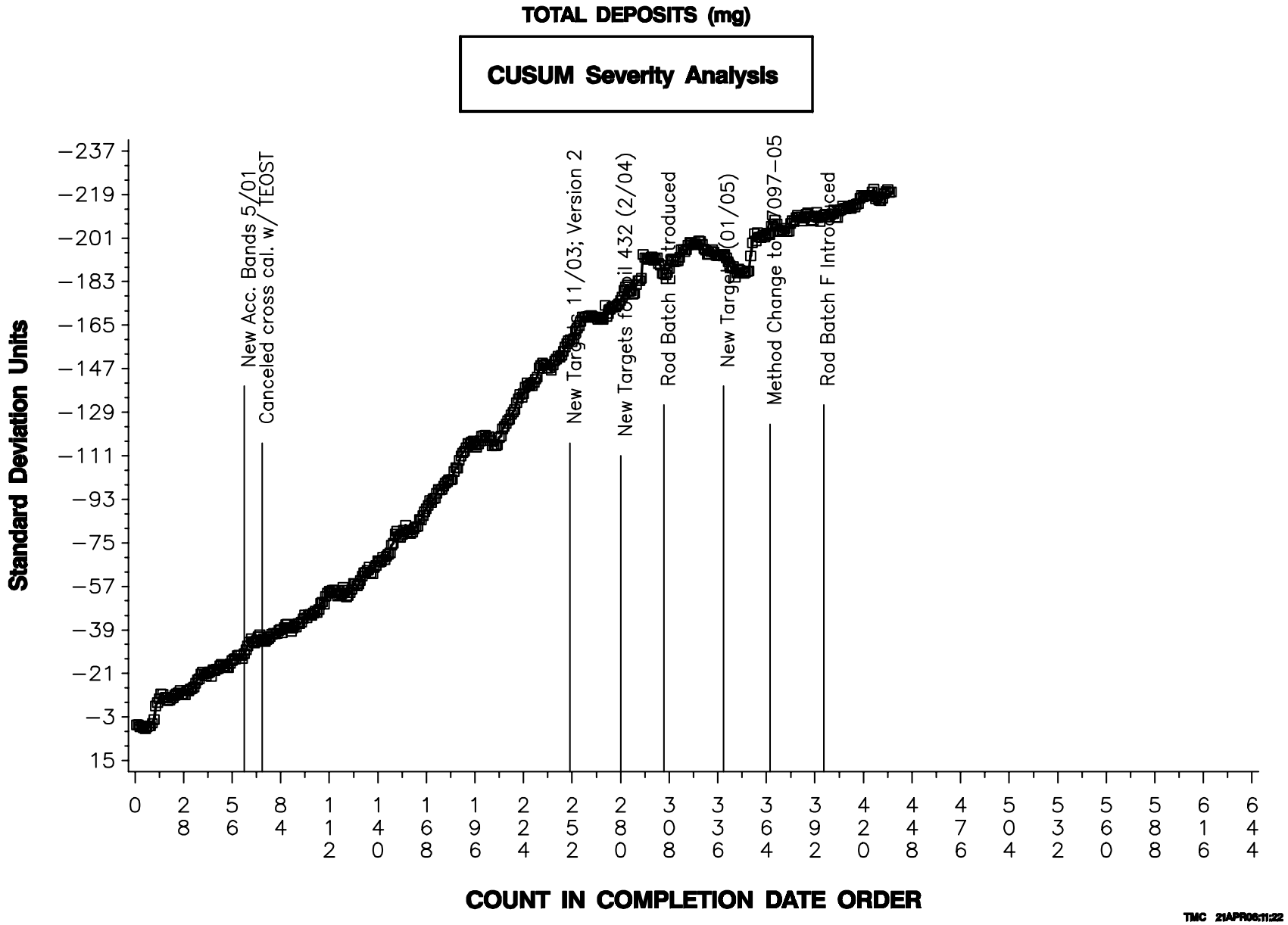
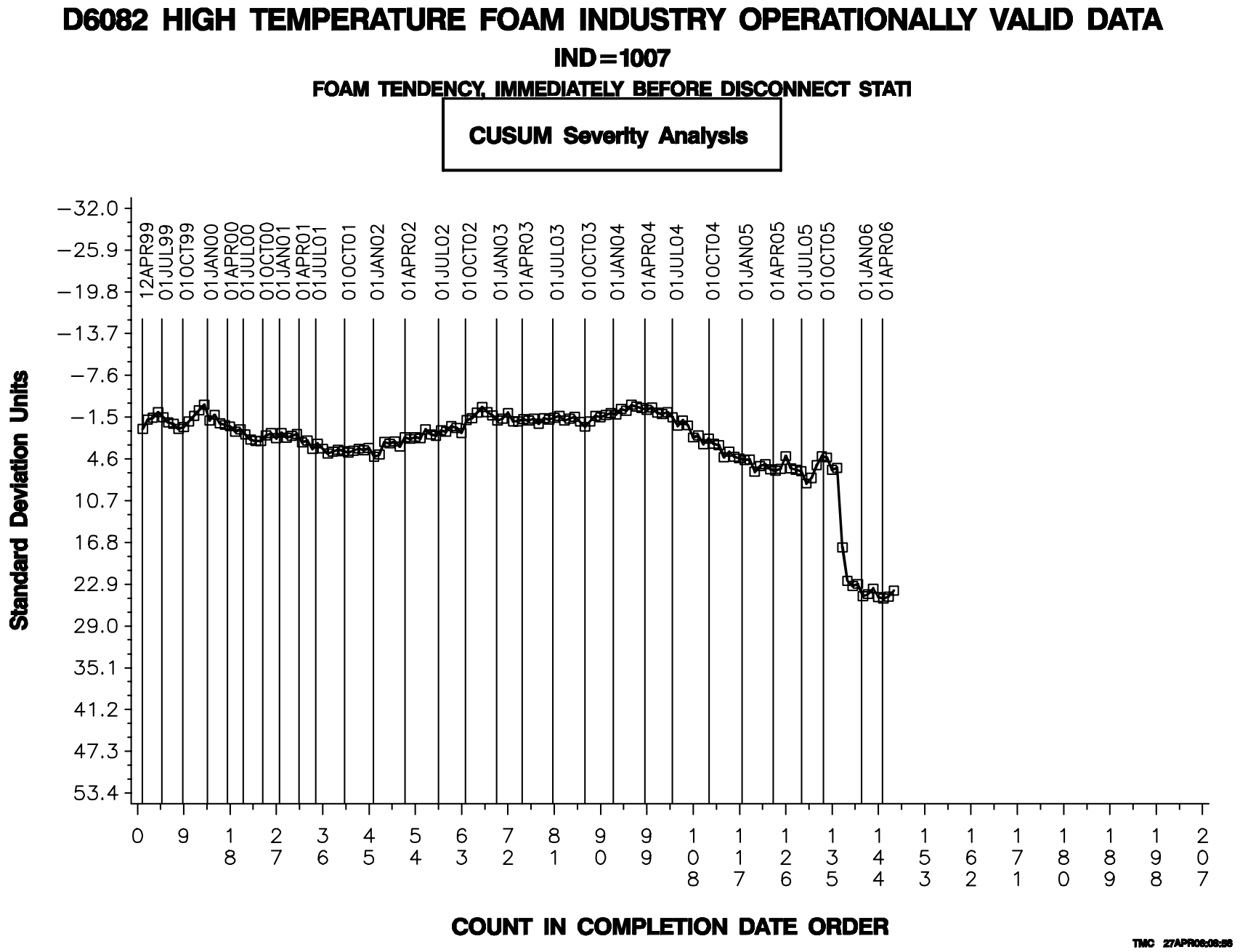


Figure 5B

MHT−4 TEOST INDUSTRY OPERATIONALLY VALID DATA




D6082 HIGH TEMPERATURE FOAM INDUSTRY OPERATIONALLY VALID DATA
IND=1007
FOAM TENDENCY, IMMEDIATELY BEFORE DISCONNECT STATI
CUSUM Severity Analysis
Standard Deviation Units
−32.0
−25.9
−19.8
−13.7
−7.6
−1.5
4.6
10.7
16.8
22.9
29.0
35.1
41.2
47.3
53.4
12APR99
01JUL99
01OCT99
01JAN00
01APR00
01JUL00
01OCT00
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
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01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
0 9 18 27 36 45 54 63 72 81 90 99 108 117 126 135 144 153 162 171 180 189 198 207
COUNT IN COMPLETION DATE ORDER
TMC 27APR06:08:56

BALL RUST TEST INDUSTRY OPERATIONALLY VALID DATA

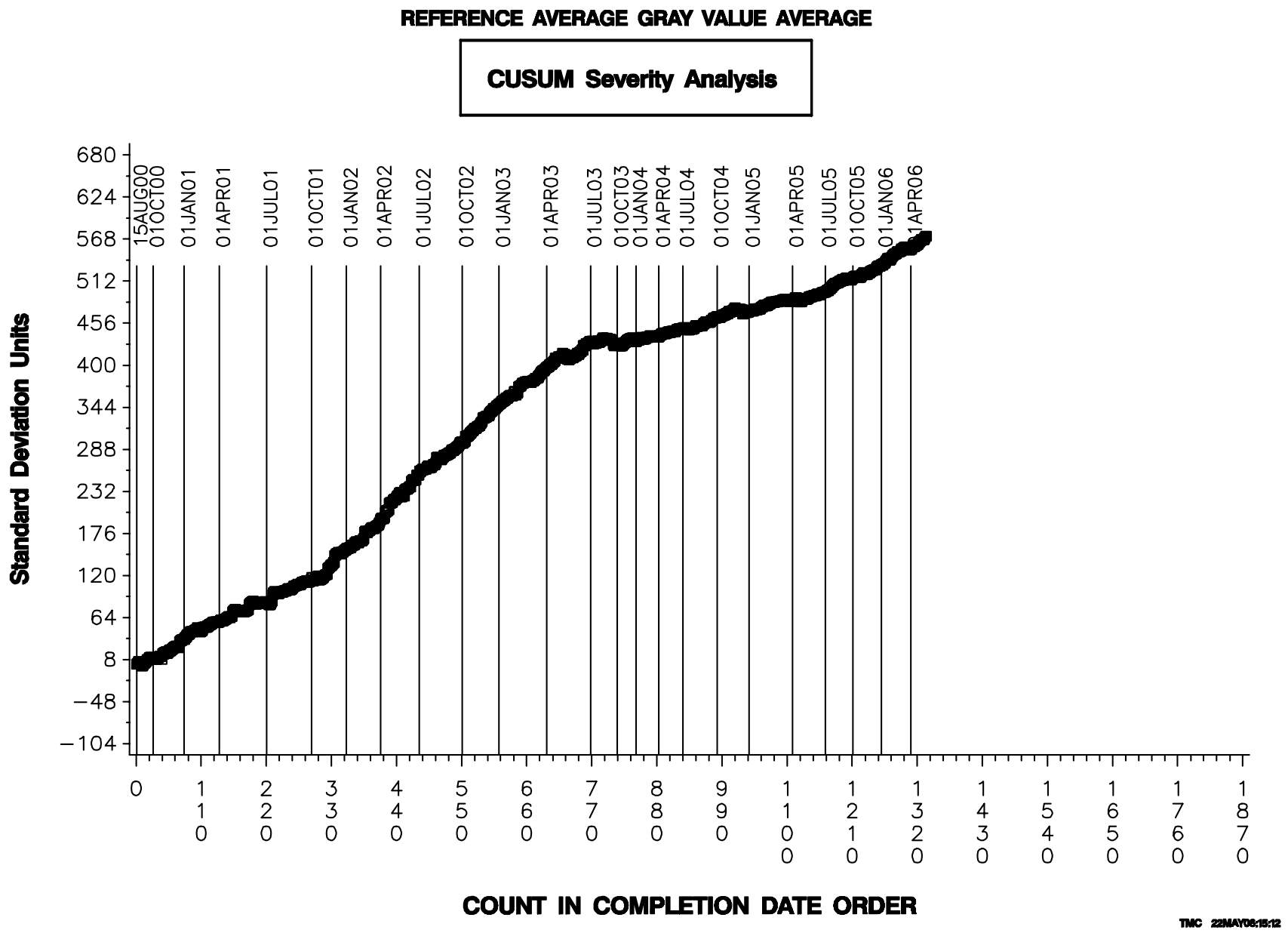
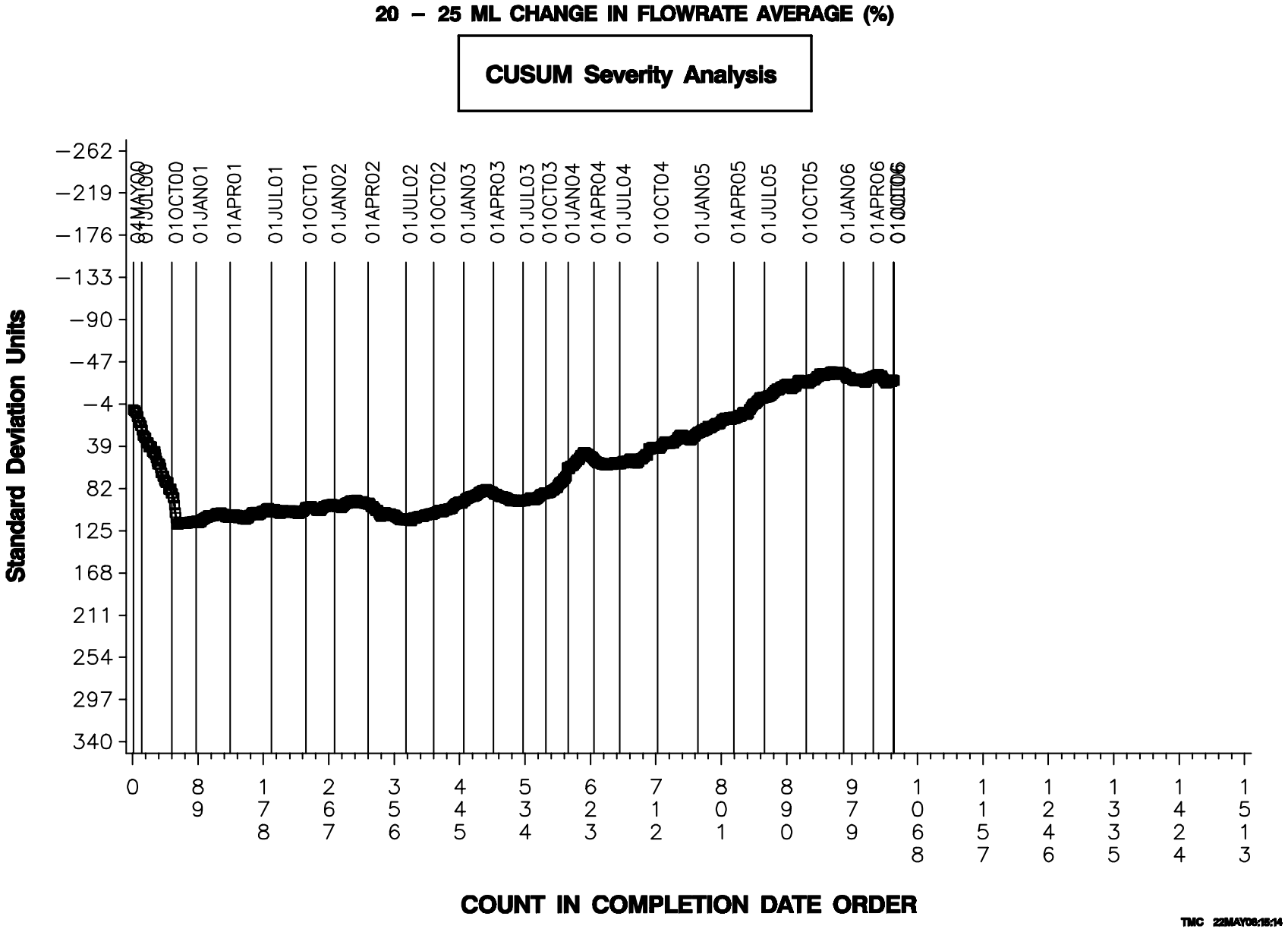


Figure 8

EOFT INDUSTRY OPERATIONALLY VALID DATA

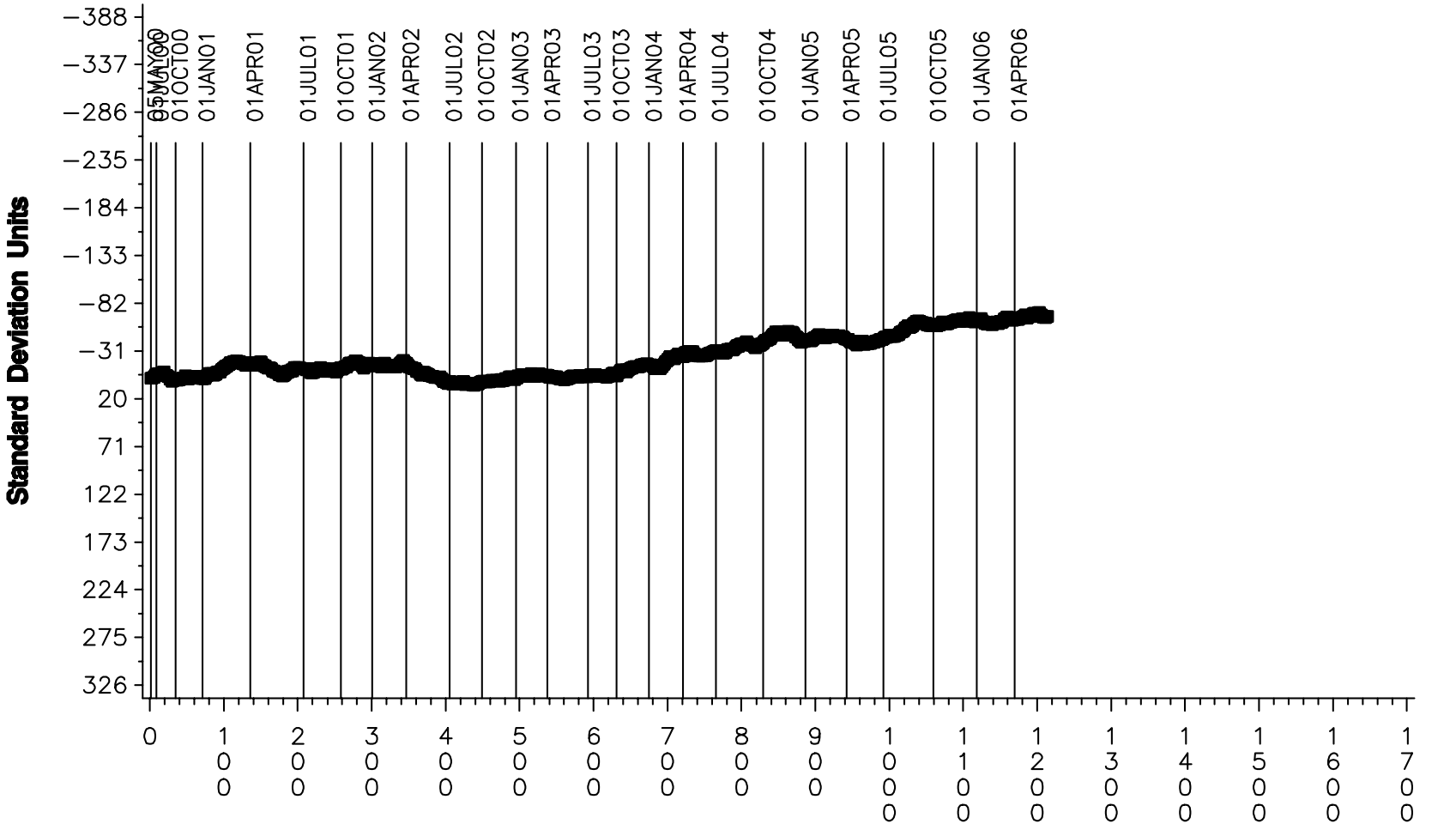


EOWT INDUSTRY OPERATIONALLY VALID DATA

0.6% Water Treatment

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE

CUSUM Severity Analysis



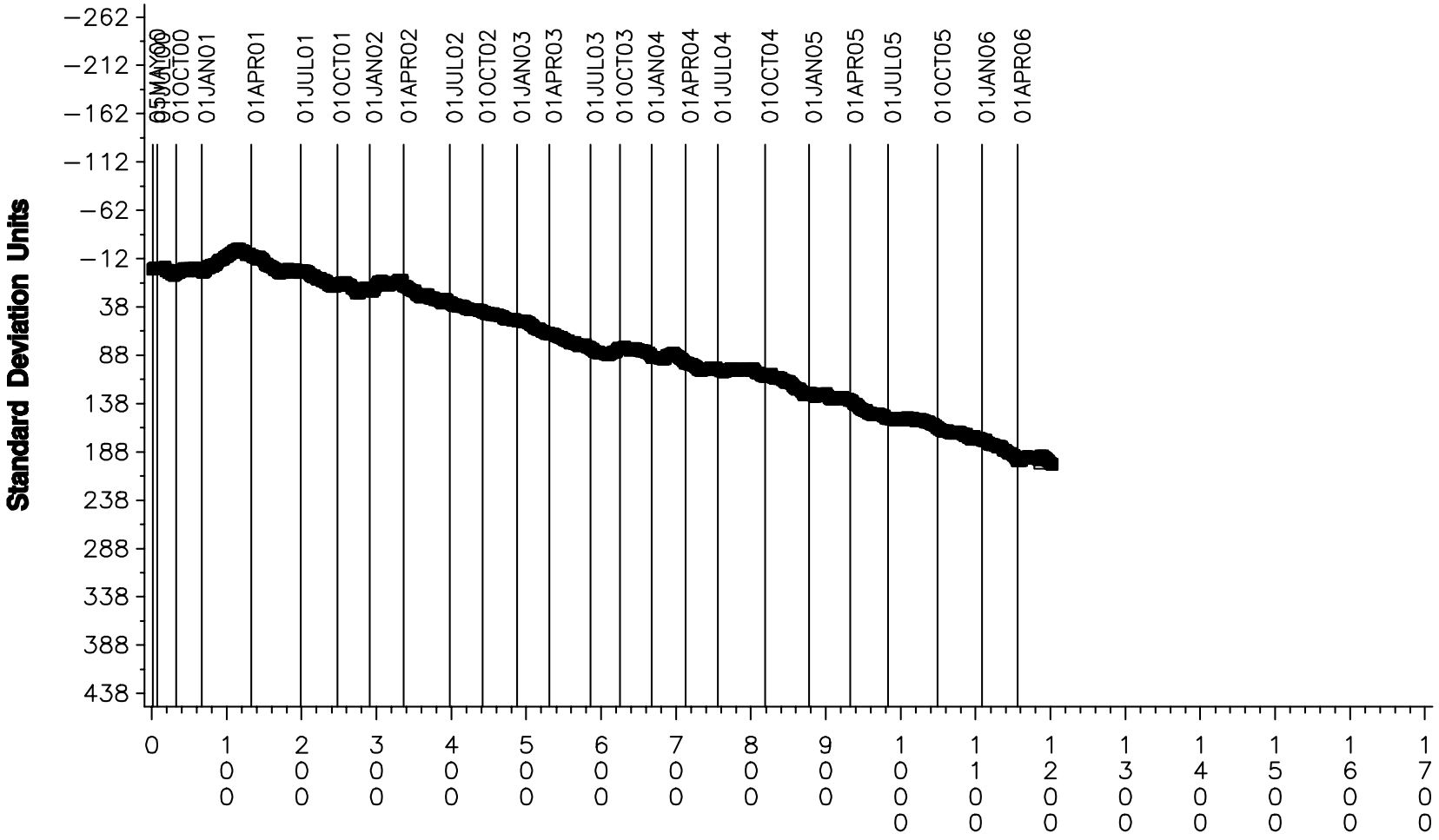
TMC 22MAY08:16:08

EOWT INDUSTRY OPERATIONALLY VALID DATA

1.0% Water Treatment

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE

CUSUM Severity Analysis



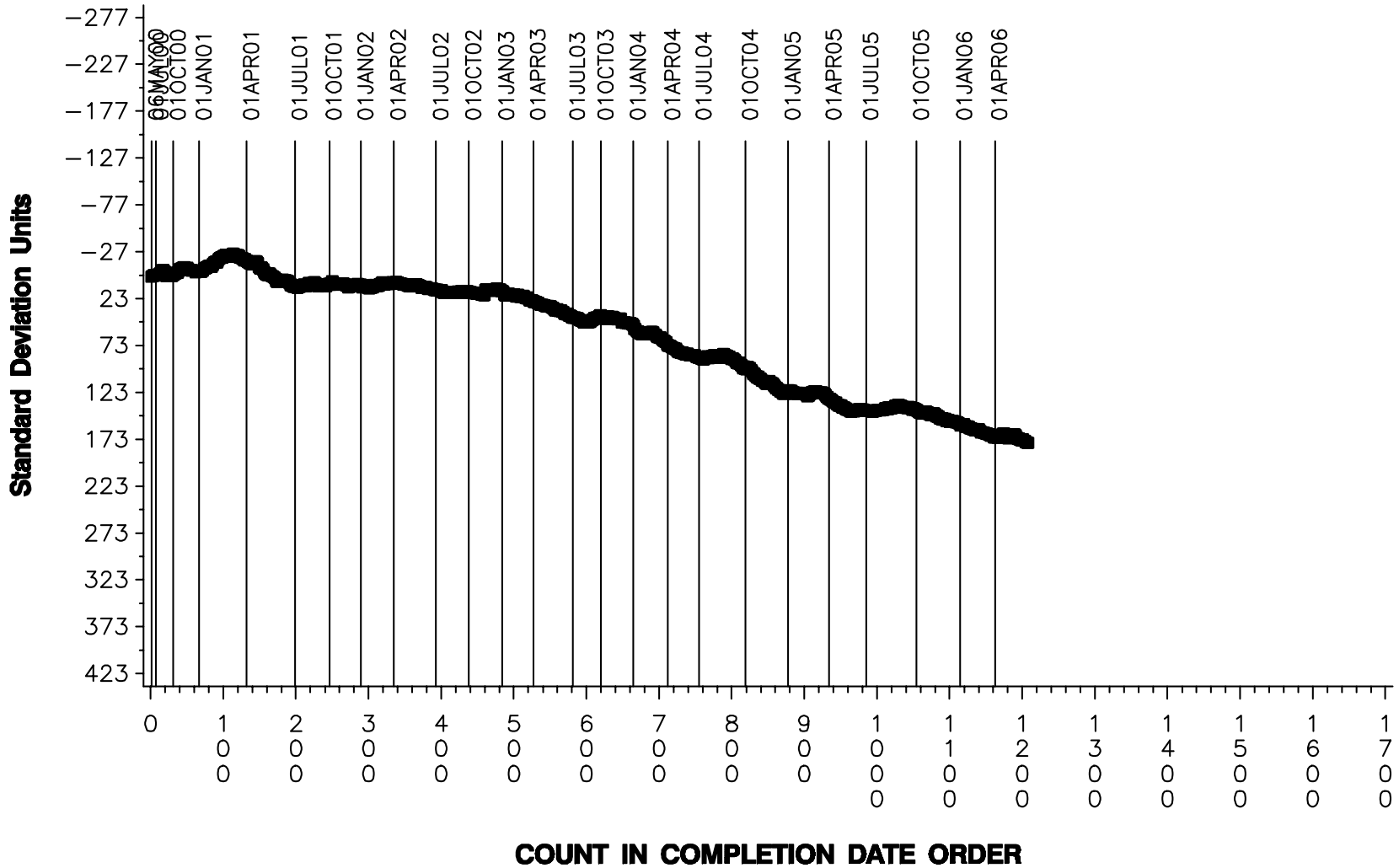
TMC 22MAY08:16:11

EOWT INDUSTRY OPERATIONALLY VALID DATA

2.0% Water Treatment

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE

CUSUM Severity Analysis

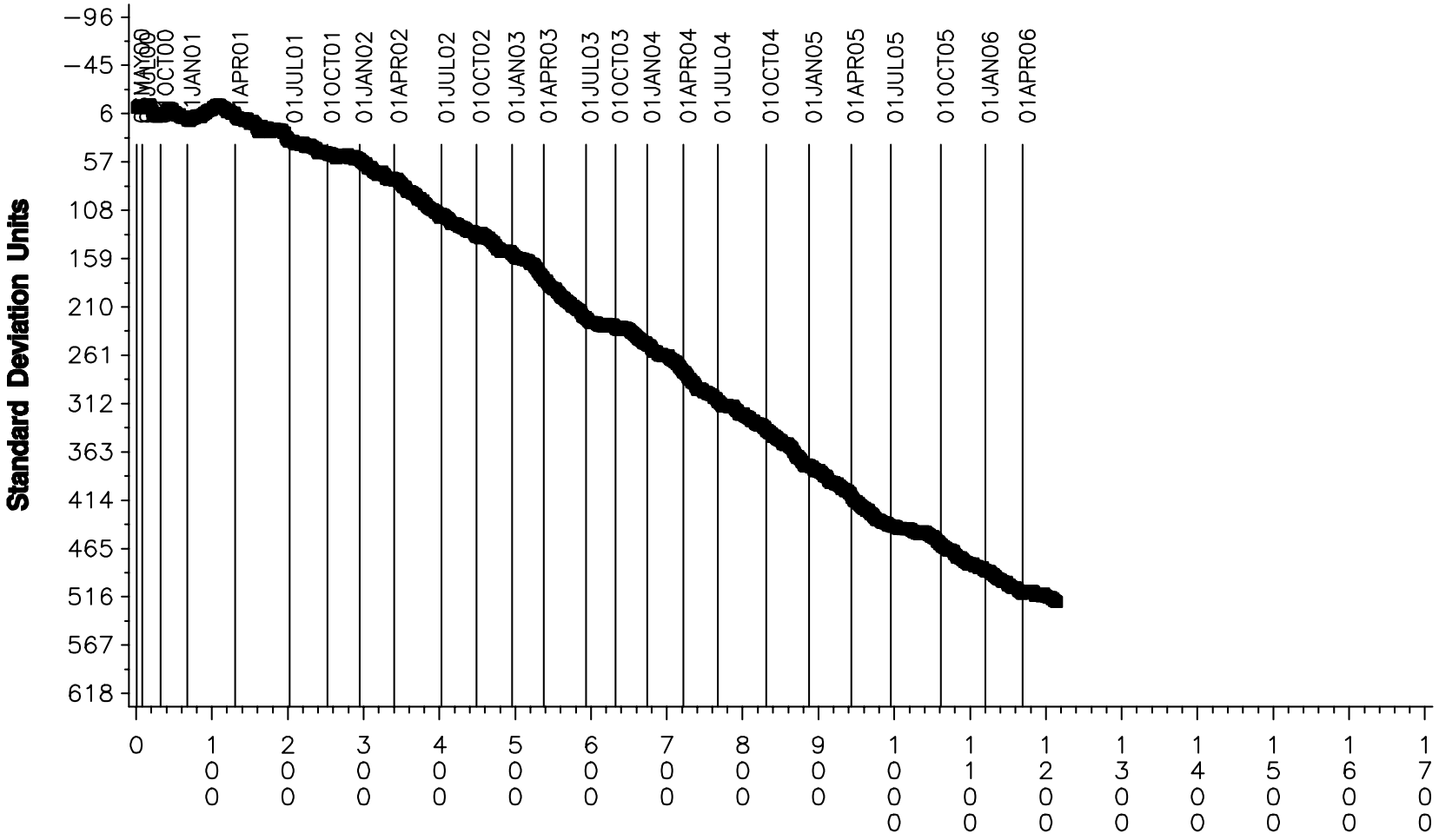


EOWT INDUSTRY OPERATIONALLY VALID DATA

3.0% Water Treatment

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE

CUSUM Severity Analysis



TMC 22MAY06:16:15

Attachment 2

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
New Targets	55	mass % volatility loss	32	17.09	0.76	15.6	18.6
7/21/2003	58	mass % volatility loss	37	15.20	0.72	13.8	16.6
TEOST by	71	Total Deposit wt. (mg)	27	51.79	4.79	42.4	61.2
D6335	72	Total Deposit wt. (mg)	27	26.72	3.46	19.9	33.5
MTEOS by	74	Total Deposit wt. (mg)	17	12.74	4.60	3.7	21.8
D7097-05	432	Total Deposit wt. (mg)	14	47.99	3.67	40.8	55.2
New Targets	434	Total Deposit wt. (mg)	11	27.68	5.57	16.8	38.6
20050630							
GI by	58	Gelation Index	17	5.8	0.69	4.4	7.2
D5133	62	Gelation Index	35	17.0	3.90	9.4	24.6
New Targets	1009	Gelation Index	16	7.3	0.68	6.0	8.6
7/15/2003							
D6082	1007	Tendency (ml)	28	66	19	29	103
(HT FOAM)	1007	Stability (ml)	28	0	0	0	0
D6082	66 (DISCRIM)	Tendency (ml)	--	-----	-----	>100	-----
(HT FOAM)	66 (DISCRIM)	Stability (ml)	--	-----	-----	0	0
BRT by	81	Average AGV	12	112	14.00	85	140
(D6557)	82	Average AGV	12	48	12.50	25	70
D02-1483	1006	Average AGV	12	128	7.21	114	142
EOFT by	78	Δ Flowrate (%)	12	15.74	6.87	2.27	29.21
(Draft 6)							
EOWT by	77	0.6% H20 Δ Flowrate (%)	12	-24.90	5.68	-36.03	-13.77
(Draft 5)	77	1.0% H20 Δ Flowrate (%)	12	-17.94	5.45	-28.62	-7.26
	77	2.0% H20 Δ Flowrate (%)	12	-17.96	8.47	-34.56	-1.36
	77	3.0% H20 Δ Flowrate (%)	12	-18.23	6.83	-31.62	-4.84
EOWT by	78	0.6% H20 Δ Flowrate (%)	12	10.87	6.16	-1.20	22.94
(Draft 5)	78	1.0% H20 Δ Flowrate (%)	12	7.54	6.15	-4.51	19.59
	78	2.0% H20 Δ Flowrate (%)	12	5.17	5.33	-5.27	15.62
	78	3.0% H20 Δ Flowrate (%)	12	-0.54	4.52	-9.40	8.32

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

			Targets			10/1/04 - 3/31/05				4/1/05 - 9/30/05				10/1/05 - 3/31/06			
Test	Oil Code	Parameter	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	8	6.8	0.50	-0.63	6	7.0	0.75	0.20	3	6.6	0.15	-1.30
	55	Area % Volatized	18	11.68	0.51	2	11.8	0.07	0.33	7	11.3	0.59	-0.77	2	11.7	0.14	0.04
	58	Area % Volatized	18	5.61	0.30	6	5.8	0.45	0.63	4	5.6	0.35	0.13	6	5.5	0.27	-0.42
D5800	52	% volatility loss	33	13.75	0.61	11	14.0	0.88	0.42	10	13.9	0.41	0.26	13	13.8	0.44	0.04
**	55	% volatility loss	32	17.09	0.76	14	16.9	0.70	-0.24	12	17.3	0.63	0.24	8	17.5	1.04	0.51
	58	% volatility loss	37	15.20	0.72	10	15.4	0.36	0.25	12	15.3	0.55	0.20	13	15.1	0.77	-0.18
TEOST	71	Deposit wt. (mg)	27	51.79	4.79	5	48.0	8.17	-0.80	5	45.5	3.87	-1.30	10	48.2	5.04	-0.75
(D6335)	72	Deposit wt. (mg)	27	26.72	3.46	5	27.2	3.54	0.15	6	25.8	4.33	-0.25	4	29.7	4.71	0.87
MTEOS	432	Deposit wt. (mg)	14	47.99	3.67	12	48.3	3.46	1.15	11	46.0	5.08	-0.23	10	45.9	4.39	-0.56
(D7097)	434	Deposit wt. (mg)	11	27.68	5.57	8	24.9	8.17	-1.95	14	29.3	7.07	-0.24	15	25.7	9.10	-0.36
***	74	Deposit wt. (mg)	17	12.74	4.60	8	11.9	3.86	-0.42	14	12.9	6.49	-0.07	15	12.9	4.79	0.04
GI	58	Gelation Index	17	5.8	0.69	12	6.9	1.78	1.62	5	6.0	0.66	0.35	8	6.0	0.66	0.29
(D5133)	62	Gelation Index	35	17.0	3.90	10	16.1	4.14	-0.22	10	17.8	4.97	0.21	6	13.3	5.96	-0.96
****	1009	Gelation Index	16	7.30	0.68	12	7.1	0.74	-0.31	7	6.6	0.38	-1.07	8	7.3	0.39	-0.02
D6082	1007	Tendency (ml)	28	65	19	12	73	16	0.37	10	62	25	-0.19	11	102	70	1.87

**D5800 Targets Adjusted 10/2/00; new oils selected; new procedures approved; targets adjusted again 7/21/03
***MTEOS Targets Adjusted: 6/1/01 (matrix); 11/1/03 (SC9 RR2); 2/18/04 (add 432); 1/12/05 (add 434, drop 433 & 1006); 6/30/05 (Batch E ref. data)
****GI: Added oil 1009 and dropped oils 52 & 53 10/15/03; added oil 58 10/24/01; dropped oils 51 & 55 7/2/01

Attachment 3B

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

Test	Oil Code	Parameter	Targets			10/1/04 - 3/31/05			4/1/05 - 9/30/05			10/1/05 - 3/31/06			
			n	Mean	sR	n	Mean	sR	n	Mean	sR	n	Mean	sR	Mean Δ/s
BRT	1006	Average AGV	12	128	7.21	27	124.3	10.57	23	126.5	5.12	22	126.2	6.71	-0.25
(D6557)	81	Average AGV	12	112	14.00	69	122.2	6.84	60	121.2	12.59	52	125.0	7.69	0.93
	82	Average AGV	12	48	11.50	31	42.5	9.01	20	44.3	7.08	24	45.4	10.85	-0.18
EOFT	77	Avg. % CF	12	-45.55	4.36	0	-----	-----	--	--	--	--	--	--	--
	78	Avg. % CF	12	15.74	6.87	105	13.7	6.58	98	13.2	6.74	91	15.4	6.14	-0.05
EOWT	77	0.6 H2O Avg. %CF	12	-24.90	5.68	59	-25.8	5.32	55	-25.3	4.80	69	-25.0	6.41	-0.02
	77	1.0 H2O Avg. %CF	12	-17.94	5.45	54	-15.8	4.58	51	-15.7	2.95	63	-15.0	4.04	0.53
	77	2.0 H2O Avg. %CF	12	-17.96	8.47	56	-13.5	5.99	70	-15.5	4.15	65	-13.8	5.66	0.49
	77	3.0 H2O Avg. %CF	12	-18.23	6.83	59	-15.0	5.35	57	-16.9	3.93	69	-16.0	4.84	0.32
EOWT	78	0.6 H2O Avg. %CF	12	10.87	6.16	54	11.3	7.01	63	9.7	5.37	41	10.2	5.28	-0.11
	78	1.0 H2O Avg. %CF	12	7.54	6.15	60	7.9	6.44	66	8.2	4.87	44	7.7	5.43	0.02
	78	2.0 H2O Avg. %CF	12	5.17	5.33	59	5.5	5.93	51	4.2	4.86	43	4.9	5.19	-0.05
	78	3.0 H2O Avg. %CF	12	-0.54	4.52	53	2.9	4.76	62	2.5	3.85	39	2.9	2.93	0.76