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

MEMORANDUM: 08-031

DATE: May 2, 2008

TO: Ball Rust Test Surveillance Panel

FROM: Michael T. Kasimirsky

SUBJECT: Reference Oil 82

Recently the Chairman expressed some concerns over the performance of reference oil 82 in the Ball Rust Test and that perhaps the oil had degraded, making it no longer suitable for use in reference oil testing, and he asked the TMC to investigate the issue further.

Tom Schofield, the TMC's Supervisor of Analytical Testing, was asked to review the in house Quality Control (QC) data on this reference oil to look for any potential problems with it. He has previously investigated this oil, at the request of a laboratory, in July 2007 and the results of his investigation are detailed below:

A more controlled 40°C viscosity measurement indicates no significant difference between fresh TOP("top of the drum" oil sample) & BQL ("scrape the bottom of the drum" oil sample) samples taken last week from the same container that your referenced samples are poured from, and compared with the TOP sample taken last November (2006). These samples appear to be about 0.5-0.7 cSt more viscous than our representative lab sample, but the lab sample appears to have absorbed a little atmospheric moisture (not unusual), which might account for the slightly lower viscosity seen in our representative lab sample. (Trace atmospheric moisture absorption is a common observance, especially with our lab samples.)

Comparison of the drum samples to our initial 40°C viscosity results shows reasonably good correlation as well, no notable change.

I don't see anything else in any of our QC data that would suggest that oil 82 has changed in any significant way from when it was first received. These analyses include D445 40°C viscosity, differential FTIR and visual inspection of TOP and BQL samples compared to our representative lab sample and to a QC sample taken November 2006. Additionally, the November QC showed no problems with the additional analyses of D5185 ICP & D4739M TBN.

While the 40°C viscosity seemed a little harder then usual to pin down on this oil, I can't say that it has actually changed over time. If it had, it's very subtle, and I would expect to see changes in the IR profile as well, and there is no such changes observed in the IR profiles.

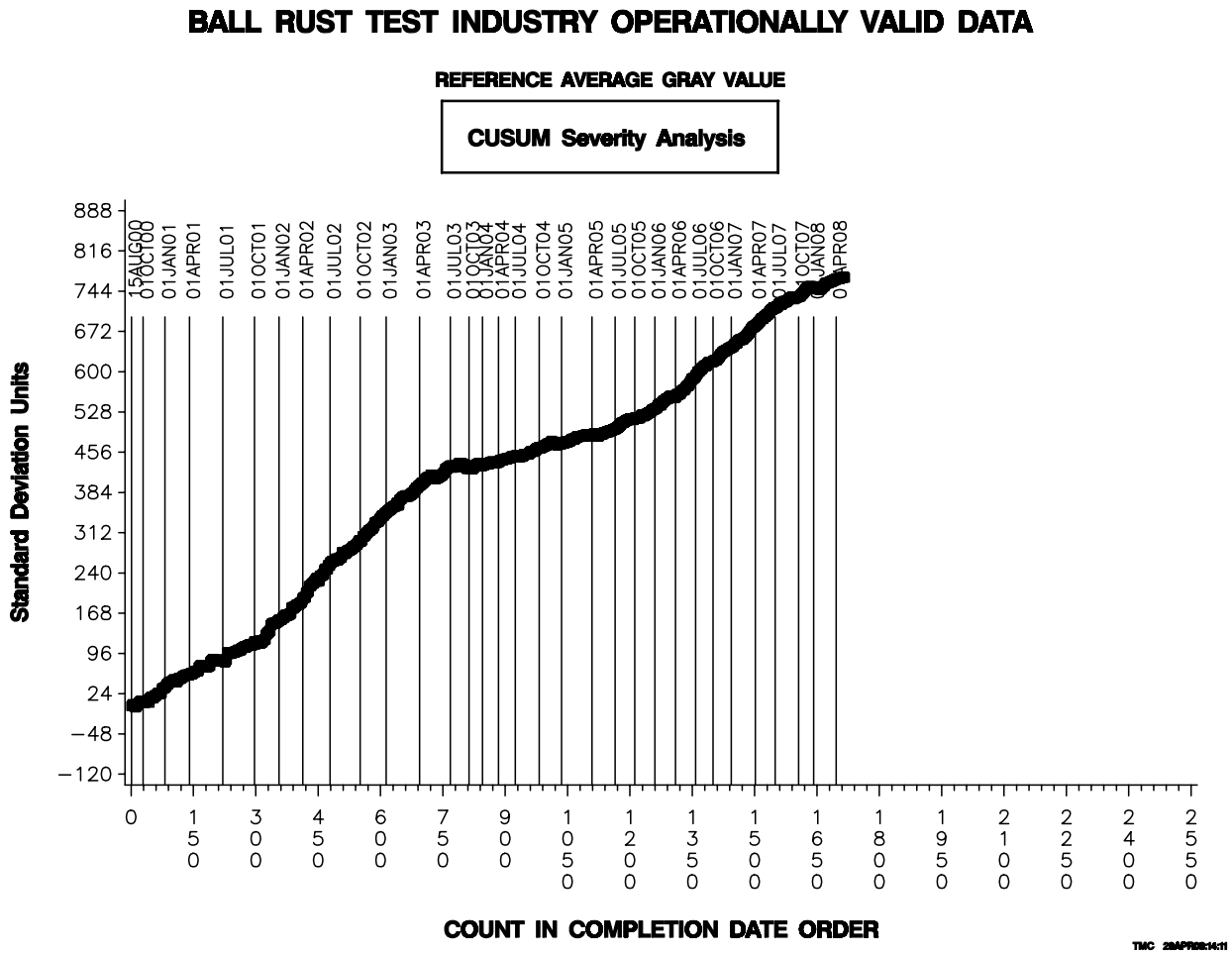
*Frankly, from my 26 years of experience with analyzing reference oils for the TMC, the fact that there is visually absolutely **no** dropout observed in the recent BQL sample tells me this oil remains stable. Of all the advanced testing that we do, a simple visual inspection of the BQL sample is still my best qualitative indicator that an oil may be changing!*

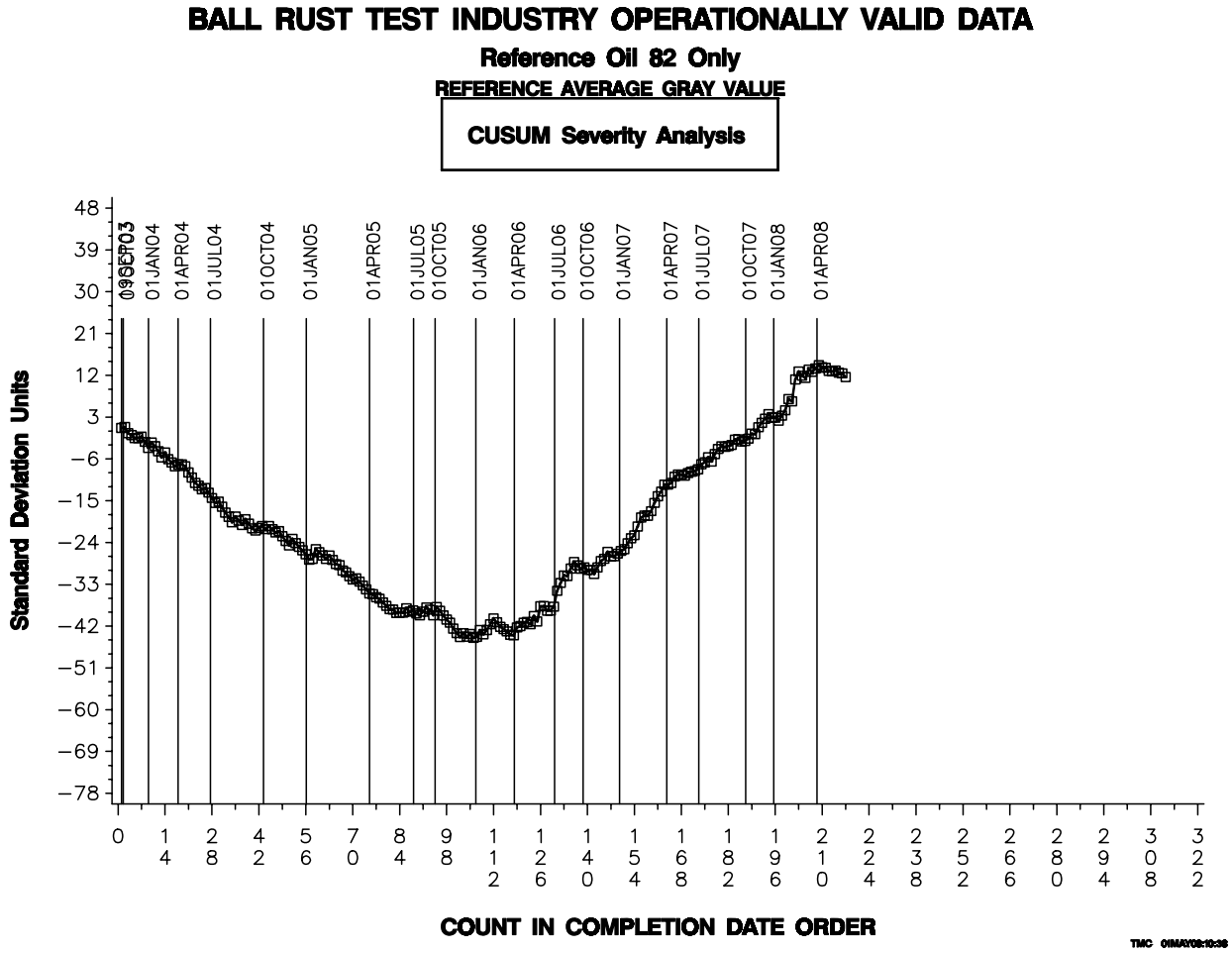
*It is my opinion, "given the preponderance of the data," and after careful and thorough review of the TMC's QC data, re-sampling of the drum and confirming analyses of the 40°C kinematic viscosities as well as running additional differential IR's, that oil 82 **has not** significantly changed in it's chemical and physical properties from when it was first received and analyzed by the TMC, within the scope and limits of our analyses.*

Tom Schofield
Supervisor, Analytical Testing

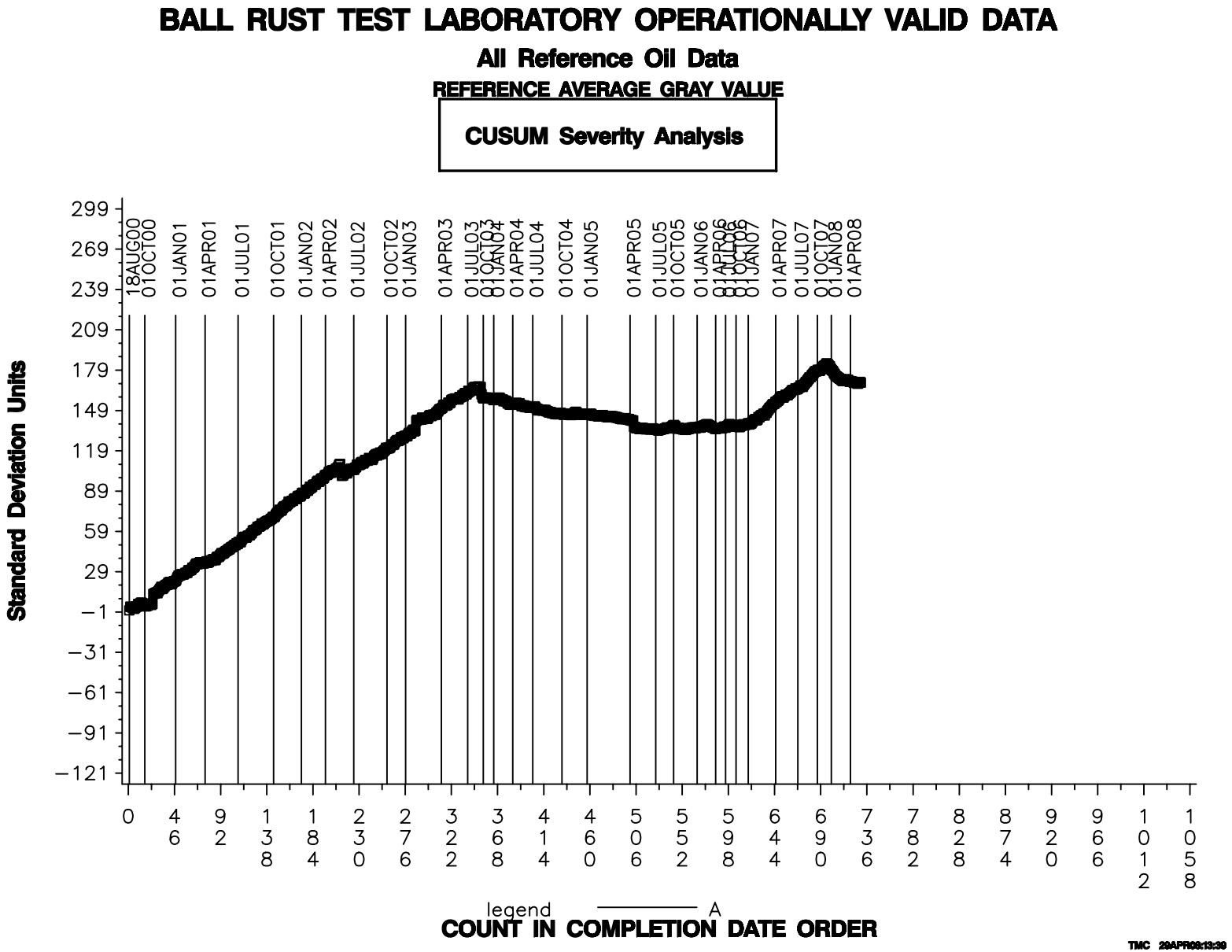
Mr. Schofield was again asked to take a look at reference oil 82 and see if more recent QC data had indicated any changes in the oil since that analysis was completed. He did not note any significant changes in the oil's QC data since that time.

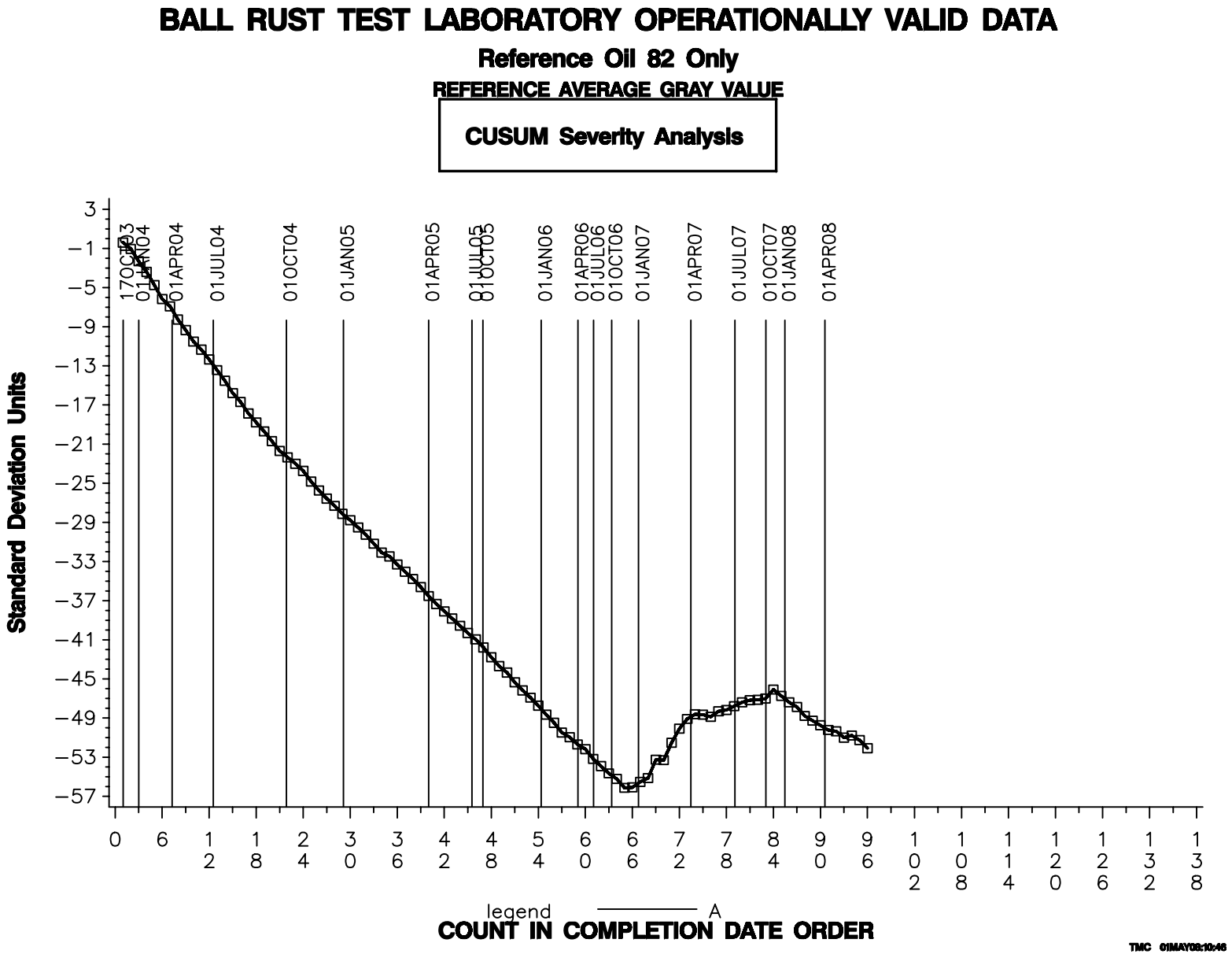
Next, we reviewed the CUSUM plots for the industry, on all reference oils and also using only reference oil 82 data. These plots are shown below.

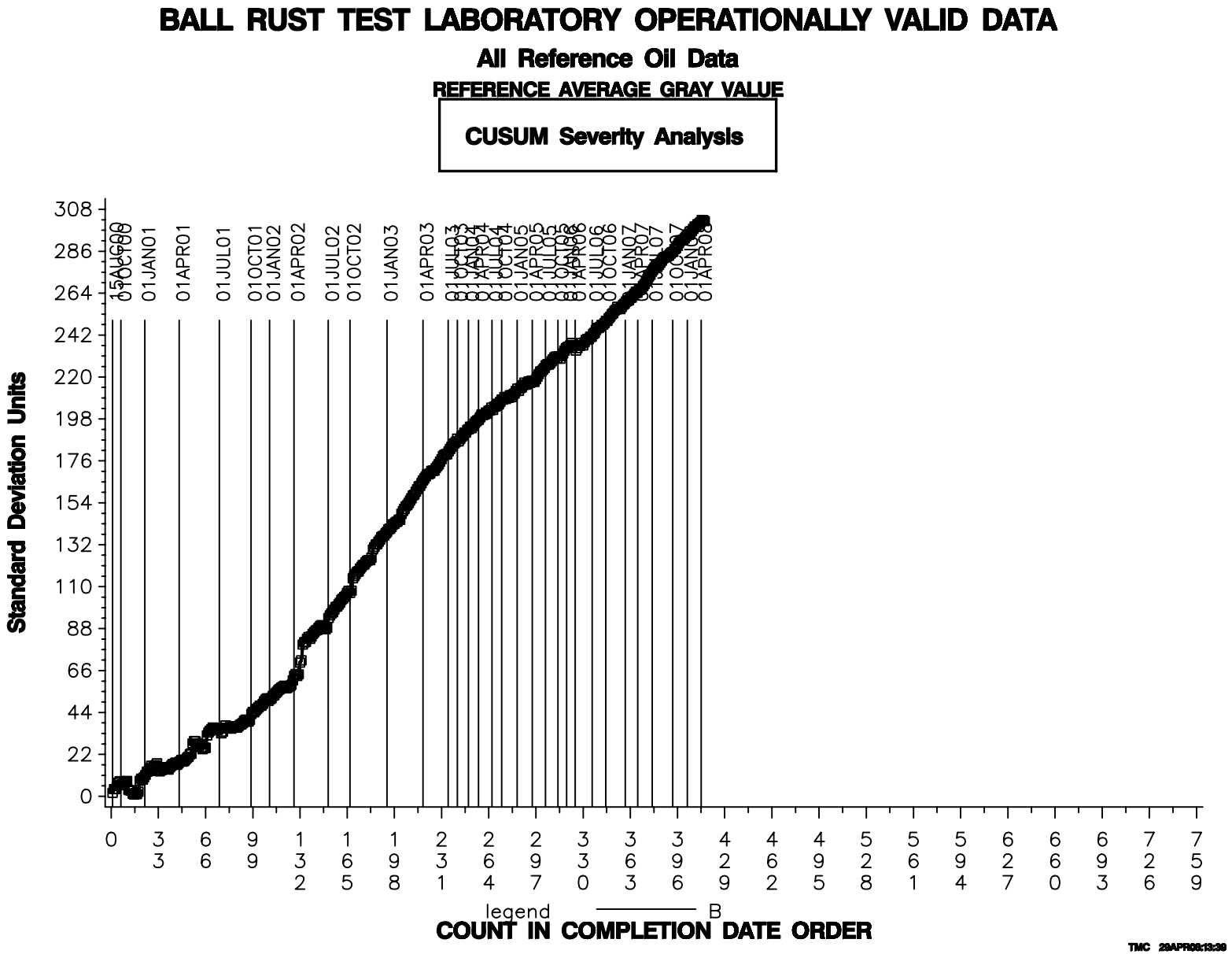


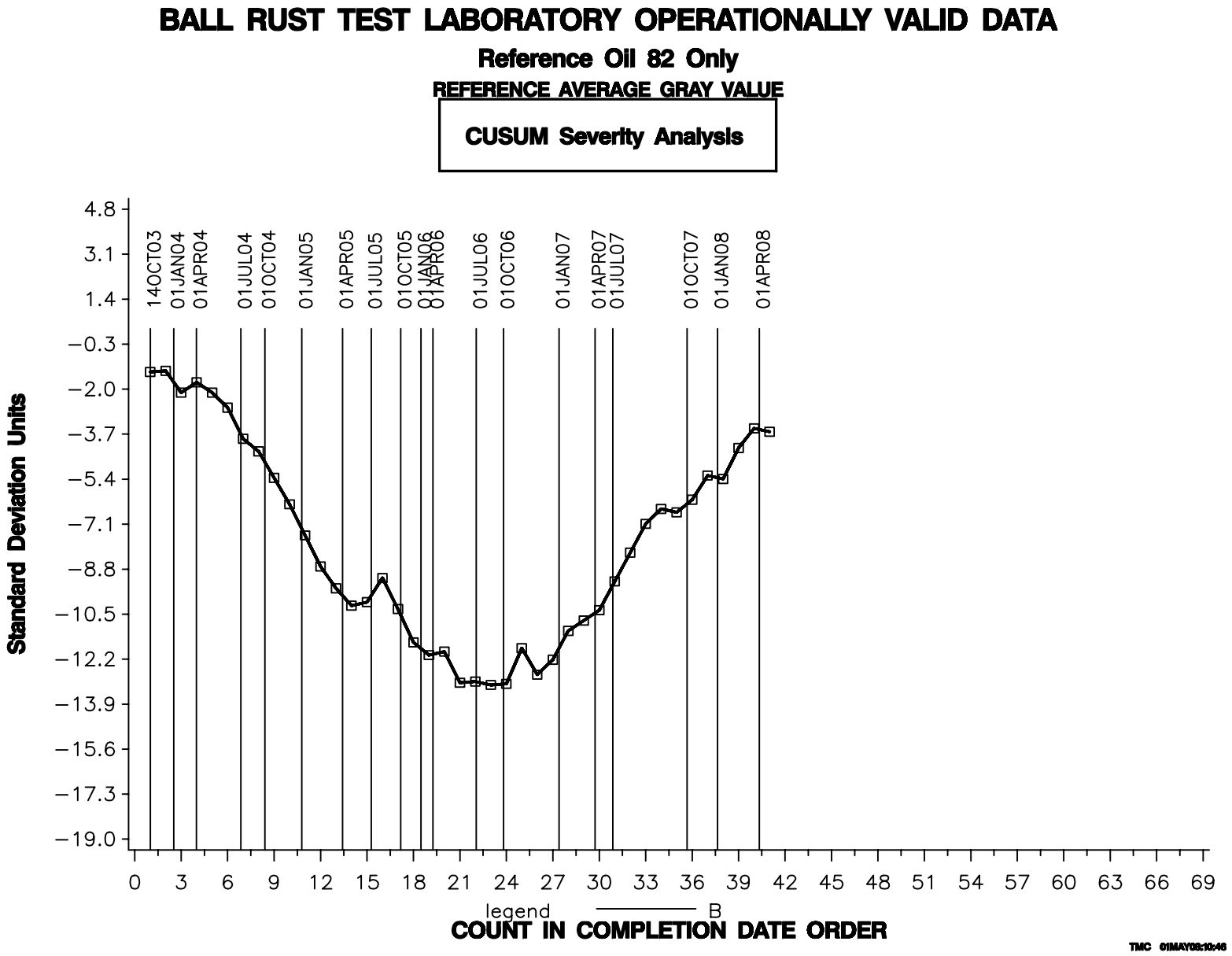


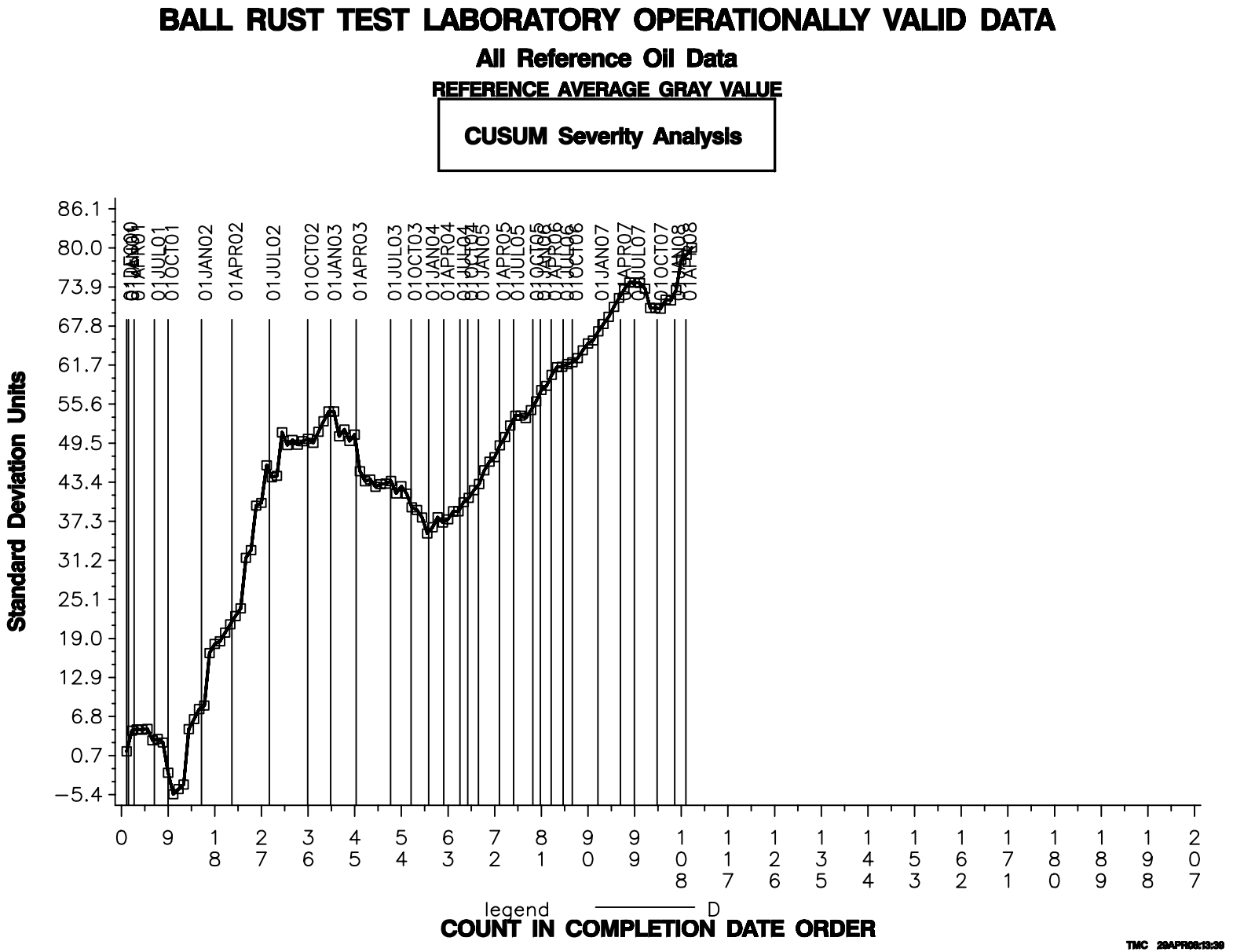
The first plot indicates that industry performance has been consistently mild since 2000. However, from the second plot (reference oil 82 only), it does appear that some change in performance may have taken place in early 2006. To investigate any possible laboratory effects on the test, the individual CUSUM plots for each test laboratory, on all oils and on reference oil 82 only, were reviewed. This review of individual laboratory CUSUM plots suggests that this problem may be laboratory-related. These CUSUM plots are shown on the following pages.

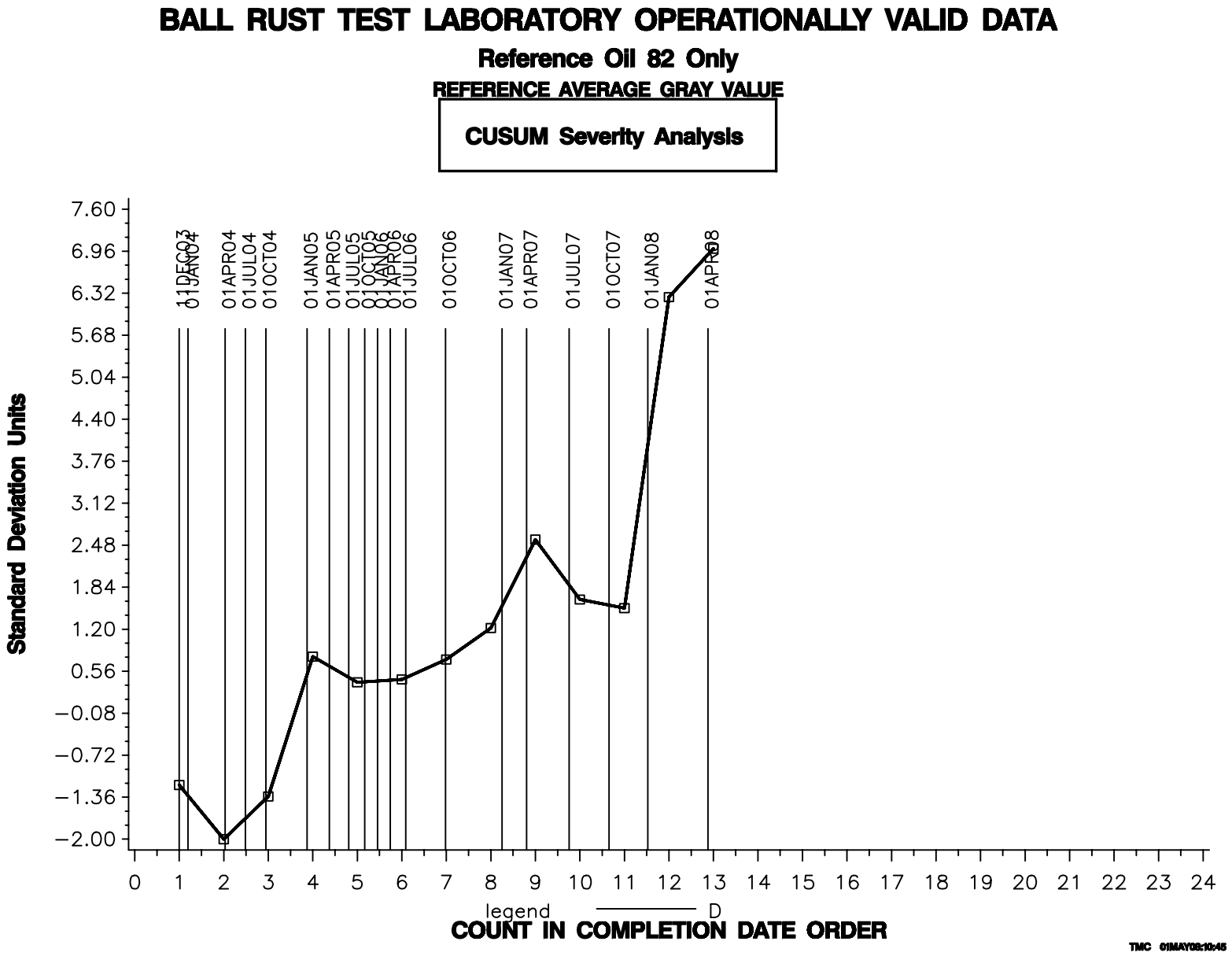

BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
All Reference Oil Data
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
299
269
239
209
179
149
119
89
59
29
−1
−31
−61
−91
−121
18AUG00
01OCT00
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
01JUL02
01OCT02
01JAN03
01APR03
01JUL03
01OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
0
46
92
138
184
230
276
322
368
414
460
506
552
598
644
690
736
782
828
874
920
966
1012
1058
legend A
COUNT IN COMPLETION DATE ORDER
TMC 29APR08:13:39

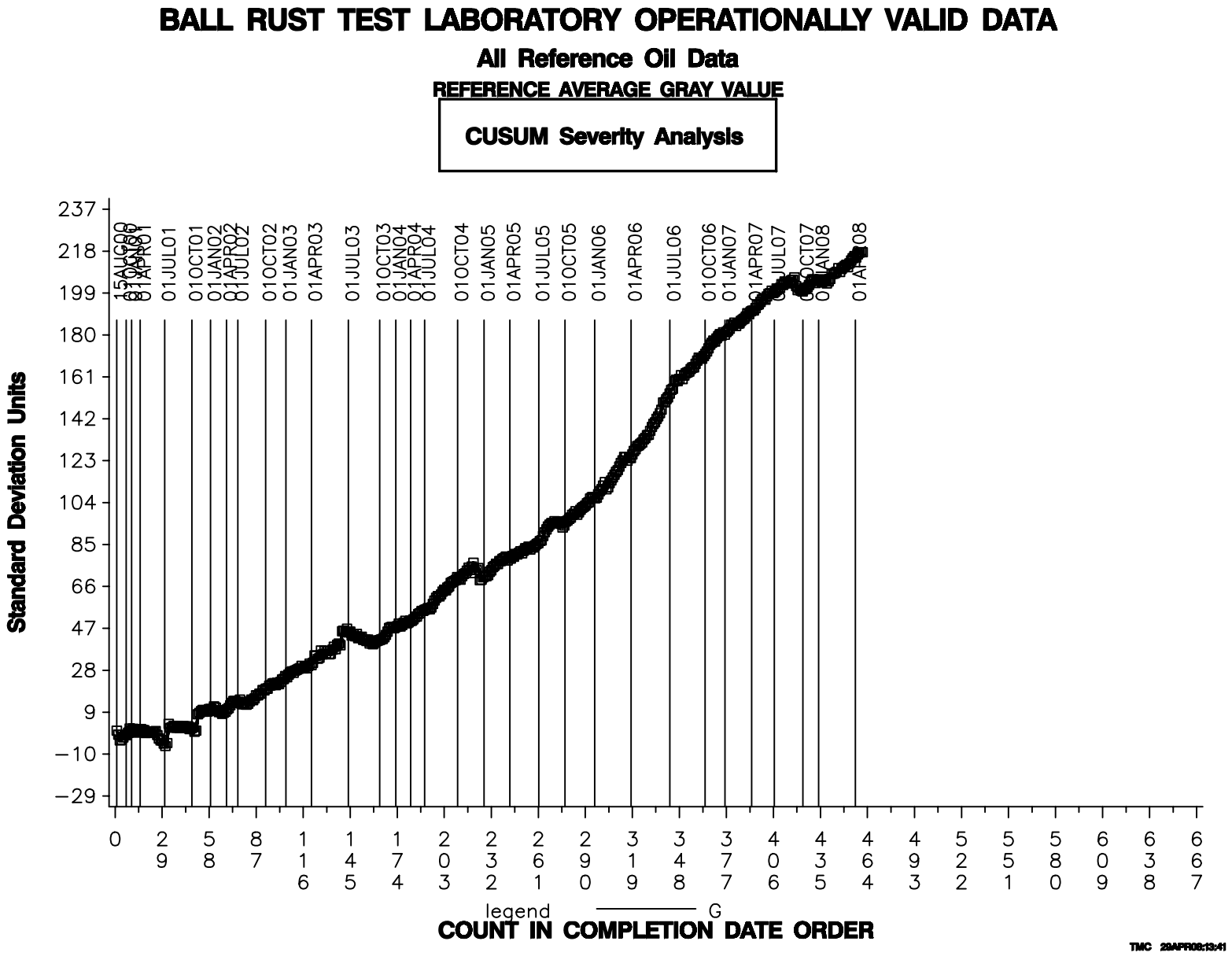

BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
Reference Oil 82 Only
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
3
−1
−5
−9
−13
−17
−21
−25
−29
−33
−37
−41
−45
−49
−53
−57
17OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138
legend A
COUNT IN COMPLETION DATE ORDER
TMC 01MAY08:10:46

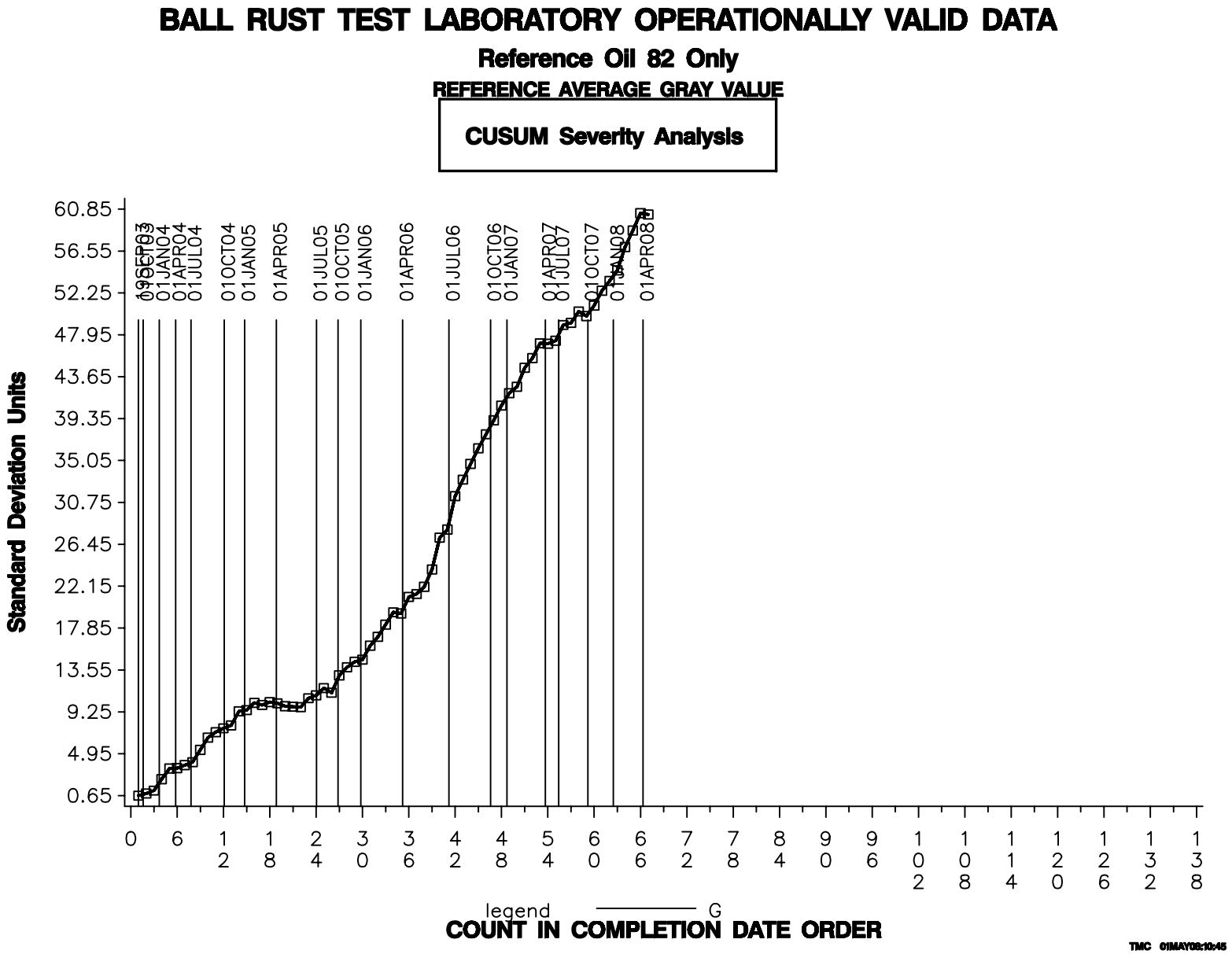

BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
All Reference Oil Data
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
308
286
264
242
220
198
176
154
132
110
88
66
44
22
0
01JAN01
01APR01
01JUL01
01OCT01
01JAN02
01APR02
01JUL02
01OCT02
01JAN03
01APR03
01JUL06
01OCT06
0 33 66 99 132 165 198 231 264 297 330 363 396 429 462 495 528 561 594 627 660 693 726 759
legend B
COUNT IN COMPLETION DATE ORDER
TMC 29APR08:13:39


BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
Reference Oil 82 Only
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
4.8
3.1
1.4
−0.3
−2.0
−3.7
−5.4
−7.1
−8.8
−10.5
−12.2
−13.9
−15.6
−17.3
−19.0
14OCT03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69
legend B
COUNT IN COMPLETION DATE ORDER
TMC 01MAY08:10:46


BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
All Reference Oil Data
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
86.1
80.0
73.9
67.8
61.7
55.6
49.5
43.4
37.3
31.2
25.1
19.0
12.9
6.8
0.7
−5.4
01JAN02
01APR02
01JUL02
01OCT02
01JAN03
01APR03
01JUL03
01OCT03
01JAN04
01APR04
01JAN05
01APR05
01JUL05
01JAN07
01APR07
01JUL07
01OCT07
0 9 18 27 36 45 54 63 72 81 90 99 108 117 126 135 144 153 162 171 180 189 198 207
legend D
COUNT IN COMPLETION DATE ORDER
TMC 29APR08:13:39


BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
Reference Oil 82 Only
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
7.60
6.96
6.32
5.68
5.04
4.40
3.76
3.12
2.48
1.84
1.20
0.56
−0.08
−0.72
−1.36
−2.00
01DEC03
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
legend D
COUNT IN COMPLETION DATE ORDER
TMC 01MAY08:10:45


BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
All Reference Oil Data
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
237
218
199
180
161
142
123
104
85
66
47
28
9
−10
−29
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
0
29
58
87
116
145
174
203
232
261
290
319
348
377
406
435
464
493
522
551
580
609
638
667
legend G
COUNT IN COMPLETION DATE ORDER
TMC 29APR08:13:41


BALL RUST TEST LABORATORY OPERATIONALLY VALID DATA
Reference Oil 82 Only
REFERENCE AVERAGE GRAY VALUE
CUSUM Severity Analysis
Standard Deviation Units
60.85
56.55
52.25
47.95
43.65
39.35
35.05
30.75
26.45
22.15
17.85
13.55
9.25
4.95
0.65
01JAN04
01APR04
01JUL04
01OCT04
01JAN05
01APR05
01JUL05
01OCT05
01JAN06
01APR06
01JUL06
01OCT06
01JAN07
01APR07
01JUL07
01OCT07
01JAN08
01APR08
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138
legend G
COUNT IN COMPLETION DATE ORDER
TMC 01MAY08:10:45

A review of the CUSUM plots on reference oil 82 only shows a change in performance at both labs A and B, however labs D and G show no such change. In addition, the change in performance at Lab A is not consistent with the change at lab B in that it has recently reversed direction. A statistical analysis of the data also showed that these laboratory differences are, in fact, statistically significant.

Based upon a review of the reference oil data and an analysis of the TMC's reference oil quality control data, any changes in the performance of the test appear to be related to laboratory differences and not due to any problem with the reference oil itself.

The TMC has also begun the process of procuring a new blend of reference oil 82 anyway, since these oils are procured in relatively small quantities and the cost to do so is not prohibitive. However, there is no reason to believe that this reblend will correct any performance problems in the industry. In addition, there will be costs associated with introducing this reblended oil into the reference system related to the testing required to generate appropriate targets for its use. Once this oil is available at the TMC, hopefully some time in May 2008, we will await further instruction from the Surveillance Panel in regards to its introduction into the reference oil system.

MTK/mtk/mem08-031.mtk.doc

c: ftp://ftp.astmtmc.cmu.edu/docs/bench/BRT/memos/mem08-031.pdf

Distribution: Email