Test Monitoring Center
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(412) 365-1000

MEMORANDUM: 01-032

DATE: April 10, 2001

TO: Gordon Farnsworth, Chairman, Sequence VG Surveillance Panel

FROM: Richard E. Grundza

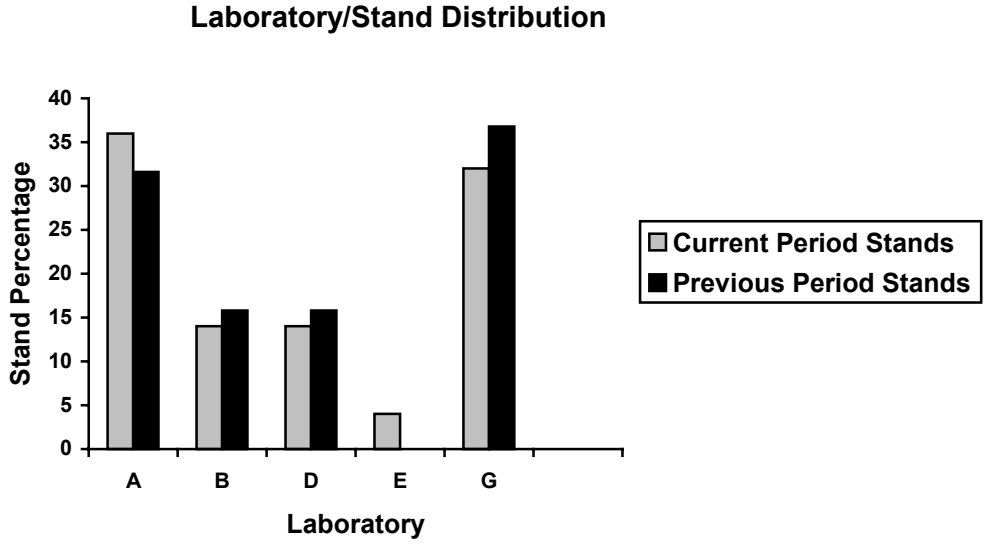
SUBJECT: Sequence VG Reference Test Status from October 1, 2000 through March 31, 2001

The following is a summary of Sequence VG reference tests that were completed during the period October 1, 2000 through March 31, 2001.

Lab/Stand Distribution

	Reporting Data	Calibrated as of 3/31/01
Number of Laboratories	5	5
Number of Stands	23	16

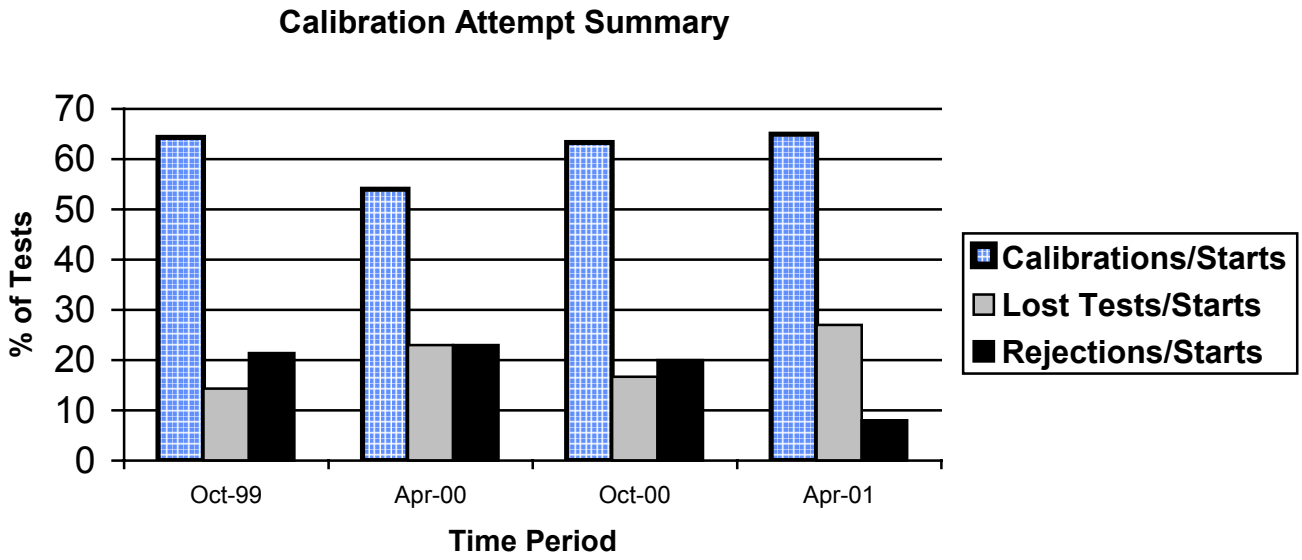
The following chart shows the laboratory/stand distribution:



The following summarizes the status of the reference oil tests reported to the TMC:

	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	19
Failed Acceptance Criteria	OC	2
Operationally Invalid, Lab Judgement	LC	8
Data Removed from Stand Chart	MC	1
Total		30

Calibrations per start, lost tests per start and rejections per start rates are summarized below:



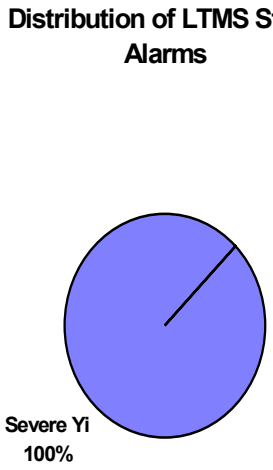
The calibration per start rate is comparable to both the previous period and also compares well with the historical rate. The lost test per start has increased and rejected test per start rate has decreased with respect to the previous period. The lost test rate is somewhat higher than the historical rate and rejected test per start rate appears to be somewhat lower than the historical rate.

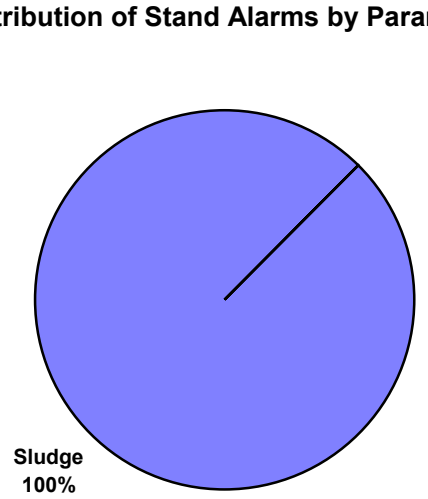
A detailed list of reasons tests failed the acceptance criteria is shown in the following table.

Reason	Number of Tests
Severe RACS	2

Failing RACS results were noted in two labs, with different reference oils.

The following charts summarize the reasons and breakdown by parameter for the failed test:





The following table lists the reasons for operationally invalid tests this period.

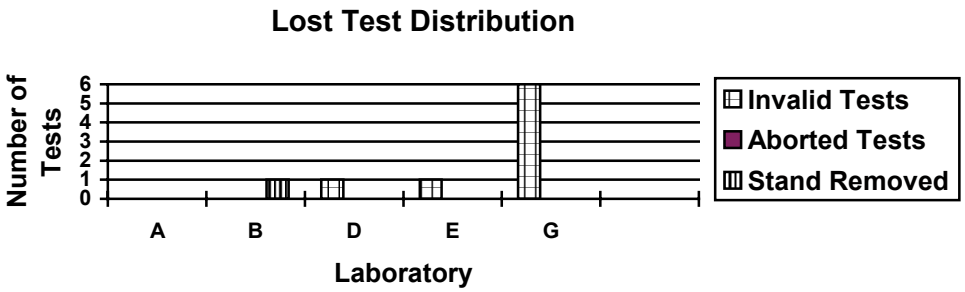
Reason	Number of Tests
Rocker Arm Cover Temperature Control Problems	4
Dyno Coil Shorted out	1
Computer Problems	1
Average Blowby Outside 23 –119 Hour Specifications, Low	1
Excessive Dyno Water Pressure, Damage to Dyno	1

The following table lists the reasons for Data Removed From Stand Chart test.

Reason	Number of Tests
Reworked RAC Cover Flow System.	1

One test was coded as stand data removed from system (MC). This result failed severe on an existing stand. Subsequent investigations into the failing result disclosed problems with the rocker cover system. The laboratory corrected the rocker cover cooling system problems, successfully completed a shakedown run and the first of two reference oil tests required to bring the stand back into the system.

Aborted and operationally invalid tests by laboratory are summarized with the following chart:



Severity and Precision

Based on the mean delta/s values and pooled standard deviation for the current period, a 95% confidence interval representing severity for the current period is given below in reported units.

Variable	Pooled s All Oils	Mean Delta/s	Confidence Interval	Based on	Delta in Reported Units
RAC	0.346	-0.428	7.69 – 8.10	8.0	-0.15
AES	0.530	-0.056	7.53 – 8.01	7.8	-0.03
APV	0.110	0.019	7.45 – 7.55	7.5	0.00
AEV	0.160	0.194	8.86 – 9.00	8.9	0.03
OSCR	0.741	-0.080	13.9 - 28.2	20	-1.2

The mean Δ/s for this period shows AEV (0.194) was mild, RACS (-0.428) was severe and AES (-0.056), APV (0.019) and OSCR (-0.080) were all on or near target. Figures 1 through 5 are current industry severity and precision EWMA control charts and plots of summations Δ/s for AES, RAC, AEV, APV, and OSCR.

Industry control charts for AES severity and precision were in control for the period. The summation Δ/s plot shows a small (~ five test) severe trend during the middle of the period, with a level trend on either side of this short trend.

RAC severity began the period in control, but sounded a series of three warning alarms, which cleared for one test, followed by another one test warning alarm. After the second warning alarm clears, the chart remains in control for the remainder of the period. The severity alarm sounds when a severe result from one lab is reported. This result (-2.639 □/s) was on reference oil 925-3, whose targets were set with only four test results. A subsequent reference test in the same stand with reference oil 925-3 was much closer (-1.611□/s) to target. The severity EWMA alarm clears for one test, when a one test warning alarm sounds, caused by a test from a different lab with a different reference oil, which was –2.75 □/s from target. Subsequent tests clear the alarm and EWMA severity remains in control for the remainder of the period. With the exception of one warning alarm, caused by the –2.75 □/s result, EWMA precision was in control for the period. The summation Δ/s chart shows a severe trend beginning about midway through the period.

AEV severity and precision charts were in control for the period. The summation Δ/s plots show a mild trend about ten tests into the period, which continues for approximately six tests, before returning near target for the remainder of the period.

APV severity and precision charts were in control the entire period. The summation Δ/s plots show APV on or near target for the period.

Oil screen clogging severity and precision charts were in control for the period. The summation Δ/s charts reflects an on or near target trend the first half of the period, and trending mild the remainder of the period.

Figures 6 and 7 chart the pooled precision estimates for all monitored parameters, by ASTM report period. Figure 6 shows precision for RAC is about the same as the previous period and OSCR has shown some improvement with respect to the previous period and both have shown significant improvement when compared to historical rates. AES precision is directionally poorer than the previous period, but still compares well with historical rates. Figure 7 also shows significant degradation for both APV and AEV when compared to the previous period. APV has also seen a significant degradation when compared to historical estimates, while AEV has degraded with respect to the previous period, but compares well with historical rates.

Fuels and Reference Oils

Reference oil quantities available at the laboratories and TMC, as well as estimated life of these oils, is tabulated below.

Oil	TMC Inventory, in gallons	TMC Inventory, in tests	Laboratory Inventory, in tests	Estimated life
925-3	227	78	5	3+ years
1006	1130	376	6	~1 year
1007	618	206	8	~18 months

Note: Oils 1007 and 1006 are used across multiple test areas, TMC inventory represents total amount of that oil on hand.
Reblends of 1006 are in TMC inventory.

Information Letters

Information Letter 00-3 was issued on November 1, 2000. This information letter revised Section clarified how to transform oil screen clogging results given in Section13.4.1 and made report forms and data dictionary changes, as documented in version 20000831. Information Letter 01-1 was issued on January 16, 2001. This information letter updated the method for determining water in the fuel, deleted Section 7.1.1 which refers to Hardware Control Guidelines in Section D0.2.B0, enhanced the measurement techniques for bore wear, oil screen clogging, pin wear and top ring gap increase, changed RAC inlet temperature ramp for stage III to I, removed ring chamfer measurements, changed calibration frequency for temperature and pressure measurement sensors. Changed dipstick calibration procedure, dropped stage I blowby measurements, dropped 0.5% O_2 calibration gas, modified fuel injector flow requirements and updated Appendix X2. Information Letter 01-2 was issued March 20, 2001. This information letter was issued against Test Method D6593 to incorporate information letters not included in the initial issue of the method and to correct the precision statement in the method.

Information Memos

The following memos were issued by the TMC during this period.

Memo	Date	Subject
00-134	10/6/00	Sequence VG Semi Annual Report
00-175	11/20/00	Reference Oil Target Update, Reference Oils 1006 and 1007
00-178	11/29/00	Reference Oil Target Update, Reference Oil 925-3
01-1	1/3/01	Report Forms and Data Dictionary, Version 20001214
01-5	1/5/01	Proposed Changes to Precision Statement in Test Method D6593
01-6	1/12/01	Fuels and Reference Oil Report, Months of November and December, 2000
01-7	1/16/01	Corrections to Report Forms and Data Dictionary, Version 20001214
01-15	2/7/01	Fuels and Reference Oil Report, Month of January, 2001
01-18	3/8/01	Fuels and Reference Oil Report, Month of February, 2001

TMC Activities

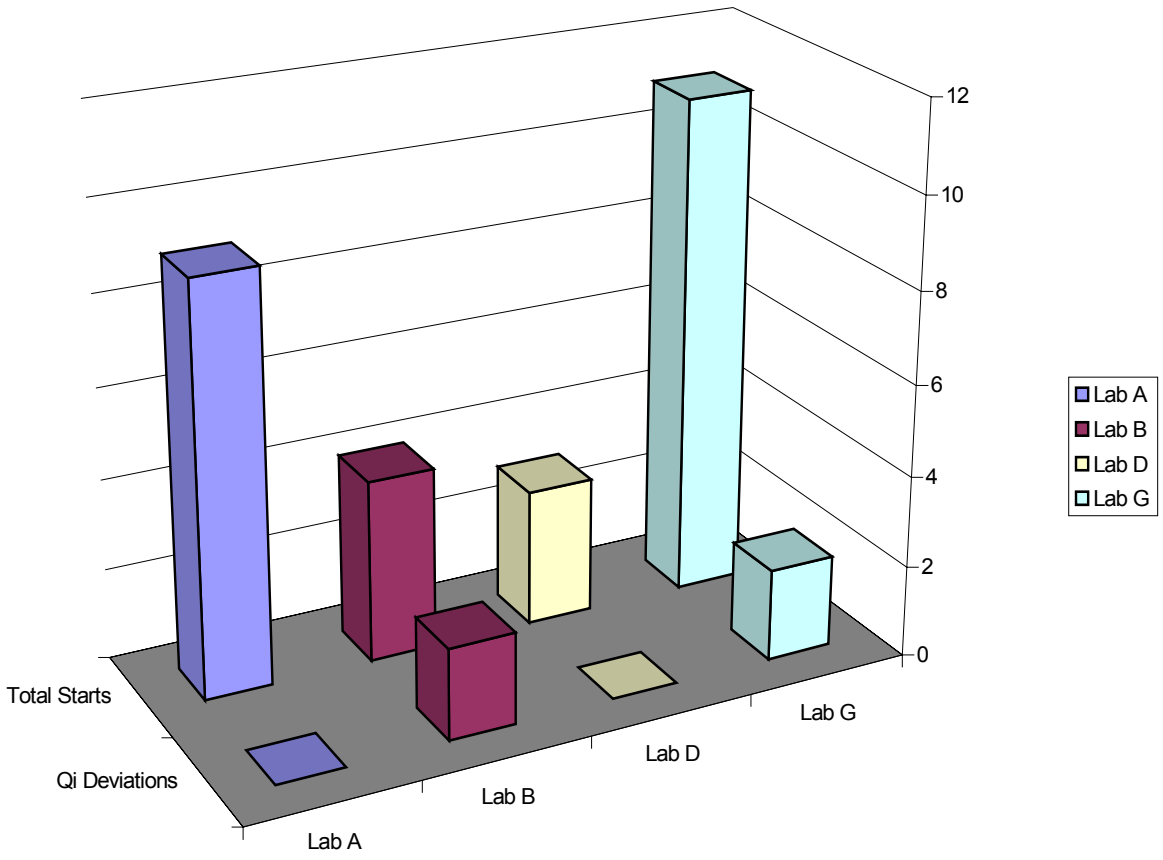
During this report period, the TMC visited one lab, with no significant discrepancies noted.

The following table compares the standard deviation used in the LTMS for severity adjustment calculation, which is a pooled estimate of precision based on oils 925-3, 1006 and 1007, with the current pooled precision of the oils 1006, 1007 and 925-3.

Parameter	Severity Adjustment Standard Deviation (n = 30)	Pooled Standard Deviation, Oils 925-3, 1006 and 1007 (n =21)
AES	0.51	0.530
RCS	0.24	0.350
AEV	0.10	0.171
APV	0.18	0.204
OSCR	0.828	0.741

QI Deviations

The following charts the number of QI deviations reviewed by the Test Monitoring Center for this report period, by laboratory.



The following tabulates the parameter(s) where QI deviations were written.

Parameter	Number of Tests
Power and Engine Coolant Flow	1
Power	1
Manifold Absolute Pressure	1
Rocker Cover Inlet Temperature	1

Both the power and power in conjunction with engine coolant flow deviations were evaluated for different stands in the same lab. The power deviations were traced to a failure to properly adjust the throttle cable, which would not allow the throttle to fully close during stage 3. The Engine coolant flow deviation was caused by a closed bypass valve in the system, which was not identified until the stand was shutdown by a low coolant flow alarm. The manifold absolute pressure deviation was caused by a sticking throttle body. The rocker cover coolant temperature deviation was caused by a heater failure. In all cases corrective action was taken to resolve the cause of the QI deviation.

Summary

Calibrations per start compares well with the previous period and historical rates, while the rejected tests per start rate has decreased and the lost test per start rate has increased with respect to the previous period. AES, OSCR and APV are on or near target, RAC was severe and AEV was mild for the period. Precision for AES is comparable with previous period and historical estimates. RAC precision has shown improvement with respect to the previous period and compares well with historical rates. AEV and APV precision have degraded significantly with respect to the previous period. AEV precision is comparable to historical rates, while APV precision has degraded significantly with respect to historical estimates. OSCR precision compares well with respect to the previous period and has shown improvement with respect to historical rates.

REG/reg

Attachments

c: Sequence VG Surveillance Panel
ftp://www.tmc.astm.cmri.cmu.edu/docs/gas/sequencev/semiannualreports/vg-4-2001
J. L. Zalar
F. M. Farber

Listing of Tables and Figures Included as Part of This Report to the Sequence VG Surveillance Panel

Figures 1 through 5 are the Industry control charts for AES, RAC, AEV, APV and OSCR.

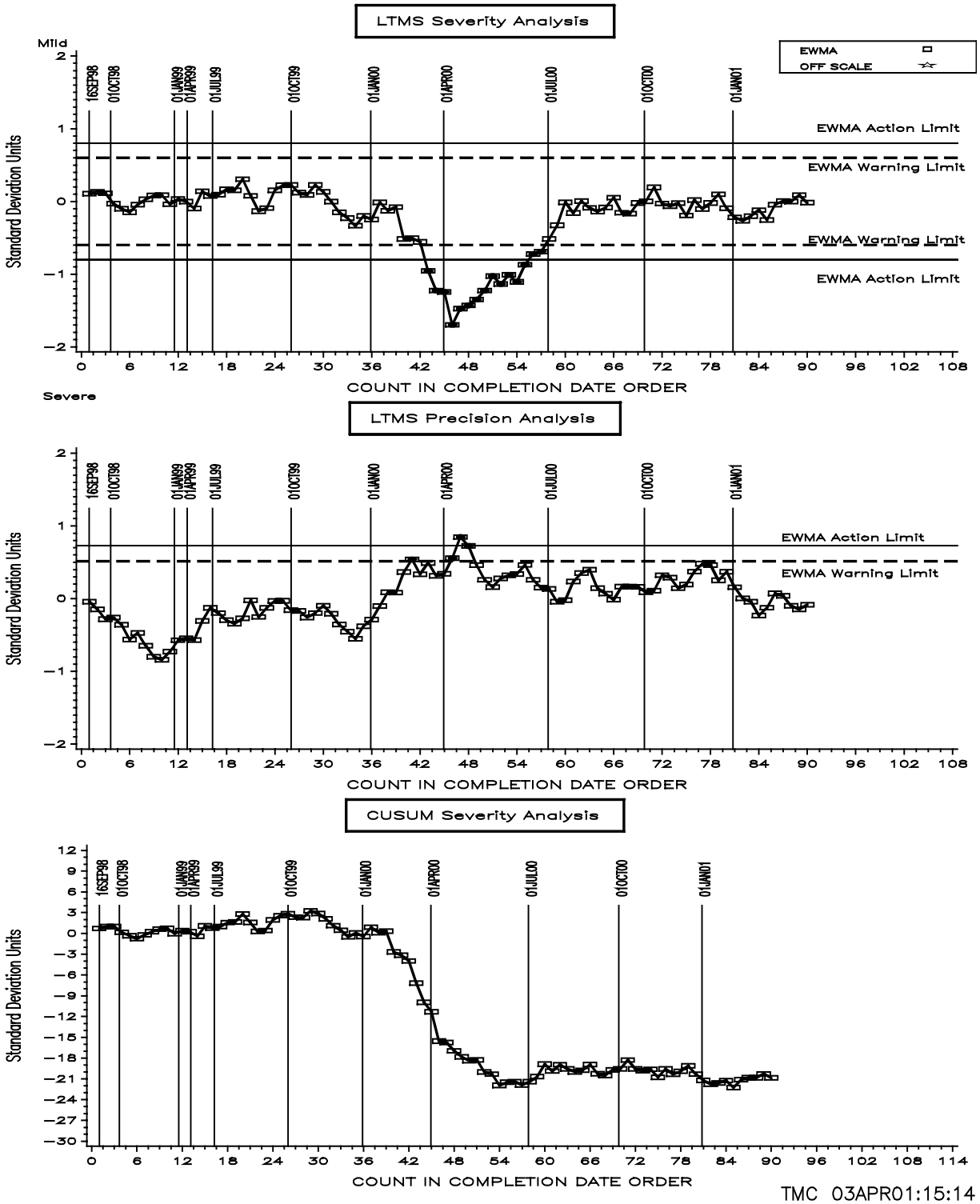
Figures 6 and 7 compare pooled precision estimates from this report period with previous periods.

Figure 8 is the Industry Timeline.

SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE SLUDGE

Figure 1



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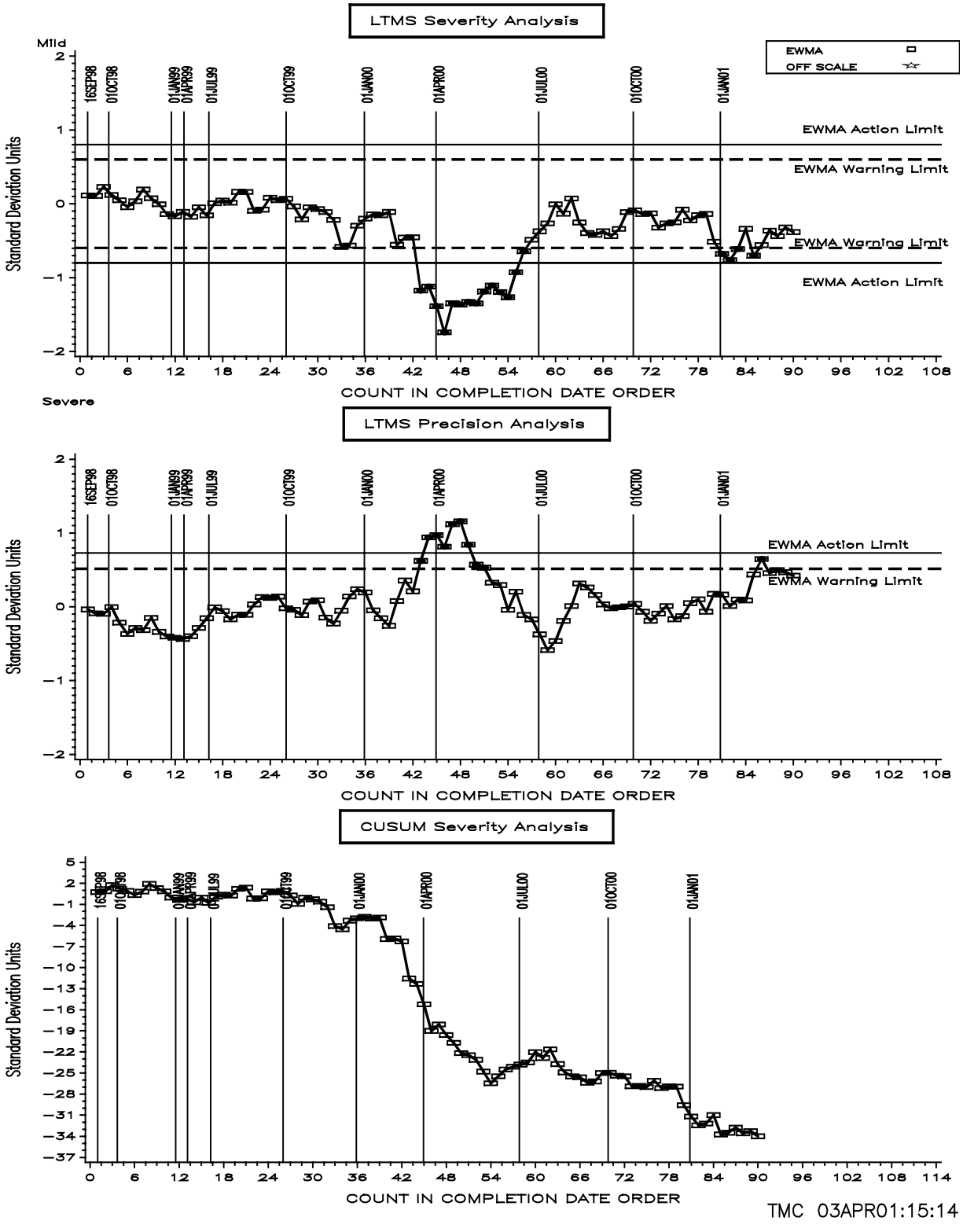
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ROCKER COVER SLUDGE

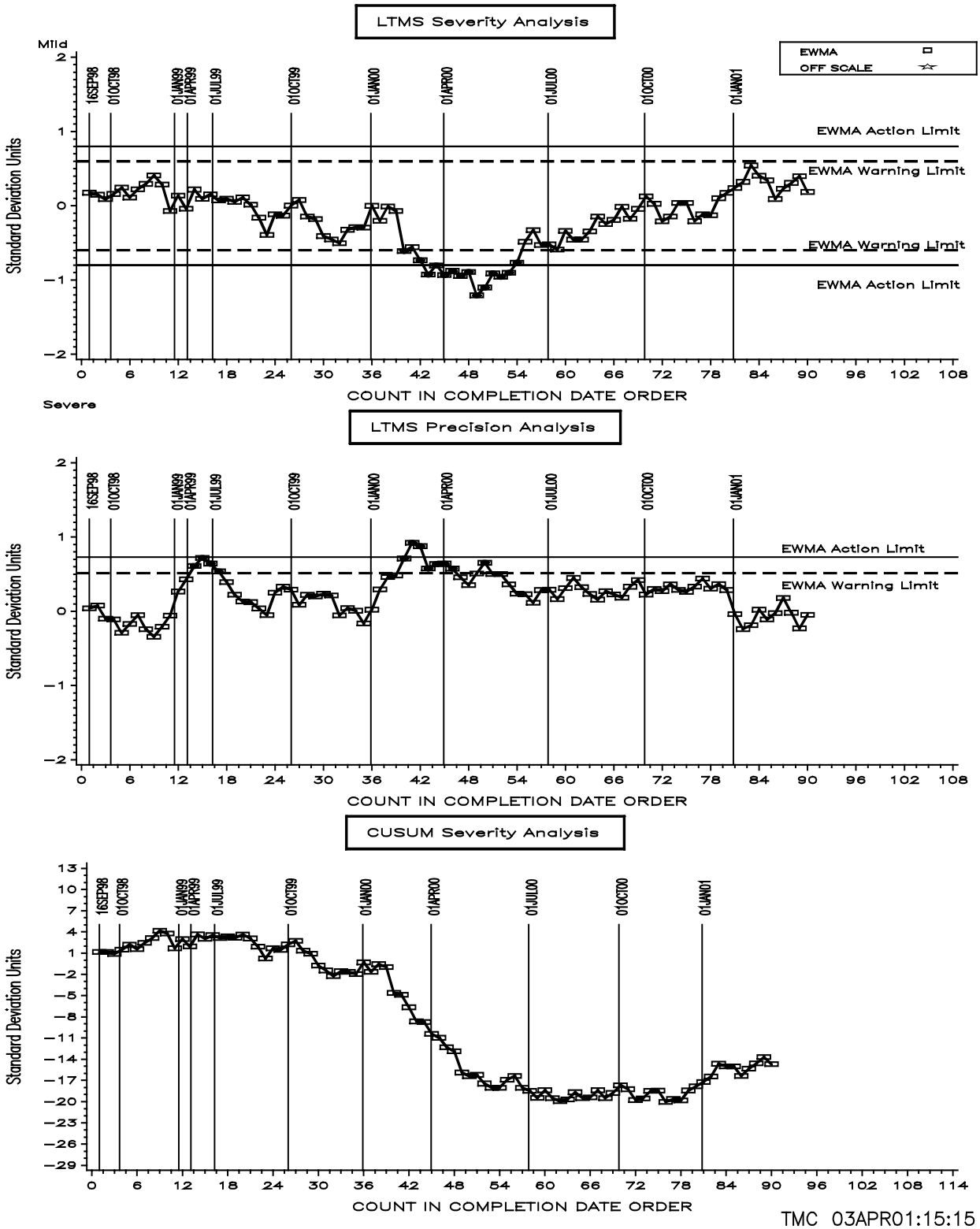
Figure 2



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE VARNISH 3—PART FINAL RESULT

Figure 3



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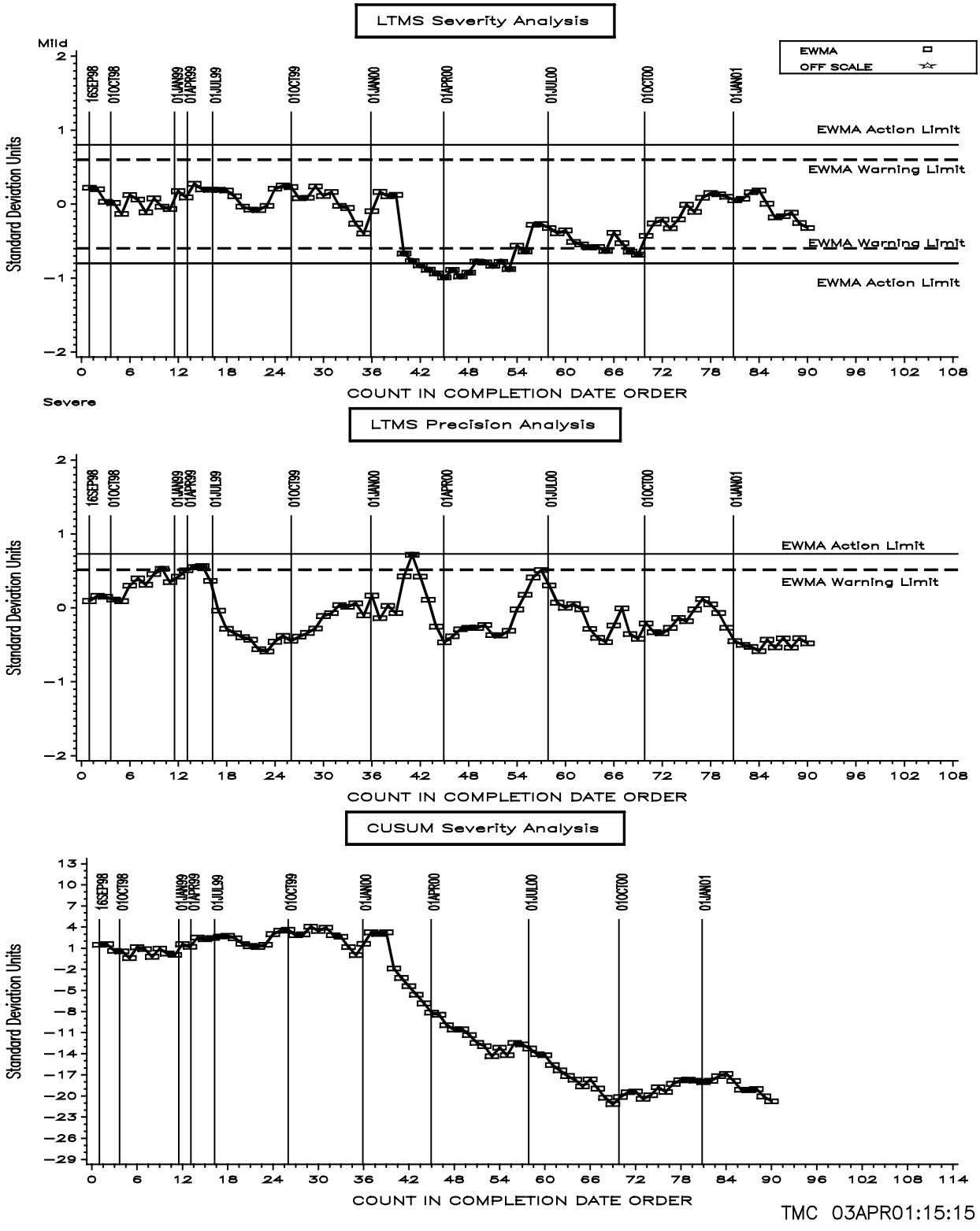
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVG PISTON SKIRT RATING (MERITS)

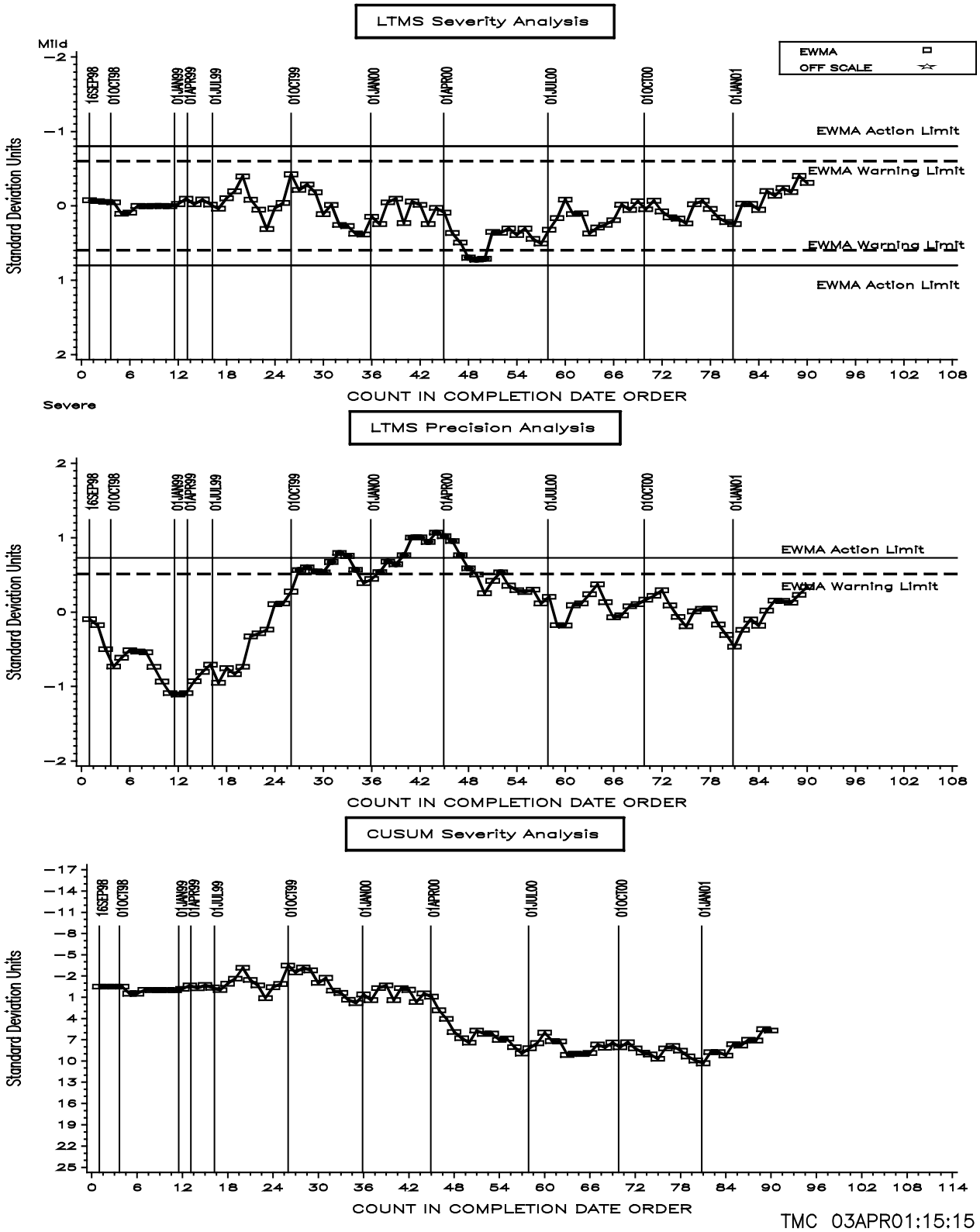
Figure 4



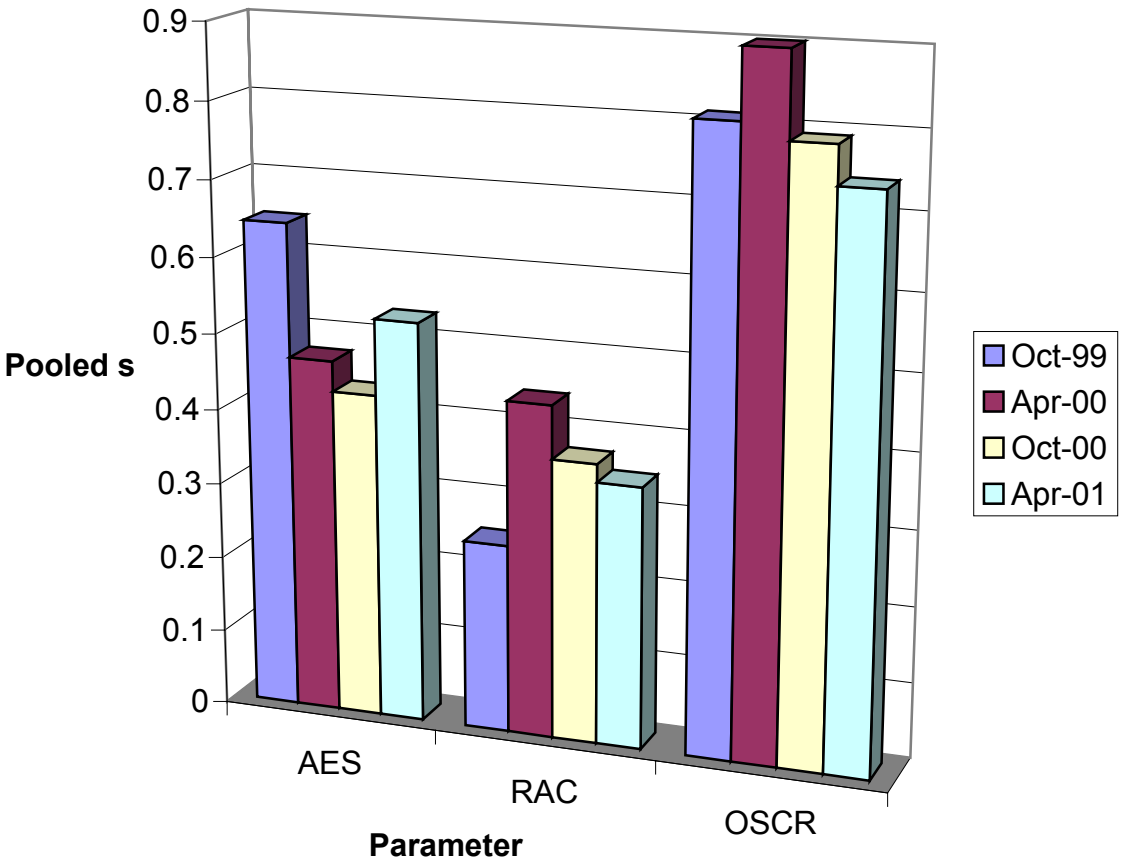
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

OIL SCREEN SLUDGE

Figure 5



Comparison of Pooled Precision Estimates By ASTM Report Period



Pooled s in Original Units, with the Exception of OSCR,
Which is transformed using ln(OSCR + 1)

Comparison of Pooled Precision Estimates By ASTM Report Period

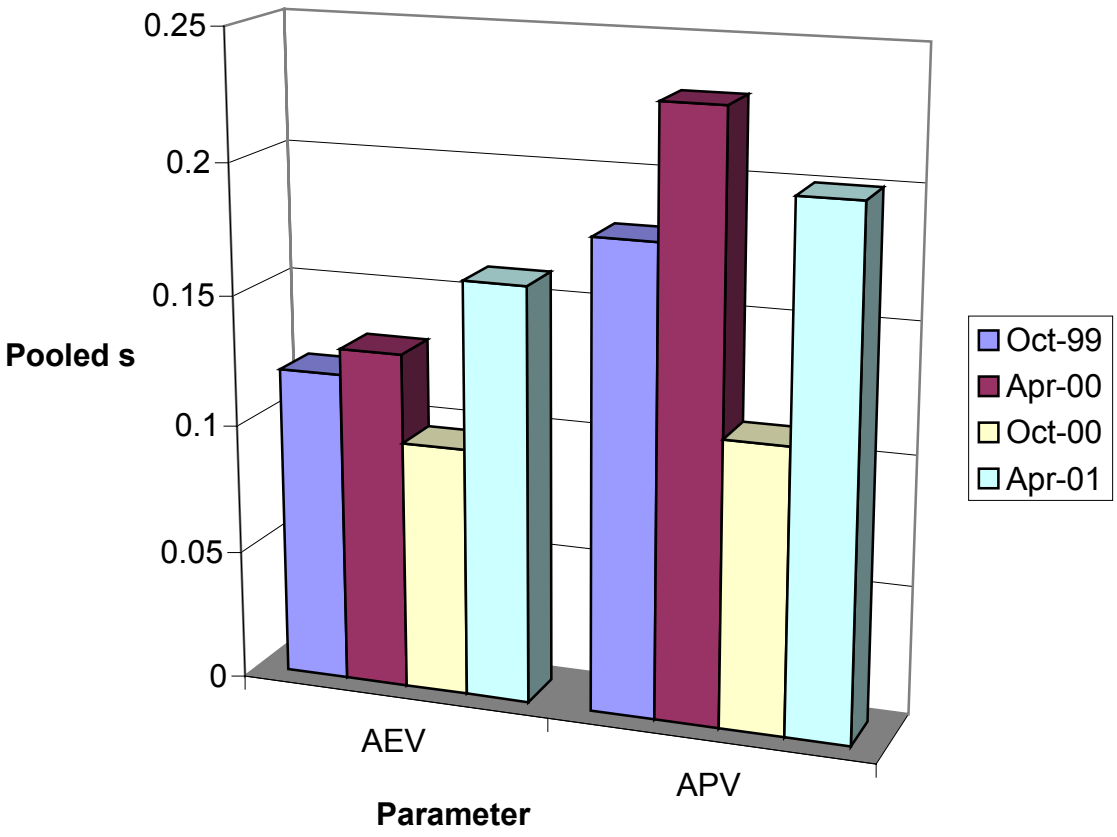


Figure 8
Sequence VG Industry Timeline

19980901		Matrix testing begins
19990211		Sequence VG Test approved, matrix stands charted and calibrated where applicable
19990503	99-1	Information Letter 99-1 issued, adding ring weight loss, bore wear and pin wear measurements; as well as other procedural changes
19990615	99-2	Numerous procedure updates as identified in Information Letter 99-2
19990830		In conjunction with approval of VG fuel batch 996416, new test targets were published for oils 1006 and 1007
19990830		Batch 996416 was approved for qualified testing at 8/13/99 Surveillance Panel meeting.
19991025	99-3	Revised Exhaust Backpressure limits for stages I and II to 102 and 106 kPa, repectively
19991025	99-3	Deleted rating of Underside of Block sludge and revised report forms and data dictionary accordingly
19991025	99-3	Added Section 11 to document stand referencing requirements
19991025	99-3	Added Section 16 and Annex A14, which give precision and bias statements
19991025	99-3	Updated listing of kit parts given in Sections 7.2 and 7.3 and Annex A5
19991025	99-3	Revised the type of oil filter and screen size, Sections 7.4.9 and 8.3.2.2 and A3.8 changed to reflect this
19991115		Update reference oil targets for oils 1006 and 1007 (n=10), also revised severity adjustment standard deviation
20000215	00-1	Revised Exhaust Backpressure Limits for stages I and II to 104 and 107 kPa, respectively
20000215	00-1	Deleted varnish ratings for cam baffles, oil pan, timing chain cover and rear seal housing.
20000215	00-1	Revised Form 8 to not allow value to be entered for oil added at cycle 54 and deleted form 7.
20000802	00-2	Added Oil Ring Clogging Rating, changed follower pin wear measurement from all 8 cylinders to cylinder 8 only Changed bore wear measurements from all cylinders to cylinders 1 and 8.
20000802	00-2	Changed from ring weight loss to ring gap increase on cylinders 1 & 8.
20000802	00-2	transformation for oil screen clogging. Deleted photos for cam baffles, timing chain cover rear seal housing varnish.
20000802	00-2	Report forms and Data dictionary changes, version 20000713
20001101	00-3	Revised Section 13.4.1. Report forms and Data dictionary changes, version 20000831
20010115	01-1	Changed analysis method for water in fuel, deleted Section 7.1.1, enhanced the measurement techniques for bore wear, oil screen clogging, pin wear and top ring gap increase, changed RAC inlet temperature ramp for stage III to I, removed ring chamfer measurements, changed calibration frequency for temperature and pressure measurement sensors. Changed dipstick calibration procedure, dropped stage I blowby measurements, dropped 0.5% O2 calibration gas, modified fuel injector flow requirements and updated Appendix X2.
20010320	01-2	This information letter was issued against Test Method D6593 to incorporate information letters not included in the initial issue of the method and to correct the precision statement in the method.