Test Monitoring Center
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(412) 365-1000

MEMORANDUM: 00-134

DATE: October 6, 2000

TO: Gordon Farnsworth, Chairman, Sequence VG Surveillance Panel

FROM: Richard E. Grundza

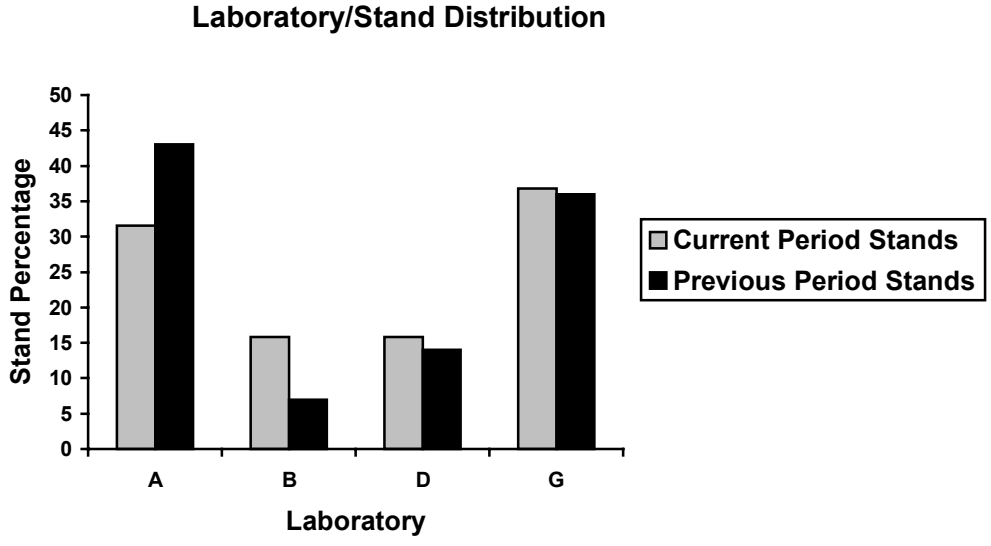
SUBJECT: Sequence VG Reference Test Status from April 1, 2000 through September 30, 2000

The following is a summary of Sequence VG reference tests that were completed during the period April 1, 2000 through September 30, 2000.

Lab/Stand Distribution

	Reporting Data	Calibrated as of 9/30/00
Number of Laboratories	4	4
Number of Stands	19	17

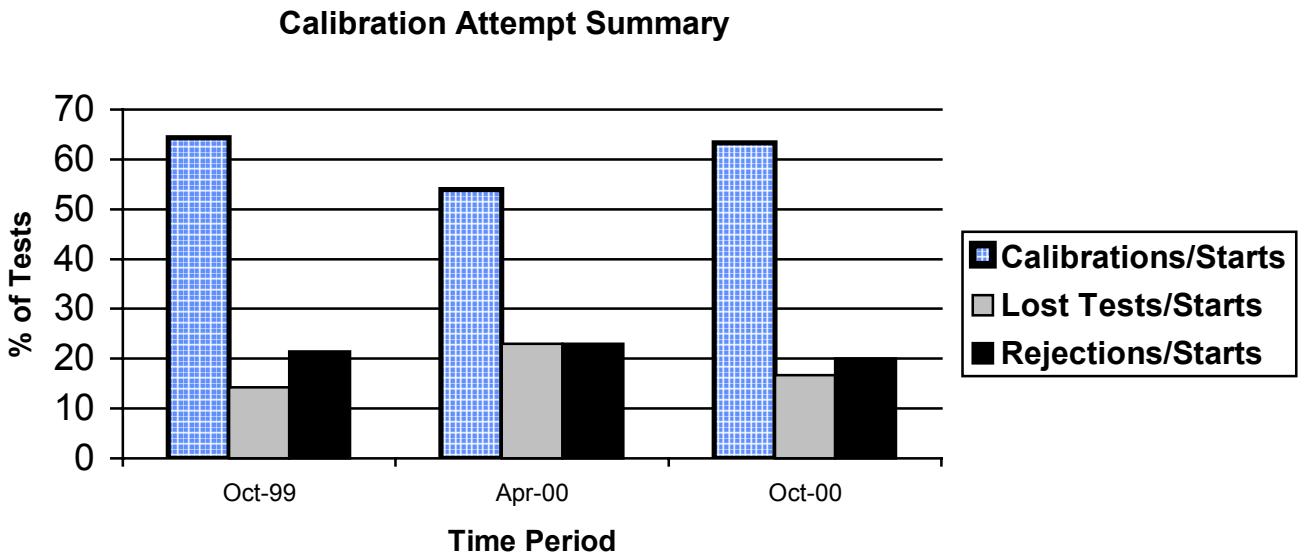
The following chart shows the laboratory/stand distribution:



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	6
Operationally Invalid, Lab Judgement	LC	4
Aborted Test	XC	1
Total		30

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



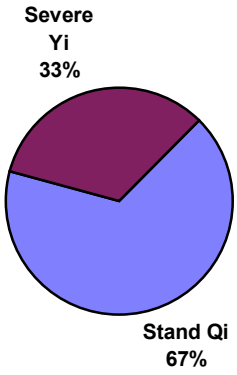
The calibration per start rate has increased when compared to the previous period and also compares well with the historical VE rate of 62%. The lost test per start and rejected test per start rate have both decreased with respect to the previous period and are comparable to the historic VE rates.

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

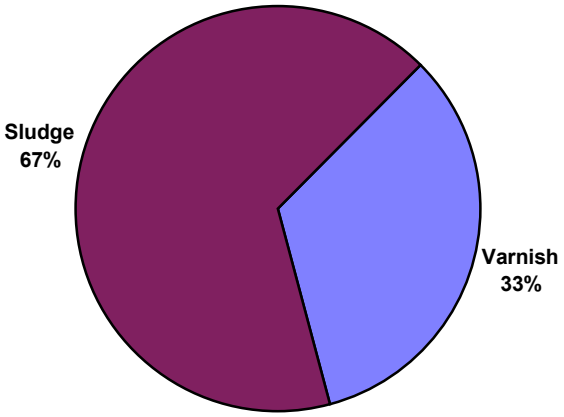
Reason	Number of Tests
Stand Precision EWMA Alarm, AEV	1
Severe RAC and Severe OSCR	1
Severe OSCR	1
Stand Precision EWMA Alarm, AES and RAC	2
Stand Precision EWMA Alarm, AEV and APV	1

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

Distribution of LTMS Stand Alarms



Distribution of Stand Alarms by Parameter



Two of the six tests which failed statistically occurred on one stand, and four of the six tests were from the same lab.

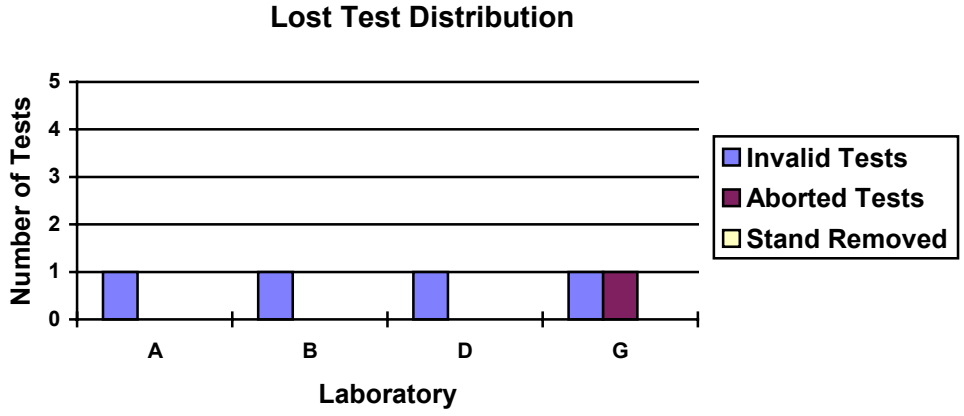
The following table lists the reasons for operationally invalid tests this period.

Reason	Number of Tests
Rocker Arm Cover Temperature Control Problems	2
Air-Fuel Ratio Control Problems	1
Excessive Fuel Dilution, Bad Wiring Harness	1

The following table lists the reasons for aborted tests.

Reason	Number of Tests
Low Oil Pressure	1

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	0.371	-0.506	7.66 – 7.96	8.0	-0.19
AES	0.441	-0.390	7.45 – 7.81	7.8	-0.17
APV	0.110	-0.572	7.40 – 7.52	7.5	-0.06
AEV	0.096	-0.325	8.83 – 8.91	8.9	-0.03
OSCR	0.788	0.277	14.2 - 28.1	20	4.9

The mean Δ/s for this period shows AES (-0.390), RAC (-0.506), AEV (-0.325), APV (-0.572) and OSCR (0.277) were all severe. 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 show a continuation of the severity EWMA alarm which occurred at the end of the last period. At the beginning of the period, a result –4.625 Δ/s from target was reported from one of the three stands which were identified in the previous report as the major contributors to the severity shift. After a total of thirteen tests the severity alarms clear and the charts remain in control for the remainder of the period. The precision EWMA charts show two warning and one action alarm occurring as a result of this –4.625Δ/s test. Once the precision EWMA alarm clears, the charts remain in control for the rest of the period. The summation Δ/s plot also reflects the severity shift in the beginning of the period, but returns on or near target at the end of the period.

RAC severity also began the period in EWMA action alarm. Again, results from stands which had severity problems in the previous report period appear to have caused these alarms. A total of 11 action and one warning alarm sound before the charts come back in control and remain that way through the end of the period. As with AES, RAC precision EWMA alarms also occur as a result of these stands. The summation Δ/s chart also reflect the severe trend, continuing from the previous period and returning on or near target near about midway through the period.

AEV severity began the period in severity EWMA action alarm, and continued in action alarm for eight more tests before sounding a warning alarm and finally clearing. The varnish alarm is a continuation of the alarms which occurred near the end of the last report period. Again, many of the results which resulted in the alarm condition came from three stands in two labs. Precision EWMA charts began the period with two warning alarms, clearing for two tests then sounding a series of four warning alarms and then clearing for the remainder of the period. The second set of warning alarms appears to have been caused by a –3.000Δ/s from one stand in one of the laboratories having sludge severity problems. The summation Δ/s plots show a severe trend at the beginning of the period, with subsequent results on or near target for the remainder of the period.

APV severity began the period in severity EWMA alarm. APV severity remains in alarm for eight tests, clears for one test, sounds a warning alarm and clears for twelve tests before sounding an additional warning alarm. Additional warning alarms occur with the last two tests reported at the end of the period. The severity alarms are a continuation of the alarms which occurred at the end of the last period. The result which started the alarm event was –5.154 Δ/s from target and was followed by four results which were all 1 Δ/s or greater from target. No one lab or stand appears to be totally responsible for this trend, as the summation Δ/s plots also show APV trending severe during this period. Precision was in control for the period.

With the exception of three warning alarms, oil screen sludge severity has been in control for the period. Oil screen clogging precision charts begin the period in action alarm, but clear after three tests, with a warning alarm sounding three tests later. With the exception of these four alarms, precision is in control for the period. The summation Δ/s charts reflect a six test severe trend during the beginning of the period, followed by results on or near target for 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 AES, RAC and OSCR have shown some improvement with respect to the previous period and have shown significant improvement when compared to historical rates. Figure 7 also shows significant improvement for APV when compared to the previous period and historical rates, while AEV has shown some improvement when compared to the previous period and significant improvement when compared 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	248	82	6	3+ years
1006	1537	512	6	3+ years
1007	657	219	6	~18 months

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

Information Letters

Information Letter 00-2 was issued on August 7, 2000. This information letter added oil ring clogging as a rate and report item, changed the pin wear and bore wear measurements and changed ring weight loss to ring gap increase. This letter also added a transformation for oil screen clogging, deleted photographs for parts that had been previously deleted, addressed several editorial changes and revised the report forms and data dictionary to address the transformation for oil ring clogging. Information Letter 00-3 was issued September 25, 2000. This letter clarified the method by which transformed values were to be calculated and also increased the accuracy to which transformed values are to be calculated and rounded.

Information Memos

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

Memo	Date	Subject
00-40	4/10/00	Sequence VG Semi Annual Report
00-59	5/4/00	Fuels and Reference Oil Report, Month of April
00-77	5/30/00	Reference Oil Target Update, Reference Oils 1006
00-88	6/8/00	Modifications to Oil Filter Housing
00-99	7/5/00	Report Forms and Data Dictionary, Version 20000627
00-101	7/6/00	Fuels and Reference Oil Report, Month of June
00-112	8/6/00	Fuels and Reference Oil Report, Month of July
00-114	8/4/00	Draft of Information Letter 00-3
00-119	9/7/00	Fuels and Reference Oil Report, Month of August
00-124	9/18/00	Report Forms and Data Dictionary, Version 20000831

TMC Activities

During this report period, the TMC visited 5 labs. During these visits, the following discrepancies were noted:

1) Transitions not in accordance with Table 4 of the Sequence VG test procedure.
2) Unable to locate the emissions calibration gases listed in Figure 8 and Fig A3.19 of the Sequence VG procedure.
3) Oil system not in accordance with Fig A3.8 of the Sequence VG test procedure.
4) Calibrations not performed at the time frames specified in the Sequence VG test procedure.

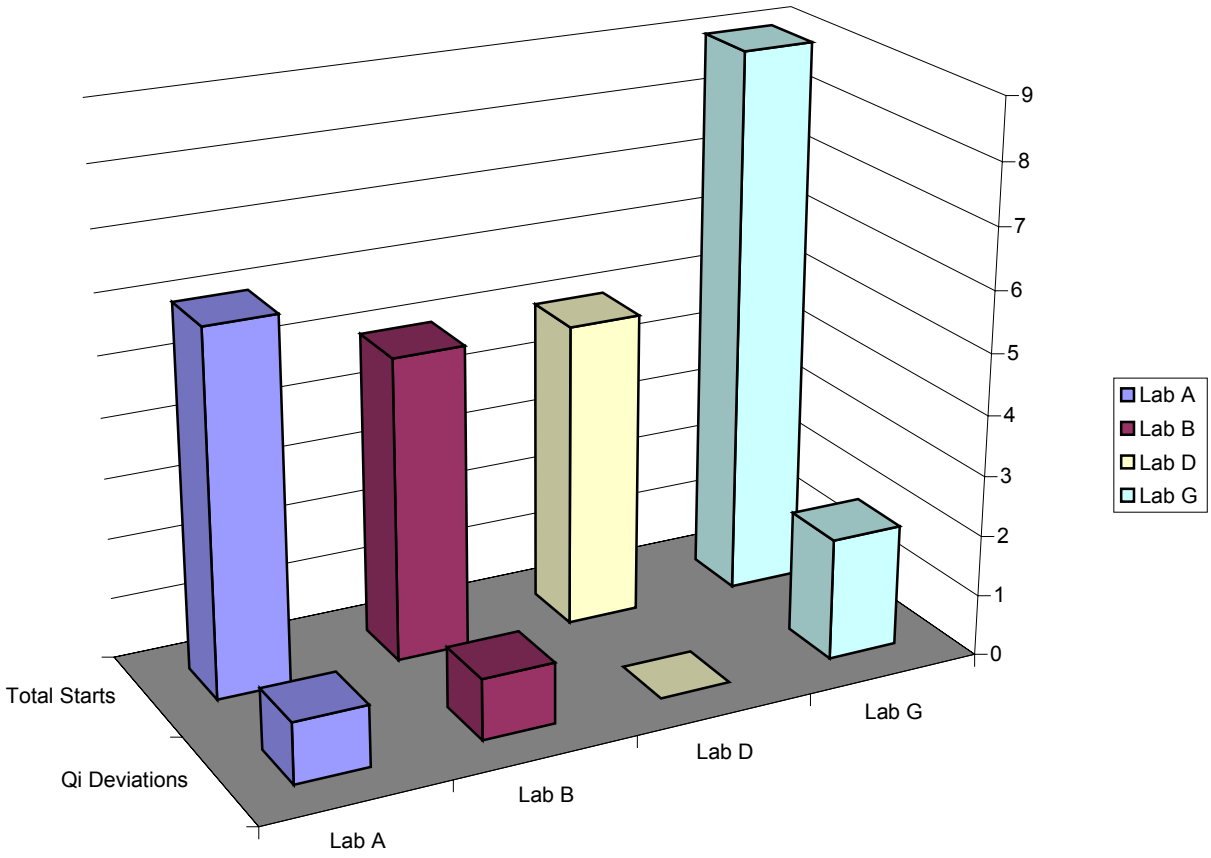
In all cases the deficiencies have been identified to the laboratory.

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 =25)
AES	0.51	0.431
RCS	0.24	0.371
AEV	0.10	0.096
APV	0.18	0.110
OSCR	0.828	0.788

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) which QI deviations were written.

Parameter	Number of Tests
Intake Air Humidity	2
Power	1
Intake Air Temperature	1

Both of the intake air humidity deviations were evaluated for different stands in the same lab. The intake air humidity deviations were traced to a wiring problem which caused the measurement sensor for the stands to be disconnected while other maintenance work was being performed. The power QI deviation was resolved by adding filtering within the limits of the response times given in the test procedure. The intake air temperature deviation was caused by high ambient temperatures in the laboratory. The stand intake air duct was insulated to address this problem. In all cases corrective action was taken to resolve the cause of the QI deviation.

Summary

Calibrations per start, lost test and rejected test per start rates all compare well with Sequence VE rates. Severity for all parameters trended severe during this period. Most of the severity and precision alarms were caused by the same stands which had caused alarms during the previous period. With the exception of APV severity, which ended the period with a two test warning alarm, all charts were in control by the end of the period. Precision estimates for all parameters compare well with the previous period and historical rates.

REG/reg

Attachments

c: Sequence VE Surveillance Panel
ftp://www.tmc.astm.cmri.cmu.edu/docs/gas/sequencev/semiannualreports/vg-10-2000
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.

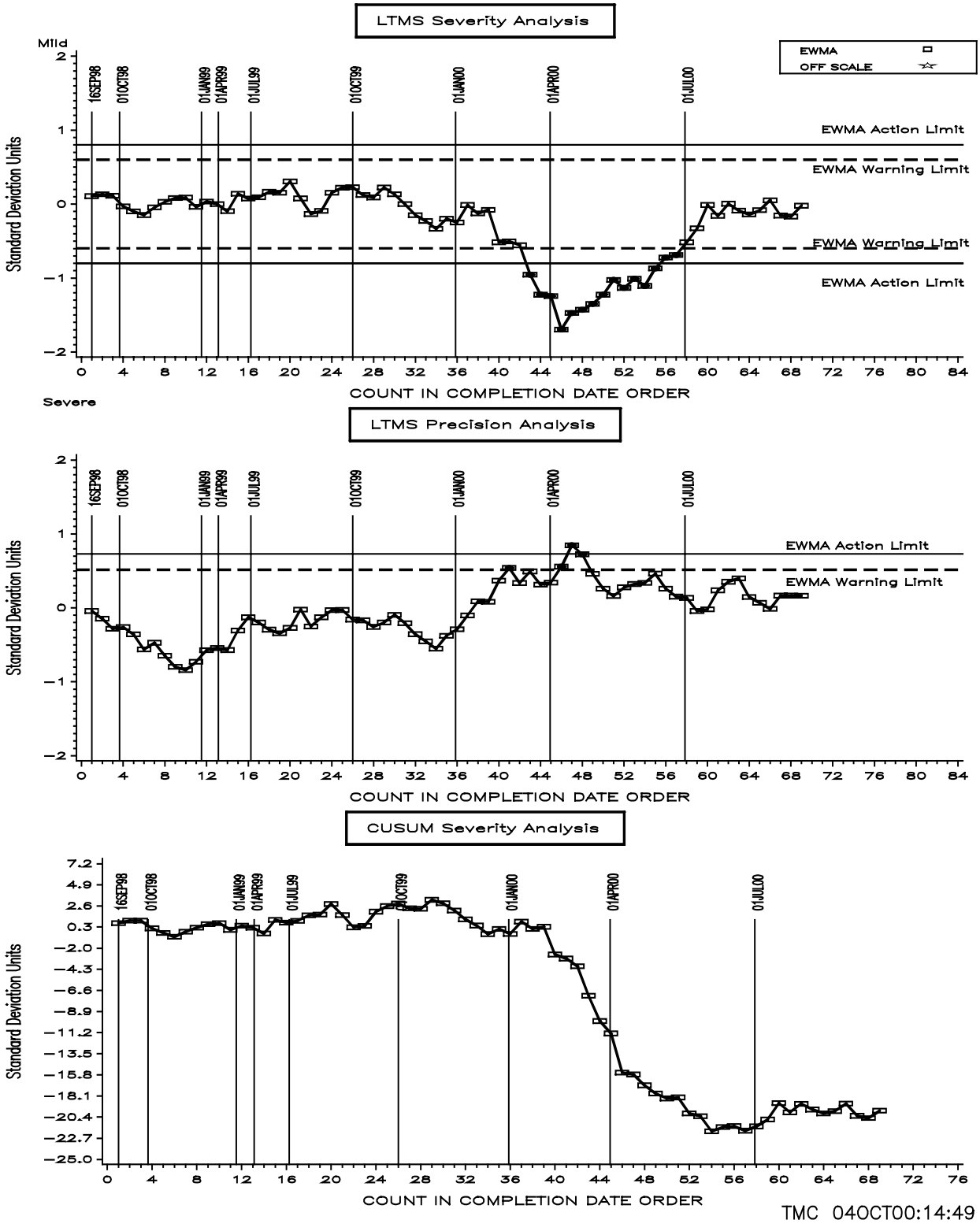
Figures 6 and 7 compare pooled precision estimates from this report period with previous periods.

Figure 8 is the Industry Timeline.

SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE SLUDGE

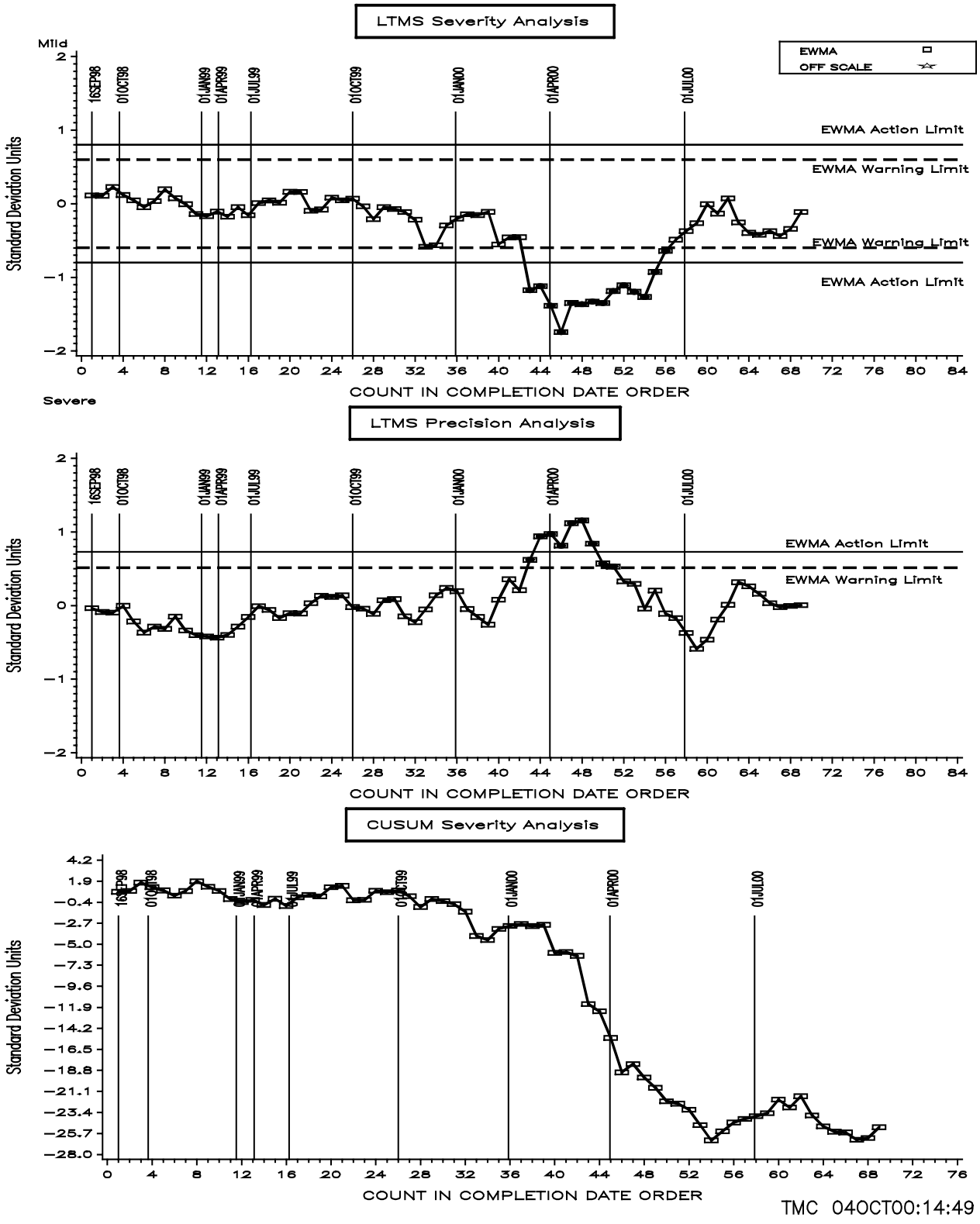
Figure 1



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ROCKER COVER SLUDGE

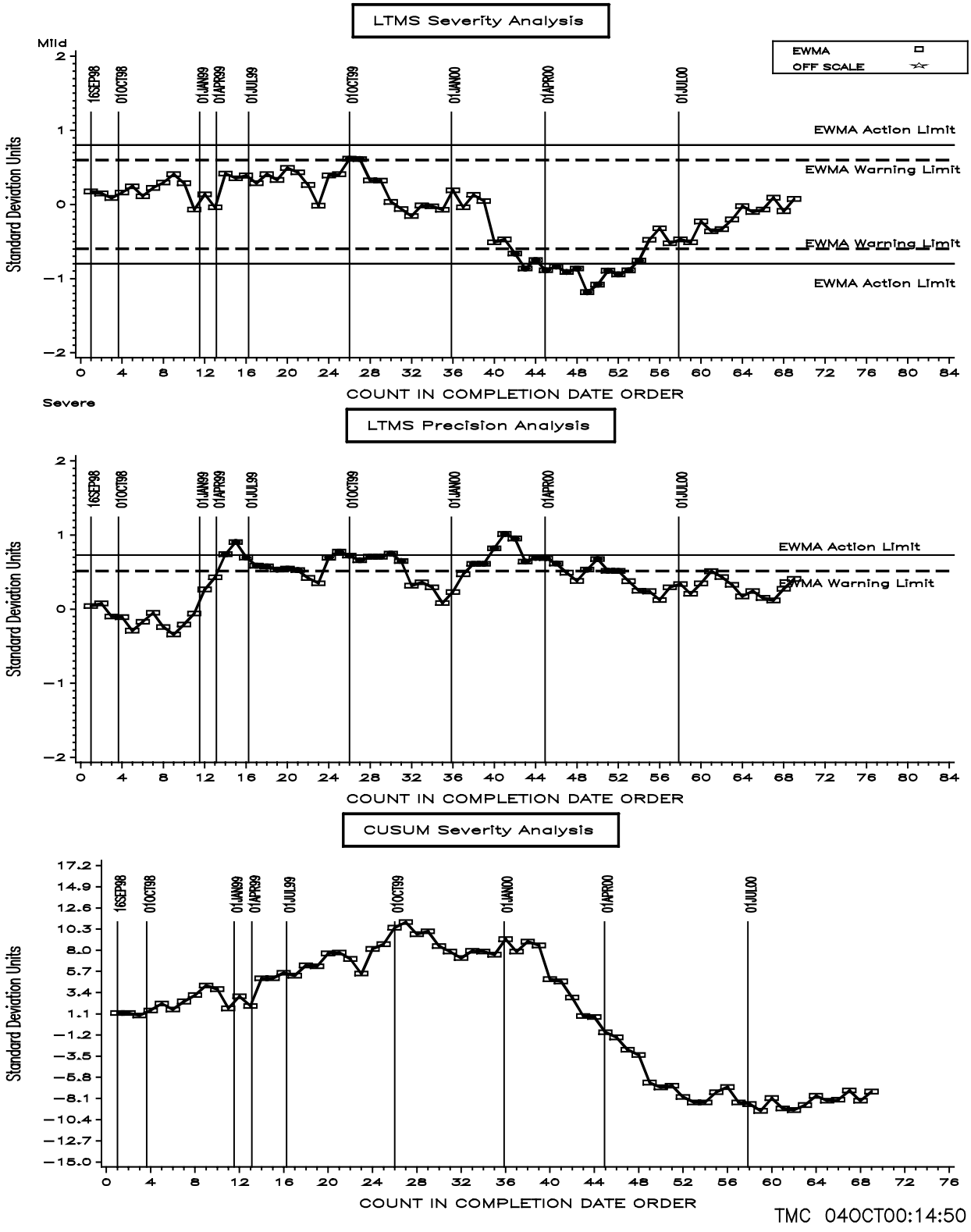
Figure 2



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE VARNISH 3–PART FINAL RESULT

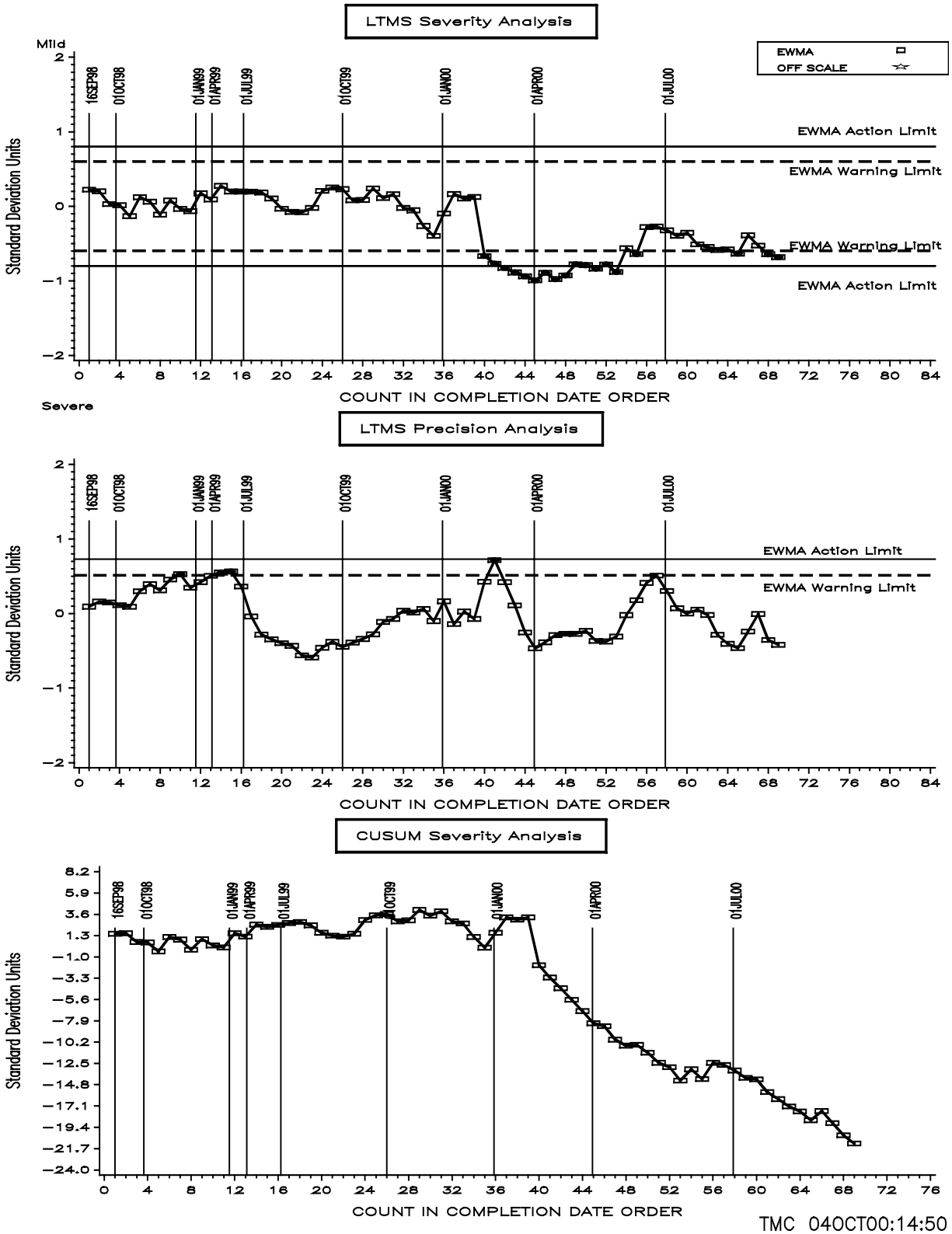
Figure 3



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVG PISTON SKIRT RATING (MERITS)

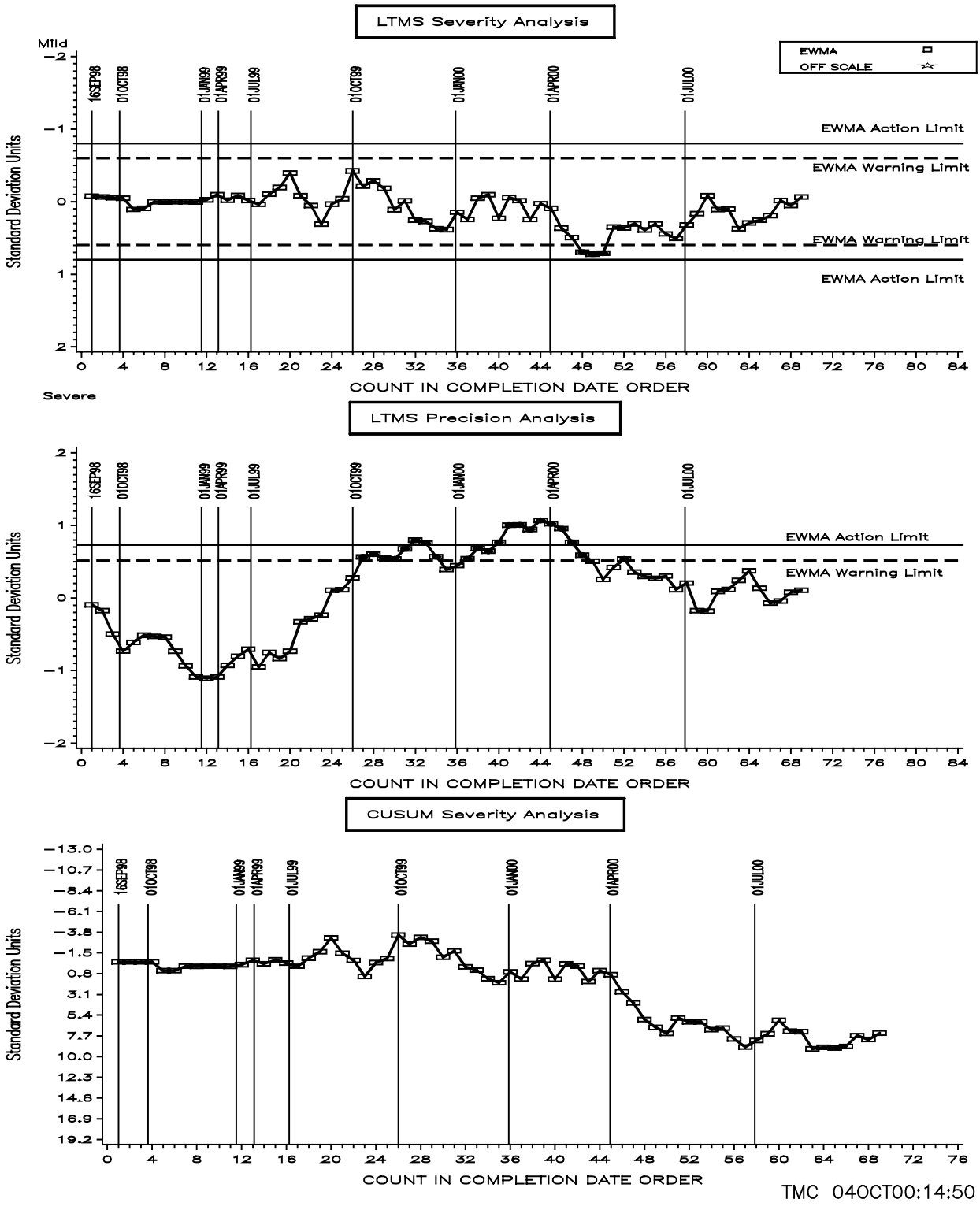
Figure 4



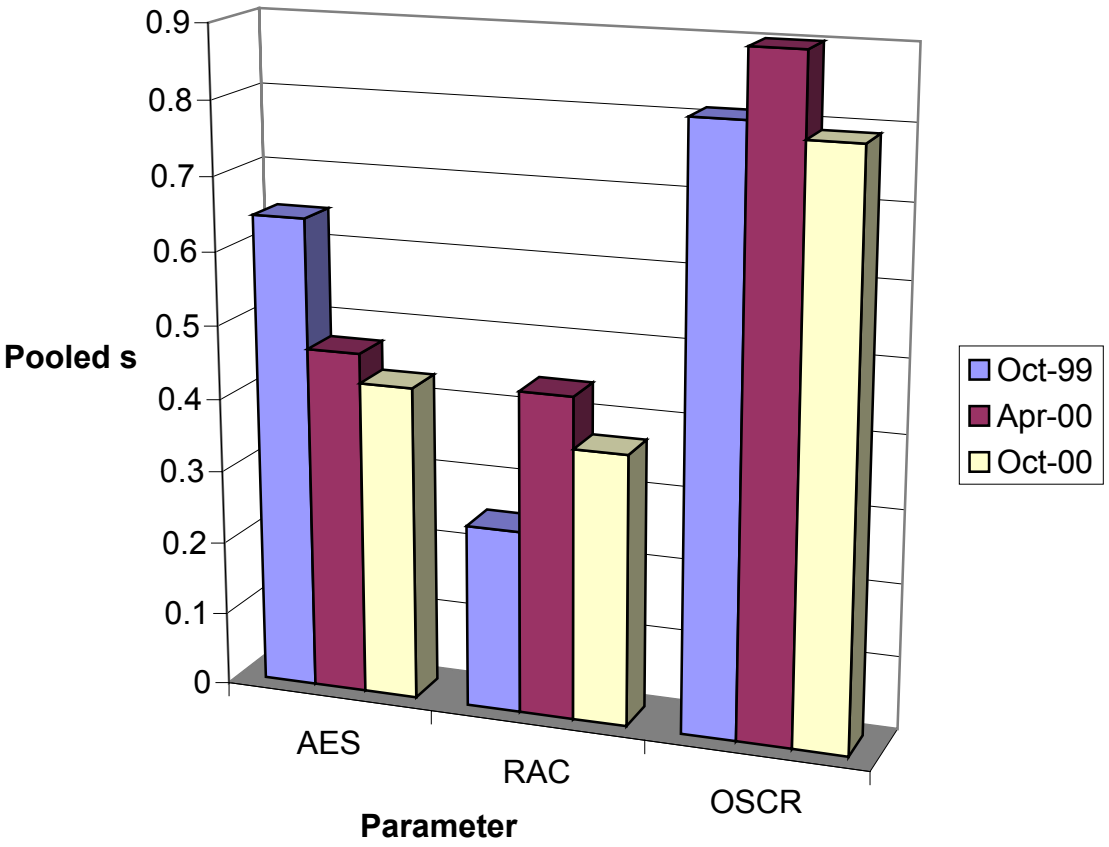
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

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

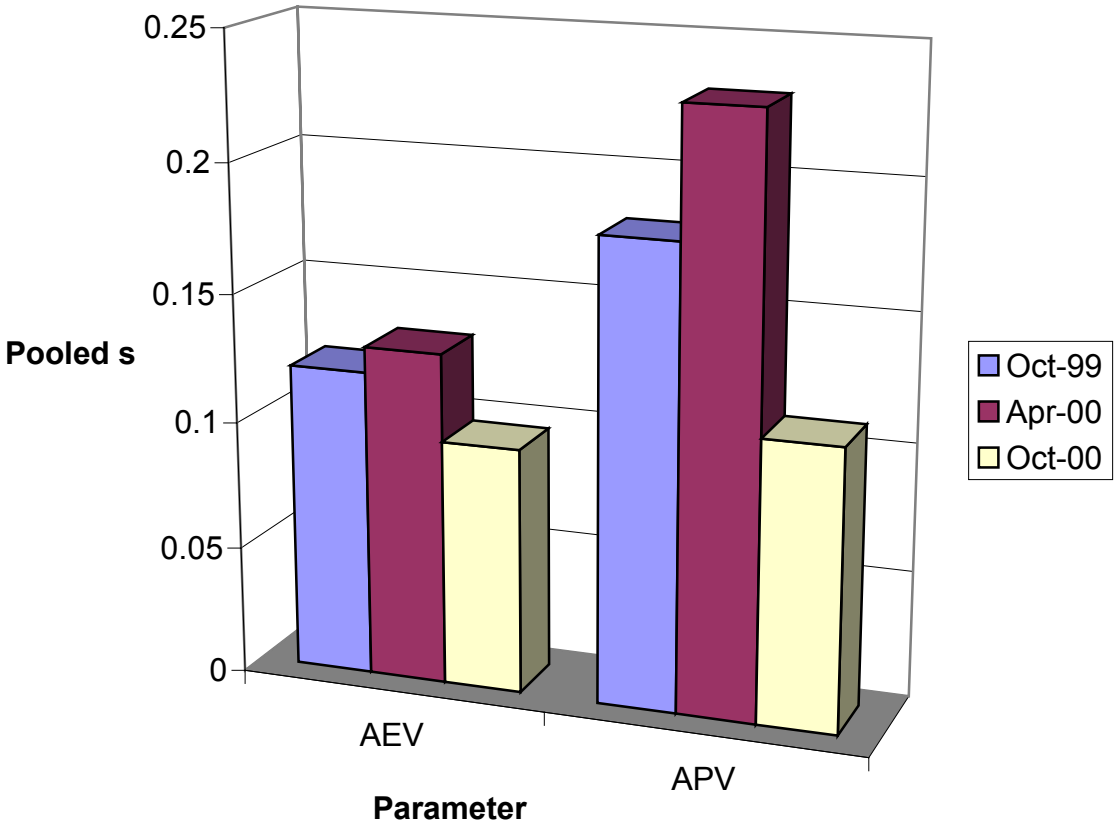


Figure 8
Sequence VG Industry Timeline

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