



Test Monitoring Center

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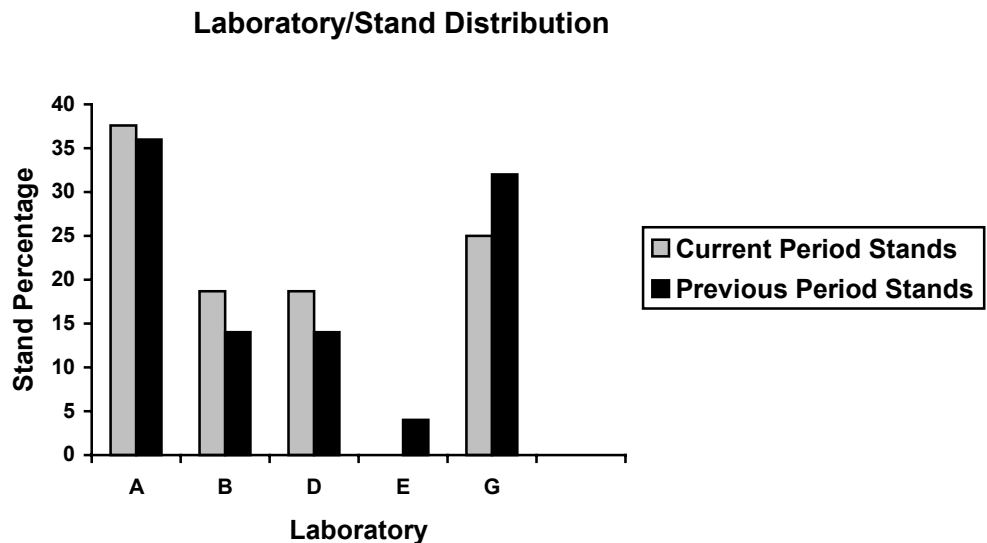
MEMORANDUM: 01-125
DATE: October 4, 2001
TO: Gordon Farnsworth, Chairman, Sequence VG Surveillance Panel
FROM: Richard E. Grundza
SUBJECT: Sequence VG Reference Test Status from April 1, 2001 through September 30, 2001

The following is a summary of Sequence VG reference tests that were completed during the period April 1, 2001 through September 30, 2001.

Lab/Stand Distribution

	Reporting Data	Calibrated as of 9/30/01
Number of Laboratories	4	4
Number of Stands	16	13

The following chart shows the laboratory/stand distribution:

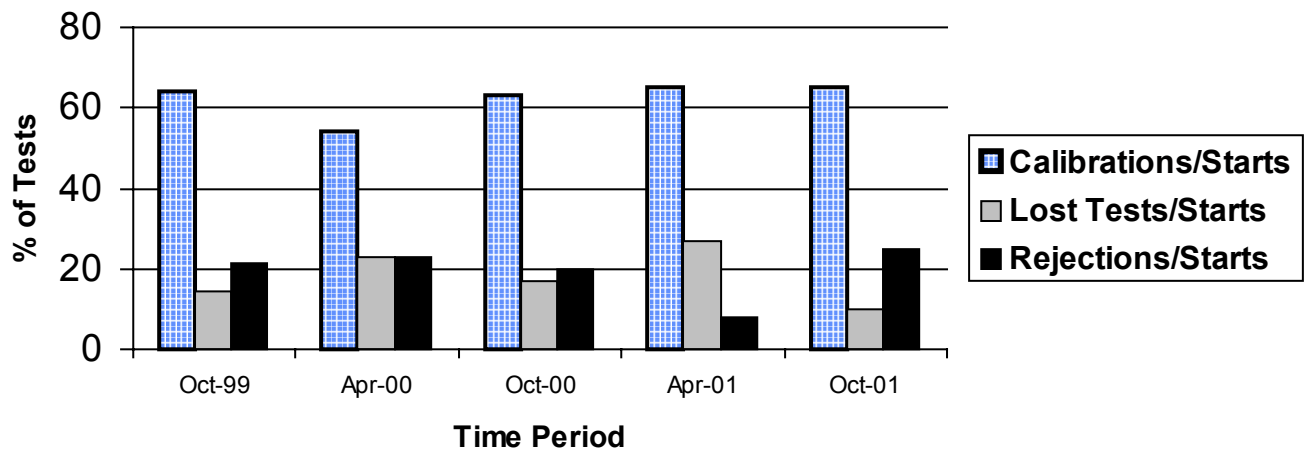


The following summarizes the status of the reference oil tests reported to the TMC:

	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	13
Failed Acceptance Criteria	OC	5
Operationally Invalid, Lab Judgement	LC	1
Data Removed from Stand Chart	XC	1
Total		20

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

Calibration Attempt Summary



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 decreased and rejected test per start rate has increased with respect to the previous period. The lost test rate is somewhat lower than the historical rate and rejected test per start rate appears to be slightly higher than the historical rate.

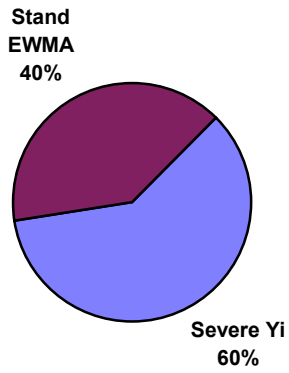
A detailed list of reasons tests failed the acceptance criteria is shown in the following table.

Reason	Number of Tests
Severe OSCR	3
Stand EWMA Precision Alarm, AEV	2

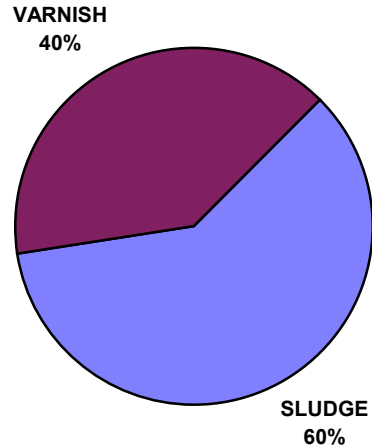
The tests which failed acceptance criteria for severe OSCR were all run on the same stand. The AEV precision alarms also occurred on one stand.

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



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

Reason	Number of Tests
Rocker Arm Cover Temperature Control Problems	1

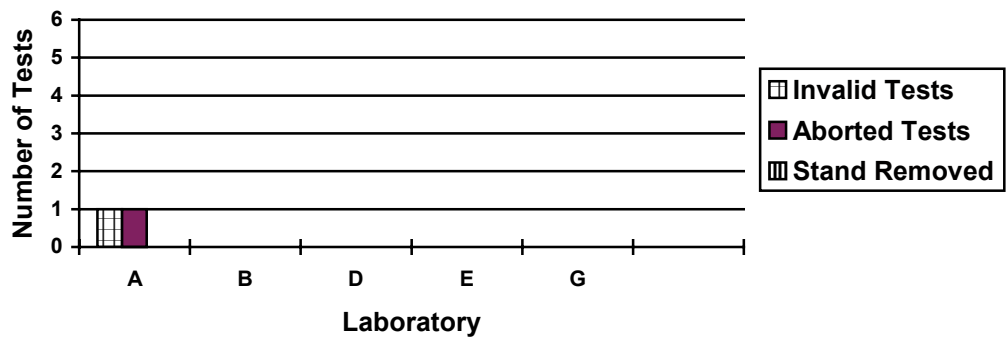
The following table lists the reasons for aborted tests.

Reason	Number of Tests
High Iron content @ 48hours, excessive crankshaft endplay	1

There was one LTMS deviation written during this report period. A total of five LTMS deviations have been written to date. Also, a test run for hardware evaluation was completed during this report period.

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

Lost Test Distribution



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.

<u>Variable</u>	<u>Pooled s</u> <u>All Oils</u>	<u>Mean</u> <u>Delta/s</u>	<u>Confidence</u> <u>Interval</u>	<u>Based</u> <u>on</u>	<u>Delta in</u> <u>Reported</u> <u>Units</u>
RAC	0.239	-0.290	7.81 - 8.04	8.0	-0.069
AES	0.533	-0.140	7.60 – 7.85	7.8	-0.03
APV	0.199	-0.031	7.40 – 7.59	7.5	-0.01
AEV	0.158	0.073	8.87 – 9.05	8.9	0.01
OSCR	1.151	0.169	23.5 - 25.6	20	4.5

The mean Δ/s for this period shows RACS (-0.140), AES (-0.290) and OSCR (0.169) were severe and AEV (0.073) and APV (-0.031) were 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 precision was in control for the period. With the exception of 3 warning alarms, severity was also in control during the period. The summation Δ/s plot shows a small (~ five test) severe trend during the middle of the period.

Industry control charts for RACS precision was in control for the period. With the exception of 4 warning alarms, severity was also in control during the period. The summation Δ/s plot shows a severe trend near the beginning of the period, leveling out around the middle of the period.

AEV severity and precision charts were in control for the period. The summation Δ/s plots show a slight mild trend about the middle of the period, which continues through 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.

With the exception of a warning alarm, OSCR severity was in control the entire period. OSCR precision was in action or warning alarm for 17 of the 18 tests reported this period. The precision problems were ultimately traced to three results from a single stand which were 2.205, 3.467 and 3.108 Δ/s from target. The summation Δ/s charts reflects a severe trend, primarily due to the above mentioned test results.

Figures 6 and 7 chart the pooled precision estimates for all monitored parameters, by ASTM report period. Figure 6 shows precision for both RACS and AES is about the same as the previous period, with OSCR showing some degradation with respect to the previous period. RACS and AES precision compares well with historical rates. OSCR precision shows degradation with respect to historical rates.

Figure 7 shows precision for both APV and AEV compares well with the previous period, as well as historical estimates..

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	4	3+ years
1006	0	0	16	< 1 year
1006-2	5445	1815	16	3+ years
1007	544	181	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 01-3 was issued on July 27, 2001. This information letter deleted the requirement to measure benzene levels in fuel stored at laboratories, defined a procedure for consensus rating and deleted the requirement to measure pentane, TBN and Viscosity @ 100 °C in used oil samples.

Information Memos

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

<u>Memo</u>	<u>Date</u>	<u>Subject</u>
01-32	4/10/01	Sequence VG Semi Annual Report
01-64	5/31/01	Reference Oil Target Update, Reference Oil 925-3
01-102	8/3/01	Editorial Change to VG report Form 8

TMC Activities

During this report period, the TMC visited four labs. Any discrepancies noted during these visits were identified to the laboratory and corrective action is being taken.

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.

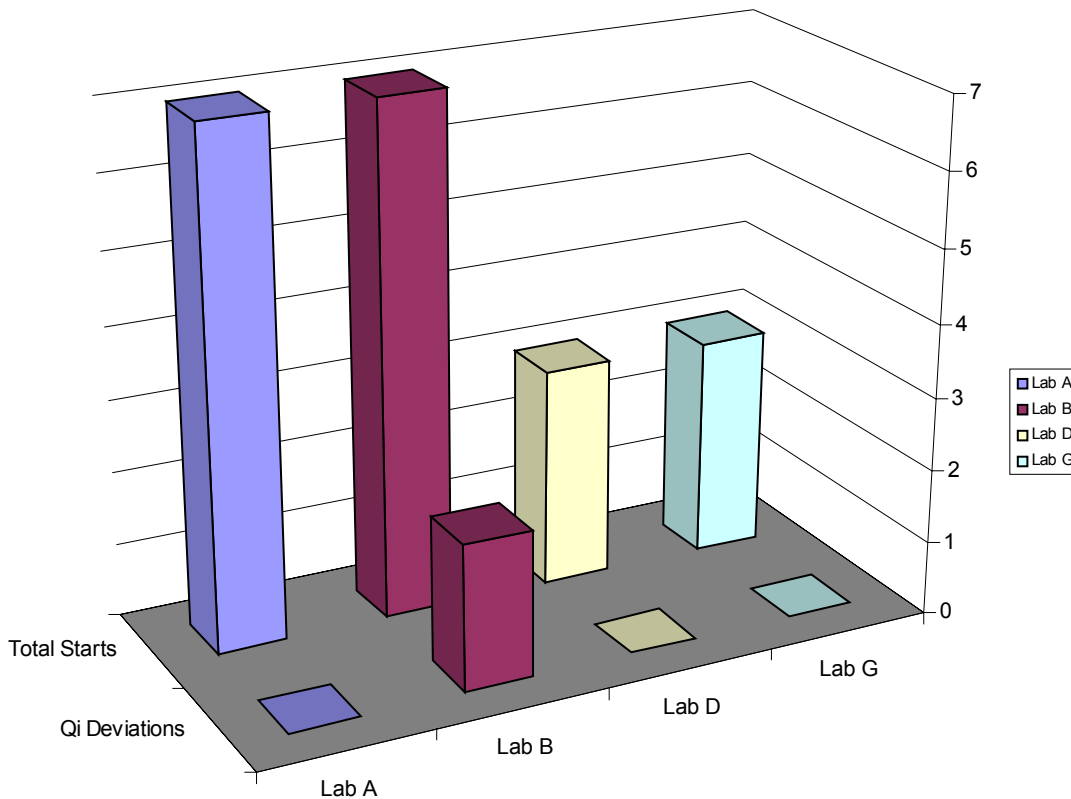
Parameter	Severity Adjustment Standard Deviation (n = 30)	Pooled Standard Deviation, Oils 925-3, 1006 and 1007 (n =21)
AES	0.51	0.533
RCS	0.24	0.239
AEV	0.10	0.158
APV	0.18	0.199
OSCR	0.828	1.151

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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 Exhaust Backpressure	1
Power	1

Both the power and power in conjunction with exhaust backpressure deviations were evaluated for different stands in the same lab. The power deviations were traced to problems with sticking throttle bodies, which were corrected early in test. The exhaust backpressure deviation was traced to problems with the controller, which was not identified until after the test. In both 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 increased and the lost test per start rate has decreased with respect to the previous period. AEV and APV are on or near target, while RACS, AES and OSCR were severe for the period. Precision for AES, AEV, APV and RACS is comparable with previous period and historical estimates. OSCR precision has degraded with respect to the previous period and historical rates.

REG/reg

Attachments

c: Sequence VG Surveillance Panel

<ftp://www.tmc.astm.cmri.cmu.edu/docs/gas/sequencev/semiannualreports/vg-10-2001>

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.

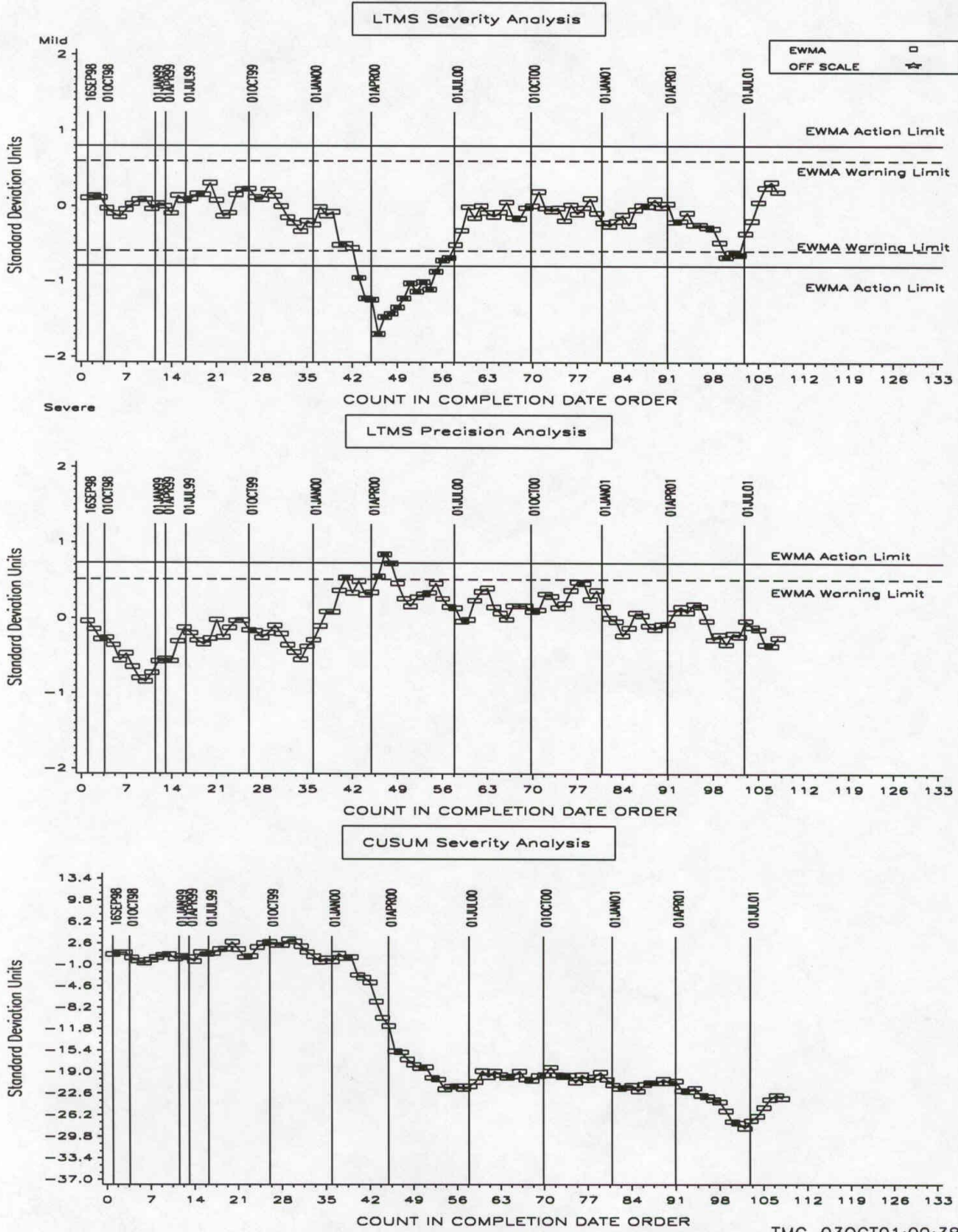
Figures 6 and 7 compare pooled precision estimates from this report period with previous periods.

Figure 8 is the Industry Timeline.

SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE SLUDGE

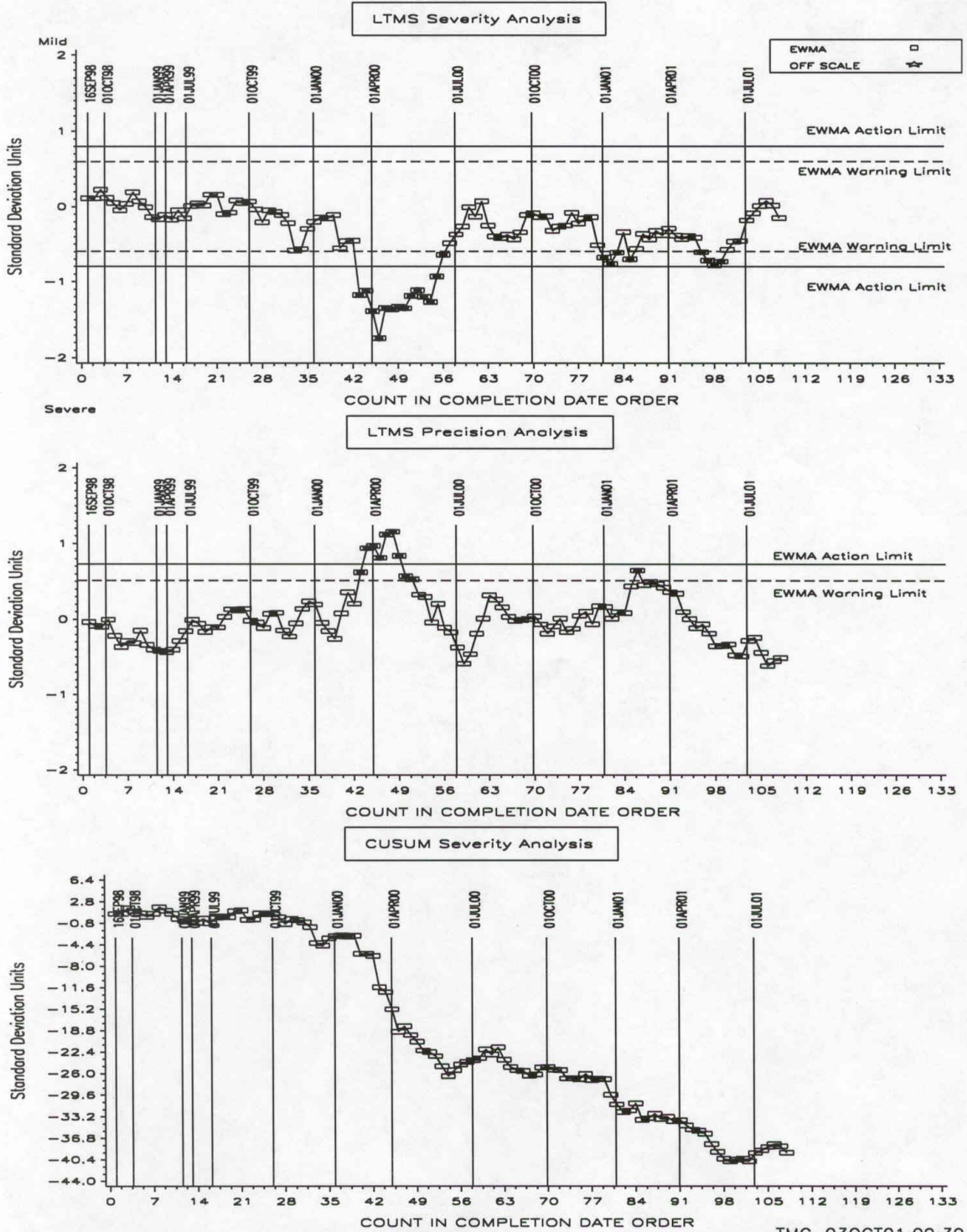
Figure 1



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ROCKER COVER SLUDGE

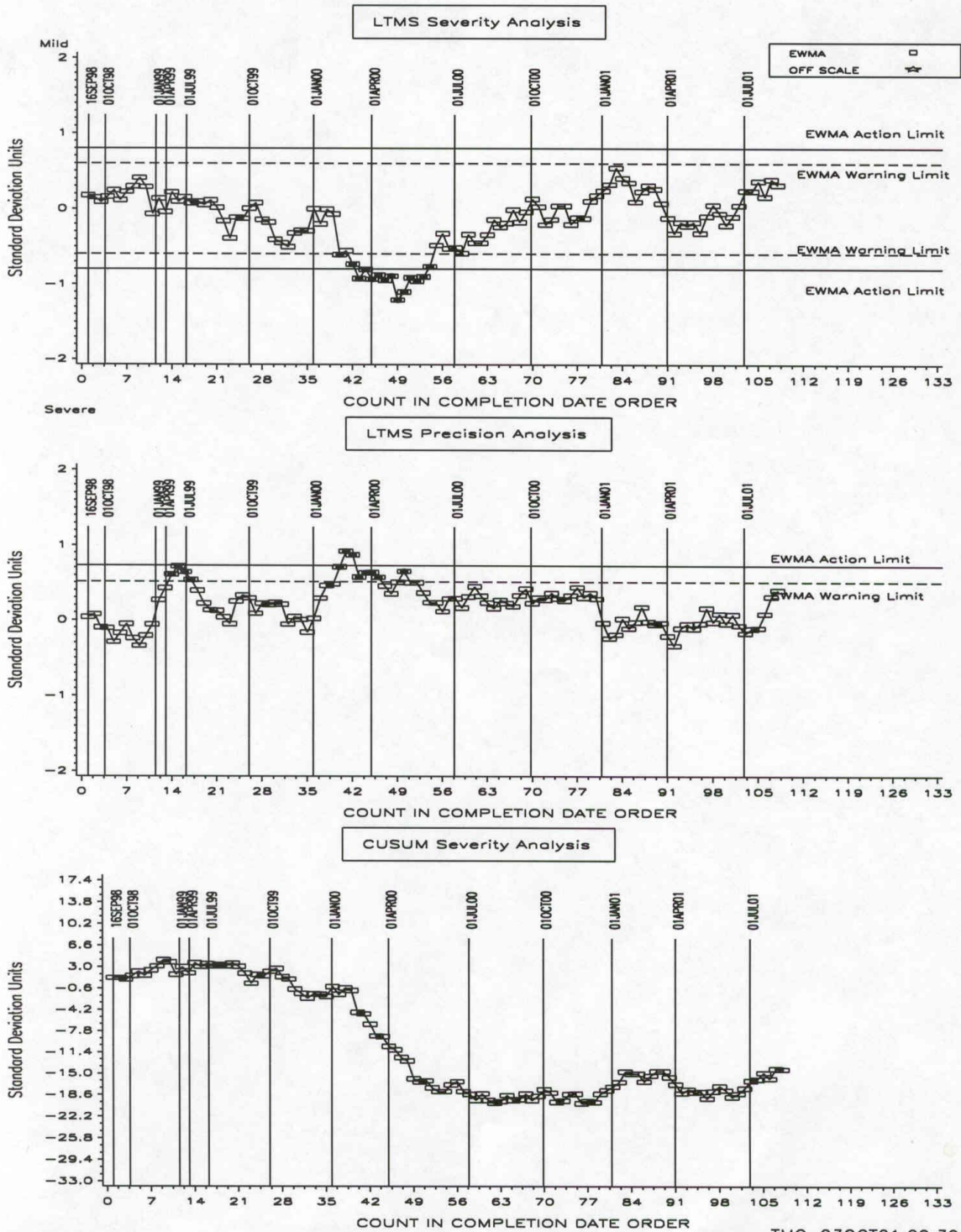
Figure 2



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ENGINE VARNISH 3-PART FINAL RESULT

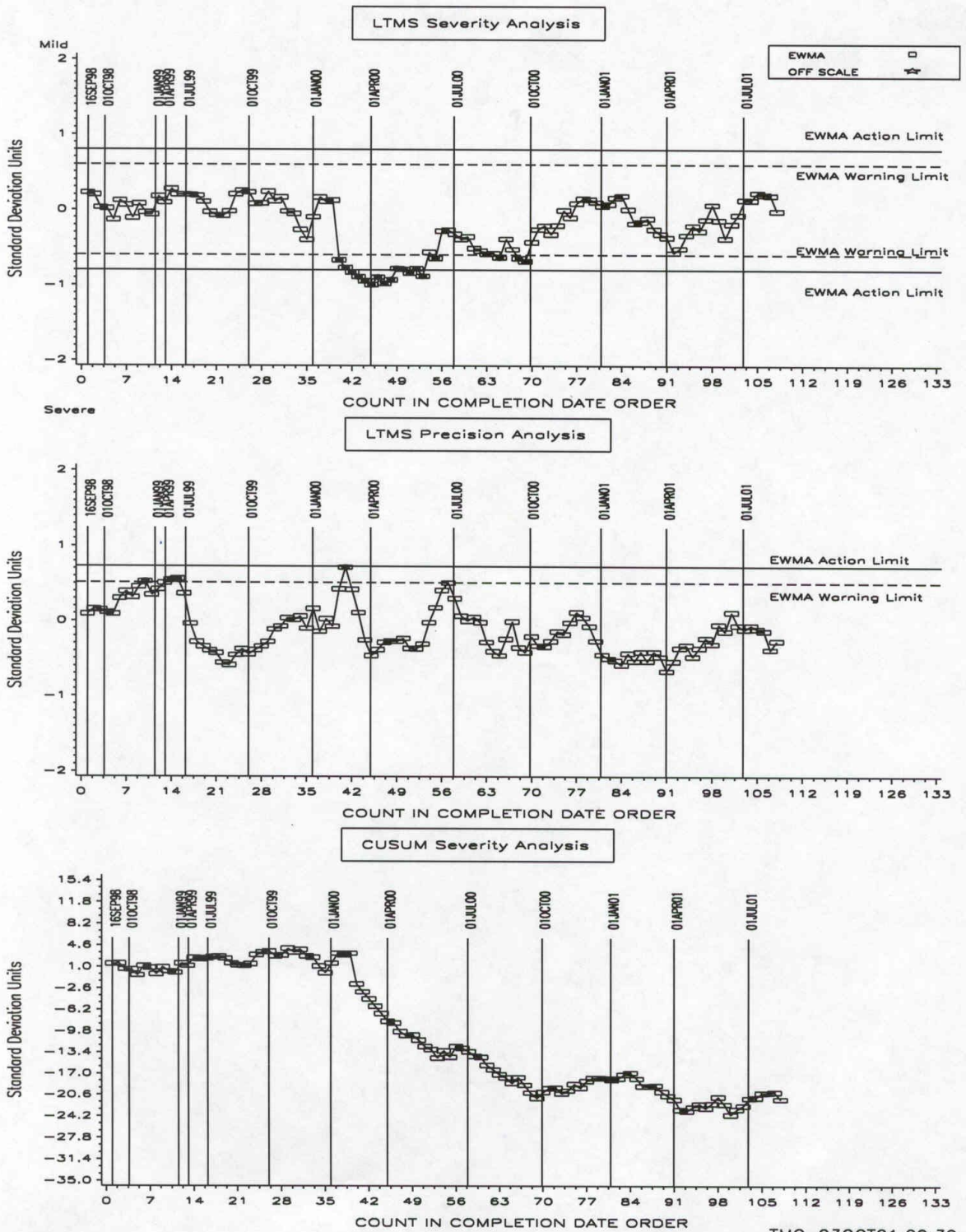
Figure 3



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVG PISTON SKIRT RATING (MERITS)

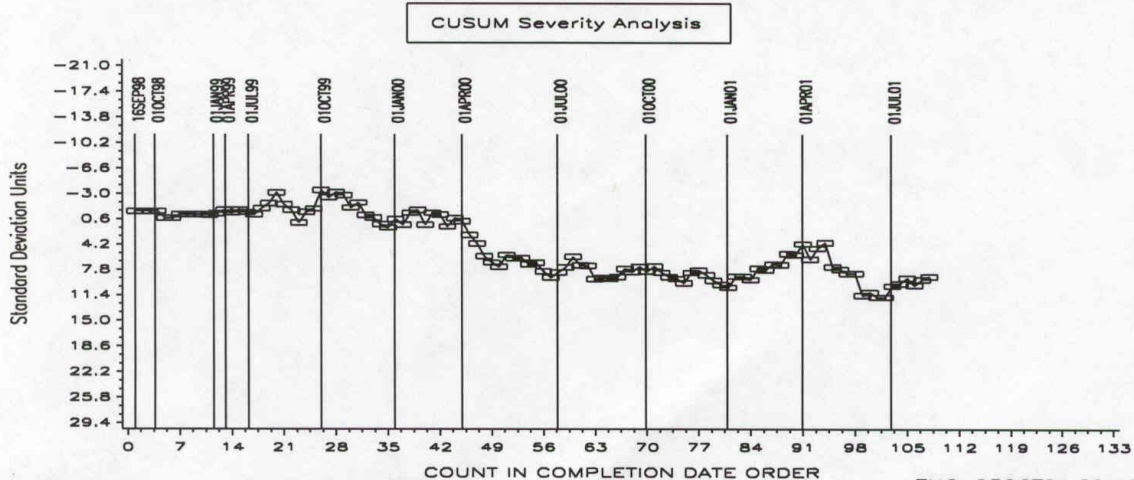
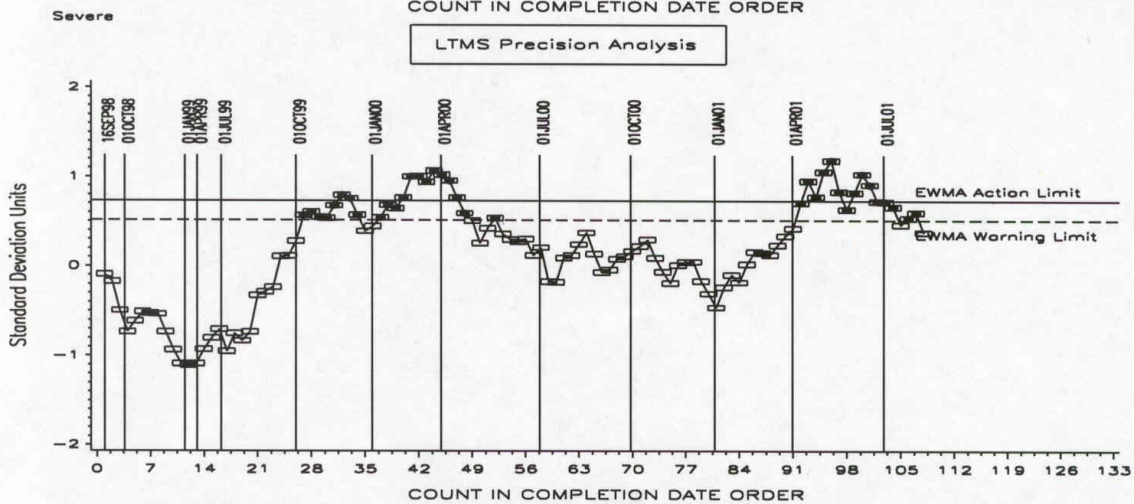
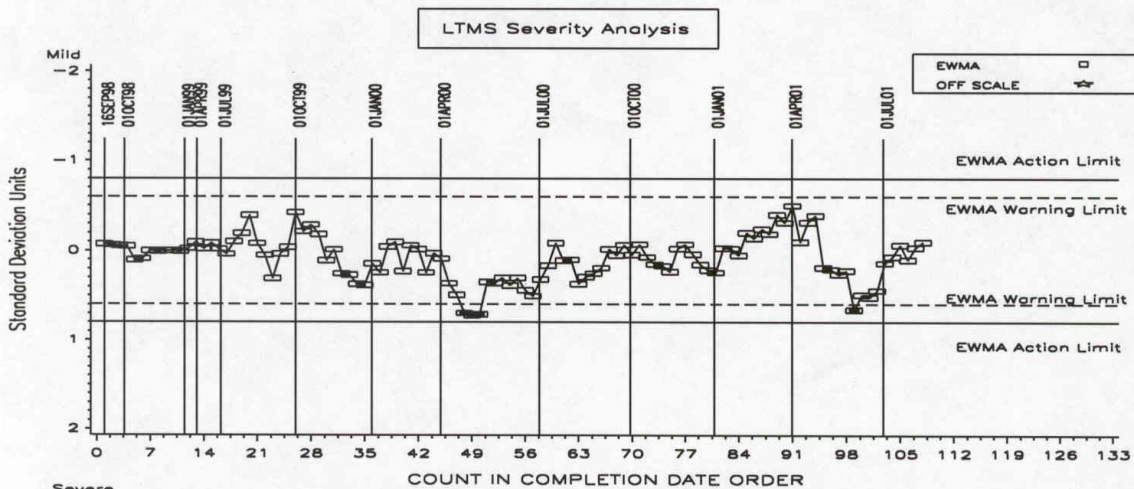
Figure 4



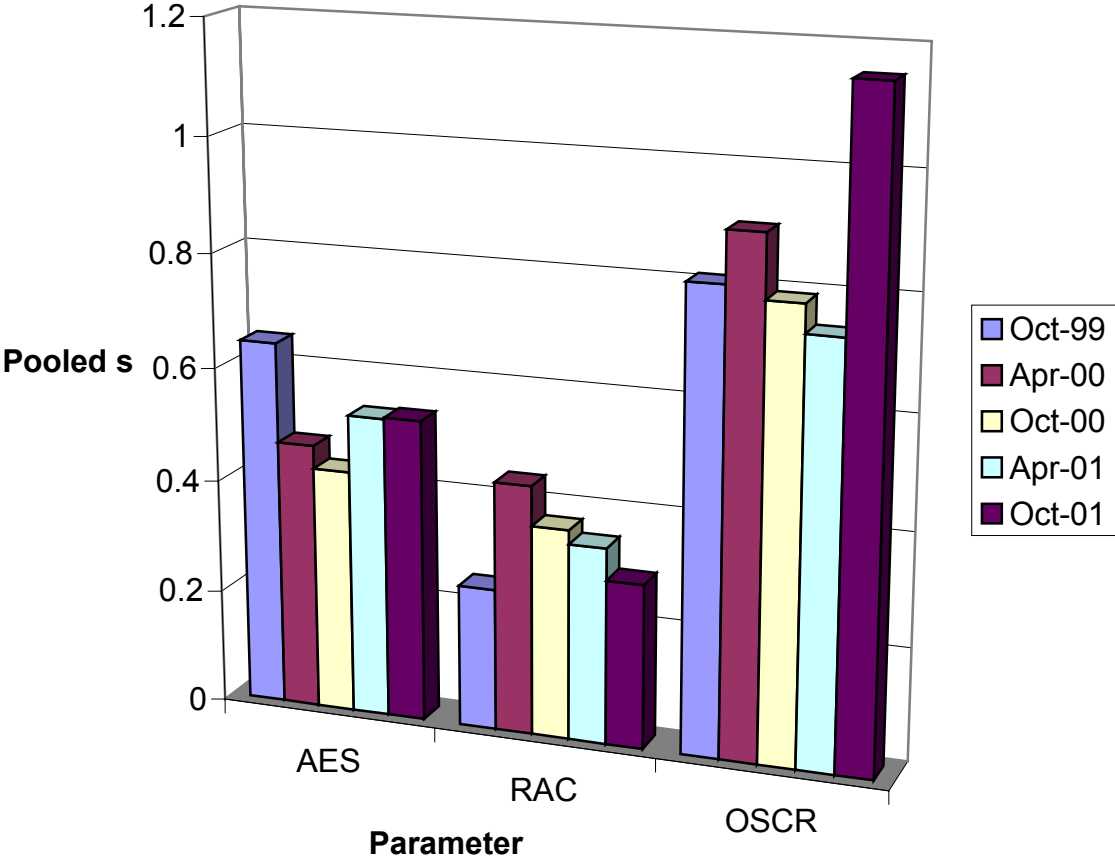
SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

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 $\ln(\text{OSCR} + 1)$

Comparison of Pooled Precision Estimates By ASTM Report Period

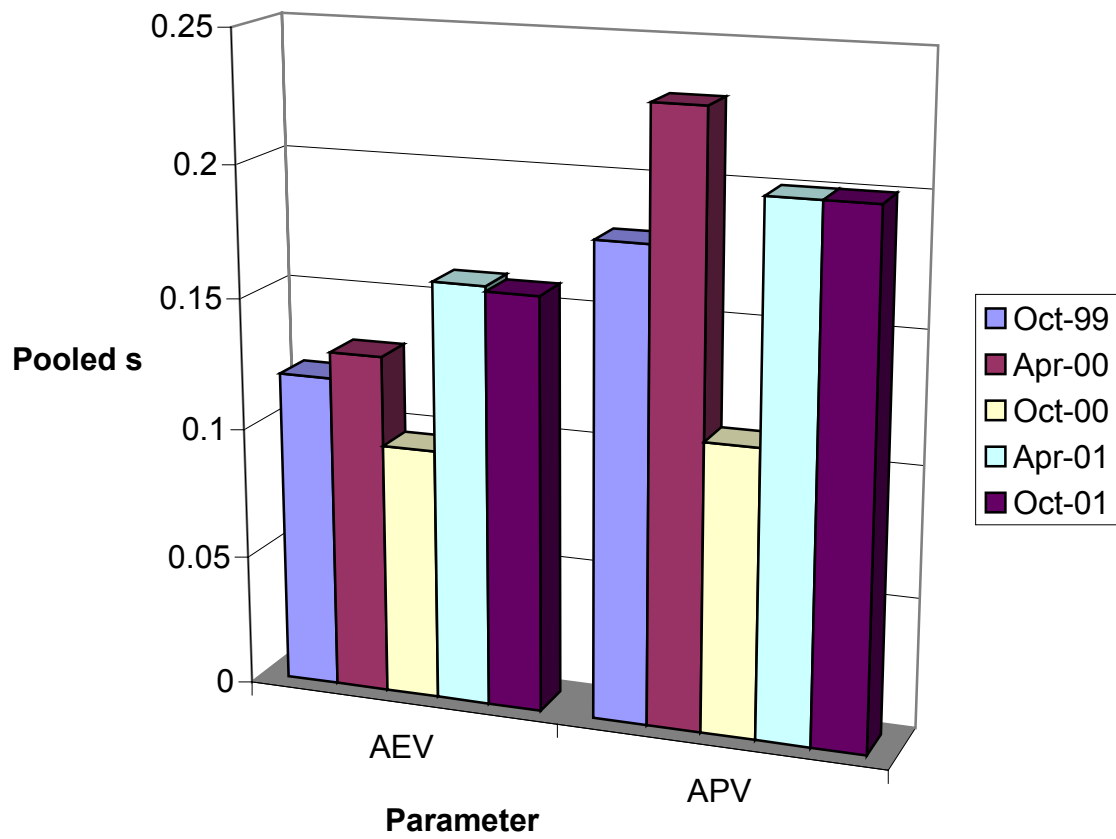


Figure 8 Sequence VG Industry Timeline

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, respectively
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.
20010320	01-3	This information letter dropped the requirement to measure benzene in the fuel, defined a process for consensus rating and no longer requires analysis of used oil for TBN, vis @ 100 °C and pentane insolubles.