



# Test Monitoring Center

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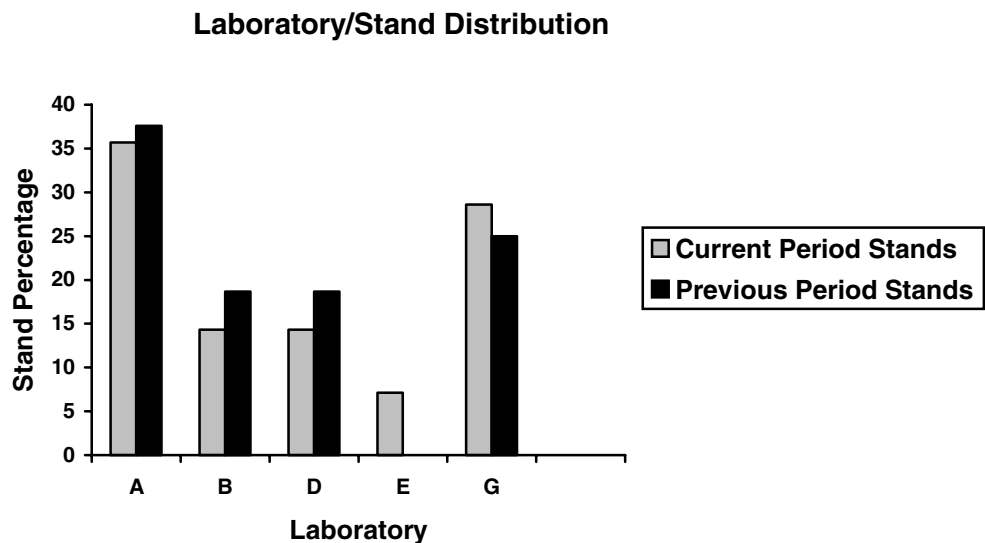
MEMORANDUM: 02-017  
DATE: April 10, 2002  
TO: Gordon Farnsworth, Chairman, Sequence VG Surveillance Panel  
FROM: Richard E. Grundza  
SUBJECT: Sequence VG Reference Test Status from October 1, 2001 through March 31, 2002

The following is a summary of Sequence VG reference tests that were completed during the period October 1, 2001 through March 31, 2002.

## Lab/Stand Distribution

	Reporting Data	Calibrated as of 3/31/02
Number of Laboratories	5	5
Number of Stands	14	12

The following chart shows the laboratory/stand distribution:

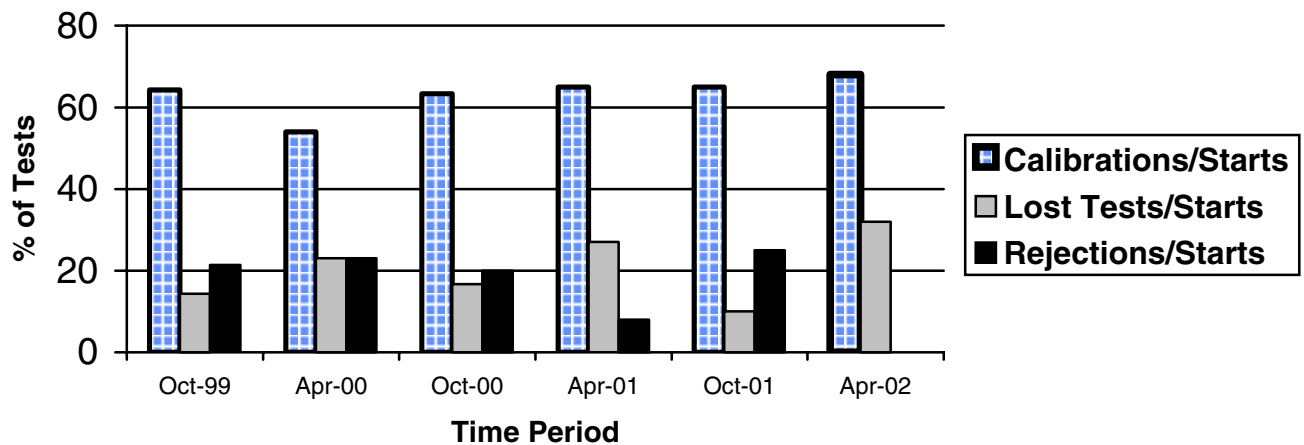


The following summarizes the status of the reference oil tests reported to the TMC:

	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	13
Failed Acceptance Criteria	OC	0
Operationally Invalid, Lab Judgement	LC	3
Aborted Calibration Test	XC	2
Aborted Hardware Evaluation Test	XN	1
Operationally Invalid, Lab and TMC Judgment	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 increased with respect to the previous period and is higher than the historical rate. There were no rejected tests this period.

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

Reason	Number of Tests
Rocker Arm Cover temperature control problems	1
Lost test data and excessive shutdowns	1
Cam Timing problems and excessive shutdowns	1
MAP control problems	1
Damaged Oberg filter	1

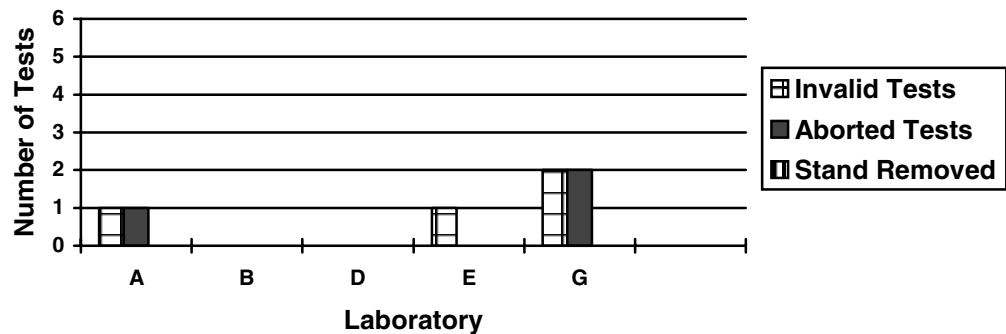
The following table lists the reasons for aborted tests.

Reason	Number of Tests
Oil contamination	1
Rocker Arm Cover cracked/coolant leak	1
Dynamometer Failed	1

There were no LTMS deviations written during this report period. A total of five LTMS deviations have been written to date. Also, a test run for hardware evaluation purposes 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	0.250	-0.124	7.73 - 8.03	8.0	-0.03
AES	0.390	0.355	7.92 - 8.39	7.8	0.14
APV	0.180	-0.222	7.17 - 7.39	7.5	-0.04
AEV	0.090	0.044	8.86 - 9.00	8.9	0.00
OSCR	0.850	-0.594	23.5 - 25.6	20	9.0

The mean  $\Delta/s$  for this period shows RACS (-0.124) and APV (-0.222) were severe and AES (0.355) and OSCR (-0.594) were mild. AEV (0.044) was on or near target. Figures 1 through 5 are current industry severity and precision EWMA control charts and plots of summations  $\Delta/s$  for AES, RAC, AEV, APV, and OSCR.

Industry control charts for AES show severity and precision in control for the period. The summation  $\Delta/s$  plot shows a small (~ four test) mild trend at the end of the period.

Industry control charts for RACS show severity and precision in control for the period. The summation  $\Delta/s$  plot shows a slight severe trend the entire period.

AEV severity and precision charts were in control for the period. The summation  $\Delta/s$  plots show severity on or near target for the period.

APV severity and precision charts were in control the entire period. The summation  $\Delta/s$  plots show APV trending severe for the period.

With the exception of a warning alarm, OSCR severity was in control the entire period. OSCR precision was in control the entire period. The summation  $\Delta/s$  charts reflect a mild trend for the period.

Figures 6 and 7 chart the pooled precision estimates for all monitored parameters, by ASTM report period. Figure 6 shows a small improvement in precision for RACS and AES with respect to the previous period while OSCR precision has improved significantly with respect to the previous period. Precision for all three parameters compares well with historical rates. Figure 7 shows precision for both APV and AEV has improved with respect to the previous two periods, and compares well with 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	174	58	10	3+ years
1006	0	0	9	< 1 year
1006-2	5246	1748	3	3+ years
1007	507	169	2	~18 months
1009	2750	818	0	3+ years

Note: Oils 1006, 1007 and 1009 are used across multiple test areas, TMC inventory represents total amount of that oil on hand.

Information Letters

Information Letter 02-1 was issued January 8, 2002. This information letter deleted the requirements to monitor power QI and NO<sub>x</sub>, accomplished some minor rating changes recommended by the Light Duty Rating Task Force and allowed reworks for blowby up to 48 hours into the test. Information Letter 02-2 was issued on February 7, 2002. This information letter deleted the requirement to monitor CO, CO<sub>2</sub> and O<sub>2</sub> and replaced these parameters with the measurement of lambda. Information Letter 02-3 was issued April 8, 2002. This letter addressed the replacement of CRC Manuals 12 and 14 with CRC Manual 20.

Information Memos

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

<u>Memo</u>	<u>Date</u>	<u>Subject</u>
01-125	10/4/01	Sequence VG Semi Annual Report
01-182	12/11/01	Dissemination of Cam Baffle Varnish Rating Worksheets
01-183	12/13/01	Report Forms and Data Dictionary, Version 20011205

In addition to the above mentioned memoranda a Report Package Revision Notice, VG-20020118 was issued on February 20, 2002.

TMC Activities

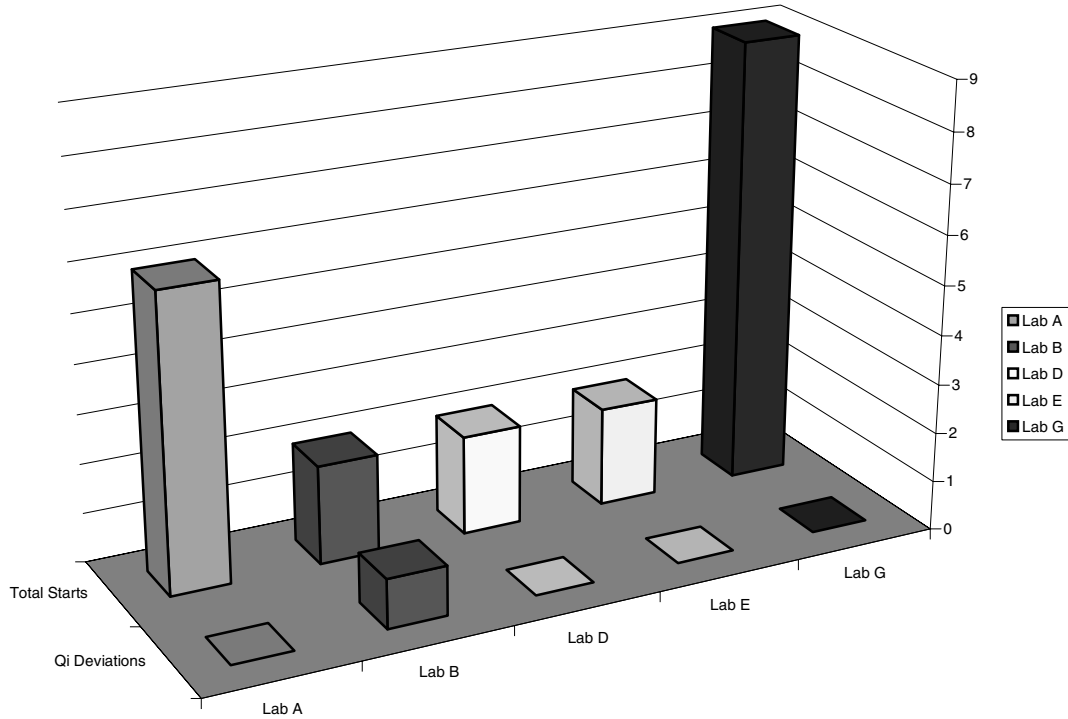
During this report period, the TMC visited two labs. Any discrepancies noted during these visits were identified to the laboratory and corrective action is being taken.

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 =13)
AES	0.51	0.390
RCS	0.24	0.250
AEV	0.10	0.090
APV	0.18	0.180
OSCR	0.828	0.850

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
Manifold Absolute Pressure (MAP)	1

The MAP deviation was traced to problems with throttle control unit, which was corrected early in test.

Summary

Calibrations per start compares well with the previous period and historical rates, while the lost test per start rate has increased with respect to the previous period. There were no rejected tests this period. AEV was on or near target, while AES and OSCR were mild and APV and RACS were severe for the period. Precision for all parameters has improved when compared with previous period and compares well with historical estimates.

REG/reg

Attachments

c: Sequence VG Surveillance Panel

<ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencev/semiannualreports/vg-04-2002.pdf>

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.

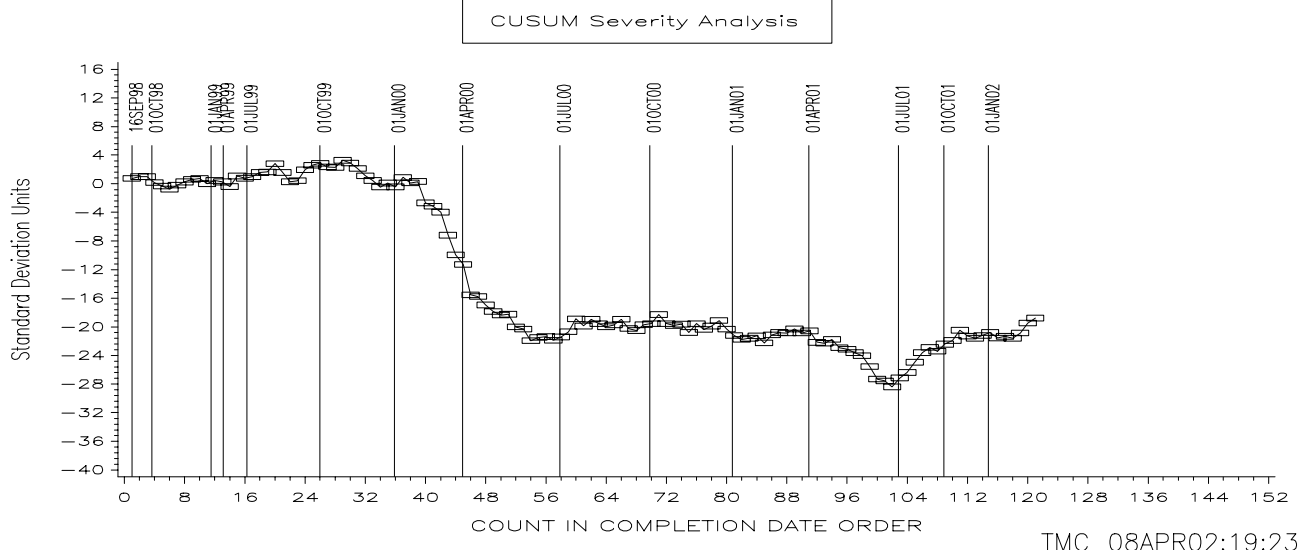
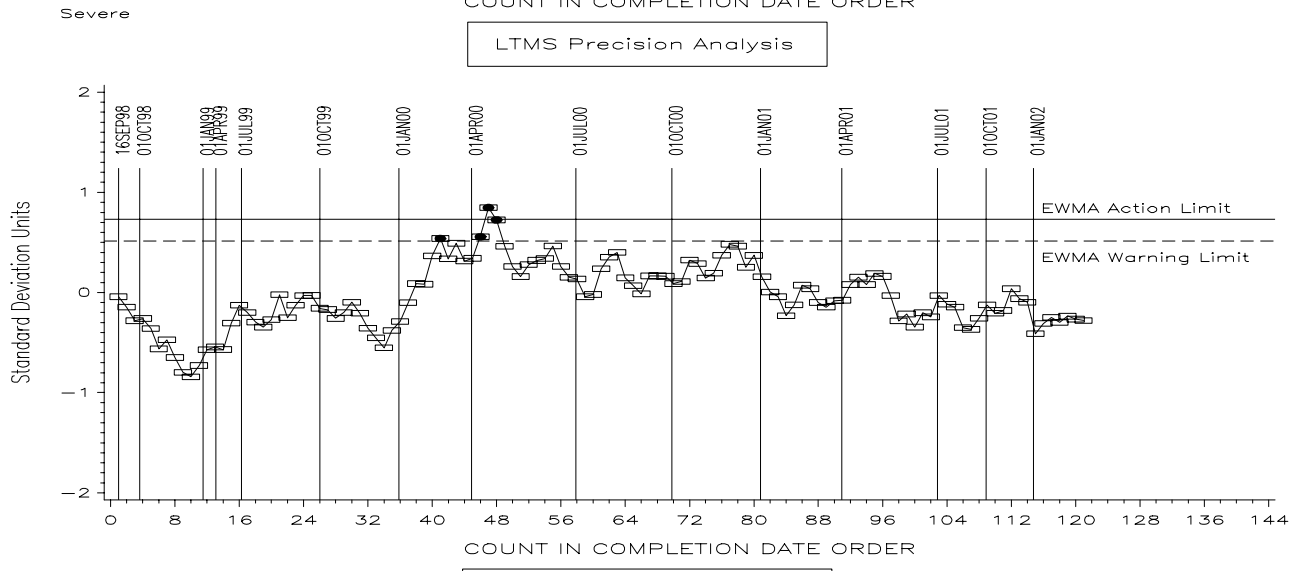
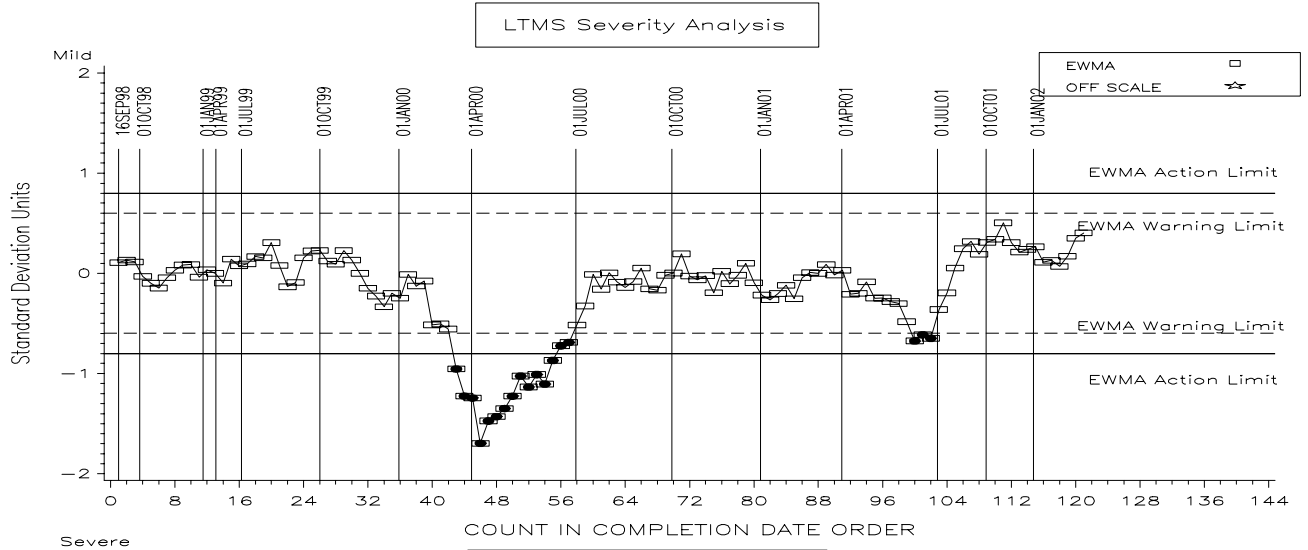
Figures 6 and 7 compare pooled precision estimates from this report period with previous periods.

Figure 8 is the Industry Timeline.

# SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

## AVERAGE ENGINE SLUDGE

FIGURE 1

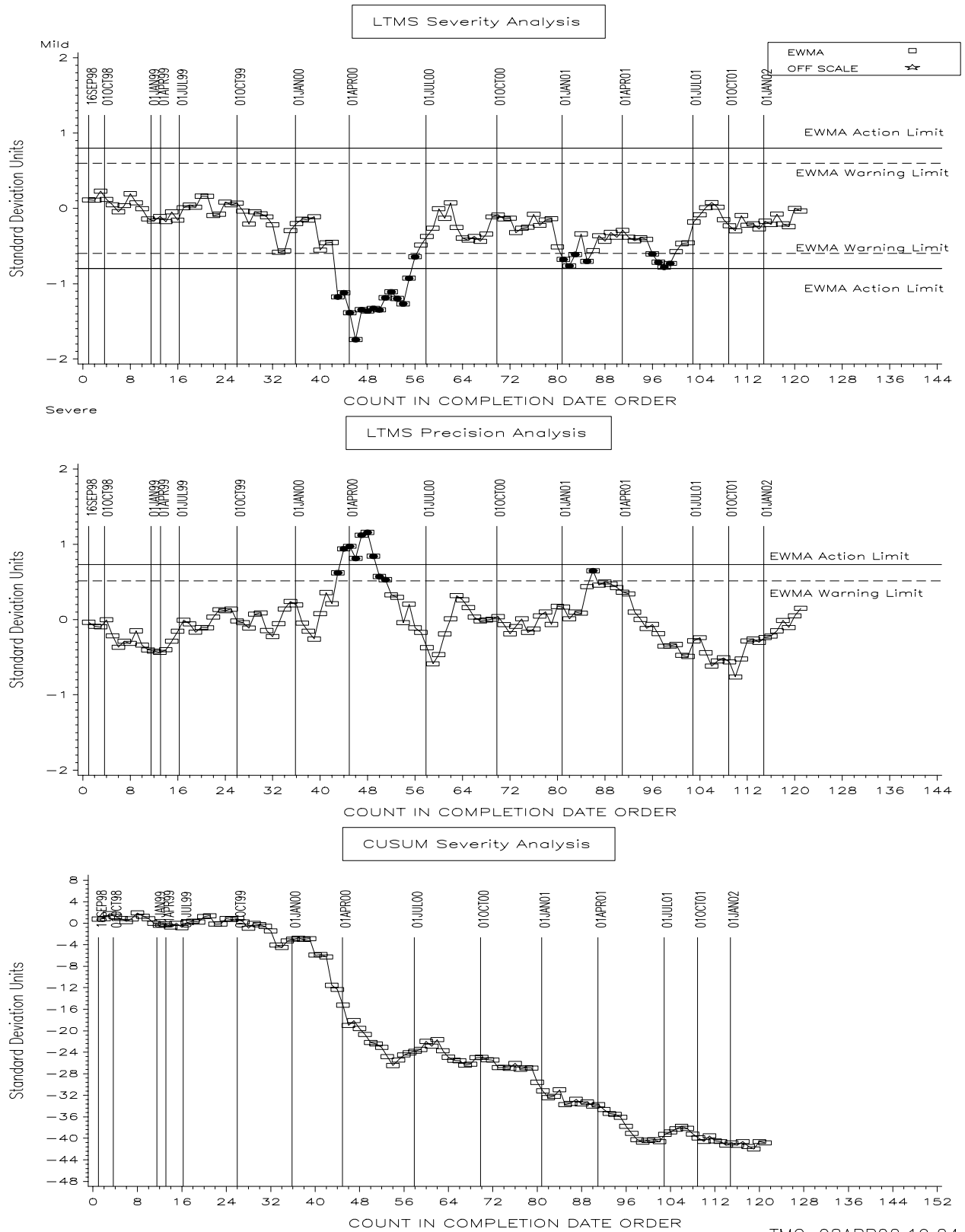




# SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

## AVERAGE ROCKER COVER SLUDGE

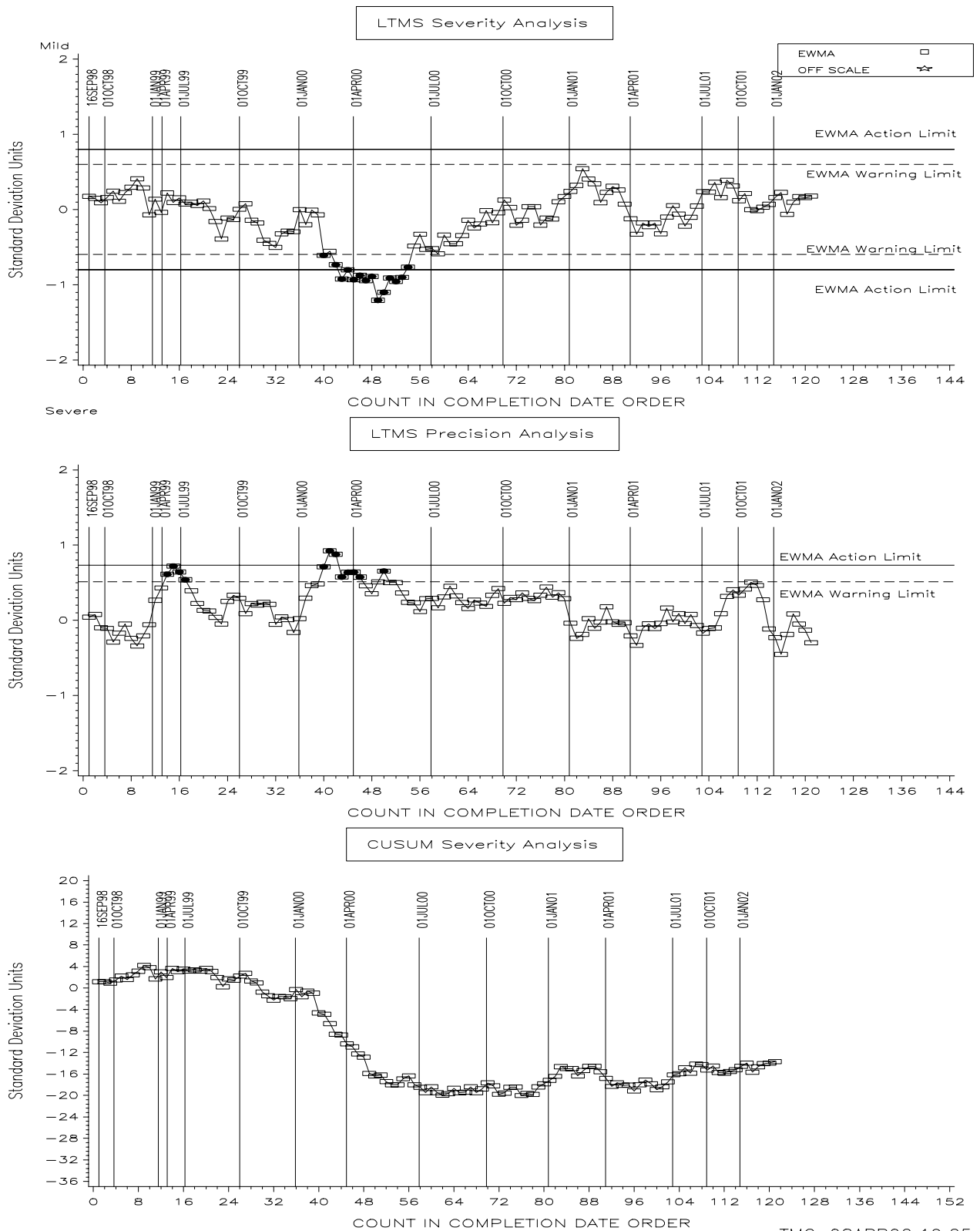
FIGURE 2



# SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

## AVERAGE ENGINE VARNISH 3-PART FINAL RESULT

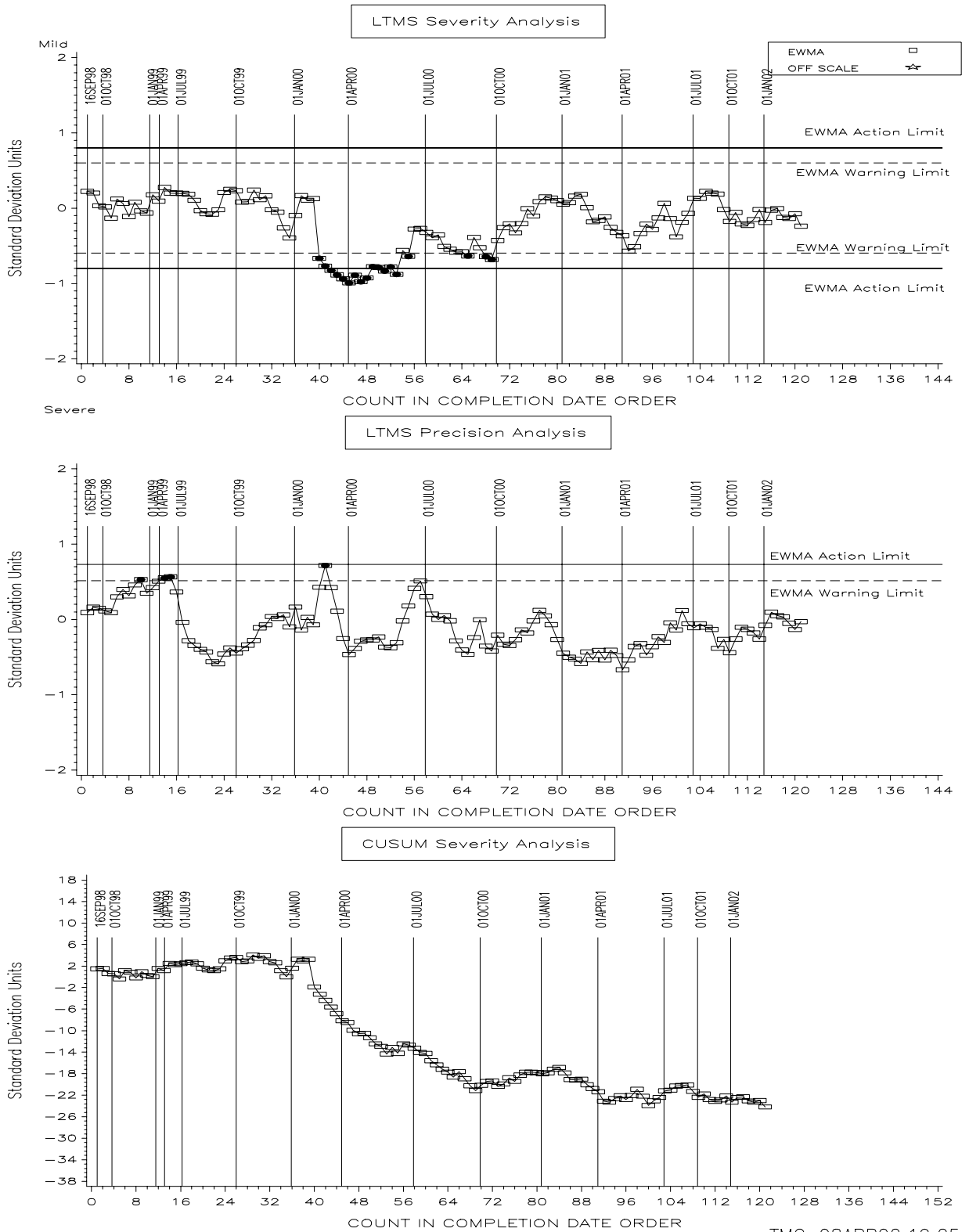
FIGURE 3



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

AVG PISTON SKIRT RATING

FIGURE 4



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

OIL SCREEN SLUDGE

FIGURE 5

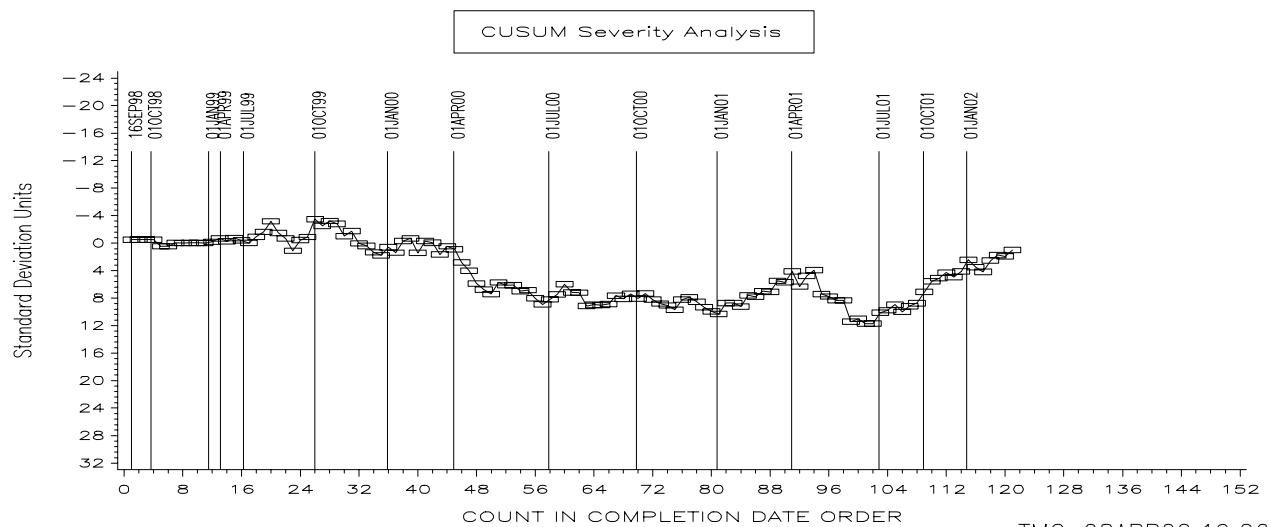
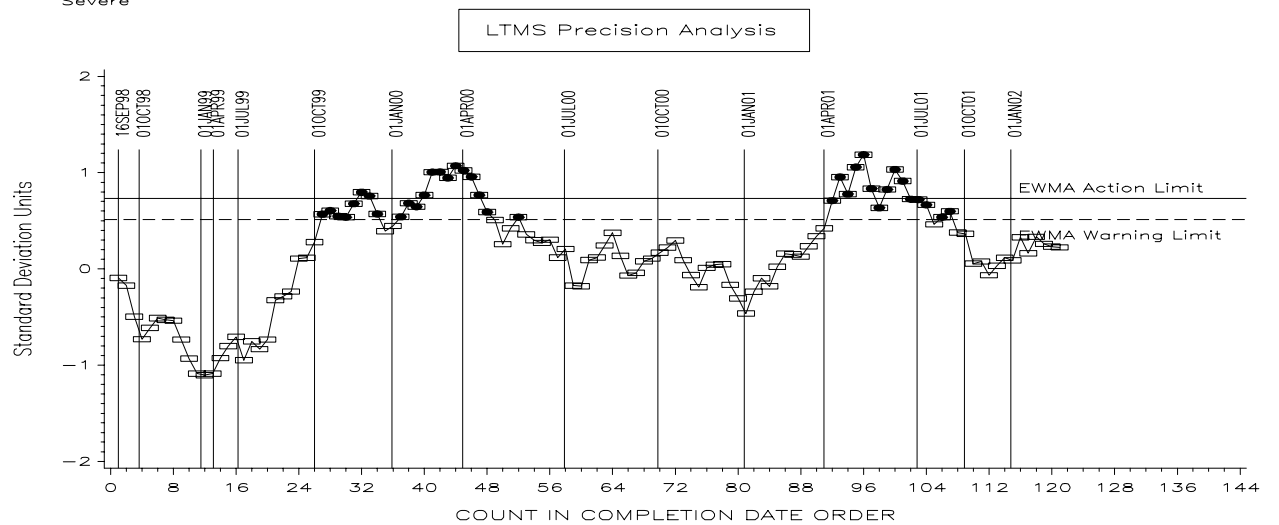
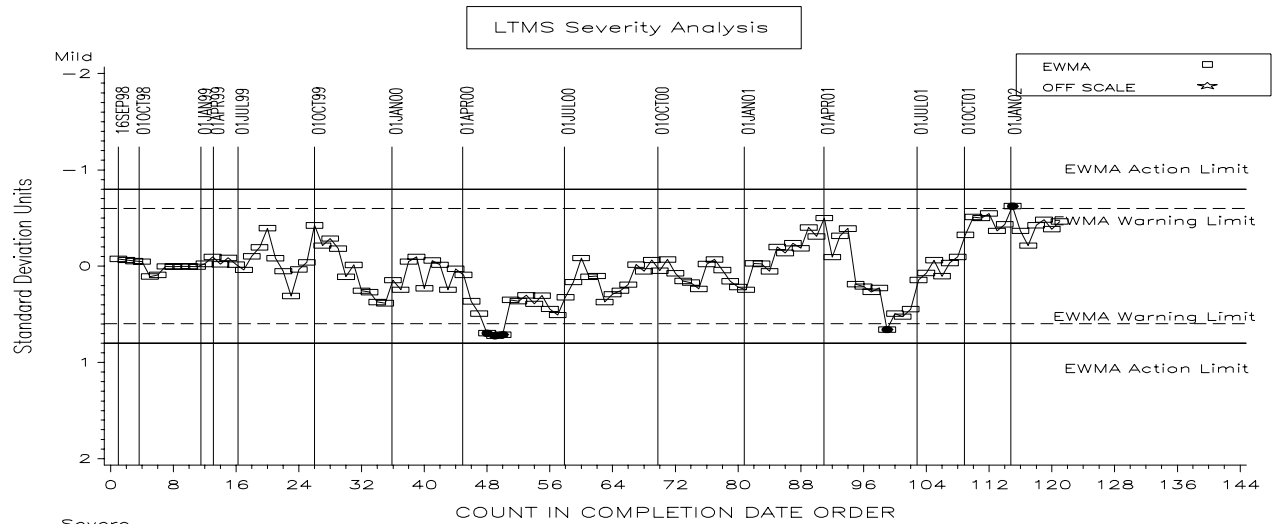
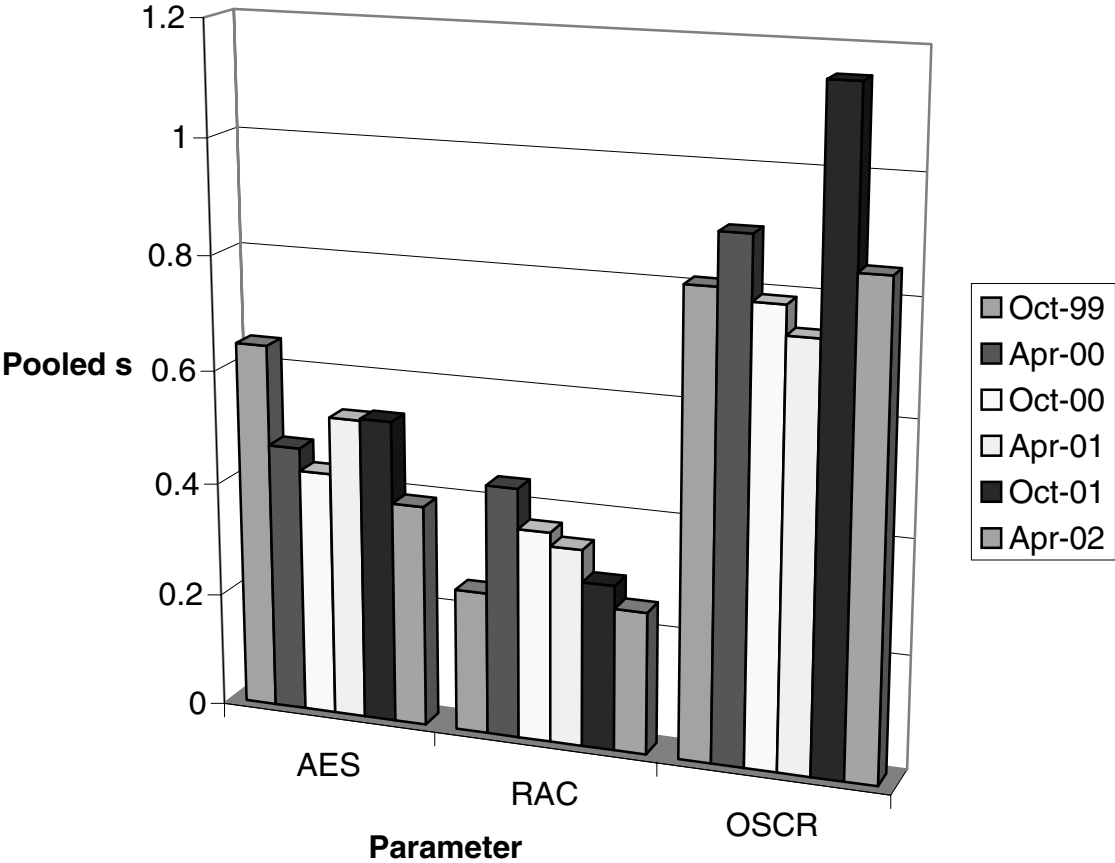


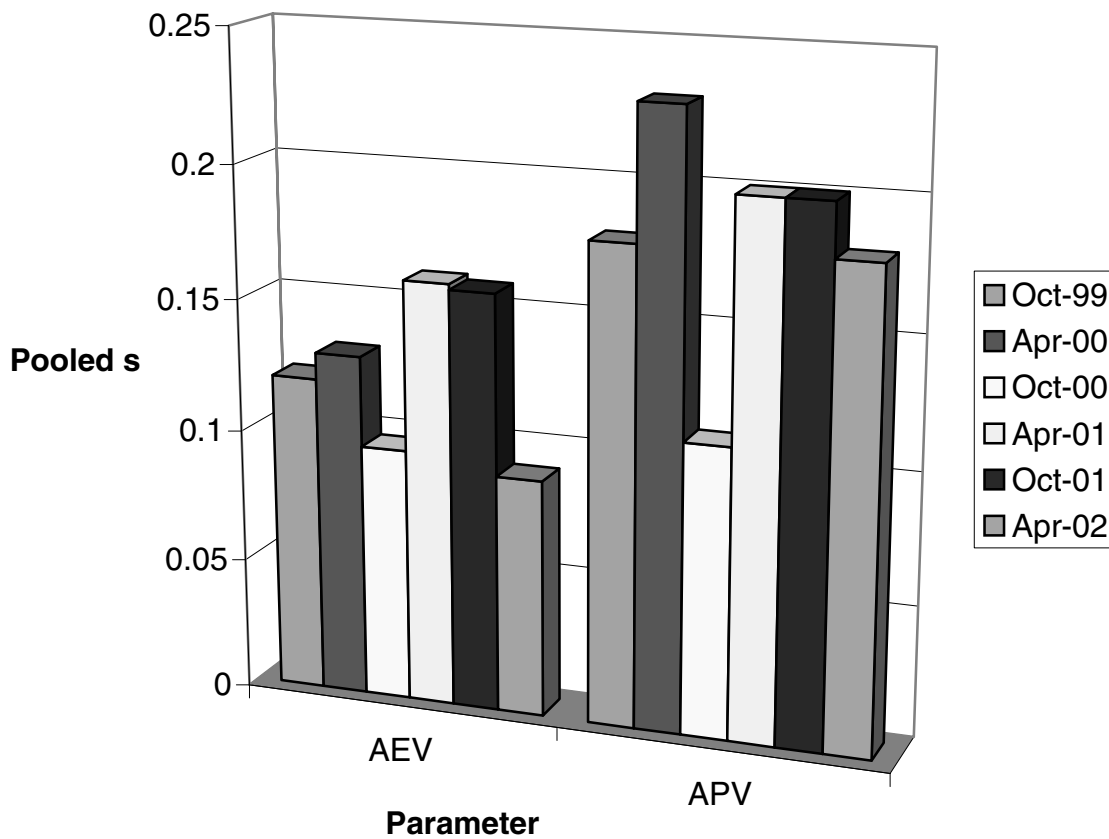
Figure 6

### 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.

20020108	02-1	This information letter dropped the requirement to monitor Power QI and NOx, made minor changes to rating techniques as recommended by LDRTF and allowed reworks for blowby adjustment up to test hour 48.
20020208	02-2	This information letter replaced CO, CO2 and O2 measurements with Lambda.
20020408	02-3	This information letter replaced CRC manuals 12 and 14 with CRC manual 20.