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

MEMORANDUM: 03-089

DATE: September 30, 2003

TO: Gordon Farnsworth, Chairman, Sequence VG Surveillance Panel

FROM: Richard E. Grundza

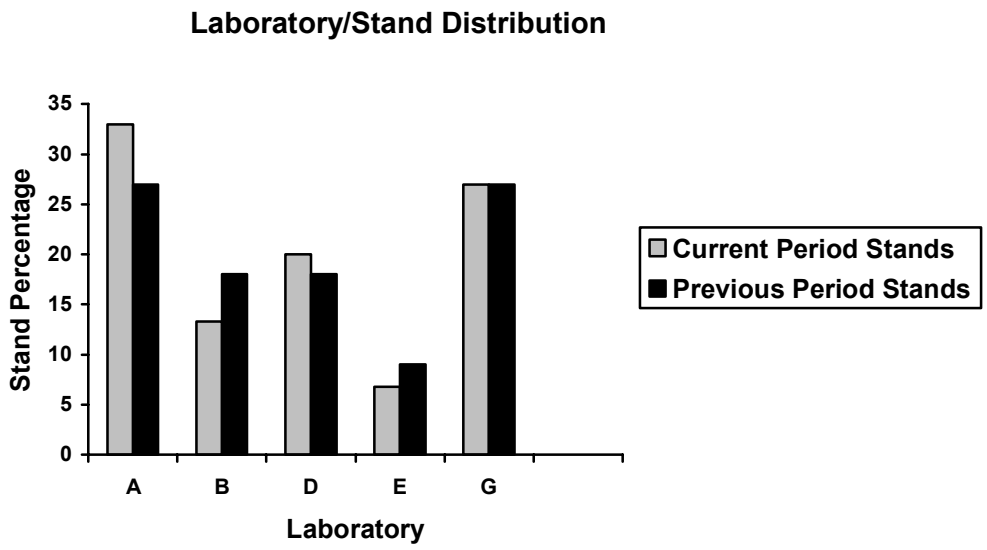
SUBJECT: Sequence VG Reference Test Status from April 1, 2003 through September 30, 2003

The following is a summary of Sequence VG reference tests that were completed during the period April 1, 2003 through September 30, 2003.

Lab/Stand Distribution

	Reporting Data	Calibrated as of 9/30/03
Number of Laboratories	5	5
Number of Stands	15	13

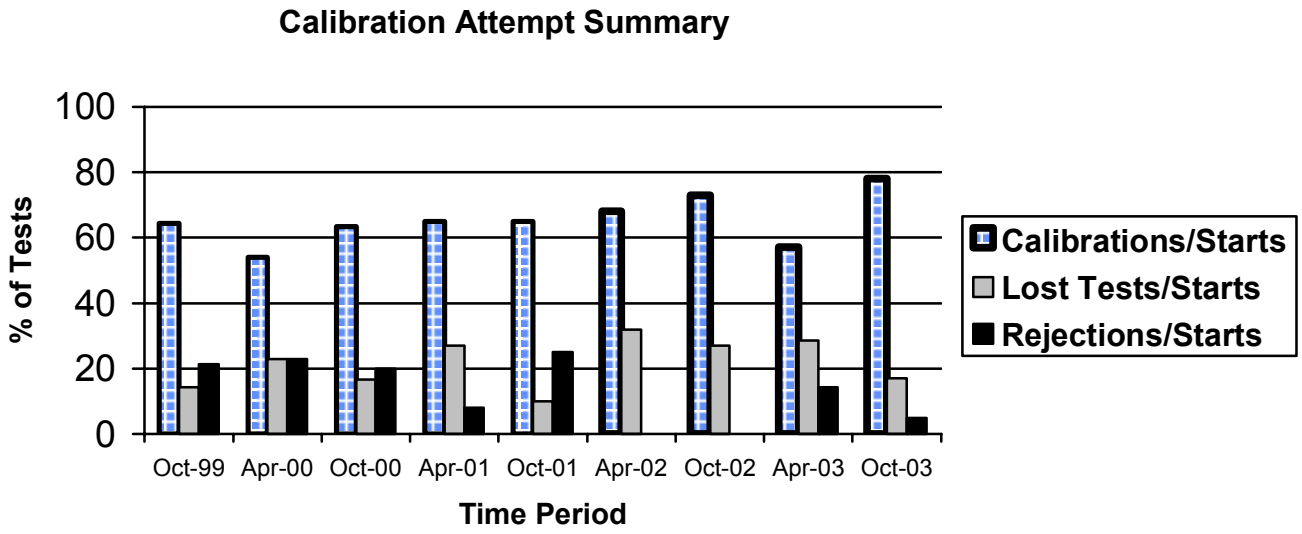
The following chart shows the laboratory/stand distribution:



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

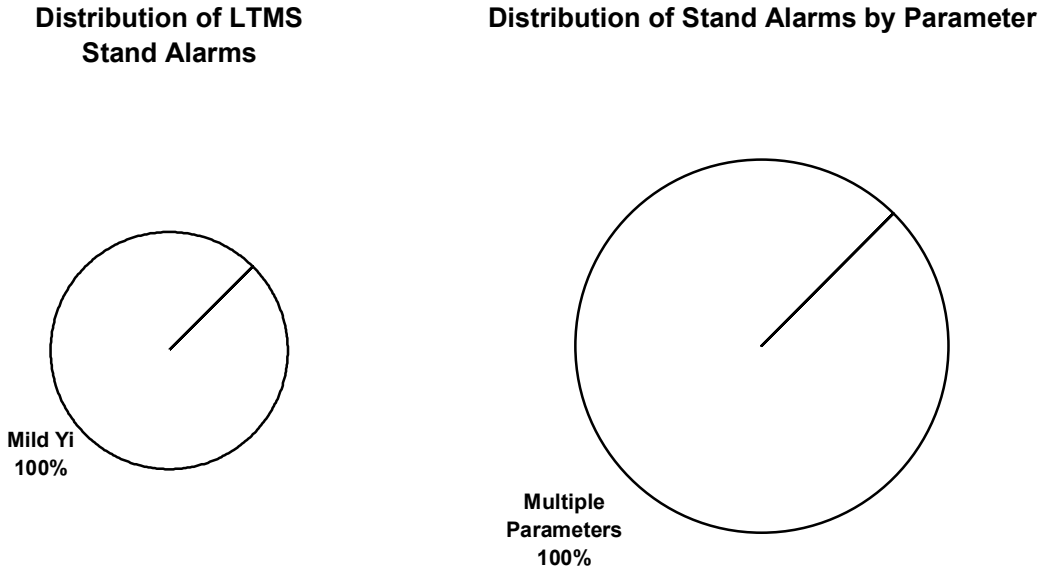
	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	14
Failed Acceptance Criteria	OC	1
Operationally Invalid, Lab Judgment	LC	3
Total		18

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



The calibration per start rate has increased with respect to the previous period and compares well with the historical rate. The lost test per start and rejected test per start rates have decreased with respect to the previous period. Both rates compare well with historical rates.

Mild AES and Mild OSCR was the reason for the statistical failure this period.

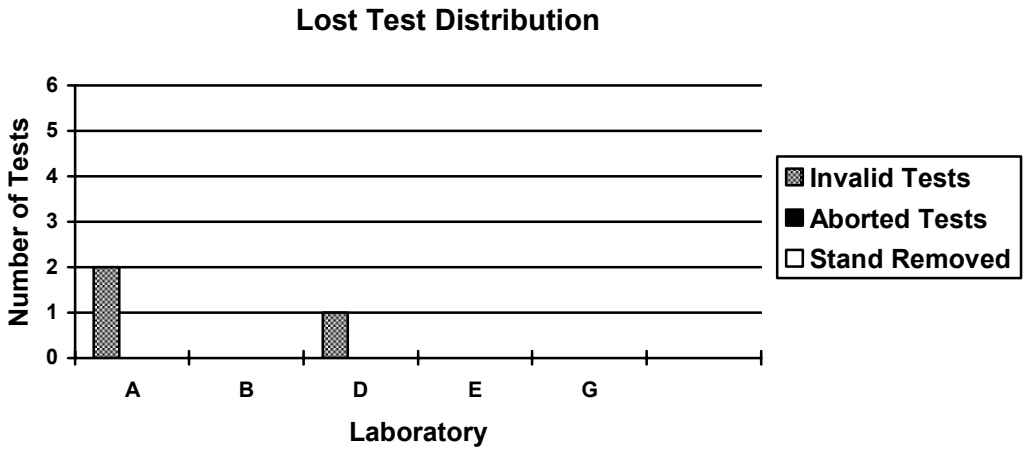


There were no LTMS deviations written during this report period. A total of five LTMS deviations have been written to date.

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

Reason	Number of Tests
Lost data caused by programming error	1
Control problems, new stand	1
Cam journal failure resulting in 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, 95% confidence intervals representing severity for the current period are given below in reported units.

Variable	Pooled s All Oils	Mean Delta/s	Confidence Interval	Based on	Delta in Reported Units
RAC	0.189	0.107	7.92 - 8.12	8.0	0.02
AES	0.371	0.310	7.71 – 8.12	7.8	0.11
APV	0.250	-0.153	7.32 – 7.60	7.5	-0.04
AEV	0.090	-0.070	8.84 – 8.94	8.9	-0.01
OSCR	0.887	-0.238	9.4 - 26.8	20	4.0

The mean Δ/s for this period shows APV (-0.153) was severe, while RAC (0.107), AES (0.310) and OSCR (-0.238) were mild. AEV (-0.070) was 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 show that with the exception of two warning alarms, severity was in control for the period. The two severity warning alarms were caused by one test, 2.667 Δ/s from target. With the exception of one EWMA warning alarm, AES precision was in control. The precision alarm also appears to have been caused by the above mentioned test. The industry summation Δ/s plot for AES shows severity trended mild for the period.

RAC severity was in control for the period. RAC precision charts began the period in control, but sounded a series of alarms midway through the period, ending the period in warning alarm. The start of the precision alarm event coincides with the introduction of the Romeo engine hardware. Laboratory severity appears to be the main cause, in that results from a lab trending severe on RAC were reported, then results from a lab trending mild were subsequently reported. This pattern appears to be consistent throughout the data. The industry summation Δ/s plot for RAC shows severity trended slightly mild for the period.

Industry control charts for AEV severity and precision were in control the entire period. The summation Δ/s plot for AEV shows on or near targets results for the period.

Industry control charts for APV severity were in control the entire period. APV precision was in control for most of the period, with the exception of the last two points, which sounded EWMA precision warning and action alarms. Like RAC above, the precision alarms appear to be the result of lab severity. The summation Δ/s plot for APV shows a slight severe trend for the period.

With the exception of a severity EWMA warning alarm, OSCR severity and precision were in control the entire period. The warning alarm appears to be the result of a test which was -2.049 Δ/s from target. The summation Δ/s plot for OSCR reflects 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 AES and OSCR precision degraded slightly with respect to the previous period while RAC precision has shown a slight improvement with respect to the previous period. Precision for all three parameters compares well with historical rates. Figure 7 shows precision for both AEV and APV precision has improved slightly with respect to the previous period and precision for both parameters is within historical estimates.

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, 1009 and 925-3.

Parameter	Severity Adjustment Standard Deviation (n = 30)	Pooled Standard Deviation, Oils 925-3, 1006, 1007 and 1009 (n = 15)
AES	0.51	0.37
RAC	0.24	0.19
AEV	0.10	0.09
APV	0.18	0.25
OSCR	0.828	0.887

Fuels and Reference Oils

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

Oil	TMC Inventory, in gallons	TMC Inventory, in tests	Laboratory Inventory, in tests	Estimated life
925-3	150	50	10	3+ years
1006	0	0	3	< 1 year
1006-2	4967	1655	9	3+ years
1007	483	151	5	3+ years
1009	958	319	7	3+ years

Note: Oils 1006, 1006-2, 1007 and 1009 are used across multiple test areas, TMC inventory represents total amount of that oil on hand.

Information Letters

Information Letter 03-2 was issued April 10, 2003. This information letter corrected Table 6 and Sections 12.1.1.3 and 12.1.1.6 to reflect Lambda values instead of exhaust gases. Information Letter 03-3 was issued September 5, 2003. This letter replaced aliphatic naphtha with a solvent meeting ASTM D235, Type II, Class C requirements, made a number of changes necessary to properly use Romeo engines, corrected Section 16.1.2.1 and revised Annex A7.1 to include an ACC Conformance Statement form.

Information Memos

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

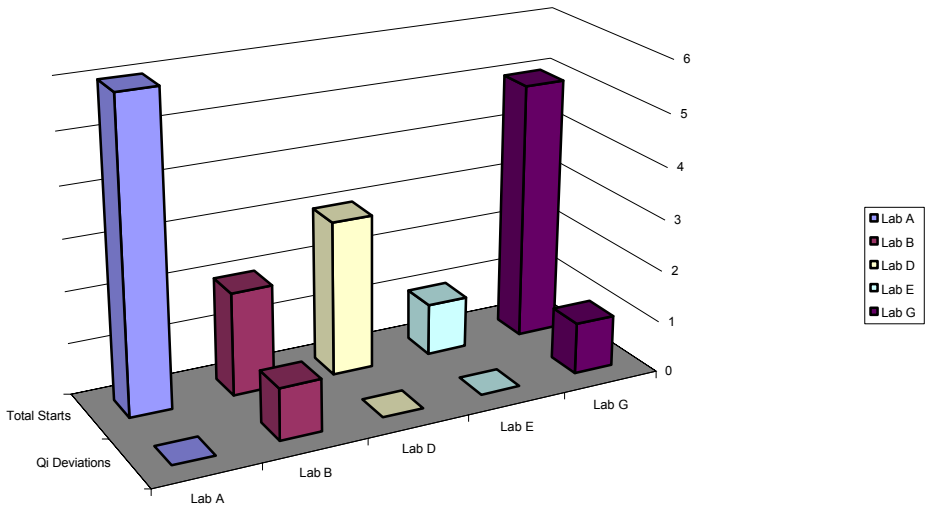
Memo	Date	Subject
03-023	04/09/03	Sequence VG Semi-Annual Report
03-056	05/15/03	Target Update, Reference Oil 1009 (n = 10)

Laboratory Visits

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

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.

Reason	Number of Tests
Exhaust Backpressure QI	2

Two QI deviations were written this period. In one case, the exhaust backpressure deviation was caused by a transducer problem. In the second case, the exhaust backpressure problem was caused by a sticking exhaust backpressure control valve. In both cases, the Test Monitoring Center concurred with the laboratory's judgment of the impact of these deviations of the specific tests validity.

Summary

The calibrations per start rate has increased with respect to the previous period and compares well with historical rates. The lost test per start and rejected tests per start rates have decreased with respect to the previous period and compare well with historical rates. AEV was on or near target, while AES, RAC and OSCR trended mild and APV trended severe for the period. Precision AES and OSCR has degraded slightly and precision for the remaining parameters has improved slightly when compared to the previous period. Precision for all parameters compares well with historical estimates.

REG/reg

Attachments

c: Sequence VG Surveillance Panel
J. L. Zalar
F. M. Farber
ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencev/semiannualreports/vg-10-2003.pdf

Distribution: Email

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

Figure 1

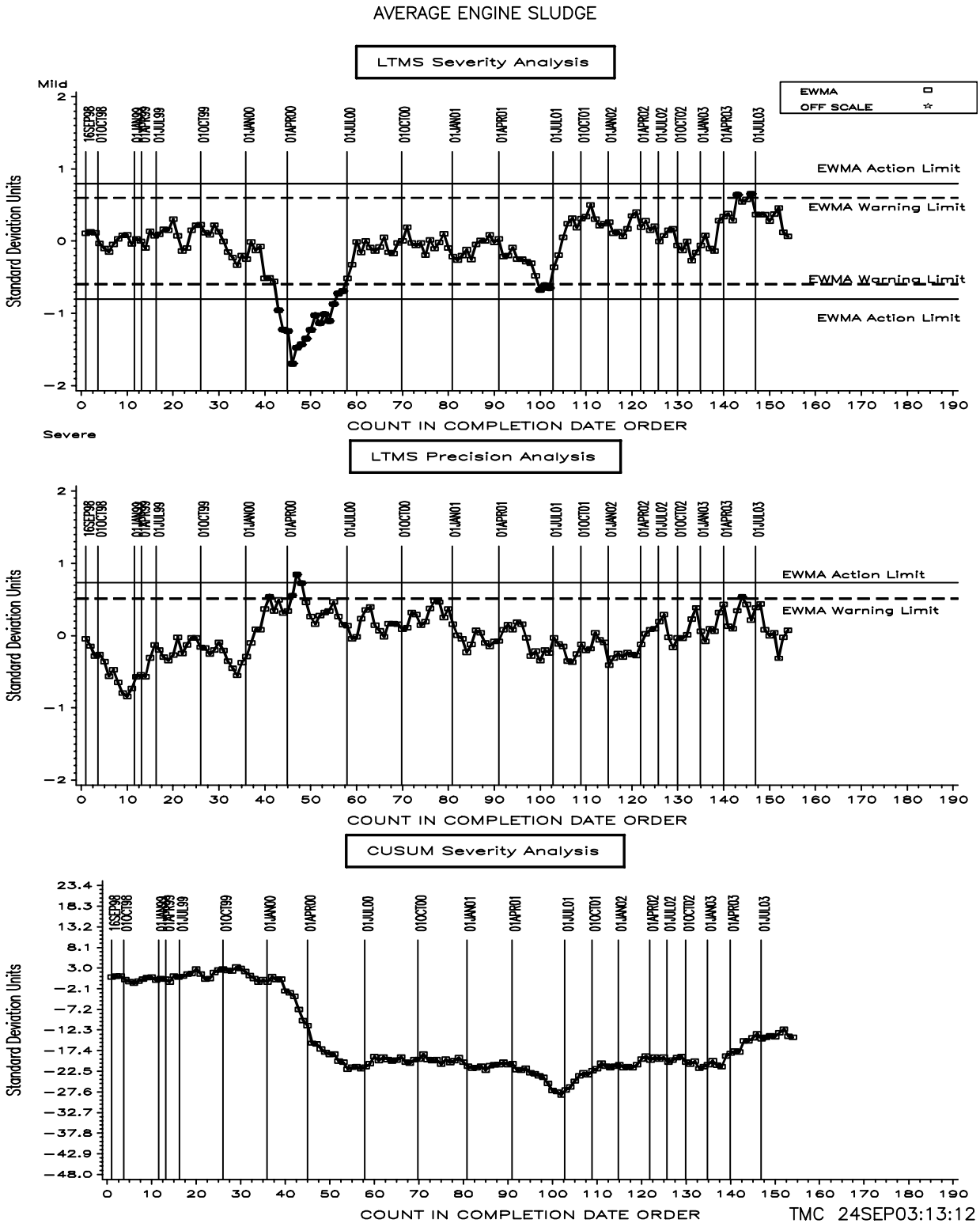
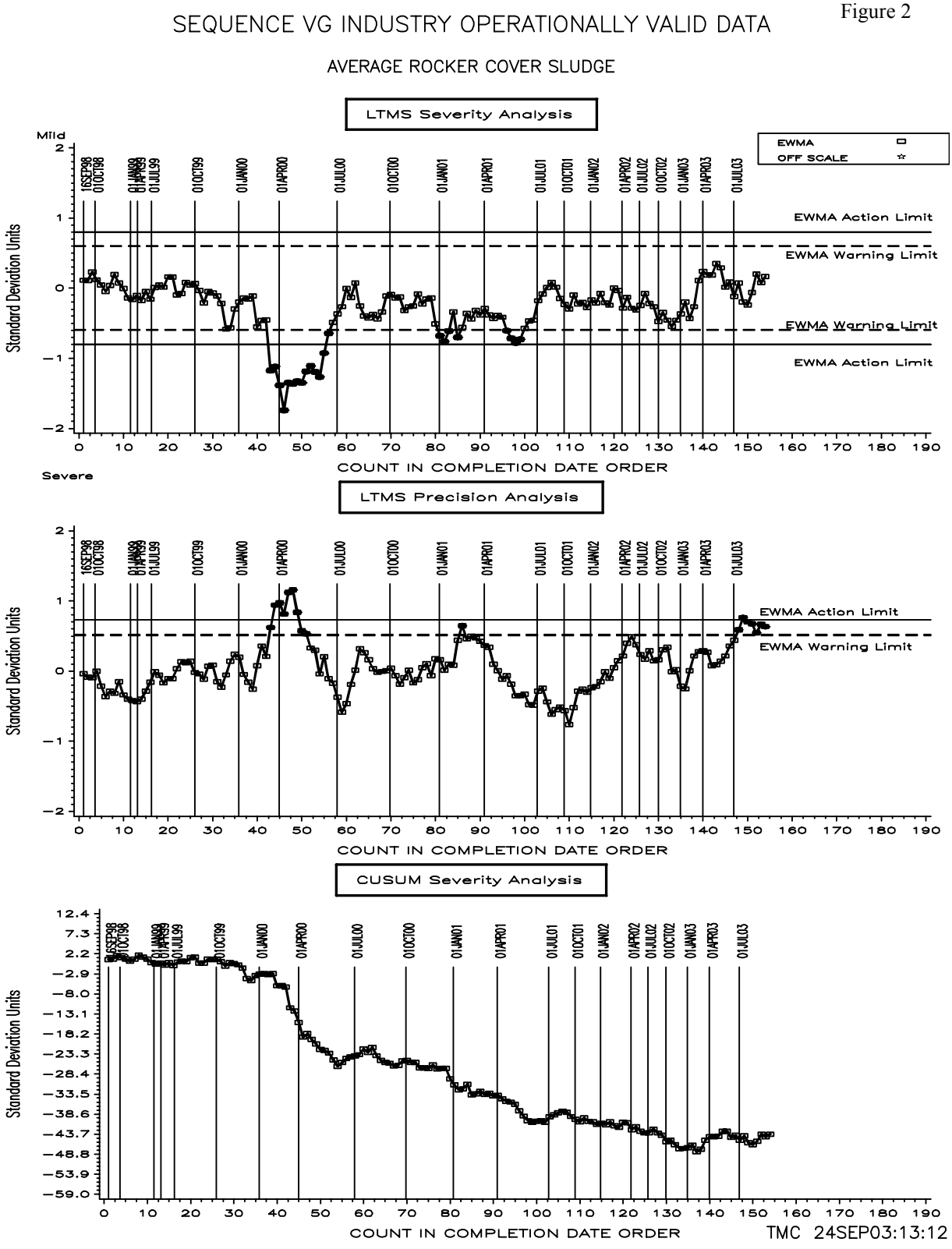


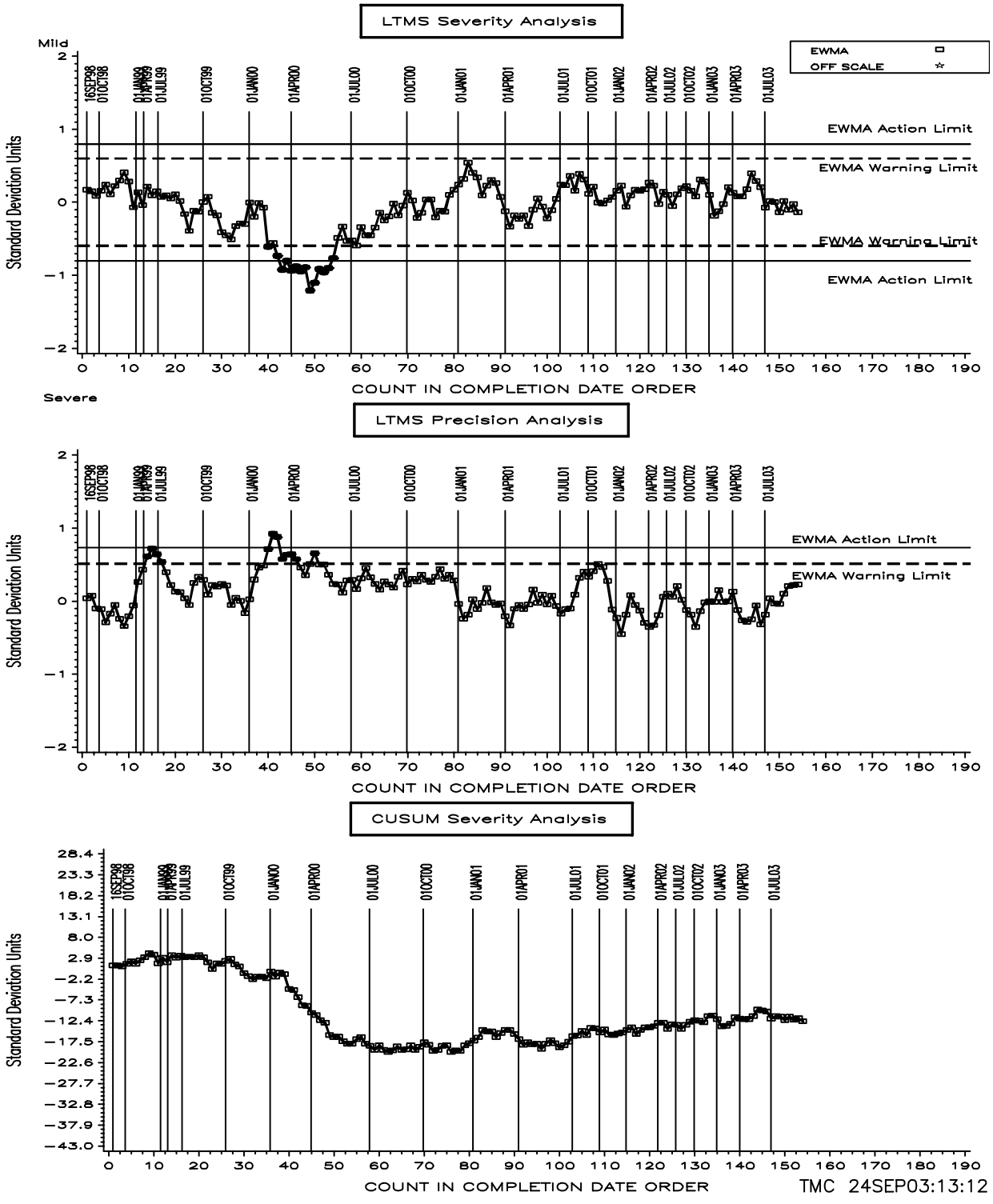
Figure 2


SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA
AVERAGE ROCKER COVER SLUDGE
LTMS Severity Analysis
Mild
Severe
EWMA
OFF SCALE
EWMA Action Limit
EWMA Warning Limit
EWMA Warning Limit
EWMA Action Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
LTMS Precision Analysis
EWMA Action Limit
EWMA Warning Limit
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
CUSUM Severity Analysis
Standard Deviation Units
COUNT IN COMPLETION DATE ORDER
TMC 24SEP03:13:12

SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

Figure 3

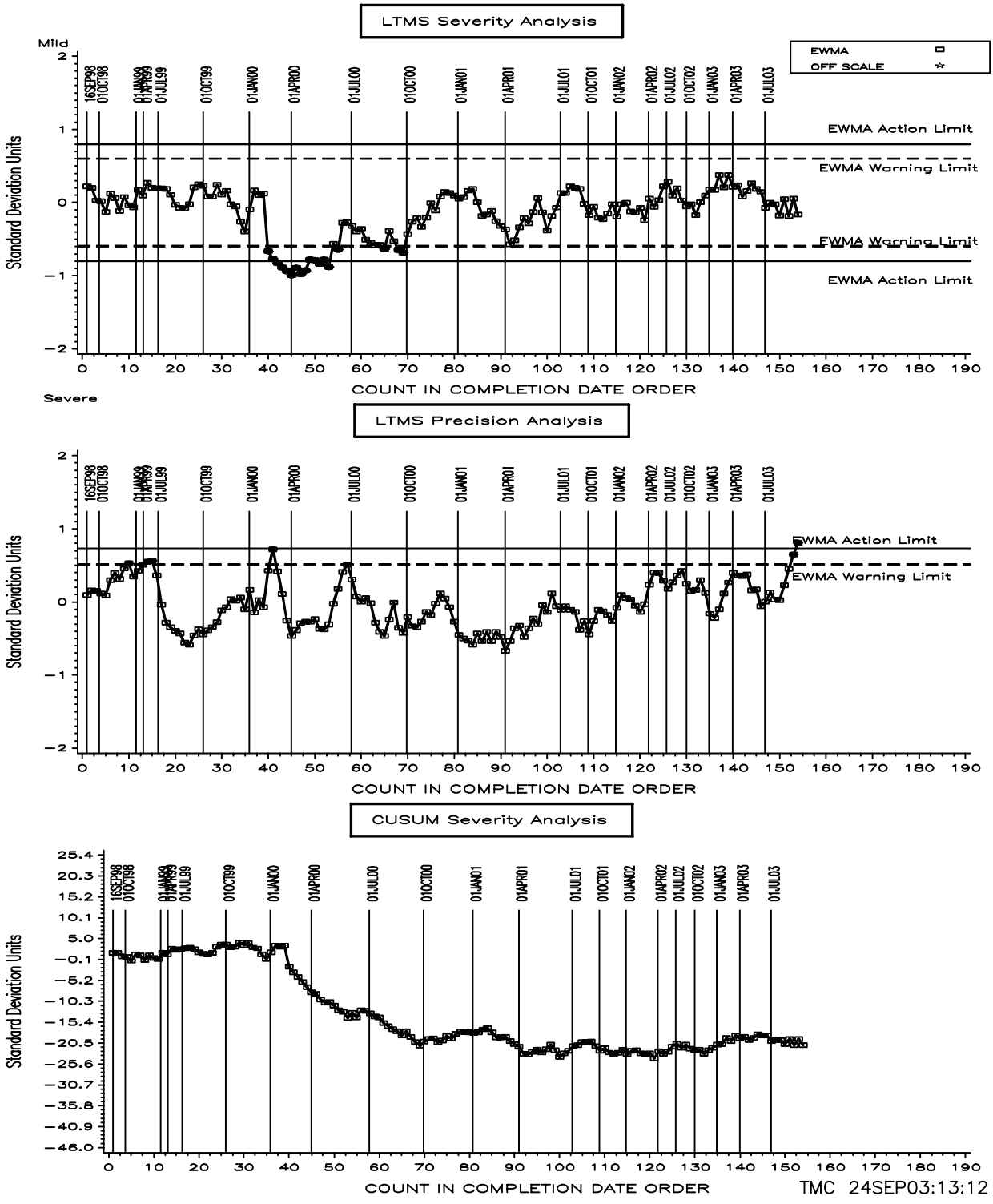
AVG. ENG. VARN. 3—PART FINAL RESULT APV + BAFFLES



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

Figure 4

AVG PISTON SKIRT RATING



SEQUENCE VG INDUSTRY OPERATIONALLY VALID DATA

Figure 5

OIL SCREEN SLUDGE

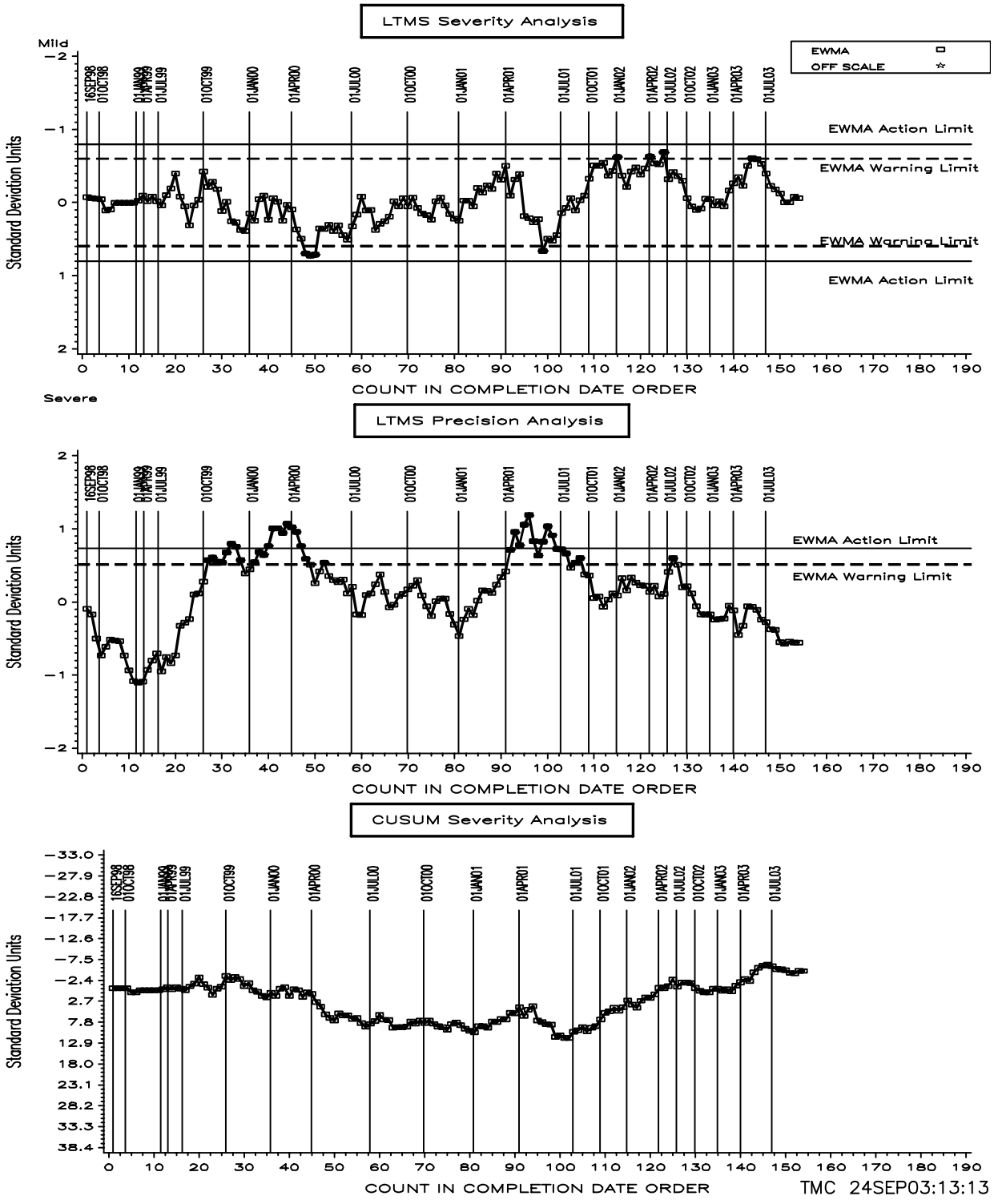
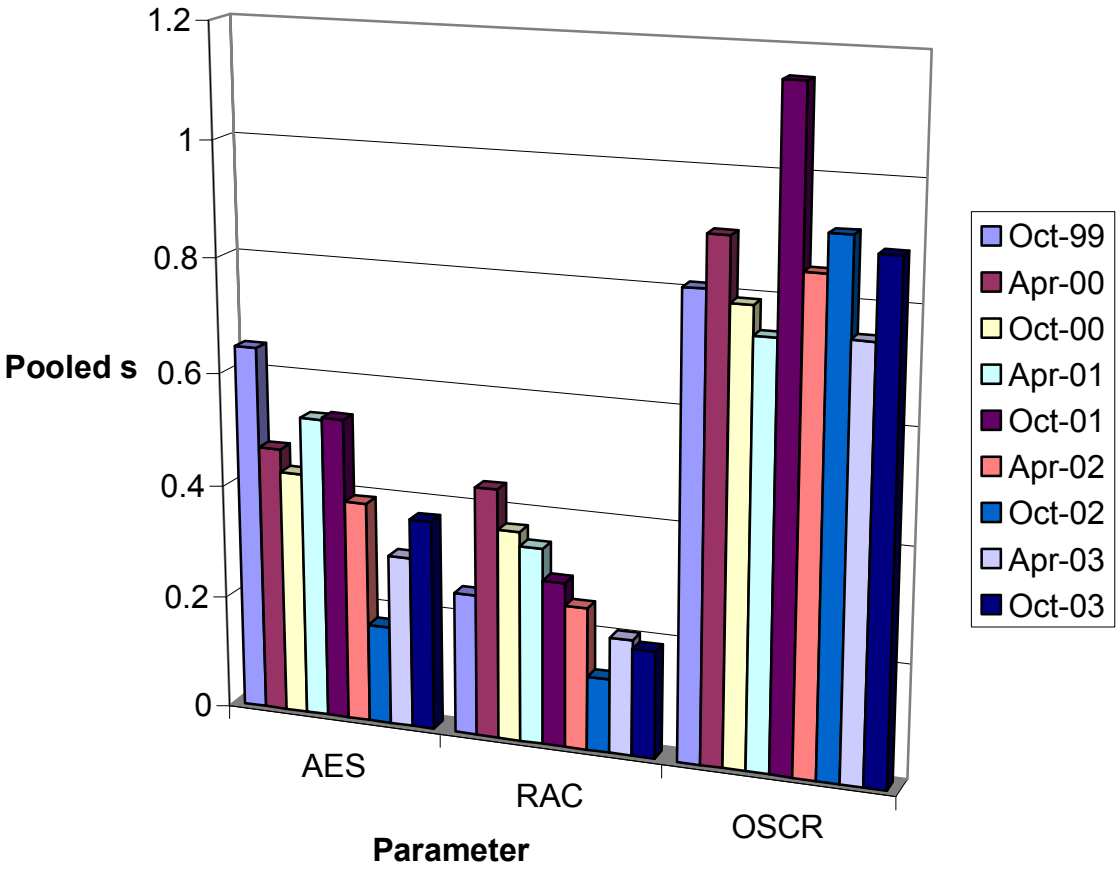


Figure 6

Comparison of Pooled Precision Estimates By ASTM Report Period



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

Figure 7

Comparison of Pooled Precision Estimates By ASTM Report Period

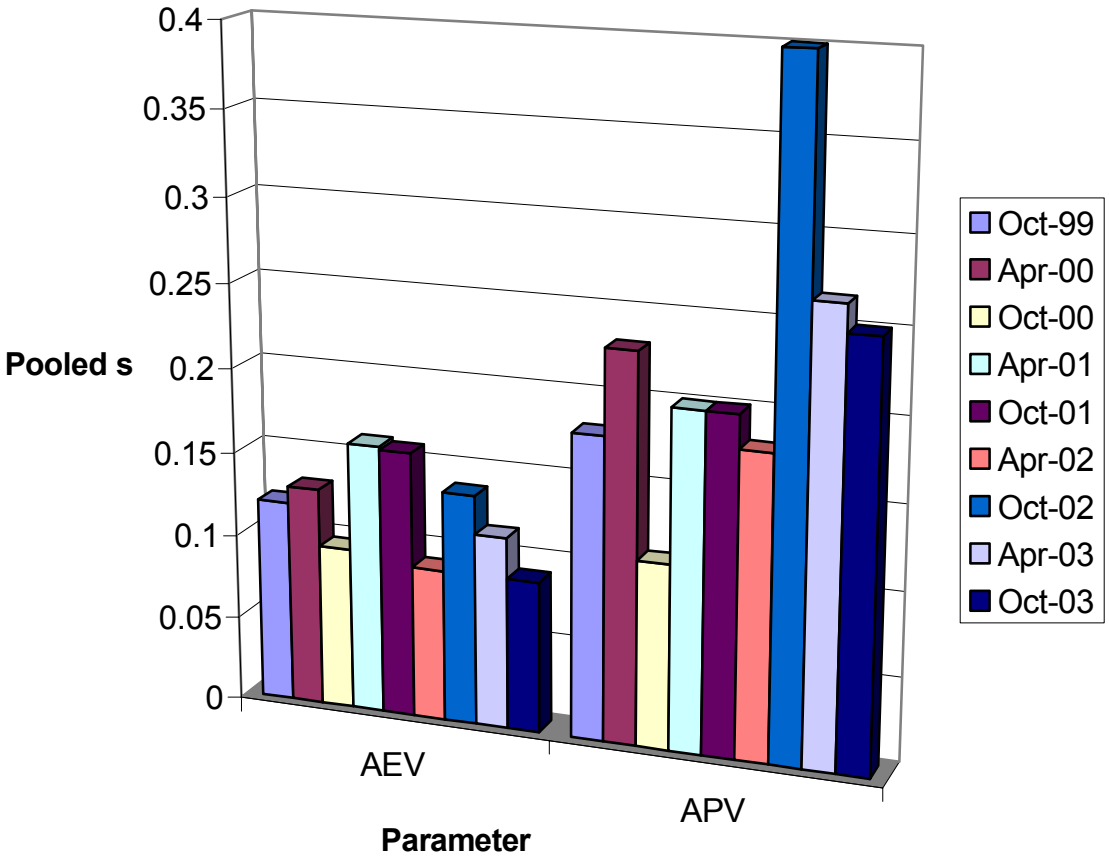


Figure 8
Sequence VG Industry Timeline

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.
20010320	01-3	This information letter dropped the requirement to measure benzene in the fuel, defined a process for concensus rating

		and no longer requires analysis of used oil for TBN, vis @ 100 °C and pentane insolubles.
20011114	02-1	This information letter dropped the requirement to measure NOx, monitor Power Qi, addressed rating changes recommended by the Light Duty Rating Task Force and allow adjustments to blowby flow rates during the first 48 hours of the test.
20020301	02-2	This information letter replaced CO, CO2 and O2 measurements with Lambda measurement.
20020408	02-3	Revised references to CRC manuals 12 and 14 with CRC manual 20.
20020515	02-4	This information letter allowed use of power supply for EEC and Lambda sensor power, replaced Rocker Arm cover varnish with cam baffle varnish, revised lambda sensor calibration frequency and dropped requirement to measure bore wear.
20020809		Test Targets, Reference oil 1009, n = 3.
20021023		Test Targets, Reference oil 1009, n = 5.
20021025	02-5	Removed remedial statements from test method and addressed other editorial changes.
20030128		Test Targets, Reference oil 1006-2, n = 10.
20030227	03-1	Removed requirement to include photographs of rated parts in final test report.
20030227	03-2	Corrected Table 6, Section 12.1.1.2 and 12.1.1.6 to remove exhaust gas analysis value and replace with appropriate Lambda values
20030515		Test Targets, Reference oil 1009, n = 10.
20030710		First Test on Romeo Hardware completes.
20030905	03-3	Change solvent from aliphatic naphtha to a solvent meeting ASTM D235, Type II, Class C specification
20030905	03-3	Procedure changes to accomplish build activities and parts required for using Romeo engine for Sequence VG testing.
20030905	03-3	Corrected Section 16.1.1 and modified A7.1 to add ACC Conformance Statement.