



## Test Monitoring Center

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**MEMORANDUM:** 00-131

**DATE:** October 13, 2000

**TO:** Daryl Baumgartner, Chairman, Sequence VIA/VIB Surveillance Panel

**FROM:** Donald Lind

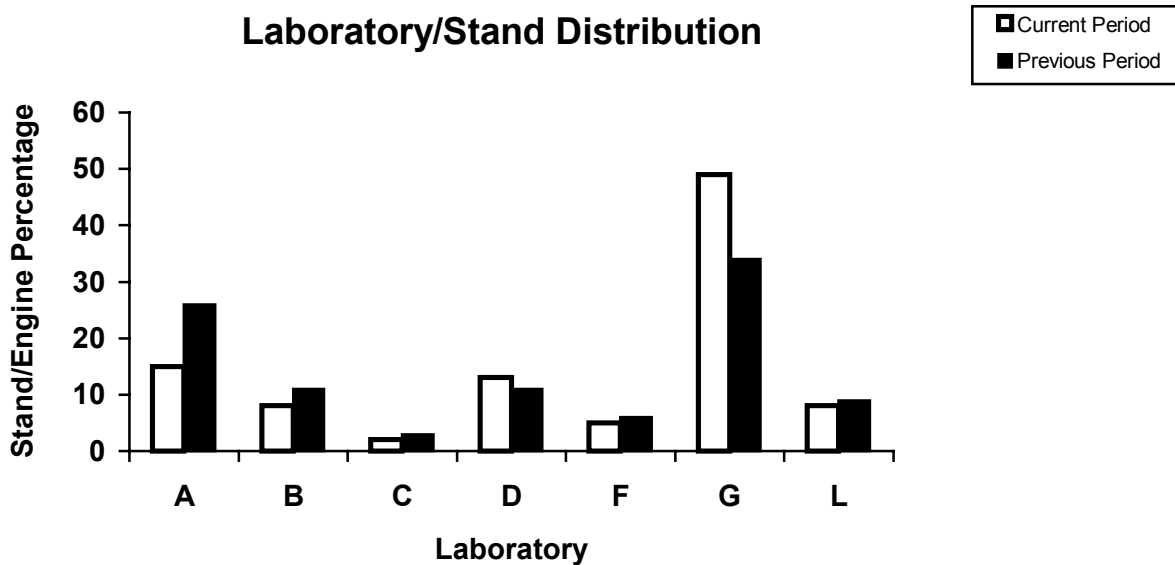
**SUBJECT:** Sequence VIB Test Results from April 1, 2000 through September 30, 2000

The following is a summary of Sequence VIB reference tests that were reported to the Test Monitoring Center during the period April 1, 2000 through September 30, 2000.

### Lab and Stand Summary

	Reported Data During Period	Calibrated as of 09/30/2000
Laboratories	7	7
Stand/Engine Combinations	39	18

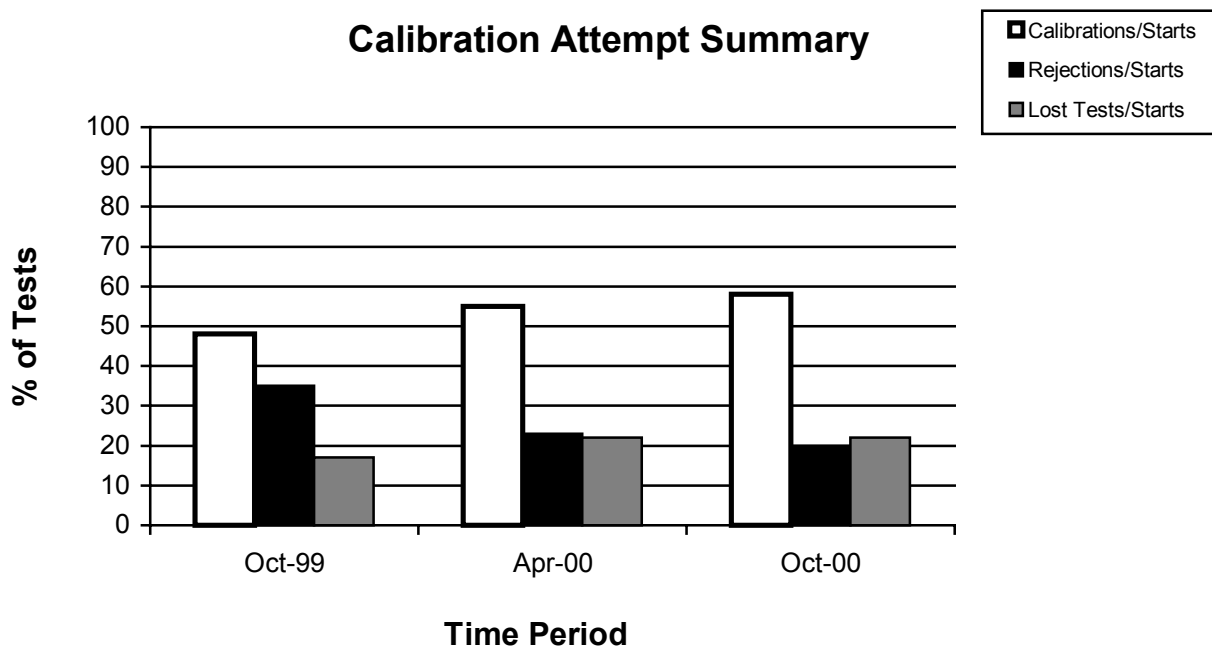
The following chart shows the laboratory stand/engine distribution for data reported during this report period:



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

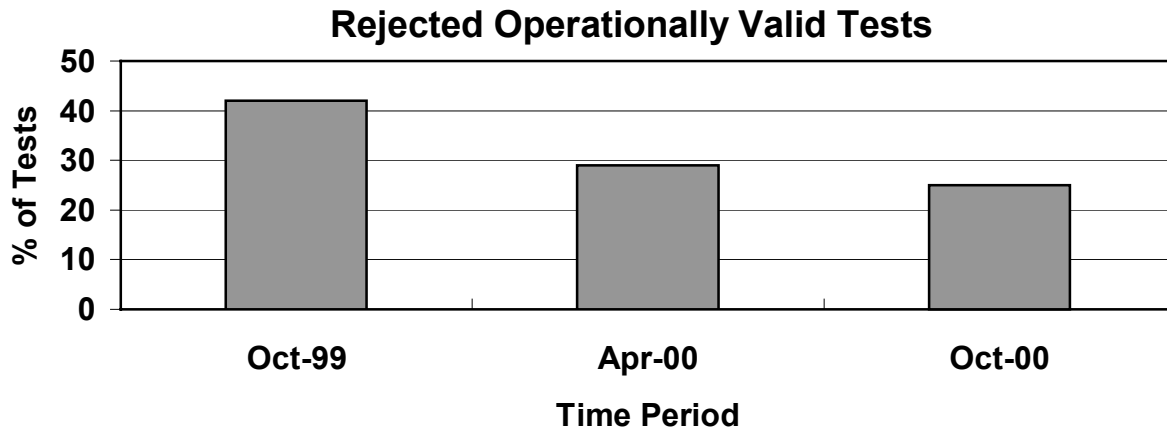
	TMC Validity Codes	No. of Tests
Operationally and Statistically Acceptable	AC	81
Failed Acceptance Criteria	OC	27
Operationally Invalid (Laboratory Judgement)	LC	13
Operationally Invalid (Laboratory & TMC Judgement)	RC	1
Aborted	XC	3
Tests Lost Due to Exceeding BC Shift Limits	MC	2
Tests Lost Due to Abandoned Engines	MC	12
Total		139

Attempted calibration tests are depicted graphically below by report period:

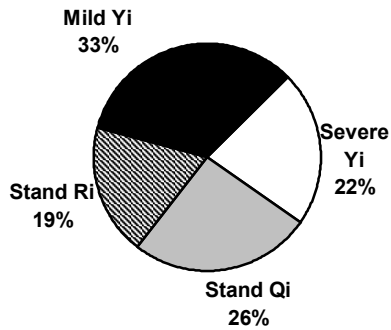


The calibration per start rate has increased this report period. The rejected per start rate has decreased this report period. The lost test per start rate remained the same as the previous period.

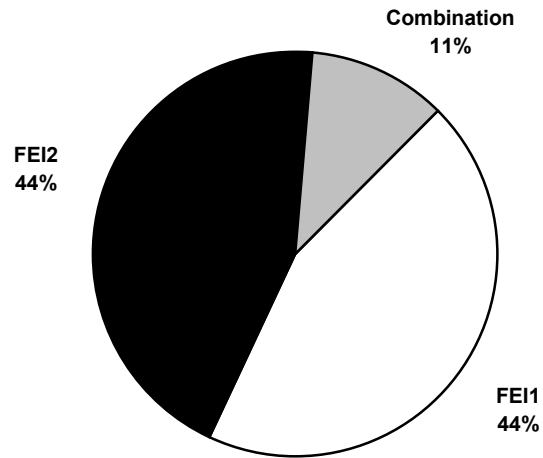
The percentage of tests failing the acceptance criteria for operationally valid tests decreased this report period. The percentages are depicted graphically below.



**Distribution of LTMS Stand Alarms**

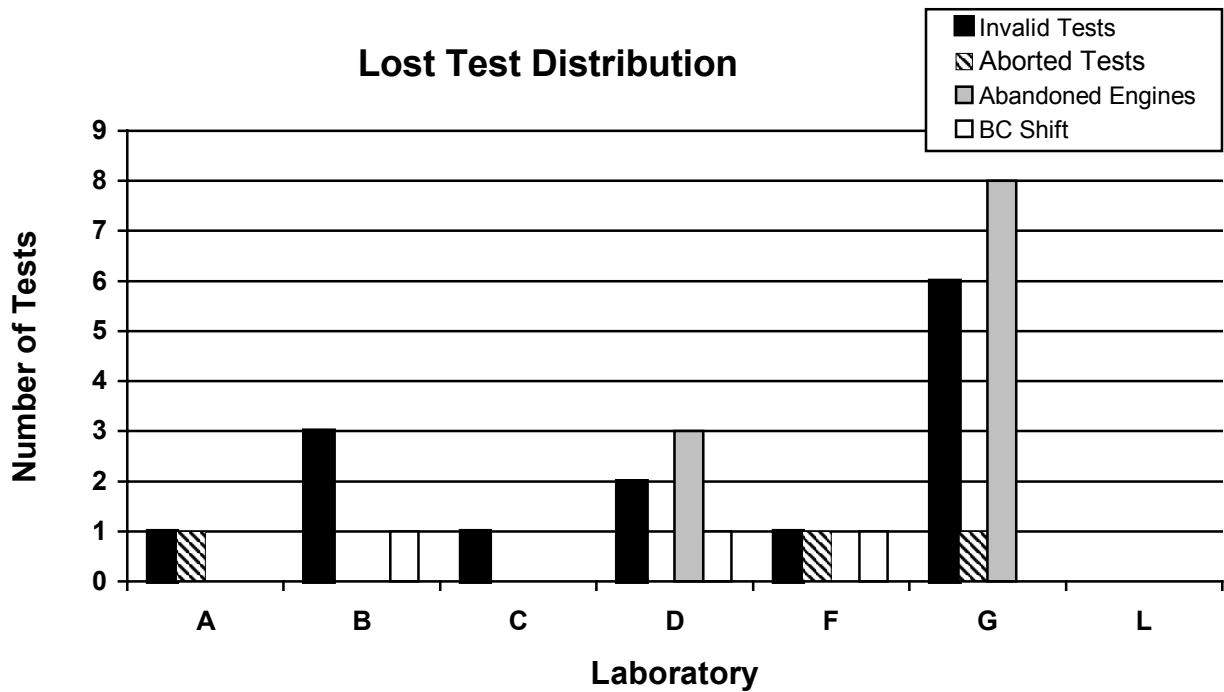


**Distribution of Stand Alarms by Parameter**



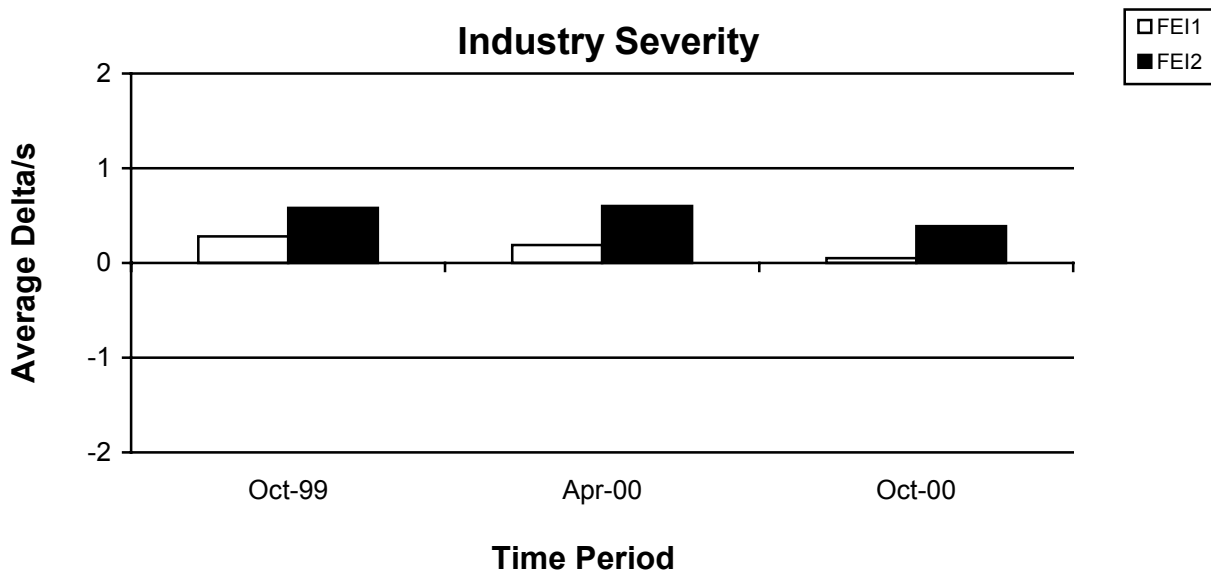
There were six tests rejected for FEI Shewhart (Yi) severe, nine tests rejected for FEI Shewhart (Yi) mild, seven tests rejected for EWMA precision alarm (Qi), and five tests rejected for Shewhart precision alarm (Ri). There has never been an LTMS deviation written for Sequence VIB.

The laboratory distribution of lost tests is shown below. A detailed list of reasons for tests declared operationally invalid, aborted, lost due to abandoned engines, or lost due to BC shift exceeding the test limits is shown in Table 2 (See Attachment).

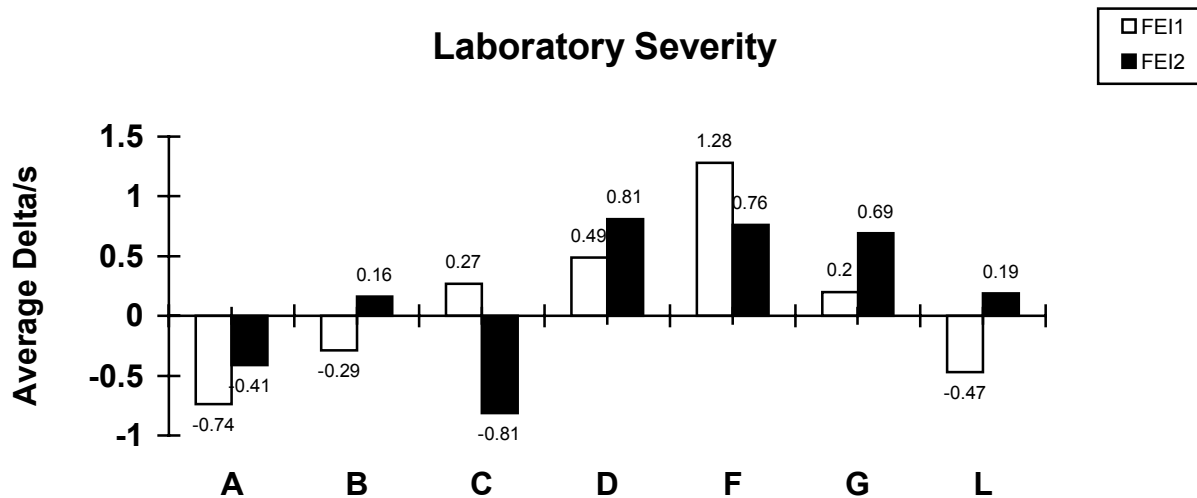


#### TEST SEVERITY AND PRECISION

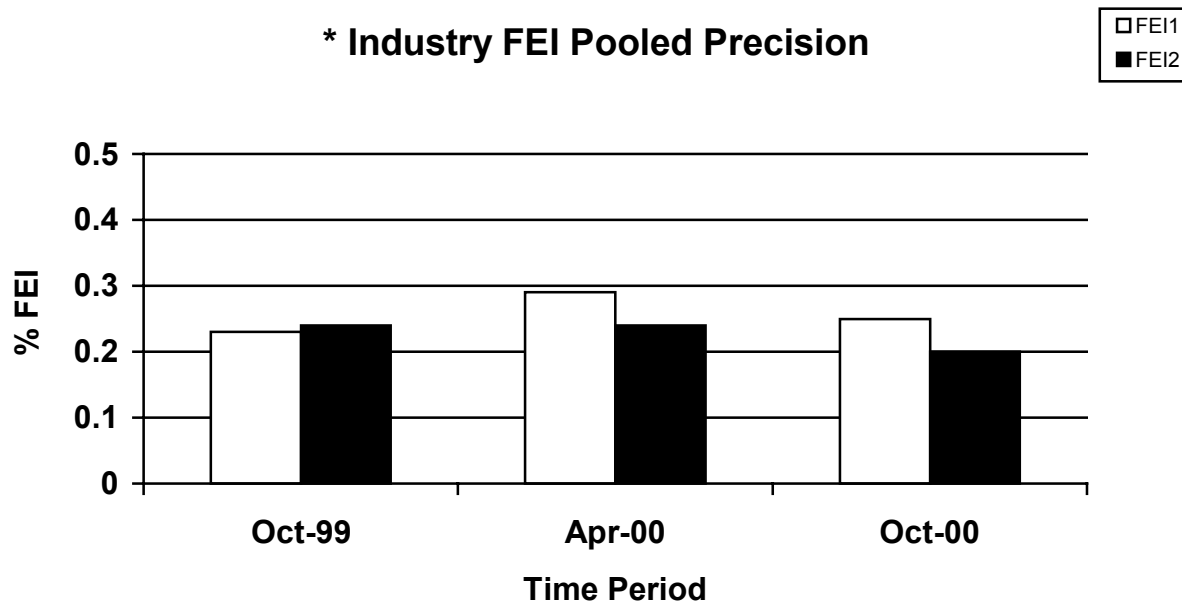
The industry mean  $\Delta/s$  for FEI1 and FEI2, for this report period, are 0.05 mild and 0.39 mild, respectively. FEI1 and FEI2 severity are not as mild as the last report period.



Shown below is a summary of the average FEI  $\Delta$ /s for all laboratories reporting data this report period.



The industry precision estimates for FEI1 and FEI2, for this report period, are 0.25 and 0.20 (pooled s), respectively. FEI1 and FEI2 precision has improved slightly this report period.



\* Precision estimates are calculated by pooling lab and std/eng combination

## INDUSTRY CONTROL CHARTS

### FEI1

There were several severity and precision alarms triggered this report period as illustrated in Figure 1. Some of the alarms appear to be related to a mix of new engines that have a tendency to produce severe results and older engines that are near the end of the calibration life that give mild results. Another reason for some of the alarms are reference oil results on engines that will no longer calibrate. These results are statistically unacceptable, operationally valid, and do not have candidate tests run against them. Figure 5 illustrates the LTMS control charts excluding these test results. An LTMS control chart for FEI1 with stand severity adjusted data is shown in Figure 3.

### FEI2

There were several severity and precision alarms triggered this report period as illustrated in Figure 2. Some of the alarms appear to be related to a mix of new engines that have a tendency to produce severe results and older engines that are near the end of their calibration life that give mild results. Some of the other alarms were triggered as a result of reference oil results on engines that will no longer calibrate. These results are statistically unacceptable, operationally valid, and do not have candidate tests run against them. Figure 6 illustrates the LTMS control charts excluding these test results. Another cause for some of the mild test results could be attributed to a problem found in the test labs. Most of the labs were not cleaning the external oil system as per the Sequence VIB procedure. This resulted in the labs having more than the specified 5.68 liters of oil in the external oil system. The labs started to correct this problem in April and completed most of the stand corrections by the end of June. As illustrated in Figure 2, the data is not as mild after the April timeframe. An LTMS control chart for FEI2 with stand severity adjusted data is shown in Figure 4.

## REFERENCE OILS

The following table quantifies reference oils by the number of tests remaining at the TMC and each laboratory. Sequence VIB reference oils are shipped in quantities of 5 gallons per test.

LAB	1006	1007	1008
A	6	7	4
B	8	3	7
C	4	2	3
D	6	5	5
F	5	3	5
G	4	3	7
L	8	5	9
TMC	*	**	***

\* 2,100 Gallons (Multiple test area usage)

\*\* 657 Gallons (Multiple test area usage)

\*\*\* 1,011 Gallons (Multiple test area usage)

### LAB VISITS

During this report period the TMC visited seven laboratories. These visits were conducted by the TMC and some members of a surveillance panel appointed task group. The objectives of the lab visits were to review and improve the crankcase ventilation system and external oil system. The following revisions were made to the Sequence VIB procedure via information letters:

1. Improved and standardized the crankcase ventilation system.
2. Improved and standardized the cleaning procedure for the external oil system.
3. Standardized the oil level in the oil pan.
4. Revised the oil charge of the test from 5.68 to 6.0 liters.

### INFORMATION LETTERS

There were two information letters issued this report period. Information Letter 00-2 was issued on May 22, 2000 and Information Letter 00-3 was issued on August 7, 2000. Items changed with these information letters are documented in the Sequence VIB timeline (Table 3).

### SUMMARY

Severity for FEI1 and FEI2 are slightly mild for this report period and compares well to historic data.

FEI1 and FEI2 precision have improved slightly this report period.

The percentage of calibrations per starts has increased this report period.

The percentage of lost tests per starts remains the same as last report period.

The percentage of statistically rejected tests per starts has decreased this report period.

The percentage of operationally valid tests rejected statistically has decreased this report period.

DML/dml

### Attachments

- c: Sequence VIA/VIB Surveillance Panel  
Sequence VIA/VIB Test Engineers  
<ftp://www.tmc.astm.cmri.cmu.edu/docs/gas/sequencevi/semiannualreports/vib-10-2000.pdf>

Sequence VIB Semiannual Report  
List of Attachments

- Table 1 is a historic statistical summary for reference oils through March 31, 2000.
- Table 1A is a statistical summary for reference oils for the current report period.
- Table 2 is a summary of lost tests due to operationally invalid, aborted, abandoned engines or lost due to BC shift exceeding the test limits.
- Table 3 is the Sequence VIB Timeline.
- Figure 1 graphically present the Industry control charts for FEI1.
- Figure 2 graphically present the Industry control charts for FEI2.
- Figure 3 graphically present the Industry control charts for FEI1 with stand severity adjustments applied.
- Figure 4 graphically present the Industry control charts for FEI2 with stand severity adjustments applied.
- Figure 5 graphically present the Industry control charts for FEI1 excluding reference oil test results on engines that would no longer calibrate and had no candidate tests run against them.
- Figure 6 graphically present the Industry control charts for FEI2 excluding reference oil test results on engines that would no longer calibrate and had no candidate tests run against them.



SEQUENCE VIB  
 OPERATIONALLY VALID DATA SET  
 DATA PRIOR TO 10/01/00

OIL CODE 1006				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
90	FEI1	1.41	0.33	0.61 - 2.50
90	FEI2	0.58	0.30	-.14 - 1.32
OIL CODE 1007				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
98	FEI1	0.76	0.30	0.24 - 2.11
98	FEI2	0.47	0.29	-.55 - 1.25
OIL CODE 1008				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
95	FEI1	1.84	0.23	1.42 - 2.41
95	FEI2	1.26	0.20	0.81 - 1.66

283 TOTAL

SEQUENCE VIB  
 OPERATIONALLY VALID DATA SET  
 DATA FROM 04/01/00 THRU 09/30/00

OIL CODE 1006				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
33	FEI1	1.42	0.39	0.61 - 2.50
33	FEI2	0.55	0.29	-.02 - 1.23
OIL CODE 1007				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
37	FEI1	0.74	0.26	0.29 - 1.29
37	FEI2	0.55	0.22	0.09 - 1.05
OIL CODE 1008				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
38	FEI1	1.84	0.21	1.48 - 2.37
38	FEI2	1.22	0.22	0.81 - 1.60

108 TOTAL

Table 2

### **Lost Tests Summary**

Tests declared operationally invalid, aborted, or lost due to abandoned engines are summarized below by laboratory, reason, number of lost tests, and percent of lost tests:

LAB	REASON	Tests Lost	% of Tests Lost
A	AFR OUT of Specification	1	11%
	Oil Leak	1	
B	BC Shift	1	27%
	Excessive Downtime	1	
	Oil Consumption Out of Specification	1	
	BC Shift	1	
C	Coolant and Oil Temperature Out of Specification	1	20%
D	Fuel Flowmeter Temperature Out of Specification	1	29%
	Excessive Downtime	1	
	Abandon Engine	3	
	BC Shift	1	
G	Coolant Flow Out of Specification	3	25%
	Coolant Temperature Out of Specification	1	
	Exceeded Allowable Number of Shutdowns	1	
	Abandon Engine	8	
	AFR Delta Out of Specification	1	
	Oil Leak	1	
	Computer Control Problem	1	
F	Speed Out of Specification	1	33%
	BC Shift	1	

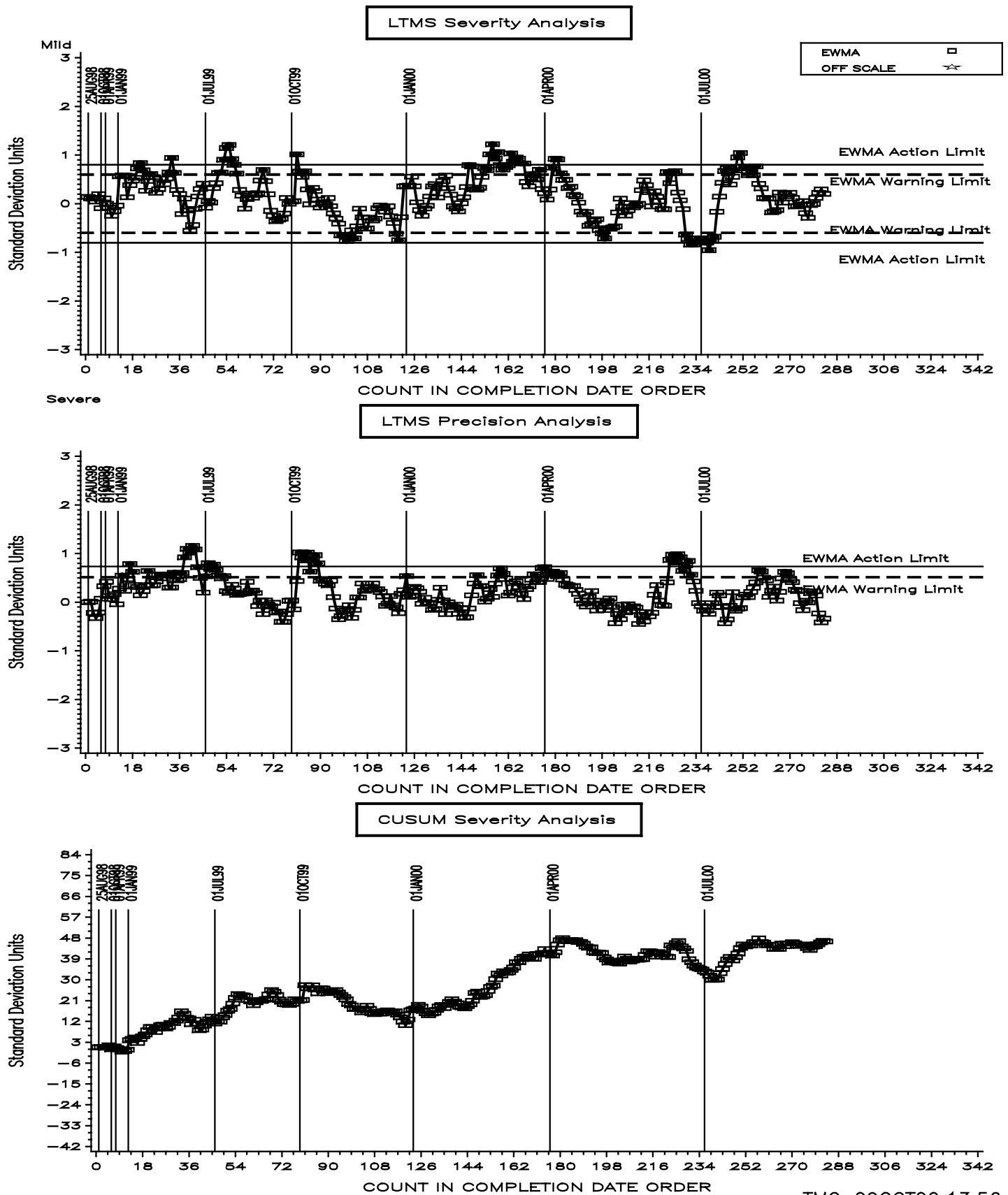
### Sequence VIB Timeline

Date	Item Changed	Information Letter
19990809	Reference oil 1006 targets updated	
19990809	Reference oil 1007 targets updated	
19990809	Reference oil 1008 targets updated	
19990924	Calibration requirements	99-1
19990924	Alternative Cooling system	99-1
19990924	Fuel injection flow procedure	99-1
19990924	Requirement for of Use Maintenance log	99-1
19990924	Coolant flow measurement device calibration revision	99-1
19990924	Preparation procedure for oil charge	99-1
19990924	Recording compression pressures	99-1
19990924	Ignition timing checks	99-1
19990924	Valve stem seal replacements	99-1
19990924	Alternative Racor oil filter (LFS-62) use approved	99-1
19990924	Engine serial number added to report	99-1
19991015	Invalid test BC shift limits of -0.5 to 0.8% added	99-2
19991015	Tests terminated due to an FEI result are not permitted	99-2
19991015	Section 11.5.17.3 deleted – Manual data logging no longer required	99-2
19991015	Exhaust back pressure calibration prior to calibration test added	99-2
19991015	Instrumentation calibration requirements	99-2
19991015	Use of Eaton 37KW (50hp) dry gap dynamometer approved	99-2
19991015	New flush oil (BCFHD) and flush oil procedure	99-2
19991015	Micro motion model CMF010 mass flow meter approved	99-2
19991015	Kinematic viscosity measurements on new reference oils permitted	99-2
19991015	Report form editorial change for LABVALID made	99-2
19990924	Valve stem seal revised part number	99-3
20000207	Oil sight glass calibration	00-1
20000207	Revised Figure A2.22 – Oil Level Marker Ruler	00-1
20000207	Revised flush effectiveness procedure	00-1
20000207	Coolant flush procedure	00-1
20000207	Oil consumption validity interpretation	00-1
20000207	Load cell temperature specification	00-1
20000410	Valve Spring Replacement	00-2
20000524	Eliminate Baseline Shift Criteria	00-3
20000601	Maximum Allowable Oil Consumption Test Limit	00-3
20000601	Oil Sample Location Defined	00-3
20000601	Revised Blow-by and Crankcase Ventilation System	00-3
20000807	Fuel Injector Calibration Flow Rate Specification Added	00-3
20000807	Dynamometer Replacement During a test is not permitted	00-3
20000807	Engine Break-in Stand Requirements	00-3
20000807	Removal of Ford Wiring Harness Diagram	00-3
20000807	Addition of Alternative Injector Wiring Harness Part Numbers	00-3
20000807	Addition of Alternative HEGO Sensor Part Numbers	00-3
20000807	Addition of Alternative Throttle Body Adapter Part Number	00-3
20000807	Visteon EEC Control Module	00-3
20000901	Barometric Pressure added to report packet as record only	00-3

# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE I (%)

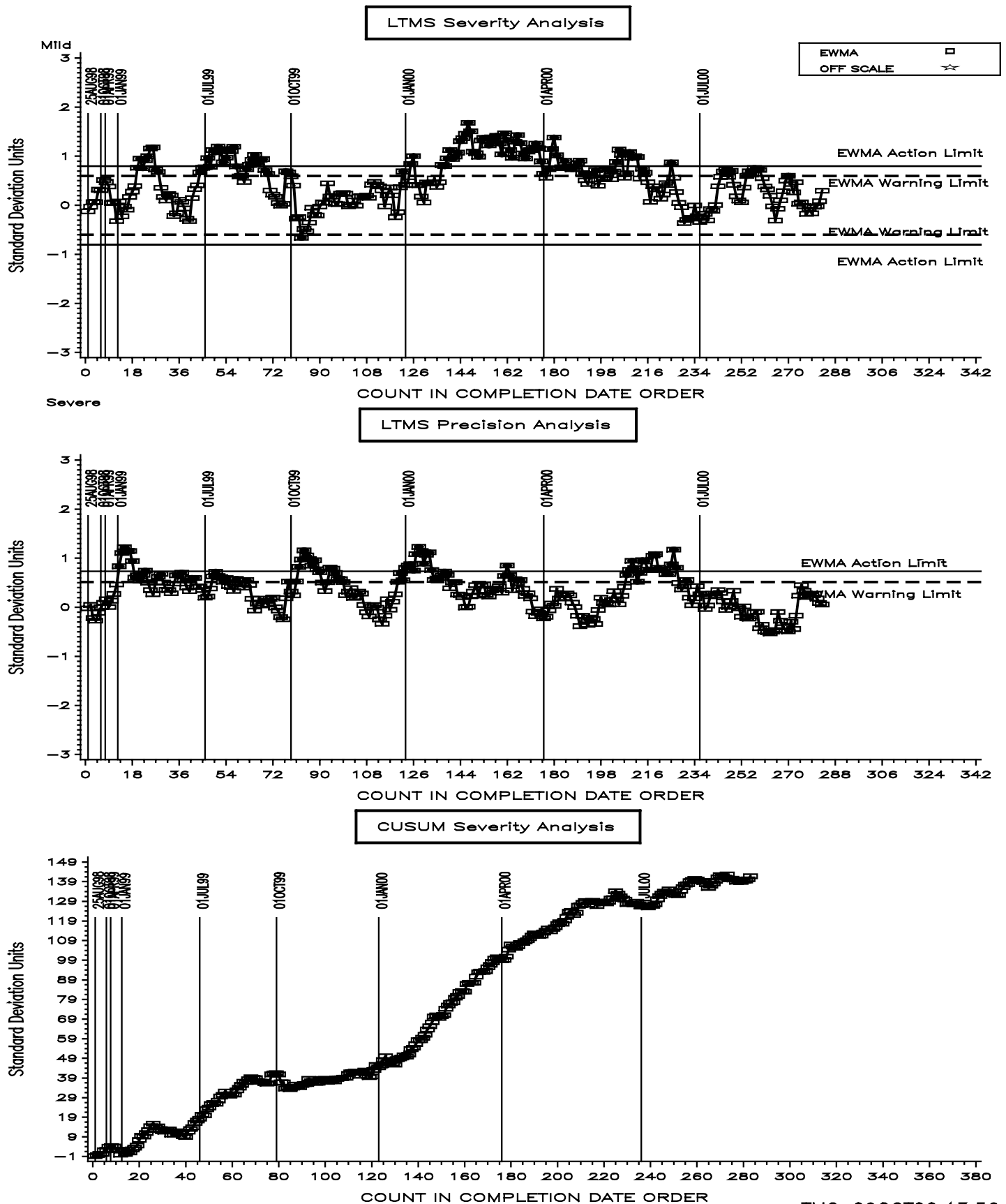
Figure 1



# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE II (%)

Figure 2

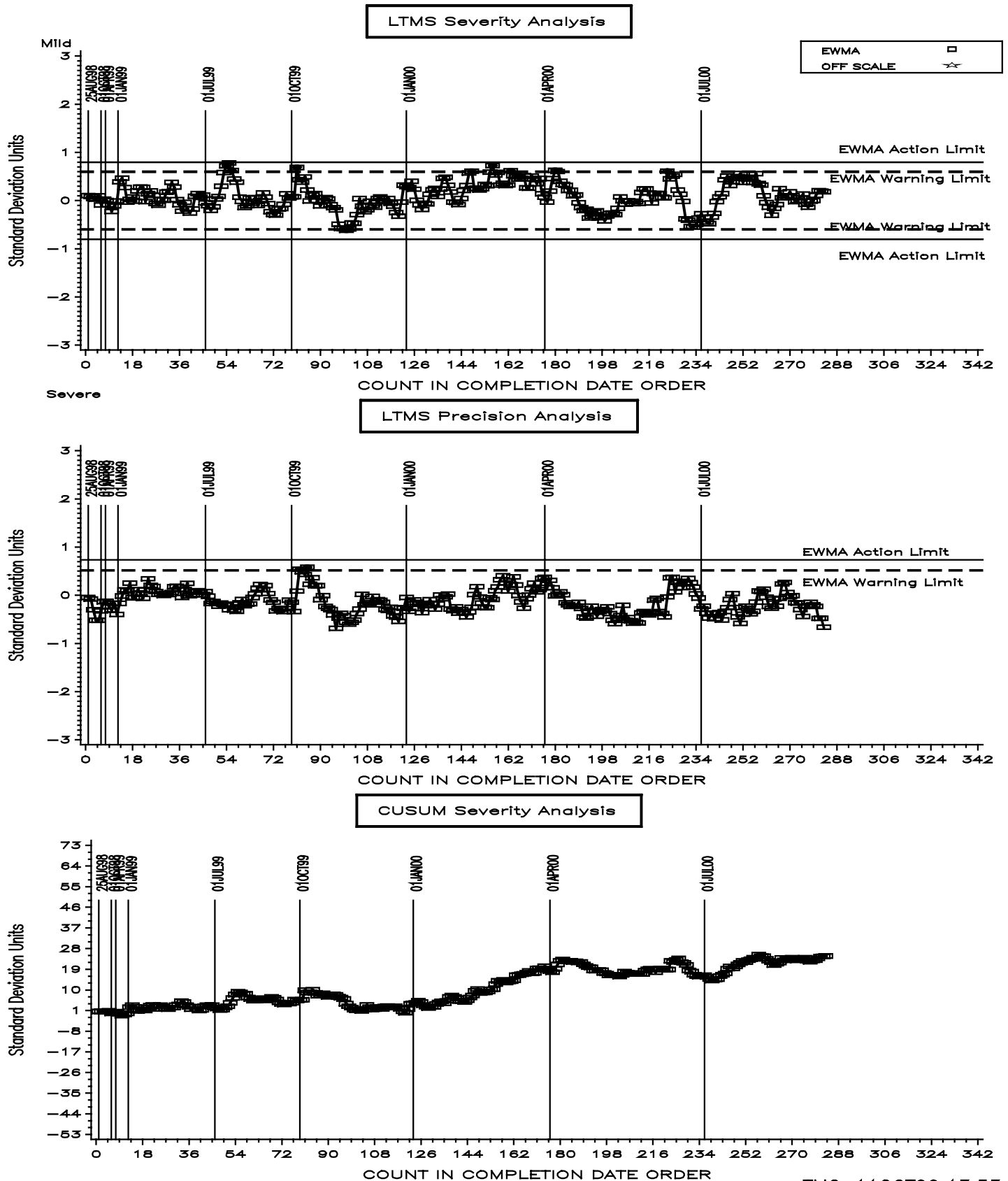


# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Stand Severity Adj. Data  $FEI_i = FEI_i + s * (-1(Z_i + Z_{i+1})/2)$

FEI FINAL RESULT PHASE I (%)

Figure 3

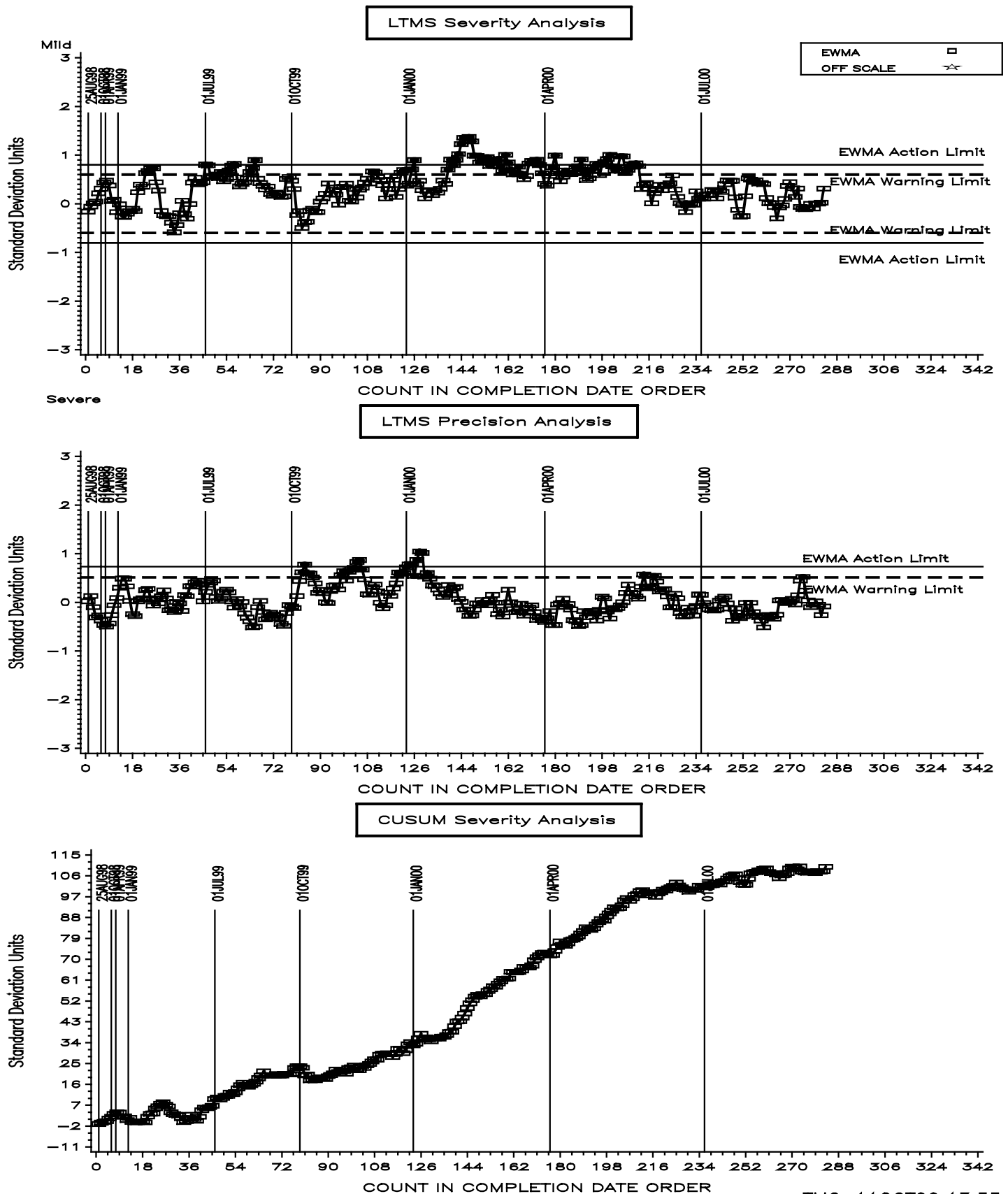


# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Stand Severity Adj. Data  $FEI_i = FEI_i + s * (-1(Z_i + Z_{i+1})/2)$

FEI FINAL RESULT PHASE II (%)

Figure 4



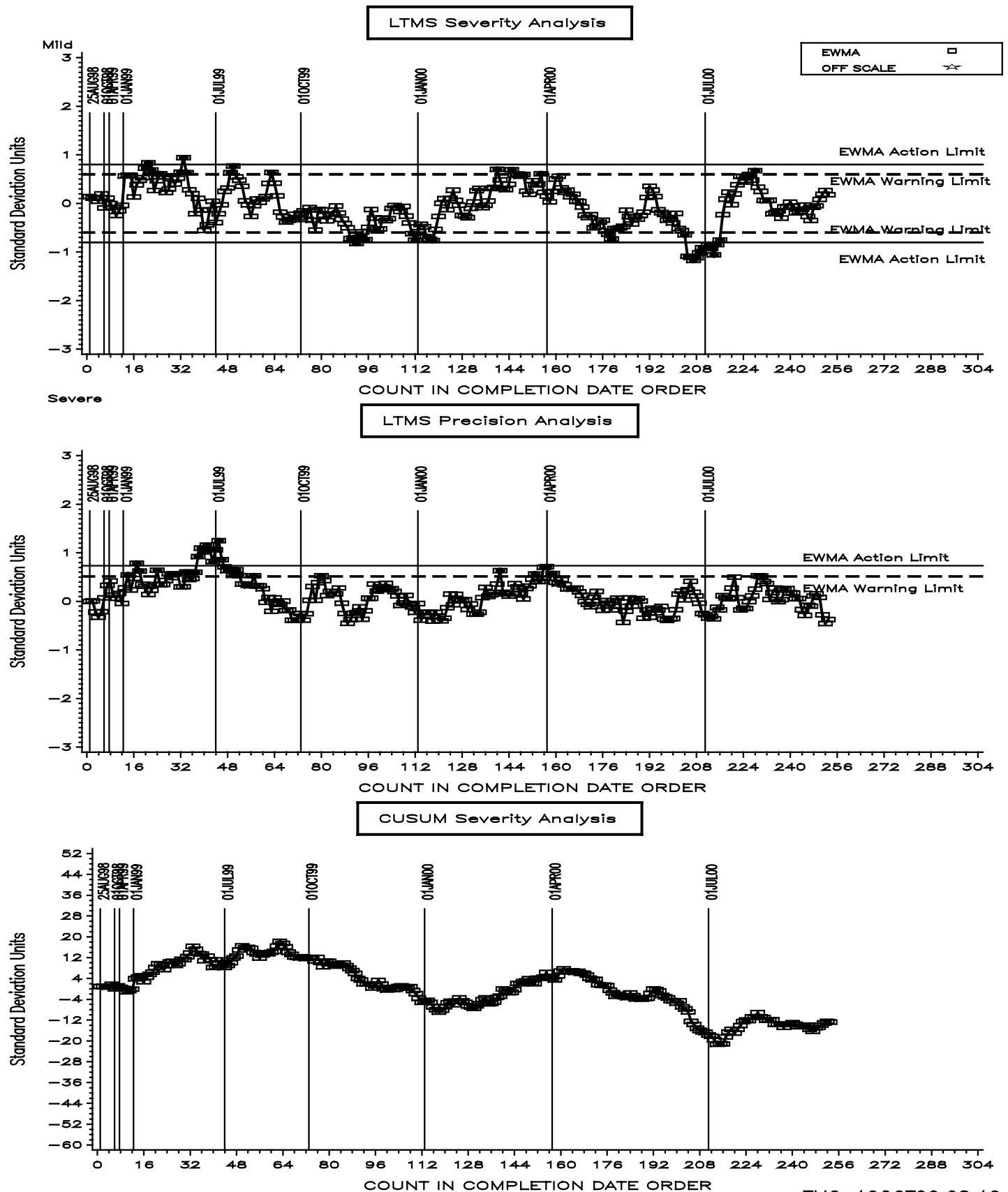


# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Excluding Ref Oil Tests That Have No Candidate Tests

FEI FINAL RESULT PHASE I (%)

Figure 5



# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Excluding Ref Oil Tests That Have No Candidate Tests

FEI FINAL RESULT PHASE II (%)

Figure 6

