



# Test Monitoring Center

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**MEMORANDUM:** 04-013

**DATE:** April 5, 2004

**TO:** Charlie Leverett, Chairman, Sequence VIB Surveillance Panel

**FROM:** Richard Grundza

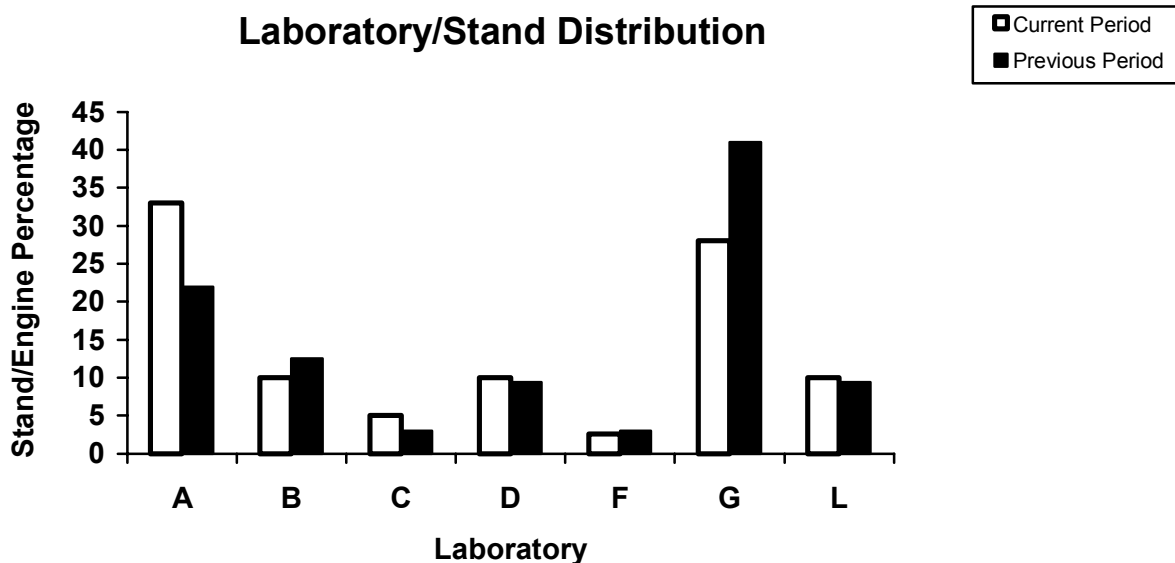
**SUBJECT:** Sequence VIB Test Results from October 1, 2003 through March 31, 2004

The following is a summary of Sequence VIB reference tests that were reported to the Test Monitoring Center during the period October 1, 2003 through March 31, 2004.

## Lab and Stand Summary

	Reported Data During Period	Calibrated as of 03/31/2004
Laboratories	7	7
Stand/Engine Combinations	39	20

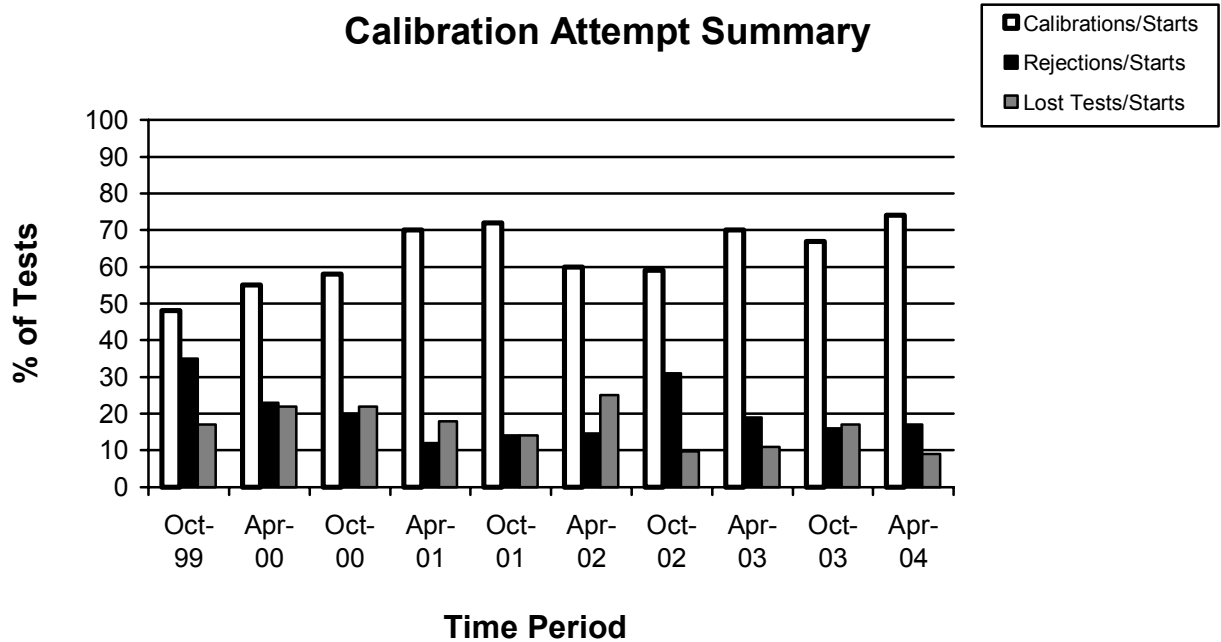
The following chart shows the laboratory stand/engine distribution for data reported during this report period:



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	77
Failed Acceptance Criteria	OC	18
Operationally Invalid (Laboratory Judgement)	LC	8
Aborted	XC	1
<b>Total</b>		<b>104</b>

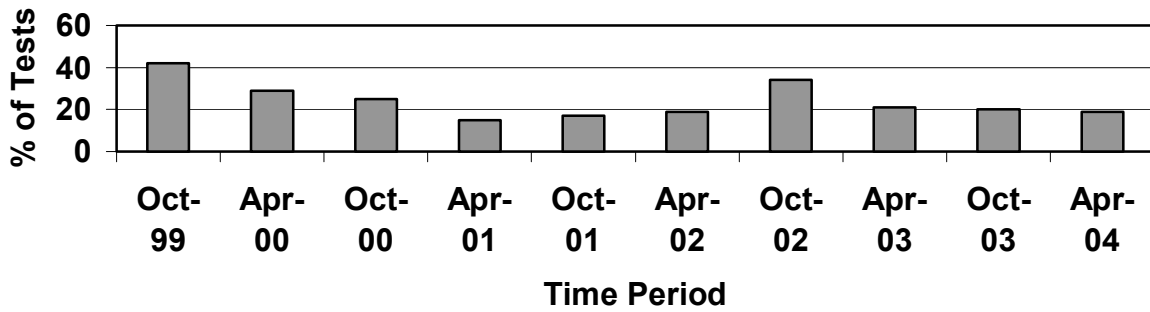
Attempted calibration tests are depicted graphically below by report period:



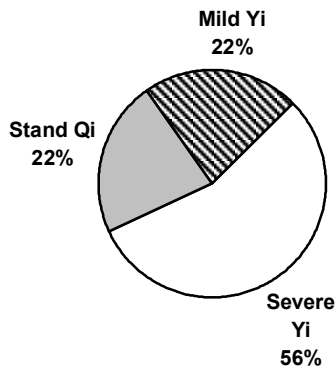
The calibration per start rate has increased with respect to the previous period, and at 74% is the highest in the history of the VIB test. The rejected per start rate is essentially unchanged, while the lost test per start rate has decreased, when compared to the previous report period.

The percentage of tests failing the acceptance criteria for operationally valid tests is essentially the same as the previous period. The percentages are depicted graphically below.

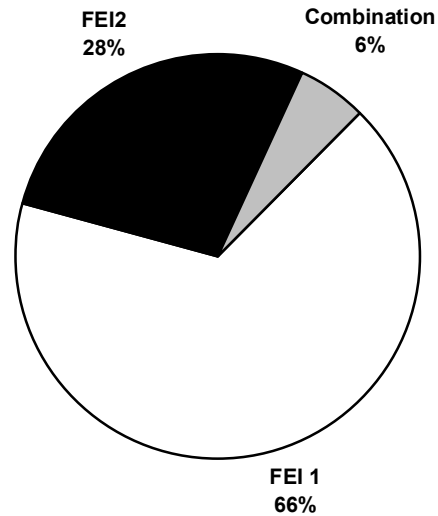
### Rejected Operationally Valid Tests



Distribution of LTMS Stand Alarms

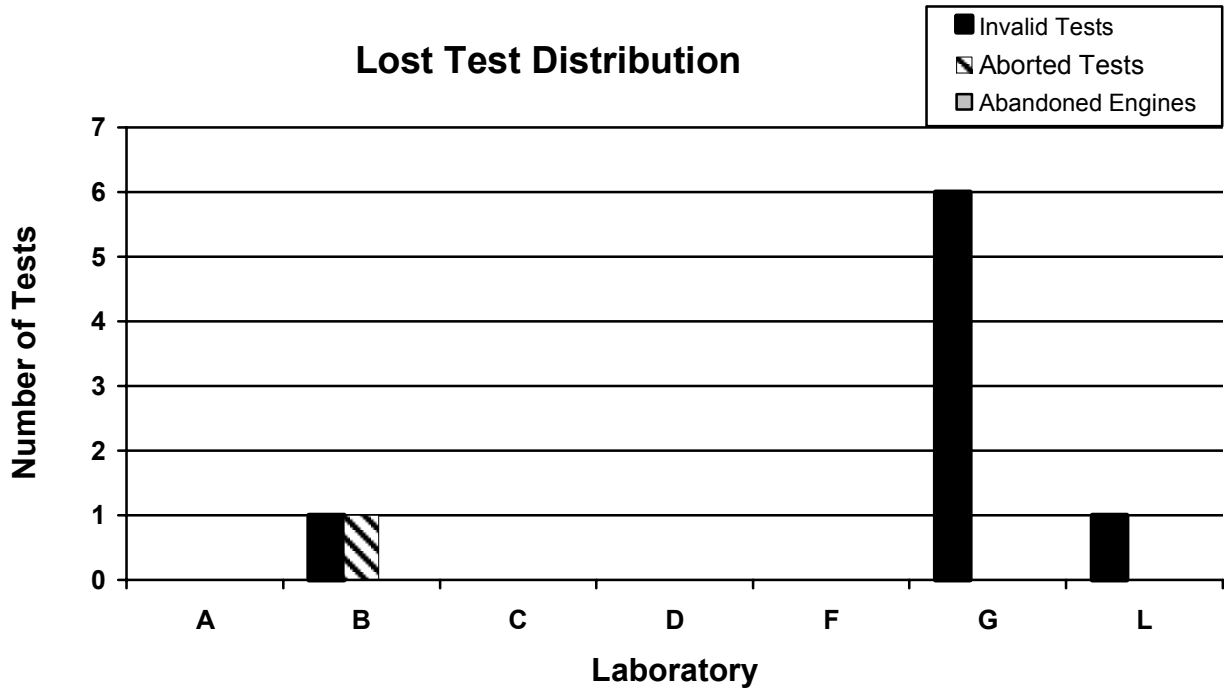


Distribution of Stand Alarms by Parameter

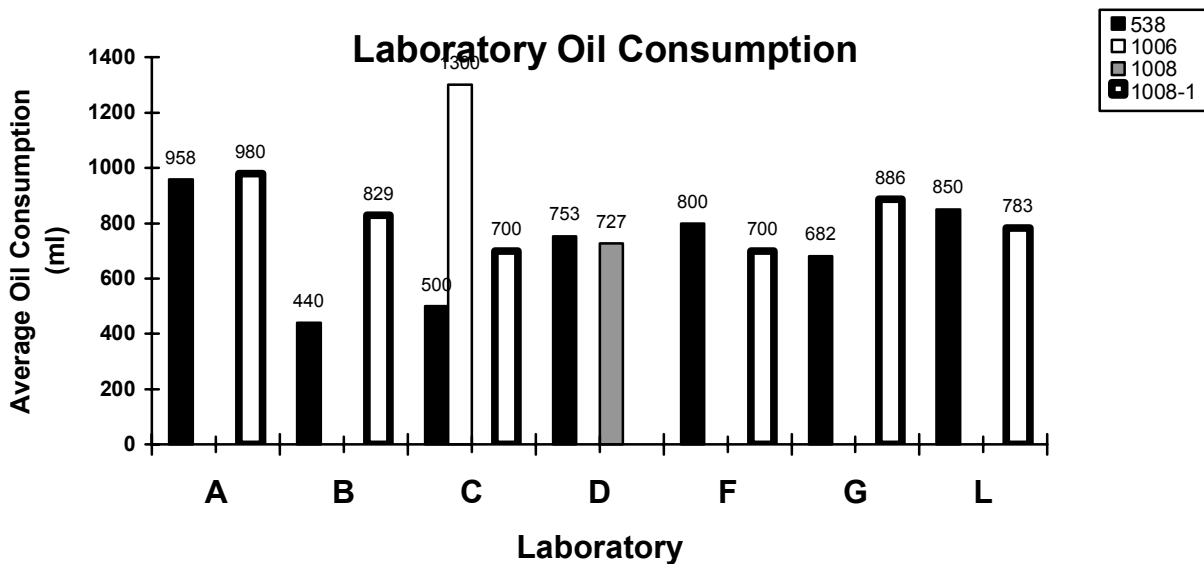


There were ten tests rejected for FEI Shewhart (Yi) severe, four tests rejected for FEI Shewhart (Yi) mild, and four tests rejected for EWMA precision alarm (Qi). There has not been a LTMS deviation written for Sequence VIB to date.

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

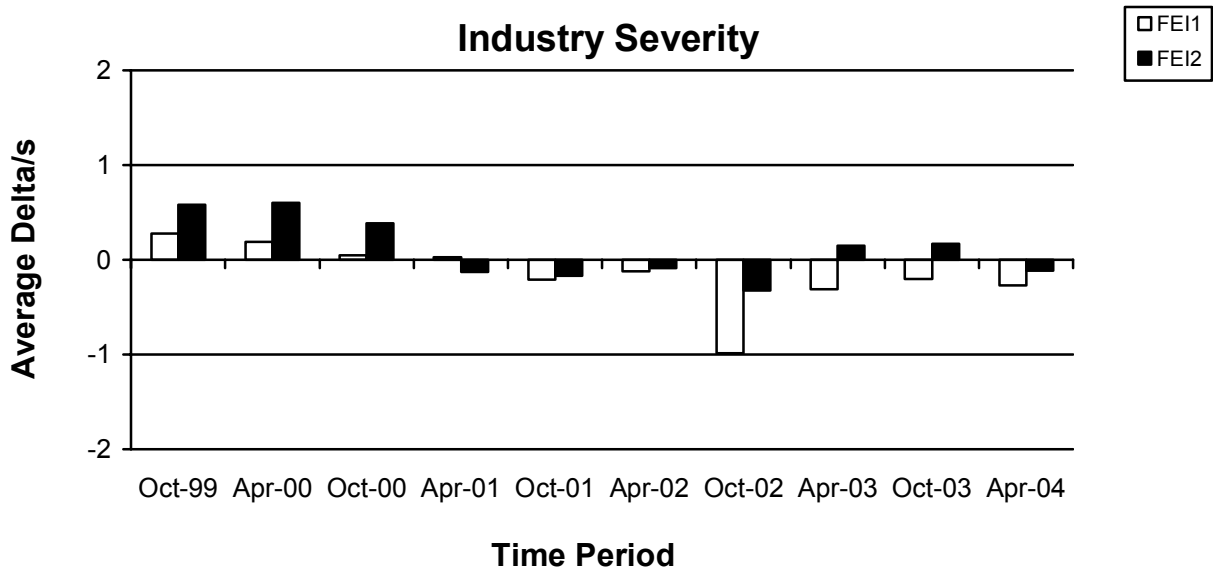


The average oil consumption by oil and laboratory are depicted graphically below. Shown below is a summary of the average oil consumption for all laboratories reporting data this report period.

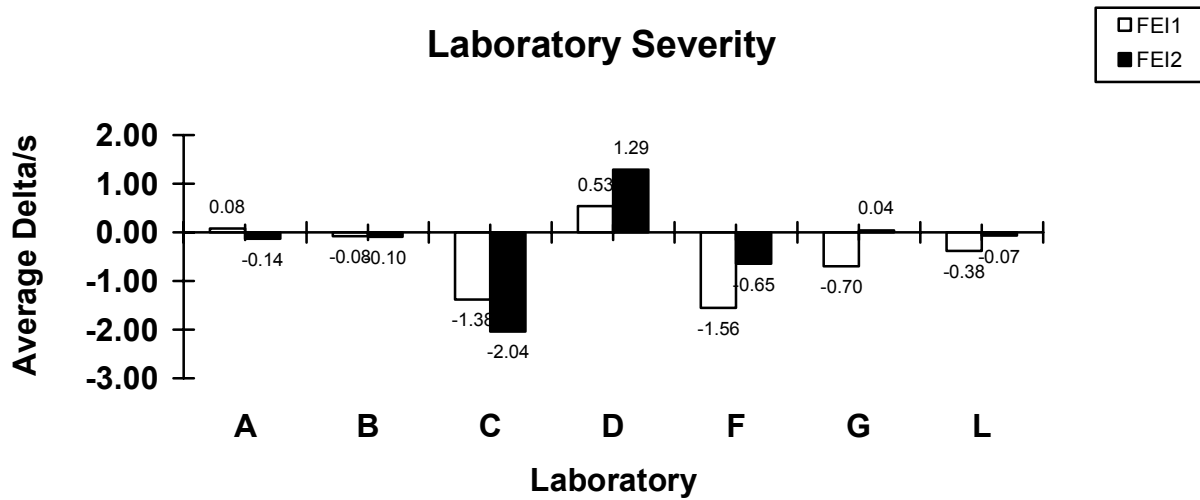


TEST SEVERITY AND PRECISION

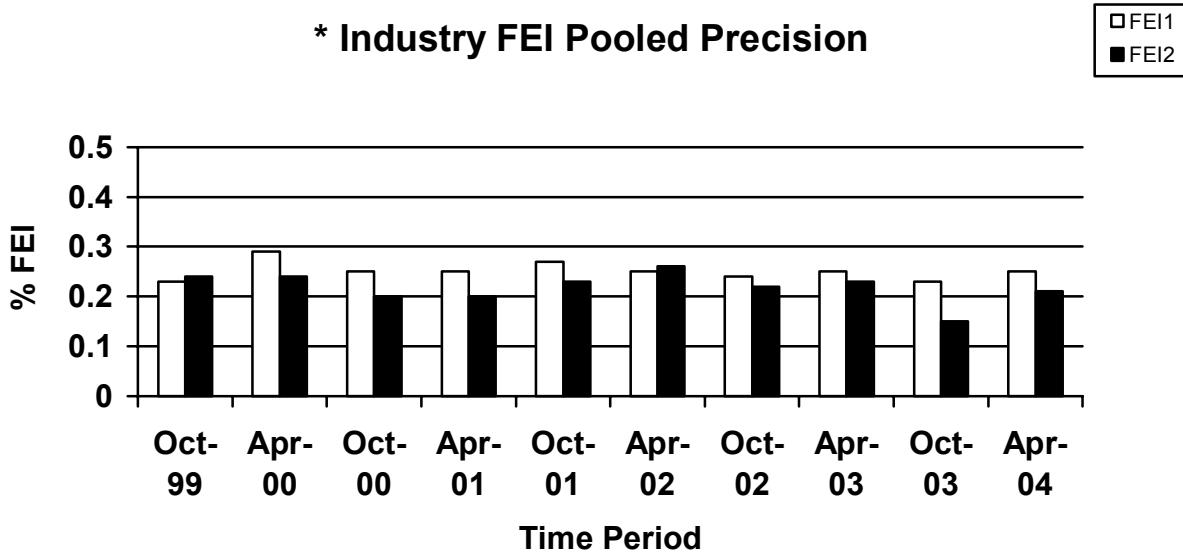
The industry mean  $\Delta/s$  for FEI1 and FEI2, for this report period are -0.27 severe and -0.11 severe, respectively.



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 0.21 (pooled s), respectively. Precision for both FEI1 and FEI2 has degraded with respect to the previous period and compare well with historical estimates.



\*Precision estimates are calculated by pooling oil and stand/engine combination.

INDUSTRY CONTROL CHARTS

FEI1

Figure 1 shows FEI1 severity began the period in control. Ten tests into the period, FEI1 severity sounded four warning and an action alarm, which cleared for nine tests before sounding a warning alarm, clearing and sounding another warning alarm. The charts remain in control for eleven tests before sounding a series of five action and three warning alarms. The charts are in control for the next nineteen tests and then a series of three action and two warning alarms sound. The industry control charts remained in control for the rest of the period. The alarms appeared to have been caused by results from new engines. FEI1 precision also began the period in control. Midway through the period, a series of two action and two warning alarms occurred, which clear for a test before an additional warning alarm sounds. The charts remained clear for four tests before a series of five warning alarms sound. After this series of alarms, the charts remained in control for the rest of the period. Precision alarms appeared to be the result of a number of severe tests from new/stand engines, intermixed with on target to mild results from existing stands.

FEI2

Figure 2 shows severity began the period in control. After sixteen tests, a warning alarm occurred, after which the charts remained in control for ten more tests. An action and two warning alarms sounded before the charts returned back in control. The charts remained in control for the next thirty-six tests before three warning alarms sounded. With the exception of an isolated, mild warning alarm the charts were in control for the period. With the exception of two warning and one action alarm near the end of the period, precision was in control for the period. Much like FEI1, severity trends and precision alarms observed during the period are a result of a relatively large number of tests reported on new engines, which tended to be more severe.

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	538	539	1006	1007	1008	1008-1
A	4	1	0	7	0	4
B	2	1	0	2	0	1
C	1	1	0	2	0	1
D	2	0	0	0	0	1
F	2	1	0	3	0	2
G	6	2	0	3	0	5
L	2	1	0	5	0	1
TMC	166	182	0	*	**	***

\* 495 Gallons (Multiple test area usage)

\*\* 29 Gallons (Multiple test area usage)

\*\*\* 1980 Gallons (Multiple test area usage)

The panel recently agreed to not use reference oil 539 for calibration tests at this time.

LAB VISITS

Three lab visits were conducted during this report period. Any discrepancies noted during these visits have been identified to the laboratory and the appropriate corrective actions taken have been documented.

INFORMATION LETTERS

Information Letter 04-1 was issued this report period. This information letter allows the use of additional models of micromotion transmitters. This letter also revised the calibration requirements for the oil heater thermocouple and also addresses some editorial changes to the precision statement.

SUMMARY

Severity for FEI1 was severe for this report period.

Severity for FEI2 trended severe for this report period.

FEI1 and FEI2 precision has degraded when compared to the last report period.

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

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

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

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

REG/reg

Attachments

c: Sequence VIB Surveillance Panel

Sequence VIB Test Engineers

<ftp://ftp.astmtmc.cmu.edu/docs/gas/sequencevi/semiannualreports/vib-04-2004.pdf>



Sequence VIB Semiannual Report  
List of Attachments

- Table 1 is a historic statistical summary for reference oils through March 31, 2004.
- 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.

TABLE 1

SEQUENCE VIB  
 OPERATIONALLY VALID DATA SET  
 DATA PRIOR TO 04/01/04

OIL CODE 1006				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
236	FEI1	1.40	0.29	0.61 - 2.50
236	FEI2	0.52	0.27	- .36 - 1.23
OIL CODE 1007				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
92	FEI1	0.75	0.30	0.24 - 2.11
92	FEI2	0.45	0.27	- .55 - 1.25
OIL CODE 1008				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
244	FEI1	1.82	0.24	1.18 - 2.47
244	FEI2	1.24	0.21	0.58 - 1.74
OIL CODE 1008-1				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
86	FEI1	1.86	0.27	1.24 - 2.45
86	FEI2	1.26	0.21	0.71 - 1.83
OIL CODE 538				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
115	FEI1	1.82	0.31	0.86 - 2.41
115	FEI2	1.56	0.22	0.93 - 2.22
773	TOTAL			

TABLE 1A

SEQUENCE VIB  
 OPERATIONALLY VALID DATA SET  
 DATA FROM 10/01/03 THRU 03/31/04

OIL CODE 1006				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
2	FEI1	1.24	0.09	1.17 - 1.30
2	FEI2	0.16	0.08	0.10 - 0.21
OIL CODE 1008				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
3	FEI1	1.85	0.28	1.60 - 2.15
3	FEI2	1.44	0.06	1.40 - 1.51
OIL CODE 1008-1				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
46	FEI1	1.90	0.23	1.34 - 2.30
46	FEI2	1.26	0.21	0.71 - 1.60
OIL CODE 538				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
44	FEI1	1.87	0.29	1.23 - 2.41
44	FEI2	1.55	0.22	0.93 - 2.22
95 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
B	Computer problems	1	22.2%
	Low oil pressure, damage oberg filter	1	
G	AFR Delta >0.50	1	66.7%
	Excessive shutdowns/downtime	1	
	Micromotion Problems	1	
	Fuel pump failure	1	
	Excessive downtime	1	
	High oil consumption	1	
L	Test length exceeded 150 hours	1	11.1%

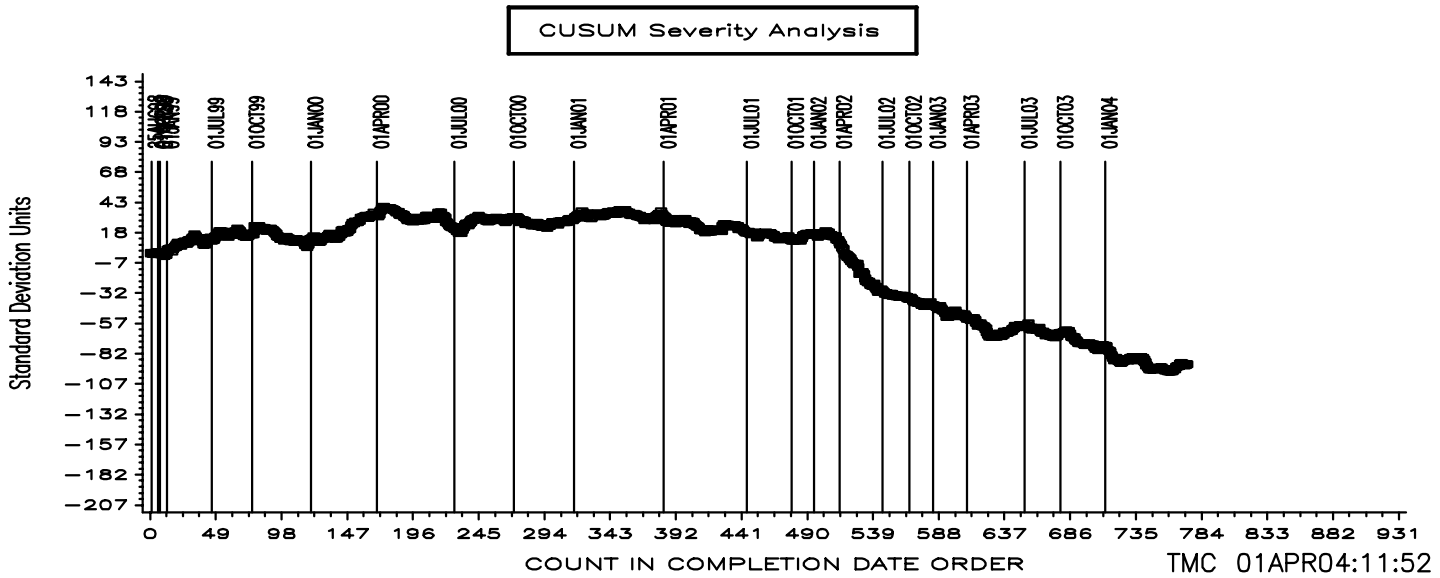
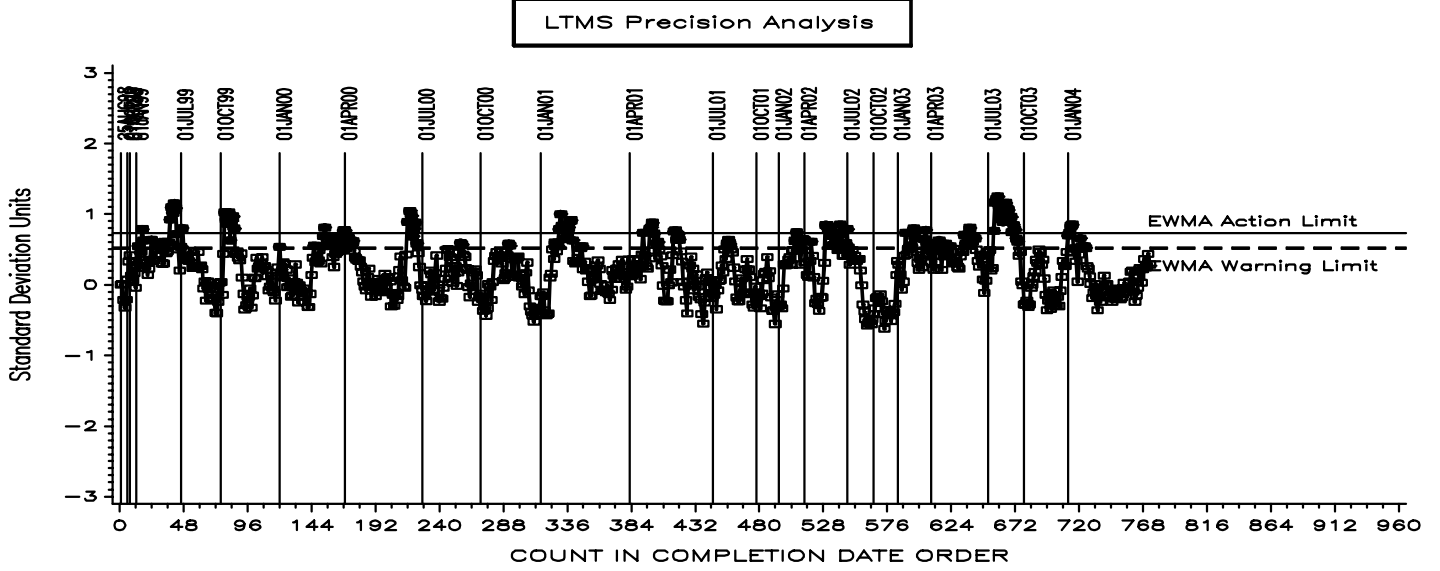
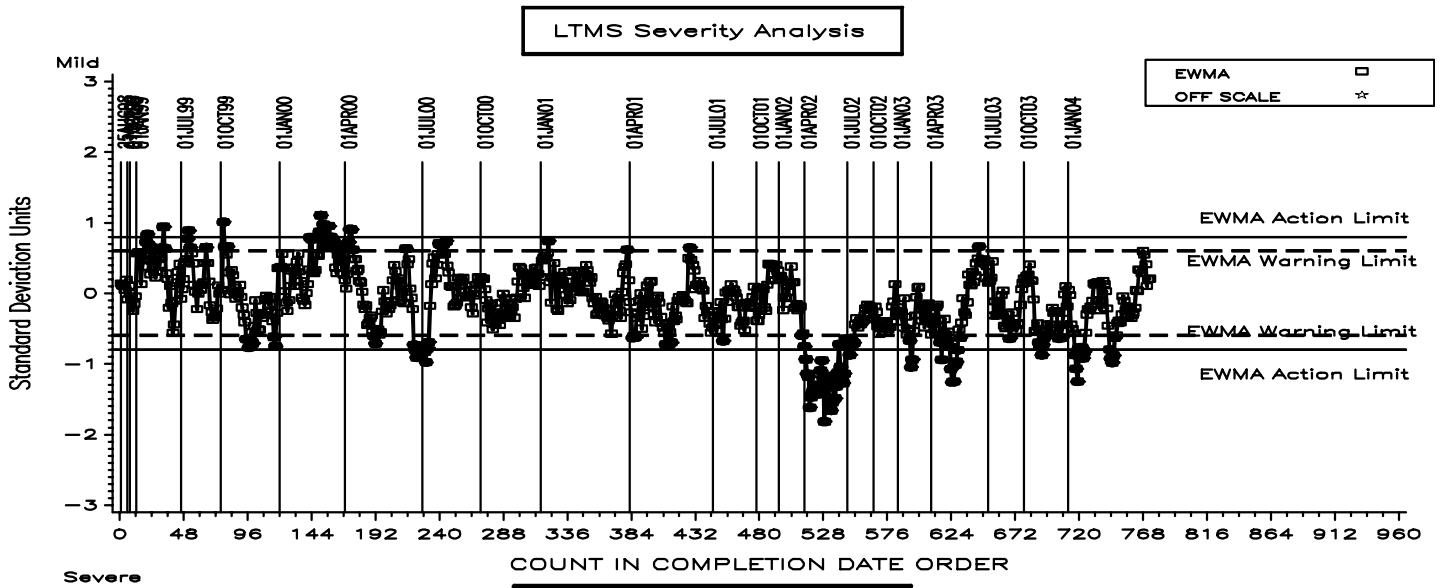
## Sequence VIB Timeline

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 use of 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 Timeline

Date	Item Changed	Information Letter
20000801	A Task Force Was Appointed by the VIB Surveillance Panel to Address Lab To Lab Differences with Oil Consumption and FEI Severity. Information Letter 00-4 was a result of the Lab Visit Discrepancies.	
20000915	Increase Oil Charge to 6.0 Liters	00-4
20000915	Revise Oil Level/Sight Glass Calibration Procedure	00-4
20000915	Oil Pan Oil Level Requirement	00-4
20001116	Reduced Calibration Frequency	01-1
20001117	Validity Interpretation During BSFC Measurement Cycle	01-1
20001117	Reporting Stage Restarts or Any Test Time Deviations	01-1
20001117	Alternate HEGO Sensor Part Number	01-1
20001117	Revisions to New Engine Cyclic Break-in	01-1
20010301	Revisions to Test Length Calculation and Reporting Format	01-1
20010301	Additional Oil Analysis Requirements	01-1
20010822	Allowed Timing Chain Tensioner with Subsequent Reference Oil Test	01-2
20010822	Defined Maximum Total Test Length as 150 h	01-2
20010822	Defined Off Test Time and Allows No More Than 2 h of Off Time During Phase I and II Aging	01-2
20010822	Added Reference to Ford 543 Engine Assembly Manual	01-2
20010822	Refined Oil Analysis Procedure for HTHS, CCS Viscosity, Friction Coefficient by HFRR, Fuel Dilution and Infrared for Oxidation & Nitration	01-2
20010822	Correction of Company Suppliers in X1.3 and X1.19	01-2
20011005	Pressurization of Engine Coolant System to 69±13.8 kPa	01-3
20011005	Deleted Requirement to Measure Blowby	01-3
20011005	Revised Load Cell Temperature Delta for 3°C to 6°C in 6.4.2.3	01-3
20011005	Corrected Fuel Supplier Name and Address in Section 7.2 and Footnote 15	01-3
20011129	Added Provisions for VIBSJ Test	01-4
20011207	Revised AFR limits from 14.25:1 - 15.25:1 to 14.00:1 – 15.00:1	01-5
20020405	Allowed Replacement of Timing Chain as Part of Tensioner Assembly	02-1
20020405	Revised Procedure to Require Viscosity Measurements for Both Reference and Non Reference Oils	02-1
20020712	Reference oil 538 targets updated (n=20)	
20021016	Reference oil 538 targets updated (n=30)	
20021114	Reference oil 1008-1 initial targets generated (n=10)	
20030327	Updated Test Method D6837 to incorporate info letter 02-1 and remove remedial statements	03-1
20030521	Reference oil 1008-1 initial targets generated (n=20)	
20030618	Dropped requirements to monitor HTHS, CCS, FC by HFRR and INI and INO	03-2
20030703	Reference oil 1008-1 initial targets generated (n=30)	
20040101	Added reference to fuel spec, replaced Aliphatic Naphtha with Type II Class C solvent	03-3
20040130	Added addition micromotion transducers to test method, revised calibration requirements for oil heat exchanger thermocouple and made editorial changes relating to precision statements.	04-1

FEI FINAL RESULT PHASE I (%)



SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Figure 2

FEI FINAL RESULT PHASE II (%)

