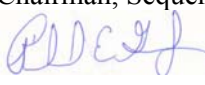




# Test Monitoring Center

Carnegie Mellon University  
6555 Penn Avenue, Pittsburgh, PA 15206, USA

<http://astmtmc.cmu.edu>  
412-365-1000

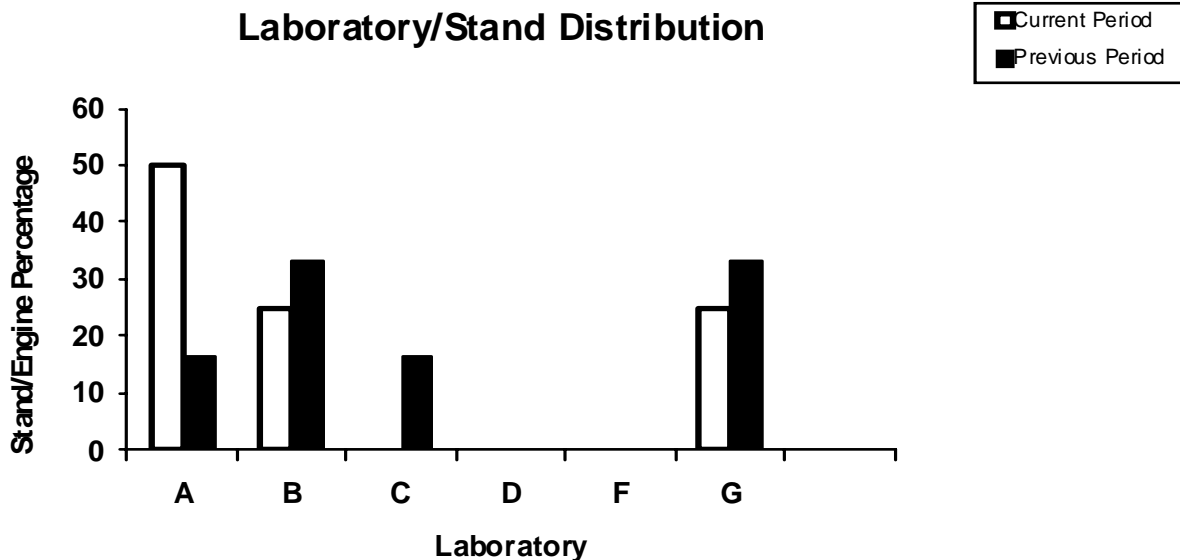
MEMORANDUM: 09-010  
 DATE: April 8, 2009  
 TO: Charlie Leverett, Chairman, Sequence VIB Surveillance Panel  
 FROM: Richard Grundza   
 SUBJECT: Sequence VIB Test Results from October 1, 2008 through March 31, 2009

The following is a summary of Sequence VIB reference tests that were reported to the Test Monitoring Center during the period October 1, 2008 through March 31, 2009.

### Lab and Stand Summary

	Reported Data During Period	Calibrated as of 09/30/2008
Laboratories	3	2
Stand/Engine Combinations	4	3

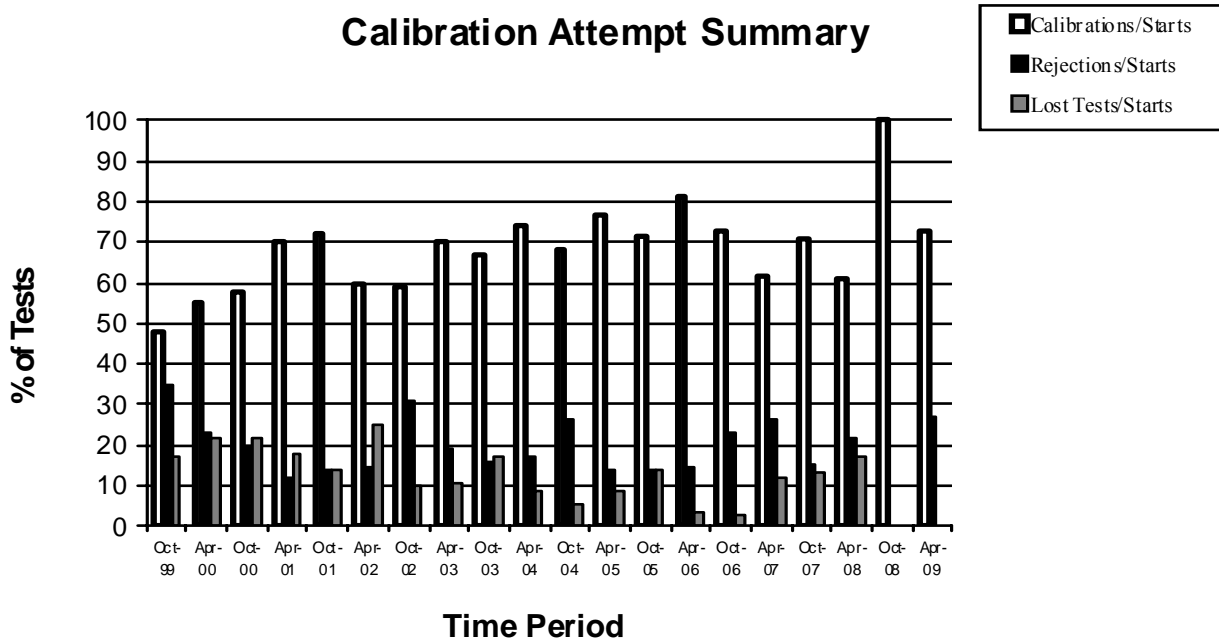
The following chart shows the laboratory stand/engine distribution for data reported during this report period:



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	8
Operationally Valid, Statistically Unacceptable	OC	3
Total		11

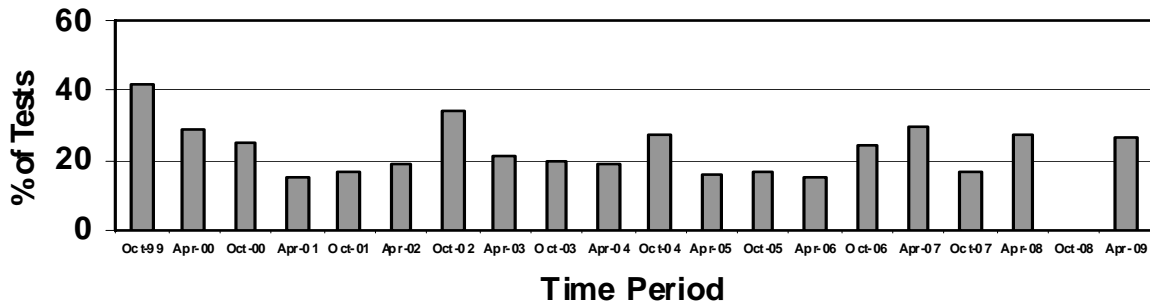
Attempted calibration tests are depicted graphically below by report period:



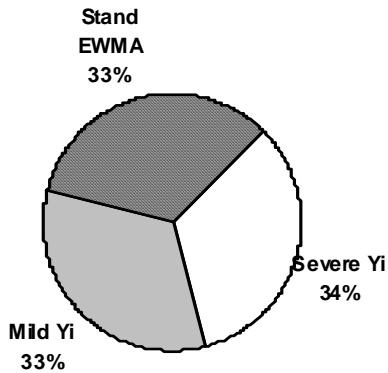
The calibration per start rate has decreased with respect to the previous period, while the rejected test per start rate has increased with respect to the previous period. There were no lost tests. Rates for all parameters compare well with previous periods.

The percentage of tests failing the acceptance criteria for operationally valid tests has increased when compared to the previous period. The percentages are depicted graphically below.

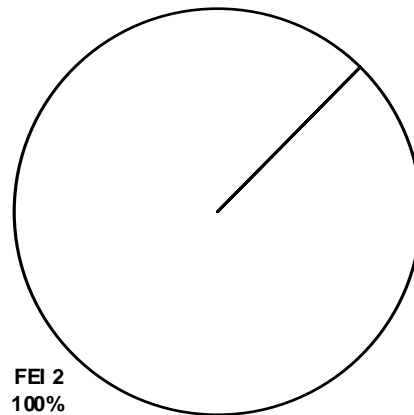
### Rejected Operationally Valid Tests



Distribution of LTMS Stand Alarms



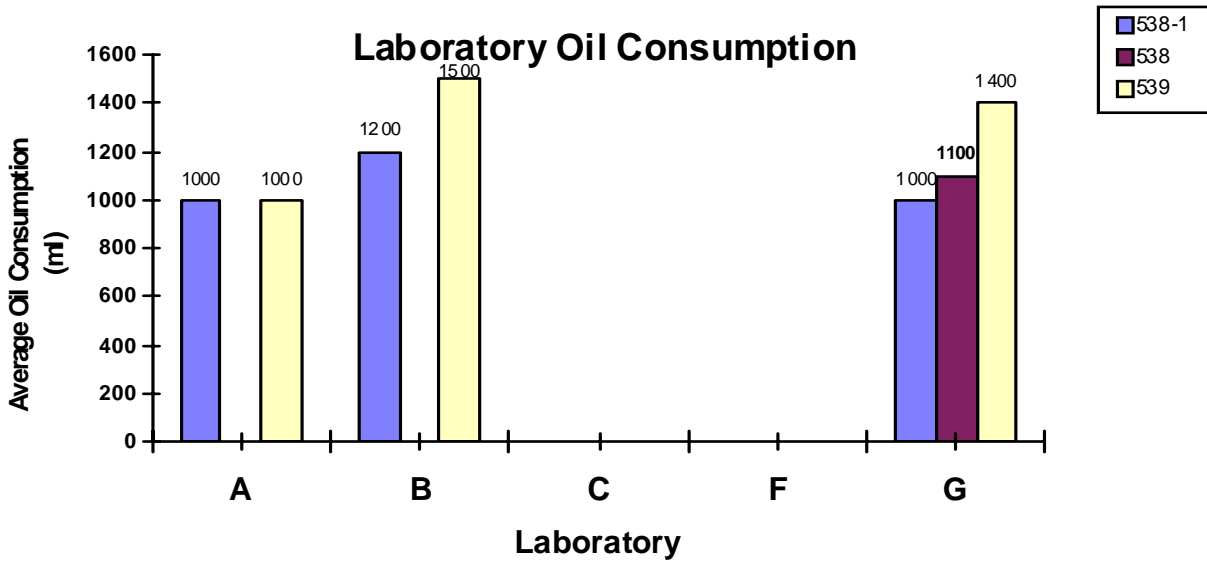
Distribution of Stand Alarms by Parameter



Three tests failed acceptance criteria. One test failed for FEI2 mild, a second test failed for FEI2 severe. A third test failed for a precision EWMA alarm for FEI2.

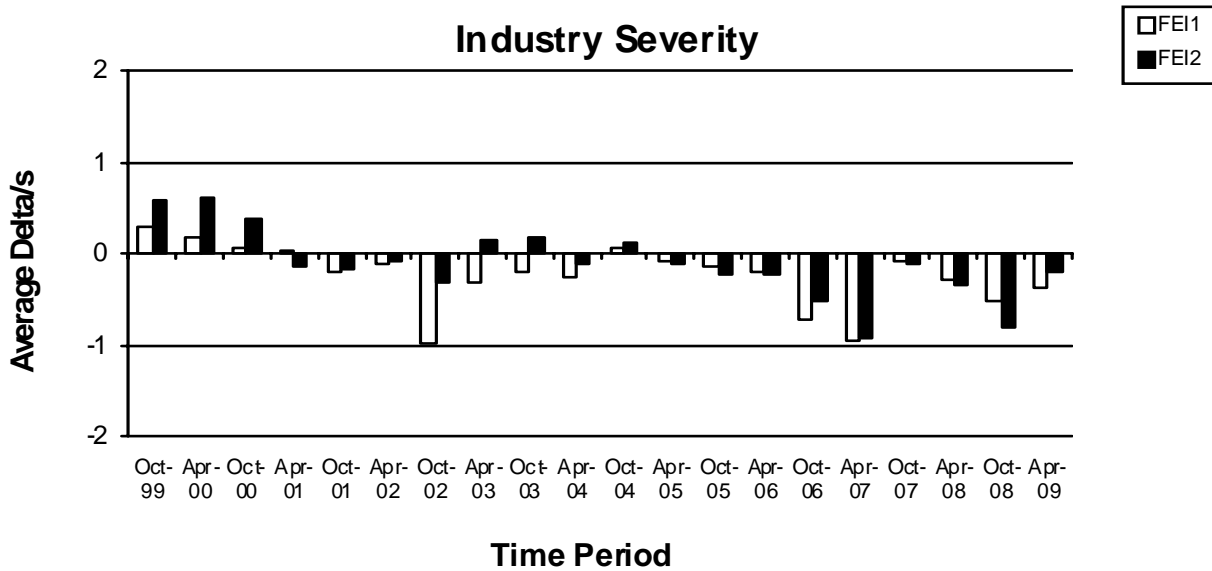
There has not been an LTMS deviation written for Sequence VIB to date.

The average oil consumption values by oil and laboratory are depicted graphically below

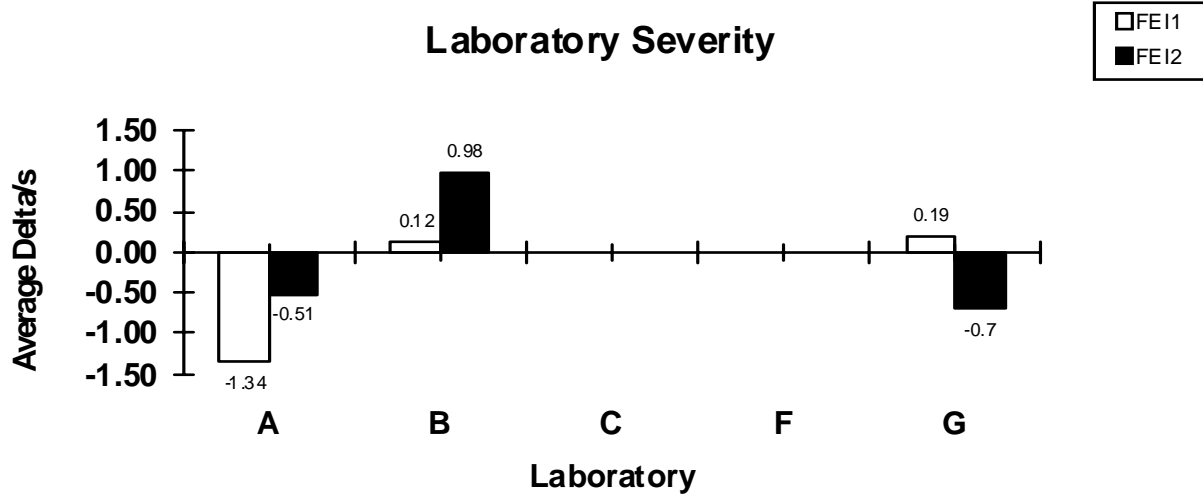


TEST SEVERITY AND PRECISION

The industry mean  $\Delta/s$  for FEI1 and FEI2, for this report period are -0.385 and -0.208, respectively. FEI1 and FEI2 both were severe of target for the period.

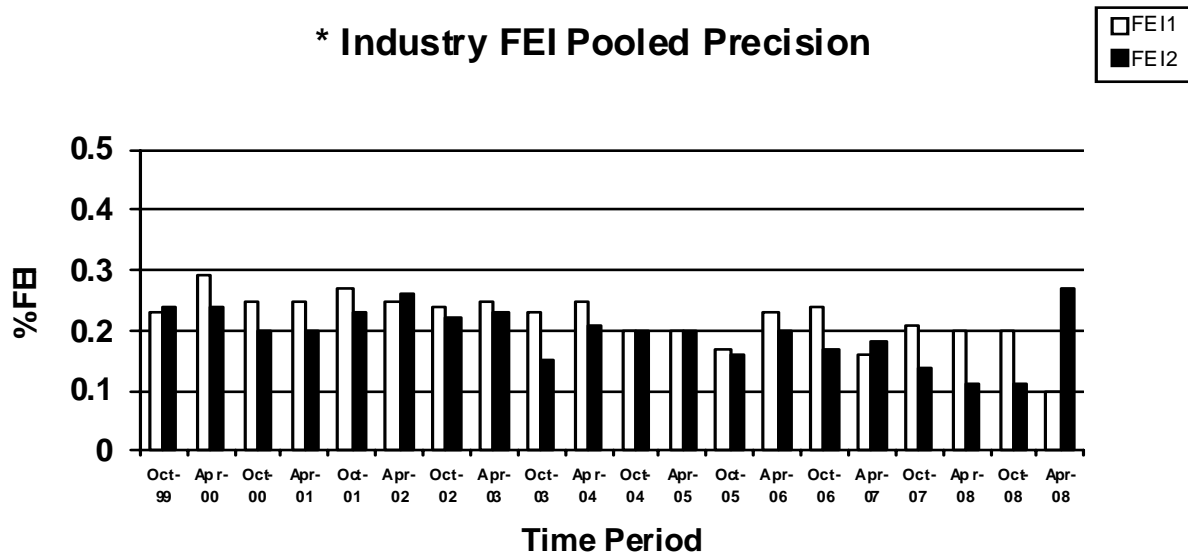


Shown below is a summary of the average FEI  $\Delta/s$  for all laboratories reporting data this report period.



Precision estimates, pooled by oil and stand/engine combination for FE11 and FE12 are 0.10 and 0.27. Precision for FE11 has improved and precision for FE12 has degraded, when compared to the previous period. Both rates are comparable to historical estimates for these parameters.

### \* Industry FEI Pooled Precision



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

INDUSTRY CONTROL CHARTSFEI1

Figure 1(last 40 test results) shows that, with the exception of a severity warning alarm at the beginning of the period, FEI1 severity and precision were in control for the period. Figure 2 shows the entire industry chart.

FEI2

Figure 3 (the last 40 test results) shows the severity EWMA chart beginning the period in warning and action alarm, with the charts in control midway through the report period and remaining that way through the end of the period. Precision was in control for most of the period, but ended the period with a series of three action alarms Figure 4 shows the entire industry chart. There does not appear to be one lab or stand/engine combination which is unduly influencing the severity control charts. The precision alarm near the end of the period, appears to have been triggered by one mild test, 2.524  $\Delta/s$  from target. This test was followed by results which were -1.286, 0.762 and -0.619  $\Delta/s$  from target, respectively. The three results were from different lab/stand/engine combinations, though the 2.524 and 0.762  $\Delta/s$  results were from the same stand/engine combination.

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	538-1	539	1006	1007	1008	1008-1
A	0	3	2	0	0	0	1
B	0	2	2	0	1	0	1
C	0	0	1	0	0	0	1
D	0	1	2	0	0	0	2
F	0	2	1	0	3	0	2
G	0	1	1	0	0	0	2
TMC	0	78	160	0	*	**	***

\* 303 gallons (Multiple test area usage)

\*\* 0 gallons (Multiple test area usage)

\*\*\* 0 gallons (Multiple test area usage)

INFORMATION LETTERS

Two information letters were issued this period. Information Letter 08-1 was issued 10-16-2008 and Information Letter 08-2 was issued 12-22-2008. Items changed with these information letters are documented in the VIB timeline (Table 3).

LAB VISITS

No lab visits were conducted by the Test Monitoring Center 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-04-2009.pdf>

Sequence VIB Semiannual Report  
List of Attachments

- Table 1 is a historic statistical summary for reference oils through March 31, 2009.
- 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, or abandoned engines.
- Table 3 is the Sequence VIB Timeline.
- Figure 1 graphically presents the Industry control charts for FEI1 for the last 40 test results.
- Figure 2 graphically presents the Industry control charts for FEI1.
- Figure 3 graphically presents the Industry control charts for FEI2 for the last 40 test results.
- Figure 4 graphically presents the Industry control charts for FEI2.



TABLE 1

SEQUENCE VIB  
 OPERATIONALLY VALID DATA SET  
 DATA PRIOR TO 04/01/09

		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
245	FEI1	1.82	0.24	1.18 - 2.47
245	FEI2	1.24	0.21	0.58 - 1.74
		OIL CODE 1008-1		
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
236	FEI1	1.91	0.25	1.24 - 2.88
236	FEI2	1.26	0.20	0.52 - 1.95
		OIL CODE 538		
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
272	FEI1	1.84	0.29	0.86 - 2.67
272	FEI2	1.55	0.24	0.93 - 2.32
		OIL CODE 538-1		
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
14	FEI1	1.94	0.19	1.65 - 2.18
14	FEI2	1.34	0.28	0.91 - 2.00
		OIL CODE 539		
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
14	FEI1	0.81	0.23	0.49 - 1.23
14	FEI2	0.36	0.25	-0.18 - 0.76

1109 TOTAL

TABLE 1A

SEQUENCE VIB  
 OPERATIONALLY VALID DATA SET  
 DATA FROM 10/01/08 THRU 03/31/09

OIL CODE 538				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
1	FEI1	1.77		1.77 - 1.77
1	FEI2	1.49		1.49 - 1.49

OIL CODE 538-1				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
4	FEI1	1.93	0.23	1.65 - 2.17
4	FEI2	1.58	0.34	1.20 - 2.00

OIL CODE 539				
N	TEST PARAMETER	MEAN	s	REPORTED RANGE
6	FEI1	0.84	0.23	0.49 - 1.10
6	FEI2	0.26	0.24	-0.18 - 0.54

11 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
	No Lost tests this report period		

### 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
20040802	Added MotorCraft AGSF32FM to test method	04-2

## Sequence VIB Timeline

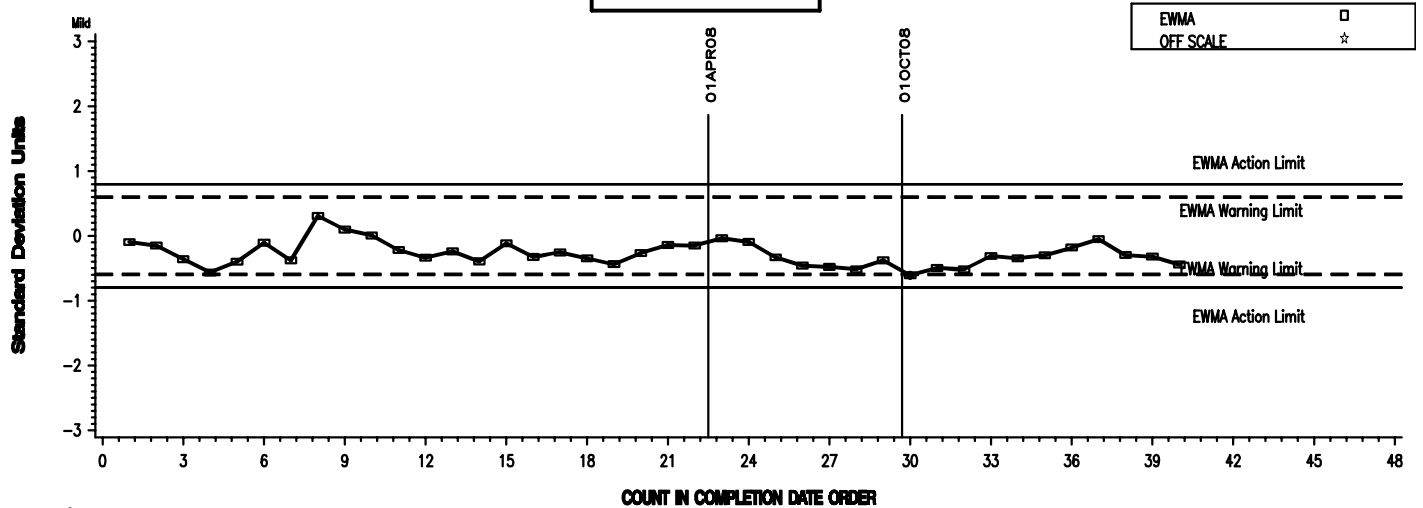
Date	Item Changed	Information Letter
20040802	Added rear crankshaft seal to parts allowed to be replaced on engine	04-2
20040802	Made editorial changes to precision statement	04-2
20040921	Changed $Z_0$ calculation to be the average of first shewhart acceptable through and including second acceptable reference test to initialize stand charts. Also excluded any unacceptable shewhart results, prior to the first acceptable result on a new stand/engine from control charts.	
20041001	Revised stand/engine calibration requirements to include engine test hours	04-3
20041001	Change calibration frequency for fuel flow, speed, AFR and EBP to prior to a reference sequence.	04-3
20041001	Decreased calibration frequency for coolant flow, thermocouple & temperature measurement systems and other instrumentation to every six months	04-3
20041115	Added provisions for external coolant flush cart	04-4
20041214	Clarified Requirement for solvent meeting ASTM D235, Type II, Class C to meet Type II, Class C requirements for Aromatic content, Color and Flash point only.	04-5
20050719	Added Throttle body F3PZ-9E926NA to test method	05-1
20070805	Added Spark Plug SP432	07-1
20071115	Initial targets, reference oil 538-1 (N=7)	
20071203	Initial targets, reference oil 539 (N=7)	
20080103	Target update, reference oil 539 (N=10)	
20080205	Target update, reference oil 538-1 (N=10)	
20081016	Removed LFS-55 oil filter housing from test method	08-1
20081222	Corrected Table 3 load cell temperature	08-2
20090211	Target update, reference oil 538-1 (N=20)	
20090326	Target update, reference oil 539 (N=20)	

# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Last 40 Data Points

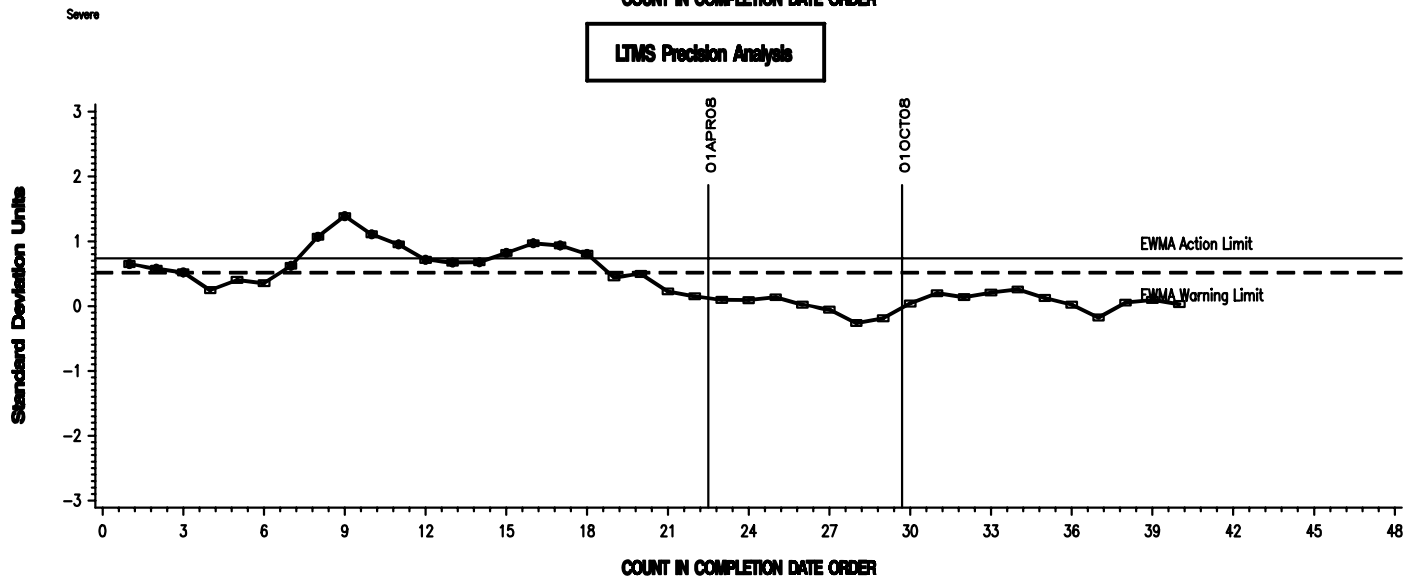
## FEI FINAL RESULT PHASE I (%)

LTMS Severity Analysis



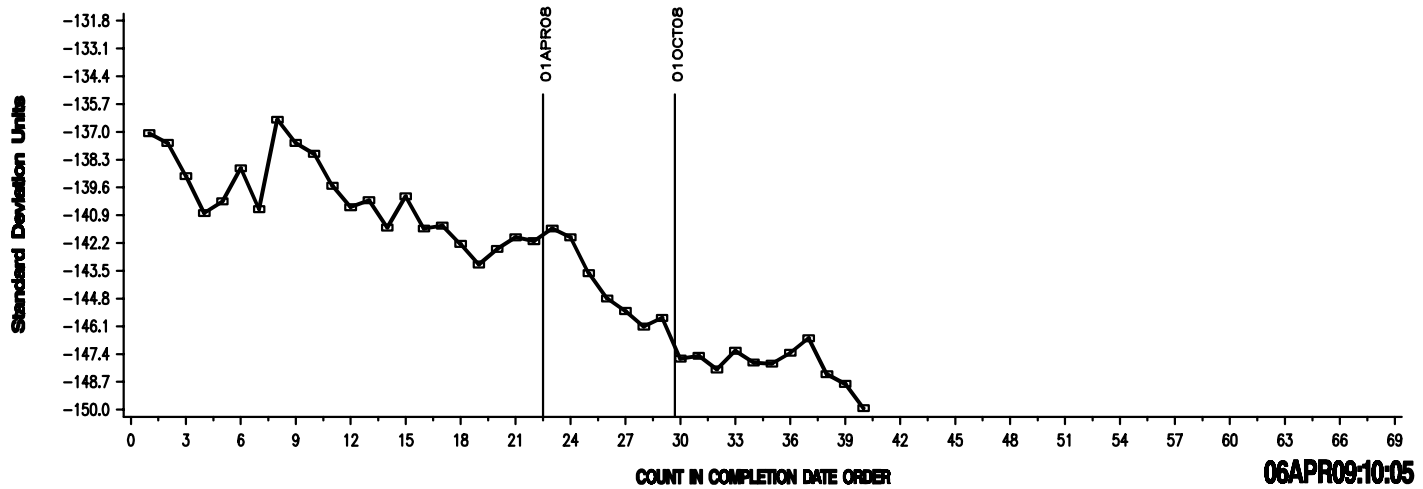
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



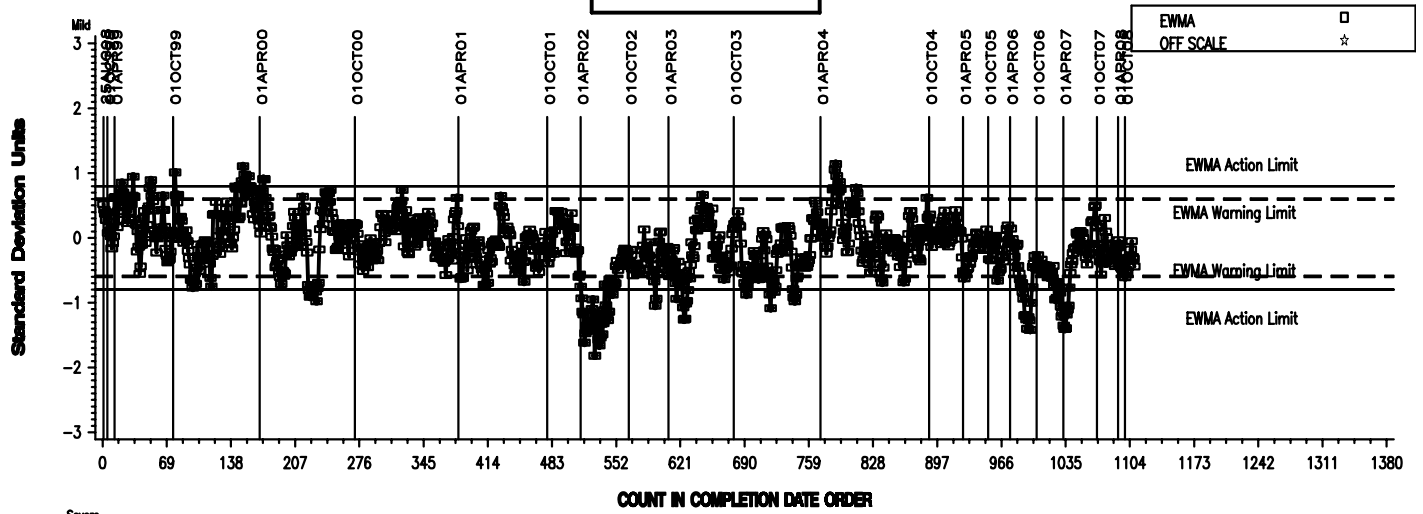
COUNT IN COMPLETION DATE ORDER

# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

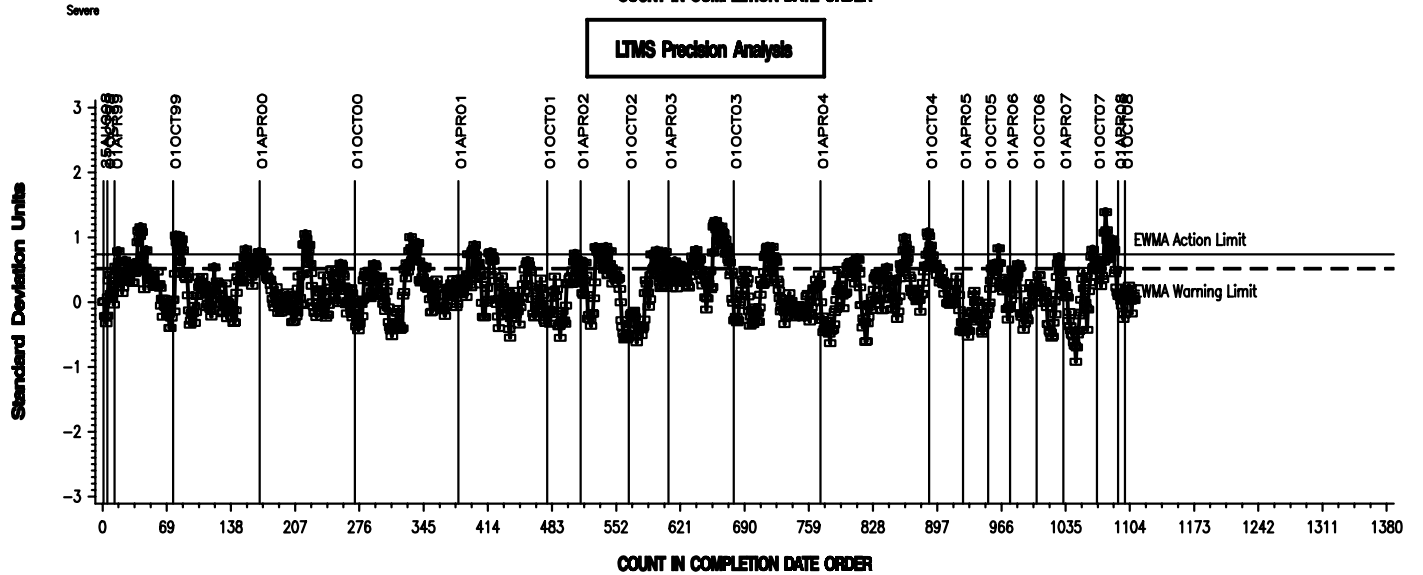
Figure 2

## FEI FINAL RESULT PHASE I (%)

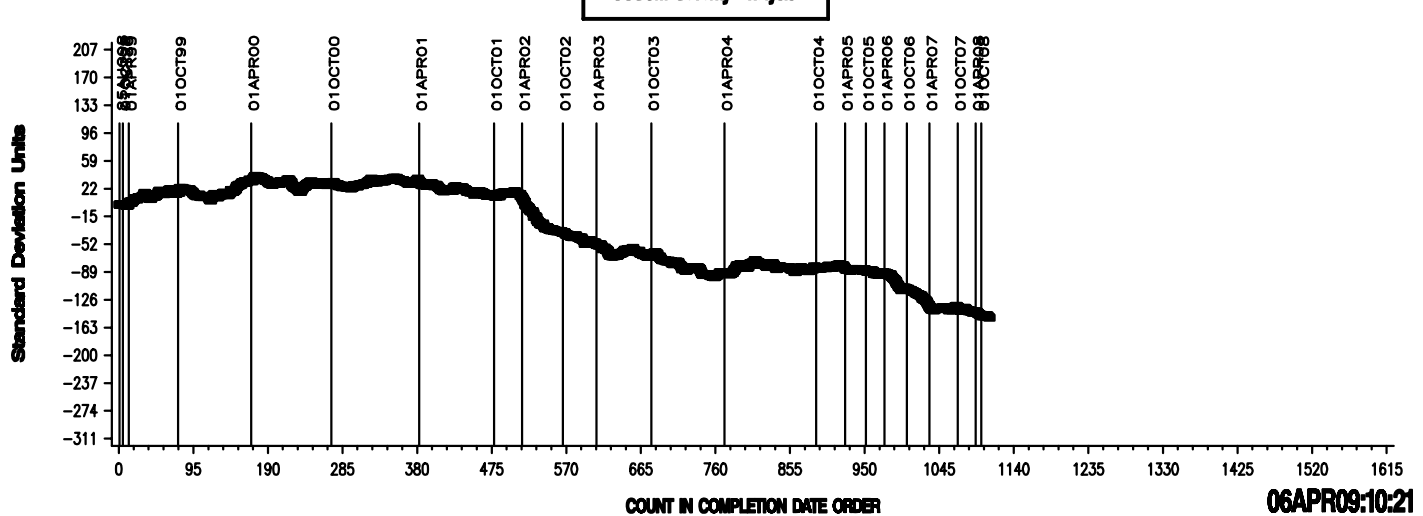
### LIMS Severity Analysis



### LIMS Precision Analysis



### CUSUM Severity Analysis



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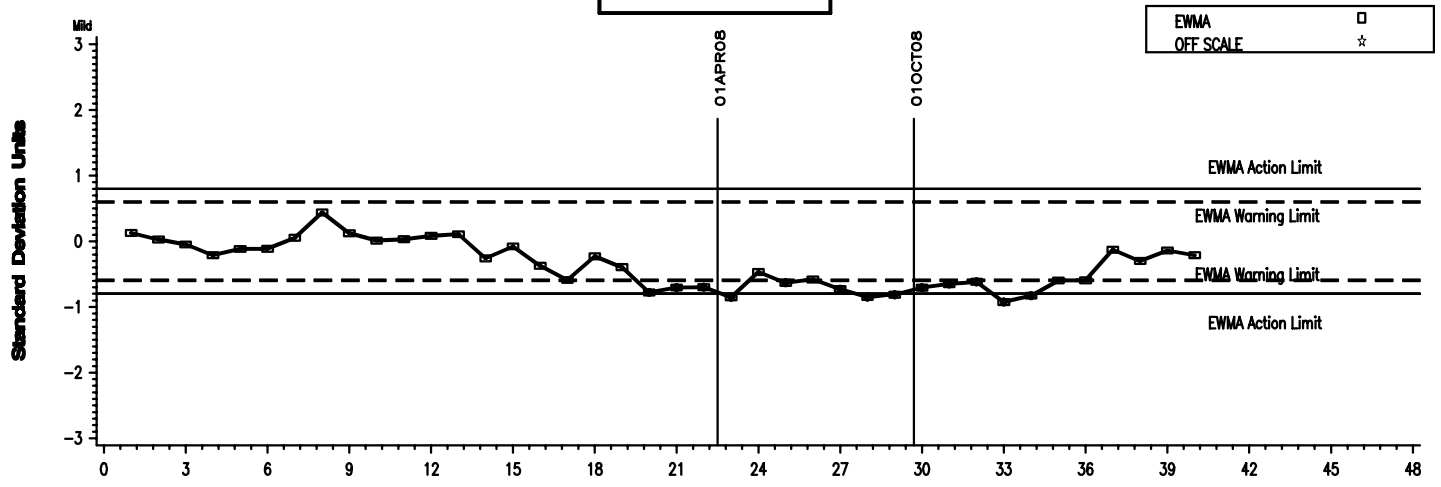
# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Last 40 Data Points

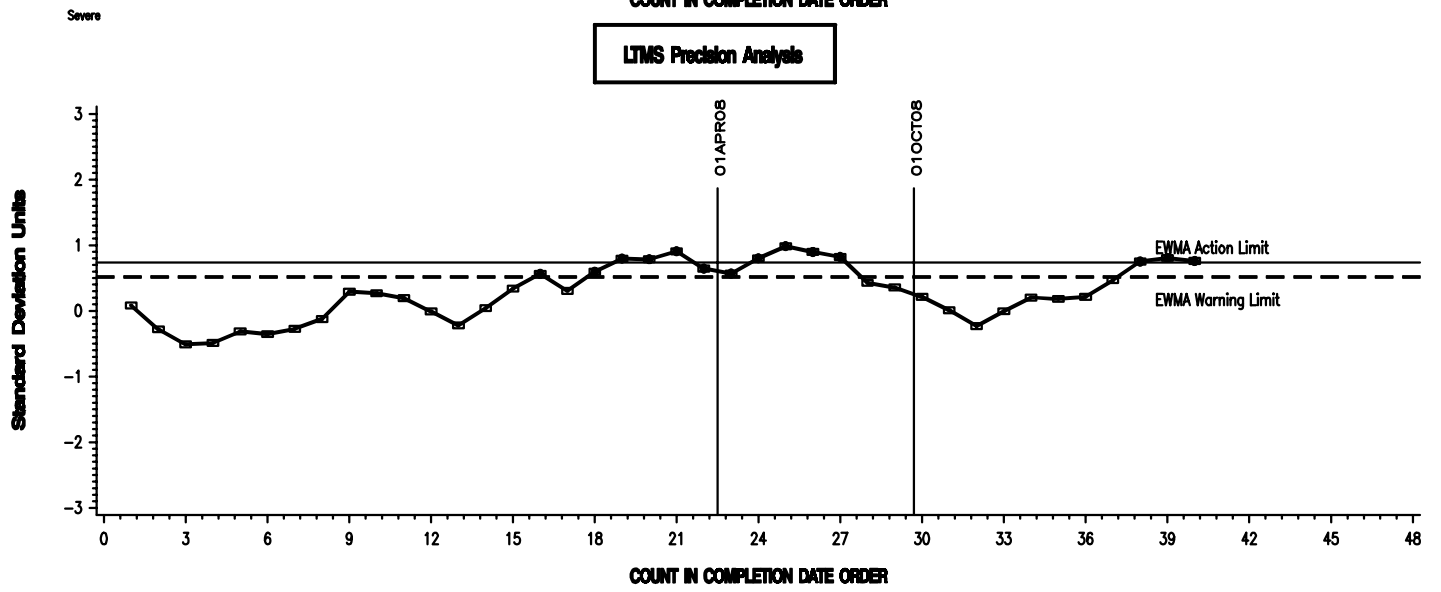
Figure 3

## FEI FINAL RESULT PHASE II (%)

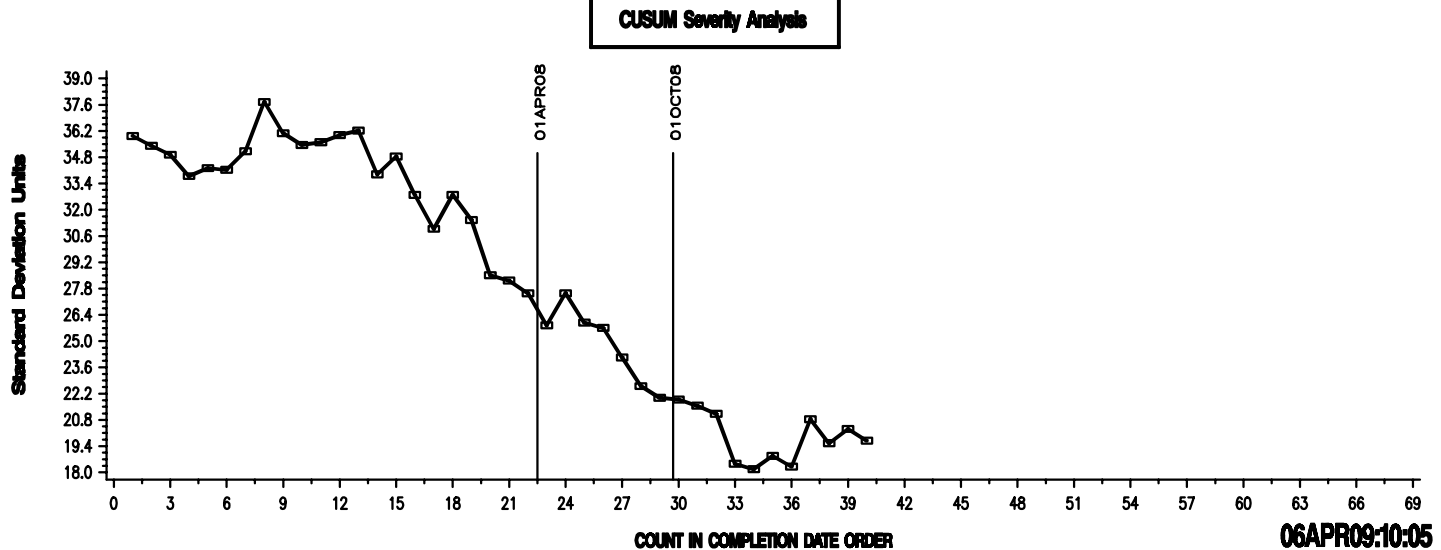
LTMS Severity Analysis



## LTMS Precision Analysis



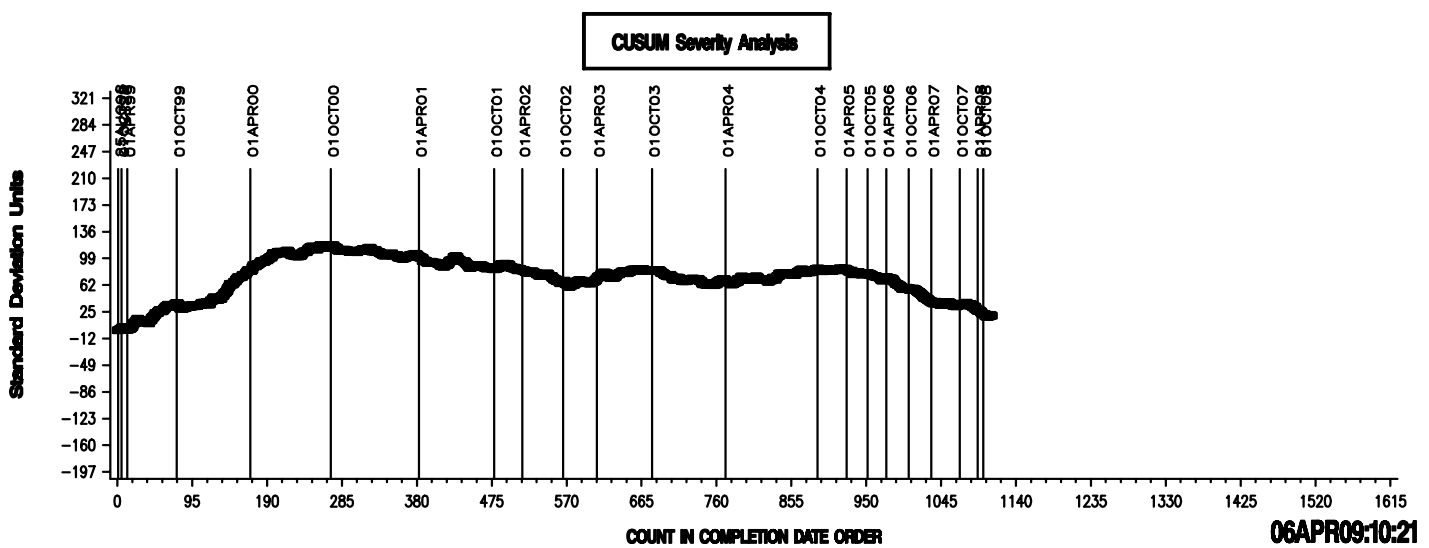
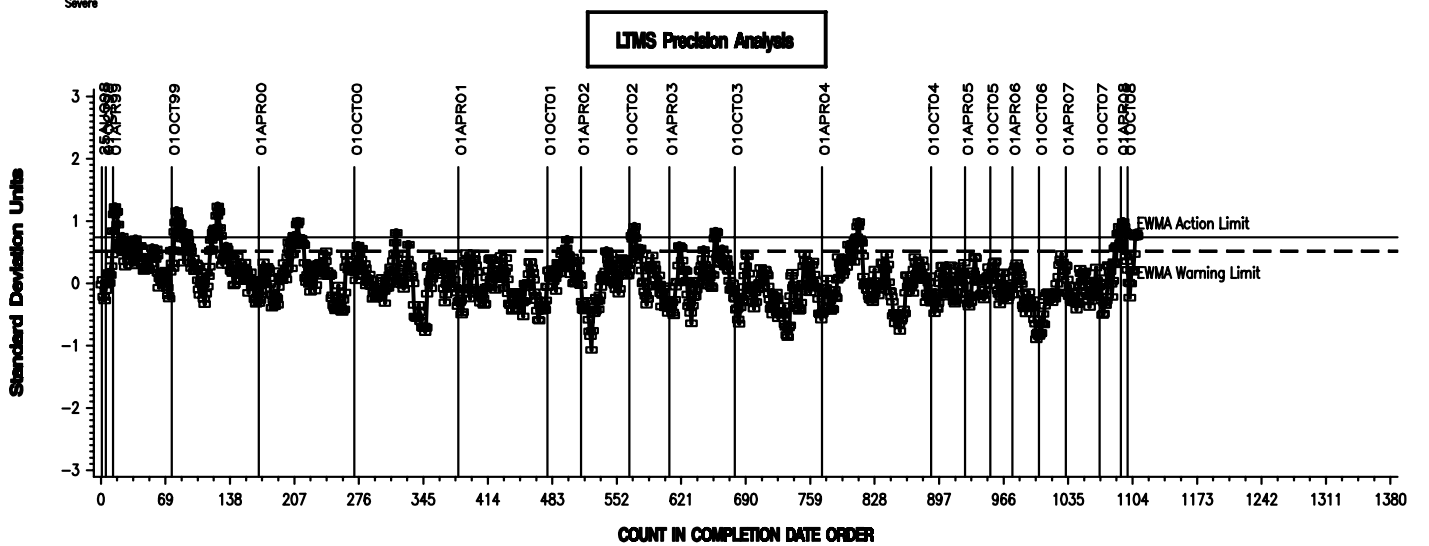
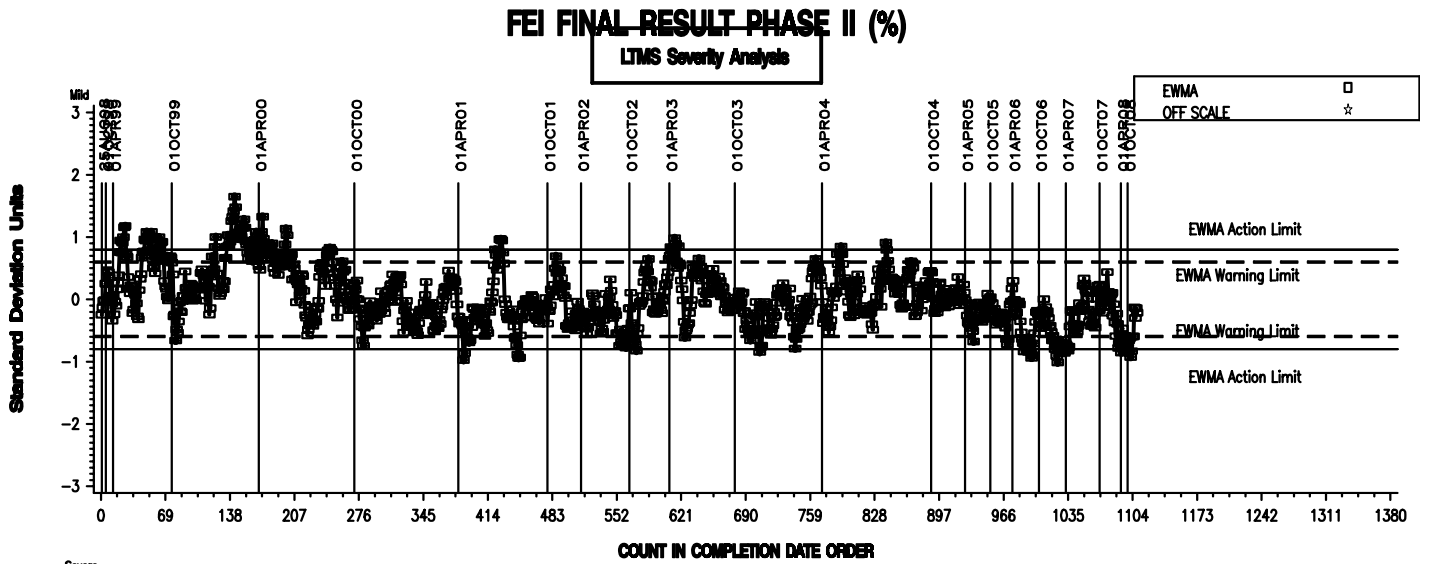
## CUSUM Severity Analysis





# SEQUENCE VIB INDUSTRY OPERATIONALLY VALID DATA

Figure 4



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