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Issued: December 10, 2009
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The unapproved minutes of the 11.18.2009 Sequence VI Surveillance Panel meeting held in Warren Michigan.

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The meeting was called to order at 9:45AM by Chairman Charlie Leverett.

Agenda

The Agenda is the included as **Attachment 1**.

Roll Call

The Attendance list is **Attachment 2**.

1.0 Action Items

1.1 The Statistical Group is to review the VID LTMS procedure, engine hours adjustment, reference oil targets and the BLB 1, 2, and 3 shift delta.

1.1.1 Jo Martinez gave a presentation on engine hours, BLB delta, and reference oils, included as **Attachment 3**. Engine hours adjustment equations are working as is, as is the BLB Delta for screening outliers, but the reference oil standard deviations should be changed slightly.

1.1.2 Doyle Boese gave a presentation on Infineum's views on the same subjects, included at **Attachment 4**. He recommended a change in the candidate oils to reference ratio.

Motion – Update the reference oil standard deviations and pooled s from 0.14 to 0.12 for FEI1 and from 0.16 to 0.14 for FEI2. Effective 12/2/09.

Jo Martinez / Andy Ritchie / Passed Unanimously 10-0-0

Action – TMC will review the latest reference data to see if standard deviations should be applied unique for each reference oil.

1.1.3 Phil Scinto gave a presentation on increasing the reference to candidate ratio for the VID test, included as Attachment 5. Data indicates moving to 10 candidate tests per reference would be acceptable, but that 3 references would be needed for each new stand/engine combination to give a better severity adjustment. This is **Attachment 5**.

Motion – Revise the calibration periods for stand/engine calibrations as follows:

- **Following the initial calibration of a new stand/engine combination, conduct a minimum of one operationally valid, statistically acceptable reference oil test after 10 full-length non-reference oil tests or 1750 engine hours or 100 days, whichever occurs first.**
- **For the second and third calibration periods of a stand/engine combination, conduct a minimum of one operationally valid, statistically acceptable reference oil test after 10 full-length non-reference oil tests or 1750 engine hours, whichever occurs first.**
- **For subsequent calibration periods of a stand/engine combination, conduct a minimum of one operationally valid, statistically acceptable reference oil test after 7 full-length non-reference oil tests or 1225 engine hours, whichever occurs first.**
- **Effective 11/18/09, and all current stand/engine combination calibration periods would be adjusted accordingly.**

Bill Buscher / Tim Miranda / Passed Unanimously 12-0-0

- 1.2 Labs were to review the 1400 ml oil consumption limit. This will remain an open action item.
- 1.3 SwRI was to present data on engine 11B. This engine was scrapped, so this action item is now removed.

2.0 New Business

- 2.1 The new BL blend is in process. There is a bidding process to bring in the new oil, with 6 runs per lab. More tests can be run if more labs bid.
- 2.2 George Szappanos gave a presentation on the fuel temperature at the MicroMotion, included as **Attachment 6**. This would widen the temperature range acceptable. This was tabled with a request to supply data for all stages and aging.

Motion – Revise the test procedure to increase the fuel-to-flow meter limit from $\leq 4^{\circ}\text{C}$ to $\leq 10^{\circ}\text{C}$.

George Szappanos, Charlie Leverett second / Tabled for further review

- 2.3 George also had a recommendation to allow an alternate dynamometer for break in only stands. As part of the discussion, it was felt that MAP control should be considered to prove equivalence. This is **Attachment 7**.

Action Item – All labs to report manifold pressure at a minimum of one second intervals for all future engine break-ins. Submit data to the TMC. Data to be reviewed at next SP meeting.

- 2.4 Section 6.5.3 allows either the 311 or 312 versions of the Burkert valves. Consensus was to standardize the wording in D 7589 [the newly released VID procedure].

Action Item – Make editorial change to test procedure section 6.6.5.3 sub-section 2 as per SP discussion (so it matches sub-sections 3, 4 and 5).

- 2.5 Section 6.5.12 specifies a Badger model TCV-101. This will be an editorial change to be “suitable for use” and only define one valve.

Action Item – Make editorial change to test procedure section 6.5.12 as per SP discussion (change required to suitable).

- 2.6 Section 6.6.4.4 gives one oil tank temperature range, and 11.6.2.1 a different range. 97 to 107 will be used and this will be an editorial change.

Action Item – Make editorial change to test procedure section 6.6.4.4 as per SP discussion.

- 2.7 System response time for critical parameters needs to be defined.

Each lab shall be required to submit to the TMC the system response time for each calibrated VID test stand by Feb. 15, 2010 for the following parameters:

***Speed
Torque
Oil Gallery Temperature
Coolant Inlet Temperature
Exhaust Back Pressure
Intake Air Temperature
Fuel to Fuel Rail Temperature
Air-to-Fuel Ratio***

Once all data has been submitted to the TMC and summarized a meeting will be held to determine acceptable limits for each parameter and the SP will determine a system to confirm these going forward. I suspect we will added this to the test procedure.

Charlie Leverett / Dave Glaenzer / Passed Unanimously 12-0-0

- 2.8 The GF-5 document will have candidate pass limits based on FEI Sum and FEI2. This needs to be defined. This was placed on hold pending approval of GF-5.
- 2.9 The VID procedure is now released as **D 7589**. This will need to be added to the cover page for each VID test report.
- 2.10 Dan Worcester noted one valve in the procedure has been superseded. That information will be supplied for review later.

Action Item – Dan Worcester to send out information on a valve that has been superseded by a new part number.

3.0 Old Business

- 3.1 Dan Worcester requested a review of Section 7.2.2 to allow the majority batch of fuel to be included on the test report rather than the most recent.

Motion – Modify test procedure section 7.2.2 to state: “Approved HF 003 fuel can be added to run tanks as needed. If a new batch of fuel is introduced to the laboratory fuel supply system, the batch number for that tank will change when 51% of the fuel in the tank is the new batch. In cases where the run tank contains more than one fuel batch, document the majority fuel batch in the report.

Dan Worcester / Dave Glaenzer / Passed 4-0-4

- 3.2 The updated Scope and Objectives is included as **Attachment 8**. All items except the new BL blend were shown completed.
- 3.3 Rich Grundza gave a TMC presentation. There are 14 engines in 4 labs. There are 105 D engines available at the supplier. One D engine has calibrated and more are in process. The test method has released as D 7589. This is **Attachment 9**.
- 3.4 Phil Scinto began a discussion on why stand selection is needed as each stand/engine combination has its own severity adjustments.

Motion – SP chair submit letter to ACC asking why stand selection criteria is needed for the VID.

Phil Scinto / No Second / Failed

The meeting adjourned at Noon.

The next meeting will be per the Chairman.

ATTACHMENT

ONE

Sequence VI Surveillance Panel Meeting Agenda November 18th, 2009 @ GM R&D in Warren MI

- 1.) Call meeting to order
- 2.) Attendance list sign-in, membership changes?
- 3.) Approval of minutes from July 30, 2009 and October 6, 2009.
- 4.) Action Items
 - 4.1 Statistical Group to review:
 - a.) VID LTMS
 - b.) Engine Hr. Adjustment.
 - c.) Reference oil targets update (Review of LTMS Yi Charts by Lab)
 - d.) BLB 1, 2 & 3 Shift Delta

 - 4.2 Review 1400 ml oil consumption limit – *Discussion?*

 - 4.3 SwRI had presented data on engine 11B after it was reassembled and installed into the stand. They have decided to abandon this engine and will tear it down and report any findings to the SP.
- 5.) New Business
 - 5.1 Report on Progress of BL Blend - TMC

 - 5.2 Fuel Temp Delta at the Micro Motion (*From George*)
Running our engines in an open lab environment makes it difficult for us to control our fuel system temperature (pre-meter) due to sporadic large swings in ambient temperature. I've been brainstorming how to redesign our system, but before we actually do I thought I'd get your thoughts on this limit.

Currently it's 4°C, but based on the specification from Micromotion we could tolerate significantly more.

5.3 New Engine Break-in (From George)

5.3.1 I'd like for the SP to consider use of alternative dyno(s) for use on break-in only. Of course the issue is that a dyno of different inertia than the 758 would provide for a different effective load on the engine. If a lab could demonstrate equivalency by virtue of manifold pressure rather than load (during transitions), you think that would be enough? *Discussion*

5.4 Procedure Question for Clarification (From Rich)

5.4.1 Section 6.6.5.3 (2) gives FCV-150A as 251 with 312 or 2000 with 311 or 330 solenoid. (3) and (4) show the 2000 with 311, 312, and 330 solenoid. (5) says use ~~an~~ **same** type Burkert piston and solenoid valve on a stand.

I think (2) should allow this based on 3, 4, and 5. I believe during one visit, a lab convinced the group that the 311's were no longer available and that the 312's were pretty much the same. **The 311 may not be available by the supplier but some labs may have some in their inventory**

5.4.2 Under coolant system, 6.5.12 TCV-101 is specified as one of two badger models. A lab suggested that we dropped that as a requirement, and would use those two models as suitable.

5.4.3 Discrepancy between temperature control of heated oils sumps, in 6.6.4.4, says $107 \pm 2.8^\circ$ and 11.6.2.1, it says 93-107, as does 11.6.2.2 thru .4

5.5 From Dan (some of these may be covered in the Statistical Review)

5.5.1 Do we need to review reference oil targets? While there is more data on each oil, there are not yet 20 tests on all 3 oils. This may have to wait for May, but it would be good to consider before GF-5 kicks off.



VID Fast Start Check
10_30_2009.xls

5.5.2 I would like a review of the BLB Delta Limits. Currently those are set at -0.2 to +0.4. Based on AC tests, and using 2 sigma, I think they should be -0.4 to +0.7. I guess related to that, is there data that has the BLB1 and 2 and possible BLB3 improved test precision? Could BLB3 go away?

INDUSTRY BLB1 TO BLB2
DELTA FOR AC REFERENCE TESTS

MEAN	SIGMA
0.13	0.267

1 SD	-0.1	0.4
2 SD	-0.4	0.7
3 SD	-0.7	0.9

5.5.3 The engine hours equations need to be reviewed. It appears there are more high engine hour tests in the data base, again not very many as one large independent lab has pulled engines rather than run references just to gather data.

5.6 System Response Times

5.6.1 During the development SwRI and IAR did a study on system response times to determine if we were close to each other. I have had a conversation with another lab and supplied them with these data for them to setup their test stand. **I would like to get a motion for the following:**

Each lab shall be required to submit to the TMC the system response time for each calibrated VID test stand by Feb. 15, 2010 for the following parameters:

Speed
Torque
Oil Gallery Temperature
Coolant Inlet Temperature
Exhaust Back Pressure
Intake Air Temperature
Fuel to Fuel Rail Temperature
Air-to-Fuel Ratio

Once all data has been submitted to the TMC and summarized a meeting will be held to determine acceptable limits for each parameter and the SP will determine a system to confirm these going forward. I suspect we will added this to the test procedure.

5.6.2 We need to define the calculation method for FEI Sum and include it in Section A12 so everyone is doing it the same, I assume we also need to add this to the report.

5.6.3 ASTM Test Method Number - ASTM has assigned the designated for the VID as D7589, **we will need to add this to the report forms as required**

6.0 Old Business

6.1 *Fuel Batch Usage/Documentation*

Current wording:

7.2.2 Fuel Batch Usage/Documentation—A complete test shall be run on a single batch of test fuel. If a new batch of test fuel is introduced to the laboratory fuel supply system, it shall be done between finite tests. Document the fuel batch designation in the test report. In cases where the run tank contains more than one fuel batch, document the most recent fuel batch in the report.

Motion: Recommend to the Surveillance Panel the following wording change to Section 7.2.2:

7.2.2 Fuel Batch Usage/Documentation – Approved HF 003 fuel can be added to run tanks as needed. If a new

batch of fuel is introduced to the laboratory fuel supply system, the batch number for that tank will change when 51% of the fuel in the tank is the new batch. In cases where the run tank contains more than one fuel batch, document the majority fuel batch in the report.

This was issued as an E-Ballot but a negative was received which was:

From Robert Stockwell

I vote NEGATIVE

Fuel in a tank ought to be pretty homogeneous and once a test is started the fuel should not be touched. In theory, adding more approved fuel to a tank of approved fuel should not change it but some contamination may occur. Plus, when testing gets slow again, the above-ground tanks in San Antonio in the summer lose some light ends from evaporation, and adding new fuel would slightly change the mixture.

I assume the motion will be made again and seconded, once this is done we will have discussion.

6.2 Review of Scope and Objectives

6.3 Any other New Business

7.0 Move for meeting to be adjourned!

ATTACHMENT

TWO

ASTM SEQUENCE VI SURVEILLANCE PANEL

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Robert Stockwell Voting Member	ConocoPhillips Lubricants R&D Passenger Car Engine Oil	office 580-767-6894 Robert.T.Stockwell@conocophillips.com	
Teri Kowalski Voting Member	Toyota	Phone: 734-995-4032 teri.kowalski@tema.toyota.com	



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ATTACHMENT

THREE



Oronite

VID Engine Hour Adjustment and BLB Shift Review

**Jo Martinez
Nov. 5, 2009**

Making the things that go, **go better.**[™]

Summary

■ Engine Hour Adjustment

- Hour Adjustment still necessary
- Hour Coefficient update NOT necessary

■ BLB Shift

- Current BLB shift range of -0.2 to 0.4 seems reasonable
- But if we center by the mean, we move it to -0.1 to 0.5

■ Reference oil targets

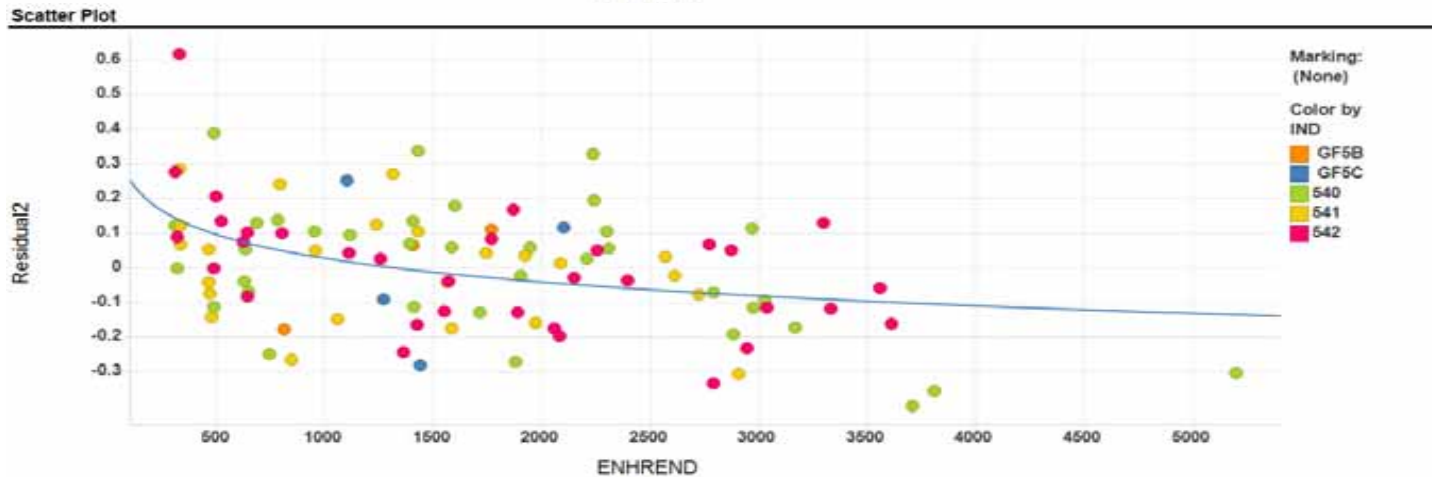
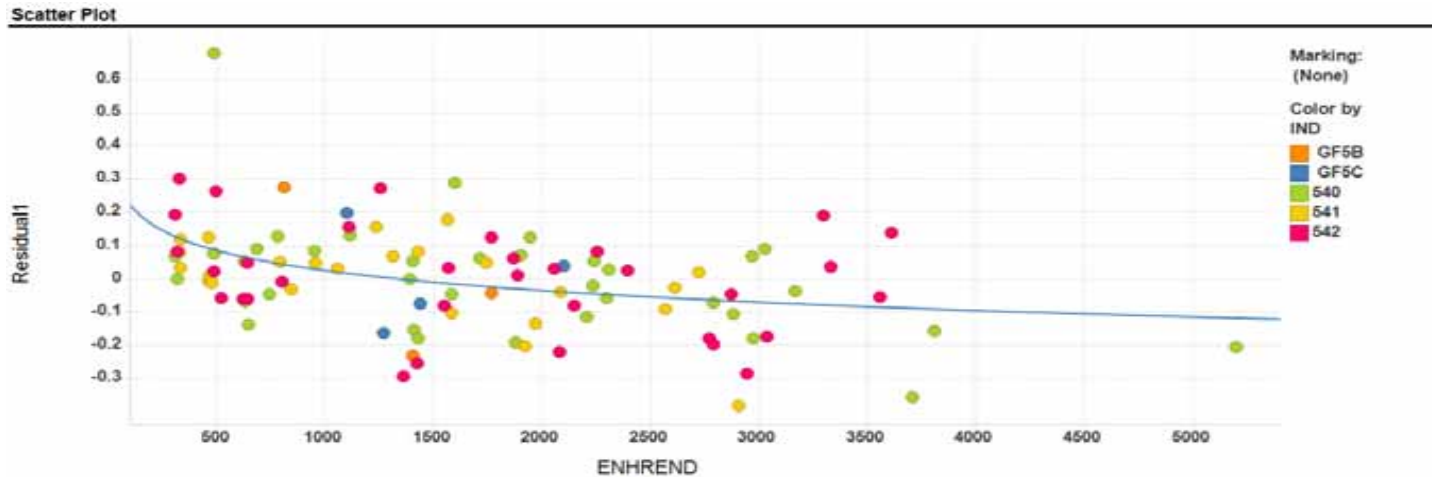
- Use current means
- Pooled standard deviations (n=100)

(RMSE from Model FEI = Oil, Lab, Engine within Lab)

▶ FEI1 = 0.12

▶ FEI2 = 0.14

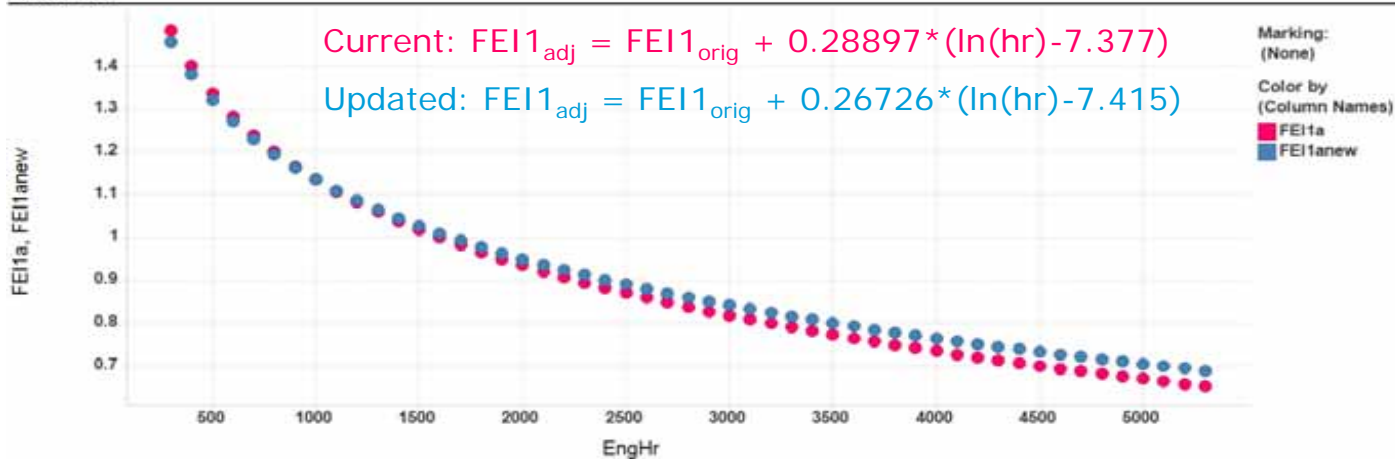
FEI Residuals by Engine Hour



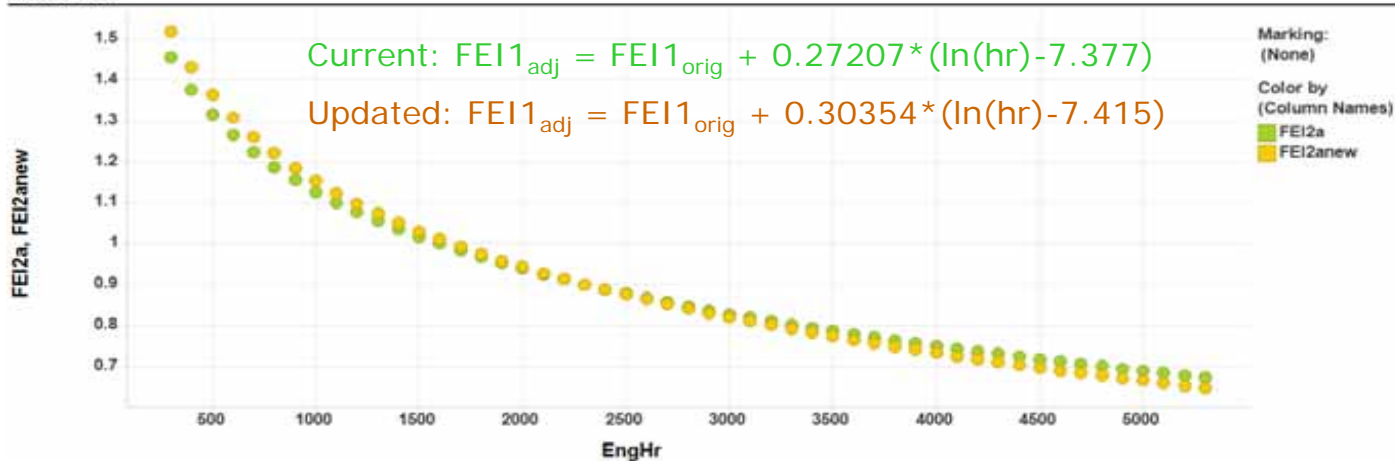
Strong indication of engine hour effect on FEI after correcting for Oil, Lab and Engine within Lab.

FEI Relative Adjustment by Engine Hours

Scatter Plot



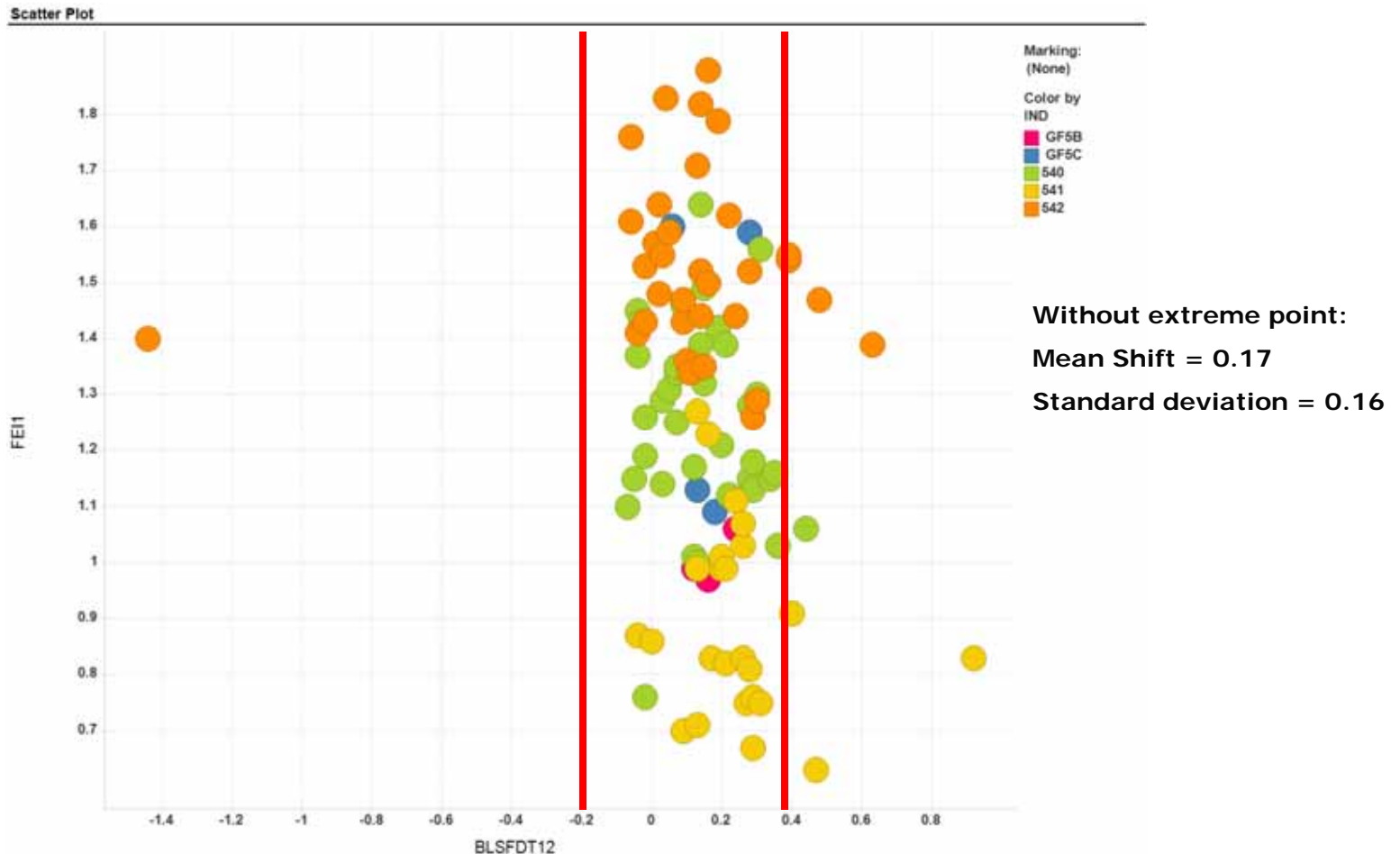
Scatter Plot



Updated engine hour coefficients would give similar adjustment as the current coefficients.



BLB Shift



Current range seems reasonable with 5 out of 100 above 0.4.

If we want to center the range by the mean we move it to -0.1 to 0.5.

ATTACHMENT

FOUR



Review of VID Items for SP Meeting November 2009

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Infineum Positions on VI SP Discussion Items

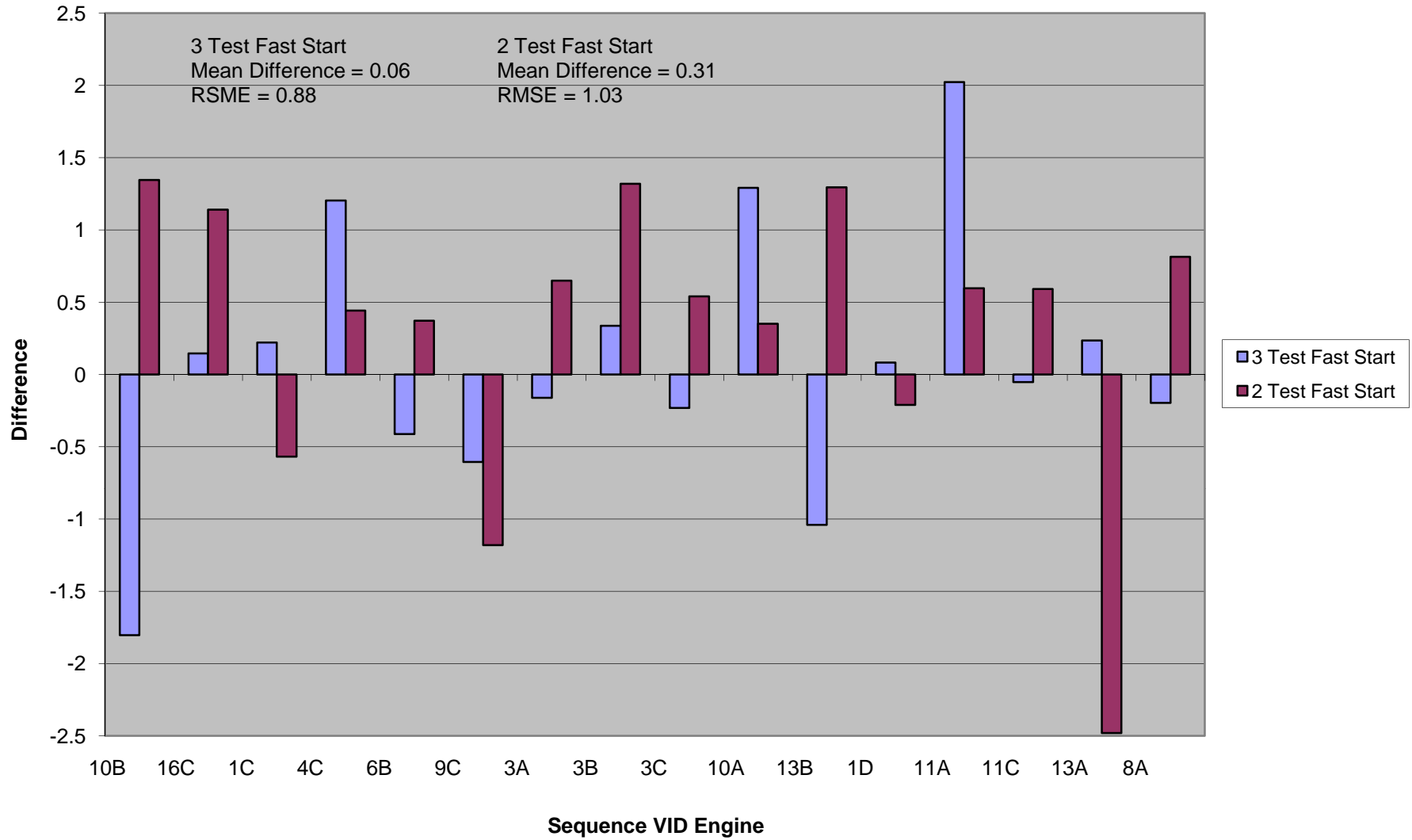
- Engine Hour Adjustment:
 - Does Engine Hour Effect level off at some point?
 - There is no evidence of the effect leveling off in the reference oil data.
 - Is there evidence that current Engine Hour Adjustment is not proper at some point in engine life (e.g., early in engine life)?
 - The current adjustment appears proper with no need to be modified.
- Can the reference oil calibration runs be reduced?
 - Three initial runs relative to two yields a better estimate of the stand severity – recommend maintaining the three initial reference runs.
 - Recommend increasing the reference interval from 4, 6, 10, 10 to 10, 10, 8, 8.
- Should the reference oil means and standard deviations be updated?
 - The Means were established after a sufficient number of tests were performed on the reference oils over a short duration – they should remain fixed. The small changes to the original standard deviation estimates do not warrant a change.
- Should the BLB delta band be eliminated or modified?
 - There is no evidence to allow eliminating the delta. Updated data indicates only slight changes to the band and therefore recommend the band not be modified.



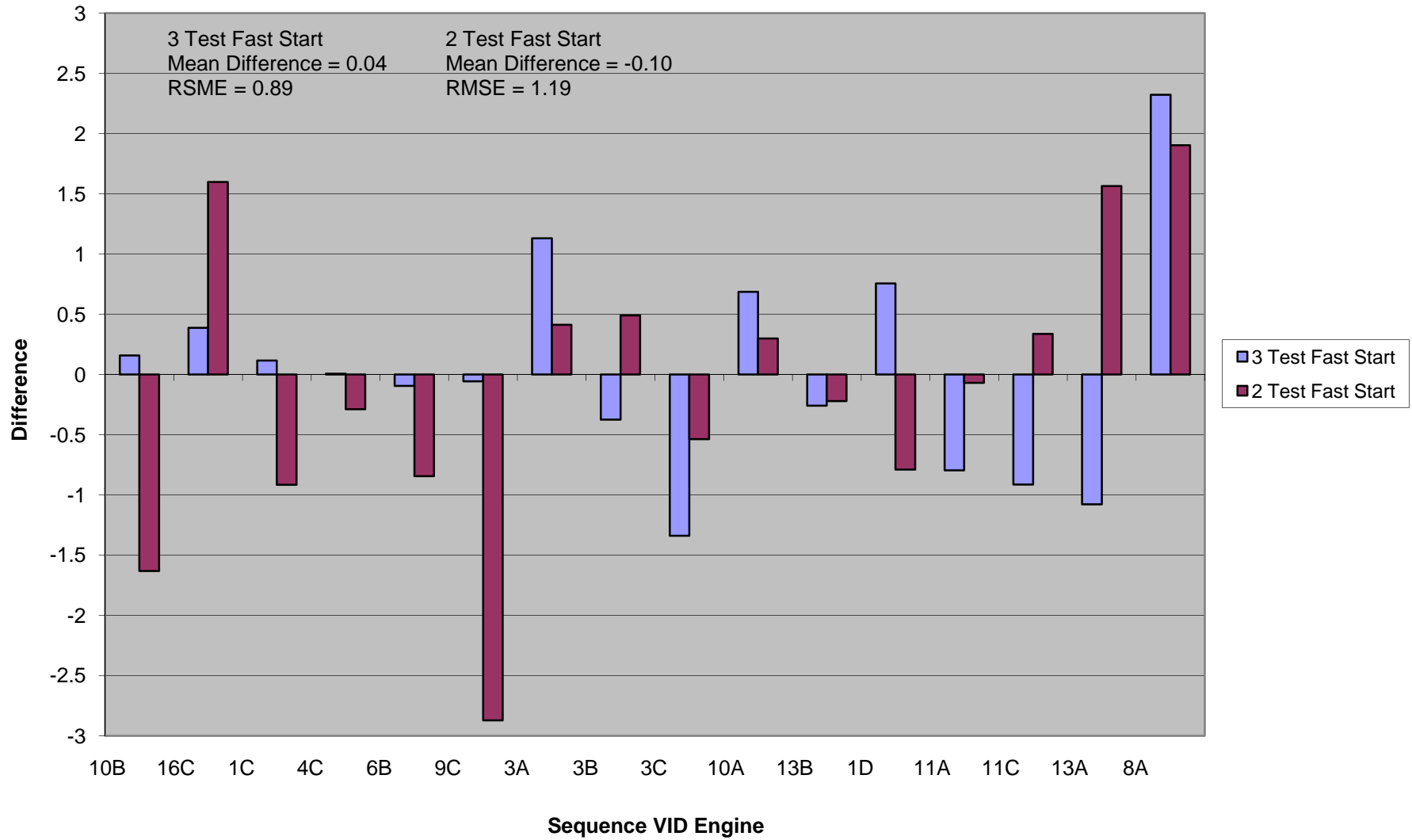
ATTACHMENT

FIVE

Difference Between EWMA and First Candidate Test Result for FEI1



Difference Between EWMA and First Candidate Test Result for FEI2



3 Test Start FEI2 Cand Diff	2 Test Start FEI1 Cand Diff	2 Test Start FEI2 Cand Diff	Hours Till Candidate	
			3 test start	2 test start
0.158833333	1.345708	-1.6325	153	154
0.386333333	1.140044	1.5975	771	153
0.1155	-0.568528	-0.915	1244	156
0.0055	0.442872	-0.2875	775	156
-0.0945	0.371372	-0.845	311	154
-0.057333333	-1.179992	-2.8725	620	243
1.130333333	0.648564	0.4125	726	164
-0.3755	1.319936	0.49	181	181
-1.339333333	0.539936	-0.5375	770	155
0.686666667	0.351436	0.3	990	159
-0.258333333	1.294272	-0.22	1097	158
0.756666667	-0.211392	-0.79	794	159
-0.795333333	0.597164	-0.07	641	201
-0.913666667	0.5915	0.3375	1096	159
-1.077166667	-2.480036	1.565	157	157
2.321666667	0.814272	1.9025	167	158
0.040645833	0.3135705	-0.0978125	655.8125	166.6875

ATTACHMENT

SIX



VID test: Proposal to increase allowable temperature delta at fuel meter

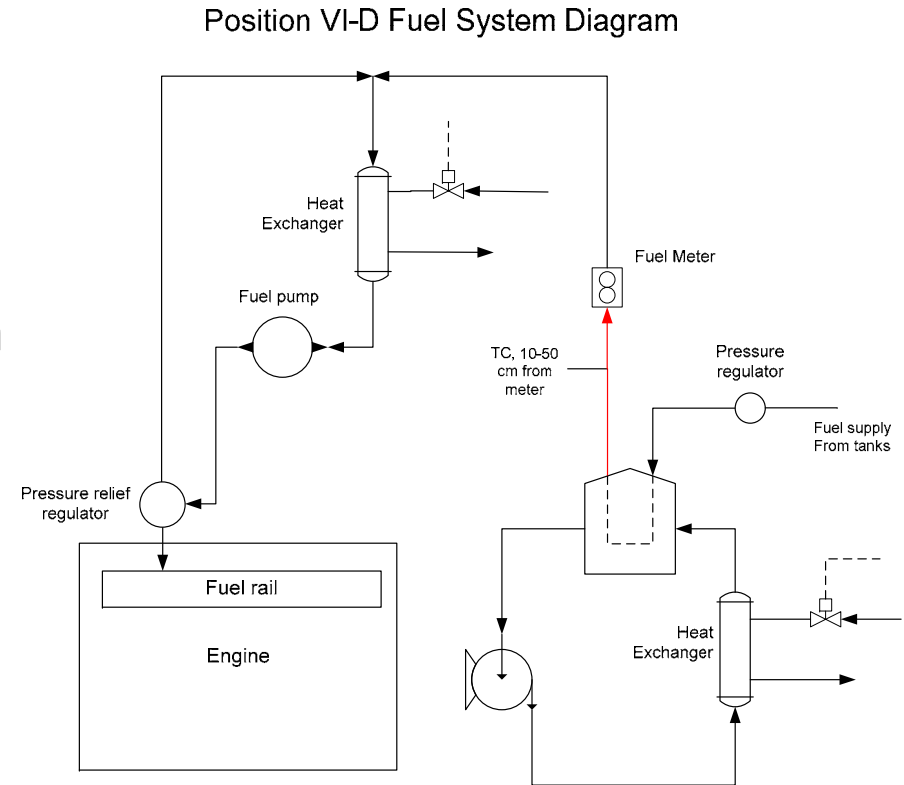
George Szappanos
11/3/2009

background...

- Current VID and VIB tests allows for a maximum difference between lowest and highest recorded temperatures during the evaluation phases of the test of 4°C (ref Table 3, *note that the VID draft has truncated the text and the actual spec is missing*)
- This temperature is measured 10-50cm before the inlet of the fuel meter (ref 6.9.5.6)
- Temperature can be controlled to any value within the range of 20-32°C (ref Table 3)

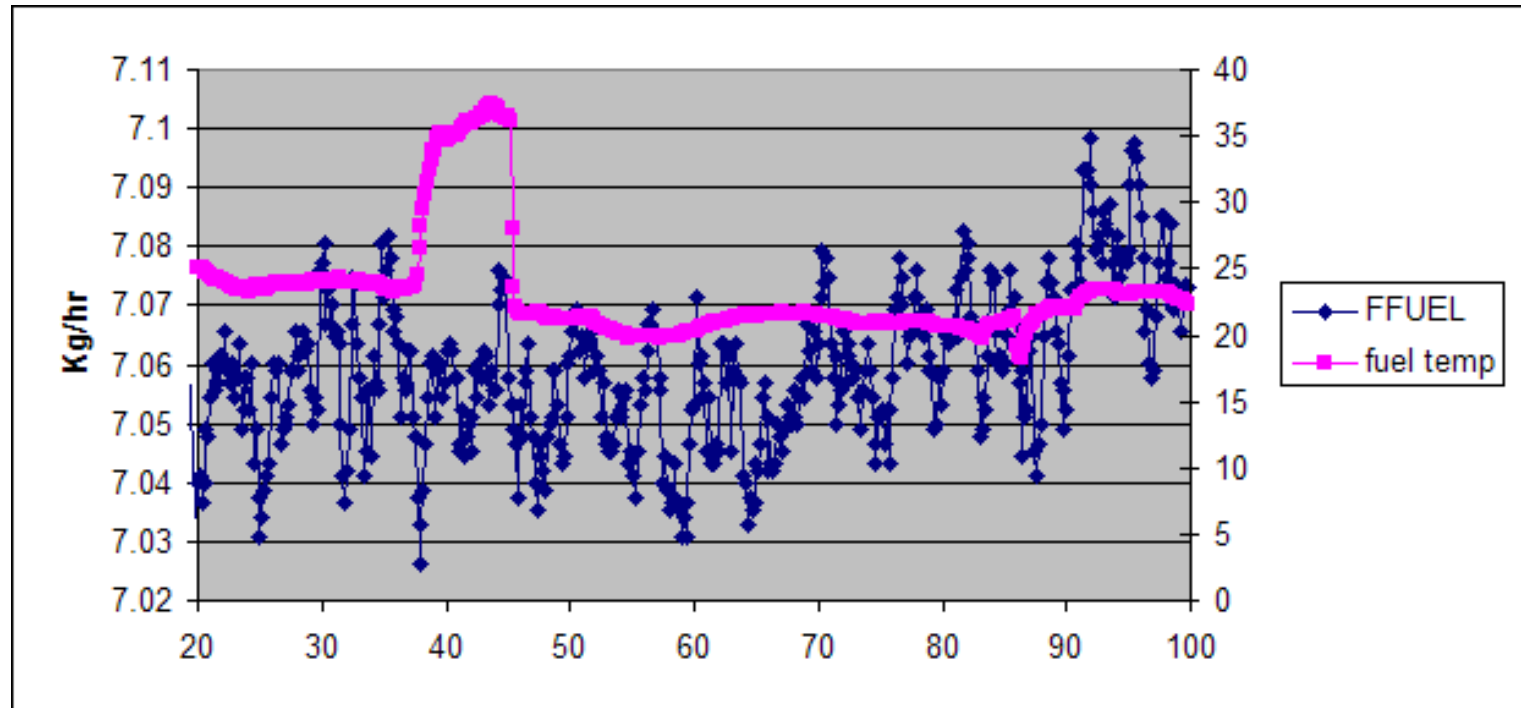
Issue:

- The temperature of the fuel entering the fuel meter (red line), especially at low flow rates, is particularly sensitive to ambient lab temperature fluctuations
- The long residence time between the heat exchanger and meter causes the temperature of the fuel to change as a function of the ambient temperature
- Open lab layouts more susceptible than enclosed cells



Supporting data

- Taken during aging phase of an unregistered test
- No distinguishable impact on fuel flow when fuel temp is suddenly increased by 10°, then decreased



Revision to Draft procedure...

- Current draft should read “reading shall be ≤ 4 ” (truncated)
- Revision would read “reading shall be ≤ 10 ”

Parameter	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Speed, r/min ^B	2000 ± 5	2000 ± 5	1500 ± 5	695 ± 5	695 ± 5	695 ± 5
Load, Nm ^B	105.0 ± 0.1	105.0 ± 0.1	105.0 ± 0.1	20.0 ± 0.1	20.0 ± 0.1	40.0 ± 0.1
Nominal, Power kW	22.0	22.0	16.5	1.5	1.5	1.5
Oil Gallery, °C ^B	115 ± 2	65 ± 2	115 ± 2	115 ± 2	35 ± 2	115 ± 2
Coolant-In, °C ^B	109 ± 2	65 ± 2	109 ± 2	109 ± 2	35 ± 2	109 ± 2
Stabilization Time, min ^C	60	60	60	60	60	60

All Stages	
Temperatures, °C	
Oil Circulation	Record
Coolant Out	Record
Intake Air ^B	29 ± 2
Fuel-to-Flowmeter ^D	20 to 32 (delta from the max stage average reading shall
Fuel-to-Fuel Rail ^B	22 ± 2
Delta Load Cell ^D	Delta from the max stage average shall be ≤ 12
Oil Heater	205 max
Pressures	
Intake Air, kPa	0.05 ± 0.02

ATTACHMENT

SEVEN

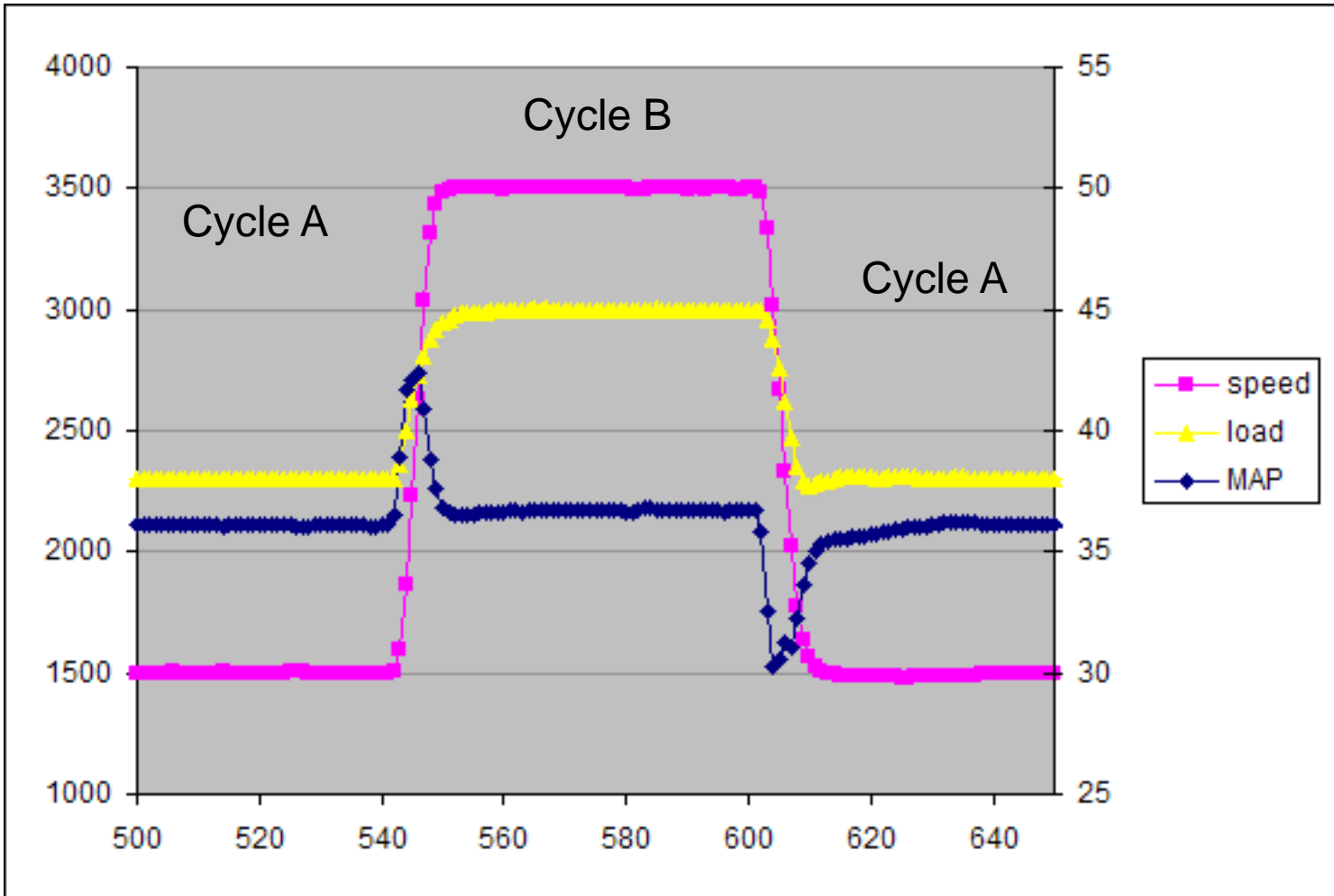


VID breakin stand proposal: alternative dynos

background

- Procedure states that break-in are to be performed using Midwest 758 dynos
- The break-in cycle is fairly dynamic and includes an accel and decel every 5 minutes
- The torque the engine produces during that time is the sum of what's measured (and absorbed) by the dyno, plus the torque to accelerate the inertia of the dyno
- The issue with dynos other than the 758 is that they are different inertias, and therefore would provide for a different effective load on the engine

Example of data generated with 758

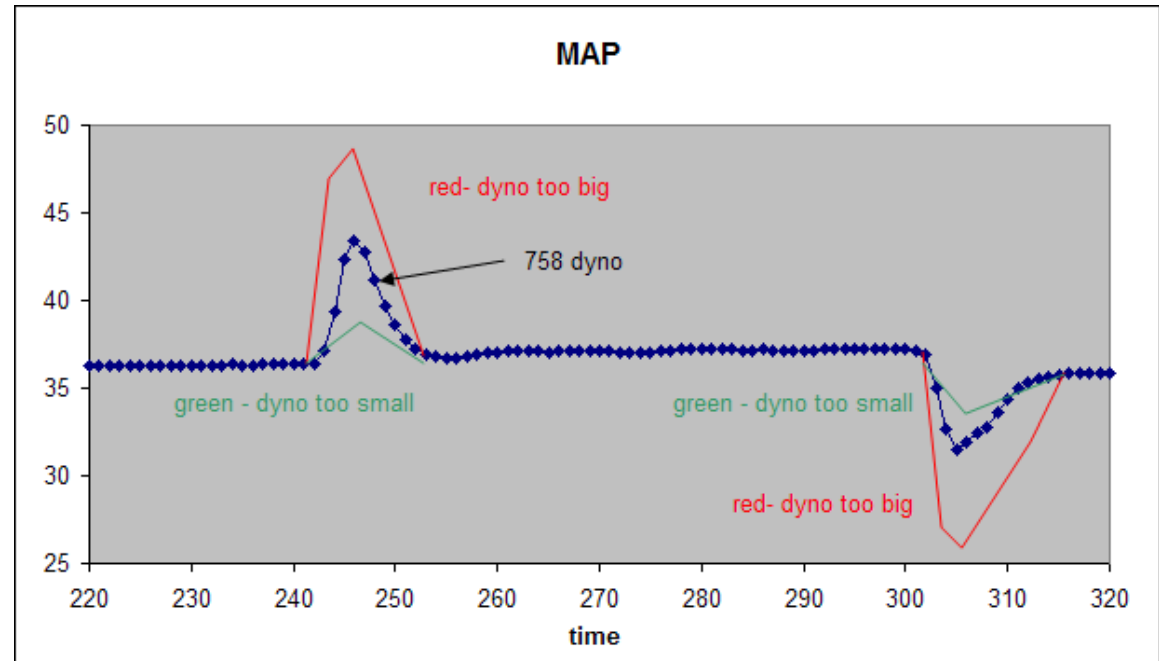


Proposal

- Allow alternate dynos, as long as the load produced by the engine during the transients is the same
- Use manifold pressure as load indicator during ramps and duplicate what a 758 generates

How to implement

- Speed follows desired setpoint, ramps and steady state
- During ramps, throttle follows MAP setpoint (established by labs providing MAP data on ramps)
- Requirement to pass through MAP window midway through ramp
 - For example, 41-43 kPa absolute for up-ramp, 30-32 kPa for down-ramp
- Then switches to torque feedback for steady state portion



Revision to Draft procedure:

- 11.5.4 The engine break-in shall be done on a test stand that has a Midwest or Eaton 37 kW Model 758 dry gap dynamometer (see X1.4) and meets the specifications shown in Table 2. **Alternative dynamometers may be used provided they meet the manifold pressure criteria shown in Table 2 during condition ramping.**
- 11.5.5 Record speed, load, **and manifold pressure** at a minimum of one second intervals.
- Table 2:

	Cycle A	Cycle B
Time at Each Step, min	4	1
Time to Decel. to Step A, s		15 max
Time to Accel. to Step B, s	15 max	
Speed, r/min	1500 ± 50	3500 ± 50
Power, kW	6.0	16.5
Load, N·m	38.00 ± 5	45.00 ± 5
MAP, kPa at mid ramp	31 ± 2	42 ± 2

TBD →

ATTACHMENT

EIGHT

ASTM Sequence VI Surveillance Panel Scope and Objectives

Scope:

The Sequence VI Surveillance Panel is responsible for the surveillance and continued improvement of the Sequence VI test documented in the current ASTM Standard/Research Report for the VIB and the VID as each is updated by the Information Letter System. Improvements in test operation, test monitoring and test validation will be accomplished through continual communication with the Test Sponsor, ASTM Test Monitoring Center, Central Parts Distributor, ASTM B.O1, and the Passenger Car Engine Oil Classification Panel. Actions to improve the process will be recommended when deemed appropriate based on input from the aforementioned. The panel will review development and correlation of updated test procedures with previous test procedures. This process will provide the best possible test procedure for evaluating automotive lubricant performance with respect to the lubricant's ability to provide fuel economy benefits.

Objectives Target Date

Blend 3 of Baseline and Baseline Flush oils	August 2009 January 2010
Work with ASTM Facilitator to complete ASTM Standard for VID	Completed
Ballot VID Procedure in SC B	Completed
Ballot VID Procedure in SC D	Completed
Statistical Group to review VID LTMS and Engine Hr. Adjustment	Completed
Request a passing VID/IIIIG Reference Oil	December
2009	

Revised 10/27/09



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Test Monitoring Center

<http://astmtmc.cmu.edu>

Sequence VID Update

November 19, 2009

Warren, MI

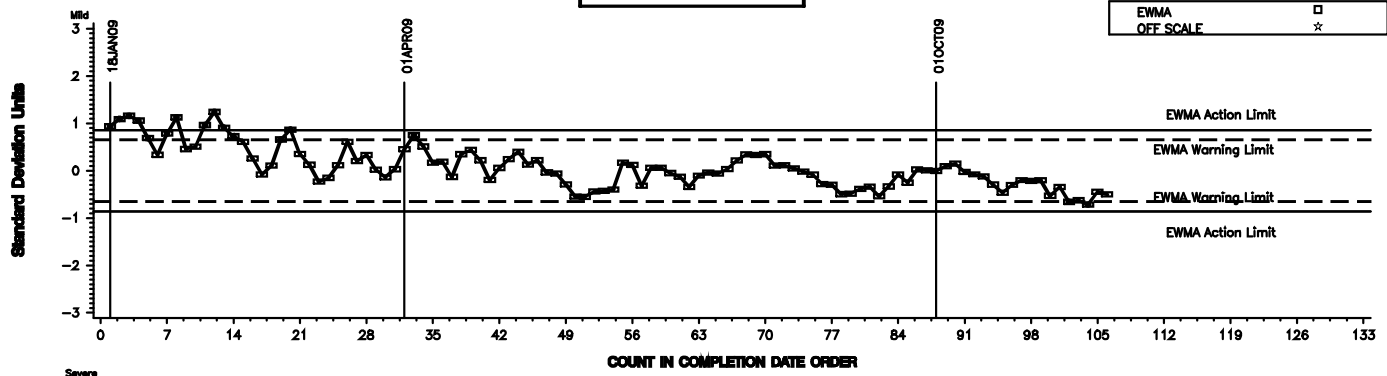
Current Trends

- Fourteen engines in four labs calibrated.
- Twenty two results from five labs reported since 10/1/09
- FEI1 and FEI2 in control, had been in warning or action alarm since the end of the report period.

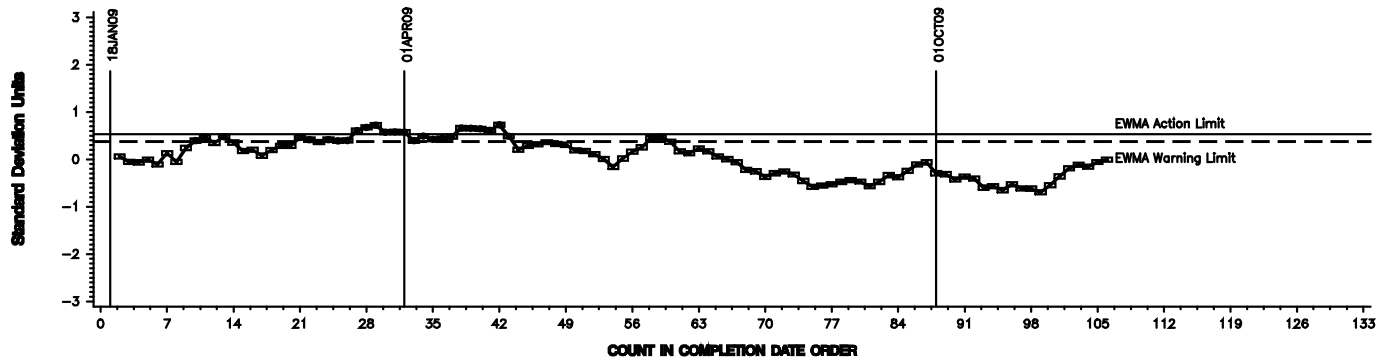
SEQUENCE VID INDUSTRY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE I

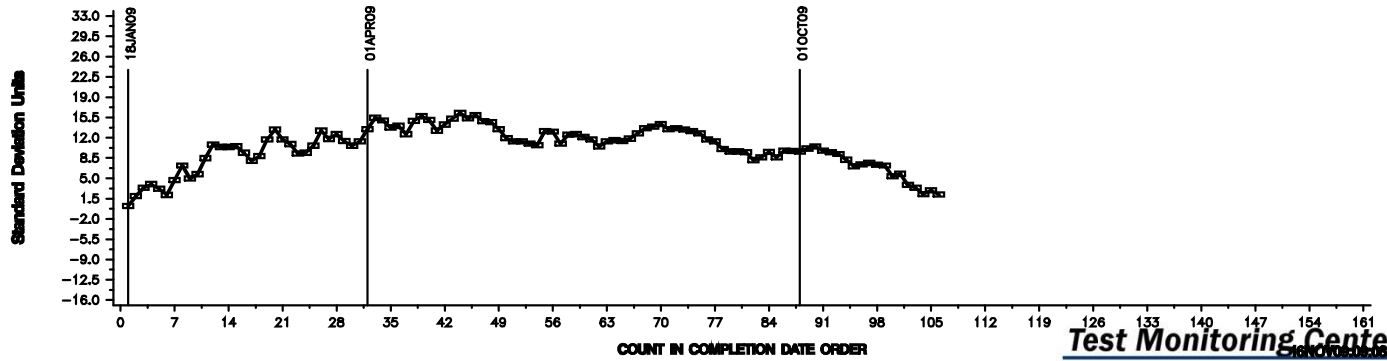
LTMS Severity Analysis



LTMS Precision Analysis



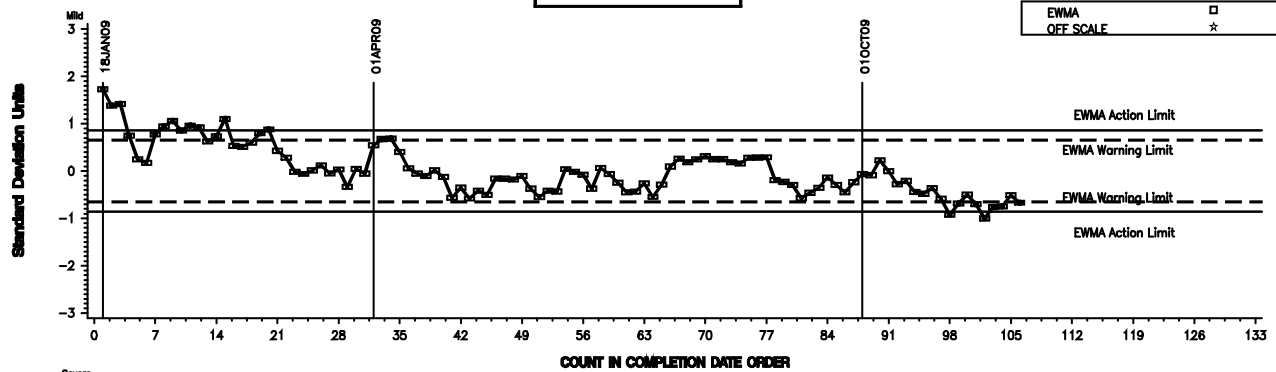
CUSUM Severity Analysis



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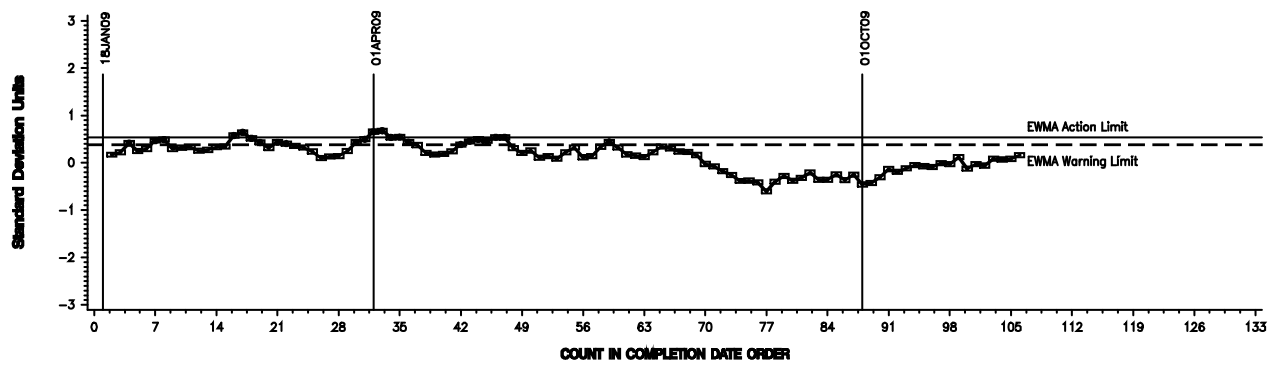
FEI FINAL RESULT PHASE II

LTMS Severity Analysis



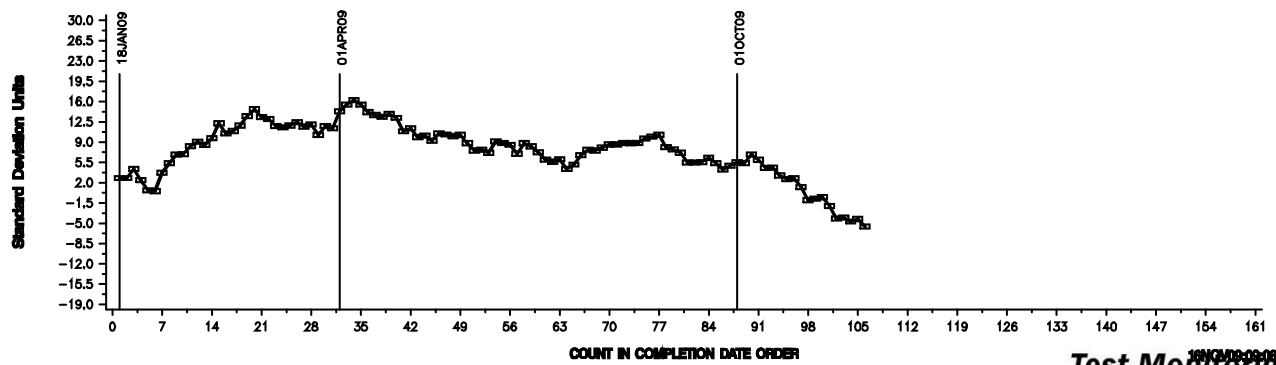
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

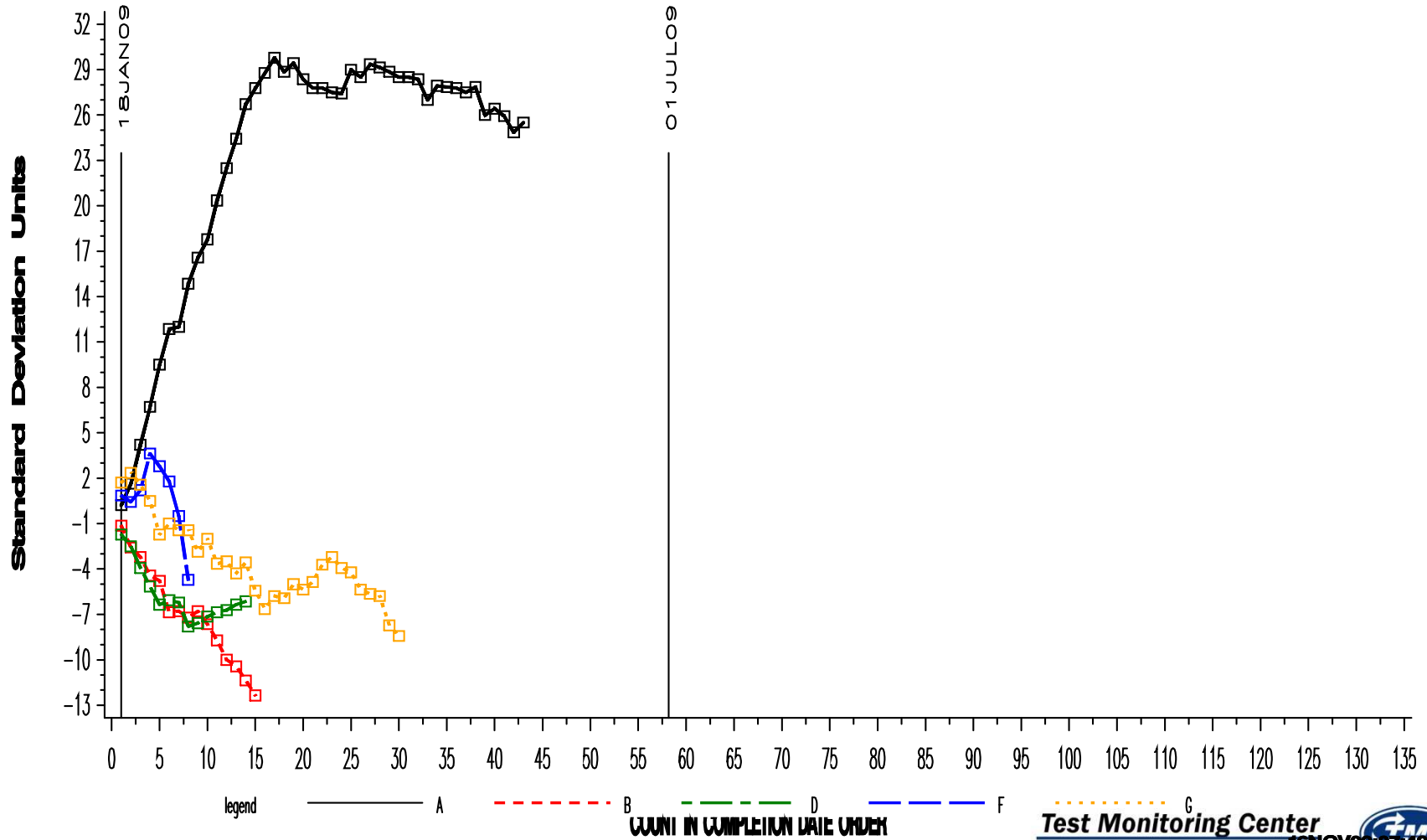


COUNT IN COMPLETION DATE ORDER

SEQUENCE VID LABORATORY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE I

CUSUM Severity Analysis



legend

— A

- - - B

- - - D

- - - F

... G

COUNT IN COMPLETION DATE ORDER

Test Monitoring Center

<http://astmtmc.cmu.edu>



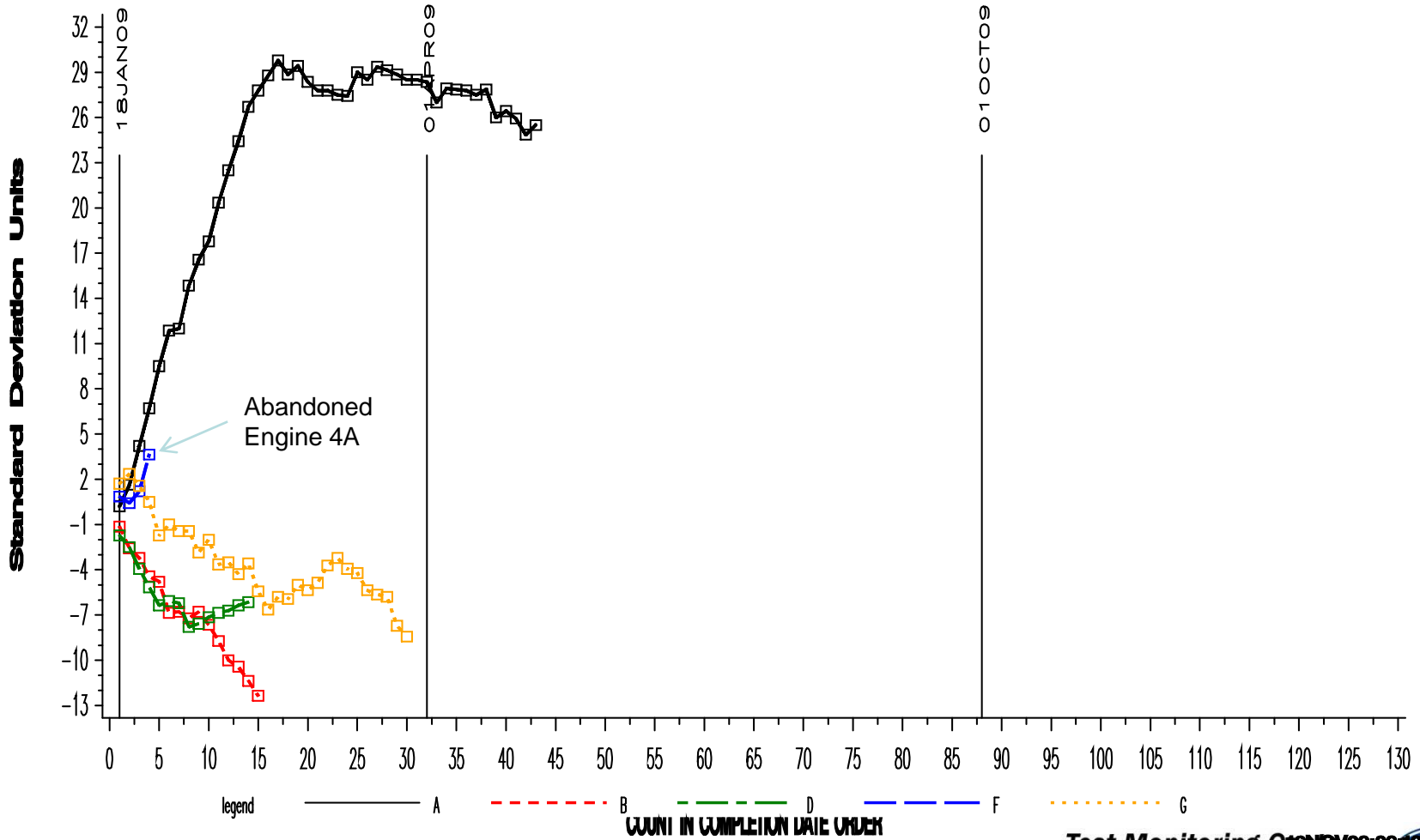
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SEQUENCE VID LABORATORY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE I

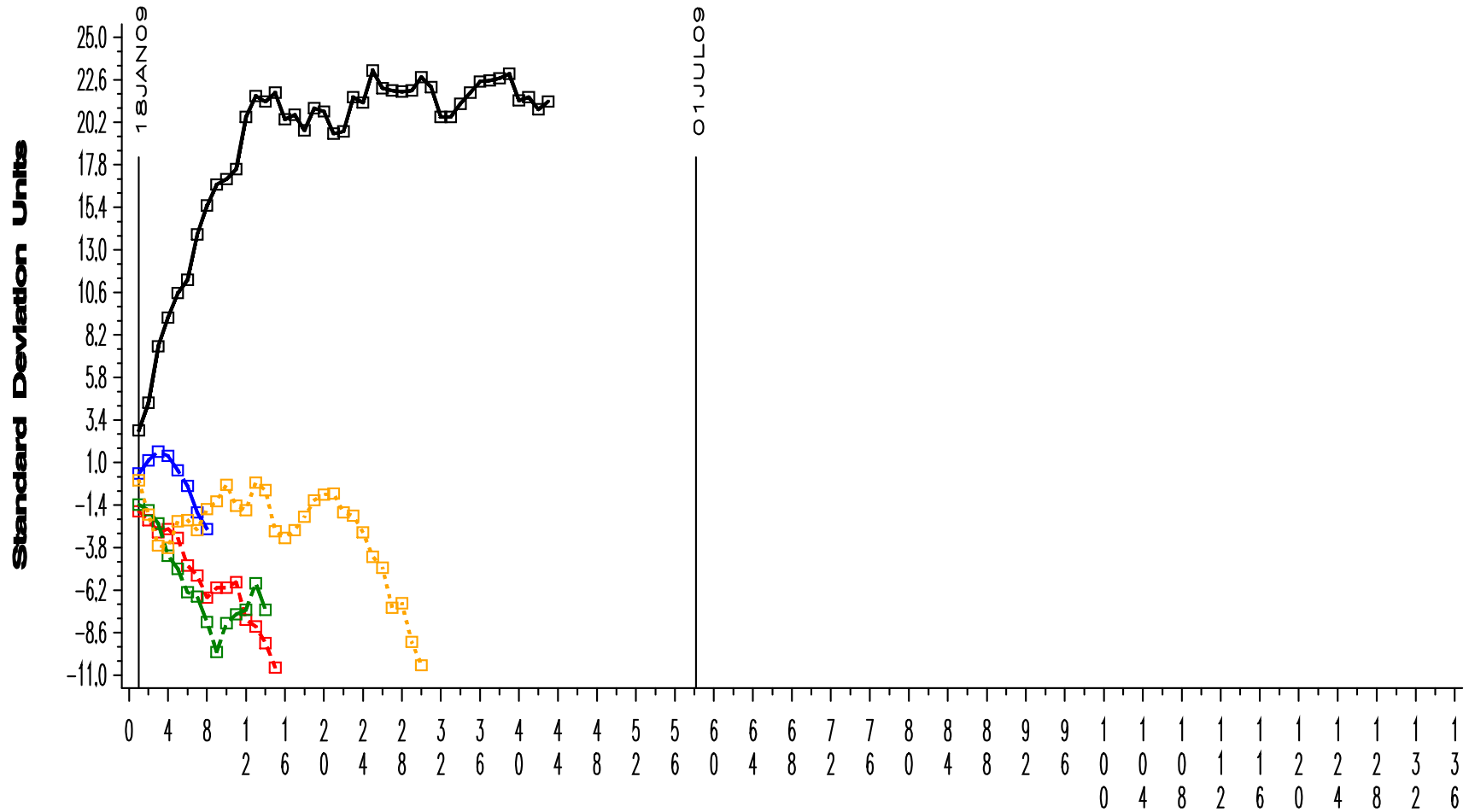
CUSUM Severity Analysis



SEQUENCE VID LABORATORY OPERATIONALLY VALID DATA

FEI FINAL RESULT PHASE II

CUSUM Severity Analysis

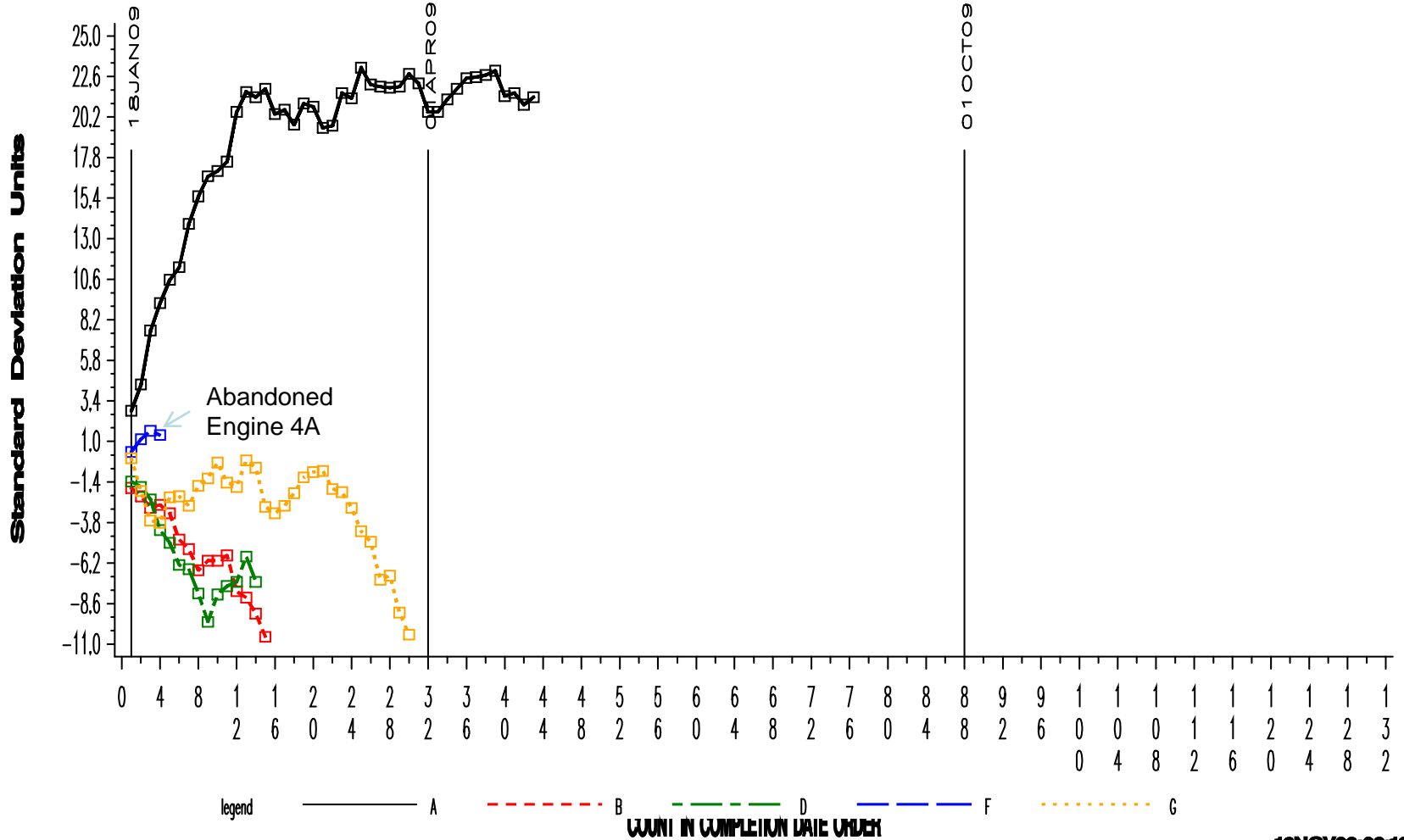


legend ——— A - - - - B - - - - D - - - - F - - - - G
 COUNT IN COMPLETION DATE ORDER

SEQUENCE VID LABORATORY OPERATIONALLY VALID DATA

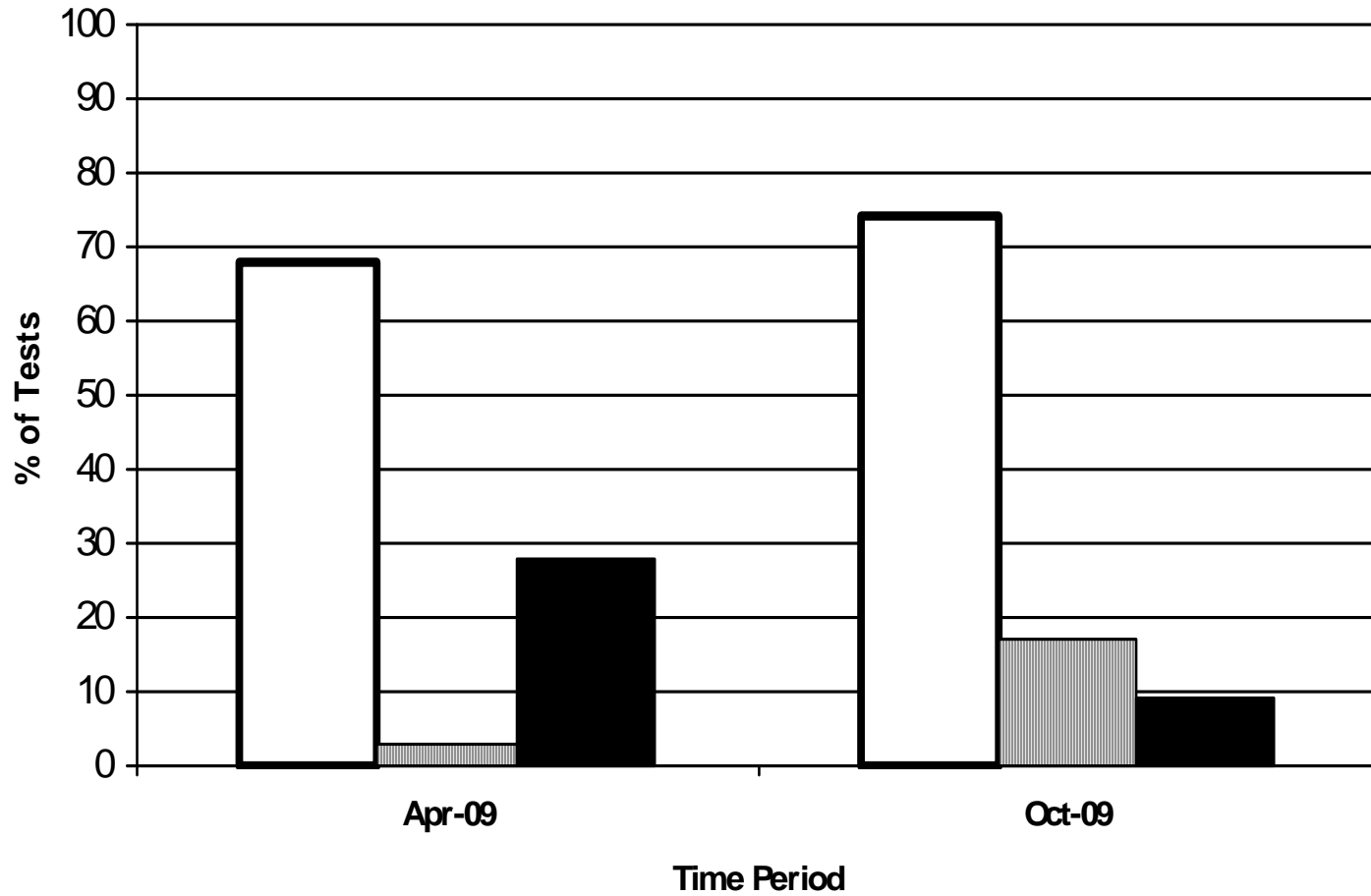
FEI FINAL RESULT PHASE II

CUSUM Severity Analysis



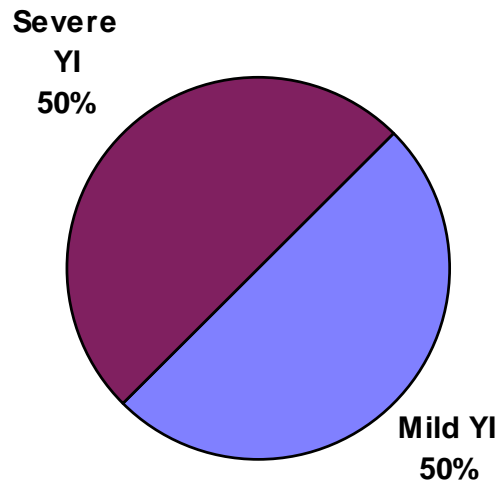
- Calibration per start rate increased slightly
- six lost tests, one aborted, five invalid
- Six tests failed, half failed severe, half mild.
- All rates compare well with historical rates
- Pooled precision estimates, 0.12 and 0.11 for FEI1 and FEI2 compare well with matrix estimates

Calibration Attempt Summary

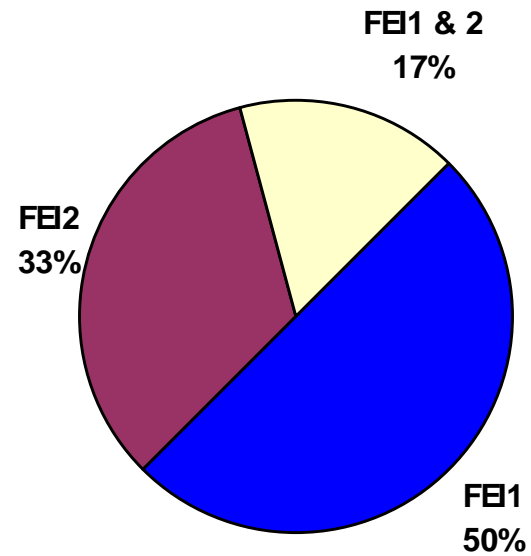


□ Calibrations/Starts ▨ Lost Tests/Starts ■ Rejections/Starts

Distribution of LTMS Stand Alarms



Distribution of Stand Alarms by Parameter



Of the six tests, two failed for FE1 in the mild direction, two failed FEI2 in the severe direction. One test failed FEI1 in the severe direction and the remaining test failed both parameters in the mild direction.

Other items

- Engines 4A and 2C were abandoned since they were unable to calibrate (multiple failing severe results)
- Batches A, B, C and D in reference data, one batch D (1D) calibrated. Second batch D engine (9D) attempting calibrations.
- Test Method successfully balloted. Test Method designated D 7589.



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