LSPI LTMS

1. Report Average LSPI Events to two decimal places to avoid bias due to rounding and reduce potential errors.
2. Adopt the transform $(AVPIE+0.5)^{0.5}$ for LTMS and severity adjustment calculations.
3. References will be conducted on RO 221 (50%) and 222 (50%) only.
4. Discrimination test runs will be run using oil 220 as defined by the test procedure.
5. Reference Oil targets
    a. 221 Mean = 3.3819, s = 0.3609
    b. 222 Mean = 4.2644, s = 0.2694
    c. Severity adjustment s = 0.2856
6. Each stand-engine combination will be charted independently for determination of reference acceptance and severity adjustments.
7. Utilize limits on Z_i (EWMA of severity), e_i (prediction error), and the excessive influence calculation to determine acceptance and calculate severity adjustments (similar to IIIH, COAT, and T13).
    a. Z_i Lambda = 0.4
    b. Z_0 = Average of tests required to achieve initial calibration
    c. Z_i Limit 1 = 0.000; continuous severity adjustments are applied
    d. Z_i Limit 2 = +1.500/-1.500; a stand-engine that exceeds these limits requires additional references until it is within the limits.
    e. R = 1.000; R is an e_i inflation factor to account for differences in the repeatability and reproducibility standard deviation; Z_i limits are in terms of reproducibility (performance across all expected stand-engine combinations) and e_i limits are in terms of repeatability (performance in a single stand-engine combination). R in this case is 1.000 as lab, stand, and engine are not significant in the model at this time.
    f. e_i Limit 1 = +/-1.000; this limit applies to a new stand-engine combination when judging the acceptance of the second reference only.
    g. e_i Limit 2 = +/-1.351; this limit applies to a previously calibrated stand-engine that has not been calibrated for two reference periods and is attempting to calibrate again. The engine can calibrate with one test if the Level 1 limits are not exceeded. Otherwise, immediately conduct another reference test in the stand-engine and utilize Level 4 limits for successive tests.
    h. e_i Limit 3 = +/-1.734; this limit applies in situations pre-determined by the SP to have potential impact to stand-engine severity. Some situations that may warrant consideration include replacing a head or turbo on a currently calibrated stand-engine (depending on how engines are defined). The engine can calibrate with one test if the Level 2 limits are not exceeded. Otherwise, immediately conduct another reference test in the engine-stand and utilize Level 4 limits for successive tests.
    i. e_i Limit 4 = +/-2.066; this limit applies to all other situations when determining an acceptable reference. If the limit is exceeded do not update control charts until after an additional reference is conducted and apply excessive influence calculations.
    j. The excessive influence calculation minimizes the impact of a failing reference test if the following reference test does not agree with the initial failing results and returns to historical severity performance (LTMS 1.A.5).

8. A minimum of two references will be required for each new stand-engine combination. The second reference will be judged against Z_i Limit 2 and e_i Limit 1 to determine the need for another reference. Additional references will be judged against Z_i Limit 2 and e_i Limit 4 to determine the need for another reference.
9. The reference calibration period will expire after five valid candidate tests, 110 engine hours at start of test, or 90 days, whichever comes first.
10. When oil 220 is run, the AvPIE must be less than or equal to 2.58 standard deviations from the target AvPIE for this oil for the engine to remain calibrated. If the AvPIE is greater than 2.58 standard deviations from the target AvPIE result and the lab determines the cause and repairs the engine, the engine can retain the present calibration status once a valid 220 test is completed with a AvPIE less than or equal to 2.58 standard deviations from the target AvPIE result.
11. The TMC will plot industry Zi charts to identify potential shifts in industry wide performance.
    a. Lambda = 0.2
    b. Z_0 = 0.000
    c. Z_i Limit 1 = +/-0.775
        i. When industry level one limits are exceeded the TMC investigates whether severity adjustments are adequately addressing the trend, investigates the possible causes, and communicates as appropriate with industry.
    d. Z_i Limit 1 = +/-0.859
        i. When industry level two limits are exceeded the TMC informs the surveillance panel that the limit has been exceeded. The surveillance panel then investigates and pursues resolution of the alarm.

Rich Grundza

From: Mounce, Felt A <felt.mounce@swri.org>
Sent: Tuesday, May 10, 2016 6:15 PM
To: Romano, Ron (R.); Rich Grundza; gordon.farnsworth@infineum.com; Alfonso Lopez Intertek; Jason Soto Intertek; Miranda, Greg; OMalley, Kevin
Subject: LSPI fuel flow discussion notes

Meeting topic: LZ test #1 had a fuel flow of ~14.9 kg/hr. The limit in the procedure for fuel flow was is 15.0-15.8 kg/hr. Should testing continue on existing engine, or should the matrix be re-started using a new engine?

Argument to continue running on existing engine:

- There is not enough data to prove that the selected limits are adequate or necessary.
- Including the low fuel flow engine will include inherit test variation in the matrix.
- Another engine in the matrix has been accepted with high fuel flow (~15.9 kg/hr)
- A single HEO data point from this engine is unlikely to change the mean by a significant amount

Argument to replace existing engine and re-start the matrix tests:

- The engine violates the test procedure.
- Including a low fuel flow engine may increase the variability of the test that will not be reflective of future production testing.

Discussed options:

1. Replace low flow fuel engine with a new engine and re-start matrix tests.
2. Continue testing on the existing engine with no changes to the matrix.
3. Run an additional HEO test on this engine before continuing with the matrix to verify result.
4. Finish running the matrix on this engine as is, and then run the same matrix on a new engine to validate matrix results as a whole.

Resolution: LZ will continue running the matrix on this engine. A new engine will also be prepared for testing in parallel. Once matrix runs are complete on exiting engine, the matrix can be repeated on the new engine. How to incorporate this data into the matrix evaluation to be determined by statistics group and task force.

Actions

1. Task force meeting to review the operation data for completed tests to date – 5/10/16 at 1:00 PM central. This meeting will include
2. Ask statistics group about effect of running extra tests on a new engine to the designed matrix. – All
3. Prepare new engine for LSPI testing – LZ

Felt Mounce
Senior Research Engineer
Southwest Research Institute
Fuels and Lubricants Research Division
210-522-5411 office
214-289-1955 mobile
felt.mounce@swri.org

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Items rated as "A" status and marked with * require supporting documentation to be attached

LSPI Test

1.0 Action Plan

1.1 Reference Oils

1.1.1 Do the majority of reference oils represent current technology? __A__

1.1.2 Are the majority of reference oils of passing or borderline pass/fail performance? __A___

One high event oil. Other two oils are above and below the expected pass fail Limit. The low event oil used for discrimination. When the pas/fail limit is established, another reference oil will be solicited.

1.1.3 Is reference oil supply and distribution handled through ASTM/TMC? Yes __A__

1.1.4 Is a quality control plan defined and in place? __A___

TMC reference oil process

1.1.5 Is a turnover plan defined/in place to ensure uninterrupted supply of reference oil and an orderly transition to reblends? __A___

TMC reference oil process

1.1.6 Is a process for introducing replacement reference oils defined and in place? __A___

Will be handled by the SP

1.1.7 Are oils blended in a homogeneous quantity to last 5 years? ___A__

All reference oils are at TMC

1.1.8 How many reference oil are there and what are the identifying oil codes?

Three reference oils. LEO -TMC220, HEO – TMC222 and 0W-16 - TMC221

Comments:

2.0 Test Parts

2.1 Are all critical parts identified? __A___

Yes, in procedure

2.1.1 List the parts consider as critical. __A___

In test procedure

2.2 Is a system defined/in place to maintain uniform hardware? __A__*

Lifetime buy

2.3 Is there a system for engineering support and test parts supply? __A___

Through test Sponsor

2.3.1 How many tests can be run with the supply of parts currently in stock? __A__

Life of the test

2.4 Are critical parts distributed through a Central Parts Distributor (CPD)? __A___

From Ford

2.5 Are critical parts serialized, and their use documented in test report? __A___

Yes

2.6 Are all parts used on a first in/first out basis? __A__

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

Yes

2.7 Are all rejected critical parts accounted for and returned to the CPD? __A___
Rejected parts are handled through Ford FCS
2.8 Does the CPD make status reports to the test surveillance body at least semi-annually? __A__
Test Sponsor at all meeting
2.9 Is there a quality control and turnover plan in place for critical test parts, including identification and measurement of key part attributes, a system for parts quality Accountability, a turnover plan in place for simultaneous industry-wide use of new parts or supply sources? __A__*
Measurement are in the procedure, Surveillance Panel will handle turn-over plan.
2.10 Is the CPD active in industry surveillance panel/group, and in industry sponsored test matrices? __A___
Test sponsor at all meetings

Comments:

3.0 Test Fuel SA CW

3.1 Is the fuel specified and the supplier(s) identified? __A__

3.1.1 Who is the fuel supplier? _Halterman , EEE_____

3.2 Is a process in place to monitor fuel stability over time? __A__*
3.3 Are approval guidelines in place for fuel certification? __A__*
COA provided for each bacth of delivered fuel.
3.4 If the test fuel is treated as a critical part of the test procedure:
Is an approval plan and severity monitoring plan for each fuel batch in place? __D__*

3.5 Is a quality control plan defined and in place to assure long term quality of the fuel? __A__*

3.6 Is a turnover plan defined, in place and demonstrated to ensure uninterrupted supply of fuel? __A__*

Comments:

4.0 Test Procedure

4.1 Is a technical report published documenting, per ASTM Flow Plan:

4.1.1 Test precision for reference oils? __A__*
LTMS complete
4.1.2 Field correlation? __A__*

4.1.3Test development history? __B__*
Will be part of the research report
4.2 Are test preparation and operation clearly documented in an ASTM standard format?
__B__*

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

Draft test procedure on the TMC website. Facilitator assigned.

4.3 Are test stand configuration requirements documented and standardized? __A__*
In draft procedure on TMC website
4.4 Are milestones for precision improvements established? __A__*
Part of SP responsibilities
4.5 Are routine engine builder workshops planned/conducted? __A__
Build workshop completed. Additional workshops determined by SP
4.5.1 How often and by whom?

Comments:

5.0 Rating and Reporting of Results

5.1 Are the reported ratings from single raters (i.e. not averages from various raters)? __D__
No subjective ratings
5.2 Is a suitable severity adjustment system in place? __A__*
LTMS established and approved by the TF
5.3 Is each pass/fail parameter unique and have a significant purpose for judging engine oil performance? __A__
Yes, only one pass/fail parameter is used.
5.3.1 List the pass/fail parameters. ___Average # of events of 4 iterations_____

5.4 Do all rate and report parameters judge operational validity, help in test interpretation or judge engine oil performance? __D___

5.5 Are routine rater workshops conducted/planned? __D___

5.5.1 How often and by whom? _____

Comments:

6.0 Calibration, Monitoring and Surveillance

6.1 Is a process in place for independent monitoring of severity and precision with an action plan for maintaining calibration of all laboratories? __A__*
Monitored by the TMC with guidance of the SP
6.2 Are stand, lab, and industry reference oil control charts of all pass/fail criteria parameters used to judge calibration status? __A__*
LTMS established and approved by the TF
6.3 Does the specified calibration test interval allow no more than 15 non-reference oil tests between successful calibration tests? __A__
Reference period is 5 non-ref oil tests
6.4 Is an ASTM Surveillance Panel in place? __B__
Taskforce will become SP once approved by PCEOCP

RATING SCALE: A - Completed; B - In Progress; C - Planned; D - No Action; E - TBD

6.4.1 Who is chairman? ____Felt Mounce_____

Comments:

7.0 Test prove out data

7.1 Has a test development Task Force/TMC visit been made to each of the labs that will participate in the industry precision matrix? __A__
Completed
7.2 Have prove out tests been run with the finalized test procedure and test parts? __A___*
PM completed along with statistical analysis
7.2.1 How many labs and stands? Three Labs, Five total stands_____