MACK-Volvo Surveillance Panel Meeting Notes
09/01/2021 @ 1:30 P.M. EST

Attendees

SwRI: Isaac Leer, Jose Starling, Michael Lochte, Robert (Bob) Warden, Travis Kostan
Oronite: David Lee, Josephine Martinez
Afton: Bob Campbell, Cory Koglin, Todd Dvorak
Infineum: David Brass (Chairman), Elisa Santos
Intertek: Garrett White (Secretary), Juan Vega
Lubrizol: Jim Matasic, Nick Ariemma
CP Chem: Jon VanScoyoc
Haltermann: Prasad Tumati
Exxon Mobil: Paul Rubas, Steve Jetter
TMC: Sean Moyer
TEI: Derek Grosch

Agenda

1) Volvo T-13 Back Order Parts
2) Mack T-12 Reference Test Review
    a. Oil Analytics
    b. Injection Timing
    c. EOT Oil Volumes
3) Mack T-12 ICF Changes
4) Mack T-12 Parts

Action Items and Key Points

- Lab B re-run completed. Iron and peak height oxidation noticeably higher in comparison to other 3 labs.
- Lab B data was determined to be excluded from the analysis for proposed ICF changes.
- Parameters that are currently under review for possible ICF changes include average liner wear and oil consumption. A change to the ICF for top ring weight loss was proposed but then removed.
- **Elisa Santos to provide a table consisting of the current, multiplicative proposed ICFs and additive proposed ICFs for review in the next meeting.**
- There are approximately 75 kits of T12 hardware at TEI, the limiting factor being X top rings (454 as of 9-1-21).

Summary of Discussion

Volvo T-13 Back Order Parts

Discussion was tabled for the next meeting.

Mack T-12 Reference Test Review

- *Oil Analytics*
  - Copper
    - Triangle markers are original testing with A subgroup piston crowns which caused high OC and hesitation on approval.
    - Circles markers are the most recent runs with subgroup E crowns.
    - Lab B had higher copper at 25 hours compared to other labs.
    - 300 hours: 20 to 35 ppm range for copper at 300 hours.
    - Lab A's run on subgroup E piston crowns higher at 300 hours around 45 ppm when compared to other labs.
  - Lead
    - 25 hours: Similar and low in all labs.
    - 300 hours: Lab B lead levels high on runs with subgroup E piston crowns (over 100 ppm for both runs). Others completed in the 40 to 75 ppm range.
    - Completed runs by labs G and D on subgroup A piston crowns ranged from 75 to 145 ppm.
  - Iron
    - 25 hours: Lab B levels high (50 to 70 ppm), others around 20-35 ppm
    - 300 hours: Lab B levels high in the 425 to 455 ppm range while others completed in the 300 to 375 ppm range.
    - Subgroup A crowns produced more iron than subgroup E based on runs in Lab G and D.
  - Peak height oxidation
    - 25 hours: Lab B peak height oxidation higher around 18 abs/cm compared to other labs which were around 2-3 abs/cm.
    - 300 hours: Lab B above 80 abs/cm, others at 70 or less abs/cm.
  - IR area
    - 25 hours, lab B deviated far from other labs (near zero),
    - Lab B overall IR area trend very different, large dip into the negative range (-1000) and then begins to rise after 100 hours, other labs stay close to zero and then rise steadily.
  - TAN
    - 300 hours: TAN approximately similar across all labs around 5 mg KOH/g with subgroup E crowns. TAN was 7-8 mg KOH/g in the runs with subgroup A crown runs.
  - TBN

        - 25 hours: All labs around 8 mg KOH/g.
        - 300 hours: All labs around 4 mg KOH/g.
    - Viscosity
        - 25 hours: Similar across all labs.
        - 300 hours: 22 and 26 cSt, results ranged across all labs.
- *Injection timing*
    - Injection timing by test hour in phase one plotted for the last 9 tests.
    - Triangles are subgroup A piston crowns, circles are subgroup E piston crowns.
    - Higher the number means more advanced the timing (trying to produce less soot), lower the number is more retarded timing (trying to produce more soot)
    - Lab A starting timing higher compared to others above 10 deg BTDC. Others start 5 to 10 deg BTDC
- *EOT Oil Drain Weights*
    - 3 of 4 labs provided end of test oil drain weight from the reference tests on the new hardware.
    - Calculated drain weights and actual weights were close (within a couple tenths of a drain) at 2 of the 3 labs that provided data
        - Calculated drain weights are estimates accounting for average oil consumption in stages 1 and 2, oil adds, and oil samples.
    - Out of the 3 labs that provided data, 2 of 3 ranged in drain weights from 18 to 21 kg drain on previous batch parts.
        - Subgroup E crowns are produced similar drain weights compared to previous batch runs.
    - Lab B numbers were later corrected. The first reference run was corrected from 17.7 to 22.2 kg. The second reference run was corrected from 11.4 to 14.4 kg.
        - Lab B numbers account for oil in the blow by bucket (1-2 kg).
- Jim M – Do other labs control humidity? We control to T13 levels (Humidity Ratio of 11.4 g/kg.)
- Bob C – We do control the humidity on our stands but not locally at the stand.
- Jim M – Ours is controlled locally at stand.

<u>Mack T-12 Industry Correction Factor (ICF) Changes</u>

- Lab B data was determined to be excluded from the CF determination, only Lab G, D and A used due to concerns about the differences in IR and iron results.
- Elisa proposed changes to the correction factors for the following parameters: average liner wear (ALW), top ring weight loss (TRWL), and oil consumption (OC).
- Elisa - ALW might be over correcting. Proposed ICF is -0.8765 and would be additive.
    - The current ICF is 0.743 and is multiplied by the transformed result.
- OC appears to be under correcting. Proposed new ICF is -0.417 and would be added to the transformed result.
    - The current ICF is 0.926 and is multiplied by the transformed result.
- Top ring weight loss proposed ICF is 0.75. Lab G high result might be skewing calculation slightly but with the new ICF it does bring the other 2 labs closer to target.

    - The current ICF is 0.846 and is multiplied by the original result (not transformed).
- PB and PB2, ICFs appear to bring results back to target. No change needed.
- Elisa – Should the ICF for TRWL be changed?
- Juan – I would be comfortable with maintaining the current ICF for TRWL.
- Liner wear and oil consumption are currently transformed, the ICF is multiplied, and then transformed back to original units.
- Josephine Martinez – How come the targets are in original units and LTMS in transformed?
- Sean – Most likely due to changes over time. The T12 began with no ICFs.
- Bob C – Could we look at both multiplicative and additive ICF's?
- **All ICFs, current and proposed, are to be placed in a table for comparison in the next meeting. Both additive and multiplicative proposed ICFs are to be provided.**

Mack T-12 Parts

- Bob C – How many pistons do we have before we have to run another set of coordinated references?
- David – Approximately 75 tests. This is dependent upon X rings which are the limiting factor.
- Derek – We have 454 X top rings which provides 75 tests.
- David – What is the current burn rate?
- Derek – Burn rate, based on 2019 numbers, is 80 to 100 T12 kits per year.
- Derek – We are still working on obtaining similar date codes for the PNB main bearings, connecting rod bearings and rings.
- David – It would be best to align date codes on parts due to the recent findings with the piston crowns.

Meeting adjourned @ 2:58 PM EST

Next Meeting Date/Time

September 9th, 2:30-3:30 PM EST