T13 Taskforce Meeting – 2/4/15, 8:00am EST

Attendance: Sean Moyer (TMC), Mark Sutherland (TEI), Jim Moritz (IAR), Bob Salgueiro (Infineum), Elisa Santos (Infineum), Robert Warden (SwRI), Kevin Omalley (Lubrizol), Mike Conrad (Lubrizol), Luiz Garcia (IAR), Christian Porter (Afton), Bob Campbell (Afton), Greg Shank (Volvo), Mike Alessi (XOM), Riccardo Conti (XOM), Mark Cooper (Oronite), Jim Rutherford (Oronite), Jim Matasic (Lubrizol), Tod Devorak (Afton), Lisa Kessel (Afton), Mrugesh Patel (XOM)

- Meeting goals:
    - Comparison of all data from tests used for the analysis
        - May be completed?
    - Measure of precision for each parameter
        - Shift from torque control to fuel flow rate control
    - Recommendation for P/F parameters (not limits)
        - IR peak at 360, kv40%300-360
    - LTMS recommendations
        - Ltms2?
- Build mechanics left to install the #6 cylinder and rear timing plate.
    - Review was very positive. Many of the labs experience similar wear issues and reuse life with non-critical components.
    - **Was decided that we will be using a fuel/water separator and not the block-off plate**
- Oil filter housing inspection noted that the ID for the bypass filter fitting was smaller on the newer filter housing styles. Two castings exist, no other major differences were found.
- IAR noted that the timing plate on their low OilJetP engine had a hole at end of the gallery that was dumping oil back to the crankcase.
- Photo was a grainy shot of something… Jim leaning against his RX-7 (half model year after the intro once the apex seals had been fixed)
- BOI: much larger 300-360 IRPK difference in technology 1 than technology 2 or 3.
    - May just need to do a transform since the magnitude of increase was highest on technology 1
    - Based on Greg's knowledge of the base stocks, the ordering of the base stocks made sense
- Operational Data
    - Oil A – tech 1, BO1
        - Severe: None
        - Mild: Lab D stand 1, Test key 103527, engine 142(engine 2)
        - Notes on operational: Lab A had very high oil gallery and jet pressure. The Lab D run identified had middle of the range operational data.
    - Oil B – tech 2, BO1 - flat to slight climb, 2 groupings and one sever run
        - Severe: Lab G Stand 2, TK-104623 engine 89024263
            - Highest fuel flow, low oil jet P
        - Mild: Lab A Stand 1 (TK-103550, eng 920867) had lowest fuel flow and lowest coolant inlet temp (T/C replaced after test), Lab D stand 1 (TK-103551, eng 142)
    - Oil C – tech 3, bo1 - oil climbs

        - Severe: Lab B Stand 1, TK103676. Engine 1389023341
            - Lowest fuel flow
        - Mild: None apparent
    - Oil D – tech 1, bo2
        - Severe: Lab F stand 1, Test Key 103773, engine 122410008
            - Second highest oil jet pressure
        - Mild: Lab A stand 1, Test Key 103770, engine 934497
            - Highest oil jet pressure
            - Highest fuel flow rate
        - Notes on operational; 2 highest oil jet pressures were the top and bottom ranges of KV40 response. Same for oil gallery pressure
            - We have a much larger spread on this value than we'd like or Volvo would expect to see
    - Oil E – tech 2, bo2 - flat to slight climb, 2 groupings (consistent KV40 and oxidation response)
        - Severe: Lab F Stand 1 TK 103588, engine 120830349
            - Median fuel flow rate
        - Second highest: lab G (low oil adder system weight)
        - High Oil Jet P: Lab B Stand 1, found that oil jet P was measured at the wrong location
        - Mild: None apparent (group of 3)
        - Odd: TK103585, Lab A – high nop_angle value
            - Engine was first use, new ECM. May have not gotten the flash file loaded properly
    - Oil F – tech 3, bo2
        - Severe: Lab G Stand 2, TK103423 engine1202487.
            - Highest fuel flow rate
            - Much higher compressor outlet temp. appears that the turbo was working a lot harder. Compressor out P was also a bit higher
        - Mild: Lab A Stand 2, TK103425 engine 934497
            - Median fuel flow rate
- Torque vs. fuel flow control
    - Fuel rate gives each oil the same energy content input
    - Torque allows for low viscosity oils to receive lower energy input
    - Would directionally shift mild labs up, severe labs down
    - What is the impact on the analysis we are doing?
        - Is the matrix wasted if we switch? – Group consensus was "No"
    - Some labs do not have heated load cells which could cause drift. Temperature differences between when the stands were calibrated to when the later tests ran could have driven results as well

    - Small changes in the load arm length have major impacts on the torque calibration with the weights required to reach our torque levels
    - Look at fuel flow rate 100-150hrs to determine a good "set point"
        - Few labs want 68. Kevin said 68.075kg/hr would be the average.
        - Statisticians to look at if a correction to 68kg/hr fuel flow would tighten up the matrix data
- Coolant Temp
    - Lab A needs to be tighter on Water outlet temp
        - Bad T/C on Oil B
    - Lab G had a T/C calibration issue on one oil that did not appear to impact the break-time for the test
- EGR Coolant temp
    - Data is somewhat useless since labs prefer slightly fouled coolers. Makes control easier
- CCP
    - All labs were within the +/- .3 kPa
- **Discussion on the oil mist separator determined that we should change out the entire unit each test**
- **OC Measured from test hours 24-192hrs on 24 hour intervals**
    - **Really, hour 25 is the starting point**
- KV40 hours to % increase (matches 75cSt)
- Liner wear is out
- Nitration peak at EOT, and 300-360hrs
- Questionable runs:
    - SwRI stand 1 run B; low fuel rate
        - **Out due to potential low torque**
    - SwRI stand 4, run D, oil adder issue
        - **Out due to 360hr data being compromised**
    - IAR run with coolant out T/C calibration
    - IAR run with high turbo outlet temp
        - Lab G Oil F stand 2
        - Was "different" somehow.
        - EGR and VGT were very stable
        - **Test included**
    - IAR run with low Oil Jet P, oil B, TK104623
        - **Oil Jet P limit set for 105kPa, pull this one out**
    - LZ run with odd boost/pressure and exhaust leak
        - Keep it
    - Exxon run with changed filter head
        - Keep it. Was in range
- Fuel flow conversion
    - Keep controlling to torque until a reference has been run based on fuel flow control

    - Candidate runs between the matrix and a reference run on fuel flow should be based on torque values
    - Control style based SA for the first reference period
        - **Potential reference period of 6 months from the end of the matrix**
    - **>>>>>>>>>TARGET IS 68.0 kg/hr<<<<<<<<**
- Hrs to increase to 100%
    - 15% did not capture things well
    - 100% looked a bit better
        - Cant put numbers on technology two since it does not reach it, but we can say its way better since it doesn't get there – Jim R.
- KV40 %300-360
    - Technology 2 shows a significant different between tech 1 and 3
    - Base oil 1 has more stability
    - 50% may be a cut off?
    - A,C,D,F in one group of >50% increase
    - B,E in one group of <50% increase
- KV40% increase at EOT
    - One high flyer on Oil F, skews plots high
    - With it removed, technology 1 looks pretty good
- IR peak height shows a much better separation
    - One odd point shown, G3. Missing IRPH data
    - IRpkHt vs KV40%EOT
        - Greg concerned scan interpretation is not as repeatable as vis testing
- Nitration peak
    - Correlates fairly well with KV40 300-360
    - Technology 1 and 3 are intermixed
    - The max peak point shows up earlier than many other criteria, then it tends to tapper off a bit
    - Overall, oxidation peak is much better behaved
- Conclusions;
    - IRPk height at EOT
        - Answers Cat's questions on nitration
    - KV40 percent increase for 300-360 since it doesn't flatten out
    - OC average is from 24-192 hours, calculated on 24 hours intervals
- Report Forms
    - Get rid of the 12hr interval OC data slots on the OC page
    - Only report in 24hour data
- Jim's "quick look" analysis
    - Technology 2 oils are significantly differ from the other oils, but not each other
    - Tech 1 and 3 are not significantly different from each other
    - Discussion lead to LTMS2

        - Sean pointed out that the second edition of a text book is usually more expensive than the first
        - "a lab should be on a target, but that target might not be the same for all labs due to lab bias. A lab SA would be applied to bring a lab back into a lab based target, but still promote a lab to reach towards the industry target"
        - A lab that runs 1 sigma mild would have the entire severity band to work within
    - Things that need to be determined;
        - Lambda values
        - How to bring in a new stand (was discussed and voted on at April '14 meeting)
        - How to bring in a new lab
    - LTMS2 issues and comments
        - A bad reference can shut down the whole lab if it had a major impact in EWMA
            - By the time you drift an EWMA value out far enough to trigger a shutdown, you would have never calibrated in LTMS1 for long enough to shutdown the lab anyway
        - LTMS2: Jim Rutherford started it, a group worked on it for a while. Had a number of meetings trying to explain it to people, but no one was accepting it so they stopped working on it. Everybody disowned it
        - We can do LTMS 1 pretty quickly if needed
        - LTMS2 acknowledges that not all labs are the same, and things change over time
    - For calibration: the last test has to be good

Short Summary;

The build mechanics found that most everyone was on the same page. There were some updated procedures on head bolt torque pattern that a few labs were not using. Most labs were seeing similar part life on the top end components, although Lubrizol was getting longer injector life than most.

Fuel flow rate will replace Torque as a primary control parameter at the next reference oil run. This will be a stand-by-stand conversion rather than full lab change-over. The target will be 68kg/hr

Reference parameters will be the IR Oxidation Peak Height at 360 hours and the percentage increase in KV40 from 300 to 360 hours.