

Test Sponsor proposed actions
Based on Task Force meeting on June 10, 2014

The following actions are proposed to ensure data generation that allows full acceptance of the test. It is anticipated that this proposed plan can be completed within a month to allow for a reasonable timeline for the new category matrix testing.

I- Review current data by TMC

- a. Provide raw data of the recent oil tests
- b. Provide engine history including hours and break-in procedure

II- Procedure:

1- Rebuild:

- a. Rebuild the engine at the three participating labs. Include new turbos in the break-in.
- b. Follow the procedure for rebuild as specified in the C13, D7549
- c. The rebuild preliminary time is every 20 tests, which will be reviewed and revised as needed and based on test results and reference oil data.

2- Warm-up and Break-in: break in the engine based on the following procedure:

- a. Follow the warm up procedure of the C13 oil consumption test
- b. Follow the break-in procedure of C13, but extend the break-in time to 50 hours
- c. Monitor blow-by during the break-in to stabilize to a range of 5% over per hour. If the engine does not stabilize within the 50 hours, extend the time until stabilization is noted. Note that different blow by meters may need to be used (rated vs aeration test)

3- When testing consecutive oils, allow the engine to cool down to a temperature of 30°C for 4 hours at a minimum.

4- For any test oil follow the warm up procedure as published and agreed upon.

5- Measure the baseline density of the test oil using bench test D4052

- a. On-engine: Measure un-aerated oil density at high pressure after the engine reaches steady state speed and temperature. This density can be used to compare to the bench for reference.

6- During the test, record all the operational parameters per the draft procedure.

- a. Review data acquisition systems and methodology. Ensure commonality among labs.
- b. Insulate the oil pan as agreed upon for the latest tests
- c. Run the test at a fixed crankcase pressure at 103 +/- 0.1 kPa absolute
- d. Measure aeration through the micromotion at 84kPa and controlled flow rate and temperature
- e. Use the following equation to measure the aeration of the oil:
 - i. Aertion: $100 * (\text{BaseDens} + \text{DvT} * (\text{Temp}_{\text{Control}} - \text{OilTemp})) / ((\text{OilDens} + \text{DvT} * (\text{Temp}_{\text{Control}} - \text{OilTemp})) - \text{AirDens})$
 - ii. Air Density (g/ccm): $(\text{OilPres} + \text{AmbP}) / 287.003 * \text{OilTemp} + 273.15$
 - iii. Base Density: $\text{OilDens} + \text{DvT} * (\text{Temp}_{\text{Control}} - \text{OilTemp})$
- f. Engine parameters, controlled parameters and test results are to be reviewed by the TMC, potentially supported by a statistician.

III- Test oils

The following matrix of oil testing is proposed in order to generate data that allows moving the test forward. Note that when an oil test is to be repeated by a lab, it is recommended that the oil is tested first then last following the testing of the two oils proposed. This sequence allows the determination of any drift in the test.

It is recommended that the engines are testing the proposed oil exclusively to ensure control and understanding of the parameters.

Lab	1	2	3	4
A	1005	LZ*	High Aeration	1005
B	LZ*	1005	High Aeration	LZ*
C	1005	High Aeration	LZ(30)	1005

Where, LZ* is the current oil A, but blended into an xW-30 grade (pending response from LZ). This potentially allows more separation among the oils