

# **Summary of the C13 Mini-Matrix Operational Data Review**

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## **Forward:**

As the result of discussions during recent C13 TDTF meetings, the TMC was requested to collect and review the operational data from the C13 discrimination mini-matrix. The following is a summary of that review. The review is broken into three parts: issues believed to be of primary importance; noted operational differences; and the remaining operating parameters for which no commentary is offered. It is recognized that other engineers may come to different conclusions in reviewing the same data, therefore, it is strongly recommended that any interested parties should review the data which is made available from the TMC website:

<ftp://ftp.astmtmc.cmu.edu/refdata/diesel/c13/data/>

*The file name is 'c13 opdata.xls'.*

Plots are not shown in this summary due to the massive file sizes.

## **Issues of Primary Importance**

### **1. Oil Gallery Temperature**

#### **Findings:**

- Lab A, Oil A, ran at a much different temperature than did all the other tests. Lab F, Oil D, showed some difference also but at a much smaller magnitude.
- The test procedure does not have a control set point for any oil temperature (sump or gallery). This means that significant differences in oil temperature are permissible. This may prove to be a problem for a test with the primary result of oil consumption. It is known that temperature effects viscosity. It has also been observed in other tests with auxiliary oil reservoirs that the amount of oil in the reservoir is viscosity dependent (and thus temperature dependent as well). Furthermore, any consideration of piston deposits is clouded with different oil temperatures.

## 2. Oil Scale Weight

### Findings:

- Initial oil scale readings vary by as much as 3 kg from lab to lab. This is possibly, though not necessarily, indicative of the following: different initial oil charge amounts, auxiliary oil system configuration differences, or different scale zeroing techniques.
- All three tests at Lab G are missing significant amounts of data.
- The Lab G, Stand 2, Oil D test does not show any readings until almost ten hours into the test, thereby missing the full mark setting at four hours. This test also, as well as the Lab F, Oil D test, appears to never make it back to initial oil scale weight similar to the other tests. (More on these tests in the Oil Add Amounts section).

## 3. Oil Add Amounts

Oil Add Amounts (g)					
Lab - Oil	A - A	F - D	G1 - D	G2 - D	G2 - A
50	2308	1311	2540	870	1000
100	2501	2149	2400	2410	1910
150	2829	2833	2360	2860	2510
200	3225	2829	2760	2850	2290
250	3694	3019	3150	2880	2510
300	4251	3202	3270	3080	2510
350	4101	2993	3420	2970	2910
400	3788	3196	3300	3180	3010
450	3860	3573	3400	3200	3480
500					
Total	30557	25105	26600	24300	22130

### Findings:

- Lab G, Stand 2, Oil D and the Lab F, Oil D test both appear to have insufficient amount of oil added at 50 hours. Neither test approaches the initial full mark value after the oil add. The Lab G test appears to be short by about 700 grams and the Lab F test short by about 1800 grams. The Lab F test showed a 3 kg drop in scale weight at 4.7 hours.
- Total oil add amounts do not appear to be driven by oil.
- The differences in oil add amounts and the oil scale weights raises the possibility that significantly different volumes of oil were run in these tests. As an example,

considering the initial oil scale readings and the oil add amounts, the total amount of oil tested for the two Oil A tests differs by approximately 7 kg.

## **Noted Operational Differences**

Plots for the following items can be found in the Excel spreadsheet mentioned above. While some differences may exist, no attempt is made to evaluate these differences or their causes.

Fuel Flow – Lab H shows massive variations.

Intake Air Temp – Lab H and Lab G, Stand 2, Oil A test show more variability. The Lab H test also shows massive set point deviations.

Intake Manifold Temp – Lab H shows significant control problems. Lab F, Oil D test shows some control problems in the early portion of the test.

Fuel Temperature – Lab H and Lab F, Oil D and Lab G, Stand 2, Oil A show more variability.

Coolant Out Temp – Lab H shows massive variability, other labs show variations as well.

Intake Air Pressure – some variability from lab to lab. Lab F shows much sharper control than the other labs.

Exhaust Back Pressure – Lab H shows set point control problems as well as variation. Lab A shows more variability (possibly due to manual control?) also.

Intake Manifold Pressure – Lab H shows large variations.

Torque – Lab G, Stand 1, Oil D torque is lower than the other tests. Lab H shows variations in the later portion of the test.

## **Remaining Operating Parameter(s)**

No real issues were apparent for Speed.