

AAFEX-II Status Report #10 – 31 March 2011

Primary Activities: Test FT fuel sulfur additive and 50:50 JP-8/HRJ Blend

Weather: Sunny and clear all day; 46 F at 0430 warming to 82 F at 1300. Winds very calm in the morning, then picking up with a slight northeasterly direction around noon.

Visitors: Jay Dryer, Head NASA Fundamental Aeronautics (Figure 1)

Summary: Despite weather predictions to the contrary, conditions were surprisingly calm at 5:55 am when engine started for the high-sulfur fuel experiment (**Test Run 9**). The test matrix followed the standard pattern, but particular emphasis was placed on measuring emission at 30 meters, where formation of new particles is most evident. The impact of fuel sulfur was quite evident at this location as PM number emissions often an order of magnitude higher than seen the previous day's data when pure FT fuel was burned (Figure 2). Extra time was allotted to profiling the exhaust with the Aerodyne Mobile Laboratory to further investigate sulfur impact on particle growth as the plume continues to cool and age. This study was further facilitated by burning FT+S fuel in both engines at the final low power test runs to prevent confusing JP-8 and FT+S plumes from the two engines. Including a couple of periods when engine power was necessarily reduced to idle to allow aircraft to pass on the adjacent taxiway, the test lasted almost three hours and included 35 test points plus extended period when a measurement time series were recorded behind the engines as fuel was switched from JP-8 to FT+S.

Test Run 10, the second JP-8/HRJ characterization study, began at 10:30 am. Again, the test followed the standard test matrix, with stepped increases in power from 4 to 100%, an intermission at 7%, then downward steps in power from 100 to 4%. Emissions measurements were similar to those from the previous day and indicate that 50% blends of HRJ produce a disproportionate reduction in PM number emissions (Figure 3). The test also reinforced an earlier observation that the DC-8's two inboard engines have different emissions characteristics, the right producing slightly lower PM number (Figure 4) than its left-wing cousin.

Test Run 10 concluded the planned emission tests, but, over the protestations of the ground crew (Figure 5), a final extended engine run focused on evaluating E-31 instruments and sampling lines was planned for midday Friday

Agenda for April 1, 2011

- Repeat JP-8 Characterization Experiment
- Conduct E-31 focused tests
- Provide downstream sampling opportunity



Figure 1. Amazingly, DC-8 project manager Frank Cutler (right), Fundamental aero program chief Jay Dryer, and AAFEX project manager Dan Bulzan can muster smiles despite the early hour of the day.

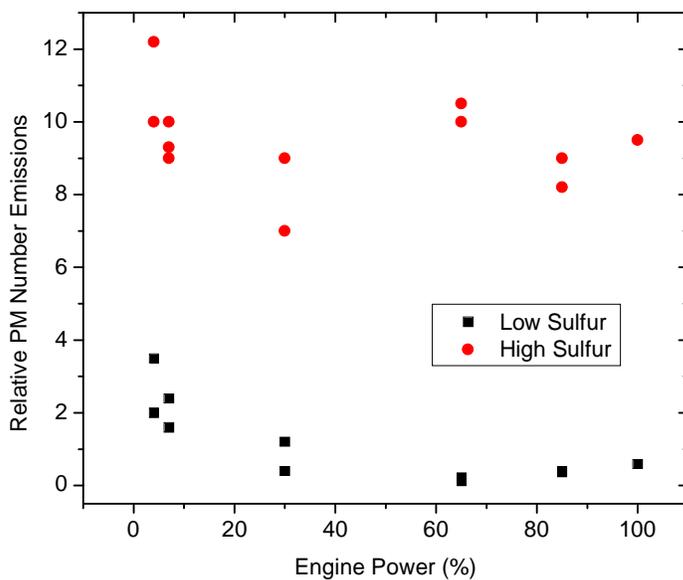


Figure 2. Comparison of PM number concentrations at 30-meter behind engine #2 as it burned pure FT fuel (black squares) and FT fuel with sulfur additive. PM mass emissions were similarly enhanced by the addition of 1000 ppmS to the fuel.

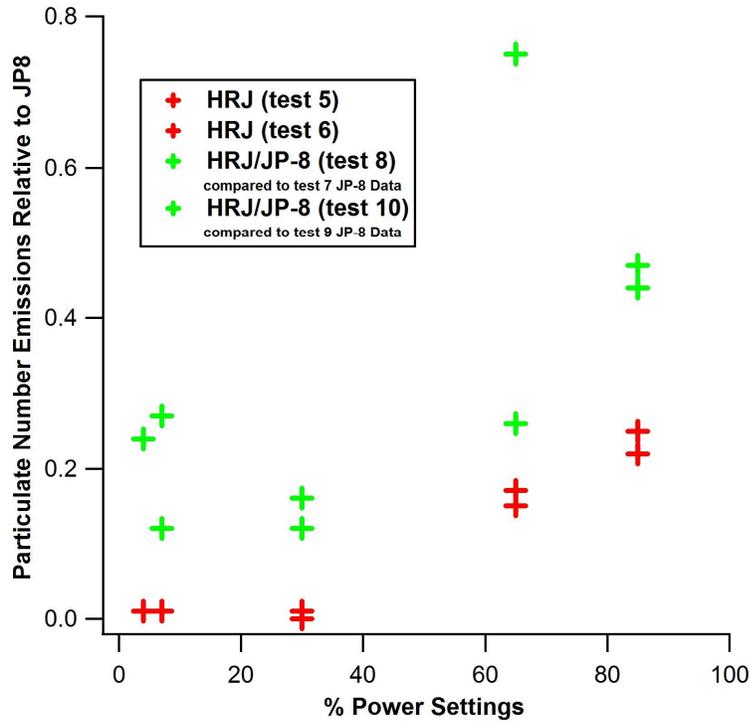


Figure 3. Relative reduction in nonvolatile PM number emissions produced by the HRJ and 50:50 JP-8/HRJ blend.

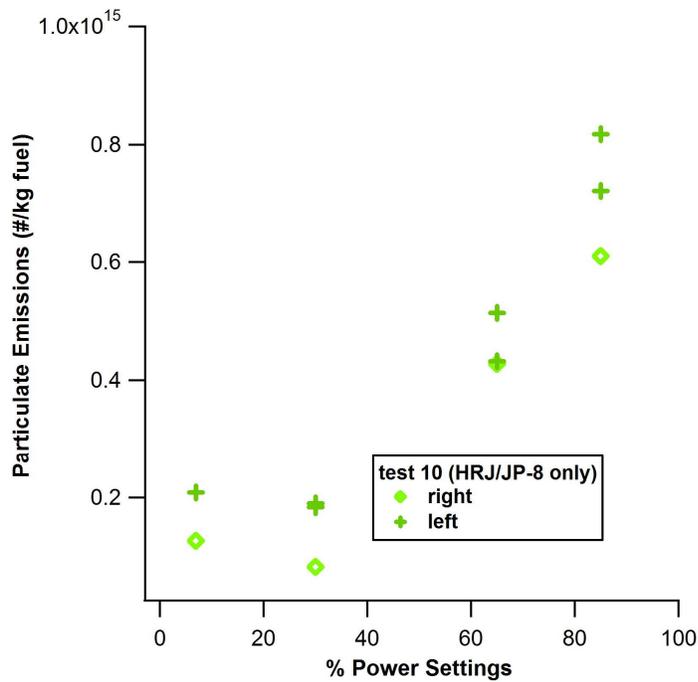


Figure 4. Measurements taken when both engines were burning HRJ/JP-8 blend illustrate the relative difference in PM number emissions between the left and right inboard engines.



Figure 5. Professing he has nothing better to do on weekends, Donnie cannot suppress his delight upon learning his help is critically needed Friday afternoon and Saturday.