

Notes on FM2 Test 101

Test FM2.101 is one of over 300 test runs carried out by SPR Ltd on the Flight Thruster originally designed and manufactured in 2009. In the first programme, designated Flight Test Model (FTM), the tests were documented as part of the Boeing contract and the technical transfer of EmDrive technology to the US government. In the second programme, designated Flight Model 2 (FM2), the tests were carried out to provide the Thrust/Load characteristics of a typical first generation thruster.

During the intervening eight years the Flight Thruster was loaned to two separate research organisations. During this period, the performance of the thruster decreased, with a lowered cavity Q value, due to a known misalignment of the end plates. However an advantage of this condition was that, as part of the FM2 programme, the effect of signal modulation on end plate misalignment could be measured, to provide data on the machining tolerances required for production.

For Test 101 the unloaded Q value was 31,000 compared to the original value of 55,000. The mean specific thrust for this test was 37mN/kW compared to 326mN/kW for the mean of the FTM test programme. This illustrates the significant effect of end plate misalignment.

The plots of Thrust and detected Cavity power show a typical test run, in this case with a power-on period of approximately 100 seconds. The Thrust and Power data sensors do not have synchronised sampling rates, leading to slight discrepancies in the time axis. The Power data has 1,038 points whilst the Thrust data has 355 points.

The Thrust plot gives a mean thrust of 506mg with a standard Deviation of 17.6mg, (29 sigma).

The power plot shows the noise generated within the cavity due to deliberately modulating the input signal to the TWT, and gives a mean value of 134 Watts.

The rise and fall times of the Thrust plot are due to the damped response of the balance beam, which has a total mass of 16 Kg. The longer rise time is also a result of a programmed, 10 second frequency sweep that is necessary to provide a stable acquisition of resonance, when the thermal responses of the input circuit and the cavity itself are significantly different in time and direction.

The beam balance is based on that used for the original experimental thruster programme and reported in the Feasibility Study Technical Report, which was published on the emdrive.com website in August 2016. Note that with different balance settings, both Thrust and Reaction Force can be measured, and the same equipment was used to produce the Thrust/Load results, and the observed Lift-off, that was reported in the 2019 lecture at the UK Shrivenham Defence Academy. An edited copy of the presentation is also available on the emdrive.com website.

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