Performance Comparison Report

Flight Stand with Solid State System vs. Thrust Stand with Bearings

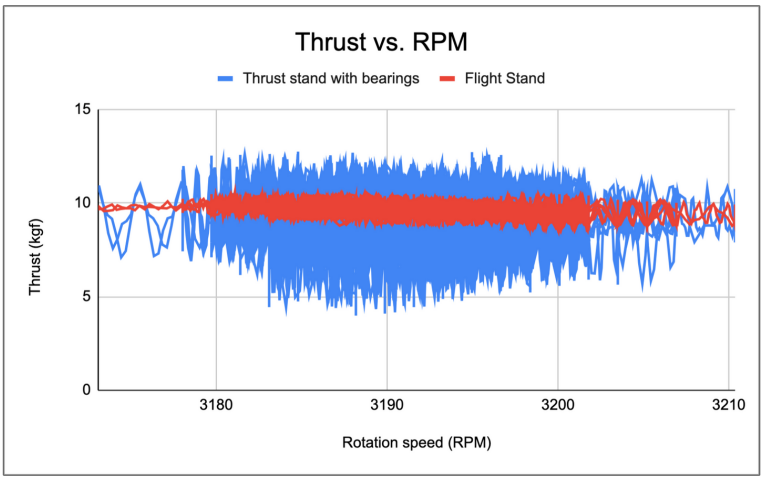
This report compares the quality of data measured by the Flight Stand, which uses a solid-state measurement system vs. a thrust stand that uses linear bearings. All tests used the same motor, propeller, ESC, and power input.

Linear bearings should be avoided in propulsion testing as they can introduce gaps, movement and friction in the force measurement system, which can lead to misalignments and faulty readings.

The key differences are visible in three areas: fluctuation in measurements, vibration, and hysteresis.

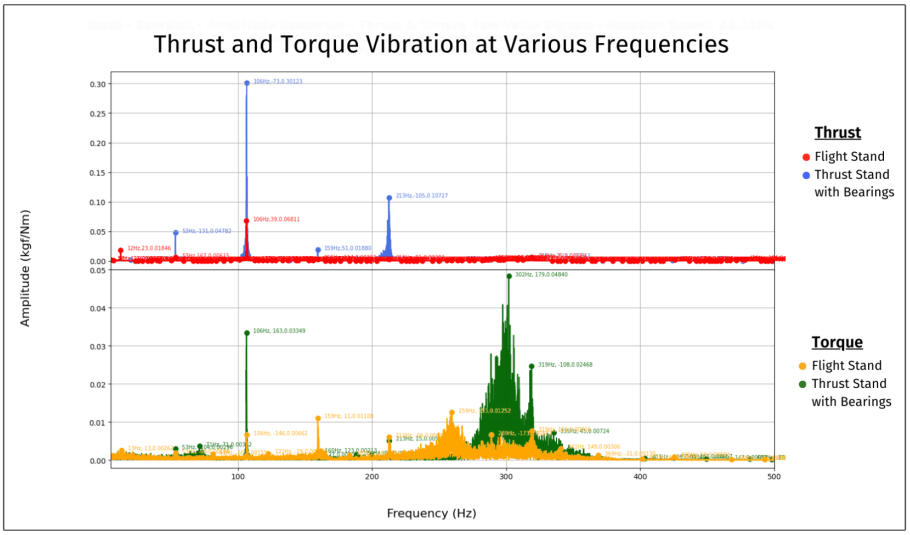
Fluctuation in Measurements

- 30-second hold test with 1436 µs throttle input.
- For the Flight Stand, the average thrust was 0.96 kgf with a standard deviation of 0.03 kgf.
- For the thrust stand with bearings, the average thrust was 0.92 kgf with a standard deviation of 0.15 kgf.
- In the plot of Thrust vs. RPM, the fluctuations in the measurements on the thrust stand with bearings are much higher, likely caused by friction in the bearings.



Vibration

- 30-second hold test at 3180 RPM / 53 Hz.
- The vibration in each system was analyzed using a Fast Fourier Transform (FFT) analysis.
- Thrust vibration was 4.5x higher for the thrust stand with bearings compared to the Flight Stand.
- Torque vibration was 3.7x higher for the thrust stand with bearings compared to the Flight Stand.
- Linear bearings introduce movement in the system which can lead to greater vibration.



Hysteresis

- We performed a step test to observe the hysteresis of each system once the load (a spinning propeller) was removed.
- When the throttle returned to zero, the Flight Stand measured 0 gf while the thrust stand with bearings measured >40 gf.
- Linear bearings introduce friction between the force application point (motor) and the load cell. The heavier the powertrain, the higher the error, which carries into subsequent measurements.