19 November 2012

EA204 Engine Test Cell Procedures and Data Reduction

Follow all instructions to obtain thrust versus time data for your Estes® A8-3 and B6-6/B6-4, and C6-5 rocket motors.

1. This test is conducted in the ventilated engine test cell in Ri035:

a. Turn on the power to the computer and the power supply and let the electronics "warm up" for at least 60 minutes prior to taking data. Make sure the ventilation is turned on to the test cell.

b. Install the solid rocket motor in the fixture on the access hatch. Fasten it securely. For B6-0 motors use the B6-6/B6-4. Each B6-X has the same thrust profile, except at the end of the burn. This will help conserve B6-0's.

c. Record the room temperature and atmospheric pressure.

d. Run the computer program designed for the test.

e. Type in a filename specific to your engine test and group.

f. Initiate the data acquisition and fire the rocket engine. Stop taking data after the engine has fired. There is no reason to collect data on the parachute ejection charge.

g. An ".lvm" file will be created with the name you gave it above. This file can be read using Excel. A hard drive will be available to copy the files over to at the end of the class period. The files will then be distribute to the section.

2. Data reduction procedure:

a. Calculate the air density in the room, ρ (kg/m³).

b. Using the thrust versus time plot, you can break up the thrust history into say 10 linear segments. Note the thrust values and times at each breakpoint.

c. Tabulate the time, t, in seconds and the thrust, T, in Newtons. From this you can integrate graphically by determining the area under the segments to get total impulse.

d. Alternatively you can enter the data into Matlab® (or a spreadsheet). Integrate numerically as compared to the graphical method in part b and c above to calculate the total impulse.

$$I_{total} \; ; \; \mathrm{V}t \sum_{i=0}^{\text{data points}} T_i$$

Note: The system collects 100 data points per second. Calculate the total impulse using only the data in and around your actual test.

e. Calculate the average and maximum thrust. Determine the specific impulse of the rocket motor which is given by $I_{sp} = I_{total} \big/ w_{propellant}$

f. Compare your results with the advertised performance of the rocket motor. Calculate the percent error of your values of $T_{\max}$, $\overline{T}$, t_b, $m_{propellant}$ and I_t. These values can be found on the Estes website.

g. Compare your results with the performance of the rocket motors from other sections (I will provide the data at the end of the day). What is the mean, median, and standard deviation for each motor type. How can you account for this in your design prediction?