Impulse Efficiency of Model Rocket Motors

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Derek Duling, Jacob Auman, Olive Patterson, Ian Kelly, Nyack Hartley

MECHANICAL ENGINEERING
COLORADO STATE UNIVERSITY

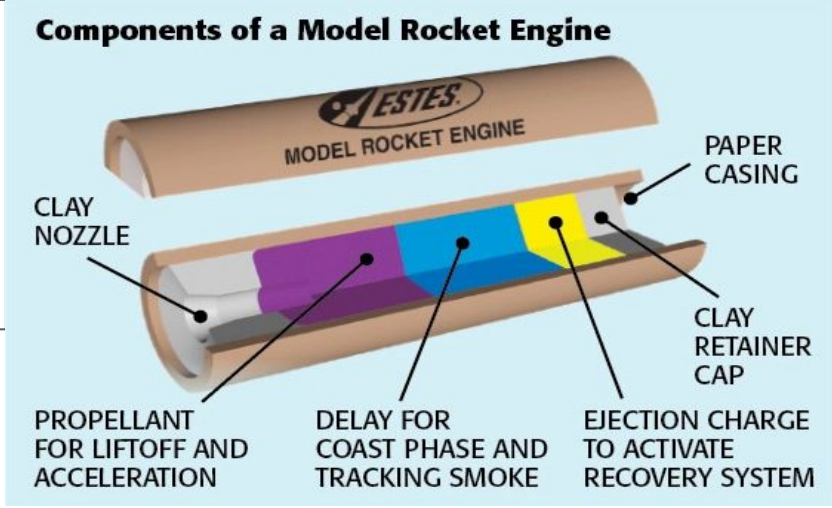
Question:

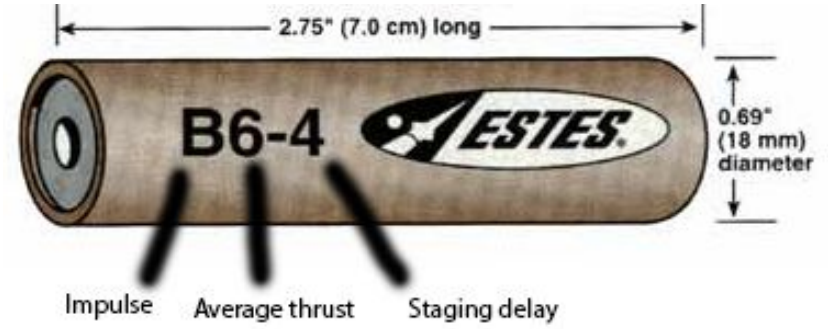
Which model rocket motor is the most fuel efficient in terms of thrust generation and pre-launch mass.

Overview:

The plan for our project is to test rockets motors and collect data for force over time by using a specialized force sensor and rocket motors that we found or purchased.

Class (Base 26)	Total Impulse (N·s)	Total Impulse (lbf·s)
Micro	0–0.3125	0–0.07
1/4A	0.3126–0.625	0.071–0.14
1/2A	0.626–1.25	0.141–0.28
A	1.26–2.50	0.281–0.56
B	2.51–5.00	0.561–1.12
C	5.01–10.0	1.121–2.25
D	10.01–20.0	2.251–4.5

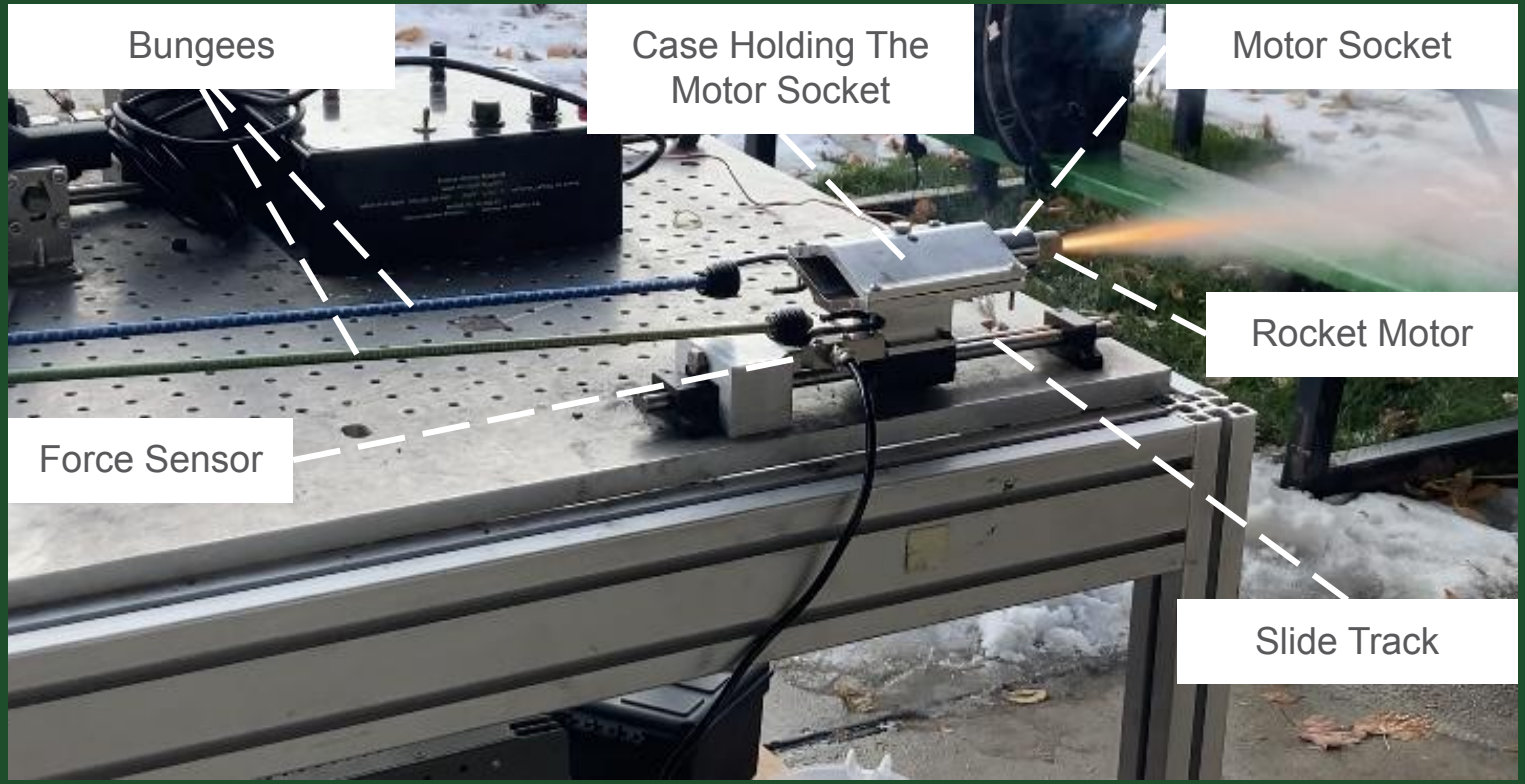




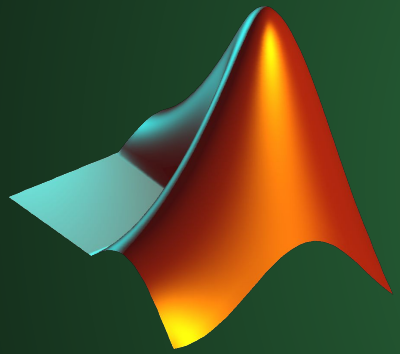
Safety Considerations

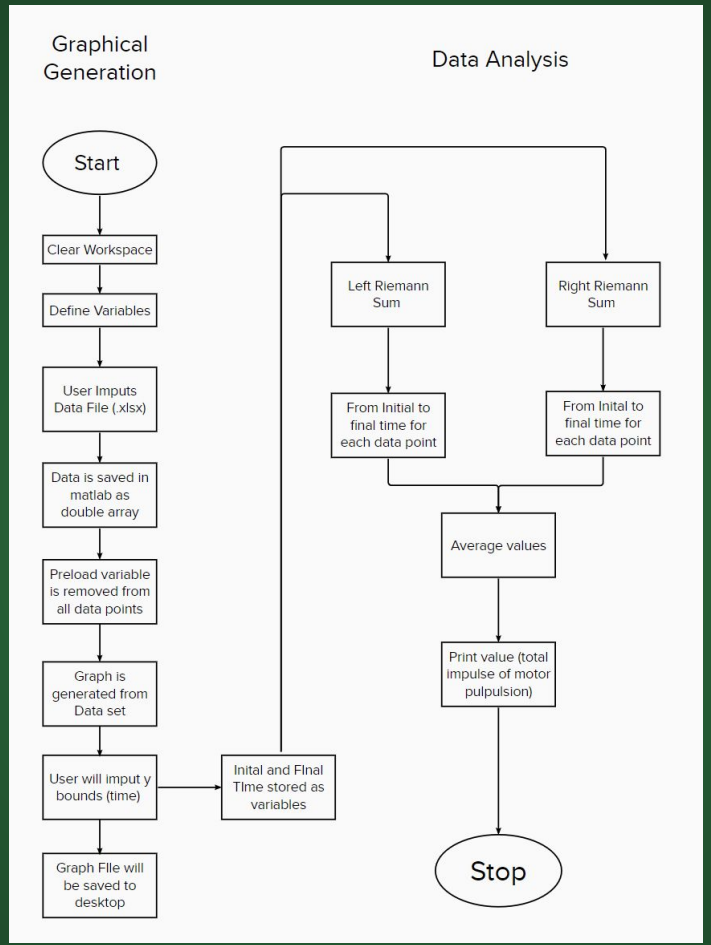
Source: https://estesrockets.com/edu-safety-data-sheets/

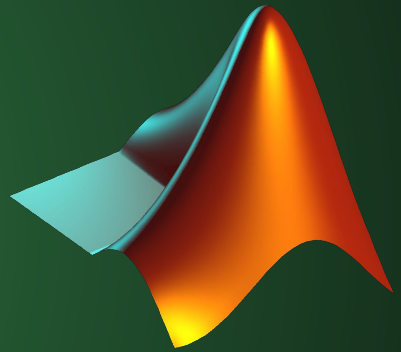
Experimental Setup



Example Trial



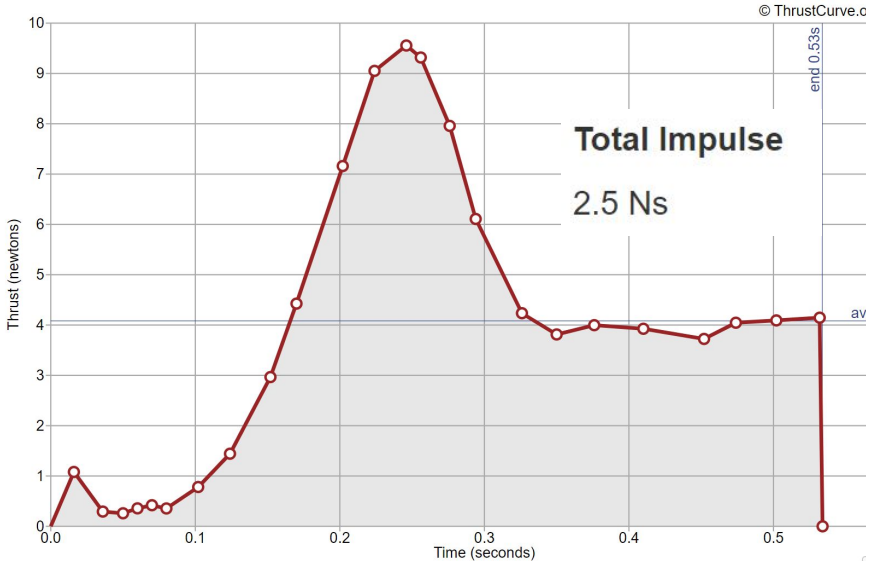

Graphical Generation
Data Analysis
Start
Clear Workspace
Define Variables
User Imputs Data File (.xlsx)
Data is saved in matlab as double array
Preload variable is removed from all data points
Graph is generated from Data set
User will imput y bounds (time)
Graph FIle will be saved to desktop
Inital and FInal TIme stored as variables
Left Riemann Sum
Right Riemann Sum
From Initial to final time for each data point
From Inital to final time for each data point
Average values
Print value (total impulse of motor pulpulsion)
Stop



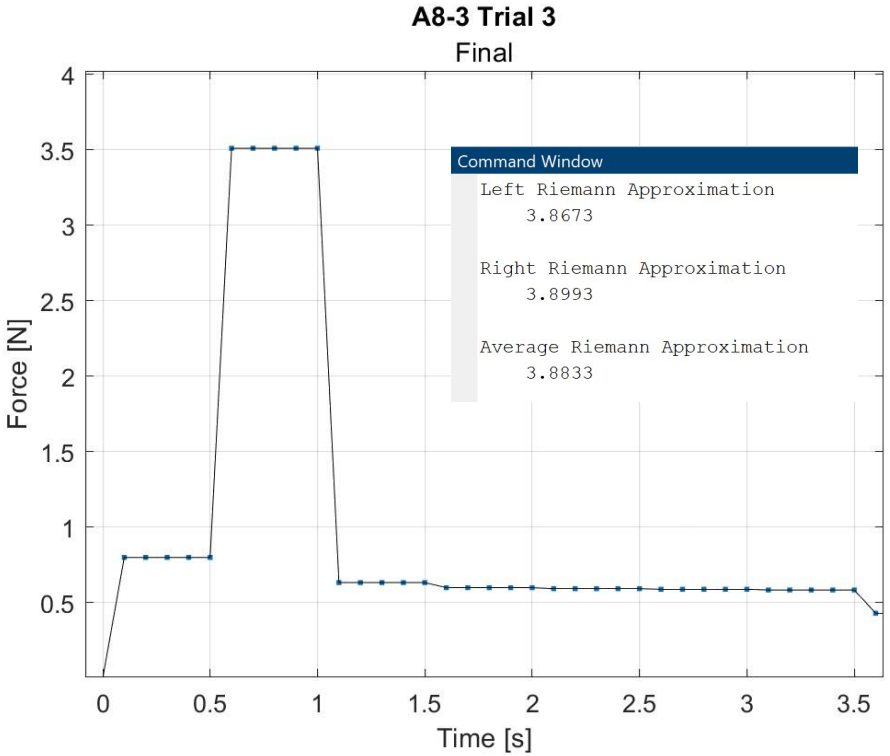
Manufacturer Data Vs. Experimental Results

A8-3

Predicted

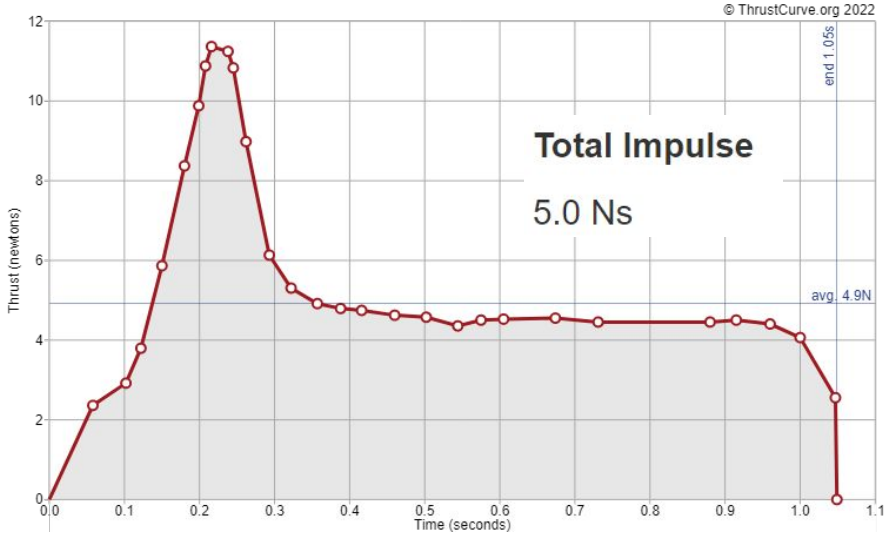


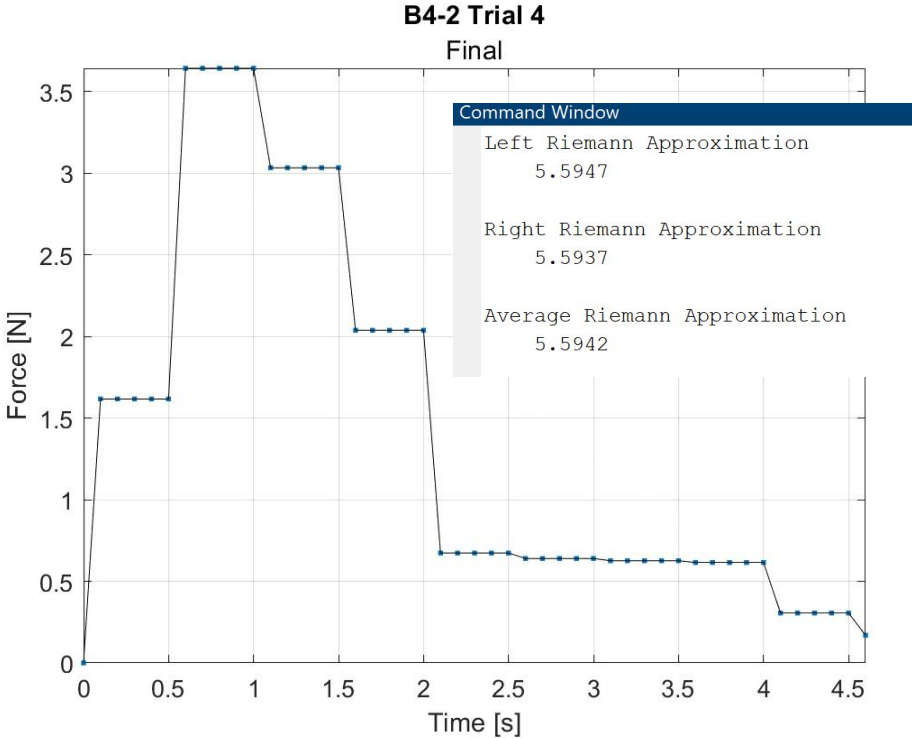
Source: Thrustcurve.org



B4-2

Predicted

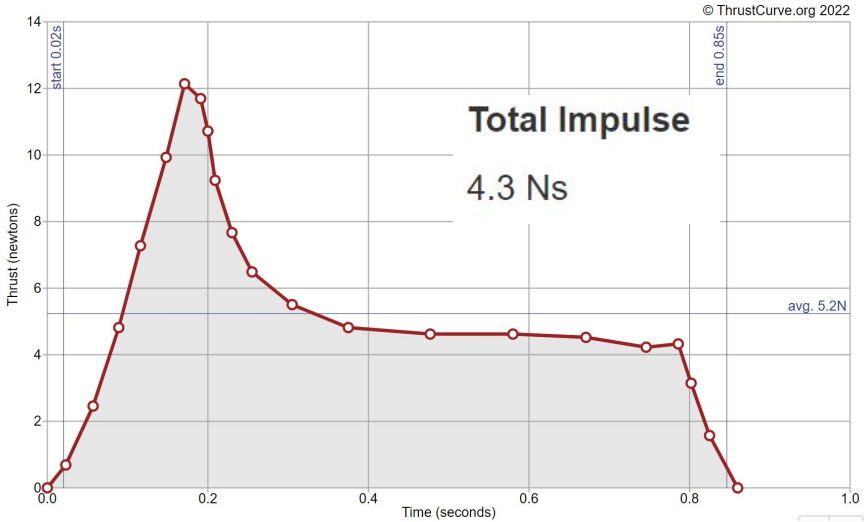




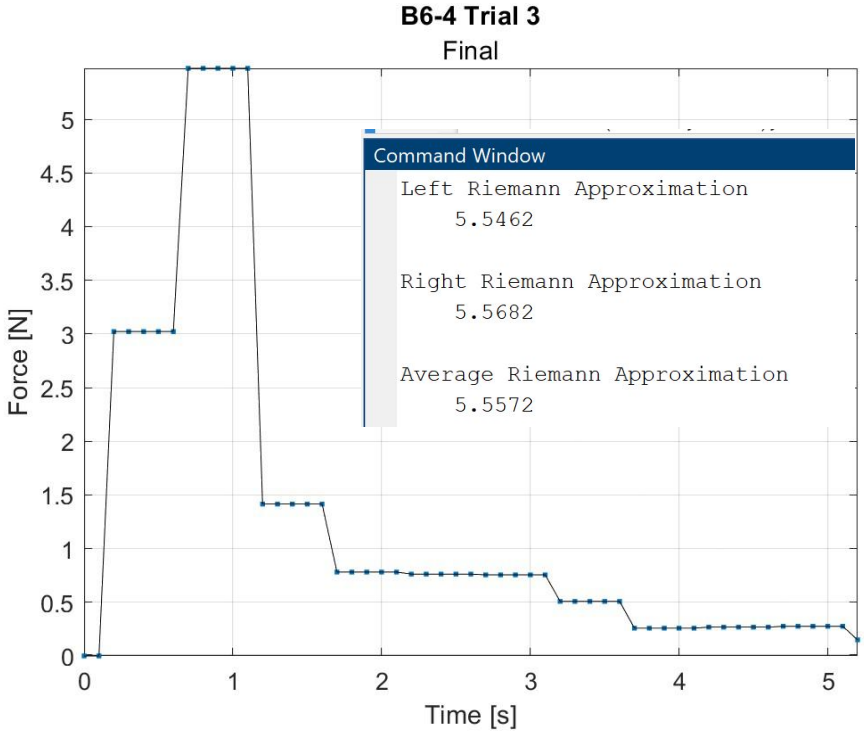
Source: Thrustcurve.org

B6-4

Predicted

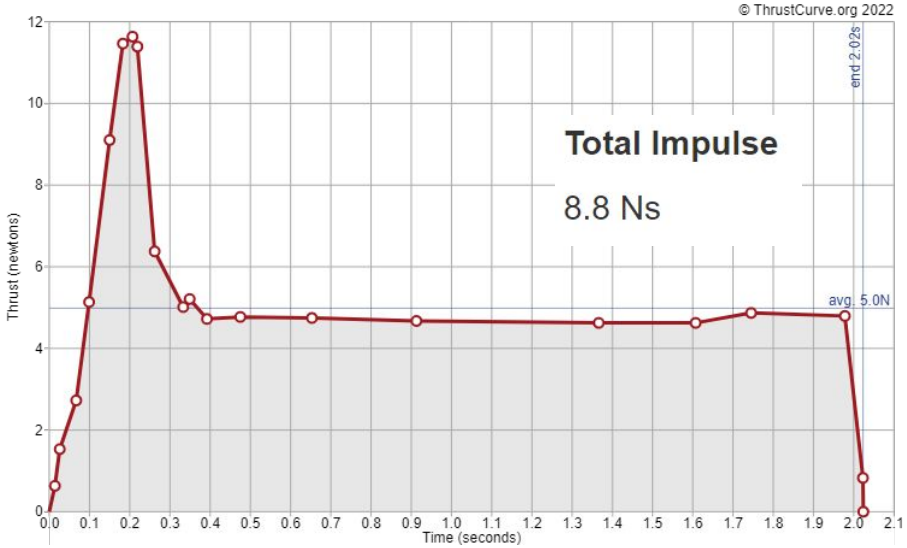


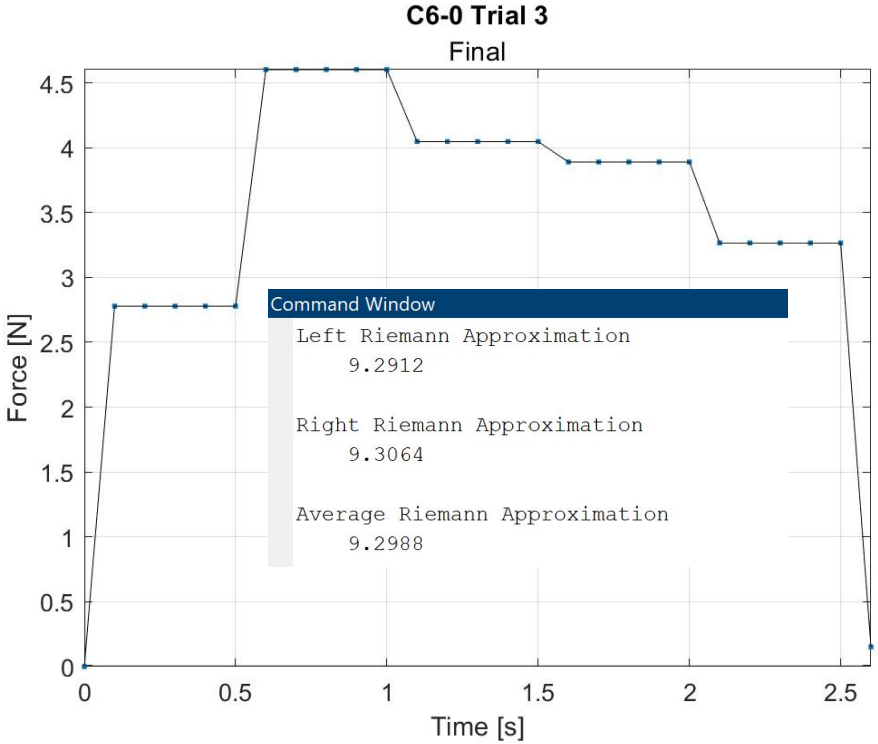
Source: Thrustcurve.org



C6-0

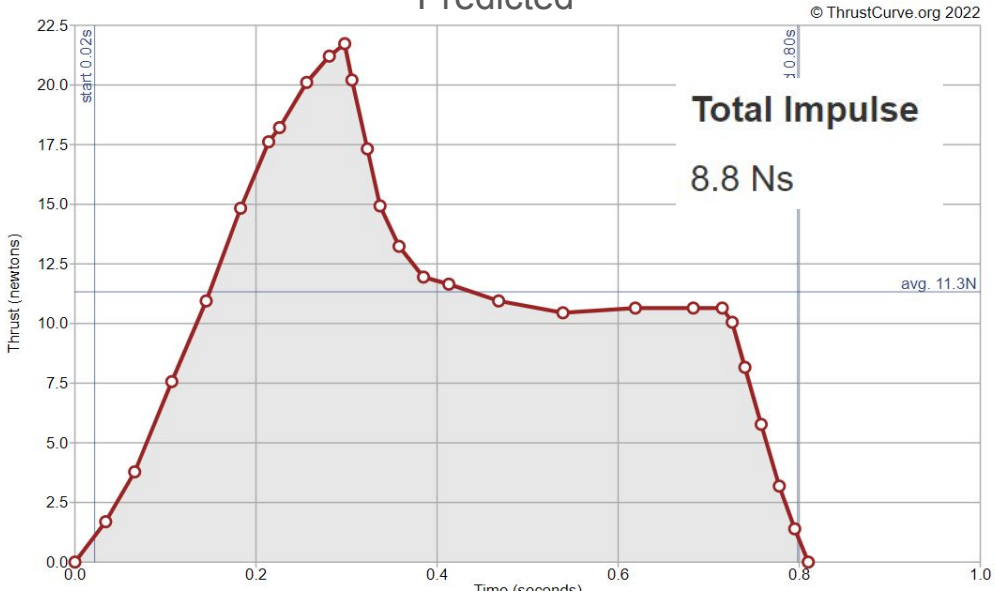
Predicted



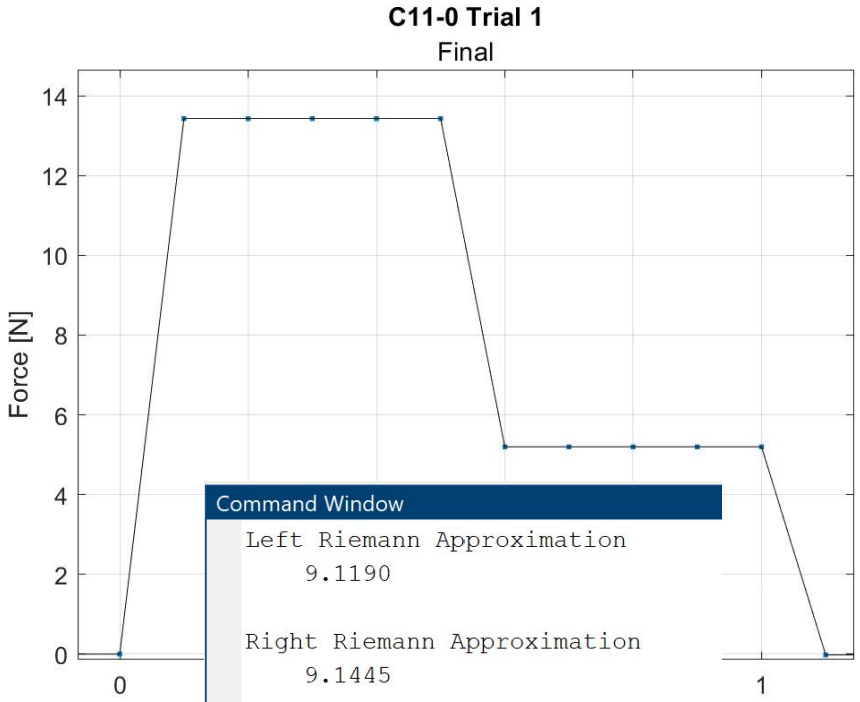


C11-0

Predicted



Source: Thrustcurve.org



Command Window

```
Left Riemann Approximation
    9.1190

Right Riemann Approximation
    9.1445

Average Riemann Approximation
    9.1318
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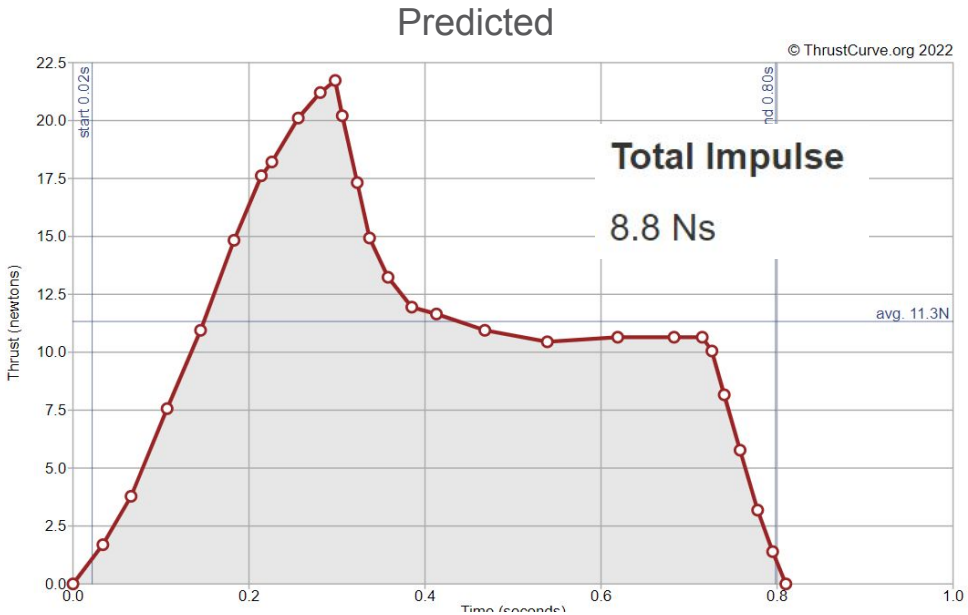
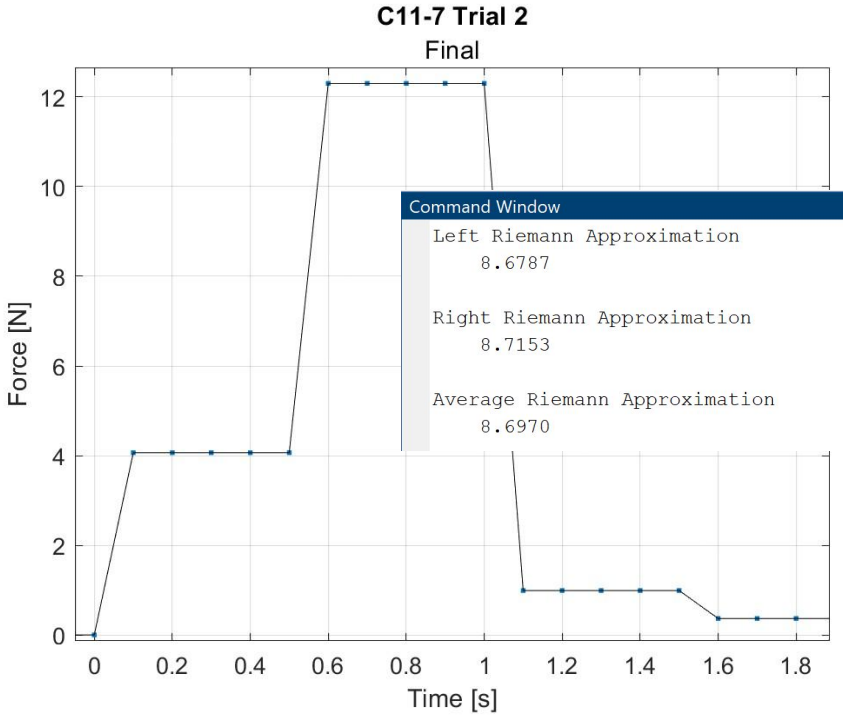
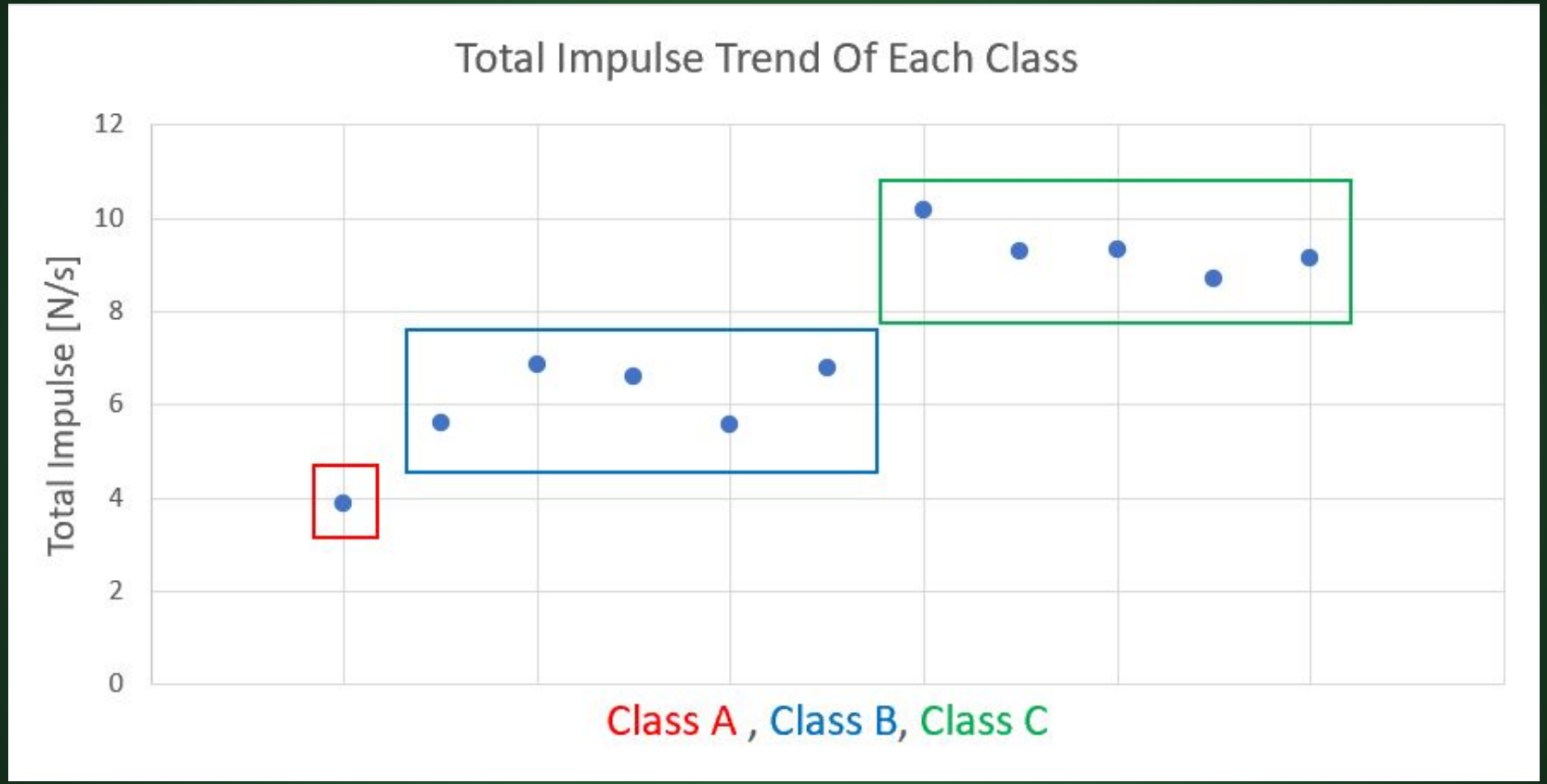
C11-7



Source: Thrustcurve.org




Total Impulse Trend Of Each Class
Total Impulse [N/s]
12
10
8
6
4
2
0
Class A , Class B, Class C

The specific impulse is :

$$I_{sp} = u_{eq} / g_e$$

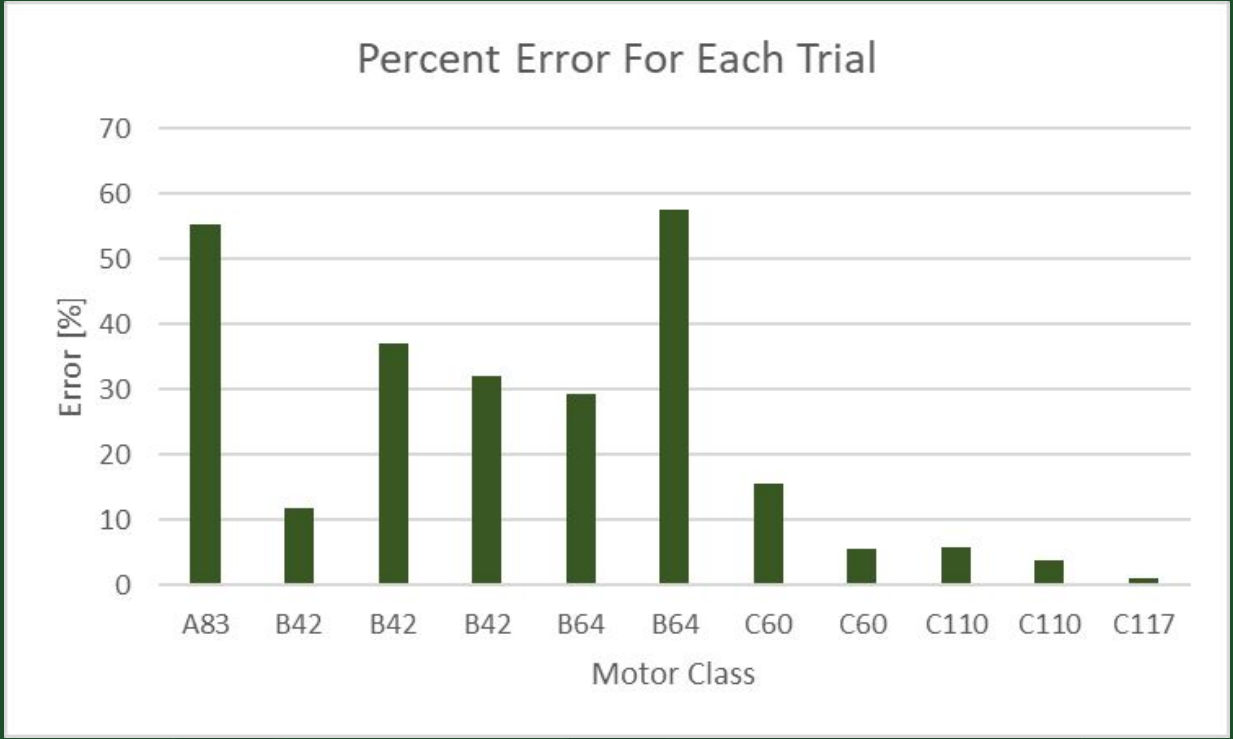
where

I_{sp} = Specific implulse

u_{eq} = Total impulse / mass of expelled propellan

g_e = Acceleration at Earth's surface (9.8 m/s^2)

Conclusion and Error



Thank you

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