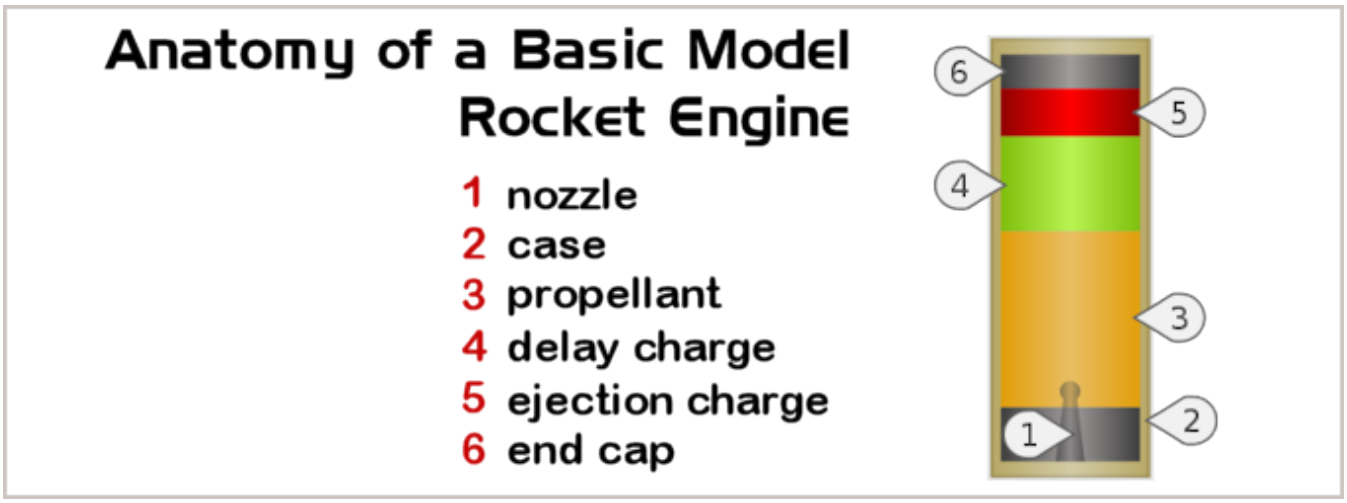
The numbers and letters of Model Rocket Motors

Learning Objective	In this lesson we will discuss the letters and number of model rocket motor classifications.
Grade Level	9 – 11

– Introduction –

The image below is a cut out of a typical model rocket engine. The nozzle (1) is the end where the hot gases from the engine eject giving the rocket its thrust. The casing (2) which holds the engine together is made usually from layers of paper or may be plastic. The propellant (3) is what actually creates the thrust for the rocket.



Model Rocket Motor

The delay charge (4) produces very little or no thrust for the rocket and serves as the gap between the thrust and the ejection charge (5) of the flight. The end cap (6) together with the

nozzle (1) keeps the contents of the model rocket engine together. Each rocket motor has a code printed representing the classification of the motor. Examples of such codes are A8-3, B6-4 and C6-3.

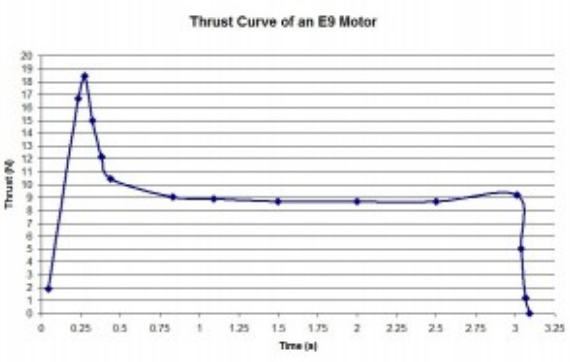


Figure 1 – Thrust curve for E9 motor

The Average Thrust

We will start with the first number that follows the letter. This number represents the average thrust of the rocket motor and is measured in Newtons. For example, an E9-6 motor, has an average thrust of 9 Newtons.

Our graph in figure 1 shows the thrust curve, or thrust vs. time, for the E9 motor. As we can see the motor reaches its peak thrust just after the 0.25 second mark and burns until the 3.1 second mark. If we were to take an average on this graph we would get 9 Newtons, the number designated in the motor code.

The Total Impulse

The letter which precedes the numbers for rocket motors and follows the first set of numbers in the case of some high power rocket motors is the Total Impulse.

Total impulse is the total power of a rocket motor. It is the

product of the Average Thrust and the Burn Time and is measured in Newton-Seconds. We represent Total Impulse for our motors using ranges which are assigned to letters.

As we can see in the table below an A motor is any motor that has a Total Impulse from 1.21 to 2.5 Newton-Seconds. We can further divide our impulse chart by size specifications.

model rocket engine impulse chart

Class	Total Impulse (Metric Standard)	Total Impulse (Imperial Standard)
A	1.26-2.50 N·s	0.29-0.56 lbf·s
B	2.51-5.00 N·s	0.57-1.12 lbf·s
C	5.01-10.00 N·s	1.13-2.24 lbf·s
D	10.01-20.00 N·s	2.25-4.48 lbf·s
E	20.01-40.00 N·s	4.49-8.96 lbf·s
F	40.01-80.00 N·s	8.97-17.92 lbf·s
G	80.01-160.00 N·s	17.93-35.96 lbf·s
H	160.01-320.00 N·s	35.97-71.92 lbf·s
I	320.01-640.00 N·s	71.93-143.83 lbf·s
J	640.01-1280.00 N·s	143.84-287.65 lbf·s
K	1,280.01-2,560.00 N·s	287.66-575.30 lbf·s
L	2,560.01-5,120.00 N·s	575.31-1150.60 lbf·s
M	5,120.01-10,240.00 N·s	1150.61-2301.20 lbf·s
N	10,240.01-20,480.00 N·s	2301.21-4602.40 lbf·s
O	20,480.01-40,960.00 N·s	4602.41-9204.80 lbf·s

Model rocket motors are those that have Total Impulses from A to E, Mid-Power motors are represented with F and G motors and High-Power rocketry motors are those with a Total Impulse of H or 160.01 Newton-Seconds and above.

If we take our E9-6 motor as an example again and multiply the average thrust 9 by the burn time of 3.1 seconds we get a Total Impulse of 27.9 Newton-Seconds. This sits about half way within the E motor designation.

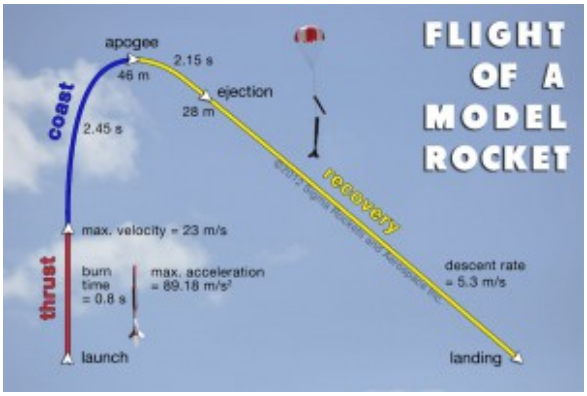


Figure 2 – Flight Path of a Model Rocket

The Delay Time

The final number in the rocket motor designation is the delay time that occurs after the thrust of the motor and before the ejection charge. An “A” may be present indicating that the delay is adjustable. Using figure 2 as a reference, the delay time is the amount of time taken from coast through apogee and right to ejection.

Figure 2 is a graphic of a model rocket flight with measured values. The data for this graph was based on a flight with a B6-4 motor. Adding the time from the beginning of the coast phase to apogee and the apogee to ejection we get 4.6 seconds. This is close to the rating on the motor of 4 seconds.

In some cases the motor may not have an ejection charge. This would be indicated with a “P” instead of a number. Such motors are used for rocket gliders and rockets where parachute deployment is controlled with electronics.

Our Video on model rocket motor classifications

We have produced a video on model rocket motor classifications. The video is based on the information above.