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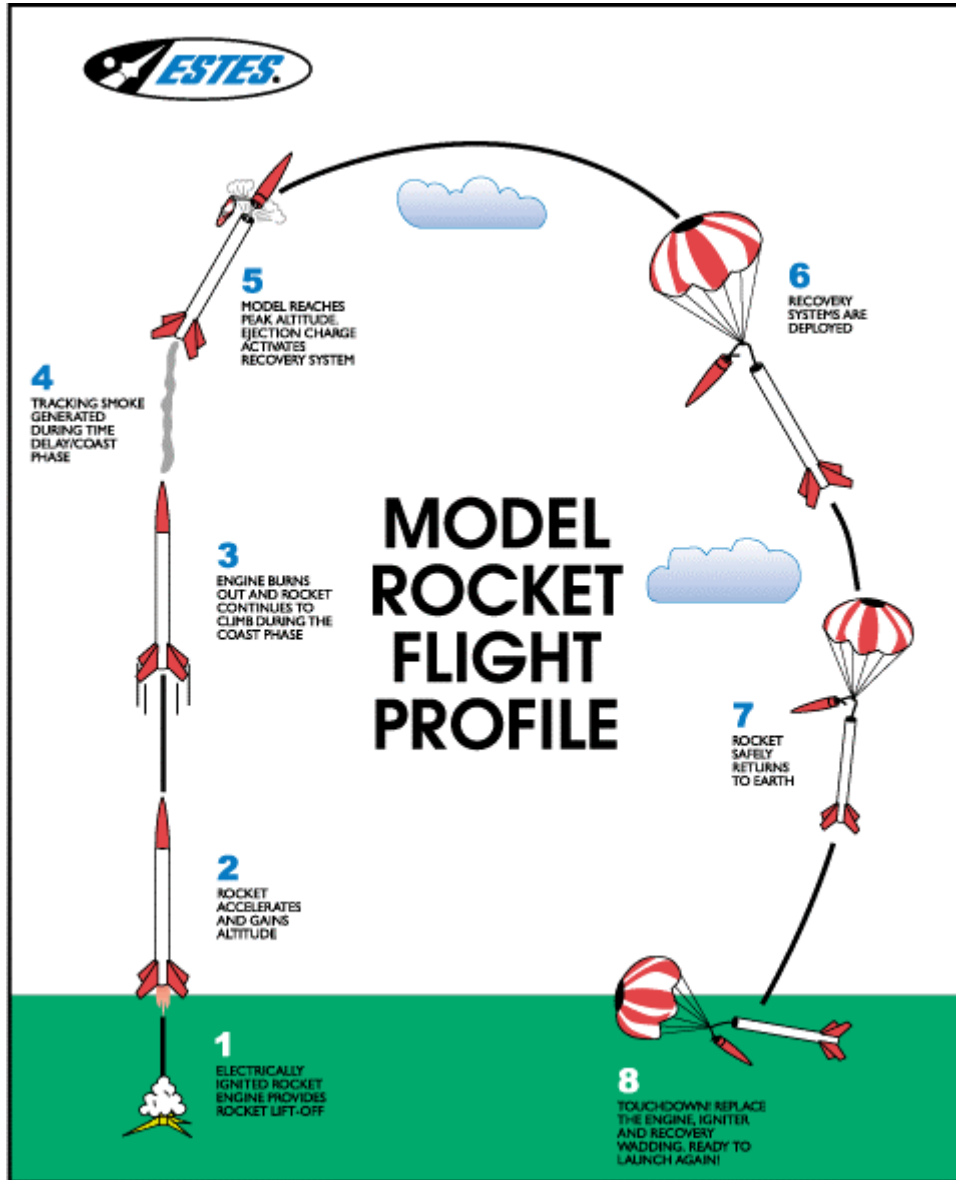
# **Rocketry**

# **101**

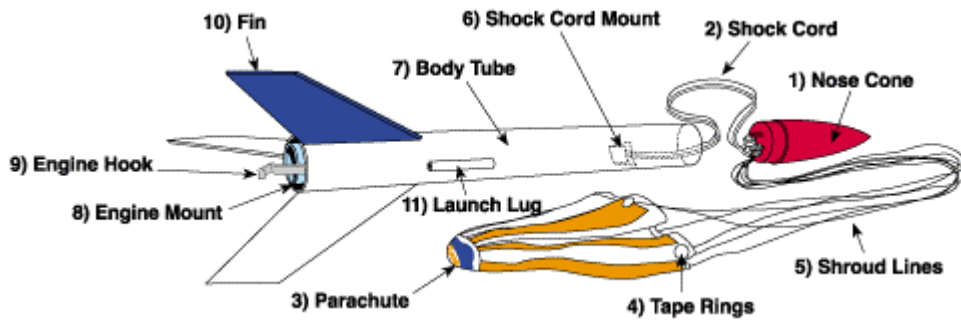
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**Cub Scout Pack 33**

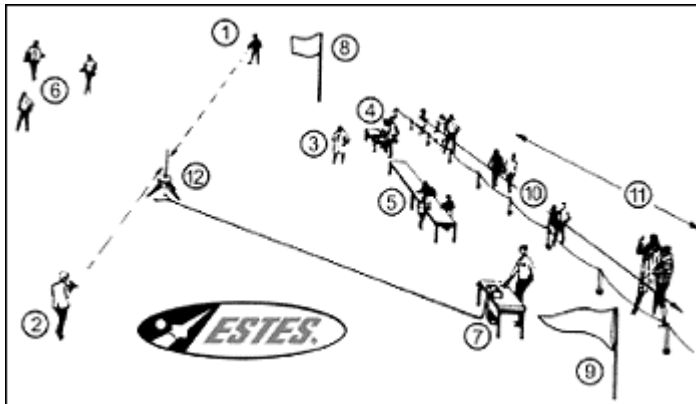
# Model Rocket Flight Profile



## Components of a Typical Model Rocket



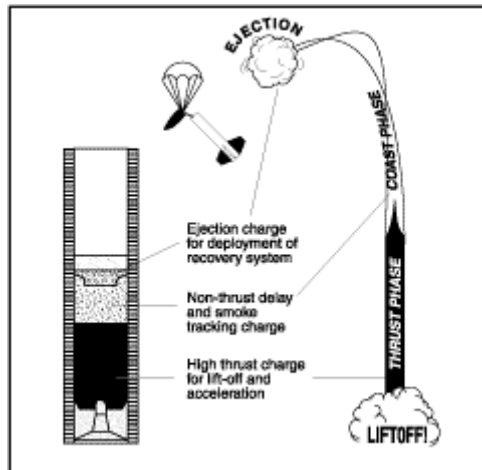
## Launch Site Layout



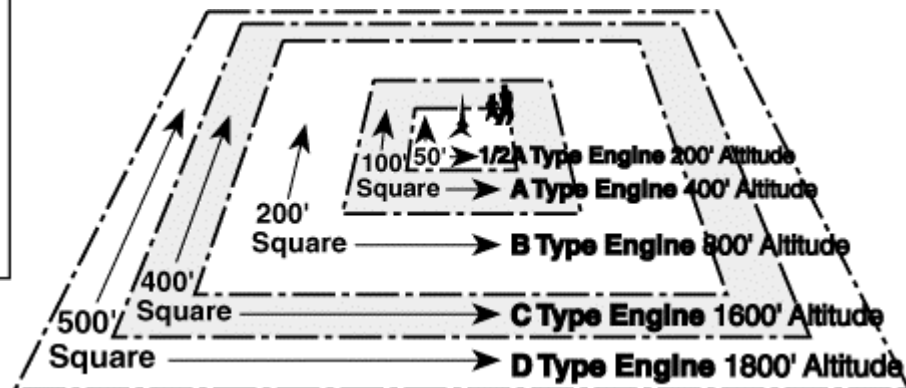
- ① Tracker 1
- ② Tracker 2
- ③ Range Safety Officer
- ④ Data Recording Table
- ⑤ Preparation Table
- ⑥ Recovery Team
- ⑦ Launch Control Officer
- ⑧ National or Club Flag
- ⑨ Range-In-Operation Pennant (optional)
- ⑩ Student-Observers
- ⑪ Parking Area (optional)
- ⑫ Launching Pad

## Recommended Launch Area

Minimum Launch Site Dimension for Circular Area is Diameter in Feet, and for Rectangular Area is Shortest Side in Feet.



Choose a large field away from power lines, buildings, tall trees, and low-flying aircraft. The larger the launch area, the better your chance of recovering your rocket. Football fields, parks, and playgrounds are great. This diagram shows the smallest recommended launch areas.



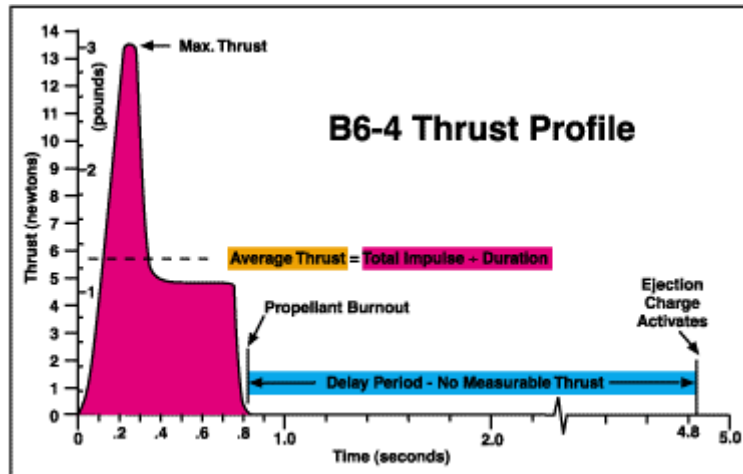
**MAKE SURE THE LAUNCH AREA IS FREE OF OBSTRUCTIONS, DRY WEEDS, BROWN GRASS, OR HIGHLY FLAMMABLE MATERIALS.** Launch only during calm weather with little or no wind and good visibility.

## Facts About Estes Rocket Engines

Safe, intelligent design, precise manufacture and strict engineering tolerances have made Estes rocket engines the standard in the industry. They have been proven consistent and reliable in more than 300 million launches. Some important features are:

- Lightweight non-metallic casings made from paper and clay materials
- Pre-loaded with propellant - the modeler does not handle any hazardous materials
- Expendable and bio-degradable - use them once and throw them away. Reloading is forbidden.
- Non-toxic propellant - however, ingestion is not recommended!
- 3% of all Estes engines made are static-tested at the factory for reliability and adherence to performance specifications. If our standards aren't met, the engines are rejected and don't make it to market.

The concept of the pre-assembled rocket engine is the foundation of this safe, scientific and educational activity.



## CODING SYSTEMS

Two codes completely describe each Estes rocket engine:

1. Color code: Provides at a glance the specific application of the engine:  
 Green – Single Stage  
 Purple – Upper Stage (on Multi-Staged Rockets)  
 Red – Booster Stage  
 Black – Plugged for special applications
2. Alpha-numeric code: Provides the engine's performance information.

### TOTAL IMPULSE

This letter indicates total impulse (total power in newton-seconds) produced by the engine. Each succeeding letter has up to twice the total power as the previous letter. (Example: "B" engines have up to twice the power of "A" engines, which results in approximately twice the altitude the rocket will reach.)

### AVERAGE THRUST

This number shows the engine's average thrust or average push in newtons. (4.45 newtons = 1 lb.)

### DELAY

This number gives you the time delay in seconds between the end of thrusting and the ejection charge (green and purple labels). It lets you choose the engine with the delay time you want for any flight. Engine types ending in "0" (red label) have no delay or ejection charge and are for use in booster stages only.



## TOTAL IMPULSE CLASSIFICATION

Code	pound-seconds	newton-seconds
1/2A	0.14-0.28	0.625-1.25
A	0.28-0.56	1.26-2.50
B	0.56-1.12	2.51-5.00
C	1.12-2.25	5.01-10.00
D	2.24-5.00	10.01-20.00

## HOW HIGH WILL YOUR ROCKET GO?

The chart below shows the approximate altitudes that can be achieved with single stage rockets.

Engine Size	Altitude Range (depending on rocket size and weight)	Approximate Altitude in a typical 1 oz. model
1/2A6-2	100 to 400	190
A8-3	200 to 650	450
B6-4	300 to 1000	750
C6-5	350 to 1500	1000

(Some high performance rockets will reach higher altitudes than shown above.)

## SELECTING THE PROPER ROCKET ENGINE

We offer several rocket engine bulk packs in five total impulse ranges. These packs may be used with the rockets listed on pages throughout this catalog or other Estes rockets. The description of each kit lists recommended engines. Select your engines based on these recommendations.

Bulk packs are convenient and include everything your students will need to prepare their rockets for flights.



### MODEL ROCKET ENGINE BULK PACKS

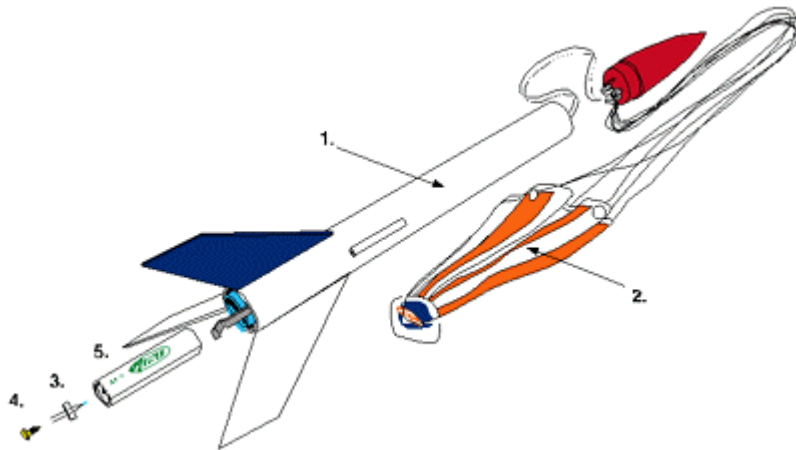
Include:

1. 24 rocket engines
2. 30 model rocket igniters
3. 24 reusable igniter plugs
4. 75 - 11.4 cm (4.5") squares of recovery wadding - enough for approximately 25 launches

1/4 A3-3T Bulk Pack .....	EST 1779
1/2A3-2T Bulk Pack .....	EST 1780
A8-3 Bulk Pack .....	EST 1781
B6-4 Bulk Pack .....	EST 1783
B6-0/B6-6 Bulk Pack .....	EST 1784
C5-3 Bulk Pack .....	EST 1785

### Rocket Preflight Preparation

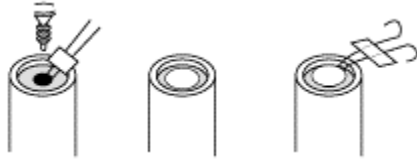
Once your rocket is complete, follow this simple sequence to ready it for flight:



1. Insert recovery wadding (refer to the instructions for the correct amount).
2. Fold and insert the recovery device.
3. Install igniter.
4. Insert igniter plug\*.
5. Insert engine into mount.

Here's how to use Estes' igniter plug\* technology.

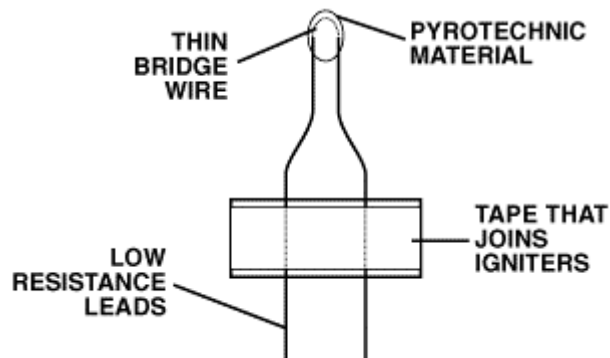
Our brightly colored reusable igniter plugs have virtually eliminated the frustrations and misfires common to other igniter systems.



\*Igniter Plugs - U.S. Patent Nr. 5,410,966

## The Estes Igniter

An igniter is a device used to ignite a rocket engine. In Estes rocketry, an igniter element is a strip of resistance wire with a coating of pyrotechnic material on it. In the system it performs like a resistor in an electrical circuit. As electricity passes through micro-clips connected to the igniter, the igniter begins to glow and give off heat. The pyrotechnic material coating is ignited and is the last step in the ignition. Igniters must be installed so that the coating is touching the dark-colored propellant grain. If the igniter is not touching the grain, this could cause a misfire.



Heat created by the igniter is not great enough to cross a gap between the igniter and propellant grain -- there must be direct contact between the igniter and the propellant. First, separate the igniter you are going to use from the other igniters by tearing or cutting the paper between any two igniters. Do not remove the paper from the igniter as this may result in cracking the pyrotechnic coating. Now take the igniter and insert it all the way into the nozzle of the engine, making sure that the igniter is touching the propellant grain. For some engines you may have to push the igniter a long way down, as when using a C5 type engine, so push down gently until the igniter will go no further. Make certain that the igniter's leads are not crossed. If the leads are crossed, this can cause a "short" in your launch system and thus a misfire. Place the igniter plug in the nozzle of the engine and press down firmly. Bend the igniter leads as shown to the below.



## MINI-ENGINE ROCKETS

ROCKET NAME	PROD #	SKILL LEVEL	1/2A3-2T	1/2A3-4T	A3-4T	A10-3T
Gnome™	0886	E2X	●	●	●	●
Mosquito™	0801	1		●	●	●
Nike Arrow™	0835	E2X	●		●	●
Ninja®	0882	1		●	●	
Star Wars Red Squadron X-wing™ Starfighter	1810	RTF			●	●
Star Wars Red Squadron X-wing™ Starter Set	1822	RTF			●	●
Quark™	0802	1		●	●	●
X-Ray™	0834	E2X	●		●	●

## D ENGINE ROCKETS

ROCKET NAME	PROD #	SKILL LEVEL	D11-P	D12-0	D12-3	D12-5	D12-7
Black Brant II™	1958	2				●	●
Comanche-3™ <sup>1</sup>	1382	3	●				1st STAGE ONLY
Longshot™ <sup>1</sup>	2128	2	●				1st STAGE ONLY
Maniac™ <sup>2</sup>	2091	3				●	●
Mean Machine™	1295	2				●	
Mercury Atlas™	2111	4		●			
Phoenix™	1380	3		●			
Python™	2129	2				●	●
Silver Comet™	2141	2			●	●	
SM-3 Seahawk™	2149	2				●	
Star Wars Star Destroyer™	2147	2		●			
Sweet Vee™	2116	R/C	●				