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# ROCKETRY 101

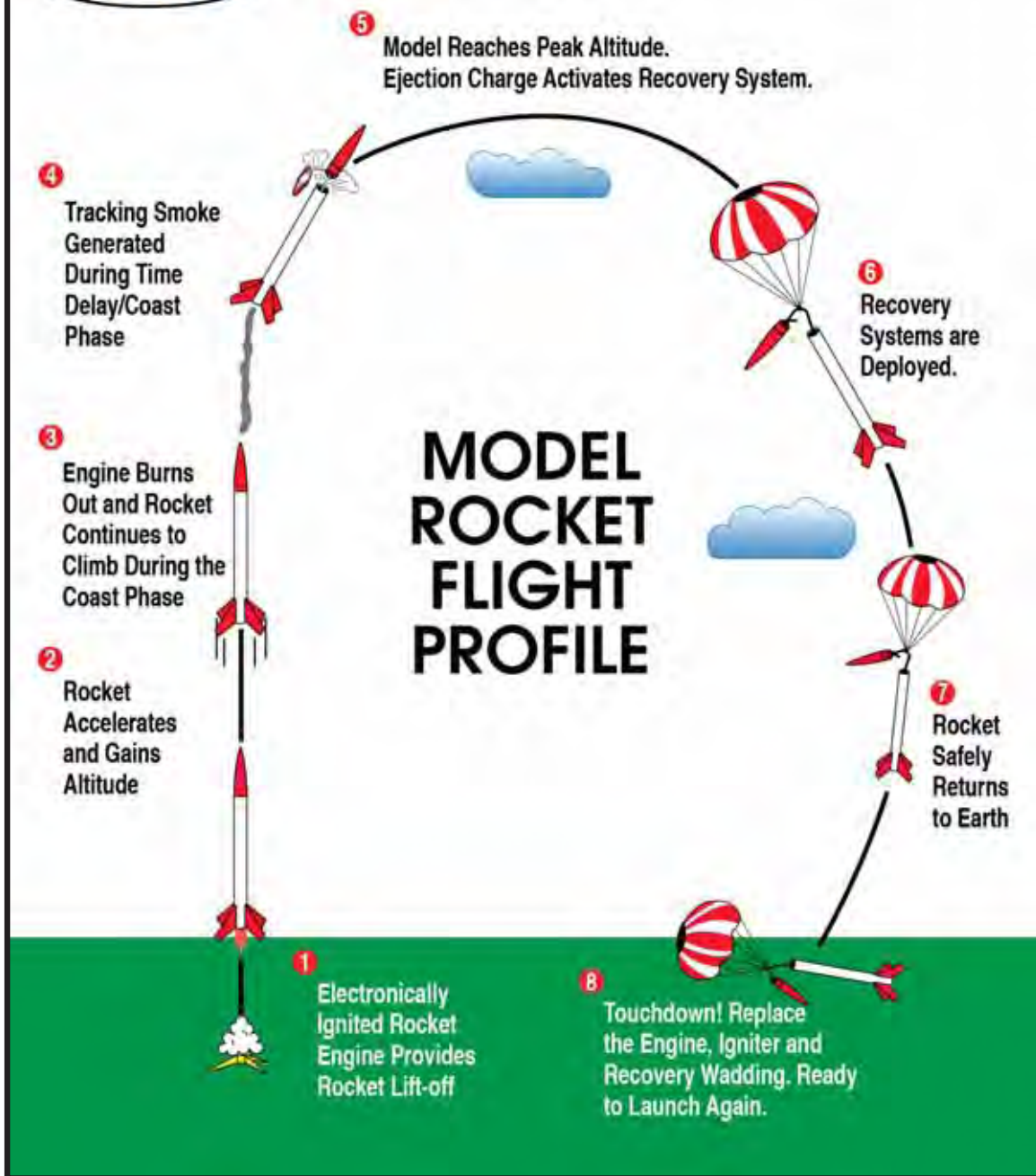
## Estes Model Rocketry Basics



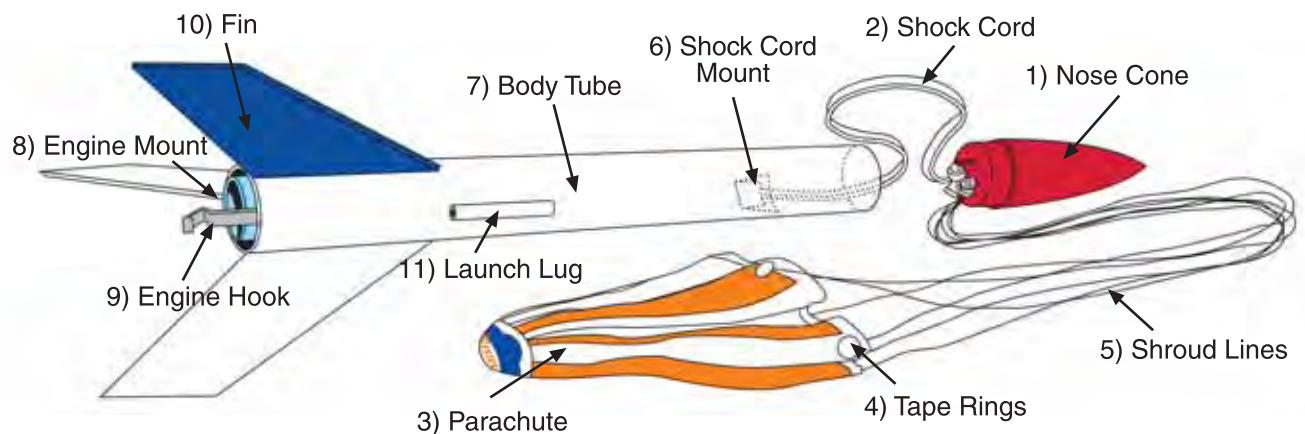
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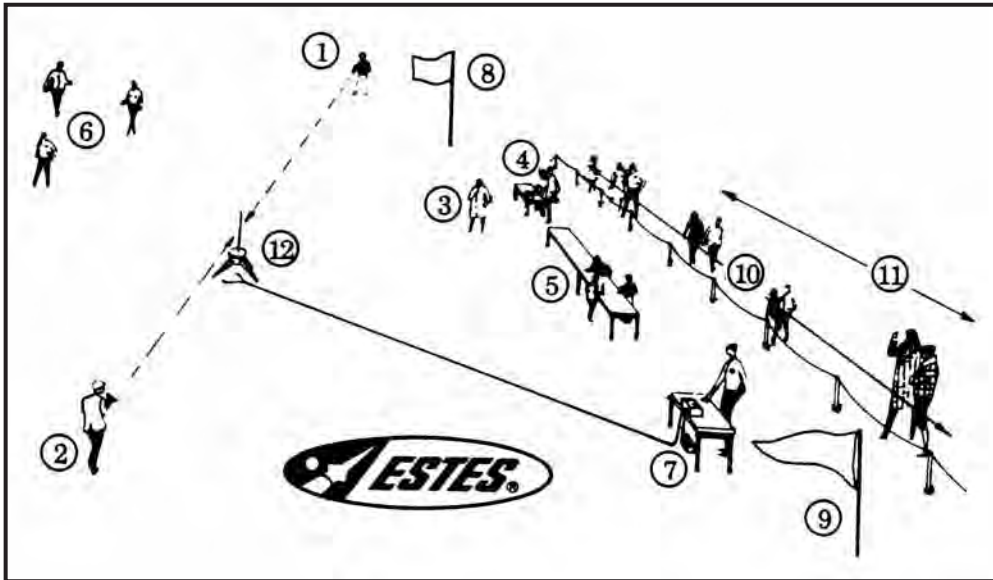
## Model Rocket Flight Profile



## Components of a Typical Model Rocket



## Launch Site Layout

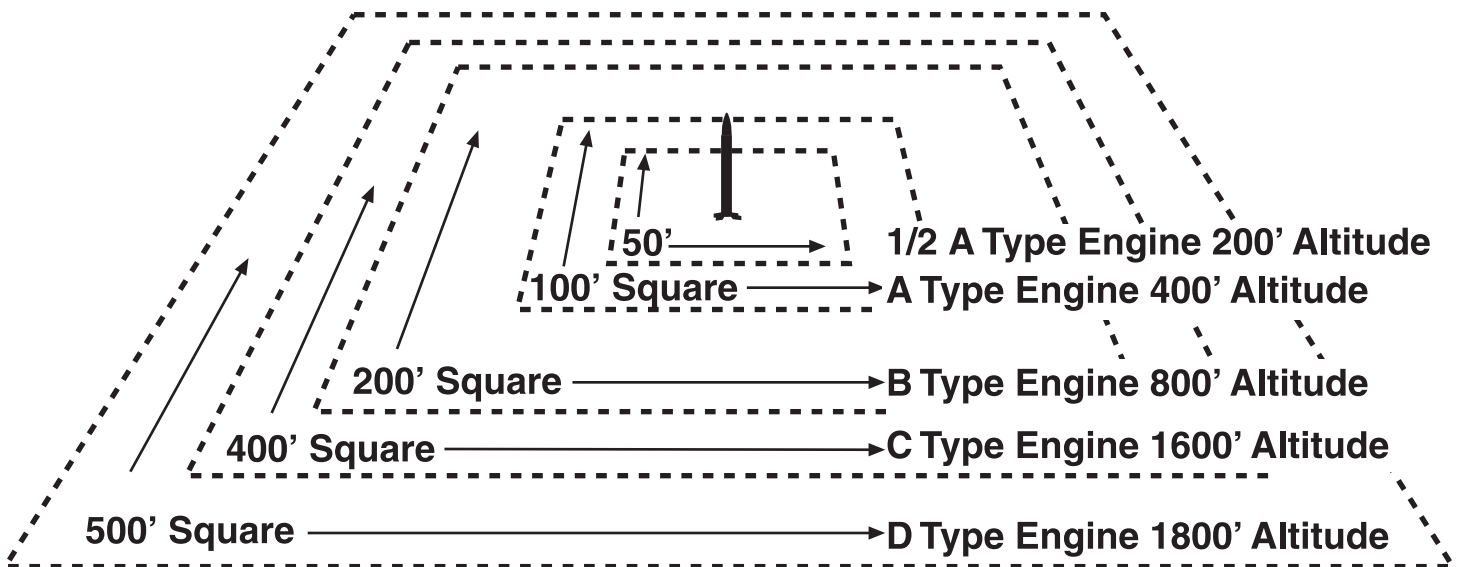


- ① Tracker 1
- ② Tracker 2
- ③ Range Safety Officer
- ④ Data Recording Table
- ⑤ Preparation Table
- ⑥ Recovery Team
- ⑦ Launch Control Officer
- ⑧ National or Club Flag
- ⑨ Range-In-Operation Pennant (optional)
- ⑩ Student-Observers
- ⑪ Parking Area (optional)
- ⑫ Launch Pad

## 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.



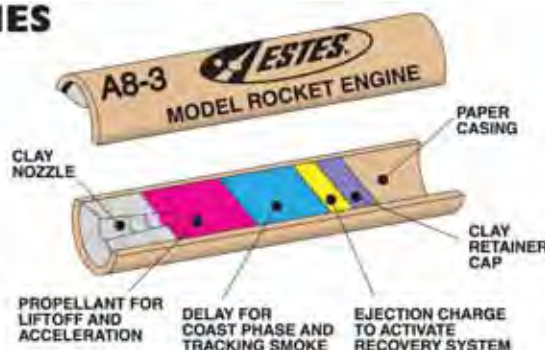
**MAKE SURE THE LAUNCH AREA IS FREE OF OBSTRUCTIONS, DRY WEEDS, BROWN GRASS, OR HIGHLY FLAMMABLE MATERIALS.** Launch only during calm weather with little or no wind and good visibility.



# ESTES MODEL ROCKET ENGINES

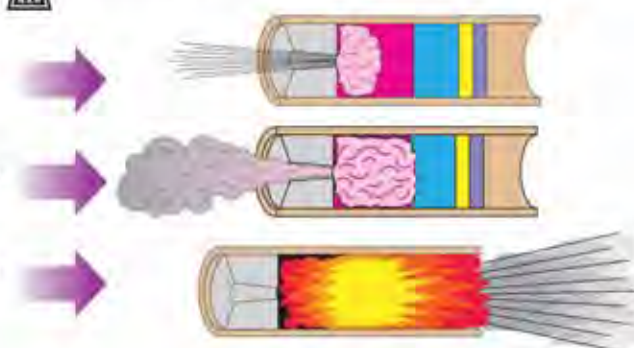
The famous model rocket engines that made model rocketry the great activity it is today. Estes model rocket engines have been proven consistent and reliable in more than 315,000,000 launches.

- The concept of a factory assembled model rocket engine is the foundation of this scientific and educational activity!
- 3% of all Estes engines are static-tested at the factory for reliability and adherence to performance specifications.
- All engines comply with the code requirements of the National Fire Protection Association and are certified by the National Association of Rocketry.



## HOW DOES A MODEL ROCKET ENGINE WORK?

1. When engine is ignited, it produces thrust and boosts rocket into sky.
2. After propellant is used up, delay is activated, producing tracking smoke and allowing rocket to coast.
3. After delay, ejection charge is activated, deploying recovery system.



## WHAT SIZES ARE AVAILABLE?

Estes engines are available in a wide variety of sizes and power levels:

TYPE	TOTAL IMPULSE	ENGINE TYPES
1/4A	0.313 - 0.625	Mini
1/2A	0.626 - 1.25	Standard, Mini
A	1.26 - 2.50	Standard, Mini
B	2.51 - 5.00	Standard
C6	5.01 - 10.00	Standard
C11	5.01 - 10.00	'D' Size
D	10.01 - 20.00	'D' Size
E	20.01 - 30.00	'E' Size

## WHAT DO THE DIFFERENT COLOR ENGINES MEAN?

Each type of engine is printed in a different color:

**Single Stage - Green**

**Upper Stage - Purple** (Upper stage engines can be used as single stage engines in lightweight rockets.)

**Booster - Red** (Booster engines contain no delay or ejection charge.)

**Plugged - Blue** (Plugged engines are used for R/C gliders and contain no delay or ejection charge.)

Each engine has a letter-number-number code. (e.g., B6-4)

Letter: B

Number: 6

Number: 4



### B = TOTAL IMPULSE

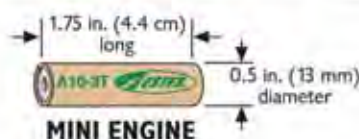
This letter is the total power (in Newton-seconds) produced by the engine. Each succeeding letter has up to twice the total power as the previous letter. (Example: 'B' engines have up to twice the power of 'A' engines, which results in approximately twice the altitude the rocket will reach.)

### 6 = AVERAGE THRUST

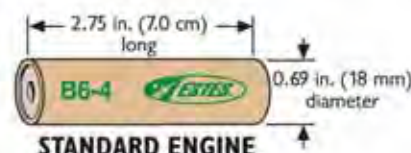
This number shows the engine's average push or how fast the engine powers the rocket to go. The higher the number, the faster the speed. It is measured in Newtons (4.45 Newtons = 1 lb.).

### 4 = TIME DELAY

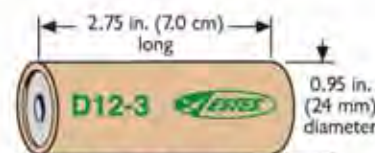
This number gives you the time delay in seconds between the end of the thrust phase and ignition of the ejection charge. Engine types ending in '0' have no time delay or ejection and are used for booster stages and special purposes only. Engines ending in 'P' have no time delay or ejection charge and the forward end is "Plugged".



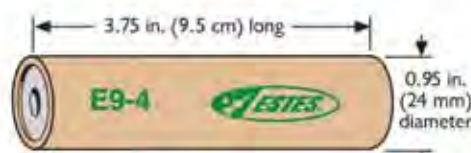
MINI ENGINE



STANDARD ENGINE



'CII' & 'D' ENGINE



'E' ENGINE

## Selecting A Rocket Engine

Estes offers several engine bulk packs in different impulse ranges. Each rocket kit lists recommended engines. Select your engines based on these recommendations.

Bulk packs are convenient and include everything your scouts 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

Blast-Off® Flight Pack

1/2A3-4T Bulk Pack

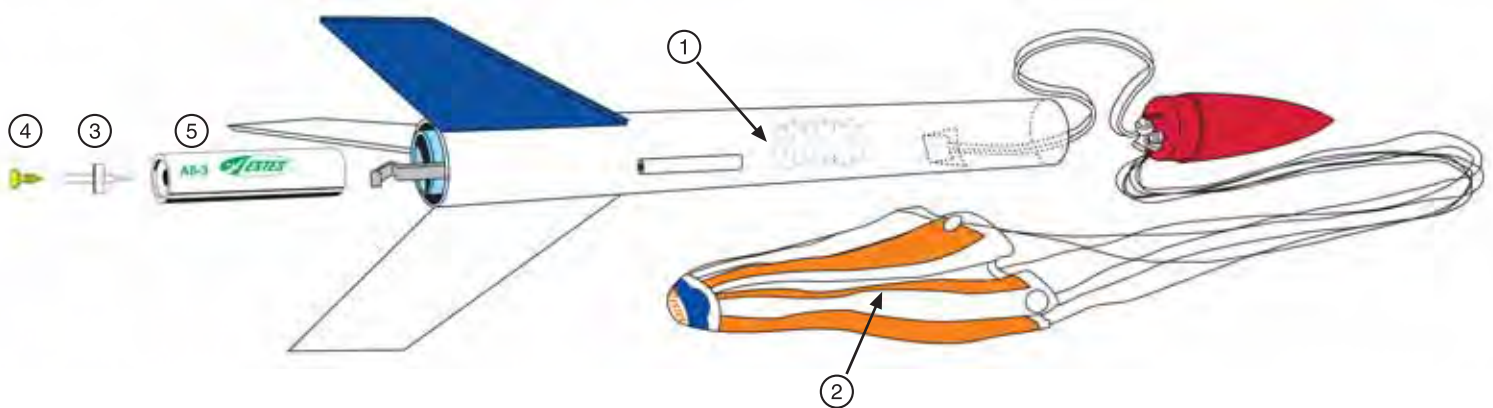
A8-3 Bulk Pack

B6-4 Bulk Pack

C6-5 Bulk Pack

## Rocket Preflight Preparation

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

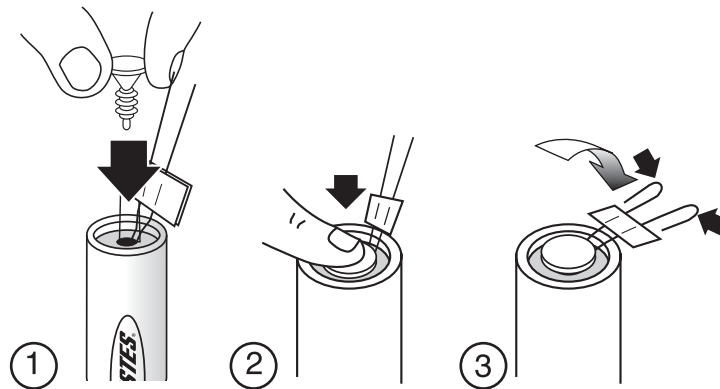


- 1) Insert recovery wadding (refer to the instructions for the correct amount).
- 2) Fold and insert the recovery device.
- 3) Install igniter.
- 4) Insert igniter plug\*.
- 5) Insert engine into mount.

### The Estes Igniter

How to Use Estes' Igniter Plug\* technology.

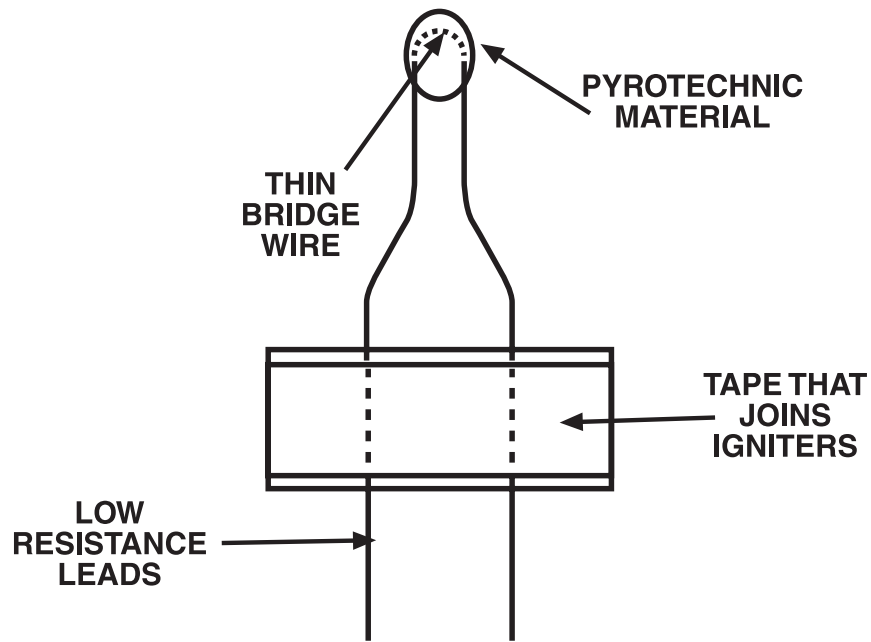
Our brightly colored reusable igniter plugs have virtually eliminated the frustrations and misfires common to other igniter systems.



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

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 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 below.

