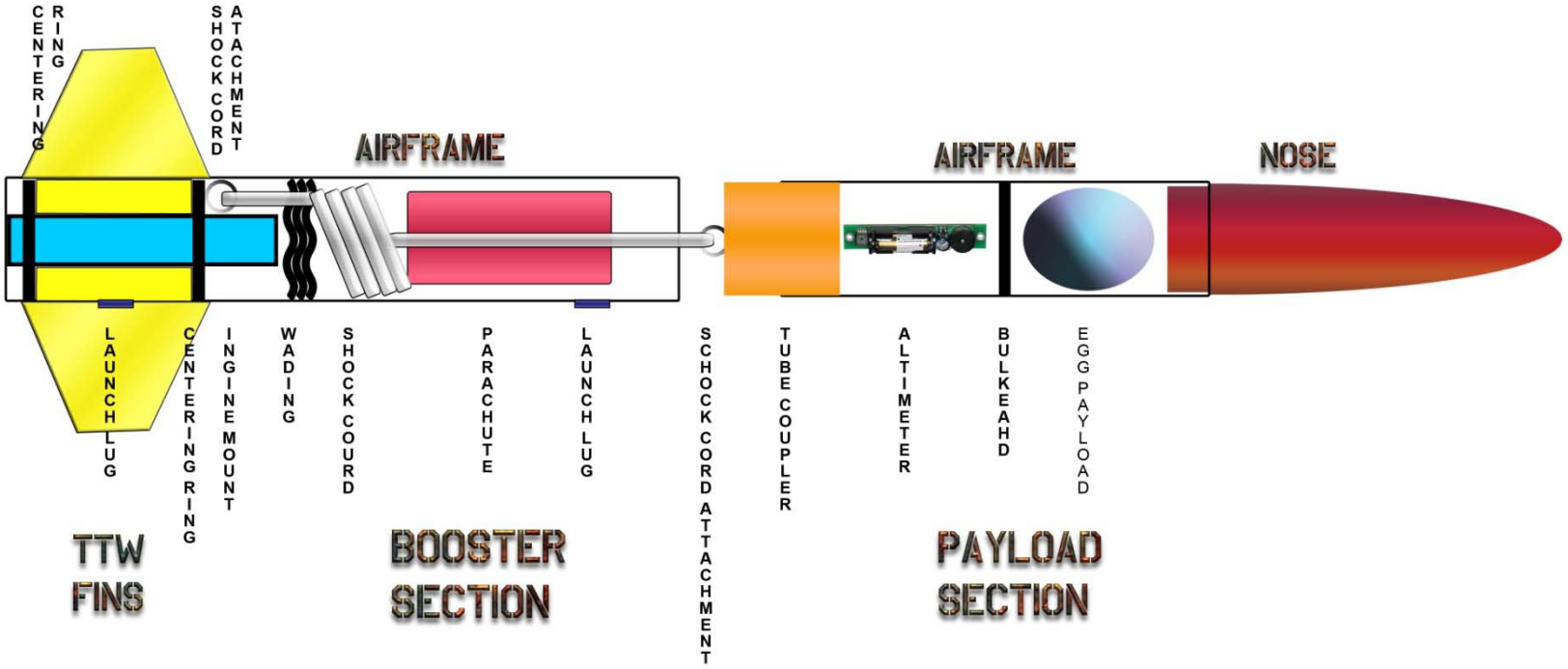
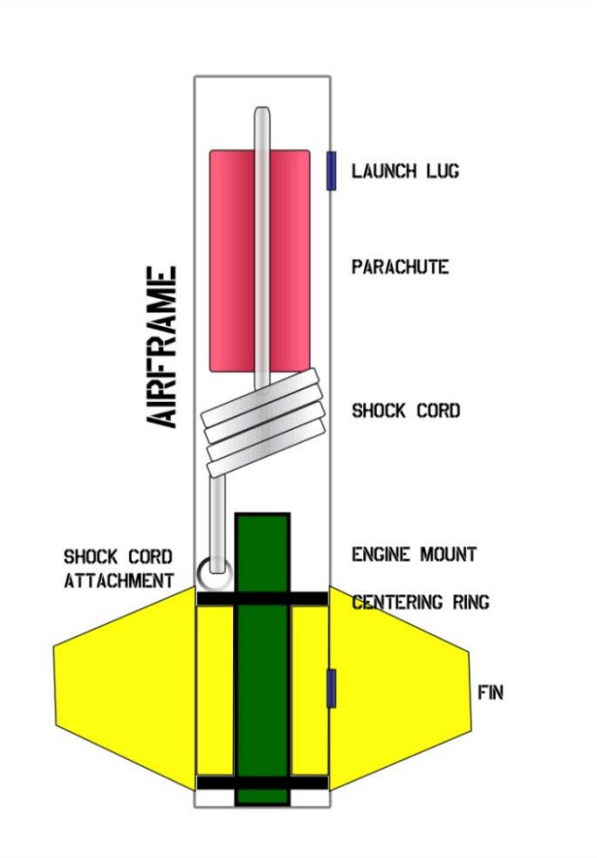
LESSON LD02

# The Model Rocket

# PAYLOAD ROCKET

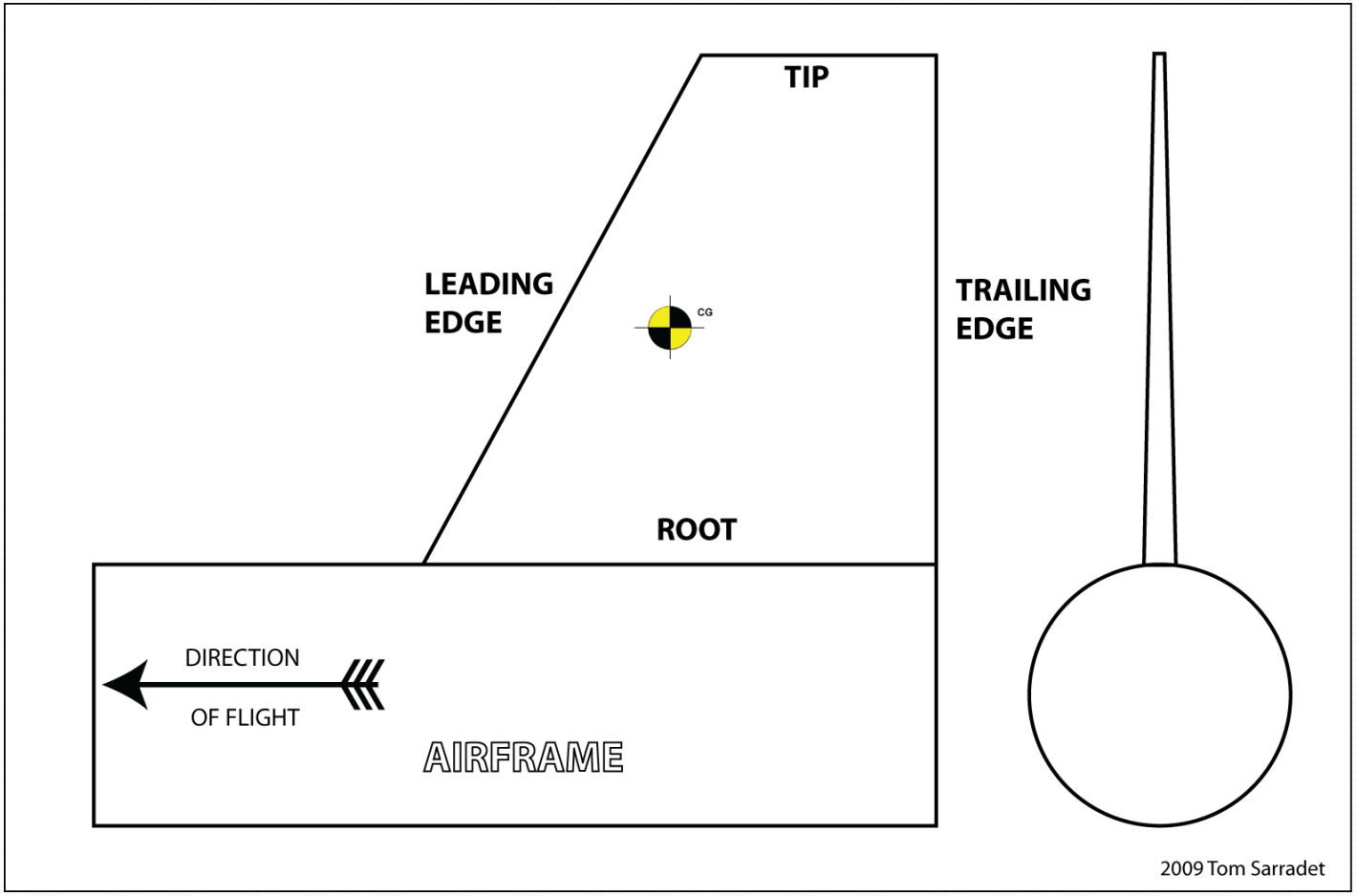


# Booster Section




- **Launch Lug** – helps to guide the rocket upward until it reaches enough velocity for the fins to engage.
- **Parachute** – assists in the safe recovery of the rocket.
- **Shock Cord** – connects the parachute and nosecone to the booster. It absorbs the shock of ejection charge.
- **Shock Cord Attachment** – attaches the shock cord to the booster section.
- **Centering Rings** – attach the engine mount (and sometimes the fins) to the airframe.
- **Engine Mount** – holds the rocket engine inside the rocket.
- **Engine Retainer** – prevents the engine from being ejected by the ejection charge.
- **Fins** – guides the rocket in a straight path.

# The Fin


TIP
LEADING EDGE
CG
TRAILING EDGE
ROOT
DIRECTION
OF FLIGHT
AIRFRAME
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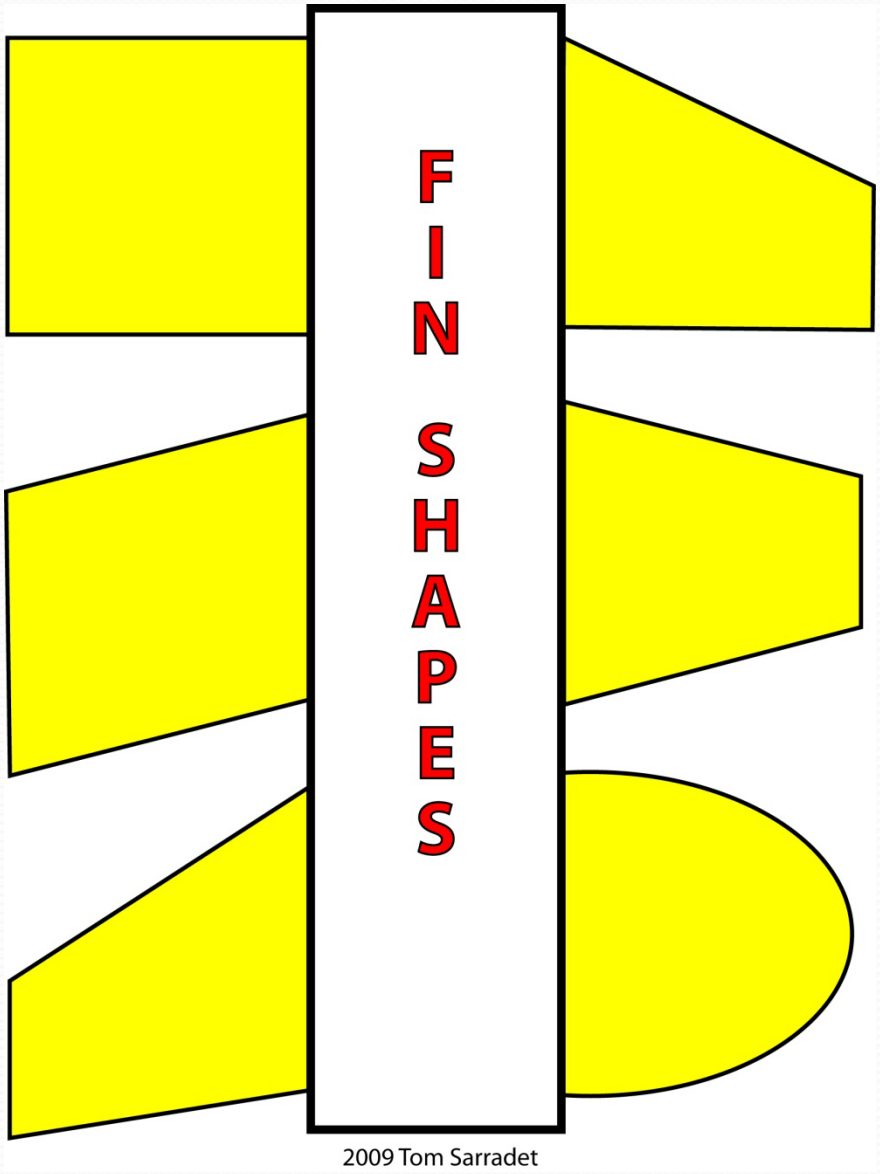
**RECTANGULAR**
Simple to make, least aerodynamic

**SWEPT**
Simple to make, slightly better aerodynamics

**TAPERED SWEPT**
Moves Center of Pressure back, good design for fast moving rockets.

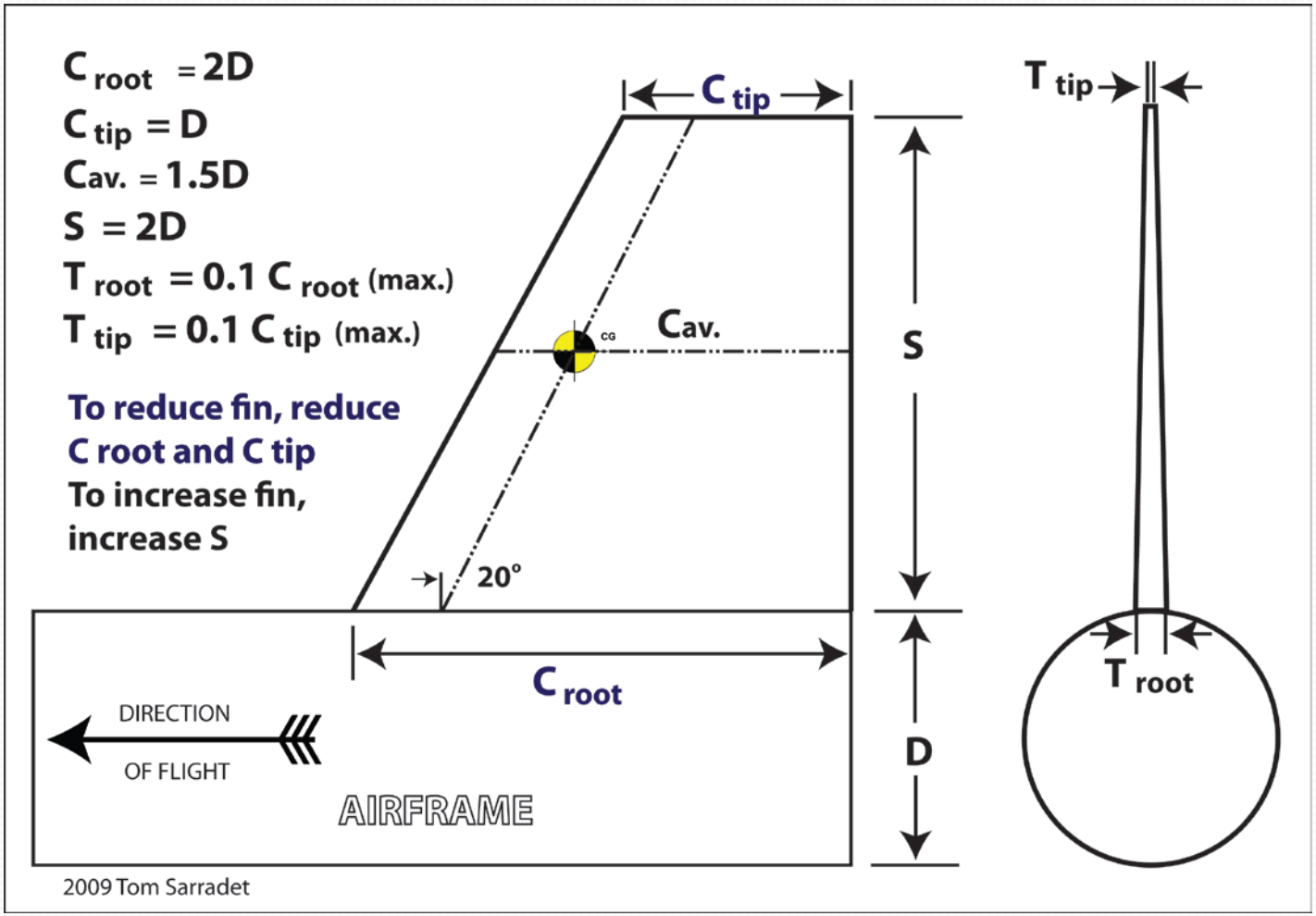



**CLIPPED DELTA**
Good aerodynamic fin, used on low-drag, high-performance rockets

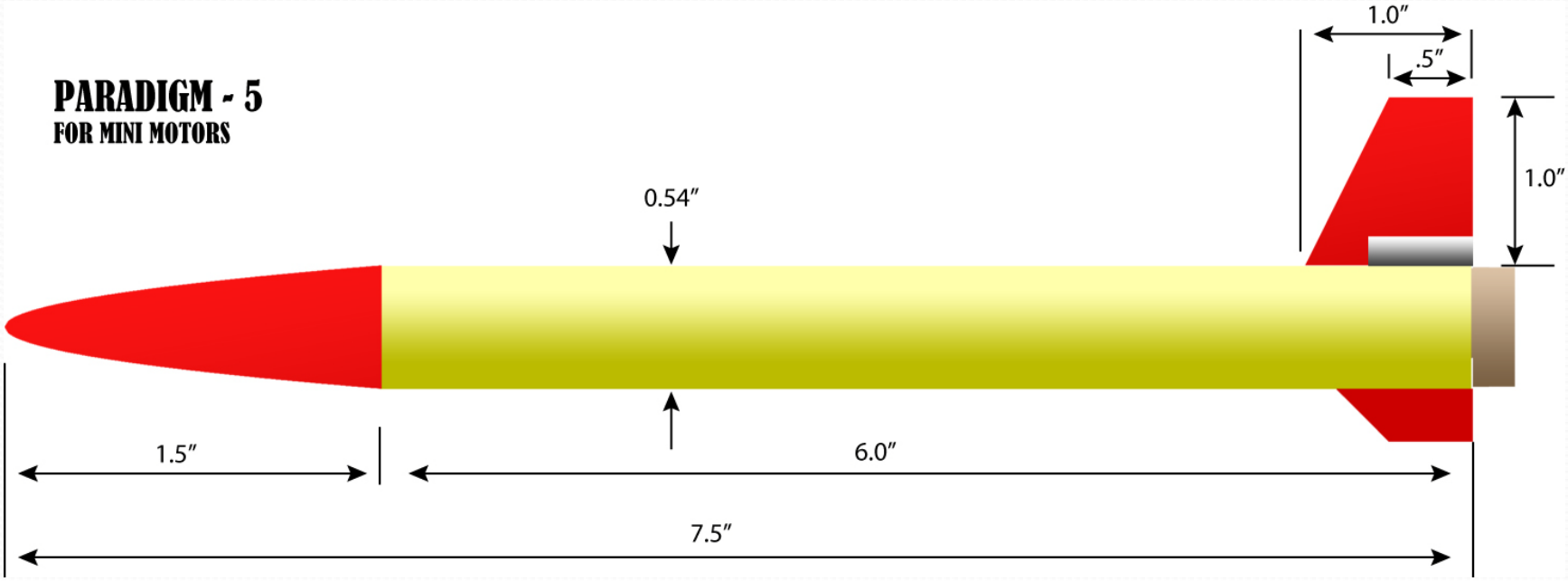
**TRAPEZOIDAL**
Good aerodynamic fin for payload rockets, moves the Center of Pressure forward.

**ELLIPTICAL**
Best aerodynamic fin, difficult to construct.

# The Fin: Low Drag Design

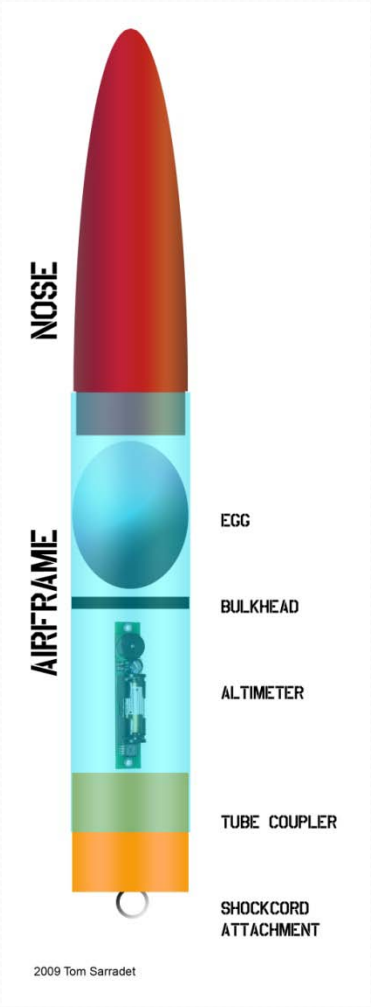


# Low Drag, High Performance Rocket




The Paradigm–5 is an example of a **low-drag**, **high performance** model rocket design that uses a low-drag clipped delta fin.

# Payload Section

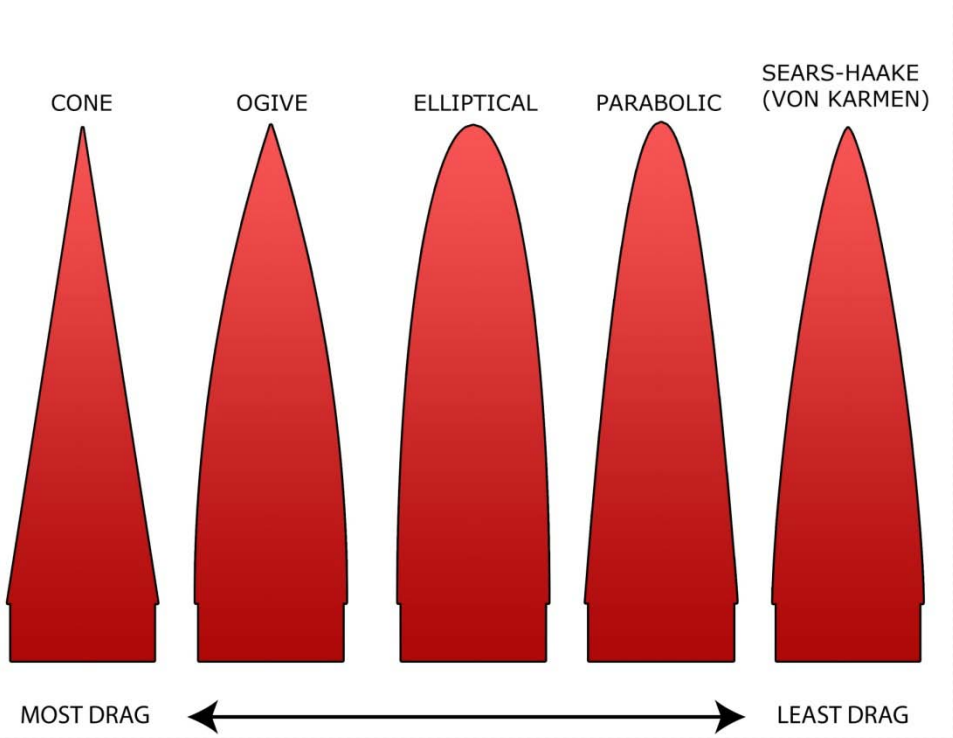



- **Nose** – creates an aerodynamic shape. May also hold a payload.
- **Airframe** – holds the payloads in place.
- **Bulkhead** – separates the egg section from the electronics section, preventing vortex effect and causing a false altimeter reading.
- **Altimeter** – measures the changing air pressure to calculate apogee. Must have vent holes in airframe in order to operate properly.
- **Tube Coupler** – connects the payload section to the booster section by means of the shock cord. Also protects the payload from the ejection gases.
- **Shock Cord Attachment** – a metal eye for the secure attachment of the shock cord.

# The Egg

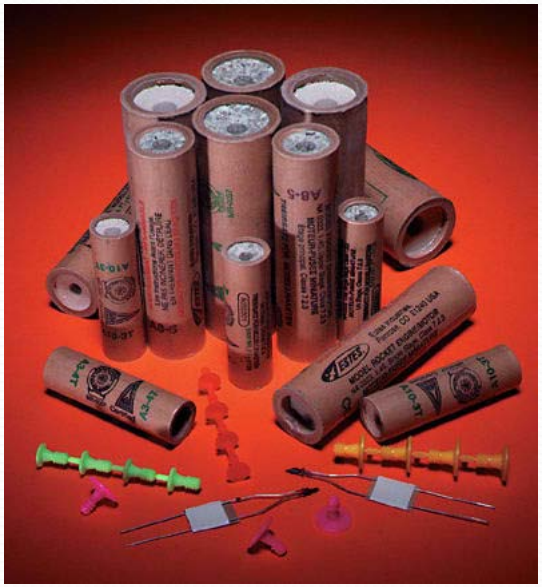
- Eggs have an '**arch structure**' at each end that transfers pressure to the sides.
- About **35 Newtons** of force is required to break an egg on its end and about **25N** to break it on its side.

# Nose Shape

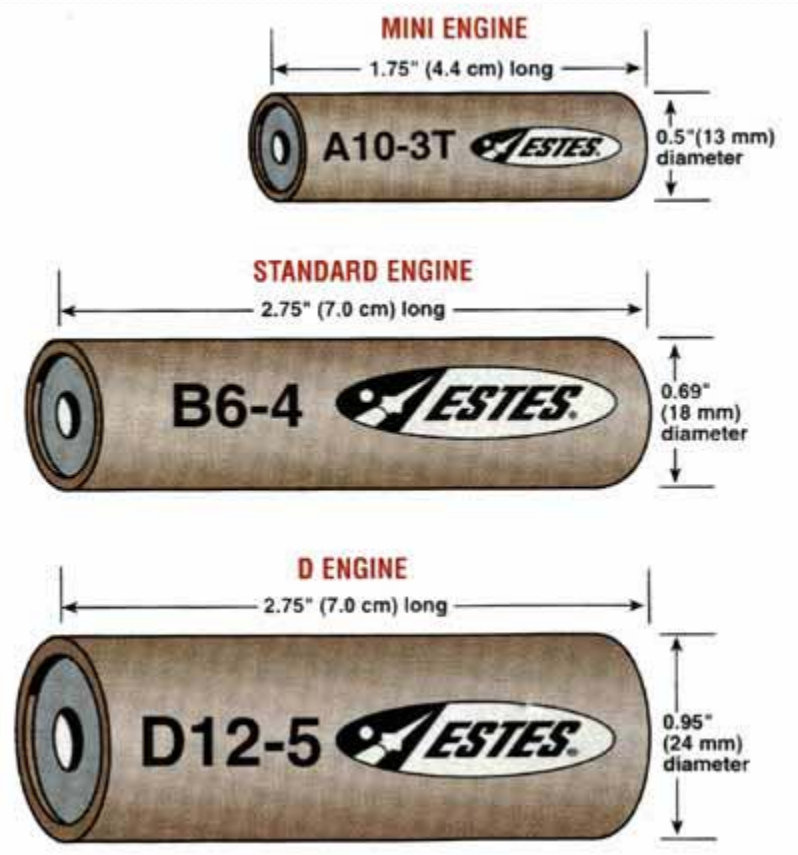



- Rocket noses are **balsa, plastic, or fiberglass**.
- For aircraft and rockets, below Mach .8, the nose pressure drag is essentially zero for all shapes and the major significant factor is friction drag.
- Having a smooth finish on the nose is more important than nose shape for rockets flying under the speed of sound.

# Rocket Motors



# Motor Sizes

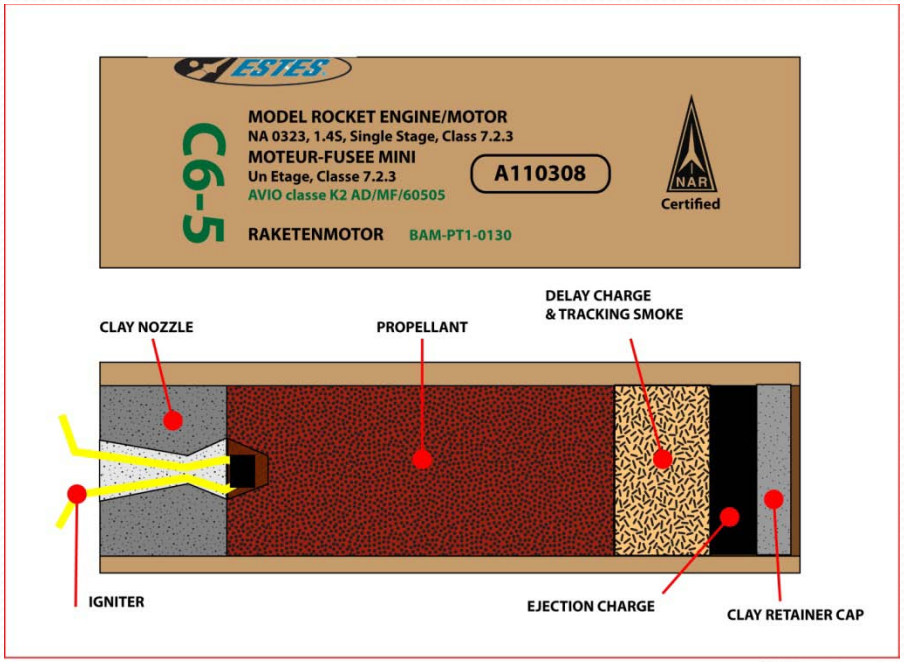



- Motor diameter is measured in **millimeters**.
- Sizes for low to mid-power rockets are **13mm, 18mm, 24mm, and 29mm**.

# Engine or Motor?

- Something that **imparts** motion is called a **motor**.
- An **engine** is a machine that **converts energy** into mechanical motion.
- While referring to the propulsion system of a model rocket as a **motor is more accurate**, the use of the term engine is common.

# Black Powder Motor

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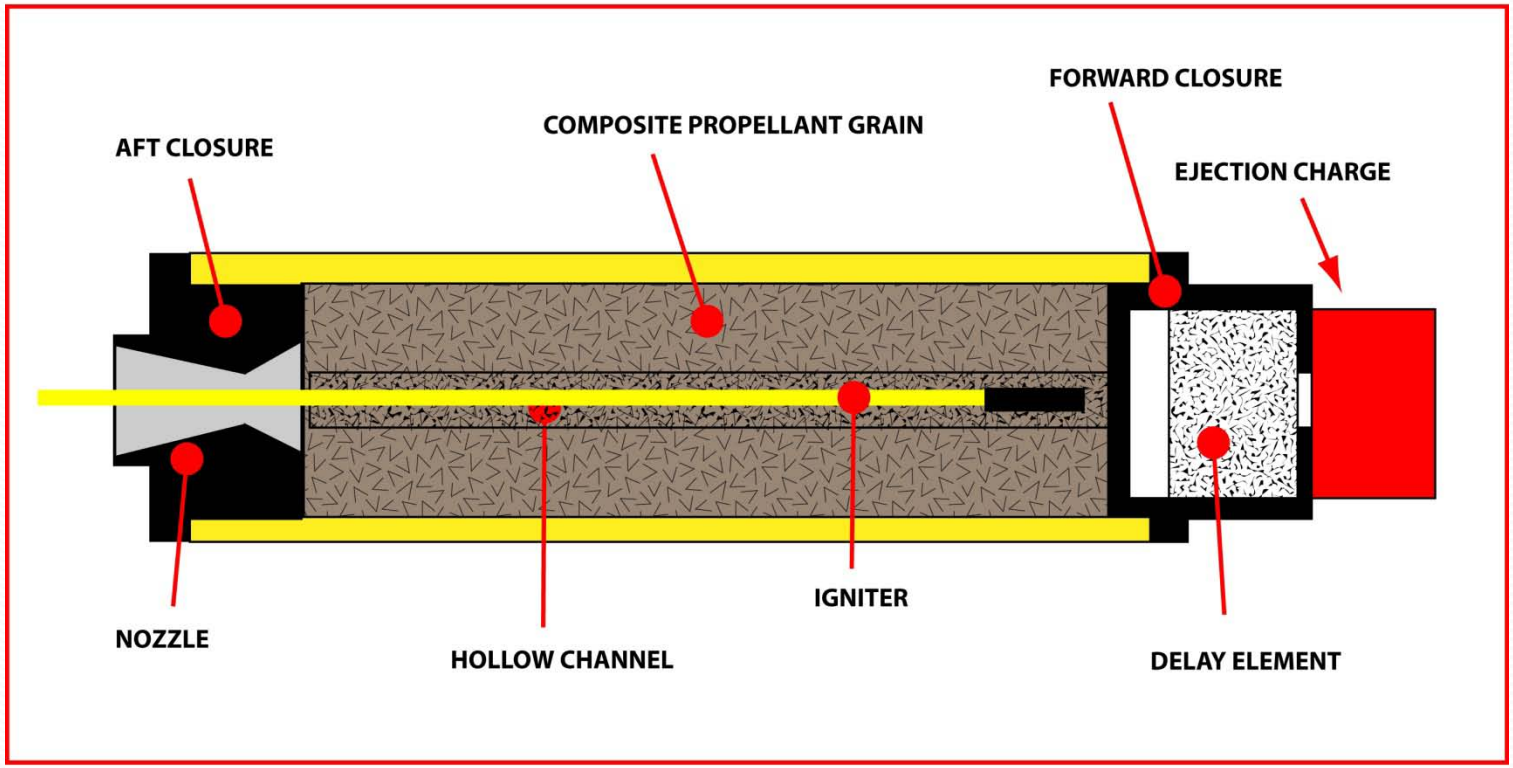
- **B** – The letter indicates the total **impulse power** produced by the motor. Each letter doubles the power.
- **6** – The first number gives the **average thrust** of the motor in Newtons.
- **4** – The last number indicates the **delay seconds** between the end of thrust and the ejection charge.

# Black Powder Motor Burn

- Black powder motors burn from the **rear forward**.
- When the propellant is spent, it ignites the **delay charge**.
- The delay charge burns forward and ignites the **ejection charge**.
- The clay nozzle forces the pressure **forward**, expelling the nose cone and recovery system.

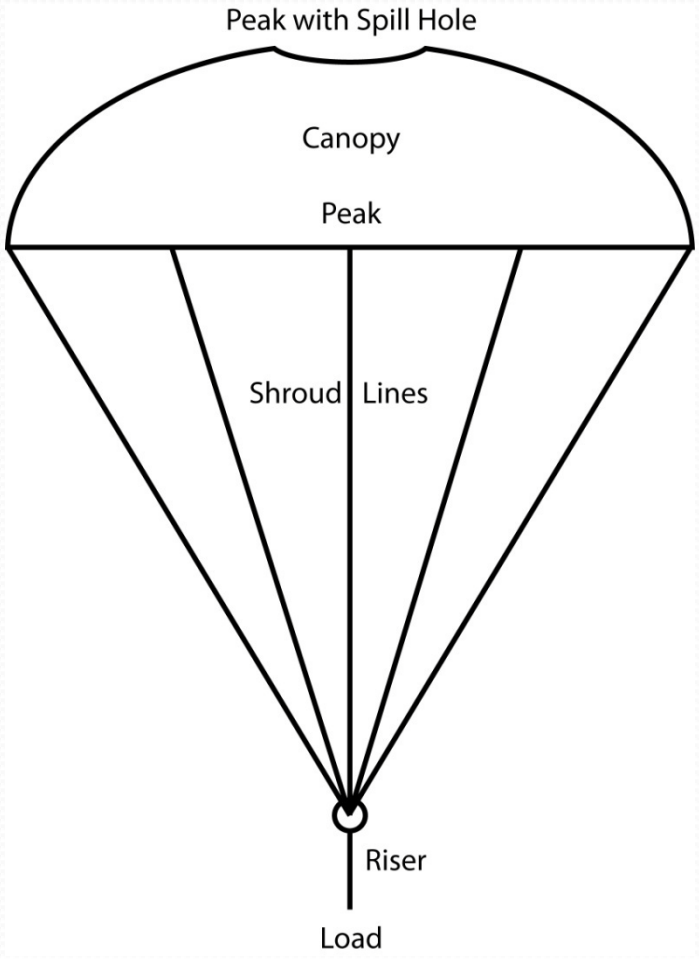
# Composite Reloadable Motor



# Composite Motor Burn


- Composite motors burn from the inner core out.
- The delay element is ignited with the propellant and burns forward. Because of this, tracking smoke is produced immediately.
- The delay element ignites the ejection charge.

# Parachute




- Parachutes are made out of **plastic**, **Mylar**, or **rip-stop nylon**.
- Shroud lines can be carpet thread or Kevlar chord.
- The **spill hole** reduces oscillation and increased descent rate.
- **Oscillation** is a swaying motion as the parachute spills air from its sides.
- Adding a **riser** lifts the parachute out of the turbulence of the rocket, but increases the risk of parachute failure.

# Streamers

- Streamers are made out of **crepe paper**, **Mylar**, **Dura-Lar**, or **rip-stop nylon**.
- The best length to width radio is **10:1** to create the most drag as the streamer flaps in the wind.
- Streamer recovery is **faster** than parachute recovery and **reduces** the recovery area.