

# Bottle Rockets

Division B only



# Team and Required Equipment

- Up to 2 team members
- Up to 2 qualified rockets
- No impound required
- Eye Protection #5 (High Impact ANSI Z87+)
  - Check the lens corners (see example)
  - These are not splash goggles
  - More like Racquet ball glasses
  - Only one warning

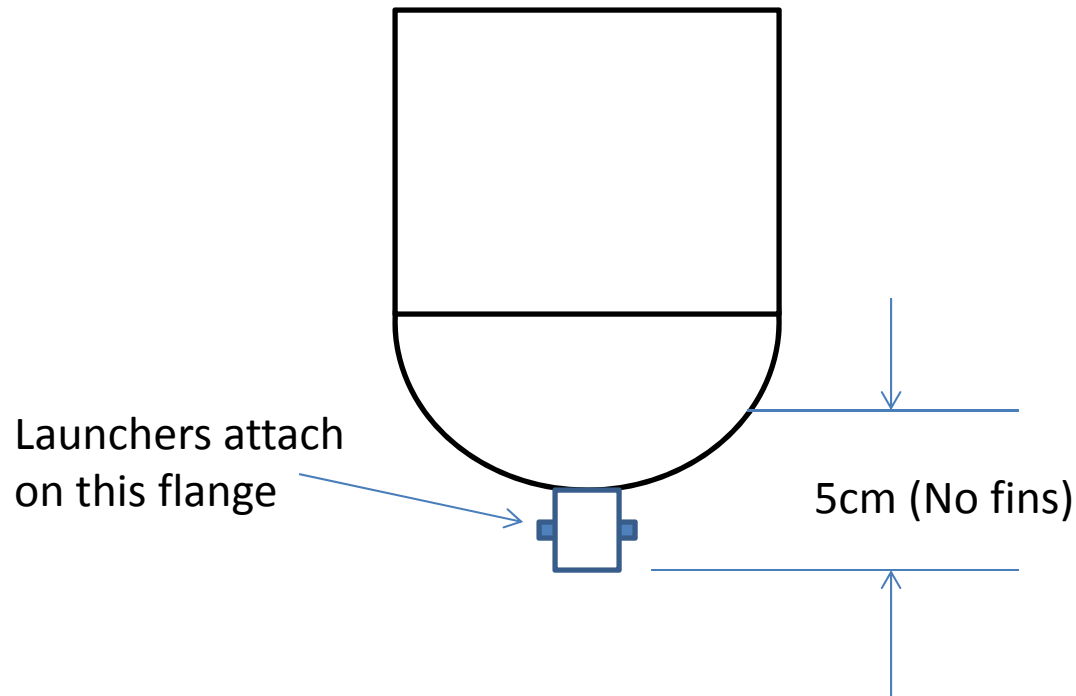
# General Construction

(Pressure Vessel)

- No larger than 1-liter (1000 ml max)
- Carbonated beverage bottles only
  - Launch pressure is 60 PSI.
- 2.2cm (22 mm) neck opening (std)
- Labels may be removed, but must be presented at pre-launch inspection
- See 5cm rule

# The 5 cm Rule

- In order to guarantee the rocket will fit on launcher. Lowest part of fins/ballast must be 5cm above the opening.



# Detailed Construction

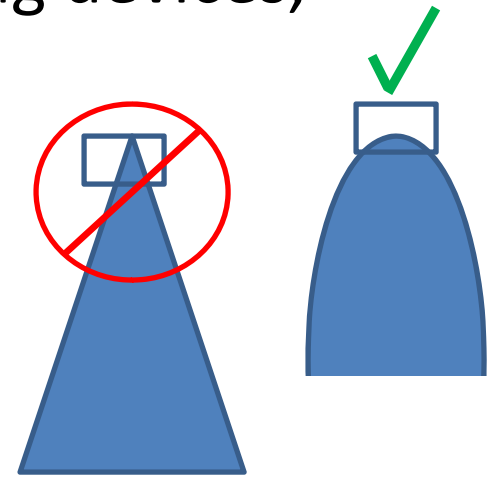
- No sanding, painting, or other damage (safety)
- No glue on the Pressure Vessel (safety)
- Preserve the integrity of pressure vessel !
- Rockets with safety violations will not launch!
  
- Tape is not glue!
  - Duct tape, masking, painter's tape, or packaging tape is OK.

# Upper portions (not pressurized)

- Most anything goes (Tape, Glue, Paint, ...etc)

However:

- Must stay attached to pressure vessel.
- No metal parts or commercial rocket parts **anywhere**
- No parachutes or other “deployed” drag devices, helicopter blades or flaps.
- No sharp nosecones or spikes
- Rocket must not change shape!
- Intention is to recover only one piece.



# Competition Day

- Following the Safety Inspection rockets will be assigned to:
- **Tier 1** (fully complies with safety and construction)
  - All T1's are scored higher than T2s
- **Tier 2** (complies with safety, but not construction)
- **DQ** (any safety violations) - you still get participation points -
- Everyone else is "**Not Competing**" (worse than last place)
  - 10 minutes to fuel and launch both rockets
    - (launcher, water and air are supplied)
  - Fuel and place on launcher
  - Remove people to the minimum safe distance (end of launch cord)
  - Pressurize rocket to 60 psi (once this starts, we are committed!)
  - Signal "ready", countdown, then launch
  - Remaining time can be used to fuel, and launch a 2<sup>nd</sup> rocket
- Each qualified rocket will launch only once.
- No parts to be re-flown, even on a different rocket!

# Scoring

- Rockets are timed to 1/100<sup>th</sup> of a second
  - First ground contact stops the clock (fin, nosecone, ...etc)
  - Or lost from sight, comes to rest in a tree, on a building ...etc
- Combined flight time of both rockets.
  - Assuming both rockets belong to same Tier
- Tie breaker goes to the team with the longest single flight.
  - A) 13.20, 8.80    B) 11.00, 11.00                  A) longer flight
- In the case where one rocket (out of two) has any violations, the non-compliant rocket time will not be added in. (use only the Tier 1 time)

# Launch Day Weather Items

- Outdoor event, weather cannot cause a foul.

## **However!**

- Temperature below 0°C , (32°F)
  - Ice pellets sting!
- Active Thunderstorm (electrocution hazard?)
- Heavy Downpour (Slips, Falls, drowning ?)
- Too much wind to keep in area assigned?

# Helpful Hints

- Stability-
  - Long and skinny rockets are easier to make stable than short and fat ones. You can lengthen the body of your rocket by stacking a second plastic bottle on top of your rocket motor bottle. A tube made of heavy paper may also be used to add length.



# Helpful Hints

- Stability-
  - The safest and easiest way to check your rocket's stability is to do a "swing test." Attach a string to the rocket at its center of gravity. Then, swing the rocket around yourself, holding on to the string, to see if it is stable.
  - If the rocket tumbles and does not straighten out, then it will probably fly badly when launched.
  - Make adjustments to your design, lengthen the body, add fin area, or nose weight, until it no longer tumbles.

# Helpful Hints

- Leave labels on the bottle
  - one less thing to forget
  - no real drag/weight effects



# Examples

