

2022 Competition Information & Rules

In Partnership with the Florida Engineering Society
& the Cox Science Center and Aquarium

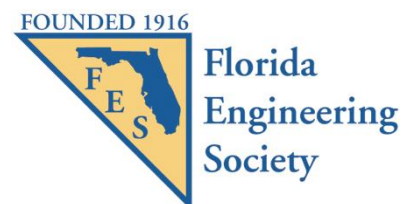


TABLE OF CONTENTS

General Information	3
General Rules	4
Drop It	5
Engineering Design Challenge	6
Construction Specifications	6
Testing and Judging	6
Thrill It	8
Engineering Design Challenge	9
Construction Specifications	9
Testing and Judging	10
Float It	13
Engineering Design Challenge	14
Construction Specifications	14
Testing and Judging	14
Launch It	16
Engineering Design Challenge	17
Construction Specifications	17
Testing and Judging	17
Diagram 1 – Rocket Diagram	19
Diagram 2 – Nose Cone Diagram	20
Diagram 3 – Fin Diagram	20
<i>Clean It – removed from 2022 competition</i>	

GENERAL INFORMATION

Engineer It! is an annual engineering design competition jointly presented to all students by the **Cox Science Center (SFSC)** and the **Florida Engineering Society (FES)**.

- **Safety** is the highest priority. Violators of safety protocol will be disqualified.
- This is an educational and fun competition for CHILDREN/STUDENTS.
- The goal of the overall event is to LEARN.
- Rules and judges attempt to be fair to all competitors – neither are perfect and people make mistakes.
- Good sportsmanship is expected from all participants, parents, and sponsors.
- ANYONE that, in the opinion of the judges and science center staff, does not behave in the true spirit of the event will be disqualified.
- Any dissension with rulings by judges, which are final, may result in participant disqualification.

Date: Saturday, April 9, 2022

Time: 7:00 – 8:30 AM Check In

9:00 AM Competition Starts

12:00 -1:00PM Break

1:00 PM Competition Resumes

3:00 PM Competition Ends

Location: Cox Science Center and Aquarium

4801 Dreher Trail North

West Palm Beach, FL 33405

Website: <https://www.coxsciencecenter.org/>

You may be photographed for Science Center media purposes throughout the competition. By registering to compete, you are giving photo consent. If you do not wish to be photographed, notify the staff members at the registration tent when you arrive.

For questions regarding the event details, please contact the following staff member from the Cox Science Center:

Chris Pait

Cpait@coxsciencecenter.org

For questions regarding the rules of the competition, please contact one of the following engineers from the Florida Engineering Society Palm Beach Chapter:

Rick Joseph, EI

Rick.Joseph@wginc.com

Jimmy Richie, PE

Jimmy.Richie@wginc.com

GENERAL RULES

1. Everyone must follow the safety protocols recommended by Palm Beach County Health Department and Cox Science Center.
 - a. Social distancing and face coverings are recommended.
 - b. Judges must also wear gloves when handling entries.
 - c. Only one student/team is permitted at the judges' table at one time.
 - d. Coaches, teachers and parents are not permitted at the judges' table during qualification and competition and must wait to speak with judges until after each rotation is complete.
 - e. Refer to the individual event rules for additional safety protocols.
2. The competition is open to students in elementary, middle and high school levels.
3. Students may participate individually or in teams--maximum of 2 students per team and maximum of 4 students for Thrill It.
4. Students must register online at <https://www.coxsciencecenter.org/>.
5. Students and their egg drop containers, rockets and roller coasters must be present and complete at the Science Center at the designated check-in time on the day of competition.
6. Students registered for Thrill It! are encouraged to arrive as early as 7:00 AM to drop off roller coasters. A maximum of two student/teams or ten people, including teachers, parents, coaches, judges and staff, will be permitted inside the room at one time. At the discretion of CSCA/FES, additional restrictions may be applied for safety and efficiency. Roller coasters may not be adjusted at this time. Drop off must be complete by 9:00 AM; otherwise the student/team must wait until their scheduled time of competition to drop off the roller coaster.
7. Entries must be clearly marked with the name(s) of the entrant(s) and meet construction specifications.
8. All questions and disputes must be brought to the attention of FES/CSC staff on the day of the event and will not be considered thereafter.
9. Video or audio recording of complaint/interaction with judges will not be tolerated and will cause dismissal from the event.
- 10. All decisions of the judges are final.**



Drop it

DROP IT!

ENGINEERING DESIGN CHALLENGE

Design and build a shipping container that will prevent an uncooked egg from breaking when dropped from a height of 50 feet.

CONSTRUCTION SPECIFICATIONS

1. MATERIALS

- A. Not permitted: parachutes, pool noodles, balloons, fins, brims (including an upside-down “witch hat”) propellers (of any type), drones, foam packing peanuts, Styrofoam, or inflatable material (i.e. inflatable foam, bubble wrap, air pillow packing material, inflated plastic bag etc.) of any kind.
- B. No kits or pre-made designs may be used.
- C. Eggs will be supplied (Grade A Large chicken eggs).

2. CONSTRUCTION

- A. The maximum dimensions of the crates shall be 8" x 8" x 8".
- B. The entire container must be able to pass through a square aperture of 8 inches by 8 inches (8"x8") in all three axes (8" cubed dimension) to qualify.

TESTING AND JUDGING

- 1. A maximum of two people per team and one container per team will be accepted.
- 2. Only one attempt will be allowed for each entry.

Note: It is recommended that students test and redesign their device prior to competition day. Practice the iterative process of engineering.

- 3. Each egg crate will be visually inspected, no further adjustments will be permitted.
- 4. One egg will be provided to each contestant. The container must be closed in the presence of the judges.
- 5. The container will be dropped from a height of 50 feet.
- 6. A successful drop is:
 - a. The egg does not show any signs of cracking. A cracked egg is a broken egg.
 - b. The egg remains in the container throughout the free-fall, impact, and after impact.
 - c. Final discretion resides with judges.

7. After the drop, the contestant will remove the egg from the container for inspection by the judges.
8. Each egg container that passes the drop test will be weighed without the egg and with all the material that was removed to open the container and remove the egg.
9. The winning entry will be determined by the container that weighs the least and successfully completes the drop, without the egg breaking/displaying any cracks.



Thrill it

THRILL IT!

ENGINEERING DESIGN CHALLENGE

Roller coasters are called "gravity rides" for a good reason: once the coaster has been dragged to the top of the first hill and released, it is the force of gravity that keeps the coaster going all the way back to the station platform at the end of the ride. As the coaster goes through its twists, turns, rolls, and loops, it gains and loses its initial potential energy (supplied by dragging it up the first hill). Energy changes from potential into kinetic energy and back into potential energy. Since some of this initial energy is lost due to friction, the roller coaster can never rise as high as the first hill. The roller coaster you will design is also a "gravity ride".

In the "Spirit of the Competition," the key ingredients are creativity and application of science principles. Doing a great job is encouraged over spending lots of money to complete the project.

DOCUMENTATION

Each team must attach a 3" x 5" index card to the roller coaster.

- a. The front of the card should include:
 - i. Name of the Roller Coaster
 - ii. Grade Level (K-5, 6-8, or 9-12)
- b. The back of the card (not showing) should include:
 - i. Team Name
Members of the Team with grade level and School Name (if applicable)

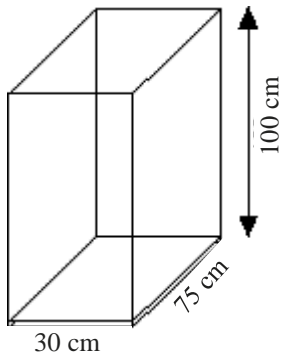
CONSTRUCTION SPECIFICATIONS

1. MATERIALS

- A. Approved materials include wood, wire, string, twine, dowels, toothpicks, cardboard, construction paper, lightweight metals (including nuts and bolts), glue, tape, and other low-cost items.
- B. Commercial roller coaster kits, including paper kits, will result in up to a 25-point deduction (see Deductions below).
- C. The use of an inclined plane with bumpers to create a "pinball" like structure is prohibited. All coasters must have a track on which the ball rolls.
- D. The coaster must be designed for a steel ball or glass marble that is 1 cm (~1/2") in diameter or greater. Each team must supply their own steel ball or glass marble.
- E. Magnets, electricity, springs, and other forms of energy may not be used – this is a "gravity ride" only. These other sources of energy can be used for aesthetics (i.e., background lighting). No electricity is provided in the contest area.

2. CONSTRUCTION

- A. The base, including all shims, must fit within a 30 cm x 75 cm rectangular footprint (image below).
- B. The entire roller coaster must fit within a 30 cm x 75 cm x 100 cm high, rectangular box (image below), including all decorations.



- C. The steel ball or glass marble when released from the top of the first hill will travel through the entire ride and arrive at the bottom loading platform. Note: for this contest, you will raise the steel ball or glass marble by hand from the loading platform to the top of the first hill to start the ride.
- D. The starting and ending positions must be clearly marked.
- E. Each team can have a maximum of 4 students.
- F. The decision of the judges is final. Any coaster that violates the rules above or the spirit of the competition will be disqualified.

TESTING AND JUDGING

1. Run Time

0-50 points will be awarded for run time. Each team will be entitled to three runs. The longest run time from start to finish positions will be the official time for that team. The time of a run that fails to make it from start to finish positions will not be recorded and will count as one of the three runs allowed.

Example: Assume the maximum time was 15 seconds and your coaster took 9 seconds.

$$\text{Points} = 50 \text{ points} \times (\text{your time} / \text{maximum time})$$

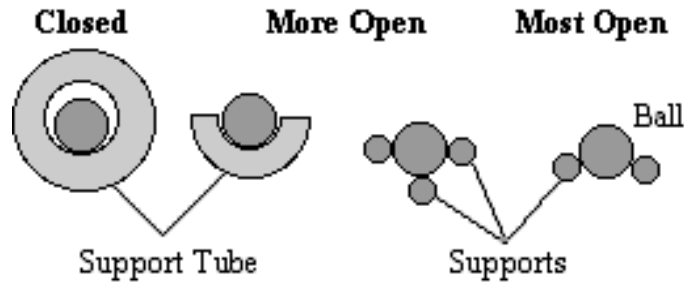
$$\text{Points} = 50 \text{ points} \times (9 \text{ sec} / 15 \text{ sec}) = \underline{30 \text{ points}}$$

The points awarded for time will be based on the maximum run time within the grade level (K-5, 6-8 or 9-12).

2. Technical Merit

A. Track Openness

0-15 points may be awarded for degree of openness of track.



B. Performance

0-10 points may be awarded based on the performance of the roller coaster with the steel ball or glass marble ending in a designated area or container during each run.

Technical merit points will be awarded based on the following rubric:

Track Openness	Mostly closed = 0	>25% open = 5 pts	>50% open = 10 pts	>80% open = 15 pts
Performance	Ball does not end in designated area=0 points	Ball ends in designated area during 1 run=3 points	Ball ends in designated area during 2 runs=6 points	Ball ends in designated area during 3 runs=10 points

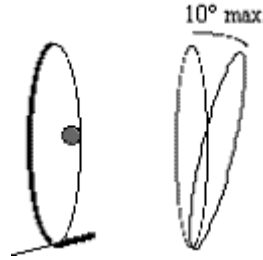
3. Theme (creativity)

0-10 points may be awarded based on the theme of the roller coaster.

Theme	No theme = 0	Theme but little follow through = 3 pts	Theme throughout ride = 6 pts	Theme well done throughout = 10 pts
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4. Bonus points for technical merit will be awarded for the following:

5 points per vertical loop. Vertical loop is defined as any time the "rider" is upside down on a loop of track that is within 10° of vertical (see illustration). If the vertical loop is a portion of a corkscrew (helix), it counts as a vertical loop. Horizontal loops do not add bonus points.



Bonus Points for technical merit will be awarded based on the following rubric:

Vertical Loops	1 = 5 pts	2 = 10 pts	3 = 15 pts	4 = 20 pts
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5. Deductions

Use of commercial roller coaster kits, including paper kits, will result in a deduction according to the following rubric:

Use of Commercial or Paper Kits	Elementary = -15 pts	Middle = -20 pts	High = -25 pts
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Float it

FLOAT IT!

ENGINEERING DESIGN CHALLENGE

Buoyancy is the upward force that keeps things afloat. When placed in water, an object will float if its buoyancy is greater than its weight. And it will sink if its weight is greater than its buoyancy.

Your job will be to design an aluminum foil boat that will hold the greatest number of pennies without sinking.

CONSTRUCTION SPECIFICATIONS

1. MATERIALS

- A. Each entrant will receive the following:
 - a. A thin foil 9"x10 $\frac{3}{4}$ ".
- B. The boat must be made at the event.
- C. Staples, adhesives, and tape is not permitted.

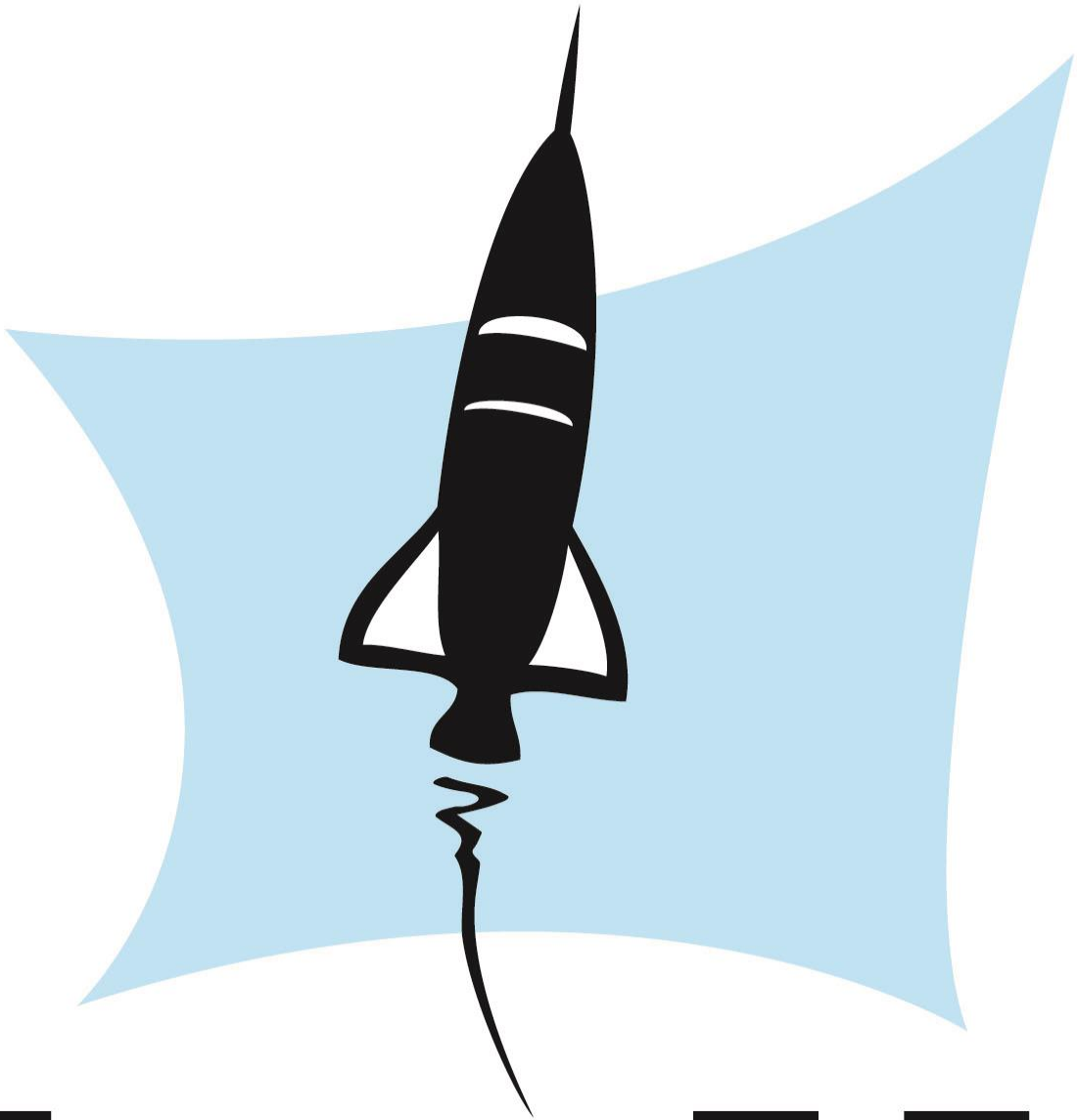
2. CONSTRUCTION

- A. Each entrant will receive the materials upon arrival to the Float It event area.
- B. The entrants must build their boat within the allotted time, have it inspected for qualification by the judges, and then wait in line for the test run.
- C. Changes may not be made after inspection.
- D. The foil may only be folded to construct the desired shape.
- E. The sides of the boat must be folded up so it will hold a cargo of pennies and not sink.
- F. The boat must be ready for inspection at the start of its turn. Note: no float tests are allowed.
- G. If the boat is found to be in violation of any of the Construction Specifications the boat will be disqualified and the student will forfeit their entry in this event.

TESTING AND JUDGING

- A. Only one entry per person will be accepted. Teams will not be permitted for this competition.

- B. Only one buoyancy test will be allowed per entry. Note: it is recommended to practice creating a boat and testing its buoyancy prior to the competition to better prepare for the event.
- C. After inspection the contestant will slowly add pennies to his/her boat.
- D. Once water enters the boat, or any part of the boat touches the bottom of the container it is considered sunk.
- E. The last penny added will not count in the total amount of cargo held.
- F. The number of pennies held will be recorded and then be used to calculate the final score.
- G. The winning entry will be determined as the boat that held the most pennies without sinking.



Launch it

LAUNCH IT!

ENGINEERING DESIGN CHALLENGE

Design and construct a rocket propelled by “fuel” (12 ounces of water) and air compressed to 60 psi that will be launched at a predetermined angle to reach the maximum flight time possible.

CONSTRUCTION SPECIFICATIONS

1. MATERIALS

- A. The pressure vessel must be one (1) clear 2-liter bottle. See Diagram 1.
- B. Do not use metal, glass, or spikes to construct the rocket. Use of these materials will result in automatic disqualification of your team from the competition.
- C. The use of a parachute is not allowed.

2. CONSTRUCTION

Note: the rules for this competition differ from the rules for the SECME Rocket.

- A. On the bottom of the rocket, leave 7.5 cm from the throat of the exit plane clear of any covering (fins, markings, drawings, etc.) See Diagram 1.
- B. Maximum total height of the rocket is 76.0 cm. See Diagram 1.
- C. Nose-cone tip must have a minimum radius of 1.5 cm. See Diagram 2.
- D. Fins must end 7.5 cm from the throat of the exit plane. See Diagram 1. Forward swept types of fins are not permitted. The quantity of fins used is up to the design team.
- E. The maximum fin width distance from the bottle is 10.0 cm (or 16.5 cm from center of bottle axis). See Diagram 3. The minimum fin width is up to the design team.

TESTING AND JUDGING

- 1. A maximum of two students per team and one rocket per team will be accepted.
- 2. Only one attempt will be allowed for each entry.
- 3. Each rocket must pass a visual inspection and height requirement in order to be eligible to compete. Entries that fail this inspection will not be permitted to enter the competition.
- 4. Only one (1) student per team is permitted at the launch pad.
- 5. The judges will record the flight time for each rocket, which will then be used to calculate the final score.
 - A. The flight time is defined as the time from the moment the launch button is pressed until the instant the rocket lands on the ground or an object on the ground. This

measurement must be taken by at least three judges and the average flight time is the final record.

- B. The final score will be calculated as a percentage of the greatest flight time recorded during the competition using the following formula:

$$\text{Final Score} = (\text{Flight time} \div \text{Max flight time}) \times 100\%$$

Example: Assume the maximum time was 15 seconds and your rocket took 9 seconds.

$$\text{Final Score} = (9 \text{ sec} / 15 \text{ sec}) \times 100\% = \underline{60 \text{ points}}$$

The points awarded for time will be based on the maximum run time within the grade level (K-5, 6-8 or 9-12).

Diagram 1 – Rocket Diagram

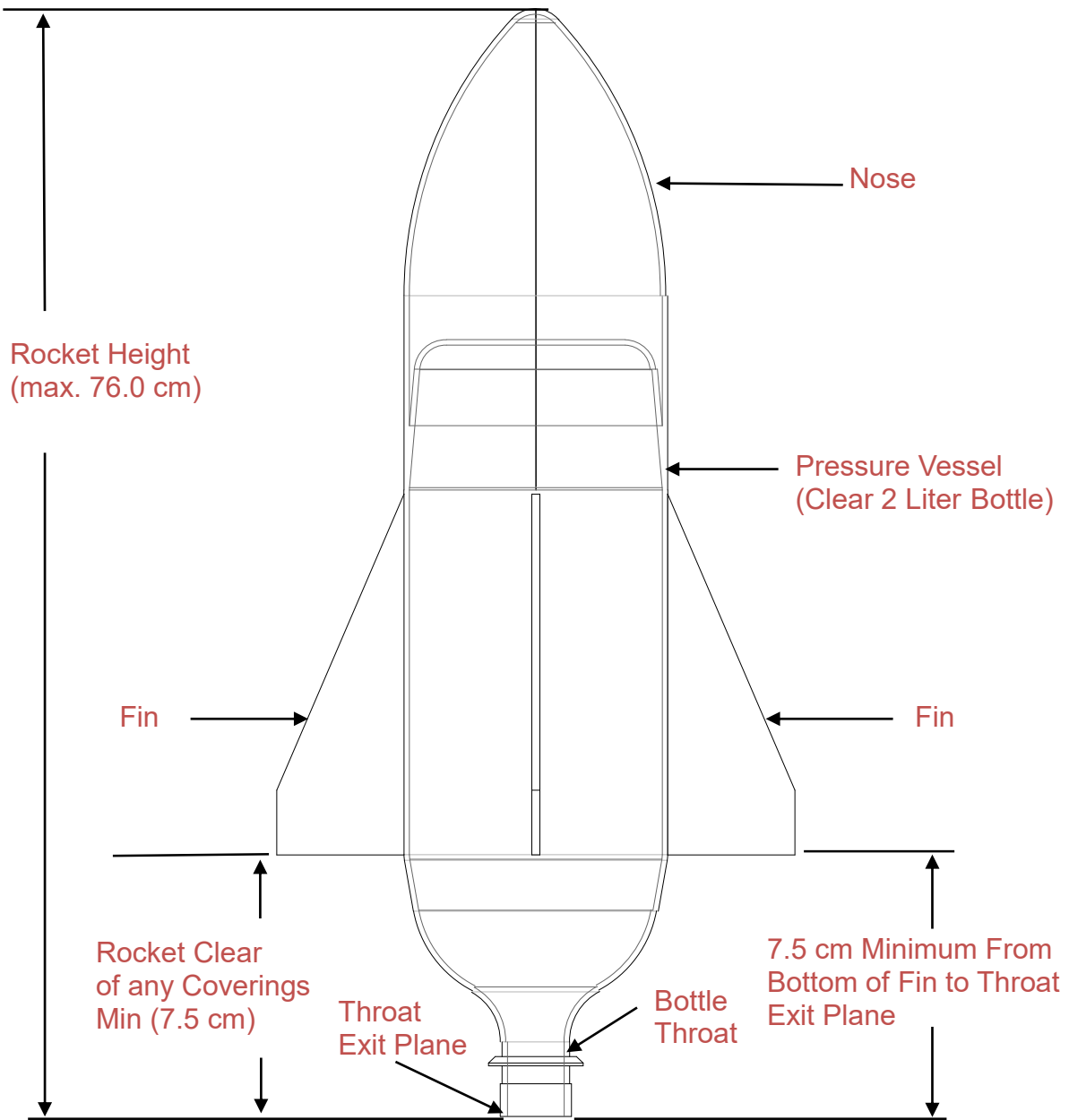


Diagram 2 – Nose Cone Diagram

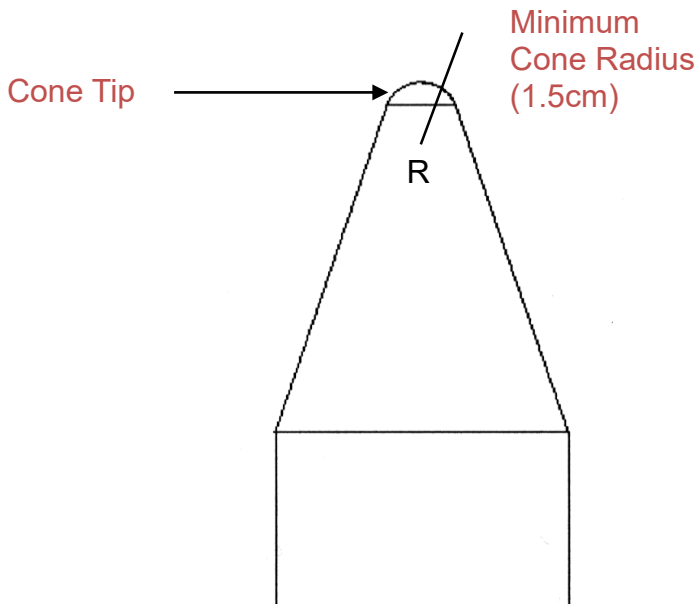


Diagram 3 – Fin Diagram

