

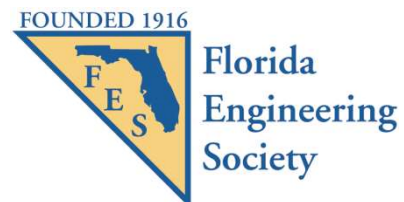
**34<sup>th</sup> Annual Competition**

South Florida Science Center and Aquarium

**Presented by Pratt & Whitney**

# 2021 Competition Information & Rules

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



## TABLE OF CONTENTS

---

<b>General Information</b>	<b>3</b>
<b>General Rules</b>	<b>4</b>
<b>Summary of Rule Changes</b>	<b>5</b>
<b>Drop It</b>	<b>6</b>
Safety	6
Engineering Design Challenge	7
Construction Specifications	7
Testing and Judging	7
<b>Thrill It</b>	<b>9</b>
Engineering Design Challenge	10
Construction Specifications	10
Testing and Judging (in-person <u>and</u> virtual)	12
<b><i>Float It – removed from 2021 competition</i></b>	
<b>Launch It</b>	<b>16</b>
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
<b><i>Clean It – removed from 2021 competition</i></b>	

## GENERAL INFORMATION

Engineer It! is an annual engineering design competition jointly presented to all students by the **South Florida 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 10, 2021

**Time:** 7:00 – 8:30AM Elementary School check-in  
9:00 AM – 12:00 PM Elementary School competition  
12:00 -1:00PM Middle and High School check-in  
1:00 PM – 3:00 PM Middle and High School competition

**Location:** South Florida Science Center and Aquarium  
4801 Dreher Trail North  
West Palm Beach, FL 33405

**Website:** <https://www.sfsciencecenter.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 South Florida Science Center:

Chris Pait  
[Cpait@sfsciencecenter.org](mailto:Cpait@sfsciencecenter.org)

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

Alejandra Schmidt, EI  
[Alejandra.Schmidt@hdrinc.com](mailto:Alejandra.Schmidt@hdrinc.com)

Rick Joseph, EI  
[Rick.Joseph@wginc.com](mailto:Rick.Joseph@wginc.com)

Jimmy Richie, PE  
[Jimmy.Richie@wginc.com](mailto:Jimmy.Richie@wginc.com)

## GENERAL RULES

1. Everyone must follow the safety protocols recommended by Palm Beach County Health Department and South Florida Science Center.
  - a. Social distancing and face coverings are required.
  - 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.sfsciencecenter.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, except those students who participate virtually in Thrill It!.
6. Students registered for on-site 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 SFSCA/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/SFSC 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.**

## **SUMMARY OF RULE CHANGES**

### **Drop It**

Safety rules added.

### **Thrill It**

Safety rules added.

Materials and scoring clarifications.

Virtual competition added.

### **Float It**

Removed from 2021 competition.

### **Launch It**

Safety rules added.

Scoring clarifications.

### **Clean It**

Removed from 2021 competition.



**Drop it**

# DROP IT!

---

## SAFETY

1. Place the container on the judges' table and step back while qualifying. Judges will set the container with egg on the table after qualifying.
2. Stand outside of the delineated drop area.

## 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. The container must be the competitor's individual design.
- 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 and measured for compliance with the rules. Once the container is qualified, 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 of 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!

---

## VIRTUAL OR IN-PERSON COMPETITION

1. Students have the option to participate in Thrill It! virtually or in-person.
2. Virtual entries will be judged and awarded prizes separately from in-person entries.
3. Virtual entries may only be submitted by students who do not participate in-person in any event.
4. Please be aware of the virtual entry requirements in each section below. All other rules apply to in-person and virtual entries.
5. Students must provide unaltered photographs and videos of sufficient quality and quantity to clearly show all rules are met. Videos shall not exceed 15 minutes with the exception of roller coasters with run times greater than five minutes each.
6. Virtual entries shall be produced in standard digital formats of sufficient size and quality. Pictures shall have a resolution of 300 pixels per inch and size of 2,400 x 3,000 pixels or greater. Picture formats shall be JPEG, TIFF or PNG, or converted to a PDF or PPT presentations. Videos shall have a resolution of 1080p or greater in WMV, MOV or MP4. Contact SFSCA/FES to determine the acceptability of another format or quality.
7. Pictures and videos for virtual entries must be received by 9:00 AM on Friday, April 9, 2021. SFSCA/FES will not be responsible for delivery (i.e. difficulty or errors uploading, emailing, file sharing links, etc.). USB drives are accepted and may be delivered to SFSCA. Notice of receipt will be emailed to the address provided in the online registration.

## SAFETY (in-person event)

1. A maximum of two teams or ten people, including teachers, coaches, parents, judges and staff, will be permitted inside the room at one time. At the discretion of SFSCA/FES, additional restrictions may be applied for safety and efficiency.
2. Each team will have a scheduled time for competition (e.g. 9:45-10:00 AM) that will be posted on the day of the event.
3. Students will be allowed up to 15 minutes for roller coaster adjustments, qualification, and trials. Qualification is anticipated to require 5 minutes.
4. Students must step away from the roller coaster during qualification.
5. Judges must step away from the roller coaster during adjustments and trials.
6. Teachers, parents and coaches must stand in the designated area.
7. Students, teachers, coaches and parents must leave the room immediately upon completion of the trials. The roller coaster may also be removed at that time or after all competitors are done.

## 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 visibly 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
  - ii. Members of the Team with grade level and School Name (if applicable)

### Virtual Entry Requirements:

- Pictures must be provided and clearly show the front and back of the card.

## CONSTRUCTION SPECIFICATIONS

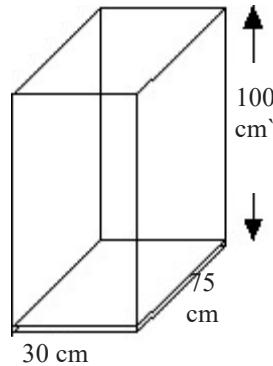
### 1. MATERIALS

- 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. Teams may choose to place their roller coaster on the ground during judging. All adjustments must still be made during the allotted judging time.
- G. The decision of the judges is final. Any coaster that violates the rules above or the spirit of the competition will be disqualified.

### Virtual Entry Requirements:

- Pictures must be provided to clearly show the size, materials and starting and ending positions of the coaster.
- Pictures must clearly show the measurements with the entire coaster shown in the picture.

## 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).

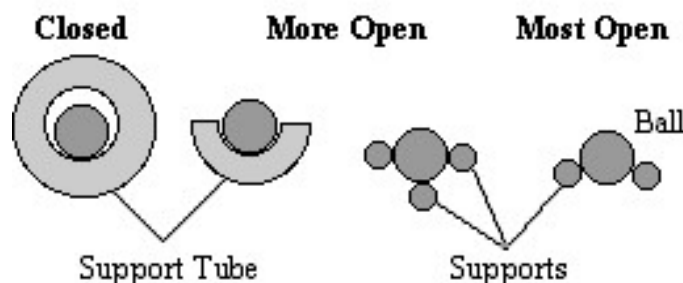
### Virtual entry requirements:

- A video recording must be provided. Record all three runs in one continuous recording. Any reasonable evidence of a non-continuous recording or editing will be grounds for disqualification.
- The camera must not move during recording.
- Student must provide a timekeeping device in digital format to one-hundredth of a second (0.01).
- Video must clearly show the ball, timekeeping device and starting and ending points for the entire duration of each run. To the greatest extent possible, construct the coaster and record the runs from the best viewpoint so these items are visible during the entire run. The only exception to showing the ball is where it is inside a closed tube (if applicable).
- Judges will measure time and those measurements shall be the official record.

## 2. Technical Merit

### A. Track Openness

**0-15 points** may be awarded for the 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
-------------	---	--	---	--

**Virtual entry requirements:**

- Pictures must be provided that clearly show the entire coaster and track openness.
- Video must be provided that clearly shows the ball starting and ending in the designated areas or containers.

3. Theme (creativity)

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

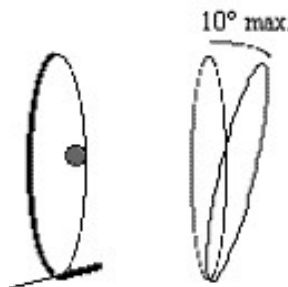
Theme	No theme = 0	Theme but little follow through = 3 pts	Theme throughout ride = 6 pts	Theme well done throughout = 10 pts
-------	--------------	---	-------------------------------	-------------------------------------

**Virtual entry requirements:**

- Pictures and video must be provided that clearly show the entire coaster and theme.

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
----------------	-----------	------------	------------	------------

**Virtual entry requirements:**

- Pictures and video must be provided that clearly show the entire coaster, vertical loops and angles of loops.

**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
---------------------------------------	----------------------	------------------	----------------

**Virtual entry requirements:**

- Pictures and video must be provided that clearly show the materials of the entire coaster.





# LAUNCH IT!

---

## SAFETY

1. Place the rocket on the judges' table and step back while qualifying. Judges will set the rocket on the table after qualifying.
2. Stand outside of the delineated flight area.

## 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

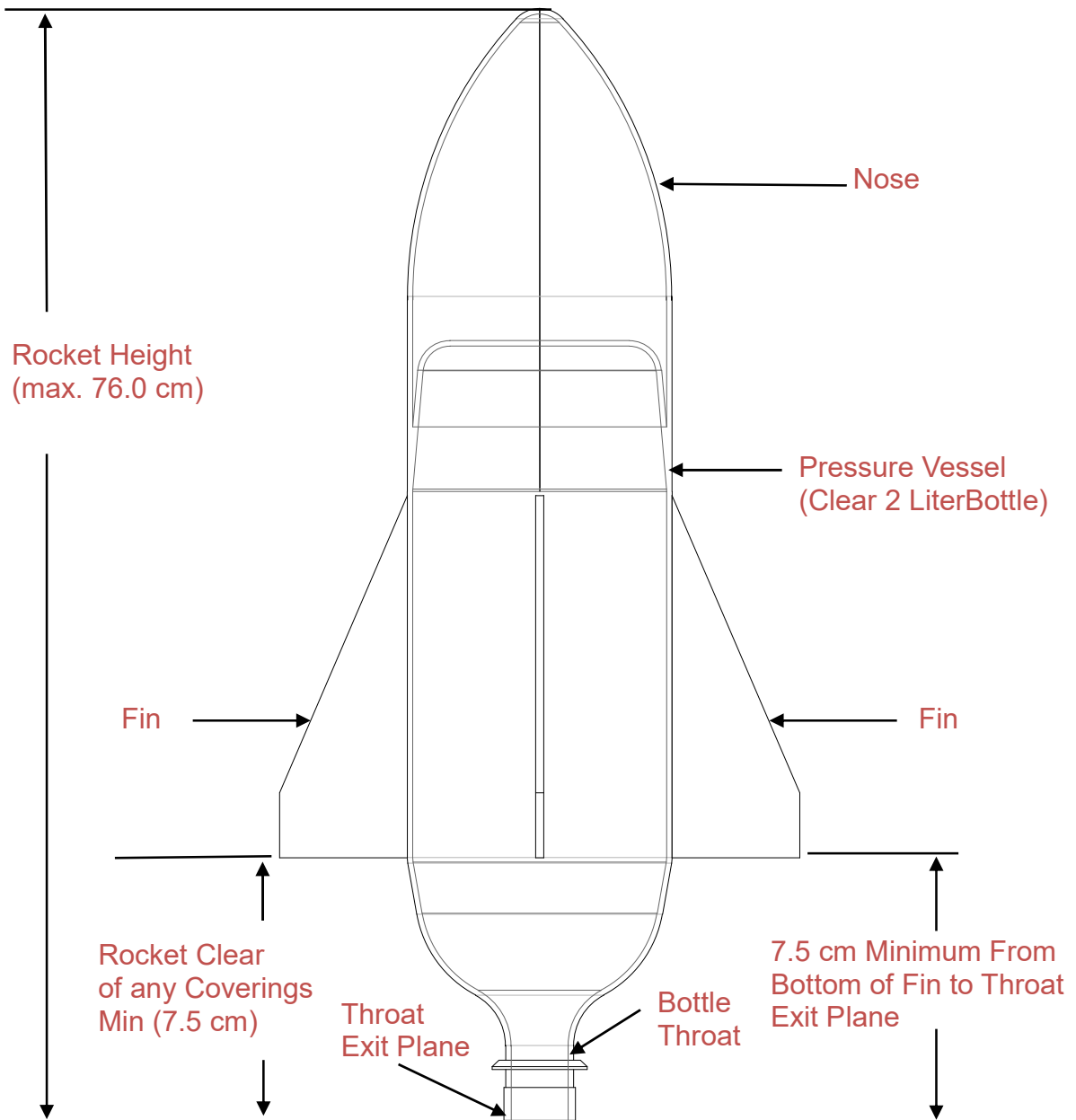


Diagram 2 – Nose Cone Diagram

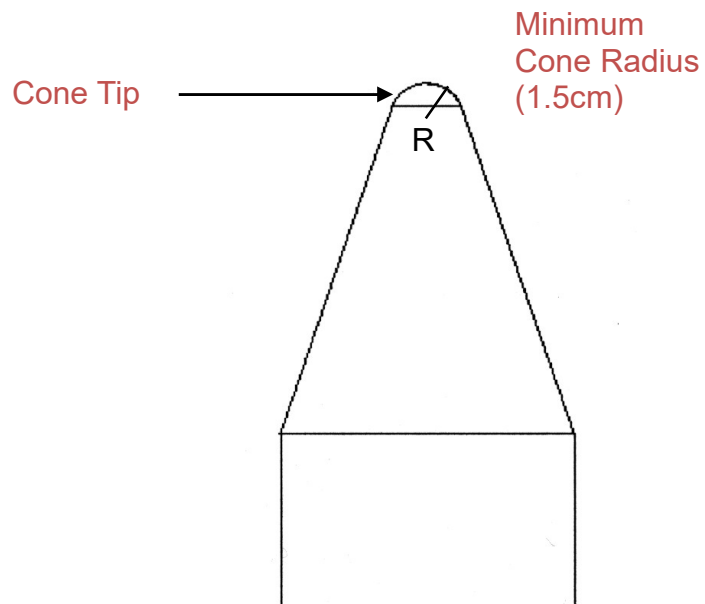


Diagram 3 – Fin Diagram

