



Category A Challenge Booklet 2022

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SAFMC 2022 CAT A CHALLENGE BOOKLET CHANGE LOG

Version	Release Date	Description
1.0	22 Nov 2021	Official challenge booklet release

SAFMC 2022 COMPETITION SCHEDULE

Date*	Event	Platform/Venue
7-18 March 2022	Pre-Challenge Submission	Email
16-23 March 2022	Presentation	Teleconference
4-14 April 2022	Category Challenges	Singapore Expo
16 April 2022	Awards Presentation Ceremony	Singapore Expo

** The competition schedule is subject to changes in accordance with the latest MOE guidelines for COVID-19. Any changes will be updated on the SAFMC Website and Facebook. Registered participants will be informed via their registered email address.*

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SINGAPORE AMAZING FLYING MACHINE COMPETITION 2022

1. INTRODUCTION

In celebration of DSO National Laboratories' (DSO) 50th Anniversary in 2022, SAFMC is enhanced in both challenges and prizes [CAT D & E] to allow students to push the boundaries of innovation by designing and creating extraordinary flying machines. The event is organised by DSO and Science Centre Singapore, and supported by Ministry of Defence (MINDEF). Open to all schools and participants, this annual competition promises a fun-filled learning journey with special talks, workshops and live demonstrations.

2. CATEGORIES

CATEGORY A – PAPER PLANES (*Primary Schools*)

Each team should consist of TWO (2) to THREE (3) members.

Design and fold paper planes to achieve the longest, farthest or most unique flight.

CATEGORY B – UNPOWERED GLIDERS (*Secondary Schools / Integrated Programme*)

Each team should consist of TWO (2) to FIVE (5) members.

Category B will be open to a maximum number of 150 registered teams.

Design and build small unpowered bungee-launched gliders to achieve the farthest and most precise flight.

CATEGORY C – RADIO CONTROL FLIGHT / FIRST PERSON VIEW (FPV) FLIGHT (NOVICE, ADVANCED)

Category C1: Radio Control Flight - Fixed Wing (*Secondary Schools / Integrated Programme / Junior Colleges / Institute of Technical Education*)

Each team should consist of TWO (2) to FIVE (5) members.

Design and build a small remote-controlled fixed-wing air platform to navigate an obstacle course.

Category C2: FPV Flight – Novice (*All Schools*)

Each team should consist of ONE (1) to TWO (2) members.

Bring, or design and build, a ducted (shielded propeller) FPV drone to compete in an obstacle course.

Category C3: FPV Flight – Advanced (*All Schools*)

Each team should consist of ONE (1) member.

Bring, or design and build, an FPV drone to compete in an obstacle course.

[ENHANCED] CATEGORY D – SEMI-AUTONOMOUS / AUTONOMOUS

(Polytechnics / Universities)

Category D1: Semi-Autonomous

Each team should consist of TWO (2) to FIVE (5) members.

Design and build up to three semi-autonomous small air platforms, controlled using wearables, to perform a multitude of tasks in an indoor course.

Category D2: Autonomous

Each team should consist of TWO (2) to FIVE (5) members.

Design and build three autonomous small air platforms to collaboratively perform a multitude of tasks in an indoor course.

[ENHANCED] CATEGORY E – SWARM (*Open to Public*)

Each team should consist of TWO (2) to TEN (10) members.

Bring, or design and build, a swarm of TEN (10) to TWENTY-FIVE (25) drones to compete in an obstacle course.

3. GENERAL SAFMC 2022 RULES

- **The deadline for registration is 18 February 2022.**
- Participants registered under a school must be a full-time student at the point of competition.
- Home-schooled participants and teams consisting of participants from different schools should be registered as “Independent teams”.

- Participants will be notified upon successful registration within two weeks of the registration deadline. The decisions made by the SAFMC organising committee are final, and are subjected to the competition schedule and availability of logistics support.
- Each person can only participate in one team within a category. However, the person can participate as a member in different categories, i.e. a person can be a member of a team in Category B and another team in Category C but the person cannot be a member of two teams in Category B.
- Teams are allowed to take part in categories beyond the specified educational level, i.e. Primary school students are allowed to take part in Category B, C, D or E. Secondary school students are allowed to take part in Category C, D or E.
- Participants of Category C1 are also eligible to register for either Category C2 or C3 but not both.
- Participants of Category C2 are not eligible to participate in Category C3 and vice versa.
- Participants of Category D1 are also eligible to participate in Category D2 and vice versa.
- Members and family members of the organising committee are not allowed to participate in the SAFMC.
- The organisers reserve the right to amend the rules and regulations. In the event of changes, all teams will be informed at least **FOUR (4)** weeks prior to the start of the competition.
- Prizes will be issued to the Team Manager.
- A safety perimeter net will be set up at the competition field for Categories B, C, D, and E. There will be a top net approximately **EIGHT (8) meters** above the ground, which will limit the maximum flight altitude of flying machines. During the challenge attempts, teams are strongly encouraged to fly their aircraft away from the netting to avoid accidental entanglement.
- The organisers of SAFMC 2022 will not be held responsible for any damage to or the loss of any flying machine(s) throughout the entire competition.

- Participants are responsible for the safe flying of their flying machine(s) for the duration of the entire competition. The organisers reserve the right to ground the flying machine(s) of any team at any point in the competition.
- For queries regarding the competition, please send an email with the title stating the category in question (e.g.: [CAT A] - Clarification about task locations) to the following email address: SAFMC@science.edu.sg

4. FORMAT OF COMPETITION

Once the teams have confirmed their registration for the competition, they are expected to start work on the different aspects of the competition, which consists of the Challenge and the Presentation.

Teams are encouraged to provide equal attention to both the Challenge and the Presentation aspects of the competition.

The top team from each category will be presented with the Championship Award at the SAFMC 2022 Awards Presentation Ceremony.

4.1 PRESENTATION

Teams will be allocated a specific time slot to showcase their flying machine on a virtual platform. Teams will present their flying machine design and learning journey in this competition to a panel of judges. These teams will be assessed for a number of awards.

The presentation plays an integral part for teams who wish to vie for the SAFMC Championship Award. Teams that do not show their flying machines for the virtual presentation may be disqualified immediately. The requirements for the Presentation Segment will be detailed in Section 8.

The Chief Referee or Judge for each category reserves the right to deduct points if the flying machines used in the Challenge is drastically different from the flying machine presented at the Presentation.

4.2 CHALLENGE

The physical competition will be conducted in accordance with Safe Management Measures (SMM) guidelines, which will be announced closer to the competition.

For the Challenge, teams are to design, build and fly their flying machines to overcome various challenges for the different SAFMC categories. The Challenge consists of a Team Video Challenge submission, and the actual in-venue flight on Competition Day.

The Team Video Challenge serves as a prelude to the team's aircraft capabilities and flight-worthiness. The Competition Day allows teams to accomplish their tasked missions in live capacity in front of an audience.

On the Competition Day, tables will be provided within the main competition hall for teams to work on their flying machines. Alternatively, teams may be assigned a designated area instead.

Teams should expect the following during the Competition Day:

- Only registered team members of the participating teams can enter the playing field and team booths/holding areas.
- Teams are expected to fully comply with safety rules. Failure to comply to safety rules after the initial warning will result in immediate disqualification and potential blacklisting from the competition. The organizer will also not be responsible for any injuries or mishaps if any participant has disregarded the safety rules.
- No trials will be allowed in the flying area unless specified by the officials.
- The participants will acknowledge that there will be variations in environmental condition between teams, despite best efforts to control them
- For all Category C and D participants, all aircraft and their transmitting devices must be presented to SAFMC officials for inspection upon arrival.
- For all Category C and D participants, no video transmitting devices, including spares, should be powered on in the competition hall unless specified by the officials. Teams may request from the Chief Referee or the Category C1 Technical Chairperson to perform power-on checks.
- Additional rules and regulations specific to Category C1 are detailed in Section 8 and 9. Participants will acknowledge that they have read the rules.

5. CATEGORY A AWARDS

The judges make all scoring decisions and their decision is **final**. For arbitrary cases, the SAFMC Organising Committee will have the **final** say.

There is no limit to the number of awards that a team can win. For example, it is possible for a team to win Range Award, Time Aloft Award and Presentation Award.

5.1 CHAMPIONSHIP AWARD

This is the most prestigious award that a team can win under CAT A. It is bestowed on the team that embodies the spirit of SAFMC. Teams are considered for the Championship Award based on their overall excellence and total learning experience during the course of the competition. The table below shows the weightage of each individual score that counts towards the Championship Award.

Scoring	Weightage
Range	20%
Time Aloft	20%
Boomerang	20%
Learning Journey	20%
Presentation	20%
Total	100%

Each score will be normalised with the highest score in the class to obtain the weightage.

E.g. Calculating Range Score:

$$\begin{array}{l} \text{Range Score used in} \\ \text{Championship} \\ \text{Award} \end{array} = \frac{\text{Team's Range Score}}{\text{Longest Range Score in the} \\ \text{Competition}} \times 20\%$$

5.2 BEST RANGE RECORD

This award is given to the team that beats the current standing Best Range Record for Category A since the inception of SAFMC. The standing Best Range Record can be found on our website at www.safmc.com.sg.

5.3 BEST TIME ALOFT RECORD

This award is given to the team that beats the current standing Time Aloft Record for Category A since the inception of SAFMC. The standing Time Aloft Record can be found on our website at www.safmc.com.sg.

5.4 RANGE AWARD, TIME ALOFT AWARD AND BOOMERANG AWARD

These awards are given to the team whose paper plane obtains the longest distance, longest time aloft, and highest boomerang score in the competition.

5.5 LEARNING JOURNEY AWARD

This award is given to the team that scores the highest in the teams learning journey criterion, highlighted in their Engineering Notebook and online submissions. This award recognises the team's knowledge in aeronautics, theory of flight and design, as well as the quality of their learning journey. The criteria for the Engineering Notebook and online submissions can be found in Section 9.

5.6 PRESENTATION AWARD

This award is given to the team that scores the highest in the Presentation Criterion during the presentation. This award recognises the team's ability to deliver a presentation with confidence, fluency, and flair.

5.7 PRIZES

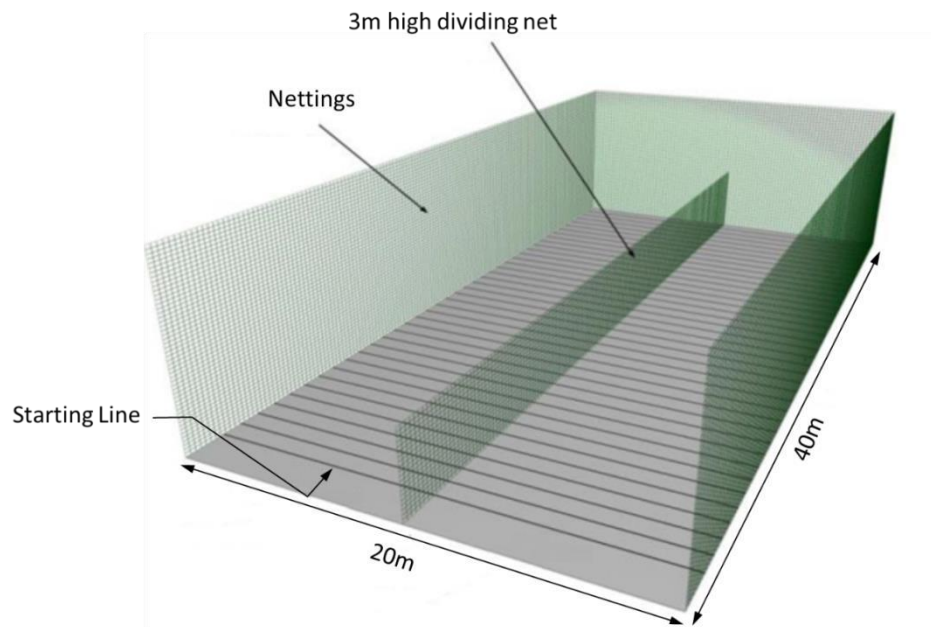
CATEGORY A				
Awards	Medals	Trophy	Cash Prize	Remarks
Championship Award	✓	✓	\$400	1 st and 2 nd Runner Up will receive only Medals
Best Range Record		✓		Current Record: 32.63m
Best Time Aloft Record		✓		Current Record: 8.03s
Range Award	✓		\$160	1 st and 2 nd Runner Up will receive only Medals
Time Aloft Award	✓		\$160	
Boomerang Award	✓		\$160	
Learning Journey Award	✓		\$160	
Presentation Award	✓		\$160	

Note: All members of winning teams will receive a certificate.

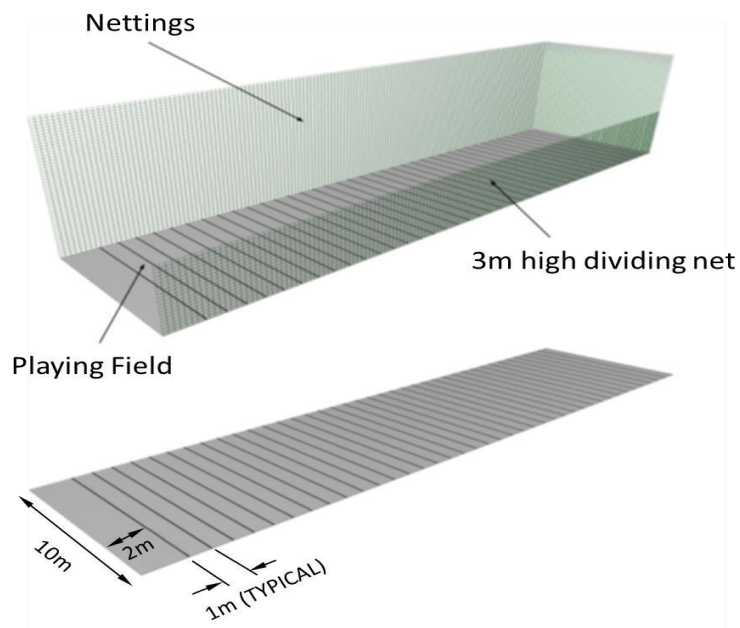
6. CATEGORY A CHALLENGE

6.1 RANGE CHALLENGE

Teams are to launch their planes behind the starting line to obtain the best distance score in the field below:



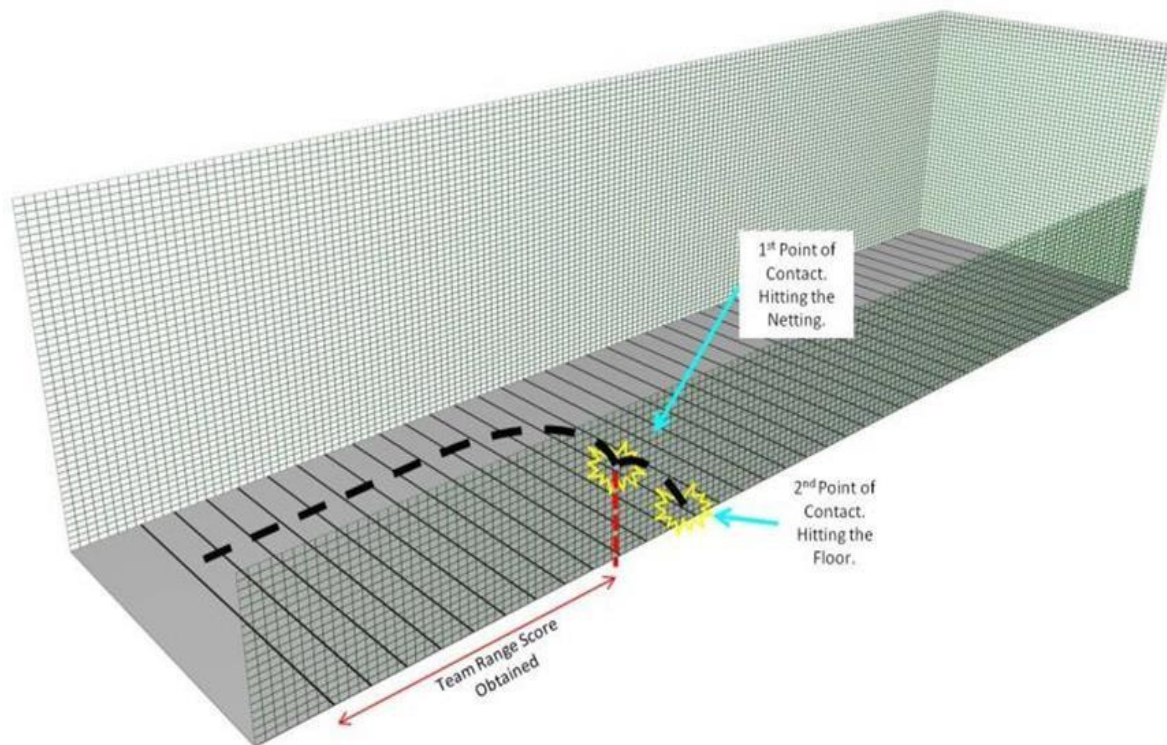
The details of the field are as shown below:



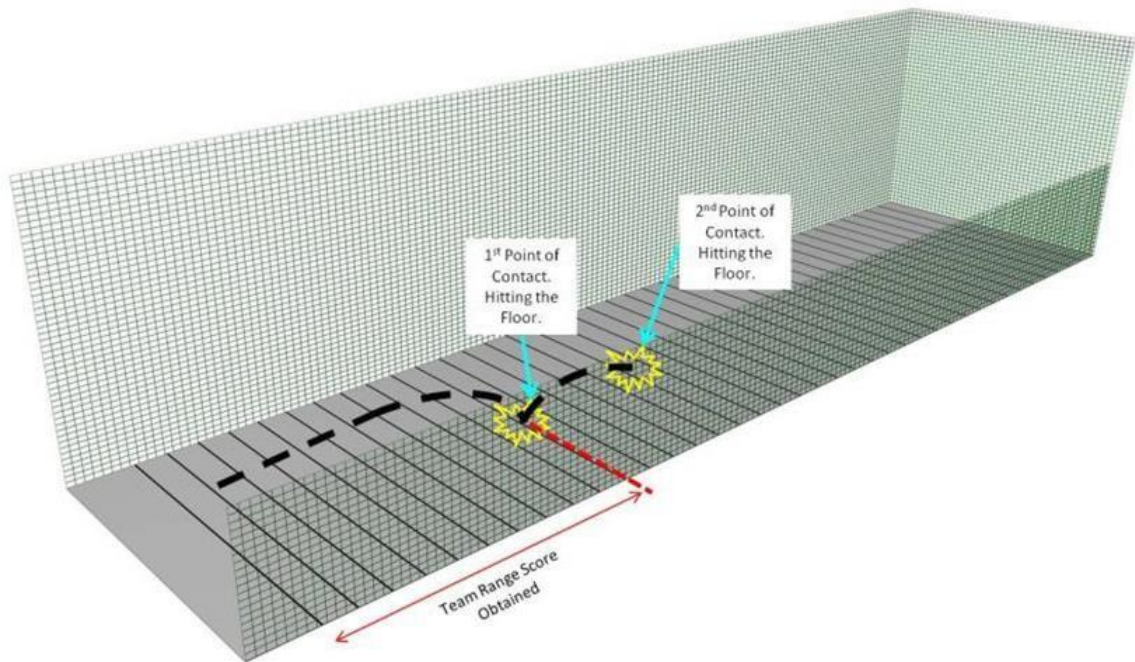
6.2 RANGE CHALLENGE RULES & SCORING

1. Teams are to launch their plane from behind the starting line onto the field.
2. The score (in metres) will be taken from the starting line to the 1st point of contact, within the playing field, where the plane touches the ground, any other objects (other props or netting), or the point where it flies over the netting.
3. If the plane flies the maximum length of the field and hits the netting at the field end, the maximum field length will be awarded to the team.
4. The distance will be taken lengthwise along the playing field.
5. The plane's flight time will also be used in the event of a tie, if any.

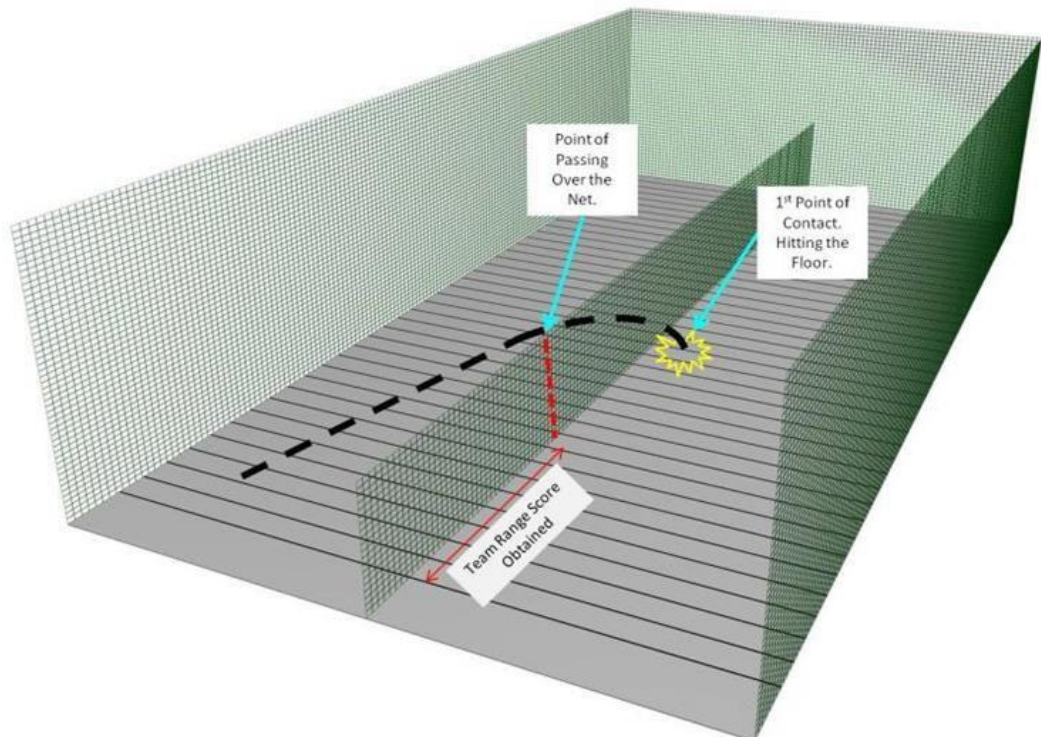
The example below shows a plane hitting the net first. The range is measured from the Starting Line to the 1st point of contact, along the edge of the field.



The example below shows a plane hitting the floor then bouncing further. The range is measured from the starting line to the 1st point of contact, along the edge of the field.

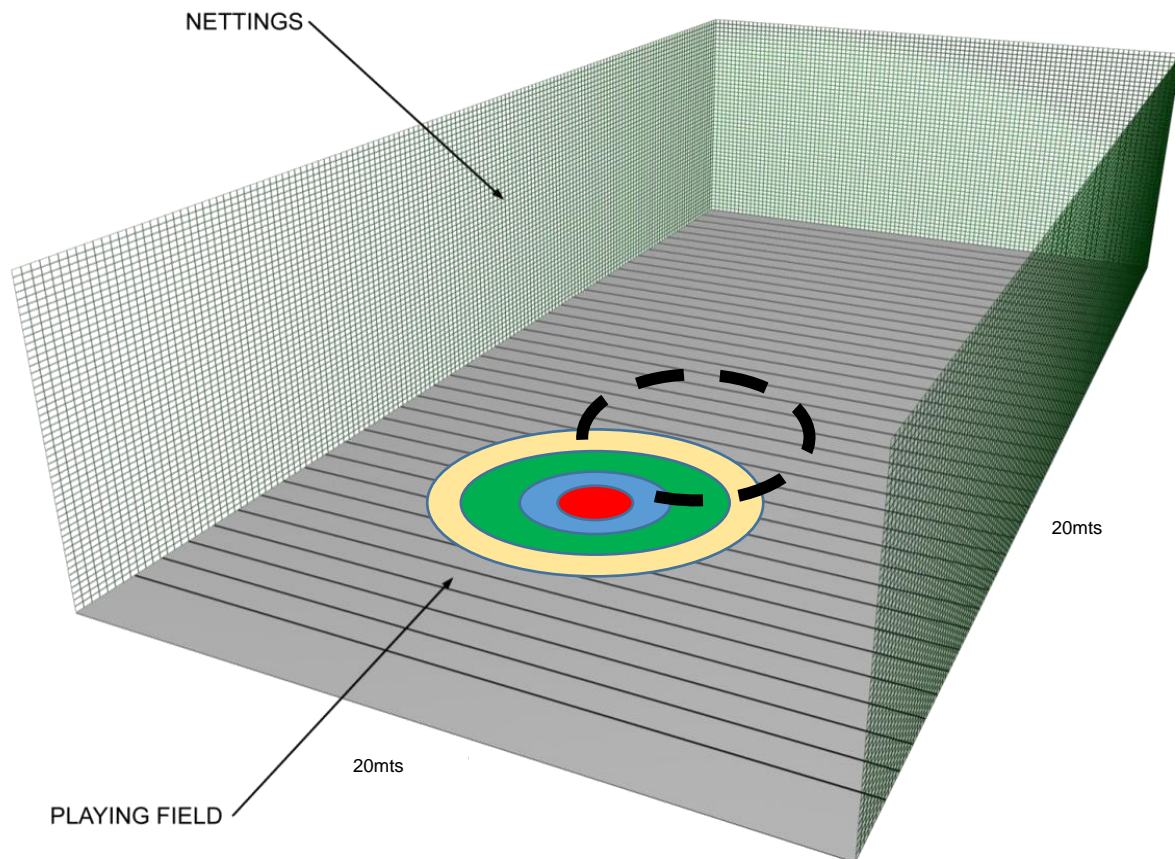


The example below shows a plane flying over the netting and hitting the floor. The range is measured from the starting line to the point where the plane flies over the net, along the edge of the field.

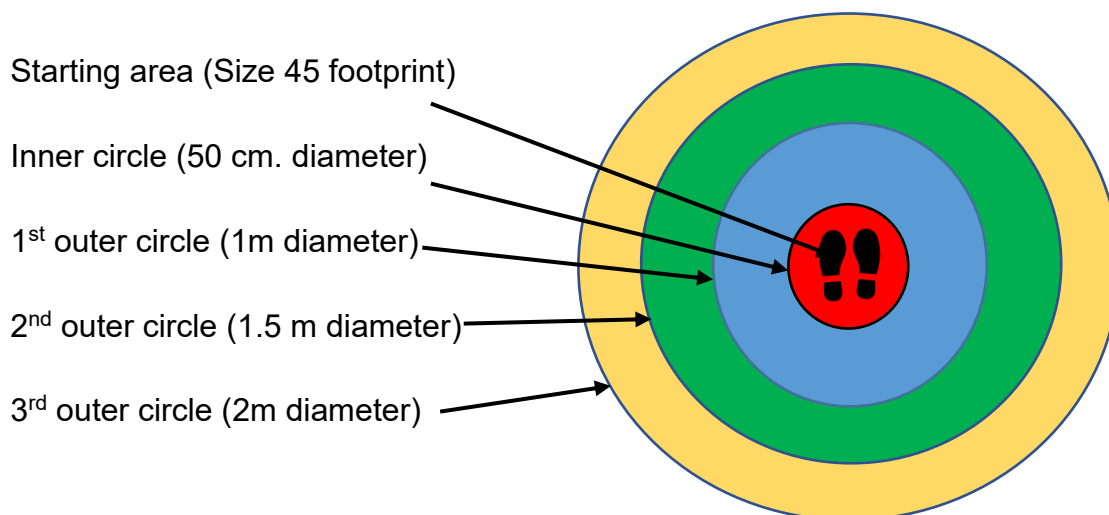


6.3 BOOMERANG CHALLENGE

Teams are to launch their planes with both foot on the size 45 footprints (the starting area) to obtain the best Boomerang score in the field below:



The details of the field are as shown:



6.4 BOOMERANG CHALLENGE RULES & SCORING

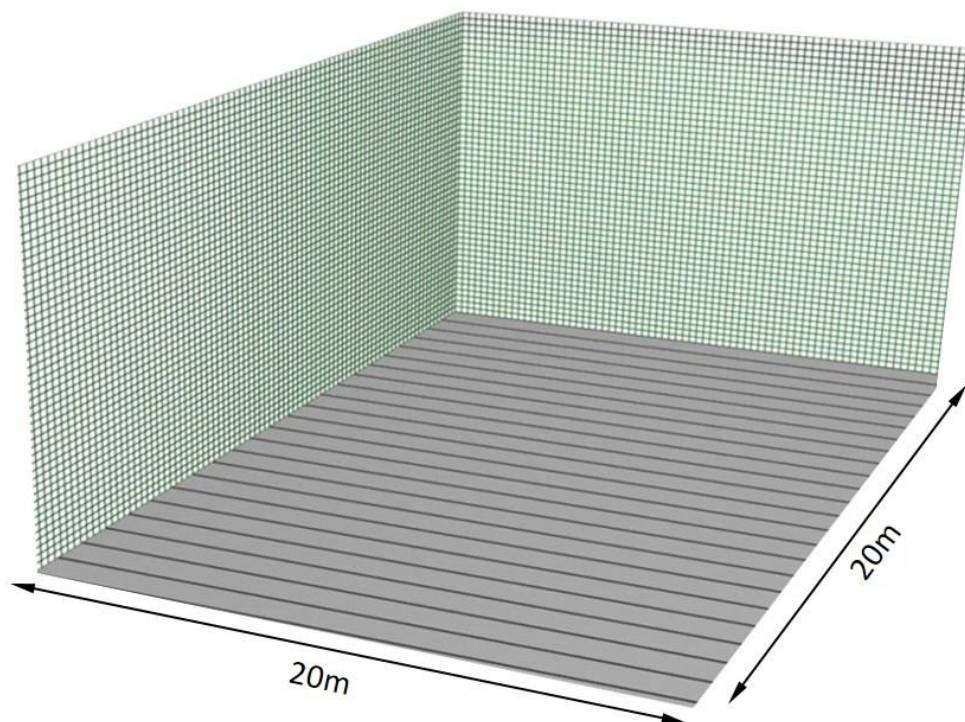
1. One participant from each team is to launch their plane at the footprint, obtaining the approval of the referee to start. Referee will approve initial launch position.
2. The participant is to launch their plane at the signal of the referee so that proper attention and flight time is taken.
3. The plane must be thrown outward in a curved/elliptical trajectory, leaving the airspace of the inner circle. Throwing the boomerang plane straight up or at an angle without taking a curved or elliptical flight path will constitute a failed attempt.
4. Failure to catch the boomerang plane after release will constitute a failed attempt.
5. **100 points** is awarded when the participant catches the boomerang plane without shifting his/her position from the footprints.

Scores are awarded accordingly based on the final position of the participant in the moment of catching the boomerang plane:

- **1 foot shifted out of footprints – 98 points**
- **Both feet shifted but within Inner circle – 95 points**
- **1 foot touching 1st outer circle – 93 points**
- **Both feet touching 1st outer circle – 90 points**
- **1 foot touching 2nd outer circle – 85 points**
- **Both feet touching 2nd outer circle – 80 points**
- **1 foot touching 3rd outer circle – 70 points**
- **Both feet touching 3rd outer circle – 60 points**
- **1 foot out of 3rd outer circle – 50 points**
- **Both feet out of 3rd circle – 40 points**
- **Failing to catch the boomerang plane – 0 points**

6.5 TIME ALOFT CHALLENGE

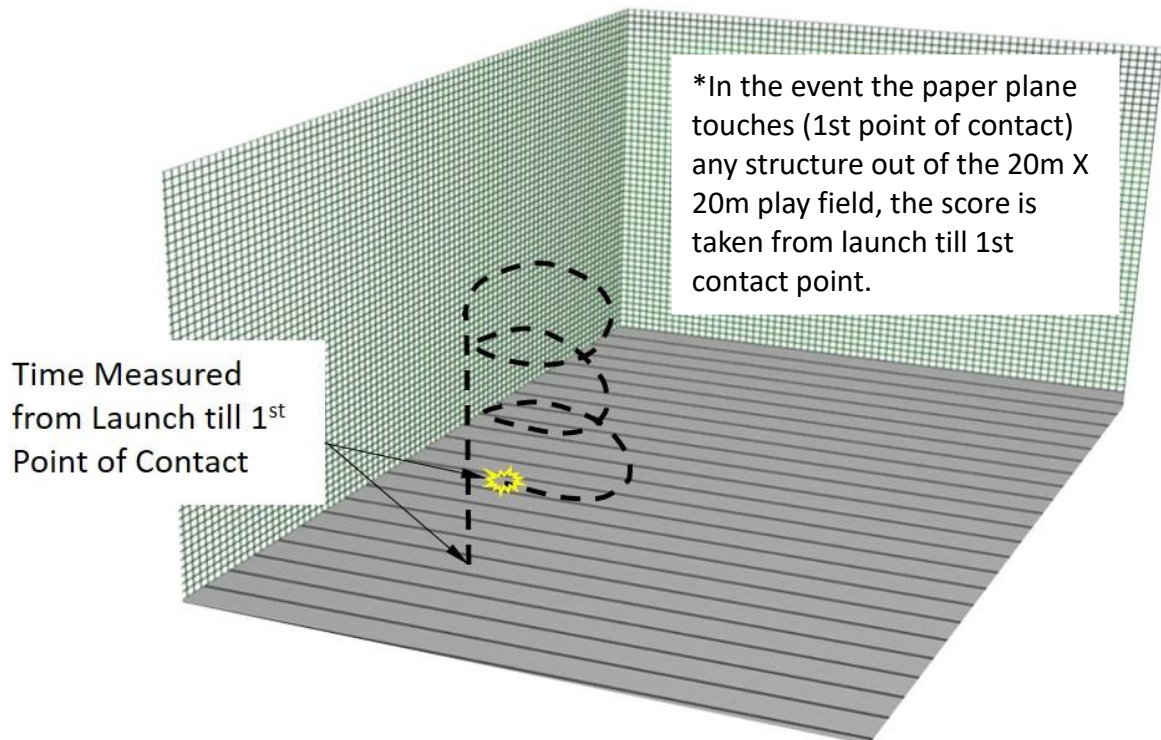
Teams are to launch their planes from within the playing field to obtain the longest time aloft score in the field below:



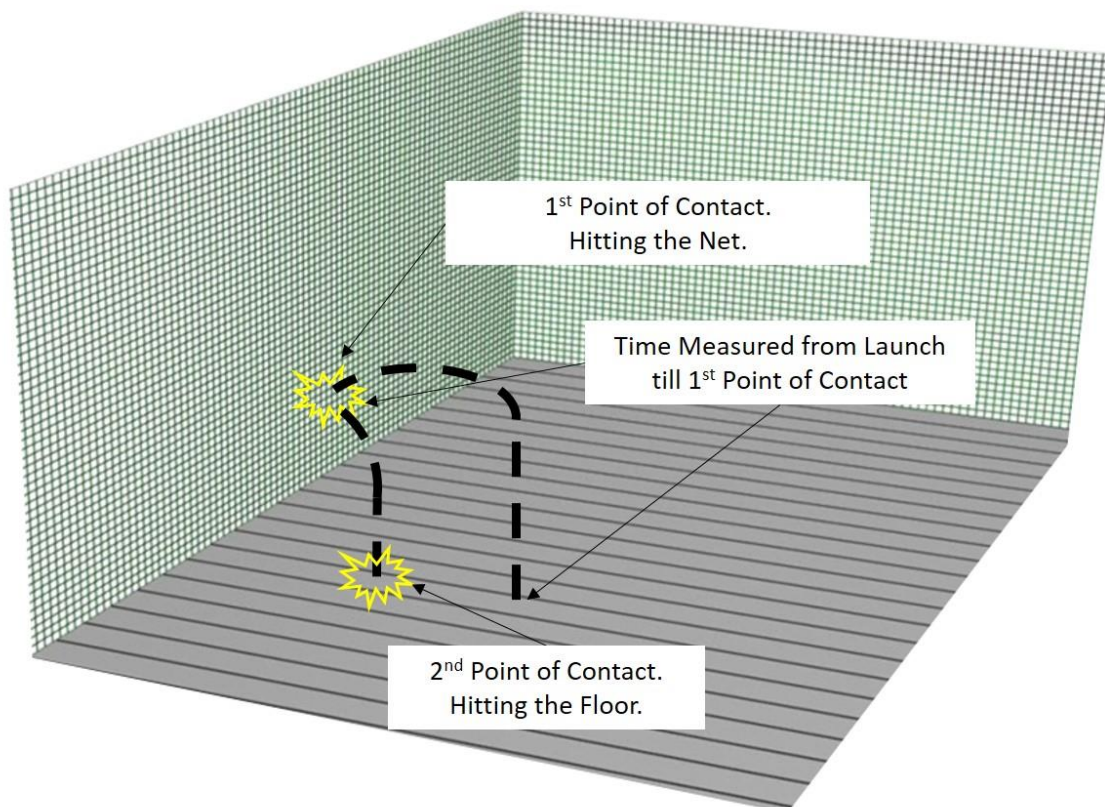
6.6 TIME ALOFT CHALLENGE RULES & SCORING

1. One participant from each team is to launch their plane from within the playing field.
2. The score (in seconds) will be taken from the time the plane leaves the participant's hand till the time the plane first touches any point in the field, any other objects (netting), or when the plane flies out of the playfield.
3. In the event of a tie, the tied teams are to do a "fly-off", to compete against each other for the best score to break the tie.

The example below shows the plane launch and flying until hitting the floor. The score is taken from launch till impact on the floor.



The example below shows the plane launch and in flight until hitting the net, and then the floor. The score is taken from launch till impact on the net.



7. CATEGORY A CHALLENGE SETUP

1. Teams are not allowed to bring in paper planes, books, manuals, notes, drawings or any material, printed or electronic, related to folding instructions or paper plane competitions. SAFMC officials may check the teams for possession of such items and teams must comply immediately.
2. Teams will be given a total of **THIRTY (30)** minutes to create **THREE (3)** paper planes, one for each challenge. The playing fields will be open for trials during this period.
3. Only one team will be allowed to use each playing field at any one time and only one team member will launch their plane. Participants need to queue to use the field. Each participant will be given **ONE (1)** minute to test their plane before being asked to re-queue.
4. Towards the end of the **THIRTY (30)** minutes, the playing field will be closed and teams must submit their planes to the SAFMC officials for them to be stored in a box. The officials will inspect the planes to ensure all the regulations are met. Any planes that fail the inspections will be given **FIVE (5)** minutes to rectify the problem. Failure to meet this may end in the team's disqualification from the challenge.
5. Teams must complete their **THREE (3)** paper planes and attempt the trials at the playing field within **THIRTY (30)** minutes. No time extension will be given.
6. The planes will be quarantined till the teams are called up again for the challenge.
7. When the challenges start, teams will be called upon and two (2) participants are to report at the Reporting Point to collect their plane for the specific challenge. One participant will throw the plane and the other will retrieve the plane upon the referee's signal.
8. Each challenge consists of **TWO (2)** attempts and both must be completed within **THREE (3)** minutes. The best score will be taken for each team.
9. Only one plane can be used for each challenge. A single plane cannot be used for different challenges.
10. Teams may not modify their planes at the launch area (i.e. starting area, starting line), or add any items on the playing field.

11. Upon the Referee's signal, the challenge will start. The participant may launch the plane.
12. All planes must be launched within the specified launch area for each challenge.
13. Each paper plane must be launched by hand and unaided (not using slingshots, elastic bands or any forms of launchers) by one participant.
14. The participant must be physically in the launch area provided for each challenge from the start of the attempt to launch until the completion of the launch (when the participant lets go of the plane).
15. For the Range Challenge, the participant, when necessary, may run up, fast walk or jump up when launching the plane. Participants must not jump/step out of the starting line even when the plane is released from the participants' hands.
 - *If there are violations to the launch rule, it will be considered a failed attempt and the scores/points gained will not be recorded.*
16. At the end of the challenge, the Referee will complete the score sheet and the participant must sign on it to acknowledge the score.
17. If any team disagrees with any of the Referee's decisions and wish to appeal, they must inform the Referee after the challenge and before leaving the playing field area.
18. The Chief Referee may call for a re-attempt if necessary. However, the following are not valid reasons to call for a re-attempt:
 - *Participant's launch technique.*
 - *Any deviations in the playing field setup, within the declared margins.*
19. Teams must heed the instructions of the referees during the game play.
20. Any teams found in violation of the rule(s) may forfeit the challenge and be awarded zero (0) points or may be disqualified from the competition. Multiple violations by the team may result in the school to be disqualified from the competition.
21. The SAFMC Category A Chief Referee has the final say on all rules and regulations.

22. The Chief Referee and Referees will not review any form of recording at any time during the competition.
23. Teams found acting in a disrespectful and/or rowdy manner may be disqualified from the competition. Multiple violations by the team may result in the school being disqualified from the competition.
24. Teams are encouraged to clear any doubts about the challenges or rules before the start of the competition.

8. CATEGORY A PAPER PLANE FOLDING REGULATIONS

Teams participating in Cat A must construct their paper planes according to the rules below. The SAFMC Category A Chief Referee has the final say on all rules, regulations and the paper plane design compliance.

1. Each paper plane must be made on-site during the competition with the SAFMC Official Paper that is provided. Each sheet of paper is standardised at A4 (297mm x 210mm), 80GSM.
 - a. Each team will be given **THREE (3)** sheets of papers of different colours by the SAFMC Officials on the day of the challenge. Teams are not allowed to use their own paper.
 - Range Challenge = Pink-coloured Paper
 - Boomerang Challenge = Orange-coloured Paper
 - Time Aloft Challenge = Blue-coloured Paper
 - b. Teams are not allowed to make a plane from more than **ONE (1)** sheet of paper.
 - c. Teams may exchange a used sheet of paper for a new one. However, the entire sheet of paper must be returned to obtain a new one (portions of the paper cannot be missing).
 - d. Paper planes should not be created by multiple papers or different coloured papers.

2. Teams are allowed to fold, cut, or tear the paper to create the plane. Any portion of the paper that was cut and detached may be reattached.
3. Teams are allowed to use the standardised UHU® stick that is provided. Each team will be given **ONE (1)** glue stick by the SAFMC Officials on the day of the challenge. Teams are not allowed to use their own glue.
4. All paper planes must be made only with materials provided by the SAFMC Officials on the day of the challenge.
5. Teams must write their team number and team name on all their planes. The number and name must be clearly visible to the SAFMC Officials.
6. Teams are allowed to use stationery (scissors, rulers, pen, etc.) and other tools (hair dryer, etc) during the competition to create the paper plane.
7. All paper planes must reasonably resemble a fixed wing structure. A crushed paper does not qualify as a paper plane and it will not be allowed in the competition.
8. Teams must create their paper planes in a safe manner (no running with scissors, throwing paper clips at others, etc.). Any teams behaving or using a method of building which is deemed unsafe by the SAFMC Officials may be disqualified.
9. The colours of the papers may change on the day of competition. However, the weight of the paper and size will remain the same.

9. CATEGORY A ONLINE PRESENTATION

Teams are to submit 2 documents online

1. Flight Engineers notebook (PDF format)
 - Shows the team learning journey log
2. Video on proof of folding and flight
 - 1 video per team
 - Not Longer than 4 minutes
 - Shows actual participant(s) folding and throwing
 - Shows A4 paper being folded into a plane

- Shows the moment of release and landing/touching of surface
- Shows attempts of all 3 challenges

3. Video Submission Guidelines:

What is NOT permitted?

- Animation is **NOT** allowed.
- All videos must **NOT** be created with professional assistance.
- Adults/Non-participants are allowed to be fringe actors/'cameo'/'extras' or cameraman but **NOT** folding and throwing.
- Students are required to upload their videos on YouTube (set as 'unlisted') and submit the video links to their school coordinator(s).
- On YouTube, the format of the title of the video should be '[School] – [Team Name]' E.g. 'Science Centre Pri – Sounders 11'
- Submission by schools - All school coordinators are required to collate the video links in the excel sheet (provided by organiser) and submit to the following email address: safmc@science.edu.sg by **17 March 2022**
- The excel filename should be 'SAFMC2022 Video Link [Name of school]' E.g. SAFMC2022 Video Link XYZ Pri .

4. Pre-Challenge Week Presentation

- Tentatively **18 March 2022**
- Teams are to present to a panel of judges via ZOOM
 - Flight Engineers Notebook
 - Learning journey experiences and stories
 - Strategies
- 5 minutes presentation + 5 minutes Q&A
- Team zoom schedule will be announced before March School Holidays

The presentation plays an integral part for teams who wish to vie for the SAFMC Championship Award.