

# SAUVC 2017 Rulebook

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## Objective

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The goal is for each team to design and build an Autonomous Underwater Vehicle (AUV) which can negotiate the tasks put forth under a prescribed time. Also to learn and have fun in the process.

## Structure of the Team

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A team may consist of up to **eight** participants and up to 3 faculty co-supervisors. At least half of the participants must be students at the time of registration.

## Video Submission

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All teams are to submit a (maximum 5 minutes long) video of their AUV at least 1 week prior to the competition. The video should showcase the AUV swimming underwater for at least 10 seconds. Videos will be reviewed by the organizing committee and accepted videos will count towards the Certificate of Participation.

## Qualification

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- AUVs have to pass a qualifying round before they can participate in the main arena.
- To qualify an AUV has to swim between two underwater markers separated by 10 meters and without surfacing or touching the bottom/wall.
- The time taken to pass the qualifier round decides the sequence in which the teams will participate in the final round of the competition. The team that finished the last in the qualifying round would participate first in the final round.

## The Arena

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The challenge will be held in an olympic sized swimming pool. There are 4 tasks in the challenge:

- Navigation
- Target Acquisition

- Localization
- Target Reacquisition

The first task, Navigation is mandatory and must be completed before attempting any other task. The other tasks can be attempted in any order. Surfacing at any point signifies end of mission.

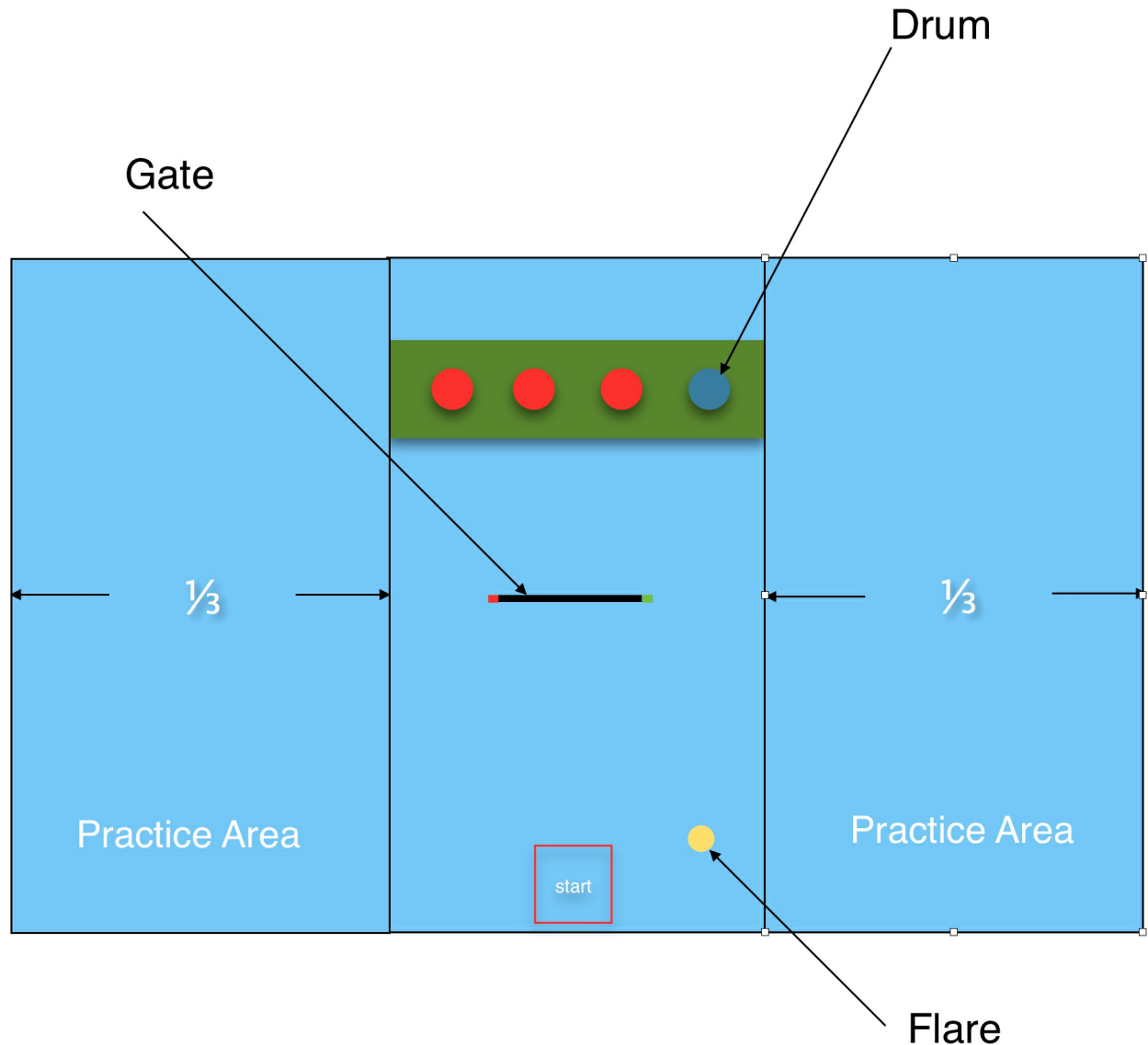


Figure 1. Map of the Arena.

## Starting Zone

The starting zone is a 140×140cm area marked on the surface of water. The teams **must** start their AUVs from this area. The team may only place the AUV at the water surface, it must autonomously submerge **before** leaving the starting zone.

## Navigation [10 Points]

The aim of the this task is to swim through a gate in water. The gate is approximately 800 cm

away from the starting point. The AUV has to swim through the 150 cm high gate. The gate will have red and green sides marking port and starboard sides respectively.

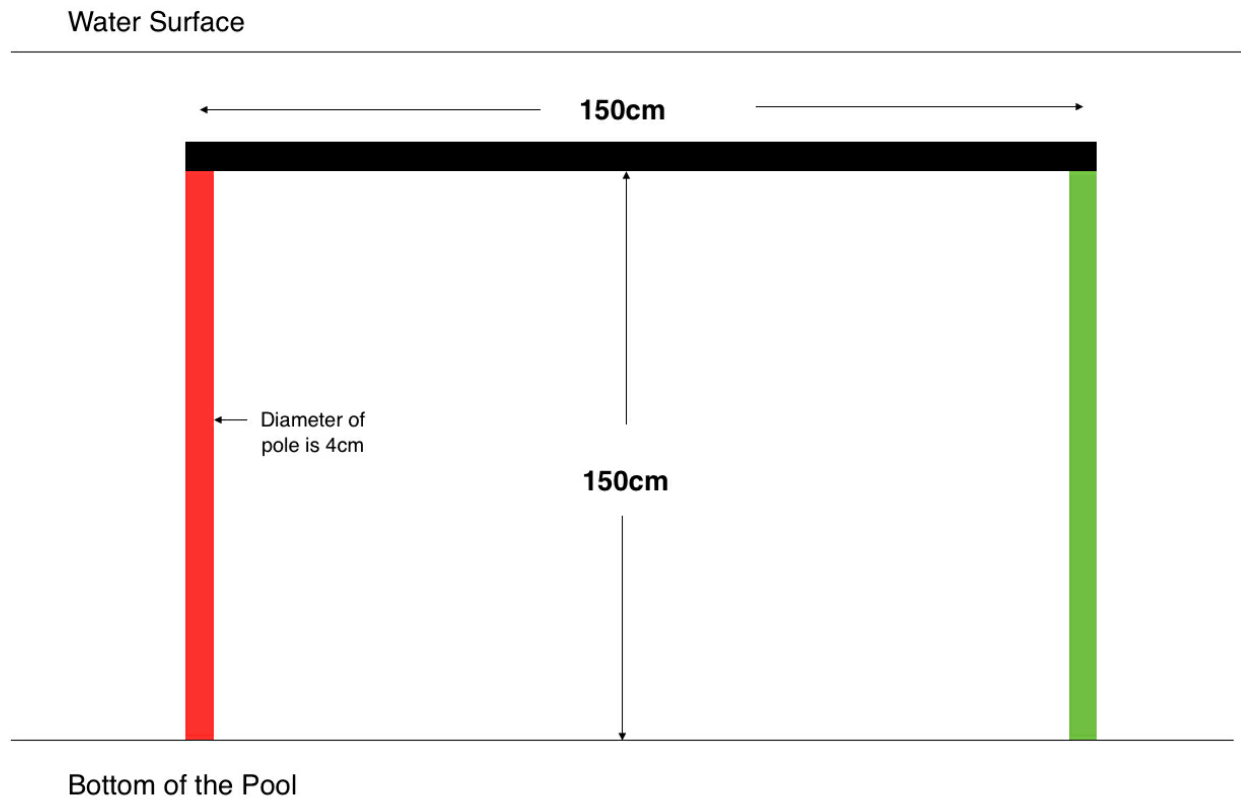


Figure 2. Structure of the gate.

## Target Acquisition [10-50 Points]

The aim of the task is to detect and acquire a target among a series of drums at the bottom of the pool, in the target zone.

A target zone is defined by a green colored mat laid out on the floor of the pool. The mat is 8m x 2m in size. Figure 1. shows the location of the mat with respect to the arena.

There are 4 colored drums in the arena. All of them are on the mat. One of the drums, chosen at random, will be **Blue** in color. One of the Red drums, chosen at random, will contain an acoustic pinger. The AUV needs to drop a ball in one of the drums to successfully complete this task.

Points will be awarded as follows.

- Drop the ball in the Blue drum. **[30 Points]**
- Drop the ball in the Red drum with the pinger. **[50 Points]**
- Dropping the ball in any other Red drum. **[10 Points]**

The target drum for the Acoustic mode may be randomized between attempts, similarly for the order of the drums.

### **Specification of props.**

- Drum: 60cm in diameter and 30cm in depth.
- Ball : 3.5-4.5cm in diameter and weigh no more than 100g in air. Provided by teams. In the event of multiple balls being dropped, only the first ball is taken to consideration.
- Bucket Pinger : RJE International Pinger Model No. ULB-362B/45 kHz

## **Target Reacquisition [60 Points]**

The aim of this task is to reacquire a previously detected target.

This task is only attemptable if the Target Acquisition has been successfully completed. Furthermore, the AUV has to leave the target zone, before it can attempt the Target Reacquisition task. Every part of the AUV needs to clear the target zone, before it can be considered outside the target zone.

After the AUV is outside the target zone, it needs to reacquire the target and pick up the ball that it dropped in the Target Acquisition task. The AUV has to hold on to the ball till the end of the attempt to successfully complete this task.

This task does not have to be attempted immediately after Target Acquisition task, other tasks may be attempted in between.

### **Specification of props.**

- Target zone : Green mat 8m x 2m in size.
- Ball : Same ball used in target acquisition task. Provided by the teams.

## **Localization [40 Points]**

The aim of the this task is to localize on a flare. The flare is marked with an acoustic pinger. This flare could be located **anywhere** within the main arena. The AUV should locate and bump the flare causing the golf ball in the flare to drop out.

### **Specification of props.**

- Flare Pinger: RJE International Pinger Model No. ULB-362B/37.5 kHz



Figure 3. Structure of the flare.

## Surfacing

Breaching the surface any point during the mission causes the current attempt to come to an end. The team may wish to try again if they still have time left. When the AUV surfaces, and the current attempt comes to an end, the total points for that attempt will be computed based on the tasks accomplished and the timing bonus.

## Timing Bonus

At the end of an attempt, as long as the AUV has successfully completed the Navigation task, bonus points proportional to the remaining time will be awarded in accordance with the

following formula.

$$\text{Bonus points} = (900 - \text{RUN\_TIME}) \cdot 0.03$$

For eg. For a run time of 420s, Bonus =  $(900-420) \cdot 0.03 = 14.4$  Points

## Penalties

There are penalty points for touching the floor or wall of the pool at any time, and also for touching the gate. This table states the penalties.

	Description	Penalty Points
1	Touching the gate	2
2	If the AUV touches the bottom of the pool or wall for a duration, t	$5 + \max(0, 4 \cdot (t - 10))$

## Specification of AUV

### Size

- The AUV must fit within a  $140 \times 100 \times 100$  cm box.
- An AUV with dimension of less than  $70 \text{ cm} \times 50 \text{ cm} \times 50 \text{ cm}$  will be given bonus **[10 points]**.
- The AUV must not weigh more than 50 kg in air.
- An AUV weighing less than 40 kg in air will be given bonus **[10 points]**.

### Power

- Power should be self contained. Tethers of any sort are not allowed.
- The voltage of the power source used by each AUV should not exceed 24VDC.

### Safety

- AUVs should not leak and pollute the pool.
- AUVs must be designed and manufactured as to pose no danger of any kind to anyone or anything at the venue.
- AUVs must have a **kill switch** that turns off the vehicle, which is easily accessible to a diver. This should be marked bright yellow.
- Pressure of any compressed gas used must not exceed 6 bars. AUV should be

completely autonomous.

- The use of explosives, fire or hazardous chemicals is prohibited. Certified lithium batteries are allowed
- If lasers are used, they must be of class 2 or lower. Care must be taken to protect all persons at the venue from harm. Beams must be oriented in such a fashion that they cannot shine into the eyes of the spectators.

## Communications

- No communication from/to the AUV of any sort is allowed during the game

## Game Procedure

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### Length of a game

- Each team is given 15 minutes to complete the tasks.
- In any of the following cases, the game ends immediately.
  - Disqualification is announced in the game.
  - When the judges determine that the game cannot continue.
- Setting up of AUV
  - Five minutes is given for setting up the AUV before the game starts.
    - No more than two members of respective teams can engage in setting up of their AUV.
    - The two designated members setting up must wear life jackets. Failure to do so may result in disqualification.
    - Any team that fails to complete setting their AUV within five minutes can resume the setting up again once the game starts.
    - Setting up during the game uses the allocated time for the tasks and game.
    - The AUV can only start from the start zone. This is the only place where the AUV is allowed to be on the water surface.
    - The AUV should start its maneuver only after it has completely submerged in the water.

### Retries

- A retry attempt can be made only after the judge's permission.
- The AUV will be passed to the two designated team members standing beside the pool by the divers.
- A retry would mean that the AUV starts from the start zone with zero points.
- A maximum of 15 minutes is allowed including all the retries.

- The attempt with the highest score (including retries) will be considered for final scoring.

## General Restrictions

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- Team members are not allowed inside the swimming pool at any point during the game.
- Team members may not disturb the water surface once the game starts.
- Members of other teams are not allowed in the game area.
- Nobody is allowed to wear any footwear near the pool area.
- The judges may suspend the challenge if weather turns unfavorable.
- The pool area must be evacuated in case of lightning.

## Disqualification

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- Oil or lubrication leak causing the pollution of pool. battery leak causing the pollution of pool.
- The team damages or tries to damage the field, facilities or equipments.
- The team performs any acts that are not in the spirit of fair play.
- The team fails to obey instructions or warnings issued by the referees.
- The team has made a false start for three times in the same match.
- If the team does not abide by the the general restrictions.

## Others

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- The legitimacy of any actions not provided in this rulebook will be subject to discretion of the Judges.
- The dimensions, weights, etc. of the field, facilities and equipments stated in this rulebook have a margin of error of  $\pm 5\%$  unless otherwise stated. However the dimensions and weights of the AUVs as stated in the rule book are the maximum and cannot be deviated.
- The judges may demand additional explanations on safety issues when the safety of a vehicle is deemed to be in question.

## Sequence of events during the competition

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- AUVs will undergo weight and size check. Bonus points, if applicable, will be awarded.
- AUVs will be tested for battery, oil or lubricant leak. Failing the leak test would lead to disqualification of team.
- AUVs will proceed to qualifying round. The bonus points for size and weight is applicable only if the AUV passes the qualifying round.



- The qualified AUVs will proceed for the final rounds of competition.

## Certificate of Participation

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- Teams whose AUVs successfully complete the qualifier round will receive Certificate of Participation.
- Teams whose video submissions have been accepted & participate in the competition will receive a Certificate of Participation.
- Failing the above two criteria, no Certificate of Participation will be awarded.

## Technical Presentation [15 Points]

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- Teams have to make a 10 minutes presentation about their AUVs and their design and engineering process on the "seminar day" of the competition.
- The date and venue of the presentation will be confirmed 1 week before the competition.
- The presentation will be judged and a maximum of **15** points can be earned towards the competition.
- There will be a 5 minutes Q&A session after the presentation.

## Presentation Rubrics

The presentation will be judged on the following Rubrics (3 points each).

- Timeliness ( $\leq 10\text{min}$ )
- Technical Overview (for eg. Mechanical & Electronics & Software architecture of the AUV.)
- Design Innovation (for eg. Novel ideas/techniques you implemented in your AUV.)
- Challenges (for eg. Major challenges and how you overcame them.)
- What did we learn (for eg. Lessons learnt from the competition.)