

UNDERWATER ROBOT COMPETITION

1. OBJECTIVE

Underwater vehicles are vital to port & harbour security, naval and scientific exploration, underwater cleaning etc. This fun-filled and challenging competition aims to introduce students to this fascinating world so that they can explore career opportunities in this field. The competition will spur interest and promote education in this area and motivate young and aspiring engineers and scientists to further pursue this field.

The competition aims at the following long term goals

- Address shortage of skilled individuals to support advanced marine engineering in Singapore
- Reach more students & get them interested in the industry. Help students develop the skills to support marine engineering early on through fun filled activities
- Complement & expand educators' knowledge and expertise in this field

2. BRIEF DESCRIPTION OF MISSION

- 2.1 The team of contestants have to design and build a remote operative vehicle (ROV) or an autonomous underwater vehicle (AUV). ROV and AUV are separate categories.
- 2.2 The mission involves the picking up of as many objects (cargoes, one at a time) from the middle section of the tank and dropping them in baskets at either ends of the tank. At the end of each run the number of objects in each basket ideally should be equal. For both ROV and AUV, each pair (one in each basket) gets four (4) points and remaining unpaired objects in the basket get one point each. For AUV's, they shall be awarded a bonus of two (2) points on condition that the robot(s) deliver(s) at least one (1) object into the basket.
- 2.3 While doing so they would have to maneuver through window frames which will be non magnetic on either sides of the tank. Hitting the windows will cause the team to loose points.

3. TANK SPECIFICATIONS

- 3.1 The game will be played in an L-shaped tank of dimension: 1425mm x 1425mm x 500mm. The tank has a glass of 12.5 mm thickness. See Figure 1 for details.
- 3.2 There shall be two rectangular window frames, 30mm thickness, and one on each section of the tank 500mm from the ends of the tank. See Figure 2 for detailed dimensions.
- 3.3 The centre section of the tank will have a bump which is 12.5mm in height.
- 3.4 In the central area of the tank there shall be a cargo holder containing 16 objects arranged in a grid. This holder will be elevated from the tank floor by about 2 cm. See Figure 1 layout.
- 3.5 The cargo holder will be a square of 100mm sides with the sixteen objects arranged in a grid. The cargo holder will be made from a non-magnetic material. See Figure 3.
- 3.6 The cargo to be lifted will be marbles in the case of ROV and nuts for AUV as shown in Figure 4. The marbles are ceramic in nature and will have a diameter of around 15 – 17 mm weighing 3 to 7 g each. The nuts will be ferromagnetic and weigh between 10g to 20g.
- 3.7 A black tape, 4 to 5cm wide, will run through the centre of the tank and on both sides of the tank at a height of 20cm from the bottom.
- 3.8 There are two basket areas at both ends of the tank. There will be a barrier of about 2cm in height separating the basket from the rest of the tank.

3.9 The water depth in the tank will be 40 cm and flush with the top of the rectangular window frames mentioned in 3.2 above.

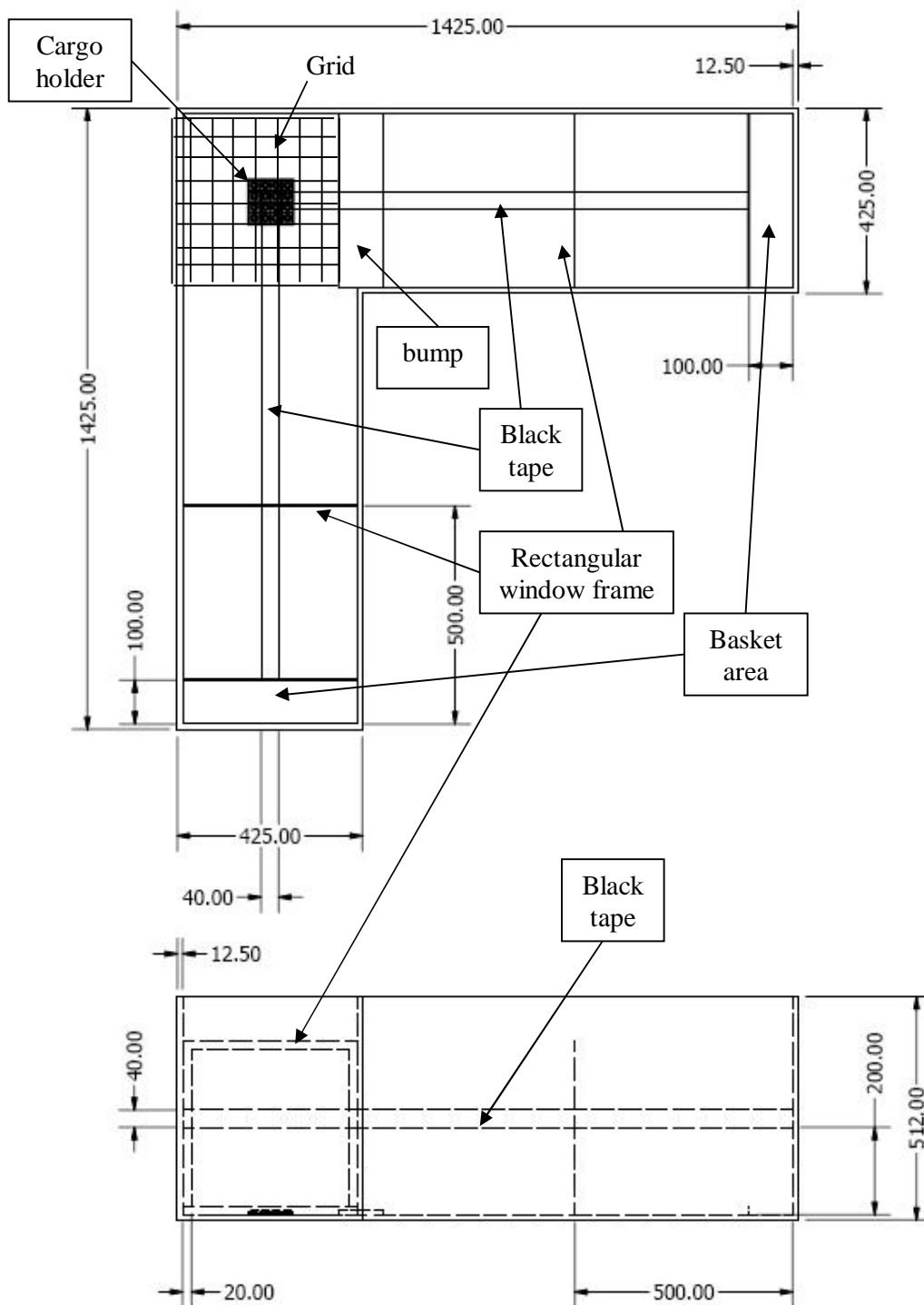


Figure 1: Tank Dimensions (in mm)

4. ROBOT SPECIFICATIONS

4.1 The robot should at the start of competition fit in a box of 30cm (width) x 30cm (length) x 30cm (height). Any vehicle found violating the dimensions shall be disqualified immediately.

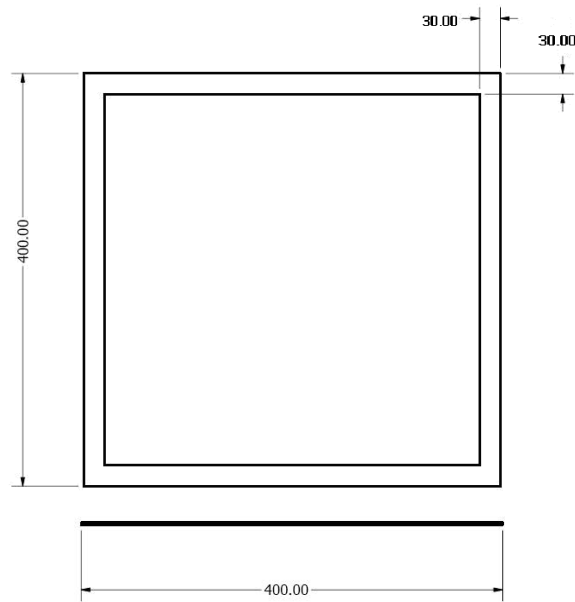
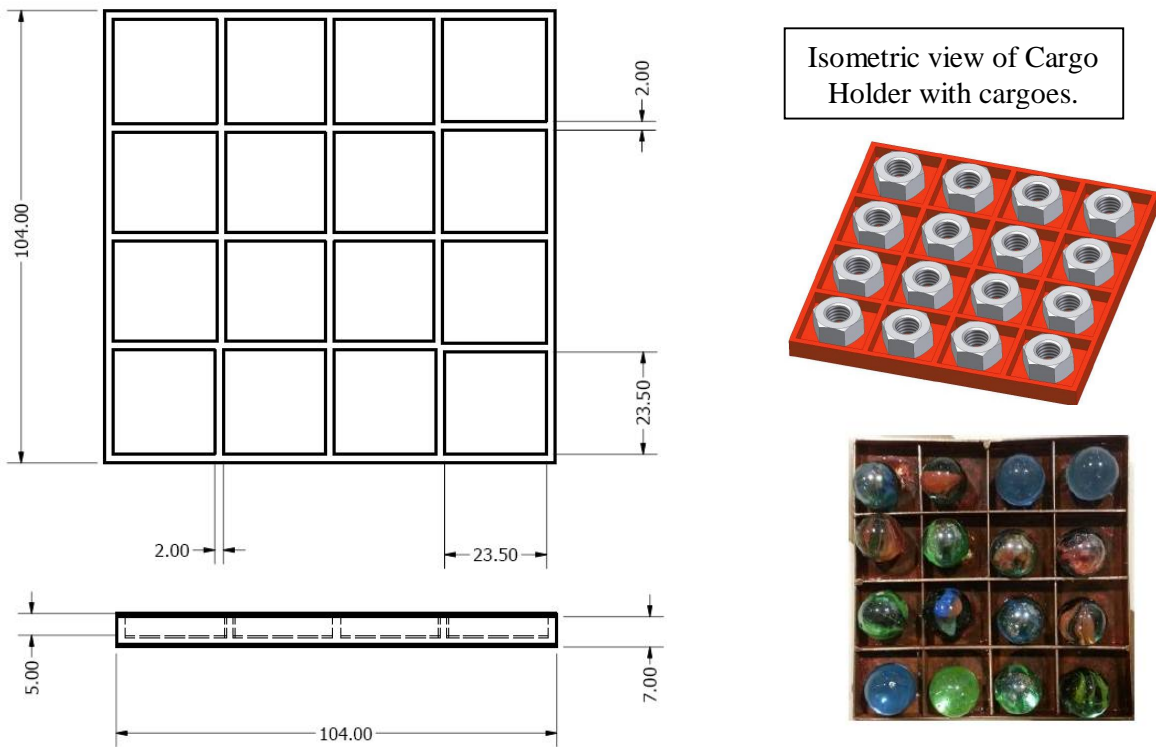


Figure 2 : Rectangular Window Dimensions (in mm)



Isometric view of Cargo Holder with cargoes.

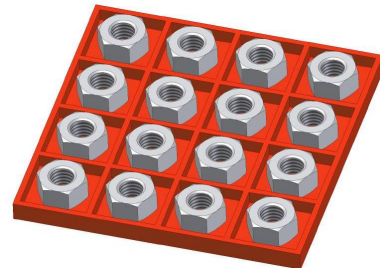


Figure 3 : Cargo Holder Dimensions (in mm)

4.2 During any attempts, the vehicle should not exceed 40cm in any one dimension. This specification however does not prevent the initial vehicle from splitting up into multiple parts as long as the above conditions are satisfied. The later condition above would then apply to each completely disconnected part. However, at the start of the competition, the vehicle must be assembled as a single unit.

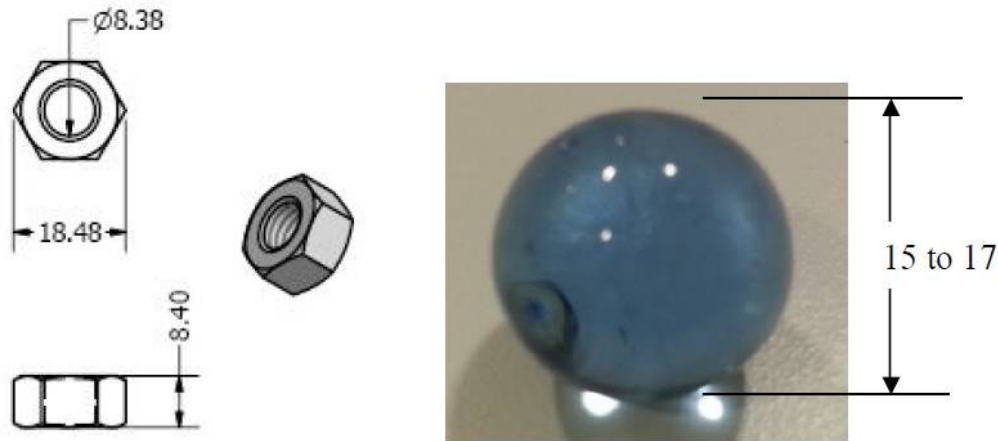


Figure 4 : Cargo Dimensions (in mm)

- 4.3 In case of AUV's, the method of wall sensing is at the discretion of the builder. However, the AUV must not exert a force on any wall of the tank likely to cause damage.
- 4.4 Wheeled or legged machines running on the tank bottom surface will not be allowed. Any other method of propulsion is at the discretion of the builder, provided that the power source is non-polluting. Use of any kind of explosive material is prohibited. Nothing may be deposited off by the machine in the tank.

5. JUDGING CRITERIA

- 5.1 For non-autonomous robots, points shall be awarded in the following manner:
- 5.1.1 4 points for each pair of objects (one in each basket.)
 - 5.1.2 1 point for any unpaired object left in either basket.
- 5.2 For autonomous robots, the points scheme shall be as follows:
- 5.2.1 2 bonus points for autonomous vehicles if it drops at least one object.
 - 5.2.2 4 points for each pair of objects (one in each basket.)
 - 5.2.3 1 point for any unpaired object left in either basket.
- 5.3 The time for the first cargo to be dropped will also be recorded, and shall be used as a tie-breaker.
- 5.4 There are no penalties for hitting the tank walls or the window frame. For RC, only ONE participant is allowed to operate ONE robot. The handler / controller and robot will be paired and identified during registration and caging.
- 5.5 To be considered for prizes, at least one object should be dropped in either basket for autonomous robots, and two objects in each basket for RC robots.

6. RULES FOR COMPETITION

- 6.1 Each team will be given a competition time of 6 minutes, inclusive of setup time. Each robot is given a maximum of 3 starts within the competition time and one attempt is counted for scoring and is limited to a maximum of 4 minutes.
- 6.2 Robots shall start from either end of the competition tank. The starting line shall be 40 cm from either edge of the tank, and the robots may not be placed beyond this line at the start. Once team has chosen the starting end, all attempts shall proceed from the same position.
- 6.3 The attempt with maximum points will be considered as the team's final score. And the time recorded for the first cargo drop for the chosen attempt shall be used as tie breaker.

- 6.4 Any objections or appeals on discrepancies on points awarded must be raised within 5 minutes after the team completes its competition attempts and its points displayed on the official results board. Objections/appeals should be submitted in the official appeals form available at the Reception Counter to the event chairperson. No further appeals and objections shall be entertained after the given window.
- 6.5 Judges decision is final and binding to all.
- 6.6 All robots will be caged half an hour before competition starts and would be checked for safety and cloning. Robots found to be of unsafe nature shall be disallowed.
- 6.7 The objects have to clearly fall within the basket. Objects on the basket barrier shall not be counted.
- 6.8 Any dropped object outside the cargo holder or basket will be considered out of play.
- 6.9 Each vehicle can lift only one object at a time. However while picking up objects within the cargo area, if multiple objects are picked, excess objects can be dropped back within the cargo area without penalty. In other words the vehicle should be carrying only one object once it is out of the cargo area. If multiple objects are carried at one time out of the grid area, all of them will be considered out of play.
- 6.10 Only two handlers are allowed in the competition arena for each team and only one remote controller is allowed in case of an ROV.

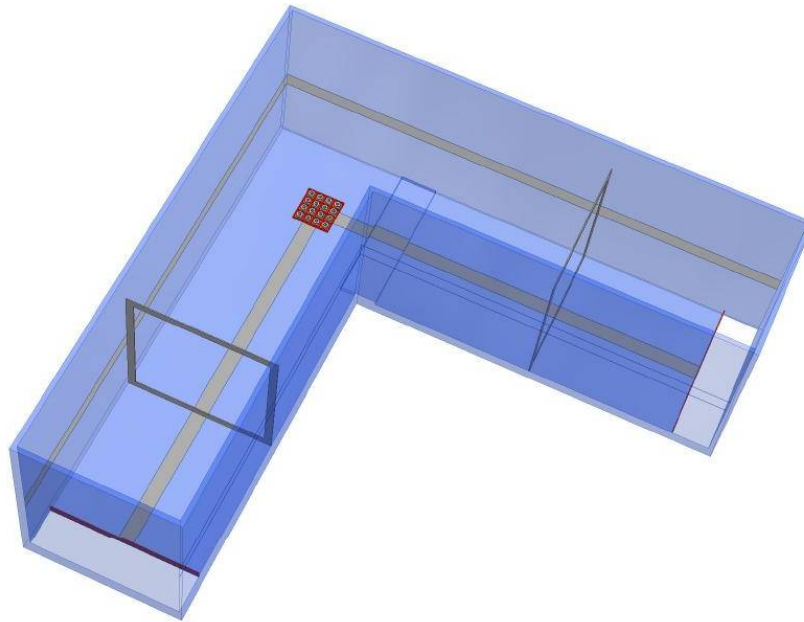


Figure 5 : Isometric view of Competition Setup

7. CLONING

- 7.1 In accordance with the spirit of the competition, clones among the winning entries will only be awarded one prize. Clones will be identified during the "caging" procedure.
- 7.2 Clones are robots with substantially identical physical appearance and working principles. This rule will be applied strictly especially for multiple entries from the same institution.
- 7.3 When in doubt, the decision of the Judges will be final. No arguments will be allowed on cloning issues once competition starts and such arguments may disqualify the team.