

## Pre-build 2. Marine Ambulance

(Rule book release, 1 February 2023)

Your task is to design and build a model of a marine ambulance. The ambulance needs to be a boat that is fast, but gentle, with minimal acceleration in any direction.

The boat must carry a cell phone that uses the Phyphox App to record the boat's total acceleration during the race. The phone should be in a closed Ziploc bag during the trials to avoid any damage to the phone should a marine accident occur.

The boats will be tested two at a time in a container 244 cm long and 88 cm wide. The width will be divided into 2 test lanes. The depth will be 12 cm. During the race, the boat may not touch the bottom. The boat may bounce off the sides of its race lane, but any such contact must be momentary. The boat may not be in continuous contact with a side of the track or any on-shore object.

The hull of the boat must be built from cardboard and saran wrap or aluminum foil. A paddle wheel or a propeller that is powered only by an elastic band or cord must be used for propulsion.

The shaft, propellers and paddle wheels may be pre-manufactured. Pre-manufactured gearboxes may also be used, if needed. Small metal pieces may be used for the purpose of mounting shafts, but such pieces may not be used to reinforce the hull.

The size of the boat can not exceed 15 cm in width, 30 cm in length and 8 cm in draft (i.e., the distance from the waterline to the bottom of the boat).

The boat should be started by cutting a thread immediately after the recording of the acceleration on the phone begins. The recording may be started remotely (from a computer) or manually. The judges must be able to see the phone at all times and verify that the data were recorded from just before to just after the race.

The acceleration sampling must be every 10 ms (100 Hz sampling rate). After the boat crosses the finish line or permanently stops on the track the recording must be stopped and the acceleration data sheet must be emailed to the judges.

The smartphone should be pre-loaded with the free [PhyPhox app \(linked to an external computer\)](#), which will be the only measuring device used in this pre-build activity. The app will record acceleration during the process of transporting the phone using the "Acceleration (**without g**)" function.

### Scoring

The score will be the sum of all recorded acceleration values during the race time to the third power. Acceleration values will be measured in  $\text{m/s}^2$ . The boat that produces the **smallest score** will win. Boats that do not finish the race (i.e., stop before the finish line or do not finish in 3 minutes) will have their score multiplied by 1000. There will be only one trial for each boat.

### **Data submission format**

Each team must submit one Excel file named according to the following template 'SCHOOL\_NAME.xls' (e.g., 'University\_Hill.xls' or 'Lord\_Byng.xls').

The file should be generated within the PhyPhox app by pressing on the menu sign and choosing "Export Data" and then "Excel" format. The data file must not be modified in any way other than changing its name according to the template described above.