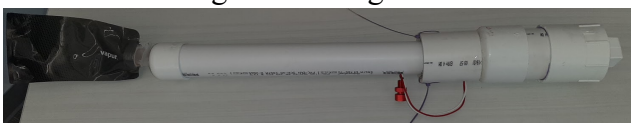
Vertical Profiling Float Design and Construction



To respond to task 3.1, *MATE Floats!*, set out by the Marine Advanced Technology Education (MATE) organization, the R-Mateys have carefully designed and constructed a float capable of completing a vertical profile over the course of this season. While building the float, it was important to the company to acknowledge the real-world implications the task reflects: addressing the damage done to the north and south poles in the form of melting glaciers and ice, diminishing food sources for wildlife, and chronically warmer temperatures. These challenges represent the overall damage that one can see done by the change in climate and mass overproduction of carbon dioxide. The company's float utilizes a buoyancy engine to complete its vertical profiles. The 2022 MATE Manual defines a buoyancy engine as something that "moves fluid from inside an internal reservoir to a flexible bladder located externally."

To ensure accuracy and efficiency, the company chose each component for a multitude of reasons. First of all, the float consists of a two-part enclosure. This enclosure is a polyvinyl chloride (PVC) pipe that is approximately 70 cm long. The R-Mateys chose PVC over other materials due to its affordability, strength, and light weight. The lower compartment has a 3 inch diameter and is 19.4 cm in length. This compartment houses three D batteries, which supply 1.5 volts each, for a total of 4.5 volts. Wires run from there to the upper compartment.

The upper compartment has a length of 50 cm and a diameter of 2 inch. The batteries from the lower compartment power the Raspberry Pi Pico. The Pico was selected for its cost-effectiveness, small size, and low power consumption. The Pico is connected to the Bar02 Depth Sensor and the motor controller. The company decided on this depth sensor for its accuracy. The Blue Robotics website states that the sensor can accurately report the depth to within four centimeters. The next component in the float is the linear actuator. The linear actuator receives voltage of a certain polarity and pushes the plunger of the 200 milliliter syringe, filled with white mineral oil. The white mineral oil was selected by the company because of its relatively low density of 0.85 grams per milliliter.

To complete the vertical profiles, the float must first be deployed by the company's ROV. The depth sensor communicates the depth of float to the Raspberry Pi (RPi). When the float reaches the depth designated by the RPi, a signal is sent to the motor controller which reverses the polarity to the linear actuator, which then pushes the mineral oil out of the syringe and into the external bladder. When the bladder inflates, the overall volume of the float increases, but the mass stays the same. This means the density decreases. It decreases to below the density of water, thus allowing the float to return to the water's surface.

To ensure the safety of the poolside operators, the float was equipped with an inline 6 amp fuse to protect from overcurrent. The float was also designed with battery compartment pressure relief in mind. The two part body allows for the battery compartment to be isolated from all other electronic components. In the battery compartment, a 2.5 cm hole was drilled and plugged with a rubber stopper, allowing for a method of pressure relief in case of a battery malfunction.