Eastwood Schools Company Safety Review

Fluid Power

According to rule 3.6.7 of the 2025 Ranger Manual, "RANGER class companies planning to use hydraulics and/or pneumatics (i.e., fluid power) are required to take and pass an online quiz with a score of 100%. Companies ONLY using manual pumps and unpressurized containers are not required to take the Fluid Power Quiz but must still submit documentation regarding their fluid power system." Because we did not use any hydraulic systems on our ROV or float, we did not take the fluid power quiz.

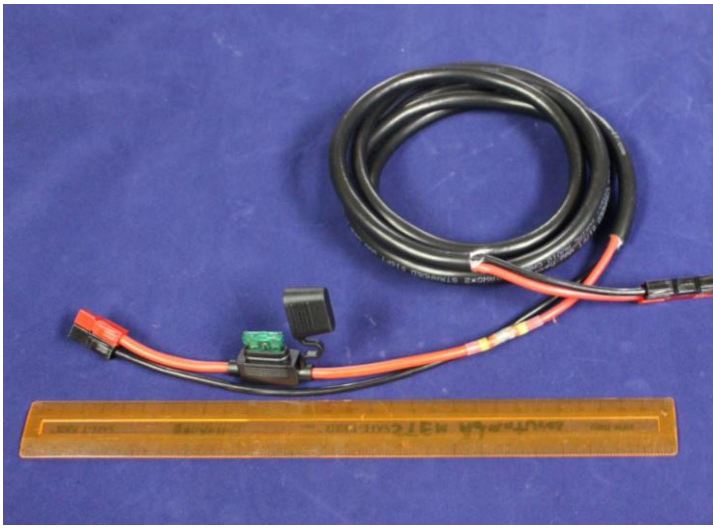
Non-ROV Device Design

Our non-ROV float was engineered to autonomously perform two vertical depth profiles and transmit the collected data to the float operator on shore in real-time. It is powered by ten 1.2V Ni-MH AA batteries, providing a total of 12 VDC—no AC power is used in the system. An ESP32 microcontroller serves as the core control unit, managing operations and data collection. A pressure sensor records depth-related pressure data during each vertical profile. The float features a mechanical test cap on the top side, which serves as the primary access point for internal electronics. To ensure operational safety, a pressure release stopper is integrated to prevent structural failure under high-pressure conditions. Further details on the design and operation of the float can be found in our Technical Documentation.

Anderson Powerpole Connectors

Official Anderson Powerpole connectors are properly crimped and used to connect both the ROV and non-ROV float to their respective battery power sources. The left photo shows the Powerpole connector used to plug in our ROV, originally equipped with a light green 30-amp fuse. After performing a full thruster test, we determined that a 10-amp fuse provided sufficient protection, and the fuse was replaced with a red 10-amp fuse for competition use. The photo on the right displays the 10-cell Ni-MH AA 12 VDC battery pack used to power our MATE Float, along with a light grey 2-amp fuse. In both photos, the fuses are placed less than 10 cm from the Anderson Powerpole connectors, ensuring compliance with safety best practices.



Fuse Calculations

To accurately determine the fuse ratings required, we measured the maximum power draw of high-current components, including the ROV's thrusters and the Float's linear actuator. We used specification values for low-current components, such as the Float's pressure sensor. For the ROV, we calculated a maximum theoretical current draw of 91.4 amps. However, this full load is unlikely, as all motors would not operate simultaneously in normal conditions. During a full down-thrust and forward-thrust test in water while activating the claw, we recorded a peak current draw of 6.2 amps. Based on this test, we selected the next highest standard fuse size—a 10-amp fuse—for use in competition.

ROV Fuse Calculations / Test

Component	Current (A)	Number of Components	Total Current (A)
Raspberry Pi	1.3	1	1.3
Navigator	0.2	1	0.2
Camera	0.2	1	0.2
Camera Servo	0.7	1	0.7
Thrusters w/ ESCs	12.5	6	75
Claw motor	12.5	1	12.5
Linear Actuator W/ MC	1.5	1	1.5
Max Calculated Current			91.4

Test Condition: A full down-thrust and forward-thrust test in water, while operating the claw, resulted in a maximum current draw of 6.2 amps.

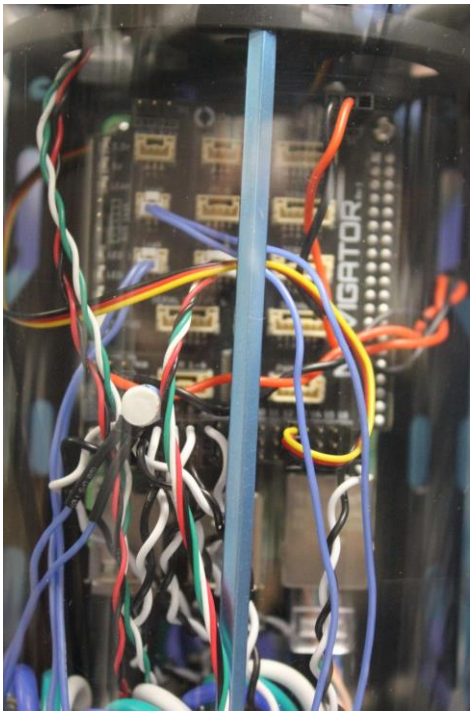
Fuse Selected: Based on this test, the next highest standard fuse size, a 10-amp fuse, was chosen for the ROV. For the float, we calculated a maximum current draw of 1.9 amps. In accordance with MATE regulations, a 2-amp fuse was selected to protect this circuit. This fuse provides appropriate protection while meeting competition requirements. This information is also documented in our non-ROV SID.

Float Fuse Calculations

Component	Current (A)	Number of Components	Total Current (A)
ESP32 MCU	0.2 A	1	0.2 A
Linear Actuator	1.5 A	1	1.5 A
Pressure Sensor	0.2 A	1	0.2 A
12V to 5V conv.	0.01 A	1	0.01 A
ADS1115 ADC	0.0002 A	1	0.0002 A
Max Current			1.9A
Factor	1.9 A	1.5	2.85 A
Fuse	**Max NIMH AA Battery: 2 A**	**1**	**2 A**

Control System

This year, we chose to pilot our ROV using a Windows laptop on the surface while placing all control electronics onboard the ROV itself. To protect these electronics, we used a Watertight Enclosure from Blue Robotics, sealed with Wet Link Penetrators to ensure full waterproofing. The ROV’s camera is housed inside this enclosure and is fitted with a dome cap at the front, allowing it to tilt up and down for a range of viewing angles. There are no loose or exposed wires—all conductors are safely contained within the watertight housing. The enclosure is rated for depths up to 65 meters, which equals approximately 635.55 kPa in freshwater. The photos below demonstrate how we properly followed MATE’s guidelines and safety protocols for assembly and waterproofing.

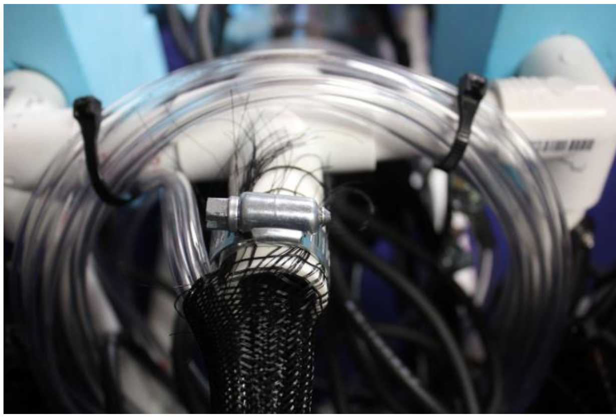



Power Source

A 12V DC battery is used to power our ROV during practice sessions and testing (shown in the left photo). Our Float is powered by 10 AA Ni-MH batteries, providing 12V DC (shown in the right photo). No AC power is used anywhere on the ROV or the Float, ensuring safety and compliance with competition guidelines. The photo on the right shows our Float power source with a 3-amp fuse, the 3-amp was replaced with a 2-amp fuse to be in accordance with a MATE requirements.

Strain Relief and Tether

In the pictures below, the MATE's tether strain relief is connected to the rear of the ROV. All our electrical control wires run inside the black expanded sleeve. The black expanded sleeving is attached to the PVC structure of the ROV using a pipe clamp. There is sufficient slack in the wires so that the black expanded sleeve takes all the strain. Our tether has enough CAT5 wiring to allow the control computer to be positioned up to 5 ft away and the power source up to 8 ft away, protecting the electrical equipment from water damage. The left photo shows the clamp, and the right photo shows a protective sleeve over the clamp. We included two clear PVC tubes to help make the tether neutrally buoyant. These tubes are **not** used for hydraulics but could be used this way or modified in future competitions.

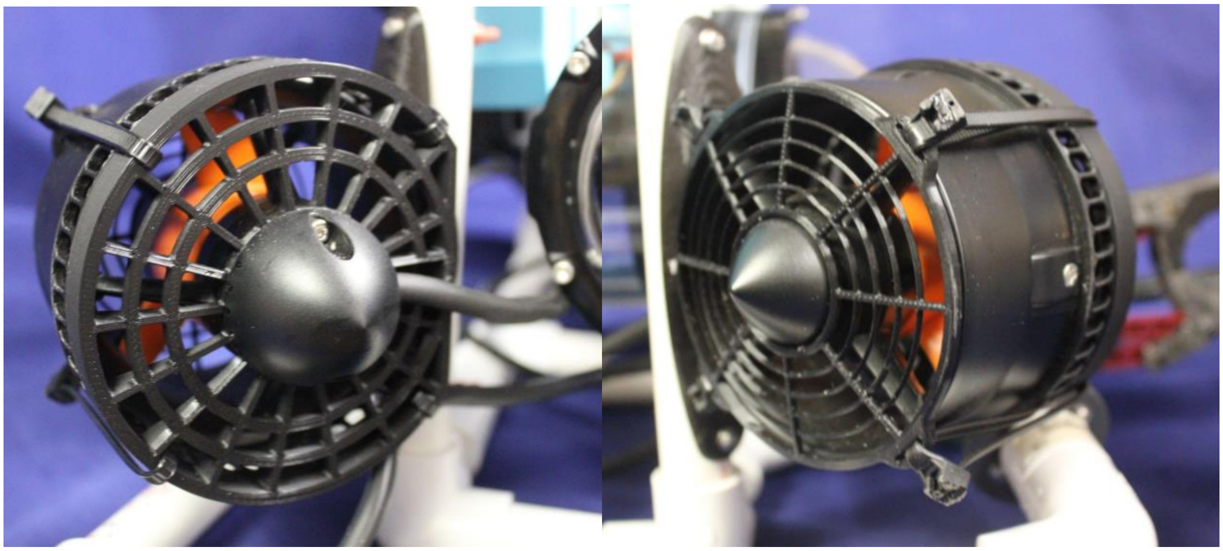


Propeller Guards

The photos below highlight one of our custom 3D-printed propeller guards, designed to protect both the ROV and its surroundings. The mesh cover at the propeller end prevents objects larger than 12.5 mm from entering the propeller area, while still allowing for minimal water flow disruption. Each guard consists of three components: a rear cover, a front cover, and a front spacer. We used four zip ties to securely fasten the components together. These were tightly cinched to prevent the guard from interfering with the propeller's motion or detaching from the thruster. To ensure safety during handling, we melted the ends of the zip ties to eliminate any sharp edges.

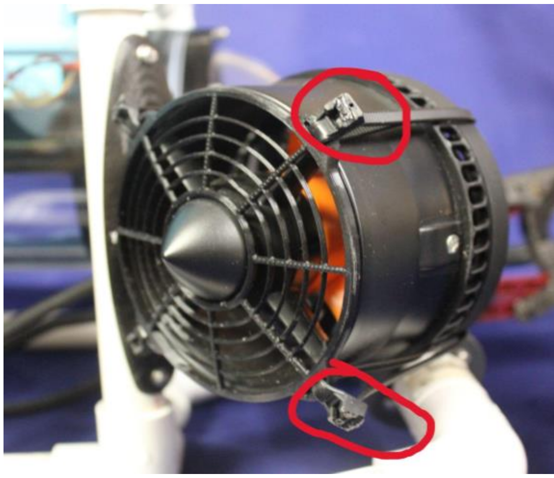
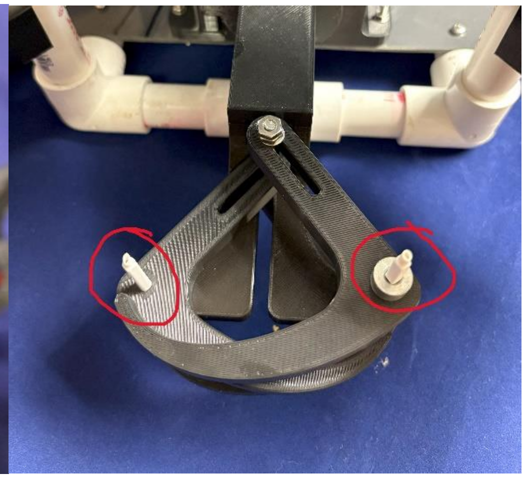
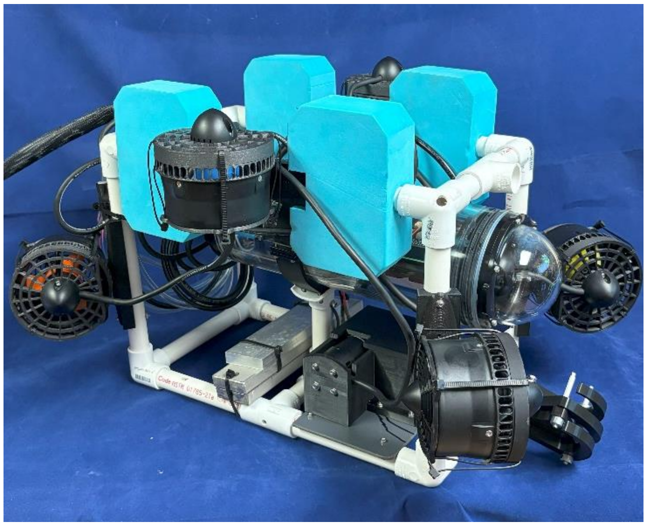
Left photo: Front view of the guard

Right photo: Oblique view showing the complete assembly



Sharp Edges and Dangerous Components

The structure of our ROV is built entirely from smooth PVC and includes foam blocks for buoyancy, resulting in a frame that is both safe to touch and easy to grip for secure manual handling. All zip-tie ends are melted to eliminate sharp edges, and a second nut is added to all exposed screws to cover their threaded shafts, preventing snagging or injury. On the claw mechanism, heat shrink tubing was applied to exposed shafts to further enhance safety and durability. The images below demonstrate that all subsystems are free of sharp edges and contain no hazardous components. Our custom 3D-printed claw is actuated using an IP54-rated linear actuator. To improve its resistance to water beyond its default rating, we applied toilet wax to seal internal electronics and wrapped the exterior with aluminum tape. These modifications significantly increase its water resistance, making the actuator suitable for underwater operation in our application.

The claw is 3D-printed out of PLA plastic not including the motor and gears.