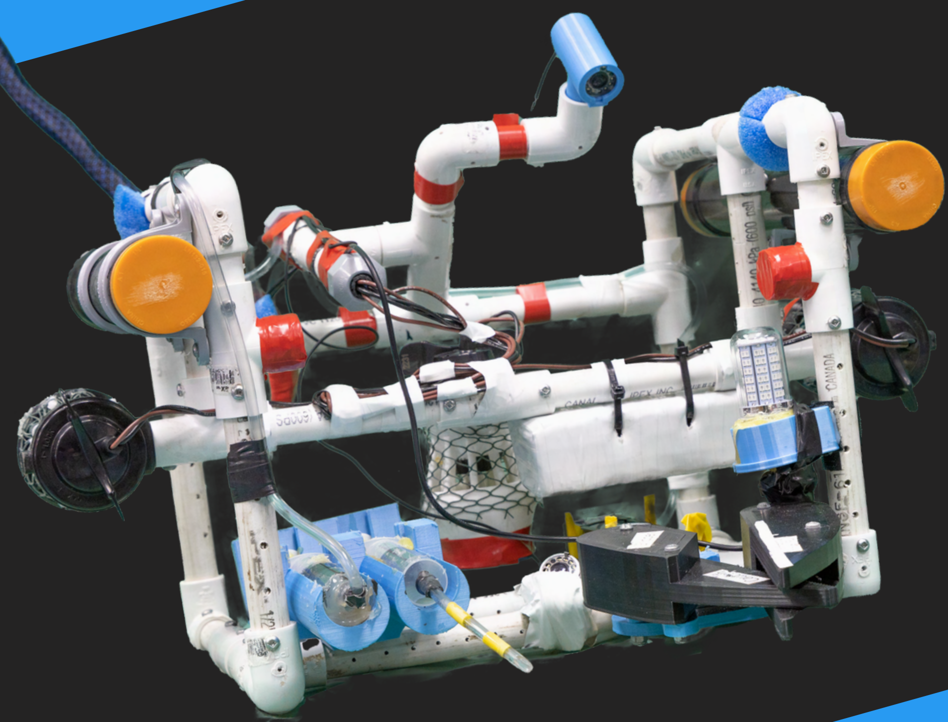
Shark Tech

The Great White 1

Labrador Straits Academy
L'Anse au Loup, NL, Canada



Team Members

Marcus Flynn- CEO
Priyanshu Gunput- Lead Engineer
James Penney- Pilot
Logan Ryland- Co-Pilot
Christian Roque - Electrical Engineer
Owen Hudson- Technical Writer
Luke Hudson- Technical Writer
Finlay Jones- Engineer
Nicole Flynn- Safety Officer
Lucas Buckle- Tether Specialist

2023 MATE ROV COMPETITION TECHNICAL DOCUMENTATION

Mentors
Mr. Riley Regular
Mr. Zachary Furlong
Mrs. Amanda Chubbs

MATE ROV COMPETITION 2023

Table of Contents

Abstract

Shark Tech is a leading developer of underwater remotely operated vehicles (ROVs), from L'Anse Au Loup, NL, Canada. For the 2023 MATE contract, Shark Tech designed and built the Great White 1. To complete contract requirements, Great White 1 was designed to be reliable, and maneuverable in a variety of applications from freshwater reservoirs to offshore installations. A hydraulic claw and water sampler were made to meet the requirements of the contract. They were designed using Solidworks and then 3D printed. The claw is used to grab underwater objects such as encrusted marine growth on wind turbines while the water sampler was designed to be simple, and efficient. Using manual hydraulic power, the water sampler can collect samples swiftly and if it is not satisfactory, Shark Tech can then empty the syringe, remove the sample, and collect a new sample. Additionally, Safety was of paramount importance to Shark Tech. Through the use of a safety officer, they made sure that the company followed strict safety policies. The CEO and lead engineer outlined the scheduling and planning which were strictly followed by the company's members. Great White 1 is suited for duties related to oceans and lakes and offshore renewable energies. These activities include identifying and collecting marine animals, determining the threat level of invasive species, mitigating environmental damage, and maintaining renewable energy sources. The knowledge acquired through the design and construction process was crucial for the MATE duties, ocean preservation, and improving the ecosystem which are displayed throughout this document.

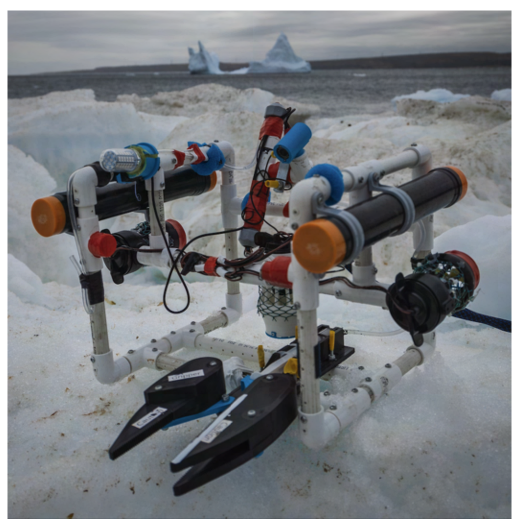


Figure 1: The Shark Tech Company and The Great White 1

Company Organization and Workflow

Project Management

The Shark Tech ROV Company prides itself on being very well organized. This can be seen in the company's design and manufacturing schedule, which was planned in January of 2023. While ambitious the schedule helped deliver the company to a successful regional competition, with time to spare for troubleshooting and testing. It also simplified the organizational challenges that occurred while the company was simultaneously working on the ROV manufacturing, marketing display creation, and engineering presentation and preparation. This schedule was followed closely, progress was tracked with weekly company meetings. These meetings gave all company members the chance to report their departments' progress on various tasks and create action plans for the coming days. In this way, the company's staff could stay up to date on the happenings in other domains and were able to work on other important tasks. Lead company staff also meet frequently to discuss high-level planning and discuss the allocation of tasks to other company members.

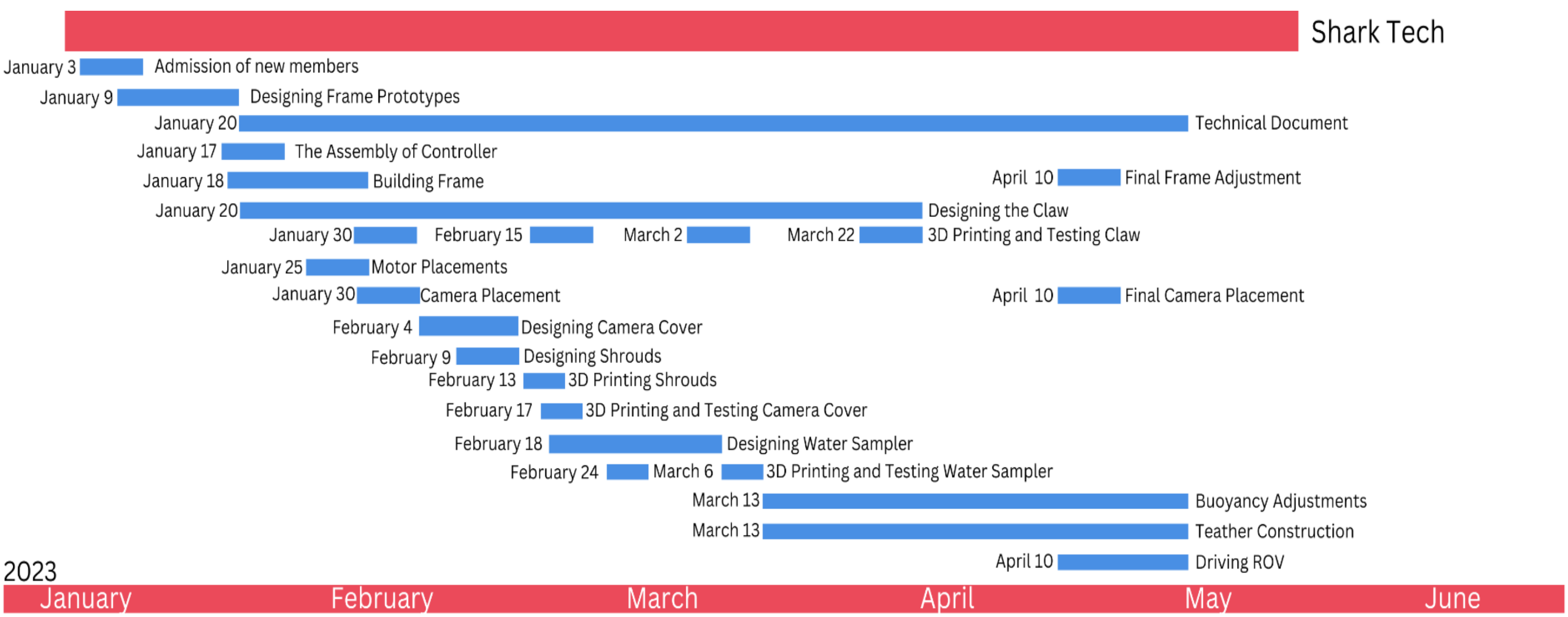


Figure 2: Shark Tech Project Timeline

Company Organization

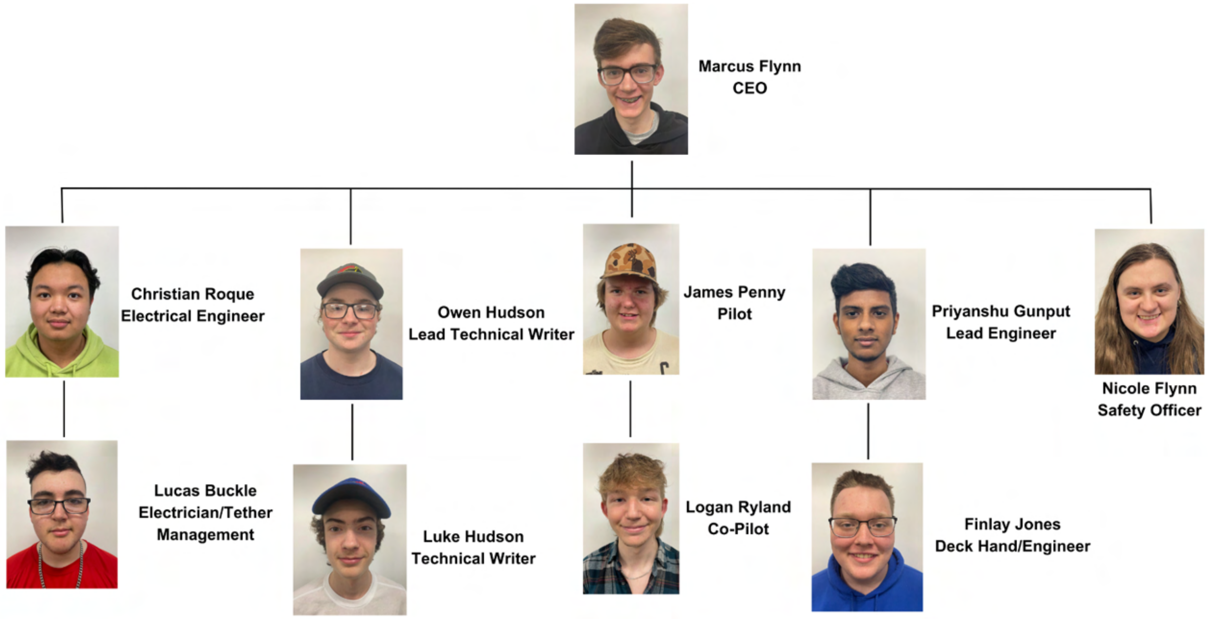


Figure 3: Shark Tech Company Organization Chart

Organization

The appointment of the CEO was collectively chosen by all the staff members because he (Marcus Flynn) was a good leader, intelligent, and good at adapting to different situations. From then on the CEO appointed the other staff members into their roles based on what areas employees excel in and their interests. The people who loved working on computers and were creative were appointed to the design and technical roles. Luke and Owen Hudson filled all the criteria to be technical writers so that is what they became. Priyanshu Gunput and Finlay Jones were also skilled at working on computers but enjoyed bringing things into the physical world so they were chosen to be the engineers that would build and select the tools for the unmanned vehicle. Christian Roque and Lucas Buckle were more tactile company members so they were given the role of electrical engineers and were in charge of designing and creating the electrical system the ROV uses. They solder and assemble components of the controls. Nicole Flynn is a safety-oriented person and really cares about the members of Shark Tech so she became the safety officer. Lastly, the people chosen to be the pilot and co-pilots were James Penny and Logan Ryland respectively. Logan was chosen because he was attentive and had a background in biology, while James was chosen because he was the best pilot during the actual testing of the ROV. In the end, the positions were chosen due to the skills and main attributes of the company's staff members and that is why Shark Tech has been successful in this competition.

Problem-solving

The project's process was made simpler by the company's usage of collaborative tools. The most significant of these is the classroom and Google Docs, which let company members work together in real-time on any kind of project. Additionally, this enabled real-time feedback from other staff members, which assisted others with challenging jobs. Canva was another piece of technology employed, enabling company staff to work together on the poster while also enhancing the software workflow. Shark Tech also made use of a common message board to make Company-wide updates and used group chats to connect outside of working sessions. The rational, consistent approach that was employed to address issues as they arose during the project's various phases was well-known to the whole Shark Tech workforce. The process is as follows:

1. Determine the problem and its root cause. Remove all other potential causes and reduce the problem to its most basic components.
2. Depending on cost, time, and simplicity, evaluate potential fixes and put the best one into action.
3. Make sure the problem has been fully resolved while keeping an eye on the remedy.

Treatment of design, production, testing, and other types of issues has shown this strategy to be quite effective.

Design Rationale

Design Evolution

The overall design was started by creating designs on paper on what the company members thought the ROV should look like. When Shark Tech decided on the design, the company started to make models out of cardboard before making the real frame out of PVC piping. The final choice was 32.5 cm long, 37.2 cm wide, and 30.5 cm tall. The company staff all agreed this was the best-suited size for the ROV. In addition, the company had three motors due to

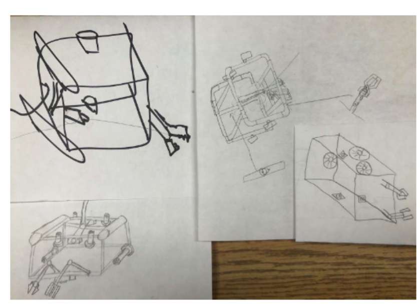


Figure 4 Early ROV designs

the budget and the company also decided the best thing to do was to place one motor in the middle of the ROV, placed vertically to move the ROV up and down. The other two were placed on each side of the ROV, placed horizontally to make the ROV go forward, backward, and turn.

The Great White 1 has two tools, a water sampler, and a claw. Both are located at the bottom of the ROV facing forwards, these were essential to complete specific tasks. Due to Shark Tech's limited budget, the ROV originally only had one camera. The company decided to place the camera on the highest part of the ROV angled down to see the claw. Since testing indicated it would be beneficial to the Pilot, the company obtained funding to add a forward-facing camera to increase the field of view from a pilot perspective. Shark Tech realized the ROV was in need of something to make it buoyant, so the company added two ballast tanks; one under each of the horizontally placed motors. Finally, the company put the ROV in the water and made adjustments where it was needed.

The Great White 1 was designed with all requirements in mind. All tools, sensors, and systems were tailored to both freshwater and saltwater environments. Despite this, the ROV is incredibly modular, allowing for future application to different uses. The Great White 1 is 32.5 cm long, 37.2 cm wide, and 30.5 cm tall.

Innovation

The biggest innovations the company made were the claw, water samplers, and camera mounts. The claw compared to other companies' claws consisted of a simplistic cost-effective design. Created by the CEO using Solidworks and the on-site 3D printer. The innovative claw is manually powered by syringes, making it a hydraulic claw unique to Shark Tech. The water sampler is a very straightforward design that is inexpensive yet effective at specifically completing the eDNA water sample task. The claw is also manually powered via syringes. Due to the geographical location, the company is far away from resources, leading us to develop a high-performance ROV with a simple and cost-effective design. The vast majority of components found on the Great White 1 can be replaced in a fraction of the time it requires the competition. Most of the tools and components have been 3D printed or are available in even the most remote parts of the world.

Vehicle Structure

Figure 5: The Great White 1 frame structure

Three options were considered for the frame's material. The first option was a cube-boxed frame made up of polyvinyl chloride (PVC) pipe and fittings. The second option was a similar design made from aluminum. Finally, the third option was a frame fabricated from plexiglass. Based on the research, PVC piping was the material of choice since it has the best availability in the region. PVC is also very cost-effective while still being strong over other options. The PVC pipes that the company used had a diameter of 0.5 inches. They were used because they are easier to replace if they were to be damaged. The final option chosen for the ROV frame size consisted of 32.5 cm long, 37.2 cm wide, and 30.5 cm tall. This size was selected due to its smaller size. The Great White 1 would have better maneuverability and performance in tight spaces. It would also be easier for the Great White 1 to fit inside the 85x85x85 cm docking station and avoid the various ropes involved with many of this year's mission tasks. This design still allowed us to attach all necessary tools and components required such as the claw and water sampler. Additionally, this small size gave us the advantage of creating a lightweight ROV under 15kg. As the MATE mission proposal stipulated, a lightweight ROV was preferred over a heavier design.

Mechanical Systems

Propulsion

In order to finish mission tasks as fast as possible, an ROV has to travel quickly through the water and, when necessary, lift heavy objects. The thruster system Shark Tech considered the best fitted for the ROV is a 1250 GPH 12V bilge pump. The two horizontally placed thrusters are used for the ROV to go forward, and backward, and turn extremely efficiently. The vertically placed thruster is for the use of moving the ROV up and down in the water column. Shark Tech's rural location limited the number of propulsion options. Shark Tech faced great difficulty in sourcing motors in the local area, which led to the use of bilge pump motors. These motors were the superior choice for Shark Tech due to their vast availability in the area and price point. The motor can be replaced at a low cost in a short time frame, limiting the amount of downtime when facing propulsion issues.

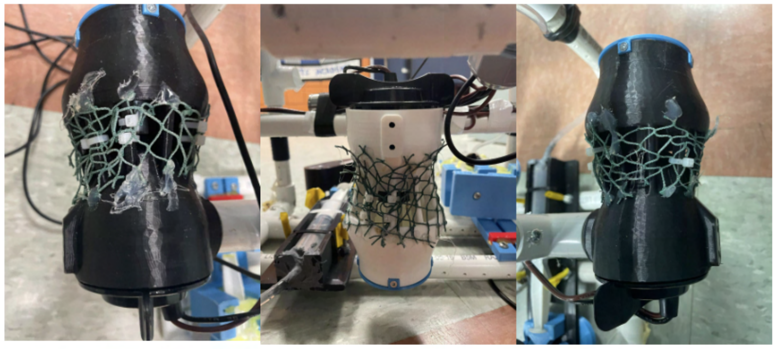


Figure 6: Horizontal and Vertical Thrusters

Buoyancy

The Great White 1 is slightly buoyant in the water, this is a design choice because Shark Tech noticed that whenever the ROV would pick up a prop in the water it would start to sink, so it was left slightly buoyant in the water to help with the lifting of any objects that were required. The components that are responsible for the buoyancy of the ROV are Two 1.125-inch ABS pipes that act as ballast and hold air in on either side of the ROV and are the major components for the buoyancy of the ROV. One piece of high-density foam that was added later on to offset the weight of the claw, the foam was placed on the opposite side of the ROV from the claw as the weight brought the Great White 1 down on the left side and made control of the ROV very difficult for the pilot. Six pieces of polyethylene foam were added to the frame in the form of small rings so that the buoyancy of the ROV could be adjusted more accurately and precisely when changes had to be made.

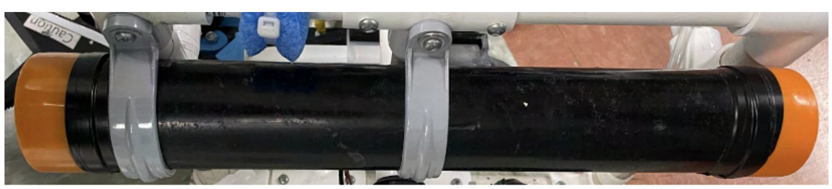


Figure 7: Ballast Tanks

Hydraulics

Great White 1 uses a simple and reliable manually actuated hydraulic system consisting of medical-grade syringes. These Hydraulic systems are used to power the claw and water sampling tools found on board the Great White 1. Shark Tech
chose this option due to its low cost compared to mechanically

powered options. For example, the entire system costs as little as $20 compared to a mechanically powered hydraulics system or pneumatics system. Shark Tech also chose the system for its high availability in the remote area. Whereas a pneumatic system can be complex and costly while providing a negligible real-world improvement over the system, a syringe side of a plastic tube.The system is much more simple making it easier to fix compared to other options and more effective than just about every competing system. This simple solution allows us to create effective solutions for the tasks outlined in this year's missions. The hydraulics systems p us to complete tasks such as removing biofouling among others.

Figure 8: Gripper and Water Sampler Hydraulics

Electrical Systems

Control System

The control box is a hard shell case. Inside, there is a controller sourced from the Seamate store that can track volts and amps by showing it on the controller's display. The controller has three double-throw switches to control the three thrusters. Shark Tech has two syringes, one syringe to control the water sampler that is mounted on the right side of the ROV and the other syringe to control the Gripper that is mounted on the left side of the ROV. The company also has the Monitor mounted in the top section of the control system allowing us to control the ROV in a compact environment.


Figure 9: The Great White 1's Control Box

Tether

The Great White 1 has a 15 m buoyant tether which consists of 8-18 gauge wires, 2-3.175mm hydraulic lines, and two camera lines. Buoyancy for the tether is provided by pool noodle foam which is evenly spaced out along the length of the tether. This helps negate the weight of the tether from impacting the performance of the ROV while in the water. The tether connects the topside control systems to the ROV. Shark Tech understands the importance of good tether management during mission operations. To help manage the tether the Shark Tech Company developed a protocol to be more efficient in the poolside area. This protocol consists of having a designated staff member managing the amount of tether on the deck at a given time, limiting tripping hazards on deck and potential damage to the tether itself.

Sensors

Camera

The Great White 1 prides itself on having a simple design. This applies to the sensors on board the ROV. The only sensor systems found on board the ROV are two video cameras. These cameras provide live video feeds of what is happening around the ROV aiding in completing various mission tasks. The camera system consists of two repurposed underwater fishing cameras. The whole system is extremely cost-effective, costing only $245 for two cameras and a monitor. The company's engineers developed a simple mounting solution for the cameras. One Camera was mounted at the top of the ROV to provide a wide angle view. The Second camera was placed close to the mission-specific tools to allow the pilot to see tools up close. Overall, this allows Great White 1 to have camera angles that provide the pilots with the best angles of the seagrass, coral imaging, and frog transect mission tasks.

Figure 10: The Great White 1's Camera

Mission-Specific Tools

The mission tasks set for this year have inspired and motivated us to develop novel approaches to the tasks the ROV is expected to do. As a result, all the tools are original designs that the company handcrafted. The ROV is very small to maximize speed and movement to get the mission tasks done more efficiently. The design for each tool underwent extensive prototyping by providing detailed drawings. The company tested using cheap materials (cardboard) and prototypes before fabricating the final product. The vehicle was tested using a fishing vat donated by The Labrador Shrimp Company. The company has developed the following tools before the Regional competition, claw, hydraulic water sampler, and a simulated UV light source.

Figure 11: The Evolution of Claw Base Prototypes

Claw

Figure 12: The Great White 1's Claw

Based on this year's mission tasks (Install a long-term camera in the designated area at the bottom of the lake, Transport the Northern Redbelly Dace fry to a safe release area, and Recover a container from the bottom of the reservoir) Shark Tech decided it would be beneficial to create a claw design for the ROV. The claw was an original design that was 3D printed, it took many prototype designs and a lot of dissatisfaction until Shark Techs engineers eventually came upon the claw the company is currently operating. It has cut teeth and is attached using screws to the PVC piping on the bottom of the frame. It works using the linear movement of the hydraulics pushing the initial piece of the claw forward and moving the grippers forward and rotating them around the arms below causing the claw to close.

Water sampler

This tool was specifically designed for the sole purpose of collecting a water sample from above the coral head. To build the sampler, the company used a 3D printed holder for the two 50ml syringes that work to collect a water sample. Much like the rest of the ROV, the water sampler was designed to be simple but effective. With the use of syringes, the water sampler was simplified for ease of repair down the line. Simplifying it in this way is also effective in improving the reliability of the system. Compared to competing options such as electric it has far fewer parts and works whether it is powered or not.

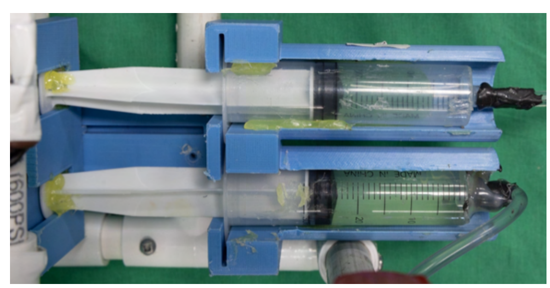


Figure 13: Water Sampler

The system has another benefit over electric options in that it is simpler to set up and does not have to worry about any of the issues that can occur when electricity and water come into contact. If it had more electrical parts on the ROV it would have the risk of water getting on it and maybe knocking the ROV out of competition all together.

Simulated UV Light Source

SharkTech developed a Simulated UV light source to irradiate a diseased area of coral as outlined in the MATE manual. To combat this challenge Shark Tech sourced and repurposed a waterproof led fishing light. To avoid developing a non-ROV device, the engineers developed an ROV-based mount for the light. The mount consisted of two velcro strips on the ROV and light to secure until required; the design allows deckhands to efficiently place the light in the claw to deliver to the task location.

Figure 14: Simulated UV Light source in mount.

Build Vs. Buy

As a new company in the MATE ROV competition, Shark Tech was starting from scratch. The Great White 1 was built entirely from newly sourced materials. Given the remote location of Shark Tech, the decision between building or buying parts often came down to the factor of time or local availability. Building custom parts offers Shark Tech more control over the product Shark Tech created compared to sourcing commercial parts and removing the risk of shipping delays associated with the geographical location of Labrador Strait Academy. The Shark Tech company felt it was best to build as many components in-house as possible. This is demonstrated in mission-specific tools like the claw and water sampler. Other components such as cameras and motors had to be ordered well in advance and decisions on these components were selected and sourced earlier in the design process to avoid any construction delays.

Critical Analysis

Troubleshooting

When troubleshooting the ROV, there were several techniques that Shark Tech used to identify and address any issues:

1. Check the connections: Ensure that all the cables and connectors are properly connected and secured. Loose connections can cause power and signal issues.
2. Review the documentation: Review the user manual and any troubleshooting guides that may be available to identify common issues and solutions.
3. Test the components: Test each component individually to isolate the problem. Check the power supply, motors, sensors, and other components to ensure they are functioning correctly.
4. Use diagnostic tools: Use diagnostic tools like a multimeter to measure voltages and continuity to identify any electrical issues.
5. Inspect for physical damage: Inspect the ROV for any physical damage, including cracks, breaks, and leaks that may affect its performance.
6. Seek help from experts: If the issue persists, seek help from experts or other experienced ROV Companies who may be able to provide guidance and support.

Overall, Shark Tech believes it is important to approach troubleshooting systematically and methodically, starting with the most common and easily fixable issues before moving on to more complex problems. Communication and collaboration among the company members have also proven to be helpful in identifying and resolving issues that occur.

Testing Methodology

Shark Tech's testing methodology consists of first testing each system on its own before testing it as a whole ROV unit. The initial tests began out of the water where possible, limiting the number of factors that could influence problems. The simple design proved to be another advantage in the test process as the ROV could be easily adjusted with little downtime between testing phases.

Propulsion testing

When testing Great White 1's propulsion systems. The motors were first tested on dry land to check for electrical issues prior to mounting on the ROV frame. Once the initial test was completed, the company looked at where to mount the motors to get the best possible use out of them and to see how they moved it compared to other places. To test this, the company did many practical tests in the in-house water tank and observed how the placement and orientation affected the movement of the ROV. Overall, the final motor placement took many failed attempts. Some initial setups had the ROV moving up toward the surface when going forward. After numerous trials as a company, Shark Tech came to the conclusion of which angle worked best.

Hydraulics Testing

To test hydraulic systems the company followed similar steps as outlined for the propulsion systems. Both the claw and water sampler began as cardboard mock-ups, then early 3D-printed models, until fully functional products were developed. The company's engineers tested different volume syringes to determine which would produce the most force on the claw. This allowed the company to calculate what tasks the ROV could complete without there being any issues. To test the water sampler, Shark Tech first tested the hydraulic connection to make sure it would work when the tether was fully out. After this, the company tested how well the pilot could maneuver with the new addition to the ROV.

Safety

Safety Philosophy

The top focus is the employee's safety. Shark Tech has an in-house safety officer who works to create safety checklists for both construction and on-deck operations. These safety protocols are periodically gone over with the members before each meeting to ensure their safety while working. Each company member received training on how to utilize new tools as the ROV was being constructed. Long hair was always pulled back and fastened, long sleeves were always rolled up, and safety glasses were always used when utilizing potentially hazardous items. A key priority has always been supervision. Without a mentor present, no members were permitted to operate any equipment. Members were also urged to practice a safe workplace and ask questions. While all construction operations were occurring, the company safety officer was on hand to ensure all employees were following proper safety measures. Anytime a company member had a safety concern with the ROV (or another member) both the safety officer, CEO, and mentor were notified. This allowed the company to collectively work through any safety issues which arose.

To prevent damage to the electrical components of the ROV, Shark Tech made sure that each connecting wire was soldered, covered in hot glue, and shrink-wrapped. In order to prevent harm to the ROV's electrical components, and to shield company employees from any injuries they could experience while working with the electrical items, a 25 amp fuse was also placed to the circuit's positive side within 30cm of the power supply. This prevented the possibility of a power surge through the equipment. Electrical safety is of the utmost importance, particularly while using the ROV for competition and poolside practice. Shark Tech always ensures that all electrical components are kept away from water. The tether management specialist also ensures no part of the tether is dragged across the ground. The tether was also secured to the frame and control system using a strain relief system. This functioned to prevent damage to the electrical system due to any employee’s pulling on the tether system.

Shark Tech places an elevated priority on wearing safety glasses and building safety procedures into the vehicle from the beginning. When handling electrical equipment and parts, the company took great care. A pre-mission checklist was finished before the vehicle was started to ensure that all connections were safe and that no wires were crossed. All the technicians operating close to the ROV were asked to keep their bodies, extremities, hair, and clothing away from the ROV while the electrical system was being handled and maintained, and fuses were also checked.

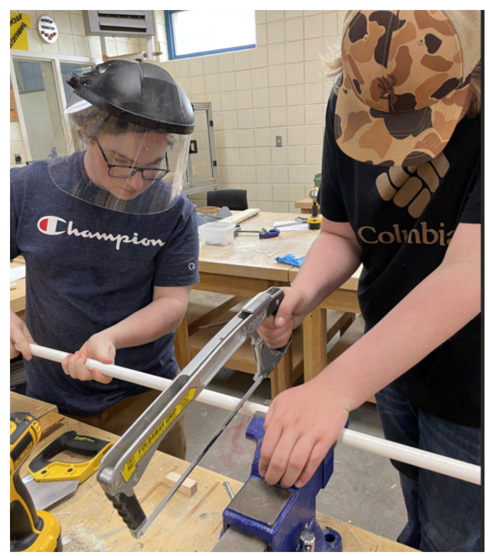


Figure 15: Shark Tech Employees Working Safely

All hazardous selections of the Great White 1 were properly labeled to warn employees of dangers. The thrusters, claw, and water sampler were marked with warning labels and as well bolts were also marked with yellow tape, and plastic wire was applied to the motors to shroud them in order to further safeguard against harm. The control system wiring was labeled to display which wires ran to each specific component for the safety of the electrical engineers and pilots.

Safety Features

Shark Tech prides itself on creating one of the most versatile yet safe ROVs on the market. The Great White 1 meets all safety guidelines outlined by MATE. A summary of key safety features can be found in the table below. Safety checklists can be found in Appendix C.

Safety Features	**Description**
Rounded Edges	All sharp edges on the great white 1 have been sanded down to prevent the injury of any employees or others.
Waterproofed electronics	All electrical components on the Great White 1 have been sealed off to the elements and are wrapped in shrink wrap and electrical tape to prevent electrical discharge.
Shrouded Thrusters	Every thruster on the Great White 1 has been covered by a protective shroud up to IP20 standard and is in place to prevent damage to the propellers and more importantly personnel.
Caution Labeling	All sharp or dangerous components on the Great White 1 have been labeled brightly to alert all personnel to their existence and dangers.
Power Supply Fuse	On the Great White 1, there is a 25A fuse within 30cm of the positive end of the power supply.
Strain relief on both ends of the tether	The tether is secured on both sides by electrical strain relief fittings that ensure that there is no strain on the tether.

Accounting

Budget

As a new company, Shark Tech was working with a limited budget. The initial budget was $1600 CAD to compete in the Newfoundland & Labrador regional competition. This budget was based on the amount of funding the company received from MATE-NL to take part in the competition. With the initial budget preset, Shark Tech collectively discussed how the budget would be spent. Shark Tech inquired at local businesses, and online stores such as SeaMATE, Amazon, and HomeDepot before purchasing any materials. Based on research Shark Tech corroborated to determine the amounts required for each system of the ROV. Once Shark Tech advanced to the MATE World Championship the company met to discuss the budget adjustments. The Second place finish at the regional competition earned us an additional $25,000 CAD from MATE-NL to cover the costs associated with travel and logistical needs associated with travel to the World Championship. Upon meeting with the company's mentor, Shark Tech determined that approximately $40,000 CAD would be required for travel, equipment upgrades, and miscellaneous expenses. Due to the company's remote location, travel and accommodations were the most taxing expenses estimated to cost $28,000 CAD. The budget outline can be found in the appendices below. In order to acquire the additional $15,000 CAD required for the World Championship, Shark Tech sold tickets on different items and held various events to raise funds. Shark Tech also connected with various companies and organizations in the local region to gain sponsorships.

Project Costing

Shark Tech worked hard to remain within the established budget. A detailed project cost breakdown can be found in Appendix E. The final ROV cost came to be approximately $2500 CAD. Travel (flights and rental vehicles) and accommodations cost approximately $30,000 CAD. Shark Tech covered some meal costs for employees which came to approximately $5000 CAD. The company also had to recover the costs associated with the travel delays home from the regional competition which cost approximately $2500 CAD.

References

MATE. (2022). *Ranger Class information*. MATE ROV Ranger Class Manual. https://20693798.fs1.hubspotusercontent-na1.net/hubfs/20693798/2023/2023_RANGER_Manual_Final_12_20_2022_cover.pdf

SeaMATE. (2022). *Pufferfish Rov Guide*. Pufferfish ROV Instruction Manual. https://materovcompetition.org/rov-kits/pufferfish-rov-guide

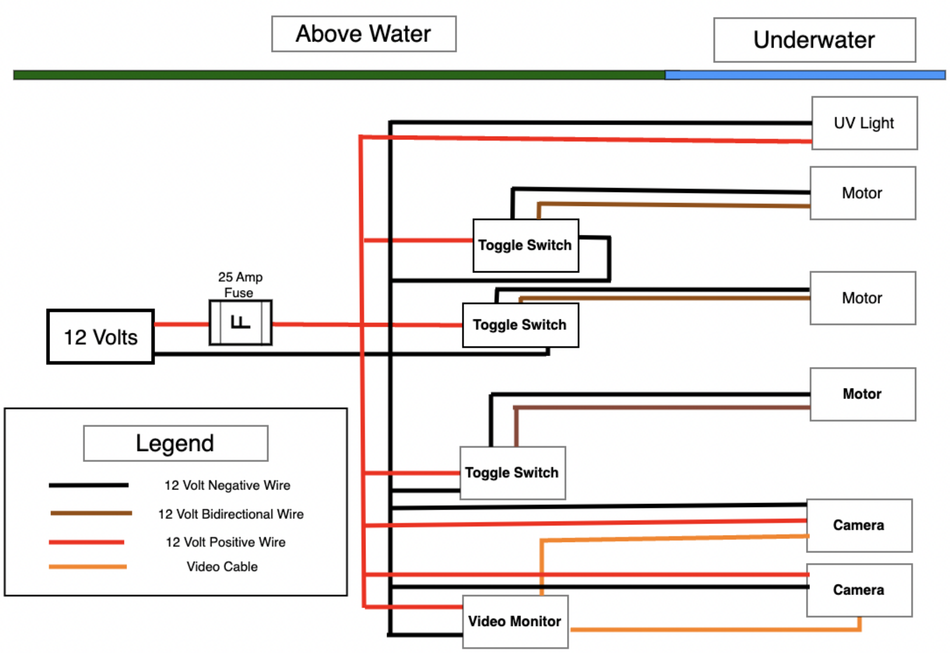
SPXFlow. (2023). *Cartridge Submersible bilge pumps 500-1250 GPH*. Cartridge Submersible Bilge Pumps 500-1250 GPH. https://www.spxflow.com/johnson-pump-marine/products/cartridge-submersible-bilge-pumps/

Acknowledgments

Shark Tech are extremely grateful for all of the sponsors, without their support, this would not have been possible. Shark Tech's members would like to thank Mr. Regular, the teacher mentor because without him Shark Tech would not exist. This project would not have been possible without donations from businesses in the local communities. Shark Tech would like to extend the gratitude of Shark Tech to the Labrador Fishermen's Union Shrimp Company Limited for donating a tub to test drive the ROV to H&F Designs Limited for making the shirts and to Lobel Management Limited for paying for the shirts. The Government of Newfoundland & Labrador, Atlantic Canada Opportunities Agency (ACOA), Hibernia, Equinor, GRI Simulations, Cenovus, Seamor Marine, SubC Imaging, Cooke Aquaculture, The Cahill Group, TCarta, and eSonar were all the regional sponsors and we are so thankful for them. Lastly, Shark Tech would like to give special thanks to the MATE center and Marine Institute for giving us the opportunity to compete with the ROV.

Appedencies

Appendix A: Main Electrical SID with Fuse Calculations

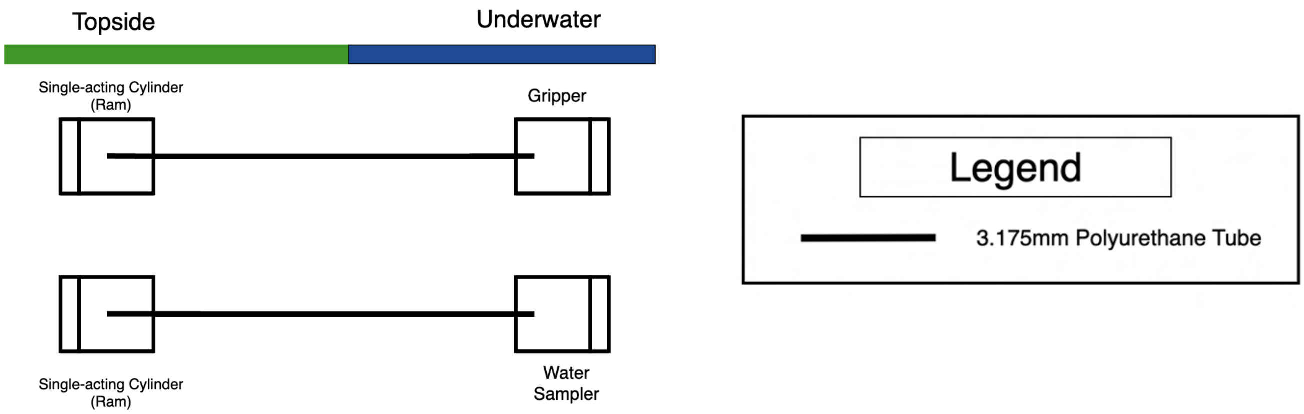


Fuse Calculations

Device	How Many	Current Draw Each (Amps)	Total Current
Thrusters	3	3.2	9.6
Camera	2	0.1	0.2
Light	1	0.45	0.45
Screen/ Control system	1	0.44	0.44

Total calculated Current (Amps)	**10.69**
Overcurrent protection Factor	**150%**
Fuse Calculation	**16.035**
Round to Fuze Size (Amps)	**25**

Appendix B: Hydraulics SID



Appendix C: Safety Checklist

Safety Procedures during construction include:

❏ Safety is a priority in discussions, displays, and actions.
❏ No loose clothing.
❏ Long hair tied up.
❏ Closed-toe footwear.
❏ Safety glasses at all times since multiple activities occur in the shop.
❏ Appropriate behavior: no running or horsing around.
❏ Safe materials handling: long or heavy stock moved by two+ people; use trolleys.
❏ Instruction and apprenticing for all shop equipment usage (power tools, heating, etc.)

Pre-Mission Checklist:

❏ Deck Crew put on PFDs.
❏ Wear Safety Glasses if using power tools.
❏ Remove loose clothing.
❏ Tie up long hair.
❏ Place ROV in a secure location on the deck.
❏ Unwrap the tether and extend it along the pool deck.
❏ Prepare to launch ROV.
❏ Place the small TV control box and panel in a suitable location.
❏ Use Anderson power pole connectors to connect to the main power supply.
❏ Connect Video cameras to the Control Panel power supply.
❏ Ensure the tether manager is in position
❏ Power up ROV and once all crew are clear, test systems

Appendix D: Project Budget

<table>
<tr><td>School: Labrador Straits Academy</td><td colspan="5">Organization: Shark Tech</td></tr>
<tr><td>Mentor: Riley Regular</td><td colspan="5">Period: Jan 2, 2023 - May 23, 2023</td></tr>
<tr><td colspan="6">Income</td></tr>
<tr><td>Sources</td><td colspan="5">Amount</td></tr>
<tr><td>MATE Newfoundland & Labrador Regional Grant</td><td colspan="5">$6,830.00</td></tr>
<tr><td>MATE NL International Grant</td><td colspan="5">$25000.00</td></tr>
<tr><td colspan="6">Expenses</td></tr>
<tr><td>Category</td><td>Description</td><td>Purchase or Reuse</td><td>Projected Cost</td><td>Budgeted Value</td><td>Notes</td></tr>
<tr><td>Mechanical</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>Frame Materials</td><td>Purchase</td><td>$100.00</td><td>$100.00</td><td></td></tr>
<tr><td></td><td>Hydraulics System</td><td>Purchase</td><td>$50.00</td><td>$50.00</td><td></td></tr>
<tr><td></td><td>PLA Filament</td><td>Purchase</td><td>$200.00</td><td>$200.00</td><td></td></tr>
<tr><td>Electronics</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>Thrusters</td><td>Purchase</td><td>$200.00</td><td>$200.00</td><td></td></tr>
<tr><td></td><td>Controls on surface</td><td>Purchase</td><td>$250.00</td><td>$250.00</td><td></td></tr>
<tr><td></td><td>Tether Wire</td><td>Purchase</td><td>$125.00</td><td>$125.00</td><td></td></tr>
<tr><td></td><td>Wire, Solder, etc</td><td>Purchase</td><td>$50.00</td><td>$50.00</td><td></td></tr>
<tr><td></td><td>Camera Systems</td><td>Purchase</td><td>$250.00</td><td>$250.00</td><td></td></tr>
<tr><td></td><td>Control Case</td><td>Purchase</td><td>$100.00</td><td>$100.00</td><td></td></tr>
<tr><td></td><td>Power Supply</td><td>Purchase</td><td>$125.00</td><td>$125.00</td><td></td></tr>
<tr><td>Travel</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>Accommodations for Regional Competition</td><td>Purchase</td><td>$3300.00</td><td>$3300.00</td><td></td></tr>
<tr><td></td><td>Transportation to Regional competition</td><td>Purchase</td><td>$1200.00</td><td>$1200.00</td><td></td></tr>
<tr><td></td><td>Accommodations for</td><td>Purchase</td><td>$11000.00</td><td>$11000.00</td><td></td></tr>
</table>

	World Championship				
	Flights to World Championship	Purchase	$15000	$15000.00	
	Car Rentals at World Championship	Purchase	$9000	$9000.00	
	Meal ($50x 9 days x 10 people)	Purchase	$4500.00	$4500.00	
General					
	Poster	Purchase	$f00.00	$200.00	
	Company Shirts	Purchase	$500.00	$500.00	
	Fluid Power Quiz	Purchase	$35.00	$35.00	
	World Championship Registration	Purchase	$390.00	$390.00	
	Income Total			**$31830.00**	
	Total Expenses			**$46575.00**	
	Total Reused			**$0.00**	
	Fundraising Needed			**$15927.00**	

All amounts are in Canadian Dollars

Appendix E: Project Cost

School: Labrador Straits Academy				**Organization: Shark Tech**
Mentor: Riley Regular				**Period: Jan 2, 2023 - May 5, 2023**
Items	**Units**	**Cost**	**Source**	**Total**
Mechanical				
PVC Pipe	3	$8.00	Purchased	$24.00
PVC Fittings	50	$2.00	Purchased	$100.00
PLA Filament	4	$36.00	Purchased	$144.00
Assorted fasteners	1	$80.00	Purchased	$80.00
U- bolt	1	$3.99	Purchased	$3.99
3/4" strain relief	1	$3.99	Purchased	$3.99
1 1/4 PVC Clamps	4	$1.99	Purchased	$7.96
pvc test end caps	4	$1.99	Purchased	$7.96

Hydraulics System	2	$20.00	Purchased	40
Electrical				
100' 18 gauge 6 conductor wire	1	$95.26	Purchased	$95.26
Bilge Pump Motor	6	$70	Purchased	$420
Pufferfish controller	1	$128.75	Purchased	$128.75
puffer fish camera system	1	$243.81	Purchased	$244.81
solder	1	$23.39	Purchased	$24.39
power supply	1	$125.35	Purchased	$126.35
12v LED fishing light	1	$26.44	Purchased	$26.44
BNC video power cable	1	$11.44	Purchased	$11.44
DC power Pigtail	2	$8.04	Purchased	$16.08
Plastic Cement	1	$46	Purchased	$47
Epoxy	1	$33.8	Purchased	$34.8
Power supply connection kit	1	$40.65	Purchased	$41.65
Heat Shrink kit	2	$35.6	Purchased	$71.2
Upgraded Camera	2	$79.89	Purchased	$157.78
General				
Fluid Power Quiz	1	$35.00	Purchased	$35.00
Marketing Poster	1	$41.00	Purchased	$41.00
Import Fees	1	$120.00	Purchased	$120.00
Company Shirts	11	$22.99	Donated	$232.87
Fishing Vat for testing	1	$800.00	Donated	$800.00
Accommodations in St.John's	1	$3300.00	Purchased	$3300.00
Transportation to St. John's from Labrador	1	$1200.00	Purchased	$1200.00
Additional Accommodations During Regionals	1	$1500.00	Purchased	$1500.00
Flights to World Championships	12	$1500.00	Purchased	$18000.00
Accommodations for World Championships	1	$10000.00	Purchased	$10000.00
Transportation for World Championships	1	$5000.00	Purchased	$5000.00
Meals for World Championships	1	$6000.00	Purchased	$6000.00
Income				
MATE-NL Regional Grant	1	$6830.00	Donated	$6830.00

Lobo Management	1	$232.87	Donated	$232.87
Labrador Straits Academy	1	$40.00	Donated	$40.00
MATE-NL World Grant	1	$25000.00	Donated	$25000.00
Labrador Shrimp Company	1	$800.00	Donated	$800.00
Fundraisers	1	$10000.00	Donated	$10000.00
Sponsors	1	$10000.00	Donated	$10000.00
Totals				
			Total ROV Cost (CAD)	$1857.88
			Total spent (CAD)	$48086.75
			Amount Fundraised (CAD)	$52902.87
			Account Balance (CAD)	$4816.12

Appendix F: Company Safety Review

Main Fuse

The Main Fuse is a 25A inline fuse that is placed within 15cm of the connection to the power supply. The Fuse Calculations can be found to the right.

Fuse Calculations

Device	How Many	Current Draw Each (Amps)	Total Current
Thrusters	3	3.2	9.6
Camera	2	0.1	0.2
Light	1	0.45	0.45
Screen/ Control system	1	0.44	0.44

Total calculated Current (Amps)	**10.69**
Overcurrent protection Factor	**150%**
Fuse Calculation	**16.035**
Round to Fuze Size (Amps)	**25**

Control Box

All of the topside electronics with the exception of the power supply are neatly stored in a plastic carrying case. The control box insert is constructed of a pressure board and allows us to have a solid surface to place the controller, gripper, and water sampler controls. All wires that are found underneath the insert are secured with zip ties and cable management ties. All wires leaving the control box are secured with proper strain relief.

Figure 16: Control box

Tether Strain Relief

Before wires and hoses reach motors and hydraulic systems, they pass through a strain relief system on the ROV. This strain relief ensures that all onboard systems are under no strain during operations.

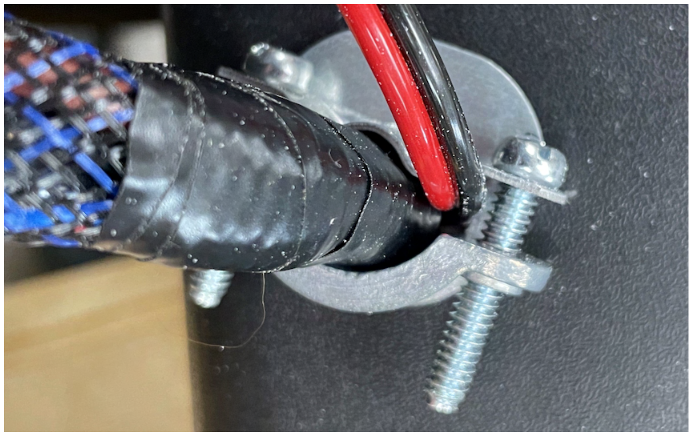


Figure 17: Example of Tether Strain Relief found on Control Box

Thruster Guards

The thrusters are protected by Shrouds which are 3D printed. The Shrouds are designed and tested to meet IP-20 Standards.

Fluid Power

There are two basic fluid power systems found on the ROV. Both systems use water as the fluid which removes the chance of environmental impacts. Single-acting cylinders in the form of basic medical-grade syringes are used to operate the claw and water sampling devices.

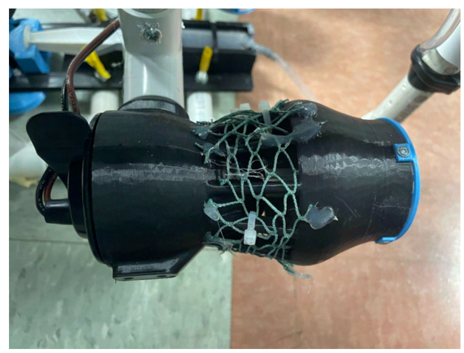


Figure 18: Thruster Guard

Dangerous Parts

The Great White 1 has no dangerous or sharp parts.

Non-ROV device design and SID

The Great White 1 is not equipped with any non-ROV Devices. Shark Tech will not be attempting any of the competition's non-ROV device tasks.