

2018 ROV Angelfish Challenge Task Manual SCOUT

March 24th 2018



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I. MARINE

Researchers at BIOS are expanding their ability to explore the ocean with the recent acquisition of undersea gliders, which are autonomous underwater vehicles (known as AUVs) programmed to travel thousands of miles at a time in pursuit of oceanographic data. To maximize the impact of this cutting-edge technology, BIOS has developed a multi-year underwater design and engineering program called Mid-Atlantic Robotics IN Education (MARINE). This program is designed to engage Bermudian students of all ages.

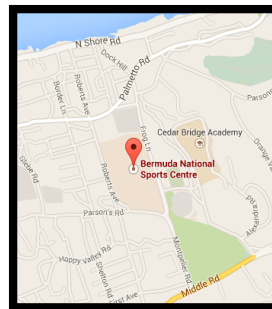
The program focuses on remotely operated vehicles (known as ROVs), hundreds of which are currently employed underwater around the globe by marine industries, underwater archaeologists, and scientific research programs. As Bermuda's students learn to build and test ROVs in the classroom, the MARINE program supports and enhances science, technology, engineering and mathematics (STEM) education. The experience of building ROVs fosters critical thinking skills, individual and group problem solving skills, and technological fluency.

The MARINE program reflects BIOS's commitment to expand the use of underwater vehicles within ongoing efforts to study and understand the complexity of ocean processes. Complementing this new focus, Ocean Academy leads ROV design challenges throughout BIOS's summer camps, and provides training and ROV kits to middle school classes during the school year. In 2018, Bermuda will continue to host a regional ROV competition under the auspices of the Marine Advanced Technology Education (MATE) Center. The 2018 Scout and Ranger Challenge will be subject to the rules and regulations as designated by MATE.

II. 2018 ROV Angelfish Challenge

Where:

National Sports Center
#50 Stadium Cottage, Frog Lane
Devonshire DV01
Bermuda
Phone: +1 441-295-8085





When: March 24th
(Rain Date: March 25th)
9:00am - 3:00pm

III. Eligibility

Students are eligible to register for two of the Marine Advanced Technology Education (MATE) Center's levels in 2018; Beginner, Scout and Ranger. Beginner level teams will receive an ROV Angelfish kit with a value of \$200.



Figure 1: Angelfish ROV kit

IV. Rules and Regulations

Beginner entries will be constructed using the following materials (materials are provided in the Angelfish ROV kit):

Angelfish Kit

- 3,500-gallon-per-hour bilge pump motors
- 30 feet of tether
- Zip ties
- 3 propellers
- 3 propeller shafts with screws
- A control box with three double pull/double throw switches
- PVC pipe
- PVC connectors
- Floatation material
- Banana plugs to plug into a 12v DC power source
- Fuse

- Wire caps

Not included but required for successful assembly of kit

- Pipe cutters
- Soldering iron
- Solder (one coil)
- Screwdriver (flat head and Phillips head)
- Hand drill
- Drill bits for control box
- Additional zip ties may be needed
- 12 volt batteries will be provided at the Challenge

For Beginner level, ROVs must be primarily constructed from ½" PVC pipe ONLY. For Scout and Navigator levels, ROVs can be built out of any materials so long as they meet the size and weight requirements as outlined by the MATE manual.

V. Resources

The Marine Advanced Technology Education (MATE) program has created a list of resources and teaching modules for design instruction and engineering principals of the Angelfish ROV. MATE has additionally created many videos that illustrate the entire process of assembling the kit, to aid teachers and sponsors in troubleshooting.

Videos can be streamed directly from the MATE website after sign up of initial free membership to MATE: <https://www.marinetech.org/angelfish-videos/> Videos cover everything from wiring up your control box to inserting the fuse.

This team manual is an excellent source of information for terminology related to the Angelfish ROV:
<http://www.marinetech.org/files/marine/files/Curriculum/Other%20Curriculum%20Resources/MIROV2MANUAL.pdf>



VI. Judging

All judges will attend a meeting where they will be briefed on all product demonstrations. For product demonstrations there will be 2 judges at each station. There will be 1 in-water judge and 1 topside judge. Safety and sizing checks will be done prior to beginning the clock at each station.

For product interviews and marketing displays the same 3 judges will see all teams over the course of the Challenge. All teams within the same challenge level will be scored by the same three judges for consistency.

VII. Frequently Asked Questions

Is this event open to the public?

Yes, this event will be free and open for the public to attend. Families and friends of competitors can view much of the Challenge from the bleachers, and there will be information available about the other educational opportunities BIOS offers. The concessions stand at the National Sports Center will be open during the Challenge for coffee.

Are the Angelfish kits reusable?

Yes, almost everything is made from highly durable parts that can be used over and over again. The motors are waterproof bilge pump motors that should run for ten or more years; the control boxes are strong and water tight (but don't submerge them). Everything else can be taken apart and reused.

If trialing kits in salt water, be sure to thoroughly rinse them after use with freshwater to prevent rusting and corrosion. Any corrosion from salt or freshwater will ultimately end the life of the kits. Make sure that the control box is completely dry before storing.

Will teachers be able to keep the kits?

Yes, teachers will be able to keep the kits for subsequent use in their classrooms.

I have never soldered before, what should I do?



If you are unfamiliar with soldering, we suggest watching the video below. One of the problems that can occur with cheap soldering irons is that they may not get hot enough or they may get too hot. Make sure you have a good quality soldering iron and follow the safety advice provided with your soldering iron.

Here is a useful video on soldering components to circuit boards:

<https://www.youtube.com/watch?v=Qps9woUGkvl>

Notes on solder: Leaded solder is easier to use because of its lower melting point so the soldering iron does not have to be as hot or held to the board as long. Lead-free solder has more flux (acid) in it, which can irritate the eyes if touched by unwashed hands after soldering. We recommend 60/40 Rosin Core Solder in .032" (0.08mm) diameter. This is available at Godet and Young and Gorham's.

Can a fourth motor be added to the Angelfish kit?

Scout and Ranger teams may add as many motors to their ROV as desired, but cannot exceed the 15-amp limit.

Can the tether be lengthened so the ROV can go deeper during the Challenge?

Yes, Scout and Ranger teams are able to change their tether length.

Can our school practice?

Yes, teams can practice using their ROV in fresh or salt water. Please note the ROV will perform differently in fresh vs. salt water. Teams will have the opportunity to trial the race course on the day of the Challenge in the testing area. Additionally, an in-pool test session will be organized ahead of the competition date.

Will there be lunch provided at the 2018 Challenge?

Yes, BIOS will provide pizza for lunch to teams and their mentors on the day of the Challenge. Lunch will rotate by teams and begin service at 11:30am and end at 1:00pm.

VIII. MISSION Jet City: Aircraft, Earthquakes and Energy

The Pacific Northwest area of Washington State is known for its beautiful and lively geography, sitting between the Olympic and Cascade Mountain ranges, their snowcapped peaks hiding temporarily dormant volcanoes and tectonic plates prone to earthquake activity. The combinations of volcanic eruptions and earthquakes have shaped this piece of North America, raising the mountains and creating rivers via the snow melt that flows into deep-water lakes. Earthquakes also cause mudslides, landslides, and lahars that have wiped out large forested areas and re-sculpted the terrain. A fjord ties the Seattle area to the rest of the world through the Pacific Ocean. Known as Puget Sound, this fjord was formed by these same earth-moving forces. Puget Sound is also susceptible to another earthquake effect: the tsunami.

Seattle's history reflects a wide variety of businesses based on the local geography and natural resources, beginning with logging, farming, and fishing and evolving to high-tech and bio-tech. In addition to this, Seattle is the birthplace of Starbucks, Microsoft, and Boeing, which is why Seattle is known as "Jet City." This only adds to the popularity of the Seattle and Tacoma ports that started booming during the Alaska gold rush. These ports continue to be some of the busiest ports on the west coast today.

The Pacific Northwest has been developed and is constantly changing, but a general reverence for the areas rugged beauty has been a constant. In light of growing concern for the humankind's impact on our world, people in the Pacific Northwest are leading efforts to research and quantify these effects. Brilliant young minds that grew into being on the cutting-edge of the manufacturing and high-tech industries are now coming together to develop renewable energy options and reduce the dependence on petroleum. Areas of previous industrial activity or environmental disasters are being restored. Invasive species are being removed, while both plant and animal native species are being reintroduced. Organized volunteers educate the public on how to responsibly enjoy all the natural beauty of the Pacific Northwest – and to fight to keep it for all to enjoy for generations to come.

NEED

The Applied Physics Laboratory at the University of Washington has issued a request for proposals (RFP) for a remotely operated vehicle (ROV) and crew that can operate in the salt and fresh water areas in the Pacific Northwest. The specific tasks for the ROV and operators include:

1. Locating the wreckage of a vintage airplane and returning its engine to the surface.
2. Installing or recovering a seismometer.
3. Installing a tidal turbine and instrumentation to monitor the environment.

Before launch and operations, the ROV must complete a series of “product demonstrations” staged at a swimming pool at various regional locations. (Depth requirements vary depending on competition class; see **SPECIFICATIONS** below.) Companies that successfully complete the product demonstrations and deliver exceptional engineering and communication components (e.g. technical documentation, engineering presentations, and marketing displays) will be awarded the contract.

REFERENCES Aircraft

- http://www.boydski.com/diving/wreck_dives.htm
- <http://kuow.org/post/whats-bottom-lake-washington-planes-trains-and>
- <http://www.memorieshop.com/Seattle/LakeWashington/>
- <http://www.cnn.com/2017/08/19/us/uss-indianapolis-wreckage-found/index.html>

Earthquakes

- <http://www.crew.org/earthquake-information/history-of-earthquakes-in-cascadia>
- <https://pnsn.org/outreach/earthquakesources/csz>
- http://www.interactiveoceans.washington.edu/story/Broadband_Ocean_Bottom_Seismometer
- <https://uwerisobservatory.wordpress.com/what/>

Energy

- <http://depts.washington.edu/nnmrec/>
- http://www.apl.washington.edu/project/project.php?id=seafloor_tidal_power
- <http://blogs.dickinson.edu/ecoreps/2014/04/01/tidal-power-in-puget-sound/>
- <https://energy.gov/eere/articles/calming-waters-impact-turbulence-tidal-energy-systems>
- <http://deepzoom.com/>

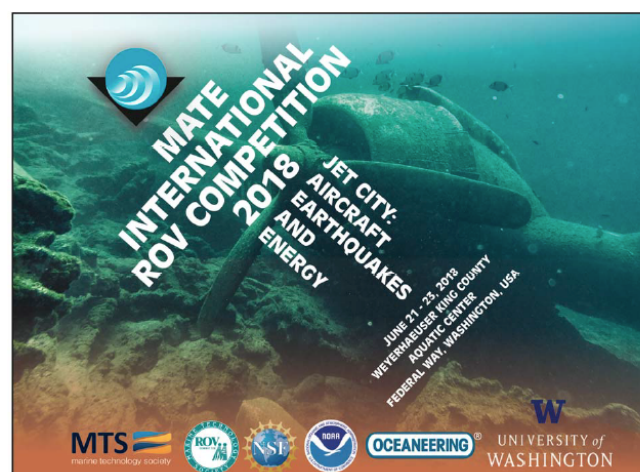


Figure 1: MATE competition Logo for 2018

IX. DEMONSTRATIONS

DEMONSTRATION #1: SIZING

Maximum Point Value for Task = up to +10 bonus points

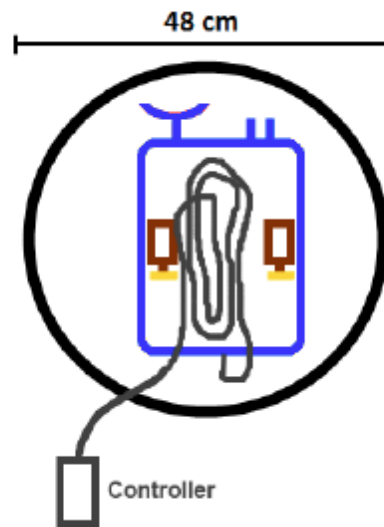
Sizing

Size measurements will be made using the two largest dimensions of the ROV. Two flat discs with 48cm and 60cm diameter holes will be located at safety check in for teams. Companies will place their vehicles on the measuring table and, when ready, ask a judge to make the size measurement. The vehicle measurement must include the vehicle, all manipulators/tools to be used in the product demonstration, and the vehicle's tether. The control system and 1 meter of tether may be outside of the measurement circle. Companies must present their completely assembled ROV for measurement; companies may **not** detach manipulator arms or other equipment for the measurement.

The ROV must fit into the two largest dimensions of the disk to receive bonus points. If the ROV and all its equipment fit within the hole of 48cm in diameter, the company will receive 10 bonus points. If the ROV and all its equipment fit within the hole of 60cm in diameter, the company will receive 5 bonus points. If the ROV and all its equipment do not fit within the hole of 60cm in diameter, the company will receive no bonus points, but can still compete in the product demonstration. If manipulators act on a swivel system they can be moved inside the frame, but can not be detached. The companies' largest/longest manipulator must be attached for the product demonstration.

Size	
< 48 cm diameter	+10 points
48.1 cm to 60 cm	+5 points

There are no weight restrictions for the ROV.



DEMONSTRATION #2: TIMING

Maximum Point Value for Task = +10 bonus points

Companies will have **25 minutes** to enter the station, mobilize their ROV, and complete as many of the 3 tasks as possible in the time allotted. The clock will continuously run even when the ROV is out of the water having any modifications made.

There will be a 10 point time bonus if companies complete all 3 tasks in **20 minutes** or under from the time they enter the station.

DEMONSTRATION #3: SAFETY

Maximum Point Value for Task = 10 points
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1. Propellers must be enclosed inside the frame of the ROV or shrouded. Companies that have propellers protruding outside of their frame will not pass the safety inspection and will not be allowed to compete.
2. All power provided to your ROV system must be obtained from the Challenge power supply. This is a singular point of connection; all power to your ROV must pass through the provided fuse on the supply **and** the single fuse in your wiring.
3. MARINE will provide a nominal 12 volt power source at the product demonstration station.
4. Voltage may never be increased above the nominal 12 volts anywhere in the ROV system.
5. The ROV **must** have a 15A maximum fuse in the positive power supply line.
6. ROV systems are allowed 2 replacement fuses during the product demonstration run. In the event that the ROV system blows the third fuse during the product demonstration, the product demonstration run will be over and no additional points will be earned. Note: MARINE will have some fuses on hand, but it would be wise for companies to bring additional fuses.
7. All electrical components going into the water must be waterproofed. ROVs with electrical connections that are exposed to the water and not sealed will not be permitted to enter the pool. Disposable motors (motors with no waterproofing) are not permitted. Taping a connection only with electrical tape does not constitute a sealed connection. The process of sealing electrical connections must include methodologies such as, but not limited to, silicone RTV, hot melt glue, epoxy, self-vulcanizing tape, and enclosing the connection inside a housing.
8. Onboard electrical power is not allowed. All power for the vehicle must come down the tether. Batteries (9-volt, AAA, AA, etc.) are **not** allowed under any circumstances.
9. Control systems must be built in a neat and workmanship like manner. Loose components and unsecured wires may not pass safety inspection. All wires entering and leaving the control system must have adequate strain relief and wire abrasion protection as the wires pass through the box.

DEMONSTRATION #4: ENGINEERING PRESENTATION

Maximum Point Value for Task = 50 points
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During the competition, your company will present to a panel of working professionals – individuals who represent science, exploration, government, and industry. Your presentation should describe the engineering behind your vehicle's design and operation and address any possible safety issues. It should also highlight

any design innovations or creative solutions to solving the product demonstration tasks. After the presentation, the judges will take 5 to 10 minutes to ask the members of your company questions about your ROV. The judges will evaluate both your presentation and responses to their questions and award a score (50 points max) based on your presentation and how you answer their questions.

All student members of your company must participate in this presentation and question and answer (Q&A) period. You are required to have your ROV with you. Be sure to organize your information and practice your presentation in advance. Ask your instructors, mentors, and parents for feedback. Practicing will help you to work out any “kinks” and be more comfortable talking in front of the judges.

Example of questions during product interview:

1. How did you decide on the shape of your ROV and the materials to build it?
2. What design trade-offs did you make? Can you explain why?
3. What type of tool(s) did you design to accomplish the product demonstration tasks and why? How does the tool(s) work?
4. How did you determine how much floatation to add to your vehicle?
5. Why is it important to think about stability when designing your ROV?
6. Did you develop a safety checklist? What other safety precautions have you taken?

Preparing for your product presentation

- Make sure that every member of your company has a good, general working knowledge of your vehicle, even though they may have specialized in one specific aspect of its design and construction.
- Research the specifications of the components that you use in your vehicle. Be familiar with such numbers as the amount of propulsive force the thrusters produce, the weight of your ROV, etc.
- Encourage each member of your company to keep a project notebook. Before the competition, set up a time where you compare notebooks. One member might have written more information about your ROVs electrical system, while another might have included details about buoyancy that others forgot. This exercise will help to refresh everyone’s memory about the design and building process. If your company submitted technical documentation, make sure all company members have read it and are familiar with it. This exercise will help to familiarize everyone with all aspects of the project.
- Generally, you will have more to say about your ROV than can be presented in 5 or 10 minutes. That is why it is critical to organize your material and practice communicating it. However, avoid coming across as having memorized your presentation. Judges want to see that you are prepared and understand the information, not that you can simply recite a rehearsed speech from memory. Ask your instructors or mentors to give you feedback.

DEMONSTRATION #5: MARKETING DISPLAY

Maximum Point Value for Task = 50 points
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Your company is required to create a display that will be showcased during the competition event. Your display should be an informative, clear, and concise presentation about your company and how you designed and built the specialized tools to effectively complete the product demonstrations. During the competition, your company's display will be evaluated and scored by a completely different group of working professionals – individuals who will represent science, business, government, industry, and education/outreach.

While some judges will have a technical background, others will have a communications, marketing, or public relations background. In addition, there will be visitors to the competition who may not completely understand what an ROV is or how it is used. You can think of these visitors as potential future clients who may hire you, but have a limited understanding of the technology (i.e., you need to explain your technology, the tasks, and “sell” them **your** products and services.) Design your display to communicate to this type of audience.

Each company will have a space approximately 3-feet x 3-feet for its display. Depending on your region, tables may or may not be provided. Each judge will award a score (50 points max). Judges' scores and comments will be returned to you shortly after the event.

General Guidelines

- Font size that is clearly legible from a distance of 1.5 meters.
- Choose a font style and use it throughout.
- All measurements are in SI units (metric). Exceptions include ½-inch PVC pipe and other items described or sold in imperial units.
- Include headers (see [required components](#) below).
- Photos should be clear and high-quality for the print sizes that you choose.
- **Every photo must have a caption.** No caption = no credit for that photo. Also include photo credits if the photo was not taken by someone in your company.
- Items that you **may** include on your marketing display:
 - Diagrams or sketches (CAD drawings, for example). The diagrams should be clearly labeled with a brief explanation that is understandable to a general, non-technical audience.

Required components of the marketing display:

These headers not only assist the judges in evaluating your display, they also make your marketing display easy to read.

1. Company name and school, club, or community organization name

Make sure that your company name is in large, bold font (larger than any other font on your marketing display). Include your school, club, or community organization

name as well as your company name. Include your geographic location (i.e. city and state). If you are an international company, include the city and country.

2. Abstract (concise – 150 word limit)

Include a written introduction to your company and how your company designed and built a specialized ROV and tools to complete the product demonstration tasks. Make sure to relate the product demonstration to how ROVs can be used in the real world. Don't assume that your audience knows what an ROV is or the details about the competition tasks. You can view this section as a summary of your company information, ROV design, and theme.

3. Company information

Include photo(s) (group or individual) of all of the members of your company. Provide a brief description of each member. This description should include the person's name, role in the company (e.g. CEO, CFO, pilot, marketing and communications specialist, etc.) and their qualifications, such as grade level, career goals, etc.

4. ROV Design

This section should be the bulk of your marketing display. It will be worth the most points.

- Why did your company build your ROV the way that you did?
- Present your ROVs "Features and Benefits." Features are the physical aspects or specifications for your vehicle, and benefits are what those features provide for the customer. For example, a feature might be a 1 horsepower thruster; the benefit would be the ability to make headway in a 2 knot current.
- Highlight your vehicle's safety features.
- Include photos of your ROV. Make sure to highlight the various systems of your vehicle.
- Include photos or drawings of any special features of your vehicle and how these features relate to the product demonstration tasks, safety, general operations, etc. This is the most important part of your design description.

5. Competition Theme

Describe this year's competition theme and how technologies are being used.

Rather than repeating information that you find within the competition manual or on the Internet, take the time to think through the competition challenges and their significance in the real world. You can choose to focus on the technical, economic, or socioeconomic issues. In addition to the Internet, you are encouraged to contact individuals (such as a local scientist or industry professional) who can offer their views. You should include appropriate photos, diagrams, or sketches with captions. Be sure to appropriately cite your references / sources at the bottom of this section.

6. Company Evaluation/Market Assessment

Answer the following questions:

- How would you characterize your company's overall success?
- What do you consider as strengths of your company and the ROV you designed?
- What areas do you see needing improvement?
- What was the most rewarding part of this experience?
- What would you do differently next time?

7. Acknowledgements

Please recognize your sponsors (companies, organizations, professionals from industry, and/or mentors) and the type of support that they provided (funds, building supplies, equipment, site visits to facilities, time, and/or technical expertise). You can include organizations and/or individuals that provided logistical and/or moral support (e.g. your parents, siblings, or pets).

Creating an effective marketing display:

- Address the theme and make real-world connections.
- Reflect your company's personality and mindset.
- Make key points and be concise.
- Keep the general public in mind.
- Make sure to label any and all figures, graphs, diagrams, and photographs and credit the source.
- Make sure that it is both informational and aesthetically pleasing.

DEMONSTRATION #6: PRODUCT

Jet City: Aircraft, Earthquakes and Energy

Maximum Point Value for 3 In-pool Tasks = 180 Points

Task #1: Aircraft

Maximum Point Value for Task = 55 Points

Mission:

Your company will place a marker buoy at the wreck site and proceed to remove debris from the engine. Companies will move debris from the wreck area, and return the engine to the surface using a lift bag to inflate and raise the engine and return it to the side of the pool. After recovery, companies will identify the aircraft using its tail structure and serial number.

- A. Place a marker buoy at the wreck site - 10 points**
- B. Remove debris from the engine using a lift bag (up to 20 points)**
 - Lifting two pieces of debris from the engine - 5 points each (10 total)
 - Moving two pieces of debris from the wreck area - 5 points each (10 total)
- C. Returning the aircraft to the surface side of the pool using the lift bag (up to 20 points)**
 - Inflating the lift bag - 10 points
 - Returning the aircraft to the surface, side of pool - 10 points
- ED After recovery, identify the aircraft using tail structure and serial number - 5 points**

Companies must complete the steps of this task in order. Companies are required to remove the debris from the aircraft before inflating the lift bag. Companies must place a marker buoy at the wreck site. Companies will receive 10 points when they successfully place their marker buoy at the wreck site. Successfully placing the marker buoy is defined as the weight of the marker buoy adjacent to the wreck site, and the buoy floating on the surface with a line connecting the two.

Companies must remove two pieces of debris from the aircraft. The debris will be constructed from 1/2-inch PVC pipe. A #310 U-bolt will act as a grab point on the debris, but companies may move the debris by any method they wish. Companies will receive 5 points for lifting each of the two pieces of debris, 10 points total. Lifting the debris is defined as the debris under control of the ROV and no longer in contact with the pool bottom or any part of the aircraft. Companies will receive 5 points for moving each of the two pieces of debris from the wreck area, 10 points total. Moving the debris from the wreck area is defined as the debris laying on the bottom, no longer in contact with any portion of the aircraft or the ROV.

After the debris has been moved, companies must fill a lift bag to bring the aircraft to the surface, by the side of the pool. The lift bag will be constructed from 3-inch pipe and will be slightly positively buoyant. The lift bag will be attached to the aircraft by a rope, and float approximately 15cm above the bottom of the pool. Companies must use a MATE provided manual air pump to fill the lift bag with air. The provided air pump will be a bicycle type manual air pump with airline tubing attached. The far (ROV) end of the airline tubing will have a 7cm length of 1/2-inch PVC attached. Companies can attach this PVC to their ROV during the set-up period, so that the ROV is prepared to bring the end of the airline tubing to the lift bag for inflation. Companies will receive 10 points when the aircraft is lifted to the surface. Companies will receive their points when the lift bag breaks the surface of the water. Once the lift bag and aircraft are on the surface, companies must use their ROV to move the aircraft to the side of the pool. Companies will receive 10 points when the aircraft wreckage is placed on the side of the pool.

Once on the pool deck, companies must use the tail structure and serial number to identify the aircraft. Companies must remove the aircraft from the water to identify it. A copy of the [SCOUT Aircraft Identification Handbook](#) will be provided at each product demonstration station. This handbook will contain photos of multiple types of aircraft tail structures and serial numbers from missing aircraft. Companies must match the tail structure and serial number to the proper aircraft in the handbook. Companies will receive 5 points for successfully identifying the aircraft using the tail structure and serial number.

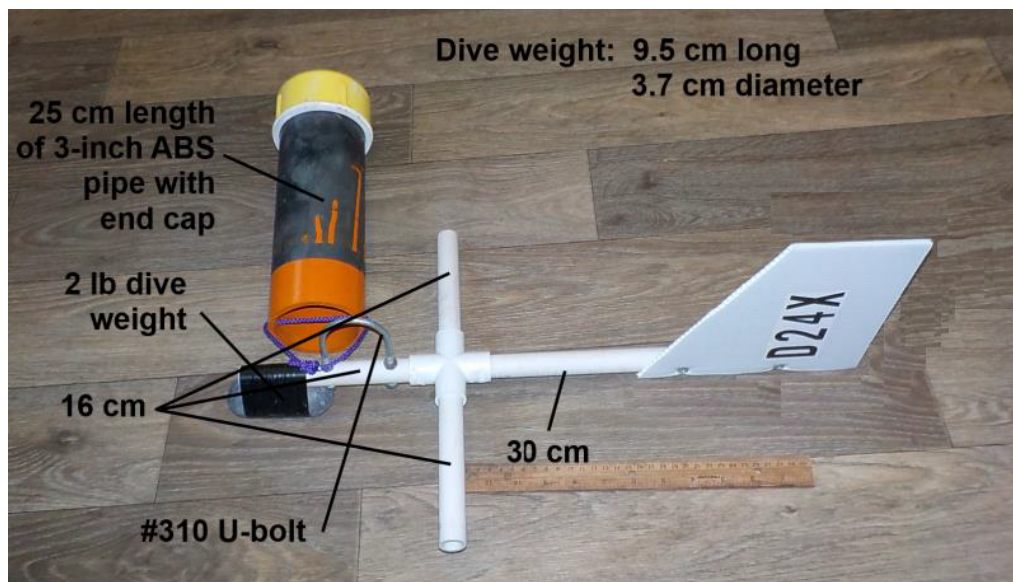


Figure 2: The aircraft is constructed of 1/2 inch PVC pipe. A lift bag, constructed of 3-inch pipe and a 2-lb weight, is attached to the front end of the aircraft.



Figure 3: The lift bag is constructed of 3" PVC. A bicycle pump and airline tubing will be provided to teams at their station.

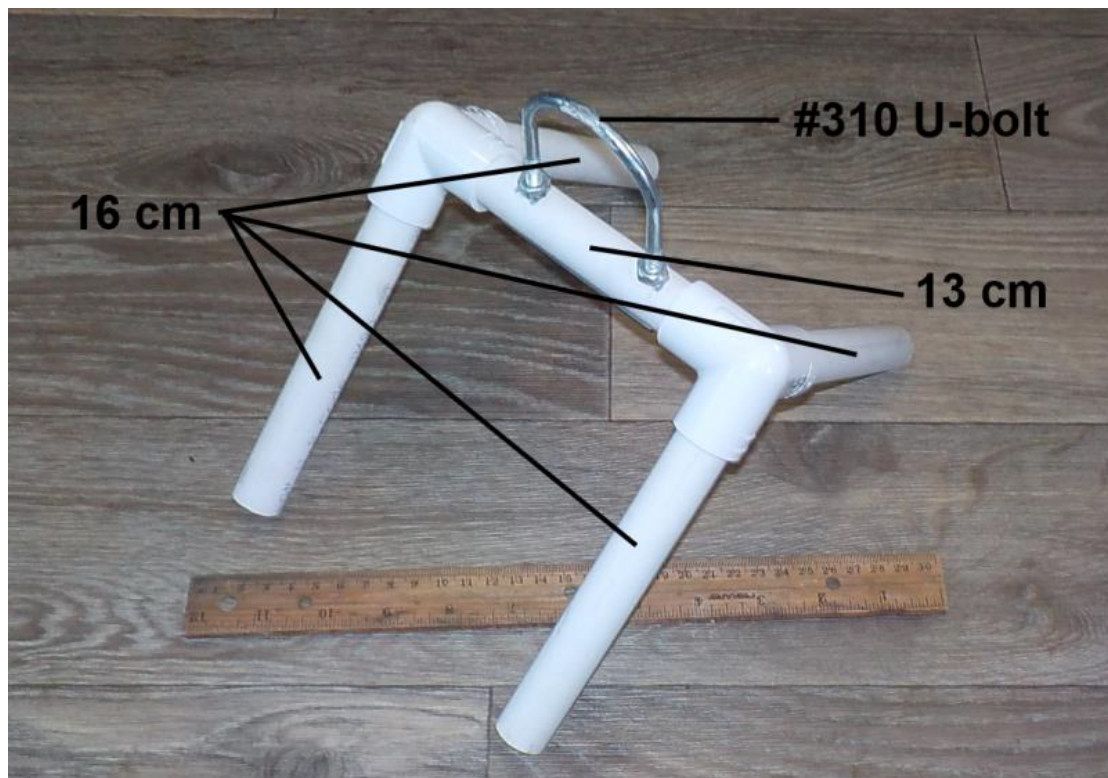


Figure 4: The wreckage debris is made of 1/2" PVC and a #310 U-bolt for removal from wreckage.



Figure 5: Complete Task 1 set up for Aircraft with lift bag, debris and airplane wreckage.

Jet City: Aircraft, Earthquakes and Energy

TASK #2: Earthquake

Maximum Point Value for Task = 60 Points
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Mission: Your company is tasked with releasing a seismometer from the seafloor and removing it from the elevator. Companies will be asked to then deploy a seismometer, level it, and connect it to its power source.

A. Deploying the seismometer - up to 30 points

- Pulling the pin to release the Ocean Bottom Seismometer (OBS) from the elevator - 5 points
- Removing the OBS from the elevator - 5 points
- Deploying the OBS into the designated area on the seafloor - 10 points
- Leveling the OBS - 10 points

B. Connecting the OBS to the power communications hub - up to 30 points

- Opening the door of the power and communications hub - 10 points
- Laying the OBS cable through one waypoint - 10 points
- Inserting the OBS cable connector into the port on the hub - 10 points

For this task, companies may choose to deploy the OBS first or to connect it to the power and communications hub first. The four steps of deploying the OBS must be done in order. Companies may lay the OBS cable through the waypoint before or after opening the door of the power and communications hub and inserting the connector. Companies must pull a pin to release the OBS from the elevator. The pin will be simulated by 1/2-inch PVC pipe. The pin will be inserted through an opening on both the seismometer and the elevator.

Companies will receive 5 points when they successfully remove the pin to release the OBS. Successfully removing the pin is defined as the pin no longer in contact with either the OBS or the elevator. Once removed, the pin may be dropped to the bottom of the pool or returned to the surface.

Once released from the elevator, companies must remove the OBS from the elevator. Both the elevator and the OBS will be constructed from 1/2-inch and 1-inch PVC pipe. A 3-meter length of wire will connect the OBS to the cable connector. A length of 1/8-inch rope will act as a grab point on the seismometer, but companies may remove the seismometer from the elevator by any method they wish. Companies will receive 5 points for successfully removing the OBS from the elevator. Successfully removing the OBS from the elevator is defined as the OBS under control of the ROV and no longer in contact with the pool bottom or the elevator.

Note: The cable wire and cable connector attached to the OBS may still be in contact with the elevator.

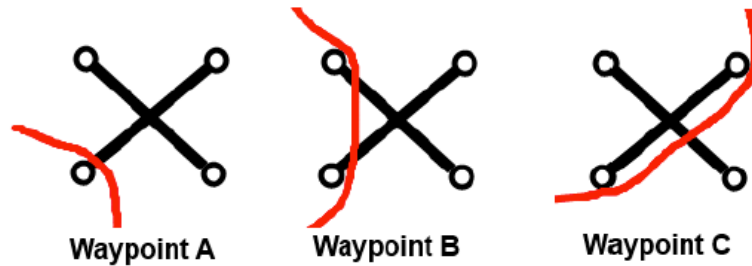
After removing the OBS from the elevator, companies must deploy it into a designated zone. The designated zone will be a 40cm x 40cm square constructed from 1/2-inch PVC pipe and painted red. Companies will receive 10 points for successfully deploying the OBS into the designated zone. Successful deployment of the OBS is defined as the OBS completely within the designated zone, with no part of it touching the PVC of the designated zone, and no longer in contact with the ROV. Note: The seismometer must be right side up to receive points for deployment.

After deploying the OBS, companies must turn a handle to level it. The handle of the OBS will be constructed from 1/2-inch PVC pipe attached to a 1/2-inch brass gate valve. Companies must turn the handle of the valve 360 degrees clockwise to level the OBS. Companies will receive 10 points for successfully leveling the OBS. Successfully leveling the OBS is defined as turning the handle 360 degrees clockwise. One segment of the handle will be painted red to help the company determine when it has turned the handle 360 degrees.

Companies must also connect the OBS to the power and communications hub.

Companies must open the door of the power and communications hub. The power and communications hub will be constructed from 3-inch pipe and 6-inch PVC pipe. The door, constructed from corrugated plastic, will be mounted over the vertical opening of the port on the hub. The door will be larger than the port and will have a 1/2-inch PVC handle attached. Companies may use the handle to open the door, or may manipulate the corrugated plastic to open the door. Companies will receive 10 points when they successfully open the door to the port on the power and communications hub. Successfully opening the door is defined as the door moved more than 90 degrees and no longer covering the 3-inch port. If after successfully opening the door the door closes on its own, due to pool currents or ROV activity, companies will not lose points, but may need to re-open the door to insert the OBS cable connector.

Companies must lay the OBS cable through one waypoint. The OBS cable will have a #310 U-bolt on a 1-inch PVC cross as a grab point on the seismometer, but companies may grab the cable by any method they wish. The waypoint will be located partway between the designated zone and the power and communications hub. The waypoint will be constructed of 6-inch PVC pipe in the shape of an X lying flat against pool bottom. The ends of the X will extend 20cm from the pool bottom. Companies must lay the cable inside any one of the vertical extensions. Companies will receive 10 points for successfully laying the cable through the waypoint. Companies may lay the cable through the waypoint before or after inserting the OBS cable connector into the port on the power and communications hub.



Depiction of successful cable lying through a waypoint. All three of these depictions would be successful laying of the cable through the waypoint.

Companies must insert the OBS cable connector into the port on the power and communications hub. The door covering the port of the power and communications hub must be open in order to insert the connector. The connector will be constructed from 1/2-inch PVC pipe. Companies will receive 10 points when the connector is successfully installed in the port on the power and communications hub. Successful installation of the connector is defined as the bottom portion of the connector inside the port, the top of the connector laying on the port, and no part of the connector or cable in contact with the ROV.

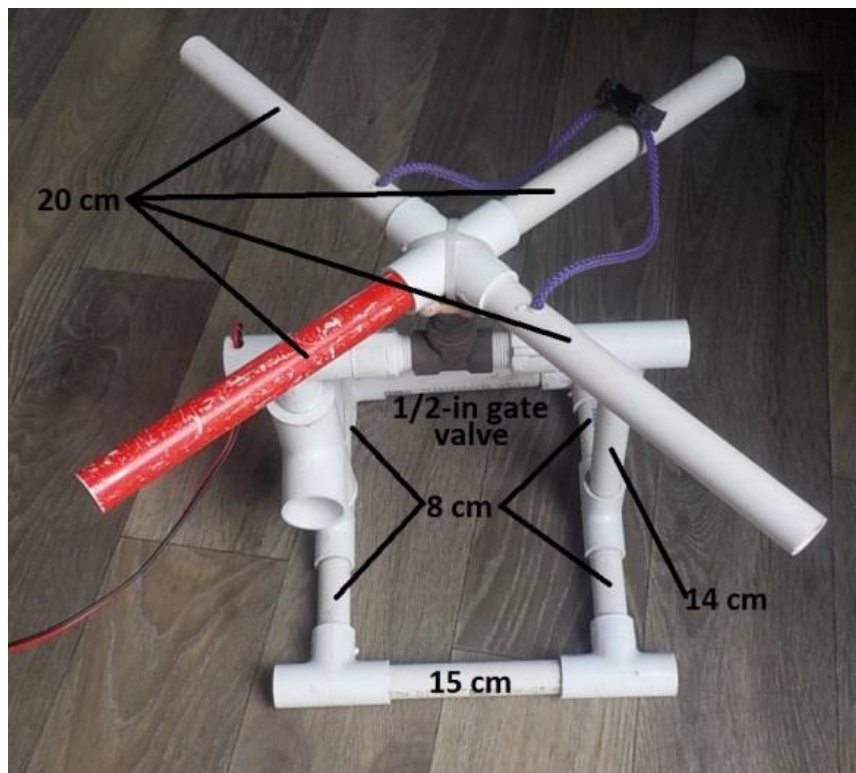


Figure 6: The Ocean Bottom Seismometer (OBS) constructed of 1/2" PVC and a 360 degree rotating wheel.

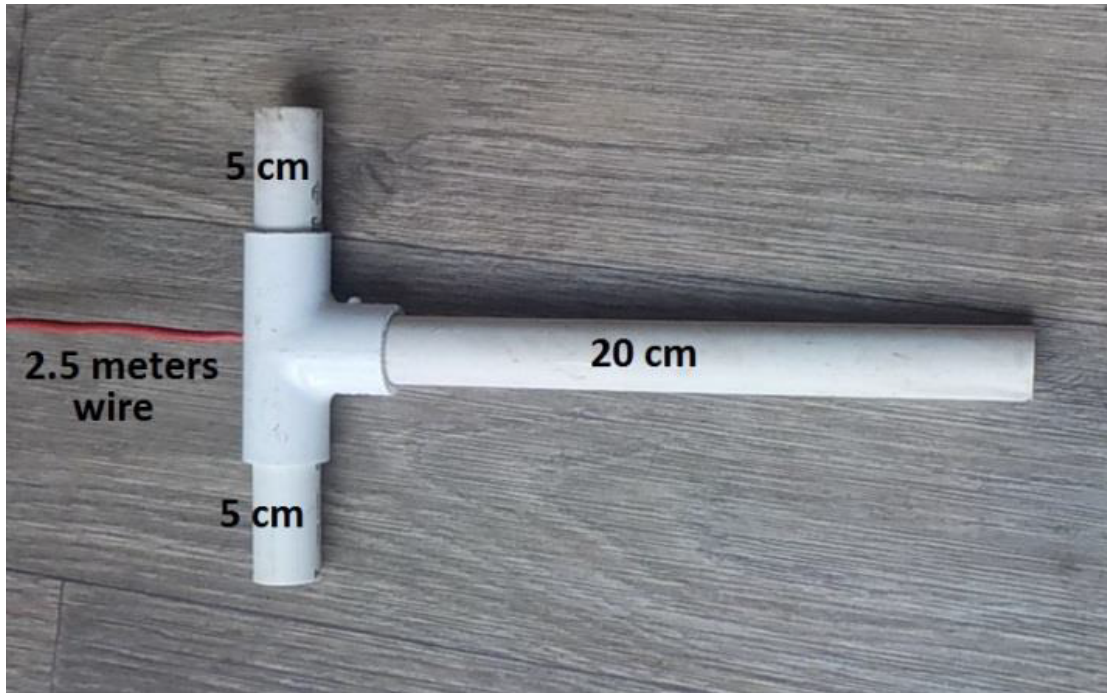


Figure 7: The cable connector that will connect to the OBS by 2.5 meters of cable.



Figure 8: The cable grab point will be situated along the 2.5 meters of wire. It is a 1" cross and #310 U-Bolt for pick up.

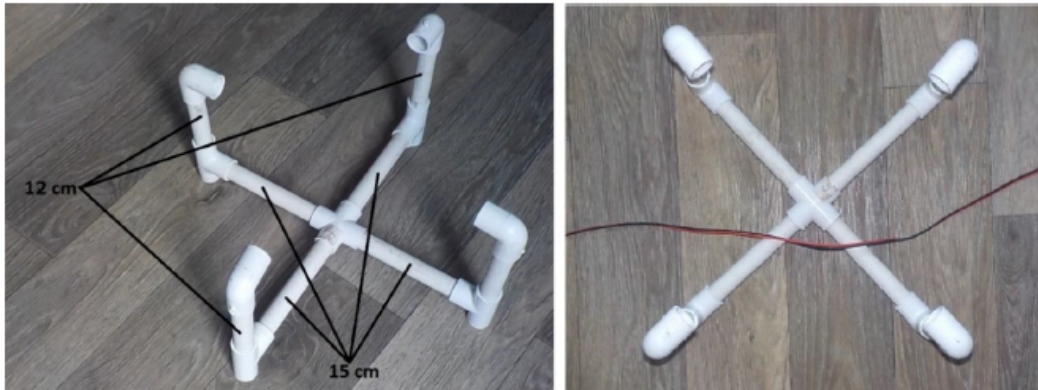


Figure 9: The waypoint. The cable must go through at least 1 “leg” of the waypoint. The right image demonstrates the cable going through 2 legs.



Figure 10: The Pin. The pin for the Bermuda Regional will have a longer T than the image pictured above. Size to be announced by Feb 15th 2018.



Figure 11: The cable connector is in its holder.

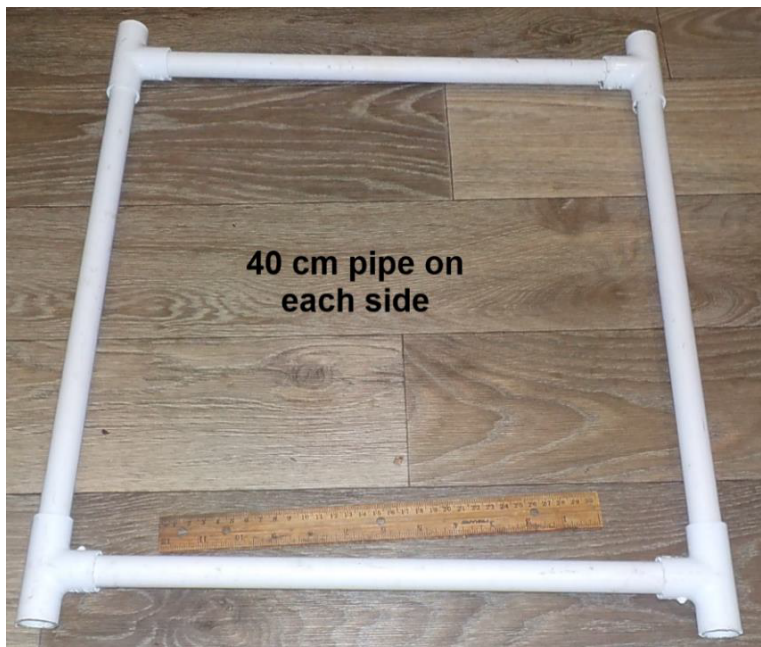


Figure 12: OBS designated area for placement of equipment during task completion.

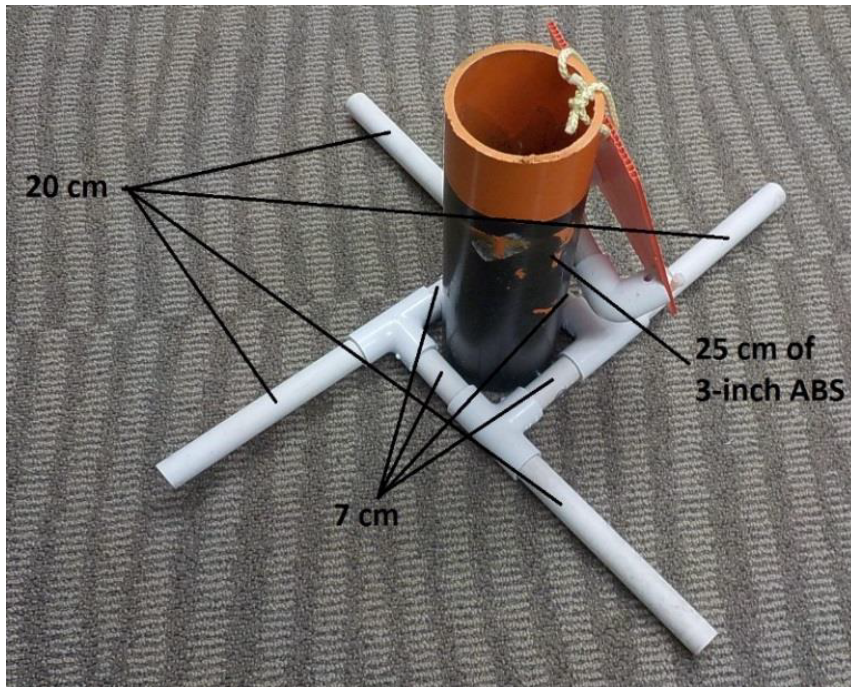


Figure 13: The power and communication hub is constructed from 3-inch PVC.

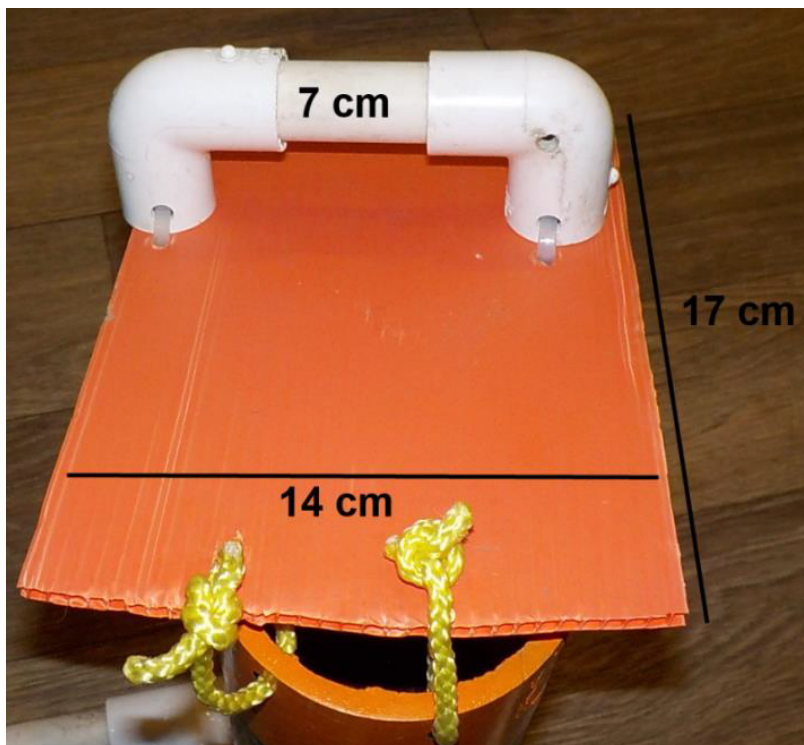


Figure 14: Door of the power communications hub made of corrugated plastic. Handle is weighted for easier opening.

Task #3 ENERGY

Maximum Point Value for Task = 65 Points
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Mission: Your company will be tasked with installing a tidal turbine in the optimum location. ROVs will be designed to install an Intelligent Adaptable Monitoring Package (I-AMP) to the area and lock it on a stand. Companies will then deploy a mooring and attach an Acoustic Doppler Velocimeter (ADV) to the mooring line. Finally, companies will be tasked with collecting two eelgrass samples and transplant two eelgrass frames to the disturbed area.

- | |
|--|
| <p>A. Installing a tidal turbine - 10 points</p> <p>B. Installing an I-AMP to monitor the area - (up to 15 points)
Installing the I-AMP onto its stand - 10 points
Locking the I-AMP onto the stand - 5 points</p> <p>C. Placing a mooring on the bottom - 10 points
D. Trigger an ADV onto the mooring - 10 points
E. Eelgrass habitat monitoring and restoration - (up to 20 points)
Collecting two samples of eelgrass for topside analysis - 5 points each (10 total)
Transplanting two eelgrass frames to a previously disturbed site - 5 points each (10 total)</p> |
|--|

The equipment, the tidal turbine, I-AMP, and mooring can be installed in any order, although the mooring must be installed before the ADV can be attached to it. The eelgrass habitat monitoring and restoration can be done at any time during the product demonstration.

A base for the tidal turbine will be located on the bottom of the pool. The base will be constructed from 1/2-inch PVC pipe and 2-inch PVC. The 2-inch PVC pipe will be set vertically in the center of the base unit. Companies must transport the tidal turbine array from the surface and install it into the 2-inch PVC of the base. The array will be constructed from 6-inch PVC pipe. Plastic airplane propellers, 15cm long, will simulate the rotors. A #310 U-bolt on top of the tidal turbine can be used as a grab point, but companies may transport the tidal turbine by any method they wish. Companies must install the 1/2-inch pipe at the bottom of the tidal turbine inside the 2-inch PVC pipe rising vertically out of the base. Companies will receive 10 points when the tidal turbine is successfully installed in the 2-inch vertical pipe of the base unit. A section of the 1/2-inch pipe at the bottom of the tidal turbine will be colored red. Successful installation of the tidal turbine is defined as the colored PVC on the bottom of the tidal turbine completely inside the 2-inch pipe of the base.

Companies must install an Intelligent Adaptable Monitoring Package (I-AMP) onto its stand near the tidal turbine array. The I-AMP will be constructed from 6-inch PVC

pipe. A length of 1/8-inch polypropylene rope will act as a grab point on the I-AMP, but companies may transport the I-AMP by any method they wish. The stand will be a 40cm square constructed from 1/2-inch and 3/4-inch PVC pipe that is painted yellow and attached to the base of the tidal turbine array. Companies will receive 10 points when they successfully install the I-AMP on the stand. Successful installation is defined as the I-AMP upright in the stand with both legs of the I-AMP inside the PVC square. No part of the legs of the I-AMP may be resting on or outside of the PVC square.

After installing the I-AMP, companies must lock the I-AMP in place. The stand of the I-AMP will have a handle constructed from 1/2 inch PVC pipe. The handle will be painted yellow. Companies will receive 5 points when they successfully turn the handle, locking the I-AMP in place. Successfully turning the handle and locking the I-AMP in place is defined as the handle rotating 90° and the locking mechanism resting on the pool bottom inside the stand or on the legs of the I-AMP.

Companies must also place a mooring inside a designated area near the tidal turbine array. The mooring line will be constructed of #100 chain connecting a PVC base to a floatation package. A 12-inch PVC cross will be located partway up the chain. The base of the mooring will be constructed from 6 inch PVC pipe and will be painted orange. The total length of the mooring, from the bottom of the base to the top of the floatation, will be the depth of the pool where it will be placed plus approximately 10cm. The designated area will be a square constructed of 1/2-inch PVC pipe painted orange and will be attached to the base of the tidal turbine array. Companies will receive 10 points when they successfully place the mooring into the designated zone. Successful placement is defined as the PVC base of the mooring completely within the designated area and the location package on the surface.

As the floatation of the mooring rises, the Acoustic Doppler Velocimeter (ADV) simulated by a PVC "T" will be triggered down the mooring line. Companies will receive 10 points if trigger is activated.

Companies are also required to assist with eelgrass monitoring and restoration. Two samples of eelgrass will be located in the product demonstration area, and two transplant "frames" of eelgrass will be located on the surface, by the side of the pool. Both the eelgrass samples and the frames will be simulated by green foam sheets attached to 1/2-inch PVC pipe. Companies must collect the two samples on the pool bottom and return them to the surface. Companies will receive 5 points for each eelgrass sample they return to the surface, 10 points total. Companies must also transplant two frames of eelgrass from the surface to a previously disturbed area. The previously disturbed area will be a 41cm square of 1/2 -inch PVC pipe painted green. Companies will receive 5 points for each eelgrass frame transplanted into this disturbed area, 10 points total.

The turbine, the I-AMP, the mooring, and the two eelgrass frames will be located on the surface, by the side of the pool at the start of the product demonstration. Companies may lower the I-AMP, the mooring, and the eelgrass into the water at the side of the pool during the set-up period, or during the product demonstration run. Companies may retrieve these items from the bottom and move them to their designated locations. Companies are not allowed to "toss" or throw these items out

into the pool; they must be released at the side of the pool. Companies are required to transport the tidal turbine array from the surface with their ROV; companies may not lower the turbine into the water.

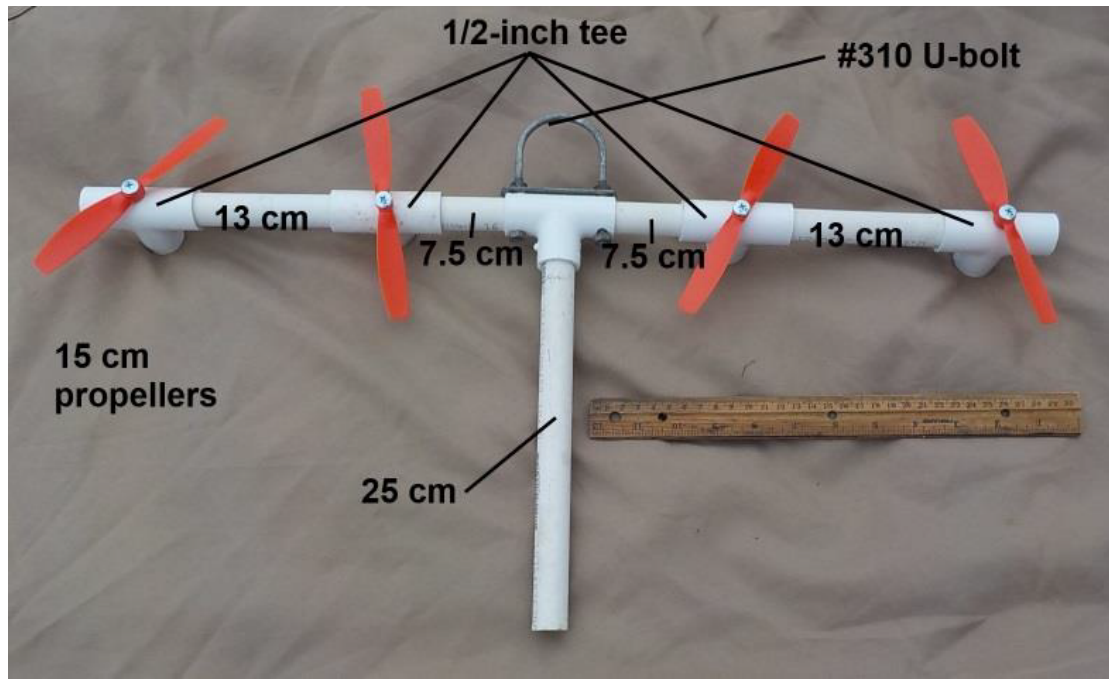


Figure 15: The tidal turbine constructed of $\frac{1}{2}$ PVC and a #310 U bolt for pick up. The Bermuda Regional will have 3 inches of $\frac{1}{2}$ PVC T's for elevation of turbine off the bottom to allow for access of #310 U bolt pick up.



Figure 16: The tidal turbine base in which the tidal turbine will be inserted.

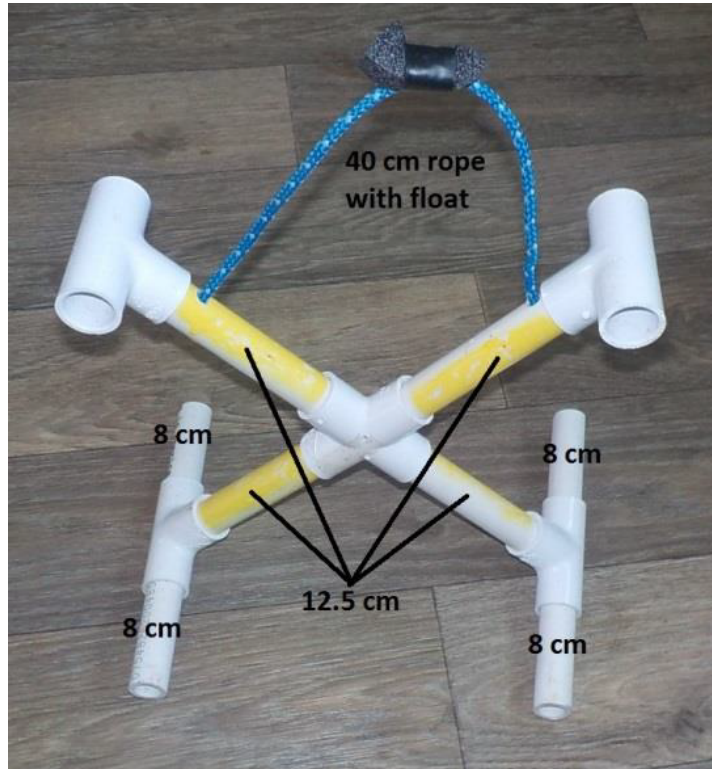


Figure 17: The Intelligent Adaptable Monitoring Package (I-AMP) with floating 1/8 nylon cord for pick up to be moved to I-AMP designated area (yellow).

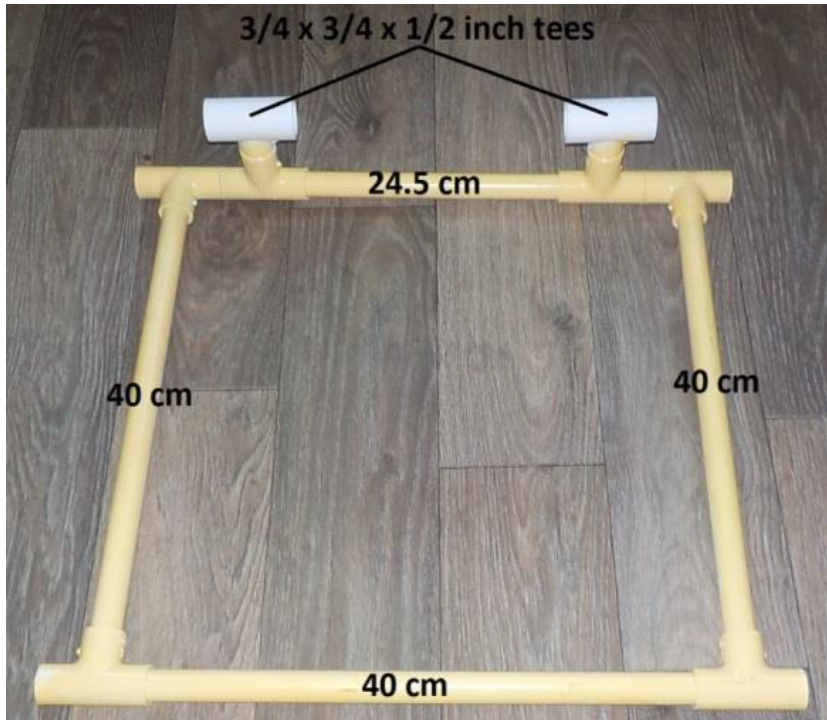


Figure 18: The I-AMP installation designated area which will be neon yellow.

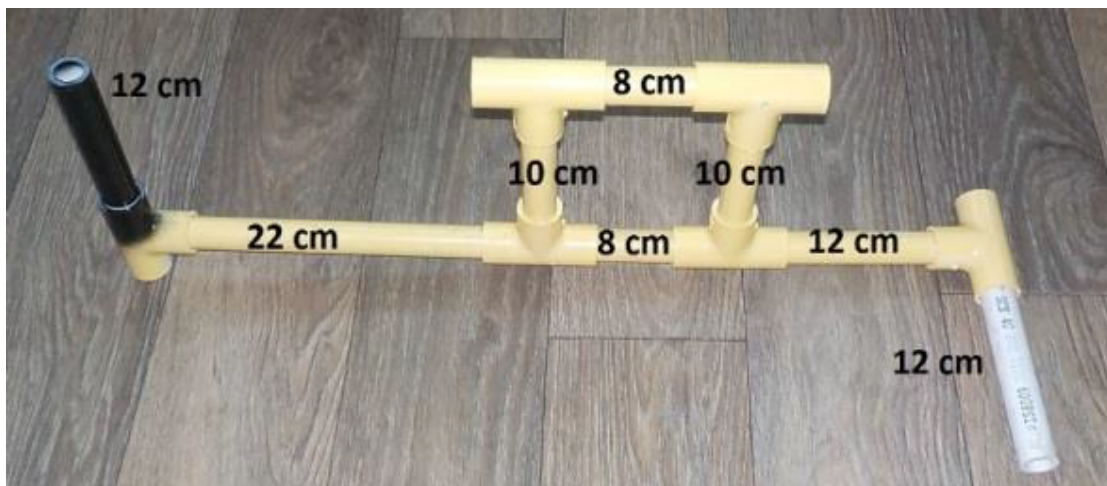


Figure 19: The I-AMP locking mechanism. As indicated here the locking mechanism is 10cm, this may be modified to make this mechanism easier to operate. Notes will be made by Feb 15th 2018.

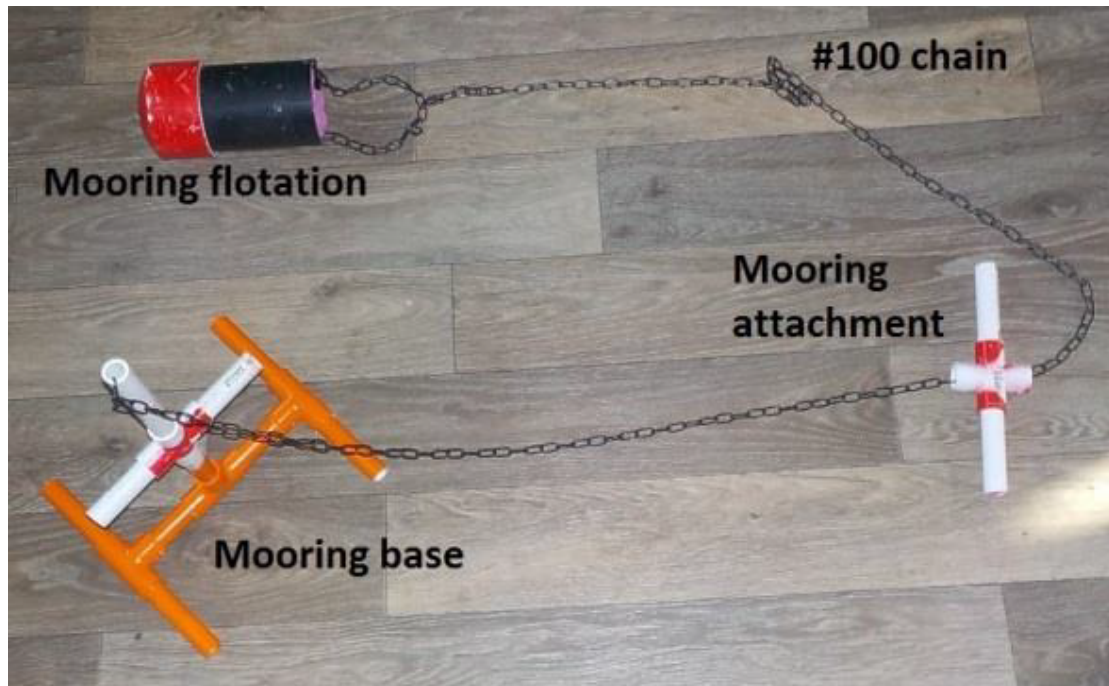


Figure 20: The mooring set-up for deploying mooring into the orange designated area.

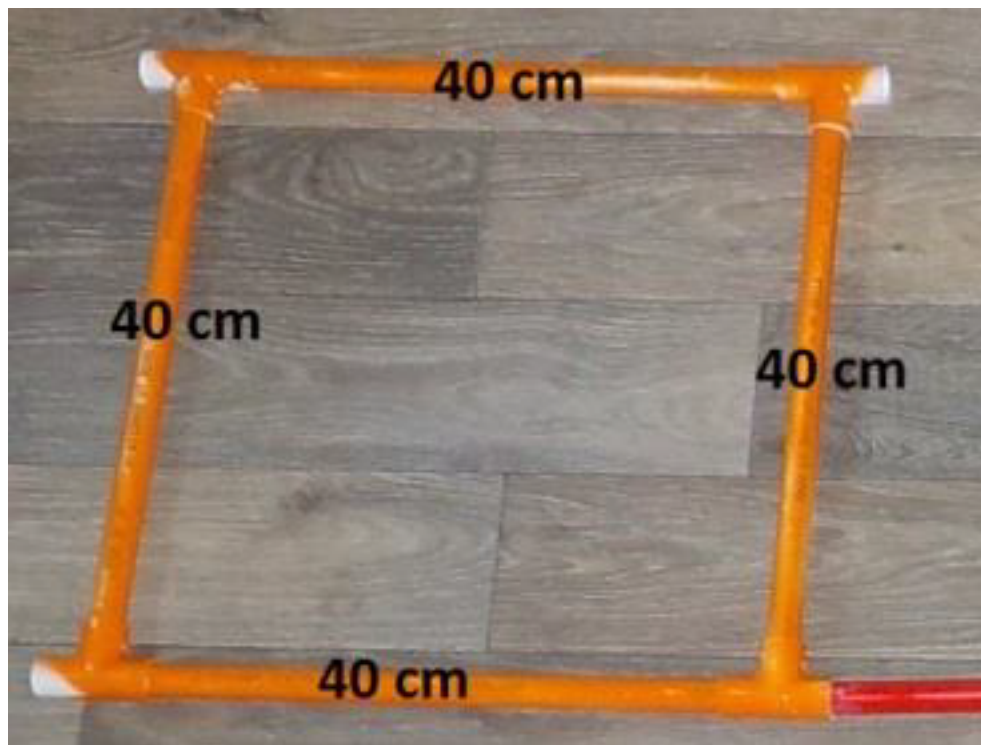


Figure 21: Mooring designated area will be neon orange.



Figure 22: Bases with successful equipment components deployed successfully.

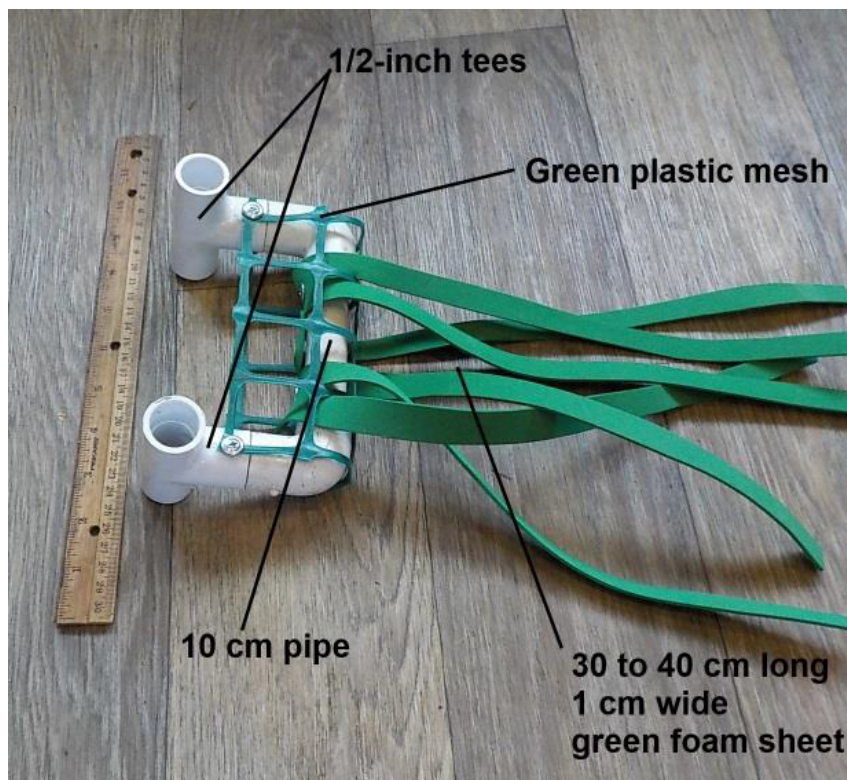


Figure 23: Eelgrass samples and frames that will be both retrieved and transplanted to designated green area.

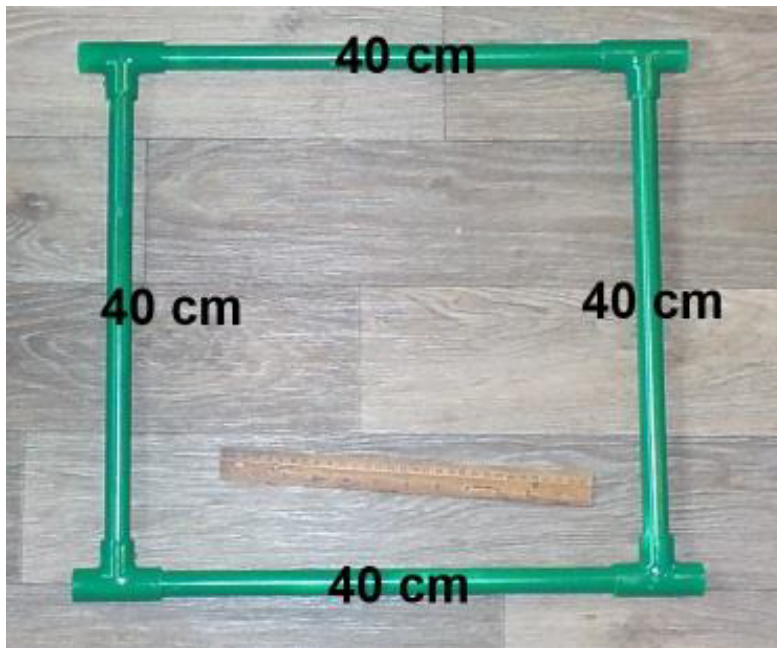


Figure 23: Eelgrass area will be green.

X. Scoring

The maximum total points that can be scored in the 2018 ROV Angelfish Challenge in Bermuda for Scout level is **310** points.

180 Maximum Total Points in Product Demonstration
50 Maximum Total Points for Engineering Interview
50 Maximum Total Points for Marketing Display
10 Points for Safety Demonstration
+ 10 Point Size Bonus
+ 10 Point Time Bonus
<hr/>
310 Points

Scoring Breakdown

Demonstration Number			Maximum Points
1. Sizing			+ 10 Bonus
2. Timing			+ 10 Points
3. Safety			10 Points
4. Engineering Interview			50 Points
5. Marketing Display			50 Bonus
6. Product Demonstration		Task 1	55 Points
		Task 2	60 Points
		Task 3	65 Points