



**New for 2013!** This document contains many revisions and additions from previous years. Be sure to read it over completely; do not assume carryover from previous years.

## DESIGN & BUILDING SPECIFICATIONS AND COMPETITION RULES

This document contains information relevant to the **RANGER** class; the **EXPLORER** and **SCOUT** competition documents contain information specific to those classes.

### COMPETITION CLASSES

The MATE Center's ROV competition is divided into three classes – **EXPLORER, RANGER, and SCOUT**. See the **General Information** document for an overview of the competition and more information about each of the competition classes.

## DESIGN & BUILDING SPECIFICATIONS

### SAFETY COMES FIRST

Safety is the competition's primary concern and guiding principle. Any system that is deemed unsafe by competition officials will not be allowed to compete. If a safety concern is identified during the initial inspection, teams are permitted to modify their system and have it re-inspected. Teams are permitted to have their vehicle re-inspected twice. If a team fails to pass its third and final safety inspection, it is disqualified from the underwater competition portion of the event. There are NO APPEALS once your ROV has been disqualified.

#### **Examples of safety violations from previous ROV competitions include:**

- The electrical schematic included in the technical report did not show a main fuse or circuit breaker.
- The ROV used pneumatics, but the technical report did not include a pneumatics diagram.
- The ROV used pneumatics, but the team had not passed the fluid power quiz two weeks prior to the competition.

#### **Safety inspection protocol:**

- 1) Before entering the water for practice or a mission run, ROVs **must** go through a safety inspection. Teams must present a SIGNED safety inspection sheet to the pool practice/mission coordinator before their vehicles are permitted to enter the water.
- 2) Competition staff will conduct a safety inspection of the vehicle using the safety inspection sheet ([www.marinetech.org/missions--specs](http://www.marinetech.org/missions--specs)).
- 3) If the safety inspector(s) identify a safety violation, teams will have the opportunity to address it. The pool practice or mission run schedule will NOT change to allow teams more time.
- 4) If during the second safety review the 1) violation has not been properly addressed or 2) another violation is revealed, teams will have ONE additional opportunity to address the



issue.

- 5) **If during the third safety review a violation still exists, teams will not be permitted to participate in the underwater mission component of the competition.** However, teams can still participate in the engineering and communication (e.g. poster display and engineering evaluation presentation) component.
- 6) Reminder: All teams must present a signed safety inspection sheet to the pool practice or mission coordinator before placing their vehicles in the water. In addition, mission station judges and competition officials can pause or stop a mission run at any time if they feel that there is a potential safety concern.

**International competition teams – additional safety inspection protocol details:**

- Prior to the competition, safety inspectors will review your technical reports to identify potential safety violations.
- Teams with violations will be notified via e-mail. Once notified, teams must 1) respond acknowledging receipt and 2) lay out a plan to address the violation.
- Safety inspectors will compile a list of the safety violations and publish them to the competition web site. This is not done to “call out” or embarrass teams in any way. It is to emphasize the fact that EVERYONE is responsible and accountable for ensuring a safe, successful event.
- Teams must complete their initial safety inspection on the first day of the competition. Teams will be assigned to a safety inspector(s). The inspector will reference the list of violations as he/she conducts the safety inspection of the vehicle using the safety inspection sheet ([www.marinetech.org/missions--specs](http://www.marinetech.org/missions--specs)).
- The safety inspection is worth 30 points. Each time a team fails its safety inspection it loses 10 points. After a team fails its second inspection, it must meet with the chief safety inspector to discuss a plan of action prior to returning to its workstation. **THREE STRIKES** and a team 1) receives 0 points for the safety inspection and 2) is disqualified from the underwater mission component.

**NUMBER OF VEHICLES**

MULTIPLE VEHICLES ARE NOT PERMITTED. Teams are required to design and build ONE ROV that can complete the necessary mission tasks. “Floating eyeballs” or other vehicles that are not hard connected to the frame of the main vehicle are NOT permitted. Cameras designed to provide a “birds-eye view” are permitted provided that these cameras are hard connected to the frame of the main vehicle. “Hard connection” does not include the wiring between the camera and the ROV.

**POWER**

Teams participating in the MATE ROV competition can utilize both **ELECTRICAL** and **NON-ELECTRICAL** power sources. These sources and the specifications for the **RANGER** class are



described below.

### **ELECTRICAL POWER – GENERAL**

MATE will provide the necessary power for the RANGER class. All power provided to your system through an external connection for any purpose during the competition must be obtained from the MATE competition power supply. This includes dedicated lines for cameras, manipulators, and any other devices. This is a singular point of connection; all power to your competition ROV must pass through the MATE-provided fuse. Laptops (two maximum) are permitted for command, control, and communications (C3) purposes. All other power (mechanical, chemical, or electrical) contained within the ROV system must comply with and not exceed the regulations specified here.

**Exposed connections:** ROVs with electrical connections that are exposed to water and not sealed are not permitted to enter the water. “Disposable motors” are also not permitted; these are exposed motors with no waterproofing.

**Nominal voltage:** Throughout this and other MATE competition specifications, references are made to 12V DC. Teams should plan their systems to handle fully charged lead acid batteries. For the RANGER class, a fully charged 12V lead acid battery has a voltage as high as 14 Volts due to surface charge. Any power supplies used will be set at  $12.7 \pm 0.3$  Volts.

**Allowed voltages and currents:** The following voltages and currents are allowed through your ROV's tether:

- Low voltage AC or DC control signals. Low voltage is defined as a voltage equal to or less than the maximum supply voltage per class specification.
- DC main-supply as per class specifications.

### **ELECTRICAL POWER**

**Voltage:** Maximum supplied power at pool-side will be a nominal 12 Volts DC. Voltage may not be increased anywhere in the ROV system.

**Note:** The voltage limits set by the MATE Center are for safety purposes. Voltages in excess of the class parameters set forth in the MATE competition rules are not allowed on the system at any time other than the brief moment of back electromotive forces (back EMF) from collapsing magnetic motor fields typical in any electrical motor situation.

**Current:** Maximum current is 25 amps. MATE's power supply includes a 25-amp fuse. In the event that your ROV blows two of MATE's fuses, your mission run will be over and you will not be able to earn any additional points.

The MATE competition does not guarantee or promise performance limits beyond the maximum



specified current for your particular class. However, any ROV causing a variance of current beyond the maximum that does not “blow” the fuse will be allowed to continue competing. Competitors should keep in mind, however, that vendors as well as tolerances in manufacture may vary and fuse performance in testing may not be representative of fuse performance in the competition setting.

**Connections:** Power supply connections will be via standard banana plugs. Your ROV’s tether must have male banana plugs to obtain power.

**Note:** RANGER Teams concerned about how voltage loss will affect their camera(s) should consider adding a separate line in the tether to supply the camera from the main power source. This dedicated line for cameras is permitted, provided that it, along with the other lines of the tether, passes through the ONE fuse and carries 12V DC.

### CIRCUIT PROTECTION

All teams must demonstrate the presence of an appropriately-sized fuse on the positive side of their vehicle’s electrical circuitry in order to pass the safety inspection. The fuse should be located within 30 cm of the connection to the MATE power supply. The MATE power supply provided at each pool station includes an in-line fuse, but each team needs to protect their system with an additional fuse. **If your vehicle is not protected with a fuse in addition to the fuse provided on the MATE power supply, YOUR VEHICLE WILL NOT PASS THE SAFETY INSPECTION and will not be allowed to compete.** Circuit breakers may be used in place of or in addition to fuses. The type of circuit protection (fuse or circuit breaker) must be documented and included in your technical report.

### POWER SOURCES

Depending upon the competition event (i.e., regional or international), power for the RANGER class may be provided by batteries or isolated power supplies. If power supplies are used, they may be a fixed output voltage and will not be “turned down” to accommodate other than the specified voltage for the class. Taps will not be made off of batteries to provide other than the specified voltage for the class.

### ONBOARD ELECTRICAL POWER (i.e., power not provided by the tether)

Onboard battery powered devices are NOT allowed under any circumstance.

Water leaking into a closed battery container can result in the generation of hydrogen gas. This gas can build up inside a pressure housing and create an unsafe situation. For this reason, onboard batteries are NOT allowed under any circumstance.

Any device that needs power must obtain that power directly from the ROV tether. For devices that operate at a voltage other than the tether voltage, an onboard ROV converter may be



included. The converter must be sealed and not exposed to water.

This rule includes commercial “watertight” battery containers; no battery of any type is permitted on any competition vehicle.

Teams looking to make voltage sources other than 12V (i.e., 9V, 6V, 5V) should look for simple linear regulators such as the LM317, LM7809, LM7805. These are simple three terminal regulators that with the addition of input and output capacitors (and resistors for LM317) can provide lower voltage power supplies as needed.

### ***NEW FOR 2013!!!***

#### **LASER SAFETY RULES**

- Lasers must have an on/off switch. This switch must be on the surface controller.
- All lasers must be powered by the MATE surface power supply. Batteries, including batteries for powering lasers, are not permitted on the vehicle.
- All lasers must operate in the visible range at either the 630-680 nm (red) or near the 532 nm (green) wavelength. All lasers must fall into the Class I, Class II, or Class IIIa category. Red lasers must operate at 5mW or less. Green lasers must operate at ~1mW.
- Teams using lasers cannot increase voltage to increase the power of their lasers. Lasers must use the voltage set in their specifications.
- Teams using lasers must prove (via the manufacturer specification sheet) that their laser falls within these guidelines. Teams should include detailed specifications of their laser in their technical report as well as have that information ready and available during their safety inspection and engineering evaluation presentations.

Teams using lasers at a MATE regional contest or MATE sponsored pool days must forward their laser specifications to competition coordinator (Jill Zande) **AT LEAST 2** weeks before the event takes place. Specifications will be forwarded to the MATE Center safety inspection team for evaluation. Once the laser specifications are reviewed, a notification will be sent to both the team and the regional competition coordinator regarding the use of that specific laser system. At the event, teams **MUST** supply the MATE notification and a specification sheet to the competition coordinator or safety inspector verifying that they are allowed to use the laser. Teams failing to bring their MATE notification or their specification sheet will not be permitted to use their laser.

- When out of the water, the laser should have a shield or enclosed beam stop attachment within 30 cm of the laser. This means that the laser beam should not travel more than 30 cm before reaching the shield. This is a requirement at all times when the laser is out of the water. The shield does not need to be attached to the ROV while it is in the water. The shield must be painted with FLAT BLACK paint.



- At no time should the laser be focused or deviate from a collimated beam.
- When testing the laser at a workstation, teams must display a sign telling others that a laser is being operated.
- Operators working with the laser while the ROV is out of the water should wear appropriate laser safety glasses at all times. This requirement is for all laser types.

Teams should observe these laser safety rules at all times, even when building their vehicles in their own workshops pre-competition.

### POWER SHUTDOWN REQUIREMENT

For safety purposes, any ROV that is disconnected from the surface supply must stop functioning in less than 5 seconds. **This applies to electrical, pneumatic, and hydraulic power sources.** Any filters, capacitors or accumulators must be sized accordingly to meet this specification.

### FLUID POWER – GENERAL

**Hydraulic fluid:** Water or biodegradable food-grade fluid, only.

- A Material Safety Data Sheet (MSDS) must be provided at the safety inspection showing the type of fluid used and its compatibility with the Biodegradable Food-Grade specification. Teams using water do not need to provide an MSDS.
- Maximum pressure allowed: 10.33 bars (150 psig)
- Hydraulic system: All lines, fittings, and hydraulic devices must be rated for a minimum pressure of two (2) times the maximum supply pressure.

The following fluids are approved for use in hydraulic systems:

1. Water
2. Mineral oil
3. Biodegradable Food-Grade Hydraulic Oil ISO Grade 32/46, SAE Grade 20, McMaster-Carr part# 3499K22

**Pneumatic:** Compressed air or inert gas.

- Maximum pressure allowed: 2.75 bars (40 psig)
- Pneumatic system: All lines, fittings, and pneumatic devices must be rated for a minimum pressure of two and a half (2.5) times the maximum supply pressure. For example, if an 83 bar (1200 psig) tank is regulated to 2 bars (30 psig), then all system components must have a minimum rating of 5.17 bars (75 psig).

**Surface power:** MATE will provide one GFI-protected outlet with a nominal 115 Volts AC (60 Hertz) and 15 amps maximum. This outlet is intended to provide power for pumps and other surface support equipment (e.g. video monitors & control boxes). This AC power source CANNOT be used to directly or indirectly power the vehicle. If hydraulic or pneumatic power is



used for vehicle thrust, the power for the pump must come from the MATE supplied DC power supply for that class.

In addition to electric pumps, hydraulic, and pneumatic systems can be powered by manual pumps (e.g. bicycle tire pump) or supplied from a pre-pressurized cylinder.

**Pressurized cylinders:** Pressurized cylinders may be used, but must remain above the water surface and meet the following specifications:

- Approved by US DOT (Department of Transportation) or TC (Transport Canada). For regional competitions taking place outside of the US, check with your regional coordinator for approval.
- Have a current official inspection/test sticker and/or stamp.
- Stamped with the maximum allowable pressure.
- Contain a pressure relief safety device.
- May be filled up to the maximum allowable pressure of the cylinder.
- Must be regulated at its output to a maximum of 2.75 bar (40 psig).
- Must have an easily accessible shut-off valve that is clearly marked with instructions.
- May only be stationed on the surface, not on the ROV.
- Must be secured in a safe manner such that they will not fall or roll around. If the judges feel that a cylinder is unsafe, they have the discretion to prevent its use.
- SCUBA tanks are permitted. They must meet all the above specifications and have a current visual inspection sticker, or “fill permit” visible.

**Pressure storage devices (pressure accumulators):** Pressure storage devices are allowed on the ROV if they do not exceed 1L in total storage and do not store pressure higher than the allowed pressure for air or hydraulics. It is recognized that a team might not be able to purchase a pressure accumulator that has the proper rating and fits in the space needed. In that case, the team must show that their designed accumulator is capable of withstanding the specified pressures without rupture.

**Note:** The MATE Center will NOT be providing teams with pneumatic power at the mission stations. If teams plan to use pneumatics on their vehicle, they must provide their own pump or source of pressurized air.

### **FLUID POWER QUIZ**

**Teams planning to use hydraulics and/or pneumatics (i.e., fluid power) are required to take and pass an online quiz.** The quiz was developed by MATE Center technical support staff and competition judges and is designed to ensure that teams understand basic information on these topics and can apply that knowledge to safe practices. The intention is not to add yet another “requirement,” but rather to provide a safe and successful learning experience and competition environment.



A link to the quiz will be circulated and posted to the MATE web site in mid January. The quiz can be completed by one (or more) STUDENT team members. The team's instructor or mentor can provide guidance and advice, but the questions should be answered by the students participating on the team.

The quiz will be scored and the results provided almost instantaneously. A score of 100% is considered a passing grade. Teams can take the quiz as many times as they need to achieve this score.

The quiz must be completed with a passing grade at least 4 weeks prior to the international competition and/or 2 weeks prior to a regional event. (See [www.marinetech.org/events](http://www.marinetech.org/events) for a listing of regional contests and their respective dates.) Teams failing to complete this quiz within the given time frame will NOT be permitted to use fluid power during their competition event.

The following are sources of information on hydraulics and pneumatics. This is not intended to be an exhaustive list, but rather a starting point to encourage teams to seek out additional information and resources.

- ***Underwater Robotics: Science, Design & Fabrication***, published by the MATE Center (see [www.marinetech.org/underwater\\_robotics](http://www.marinetech.org/underwater_robotics))
- <http://www.fxsupply.com/pneumatics/psafety.html>
- <http://mining.state.co.us/safety/downloads/ppoint/HydraulicPressureIntensification.ppt>
- National Fluid Power Association – <http://www.nfpa.com/education/mini-book.asp>
- Parker Hannifin Corporation – <http://www.parker.com/> (look for technical literature links)

### **COMMAND, CONTROL & COMMUNICATIONS (C3)**

For Command, Control & Communications (C3) purposes, RANGER class teams are limited to a maximum of three monitors to display video feeds. In addition, RANGER class teams may have two supplemental screens that display ROV data and status information. These display screens may be made up of any combination of TVs, monitors, laptops and/or computer displays. Display screens may be split into multiple feeds, or cycle through input. These display devices may be powered by the MATE provided GFI-protected 115-Volt AC (60-cycle) and 15-amp AC power source described in the **Surface Power** section above. In addition, teams' C3 station may include devices like video recorders. All C3 devices must be able to run on the single AC power outlet provided or on its own internal battery power. Any device plugged into this AC power outlet can only provide C3 functions and cannot provide power to the ROV.

MATE will provide ONE video monitor at each control station that may be used by teams. This monitor will be powered by the GFI-protected 115-Volt AC (60-cycle) and 15-amp AC power





source described in the **Surface Power** section above. This monitor will have both RCA and RF inputs. (Teams should assume that only NSTC monitors will be available at the international competition.)

Teams must supply any additional monitors (including monitors for practice sessions\*), video recorders, etc. These additional video devices and/or any repair tools (but NOT ROV payload tools) can be powered by the GFI-protected power strip described in the **Surface Power** section above. Only video monitors, video recording devices, and repair tools can use this AC power.

\*MATE cannot guarantee that the practice area will have power for your video monitor.

### **SIZE RESTRICTIONS**

The mission team must be able to personally transport the vehicle and associated equipment to the mission station and to the engineering evaluation room. In this case, your team must be able to transport the vehicle and associated equipment from the pool venue to the building.

The vehicle must be launched and recovered manually; no powered winches or portable cranes can be used. Hand-powered lifts and levers may be used to launch and recover the vehicle. The vehicle and any associated equipment must not damage any part of the pool or pool deck.

## **OPERATING ENVIRONMENTS**

### **SALINITY/WATER CHEMISTRY**

Your vehicle must be able to function in fresh, chlorinated water. The water should be considered conductive of electrical currents.

### **DEPTH/TETHER LENGTH**

RANGER class ROVs must be capable of operating in a maximum pool depth of 3.2 meters (10 feet). All underwater missions will take place within 10 meters from the side of the pool. The mission station will be no more than 2 meters from the side of the pool. Tether length should be calculated accordingly.

**Note:** Regional competitions may be held in pools with a shallower minimum depth and/or greater maximum depth. Contact the coordinator in your area to determine the maximum mission depth at your regional competition.

### **VISIBILITY**

Visibility in the pool is unlimited. The pool will not be covered or purposefully darkened in any way, although the specific mission tasks may require that your ROV operated in low-light conditions.



### **CURRENT**

There will be no water currents intentionally created. However, depending on the venue, pressurized pool filtration system outlets may cause unexpected currents.

### **OTHER ENVIRONMENTAL PARAMETERS**

The international competition pool may have small bottom features. Teams should be prepared to deal with small bottom topography.

**Note:** Regional competitions may be held in pool venues with slopes or other bottom features. Contact the coordinator in your area to determine the bottom topography of the pool at your regional competition.

## **COMPETITION RULES**

### **GENERAL**

- All members of the team and their supporters must follow the safety regulations of the ROV competition, pool facility, and event venue.
- All team members and their supporters are expected to conduct themselves in a professional and responsible manner during the competition. Disrespectful behavior towards the judges, officials, pool staff, audience, or other teams will lead to penalty points or disqualification.
- Sabotaging, stealing, or pilfering equipment of other teams will lead to disqualification. Teams found cheating will also be disqualified.
- The MATE ROV competition is, at its core, designed to be an educational and inspirational event for **STUDENTS**. It is designed to challenge them to apply the physics, math, electronics, and engineering skills they are learning in the classroom to solving practical problems from the marine workplace.

It is expected that all “adults” (non-students; e.g. teachers, mentors, parents) involved in the competition limit their input to educational and inspirational roles. Actual construction of the ROV (particularly in the complex electrical and software areas) must be completed by the student team members. Adults should teach and advise students about design, electronics, software, and construction, but not complete the work for the students. Throughout the process adults are encouraged to focus on benefits to the students from the process and not simply “winning” the competition. If during the engineering judging or mission execution it becomes apparent that adults exercised more than an advisory role, judges reserve the right to deduct points or, in extreme cases, disqualify teams.



While at any MATE ROV competition (international and regional), **ALL** work done on the vehicle must be conducted by team members. Teachers, mentors, parents, and non-competing students are not permitted to work on the ROVs. They may provide advisory input, but they may not work on the ROV directly. This includes writing or editing software code. All mechanical electrical and software modifications and/or repairs to the ROV must be completed by student team members. Judges or other competition officials who observe unauthorized work by non-team members will issue two warnings before asking the individual to leave the venue. If teams choose to take their ROVs off the competition grounds for maintenance and repair, they are expected to observe this rule in the interests of the spirit of the competition.

- To encourage student participation at all levels, MATE is discouraging the use of “off-the-shelf” technology. The rationale is that engineering involves integrating existing technology into new systems. As such, students are encouraged to turn to commercially-available technology where available (and affordable). Individual discrete “components” obtained commercially are acceptable. However, as this is an educational event, students are strongly discouraged from using commercially available “plug-and-play systems” within their ROVs. These devices violate the spirit of the competition in that they remove many of the technical challenges of electrical and software engineering. Thus, they eliminate much of the educational value of the event. An extreme example would be a team that focused its efforts on fundraising and simply purchased one of the low-cost ROVs available commercially. Such an entry would not be permitted.

**In summary:**

Multiple commercial components are **ENCOURAGED**.

Systems designed to perform multiple, complex functions from one “black box” or a series of components designed to integrate with each other are **DISCOURAGED**.

Examples of “components” versus “systems” are provided below. If teams are uncertain about the commercially-available items that they plan to use, they should contact the MATE competition coordinator ([jzande@marinetech.org](mailto:jzande@marinetech.org)) early in their design phase. All such questions (and answers) will be posted to the FAQs section of the MATE competition web site.

The engineering evaluation and technical report score sheets will reflect MATE’s effort to discourage the use of off-the-shelf systems. For example, both score sheets contain sections devoted to control systems. However, teams that demonstrate control systems constructed from “scratch” versus complete control system purchased from a



commercial vendor will be awarded higher scores. In addition, the originality of design and teamwork sections will be weighted more heavily.

### Examples of commercially-sourced components:

- Tethers
- Thrusters
- Radio control transmitters and/or receivers
- RC servo and/or motor controllers
- Pressure housings
- Watertight connectors
- Cameras with or without watertight housings
- Structural materials

### Examples of commercially-sourced systems:

- “Black box” controllers that provide for multiple power and control signal interconnections and manipulations (e.g. FIRST Robotics controller systems)
- Thrusters, motor controllers, cabling, and control box designed and sold as a “system”
- Commercially available ROVs, such as VideoRays, LBVs, or SeaMATEs

## PROCEDURAL

- Teams must compete during their assigned time slots. Your team is **NOT** permitted to switch time slots with another team. Failure to show at the mission station\* for your scheduled mission performance run or at the room assigned for your team’s engineering evaluation interview will result in “no score” for that particular competition category. **No exceptions.** Assigned time slots will be sent out in advance so that any scheduling concerns can be addressed prior to the event.

\*Individual contests may refer to the mission station as the control “station” or “shack.”

- While there is no limit to the number of students who can compete as part of a team, **the pool mission team is limited to six students.** The mission team is defined as the team of students who operate the vehicle and its associated equipment during the mission performance period. Only six students will be allowed to enter the mission control area, launch, pilot, and perform the mission. Instructors, mentors, and/or non-student members cannot participate as part of the mission team. **Teams may alternate students on the mission team for the two mission attempts.** (All members of the team should participate in the engineering presentations; see the **Engineering & Communication** document for more information.)
- Only the mission team members and judges are allowed in the mission station during



the mission period, which includes the set-up and demobilization periods. Other team members, instructors, mentors, audience members, and observers (press or special invited guests) must remain outside the mission station or in designated viewing areas.

- **NEW for 2013!!!** Instructors, mentors, parents, and “fans” are **NOT** permitted at the safety inspection stations or repair tables. Two warnings will be issued before individuals not heeding this rule will be asked to leave the venue.
- **NEW for 2013!!!** In addition, instructors, mentors, parents, and fans are **NOT** permitted to work on the ROV. Individuals who are seen working on the ROV who are not student team members will be issued a warning. Two warnings will be issued before individuals not heeding this rule will be asked to leave the venue.
- Video devices may be used to record the underwater activities for entertainment and learning purposes **only**. Video will not be used as an instant replay to review judges’ decisions or to challenge mission timing.
- Mission stations will be roped off and marked as the either RANGER or EXPLORER. Mission stations will contain 2-3 chairs and one 6-foot table long table for teams to use. This table will be within 2 meters of the pool edge. Mission stations will be set up to prevent the pilot(s) from looking at the ROV in or under the water except through the ROV cameras.
- Teams will compete in ONE mission that consists of four distinct mission tasks. These tasks, in turn, consist of several components. Teams will get up to **TWO** attempts to complete this single mission. The **higher** of the two scores will be added to the engineering and communication score to determine the total overall score for the competition.

**Note:** Regional contests may or may NOT offer teams two attempts at the mission tasks. Contact the coordinator in your area to determine if teams will receive one or two attempts.

- The mission time consists of a 5-minute set-up period, a 15-minute mission performance period, and a 5-minute demobilization period. If the mission team and all of their equipment are not out of the mission station at the end of the 5-minute demobilization period, the team will be **penalized 1 point for each additional minute**.
- Manipulating the tether to free it from underwater obstacles is permitted. Pulling on the tether to speed up the recovery of items or to return your vehicle more quickly to



the surface is not permitted and will result in penalty points. Judges will issue one warning if tether pulling occurs. Each future infraction will result in **5** points deducted from the final mission score.

- If your vehicle is completely disabled and/or its tether tangled and unable to free itself from the underwater environment, SCUBA divers can be called in to assist. However, the mission performance period time will NOT stop and **5** points will be deducted from the final mission score.

**Note:** Some regional events may not provide SCUBA diver support. If that is the case, ROVs that become tangled and unable to free themselves or otherwise disabled will not be “rescued” by a SCUBA diver until the mission performance period is over. Unfortunately, that means that no additional mission points can be received. Contact the coordinator in your area to determine if your regional will have SCUBA diver support during your mission run.

- Pilots can only leave the mission station and move poolside to repair, adjust, or alter a vehicle if the ROV is surfaced and at the side of the pool.
- No team member shall enter the water to complete an object recovery. Only arms and hands are allowed into the pool to retrieve an object or to retrieve the vehicle. Teams will be disqualified or penalized depending on the severity of the infraction.
- Communication between mission team members at the pool edge and those in the mission station will be limited. Only tether management issues (e.g. how much tether is out, how much is remaining on the pool deck) can be discussed. Those mission team members at the pool edge cannot give any directional or mission information to the pilot. Judges will issue one warning regarding illegal communication. Each future infraction will result in **5** points deducted from the final mission score.
- Communication using cell phones, text messaging, and online social media tools such as Skype, Facebook, Twitter, instant messaging, etc. is NOT permitted during the mission period, either between mission team members at poolside or between any mission team member and anyone outside of the mission station.
- Mission judges and other competition officials will only communicate with the student team members. Judges and officials will NOT communicate with mentors, parents, or other non-student members regarding mission information, challenges, or other issues except during pre- and post-competition briefing sessions.



## DESIGN & SAFETY CONSIDERATIONS

- The competition coordinators and host venues stress the importance of safety practices and procedures to all competition teams. The score sheets will reflect the MATE Center's efforts to encourage and reward teams that demonstrate exceptional safety practices and procedures.

"Safety practices and procedures" includes both how team members conduct themselves and how they design and build their vehicles.

- **ALL ROVS MUST PASS A SAFETY INSPECTION CONDUCTED BY COMPETITION OFFICIALS PRIOR TO ENTERING THE POOL.** These inspections will be conducted topside to ensure that ROV systems meet the design and building specifications and do not pose a risk to the integrity of the event venue. See the SAFETY COMES FIRST section at the beginning of this document for additional information.
- Keep an eye out for tripping hazards in the mission station and at your team's work station. Make sure power cords are not laying in pools of water on the deck.
- During your mission period, be sure to secure any equipment so that it does not fall off the mission station table, damage the deck, or cause injury.
- Loose fitting clothing, jewelry, and long hair could all become safety issues. Consider securing long shirts or baggy pants, removing jewelry, and tying back long hair when working on or operating your ROV.
- ROVs may be constructed out of materials of your team's choice, provided they meet the competition rules and safety regulations. Warning labels should be posted on potentially hazardous components of your ROV system.
- All teams must wear close-toed shoes and safety glasses or goggles. **No one will be allowed into the work station area without close-toed shoes and safety glasses or goggles. No one will be allowed on the pool decks without close-toed shoes.** This includes team members, parents, mentors, and guests. Safety glasses/goggles are also recommended when working with your vehicle on deck.
- Personal flotation devices (PFDs) may be required when launching and recovering your vehicles. Contact your regional coordinator or the international competition coordinator to determine if this is a requirement at your event. If PFDs are required, the coordinator will provide them.