2005 MATE Center/MTS ROV Committee ROV Competition for High School & College Students

www.marinetech.org/rov_competition/index.php

Design & Building Specifications and Competition Rules

Competition Classes:

The MATE Center's ROV competition is divided into two classes – **EXPLORER** and **RANGER**.

EXPLORER class ROVs operate at a maximum of 48 volts DC, 40 amps.
RANGER class ROVs operate at a maximum of 13 volts DC, 25 amps.

Teams must choose to enter **one** competition class. Two teams per instructor will be considered as long as one team represents a high school or home school and the other a college or university. Institutions/instructors interested in entering one team per competition class will also be considered.

Design & Building Specifications:

Note: Teams ARE permitted to design, build, and operate more than one ROV. However, the combined power of these vehicles CANNOT exceed the maximum power limits listed below. The power limits in each class are not per vehicle, but for all vehicles combined.

EXPLORER

Power: Maximum surface supplied power – 48 volts, 40 amps.
Maximum onboard power – 13 volts, 25 amps.

Your ROV must operate on DC voltages. Only low-voltage (i.e., 24 volts or less) AC control signals are allowed through the tether. The total electrical power allowed to travel down the tether is limited to a maximum of 48 volts and 40 amps. Other sources of "stored" power (hydraulic or inert compressed gas) are permitted.

Onboard power is permitted but is limited to a maximum of 13 volts DC and 25 amps. Onboard power must be must be electrically isolated from surface-supplied power and use a power source that is safe for the event venue (e.g., gel cell batteries, non-liquid type batteries, generators, etc.). All onboard power systems must be connected in series to a single fuse that does not exceed 25 amps and is readily accessible to competition officials.

Monitors: Three.

MATE will provide one video monitor and one 6-outlet power strip at the control shack. This monitor will be powered by a separate GFI-protected 110/120-volt, 15-amp AC power source. Your team must supply any additional monitors (including monitors for practice sessions), video recorders, etc.

Depth Rating: Up to 13 meters (~40 feet).

Your vehicle must be able to operate at a water depth of up to 13 meters (~40 feet).

Tether Length:

Depth will be 13 meters maximum. All underwater missions will take place within 10 meters from the side of the pool. The control shack will be no more than 2 meters from the side of the pool. Tether length should be calculated accordingly.

Operating Environment: Chlorinated freshwater.

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

Size Restrictions: 60 centimeters x 60 centimeters.

Your ROV must descend through a tunnel melted through the ice. This tunnel is 60 cm x 60 cm square and at least 1 meter long. The mission team must be able to personally transport the vehicle and associated equipment to the control shack. The vehicle must be launched and recovered manually; no winches or portable cranes can be used. The vehicle and any associated equipment must not damage any part of the pool or pool deck.

RANGER

Power: Maximum surface power – 13 volts, 25 amps.

MATE will provide a 12-volt DC power source capable of 25+ amps to operate your ROV. Your ROV must operate on DC voltages. Connections to this power supply will be via standard banana plugs. Your ROV must have male banana plugs in order to make this connection. (Note: Banana plugs are available at your local Radio Shack or through electronics supply companies such as Digikey and Newark.)

All ROV systems (cameras, lights, motors, manipulators, control systems) must operate off of this 12-volt power source and are limited to a total current draw of 25 amps. ROV cameras **MUST** operate off the 12-volt power supply, not AC power.

Other sources of "stored" power (hydraulic, pneumatic, or compressed air) are permitted as long as this equipment operates off the single 12-volt battery provided (if electrical power is needed for these devices) and does not exceed the 25 amp limit for all systems.

Monitors: Three.

MATE will provide one video monitor at each control shack. This monitor will be powered by a separate GFI-protected 110/120-volt, 15-amp AC power source. Your team must supply any additional monitors (including monitors for practice sessions), video recorders, etc. These additional video devices and/or any repair tools (repair tools **NOT** payload tools) can be powered by AC. MATE will provide a single 6-outlet power strip at each control shack. Only video monitors, video recording devices, and repair tools can use this AC power. All other systems must run of the 12-volt DC power supply.

Depth Rating: Up to 5 meters (~16 feet).

Your vehicle must be able to operate at a water depth of up to 5 meters (~16 feet).

Tether Length:

Depth will be 5 meters maximum. All underwater missions will take place within 8 meters from the side of the pool. The control shack will be no more than 2 meters from the side of the pool. Tether length should be calculated accordingly.

Operating Environment: Chlorinated freshwater.

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

Size Restrictions: Maximum size 80 centimeters x 60 centimeters x 60 centimeters.

The mission team must be able to personally transport the vehicle and associated equipment to the control shack. The vehicle must be launched and recovered manually; no winches or portable cranes can be used. The vehicle and any associated equipment must not damage any part of the pool or pool deck. The ROV body, not including the tether, must be able to fit within an 80 cm x 60 cm x 60 cm box. While in operation, tools and manipulators can extend beyond this range, but must be able to be retracted to fit within the specified size limitations.

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.

Procedural:

- Teams must compete during their assigned time slot. You are **NOT** permitted to switch time slots with another team. Failure to show at the control shack 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.

- The mission team is limited to six students. Only these six students will be allowed to launch, pilot, and perform the mission. Instructors, mentors, and/or non-student members cannot participate as part of the mission team. RANGER teams may alternate students on the mission team for the various events and/or heats.

- Only the mission team members and judges are allowed in the control shack 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 control shack or in designated viewing areas.

- Control shacks will be marked, roped off, and designated as the either RANGER or EXPLORER. Control shacks 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. Control shacks will be set up to prevent the pilot and team members from looking at the ROV in or under water except through the ROV cameras.

- The mission consists of a 5-minute set-up period, the mission performance period, and a 5-minute demobilization period. Each RANGER mission performance period is 5 minutes; the EXPLORER mission performance period is 30 minutes. If the mission team and all of their equipment are not out of the control shack at the end of the 5-minute demobilization period, they will be penalized **1** point per each additional minute.

- RANGER class teams will get two attempts or "heats" at each event. (Note that these heats will not be scheduled back-to-back.) The better of the two scores will be used to determine the winner of each event and to calculate the total, overall score for the competition. In the case of a tie, the second (lower) score will be used to determine the winner of a particular event.

- EXPLORER class teams will get only one attempt at their mission. That score will be used to calculate the total, overall score for the competition.

- 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.

- Communication between mission team members poolside and those in the control shack will be limited. Only tether management issues (e.g., how much tether is out, how much is remaining on the pool deck, whether the tether is entangled) can be discussed. Those mission team members at poolside 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.

- Pilots can only leave the control shack 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.

Mission:

- EXPLORER vehicles must descend through the $60cm^2$ hole in the "ice." This "hole" is a vertical tunnel 60 cm x 60 cm square and at least 1 meter long (referring to its height). The remaining area of the pool is considered an impenetrable ice sheet. All vehicles must be launched and recovered through this hole. If a team elects to return their ROV to the surface any time during the mission performance period, the ROV must surface through this hole.

- RANGER class teams that in any way sever the cable attached to the communications probe as they transport it to the junction box will be penalized **5** points.

- EXPLORER class teams that in any way sever the cable attached to the communications link as they transport it to the remote science package will be penalized **5** points.

Safety & Power:

- All ROVs must be operated using DC voltages. Only low-voltage AC control signals are allowed through the tether.

- Maximum DC voltage for RANGER class teams is 13 volts.
  Maximum DC voltage for EXPLORER class teams is 48 volts.

- Maximum DC amperage for RANGER class teams is 25 amps.
  Maximum DC amperage for EXPLORER class teams is 40 amps.

- **All teams – RANGER and EXPLORER – must demonstrate the presence of a fuse within their vehicle's electrical circuitry to competition officials in order to pass the safety inspection.** EXPLORER class teams using onboard power must also demonstrate the presence of a fuse within their vehicle's onboard electrical circuitry.

  The MATE battery provided at each RANGER class station does include 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 above and beyond the fuse provided on the MATE battery for the RANGER class, **YOU WILL NOT PASS THE SAFETY INSPECTION**.

- If a RANGER class team blows MATE's in-line 25-amp fuse, they are allowed one replacement fuse per heat. If the vehicle blows a second MATE fuse in a single heat, their mission performance period is over. The team will receive points for the mission tasks they have completed up to that point, but will not receive a time bonus score.

- If an EXPLORER class team blows their 40-amp fuse, their mission performance period is over. The team will receive points for the mission tasks they have completed up to that point, but will not receive a time bonus score.

- Hazardous and/or non-biodegradable materials may not be intentionally released into the competition waters or atmosphere.

Design & Safety Considerations:

- **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.

  Teams will be informed immediately if their ROVs do not meet safety requirements. Teams are permitted to correct any issues, although they will not be given additional time to do so. A final safety check will take place during the 5-minute set-up period. If the safety issue has not been corrected, the team will not be allowed to compete.

- Keep an eye out for tripping hazards in the control shack and at your team's work station. Make sure any power cords are not lying 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 control shack table, damage the deck, or cause injury. Make sure any power cords are not lying in pools of water on the deck.

- EXPLORER class teams using AC to DC power supplies (transformers) must be locate them at least 3 meters from the pool's edge. They must be elevated off the pool deck to prevent standing water from creating an electrical hazard.

- RANGER teams may use their own 12-volt DC power source. This is permitted as long as the competition officials are ensured that the supply is safe, fused, and gives no advantages over other teams using the power source supplied by MATE. **If you do plan to use your own power source, you must submit your intention in advance of the competition; include it with your technical report.**

- RANGER class teams must have male banana plugs on the end of your 12-volt DC power connections in order to connect to the 12-volt DC power source provided by MATE.

- Lead-acid storage batteries with liquid electrolyte MUST be carried and kept in a leak proof container to prevent accidental spillage of electrolyte if a battery is dropped.

- It is recommended that EXPLORER class teams design their temperature sensor to measure a range of 0 to 40 degrees Celsius (C).

- 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.

- Light levels may be reduced and the surface of the water near the control shacks may be rippled to make it difficult to clearly see your vehicle or the pool bottom.

- All teams should wear close-toed shoes when operating or carrying equipment. Clogs, sandals, etc. are considered a safety hazard.