NAVIGATOR & SCOUT Class Safety Inspection Tutorial

This tutorial goes through the safety practices required by the MATE ROV Competition. It covers:

- Initial Safety Inspection (if required)
- Onsite Safety Inspection
- Examples and photographs of what will and will not pass safety inspection

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INITIAL SAFETY INSPECTION

Most regionals DO NOT require SCOUT and NAVIGATOR teams to turn in safety documentation early for an Initial Safety Inspection.

Your regional coordinator will let you know if any documentation is due early. Contact your regional coordinator or check your regional information page for information on any documentation due prior to competition day.

Most regional require the following documentation on competition day:

- SID (ROV electrical)
- SID (non-ROV device – if used)
- SID (fluid power – if used)

These documents will be reviewed during your onsite safety inspection.

DOCUMENTATION REQUIRED

DOC-001: Companies must provide a system interconnection diagram (SID) of their vehicle control system. An SID is an electrical diagram of their wiring, including their control box, motors, and any other electrical systems on their vehicle. The SID should separate and show what systems are on the surface and what systems are on the vehicle.

The SID is the starting point for SCOUT & NAVIGATOR Safety. Companies should be aware of safety and every team is required to submit a SID. If not required early by the regional, a SID must be present for the on-site safety inspection.

DOC-002: Any electrical diagram should use ANSI, NEMA, or IEC symbols. They should be neatly hand drawn or created using a CAD software program. AN EXAMPLE OF A SID IS SHOWN IN THE COMPETITION MANUAL.

DOC-003: Companies using fluid power must submit a fluid interconnection diagram (Fluid SID) of their system. Companies using syringe hydraulics only need a simple diagram and could include it on their electrical SID. NAVIGATOR companies using powered pumps or compressors MUST include a full fluid SID.

Onsite Safety Inspection

Safety is the competition's primary concern and guiding principle. Any system that is considered unsafe by competition officials will not be allowed to compete.

If a concern is found during the first safety inspection, companies are permitted to attempt to correct it and have their ROV re-inspected. However, the competition schedule will NOT change to allow companies more time.

Companies are allowed to have their vehicle re-inspected twice. If a company 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.

Onsite Safety Inspection

Examples of safety violations from previous ROV competitions include:

- The ROV does not use Anderson Powerpole connectors to attach to main power.
- No SID was provided at the safety check.
- The SID did not show a main fuse.
- The ROV used pneumatics, but the technical documentation did not include a pneumatics diagram (fluid SID).
- Sharp items, or potentially sharp items, (fishing hooks, glass bottles) were included on the vehicle.
- The vehicle motors were not waterproofed.
- Propellers were not protected inside the framework or not shrouded.
- **Note for 2025 NAVIGATOR Class teams!!!** Propellers MUST be shrouded to IP-20 standards. This means an ½-inch (1.252 cm) wooden dowel cannot touch any propeller.
- Camera did not operate off the 12-volt MATE power supply.

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Onsite Safety Inspection

Competition staff will conduct a safety inspection of the vehicle using the safety inspection rubric.

> The rubric / scoresheet is posted. If you want to know exactly what will be evaluated during your onsite safety inspection, look at this score sheet.

If the safety inspector(s) identify a safety violation, companies will have the opportunity to address it. The pool practice or product demonstration run schedule will NOT change to allow companies more time.

If during the second safety review the

a. violation has not been properly addressed or

b. another violation is revealed

companies will have ONE additional opportunity to address the issue.

SCOUT SAFETY INSPECTION SHEET

Company Name: _____ Company Number: _____

2025 MATE ROV COMPETITION. UN Decade of the Ocean, MATE Year of the Great Lakes

SCOUT CLASS SAFETY INSPECTION CHECKLIST

Companies must bring this checklist, the ROV, tether, surface controls, and any other item used in the deployment and operation of the ROV; they will all be inspected as part of the safety check. In addition, the SID, must be made available to the Safety Inspectors during the inspection process.

1.0 Initial Safety Inspection	
	Fluid power used? If yes, see Section 4.0 Pneumatics / Hydraulics
2.0 ROV Physical	
	All items attached to ROV are secure.
	Hazardous items are identified and protection provided.
	ALL propellers are completely shrouded or are enclosed inside the frame of the ROV.
	No sharp edges or elements of the ROV design that could cause injury to personnel or damage the pool surface.
3.0 ROV Electrical	
	Tether is properly secured at the ROV.
	No exposed motors. Brushless motors are considered exposed unless electrically sealed after purchase. Companies should provide proof of sealing procedure.
	No exposed copper or bare wire.
	All wiring securely fastened and properly sealed.*
	Any splices in tether are properly sealed.*
3.1 Surface Controls Electrical & Physical	
	Single attachment point to the power source.
	Anderson powerpole attachment to power source.
	15 amp (or less) single inline **ATO** or **MINI** fuse within 30 cm of power supply attachment point.
	The surface control station is built in a neat and workmanship like manner. No loose components or unsecured wires. All electrical components are covered inside an enclosure.
	No exposed copper or bare wire.
	All wires entering and leaving the surface control station must have adequate strain relief and wire abrasion protection as the wires pass through the enclosure.
	No AC power sources
	Cameras operate off the MATE 12VDC power supply thrugh the single attachment point to the power source.

* Properly sealed means that the wires cannot be exposed to water. Tape only sealing will allow the conduction of electricity through water.

* At minimum, joints must be soldered, sealed with a proper waterproof sealant, and covered in tape or shrink wrap. For in water taping, silicone self-vulcanizing tape is preferred over thermoplastic tape. Cables with exposed male connections on both ends are not allowed.

4.0. Pneumatic / Hydraulic (if applicable)	
	Pneumatic or hydraulic diagram (SID) present.
	Hydraulics utilize water. Pneumatics utilize compressed air.
	No electrical pumps allowed. Manual (and or foot pumps only!)
	No pressure accumulators (pressure inside a containter should never be higher than ambient pressure).
	Any container that air is being pumped into is vented to the pool with vent holes at least 1/4-inch (6.35 mm) diameter.
5.0 Lasers	
	No lasers present (lasers are not allowed in the SCOUT class).

SAFETY INSPECTION #1	**PASSED: 10 POINTS**
Failed: Items to correct noted on rear of this sheet.	
SAFETY INSPECTION #2	**PASSED: 10 POINTS**
Failed: Items to correct noted on rear of this sheet.	
SAFETY INSPECTION #3	**PASSED: 10 POINTS**
Failed: Reason / details are noted on rear of this sheet.	
Total Safety Points:	
On Site Inspection 0 or 10 points	

Inspection #1: Items to address **Judge:** _____

Inspection #2: Items to address **Judge:** _____

Inspection #3: Reason **Judge:** _____

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NAVIGATOR SAFETY INSPECTION SHEET

Company Name: _____ Company Number: _____

2025 MATE ROV COMPETITION. UN Decade of the Ocean, MATE Year of the Great Lakes
NAVIGATOR CLASS SAFETY INSPECTION CHECKLIST

Companies must bring this checklist, the ROV, tether, surface controls, and any other item used in the deployment and operation of the ROV; they will all be inspected as part of the safety check. In addition, the SID, must be made available to the Safety Inspectors during the inspection process.

1.0 Initial Safety Inspection	
	Fluid power approved? Fluid power used? If yes to both, see Section 4.0 Pneumatics / Hydraulics
	Laser approved? Laser used? If yes to both, see attached laser safety inspection sheet.
2.0 ROV Physical	
	All items attached to ROV are secure.
	Hazardous items are identified and protection provided.
	ALL propellers are completely shrouded to IP-20 standards. Mesh size is less than 12.5 mm.
	No sharp edges or elements of the ROV design that could cause injury to personnel or damage the pool surface.
3.0 ROV Electrical	
	Tether is properly secured at the ROV.
	No exposed motors. Brushless motors are considered exposed unless electrically sealed after purchase. Companies should provide proof of sealing procedure.
	No exposed copper or bare wire.
	All wiring securely fastened and properly sealed.*
	Any splices in tether are properly sealed.*
3.1 Surface Controls Electrical & Physical	
	Single attachment point to the power source.
	Anderson powerpole attachment to power source.
	15 amp (or less) single inline **ATO** or **MINI** fuse within 30 cm of power supply attachment point.
	The surface control station is built in a neat and workmanship like manner. No loose components or unsecured wires. All electrical components are covered inside an enclosure.
	No exposed copper or bare wire.
	If used, 120VAC wiring is separated from the DC wiring.
	If used, 120VAC wiring must be clearly identified from the DC and control voltages with signage and/or wire color schemes. If the color scheme is used, a key must be provided for identification.
	All wires entering and leaving the surface control station must have adequate strain relief and wire abrasion protection as the wires pass through the enclosure.
	Cameras operate off the MATE 12VDC power supply through the single attachment point to the power source.
* Properly sealed means that the wires cannot be exposed to water. Tape only sealing will allow the conduction of electricity through water.	
* At minimum, joints must be soldered, sealed with a proper waterproof sealant, and covered in tape or shrink wrap. For in water taping, silicone self-vulcanizing tape is preferred over thermoplastic tape. Cables with exposed male connections on both ends are not allowed.	

4.0. Pneumatic / Hydraulic (if applicable)	
	Passed fluid power quiz.
	Pneumatic or hydraulic diagram (SID) present.
	Hydraulics utilize water. Pneumatics utilize compressed air or inert gas.
	All pressure lines have a minimum pressure rating of 100 PSI (pneumatic) or 300 PSI (hydraulic) stamped on the line or verified with specifications.
	Valves meet the minimum pressure rating of 100 PSI (pneumatic) or 300 PSI (hydraulic)
	Attachment to the pressure source is secure.
	Pressure is regulated to: 40 PSI max for pneumatics 150 PSI max for hydraulics
	Company fabricated pressure accumulator test results are provided (if used).
	No hydraulic fluids are leaking.

SAFETY INSPECTION #1	**PASSED: 10 POINTS**
Failed: Items to correct noted on rear of this sheet.	
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Total Safety Points:	
On Site Inspection 0 or 10 points	

Inspection #1: Items to address **Judge:** _____

Inspection #2: Items to address **Judge:** _____

Inspection #3: Reason **Judge:** _____

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2025 MATE Floats!

Documentation

If you plan to operate a float you will need to bring a SID of your float to the onsite safety inspection. Hint: Your float is probably a 1-motor ROV. SID should include the power source, fuse, tether, motor(s). If you have a temperature sensor attached, show its power source, readout, tether and temperature probe.

Temperature probe can be powered by a small onboard battery if:

- It comes that way “off the shelf” with integrated battery
- That battery is 9-volts or less

Examples and photos of items that will (and will not) pass a safety inspection.

The following section has examples (with photos) of what will or will not pass safety inspection.

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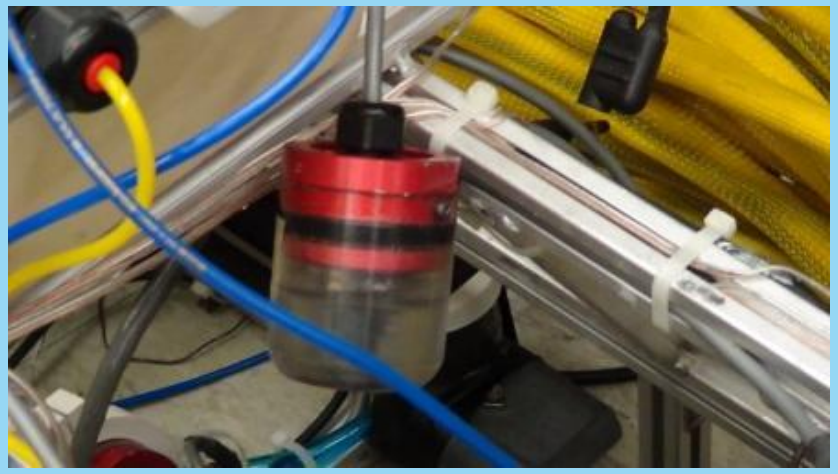
2.0 Physical

All items attached to ROV are secure and will not fall off.

Examples:

loose camera



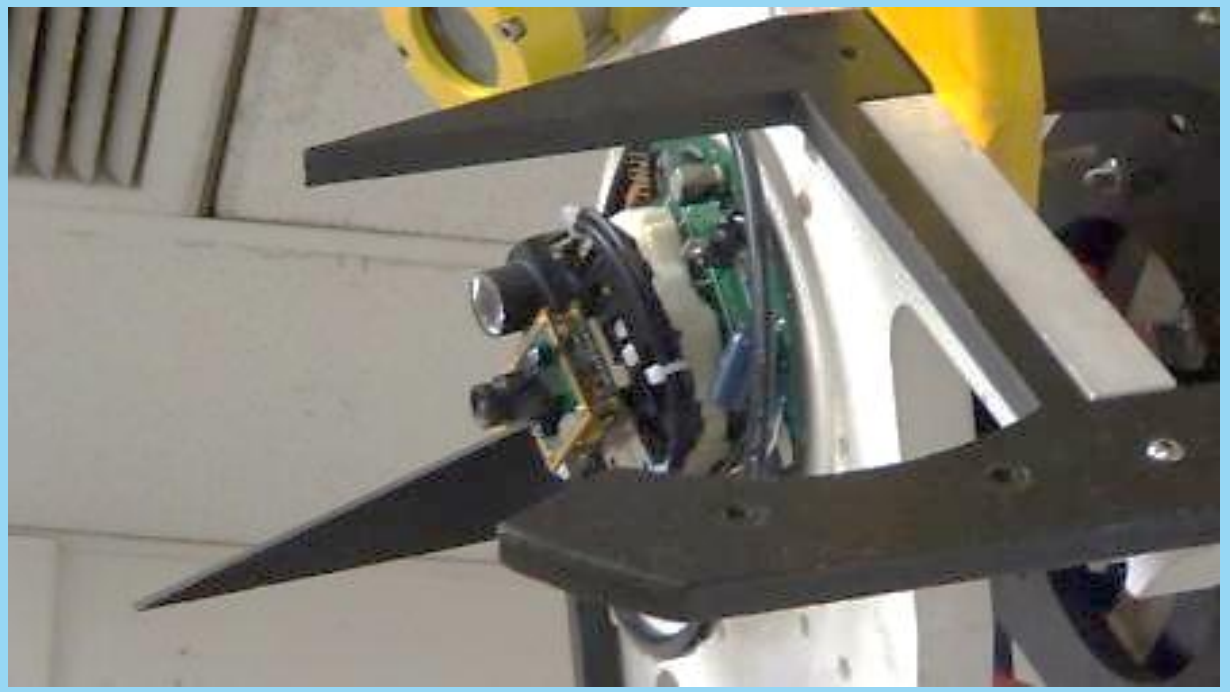
securely attached camera

Note for NAVIGATOR class: Large monitors not secured to the control station will be considered a loose item. Any monitor / video screen should be secured to the control station or stabilized on the table.

2.0 Physical

No sharp edges or elements of ROV design that could cause injury to personnel or damage to pool surface.

Examples:
The points on the front of this ROV may look cool, but the inspector failed the company during safety inspection for putting something that could be a danger to the divers.



NOTE: Monitors with glass fronts could create sharp edges if they become broken! Monitors with glass fronts will not pass safety inspection.

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2.0 Physical

Hazardous items are identified and protection provided.

Examples:
Sharp edges on the scoop are painted red; yellow and black safety warning colors are used elsewhere. The company successfully passed their safety inspection because potentially hazardous items that are needed to complete a task are identified and protected.

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2.0 Physical

NAVIGATOR: ***Propellers must be shrouded to IP-20 standards even if they are enclosed inside the frame of the ROV***

Eastern Edge Robotics shrouds. Photo credit: Stephen Fudge

Propellers are properly shrouded to IP-20 standards on both sides of the propeller. These shrouds were 3D printed. A ½-inch wooden dowel cannot touch the propeller from any angle.

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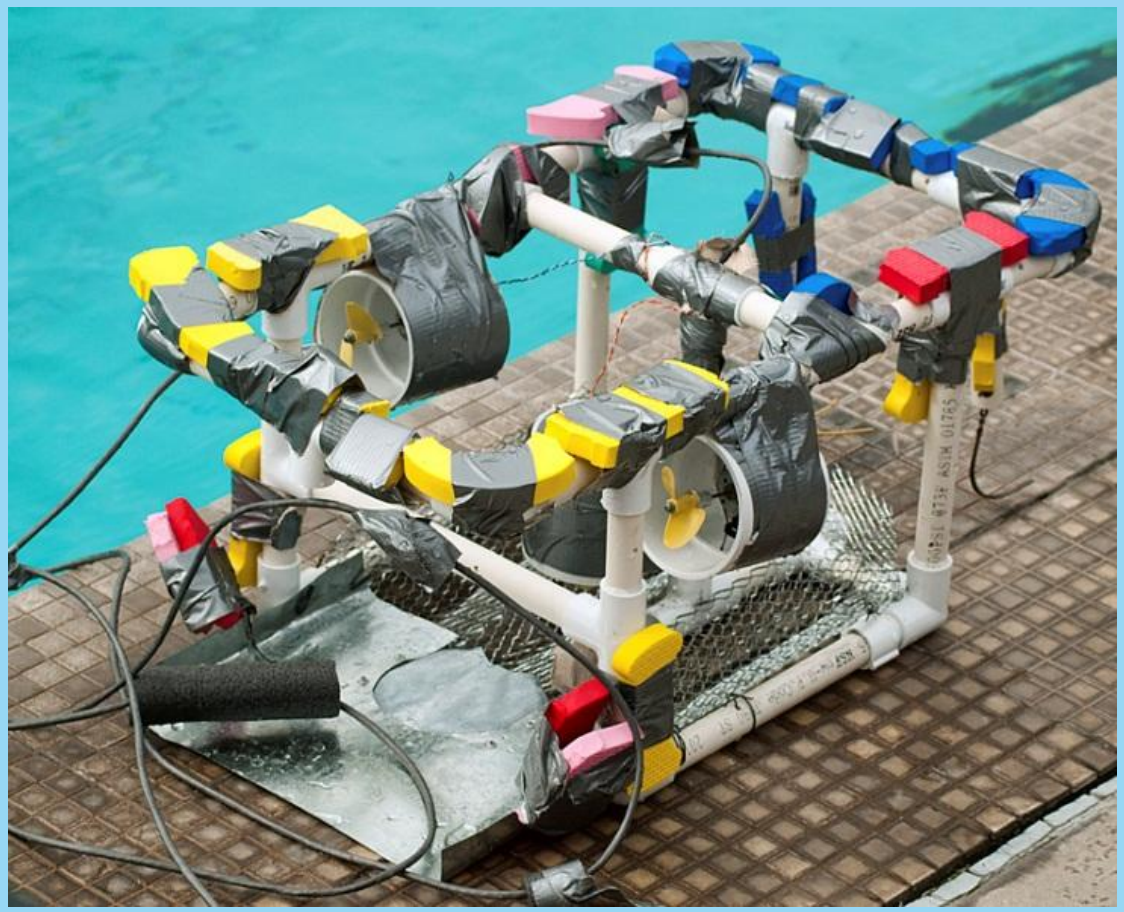
2.0 Physical

SCOUT!

ALL Propellers must be shrouded or completely enclosed inside the frame of the ROV

If your ROV bumps up against the wall of the pool, turning propellers should not impact the side of the pool or other objects.



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3.0 Electrical

Single attachment point to power source.

Anderson powerpole connectors are required to connect to the MATE power source.

A single inline fuse (not shown) must be within 30cm of attachment point (power connectors). Fuses in each line are acceptable.

NAVIGATOR and SCOUT class utilize the RED & BLACK powerpole connectors. Looking at the end of the connectors, you will see a small A on the end of each. With the tip of the A pointing up, black should be on the left and red on the right

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3.0 Electrical

Problems with the Anderson powerpoles have developed when teams do NOT use the proper crimper for these connectors.

Standard Electricians Crimpers will NOT work!

The crimp must be a roll crimp not a “squish” crimp.

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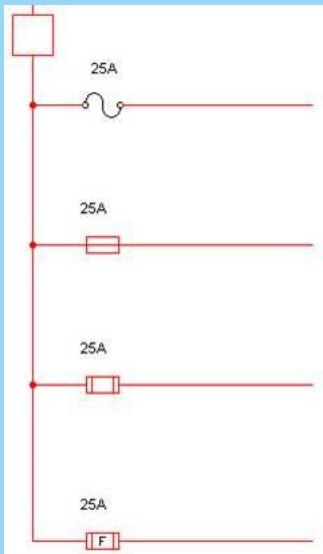
3.0 Electrical
System Interconnection Diagram (SID)

- **System Interconnection Diagram (SID)** A SID is a system-level, connection diagram that includes electrical and, if applicable, fluid power wiring information. Board-level and component-level schematics should not be included; however, these may be brought to the engineering evaluation for reference purposes. The intent is to provide the competition judges with a one-line diagram showing how the various systems are interconnected without the detail of each and every wire.



These are the only acceptable fuse symbols.
A fuse is not a box, a line with an letter S over it, or any other non-standard symbol

See the Competition Manual or the next two slides for examples of a SID. However, you must create your own SID for your vehicle. Do not directly copy the SID from a MATE resource, even if it is a proper SID for your vehicle.

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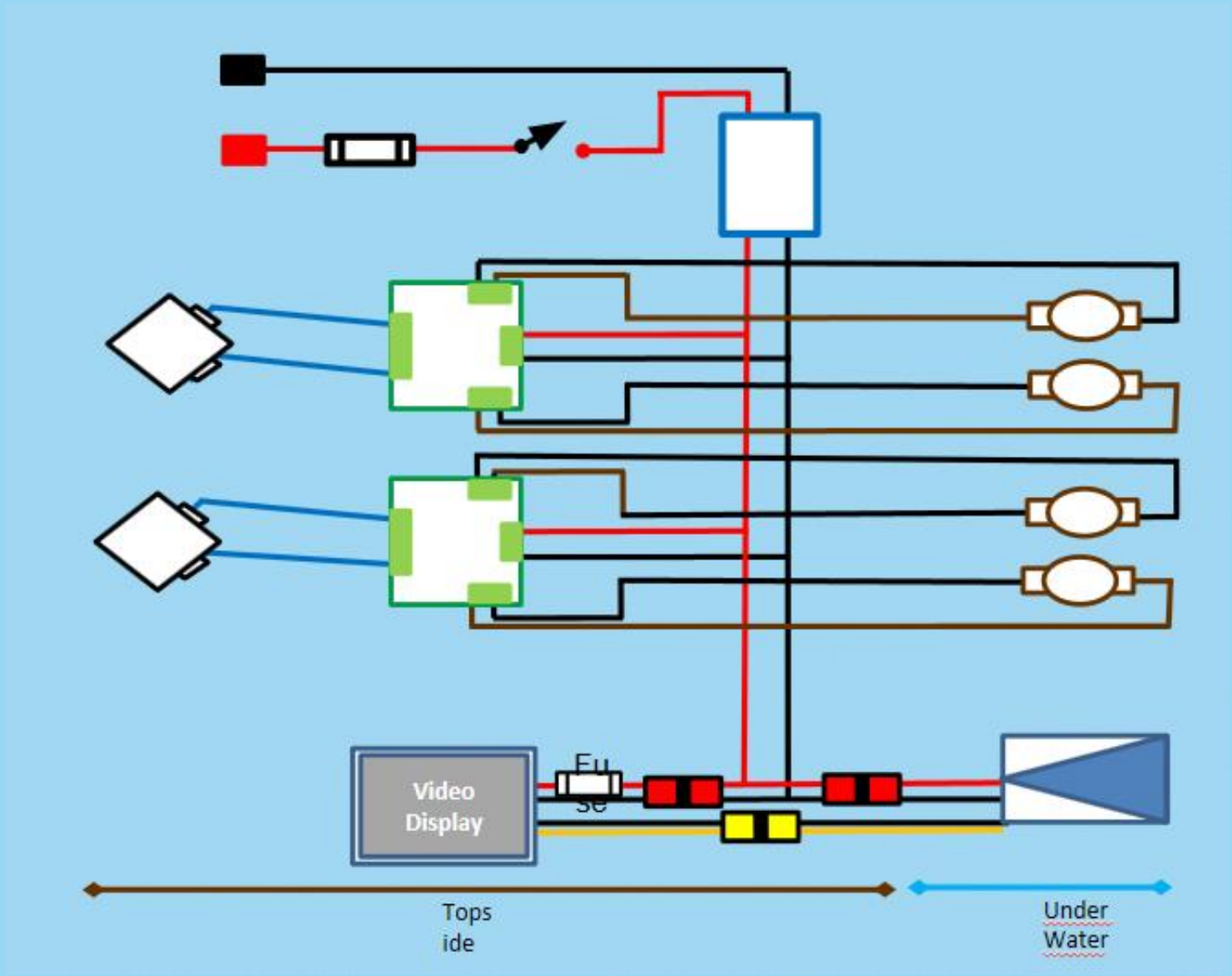
Example SID 1



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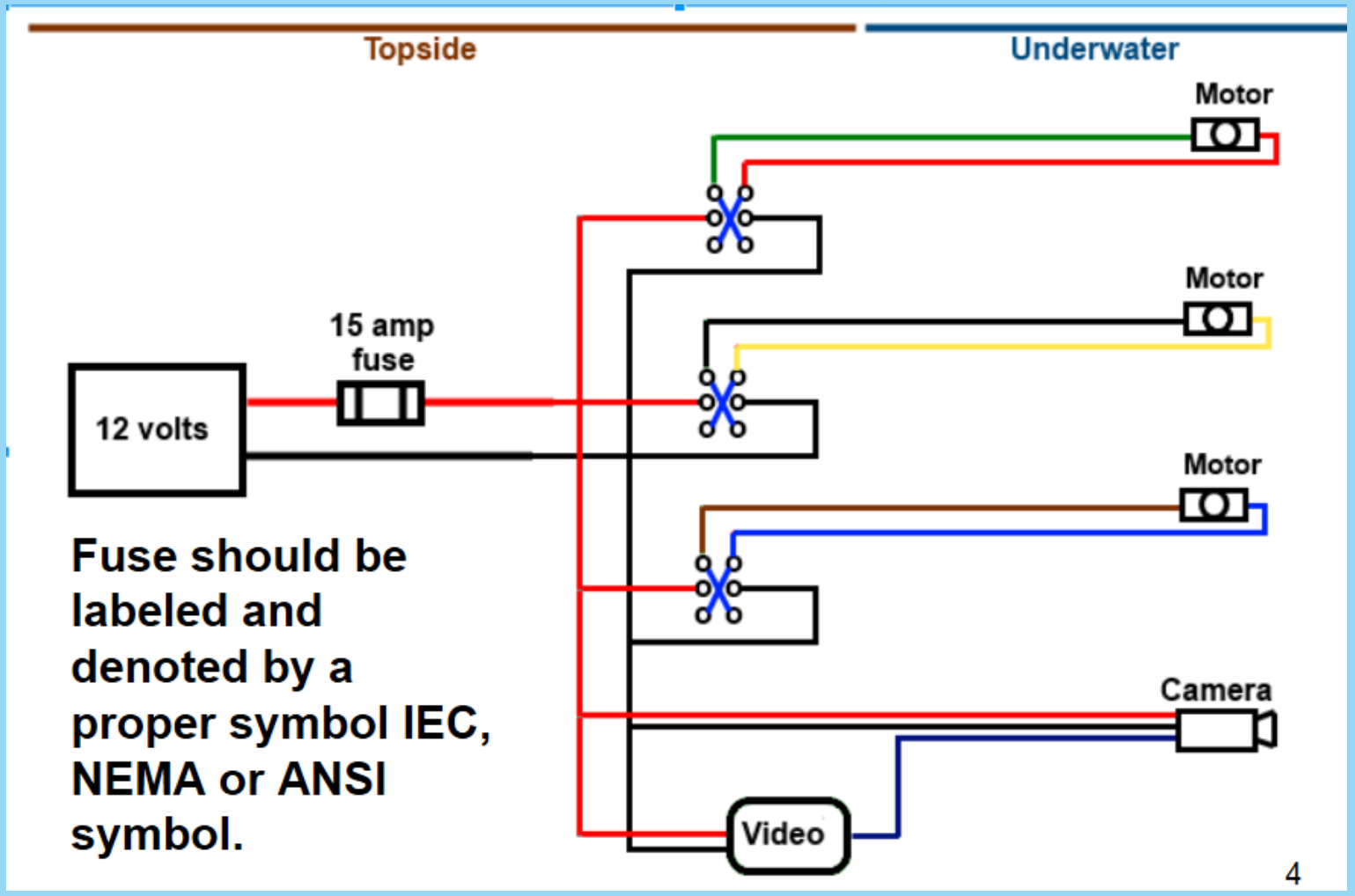
Example SID 2



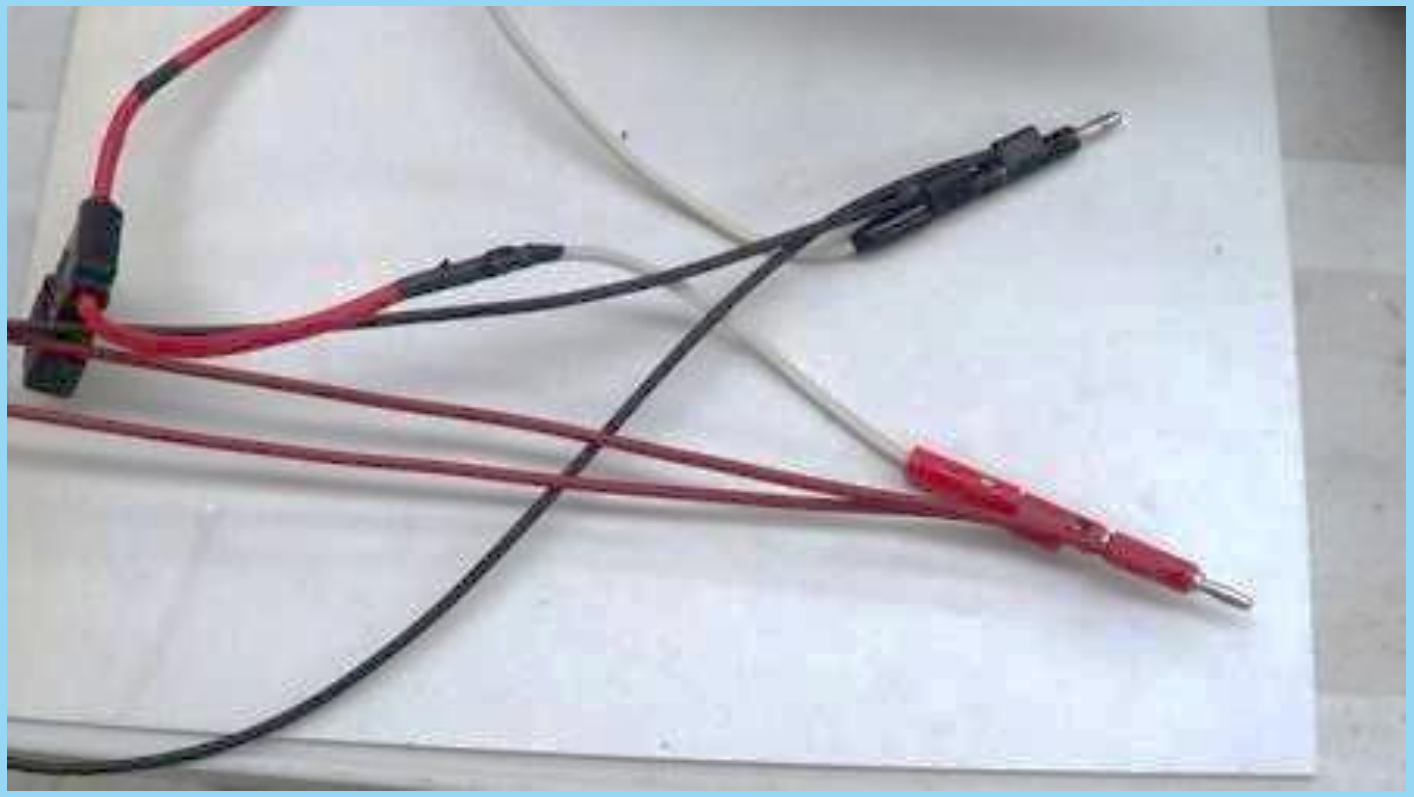
3.0 Electrical

Single inline fuse within 30cm of attachment point.

Examples:

This is an example of multiple attachments ahead of the fuse that WILL NOT PASS.

In addition, MATE no longer uses banana plugs for power attachment.



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3.0 Electrical

Single inline fuse within 30cm of attachment point.

Safety inspectors want to see the proper Anderson connection to the MATE power supply (where you plug into the power supply) and a fuse within 30 cm.

Nothing should be in between this connection to power and the fuse!

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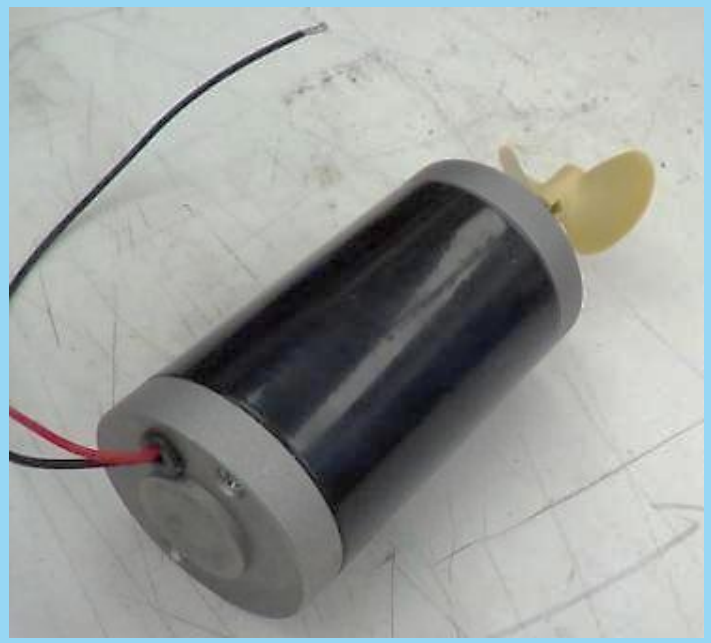
3.0 Electrical

No exposed copper or bare wire. No exposed motors.

Examples:
These WILL NOT PASS. The motor on the left is both exposed and has bare wire.
The motor on the right is exposed and not sealed.



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3.0 Electrical

No exposed copper or bare wire.

Examples:

This WILL NOT PASS. Using banana plugs at both ends of the wire to route power from one section to another violates MATE's safety rules. It is possible for the hot end of the wire to become unplugged and create a safety hazard.

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3.0 Electrical

Tether is properly secured at surface control point and at ROV.

Example:
The wires on the ROV are loose or could get caught in a propeller when moving around the pool. Use tape, cable ties, or other methods to secure the wires away from any moving or potentially dangers parts.

Wires entering into the control box should also be secured. If you accidentally walk the controller away from the ROV, you want any strain to be contained. You do not want to pull wires inside the control box.

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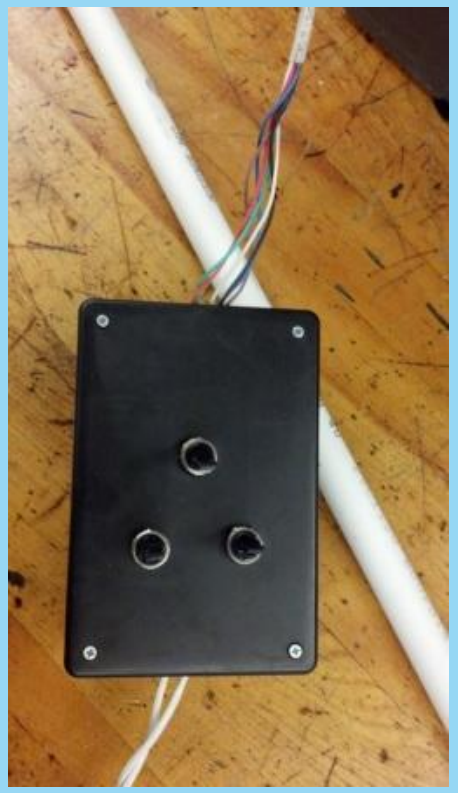
3.0 Electrical

Surface controls: All wiring and devices properly secured.

Examples:
The two pictures below are examples of loose wiring. There is no strain relief and the wires can easily pull loose from their connections. Hot melt glue and tape are not acceptable strain relief items.



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3.0 Electrical

Surface controls: All wiring and devices properly secured.

Example: both the red/black power wires and the tether wires going into the control box are properly secured by tight strain relief.

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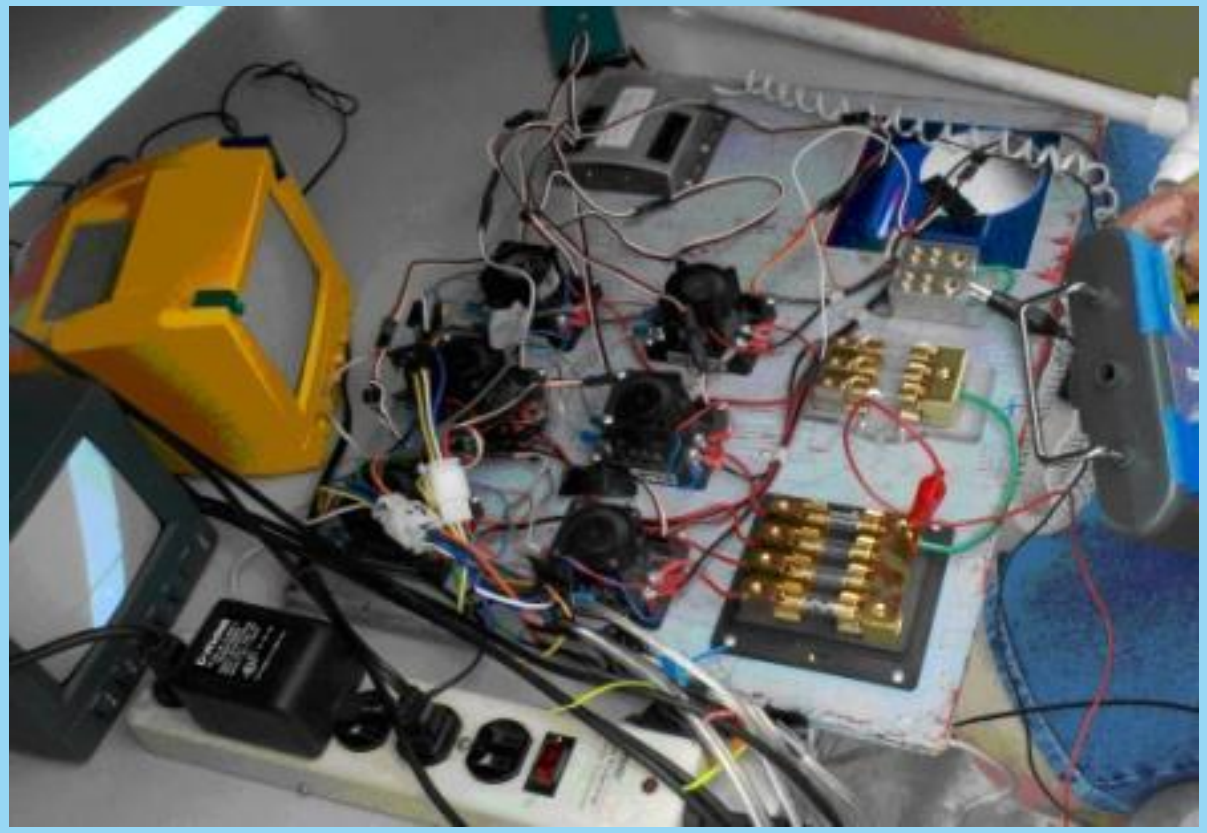
3.0 Electrical

Surface controls: All control elements are mounted with wiring inside an enclosure.

There are multiple FAILS in the picture below!



- Exposed wiring
- Multiple fuses instead of single point fuse for power.
- Loose wires.
- Alligator clips used for connections.
- No strain relief provided for wires coming from power or going to ROV.

See the MATE Expected Work Practices for more on wire discipline.

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Fluid Power
SCOUT class or NAVIGATOR class using manual pumps only

4.0 Pneumatic / Hydraulic Checklist

- Is a pneumatic or hydraulic diagrams (SID) present?
- Is the team using a **Hand or Foot pump** only?
- Is the fluid air or water?
- Are teams pressurizing a container (not allowed for SCOUT)
- Does any container that air is being pumped into is vented to the pool with vent holes at least ¼” (6.35mm) in diameter?

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Fluid Power
NAVIGATOR class (only) if using pressurized fluid power.

4.0 Pneumatic / Hydraulic Checklist

- Did you PASS the Fluid Power Quiz?
- Do you have your pneumatic or hydraulic SID(s) present?
- Are pneumatic and/or hydraulic component specifications provided? Are you using pressure rated lines and fittings?
- Is your attachment to pressure source is secure?
- Is your pressure regulated to 40psi max for pneumatics and 150 psi max for hydraulics? COMPANIES MUST PROVIDE THE REGULATOR.
- If a company fabricated pressure accumulator is used, are pressure test results provided?
- Are hydraulic fluids leaking?
- Do your pneumatics utilize compressed air or inert gas?

MATE will not provide compressors (see regional information) but see Compressed Air Guidelines for what components you should have in your system.

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5.0 Laser Checklist (NAVIGATOR only)

- Did the team send the laser specs to the competition technical manager two weeks prior to the regional?
- Does your SID show the laser driver (laser power source)?
- Does your laser have an on/off switch on the surface controller?
- Is the laser powered through the MATE surface power supply?
- Are batteries used to power the laser? (this is not allowed)
- Are your lasers the proper type? Visible Laser in 630-680 nm (red) or near 532 nm (green) Class I, Class II, or Class IIIa Category; Red Laser: 5mW or less. Green Laser: 1 mW or less. Be sure and bring your laser specs to the safety inspection.
- Is the laser voltage at or below laser rated voltage & current?
- Was a specification sheet showing laser and laser glasses sent to, and approved by, MATE Competition technical manager prior to event?
- Does your ROV have a Laser shield or beam stop attachment within 30 cm of laser when out of water?
- Do the team members have laser safety glasses, regardless of the laser output power?

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SAFETY FIRST!

Our goal is not to fail teams and keep them from competing, but rather to run a fair and SAFE competition for all. We work with **industry** to align the MATE safety specifications with **industry standards**. We want to familiarize our competitors with the safety specifications they may see one day in the workforce.

If you have a question or concern, contact that MATE ROV Competition Technical Manager on the MATE Q&A Forum Board. In this case it is better to ask for permission, not forgiveness. Remember, it is better to be SAFE than sorry!