



MATE ROV Competition Tech Bulletin - MATE Expected Work Practices

MATE ROV Competition safety inspectors have observed a wide variation in workmanship in the development of ROVs, control systems and non-ROV devices. At one end, well-crafted devices meet industry expectations with boards that are fastened in-place, connections that are secure, and wiring that is neatly organized. At the other end, devices use haphazard wiring, pins stuck into sockets, electronic boards hanging loose and not secure. These systems are examples of what industry does not expect or accept. Haphazard wiring, including loose and misplaced connections leads to companies having technical issues at the competition. Safety inspectors and judges have observed companies using pin jumpers to connect to sockets on their Arduino or other boards. Pin jumpers are fine for prototyping a system, but are considered loose connections in a final, delivered product. All connections should be soldered or use terminal connections with screw or spring locks.

With this in mind, the MATE ROV Competition is now challenging companies to up their game and bring systems up to what could be considered minimum industry standards. Companies that fail to meet these MATE Expected Work Practices will lose 5 points per issue on the workmanship portion of their onsite safety inspection. These workmanship rules apply to ROVs, surface control systems and non-ROV devices (ie: profiling floats). To reflect this:

- [Circuit boards](#) – must be securely mounted on to a frame or backboard. Loose, dangling boards will not pass inspection.
Circuit board wiring – all connections should be soldered or through terminal connections with screw or spring locks. Pin jumpers should not be used in the final system and will not pass inspection.
- No exposed wiring – insulation must be trimmed so that the insulation starts where the wires terminate. Exposed copper wires are potential short-circuits.
- When the ROV is in use, any connection in a surface control box should be protected to [IP-30 standards](#). IP-30 standards equates to <2.5 mm and should protect against tools, thick wires, and the like. Any guards / shields must be in place when the control system is connected to power.
- Encapsulating – some companies have taken to encapsulating their electronics in permanent epoxy resin. This satisfies the requirements for no exposed wiring, but these devices must be secured and not dangling.
- [Wiring](#) – Wires should be routed paying attention to high power wires (supply and motor loads) and low power control wiring. Separation of these types of signals should be designed into the system wherever possible. Crossing of these two types of wires should be done at right angles to minimize any capacitive coupling that may induce system problems. Spaghetti wiring is not acceptable for delivered products.

- Wires in control boxes should be cut long enough that they stretch between components when the control box is fully opened. Companies should not need to only open a control box partway due to lengths of wires. This could cause strain on wire connections, and would not pass the workmanship inspection.
- Wire discipline on the ROV – Loose wires on the ROV should be secured to the frame. Cables and wires should not protrude outside of the frame. These wire loops outside the frame create snag points, which could catch on external objects, mission props, etc. The MATE ROV Competition understands that it may not always be possible to keep wires and cables inside and secured to the frame, especially where multiple wires penetrate through the end cap of the onboard canister. But if possible, secure all wires and cables on the ROV to the frame of the ROV. For vehicles without an onboard canister, secure the wires to the motors and other components to the frame.
- Wire termination: Proper wire termination is essential. If you are using a terminal connector, follow the termination standards outlined in the links below:
 - [Close-Barreled Fastener Termination](#)
 - [Ferrule Pin Termination](#)
 - [Molex MX150L Connectorization](#)
 - [Solder Sleeve Wire Termination](#)
- [Strain Relief](#) – strain relief is the process of providing a protection of wiring as it passes through walls from one system to another. For an ROV system, strain relief is needed at the ROV side (bottom side) where the tether enters the ROV or ROV canister. It is also needed at the surface where the tether and other wires are connected to the control system or pass through a wall of the control system. For the tether entering the ROV or control box, any strain should not impact a connection point. If the tether is pulled, any strain should be transferred to the frame of the ROV. For the tether at the surface, MATE will supply a loop of rope securely attached to a table leg. Companies should build a carabiner into their tether to connect to this loop and provide strain relief for the topside of the tether. For wires passing through the wall of an enclosure, simply drilling a hole and passing wires through is not acceptable. The wires are not protected from damage by the wall. Within a system, rubber grommets may be used as wires pass through a wall. When going from inside an enclosure to outside, a true strain relief must be used. This can come in the form of a bulkhead connector or a cable gland. See specifics on [Strain Relief](#) for more information.
- Tether – the various cables of the tether should be controlled and covered. Simply taping or cable tying the tether cables every 30 cm is not sufficient. Consider [Expandable Braided Sleeving](#), [Spiral Cable Wrap](#), or similar protection to cover all tether cables. Both expandable braided sheathing and spiral cable wrap come in a variety of diameters to protect and cover various sized tethers.