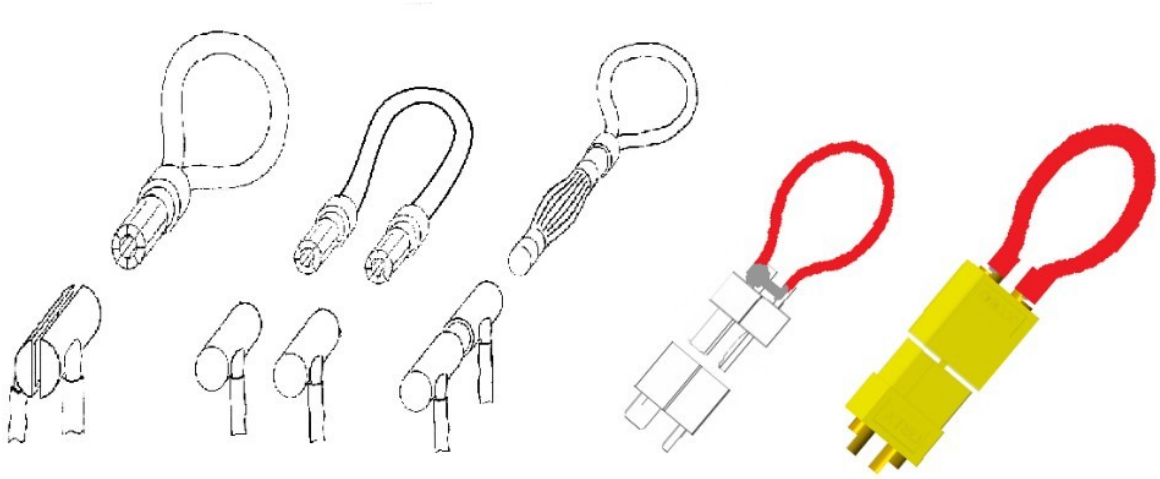
Safety cut-offs for electric boats

Club and racing event rules are now such that the power train of an electric powered boat needs to be capable of being completely disabled in some way. This feature is especially important for the safety of people in general, but especially for those people in the rescue boats! After all many electric boats have far more power than petrol boats and arguably they can be more unpredictable in a “failed” situation. This article describes some of the options available to provide a reliable safety cut-off.

Virtually all practical solutions involve mechanically interrupting the electrical circuit(s) between the motor and the batteries so that no power can flow once the cut-off device is operated.

Connectors

The most common approach is to use a so-called safety loop, i.e. a loop of wire usually external to the hull that is connected to the power circuit via electrical connectors. Pulling the loop disconnects the electrical power supply to the motor(s). There are many variations in the design of safety loops, those shown below are taken from the 2024 Naviga Rules Appendix B, but their function is essentially the same.



Larger boats require similar arrangements but with exactly the same function, see below. The set-up shown below uses 10 mm connectors and 6 awg wire, but 8 mm connectors and 8 awg wire is probably the most commonly used size and is adequate for most purposes.

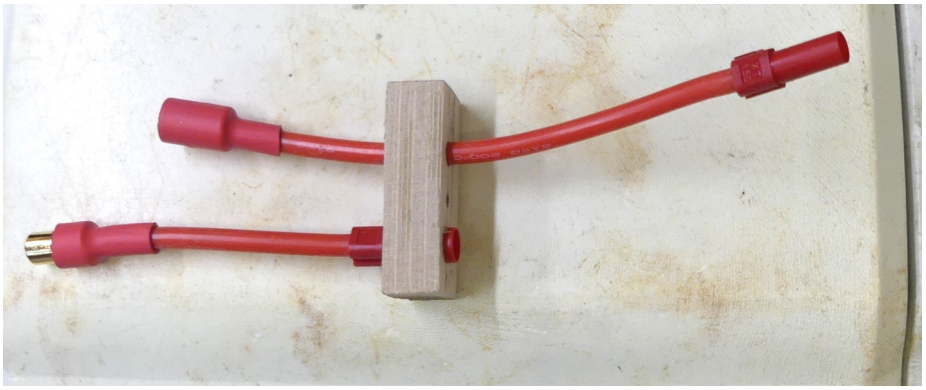
Safety loop where the location has considerable curvature on the deck.

The QS series of connectors can be adapted as a safety loop, here a QS8 unit is the basis of this loop, but note it is not the most commonly encountered QS8 connector.

There are certain design features which are important to follow:

1. One plug/socket connection in one leg of the safety loop is simplest but it should be made in such a way that it is obvious which end of the connection to disconnect to break the power circuit.
2. The plug/socket connection should be reasonably easy to disconnect, but not to the extent that it will disconnect of its own accord in rough conditions.
3. Not all suitable locations on the hull are easy to mount a safety loop – especially if there are steep curves, it may be necessary to mould a flat platform onto the hull to ensure a watertight fit.

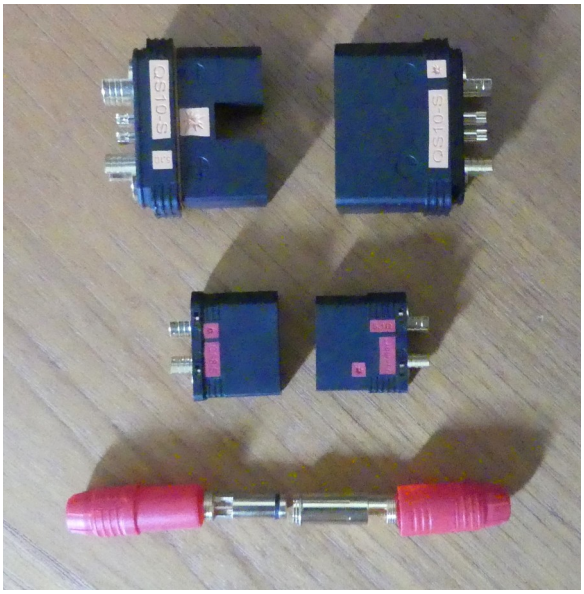
Another example of a loop that uses XT150 connectors is shown below – remember to solder the connector after fitting in the hull (how do I know this?).



“Big” scale

There is an obvious reluctance to install large connector blocks/switches externally on a big cat or mono which would have an undoubted impact on the look/finish, etc. of such a boat. Nevertheless, canopies take a while to remove if there is a major problem and much expensive damage can be done in those few moments. Moreover, rescuing a large, heavy and slippery hull is likely to be highly problematic with a motor that may start unexpectedly.

A simple solution is to mount the fail-safe connector(s) inside the hull. An insulated Bowden cable run through the deck or transom connected to one side of the connector(s) is then used to separate the connector(s) and so disconnect the supply. The added advantage of this approach is that once activated the power cannot be inadvertently restored. I would recommend using a cut-off in one power-line because a double connector with, or without, a built-in flash arrestor requires a very large force to physically pull apart. Such twin connectors are of course perfectly fine for the initial connection of the batteries, etc.



Top: QS10 (good for 250 A); middle: QS8 (good for 150 A) both shown without cable protectors, and bottom: XS160 (good for 150 A) are shown above.

Switches

A mechanical switch used for automotive applications is probably the only practical choice as a power cut-off because such switches can reliably switch extremely high currents. A typical switch is shown below. The drawback with such switches is that when the switch is part of the power circuit the switch contacts can have a relative high resistance (sometimes 10's of milliohms) which will reduce the boat's performance slightly and be an unwanted source of heat – a normal electrical connector will have a resistance of the order of 0.5 milliohm. Nevertheless, unless the very best performance is required this approach is one that deserves consideration.

Battery isolation switch for automotive applications

Electrical/electronic fail safes

There are electric modules that can be built into a motor supply which are capable of remotely switching up to about 300 A by using a small switch mounted externally on the hull. The units are expensive and arguably do not offer any significant advantages to the boater. Their main use is for electric surfboards and e-bikes.

In theory, the transmitter fail-safe function could be used to default the ESC to stop the motor. Additionally, several the descriptions of ESCs say that the ESC will cut-off when the transmitter signal is lost, or there is interference. However, there are many fault conditions that can arise in an electric boat's power circuit, both electrical and/or mechanical, which might not be covered by a simple "fail-safe" function.