Water, water, …..

Model powerboats depend on water in one way or another. However, sometimes water can be too much of a good thing. Petrol- and nitro-engined boats need air to feed the carburettor and the trick is to supply this air with the minimum amount of extraneous water. Good aerodynamics of the hull help to reduce water ingress, as do sensibly placed air inlets, but the presence of rough water, wash and rooster tail water from other boats can lead to significant amounts of water entering the boat. In the case of electric boats surprising quantities of water can enter the hull via the propshaft. From whatever source this excess water comes it is bad for the boat's handling, and in the case of electric boats, bad for the health of unprotected electrical components as well. There are several very effective ways of reducing the amount of water in the hull and managing it, if it does enter.

Removing unwanted water

An open water outlet in the transom

Generally, a racing boat is always on the move so any water picked up can be quickly ejected through a simple hole, or holes, in the transom. This approach is fine unless the boat stops unexpectedly. For a hole made low down in the transom sufficient buoyancy is required to avoid problems from water flooding back into the hull from the open hole(s). However, by siting the hole, or holes, higher up the transom most water will be ejected when the boat is moving and little water will be shipped when stopped. The effectiveness of such outlets is dependent on their size and location and so some experiment might be required.

An open outlet in the transom, but with a flap, or valve

As before when a boat is underway unwanted water is ejected via a hole, or holes, in the transom. However, this time the water outlet is covered by a flap. In operation, the flap is held open by the water stream passing under the hull which acts on the edge of the flap. When the boat stops the flap shuts and is held shut by the external water pressure, so water is prevented from entering the hull. The advantage of this arrangement is that a relatively large outlet aperture can be used, close to the bottom of the transom so that very little water remains in the hull. It is important that a path is provided for water in the hull to reach the transom outlet otherwise water can build up; holes at the base of the stringers works very well.

A ball valve can also be used in place of the flap, the operating principal is essentially the same, but most commercially-available devices use quite small balls and so can be easily blocked by debris.

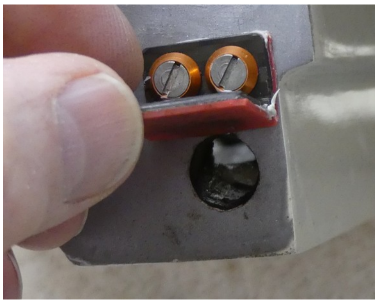


Photo of a flap on one sponson of a catamaran, silicone sheet is used to form the flap and the hinge; a small piece of carbon sheet provides some added weight and ensures the flap seals well on the hull. ©GNP

Reversed water pick-up tubes

A conventional water pick-up – for example, an under-hull water inlet or transom mounted pipe – can be used to remove water from the hull. The set up is shown in the diagram below. The pick up faces away from the front of the boat and the motion of water past the underside of the boat creates suction. A pipe is connected to the water pick up and this pipe is continued in an arc to finish up close to the rear of the boat near the transom. Water is removed via the pipe by the syphon effect. If the boat stops the syphon is broken and so the boat does not fill with water.

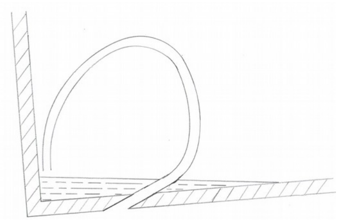


Diagram of a reversed pick up circuit. ©GNP

An electrical bilge pump

Because, self-priming electrically-powered water pumps consume a relatively small amount of power they can be an effective way of removing water from the hull. It is important to site the internal water pick-ups where there is known to be a build up of water – an effective float arrangement is needed to control the pump so that it is not operating needlessly.

Avoiding water ingress

Sealing the flexi-shaft

In the case of petrol- and nitro-engined boats water ingress through the flexi-shaft is a relatively minor problem, but a sealed ball-race fitted to the engine end of the flexi-shaft in a housing mounted on the end of the stuffing tube should almost eliminate any water being forced up the stuffing tube. Such bearing housing assemblies can be obtained from several suppliers. For electric boats a short length of silicone tube placed to slightly overlap the end of the stuffing tube so that the edge of the silicone tube just touches the flexi-shaft works quite effectively, although it is equally possible to use a ball-race system.

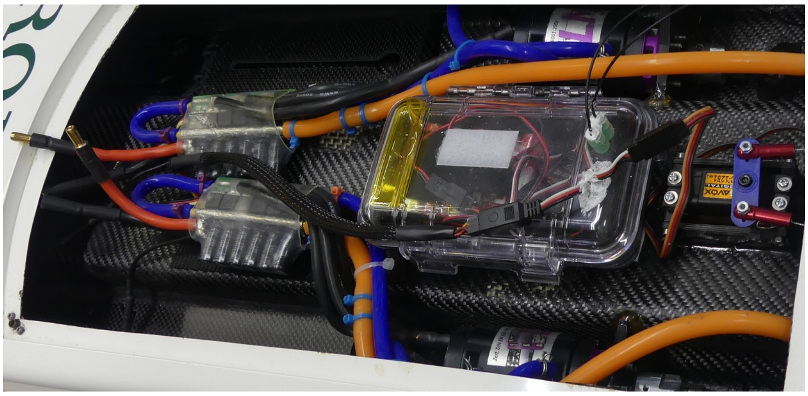
However, when an oval aperture is left in the transom to allow the strut and flexi-drive to be raised and lowered this feature can be a source of water ingress. Sometimes Blu Tack is used to seal the gap, silicone, or possibly a custom-made boot, nevertheless the base of the aperture is always difficult to seal completely. A more effective solution is to fit a so-called “flood tube”. This is a relatively large diameter tube which is fitted to the bottom of the hull, at the outer end it is sealed into the transom and at the inner end it is sealed with the stuffing tube passing through its end face. This set up enables adjustments to be made to the trim of the boat via the strut height and drive angle without the risk of water getting into the hull. Such a modification works very well with electric boats, usually with deep-vee hulls, where it is important to maintain a high level of water sealing.

Baffles

Using mechanical baffles can help manage unwanted water ingress into the hull in very rough conditions – such as those that might be encountered in off-shore racing. The idea is to engineer pathways for water to escape from the hull and air to flow relatively unhindered to the engine. The precise nature of the set up depends on the design of the boat, but large diameter tubes and/or flat baffles can be used to shepherd water away safely.

Protecting electronics from water

Increasingly, components such as servos, electronic speed controllers, etc. are being made to have some level of resistance to the effects of water. But, in general, the long term consequences of water immersion, water spray and dampness on electronic components and connections do not contribute to their reliability. Particularly, for the case of electric powerboats it is recommended that some additional water protection is a wise precaution as a second line of defence in view of the potential cost of damage to receivers, telemetry systems and other electronics.



Photograph illustrates a small hinged waterproof box to protect the receiver and telemetry modules in a HPR 115. ©GNP

Radio boxes

The purpose of a radio box is to provide a watertight space into which the servos, receiver, batteries, on/off switch, kill switch and anything else that needs to be protected, can be located. There are many commercially-available radio boxes, some of which can be fabricated from plywood and some that use plastic mouldings. Bespoke boxes can be made from composites such as carbon fibre, carbon-kevlar, or glass fibre. Clearly, it is important that the box structure is watertight with as few seals as possible. All-out multi-racing boats tend to be built with the servos mounted onto the hull, this creates a very strong and very compact set-up which is needed because these boats often have up to six servos. The radio box is then built around the servos with space for the receiver, batteries, transponder, etc. Sports boats generally have fewer servos and these are often built onto a board mounted on hard-points within the box itself. Key to all these set-ups is the removeable lid by which access is gained to the servos, etc, for servicing, adjustment, and so on.

Again, there are a wide range of sealing arrangements for the lid. Virtually all sealing arrangements use some sort of flexible seal clamped down with screws, or even a single bar across the top of the box.

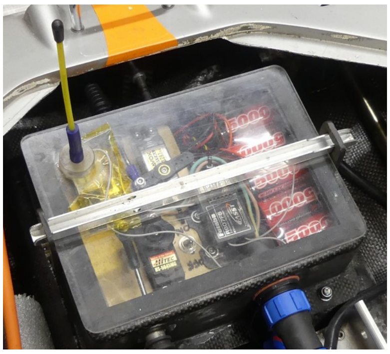
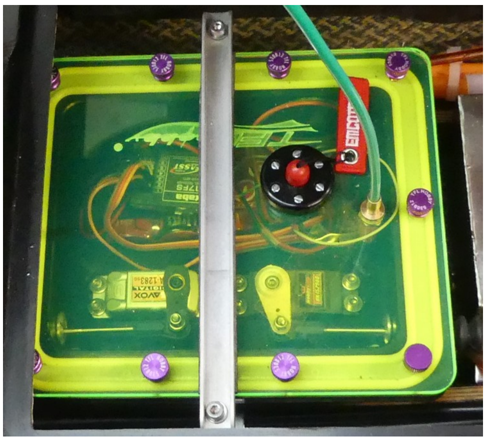


Photo illustrates a single bar closure, the advantage is that access to the inside of the radio box is quick and easy, but this set up needs to be tested carefully to ensure that there are no leaks. Moreover, the lid needs to be very thick to ensure reliable closure. ©GNP

The simplest type of seal is an o-ring made from Viton®, silicone, or some other flexible yet waterproof materials, clamped down between the flat face of the top of the radio box and the lid. This approach works very well provided that the lid does not distort when tightened. In most cases, poly-carbonate sheet is used as the material for the lid because it is transparent and extremely strong. If a simple o-ring is used it should be fitted close to the clamping screws and it is best to super-glue it to the face of the radio box to keep it in place.

More sophisticated designs use o-rings that are accurately located in a semi-circular groove in the face of the radio box. Other designs use a moulded seal which has either one or two semi-circular, or circular, forms on its edge(s). Properly designed all these approaches can work very well. The more expensive radio boxes use more closely spaced fixing screws than the more commonly used boxes to ensure a good seal. Alternatively, making a duplicate lid to fit over the original can significantly reduce bending effects.

However, whichever sealing arrangement is chosen it is very important to minimise the time the seal is actually under compression as the seal can loose its flexibility after a time. Replacement seals are available for some, but not all, commercially-available boxes. Checking for leaks in the radio box is a sensible precaution. Probably the easiest way to test for leaks, if the radio box has a small pipe fitting for the aerial, is to pressurise the radio box via the aerial fitting and search for bubbles with a mild soap solution.

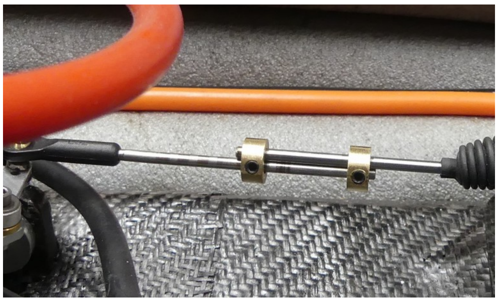


Photograph illustrates a typical commercial radio box which is easily removable from the boat and is held in place with a simple clamp. It is important to ensure that the box is accurately fixed in position so that the adjustment of the servo control rods is not changed when the box is replaced. Note a magnetic switch which is a convenient way of switching the power on and off, of course such switches need to be carefully sealed into the lid. ©GNP

It is a good idea to minimise the number of holes in the radio box. Clearly, some sort of flexible seals are required for the servo control rods – these have a finite life and can develop cracks so should be checked periodically for leaks. Care should be taken with electrical connections to kill switches, if commercial plugs and sockets are used it is a good idea to check that they will accommodate wire of the correct size.

For sports boats, the radio box can be fixed to the stringers with screws but it is worth taking care that the fixing is completely waterproof with, for example, nylon washers, etc.. It is quite a good idea to be able to remove the whole radio box to enable access to the fixing bolts for the strut and rudder on the transom. However, this does mean that a cradle to hold the radio box is required together with a clamp to hold the radio box in place.

Servo control linkages need to be very robust – it is surprising how much force is needed to move a rudder especially under racing conditions. Although clevis fixtures are convenient they have a habit of springing away from the control arms when least expected. Ball-ended fittings are probably best, with nylon units being especially robust and reliable when high levels of vibration are present. The only drawback with ball-ended fittings is there is very little length adjustment. In some set ups the length of the control arm needs to be quite precise, for example when setting up throttle linkages with multiple ball joints. Splitting the control arm into two and using a collar, or collars, to introduce some adjustment, works well. It is worth making bespoke collars with a bore very slightly greater than the combined diameters of the control arms and arranging that the clamping screw bears down on the join between the two control rods.



Photograph shows a typical adjustable control rod set up. ©GNP

Acknowledgements

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