Diesel Engine Basics for Boat Users

8 First aid for a Water Flooded Engine

As you return to the boat after a few weeks away you notice she is floating low in the water. So you open her up and notice water in the lower cabin sole, several inches of it. Then worse horror, you open the engine bay to find the bilge water level with the cylinder heads !

So what are you going to do, after you've finished crying that is ?

This article is intended to concentrate upon your engine/s, and the immediate first aid needed if major cost to remedy the situation is to be avoided / reduced. Some significant cost will be inevitable, this is about mitigating against some of those costs.

DO NOT UNDER ANY CIRCUMSTANCES ATTEMPT TO START OR EVEN TURN THE ENGINE/S OVER BY HAND.

Disconnect the batteries, to ensure they cannot inadvertently be started.

Make an initial assessment …

1. Is the water Fresh or Seawater ?
2. Is the sump flooded with this water ?
3. How high has the water reached ?
4. What ancillary parts have been flooded – Alternator; Starter; Loom; etc ?
5. **DO NOT DRAIN THE WATER YET.** As soon as you do the free water will be replaced by air, yet the surfaces will remain very wet. The corrosion will begin immediately.

Plan of attack …

A Materials & Equipment

1. Heavy duty Bin bags, e.g. Rubble sacks, for placing engine parts in
2. Several large boxes to put bags of parts in.
3. Ordinary bin bags that are easily distinguished from the above so you don't inadvertently throw crucial parts away.
4. Several Industrial grade tissue wipe rolls, or heavy duty kitchen roll.
5. Several cans of WD40
6. Industrial grade heavy detergent and / or Gunk / Jizer.
7. Some empty 20lt oil drums – you are going to use quite a bit for purging.
8. A priming pressure hand-pump that can pump fresh oil into the engine. Refrigeration wholesalers sell these. You will also need a suitable hose and fitting to connect into the engine at the oil pressure sensor port.
9. A vacuum oil change pump, e.g. Pella or similar.
10. 5 litre plastic container half full of diesel or paraffin to put small parts and bolts in.
11. Several large buckets.
12. A means of preventing oil & used coolant from being pumped overboard, otherwise you will end up even more out of pocket with a hefty fine. However, the water sitting below the oily scum floating on top can be safely pumped away, so get the water level below the engines. Collect the coolant direct into a suitable container.
13. Several drums (enough for at least 4 oil changes) of the cheapest engine oil you can find.

B Initial preparation During this phase leave the watery sump content in the engine

1 Wash the entire engine/s down with fresh water, then repeat with a heavy solution of detergent. Leave this to soak for an hour or so. Rinse again with fresh water.
2 Remove affected external assemblies – Starter, Alternator, Wiring Loom, Turbo charger.
3 Leave the fuel system intact for now. As this would have been filled with fuel, it is unlikely to have become contaminated. Check separately for contamination of the fuel tanks, and purge the fuel lines later if necessary. For petrol engines remove the Carb.
4 Re-rinse with detergent any areas revealed having removed the sub-assemblies.
5 For each water flooded sub-assembly removed immerse these in fresh water in a bucket and leave to soak, changing the water several times. The idea is dilute out the contaminants, especially the salty seawater.
6 It is OK to similarly rinse and immerse the wiring loom, as it will have to be opened and thoroughly re-rinsed and dried later. Any electronic items will need careful assessment, but simple sensors will mostly dry out OK.
7 Saturate each item with WD40, wrap in WD40 soaked tissue, before double bagging in the rubble bin bags. Be careful not to mix up these with the rubbish filled bin liners.
8 If you are dealing with two engines keep the parts from each clearly marked and separate.

C Drain down of the sump content

Note as soon as this phase is started you should try to follow the sequence of getting the engine drained and largely dry without delay, and ideally in one day.

Mating parts being dismantled should be dot / scribe marked where adjacent parts meet, using differing dot patterns where assembly confusion may later arise, and take plenty of photos so you can check later if you need to. As each part is removed thoroughly rinse it as for the ancillaries, then smother it in WD40 and wrap in tissue. Each part will require further attention later, but this initial attention should stop the corrosion.

1 Drain the sump content using the Pella, and allow the water to separate from the oil. Try to estimate how much water drains, as this will indicate how high within the engine the water reached. The oil will always float on top of the water, and will continue to protect the parts it is smothering.
2 From the quantity removed try to assess where the water level reached. If the whole engine was full, or pretty close to full then you are going to have to completely refill the engine at the next stage.
3 The next part may seem bizarre, but you need to fill and drain the engine at least five times with fresh water and just above the level reached by the seawater. If the seawater didn't reach the crankshaft centreline then avoid the rinse level doing so. As mentioned the idea is to dilute out as much of the salt as possible.
4 After the final drain down remove the manifolds, the fuel lines (seal each open fuel line with a plastic bag filled with WD40 soaked tissue – nappy bags are ideal). Remove the injectors and place these in a tray of diesel.
5 Remove the cylinder head/s, and again rinse and WD40 smother as for the ancillaries.

This should leave the main block in place.

6 Fill the block to the brim with the cheap engine oil, so every passage is full with oil (coolant passages can be simply plugged with oily tissue). Pour plenty of oil on top of the pistons, and down the valve push rod holes. Drain with the Pella and allow the oil to separate – any solids or water will fall to the bottom, so you can re-use the oil above the lower level for the next oil rinse fill. Repeat this a couple of times, then leave drained.

7 Remove the oil filters and drain these. These should only contain oil, which will as normal be black. Then refill with the cheap oil and re-attach – we will replace these later. If they have been contaminated with water then renew (further filters will be required later).

8 Attach the oil priming hand-pump to the oil pressure switch sensor port. Now pump several litres of clean cheap oil into the engine via this route. The idea is to flush out any water vestiges laying within the bearings into the sump.

9 By now you will have removed ~95% of the contamination, so it is that last 5% that will be causing the most risk.

10 If there is to be any delay before you can go on to the re-assembly phase again leave the engine filled with fresh / separated oil, but by now the engine should be OK for several days, although isolated pockets of water could still be causing corrosion, so do not leave it too long.

D Do I require a Professional for the re-start ?

Most DIY mechanics should be able to achieve the above. If you are not confident to complete the job now is the time to hand over to a professional, but for those who are more handy then the following is an approximate guide as to how to proceed. You will also require the workshop manual and OE / Pattern spares such as filters, gaskets, etc. Also there is no reason why you should not deal with the cleaning of the ancillary parts, but discuss this with your mechanic, as I would expect most will be happy for you to do some of the work, as long as it meets the standard they would require.

E First rotation of the engine

1 Whilst continuing to hand-pump in oil via the sensor port, and with approx 1/3 of the standard qty of oil in the sump for the engine's oil pump to pick up, slowly revolve the engine by hand through at least 4 full revolutions. At the same time keep the cylinder bores well oiled.

2 Try to assess how the engine feels – is it smooth ? Any roughness then the whole thing is going to have to come to bits.

Now for an important decision:- Full Strip down or Re-assemble and re-start

Many immersed engines will have had a good deal less than the approach above and will still successfully run from a re-start. However, this article cannot know your specific situation, and if you have doubts then seek professional advice as to how you proceed from here.

But if the oil being drained by now has little contamination showing, and if it were me, I would be looking at the re-start option.

F Ancillary part preparation

Each part removed requires thorough cleaning and drying in a workshop or at home. The fuel system should be largely unaffected, so avoid removing the fuel pump, but if you need to ensure you dot & scribe mark its position and you may need to have someone suitably qualified to ensure the timing is correctly reset / aligned upon re-assembly.

It is worth taking the injectors to a specialist to be checked, and this is not that expensive.

The electrical parts should be stripped right out. Standard workshop procedure for a flooded motor is to immerse the winding coils several times is fresh water then a suitable cleaning solvent, followed by a thorough dry off, then place is a low oven (~95^{o}C) to bake the windings

dry. Similar approach for wiring looms, but you will likely need to remove any outer insulation coverings / conduits so the individual insulated wires can be thoroughly cleaned. Plenty of cable ties to hold the loom together then simply open up the loom several inches at a time to clean and dry the wires. Any contaminated joints should be replaced unless you can be sure they are 100% clean and dry.

G Re-Assembly

1 Re-install the parts removed, following makers specific instructions. Use new gaskets and seals where necessary.
2 Pre-lube the turbo charger bearings.
3 Complete the assembly ready for re-start.

Pre-start

4 Remove the oil filters re-used for the hand priming process with new filters, and prime these with fresh cheap oil.
5 Fill the engine with oil to the bottom of the dipstick.
6 Refill the fresh water system with water only at this stage.
7 Replace the air filter element with a new or re-oiled if using a K&N or similar.
8 Fuel system purge – bled the fuel system as for any first start.

First start

At this stage any residual contaminants will be flushed out by the engine's motion in to the sump, where if left will get picked up by the oil pump and passed to the bearings. To prevent this, the first start should literally allow the oil pressure to establish and run for approx 1 minute, this will purge the lubricating system, and will get the oil where the hand priming process could not. So drain the oil and replenish with the cheap oil, again to the bottom of the dipstick. Remove the filter element, and check if there is any water within the oil content of the filter, if so flush the filter out with further cheap oil, and consider repeating the hand pump flush through procedure.

Second start

This time repeat but allow the engine to run at tick-over for 5-10 minutes, and listen carefully to the engine. If it sounds distressed then this is bad news – strip down is going to be required. If all sounds OK then take an oil sample with the Pella pump from the bottom of the sump and check the oil filter content. If no water present continue, and allow the engine to run for say an hour, and try to apply some load.

If you find any water and / or other contaminants then undertake further oil changes / purges until the oil remains clean.

Otherwise drain the oil, change and prime the oil filter this time refill using your normal grade and to the normal level.

H Next Change

Run the engine for approx 30 hours, then undertake a routine Oil & Filter change. As long as no secondary issues have occurred you have saved you engine, and considerable cost.