Flooded Engine

4-Stroke Engines

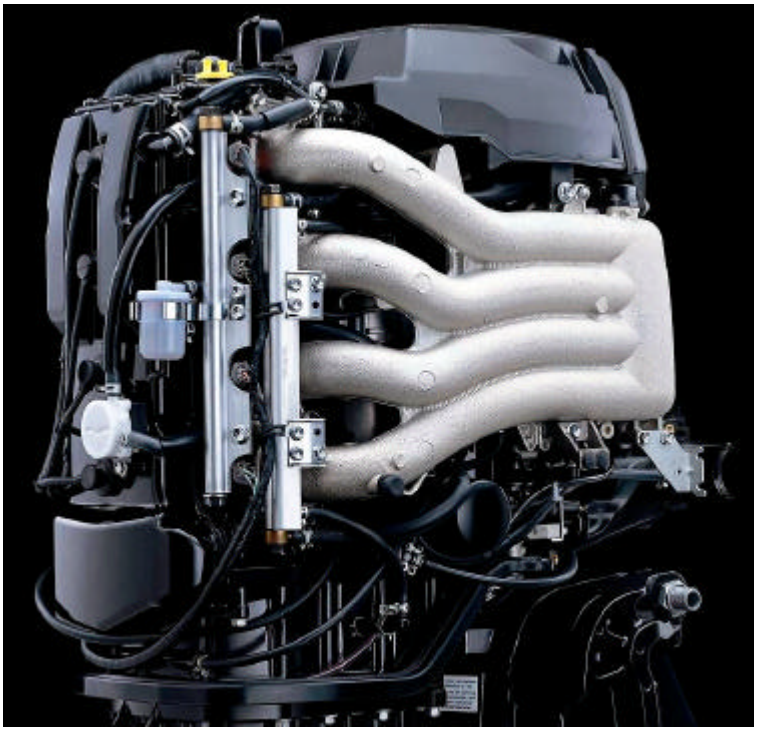
With 4-stroke engines there are some different methods to employ and problems to avoid, but it's still a wet engine and so many of the basics are the same.

First, as we did with 2-stroke engines think safety, there WILL BE some fuel in the water that comes out of the engine so there is a significant fire risk. Disable the ignition system at its source as well as ground out all spark plug leads. Ensure there are NO sources of ignition around when you're drying out an engine. Don't forget to disconnect (always the negative or ground lead first) then remove the battery.

If the engine has been under water for several hours or if there is any evidence of sand or silt having entered the engine, don't try to get it started. You may just cause more damage. Instead prevent or reduce the chance of internal corrosion by flushing it out liberally with fresh water, then get some dewatering fluid into it. Even filling the engine with fresh water or old sump oil (it's been done) is better than letting the air get at it, until you get into the workshop for a proper clean-out.

With a 2-stroke engine the main danger with internal corrosion was to the roller bearing surfaces, something that most 4-strokes don't have to worry about. But they do have their fair share of polished steel bearing surfaces with very small clearances, so a little rust can lock the engine up easily. One area that is quite sensitive to rust damage are the valve guides, which usually have very little oil around to protect them. A little rust can easily stick a valve open, with dire consequences if someone cranks it over.

The big difference with cleaning out 4-stroke engines is that you MUST NOT crank the engine, even by hand, until you get ALL the water out of the intake and exhaust manifolds. On most marine 4-stroke engines the intake and exhaust manifolds can hold more water than the cylinders, plus some cylinders will have their valves closed and be dry. If you crank it before the manifolds are empty, you stand a good chance of getting LOTS MORE water into the engine and even having a hydraulic lock in a cylinder, with dire consequences.



To boost mid range torque, 4-stroke marine engines typically employ very long intake manifold branches, like this 115 HP Johnson outboard. The manifolds must be emptied first.

Drain the fuel system and get the water out. Leave the carb's or injectors empty for now. Drain any water from the oil tank or sump. Getting all the water out of the oil is sometimes a challenge and we will probably need to change the oil more than once, before this job is finished.

Draining the manifolds can be tricky on some engines, but one tool that works well here are those oil drain devices that are intended to suck the oil out via the dipstick tube. These have a long thin tube that you can insert a long way into a manifold and suck the water out, right up to the valves. A good trick on EFI engines is to remove the injectors from the manifold which on most engines allows you to inset a thin tube right up to the back of the intake valves. When the manifolds (and don't forget the rest of the exhaust system) are empty, we can remove the spark plugs and slowly rotate the engine by hand to get the water out of the cylinders.

While you're at it, feel for any tight spots that might indicate some damage due to hydraulic lock has occurred. If there is any signs of this, don't try to start it. Get it stripped quickly or fill it up with a preservative to stop further rust until it can be stripped.

When all of the easy water in out, it's time to use the starter to crank it faster. But first clean up ALL that spilled fuel BEFORE connecting up the battery. Several boatsheds and marine workshops have been burnt down because a technician got a little careless at about this stage. Now you've cleaned up, connected the battery and are ready to crank, but first have you put some oil in, after you drained it earlier? Now is a good time (while we're cranking the last of the water out) to get some oil pressure through the system before it starts up and flush out some more water from those hidden passages.

"Oil Vac" a typical tool used to suck engine oil out through the dipstick tube, also very handy for removing water from inside manifolds, oil sump etc.

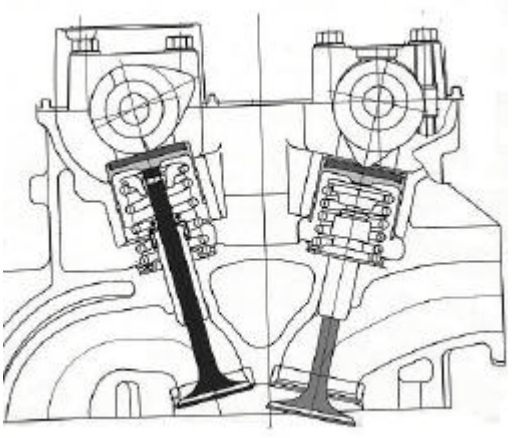
Install some dry spark plugs, ensure the fuel system is all back together and top up with some fresh fuel. Check there are no fuel leaks. Connect a water hose to the cooling system, if the boat is out of the water, so we can run it long enough to get it thoroughly warmed up. Start the engine and run it at low speed. Visually check all systems for signs of leaks or damage. If it does not start up straight away, look for a little water on the spark plugs. It's amazing how the last little drop or two in the engine always seems to migrate straight to the spark plugs!

Once it's running, there's no leaks, no unusual noises and you have oil pressure, run it for several minutes, then stop the engines and check the oil. If there's any signs of a "milky" colour to the oil, indicating there's some water mixed with the oil, change the oil. You may need to do this more than once on some engines where it's difficult to get all the water out of the lubricating system. Once you're happy with the oil colour, then it's time for a longer run to really dry it out.

This is best dome with the boat in the water so you can drive with the throttles open enough to ensure every last little nook and cranny is dried out. Check the oil again, ensure there are no signs of water mixed with the oil. If there's still water in there, change the oil and run it again. This is very important because any "milky" oil will settle and separate back out into water and oil, after a few hours of inactivity. Then when you next start it up the water will be on the BOTTOM of the oil tank, right where the pump pick-up usually is.

Summary

Both 2-stroke and 4-stroke engines have some similarities when it comes to drying out a flooded marine engine. In both cases it's critical to get moving quickly, because as soon as the engine is recovered from the water and exposed to the air, internal corrosion starts. In salt water it takes just a few hours for rust to seriously pit a roller bearing surface or stick a valve in the valve guide. If the engine is not damaged when recovered you can prevent further damage and dry it quickly by running the engine. The engine's internal cooling, air, fuel and oil systems are largely self cleaning, if you get most of the water out first.


The very small amount of oil normally found on valve stems makes this area a prime candidate for rust damage

Some areas, like under the flywheel and inside the starter motor will require manual cleaning, but not immediately, so these can be done after the test run.

However, there will be some areas that are damaged by immersion no matter how quickly you get it cleaned up. Most engine mounted electronics (ECU, coils and sensors) are sealed and OK, but accessories like relays, solenoids, dash panel instruments, warning horns and ignition key switches are rarely waterproof and very

difficult to clean, so these must be replaced. Don't be fooled by the fact that they often still work immediately after recovery, the water trapped inside will soon cause problems with the internal exposed electrical circuits.

If however, because of damage or any other reason, you can't start it then it is imperative that you prevent further internal corrosion, if you to keep the repair bill down. Filling the engine with a rust preventative is best, but if this is not available to you, re-submerging it in fresh water will keep the air out and slow down corrosion a lot.