

This heat exchange tube stack is properly clogged up - the engine must have been running pretty hot!



ESSENTIALS
 Time taken:
 1 DAY
 Skill level:
 INTERMEDIATE

Cooling system service

Is your engine running hotter than normal? It might be time to service the cooling system. Tony Davies shows how it's done

There are two main types of engine cooling system. The most basic is the direct or raw water cooling system, where sea or river water passes directly through the engine block

A simple system, it's seldom seen on modern engines as it generally 'over cools' and significantly reduces engine efficiency

as the engine always runs well below its designed running temperature of 80-85°C.

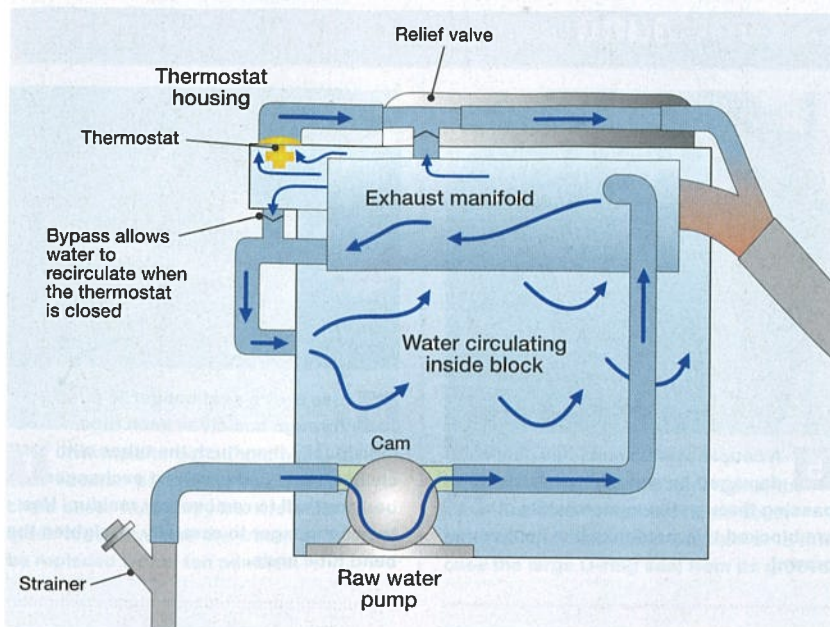
The far more efficient type is the indirect or freshwater cooling system. This keeps the water passages clean as only fresh water and coolant inhibitors circulate around the block within a sealed system. The raw water passes through a heat exchanger tube stack and this takes the

heat from the clean water circulating within the block.

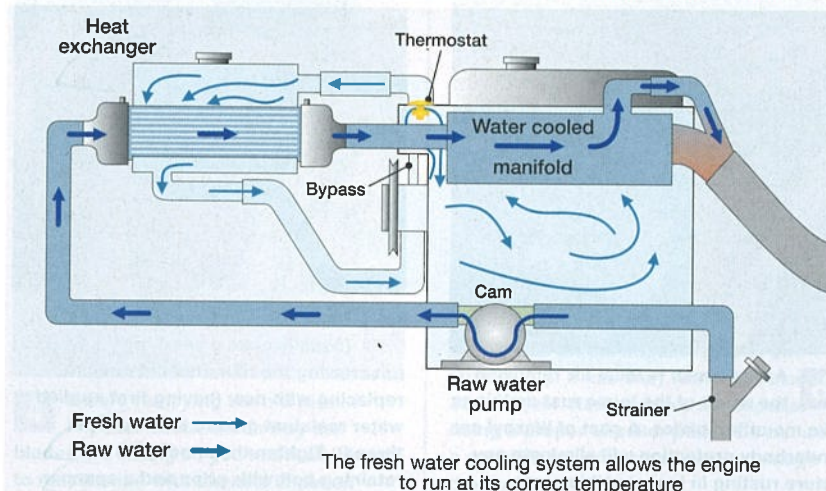
For raw water cooled engines the normal recommended running temperature is about 52°C as this cuts down the amount of salts and sediment deposits that cling to the cooling system walls while running.

However, over a long period the cooling system will gradually become clogged and the engine temperature will rise causing hot-spots in the areas where the water can least easily pass through.

Having said all this there are plenty of Volvo B-series petrol engines, such as the AQ130, that are still running well despite being 'under cooled' throughout their lives!



A raw water cooling system is very likely to become clogged over time



The fresh water cooling system allows the engine to run at its correct temperature

A sealed, freshwater cooling system allows the engine to run at its correct temperature

There is very little that can be done to prevent the silting of the engine block. However, it is possible to occasionally back-flush the engine by removing the hoses and running clean water through the system. This will remove loose debris and if done regularly from new will make a real difference to helping keep engine cooling passages clear.

Efficiency

Freshwater cooling allows the engine to run at its correct temperature of around 85°C, while introducing coolant inhibitors and antifreeze into the cooling system ensures a long and efficient engine life.

The downside is you need to service the cooling system regularly to keep it working. This mainly concerns cleaning the small tubes in the tube stacks located within the heat exchanger, the engine and gearbox oil coolers and also – on more powerful engines – the intercooler that

cools the turbo or supercharger air before it enters the cylinders. In these latter cases it's not only engine temperature but also engine performance that suffers when the tubes become blocked.

Keeping the water system clear is a very important aspect of engine servicing, especially the tube stack cleaning, yet it's rarely offered as part of the annual engine service. Unless it's attended to on a regular basis – say every three years – then you've got a big unseen problem building up within the engine.

ABOUT THE AUTHOR



Tony Davies has been building and repairing wooden, steel and GRP boats, and servicing inboard, outboard and saildrive engines for more than 40 years

Tube stack cleaning

Heat exchangers, oil coolers and intercoolers come in many designs so the method of dismantling prior to cleaning the stacks will vary slightly between engines. This is a Cummins heat exchanger with a separate header tank and is relatively easy to remove for cleaning. It is just possible to clean the tube stacks while the heat exchanger is in place but a much better job can be made with the unit removed.



1 Detach the hoses and remove the four bolts securing the heat exchanger to the engine block so you can lift it out.

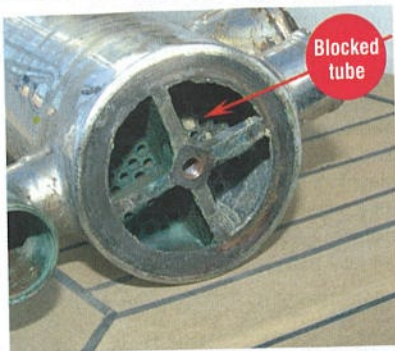


2 This Bowman heat exchanger is combined with the exhaust manifold and has a removable tube stack that can be accessed after removing the rubber end caps.



3 An end plate bolt was too stiff to remove in situ, so this intercooler was removed from the engine. With both end plates removed you can push the tube stack out from one end.

Tube stack cleaning... continued



Blocked tube

4 Although this heat exchanger is in generally clean condition, some tubes have become blocked with marine detritus. Cleaning every three years will help prevent this before flow is reduced.



5 A couple of tube ends have been damaged by something hard passing through the system while others are blocked by what looks like cooked prawn!



6 Use a wire coat hanger to push through and clean each tube individually then flush the tubes with clean water. Flush the heat exchanger body as well to remove any residue. Use the coat hanger to carefully straighten the bend tube ends.



7 If you removed the tube stack from its housing it can now be returned. Clean up the end cover plates and refit the seals before bolting the cover plates back in place.



8 A wire brush is ideal for removing the worst of the loose rust on things like mounting plates. A coat of Waxoyl car underbody protection will eliminate any future rusting in inaccessible areas.



9 Replace worn pencil anodes (usually once a year), by unscrewing the denuded old one and replacing with new (having first applied water resistant grease to the anode thread). Tighten the anode into its retaining bolt with grips and a spanner.



10 Apply more water resistant grease to the bolt thread and tighten it back into the end plate. Treat other pencil anodes on the engine in the same way.



11 The intercooler can now be refitted to the engine and the pipework reconnected. Hose clips must be tight on every joint on the intercooler air-side otherwise a loss of pressure will reduce power and create a smoky exhaust.



12 The last items requiring tube cleaning are the engine and gearbox oil coolers. If they can be cleaned without disconnecting the oil pipes (such as this Bowman engine cooler, inset) this saves additional work.

Raw water pump maintenance

The raw water pump should be an annual service item but this one had been neglected for several years. I carry a complete spare pump for emergency use as it's generally far quicker to change the pump than try to change the impeller at sea.



1 Awkward to get at, this pump is located behind the engine timing chain case. Thankfully it's two bolts are quick to remove and the whole thing can be replaced within ten minutes.



2 With the pump off the engine, the first task is to remove the cover plate bolts. Remove the gasket – or in this case the large O-ring seal from its groove.



3 Check the inside of the cover for wear. If excessive, a flat cover can sometimes be reversed to provide a new surface for the impeller to seal against – but ensure the face is clean and there are no sharp raised edges.



4 Before removing the old rubber impeller check which way the blades are sitting so you know which way to reassemble with the new impeller.



5 Prise off the impeller plastic end cap (if it has one) with a flat-bladed screwdriver. Next, remove the impeller using a proper impeller puller. Do not use a screwdriver, which can easily damage the housing.



6 With the impeller removed, check for wear in the bottom of the pump body. Many pumps have a separate wear plate in the bottom that can be reversed in the same way as the pump cover.



7 This split shows the impeller is close to breaking up and should have been replaced some time ago.



8 Before fitting the new impeller (or refitting the old one if it is still in good condition) liberally grease the shaft tube to ensure it will come out easily next time. If there's a separate woodruff key, grease this at the same time.



9 Give the impeller blades a liberal wash with soapy water – this lubricates them so they'll slide into the housing more easily – then insert them into the pump, turning it while pushing home to align the blades the correct way. →

Raw water pump... continued



10 If your pump has a woodruff key, line up the slots on the impeller and the pump driveshaft, then slide the key into its slot.



11 Don't forget to replace the impeller plastic end cap if yours has one – some pumps won't prime if this is left out.



12 If the pump uses an O-ring seal, clean out the groove prior to refitting. If a gasket is used, clean the mating faces and use a new gasket.



13 Apply a little grease to the ring seal groove to keep the O-ring in position on the pump housing while the face plate is bolted back in place.



14 Clean up the inner surface of the face plate – ensuring there are no burrs if you have reversed it – before bolting it back in place.



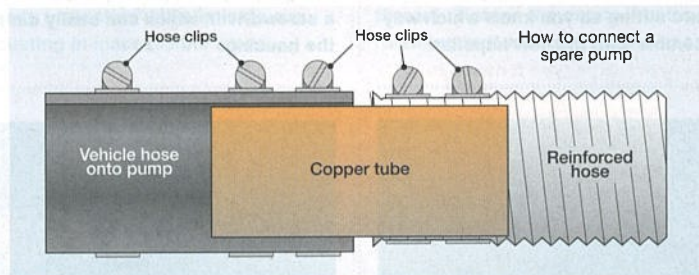
15 Make sure the pump-mounting gasket is in good condition or fit a new one. When refitting the pump make sure it's the right way up with outlet and inlet in the correct orientation!

Easy pump connection

When using a spare pump as the quick-change standby it is important to be able to remove the hoses quickly and easily. Marine reinforced hose, which is used to withstand collapsing under pump suction, hardens over time, and often the only way to disconnect it is to cut it off. This is clearly of no use where the pump needs to be changed quickly. But there is a solution...

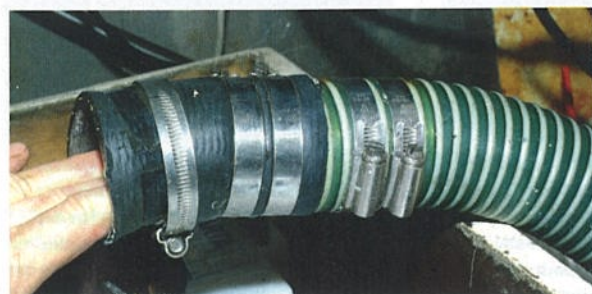
Where it's essential to use reinforced hose, make up an end connection using a copper tube stub 4in or 5in long in the appropriate size to fit inside the hose.

Using hot water, warm the end of the reinforced hose to soften it, push the copper tube stub halfway into the hose



and fix permanently with two hose clips. Then use a 4in length of vehicle hose on the exposed end of the copper, again secured with two hose clips.

This hose is connected to the pump with a single hose clip and ensures it can be fitted and removed very easily while still providing a reliable seal every time.



Here's a typical hose connector arrangement for a quick change of a water pump. They don't take very long to make up, but will be well worth the effort every time the pump has to be disconnected

COSTS

Spare pump: £100-£1,000 depending on make and size of engine.

Alternator and pump belts: £3-£5 per belt

Impellers and gasket kits: £10-£150, depending on make and size of engine.

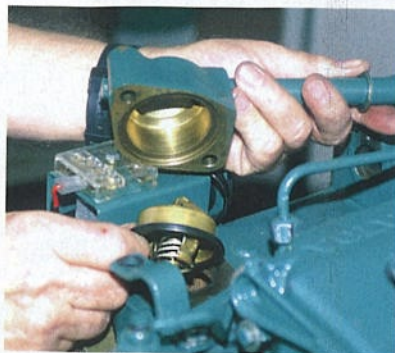
Thermostats: less than £10.

Thermostat

Thermostats are often overlooked but they can eventually go wrong and usually in the closed position, which means the engine overheats quickly. Less serious is when they fail in the open position. In that case the engine simply never reaches its correct operating temperature.

The quickest cure for a closed thermostat, when away from home, is to simply remove it and fit a replacement. For an open thermostat, simply keep a careful eye on the engine temperature to ensure the thermostat doesn't decide to close. Again, replace it at the next convenient port.

Test the thermostat by placing it in a pan of hot water and watching to see when it opens. As long as it opens before the water boils you can assume it is OK. For a more accurate test, place a thermometer in the water and check the temperature when the thermostat opens.



1 Thermostats can be mounted in various ways but generally speaking they're easy to get at and can be removed and replaced by removing the housing, lifting the old one out and fitting the new one. Fit a new gasket to ensure the housing doesn't leak after replacement.



2 Once everything has been reconnected the heat exchanger system must be refilled with a 50/50 mixture of good quality antifreeze and water. Run the engine up to temperature then recheck the fluid level once the engine has been allowed to cool again. Top up as necessary.

Drive belts



1 If the belts are protected by a cover this needs to be removed first. There are several different types of belt. This is a 'poly-vee' type on this Cummins engine. Whatever the type it needs to be checked for wear and damage.



2 On this engine the belt tension is achieved using a spring loaded idler pulley. Tension is released using a $\frac{3}{16}$ in square drive ratchet in the square hole on the idler arm to allow the belt to be replaced.



3 A new standard 'vee' belt can sometimes be a little on the short side. To get it onto the pulleys, place it round the crankshaft pulley and then push it as far onto the alternator (or pump) pulley as possible. Then, while holding the belt in position, turn the engine over with a spanner on the crankshaft pulley nut and the belt will roll into place. Tension in the normal manner.

Water strainers



1 The raw water strainers need to be checked on a regular basis, especially if cruising in shallow waters - this one is clogged with mud and silt. A quick flush out with clean water is usually all they need.



2 Make sure pipework to the strainer is not partially blocked by rodding it through after cleaning the strainer basket. Check the cover seal is in good condition and give it a light greasing to help it seal when the cover is refitted, otherwise the system may not prime.



3 Here the strainers are mounted under a hatch in the saloon, well above the waterline and convenient for quick access. If a straight down connection to the skin fittings can be arranged there's less chance of blockage in the pipe and rodding-through is easy.