

Fuel injectors: DIY service tips

Stu Davies explains how to test, extract and service diesel injectors



Volvo engines use a variety of different nozzles in their injectors. Check before ordering

My Beneteau Oceanis 381, Sacha, is nearly 20 years old. Her engine is a Volvo Penta MD22, which is an old fashioned 4-cylinder Perkins-derived diesel engine. It has done 3,250 hours running time and is still going strong, using only about a litre of oil per season of about 120 hours running.

But last year I noticed it was vibrating a bit at low revs and blowing lots of grey/black smoke out of the exhaust under load and at high revs.

I tested each injector in turn and concluded that two of them were functioning poorly, but decided to pull, check and service them all.

After removing the injectors, I could see two injector nozzles were damp, indicating that the needle valve wasn't seating properly and was leaking. One of the others had two nozzle holes blocked.

I was pretty sure that misfiring was causing the vibration at low revs, while the incomplete combustion at high revs was causing the excess smoke.

How to test your diesel injectors

To test whether an injector is working or not, use a spanner to slacken the nut holding the fuel feed pipe to the injector while the engine is ticking over. If the injector is good, starving it of fuel will make the engine lose revs and vibrate. If a cylinder is misfiring, like two of mine were, slackening the fuel pipe nuts won't make that much difference to tick-over noise.



Extreme caution! Fuel to the injectors is pressurised to over 3000psi, which will cut your skin if it comes into contact. Slackening the injector pipe nut will force the fuel to leak outside the injector instead of being injected into the cylinder. I use an old rag around the nut to catch the leak.

I cured it by replacing the nozzles and checking and setting the pressures at which they operate.

How to remove injectors from an MD22 engine

First of all I switched off the fuel supply from the tank and removed the injector pipes and leak-off pipes completely. I also

removed the raw water pump for better access. The injector pipe nuts need a 17mm spanner and the leak-off pipes are

held on with 10mm headed banjo bolts. These have copper sealing washers – don't let them drop down the side of the engine.



1 The injectors are held in place by a forked spring leaf type of clamp and a single 10mm bolt with a 13mm head. Slackening the bolt allows the clamp to come away from the injector, but note: the bolt has rolled threads and won't come out of the clamp so care must be taken to lift the clamp as you are undoing the bolt.



2 Once the clamp is off then a suitable spanner can be used to twist the push-fit injector back and forth while pulling on it as it comes out.



3 There should be a copper sealing washer on the bottom of the injector (see inset image). If the washer sticks in the cylinder head then a piece of 8mm threaded bar can be screwed in to the washer to grip it and pull it out.

Changing injector nozzles



To change the nozzles all that is needed is a long 15mm socket (long enough to fit over the nozzle on the bottom nut on the injector) and a big enough adjustable spanner to hold the body. A socket breaker bar (an extra-long 1/2in drive socket bar) is needed for the socket – the nuts are tight after 20 years of service!

Once the nut is started they come off quite easily and then the nozzle and internal parts can be taken out.

Inside you'll find a pressure adjusting shim first of all followed by a

CAUTION:
don't pull the needle out of the new nozzle. The heat of your fingers can make it expand and then it'll be difficult to get it back in without damaging it.



INJECTOR COMPONENTS

1. Main injector body
2. Adjusting shim
3. Pressure control spring
4. Cone spacer
5. Locating spacer (still attached to old nozzle)
6. New nozzle
7. Injector nut fastens nozzle to main body of injector (1)

spring, then a cone spacer, which goes in one way only, then another locating spacer and finally the nozzle. A brass wire brush is advisable to clean any carbon in the corners where the nozzle fits and I usually have a bowl of clean diesel to immerse the parts in as I clean them.

How injectors work

The injector has a nozzle with four tiny holes in it, which pokes into the cylinder through the cylinder head. The nozzle contains a tapered needle which controls the passage of fuel through the nozzle. This needle is moved or controlled by the pressure of the fuel from the injector pump.

When the needle is lifted off its sealing seat by the fuel pressure, the fuel passes through the nozzles and atomizes in the hot air in the cylinder, causing it to ignite.



Shiny new nozzle alongside old one

Reassembly and testing



Injector body smeared in lithium white grease

Normally at this point I'd use a specialised hand pump and pressure gauge to check the injecting (or 'breaking') pressure, which is controlled by the shim and the spring. However, I don't keep those tools on the boat in Portugal, so I decided to check my work by reinstalling the injectors and starting the engine. I'd have them properly calibrated later.

Reinserting injectors

Before refitting the injectors into the cylinder head I cleaned up the apertures with a piece of wooden dowel and some cloth. The copper sealing washers had come out with the injectors and had left a clean smooth seat in the head.

The injectors were smeared with lithium white grease to prevent corrosion and the

copper washers on the tip of the injector were held in place by a smear of grease.

I made sure the stainless centralising collars were in place as well and the injector clamps and bolts were torqued up to 43Nm (32ft/lb).

The pipes and raw-water pump were refitted in the reverse order they came off.

After slackening the injector pipes to bleed the air out of the pipes and injectors, the engine started easily enough. It was a lot smoother and the hesitancy causing the vibration had gone. I warmed it up in gear tethered to the pontoon and then ran it in stages up to full throttle.

There was lots of smoke at first – the leaking injectors had caused incomplete combustion and allowed a build-up of soft carbon in the exhaust manifold area – but



The clean injector seat can just be seen

it soon settled down to a clear exhaust.

The new clean burning nozzles have solved that problem and now full wide open throttle is available without excess vibration or smoking.

I'm also now expecting a much reduced fuel consumption figure.

Direct injection vs indirect injection

Unlike Geoff Higginbottom's Volvo Penta MD2020 engine (from page 56 this issue), my MD22 is a direct injection system. This means each piston has a bowl in the top where the injector sprays the fuel and from where the flame front is propagated. Direct injection engines tend to be more noisy, with the 'crack' of the ignition or 'diesel knock' being a lot louder than an indirect system.

Geoff's MD2020 generates half the cylinder pressure of my MD22, and in general indirect injection engines don't need to be as robust as direct injection ones. Their injectors are cheaper to produce and they can run at higher speeds, but they're less fuel efficient and unsuited to turbocharging. They also need glow plugs for cold starts.