

Diesel: Troubleshooting

| Probable Cause | Engine not starting | Hard to start engine | Runs rough at lower RPM | Lack of power | Diesel knock / pinking | Black smoke | White smoke | Blue smoke |
|---------------------------------------|---------------------|----------------------|-------------------------|---------------|------------------------|-------------|-------------|------------|
| Low compression | X | X | | | | | X | |
| Low fuel pressure | X | X | X | X | | X | X | |
| Low cranking speed – flat battery | X | X | | | | | | |
| Glow plugs or relay faulty | X | X | | | | | X | |
| Insufficient fuel supply | X | X | X | X | | | X | |
| Fuel Quality – petrol - contamination | X | X | X | X | X | | X | |
| Air – vacuum in fuel supply | X | X | X | X | | | | |
| Blocked fuel supply - filters | X | X | X | X | X | | | |
| Faulty diesel injector/s | X | X | X | X | X | X | X | |
| Faulty high pressure pump | X | X | X | X | | X | | |
| Faulty pressure regulator - sensor | X | X | X | X | | | | |
| Faulty low pressure supply pump | X | X | X | X | | | | |
| Air intake restriction | | | X | X | | X | | |
| Turbo problems – waste gate | | | | X | | X | X | X |
| EGR problems | | | | X | | X | X | |
| Injector blow-by seat leaking | | | X | X | X | X | | |
| Cam – crank sensor | X | X | X | | X | X | X | |
| Injector wiring harness | | | X | | X | X | X | |
| Internal engine problems | X | X | X | X | | | | X |

Low compression

Low engine compression will result in insufficient heat being generated to ignite the fuel and cause hard starting. This is more of a problem with older or high mileage vehicles. To find out the compression perform a cold engine compression test. Compression should be between 20 to 35 bars or 300 to 500 PSI. Anything below this will cause starting problems.

Low fuel pressure

It is in this area that most fuel supply problems occur. The problem could either be poor fuel supply to the rail/injectors or the rail/injectors are not holding the fuel within the system. The best way to diagnose this is to look at the fuel supply in 3 areas.

1. Low pressure supply **from the tank to the high pressure pump (HPP)** - some vehicles rely on the HPP to suck the fuel from the tank whilst others have an electric pump in the tank or fuel line to supply fuel to the to the HPP. The supply from the tank to the HPP should be about 2 to 5 bars.
2. Fuel is delivered **from the HPP to the rail/injectors** at about 200 bars during cranking, 300 bars at idle and anything from 1200 to 1800 bars running.
3. Once the fuel is delivered into the rail/injectors at the relevant pressure it must be **maintained within the injectors or rail**.

Low cranking speed

If the engine turns over too slowly, the pump cannot generate enough fuel pressure to activate start of injection causing hard starting problems. This is usually seen more in the colder months especially if the battery is run down.

Glow plugs or relay faulty

The engine relies on the glow plugs to generate heat to help with the combustion cycle. Some engines only use the glow plugs when cold but others will allow the glow plugs to work when the ECU (vehicle's computer) needs them to be on to help with combustion. Problems in this area will cause diesel engine starting problems, uneven running and white smoke when the engine is cold.

Insufficient fuel supply

This speaks for itself, not enough fuel in the tank or a problem with supply pipes being cracked or bent. The fuel tank breather can sometimes be blocked causing a vacuum in the tank which in turn draws the fuel back to the tank.

Fuel quality – contamination

I have been involved with diesel fuel injection all my working life and still find the topic of fuel and solutions controversial. Working with diesel injectors we see the result of poor fuel quality - damage and condition of the internal components. I know that if a good quality diesel and an solution is used regularly it will prolong the life of diesel injection equipment.

Poor fuel quality and general wear and tear are not the only cause of injector failure, the newer type of injectors sometimes fail due to design problems.

I would estimate that about 85% of injectors fail due to fuel related issues and the balance due to design problems.

Air - Vacuum in fuel supply and Blocked fuel supply

This is similar to insufficient fuel supply, but dirty fuel filters or a faulty filter head assembly may also cause fuel supply issues and hard starting.

Faulty injector/s

Probably the biggest result of injector failure is due to the injectors having excessive return flow or back leakage. This is due to worn parts which allow excessive fuel to go through the diesel injector and to return back to the tank or fuel system. This causes a drop in rail pressure (see "low fuel pressure") which results in hard starting or not starting at all.

Another problem resulting from worn parts is a delay in the start of injection which in turn results in rough running at low RPM or your diesel not starting.

Faulty high pressure pump

If the pump is faulty there will be a low fuel pressure problem. This problem arises if the pump "breaks up" internally causing swarf and iron filings to get into the fuel system. Normally this causes damage to the diesel injectors and unless the complete fuel system is attended to the problem will arise again. This is an expensive failure and no short cuts can be taken.

Faulty pressure regulator – sensor

Most vehicles have a pressure regulator fitted on the high pressure pump and a sensor fitted on the rail. If either of these are faulty there will be running issues like hard starting, uneven tick over and the vehicle cutting out when the RPM is increased.

Faulty low pressure pump

Not all vehicles have a low pressure supply pump but if they do it can be found either in the tank or on the fuel pipe near the tank. If your low pressure pump is faulty, you may experience symptoms similar to those of a faulty high pressure pump.

Air intake restriction

This would be due to a dirty air cleaner, blocked pipes or a stuck butterfly valve found on some vehicles. In addition, a faulty air flow sensor on the air intake will cause problems running and excessive smoke.

Turbo problems

We are seeing more turbochargers failing with newer vehicles, I put it down to a combination of things, high revving engines demanding more power, incorrect driver actions(not allowing the engine to idle a while when started and before switching off), poor maintenance and not replacing old oil with a good quality oil. A turbo spins at about 42000 revolutions per minute, the average washing machine at 1000 rpm.

As vehicles get older the turbo waste gate sticks causing the vehicle to either shut down, go into limp home mode or smoke excessively.

If a vehicle has a variable vane turbo, problems can arise if the vane carbon up, the symptoms are lack of power, black smoke and hesitation on acceleration. Also make sure that all the vacuum pipes and sensors that operate the turbo are operating correctly.

Another problem is if the air pipes to and from the inlet, inter cooler and turbo leak due to damage or loose clamps, the vehicle can experience similar problems.

EGR problems

I do not know why EGR (exhaust gas recycling) valves were ever put onto diesel engines, they cause more trouble than they are worth. The idea is that whilst the engine is at tick over, a valve opens and allows some of the exhaust gases to pass back into the nice clean air intake manifold.

After a while the gases containing dirty, sooty carbons start to cover and coat the intake area and valves causing the air to fuel ratio to become unbalanced thus resulting in more black smoke being emitted from the exhaust. This black smoke is then drawn back into the air intake via the EGR valve. A vicious cycle then starts with the engine producing more smoke and sootier carbons being drawn into the intake, a major problem. I would always recommend the EGR valve to be blanked off but some vehicles will not allow this.

Injector blow-by, seat leaking

Injector "blow-by" can be the cause of some of the following symptoms. Hard or difficult starting / erratic or uneven tick over or idle / lumpy running / smoke on tick over or acceleration / black tar around the injectors and a chuffing sound from the engine when running. Injector "blow-by" occurs when the injector does not seal against the injector seat in the cylinder head. Often a chuffing sound is heard or black "tar" can be seen around the injectors.

On some engine applications if this continues serious engine damage could result due to the fact that the ECU will over compensate the fuelling on the cylinder or cylinders with the seating problem causing piston washing or cylinder over fuelling. Even if the injector is removed, cleaned, a new copper washer fitted and then replaced it will not always rectify the problem. The reason for this is that the seat in the cylinder head has been eroded by the escaping combustion gases resulting in damage to the seat. The only way to reface the seat is to use a seat cutting tool and gently reface the seat in the head.

Check that the sensors are not loose, cracked or damaged as they are not very expensive. If you have any doubts I would recommend replacing them.

Injector wiring harness

More of a problem with vehicles that have the injectors under the rocker cover and allow oil to come in contact with the electrical connections. Even though some diagnostic machines will condemn the injector/s, many times the fault lies with the wiring harness.

Check that the electrical connections on the injectors are good and are making contact.

Internal engine problems

This is generally mechanical failure such as problems with bearings, pistons, oil pressure, overheating, valves and more. The list is endless, it is best to get an engine specialist to diagnose the fault.

The Answer is in the Smoke

We can generally understand what is wrong with a diesel engine by the color of smoke emitted from the exhaust. There are three basic colors - black, white and blue.

Black Smoke

This is due to a air to fuel ratio imbalance, either the fuel system is delivering too much fuel into the engine or there is not enough clean air (oxygen) a few things to look for :

- Faulty injectors (injectors need attention at about 100.000 to 120 000 miles)
- Faulty injector pump
- Dirty air cleaner
- Turbocharger or intercooler faulty
- Problems within cylinder head, valves clogged up due to faulty EGR (exhaust gas recycling unit)

White Smoke

Normally means that the fuel injected into the cylinder is not burning correctly. The smoke will burn your eyes.

- Engine/pump timing out
- Fuel starvation to the pump causing the pumps timing not to operate correctly
- Low engine compression
- Water/petrol in the fuel

Blue Smoke

The engine is burning engine oil

- Worn cylinders or piston rings
- Faulty valves or valve stem seals
- Engine over full with engine oil
- Faulty injector pump/lift pump allowing engine oil to be mixed with the diesel