

## Nuffield and Leyland Tractor - Diesel engine problems - Trouble shooting

| Possible cause                      | Engine won't start | Engine hard to start | Runs rough at idle | Lack of power | Diesel knock | Black smoke | White smoke | Blue smoke |
|-------------------------------------|--------------------|----------------------|--------------------|---------------|--------------|-------------|-------------|------------|
| Low compression                     | X                  | X                    |                    |               |              |             | X           |            |
| Low fuel pressure                   | X                  | X                    | X                  | X             |              | X           | X           |            |
| Low cranking speed - Faulty battery | X                  | X                    |                    |               |              |             |             |            |
| Thermostart or Glow plugs faulty    | X                  | X                    |                    |               |              |             | X           |            |
| Poor or Low fuel supply             | X                  | X                    | X                  | X             |              |             | X           |            |
| Contaminated fuel                   | X                  | X                    | X                  | X             | X            |             | X           |            |
| Air in fuel                         | X                  | X                    | X                  | X             |              |             |             |            |
| Fuel filter or pipes blocked        | X                  | X                    | X                  | X             | X            |             |             |            |
| Injectors faulty                    | X                  | X                    | X                  | X             | X            | X           | X           |            |
| Injection pump faulty               | X                  | X                    | X                  | X             |              | X           |             |            |
| Fuel lift pump faulty               | X                  | X                    | X                  | X             |              |             |             |            |
| Blocked or Dirty air cleaner        |                    |                      | X                  | X             |              | X           |             |            |
| Turbocharger faulty                 |                    |                      |                    | X             |              | X           | X           | X          |
| Injector washers leaking            |                    |                      | X                  | X             | X            | X           |             |            |
| Internal engine faults              | X                  | X                    | X                  | X             | X            |             |             | X          |

### **Low compression;**

Low cylinder compression will result in insufficient heat being generated to ignite the fuel and cause hard starting (The flash point of diesel is 210°C). This is more of a problem with higher hour engines. A cold engine compression test should be performed. Compression should be between 20 to 35 bars (300 to 500 psi) (24 to 27 bar (350 to 400 psi) is ideal), although it's more important to have equal pressures, no more than  $\pm 3$  bar (50 psi) between cylinders. Anything below this will cause starting problems.

### **Low fuel pressure;**

Low fuel pressure could be either poor fuel supply to the injectors or the injectors are worn and not holding the fuel pressure. The best way to diagnose this is to look at the fuel supply in 3 areas.

- A. Low pressure supply from the tank to the fuel injection pump. The supply from the tank to the injection pump via the lift pump should be about 3 to 7 psi.
- B. Fuel is delivered from the injection pump to the injectors at approx. 175 atmos.
- C. Once the fuel is delivered to the injectors at the relevant pressure it must lift the needle and spray finely atomised fuel into the cylinder.

### **Low cranking speed or Faulty battery;**

If the engine turns over too slowly, the injection pump can't generate enough fuel pressure, and the piston speed will be too low to generate a high enough air temperature to initiate combustion, causing hard starting problems. This is usually in the colder months especially if the battery is run down, the tractor has been left sitting or if the battery terminals are corroded. The battery should be kept fully charged and all connections in good order.

### **Thermostart or Glow plugs faulty;**

The engine relies on the thermostart or glow plugs (If fitted), to heat the air in the combustion chamber while the engine is being cranked. Problems in this area will cause starting problems, uneven running and white smoke when the engine is cold.

### **Poor or low fuel supply;**

If there isn't enough fuel in the tank or there's a problem with the fuel pipes being split or kinked the fuel supply can be restricted. The fuel tank cap breather can sometimes be blocked causing a vacuum in the tank.

### **Contaminated fuel;**

Poor quality fuel and water in the fuel can cause injection pump and injector failure. Filters and sediment bowls must be changed and drained regularly. Diesel contaminated with other fuels is a fairly common problem. Most pump and injectors failures are due to fuel related issues.

### **Air in fuel;**

This is similar to '**Poor or low fuel supply**'. Loose or faulty fuel pipe connections can allow air to be drawn into the system, but dirty fuel filters or a faulty filter head assembly may also cause fuel supply issues and hard starting. The banjo bolt with the 'restriction' hole must be in place between the leak off pipe and the filter head to build up back pressure in the injection pump, the leak off return pipe must go the bottom of the fuel tank.

### **Fuel filter fuel pipes blocked;**

Dirty fuel containers/tanks/fuel can cause filters in the tank, lift pump and main filter to become blocked. They must be cleaned or changed on a regular basis. Bio-diesel with a high Bio concentration is a very effective cleaner and can cause blockages.

### **Faulty injectors;**

The greatest cause of injector failure is due to the injectors having worn needles and nozzles or a build up of carbon. This can cause a poor spray pattern or fuel 'Dribble'. This results in hard or poor starting. The injectors should be serviced or replaced at regular intervals. Diesel additives can help to clean injectors and fuel systems. Over time the injector springs can weaken.

### **Injection pump faulty;**

If the pump is faulty there will be a '**Low fuel pressure**' problem. The transfer pump blades may be worn (DPA), the plungers may be stuck or worn (DPA & Minimec), the rack may be stuck (Minimec) or the cold start device may be stuck or inoperative (DPA & Minimec).

### **Fuel lift pump faulty;**

Known faults in the lift pump are:- Split diaphragms and leaking, loose or displaced non-return valves. If the lift pump is faulty there will be a '**Low fuel pressure**' problem, a split diaphragm will dilute the engine oil with diesel.

### **Blocked or Dirty air cleaner;**

A blocked or dirty air cleaner element can severely restrict air flow to the engine. Whether it's an oil bath or dry element air cleaner it must be serviced at regular intervals.

### **Turbocharger faulty;**

The most common turbocharger fault is due to incorrect operator actions (Not allowing the engine to idle when started and before stopping), poor maintenance and not using the correct type of oil. A turbocharger can rotate at up to 160,000 revolutions per minute under full power, therefore the rotor bearings require adequate lubrication. Worn bearings and seals will allow oil to pass into the engine! Another problem is if the air hoses to and from the turbocharger leak due to damaged or loose hose clips allowing air to escape.

### **Injector washers leaking;**

Leaking injector washers can be the cause of some of the following symptoms. Hard or difficult starting, erratic or uneven idle speed, lumpy running, smoke on idle, a black deposit around the injectors and a characteristic chuffing sound from the engine when running. Leaking injector washers occur when the injector does not seal against the copper injector washer in the cylinder head (This could be due to uneven tightening of the injector). Copper 'Work hardens' in time making sealing difficult if the injector is removed and replaced. Injector washers can be annealed to re-soften them. If closed end injector sleeves are fitted they can be removed and annealed (Heat to cherry red and quench in cold water).

### **Internal engine faults;**

This is usually a mechanical failure such as; cracked pistons, worn or broken piston rings, low oil pressure, overheating, blowing valves, cracked liners, leaking liner seals, blowing head gasket, worn bearings, leaking valve seals and much more. The list is endless, so it's best to get an engine specialist to diagnose the fault.

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## **The Answer is in the Smoke!**

Generally a diagnosis as to what's wrong with a diesel engine can be identified by the colour of smoke coming from the exhaust pipe. There are three basic colours - '**Black**', '**White**' and '**Blue**'.

### **Black Smoke;**

This is due to an air to fuel ratio imbalance, either the fuel system is delivering too much fuel or there's not enough clean air (oxygen) for complete combustion, a few things to look for are:-

- A. Faulty injectors
- B. Faulty injector pump
- C. Dirty or blocked air cleaner
- D. Turbocharger faulty
- E. Problems within the cylinder head or inlet valves not seating due to a build up of carbon
- F. Over fuelling
- G. High altitude operation

## **White Smoke**

This is normally caused by the fuel being injected and not burning correctly. The smoke will 'Sting' your eyes. This problem can be caused by any of the following:-

- A. Injection pump timing incorrect
- B. Fuel starvation to the injection pump
- C. Low engine compression
- D. Water in the fuel
- E. Water entering the combustion chamber

Faulty head gaskets and cracked cylinder liners & heads are a common cause of water entering the cylinder.

## **Blue Smoke**

Blue smoke will be emitted when the engine is burning oil, this can sometimes be accompanied by oil coming out of the end of the exhaust pipe, common problems are:-

- A. Worn cylinder liners or piston rings
- B. Piston rings sticking
- C. Faulty valves stem seals
- D. Engine over full with engine oil
- E. Dilution of the engine oil with fuel
- F. Wrong 'Grade' of oil, I.E. Too thin
- G. Too good a quality of oil in an old 'Classic' engine, I.E. Using semi synthetic or fully synthetic oil.
- E. The engine not being 'Worked' hard enough, all diesel engines need hard work otherwise the cylinder bores can become 'Glazed'.

## **Note:-**

**All of the above assumes that the engine is in its original build configuration without non standard pistons, liners and crankshafts being fitted, after market turbochargers being fitted or the fuel injection pump being tampered with to increase the fuelling. If a non standard or different type of injection pump is fitted then timing and fuelling will be a major issue and the engine will most likely 'Smoke'.**

**The problems and faults contained in this article are not exhaustive, there may very well be other factors causing similar symptoms.**

**An engine that 'Black Smokes' is inefficient, uses too much fuel and is environmentally damaging.**