

# **Misfiring**

## **Diagnosis and Correction**

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## 1 DIAGNOSING MISFIRES

Misfire is a common drivability problem that may or may not be easy to diagnose and correct, depending on the cause. There's really no magic bullet for diagnosing misfires. A certain amount of detective work is required to isolate the fault and determine the underlying cause.

A misfiring cylinder can cause the engine to shake so badly at idle that it creates vibrations that can be felt in the steering wheel and throughout the vehicle. The engine also may be hard to start and may even stall at idle, depending on the accessory load (for example air conditioning, headlights, or electric rear defroster).

When misfire occurs, performance suffers along with fuel economy, emissions and idle quality. And, when a misfiring vehicle is subjected to an emissions test, it will usually fail because of the unusually high levels of hydrocarbons (HC) in its exhaust.

### 1.1 Reasons for Misfiring

Cylinder misfiring is generally caused by one of three things: loss of spark; air/fuel mixture too far out of balance to ignite; or loss of compression.

#### 1.1.1 Loss of Spark

Loss of spark includes anything that prevents coil voltage from jumping the electrode gap at the end of the spark plug. Causes include worn, fouled or damaged spark plugs, bad plug wires, a weak coil, or a cracked distributor cap. On distributor-equipped vehicles, excessive rotor gas inside a distributor will affect all cylinders, rather than a single cylinder.

#### 1.1.2 Improper Air/Fuel Ratio

"Lean misfire" occurs when there is insufficient gasoline in the air/fuel mixture, creating a mixture that is too lean to burn. Lean misfire can be caused by a dirty, clogged or inoperative fuel injector; air leaks; or low fuel pressure resulting from a weak pump, restricted filter or leaky pressure regulator. Low fuel pressure will affect all cylinders, rather than an individual cylinder, as would most air leaks. A leaky EGR valve can also have the same effect as an intake air leak.

#### 1.1.3 Loss of Compression

Compression loss causes the cylinder to lose most of its air/fuel charge before it can be ignited. The most likely reasons for compression loss are leaky (burned) exhaust valves or blown head gaskets. If two adjacent cylinders are misfiring, the head gasket between them has probably failed. Also, if the engine is overheating and/or losing coolant, the head gasket is likely to be the culprit.

## 1.2 Intermittent Misfiring

Intermittent misfires are the worst kind to diagnose, because the problem comes and goes depending on engine load or operating conditions. The engine may misfire and run rough when cold, but then smooth out as it warms up. Or the engine may start and idle fine, but then misfire or hesitate when placed under load. Or an engine may run fine most of the time but suddenly misfire or cut out for no apparent reason. Since intermittent misfires can be a real challenge to diagnose, let's start with a steady misfire in one cylinder before moving on to intermittent misfires.

## 1.3 Consistent Misfiring

For a steady misfire condition, isolating the misfiring cylinder is the first step in diagnosing the problem. Today's OBDII systems make this easy. Use a scan tool to read the Diagnostic Trouble Code (DTC) stored in the PCM. The PCM will set a P030x series code, where the value of "x" indicates the number of the misfiring cylinder, when it detects a misfire condition.

This is preferable to the traditional method of pulling plug wires to identify a weak cylinder, because it prevents the voltage from causing any damage to the electronics in the ignition system. When a plug wire is physically disconnected from a spark plug, the high voltage surge from the coil cannot follow its normal path to ground through the plug wire and spark plug, so it passes back through the coil. Most ignition systems are robust enough to withstand such voltage backups intermittently but not on a prolonged basis. If the coil or ignition module is already weak, this may cause the component to fail.

### 1.3.1 Ignition Checks

Once you've isolated a misfire to a particular cylinder, the cause will usually become obvious as soon as you remove and inspect the spark plug. If the plug's insulator is cracked or broken (Figure 1), this is what is causing the problem. Severe detonation, incorrect gapping procedures, or careless installation can cause such plug damage.

If the plug is fouled, this is the reason for the misfiring, but you must still determine what has caused the plug to foul. Heavy, black, oily deposits (Figure 2) indicate that the engine is burning oil. The most likely cause is worn valve guide seals and/or guides, but worn rings and cylinders can also allow oil into the combustion chamber. Replacing the spark plug will temporarily cure the misfire problem, but the engine will continue to foul plugs until the oil consumption problem is corrected.

Carbon fouling, another type of plug fouling, can be recognized by a buildup of soft, dry, black deposits on the plug. Carbon fouling (Figure 3) can be caused by an overly rich A/F mixture, overly retarded ignition timing, too cold a plug for the application, or faulty ignition wires.



Figure 1



Figure 2

Short trip stop-and-go driving can cause a rapid buildup of normal deposits on plugs, especially if the engine has a lot of miles and there has been some oil leakage past the valve guide seals and rings. The cure here might be to switch to a one-step hotter spark plug.

A spark plug that shows heavy whitish to brown deposits (Figure 4) may indicate a coolant leak, either past the head gasket or through a crack in the combustion chamber. This type of problem will only get worse and may soon lead to even greater problems if the leak isn't fixed. Coolant makes a poor lubricant and can cause ring, cylinder, and bearing damage when it gets into a cylinder or the crankcase. Loss of coolant can also lead to overheating, which may result in cracking or warping of aluminum cylinder heads. If you suspect this kind of problem, pressure-test the cooling system to check for internal coolant leakage.

Spark plugs that show pre-ignition or detonation damage, such as melted or burned electrodes (Figure 5), blistered insulators, and/or metallic deposits, may indicate that timing is advanced too far, a cooling system problem, too hot a plug for the application, or an overly lean air/fuel mixture. You may also want to try a colder heat range plug.

Figure 6 shows a plug exhibiting normal wear. If the plug appears to be OK but is wet, inspect the plug wire and boots for damage. Measure the plug wire's resistance, end to end, with an ohmmeter. Refer to the vehicle manufacturer's specifications, but, as a rule, resistance should not exceed 8K ohms/foot. Replace the wire if resistance exceeds specifications.

If the spark plug and plug wire are OK but the cylinder is weak, a leakdown or compression test should be done to determine if the problem is compression related.

### 1.3.2 Leakdown and Compression Tests

Leakdown and compression tests will help you determine if oil is getting past the valve guides or the rings. A cylinder demonstrates excessive leakdown when dry, but holds good compression when a little oil is squirted into the cylinder (wet compression test), indicates that the engine needs new valve guide seals and/or guide work.

First, perform a dry compression test. The exhaust valves are the ones most likely to lose their seal and leak compression, so, if you find unusually low compression, follow up with a wet compression test to determine if the problem lies with the valves or rings.

If the wet compression test readings are significantly higher than the dry test readings, the piston rings and/or cylinder walls are worn. The only cure for worn rings and cylinders is to overhaul or replace the engine.



Figure 3



Figure 4



Figure 5



Figure 6

No change in compression between the dry and wet tests indicates that the problem is either valve related (possibly a bad exhaust valve) or a blown head gasket. For a leaky head gasket, replace the gasket.

A valve job will be required to cure a leaky valve. However, most late model OHC engines have positive valve guide seals, and often the guides are fine, but the seals are worn or cracked. The seals can be replaced on some engines without too much effort and without having to remove the heads. The procedure involves pulling off the valve cover, removing the valvetrain hardware, and using an external spring compressor to remove the springs so new seals can be installed. Connecting a regulated air hose to the spark plug hole will prevent the valve from dropping down into the cylinder. Unfortunately, on many OHC engines, so much disassembly is involved in getting to the valve springs that it's easier to remove the head.

Although rare, a rounded cam lobe can also cause low cylinder compression. If the intake valve can't open, the cylinder will be unable to breathe normally, and compression will be low. If you suspect this kind of problem, conduct a visual inspection of the valvetrain and cam.

### **1.3.3 Fuel System Tests**

If the ignition components and compression in a misfiring cylinder are okay, the air/fuel mixture is the only other possibility. Begin by checking for voltage at the injector. A good injector should also buzz while the engine is running. Silence indicates that the injector is inoperative, but no voltage at the injector indicates that the problem lies in the wiring or computer driver circuit, not with the injector.

If the injector is buzzing and spraying fuel but the cylinder is getting an insufficient fuel volume, the injector is dirty or clogged. On-car cleaning may remove the varnish deposits that are restricting the injector and inhibiting fuel delivery.

In the presence of a random misfire that can't be isolated to a particular cylinder, all the injectors may be somewhat dirty. However, check fuel pressure to ensure the fuel filter isn't plugged, the fuel pump is okay, and the fuel pressure regulator is operating properly. A plugged fuel filter is the most likely cause of reduced fuel pressure.

If fuel pressure is within specifications, check the intake vacuum to determine if there is an air leak upsetting the overall air/fuel ratio. Other possible reasons for low vacuum are a leaky EGR valve or a leaky power brake booster.

### **1.3.4 Scan Tool Misfire Diagnostics**

When the OBD II system detects a misfire rate that exceeds a preprogrammed maximum, it illuminates the Check Engine light and sets a P-code that corresponds to the misfiring cylinder. The last number in a P300 series code identifies the misfiring cylinder. A code P304, for example, indicates that cylinder number four is misfiring. If you also pull a P204 code (P200 series codes cover the injectors), a bad injector is probably causing the misfire.

A P300 code indicates that the misfire is random and is moving around from cylinder to cylinder. The cause here is most likely something that upsets the engine's air/fuel mixture, such as a major vacuum leak, leaky EGR valve or unusually low fuel pressure (weak pump or faulty pressure regulator).