

VOLKSWAGEN · POWERTRAIN

P1166

OBD-II DIAGNOSTIC TROUBLE CODE (DTC)

P1166 · Volkswagen

Bank 1 Long Term Fuel Trim Range 2 Upper Rich Limit Exceeded

P1166 on Volkswagen vehicles means the engine control module has detected that the long-term fuel trim for bank 1 has exceeded its upper rich limit within a specific operating range, indicating the engine is running too rich and the computer can no longer compensate by leaning out the mixture. The ECM monitors fuel trim over time and sets this code when the long-term correction value stays beyond the rich threshold for that range, typically because of a persistent rich condition.

SYSTEM

Powertrain

CODE TYPE

Volkswagen specific

SEVERITY

Medium

FIX DIFFICULTY

Intermediate

AREA

Fuel and air metering

Symptoms you may notice

- Often no symptoms besides the warning light, especially if the rich condition is mild
- Noticeably reduced fuel economy compared to normal driving
- A strong fuel odor from the exhaust or around the engine bay
- Rough idle or engine stumbling when the mixture becomes excessively rich
- Black sooty exhaust smoke under acceleration
- Possible hesitation or poor throttle response as the ECM struggles to correct the mixture

Common causes, most likely first

- 1 Leaking or dripping fuel injectors that deliver more fuel than the ECM commands
- 2 A faulty mass air flow sensor that over-reports airflow, causing the ECM to add excess fuel
- 3 A stuck-open or leaking purge valve in the evaporative emissions system, allowing fuel vapor to enter the intake
- 4 High fuel pressure from a failing fuel pressure regulator or a restricted fuel return line
- 5 A contaminated or faulty oxygen sensor that reads lean and tricks the ECM into enriching the mixture
- 6 An engine coolant temperature sensor stuck on cold, making the ECM apply cold-start enrichment continuously
- 7 Mechanical issues such as low compression or a leaking intake manifold gasket that alter the air-fuel mixture



How to diagnose and fix it

- 1 Connect a scan tool and record live fuel trim data, then compare short-term and long-term trims at idle and at cruise to confirm the rich condition
- 2 Inspect the air intake system for restrictions or leaks after the mass air flow sensor, and clean or replace the sensor if its readings are skewed
- 3 Test the evaporative emissions purge valve for sticking open and allowing fuel vapor into the intake when it should be closed
- 4 Check fuel pressure with a gauge and compare it to the manufacturer's specification to rule out a failing regulator or restricted return line
- 5 Perform an injector balance test or remove injectors for bench testing to identify leaking or dripping injectors
- 6 Verify oxygen sensor operation with a scan tool or oscilloscope, looking for a sensor that is slow or biased lean
- 7 Check engine coolant temperature sensor readings against actual engine temperature and replace the sensor if it is stuck on cold

Rich fuel trim traps on Volkswagen engines

- A leaking purge valve is one of the most commonly overlooked causes of a rich fuel trim code on Volkswagens, because the valve can stick open intermittently and not set an evaporative emissions code.
- A mass air flow sensor that over-reports airflow will cause the ECM to add fuel, but the sensor may not set its own fault code because its signal stays within the normal voltage range.
- Fuel trim range 2 often corresponds to a specific operating window such as idle or low load, so the rich condition may only appear during certain driving conditions and not during a quick scan tool check.
- A dirty or contaminated mass air flow sensor element can skew readings without triggering a mass air flow code, so cleaning the sensor is a cheap first step before replacing it.
- A stuck-open thermostat can keep the engine running cold, causing the ECM to apply enrichment and eventually set a rich fuel trim code even though the thermostat seems unrelated.

Can I keep driving with P1166?

You can usually drive the vehicle short distances to a repair shop, but avoid hard acceleration and prolonged driving because the rich mixture can overheat and damage the catalytic converter over time. If the engine runs rough or you smell strong fuel, stop driving and have the vehicle towed to prevent safety hazards.

Tools that help

- OBD-II scan tool with live data and fuel trim graphing capability
- Digital multimeter for testing sensors and wiring
- Fuel pressure gauge
- Vacuum gauge for checking intake integrity
- Hand tools for removing and inspecting injectors and sensors



Reading P1166

- P** Powertrain: engine, transmission and emissions.
- 1** Manufacturer-specific code (Volkswagen): its meaning depends on the make.
- 1** Fuel and air metering.
- 66** The exact fault within that area.

Often seen with

P1165 Bank 1 Long Term Fuel Trim Range 1 Lower Lean Limit Exceeded · **P1165** Swirl Control Valve Control Vacuum Switch · **P1165** HO2S11 Slow Response Bank 1 Sensor 1 · **P1165** HO2S Cross Counts Bank 2 Sensor 2 · **P1165** HO2S Cross Counts Bank 2 Sensor 2 · **P1165** Fuel Trim Adaptation Additive Per Ignition Bank 2 High · **P0172** System Too Rich (Bank 1) · **P0175** System Too Rich (Bank 2) · **P2188** System Too Rich at Idle (Bank 1) · **P2190** System Too Rich at Idle (Bank 2)

See it working

Watch the animated explainer [How a Radiator Fan Relay Circuit Works](#) on Auto Veteran to see the parts involved moving.

Full guide, related articles and animations: <https://www.autoveteran.tech/dtc-codes/volkswagen-p1166/>

