**DTC P0171 or P0172**

 **[Diagnostic Instructions](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406" \l "d4159e3)**

* Perform the [Diagnostic System Check - Vehicle](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=72794&refDoc=2090010&from=sm) prior to using this diagnostic procedure.
* Review [Strategy Based Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=161235&refDoc=2090010&from=sm) for an overview of the diagnostic approach.
* [Diagnostic Procedure Instructions](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=161236&refDoc=2090010&from=sm) provides an overview of each diagnostic category.

[**DTC Descriptors**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e39)

**DTC P0171**

Fuel Trim System Lean

**DTC P0172**

Fuel Trim System Rich

[**Circuit/System Description**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e66)

The engine control module (ECM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open Loop and Closed Loop (CL). During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During CL, the ECM adds HO2S inputs and level of purge to calculate the short and long term fuel trim (FT) adjustments. If the HO2S indicates a lean condition, the fuel trim values will be above 0 percent. If the HO2S indicates a rich condition, the FT values will be below 0 percent. The short term FT values change rapidly in response to the HO2S voltage signals. The long term FT makes coarse adjustments in order to maintain an optimum air/fuel ratio. A block of memory cells contain information arranged in combinations of engine RPM and engine load for a full range of vehicle operating conditions. The long term FT diagnostic is based on an average of cells currently being used. The ECM selects the cells based on the engine speed and load. The FT diagnostic will conduct a test to determine if a rich failure actually exists or if excessive vapor from the evaporative emission (EVAP) canister is causing a rich condition.

If the ECM detects an excessively lean condition, DTC P0171 sets. If the ECM detects an excessively rich condition, DTC P0172 sets.

**3.5L RPO LZE, VIN Code K—E85 compatible engines only**

Over-estimation of the ethanol content will result in a rich shift of fuel trim values, and under-estimation will result in a lean shift of fuel trim values. A fuel trim DTC may set if the learned alcohol content, Fuel Alcohol Content parameter on the scan tool, is different than the measured alcohol content in the vehicle such that fuel trim values exceed failure threshold values.

[**Conditions for Running the DTC**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e87)

* DTCs P0030, P0036, P0053, P0054, P0068, P0101, P0102, P0103, P0107, P0108, P0112, P0113, P0116, P0120, P0121, P0122, P0123, P0128, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P013A, P013B, P013E, P013F, P0140, P0141, P0201–P0206, P0220, P0222, P0223, P0300, P0442, P0443, P0446, P0449, P0451, P0452, P0453, P0454, P0455, P0461, P0462, P0463, P0464, P0496, P0506, P0507, P1133, P1516, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, P2176, P2270, P2271, P2A00 are not set.
* The engine is in Closed Loop status.
* The Fuel Trim Learn is enabled.
* The engine coolant temperature (ECT) is between −38 and +150°C (−36.4 and +302°F).
* The intake air temperature (IAT) is between −38 and +150°C (−36.4 and +302°F).
* The manifold absolute pressure (MAP) is between 10–105 kPa.

OR

* The MAP is between 10–255 kPa for vehicles equipped with secondary air injection (AIR) reaction systems.
* The vehicle speed is less than 300 km/h (186 mph).
* The engine speed is between 400–7,000 RPM.
* The mass airflow (MAF) is between 1–510 g/s.
* The barometric pressure (BARO) is more than 70 kPa.
* The fuel level is more than 10 percent.
* DTC P0171 and P0172 run continuously when the above conditions have been met.

[**Conditions for Setting the DTC**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e179)

* The average long term FT value is more than a calibrated value.
* The above condition is present for more than 3 minutes after the Conditions for Running the DTC have been met.
* The diagnostic runs continuously.

[**Action Taken When the DTC Sets**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e207)

* DTCs P0171 and P0172 are Type B DTCs.
* The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the ECM stores this information in the Failure records. If the diagnostic reports a failure on the second ignition cycle, the ECM records the operating conditions at the time of the failure. The ECM writes the operating conditions to the Freeze Frame and updates the Failure records. The ECM illuminates the malfunction indicator lamp (MIL) when one of the following occurs:
	+ The ECM detects the same fuel trim failure during 2 consecutive trips.
	+ The ECM detects any fuel trim failure during any subsequent trip if the conditions at the time of failure meet the following criteria:
		- The engine load is within 20 percent of the previous test that failed.
		- The engine speed is within 375 RPM of the previous test that failed.
		- The engine coolant temperature is in the same range of the previous test that failed.

[**Conditions for Clearing the MIL/DTC**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e264)

* DTCs P0171 and P0172 are Type B DTCs.
* The ECM turns OFF the malfunction indicator lamp (MIL) at the beginning of the fourth ignition cycle, after 3 ignition cycles that the diagnostic runs and does not fail.
* A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
* A history DTC and related Freeze Frame data clears after 40 warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
* Clear the MIL and the DTC with a scan tool.

[**Diagnostic Aids**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e303)

On vehicles equipped with a vacuum brake booster, rapid brake pedal cycling may imitate a vacuum leak.

[**Reference Information**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e312)

**Electrical Information Reference**

* [Circuit Testing](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=62194&refDoc=2090010&from=sm)
* [Connector Repairs](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=61973&refDoc=2090010&from=sm)
* [Testing for Intermittent Conditions and Poor Connections](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=62112&refDoc=2090010&from=sm)
* [Wiring Repairs](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=61965&refDoc=2090010&from=sm)

**DTC Type Reference**

[Powertrain Diagnostic Trouble Code (DTC) Type Definitions](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=161179&refDoc=2090010&from=sm)

**Scan Tool Reference**

[Control Module References](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=72864&refDoc=2090010&from=sm) for scan tool information

[**Circuit/System Verification**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e379)

**Note:**

* Disregard any transmission symptoms, antilock brake system (ABS) indicators, and traction control system (TCS) indicators until any fuel trim faults are repaired. A fuel trim fault may cause default actions such as harsh shifts and illumination of the ABS/TCS indicators.
* The 3.5L engine, RPO LZE, VIN Code K, may use American Society for Testing and Materials (ASTM) gasoline with 10 percent or less ethanol or unleaded fuel containing 85 percent ethanol, or ASTM E85. Refer to [Fuel System Description](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83910&refDoc=2090010&from=sm).
* The 3.5L RPO LZE, VIN Code K, E85 compatible engines only—Over-estimation of the ethanol content will result in a rich shift of fuel trim values, and under-estimation will result in a lean shift of fuel trim values. A fuel trim DTC may set if the learned alcohol content, Fuel Alcohol Content parameter on the scan tool, is different than the measured alcohol content in the vehicle such that fuel trim values exceed failure threshold values. Refer to [Fuel Composition Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=160349&refDoc=2090010&from=sm).
* If any DTCs other than DTC P0171 or P0172 are also set, refer to [Diagnostic Trouble Code (DTC) List - Vehicle](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=72795&refDoc=2090010&from=sm).
* Allow the engine to reach operating temperature. With the engine running, observe the HO2S parameter with a scan tool. The HO2S 1 value should vary from approximately 40 mV to approximately 900 mV, and respond to fueling changes.
	+ If the value does not vary from approximately 40 mV to approximately 900 mV, refer to [DTC P0030, P0036, P0053, P0054, P0135, or P0141](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=143643&refDoc=2090010&from=sm), [DTC P0131, P0132, P0137, or P0138](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=159874&refDoc=2090010&from=sm), or [DTC P0133, P0134, P013A, P013B, P013E, P013F, P0140, P1133, P2270, P2271, or P2A00](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=164738&refDoc=2090010&from=sm).

**Note:**The EVAP purge enablement may cause the FT to be momentarily outside the normal range.

* The normal Short Term FT parameter should be moving rapidly between +10 percent and −10 percent, with near 0 percent the optimum, with the engine running at operating temperature.
* The Long Term FT parameter should be moving slowly between +10 percent and −10 percent, with near 0 percent the optimum, with the engine running at operating temperature.
* Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.

[**Circuit/System Testing**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e482)

**Note:**The Circuit/System Verification MUST be performed first or misdiagnosis may result.

**P0171**

Allow the engine to reach operating temperature. With the engine running, observe the affected Long Term FT parameter with a scan tool. The reading should be between 0–19.5 percent.

* + If not within the specified range, inspect for the following:
* With the ignition ON and the engine OFF, observe the MAP sensor parameter. The MAP sensor pressure should be within the range specified for your altitude. Refer to [Altitude Versus Barometric Pressure](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83671&refDoc=2090010&from=sm).
	+ If the MAP sensor does not indicate the correct barometric pressure, refer to [DTC P0106](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83697&refDoc=2090010&from=sm).
* With the engine idling and the transmission in the Park or Neutral position, observe the MAP sensor parameter. The MAP sensor parameter should be between 19–42 kPa.
	+ If the MAP sensor parameter is not between 19–42 kPa, refer to [DTC P0106](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83697&refDoc=2090010&from=sm).
* With the engine idling, observe the mass airflow (MAF) sensor parameter. The MAF sensor parameter should be between 3–10 g/s at idle.
	+ If the MAF sensor parameter is not between 3–10 g/s at idle, refer to [DTC P0101 or P1101](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=144881&refDoc=2090010&from=sm) or [DTC P0102 or P0103](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=143645&refDoc=2090010&from=sm).
* Vacuum hoses for splits, kinks, and proper connections
* Insufficient fuel in the tank
* Low fuel pressure—Refer to [Fuel System Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83807&refDoc=2090010&from=sm).
* Fuel contamination—Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83813&refDoc=2090010&from=sm).
* Fuel composition—Refer to [Fuel Composition Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=160349&refDoc=2090010&from=sm) — RPO LZE, VIN code K, E85 compatible engines only.
* Malfunctioning fuel injectors—Refer to [Fuel Injector Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=144898&refDoc=2090010&from=sm).
* Missing, loose, or leaking exhaust components from the HO2S forward—Refer to [Symptoms - Engine Exhaust](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=37994&refDoc=2090010&from=sm).
* Vacuum leaks at the intake manifold, the throttle body, the brake booster hose, and the injector O-rings
* The air induction system and the air intake ducts for leaks or for a missing air filter element
* A cracked evaporative canister
* Evaporative pipes plugged, obstructed, or leaking
* The crankcase ventilation system for leaks—Refer to [Crankcase Ventilation System Inspection/Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=80951&refDoc=2090010&from=sm).
* The HO2S sensor 1 for proper installation and for electrical wires or connectors that may have contacted the exhaust system
* The HO2S sensor 1 signal circuit open, shorted to ground, or shorted to the low reference circuit
* The HO2S sensor 1 low signal circuit for an open circuit or high resistance
* Malfunctioning engine components—Refer to [Symptoms - Engine Mechanical](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=80933&refDoc=2090010&from=sm).

Repair or replace as necessary.

**Note:**The Circuit/System Verification MUST be performed first or misdiagnosis may result.

**P0172**

Allow the engine to reach operating temperature. With the engine running, observe the affected Long Term FT parameter with a scan tool. The reading should be between −25 and 0 percent.

* + If not within the specified range, inspect for the following:
* With the ignition ON and the engine OFF, observe the MAP sensor parameter. The MAP sensor pressure should be within the range specified for your altitude. Refer to [Altitude Versus Barometric Pressure](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83671&refDoc=2090010&from=sm).
	+ If the MAP sensor does not indicate the correct barometric pressure, refer to [DTC P0106](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83697&refDoc=2090010&from=sm).
* With the engine idling and the transmission in the Park or Neutral position, observe the MAP sensor parameter. The MAP sensor parameter should be between 19–42 kPa.
	+ If the MAP sensor parameter is not between 19–42 kPa, refer to [DTC P0106](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83697&refDoc=2090010&from=sm).
* With the engine idling, observe the mass airflow (MAF) sensor parameter. The MAF sensor parameter should be between 3–10 g/s at idle.
	+ If the MAF sensor parameter is not between 3–10 g/s at idle, refer to [DTC P0101 or P1101](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=144881&refDoc=2090010&from=sm) or [DTC P0102 or P0103](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=143645&refDoc=2090010&from=sm).
* Vacuum hoses for splits, kinks, and proper connections
* The air duct for being collapsed or restricted
* The air filter for being dirty or restricted
* Objects blocking the throttle body
* Excessive fuel in the crankcase due to leaking fuel injectors—Refer to [Fuel Injector Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=144898&refDoc=2090010&from=sm).
* The evaporative emissions control system for improper operation
* Excessive fuel pressure—Refer to [Fuel System Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83807&refDoc=2090010&from=sm).
* Malfunctioning fuel injectors—Refer to [Fuel Injector Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=144898&refDoc=2090010&from=sm).
* Fuel contamination—Refer to [Alcohol/Contaminants-in-Fuel Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83813&refDoc=2090010&from=sm).
* Fuel composition—Refer to [Fuel Composition Diagnosis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=160349&refDoc=2090010&from=sm) – RPO LZE, VIN code K, E85 engines only.
* The HO2S sensor 1 for proper installation and for electrical wires or connectors that may have contacted the exhaust system
* The HO2S sensor 1 signal circuit shorted to voltage
* Malfunctioning engine components—Refer to [Symptoms - Engine Mechanical](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=80933&refDoc=2090010&from=sm).

Repair or replace as necessary.

[**Repair Instructions**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e898)

* [Air Cleaner Assembly Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83907&refDoc=2090010&from=sm)
* [Air Cleaner Element Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83906&refDoc=2090010&from=sm)
* [Air Cleaner Outlet Duct Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=143930&refDoc=2090010&from=sm)
* [Evaporative Emission Canister Purge Solenoid Valve Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=121124&refDoc=2090010&from=sm)
* [Evaporative Emission Canister Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83872&refDoc=2090010&from=sm)
* [Evaporative Emission Canister Vent Solenoid Valve Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=121123&refDoc=2090010&from=sm)
* [Evaporative Emission Line Replacement - Engine to Chassis](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83871&refDoc=2090010&from=sm)
* [Evaporative Emission System Cleaning](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83873&refDoc=2090010&from=sm)
* [Fuel Hose/Pipe Assembly Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83860&refDoc=2090010&from=sm)
* [Fuel Injection Fuel Rail Assembly Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83862&refDoc=2090010&from=sm)
* [Fuel Injector Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83864&refDoc=2090010&from=sm)
* [Fuel Level Sensor Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83852&refDoc=2090010&from=sm)
* [Fuel System Cleaning](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83861&refDoc=2090010&from=sm)
* [Fuel Tank Draining](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83848&refDoc=2090010&from=sm)
* [Heated Oxygen Sensor Replacement - Sensor 1](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83834&refDoc=2090010&from=sm) and [Heated Oxygen Sensor Replacement - Sensor 2](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83835&refDoc=2090010&from=sm)
* [Manifold Absolute Pressure Sensor Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83833&refDoc=2090010&from=sm)
* [Mass Airflow Sensor with Intake Air Temperature Sensor Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=145003&refDoc=2090010&from=sm)
* [Throttle Body Assembly Replacement](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83841&refDoc=2090010&from=sm)

[**Repair Verification**](https://gsi.ext.gm.com/gsi/showDoc.do?laborOpCode=&docSyskey=2090010&cellId=134316&pubObjSyskey=5299969&from=sm&pubCellSyskey=322406#d4159e1075)

**Note:**After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim values.

1. Install any components that have been removed or replaced during diagnosis.
2. Perform any adjustments, programming, or setup procedures that are required when a component or module is removed or replaced.
3. Turn ON the ignition, with the engine OFF.

**Note:**DO NOT clear codes with the engine running. DTCs may reset in the same ignition cycle.

1. Clear the DTCs.
2. Turn OFF the ignition for 60 seconds.
3. Start the engine.
4. Duplicate the Conditions for Running the DTC and use Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the [Diagnostic Trouble Code (DTC) List - Vehicle](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=72795&refDoc=2090010&from=sm) and perform the appropriate diagnostic procedure.
5. To verify that the performance of the catalytic converter has not been affected by the condition that set this DTC, perform the Repair Verification for DTC P0420. Refer to [DTC P0420](https://gsi.ext.gm.com/gsi/cellHandler.do?cellId=83746&refDoc=2090010&from=sm).