
Electric Exhaust Gas Recirculation (EEGR) System Monitor

The EEGR system monitor is an on-board strategy designed to test the integrity and flow characteristics of the EGR system. The monitor is activated during EGR system operation and after certain base engine conditions are satisfied. Inputs from the engine coolant temperature (ECT) or cylinder head temperature (CHT), intake air temperature (IAT), throttle position (TP), crankshaft position (CKP), mass air flow (MAF), and manifold absolute pressure (MAP) sensors are required to activate the EGR system monitor. Once activated, the EGR system monitor carries out each of the tests described below during the engine modes and conditions indicated. Some of the EGR system monitor tests are also carried out during a key on engine off (KOEO) or key on engine running (KOER) self-test.

The EEGR monitor consists of an electrical and functional test that checks the stepper motor and the EEGR system for correct flow. The powertrain control module (PCM) controls the EEGR valve by commanding from 0 to 52 discrete increments or steps to get the valve from fully closed to fully open respectively. The stepper motor electrical test is a continuous check of the four electric stepper motor coils and circuits to the PCM. A concern is indicated if an open circuit, short to voltage, or short to ground has occurred in one or more of the stepper motor coils or circuits for a calibrated period of time. If a concern has been detected, the EEGR system is disabled, setting diagnostic trouble code (DTC) P0403. Additional monitoring is suspended for the remainder of the drive cycle, or until the next engine startup.

After the vehicle has warmed up and normal EEGR flow rates are being commanded by the PCM, the EEGR flow check is carried out. The flow test is carried out once per drive cycle when a minimum amount of exhaust gas is requested and the remaining entry conditions required to initiate the test are satisfied. If a concern is detected, the EEGR system, as well as the EEGR monitor, is disabled until the next engine startup.

An EGR flow concern is indicated by either a no flow condition or a low flow condition prior to exceeding 1.5 times the applicable emission standard. The criteria used to determine which flow concern threshold applies is based upon whether or not the applicable emission standards are exceeded on the federal test procedure test cycle without EGR delivery.

The EGR flow test is done by observing the behavior of two different values of MAP: the analog MAP sensor reading, and inferred MAP, (MAP calculated from the MAF, throttle position, RPM, barometric pressure (BARO) and other sensors). Due to the location of the MAF sensor, the calculation of inferred MAP is not compensated for EGR flow. Therefore, it does not account for the effects of EGR flow whereas measured MAP does respond to the effects of EGR flow. The amount of EGR flow can therefore be calculated by looking at the difference between measured MAP and inferred MAP under the correct engine operating conditions.

Some differences always exist between measured MAP and inferred MAP due to hardware variations. These variations are learned during steady engine operating conditions without EGR flow and the estimated EGR flow is compensated for these differences. The result of this compensation is values of measured MAP and inferred MAP that are equal under conditions where no EGR is flowing. Hence, when EGR is flowing the increased pressure in measured MAP over inferred MAP represents the pressure change due to EGR flow. This pressure change is normalized to a value between 0 and 1 representing the ratio of measured EGR flow to the scheduled EGR flow and is referred to as the EGR flow degradation index. A value near 1 indicates the system is functioning correctly whereas a value near 0 reflects EGR severe flow degradation.

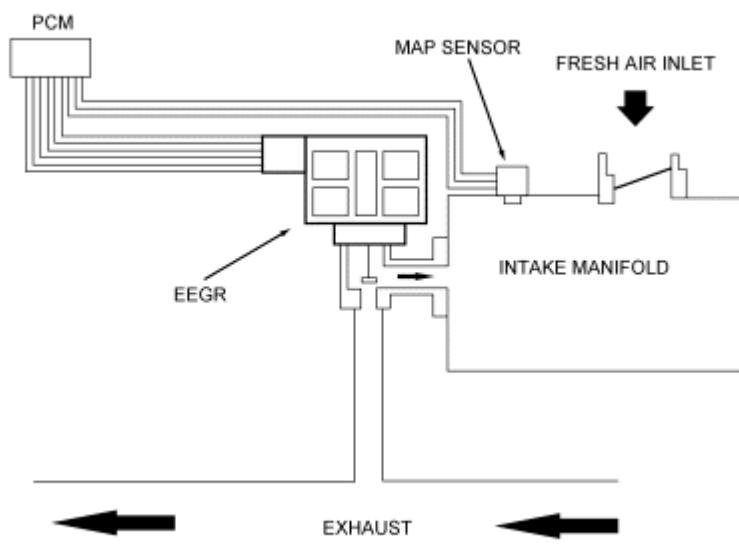
The EGR flow degradation index is compared to a calibrated threshold to determine if a low flow concern has occurred. If an EGR flow concern has occurred, DTC P0400 flow concern is registered.

If the inferred ambient temperature is less than -7°C (20°F), greater than 54°C (130°F), or the altitude is greater than 8,000 feet (BARO less than 22.5 in-Hg), the EEGR flow test cannot be reliably done. In these conditions, the EEGR flow test is suspended and a timer starts to accumulate the time in these conditions. When the vehicle leaves these extreme conditions, the timer starts to decrement, and if conditions permit, attempts to complete the EGR flow monitor. If the timer reaches 800 seconds, the EEGR flow test is disabled for the remainder of the current driving cycle and the EGR monitor is set to a ready condition.

Note: BARO is inferred at engine startup using the KOEO MAP sensor reading. It is updated during high, part-throttle, engine operation.

A DTC P1408, like the P0400, indicates an EGR flow concern (outside the minimum or maximum limits) but is

only set during the KOER self-test. DTCs P0400 and P0403 are malfunction indicator lamp (MIL) codes. DTC P1408 is a non-MIL code.



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EGR System Monitor
