

Module 29

Monitor Tests - Overview

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- EGR Monitor
- Evaporative Monitor
- Fuel System Monitor
- Misfire Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- "P" Codes

Miscellaneous Training Material

- Glossary of Terms

29 Monitor Tests – Overview

29.1 General Overview

To fully understand OBD-II, you must understand how the system performs diagnostics on the car's emission control systems. The diagnostic tests that the OBD-II system runs on the emission control systems are called monitors.

The monitor requirements are specified in OBD-II regulations, but how each manufacturer complies with the regulations is left up to the manufacturer. For example, OBD-II regulations require that a car equipped with an exhaust gas recirculation (EGR) system must test it, once per trip, for correct exhaust gas flow. How a manufacturer tests for proper exhaust gas flow is left up to the manufacturer. Honda, like many manufacturers, activates the EGR valve and watches for a change in the manifold absolute pressure (MAP) sensor input voltage. Some manufacturers activate the EGR valve and watch for a change in the oxygen (O₂) sensor's voltage or a deviation in the engine's RPM.

Running of the monitors is controlled by the engine control module (ECM)'s programming. Some of the tests are run continuously and some are run once per trip. The continuously run tests are run during normal engine operation. These tests are sometimes called passive tests since they only monitor input / output parameters and do not interrupt the normal operation of the ECM.

The non-continuous (once per trip) monitors are only run after a specific set of conditions has been met. The running of the non-continuous monitors is under the control of the ECM. They are sometimes called active tests since they can interrupt the normal operation of the ECM while they are running. It is the goal of automotive engineers to be able to run the active test without being noticed by the driver. If an active test noticeably affects the driveability of a vehicle it is called an intrusive test.

Continuous Monitors	Once Per Trip Monitors
Comprehensive Component Monitor	Catalyst Monitor
Misfire Monitor	EGR Monitor
Fuel System Monitor	Evaporative Monitor
	Oxygen Sensor Monitor
	Oxygen Sensor Heater Monitor

29.2 Enable Criteria

The monitors are not run unless a specific set of conditions has been met. The set of conditions needed to run a monitor are often referred to as set conditions or en-

able criteria. Every monitor, both continuous and non-continuous monitors, has pre-programmed enabling criteria requirements.

29.3 Continuous Run Monitors

Three of the monitors - comprehensive component, fuel system, and misfire - run "continuously". In reality they do not run continuously, but close to it. OBD-II regulations allow for the manufacturers to turn off even continuously run monitors under certain conditions. Manufacturers are typically allowed to turn off some continuous run monitors at extremely low temperatures and high altitudes. The Comprehensive Component Monitor is turned on as soon as the car is started; however, the misfire and fuel system monitors do not have to be turned on until a specified amount of time has passed since the starting of the car. The amount of time varies with the year model and other conditions, such as ambient temperature.

CARB allowed many manufacturers to limit the conditions under which the misfire monitor ran during the 96-97 model years. Some manufacturers were having difficulty with false alarms when they ran the misfire monitors under all driving conditions. By 1998 CARB expected all manufacturers to have developed their misfire filtering software to the point that misfires could be monitored under all engine conditions.

As a rule of thumb, if a car is warmed up and being driven under typical driving conditions, the continuously run monitors should be running.

29.4 Non-Continuous Run Monitors

The enable criteria used to run a once per trip monitor is much more sophisticated. It is also much more important to understand how enable criteria affects the running of a once per trip monitor than a continuously run monitor.

Since once per trip monitors are an active test, the conditions under which the test run must be more specific. For instance, the EGR monitor is designed to test the EGR system only after the car has reached operating temperature and the car is in a sustained deceleration. Activating the EGR valve with the engine cold or not during a deceleration period would probably result in the driver noticing the valve opening.

The enable criteria for a given monitor usually varies among manufactures and can even vary among similar models. The enable criteria, in some cases, could be very basic and simple, but is usually somewhat complex. It is virtually impossible to get a monitor to run if it requires a complex set of criteria to occur and you do not know what that criteria is.

29.5 OBD-II Drive Cycles

When you drive a car in such a way as to satisfy the enabling criteria of a specific monitor and the monitor runs to completion, it is considered a drive cycle. If you are only concerned about getting a specific monitor to run, run that specific monitor's drive cycle and do not worry about any of the other monitors. The other monitors can run to completion after the customer takes delivery of the car.

The best place to get enabling criteria for a Honda is from a diagnostic trouble code (DTC)'s diagnostic trouble tree in the factory service manual. If enabling criteria is needed to run a monitor, to test the DTC, it will be listed early in the diagnostic troubleshooting tree in a box labeled "Problem Verification". I have gone through all the service manuals and have consolidated that information in each specific monitor's training module in this series.

These problem verifications seem to be abbreviated when compared to the rest of the automotive industry. Mazda even produces a separate manual (1/2" thick) of just enabling criteria. The problem verifications listed in a Honda service manual rarely exceed 3-4 conditions. It is not uncommon to see very detailed enabling criteria on other make vehicles. It may be just that simple, but if you are unable to get a monitor to run by following the problem verifications listed in the service manuals, you may have to drive the car for an extended amount of time under various conditions.

For an example of the difference between Honda's listed problem verification (enabling criteria) and another major Asian manufacturer, look at these two examples.

Enabling Criteria To Run the Honda ERG Monitor

The 1997 Honda Accord factory service manual lists the following problem verification information for checking an EGR DTC:

1. With no electrical load
2. Decelerate from 55MPH for at least 5 seconds

Enabling Criteria to Run an EGR Monitor on Another Asian Make

Following is the enabling criteria for the EGR monitor of a major Asian make.

1. Start the car
2. Let the engine idle
3. Right Before Reaching 1 minute run time, race the engine, once
4. Let the car idle at 0 MPH for 6 minutes.
5. Smoothly accelerate to 35 MPH by 7 minutes
6. At 8 minutes and 10 seconds running time decelerate the car to 0 MPH by 9 minutes and 10 seconds
7. Let engine idle and car sit at 0 MPH until 11 minutes
8. Accelerate back to 35 MPH over the next minute
9. Drive the car at 35 MPH until 17 minutes of test time have expired
10. Quickly decelerate to 0 MPH and let the car idle at 0 MPH for two more minutes, ending the test at 19 minutes

29.6 Misc Conditions That Affect Monitor Running

In addition to the enable criteria requirements for a given monitor, there are other conditions that can keep a monitor from running. Some of these deal with severe operating conditions and some deal with DTC back-up strategies.

29.6.1 Temperature / Altitude Variance

Manufacturers may request CARB's approval to disable a monitor at starting temperatures below 20 deg F (based on intake air or engine coolant temperature at engine starting), and at elevations above 8,000 ft. Keep this in mind if you are trying to get a monitor to run and the temperature or altitude is in this variance range. Most manufacturers applied for and received permission to disable monitors under these conditions.

29.6.2 Low Fuel Variance

Manufacturers may disable monitoring systems that can be affected by running out of fuel (e.g., misfire detection, EVAP testing) when the fuel level is low (less than 15% of capacity).

29.6.3 "Warm-Up Cycle" Is Not a Requirement To Run a Monitor

OBD-II regulations require that a vehicle go through a warm-up cycle before a new trip is counted, as part of the strategy for erasing a stored DTC. This is the only condition that OBD-II requires the use of warm-up cycles. Some OBD-II training material implies that a warm-up cycle is required before a new trip is counted in the strategies of running monitors. This is not accurate. A specific

monitor may include a warm-up cycle style requirement in its enabling criteria, but is not required to.

29.6.4 "Back-Up" Strategy - Due to Set DTC

A tech should NEVER attempt to run a monitor with a DTC set in the PCM. Many monitors will not run if a specific DTC has been set. An example would be if an O2 sensor DTC is stored, the ECM will disable the catalyst monitor since the catalyst cannot be tested with a malfunctioning O2 sensor.

29.7 Readiness Status

So how do we know that a monitor has run to completion? Simple, you can get that information from the "Monitor Readiness Status" screen which is available on any OBD-II compliant scan tool. Screen Captures 29-1, 29-2, and 29-3 were taken from a Mastertech scan tool, using the Multi-Function Tester card and operating in the generic OBD-II mode. The vehicle being used was a 1996 Civic V-TEC.

The monitor readiness status screen will list all the monitors that are required by OBD-II regulations. Any monitor followed by a "N/A" is not used on the vehicle being scanned.

Screen Capture 29-1

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MISFIRE MON.....AVAIL
FUEL SYS MON...AVAIL
COMP MON.....AVAIL
CAT MON.....COMPL
HTD CAT MON.....N/A
EVAP MON.....N/A
2nd AIR MON.....N/A
A/C MON.....N/A
O2S MON.....COMPL
O2S HTR MON...COMPL
EGR MON.....N/A
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In Screen Capture 29-1, the heated catalyst monitor, secondary air supply monitor, A/C monitor, and EGR monitor were "N/A" because these systems were not used on this particular vehicle. A/C only has to be monitored if R-12 is still being used in the car. Honda apparently had a waiver for the EVAP monitor on this particular car since it too is showing as "N/A" and is a required monitor by OBD-II regulations.

The continuously run monitors are listed at the top and are listed as available. The continuously run monitors do not have complete / incomplete status.

As seen in Screen Capture 29-1, this car is equipped with a catalyst monitor, an O2 sensor monitor, and an O2 sensor heater monitor. These three monitors are shown as complete. This means that sometime in the past, the monitors have run to completion. Once a monitor has successfully ran to completion the status will always indicate complete, unless the ECM is reset.

Screen Capture 29-2 shows the readiness status right after performing a DTC reset with a scan tool. Notice now that the status on all the monitors (except the continuously run monitors) are listed as incomplete. Removing power from the ECM will also reset the monitor status back to incomplete. It is best to reset monitor

Screen Capture 29-2

MISFIRE MON.....	AVAIL
FUEL SYS MON.....	AVAIL
COMP MON.....	AVAIL
CAT MON.....	INCMPL
HTD CAT MON.....	N/A
EVAP MON.....	N/A
2nd AIR MON.....	N/A
A/C MON.....	N/A
O2S MON.....	INCMPL
O2S HTR MON.....	INCMPL
EGR MON.....	N/A

Screen Capture 29-3

MISFIRE MON.....	AVAIL
FUEL SYS MON.....	AVAIL
COMP MON.....	AVAIL
CAT MON.....	INCMPL
HTD CAT MON.....	N/A
EVAP MON.....	N/A
2nd AIR MON.....	N/A
A/C MON.....	N/A
O2S MON.....	INCMPL
O2S HTR MON.....	COMPL
EGR MON.....	N/A

readiness status with a scan tool since removing power to the ECM would erase any adaptive learning.

CARB and EPA are looking at the feasibility of adding Readiness Status Monitor checking to the annual tailpipe emissions test. They are proposing to fail a car unless all the monitors on the car have run to completion. They are presently testing the procedure in Salt Lake City, Utah. This could further complicate the inspection process. If someone had just installed a battery (and did not use back-up power) prior to coming by for an inspection, they would most likely fail on count of the status of the monitors. In some mountainous areas of the country it could take days, or weeks, to get all the monitors to run to completion even on a car in perfect shape.

Screen Capture 29-3 shows the monitor readiness status after the O2 sensor heater has run to completion. you will notice that the catalyst monitor and O2 sensor monitor have not completed yet. After the monitor flags have been reset to incomplete, it is common for the individual monitors to run to completion at different times. Remember that each

monitor has its own set of enabling criteria. In some cases it may take days of driving to get all the monitors to run to completion.

Once all the enabling criteria has been met, the ECM will begin to run a monitor. The monitor will attempt to run to completion. The readiness status will not show the monitor as complete unless it has run its entire set of diagnostics. When a monitor runs it performs a series of tests, with each test having a DTC assigned to it. The monitor itself does not generate any DTCs directly. The DTCs are generated from the individual tests that are performed when the monitor is run.

If you happen to work in an area with extreme elevation or extreme low temperatures, it gets even more complicated for you if you are in a situation where you want the monitor to run. Subject to CARB approval, if monitoring is disabled for a multiple number of driving cycles due to the continued presence of extreme operating conditions (e.g., cold ambient temperatures, high altitudes, etc), readiness for the subject monitoring system may be set without monitoring having been completed.

29.8 Service Issues - Putting It All Together

Let's put all this together so you can see how to use this new information about once per trip monitors in the service bay.

Lets start off with 4 truths about monitors.... make sure you understand this!

- Every DTC is generated by the running of a specific monitor
- A DTC generated from the running of a once-per-trip monitor will only be generated during the running of that monitor
- A monitor will only run when a specific set of conditions have been met.
- The only way to know that a monitor has run is to reset its status to "incomplete" and drive the vehicle until the status is "complete".

Now lets look at how not applying these truths can lead to improperly repaired vehicles.

1. A customer brings in a vehicle with the malfunction indicator light (MIL) illuminated.
2. You use a scan tool and retrieve the DTC PO401 - EGR Insufficient Flow Detected.
3. You do some repairs to the EGR system that you think will repair the EGR low flow problem.
4. You reset the ECM and test drive the car
5. After driving the car for several miles the DTC does not reset
6. You consider the car fixed and let the customer take delivery of the car.
7. The customer is back in the shop the next day with another PO401 DTC

What went wrong here ? The EGR system was not properly repaired and the test drive did not result in the running of the EGR monitor. The repairs were never checked because the exhaust flow is only checked during the running of the EGR monitor. The tech thought the work had been checked when in reality it was not.

If you want to reduce the chances of a comeback and have the OBD-II system re-check your work you must follow this procedure.

1. When a DTC has been stored, determine which monitor generated the DTC.
2. If the DTC was generated from a once-per-trip monitor, reset the monitor status to incomplete using the DTC reset mode on an OBD-II compliant scan tool.
3. Test drive the car until the monitor that generated the DTC has run to completion and the DTC did not reset either as a pending or stored DTC.