Module 25
Diagnostic Trouble Codes - "P" Type

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- "P" Codes

Miscellaneous Training Material

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25 Diagnostic Trouble Codes (DTC)

With the introduction of the OBD-II system, came big changes in the way diagnostic trouble codes (DTC)s were set and the malfunction indicator light (MIL) operated. These new features are as follows:

25.1 New DTC Features on OBD-II Systems

- Standardized DTCs For all Manufacturers
- Introduction of Pending DTCs (do not illuminate the MIL)
- Introduction of storing current engine parameters (Freeze Frame) when a DTC is set
- Introduction of DTCs that are set as a result of a "once per trip" test run by the engine control module (ECM).

25.2 General Overview

Every manufacturer is required to monitor any device (or system) that could cause the emissions to exceed the limits set by the Federal Test Procedure (FTP) by 1.5 times. When a malfunction of this level does occur, a DTC is to be recorded and if certain requirements have been met, the MIL illuminated.

OBD-II regulations greatly increased the level of testing done by the ECM on the emission control systems. In addition to the standard high/low value tests run on input signals prior to OBD-II, they must also be tested for rationality. The output devices must now be tested for functionality. Also, new ECM run tests (monitors) are run on many emission control components and sub systems. This new expanded testing has caused the number of DTCs used to increase dramatically.

OBD-II defined DTCs must be retrieved using an OBD-II compliant scan tool. Honda continues to offer MIL flash DTCs, however they do not give the level of detail that the scan tool retrieved OBD-II DTCs do. Most input signals are given only one MIL flash DTC that indicates a general malfunction, while the OBD-II system will typically assign at least two DTCs to each input signal, a low input and a high input.

For example, the engine coolant temperature (ECT) sensor has a MIL flash DTC of 7. This code is issued for all malfunctions of the ECT. There are 2 OBD-II DTCs assigned to the ECT sensor, P0117 for low input and P0118 for high input. In some cases even more codes are assigned to an input signal.

25.3 DTC Numbering Scheme

So that one scan tool could be used to test the OBD-II systems on all the manufacturers, the DTC numbering scheme had to be standardized. The standardization of the OBD-II DTCs was handled by the Society of Automotive Engineers (SAE).

The standards are published in SAE's standard J-2012. The standardization of the DTCs also required the standardization of the terminology used throughout the automotive industry. The terminology standardization was also handled by SAE and is published in standard J-1930.

The standardized OBD-II DTCs are 5 characters long and follow the following scheme:

25.3.1 Digit 1

The first digit indicates which major system produced the DTC. All engine and transmission related DTCs are "P" codes.

P 0 3 0 1

P Powertrain

C Chassis

B Body

U Network Communication

25.3.2 Digit 2

The second digit indicates if the DTC is SAE defined, or manufacturer defined. If a manufacturer has components (or systems) on its vehicles that are unique, the manufacturer can define a DTC for them. A good example of this would be the VTEC system. This system is only found on Hondas and therefore, Honda establishes the DTCs for the VTEC system. Manufacturers are expected to follow a standardized numbering scheme (covered later in the article) when assigning these DTCs.

Some of the early Honda OBD-II systems used some Honda defined DTCs even when a SAE defined DTC was available. I assume that at the time the ECM was being programmed, SAE had not finalized the DTC standardization for that particular fault code and Honda went with a manufacturer defined DTC. All the later models seem to use SAE defined DTCs unless it is a component or system that is unique to Honda.

P 0 3 0 1

0 SAE Defined

1 Manufacturer Defined

2 Reserved for Future Use

3 Reserved for Future Use

25.3.3 Digit 3

Digit 3 indicates which major system the default occurred in.

P 0 3 0 1

1 Air & Fuel Metering

2 Air & Fuel Metering

3 Ignition Systems / Misfires

4 Auxiliary Emission Controls

5 Vehicle Speed / Idle Control

6 Computer and Output Circuits

7 Transmission Codes

8 Transmission Codes

9 Reserved For Future Use

0 Reserved For Future Use

25.3.4 Digits 4-5

The 4th and 5th digit identify a specific component or system that has malfunctioned and the type of malfunction.

P 0 3 0 1

The 4th and 5th digits do not follow a strongly defined scheme. In the case of this DTC, the 01 indicates the engine is misfiring on the number one cylinder

25.4 DTC Description

In addition to displaying the 5 digit DTC an OBD-II compliant scan tool will include a standardized description of the code. The description will identify the malfunctioning component and indicate the type of malfunction. Here is the SAE defined descriptor words:

25.4.1 General Circuit Malfunction

Indicates a fixed value or no response from the system. This descriptor can be used in place of a dual high/low code or used to indicate another failure mode.

25.4.2 Range / Performance

Indicates that the circuit is functional, but not in a normal range. This descriptor may also indicate stuck, erratic, intermittent, or skewed values indicating poor performance of a circuit, component, or system.

25.4.3 Low Input

Indicates a signal voltage, frequency, or other signal measurement at a ECM input terminal is at or near zero

25.4.4 High Input

Indicates a signal voltage, frequency, or other signal measurement at a ECM input terminal is at or near full scale

25.5 Storing A DTC

OBD-II introduced some new characteristics to the DTCs used by the automotive industry. Now DTCs fall into three major categories: pending DTCs, stored DTCs, and DTCs generated from the running of a once per trip monitor.

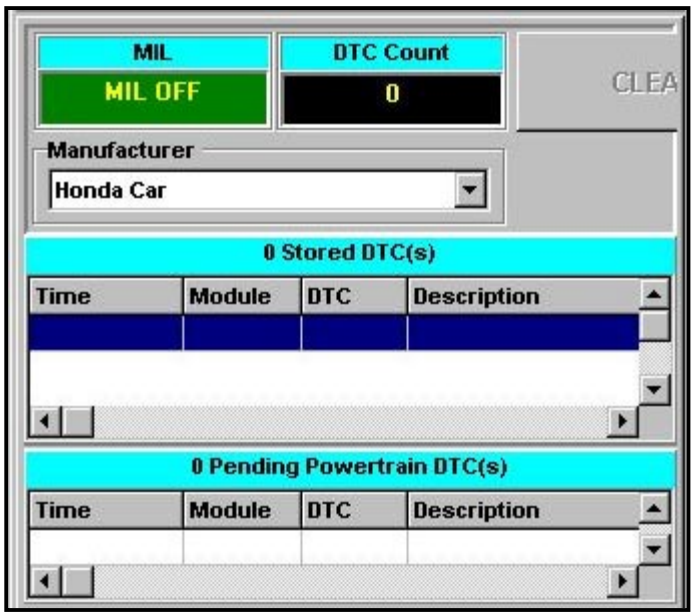
25.6 Pending / Temporary DTC

Prior to OBD-II, when a DTC was set the MIL was immediately illuminated. The only exception was the 94 and later Accord oxygen sensor (O2) input, which required two trip malfunctions.

Since the OBD-II system tests the inputs and outputs more extensively, the manufacturers are allowed to utilize a multiple malfunction criteria to illuminate the MIL under certain conditions. Without using this technique the OBD-II system would be prone to illuminate the MIL when a true problem did not exist.

Each manufacturer is allowed to establish if a specific malfunction will illuminate the MIL on the first occurrence or after multiple occurrences. The manufacturer looks at each DTC and determines how that DTC would effect the tailpipe emissions on their vehicles. For a manufacturer to establish multiple trip DTCs, engineering data is submitted the the California Air Resource Board (CARB) for approval. OBD-II regulations do not allow any multiple trips DTCs to exceed 6. At present all Honda DTCs are 1, 2, or 3 trip DTCs.

Screen Capture 25-1



On a multiple trip DTC, the malfunctions must occur on consecutive trips. For instance if a 3-trip DTC malfunctions on two consecutive trips and does not malfunction on the third, that DTC's failure counter is reset to zero and the process starts all over.

With the introduction of pending DTCs, the service tech needs to use a slightly different diagnostic approach. Pending DTCs are recorded and are available via a scan tool. Screen Capture 25-1 is a PC Based OBD-II scan tool program (Ease Simulation). You can see how the pending codes are listed in one window and the stored codes are listed in another window.

This means that a car may have a DTC stored in the ECM's memory even though the MIL never came on. If a customer comes in with a driveability complaint on an OBD-II equipped Honda, the car should be checked for pending DTCs. This might give the service tech some useful diagnostic information. A freeze frame (covered in detail later in this module) is not recorded until a DTC is stored and the MIL is illuminated.

If a car does come in with an illuminated MIL and a 2 or 3 trip DTC set, the odds are pretty high that there is a problem, especially with a 3 tripper. Remember, that this means the component, or system, failed on three consecutive trips. The old approach of resetting the ECM and letting them drive the car until it illuminates the MIL again will usually result in a comeback. Techs need to be aware of which DTCs are multiple trip DTCs, and give them more consideration than a single trip DTC.

A second issue comes into play when a tech is road checking certain repair work. Consider this scenario...

- A car comes into your shop with a stored DTC
- You then record the DTC and freeze frame parameters for reference and clear the DTC.
- You diagnose the problem that caused the DTC to set and repair the vehicle
- You then take the car for a test drive to see if the DTC will set again

The problem is that since the DTC is a multiple trip DTC, even if it fails on the test drive, it will not illuminate the MIL. The tech has two choices, either check the car for a pending DTC after a test drive with a scan tool or jump the service check connector. On a Honda, when you jump the service check connector all DTCs are turned into single trip DTCs.

25.7 Stored / Hard / Mature DTC

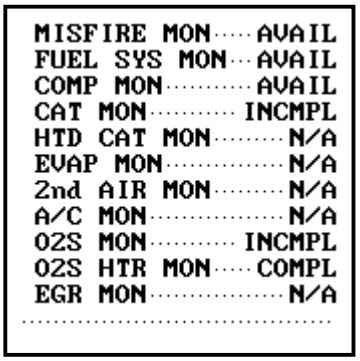
A DTC that actually illuminates the MIL is typically called a stored, hard, or mature DTC. It could simply be a single trip DTC or the DTC that meets the trip requirement on a multiple trip DTC.

25.8 "Once Per Trip" Monitor Generated DTCs

OBD-II diagnostics are grouped into different tests called monitors. There are two different types of monitors, continuously run monitors and non-continuously run (once per trip) monitors. Once per trip monitors are special tests that are run by the ECM when certain conditions are met. Every DTC is generated from a specific monitor. It is helpful for a tech to know which monitor generated the DTC. Special diagnostic procedures need to be followed when working with DTCs that originate from a once per trip monitor.

Screen Capture 25-2 is a screen capture from a generic scan tool (GST) showing the readiness status of the monitors on a 1996 Civic. The top three monitors, listed as available, are run continuously.

Screen Capture 25-2



The monitors listed as incomplete and complete are run once per trip. The monitors are run whenever a specific set of circumstances has been met. Some DTCs are only generated when a malfunction occurs during the running of a once per trip monitor. When road checking a repair that was done to repair a once per trip monitor generated DTC, the monitor must be run, or the work will

not be checked.

To know that a monitor has run you will need to set the monitors to incomplete by using a scan tool. As the monitors run to completion, they will change to the complete status. It is also helpful to know the conditions that need to be met so that the ECM will run the monitor.

For more information about the readiness status of the monitors, read the Monitors - Overview Training Module. For specific enable criteria information about each monitor, read the training module on that specific monitor

25.9 DTC Retrieval

Honda has maintained a MIL Flash DTC since the first PGMFI systems in 1985. With the introduction of the OBD-II DTC the MIL flash DTC should not be used unless you are in a situation in which an OBD-II compliant scan tool is not available. If you want to retrieve the MIL flash DTC you jump the service check connector and count the flashes of the MIL. For complete information about how to retrieve and read the MIL flash DTC read the "DTC Training Module".

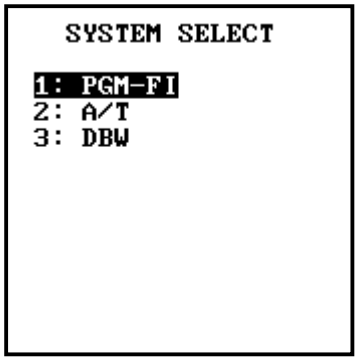
If a Honda is equipped with OBD-II (95 Accord V-6, all models 96 and up) the DTCs should be retrieved using any OBD-II compliant scan tool. A scan tool can also be used to retrieve freeze frame data and to clear the DTC codes without loosing any adaptive learning.

25.10 Transmission DTCs

Some Honda models, equipped with automatic transmissions, have an ECM and a separate transmission control module (TCM). Most later model Hondas have both units combined into a powertrain control module (PCM). In either case the automatic transmission control is handled by a separate part of the processor than where engine control is handled. The transmission has a whole series of DTCs that fall into the PX700-PX800 range.

When a transmission DTC is initially stored, the D4 light is illuminated, and if the malfunction would effect emissions it will also illuminate the MIL. On subsequent trips the MIL will stay illuminated and the D4 will not be illuminated.

Screen Capture 25-3



When diagnosing transmission related DTCs you should pull the DTCs from the transmission module. You can identify a transmission generated DTC by an illuminated D4 light, or an DTC present in the PX700-PX800 range.

All OBD-II compliant scan tools will allow you to check either the engine module or the transmission module (even if both modules are combined into one unit). Screen Capture 25-3 from a Mastertech (using the Honda aftermarket software). This menu is giving the user the option of accessing the PGM-FI, Automatic Transmission, or Drive by Wire controller. If while checking DTCs stored in the ECM you find a transmission generated DTC, redirect your scan tool to the TCM for more detailed information.

25.11 Clearing A DTC

25.11.1Manually Clearing a DTC

DTCs can be manually cleared from the ECM's memory by using an OBD-II compliant scan tool. The DTC clearing function of the scan tool will also clear freeze frame data, and reset the monitor's status to incomplete, but will not erase any adaptive learning.

Clear DTCs BEFORE Attempting to Diagnose

It is important to clear all DTCs before attempting to diagnose what set a DTC for at least two reasons. Remember to record the freeze frame and all stored DTCs before clearing the ECM.

Freeze Frame
The OBD-II system will only record one freeze frame. If a freeze frame has been recorded, it will not record another set of engine parameters unless it is cleared. Before manually clearing a DTC, record the freeze frame data for future reference. More information about the freeze frame follows in the freeze frame section.

Remove any "Back Up" Strategies
In many cases, when a DTC is set, the ECM will evoke a "back up" strategy for that particular DTC. This is a different mode than a full ECM back-up mode, sometimes referred to as "limp home" mode. Certain stored DTCs can also prevent certain monitors from running.

For instance, when a DTC is set for an input signal, that input is ignored and a pre-programmed strategy is followed. Typically what will happen is the ECM will

substitute the input signal with a value from an internal table. The substitute value is a fixed value and will usually be an average of the input range. When the ECM substitutes the fixed value for an input signal, many of the engine parameters will become skewed. To be certain the engine parameters are accurate, be sure no DTCs are stored in the ECM's memory.

Another 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 oxygen sensor.

25.11.2 ECM Cleared DTCs

Another feature new to OBD-II is ECM erasable DTCs. If the car goes through 40 engine warm-up cycles without the DTC resetting, the DTC will be erased from memory.

25.12 MIL Illumination

When an emission-related component/system malfunctions and a hard DTC is set, the MIL is illuminated and will stay illuminated until certain conditions have been met. More information about the characteristics of the MIL follow in the MIL section.