

**SUBARU** 

**QUALITY DRIVEN**®

S E R V I C E

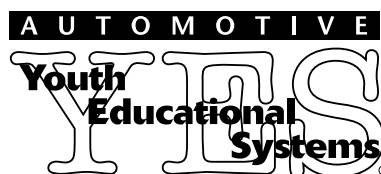


# **Technicians Reference Booklet**

## **On Board Diagnostics-II (OBD II)**

**Module 407**

MSA5P0162C



**Technical Training**

**© Copyright 2001  
Subaru of America, Inc.**

All rights reserved. This book may not be reproduced in whole or in part without the express permission of Subaru of America, Inc.

Subaru of America, Inc. reserves the right at any time to make changes or modifications to systems, procedures, descriptions, and illustrations contained in this book without necessarily updating this document. Information contained herein is considered current as of October 2001.

# On Board Diagnostics-II (407)

---

## Table of Contents

Introduction .....	6
Enabling Criteria .....	6
Confirmation Driving Pattern .....	7
Readiness Codes .....	8
OBD II Logic .....	9
Malfunction Indicator Lamp Operation .....	10
DTC Memory .....	10
Warm Up Cycle .....	11
Freeze Frame .....	11
State I/M Program Advisories Bulletins .....	12
Service Bulletins .....	13
406 Module Service Help-Line Updates .....	14

# Slide Sequence

<b>Slide No.</b>	<b>Description</b>	<b>Page No.</b>
1	Title Slide (Boxer Engine Series Module)	
2	Created By	
3	Teaching Aids	
4	Title Slide (Introduction)	6
5	Title Slide (Enabling Criteria)	6
6	OBD II Logic	6
7	Title Slide (Confirmation Driving Pattern)	7
8	Confirmation Driving Pattern	7
9	Title Slide (Readiness Codes)	8
10	Readiness codes after memory has been cleared	8
11	Readiness codes after meeting enabling criteria	8
12	Title Slide (OBD II Logic)	9
13	OBD II Logic	9
14	Accessing DTC's	9
15	DTC Structure P0440	10
16	Malfunction Indicator Lamp Operation	10
17	1 Hz	10
18	3 Hz	10
19	Title Slide (Freeze Frame)	11
20	Freeze Frame	11
21	Fuel Trim Map	11

# On Board Diagnostics-II (407)

## Introduction

On Board Diagnostics II was introduced to the Subaru line with the 1995 Legacy. This system combines engine and automatic transmission "Diagnostic Trouble Codes" or DTCs that have an affect on vehicle emissions. The number of codes and the diagnostics for codes is always changing due to the introduction of new components and newer operating logic for them. But the key to diagnosing OBDII remains the same. That is firstly understanding the systems that are being checked. Then apply that understanding to the logic provided to the OBDII system.

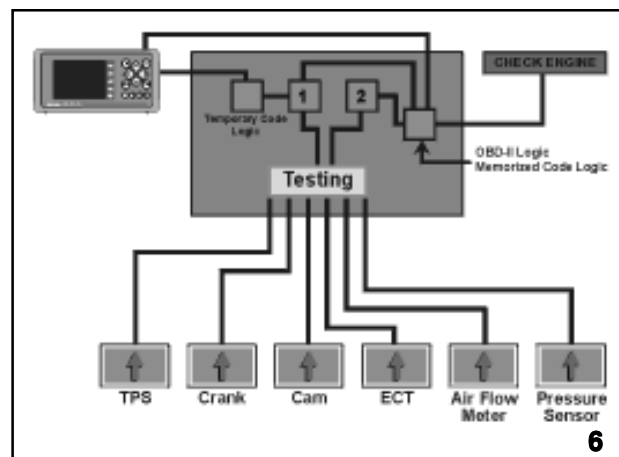
OBDII checks a component and it's system for the ability to function (circuitry tests) and the result while functioning (Performance tests) for key systems.

## Enabling Criteria

Before OBDII can begin to work the vehicle must meet the "Enabling Criteria". This is the vehicle operating condition that must exist for the Engine Control Module (ECM) to begin diagnostics. "Enabling Criteria" will not be the same for all diagnostics. For example; the ECM checks an EGR solenoid as soon as the ignition is turned on.

The performance of the EGR system is checked after these conditions are met;

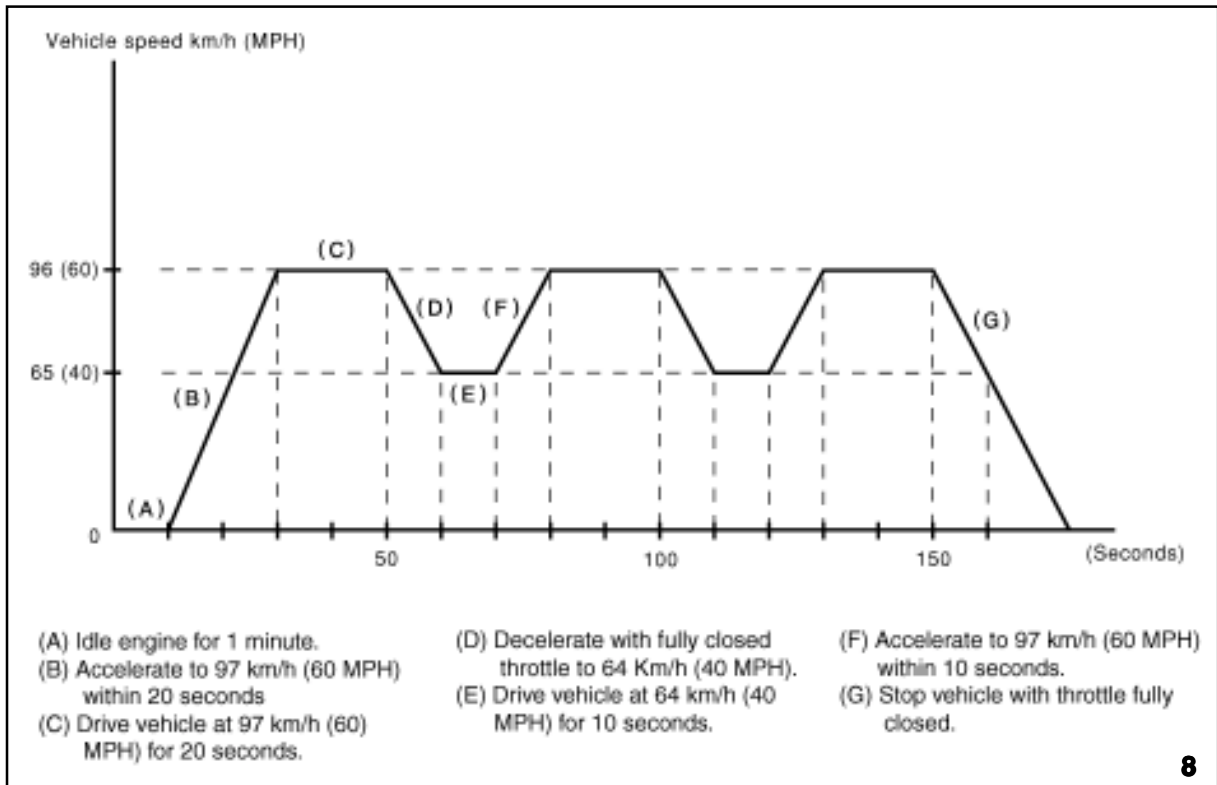
- Engine has been operating for at least 190 seconds
  - EGR Solenoid has been energized
  - Engine coolant temperature is equal to or Greater than 158°F (70°C)
  - Engine speed is 2000-2600 RPM
  - Injection duration is 4.1-6.92 ms
  - Throttle angle is 5.76-24.96 degrees
  - Throttle angle fluctuation during 100 Milliseconds is less than 0.96 degrees.
  - Barometric pressure is greater than 507mm HG
- **There can be no failures in the Following components or circuits;**
    - Air Flow Sensor
    - Crank Angle Sensor
    - Cam Angle Sensor
    - Throttle Position Sensor
    - Coolant Temp Sensor, EGR SOL



OBD II Logic

# On Board Diagnostics-II (407)

## Confirmation Driving Pattern



*Confirmation Driving Pattern*

Generally the “Enabling Criteria” is not published for all DTCs or the logic that the ECM uses to determine if a DTC should exist. What is published is the “Confirmation Driving Pattern” This is the description of the exact way a vehicle is to be driven for the “Enabling Criteria” to be met. Driving a vehicle on a lift will not substitute for actual on the road driving. A slight deviation in the confirmation-driving pattern will usually cancel the diagnostics until the right conditions can be duplicated.

OBDII checks or monitors in two methods. The first method is called Continuous Monitoring. This process will monitor for misfire, fuel system, and electrical output devices any time the vehicle is operating. The second type is non-continuous monitoring. This process will check the condition of the catalyst, heated catalyst, evaporative system, secondary air system, a/c system refrigerant, oxygen sensor, oxygen sensor heater and egr system once per “Trip”

A “Trip” is the operating of the vehicle where the Enabling Criteria is reached and the ECM has powered down.

Notes:

---

---

---

---

---

---

---

---

---

---

# On Board Diagnostics-II (407)

## Readiness Codes

Readiness codes report the availability and status of the monitors through the Select Monitor. While viewing the OBD II section from the engine main menu the first 8 items will indicate no support, complete or incomplete. No Support indicates that the vehicle is not equipped with that system. Incomplete indicates that the vehicle has this system but has not diagnosed this system but will once the Enabling Criteria has been met. Complete indicates that the diagnostics have been performed for that system. These values will not default to incomplete once they are complete unless the memory has been cleared or battery power has been removed for more than 10 minutes. (1996 vehicles default to incomplete when the ignition is turned off.) See State I/M Program Advisory Bulletin 11-49-97R. (Located in back of booklet.)

<b>MI (MIL)</b>	<b>OFF</b>
Misfire monitoring	complete
Fuel system monitoring	complete
Component monitoring	complete
Catalyst Diagnosis	incomplete
Heated catalyst	no support
Evaporative purge system	incomplete
Secondary air system	no support
A/C system refrigerant	no support
Oxygen sensor	incomplete
O2 Heater Diagnosis	incomplete
EGR system	no support

**10**

*Readiness codes after memory has been cleared*

<b>MI (MIL)</b>	<b>OFF</b>
Misfire monitoring	complete
Fuel system monitoring	complete
Component monitoring	complete
Catalyst Diagnosis	complete
Heated catalyst	no support
Evaporative purge system	complete
Secondary air system	no support
A/C system refrigerant	no support
Oxygen sensor	complete
O2 Heater Diagnosis	complete
EGR system	no support

**11**

*Readiness codes after meeting Enabling Criteria*

Notes

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

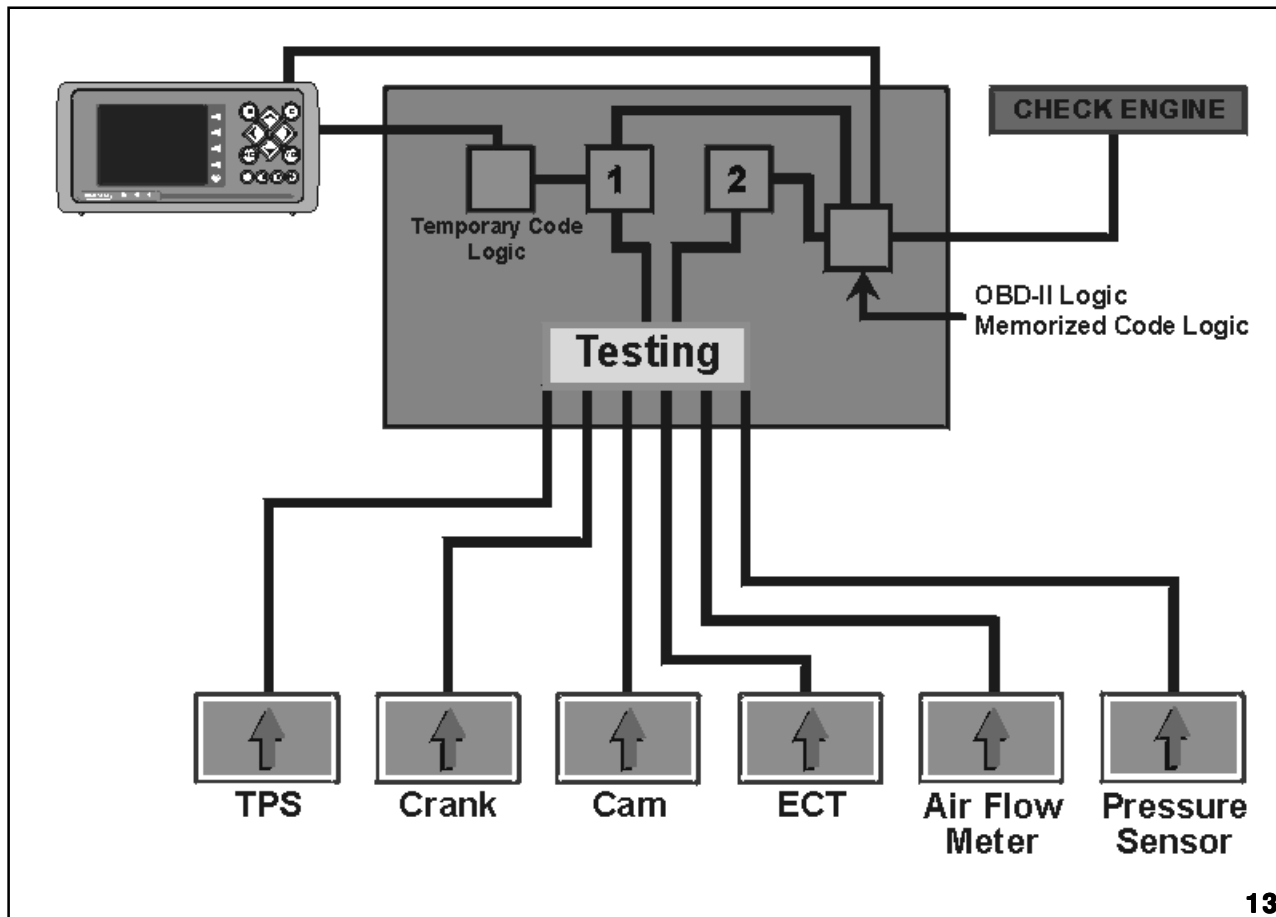
---

---

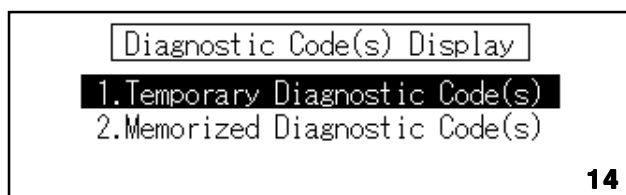
---

# On Board Diagnostics-II (407)

## OBD II Logic



OBD II Logic



Accessing DTC's

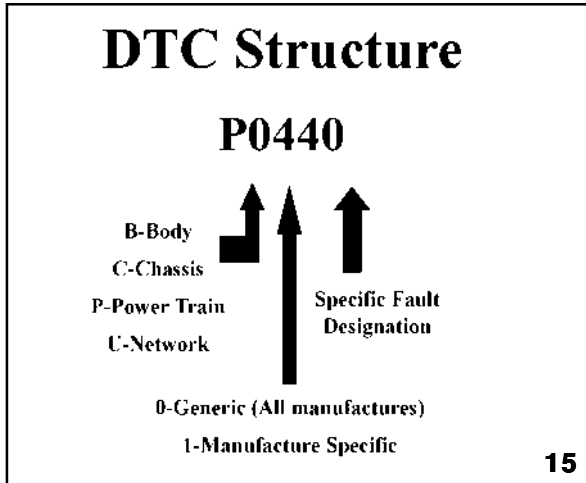
During the actual testing or diagnostics performed by the ECM, vehicle sensors send information to a testing area of the ECM. The information is evaluated to determine if the vehicle has met the Enabling Criteria and the results of the forced testing of systems diagnosed.

Each system is assigned to trigger the illumination of the Check Engine Light in either a single fault or double fault occurrence (Trip). The single fault Trip DTCs will store a memorized code and record the vehicle operating conditions (Freeze Frame Data) when the ECM determines a fault exists. Illuminating the check engine light. The double fault Trip DTCs will not illuminate the Check Engine Light when the first fault is detected. It will register the DTC as a temporary code and wait for the second consecutive failed trip to occur before illuminating the Check Engine Light.



# On Board Diagnostics-II (407)

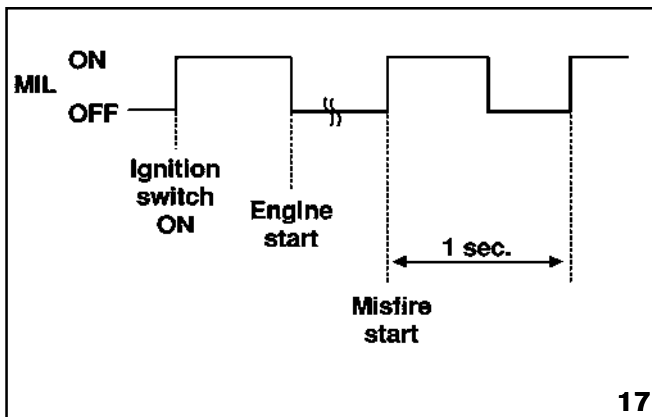
The exception to the second fault rule is any DTC that is related to Fuel Trim or Misfire. The second fault trip for these items must occur within 375 RPMs and 20% of the engine load of the first fault. At that point the Check Engine Light will illuminate and the DTC and Freeze Frame data will be memorized.



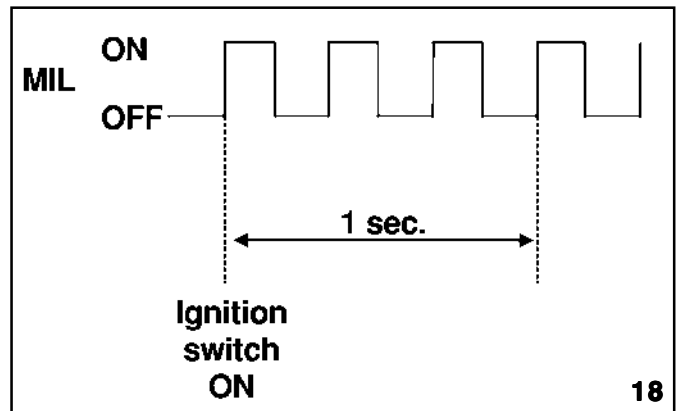
DTC Structure

OBDII requirements state that all manufactures standardize code assignments. Each code will consist of 5 characters.

## Malfunction Indicator Lamp Operation



1 Hz



3 Hz

The Check Engine Light, now called the MIL, Malfunction indicator Lamp, provides communication to the driver and the Technician. The steady illumination to the driver with the engine running indicates an existing problem. Flashing at 1 Hz indicates that a misfire that can cause catalyst damage presently exists (Immediate dealer attention to the vehicle is recommended).

Technician communications include three messages. The first is a 3 Hz flash-The inspection mode connectors are connected. The second is a 1 Hz flash-Misfire that causes catalyst damage exists. And the third, Steady illumination-Indicates a problem exists or has recently occurred and a DTC has been set.

## DTC Memory

Memory of a DTC (as it relates to illuminating the MIL) is maintained until 3 consecutive passing trips have been made. (The Enabling Criteria was reached 3 times in a row and the tests were performed with good results). The MIL will turn off at this point.

The DTC will remain available for viewing with the select monitor and the freeze frame information associated with it for 40 warm up cycles.

The exception to this rule is if the code is associated to misfire or fuel trim which will require 80 warm up cycles for full erasure.

# On Board Diagnostics-II (407)

## Warm Up Cycle

A warm up cycle is the operating conditions of the vehicle where the coolant temperature rises to at least 40°F (22.2°C) above the temperature at start up, and reaches a minimum of 160°F(71.1)

## Freeze Frame

Freeze Frame is the vehicle operating conditions that exist when a DTC has been set.

Freeze frame data	P0108
Fuel system for Bank 1	Op_init.
Calculated load value	1.2 %
Coolant Temp.	+133 °F
Short term fuel trim B1	+0.0 %
Long term fuel trim B1	+0.0 %
Mani. Absolute Pressure	75.5 inHg
Engine Speed	0 rpm
Vehicle Speed	0 MPH

20

*Freeze Frame*

Engine RPM

Engine Load

Fuel Pressure

Fuel Trim Values

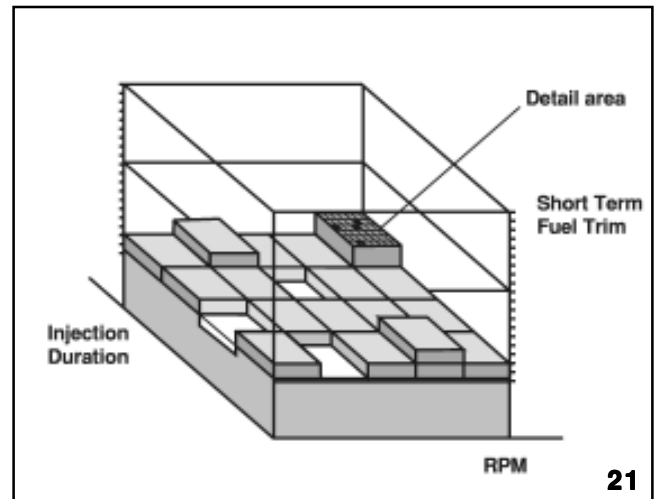
Coolant Temperature

Intake Manifold Pressure

Loop Status

DTC causing the MIL to illuminate

A DTC associated with misfire or fuel trim will over write the freeze frame data from all other DTCs.



21

*Fuel Trim Map*

Short term and long-term fuel trim are visual interpretations on the current (short term) and historical (Long term) corrections to the air fuel mixture required to give the vehicle the best drivability and lowest emission output.

The ECM continuously monitors the amount of fuel injected and places the information recorded into memory. The ECM places the memorized information into a position that is referenced by engine load and engine rpm. The next time the vehicle is in those same conditions the memorized information is compared to the amount currently being injected. A DTC will be registered if the difference between the two is too much.





## ATTENTION:

GENERAL MANAGER PARTS MANAGER CLAIMS PERSONNEL SERVICE MANAGER 


IMPORTANT - All Service Personnel Should Read and Initial



NUMBER 11-49-97R

## STATE I/M PROGRAM ADVISORY BULLETIN

**APPLICABILITY** 1996 Model Year Legacy, Impreza & SVX

**DATE** 9/2/98

**SUBJECT** OBD Check During State I/M Program

This bulletin is a reprint of Bulletin 11-49-97 dated 3/24/97, and serves as advisory information for state Inspection/Maintenance (I/M) programs.

Both the California Air Resources Board and the U.S. Environmental Protection Agency (EPA) have issued regulations requiring manufacturers of passenger cars, light-duty trucks, and medium-duty vehicles to install an enhanced On-Board Diagnostic (OBD) system for emission control systems on 1994 and later model year vehicles with exemption provisions. Our 1995 model year vehicles with a 2.2 liter engine and all 1996 and later model year Subaru vehicles are equipped with this type of OBD system.

The U.S. EPA has published regulations requiring state I/M programs to perform OBD testing on all 1996 and newer model year vehicles beginning January 1, 1998. At this time, the U.S. EPA has not provided I/M programs with their OBD testing guidance procedures.

**This notice is to advise you that our 1996 model year vehicles may experience a “not ready” condition during the readiness code check of the OBD test,** since our 1996 model readiness code is reset at each engine key-off or engine stall event. This condition may result in 1996 Subaru vehicles being rejected by state I/M facility inspectors. In our approved 1996 model year OBD systems, when the system detects a malfunction, it stores the identified diagnostic trouble code(s) and illuminates the malfunction indicator light (MIL) regardless of the readiness code status. Any malfunction can be confirmed by the existence of a trouble code and MIL illumination. Even if the readiness code is observed in a “not ready” condition, our vehicles will meet the I/M emissions standard.

The U.S. EPA has been informed of the 1996 model year Subaru vehicle readiness code issue and plans to release I/M OBD guidance procedures to the states in the future. **Until publication of the agency’s guidance document, we request that state I/M facility inspectors not notify the affected 1996 model year Subaru vehicle owners/drivers of the readiness code condition nor refer these owners to an authorized Subaru dealer because it will only lead to unnecessary confusion.**

**CAUTION**
**VEHICLE SERVICING PERFORMED BY UNTRAINED PERSONS COULD RESULT IN SERIOUS INJURY TO THOSE PERSONS OR TO OTHERS.**

Subaru Service Bulletins are intended for use by professional technicians ONLY. They are written to inform those technicians of conditions that may occur in some vehicles, or to provide information that could assist in the proper servicing of the vehicle. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do the job correctly and safely. If a condition is described, DO NOT assume that this Service Bulletin applies to your vehicle, or that your vehicle will have that condition.





# **On Board Diagnostics-II (407)**

---

## **Service Bulletins**

<b>No.</b>	<b>Date</b>	<b>Title</b>	<b>Subject</b>

# On Board Diagnostics-II (407)

## 406 Module Service Help-Line Updates

<b>Date</b>	<b>Subject</b>
11/94	OBD II - DTC P0441 "Evaporative emission control system incorrect purge flow"
11/94	OBD II Test Drives
06/95	1995 Subaru Legacy DTC P0505 - Idle control system malfunction
06/95	1995 Subaru Legacy DTC P0325 - Knock sensor circuit malfunction
06/95	1995 Subaru Legacy DTC P0130 Front O2 sensor circuit malfunction
09/95	DTC P0505 Idle control system when solenoid measures 5 $\Omega$ or less
12/95	Extreme cold weather engine warm up and OBD II
11/96	Extreme cold weather engine warm up and OBD II
03/97	DTC P1500 Radiator fan relay one circuit
04/97	Understanding P0440
05/97	DTC P0507-Idle control system RPM higher than expected
07/97	Code P0500
07/97	Additional information regarding code P0440
08/97	OBD II cylinder misfire codes
10/97	More P0440 information
01/98	Model Year 1998 changes in P0449 operation
05/98	Model Year 1998 changes in P0449 operation
05/98	DTC P0440 revisited
11/98	P0440 TIP
11/98	DTC P1507





Subaru of America, Inc.