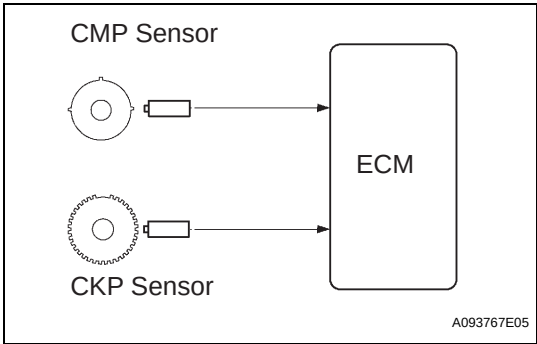


|     |       |                                             |
|-----|-------|---------------------------------------------|
| DTC | P0300 | Random / Multiple Cylinder Misfire Detected |
| DTC | P0301 | Cylinder 1 Misfire Detected                 |
| DTC | P0302 | Cylinder 2 Misfire Detected                 |
| DTC | P0303 | Cylinder 3 Misfire Detected                 |
| DTC | P0304 | Cylinder 4 Misfire Detected                 |

DESCRIPTION



When the engine misfires, high concentrations of hydrocarbons (HC) enter the exhaust gas. Extremely high HC concentration levels can cause an increase in exhaust emission levels. High concentrations of HC can also cause an increase in the Three-Way Catalytic Converter (TWC) temperature, which may cause damage to the TWC. To prevent this increase in emissions and to limit the possibility of thermal damage, the ECM monitors the misfire rate. When the temperature of the TWC reaches the point of thermal degradation, the ECM blinks the MIL. To monitor misfires, the ECM uses both the Camshaft Position (CMP) sensor and the Crankshaft Position (CKP) sensor. The CMP sensor is used to identify any misfiring cylinders and the CKP sensor is used to measure variations in the crankshaft rotation speed. Misfires are counted when the crankshaft rotation speed variations exceed predetermined thresholds. If the misfire exceeds the threshold levels, and could cause emission deterioration, the ECM illuminates the MIL and sets a DTC.

| DTC No. | DTC Detection Conditions                                                      | Trouble Areas                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P0300   | Simultaneous misfiring of several cylinders detected (2 trip detection logic) | <ul style="list-style-type: none"><li>• Open or short in engine wire harness</li><li>• Connector connection</li><li>• Vacuum hose connections</li><li>• Ignition system</li><li>• Injector</li><li>• Fuel pressure</li><li>• Mass Air Flow (MAF) meter</li><li>• Engine Coolant Temperature (ECT) sensor</li><li>• Compression pressure</li><li>• Valve clearance</li><li>• Valve timing</li><li>• PCV valve and hose</li><li>• PCV hose connections</li><li>• ECM</li></ul> |

| DTC No.                          | DTC Detection Conditions                                            | Trouble Areas                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P0301<br>P0302<br>P0303<br>P0304 | Misfiring of specific cylinder detected<br>(2 trip detection logic) | <ul style="list-style-type: none"> <li>• Open or short in engine wire harness</li> <li>• Connector connection</li> <li>• Vacuum hose connections</li> <li>• Ignition system</li> <li>• Injector</li> <li>• Fuel pressure</li> <li>• MAF meter</li> <li>• ECT sensor</li> <li>• Compression pressure</li> <li>• Valve clearance</li> <li>• Valve timing</li> <li>• PCV valve and hose</li> <li>• PCV hose connections</li> <li>• ECM</li> </ul> |

**HINT:**

When DTCs for misfiring cylinders are randomly set, but DTC P0300 is not set, it indicates that misfires have been detected in different cylinders at different times. DTC P0300 is only set when several misfiring cylinders are detected at the same time.

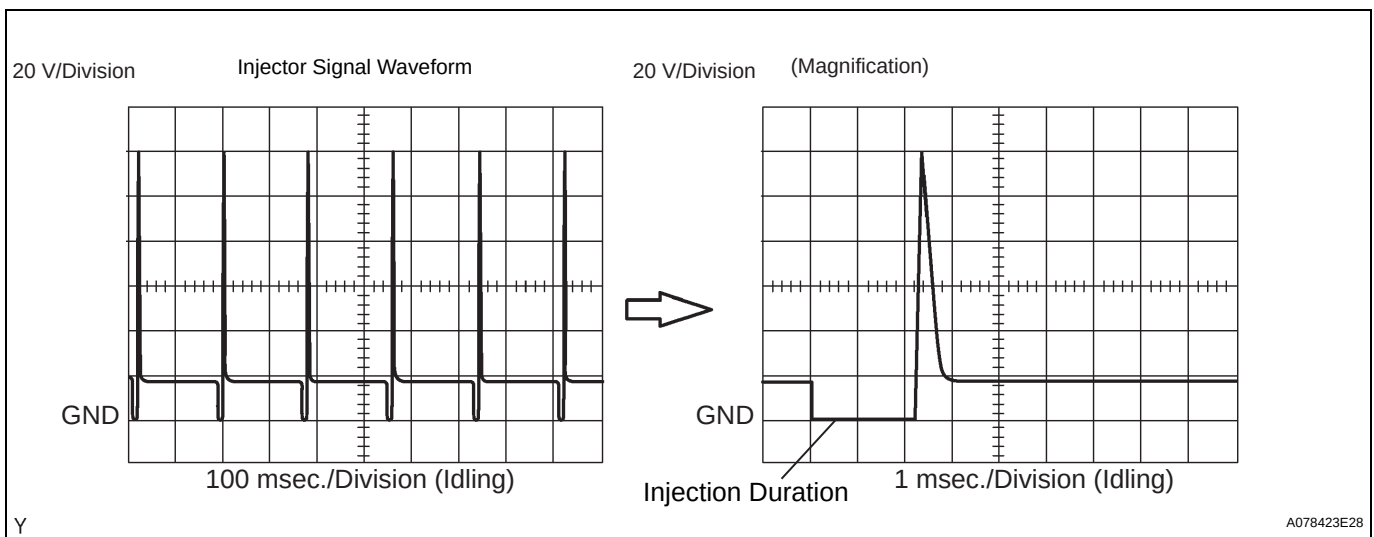
Reference: Inspection using an oscilloscope

With the engine idling, check the waveform between terminals #10 to #40 and E01 of the ECM connectors.

| Items              | Contents                            |
|--------------------|-------------------------------------|
| Terminals          | #10 to #40 - E01                    |
| Equipment Settings | 20 V/Division, 100 or 1 ms/Division |
| Conditions         | Idling                              |

**HINT:**

The correct waveform is as shown.

**MONITOR DESCRIPTION**

The ECM illuminates the MIL and sets a DTC when either one of the following conditions, which could cause emission deterioration, is detected. (2 trip detection logic.)

- Within the first 1,000 crankshaft revolutions of the engine starting, an excessive misfiring rate (approximately 20 to 50 misfires per 1,000 crankshaft revolutions) occurs once.
- After the first 1,000 crankshaft revolutions, an excessive misfiring rate (approximately 20 to 60 misfires per 1,000 crankshaft revolutions) occurs 4 times in sequential crankshaft revolutions.

The ECM flashes the MIL and sets a DTC when either one of the following conditions, which could cause the Three-Way Catalytic Converter (TWC) damage, is detected. (2 trip detection logic.)

- In every 200 crankshaft revolutions at a high engine rpm, the threshold misfiring percentage is recorded once.
- In every 200 crankshaft revolutions at a normal engine rpm, the threshold misfiring percentage is recorded 3 times.

## MONITOR STRATEGY

|                                       |                                                                                                                                                      |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Related DTCs                          | P0300: Multiple cylinder misfire<br>P0301: Cylinder 1 misfire<br>P0302: Cylinder 2 misfire<br>P0303: Cylinder 3 misfire<br>P0304: Cylinder 4 misfire |
| Required Sensors/Components (Main)    | Injector, Ignition coil, Spark plug                                                                                                                  |
| Required Sensors/Components (Related) | Crankshaft, Camshaft, Engine coolant temperature, Intake air temperature sensors and Mass air flow meter                                             |
| Frequency of Operation                | Continuous                                                                                                                                           |
| Duration                              | 1,000 to 4,000 crankshaft revolutions: Emission related misfire<br>200 to 600 crankshaft revolutions: Catalyst damaged misfire                       |
| MIL Operation                         | 2 driving cycles: Emission related misfire<br>MIL flashes immediately: Catalyst damaged misfire                                                      |
| Sequence of Operation                 | None                                                                                                                                                 |

## TYPICAL ENABLING CONDITIONS

### Misfire:

|                                                                  |                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The monitor will run whenever the following DTCs are not present | P0100, P0102, P0103 (MAF sensor), P0110, P0112, P0113 (IAT sensor), P0115, P0117, P0118 (ECT sensor), P0120, P0122, P0123, P0220, P0222, P0223, P2135 (TP sensor), P0125 (Insufficient ECT for closed loop), P0325, P0327, P0328 (Knock sensor), P0335 (CKP sensor), P0340, P0341 (CMP sensor), P0500 (VSS) |
| Battery voltage                                                  | 8 V or more                                                                                                                                                                                                                                                                                                 |
| Throttle position learning                                       | Completed                                                                                                                                                                                                                                                                                                   |
| VVT system                                                       | Not operated by scan tool                                                                                                                                                                                                                                                                                   |
| Engine RPM                                                       | M/T: 450 to 6,600 rpm<br>A/T: 450 to 6,700 rpm                                                                                                                                                                                                                                                              |
| All of the following conditions are met:                         | Condition 1 and 2                                                                                                                                                                                                                                                                                           |
| 1. ECT                                                           | -10°C (14°F) or more                                                                                                                                                                                                                                                                                        |
| 2. Either of the following conditions is met:                    | Condition (a) or (b)                                                                                                                                                                                                                                                                                        |
| (a) ECT at engine start                                          | More than -7°C (19°F)                                                                                                                                                                                                                                                                                       |
| (b) ECT                                                          | More than 20°C (68°F)                                                                                                                                                                                                                                                                                       |
| Fuel-cut                                                         | OFF                                                                                                                                                                                                                                                                                                         |

### Monitor period of emission-related-misfire:

|                                                           |                                  |
|-----------------------------------------------------------|----------------------------------|
| First 1,000 revolutions after engine start, or check mode | Crankshaft 1,000 revolutions     |
| Except above                                              | Crankshaft 1,000 revolutions x 4 |

### Monitor period of catalyst-damage-misfire (MIL blinks):

|                                                     |                                |
|-----------------------------------------------------|--------------------------------|
| All of the following conditions 1, 2 and 3 are met: | Crankshaft 200 revolutions     |
| 1. Driving cycle                                    | 1st                            |
| 2. Check mode                                       | OFF                            |
| 3. RPM                                              | Less than 4,000 rpm            |
| Except above                                        | Crankshaft 200 revolutions x 3 |

## TYPICAL MALFUNCTION THRESHOLDS

### Monitor period of emission-related-misfire:

|         |                |
|---------|----------------|
| Misfire | 2.86 % or more |
|---------|----------------|

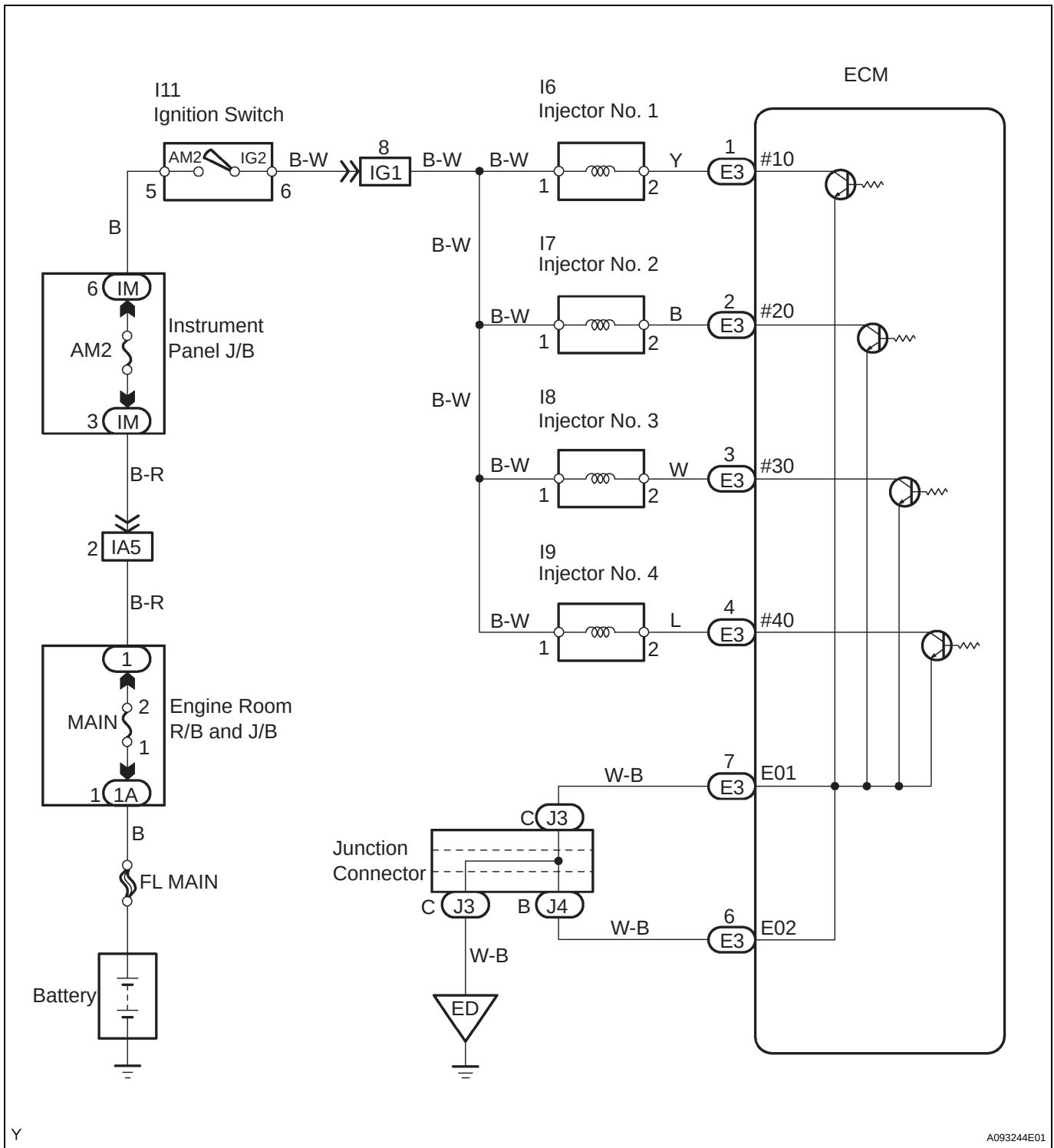
**Monitor period of catalyst-damage-misfire (MIL blinks):**

Number of misfire per 200 revolutions

151 or more (varies with intake air amount and RPM)

HINT:

The threshold value varies with intake air amount and the engine RPM.

**WIRING DIAGRAM**Refer to DTC P0351 for the wiring diagram of the ignition system (See page [ES-187](#)).

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## CONFIRMATION DRIVING PATTERN

1. Connect an intelligent tester or OBD II scan tool to the DLC3.
2. Turn the ignition switch to ON.
3. Turn the tester or scan tool ON.
4. Record the DTC(s) and freeze frame data.
5. Using the tester, switch the ECM from normal mode to check mode.
6. Read the misfire counts of each cylinder (CYL #1 to #4) with the engine in an idling condition. If any misfire count is displayed, skip the following confirmation driving pattern.
7. Drive the vehicle several times with the conditions, such as engine rpm and engine load, shown in MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

### HINT:

In order to store misfire DTCs, it is necessary to drive the vehicle for the period of time shown in the table below, with the MISFIRE RPM and MISFIRE LOAD in the DATA LIST.

| Engine RPM | Duration            |
|------------|---------------------|
| Idling     | 3.5 minutes or more |
| 1,000      | 3 minutes or more   |
| 2,000      | 1.5 minutes or more |
| 3,000      | 1 minute or more    |

8. If using an OBD II scan tool, follow the operations below to allow DTCs to be set by the ECM.
  - (a) Drive the vehicle several times with the conditions, such as engine rpm and engine load, stored in the freeze frame data (Procedure "A").
  - (b) Turn the ignition switch OFF and then turn it to ON again (Procedure "B").
  - (c) Repeat procedure "A" described above (Procedure "C").
9. Check whether misfires have occurred by checking DTCs and freeze frame data.
 

HINT:

Do not turn the ignition switch OFF until the stored DTC(s) and freeze frame data have been recorded. When the ECM returns to normal mode (default), the stored DTC(s), freeze frame data and other data will be erased.
10. Record the DTC(s), freeze frame data and misfire counts.
11. Turn the ignition switch OFF and wait for at least 5 seconds.

## INSPECTION PROCEDURE

### HINT:

- If any DTCs other than the misfire DTCs are output, troubleshoot those DTCs first.
- Read freeze frame data using the intelligent tester or the OBD II scan tool. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air/fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.
- If the misfire does not recur when the vehicle is brought to the workshop, reproduce the conditions stored in the freeze frame data.
- If the misfire still cannot be reproduced even though the conditions stored in the freeze frame data have been duplicated, one of the following factors is considered to be a possible cause of the problem:
  - (a) The fuel level in the tank is low.
  - (b) Improper fuel is used.
  - (c) The spark plugs have been contaminated.
  - (d) The problem is complex.
- After finishing repairs, check the misfire counts of the cylinders (CYL #1, #2, #3 and #4).
- After repairs, be sure to confirm that no misfiring cylinder DTCs are set again by conducting the confirmation driving pattern.
- For 6 and 8 cylinder engines, the ECM intentionally does not set the specific misfiring cylinder DTCs at high engine RPM. If misfires occur only in high engine RPM areas, only DTC P0300 is set. In the event of DTC P0300 being present, perform the following operations:

- (a) Clear the DTC (See page [ES-30](#)).
- (b) Start the engine and conduct the confirmation driving pattern.
- (c) Read the misfiring rates of each cylinder or DTC(s) using the tester or scan tool.
- (d) Repair the cylinder(s) that has a high misfiring rate or is indicated by the DTC.
- (e) After finishing repairs, conduct the confirmation driving pattern again, in order to verify that DTC P0300 is not set.
- When one of SHORT FT #1, LONG FT #1, SHORT FT #2 and LONG FT #2 in the freeze frame data is outside the range of  $\pm 20\%$ , the air-fuel ratio may be rich ( $-20\%$  or less) or lean ( $+20\%$  or more).
- When the COOLANT TEMP in the freeze frame data is less than  $75^{\circ}\text{C}$  ( $167^{\circ}\text{F}$ ), the misfires have occurred only while warming up the engine.

**1****CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO MISFIRE DTCS)**

- (a) Connect an intelligent tester or OBD II scan tool to the DLC3.
- (b) Turn the ignition switch to ON.
- (c) Turn the tester or scan tool ON.
- (d) On the tester, select the following menu items:  
DIAGNOSIS / ENHANCED OBD II / DTC INFO /  
CURRENT CODES.
- (e) Read DTCs.
- (f) If using an OBD II scan tool, refer to the instruction manual.

**Result**

| Display (DTC Output)                                   | Proceed to |
|--------------------------------------------------------|------------|
| P0300, P0301, P0302, P0303 and/or P0304                | A          |
| P0300, P0301, P0302, P0303 and/or P0304 and other DTCs | B          |

**HINT:**

If any DTCs other than P0300, P0301, P0302, P0303 and P0304 are output, troubleshoot those DTCs first.

**B****GO TO DTC CHART****A****2****READ VALUE OF INTELLIGENT TESTER (MISFIRE RPM AND MISFIRE LOAD)****NOTICE:**

**If an intelligent tester is not available, proceed to step 3.**

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch to ON and turn the tester ON.
- (c) Select the following menu items: DIAGNOSIS /  
ENHANCED OBD II / DATA LIST / MISFIRE / MISFIRE  
RPM and MISFIRE LOAD.
- (d) Read and note the MISFIRE RPM and MISFIRE LOAD  
(engine load) values.

**HINT:**

The MISFIRE RPM and MISFIRE LOAD indicate the vehicle conditions under which the misfire occurred.

**NEXT****ES**

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**3 CHECK PCV HOSE (CONNECTIONS)**

OK:

PCV hose is connected correctly and is not damaged.

NG

REPAIR OR REPLACE PCV HOSE

OK

**4 CHECK MISFIRE COUNT (CYL #1, #2, #3 AND #4)**

ES

- (a) Connect the intelligent tester or OBD II scan tool to the DLC3 (Procedure "A").
- (b) Turn the ignition switch to ON (Procedure "B").
- (c) Turn the tester or scan tool ON (Procedure "C").
- (d) Clear DTCs (See page [ES-30](#)) (Procedure "D").
- (e) If using an OBD II scan tool, go to step 5 (Procedure "E").
- (f) On the tester, select the following menu items:  
DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL /  
CYL #1, #2, #3 and #4 (Procedure "F").
- (g) Allow the engine to idle (Procedure "G").
- (h) Read each value of CYL #1 to #4 displayed on the tester.  
If no misfire counts occur in any cylinders, perform the following operations: (Procedure "H")
  - (1) Shift the gear selector lever to the D position.
  - (2) Repeat procedures "D" to "F" above.
  - (3) Check the CYL #1 to #4.
  - (4) If misfire counts are still not displayed, repeat procedure "G" and then check the misfire counts again.
- (i) Drive the vehicle with the MISFIRE RPM and MISFIRE LOAD noted in step 2 (Procedure "I").
- (j) Read the CYL #1 to #4 or DTCs displayed on the tester (Procedure "J").

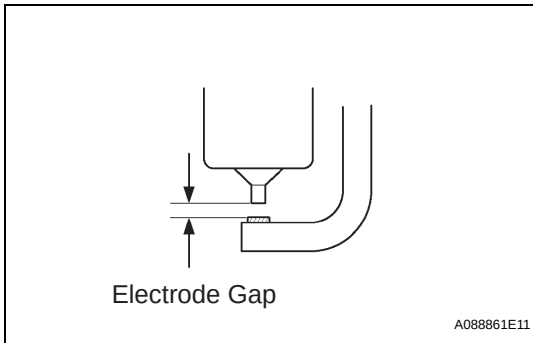
**Result**

| Misfire Count                               | Proceed to |
|---------------------------------------------|------------|
| One or two cylinders have misfire counts    | A          |
| Three cylinders or more have misfire counts | B          |

B

Go to step 13

A

**5 CHECK SPARK PLUG**

- (a) Remove cylinder head cover No. 2.
- (b) Remove the ignition coil and the spark plug of the misfiring cylinder.
- (c) Measure the spark plug electrode gap.

**Standard:**

**Between 1.0 mm and 1.3 mm (0.039 in. and 0.051 in.)**

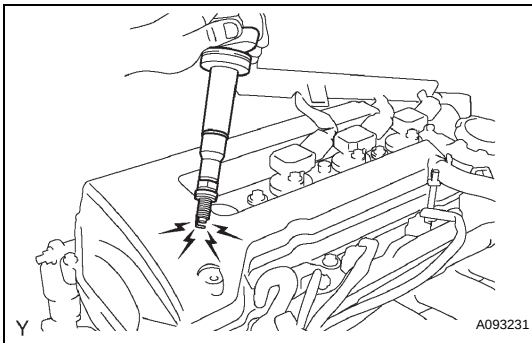
- (d) Check the electrode for carbon deposits.

**Recommended spark plug**

| Manufacturers | Products |
|---------------|----------|
| DENSO         | SK16R11  |
| NGK           | IFR5A11  |

**NOTICE:**

If the electrode gap is larger than standard, replace the spark plug. Do not adjust the electrode gap.

**NG****REPLACE SPARK PLUG****OK****6 CHECK FOR SPARKS AND IGNITION**

- (a) Disconnect the injector connectors, in order to prevent the engine from starting.
- (b) Install the spark plug to the ignition coil.
- (c) Attach the spark plug assembly to the cylinder head cover.
- (d) Crank the engine for less than 2 seconds and check the spark.

**OK:**

**Sparks jump across electrode gap**

- (e) Reconnect the injector connectors.

**NG****Go to step 8****OK****7 CHECK CYLINDER COMPRESSION PRESSURE (MISFIRING CYLINDER)**

- (a) Measure the cylinder compression pressure of the misfiring cylinder (See page [EM-2](#)).

**OK****Go to step 9****NG****REPAIR OR REPLACE ENGINE TO DETERMINE CAUSE OF LOW COMPRESSION****ES**

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8

CHANGE NORMAL SPARK PLUG AND CHECK SPARK OF MISFIRING CYLINDER

- (a) Change the installed spark plug to a spark plug that functions normally.
- (b) Perform a spark test.

**CAUTION:**  
Always disconnect each injector connector.

**NOTICE:**  
Do not crank the engine for more than 2 seconds.

- (1) Install the spark plug to the ignition coil and connect the ignition coil connector.
- (2) Disconnect the injector connector.
- (3) Ground the spark plug.
- (4) Check if sparks occur while the engine is being cranked.

**OK:**  
Sparks jump across electrode gap.

NG

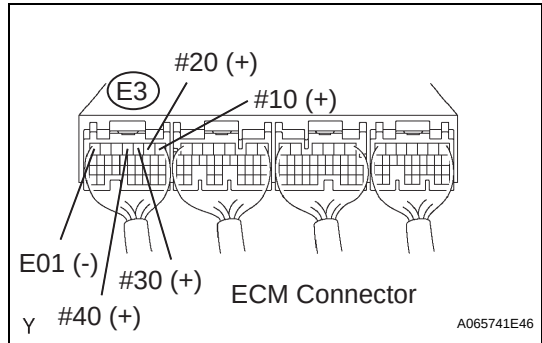
REPLACE IGNITION COIL ASSEMBLY

OK

REPLACE SPARK PLUG

9

INSPECT ECM TERMINAL VOLTAGE (MISFIRING CYLINDER)



- (a) Turn the ignition switch to ON.
- (b) Measure the voltage between the terminals of the E3 ECM connector.

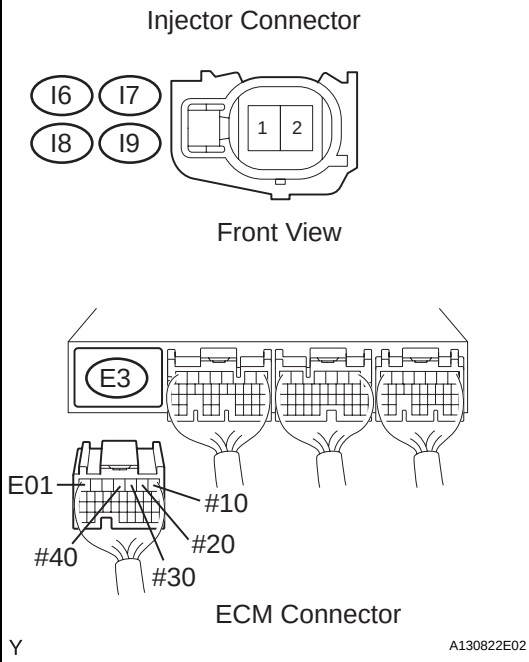
**Standard voltage**

| Tester Connections      | Specified Conditions |
|-------------------------|----------------------|
| #10 (E3-1) - E01 (E3-7) | Between 9 V and 14 V |
| #20 (E3-2) - E01 (E3-7) | Between 9 V and 14 V |
| #30 (E3-3) - E01 (E3-7) | Between 9 V and 14 V |
| #40 (E3-4) - E01 (E3-7) | Between 9 V and 14 V |

OK

Go to step 11

NG

**10 CHECK HARNESS AND CONNECTOR (INJECTOR - ECM)****Wire Harness Side:**

- Disconnect the injector connector (of the misfiring cylinder).
- Disconnect the E3 ECM connector.
- Turn the ignition switch to ON.
- Measure the resistance and voltage between the injector and the ECM connector terminals.

**Standard (Cylinder No. 1)**

| Tester Connections | Specified Conditions    |
|--------------------|-------------------------|
| I6-1 - Ground      | Between 11 V and 14 V   |
| I6-2 - Ground      | 10 k $\Omega$ or higher |
| I6-2 - #10 (E3-1)  | Below 1 $\Omega$        |

**Standard (Cylinder No. 2)**

| Tester Connections | Specified Conditions    |
|--------------------|-------------------------|
| I7-1 - Ground      | Between 11 V and 14 V   |
| I7-2 - Ground      | 10 k $\Omega$ or higher |
| I7-2 - #20 (E3-2)  | Below 1 $\Omega$        |

**Standard (Cylinder No. 3)**

| Tester Connections | Specified Conditions    |
|--------------------|-------------------------|
| I8-1 - Ground      | Between 11 V and 14 V   |
| I8-2 - Ground      | 10 k $\Omega$ or higher |
| I8-2 - #30 (E3-3)  | Below 1 $\Omega$        |

**Standard (Cylinder No. 4)**

| Tester Connections | Specified Conditions    |
|--------------------|-------------------------|
| I9-1 - Ground      | Between 11 V and 14 V   |
| I9-2 - Ground      | 10 k $\Omega$ or higher |
| I9-2 - #40 (E3-4)  | Below 1 $\Omega$        |

- Reconnect the injector connector.
- Reconnect the ECM connector.

NG

**REPAIR OR REPLACE HARNESS OR CONNECTOR**

OK

**11 CHECK FUEL INJECTOR (MISFIRING CYLINDER)**

- Check the injector injection (whether fuel volume is high or low, and whether injection pattern is poor) (See page [FU-13](#)).

NG

**REPLACE FUEL INJECTOR ASSEMBLY**

OK

ES

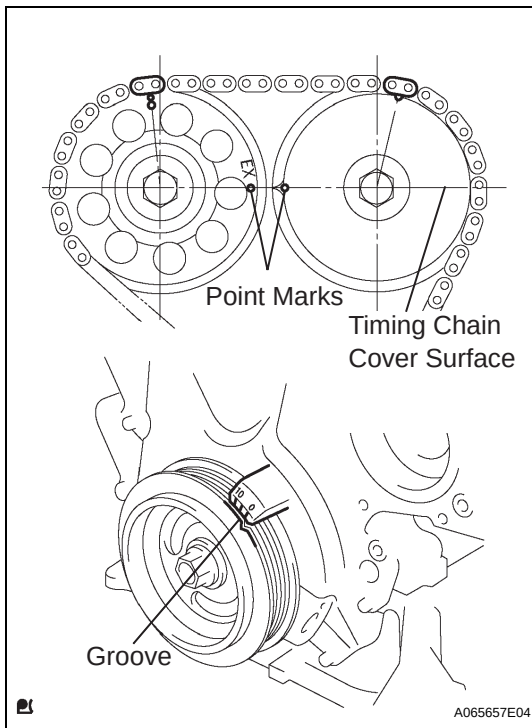
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**12 CHECK VALVE CLEARANCE (MISFIRING CYLINDER)**

- (a) Check the valve clearance of misfiring cylinder (See page [EM-6](#)).

**NG****ADJUST VALVE CLEARANCE****OK****13 CHECK AIR INDUCTION SYSTEM**

- (a) Check the air induction system for vacuum leakage.

**OK:****No leakage from air induction system.****NG****REPAIR OR REPLACE AIR INDUCTION SYSTEM****OK****14 CHECK VALVE TIMING**

- (a) Remove the cylinder head cover (See page [EM-44](#)).
- (b) Turn the crankshaft pulley, then align its groove with the timing mark "0" on the timing chain cover.
- (c) Check that the point marks on the camshaft timing gears are aligned with the timing chain cover surface as shown in the illustration.  
If not, turn the crankshaft 1 revolution (360°), then align the marks as above.

**OK:****Point marks on camshaft timing gears are aligned with timing chain cover surface.**

- (d) Reinstall the cylinder head cover (See page [EM-63](#)).

**NG****ADJUST VALVE TIMING****OK****15 CHECK FUEL PRESSURE**

- (a) Check the fuel pressure (See page [FU-8](#)).

NG

**CHECK AND REPLACE FUEL PUMP,  
PRESSURE REGULATOR, FUEL PIPE LINE  
AND FILTER**

OK

16

**READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (COOLANT TEMP.)**

- (a) Connect the intelligent tester or OBD II scan tool to the DLC3.
- (b) Turn the ignition switch to ON.
- (c) Turn the tester or scan tool ON.
- (d) On the tester, select the following menu items:  
DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / COOLANT TEMP.
- (e) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.
- (f) If using an OBD II scan tool, refer to the instruction manual.

**Standard:****With cold engine:****Same as ambient air temperature.****With warm engine:****Between 75°C and 95°C (167°F and 203°F).**

NG

**REPLACE ENGINE COOLANT  
TEMPERATURE SENSOR**

OK

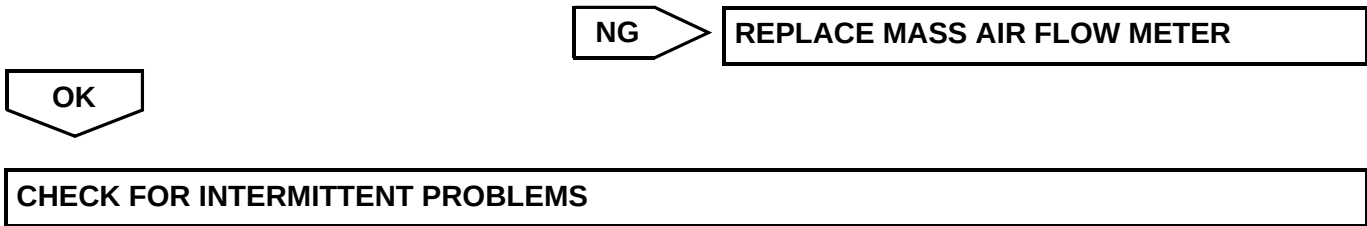
17

**READ VALUE OF INTELLIGENT TESTER OR OBD II SCAN TOOL (MAF)**

- (a) Connect the intelligent tester or OBD II scan tool to the DLC3.
- (b) Turn the ignition switch to ON.
- (c) Turn the tester or scan tool ON.
- (d) On the tester, select the following menu items:  
DIAGNOSIS / ENHANCED OBD II / DATA LIST / ALL / MAF and COOLANT TEMP.
- (e) Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
- (f) Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.
- (g) If using an OBD II scan tool, refer to the instruction manual.

**Standard:****MAF while engine idling:****Between 1.4 g/sec and 2.3 g/sec (shift position: N, A/C: OFF).****MAF at engine speed of 2,500 rpm:****Between 5.4 g/sec and 7.9 g/sec (shift position: N, A/C: OFF).**

ES



NG

REPLACE MASS AIR FLOW METER

OK

CHECK FOR INTERMITTENT PROBLEMS