

## HM: Secondary Air Injection (AIR) System

← [HM: Introduction](#)

### HM1 CHECK B+ VOLTAGE TO SOLID STATE RELAY

Diagnostic Trouble Code (DTC) P0412 indicates EAIR primary circuit fault.

Possible causes:

- EAIR circuit open.
- EAIR circuit short to power.
- AIR bypass solenoid fault.
- Solid state relay fault.
- Damaged PCM.
- Damaged electric AIR pump.
- Disconnect SSR.
- Key on, engine off.
- Measure voltage of B+ circuit at SSR harness connector and battery negative post.
- Key off.

Was voltage greater than 10.5 volts?

| Yes   | No                          |
|---|-----------------------------|
| Supplied voltage is OK, GO to <a href="#">HM2</a> . | GO to <a href="#">HM6</a> . |

### HM2 CHECK EAIR CIRCUIT FOR OPEN IN HARNESS

- Disconnect AIR bypass solenoid.
- Remove Secondary Air Injection System dedicated fuse temporarily.
- Install breakout box, leave PCM disconnected.
- Measure resistance of EAIR circuit between PCM test pin 70 and SSR harness connector and AIR bypass harness connector.

Is resistance less than 5.0 ohms?

| Yes                         | No   |
|-----------------------------|--|
| GO to <a href="#">HM3</a> . | REPAIR open circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM3 CHECK EAIR CIRCUIT FOR SHORT TO POWER AND GROUND WITH DISCONNECT AIR BYPASS SOLENOID

- Measure resistance between PCM test pin 70 and PCM test pins 51, 71, 90, 97 and 103.

**Is each resistance greater than 10,000 ohms?**

| Yes   | No  |
|---|---|
| The EAIR harness is OK. GO to <a href="#">HM4</a> . | REPAIR short circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM4 CHECK EAIR CIRCUIT FOR SHORT TO POWER AND GROUND

- Reconnect AIR bypass solenoid.
- Measure resistance between PCM test pin 70 and PCM test pins 51, 71, 90, 97 and 103 at the breakout box.

**Is each resistance greater than 10,000 ohms?**

| Yes   | No   |
|---|--|
| EAIR circuit with AIR bypass solenoid OK. GO to <a href="#">HM5</a> . | REPLACE AIR bypass solenoid. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM5 CHECK EAIR CIRCUIT FOR SHORT TO POWER AND GROUND WITH SOLID STATE RELAY RECONNECTED

- AIR bypass solenoid disconnected.
- Reconnect solid state relay.
- Measure resistance between PCM test pin 70 and PCM test pins 51, 71, 90, 97 and 103.

**Is each resistance greater than 10,000 ohms?**

| Yes  | No   |
|--|--|
| <p>If DTC P0411 or P1411 is also present:</p> <p>GO to <a href="#">HM9</a>.</p> <p><b>All others:</b></p> <p>GO to <a href="#">HM14</a>.</p> | REPLACE solid state relay. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM6 CHECK B+ CIRCUIT FOR OPEN IN HARNESS

- Measure resistance of B+ circuit between solid state relay harness connector and Secondary Air Injection System dedicated fuse.

**Is resistance less than 5.0 ohms?**

|  |  |
|--|--|
|  |  |
|--|--|

| Yes  | No   |
|--|--|
| REPLACE Secondary Air Injection System dedicated fuse, then GO to <a href="#">HM8</a> to check electric AIR pump. RECONNECT solid state relay. | REPAIR open circuit. RECONNECT solid state relay and fuse. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

## HM7 VISUALLY INSPECT ELECTRIC AIR PUMP HOSES

DTC P0411/P1411 indicates Secondary Air not detected. In order to test the pump, it must be capable of driving the HO2S lean.

**Note:** Some applications have one or two AIR diverter valves.

Possible causes:

- Electric AIR pump fault.
- Hose from electric AIR pump blocked.
- Hose from electric AIR pump leak.
- AIR bypass solenoid stuck open/closed.
- AIR bypass solenoid leak/blocked.
- Visually inspect electric AIR pump hoses from the electric AIR pump to the AIR diverter valves.
- Inspect air hose for cracks, binding, obstructions, water or ice.

### Are electric AIR pump hoses OK?

| Yes                         | No   |
|-----------------------------|--|
| GO to <a href="#">HM8</a> . | DRAIN all water from hoses or REPLACE damaged parts. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

## HM8 CHECK ELECTRIC AIR PUMP OPERATION

- Key on, engine off.
- Enter Output Test mode.

### Does the pump run?

| Yes  | No   |
|--|--|
| GO to <a href="#">HM15</a> to check electric AIR pump for water contamination. | REPLACE air hose to AIR diverter valves for leaks or blockage. If OK, GO to <a href="#">HM11</a> . |

## HM9 CHECK FOR VACUUM AT AIR DIVERTER VALVES

- Connect a vacuum gauge to the control vacuum hose at the AIR diverter valve(s).
- Apply 53 kPa (16 in-HG) of vacuum to source side of AIR bypass solenoid at the intake manifold.

- Key on, engine off.
- Enter Output Test mode.

**Is vacuum present at the AIR diverter valve(s)?**

| Yes                          | No                           |
|------------------------------|------------------------------|
| GO to <a href="#">HM10</a> . | GO to <a href="#">HM30</a> . |

## HM10 CHECK AIR DIVERTER VALVE(S) INTEGRITY



**CAUTION:** Caution must be observed while performing this test.

**Note:** On a two valve system, make sure air is flowing from both valves.

- Reconnect vacuum control line.
- Disconnect air tube from AIR diverter valve(s).
- Inspect AIR diverter valve(s) outlets for damage from hot exhaust gases. Repair as necessary.
- Key on, engine off.
- Enter Output Test mode.

**Is air present from the AIR diverter valve(s)?**

| Yes  | No   |
|--|--|
| GO to Powertrain/Engine Group of the Workshop Manual to repair the exhaust tubes from the AIR diverter valve to the exhaust manifold(s). COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPLACE hose from electric AIR pump to AIR diverter valve. If OK, REPLACE the appropriate AIR diverter valve(s). COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

## HM11 CHECK VOLTAGE ON EAIR MONITOR CIRCUIT

- Disconnect electric AIR pump.
- Key on, engine off.
- Enter Output Test mode.
- Measure voltage of EAIR monitor circuit between electric AIR pump harness connector and battery negative post.

**Is voltage greater than 10.5 volts?**

| Yes                          | No                           |
|------------------------------|------------------------------|
| GO to <a href="#">HM13</a> . | GO to <a href="#">HM12</a> . |

## HM12 CHECK ELECTRIC AIR PUMP GROUND FOR OPEN IN HARNESS

- Measure resistance of EAP ground circuit between electric AIR pump GND circuit at the harness

connector and battery negative post.

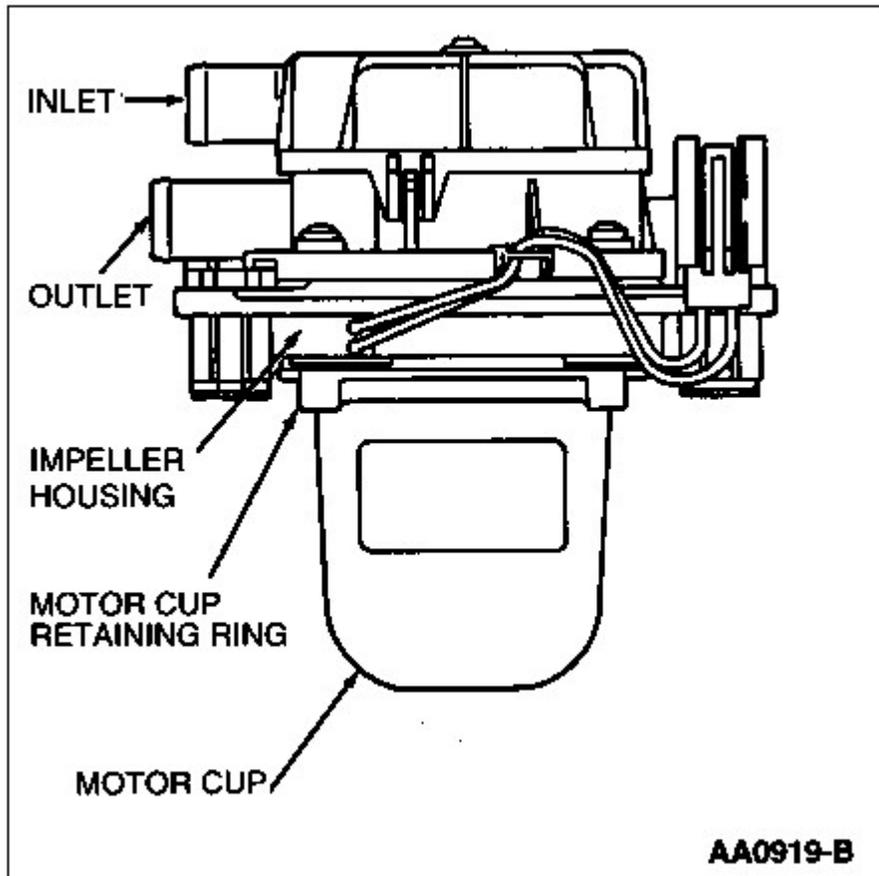
Is resistance less than 5 ohms?

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM19</a> . | REPAIR open circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM13 CHECK AIR HOSE TO ELECTRIC AIR PUMP**

- Disconnect inlet air hose.
- Visually inspect inlet air hose for binding, obstructions, water or ice to the electric AIR pump.

Is the hose integrity OK?



| Yes   | No  |
|---|---|
| REPLACE electric AIR pump. ADD RTV Silicone Sealant F5TZ-19G204-AB or equivalent to seal the new electric AIR pump. REFER to the illustration below. COMPLETE PCM Reset | SERVICE air hose by draining all water. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

|   |  |
|---|--|
| to clear DTCs. RESTORE vehicle RERUN <a href="#">Quick Test</a> . |  |
|---|--|

## HM14 CHECK SOLID STATE RELAY OUTPUT

- AIR bypass solenoid reconnected.
- PCM connected.
- Key on.
- Measure voltage between PCM test pin 5 and chassis ground.
- Measure voltage between PCM test pin 70 and chassis ground.
- Key off.

**Were both greater than 10.5 volts?**

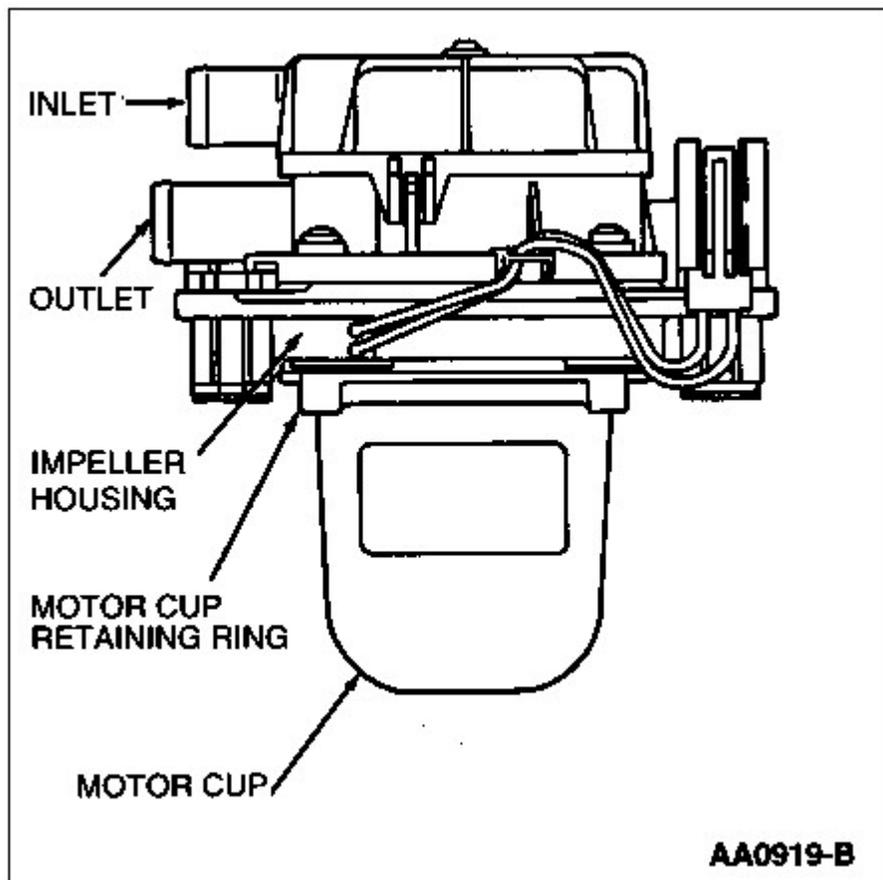
| Yes   | No   |
|---|--|
| REPLACE solid state relay. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. | REPLACE PCM. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

## HM15 CHECK AIR PUMP FOR WATER

**Note:** Water ingested in the electric AIR pump will reduce the life of the pump.

- Disconnect electric AIR pump connector and air hoses.
- Carefully tilt electric AIR pump in various positions to verify if any water is present.

**Is any water present?**



| Yes   | No  |
|---|---|
| <p>REPLACE electric AIR pump. Water in electric AIR pump will reduce the life of the pump. ADD RTV to seal new electric AIR pump. REFER to illustration below. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle.</p> | <p>If fuse was replaced in <a href="#">HM6</a>,<br/>                     Testing is complete. RESTORE vehicle.<br/>                     RERUN <a href="#">Quick Test</a>.<br/>                     All others, GO to <a href="#">HM9</a>.</p> |

### HM17 CHECK B+ CIRCUIT VOLTAGE TO SOLID STATE RELAY

DTC P1413 indicates EAIR monitor circuit is low while the electric AIR pump was commanded ON.

Possible Causes:

- Open VPWR
- Open B+ circuit
- EAIR circuit short to ground
- Open EAIR circuit
- Damaged AIR pump
- Damaged PCM
- Damaged solid state relay
- Disconnect solid state relay.

- Key on.
- Measure voltage of B+ circuit between solid state relay harness connector and chassis ground.
- Key off.

**Was voltage greater than 10.5 volts?**

| Yes                          | No                           |
|------------------------------|------------------------------|
| GO to <a href="#">HM18</a> . | GO to <a href="#">HM24</a> . |

**HM18 CHECK FOR VPWR TO SOLID STATE RELAY**

- Key on, engine off.
- Measure voltage of VPWR circuit between solid state relay harness and chassis ground.
- Key off.

**Was voltage greater than 10.5 volts?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM19</a> . | REPAIR open VPWR circuit between the solid state relay and Electronic Engine Control power relay. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM19 CHECK VOLTAGE ON EAIR MONITOR CIRCUIT**

- Reconnect solid state relay.
- Disconnect electric AIR pump.
- Key on.
- Measure voltage of EAIR monitor circuit between electric AIR pump harness connector and chassis ground.
- Key off.

**Was voltage greater than 10.5 volts?**

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM23</a> . | If DTC P0411 is present, REPLACE electric AIR pump. GO to <a href="#">HM20</a> . |

**HM20 CHECK EAIR MONITOR VOLTAGE TO PCM**

- Install breakout box, leave PCM disconnected.
- Key on.
- Measure voltage between PCM test pin 5 and chassis ground.
- Key off.

**Was voltage greater than 10.5 volts?**

| Yes | No |
|-----|----|
|     |    |

| Yes  | No                           |
|--|------------------------------|
| REPLACE PCM. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | GO to <a href="#">HM21</a> . |

### HM21 CHECK EAIR DRIVER AND EAIR MONITOR CIRCUITS FOR OPEN IN HARNESS

- Disconnect solid state relay.
- Measure resistance of EAIR driver circuit between PCM test pin 70 and solid state relay harness connector.
- Measure resistance of EAIR monitor circuit between PCM test pin 5 and solid state relay harness connector.
- Measure resistance of EAIR monitor circuit between the solid state relay harness connector and the electric AIR pump harness connector.

Is each resistance less than 5.0 ohms?

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM22</a> . | REPAIR the circuit in question. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM22 CHECK EAIR MONITOR CIRCUIT FOR SHORT TO GROUND IN HARNESS

- Measure resistance between PCM test pin 5 and PCM test pins 51, 76 and 91.

Is each resistance greater than 10,000 ohms?

| Yes  | No  |
|--|---|
| REPLACE solid state relay. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPAIR short circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM23 CHECK EAIR MONITOR VOLTAGE TO PCM

- Reconnect electric AIR pump.
- Install breakout box. PCM connected.
- Key on, engine running.
- Measure voltage between PCM test pin 5 and chassis ground.
- Key off.

Was voltage greater than 10.5 after the 5 second delay?

| Yes                                | No                                      |
|------------------------------------|---|
| REPLACE PCM. COMPLETE PCM Reset to | REPAIR open circuit. COMPLETE PCM Reset |

|   |  |
|---|--|
| clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |
|---|--|

### HM24 CHECK B+ CIRCUIT FOR OPEN IN HARNESS

- Measure resistance of B+ circuit between solid state relay harness connector and dedicated fuse B+ circuit.

Is resistance less than 5 ohms?

| Yes   | No   |
|---|--|
| REPLACE solid state relay dedicated fuse. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPAIR open circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM25 CHECK EAIR MONITOR CIRCUIT FOR OPEN IN HARNESS

DTC P1414 indicates electric AIR pump commanded off, but PCM indicates electric AIR pump is on.

Possible Causes:

- Open EAIR circuit.
- Open AIR pump ground.
- EAIR circuit short to power.
- Damaged AIR pump.
- Damaged solid state relay.
- Damaged PCM.
- Disconnect solid state relay.
- Install breakout box, leave PCM disconnected.
- Disconnect electric AIR pump.
- Measure resistance of EAIR monitor circuit between PCM test pin 5 and electric AIR pump harness connector.

Is resistance less than 5 ohms?

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM26</a> . | REPAIR open circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM26 CHECK ELECTRIC AIR PUMP FOR OPEN

- Measure electric AIR pump resistance.

Is resistance between 0.5-5.0 ohms?

|  |  |
|--|--|
|  |  |
|--|--|

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM27</a> . | REPLACE electric AIR pump. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM27 CHECK EAIR MONITOR CIRCUIT FOR SHORT TO POWER IN HARNESS**

- Key on.
- Measure voltage between PCM test pin 5 and chassis ground.
- Key off.

**Was voltage greater than 10.5 volts?**

| Yes   | No   |
|---|--|
| REPAIR short circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | EAIR Monitor circuit is OK. GO to <a href="#">HM28</a> . |

**HM28 CHECK BOTH EAIR MONITOR CIRCUIT AND EAIR CIRCUIT FOR VOLTAGE**

- Reconnect solid state relay and electric AIR pump.
- Connect PCM.
- Key on, engine running.
- Measure voltage between PCM test pin 5 and chassis ground.
- Measure voltage between PCM test pin 70 and chassis ground.
- Key off.

**Were both greater than 10.5 volts?**

| Yes  | No   |
|--|--|
| REPLACE solid state relay. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPLACE PCM. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM30 CHECK VACUUM HOSE INTEGRITY**

- Key off.
- Check vacuum hose between AIR bypass solenoid and AIR diverter valve.
- Check for blockage and restrictions.
- Check for leaks and cracks.
- Check for kinks or disconnects.

**Are the above checks OK?**

| Yes | No |
|-----|----|
|     |    |

GO to [HM31](#).

REPLACE the vacuum line connecting the AIR bypass solenoid to AIR diverter valve(s).  
COMPLETE PCM Reset to clear DTCs.  
RESTORE vehicle. RERUN [Quick Test](#).

## HM31 CHECK AIR BYPASS SOLENOID ELECTRICAL OPERATION

- Key on, engine off.
- Connect scan tool.
- Access Output Test Mode (OTM). Refer to [Section 2A](#), Diagnostic Methods.
- Disconnect AIR bypass solenoid.
- Connect digital multimeter to AIR bypass solenoid vehicle harness connector.
- Turn the outputs on, then turn outputs off while observing digital multimeter.

Does EAIR circuit voltage cycle greater than 0.5 volt?

| Yes  | No                                    |
|--|---------------------------------------|
| REMAIN in Output Test Mode. GO to <a href="#">HM32</a> . | Key off. GO to <a href="#">HM33</a> . |

## HM32 CHECK AIR BYPASS SOLENOID FOR MECHANICAL OPERATION

- While remaining in Output Test Mode, reconnect AIR bypass solenoid.
- Disconnect source vacuum hose from AIR bypass solenoid.
- Apply 53 kPa (16 in-Hg) of vacuum to source side of AIR bypass solenoid.
- Turn the outputs on, then turn outputs off.

Was vacuum released?

| Yes  | No   |
|--|--|
| REPAIR vacuum hose from manifold vacuum tree to AIR bypass solenoid. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPLACE AIR bypass solenoid. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

## HM33 CHECK AIR BYPASS SOLENOID RESISTANCE

- Disconnect AIR bypass solenoid harness connector.
- Measure AIR bypass solenoid resistance.

Is resistance between 50 and 100 ohms?

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM34</a> , | REPLACE AIR bypass solenoid. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM34 CHECK VPWR CIRCUIT FOR OPEN IN HARNESS**

- Key on, engine off.
- Measure voltage of VPWR circuit between AIR bypass solenoid harness connector and battery ground.
- Key off.

**Was voltage greater than 10.5 volts?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM35</a> . | REPAIR open VPWR circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM35 CHECK EAIR CIRCUIT FOR OPEN IN HARNESS**

- Disconnect solid state relay.
- Install breakout box, leave PCM disconnected.
- Measure resistance of EAIR circuit between PCM test pin 70 and the AIR bypass solenoid harness connector and at the solid state relay harness connector.

**Is resistance less than 5.0 ohms?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM36</a> . | REPAIR open EAIR circuit. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM36 CHECK EAIR CIRCUIT FOR SHORT TO GROUND IN HARNESS**

- Disconnect scan tool.
- Measure resistance between PCM test pin 70 and PCM test pins 51, 76 and 91.

**Is each resistance greater than 10,000 ohms?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM37</a> . | REPAIR short to ground. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

**HM37 CHECK EAIR CIRCUIT FOR SHORT TO POWER IN HARNESS**

- Measure resistance between PCM test pin 70 and PCM test pins 71 and 97.

**Is each resistance greater than 10,000 ohms?**

|  |  |
|--|--|
|  |  |
|--|--|

| Yes  | No   |
|--|--|
| REPLACE PCM. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPAIR short to power. COMPLETE PCM Reset to clear DTCs. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

## HM40 DIAGNOSTIC TROUBLE CODE (DTC) P0411: VISUAL INSPECTION

DTC P0411 indicates that Secondary Air is not being diverted when requested.

Possible causes:

- Vacuum hoses damaged.
- AIR diverter valve inoperative.
- AIR pump inoperative.
- AIR diverter solenoids damaged.
- Visually inspect vacuum lines for disconnects in the AIR system.
- Visually inspect for proper vacuum line routing. Refer to VECI decal.
- Visually inspect AIR pump for broken or loose AIR pump belt. Refer to [HM81](#) for adjustment/replacement.

Were any of these conditions found?

| Yes   | No                           |
|---|------------------------------|
| REPAIR as necessary. RERUN <a href="#">Quick Test</a> . | GO to <a href="#">HM41</a> . |

## HM41 CHECK AIR VACUUM LINES

- Carefully check AIR vacuum lines;
  - From AIR diverter solenoid to AIR diverter valve.
  - From manifold vacuum tree to AIR diverter solenoids.
- Check for obstructions, cracks, kinks and leaks.

Are vacuum lines in good condition?

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM42</a> . | SERVICE as necessary. RERUN <a href="#">Quick Test</a> . |

## HM42 CHECK FOR VACUUM AT THE AIR DIVERTER VALVES

- Remove control vacuum line from AIR diverter valves.
- Key on, engine running at normal operating temperature.
- Check for vacuum at control vacuum line.
- Key off.

Was vacuum present?

---

| Yes                          | No                           |
|------------------------------|------------------------------|
| GO to <a href="#">HM43</a> . | GO to <a href="#">HM63</a> . |

### HM43 INSPECT AIR DIVERTER VALVES

- Disconnect air hose to the AIR check valves at AIR diverter valve outlet.
- Inspect AIR diverter valve outlet for damage from hot exhaust gas.

#### Is AIR diverter valve damaged?

| Yes   | No                           |
|---|------------------------------|
| REPLACE AIR diverter valves, then GO to <a href="#">HM60</a> to inspect AIR check valves. | GO to <a href="#">HM44</a> . |

### HM44 CHECK AIR DIVERTER VALVE DIAPHRAGM

- Connect auxiliary vacuum source to one AIR diverter valve.
- Apply 34 kPa (10 in-Hg) vacuum and trap.
- Repeat for other AIR diverter valve.

#### Does valve hold vacuum?

| Yes  | No   |
|--|--|
| LEAVE vacuum applied. GO to <a href="#">HM45</a> . | REPLACE AIR diverter valve. VERIFY a symptom no longer exists. |

### HM45 CHECK AIR DIVERTER OPERATION/FLOW

- Key on, engine running.
- Increase engine speed to 1500 rpm.
- Check for air flow at valve outlet (audibly or by feel).
- Key off.

#### Was air flow present?

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM46</a> . | GO to <a href="#">HM71</a> to check AIR pump operation and belt. |

### HM46 CHECK AIR DIVERTER OPERATION/DUMP

- Key on, engine running.
- Vent auxiliary vacuum source to 0.

- Check that air flow switches from the valve outlet to the dump port or silencer ports (audibly or by feel).
- Key off.

**Did the air flow switch?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM47</a> . | REPLACE AIR diverter valves. RESTORE vehicle. |

**HM47 VISUALLY INSPECT AIR BYPASS VALVE**

- Remove hoses from AIR bypass valve outlets.
- Inspect outlets for damage from hot exhaust gases.

**Is AIR bypass valve damaged?**

| Yes  | No                           |
|--|------------------------------|
| REPLACE AIR bypass valve, then GO to <a href="#">HM60</a> for AIR check valve. | GO to <a href="#">HM48</a> . |

**HM48 CHECK FOR VACUUM AT AIR BYPASS VALVE**

**Note:** The next two test steps will require your attention to time.

- Remove vacuum supply line from vacuum nipple on valve.
- Key on, engine running at normal operating temperature.
- After engine has started, check for vacuum.
- Key off.

**Was vacuum present after a 10-second delay?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM49</a> . | GO to <a href="#">HM63</a> to VERIFY solenoid AIR bypass vacuum function. |

**HM49 CHECK AIR BYPASS VALVE DIAPHRAGM**

- Connect an auxiliary vacuum source to the AIR bypass valve.
- Apply 34 kPa (10 in-Hg) vacuum and hold.

**Does valve hold vacuum?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM50</a> . | REPLACE AIR bypass valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

**HM50 CHECK FOR AIR SUPPLY AT AIR BYPASS VALVE**

- Key on, engine running to normal operating temperature.
- Remove vacuum supply to AIR bypass valve.
- Verify that the air is being supplied to the AIR bypass valve.
- Key off.

**Was air present?**

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM51</a> . | GO to <a href="#">HM71</a> for AIR pump operation. |

**HM51 CHECK FOR AIR AT AIR BYPASS OUTLET(S)**

- Key on engine running.
- Apply 34 kPa (10 in-Hg) of vacuum to AIR bypass valve.
- Increase engine speed to 1500 rpm.
- Key off.

**Did air flow out of valve outlet?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM52</a> . | REPLACE AIR bypass valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

**HM52 CHECK FOR AIR AT OTHER AIR BYPASS OUTLET**

- Key on, engine running.
- Vent the auxiliary vacuum source to 0 kPa (0 in-Hg).
- Key off.

**Did air flow switch from one outlet to the other outlet?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM63</a> . | REPLACE AIR bypass valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

**HM60 VISUALLY INSPECT CHECK VALVE SYSTEM—(EXTERNALLY)**

- Visually inspect secondary air hoses, tubes, control valves and check valves for leaks or external signs of damage (from back flow of hot exhaust gases).

**Are hoses and valves intact?**

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM61</a> . | REPAIR or REPLACE damaged parts including check valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

### HM61 VISUALLY INSPECT HOSES AT VALVES—(INTERNALLY)

- Remove hose from check valve inlet.
- Inspect inside the hose for damage from hot exhaust gas.

Is the hose clean and undamaged?

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM62</a> . | REPLACE hose and check valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

### HM62 INSPECT CHECK VALVE FUNCTION

**Note:** Check valve may "burble" as air is drawn in.

- Key on, engine running.
- Listen for escaping exhaust gas or feel for gas (only if engine temperature is at an acceptable level).
- Key off.

Was any exhaust gas escaping?

| Yes  | No  |
|--|---|
| REPLACE check valve. VERIFY a symptom no longer exists. RESTORE vehicle. | RETURN to <a href="#">Section 3A</a> Symptom Charts to address other possible causes. |

### HM63 CHECK AIR BYPASS AND AIR DIVERTER SOLENOIDS ELECTRICAL OPERATION

- Connect scan tool.
- Access Output Test Mode (OTM). Refer to [Section 2A](#), Diagnostic Methods.
- Disconnect suspect solenoid.
- Connect digital multimeter positive test lead to VPWR circuit and negative test lead to signal circuit of suspect vehicle harness connector.
- While observing digital multimeter, turn outputs on, then turn outputs off.

Does solenoid circuit cycle voltage?

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM64</a> . | REMOVE jumper. GO to <a href="#">HM76</a> . |

**HM64 CHECK VACUUM SUPPLY TO AIR DIVERTER/AIR BYPASS SOLENOID**

- Remove vacuum inlet line at suspect (AIR diverter/AIR bypass) solenoid.
- Start engine and let idle.
- Check vacuum at line.
- Key off.

**Was vacuum present?**

| Yes  | No                           |
|--|------------------------------|
| REPLACE AIR bypass or AIR diverter solenoid.<br>COMPLETE PCM Reset to clear DTCs.<br>RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | GO to <a href="#">HM66</a> . |

**HM66 CHECK VACUUM SUPPLY TO RESERVOIR**

- Remove vacuum inlet line at reservoir (For single piece connector, this port is marked MAN or VAC).
- Key on, engine running.
- Check for vacuum on line.
- Key off.

**Was vacuum present?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM68</a> . | <p><b>If vehicle has a check valve:</b></p> <p>GO to <a href="#">HM69</a>.</p> <p><b>If no check valve:</b></p> <p>REPAIR or REPLACE vacuum line for leaks, blockage or damage. Verify a symptom no longer exists. RESTORE vehicle.</p> |

**HM68 CHECK RESERVOIR TO HOLD VACUUM**

- Connect vacuum gauge to outlet port (not marked MAN or VAC), keep inlet line connected to vacuum port.
- Start and run engine for 30 seconds while observing gauge.
- Key off.

**Did vacuum gauge reading increase approximately 50-68 kPa (15 to 20 in-Hg)?**

| Yes   | No  |
|---|---|
| REPLACE reservoir outlet hose. If symptom is still present, GO to Symptom Charts, <a href="#">Section 3A</a> for other possible causes. | REPLACE vacuum reservoir. VERIFY a symptom no longer exists. RESTORE vehicle. |

**HM69 CHECK AIR FLOW AT CHECK VALVE**

- Remove check valve from vacuum lines (note which direction check valve is installed).
- Connect auxiliary vacuum source to black side of check valve.
- Connect vacuum gauge to opposite side of check valve.
- Apply 54 kPa (16 in-Hg) vacuum to black side.

**Does gauge indicate 54 kPa (16 in-Hg)?**

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM70</a> . | REPLACE check valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

**HM70 VERIFY CHECK VALVE'S ABILITY TO HOLD VACUUM**

- Remove auxiliary vacuum source from the check valve.

**Does vacuum gauge reading remain above 50 kPa (15 in-Hg) for 10 seconds?**

| Yes  | No   |
|--|--|
| GO to Symptom Charts, <a href="#">Section 3A</a> , to address other possible causes. | REPLACE check valve. VERIFY a symptom no longer exists. RESTORE vehicle. |

**HM71 CHECK BELT TENSION**

**CAUTION:** Do not pry on AIR pump to adjust belt. The aluminum housing is likely to collapse. Refer to AIR Pump drive belt adjustment.

- Check belt tension and adjust to specification.

**Is belt tension adjusted properly?**

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM72</a> . | ADJUST to specification. GO to <a href="#">HM81</a> to adjust belt tension. |

**HM72 CHECK AIR PUMP OPERATION**

- Disconnect air supply hose from AIR diverter valves.
- Key on, engine running.
- Check air flow at the pump outlet as engine speed increases.
- Key off.

**Did air flow increase as the engine speed increases?**

| Yes  | No                           |
|--|------------------------------|
| RETURN to Symptom Chart, <a href="#">Section 3A</a> for other possible causes. | GO to <a href="#">HM73</a> . |

### HM73 CHECK SILENCER/FILTER FOR OBSTRUCTION

- Remove inlet hose (if equipped).
- Inspect inlet of silencer/filter for blockage (bugs, leaves, debris).

Is inlet open?

| Yes  | No  |
|--|---|
| REPLACE AIR pump and VERIFY a symptom no longer exists. RESTORE vehicle. | REMOVE all debris and VERIFY a symptom no longer exists. RESTORE vehicle. |

### HM75 DIAGNOSTIC TROUBLE CODES (DTCs) P0413, P0414, P0416 AND P0417: CHECK VPWR CIRCUIT FOR OPEN IN HARNESS

DTCs P0413, P0414, P0416 and P0417 indicate that voltage output for Secondary Air Injection solenoid(s) did not change when activated.

Possible causes:

- AIRB/AIRD circuit(s) shorted to power.
- AIRB/AIRD circuit(s) open or shorted to ground.
- AIR bypass /AIR diverter solenoid(s) resistance out of range.
- Damaged PCM.
- Disconnect AIR bypass /AIR diverter solenoid connector.
- Key on, engine off.
- Measure voltage of VPWR circuit between AIR bypass solenoid and battery negative post.
- Repeat for AIRO diverter solenoid if equipped.
- Key off.

Was each voltage greater than 10.5 volts?

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM76</a> . | REPAIR open circuit. RESTORE vehicle.<br>RERUN <a href="#">Quick Test</a> . |

### HM76 CHECK BOTH AIR BYPASS/AIR DIVERTER SOLENOID RESISTANCE

- Measure both AIR bypass/AIR diverter solenoid for resistances.

Is each resistance between 50 and 100 ohms?

|  |  |
|--|--|
|  |  |
|--|--|

| Yes                          | No   |
|------------------------------|--|
| GO to <a href="#">HM77</a> . | REPLACE solenoid assembly. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM77 CHECK AIRB AND AIRD CIRCUIT FOR OPEN IN HARNESS

- Install breakout box, leave PCM disconnected.
- Measure resistance of AIRB circuit between AIRB circuit at breakout box and AIRB circuit at harness connector.
- Measure resistance of AIRD circuit between AIRD circuit at the breakout box and AIRD circuit at harness connector.

Is each resistance less than 5.0 ohms?

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM78</a> . | SERVICE open harness circuit. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM78 CHECK AIRB AND AIRD CIRCUIT FOR SHORT TO GROUND IN HARNESS

- Disconnect scan tool.
- Measure resistance of AIRB circuit between AIRB circuit at the breakout box and PCM test pins 51, 91 and 103.
- Measure resistance of AIRD circuit between AIRD circuit at the breakout box and PCM test pins 51, 91 and 103.

Is each resistance greater than 10,000 ohms?

| Yes                          | No  |
|------------------------------|---|
| GO to <a href="#">HM79</a> . | REPAIR short circuit. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . |

### HM79 CHECK AIRB AND AIRD CIRCUIT FOR SHORT TO POWER IN HARNESS

- Measure resistance of AIRB circuit between AIRB circuit at the breakout box and PCM test pins 71 and 97.
- Measure resistance of AIRD circuit between AIRD circuit at the breakout box and PCM test pins 71 and 97.

Is each resistance greater than 10,000 ohms?

| Yes  | No  |
|--|---|
| REPLACE PCM. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . | REPAIR short circuit. RESTORE vehicle. RERUN <a href="#">Quick Test</a> . If secondary AIR DTC is present, REPLACE PCM. |

### HM81 EXCESSIVE BELT NOISE

Possible causes:

- Loose belt.
  - Seized pump.
  - Loose pulley.
  - Loose or broken mounting brackets or bolts.
- Inspect for loose belt.



**CAUTION: Do not use pry bar to move the AIR pump for belt adjustment.**

- Use a belt tension gauge to measure belt tension.

**Is belt loose?**

| Yes  | No                           |
|--|------------------------------|
| TIGHTEN to specification. VERIFY a symptom no longer exists. | GO to <a href="#">HM82</a> . |

### HM82 CHECK LOOSE PULLEY, MOUNTING BRACKETS

- Check for loose pulley and mounting brackets.
- Check for seized AIR pump.
- Check for broken bolts.

**Are the above components OK?**

| Yes  | No  |
|--|---|
| RETURN to <a href="#">Section 3A</a> , Symptom Charts. | <p><b>For seized pump:</b></p> <p>REPLACE pump.</p> <p><b>For loose or broken bolts or brackets:</b></p> <p>REPLACE components as required and TIGHTEN bolts to 14-17 Nm (120-150 lb-in).</p> |

### HM83 CHECK FOR EXCESSIVE AIR NOISE

**Note:** The Secondary Air Injection (AIR) System is not completely noiseless. To determine if the AIR System is the root cause, proceed with the following:

- CONDITIONS: Chirps, Squeaks, Ticks, Putt-Putt, Hiss, Rap or Roar.
- Disconnect the belt drive only after verifying that the belt tension is correct. (Refer to [HM81](#).)
- Start and run engine.

**Did the above conditions disappear?**

| Yes  | No   |
|--|--|
| REPLACE any cracked or worn hoses. TIGHTEN mounting bolts to 34 Nm (25 lb-ft). DO NOT OVERTIGHTEN. CHECK AIR pump fittings. REPAIR as required. ADJUST belt tension to specification. VERIFY a symptom no longer exists. | ADJUST belt tension to specification. RETURN to <a href="#">Section 3A</a> , Symptom Charts. |

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