# Computers and Control Systems: Pinpoint Tests
# Test DA: Intake Air Temp. (IAT)/Engine Coolant Temp. (ECT) Sensors

DA: Intake Air Temperature (IAT)/Engine Coolant Temperature (ECT)/EngineOil Temperature (EOT) Sensors Introduction **DA**

## Note

This Pinpoint Test is intended to diagnose the following:

- Intake air temperature (IAT) sensor (12A697)
- Integrated intake air temperature (IAT) sensor (12B579)
- Engine coolant temperature (ECT) sensor (12A648)
- Engine oil temperature (EOT) sensor (12A648)
- Harness circuits: IAT, ECT, EOT and SIG RTN
- Powertrain control module (PCM) (12A650)

The term "applicable" is used in this pinpoint test and refers to the temperature sensor indicated by the DTC. Example: ECTV, IATV, EOTV.

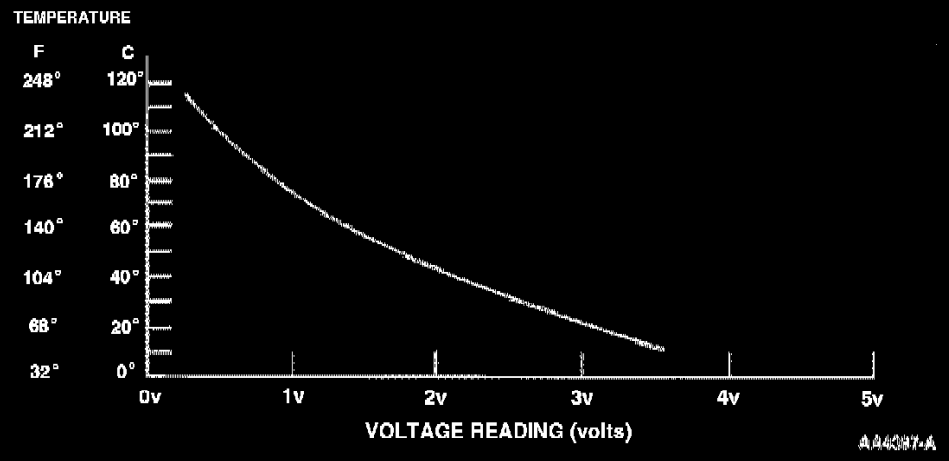
## Tables and Graphs

**Note:** Engine coolant temperature must be greater than 10°C (50°F) to pass the KOEO Self-Test and greater than 82°C (180°F) to pass the KOER Self-Test. To accomplish this, the engine must be at normal operating temperature.

Ambient temperature must be above 10°C (50°F) to receive acceptable input from the intake air temperature (IAT) sensor.

Engine oil temperature must be greater than 10°C (50°F) to pass the KOEO Self-Test and greater than 66°C (150°F) to pass the KOER Self-Test.

Voltage values were calculated for VREF = 5.0 volts. These values can vary 15 percent due to sensor and VREF variations.



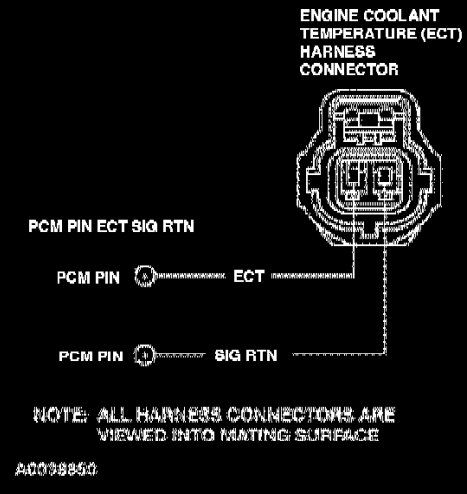

TEMPERATURE SENSOR VOLTAGE AND RESISTANCE SPECIFICATIONS

| Temperature | | Temperature Sensor Values | | |
|---|---|---|---|---|
| | | Voltage (volts) | | Resistance |
| °C | °F | w/o Resistor | w/ Resistor | K ohms |
| 120 | 248 | 0.28 | 0.27 | 1.18 |
| 110 | 230 | 0.36 | 0.35 | 1.55 |
| 100 | 212 | 0.47 | 0.46 | 2.07 |
| 90 | 194 | 0.61 | 0.60 | 2.80 |
| 80 | 176 | 0.80 | 0.78 | 3.84 |
| 70 | 158 | 1.05 | 1.02 | 5.37 |
| 60 | 140 | 1.37 | 1.33 | 7.70 |
| 50 | 122 | 1.77 | 1.70 | 10.97 |
| 40 | 104 | 2.23 | 2.13 | 16.15 |
| 30 | 86 | 2.74 | 2.60 | 24.27 |
| 20 | 68 | 3.26 | 3.07 | 37.30 |
| 10 | 50 | 3.73 | 3.51 | 58.75 |
| 0 | 32 | 4.14 | 3.91 | 95.85 |
| -10 | 14 | 4.45 | 4.15 | 160.31 |

## Pinpoint Test Schematics and Connectors

**For PCM connector views, refer to Section 1, Powertrain Control Hardware .**

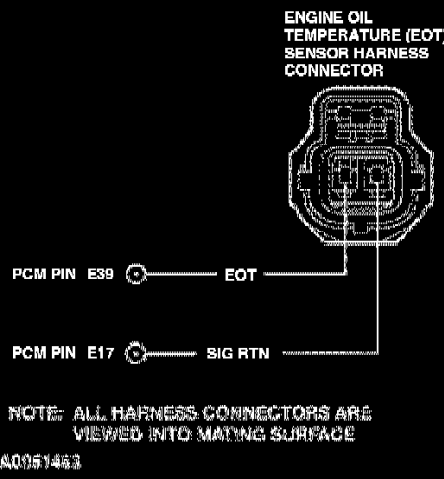
**ENGINE COOLANT TEMPERATURE SENSOR**




| PCM CONNECTOR PIN NUMBERS | | |
|---|---|---|
| **PCM TYPE** | **ECT** | **SIG RTN** |
| 104 PIN | 38 | 91 |
| 122 PIN | E32 | E25 |
| 150 PIN | E46 | E17 |

## ENGINE OIL TEMPERATURE SENSOR

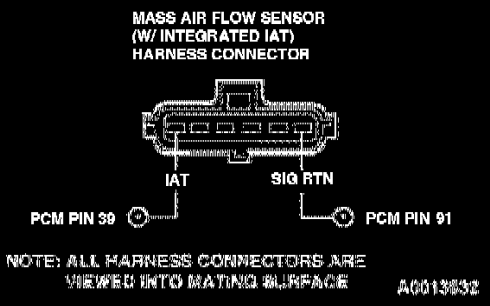
**LS6/LS8, Thunderbird**




## INTAKE AIR TEMPERATURE SENSOR

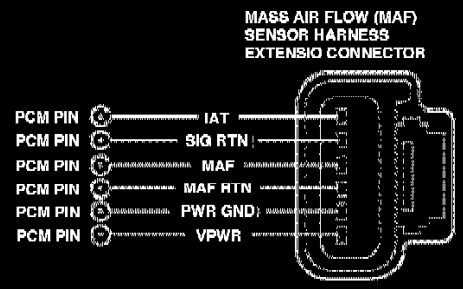
**Focus**

**Note:** On some applications the integrated IAT/MAF sensor connector is located inside the air cleaner assembly.



**2.3L Focus (w/integrated IAT)**

**Note:** On some applications the integrated IAT/MAF sensor connector is located inside the air cleaner assembly.

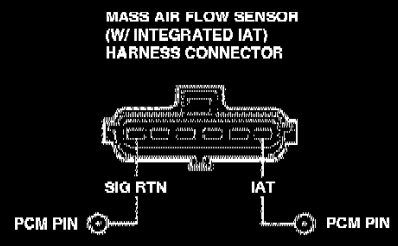



PCM CONNECTOR PIN NUMBERS

| PCM TYPE | IAT | SIGRTN | MAF | MAFRTN | PWRGND | VPWR |
|---|---|---|---|---|---|---|
| 150 PIN | B20 | B41 | B32 | B43 | B47 | B35 |

**Escort 4V, Taurus/Sable, FF Taurus, 3.8L/4.6L 2V,4V Mustang, Crown Victoria/Grand Marquis, Crown Victoria NGV, Marauder, Town Car, Windstar, Ranger, Escape, Explorer/Mountaineer, Explorer Sport/Sport Trac, Aviator, Econoline, Excursion, 4.6L F150, 5.4L/6.8L F250/F350/F450/F550**

**Note:** On some applications the integrated IAT/MAF sensor connector is located inside the air cleaner assembly.



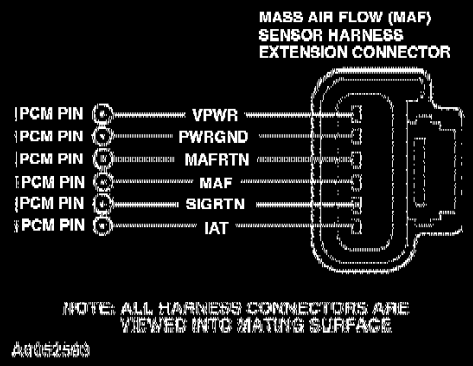

NOTE: ALL HARNESS CONNECTORS ARE VIEWED INTO MATING SURFACE

PCM CONNECTOR PIN NUMBERS

| APPLICATION | IAT | SIG RTN |
|---|---|---|
| 104 PIN | 39 | 91 |
| 150 PIN | B51 | B17 |

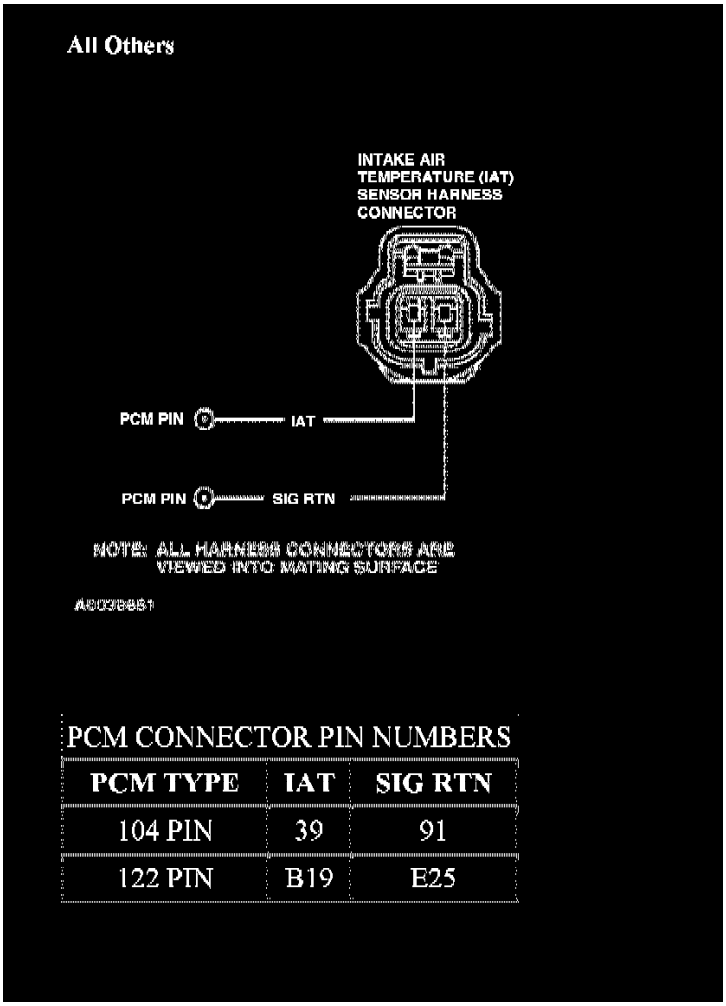
**LS6/LS8, Thunderbird (w/integrated IAT)**

**Note:** On some applications the integrated IAT/MAF sensor connector is located inside the air cleaner assembly.




PCM CONNECTOR PIN NUMBERS

| PCM TYPE | VPWR | PWRGND | MAFRTN | MAF | SIGRTN | IAT |
|---|---|---|---|---|---|---|
| 150 PIN | B32-33 | B24-27 | B38 | B31 | B5 | B51 |




PCM CONNECTOR PIN NUMBERS

| PCM TYPE | IAT | SIG RTN |
|---|---|---|
| 104 PIN | 39 | 91 |
| 122 PIN | B19 | E25 |

**DA : Introduction Part 7 Of 7**

# DA: Intake Air Temperature (IAT)/Engine Coolant Temperature (ECT)/EngineOil Temperature (EOT) Sensors

DA

## DA1 DTC P1116: CHECK OPERATION OF ECT SENSOR

- Run engine at 2000 rpm until engine temperature becomes stabilized.
- **No Starts:**
  - GO to DA3 .
- **Vehicles that stall:**
  - Return to Section 3 , Symptom Charts.
- Check that upper radiator hose is hot and pressurized.
- Rerun Key On Engine Running (KOER) Self-Test.

**Is DTC P1116 present?**

| Yes | No |
|---|---|
| KEY OFF. GO to DA2 . | Engine was not at closed loop operating conditions. REPAIR any other DTCs as necessary. |

## DA2 CHECK VREF VOLTAGE TO TP SENSOR

- Disconnect throttle position (TP) sensor.

**Note:** GO to Pinpoint Test DH and refer to**Pinpoint Test Schematics and Connectors** for TP harness connector pin-out information.

- Key on, engine off.
- Measure the voltage between VREF and SIG RTN circuits at the TP sensor harness connector.

**Is voltage between 4.0 volts and 6.0 volts?**

| Yes | No |
|---|---|
| There is sufficient VREF voltage. RECONNECT TP sensor. GO to DA3 . | GO to C1 . |

## DA3 CHECK TEMPERATURE SENSOR RESISTANCE WITH ENGINE OFF

- Disconnect ECT sensor.
- Measure ECT sensor resistance. Refer to the chart at the beginning of this Pinpoint Test for resistance specifications.

**Is resistance within specification?**

| Yes | No |
|---|---|
| **For ECT sensor with a No Start:**<br><br>Do not repair DTC P1116 at this time. RETURN to Section 3 , Symptom Charts.<br><br>For symptoms of cooling fan concerns, overheating and lack of heat, do not repair DTC P1116. REPAIR next DTC. If no other DTC exists, RETURN to Section 3 , Symptom Charts.<br><br>**All others:**<br><br>GO to DA4 . | REPLACE suspect sensor. |

## DA4 CHECK TEMPERATURE SENSOR RESISTANCE WITH ENGINE RUNNING

**Note:** Verify that engine is at operating temperature before taking ECT readings.

- Run engine for two minutes at 2000 rpm.
- Measure temperature sensor resistance. Refer to the chart at the beginning of this Pinpoint Test for resistance specifications.

**Is resistance within specification?**

| Yes | No |
|---|---|
| REPLACE PCM (refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). RESTORE vehicle. | REPLACE suspect sensor. |

## DA10 DTC P0118 OR P0113: CHECK VOLTAGE BETWEEN VREF AND SIG RTN

**Note:** For LS6/LS8 and Thunderbird with Electronic Throttle Control GO to DA11 . All Others continue with this test step.

- Disconnect throttle position (TP) sensor.

**Note:** GO to Pinpoint Test DH and refer to **Pinpoint Test Schematics and Connectors** for TP harness connector pin-out information.

- Key on, engine off.
- Measure the voltage between VREF and SIG RTN circuits at the TP sensor harness connector.

**Is voltage between 4.0 volts and 6.0 volts?**

| Yes | No |
|---|---|
| GO to DA11 . | GO to C1 . |

## DA11 SIMULATE OPPOSITE SIGNAL TO PCM

Diagnostic Trouble Codes (DTC) P0113 (IAT) or P0118 (ECT) indicates the sensor signal is greater than the Self-Test maximum.

Possible causes:

- Open in harness (IAT or ECT).
- Improper harness connection or damaged sensor (IAT, MAF w/integrated IAT or ECT).
- Damaged PCM.

- With applicable temperature sensor disconnected, connect a jumper wire between the sensor signal and SIG RTN circuits at the temperature sensor harness connector.
- Key on.

**Note:** If a scan tool communication concern exists, remove jumper wire immediately and GO to DA13 .

- Access applicable temperature sensor voltage PID.

**Is the applicable temperature sensor voltage PID 0.2 volts or less?**

| Yes | No |
|---|---|
| REPLACE suspect sensor. | REMOVE jumper wire. GO to DA12 . KEY OFF. |

## DA12 CHECK TEMPERATURE SENSOR SIGNAL AND SIG RTN CIRCUITS FOR OPEN IN HARNESS

**Note:** Refer to the PCM connector pin numbers on this pinpoint test cover page.

- Disconnect PCM.
- Measure resistance of sensor signal circuit between PCM harness connector pin and applicable sensor harness connector.
- Measure resistance of SIG RTN circuit between PCM harness connector pin and applicable temperature sensor harness connector.

**Is each resistance less than 5.0 ohms?**

| Yes | No |
|---|---|
| REPLACE PCM (refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). | REPAIR open circuits. |

## DA13 CHECK TEMPERATURE SENSOR SIGNAL FOR SHORT TO VREF IN HARNESS

- Key off.
- Disconnect PCM.
- Measure resistance between applicable temperature sensor signal and VREF circuits at the PCM harness connector.

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

| Yes | No |
|---|---|
| REPLACE PCM (refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). | REPAIR short to VREF. |

## DA20 DTC P0112 OR P0117: SIMULATE OPPOSITE SIGNAL TO PCM

Diagnostic Trouble Code (DTC) P0112 (IAT) or P0117 (ECT) indicates the sensor signal is less than Self-Test minimum.

Possible causes:

- Grounded circuit in harness.
- Improper harness connection or damaged sensor (IAT, MAF w/integrated IAT or ECT).
- Damaged PCM.

- Disconnect harness from applicable temperature sensor.
- Connect scan tool.
- Key on.
- Access applicable temperature sensor voltage PID.

**Is the applicable temperature sensor voltage PID 4.2 volts or greater?**

| Yes | No |
|---|---|
| REPLACE sensor. | For LS6/LS8 and Thunderbird with Electronic Throttle Control: GO to DA22 .<br><br>All Others:<br><br>GO to DA21 . |

## DA21 CHECK VREF VOLTAGE TO TP SENSOR

- Disconnect throttle position (TP) sensor.

**Note:** GO to Pinpoint Test DH and refer to **Pinpoint Test Schematics and Connectors** for TP harness connector pin-out information.

- Key on, engine off.
- Measure the voltage between VREF and SIG RTN circuits at the TP sensor harness connector.

**Is voltage between 4.0 and 6.0 volts?**

| Yes | No |
|---|---|
| There is sufficient VREF voltage.<br>RECONNECT TP sensor. GO to DA22 .<br>KEY OFF. | GO to C1 . |

## DA22 CHECK TEMPERATURE SIGNAL CIRCUIT FOR SHORT TO GROUND IN HARNESS

**Note:** Refer to the PCM connector pin numbers on this pinpoint test cover page.

- Disconnect PCM.
- Measure resistance between sensor signal and SIG RTN circuits and then between sensor signal and PWR GND circuits at the PCM harness connector.

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

| Yes | No |
|---|---|
| REPLACE PCM (refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). | REPAIR short circuit. |

## DA80 P0116: CHECK TEMPERATURE SENSOR RESISTANCE WITH ENGINE OFF

**Note:** Verify that engine temperature is at ambient room temperature before continuing with this test. A soak period of 6 hours may be required. Refer to Diagnostic Trouble Code (DTC) Descriptions, in Section 4 for information concerning P0116.

- Key on, engine off.
- Disconnect ECT sensor.
- Measure ECT sensor resistance. Refer to the chart at the beginning of this Pinpoint Test for resistance specifications.

**Is resistance within specification?**

| Yes | No |
|---|---|
| GO to DA81 . | REPLACE suspect sensor. |

## DA81 P0116: CHECK TEMPERATURE SENSOR RESISTANCE WITH ENGINE RUNNING

**Note:** Verify that engine is at operating temperature before taking ECT readings.

- Run engine for two minutes at 2000 rpm.
- Once engine temperature is stabilized, allow engine to idle.
- Measure temperature sensor resistance. Refer to the chart at the beginning of this Pinpoint Test for resistance specifications.

**Is resistance within specification?**

| Yes | No |
|---|---|
| Fault is not present at this time. COMPLETE OBDII Drive Cycle to determine if Fuel, HEGO, Catalyst and Misfire monitors can be executed (REFER to Section 2, Drive Cycles). Retest if necessary. | Verify thermostat and cooling system for correct operation. If OK, REPLACE suspect sensor. |

## DA90 DTCS P0112, P1112, P0113, P0117, P1117 OR P0118: INTERMITTENT CHECK

- Connect scan tool.
- Key on.
- Monitor the applicable temperature sensor voltage PID.
- While observing the PID, complete the following:
  - Tap on the sensor to simulate road shock.
  - Wiggle the sensor connector.

**Is there any large change in the voltage reading?**

| Yes | No |
|---|---|
| Key OFF. DISCONNECT and INSPECT connectors. If OK, REPLACE the sensor. For Continuous DTCs P1112 and P1117, COMPLETE OBDII Drive Cycle to verify repair (REFER to Section 2, Drive Cycles). | GO to DA91 . |

## DA91 CHECK ELECTRONIC ENGINE CONTROL (EC) WIRING HARNESS

- Again access applicable temperature sensor PID.
- While observing the appropriate PID, complete the following:
  - Hold the sensor harness close to the sensor connector. Wiggle, shake and bend small sections of wiring harness while working toward the PCM.

**Is there any change in the voltage reading?**

| Yes | No |
|---|---|
| ISOLATE fault. REPAIR as necessary. For Continuous DTCs P1112 and P1117, COMPLETE OBDII Drive Cycle to verify repair (REFER to Section 2, Drive Cycles). | GO to DA92 . |

## DA92 CHECK PCM AND VEHICLE HARNESS CONNECTOR

- Disconnect PCM.
- Disconnect sensor connector.

**Are connectors and terminals OK?**

| Yes | No |
|---|---|
| Fault is not present at this time. For Continuous Memory DTCs P1112 and P1117, COMPLETE OBDII Drive Cycle (REFER to Section 2, Drive Cycles). | REPAIR as necessary. For Continuous Memory DTCs P1112 or P1117, COMPLETE OBDII Drive Cycle to verify repair (REFER to Section 2, Drive Cycles). |

## DA100 DTC P0125, P0128: CHECK ENGINE COOLANT LEVEL

Diagnostic Trouble Code (DTC) P0125 or P0128 indicates the engine coolant temperature has not achieved the required calibrated temperature level since engine start up within a specified amount of time.

Possible causes:

- Insufficient warm up time.
- Leaky or stuck open thermostat.
- Incorrect temperature thermostat installed.
- Low engine coolant level.
- Malfunctioning ECT sensor.

**⚠ WARNING: TO AVOID PERSONAL INJURY, DO NOT UNSCREW THE COOLANT PRESSURE RELIEF CAP WHILE THE ENGINE IS OPERATING OR HOT. THE COOLING SYSTEM IS UNDER PRESSURE; STEAM AND HOT LIQUID CAN COME OUT FORCEFULLY WHEN THE CAP IS LOOSENED SLIGHTLY.**

- Check engine coolant level.

**Is the engine coolant level fill correct?**

| Yes | No |
|---|---|
| REFER to Engine Cooling, Section 303 in the Workshop Manual for further diagnostics. | REPAIR cooling system as necessary. Fill engine coolant to proper level. COMPLETE OBDII Drive Cycle to verify repair (REFER to Section 2, Drive Cycles). |

## DA105 DTC P0217: ENGINE COOLANT OVER TEMPERATURE

An engine overheat condition was sensed by the Engine Coolant Temperature sensor (ECT).

Possible causes:

- Blockage of radiator (air or coolant flow).
- Water pump or hose problems.
- Internal or external coolant leaks.
- Low engine coolant level.

**⚠ WARNING: TO AVOID PERSONAL INJURY, DO NOT UNSCREW THE COOLANT PRESSURE RELIEF CAP WHILE THE ENGINE IS OPERATING OR HOT. THE COOLING SYSTEM IS UNDER PRESSURE; STEAM AND HOT LIQUID CAN COME OUT FORCEFULLY WHEN THE CAP IS LOOSENED SLIGHTLY.**

- Check engine coolant level.

**Is the engine coolant level fill correct?**

| Yes | No |
|---|---|
| REFER to Engine Cooling, Section 303 in the Workshop Manual for further diagnostics. | REPAIR cooling system as necessary. Fill engine coolant to proper level. COMPLETE OBDII Drive Cycle to verify repair (REFER to Section 2, Drive Cycles). |

## DA110 DTC P0196, P1184: CHECK OPERATION OF EOT TEMP SENSOR

- Connect scan tool.
- Run engine at 2000 rpm until engine temperature becomes stabilized.
- Run Key On Engine Running (KOER) Self-Test.

**Is DTC P0196 or P1184 present?**

| Yes | No |
|---|---|
| GO to DA111. | Engine oil temperature was not at operating temperature. REPAIR any other DTCs as necessary. |

## DA111 DTC P0196, P0197, P0198, P1184 OR P0298: CHECK TEMPERATURE SENSOR SIGNAL

- Connect scan tool.
- Key on.
- Access EOTV PID.

**Is EOTV PID less than 0.3 volts?**

| Yes | No |
|---|---|
| GO to DA112 . | GO to DA115 . |

## DA112 SIMULATE OPPOSITE EOT SIGNAL TO PCM

- Again access EOTV PID.
- Disconnect EOT sensor.

**Is EOTV PID greater than 4.2 volts?**

| Yes | No |
|---|---|
| REPLACE suspect sensor. | GO to DA113 . |

## DA113 CHECK EOT SIGNAL CIRCUIT FOR SHORT TO GROUND IN HARNESS

**Note:** Refer to the PCM connector pins numbers on this pinpoint test cover page.

- Disconnect PCM.
- Measure resistance between EOT and SIG RTN circuits and then between EOT and PWR GND circuits at the PCM harness connector.

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

| Yes | No |
|---|---|
| REPLACE PCM (refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). | REPAIR short circuit. |

## DA115 CHECK FOR HIGH EOT SIGNAL

- Again access EOTV PID.

**Is EOTV PID greater than 4.2 volts?**

| Yes | No |
|---|---|
| GO to DA116 . | GO to DA120 . |

## DA116 SIMULATE LOW SIGNAL TO PCM

- Disconnect EOT temperature sensor.
- Connect a jumper wire between the sensor signal and SIG RTN circuits at the temperature sensor harness connector.
- Key on.
- Access EOTV PID.

**Is EOTV PID less than 0.3 volts?**

| Yes | No |
|---|---|
| REPLACE suspect sensor. | KEY OFF. GO to DA117 . |

## DA117 CHECK TEMPERATURE SENSOR SIGNAL AND SIG RTN CIRCUIT FOR OPEN IN HARNESS

**Note:** Refer to the PCM connector pins numbers on this pinpoint test cover page.

- Disconnect PCM.
- Measure resistance of EOT circuit between PCM harness connector pin and EOT sensor harness connector.
- Measure resistance of SIG RTN circuit between PCM harness connector pin and EOT sensor harness connector.

**Is each resistance less than 5.0 ohms?**

| Yes | No |
|---|---|
| REPLACE PCM (refer to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM)). | REPAIR open circuits. |

## DA120 INTERMITTENT EOT SENSOR CHECK

- Again access EOTV PID and complete the following:
  - Tap on sensor to simulate road shock.
  - Wiggle the sensor connector.

**Is there any large change in the PID reading?**

| Yes | No |
|---|---|
| KEY OFF. DISCONNECT and INSPECT connector. If OK, REPLACE the sensor. | GO to DA121. |

## DA121 CHECK EOT ELECTRONIC ENGINE CONTROL (EC) WIRING HARNESS

- Again access EOTV PID and complete the following:
  - Wiggle, shake and bend small sections of wiring harness while working from the sensor to the PCM.

**Is there any large change in the PID reading?**

| Yes | No |
|---|---|
| ISOLATE fault. REPAIR as necessary. | GO to DA122. |

## DA122 CHECK TEMPERATURE SENSOR RESISTANCE WITH ENGINE RUNNING

- Run engine for two minutes at 1,500 rpm.

**Note:** Verify that engine is at correct operating temperature before taking reading.

- Measure temperature sensor resistance. Refer to the chart at the beginning of this Pinpoint Test for resistance specifications.

**Is resistance within specification for the given engine temperature?**

| Yes | No |
|---|---|
| Fault is not present at this time. GO to Z1. | REPLACE suspect sensor. |

## DA130 DTC P0298: ENGINE OIL OVER TEMPERATURE CONDITION

- Engine oil temperature protection strategy in the PCM has been activated.
  - Check for overheating condition and base engine concerns.

**Is there any overheating or base engine concerns?**

| Yes | No |
|---|---|
| ISOLATE fault. REPAIR as necessary. REFER to Engine System — General Information, Section 303 in the Workshop Manual. | GO to DA131 . |

## DA131 CHECK FOR EOT SENSOR HARDWARE

- Engine oil temperature protection strategy in the PCM can be activated with or without an EOT sensor.

**Does vehicle have an EOT sensor?**

| Yes | No |
|---|---|
| GO to DA111 . | IDENTIFY customer driving habits. Advise customer improper transmission gear selection and high rpm for extended period will initialize engine protection strategy. |