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|---|---|---|
| **Last Modified:** 12-04-2024 | 6.11:8.1.0 | **Doc ID:** RM100000002BLV7 |
| **Model Year Start:** 2023 | **Model:** Prius Prime | **Prod Date Range:** [03/2023 - ] |
| **Title:** M20A-FXS (ENGINE CONTROL): SFI SYSTEM: P012800,P012807; Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature); 2023 - 2024 MY Prius Prius Prime [03/2023 - ] | | |

| | | |
|---|---|---|
| **DTC** | **P012800** | **Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)** |

| | | |
|---|---|---|
| **DTC** | **P012807** | **Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature) Mechanical Failure** |

# DESCRIPTION

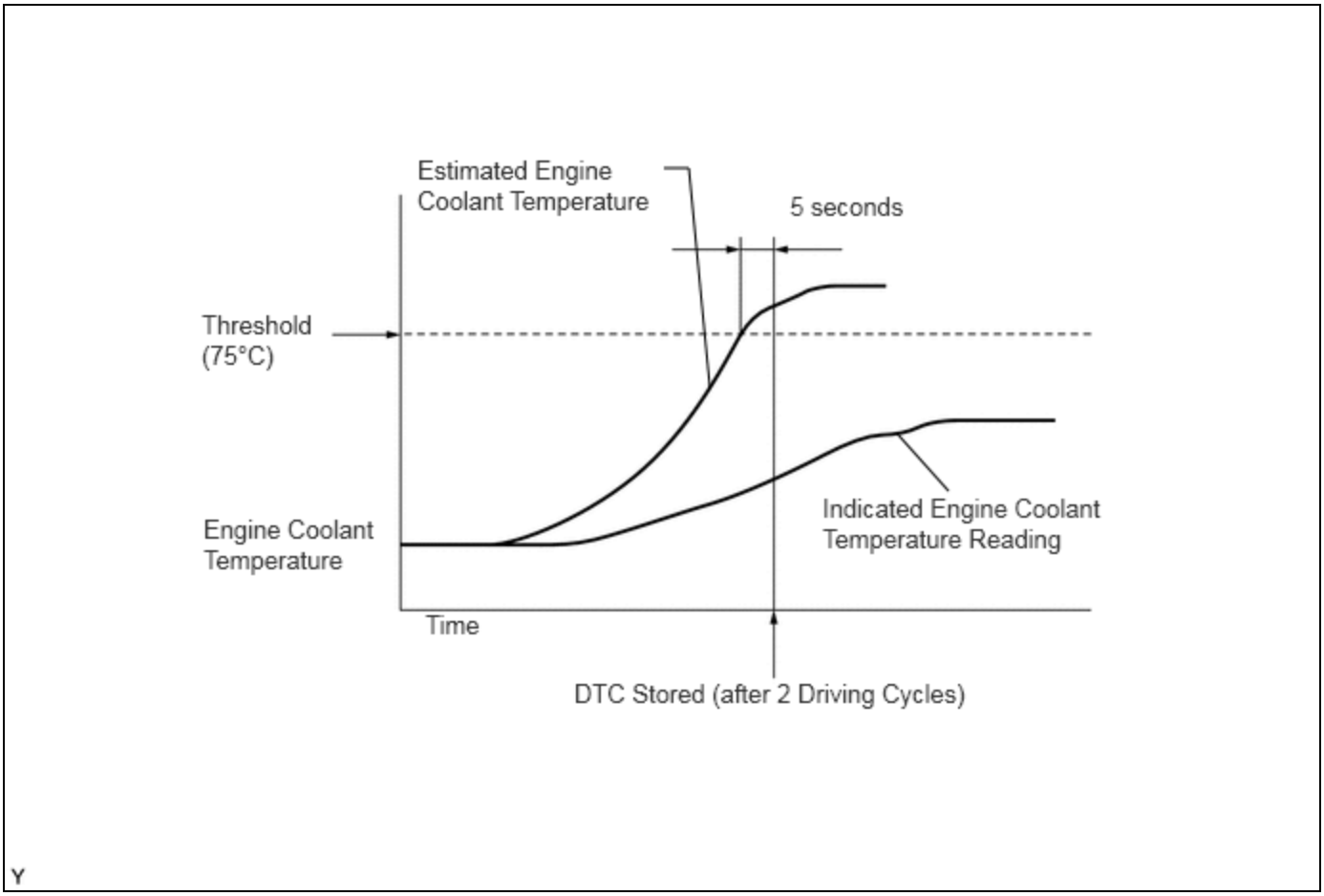
The ECM uses the engine coolant temperature sensor, installed to the water outlet, and the No. 2 engine coolant temperature sensor, installed to the radiator pipe assembly, to monitor the operation of the thermostat.

| DTC NO. | DETECTION ITEM | DTC DETECTION CONDITION | TROUBLE AREA | MIL | DTC OUTPUT FROM | PRIORITY | NOTE |
|---|---|---|---|---|---|---|---|
| P012800 | Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature) | All of the following conditions are met for 5 seconds or more (2 trip detection logic):<br>• The engine is started cold and then warmed up.<br>• When the estimated engine coolant temperature is 75°C (167°F) or higher, the actual engine coolant temperature is less than 75°C (167°F). | • Water inlet with thermostat sub-assembly (thermostat)<br>• Cooling system<br>• Engine coolant temperature sensor<br>• No. 2 engine coolant temperature sensor<br>• ECM | Comes on | Engine | B | SAE Code: P0128 |
| P012807 | Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature) | All of the following conditions are met for 30 seconds or more (2 trip detection logic):<br>1. Water inlet housing with water pump | • Water inlet with thermostat sub-assembly (thermostat)<br>• Cooling system | Comes on | Engine | B | SAE Code: P0128 |

| DTC NO. | DETECTION ITEM | DTC DETECTION CONDITION | TROUBLE AREA | MIL | DTC OUTPUT FROM | PRIORITY | NOTE |
|---|---|---|---|---|---|---|---|
| | Mechanical Failure | sub-assembly is operating,<br>2. The engine coolant temperature is less than 75°C (167°F).<br>3. The difference between the rate of change of the engine coolant temperature sensor and No. 2 engine coolant temperature sensor is within the threshold.<br>4. The difference between the temperature detected by the engine coolant temperature sensor and that detected by the No. 2 engine coolant temperature sensor is within the threshold. | • Engine coolant temperature sensor<br>• No. 2 engine coolant temperature sensor<br>• ECM | | | | |

## MONITOR DESCRIPTION

### P012800: Judgment by Simulated Engine Coolant Temperature




The ECM estimates the engine coolant temperature based on the starting temperature, engine load, and engine speed. The ECM then compares the estimated temperature with the actual engine coolant temperature. When the estimated engine coolant temperature reaches 75°C (167°F), the ECM checks the actual engine coolant temperature. If the actual engine coolant temperature is less than 75°C (167°F), the ECM interprets this as a malfunction of the thermostat or in the engine cooling system, illuminate the MIL and stores this DTC.

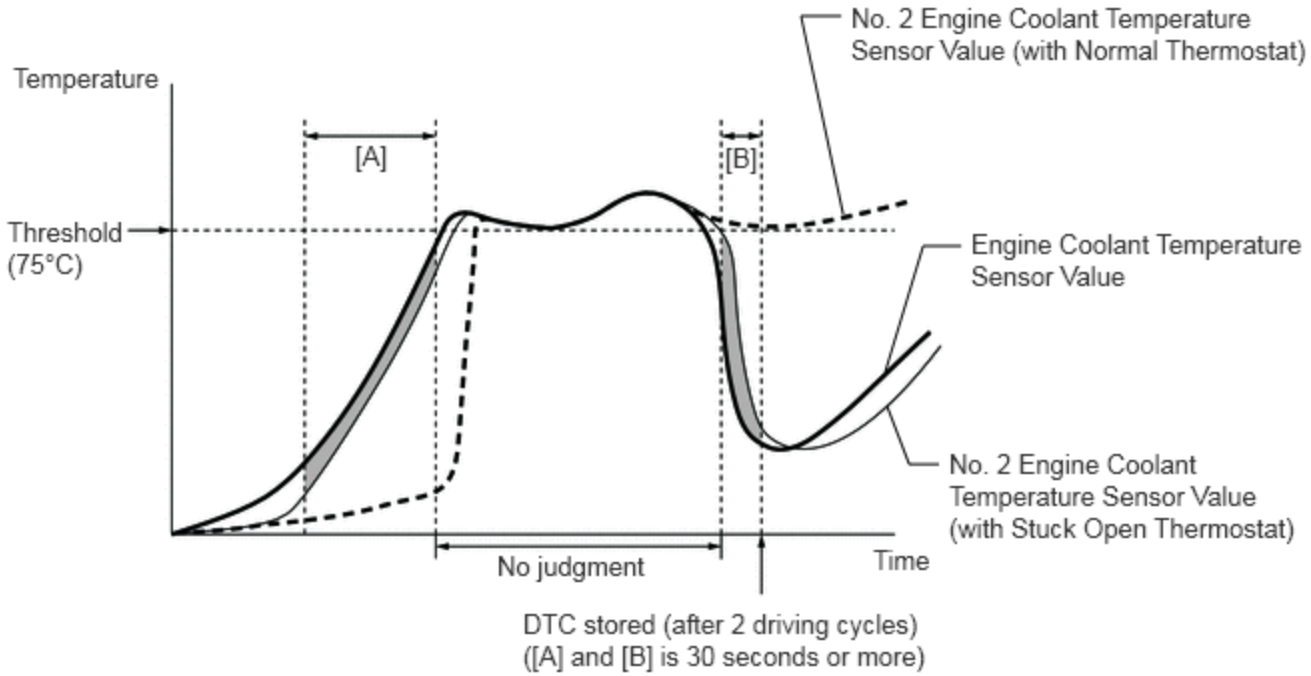
## P012807: Judgment by Engine Coolant Temperature and No. 2 Engine Coolant Temperature Changes

: All of the following conditions are met

- Difference between engine coolant temperature sensor value and No. 2 engine coolant temperature sensor value is between +/-6.6°C

- Difference between change of engine coolant temperature sensor value and No. 2 engine coolant temperature sensor value is between +/-0.1°C/sec.

- Engine coolant temperature change speed is less than -0.4°C/sec., or higher than 0.15°C/sec.

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When the engine coolant temperature is less than 75°C (167°F) and the water inlet housing with water pump sub-assembly is operating, if the rate of change and detected temperature of the engine coolant temperature sensor and No. 2 engine coolant temperature sensor differ by less than 0.1°C/sec. and 6.6°C respectively for a certain amount of time, the ECM will determine that the thermostat is stuck open, illuminate the MIL and store a DTC.

## MONITOR STRATEGY

| | |
|---|---|
| Related DTCs | P0128: Coolant thermostat (judgment by simulated engine coolant temperature)<br>P0128: Coolant thermostat (judgment by engine coolant temperature and No. 2 engine coolant temperature changes) |
| Required Sensors/Components (Main) | Thermostat<br>Engine coolant temperature sensor |

| | |
|---|---|
| Required Sensors/Components (Related) | Intake air temperature sensor<br>No. 2 engine coolant temperature sensor |
| Frequency of Operation | Once per driving cycle |
| Duration | 90 seconds: Judgment by simulated engine coolant temperature (for HEV Model)<br>300 seconds: Judgment by simulated engine coolant temperature (for PHEV Model)<br>-: Judgment by engine coolant temperature and No. 2 engine coolant temperature changes |
| MIL Operation | 2 driving cycles |
| Sequence of Operation | None |

## TYPICAL ENABLING CONDITIONS

**All**

| | |
|---|---|
| Monitor runs whenever the following DTCs are not stored | P0010, P1360, P1362, P1364, P1366, P2614 (Motor drive VVT system control module)<br>P0011 (VVT system - advance)<br>P0012 (VVT system - retard)<br>P0013 (Exhaust VVT oil control solenoid)<br>P0014 (Exhaust VVT system - advance)<br>P0015 (Exhaust VVT system - retard)<br>P0016 (VVT system - misalignment)<br>P0017 (Exhaust VVT system - misalignment)<br>P0031, P0032, P101D (Air fuel ratio sensor (sensor 1) heater)<br>P0087, P0088, P0191, P0192, P0193 (Fuel pressure sensor (for high pressure side))<br>P0101, P0102, P0103 (Mass air flow meter)<br>P0107, P0108 (Manifold absolute pressure)<br>P0111, P0112, P0113 (Intake air temperature sensor)<br>P0116, P0117, P0118 (Engine coolant temperature sensor)<br>P0121, P0122, P0123, P0222, P0223, P2135 (Throttle position sensor)<br>P014C, P014D, P015A, P015B, P2195, P2196, P2237, P2238, P2239, P2252, P2253 (Air fuel ratio sensor (sensor 1))<br>P0171, P0172 (Fuel system)<br>P0201, P0202, P0203, P0204, P062D, P21CF, P21D0, P21D1, P21D2 (Fuel injector)<br>P0300, P0301, P0302, P0303, P0304 (Misfire)<br>P0335, P0337, P0338 (Crankshaft position sensor)<br>P0340, P0342, P0343 (Camshaft position sensor)<br>P0365, P0367, P0368 (Exhaust camshaft position sensor)<br>P0400 (EGR system)<br>P0401 (EGR system (closed))<br>P0489, P0490 (EGR control circuit)<br>P059F, P05A0, P05A2, P05A3, P05A4, P05A5, P05B2, P05B3, P05B4, U0284, U1293, (Active grille air shutter)<br>P107B, P107C, P107D (Fuel pressure sensor (for low pressure side)) |

| | |
|---|---|
| | P11EA, P11EC, P11ED, P11EE, P11EF, P219A, P219C, P219D, P219E, P219F (Air-fuel ratio imbalance)<br>P1235 (High pressure fuel pump circuit) |

**Judgment by Simulated Engine Coolant Temperature**

| | |
|---|---|
| Auxiliary battery voltage | 11 V or higher |
| Either of the following conditions is met | 1 or 2 |
| 1. All of the following conditions are met | - |
| Engine coolant temperature at engine start - Intake air temperature at engine start | -15 to 7°C (-5 to 44.6°F) |
| Engine coolant temperature at engine start | -10 to 56°C (14 to 133°F) |
| Intake air temperature at engine start | -10 to 56°C (14 to 133°F) |
| 2. All of the following conditions are met | - |
| Engine coolant temperature at engine start - Intake air temperature at engine start | Higher than 7°C (44.6°F) |
| Engine coolant temperature at engine start | 56°C (133°F) or less |
| Intake air temperature at engine start | -10°C (14°F) or higher |
| Accumulated time that vehicle speed is 128 km/h (80 mph) or more | Less than 20 seconds |

**Judgment by Engine Coolant Temperature and No. 2 Engine Coolant Temperature Changes**

| | |
|---|---|
| Auxiliary battery voltage | 11 V or higher |
| Engine coolant temperature at first engine start | -10°C (14°F) or higher |
| Target engine coolant flow by engine water pump | 1.5 L/min or higher |
| Engine coolant temperature sensor malfunction (P0117, P0118) | Not detected |
| No. 2 engine coolant temperature sensor malfunction (P00B3, P00B4) | Not detected |

## TYPICAL MALFUNCTION THRESHOLDS

**Judgment by Simulated Engine Coolant Temperature**

| | |
|---|---|
| Duration that both of the following conditions are met | 5 seconds or more |
| Estimated engine coolant temperature | 75°C (167°F) or higher |
| Engine coolant temperature sensor output | Less than 75°C (167°F) |

**Judgment by Engine Coolant Temperature and No. 2 Engine Coolant Temperature Changes**

| | |
|---|---|
| Engine coolant temperature change speed | Less than -0.4°C/sec (-0.72°F/sec), or higher than 0.15°C/sec (0.27°F/sec) |
| Engine coolant temperature | Less than 75°C (167°F) |
| Grade of engine coolant temperature - No. 2 engine coolant temperature | Higher than -0.1°C/sec (-0.18°F/sec), and less than 0.1°C/sec (0.18°F/sec) |
| Absolute engine coolant temperature - No. 2 engine coolant temperature | Less than 6.6°C (43.8°F) |

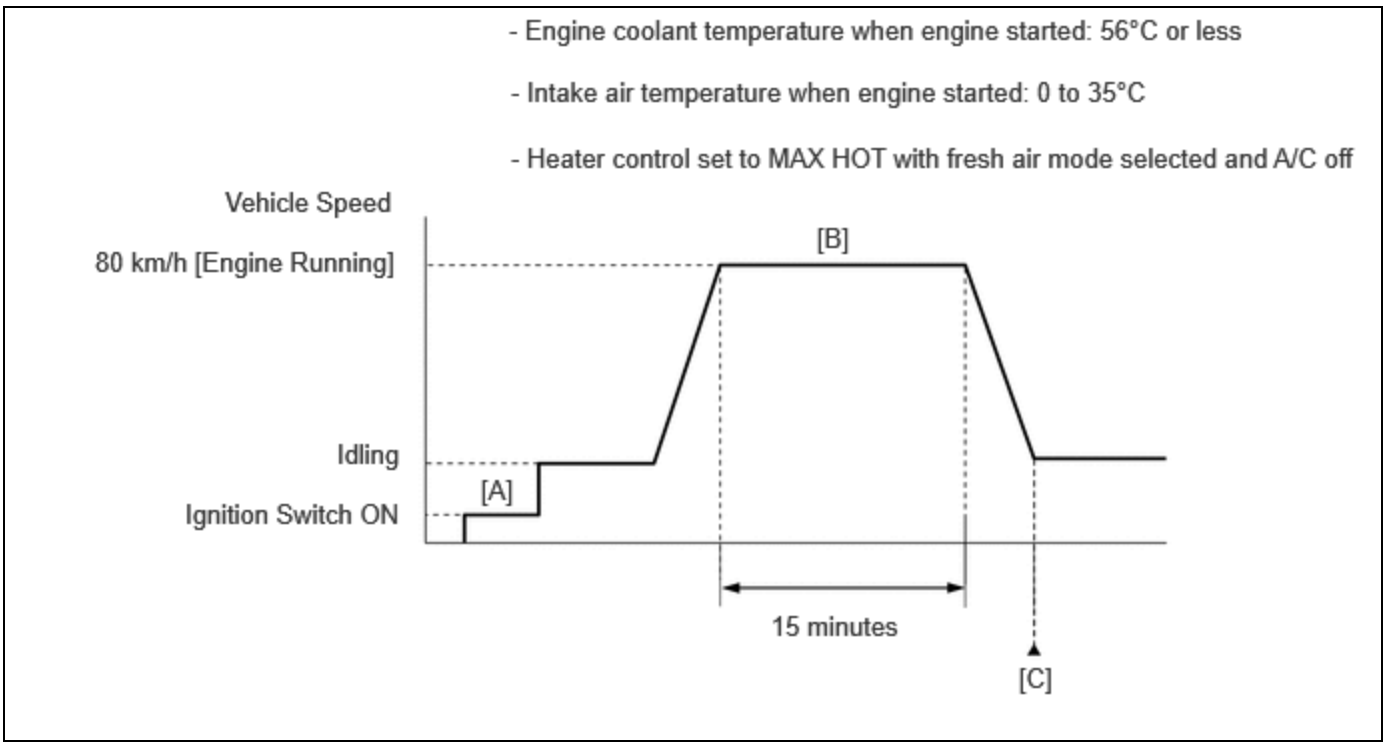
# CONFIRMATION DRIVING PATTERN

**HINT:**

- After repair has been completed, clear the DTC and then check that the vehicle has returned to normal by performing the following All Readiness check procedure.

  Click here INFO
- When clearing the permanent DTCs, refer to the "CLEAR PERMANENT DTC" procedure.

  Click here INFO




1. Turn the ignition switch off and leave the vehicle for several hours.
2. Turn the ignition switch to ON [A].
3. Enter the following menus: Powertrain / Engine / Data List / Coolant Temperature and Intake Air Temperature.
4. Check that the value of the Data List item Coolant Temperature is 56°C (133°F) or less and the value of the Data List item Intake Air Temperature is between 0 and 35°C (32 and 95°F).
5. Put the engine in Inspection Mode (Maintenance Mode).

   Click here INFO
6. Start the engine.
7. Set the heater control to MAX HOT with fresh air mode selected and turn the A/C off.
8. Press the EV/HV mode selection switch to select HV mode. (for PHEV Model)
9. With the engine running, drive the vehicle at 80 km/h (50 mph) for 15 minutes [B].

   **CAUTION:**

   When performing the confirmation driving pattern, obey all speed limits and traffic laws.

   **HINT:**

   If the engine stops, further depress the accelerator pedal to restart the engine.
10. After the value of the Data List item Coolant Temperature stabilizes, check that it is 75°C (167°F) or higher.

    **HINT:**

If the value of the Data List item Coolant Temperature is less than 75°C (167°F) while driving the vehicle at 80 km/h (50 mph), inspect the cooling system and thermostat.

11. Enter the following menus: Powertrain / Engine / Trouble Codes [C].
12. Read the pending DTCs.

**HINT:**

- If a pending DTC is output, the system is malfunctioning.
- If a pending DTC is not output, perform the following procedure.

13. Enter the following menus: Powertrain / Engine / Utility / All Readiness.
14. Input the DTC: P012800, P012807.
15. Check the DTC judgment result.

**HINT:**

- If the judgment result shows NORMAL, the system is normal.
- If the judgment result shows ABNORMAL, the system has a malfunction.
- If the judgment result is INCOMPLETE, let the engine cool down (engine coolant temperature is 56°C (133°F) or less), and then perform steps [A] through [C]: Normal judgment procedure.

  The normal judgment procedure is used to complete DTC judgment and also used when clearing permanent DTCs.
- When clearing the permanent DTCs, do not disconnect the cable from the auxiliary battery terminal or attempt to clear the DTCs during this procedure, as doing so will clear the universal trip and normal judgment histories.

## CAUTION / NOTICE / HINT

**NOTICE:**

- Vehicle Control History may be stored in the hybrid vehicle control ECU if the engine is malfunctioning. Certain vehicle condition information is recorded when Vehicle Control History is stored. Reading the vehicle conditions recorded in both the Freeze Frame Data and Vehicle Control History can be useful for troubleshooting.

  for HEV Model: Click here INFO

  for PHEV Model: Click here INFO

  (Select Powertrain in Health Check and then check the time stamp data.)
- If any "Engine Malfunction" Vehicle Control History item has been stored in the hybrid vehicle control ECU, make sure to clear it. However, as all Vehicle Control History items are cleared simultaneously, if any Vehicle Control History items other than "Engine Malfunction" are stored, make sure to perform any troubleshooting for them before clearing Vehicle Control History.

  for HEV Model: Click here INFO

  for PHEV Model: Click here INFO

**HINT:**

When this DTC is output, check the engine coolant temperature using the GTS. Enter the following menus: Powertrain / Engine / Data List / Coolant Temperature. If the value of Coolant Temperature is lower than the actual engine coolant temperature, the engine coolant temperature sensor circuit may be malfunctioning. In this case, check the wire harnesses and connectors (and their connection condition) between the ECM and the engine coolant temperature sensor first.

## PROCEDURE

| | |
|---|---|
| **1.** | **CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P012800 OR P012807)** |

(a) Read the DTCs.

**Powertrain > Engine > Trouble Codes**

| RESULT | PROCEED TO |
|---|---|
| P012800 or P012807 and other DTCs are output | A |
| P012800 or P012807 is output | B |

**HINT:**

If any DTCs other than P012800 or P012807 are output, troubleshoot those DTCs first.

**A** ▶ **GO TO DTC CHART**

**B** ▼

| | |
|---|---|
| **2.** | **CHECK ENGINE COOLING SYSTEM** |

(a) Check for defects in the engine cooling system that might cause the system to be too cold, such as abnormal cooling fan operation or any modifications.

**NG** ▶ **REPAIR OR REPLACE ENGINE COOLING SYSTEM**

**OK** ▼

| | |
|---|---|
| **3.** | **INSPECT WATER INLET WITH THERMOSTAT SUB-ASSEMBLY** |

(a) Inspect the water inlet with thermostat sub-assembly (thermostat opening temperature).

Click here INFO

**NG** ▶ **REPLACE WATER INLET WITH THERMOSTAT SUB-ASSEMBLY**

**OK** ▼

| | |
|---|---|
| **4.** | **INSPECT ENGINE COOLANT TEMPERATURE SENSOR** |

Click here INFO

NG ▶ **REPLACE ENGINE COOLANT TEMPERATURE SENSOR**

**OK**
▼

| | |
|---|---|
| **5.** | **INSPECT NO. 2 ENGINE COOLANT TEMPERATURE SENSOR** |

Click here INFO

**OK** ▶ **REPLACE ECM**

**NG** ▶ **REPLACE NO. 2 ENGINE COOLANT TEMPERATURE SENSOR**