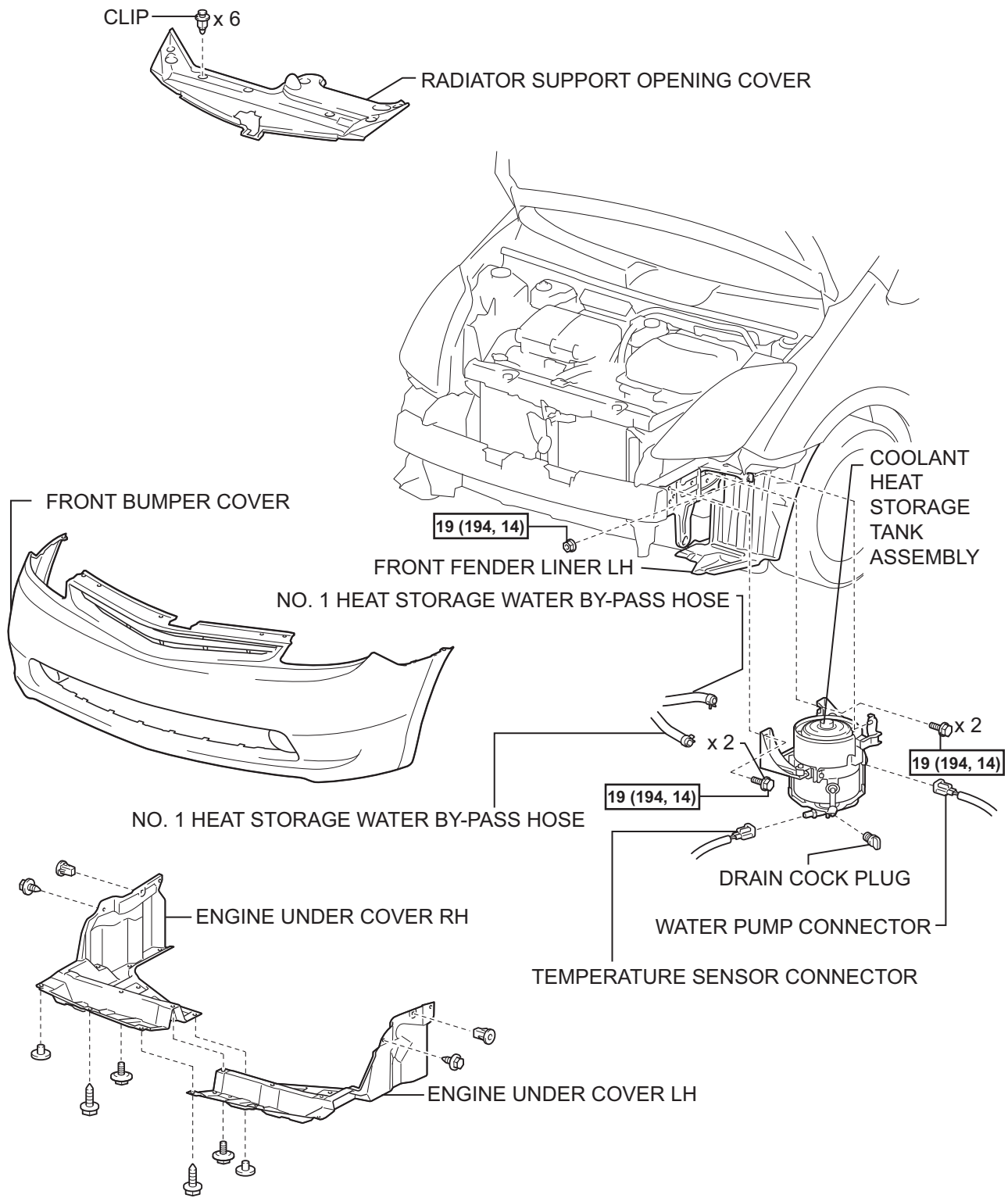


COOLANT HEAT STORAGE TANK

COMPONENTS



CO

N*m (kgf*cm, ft.*lbf) : Specified torque

P

A124653E01

REMOVAL

CAUTION:

- Before and after the procedure, be sure to check DTCs and confirm that no DTCs are output.
- If the tank has any malfunctions, the tank surface becomes hot. To prevent injuries from burns, do not touch the tank.
- The coolant heat storage tank assembly is prohibited from being disassembled and can be disassembled only as instructed.

1. REMOVE REAR NO. 2 FLOOR BOARD (See page CH-4)
2. REMOVE REAR DECK FLOOR BOX (See page CH-4)
3. REMOVE REAR NO. 3 FLOOR BOARD (See page CH-4)

4. DISCONNECT CABLE FROM BATTERY NEGATIVE TERMINAL

CAUTION:

Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

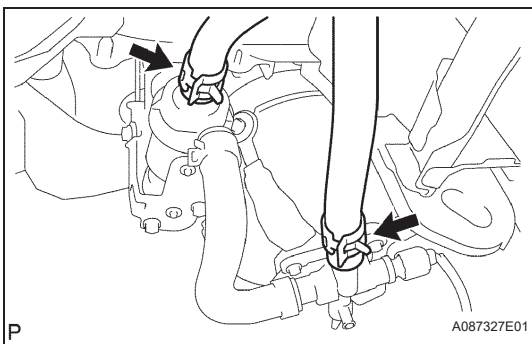
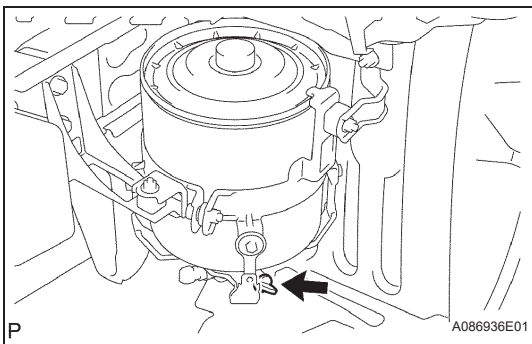
5. REMOVE RADIATOR SUPPORT OPENING COVER (See page CO-6)
6. REMOVE ENGINE UNDER COVER LH
7. REMOVE ENGINE UNDER COVER RH
8. REMOVE FRONT BUMPER COVER (See page ET-4)
9. REMOVE FRONT FENDER LINER LH
 - (a) Partially remove the front fender liner LH.

10. DRAIN ENGINE COOLANT

- (a) Loosen the drain cock plug, then drain the coolant.

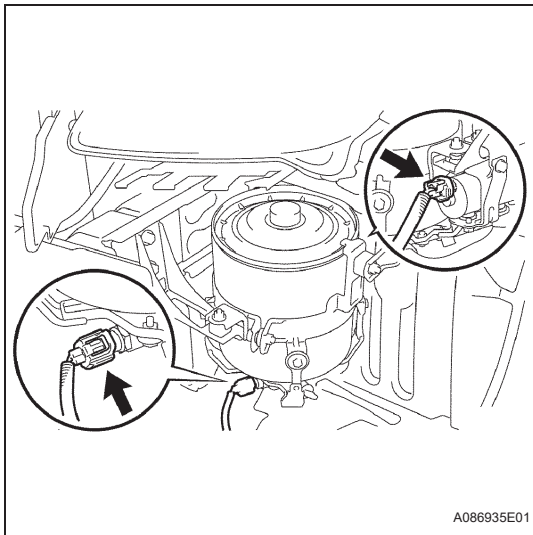
CAUTION:

Even if the engine is cold, the coolant in the coolant heat storage tank is still hot. Be careful of the hot coolant when draining it.

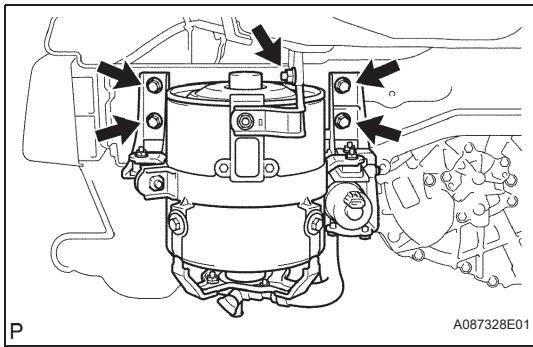


11. REMOVE COOLANT HEAT STORAGE TANK ASSEMBLY

- (a) Disconnect the 2 hoses.



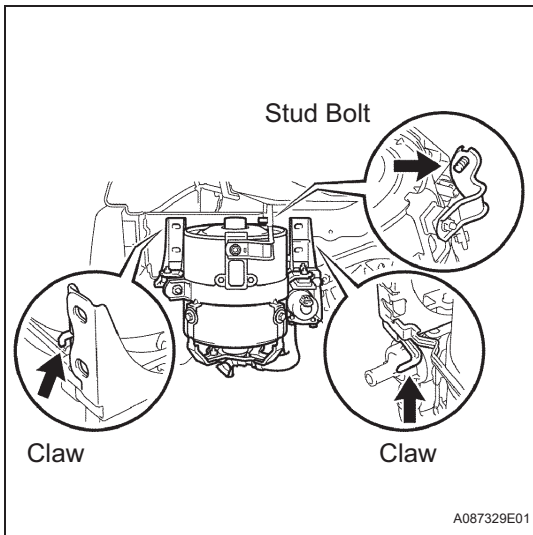
- (b) Disconnect the water pump motor and temperature sensor connectors.



- (c) Remove the nut and 4 bolts.

NOTICE:

The coolant heat storage tank bracket can be easily bent. Hold the coolant heat storage tank tightly when removing the nut and bolts.



- (d) Separate the stud bolt and 2 claws shown in the illustration, then remove the coolant heat storage tank.

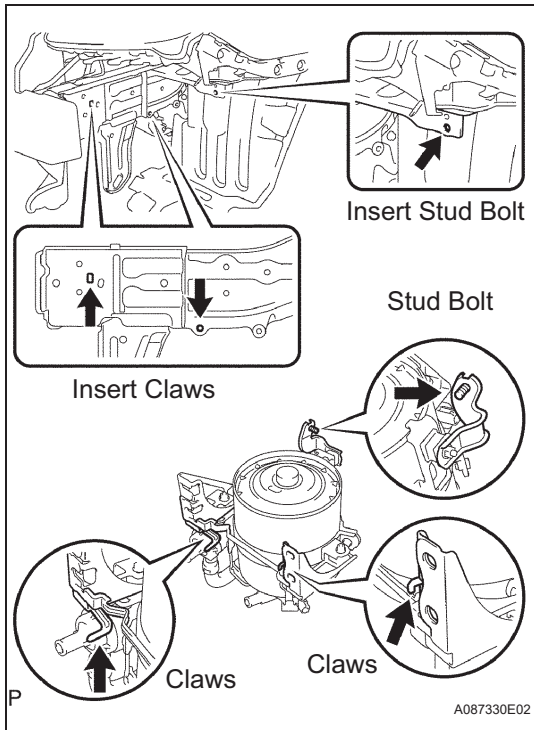
INSTALLATION

1. INSTALL COOLANT HEAT STORAGE TANK ASSEMBLY

- (a) Insert the 2 claws shown in the illustration to the vehicle side, then insert the stud bolt to the vehicle side.

NOTICE:

The coolant storage tank bracket can be easily bent. Hold the coolant storage tank tightly when inserting the claws and stud bolt.

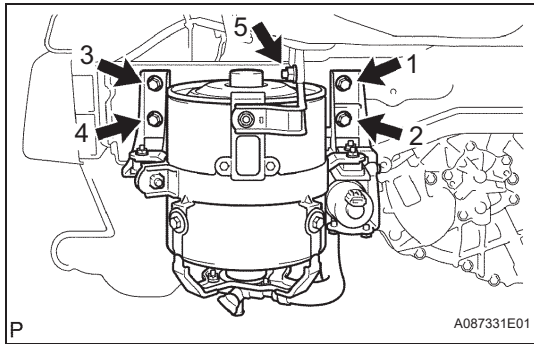


- (b) Install the 4 bolts and nut.

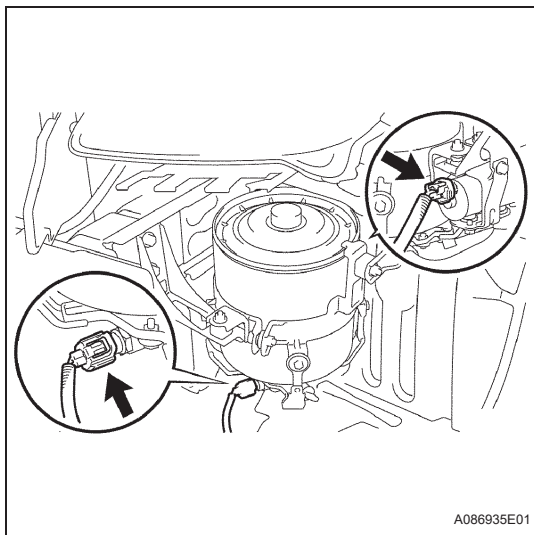
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)

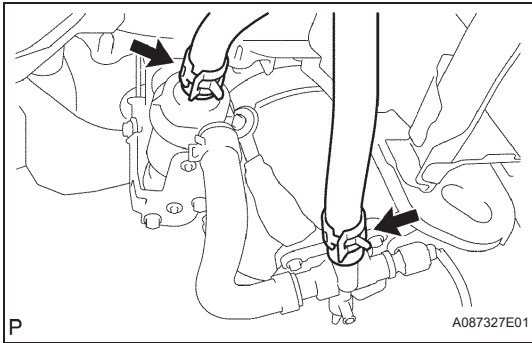
NOTICE:

- When tightening bolt 1 and 2, push the coolant heat storage tank bracket to the vehicle front.
- The coolant heat storage tank bracket can be easily bent. Hold the coolant heat storage tank tightly when installing the bolts and nut.



- (c) Connect the water pump motor and temperature sensor connectors.





(d) Connect the 2 hoses shown in the illustration.

2. **CONNECT CABLE TO BATTERY NEGATIVE TERMINAL**
3. **INSTALL REAR NO. 3 FLOOR BOARD** (See page [CH-8](#))
4. **INSTALL REAR DECK FLOOR BOX** (See page [CH-8](#))
5. **INSTALL REAR NO. 2 FLOOR BOARD** (See page [CH-8](#))
6. **ADD ENGINE COOLANT** (See page [HX-58](#))
7. **CHECK FOR ENGINE COOLANT LEAKS**
8. **INSTALL FRONT FENDER LINER LH**
9. **INSTALL FRONT BUMPER COVER** (See page [ET-6](#))
10. **INSTALL ENGINE UNDER COVER RH**
11. **INSTALL ENGINE UNDER COVER LH**
12. **INSTALL RADIATOR SUPPORT OPENING COVER** (See page [CO-9](#))
13. **PERFORM INITIALIZATION**
 - (a) Perform initialization (see page [IN-32](#)).

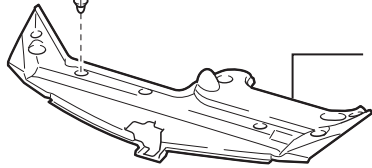
NOTICE:

Certain systems need to be initialized after disconnecting the cable from the negative (-) battery terminal.

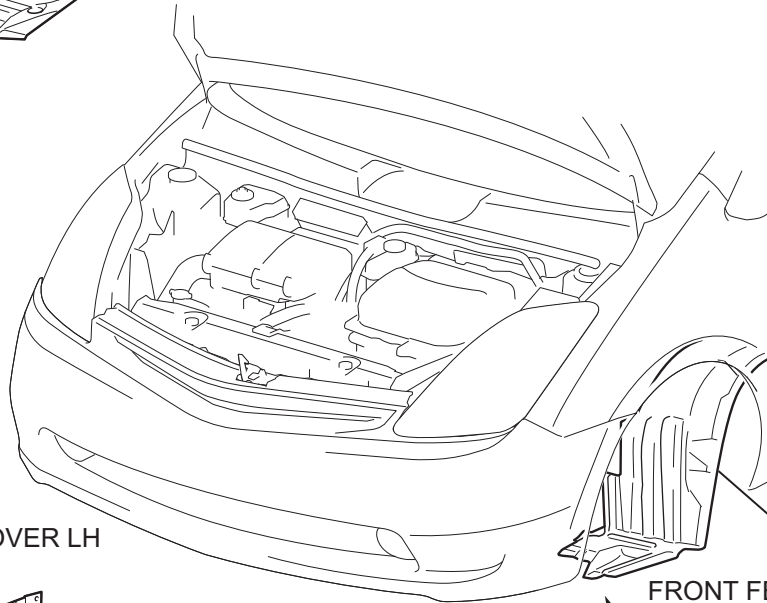
COOLANT HEAT STORAGE WATER PUMP

COMPONENTS

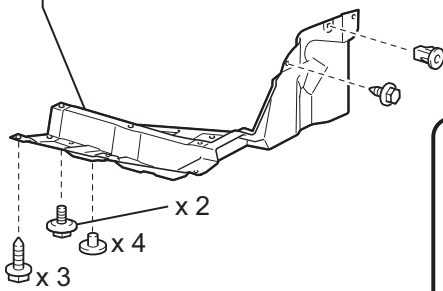
CLIP x 6



RADIATOR SUPPORT OPENING COVER

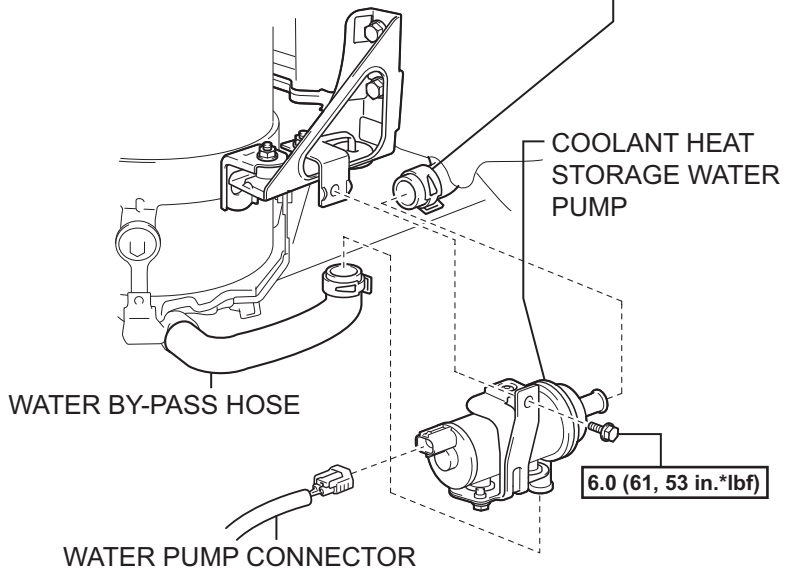


ENGINE UNDER COVER LH



FRONT FENDER LINER LH

NO. 1 HEAT STORAGE WATER BY-PASS HOSE



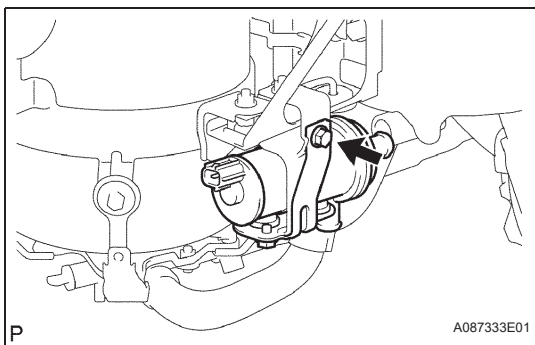
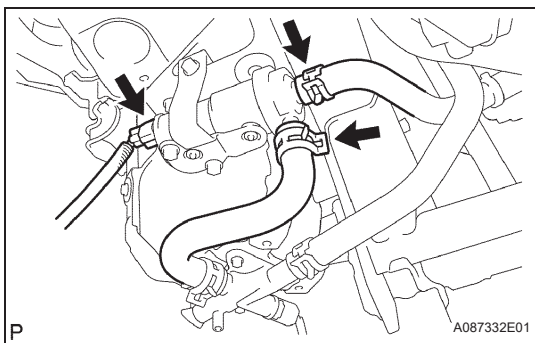
6.0 (61, 53 in.*lbf)

N*m (kgf*cm, ft.*lbf) : Specified torque

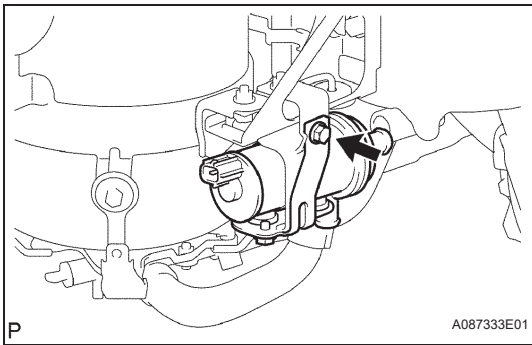


REMOVAL

1. REMOVE REAR FLOOR NO. 2 BOARD (See page [CH-4](#))
2. REMOVE REAR DECK FLOOR BOX (See page [CH-4](#))
3. REMOVE REAR FLOOR NO. 3 BOARD (See page [CH-4](#))
4. DISCONNECT CABLE FROM BATTERY NEGATIVE TERMINAL
CAUTION:
 Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
5. REMOVE RADIATOR SUPPORT OPENING COVER (See page [CO-6](#))
6. REMOVE FRONT WHEEL LH
7. REMOVE ENGINE UNDER COVER LH
8. REMOVE FRONT FENDER LINER LH
 (a) Partially remove the front fender liner LH.
9. DRAIN ENGINE COOLANT (See page [HX-58](#))
10. REMOVE COOLANT HEAT STORAGE WATER PUMP
 (a) Disconnect the coolant heat storage water pump connector.
 (b) Disconnect the 2 hoses.



- (c) Remove the bolt and coolant heat storage water pump.

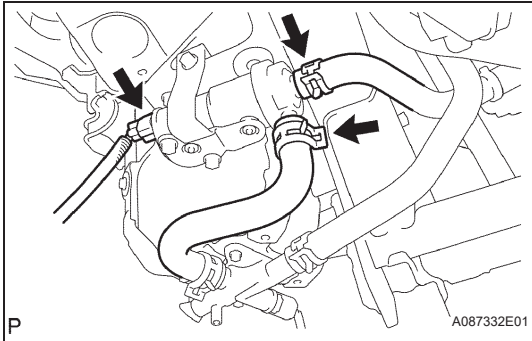


INSTALLATION

1. INSTALL COOLANT HEAT STORAGE WATER PUMP

- (a) Install the coolant heat storage pump water pump with the bolt.

Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)



- (b) Connect the 2 hoses.

- (c) Connect the connector to the coolant heat storage pump.

2. CONNECT CABLE TO BATTERY NEGATIVE TERMINAL

3. INSTALL REAR FLOOR NO. 3 BOARD (See page CH-8)

4. INSTALL REAR DECK FLOOR BOX (See page CH-8)

5. INSTALL REAR FLOOR NO. 2 BOARD (See page CH-8)

6. ADD ENGINE COOLANT (See page HX-58)

7. CHECK FOR ENGINE COOLANT LEAKS

8. INSTALL FRONT FENDER LINER LH

9. INSTALL ENGINE UNDER COVER LH

10. INSTALL FRONT WHEEL LH

Torque: 103 N*m (1050 kgf*cm, 76 ft.*lbf)

11. INSTALL RADIATOR SUPPORT OPENING COVER (See page CO-9)

12. PERFORM INITIALIZATION

- (a) Perform initialization (see page IN-32).

NOTICE:

Certain systems need to be initialized after disconnecting and reconnecting the cable from the negative (-) battery terminal.

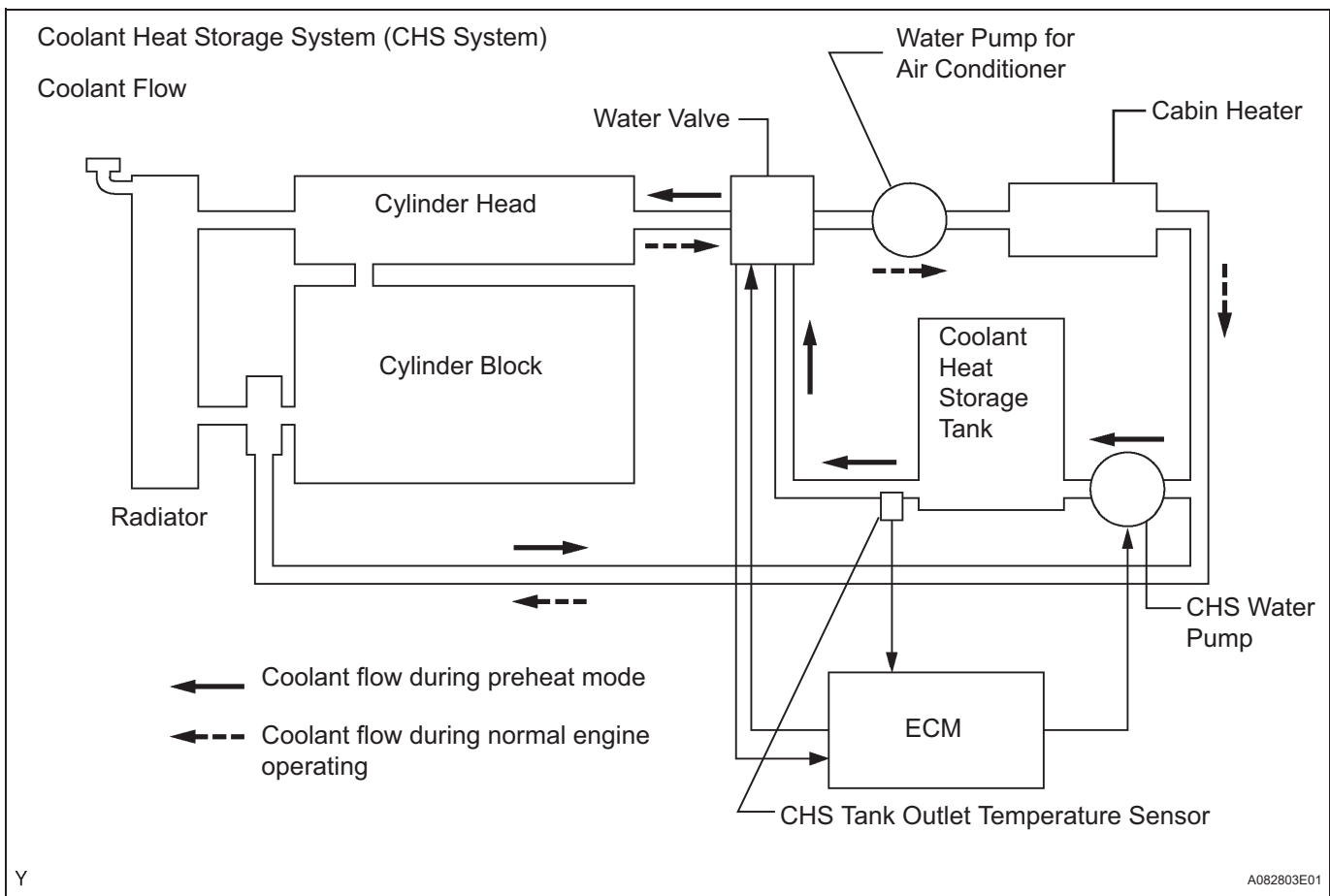
DTC	P1115	Coolant Temperature Sensor Circuit for Coolant Heat Storage System
DTC	P1117	Coolant Temperature Sensor Circuit Low for Coolant Heat Storage
DTC	P1118	Coolant Temperature Sensor Circuit High for Coolant Heat Storage

DESCRIPTION

ES

HINT:

Although each DTC title says "Coolant Temperature Sensor", these DTCs are related to the coolant heat storage tank outlet temperature sensor.



This system uses an electric pump to supply hot coolant stored in the coolant heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

The sensor for the system, which is provided at the tank outlet, is constructed similarly to the engine coolant temperature sensor and is connected to the ECM. The CHS tank outlet temperature sensor has a built in thermistor, whose resistance varies with the coolant temperature.

HINT:

If the ECM detects the DTC P0115, P0117 or P0118, it operates the fail-safe function in which the engine coolant temperature is assumed to be 80°C (176°F).

DTC No.	DTC Detection Condition	Trouble Area
P1115	Open or short in CHS tank outlet temperature sensor circuit for 0.5 seconds	<ul style="list-style-type: none"> Open or short in CHS tank outlet temperature sensor circuit CHS tank outlet temperature sensor ECM
P1117	Short in CHS tank outlet temperature sensor circuit	<ul style="list-style-type: none"> Short in CHS tank outlet temperature sensor circuit CHS tank outlet temperature sensor ECM
P1118	Open in CHS tank outlet temperature sensor circuit	<ul style="list-style-type: none"> Open in CHS tank outlet temperature sensor circuit CHS tank outlet temperature sensor ECM

ES

MONITOR DESCRIPTION

The ECM monitors the sensor voltage and uses this value to control the coolant heat storage (CHS) system properly. If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and outputs a DTC.

Example:

A sensor output voltage of -40°C (-40°F) or 140°C (284°F) is determined to be malfunction.

MONITOR STRATEGY

Related DTCs	P1115: Coolant temperature sensor circuit for coolant heat storage system P1117: Coolant temperature sensor circuit low for coolant heat storage system P1118: Coolant temperature sensor circuit high for coolant heat storage system
Required sensors/components	Coolant heat storage tank outlet temperature sensor
Frequency of operation	Continuous
Duration	0.5 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
--	------

TYPICAL MALFUNCTION THRESHOLDS**P1115:**

Sensor resistance (coolant temperature at CHS tank outlet)	Less than 0.14 V or more than 4.91 V (more than 140°C (284°F) or -40°C (-40°F) or less)
--	--

P1117:

Sensor resistance (coolant temperature at CHS tank outlet)	Less than 0.14 V (more than 140°C (284°F))
--	---

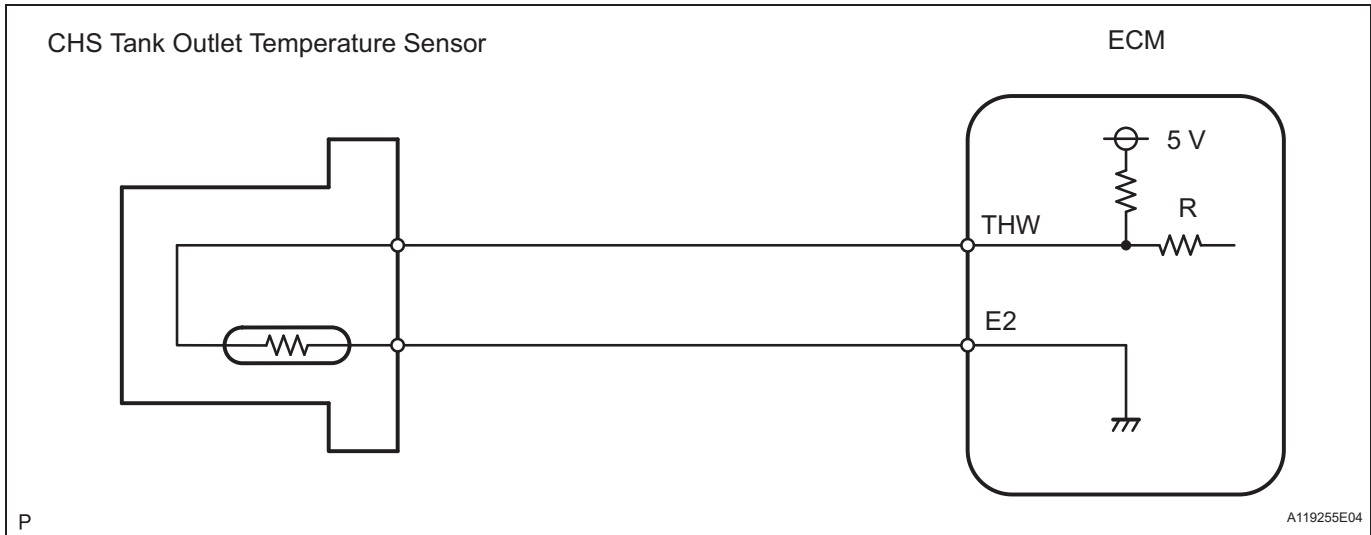
P1118:

Sensor resistance (coolant temperature at CHS tank outlet)	More than 4.19 V (-40°C (-40°F) or less)
--	---

COMPONENT OPERATING RANGE

Sensor resistance	79 Ω (140°C (284°F)) to 156 k Ω (-40°C (-40°F))
-------------------	---

WIRING DIAGRAM



INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- If different DTCs related to different systems that have terminal E2 as the ground terminal are output simultaneously, terminal E2 may have an open circuit.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 READ VALUE OF INTELLIGENT TESTER

- Connect the intelligent tester to the DLC3.
- Turn the power switch ON (IG) and turn the intelligent tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

Result

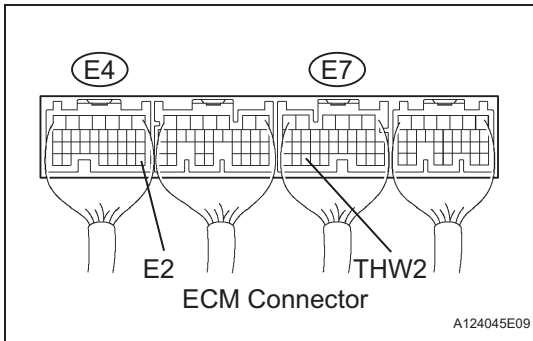
Display (DTC Output)	Proceed to
P1115	A
P1117	B
P1118	B

B

Go to step 3

A

2 CHECK ECM (THW2 - E2 VOLTAGE)



- (a) Turn the power switch ON (IG).
- (b) Measure voltage between the terminals THW2 and E2 of the ECM E4 and E7 connector.

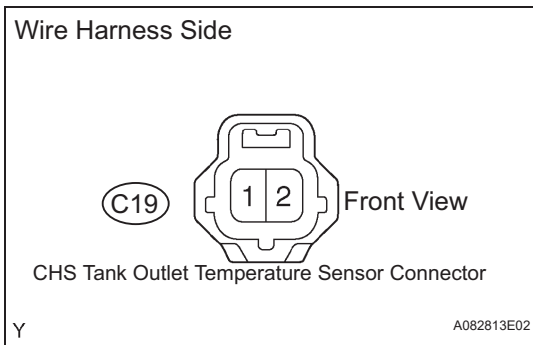
Standard voltage

Water Temperature °C (°F)	Voltage
20 (68)	0.5 to 3.4 V
60 (140)	0.2 to 1.0 V

OK CHECK FOR INTERMITTENT PROBLEMS

NG

3 CHECK HARNESS AND CONNECTOR (CHS TANK OUTLET TEMPERATURE SENSOR - ECM)



- (a) Check the harness and the connectors between the coolant heat storage tank outlet temperature sensor and the ECM connectors.

- (1) Disconnect the C19 engine coolant heat storage tank outlet temperature sensor connector.

- (2) Disconnect the E4 and E7 ECM connector.
- (3) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

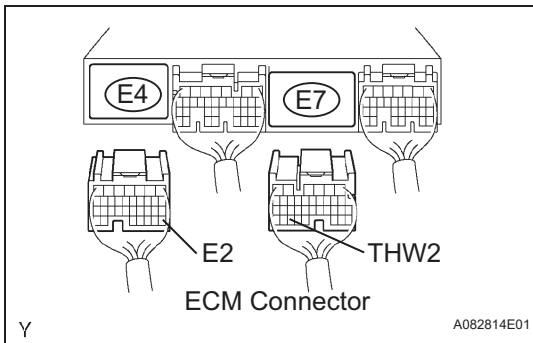
Tester Connection	Specified Condition
C19-2 (CHS temperature sensor) - E7-33 (THW2)	Below 1 Ω
C19-1 (CHS temperature sensor) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
C19-2 (CHS temperature sensor) or E7-33 (THW2) - Body ground	10 kΩ or higher

- (4) Reconnect the coolant heat storage tank outlet temperature sensor connector.
- (5) Reconnect the ECM connector.

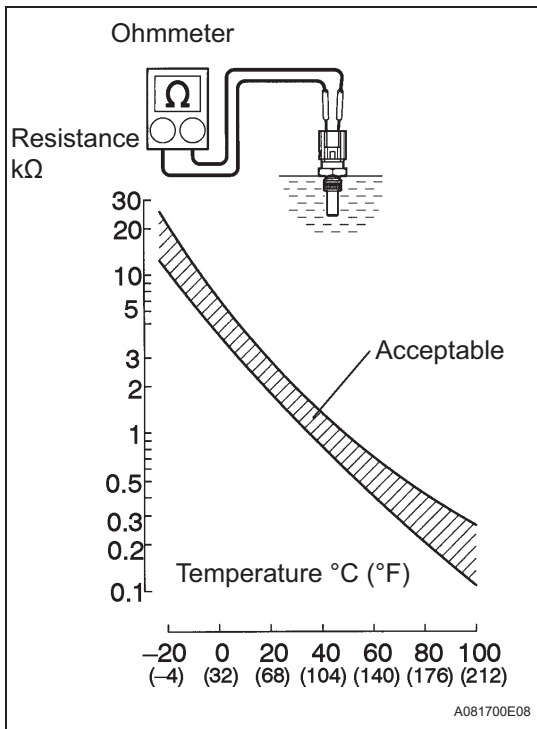
NG REPAIR OR REPLACE HARNESS AND CONNECTOR



ES

OK

4 INSPECT TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)



- (a) Remove the coolant heat storage (CHS) tank outlet temperature sensor.
- (b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

- (c) Reinstall the coolant heat storage tank outlet temperature sensor.

NG → **REPLACE TEMPERATURE SENSOR**

OK

REPLACE ECM

ES

DTC	P1116	Coolant Temperature Sensor Circuit Stack for Coolant Heat Storage
------------	--------------	--

DESCRIPTION

Refer to DTC P1115 (see page [ES-291](#)).

DTC No.	DTC Detection Condition	Trouble Area
P1116	<ul style="list-style-type: none"> • Temperature change during hot coolant recovering: 3°C (1.8°F) or less • Difference between CHS tank outlet temperature and engine coolant temperature during hot coolant recovering: More than 25°C (45°F) 	<ul style="list-style-type: none"> • Coolant heat storage tank outlet temperature sensor • Cooling system (clogging)

ES

MONITOR DESCRIPTION

The coolant heat storage (CHS) tank outlet temperature sensor is used for monitoring coolant temperature in the vicinity of the outlet port of the heat storage tank of the CHS system. The resistance of the sensor increases when the CHS tank outlet temperature is low, and conversely, the resistance decreases when the temperature is high. The changes in resistance are reflected in the voltage that is output by the sensor. The ECM monitors the sensor voltage and uses this value to control CHS system properly.

If the sensor output voltage deviates from the normal operating range, the ECM determines that the CHS tank outlet temperature sensor circuit has malfunctioned, and sets a DTC.

Examples:

- 1) No changes occur in the CHS tank outlet temperature sensor signal (over 1°C [1.8°F]) after a predetermined length of time has elapsed from the start of the coolant recovering.
- 2) A significant difference (over 25°C [45°F]) exists between the engine coolant temperature signal and the CHS tank outlet temperature sensor signal after a predetermined length of time has elapsed from the start of the coolant recovering.

MONITOR STRATEGY

Related DTCs	P1116 : Coolant temperature sensor circuit range check (stuck)
Required sensors/components	Main: Coolant heat storage tank outlet temperature sensor Related: Engine coolant temperature sensor
Frequency of operation	Once per driving cycle
Duration	45 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Coolant heat recovering	ON
Difference between engine coolant temperature and CHS tank outlet temperature	More than 30°C (54°F)

TYPICAL MALFUNCTION THRESHOLDS

Temperature variation of CHS tank outlet during hot coolant recovery	3°C or less
--	-------------

Difference between temperatures of CHS tank outlet and engine coolant during hot coolant recovery	More than 25°C (45°F)
---	-----------------------

WIRING DIAGRAM

Refer to DTC P1115 (see page ES-293).

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1116)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the power switch ON (IG).
- (c) Turn the tester ON.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (e) Read DTCs.

Result

Display (DTC output)	Proceed to
P1116	A
P1116 and other DTCs	B

HINT:

If any other codes besides P1116 are output, perform troubleshooting for those DTCs first.

B → **GO TO RELEVANT DTC CHART**

A

2 CHECK COOLING SYSTEM (CHECK FOR CLOGGING IN THE COOLANT SYSTEM)

OK:

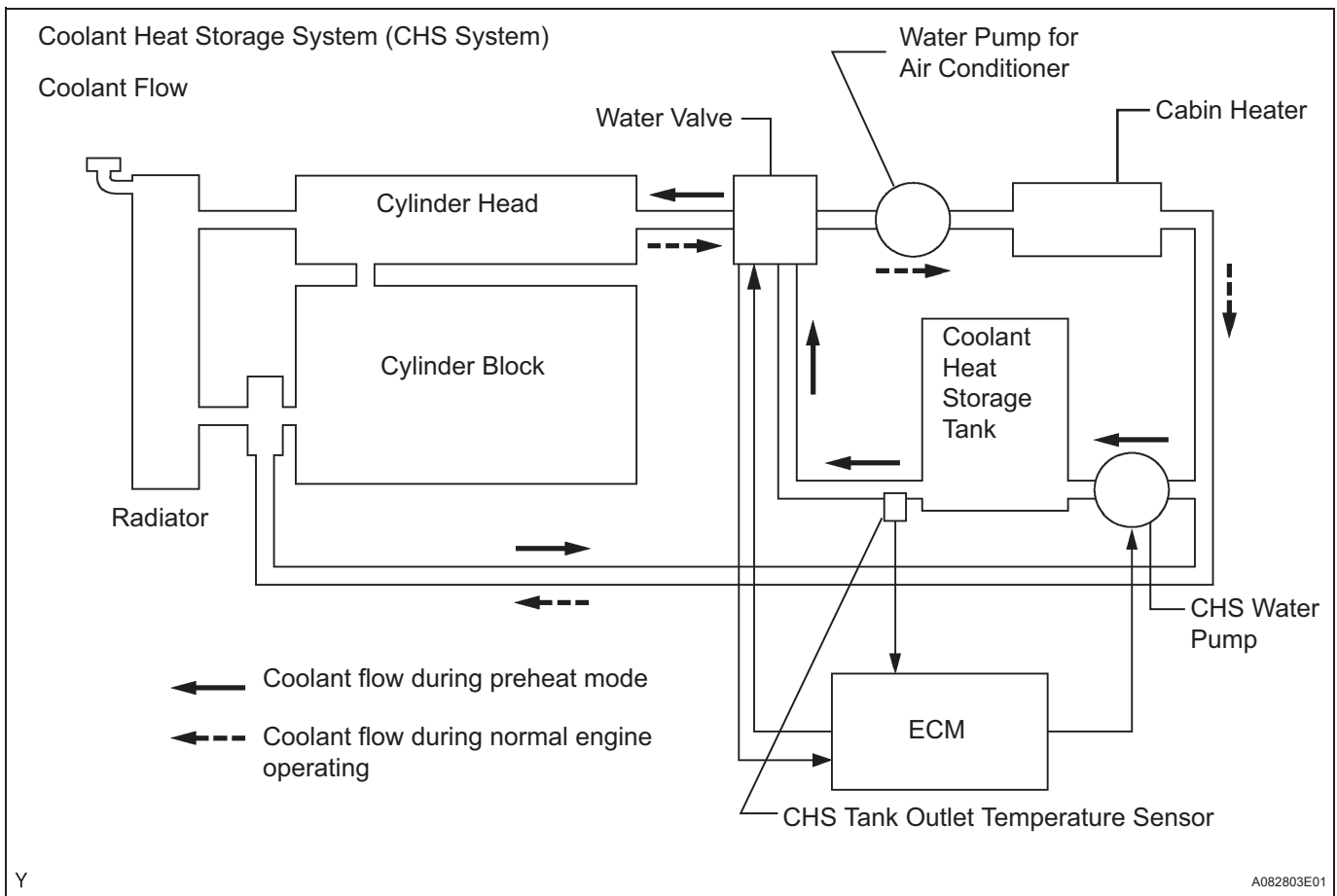
Coolant passage has no blockage.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

REPLACE TEMPERATURE SENSOR (CHS TANK OUTLET TEMPERATURE SENSOR)

DTC	P1120	Coolant Flow Control Valve Position Sensor Circuit
DTC	P1122	Coolant Flow Control Valve Position Sensor Circuit Low
DTC	P1123	Coolant Flow Control Valve Position Sensor Circuit High

DESCRIPTION

This system uses an electric pump to supply hot coolant stored in the heat storage tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the heat storage tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During the normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

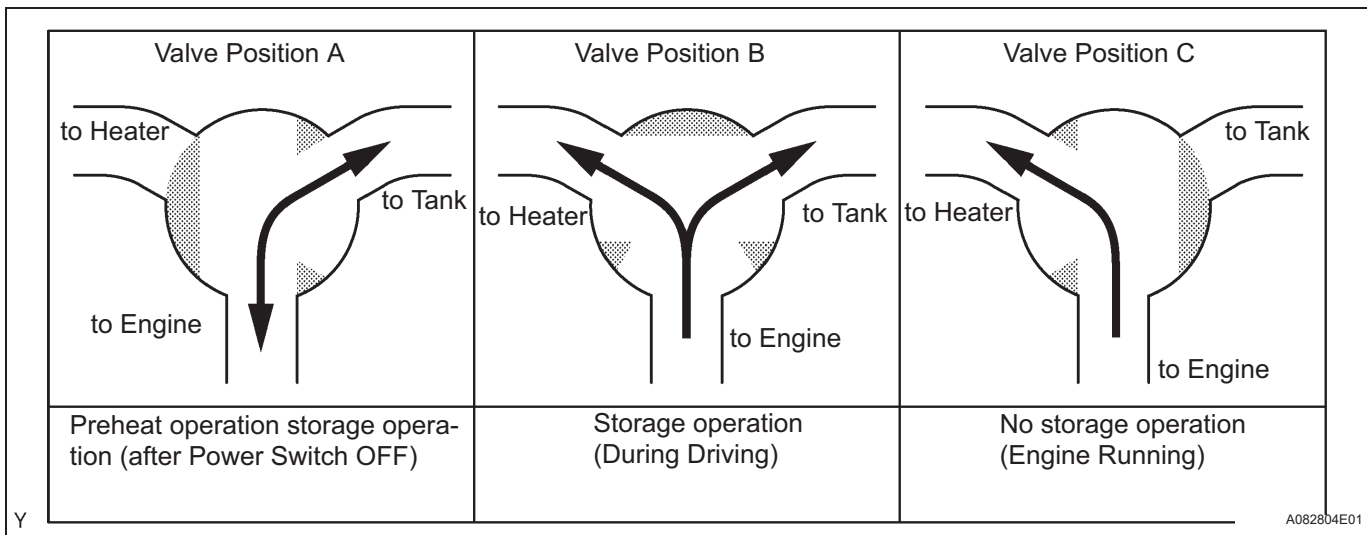
The water valve for the coolant heat storage (CHS) system, which is located at the heater hoses, controls the coolant passages to the engine, heater core, and the CHS tank in accordance with the operating conditions of the system.

The water valve consists of a water valve, valve position sensor, and valve control motor. The potentiometer, which is coupled coaxially to the water valve, converts the valve position into voltage and transmits it to the ECM in the form of a position signal.

DTC No.	DTC Detection Condition	Trouble Area
P1120	Water valve position sensor voltage is less than 0.2 V or more than 4.8 V	<ul style="list-style-type: none"> • Open or short in water valve position sensor circuit • Water valve (coolant flow control valve) • ECM
P1122	Water valve position sensor voltage stays less than 0.2 V for 2 seconds or more	<ul style="list-style-type: none"> • Water valve (coolant flow control valve) • Short in WBAD circuit • Open in VC circuit • ECM
P1123	Water valve position sensor voltage stays more than 4.8 V for 2 seconds or more	<ul style="list-style-type: none"> • Water valve (coolant flow control valve) • Short in WBAD circuit • Open in E2 circuit • VC and WBAD circuits are short-circuited • ECM

ES

MONITOR DESCRIPTION



A potentiometer is provided in the coolant heat storage (CHS) system. The ECM uses the valve position signal output by the water valve for effecting control that is appropriate for the operating condition of the engine. The water valve effects control in three steps as indicated below, and the ECM determines the position of the valve according to the voltage of the respective step.

If the signal output by the water valve exceeds the normal range, the ECM determines that a malfunction has occurred in the water valve position sensor circuit and outputs a DTC.

Water Valve Operation

System Condition	Valve Position	Coolant Flow
Normal engine operation	C	Engine to Cabin heater
Preheat mode	A	Coolant heat storage tank to Engine
Coolant recovering (after engine stop)	A	Engine to Coolant heat storage tank
Coolant recovering (while engine is running)	B	Engine to Cabin heater and Coolant heat storage tank
Soak mode	A	Coolant heat storage tank to Engine

MONITOR STRATEGY

Related DTCs	<ul style="list-style-type: none"> • P1120: Coolant flow control valve (water valve) position sensor circuit range check (fluttering) • P1122: Coolant flow control valve (water valve) position sensor circuit range check (low voltage) • P1123: Coolant flow control valve (water valve) position sensor circuit range check (high voltage)
Required sensors/components	Water valve position sensor
Frequency of operation	Continuous
Duration	2 seconds
MIL operation	Immediately
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
--	------

TYPICAL MALFUNCTION THRESHOLDS**P1120:**

Water valve position signal	Less than 0.2 V or more than 4.8 V
-----------------------------	------------------------------------

P1122:

Water valve position signal	Less than 0.2 V
-----------------------------	-----------------

P1123:

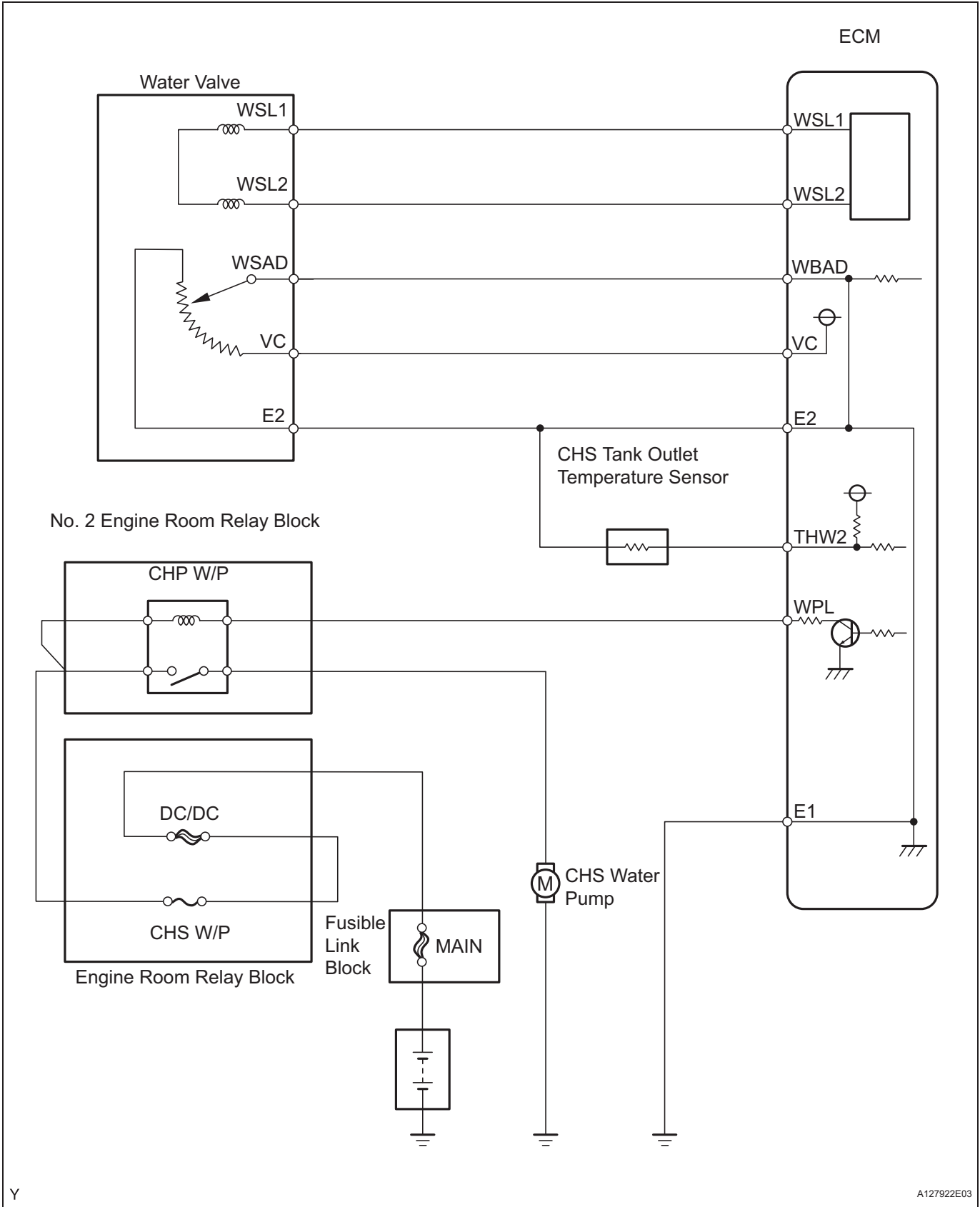
Water valve position signal	More than 4.8 V
-----------------------------	-----------------

COMPONENT OPERATING RANGE

Water valve position signal	0.4 to 2.2 V
-----------------------------	--------------

WIRING DIAGRAM

ES



Y

A127922E03

INSPECTION PROCEDURE

HINT:

Although each DTC title says "Coolant Flow Control Valve", these DTCs are related to the water valve.

CAUTION:

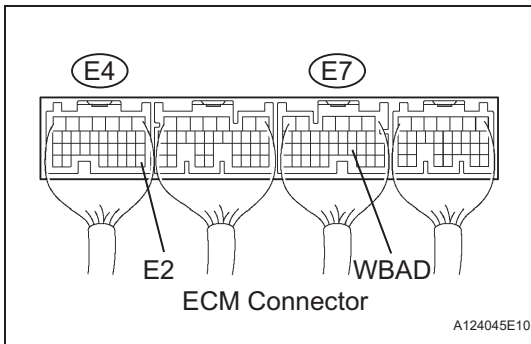
Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1 CHECK ECM (WBAD - E2 VOLTAGE)



- Turn the power switch ON (IG).
- Measure voltage between the terminals WBAD and E2 of the E4 and E7 ECM connectors.

Standard voltage

Water Valve	Specified Condition
Valve position "A" (Preheat mode)	Approximately 2.5 V
Valve position "B" (Recovering mode)	Approximately 3.5 V
Valve position "C" (Normal Operation)	Approximately 4.5 V

HINT:

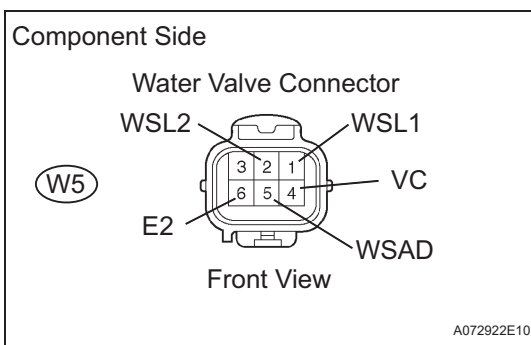
After the HV main system is turned OFF (READY to IG OFF condition), the valve position will be set to position A.

OK

CHECK FOR INTERMITTENT PROBLEMS

NG

2 INSPECT WATER M/BRACKET VALVE ASSEMBLY



- Disconnect the W5 water valve connector.
- Measure resistance between terminals WSL1 and WSL2 of the water valve connector.
- Measure resistance between terminals WSAD and E2 of the water valve connector.

Standard resistance

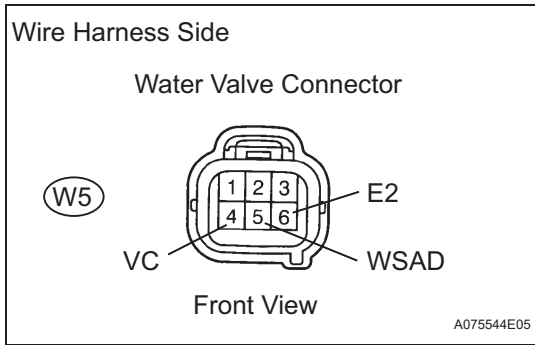
Tester Connection	Specification Condition
1 (WSL1) - 2 (WSL2)	Approximately 0.04 kΩ
5 (WSAD) - 6 (E2)	0.2 to 5.7 kΩ

NG

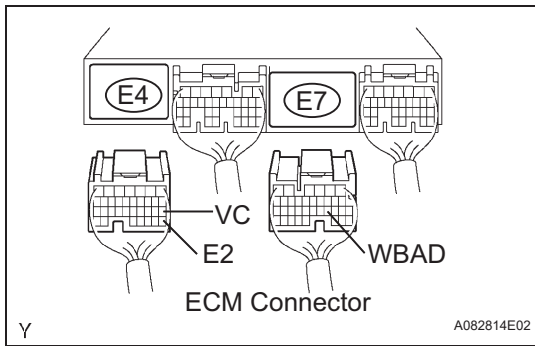
REPLACE WATER W/BRACKET VALVE ASSEMBLY

OK

3 CHECK HARNESS AND CONNECTOR (WATER VALVE - ECM)



(a) Disconnect the W5 water valve connector.



(b) Disconnect the E4 and E7 ECM connectors.
 (c) Measure the resistance between the wire harness side connectors.

Standard resistance (Check for open)

Tester Connection	Specified Condition
W5-5 (Water valve) - E7-20 (WBAD)	Below 1 Ω
W5-4 (Water valve) - E4-18 (VC)	Below 1 Ω
W5-6 (Water valve) - E4-28 (E2)	Below 1 Ω

Standard resistance (Check for short)

Tester Connection	Specified Condition
W5-5 (Water valve) or E7-20 (WBAD) - Body ground	10 kΩ or higher

(d) Reconnect the water valve connector.
 (e) Reconnect the ECM connectors.

NG → **REPAIR OR REPLACE HARNESS AND CONNECTOR**

OK

REPLACE ECM

ES

DTC	P1121	Coolant Flow Control Valve Position Sensor Circuit Stuck
------------	--------------	---

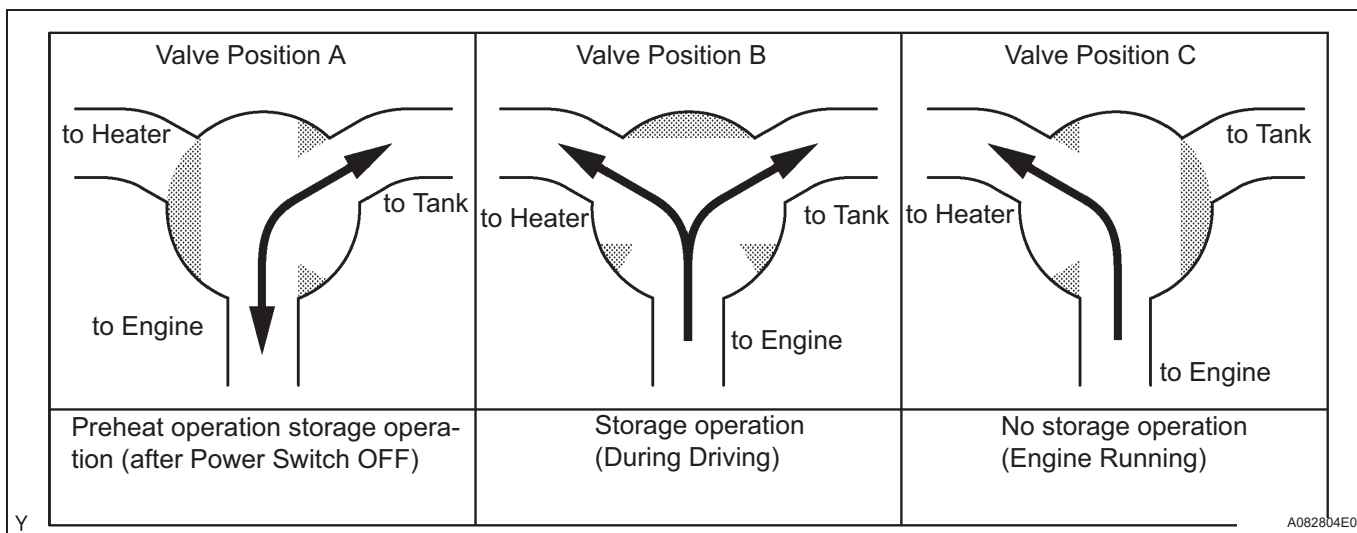
DESCRIPTION

Refer to DTC P1120 (see page [ES-298](#)).

DTC No.	DTC Detection Condition	Trouble Area
P1121	<ul style="list-style-type: none"> Water valve position sensor output voltage: No change despite the ECM sending a valve control signal or slow response CHS tank outlet temperature sensor output: 60°C (140°F) or more (when hot coolant recovering starts) CHS tank outlet temperature sensor output: No change despite the hot coolant is recovered 	<ul style="list-style-type: none"> Water valve Cooling system (clogging) ECM

ES

MONITOR DESCRIPTION



The ECM monitors the position of the water valve based on the valve position signal that is output by the water valve position sensor (potentiometer), which is coupled coaxially to the valve. The water valve effects control in three steps as indicated above, and the ECM determines the position of the valve according to the voltage of the respective step.

In order to ensure the proper monitoring of the water valve, the ECM checks for malfunctions with the combination of the output of the potentiometer and CHS tank outlet temperature sensor.

If no changes occur in the valve position signal that is being input into the ECM or if the response signal from the water valve is very slow, despite of the ECM commanding the water valve motor to operate the ECM determines that malfunction has occurred in the water valve position sensor circuit, and sets a DTC.

MONITOR STRATEGY

Potentiometer detection

Related DTCs	P1121: Coolant flow control valve position sensor circuit stuck
Required sensors/components	Main: Water valve Related: CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle

Duration	20 seconds
MIL operation	2 driving cycle
Sequence of operation	None

Tank outlet coolant temperature detection

Related DTCs	P1121: Coolant flow control valve position sensor circuit stuck
Required sensors/components	Main: Water valve Related: CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

Potentiometer detection

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Battery voltage	10 V or more
Engine coolant temperature	0°C (32°F) or more
Water valve operation	Commanded
Response time of valve movement	Time under calculation with valve position

Tank outlet coolant temperature detection

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Battery voltage	10 V or more
System status	During recovering
CHS tank outlet temperature difference between preheating start and engine start	20°C (36°F) or more
Difference between engine coolant temperature and CHS tank outlet temperature	More than 30°C (54°F)

TYPICAL MALFUNCTION THRESHOLDS

Potentiometer detection

Either of the following conditions is met:	(a) or (b)
(a) Potentiometer output difference [D divided C] C: Difference between previous and current target D: Difference between potentiometer output and previous target	10% or more
(b) Potentiometer output deviation from target	0.1 V or more

Tank outlet coolant temperature detection

Either of the following conditions is met:	(a) or (b)
(a) Heat storage tank outlet coolant temperature when recover starts	60°C (108°F) or more
(b) Heat storage tank outlet coolant temperature difference during water valve check	Less than 3°C (5.4°F)

WIRING DIAGRAM

Refer to DTC P1120 (see page [ES-301](#)).

INSPECTION PROCEDURE

HINT:

- Although each DTC title says "Coolant Flow Control Valve", these DTCs are related to the water valve.
- CHS stands for Coolant Heat Storage.

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine is cold.

HINT:

- If DTCs P1121 and P1150 are detected simultaneously, there may be malfunction in the water valve system.
- If DTC P1121 is detected, coolant passages may be clogged.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

ES

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1121)

- Connect the intelligent tester to the DLC3.
- Turn the power switch ON (IG).
- Turn the tester ON.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

Result

Display (DTC Output)	Proceed to
P1121	A
P1121 and other DTCs	B

HINT:

If any other codes besides P1121 are output, perform troubleshooting for those DTCs first.

B

GO TO RELEVANT DTC CHART

A

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER

- Connect the intelligent tester to the DLC3.
- Turn the power switch ON (IG).
- Turn the tester ON.
- Put the engine in inspection mode (see page [ES-1](#)).
- Start the engine and warm it up.
- Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / WATER FLW VLV3, WATER FLW VLV4 or WATER FLW VLV5.
- Measure the voltage between terminals WBAD and E2 of the ECM connector.

Standard voltage

Tester Operation	Specified Condition
"WATER FLW VLV 3" ON	Approximately 2.5 V
"WATER FLW VLV 4" ON	Approximately 3.5 V
"WATER FLW VLV 5" ON	Approximately 4.5 V

NG → **REPLACE WATER W/BRACKET VALVE ASSEMBLY**

OK

ES

3 **CHECK COOLING SYSTEM (CHECK FOR CLOGGING IN THE COOLANT SYSTEM)**

OK:
Coolant passages are not clogged.

NG → **REPAIR OR REPLACE COOLING SYSTEM**

OK

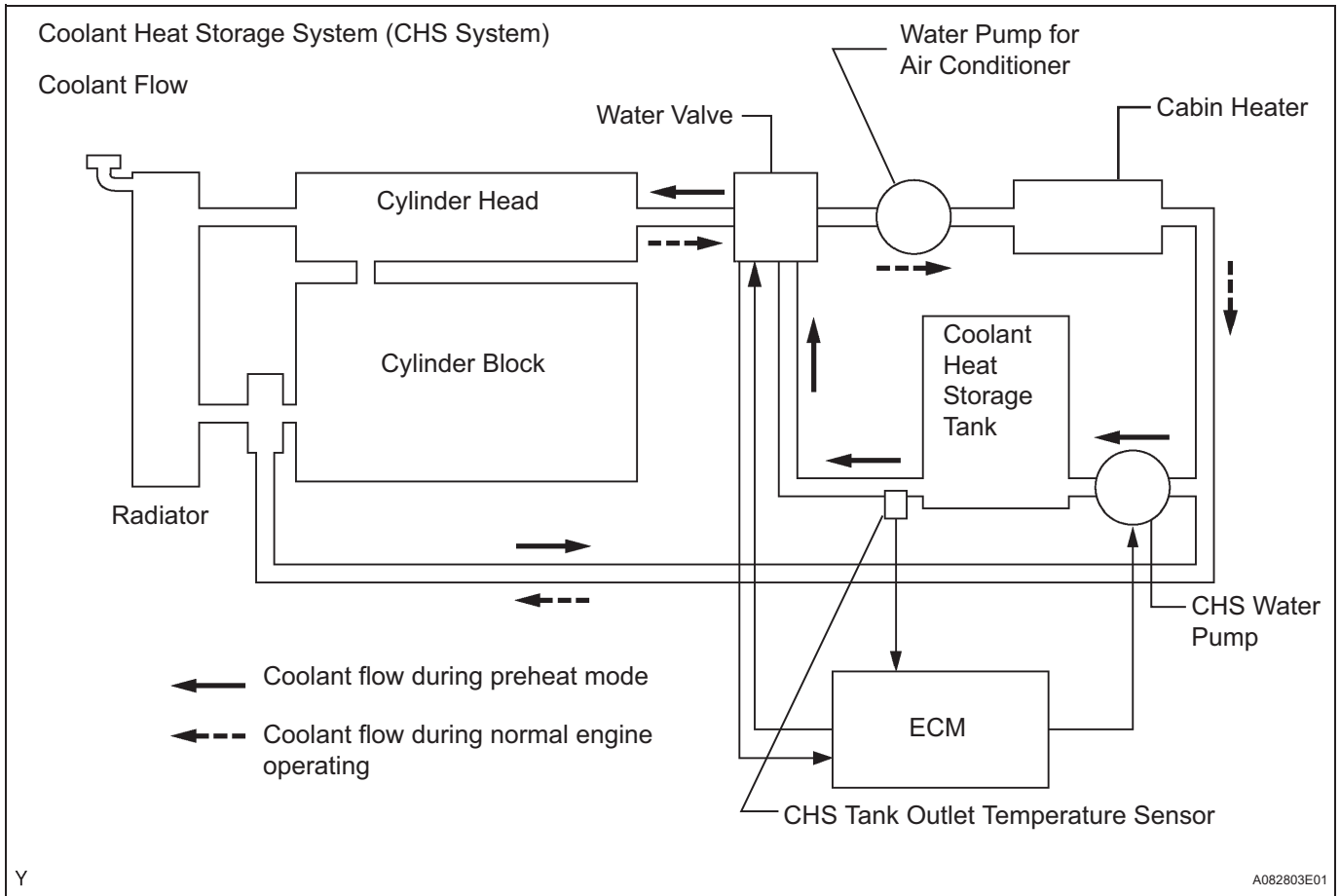
REPLACE ECM

DTC

P1150

Coolant Path Clog of Coolant Heat Storage System

DESCRIPTION



This system uses an electric pump to supply hot coolant stored in the coolant heat storage (CHS) tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During the preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P1150	Following conditions are met: <ul style="list-style-type: none"> Change in CHS tank outlet temperature and engine coolant temperature after water pump is ON during preheat mode: below 2°C (3.6°F) Change in CHS tank outlet temperature as water valve is opened to tank, on a warm engine: below 3°C (5.4°F) 	<ul style="list-style-type: none"> CHS tank outlet temperature sensor Water valve (coolant flow control valve) Cooling system (clogging) ECM

MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank outlet temperature signal, the position of the water valve and the engine running condition. In order to ensure the reliable malfunction detection, the ECM detects coolant passage clogging malfunction in two ways. Thus, when the following two detection conditions are met, the ECM determines that the coolant passage has clogged and sets a DTC.

- When starting the engine, a variation in the CHS tank outlet temperature and engine coolant temperature before and after preheating is below 2°C (3.6°F).
- After the engine is warmed up, a variation in the CHS tank outlet temperature when the ECM opens the water valve is below 3°C (5.4°F).

ES

MONITOR STRATEGY

Related DTCs	P1150: Coolant path clog up for coolant heat storage system
Required sensors/components (main)	CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	1 driving cycle
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Coolant heat storage water pump operation time	3 seconds or more
Variation in CHS tank coolant temperature and engine coolant temperature before and after preheating	2°C (3.6°F) or less
Engine coolant temperature	65°C(149°F) or more

TYPICAL MALFUNCTION THRESHOLDS

Variation in CHS tank coolant temperature during passage clogging check	Less than 3°C (5.4°F)
---	-----------------------

WIRING DIAGRAM

Refer to DTC P1115 (see page [ES-293](#)).

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine and the radiator are cold.

HINT:

- The detection of this DTC may indicate that the coolant heat storage (CHS) tank outlet water temperature sensor stuck or the water valve stuck.
- If DTC P1121 is detected, coolant passages may be clogged.
- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1 CHECK OTHER DTC OUTPUT (IN ADDITION TO DTC P1150)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the power switch ON (IG).
- (c) Turn the tester ON.
- (d) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- (e) Read DTCs.

Result

Display (DTC Output)	Proceed to
P1150	A
P1150 and other DTCs	B

ES

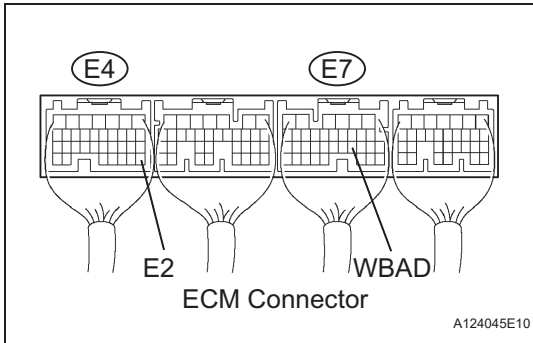
HINT:

If any other codes besides P1150 are output, perform troubleshooting for those DTCs first.

B **GO TO RELEVANT DTC CHART**

A

2 PERFORM ACTIVE TEST BY INTELLIGENT TESTER



- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the power switch ON (IG).
- (c) Turn the tester ON.
- (d) Put the engine in inspection mode (see page ES-1).
- (e) Start the engine and warm it up.
- (f) Enter the following menus: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / WATER FLW VLV3, WATER FLW VLV4 or WATER FLW VLV5.
- (g) Measure the voltage between terminals WBAD and E2 of the ECM connector.

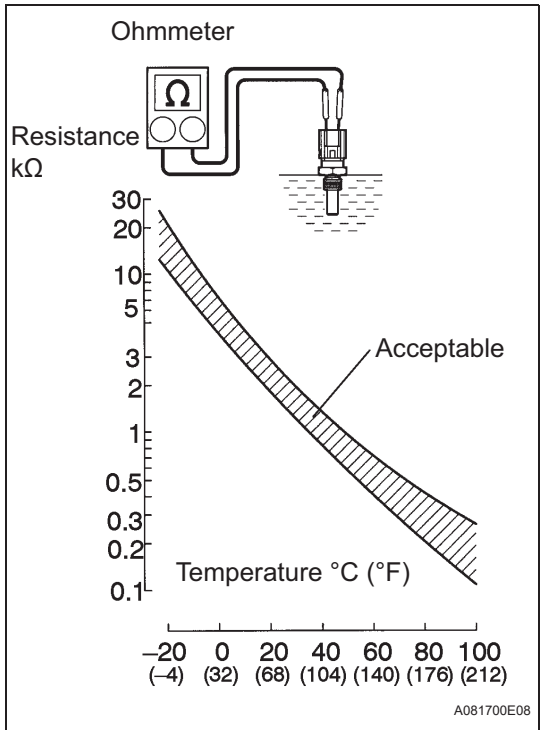
Standard voltage

Tester Operation	Specified Condition
"WATER FLW VLV 3" ON	Approximately 2.5 V
"WATER FLW VLV 4" ON	Approximately 3.5 V
"WATER FLW VLV 5" ON	Approximately 4.5 V

NG **REPLACE WATER W/BRACKET VALVE ASSEMBLY**

OK

3 INSPECT TEMPERATURE SENSOR



- (a) Remove the CHS tank outlet temperature sensor.
- (b) Measure the resistance between the terminals.

Standard resistance

Tester Connection	Specified Condition
1 - 2	2 to 3 kΩ at 20°C (68°F)
1 - 2	0.2 to 0.4 kΩ at 80°C (176°F)

NOTICE:

In case of checking the CHS tank outlet temperature sensor in the water, be careful not to allow water to contact the terminals. After checking, dry the sensor.

HINT:

Alternate procedure: Connect an ohmmeter to the installed CHS tank outlet temperature sensor and read the resistance. Use an infrared thermometer to measure the CHS tank outlet temperature in the immediate vicinity of the sensor. Compare these values to the resistance/temperature graph. Change the engine temperature (warm up or allow to cool down) and repeat the test.

- (c) Reinstall the CHS tank outlet temperature sensor.

ES

NG

REPLACE TEMPERATURE SENSOR

OK

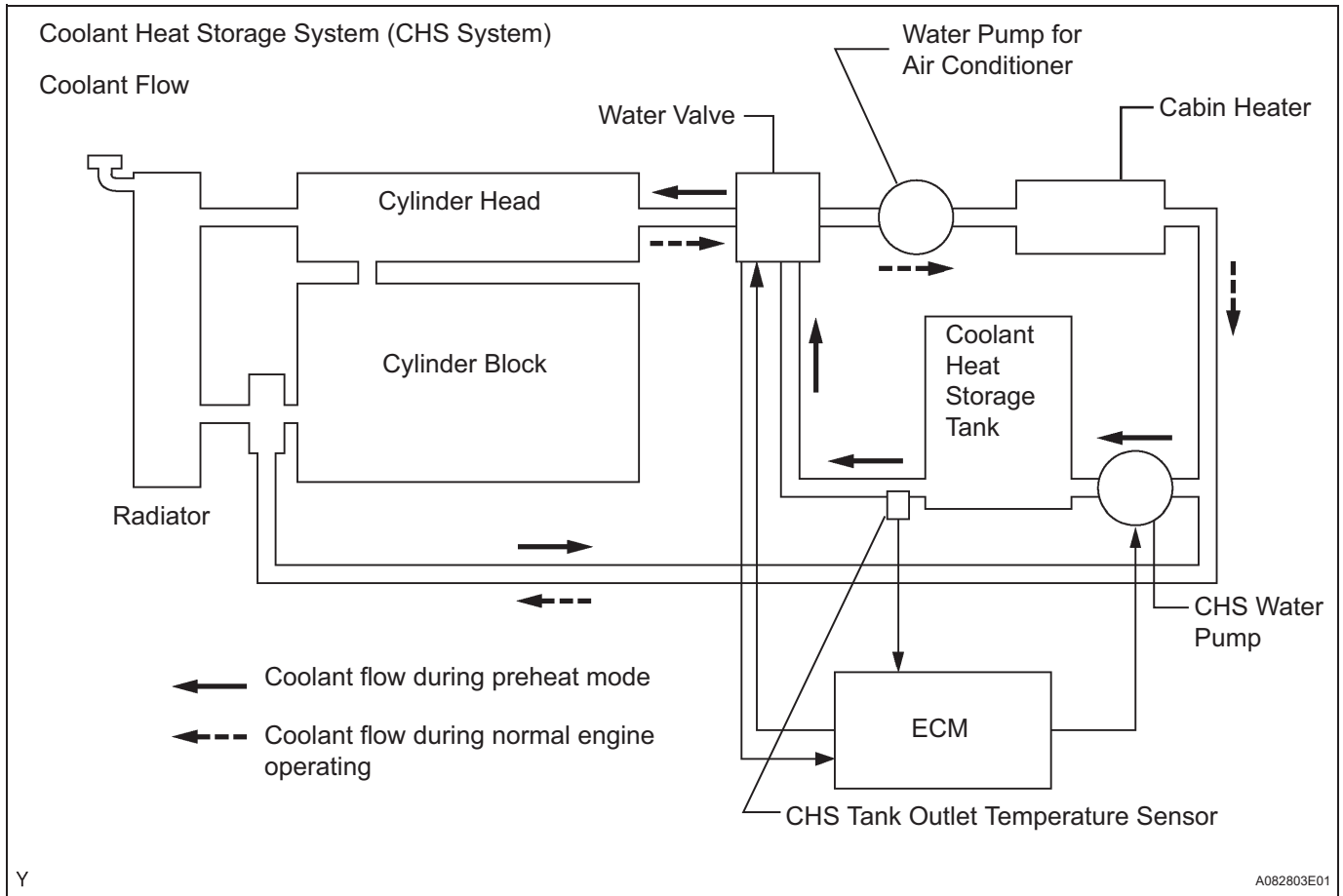
CHECK COOLING SYSTEM (CHECK FOR CLOGGING IN THE COOLING SYSTEM)

DTC

P1151

Coolant Heat Storage Tank

DESCRIPTION



ES

This system uses an electric pump to supply hot coolant stored in the coolant heat storage (CHS) tank into the cylinder head of the engine, in order to optimize engine starting combustion and reduce the amount of unburned gas that is discharged while the engine is started. Before the engine starts, the ECM operates the electric water pump to direct the hot coolant in the CHS tank into the engine, in order to heat the cylinder head (this process is called "preheat mode"). The duration of the operation of the electric water pump is variable, depending on the temperature of the cylinder head. During normal operation of the engine, the water valve opens the passage between the cylinder head and the heater and closes the passage between the cylinder head and the tank. During the preheat mode in which the cylinder head is heated, the water valve opens the passage between the tank and the cylinder head, in order to allow the coolant to flow from the tank to the cylinder head. At this time, in order to warm up the intake port quickly before the engine is started, the coolant flows in the reverse direction.

This system consists of the CHS tank, CHS water pump, CHS tank outlet temperature sensor, water valve, and a soak timer that is built in the ECM.

DTC No.	DTC Detection Condition	Trouble Area
P1151	Following conditions are successively met: <ul style="list-style-type: none"> • CHS tank outlet temperature during preheating: below 50°C (122°F) (2 trip detection condition) • CHS tank outlet temperature during soaking: 30°C (54°F) or more lower than during coolant recovering 	<ul style="list-style-type: none"> • Coolant heat storage tank

MONITOR DESCRIPTION

The ECM detects malfunction in the coolant heat storage (CHS) system with the CHS tank coolant temperature, the position of the water valve, the running condition of the engine and the operating condition of the soak timer. The soak timer built in the ECM prompts the ECM to actuate the water pump 5 hours after the HV main system has been turned OFF by using the power switch. The ECM then checks the heat retention condition of the CHS tank. In order to ensure the reliable malfunction detection, the ECM detects the CHS tank heat retention malfunction in two ways. Thus, when the following two detection conditions are consecutively met, the ECM determines that the heat retention has deteriorated and sets a DTC.

(1) During preheating, the CHS tank outlet water temperature is below 50°C (122°F) (2 trip detection logic).

(2) During soaking, the CHS tank outlet temperature is more than 30°C (86°F) lower than that during the got coolant recovery.

ES

MONITOR STRATEGY

Related DTCs	P1151: Coolant heat storage tank
Required sensors/components	CHS tank outlet temperature sensor
Frequency of operation	Once per driving cycle
Duration	10 seconds
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

The monitor will run whenever the following DTCs are not present	None
Coolant heat storage system malfunction	Not detected
Coolant heat storage water pump operation time	3 seconds or more
Storage coolant temperature	More than 65°C (149°F)

TYPICAL MALFUNCTION THRESHOLDS

Difference storage coolant temperature and heat storage tank outlet coolant temperature	30°C (54°F) or more
---	---------------------

INSPECTION PROCEDURE

CAUTION:

Be careful when replacing any part in the system or changing the coolant because the coolant in the heat storage tank is hot even if the engine and the radiator are cold.

NOTICE:

If air bleeding is not performed completely, this DTC may be detected after changing the coolant.

HINT:

- To check the coolant heat storage (CHS) system, the ECM may cause the water pump of the CHS system to operate 5 hours after the power switch has been turned OFF.
- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunction is detected. When troubleshooting, freeze frame data can help determine if the vehicle was running or stopped, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.

1

REPLACE COOLANT HEAT STORAGE TANK

NEXT

REPAIR COMPLETED

DTC	P1450	Fuel Tank Pressure Sensor
DTC	P1451	Fuel Tank Pressure Sensor Range/Performance
DTC	P1452	Fuel Tank Pressure Sensor Low Input
DTC	P1453	Fuel Tank Pressure Sensor High Input

DTC SUMMARY

DTC No.	Monitoring Item	DTC Detection Condition	Trouble Area	Detection Timing	Detection Logic
P1450	Pressure sensor abnormal voltage fluctuation	Sensor output voltage rapidly fluctuates beyond upper and lower malfunction thresholds for 7 seconds.	<ul style="list-style-type: none"> Fuel tank pressure sensor ECM 	<ul style="list-style-type: none"> Power switch ON (IG) 	1 trip
P1451	Pressure sensor abnormal voltage fluctuation	Sensor output voltage fluctuates frequently in certain time period.	<ul style="list-style-type: none"> Fuel tank pressure sensor Connector/wire harness (Fuel tank pressure sensor - ECM) ECM 	<ul style="list-style-type: none"> EVAP monitoring (power switch OFF) Engine running 	2 trips
P1451	Pressure sensor constant voltage	Sensor output voltage does not vary in certain time period.	<ul style="list-style-type: none"> Fuel tank pressure sensor Connector/wire harness (Fuel tank pressure sensor - ECM) ECM 	<ul style="list-style-type: none"> Engine running) 	2 trips
P1452	Pressure sensor voltage low	Sensor output is less than -3,999 Pa for 7 seconds.	<ul style="list-style-type: none"> Fuel tank pressure sensor Connector/wire harness (Fuel tank pressure sensor - ECM) ECM 	<ul style="list-style-type: none"> EVAP monitoring (power switch OFF) Power switch ON (IG) 	1 trip
P1453	Pressure sensor voltage high	Sensor output 1,999 Pa for 7 seconds.	<ul style="list-style-type: none"> Fuel tank pressure sensor Connector/wire harness (Fuel tank pressure sensor - ECM) ECM 	<ul style="list-style-type: none"> EVAP monitoring (power switch OFF) Power switch ON (IG) 	1 trip

DESCRIPTION

NOTICE:

In this vehicle's EVAP system, turning ON the vent valve does not seal off the EVAP system. To check for leaks in the EVAP system, disconnect the air inlet vent hose and apply pressure from the atmosphere side of the canister.

While the engine is running, if a predetermined condition (closed loop, etc.) is met, the purge VSV is opened by the ECM and stored fuel vapors in the canister are purged to the intake manifold. The ECM changes the duty cycle ratio of the purge VSV to control purge flow volume.

The purge flow volume is also determined by the intake manifold pressure. Atmospheric pressure is allowed into the canister through the vent valve to ensure that the purge flow is maintained when the negative pressure (vacuum) is applied to the canister.

Key-off monitor

This monitor checks for Evaporative Emission (EVAP) system leaks and canister pump module malfunctions. The monitor starts 5 hours* after the power switch is turned OFF. More than 5 hours are required to allow the fuel to cool down to stabilize the Fuel Tank Pressure (FTP), thus making the EVAP system monitor more accurate.

The leak detection pump creates negative pressure (vacuum) in the EVAP system and the pressure is measured. Finally, the ECM monitors for leaks from the EVAP system and malfunctions in both the canister pump module and purge VSV, based on the EVAP pressure.

HINT:

*: If the engine coolant temperature is not below 35°C (95°F) 5 hours after the power switch is turned OFF, the monitor check starts 2 hours later. If it is still not below 35°C (95°F) 7 hours after the power switch is turned OFF, the monitor check starts 2.5 hours later.