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4.1 ENGINE ELECTRONIC CONTROL SYSTEM

1 Warnings and Precautions

1.1 Precautions

In order to avoid dangerous operation and damage to the vehicle, always follow the instructions below before repair:

- (1) Digital multimeter can only be used to perform inspection for electronic injection system.
- (2) Use genuine components to perform service work, otherwise appropriate electronic injection system operation cannot be guaranteed.
- (3) Only use unleaded gasoline during service.
- (4) Please observe normative service and diagnostic flowchart to perform service work.
- (5) Never disassemble or remove components of electronic injection system during service.
- (6) When holding electronic elements (electronic control unit, sensor etc.), take extra care not to drop them on the ground.
- (7) Set up a consciousness of environmental protection and dispose of waste effectively that is produced during service.
- (8) Never use an needle multimeter to check electronic fuel injection system circuit.
- (9) Never use high power test light to measure when testing each pin voltage signal of sensor.
- (10) It is recommended that the measurement status when testing each pin voltage signal of sensor is on-line measurement.
- (11) It is recommended to use voltage drop method when measuring sensor, actuator connecting wire harness.
- (12) Do not causally remove any electronic injection system component or its connector from its installation position to prevent damaging accidentally, or foreign matter, such as moisture, oil from entering connectors, which will affect the normal operation of electronic injection system.
- (13) Be sure to turn ignition switch off when disconnecting and connecting connectors. Otherwise electronic elements may be damaged.
- (14) When simulating hot operating condition of malfunction and performing other service work that may cause temperature to rise, never allow temperature of electronic control unit to exceed 80°C.
- (15) As the supplying pressure of electronic injection system is high, high pressure resistant fuel pipes are adopted for all fuel lines. Fuel pressure in fuel lines is still high even when the engine is not running. Therefore, be careful not to casually remove fuel pipes during service; When it is necessary to service fuel system, discharge pressure in the fuel system before removing fuel pipes. The way to discharge pressure is as follows: After removing fuel pump controller power supply fuse, start engine and idle it until the engine stops running by itself. Removal of fuel pipes should be performed in a well-ventilated area by professional service men.
- (16) Do not energize electric fuel pump when removing it from fuel tank to prevent electric sparks, which will cause a fire.
- (17) It is not allowed to perform running test for fuel pump under dry state or in water. Otherwise service life will be reduced. In addition, do not inversely connect fuel pump positive and negative poles.
- (18) When performing inspection to ignition system, perform spark jump test only when necessary and make sure that the test time is as short as possible. Do not open the throttle during detection, otherwise a large amount of unburned gasoline will enter the exhaust pipe, thus damaging the three-way catalytic converter.
- (19) Since the adjustment of idle speed is completely completed by electronic injection system, manual adjustment is not required. Throttle limit screw of throttle body has been adjusted properly at the factory, and users are not allowed to change its original position at will.
- (20) Do not connect battery with its polarity reversed to prevent damage to electronic elements. This system adopts negative ground.
- (21) Never remove battery cable when engine is running.
- (22) The positive, negative battery cable wires and electronic control unit must be removed before performing welding on vehicle.
- (23) Do not puncture wire outer coat to detect electric signals input and output by components.

1.2 Read

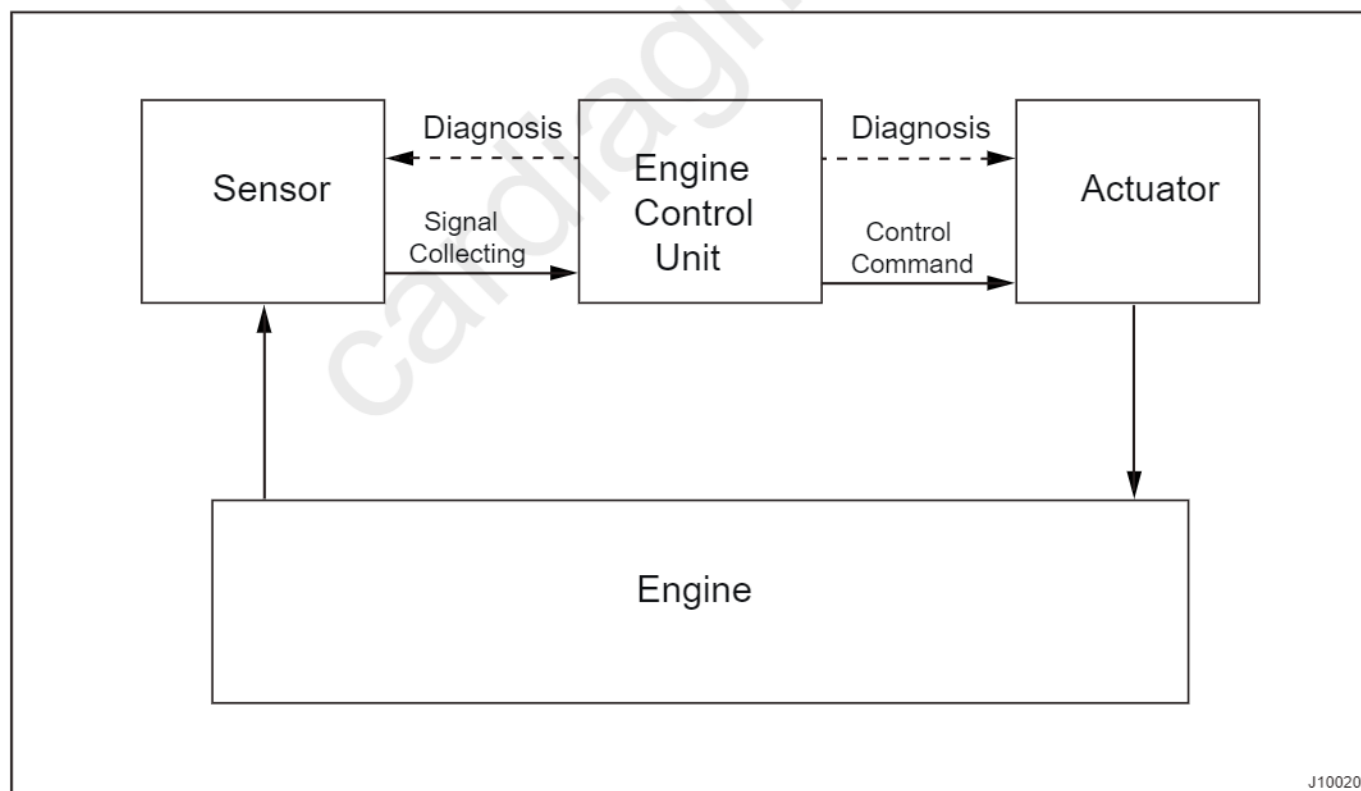
Electronic control sets (abbreviations) include: electronic controller (ECM), intake pressure/temperature sensor (DS-S3-TF), ambient pressure sensor (integrated inside the ECM), coolant temperature sensor (TF), phaser sensor (PG), speed sensor (DG), knock sensor (KS), oxygen sensor (LS), electronic throttle body (DVE), electronic accelerator pedal (APM), low pressure oil pump (EKPT), high pressure oil pump (HDP), high pressure fuel distribution pipe (KSZ-HD), high pressure fuel injector (HDEV), high pressure sensor (DS-HD), canister control valve (TEV), ignition coil (ZS), etc.

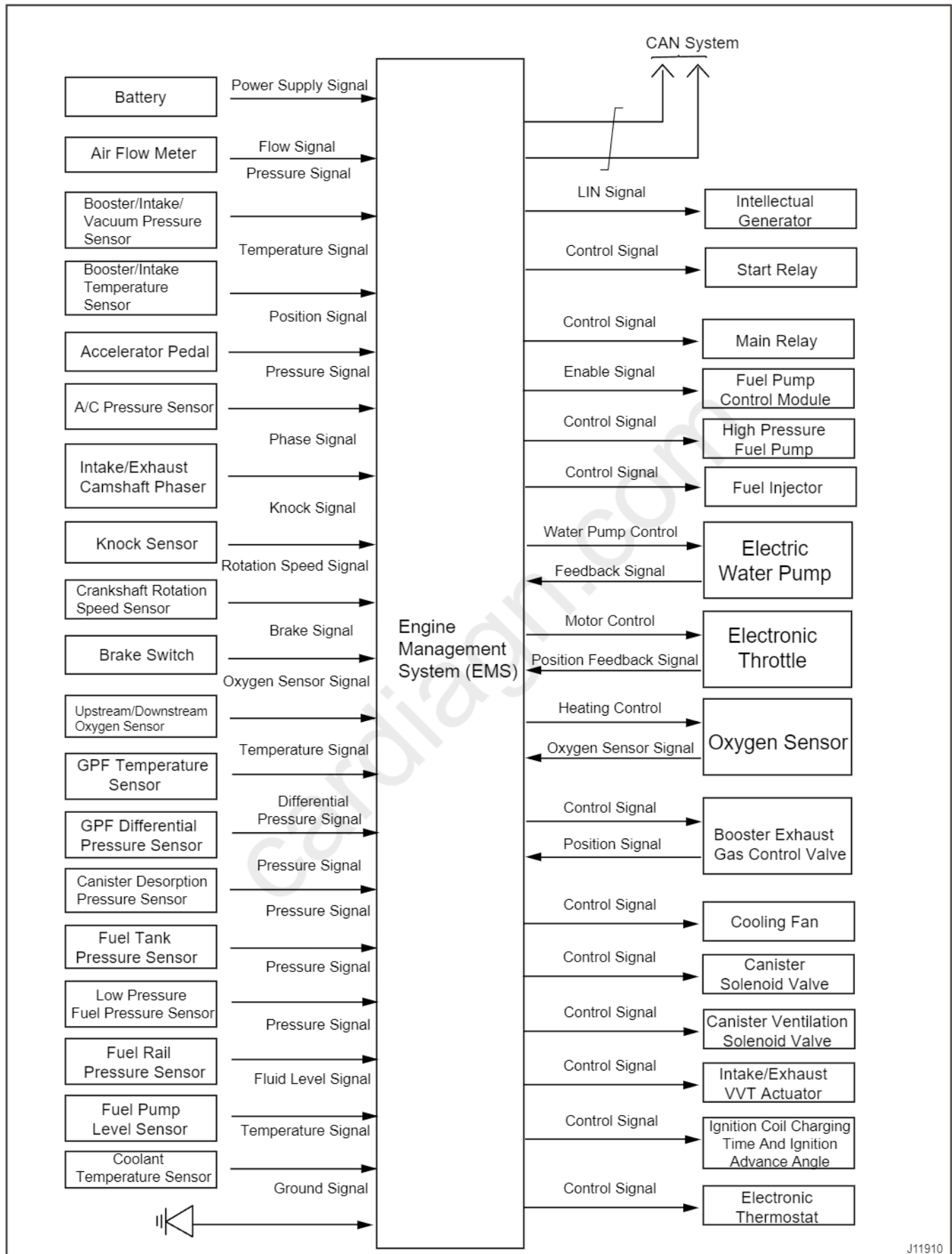
2 System Overview

2.1 System Description

Engine Management System mainly consists of Engine Control Module (ECM), sensors and actuators, which controls intake air amount, injection volume and ignition timing, etc. when engine is operating. In the engine management system, sensors are used as the input part to measure various physical signals (temperature and pressure, etc.), and converts them into corresponding electrical signals; the function of ECM is to receive the input signals from sensors and perform calculation according to set procedure, producing corresponding control signals and outputting them to power drive circuit. The power drive circuit drives each actuator to perform various actions, thus making the engine run according to the preset program. Also, the trouble diagnosis system of ECM monitors each component and control function in this system. Once detecting and confirming a fault, it will store the trouble code. When detecting that fault has been eliminated, it will return to use normal value. UAES GDI (Gasoline Direct Injection) system is a torque control-based system developed on the MG1US008 ECM platform. Its main purpose is to link a large number of different control objectives together and convert various engine requirements into torque or efficiency control variables. MG1US008 system can prioritize these requirements and execute the highest priority requirement. Obtain engine control variables such as intake air volume, injection volume, ignition timing. The execution of each control variable has no effect on other variables. This is the advantage of the torque-based control system.

2.2 System Schematic Diagram





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2.3 System Function Description

MG1US008-Motronic 0 engine management system is an electronically controlled gasoline engine control system, which provides many control features related to the operator and vehicle or equipment. The system adopts a combination of open loop and closed loop (feedback) control to provide various control signals for engine operation. The basic functions of the system include: start control, warm-up and three-way catalytic converter heating control, acceleration/deceleration and motored fuel cut-off control, idle control, λ closed loop control, air-fuel mixture control function, evaporative emission control, knock control, OBD diagnostic control, etc. In addition, additional functions include engine control anti-theft function, start and stop control, fan control, A/C control, VVT control, turbocharger control and so on.

■ Start Control

- (1) Start control: During starting, special calculation methods are used to control the filling, fuel injection and ignition timing. At the beginning of the process, the air in intake manifold is still, and the internal pressure of intake manifold is shown to be ambient pressure. The electronic throttle specifies a fixed opening parameter based on the current starting temperature. The fuel injection mode and injection volume is changed according to engine temperature to promote better mixing of oil and air in the cylinder. In order to form a reliable combustible mixture near the spark plug, the mixture must be enriched before the engine reaches a certain speed. Once the engine starts to run, the system starts to gradually reduce the fuel injection volume immediately, until the start condition ends to completely cancel the start and thicken. Ignition angle is constantly adjusted with starting conditions. It varies with engine temperature, intake air temperature and engine speed. High-pressure start is usually used. In failure mode or extremely low temperature, low-voltage start is used.

■ Heating control of engine warm-up and three-way catalytic converter

- (1) For a period of time after the engine has been started at low temperature, additional injections are still required to be supplied, there may be several times depending on the operating conditions, and cylinder filling amount and ignition angle are adjusted to compensate for the higher torque requirements of engine; And this process continues until temperature rises to a proper threshold. In this stage, rapid heating of three-way catalytic converter is the most important, since rapid transition to operation of three-way catalytic converter can greatly reduce exhaust emissions. Under this operating condition, use exhaust gas to perform "three-way catalytic converter heating" by adopting methods of appropriate fuel injection mode (multiple injections) and a moderate delay in the ignition advance angle.

■ Acceleration/deceleration and motored fuel cut-off control

- (1) In fact, a small part of the fuel injected into the cylinder will not be combusted in time. Conversely, it forms a layer of oil film on the cylinder wall or piston. When the throttle opening increases, a small part of the injected fuel is absorbed by the oil film. Therefore, it is necessary to inject the corresponding fuel amount to compensate and prevent the mixture from becoming lean during acceleration. Once the load factor is reduced, the additional fuel contained in the oil film will be released again, so the corresponding injection duration must be reduced during deceleration.
- (2) Motored or traction condition indicates that the power provided by engine at the flywheel is negative. In this case, engine friction and pump air loss can be used to slow down the vehicle. When the engine is in motored or traction condition, the fuel is cut off to reduce fuel consumption and exhaust emissions, and more importantly to protect the three-way catalyst. Once the speed has been reduced to a set recovery of the fuel supply speed above idle speed, the fuel injection system is resupplied. In fact, the ECM program has a range of recovery speed. They vary according to dynamic changes of parameters such as engine temperature, gear position and engine speed, and prevent the speed from falling to the specified minimum threshold by calculation. Once the injection system is resupplied, the system begins to use the initial injection pulse to supply the fuel. After recovery of fuel injection, the torque-based control system increases the engine torque slowly and smoothly (smooth transition).

■ Idle control

- (1) Engine does not provide torque to the flywheel at idle. To ensure stable operation of the engine at as low an idle speed as possible, the closed-loop idle speed control system must maintain the balance between the generated torque and the engine power consumption. The idle speed requires a certain amount of power to meet the load requirements of all aspects. They include internal friction from the engine crankshaft and valve gear and auxiliary components such as the water pump. MG1US008 system uses torque based control strategy to determine engine output torque requested by maintaining required idling speed in all working conditions according to closed loop idle control. This output torque increases as engine speed reduces, and reduces as engine speed increases. System responses to the new "interference factor" through requesting higher torque, such as turning on/off air conditioning compressor or shifting of automatic transmission. When engine temperature is low, torque is also needed to be increased to compensate higher internal friction and/or maintain higher idling speed. The sum of

these required output torque will be transmitted to torque coordinator which will process, calculate and obtain corresponding volumetric density, mixture contents and ignition timing.

■ Closed-loop control

- (1) Exhaust aftertreatment in three-way catalytic converter is an effective method for reducing concentration of harmful substance in exhaust gas. Three-way catalytic converter can reduce hydrocarbon (HC), carbon monoxide (CO) and nitric oxide (NO_x) up to 98% or more, and convert them into water (H_2O), carbon dioxide (CO_2) and nitrogen (N_2). However, such high efficiency can be achieved only within small range of engine excess air coefficient $\lambda=1$, λ closed loop control is aimed to ensure mixture concentration within this range. λ closed loop control system functions only when oxygen sensor is equipped. Oxygen sensor on side of three-way catalytic converter monitors oxygen content in exhaust gas, lean mixture ($\lambda > 1$) will generate about 100 mV sensor voltage, and rich mixture ($\lambda < 1$) will generate about 800mV sensor voltage. When $\lambda = 1$, sensor voltage will jump. λ closed loop control responses to input signal ($\lambda > 1$ = lean mixture, $\lambda < 1$ = rich mixture) to correct control variable, a correction factor is generated as a multiplier to correct the fuel injection duration.

■ Evaporative emission control

- (1) Due to external transfer of radiant heat and returned fuel heat, the fuel in fuel tank is heated and forms fuel vapor. Due to limits of evaporative emission regulations, these vapors containing a large amount of HC components are not allowed to be discharged directly into the atmosphere. In system, fuel vapor will be collected in activated carbon canister through guide pipe and enters into engine and participates in the combustion process through scour at the right moment. Flow rate of scour airflow is realized by ECM controlling canister control valve. This control operates only under closed loop working condition of λ closed loop control system.

■ Knock control

- (1) System detects characteristic vibration at moment knock occurs through knock sensor installed in proper position of engine, and converts it into electrical signal to transmit it to ECM for processing. ECM uses special processing method to detect if knock occurs in each combustion cycle in each cylinder. Once knock is detected, knock closed loop control is triggered. After knock danger is eliminated, ignition of affected cylinder will be gradually advanced to predetermined ignition advance angle.

■ OBD Trouble Diagnosis

- (1) Electronic control unit constantly monitors sensors, actuators, related circuits, malfunction indicator light, battery voltage and so on, and even electronic control unit itself. And it performs rationality detection for sensor output signal, actuator drive signal and internal signals (such as λ closed loop control, coolant temperature, knock control, idle speed control and battery voltage control, etc.). Once a certain step failure or unreasonable signal value is found, electronic control unit will immediately set malfunction information record in RAM malfunction memory. Malfunction information record is stored in the form of trouble code and displays in the order in which malfunctions occurred.

■ Idle Start and Stop

- (1) Idle automatic start and stop function can realize the automatic start-stop function when the vehicle stops briefly (such as red traffic light) during driving. The system can judge whether the driver has parking or driving intention according to the information of vehicle speed, engine speed, transmission chain state and vehicle body state, and automatically controls the starting and stopping of engine. So as to achieve the purposes of fuel saving and emission reduction, and fuel consumption reduction of end users. The control is the same as 1.6T.

2.4 Introduction to National VI OBD Diagnostic Control

■ Catalytic Converter Monitor

- (1) The catalytic converter is equipped with two main components of cerium oxide and precious metals (-platinum, rhodium, palladium). The former is a container for storing and releasing oxygen and is used to oxidize CO and HC in the concentrated gas mixture, while the latter is a catalyst to promote oxidation and reduction reactions. Under the premise that the aging speed of the two is basically the same, because the damage degree of precious metals cannot be accurately assessed, and the aging degree of cerium oxide can be expressed by the amount of oxygen storage, research shows that there is a nonlinear relationship between the conversion efficiency and oxygen storage capacity of catalytic converter. The oxygen storage capacity of the catalytic converter, that is, the oxidation capacity of the catalytic converter, decreases over time. Therefore, the current catalytic converter diagnosis strategy is realized by evaluating the oxygen storage capacity of catalytic converter.
- (2) During the measurement of oxygen storage, first use the concentrated gas mixture to completely empty the residual oxygen in catalytic converter, and the oxygen in the catalytic converter is considered to be completely empty when the downstream oxygen indicator is rich, and then the lean mixture is used to

oxygenate the catalytic converter, and the downstream oxygen indicator is lean, the catalytic converter is considered to be full of oxygen. Through this process, the oxygen storage capacity of the catalytic converter can be calculated to evaluate the conversion capacity of the catalytic converter. Before the decrease of catalytic converter conversion capacity causes the emission of non-methane hydrocarbons + nitrogen oxides (NMHC + NOx) in the exhaust pollutants of the vehicle to exceed the OBD threshold, The OBD system alarms and illuminates MIL light.

- (3) The catalytic converter is monitored by directly measuring the oxygen storage capacity during the transition process of the gas mixture from rich to lean. In this process, the upstream oxygen sensor accurately controls the air-fuel ratio, and the downstream oxygen sensor is used to measure the oxygen storage capacity of the catalytic converter.

■ Overview of Misfire Monitoring

- (1) The basic principle of engine misfire monitoring is based on calculating the crankshaft acceleration during each individual combustion process.
- (2) In order to calculate the crankshaft acceleration, a toothed sensor signal wheel with a reference mark is installed on the crankshaft. The sensor signal wheel is divided into several segments, the segment number is equal to half of cylinder number in an engine with even number of cylinder, and the cylinder number is the number of cylinders in an engine with odd-number of cylinder. Each time the combustion pushes the crankshaft to accelerate rotation and generate a certain crankshaft acceleration. The engine speed sensor is used to calculate the time for crankshaft to rotate around each segment window, and the crankshaft acceleration corresponding to each cylinder can be calculated from the relative segment time.
- (3) When a cylinder is unburned or not fully burned, it will take longer for the corresponding segment window to pass the crankshaft position sensor, the corresponding segment window acceleration will exceed the matching threshold, and the system will diagnose a misfire.

■ Evaporation System Monitoring (Dual Lines, DTEV + DTESK)

Evaporation system monitor includes two parts:

- (1) Monitor the desorption flow of evaporation system. When the desorption flow from the fuel evaporation system to the engine cannot be monitored, the OBD system should detect a fault, that is, the desorption flow monitor. Related faults: P0497 (EVAP System Low Purge Flow) P04F0 (EVAP System High Pressure Purge).
- (2) Monitor the integrity of the entire evaporation system except for the lines and connectors between canister valve and the intake manifold to prevent fuel vapor from leaking into the atmosphere, that is, leakage monitor. Related faults: P2422 (EVAP System Vent Valve Stuck Closed), P0455 (EVAP System Leak Detected (Large Leak)), P0442 (EVAP System Leak Detected (Small Leak)).
- (3) Pressure sensor-based desorption flow monitoring (DTEV) and fuel tank pressure sensor-based leakage monitoring (DTESK).
 - DTEV actively controls the opening and closing of the canister valve, and detects the desorption flow of the evaporation system according to the pressure fluctuations in desorption line during the canister valve opening; DTESK controls the canister valve and canister vent valve to create the vacuum degree, and detects the leakage of evaporation system based on the vacuum attenuation gradient. The system can also monitor the canister valve and canister vent valve. The canister vent valve is used to control the communication between evaporation system and atmosphere, and the canister valve is used to control the communication between evaporation system and engine intake line. If the system leaks, it is recommended to use a smoke-type leak detector for troubleshooting.

■ Fuel System Monitoring

- (1) Adaptive feedback monitoring based on upstream oxygen
 - P2177 (System Too Lean Off Idle Bank 1)
 - P2178 (System Too Rich Off Idle Bank 1)
 - P2187 (System Too Lean at Idle Bank 1)
 - P2188 (System Too Rich at Idle Bank 1)
 - The fuel injection time of the injector is mainly calculated according to the engine load signal, additive correction factor of mixture adaptive feedback, the multiplicative correction factor of mixture adaptive feedback and the mixture closed-loop adjustment factor.
 - Considering that different fault sources have different effects on engine operating conditions and have different meanings for mixture correction, the system divides the self-learning region of mixture according to engine speed and load and carries out corresponding correction. Therefore, adaptive feedback learning is divided into two types: (1) Additive self-learning (such as air leakage in intake manifold); (2) Multiplicative self-learning (such as fuel pressure signal error). The corresponding fault

types are also divided into: additive self-learning over-limit fault (P2187/P2188) and multiplicative self-learning over-limit fault (P2177/P2178).

- Under idling conditions, the additive self-learning plays the main role of fuel correction, while under relatively high speed and load conditions, the multiplicative self-learning plays the main role of fuel correction.
- Additive self-learning is carried out under idling conditions, and multiplicative self-learning is carried out under relatively high speed and load conditions. Only when the engine is running to corresponding self-learning operating area, the corresponding self-learning of mixture will be activated.

(2) Fuel correction monitoring based on downstream oxygen

- P2097 (Post Catalyst Fuel Trim System Too Rich Bank 1)
- P2096 (Post Catalyst Fuel Trim System Too Lean Bank 1)
- Downstream oxygen closed loop correction principle
- There are two main functions and meanings of installing the downstream oxygen sensor behind the catalytic converter: One is to monitor the failure of catalytic converter according to the signal of downstream oxygen sensor; the other is to further correct the closed-loop adjustment deviation of upstream oxygen according to the signal feedback of downstream oxygen sensor to ensure that the mixture λ is always within the catalytic converter optimal conversion window.
- For closed-loop adjustment based on downstream oxygen, the principle is to compare the downstream oxygen voltage signal with the target voltage under steady condition. If the downstream oxygen voltage deviates from the target voltage, the system will perform self-learning correction according to the degree of deviation and determine fault based on the self-learning value.

■ Exhaust Sensor Monitoring

The exhaust sensor system monitors the working status of upstream oxygen sensor and upstream oxygen sensor, including oxygen sensor circuit monitoring, heating performance monitoring, responsive monitoring, and upstream oxygen sensor characteristic deviation monitoring. Oxygen sensor circuit monitoring (upstream and downstream oxygen sensors) Oxygen sensor heating monitoring (upstream and downstream oxygen sensors) Upstream oxygen sensor responsive monitoring Upstream oxygen sensor characteristic deviation monitoring Downstream oxygen sensor aging monitoring

(1) Upstream oxygen sensor responsive monitoring

- P0133 (O2 Sensor Circuit Slow Response Bank 1 Sensor 1)
- Aging and pollution will cause the responsiveness of the oxygen sensor to become sluggish, and a upstream oxygen sensor signal with a slower dynamic response will cause emissions to deteriorate. The system response monitoring function can monitor the symmetry response failure of upstream oxygen sensor when the monitoring conditions are met.
- The system monitors the responsiveness of upstream oxygen sensor by adjusting the required air-fuel ratio. When the air-fuel ratio changes, it performs fault monitoring by comparing the reversed actual oxygen sensor signal and the target oxygen sensor signal.

(2) Upstream oxygen sensor characteristic deviation monitoring

- The measured air-fuel ratio signal deviates from the actual value when the characteristics of upstream oxygen sensor deviate. The deviation of the positive or lean side can cause the measured value of the excess air coefficient to be too large (lean). The deviation of the negative or rich side can cause the measured value of the excess air coefficient to be too small (rich). The system monitors the characteristic deviation of upstream oxygen sensor through the fuel self-learning integral value in closed-loop control of downstream oxygen. When the characteristic of upstream oxygen sensor is deviation, the air-fuel ratio indication will be lean or rich, which will cause the downstream oxygen self-learning integral value is too large or too small.
- Malfunction Detection Standard
- P2195 O2 Sensor Signal Biased/Stuck Lean Bank 1 Sensor 1
- P2196 O2 Sensor Signal Biased/Stuck Rich Bank 1 Sensor 1
- When the characteristics of upstream oxygen sensor deviate to the lean side, the upstream oxygen signal will always be lean compared to the actual air-fuel ratio, which leads to the enrichment of upstream oxygen closed-loop control, the mixture will be rich, and downstream oxygen signal will continue to be high and deviate from the target voltage level. At this time, the closed-loop correction factor of downstream oxygen closed-loop control based on the downstream oxygen signal will be

corrected by feedback. When the self-learning integral value of correction factor exceeds the upper fault threshold, the system will report P2195 (Lean Side Fault (Lean Side Deviation Fault)).

(3) Upstream Oxygen Sensor Voltage Range Monitoring

- If the upstream oxygen sensor is installed incorrectly, the sensor is likely to be in communication with atmosphere and cannot accurately reflect the oxygen concentration in exhaust gas. Generally, when the oxygen sensor is placed in a mixture with an air-fuel ratio around 1.0, its output voltage is much lower than the output voltage when upstream oxygen sensor is in the air. When upstream oxygen sensor is not correctly installed in the exhaust system, it will report the fault.
- P2414 O2 Sensor Exhaust Sample Error Bank 1 Sensor 1
- Generally, when the oxygen sensor is placed in a mixture with an air-fuel ratio around 1.0, its output voltage is much lower than the output voltage when upstream oxygen sensor is in the air. When upstream oxygen sensor is not correctly installed in the exhaust system, it will report P2414. Since an empty fuel tank may lead to misdiagnosis, it is necessary to add an empty fuel tank verification before fault confirmation.

(4) Downstream Oxygen Sensor Aging Monitoring

- Downstream oxygen sensor signal continues to be rich
- P2271 O2 Sensor Signal Biased&Stuck Rich Bank 1 Sensor 2
- When downstream oxygen sensor signal is always rich, under the action of fuel cut-off condition or the active adjustment of the air-fuel ratio, when the downstream oxygen voltage still cannot drop to the setting threshold after a certain period of time (considering the oxygen storage factor of catalytic converter), it will report P2271.
- Downstream oxygen sensor signal continues to be lean
- P2270 O2 Sensor Signal Biased&Stuck Lean Bank 1 Sensor 2
- When downstream oxygen sensor signal is always lean, under the action of purging oxygen condition or the active adjustment of the air-fuel ratio, when the downstream oxygen voltage still cannot rise to the setting threshold after a certain period of time (considering the oxygen storage factor of catalytic converter), it will report P2270.
- Responsive monitoring of downstream oxygen sensor under fuel cut-off conditions
- P013A O2 Sensor Slow Response - Rich to Lean Bank 1 Sensor 2
- In the fuel cut-off condition that meets the diagnostic conditions, when the output voltage time constant of downstream oxygen sensor exceeds the setting threshold, it will report P013A.

(5) Downstream Oxygen Sensor Circuit Monitoring

- Downstream oxygen sensor signal circuit is short to power supply
- P0138 O2 Sensor High Voltage Bank 1 Sensor 2
- When all monitoring conditions are met, if the output voltage of oxygen sensor is greater than threshold, it will report P0138.
- Downstream oxygen sensor signal circuit is short to ground
- P0137 O2 Sensor Low Voltage Bank 1 Sensor 2
- When all monitoring conditions are met, if the output voltage of oxygen sensor is less than threshold, it will report P0137.
- Downstream oxygen sensor signal circuit open
- P0136 O2 Sensor Circuit Bank 1 Sensor 2
- When all monitoring conditions are met, if the output voltage of downstream oxygen sensor stays within the set threshold interval, it will report P0136.
- Unreasonable monitoring of downstream oxygen sensor signal
- P2232 O2 Sensor Signal Circuit Shorted to Heater Circuit Bank 1 Sensor 2
- When all monitoring conditions are met, if downstream oxygen sensor signal circuit is coupled with heating line, it will report P2232.

(6) Upstream Oxygen Sensor Heating Monitoring

- When the exhaust temperature is not enough to heat the oxygen sensor to a suitable working temperature, the internal heating circuit of oxygen sensor can auxiliary heating. When the heating circuit of oxygen sensor fails, the oxygen sensor will not work reliably and needs to be monitored for failure.
- P0053 HO2S Heater Resistance Bank 1 Sensor 2

- After engine is started, if the temperature of upstream oxygen ceramic body cannot exceed the setting threshold within a certain period of time, it will report P0053.
- When the heating control circuit is heated at full-power and temperature of upstream oxygen ceramic body cannot exceed the setting threshold, it will report P0053.

(7) Downstream Oxygen Sensor Heating Monitoring

- P0054 HO2S Heater Resistance Bank 1 Sensor 2
- Under high temperature exhaust and circuit heating, the internal resistance of two-point oxygen sensor decreases and the temperature increases. If the circuit heating of oxygen sensor fails, the internal resistance of oxygen sensor is higher than the normal value. Nernst internal resistance monitoring of oxygen sensor.
- When the Nernst internal resistance of oxygen sensor is higher than the normal value, it will report P0054.

■ Engine Cooling Monitoring

(1) Engine coolant temperature (ETC) sensor monitoring

- The engine coolant temperature sensor measures the engine coolant temperature, and its monitoring includes circuit monitoring, various signal rationality monitoring, and cold start rationality monitoring.

(2) Thermostat monitoring

- The system uses a thermal management module to control the temperature of engine coolant, so the thermal management module is required to monitor in accordance with the thermostat monitoring specification. The cooling system is equipped with an engine coolant temperature sensor (ECT sensor) in the small circulation water circuit, which is used to measure the water temperature of small circulation water circuit, and a coolant temperature sensor (ECT sensor 2) is installed in the large circulation water circuit, which is used to measure the water temperature of large circulation water circuit. In the normal state of thermal management module, when the coolant does not reach the regulating temperature, the large circulation water circuit of cooling system is in the closed state, the coolant flows in the small circulation, and the ECT sensor 2 is cold coolant. When the coolant reaches the regulating temperature, the large circulation water circuit of cooling system is in an open state, and the hot coolant flows to the radiator to dissipate heat, and the ECT sensor 2 is the hot coolant that passes through the radiator to dissipate heat. When the thermal management module is stuck in the fully open position, the coolant flows to the radiator to dissipate heat, and the ECT sensor 2 always senses the hot coolant that passes through the radiator to dissipate heat.
- P0128 Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)
- If the water temperature of small circulation water circuit is higher than the threshold, the thermal management module is determined to be normal; if the water temperature of small circulation water circuit is lower than the threshold and the water temperature of large circulation water circuit reaches a certain threshold, it is determined that the thermostat is stuck in the fully open position, and the performance of thermostat module is considered unreasonable.

■ Cold Start Emission Reduction Strategy Monitoring (CSERS)

(1) System overview

- The cold start emission reduction strategy is generally catalytic converter heating, that is, by increasing the engine idle speed, delayed ignition angle, adjusting the variable valve timing, multiple injections and other strategies to achieve the goal of quick ignition of catalytic converter during the warm-up. Cold start emission reduction strategy diagnosis is not a diagnosis of a specific function, but a monitoring and diagnosis of the above strategies, and corresponding diagnosis of key engine parameters corresponding to these strategies.
- Before the failure or deterioration of cold start emission reduction strategy relevant parts or components causes the vehicle emissions to exceed OBD threshold, the OBD system should detect a failure. If the failure of strategy does not lead to emission exceeding the OBD threshold, the corresponding faults should be diagnosed when the function control reaches the adjustment limit. The strategy corresponding to the cold start emission reduction strategy of this project is to increase engine idle speed, delay ignition angle, adjust variable valve timing, perform multiple injection, and increase high pressure fuel rail pressure. Details are as follows:

(2) Engine idle speed control monitoring in catalytic converter heating

- P050A 21 (Cold Start Idle Control System Performance)
- P050A 22 (Cold Start Idle Control System Performance)
- P050D (Cold Start Rough Idle)

- Similar to the normal phase (catalytic converter heating does not work), the engine idle speed control and diagnosis principle is the same in catalytic converter heating. The idle speed uses PID to adjust the engine torque to achieve the actual idle speed consistent with the target idle speed; Idle speed diagnosis is a corresponding diagnosis based on the difference between the target speed and actual speed, and the performance of actual idle speed.
- (3) Ignition angle efficiency monitoring when catalytic converter is heated
- P050B 00 (Cold Start Ignition Timing Performance)
 - P050B 20 (Cold Start Ignition Timing Performance)
 - The important measures of delaying the ignition angle and the quick ignition of catalytic converter are used to shorten the ignition time of catalytic converter, thereby greatly reducing exhaust emissions. This diagnostic function monitors the ignition angle efficiency during catalytic converter heating. The diagnostic principle diagram is as follows, by calculating the deviation of actual ignition angle efficiency and target ignition angle efficiency, considering that the catalytic converter heating is a process, the system obtains the average efficiency difference of the entire catalytic converter heating process, and compares it with the matching threshold at the corresponding operating point.
 - Theoretically, only when the actual ignition angle is greater than the set optimal ignition angle (ignition angle delayed when the catalytic converter is heated in the normal state), that is, the ignition angle is not delayed or delayed not enough, the quick ignition of catalytic converter will be adversely affected, therefore, the system only performs the diagnosis, that is, when the average deviation between actual ignition angle efficiency and target ignition angle efficiency is greater than the setting threshold (- ignition angle is not delayed or delayed not enough), and the duration exceeds the setting threshold, it will report P050B 00 (it will report P050B 20 when part load).
- (4) Variable Valve Timing Monitoring when Catalytic Converter Heating
- P052A (Cold Start "A" Camshaft Position Timing Over-Advanced Bank 1)
 - P054A (Cold Start "B" Camshaft Position Timing Over-Advanced Bank 1)
 - The diagnostic method of variable valve timing in catalytic converter heating is to monitor the effective difference between actual position and the expected position of intake and exhaust VVT, and detect the accuracy and timeliness of required valve timing.
 - If the catalytic converter heating is activated after the engine is cold-started, and all the secondary factors are satisfied, the VVT diagnosis is performed by comparing the target camshaft angle with the actual camshaft angle.
 - If the deviation between expected angle and actual angle is greater than the matching fault threshold within the specified time, the fault will be detected and the P052A/P054A will be confirmed. The fault threshold is obtained based on the engine speed and oil temperature at this time.
 - When the deviation between expected angle and actual angle is within the specified range, and the camshaft phase adjustment range exceeds the threshold, no fault diagnosis is completed.
- (5) Multi-injection Monitoring when Catalytic Converter Heating
- P05EC (Cold Start Injection Timing Performance)
 - One of the advantages of a direct injection engine is that it can effectively carry out multiple injections such as two injections, especially by activating the multiple injection mode, greatly delays the ignition angle to achieves the quick ignition of catalytic converter during the heating process, thus effectively reduce emission pollution. Therefore, just as the ignition angle is an important factor in the catalytic converter heating, the fuel injection pulse width and fuel injection phase corresponding to multiple injections are all important control parameters, that is, corresponding diagnosis is required.
 - Monitor the injection pulse width, injection angle, and injection times of the multiple injection control parameters. When the absolute value of difference between expected value and actual value exceeds the setting threshold, it will report P05EC.
- (6) High Pressure Oil Passage Pressure Monitoring When Catalytic Converter Heating
- P053F 21 (Cold Start Fuel Pressure Performance)
 - P053F 22 (Cold Start Fuel Pressure Performance)
 - In the catalytic converter heating process of high pressure direct injection engine, it can reduce the emission pollution by increasing the high pressure oil passage pressure, that is, it is also an important control parameter for cold start to reduce the emission pollution, so effective diagnosis is required. Diagnosis principle for this part is the same as the high pressure oil passage diagnosis when the catalytic converter heating, that is, the expected pressure is compared with the actual pressure, and the corresponding fault is reported when the difference exceeds the setting threshold.

■ Gasoline Particulate Filter (GPF) Monitoring

- (1) Gasoline particulate filter (GPF) is installed on engine exhaust pipe to trap particulate in exhaust gas. According to the provisions of the National VI Emission Regulation J.4.13.2.1, it is necessary to monitor the GPF to remove the failure.
- (2) When the particulate trapped in GPF is too much, causing GPF back pressure is too high, it will cause the engine exhaust back pressure to rise, which will affect the engine power performance. Therefore, it is necessary to monitor the fault of high GPF back pressure.
- (3) In order to realize the monitoring of GPF removal and high back pressure failure, it is necessary to install a differential pressure sensor on GPF to measure the pressure drop generated when the exhaust gas flows through GPF.

2.5 System Components Description

■ Intake pressure sensor

Intake manifold absolute pressure sensing element consists of a piece of silicon chip. Etch a piece of pressure diaphragm on silicon chip. There are 4 piezoresistors on pressure diaphragm, and the 4 piezoresistors form a Wheatstone bridge as strain element. Except for the pressure diaphragm, silicon chip is also integrated with signal processing circuit. Active surface of the silicon chip is subjected to a pressure close to zero, and its surface is subjected to the absolute pressure of the intake manifold to be measured. Thickness of silicon chip is only several micrometer, so the silicon chip will deform mechanically as intake manifold absolute pressure changes, and 4 piezoresistors will also deform, thus changing the resistance. Voltage signal linearly related to the pressure is generated after processing by signal processing circuit of silicon chip.

Intake temperature sensing element is a negative temperature coefficient (NTC) resistor, whose resistance changes with the intake temperature. This sensor transfers a voltage of intake temperature change to controller.



- (1) Pressure sensor limit parameter

Parameters	Value		
	Minimum	Representative	Maximum
Power supply voltage			16V
Pressure			500 kpa
Operating temperature	-40°C		+130°C

- (2) Pressure sensor characteristic parameters

Parameters	Value		
	Minimum	Representative	Maximum
Pressure measurement range	10 kpa		300 kpa
Operating temperature	-40°C		130°C
Power supply voltage	4.75 V	5.0 V	5.25 V
Power supply current when $U_s = 5.0 V$			12.5 mA
Output terminal load current	-1.0 mA		0.5 mA

Parameters		Value		
		Minimum	Representative	Maximum
Load resistance to voltage U_S or ground	Pull-up resistor	5 k Ω		
	Pull-down resistor	10 k Ω		
Response time $t_{10/90}$				1.0 ms
Weight			24g	

(3) Temperature sensor limit parameters

- Storage temperature: -40/+130°C;
- The maximum power at 25°C: 100 mW.

(4) Temperature sensor characteristic parameters

- Operating temperature: -40/+130°C;
- Rated voltage: Pull-up resistor (power is 1 kW) operates at 5 V or operates at a constant current of 1mA;
- Rated resistance at 20°C: 2.5 kW $\pm$ 5%;

■ Electronic Throttle Body

Electronic throttle body is a critical part for engine intake system in EGAS system. Its main function is to control intake air volume by adjusting intake passage area according to driver's driving intention to meet intake requirements in different engine operating conditions, and send back position signals of throttle valve plate to control unit to achieve accurate control.

DVE consists of four parts: drive module, train module, executive module and feedback module, and all components are integrated into the same throttle valve housing. Throttle feedback module uses two redundant structures. When malfunction occurs, throttle valve plate will stop at the limp home position (NLP) determined by mechanical way, which is located above mechanical bottom dead center. DVE performs control only by corresponding electronic control unit or electronic test circuit. In principle, it is necessary to ensure that the throttle valve plate does not operate dynamically to the mechanical dead center.



(1) Basic performance parameters:

Test Item	Potentiometer Voltage				Response Time (ms)		Return Time (ms)
	Mechanical Bottom Dead Center (%)		Mechanical Top Dead Center (%)				
	IP1S	IP2S	IP1S	IP2S	Open	Close	
Parameter range	10 ± 4	90 ± 4	93 ± 4	7 ± 4	≤ 100	≤ 100	≤ 300

■ Knock Sensor

Knock sensor is installed on cylinder block, and used to detect engine vibration caused by detonation. You can install one or more.

The sensitive element of sensor is a piezoelectric ceramic. Vibration of engine cylinder block is transferred to the piezoelectric ceramic through a mass block in the sensor. Due to the pressure generated by vibration of mass block, the piezoelectric ceramic generates a voltage at both electrode faces, and converts the vibration signal to an A/C voltage signal to output it.

Because intensity of vibration signal caused by engine knocking is far more than that of normal engine vibration signal, ECM can distinguish between knock or non-knock signals by processing these signals from knock sensor.



J12860

(1) Limit data

Quantity	Value		
	Minimum	Representative	Maximum
Operating temperature	-40°C		130°C

(2) Characteristic data (cable type)

Quantity		Value
Sensitivity of new sensor to 7 kHz signal		23.6~35.4 mV/g
Sensitivity of new sensor to 19kHz signal		28.3~42.4 mV/g
Linearity between 5 and 15 kHz		±10% of 5 kHz (based on 10m/s ²)
Main resonance frequency		> 30 kHz
Impedance	Resistance (terminal and copper bush)	> 1 MΩ
	Capacitance (probe)	1150 ± 200 pF
Leakage resistance (resistance between two output terminals of sensor)		4.9 ± 20% MΩ
Variation in sensitivity due to temperature (9 kHz)		≤ -0.04 mV/g°C

■ Coolant Temperature Sensor

Temperature sensor function is used to monitor engine coolant temperature. On the one hand, it makes the electronic system judge the engine operating condition by outputting resistance signal; On the other hand, it also outputs signals to relevant instrument cluster, so that operators can directly judge the engine operating condition through visual inspection. Coolant temperature sensor encapsulates NTC thermistor in temperature sensor, its resistance varies in accordance with ambient temperature, so that the small change of outside temperature can be measured accurately and timely. Temperature of contact medium can be reflected by measuring its output resistance.



P10130

(1) Limit data

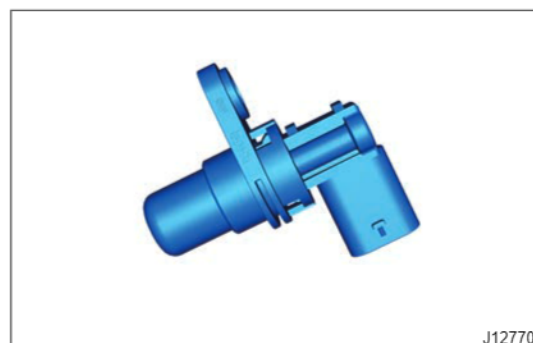
Quantity	Value
Rated voltage	Operates with ECM connected, standard operating condition is 5 V (power of pull-up resistor is 1 kW)
Rated resistance at 20°C	2.5 ± 5% kΩ
Operating temperature range	-40 ~ +130°C
Vibration level	≤ 600 m/s ²

(2) Characteristic data

Temperature (°C)	Resistance (Ω)
-40	45313
-30	26114
-20	15462
-10	9397
0	5896
10	3792
20	2500
30	1707
40	1175
50	833.9
60	595.5
70	435.7
80	322.5
90	243.2
100	186.6
110	144.2
120	112.7
130	89.30

■ Speed Sensor

Speed sensor is a component of the engine management system. This sensor is installed on engine block, which used to detect crankshaft position and speed. Rotation of the signal plate causes the magnetic field at the induction point inside the speed sensor to alternate. The alternating magnetic field is induced by the differential Hall chip, and the induced alternating magnetic signal is converted into an electrical signal by the internal processing circuit of the sensor and output.



J12770

(1) Technical Characteristic Parameters

Parameters	Minimum	Representative	Maximum
Storage temperature	-40 °C		+80 °C
Speed range	20 rpm		8000 rpm
Air clearance	0.2 mm	1.0 mm	1.8 mm
Phase accuracy (falling edge of 800 rpm)	-1 deg		+1 deg
Operating temperature (- plug area)	-40 °C		+150 °C
Operating temperature (sensor)	-40 °C		+150 °C
Power supply voltage range	4.75 V	5.0 V	16 V
Power supply current		4.2 mA	10 mA
Output signal rising time (Low - High)			25 us
Output signal falling time (- High - Low)			1 us
Output signal power supply voltage			18 V
Output current			20 mA
Output signal low voltage			0.5 V
Output signal high voltage	$U_{S,0} - 0.5 \text{ V}$	$U_{S,0} - 0.3 \text{ V}$	
Power-on time			250 ms
n: Repeated accuracy at 800 rpm	-0.1 deg	+0.1 deg	

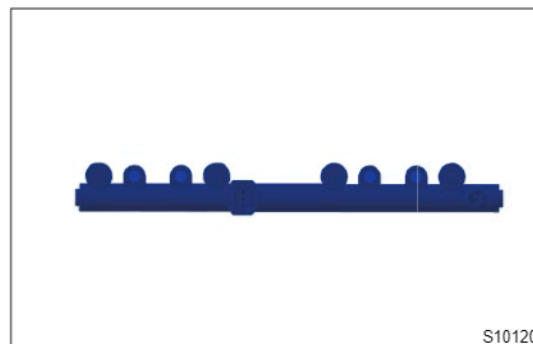
■ Camshaft Position Sensor

Camshaft position sensor is a Hall type sensor. A phaser is installed on camshaft. When phaser is in high teeth, the applicable circuit outputs low voltage; when phaser is in missing teeth, the applicable circuit outputs high voltage. As a result, the crankshaft phase information is provided to Engine Control Module (ECM), so that the compression top dead center and exhaust top dead center of crankshaft can be distinguished.



■ High pressure fuel distribution pipe assembly

The high pressure fuel distribution pipe assembly is integrated with high pressure fuel distribution pipe (fuel rail), high pressure fuel injector and high pressure sensor. Its operation principle is to optimize design through structure of high pressure fuel distribution pipe, the accurate fuel rail pressure signal feedback can uniformly and precisely distribute fuel for engine through injector.



S10120

(1) Technical Characteristic Parameters

Items	Target Specifications
System pressure	35 MPa
Target life	10/160,000 y/km
Temperature Condition	-40 ~ 130 °C

■ High Pressure Fuel Injector

Operation principle of solenoid valve type high pressure fuel injector: When the electricity is applied, electromagnetic coil generates magnetic force, and the needle valve set is sucked up, and separated from valve seat, so that fuel is injected. When the power is off, compression spring returns and needle valve set moves downwards, so that it contacts valve seat eventually to seal the fuel.



J12840

(1) Technical Characteristic Parameters

Electronic Control Fuel Injection	High pressure direct injection system
Fuel Entering Direction	Injector axial
System Pressure	35 Mpa
Maximum Operating Voltage	65 V
Target Life	240,000 kilometers, up to 15 years

■ Ignition Coil

Ignition coil consists of primary winding, secondary winding, iron core and housing etc. When the ground passage of a primary winding is on, this primary winding is charged. If ECM cuts off the primary winding circuit, the charging will be suspended, and a high voltage will be induced in the secondary winding at same time, cause spark plugs to discharge.



N10180

(1) Technical Parameters

Primary current	8.5A X (1 ± 8%)
Secondary voltage	≥ 37 KV (40 pF ± 5 pF of load)
Load (Zener diode)	1000 ± 20 V
Ignition energy	≥ 90mJ

■ Upstream Oxygen Sensor

LSU oxygen sensor is much more advanced in functions than LSH and LSF. It is a combination of ceramic body principle and a "micro pump" for oxygen ion delivery. Sufficient oxygen is supplied to the electrode on contact side of exhaust by the pump to keep the voltage on both sides constant at about 450 mV. Electronic controller converts the electric energy consumption of the pump into the excess air coefficient, and the output current has an almost linear relationship with it, which $\lambda = 0.65 \sim \infty$, so it is also called linear oxygen sensor. Not only can determine λ is more than 1 or less than 1, but also can measure specific values of λ in lean and rich areas, so that excess air coefficient in a large range (that is, wide frequency) can be measured, and enables continuous control from $\lambda < 1$ to $\lambda > 1$.



Q10160

(1) Characteristic Data

Description	New	After Platform Test
λ signal when $\lambda = 1.7$	1.70 ± 0.077	1.70 ± 0.132
λ signal when $\lambda = 0.8$	0.80 ± 0.012	0.80 ± 0.020

(2) Sensor electrical data

Description		Value
Resistance between housing and each flat insert pieces	Room temperature, 800 V DC	≥ 10 MΩ
Power supply voltage on connector	Rated voltage	6.8 V
	Continuous operating voltage	≤ 12 V
	Maximum system power supply voltage	≤ 16.5 V

Description		Value
	Short time voltage peak value within 60 ms (10 times in life cycle, ceramic temperature $\geq 20^{\circ}\text{C}$)	$\leq 28\text{ V}$
	Minimum system power supply voltage	$\geq 9.8\text{ V}$
Heating power for 6.8V of operating voltage		8.1 W

■ Downstream Oxygen Sensor

Sensing element of LSF oxygen sensor is a ceramic planar body with pores, and the outside of ceramic body is surrounded by engine exhaust, and the inside is ventilated. Sensing ceramic body wall is a type of solid electrolyte with heating electrodes inside. Operation of oxygen sensor is realized by converting the concentration difference of oxygen ions inside and outside the sensing ceramic body into voltage signals for output. When the temperature of sensing ceramic body reaches 350°C , it will have the characteristics of solid electrolyte. Oxygen ions can freely pass through it due to special material of ceramic body. It is precisely by taking advantage of this characteristic, it converts the concentration difference into the potential difference, thus forming the electrical signal output. If the gas mixture is rich, oxygen ion concentration difference in and out of the ceramic is high, electric potential difference is high, a large number of oxygen ions move from the inside to the outside, and the output voltage is higher (approximately 800mV-1000mV); If the mixture concentration is too lean, oxygen ion concentration difference in and out of the ceramic is low, electric potential difference is low, only a small amount of oxygen ion moves from the inside to the outside, and the output voltage is lower (approximately 100mV). Signal voltage changes abruptly at about the theoretical equivalent air fuel ratio ($\lambda=1$).



Q10170

(1) Characteristic Data

Description	New		After 500 Hours of Platform Test	
Exhaust temperature when characteristic data is established	350°C	850°C	350°C	850°C
When $\lambda=0.97$ (CO=1%); Sensing element voltage (mV)	800 ± 55	700 ± 55	800 ± 60	700 ± 60
When $\lambda=1.10$: Sensing element voltage (mV)	50 ± 30	50 ± 30	50 ± 40	50 ± 40
Sensing element internal resistance (k Ω)	≤ 0.5	≤ 0.25	≤ 1	≤ 0.5

Description	New		After 500 Hours of Platform Test	
Response Time (ms) (600 mV to 300 mV)	< 250	< 250	< 400	< 250
Response Time (ms) (300mV to 600mV)	< 100	< 60	< 200	< 60

(2) Sensor electrical data

Description		Value
Between heating circuit and signal circuit	Room temperature, 800 V DC	≥ 30
Power supply voltage on connector	Rated voltage	12 V
	Continuous operating voltage	12 to 14 V
	Operating voltage which can be maintained 1% of the total life at most (exhaust temperature $\leq 850^{\circ}\text{C}$)	15 V
	Operating voltage which can be maintained 75 seconds at most (- exhaust temperature $\leq 350^{\circ}\text{C}$)	18 V
	Test voltage	13 V
Heating power for 13 V of operating voltage, and 350°C of exhaust temperature		7 W
Short time heating current at 13 V of operating voltage and -40°C of ambient temperature		$\leq 2.1\text{ A}$

■ High Pressure Fuel Pump

High pressure fuel pump is an element specially used for direct injection engine. It functions to increase the system pressure and provide high pressure fuel for the fuel rail assembly. High pressure fuel pump supplies fuel for system as demands, thus providing a better fuel economy. It is made of stainless steel material and has a wide fuel application; also, it has the advantages of light weight, small volume, zero evaporative emission, etc. At present, high pressure fuel pump of the main vehicle factory widely used in the world adopts the single plunger pump design of integrated voltage regulator, flow control valve, relief valve, its working principle is through cam drive high pressure pump plunger movement up and down to achieve fuel absorption and fuel discharge. ECM controls high pressure fuel flow via flow control valve according to the set control program through pressure sensor on fuel rail, thus performing closed loop control for pressure in high pressure fuel rail. Regulator functions to suppress the pressure pulsation at the low pressure end and improve the stability of system. Pressure relief valve will open when high pressure fuel rail pressure exceeds the safety limit, so as to protect the system.



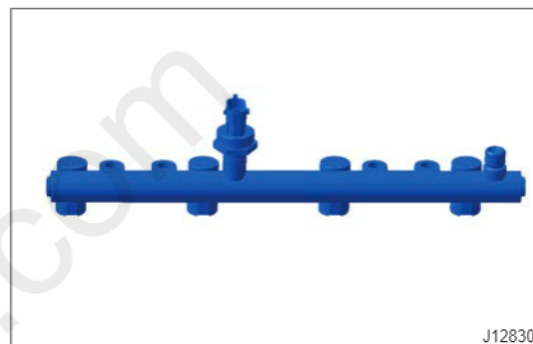
S10100

(1) Characteristic parameters

Items	Target Specifications
Mass	Approx. 083 kg
Oil outlet pressure	2-20 MPa
Maximum oil inlet pressure	9.0 bar
Relief valve opening pressure	35 MPa system: 39.9-41.4 for new parts, 36.5-42.4 MPa for durable parts
Driving voltage	10.8-16 V
Control type	Applied to ECM, which adopts current control

■ High pressure fuel rail pressure sensor

Oil pressure acts on metal diaphragm of pressure sensor to deform the diaphragm. There is a Wheatstone bridge composed of 4 metal strain gauge on diaphragm. The deformation of diaphragm causes a change in the resistance of strain gauge. After the signal processing of peripheral circuit, form the voltage signal that is linearly related to the pressure.



(1) Limit data

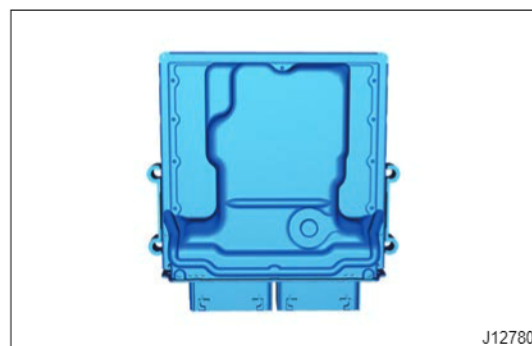
Parameters	Value		
	Minimum	Representative	Maximum
Power supply voltage (MAX. 1h)			18 V
Pressure			32 Mpa
Burst pressure			375 Mpa
Operating temperature			150 °C

(2) Characteristic data

Parameters	Value		
	Minimum	Representative	Maximum
Pressure measurement range	0 Mpa		42 Mpa
Operating temperature	-40 °C		140 °C
Power supply voltage	4.75 V	5.0 V	5.25 V
Power supply current when $U_S = 5.0 \text{ V}$	9 mA	12 mA	15 mA
Response time $t_{10/90}$			1.0 mS

■ Electronic Controller Unit

Engine Control Module (ECM) is a pre-programmed microprocessor digital computer, which is used to adjust ignition timing, air-fuel ratio, emission control device, speed control, A/C compressor and idle speed etc. Engine Control Module (ECM) enables the program to suit ever-changing operation conditions.



J12780

(1) Limit data

Quantity		Value	
		Minimum	Maximum
Battery voltage	Normal operation	10.8 V	16 V
	Limit function	6.5 to 9 V	16 to 28 V
Limits and time for withstanding battery overvoltage	24 V	Keep starting some functions	60 s

■ Canister solenoid valve

Canister control valve consists of solenoid coil, armature, valve body and other parts.

Air volume through canister control valve is related to the electric pulse duty ratio output from ECM to canister control valve and the differential pressure between canister control valve inlet and outlet. When there is no electric pulse, canister control valve closes.



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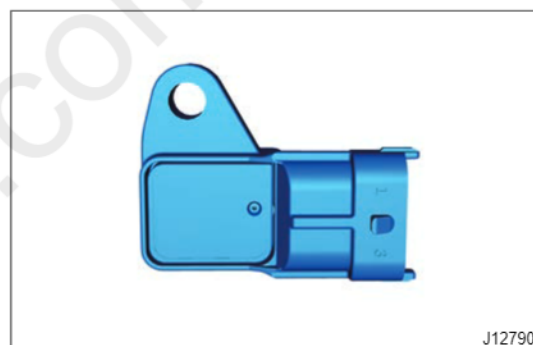
(1) Technical Characteristic Parameters

Quantity	Value		
	Minimum	Representative	Maximum
Rated Voltage	10 V	13.5 V	16 V
Resistance at +20°C	14 Ω	16 Ω	18 Ω
Current under rated voltage		0.85 A	
Frequency of control pulse	5 Hz		30 Hz
Rate of flow when differential pressure is 700 mbar and duty ratio is 100%	6 m ³ /h	6.5 m ³ /h	7 m ³ /h

Quantity	Value		
	Minimum	Representative	Maximum
Permitted operating temperature	-40°C		140 °C
Allowable differential pressure between inlet and outlet			-800 mbar
Permitted vibration acceleration marked on products			300 m/s ²
Leakage amount when differential pressure is 700 mbar			33 mL/min

■ Brake vacuum pressure sensor

Absolute pressure sensing element consists of a piece of silicon chip. Etch a piece of pressure diaphragm on silicon chip. There are 4 piezoresistors on pressure diaphragm, and the 4 piezoresistors form a Wheatstone bridge as strain element. Except for the pressure diaphragm, silicon chip is also integrated with signal processing circuit. Active surface of the silicon chip is subjected to a pressure close to zero, and its surface is subjected to the absolute pressure of the intake manifold to be measured. Thickness of silicon chip is only several micrometer, so the silicon chip will deform mechanically as line absolute pressure changes, and 4 piezoresistors will also deform, thus changing the resistance. Voltage signal linearly related to the pressure is generated after processing by signal processing circuit of silicon chip.



J12790

(1) Limit parameters

Parameters	Value		
	Minimum	Representative	Maximum
Power supply voltage			16 V
Pressure			500 kpa
Operating temperature	-40°C		+130 °C

(2) Characteristic parameters

Parameters	Value		
	Minimum	Representative	Maximum
Pressure measurement range	20 kpa		115 kpa
Operating temperature	-40°C		130 °C
Power supply voltage	4.75 V	5.0 V	5.25 V
Power supply current when $U_S = 5.0 \text{ V}$			12.5 mA
Output terminal load current	-1.0 mA		0.5 mA

Parameters		Value		
		Minimum	Representative	Maximum
Load resistance to voltage U_s or ground	Pull-up resistor	5 k Ω		
	Pull-down resistor	10 k Ω		
Response time $t_{10/90}$				1.0 ms
Weight			17 g	

■ GPF temperature sensor

The temperature sensor uses Pt200 type thermal-sensitive platinum resistor sensing element as the temperature sensing element. The outside of the sensing element is encapsulated by a stainless steel shell with high temperature resistance and corrosion resistance. The sensing element and the stainless steel shell are filled with heat conduction materials to facilitate the timely transfer of exhaust gas heat to the surface of sensing element. During operation, the sensor head is placed inside the engine exhaust pipe, and the high temperature airflow transmits heat to the sensing element, so that the temperature of the sensing element interior platinum resistor changes accordingly, and the resistance value of platinum resistor varies with the temperature. Through a specific monitoring circuit, the engine controller (ECM) monitors the resistance signal output by the sensor to calculate the corresponding exhaust gas temperature signal.



(1) Signal Accuracy

Signal accuracies of sensor (new parts) are shown as follows:

Temperature Range	Signal Accuracy
-40°C ~ 300°C	± 2.5°C
301°C ~ 900°C	± 1.0 % of temperature in °C
901 °C ~ 950 °C	± 2.0 % of temperature in °C

Signal accuracies of sensor (deteriorated parts) are shown as follows:

Temperature Range	Signal Accuracy
10 °C	± 3.8 Ω (± 5°C)
650 °C	± 8 Ω (± 13 °C)

(2) Dynamic response performance

Dynamic response performance of the exhaust temperature sensor is based on the change speed of output signal when the ambient temperature changes abruptly, which should meet the requirements of the following table

Temperature Jump	Air-flow Velocity	Response Time
300 °C	11 m/s	< 12 s

■ GPF differential pressure sensor

Differential pressure sensor (double membrane) unit consists of housing, two same LGA (Land Grid Array) sensing element modules, cover plate, sealing glue, connecting glue, bonding wire and other sub components. The values measured by sensor are upstream gas absolute pressure and downstream gas absolute pressure of GPF.

Differential pressure sensor (double membrane) unit consists of housing, two same LGA (Land Grid Array) sensing element modules, cover plate, sealing glue, connecting glue, bonding wire and other sub components. The values measured by sensor are upstream gas absolute pressure and downstream gas absolute pressure of GPF. Sensing element module of differential pressure sensor (LPS4-2ABS) consists of a piece of silicon chip. Etch a piece of pressure diaphragm on silicon chip. There are 4 piezoresistors on pressure diaphragm, and the 4 piezoresistors form a Wheatstone bridge as strain element. Silicon chip will deform mechanically as emission gas pressure changes, and 4 piezoresistors will also deform, thus changing the resistance. Output the information in SENT signal format to ECM after processing by signal processing circuit of silicon chip.



■ Electronic control actuator

Electronic control actuator is used to drive exhaust gas bypass valve of turbocharger. Its main function is to adjust waste gate opening angle and control rotation speed of turbocharger according to driver's driving intention, so as to control intake air demand when the intake air amount meets different engine operating conditions, and feed back the position signal of waste gate to control unit to realize accurate control.

Electronic control actuator consists of four parts: drive module, train module, executive module and feedback module, and all sub components of drive module, train module and feedback module are integrated into the same housing. Feedback module contains non-contact type sensors, which can accurately feedback the valve position according to Hall principle. Electronic control actuator performs control only by corresponding electronic control unit or electronic test circuit. In principle, it is necessary to ensure that the actuator connecting rod does not operate dynamically to the mechanical dead center.



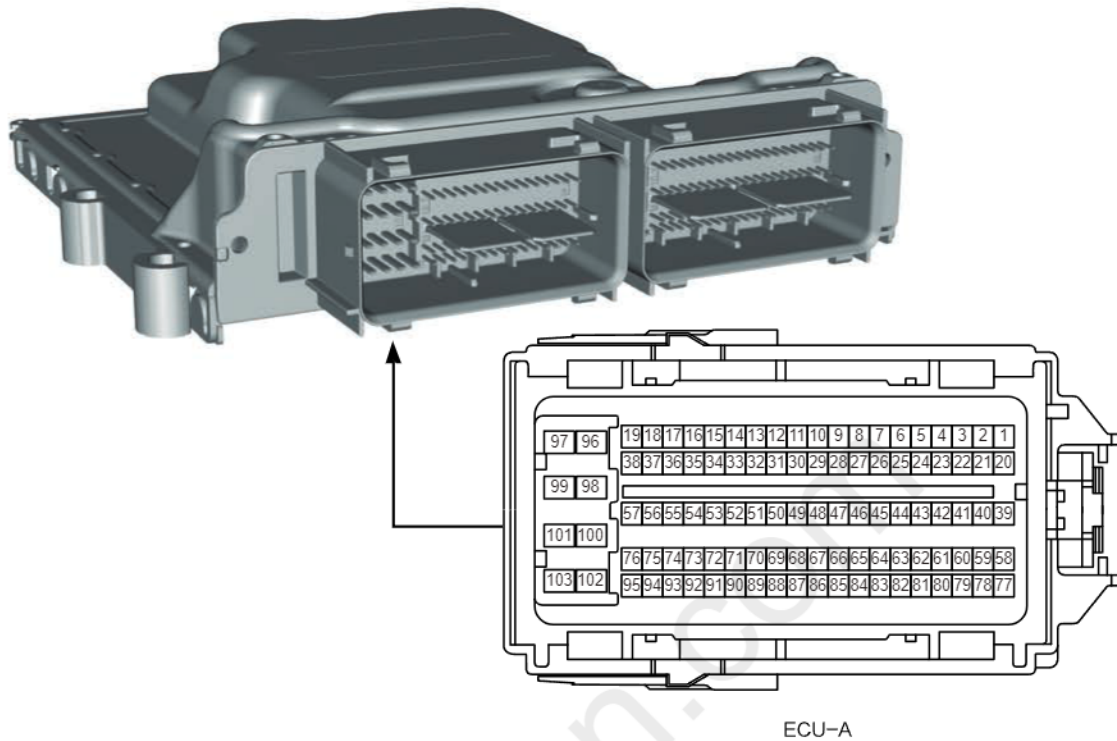
(1) Technical Characteristic Parameters

Test Item	Potentiometer Voltage		Response Time (ms)		Driving Torque (New Parts) (Nm)
	Mechanical Top Dead Center (%)	Mechanical Bottom Dead Center (%)	Open	close	
Parameter range	5+/-2.2	95+/-2.2	≤ 200	≤ 200	≥ 0.8

3 System Circuit Diagram

3.1 Module Terminal Definition

Terminal A Definition



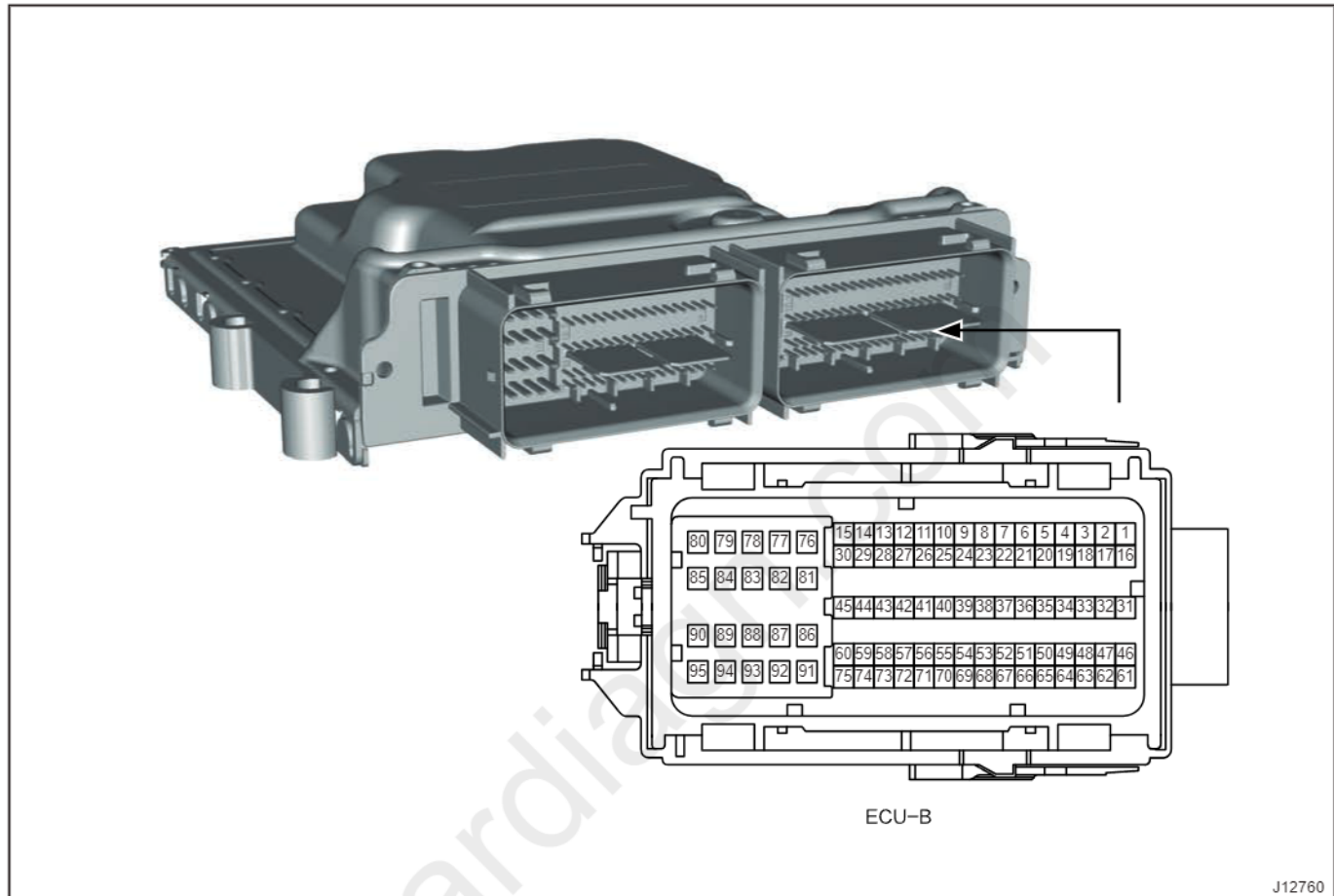
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Pin	Definition	Pin	Definition
A1	Starter Control LSD	A53	—
A2	—	A54	—
A3	—	A55	Brake Light Switch Signal
A4	—	A56	Brake Switch
A5	—	A57	Starter State Feedback Signal
A6	Main Relay	A58	Activated Charcoal Canister Cut-off Valve
A7	Crankshaft Heating Valve	A59	Variable Oil Pump
A8	Downstream Oxygen Sensor	A60	Electronic Thermostat
A9	Analog Sensor Ground 5	A61	Downstream Oxygen Sensor Heater
A10	Analog Sensor Ground 6	A62	Upstream Oxygen Sensor Heater
A11	Analog Sensor Ground 7	A63	Continuous Power Supply
A12	Analog Sensor Ground 8	A64	Refresh and Body CAN Low
A13	Accelerator Pedal Sensor 1 Ground	A65	Refresh and Body CAN High
A14	Analog Sensor Power Supply 1	A66	Upstream Oxygen IA
A15	Accelerator Pedal Position Sensor 1 Power Supply	A67	Upstream Oxygen VN

Pin	Definition	Pin	Definition
A16	Accelerator Pedal Position Sensor 2 Power Supply	A68	—
A17	—	A69	—
A18	Sensor Power Supply (5 V)	A70	—
A19	—	A71	—
A20	—	A72	—
A21	Electronic Vacuum Pump	A73	—
A22	—	A74	—
A23	—	A75	—
A24	A/C Compressor Relay	A76	—
A25	Pressure Discharge Control Valve	A77	—
A26	Fuel Control Enable Signal	A78	—
A27	Vacuum Pressure Sensor	A79	—
A28	Oxygen Sensor Ground	A80	—
A29	Accelerator Pedal Sensor 2 Ground	A81	—
A30	—	A82	—
A31	Accelerator Pedal Position Sensor 1	A83	—
A32	—	A84	—
A33	—	A85	—
A34	A/C Pressure Sensor	A86	—
A35	—	A87	—
A36	Fuel Level Sensor	A88	—
A37	—	A89	—
A38	—	A90	—
A39	PWM Cooling Fan	A91	—
A40	Variable Valve Timing Valve (Exhaust)	A92	—
A41	Variable Valve Timing Valve (Intake)	A93	—
A42	Canister Control Valve	A94	—
A43	—	A95	—
A44	—	A96	ECM Ground 4
A45	—	A97	ECM Ground 3
A46	Ignition Switch	A98	ECM Ground 2
A47	LIN Bus	A99	ECM Ground 1
A48	Upstream Oxygen IP	A100	Main Relay Power Supply 1
A49	Upstream Oxygen VM	A101	Main Relay Power Supply 2

Pin	Definition	Pin	Definition
A50	—	A102	Main Relay Power Supply 3
A51	Accelerator Pedal Position Sensor 2	A103	Main Relay Power Supply 4
A52	GPF Front Temperature Sensor		

B Terminal Definition

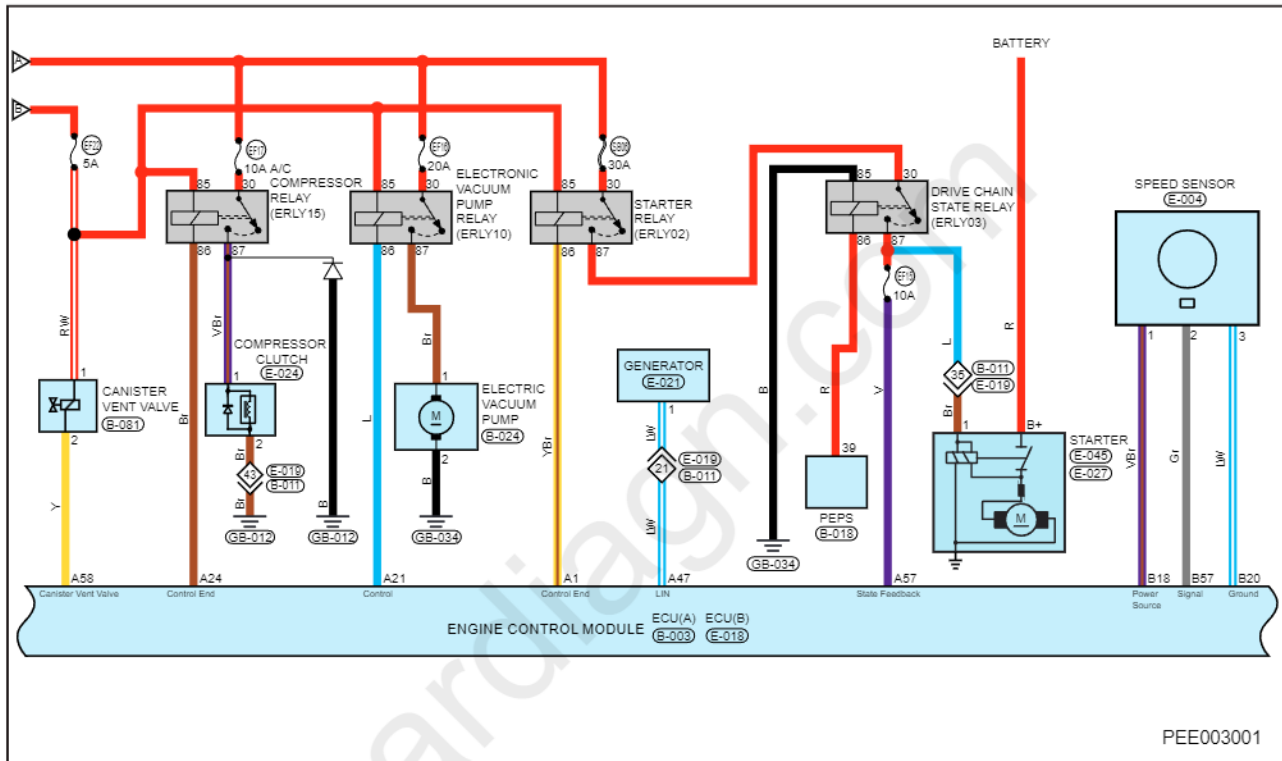


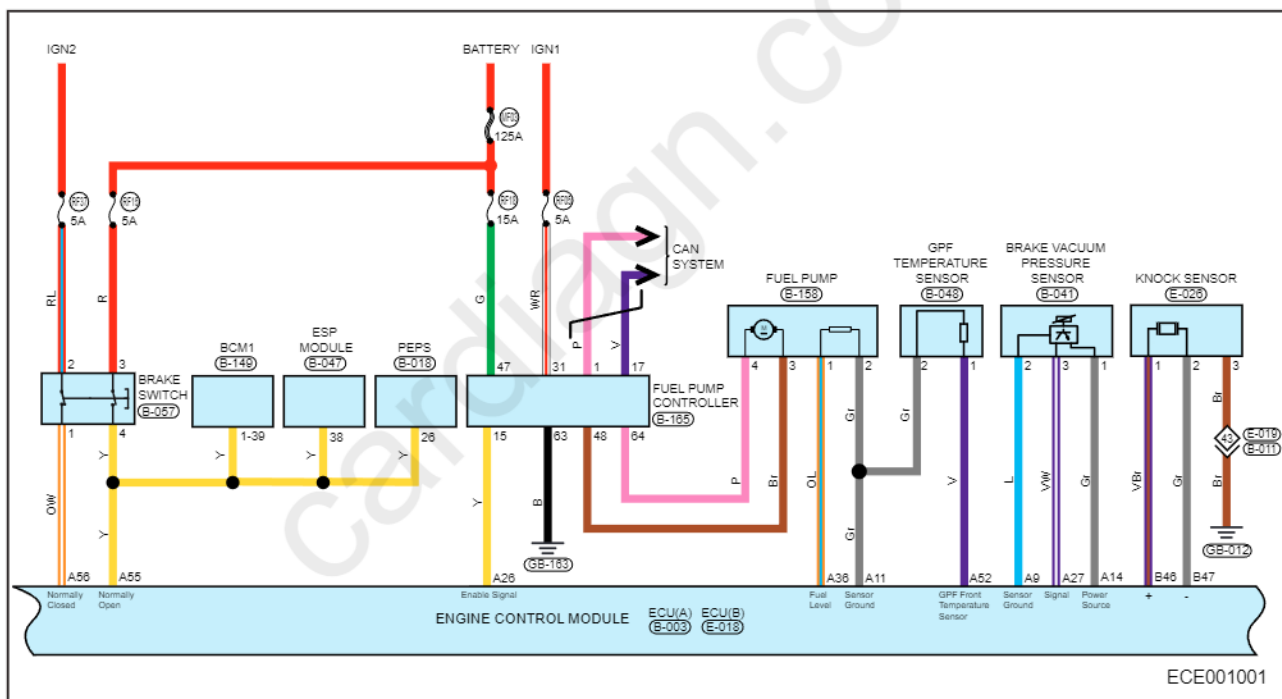
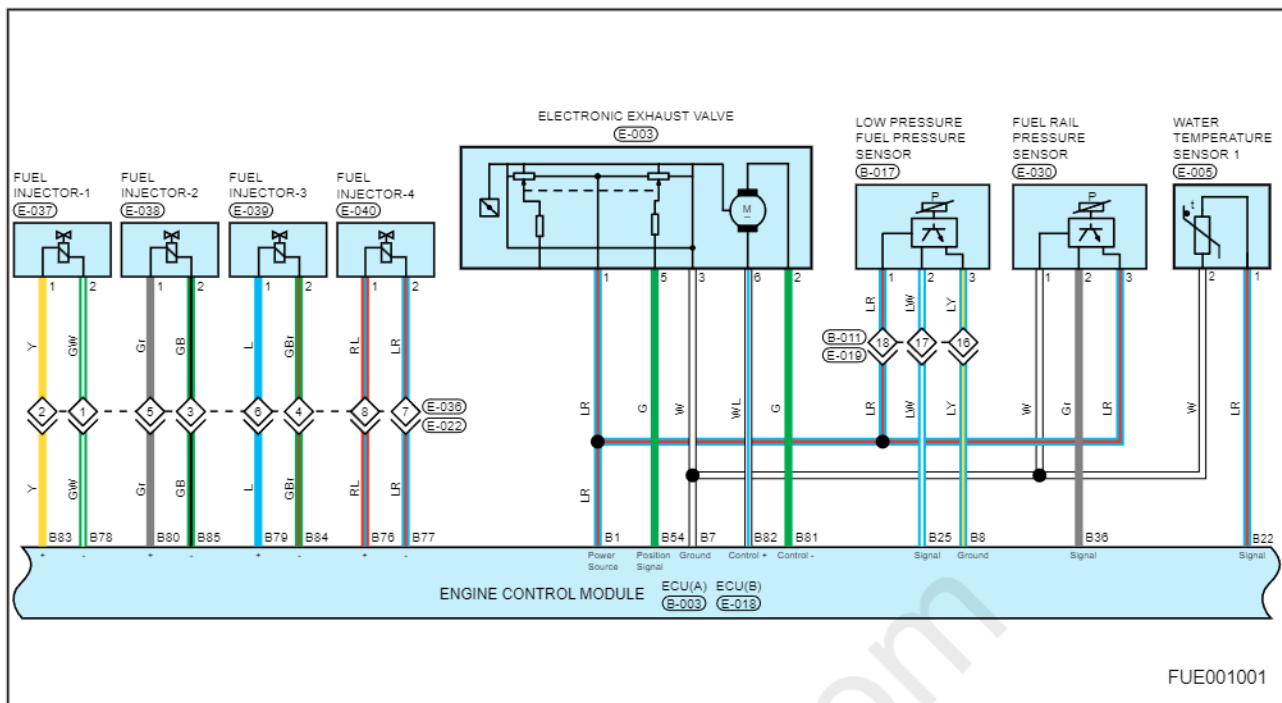
Pin	Definition	Pin	Definition
B1	Sensor Power Supply (5 V)	B49	—
B2	Sensor Power Supply (5 V)	B50	—
B3	Sensor Power Supply (5 V)	B51	—
B4	—	B52	—
B5	Digital Sensor Ground 2	B53	—
B6	Analog Sensor Ground 1	B54	Electronic Waste Gate Position Signal
B7	Analog Sensor Ground 2	B55	—
B8	Analog Sensor Ground 3	B56	—
B9	Analog Sensor Ground 4	B57	Engine Speed Sensor Signal
B10	Exhaust Phase Sensor Ground	B58	—
B11	Intake Phase Sensor Ground	B59	—

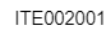
Pin	Definition	Pin	Definition
B12	2nd Cylinder Ignition	B60	—
B13	4th Cylinder Ignition	B61	—
B14	1st Cylinder Ignition	B62	—
B15	3rd Cylinder Ignition	B63	—
B16	Sensor Power Supply (5 V)	B64	—
B17	Exhaust Phase Sensor Power Supply	B65	—
B18	Speed Sensor Power Supply	B66	—
B19	—	B67	—
B20	Speed Sensor Ground	B68	—
B21	—	B69	—
B22	Engine Coolant Temperature Sensor Signal 1	B70	—
B23	—	B71	—
B24	—	B72	—
B25	Low Pressure Fuel Rail Pressure Sensor	B73	—
B26	Charcoal Canister Desorption Pressure Sensor	B74	—
B27	Boost Pressure Sensor Signal	B75	—
B28	Intake Pressure Sensor Signal	B76	4th Cylinder Injector+
B29	Boost Temperature Sensor Signal	B77	4th Cylinder Injector-
B30	Intake Phase Sensor Signal	B78	1st Cylinder Injector-
B31	Fuel Tank Pressure Sensor	B79	3rd Cylinder Injector+
B32	—	B80	2nd Cylinder Injector+
B33	—	B81	Electronic Waste Gate Control-
B34	Electronic Throttle Feedback Signal 2	B82	Electronic Waste Gate Control+
B35	Engine Coolant Temperature Sensor Signal 2	B83	1st Cylinder Injector+
B36	High Pressure Fuel Rail Sensor Signal	B84	3rd Cylinder Injector-
B37	—	B85	2nd Cylinder Injector-
B38	Manifold Temperature Sensor Signal	B86	Electronic Throttle Control-
B39	—	B87	—
B40	Electronic Throttle Feedback Signal 1	B88	—
B41	Dual-mode GPF Differential Pressure Sensor (SENT 2)	B89	—
B42	Dual-mode GPF Differential Pressure Sensor (SENT 1)	B90	Fuel Pressure Control Valve-

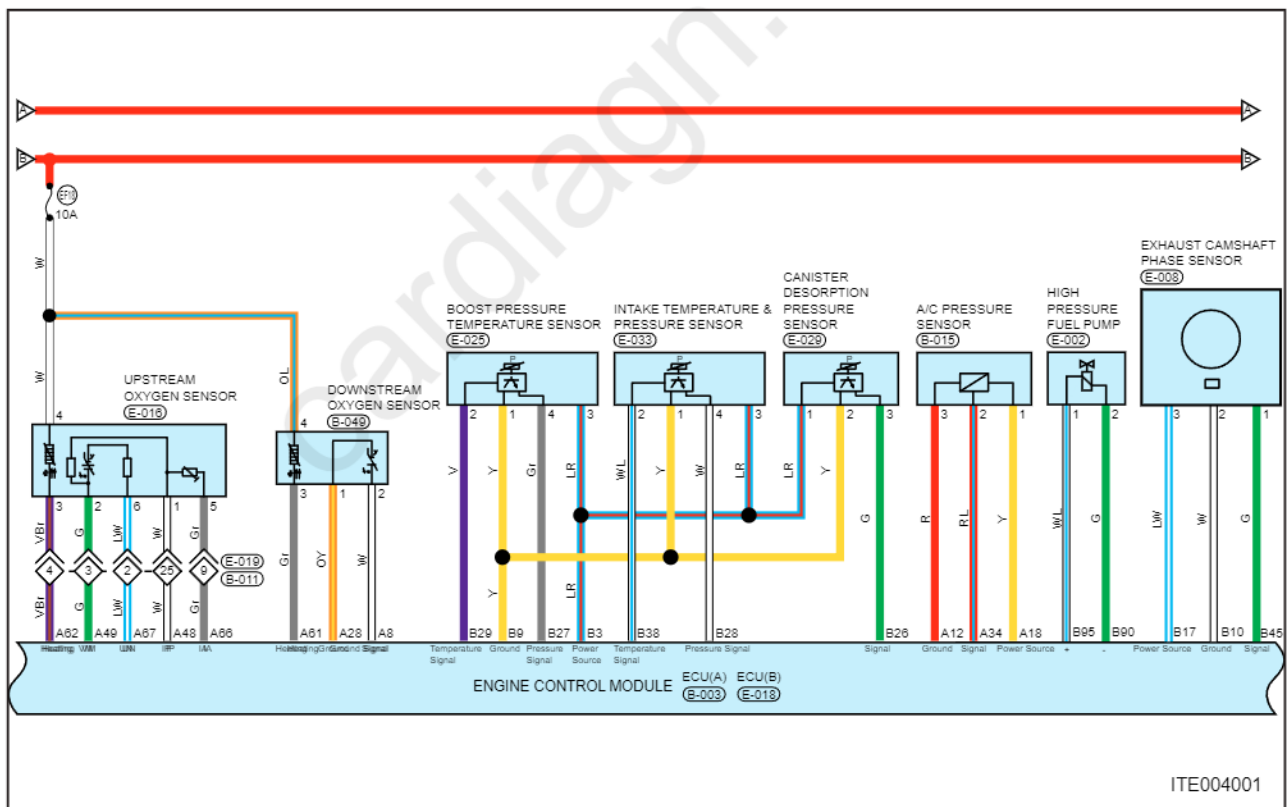
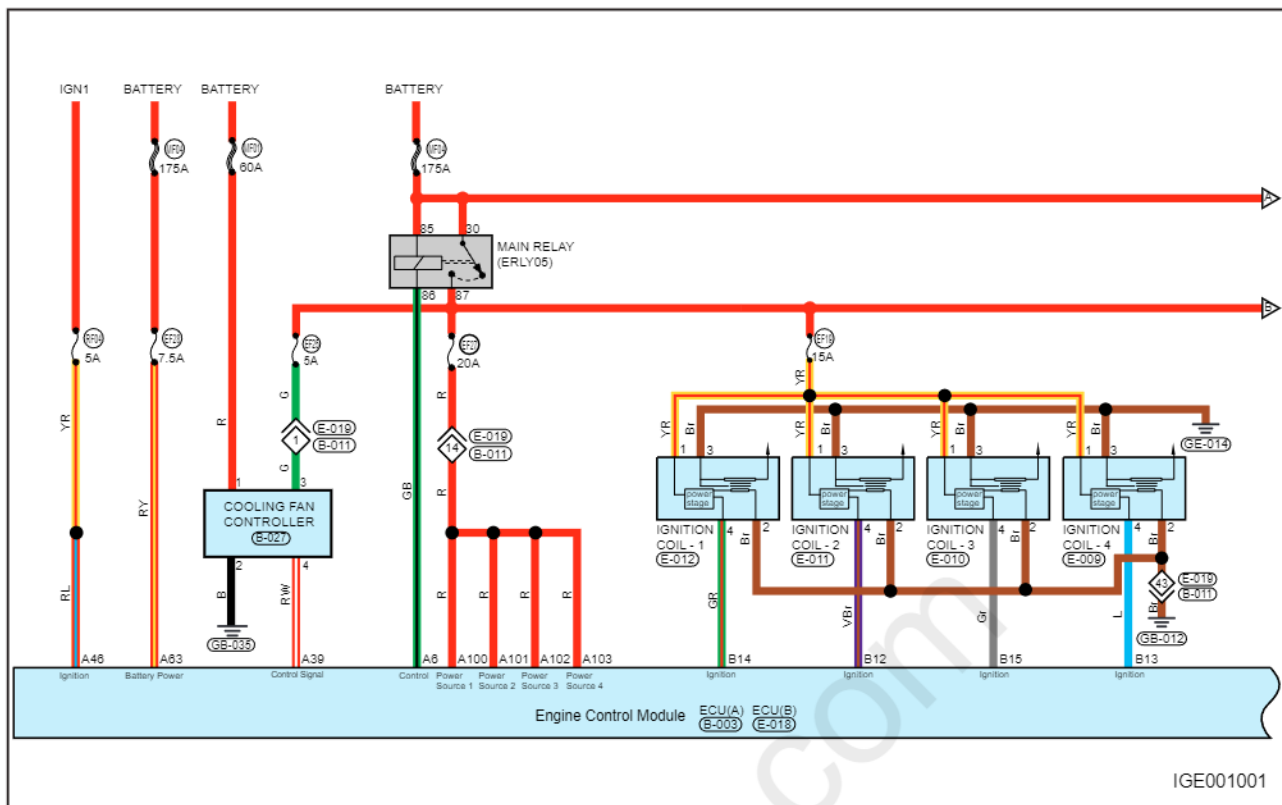
Pin	Definition	Pin	Definition
B43	—	B91	Electronic Throttle Control+
B44	—	B92	—
B45	Exhaust Phase Sensor Signal	B93	—
B46	Knock Sensor (+)	B94	—
B47	Knock Sensor (-)	B95	Fuel Pressure Control Valve+
B48	—		

3.2 Circuit Diagram









4 Diagnosis & Testing

4.1 Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Symptom	Possible Cause
Engine does not crank or cranks slowly while starting	Battery
	Starter
	Wire harness or ENGINE START STOP switch
	Starter relay
	ECM, TCU
	Engine mechanical
Engine cranks normally but cannot start successfully while starting	No fuel in tank
	Fuel pump
	Fuel injector
	Engine speed sensor
	Ignition coil
	Engine immobilizer
	ECM
	Engine mechanical
Difficult to start with hot engine	Engine speed sensor
	Ignition coil
	Fuel pump
	Coolant temperature sensor
	Engine mechanical
	Camshaft sensor
Difficult to start with cold engine	Fuel pump
	Coolant temperature sensor
	Fuel injector
	Ignition coil
	Engine mechanical
Engine speed is normal, but it is difficult to start at anytime	Fuel quality
	Fuel pump
	Coolant temperature sensor
	Fuel injector

Symptom	Possible Cause
	Ignition coil
	Intake passage
	Ignition timing
	Spark plug
	Engine mechanical
Engine starts normally, but idles roughly at anytime	Fuel quality
	Fuel pump
	Coolant temperature sensor
	Fuel injector
	Electronic throttle body
	Intake passage
	Ignition timing
	Spark plug
	Engine mechanical
Engine starts normally, but idles roughly after warming up	Fuel quality
	Coolant temperature sensor
	Electronic throttle body
	Intake passage
	Spark plug
	Engine mechanical
Engine starts normally, but idles roughly or stalls with part load (for example, A/C is ON)	Electronic throttle
	Alternator
Engine starts normally, but idle speed is too high	Electronic throttle body
	Intake pipe air leaked
	Coolant temperature sensor
Low engine speed or stalls when accelerating	Intake pressure sensor
	Intake pipe
	Exhaust pipe
	Ignition timing
	Throttle position sensor
	Fuel injector
	Spark plug
Slow response when accelerating	Intake pressure sensor

Symptom	Possible Cause
	Intake pipe
	Exhaust pipe
	Ignition timing
	Throttle position sensor
	Fuel injector
	Spark plug
Lack of power and poor performance when accelerating	Intake pressure sensor
	Intake pipe
	Exhaust pipe
	Ignition timing
	Throttle position sensor
	Fuel injector
	Spark plug

4.2 Diagnosis Procedure

Hint:

Use following procedures to troubleshoot the control system.

1	Vehicle brought to workshop
---	-----------------------------

NEXT

2	Examine vehicle and check basic items
---	---------------------------------------

Check system power supply voltage, and check that fuse, wire harness and connector are connected normally.

OK

Standard voltage: Not less than 12 V.

Result

NG

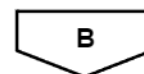
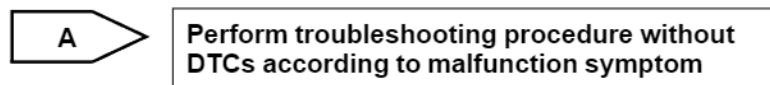
Check and replace malfunctioning parts

OK

3	Using a diagnostic tester, read related DTC and data stream information
---	---

Result

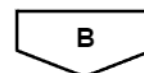
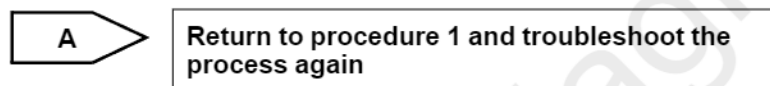
Result	Go to
No DTC	A
DTC is output	B



4	Troubleshoot according to DTCs troubleshooting procedure
---	--

Result

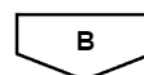
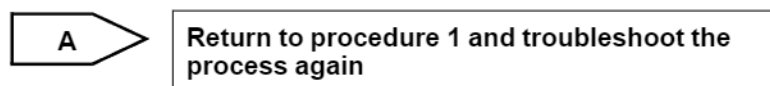
Result	Go to
Problem is not resolved	A
Problem is resolved	B



5	According to airbag system malfunction repair completion inspection and delivery, confirm that malfunction is resolved
---	--

Result

Result	Go to
Delivery inspection is failed	A
Delivery inspection is qualified	B



6	Finished
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4.3 DTC Confirmation Procedure

Confirm that battery voltage is normal before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software) to Data Link Connector (DLC).
- Turn ENGINE START STOP switch to ON.
- Use the diagnostic tester to record and clear DTCs stored in engine system.
- Turn ENGINE START STOP switch to OFF and wait for several seconds.
- Turn ENGINE START STOP switch to ON, and then select Read DTC.
- If DTC is detected, it indicates current malfunction. Go to inspection procedure - Step 1.
- If no DTC is detected, malfunction indicated by the DTC is intermittent.

4.4 Intermittent DTC Troubleshooting

If malfunction is intermittent, perform the followings:

- Check if connector is loose.
- Check if wire harness is worn, pierced, pinched or partially broken.
- Monitor diagnostic tester (the latest software) data that is related to this circuit.
- Wiggle related wire harnesses and connectors and observe if signal is interrupt in related circuit.
- If possible, try to duplicate the conditions under which DTC was set.
- Look for data that has changed or DTC to reset during wiggle test.
- Look for broken, bent, protruded or corroded terminals.
- Check engine system components and mounting areas for damage, foreign matter, etc. that will cause incorrect signals.
- Check and clean all wire harness connectors and ground parts related to DTC.
- If multiple trouble codes were set, refer to circuit diagrams to look for any common ground circuit or power supply circuit applied to DTC.
- Refer to any Technical Bulletin that may apply to this malfunction.

4.5 Ground Inspection

Ground points are very important to the proper operation of circuits. Ground points are often exposed to moisture, dirt and other corrosive environments. Corrosion (rust) may increase load resistance. This situation may change the way in which a circuit operates. Circuits are very sensitive to proper grounding. A loose or corroded ground can seriously affect the control circuit. Check the ground points as follows:

- (1) Remove ground bolt or nut.
- (2) Check all contact surfaces for tarnish, dirt and rust, etc.
- (3) Clean as necessary to ensure that contact is in good condition.
- (4) Reinstall ground bolt or nut securely.
- (5) Check if any additional accessories interfere with ground circuit.
- (6) If several wire harnesses are crimped into one ground terminal, check for proper crimp condition. Make sure that all wire harnesses are clean and securely fastened while providing a proper ground path.

4.6 Diagnostic Trouble Code (DTC) Chart

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P000A00	"A" Camshaft Position Slow Response Bank 1	The actual position of VVT has poor follow-up to the target position	1. Insufficient OCV oil valve pressure 2. OCV oil valve is blocked or leaking	- Check if operating condition of cam phase regulator is normal (dirt blocked, oil leakage, stuck) - Check if operating condition of OCV oil control valve is normal
P003C00	"A" Camshaft Profile Control Performance/ Stuck Off Bank 1	The actual position of VVT cannot be moved to the vicinity of the target position	1. Insufficient OCV oil valve pressure 2. OCV oil valve is blocked or leaking	- Check if operating condition of cam phase regulator is normal (dirt blocked, oil leakage, stuck) - Check if operating condition of OCV oil control valve is normal
P000B00	"B" Camshaft Position Slow Response Bank 1	The actual position of VVT has poor follow-up to the target position	1. Insufficient OCV oil valve pressure 2. OCV oil valve is blocked or leaking	- Check if operating condition of cam phase regulator is normal (dirt blocked, oil leakage, stuck) - Check if operating condition of OCV oil control valve is normal
P005A00	"B" Camshaft Profile Control Performance/ Stuck Off Bank 1	The actual position of VVT cannot be moved to the vicinity of the target position	1. Insufficient OCV oil valve pressure 2. OCV oil valve is blocked or leaking	- Check if operating condition of cam phase regulator is normal (dirt blocked, oil leakage, stuck) - Check if operating condition of OCV oil control valve is normal
P001000	"A" Camshaft Position Actuator Control Circuit Open Bank 1	Drive channel self-diagnosis failure	1. Open circuit in intake VVT control circuit corresponding pin 2. Connector looseness or open 3. Actuator side circuit is damaged	- Open circuit in intake VVT control circuit corresponding pin - Connector looseness or poor contact - Intake VVT circuit damaged - Control pin fault of VVT corresponding to ECM
P001300	"B" Camshaft Position Actuator Control Circuit Open Bank 1	Drive channel self-diagnosis failure	1. Open circuit in exhaust VVT control circuit corresponding pin 2. Connector looseness or open 3. Actuator side circuit is damaged	- Open circuit in exhaust VVT control circuit corresponding pin - Connector looseness or poor contact - Intake VVT circuit damaged - Control pin fault of VVT corresponding to ECM

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P001676	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor A	Relative position self-learning deviation absolute value of intake camshaft and crankshaft is greater than 20 degrees of crankshaft angle	1. Installation deviation	Check if relative installation position of crankshaft and intake camshaft is correct
P001678	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor A	Absolute value of offset deviation between intake camshaft and crankshaft is greater than 15 degrees of crankshaft angle	1. Intake camshaft is aging and twisted	Check whether the position of intake camshaft has a large deviation from the installation
P001776	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor B	Relative position self-learning deviation absolute value of exhaust camshaft and crankshaft is greater than 20 degrees of crankshaft angle	1. Installation deviation	Check if relative installation position of crankshaft and exhaust camshaft is correct
P001778	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor B	Absolute value of offset deviation between exhaust camshaft and crankshaft is greater than 15 degrees of crankshaft angle	1. Exhaust camshaft is aging and twisted	Check whether the position of exhaust camshaft has a large deviation from the installation
P003000	HO2S Heater Control Circuit Bank 1 Sensor 1	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Open circuit in upstream oxygen sensor heater control circuit pin terminal 3. Upstream oxygen sensor heater control circuit power supply terminal is not connected to main relay 4. Sensor is damaged 5. Open circuit or internal circuit damage in upstream oxygen sensor heater pin circuit corresponding to ECM terminal	- Check connector for looseness or poor contact - Open circuit in upstream oxygen sensor heater control circuit pin terminal - Upstream oxygen sensor heater control circuit power supply terminal is not connected to main relay - Sensor is damaged - Open circuit or internal circuit damage in upstream oxygen sensor heater pin circuit corresponding to ECM terminal
P003100	HO2S Heater Control Circuit Low Bank 1 Sensor 1	Drive channel self-diagnosis failure	1. Upstream oxygen sensor heater control circuit pin terminal is short to ground 2. Upstream	- Check upstream oxygen sensor heater control circuit pin terminal for short to ground - Check upstream oxygen sensor heater control

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			oxygen sensor heater control circuit power supply terminal is grounded 3. Upstream oxygen sensor heater pin corresponding to ECM terminal is short to ground	circuit power supply terminal for ground Check upstream oxygen sensor heater pin corresponding to ECM terminal for short to ground
P003200	HO2S Heater Control Circuit High Bank 1 Sensor 1	Drive channel self-diagnosis failure	1. Upstream oxygen sensor heater control circuit pin terminal is short to power supply 2. Upstream oxygen sensor heater pin corresponding to ECM terminal is short to power supply	- Check upstream oxygen sensor heater control circuit pin terminal for short to power supply - Check upstream oxygen sensor heater pin corresponding to ECM terminal for short to power supply
P003313	Boost Discharge Control Valve Drive Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Open circuit in boost discharge control valve drive circuit pin 3. Open circuit or internal circuit damage in boost discharge control valve drive circuit pin corresponding to ECM terminal	- Check connector for looseness or poor contact - Check boost discharge control valve drive circuit pin for open circuit - Check boost discharge control valve drive circuit pin corresponding to ECM terminal for open circuit or internal circuit damage
P003411	Boost Discharge Control Valve Drive Circuit Short to Ground	Drive channel self-diagnosis failure	1. Short circuit to ground in boost discharge control valve drive circuit 2. Short circuit to ground in boost discharge control valve drive circuit corresponding to ECM terminal	- Check boost discharge control valve drive circuit pin for short circuit to ground - Check boost discharge control valve drive circuit pin corresponding to ECM terminal for short circuit to ground
P003512	Boost Discharge Control Valve Drive Circuit Short to Power Supply	Drive channel self-diagnosis failure	1. Short circuit to power supply in boost discharge control valve	Check boost discharge control valve drive circuit pin for short circuit to power supply

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			drive circuit 2. Short circuit to power supply in boost discharge control valve drive circuit corresponding to ECM terminal	Check boost discharge control valve drive circuit pin corresponding to ECM terminal for short circuit to power supply
P003600	HO2S Heater Control Circuit Bank 1 Sensor 2	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Open circuit in downstream oxygen sensor heater control pin 3. Downstream oxygen sensor heater power supply terminal is not connected to main relay 4. Sensor is damaged 5. Internal circuit damage in downstream oxygen sensor heater pin corresponding to ECM terminal	- Check connector for looseness or poor contact - Check downstream oxygen sensor heater control pin for open - Check downstream oxygen sensor heater circuit power supply terminal for not connected to main relay - Check sensor for damage - Check downstream oxygen sensor heater pin corresponding to ECM terminal for open or internal circuit damage
P003700	HO2S Heater Control Circuit Low Bank 1 Sensor 2	Drive channel self-diagnosis failure	1. Downstream oxygen sensor heater control circuit pin terminal is short to ground 2. Downstream oxygen sensor heater control circuit power supply terminal is grounded 3. Downstream oxygen sensor heater pin corresponding to ECM terminal is short to ground	- Check downstream oxygen sensor heater control circuit pin terminal for short to ground - Check downstream oxygen sensor heater control circuit power supply terminal for ground - Check downstream oxygen sensor heater pin corresponding to ECM terminal for short to ground
P003800	HO2S Heater Control Circuit High Bank 1 Sensor 2	Drive channel self-diagnosis failure	1. Downstream oxygen sensor heater control circuit pin terminal is short to power supply 2. Downstream oxygen sensor	- Check downstream oxygen sensor heater control circuit pin terminal for short to power supply - Check downstream oxygen sensor heater pin corresponding to ECM

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			heater pin corresponding to ECM terminal is short to power supply	terminal for short to power supply
P003A22	Turbocharger/ Supercharger Boost Control "A" Position Exceeded Learning Limit	The zero point voltage learned for the first time exceeds the upper limit	1. Actuator status is inconsistent with SPEC 2. Closed position of actuator is blocked by foreign objects	- Push the turbocharger to closed position manually, read position voltage to check if it is out of the range of SPEC - Check for foreign matter near turbocharger closed position
P003A21	Turbocharger/ Supercharger Boost Control "A" Position Exceeded Learning Limit	The zero point voltage learned for the first time exceeds the lower limit	1. Actuator status is inconsistent with SPEC 2. Closed position of actuator is blocked by foreign objects	- Push the turbocharger to closed position manually, read position voltage to check if it is out of the range of SPEC - Check for foreign matter near turbocharger closed position
P003A72	Turbocharger/ Supercharger Boost Control "A" Position Exceeded Learning Limit	The zero point voltage learned exceeds the upper limit	1. Actuator status is inconsistent with SPEC 2. Closed position of actuator is blocked by foreign objects	- Push the turbocharger to closed position manually, read position voltage to check if it is out of the range of SPEC - Check for foreign matter near turbocharger closed position
P003A73	Turbocharger/ Supercharger Boost Control "A" Position Exceeded Learning Limit	The zero point voltage learned exceeds the lower limit	1. Actuator status is inconsistent with SPEC 2. Closed position of actuator is blocked by foreign objects	- Push the turbocharger to closed position manually, read position voltage to check if it is out of the range of SPEC - Check for foreign matter near turbocharger closed position
P024477	Turbocharger/ Supercharger Wastegate Actuator "A" Range/ Performance	The deviation between target position of turbocharger electronic waste gate and actual position exceeds the threshold	1. Actuator status is inconsistent with SPEC 2. Closed position of actuator is blocked by foreign objects	- Check electronic waste gate for stuck - Check wire harness and connector for aging
P024437	Turbocharger/ Supercharger Wastegate Actuator "A" Range/ Performance	The duty ratio of turbocharger electronic waste gate control exceeds the limit	1. Actuator status is inconsistent with SPEC 2. Closed position of actuator is blocked by foreign objects	- Check electronic waste gate for stuck - Check wire harness and connector for aging

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P256400	Turbocharger Boost Control Position Sensor "A" Circuit Low	The voltage of turbocharger electronic waste gate position sensor is below the limit	1. Sensor circuit short to ground 2. Pin corresponding to ECM short to ground	Check electronic waste gate position sensor wire harness for short to ground
P256500	Turbocharger Boost Control Position Sensor "A" Circuit High	The voltage of turbocharger electronic waste gate position sensor is higher than the limit	1. Sensor circuit short to power supply or open 2. Pin corresponding to ECM short to power supply or open	Check electronic waste gate position sensor wire harness for short to power supply
P170300	Communication Failure of Supercharger Wastegate Control Circuit	Communication failure of supercharger wastegate control circuit SPI	1. Communication failure of supercharger wastegate control circuit SPI	Check electronic waste gate control circuit for problem
P005300	HO2S Heater Resistance Bank 1 Sensor 1	Current internal resistance value is higher than the threshold value of corresponding working condition	1. Heating circuit failure 2. Oxygen sensor resistor deteriorated	- Do not disconnect oxygen sensor connector, measure if voltage of upstream oxygen sensor wire oxygen sensor terminal No.1 wire (white, heater power supply positive) is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage of upstream oxygen sensor wire oxygen sensor terminal No.2 wire (white, heater power supply grounded) is 12 V. - Disconnect upstream oxygen sensor wire connector to remove upstream oxygen sensor. Place the oxygen sensor at room temperature to cool it down. Measure if resistance between sensor terminal No.1 interface (white, heater power supply positive) and No.2 interface (- white, heater power supply grounded) is higher than 15 Ω with a multimeter when temperature of oxygen sensor cools down to

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				room temperature. (- Oxygen sensor resistance measurement must be performed when temperature of oxygen sensor cools down to room temperature, as resistance is related to temperature.)
P005400	HO2S Heater Resistance Bank 1 Sensor 2	Current internal resistance value is higher than the threshold value of corresponding working condition	1. Heating circuit failure 2. Oxygen sensor resistor deteriorated	- Do not disconnect oxygen sensor connector, measure if voltage of upstream oxygen sensor wire oxygen sensor terminal No.1 wire (white, heater power supply positive) is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage of upstream oxygen sensor wire oxygen sensor terminal No.2 wire (white, heater power supply grounded) is 12 V. - Disconnect upstream oxygen sensor wire connector to remove upstream oxygen sensor. Place the oxygen sensor at room temperature to cool it down. Measure if resistance between sensor terminal No.1 interface (white, heater power supply positive) and No.2 interface (- white, heater power supply grounded) is higher than 15 Ω with a multimeter when temperature of oxygen sensor cools down to room temperature. (- Oxygen sensor resistance measurement must be performed when temperature of oxygen sensor cools down to room temperature, as resistance is related to temperature.)
P222900	Barometric Pressure Sensor "A" Circuit High	The sensor sends fault information by itself	1. The built-in ambient pressure sensor in ECM fails.	Check whether the signal value of ambient

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P222800	Barometric Pressure Sensor "A" Circuit Low Problem			pressure sensor is too large or too small
P222722	Barometric Pressure Sensor "A" Circuit Range/ Performance	The sensor sends fault information by itself	1. The built-in ambient pressure sensor in ECM fails.	Check whether the signal value of ambient pressure sensor is significantly different from the current atmospheric pressure
P222721	Barometric Pressure Sensor "A" Circuit Range/ Performance			
P222785	Barometric Pressure Measurement System - Multiple Sensor Correlation Bank 1			
P222784	Barometric Pressure Measurement System - Multiple Sensor Correlation Bank 1			
P120200	Barometric Pressure Sensor "A" Circuit Range/ Performance			
P120300	Barometric Pressure Sensor "A" Circuit Range/ Performance			
P008985	Fuel Pressure Regulator 1 Performance-Pressure Too Low	PID control deviation of high pressure oil supply is higher than 5MPa	1. Oil passage is leakage 2. Insufficient fuel 3. Low pressure oil pump is damaged 4. The working capacity of high pressure oil pump is reduced	- Check for leakage in oil passage - Check if fuel is insufficient - Check low pressure oil pump for damage - Check whether the working capacity of high pressure oil pump has decreased
P008984	Fuel Pressure Regulator 1 Performance-Pressure Too High	PID control deviation of high pressure oil supply is lower than -5MPa	1. High pressure oil pump control failure 2. Pressure relief valve blocked	Check whether the high pressure oil pump control is normal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				Check relief valve for blockage or abnormal operation
P008700	Fuel Rail/System Pressure - Too Low	High pressure fuel rail pressure control deviation is lower than -3MPa	1. Oil passage is leakage 2. Insufficient fuel 3. Low pressure oil pump is damaged 4. The working capacity of high pressure oil pump is reduced	- Check for leakage in oil passage - Check if fuel is insufficient - Check low pressure oil pump for damage - Check whether the working capacity of high pressure oil pump has decreased
P008800	Fuel Rail/System Pressure - Too High	High pressure fuel rail pressure control deviation is higher than 3MPa	1. High pressure oil pump control failure 2. Pressure relief valve blocked	- Check whether the high pressure oil pump control is normal - Check relief valve for blockage or abnormal operation
P009000	Short Circuit in High Side and Low Side Control Circuit of Flow Control Valve	Drive channel self-diagnosis failure	1. High-side and low-side control circuits of flow control valve are short circuit	Check whether the high-side and low-side control circuits of flow control valve are short circuit
P009626	Intake Air Temp. Circ. Performance Non-plausible	The measured value of boost temperature sensor remains unchanged	1. Sensor aging deviation	- Connect the diagnostic tester and turn ignition switch to ON. Do not start engine, and observe if "Intake Temperature Sensor Measured Value" in data flow is too high. If value is higher than normal condition, observe maximum boost temperature range. You can also use a multimeter to measure if boost temperature sensor signal terminal voltage is close to or equal to 0 V. - Sensor aging deviation
P009800	Intake Air Temperature Sensor 2 Circuit High Bank 1	Temperature sensor voltage is higher than 4.9 V	1. Boost temperature sensor signal terminal is short to power supply or open 2. Open circuit in sensor reference ground 3. Short circuit to power supply, open	Connect the diagnostic tester and turn ignition switch to ON. Do not start engine, and observe if "Intake Temperature Sensor Measured Value" in data flow is too low. If value is lower than normal condition, observe minimum intake

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			circuit or internal circuit damage in boost temperature sensor signal pin corresponding to ECM terminal 4. Sensor is damaged	manifold temperature range. You can also use a multimeter to measure if voltage between boost temperature sensor signal terminal and ground is close to or equal to 5 V. • Turn ignition switch OFF and check connector for looseness or poor contact • Check sensor signal terminal for short to power supply or open • Check sensor reference ground for open • Check sensor for damage • Check if short circuit to power supply, open or internal circuit damage in boost temperature sensor signal pin corresponding to ECM
P009700	Intake Air Temperature Sensor 2 Circuit Low Bank 1	Temperature sensor voltage is lower than 0.1 V	1. Boost temperature sensor signal terminal is short to ground 2. Short circuit to ground in boost temperature sensor signal pin corresponding to ECM terminal	• Connect the diagnostic tester and turn ignition switch to ON. Do not start engine, and observe if "Intake Temperature Sensor Measured Value" in data flow is too low. If value is lower than normal condition, observe minimum intake manifold temperature range. You can also use a multimeter to measure if voltage between boost temperature sensor signal terminal and ground is close to or equal to 5 V. • Turn ignition switch OFF and check connector for looseness or poor contact • Check sensor signal terminal for short to ground • Check if short circuit to ground in boost temperature sensor signal pin corresponding to ECM

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P009900	Intake Air Temperature Sensor 2 Circuit Intermittent Bank 1	Boost temperature sensor voltage discontinuity is higher than 4.9 V	1. Boost temperature sensor signal terminal is poor contact 2. Connector looseness 3. Poor contact in boost temperature sensor signal pin corresponding to ECM terminal	- Connect the diagnostic tester and turn ignition switch to ON. Do not start engine, and observe if "Intake Temperature Sensor Measured Value" in data flow is too low. If value is lower than normal condition, observe minimum boost temperature range. You can also use a multimeter to measure if voltage between boost temperature sensor signal terminal and ground is close to or equal to 5 V. - Turn ignition switch OFF and check connector for looseness or poor contact - Check sensor signal terminal for poor contact - Check if there is poor contact in boost temperature sensor signal pin corresponding to ECM
P01062A	Manifold Absolute Pressure Sensor Circuit Range/Performance	The difference between intake pressure value and initial pressure value at startup is always less than 20 hPa	1. Sensor is icing and oily 2. Incorrect installation position of sensor 3. Intake line is detached or seriously air leaked	- Do not start engine, and observe if "Intake Pressure" item in data flow is seriously deviated from ambient pressure by about 101 kpa (-specific value is related to current pressure). - Turn ignition switch to "OFF", and check if there is any freeze, oil stain, etc. on measurement terminal, which will affect normal measurement. - Check if intake pressure sensor installation position is incorrect, intake pipe is disconnected or seriously leaked.
P010622	Manifold Absolute Pressure Sensor Circuit Range/Performance	The intake pressure value exceeds the reasonableness threshold	1. Sensor is icing and oily 2. Sensor is aging 3. Intake line is detached or	Do not start engine, and observe if "Intake Pressure" item in data flow is seriously deviated from ambient pressure by about 101 kpa

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P010621	Manifold Absolute Pressure Sensor Circuit Range/Performance		seriously air leaked	(specific value is related to current pressure). - Turn ignition switch to "OFF", and check if there is any freeze, oil stain, etc. on measurement terminal, which will affect normal measurement. - Check if intake pressure sensor installation position is incorrect, intake pipe is disconnected or seriously leaked.
P120000	Manifold Absolute Pressure Sensor Circuit Range/Performance			
P120100	Manifold Absolute Pressure Sensor Circuit Range/Performance			
P00C721	Intake Air Pressure Measurement System - Multiple Sensor Correlation Bank 1			
P00C722	Intake Air Pressure Measurement System - Multiple Sensor Correlation Bank 1			
P120400	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance	The boost pressure value exceeds the reasonableness threshold	1. Sensor is icing and oily 2. Sensor is aging 3. Intake line is detached or seriously air leaked	- Turn ignition switch to "OFF", and check if there is any freeze, oil stain, etc. on measurement terminal, which will affect normal measurement. - Check if boost pressure sensor installation position is incorrect, intake pipe is disconnected or seriously leaked
P120500	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance			
P023622	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance			
P023621	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance			
P010700	Intake Manifold Pressure Sensor Circuit Voltage Too Low	Sensor voltage is lower than the threshold	1. Intake pressure sensor signal terminal is short to ground 2. 5 V	Connect the diagnostic tester and turn ignition switch to ON. Use a multimeter to measure whether the intake

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			reference voltage of sensor is open 3. Short circuit to ground in intake pressure sensor signal pin corresponding to ECM terminal	manifold pressure sensor signal terminal voltage is close to or equal to 0 V without starting the engine. - Turn ignition switch "OFF", check pressure sensor signal terminal for short to ground - Check 5 V reference voltage terminal of sensor for open - Check if short circuit to ground in intake pressure sensor signal pin terminal corresponding to ECM
P010800	Intake Manifold Pressure Sensor (Electric) Circuit Short to Battery	Sensor voltage is higher than the threshold	1. Intake manifold pressure sensor signal terminal is short to power supply or open 2. Sensor reference ground terminal is open 3. Short circuit to power supply or open circuit in intake pressure sensor signal pin terminal corresponding to ECM terminal 4. Sensor is damaged	- Connect the diagnostic tester and turn ignition switch to ON. Use a multimeter to measure whether the voltage between intake manifold pressure sensor signal terminal and ground is close to or equal to 5 V without starting the engine. - Turn ignition switch OFF and check connector for looseness or poor contact - Check for short circuit to power supply or open circuit in intake manifold pressure sensor signal terminal - Check sensor reference ground terminal for open - Check sensor for damage - Check if short circuit to power supply, open or internal circuit damage in intake pressure sensor signal pin terminal corresponding to ECM terminal
P011126	Intake Air Temp. Circ. Performance Non-plausible	No fluctuations in intake temperature sensor measured value	1. Intake manifold temperature sensor signal end circuit interference 2.	- Check whether there is interference or contact resistance in signal end circuit of intake manifold temperature sensor - Sensor is damaged

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			Sensor is damaged	
P011200	Intake Air Temp. Circ. Low Input	Temperature sensor voltage is lower than 0.1 V	1. Intake manifold temperature sensor signal terminal short to ground 2. Sensor is damaged	• Use a multimeter to measure if intake temperature sensor signal terminal voltage is close to or equal to 0 V • Turn ignition switch "OFF", and check if intake manifold temperature sensor signal terminal is short to ground. • Sensor is damaged • short to ground in intake manifold temperature sensor signal pin terminal corresponding to ECM terminal.
P011300	Intake Air Temp. Circ. High Input	Temperature sensor voltage is higher than 4.9 V	1. Intake manifold temperature sensor signal terminal is short to power supply or open 2. Open circuit in sensor reference ground 3. Short circuit to power supply, open circuit or internal circuit damage in intake manifold temperature sensor signal pin corresponding to ECM terminal 4. Sensor is damaged	• Use a multimeter to measure if voltage between intake manifold temperature sensor signal terminal and ground is close to or equal to 5 V • Turn ignition switch OFF and check connector for looseness or poor contact • Check sensor signal terminal for short to power supply or open • Check sensor reference ground for open • Check sensor for damage • Check if short circuit to power supply, open or internal circuit damage in intake manifold temperature sensor signal pin corresponding to ECM terminal
P011400	Poor Contact in Intake Manifold Temperature Sensor Circuit	Temperature sensor voltage discontinuity is higher than 4.9 V	1. Intake manifold temperature sensor signal terminal is poor contact 2. Connector looseness 3. Poor contact in intake manifold temperature	• Use a multimeter to measure if voltage between intake manifold temperature sensor signal terminal and ground is close to or equal to 5 V • Turn ignition switch OFF and check connector for looseness or poor contact

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			sensor signal pin corresponding to ECM terminal	- Check sensor signal terminal for poor contact - Check if there is poor contact in intake manifold temperature sensor signal pin corresponding to ECM
P00CE23	Intake Air Temperature Sensor 2 Multiple Check Bank1	The intake air temperature sensor deviates too much from the average model during cold start	1. Internal resistance of intake air temperature sensor is unreasonable	- Check wire harness for contact resistance - Check whether the internal resistance of sensor has a large deviation from the normal value
P138024	Intake Air Temperature Sensor 2 Multiple Check Bank1			
P138023	Intake Air Temperature Sensor 2 Multiple Check Bank1			
P011623	Coolant Temperature Sensor 1 Signal Not Plausible	Coolant temperature sensor 1 signal is less than 30°C of lowest model value	1. Internal resistance of coolant temperature sensor is unreasonable	- Check wire harness for contact resistance - Check whether the internal resistance of sensor has a large deviation from the normal value
P011626	Engine Coolant Temperature Sensor 1 Circuit Range/ Performance	Coolant temperature sensor 1 signal remains unchanged		
P050C24	Cold Start Engine Coolant Temperature Performance	Deviation of coolant temperature sensor 1 cold start and the model value is too large		
P050C23	Cold Start Engine Coolant Temperature Performance	Deviation of coolant temperature sensor 1 cold start and the model value is too large		
P011700	Engine Coolant Temperature Sensor 1 Circuit Low	Coolant temperature sensor 1 voltage is lower than 0.09 V	1. Coolant temperature sensor signal terminal is short to ground 2. Short circuit to ground in coolant temperature sensor 1 signal pin corresponding to ECM terminal 3. Sensor is damaged	- Connect the diagnostic tester and turn ignition switch to ON. Do not start engine, and observe if "Coolant Temperature Sensor Measured Value" in data flow is much higher than proper temperature range. You can also use a multimeter to measure if coolant temperature sensor 1 signal terminal voltage is close to or equal to 0 V. - Turn ignition switch "OFF", check coolant

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				temperature sensor 1 signal terminal for short to ground • Check sensor for damage • Check coolant temperature sensor 1 signal pin terminal corresponding to ECM for short to ground
P011800	Engine Coolant Temperature Sensor 1 Circuit High	Coolant temperature sensor 1 voltage is higher than 4.9 V	1. Connector looseness or poor contact 2. Short circuit to power supply or open in coolant temperature sensor signal terminal 3. Short circuit to power supply or open in coolant temperature sensor signal pin corresponding to ECM terminal 4. Sensor is damaged	• Connect the diagnostic tester and turn ignition switch to ON. Do not start engine and observe if "Intake Temperature Sensor Measured Value" in data flow is much lower than current ambient temperature. You can also use a multimeter to measure if voltage between coolant temperature sensor 1 signal terminal and ground is close to or equal to 5 V • Turn ignition switch OFF and check connector for looseness or poor contact • Check for short circuit to power supply or open circuit in sensor signal terminal • Open circuit in sensor reference ground • Sensor is damaged • Short circuit to power supply, open circuit or internal circuit damage in coolant temperature sensor signal pin terminal corresponding to ECM
P011900	Engine Coolant Temperature Sensor 1 Circuit Intermittent	Coolant temperature sensor voltage jumps	1. Coolant temperature sensor signal terminal circuit is in poor contact	• Check if the signal terminal circuit of coolant temperature sensor is in poor contact
P012800	Coolant Thermostat (- Coolant Temperature Below Thermostat	Coolant temperature below thermostat regulating temperature	1. Thermostat normally open 2. Coolant temperature sensor	• Check if thermostat is normally open or damaged • Short circuit to power supply, open circuit or

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Regulating Temperature)		measurement value offset	internal circuit damage in coolant temperature sensor signal pin terminal corresponding to ECM
P013100	O2 Sensor Circuit Low Voltage Bank 1 Sensor 1	Upstream oxygen sensor signal line IA, IP, UN, VM signal is zero	1. The signal circuit voltage of upstream oxygen sensor is too low (APE IPE RE circuit is short to ground)	- Start the vehicle, keep it idling and slightly change the accelerator pedal to run for a period of time, puncture the red (IP), yellow (VM), green (IA), and black (UN) wire insulation layer of wire harness connector near ECM terminal with the red probe of a multimeter, ground the black probe, and check whether the voltage is short circuit. - Replace LSU oxygen sensor, check if failure will continue to be reported. - Check whether there is any abnormality in LSU processing circuit inside ECM.
P013200	O2 Sensor Circuit High Voltage Bank 1 Sensor 1	Upstream oxygen sensor signal line IA, IP, UN, VM signal is always high	1. Upstream oxygen sensor signal circuit voltage is too high (APE IPE RE wire is short to power supply)	- Start the vehicle, keep it idling and slightly change the accelerator pedal to run for a period of time, puncture the red (IP), yellow (VM), green (IA), and black (UN) wire insulation layer of wire harness connector near ECM terminal with the red probe of a multimeter, ground the black probe, and check whether the voltage is always high and has small changes. - Replace LSU oxygen sensor, check if failure will continue to be reported. - Check whether there is any abnormality in LSU processing circuit inside ECM.
P013300	O2 Sensor Circuit Slow Response Bank 1 Sensor 1	The dynamic factor of upstream oxygen sensor is less than the threshold	1. The oxygen sensor is aging and the response becomes slow	Check intake and exhaust system for air leakage.

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				Replace upstream LSU oxygen sensor, return vehicle to the customer, and check whether fault reappears.
P013600	O2 Sensor Circuit Bank 1 Sensor 2	The voltage range of downstream oxygen sensor exceeds the limit	1. Oxygen sensor signal wire is short to heating power supply ground wire 2. Oxygen sensor is damaged	- Do not disconnect oxygen sensor connector, measure if voltage of downstream oxygen sensor wire oxygen sensor terminal No.1 wire (white, heater power supply positive) is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage of downstream oxygen sensor wire oxygen sensor terminal No.2 wire (white, heater power supply grounded) is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.4 wire (- black, oxygen sensor signal wire) and No.3 wire (gray, oxygen sensor signal grounded) is about 0.45 V. - Start and keep vehicle idling until coolant temperature reaches normal value. Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.4 wire (- black, oxygen sensor signal wire) and No.3 wire (gray, oxygen sensor signal grounded) is changed in range of 0 V - 1 V. - Start and keep vehicle idling until coolant temperature reaches normal value. Disconnect downstream oxygen sensor connector, measure if

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				there is short circuit between oxygen sensor terminal No.2 wire (- white, heater power grounded) and No.4 wire (black, oxygen sensor signal wire). Connect downstream oxygen sensor connector properly, repeat steps 5-6 and check if voltage signal changes between 0.44 V and 0.46 V, 0 V and 1 V respectively.
P013700	O2 Sensor Circuit Low Voltage Bank 1 Sensor 2	The downstream oxygen sensor voltage range is less than 0.06 V	1. Downstream oxygen sensor signal circuit is short to ground	- Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.2 wire (- black, oxygen sensor signal wire) and No.1 wire (gray, oxygen sensor signal grounded) is about 0.45 V. - Start and keep vehicle idling until coolant temperature reaches normal value. Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.2 wire (- black, oxygen sensor signal wire) and No.1 wire (gray, oxygen sensor signal grounded) is changed in range of 0V - 1V. - Disconnect downstream oxygen sensor connector, measure if sensor terminal No.1 wire (gray, oxygen sensor signal grounded) and No.2 wire (black, oxygen sensor signal wire) are short circuit with a multimeter. - Connect downstream oxygen sensor connector properly, repeat steps 3-4 and check if voltage signal changes between

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				0.44 V and 0.46 V, 0 V and 1 V respectively.
P013800	O2 Sensor Circuit High Voltage Bank 1 Sensor 2	The downstream oxygen sensor voltage range is higher than 1.2 V	1. Downstream oxygen sensor signal circuit is short to power supply	- Do not disconnect oxygen sensor connector, measure if voltage of downstream oxygen sensor wire oxygen sensor terminal No.4 wire (white, heater power supply positive) is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage of downstream oxygen sensor wire oxygen sensor terminal No.3 wire (white, heater power supply grounded) is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.2 wire (- black, oxygen sensor signal wire) and No.1 wire (gray, oxygen sensor signal grounded) is about 0.45 V. - Start and keep vehicle idling until coolant temperature reaches normal value. Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.2 wire (- black, oxygen sensor signal wire) and No.1 wire (gray, oxygen sensor signal grounded) is changed in range of 0V - 1V. - Disconnect downstream oxygen sensor connector, measure if there is short circuit between sensor terminal No. 4 wire (white, heater power supply positive) and No. 2 wire (black, oxygen sensor signal wire) with a multimeter.

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				Connect downstream oxygen sensor connector properly, repeat steps 5-6 and check if voltage signal changes between 0.44 V and 0.46 V, 0 V and 1 V respectively.
P019200	Fuel Rail Pressure Sensor Circuit Short to Ground	Fuel rail pressure sensor circuit voltage is lower than 0.2 V	1. Fuel rail pressure sensor circuit short to ground 2. Fuel rail pressure sensor pin corresponding to ECM short to ground	- Check sensor signal terminal for short to ground - Check sensor for damage - Check for short circuit to power supply, open or internal circuit damage in fuel rail pressure sensor signal pin corresponding to ECM terminal
P019300	Fuel Rail Pressure Sensor Circuit Short to Power Supply	Fuel rail pressure sensor circuit voltage is higher than 4.8 V	1. Fuel rail pressure sensor circuit short to power supply 2. Fuel rail pressure sensor pin corresponding to ECM short to power supply	- Check sensor signal terminal for short to power supply or open - Check sensor for damage - Check for short circuit to power supply, open or internal circuit damage in fuel rail pressure sensor signal pin corresponding to ECM terminal
P019400	Fuel Rail Pressure Sensor Circuit Intermittent/ Erratic Bank 1	The maximum fluctuation value of fuel rail pressure sensor signal voltage before and after fuel injection is lower than the threshold	1. Fuel rail pressure sensor is damaged 2. Injector is blocked or damaged 3. High pressure fuel rail is abnormal	- Replace the fuel rail pressure sensor, start vehicle for 10 minutes and check whether the fault reappears - Replace the injector, start vehicle for 10 minutes and check whether the fault reappears - Check if high pressure fuel rail system is abnormal - Repair or replace the corresponding components, start vehicle for 10 minutes and check whether the fault reappears
P020113	Cylinder 1 Fuel Injector Control Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Open circuit in fuel injector 3. Open circuit in	- Check connector for looseness or poor contact - Check for open circuit in corresponding fuel injector circuit

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P020213	Cylinder 2 Fuel Injector Control Circuit Open		fuel injector power supply terminal or fuel injector damage 4. Open or internal circuit damage in injector control pin corresponding to ECM	- Check for open circuit in corresponding fuel injector power supply terminal or fuel injector damage - Check for open or internal circuit damage in injector control pin corresponding to ECM
P020313	Cylinder 3 Fuel Injector Control Circuit Open			
P020413	Cylinder 4 Fuel Injector Control Circuit Open			
P230112	Ignition Coil "A" Primary Control Circuit High	Drive channel self-diagnosis failure	1. Short circuit to power supply in ignition coil circuit 2. Short circuit to power supply in ignition coil power supply terminal 3. Short to power supply in ignition coil control pin corresponding to ECM	- Check for short circuit to power supply in corresponding ignition coil circuit - Check for short circuit to power supply in ignition coil control pin corresponding to ECM
P230412	Ignition Coil "B" Primary Control Circuit High			
P230712	Ignition Coil "C" Primary Control Circuit High			
P231012	Ignition Coil "D" Primary Control Circuit High			
P230011	Ignition Coil "A" Primary Control Circuit Low	Drive channel self-diagnosis failure	1. Connector is short to ground 2. Short circuit to ground in ignition coil circuit 3. Short circuit to ground in ignition coil control pin corresponding to ECM	- Check connector for short to ground - Check for short circuit to ground in corresponding ignition coil circuit - Check for short circuit to ground in ignition coil control pin corresponding to ECM
P230311	Ignition Coil "B" Primary Control Circuit Low			
P230611	Ignition Coil "C" Primary Control Circuit Low			
P230911	Ignition Coil "D" Primary Control Circuit Low			
P026200	Cylinder 1 Fuel Injector Control Circuit Short to Power Supply	Drive channel self-diagnosis failure	1. Injector circuit is short to power supply 2. Injector power supply terminal is short to power supply 3. Short to power supply in injector control pin	- Check for short circuit to power supply in corresponding injector circuit - Check for short circuit to power supply in injector control pin corresponding to ECM
P026800	Cylinder 3 Fuel Injector Control Circuit Short to Power Supply			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P027100	Cylinder 4 Fuel Injector Control Circuit Short to Power Supply		corresponding to ECM	
P026500	Cylinder 2 Fuel Injector Control Circuit Short to Power Supply			
P025100	Flow Control Valve Positive or Negative Control Circuit Open	Hardware circuit self-diagnostic	1. Open circuit in positive or negative control circuit of flow control valve 2. Open circuit in positive or negative control circuit of flow control valve corresponding to ECM	- Check if actuator terminal is open - Check if open or internal circuit damage in actuator pin corresponding to ECM terminal
P025400	Flow Control Valve High Side Control Circuit Voltage Too High or Too Low	Hardware circuit self-diagnostic	1. flow control valve high side control circuit short to power supply or ground 2. Short to power supply or ground in high side control valve circuit corresponding to ECM	- Check for short circuit to power supply or ground in actuator terminal - Check for short circuit to power supply or ground in actuator pin corresponding to ECM terminal
P025900	Injection Pump Fuel Metering Control "A" Low (Cam/Rotor/Injector)	Hardware circuit self-diagnostic	1. Flow control valve low side control circuit short to power supply or ground 2. Short to power supply or ground in low side control valve circuit corresponding to ECM	- Check for short circuit to power supply or ground in actuator terminal - Check for short circuit to power supply or ground in actuator pin corresponding to ECM terminal
P030000	Random/Multiple Cylinder Misfire Detected	Misfire counter exceeds threshold	1) Injector circuit failure 1) Ignition coil circuit failure 1) Injector control pin or ignition coil pin corresponding to ECM failure	- Check if there is any DTC related to corresponding cylinder and injector - Connector looseness or disengagement - Check if there is open circuit or short circuit to power supply in ignition coil signal terminal - Check if there is open circuit or short circuit to
P030100	Cylinder 1 Misfire Detected			
P030200	Cylinder 2 Misfire Detected			
P030300	Cylinder 3 Misfire Detected			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P030400	Cylinder 4 Misfire Detected			ground in ignition coil power supply terminal
P036300	Cylinder Selective Fuel Cutoff Active due to Catalyst Damaging Misfire			• Check if there is open circuit or short circuit to power supply in ignition coil grounded terminal • Check ignition coil for malfunction • Check if spark plug is abnormal • Check for open circuit or internal circuit damage in ignition coil control pin corresponding to ECM
P033900	Crankshaft Position Sensor "A" Circuit Intermittent	The speed sensor signal failure counter exceeds the threshold	1. Connector looseness or disengagement 2. Open circuit in signal terminal 3. Sensor damage	• Connector looseness or disengagement • Open circuit in speed sensor signal terminal • Short to power supply or ground, or short circuit in sensor signal terminal pins • Sensor is damaged • Pin corresponding to speed sensor signal on ECM fault
P261700	Crankshaft Position Signal Output Circuit Open			
P032700	Knock Sensor Signal Short to Ground (A)			• Connector looseness or poor contact • Check knock sensor signal terminal pin for short circuit to ground or open circuit • Replace the knock sensor, reconnect it, and check whether the fault is eliminated • Check knock sensor signal terminal pin corresponding to ECM terminal for short circuit to ground or open circuit
P032714	Knock Sensor Signal Short to Ground (B)			
P032800	Knock Sensor Signal Short to Power Supply (A)			• Connector looseness or poor contact • Check knock sensor signal terminal pin for short to power supply • Replace the knock sensor, reconnect it, and check whether the fault is eliminated • Check if short to power supply in knock sensor signal terminal pin
P032815	Knock Sensor Signal Short to Power Supply (B)			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				corresponding to ECM terminal
P032500	Knock Sensor Signal Circuit Voltage Too Low	The average value of knock sensor port voltage is less than 0.7 V	1. Connector looseness or disengagement 2. Open circuit in signal terminal 3. Sensor damage	- Check connector for looseness or poor contact - Check knock sensor signal terminal for short circuit to ground or open circuit - Check whether the knock sensor connection wire is a non-standard shielded wire and is subject to electromagnetic interference - Check knock sensor for damage - Check knock sensor pin or circuit corresponding to ECM terminal for damage
P151000	Knock Control System Failure	The number of window length errors is higher than 4, and the number of non-measurement window output is higher than 28	1. Sensor is damaged 2. ECM is damaged	- Check knock sensor for damage - Check ECM for damage
P032600	Knock/Combustion Vibration Sensor 1 Circuit Bank 1 or Single Sensor	Knock background noise is greater than the maximum noise signal threshold	1. Sensor is damaged 2. ECM is damaged 3. Engine is abnormal	- Check knock sensor for damage - Check ECM for damage - Check whether engine is abnormal
P034100	Intake Camshaft Phaser Sensor Signal Improper	Intake camshaft phase sensor signal failure counter exceeds threshold	1. Connector looseness or disengagement 2. Relative installation position between intake phase sensor and its signal plate do not meet the installation requirements 3. Intake phase signal plate teeth mechanical malfunction	- Check connector for looseness or poor contact - Check if there is external interference on wire harness - Check if relative installation position between phase sensor and its signal plate are meet the installation requirements (such as too far, misaligned, etc.) - Check intake phase signal plate teeth for mechanical malfunction
P034200	Camshaft Position Sensor "A" Circuit Low Bank 1 or Single Sensor	Intake camshaft phase sensor signal failure counter exceeds threshold	1. Intake phase sensor power supply failure 2. Intake phase sensor signal	Unplug the intake phase sensor connector on wire harness, and use a multimeter to check whether the voltage

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			terminal is short to ground 3. Intake phase sensor signal terminal ECM pin is short to ground	between power supply terminal pin and ground terminal pin of the phase sensor is about 12 V. • Check whether the voltage between intake phase sensor signal terminal pin and ground terminal pin is 0 V • Check whether the intake phase sensor power supply terminal pin is open or short to ground, and whether the ground terminal pin is in poor contact • Check whether the intake phase sensor signal terminal pin is short to ground • Check whether the intake phase sensor signal terminal pin corresponding to ECM is short to ground
P034300	Camshaft Position Sensor "A" Circuit High Bank 1 or Single Sensor	Intake camshaft phase sensor signal failure counter exceeds threshold	1. Intake phase sensor ground terminal failure 2. Intake phase sensor signal terminal is short to power supply 3. Intake phase sensor signal terminal ECM pin is short to power supply	• Unplug the intake phase sensor connector on wire harness, and use a multimeter to check whether the voltage between power supply terminal pin and ground terminal pin of the phase sensor is about 12 V. • Check whether the voltage between intake phase sensor signal terminal pin and power supply terminal pin is 12 V • Check intake phase sensor ground terminal pin for open or short to power supply • Check intake phase sensor signal terminal pin for short to power supply or open • Check if short to power supply, open or internal circuit damage in intake phase sensor signal terminal pin corresponding to ECM

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P035113	Ignition Coil "A" Primary Control Circuit Failure	Drive channel self-diagnosis failure	1. Short circuit to ground or open circuit in ignition coil circuit 2. Short circuit to ground or open circuit in ignition coil control pin corresponding to ECM	- Check corresponding ignition coil circuit for short to ground or open - Check ignition coil control pin corresponding to ECM for short circuit to ground or open circuit
P035213	Ignition Coil "B" Primary Control Circuit Failure			
P035313	Ignition Coil "C" Primary Control Circuit Failure			
P035413	Ignition Coil "D" Primary Control Circuit Failure			
P036600	Exhaust Camshaft Phaser Sensor Signal Improper	Exhaust camshaft phase sensor signal failure counter exceeds threshold	1. Connector looseness or disengagement 2. Relative installation position between exhaust phase sensor and its signal plate do not meet the installation requirements 3. Exhaust phase signal plate teeth mechanical malfunction	- Check connector for looseness or poor contact - Check if there is external interference on wire harness - Check if relative installation position between exhaust phase sensor and its signal plate are meet the installation requirements (such as too far, misaligned, etc.) - Check exhaust phase signal plate teeth for mechanical malfunction
P036700	Camshaft Position Sensor "B" Circuit Low (Bank1)	Exhaust camshaft phase sensor signal failure counter exceeds threshold	1. Exhaust phase sensor power supply failure 2. Exhaust phase sensor signal terminal is short to ground 3. Exhaust phase sensor signal terminal ECM pin is short to ground	- Unplug the exhaust phase sensor connector on wire harness, and use a multimeter to check whether the voltage between power supply terminal pin and ground terminal pin of the phase sensor is about 12 V. - Check whether the voltage between exhaust phase sensor signal terminal pin and ground terminal pin is 0 V - Check whether the exhaust phase sensor power supply terminal pin is open or short to ground, and whether the ground terminal pin is in poor contact - Check whether the exhaust phase sensor signal terminal pin is short to ground

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				Check whether the exhaust phase sensor signal terminal pin corresponding to ECM is short to ground
P036800	Camshaft Position Sensor "B" Circuit High (Bank1)	Exhaust camshaft phase sensor signal failure counter exceeds threshold	1. Exhaust phase sensor ground terminal failure 2. Exhaust phase sensor signal terminal is short to power supply 3. Exhaust phase sensor signal terminal ECM pin is short to power supply	- Unplug the exhaust phase sensor connector on wire harness, and use a multimeter to check whether the voltage between power supply terminal pin and ground terminal pin of the phase sensor is about 12 V. - Check whether the voltage between exhaust phase sensor signal terminal pin and power supply terminal pin is 12 V - Check exhaust phase sensor ground terminal pin for open or short to power supply - Check exhaust phase sensor signal terminal pin for short to power supply or open - Check if short to power supply, open or internal circuit damage in exhaust phase sensor signal terminal pin corresponding to ECM
P06DA13	Secondary Oil Pump Drive Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Secondary oil pump drive circuit pin is open 3. Open circuit or internal circuit damage in secondary oil pump drive circuit pin corresponding to ECM terminal	- Check connector for looseness or poor contact - Check secondary oil pump drive circuit pin for open - Check if open or internal circuit damage in secondary oil pump drive circuit pin corresponding to ECM terminal
P06DB11	Secondary Oil Pump Drive Circuit Short to Ground	Drive channel self-diagnosis failure	1. Short to ground in secondary oil pump drive circuit 2. Short to ground in secondary oil pump drive	- Check secondary oil pump drive circuit pin for short to ground - Check secondary oil pump drive circuit pin corresponding to ECM terminal for short to ground

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			circuit corresponding to ECM terminal	
P06DC12	Secondary Oil Pump Drive Circuit Short to Power Supply	Drive channel self-diagnosis failure	1. Secondary oil pump drive circuit short to power supply 2. Short to power supply in secondary oil pump drive circuit corresponding to ECM terminal	- Check secondary oil pump drive circuit pin for short to power supply - Check if short to power supply in secondary oil pump drive circuit pin corresponding to ECM terminal
P042000	Catalyst System Efficiency Below Threshold Bank 1	The calculated oxygen storage capacity of catalytic converter is lower than the threshold	1. Check exhaust system for leakage, gasket for damage 2. Catalytic converter is aging	- Check exhaust system for leakage, gasket for damage. - Replace the catalytic converter. Check if malfunction reappears after returning vehicle to customer.
P044413	Evaporative Emission System Purge Control Valve Circuit Open	Drive channel self-diagnosis failure	3. Connector looseness or poor contact 2. Canister control valve circuit is open 3. Canister control valve circuit corresponding to ECM terminal is open	- Connector looseness or poor contact - Open circuit in canister control valve signal terminal pin - Open circuit in canister control valve power supply terminal pin - Canister control valve damaged - Open circuit or internal circuit damage in canister control terminal pin corresponding to ECM terminal
P045811	Evaporative Emission System Purge Control Valve Circuit Low	Drive channel self-diagnosis failure	1. Canister control valve signal terminal is short to ground 2. Canister control terminal pin corresponding to ECM terminal is short to ground	- Canister control valve signal terminal short to ground - Canister control valve power supply terminal pin short to ground - Canister control terminal pin corresponding to ECM terminal short to ground
P045912	Evaporative Emission System Purge Control Valve Circuit High	Drive channel self-diagnosis failure	1. Canister control valve signal terminal is short to power supply 2. Canister control terminal pin	- Canister control valve signal terminal is short to power supply - Canister control terminal pin corresponding to

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			corresponding to ECM terminal is short to power supply	ECM terminal short to power supply
P050600	Idle Control System RPM Lower Than Expected	Idle speed control speed is lower than the target idle speed 100r/min	1. Electronic throttle is stuck in a position with a small opening. 2. Check if intake manifold is leakage, injector is blocked, exhaust resistance is too large, oil supply pressure is too low	- Check if electronic throttle is stuck in smaller opening position due to ice or oil. - Check if intake manifold is leakage, fuel injector is blocked, exhaust resistance is too large, oil supply pressure is too low
P050A21	Cold Start Idle Control System Performance			
P050700	Idle Control System RPM Higher than Expected	Idle speed control speed is higher than the target idle speed 200r/min	1. Electronic throttle is stuck in a position with a large opening. 2. Check if system is leakage, injector is leaked, oil supply pressure is too high	- Check if electronic throttle is stuck in larger open position due to ice or oil. - Check if system is air leaked, fuel injector is leaked, fuel supply pressure is too high
P050500	Unreasonable Engine Idling-large Fluctuation	Idle control speed fluctuates too much		
P050A22	Cold Start Idle Control System Performance	Idle control speed is higher than the target idle 200r/min during the heating process of catalytic converter		
P050D00	Cold Start Rough Idle	Engine idle fluctuates too much during the heating process of catalytic converter		
P056200	System Voltage Low	Power supply voltage is lower than 6 V	1. Open circuits in all pins on ECM which are connected with battery or main relay 2. Battery electric leakage or damage	- Connect diagnostic tester, turn ignition switch to OFF. Measure battery voltage with a multimeter and check if it is too low. - Check if there are open circuits in all pins on ECM which are connected with battery or main relay - Check engine wire grounded point for malfunction - Regulator failure - Battery electric leakage or damage - Alternator failure
P056300	System Battery Voltage High	Power supply voltage is higher than 20 V	1. Engine wire harness ground point is	Connect diagnostic tester, turn ignition switch to OFF. Measure battery

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			malfunction 2. Alternator regulator malfunction, motor power generation cannot be controlled effectively	voltage with a multimeter and check if it is too high - Check engine wire grounded point for malfunction - Alternator regulator malfunction, motor power generation cannot be controlled effectively
P061513	Starter Relay Control Circuit Error	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Starter relay control high terminal is open 3. Starter control high terminal pin corresponding to ECM terminal is open or damage	- Connector looseness or poor contact - Starter relay control high terminal is open - Starter relay 1 fuse blown or damaged - Open or damage in starter control high terminal pin corresponding to ECM
P061611	Starter Relay "A" High Circuit Low	Drive channel self-diagnosis failure	1. Starter control circuit high terminal is short to ground 2. Starter control high terminal pin corresponding to ECM is short to ground	- Starter control circuit high terminal is short to ground - Starter control high terminal pin corresponding to ECM is short to ground
P061712	Starter Relay "A" Circuit High	Drive channel self-diagnosis failure	1. Starter control circuit high terminal is short to power supply 2. Starter control high terminal pin corresponding to ECM is short to power supply	- Starter relay control circuit high terminal is short to power supply - Starter control high terminal pin corresponding to ECM is short to power supply
P055700	Brake Booster Pressure Sensor Circuit Low	Sensor voltage is lower than the threshold	1. Brake vacuum sensor signal terminal is short to ground 2. 5 V reference voltage of sensor is open 3. Short circuit to ground in brake vacuum sensor signal pin corresponding to ECM terminal	- Connect the diagnostic tester and turn ignition switch to ON. Use a multimeter to measure whether the brake vacuum sensor signal terminal voltage is close to or equal to 0 V without starting the engine. - Turn ignition switch "OFF", check brake vacuum sensor signal terminal for short to ground - Check 5 V reference voltage terminal of sensor for open

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				Check terminal if short circuit to ground in brake vacuum sensor signal pin corresponding to ECM
P055800	Brake Booster Pressure Sensor Circuit High	Sensor voltage is higher than the threshold	1. Brake vacuum sensor signal terminal is short to power supply or open 2. Brake vacuum sensor reference ground terminal is open 3. Short circuit to power supply or open circuit in brake vacuum sensor signal pin terminal corresponding to ECM terminal 4. Sensor is damaged	- Connect the diagnostic tester and turn ignition switch to ON. Use a multimeter to measure whether the voltage between brake vacuum sensor signal terminal and ground is close to or equal to 5 V without starting the engine. - Turn ignition switch OFF and check connector for looseness or poor contact - Check brake vacuum sensor signal terminal for short circuit to power supply or open - Check sensor reference ground terminal for open - Check sensor for damage - Check brake vacuum sensor signal pin terminal corresponding to ECM terminal for short circuit to power supply, open or internal circuit damage
P064513	A/C Clutch Relay Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Open circuit in A/C compressor relay control circuit 3. Open circuit or short circuit to ground in A/C compressor relay control circuit power supply terminal 4. A/C compressor relay fuse is blown or damaged 5. Open circuit or internal circuit damage in A/C compressor	- Connector looseness or poor contact - Open circuit in A/C compressor relay control circuit - Open circuit or short circuit to ground in A/C compressor relay control circuit power supply terminal - A/C compressor relay fuse blown or damaged - Open circuit or internal circuit damage in A/C compressor control pin corresponding to ECM

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			control pin corresponding to ECM	
P064611	A/C Compressor Relay Circuit Low	Drive channel self-diagnosis failure	1. A/C compressor relay control circuit is short to ground 2. A/C compressor relay pin corresponding to ECM terminal is short to ground	- A/C compressor relay control circuit is short to ground - A/C compressor relay pin corresponding to ECM terminal is short to ground
P064712	A/C Compressor Relay Control Circuit High	Drive channel self-diagnosis failure	1. A/C compressor relay circuit is short to power supply 2. A/C compressor relay pin corresponding to ECM terminal is short to power supply	- A/C compressor relay circuit is short to power supply - A/C compressor relay pin corresponding to ECM terminal is short to power supply
P208800	"A" Camshaft Position Actuator Control Circuit Low Bank 1	Drive channel self-diagnosis failure	1. Intake VVT control solenoid valve signal terminal is short to ground 2. Intake VVT control solenoid valve power supply terminal is short to ground 3. Intake VVT control solenoid valve signal terminal pin corresponding to ECM is short to ground	- Intake VVT control solenoid valve signal terminal is short to ground - Intake VVT control solenoid valve power supply terminal is short to ground - Intake VVT control solenoid valve signal terminal pin corresponding to ECM is short to ground
P208900	"A" Camshaft Position Actuator Control Circuit High Bank 1	Drive channel self-diagnosis failure	1. Intake VVT control solenoid valve signal terminal is short to power supply 2. Intake VVT control solenoid valve signal terminal pin corresponding to ECM terminal is short to power supply	- Intake VVT control solenoid valve signal terminal is short to power supply - Intake VVT control solenoid valve signal terminal pin corresponding to ECM terminal is short to power supply

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P209000	"B" Camshaft Position Actuator Control Circuit Low Bank 1	Drive channel self-diagnosis failure	1. Exhaust VVT control solenoid valve signal terminal is short to ground 2. Exhaust VVT control solenoid valve power supply terminal is short to ground 3. Exhaust VVT control solenoid valve signal terminal pin corresponding to ECM is short to ground	- Exhaust VVT control solenoid valve signal terminal is short to ground - Exhaust VVT control solenoid valve power supply terminal is short to ground - Exhaust VVT control solenoid valve signal terminal pin corresponding to ECM is short to ground
P209100	"B" Camshaft Position Actuator Control Circuit High Bank 1	Drive channel self-diagnosis failure	1. Exhaust VVT control solenoid valve signal terminal is short to power supply 2. Exhaust VVT control solenoid valve signal terminal pin corresponding to ECM terminal is short to power supply	- Exhaust VVT control solenoid valve signal terminal is short to power supply - Exhaust VVT control solenoid valve signal terminal pin corresponding to ECM terminal is short to power supply
P217700	System Too Lean Off Idle Bank 1	Self-learning factor exceeds the threshold	1. Oil system hardware leakage or blockage 2. Intake pipe failure 3. Oxygen sensor wire harness connector circuit failure 4. Oxygen sensor failure	- Connect the fuel pressure gauge (the connection position is the front end of fuel distribution pipe assembly inlet pipe), start the engine and check whether the fuel pressure is normal when the fuel pressure is under idle conditions and when the fuel pressure regulator vacuum tube is removed? - Use a special tool to check whether the injector is leaking or blocked. - Check the fuel condition, and ask the customer whether to fill the designated gasoline? After filling, does the vehicle work abnormally? - Check whether the intake line is blocked,
P217800	System Too Rich Off Idle Bank 1			
P218700	System Too Lean at Idle Bank 1			
P218800	System Too Lean at Idle Bank 1			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				leakage, crush or damage; whether the carbon canister control valve is stuck; whether the valve clearance is abnormal; whether the throttle body is contaminated, causing the air passage to be blocked. • Check whether the ignition coil, cylinder wire, and spark plug work abnormally? • Do not disconnect oxygen sensor connector, measure if voltage of upstream oxygen sensor wire oxygen sensor terminal No.1 wire (white, heater power supply positive) is 12 V. • Do not disconnect oxygen sensor connector, measure if voltage of upstream oxygen sensor wire oxygen sensor terminal No.2 wire (white, heater power supply grounded) is 12 V. • Puncture wire harness connector near ECM terminal No. 1 wire insulation layer (white, heater power supply positive) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 2 wire insulation layer (- white, heater power supply grounded) with black pole of multimeter. Check if voltage between two ends is about 12 V. • Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal No.4 wire (- black, oxygen sensor signal wire) and No.3 wire (gray, oxygen sensor signal grounded) is about 0.45 V.

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				- Start and keep vehicle idling until coolant temperature reaches normal value. Puncture wire harness connector near ECM terminal No. 4 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 3 wire insulation layer (gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage is between 0 V and 1 V. - Disconnect upstream oxygen sensor connector, measure if there is short circuit between sensor terminal No.3 interface (gray, oxygen sensor signal grounded) and No.4 interface (black, oxygen sensor signal wire) with a multimeter. Connect upstream oxygen sensor connector properly, repeat step 6-7 and check if voltage signal is changed in range of 0.44 V- 0.46 V and 0 V - 1 V respectively.
P219500	O2 Sensor Signal Biased/ Stuck Lean Bank 1 Sensor 1	Downstream oxygen control integral value exceeds the upper limit	1. Exhaust system leaks 2. Oxygen sensor is aging	- Check intake and exhaust system for air leakage. - Replace upstream LSU oxygen sensor, return vehicle to the customer, and check whether fault reappears.
P219600	O2 Sensor Signal Biased/ Stuck Rich Bank 1 Sensor 1	Downstream oxygen control integral value exceeds the lower limit	1. Exhaust system leaks 2. Oxygen sensor is aging	- Check intake and exhaust system for air leakage. - Replace upstream LSU oxygen sensor, return vehicle to the customer, and check whether fault reappears.
P227000	O2 Sensor Signal Biased&Stuck	Downstream oxygen voltage continues to be high	1. Exhaust system leaks 2.	Check exhaust system for leakage, gasket for damage.

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Lean Bank 1 Sensor 2		Oxygen sensor is aging	- Downstream oxygen sensor: Puncture wire harness connector near ECM terminal No. 2 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 1 wire insulation layer (- gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage is in range of 0.44 V — 0.46 V - Start and keep vehicle idling until coolant temperature reaches normal value. Downstream oxygen sensor: Puncture wire harness connector near ECM terminal No. 2 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 1 wire insulation layer (- gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage changes in range of 0 V - 1 V - Start and keep vehicle idling until coolant temperature reaches normal value. Depress and release accelerator pedal frequently and alternately for 90 s, at the same time, puncture downstream oxygen sensor wire harness connector near ECM terminal No. 2 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 1 wire insulation layer (- gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage is

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				beyond range of 0.55 V - 0.65 V
P227100	O2 Sensor Signal Biased&Stuck Rich Bank 1 Sensor 2	Downstream oxygen voltage continues to be low	1. Exhaust system leaks 2. Oxygen sensor is aging	- Check exhaust system for leakage, gasket for damage. - Downstream oxygen sensor: Puncture wire harness connector near ECM terminal No. 2 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 1 wire insulation layer (- gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage is in range of 0.44 V — 0.46 V - Start and keep vehicle idling until coolant temperature reaches normal value. Downstream oxygen sensor: Puncture wire harness connector near ECM terminal No. 2 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 1 wire insulation layer (- gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage changes in range of 0 V - 1 V - Start and keep vehicle idling until coolant temperature reaches normal value. Depress and release accelerator pedal frequently and alternately for 90 s, at the same time, puncture downstream oxygen sensor wire harness connector near ECM terminal No. 2 wire insulation layer (black, oxygen sensor signal wire) with red pole of multimeter, and puncture wire harness connector near ECM terminal No. 1

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				wire insulation layer (-gray, oxygen sensor signal grounded) with black pole of multimeter. Check if voltage is beyond range of 0.55 V - 0.65 V
P023400	Turbocharger Boost Pressure Too High	The boost pressure is higher than the target pressure plus a certain offset	1. Turbocharger relief valve is damaged 2. Exhaust gas by-pass valve is damaged (-normally closed)	- Turbocharger relief valve is damaged - Exhaust gas by-pass valve is damaged (-normally closed)
P023700	Turbocharger/ Supercharger Boost Sensor "A" Circuit Low	Boost pressure sensor voltage is lower than 0.15 V	1. Sensor signal terminal pin is short to ground 2. Short to ground in sensor signal terminal pin corresponding to ECM	- Sensor signal terminal pin is short to ground - Sensor power supply terminal pin is short to ground - Offset or damage to sensor resistance and other characteristics - Short to ground in sensor signal terminal pin corresponding to ECM
P023800	Turbocharger/ Supercharger Boost Sensor "A" Circuit High	Boost pressure sensor voltage is higher than 4.85 V	1. Sensor signal terminal pin is short to power supply or open 2. Connector looseness or disengagement 3. Short circuit to power supply or open in sensor signal terminal pin corresponding to ECM	- Connector looseness or disengagement - Sensor signal terminal pin is short to power supply or open - Sensor power supply terminal, grounded terminal pin open - Offset or damage to sensor resistance and other characteristics - Short circuit to power supply, open circuit or internal circuit damage in sensor signal terminal pin corresponding to ECM
P024300	Booster Exhaust Gas Control Circuit Open	Drive channel self-diagnosis failure	1. Control valve drive circuit is open 2. Connector looseness or disengagement 3. Pin corresponding to ECM is open	- Connector looseness or disengagement - Exhaust gas control valve drive circuit pin is open - Exhaust gas control valve power supply terminal is open - Open circuit or internal circuit damage in drive pin corresponding to ECM

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P024600	Booster Exhaust Gas Control Circuit Voltage Too High or Too Low	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Exhaust gas control valve drive circuit pin is short to power or ground 3. Short to power supply or ground in drive circuit pin corresponding to ECM	- Connector looseness or poor contact - Exhaust gas control valve drive circuit pin is short to power supply or ground - Short to power supply or ground or internal circuit damage in drive pin corresponding to ECM
P029900	Turbocharger Boost Pressure Too Low	The actual boost pressure is the target boost pressure minus a certain offset	1. The line between compressor outlet and throttle valve is leaking 2. Leakage between turbine and exhaust pipe 3. Failure of waste gate valve or discharge valve 4. Turbocharger damaged 5. Working parts such as compressor impeller are dirty or damaged 6. Exhaust manifold is leaking or blocked 7. Air filter dirty	- Line between compressor outlet and throttle valve is leaking - Leakage between turbine and exhaust pipe - Exhaust manifold is leaking or blocked - Air filter dirty - The waste gate valve or discharge valve failure and is in a normally open state - Working parts such as compressor impeller are dirty or damaged - Turbocharger damaged
P226100	Turbocharger/ Supercharger Bypass Valve "A" - Mechanical	Number of pressure fluctuations front of throttle is greater than a certain threshold	1. Discharge control valve wire harness interrupted 2. Discharge control valve is damaged 3. Discharge control valve pin corresponding to ECM terminal is damaged	- Discharge control valve Wire Harness interrupted - Discharge control valve is damaged - Discharge control valve pin corresponding to ECM terminal is damaged
P224300	O2 Sensor Negative Current Control Circuit Open Bank 1 Sensor 1	After the heating control of oxygen sensor starts, the internal resistance of LSU is unreasonably high	1. Upstream oxygen sensor RE wire is open	- Check whether the pins of black wire at oxygen sensor connector is poor contacted - Check the continuity of oxygen sensor wire

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				harness, whether there is an open circuit - Check the connector between wire harness and ECM for pin abnormality, resulting in poor contact - Clear DTC, start the vehicle and run until the coolant temperature reach the normal valve, and check whether the fault is reported again. - Check whether there is any abnormality in LSU oxygen sensor processing circuit inside ECM
P225100	O2 Sensor Negative Current Control Circuit Open Bank 1 Sensor 1	After the heating control of oxygen sensor starts, the internal resistance of LSU and signal terminal voltage is remains 1.5 V	1. Upstream oxygen sensor IPE wire is open	- Check whether the pins of yellow wire at connector of oxygen sensor is poor contacted - Check the continuity of oxygen sensor wire harness, whether there is an open circuit - Check the connector between wire harness and ECM for pin abnormality, resulting in poor contact - Clear DTC, start the vehicle and run until the coolant temperature reach the normal valve, and check whether the fault is reported again. - Check whether there is any abnormality in LSU oxygen sensor processing circuit inside ECM
P241400	O2 Sensor Exhaust Sample Error Bank 1 Sensor 1	LSU is sensing lean, no circuit failure and target air-fuel ratio is lean	1. Expose LSU in the air or LSU connector is in poor connection	- Check whether the oxygen sensor is not installed correctly, check if it is installed outside of exhaust manifold and contact with air - Check the regulating resistance in oxygen sensor connector for failure or infinity - Check whether the resistance between IA and IP circuit in oxygen

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				sensor processing circuit inside of ECM is infinity
P019128	Fuel Rail Pressure Sensor Circuit Bank 1- Negative Offset	After fully cold soaking, the start fuel rail pressure is higher than the threshold, and the oil passage self-learning failure is reported in this driving cycle.	1. Fuel rail pressure sensor internal circuit and wire harness are deteriorated	- Check whether there is gas in the fuel rail, causing the rail pressure to fail to build up quickly? - Replace the fuel rail pressure sensor, return the vehicle to customer, and check whether the fault will be reported again?
P019129	Fuel Rail Pressure Sensor Circuit Bank 1- Positive Offset	After fully cold soaking, the start fuel rail pressure is lower than the threshold, and the oil passage self-learning failure is reported in this driving cycle.	1. Fuel rail pressure sensor internal circuit and wire harness are deteriorated	- Check whether there is a large contact resistance at the connector of fuel rail pressure sensor or in the wire harness? - Replace the fuel rail pressure sensor, return the vehicle to customer, and check whether the fault will be reported again?
U012287	Lost Communication With ESP (- Electronic Stability Program)	ECM receiving ESP information timed out	1. ESP connector looseness or separation 2. Transmission line between ESP and ECM damaged or interrupted 3. ESP is damaged and signal cannot be transmitted to ECM normally	- ESP connector looseness or separation - There is wire harness signal interference - Transmission line between ESP and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - ESP is damaged and signal cannot be transmitted to ECM normally
U014687	Lost Communication With GW (Gateway)	ECM receiving GW information timed out	1. GW connector looseness or separation 2. Transmission line between GW and ECM damaged or interrupted 3. GW is damaged and signal cannot be transmitted to ECM normally	- GW connector looseness or separation - There is wire harness signal interference - Transmission line between GW and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - GW is damaged and signal cannot be transmitted to ECM normally
U012687	Lost Communication	ECM receiving SAS information timed out	1. SAS connector looseness or	SAS connector looseness or separation

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	With SAS (- Steering Angle)		separation 2. Transmission line between SAS and ECM damaged or interrupted 3. SAS is damaged and signal cannot be transmitted to ECM normally	- There is wire harness signal interference - Transmission line between SAS and ECM damaged or interrupted - Check if there is SAS hardware circuit fault - SAS is damaged and signal cannot be transmitted to ECM normally
U010187	Lost Communication With TCM (- Transmission Controller)	ECM receiving TCM information timed out	1. TCM connector looseness or separation 2. Transmission line between TCM and ECM damaged or interrupted 3. TCM is damaged and signal cannot be transmitted to ECM normally	- TCM connector looseness or separation - There is wire harness signal interference - Transmission line between TCM and ECM damaged or interrupted - Check if TCM hardware circuit fault - TCM is damaged and signal cannot be transmitted to ECM normally
U110017	CAN Module Input Power Voltage High	CAN communication voltage is higher than the threshold	1. CAN bus interface looseness or poor contact 2. Short circuit to power supply / ground or open circuit in CAN bus interface pin 3. Short circuit to power supply / ground, open circuit or internal circuit damage in CAN bus interface pin corresponding to ECM terminal	- CAN bus interface looseness or poor contact - Short circuit to power supply / ground or open circuit in CAN bus interface pin - There is wire harness signal interference - Short circuit to power supply / ground, open circuit or internal circuit damage in CAN bus interface pin corresponding to ECM terminal
P141500	Response Reception Time Out Error of LIN Bus (Contact Between EMS and Intellectual Generator)	ECM receives LIN communication and sends fault information	1. Alternator LIN bus interface looseness or poor contact 2. LIN wire interference 3. LIN line is broken or interrupted 4. Alternator is damaged and cannot normally transmit signals to ECM	- Alternator LIN bus interface looseness or poor contact - There is wire harness signal interference - Alternator LIN bus is damaged or interrupted - Alternator is damaged and signal cannot be transmitted to ECM normally

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P141700	Checksum Error of LIN Bus (- Contact Between EMS and Intellectual Generator)	ECM receives LIN communication and sends fault information	1. LIN communication version of intelligent alternator is inconsistent with ECM	Whether the LIN communication version of intelligent alternator is consistent with ECM
P051300	Immobilizer Malfunction	Anti-theft data authentication failed	1. ECM does not perform anti-theft matching or anti-theft status is wrong	- Immobilizer connector looseness or separation - Immobilizer circuit fault - If ECM has been replaced, check if anti-theft authentication code is incorrect or not updated - Immobilizer fault - Anti-theft module circuit fault corresponding to ECM terminal
P063300				
P161000				
P161400				
P161200				
P161300				
P161100				
P242200	Canister Vent Valve Stuck Normally Closed	Fuel tank pressure is below the threshold	1. Canister vent valve pin is low, which makes the canister vent valve close 2. Canister vent valve is stuck in the normally closed position and cannot be opened 3. Canister vent valve line is blocked 4. Canister valve stuck in normally open position 5. Fuel tank pressure sensor is damaged	- Keep the sensor connector normal, use a multimeter to check whether the canister vent valve pin voltage is low and whether it is short to ground - Remove the canister vent valve line and check whether it is blocked - Check if canister vent valve is stuck in closed position - Check if canister vent valve is stuck in normally open position - Replace the fuel tank pressure sensor, start vehicle for 10 minutes, and check whether the fault reappears
P045300	Fuel Tank Pressure Sensor Signal Short to Power Supply	Pressure sensor voltage signal is higher than 4.8 V	1. Fuel tank pressure sensor signal terminal is short to power supply 2. Short to power supply in fuel tank pressure sensor signal pin corresponding to ECM terminal	- Use a multimeter to measure if fuel tank pressure signal wire voltage is close to or equal to 5 V - Measure whether the wire harness terminal voltage corresponding to fuel tank pressure signal is close to or equal to 5 V - Check if short circuit to power supply or internal circuit damage in intake pressure sensor signal pin terminal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				corresponding to ECM terminal
P045200	Fuel Tank Pressure Sensor Signal Short to Ground	Boost sensor voltage signal is lower than 0.2 V	1. Fuel tank pressure sensor signal terminal is short to ground 2. Short to ground in fuel tank pressure sensor signal pin corresponding to ECM terminal	- Use a multimeter to measure if fuel tank pressure signal wire voltage is close to or equal to 0V - Measure whether the wire harness terminal voltage corresponding to fuel tank pressure signal is close to or equal to 0V - Check if short circuit to ground or internal circuit damage in intake pressure sensor signal pin terminal corresponding to ECM terminal
P128200	EVAP System Pressure Sensor/ Switch Circuit Range Performance	Fuel tank pressure sensor pressure signal is continuously higher than the threshold	1. Canister vent valve closed 2. Line from fuel tank to canister is blocked 3. Fuel tank pressure sensor is damaged	- Check whether canister vent valve is closed - Check whether the line from fuel tank to the canister is blocked - Replace fuel tank pressure sensor. Start vehicle for 10 minutes, and check whether the fault reappears
P128300	EVAP System Pressure Sensor/ Switch Circuit Range Performance	Fuel tank pressure sensor pressure signal is continuously lower than the threshold	1. Canister vent valve closed 2. Line from fuel tank to canister is blocked 3. Fuel tank pressure sensor is damaged 4. Canister valve stuck in normally open position	- Check whether canister vent valve is closed - Check whether the line from fuel tank to the canister is blocked - Replace fuel tank pressure sensor. Start vehicle for 10 minutes, and check whether the fault reappears - Check if canister vent valve is stuck in normally open position
P04512A	EVAP System Pressure Sensor&Switch Circuit Range Performance	Difference between maximum and minimum fuel tank pressure is below the threshold	1. Canister solenoid valve stuck in normally closed or normally open position 2. Line from fuel tank to canister is blocked or disconnected 3. Line from canister to canister valve is	- Check whether the carbon canister solenoid valve is in normally closed or normally open position - Check whether the line from fuel tank to the canister is blocked/ disconnect - Check whether the line from canister to canister

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			blocked or disconnected 4. Fuel tank pressure sensor is damaged	valve is blocked/ disconnect Replace fuel tank pressure sensor. Start vehicle for 10 minutes, and check whether the fault reappears
P045125	EVAP System Pressure Sensor&Switch Circuit Range Performance	Fluctuating amount of fuel tank pressure continues to exceed the threshold	1. Fuel tank pressure sensor damaged 2. Canister valve is damaged	- Replace the fuel tank pressure sensor, restart vehicle for 10 minutes, and check whether the fault reappears - Replace ECM. Restart vehicle for 10 minutes, and check whether the fault reappears - Check the canister valve wire harness and replace the canister valve, restart vehicle for 10 minutes, and check whether the fault reappears
P045128	EVAP System Pressure Sensor&Switch Circuit Range Performance	Difference between fuel tank pressure value and reference fuel tank pressure value during cold start exceeds the threshold	1. Fuel tank pressure sensor damaged 2. Line from fuel tank to canister is blocked	- Replace the fuel tank pressure sensor, and check whether the fault reappears - Check whether the line from fuel tank to the canister is blocked - Replace ECM, and check whether the fault reappears
P046300	Fuel Level Sensor "A" Circuit High	Self-diagnosis of fuel level signal circuit connectivity	1. Abnormal connection of fuel level sensor wire harness 2. Abnormal connection of fuel level sensor wire harness 3. ECM internal circuit abnormal	- Using multimeter, check whether the sensor pin voltage is normal - Check whether CAN signal is normal - Check whether wire harnesses is normal - Replace ECM, and check whether the fault reappears
P046200	Fuel Level Sensor "A" Circuit Low	Self-diagnosis of fuel level signal circuit connectivity	1. Abnormal connection of oil level sensor wire harness 2. Fuel level sensor is damaged 3. ECM internal circuit abnormal	- Using multimeter, check whether the sensor pin voltage is normal - Check whether CAN signal is normal - Check whether wire harnesses is normal - Replace ECM, and check whether the fault reappears

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P25B000	Fuel Level Sensor "A" Stuck	Fuel level signal change does not exceed the threshold	1. ECM CAN signal is abnormal 2. Fuel level sensor is damaged 3. Fuel level float inside fuel tank is stuck	- Replace the fuel level sensor, and check whether the fault reappears - Check whether the fuel level float inside fuel tank is stuck - Replace ECM, and check whether fault reappears
P046129	Fuel Level Sensor Unreasonable	There is a big difference between liquid level change and the calculated fuel consumption	1. ECM CAN signal is abnormal 2. Fuel level sensor is damaged	- Check whether CAN signal is normal - Replace ECM, and check whether fault reappears - Replace the fuel level sensor, and check whether the fault reappears
P044200	EVAP System Leak Detected (- Small Leak)	The vacuum attenuation gradient of evaporation system exceeds the threshold	1. Fuel tank cap is not tightened or there is a leak 2. Canister vent valve cannot be completely closed 3. There is leakage in fuel tank - line - canister valve - canister solenoid valve - canister vent valve 4. Canister solenoid valve cannot be completely closed	- Check whether the fuel tank cap is tightened - Check the fuel tank - line - canister valve - canister solenoid valve - canister vent valve for leakage/ blockage, and whether the connectors are installed correctly - Check whether canister vent valve completely closed, and short to pin - Check whether the carbon canister solenoid valve is completely closed when power-on
P045500	EVAP System Leak Detected (- Large Leak)	The vacuum degree of evaporation system cannot reach the target vacuum degree during the vacuuming process	1. Fuel tank cap is not tightened or there is a leak 2. Canister vent valve cannot be completely closed 3. There is leakage in fuel tank - line - canister valve - canister solenoid valve - canister vent valve 4. Canister solenoid valve cannot be	- Check whether the fuel tank cap is tightened - Check the fuel tank - line - canister valve - canister solenoid valve - canister vent valve for leakage/ blockage, and whether the connectors are installed correctly - Check whether canister vent valve completely closed, and short to pin - Check whether the carbon canister solenoid valve is completely closed when power-on

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			completely closed	
P049700	EVAP System Low Purge Flow	The pressure fluctuation of low load desorption line does not reach the threshold	1. Low load desorption line, check valve and connection between canister valve and engine are blocked or disconnected 2. Canister valve stuck in normally closed or normally open position	- Check whether the desorption line, check valve (if equipped) and connection between canister valve and engine are blocked or disconnected. - Replace the corresponding line. - Check whether the canister valve hardware is stuck in normally closed/normally open position - Replace canister valve
P04F000	EVAP System High Pressure Purge	The pressure fluctuation of high load desorption line does not reach the threshold	1. High load desorption line, check valve, venturi tube and connection between canister valve and engine are blocked or disconnected 2. The check valve of low load line is damaged and cannot function correctly 3. Canister valve stuck in normally open or normally closed position	- Check whether the desorption line, check valve (if equipped), venturi tube (if equipped) and connection between canister valve and engine are blocked or disconnected. - Replace the corresponding line. - Check whether the check valve of low load line is damaged or not functioning correctly - Check whether the canister valve hardware is stuck in normally closed/normally open position - Replace canister valve
P046800	EVAP Purge Flow Sensor Circuit High	high load desorption line pressure sensor voltage signal is higher than 4.88 V	1. Pressure sensor signal terminal is short to power supply 2. Short to power supply in high load desorption line voltage sensor signal corresponding to the ECM terminal	- Use a multimeter to measure whether the voltage of high load desorption line voltage sensor signal wire is close to or equal to 5 V - Measure whether the pressure sensor wire harness terminal voltage is close to or equal to 5 V - Check if short circuit to power supply or internal circuit damage in high load desorption line pressure sensor signal pin terminal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				corresponding to ECM terminal
P046700	EVAP Purge Flow Sensor Circuit Low	High load desorption line pressure sensor voltage signal is lower than 0.2 V	1. Pressure sensor signal terminal is short to ground 2. Short to ground in high load desorption line voltage sensor signal corresponding to the ECM terminal	- Use a multimeter to measure whether the voltage of high load desorption line voltage sensor signal wire is close to or equal to 0V - Measure whether the pressure sensor wire harness terminal voltage is close to or equal to 0V - Check if short circuit to ground or internal circuit damage in high load desorption line pressure sensor signal pin terminal corresponding to ECM terminal
P128500	EVAP Purge Flow Sensor Circuit Range Performance	High load desorption line pressure sensor pressure signal exceeds the threshold	1. Pressure sensor signal terminal is short to power supply 2. Short to power supply in high load desorption line voltage sensor signal corresponding to the ECM terminal 3. High load desorption line pressure sensor is damaged 4. Check valve of low load desorption line is damaged and cannot function correctly 5. Venturi tube is disconnected	- Use a multimeter to measure whether the voltage of high load desorption line voltage sensor signal wire is close to or equal to 5 V - Measure whether the pressure sensor wire harness terminal voltage is close to or equal to 5 V - Check if short circuit to power supply or internal circuit damage in high load desorption line pressure sensor signal pin terminal corresponding to ECM terminal - Replace the high-load desorption line pressure sensor and drive the vehicle with a heavy load, check whether the fault reappears - Replace the low load desorption line check valve and drive the vehicle with a heavy load, check whether the fault reappears - Check whether the venturi tube is disconnected
P128600	EVAP Purge Flow Sensor Circuit Range Performance	High load desorption line pressure sensor pressure signal is lower than the threshold	1. Pressure sensor signal terminal is short to ground 2.	Use a multimeter to measure whether the voltage of high load desorption line voltage

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			Short to ground in high load desorption line voltage sensor signal corresponding to the ECM terminal 3. High load desorption line pressure sensor is damaged 4. Venturi tube or check valve of high load desorption line is blocked	sensor signal wire is close to or equal to 0V • Measure whether the pressure sensor wire harness terminal voltage is close to or equal to 0V • Check if short circuit to ground or internal circuit damage in high load desorption line pressure sensor signal pin terminal corresponding to ECM terminal • Replace the high-load desorption line pressure sensor and drive the vehicle, check whether the fault reappears • Replace the high load desorption line check valve or venturi tube, drive the vehicle and check whether the fault reappears
P019000	Fuel Rail Pressure Sensor Circuit Bank 1	Fuel rail pressure sensor circuit voltage is lower than 0.2 V or higher than 4.8 V	1. Fuel rail pressure sensor signal terminal is short to ground or power supply 2. Short to power or ground in fuel rail pressure sensor pin corresponding to ECM	• Check whether the sensor signal terminal is short to power supply or ground • Check sensor for damage • Check if short circuit to power supply or ground or internal circuit damage in fuel rail pressure sensor signal pin corresponding to ECM terminal
P209700	Post Catalyst Fuel Trim System Too Rich Bank 1	The offset value of upstream oxygen characteristic based on downstream oxygen exceeds the upper threshold	1. Upstream oxygen has a negative characteristic deviation (rich) 2. A certain degree of aging occurs in downstream oxygen 3. Leakage in intake and exhaust system 4. Catalytic converter is seriously degraded	• Check intake and exhaust system for leakage • Replace upstream LSU oxygen sensor, return vehicle to the customer, and check whether fault reappears • Replace the downstream oxygen sensor, and check whether the fault reappears • Check whether the catalytic converter is degraded • Replace catalytic converter, and check whether the fault reappears

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P209600	Post Catalyst Fuel Trim System Too Lean Bank 1	The offset value of upstream oxygen characteristic based on downstream oxygen is lower than the lower threshold	1. Upstream oxygen has a positive characteristic deviation (lean) 2. A certain degree of aging occurs in downstream oxygen 3. Leakage in intake and exhaust system 4. Catalytic converter is seriously degraded	- Check intake and exhaust system for leakage - Replace upstream LSU oxygen sensor, return vehicle to the customer, and check whether fault reappears - Replace the downstream oxygen sensor, and check whether the fault reappears - Check whether the catalytic converter is degraded - Replace catalytic converter, and check whether the fault reappears
P223200	O2 Sensor Signal Circuit Shorted to Heater Circuit Bank 1 Sensor 2	Within a certain number of times that the downstream oxygen sensor is heated and turned off, the change in voltage of downstream oxygen sensor is higher than the threshold	1. Downstream oxygen sensor wire harness and connector are abnormal 2. Oxygen sensor terminal heater power supply ground is short to oxygen sensor signal line	- Do not disconnect oxygen sensor connector, measure if heater power supply positive voltage of downstream oxygen sensor wire harness oxygen sensor terminal is 12 V. - Do not disconnect oxygen sensor connector, measure if heater power supply grounded voltage of downstream oxygen sensor wire oxygen sensor terminal is 12 V. - Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal oxygen sensor signal wire and oxygen sensor signal grounded is about 0.45 V. - Start and keep vehicle idling until coolant temperature reaches normal value. Do not disconnect oxygen sensor connector, measure if voltage between downstream oxygen sensor wire ECM terminal oxygen sensor signal wire and oxygen

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				sensor signal grounded is changed in range of 0V - 1V. - Start and keep vehicle idling until coolant temperature reaches normal value. Disconnect downstream oxygen sensor connector, measure if oxygen sensor terminal heater power grounded and oxygen sensor signal wire are short circuit. - Connect downstream oxygen sensor connector properly, repeat steps 5-6 and check if voltage signal changes between 0.44 V and 0.46 V, 0 V and 1 V respectively.
P013A00	O2 Sensor Slow Response - Rich to Lean Bank 1 Sensor 2	The transition time from rich to lean of downstream oxygen sensor voltage signal exceeds the threshold	1. Downstream oxygen sensor is aging	Replace downstream oxygen sensor and connect wire harness properly. Start the vehicle and run until the coolant temperature reach the normal value. The accelerator pedal was released at a speed about 70 km/h for several times, and the fault reappears.
P064D00	LSU Integrated Ship Failure	Chip communication self-diagnostic	1. LSU oxygen sensor is damaged 2. ECM internal communication is abnormal	- Replace oxygen sensor, and check whether the fault reappears - Replace ECM, and check whether the fault reappears
P064D13	Upstream Oxygen Sensor Sensing Element Failure			
P223700	O2 Sensor Positive Current Control Circuit Open Bank 1 Sensor 1 (Close to ECM)	Chip fault memory diagnosis	1. Open circuit in LSU oxygen sensor APE line, which is close to ECM terminal 2. ECM internal circuit is abnormal	- Replace oxygen sensor, and check whether the fault reappears - Replace ECM, and check whether the fault reappears
P223713	O2 Sensor Positive Current Control Circuit Open Bank 1 Sensor 1	Before and after applying the pump current, the current difference between APE wire and IPE wire is lower than threshold, and current difference between RE wire and IPE wire is higher than threshold	1. LSU oxygen sensor APE wire is disconnected	- Check whether the wire harness and connector of oxygen sensor are disconnected or poor connection. - Replace upstream oxygen sensor. Start the

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				vehicle and run until the coolant temperature reach the normal valve. Fault reappears.
P053F21	Cold Start Fuel Pressure Performance	During the catalytic converter is heating, the deviation between target fuel rail pressure of high pressure fuel rail and the actual fuel rail pressure exceeds the threshold	1. Oil passage is leakage 2. Insufficient fuel 3. Low pressure oil pump is damaged 4. The working capacity of high pressure oil pump is reduced	• Check for leakage in oil passage • Check if fuel is insufficient • Check low pressure oil pump for damage • Check whether the working capacity of high pressure oil pump has decreased
P053F22	Cold Start Fuel Pressure Performance	During the catalytic converter is heating, the deviation between target fuel rail pressure of high pressure fuel rail and the actual fuel rail pressure is lower than the threshold	1. High pressure oil pump control failure 2. Pressure relief valve blocked	• Check whether the high pressure oil pump control is normal • Check relief valve for blockage or abnormal operation
P00C600	Fuel Rail Pressure Too Low - Engine Cranking Bank 1	The fuel rail pressure is low when starting and the high pressure starting is unsuccessful	1. Oil passage is leakage 2. Insufficient fuel 3. Low pressure oil pump is damaged 4. The working capacity of high pressure oil pump is reduced 5. Injector is damaged 6. Replace the new fuel pipe or new vehicle has just off the production line, the oil passage pressure has not been established yet, and a malfunction may be reported	• Check for leakage in oil passage • Check if fuel is insufficient • Check low pressure oil pump for damage • Check whether the working capacity of high pressure oil pump has decreased • Check injector for damage • Whether the new fuel pipe has been replaced or the new vehicle has just off the production line • Repair the malfunction, drive the vehicle for 10 minutes, let the oil pressure be fully established, turn off the engine and start again, check whether the fault reappears
P02CD00	Cylinder 1 Fuel Injector Offset Learning At Max Limit	CVO self-learning value of cylinder 1 injector exceeds the upper threshold	1. Cylinder 1 injector is damaged	• Check cylinder 1 injector for damage
P02D100	Cylinder 3 Fuel Injector Offset Learning At Max Limit	CVO self-learning value of cylinder 3 injector exceeds the upper threshold	1. Cylinder 3 injector is damaged	• Check cylinder 3 injector for damage

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P02D300	Cylinder 4 Fuel Injector Offset Learning At Max Limit	CVO self-learning value of cylinder 4 injector exceeds the upper threshold	1. Cylinder 4 injector is damaged	Check cylinder 4 injector for damage
P02CF00	Cylinder 2 Fuel Injector Offset Learning At Max Limit	CVO self-learning value of cylinder 2 injector exceeds the upper threshold	1. Cylinder 2 injector is damaged	Check cylinder 2 injector for damage
P02CC00	Cylinder 1 Fuel Injector Offset Learning At Min Limit	CVO self-learning value of cylinder 1 injector is lower than the lower threshold	1. Cylinder 1 injector is damaged	Check cylinder 1 injector for damage
P02D000	Cylinder 3 Fuel Injector Offset Learning At Min Limit	CVO self-learning value of cylinder 3 injector is lower than the lower threshold	1. Cylinder 3 injector is damaged	Check cylinder 3 injector for damage
P02D200	Cylinder 4 Fuel Injector Offset Learning At Min Limit	CVO self-learning value of cylinder 4 injector is lower than the lower threshold	1. Cylinder 4 injector is damaged	Check cylinder 4 injector for damage
P02CE00	Cylinder 2 Fuel Injector Offset Learning At Min Limit	CVO self-learning value of cylinder 2 injector is lower than the lower threshold	1. Cylinder 2 injector is damaged	Check cylinder 2 injector for damage
P02EE00	Cylinder 1 Fuel Injector Control Circuit Short	Drive channel self-diagnosis failure	1. Injector high side control circuit is short to low side control circuit	Check whether the high side control circuit of corresponding injector is short to low side control circuit
P02EF00	Cylinder 2 Fuel Injector Control Circuit Short			
P02F000	Cylinder 3 Fuel Injector Control Circuit Short			
P02F100	Cylinder 4 Fuel Injector Control Circuit Short			
P062B9A	Internal Control Module Fuel Injector Control Performance - Component Internal Failure	All cylinders have CVO self-learning values that exceed the threshold or have unreasonable circuit signals	1. Injector wires for all cylinders are abnormal 2. ECM internal circuit is abnormal	- Check whether all cylinder injector wire harness connections are normal - Replace the injectors of all cylinders, start the vehicle, and check whether the fault reappears - After replacing ECM, start the vehicle, and check whether the fault reappears
P062B64				
P062B96				
P012200	Electronic Throttle 1st Path	The voltage value of a certain path of throttle signal	1. The first/second signal line of the	Collect the both paths signal voltage values ThrVlv_uRawSens1B1,
P022200				

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	/ 2nd Path Signal Voltage Minimum	is lower than a certain value and lasts for a period of time	electronic throttle is open 2. The first/ second signal wire of electronic throttle is short to GND 3. An open circuit of electronic throttle 5 V power supply line will cause two faults to be reported at the same time	ThrVlv_uRawSens2B1 of electronic throttle valve and check whether it drops to near zero. - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Through the electronic throttle flying wire connection to verify whether it is the cause by the wire harness resistance. - Replace the throttle body to determine whether there is an internal problem of throttle. - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P012300	Electronic Throttle 1st Path / 2nd Path Signal Voltage Maximum	The voltage value of a certain path of throttle signal is higher than a certain value and lasts for a period of time	1. The first/ second signal wire of the electronic throttle is short to 5 V 2. An open circuit of electronic throttle signal ground wire cause two faults to be reported at the same time	- Collect the both paths signal voltage values ThrVlv_uRawSens1B1, ThrVlv_uRawSens2B1 of electronic throttle valve and check whether it drops to near zero. - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Through the electronic throttle flying wire connection to verify whether it is the cause by the wire harness resistance. - Replace the throttle body to determine whether there is an internal problem of throttle. - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P022300				
P012100	Electronic Throttle 1st Path / 2nd Path Signal Voltage Improper	Compare the first path signal of electronic throttle body with 5 V minus the second path signal. When the deviation exceeds threshold and after a period of time, compare the both paths	1. The first path signal of electronic throttle is short to the second path signal 2. There is resistance on	Collect and observe whether the voltage value of the two DVE signals ThrVlv_uRawSens1B1 and ThrVlv_uRawSens2B1
P022100				

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
		signals with the signal after inflation pressure conversion, the signal that deviates from the main inflation pressure signal exceeds a certain value and is confirmed after a period of time reports a failure	electronic throttle 5 V power supply wire or GND wire, causing the pedal voltage to drop by 5 V or the zero voltage to be raised	deviate from 5 V in addition - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Measure the voltage drop of each section on wire harness by AD-Scan. If the wire harness is normal, there is no voltage drop, and if there is a voltage drop, it means that there is resistance in wire harness or connector. - Through the electronic throttle flying wire connection to verify whether it is the cause by the wire harness - Replace the throttle body to determine whether there is an internal problem of throttle - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P155400	Max Error of DVE Return Spring Check Failure	After each ignition ON, the system will command DVE to open to a certain opening through ECM, and then check whether DVE can be reached within the specified time, and then check whether DVE can be returned within the specified time; if it cannot be reached to the specified position within the specified time, it is judged as P1555; if it cannot return to the specified range within the specified time after opening, it is judged as P1554. When ECM drives the throttle, the ECM will always compare the target opening with the actual throttle feedback. When the deviation between target and actual exceeds a certain value and after a certain period of time to confirmed, it will be judged as P1561	1.The PIN of electronic throttle drive motor is open or short 2. Electronic throttle body valve plate is dirty or there are foreign matters, which makes the valve plate stuck	- Whether the actual opening ThrVlv_ratActIntB1 is consistent with the target opening ThrVlv_ratDesB1 - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Through the electronic throttle flying wire connection to verify whether it is the cause by the wire harness - Replace the throttle body to determine whether there is an internal problem of throttle - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P155500				
P156100				

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P156000	Electronic Throttle PID Adjustment Malfunction	When the duty ratio that ECM output to the throttle valve continues to exceed 80% and maintains for 5 seconds, P1560 (DFC_ThrVlvDycB1) is reported	1. The PIN of electronic throttle drive motor is open or short 2. Electronic throttle body valve plate is dirty or there are foreign matters, which makes the valve plate resistance large and sticky 3. Throttle drive chip in ECM is abnormal	- It may be caused by foreign matter sticking on throttle valve plate (the possibility is greater); it may be caused by the failure of throttle drive motor pin; or it may be also caused the DVE drive module inside ECM may have a hardware failure (the possibility is less) - By replacing the throttle body to determine whether there is an internal problem of throttle - By replacing ECM to determine whether there is a fault in ECM internal throttle drive module - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P155000	Electronic Throttle Self-learning Unable to Complete / Throttle Initial Self-learning Unable to Complete	Throttle self-learning must meet 7 conditions at the same time: no DVE or monitoring failure; speed is 0; vehicle speed is 0; pedal is 0; battery voltage is higher than 10 V; engine coolant temperature is higher than 5°C; intake air temperature is higher than 5°C. When the above 7 conditions cannot be met at the same time, P155000 will be reported. ECM will report P1551 if the conditions are not met during the first self-learning	1. The conditions of DVE self-learning are not met, please refer to the above 7 conditions 2. When the coolant temperature or intake air temperature sensor is faulty, the temperature condition will not be met because the correct temperature is not collected. 3. Some vehicle assembly factories do not turn on the heater in workshop in winter, and the fault may be caused when the temperature is too low	- Compare the above 7 conditions and find out whether there are any unsatisfied ones one by one - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P155100				

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P210000	Electronic Throttle Drive Level Malfunction	Monitor DVE power driver stage-SPI bus or signal failure	1. Throttle valve failure (valve plate stuck or motor failure) 2. Throttle drive module failure in ECM	- By replacing the throttle body to determine whether there is an internal problem of throttle - By replacing ECM to determine whether there is a fault in ECM internal throttle drive module - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P210300				
P210600				
P211800				
P155800	Not Plausible Error of DV-E Limphone Learning Position	The NLP position learned by throttle is out of the reasonable range, and a fault is reported	1. Throttle valve or ECM is abnormal during throttle self-learning	- In an environment with a temperature higher than 5°C, ignition ON again, use the diagnostic tester to trigger throttle self-learning once, and observe whether the throttle can successfully complete the self-learning - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P155900				
P155A00				
P155B00				
P155600	Electronic Throttle Lower Mechanic Stop Re-learning Error	When the bottom dead center position learned by throttle is out of the reasonable range, and a fault is reported	1. Throttle valve or ECM is abnormal during throttle self-learning	- In an environment with a temperature higher than 5°C, ignition ON again, use the diagnostic tester to trigger throttle self-learning once, and observe whether the throttle can successfully complete the self-learning - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P155700				
P15A000	CPU0: MPU Error (Memory, DSPR, PSPR)	ECM chip hardware premier error	ECM hardware fault	- Replace ECM - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P15A100	CPU0: DCACHE/DSPR ECC Uncorrectable Error			
P15A200	CPU0: DCACHE/ DSPR Address Error			
P15A300	CPU0:DCACHE TAG SRAM ECC			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Uncorrectable Error			
P15A400	CPU0:DCACHE TAG SRAM Address Error			
P15A500	CPU0:PCACHE TAGRAM ECC Uncorrectable Error			
P15A600	CPU0:PCACHE TAGRAM Address Error			
P15A700	CPU0: PCACHE/ PSPR ECC Uncorrectable Error			
P15A800	CPU0:PCACHE/ PSPR Address Error			
P15A900	CPU1:Lockstep Comparator Error			
P15AA00	CPU1:MPU Error (Memory, DSPR, PSPR)			
P15AB00	CPU1:DCACHE/ DSPR ECC Uncorrectable Error			
P15AC00	CPU1:DCACHE/ DSPR Address Error			
P15AD00	CPU1:DCACHE TAGRAM ECC Uncorrectable Error			
P15AE00	CPU1:DCACHE TAGRAM Address Error			
P15AF00	CPU1:PCACHE TAGRAM ECC Uncorrectable Error			
P15B000	CPU1:PCACHE TAGRAM Address Error			
P15B100	CPU1:PCACHE TAGRAM Address Error			
P15B100	CPU1:PCACHE/ PSPR ECC			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Uncorrectable Error			
P15B200	CPU1:PCACHE/ PSPR Address Error			
P15B300	LMU:SRAM ECC Monitoring Error			
P15B400	LMU:SRAM ECC Uncorrectable Error			
P15B500	LMU:SRAM Address Error			
P15B600	SMU: Recover Timer 0 Timeout Error			
P15B700	SMU: Recover Timer 1 Timeout Error			
P15B800	PMU:PFLASH ECC Uncorrectable Multi-bit Error			
P15B900	PMU:PFLASH Address Error			
P15BA00	PMU: PFLASH ECC Monitoring Error (Cover All ECC Module)			
P15BB00	PMU: PFLASH EDC Comparator Error (Cover All PFLASH Instances)			
P15BC00	SCU/CGU: System PLL OSC_WDT: Input Clock Exceeds Limit Error			
P15BD00	SCU/CGU: System PLL VCO Clock Event Loss Error			
P15BE00	SCU/EVR: EVR 1.3V Digital Undervoltage Error			
P15BF00	SCU/EVR: EVR 3.3V Overvoltage Error			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P15C000	SCU/EVR: External Power Supply Overvoltage Error			
P15C100	SCU/WDTS: Safety Watchdog Timeout Error			
P15C200	SCU/WDTCPU0: Watchdog CPU0 Timeout Error			
P15C300	SCU/WDTCPU1: Watchdog CPU1 Timeout Error			
P15C400	SCU/CGU: PLL_ ERAY VCO Clock Event Loss Error			
P15C500	SCU/WDTCPU2: Watchdog CPU2 Timeout Error			
P15C600	SCU/DTS: Temperature Sensor Overflow Error			
P15C700	Registers: Register Monitor Detects Error			
P15C800	SCU/LSCU: SCU Configuration Error: Monitor Dual-track Properties (- Inverted Signal) Alarm from Lockstep Comparator (LSCU)			
P15C900	SCU/CGU: Clock Monitoring: STM Exceed Frequency Range Error			
P15CA00	SCU/CGU: Clock Monitoring: PLL_ ERAY Exceed Frequency Range Error			
P15CB00	SCU/CGU: Clock Monitoring: PLL Exceed			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Frequency Range Error			
P15CC00	SCU/CGU: Clock Monitoring: SRI Exceed Frequency Range Error			
P15CD00	SCU/CGU: Clock Monitoring: SPB Exceed Frequency Range Error			
P15CE00	SCU/CGU: Clock Monitoring: GTM Exceed Frequency Range Error			
P15CF00	SCU/CGU: Clock Monitoring: ADC Exceed Frequency Range Error			
P15D000	GTM: SRAMs Uncorrectable Error			
P15D100	FLEXRAY:SRAM Address Error			
P15D200	Misc SRAMs: SRAM ECC Uncorrectable Error			
P15D300	Misc SRAMs: SRAM Address Error			
P15D400	GTM: SRAMs Address Error			
P15D500	CAN: SRAM Uncorrectable Error			
P15D600	CAN: SRAM Address Error			
P15D700	FLEXRAY:SRAM ECC Uncorrectable Error			
P15D800	CPU2:MPU Error (Memory, DSPR, PSPR)			
P15D900	CPU2: DCACHE/ DSPR ECC			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Uncorrectable Error			
P15DA00	CPU2: DCACHE/ DSPR Address Error			
P15DB00	CPU2: DCACHE TAG SRAM ECC Uncorrectable Error			
P15DC00	CPU2:DCACHE TAG SRAM Address Error			
P15DD00	CPU2:121 PCACHE TAGRAM ECC Uncorrectable Error			
P15DE00	CPU2:PCACHE TAGRAM Address Failure			
P15DF00	CPU2: PCACHE/ PSPR ECC Uncorrectable Error			
P15E000	CPU2: PCACHE/ PSPR Address Error			
P061A00	Safely Monitor Torque Exceeds Limit	In the 2nd layer monitoring, when the actual torque calculated by ECM exceeds the 2nd layer allowable torque and the duration exceeds 520 ms, a fault is reported	1. ECM data settings are wrong, usually because the EGAS safety monitoring function is not matched or preset 2. The external torque increase request was not considered during the data setting process	- Communicate with EGAS safety monitoring matching engineer to confirm whether it is necessary to perform safety monitoring presetting or matching - Confirm with the customer whether there is an external torque increase request (ESP increase torque request, TCU increase torque request, etc.) - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P060D00	Accelerator Pedal 2nd Layer Monitoring Error	In the 2nd layer of monitoring, when the deviation of pedal two signals exceeds the limit, a fault will be reported	1. ECM data settings are wrong, usually because the EGAS safety monitoring function is not matched or	Communicate with EGAS safety monitoring matching engineer to confirm whether it is necessary to perform safety monitoring presetting or matching

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			preset 2. The application layer data of pedal module does not match the monitoring layer data during the data setting process	- Confirm with the customer whether the pedal model has been changed - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P152000	Function Monitoring: Check of Predicted Air Mass Failed	In the 2nd layer of monitoring, when recognizing that there is a deviation between the calculation of load to fuel injection volume and calculation of monitoring layer in the calculation of ECM application layer, the fault is reported.	1. ECM data settings are wrong, usually because the EGAS safety monitoring function is not matched or preset 2. The calculation of application layer from load to fuel injection volume is wrong	- Communicate with EGAS safety monitoring matching engineer to confirm whether it is necessary to perform safety monitoring presetting or matching - Check whether there is any error in calculation process from load to fuel injection volume at the application layer - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P152100	Function Monitoring: Fault of ECM Check of Injection Cut-off			
P152200	Function Monitoring: Fault of ECM in Check of Cylinder Individual Fuel Corrections			
P153900	Synchronization process rationality check (based on speed and synchronization count)			
P153700	Function Monitoring: Fault of ECM or Sensor in rI-Comparison			
P153500	Function Monitoring: Fault of ECM or Sensor in Mixture Check			
P153600	Function Monitoring: Fault of ECM Comparison of Lambda and Operation Mode			
P153800	Electronic Throttle Safety Monitoring Function Error (- Ignition Angle Signal, Wire	ECM Bottom Fault Response Measure Error	1. ECM Internal Malfunction	- Replace ECM - Clear DTC, restart the vehicle, and check whether the DTC is eliminated

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Harness or ECM Error)			
P152700	Function Monitoring: Monitoring of ICO From Level1	Monitoring layer recognizes an abnormal safety oil cut-off	1. ECM Internal Malfunction	- Replace ECM - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P152800	Function Monitoring: Monitoring of ICO From Level2			
P061C00	Safety Monitoring Function Error (2nd Layer Engine Speed Monitoring Error)	The monitoring layer speed signal is inconsistent with the application layer speed signal	1. ECM Internal Malfunction	- Replace ECM - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P152900	Function Monitoring: Fault of Starter Control	2nd layer of monitoring identified an abnormal start-stop function	1. ECM Internal Malfunction	- Replace ECM - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P153000	Function Monitoring: Fault of ECM ADC - Null Load Test Pulse	Hardware bottom data error	1. ECM Internal Malfunction	- Replace ECM - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P153100	Function Monitoring: Fault of ECM ADC - Test Voltage			
P157100	Closed Path Checking, Driver Level Check Error Or Communication Error			
P157200	Under Normal Voltage, ABE Activated			
P157300	Diagnostic Fault Check to Report "WDA active" Due to Errors in Query/Response Communication			
P157400	Errorpin Activated and Monitoring Communication Normal			
P157500	Diagnostic Fault Check to Report "WDA active"			

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Due to Overvoltage Detection			
P213800	Deviation Between Both Paths Signal of Accelerator Pedal Out of Limit	Both paths signal of accelerator pedal are compared. When the deviation exceeds the threshold and confirmed after a period of time, the fault will be reported.	1. There is a short circuit or resistance between first path and second path signal wires of accelerator pedal 2. There is resistance on first path/second path 5 V power supply wire of accelerator pedal or GND wire, causing the pedal terminal voltage to drop by 5 V or the zero voltage to be raised	- Collect the both paths voltage value APP_uRaw1 and APP_uRaw2 of accelerator pedal, and observe whether the relationship between them is two times when the fault occurs - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Measure the voltage drop of each section on wire harness by AD-Scan. If the wire harness is normal, there is no voltage drop, and if there is a voltage drop, it means that there is resistance in wire harness or connector. - Verify whether it is caused by the wire harness resistance by connecting the accelerator pedal flying wire - Determine whether there is an internal problem with the pedal by replacing it - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P212300	Accelerator Pedal 1st Path / 2nd Path Signal Voltage High	The voltage value of one path of pedal is higher than APP_uRaw1SRCHigh_C / APP_uRaw2SRCHigh_C and continues for TUPWGO time	1. The first path /second path signal ground wire GND of accelerator pedal is open 2. First path /- second path signal wire of accelerator pedal is short to 5 V	- Collect the both paths voltage value APP_uRaw1 and APP_uRaw2 of accelerator pedal, and observe whether it is up to 5 V at the moment the fault occurs - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Verify whether it is caused by the wire harness by connecting
P212800				

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				the accelerator pedal flying wire - Replace the pedal, check whether it is the cause of pedal - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P212200	Accelerator Pedal 1st Path / 2nd Path Signal Voltage Low	The voltage value of one path of pedal is lower than APP_uRaw1SRCLow_C / APP_uRaw2SRCLow_C and continues for TUPWGU time	1. The 5 V power supply line of the first path /second path signal of accelerator pedal is open 2. The first path /- second path signal wire of accelerator pedal is open 3. First path /- second path signal wire of accelerator pedal is short to GND	- Collect the both paths voltage value APP_uRaw1 and APP_uRaw2 of accelerator pedal, and observe whether it is down to 5 V at the moment the fault occurs - Will actions such as unplugging and plugging connectors and shaking the wire harness affect the frequency of faults? - Verify whether it is caused by the wire harness by connecting the accelerator pedal flying wire - Replace the pedal, check whether it is the cause of pedal - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P212700				
P049900	EVAP System Vent Control Circuit Short to Power Supply	Drive channel self-diagnosis failure	1. Canister vent valve control circuit is short to power supply 2. Canister vent valve control circuit pin corresponding to ECM terminal is short to power supply	- EVAP System Vent Control Circuit Short to Power Supply - Canister vent valve control circuit pin corresponding to ECM terminal is short to power supply
P049800	EVAP System Vent Control Circuit Short to Ground	Drive channel self-diagnosis failure	1. Canister vent valve control circuit is short to ground 2. Canister vent valve control circuit pin is short to ground	- Canister vent valve control circuit is short to ground - Canister vent valve control circuit pin is short to ground
P044700	EVAP System Vent Control Circuit Short to Ground	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Canister vent	Connector looseness or poor contact

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			valve control circuit is open 3. Canister vent valve control circuit power supply terminal is open or shorted to ground 4. Canister vent valve control circuit fuse is blown or damaged 5. Open or internal circuit damage in canister vent valve control circuit pin corresponding to ECM	- Canister vent valve control circuit is open - Canister vent valve control circuit power supply terminal open or short to ground - Canister vent valve control circuit fuse is blown or damaged - Open circuit or internal circuit damage in canister vent valve control circuit pin corresponding to ECM terminal
P069100	Fan Control Circuit Low	Drive channel self-diagnosis failure	1. Cooling fan relay control circuit is short to ground 2. Cooling fan relay control pin corresponding to ECM terminal is short to ground	- Cooling fan relay control circuit is short to ground - Cooling fan relay control pin corresponding to ECM terminal short to ground
P069200	Fan Control Circuit High	Drive channel self-diagnosis failure	1. Cooling fan relay control circuit is short to power supply 2. Cooling fan relay control pin corresponding to ECM terminal is short to power supply	- Cooling fan relay control circuit is short to power supply - Cooling fan relay control pin corresponding to ECM terminal is short to power supply
P048000	Cooling Fan Control Circuit Error	Drive channel self-diagnosis failure	1. Cooling fan relay control circuit is open 2. Cooling fan relay control circuit pin corresponding to ECM terminal is open	- Connector looseness or poor contact - Open circuit in cooling fan relay circuit signal terminal - Cooling fan relay malfunction (fuse blown or damaged) - Open circuit or internal circuit damage in cooling fan relay pin corresponding to ECM terminal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P063400	Cooling Fan Drive Chip Overheating	Drive channel self-diagnosis failure	1. Cooling fan relay control circuit is short to power supply 2. Cooling fan relay control pin corresponding to ECM terminal is short to power supply	- Cooling fan relay control circuit is short to power supply - Whether there is a fault in internal chip of ECM
P214800	Cylinder 1 or Cylinder 4 Fuel Injector Control Circuit Short to Power Supply	Drive channel self-diagnosis failure	1. Injector high side control circuit is short to power supply 2. Short to power supply in injector high side control pin corresponding to ECM	- Check corresponding injector high side control circuit for short to power supply - Check whether injector high side control circuit pin corresponding to ECM is short to the power supply
P215100	Cylinder 2 or Cylinder 3 Fuel Injector Control Circuit Short to Power Supply			
P070000	TCU Requests to Illuminate MIL Light	TCU Requests to Illuminate MIL Light	1. TCU fault	Check whether TCU fault memory is faulty
P145000	Brake Booster Pressure Sensor Circuit Range/Performance (High)	The brake chamber pressure is higher than the possible limit	1. Brake vacuum sensor characteristics have deviation 2. Brake vacuum chamber leakage	- Check whether there is contact resistance in brake vacuum sensor wire harness - Check whether sensor is damaged - Check whether brake vacuum chamber is leakage
P145100	Brake Booster Pressure Sensor Circuit Range/Performance (Low)	The brake chamber pressure is lower than the possible limit		
P121200	Vehicle Speed Sensor Performance Failure (Vehicle Speed Exceed Maximum Range)	Vehicle speed signal exceeds maximum possible value	1. ESP sends wrong speed signal	Check whether the CAN signal sent by ESP is too high
P050184	Vehicle Speed Sensor Performance Failure (Vehicle Speed Exceed Minimum Range)	Vehicle speed signal exceeds minimum possible value	1. ESP sends wrong speed signal 2. Vehicle speed signal frame communication between ESP and ECM is lost	- Check whether the communication between ESP and ECM is lost - Check whether the CAN signal sent by ESP is still 0
P050165	Vehicle speed sensor performance failure (vehicle speed is too low when oil cut-off during coasting)	Vehicle speed signal exceeds minimum possible value		

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P050166	Vehicle Speed Sensor "A" Circuit Range/Performance	Vehicle speed signal exceeds minimum possible value		
P050000	Vehicle Speed Sensor Input Signal Fault	CAN speed signal received by ECM is wrong		
P050B00	Cold Start Ignition Timing Performance	The ignition angle efficiency exceeds the setting threshold during heating of parking idle catalytic converter	1. There are other DTC such as throttle valve failure or misfire failure, resulting in a decrease in intake air flow and abnormal ignition angle efficiency 2. Electronic throttle is stuck in a position with a small opening 3 check whether the intake manifold is leakage, exhaust resistance is too large, and the oil supply pressure is too low 4. ECM failure	• Use diagnostic tester to check if there are other failures such as misfire failure and throttle failure • Electronic throttle is stuck in a position with a small opening • Check whether the intake manifold is leakage, whether the fuel injector is blocked, whether the exhaust resistance is too large, and whether the oil supply pressure is too low • Check whether ECM is faulty
P050B20	Cold Start Ignition Timing Performance	The ignition angle efficiency exceeds the setting threshold during heating of running catalytic converter	1. There are other DTC such as throttle valve failure or misfire failure, resulting in a decrease in intake air flow and abnormal ignition angle efficiency 2. Electronic throttle is stuck in a position with a small opening 3 Electronic throttle is stuck in a position with a small opening 4. ECM failure	• Use diagnostic tester to check if there are other failures such as misfire failure and throttle failure • Electronic throttle is stuck in a position with a small opening • Check whether the intake manifold is leakage; whether the exhaust resistance is too large; whether the fuel supply pressure is too low; whether the boost system has insufficient supercharging • Check whether ECM is faulty
P057100	Brake Pedal Signal Synchronization Malfunction	When the both paths of brake signal Brk_stMn and Brk_stRed are out of synchronization for more than 1 second, and the number of consecutive times exceeds Brk_	1. The brake switch or the brake light switch is open or short circuit 2. The switch in brake pedal has	• Collect the brake switch main signal Brk_stMn and brake redundancy signal Brk_stRed, check whether they meet the requirements of UMC: the brake can not be set

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
		cntrSynErrThd_C, a fault will be reported	a mechanical failure	when the brake is lightly depressed, and the stroke of two asynchronous sections cannot be too long - Check whether the brake pedal wire harness connection is reliable and whether the brake pedal mechanical structure is abnormal - Clear DTC, restart the vehicle, and check whether the DTC is eliminated
P142000	CAN Hardware Memory Response Timeout	CAN module initialization failed	1. CAN module of MCU initialization failed	Power off the key until the ECM is completely powered off, then power on the key to check whether the fault is eliminated
P142100	LIN Hardware Memory Response Timeout	LIN module initialization failed	1. LIN module of MCU initialization failed	Power off the key until the ECM is completely powered off, then power on the key to check whether the fault is eliminated
P064100	5 V Power Supply Module 1 Fail	5 V power supply module 1 has an overvoltage or undervoltage problem	1.5 V power supply module 1 has an overvoltage or undervoltage problem	There is wire harness signal interference
P065100	5 V Power Supply Module 2 Fail	5 V power supply module 2 has an overvoltage or undervoltage problem	1.5 V power supply module 2 has an overvoltage or undervoltage problem	There is wire harness signal interference
P069700	5 V Power Supply Module 3 Fail	5 V power supply module 3 has an overvoltage or undervoltage problem	1.5 V power supply module 3 has an overvoltage or undervoltage problem	There is wire harness signal interference
P068500	Main Relay Open Circuit Error	When ECM is powered on, the main relay is open	1. Open circuit in main relay	- There is wire harness interference - Transmission line between main relay and ECM damaged or interrupted

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P068700	Main Relay Short to Power Supply	When ECM is powered on, the main relay is short to power supply	1. Open circuit in main relay	- There is wire harness interference - Transmission line between main relay and ECM is damaged, resulting in short to power supply
P068600	Main Relay Short to Ground	When ECM is powered on, the main relay is short to ground	1. Short to ground in main relay	- There is wire harness interference - Transmission line between main relay and ECM is damaged, resulting in short to ground
P06869E	ECM/PCM Power Relay Control Circuit Low	When ECM is powered off, the UBR voltage is greater than the reasonable range after main relay is disconnected	1. When ECM is powered off, the UBR voltage is greater than the reasonable range after main relay is disconnected	- Main relay is stuck - There is interference in BR wire harness, and it is short to UBD
P261000	Unreasonable Shutdown Timing	When ECM is powered on, shutdown timing data is unreasonable	1. Shutdown timing data is unreasonable	Power off the key until the ECM is completely powered off, then power on the key to check whether the fault is eliminated
P06B842	Error when Reading/Writing Flash Block	When ECM is powered on, failure occurs when reading/writing Flash Block	1. Failure occurs when reading/writing Flash Block	Power off the key until the ECM is completely powered off, then power on the key to check whether the fault is eliminated
P06B843				
P126100	Cylinder 1 Injector Circuit Range/ Performance - Signal Plausibility Failure	The first five times the voltage signal value of cylinder 1 injector is lower than the lower threshold, or the last three times the voltage signal value exceeds the upper threshold	1. Injector wire harness for cylinder 1 is abnormal 2. ECM internal circuit is abnormal	- Check whether cylinder 1 injector wire harness connection is normal - Replace the injector of cylinder 1, start the vehicle, and check whether the fault reappears - After replacing ECM, start the vehicle, and check whether the fault reappears
P126300	Cylinder 3 Injector Circuit Range/ Performance - Signal Plausibility Failure	The first five times the voltage signal value of cylinder 3 injector is lower than the lower threshold, or the last three times the voltage signal value exceeds the upper threshold	1. Injector wire harness of cylinder 3 is abnormal 2. ECM internal circuit is abnormal	- Check whether cylinder 3 injector wire harness connection is normal - Replace the injector of cylinder 3, start the vehicle, and check

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				whether the fault reappears After replacing ECM, start the vehicle, and check whether the fault reappears
P126400	Cylinder 4 Injector Circuit Range/ Performance - Signal Plausibility Failure	The first five times the voltage signal value of cylinder 4 injector is lower than the lower threshold, or the last three times the voltage signal value exceeds the upper threshold	1. Injector wire harness of cylinder 4 is abnormal 2. ECM internal circuit is abnormal	- Check whether cylinder 4 injector wire harness connection is normal - Replace the injector of cylinder 4, start the vehicle, and check whether the fault reappears - After replacing ECM, start the vehicle, and check whether the fault reappears
P126200	Cylinder 2 Injector Circuit Range/ Performance - Signal Plausibility Failure	The first five times the voltage signal value of cylinder 2 injector is lower than the lower threshold, or the last three times the voltage signal value exceeds the upper threshold	1. Injector wire harness of cylinder 2 is abnormal 2. ECM internal circuit is abnormal	- Check whether cylinder 2 injector wire harness connection is normal - Replace the injector of cylinder 2, start the vehicle, and check whether the fault reappears - After replacing ECM, start the vehicle, and check whether the fault reappears
P143000	Battery Has Been Changed and Long Time No Tester Confirmation	ECM receives LIN communication and sends fault information	1. The battery type has changed	Check whether the battery type has changed
P143100	EBS or Battery Error	ECM receives LIN communication and sends fault information	1. EBS circuit is open 2. EBS is damaged	- Check whether the EBS circuit is open - EBS damaged
P143200	EBS Temporary Error	ECM receives LIN communication and sends fault information	1. Wire harness interference in EBS LIN communication	Check whether there is wire harness interference in EBS LIN communication
P144200	Communication Fault of Generator	ECM receives LIN communication and sends fault information	1. Interference or damage in generator LIN wire harness	Check whether there is interference or damage in generator LIN communication module
P144100	Mechanical Fault of Generator	ECM receives LIN communication and sends fault information	1. The mechanical part of generator is stuck or damaged	Check whether the mechanical part of generator is stuck or damaged

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P144000	Generator Circuit Error	ECM receives LIN communication and sends fault information	1. Electronic part of generator is damaged	Check whether the electronic part of generator is damaged
P001100	"A" Camshaft Position - Timing Over-Advanced or System Performance Bank 1	When the engine starts, the intake camshaft is not in the locked position and exceeds the calibrated threshold	1. Intake VVT phase regulator and oil control valve are failure	Check the operating status of intake VVT phase regulator and oil control valve (Blocked by dirt, stuck, oil pressure not completely relieved, lock pin invalid, etc.)
P001400	"B" Camshaft Position - Timing Over-Advanced or System Performance Bank 1	When the engine starts, the exhaust camshaft is not in the locked position and exceeds the calibrated threshold	1. Exhaust VVT phase regulator and oil control valve are failure	Check the operating status of intake VVT phase regulator and oil control valve (Blocked by dirt, stuck, oil pressure not completely relieved, lock pin invalid, etc.)
P062700	Fuel Pump "A" Control Circuit Open	Hardware circuit self-diagnostic	1. Open circuit in fuel pump relay control circuit 2. Open circuit in fuel pump relay control terminal corresponding to ECM	- Check whether the fuel pump relay control circuit is open - Check whether the fuel pump relay control pin corresponding to ECM terminal is open
P062800	Fuel Pump "A" Control Circuit Low	Hardware circuit self-diagnostic	1. Fuel pump relay control circuit is short to ground 2. Fuel pump relay control terminal corresponding to ECM is short to ground	- Check whether the fuel pump relay control circuit is short to ground - Check whether the fuel pump relay control pin corresponding to ECM terminal is short to ground
P062900	Fuel Pump "A" Control Circuit High	Hardware circuit self-diagnostic	1. Fuel pump relay control circuit is short to power supply 2. Fuel pump relay control terminal corresponding to ECM is short to power supply	- Check whether the fuel pump relay control circuit is short to power supply - Check whether the fuel pump relay control pin corresponding to ECM terminal is short to power supply
P05BD00	Start and Stop Main Switch is Stuck Failure	The sticky time of start and stop main switch exceeds the threshold	1. The start and stop main switch is damaged 2. The corresponding pin of the start and stop main switch is short to power supply	- Check whether the start and stop main switch is damaged, whether it cannot be reset for a long time after being pressed - Check whether the corresponding pin of the start and stop main

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				switch is short to power supply
P26F100	Starter Relay R1 (Crank Relay) or Starter (Drive Chain) Relay R2 (Pt State Relay) Cannot Be Combined	There is a start request but no starter feedback signal	1. Start relay R1 is damaged 2. Starter (drive chain) relay R2 is damaged	- Check whether the start relay R1 is damaged - Check whether the starter (drive chain) relay R2 is damaged
P26F200	Starter (Drive Chain) Status Relay R2 (PT State Relay) Cannot Be Disconnected	The starter feedback signal can be detected by sending the start test pulse when the drive chain is locked	1. Starter (drive chain) relay R2 switch adhesion damage	Check whether the switch of starter (drive chain) relay R2 is adhesion
P26F000	Starter Relay R1 (Crank relay) Cannot Be Disconnected	After the start, the starter feedback signal is detected when there is no start request	1. Starter relay R1 switch adhesion damage	Check whether the starter relay R1 switch is adhesion
P14AD00	Engine Block or Starter is not Engaged	There is voltage drop and start feedback signal when starting, but the engine does not turn	1. Engine crankshaft or flywheel is stuck 2. The starter and the flywheel cannot be meshed	- Check whether the engine crankshaft and flywheel are blocked by foreign matters - Turn the key to "start", and check whether the starter and flywheel can mesh normally
P14AF00	KL50r Wire Short Circuit to Ground	The engine can start normally, but there is no starter feedback voltage signal	1. Start feedback signal circuit is open 2. Start feedback signal circuit is short to ground	Check whether the starter feedback voltage signal circuit is short to ground or open
P14AE00	KL50r Wire Short Circuit to Battery	No start request, but the starter feedback voltage signal setting time exceeds the threshold	1. Start feedback signal circuit is short to power supply	Check whether the start switch feedback signal circuit is short to power supply
P14AC00	Starter Damaged or Wire Dropped	There is no voltage drop and start feedback signal when starting, and engine does not turn	1. The starter power supply circuit is disconnected or damaged and short to power supply 2. The starter body is damaged or cannot work normally	- Check whether the starter power supply circuit is disconnected or damaged - Check whether the starter body is damaged or not working properly
P1388 24	Ambient Temperature Sensor Cold Start Test Positive		1. The initial value of ambient temperature is much higher than the basic	

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	Deviation Unreasonable		calibration value (main water temperature, average intake air temperature)	
P1388 23	Ambient Temperature Sensor Cold Start Test Negative Deviation Unreasonable		2. The initial value of ambient temperature is much lower than the basic calibration value (main water temperature, average intake air temperature)	
P0070	Ambient Air Temperature Sensor Circuit "A"		1. ECM failed to normally receive the ambient temperature status transmitted from CAN 2. The transmitter of ambient temperature fails to send the signal normally	- Read ambient temperature value on CAN and check if it is reasonable - Read ambient temperature value on CAN 2 and check if it is reasonable - Read ambient temperature status on CAN and check if it is reasonable
U0128	Lost Communication With EPB Module	ECM receiving EPB information timed out	1. EPB connector looseness or separation 2. Transmission line between EPB and ECM damaged or interrupted 3. EPB is damaged and signal cannot be transmitted to ECM normally	- EPB connector looseness or separation - There is wire harness signal interference - Transmission line between EPB and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - EPB is damaged and signal cannot be transmitted to ECM normally
U0131	Lost Communication With EPS (HS CAN)	ECM receiving EPS information timed out	1. EPS connector looseness or separation 2. Transmission line between EPS and ECM damaged or interrupted 3. EPS is damaged and signal cannot be transmitted to ECM normally	- EPS connector looseness or separation - There is wire harness signal interference - Transmission line between EPS and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - EPS is damaged and signal cannot be transmitted to ECM normally

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
U0151	Lost Communication With Airbag Module (SDM) (HS CAN)	ECM receiving SDM information timed out	1. SDM connector looseness or separation 2. Transmission line between SDM and ECM damaged or interrupted 3. SDM is damaged and signal cannot be transmitted to ECM normally	- SDM connector looseness or separation - There is wire harness signal interference - Transmission line between SDM and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - SDM is damaged and signal cannot be transmitted to ECM normally
U0073	Control Module Communication Bus 1 Off (CAN1 Bus off)	CAN 1 bus is off	1. CAN 1 bus interface looseness or poor contact 2. Short circuit to power supply / ground or open circuit in CAN bus interface pin 3. Short circuit to power supply / ground, open circuit or internal circuit damage in CAN 1 bus interface pin corresponding to ECM terminal	- CAN 1 bus interface looseness or poor contact - Short circuit to power supply / ground or open circuit in CAN 1 bus interface pin - There is wire harness signal interference - Short circuit to power supply / ground, open circuit or internal circuit damage in CAN 1 bus interface pin corresponding to ECM terminal
P150100	Airbag Communicate Message Unplausible	The signal sent by airbag controller to engine ECM has not passed the verification	1. There is wire harness interference or unreliable signal transmission 2. The signal sent by airbag controller to engine ECM has not passed the verification, check whether the signal is abnormal	- Wire harness interference or unreliable signal transmission - The signal sent by airbag controller to engine ECM has not passed the verification, check whether the signal is abnormal
P150000	EMS Received Crash Signal	CAN information is unreasonable	1. The vehicle crashes and airbag pops up 2. There is electromagnetic interference in the connection wire harness between airbag and ECM 3. There is electromagnetic	- The vehicle crashes and airbag pops up - There is electromagnetic interference in the connection wire harness between airbag and ECM - The signal sent by airbag to ECM is error and unreasonable

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			interference in the connection wire harness between airbag and ECM	
P053300	A/C Refrigerant Pressure Sensor "A" Circuit High	Sensor voltage is higher than the threshold	1. Intake manifold pressure sensor signal terminal is short to power supply or open 2. Sensor reference ground terminal is open 3. Short circuit to power supply or open circuit in intake pressure sensor signal pin terminal corresponding to ECM terminal 4. Sensor is damaged	- Connect the diagnostic tester and turn ignition switch to ON. Use a multimeter to measure whether the voltage between intake manifold pressure sensor signal terminal and ground is close to or equal to 5 V without starting the engine. - Turn ignition switch OFF and check connector for looseness or poor contact - Check for short circuit to power supply or open circuit in intake manifold pressure sensor signal terminal - Check sensor reference ground terminal for open - Check sensor for damage - Check if short circuit to power supply, open or internal circuit damage in intake pressure sensor signal pin terminal corresponding to ECM terminal
P053200	A/C Refrigerant Pressure Sensor "A" Circuit Low	Sensor voltage is lower than the threshold	1. A/C pressure sensor signal terminal is short to ground 2. 5 V reference voltage of sensor is open 3. Short circuit to ground in A/C pressure sensor signal pin corresponding to ECM terminal	- Connect the diagnostic tester and turn ignition switch to ON. Use a multimeter to measure whether the A/C pressure sensor signal terminal voltage is close to or equal to 0 V without starting the engine. - Turn ignition switch "OFF", check pressure sensor signal terminal for short to ground - Check 5 V reference voltage terminal of sensor for open - Check if short circuit to ground in intake pressure sensor signal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				pin terminal corresponding to ECM
P050F00	Brake Assist Vacuum Too Low	When the vacuum pump is working, the differential pressure between front and rear of brake disc vacuum is lower than the setting threshold within a certain period of time (such as 1 second)	1. There is a problem with the sealing characteristics of brake booster system 2. Vacuum pump is damaged	- Check whether the sealing characteristics of brake booster system are abnormal - Check whether the vacuum pump is damaged
P258A00	Vacuum Pump Control Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Brake vacuum pump relay control circuit is open 3. Brake vacuum pump relay control circuit power supply terminal is open or shorted to ground 4. Brake vacuum pump relay fuse is blown or damaged 5. Open or internal circuit damage in brake vacuum pump control pin corresponding to ECM	- Connector looseness or poor contact - Brake vacuum pump relay control circuit is open - Brake vacuum pump relay control circuit power supply terminal open or short to ground - Brake vacuum pump relay fuse blown or damaged - Open circuit or internal circuit damage in brake vacuum pump control pin corresponding to ECM
P258C00	Vacuum Pump Control Circuit "A" Low	Drive channel self-diagnosis failure	1. Brake vacuum pump relay control circuit is short to ground 2. Brake vacuum pump relay pin corresponding to ECM terminal is short to ground	- Brake vacuum pump relay control circuit is short to ground - Brake vacuum pump relay pin corresponding to ECM terminal is short to ground
P258D00	Vacuum Pump Control Circuit "A" High	Drive channel self-diagnosis failure	1. Brake vacuum pump relay circuit is short to power supply 2. Brake vacuum pump relay pin corresponding to ECM terminal is short to power supply	- Brake vacuum pump relay circuit is short to power supply - Brake vacuum pump relay pin corresponding to ECM terminal is short to power supply

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
U015187	Lose Communication With ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS or Signal Abnormal	ECM receiving ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS information timed out	1. ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS connector looseness or separation 2. Transmission line between ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS and ECM damaged or interrupted 3. ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS is damaged and signal cannot be transmitted to ECM normally	- ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS connector looseness or separation - There is wire harness signal interference - Transmission line between ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS is damaged and signal cannot be transmitted to ECM normally
U010387				
U012887				
U118787				
U024887				
U021287				
U01B000				
U010987				
U041681	Data Received by ECM from ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM Module not Reliable	Data from ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM module is invalid	1. The checksum value sent by ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM module is abnormal 2. The Alive counter value sent by ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM module is abnormal 3. The value sent by ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM module contains an Invalid value	- ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM connector looseness or separation - There is wire harness signal interference - Transmission line between ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM is damaged and signal cannot be transmitted to ECM normally
U040281				
U045281				
U042281				
U042481				
U040481				
U041781				
U041081				
U042381				
U059B81				
U042681				
U042981				
P059700	Thermostat Heater Control Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Electronic thermostat drive circuit pin is open 3. Open circuit or internal circuit damage in electronic thermostat drive	- Check connector for looseness or poor contact - Check electronic thermostat drive circuit pin for open - Check if open or internal circuit damage in electronic thermostat drive circuit pin

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			circuit pin corresponding to ECM terminal	corresponding to ECM terminal
P059800	Thermostat Heater Control Circuit Low	Drive channel self-diagnosis failure	1. Electronic thermostat drive circuit short to ground 2. Short to ground in electronic thermostat drive circuit corresponding to ECM terminal	- Check electronic thermostat drive circuit pin for short to ground - Check if short to ground in electronic thermostat drive circuit pin corresponding to ECM terminal
P059900	Thermostat Heater Control Circuit High	Drive channel self-diagnosis failure	1. Electronic thermostat drive circuit short to power supply 2. Short to power supply in electronic thermostat drive circuit corresponding to ECM terminal	- Check electronic thermostat drive circuit pin for short to power supply - Check if short to power supply in electronic thermostat drive circuit pin corresponding to ECM terminal
U007388	CAN1 Bus OFF (Communication Closed)	CAN 1 bus is off	1. CAN 1 bus interface looseness or poor contact 2. Short circuit to power supply / ground or open circuit in CAN bus interface pin 3. Short circuit to power supply / ground, open circuit or internal circuit damage in CAN 1 bus interface pin corresponding to ECM terminal	- CAN 1 bus interface looseness or poor contact - Short circuit to power supply / ground or open circuit in CAN 1 bus interface pin - There is wire harness signal interference - Short circuit to power supply / ground, open circuit or internal circuit damage in CAN 1 bus interface pin corresponding to ECM terminal
P007200	Ambient Air Temperature Sensor Circuit "A" Low	Ambient temperature sensor circuit connectivity self-diagnosis	1. Wire harness of ambient temperature sensor is abnormally connected 2. Ambient temperature sensor is damaged	- Using multimeter, check whether the sensor pin voltage is normal - Check whether CAN signal is normal - Check whether wire harnesses is normal - Replace ECM, and check whether the fault reappears
P007300	Ambient Air Temperature Sensor Circuit "A" High	Ambient temperature sensor signal circuit connectivity self-diagnosis	1. Wire harness of ambient temperature sensor is	Using multimeter, check whether the sensor pin voltage is normal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			abnormally connected 2 Ambient temperature sensor is damaged	- Check whether CAN signal is normal - Check whether wire harnesses is normal - Replace ECM, and check whether the fault reappears
P254200	DECOS Oil Passage Pressure Sensor Circuit High Voltage	Fuel rail pressure sensor circuit voltage is higher than 4.8 V	1. Fuel rail pressure sensor circuit short to power supply 2. Fuel rail pressure sensor pin corresponding to ECM short to power supply	- Check sensor signal terminal for short to power supply or open - Check sensor for damage - Check for short circuit to power supply, open or internal circuit damage in fuel rail pressure sensor signal pin corresponding to ECM terminal
P254100	DECOS Oil Passage Pressure Sensor Circuit Low Voltage	Fuel rail pressure sensor circuit voltage is lower than 0.2 V	1. Fuel rail pressure sensor circuit short to ground 2. Fuel rail pressure sensor pin corresponding to ECM short to ground	- Check sensor signal terminal for short to ground - Check sensor for damage - Check for short circuit to power supply, open or internal circuit damage in fuel rail pressure sensor signal pin corresponding to ECM terminal
P254029	DECOS Oil Passage Pressure Sensor Circuit Bank 1-Positive Offset	The low pressure fuel rail pressure signal during the end of engine operation is higher than the upper threshold	1. Low pressure oil passage sensor internal circuit and wire harness are deteriorated	- Check whether there is a large contact resistance at the connector of DECOS pressure sensor or in the wire harness? - Replace the DECOS pressure sensor, return the vehicle to customer, and check whether the fault will be reported again?
P254028	DECOS Oil Passage Pressure Sensor Circuit Bank 1-Negative Offset	The low pressure fuel rail pressure signal during the end of engine operation is lower than the threshold	1. Low pressure oil passage sensor internal circuit and wire harness are deteriorated	- Check whether there is a large contact resistance at the connector of DECOS pressure sensor or in the wire harness? - Replace the DECOS pressure sensor, return the vehicle to customer, and check whether the fault will be reported again?

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P137000	DECOS Oil Passage Pressure Sensor Relative Pressure Too Low	The relative pressure of pressure sensor is lower than the fault threshold	1. Oil passage is leakage 2. Insufficient fuel 3. Check valve is damaged 4. Low pressure oil pump is damaged	- Check for leakage in oil passage - Check if fuel is insufficient - Check if the check valve is damaged - Check low pressure oil pump for damage
P137100	DECOS Oil Passage Pressure Sensor Relative Pressure Too High	The low pressure fuel rail pressure signal is higher than the upper threshold	1. Relief valve is blocked 2. Low pressure oil pump is damaged	- Check whether the relief valve of low pressure oil passage is blocked - Check low pressure oil pump for damage
P025D00	Fuel Pump Module "A" Control Circuit High	Hardware circuit self-diagnostic	1. Low pressure oil pump control circuit short to power supply 2. Short to power supply in low pressure oil pump pin corresponding to ECM	- Check whether the actuator terminal is short to the power supply - Check whether the actuator pin corresponding to ECM is short to the power supply
P025A00	Fuel Pump Module "A" Control Circuit Open	Hardware circuit self-diagnostic	1. Low pressure oil pump control circuit is open 2. Open circuit in low pressure oil pump pin corresponding to ECM	- Check if actuator terminal is open - Check whether the actuator pin corresponding to ECM terminal is open
P008A00	DECOS Low Pressure Oil Passage Pressure Too Low	The low pressure fuel rail pressure is lower than the expected value	1. Oil passage is leakage 2. Insufficient fuel 3. Check valve is damaged 4. Low pressure oil pump is damaged	- Check for leakage in oil passage - Check if fuel is insufficient - Check if the check valve is damaged - Check low pressure oil pump for damage
P008B00	Low Pressure Fuel System Pressure - Too High	The low pressure fuel rail pressure is higher than the expected value	1. Low pressure oil pump is damaged 2. Relief valve is blocked	- Check whether the damage of low pressure oil pump is normal - Check relief valve for blockage or abnormal operation
P016F00	DECOS Low Pressure Oil Passage PWM Control Deviation Too Large	Control deviation exceeds the maximum	1. Relief valve is blocked 2. Low pressure oil pump is damaged	- Check whether the relief valve of low pressure oil passage is blocked - Check low pressure oil pump for damage

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P062A00	Fuel Pump Module Control Circuit High	Drive channel self-diagnosis failure	1. Fuel pump relay control circuit is short to power supply 2. Fuel pump relay control pin corresponding to ECM is short to power supply	- Check whether the fuel pump relay terminal is short to power supply - Whether there is a fault in internal chip of ECM
P013000	Upstream Oxygen Sensor Compensating Circuit Open	Under the condition of low exhaust temperature and oil cut-off, the oxygen sensor voltage signal is high for a long time	1. Upstream oxygen sensor compensation circuit is open	- Check whether there is poor contact at the connector of oxygen sensor (pin opposite to green wire) - Check the continuity of oxygen sensor wire harness, whether there is an open circuit - Check the connector between wire harness and ECM for pin abnormality, resulting in poor contact - Clear DTC, start the vehicle and run until the coolant temperature reach the normal value, and check whether the fault is reported again. - Check whether there is any abnormality in LSU processing circuit inside ECM
P223700	O2 Sensor Positive Current Control Circuit Open Bank 1 Sensor 1 (Close to ECM)	Chip fault memory diagnosis	1. Open circuit in LSU oxygen sensor APE line, which is close to ECM terminal 2. ECM internal circuit is abnormal	- Replace oxygen sensor, and check whether the fault reappears - Replace ECM, and check whether the fault reappears
P208062	Particulate Filter Upstream Temperature Sensor Signal Measured Value Unreasonable	The measured value of upstream temperature sensor of particulate filter is too different from the model value	1. There is interference in upstream temperature sensor circuit of particulate filter 2. The particulate filter upstream temperature sensor characteristic is aging and deviation	- Check the upstream temperature sensor circuit of particulate filter for interference - Check whether the upstream temperature sensor of particulate filter is aging and deviation

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P20802A	Particulate Filter Upstream Temperature Sensor Signal Stuck	The signal of upstream temperature sensor of particulate filter is sticky	1. There is interference in upstream temperature sensor circuit of particulate filter 2. The particulate filter upstream temperature sensor characteristic is aging and deviation	- Check the GPF temperature sensor circuit for interference - Check whether the GPF temperature sensor is aging and deviation
P054500	Particulate Filter Upstream Temperature Sensor Circuit Voltage Low	The voltage of upstream temperature sensor circuit of particulate filter is below the limit	1. The upstream temperature sensor signal terminal of particulate filter is short to the ground	- Use a multimeter to measure if upstream temperature sensor signal terminal voltage of particulate filter is close to or equal to 0 V - Turn ignition switch "OFF", and check if particulate filter upstream temperature sensor signal terminal is short to ground - Sensor is damaged - The particulate filter upstream temperature sensor signal pin terminal corresponding to the ECM terminal is short to ground
P054600	Particulate Filter Upstream Temperature Sensor Circuit Voltage High	The voltage of upstream temperature sensor circuit of particulate filter is higher than the limit	1. Particulate filter upstream temperature sensor signal terminal is short to power supply or open 2. Short circuit to power supply, open circuit or internal circuit damage in particulate filter upstream temperature sensor signal pin	- Use a multimeter to measure if the voltage between particulate filter upstream temperature sensor signal terminal and ground is close to or equal to 5 V - Turn ignition switch OFF and check connector for looseness or poor contact - Check sensor signal terminal for short to power supply or open - Check sensor reference ground for open - Check sensor for damage - Check if short circuit to power supply, open or internal circuit damage in particulate filter upstream temperature

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
				sensor signal pin corresponding to ECM
P20E224	Particulate Filter Upstream Temperature Sensor Cold Start Correction Improper (- Positive Deviation)	The particulate filter upstream temperature sensor signal is too high for cold start calibration	1. There is interference in upstream temperature sensor circuit of particulate filter 2. The particulate filter upstream temperature sensor characteristic is aging and deviation	- Check the upstream temperature sensor circuit of particulate filter for interference - Check whether the upstream temperature sensor of particulate filter is aging and deviation
P20E223	Particulate Filter Upstream Temperature Sensor Cold Start Correction Improper (- Negative Deviation)	The particulate filter upstream temperature sensor signal is too low for cold start calibration		
P218324	Engine Coolant Temperature Sensor 2 Circuit Range/ Performance	Deviation of coolant temperature sensor 2 cold start and the model value is too large	1. Internal resistance of coolant temperature sensor 2 is unreasonable	- Check wire harness for contact resistance - Check whether the internal resistance of sensor has a large deviation from the normal value
P218323	Engine Coolant Temperature Sensor 2 Circuit Range/ Performance			
P12A300	Particulate Filter Differential Pressure Sensor Line Connection Error	The measured value of particulate filter differential pressure sensor is unreasonable	1. The front/rear differential pressure sensor line falls off or leaks 2. The front and rear differential pressure sensor lines are reversed	- Check whether the front and rear differential pressure sensor lines fall off or leak - Check whether there is a reverse connection between the front and rear differential pressure sensor lines
U060100	Particulate Filter Differential Pressure Sensor Sent Communication Failure	Sent message indicates communication failure	1. Differential pressure sensor itself failure	- Check whether the differential pressure sensor circuit harness is faulty - Check whether the sensor itself is faulty
U060141	Particulate Filter Differential Pressure Sensor Data Inspection Non-plausible	Sent information indicates that the data check is unreasonable		
P129300	Particulate Filter Differential Pressure Sensor Channel 1 Digital Signal Non-	Channel 1 digital signal is unreasonable		

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
	plausible (SENT Signal High or Low)			
P245500	Particulate Filter Differential Pressure Sensor Circuit Voltage High	Particulate Filter Differential Pressure Sensor Circuit Voltage High	1. The differential pressure sensor circuit is short to power supply	- Check whether the wire harness of differential pressure sensor circuit is short to power supply - Check whether the sensor itself is short
P245400	Particulate Filter Differential Pressure Sensor Circuit Voltage Low	Particulate Filter Differential Pressure Sensor Circuit Voltage Low	1. The differential pressure sensor circuit is short to ground	- Check whether the wire harness of differential pressure sensor circuit is short to ground - Check whether the sensor itself is short
P129100	Dynamic Response Performance of Particulate Filter Differential Pressure Sensor Non-plausible	The measured value of particulate filter differential pressure does not match the flow model	1. Differential pressure sensor failure 2. Frozen in the sampling line	- Check whether the differential pressure sensor line is frozen - Replace the sensor and check if the fault is repaired
P226D00	Particulate Filter Removed	The calculation amount of particulate filter differential pressure model is lower than the threshold	1. The particulate filter is removed 2. Particulate filter is burnt	- Check whether the particulate filter has been removed - Check whether the particulate filter is burnt
P129000	Offset Check Value After Running Particulate Filter Differential Pressure Sensor Unreasonable	The running learning value of particulate filter differential pressure sensor exceeds the limit	1. The zero offset of differential pressure sensor is too large	- Check whether there is contact resistance in differential pressure sensor circuit wire harness - Check whether the characteristic deviation of sensor itself is too large
P054A00	Exhaust VVT actual position deviation fault during catalytic converter heating	The actual position of exhaust VVT during the heating process of catalytic converter is too different from the target position	1. Insufficient OCV oil valve pressure 2. OCV oil valve is blocked or leaking	- Check if operating condition of cam phase regulator is normal (dirt blocked, oil leakage, stuck) - Check if operating condition of OCV oil control valve is normal
P048371	Fan Rationality Check Error (- Type 1)	The fan feedback signal type is fault type 1	1. Fan blocking	Check if the cooling fan is blocked
P048372	Fan Rationality Check Error (- Type 2)	The fan feedback signal type is fault type 2	1. Fan overload	Check whether the cooling fan load is too high

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P048373	Fan Rationality Check Error (- Type 3)	The fan feedback signal type is fault type 3	1. Fan power supply is too high or too low	Check whether the cooling fan power supply is too high or too low
P048374	Fan Rationality Check Error (- Type 4)	The fan feedback signal type is fault type 4	1. Fan control circuit over temperature	Check whether the cooling fan control circuit is short circuit or overload
U010187	Lost Communication With TCM (- Transmission Controller)	ECM receiving TCM information timed out	1. TCM connector looseness or separation 2. Transmission line between TCM and ECM damaged or interrupted 3. TCM is damaged and signal cannot be transmitted to ECM normally	- TCM connector looseness or separation - There is wire harness signal interference - Transmission line between TCM and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - TCM is damaged and signal cannot be transmitted to ECM normally
U012287	Lost Communication With ESP (- Electronic Stability Program)	ECM receiving ESP information timed out	1. ESP connector looseness or separation 2. Transmission line between ESP and ECM damaged or interrupted 3. ESP is damaged and signal cannot be transmitted to ECM normally	- ESP connector looseness or separation - There is wire harness signal interference - Transmission line between ESP and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - ESP is damaged and signal cannot be transmitted to ECM normally
P218400	Engine Coolant Temperature Sensor 2 Circuit Low	Coolant temperature sensor 2 voltage is lower than 0.09 V	1. Coolant temperature sensor 2 signal terminal is short to ground 2. Short circuit to ground in coolant temperature sensor 2 signal pin corresponding to ECM terminal 3. Sensor is damaged	- Use a multimeter to measure if coolant temperature sensor 2 signal terminal voltage is close to or equal to 0 V - Turn ignition switch "OFF", check coolant temperature sensor 2 signal terminal for short to ground - Check sensor for damage - Check coolant temperature sensor 2 signal pin terminal corresponding to ECM for short to ground

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P218500	Engine Coolant Temperature Sensor 2 Circuit High	Coolant temperature sensor 2 voltage is higher than 4.9 V	1. connector looseness or poor contact 2. Coolant temperature sensor 2 signal terminal is short to power supply or open 3. Short circuit to power supply or open in coolant temperature sensor 2 signal pin corresponding to ECM terminal 4. Sensor is damaged	- Use a multimeter to measure if voltage between coolant temperature sensor 2 signal terminal and ground is close to or equal to 5 V - Turn ignition switch OFF and check connector for looseness or poor contact - Check for short circuit to power supply or open circuit in sensor signal terminal - Open circuit in sensor reference ground - Sensor is damaged - Short circuit to power supply, open circuit or internal circuit damage in coolant temperature sensor 2 signal pin terminal corresponding to ECM
U015587	Lost Communication With IP (- Instrument Cluster)	ECM receiving IP information timed out	1. IP connector looseness or separation 2. Transmission line between IP and ECM damaged or interrupted 3. IP is damaged and signal cannot be transmitted to ECM normally	- IP connector looseness or separation - There is wire harness signal interference - Transmission line between IP and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - IP is damaged and signal cannot be transmitted to ECM normally
U016487	Communication between ECM and AC Control Module Failure	ECM receiving AC information timed out	1. AC connector looseness or separation 2. Transmission line between AC and ECM damaged or interrupted 3. AC is damaged and signal cannot be transmitted to ECM normally	- AC connector looseness or separation - There is wire harness signal interference - Transmission line between AC and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - AC is damaged and signal cannot be transmitted to ECM normally
U014087	Lost Communication With BCM (Body Control Module)	ECM receiving BCM information timed out	1. BCM connector looseness or separation 2.	BCM connector looseness or disengagement

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
			Transmission line between BCM and ECM damaged or interrupted 3. BCM is damaged and signal cannot be transmitted to ECM normally	- There is wire harness signal interference - Transmission line between BCM and ECM damaged or interrupted - Check if there is CAN hardware circuit fault - BCM is damaged and signal cannot be transmitted to ECM normally
P12E000	Offset Check Value After Running Particulate Filter Differential Pressure Sensor Unreasonable	The running learning value of particulate filter differential pressure sensor exceeds the limit	1. The zero offset of differential pressure sensor is too large	- Check whether there is contact resistance in differential pressure sensor circuit wire harness - Check whether the characteristic deviation of sensor itself is too large
P12E100	Dynamic Response Performance of Particulate Filter Differential Pressure Sensor Non-plausible	The measured value of particulate filter differential pressure does not match the flow model	1. Differential pressure sensor failure 2. Frozen in the sampling line	- Check whether the differential pressure sensor line is frozen - Replace the sensor and check if the fault is repaired
P12E300	Particulate Filter Differential Pressure Sensor Channel 1 Digital Signal Non-plausible (SENT Signal High or Low)	Channel 1 digital signal is unreasonable	1. Differential pressure sensor itself failure	- Check whether the differential pressure sensor circuit harness is faulty - Check whether the sensor itself is faulty
P12A200	Particulate Filter Differential Pressure Sensor Line Connection Error	The measured value of particulate filter differential pressure sensor is unreasonable	1. The front/rear differential pressure sensor line falls off or leaks 2. The front and rear differential pressure sensor lines are reversed	- Check whether the front and rear differential pressure sensor lines fall off or leak - Check whether there is a reverse connection between the front and rear differential pressure sensor lines
P246100	Particulate Filter Differential Pressure Sensor Circuit Voltage High	Particulate Filter Differential Pressure Sensor Circuit Voltage High	1. The differential pressure sensor circuit is short to power supply	- Check whether the wire harness of differential pressure sensor circuit is short to power supply - Check whether the sensor itself is short

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P246000	Particulate Filter Differential Pressure Sensor Circuit Voltage Low	Particulate Filter Differential Pressure Sensor Circuit Voltage Low	1. The differential pressure sensor circuit is short to ground	- Check whether the wire harness of differential pressure sensor circuit is short to ground - Check whether the sensor itself is short
U060200	Particulate Filter Differential Pressure Sensor Sent Communication Failure	Sent message indicates communication failure	1. Differential pressure sensor itself failure	- Check whether the differential pressure sensor circuit harness is faulty - Check whether the sensor itself is faulty
U060241	Particulate Filter Differential Pressure Sensor Data Inspection Non-plausible	Sent information indicates that the data check is unreasonable	1. Differential pressure sensor itself failure	Check whether the differential pressure sensor circuit harness is faulty
P025C00	Fuel Pump Module "A" Control Circuit Low	Hardware circuit self-diagnostic	1. Low pressure oil pump control circuit short to ground 2. Short to ground in low pressure oil pump pin corresponding to ECM	- Check whether the actuator terminal is short to the ground - Check whether the actuator pin corresponding to ECM is short to the ground
P016E00	Closed Loop Fuel Pressure Control At Limit - Pressure Too High	Control deviation is below minimum	1. Low pressure oil pump is damaged 2. Relief valve is blocked	- Check whether the damage of low pressure oil pump is normal - Check relief valve for blockage or abnormal operation
P053A00	Crankcase Heating Line Circuit Open	Drive channel self-diagnosis failure	1. Connector looseness or poor contact 2. Open circuit in crankcase line heater control circuit pin terminal 3. Crankcase line heater control circuit power supply terminal is not connected to main relay 4. Sensor is damaged 5. Open circuit or internal circuit damage in crankcase line heater pin circuit corresponding to ECM terminal	- Check connector for looseness or poor contact - Open circuit in crankcase line heater control circuit pin terminal - Crankcase line heater control circuit power supply terminal is not connected to main relay - Sensor is damaged - Open circuit or internal circuit damage in crankcase line heater pin circuit corresponding to ECM terminal

DTC	DTC Definition	Detection Condition	Possible Cause	Maintenance Advice
P053C00	Crankcase Heating Line Circuit Voltage Too High	Drive channel self-diagnosis failure	1. Short to power supply in crankcase line heater control circuit pin terminal	- Check whether the crankcase line heater control circuit pin terminal is short to power supply - Check whether the crankcase line heater pin corresponding to ECM terminal is short to power supply
P053B00	Crankcase Heating Line Circuit Voltage Too Low	Drive channel self-diagnosis failure	1. Crankcase line heater control circuit pin terminal is short to ground 2. Crankcase line heater control circuit power supply terminal is grounded 3. Crankcase line heater pin corresponding to ECM terminal is short to ground	- Check connector for looseness or poor contact - Open circuit in crankcase line heater control circuit pin terminal - Crankcase line heater control circuit power supply terminal is not connected to main relay
P121B00	Front Left Wheel Speed Sensor Signal NG	ABS-ECM sends the front left wheel speed sensor fault flag bit	1. The front left wheel speed sensor is faulty	Check whether the ABS-ECM fault memory is faulty
P121C00	Front Right Wheel Speed Sensor Signal NG	ABS-ECM sends the front right wheel speed sensor fault flag bit	1. The front right wheel speed sensor is faulty	Check whether the ABS-ECM fault memory is faulty
P121D00	Rear Left Wheel Speed Sensor Signal NG	ABS-ECM sends the rear left wheel speed sensor fault flag bit	1. The rear left wheel speed sensor is faulty	Check whether the ABS-ECM fault memory is faulty
P121E00	Rear Right Wheel Speed Sensor Signal NG	ABS-ECM sends the rear right wheel speed sensor fault flag bit	1. The rear right wheel speed sensor is faulty	Check whether the ABS-ECM fault memory is faulty
P063449	Brake Vacuum Pump Drive Chip Overheat	Drive channel self-diagnosis failure	1. Short circuit to power supply in brake vacuum pump control circuit 2. Brake vacuum pump control pin corresponding to ECM terminal is short to power supply	- Short circuit to power supply in brake vacuum pump control circuit - Whether there is a fault in internal chip of ECM

4.7 DTC Diagnosis Procedure

■ Intake/Exhaust Phaser Operation (Slow, Stuck) Malfunctions

DTC	P000A00	"A" Camshaft Position Slow Response Bank 1
DTC	P003C00	"A" Camshaft Profile Control Performance/Stuck Off Bank 1
DTC	P000B00	"B" Camshaft Position Slow Response Bank 1
DTC	P005A00	"B" Camshaft Profile Control Performance/Stuck Off Bank 1
DTC	P001100	"A" Camshaft Position - Timing Over-Advanced or System Performance Bank 1
DTC	P001400	"B" Camshaft Position - Timing Over-Advanced or System Performance Bank 1
DTC	P054A00	Exhaust VVT actual position deviation fault during catalytic converter heating

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check phaser solenoid valve, valve body bolt components state

- Disconnect the negative battery cable.
- Remove intake/exhaust phaser solenoid valve; Check for blockage or dirty.
- Remove intake/exhaust phaser valve body bolts; Check for blockage or dirt.

NG

Clean or replace phaser solenoid valve and valve body bolts.

OK

2 Check engine maintenance condition

- Check if engine oil level is normal, and check for oil leakage and oil seepage.
- Remove valve trim cover, and check engine lubrication and cleaning conditions, and check for wear or sludge dirty

NG

Clean and maintain the engine, replace the damaged components.

OK

3 Check engine oil pressure

- (a) Remove oil pressure sensor; Connect oil pressure tester to test oil pressure.

Main oil passage pressure: Limit pressure range (0.9 - 10 bar)

NG

Check or replace oil pump assembly.

OK

4 Check intake/exhaust phaser assembly

- (a) Check if operating condition of cam phase regulator is normal (dirt blocked, oil leaked, stuck, etc.).

NG

Replace intake/exhaust phaser assembly.

OK

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Intake Phaser Solenoid Valve Control Circuit Open**

DTC	P001000	“A” Camshaft Position Actuator Control Circuit Open Bank 1
------------	----------------	---

■ **Description**

Control schematic diagram

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check intake phaser solenoid valve connector
----------	---

- (a) Disconnect the negative battery.
- (b) Unplug intake phaser solenoid valve connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG

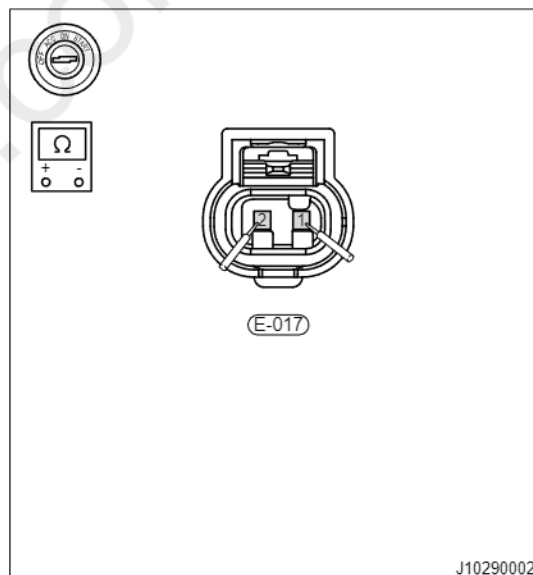
Repair connector or replace intake phaser solenoid valve.

OK

2	Check intake phaser solenoid valve internal resistance
----------	---

- (a) Using ohm band of multimeter, measure if internal resistances of intake phaser solenoid valve E-017 (1-2) are normal with red and black probes respectively.

Resistance at ambient temperature: 6 Ω



NG

Replace intake phaser solenoid valve assembly.

OK

3	Check intake phaser solenoid valve power supply fuse
----------	---

- (a) Turn ENGINE START STOP switch to ON.
- (b) Check fuse EF21 15A in engine compartment fuse and relay box with 21 W test light.

Test light should be bright

NG

It indicates that there is short to ground in circuit.

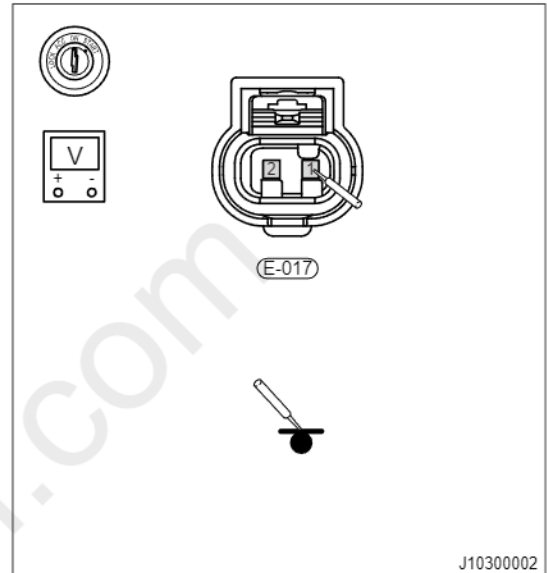
OK

4

Check intake phaser solenoid valve power supply and control terminal

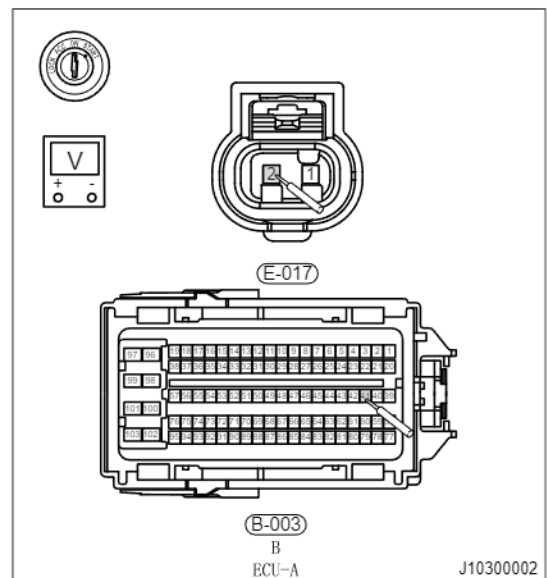
- (a) Connect intake phaser solenoid valve connector.
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of intake phaser solenoid valve E-017 (1, 2) with red probe.

Test voltage is current battery voltage



- (d) Start the engine.
- (e) Using voltage band of multimeter (voltage drop method), connect black probe to ECM B-003 (A41), measure voltages of intake phaser solenoid valve E-017 (2) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****6 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ Exhaust Phaser Solenoid Valve Control Circuit Open**

DTC	P001300	"B" Camshaft Position Actuator Control Circuit Open Bank 1
-----	---------	--

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

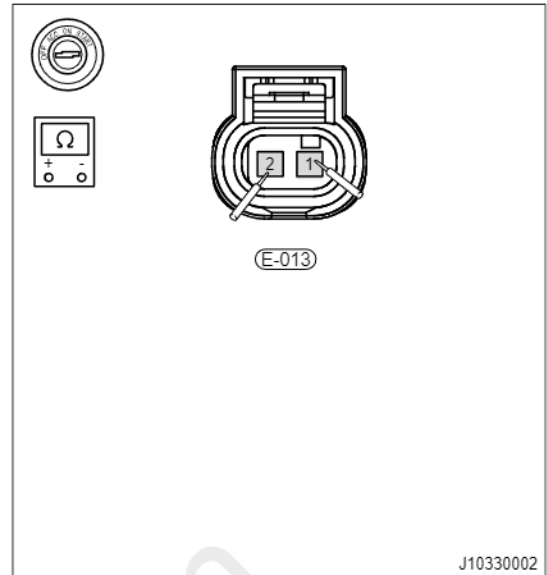
When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check exhaust phaser solenoid valve connector

- (a) Disconnect the negative battery.
- (b) Unplug exhaust phaser solenoid valve connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG**Repair connector or replace exhaust phaser solenoid valve.****OK****2 Check exhaust phaser solenoid valve internal resistance**

- (a) Using ohm band of multimeter, measure if internal resistances of exhaust phaser solenoid valve E-013 (1-2) are normal with red and black probes respectively.



NG

Replace exhaust phaser solenoid valve assembly.

OK

3

Check exhaust phaser solenoid valve power supply fuse

- (a) Turn ENGINE START STOP switch to ON.
(b) Check fuse EF21 15A in engine compartment fuse and relay box with 21 W test light.

Test light should be bright

NG

It indicates that there is short to ground in circuit.

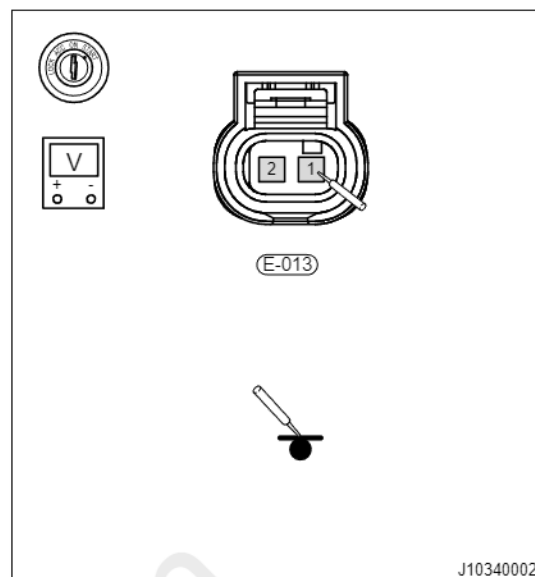
OK

4

Check exhaust phaser solenoid valve power supply and control terminal

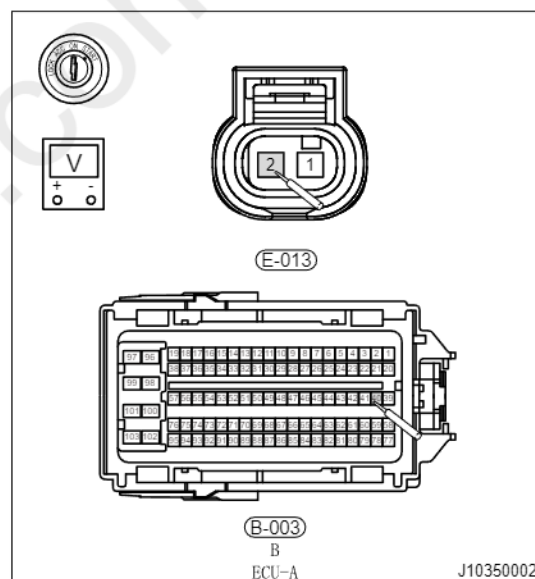
- (a) Connect exhaust phaser solenoid valve connector.
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of exhaust phaser solenoid valve E-013 (1, 2) with red probe.

Test voltage is current battery voltage



- (d) Start the engine.
- (e) Using voltage band of multimeter (voltage drop method), connect black probe to ECM B-003 (A40), measure voltages of exhaust phaser solenoid valve E-013 (2) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Crankshaft - Intake/Exhaust Camshaft Installation Position Non-plausible/Deviation Excessive Malfunction

DTC	P001676	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor A
DTC	P001678	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor A
DTC	P001776	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor B
DTC	P001778	Crankshaft Position - Camshaft Position Correlation Bank 1 Sensor B

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check phaser solenoid valve, valve body bolt components state

- (a) Disconnect the negative battery cable.
- (b) Remove intake/exhaust phaser solenoid valve; Check for blockage or dirty.
- (c) Remove intake/exhaust phaser valve body bolts; Check for blockage or dirt.

NG

Clean or replace phaser solenoid valve and valve body bolts.

OK

2 Check engine maintenance condition

- (a) Check if engine oil level is normal, and check for oil leakage and oil seepage.
- (b) Remove valve trim cover, and check engine lubrication and cleaning conditions, and check for wear or sludge dirty

NG

Clean and maintain the engine, replace the damaged components.

OK

3 Check engine oil pressure

- (a) Remove oil pressure sensor; Connect oil pressure tester to test oil pressure.

Main oil passage pressure: Limit pressure range (0.9 - 10 bar)

NG

Check or replace oil pump assembly.

OK

4 Check valve mechanism timing

- (a) Check if valve mechanism timing is normal, and check timing chain for teeth skipping, misalignment, elongation, etc.
- (b) Check camshaft signal plate for misalignment, looseness, etc.

NG

Replace timing chain or camshaft assembly.

OK

5 Check intake/exhaust phaser assembly

- (a) Check if operating condition of cam phase regulator is normal (dirt blocked, oil leaked, stuck, etc.).

NG

Replace intake/exhaust phaser assembly.

OK

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Downstream Oxygen Sensor Heater Control Circuit Open/Low/High/Faulty

DTC	P003000	HO2S Heater Control Circuit Bank 1 Sensor 1
DTC	P003100	HO2S Heater Control Circuit Low Bank 1 Sensor 1
DTC	P003200	HO2S Heater Control Circuit High Bank 1 Sensor 1
DTC	P005300	HO2S Heater Resistance Bank 1 Sensor 1
DTC	P064D00	LSU Integrated Ship Failure
DTC	P064D13	Upstream Oxygen Sensor Sensing Element Failure

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check upstream oxygen sensor connector

- (a) Disconnect the negative battery.
- (b) Unplug upstream oxygen sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

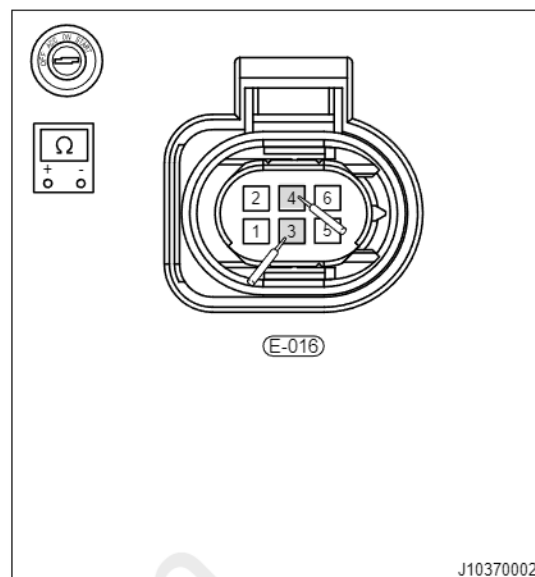
NG

Repair and adjust connector, or replace upstream oxygen sensor.

OK

2 Check upstream oxygen sensor heater internal resistance

- (a) Using ohm band of multimeter, measure if internal resistances of upstream oxygen sensor E-016 (3-4) are normal with red and black probes respectively.



NG

Replace upstream oxygen sensor assembly.

OK

3

Check upstream oxygen sensor heater power supply fuse

- (a) Turn ENGINE START STOP switch to ON.
 (b) Check fuse EF18 10A in engine compartment fuse and relay box with 21 W test light.

Test light should be bright

NG

It indicates that there is short to ground in circuit.

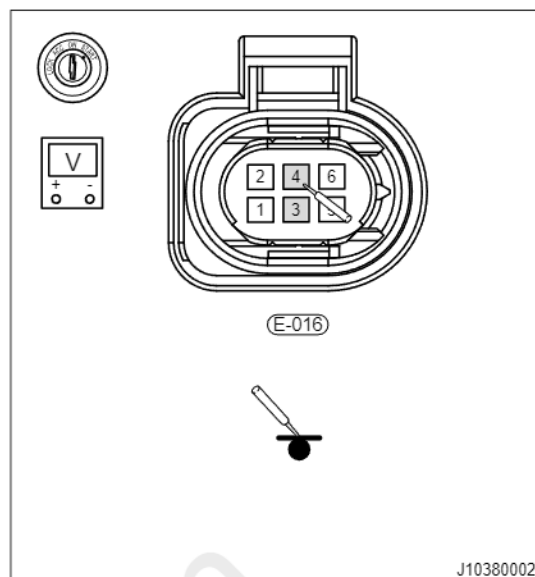
OK

4

Check upstream oxygen sensor heater power supply and heater control terminal

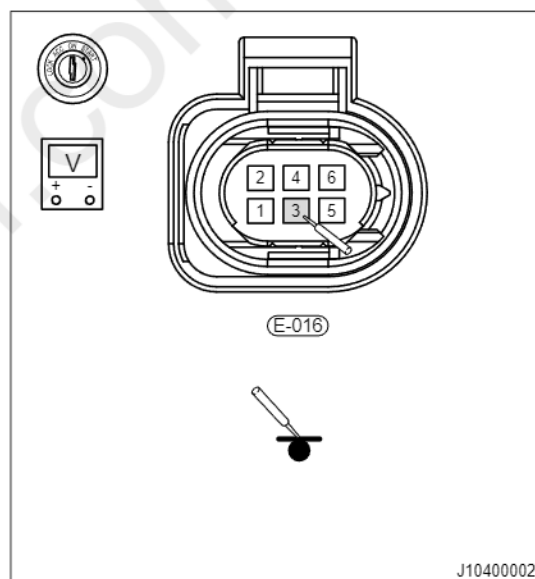
- (a) Install the upstream oxygen sensor connector.
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of upstream oxygen sensor E-016 (3, 4) with red probe.

Test voltage is current battery voltage



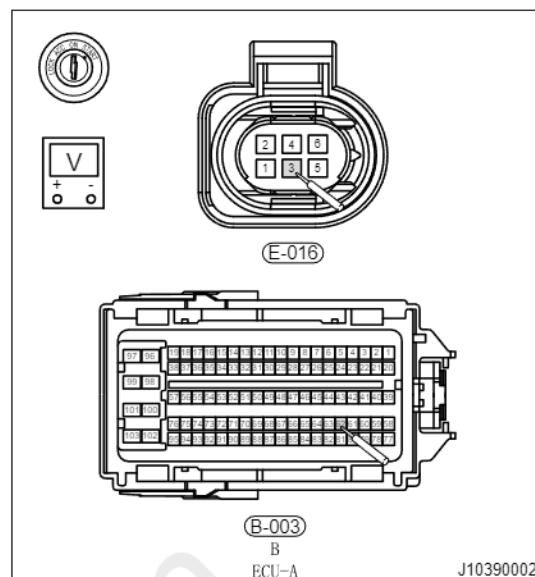
- (d) Start the engine.
- (e) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of upstream oxygen sensor E-016 (3) with red probe.

Control heating voltage should be within 0 V and current battery voltage



- (f) Start the engine.
- (g) Using voltage band of multimeter (voltage drop method), connect black probe to ECM B-003 (A62), measure voltage of upstream oxygen sensor E-016 (3) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Boost Discharge Control Valve Drive Circuit Short to Ground/Power Supply

DTC	P003411	Boost Discharge Control Valve Drive Circuit Short to Ground
DTC	P003512	Boost Discharge Control Valve Drive Circuit Short to Power Supply

■ Description

Control schematic diagram

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check boost discharge control valve connector

- Disconnect the negative battery.
- Unplug boost discharge valve connector, check if this connector is loose, and contact between male and female terminals is in good condition.

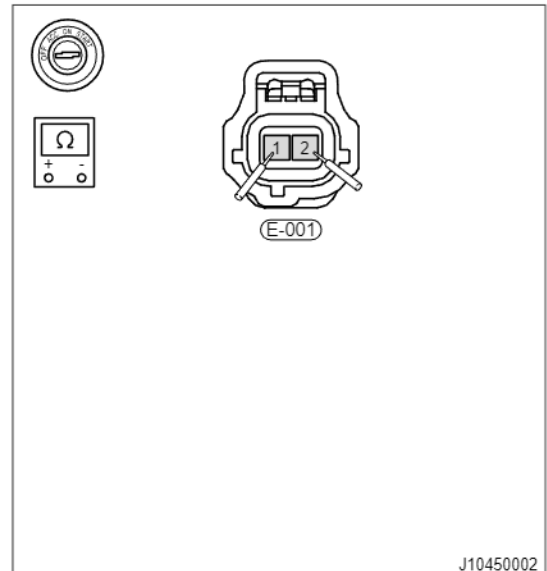
NG

Repair and adjust connector, or replace boost discharge valve connector.

OK

2 Check boost discharge valve internal resistance

- Using ohm band of multimeter, measure if internal resistances of boost discharge valve E-001 (1-2) are normal with red and black probes respectively.



NG

Replace boost discharge valve assembly.

OK

3 Check boost discharge valve power supply fuse

- (a) Turn ENGINE START STOP switch to ON.
- (b) Check fuse EF21 15A in engine compartment fuse and relay box with 21 W test light.

Test light should be bright

NG

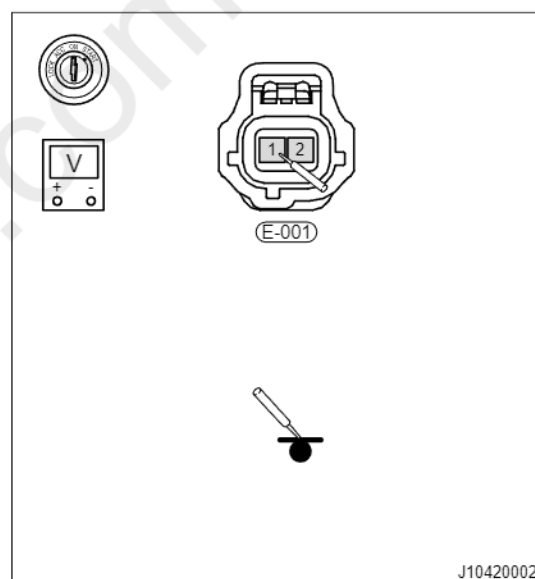
It indicates that there is short to ground in circuit.

OK

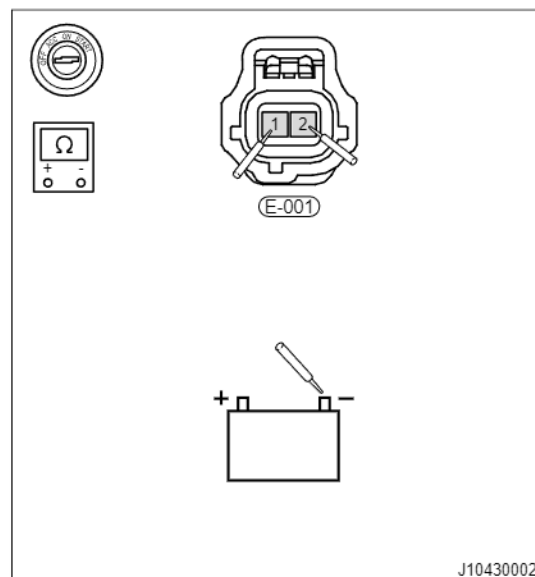
4 Check boost discharge valve power supply and heater control terminal

- (a) Connect the boost discharge valve connector.
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of boost discharge valve E-001 (1, 2) with red probe.

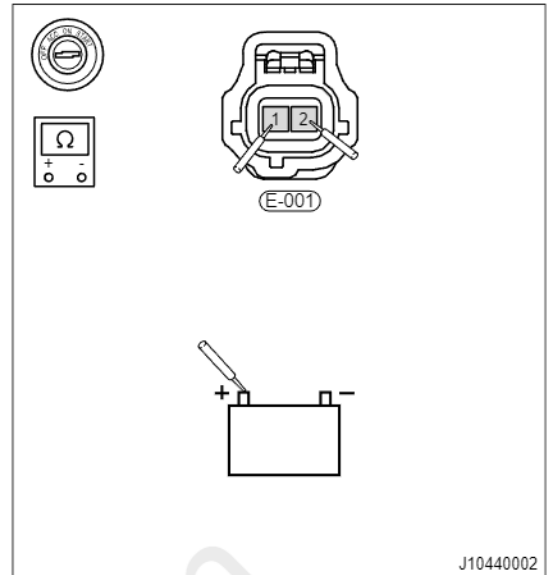
Test voltage is current battery voltage



- (d) Disconnect the boost discharge valve connector.
- (e) Disconnect engine compartment fuse and relay box fuse EF21 15A.
- (f) Disconnect the ECM connector (B-003).
- (g) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of boost discharge valve E-001 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (h) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of boost discharge valve E-001 (1, 2) with red probe respectively. Check if circuit is short to power supply.



NG

Repair or replace wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Downstream Oxygen Sensor Heater Control Circuit Open/Low/High/Heater Internal Resistance Non-plausible

DTC	P003600	HO2S Heater Control Circuit Bank 1 Sensor 2
DTC	P003700	HO2S Heater Control Circuit Low Bank 1 Sensor 2

DTC	P003800	HO2S Heater Control Circuit High Bank 1 Sensor 2
DTC	P005400	HO2S Heater Resistance Bank 1 Sensor 2
DTC	P223200	O2 Sensor Signal Circuit Shorted to Heater Circuit Bank 1 Sensor 2

■ **Description**

Control schematic diagram

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check downstream oxygen sensor connector

- (a) Disconnect the negative battery.
- (b) Unplug downstream oxygen sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

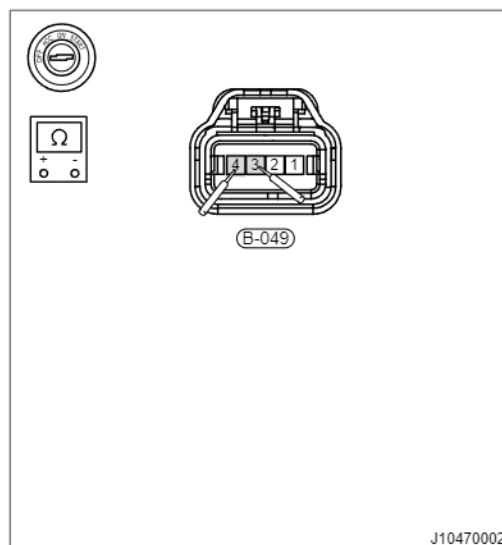
NG

Repair and adjust connector, or replace downstream oxygen sensor.

OK

2 Check downstream oxygen sensor heater internal resistance

- (a) Using ohm band of multimeter, measure if internal resistances of downstream oxygen sensor E-049 (3-4) are normal with red and black probes respectively.



NG

Replace downstream oxygen sensor assembly.

OK

3 Check downstream oxygen sensor heater power supply fuse

- (a) Turn ENGINE START STOP switch to ON.
- (b) Check fuse EF18 10A in engine compartment fuse and relay box with 21 W test light.

Test light should be bright

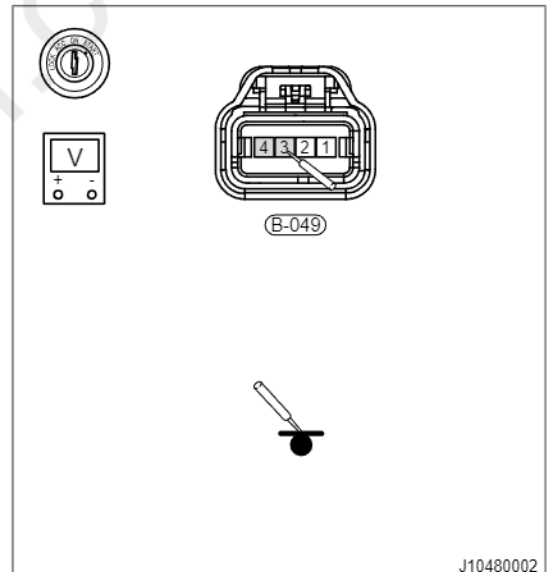
NG

It indicates that there is short to ground in circuit.

OK

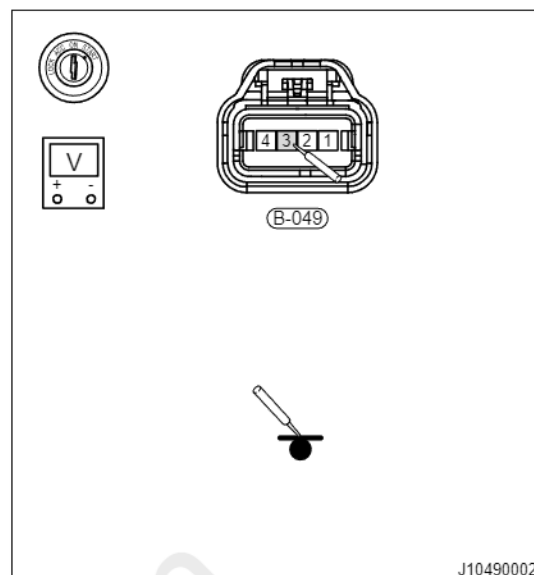
4 Check downstream oxygen sensor heater power supply and heater control terminal

- (a) Install the upstream oxygen sensor connector.
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of downstream oxygen sensor E-049 (3, 4) with red probe.

Test voltage is current battery voltage

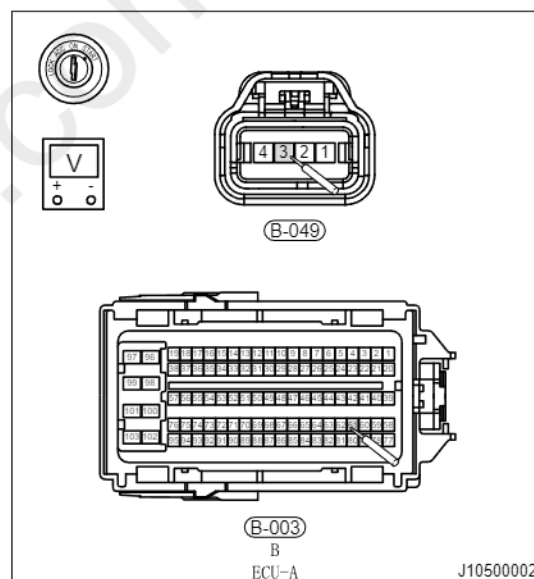
- (d) Start the engine.
- (e) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of downstream oxygen sensor E-049 (3) with red probe.

Control heating voltage should be within 0 V and current battery voltage



- (f) Start the engine.
- (g) Using voltage band of multimeter (voltage drop method), connect black probe to ECM B-003 (A61), measure voltage of downstream oxygen sensor E-049 (3) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Turbocharger Electronic Waste Gate Self-learning/Duty Ratio Out of Limit**

DTC	P003A22	Turbocharger/Supercharger Boost Control "A" Position Exceeded Learning Limit
DTC	P003A21	Turbocharger/Supercharger Boost Control "A" Position Exceeded Learning Limit
DTC	P003A72	Turbocharger/Supercharger Boost Control "A" Position Exceeded Learning Limit
DTC	P003A73	Turbocharger/Supercharger Boost Control "A" Position Exceeded Learning Limit
DTC	P024437	Turbocharger/Supercharger Wastegate Actuator "A" Range/Performance

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check by-pass valve actuator conditions

- (a) Check for foreign matter near turbocharger closed position.
- (b) Check if electronic waste gate is stuck.
- (c) Push the turbocharger to closed position manually, read position voltage to check if it is out of the range of SPEC.

NG

Clean up foreign matter or replace turbocharger assembly.

OK

2 Check by-pass valve actuator connector

(a) Check if connector and wire harness are deteriorated.

NG

Repair or replace wire harness.

OK

3 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Turbocharger Electronic Waste Gate Position Sensor Voltage Low/High**

DTC	P256400	Turbocharger Boost Control Position Sensor "A" Circuit Low
DTC	P256500	Turbocharger Boost Control Position Sensor "A" Circuit High

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check electronic waste gate connector

- (a) Disconnect the negative battery.
 (b) Unplug electronic waste gate connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

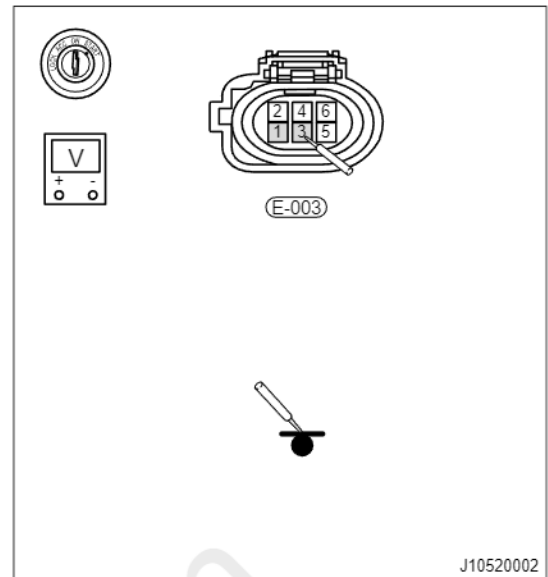
OK

2 Check electronic waste gate position sensor power supply and ground

- (a) Connect electronic waste gate connector.
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of electronic waste gate position sensor E-003 (1, 3) with red probe.

Reference power supply: 5 V

Ground: 0 V



NG

Repair wire harness or replace engine control unit.

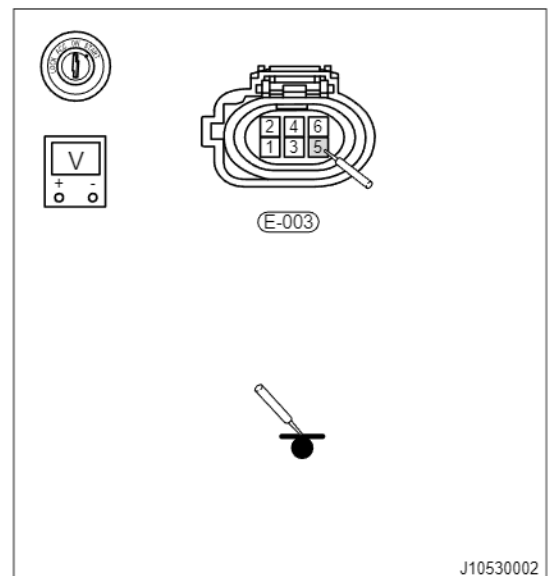
OK

3

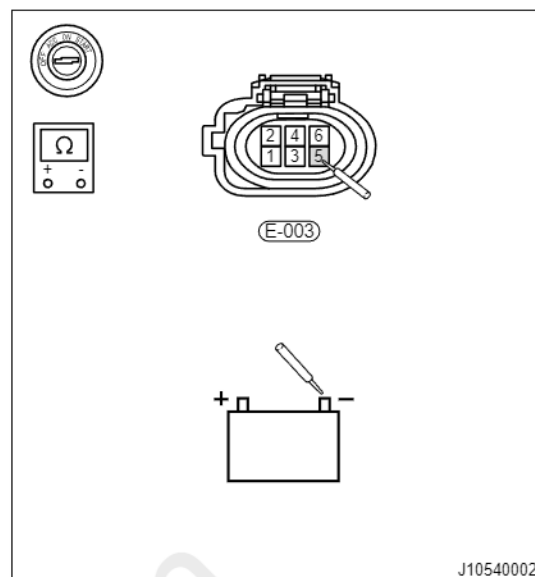
Check electronic waste gate position sensor signal terminal

- (a) Connect the boost discharge valve connector.
- (b) Start the engine.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure if voltage of electronic waste gate position sensor E-003 (5) varies according to opening angle with red probe.

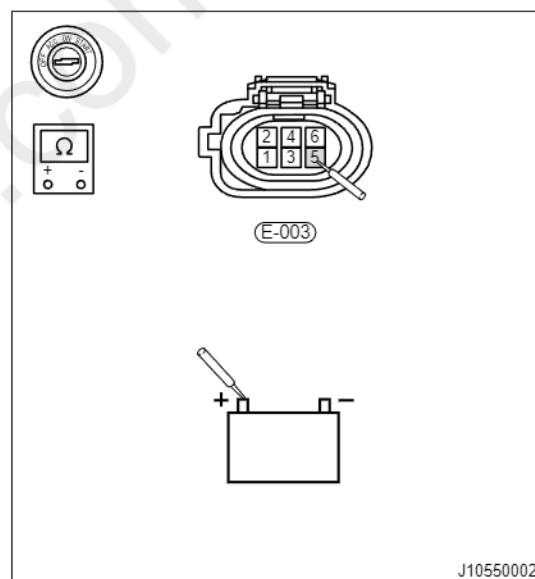
Test voltage is current battery voltage



- (d) Disconnect the electronic waste gate connector.
- (e) Disconnect the ECM connector (E-018).
- (f) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of electronic waste gate position sensor E-003 (5) with red probe respectively. Check if circuit is short to ground.



- (g) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistance of electronic waste gate position sensor E-003 (5) with red probe respectively. Check if circuit is short to power supply.



NG

Repair or replace wire harness or replace turbocharger assembly.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Communication Failure of Supercharger Wastegate Control Circuit**

DTC	P170300	Communication Failure of Supercharger Wastegate Control Circuit
-----	---------	---

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check electronic waste gate connector
---	--

- (a) Disconnect the negative battery.
- (b) Unplug electronic waste gate connector, check if this connector is loose, and contact between male and female terminals is in good condition.

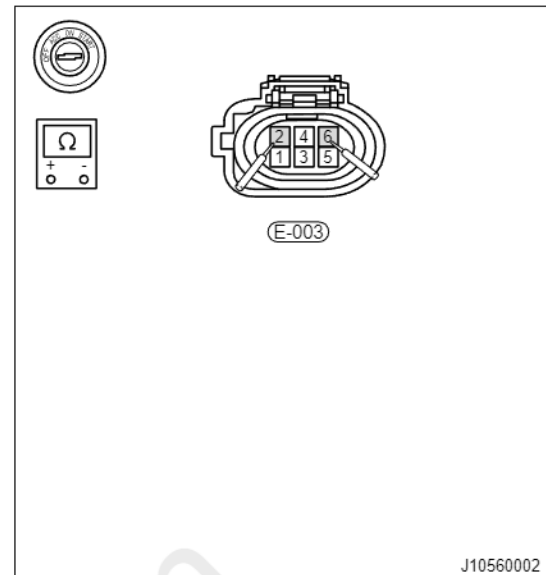
NG

Repair and adjust connector, or replace it.

OK

2	Check electronic waste gate internal resistance
---	--

- (a) Using ohm band of multimeter, measure if internal resistances of boost discharge valve E-003 (6-2) are normal with red and black probes respectively.



NG

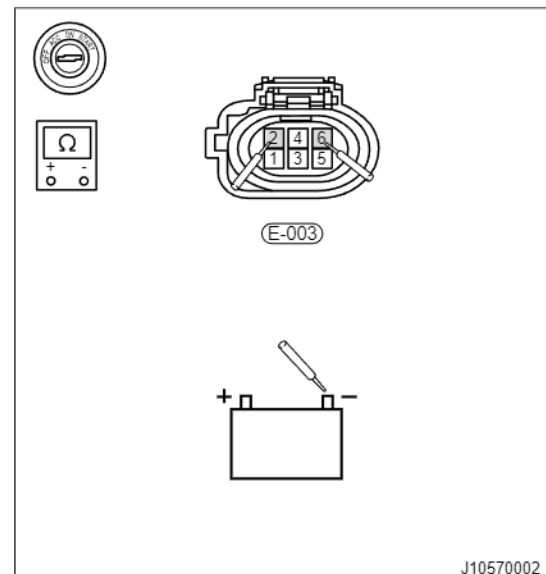
Replace turbocharger assembly.

OK

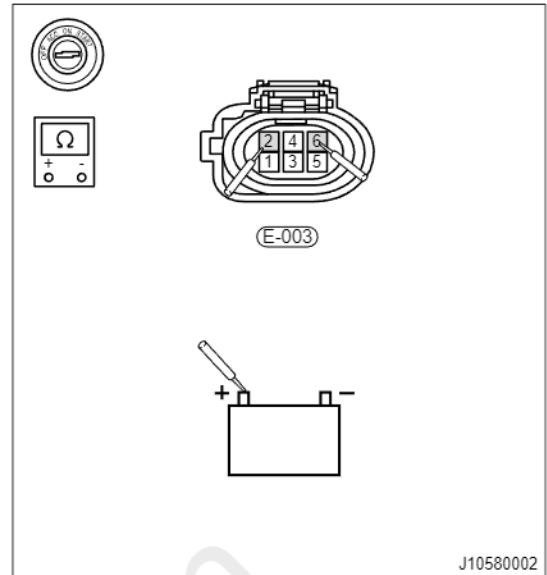
3

Check for short circuit to ground / power supply in electric waste gate control circuit

- (a) Disconnect the electronic waste gate connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistances of waste gate E-003 (6, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of waste gate E-003 (6, 2) with red probe respectively. Check if circuit is short to power supply.



NG

Repair or replace wire harness.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Ambient pressure sensor malfunction

DTC	P222900	Barometric Pressure Sensor "A" Circuit High
DTC	P222800	Barometric Pressure Sensor "A" Circuit Low Problem

DTC	P222722	Barometric Pressure Sensor "A" Circuit Range/Performance
DTC	P222721	Barometric Pressure Sensor "A" Circuit Range/Performance
DTC	P222785	Barometric Pressure Measurement System - Multiple Sensor Correlation Bank 1
DTC	P222784	Barometric Pressure Measurement System - Multiple Sensor Correlation Bank 1
DTC	P120200	Barometric Pressure Sensor "A" Circuit Range/Performance
DTC	P120300	Barometric Pressure Sensor "A" Circuit Range/Performance

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check Engine Control Module (ECM)

- The built-in ambient pressure sensor in ECM fails.
- Remove Engine Control Module (ECM) from malfunctioning vehicle.
- Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

2 Reconfirm DTCs

- Connect diagnostic tester and clear DTCs.
- Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ High Pressure Fuel Supply Control Deviation Too High/Fuel Rail Pressure Too Low/Too High

DTC	P008985	Fuel Pressure Regulator 1 Performance-Pressure Too Low
DTC	P008984	Fuel Pressure Regulator 1 Performance-Pressure Too High
DTC	P008700	Fuel Rail/System Pressure - Too Low
DTC	P008800	Fuel Rail/System Pressure - Too High

DTC	P053F21	Cold Start Fuel Pressure Performance
DTC	P053F22	Cold Start Fuel Pressure Performance
DTC	P00C600	Fuel Rail Pressure Too Low - Engine Cranking Bank 1

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check if fuel is insufficient
----------	--------------------------------------

(a) Check that fuel in fuel tank is sufficient.

NG	Add the fuel.
-----------	---------------

OK

2	Check fuel connecting line for leakage
----------	---

(a) Check low pressure/high pressure fuel connecting lines for squash, leakage.

NG	Replace the corresponding line.
-----------	---------------------------------

OK

3	Check low pressure fuel pressure
----------	---

(a) Connect fuel pressure gauge to test if low pressure fuel pressure is met the standard.

NG	Replace fuel pump assembly.
-----------	-----------------------------

OK

4	Check high pressure fuel pump
----------	--------------------------------------

- (a) Remove the high pressure fuel pump;
- (b) Check high pressure fuel pump for fuel leakage.
- (c) Check relief valve for blockage or abnormal operation.

NG

Replace high pressure fuel pump assembly.

OK

5

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Short Circuit in High Side and Low Side Control Circuit of Flow Control Valve

DTC	P009000	Short Circuit in High Side and Low Side Control Circuit of Flow Control Valve
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■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check flow control valve connector

- (a) Disconnect the negative battery.
- (b) Unplug flow control valve connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG

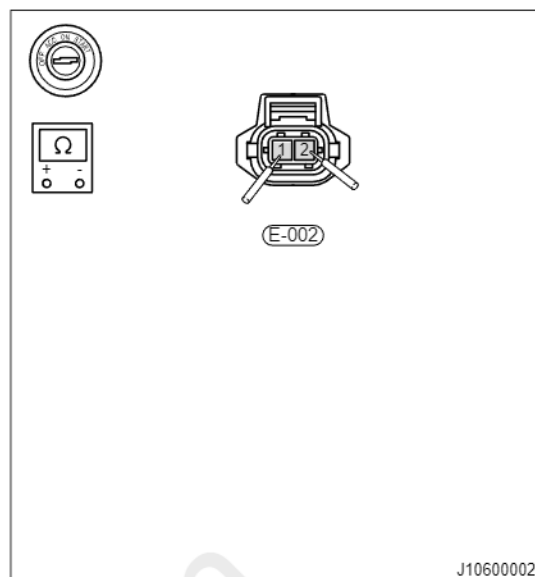
Repair and adjust connector, or replace it.

OK

2

Check flow control valve internal resistance

- (a) Using ohm band of multimeter, measure if internal resistances of flow control valve E-002 (1-2) are normal with red and black probes respectively.



NG

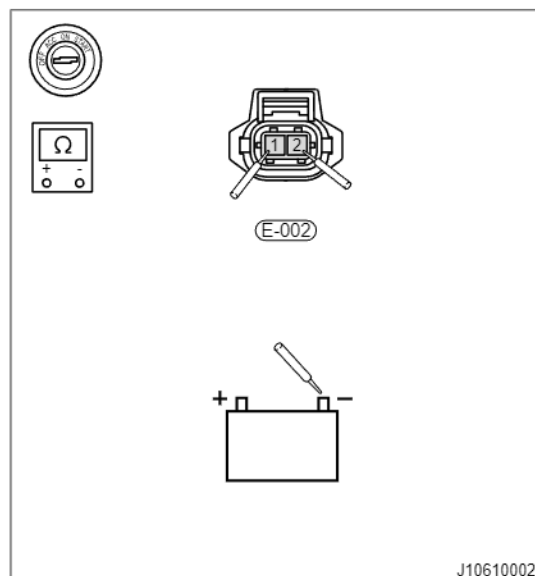
Replace high pressure fuel pump assembly.

OK

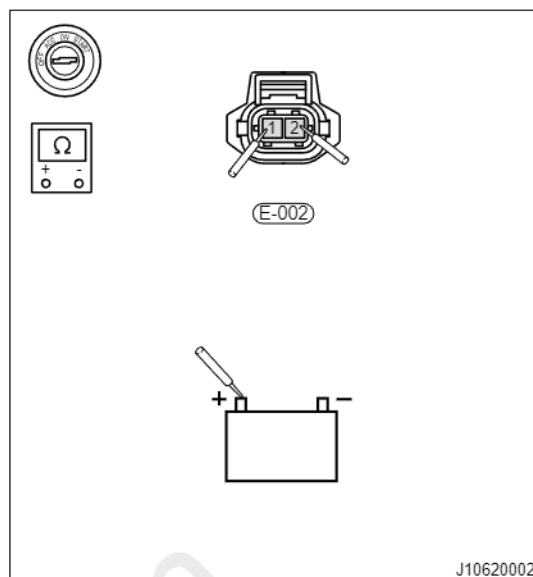
3

Check for short circuit to ground / power supply in flow control valve control circuit

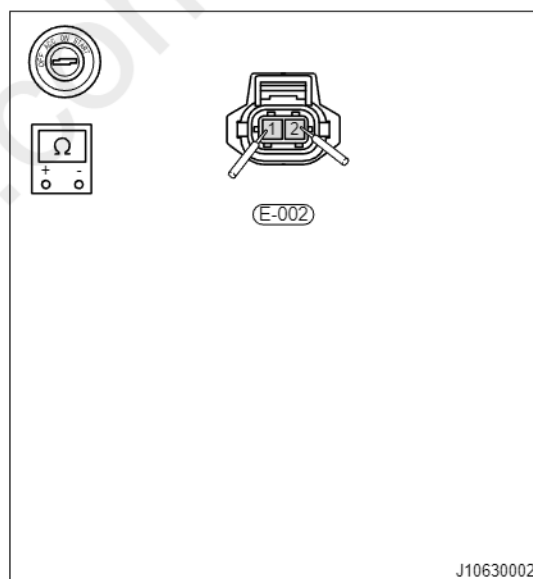
- (a) Disconnect the high pressure fuel pump connector.
 (b) Disconnect the ECM connector (E-018).
 (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of high pressure fuel pump E-002 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of high pressure fuel pump E-003 (1, 2) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of high pressure fuel pump E-003 (1, 2) with red and black probes respectively. Check if control circuits are shorted with each other.



NG

Repair or replace wire harness.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Intake Air Sensor 2 Voltage Too High/Too Low/Signal Non-plausible

DTC	P009626	Intake Air Temp.Circ. Performance Non-plausible
DTC	P009800	Intake Air Temperature Sensor 2 Circuit High Bank 1
DTC	P009700	Intake Air Temperature Sensor 2 Circuit Low Bank 1
DTC	P009900	Intake Air Temperature Sensor 2 Circuit Intermittent Bank 1

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check boost pressure/temperature sensor connector

- (a) Disconnect the negative battery.
- (b) Unplug boost pressure/temperature sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

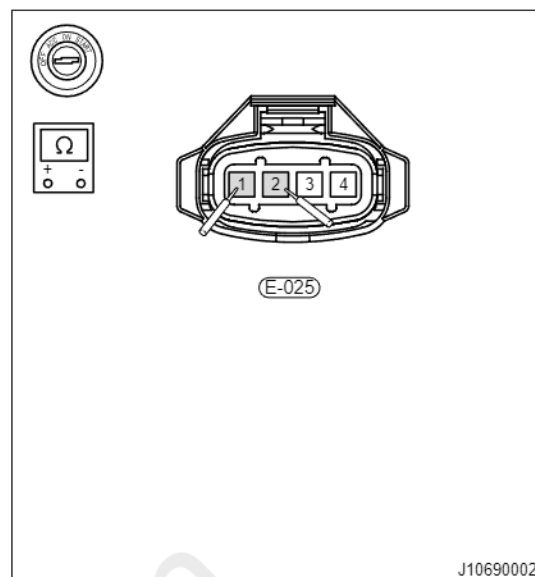
NG

Repair and adjust connector, or replace boost pressure/temperature sensor.

OK

2 Check boost pressure/temperature sensor internal resistance

- (a) Using ohm band of multimeter, measure if resistances of boost pressure/temperature sensor E-025 (1-2) are normal with red and black probes respectively. They should vary in accordance with intake temperature.



NG

Replace boost pressure/temperature sensor assembly.

OK

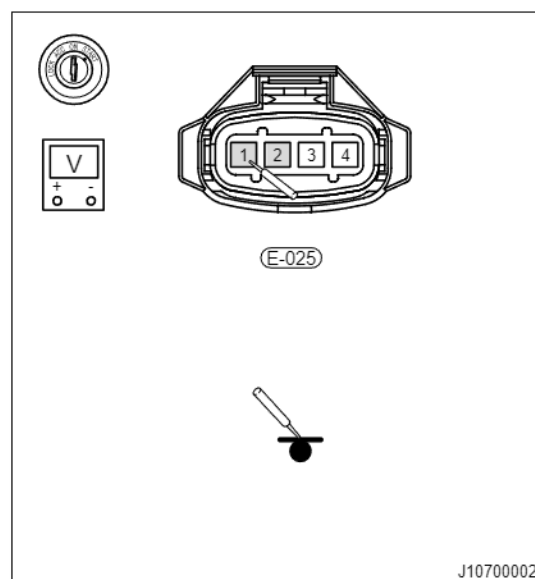
3

Check boost pressure/temperature sensor signal terminal and ground terminal

- (a) Connect boost pressure/temperature sensor connector.
 (b) Start the engine.
 (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of boost pressure/temperature sensor E-025 (1, 2) with red probe.

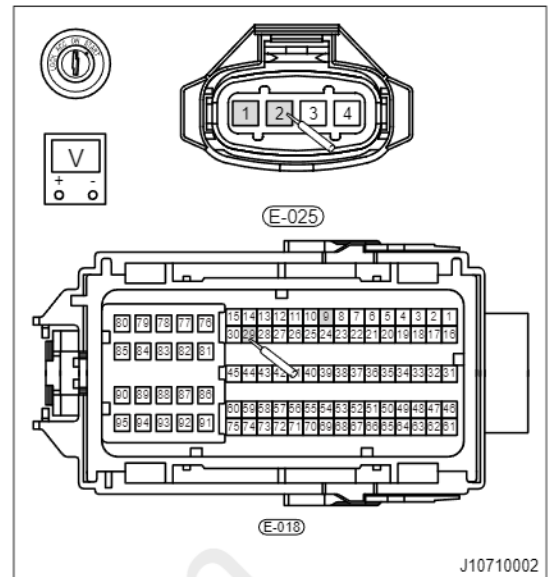
Signal terminal: Voltage signal should vary in accordance with intake temperature.

Ground terminal: Voltage < 0.2 V



- (d) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B29, B9), measure voltages of boost pressure/temperature sensor E-025 (1, 2) with red probe

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Intake Pressure/Temperature Sensor Malfunction

DTC	P01062A	Manifold Absolute Pressure Sensor Circuit Range/Performance
DTC	P010622	Manifold Absolute Pressure Sensor Circuit Range/Performance

DTC	P010621	Manifold Absolute Pressure Sensor Circuit Range/Performance
DTC	P120000	Manifold Absolute Pressure Sensor Circuit Range/Performance
DTC	P120100	Manifold Absolute Pressure Sensor Circuit Range/Performance
DTC	P00C721	Intake Air Pressure Measurement System - Multiple Sensor Correlation Bank 1
DTC	P00C722	Intake Air Pressure Measurement System - Multiple Sensor Correlation Bank 1
DTC	P010700	Intake Manifold Pressure Sensor Circuit Voltage Too Low
DTC	P010800	Intake Manifold Pressure Sensor (Electric) Circuit Short to Battery

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check intake pressure/temperature sensor connector
----------	---

- (a) Disconnect the negative battery.
- (b) Unplug intake pressure sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace intake pressure sensor.

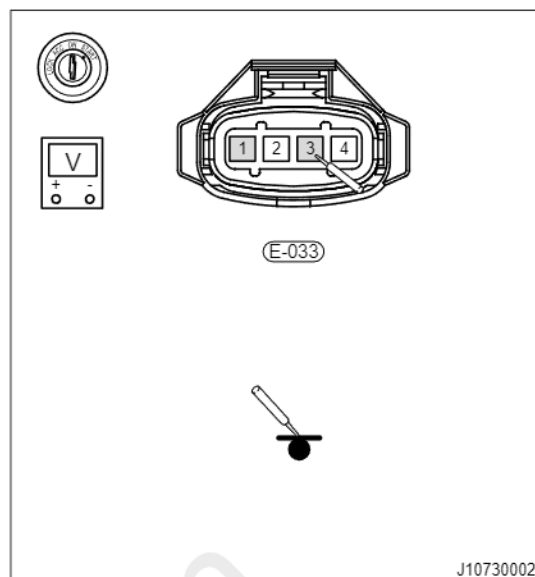
OK

2	Check intake pressure/temperature sensor power supply and ground terminals
----------	---

- (a) Connect boost pressure/temperature sensor connector.
- (b) Start the engine.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of intake pressure/temperature sensor E-033 (1, 3) with red probe.

Power supply terminal: 5 V

Ground terminal: Voltage < 0.2 V



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NG

Repair or replace wire harness.

OK

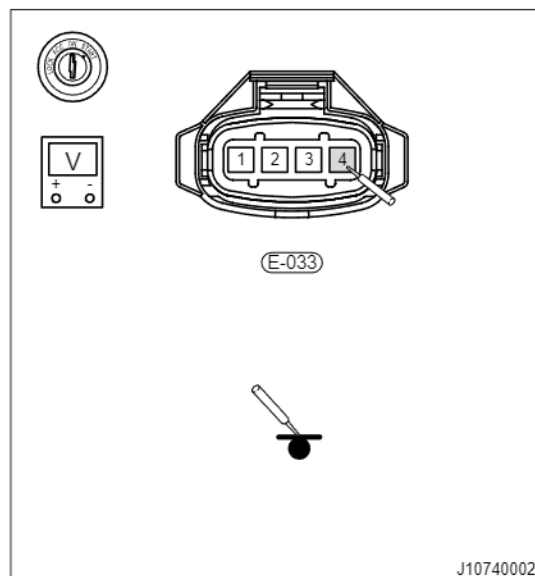
3

Check intake pressure/temperature sensor signal terminal

- (a) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of intake pressure/temperature sensor E-033 (4) with red probe.

Under idling state: 1 V

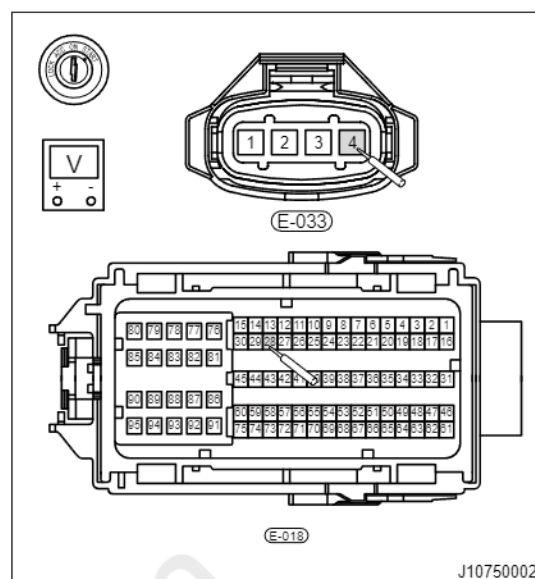
When the vehicle accelerates rapidly, voltage can instantly reach 4 V, and then drop to 1.7 V



J10740002

- (b) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B28), measure voltage of intake pressure/temperature sensor E-033 (4) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair and replace wire harness, or replace intake pressure/temperature sensor.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Boost Pressure Out of Range High/Low/Non-plausible

DTC	P120400	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance
DTC	P120500	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance
DTC	P023622	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance
DTC	P023621	Turbocharger/Supercharger Boost Sensor "A" Circuit Range/Performance

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check intake line condition
---	-----------------------------

(a) Check if intake line is detached or seriously air leaked.

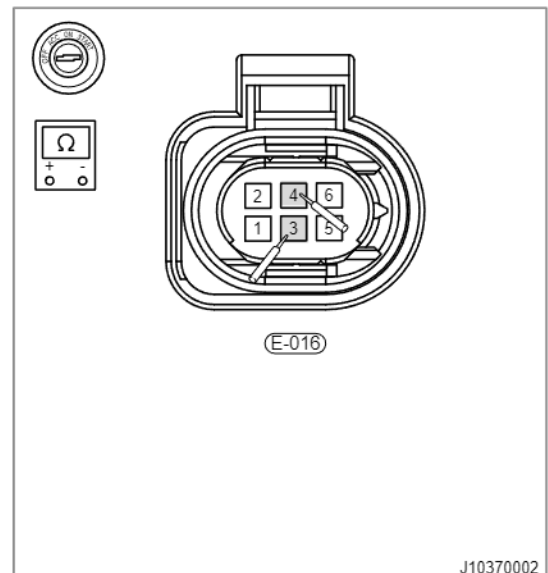
NG

Repair and adjust or replace related connecting lines.

OK

2	Check boost pressure/temperature sensor
---	---

- (a) Check boost pressure/temperature sensor connector for looseness or poor contact.
- (b) Check if there is any freeze, oil stain, etc. on measurement terminal of boost pressure/temperature sensor, which will affect normal measurement.



NG

Adjust connector, or replace boost pressure/temperature sensor.

OK

3

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Intake pressure sensor malfunction

DTC	P011126	Intake Air Temp.Circ. Performance Non-plausible
DTC	P011200	Intake Air Temp.Circ. Low Input
DTC	P011300	Intake Air Temp.Circ. High Input
DTC	P011400	Poor Contact in Intake Manifold Temperature Sensor Circuit
DTC	P00CE23	Intake Air Temperature Sensor 2 Multiple Check Bank1
DTC	P138024	Intake Air Temperature Sensor 2 Multiple Check Bank1
DTC	P138023	Intake Air Temperature Sensor 2 Multiple Check Bank1

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check intake pressure/temperature sensor connector

- (a) Disconnect the negative battery.
- (b) Unplug intake pressure/temperature sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG

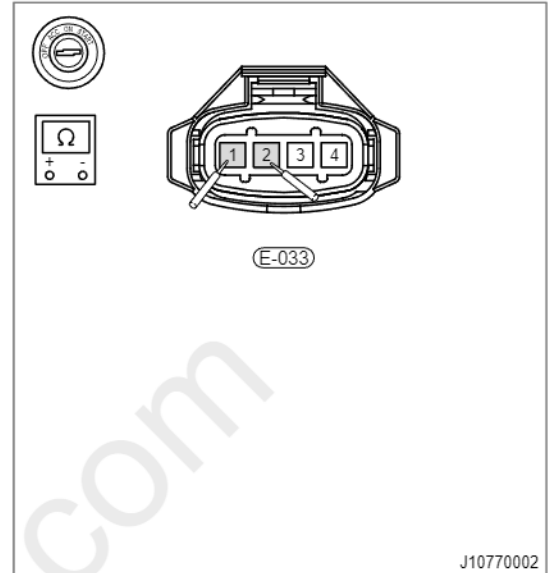
Repair and adjust connector, or replace intake pressure/temperature sensor.

OK

2 Check intake pressure/temperature sensor resistance

- (a) Using ohm band of multimeter, measure if resistances of intake pressure/temperature sensor E-033 (1-2) are normal with red and black probes respectively.

Rated resistance at 20°C: $2.5\text{ K}\Omega \pm 5\%$



NG

Replace intake pressure/temperature sensor assembly.

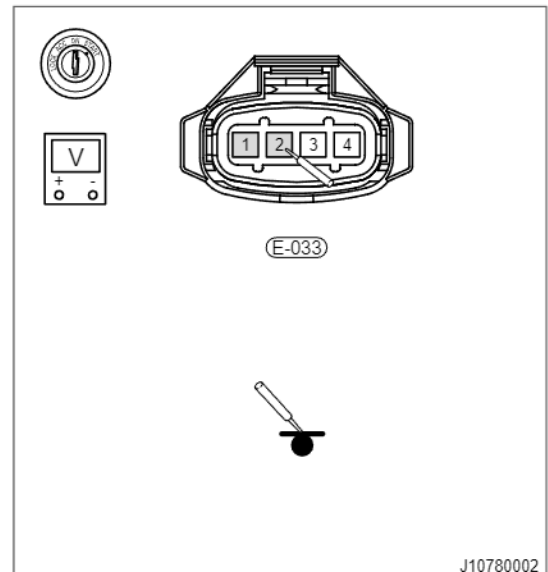
OK

3 Check intake pressure/temperature sensor signal and ground terminals

- (a) Connect the intake pressure/temperature sensor connector.
 (b) Start the engine.
 (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of intake pressure/temperature sensor E-033 (1, 2) with red probe.

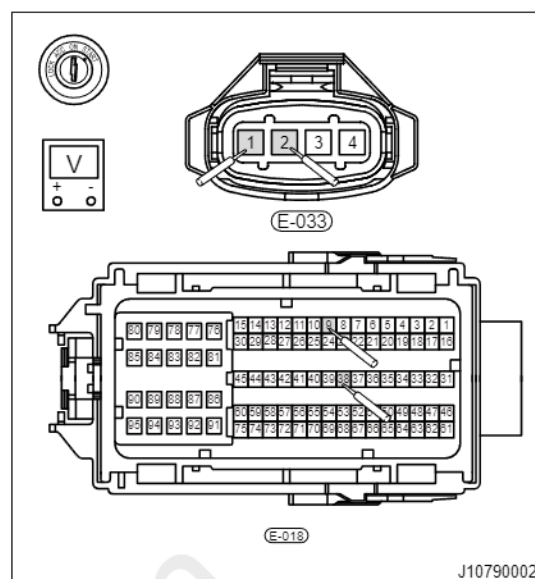
Signal terminal: Signal voltage should vary in accordance with temperature

Ground terminal: Voltage < 0.2 V



- (d) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B38, B9), measure voltage of intake pressure/temperature sensor E-033 (1, 2) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Coolant Temperature Sensor 1 Malfunction

DTC	P011623	Coolant Temperature Sensor 1 Signal Not Plausible
DTC	P011626	Engine Coolant Temperature Sensor 1 Circuit Range/Performance

DTC	P050C24	Cold Start Engine Coolant Temperature Performance
DTC	P050C23	Cold Start Engine Coolant Temperature Performance
DTC	P011700	Engine Coolant Temperature Sensor 1 Circuit Low
DTC	P011800	Engine Coolant Temperature Sensor 1 Circuit High
DTC	P011900	Engine Coolant Temperature Sensor 1 Circuit Intermittent

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check coolant temperature sensor 1 connector
----------	---

- (a) Disconnect the negative battery.
- (b) Unplug coolant temperature sensor 1 connector, check if this connector is loose, and contact between male and female terminals is in good condition.

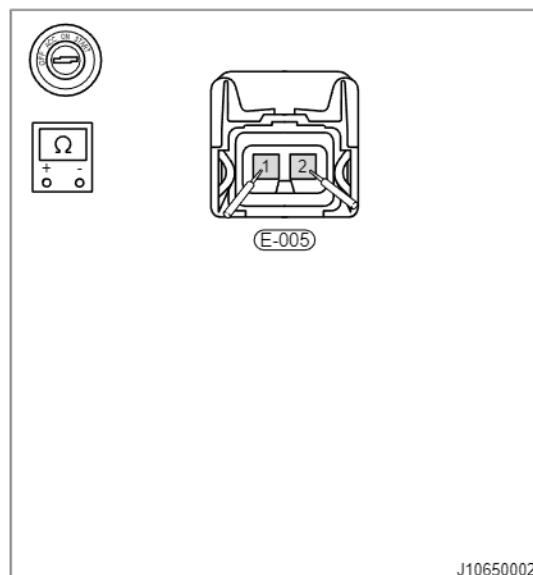
NG

Repair and adjust connector, or replace coolant temperature sensor 1.

OK

2	Check coolant temperature sensor internal resistance
----------	---

- (a) Using ohm band of multimeter, measure if internal resistances of coolant temperature sensor 1 E-005 (2-1) are normal with red and black probes respectively. They should vary in accordance with coolant temperature.



J10650002

NG

Replace coolant temperature sensor 1 assembly.

OK

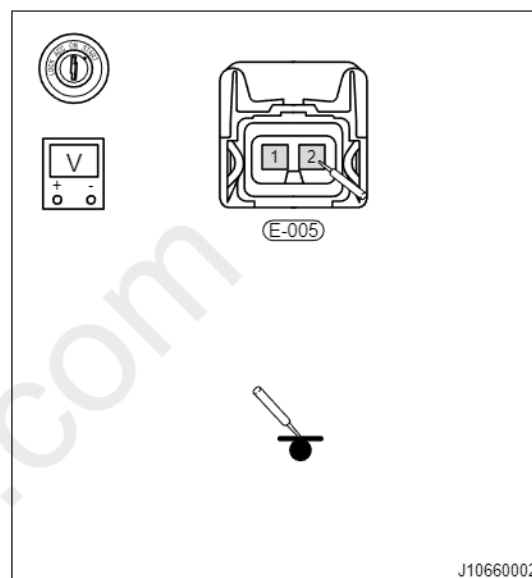
3

Check coolant temperature sensor 1 signal terminal and ground terminal

- (a) Check coolant temperature sensor 1 connector.
- (b) Start the engine.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of coolant temperature sensor 1 E-005 (1, 2) with red probe.

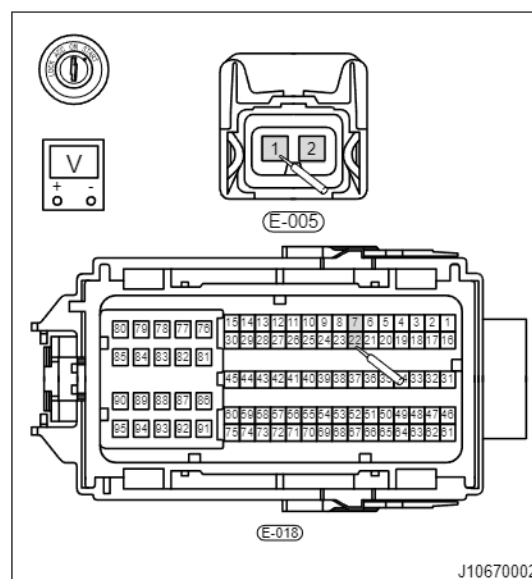
Signal terminal: Voltage signal should vary in accordance with temperature.

Ground terminal: Voltage < 0.2 V



- (d) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B22, B7), measure voltages of coolant temperature sensor E-005 (1, 2) with red probe

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****5 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ Thermostat Performance Unreasonable**

DTC	P012800	Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)
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■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

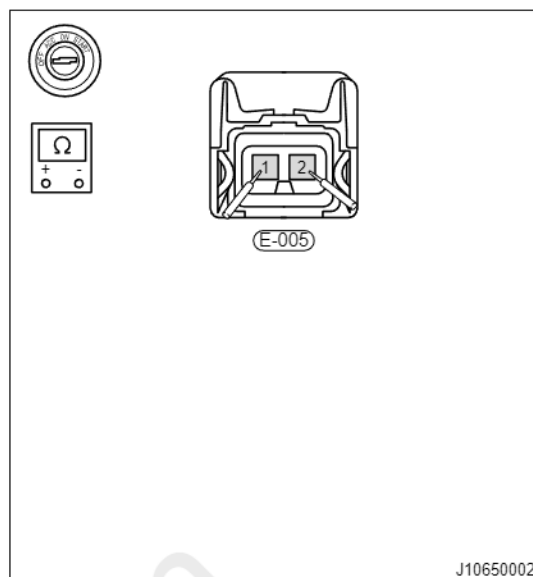
1 Check electronic thermostat

- (a) Check if electronic thermostat is normally open or damaged

NG**Replace electronic thermostat assembly.****OK****2 Check coolant temperature sensor 1 resistance**

- (a) Using ohm band of multimeter, measure if internal resistances of coolant temperature sensor 1 E-005 (2-1) are normal with red and black probes respectively. They should vary in accordance with coolant temperature.

Rated resistance at 20°C: $2.5\text{ K}\Omega \pm 10\%$



NG

Replace coolant temperature sensor 1 assembly.

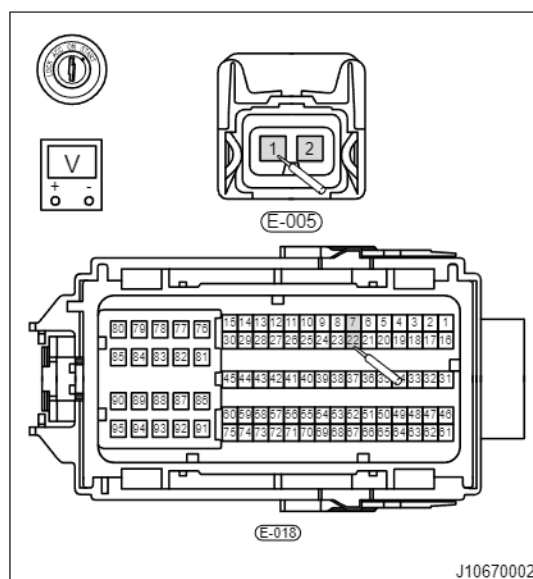
OK

3

Check coolant temperature sensor 1 connecting wire voltage drop value

- (a) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B22, B7), measure voltages of coolant temperature sensor E-005 (1, 2) with red probe

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

4	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Upstream Oxygen Sensor Signal Circuit Voltage Low/High (APE IPE RE Line Short to Ground/ Power Supply)

DTC	P013100	O2 Sensor Circuit Low Voltage Bank 1 Sensor 1
DTC	P013200	O2 Sensor Circuit High Voltage Bank 1 Sensor 1
DTC	P223700	O2 Sensor Positive Current Control Circuit Open Bank 1 Sensor 1 (- Close to ECM)
DTC	P223713	O2 Sensor Positive Current Control Circuit Open Bank 1 Sensor 1

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check upstream oxygen sensor connector
---	---

- (a) Disconnect the negative battery.
- (b) Unplug upstream oxygen sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

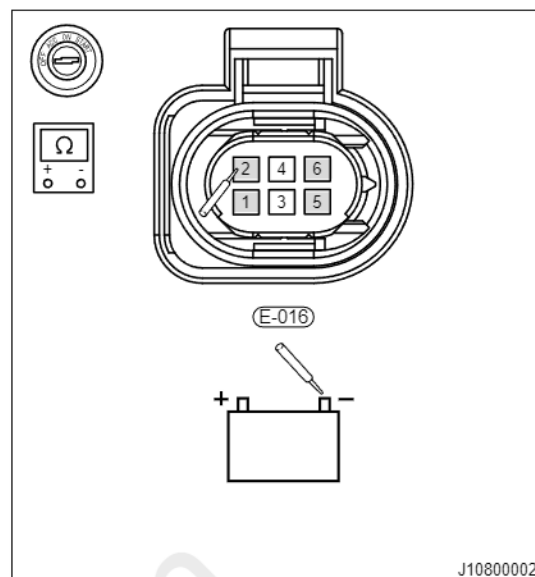
NG

Repair and adjust connector, or replace it.

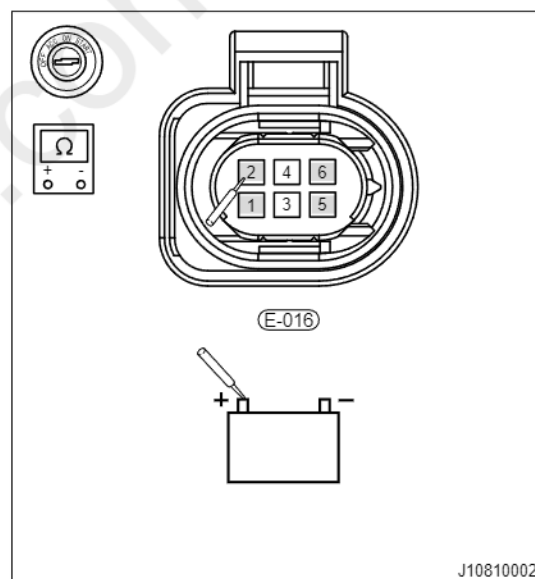
OK

2	Check for short circuit to ground / power supply in upstream oxygen sensor circuit
---	---

- (a) Disconnect the upstream oxygen sensor connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of upstream oxygen sensor E-016 (2, 6, 1, 5) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of upstream oxygen sensor E-016 (2, 6, 1, 5) with red probe respectively. Check if circuit is short to power supply.



NG

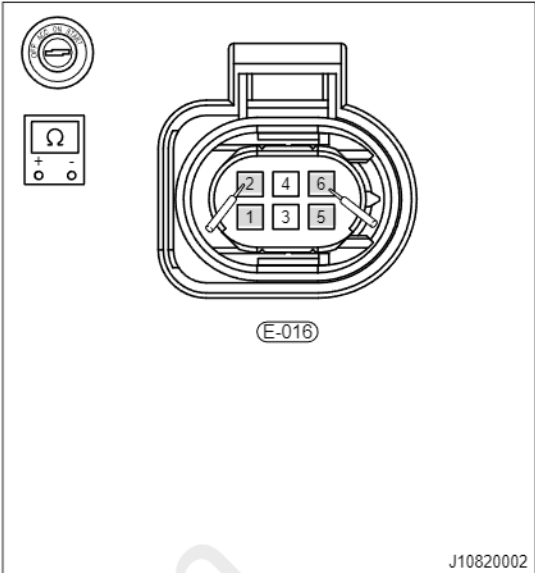
Repair or replace wire harness.

OK

3

Check if circuits of upstream oxygen sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of upstream oxygen sensor E-016 (2, 6, 1, 5) with red and black probes respectively. Check if internal circuits are shorted to each other.



NG Replace upstream oxygen sensor assembly.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK Conduct test and confirm malfunction has been repaired.

■ O2 Sensor Circuit Slow Response Bank 1 Sensor 1

DTC	P013300	O2 Sensor Circuit Slow Response Bank 1 Sensor 1
-----	---------	---

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check intake/exhaust air for leakage
----------	---

- (a) Check intake system for air leakage.
 (b) Check exhaust system for air leakage.

NG	Repair and handle parts related to air leakage.
-----------	--

OK

2	Check the upstream oxygen sensor.
----------	--

- (a) Check if upstream oxygen sensor is deteriorated; Check if response speed is slow.

NG	Replace upstream oxygen sensor assembly.
-----------	---

OK

3	Reconfirm DTCs
----------	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK	Conduct test and confirm malfunction has been repaired.
-----------	--

■ **Downstream Oxygen Sensor Signal Improper/Signal Wire Short to Ground/Power Supply**

DTC	P013600	O2 Sensor Circuit Bank 1 Sensor 2
DTC	P013700	O2 Sensor Circuit Low Voltage Bank 1 Sensor 2
DTC	P013800	O2 Sensor Circuit High Voltage Bank 1 Sensor 2

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).

- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check downstream oxygen sensor connector
----------	---

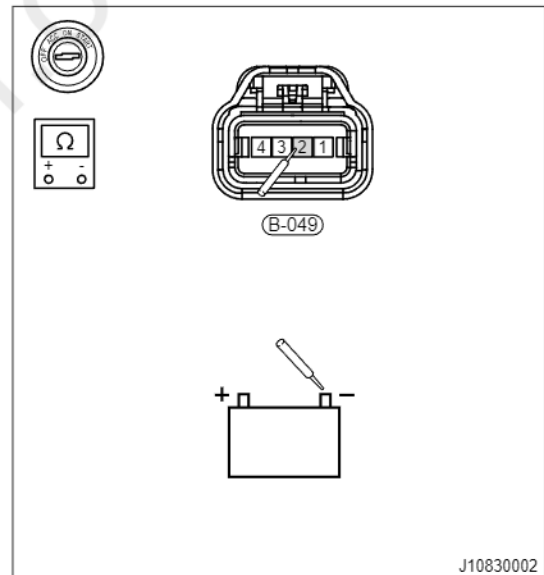
- (a) Disconnect the negative battery.
- (b) Unplug downstream oxygen sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG **Repair and adjust connector, or replace it.**

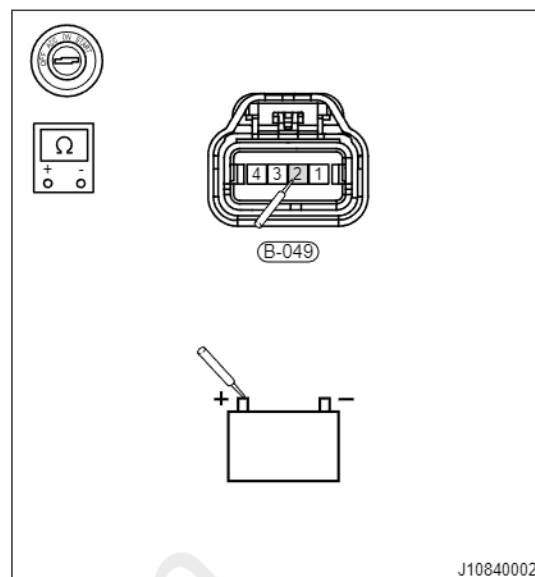
OK

2	Check for short circuit to ground / power supply in downstream oxygen sensor signal
----------	--

- (a) Disconnect the downstream oxygen sensor connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of downstream oxygen sensor B-049 (2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistance of downstream oxygen sensor E-049 (2) with red probe respectively. Check if circuit is short to power supply.



NG

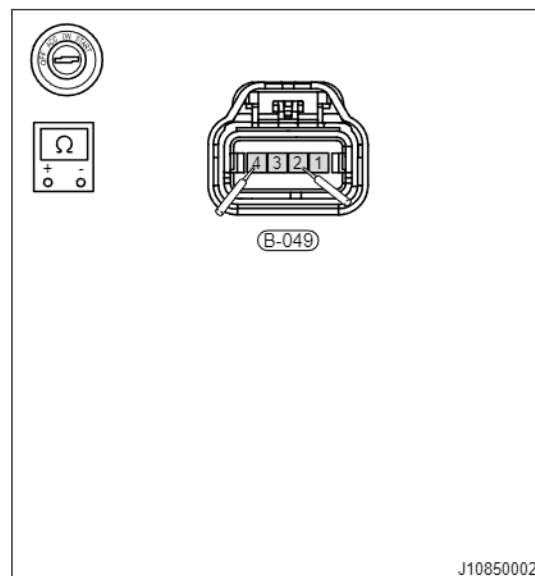
Repair or replace wire harness.

OK

3

Check if downstream oxygen sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of upstream oxygen sensor E-049 (1, 2, 3, 4) with red and black probes respectively. Check if internal circuits are shorted to each other.



NG

Replace downstream oxygen sensor assembly.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****5 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ Fuel Rail Pressure Sensor Circuit Short to Ground/Power Supply/Signal Stuck/Signal Non-plausible**

DTC	P019200	Fuel Rail Pressure Sensor Circuit Short to Ground
DTC	P019300	Fuel Rail Pressure Sensor Circuit Short to Power Supply
DTC	P019400	Fuel Rail Pressure Sensor Circuit Intermittent/Erratic Bank 1
DTC	P019128	Fuel Rail Pressure Sensor Circuit Bank 1-Negative Offset
DTC	P019129	Fuel Rail Pressure Sensor Circuit Bank 1-Positive Offset
DTC	P019000	Fuel Rail Pressure Sensor Circuit Bank 1
DTC	P254200	DECOS Oil Passage Pressure Sensor Circuit High Voltage
DTC	P254100	DECOS Oil Passage Pressure Sensor Circuit Low Voltage

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check fuel rail pressure sensor connector

- (a) Disconnect the negative battery.
- (b) Unplug fuel rail pressure sensor connector, check if this connector is loose, and contact between male and female terminals is in good condition.

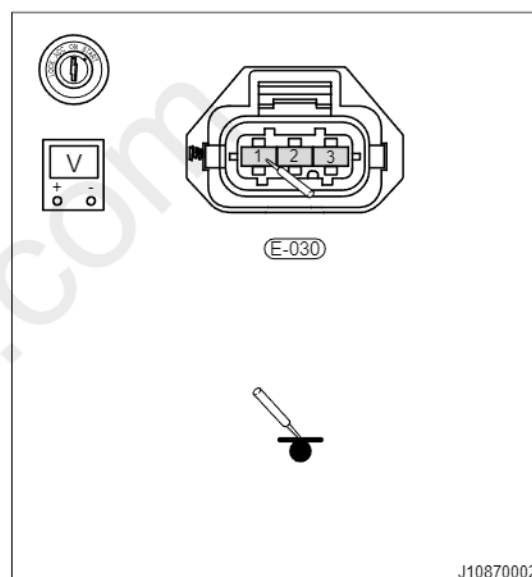
NG

Repair and adjust connector, or replace it.

OK

2 Check fuel rail pressure sensor circuit

- (a) Connect the fuel rail pressure sensor connector.
- (b) Ignition switch ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of fuel rail pressure sensor E-030 (1, 2, 3) with red probe respectively.

Power supply: 5 V**Ground: < 0.2 V****Signal: Under atmospheric pressure (100 Kpa), signal output is 0.500 ± 0.048 V**

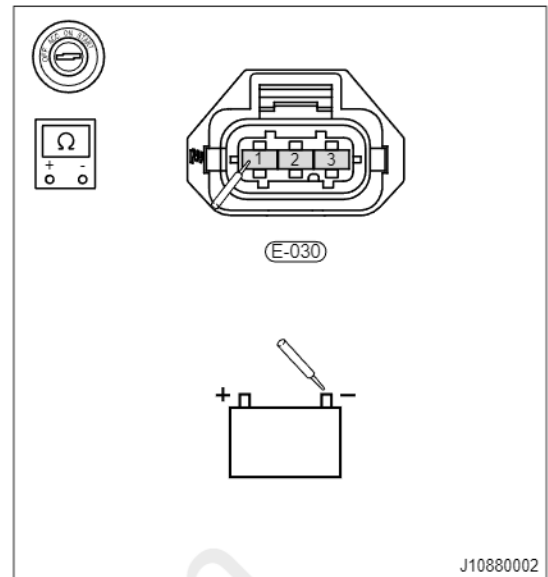
NG

Check and repair wire harness, or replace fuel rail pressure sensor.

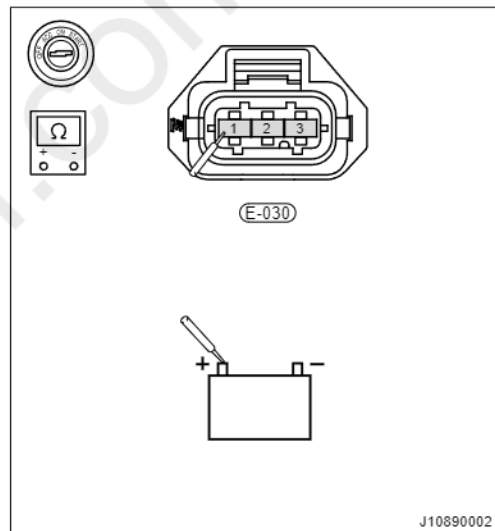
OK

3 Check for short circuit to ground / power supply in fuel rail pressure sensor

- (a) Disconnect the fuel rail pressure sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of fuel rail pressure sensor E-030 (1, 2, 3) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of fuel rail pressure sensor E-030 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



NG

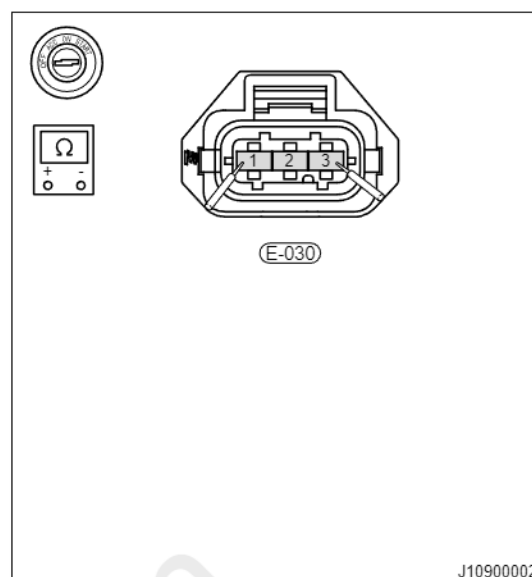
Check and repair wire harness.

OK

4

Check if circuits of fuel rail pressure sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of fuel rail pressure sensor E-030 (1, 2, 3) with red and black probes respectively. Check if internal circuits are shorted to each other.



NG

Replace fuel rail pressure sensor assembly.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 Fuel Injector Control Circuit Open

DTC	P020113	Cylinder 1 Fuel Injector Control Circuit Open
DTC	P020213	Cylinder 2 Fuel Injector Control Circuit Open

DTC	P020313	Cylinder 3 Fuel Injector Control Circuit Open
DTC	P020413	Cylinder 4 Fuel Injector Control Circuit Open

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Take troubleshooting of cylinder 1 fuel injector as an example.

1	Check injector connector
----------	---------------------------------

- (a) Disconnect the negative battery.
- (b) Check if fuel injector connector is loose, and contact between male and female terminals is in good condition.

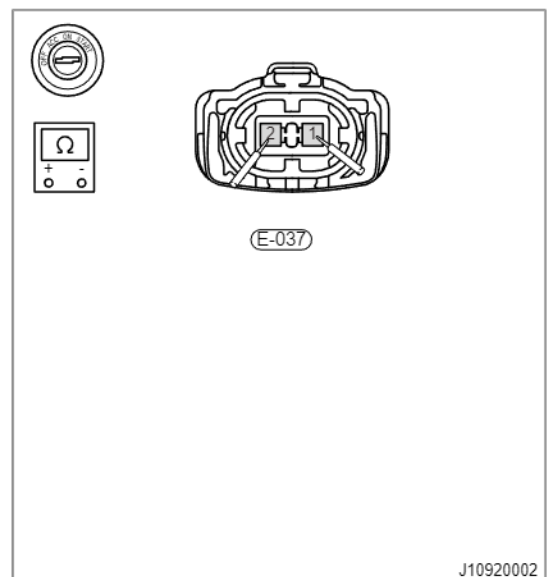
NG

Repair and adjust connector, or replace it.

OK

2	Check internal resistance of fuel injector
----------	---

- (a) Disconnect the injector connector.
- (b) Using ohm band of multimeter, measure resistances of fuel injector E-037 (1, 2) with red and black probes respectively.



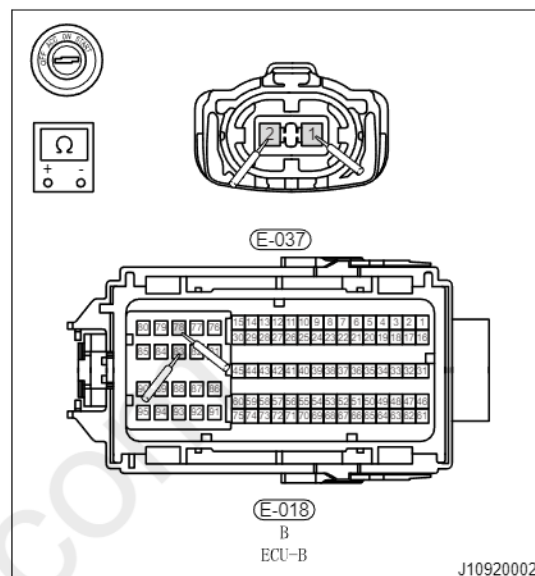
NG

Replace cylinder 1 fuel injector assembly.

OK

3 Check fuel injector control circuit

- (a) Disconnect the injector connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to ECM E-018 (B83, B78), measure for continuity between fuel injector E-037 (1, 2) with red probe respectively.



NG

Check and repair circuit.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 Ignition Coil Control Circuit Voltage High/Low

DTC	P230112	Ignition Coil "A" Primary Control Circuit High
DTC	P230412	Ignition Coil "B" Primary Control Circuit High
DTC	P230712	Ignition Coil "C" Primary Control Circuit High
DTC	P231012	Ignition Coil "D" Primary Control Circuit High
DTC	P230011	Ignition Coil "A" Primary Control Circuit Low
DTC	P230311	Ignition Coil "B" Primary Control Circuit Low
DTC	P230611	Ignition Coil "C" Primary Control Circuit Low
DTC	P230911	Ignition Coil "D" Primary Control Circuit Low
DTC	P035113	Ignition Coil "A" Primary Control Circuit Failure
DTC	P035213	Ignition Coil "B" Primary Control Circuit Failure
DTC	P035313	Ignition Coil "C" Primary Control Circuit Failure
DTC	P035413	Ignition Coil "D" Primary Control Circuit Failure

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Take troubleshooting of cylinder 1 ignition coil as an example.

1	Check ignition coil connector
---	--------------------------------------

- (a) Disconnect the negative battery.
- (b) Unplug ignition coil connector, check if this connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check ignition coil power supply fuse
---	--

- (a) Check if fuse EF19 15A of engine compartment fuse and relay box is blown.

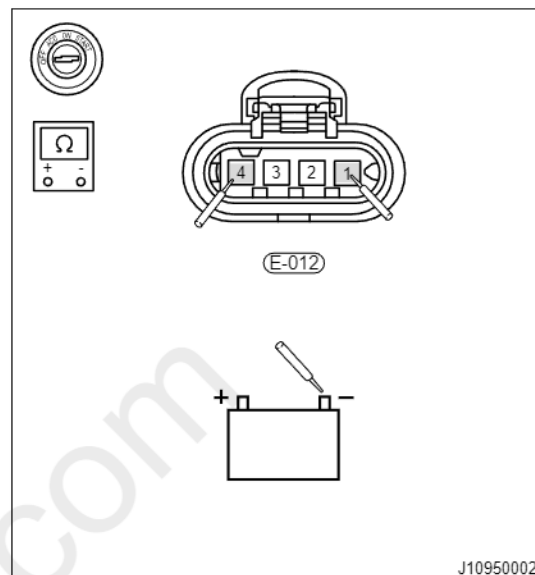
NG

There is short circuit in circuit or ignition coil.

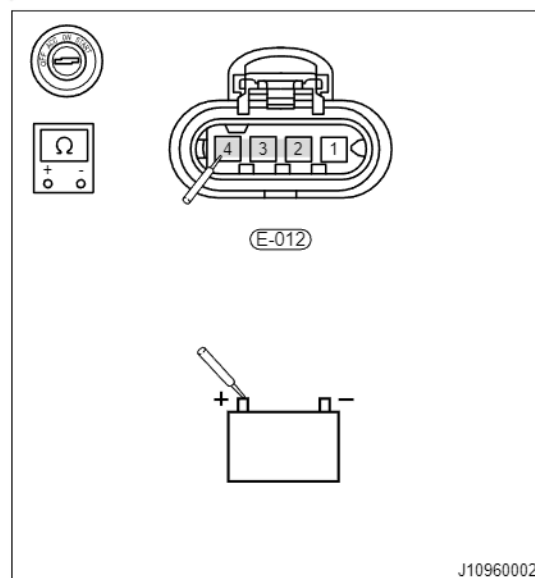
OK

3 Check for short circuit to ground / power supply in ignition coil circuit

- (a) Disconnect the ignition coil connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of ignition coil E-012 (1, 4) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of ignition coil E-012 (2, 3, 4) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair wire harness.

OK

4 Check ignition coil control circuit

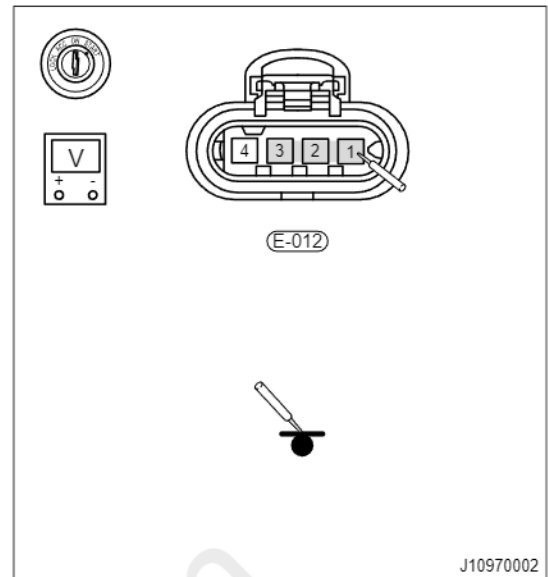
- (a) Connect the ignition coil connector.
- (b) Ignition switch ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of ignition coil E-012 (1, 2, 3) with red probe respectively.

Power supply: 12 V

Ground: < 0.2 V

- (d) Start the engine.
- (e) Using the LED test light, connect clip to battery negative terminal, measure ignition coil E-012 (4) with another end.

Under normal conditions, test light should flash.



NG

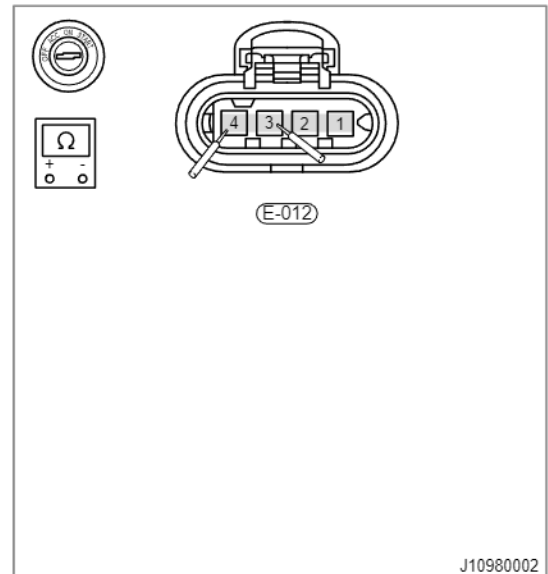
Check and repair wire harness

OK

5

Check if circuits of ignition coil themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of ignition coil E-012 (1, 2, 3, 4) with red and black probes respectively. Check if internal circuits are shorted to each other.



NG

Replace ignition coil assembly.

OK

6

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

7

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 Fuel Injector Control Circuit Short to Power Supply

DTC	P026200	Cylinder 1 Fuel Injector Control Circuit Short to Power Supply
DTC	P026800	Cylinder 3 Fuel Injector Control Circuit Short to Power Supply
DTC	P027100	Cylinder 4 Fuel Injector Control Circuit Short to Power Supply
DTC	P026500	Cylinder 2 Fuel Injector Control Circuit Short to Power Supply

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Take troubleshooting of cylinder 1 fuel injector as an example.

1

Check injector connector

- (a) Disconnect the negative battery.
- (b) Check if fuel injector connector is loose, and contact between male and female terminals is in good condition.

NG

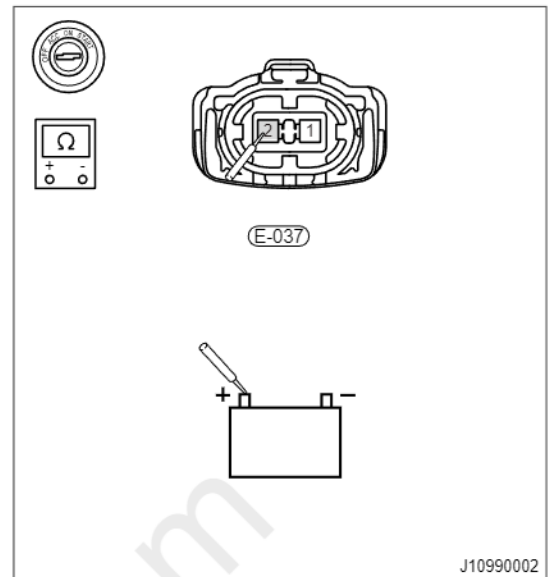
Repair and adjust connector, or replace it.

OK

2

Check if fuel injector control terminal is short to power supply

- (a) Disconnect the injector connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistance of fuel injector E-037 (2) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair circuit.

OK

3

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

4

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Flow Control Valve Control Circuit Open/Too High/Too Low

DTC	P025100	Flow Control Valve Positive or Negative Control Circuit Open
DTC	P025400	Flow Control Valve High Side Control Circuit Voltage Too High or Too Low
DTC	P025900	Injection Pump Fuel Metering Control "A" Low (Cam/Rotor/Injector)

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check high pressure fuel pump connector

- Disconnect the negative battery.
- Unplug high pressure fuel pump connector, check if this connector is loose, and contact between male and female terminals is in good condition.

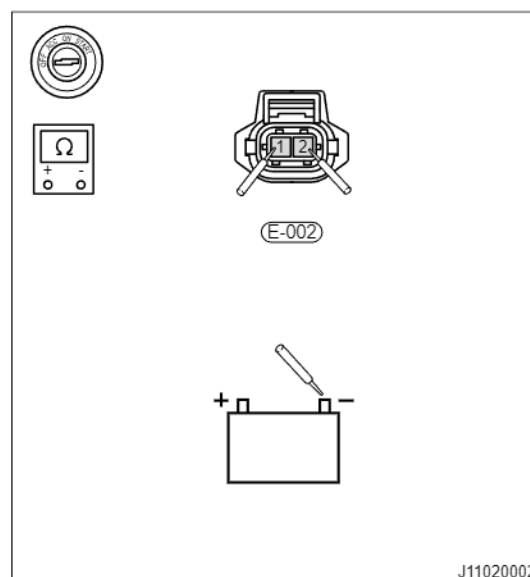
NG

Repair and adjust connector, or replace it.

OK

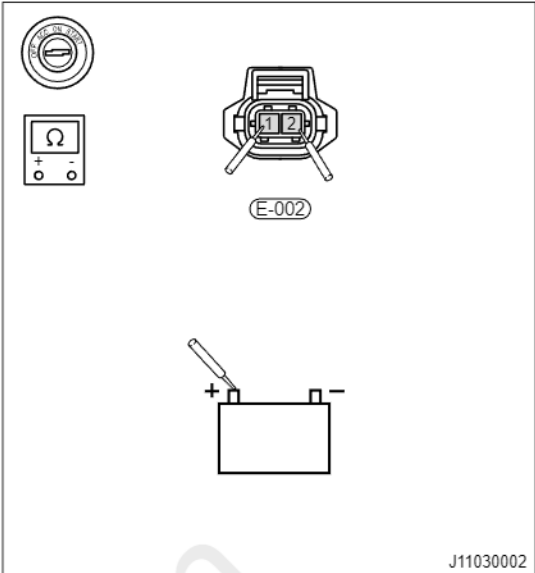
2 Check for short circuit to ground / power supply in high pressure fuel pump circuit

- Disconnect the high pressure fuel pump connector.
- Disconnect the ECM connector (E-018).
- Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of high pressure fuel pump E-002 (1, 2) with red probe respectively. Check if circuit is short to ground.

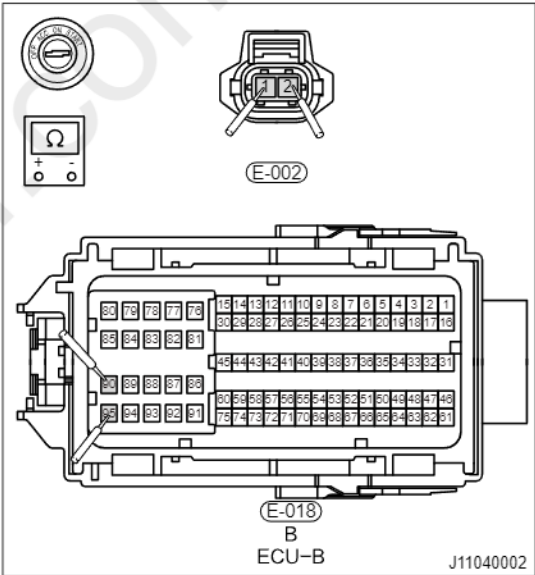


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(d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of high pressure fuel pump E-002 (1, 2) with red probe respectively. Check if circuit is short to power supply.



(e) Using ohm band of multimeter, connect black probe to ECM E-018 (B95, B90), measure for continuity between high pressure fuel pump E-002 (1, 2) with red probe respectively; Check for open circuit.

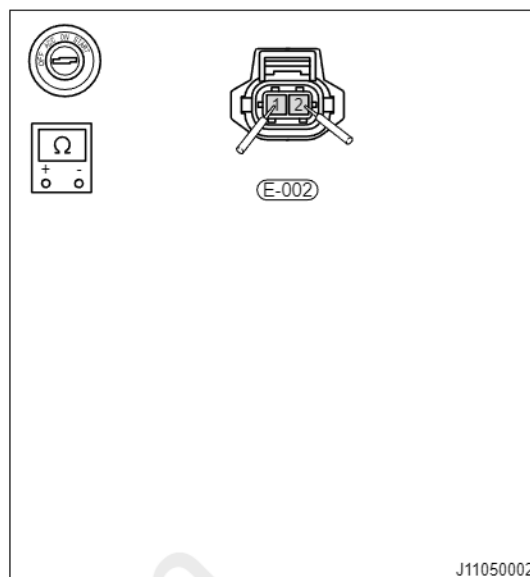


NG Check and repair wire harness.

OK

3	Check if circuits of flow control valve themselves are shorted to each other
---	--

- (a) Using ohm band of multimeter, measure resistances of high pressure fuel pump E-002 (1, 2) with red and black probes respectively. Check if internal circuits are shorted to each other.



NG

Replace high pressure fuel pump assembly.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Multiple Cylinder Misfire Detected

DTC	P030000	Random/Multiple Cylinder Misfire Detected
DTC	P030100	Cylinder 1 Misfire Detected

DTC	P030200	Cylinder 2 Misfire Detected
DTC	P030300	Cylinder 3 Misfire Detected
DTC	P030400	Cylinder 4 Misfire Detected
DTC	P036300	Cylinder Selective Fuel Cutoff Active due to Catalyst Damaging Misfire

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check fuel injector, ignition coil connector
----------	---

- (a) Disconnect the negative battery.
- (b) Check if fuel injector, ignition coil connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check if ignition coil control circuit is abnormal
----------	---

- (a) Check if ignition coil control circuit is abnormal.
- (b) Under normal conditions of control circuit, replace ignition coil and perform test.

NG

Check and repair circuit, or replace ignition coil assembly.

OK

3	Check spark plug
----------	-------------------------

- (a) Check spark plug insulating ceramic for cracks;
- (b) Check spark plug head electrode for corrosion, damage;
- (c) Check if clearance between spark plug head side electrode and center electrode is normal.

NG

Replace spark plug assembly.

OK

4 Check if fuel injector control circuit is abnormal

- (a) Check if fuel injector control circuit is abnormal.
 (b) Under normal conditions of control circuit, replace fuel injector and perform test.

NG

Check and repair circuit, or replace fuel injector assembly.

OK

5 Check fuel quality

- (a) Check if fuel quality is abnormal.

NG

Replace fuel.

OK

6 Check engine system for serious carbon deposition

- (a) Check if fuel injector is dirty or blocked.
 (b) Check if electronic throttle is dirty.
 (c) Check intake valve for serious carbon deposition.

NG

Clean engine system.

OK

7 Test engine cylinder pressure

- (a) Test if cylinder pressure of each cylinder is met standard with the cylinder pressure gauge.

NG

Repair the engine.

OK

8	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Crankshaft Position Sensor Signal Improper/Missing**

DTC	P033900	Crankshaft Position Sensor "A" Circuit Intermittent
DTC	P261700	Crankshaft Position Signal Output Circuit Open

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check speed sensor connector
---	-------------------------------------

- (a) Disconnect the negative battery.
- (b) Check if speed sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check speed sensor and signal gear ring condition
---	--

- (a) Remove the speed sensor.
- (b) Check head of speed sensor for a large amount of iron chips.
- (c) Check signal gear ring for tooth missing, damage or iron chips adhesion.

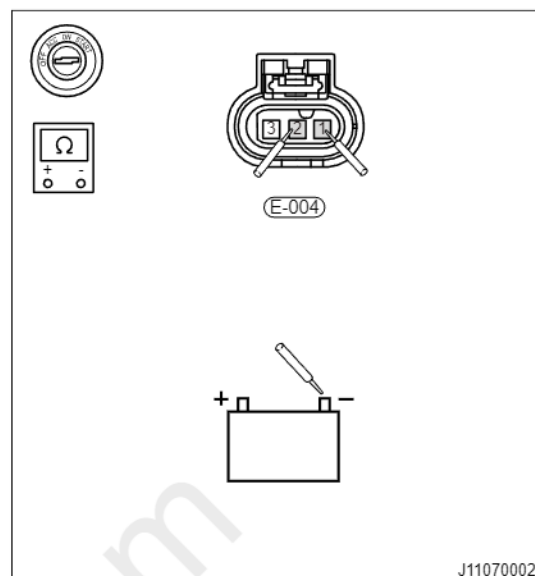
NG

Clean up iron chips or replace damaged flywheel.

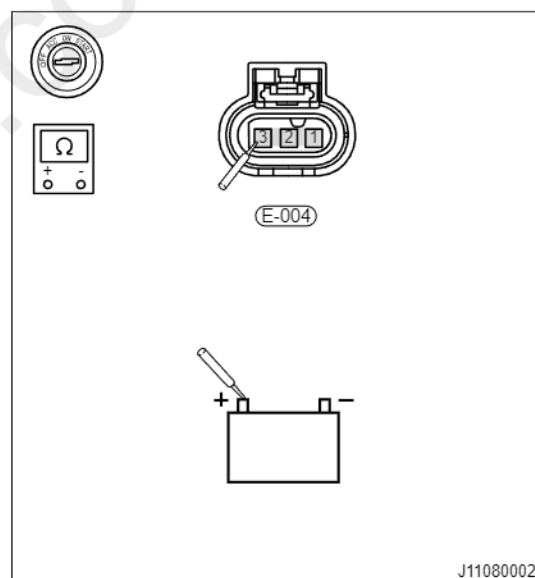
OK

3	Check for short circuit to ground / power supply in speed sensor circuit
---	---

- (a) Disconnect the speed sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of speed sensor E-004 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of speed sensor E-004 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair wire harness.

OK

4	Check speed sensor signal circuit
---	--

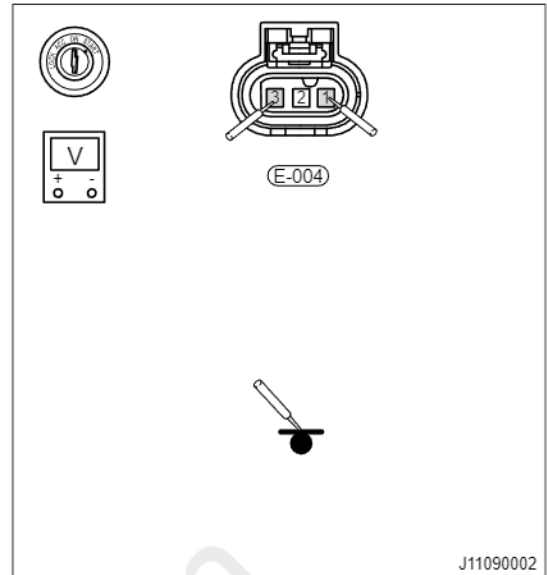
- (a) Connect the speed sensor connector.
- (b) Ignition switch ON.
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure voltage of speed sensor E-004 (1, 3) with red probe respectively.

Power supply: 5 V

Ground: < 0.2 V

- (d) Start the engine.
- (e) Using the LED test light, connect clip to battery negative terminal, measure speed sensor E-004 (2) with another end.

Under normal conditions, test light should flash.



NG

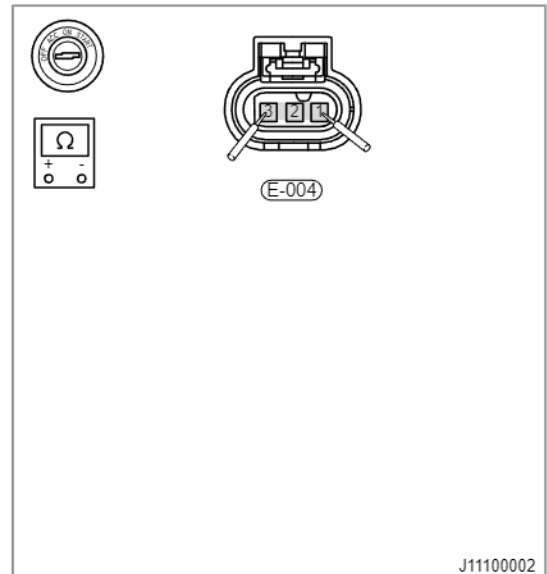
Check and repair wire harness

OK

5

Check if circuits of speed sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of speed sensor E-004 (1, 2, 3) with red and black probes respectively. Check if internal circuits are shorted to each other.



NG

Replace speed sensor assembly.

OK

6

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

7

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Knock Sensor (Terminal A/B) Signal Short to Ground/Power Supply/Voltage Too High/Too Low

DTC	P032700	Knock Sensor Signal Short to Ground (A)
DTC	P032714	Knock Sensor Signal Short to Ground (B)
DTC	P032800	Knock Sensor Signal Short to Power Supply (A)
DTC	P032815	Knock Sensor Signal Short to Power Supply (B)
DTC	P032500	Knock Sensor Signal Circuit Voltage Too Low
DTC	P151000	Knock Control System Failure
DTC	P032600	Knock/Combustion Vibration Sensor 1 Circuit Bank 1 or Single Sensor

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check knock sensor connector

- (a) Disconnect the negative battery.
- (b) Check if knock sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check knock sensor condition

- (a) Check if knock sensor is exposed to oil, coolant, water, etc. for a long time; Avoid corrosion to sensor.
- (b) Check knock sensor fixing bolts for looseness.

Tightening torque: 20 ± 5 N·m

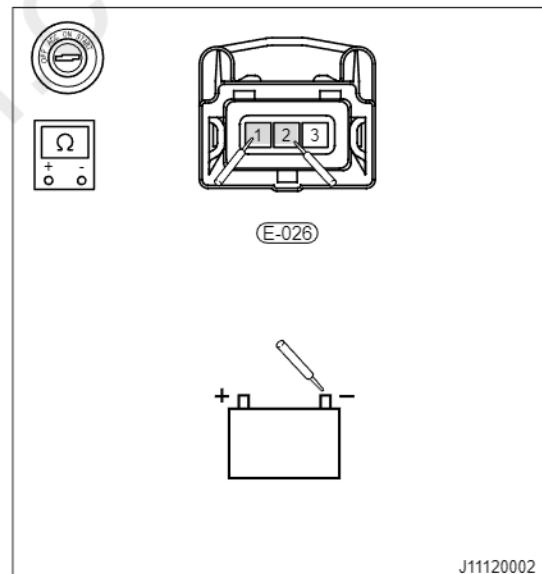
NG

Clean and tighten fixing bolts to specified torque.

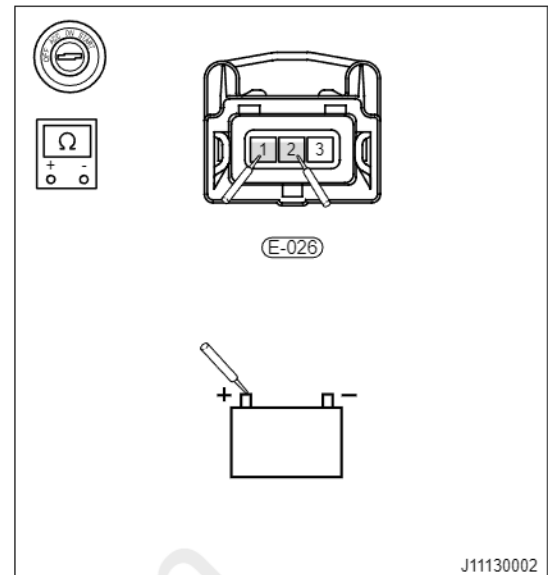
OK

3 Check for short circuit to ground / power supply in knock sensor circuit

- (a) Disconnect the knock sensor connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of knock sensor E-026 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of knock sensor E-026 (1, 2) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair wire harness.

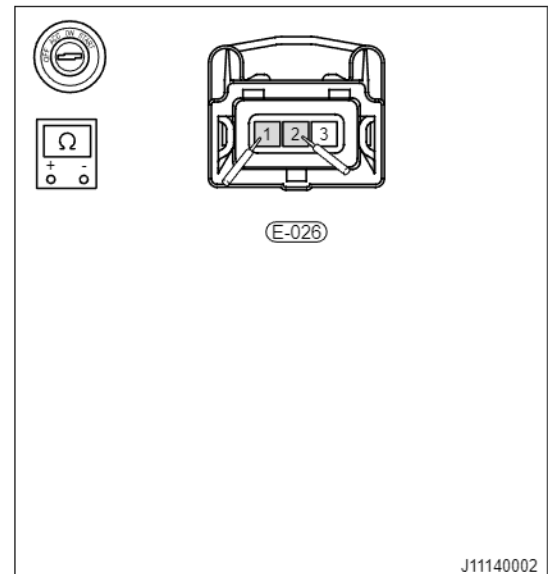
OK

4

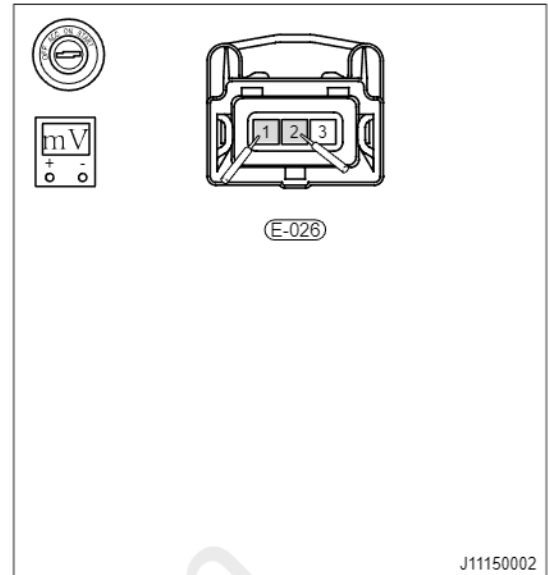
Check knock sensor itself

- (a) Using ohm band of multimeter, measure resistances of knock sensor E-026 (1, 2) with red and black probes respectively.

Resistance at ambient temperature should be $4.9 \text{ M}\Omega \pm 20\%$



- (b) Using mV band of multimeter, measure voltages of knock sensor E-026 (1, 2) with red and black probes respectively. Using a small hammer to tap near knock sensor, there should be a voltage signal output at this time.



NG

Replace knock sensor assembly.

OK

5

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Intake/Exhaust Camshaft Phaser Sensor Signal Improper

DTC	P034100	Intake Camshaft Phaser Sensor Signal Improper
DTC	P036600	Exhaust Camshaft Phaser Sensor Signal Improper

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check phaser solenoid valve, valve body bolt components state

- Disconnect the negative battery cable.
- Remove intake/exhaust phaser solenoid valve; Check for blockage or dirty.
- Remove intake/exhaust phaser valve body bolts; Check for blockage or dirt.

NG

Clean or replace phaser solenoid valve and valve body bolts.

OK

2 Check engine maintenance condition

- Check if engine oil level is normal, and check for oil leakage and oil seepage.
- Remove valve trim cover, and check engine lubrication and cleaning conditions, and check for wear or sludge dirty

NG

Clean and maintain the engine, replace the damaged components.

OK

3 Check valve mechanism timing

- Check if valve mechanism timing is normal, and check timing chain for teeth skipping, misalignment, elongation, etc.
- Check camshaft signal plate for misalignment, looseness, etc.

NG

Replace timing chain or camshaft assembly.

OK

4 Check intake/exhaust phaser assembly

- (a) Check if operating condition of cam phase regulator is normal (dirt blocked, oil leaked, stuck, etc.).

NG

Replace intake/exhaust phaser assembly.

OK

5

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

Exhaust Camshaft Phase Signal Circuit Voltage Low/High

DTC	P034200	Camshaft Position Sensor "A" Circuit Low Bank 1 or Single Sensor
DTC	P034300	Camshaft Position Sensor "A" Circuit High Bank 1 or Single Sensor

Description**Control schematic diagram****DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check intake camshaft phaser sensor connector

- (a) Disconnect the negative battery.
 (b) Check if intake camshaft phaser sensor connector is loose, and contact between male and female terminals is in good condition.

NG

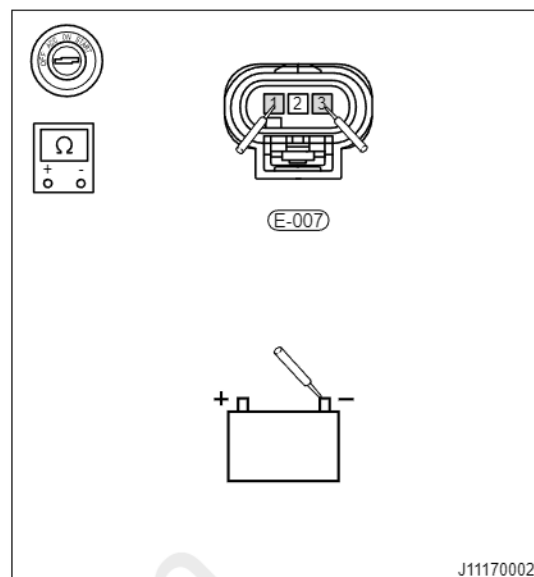
Repair and adjust connector, or replace it.

OK

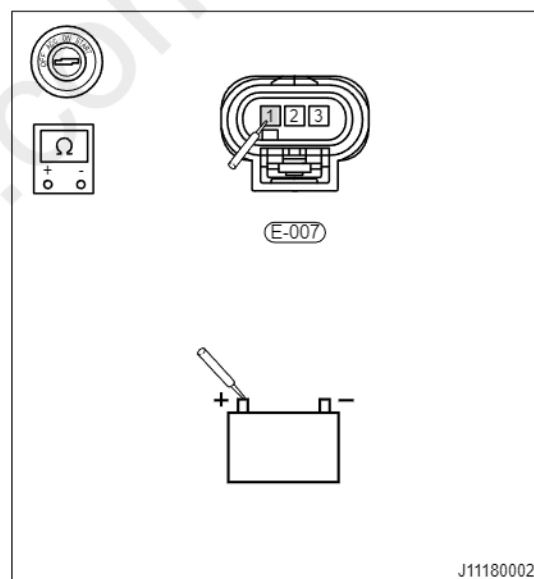
2

Check for short circuit to ground / power supply in intake camshaft phaser sensor circuit

- (a) Disconnect the intake camshaft phaser sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of intake camshaft phaser sensor E-007 (1, 3) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure intake camshaft phaser sensor E-007 (1) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair wire harness.

OK

3

Check intake camshaft phaser sensor circuit

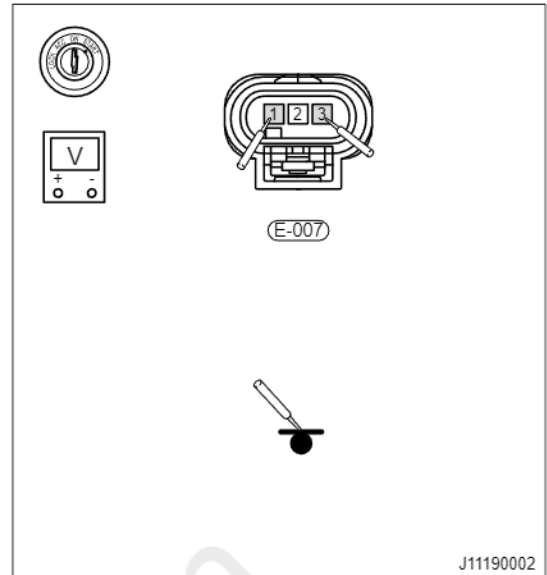
- (a) Connect the intake camshaft phaser sensor connector.
- (b) Start the engine.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of intake camshaft phaser sensor E-007 (1, 3) with red probe respectively.

Power supply: 12 V

Ground: < 0.2 V

- (d) Using the LED test light, connect clip to battery negative terminal, measure intake camshaft phaser sensor E-007 (1) with another end.

Under normal conditions, test light should flash.



NG

Check wire harness or replace intake camshaft phaser sensor assembly.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Exhaust Camshaft Phaser Signal Circuit Voltage Low/High

DTC	P036700	Camshaft Position Sensor "B" Circuit Low (Bank1)
DTC	P036800	Camshaft Position Sensor "B" Circuit High (Bank1)

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check exhaust camshaft phaser sensor connector

- Disconnect the negative battery.
- Check if exhaust camshaft phaser sensor connector is loose, and contact between male and female terminals is in good condition.

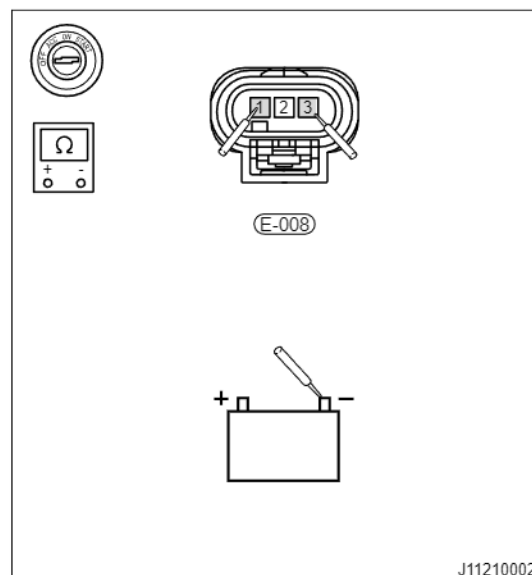
NG

Repair and adjust connector, or replace it.

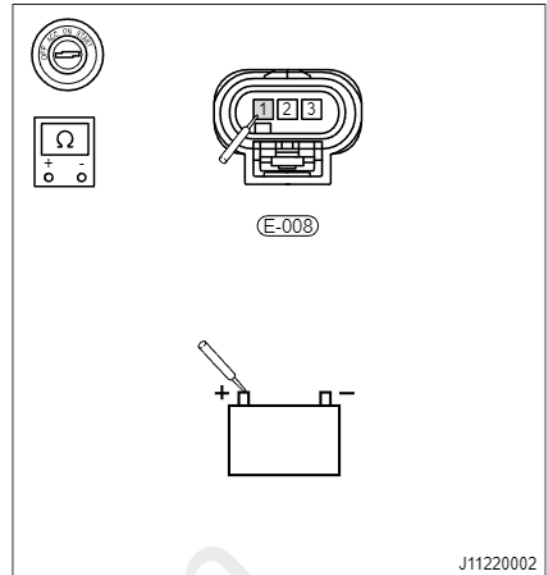
OK

2 Check for short circuit to ground / power supply in exhaust camshaft phaser sensor circuit

- Disconnect the exhaust camshaft phaser sensor connector.
- Disconnect the ECM connector (E-018).
- Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of exhaust camshaft phaser sensor E-008 (1, 3) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure exhaust camshaft phaser sensor E-008 (1) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair wire harness circuit.

OK

3

Check exhaust camshaft phaser sensor circuit

- (a) Connect the exhaust camshaft phaser sensor connector.
(b) Start the engine.

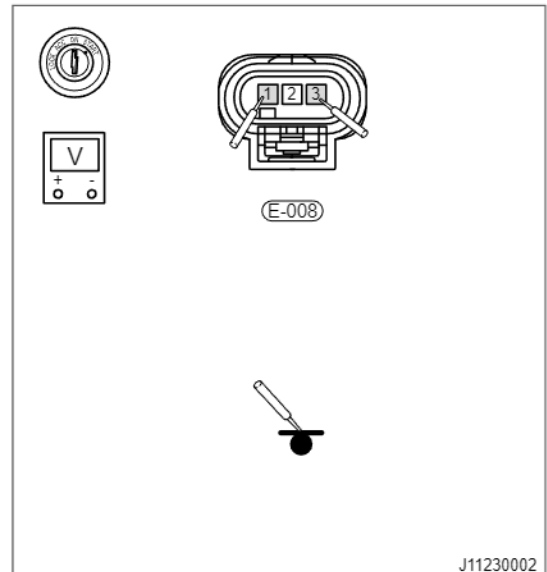
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of exhaust camshaft phaser sensor E-008 (1, 3) with red probe respectively.

Power supply: 12 V

Ground: < 0.2 V

- (d) Using the LED test light, connect clip to battery negative terminal, measure exhaust camshaft phaser sensor E-008 (1) with another end.

Under normal conditions, test light should flash.



NG

Check wire harness or replace exhaust camshaft phaser sensor assembly.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****5 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ Secondary Oil Pump Drive Circuit Open/Short to Ground/Power Supply**

DTC	P06DA13	Secondary Oil Pump Drive Circuit Open
DTC	P06DB11	Secondary Oil Pump Drive Circuit Short to Ground
DTC	P06DC12	Secondary Oil Pump Drive Circuit Short to Power Supply

■ Description**Control schematic diagram****■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check variable oil pump connector

- (a) Disconnect the negative battery.
- (b) Check if variable oil pump connector is loose, and contact between male and female terminals is in good condition.

NG**Repair and adjust connector, or replace it.****OK**

2 Check variable oil pump power supply fuse

- (a) Check if engine compartment fuse and relay box fuse EF21 15A is damaged.

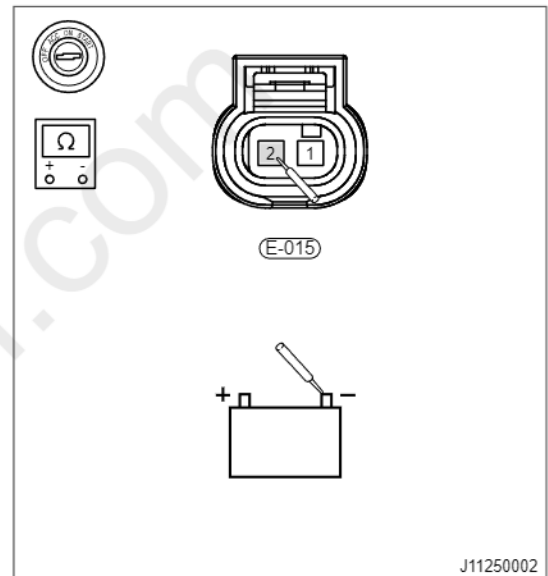
NG

Check and repair short circuit malfunction of circuit.

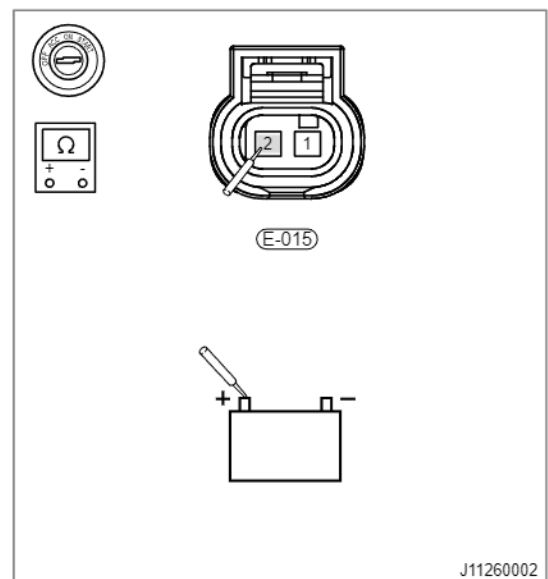
OK

3 Check for short circuit to ground / power supply in variable oil pump circuit

- (a) Disconnect the variable oil pump connector.
 (b) Disconnect the ECM connector (B-003).
 (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of variable oil pump E-015 (2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure variable oil pump E-015 (2) with red probe respectively. Check if circuit is short to power supply.



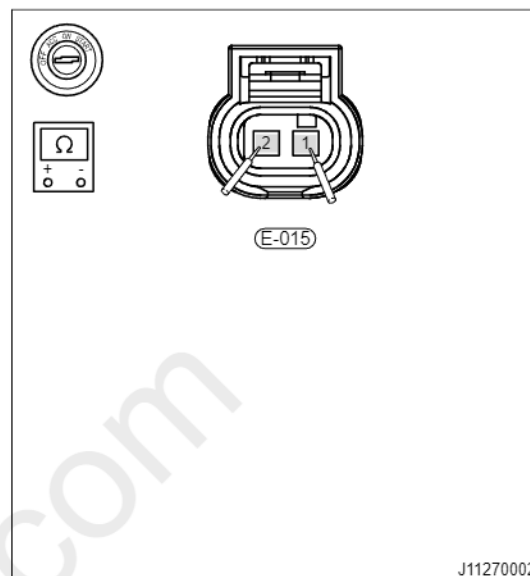
NG

Check and repair control circuit.

OK

4 Check if circuits of variable oil pump themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of variable oil pump E-015 (1, 2) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace variable oil pump assembly.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Catalyst System Efficiency Below Threshold Bank 1

DTC	P042000	Catalyst System Efficiency Below Threshold Bank 1
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■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

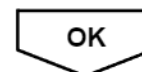
- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

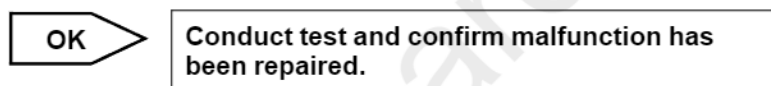
1	Check pre-catalytic converter
----------	--------------------------------------

- (a) Check pre-catalytic converter for mechanical damage.
 (b) Check pre-catalytic converter for lead intoxication.



2	Reconfirm DTCs
----------	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.



■ Canister Control Valve Control Circuit Open/Low/High

DTC	P044413	Evaporative Emission System Purge Control Valve Circuit Open
DTC	P045811	Evaporative Emission System Purge Control Valve Circuit Low
DTC	P045912	Evaporative Emission System Purge Control Valve Circuit High

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check canister solenoid valve connector

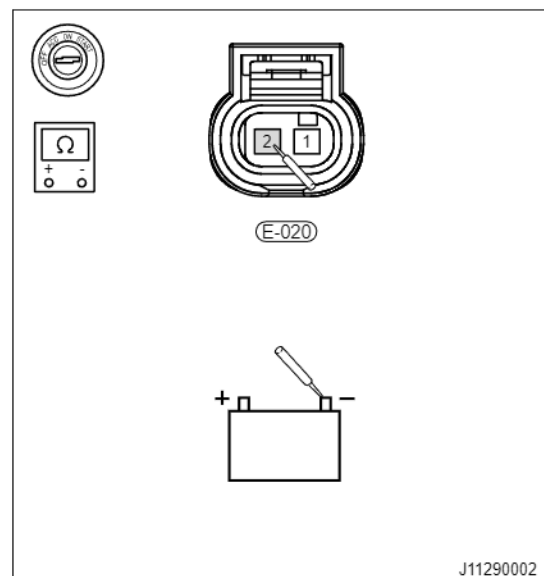
- (a) Disconnect the negative battery.
- (b) Check if canister solenoid valve connector is loose, and contact between male and female terminals is in good condition.

NG**Repair and adjust connector, or replace it.****OK****2 Check canister solenoid valve power supply fuse**

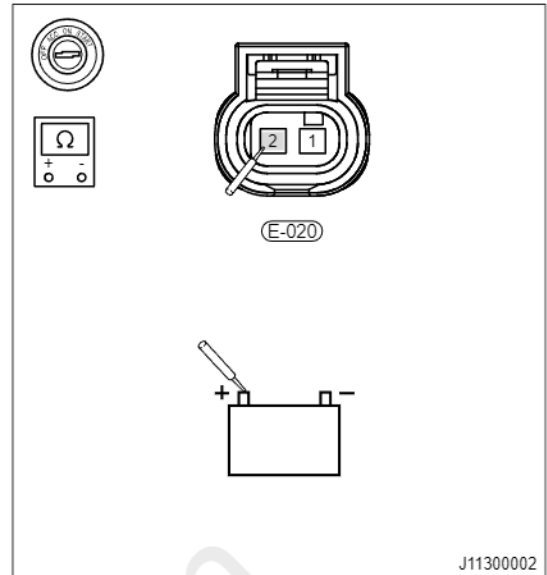
- (a) Check if engine compartment fuse and relay box fuse EF21 15A is damaged.

NG**Check and repair short circuit malfunction of circuit.****OK****3 Check for short circuit to ground / power supply in canister solenoid valve circuit**

- (a) Disconnect the variable oil pump connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of canister solenoid valve E-020 (2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure canister solenoid valve E-020 (2) with red probe respectively. Check if circuit is short to power supply.



NG

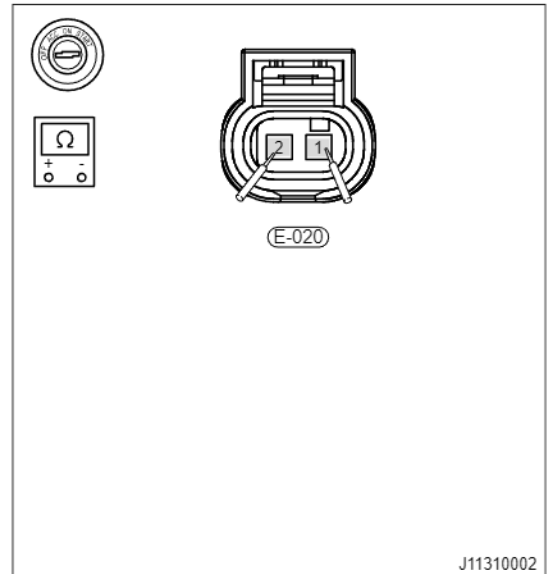
Check and repair control circuit.

OK

4

Check if circuits of canister solenoid valve themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of canister solenoid valve E-020 (1, 2) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace canister solenoid valve assembly.

OK

5

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Idling Too High/Too Low

DTC	P050600	Idle Control System RPM Lower Than Expected
DTC	P050A21	Cold Start Idle Control System Performance
DTC	P050700	Idle Control System RPM Higher than Expected
DTC	P050500	Unreasonable Engine Idling-large Fluctuation
DTC	P050A22	Cold Start Idle Control System Performance
DTC	P050D00	Cold Start Rough Idle

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check electronic throttle connector

- (a) Disconnect the negative battery.
- (b) Check if electronic throttle connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check electronic throttle condition

- (a) Check if electronic throttle is stuck.
(b) Check if electronic throttle is dirty.

NG**Clean or replace electronic throttle.****OK****3 Check intake manifold for air leakage**

- (a) Check intake manifold or connecting lines for air leakage.

NG**Replace parts related to air leakage.****OK****4 Check if fuel pressure too low**

- (a) Check if low/high pressure fuel pressure is too low.

NG**Replace parts that cause low fuel pressure****OK****5 Check injector for blockage**

- (a) Check fuel injector for blockage or leakage.

NG**Clean or replace fuel injector assembly.****OK****6 Check if exhaust back pressure is too high**

- (a) Check pre-catalytic converter for blockage.
(b) Check GPF converter for blockage.

NG**Replace blocked parts or perform regeneration function.**

OK

7	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Battery Voltage Low Malfunction**

DTC	P056200	System Voltage Low
------------	----------------	---------------------------

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check battery voltage
---	------------------------------

- (a) Check that battery voltage should not be lower than 12 V.

NG

It is necessary to recharge or replace the battery assembly.

OK

2	Check generating capacity of alternator
---	--

- (a) Check if generating capacity of alternator is normal.

Alternator output voltage: 13.5 V - 15 V

NG

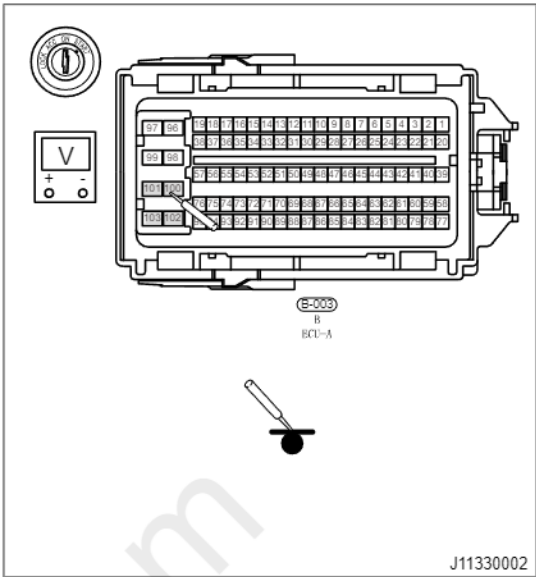
Replace alternator assembly.

OK

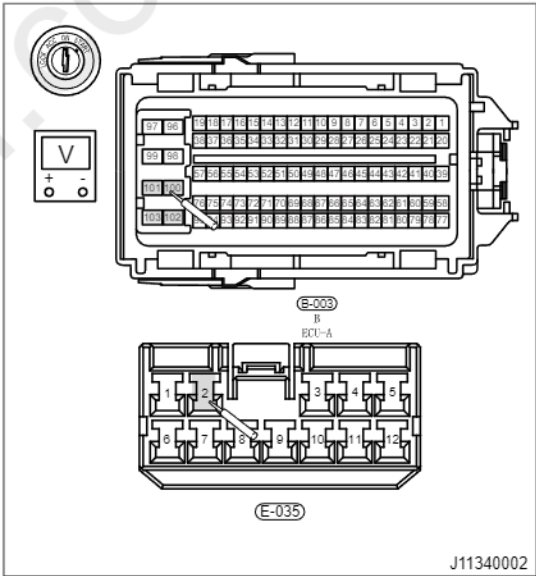
3

Check ECM power supply circuit

- (a) Disconnect the ECM connector (B-003).
- (b) Short the main relay switch side with wire harness.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of ECM B-003 (A100, A101, A102, A103) with red probe respectively.
- (d) Or use test light to measure ECM B-003 (A100, A101, A102, A103); Test light should be bright.



- (e) Connect the ECM connector (B-003).
- (f) Using voltage band of multimeter, connect black probe to engine compartment fuse and relay box B-035 (D2), measure ECM B-003 (A100, A101, A102, A103) with red probe respectively. Check if circuit voltage drop value is too large.



NG

Check and repair control circuit.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5	Reconfirm DTCs
---	-----------------------

- Connect diagnostic tester and clear DTCs.
- Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ System Battery Voltage High

DTC	P056300	System Battery Voltage High
------------	----------------	------------------------------------

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check generating capacity of alternator
---	--

- Check if generating capacity of alternator is normal.

Alternator output voltage: 13.5 V - 15 V

NG

Replace alternator assembly.

OK

2	Check Engine Control Module (ECM)
---	--

- Remove Engine Control Module (ECM) from malfunctioning vehicle.
- Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

3	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Starter Relay Control Terminal Circuit Low/High**

DTC	P061513	Starter Relay Control Circuit Error
DTC	P061611	Starter Relay "A" High Circuit Low
DTC	P061712	Starter Relay "A" Circuit High

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check starter relay coil terminal power supply fuse
---	--

- (a) Check if engine compartment fuse and relay box fuse EF22 5A is blown.

NG

Check and repair short circuit malfunction of circuit.

OK

2	Check starter relay
---	----------------------------

- (a) Replace starter relay.

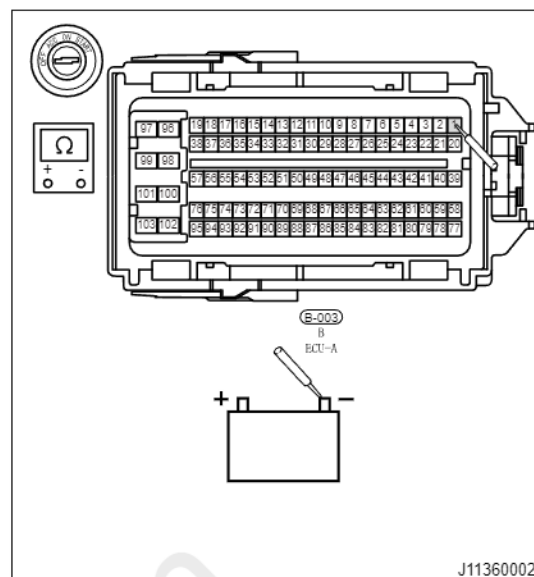
NG

Replace starter relay.

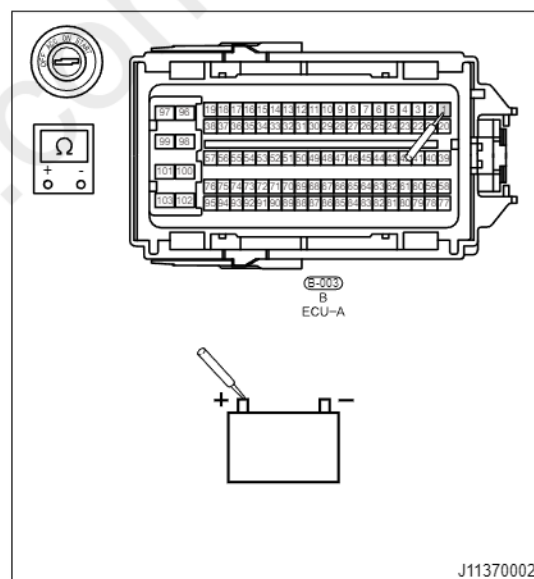
OK

3	Check for short circuit to ground / power supply in ECM control circuit
---	--

- (a) Disconnect the engine compartment fuse and relay box connector (B-043).
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A1) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure ECM B-003 (A1) with red probe respectively. Check if circuit is short to power supply.



NG

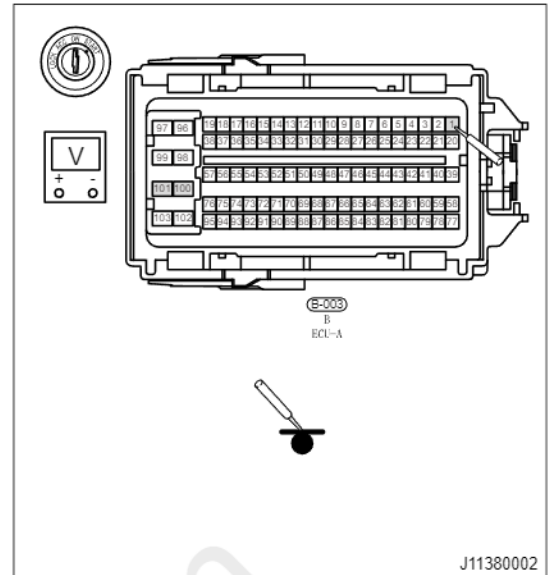
Check and repair control circuit.

OK

4

Check ECM control circuit

- (a) Connect the engine compartment fuse and relay box connector (B-043).
- (b) Short the main relay switch side with wire harness.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of ECM B-003 (A1) with red probe respectively.
- (d) Or use test light to measure ECM B-003 (A1); Test light should be bright.



NG

Check and repair control circuit.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Brake Chamber Vacuum Pressure Sensor Voltage High/Low

DTC	P055800	Brake Booster Pressure Sensor Circuit High
DTC	P055700	Brake Booster Pressure Sensor Circuit Low

DTC	P145000	Brake Booster Pressure Sensor Circuit Range/Performance (High)
DTC	P145100	Brake Booster Pressure Sensor Circuit Range/Performance (Low)

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check vacuum pressure sensor connector
----------	---

- (a) Disconnect the negative battery.
- (b) Check if vacuum pressure sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check brake vacuum booster system for damage or air leakage
----------	--

- (a) Check brake vacuum booster system each line for damage, or connecting pipe port for air leakage, vacuum pump for abnormal operation, etc.

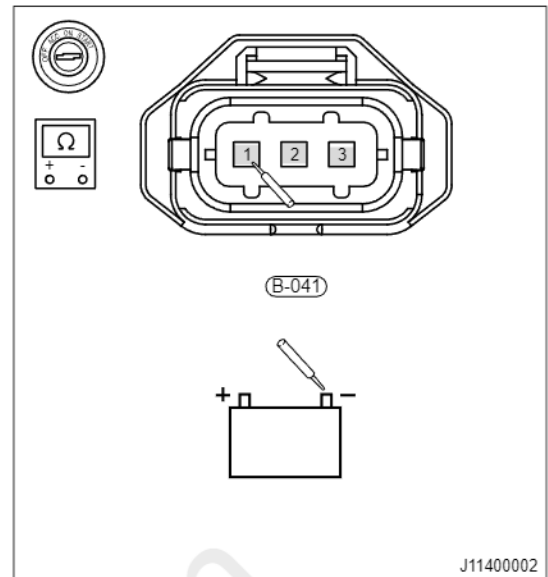
NG

Repair or replace the damaged parts related to brake booster system.

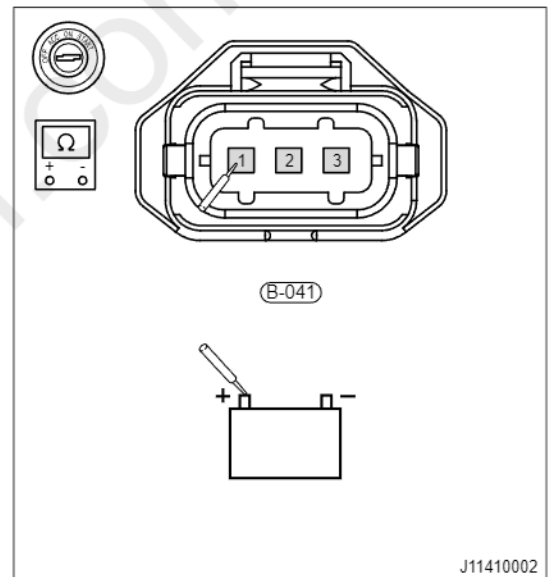
OK

3	Check for short circuit to ground / power supply in vacuum pressure sensor
----------	---

- (a) Disconnect the vacuum pressure sensor connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of vacuum pressure sensor B-041 (1, 2, 3) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of vacuum pressure sensor B-041 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



NG Check and repair wire harness.

OK

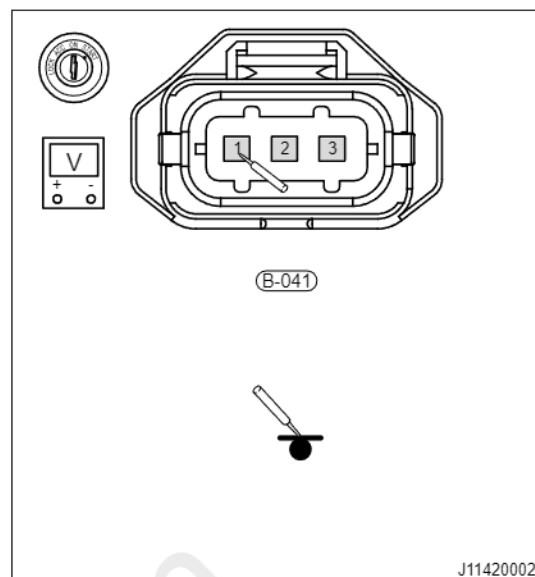
4	Check vacuum pressure sensor voltage signal
---	---

- (a) Connect vacuum pressure sensor and ECM connectors.
- (b) Ignition switch ON.
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure voltage of vacuum pressure sensor B-041 (1, 2, 3) with red probe respectively.

Power supply: 5 V

Ground: < 0.2 V

Depress brake pedal consecutively; Signal voltage should vary in accordance with pressure.



NG

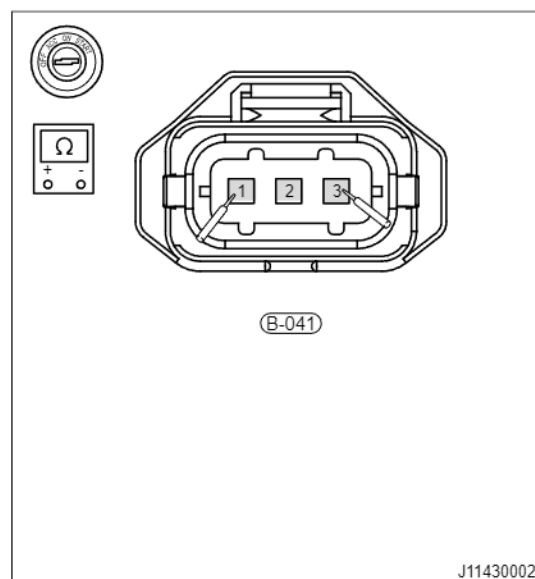
Check and repair wire harness, or replace vacuum pressure sensor.

OK

5 Check vacuum pressure sensor itself

- (a) Using ohm band of multimeter, measure resistance between vacuum pressure sensor B-041 (1, 3), and resistance between (1, 2) with red and black probes respectively. Check if internal circuits are shorted to each other.

Resistance at ambient temperature: 1 K Ω ~ 2 K Ω



NG

Replace vacuum pressure sensor assembly.

OK

6 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****7 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ A/C Compressor Circuit Voltage Too Low/Too High**

DTC	P064513	A/C Clutch Relay Circuit Open
DTC	P064611	A/C Compressor Relay Circuit Low
DTC	P064712	A/C Compressor Relay Control Circuit High

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check A/C compressor relay coil terminal power supply fuse

- (a) Check if engine compartment fuse and relay box fuse EF22 5A is blown.

NG**Check and repair short circuit malfunction of circuit.****OK**

2 Check A/C compressor relay

(a) Replace A/C compressor relay.

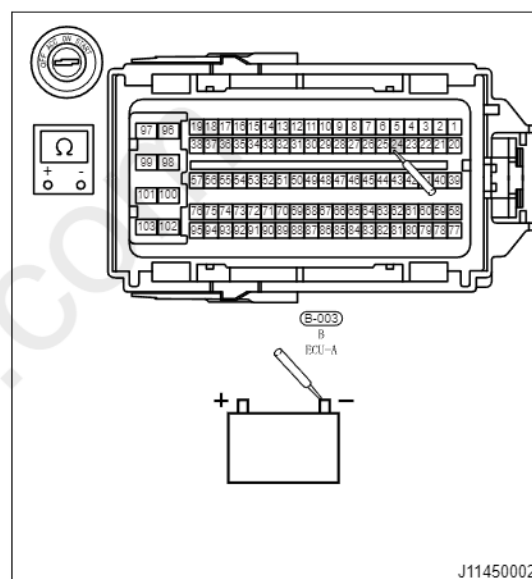
NG

Replace A/C compressor relay.

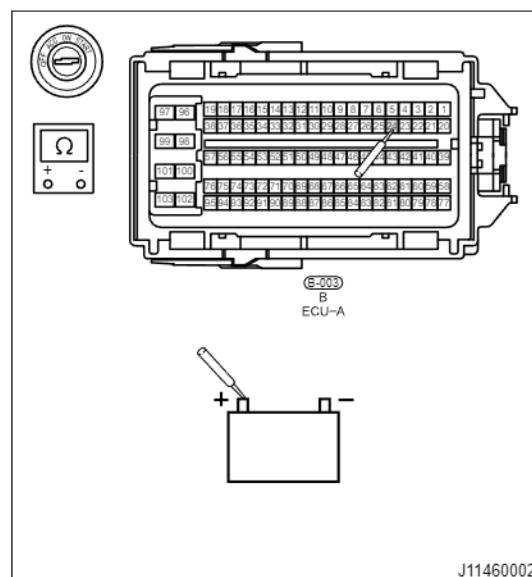
OK

3 Check for short circuit to ground / power supply in ECM control circuit

- (a) Unplug the A/C compressor relay.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A24) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure ECM B-003 (A24) with red probe respectively. Check if circuit is short to power supply.



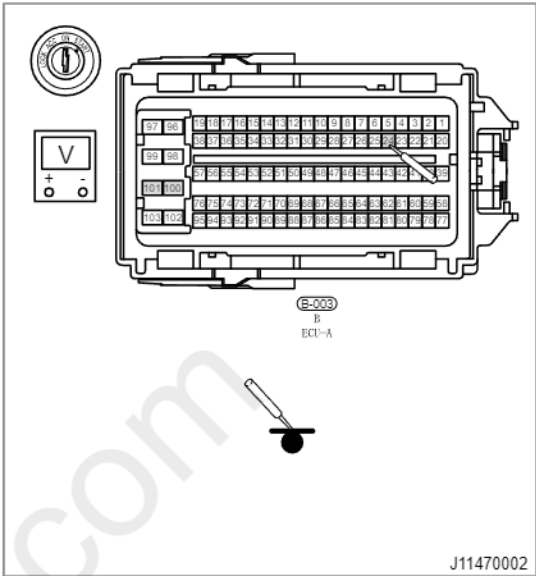
NG

Check and repair control circuit.

OK

4 Check ECM control circuit

- (a) Connect A/C compressor relay.
- (b) Short the main relay switch side with wire harness.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of ECM B-003 (A24) with red probe respectively.
- (d) Or use test light to measure ECM B-003 (A24); Test light should be bright.



NG Check and repair control circuit.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK Conduct test and confirm malfunction has been repaired.

■ Intake VVT Control Circuit Voltage Too Low/Too High

DTC	P208800	"A" Camshaft Position Actuator Control Circuit Low Bank 1
DTC	P208900	"A" Camshaft Position Actuator Control Circuit High Bank 1

■ Description

Control schematic diagram

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check intake phaser solenoid valve connector

- (a) Disconnect the negative battery.
- (b) Check if intake phaser solenoid valve connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check intake phaser solenoid valve power supply fuse

- (a) Check if engine compartment fuse and relay box fuse EF21 15A is blown.

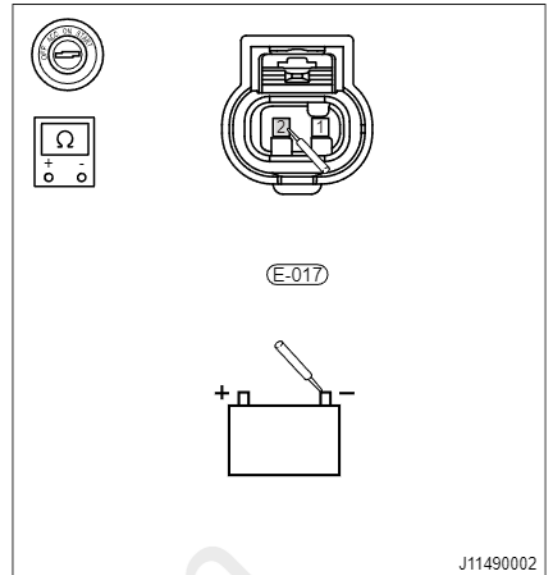
NG

Check and repair short circuit malfunction of circuit.

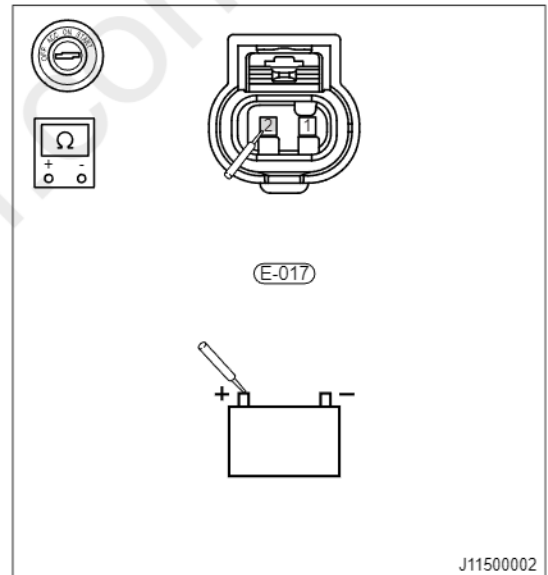
OK

3 Check for short circuit to ground / power supply in intake phaser solenoid valve circuit

- (a) Disconnect the intake phaser solenoid valve connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of intake phaser solenoid valve E-017 (2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistance of intake phaser solenoid valve E-017 (2) with red probe respectively. Check if circuit is short to power supply.

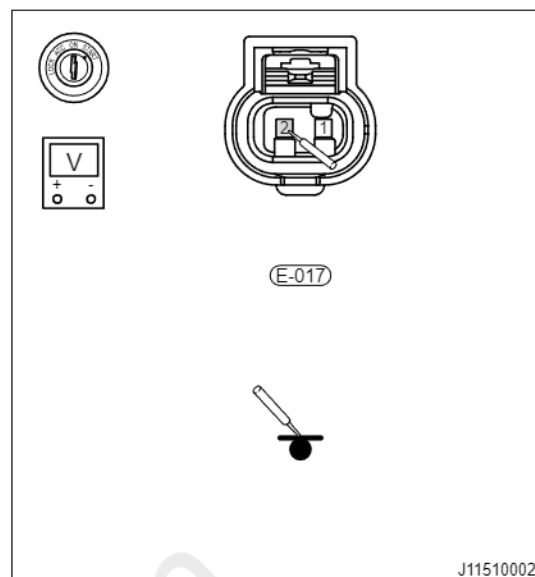


NG Check and repair control circuit.

OK

4	Check intake phaser solenoid valve control circuit
---	--

- (a) Connect the intake phaser solenoid valve connector.
- (b) Turn the ignition switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of intake phaser solenoid valve E-017 (2) with red probe.
- (d) Or use test light to measure intake phaser solenoid valve E-017 (2); Test light should be bright.



NG

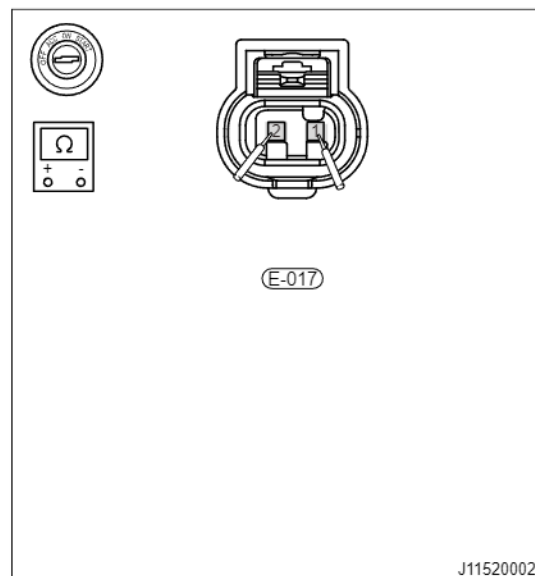
Check and repair control circuit.

OK

5

Check if circuits of intake phaser solenoid valve themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of intake phaser solenoid valve E-017 (1, 2) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace intake phaser solenoid valve assembly.

OK

6 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****7 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****Exhaust VVT Control Circuit Voltage Too Low/Too High**

DTC	P209000	"B" Camshaft Position Actuator Control Circuit Low Bank 1
DTC	P209100	"B" Camshaft Position Actuator Control Circuit High Bank 1

Description**Control schematic diagram****DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check exhaust phaser solenoid valve connector

- (a) Disconnect the negative battery.
- (b) Check if exhaust phaser solenoid valve connector is loose, and contact between male and female terminals is in good condition.

NG**Repair and adjust connector, or replace it.****OK**

2 Check exhaust phaser solenoid valve power supply fuse

- (a) Check if engine compartment fuse and relay box fuse EF21 15A is blown.

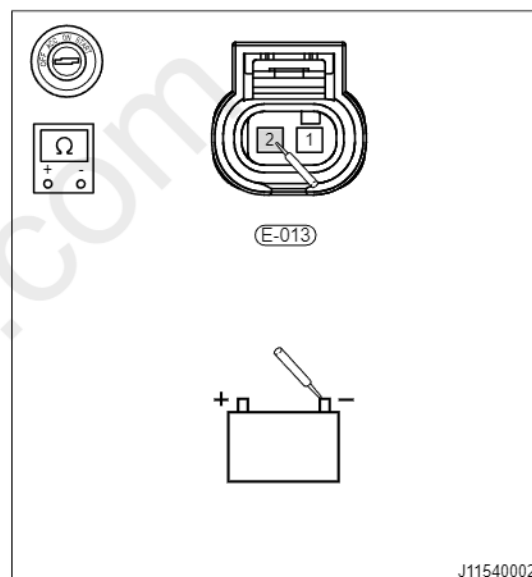
NG

Check and repair short circuit malfunction of circuit.

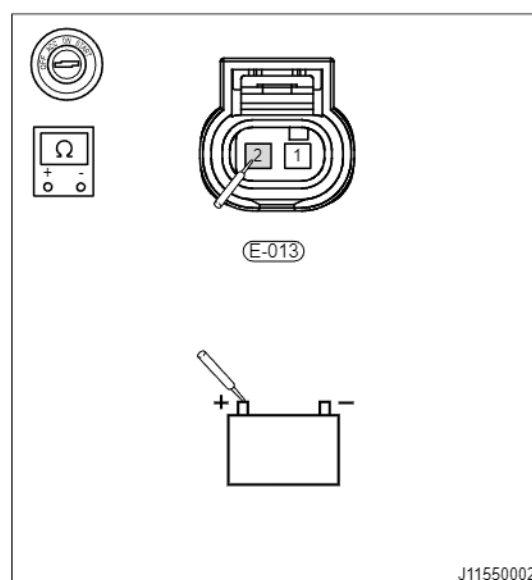
OK

3 Check for short circuit to ground / power supply in exhaust phaser solenoid valve circuit

- (a) Disconnect the exhaust phaser solenoid valve connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of exhaust phaser solenoid valve E-013 (2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistance of exhaust phaser solenoid valve E-013 (2) with red probe respectively. Check if circuit is short to power supply.



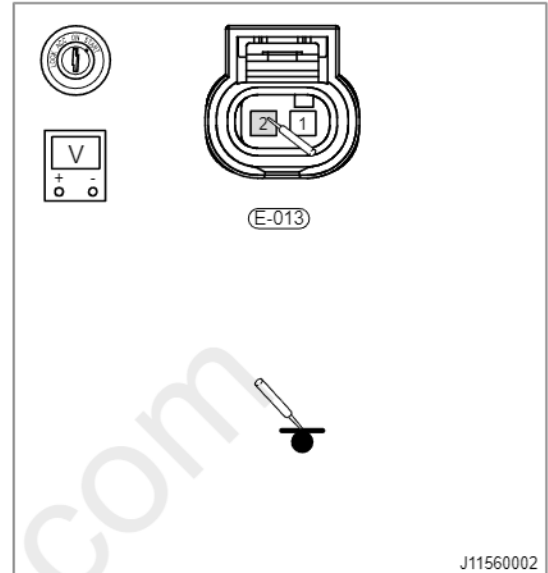
NG

Check and repair control circuit.

OK

4 Check exhaust phaser solenoid valve control circuit

- (a) Connect exhaust phaser solenoid valve connector.
- (b) Turn the ignition switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of exhaust phaser solenoid valve E-013 (2) with red probe.
- (d) Or use test light to measure exhaust phaser solenoid valve E-013 (2); Test light should be bright.



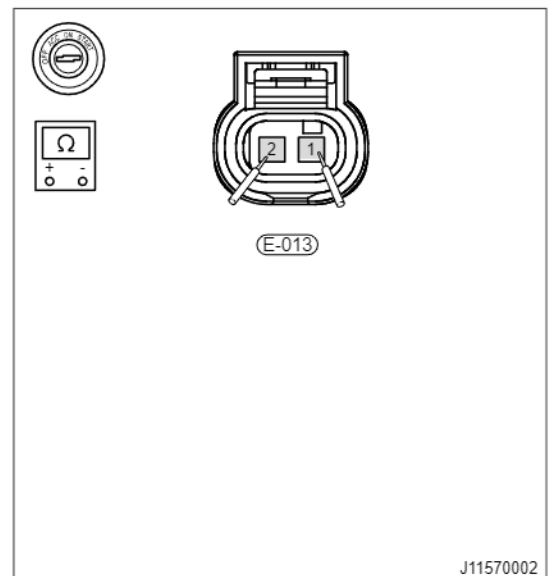
NG

Check and repair control circuit.

OK

5 Check if circuits of exhaust phaser solenoid valve themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of exhaust phaser solenoid valve E-013 (1, 2) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace exhaust phaser solenoid valve assembly.

OK

6 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

7 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Air-fuel Ratio Closed Loop Control Correction

DTC	P217700	System Too Lean Off Idle Bank 1
DTC	P217800	System Too Rich Off Idle Bank 1
DTC	P218700	System Too Lean at Idle Bank 1
DTC	P218800	System Too Lean at Idle Bank 1
DTC	P219500	O2 Sensor Signal Biased/Stuck Lean Bank 1 Sensor 1
DTC	P219600	O2 Sensor Signal Biased/Stuck Rich Bank 1 Sensor 1
DTC	P241400	O2 Sensor Exhaust Sample Error Bank 1 Sensor 1
DTC	P209700	Post Catalyst Fuel Trim System Too Rich Bank 1
DTC	P209600	Post Catalyst Fuel Trim System Too Lean Bank 1

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check upstream oxygen sensor

- (a) Depress the accelerator pedal sharply under idling condition, oxygen pump control voltage of oxygen sensor should be lower than 2.5 V at this time.
- (b) Oxygen pump control voltage of oxygen sensor should be higher than 2.5 V when releasing the accelerator pedal quickly.

NG**Replace upstream oxygen sensor assembly.****OK****2 Check intake pressure/temperature sensor**

- (a) Check intake pressure/temperature sensor (pressure signal).

Under idling state: Approximately 1 V

When the vehicle accelerates rapidly, voltage can instantly reach 4 V, and then drop to approximately 1.7 V

NG**Replace intake pressure/temperature sensor.****OK****3 Check fuel system**

- (a) Check if low/high pressure fuel pressure is within the proper range.
- (b) Check if fuel injector is dirty.

NG**Replace fuel system damaged parts or clean fuel injector.****OK****4 Check intake system**

- (a) Check intake manifold, etc. to determine each line for air leakage.

NG**Replace the leaked or damaged parts.**

OK

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Downstream Oxygen Sensor Deteriorated

DTC	P227000	O2 Sensor Signal Biased&Stuck Lean Bank 1 Sensor 2
DTC	P227100	O2 Sensor Signal Biased&Stuck Rich Bank 1 Sensor 2
DTC	P013A00	O2 Sensor Slow Response - Rich to Lean Bank 1 Sensor 2

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check downstream oxygen sensor

- (a) Check if downstream oxygen sensor heating resistance is normal.

Resistance at ambient temperature: 7 ~ 11 Ω

- (b) Check if downstream oxygen sensor signal voltage is normal.

It is normal when signal voltage fluctuates slightly from 0.55 to 0.65 V

NG

Replace downstream oxygen sensor assembly.

OK

2 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Turbocharger Boost Pressure Too High

DTC	P023400	Turbocharger Boost Pressure Too High
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■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check turbocharger relief valve
----------	--

- (a) Check turbocharger relief valve connector for looseness or poor contact.
- (b) Check if turbocharger relief valve stuck.

NG

Replace turbocharger relief valve assembly.

OK

2	Check exhaust gas by-pass valve
----------	--

- (a) Pull exhaust gas by-pass valve pulling rod with hand to check that it can move smoothly and there is no stuck.

NG

Replace turbocharger assembly.

OK

3	Reconfirm DTCs
----------	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Turbocharger Pressure Sensor Short to Ground/Power Supply

DTC	P023700	Turbocharger/Supercharger Boost Sensor "A" Circuit Low
DTC	P023800	Turbocharger/Supercharger Boost Sensor "A" Circuit High

■ Description

Control schematic diagram

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check boost pressure/temperature sensor connector

- Disconnect the negative battery.
- Check if boost pressure/temperature sensor connector is loose, and contact between male and female terminals is in good condition.

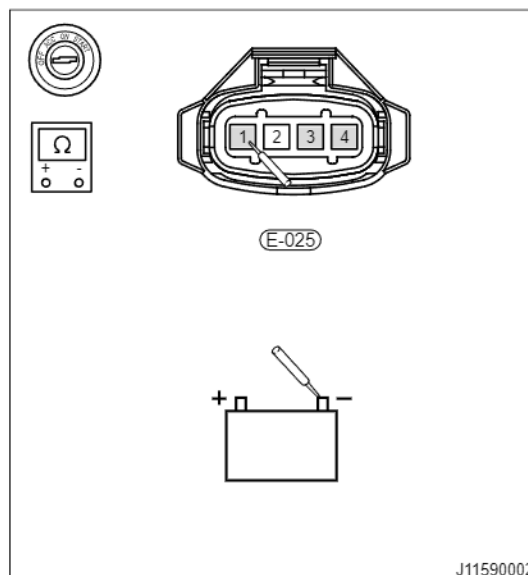
NG

Repair and adjust connector, or replace it.

OK

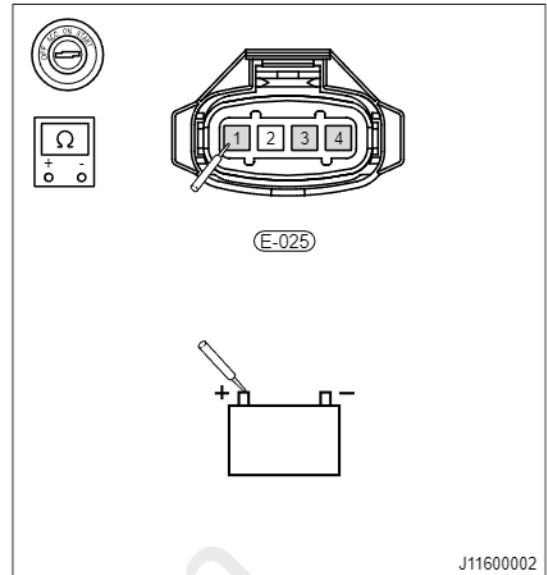
2 Check for short circuit to ground / power supply in boost pressure/temperature sensor circuit

- Disconnect the boost pressure/temperature sensor connector.
- Disconnect the ECM connector (E-018).
- Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of boost pressure/temperature sensor E-025 (1, 3, 4) with red probe respectively. Check if circuit is short to ground.



J11590002

- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of boost pressure/temperature sensor E-025 (1, 3, 4) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair control circuit.

OK

3

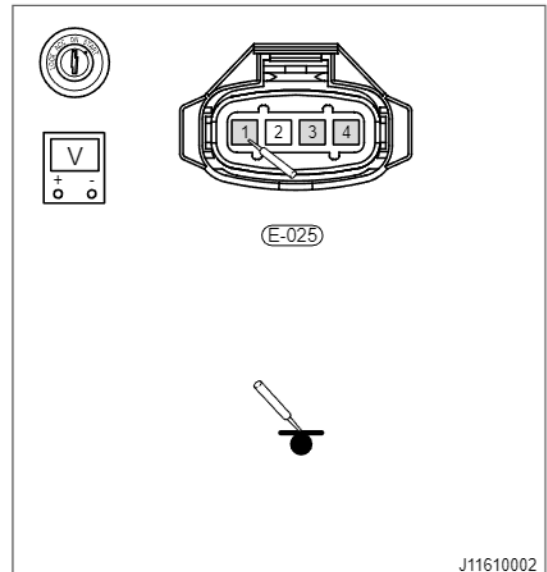
Check boost pressure/temperature sensor control circuit

- (a) Connect boost pressure/temperature sensor connector.
 (b) Turn the ignition switch to ON.
 (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of boost pressure/temperature sensor E-025 (1, 3, 4) with red probe respectively.

Power supply terminal: 5 V

Ground terminal: < 0.2 V

Signal voltage varies in accordance with turbocharger line pressure



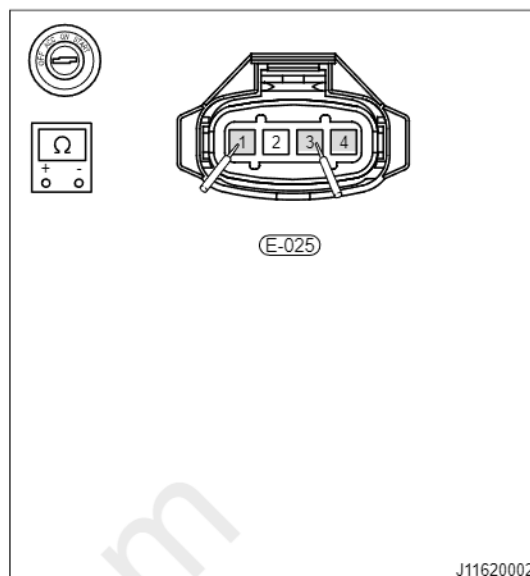
NG

Check and repair control circuit, or replace boost pressure/temperature sensor.

OK

4 Check if circuits of boost pressure/temperature sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of boost pressure/temperature sensor E-013 (1, 3, 4) with red and black probes respectively; Check if they are shorted to each other.


NG
Replace boost pressure/temperature sensor assembly.
OK
5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK
Repair or replace new module.
NG
6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK
Conduct test and confirm malfunction has been repaired.

■ Booster Exhaust Gas Control Circuit Open, Voltage Too High or Too Low

DTC	P024300	Booster Exhaust Gas Control Circuit Open
DTC	P024600	Booster Exhaust Gas Control Circuit Voltage Too High or Too Low

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check exhaust gas bypass actuator connector
---	---

- Disconnect the negative battery.
- Check if exhaust gas bypass actuator connector is loose, and contact between male and female terminals is in good condition.

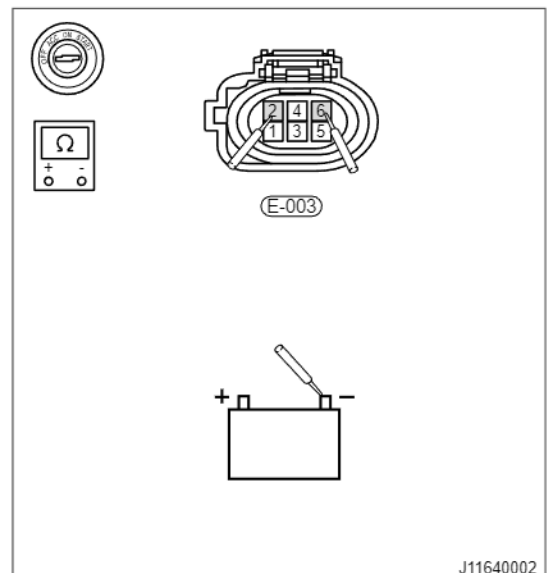
NG

Repair and adjust connector, or replace it.

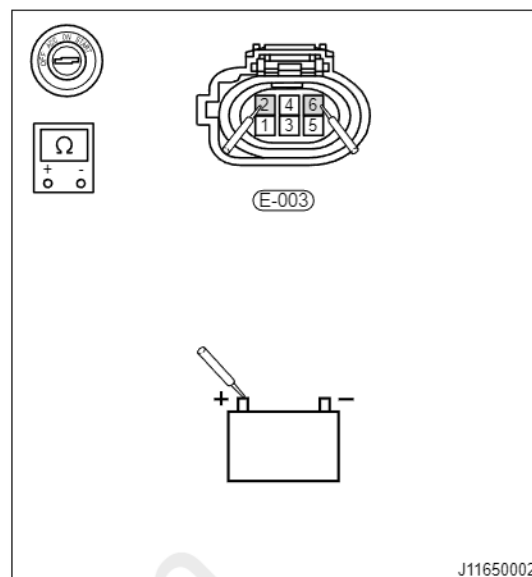
OK

2	Check whether the exhaust gas bypass actuator circuit is short to ground or power supply
---	--

- Disconnect the exhaust gas bypass actuator connector.
- Disconnect the ECM connector (E-018).
- Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of exhaust gas bypass actuator E-003 (2, 6) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of exhaust gas bypass actuator E-003 (2, 6) with red probe respectively. Check if circuit is short to power supply.



NG

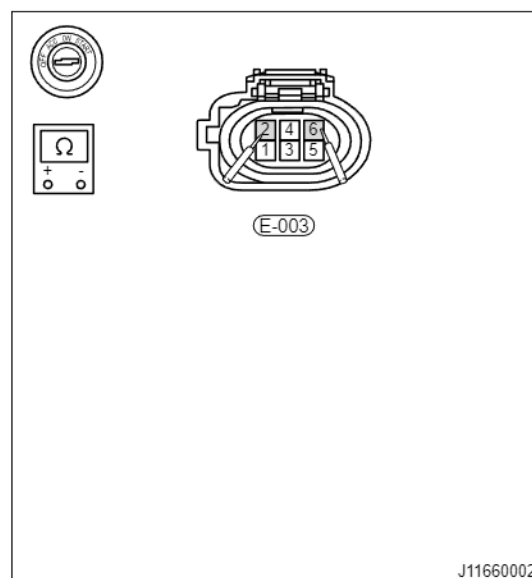
Check and repair control circuit.

OK

3

Check whether the exhaust gas bypass actuator is short to each other

- (a) Using ohm band of multimeter, measure resistances of exhaust gas bypass actuator E-003 (2, 6) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace the exhaust gas bypass actuator assembly.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****5 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ Turbocharger Boost Pressure Too Low**

DTC	P029900	Turbocharger Boost Pressure Too Low
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■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check air filter

- (a) Check if air filter is dirty, blocked, etc.

NG**Replace the air filter assembly.****OK****2 Check each connecting line of turbocharger**

- (a) Check each connecting line of turbocharger for falling off, damage or air leakage, etc.

NG**Replace the damaged line.**

OK

3 Check exhaust gas by-pass valve

- (a) Pull exhaust gas by-pass valve pulling rod with hand, there should be no stuck.

NG

Replace turbocharger assembly.

OK

4 Check relief solenoid valve

- (a) Check that relief solenoid valve connector is not loose or does not fall off.
 (b) Check if relief solenoid valve is stuck at normally open position.

NG

Replace relief solenoid valve assembly.

OK

5 Check turbocharger

- (a) Check operation parts such as turbine, impeller for damage or blade missing.

NG

Replace turbocharger assembly.

OK

6 Check if exhaust back pressure is too high

- (a) Check pre-catalytic converter for blockage.
 (b) Check GPF particulate filter for blockage.

NG

Replace pre-catalytic converter assembly or perform GPF regeneration.

OK

7	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Turbocharger/Supercharger Bypass Valve "A" - Mechanical**

DTC	P226100	Turbocharger/Supercharger Bypass Valve "A" - Mechanical
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■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check relief solenoid valve
---	------------------------------------

- (a) Check that relief solenoid valve connector is not loose or does not fall off.
 (b) Check if relief solenoid valve is not stuck.

NG

Replace relief solenoid valve assembly.

OK

2	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Upstream Oxygen Sensor RE Line, IPE Line Open**

DTC	P224300	O2 Sensor Negative Current Control Circuit Open Bank 1 Sensor 1
DTC	P225100	O2 Sensor Negative Current Control Circuit Open Bank 1 Sensor 1

DTC	P013000	Upstream Oxygen Sensor Compensating Circuit Open
DTC	P223700	O2 Sensor Positive Current Control Circuit Open Bank 1 Sensor 1 (- Close to ECM)

■ Description

Control schematic diagram

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check upstream oxygen sensor connector
----------	---

- Disconnect the negative battery.
- Check if upstream oxygen sensor connector is loose, and contact between male and female terminals is in good condition.

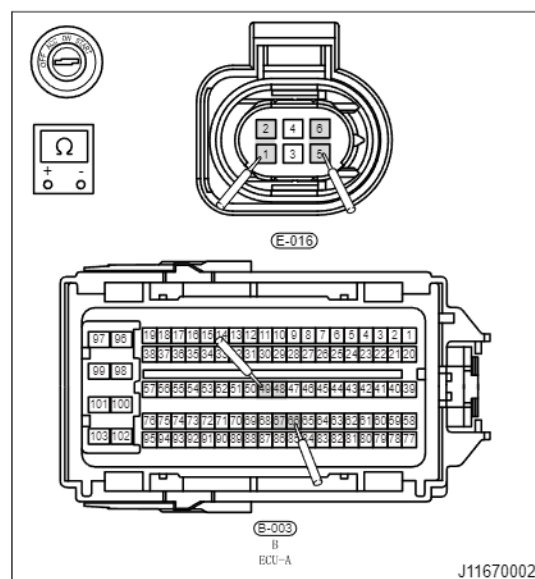
NG

Repair and adjust connector, or replace it.

OK

2	Check upstream oxygen sensor circuit for open
----------	--

- Disconnect the upstream oxygen sensor connector.
- Disconnect the ECM connector (B-003).
- Using ohm band of multimeter, connect black probe to ECM B-003 (A48, A49, A66, A67), measure resistances of upstream oxygen sensor E-016 (1, 2, 5, 6) with red probe respectively. Check the circuit for open.



NG

Check and repair control circuit.

OK

3 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

4 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Network Malfunction

DTC	U012287	Lost Communication With ESP (Electronic Stability Program)
DTC	U014687	Lost Communication With GW (Gateway)
DTC	U012687	Lost Communication With SAS (Steering Angle)
DTC	U010187	Lost Communication With TCM (Transmission Controller)
DTC	U110017	CAN Module Input Power Voltage High
DTC	P1388 24	Ambient Temperature Sensor Cold Start Test Positive Deviation Unreasonable
DTC	P1388 23	Ambient Temperature Sensor Cold Start Test Negative Deviation Unreasonable
DTC	P0070	Ambient Air Temperature Sensor Circuit "A"
DTC	U0128	Lost Communication With EPB Module
DTC	U0131	Lost Communication With EPS (HS CAN)
DTC	U0151	Lost Communication With Airbag Module (SDM) (HS CAN)
DTC	U0073	Control Module Communication Bus 1 Off (CAN1 Bus off)
DTC	P150100	Airbag Communicate Message Unplausible
DTC	P150000	EMS Received Crash Signal
DTC	U015187	Lose Communication With ABM/EGS/EPB/MFS/PEPS/SAM/EBS/DECOS or Signal Abnormal

DTC	U010387	
DTC	U012887	
DTC	U118787	
DTC	U024887	
DTC	U021287	
DTC	U01B000	
DTC	U010987	
DTC	U041681	Data Received by ECM from ESP/TCM/ABM/BCM/CLM/EGS/EPB/FPC/ICM/MFS/PEPS/SAM Module not Reliable
DTC	U040281	
DTC	U045281	
DTC	U042281	
DTC	U042481	
DTC	U040481	
DTC	U041781	
DTC	U041081	
DTC	U042381	
DTC	U059B81	
DTC	U042681	
DTC	U042981	
DTC	U007388	CAN1 Bus OFF (Communication Closed)
DTC	U010187	Lost Communication With TCM (Transmission Controller)
DTC	U012287	Lost Communication With ESP (Electronic Stability Program)
DTC	U015587	Lost Communication With IP (Instrument Cluster)
DTC	U016487	Communication between ECM and AC Control Module Failure
DTC	U014087	Lost Communication With BCM (Body Control Module)

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Refer to diagnosis in CAN network section.

■ Response Reception Time Out/Error of LIN Bus (Contact Between EMS and Intellectual Generator)

DTC	P141500	Response Reception Time Out Error of LIN Bus (Contact Between EMS and Intellectual Generator)
DTC	P141700	Checksum Error of LIN Bus (Contact Between EMS and Intellectual Generator)

DTC	P144200	Communication Fault of Generator
DTC	P144100	Mechanical Fault of Generator
DTC	P144000	Generator Circuit Error

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check alternator connector
---	----------------------------

- (a) Disconnect the negative battery.
 (b) Check if alternator connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check LIN line voltage
---	------------------------

- (a) Disconnect the alternator connector.
 (b) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of alternator LIN line with red probe respectively.

Equivalent voltage: Approximately 10 V

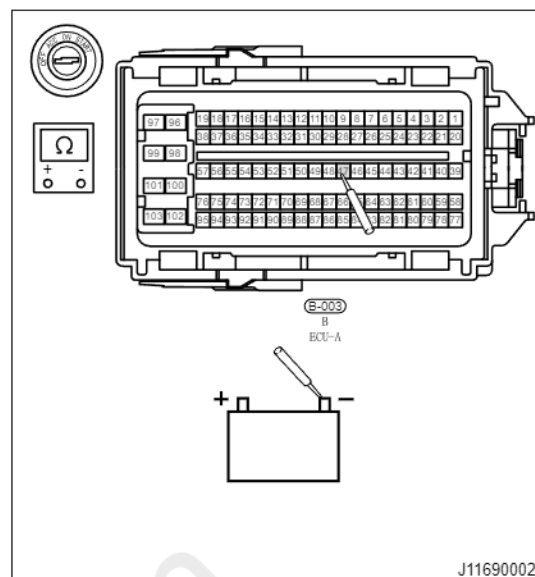
OK

Replace alternator.

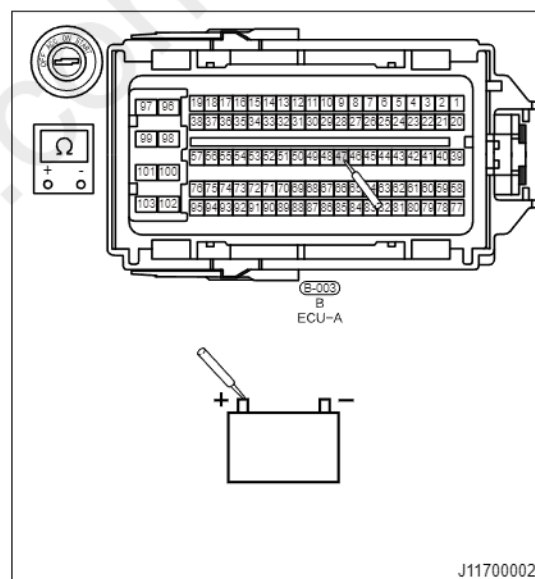
NG

3	Check for short circuit to ground / power supply in LIN line
---	--

- (a) Disconnect the alternator connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A47) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistance of ECM B-003 (A47) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair control circuit.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

5	Reconfirm DTCs
---	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Immobilizer Malfunction**

DTC	P051300	Immobilizer Malfunction
DTC	P063300	
DTC	P161000	
DTC	P161400	
DTC	P161200	
DTC	P161300	
DTC	P161100	

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.
Refer to diagnosis in immobilizer system section.

■ **Canister Vent Valve Stuck Normally Closed**

DTC	P242200	Canister Vent Valve Stuck Normally Closed
-----	---------	---

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check canister vent valve
---	----------------------------------

- (a) Check if line or charcoal canister filter at canister vent valve is blocked.
- (b) Check if canister vent valve is stuck closed position.

NG

Replace charcoal canister filter or canister vent valve.

OK

2

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Fuel Tank Pressure Sensor Malfunction

DTC	P045300	Fuel Tank Pressure Sensor Signal Short to Power Supply
DTC	P045200	Fuel Tank Pressure Sensor Signal Short to Ground
DTC	P128200	EVAP System Pressure Sensor/Switch Circuit Range Performance
DTC	P128300	EVAP System Pressure Sensor/Switch Circuit Range Performance
DTC	P04512A	EVAP System Pressure Sensor&Switch Circuit Range Performance
DTC	P045125	EVAP System Pressure Sensor&Switch Circuit Range Performance
DTC	P045128	EVAP System Pressure Sensor&Switch Circuit Range Performance

■ Description**Control schematic diagram****■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check fuel tank pressure sensor connector

- (a) Disconnect the negative battery.
- (b) Check if fuel tank pressure sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2

Check canister vent valve

- (a) Check if line or charcoal canister filter at canister vent valve is blocked.
- (b) Check if canister vent valve is stuck closed or normally open position.

NG

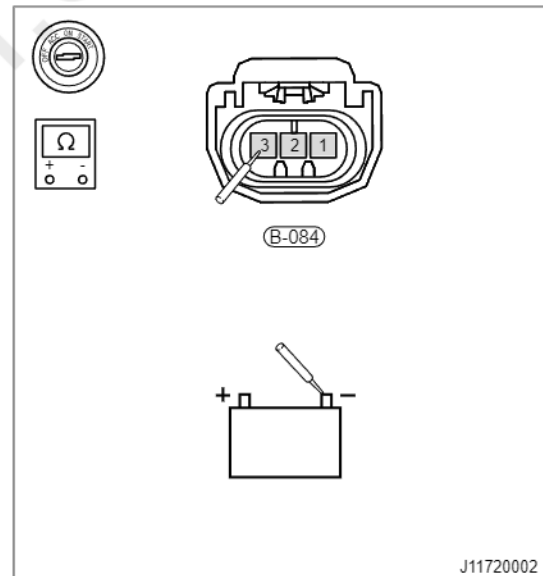
Replace charcoal canister filter or canister vent valve.

OK

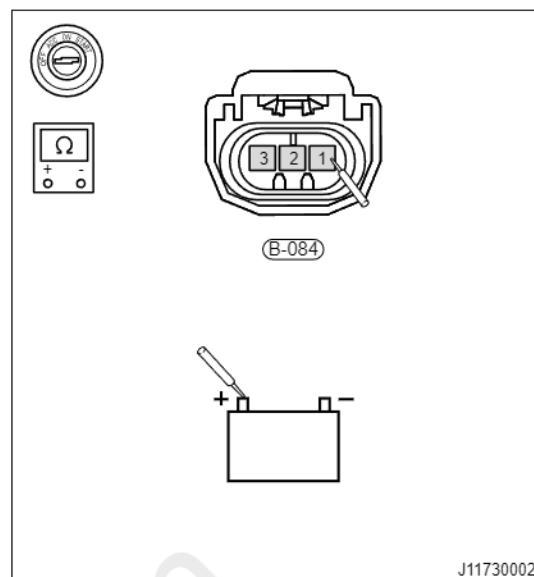
3

Check for short circuit to ground / power supply in fuel tank pressure sensor circuit

- (a) Disconnect fuel tank pressure sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of fuel tank pressure sensor B-084 (1, 2, 3) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of fuel tank pressure sensor B-084 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



NG

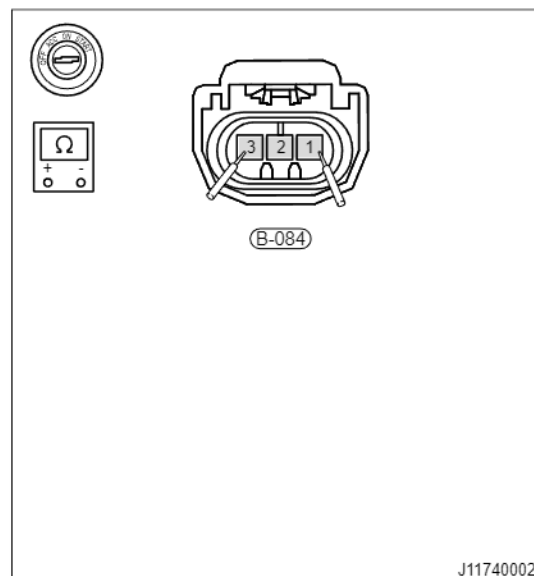
Check and repair control circuit.

OK

4

Check if circuits of fuel tank pressure sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of fuel tank pressure sensor B-084 (1, 2, 3) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace fuel tank pressure sensor assembly.

OK

5

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

Fuel Level Sensor Malfunction

DTC	P046300	Fuel Level Sensor "A" Circuit High
DTC	P046200	Fuel Level Sensor "A" Circuit Low
DTC	P25B000	Fuel Level Sensor "A" Stuck
DTC	P046129	Fuel Level Sensor Unreasonable

Description**DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check fuel pump connector

- (a) Disconnect the negative battery.
- (b) Check if fuel pump connector is loose, and contact between male and female terminals is in good condition.

NG

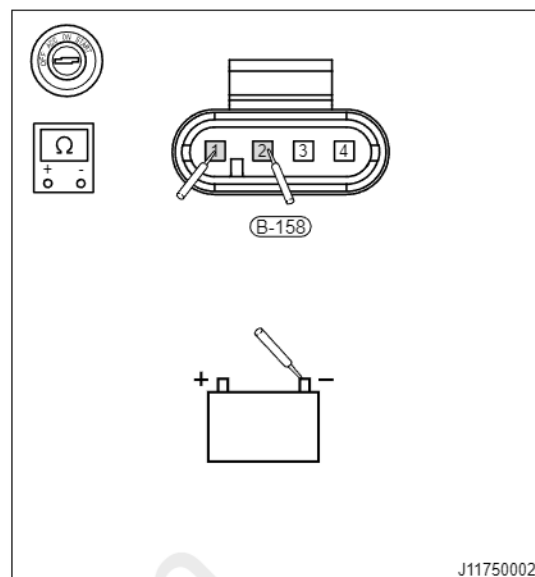
Repair and adjust connector, or replace it.

OK

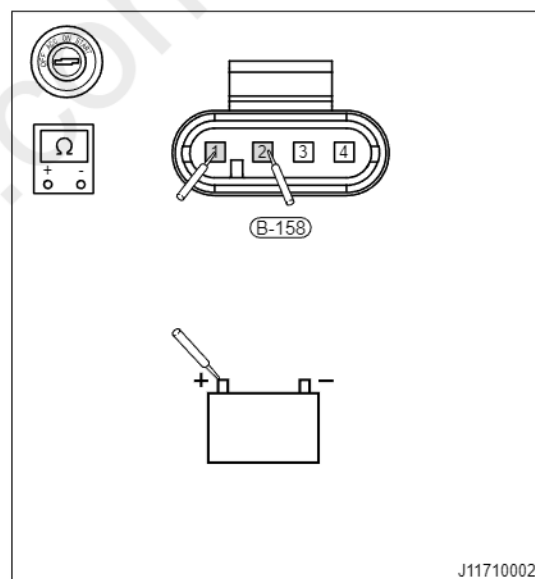
2

Check for short circuit to ground / power supply in fuel level sensor circuit

- (a) Disconnect the fuel level sensor connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of fuel level sensor B-158 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of fuel level sensor B-158 (1, 2) with red probe respectively. Check if circuit is short to power supply.



NG

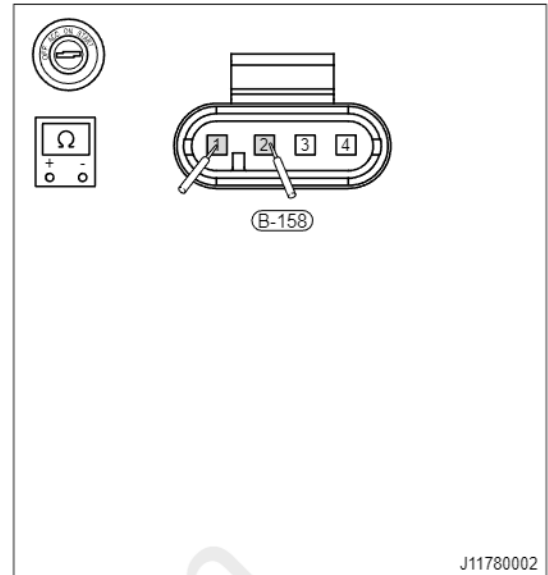
Check and repair control circuit.

OK

3

Check if circuits of fuel level sensor themselves are shorted to each other or opened

- (a) Using ohm band of multimeter, measure resistances of fuel level sensor B-158 (1, 2) with red and black probes respectively; Check if they are shorted to each other or opened.



NG

Replace fuel level sensor assembly.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Evaporation System Leakage Malfunction

DTC	P044200	EVAP System Leak Detected (Small Leak)
DTC	P045500	EVAP System Leak Detected (Large Leak)

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check fuel tank cap

- (a) Check if fuel tank cap is tightened, and check if internal seal ring is deformed.
- (b) Check fuel tank cap for damage or leaked port.

NG

Repair and adjust or replace fuel tank assembly.

OK

2 Check evaporation system connecting line

- (a) Check each line for damage or small hole, etc.
- (b) Check each line joint is clamped into place and check if worm clamp is tightened.

NG

Repair and adjust or replace the damaged parts.

OK

3 Check charcoal canister

- (a) Check charcoal canister for damage or small hole, etc.
- (b) Check if connecting pipe joint is clamped into place.

NG

Repair and adjust or replace charcoal canister assembly.

OK

4 Check canister vent valve

- (a) Check if canister vent valve is not closed tightly or stuck.

NG

Replace canister vent valve assembly.

OK

5

Check canister solenoid valve

(a) Check if canister solenoid valve is not closed tightly or stuck.

NG

Replace canister solenoid valve assembly.

OK

6

Reconfirm DTCs

(a) Connect diagnostic tester and clear DTCs.

(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.

(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ High/Low Load Desorption Pipeline Malfunction - Canister Solenoid Valve

DTC	P049700	EVAP System Low Purge Flow
DTC	P04F000	EVAP System High Pressure Purge

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check low/high load desorption pipeline

(a) Check each connecting line for breakage, damage or small hole, etc.

(b) Check if line check valve is damaged or inoperative.

(c) Check connection position between intake hose and desorption pipeline for blockage.

NG

Repair and adjust or replace the damaged parts.

OK

2 Check canister vent valve

(a) Check if canister vent valve is stuck closed position.

NG

Replace canister vent valve assembly.

OK

3 Check canister solenoid valve

(a) Check if canister solenoid valve is stuck closed position.

NG

Replace canister solenoid valve assembly.

OK

4 Reconfirm DTCs

(a) Connect diagnostic tester and clear DTCs.

(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.

(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Desorption pressure sensor malfunction

DTC	P046800	EVAP Purge Flow Sensor Circuit High
DTC	P046700	EVAP Purge Flow Sensor Circuit Low
DTC	P128500	EVAP Purge Flow Sensor Circuit Range Performance
DTC	P128600	EVAP Purge Flow Sensor Circuit Range Performance

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check desorption pressure sensor connector

- (a) Disconnect the negative battery.
- (b) Check if desorption pressure sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check high load desorption pipeline

- (a) Check each connecting line for breakage, damage or small hole, etc.
- (b) Check if line check valve is damaged or inoperative.
- (c) Check connection position between intake hose and desorption pipeline for blockage.

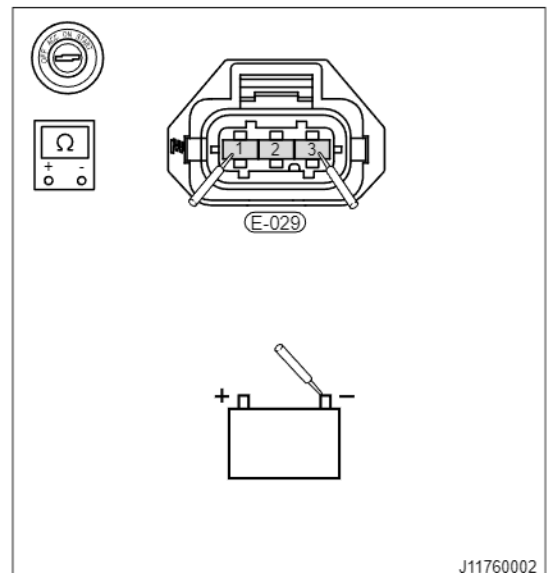
NG

Repair and adjust or replace the damaged parts.

OK

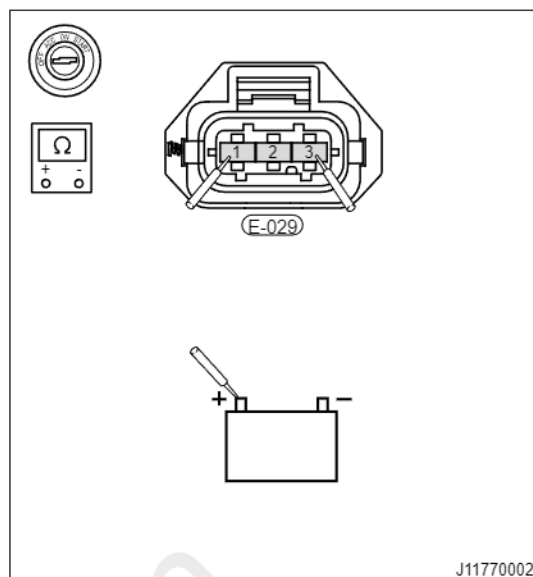
3 Check for short circuit to ground / power supply in desorption pressure sensor circuit

- (a) Disconnect the desorption pressure sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of desorption pressure sensor E-029 (1, 2, 3) with red probe respectively. Check if circuit is short to ground.



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- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of desorption pressure sensor E-029 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



NG

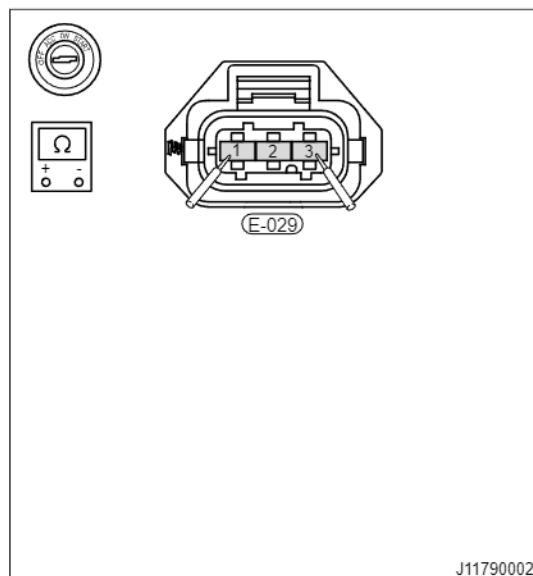
Check and repair control circuit.

OK

4

Check if circuits of desorption pressure sensor themselves are shorted to each other or opened

- (a) Using ohm band of multimeter, measure resistances of desorption pressure sensor E-029 (1, 2, 3) with red and black probes respectively; Check if they are shorted to each other or opened.



NG

Replace desorption pressure sensor assembly.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****6 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.**

■ **Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 CVO Self-learning Adjustment Reach Upper Limit/Lower Limit Malfunction**

DTC	P02CD00	Cylinder 1 Fuel Injector Offset Learning At Max Limit
DTC	P02D100	Cylinder 3 Fuel Injector Offset Learning At Max Limit
DTC	P02D300	Cylinder 4 Fuel Injector Offset Learning At Max Limit
DTC	P02CF00	Cylinder 2 Fuel Injector Offset Learning At Max Limit
DTC	P02CC00	Cylinder 1 Fuel Injector Offset Learning At Min Limit
DTC	P02D000	Cylinder 3 Fuel Injector Offset Learning At Min Limit
DTC	P02D200	Cylinder 4 Fuel Injector Offset Learning At Min Limit
DTC	P02CE00	Cylinder 2 Fuel Injector Offset Learning At Min Limit
DTC	P062B9A	Internal Control Module Fuel Injector Control Performance - Component Internal Failure
DTC	P062B64	
DTC	P062B96	
DTC	P126100	Cylinder 1 Injector Circuit Range/Performance - Signal Plausibility Failure
DTC	P126300	Cylinder 3 Injector Circuit Range/Performance - Signal Plausibility Failure
DTC	P126400	Cylinder 4 Injector Circuit Range/Performance - Signal Plausibility Failure
DTC	P126200	Cylinder 2 Injector Circuit Range/Performance - Signal Plausibility Failure

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check injector connector
----------	---------------------------------

- (a) Disconnect the negative battery.
- (b) Check fuel injector connector for looseness or poor contact, and contact between male and female terminals is in good condition.

NG	Repair and adjust connector, or replace it.
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OK

2	Check injector
----------	-----------------------

- (a) Remove the fuel injector assembly.
- (b) Check fuel injector for blockage or leakage.

NG	Clean or replace fuel injector assembly.
-----------	---

OK

3	Reconfirm DTCs
----------	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK	Conduct test and confirm malfunction has been repaired.
-----------	--

■ **Cylinder 1 / Cylinder 2 / Cylinder 3 / Cylinder 4 Fuel Injector Control Circuit Short**

DTC	P02EE00	Cylinder 1 Fuel Injector Control Circuit Short
DTC	P02EF00	Cylinder 2 Fuel Injector Control Circuit Short
DTC	P02F000	Cylinder 3 Fuel Injector Control Circuit Short
DTC	P02F100	Cylinder 4 Fuel Injector Control Circuit Short

DTC	P214800	Cylinder 1 or Cylinder 4 Fuel Injector Control Circuit Short to Power Supply
DTC	P215100	Cylinder 2 or Cylinder 3 Fuel Injector Control Circuit Short to Power Supply

■ Description

Control schematic diagram

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Take troubleshooting of cylinder 1 fuel injector as an example.

1	Check injector connector
----------	---------------------------------

- Disconnect the negative battery.
- Check if fuel injector connector is loose, and contact between male and female terminals is in good condition.

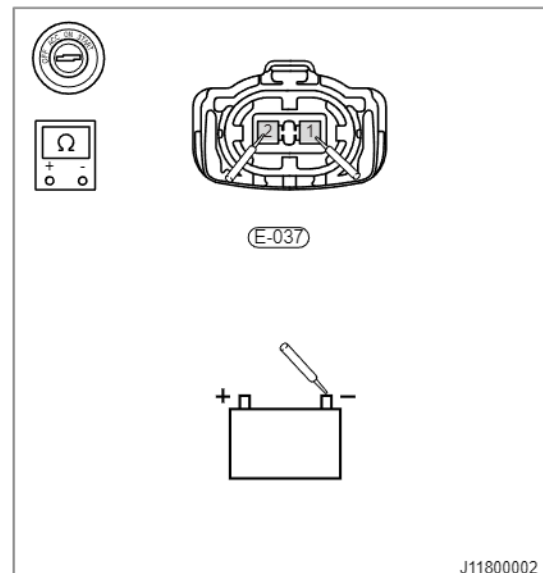
NG

Repair and adjust connector, or replace it.

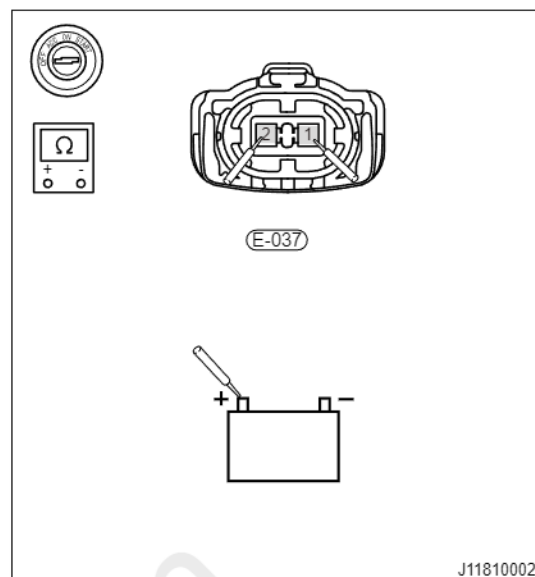
OK

2	Check if fuel injector control terminal is short to ground/power supply or short to each other
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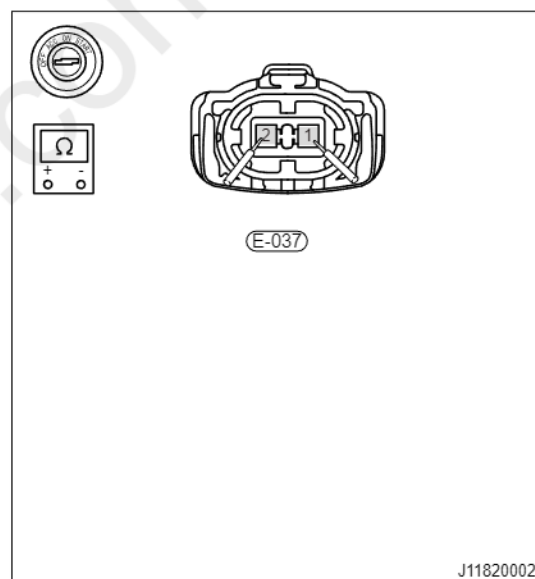
- Disconnect the injector connector.
- Disconnect the ECM connector (E-018).
- Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of fuel injector E-037 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of fuel injector E-037 (1, 2) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of fuel injector E-037 (1, 2) with red and black probes respectively. Check if circuits are shorted to each other.



NG

Check and repair circuit.

OK

3

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

4 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Electronic Throttle 1st Path / 2nd Path Signal Voltage Minimum / Maximum / Improper**

DTC	P012200	Electronic Throttle 1st Path / 2nd Path Signal Voltage Minimum
DTC	P022200	
DTC	P012300	Electronic Throttle 1st Path / 2nd Path Signal Voltage Maximum
DTC	P022300	
DTC	P012100	Electronic Throttle 1st Path / 2nd Path Signal Voltage Improper
DTC	P022100	

■ **Description**

Control schematic diagram

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check electronic throttle connector

- (a) Disconnect the negative battery.
- (b) Check if electronic throttle connector is loose, and contact between male and female terminals is in good condition.

NG

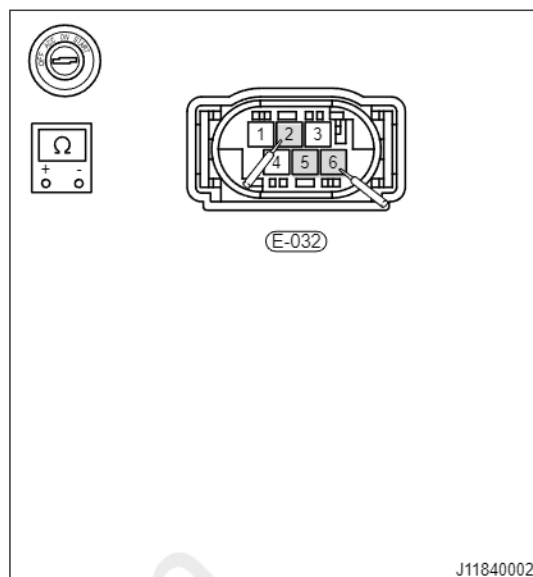
Repair and adjust connector, or replace it.

OK

2 Check electronic throttle internal resistance

- (a) Using ohm band of multimeter, measure if resistances of electronic throttle E-032 (2 - 6) and (2 - 5) are normal with red and black probes respectively.

Resistance values should change continuously when the valve plate is toggled by hand



NG

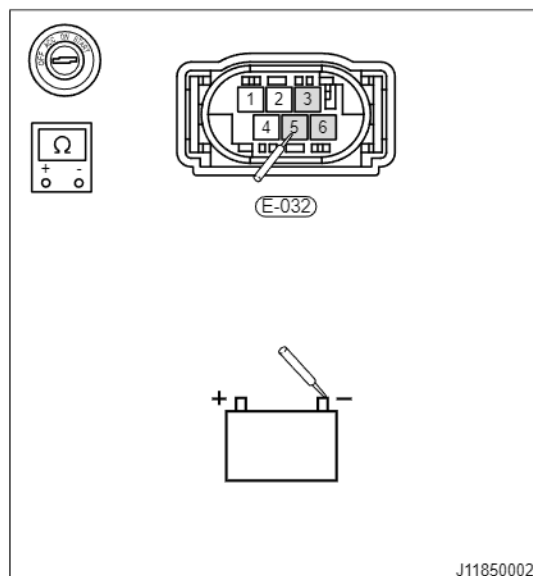
Replace electronic throttle assembly.

OK

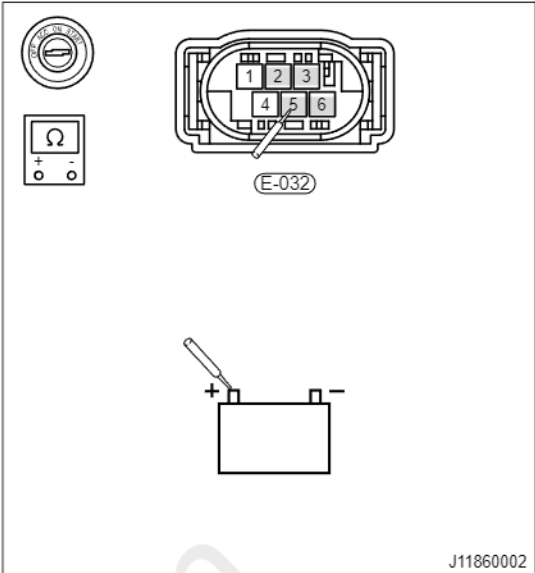
3

Check for short circuit to ground / power supply or short to each other in electronic throttle line

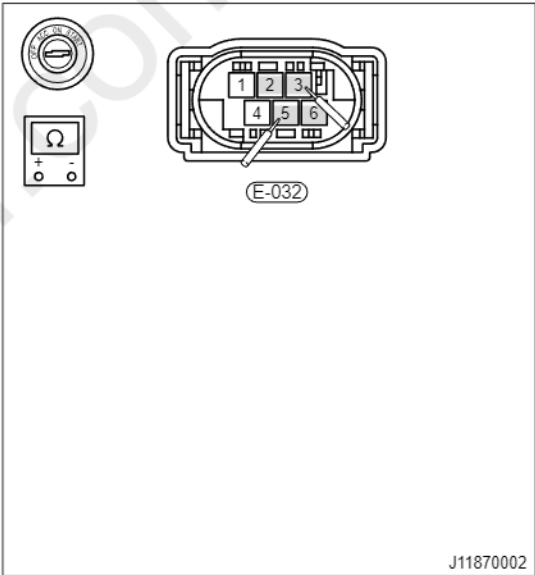
- (a) Disconnect the electronic throttle connector.
 (b) Disconnect the ECM connector (E-018).
 (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistances of electronic throttle E-032 (3, 5, 6) with red probe respectively. Check if circuit is short to ground.



(d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of electronic throttle E-032 (2, 3, 5, 6) with red probe respectively. Check if circuit is short to power supply.



(e) Using ohm band of multimeter, measure resistances of electronic throttle E-032 (2, 3, 5, 6) with red and black probes respectively. Check if circuits are shorted to each other.



NG Check and repair circuit.

OK

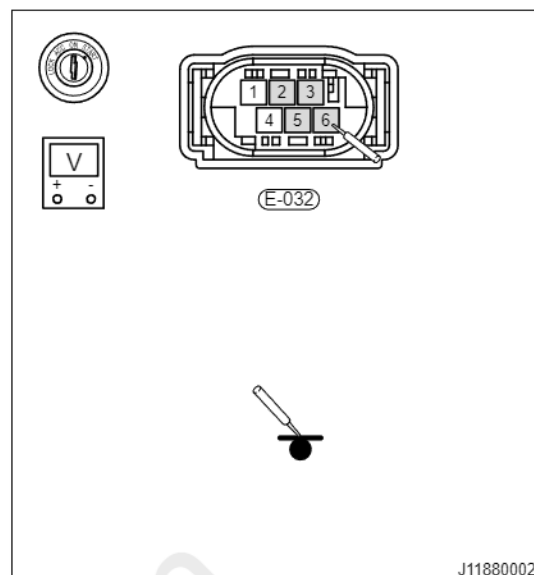
4	Check electronic throttle position sensor power supply / ground / signal
---	--

- (a) Connect electronic throttle and ECM connector (E-018)
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, and measure voltages of electronic throttle E-032 (2, 3, 5, 6) with red probe respectively.

Power supply terminal: 5 V

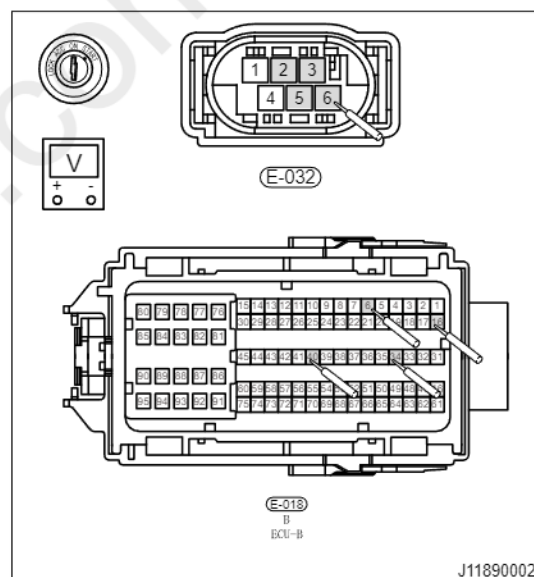
Ground terminal: < 0.2 V

The sum of signal 1 voltage and signal 2 voltage is approximately 5 V



- (d) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B40, B16, B34, B6), measure electronic throttle E-032 (2, 3, 5, 6) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Electronic Throttle Spring Inspection Malfunction Minimum, Maximum / Deviation Between Throttle Target Opening Angle and Actual Opening Angle / Adjustment / Drive Level Malfunction**

DTC	P155400	Max Error of DV-E Return Spring Check Failure
DTC	P155500	
DTC	P156100	
DTC	P156000	Electronic Throttle PID Adjustment Malfunction
DTC	P210000	Electronic Throttle Drive Level Malfunction
DTC	P210300	
DTC	P210600	
DTC	P211800	

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check electronic throttle connector

- (a) Disconnect the negative battery.
- (b) Check if electronic throttle connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check electronic throttle condition

- (a) Electronic throttle body valve plate is dirty or there are foreign matters, so that the valve plate resistance is large or valve plate is stuck.

NG

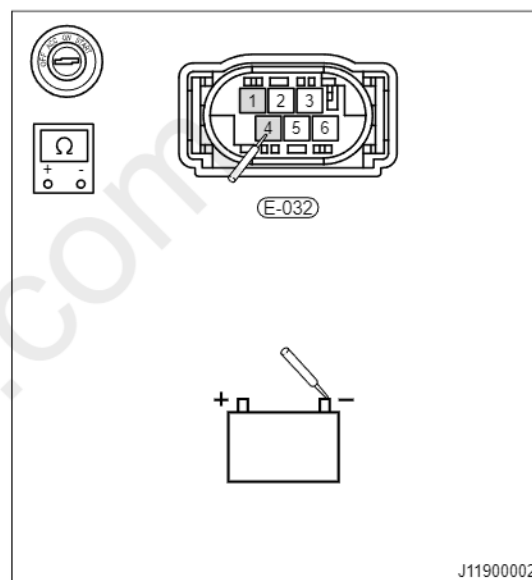
Clean or replace electronic throttle assembly.

OK

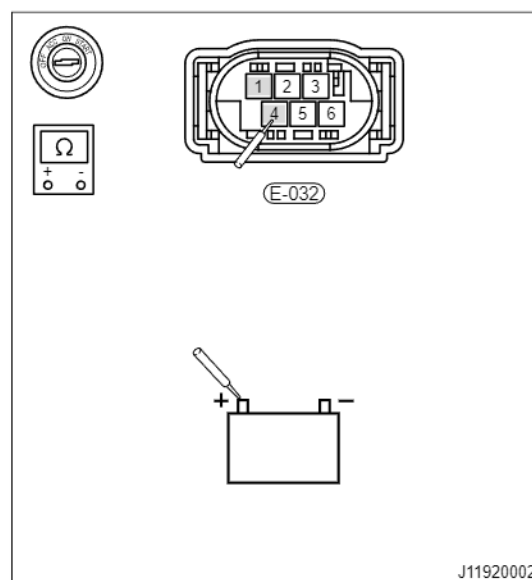
3

Check for short circuit to ground / power supply or short to each other in electronic throttle line

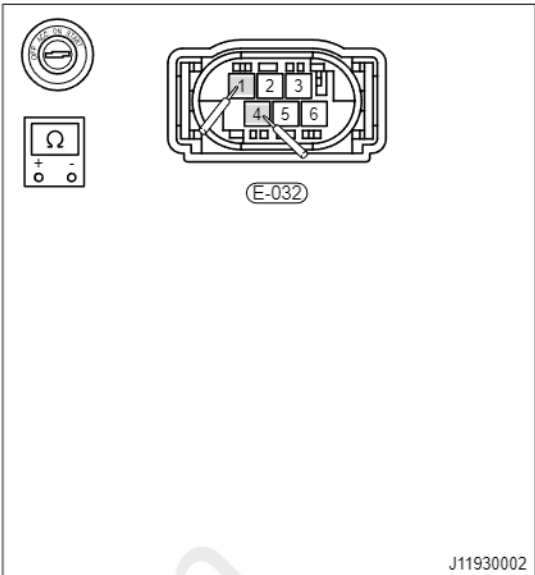
- (a) Disconnect the electronic throttle connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistances of electronic throttle E-032 (4, 1) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of electronic throttle E-032 (4, 1) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of electronic throttle E-032 (4, 1) with red and black probes respectively. Check if circuits are shorted to each other.



NG Check and repair circuit.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK Conduct test and confirm malfunction has been repaired.

Electronic Throttle Self-learning Unable to Complete / Throttle Initial Self-learning Unable to Complete

DTC	P155000	Electronic Throttle Self-learning Unable to Complete / Throttle Initial Self-learning Unable to Complete
DTC	P155100	

DTC	P155800	Not Plausible Error of DV-E Limphome Learning Position
DTC	P155900	
DTC	P155A00	
DTC	P155B00	
DTC	P155600	Electronic Throttle Lower Mechanic Stop Re-learning Error
DTC	P155700	

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check if electronic throttle self-learning condition is met

- (a) No malfunctions related to DVE or monitoring;
- (b) Rotation speed is 0;
- (c) Vehicle speed is 0;
- (d) Pedal opening angle is 0;
- (e) Battery voltage is higher than 10 V;
- (f) Engine coolant temperature is higher than 5°C;
- (g) Intake temperature is higher than 5°C

NG

Handle the malfunctions that do not meet the self-learning conditions.

OK

2 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

3 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ ECM Internal Malfunction

DTC	P15A000	CPU0: MPU Error (Memory, DSPR, PSPR)
DTC	P15A100	CPU0: DCACHE/DSPR ECC Uncorrectable Error
DTC	P15A200	CPU0: DCACHE/DSPR Address Error
DTC	P15A300	CPU0:DCACHE TAG SRAM ECC Uncorrectable Error
DTC	P15A400	CPU0:DCACHE TAG SRAM Address Error
DTC	P15A500	CPU0:PCACHE TAGRAM ECC Uncorrectable Error
DTC	P15A600	CPU0:PCACHE TAGRAM Address Error
DTC	P15A700	CPU0: PCACHE/PSPR ECC Uncorrectable Error
DTC	P15A800	CPU0:PCACHE/PSPR Address Error
DTC	P15A900	CPU1:Lockstep Comparator Error
DTC	P15AA00	CPU1:MPU Error (Memory, DSPR, PSPR)
DTC	P15AB00	CPU1:DCACHE/DSPR ECC Uncorrectable Error
DTC	P15AC00	CPU1:DCACHE/DSPR Address Error
DTC	P15AD00	CPU1:DCACHE TAGRAM ECC Uncorrectable Error
DTC	P15AE00	CPU1:DCACHE TAGRAM Address Error
DTC	P15AF00	CPU1:PCACHE TAGRAM ECC Uncorrectable Error
DTC	P15B000	CPU1:PCACHE TAGRAM Address Error
DTC	P15B100	CPU1:PCACHE/PSPR ECC Uncorrectable Error
DTC	P15B200	CPU1:PCACHE/PSPR Address Error
DTC	P15B300	LMU:SRAM ECC Monitoring Error
DTC	P15B400	LMU:SRAM ECC Uncorrectable Error
DTC	P15B500	LMU:SRAM Address Error
DTC	P15B600	SMU: Recover Timer 0 Timeout Error
DTC	P15B700	SMU: Recover Timer 1 Timeout Error
DTC	P15B800	PMU:PFLASH ECC Uncorrectable Multi-bit Error
DTC	P15B900	PMU:PFLASH Address Error
DTC	P15BA00	PMU: PFLASH ECC Monitoring Error (Cover All ECC Module)
DTC	P15BB00	PMU: PFLASH EDC Comparator Error (Cover All PFLASH Instances)
DTC	P15BC00	SCU/CGU: System PLL OSC_WDT: Input Clock Exceeds Limit Error

DTC	P15BD00	SCU/CGU: System PLL VCO Clock Event Loss Error
DTC	P15BE00	SCU/EVR: EVR 1.3V Digital Undervoltage Error
DTC	P15BF00	SCU/EVR: EVR 3.3V Overvoltage Error
DTC	P15C000	SCU/EVR: External Power Supply Overvoltage Error
DTC	P15C100	SCU/WDTS: Safety Watchdog Timeout Error
DTC	P15C200	SCU/WDTCPU0: Watchdog CPU0 Timeout Error
DTC	P15C300	SCU/WDTCPU1: Watchdog CPU1 Timeout Error
DTC	P15C400	SCU/CGU: PLL_ERAY VCO Clock Event Loss Error
DTC	P15C500	SCU/WDTCPU2: Watchdog CPU2 Timeout Error
DTC	P15C600	SCU/DTS: Temperature Sensor Overflow Error
DTC	P15C700	Registers: Register Monitor Detects Error
DTC	P15C800	SCU/LSCU: SCU Configuration Error: Monitor Dual-track Properties (- Inverted Signal) Alarm from Lockstep Comparator (LSCU)
DTC	P15C900	SCU/CGU: Clock Monitoring: STM Exceed Frequency Range Error
DTC	P15CA00	SCU/CGU: Clock Monitoring: PLL_ERAY Exceed Frequency Range Error
DTC	P15CB00	SCU/CGU: Clock Monitoring: PLL Exceed Frequency Range Error
DTC	P15CC00	SCU/CGU: Clock Monitoring: SRI Exceed Frequency Range Error
DTC	P15CD00	SCU/CGU: Clock Monitoring: SPB Exceed Frequency Range Error
DTC	P15CE00	SCU/CGU: Clock Monitoring: GTM Exceed Frequency Range Error
DTC	P15CF00	SCU/CGU: Clock Monitoring: ADC Exceed Frequency Range Error
DTC	P15D000	GTM: SRAMs Uncorrectable Error
DTC	P15D100	FLEXRAY:SRAM Address Error
DTC	P15D200	Misc SRAMs:SRAM ECC Uncorrectable Error
DTC	P15D300	Misc SRAMs:SRAM Address Error
DTC	P15D400	GTM: SRAMs Address Error
DTC	P15D500	CAN: SRAM Uncorrectable Error
DTC	P15D600	CAN: SRAM Address Error
DTC	P15D700	FLEXRAY:SRAM ECC Uncorrectable Error
DTC	P15D800	CPU2:MPU Error (Memory, DSPR, PSPR)
DTC	P15D900	CPU2: DCACHE/DSPR ECC Uncorrectable Error
DTC	P15DA00	CPU2: DCACHE/DSPR Address Error
DTC	P15DB00	CPU2: DCACHE TAG SRAM ECC Uncorrectable Error
DTC	P15DC00	CPU2:DCACHE TAG SRAM Address Error
DTC	P15DD00	CPU2:121 PCACHE TAGRAM ECC Uncorrectable Error
DTC	P15DE00	CPU2:PCACHE TAGRAM Address Failure

DTC	P15DF00	CPU2: PCACHE/PSPR ECC Uncorrectable Error
DTC	P15E000	CPU2: PCACHE/PSPR Address Error
DTC	P061A00	Safely Monitor Torque Exceeds Limit
DTC	P060D00	Accelerator Pedal 2nd Layer Monitoring Error
DTC	P152000	Function Monitoring: Check of Predicted Air Mass Failed
DTC	P152100	Function Monitoring: Fault of ECM Check of Injection Cut-off
DTC	P152200	Function Monitoring: Fault of ECM in Check of Cylinder Individual Fuel Corrections
DTC	P153900	Synchronization process rationality check (based on speed and synchronization count)
DTC	P153700	Function Monitoring: Fault of ECM or Sensor in rl-Comparison
DTC	P153500	Function Monitoring: Fault of ECM or Sensor in Mixture Check
DTC	P153600	Function Monitoring: Fault of ECM Comparison of Lambda and Operation Mode
DTC	P153800	Electronic Throttle Safety Monitoring Function Error (Ignition Angle Signal, Wire Harness or ECM Error)
DTC	P152700	Function Monitoring: Monitoring of ICO From Level1
DTC	P152800	Function Monitoring: Monitoring of ICO From Level2
DTC	P061C00	Safety Monitoring Function Error (2nd Layer Engine Speed Monitoring Error)
DTC	P152900	Function Monitoring: Fault of Starter Control
DTC	P153000	Function Monitoring: Fault of ECM ADC - Null Load Test Pulse
DTC	P153100	Function Monitoring: Fault of ECM ADC - Test Voltage
DTC	P157100	Closed Path Checking, Driver Level Check Error Or Communication Error
DTC	P157200	Under Normal Voltage, ABE Activated
DTC	P157300	Diagnostic Fault Check to Report "WDA active" Due to Errors in Query/Response Communication
DTC	P157400	Errorpin Activated and Monitoring Communication Normal
DTC	P157500	Diagnostic Fault Check to Report "WDA active" Due to Overvoltage Detection
DTC	P142000	CAN Hardware Memory Response Timeout
DTC	P142100	LIN Hardware Memory Response Timeout
DTC	P064100	5 V Power Supply Module 1 Fail
DTC	P065100	5 V Power Supply Module 2 Fail
DTC	P069700	5 V Power Supply Module 3 Fail
DTC	P261000	Unreasonable Shutdown Timing
DTC	P06B842	Error when Reading/Writing Flash Block

DTC	P06B843	
------------	----------------	--

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check Engine Control Module (ECM)
----------	--

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

2	Reconfirm DTCs
----------	-----------------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Deviation Between Both Paths Signal of Accelerator Pedal Out of Limit/Voltage Too High/Too Low

DTC	P213800	Deviation Between Both Paths Signal of Accelerator Pedal Out of Limit
DTC	P212300	Accelerator Pedal 1st Path / 2nd Path Signal Voltage High
DTC	P212800	
DTC	P212200	Accelerator Pedal 1st Path / 2nd Path Signal Voltage Low
DTC	P212700	

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check electronic accelerator pedal connector
----------	---

- (a) Disconnect the negative battery.
- (b) Check if electronic accelerator pedal connector is loose, and contact between male and female terminals is in good condition.

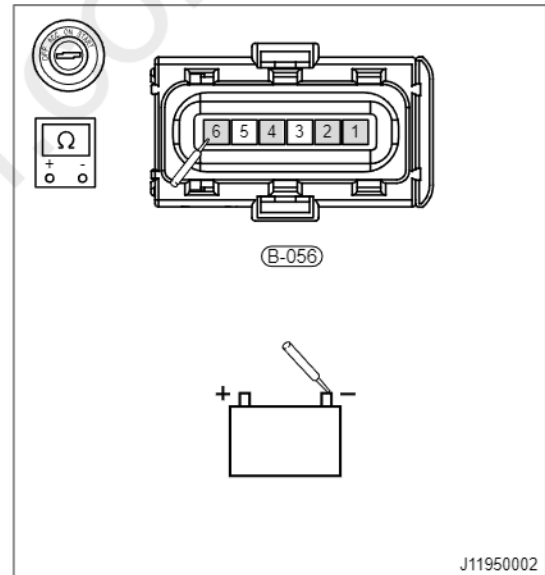
NG

Repair and adjust connector, or replace it.

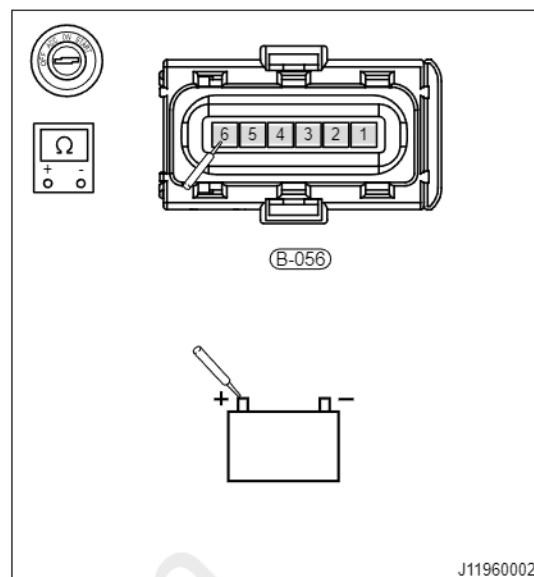
OK

2	Check for short circuit to ground / power supply or short to each other in electronic accelerator pedal line
----------	---

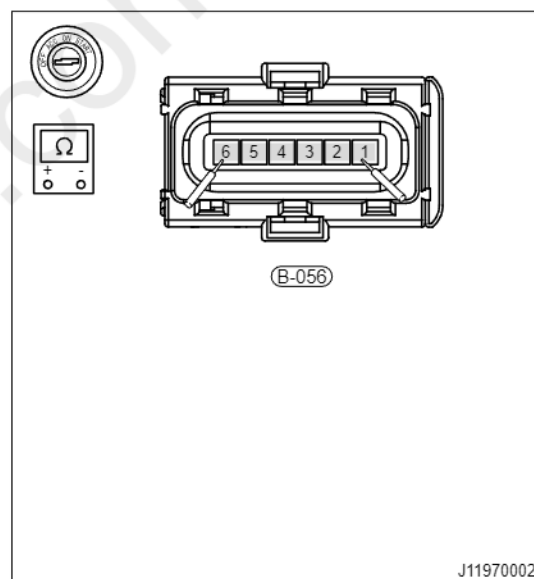
- (a) Disconnect the electronic accelerator pedal connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistances of electronic accelerator pedal B-056 (1, 2, 4, 6) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of electronic accelerator pedal B-056 (1, 2, 3, 4, 5, 6) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of electronic accelerator pedal B-056 (1, 2, 3, 4, 5, 6) with red and black probes respectively. Check if circuits are shorted to each other.



NG

Check and repair circuit.

OK

3

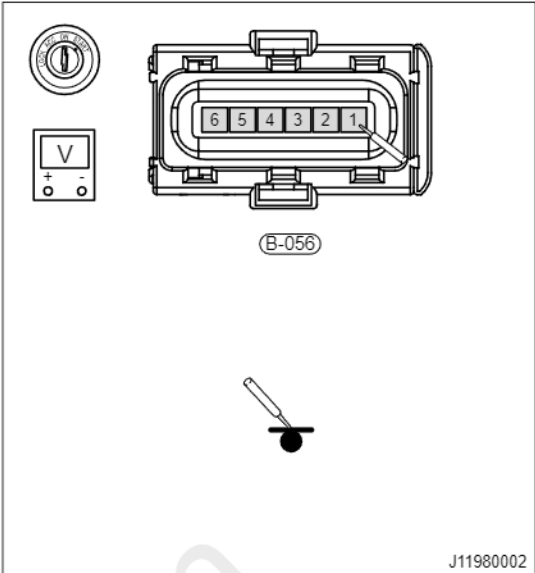
Check electronic accelerator pedal position sensor power supply / ground / signal

- (a) Connect electronic accelerator pedal and ECM connector (B-003)
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, and measure voltages of electronic accelerator pedal B-056 (1, 2, 3, 4, 5, 6) with red probe respectively.

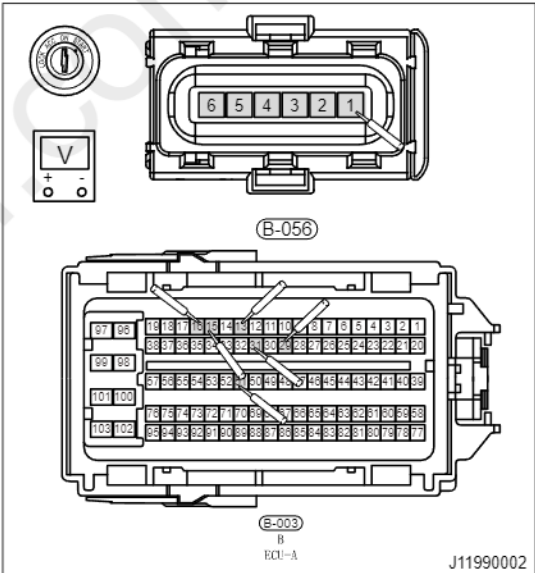
Power supply terminal: 5 V

Ground terminal: < 0.2 V

Signal 1 voltage value and signal 2 voltage value maintain a voltage multiplying relationship



- (d) Using voltage band of multimeter (voltage drop method), connect black probe to ECM B-003 (A15, A31, A13, A16, A51, A29), measure electronic accelerator pedal B-056 (1, 2, 3, 4, 5, 6) with red probe.
- Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ EVAP System Vent Control Circuit Short to Ground or Power Supply

DTC	P049900	EVAP System Vent Control Circuit Short to Power Supply
DTC	P049800	EVAP System Vent Control Circuit Short to Ground
DTC	P044700	EVAP System Vent Control Circuit Short to Ground

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check canister vent valve connector

- (a) Disconnect the negative battery.
- (b) Check if canister vent valve connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check canister vent valve power supply fuse

- (a) Check if engine compartment fuse and relay box fuse EF22 5A is blown.

NG

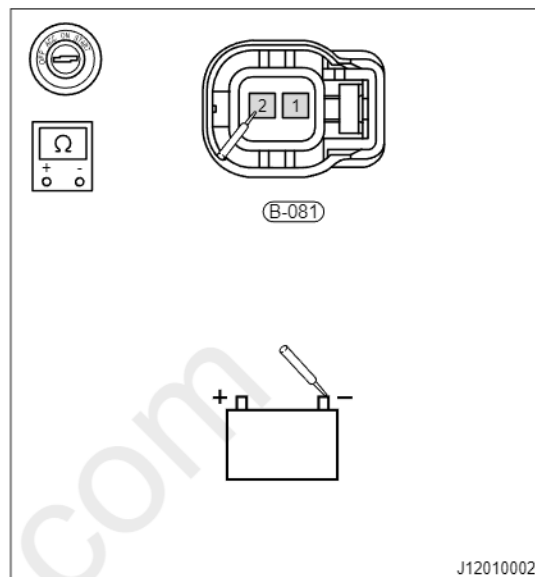
Check and repair short circuit malfunction and replace fuse.

OK

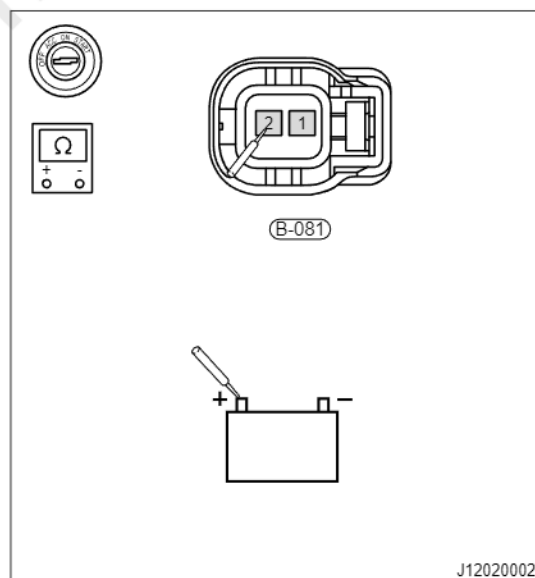
3

Check for short circuit to ground / power supply or short to each other in canister vent valve line

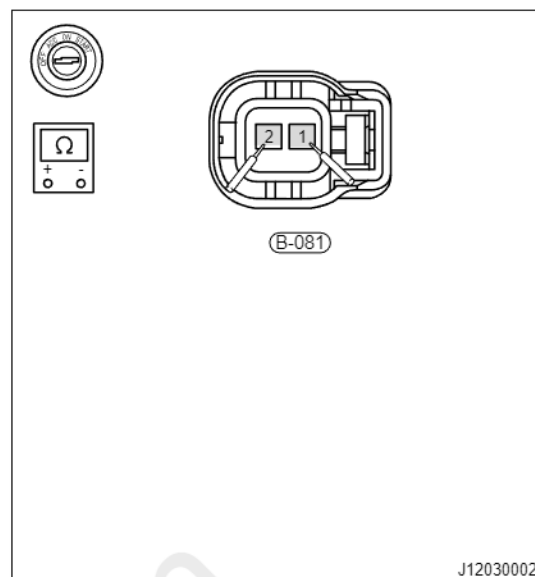
- (a) Disconnect the canister vent valve connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of canister vent valve B-081 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of canister vent valve B-081 (1, 2) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of canister vent valve B-081 (1, 2) with red and black probes respectively. Check if circuits are shorted to each other.



NG

Check and repair circuit.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Cooling Fan Control Circuit Voltage Too Low/Too High

DTC	P069100	Fan Control Circuit Low
DTC	P069200	Fan Control Circuit High

DTC	P048000	Cooling Fan Control Circuit Error
DTC	P063400	Cooling Fan Drive Chip Overheating
DTC	P048371	Fan Rationality Check Error (Type 1)
DTC	P048372	Fan Rationality Check Error (Type 2)
DTC	P048373	Fan Rationality Check Error (Type 3)
DTC	P048374	Fan Rationality Check Error (Type 4)

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check cooling fan connector
----------	------------------------------------

- (a) Disconnect the negative battery.
- (b) Check if cooling fan connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check cooling fan power supply fuse
----------	--

- (a) Check if engine compartment fuse and relay box fuse EF25 5A is blown.

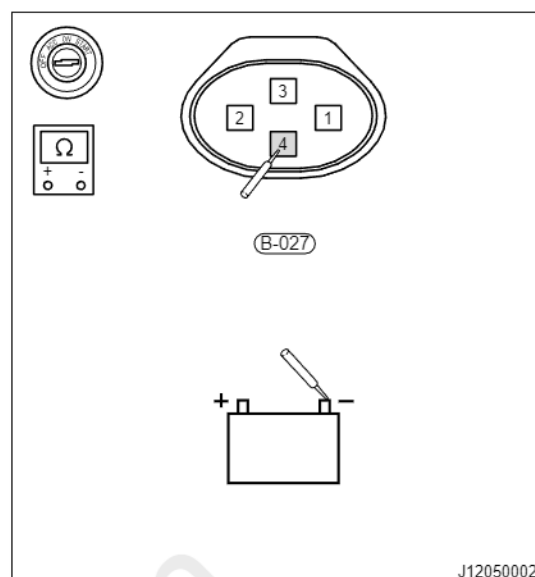
NG

Check and repair short circuit malfunction of circuit.

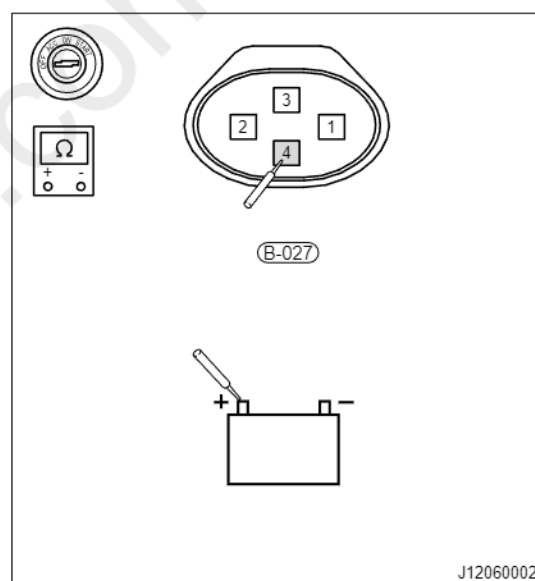
OK

3	Check for short circuit to ground / power supply in cooling fan control circuit
----------	--

- (a) Disconnect the cooling fan connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistances of cooling fan B-027 (4) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of cooling fan B-027 (4) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair circuit.

OK

4

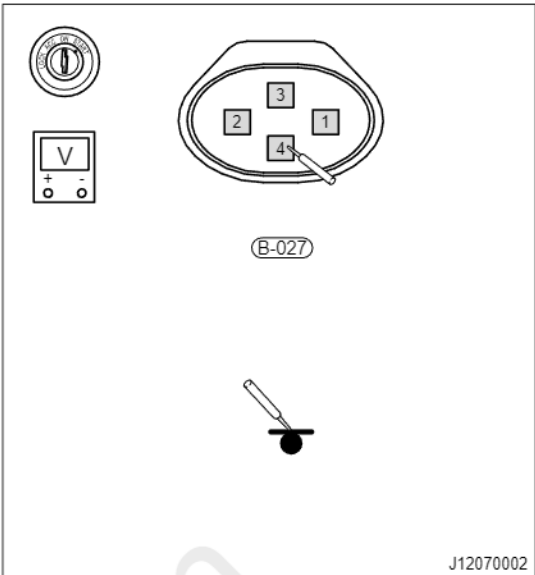
Check cooling fan power supply / ground / control signal

- (a) Connect cooling fan and ECM connector (B-003)
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, and measure voltages of cooling fan B-027 (1, 2, 3, 4) with red probe.

Power supply terminal: 12 V

Ground terminal: < 0.2 V

The control signal adopts duty ratio control (high level is effective)



NG

Repair or replace wire harness.

OK

5	Check Engine Control Module (ECM)
---	-----------------------------------

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6	Reconfirm DTCs
---	----------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ TCU Requests to Illuminate MIL Light

DTC	P070000	TCU Requests to Illuminate MIL Light
-----	---------	--------------------------------------

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Read transmission system DTCs and refer to transmission system diagnosis.

■ Vehicle Speed Sensor Performance / Improper / Input Signal Fault

DTC	P121200	Vehicle Speed Sensor Performance Failure (Vehicle Speed Exceed Maximum Range)
DTC	P050184	Vehicle Speed Sensor Performance Failure (Vehicle Speed Exceed Minimum Range)
DTC	P050165	Vehicle speed sensor performance failure (vehicle speed is too low when oil cut-off during coasting)
DTC	P050166	Vehicle Speed Sensor "A" Circuit Range/Performance
DTC	P050000	Vehicle Speed Sensor Input Signal Fault

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Read brake control system DTCs and refer to brake control system diagnosis.

■ Ignition Angle Efficiency Monitoring During Catalytic Converter Heating

DTC	P050B00	Cold Start Ignition Timing Performance
DTC	P050B20	Cold Start Ignition Timing Performance

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check electronic throttle condition

- (a) Check if electronic throttle is dirty or is stuck at position with a small opening angle.

NG**Clean or replace electronic throttle assembly.**

OK

2 Check ignition system

- (a) Check engine for DTCs related to ignition.
 (b) Check ignition coil and spark plug for damage.

NG

Replace the damaged parts.

OK

3 Check intake system

- (a) Check intake manifold or each connecting line for air leakage.

NG

Replace the leaked or damaged parts.

OK

4 Check fuel system

- (a) Check if low/high pressure fuel pressure is too low.

NG

Replace the damaged parts.

OK

5 Check if exhaust back pressure is too high

- (a) Check pre-catalytic converter for blockage.
 (b) Check GPF particulate filter for blockage.

NG

Replace pre-catalytic converter assembly or perform GPF regeneration.

OK

6 Check boost system

- (a) Check each connecting line of boost system for falling off.
- (b) Check if turbocharger can boost normally and each actuator can operate normally.

NG

Replace turbocharger assembly.

OK

7

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

8

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Brake Pedal Signal Synchronization Malfunction

DTC	P012200	Brake Pedal Signal Synchronization Malfunction
-----	---------	--

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check brake switch connector

- (a) Disconnect the negative battery.
- (b) Check if brake switch connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2

Check brake switch power supply fuse

- (a) Check if fuse RF37 5A and fuse RF15 5A in instrument panel fuse and relay box are blown.

NG

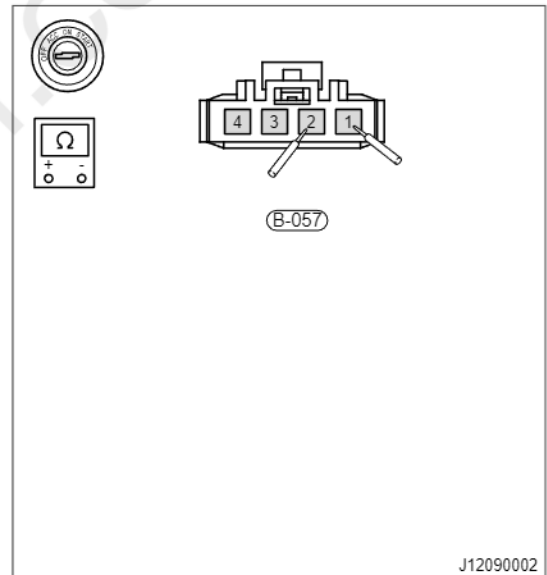
Check and repair short circuit malfunction of circuit.

OK

3

Check brake switch condition

- (a) Unplug the brake switch connector.
- (b) Using ohm band of multimeter, measure brake switch B-057 (1, 2) with red and black probes; There should be continuity without brake pedal depressed and no continuity with brake pedal depressed.
- (c) Using ohm band of multimeter, measure brake switch B-057 (3, 4) with red and black probes; There should be no continuity without brake pedal depressed and there should be continuity with brake pedal depressed.



NG

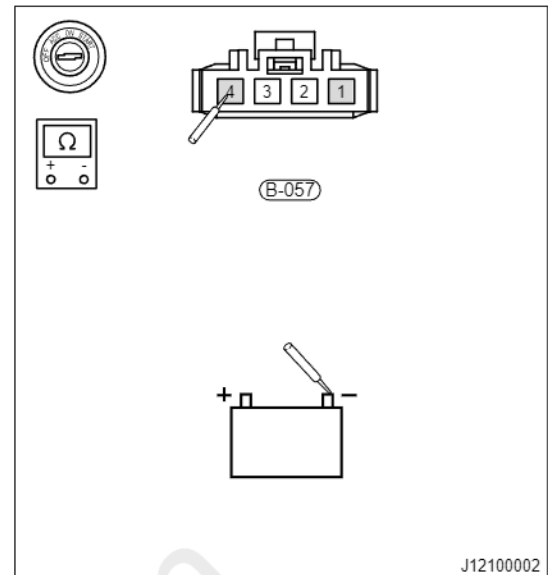
Replace brake switch assembly.

OK

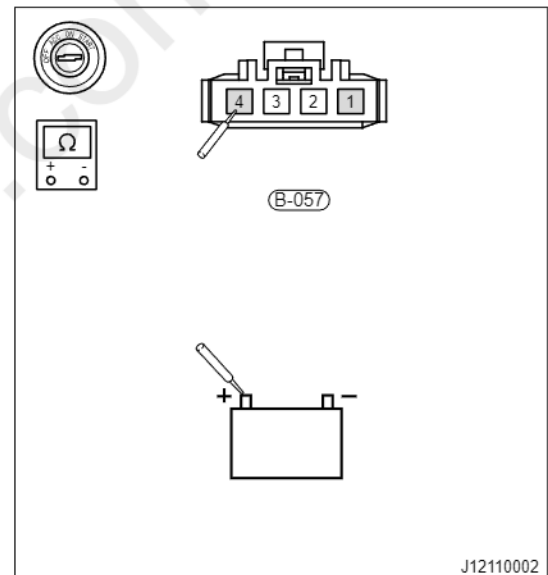
4

Check for short circuit to ground / power supply or short to each other in brake switch line

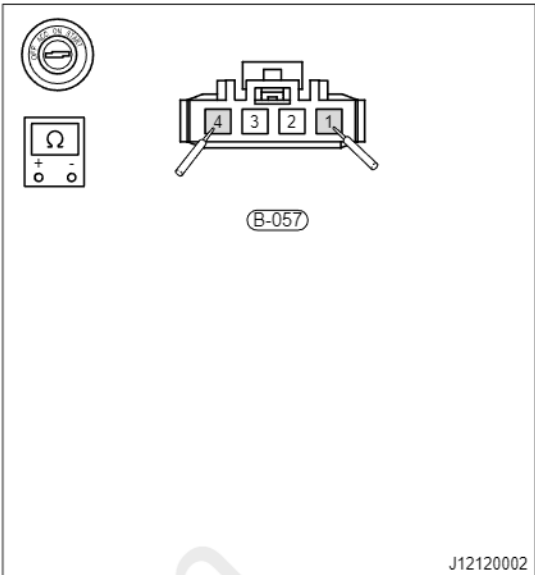
- (a) Disconnect the brake switch connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistances of brake switch B-057 (1, 4) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of brake switch B-057 (1, 4) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of brake switch B-057 (1, 4) with red and black probes respectively.
Check if circuits are shorted to each other.



NG Check and repair circuit.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK Conduct test and confirm malfunction has been repaired.

■ Main Relay Open / Short to Ground / Power Supply

DTC	P068500	Main Relay Open Circuit Error
DTC	P068700	Main Relay Short to Power Supply

DTC	P068600	Main Relay Short to Ground
DTC	P06869E	ECM/PCM Power Relay Control Circuit Low

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check main relay
----------	-------------------------

- (a) Replace the main relay in engine compartment fuse and relay box.

NG

Replace main relay.

OK

2	Check main relay coil terminal power supply fuse
----------	---

- (a) Check if fuse MF04 175A in engine compartment fuse and relay box is blown.

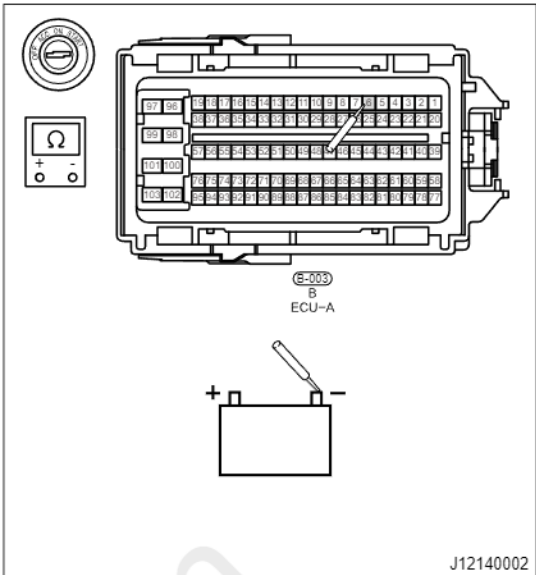
NG

Check and repair short circuit malfunction of circuit.

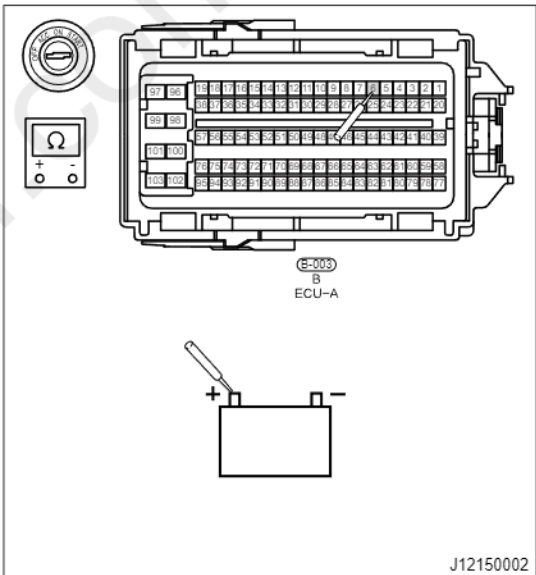
OK

3	Check for short circuit to ground / power supply in main relay control circuit
----------	---

- (a) Disconnect the engine compartment fuse and relay box connector (B-043).
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A6) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistance of ECM B-003 (A6) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair circuit.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5	Reconfirm DTCs
---	----------------

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Response Reception Time Out/Error of LIN Bus (Contact Between EMS and Intellectual Generator)

DTC	P143000	Battery Has Been Changed and Long Time No Tester Confirmation
DTC	P143100	EBS or Battery Error
DTC	P143200	EBS Temporary Error

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check battery model
---	---------------------

- (a) Check if battery model is in agreement with genuine battery.

Type: Sail AGM

Specification: 12 V 70 AH

NG

Use genuine battery to replace.

OK

2	Check battery sensor connector
---	--------------------------------

- (a) Disconnect the negative battery.
- (b) Check if battery sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

3

Check LIN line voltage

- (a) Disconnect the battery sensor connector.
- (b) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltage of battery sensor LIN line with red probe respectively.

Equivalent voltage: Approximately 10 V

NG

Check and repair LIN line.

OK

4

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Starter Relay / Drive Chain State Relay Fault

DTC	P26F100	Starter Relay R1 (Crank Relay) or Starter (Drive Chain) Relay R2 (Pt State Relay) Cannot Be Combined
DTC	P26F200	Starter (Drive Chain) Status Relay R2 (PT State Relay) Cannot Be Disconnected
DTC	P26F000	Starter Relay R1 (Crank relay) Cannot Be Disconnected
DTC	P14AD00	Engine Block or Starter is not Engaged
DTC	P14AF00	KL50r Wire Short Circuit to Ground
DTC	P14AE00	KL50r Wire Short Circuit to Battery
DTC	P14AC00	Starter Damaged or Wire Dropped

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.

- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check drive chain state relay
----------	--------------------------------------

- (a) Replace the drive chain state relay in engine compartment fuse and relay box.

NG

Replace drive chain state relay.

OK

2	Check drive chain state relay feedback terminal power supply fuse
----------	--

- (a) Check if fuse EF15 10A in engine compartment fuse and relay box is blown.

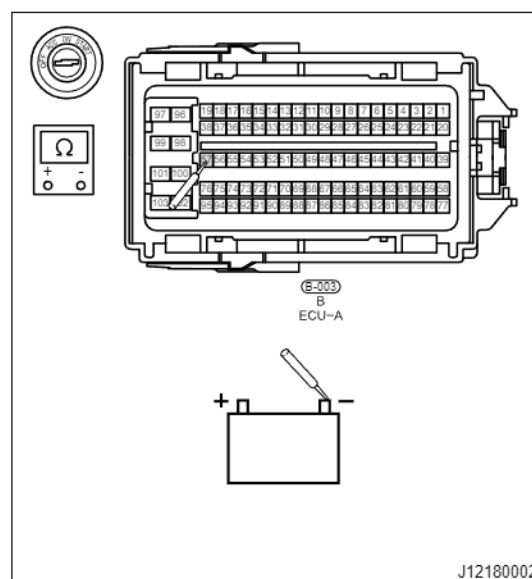
NG

Check and repair short circuit malfunction of circuit.

OK

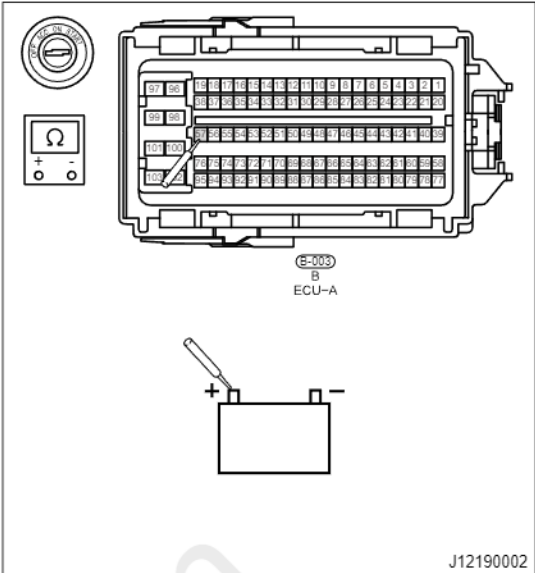
3	Check for short circuit to ground / power supply in drive chain state relay feedback circuit
----------	---

- (a) Disconnect the engine compartment fuse and relay box connector (B-043).
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A57) with red probe respectively. Check if circuit is short to ground.



J12180002

- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistance of ECM B-003 (A57) with red probe respectively. Check if circuit is short to power supply.



NG Check and repair circuit.

OK

4 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK Conduct test and confirm malfunction has been repaired.

■ A/C Pressure Sensor Circuit Voltage High/Low

DTC	P053300	A/C Refrigerant Pressure Sensor "A" Circuit High
DTC	P053200	A/C Refrigerant Pressure Sensor "A" Circuit Low

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check A/C pressure sensor connector

- Disconnect the negative battery.
- Check if A/C pressure sensor connector is loose, and contact between male and female terminals is in good condition.

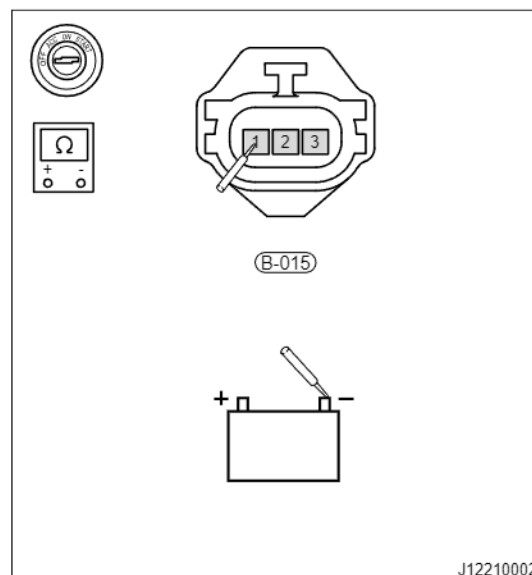
NG

Repair and adjust connector, or replace it.

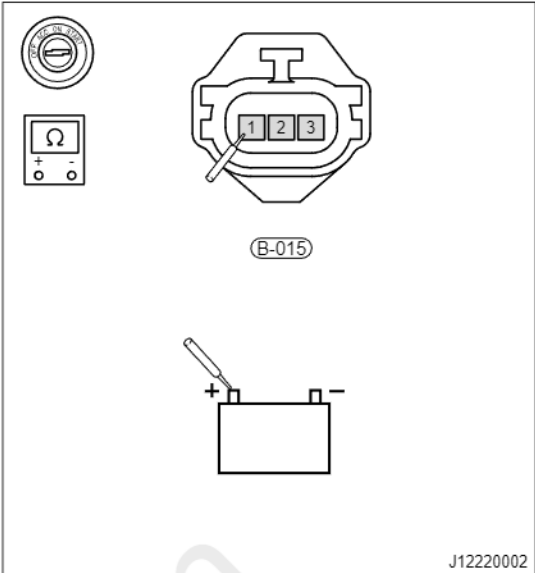
OK

2 Check for short circuit to ground / power supply or short to each other in A/C pressure sensor circuit

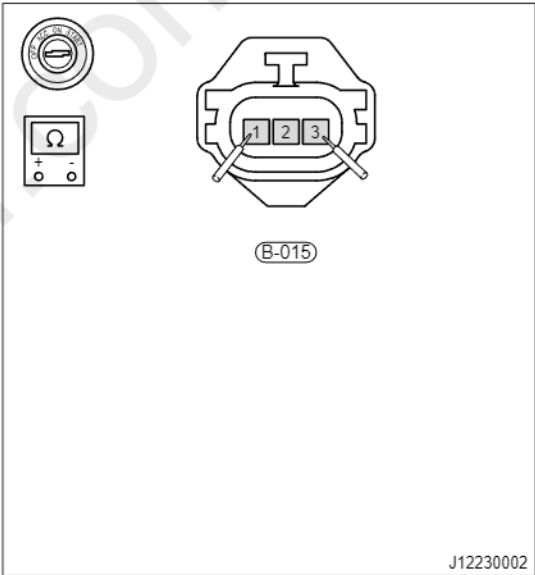
- Disconnect the A/C pressure sensor connector.
- Disconnect the ECM connector (B-003).
- Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of A/C pressure sensor B-015 (1, 2, 3) with red probe respectively. Check if circuit is short to ground.



(d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of A/C pressure sensor B-015 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



(e) Using ohm band of multimeter, measure resistances of A/C pressure sensor B-015 (1, 2, 3) with red and black probes respectively. Check if circuits are shorted to each other.



NG Check and repair circuit.

OK

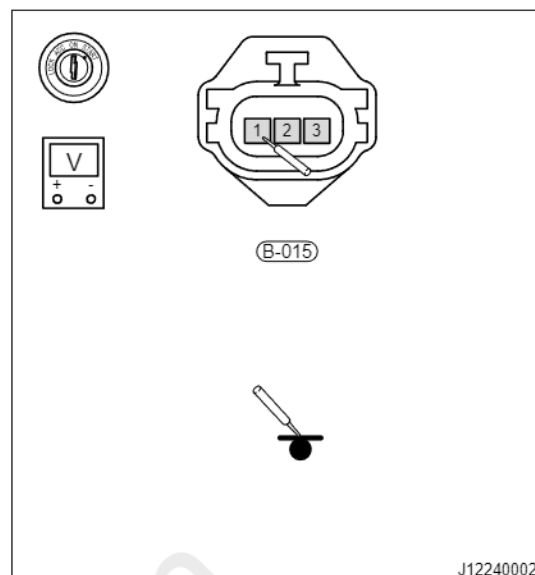
3	Check A/C pressure sensor power supply / ground / signal
---	--

- (a) Connect A/C pressure sensor and ECM connector (B-003)
- (b) Turn ENGINE START STOP switch to ON.
- (c) Using voltage band of multimeter, connect black probe to battery negative terminal, measure voltages of A/C pressure sensor B-015 (1, 2, 3) with red probe.

Power supply terminal: 5 V

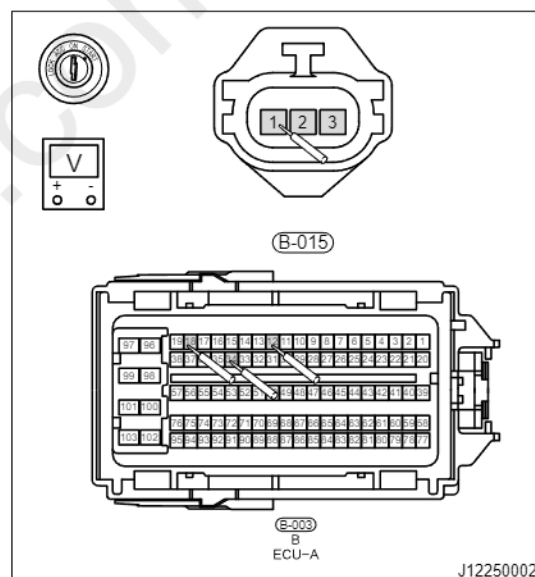
Ground terminal: < 0.2 V

Voltage of signal terminal should increase as the pressure rises



- (d) Using voltage band of multimeter (voltage drop method), connect black probe to ECM B-003 (A12, A34, A18), measure A/C pressure sensor B-015 (1, 2, 3) with red probe.

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ **Brake Vacuum Pump Control Circuit Open / Voltage Too Low / Too High**

DTC	P050F00	Brake Assist Vacuum Too Low
DTC	P258A00	Vacuum Pump Control Circuit Open
DTC	P258C00	Vacuum Pump Control Circuit "A" Low
DTC	P258D00	Vacuum Pump Control Circuit "A" High
DTC	P063449	Brake Vacuum Pump Drive Chip Overheat

■ **Description**

■ **DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check electric vacuum pump connector

- (a) Disconnect the negative battery.
- (b) Check if electric vacuum pump connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check electric vacuum pump relay

- (a) Replace the electric vacuum pump relay in engine compartment fuse and relay box.

NG

Replace electric vacuum pump relay.

OK

3

Check electric vacuum pump relay coil terminal power supply fuse

- (a) Check if engine compartment fuse and relay box fuse EF22 5A is blown.

NG

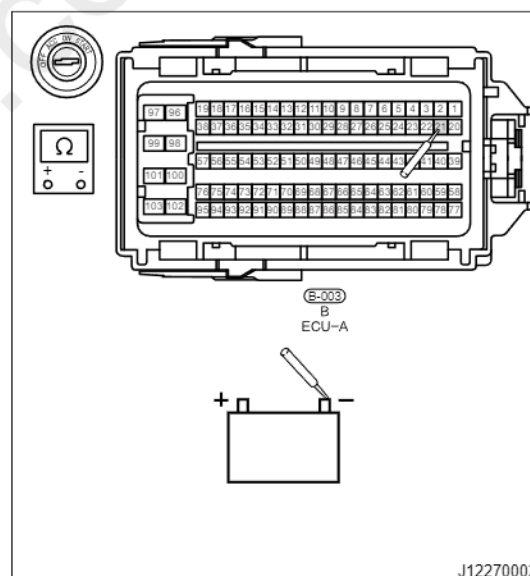
Check and repair short circuit malfunction of circuit.

OK

4

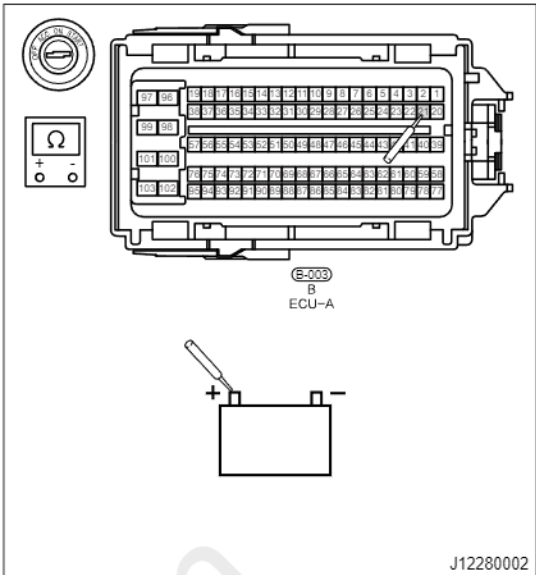
Check for short circuit to ground / power supply in electric vacuum pump relay control circuit

- (a) Unplug the electric vacuum pump relay.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A21) with red probe respectively. Check if circuit is short to ground.



J12270002

- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistance of ECM B-003 (A21) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair circuit.

OK

5

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Electronic Thermostat Control Circuit Open / Voltage Too Low / Too High

DTC	P059700	Thermostat Heater Control Circuit Open
DTC	P059800	Thermostat Heater Control Circuit Low
DTC	P059900	Thermostat Heater Control Circuit High

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check electronic thermostat connector

- (a) Disconnect the negative battery.
 (b) Check if electronic thermostat connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check electronic thermostat power supply fuse

- (a) Check if fuse EF21 15A in engine compartment fuse and relay box is blown.

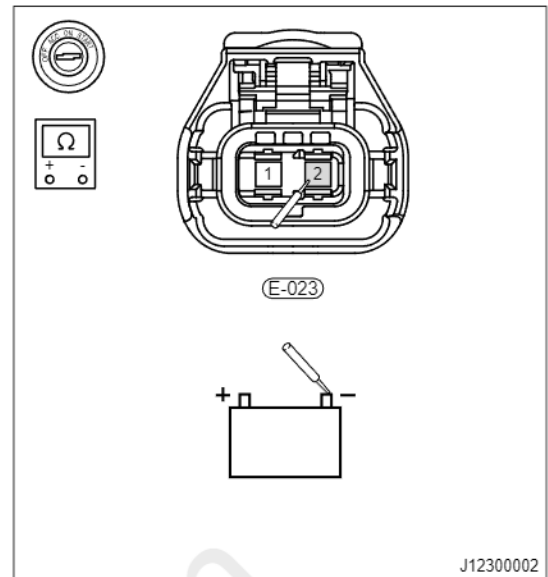
NG

Check and repair short circuit malfunction of circuit.

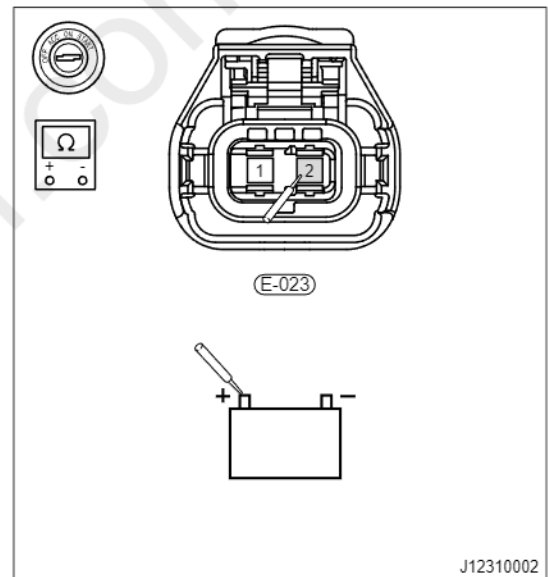
OK

3 Check for short circuit to ground / power supply in electronic thermostat control circuit

- (a) Disconnect the electronic thermostat connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of electronic thermostat E-023 (2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistance of electronic thermostat E-023 (2) with red probe respectively. Check if circuit is short to power supply.



NG

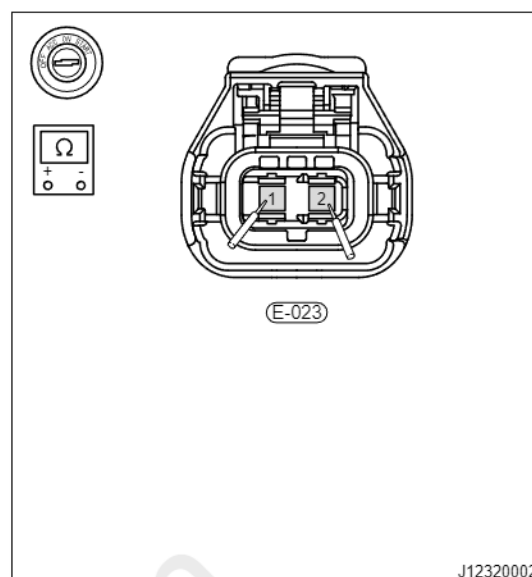
Check and repair circuit.

OK

4

Check if circuits of electronic thermostat themselves are shorted to each other or opened

- (a) Using ohm band of multimeter, measure resistances of electronic thermostat E-023 (1, 2) with red and black probes respectively; Check if they are shorted to each other or opened.



NG

Replace electronic thermostat assembly.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Ambient Temperature Sensor Circuit Voltage Too Low / Too High

DTC	P007200	Ambient Air Temperature Sensor Circuit "A" Low
DTC	P007300	Ambient Air Temperature Sensor Circuit "A" High

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Read A/C system DTCs and refer to A/C system diagnosis.

■ Low Pressure Fuel Pressure Sensor Malfunction

DTC	P254029	DECOS Oil Passage Pressure Sensor Circuit Bank 1-Positive Offset
DTC	P254028	DECOS Oil Passage Pressure Sensor Circuit Bank 1-Negative Offset
DTC	P137000	DECOS Oil Passage Pressure Sensor Relative Pressure Too Low
DTC	P137100	DECOS Oil Passage Pressure Sensor Relative Pressure Too High
DTC	P008A00	DECOS Low Pressure Oil Passage Pressure Too Low
DTC	P008B00	Low Pressure Fuel System Pressure - Too High
DTC	P016F00	DECOS Low Pressure Oil Passage PWM Control Deviation Too Large
DTC	P016E00	Closed Loop Fuel Pressure Control At Limit - Pressure Too High

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check low pressure fuel pressure sensor connector
----------	--

- (a) Disconnect the negative battery.
- (b) Check if low pressure fuel pressure sensor connector is loose, and contact between male and female terminals is in good condition.

NG**Repair and adjust connector, or replace it.****OK**

2	Check low pressure end fuel pressure
----------	---

- (a) Using the fuel pressure gauge to test if low pressure end fuel pressure is met the standard.

NG

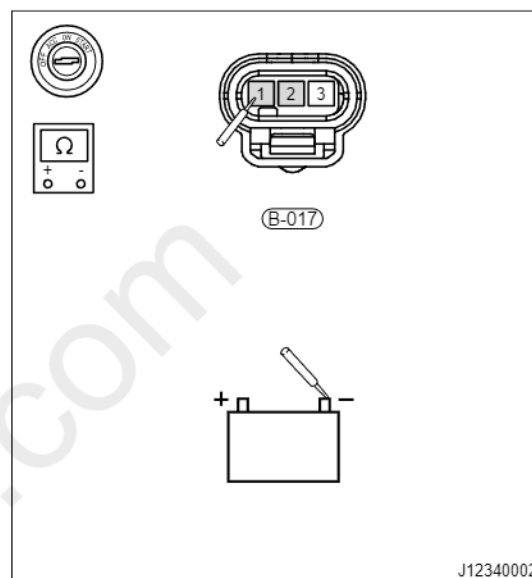
Replace electric fuel pump assembly.

OK

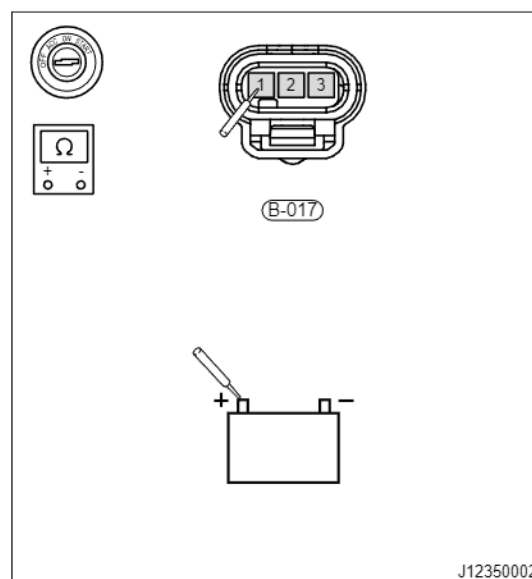
3

Check for short circuit to ground / power supply or short to each other in low pressure fuel pressure sensor

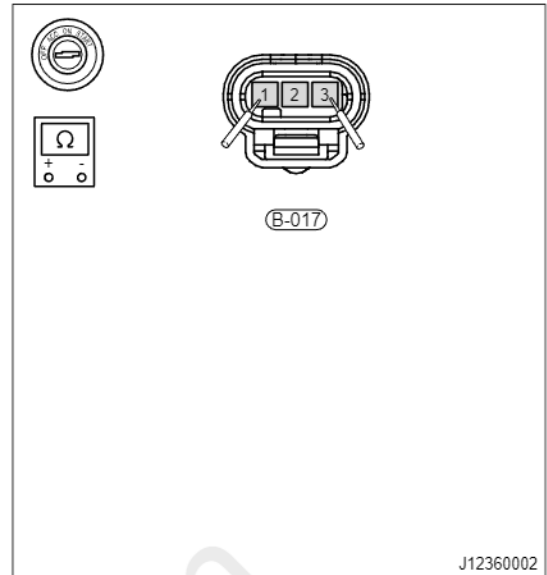
- (a) Disconnect the low pressure fuel pressure sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of low pressure fuel pressure sensor B-017 (1, 2) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of low pressure fuel pressure sensor B-017 (1, 2, 3) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of low pressure fuel pressure sensor B-017 (1, 2, 3) with red and black probes respectively. Check if circuits are shorted to each other.



NG

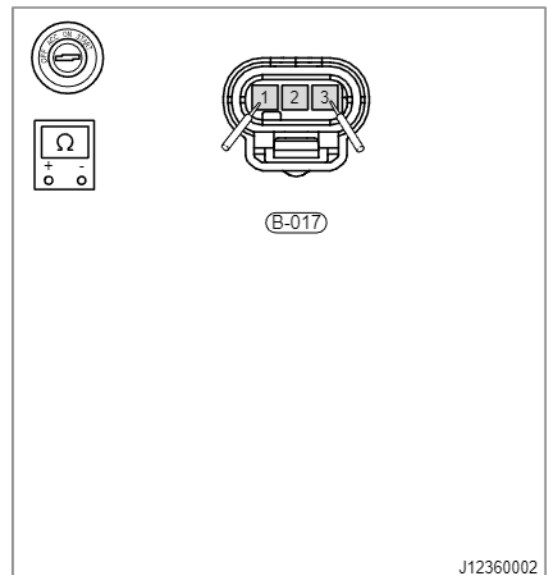
Check and repair circuit.

OK

4

Check if circuits of low pressure fuel pressure sensor themselves are shorted to each other or opened

- (a) Using ohm band of multimeter, measure resistances of low pressure fuel pressure sensor B-017 (1, 2, 3) with red and black probes respectively; Check if they are shorted to each other or opened.



NG

Replace low pressure fuel pressure sensor assembly.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK**Repair or replace new module.****NG****6 Reconfirm DTCs**

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK**Conduct test and confirm malfunction has been repaired.****■ Particulate Filter Upstream Temperature Sensor Error**

DTC	P208062	Particulate Filter Upstream Temperature Sensor Signal Measured Value Unreasonable
DTC	P20802A	Particulate Filter Upstream Temperature Sensor Signal Stuck
DTC	P054500	Particulate Filter Upstream Temperature Sensor Circuit Voltage Low
DTC	P054600	Particulate Filter Upstream Temperature Sensor Circuit Voltage High
DTC	P20E224	Particulate Filter Upstream Temperature Sensor Cold Start Correction Improper (Positive Deviation)
DTC	P20E223	Particulate Filter Upstream Temperature Sensor Cold Start Correction Improper (Negative Deviation)

■ Description**■ DTC Confirmation Procedure**

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check GPF temperature sensor connector

- (a) Disconnect the negative battery.
- (b) Check if GPF temperature sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

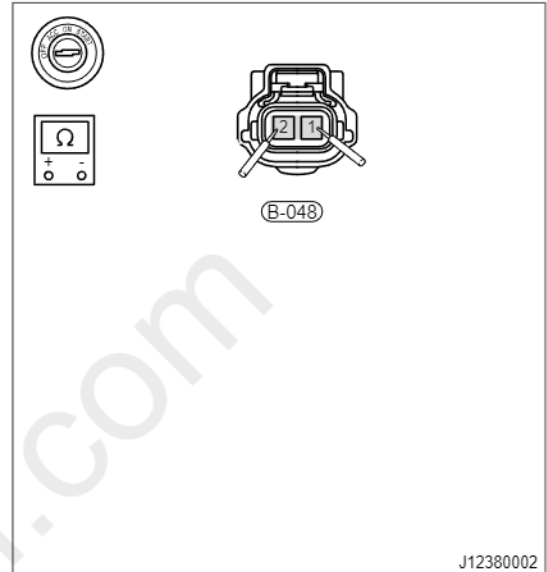
OK

2

Check GPF temperature sensor internal resistance

- (a) Disconnect the GPF temperature sensor connector
- (b) Using ohm band of multimeter, measure if resistances of GPF temperature sensor B-048 (1, 2) are normal with red and black probes respectively.

Normal resistance value at ambient temperature (10~30°C) should be: 200 ~ 230Ω.



NG

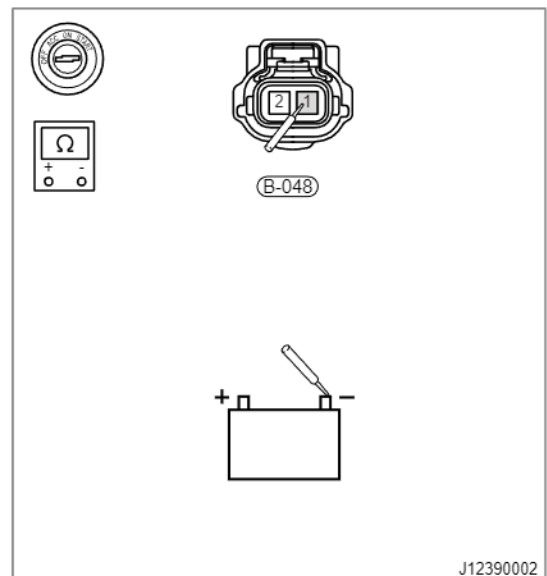
Replace GPF temperature sensor assembly.

OK

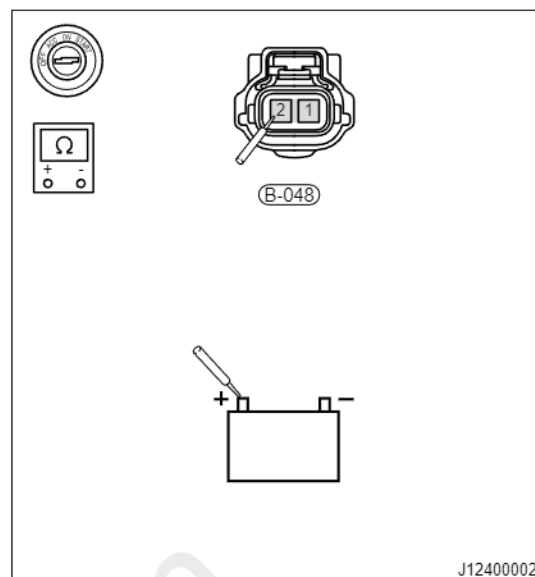
3

Check for short circuit to ground / power supply or short to each other in GPF temperature sensor circuit

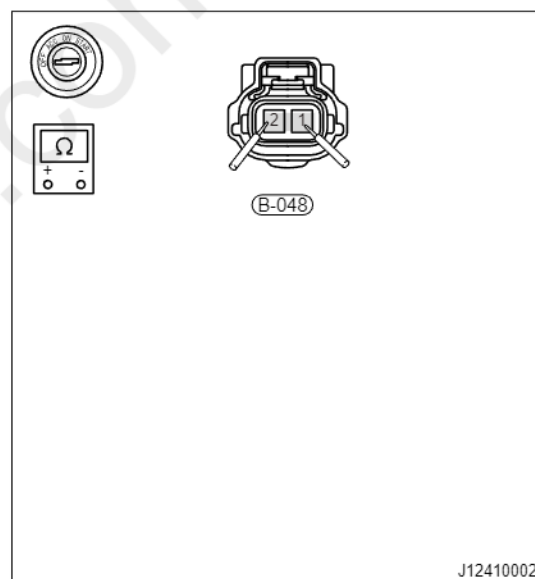
- (a) Disconnect the GPF temperature sensor connector.
- (b) Disconnect the ECM connector (B-048).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistance of GPF temperature sensor B-048 (1) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of GPF temperature sensor B-048 (1, 2) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of GPF temperature sensor B-048 (1, 2) with red and black probes respectively. Check if circuits are shorted to each other.



NG

Check and repair circuit.

OK

4

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

5 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Engine Coolant Temperature Sensor 2 Cold Start Calibration Unreasonable (Positive Deviation)/ (Negative Deviation)

DTC	P218324	Engine Coolant Temperature Sensor 2 Circuit Range/Performance
DTC	P218323	Engine Coolant Temperature Sensor 2 Circuit Range/Performance
DTC	P218400	Engine Coolant Temperature Sensor 2 Circuit Low
DTC	P218500	Engine Coolant Temperature Sensor 2 Circuit High

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check coolant temperature sensor 2 connector

- (a) Disconnect the negative battery.
- (b) Check if coolant temperature sensor 2 connector is loose, and contact between male and female terminals is in good condition.

NG

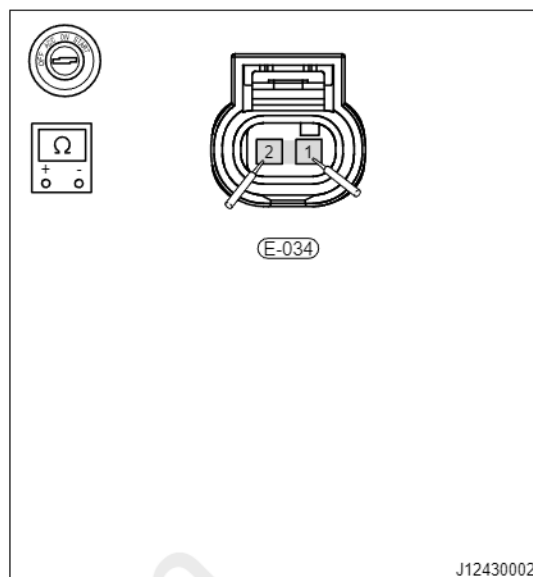
Repair and adjust connector, or replace it.

OK

2 Check coolant temperature sensor 2 internal resistance

- (a) Disconnect the coolant temperature sensor 2 connector
- (b) Using ohm band of multimeter, measure if resistances of coolant temperature sensor 2 E-034 (1, 2) are normal with red and black probes respectively.

Rated resistance at 20°C: $2.5\text{ K}\Omega \pm 5\%$



NG

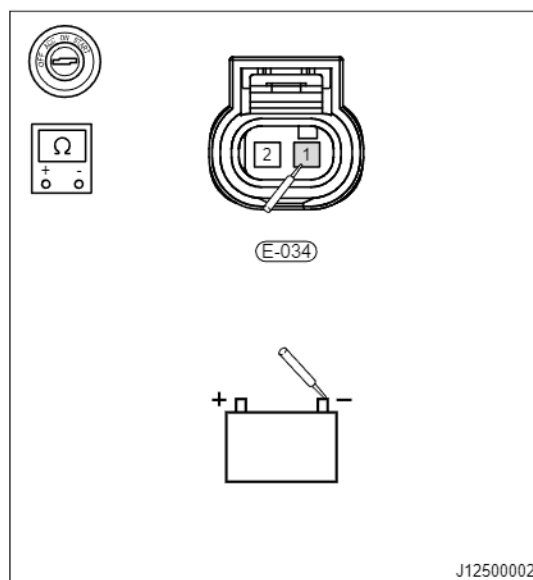
Replace coolant temperature sensor 2 assembly.

OK

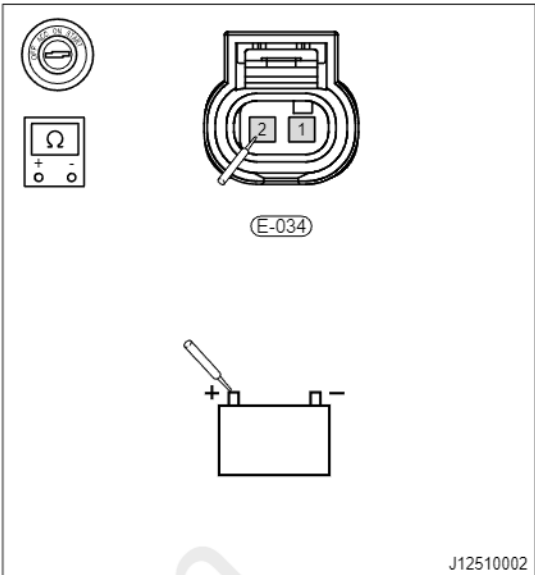
3

Check for short circuit to ground / power supply or short to each other in coolant temperature sensor 2 circuit

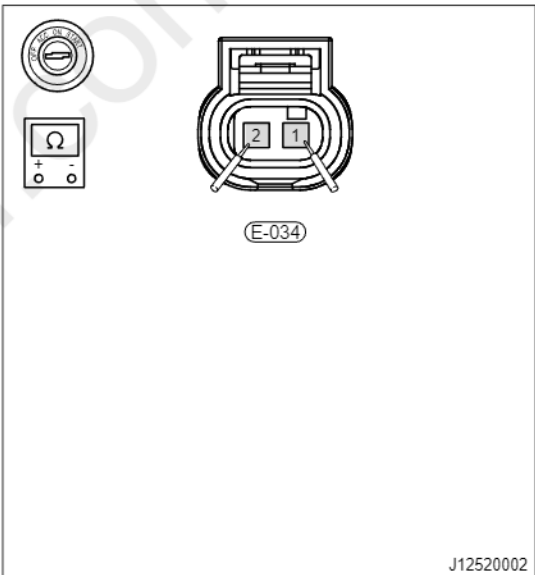
- (a) Disconnect the coolant temperature sensor 2 connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of coolant temperature sensor 2 E-034 (1) with red probe respectively. Check if circuit is short to ground.



(d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of coolant temperature sensor 2 E-034 (1, 2) with red probe respectively. Check if circuit is short to power supply.



(e) Using ohm band of multimeter, measure the resistances of coolant temperature sensor 2 E-034 (1, 2) with red and black probes respectively. Check if circuits are shorted to each other.



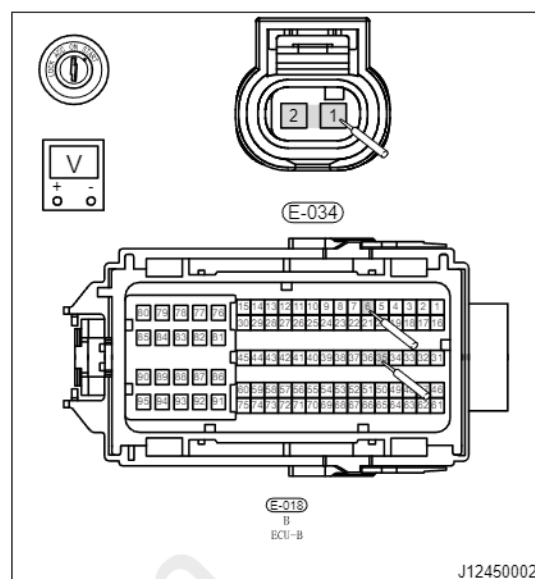
NG Check and repair circuit.

OK

4	Check whether there is contact resistance in coolant sensor 2 circuit
---	---

- (a) Connect the coolant temperature sensor 2 and ECM connector (E-018).
- (b) Using voltage band of multimeter (voltage drop method), connect black probe to ECM E-018 (B6, B35), measure voltages of coolant temperature sensor 2 E-034 (1, 2) with red probe

Test voltage drop value should be less than approximately 0.2 V



NG

Repair or replace wire harness.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
- (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
- (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
- (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Particulate Filter Differential Pressure Sensor Malfunction

DTC	P12A300	Particulate Filter Differential Pressure Sensor Line Connection Error
DTC	U060100	Particulate Filter Differential Pressure Sensor Sent Communication Failure

DTC	U060141	Particulate Filter Differential Pressure Sensor Data Inspection Non-plausible
DTC	P129300	Particulate Filter Differential Pressure Sensor Channel 1 Digital Signal Non-plausible (SENT Signal High or Low)
DTC	P245500	Particulate Filter Differential Pressure Sensor Circuit Voltage High
DTC	P245400	Particulate Filter Differential Pressure Sensor Circuit Voltage Low
DTC	P129100	Dynamic Response Performance of Particulate Filter Differential Pressure Sensor Non-plausible
DTC	P129000	Offset Check Value After Running Particulate Filter Differential Pressure Sensor Unreasonable
DTC	P12E000	Offset Check Value After Running Particulate Filter Differential Pressure Sensor Unreasonable
DTC	P12E100	Dynamic Response Performance of Particulate Filter Differential Pressure Sensor Non-plausible
DTC	P12E300	Particulate Filter Differential Pressure Sensor Channel 1 Digital Signal Non-plausible (SENT Signal High or Low)
DTC	P12A200	Particulate Filter Differential Pressure Sensor Line Connection Error
DTC	P246100	Particulate Filter Differential Pressure Sensor Circuit Voltage High
DTC	P246000	Particulate Filter Differential Pressure Sensor Circuit Voltage Low
DTC	U060200	Particulate Filter Differential Pressure Sensor Sent Communication Failure
DTC	U060241	Particulate Filter Differential Pressure Sensor Data Inspection Non-plausible

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check GPF pressure sensor connector
---	-------------------------------------

- (a) Disconnect the negative battery.
- (b) Check if GPF pressure sensor connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2 Check GPF pressure sensor connecting line

- (a) Check if GPF pressure sensor connecting line falls off or is connected incorrectly.

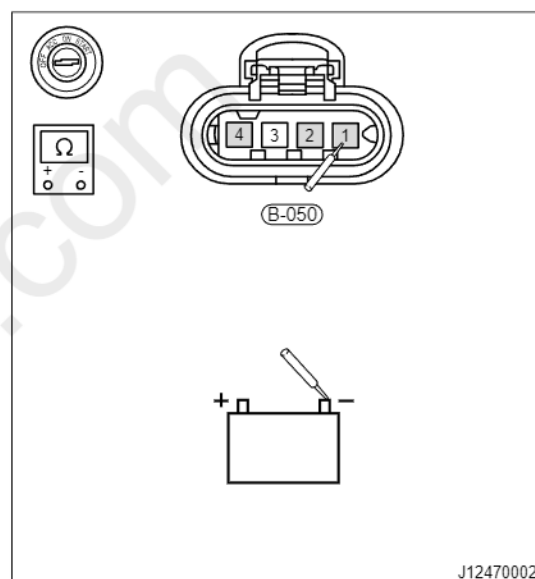
NG

Adjust the connecting line.

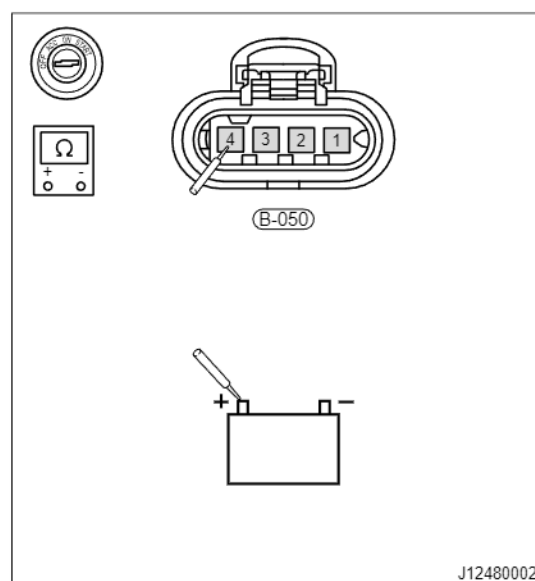
OK

3 Check for short circuit to ground / power supply or short to each other in GPF pressure sensor circuit

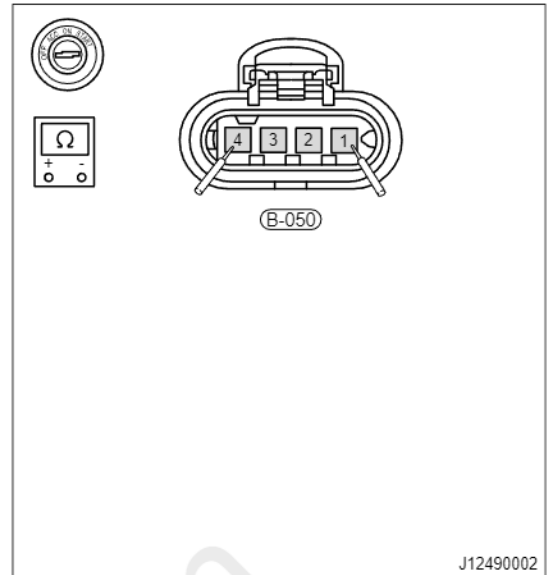
- (a) Disconnect the GPF pressure sensor connector.
- (b) Disconnect the ECM connector (E-018).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, measure resistances of GPF pressure sensor B-050 (1, 2, 4) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, measure resistances of GPF pressure sensor B-050 (1, 2, 3, 4) with red probe respectively. Check if circuit is short to power supply.



- (e) Using ohm band of multimeter, measure resistances of GPF pressure sensor B-050 (1, 2, 3, 4) with red and black probes respectively. Check if circuits are shorted to each other.



NG

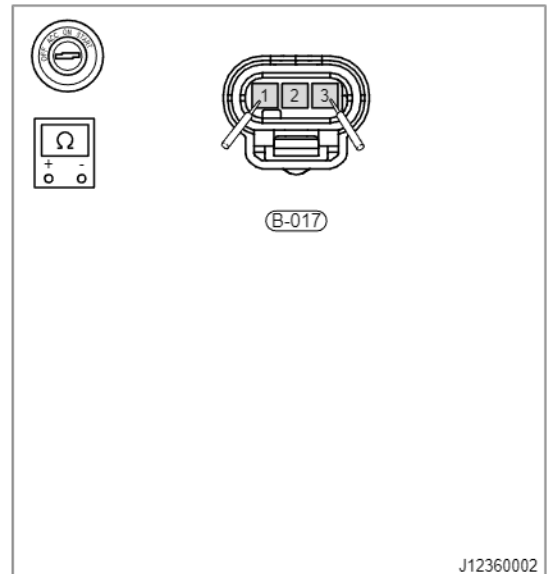
Check and repair circuit.

OK

4

Check if circuits of GPF pressure sensor themselves are shorted to each other

- (a) Using ohm band of multimeter, measure resistances of GPF pressure sensor B-050 (1, 2, 3, 4) with red and black probes respectively; Check if they are shorted to each other.



NG

Replace GPF pressure sensor assembly.

OK

5

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Particulate Filter is Removed

DTC	P226D00	Particulate Filter Removed
-----	---------	----------------------------

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1

Check GPF particulate filter

- (a) Check if GPF particulate filter is removed.
 (b) Check if GPF particulate filter is melted.

NG

Replace GPF particulate filter.

OK

2

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Fuel Pump Enable Control Circuit is Open/Voltage Too High/Too Low

DTC	P025D00	Fuel Pump Module "A" Control Circuit High
DTC	P025A00	Fuel Pump Module "A" Control Circuit Open
DTC	P025C00	Fuel Pump Module "A" Control Circuit Low

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1 Check fuel pump controller connector

- Disconnect the negative battery.
- Check if fuel pump controller connector is loose, and contact between male and female terminals is in good condition.

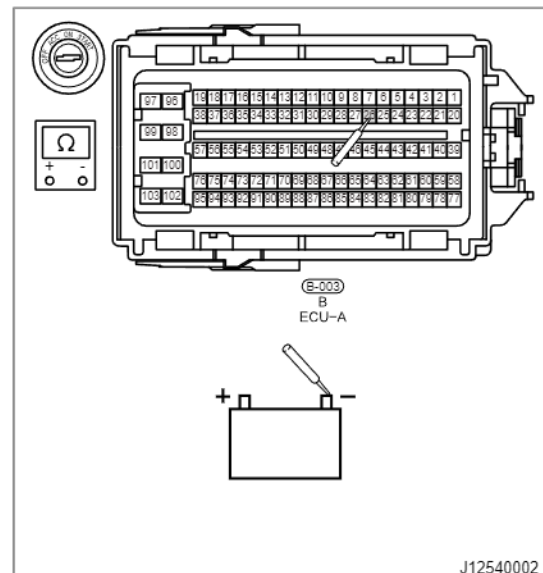
NG

Repair and adjust connector, or replace it.

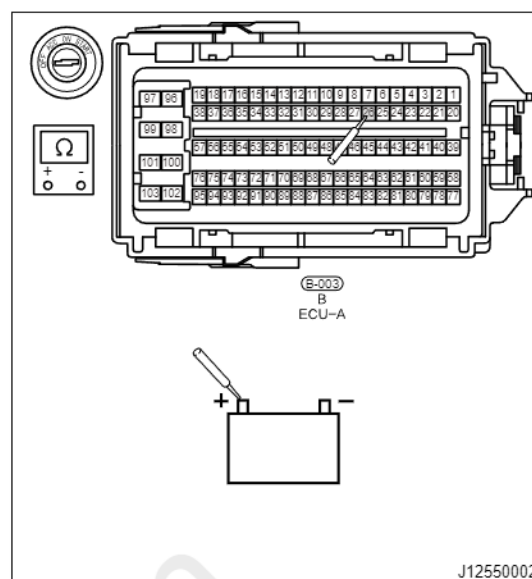
OK

2 Check whether the fuel pump enable signal circuit is short to ground/power supply

- Disconnect the fuel pump controller connector.
- Disconnect the ECM connector (B-003).
- Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of ECM B-003 (A26) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistance of ECM B-003 (A26) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair circuit.

OK

3

Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
 (b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

4

Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
 (b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
 (c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Crankcase Heating Line Circuit Open / Voltage Too High / Too Low

DTC	P053A00	Crankcase Heating Line Circuit Open
DTC	P053C00	Crankcase Heating Line Circuit Voltage Too High
DTC	P053B00	Crankcase Heating Line Circuit Voltage Too Low

■ Description

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

1	Check crankshaft heating valve connector
----------	---

- (a) Disconnect the negative battery.
- (b) Check if crankshaft heating valve connector is loose, and contact between male and female terminals is in good condition.

NG

Repair and adjust connector, or replace it.

OK

2	Check crankshaft heating valve power supply fuse
----------	---

- (a) Check if fuse EF21 15A in engine compartment fuse and relay box is blown.

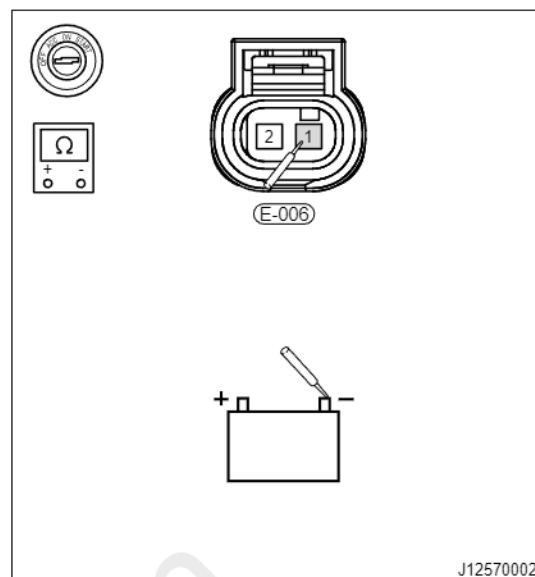
NG

Check and repair short circuit malfunction of circuit.

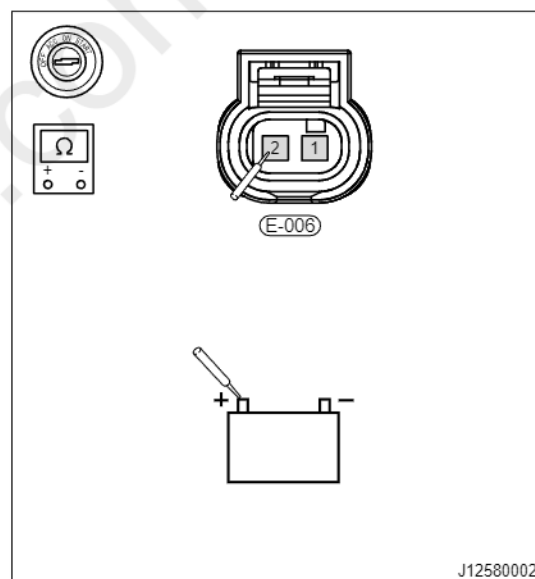
OK

3	Check for short circuit to ground / power supply in crankshaft heating valve control circuit
----------	---

- (a) Disconnect the crankshaft heating valve connector.
- (b) Disconnect the ECM connector (B-003).
- (c) Using ohm band of multimeter, connect black probe to battery negative terminal, and measure resistance of crankshaft heating valve E-006 (1) with red probe respectively. Check if circuit is short to ground.



- (d) Using ohm band of multimeter, connect black probe to battery positive terminal, and measure resistances of crankshaft heating valve E-006 (1, 2) with red probe respectively. Check if circuit is short to power supply.



NG

Check and repair circuit.

OK

4

Check if circuits of crankshaft heating valve themselves are shorted to each other or opened

- (a) Using ohm band of multimeter, measure resistances of crankshaft heating valve E-006 (1, 2) with red and black probes respectively; Check if they are shorted to each other or opened.



NG

Replace crankshaft heating valve assembly.

OK

5 Check Engine Control Module (ECM)

- (a) Remove Engine Control Module (ECM) from malfunctioning vehicle.
(b) Install a new engine control module to malfunctioning vehicle.

OK

Repair or replace new module.

NG

6 Reconfirm DTCs

- (a) Connect diagnostic tester and clear DTCs.
(b) Run the vehicle as specified procedure. The operating way should meet the conditions for corresponding fault diagnosis.
(c) Read the fault information and confirm that the fault has been solved.

OK

Conduct test and confirm malfunction has been repaired.

■ Ambient Temperature Sensor Circuit Voltage Too Low / Too High

DTC	P121B00	Front Left Wheel Speed Sensor Signal NG
DTC	P121C00	Front Right Wheel Speed Sensor Signal NG

DTC	P121D00	Rear Left Wheel Speed Sensor Signal NG
DTC	P121E00	Rear Right Wheel Speed Sensor Signal NG

■ DTC Confirmation Procedure

Confirm that battery voltage is not less than 12 V before performing following procedures.

- Turn ENGINE START STOP switch to OFF.
- Connect the diagnostic tester (the latest software).
- Start engine and warm it up, and then read DTC again. If DTC is detected, malfunction is current.
- If DTC is not detected, malfunction is intermittent.

Hint:

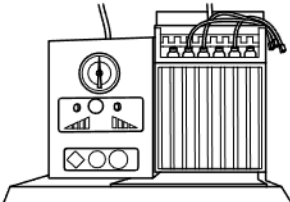
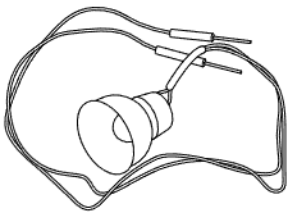
When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

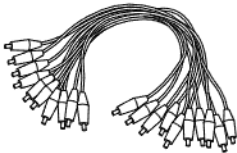
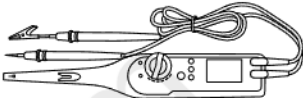
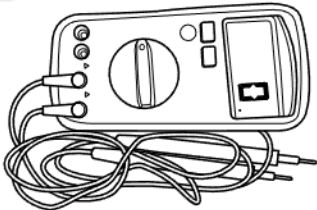
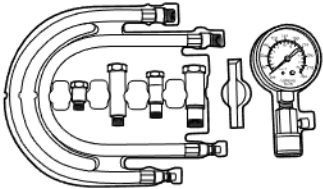
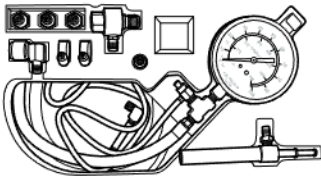
Read brake control system DTCs and refer to brake control system diagnosis.

5 On-Vehicle Service

5.1 Tools

■ General Tools

Tool Name	Tool Drawing
Fuel Injector Cleaning Analyzer	 S00043
21 W Test Light	 S00061
LED Test Light	 S00077

Tool Name	Tool Drawing
Jumper Wire	 S00062
Diode Test Light	 S00078
Digital Multimeter	 S00002
Cylinder Pressure Gauge	 S00033
Fuel Pressure Gauge	 S00035

■ Special Tool

Tool Name	Tool Drawing
Diagnostic Tester	 S00001

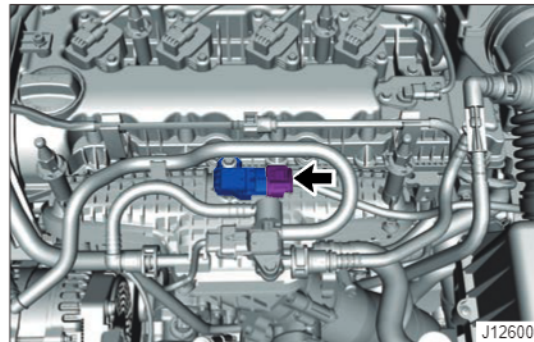
5.2 Intake Pressure/Temperature Sensor

■ Removal

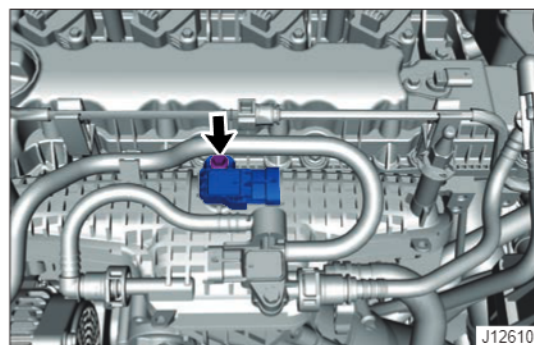
⚠ Warning

- Be sure to wear necessary safety equipment to prevent accidents, when removing intake pressure/temperature sensor.
- Appropriate force should be applied when removing intake pressure/temperature sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Disconnect the intake pressure/temperature sensor connector.



- (5) Remove the intake pressure/temperature sensor fixing bolt and take it out carefully.



■ Inspection

- (1) Temperature sensor part: (Remove the connector) Turn digital multimeter to ohm band, connect two probes to sensor pins 1# and 2# respectively, the rated resistance is $2.5 \text{ k}\Omega \pm 5\%$ at 20°C . Measurement can also be performed by simulating. Specific operations are to send wind to the sensor with blow drier

(be careful that blow drier shouldn't be too close to the sensor) and observe the changes of sensor resistance. The resistance should reduce at the moment.

- (2) Pressure sensor part: (Connect the connector) Turn digital multimeter to DC voltage band, ground the black probe, connect red probe to pins 3# and 4# respectively. Under idling status, there should be 5 V of reference voltage at pin 3#, and about 1 V of voltage at pin 4#; Under unloaded status, slowly open the throttle, the voltage of pin 4# has not changed too much; Quickly open the throttle, the voltage of pin 4# can reach about 4 V instantaneously (value changes with model), and then drops to about 1.7 V (value changes with model).

■ Installation

- (1) Install the intake pressure/temperature sensor fixing bolt.

Torque: 6 ± 1 N m

- (2) connector and intake pressure/temperature sensor connector.

5.3 Electronic Throttle

■ Removal

- (1) For details about removal methods, refer to the removal steps of electronic throttle assembly in intake system.

■ Inspection

- (1) Judgment methods for specific mechanical damage: Valve plate should be in NLP position with power off and can rotate smoothly when flipping it by hand. If stuck occurs, it indicates that internal components may be damaged.
- (2) Simple measurement of internal sensors: (remove the connector) Turn digital multimeter to ohm band.
 - 1) Connect two probes to pin IP1S and pin IPM respectively, flip valve plate by hand, and resistance should change continuously.
 - 2) Connect two probes to pin IP2S and pin IPM respectively, flip valve plate by hand, and resistance should change continuously.
 - 3) If there are conditions, you can fully close or fully open throttle body with constant current source [fully close throttle body with 3A current (UMA), fully open throttle body with 2A current (OMA)], connect 5 V constant voltage source to pins UIP and IPM simultaneously, measure the output voltage values of IP1S and IP2S at fully close and fully open positions.

■ Installation

- (1) For details about installation methods, refer to the installation steps of electronic throttle assembly in intake system.

5.4 Knock Sensor

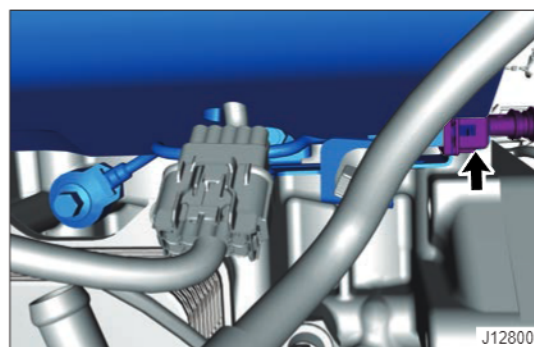
■ Removal

Warning

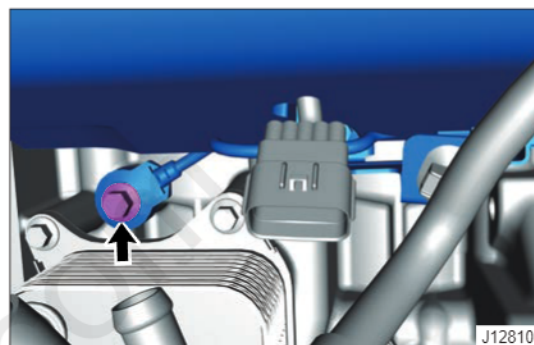
- **Be sure to wear necessary safety equipment to prevent accidents, when removing knock sensor.**
- **Appropriate force should be applied when removing knock sensor. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the intake hose assembly.

- (5) Disconnect the knock sensor connector.



- (6) Remove the knock sensor fixing bolt and take it out carefully.



■ Inspection

- (1) Simple measurement method: (Remove the connector) Turn digital multimeter to ohm band, connect two probes to the pins of sensor type knock sensor 1#, 2# or cable type knock sensor 1#, 2#, and their resistance value at normal temperature should be $(4.9 \pm 20\%)$ MW. Turn digital multimeter to mV band, use a small hammer to tap near knock sensor, there should be output a voltage signal.

■ Installation

⚠ Caution

- Be careful not to allow liquids such as oil, coolant, brake fluid and water to contact the sensor for a long periods of time.
- Do not use any type of gasket during installation. The sensor must be pressed against the cylinder block with its metal surface.
- When wiring the sensor signal cable, you should pay attention not to make the signal cable resonate, so as not to break.

- (1) Install the knock sensor fixing bolt.

Torque: 20 ± 5 N m

- (2) Connect the knock sensor connector.

5.5 Coolant Temperature Sensor

■ Removal

- (1) For details about removal methods, refer to removal steps of coolant temperature sensor assembly in cooling system.

■ Inspection

Step	Operation	Test Value	Test Result	Subsequent Step
1	Remove coolant temperature sensor wire harness connector, use a multimeter to measure if resistance between two terminals of sensor is normal.	Rated resistance is $2.5\text{ k}\Omega \pm 10\%$ at 20°C . Measurement can also be performed by simulating. Specifically, the working area of sensor is placed in 100°C of boiled water (note that the soaking time must be sufficient), and observe the changes of sensor resistance. At this time, the resistance should drop to $170\ \Omega \sim 200\ \Omega$.	Yes	Next
			No	Replace coolant temperature sensor
2	Connect coolant temperature sensor wire harness connector, turn ignition switch to ON, measure the voltage between two pins of coolant temperature sensor wire harness.	$5 \pm 0.5\text{ V}$	Yes	Diagnostic Help
				Check for continuity and ground of wire harness

■ Installation

- (1) For details about installation methods, refer to installation steps of coolant temperature sensor assembly in cooling system.

5.6 Speed Sensor

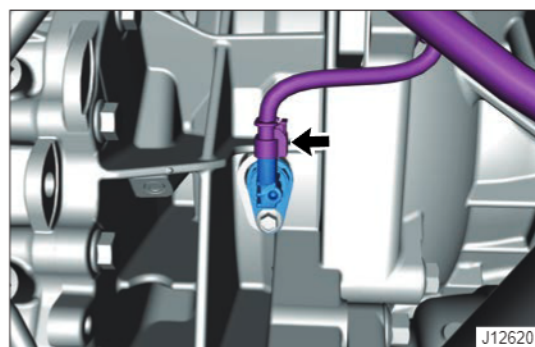
■ Removal

Warning

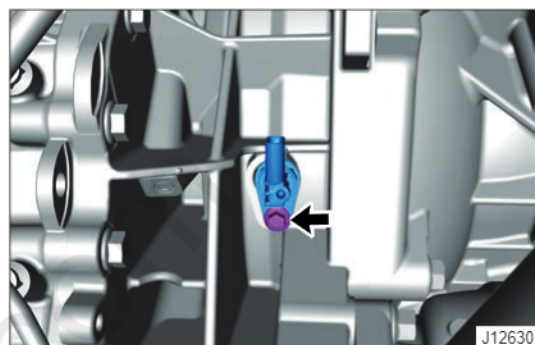
- **Be sure to wear necessary safety equipment to prevent accidents, when removing speed sensor.**
- **Appropriate force should be applied when removing speed sensor. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

- (4) Disconnect the speed sensor connector.



- (5) Remove the speed sensor fixing bolt and take it out carefully.



■ Inspection

- (1) Simple measurement method: (Remove the connector) Turn LCR meter to ohm band (in-line mode, test frequency is 10 kHz), connect two probes to sensor connector terminals 1 and 3, rated resistance is $33\ \Omega \pm 20\%$; Turn LCR meter to capacitance band (in-parallel mode, est frequency is 1 kHz), connect two probes to sensor connector terminals 1 and 3, rated capacitance is $100\ \text{nF} \pm 20\%$; Turn LCR meter to capacitance band (in-parallel mode, est frequency is 1 kHz), connect two probes to sensor connector terminals 2 and 3, rated capacitance is $4.7\ \text{nF} \pm 20\%$.

■ Installation

⚠ Caution

- Ensure that the sensor is clean and the sensor is allowed to be removed from the package before it is installed in the engine or test bench. Users with cardiac pacemakers should take precautions before operation.
- The sensor is only allowed to be pressed into installation hole by press-in. It is not allowed to install the sensor with a tapping tool (such as hammer).

- (1) Install the speed sensor fixing bolt.

Torque: $7 \pm 1\ \text{N m}$

- (2) Connect the speed sensor connector.

5.7 Camshaft Position Sensor

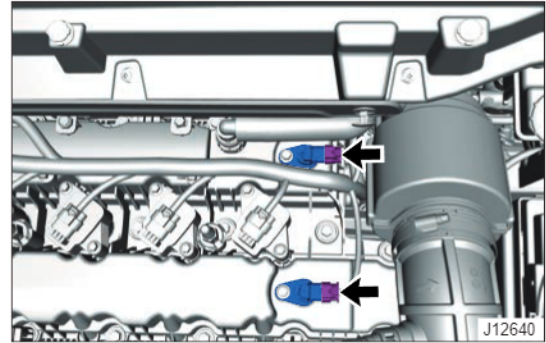
■ Removal

⚠ Warning

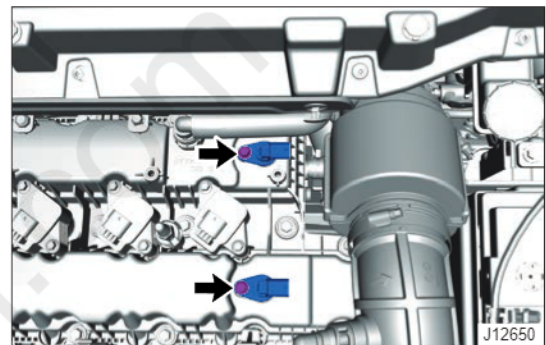
- Be sure to wear necessary safety equipment to prevent accidents, when removing camshaft position sensor.
- Appropriate force should be applied when removing camshaft position sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

- (4) Disconnect the intake/exhaust phaser sensor connector.



- (5) Remove the intake/exhaust phaser sensor and take it out carefully.



■ Installation

⚠ Caution

- The sensor is only allowed to be pressed into installation hole by press-in. It is not allowed to install the sensor with a tapping tool (such as hammer).

- (1) Install the intake/exhaust phaser sensor fixing bolts.

Torque: 8 ± 3 N m

- (2) Connect the phaser sensor connector.

5.8 Boost pressure/temperature sensor

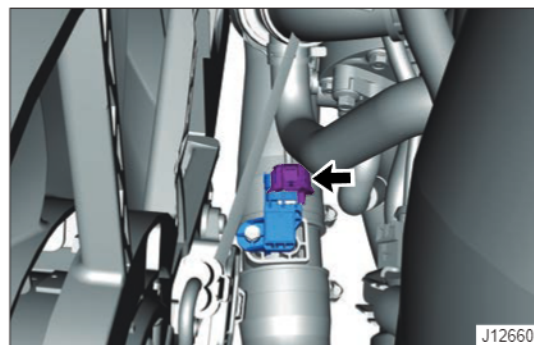
■ Removal

⚠ Warning

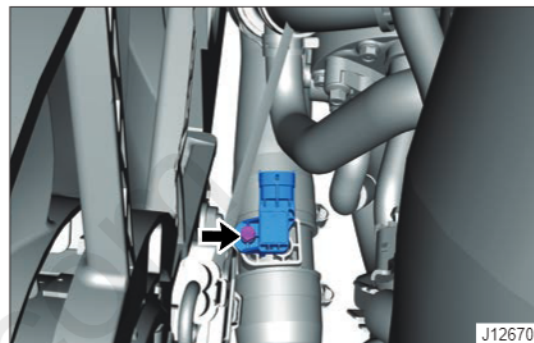
- Be sure to wear necessary safety equipment to prevent accidents, when removing boost pressure/temperature sensor.
- Appropriate force should be applied when removing boost pressure/temperature sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

- (4) Disconnect the boost pressure/temperature sensor connector.



- (5) Remove the boost pressure/temperature sensor fixing bolt and take it out carefully.



■ Installation

- (1) Install the boost pressure/temperature sensor fixing bolt.
Torque: 9 ± 1.5 N m
- (2) Connect the boost pressure/temperature sensor connector.

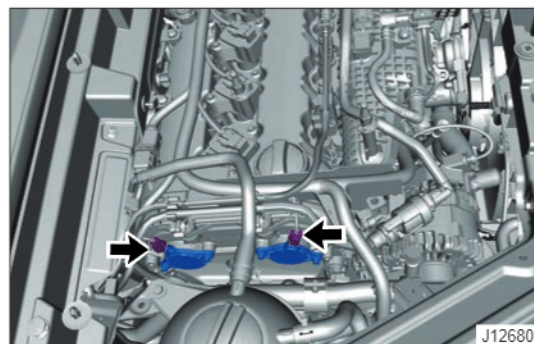
5.9 VVT Control Valve

■ Removal

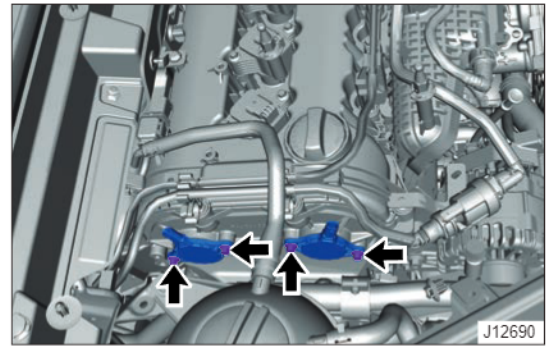
Warning

- Be sure to wear safety equipment to prevent accidents, when removing VVT control valve.
- Appropriate force should be applied, when removing VVT control valve. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Disconnect the intake/exhaust VVT control valve connector.



- (5) Remove the intake/exhaust VVT control valve fixing bolt respectively and take them out carefully.



■ Inspection

Step	Operation	Test Value	Test Result	Subsequent Step
1	Remove VVT control valve wire harness connector, use a multimeter to measure if resistance between two terminals of sensor is normal.	Resistance at ambient temperature: 6 Ω	Yes	Next
			No	Replace VVT control valve
2	Remove VVT control valve, and check for foreign matter stuck or internal leakage.		Yes	Replace VVT control valve
			No	Diagnostic Help

■ Installation

⚠ Caution

- Control valve is only allowed to be pressed into installation hole by press-in. It is not allowed to install the sensor with a tapping tool (such as hammer).

- Install the intake/exhaust VVT control valve fixing bolt.
- Connect the intake/exhaust VVT control valve connector.

5.10 Fuel Rail Injector

■ Removal

- For details about removal methods, refer to removal steps of fuel rail injector assembly in fuel system.

■ Inspection

- Simple measurement method: (Remove the connector) Turn digital multimeter to ohm band, connect two probes to two terminals of fuel injector respectively, the rated resistance is 1.83 Ω at 20°C.

■ Installation

- For details about installation methods, refer to installation steps of fuel rail injector assembly in fuel system.

5.11 High Pressure Fuel Rail Pressure Sensor

■ Removal

- For details about removal methods, refer to removal steps of high pressure fuel rail pressure sensor assembly in fuel system.

■ Inspection

- (1) Simple measurement method: Remove the sensor, connect 5 V power supply at normal temperature and atmospheric pressure, pressure signal output is 0.500 ± 0.048 V at this time.

■ Installation

- (1) For details about installation methods, refer to installation steps of high pressure fuel rail pressure sensor in fuel system.

5.12 Canister Control Valve

■ Removal

- (1) For details about removal methods, refer to removal steps of canister control valve assembly in fuel system.

■ Inspection

- (1) Simple measurement method: (Remove the connector) Turn digital multimeter to ohm band, connect two probes to two terminals of canister control valve respectively, resistance is $14 \sim 18 \Omega$ at 20°C . Replace it if the resistance does not meet the specification.

■ Installation

- (1) For details about installation methods, refer to installation steps of canister control valve assembly in fuel system.

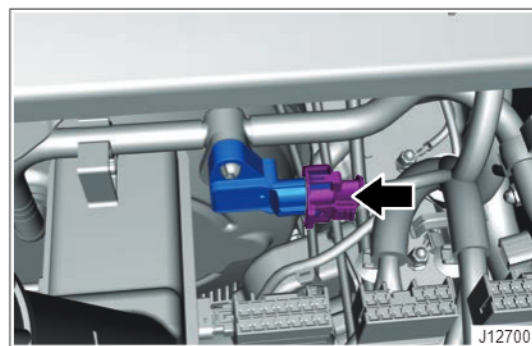
5.13 Brake Vacuum Pressure Sensor

■ Removal

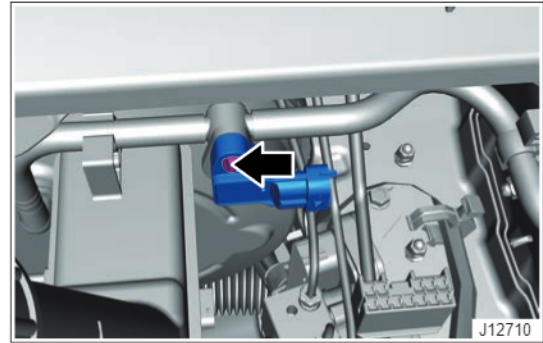
⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing brake vacuum pressure sensor.**
- **Appropriate force should be applied when removing brake vacuum pressure sensor. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine compartment fuse and relay box main body.
- (5) Disconnect the brake vacuum pressure sensor connector.



- (6) Press brake vacuum pressure sensor fixed clamping area and take out sensor carefully.



■ Inspection

- (1) Simple measurement method: (Remove the connector) Turn digital multimeter to ohm band, you can perform the following simple measurements respectively:
 - 1) Connect two probes to sensor pins 1# and 2# respectively, the resistance is $1\text{ k}\Omega \sim 2\text{ k}\Omega$ at normal temperature. There may be short or open circuit in power supply circuit if the resistance is abnormal;
 - 2) Connect two probes to sensor pins 1# and 3# respectively, the resistance is $1\text{ k}\Omega \sim 2\text{ k}\Omega$ at normal temperature. There may be short or open circuit in output circuit if the resistance is abnormal.

■ Installation

⚠ Caution

- Always make sure the O-ring is not damaged during installation. Apply a light coat of oil (such as 5W20) to O-ring surface before installation, and do not use silicon grease.
- Press sensor detecting sleeve into installation hole manually during installation, and do not install sensor with striking tool.

- (1) Insert the brake vacuum pressure sensor into installation hole carefully, and make sure that fixing clip has been fully clamped.
- (2) Connect the brake vacuum pressure sensor connector.

5.14 Engine Control Unit (ECU)

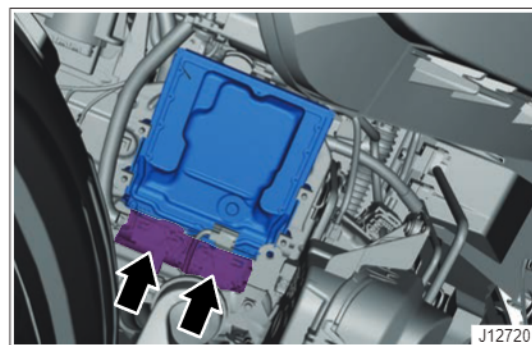
■ Removal

⚠ Warning

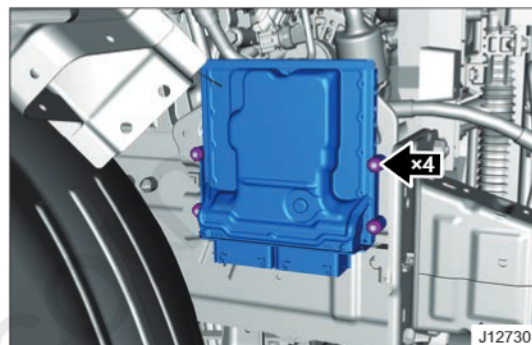
- Be sure to wear safety equipment to prevent accidents, when removing engine control unit.
- Appropriate force should be applied, when removing engine control unit. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the front right wheel.
- (5) Remove the front right wheel house protector.

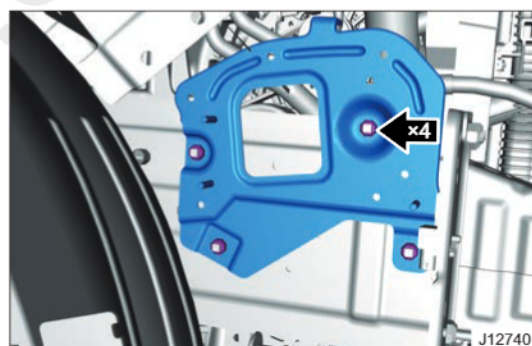
- (6) Disconnect the engine control module connector.



- (7) Remove 4 fixing bolts from engine control module, and take out engine control module assembly carefully.



- (8) Remove 4 fixing bolts from engine control unit mounting bracket, and take out mounting bracket assembly.



■ Inspection

- (1) Simple measurement method: 1. (Connect the connector) Use engine data CAN line to read engine trouble records; 2. (Remove the connector) Check if ECM connecting wire is in good condition, focusing on if ECM power supply and ground line are normal; 3. Check if the external sensor is operating properly, output signal is reliable and its circuit is in good condition; 4. Check if the actuator is operating properly and its circuit is in good condition; 5. Finally replace ECM and perform test.

■ Installation

⚠ Caution

- Pay attention to static electricity protection during installation; Pay attention to the protection of the connector pin.

- (1) Install 4 fixing bolts to engine control unit mounting bracket.

Torque: 8 ± 2 N m

- (2) Install 4 fixing bolts to engine control unit.

Torque: 8 ± 2 N m

- (3) Connect the engine control unit connector.

5.15 Matching Learning

■ Matching Learning

Hint

- Before performing matching and learning of vehicle module, be sure to carefully read the related precautions and perform the operation strictly according to standard working procedures.

For details of matching and learning of engine management system (EMS) module performed under different situations, see table below:

Items	Applicable Situations	Actions Required by Diagnostic Tester	Note
Module replacement	• Module is damaged; • Module failure.	Write VIN Code	If it is a bare spare part (- module has no basic program and software), after writing the VIN code, the software must first enter the "Integrated Service" to refresh the control software, and write the control software into the module.
		Write configuration code	
		Read transmission storage data	
		CVO self-learning	
		VVT self-learning	
		Throttle Self-learning	
		Replace EMS (Engine Management System) - GPF (Gasoline Particulate Filter) Related	
		ESK Writing (PIN Is Required To Input)	
Software upgrading	• Low software version; • Software error.	Controller software refreshing	Refresh data can be requested from EXEED after-sales service department. The upgrade method is the same as 1.6T.
Calibration	/	/	/
Write VIN Code	Replace module	Write VIN Code	If configuration code cannot be read in the original module, try to get it from same configuration model or EXEED after-sales service department.
Learn	• Replace module; • Vehicle battery powered off.	Throttle Self-learning	/
	• Removal, installation or replacement of phaser sensor or speed sensor; • Removal/installation of camshaft/phaser sensor signal plate/phaser;	VVT self-learning	/

Items	Applicable Situations	Actions Required by Diagnostic Tester	Note
	- Removal/installation of crankshaft/flywheel; - Replace the timing chain; - Readjust the timing; - Replace ECM.		
	Replace GPF	Replace EMS (Engine Management System) - GPF (Gasoline Particulate Filter) Related	/
		Replace GPF(gasoline particulate filter) learning	
	Replace GPF pressure sensor	Replace GPF (gasoline particulate filter) pressure sensor learning	/
		Replace EMS (Engine Management System) - GPF (Gasoline Particulate Filter) Related	

■ Self-diagnostic

- (1) Mainly include: read DTC, clear DTC; freeze frame, DTC extended information, DTC failure type (DTC low byte).

■ System Parameter Display - Data Flow Collection Based On CAN UDS Protocol

- (1) Mainly include: Coolant temperature, intake temperature, intake pressure, boost, throttle opening, engine speed, ignition angle, air-fuel ratio short term correct, air-fuel ratio long term addition and multiplication correct, intake pressure, intake flow, oxygen sensor signal, system voltage, torque demand value, etc.

■ System Condition

- (1) Mainly include: It displays 10 conditions such as program condition, cooling system, stable condition, dynamic condition, emission control, oxygen sensor, idle speed, malfunction indicator, emergency condition, A/C, etc.

■ Actuator Test

- (1) Mainly include: Canister control valve control, fuel pump relay control, cooling fan control, electronic throttle control, PWM fan control, DVE self-learning, DVE first self-learning, conventional idle control, high speed idle control, CVO self-learning test.

■ System Initialization Reset (Adaptive Reset)

- (1) After the engine stalling, initialization command is sent and system resets the previous self-adaption. The functions involved are: VVT learning, anti-theft learning after-sales, EBS battery data reading and writing, and command to replace GPF.

■ Odometer

- (1) Mainly include: Display of vehicle driving distance and driving time.

■ Edition Information

- (1) Mainly include: Display of vehicle identification number (VIN), ECM hardware number, ECM software number.

■ Write VIN Code

- (1) After replacing ECM, rewrite the VIN.

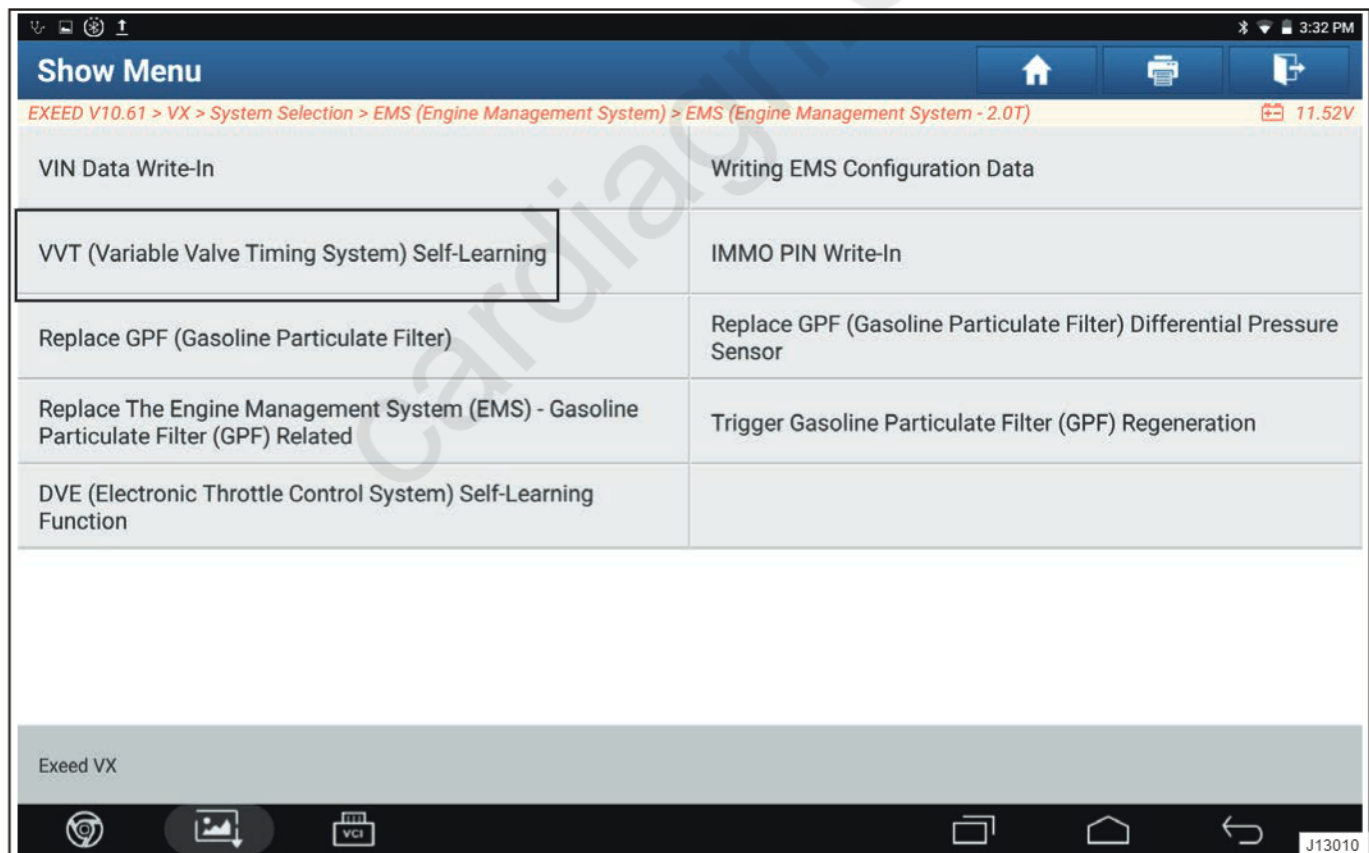
■ Refresh (Optional)

5.16 Write Self-learning and GPF Information

■ VVT Self-learning Guide

Working conditions and operating methods that need to be forced to trigger self-learning During offline or after-sales maintenance, any operation that may change the phase relationship between camshaft position sensor and crankshaft position sensor must perform the first VVT self-learning.

- (1) The first self-learning of VVT includes the following situations:
 - 1) Removal, installation or replacement of PG or DG sensor
 - 2) Removal/installation of camshaft/PG signal plate/phaser
 - 3) Removal/installation of DG signal plate
 - 4) Removal/installation of crankshaft/flywheel
 - 5) Replace the timing chain
 - 6) Readjust the timing
 - 7) Replace ECM
- (2) Operation step:
 - 1) When the ECM is powered on, the AE09 command is sent by UDS service of diagnostic tester without starting the engine, and the command lasts for more than 1 second;
 - 2) Power off, waiting for 720 seconds;
 - 3) Power on and start again, idling for 15 seconds;
 - 4) Power off, waiting for 720 seconds.

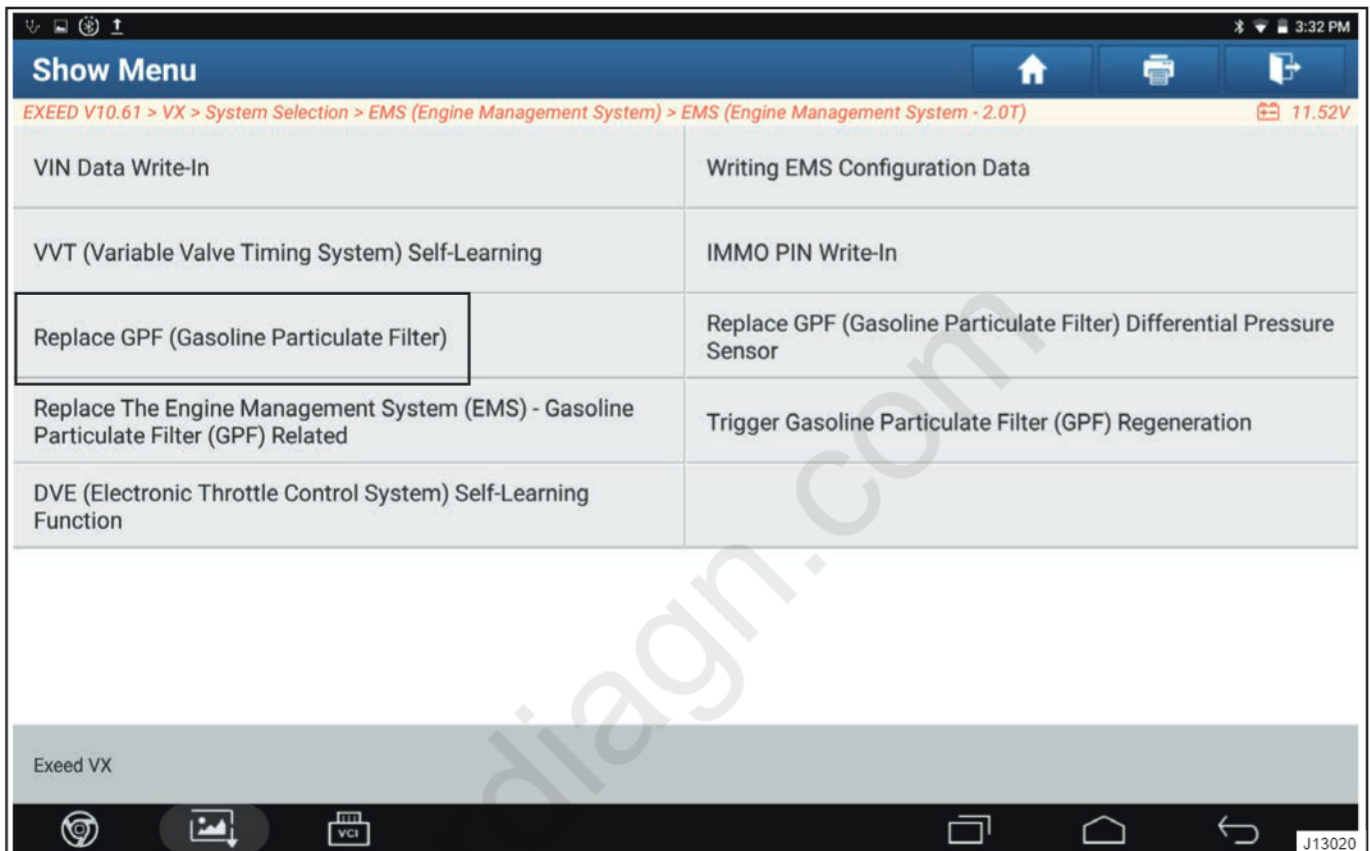


■ Write GPF Information

In the following cases, GPF information needs to be written

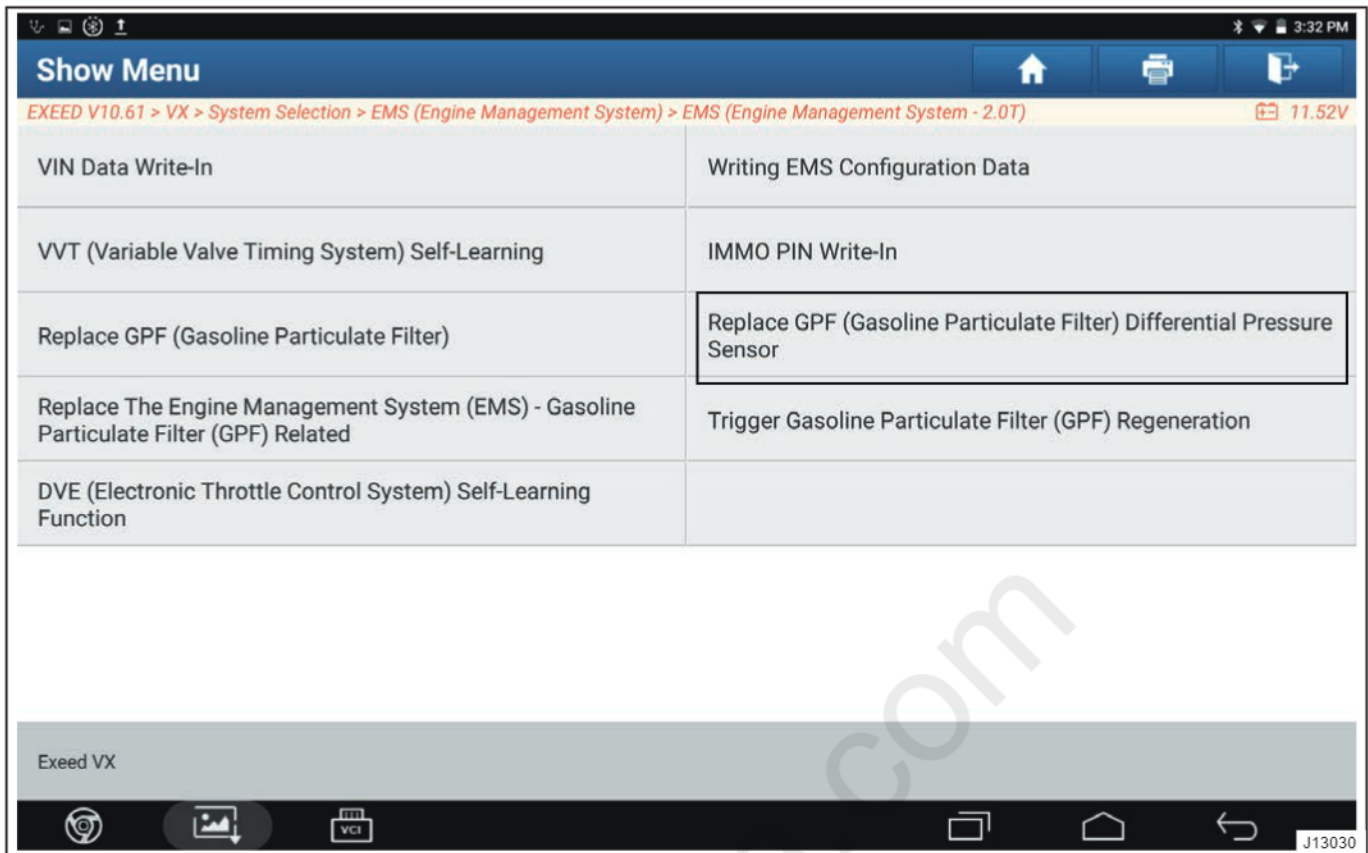
- (1) Replace GPF
 - 1) Stop the vehicle in a safe place;

- 2) The engine stops, after the GPF temperature has cooled to room temperature, replace GPF with a new one;
- 3) When the engine is powered on and not started, the command will be sent by UDS service of diagnostic tester;
- 4) Power off, wait for 720 seconds, power on again to read the current model carbon value ≤ 0.6 , the corresponding fuel cumulative value is 0, that is, write to EEPROM is successful;
- 5) Replacement of GPF is complete.



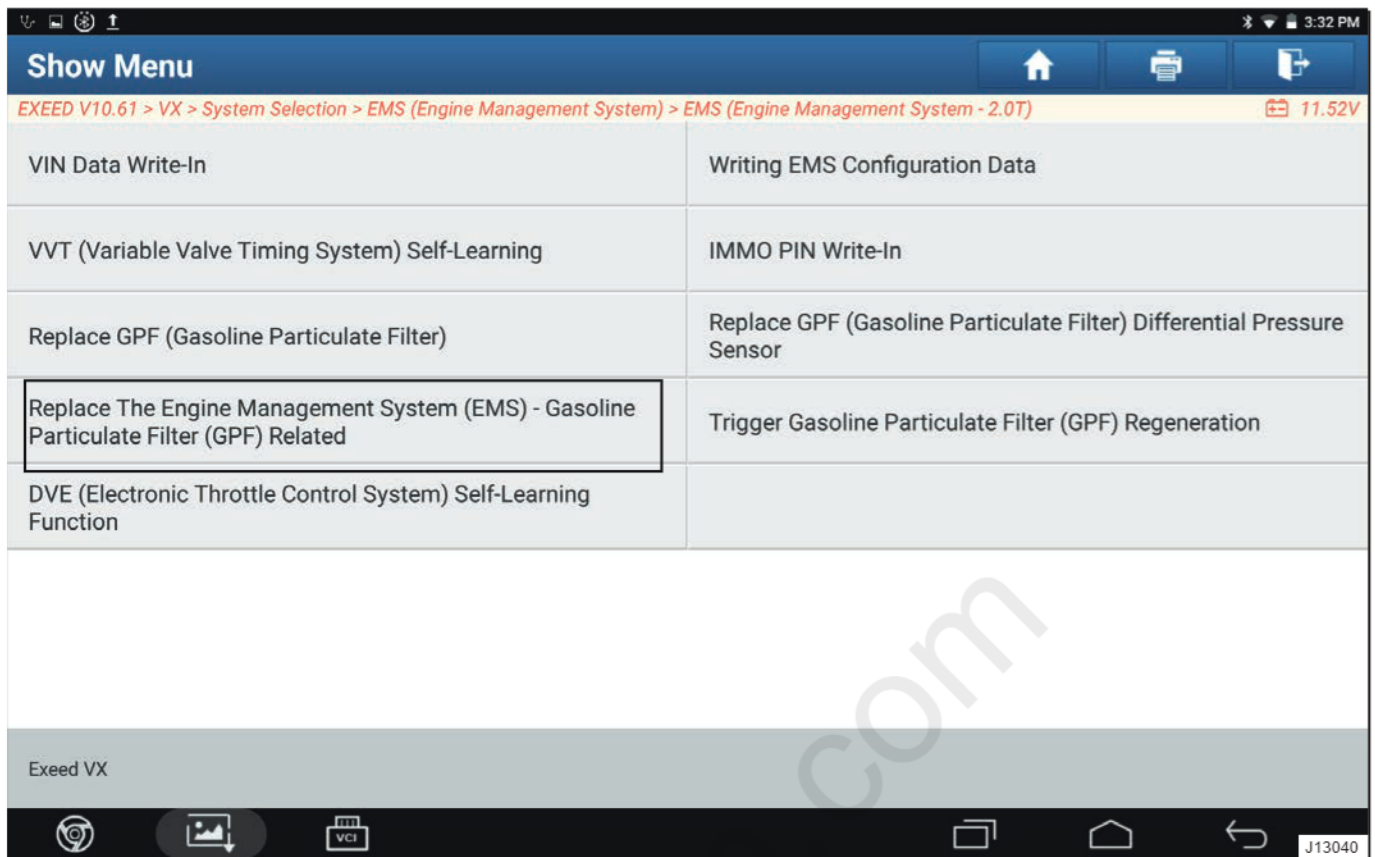
(2) Replace differential pressure sensor

- 1) Stop the vehicle in a safe place;
- 2) The engine stops, after the GPF temperature has cooled to room temperature, replace differential pressure sensor with a new one and ensure that the upstream and downstream lines are installed correctly;
- 3) When the engine is powered on and not started, the command will be sent by UDS service of diagnostic tester;
- 4) Power off, wait for 720 seconds, power on again to read the learning value of differential pressure sensor as 0, that is, write to EEPROM successfully;
- 5) Replacement of differential pressure sensor is complete.



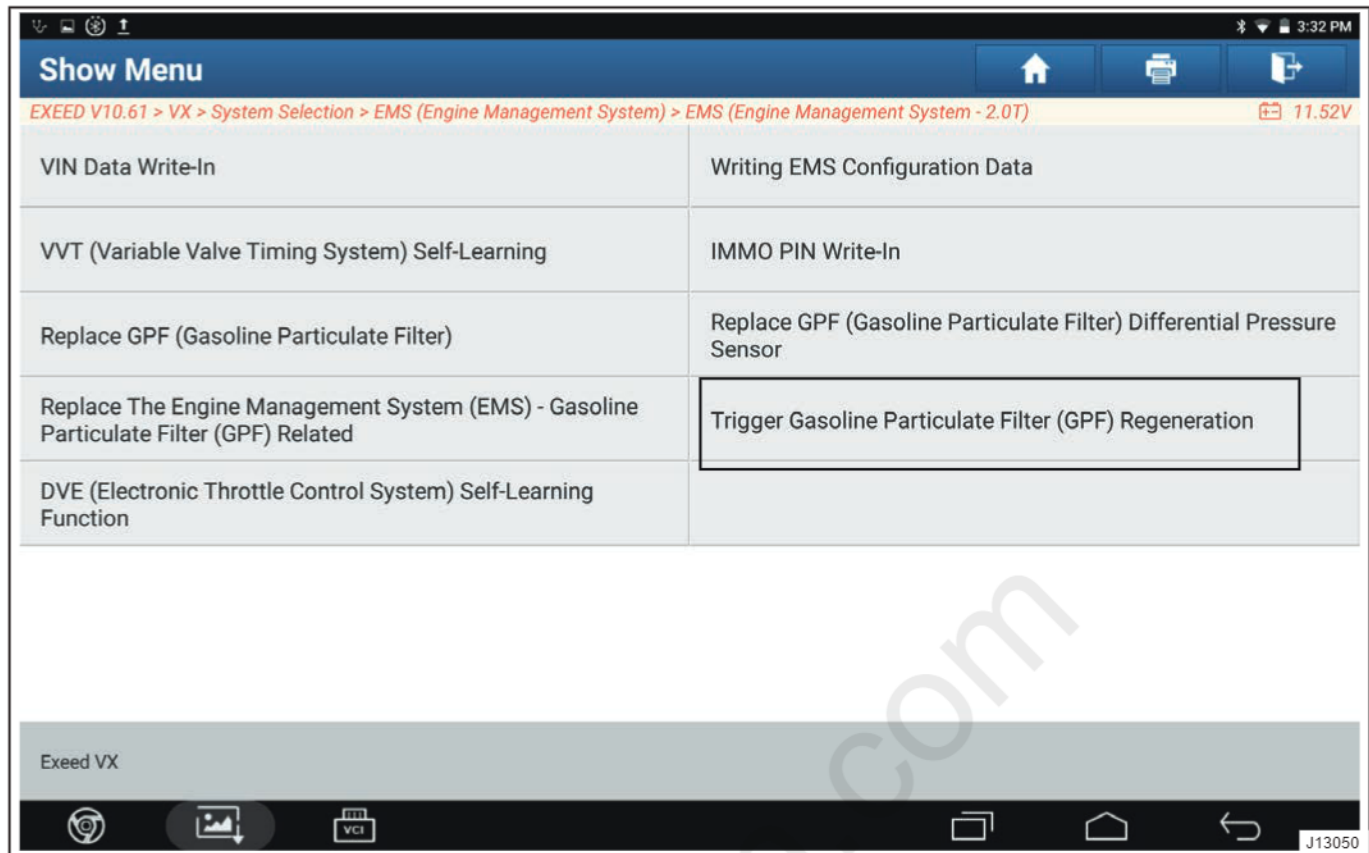
(3) Replace ECM

- 1) Stop the vehicle in a safe place;
- 2) When the engine is stopped, power on and use the UDS service of diagnostic tester to read out the expected rewritten amount (if the diagnostic tester has a storage function, store it in the diagnostic tester; if not, you need to manually record each EEP value);
- 3) Power off the engine, after the ECM is cooled to room temperature, replace it with a new one;
- 4) When the engine is powered on and not started, send commands by UDS service, and send (flag bit + value) fields to new ECM one by one;
- 5) Power off, wait for 720 seconds, power on again to read the current model carbon value ≥ 0.6 , the corresponding fuel cumulative value is not 0, that is, write to EEPROM is successful;
- 6) Replacement of ECM complete.



(4) Parking service regeneration

- 1) Stop the vehicle in a safe place, avoid exposure to the sun and around inflammables, do not open the hood, if there is a blower, it can be placed in front of the intake grille to blow;
- 2) Power on and shift to P, start the engine, idle until the coolant temperature exceeds 60°C, turn off the air conditioning, turn on the vehicle heater, turn the target temperature to maximum, and make the wind speed to maximum;
- 3) Send the command by the UDS service of diagnostic tester, and the engine speed reaches 3900 rpm, then the parking regeneration is triggered successfully;
- 4) Within 1 hour after triggering regeneration, the engine returns to normal idle speed;
- 5) Use the diagnostic tester to read the current model carbon value $\leq 1.5\text{g}$, and the mileage value since the last fully successful regeneration is 0, the regeneration is successful, if not, turn the engine OFF and power off. Restart the engine and trigger the parking regeneration again according to the above steps.
- 6) Service regeneration is complete.



⚠ Caution

- Before performing parking regeneration, all DTC of vehicle engine should be repaired according to the regulations.
- Non-related personnel should not approach the regenerative vehicle.
- During the regeneration process, there are the following possibilities to interrupt the process:
 - (1) GPF temperature is too high
 - (2) Regeneration time is too long
 - (3) The remaining gasoline is too low
 - (4) Vehicle movement
 - (5) Engine knock
 - (6) Enriched with air-fuel ratio
 - (7) Shifting
 - (8) Accelerator pedal depressed
 - (9) Brake pedal depressed
 - (10) Coolant temperature is too high or too low
 - (11) Misoperation of diagnostic tester

4.2 ENGINE MECHANICAL

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.

2 System Overview

2.1 Description

SQRF4J20 engine has the following features

- (1) DVVT
- (2) In-line DOHC with 4 cylinders
- (3) Four valves per cylinder
- (4) Aluminum cylinder head
- (5) Aluminum cylinder block
- (6) Supercharged intercooler
- (7) Equipped with balance shaft

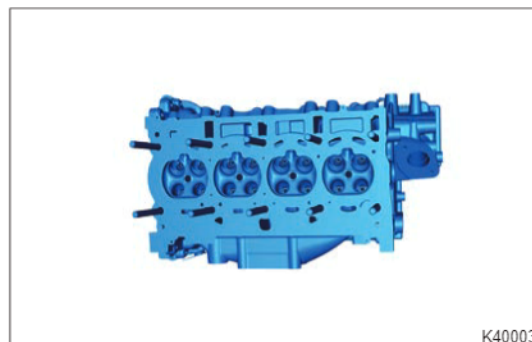
2.2 System Principle

- (1) SQRF4J20 engine adapts a design of transverse, direct injection, in-line 4-cylinder, 4-stroke, four valves per cylinder, DOHC, supercharged intercooler, VVT and electronic controlled multi-port fuel injection, the engine adapts independent ignition.
- (2) SQRF4J20 engine adapts aluminum cylinder block. Aluminum oil pan is fixed to aluminum frame with bolts. The aluminum cylinder head is secured to the block with bolts. The camshaft is installed on cylinder head. Power output from crankshaft drives camshaft by crankshaft sprocket through timing belt to rotate, thus making camshaft interact with rocker arm lifter to open and close valve. Piston assembly is an aluminum piston with cast iron connecting rod. This engine has features of reliable structure and excellent performance.

2.3 System Components Description

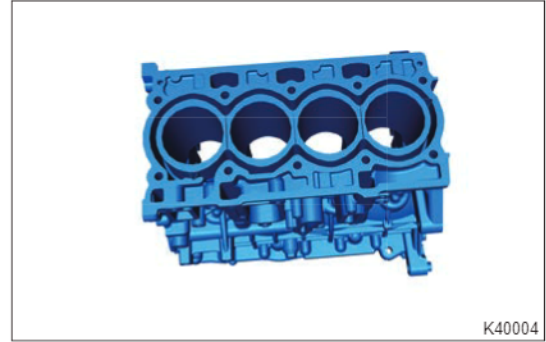
■ Cylinder Head

The upper part of the cylinder is closed to form a combustion chamber, and as the support of the camshaft, rocker arm, intake pipe and exhaust pipe. It mainly sucks air into the cylinder, the spark plug ignites the combustible gas mixture to drive the piston, and the exhaust gas is discharged from the exhaust pipe.



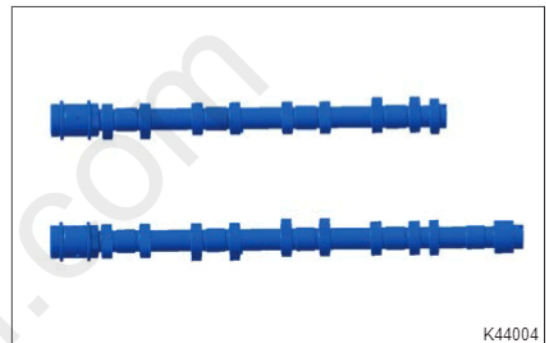
■ Cylinder Block

The main body of the engine, which connects each cylinder and crankcase into a whole, is the support frame for installing piston, crankshaft, other parts and accessories.



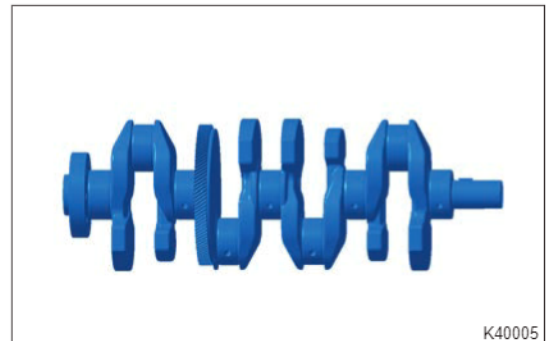
■ Camshaft

Camshaft is a component located inside engine, which is used to control valve opening and closing operations.



■ Crankshaft

Crankshaft is an important component in engine, which bears force from connecting rod and transfers it into rotation torque and outputs it through crankshaft to drives other accessories of engine.



■ Valve

Valve is used to allow air to flow in engine and bleed exhausted air after combustion; Intake valve is used to absorb air in engine and mix it with fuel for combustion; Exhaust valve is used to bleed exhausted air after combustion for radiation.



■ Piston

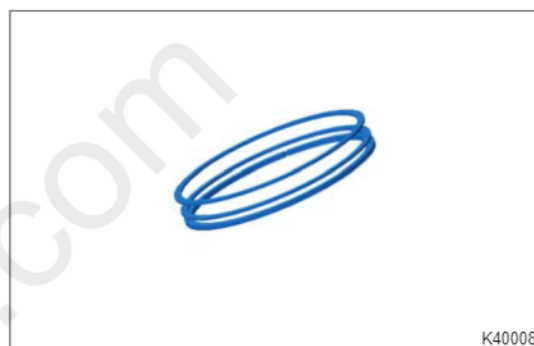
Piston is used to bear combustion compression from cylinder and transfer it to the crankshaft through piston pin and connecting rod.



K40007

■ Piston Ring

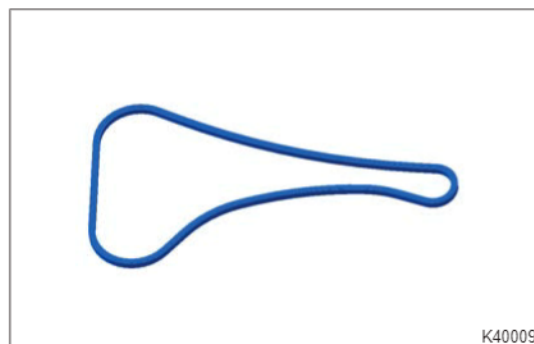
Piston ring has two types of air ring and oil ring. Air ring is used to keep air tightness between cylinder and piston to avoid air leakage. Also it transmits most heat to cylinder wall which is carried away by coolant; Oil ring is used to apply and scrape the oil. Excessive oil can be scraped when oil ring moves downward and a layer of even oil can be applied to cylinder wall when oil ring moves upward. It not only can prevent oil entering the cylinder for combustion and also can reduce friction resistance between piston and cylinder. Furthermore, oil ring helps in air tightness.



K40008

■ Engine Timing Chain

Engine timing chain is mainly used to drive valve mechanism, which allows intake valve and exhaust valve to open and close in proper time so that engine cylinder can absorb and exhaust air normally.



K40009

■ Engine Timing Chain

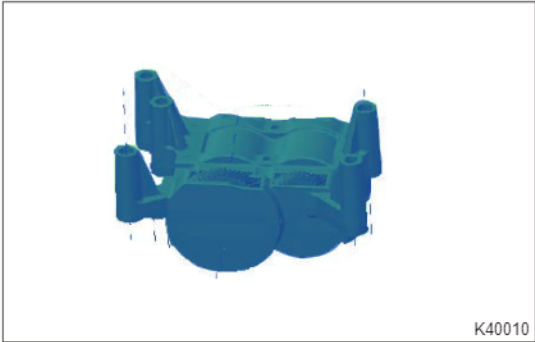
Engine timing chain is mainly used to drive valve mechanism, which allows intake valve and exhaust valve to open and close in proper time so that engine cylinder can absorb and exhaust air normally.



K44009

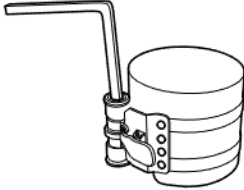
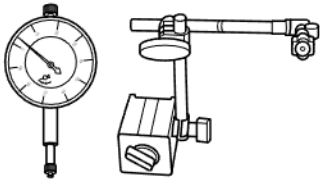
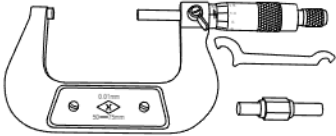
■ Balance Shaft Assembly

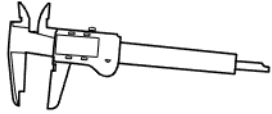
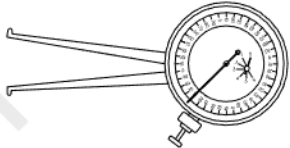
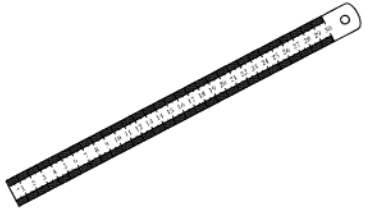
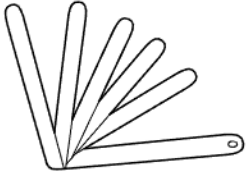
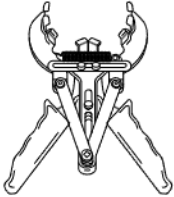
In order to balance the speed difference of piston at the top and bottom dead centers, the vibration of the engine is significantly improved, allowing engine to work more smoothly.

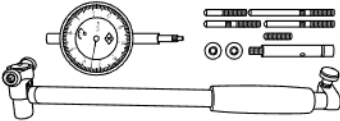
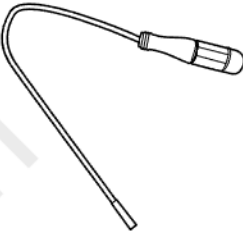
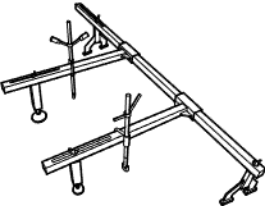
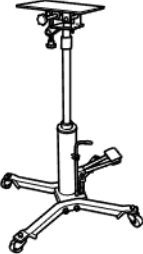


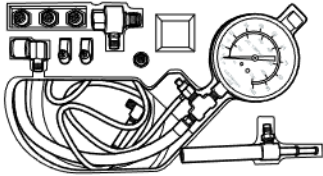
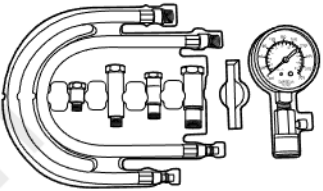
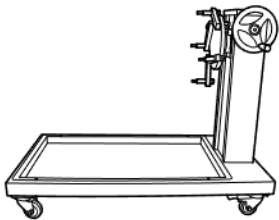
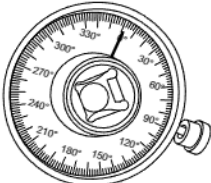
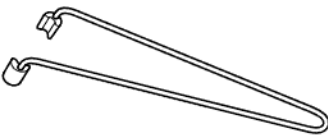
3 Special Tool and Equipment

3.1 General Tools

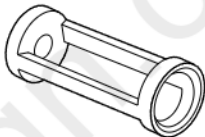
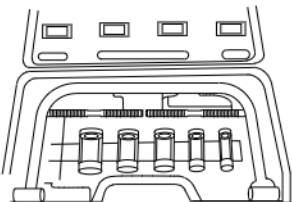
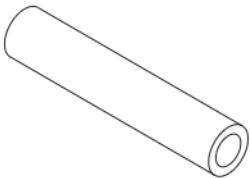
Tool Name	Tool Drawing
Piston Installer	 S00030
Dial Indicator and Magnetic Holder	 S00018
External Micrometer	 S00045

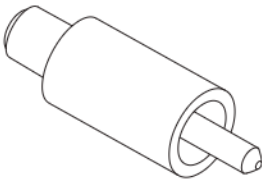
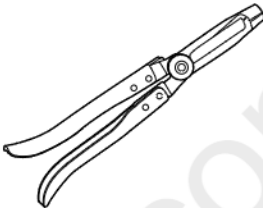
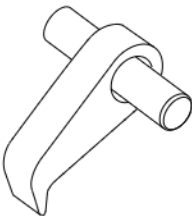
Tool Name	Tool Drawing
Vernier Caliper	 S00051
Inner Diameter Micrometer	 S00049
Precision Straightedge	 S00044
Feeler Gauge	 S00041
Piston Ring Remover	 S00047

Tool Name	Tool Drawing
Cylinder Gauge	 S00046
Flexional Magnetic Rod	 S00031
Engine Hoist	 S00032
Engine Equalizer	 S00021
Transmission Carrier	 S00004

Tool Name	Tool Drawing
Fuel System Pressure Tester	 S00035
Cylinder Pressure Gauge	 S00033
Engine Service Platform	 S00039
Angle Gauge	 S00065
Valve Cotter Installer	 S00024

3.2 Special Tools

Tool Name	Applicable (Model, Power, Chassis)	Part No.	Tool Drawing	Main Application
Crankshaft Front Oil Seal Guide Tool	F4J20 Engine	EPT-0021		Used in conjunction with the crankshaft front oil seal installer to install the crankshaft front oil seal
Crankshaft Front Oil Seal Installer	F4J20 Engine	EPT-0022		Used to install the crankshaft front oil seal
Crankshaft Rear Oil Seal Installer	F4J20 Engine	EPT-0023		Used to install the crankshaft rear oil seal
Crankshaft Rear Oil Seal Guide Tool	F4J20 Engine	EPT-0024		Used in conjunction with the crankshaft rear oil seal installer to guide the rear oil seal, so as to prevent damage to rear oil seal
Valve Spring Compression Adapter	F4J16 Engine/ F4J20 Engine	EPT-0001	 S00037	
Valve Spring Compressor	F4J16 Engine/ F4J20 Engine	EPT-0002	 S00087	
Valve Oil Seal Installer	F4J16 Engine/ F4J20 Engine	EPT-0010	 S00093	

Tool Name	Applicable (Model, Power, Chassis)	Part No.	Tool Drawing	Main Application
Valve Oil Seal Guide Sleeve	F4J16 Engine/ F4J20 Engine	EPT-0009	 S00092	
Valve Oil Seal Remover	F4J16 Engine/ F4J20 Engine	EPT-0003	 S00029	
Camshaft Timing Tool	F4J20 Engine	EPT-0025		Fix the intake/exhaust camshafts with special tools and perform engine camshaft timing calibration
Crankshaft Timing Tool	F4J20 Engine	EPT-0026		Fix the engine crankshaft and perform engine crankshaft timing calibration
Balance Shaft Locking Special Fixture	F4J20 Engine	EPT-0027		Used for balance shaft installation
Flywheel Holding Tool	F4J16 Engine/ F4J20 Engine	EPT-0008	 S00099	

4 Parameters

4.1 Engine Specifications

Items	Specifications
Engine Type	Vertical, direct injection, in-line 4-cylinder, water-cooled, 4-stroke, DOHC
Engine Model	SQRF4J20
Valve Number Per Cylinder	4

Items	Specifications
Cylinder Diameter (mm)	80.5
Piston Stroke (mm)	98
Displacement (ml)	1998
Compression Ratio	10.2:1
Ignition Type	Independent
Rated Power (kw)	187
Max. Torque (N·m)	390
Fuel Octane Number	Unleaded gasoline, octane number 92 or above
Oil Grade	C5 0W-20
Starting Type	Electric starting
Cooling Type	Forced circulation type antifreeze cooling
Lubrication Type	Compound type (pressure, splash lubrication)
Cylinder Compression Pressure (bar) (180 - 250) r/min	7 - 10

4.2 Tolerance Matching Between Engine Main Components

Series Number	Part Name	Size and Tolerance	Matching Clearance
1	Intake Side 1st Bearing Hole	$\Phi 33 (0, +0.025)$	0.050 - 0.91
	Intake Camshaft Assembly 1st Journal	$\Phi 33 (-0.066, -0.050)$	
	Intake Side 2nd-6th Bearing Holes	$\Phi 24 (0, +0.021)$	0.040 - 0.074
	Intake Camshaft Assembly 2nd-6th Journals	$\Phi 24 (-0.053, -0.040)$	
2	Exhaust Side 1st Bearing Hole	$\Phi 33 (0, +0.025)$	0.050 - 0.91
	Exhaust Camshaft Assembly 1st Journal	$\Phi 33 (-0.066, -0.050)$	
	Exhaust Side 2nd-5th Bearing Holes	$\Phi 24 (0, +0.021)$	0.040 - 0.074
	Exhaust Camshaft Assembly 2nd-5th Journals	$\Phi 24 (-0.053, -0.040)$	
3	Cylinder Head Intake Side Camshaft Thrust Gear Width	23.85 (-0.1, 0)	0.15 - 0.275
	Intake Camshaft Assembly Thrust Gear Width	24 (0, +0.025)	
4	Cylinder Head Exhaust Side Camshaft Thrust Gear Width	23.85 (-0.1, 0)	0.15 - 0.275
	Exhaust Camshaft Assembly Thrust Gear Width	24 (0, +0.025)	
5	Hydraulic Lifter Assembly Outer Diameter	$\Phi 11.994 \pm 0.006$	0.006 - 0.036

Series Number	Part Name	Size and Tolerance	Matching Clearance
	Cylinder Head Hydraulic Lifter Hole Diameter	$\Phi 12 (+0.006, +0.024)$	
6	Valve Guide Hole Diameter	$\Phi 6 (0, +0.015)$	0.013 - 0.042
	Intake Valve Stem Diameter	$\Phi 5.98 \pm 0.007$	
7	Valve Guide Hole Diameter	$\Phi 6 (0, +0.015)$	0.033 - 0.062
	Exhaust Valve Stem Diameter	$\Phi 5.96 \pm 0.007$	
8	Valve Guide Mounting Hole	$\Phi 11 (0, +0.018)$	-0.051 - -0.022
	Valve Guide Outer Diameter	$\Phi 11 (+0.040, +0.051)$	
9	Intake Valve Retainer Mounting Hole	$\Phi 31.9 (0, +0.016)$	-0.1 - -0.068
	Intake Valve Retainer Outer Diameter	$\Phi 32 (-0.016, 0)$	
10	Exhaust Valve Retainer Mounting Hole	$\Phi 27.2 (0, +0.013)$	-0.1 - -0.071
	Exhaust Valve Retainer Outer Diameter	$\Phi 27.3 (-0.016, 0)$	
11	Cylinder Block Bore	$\Phi 80.5 (+0.013/0)$	0.04 - 0.063
	Piston Skirt	80.455 ± 0.005	
12	Piston Pin Hole	$\Phi 22 (+0.009/+0.004)$	0.004 - 0.014
	Piston Pin	$\Phi 22 (0/-0.005)$	
13	Connecting Rod Small End Bore	$\Phi 22 (+0.018/+0.010)$	0.010 - 0.023
	Piston Pin	$\Phi 22 (0/-0.005)$	

4.3 Valve Timing

■ Intake (180.5° Wrapped Angle)

	Angle (°)	Valve Lift (mm)
Valve Opening 0 mm	346.5	0
Valve Opening 0.5 mm	377.5	0.49
Valve Opening 1 mm	385	0.99
Maximum Valve Lift	475.5	9.49
Valve Closed 1 mm	565.5	0.99
Valve Closed 0.5 mm	573.5	0.50
Valve Closed 0 mm	614.5	0

■ Exhaust (180.5° Wrapped Angle)

	Angle (°)	Valve Lift (mm)
Valve Opening 0 mm	107.5	0
Valve Opening 0.5 mm	137	0.49

	Angle (°)	Valve Lift (mm)
Valve Opening 1 mm	144.5	0.99
Maximum Valve Lift	234	8.5
Valve Closed 1 mm	325	0.99
Valve Closed 0.5 mm	333	0.50
Valve Closed 0 mm	370	0

4.4 Lubrication Area

Lubrication Area	Type
Valve Guide Bottom Hole	Use same type of lubricant as engine
Intake Valve Retainer Bottom Hole	Use same type of lubricant as engine
Exhaust Valve Retainer Bottom Hole	Use same type of lubricant as engine
Valve Stem and Valve Guide Hole	Use same type of lubricant as engine
Valve Oil Seal Lip	Use same type of lubricant as engine
Hydraulic Lifter Assembly External Circular Surface and Hydraulic Lifter Hole	Use same type of lubricant as engine
Camshaft Assembly Journal and Bearing Seat Hole	Use same type of lubricant as engine
Roller Rocker Arm Assembly Bearing	Use same type of lubricant as engine
Phaser Solenoid Valve Seal Ring (O-ring)	Use same type of lubricant as engine
Upper and Lower Connecting Rod Bearing Shell and Connecting Rod Journal	Use same type of lubricant as engine
Upper and Lower Main Bearing Shell and Main Journal	Use same type of lubricant as engine
Thrust Washer (Oil Rail Side) and Crankshaft Thrust Surface	Use same type of lubricant as engine
Front and Rear Oil Seal Inner Lip and Crankshaft Oil Seal Journal	Use same type of lubricant as engine
Piston Pin Hole	Use same type of lubricant as engine
Piston Ring Groove	Use same type of lubricant as engine
Cylinder Bore Inner Wall	Use same type of lubricant as engine
Crankshaft Front and Rear Oil Seal External Circular Surface	Use same type of lubricant as engine
Timing System	Use same type of lubricant as engine

4.5 Seal Gum Application Area

Seal Gum Application Area	Seal Gum Type
Bowl Plug - Front and Rear End	Loctite 11747
Bowl Plug - Exhaust Side	Loctite 121078
Top and Bottom Sides of Cylinder Head Front End (T-shaped Area)	Loctite 5900H

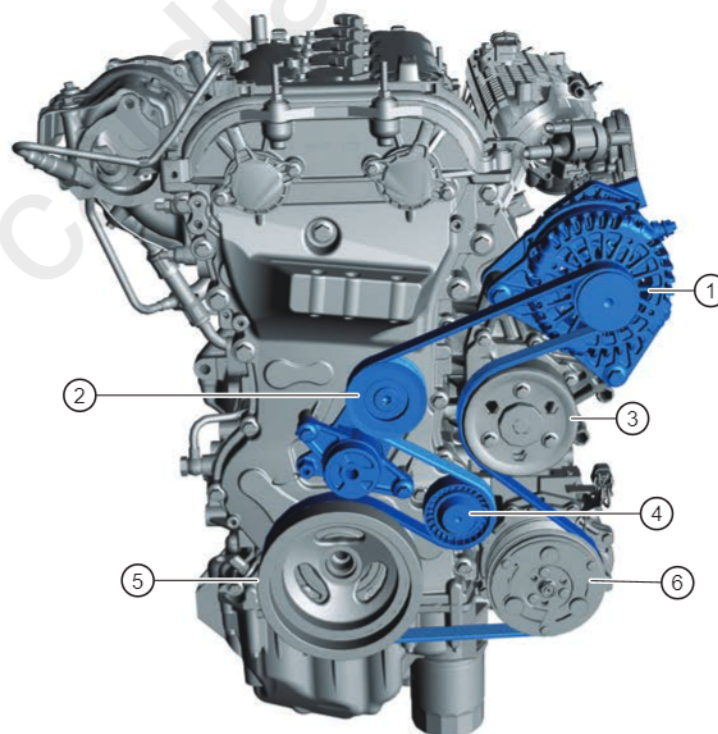
Seal Gum Application Area	Seal Gum Type
"T" Shaped Area Between Timing Chain Cover and Cylinder Head	Loctite 5900H
Timing Chain Cover Frame Bottom Arc Part	Loctite 5900H
Timing Chain Cover Seal Surface	Loctite 5900H/Loctite 5900HA
Upper Guide Rail Assembly Bolt	Loctite 243

4.6 Non-reusable Part

Non-reusable Part	
Cylinder Head Fixing Bolt	Replace it
Valve Oil Seal	Replace it
Crankshaft Front Oil Seal	Replace it
Crankshaft Rear Oil Seal	Replace it
Cylinder Head Gasket	Replace it
Connecting Rod Bearing Cap Fixing Bolt	Replace it
Flywheel Fixing Bolt	Replace it
Main Bearing Cap Fixing Bolt	Replace it

5 ON-VEHICLE SERVICE

5.1 Accessory Gear Train



K40012

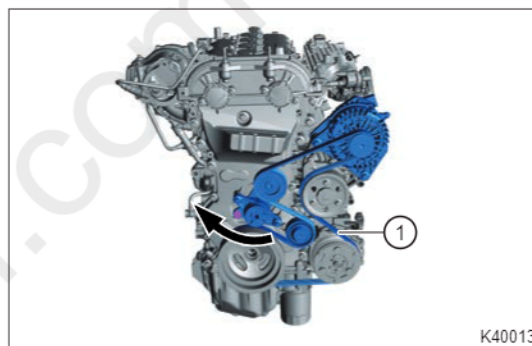
1	Alternator Assembly	4	Idler Pulley Assembly
2	Tensioner Assembly	5	Torsion Shock Absorber Assembly
3	Water Pump Pulley	6	Compressor Assembly

■ Removal

⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing accessory drive belt.**
- **Appropriate force should be applied when removing accessory drive belt. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Insert tool into tensioner and pull it upward in direction of arrow as shown in illustration, then remove accessory drive belt assembly (1).



⚠ Warning

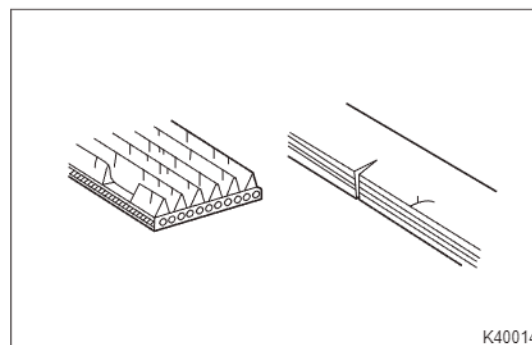
Prevent hand from contacting belt tensioner when raising it upward, so as to avoid damage.

■ Inspection

- (1) Visually check accessory drive belt for excessive wear and cords for wear, etc. If any of these defects is found, replace accessory drive belt.

Hint:

- If accessory drive belt has chunks missing from ribs, it should be replaced.
- After installing accessory drive belt, check that it fits properly in the ribbed grooves. Check that belt has not slipped out of grooves on bottom of the crankshaft pulley by hand.



■ Installation

⚠ Caution

- **Before installation, remove the dirt from accessory drive belt.**
- **After installation, check if scale on tensioner arm is almost corresponding to the middle scale of tensioner base.**
- **Check that belt fits well to grooves on bottom of pulley properly. Avoid improper installation and misalignment.**

- (1) Install the accessory drive belt properly according to its moving direction.
- (2) Install drive belt on each pulley to operate tensioner freely.

■ Adjustment

- (1) Rotate crankshaft pulley 2 turns, so that belt tension between each pulley is even.
- (2) Apply 100 N of force to center part of the belt between alternator and tensioner pulley with your thumb. Check that displacement of belt is within 5 - 6 mm. If displacement is too large or too small, adjust, check or repair.

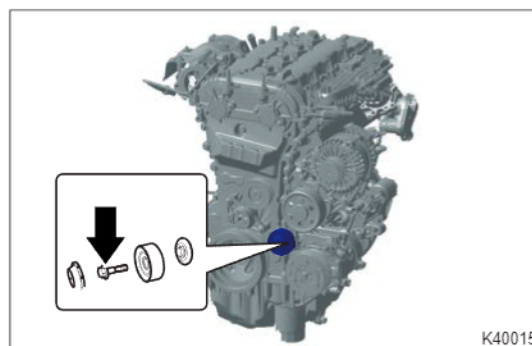
5.2 Idler Pulley Assembly

■ Removal

⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing idler pulley assembly.**
- **Appropriate force should be applied, when removing idler pulley assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the accessory drive belt.
- (5) Remove the idler pulley assembly dust boot.
- (6) Remove fixing bolt and idler pulley assembly.



K40015

■ Inspection

- (1) Rotate idler pulley by hands and check if rotation is smooth and if abnormal noise occurs.
- (2) Wiggle idler pulley in axial and radial directions to check bearing for looseness.
- (3) Check if there is damage on idler pulley assembly operating surface.

■ Installation

⚠ Caution

- **Pretighten it by 2 to 3 threads first.**
- **After installation, turn crankshaft to run accessory drive belt by several turns, and check if crankshaft turns smoothly and belt runs well. If it cannot turn smoothly, reinstall accessory drive belt.**
- **Make sure to correctly install accessory drive belt, and it does not interfere with other components.**

- (1) Install the idler pulley assembly fixing bolt.

Torque: $47 \pm 5 \text{ N}\cdot\text{m}$

- (2) Install the idler pulley assembly dust boot.
- (3) Install the accessory drive belt.
- (4) Install the engine trim cover.
- (5) Install the engine compartment trim cover.

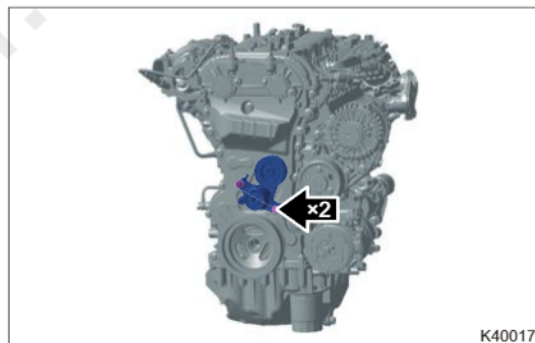
5.3 Tensioner Assembly

■ Removal

⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing tensioner assembly.**
- **Appropriate force should be applied, when removing the tensioner assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the accessory drive belt.
- (5) Remove 2 fixing bolts from tensioner assembly.



- (6) Remove the tensioner assembly.

■ Inspection

- (1) Rotate tensioner pulley assembly by hands and check if rotation is smooth and if abnormal noise occurs.
- (2) Wiggle tensioner pulley assembly in axial and radial directions to check for looseness.
- (3) Check if there is damage on tensioner pulley operating surface.

■ Installation

- (1) Install 2 tensioner assembly fixing bolts.

Torque: $20 \pm 5 \text{ N}\cdot\text{m}$

- (2) Install the accessory drive belt.
- (3) Install the engine trim cover.
- (4) Install the engine compartment trim cover.

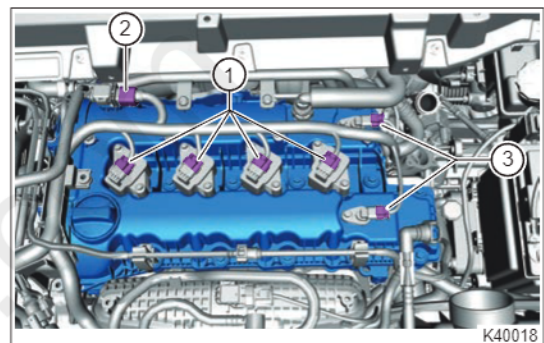
5.4 Cylinder Head Cover

■ Removal

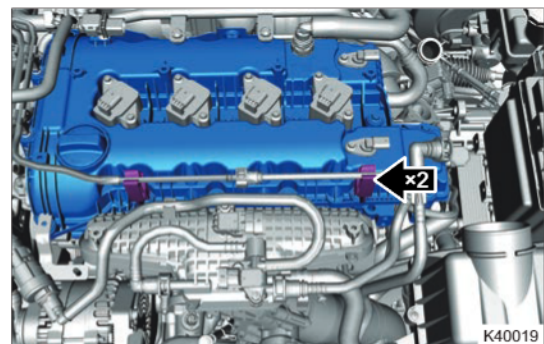
⚠ Warning

- Blow dirt and debris away from surface of cylinder head cover with compressed air.
- Be sure to wear safety equipment to prevent accidents, when removing cylinder head cover.
- Appropriate force should be applied when removing cylinder head cover. Be careful not to operate roughly.

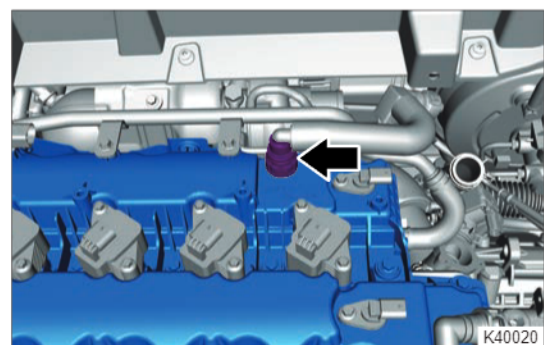
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover.
- (4) Remove the intake hose.
- (5) Disconnect ignition coil connector (1), upstream oxygen sensor connector (2), and camshaft position sensor connector (3).



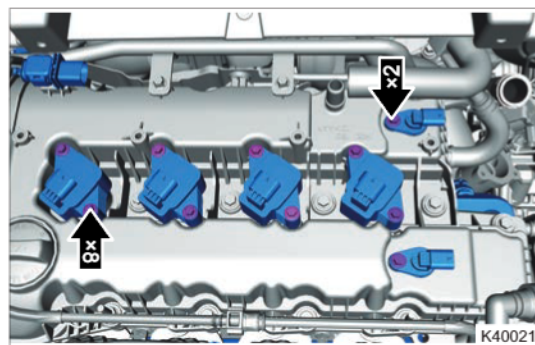
- (6) Remove 2 oil inlet pipe single tube clamps from cylinder head cover.



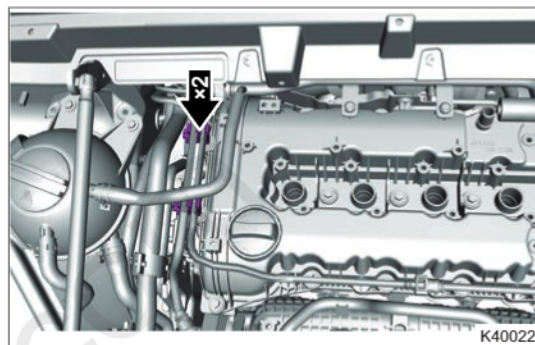
- (7) Disconnect the hose - intake hose from cylinder head cover.



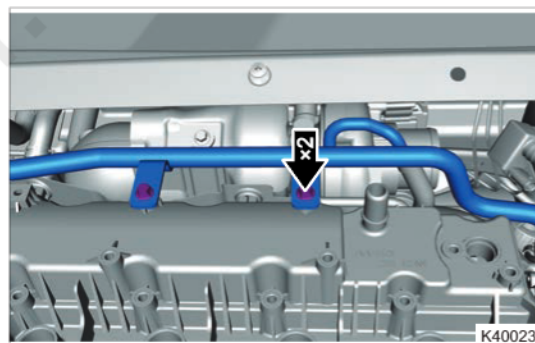
- (8) Remove 8 fixing bolts and ignition coil.
- (9) Remove 2 fixing bolts and camshaft position sensor.



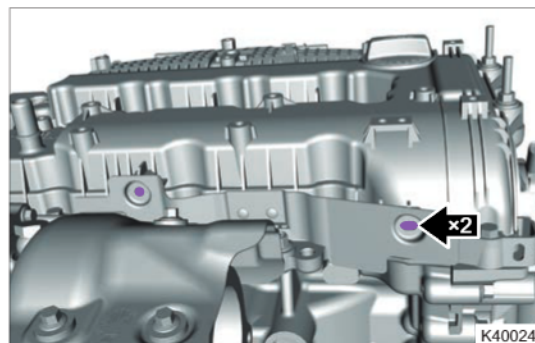
- (10) Remove 2 three-tube clamps from cylinder head cover.



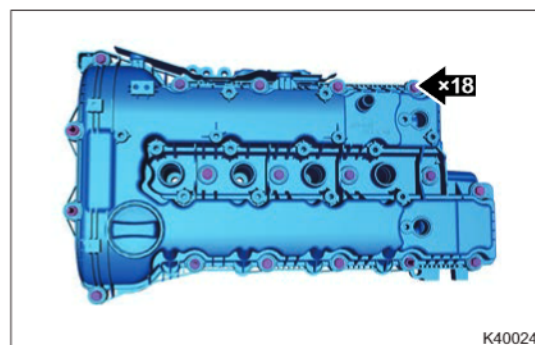
- (11) Remove 2 fixing bolts from cooling pipe assembly.



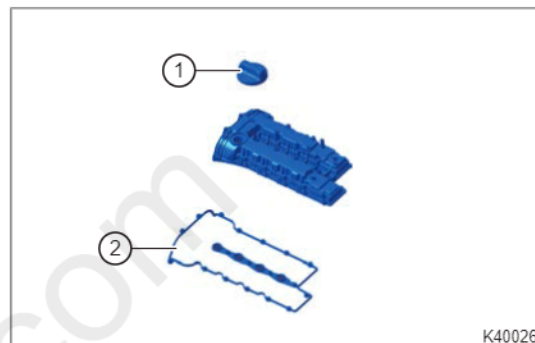
- (12) Remove 2 fixing bolt from heat insulator.



- (13) Remove 18 fixing bolts cylinder and cylinder head cover.



- (14) Remove fuel filler cap (1) and gasket (2) from cylinder head cover assembly.



■ Inspection

- (1) Check the appearance of the cylinder head cover for cracks, and replace the assembly if necessary.

■ Installation

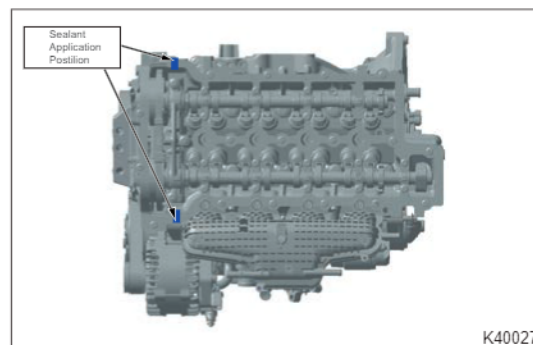
⚠ Caution

- Remove oil dirt and sealant on cylinder head cover and cylinder head before installation.
- Check if gasket is damaged or loses elasticity. If so, replace gasket.

- (1) As shown in illustration, apply seal gum (Loctite 5900H) to "T" position of junction area between timing chain cover and cylinder head.

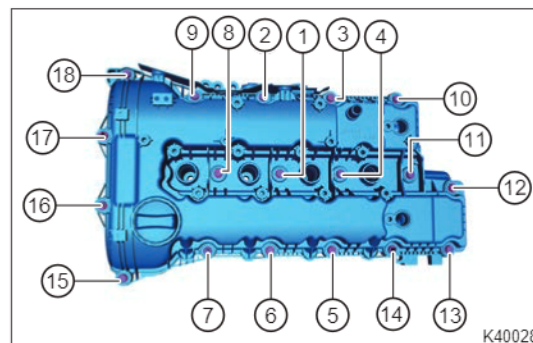
Hint:

- Note that the sealant should not be too thick, to prevent excess sealant into the engine when the valve chamber cover is pressed.
- Install the cylinder head cover assembly and wait for 15 minutes to apply seal gum.



- (2) Install cylinder head cover and first manually install fixing bolts by 1 to 2 threads.
- (3) Tighten 18 cylinder head cover fixing bolts in order shown in illustration.

Torque: 10.5 - 12.5 N·m



- (4) Install fuel filler door.
- (5) Install 2 fixing bolts to heat insulator.

Torque: 8 + 3 N·m

- (6) Install the cooling pipe assembly.
- (7) Install the camshaft position sensor.
- (8) Install the ignition coil.
- (9) Install hose - intake hose.
- (10) Connect the wire harness connector.
- (11) Install the oil inlet pipe tube clamp.
- (12) Install the engine trim cover.

5.5 Crankshaft Front Oil Seal

■ Removal

⚠ Warning

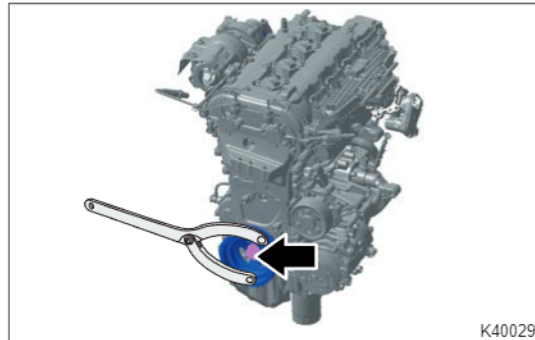
- **Be sure to wear safety equipment to prevent accidents, when removing crankshaft front oil seal.**
- **Appropriate force should be applied when removing crankshaft front oil seal. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover.
- (3) Disconnect the negative battery cable.
- (4) Remove the accessory drive belt.

- (5) Remove fixing bolt from torsion absorber assembly.

Hint:

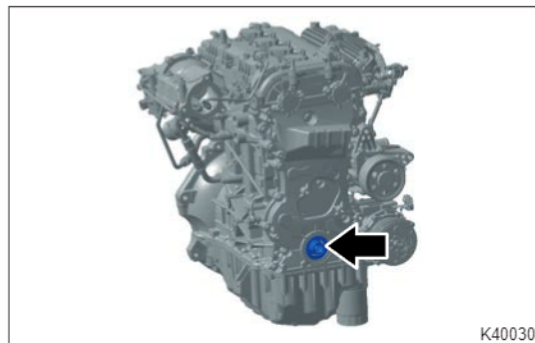
Use tool to lock torsion absorber assembly and fixing bolt.



- (6) Remove the torsion shock absorber assembly.
- (7) Carefully remove the crankshaft front oil seal with proper tool.

Hint:

Be careful not to scratch junction surface, when removing crankshaft front oil seal.



■ Installation

⚠ Caution

- Apply a small amount of engine oil to the crankshaft front oil seal guide tool before installing a new oil seal.
- Remove dirt on junction surface and apply a small amount of engine oil to oil seal external circular surface and oil seal guide tool (except the oil seal with surface applied wax) before assembly.
- Be sure to prevent the lip of crankshaft front oil seal from being scratched during installation; If it is damaged, replace it immediately.

- (1) Install crankshaft front oil seal to crankshaft front oil seal installer, then install crankshaft front oil seal in place with crankshaft front oil seal guide tool.

Hint:

- Make sure oil seal surface is 0 to 0.5 mm lower than end surface of timing chain cover oil seal hole.
- Never allow tilting it by more than 5°, oil seal external rubber breakage or flanges during oil seal press fitting.

- (2) Install fixing bolt of torsion shock absorber assembly.

Torque: 1st step: 35 ± 5 N·m, 2nd step: $30 \pm 5^\circ$

- (3) Install the accessory drive belt.
- (4) Install the engine compartment trim cover assembly.

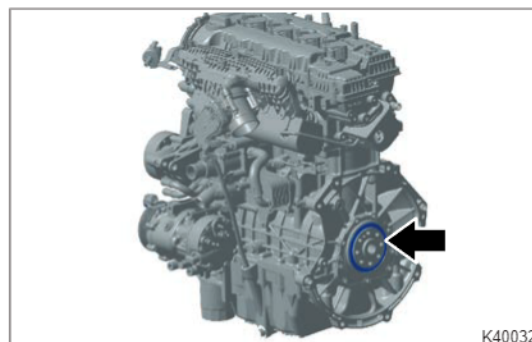
5.6 Crankshaft Rear Oil Seal

■ Removal

⚠ Warning

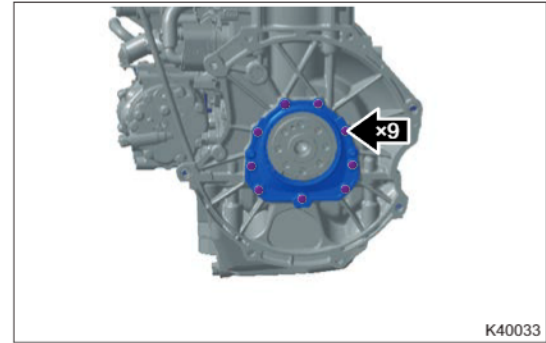
- Be sure to wear safety equipment to prevent accidents, when removing crankshaft rear oil seal.
- Appropriate force should be applied when removing crankshaft rear oil seal. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover.
- (3) Disconnect the negative battery cable.
- (4) Remove the transmission assembly.
- (5) Remove the flywheel assembly.
- (6) Remove the crankshaft rear oil seal with proper tool carefully.



- (7) Remove the crankshaft rear oil seal.

- (8) Remove 9 fixing bolts from rear oil seal bracket.



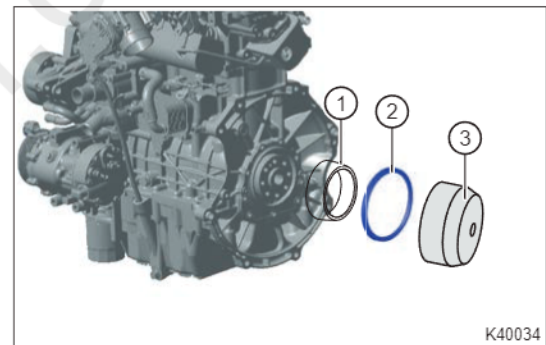
- (9) Remove the rear oil seal bracket.

■ Installation

⚠ Caution

- Be sure to clean dirt around oil seal retainer and on inside wall before installation.
- Check oil seal for damage before installation. If there is any damage, replace it.
- Be sure to prevent the lip of crankshaft rear oil seal from being scratched during installation.
- Be careful not to damage oil seal retainer during installation.

- (1) Install guide tool (1) to crankshaft.
- (2) Install new oil seal (2) to crankshaft rear oil seal guide tool, then install new oil seal evenly and fully into oil seal retainer with a crankshaft rear oil seal installer (3).



⚠ Caution

- Make sure oil seal surface is 0.5 to 1 mm lower than end surface of timing chain cover oil seal hole.
- Ensure that oil seal lip has no damage during assembly.
- Never allow tilting it by more than 5°, oil seal external rubber breakage or flanges during oil seal press fitting.

- (3) Install the flywheel assembly.
- (4) Install the transmission assembly.

5.7 Flywheel Assembly

■ Removal

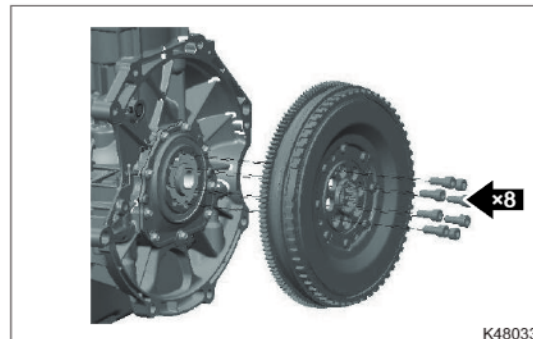
⚠ Warning

- Be sure to wear safety equipment to prevent accidents, when installing flywheel assembly.
- Appropriate force should be applied, when removing flywheel assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the transmission assembly.
- (4) Remove 8 fixing bolts and flywheel assembly.

Hint:

Flywheel assembly fixing bolts must be disposed after removal. Never reuse them.

**■ Inspection**

- (1) Check if crankshaft position signal gear is distorted or deformed. If damaged, replace flywheel. Clean signal gear before installation.

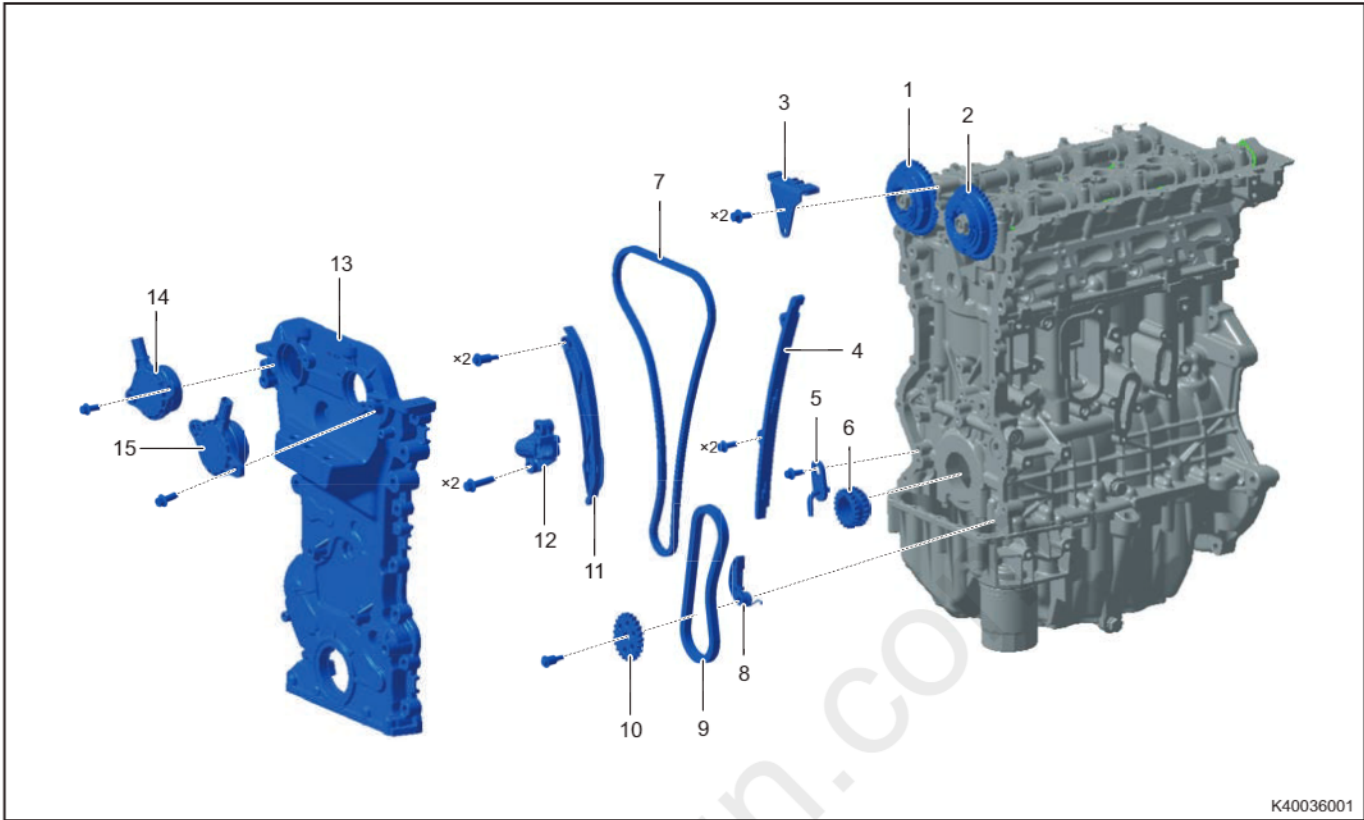
■ Installation**⚠ Caution**

- Lightly push flywheel after alignment during assembly. Do not tap flywheel with a hammer.
- Replace flywheel fixing bolts with new ones.

- (1) Install 8 fixing bolts to flywheel assembly, and pretighten the bolts.
- (2) Installing flywheel holding tool, then tighten each flywheel bolt diagonally in order.

Torque: 1st step: 35 ± 5 N·m, 2nd step: $30 \pm 5^\circ$

5.8 Engine Timing Chain



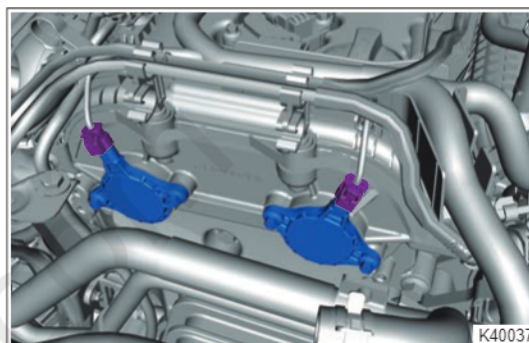
1	Exhaust Phaser Assembly	9	Oil Pump Chain Assembly
2	Intake Phaser Assembly	10	Oil Pump Sprocket
3	Upper Chain Guide Rail Assembly	11	Movable Guide Rail Assembly
4	Fixing Guide Rail Assembly	12	Hydraulic Tensioner Assembly
5	Nozzle - Timing Chain	13	Timing Chain Cover
6	Crankshaft Timing Sprocket	14	Exhaust Phaser Solenoid Valve
7	Timing Chain Assembly	15	Intake Phaser Solenoid Valve
8	Oil Pump Movable Rail Assembly		

■ Removal

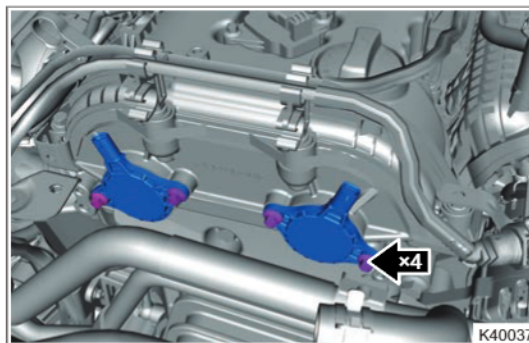
 **Warning**

- **Be sure to wear necessary safety equipment to prevent accidents, when removing engine timing chain.**
- **Appropriate force should be applied when removing engine timing chain. Be careful not to operate roughly.**

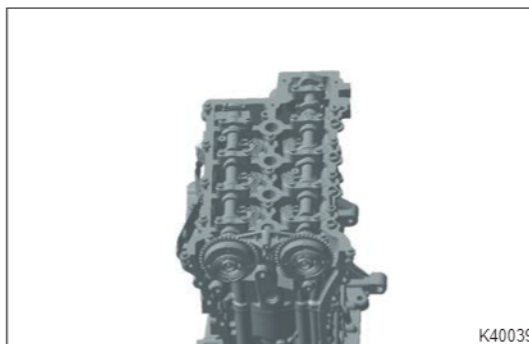
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the cylinder head cover.
- (5) Remove the engine lower protector assembly.
- (6) Remove the accessory drive belt.
- (7) Remove the accessory drive belt tensioner assembly.
- (8) Remove the idler pulley assembly.
- (9) Remove the torsion shock absorber assembly.
- (10) Use an engine equalizer to hang engine assembly.
- (11) Remove the engine right mounting cushion assembly.
- (12) Disconnect the intake/exhaust phaser solenoid valve connector.



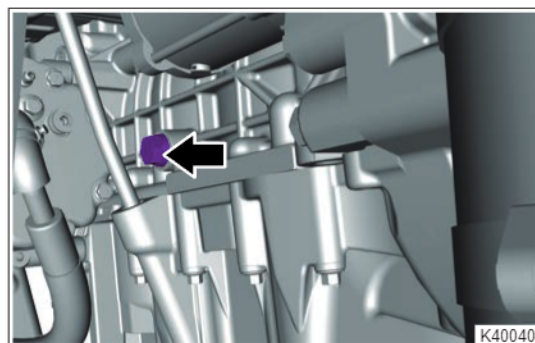
- (13) Remove 4 fixing bolts and intake/exhaust phaser solenoid valve.



- (14) Place camshaft timing positioning special tool on the back of cylinder head upper plane, rotate intake and exhaust camshafts separately in order to clamp the special tool into slots on rear end of both camshafts.



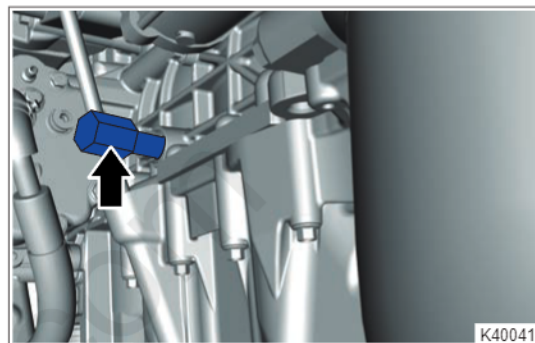
- (15) Remove crankshaft balancer locating hole fixing bolt from engine block.



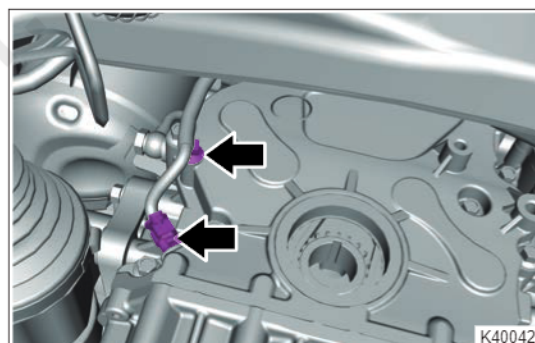
- (16) Install crankshaft timing positioning pin to cylinder block through thread hole on intake side of cylinder block, and insert front end of positioning pin into positioning hole of crankshaft balancer (each cylinder piston should be in the same plane).

Hint:

It takes patience to perform this operation and pay more attention to avoid damage to crankshaft.



- (17) Disconnect oil pump assembly connector and detach wire harness fixing clip.

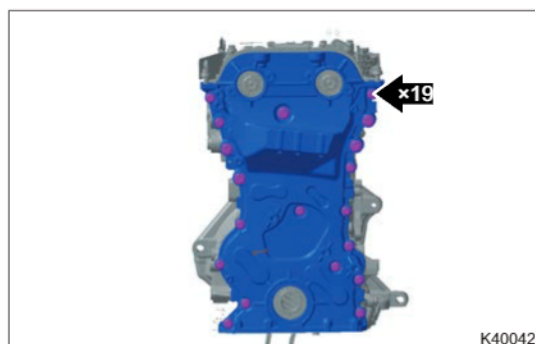


- (18) Remove the oil pan assembly.

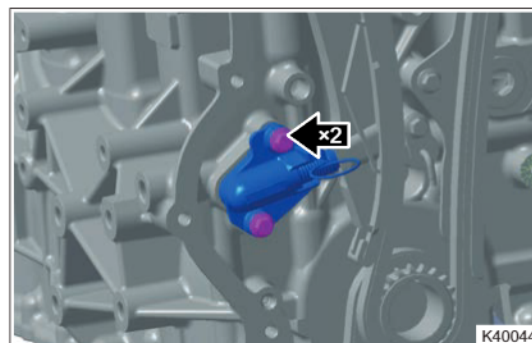
- (19) Remove 19 fixing bolts and timing chain cover.

Hint:

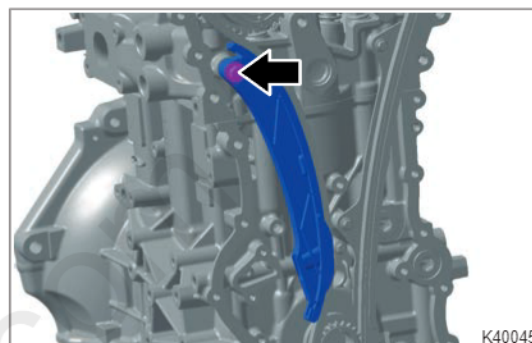
Carefully observe timing chain cover for cracks or oil leakage; If exists, replace timing chain cover assembly.



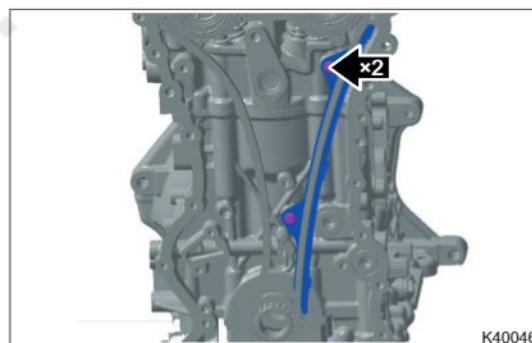
- (20) Remove 2 fixing bolts and hydraulic tensioner assembly.



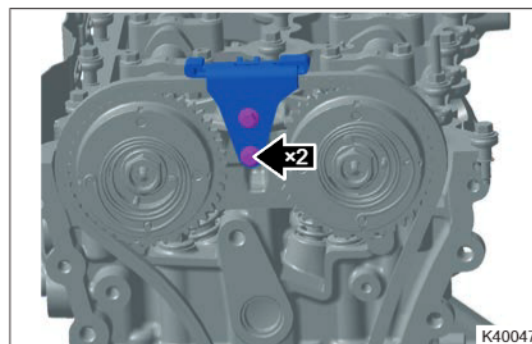
- (21) Remove 1 fixing bolt and movable guide rail assembly.



- (22) Remove 2 fixing bolts and fixing guide rail assembly.

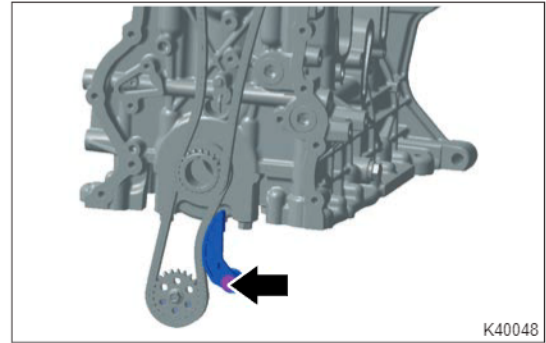


- (23) Remove 2 fixing bolts and upper chain guide rail assembly.



- (24) Remove the engine timing chain.

- (25) Remove 1 fixing bolt from oil pump chain movable guide rail and remove oil pump chain.

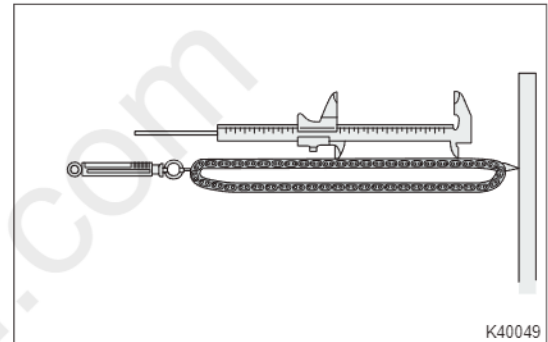


■ Inspection

- (1) Carefully check if timing chain is seriously worn or cracked. If exists, replace timing chain assembly.
- (2) Use a force of 147 N to pull the chain. Take 15 links from chain and perform measurement with a vernier caliper. Max. elongation: 120.6 mm.

Hint:

Take 3 positions for measurement. If the average value is larger than max. elongation ratio, replace timing chain assembly. If it is not as specified, replace timing chain cover assembly.



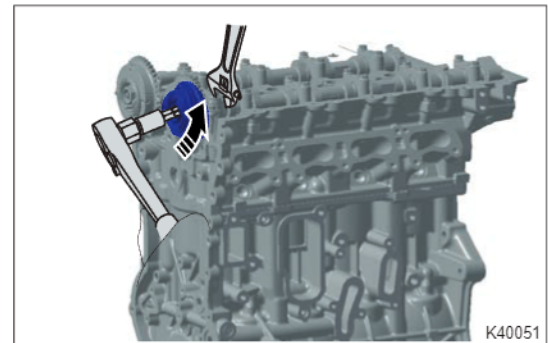
- (3) Measure depth of movable guide rail with a vernier caliper.

Hint:

If wear limit is beyond 2 mm, replace movable guide rail assembly.

■ Installation

- (1) Use a proper wrench to hold intake camshaft and loosen fixing bolt from intake phaser assembly.

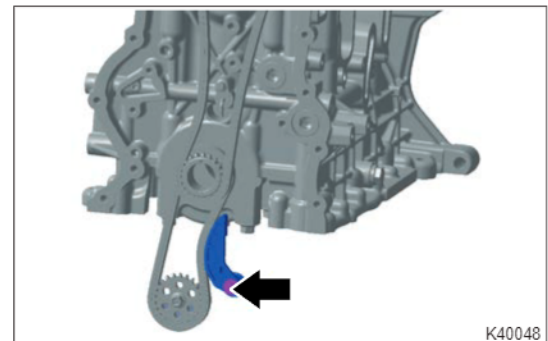


- (2) Install oil pump chain and 1 movable guide rail fixing bolt.

Torque: 9 + 3 N·m

Hint:

The movable guide rail should rotate smoothly around the bolt after assembling and either end of spring should hook the oil pump housing.



- (3) Install 2 fixing bolts to upper chain guide rail assembly.

Torque: 8 + 3 N·m

- (4) Install 2 fixing bolts from fixing guide rail assembly.

Torque: 8 + 3 N·m

- (5) Install 1 fixing bolt to movable guide rail assembly.

Torque: 20 + 5 N·m

Hint:

The movable guide rail should rotate smoothly around the bolt after installation.

- (6) Install the timing chain.

Hint:

Ensure timing chain is set to intake and exhaust phasers and crankshaft sprocket. Make sure that timing chain and upper guide rail are in level.

- (7) Install hydraulic tensioner assembly, and tighten 2 fixing bolts.

Torque: 8 + 3 N·m

Hint:

Pull up hydraulic tensioner upper steel ring pin after installation and tightening.

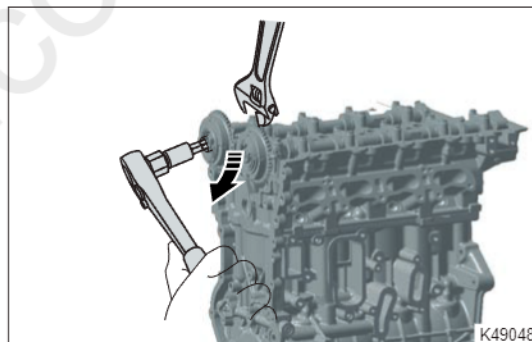
- (8) Use a proper wrench to hold intake camshaft and tighten fixing bolt of intake and exhaust phaser valve body.

Torque: 1st step: 30 ± 1.5 N·m 2nd step: clockwise rotation angle $34^\circ \pm 2^\circ$

Hint:

- Tighten exhaust phase valve body bolt first, and then tighten intake phaser valve body bolt. Failure to tighten in order may cause "tooth missing" phenomenon in timing chain.
- The accumulative tightening times of the phaser valve body bolts shall not exceed three times.

- (9) Remove crankshaft timing tool and camshaft timing tool, then rotate crankshaft clockwise 2 turns at least to check if timing system can operate normally.



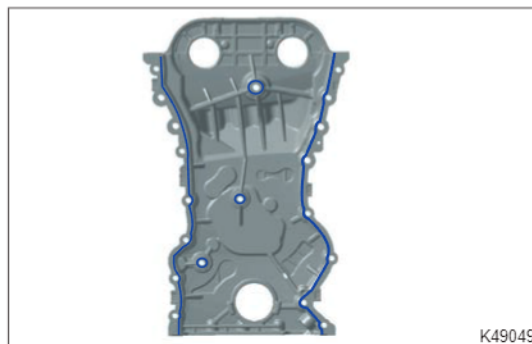
K49048

⚠ Caution

- **Never rotate crankshaft counterclockwise.**

- (10) Apply seal gum to inside of timing chain cover mounting bolt hole.

Seal gum: Loctite 5900H

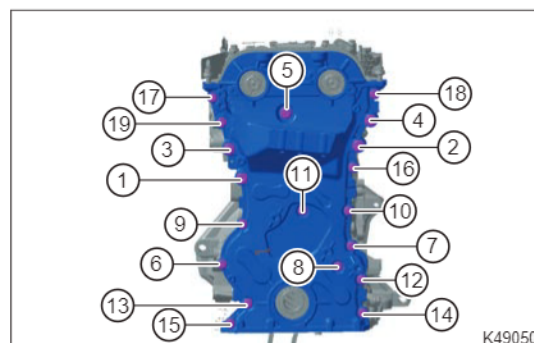


K49049

- (11) Install and tighten 19 cylinder head cover fixing bolts in order shown in illustration.

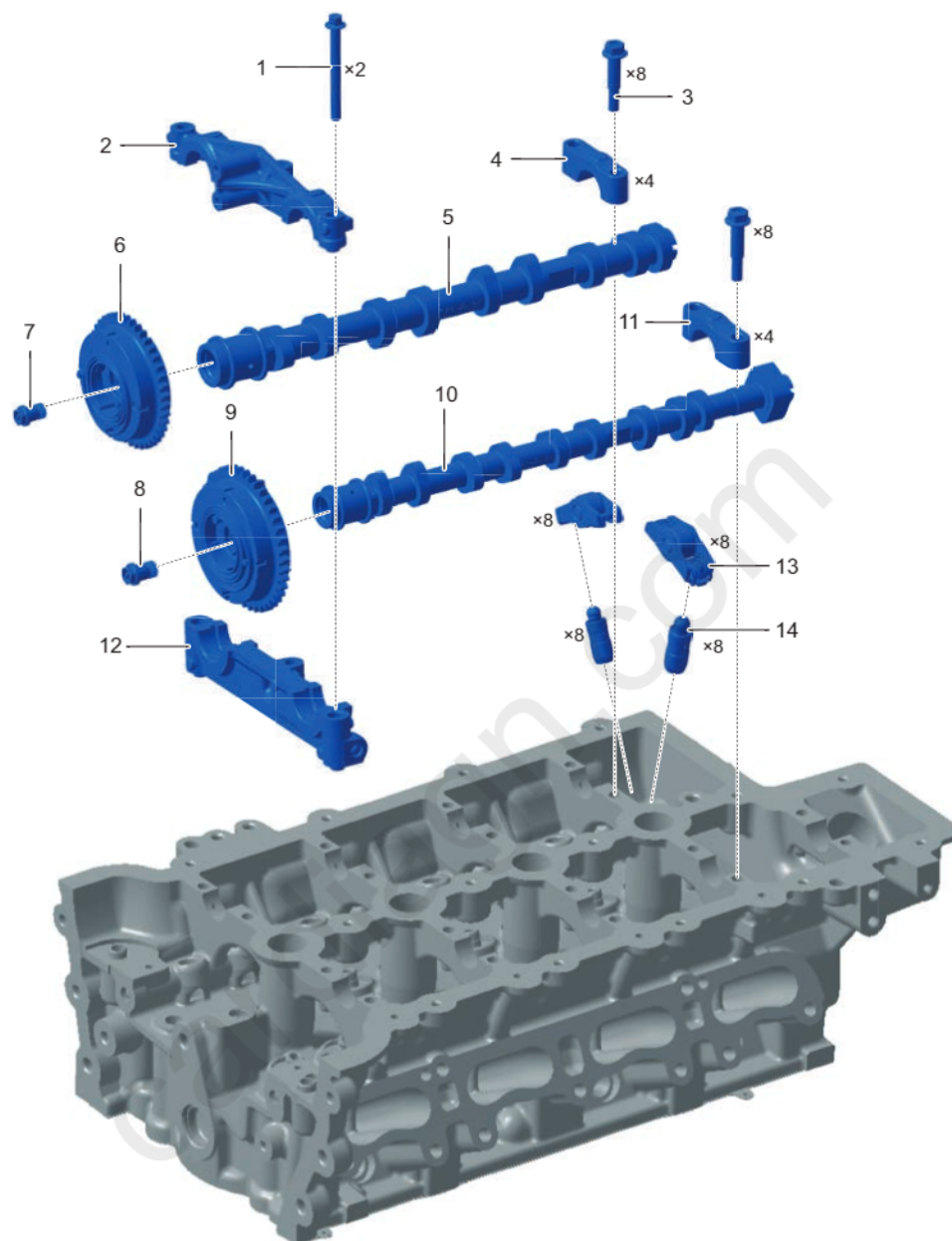
M8x35 Torque: 25 + 5 N·m

M10x45 Torque: 40 + 5 N·m



- (12) Connect the oil pump assembly connector.
 (13) Install the idler pulley assembly.
 (14) Install the torsion shock absorber assembly.
 (15) Install the accessory drive belt tensioner assembly.
 (16) Install the accessory drive belt.
 (17) Install the right mounting cushion assembly.
 (18) Install the engine lower protector assembly.
 (19) Install the phaser magnet.
 (20) Install the cylinder head cover assembly.
 (21) Install the engine trim cover assembly.
 (22) Install the engine compartment trim cover assembly.

5.9 Camshaft & Rocker Arm



K40005001

1	1st Bearing Cap Fixing Bolt	8	Intake Phaser Valve Body Bolt
2	1st Bearing Upper Cap	9	Intake Phaser Assembly
3	Exhaust Camshaft Bearing Cap Fixing Bolt	10	Intake Camshaft Assembly
4	Exhaust Camshaft Bearing Cap	11	Intake Camshaft Bearing Cap
5	Exhaust Camshaft Assembly	12	1st Bearing Lower Cap
6	Exhaust Phaser Assembly	13	Roller Rocker Arm Assembly
7	Exhaust Phaser Valve Body Bolt	14	Hydraulic Lifter Assembly

■ Removal

⚠ Warning

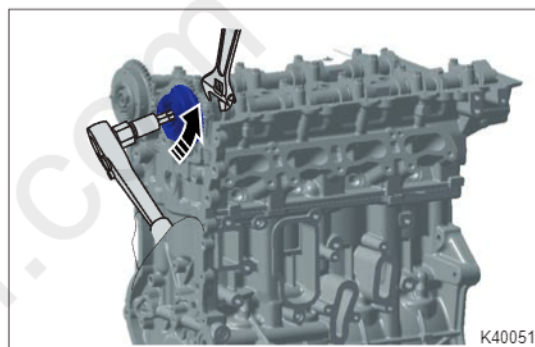
- **Blow dirt and debris away from surface of cylinder head cover with compressed air.**
- **Be sure to wear necessary safety equipment to prevent accidents, when removing camshaft and rocker arm.**
- **Appropriate force should be applied when removing camshaft and rocker arm. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the cylinder head cover.
- (5) Remove the accessory drive belt.
- (6) Remove the engine timing chain.

- (7) Use a proper wrench to hold intake camshaft, and remove fixing bolt from intake phaser in direction of arrow, remove intake phaser.

Hint:

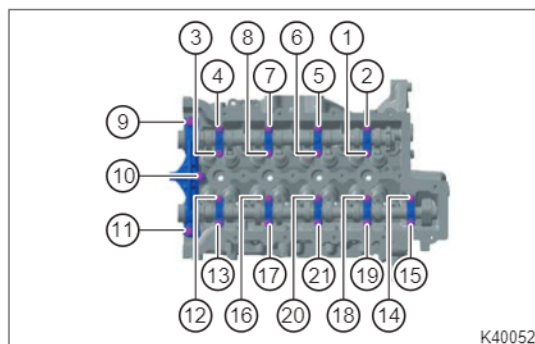
Removal method for exhaust phaser is the same as that of intake phaser.



- (8) Remove intake and exhaust camshaft bearing cap fixing bolts.

Hint:

During removal, loosen fixing bolts in order shown in illustration first, and then remove bolts thoroughly in order.



- (9) Remove the camshaft bearing caps.
- (10) Remove intake and exhaust camshaft.
- (11) Remove rocker arm and hydraulic lifter component.

■ Camshaft Appearance Inspection

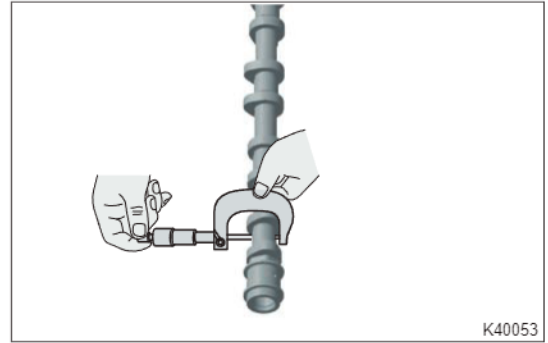
- (1) Check if there are scratches on camshaft surface. If there are scratches, replace camshaft.
- (2) Check if there are leaking holes and cracks on camshaft bearing caps. If so, replace camshaft.

■ Measure camshaft journal diameter with a micrometer

Measurement Item	Specification (mm)
1st journal diameter (same for intake and exhaust sides) (mm)	$\Phi 30$ (-0.066 - 0.050)
2nd - 5th journals (same for intake and exhaust sides)	$\Phi 24$ (-0.053 - 0.040)

Hint:

If camshaft journal diameter is not within specified range, replace intake/exhaust camshaft assembly.



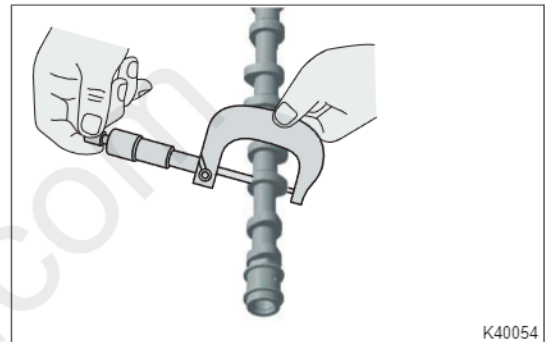
K40053

■ Measure highest point of cam with a micrometer

Measurement Item	Specification (mm)
Cam Flange Height (Highest Point)	Intake: 37.07 - 37.31
	Exhaust: 36.94 - 37.18

Hint:

If cam height is not within specified range, replace intake/exhaust camshaft assembly.



K40054

■ Check camshaft axial clearance

- (1) Perform measurement with roller rocker arm and intake and exhaust phasers not installed.
- (2) Place dial indicator on cylinder head body. Press indicator tip on front end of camshaft, and push camshaft forward and backward. The difference between the two limit reading equals to camshaft axial clearance. It is normal if the difference is between 0.15 and 0.275 mm.

■ Check hydraulic lifter

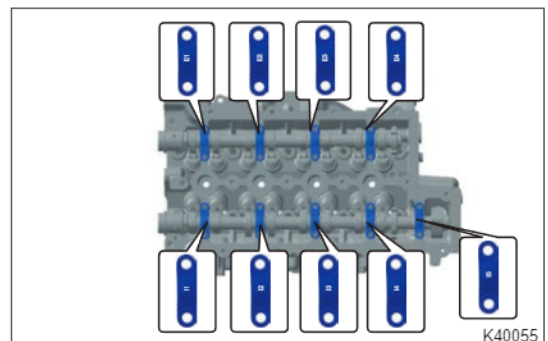
- (1) Check if end surface and cylindrical operating surface of hydraulic lifter are normal.
- (2) Check if hydraulic lifter slides smoothly in cylinder head guide hole.
- (3) Check each hydraulic lifter for weakness. If exists, remove and soak it for 24 hours, then press the hydraulic lifter plunger. If the plunger can be clearly pushed, it means that the tappet is "soft" and the hydraulic tappet can be replaced.

■ Installation

- (1) Clean intake and exhaust camshafts and camshaft bearing caps.
- (2) Apply engine oil to camshaft cam surface and add a proper amount of engine oil to camshaft bearing hole.
- (3) Install intake, exhaust camshaft assemblies and intake and exhaust camshaft bearing caps.

Hint:

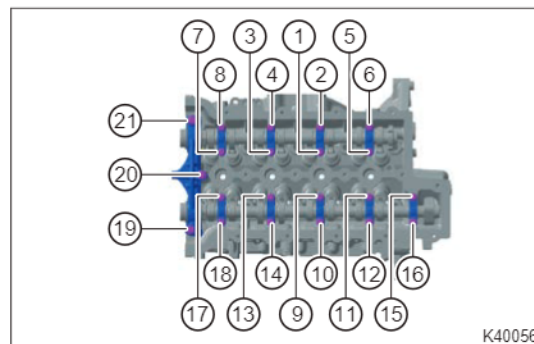
- Install according to marks on bearing cap: "I" indicates intake camshaft bearing cap and "E" indicates exhaust camshaft bearing cap.



K40055

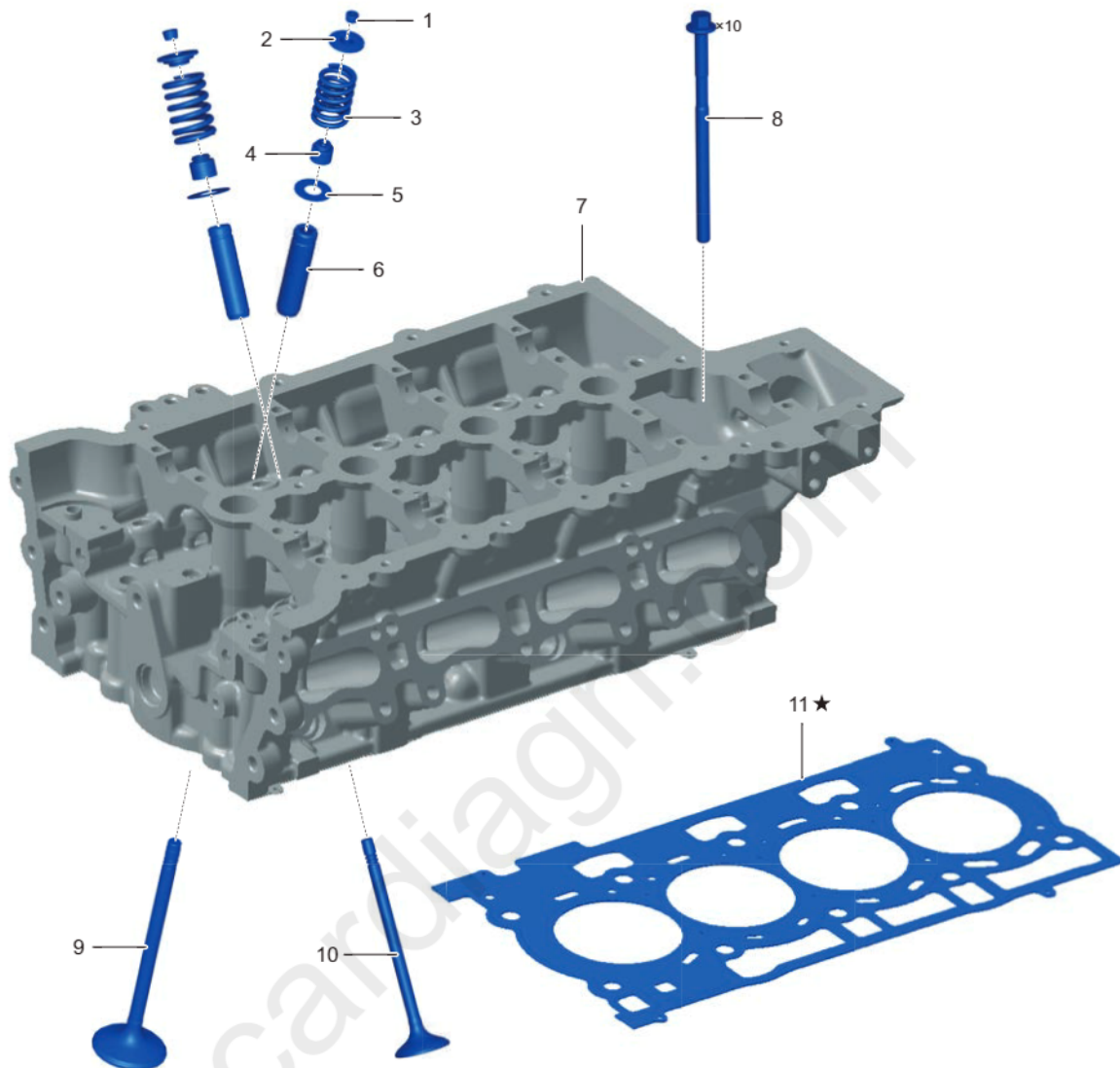
- (4) Tighten the camshaft bearing cap fixing bolt manually then tighten camshaft bearing cap fixing bolt.

Torque: For the 1st bearing cap fixing bolt 20 + 3 N·m, for bearing cap bolt 8 + 3 N·m



- (5) Install the engine timing chain.
(6) Install the accessory drive belt.
(7) Install the cylinder head cover.
(8) Install the engine trim cover assembly.
(9) Install the engine compartment trim cover assembly.

5.10 Cylinder Head



★ : Indicates that it is a non-reusable part

K40057

1	Valve Cotter	7	Cylinder Head
2	Valve Spring Upper Seat	8	Cylinder Head Bolt
3	Valve Spring	9	Exhaust Valve
4	Valve Oil Seal	10	Intake Valve
5	Valve Spring Lower Seat	11	Cylinder Gasket
6	Valve Guide	★	Non-reusable Part

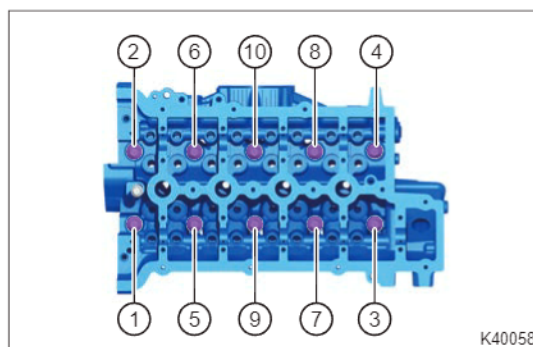
■ Removal

⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing cylinder cover.**
- **Appropriate force should be applied when removing cylinder cover. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Drain the engine oil
- (5) Drain the coolant.
- (6) Remove the battery assembly.
- (7) Remove the battery tray assembly.
- (8) Remove the intake hose assembly.
- (9) Remove the air filter assembly.
- (10) Remove the cooling pipe assembly.
- (11) Remove expansion tank inlet pipe assembly.
- (12) Remove the intake manifold assembly.
- (13) Remove the fuel rail injector assembly.
- (14) Remove the precataltic converter assembly.
- (15) Remove the turbocharger assembly.
- (16) Remove the accessory drive belt.
- (17) Remove the tensioner assembly.
- (18) Remove the idler pulley assembly.
- (19) Remove the cylinder head cover.
- (20) Remove the timing chain cover.
- (21) Remove the engine timing chain.
- (22) Remove camshaft and rocker arm.

- (23) Remove 10 fixing bolts from cylinder cover in order shown in illustration.



⚠ Caution

- **When engine is in high temperature, removal and installation may cause deformation to cylinder head, so perform removal and installation at normal temperature.**
- **Failure to remove cylinder head bolts in order may cause cylinder head deformation.**
- **Make scraping marks on removed cylinder head bolt, and they cannot be reused.**

- (24) Remove cylinder head assembly and cylinder head gasket.



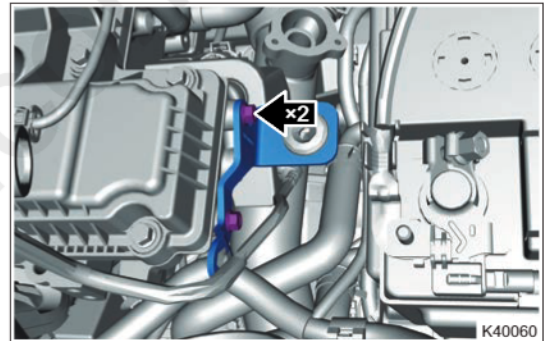
K40059

⚠ Caution

- **DO NOT** reuse the removed cylinder head gasket, and it is necessary to replace with a new one.
- **Be careful not to lose cylinder head mounting dowel pin during removal.**

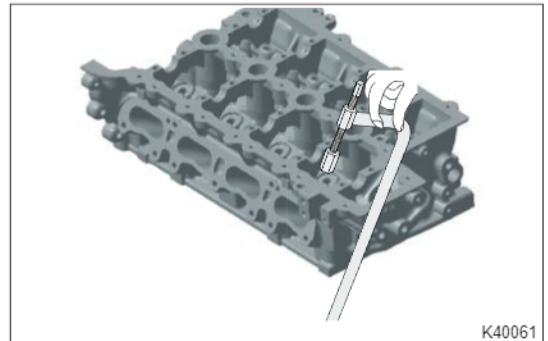
■ Disassembly

- (1) Remove 2 fixing bolts and bracket.



K40060

- (2) Using a valve spring compressor, compress valve spring to a position so that valve cotter can be removed.



K40061

- (3) Using a magnetic rod, remove valve cotter.

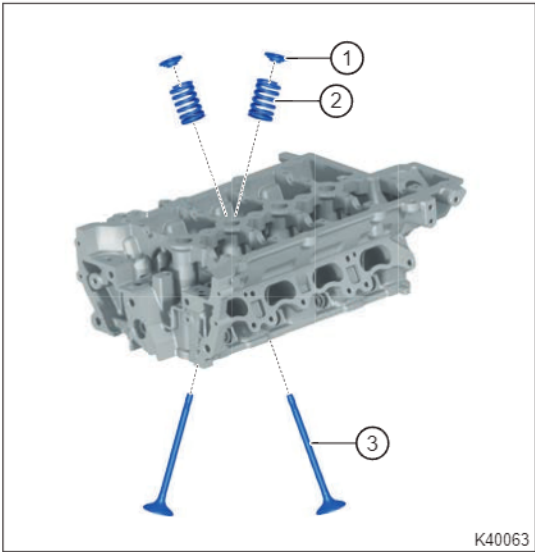
Hint:

Due to the valve cotter is small, please operate carefully when operating it, so as to avoid loss.



K40062

- (4) Remove valve spring upper seat (1), valve spring (2) and intake and exhaust valve (3) from cylinder head.



- (5) Using a valve oil seal remover, remove the valve oil seal.



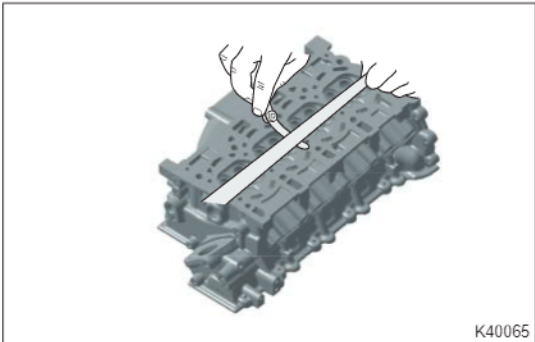
- (6) Using a magnetic rod, remove valve spring lower seat.

■ Check cylinder head

- (1) Check the appearance.
- 1) Remove carbon deposits inside valve guides with cleaner.
 - 2) Make sure valve stem can move and rotate freely in its mounting hole.
- (2) Using a precision straightedge and feeler gauge, check cylinder head flatness.

Measurement Item	Specification (mm)
Cylinder Head Flatness	0.04

Hint:
If cylinder head flatness is not within specified range, replace cylinder head assembly.

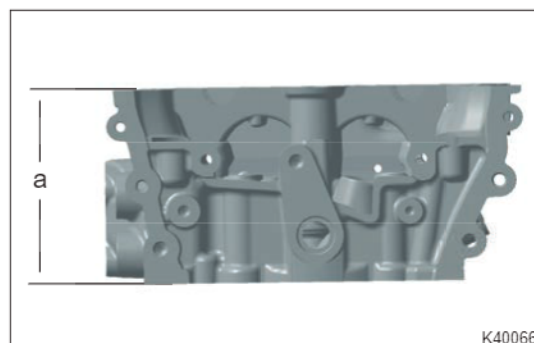


- (3) Using a precision straightedge, measure cylinder head height a.

Measurement Item	Specification (mm)
Cylinder Head Height	136.9

Hint:

If cylinder head height is not within specified range, replace cylinder head assembly.



K40066

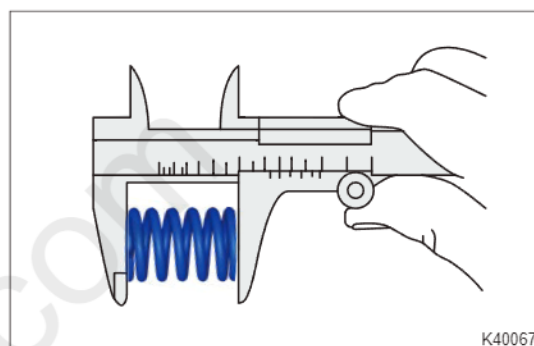
■ Check valve spring

- (1) Using a vernier caliper, measure free length of valve spring and length of valve spring under the pre-pressure of $(230 \pm 11 \text{ N})$.

Measurement Item	Specification (mm)
Valve Spring Free Length	45.4 ± 2
Valve Spring Length Under Pre-pressure	Intake: 36.5
	Exhaust: 34.8

Hint:

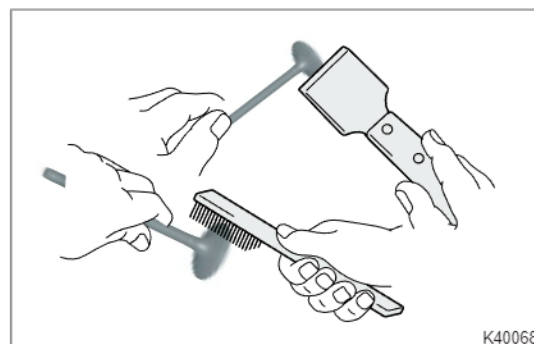
If valve spring length is not within specified range, replace valve spring.



K40067

■ Check valve

- (1) Clean the valve.
- 1) Using a scraper, remove carbon deposited on valve head.
 - 2) Using a thin and soft wire brush, clean the valve thoroughly.



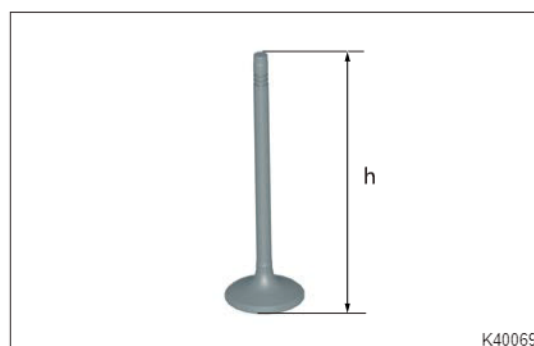
K40068

- (2) Using a micrometer, measure the valve height h.

Measurement Item	Specification (mm)
Intake Valve	107.86 ± 0.25
Exhaust Valve	109.06 ± 0.25

Hint:

If valve height is less than specified value, replace valve.



K40069

(3) Check the valve head.

- 1) Measure margin thickness (a) of valve head.
- 2) Measure width (b) of valve face.

Measurement Item	Specification (mm)
Valve Head Margin Thickness (Intake)	1.3 ± 0.15
Valve Head Margin Thickness (Exhaust)	1.4 ± 0.15
Valve Face Width (Intake)	2.12
Valve Face Width (Exhaust)	3.12

Hint:

If valve head margin thickness and face width are not within specified range, replace valve.

(4) Using a micrometer, measure the valve stem diameter.

- 1) Measure margin thickness (a) of valve head.
- 2) Measure width (b) of valve face.

Measurement Item	Size and Tolerance (mm)
Valve Stem Diameter (Intake)	$\Phi 5.98 \pm 0.007$
Exhaust Valve Stem Diameter (Exhaust)	$\Phi 5.96 \pm 0.007$

Hint:

If valve stem diameter is not within specified range, check clearance between valve stem and valve guide.

(5) Check clearance between valve stem and valve guide.

- 1) Using a caliper gauge, measure inner diameter of valve guide.

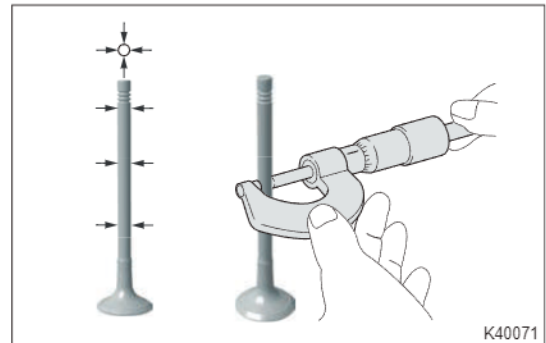
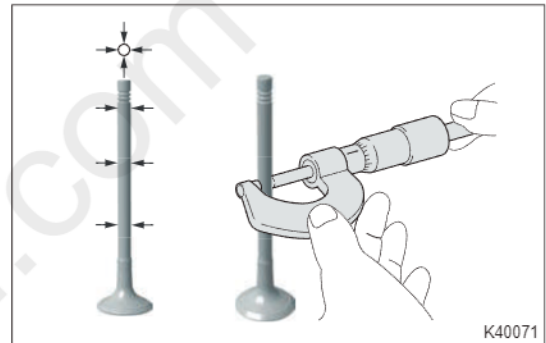
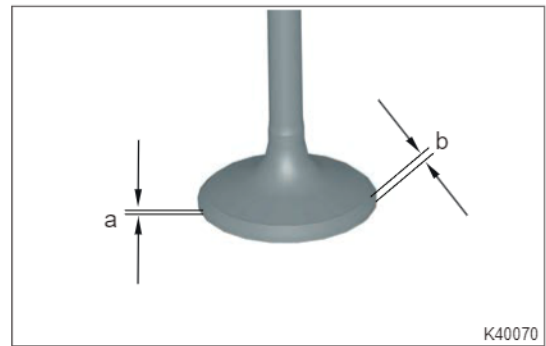
Measurement Item	Size and Tolerance (mm)
Valve Guide Inner Diameter	$\Phi 6 (0, +0.015)$

- 2) Clearance between valve stem and valve guide = Valve guide inner diameter - Valve stem diameter.

Measurement Item	Specification (mm)
Clearance Between Intake Valve and Valve Guide	0.013 - 0.042
Clearance Between Exhaust Valve and Valve Guide	0.033 - 0.062

Hint:

If clearance between valve and valve guide is not within specified range, replace valve or valve guide.

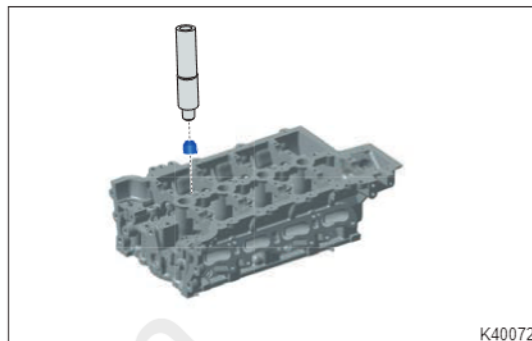


■ Assembly

⚠ Caution

- Apply lubricant to valve oil seal lip before installing valve oil seal.
- Before installing valve spring, check valve spring lower seat for proper installation.
- Clean all components to be assembled thoroughly before assembly.

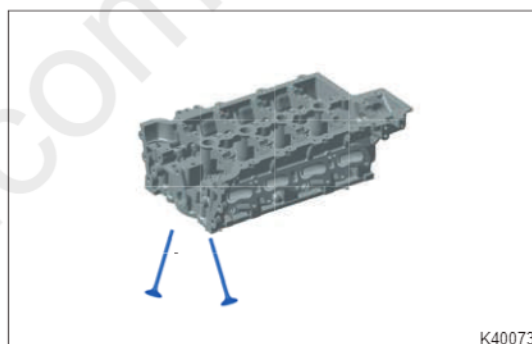
- (1) Install valve spring lower seat to valve guide end to fit it with cylinder head.
- (2) Install valve oil seal to valve oil seal special tool and press it on valve guide. Tap the tool end with a hammer to press in oil seal.



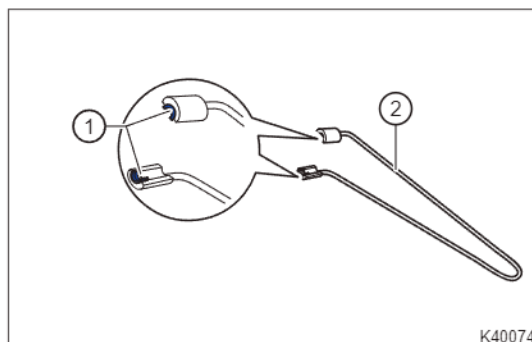
- (3) Clean valve surface, install exhaust valve into cylinder head guide hole.

Hint:

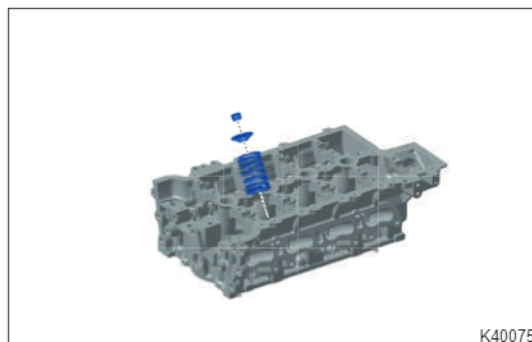
Slightly rotate valve collar until valve conical face fully contacts retainer conical face.



- (4) Install valve cotter (1) to valve cotter installer (2).



- (5) Install valve spring (1) and valve spring upper seat (2). Using a valve spring compressor, compress valve spring to a position so that valve cotter can be installed; Using a valve cotter installer, install valve cotter (3) in place.



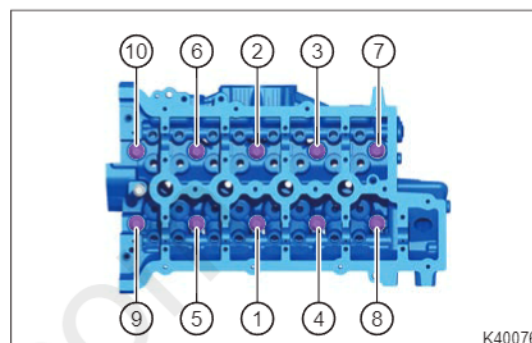
- (6) Tap tip of valve stem lightly with a rubber hammer to make sure valve cotter is installed in place after assembly.

■ Installation

⚠ Caution

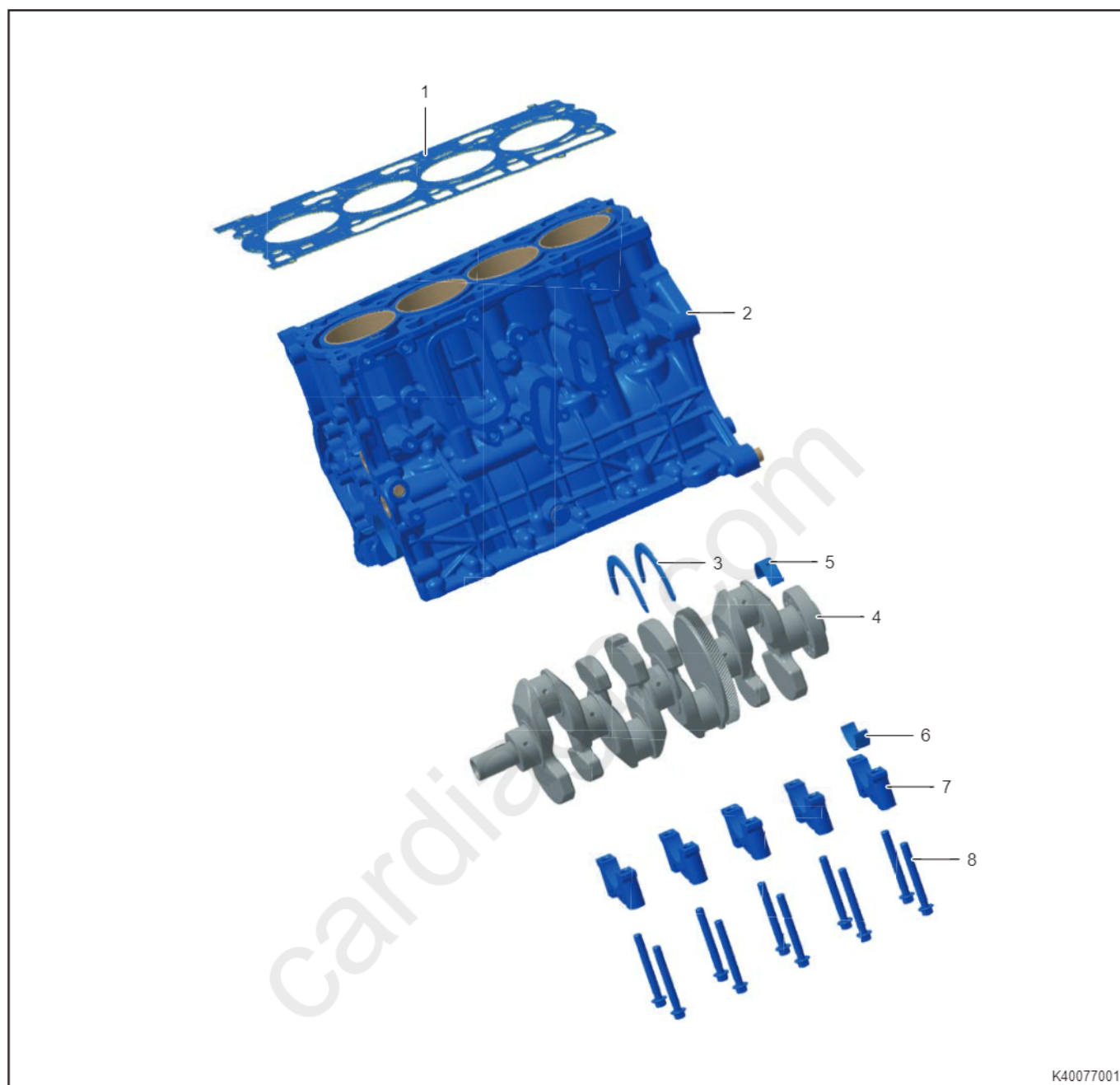
- **DO NOT** damage or lose dowel pin on cylinder block.
- **Remove** residual oil on cylinder head and cylinder block.
- **Replace** cylinder head gasket with a new one.
- **Check** that cylinder head gasket is neat and clean without any chips and scratches.
- **Clean** junction surface between cylinder head and combustion chamber, and remove any accumulated oil at bottom of cylinder block thread.
- **Replace** cylinder head fixing bolt, and make scraping marks on removed cylinder head bolt.

- (1) Tighten bolts in place by hands.
- (2) 1st step: Tighten bolts to $55 \pm 5 \text{ N}\cdot\text{m}$ in order from (1) to (10) shown in illustration.
- (3) 2nd step: Rotate bolts clockwise by $100^\circ \pm 5^\circ$ in tightening order.
- (4) 3rd step: Rotate bolts clockwise by $70^\circ \pm 5^\circ$ in tightening order again.



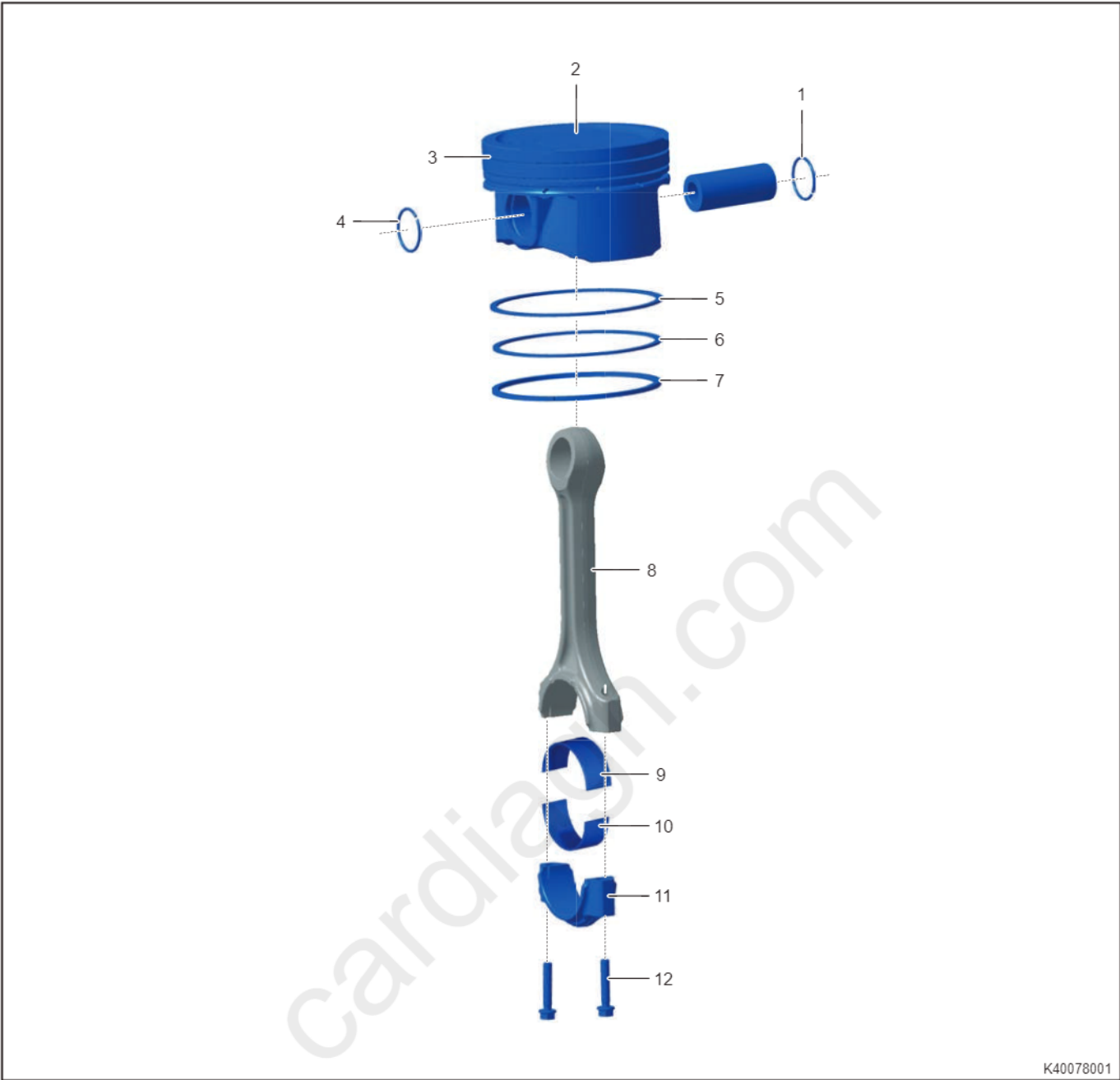
- (5) Install the camshaft and rocker arm.
- (6) Install the engine timing chain.
- (7) Install the cylinder head cover.
- (8) Install the idler pulley assembly.
- (9) Install the tensioner assembly.
- (10) Install the accessory drive belt.
- (11) Install the turbocharger assembly.
- (12) Install the precatlytic converter assembly.
- (13) Install the fuel rail injector assembly.
- (14) Install the intake manifold assembly.
- (15) Install the cooling pipe assembly.
- (16) Install the intake hose assembly.
- (17) Install the battery tray.
- (18) Install the battery assembly.
- (19) Install the air filter assembly.
- (20) Add the coolant as specified.
- (21) Add the engine oil as specified.
- (22) Install the engine trim cover assembly.
- (23) Install the engine compartment trim cover assembly.

5.11 Cylinder Block



K40077001

1	Cylinder Gasket	5	Crankshaft Main Bearing Upper Shell
2	Cylinder Block	6	Crankshaft Main Bearing Lower Shell
3	Thrust Washer	7	Main Bearing Cap
4	Crankshaft	8	Main Bearing Cap Fixing Bolt



K40078001

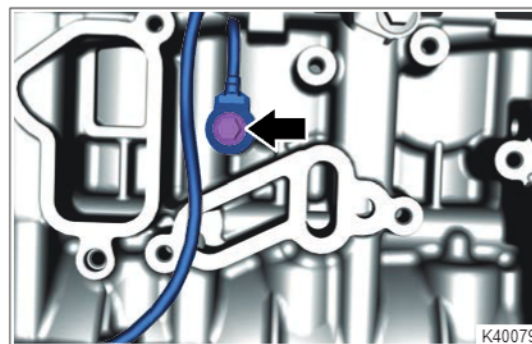
1	Elastic Circlip	7	Oil Ring Assembly
2	Piston pin	8	Connecting Rod Assembly
3	Piston	9	Connecting Rod Bearing Upper Shell
4	Elastic Circlip	10	Connecting Rod Bearing Lower Shell
5	First Compression Ring - Piston	11	Connecting Rod Bearing Cap
6	Second Compression Ring - Piston	12	Connecting Rod Bearing Cap Fixing Bolt

■ Removal

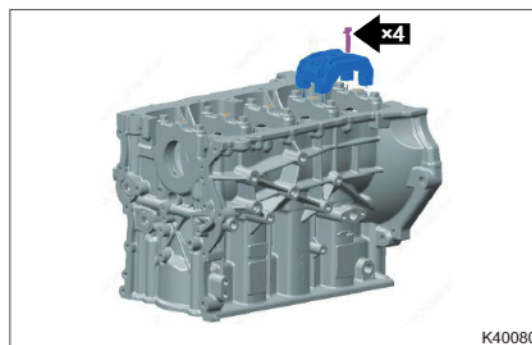
⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing cylinder block.**
- **Appropriate force should be applied when removing cylinder block. Be careful not to operate roughly.**

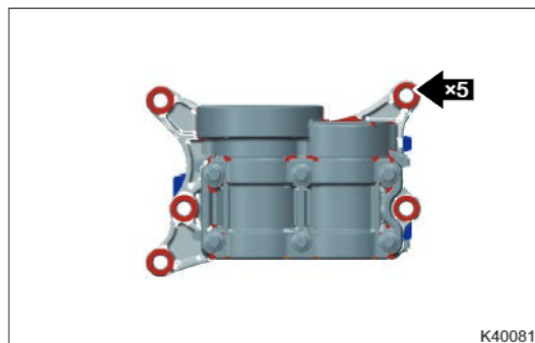
- (1) Remove engine assembly from vehicle.
- (2) Separate transmission from engine.
- (3) Remove the flywheel assembly.
- (4) Remove the turbocharger assembly.
- (5) Remove the turbocharger oil inlet pipe.
- (6) Remove the turbocharger oil return pipe.
- (7) Remove the intake manifold assembly.
- (8) Remove the accessory drive belt.
- (9) Remove the idler pulley assembly.
- (10) Remove the tensioner assembly.
- (11) Remove the torsion shock absorber.
- (12) Remove the water pump module assembly.
- (13) Remove the oil filter.
- (14) Remove the A/C compressor bracket.
- (15) Remove the oil pan assembly.
- (16) Remove the engine timing chain.
- (17) Remove the oil pump chain.
- (18) Remove the cylinder head assembly.
- (19) Remove the oil pump assembly.
- (20) Remove the knock sensor fixing bolt and remove the knock sensor.



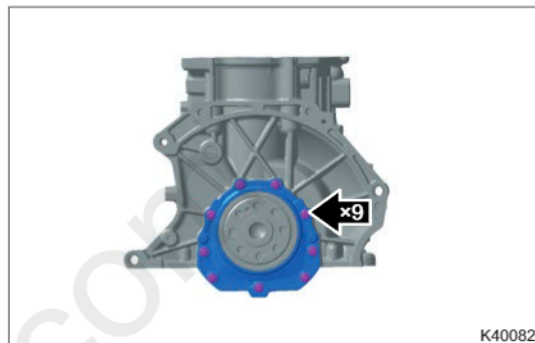
- (21) Remove 4 fixing bolts and connecting bracket.



- (22) Remove 5 fixing bolts and balance shaft with housing assembly.



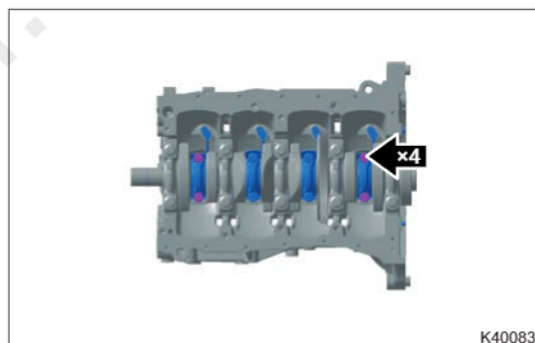
- (23) Remove 9 fixing bolts and crankshaft rear oil seal bracket.



- (24) Turn crankshaft, so that of cylinders 1 and 4 are at bottom dead center, remove fixing bolts from connecting rod bearing caps of cylinders 1 and 4, and remove connecting rod bearing caps of cylinders 1 and 4.

Hint:

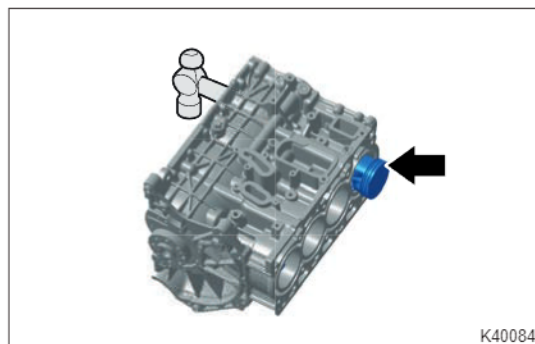
Removal procedures of cylinders 2 and 3 are the same as cylinders 1 and 4.



- (25) Using a hammer handle, push out piston connecting rod assembly from cylinder block.

Hint:

- Please operate carefully when pushing out piston, to avoid cylinder liner damage.
- Mark the removed piston connecting rod assemblies, so as to distinguish them.
- Replace with new connecting rod bearing cap bolts during assembly.

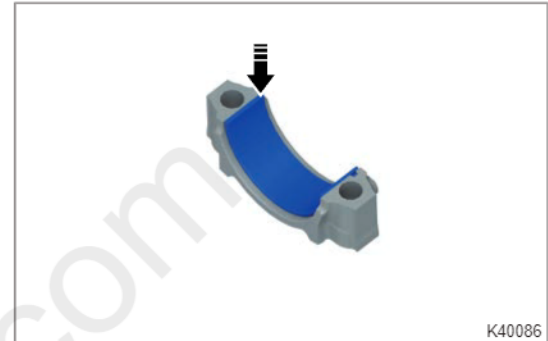


- (26) Push out upper shell from connecting rod body slightly in direction of arrow to remove it.



K40085

- (27) Push out bearing lower shell slightly from connecting rod bearing cap in direction of arrow to remove it.

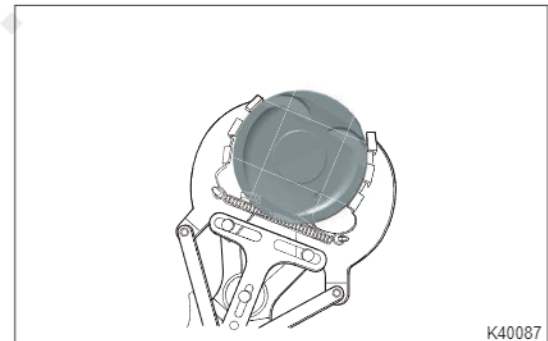


K40086

- (28) Using a piston ring remover, remove first compression ring and second compression ring.

Hint:

Before removing piston ring, check piston ring side clearance; If it is necessary to be reused, be sure to mark piston ring position.



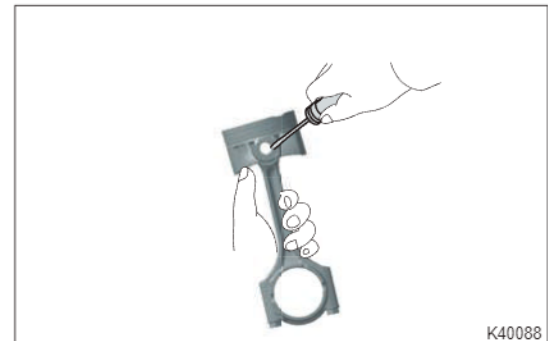
K40087

- (29) Remove oil ring rail and expander.

- (30) Using a flat tip screwdriver, pry out elastic circlips at both sides of piston pin carefully from notch.

⚠ Caution

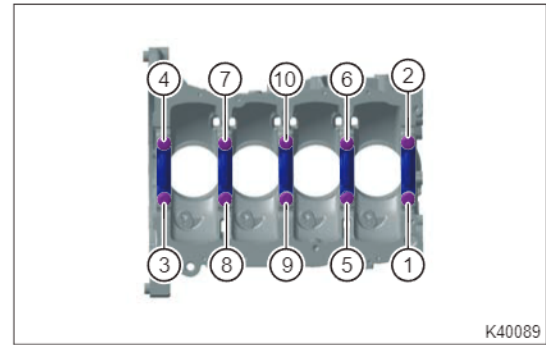
- **Elastic circlip has a large tensile force. Be careful during removal to prevent personal injury.**



K40088

- (31) Remove the piston pin assembly.

- (32) Remove 10 fixing bolts from crankshaft main bearing cap in order as shown in illustration.

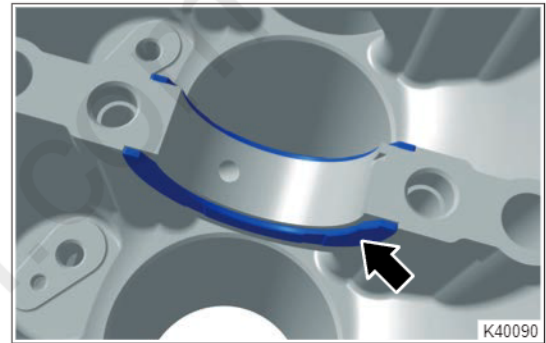


- (33) Remove the crankshaft assembly.

Hint:

Take care when removing crankshaft, ask other operators to assist when necessary. Avoid scratching contact surfaces between crankshaft and bearing shell.

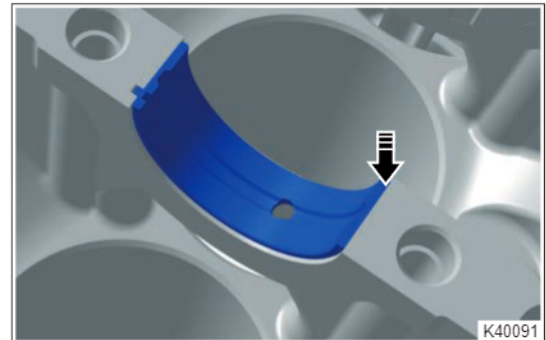
- (34) Remove crankshaft thrust washers from cylinder block.



- (35) Push out main bearing upper shell slightly from cylinder block in direction of arrow to remove it.

Caution

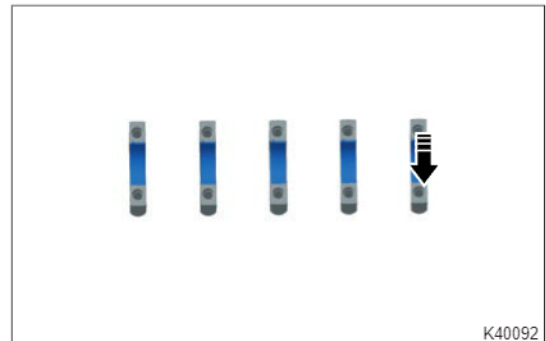
- Pay attention to the notch position. Push out bearing shell carefully. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.



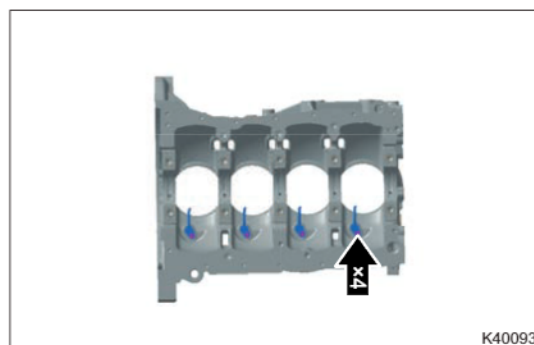
- (36) Push out main bearing lower shell slightly from main bearing cap in direction of arrow to remove it.

Caution

- Pay attention to the notch position. Push out bearing shell carefully. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.



(37) Remove 4 fixing bolts and piston cooling nozzles.



K40093

■ Inspection

(1) Check the cylinder block appearance.

- 1) Clean engine block thoroughly and check all hole passages for leakage.
- 2) Check cylinder liner for cracks.
- 3) Check cylinder block for cracks.

Hint:

DO NOT wash cylinder at high temperature; otherwise, cylinder liner will stick out beyond cylinder block.

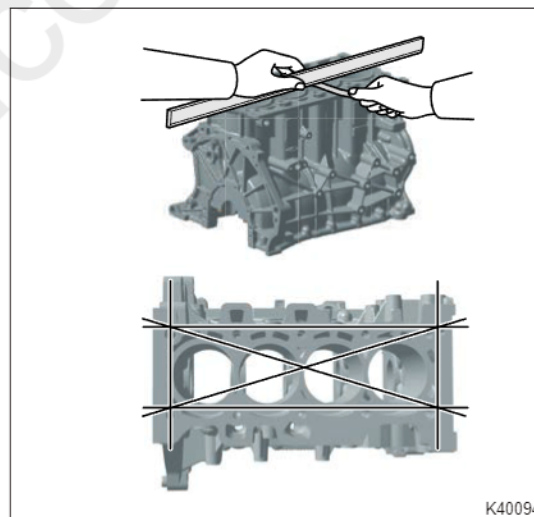
(2) Check the cylinder block upper surface flatness.

- 1) Clean the cylinder block upper surface, using precision straightedge and feeler gauge, measure cylinder block upper surface flatness.

Measurement Item	Specification (mm)	Limit Value (mm)
Cylinder Block Upper Surface Flatness	0.04	0.1

Hint:

Never grind the cylinder block upper surface. If the engine block upper surface flatness is above the limit, replace the engine block.



K40094

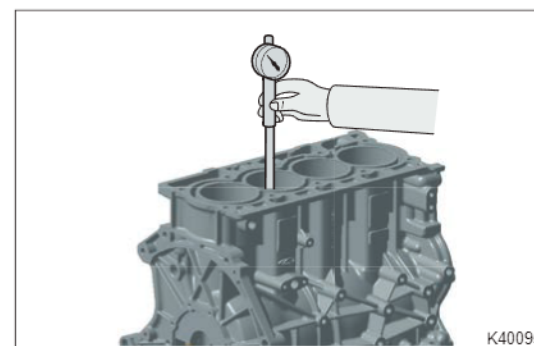
(3) Check cylinder diameter and piston clearance.

- 1) Using a cylinder gauge, measure cylinder diameter and calculate the gap between cylinder and piston.

Measurement Item	Specification (mm)	Limit Value (mm)
Cylinder Diameter	80.5	80.513
Clearance Between Piston and Cylinder	0.04	0.063

Hint:

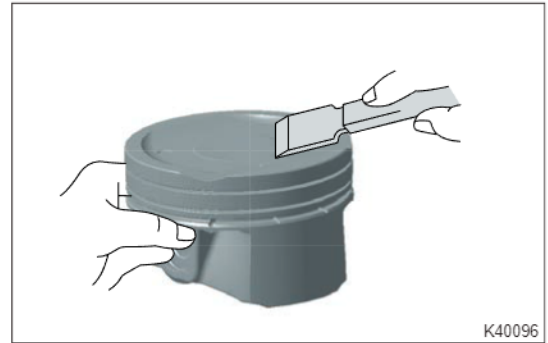
If the cylinder diameter is beyond the limit, replace the cylinder block. If the clearance between piston and cylinder is beyond the specified value, check cylinder diameter and piston diameter. Replace as necessary.



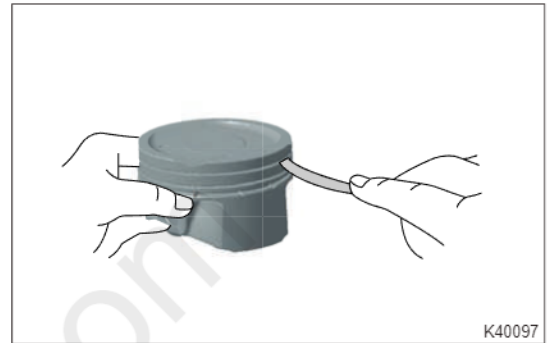
K40095

(4) Check piston

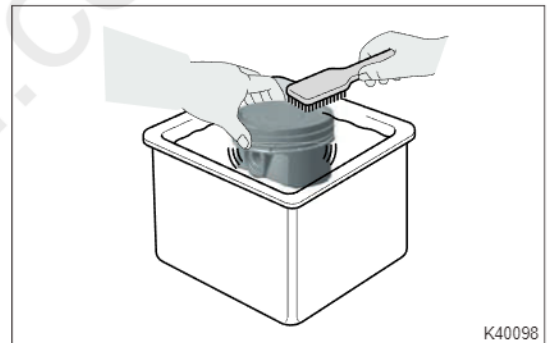
- 1) Using a scraper, remove carbon deposits on piston top.



- 2) Using a piston ring, remove carbon deposits from piston ring grooves.



- 3) Using a brush and solvent, thoroughly clean piston.



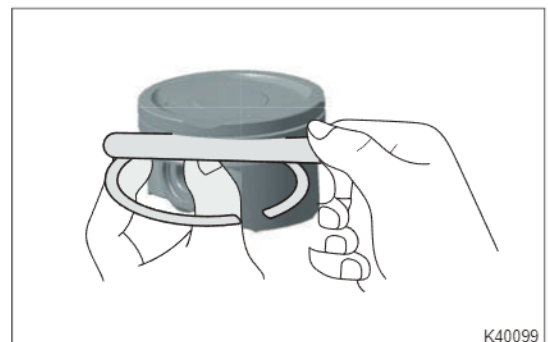
- (5) Check piston ring

- 1) Using a feeler gauge, measure clearance between new piston ring and ring groove side.

Measurement Item	Specification (mm)
First compression ring groove side clearance	0.035 - 0.075
Second compression ring groove side clearance	0.03 - 0.07

Hint:

If piston ring side clearance exceeds specified range, replace piston ring and piston assembly.

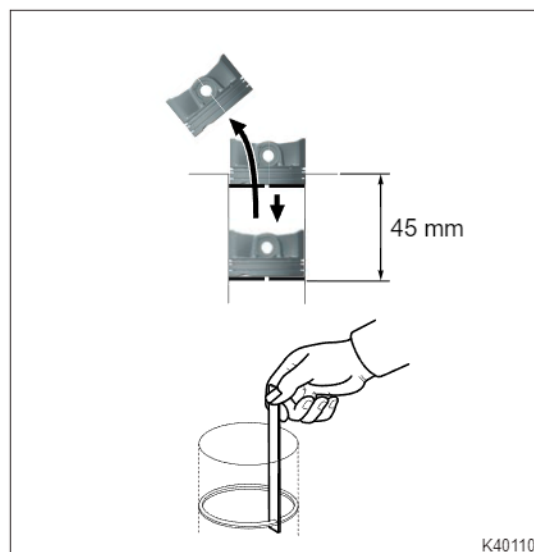


- 2) Using a piston, push piston ring from top of cylinder to bottom of cylinder bore, that is 45 mm from bottom of cylinder bore. Keep the piston ring level.
- 3) Measure at the specified position, which has the minimum piston ring wear with a feeler gauge.

Measurement Item		Limit Value (mm)
Piston Ring End Gap	First ring	0.2 - 0.39
	Second ring	0.4 - 0.6

Hint:

- If piston ring end gap is not within specified range, replace piston ring with a new set.
- If end gap is still not within specified range after replacement, replace cylinder block assembly.



K40110

(6) Check piston pin

- 1) Using a feeler gauge, measure diameter of piston pin hole.

Measurement Item	Specification (mm)
Piston Pin Hole Diameter	22.004 - 22.009

Hint:

If piston pin hole diameter is not within specified range, replace piston.



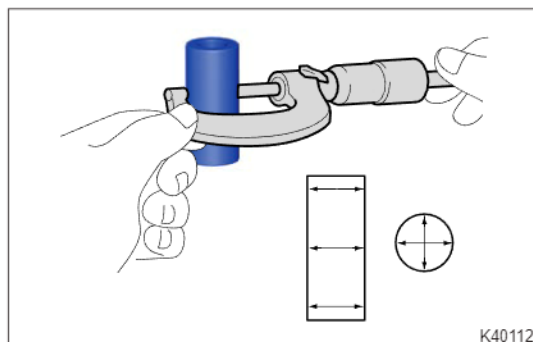
K40111

- 2) Using an external micrometer, measure diameter of piston pin.

Measurement Item	Specification (mm)
Piston Pin Diameter	21.995 - 22

Hint:

If piston pin diameter is not within specified range, replace piston.



K40112

(7) Check crankshaft main journal diameter

- 1) Measure crankshaft main bearing diameter with an external micrometer, and measure again after rotating the crankshaft 90°.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Main Journal Diameter	52	51.981

Hint:

- If crankshaft main journal diameter is not within specified range, replace main bearing shells with new ones and check matching clearance of crankshaft main bearing.
- If matching clearance of main bearing is still not within specified range after replacing with new main bearing shells, replace crankshaft.

- (8) Check matching clearance of crankshaft main bearing

- 1) Clean crankshaft main journals and main bearing shells.
- 2) Install the crankshaft. Place feeler gauge (1) on crankshaft main journal, parallel to crankshaft center axis and as wide as distance covered by main bearing cap.
- 3) Install main bearing cap and tighten main bearing cap fixing bolts to specified torque.

Torque: 1st step: 60 ± 5 N·m, 2nd step: 120° ± 5°

- 4) Remove the main bearing cap; Using a feeler gauge, measure widest part of compressed feeler gauge. Measured value is matching clearance of crankshaft main bearing.

Measurement Item	Specification (mm)
Matching Clearance of Crankshaft Main Bearing	0.020 -0.048

Hint:

- If matching clearance of crankshaft main bearing is not within specified range, install new main bearing shells; Replace crankshaft assembly if necessary.
- Replace bearing shells in pairs.

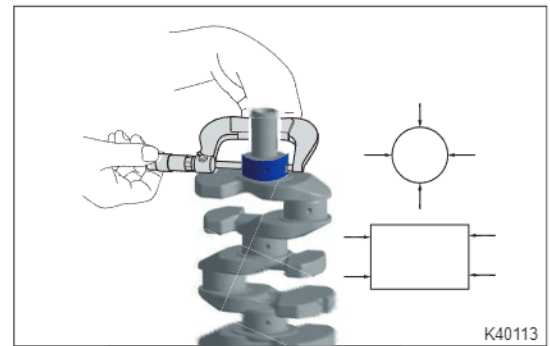
- (9) Check crankshaft axial clearance

- 1) Clean crankshaft main journals and main bearing shells.
- 2) Install main bearing cap and tighten main bearing cap fixing bolts to specified torque.

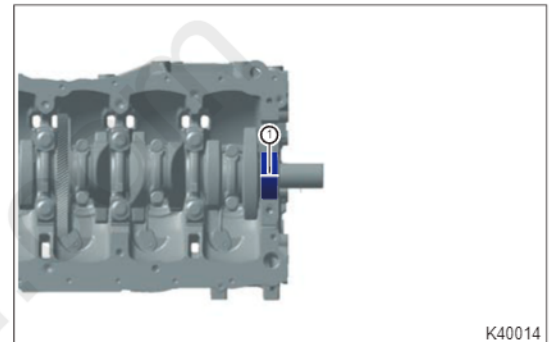
Torque: 1st step: 60 ± 5 N·m, 2nd step: 120° ± 5°

- 3) Using a flat tip screwdriver, pry crank position left and right, and read value on dial indicator.

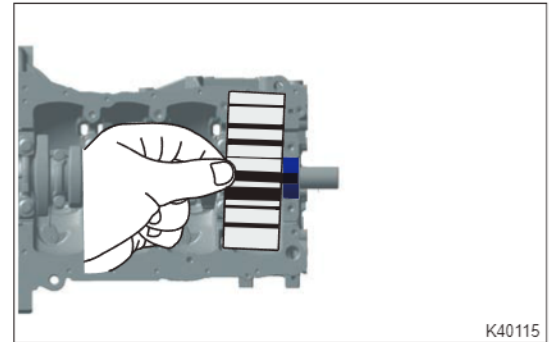
Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Axial Clearance	0.120 - 0.315	0.315



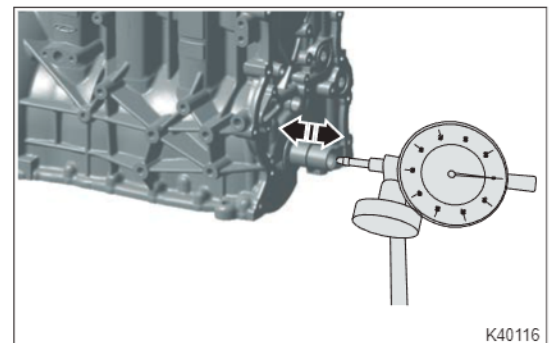
K40113



K40114



K40115



K40116

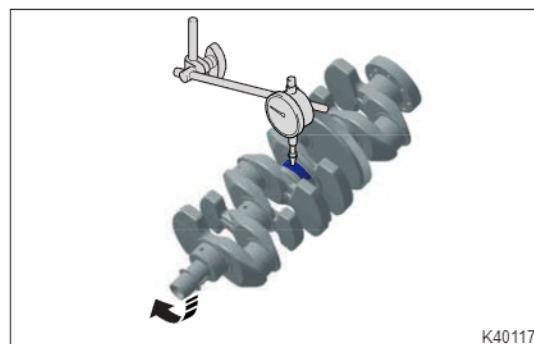
(10) Check crankshaft main journal coaxiality

- 1) Install crankshaft onto tester and keep it level.
- 2) Rotate crankshaft slowly and read maximum change value from dial indicator. (Readings on dial indicator)/ 2 is the coaxiality of crankshaft main journal.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Main Journal Coaxiality	0	0.05

Hint:

If crankshaft main journal coaxiality is not within specified range, replace crankshaft assembly.



K40117

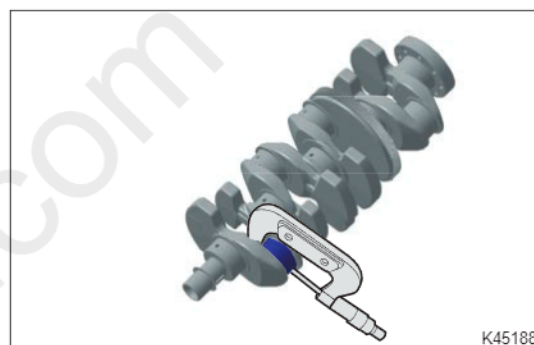
(11) Measure diameter of crankshaft connecting rod journal

- 1) Using an external micrometer, measure diameter of crankshaft connecting rod journal.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Connecting Rod Journal Diameter	50	49.984

Hint:

- If connecting rod journal diameter is not within specified range, replace connecting rod bearing shells with new ones, and check radial clearance of connecting rod bearing shell.
- If radial clearance of connecting rod bearing shell is still not within specified range after replacement, replace crankshaft.



K45188

(12) Check radial clearance of crankshaft connecting rod bearing shell

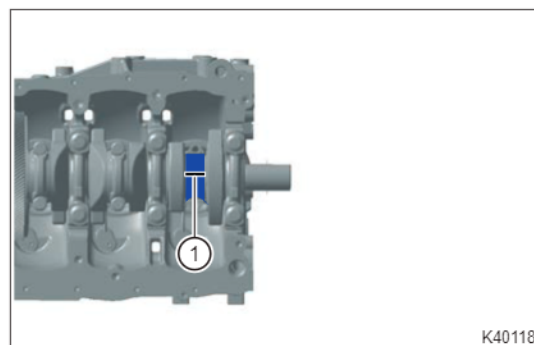
- 1) Clean connecting rod journals and connecting rod bearing shells.
- 2) Place a feeler (1) on connecting rod journal.
- 3) Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: $25 \pm 3 \text{ N}\cdot\text{m}$, 2nd step: $90^\circ \pm 5^\circ$

Hint:

DO NOT turn crankshaft during installation.

- 4) Remove the connecting rod bearing cap.



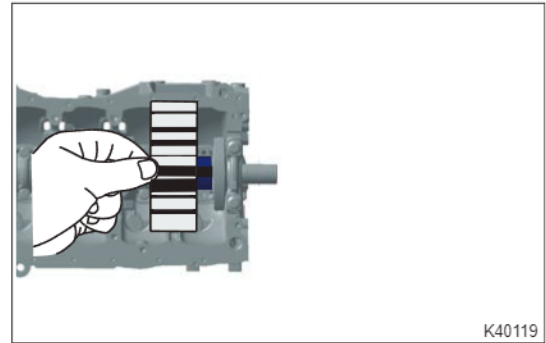
K40118

- 5) Using gauge scale of feeler gauge, measure the widest part of compressed feeler gauge to obtain radial clearance of connecting rod bearing shell.

Measurement Item	Specification (mm)
Connecting Rod Bearing Shell Radial Clearance	0.035 - 0.067

Hint:

If radial clearance of connecting rod outer diameter is not within specified range, replace connecting rod bearing shells. Replace crankshaft assembly if necessary.



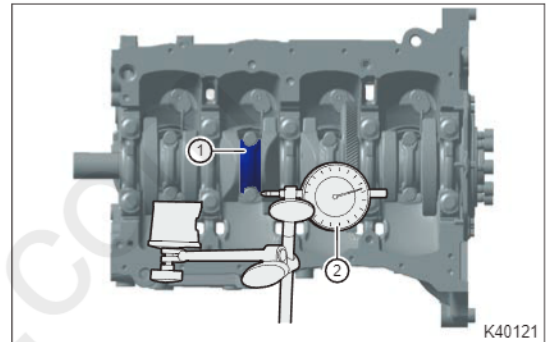
K40119

- (13) Check axial clearance of connecting rod

- 1) Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: 25 ± 3 N·m, 2nd step: $90^\circ \pm 5^\circ$

- 2) Install a dial indicator (2) with its plunger contacting the side of connecting rod cap (1) Reset dial of dial indicator to zero.
3) Push connecting rod bearing cap forward and backward (do not move crankshaft forward and backward) and read value on dial indicator.



K40121

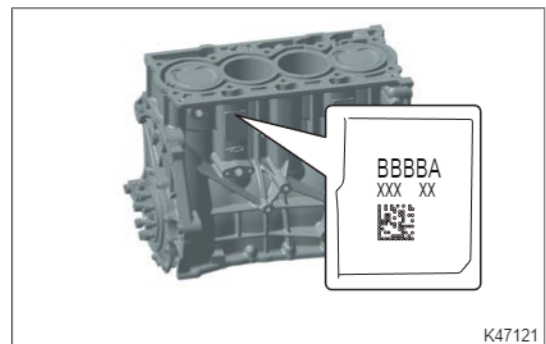
Measurement Item	Specifications
Connecting Rod Axial Clearance	0.15 - 0.40

Hint:

If axial clearance of connecting rod is not within specified range, replace piston connecting rod assembly. Replace crankshaft assembly if necessary.

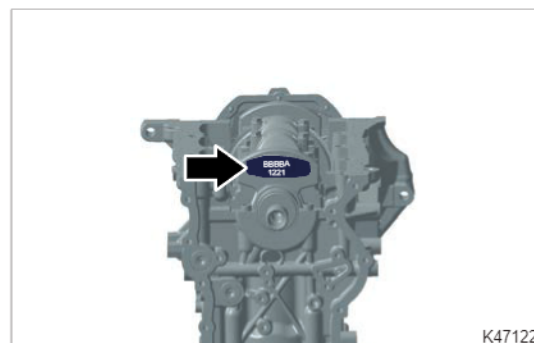
■ Selection of Main Bearing Shell

- (1) Related letter marks are available on cylinder block (- consisting of A, B, C). Such as "BBBBB" in illustration, each letter from left to right is corresponding to the size of each cylinder block main bearing hole. First letter "B" indicates the first main bearing hole and the fifth letter "A" indicates the fifth main bearing hole.



K47121

- (2) Related letter marks are available on first balancer at front end of crankshaft (consisting of A, B, C). Such as "BBBBB" in illustration, each letter from left to right is corresponding to the size of each crankshaft main journal. First letter "B" indicates the first main journal and the fifth letter "A" indicates the fifth main journal.



(3) Classification Method

No.	Name	Color	Level	Size (mm)
1	Main Bearing Hole	Red	A	57.000 - 57.005
2	Main Bearing Hole	Blue	B	57.005 - 57.010
3	Main Bearing Hole	Yellow	C	57.010 - 57.015
4	Main Bearing Hole	Black	D	57.015 - 57.019
5	Main Bearing Upper Shell	Red	/	2.489 - 2.493
6	Main Bearing Upper Shell	Blue	/	2.493 - 2.497
7	Main Bearing Upper Shell	Yellow	/	2.497 - 2.501
8	Main Bearing Upper Shell	Black	/	2.501 - 2.505
9	Main Journal	Red	A	51.995 - 52.000
10	Main Journal	Blue	B	51.990 - 51.995
11	Main Journal	Yellow	C	51.985 - 51.990
12	Main Journal	Black	D	51.981 - 51.985
13	Main Bearing Lower Shell	Red	/	2.489 - 2.493
14	Main Bearing Lower Shell	Blue	/	2.493 - 2.497
15	Main Bearing Lower Shell	Yellow	/	2.497 - 2.501
16	Main Bearing Lower Shell	Black	/	2.501 - 2.505

(4) Selection Method

No.	Main Bearing Hole	Main Journal	Main Bearing Upper Shell	Main Bearing Lower Shell
1	A Red	A Red	A Red	A Red
2	A Red	B Blue	A Red	B Blue
3	A Red	C Yellow	A Red	C Yellow
4	A Red	D Black	A Red	D Black
5	B Blue	A Red	B Blue	A Red
6	B Blue	B Blue	B Blue	B Blue
7	B Blue	C Yellow	B Blue	C Yellow
8	B Blue	D Black	B Blue	D Black
9	C Yellow	A Red	C Yellow	A Red
10	C Yellow	B Blue	C Yellow	B Blue
11	C Yellow	C Yellow	C Yellow	C Yellow
12	C Yellow	D Black	C Yellow	D Black
13	D Black	A Red	D Black	A Red
14	D Black	B Blue	D Black	B Blue
15	D Black	C Yellow	D Black	C Yellow
16	D Black	D Black	D Black	D Black

(5) Selection of Connecting Rod Bearing Shell

No.	Connecting Rod Big End Hole	Connecting Rod Upper Shell	Connecting Rod Journal	Connecting Rod Lower Shell
1	A Red	A Red	1 Red	A Red
2	A Red	A Red	2 Blue	B Blue
3	A Red	A Red	3 Yellow	C Yellow
4	A Red	A Red	4 Black	D Black
5	B Blue	B Blue	1 Red	A Red
6	B Blue	B Blue	2 Blue	B Blue
7	B Blue	B Blue	3 Yellow	C Yellow
8	B Blue	B Blue	4 Black	D Black
9	C Yellow	C Yellow	1 Red	A Red
10	C Yellow	C Yellow	2 Blue	B Blue
11	C Yellow	C Yellow	3 Yellow	C Yellow
12	C Yellow	C Yellow	4 Black	D Black
13	D Black	D Black	1 Red	A Red
14	D Black	D Black	2 Blue	B Blue
15	D Black	D Black	3 Yellow	C Yellow
16	D Black	D Black	4 Black	D Black

(6) Classification Method

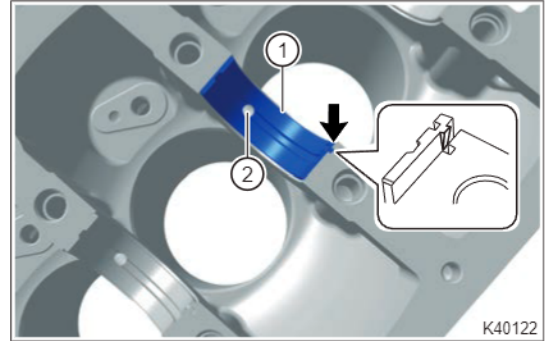
No.	Name	Color	Level	Size (mm)
1	Connecting Rod Big End Hole	Red	A	53.000 - 53.005
2	Connecting Rod Big End Hole	Blue	B	53.005 - 53.010
3	Connecting Rod Big End Hole	Yellow	C	53.010 - 53.015
4	Connecting Rod Big End Hole	Black	D	53.015 - 53.019
5	Connecting Rod Upper Shell	Red	/	1.483 - 1.487
6	Connecting Rod Upper Shell	Blue	/	1.487 - 1.491
7	Connecting Rod Upper Shell	Yellow	/	1.491 - 1.495
8	Connecting Rod Upper Shell	Black	/	1.495 - 1.499
9	Connecting Rod Journal	Red	1	49.996 - 50.000
10	Connecting Rod Journal	Blue	2	49.992 - 49.996
11	Connecting Rod Journal	Yellow	3	49.988 - 49.992
12	Connecting Rod Journal	Black	4	49.984 - 49.988
13	Connecting Rod Lower Shell	Red	/	1.483 - 1.487
14	Connecting Rod Lower Shell	Blue	/	1.487 - 1.491
15	Connecting Rod Lower Shell	Yellow	/	1.491 - 1.495
16	Connecting Rod Lower Shell	Black	/	1.495 - 1.499

■ Installation

- (1) Install 4 fixing bolts to piston cooling nozzles.

Torque: 20 - 25 N·m

- (2) Carefully install crankshaft main bearing upper shell in direction of arrow, and notch of each main bearing upper shell should be aligned with cylinder block. Oil passage hole (2) on crankshaft main bearing upper shell should be aligned with passage hole on cylinder block after installation.



K40122

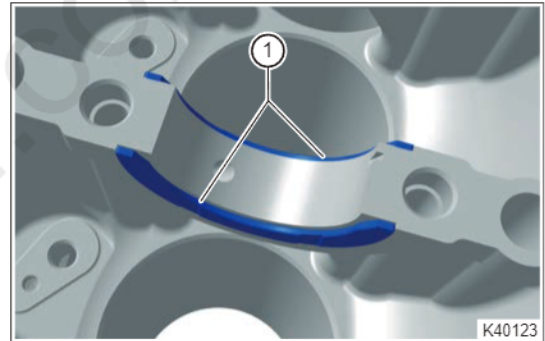
⚠ Caution

- Apply a proper amount of engine oil to inner surface of main bearing shell before installation.
- Install main bearing lower shell in the same way of crankshaft main bearing upper shell.

- (3) Install crankshaft thrust washer to front and rear thrust surfaces of 3rd main bearing seat respectively.

Hint:

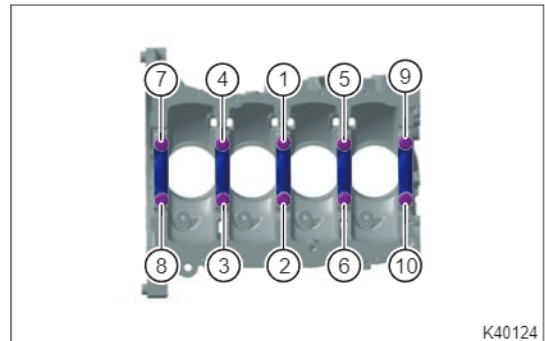
The side of crankshaft thrust washers (1) without groove should face cylinder block side while the other side with groove should face crankshaft side.



K40123

- (4) Place crankshaft on cylinder block carefully.
- (5) Install the crankshaft main bearing cap. Install crankshaft main bearing cap fixing bolts in place by hands, and then tighten 10 crankshaft main bearing cap fixing bolts in order shown in illustration.

Torque: 1st step: 60 ± 5 N·m, 2nd step: $120^\circ \pm 5^\circ$



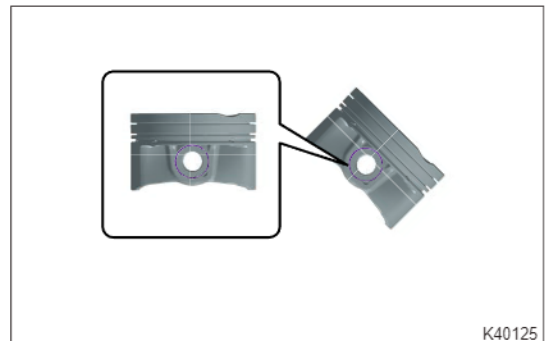
K40124

- (6) Using a small screwdriver, install new elastic circlip to one end of piston pin hole.

Hint:

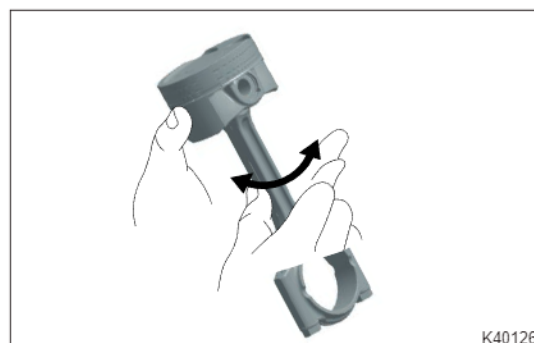
Relative angle between elastic circlip opening and removed notch is $180^\circ \pm 40^\circ$

- (7) Align front marks on piston and connecting rod, push piston pin with thumb until it contacts with elastic circlip.



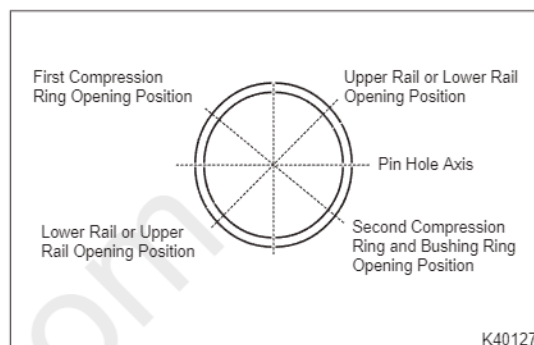
K40125

- (8) Install elastic circlip to the other end of piston pin hole, and check for free rotation between piston and connecting rod assembly.



K40126

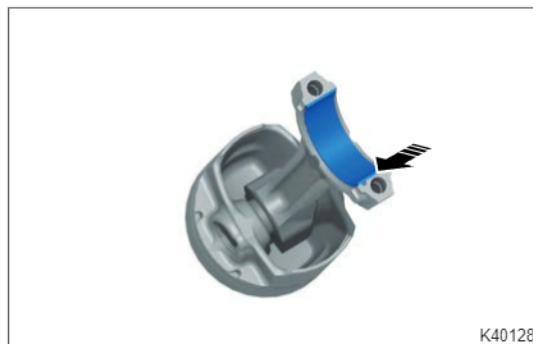
- (9) Apply a small amount of engine oil to piston ring groove and piston. Pay attention that the sides with words of first compression ring (1) and second compression ring (2) should face upward.
- (10) When installing the oil ring, first install the expander into oil groove, then install upper and lower rails with opening staggered by 90° from the expander, and the upper and lower rails at 180° . Then install the second compression ring, and install the first compression ring finally with two compression rings staggered by 90° from upper rail opening; The piston ring should rotate in the ring groove freely without any stuck condition.
- (11) Rotate piston ring several turns after adding engine oil to piston ring groove, and note that the position of ring notch should be the same with that described above; clean crankshaft connecting rod journal and cylinder with a non-woven fabric cloth.
- (12) Carefully install the connecting rod bearing upper shell in direction of arrow, and keep notch of each connecting rod bearing upper shell face the cutout of connecting rod bearing cap.



K40127

Hint:

Apply a proper amount of engine oil to connecting rod bearing shell inner surface before installation.

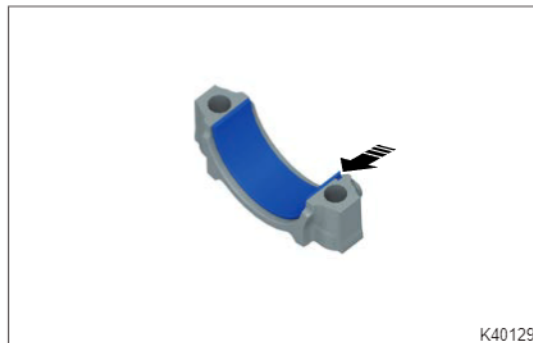


K40128

- (13) Carefully install connecting rod bearing lower shell in direction of arrow, and keep notch of each connecting rod bearing lower shell face the cutout of connecting rod bearing cap.

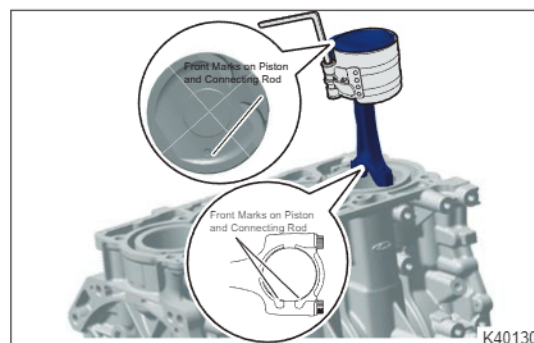
Hint:

Back side of connecting rod bearing shell should be clean without any foreign matter during assembly.



K40129

- (14) Rotate crankshaft to top dead center of cylinder 1 and cylinder 4.
- (15) Apply a coat of engine oil to piston surface and cylinder inner wall.
- (16) As shown in illustration, install piston connecting rod assembly to cylinder with piston installer; Pay attention to front marks on piston and connecting rod during assembly, without being reversed.

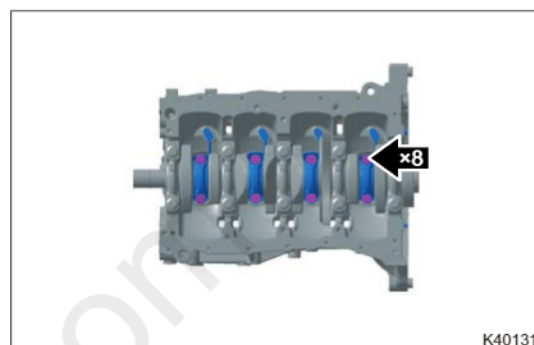


- (17) Install connecting rod bearing caps in place, install connecting rod bearing cap fixing bolts and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: $25 \pm 3 \text{ N}\cdot\text{m}$, 2nd step: $90^\circ \pm 5^\circ$

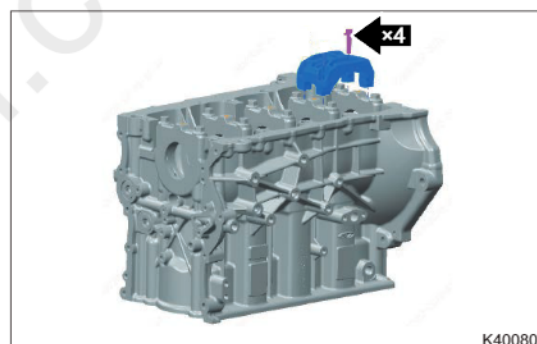
Hint:

Apply a small amount of engine lubricant to connecting rods, connecting rod bearing caps and thread joint surfaces.



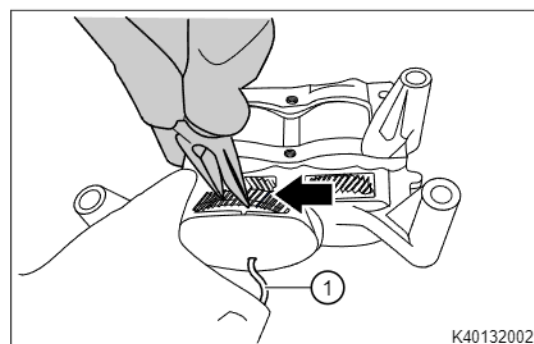
- (18) Install the connecting bracket and tighten 4 fixing bolts.

Torque: $8 + 3 \text{ N}\cdot\text{m}$



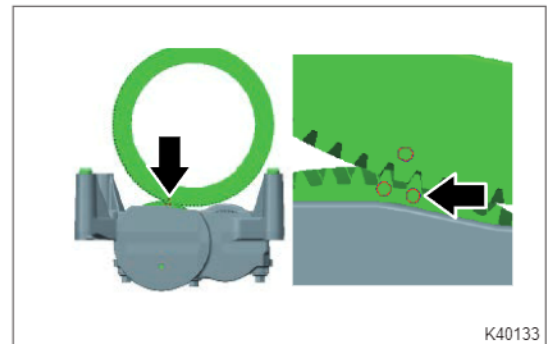
- (19) Install the balance shaft with housing assembly

- 1) After aligning the balance shaft gears, insert the locking fixture (1) and reset the balance shaft.



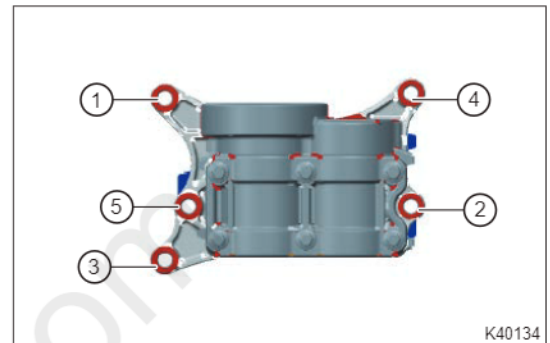
- 2) Align the pin sleeve hole of the balance shaft with housing assembly with the pin sleeve, assemble the balance shaft with housing assembly, slightly turn the balance shaft assembly locking fixture on the left and right to make the balance shaft gear mesh with the crankshaft gear ring.

- 3) Check the gear timing mark, and the three mark points are required to be aligned as shown in illustration.



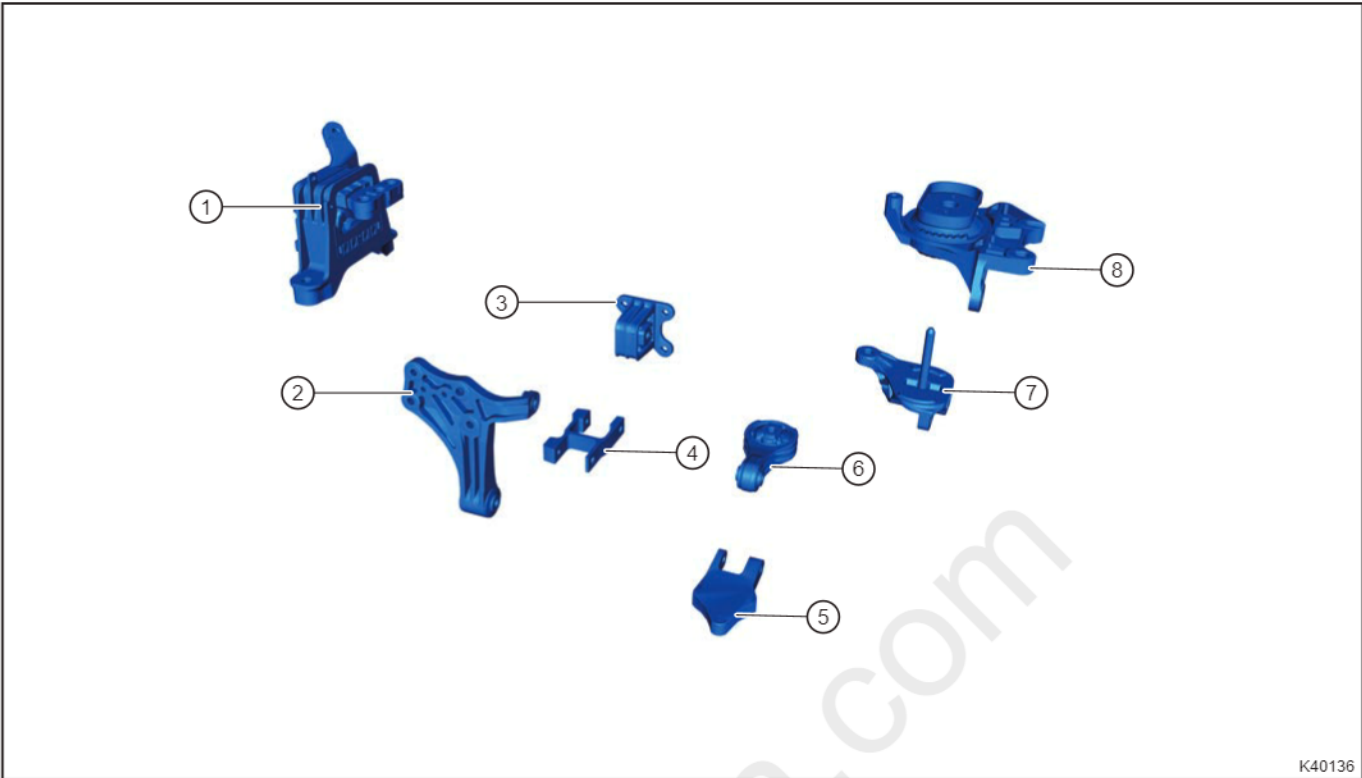
- 4) Press the balance shaft housing firmly and make it is closed to the lower end surface of cylinder block, install 5 fixing bolts, and tighten them to the specified torque in sequence.

Torque: 45 ± 5 N m



- 5) After the installation is complete, the balance shaft locking fixture needs to be removed.
- (20) Install the knock sensor.
 - (21) Install the oil pump assembly.
 - (22) Install the oil pump chain.
 - (23) Install the oil pan assembly.
 - (24) Install the cylinder cover assembly.
 - (25) Install the engine timing chain.
 - (26) Install the A/C compressor bracket and A/C compressor.
 - (27) Install the oil filter.
 - (28) Install the water pump assembly.
 - (29) Install the alternator assembly.
 - (30) Install the timing chain cover.
 - (31) Install the torsion shock absorber.
 - (32) Install the tensioner assembly.
 - (33) Install the idler pulley assembly.
 - (34) Install the engine accessory drive belt.
 - (35) Install the intake manifold assembly.
 - (36) Install the turbocharger assembly.
 - (37) Install the flywheel assembly.
 - (38) Install the transmission assembly.
 - (39) Install the engine assembly to vehicle body.

5.12 Engine Mounting Assembly



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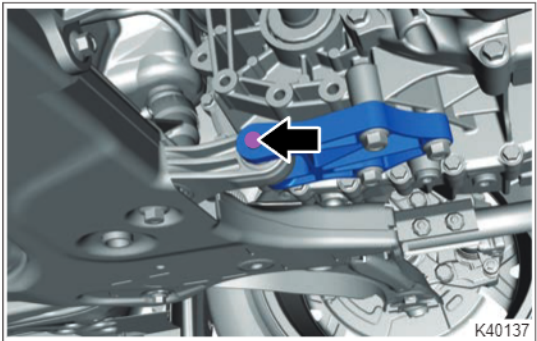
1	Right Mounting Cushion Assembly	5	Rear Mounting Bracket
2	Rear Right Mounting Bracket	6	Rear Mounting Pull Rod
3	Rear Right Mounting Cushion Assembly	7	Left Mounting Bracket
4	Rear Right Mounting Connecting Rod	8	Left Mounting Cushion Assembly

■ Removal of Rear Mounting Assembly

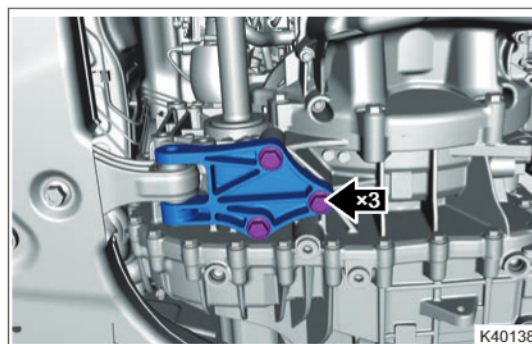
 **Warning**

- **Be sure to wear safety equipment to prevent accidents, when removing rear mounting assembly.**
- **Appropriate force should be applied when removing rear mounting assembly. Be careful not to operate roughly.**

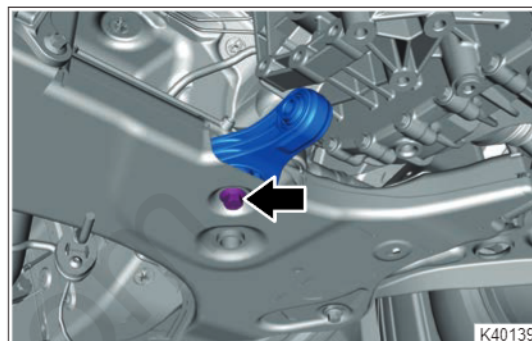
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Raise the vehicle to a proper position.
- (3) Remove 1 fixing bolt between rear mounting bracket and rear mounting pull rod.



- (4) Remove 3 fixing bolts between rear mounting bracket and transmission assembly and remove rear mounting bracket.



- (5) Remove 1 fixing bolt between rear mounting pull rod and front sub frame and remove rear mounting pull rod.



■ Inspection

- (1) Check rubber part on rear mounting pull rod for damage or deformation. Replace rear mounting pull rod as necessary.
- (2) Check rear mounting bracket for deformation or cracks. Replace rear mounting bracket as necessary.

■ Installation

⚠ Caution

- **Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.**

- (1) Install 1 fixing bolt between rear mounting pull rod and front sub frame.
Torque: 200 ± 15 N·m
- (2) Install 3 fixing bolts between rear mounting bracket and transmission assembly.
Torque: 110 ± 8 N·m
- (3) Install 1 fixing bolt to rear mounting pull rod and rear mounting bracket.
Torque: 200 ± 15 N·m

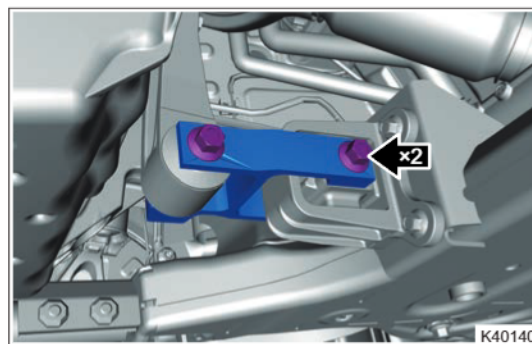
■ Removal of Rear Right Mounting Assembly

⚠ Warning

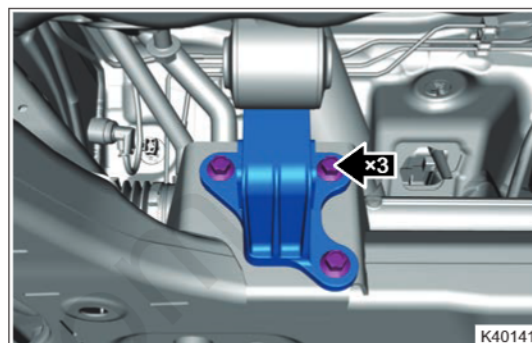
- **Be sure to wear safety equipment to prevent accidents, when removing rear right mounting assembly.**
- **Appropriate force should be applied when removing rear right mounting assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Raise the vehicle to a proper position.
- (3) Remove the drive shaft.
- (4) Remove the transfer case assembly.

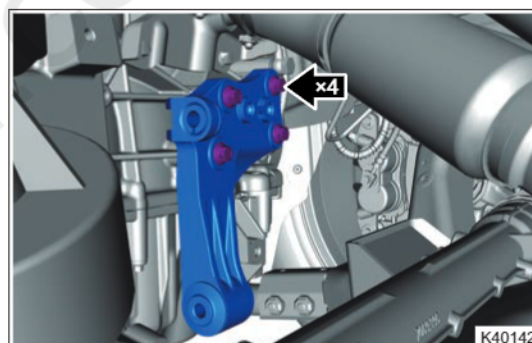
- (5) Remove 1 fixing bolt between rear right mounting connecting rod and rear right mounting bracket.
- (6) Remove 1 fixing bolt between rear right mounting connecting rod and rear right mounting cushion assembly.
- (7) Remove the rear right mounting connecting rod.



- (8) Remove 3 fixing bolts between rear right mounting cushion assembly and front sub frame and remove rear right mounting cushion assembly.



- (9) Remove 4 fixing bolts between rear right mounting bracket and cylinder block and remove rear right mounting bracket.



■ Inspection

- (1) Check rubber part on rear right mounting pull rod for damage or deformation. Replace rear right mounting pull rod as necessary.
- (2) Check rear right mounting bracket for deformation or cracks. Replace rear right mounting bracket as necessary.

■ Installation

⚠ Caution

- Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.

- (1) Install 4 fixing bolts between rear right mounting bracket and cylinder block.
Torque: 70 ± 15 N m
- (2) Install 3 fixing bolts between rear right mounting cushion and front sub frame.
Torque: 70 ± 15 N·m
- (3) Installation 1 fixing bolt between rear right mounting connecting rod and rear right mounting bracket.
Torque: 105 ± 10 N m

- (4) Install 1 fixing bolt between rear right mounting connecting rod and rear right mounting cushion assembly.

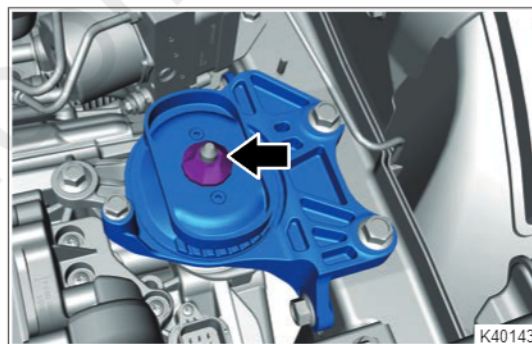
Torque: 105 ± 10 N m

■ Removal of Left Mounting Assembly

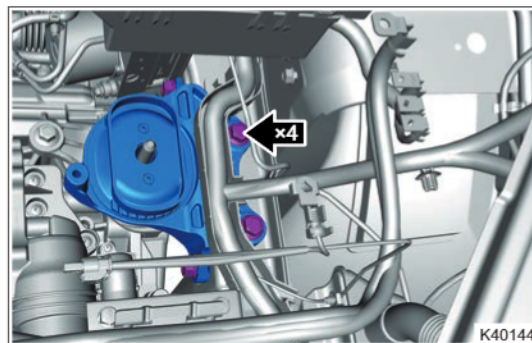
Warning

- **Be sure to wear safety equipment to prevent accidents, when removing left mounting assembly.**
- **Appropriate force should be applied when removing left mounting assembly. Be careful not to operate roughly.**

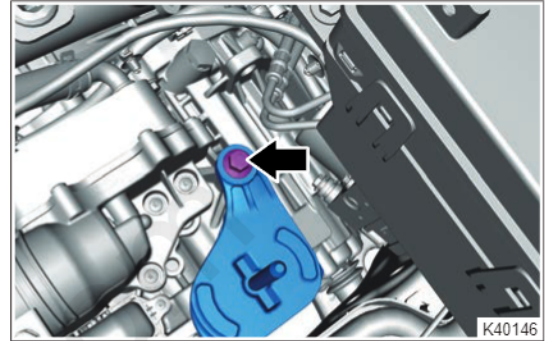
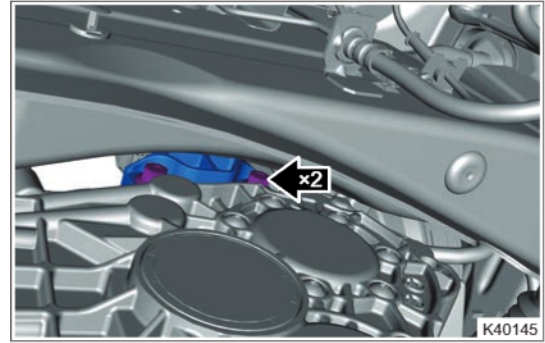
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the battery assembly.
- (6) Remove the battery tray.
- (7) Remove 1 fixing nut between left mounting cushion assembly and left mounting bracket.



- (8) Remove 4 fixing bolts between left mounting cushion assembly and body and remove left mounting cushion assembly.



- (9) Remove 3 fixing bolts between left mounting bracket and transmission assembly and remove left mounting bracket.



■ Inspection

- (1) Check rubber part on left mounting cushion assembly for damage or deformation. Replace left mounting cushion as necessary.
- (2) Check left mounting bracket for deformation or cracks. Replace left mounting bracket as necessary.

■ Installation

⚠ Caution

- **Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.**

- (1) Install 3 fixing bolts between left mounting bracket and transmission assembly.

Torque: 110 ± 15 N·m

- (2) Install 4 fixing bolts between left mounting cushion assembly and body.

Torque: 110 ± 15 N·m

- (3) Install 1 fixing nut between left mounting cushion assembly and left mounting bracket.

Torque: 110 ± 15 N·m

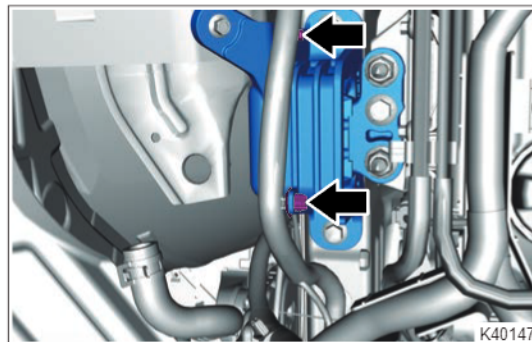
- (4) Install the battery tray.
- (5) Install the battery assembly.
- (6) Install the air filter assembly.
- (7) Install the engine compartment trim cover.

■ Removal of Right Mounting Cushion Assembly

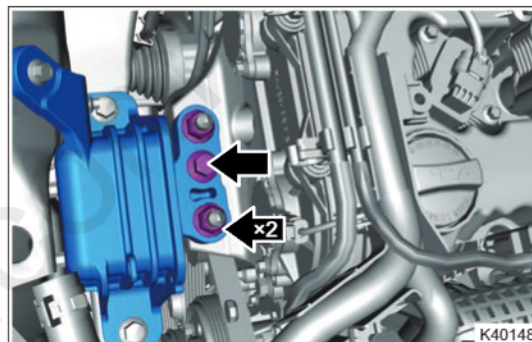
⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing right mounting cushion assembly.**
- **Appropriate force should be applied when removing right mounting cushion assembly. Be careful not to operate roughly.**

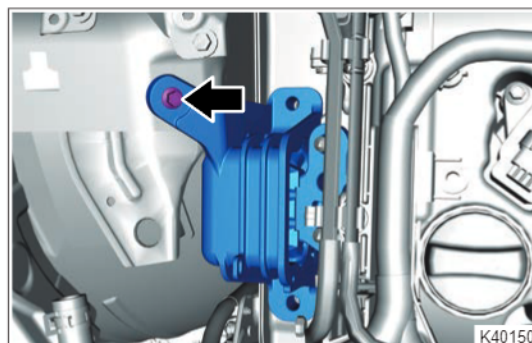
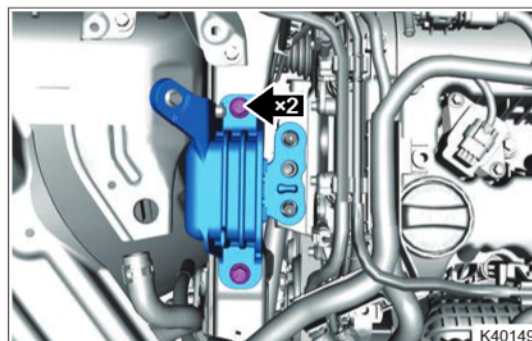
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Move the expansion tank to proper position.
- (4) Disconnect the fixing clips from interior floor wire harness.



- (5) Remove 2 fixing nuts and 1 fixing bolt between right mounting cushion assembly and timing chain cover assembly.



- (6) Remove 3 fixing bolts between right mounting cushion assembly and right side rail.



- (7) Remove the right mounting cushion assembly.

■ Inspection

- (1) Check rubber part on right mounting cushion assembly for damage or deformation. Replace right mounting cushion as necessary.

■ Installation

⚠ Caution

- **Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.**

(1) Install 3 fixing bolts between right mounting cushion assembly and right side rail.

Torque: 110 ± 15 N·m

Torque: 25 ± 3 N·m

(2) Install 2 fixing nuts and 1 fixing bolt on right mounting cushion assembly and timing chain cover assembly.

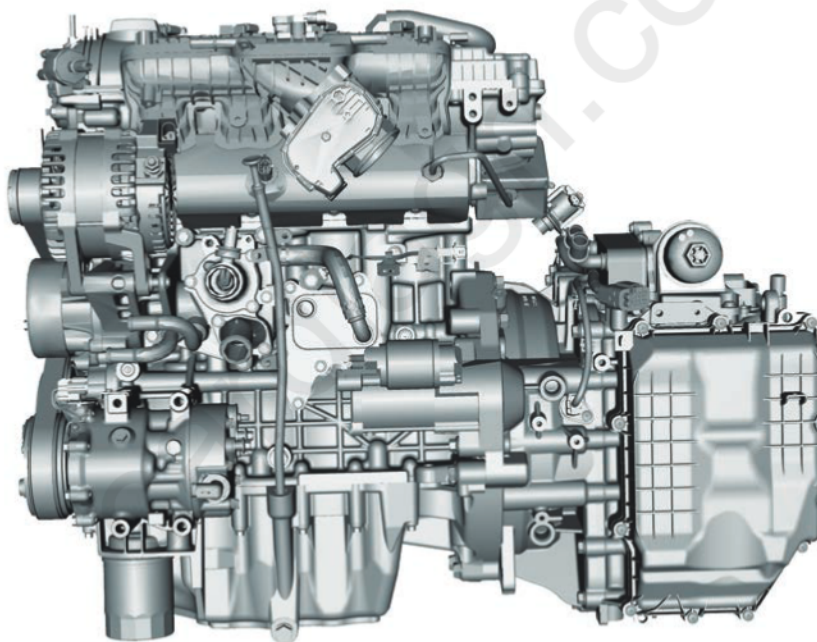
Torque: 110 ± 15 N·m

(3) Fix the fixing clips to interior floor wire harness.

(4) Install the expansion tank.

(5) Install the engine compartment trim cover.

5.13 Engine Assembly



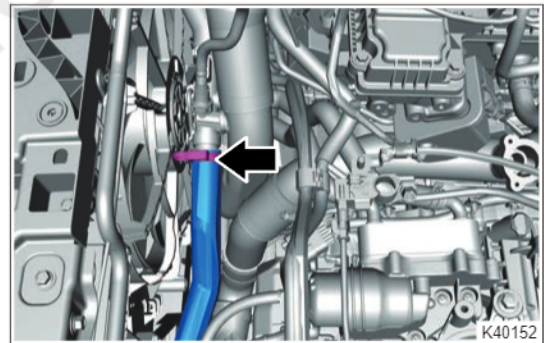
K40151

■ Removal

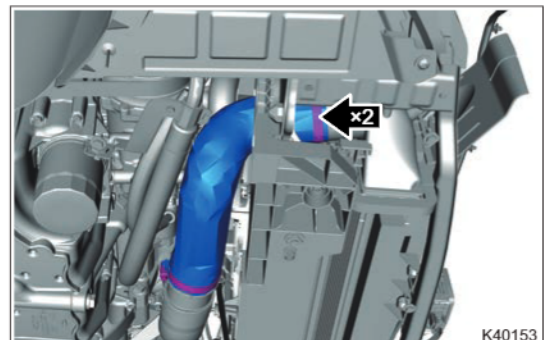
⚠ Caution

- **Remove engine and transmission as an assembly.**
- **Install protector to prevent body from being scratched.**
- **Plug inlet port of intake pipe to prevent foreign matter from entering after removing intake system components. Or the foreign matter will block cylinder intake passage when starting to seriously damage the engine.**

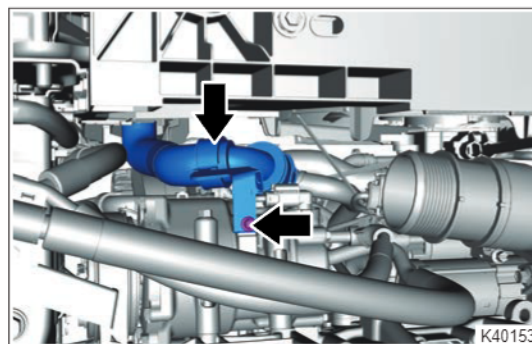
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Disconnect the negative battery cable.
- (5) Drain the coolant.
- (6) Recover/Drain the refrigerant.
- (7) Drain the transmission oil.
- (8) Remove the air filter assembly.
- (9) Remove the intake hose assembly.
- (10) Remove the battery assembly.
- (11) Remove the battery tray.
- (12) Remove the engine compartment lower protector assembly.
- (13) Remove the intercooler outlet pipe assembly II .
- (14) Remove the intercooler intake pipe assembly III .
- (15) Remove the front wheel tire.
- (16) Remove the left/right side rail assembly.
- (17) Remove the front left drive shaft assembly.
- (18) Remove the front right drive shaft assembly.
- (19) Remove the transfer case assembly.
- (20) Remove the precataltic converter assembly.
- (21) Remove the front sub frame assembly.
- (22) Loosen elastic clamps and disconnect engine inlet pipe connection.



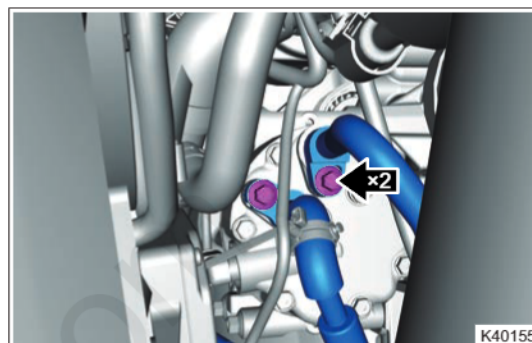
- (23) Loosen 2 elastic clamps and remove the intercooler outlet pipe assembly I .



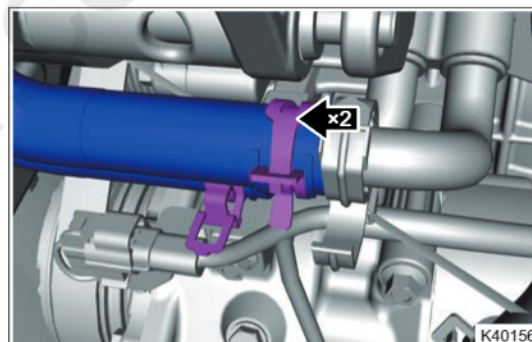
- (24) Loosen elastic clamps, remove 1 bolt from fixing bracket and disconnect engine outlet pipe connection.



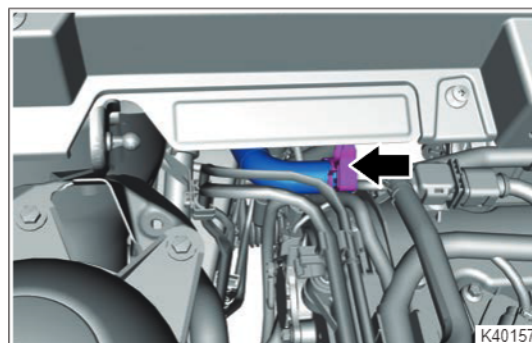
- (25) Remove 2 fixing bolts from A/C pipes, disconnect the compressor.



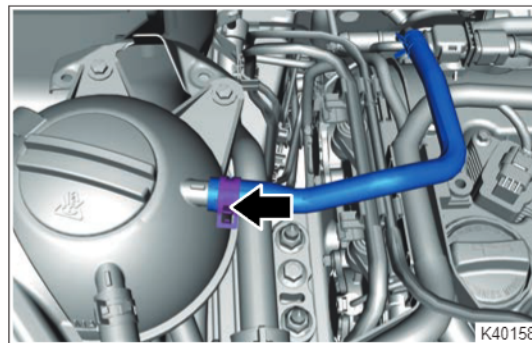
- (26) Loosen 2 elastic clamps and disconnect the expansion tank inlet pipe.



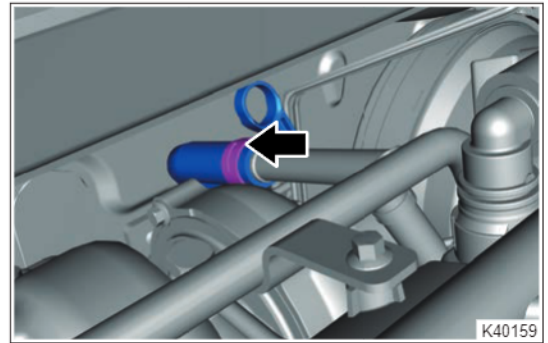
- (27) Loosen elastic clamp and disconnect the heater inlet pipe assembly II.



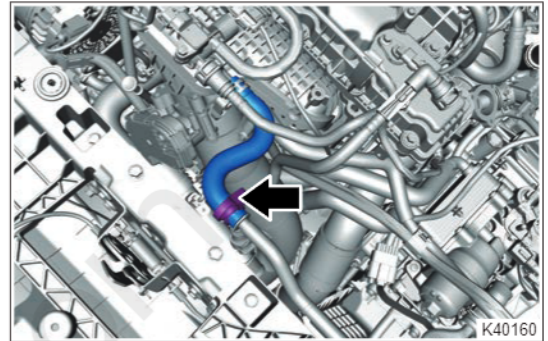
- (28) Loosen elastic clamps and disconnect engine discharge pipe.



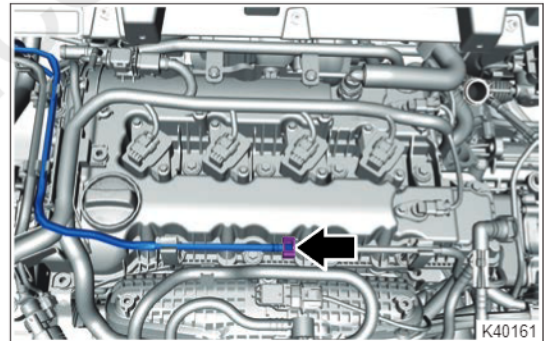
(29) Loosen elastic clamp and disconnect the rear heater inlet and outlet pipe assembly II (if equipped).



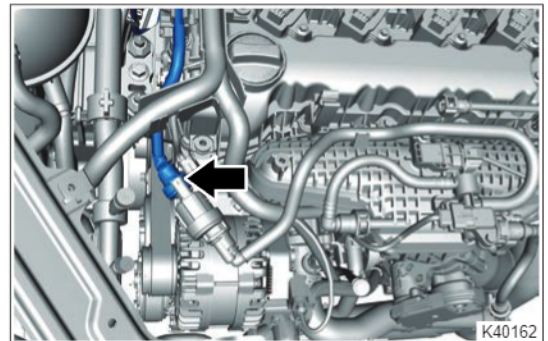
(30) Loosen elastic clamps and disconnect vacuum pipe.



(31) Disconnect the oil inlet pipe I.

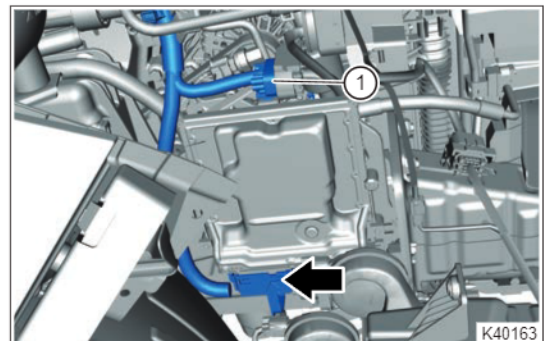


(32) Disconnect the fuel vapor pipe III.

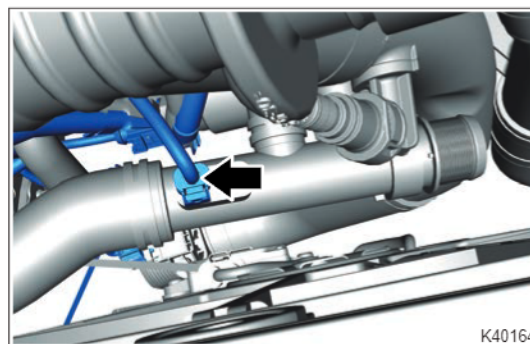


(33) Disconnect the connector (1) between engine electronic injection wire harness and interior floor wire harness.

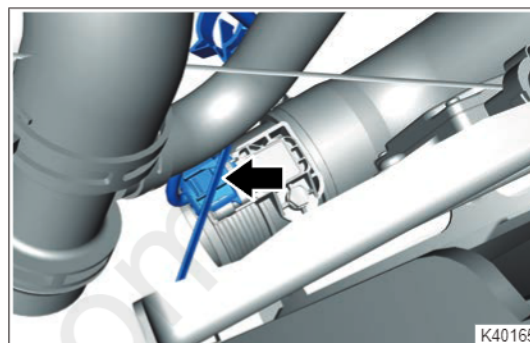
(34) Disconnect the ECM connector.



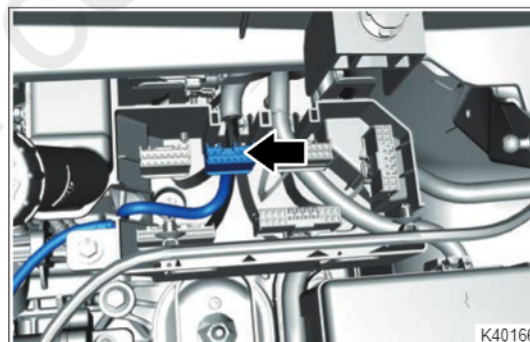
(35) Disconnect the coolant temperature sensor connector.



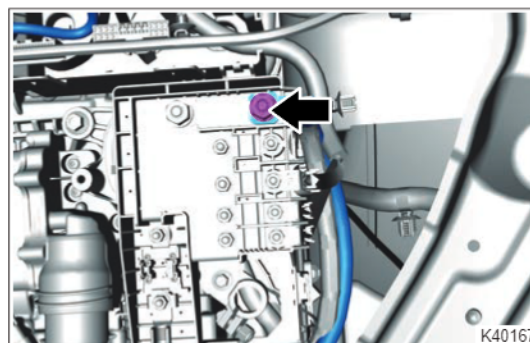
(36) Disconnect the boost pressure sensor connector.



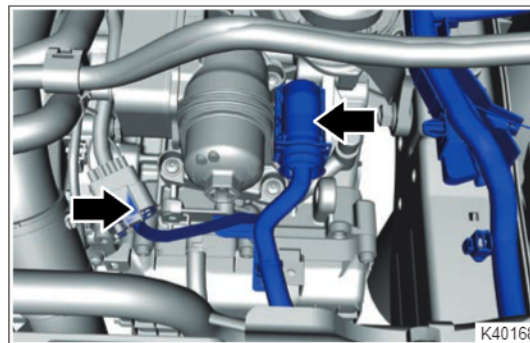
(37) Disconnect connector between engine electronic injection wire harness and engine compartment fuse and relay box.



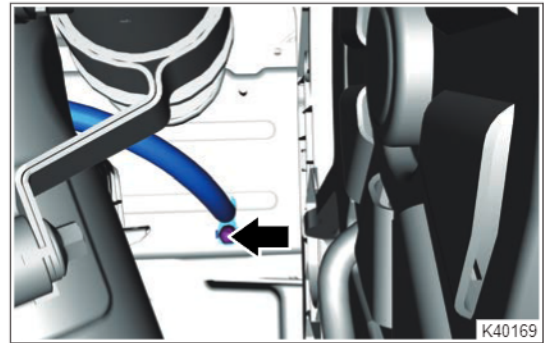
(38) Remove fixing nuts from positive battery wire harness and positive battery wire harness.



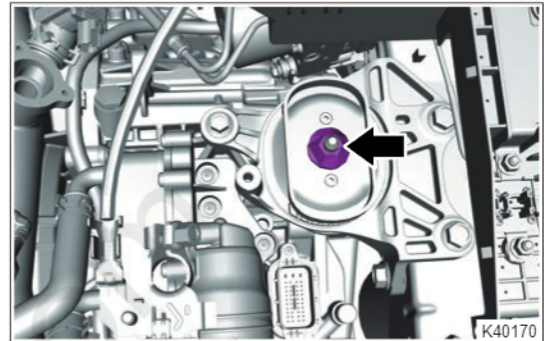
(39) Disconnect the transmission assembly connectors connector.



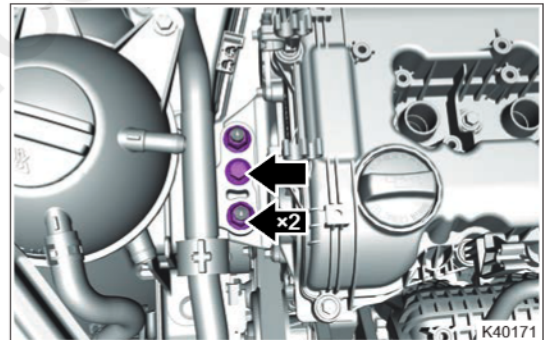
- (40) Remove fixing nuts from ground wire harness and move away the ground wire.



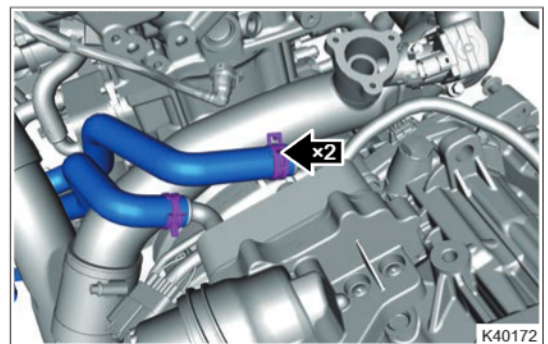
- (41) Remove 1 fixing nut between left mounting cushion assembly.



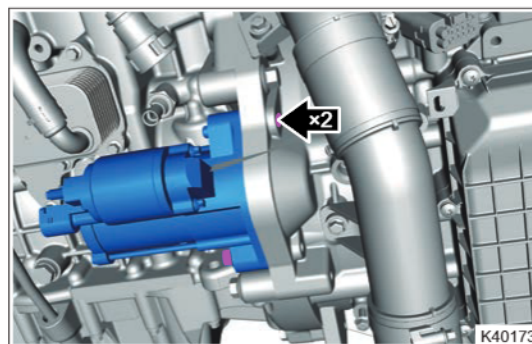
- (42) Remove 2 fixing nuts and 1 fixing bolt from right mounting cushion assembly.



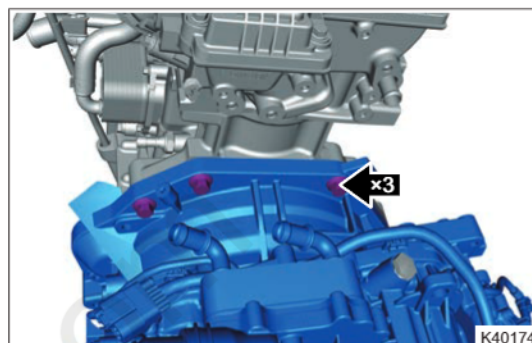
- (43) Check that engine assembly is separated with external components.
(44) Remove engine and transmission assembly.
(45) Remove engine electronic injection wire harness from engine assembly.
(46) Loosen 2 elastic clamps and disconnect engine inlet pipe assembly - rear connections.



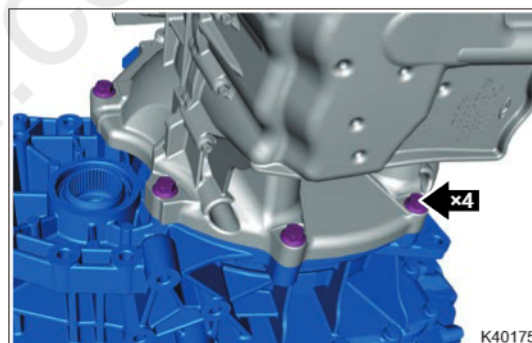
(47) Remove 2 fixing bolts and starter assembly.



(48) Remove 3 fixing bolts from upper part of transmission assembly.



(49) Remove 4 fixing bolts from lower part of transmission assembly.



(50) Separate transmission assembly from engine assembly.

(51) Install engine assembly to engine service platform.

■ Installation

- (1) Install the transmission assembly.
- (2) Install engine electronic injection wire harness to engine.
- (3) Install 2 fixing nuts and 1 fixing bolt to right mounting cushion assembly.
- (4) Install 1 fixing nut on left mounting cushion assembly.
- (5) Fix the connecting clip between interior floor wire harness and right mounting cushion assembly.
- (6) Connect transmission assembly connectors.
- (7) Connect the engine ground wire harness and tighten fixing nut.
- (8) Install and tighten the fixing nut between engine compartment fuse and relay box positive cable and engine compartment fuse box.
- (9) Connect the ECU connector.
- (10) Connect connectors between interior floor wire harness and engine electronic injection wire harness.
- (11) Connect connector between engine electronic injection wire harness and engine compartment fuse and relay box.
- (12) Connect the coolant temperature sensor.
- (13) Connect boost pressure sensor.
- (14) Connect fuel vapor pipe III.
- (15) Connect oil inlet pipe I.
- (16) Connect vacuum tube and install elastic clamps.
- (17) Connect rear heater inlet and outlet pipe assembly II and install elastic clamp.
- (18) Connect engine outlet pipe and install elastic clamp.
- (19) Connect heater inlet pipe assembly II and install elastic clamp.
- (20) Connect expansion tank inlet pipe assembly and install elastic clamp.
- (21) Connect compressor A/C line and tighten fixing bolts.
- (22) Connect engine inlet pipe and install elastic clamp.
- (23) Install the front sub frame assembly.
- (24) Install the precatalytic converter assembly.
- (25) Install the transfer case assembly.
- (26) Install the front left drive shaft assembly.
- (27) Install the front right drive shaft assembly.
- (28) Install the left/right side rail assembly.
- (29) Install the battery tray and battery assembly.
- (30) Install the intake hose assembly.
- (31) Install the air filter assembly.
- (32) Add transmission oil to specified position.
- (33) Add coolant to specified value.
- (34) Connect the negative battery cable.
- (35) Add refrigerant to specified value.
- (36) Install the engine trim cover assembly.
- (37) Install the engine compartment trim cover assembly.
- (38) Install the engine compartment lower protector assembly.

4.3 INTAKE SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

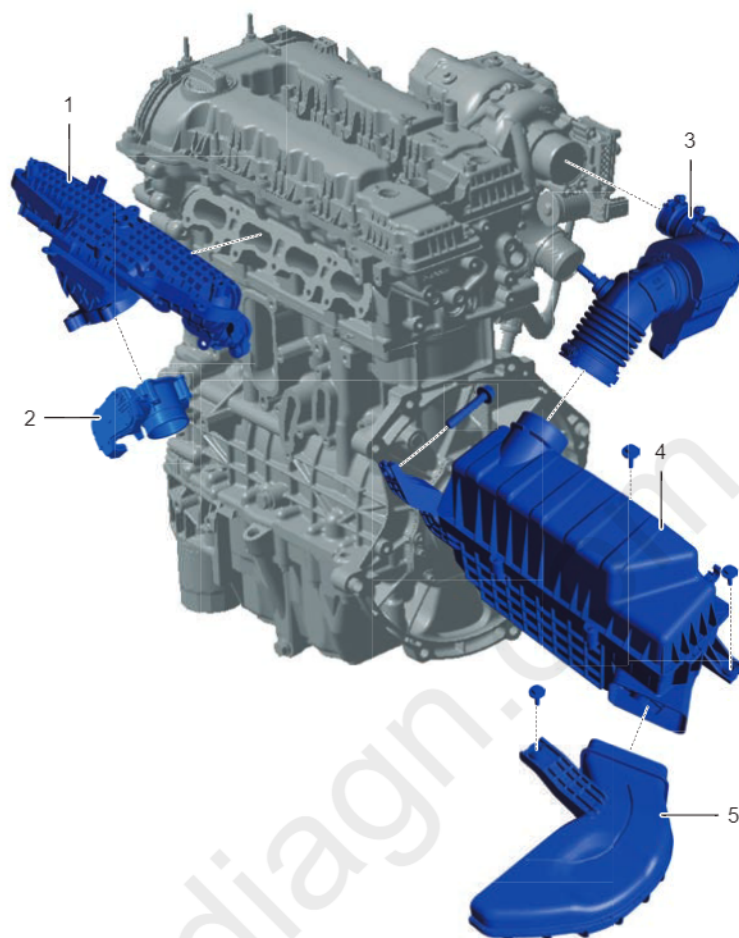
- (1) Wasted air filter element should be handled by the specialized department according to local laws and regulations. Never discard it at will.
- (2) Check for foreign matter in air filter and hose when installing. Avoid inhaling foreign matter after engine running, causing damage to the components.
- (3) After removing electronic throttle, block intake manifold intake port with suitable blocking pieces to prevent foreign matter from entering, causing damage to the components.

2 System Overview

2.1 System Description

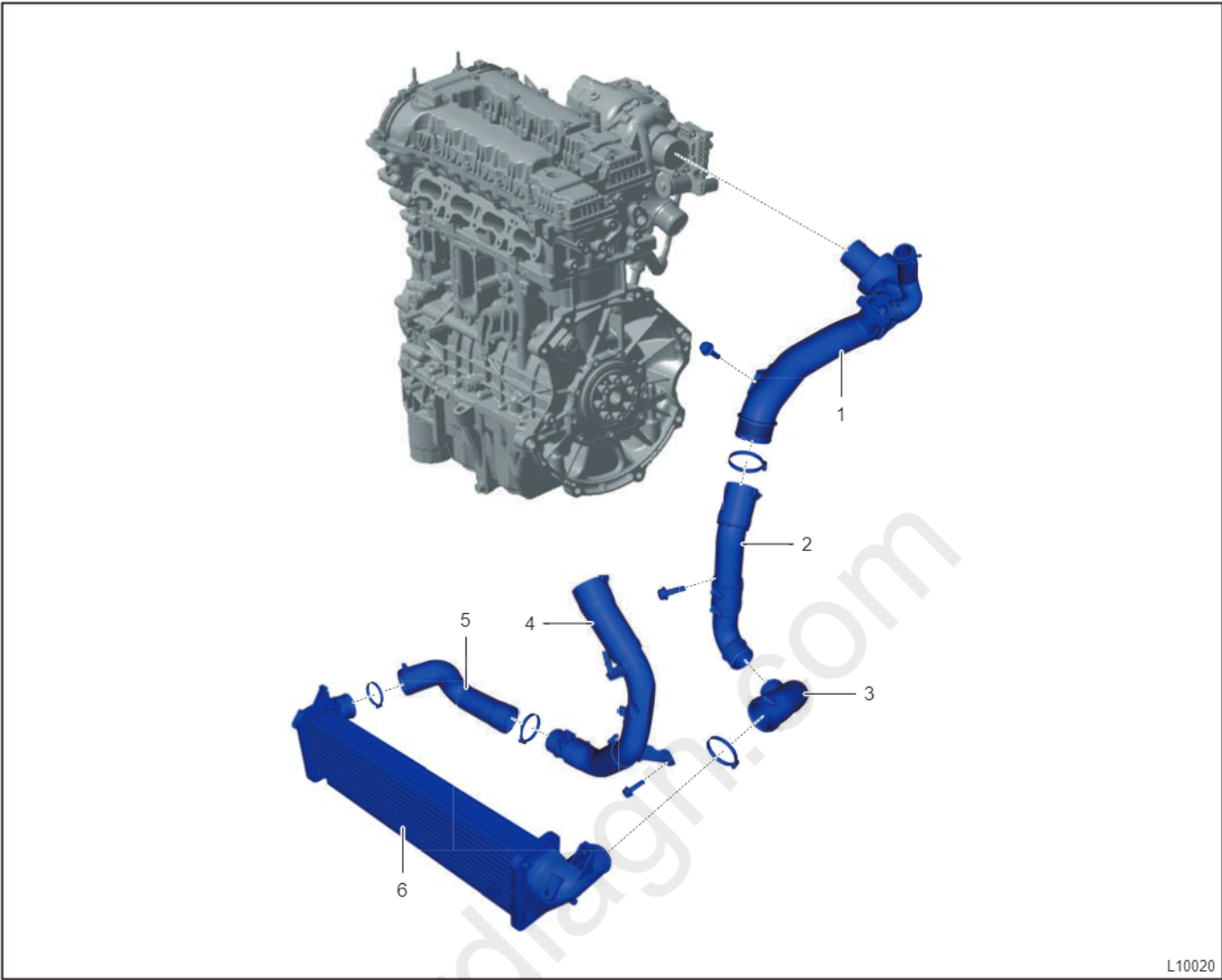
Intake system uses air filter to remove particulates and dust in the air, the air is pressurized by the turbocharger and cooled by the intercooler, then flows into the intake manifold assembly through the electronic throttle assembly, and the cooled fresh air is evenly delivered to each cylinder by the intake manifold to cooperate with the engine.

2.2 System Components Diagram



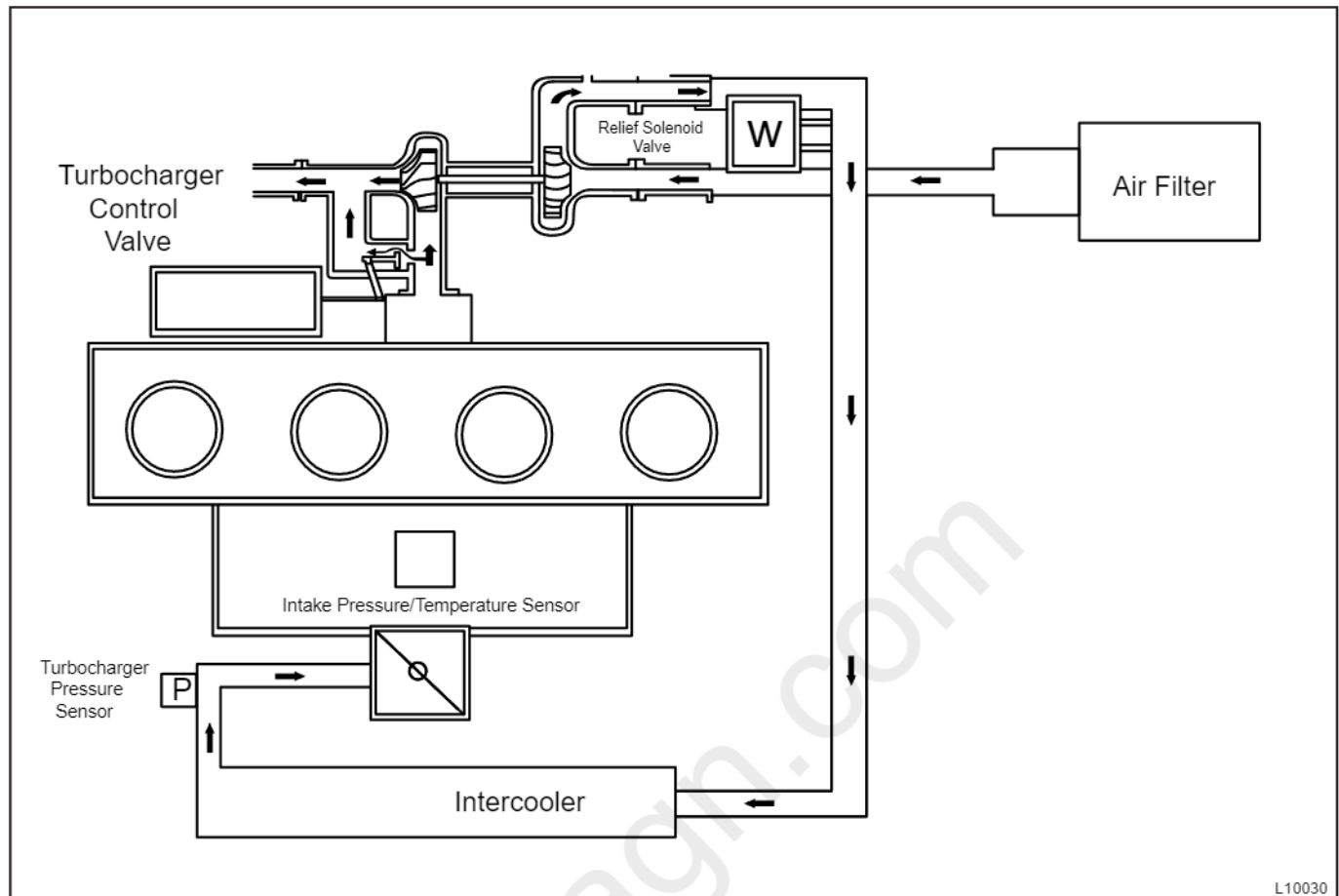
L10010

1	Intake Manifold Assembly	4	Air Filter Assembly
2	Electric Throttle Assembly	5	Air Direct Pipe Assembly
3	Intake Hose Assembly		



1	Intercooler Inlet Pipe I Assembly	4	Intercooler Outlet Pipe II
2	Intercooler Inlet Pipe II Assembly	5	Intercooler Outlet Pipe I
3	Intercooler Inlet Pipe III	6	Intercooler Assembly

2.3 System Schematic Diagram



2.4 System Components Description

■ Intake Pressure/Temperature Sensor

Intake pressure sensor: monitor absolute pressure changes of the intake manifold, send reference signal to ECU for calculating the duration of fuel injection.
 Intake temperature sensor: monitor intake temperature, provide it to ECU as the basis for calculating air density.



■ Intercooler

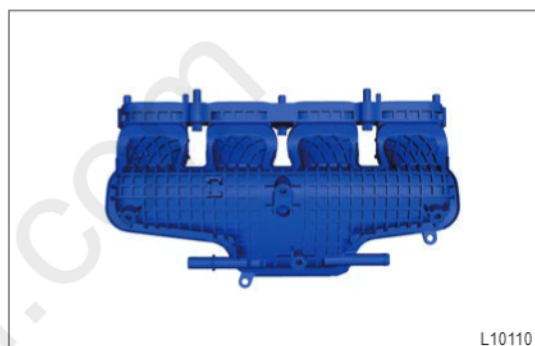
Its function is to reduce the high temperature air temperature after supercharging, so as to reduce the heat load of engine, increase the intake air volume, and then increase the engine power; For the engine, intercooler is an important component of supercharging system.



L10100

■ Intake Manifold Assembly

Distribute the fresh air cooled by intercooler to each cylinder.



L10110

■ Air Filter Assembly

The air filter is mainly used to remove particulate impurities in the air.



L10120

■ Electronic Throttle

It consist of four parts: drive module, train module, executive module and feedback module, and all components are integrated into the same throttle valve housing. Throttle feedback module uses two redundant structures. When malfunction occurs, throttle valve plate will stop at the limp home position (above mechanical bottom dead center) determined by mechanical way. Electronic throttle performs control only by corresponding electronic control unit or electronic test circuit. In principle, it is necessary to ensure that the throttle valve plate does not operate dynamically to the mechanical dead center.



L10130

Electronic Accelerator Pedal

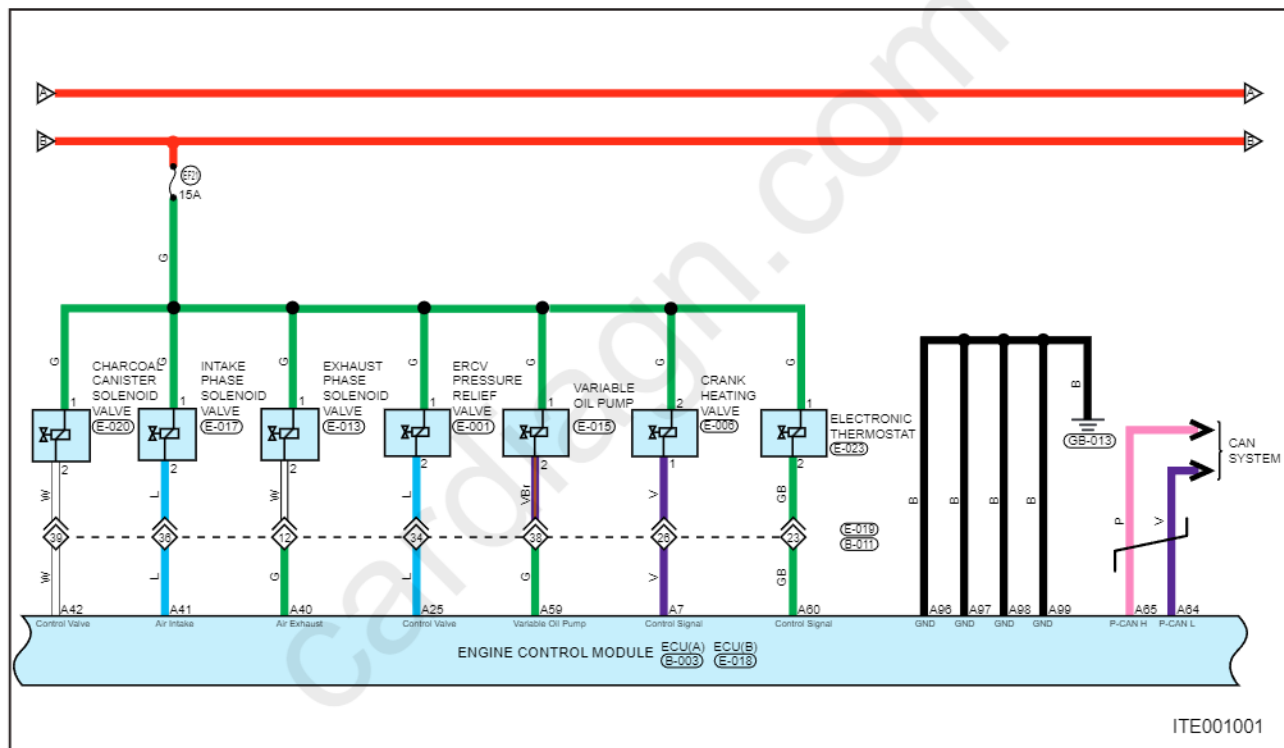
There are two identical potentiometer type sensors in the electronic accelerator pedal, which provide the driving demand signal of driver to the ECU. This process is exactly the same as the current mechanical pedal in operation to adapt to the driver's driving habits for many years. Two identical sensors provide accelerator signals to ECU respectively, thus ensuring the safety and reliability of this system.



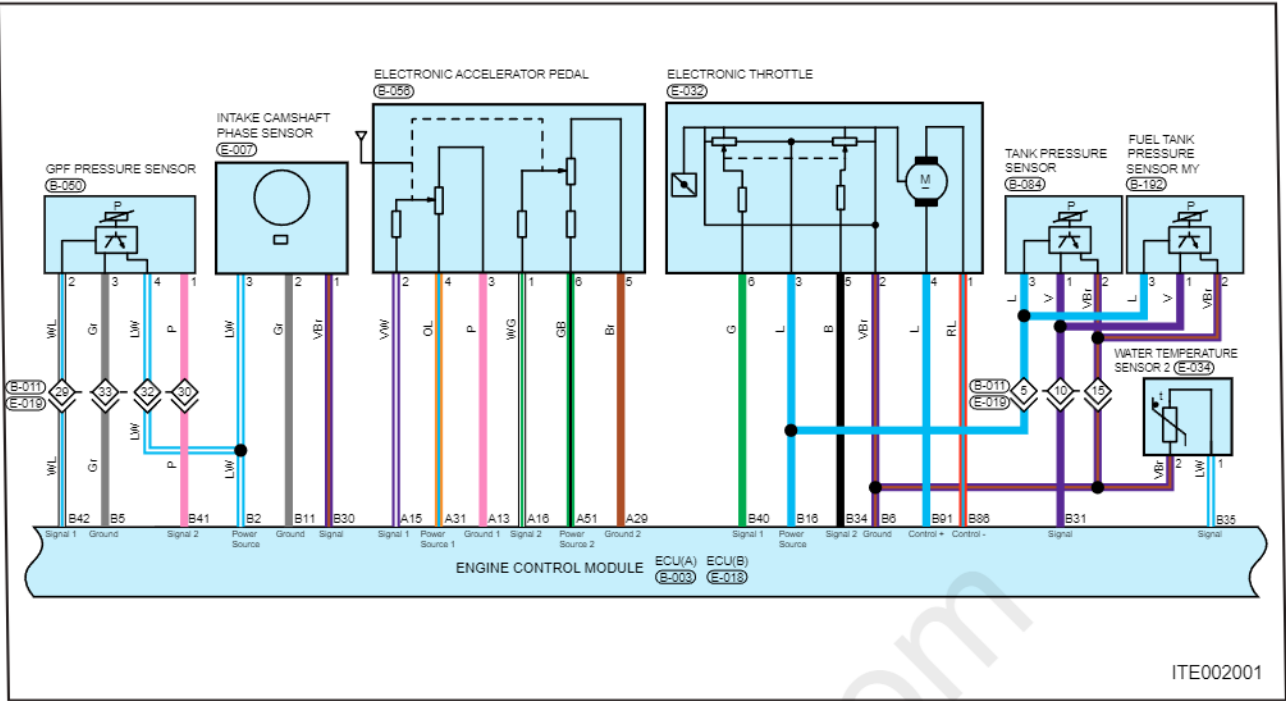
L10140

3 System Circuit Diagram

3.1 Circuit Diagram



ITE001001



4 Diagnosis & Testing

4.1 Problem Symptoms Table

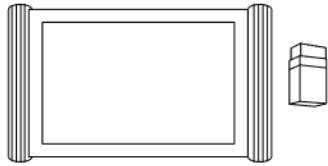
Hint:
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence.
Repair, replace or adjust faulty components as necessary.
Intake System

Symptom	Possible Cause
Engine idles roughly	Electronic throttle assembly (dirty)
	Intake manifold assembly (broken, leaked)
	Activated charcoal canister solenoid valve (remains on)
	Intake pressure sensor
	Electronic throttle assembly gasket (damaged)
	Fuel rail injector assembly (installed incorrectly)

5 ON-VEHICLE SERVICE

5.1 Tools

■ Special Tool

Tool Name	Tool Drawing
Diagnostic Tester	 S00001

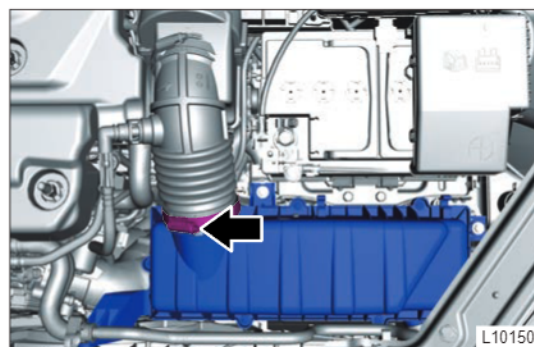
5.2 Air Filter Element

■ Removal

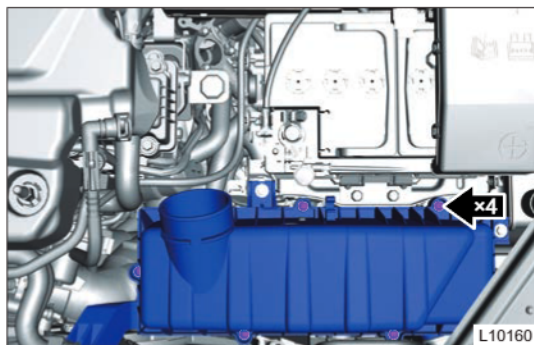
⚠ Warning

- Be sure to wear safety equipment to prevent accidents, when removing air filter element.
- Appropriate force should be applied when removing air filter element. Be careful not to operate roughly.

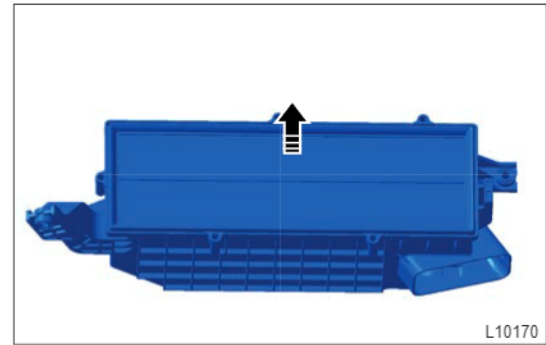
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the negative battery cable.
- (4) Loosen worm clamp and disconnect intake hose.



- (5) Remove 5 fixing screws (cross screwdriver) between air filter upper housing and lower housing, and remove upper housing carefully.



- (6) Remove the air filter element in the direction of arrow.



■ Inspection

- (1) Check if air filter is dirty, if it is dirty severely, it is required to replace new air filter.

■ Installation

⚠ Caution

- Clean the air filter upper housing and lower housing.
- Wasted air filter element should be handled by the specialized department according to local laws and regulations. Never discard it at will.

- (1) Install 5 fixing screws between air filter upper housing and lower housing.

Torque: $1.3 \pm 0.2 \text{ N}\cdot\text{m}$

- (2) Connect intake hose, and tighten worm clamp.

Torque: $4 \pm 0.5 \text{ N}\cdot\text{m}$

- (3) Install the engine compartment trim cover assembly.

5.3 Air Filter Assembly

■ Removal

⚠ Caution

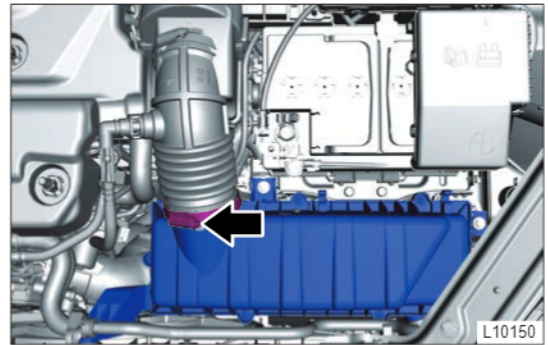
- Be sure to wear safety equipment to prevent accidents, when removing air filter assembly.
- Appropriate force should be applied when removing air filter assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.

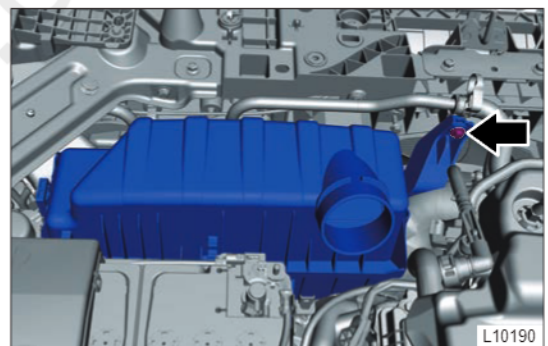
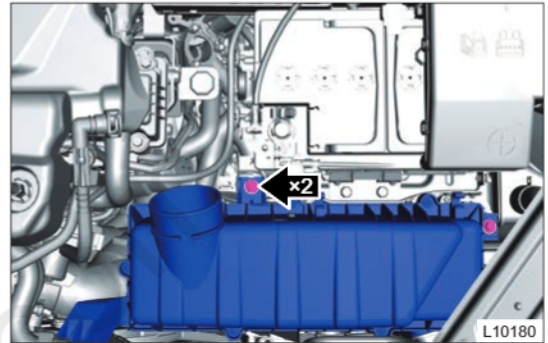
- (2) Remove the engine compartment trim cover assembly.

- (3) Disconnect the negative battery cable.

- (4) Loosen worm clamp and disconnect intake hose.



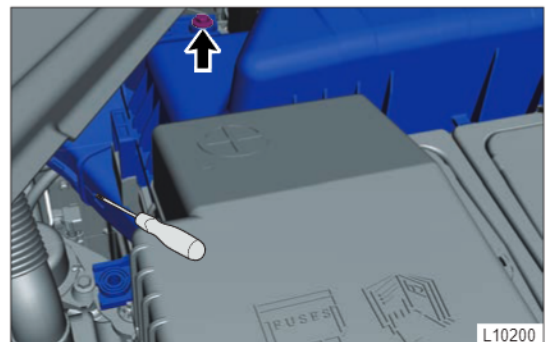
- (5) Remove 3 fixing bolts from air filter assembly (10# socket wrench).



- (6) Using a flat tip screwdriver, separate air direct pipe and air filter assembly carefully. Remove the air filter assembly carefully.

Hint:

In order to separate the air direct pipe from air filter assembly more conveniently and effectively, it is recommended to remove the drainage pipe on the wiper washer reservoir first to reserve enough space, and then remove one fixing bolt of the air direct pipe. At this time, it will be easier to separate and remove the air direct pipe from air filter assembly.



■ Installation

⚠ Caution

- Check for foreign matter in air filter and hose when installing. Avoid inhaling foreign matter after engine running, causing damage to the components.

- (1) Insert air direct pipe into air filter assembly, and install 3 fixing bolts to air filter assembly.

Torque: $7 \pm 1 \text{ N}\cdot\text{m}$.

- (2) Connect intake hose, and tighten worm clamp.

Torque: $4 \pm 0.5 \text{ N}\cdot\text{m}$

- (3) Install the engine compartment trim cover assembly.

5.4 Air Direct Pipe

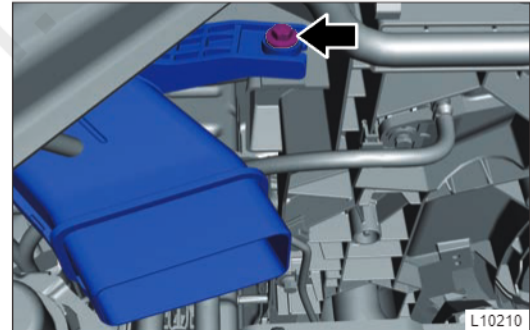
■ Removal

⚠ Caution

- **Be sure to wear safety equipment to prevent accidents, when removing air direct pipe assembly.**
- **Appropriate force should be applied, when removing air direct pipe assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.

- (5) Remove 1 fixing bolt from air direct pipe. Remove the air direct pipe assembly carefully.



■ Installation

⚠ Caution

- **Check for foreign matter in air filter and related lines when installing. Avoid inhaling foreign matter after engine running, causing damage to the components.**

- (1) Insert air direct pipe into air filter assembly, and install 3 fixing bolts to air filter assembly.

Torque: $7 \pm 1 \text{ N}\cdot\text{m}$.

- (2) Install 1 fixing bolt to air direct pipe.

Torque: $7 \pm 1 \text{ N}\cdot\text{m}$.

- (3) Connect intake hose, and tighten worm clamp.

Torque: $4 \pm 0.5 \text{ N}\cdot\text{m}$

- (4) Install the engine compartment trim cover assembly.

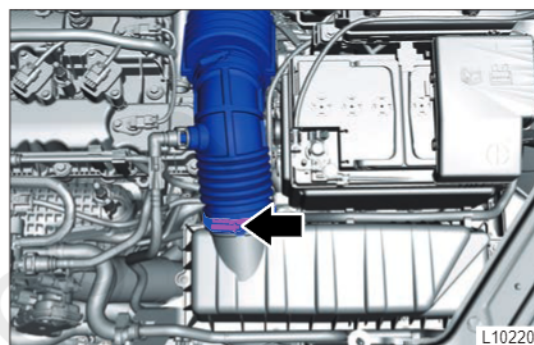
5.5 Intake Hose Assembly

■ Removal

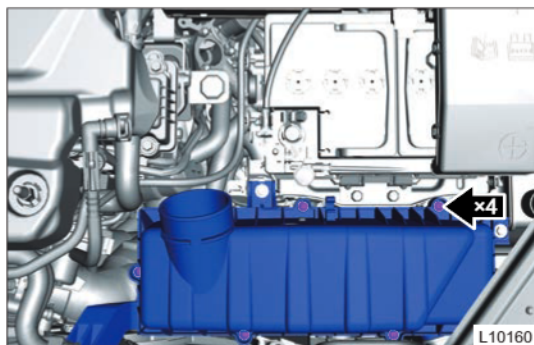
Warning

- Be sure to wear safety equipment to prevent accidents, when removing intake hose assembly.
- Appropriate force should be applied, when removing intake hose assembly. Be careful not to operate roughly.
- Try to prevent body paint surface from being scratched during removal of intake hose assembly.

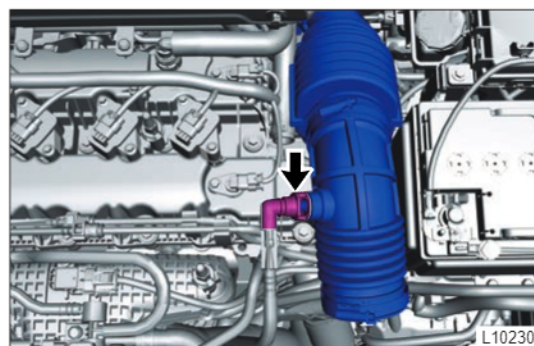
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Loosen worm clamp and disconnect the connection between intake hose and air filter assembly.



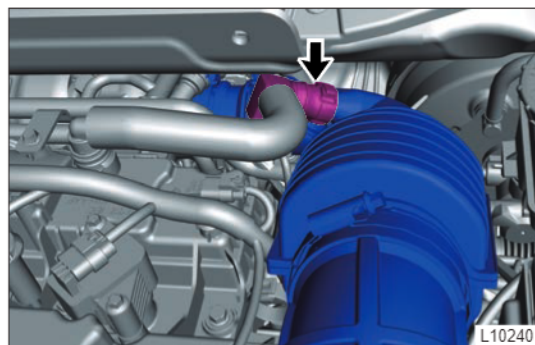
- (4) Remove 5 fixing bolts from air filter upper housing and remove the air filter upper housing.



- (5) Disconnect the connection between canister solenoid valve outlet pipe and intake hose assembly.



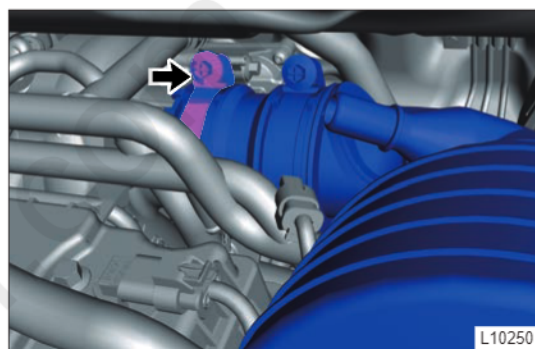
- (6) Disconnect the connection between crankcase ventilation hose and intake hose assembly.



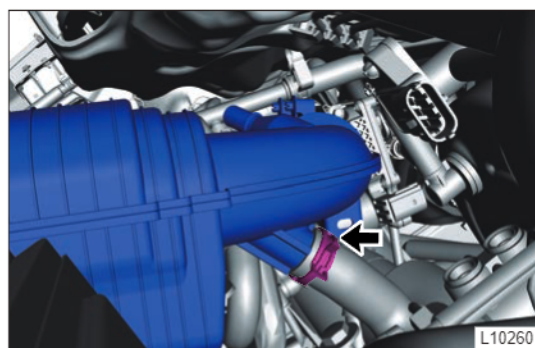
⚠ Caution

- The crankshaft ventilation system line is a non-reusable part, which must be destroyed before being removed and cannot be reused.

- (7) Loosen worm clamp and disconnect the connection between intake hose assembly and turbocharger.



- (8) Loosen elastic clamp (slip-joint plier) and disconnect the connection between intercooler inlet pipe to hose and intake hose assembly.



- (9) Remove the intake hose assembly carefully.

■ Installation

- (1) Connect the intercooler inlet pipe to hose and intake hose assembly. Use a tool (slip-joint plier) to install and return the elastic clamp to its original position.
- (2) Install the intake hose outlet to the turbocharger inlet. Tighten the worm clamp.
Torque: 4 ± 0.5 N·m
- (3) Insert the lower bracket of intake hose assembly muffler into the rubber cushion.

- (4) Install the air filter upper housing, and fix 5 screws

Torque: $1.3 \pm 0.2 \text{ N}\cdot\text{m}$

- (5) Install the intake hose inlet to the air filter assembly. Tighten the worm clamp.

Torque: $4 \pm 0.5 \text{ N}\cdot\text{m}$

- (6) Connect the canister solenoid valve outlet pipe and crankcase ventilation hose to the intake hose separately, and lock the quick connector buckle after they are connected.

Caution

- When pipe is connected using quick connector, pay attention to the fitting size and direction of the connector. During assembly, install the connector into place along the axial direction of quick connector until it is clip into mechanically and a "click" sound is heard. In order to check if the installation is in good condition, pull it forcibly in reverse direction and make sure it does not fall off.

- (7) Install the engine compartment trim cover assembly.

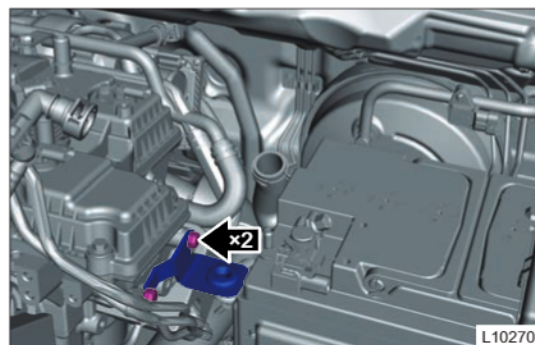
5.6 Intake Hose Bracket

■ Removal

Warning

- Be sure to wear safety equipment to prevent accidents, when removing intake hose bracket assembly.
- Appropriate force should be applied, when removing intake hose bracket assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the intake hose assembly.
- (4) Remove 2 bolts from intake hose bracket.



- (5) Remove the intake hose bracket assembly carefully.

■ Installation

- (1) Align intake hose bracket and mounting hole of engine bolt, and secure 2 fixing bolts.

Torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$

- (2) Install the intake hose assembly.
- (3) Install the engine compartment trim cover assembly.

5.7 Electronic Throttle

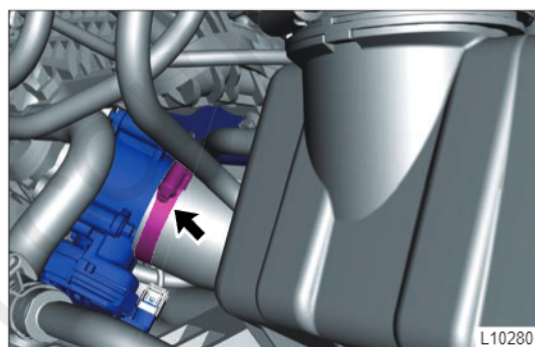
■ Removal

⚠ Warning

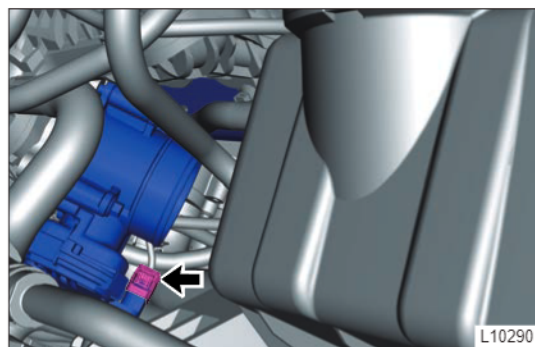
- Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear necessary safety equipment to prevent accidents, when removing electronic throttle.
- Appropriate force should be applied when removing electronic throttle. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

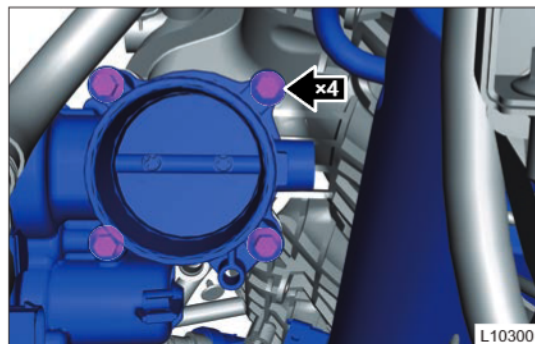
- (4) Loosen worm clamp and disconnect the connection between electronic throttle and intercooler outlet pipe II.



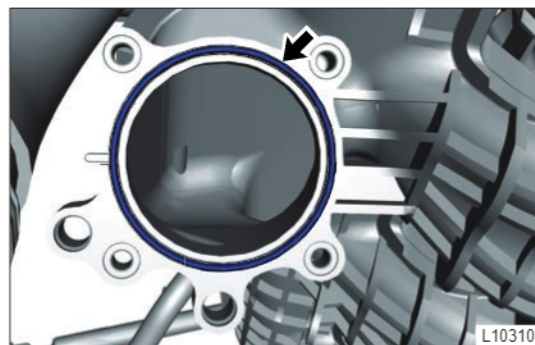
- (5) Disconnect the electronic throttle connector.



- (6) Remove 4 fixing bolts from electronic throttle (8#-socket wrench).



- (7) Remove the electronic throttle assembly.
- (8) Remove electronic throttle gasket from intake manifold.



⚠ Caution

- **After removing electronic throttle, block intake manifold intake port with suitable blocking pieces to prevent foreign matter from entering, causing damage to the components.**

■ Throttle Cleaning

(1) Cleaning Tool

- Thin stick: Used to support throttle valve plate for cleaning the carbon deposited on contact wall between valve plate and throttle. Please use plastic, wooden or bamboo thin stick. Do not use metal thin stick to avoid scratching or deforming the valve plate.
- Clean cloth or paper towel.

■ Cleaning Process

- (1) Remove electronic throttle assembly, and make the valve plate face upward in free condition. Avoid cleaner flowing into electronic element through valve plate shaft, resulting in functional failure.
- (2) Apply appropriate amount of cleaner to the inner wall of throttle valve body, and wipe off the carbon with clean cloth.
- (3) Support the throttle valve plate with a thin stick, and clean the carbon on valve plate and throttle valve body inner wall.



- (4) Turn over the throttle 90°, and clean with the same procedures as above. Repeat several times until it is clean.
- (5) Push the valve plate by hand, and check if it rotates smoothly. If it is stuck, clean again according to the cleaning procedures.
- (6) After cleaning, wipe off the cleaner in throttle valve body with absorbent paper.

⚠ Warning

- **Cleaner is a kind of flammable and corrosive fluid. Follow safety cautions to prevent accidents, and avoid skin contacting with cleaner.**
- **Pay attention to that the amount of cleaner should not be too much, so as to overflows into sensor and motor, resulting in functional failure.**

■ Check Electronic Throttle

(1) Judgment methods for specific mechanical damage

- Valve plate should be in default position with power off and can rotate smoothly when flipping it by hand. If catching occurs, it indicates that internal components may be damaged.

(2) Perform the simple measurement for throttle internal sensor in following steps:

Step	Operation	Test Value	Test Result	Subsequent Step
1	Apply 5V direct current to terminal 3 (+) and 2 (-), close valve plate to full close manually, and measure voltages between terminals 5 and 2, and between terminals 6 and 2 with voltage band of multimeter. Voltage between terminals 6 and 2 is within 0.25 V and 0.75 V, voltage between terminals 5 and 2 is within 4.25 V and 4.75 V, and the sum of both voltages is about 5 V.	/	Yes	Next
		/	No	Replace throttle body
2	Apply 5V direct current to terminal 3 (+) and 2 (-), turn valve plate to full open manually, and measure voltages between terminals 5 and 2, and between terminals 6 and 2 with voltage band of multimeter. Voltage between terminals 6 and 2 is within 4.4V and 4.9V, voltage between terminals 5 and 2 is within 0.1V and 0.6V, and the sum of both voltages is about 5 V.	/	Yes	Next
		/	No	Replace throttle body
3	Turn the digital multimeter to ohm band, directly measure resistance of copper windings on DC motor between terminals 1 and 4. It is usually between 1.5 and 3.0 Ω at normal temperature, this value does not change with the valve plate opening.	/	Yes	Check wire harness or diagnostic help
		/	No	Replace throttle body

■ Electronic Throttle Learning Method

(1) Perform throttle body self-learning once after installing electronic throttle body (turn ENGINE START STOP switch to ON and then to OFF after waiting for 30 seconds, and then perform ignition normally). Start vehicle and observe if it operates normally after self-learning is finished.

■ Installation

Caution

- Clean fitting surface of electronic throttle.
- Check if O-ring in the manifold fitting surface groove is in good condition has no damage.
- Perform electronic throttle self-learning procedures after installation.
- After self-learning is completed, start the vehicle and check for proper operation.

(1) Install 4 fixing bolts to electronic throttle. Tighten in diagonally installation order.

Torque: 8 + 3 N·m

(2) Connect intercooler outlet pipe, and tighten worm clamp.

Torque: 5 ± 1 N m

(3) Connect electronic throttle assembly connector.

(4) Install the engine compartment trim cover assembly.

5.8 Intake Manifold Assembly

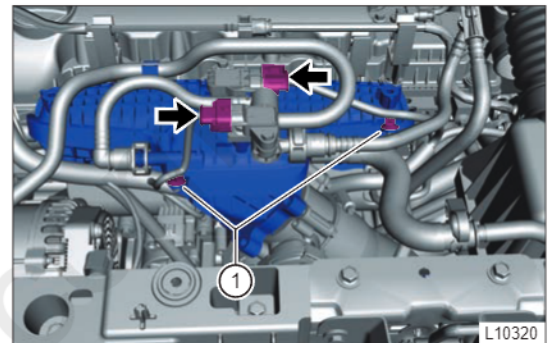
■ Removal

Warning

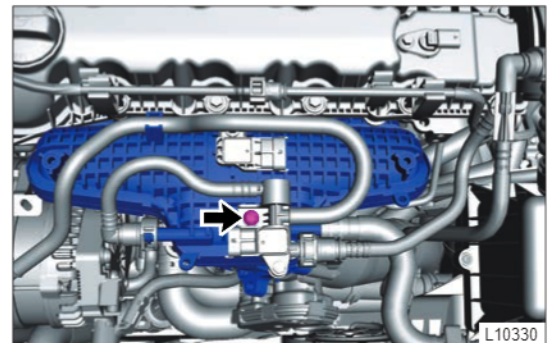
- **Be sure to wear safety equipment to prevent accidents, when removing intake manifold assembly.**
- **Appropriate force should be applied, when removing intake manifold assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

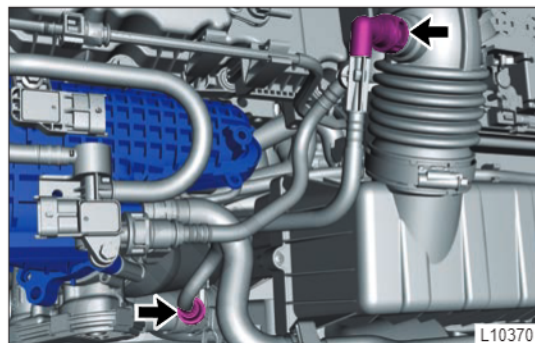
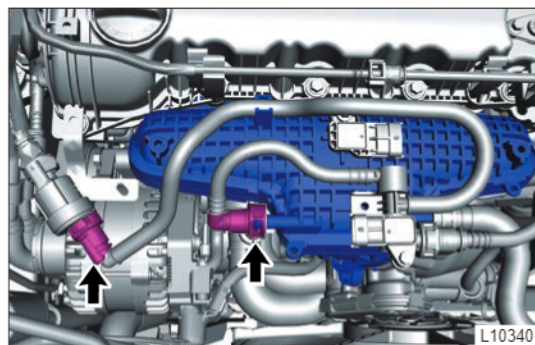
- (4) Disconnect the intake pressure/temperature sensor connector and detach the wire harness fixing clip (1).
- (5) Disconnect the desorption pressure sensor connector, and detach the wire harness fixing clip (1).



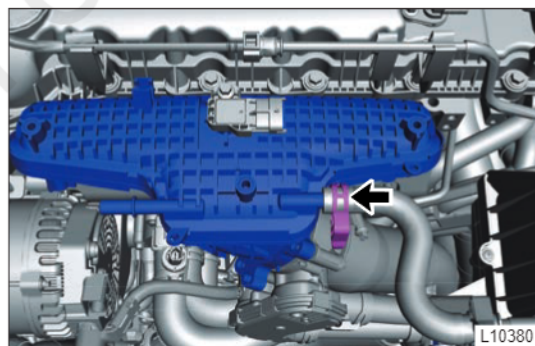
- (6) Remove 1 fixing bolt from canister solenoid valve outlet pipe assembly.



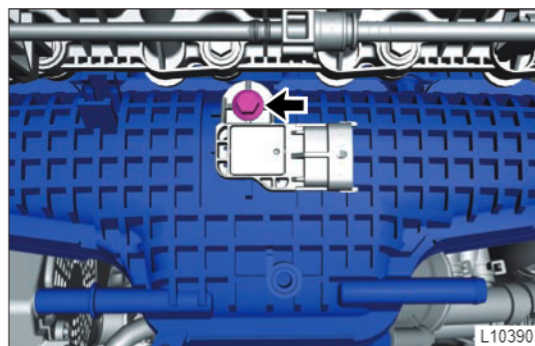
- (7) Disconnect the canister solenoid valve outlet pipe from the canister solenoid valve, intake manifold, intake hose, and intercooler outlet pipe II.
- (8) Separate the fixing clip from canister solenoid valve outlet pipe and remove the canister solenoid valve outlet pipe assembly.



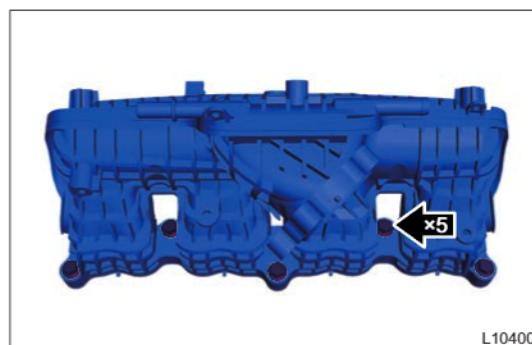
- (9) Loosen elastic clamp and disconnect the connection between brake vacuum pipe and intake manifold assembly.



- (10) Remove the electronic throttle assembly.
- (11) Remove 1 fixing bolt and intake pressure/temperature sensor.



(12) Remove 5 fixing bolts from intake manifold assembly.



(13) Remove the intake manifold assembly.

■ Inspection

- (1) Clean and check contact surface between intake manifold assembly and cylinder head. If warpage on surface is greater than 0.8 mm, replace intake manifold assembly.
- (2) Check the appearance of intake manifold assembly for damage and cracks.
- (3) Check the intake manifold gasket, and replace if it is deteriorated or damaged.

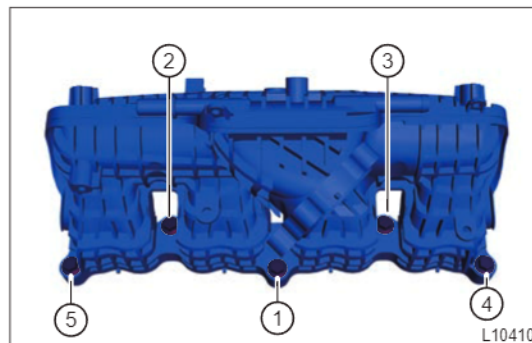
■ Installation

⚠ Caution

- Before assembly, visually check that intake manifold surface is free of collision, and the sealing rings on the flange surface of the intake manifold are free of mistakes, omissions, damages, lodging etc.

- (1) Align the two positioning pins on the intake manifold and press them into the positioning hole of the cylinder head.
- (2) As shown in illustration, install 5 fixing bolts respectively and tighten them in the corresponding order.

Torque: 20 + 5 N·m



- (3) Fix the engine wire harness clip and bracket.
- (4) Install intake pressure/temperature sensor.
- (5) Connect the brake vacuum pipeline.
- (6) Install canister solenoid valve outlet pipe assembly.
- (7) Install the air filter assembly.
- (8) Install the engine compartment trim cover assembly.

5.9 Electronic Accelerator Pedal

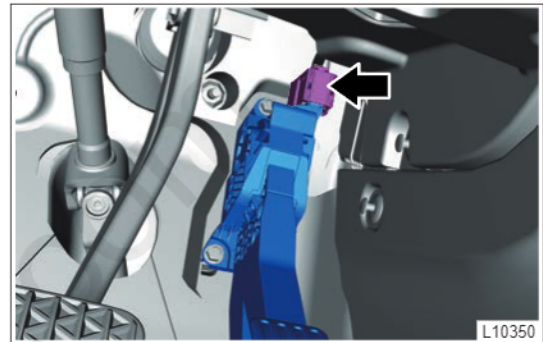
■ Removal

⚠ Warning

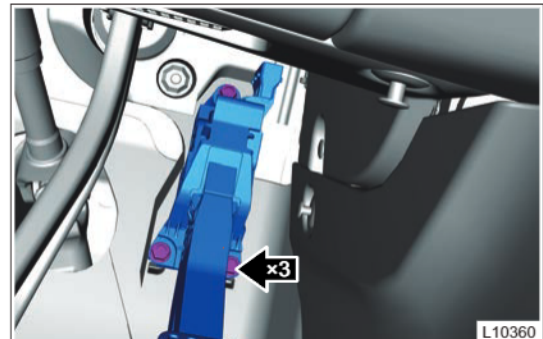
- Be sure to wear necessary safety equipment to prevent accidents, when removing electronic accelerator pedal.
- Appropriate force should be applied when removing electronic accelerator pedal. Be careful not to operate roughly.
- Try to prevent interior from being scratched during removal and installation.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.

- (3) Disconnect the electronic accelerator pedal connector.



- (4) Remove of 3 fixing bolts from electronic accelerator pedal.



- (5) Remove the electronic accelerator pedal.

■ Inspection

- (1) Press the electronic accelerator pedal by hand, If it is stuck, it indicates that internal components may be damaged.

■ Installation

- (1) Install 3 fixing bolts on electronic accelerator pedal.
Torque: 3.5 ± 0.5 N·m
- (2) Connect the electronic accelerator pedal connector.

5.10 Intercooler Assembly

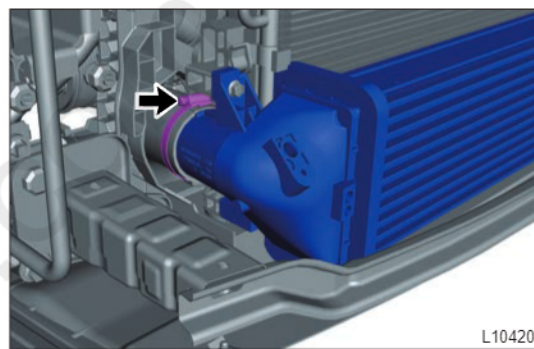
■ Removal

⚠ Warning

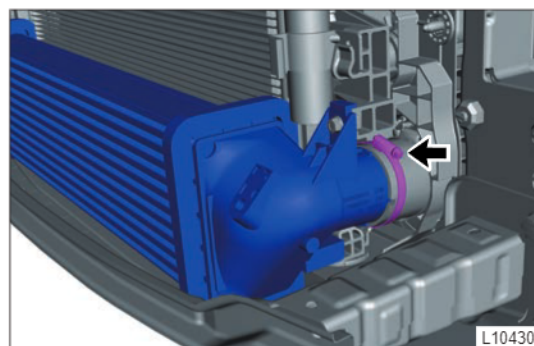
- **Be sure to wear safety equipment to prevent accidents, when removing intercooler assembly.**
- **Appropriate force should be applied, when removing the intercooler assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the engine compartment lower protector assembly.
- (4) Remove the front bumper assembly.
- (5) Remove the front upper impact beam assembly.
- (6) Remove the left and right air deflector assembly.

- (7) Loosen worm clamp and disconnect the connection between intercooler outlet pipe I and intercooler.



- (8) Loosen worm clamp and disconnect the connection between intercooler inlet pipe III and intercooler.



- (9) Remove 2 fixing bolts from intercooler assembly.



- (10) Remove the intercooler assembly.

■ Cleaning

- (1) Exterior cleaning: Use a water gun with a low pressure to spray water from top to bottom and from left to right at an angle perpendicular to the intercooler plane. Never flush the intercooler at an angle, it will damage the intercooler.
- (2) Interior cleaning: Fill the intercooler with water solution containing 2% soda ash at 80 °C. After waiting for half an hour, check for leaks. If so, replace the intercooler. If not, shake it back and forth several times, and then pour out the sewage. Then fill with water solution containing 2% soda ash again until it is washed out. Increase water temperature to 90 °C properly at the last washing. Wash out with same method and water solution.

■ Installation

- (1) Install 2 fixing bolts on intercooler assembly.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

- (2) Connect intercooler inlet pipe III, and tighten worm clamp after aligned and connected.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

- (3) Connect intercooler outlet pipe I, and tighten worm clamp after aligned and connected.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$.

Caution

- The connection clearing between rubber pipe and plastic should not exceed 3 mm.

- (4) Install the left and right air deflector assembly.
- (5) Install the front upper impact beam assembly.
- (6) Install the front bumper assembly.
- (7) Install the engine compartment lower protector assembly.

5.11 Intercooler Inlet Pipe I Assembly

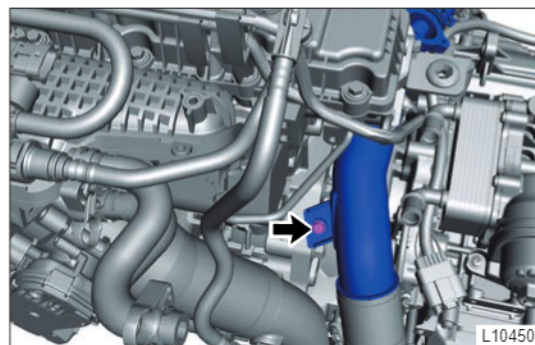
■ Removal

Warning

- Be sure to wear safety equipment to prevent accidents, when removing intercooler inlet pipe I assembly.
- Appropriate force should be applied, when removing the intercooler inlet pipe I assembly. Be careful not to operate roughly.

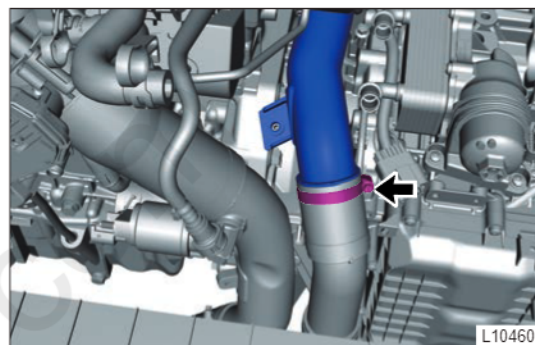
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the air filter assembly.
- (4) Remove the intake hose assembly.

- (5) Remove 1 fixing bolt between intercooler inlet pipe I and transmission.

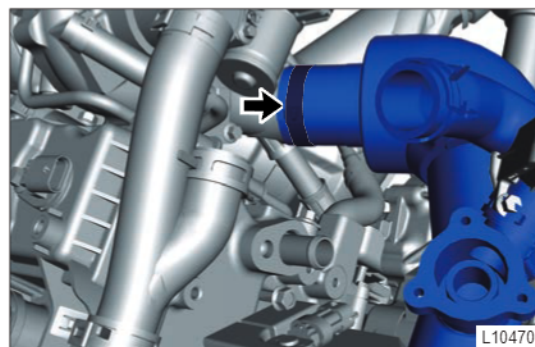


- (6) Disconnect the relief solenoid valve connector.

- (7) Loosen worm clamp and disconnect the connection between intercooler inlet pipe II and intercooler inlet pipe assembly I.



- (8) Loosen worm clamp and disconnect connection between intercooler inlet pipe I and turbocharger intake port.



- (9) Remove the intercooler inlet pipe I assembly carefully.

- (10) Remove the relief solenoid valve assembly.

■ Inspection

- (1) Check the appearance of intercooler inlet pipe assembly I for damage.
- (2) Check if the inner of intercooler inlet pipe assembly I is dirty.

■ Installation

- (1) Install the relief solenoid valve assembly.
- (2) Connect the intercooler inlet pipe I to turbocharger intake port and intercooler inlet pipe II respectively, and tighten worm clamp after aligned and connected.

Torque: 5 ± 1 N·m

⚠ Caution

- The connection clearing between rubber pipe and plastic should not exceed 3 mm.

- (3) Connect the relief solenoid valve connector.
- (4) Fix the intercooler inlet pipe I to transmission with 1 bolt.

Torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$

- (5) Install the intake hose assembly.
- (6) Install the air filter assembly.
- (7) Install the engine compartment trim cover assembly.

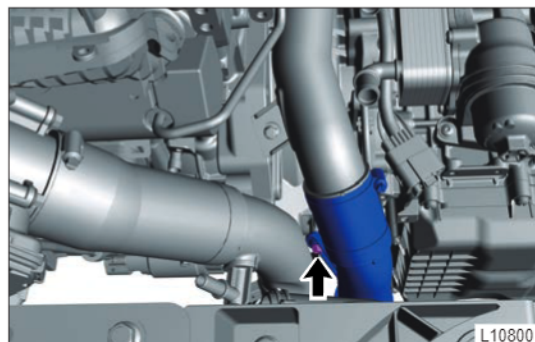
5.12 Intercooler Inlet Pipe II Assembly

■ Removal

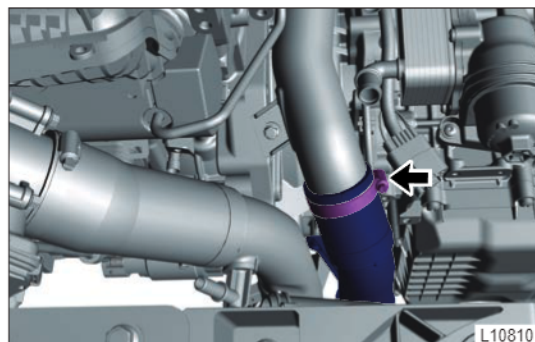
⚠ Warning

- Be sure to wear safety equipment to prevent accidents, when removing intercooler inlet pipe II assembly.
- Appropriate force should be applied, when removing the intercooler inlet pipe II assembly. Be careful not to operate roughly.

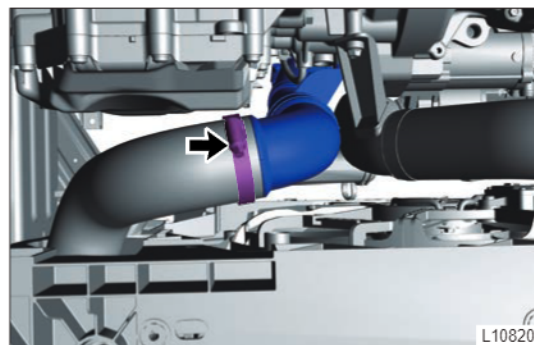
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the air filter assembly.
- (4) Remove 1 fixing bolt between intercooler inlet pipe II and transmission.



- (5) Loosen worm clamp and disconnect the connection between intercooler inlet pipe II and intercooler inlet pipe assembly I.



- (6) Loosen worm clamp and disconnect the connection between intercooler inlet pipe II and intercooler inlet pipe III assembly.



- (7) Remove the intercooler inlet pipe II assembly carefully.

■ Inspection

- (1) Check the appearance of intercooler inlet pipe assembly I for damage.
- (2) Check if the inner of intercooler inlet pipe assembly I is dirty.

■ Installation

- (1) Connect the intercooler inlet pipe II to intercooler inlet pipe III and intercooler inlet pipe I respectively, and tighten worm clamp after aligned and connected.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

⚠ Caution

- The connection clearing between rubber pipe and plastic should not exceed 3 mm.

- (2) Fix the intercooler inlet pipe II to transmission with 1 bolt.

Torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$

- (3) Install the air filter assembly.
- (4) Install the engine compartment trim cover assembly.

5.13 Intercooler Inlet Pipe III Assembly

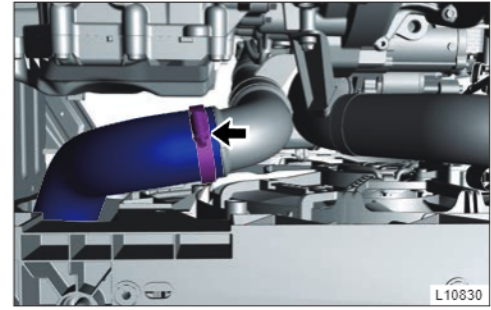
■ Removal

⚠ Warning

- Be sure to wear safety equipment to prevent accidents, when removing intercooler connecting pipe assembly.
- Appropriate force should be applied, when removing the intercooler connecting pipe assembly. Be careful not to operate roughly.

- (1) Raise the vehicle to a proper position.
- (2) Remove the engine compartment lower protector assembly.

- (3) Loosen worm clamp and disconnect the connection between intercooler inlet pipe II and intercooler inlet pipe III.



- (4) Loosen worm clamp and disconnect the connection between intercooler inlet pipe III and intercooler assembly.



- (5) Remove the intercooler inlet pipe III assembly carefully.

■ Installation

- (1) After aligning and connecting intercooler inlet pipe III and intercooler assembly, tighten worm clamp.
Torque: 5 ± 1 N·m
- (2) After aligning and connecting intercooler inlet pipe III and intercooler inlet pipe II, and tighten worm clamp.
Torque: 5 ± 1 N·m

⚠ Caution

- The connection clearing between rubber pipe and plastic should not exceed 3 mm.

- (3) Install the engine compartment lower protector assembly.

5.14 Intercooler Outlet Pipe | Assembly

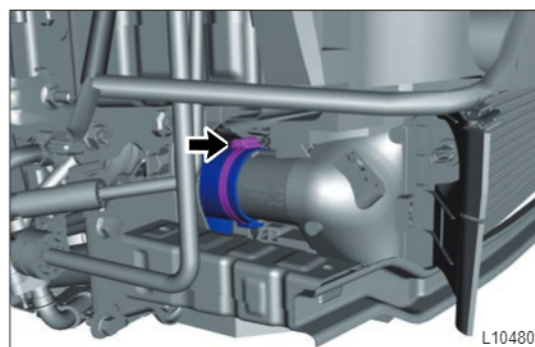
■ Removal

⚠ Warning

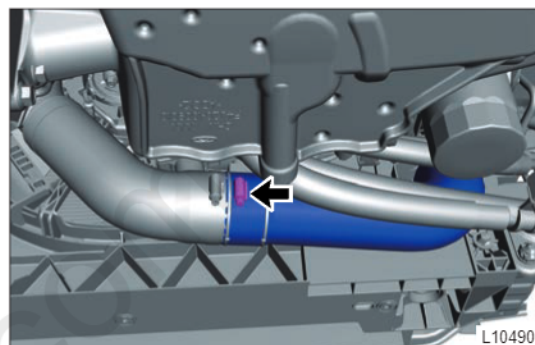
- Be sure to wear safety equipment to prevent accidents, when removing intercooler outlet pipe | assembly.
- Appropriate force should be applied, when removing the intercooler outlet pipe | assembly. Be careful not to operate roughly.

- (1) Raise the vehicle to a proper position.
- (2) Remove the engine compartment lower protector assembly.
- (3) Remove the front bumper assembly.

- (4) Loosen worm clamp and disconnect the connection between intercooler outlet pipe I and intercooler assembly.



- (5) Loosen worm clamp and disconnect the connection between intercooler outlet pipe I and intercooler outlet pipe II assembly.



- (6) Remove the intercooler outlet pipe I assembly carefully.

■ Installation

- (1) After aligning and connecting intercooler outlet pipe I and intercooler assembly, tighten worm clamp.
Torque: $5 \pm 1 \text{ N}\cdot\text{m}$
- (2) After aligning and connecting intercooler outlet pipe I and intercooler outlet pipe II assembly, tighten worm clamp.
Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

⚠ Caution

- The connection clearing between rubber pipe and plastic should not exceed 3 mm.

- (3) Install the engine compartment lower protector assembly.

5.15 Intercooler Outlet Pipe II Assembly

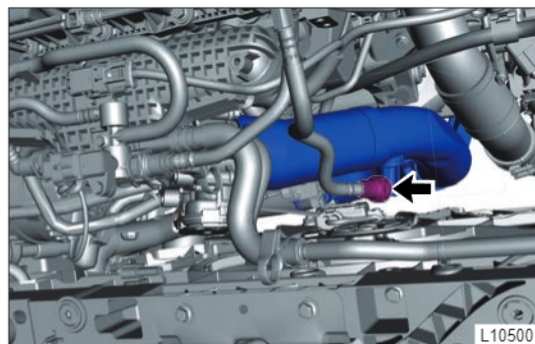
■ Removal

⚠ Warning

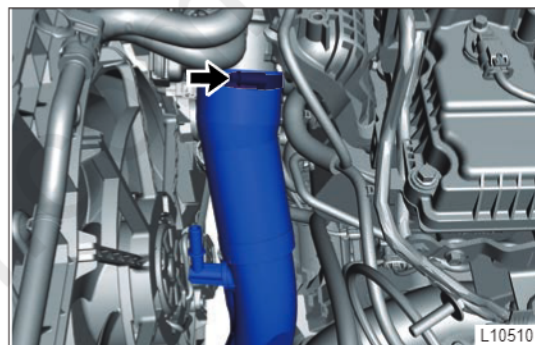
- Be sure to wear safety equipment to prevent accidents, when removing intercooler outlet pipe II assembly.
- Appropriate force should be applied, when removing the intercooler outlet pipe II assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine compartment lower protector assembly.

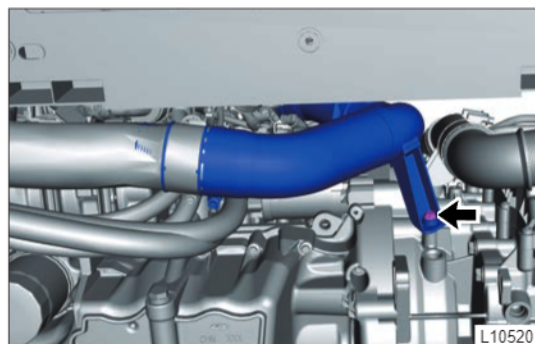
- (5) Disconnect the connection between charcoal canister solenoid valve outlet pipe and intercooler outlet pipe II.



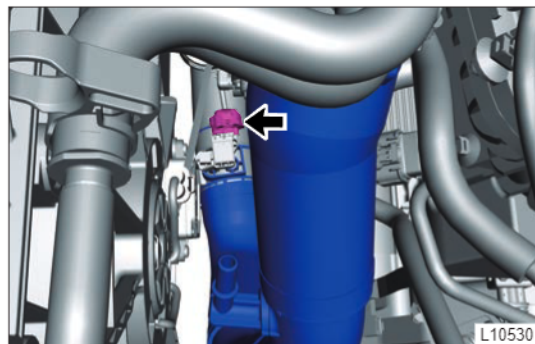
- (6) Loosen worm clamp and disconnect connection between intercooler outlet pipe II and throttle assembly.



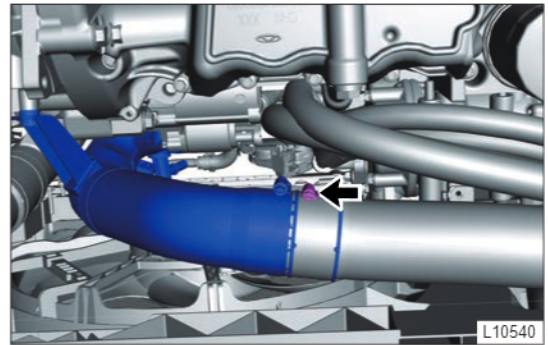
- (7) Remove 1 fixing bolt between intercooler outlet pipe II and transmission.



- (8) Disconnect the boost pressure sensor connector.



- (9) Loosen worm clamp and disconnect the connection between intercooler outlet pipe I and intercooler outlet pipe II.



- (10) Remove the intercooler outlet pipe II assembly carefully.

- (11) Remove the boost pressure/temperature sensor from intercooler outlet pipe II.

■ Installation

- (1) Install the boost pressure/temperature sensor to intercooler outlet pipe II assembly.
- (2) After aligning and connecting intercooler outlet pipe II and intercooler outlet pipe I, tighten worm clamp.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

⚠ Caution

- The connection clearing between rubber pipe and plastic should not exceed 3 mm.

- (3) Connect the boost pressure/temperature sensor connector.
- (4) After connecting intercooler outlet pipe II and throttle assembly, and tighten worm clamp.
- Torque: $5 \pm 1 \text{ N}\cdot\text{m}$**
- (5) Connect charcoal canister solenoid valve outlet pipe and intercooler outlet pipe II assembly.
- (6) Install and tighten 1 fixing bolt.
- Torque: $7 \pm 1 \text{ N}\cdot\text{m}$**
- (7) Install the engine compartment lower protector assembly.

4.4 EXHAUST SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Before repairing the exhaust system, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

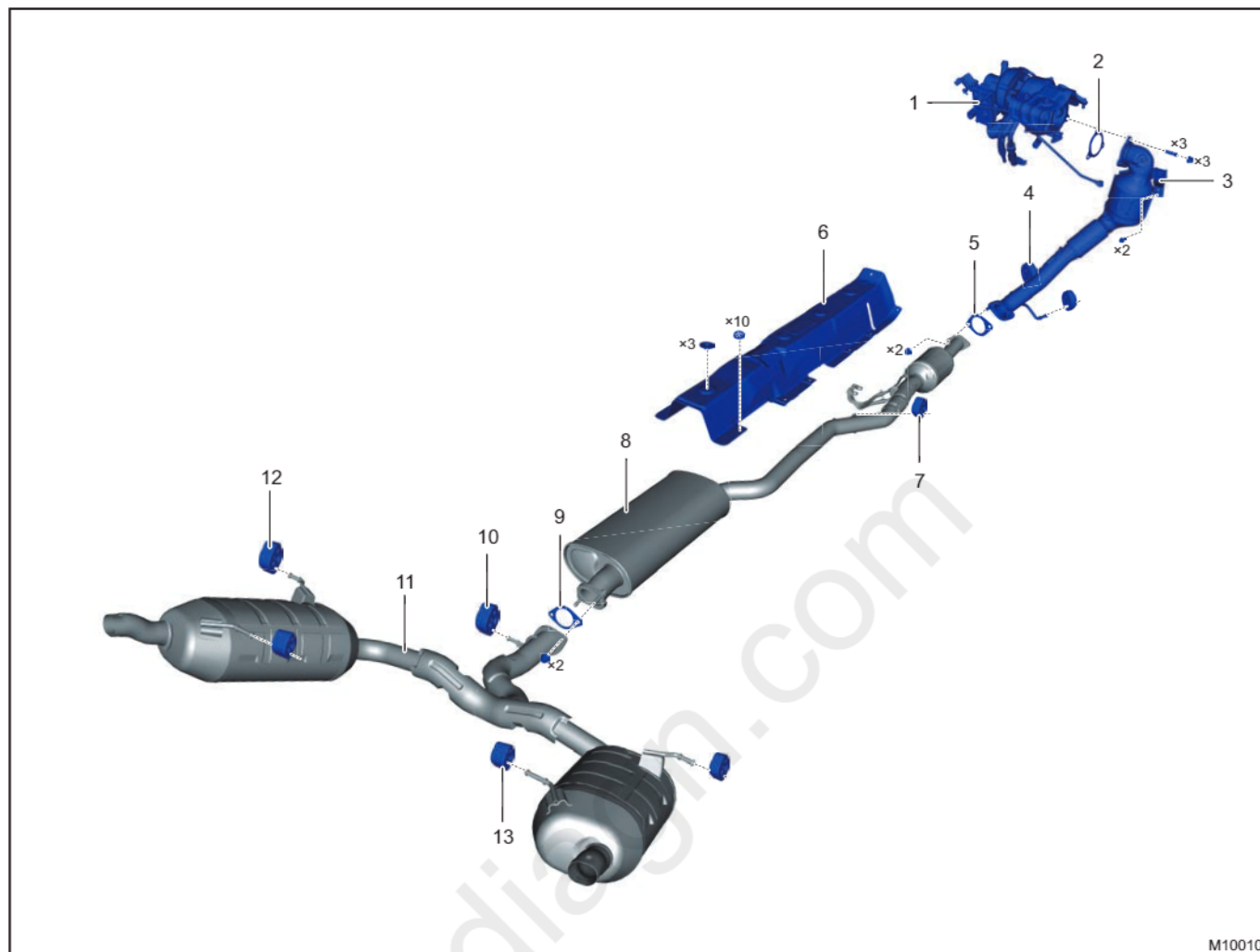
- (1) If exhaust gasket is damaged, replace it, and remove foreign matters on joints and threads.
- (2) Check exhaust gas for leakage. If gas leaks, tighten malfunctioning part to prevent leakage. Replace damaged parts as necessary.

2 System Overview

2.1 System Description

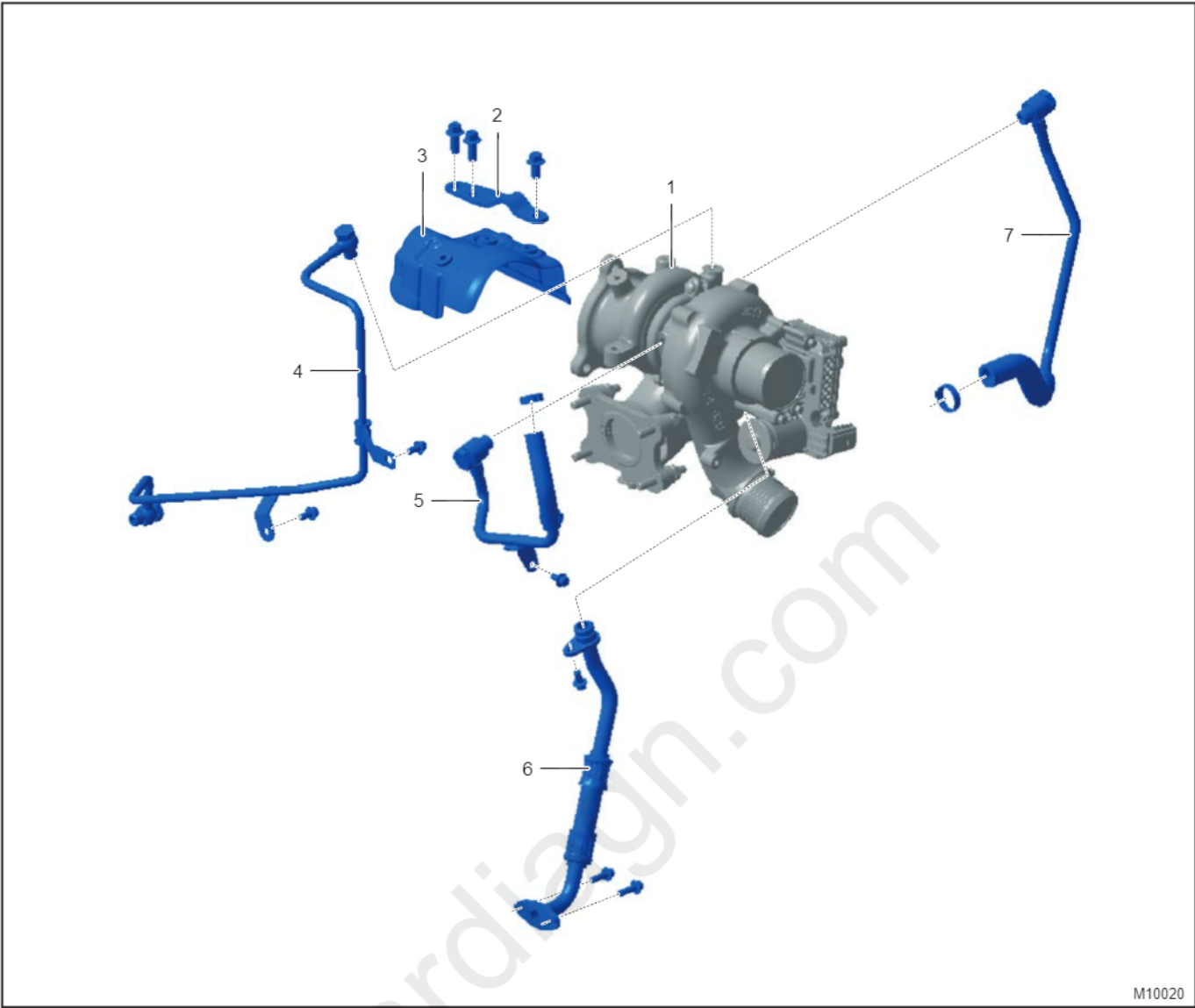
Exhaust system controls engine exhaust, reducing vehicle emissions by precatlytic converter and main catalytic converter, and eliminating exhaust noise by muffler. When exhaust system discharges exhaust gas, oxygen sensor monitors oxygen content in exhaust gas. Engine control module adjusts air-fuel ratio of combustible gas mixture to control vehicle emissions and achieve optimal fuel economy and satisfy the emissions standard of regulation according to feedback signals of oxygen sensor and combining with other sensor signals.

2.2 System Components Diagram



M10010

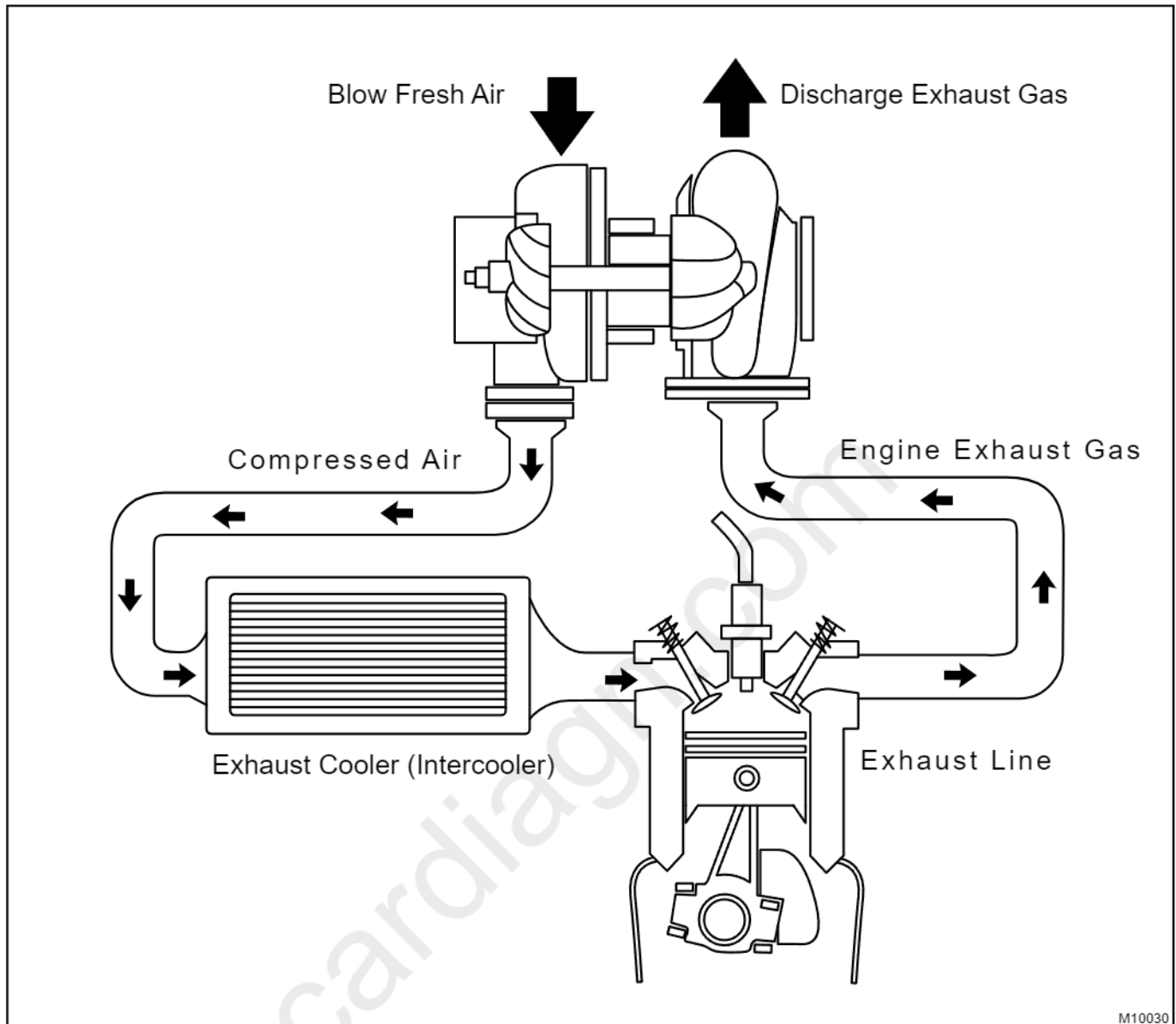
1	Turbocharger Assembly	8	Front Muffler and Line
2	Washer Between Turbocharger and Precatalytic Converter	9	Gasket Between Front Muffler and Rear Muffler
3	Precatalytic Converter Assembly	10	Front Muffler Hanger Block
4	Main Catalytic Converter Assembly Hanger Block	11	Muffler Assembly
5	Washer	12	Rear Muffler Hanger Block
6	Center Passage Heat Insulator Assembly	13	Rear Muffler Hanger Block
7	Front Muffler Hanger Block		



M10020

1	Supercharger Assembly	5	Turbocharger Cooling Water Outlet Pipe
2	Turbocharger Bracket	6	Turbocharger Oil Return Pipe Assembly
3	Turbocharger Heat Insulator	7	Turbocharger Water Inlet Pipe Assembly
4	Turbocharger Oil Inlet Pipe Assembly		

2.3 System Schematic Diagram

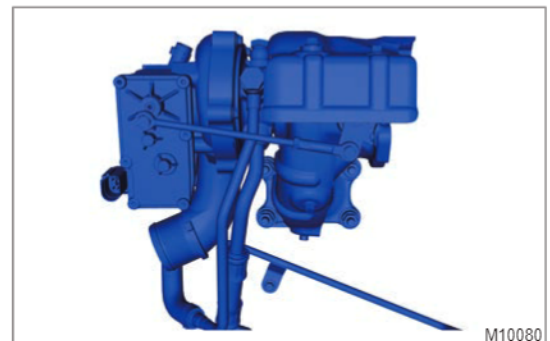


The fresh air filtered by the air filter enters the intercooler after being pressed by the turbocharger, and then enters the cylinder after being cooled by the intercooler. The exhaust gas drives turbo impeller to rotate, and then drives compressor impeller to press the inlet fresh air.

2.4 System Components Description

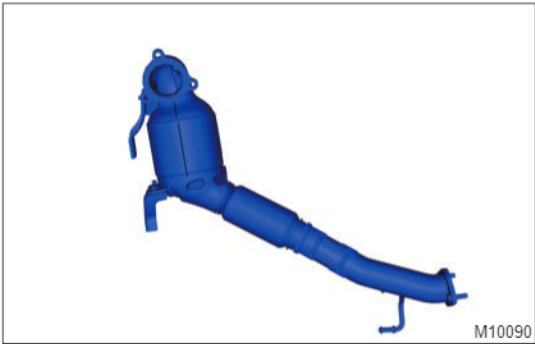
■ Turbocharger

Turbocharger uses the exhaust gas discharged from the engine to push the turbine impeller to rotate, and then drives the compressor impeller to pressurize the air filtered by the air filter and send it to the cylinder. As more air enters the cylinder, more fuel is allowed to be injected, thus generating more power from the engine. In addition, the turbocharger can also make the engine obtain power compensation when working at high altitude.



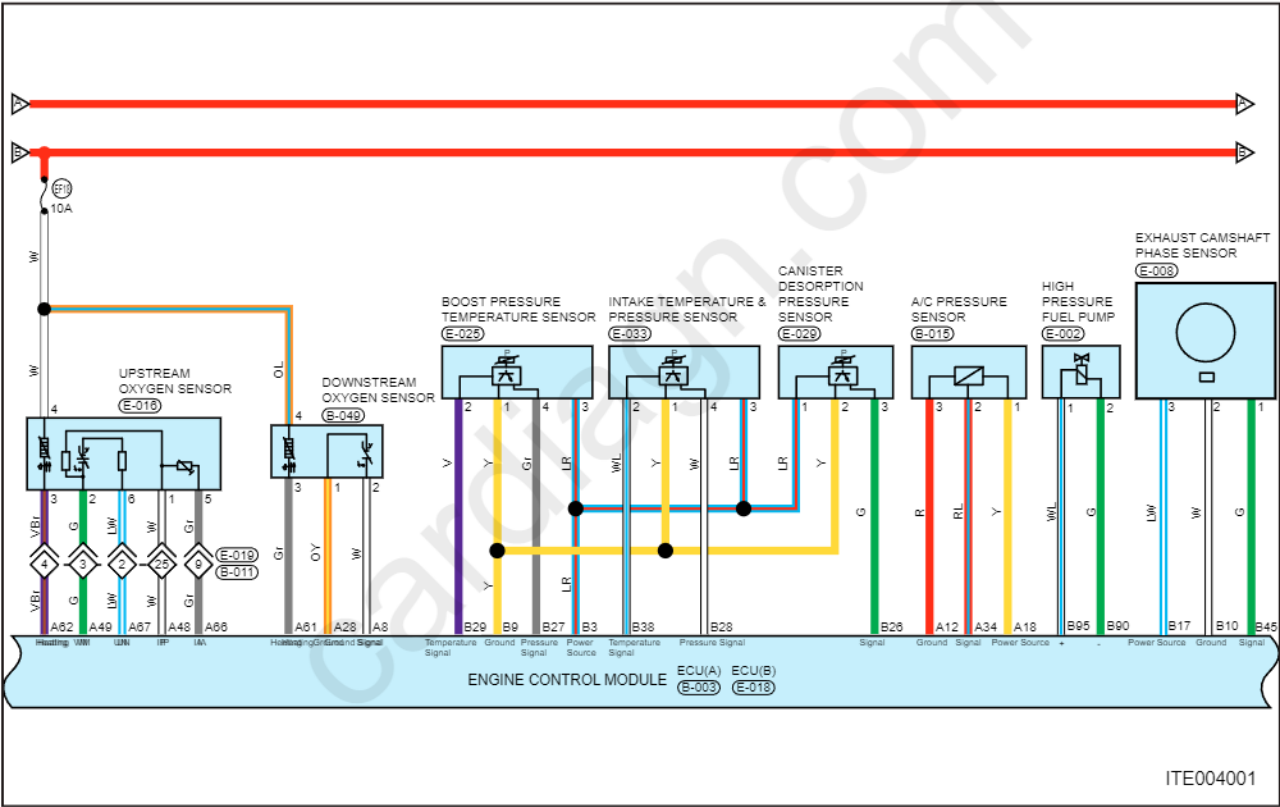
Catalytic Converter

Catalytic converter is the most important external purification device fixed in vehicle exhaust system, which can convert harmful gases such as carbon monoxide, hydrocarbons and nitrogen oxides from exhaust gas into carbon dioxide, water and nitrogen by oxidation and reduction.



3 System Circuit Diagram

3.1 Circuit Diagram



4 Diagnosis & Testing

4.1 Problem Symptoms Table

Hint:
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Exhaust System

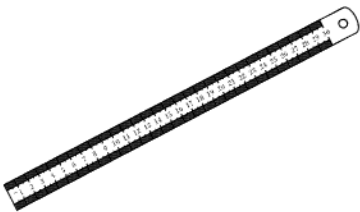
Symptom	Possible Cause
Excessive exhaust noise	Exhaust pipe (loose connection)
	Turbocharger (damaged)

Symptom	Possible Cause
	Muffler assembly (damaged or leaked)
	Main catalytic converter assembly (damaged or leaked)
	Exhaust pipe gasket (damaged)
Excessive exhaust temperature	Inadequate gas mixture combustion
	Main catalytic converter assembly (blocked)
	Precatalytic converter assembly (blocked)
	Turbocharger (blocked)
Exhaust pipe leakage	Main catalytic converter assembly (damaged or leaked)
	Muffler assembly (damaged or leaked)
	Precatalytic converter assembly (damaged or leaked)

5 ON-VEHICLE SERVICE

5.1 Tool

■ General Tool

Tool Name	Tool Drawing
Precision Straightedge	 S00044

5.2 Turbocharger Heat Insulator

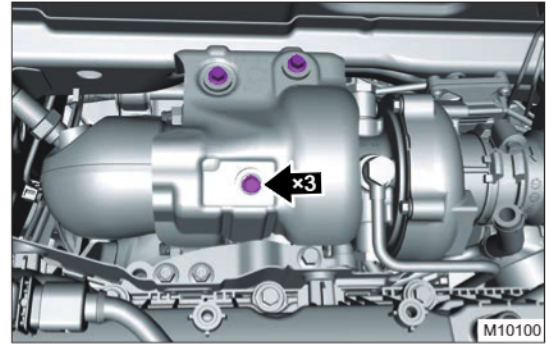
■ Removal

⚠ Warning

- Before removing turbocharger heat insulator assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear safety equipment to prevent accidents, when removing turbocharger heat insulator assembly.
- Appropriate force should be applied, when removing the turbocharger heat insulator assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the negative battery cable.

- (4) Remove 3 fixing bolts from turbocharger heat insulator assembly.



- (5) Remove turbocharger heat insulator assembly carefully.

■ Installation

- (1) Install 3 fixing bolts on turbocharger heat insulator assembly.

Torque: 8 + 3 N·m

- (2) Install the engine compartment trim cover assembly.

5.3 Turbocharger Bracket

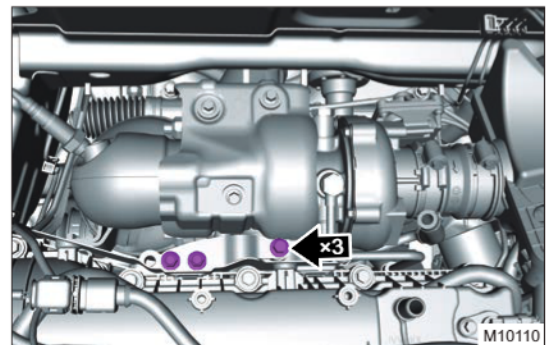
■ Removal

⚠ Warning

- Before removing turbocharger bracket assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear safety equipment to prevent accidents, when removing turbocharger bracket assembly.
- Appropriate force should be applied, when removing turbocharger bracket assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the negative battery cable.

- (4) Remove 3 fixing bolts from turbocharger bracket assembly.

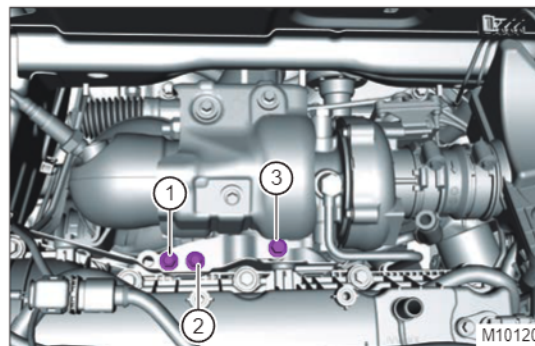


- (5) Remove turbocharger bracket assembly carefully.

■ Installation

- (1) Tighten 3 installation bolts in order shown in illustration.

Torque: 1st step: 6 ± 2 N·m, 2nd step: 30 ± 5 N·m



- (2) Install the engine compartment trim cover assembly.

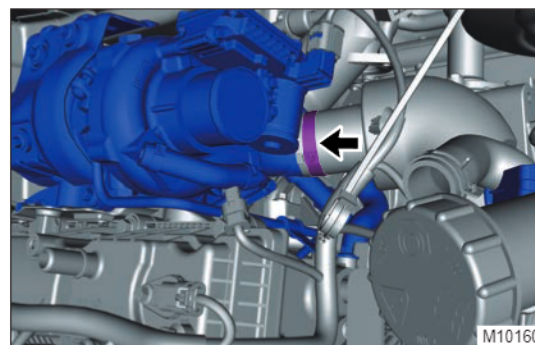
5.4 Turbocharger Assembly

■ Removal

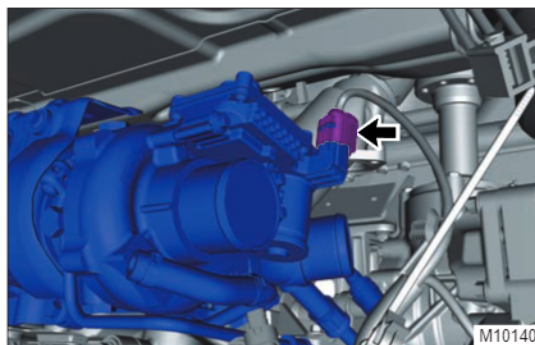
⚠ Warning

- **Before removing turbocharger assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing turbocharger assembly.**
- **Appropriate force should be applied, when removing turbocharger assembly. Be careful not to operate roughly.**

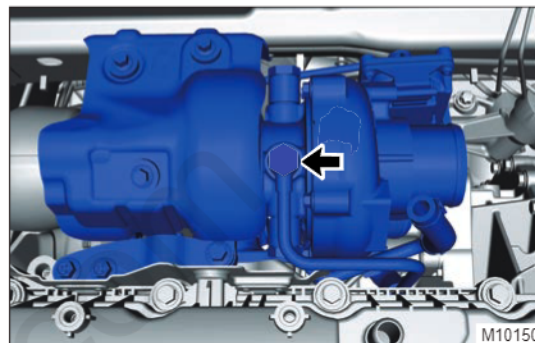
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the intake hose assembly.
- (6) Drain the coolant.
- (7) Removal turbocharger heat insulator assembly.
- (8) Remove the heating inlet pipe assembly 1.
- (9) Remove the turbocharger bracket.
- (10) Remove the precatalytic converter assembly.
- (11) Loosen worm clamp and disconnect connection between intercooler inlet pipe 1 and turbocharger assembly.



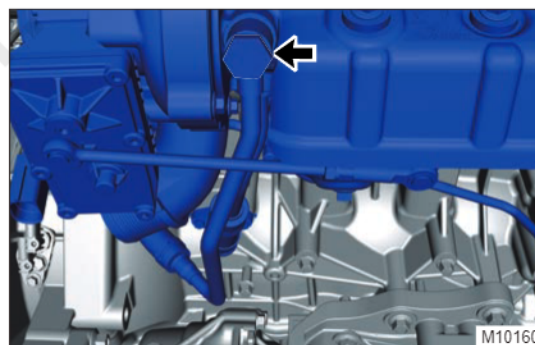
- (12) Disconnect turbocharger electronic exhaust gas valve connector.



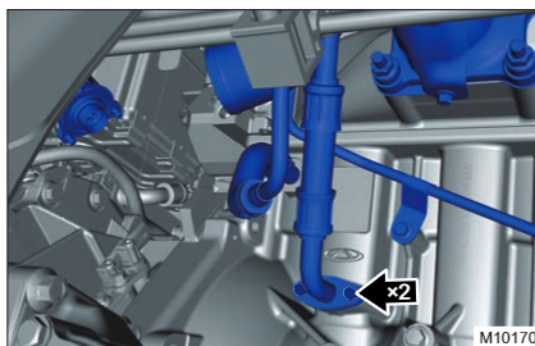
- (13) Remove 1 hollow bolt between oil inlet pipe assembly and turbocharger. Remove the copper washer carefully.



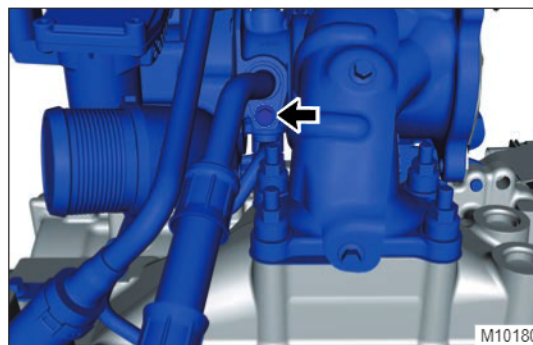
- (14) Remove 1 hollow bolt between oil inlet pipe assembly and turbocharger. Remove the copper washer carefully.



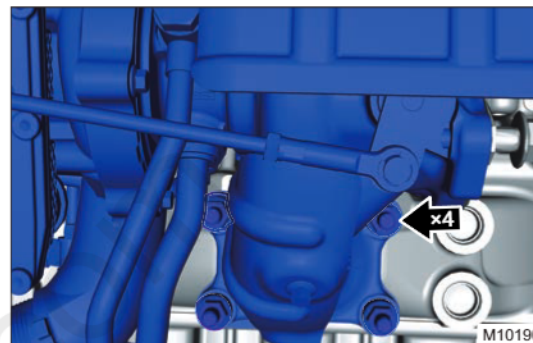
- (15) Remove 2 fixing bolts between oil return pipe assembly and cylinder block. Remove the washer carefully.



- (16) Remove 1 fixing bolt between oil return pipe assembly and turbocharger. Unplug the oil return pipe assembly from turbocharger oil return hole.

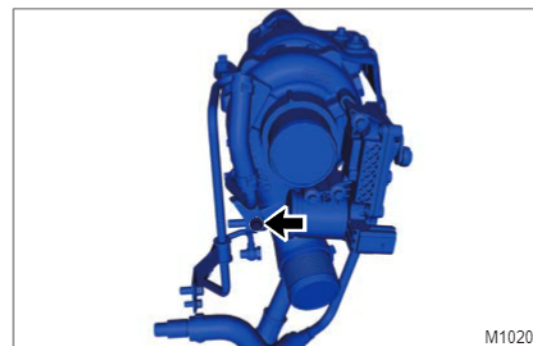


- (17) Remove 4 high temperature nuts between turbocharger and cylinder head, and remove the cushion from each bolt.

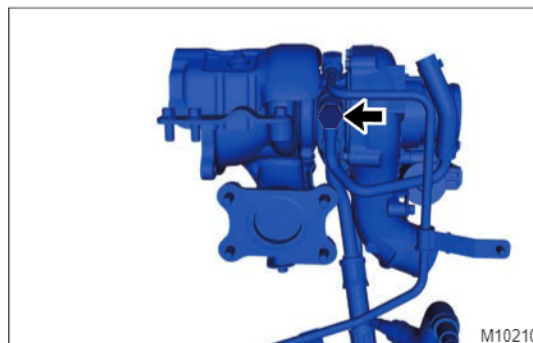


- (18) Remove the turbocharger assembly carefully. And remove gasket from cylinder head flange.

- (19) Remove 1 fixing bolt between water outlet pipe bracket and turbocharger.



- (20) Remove 1 hollow bolt between water outlet pipe assembly and turbocharger. Remove the washer carefully.



■ Daily inspection of turbocharger

- (1) Check the sealing and tightness of connecting lines between air filter and turbocharger, turbocharger and engine intake/exhaust pipe.
- (2) Check if turbocharger oil inlet pipe and return pipe are damaged or throttling, and if the connecting bolts of joints are loose.

- (3) Check the air filter and clean or replace the element regularly.
- (4) Check if engine crankcase blow-by gas is too large, breather is smooth, ensure crankcase pressure is normal.

■ **Other requirements of turbocharger**

- (1) Avoid low engine idle for long time (maximum should not exceed 20 minutes).
- (2) Never use the operation with "Accelerate - Stall - Neutral coasting", before the engine lubricating oil pressure is established, the engine must be kept in idling condition (3 - 5 minutes).
- (3) Before stopping the engine, let it gradually decrease its temperature and speed from maximum value (3 - 5 minutes).

■ **Firstly perform basic inspection to turbocharger system when DTC indicating too high or too low boost pressure occurs or when power decreases.**

- (1) Check there are no cracks causing by overheating, biting, deformation or other damage on exhaust turbocharger turbo housing, otherwise, replace exhaust turbocharger.
- (2) Check there are no deposition and blocking on turbo oil hole.
- (3) Check there are no blockage, squash, deformation or other damage on oil inlet and return pipes of exhaust turbocharger.
- (4) Check there is no sticking in actuator mechanism, and if actuator connector is connected normally.
- (5) Check there is no obvious deformation in turbocharger impeller, and the rotation is normal without blocking.
- (6) Check if each actuator connector is connected reliably (intake relief valve and exhaust gas bypass electric valve) and check for no damage of appearance.

■ **Installation**

 Caution

- **Do not pull the turbocharger actuator rod by hand, and avoid impacting the turbocharger during assembly.**
- **Check for foreign matter in turbocharger and line when installing. Avoid inhaling foreign matter after turbocharger running, causing damage to the components.**

- (1) If the four high temperature studs on flange surface of the cylinder head are removed, the bolts need to be replaced. Before installing the bolts, apply high temperature thread adhesive to the short threads of the high temperature studs, and screw them into threaded hole of cylinder head according to the corresponding torque.

Torque: 14 + 3 N·m

Thread adhesive: Loctite 2422

 Caution

- **Use it immediately after applying the thread adhesive. The stud should be fastened within 5 minutes after applying the thread adhesive. If removal, the bolts need to be replaced and re-apply thread adhesive to tighten.**

- (2) Pass the washer through the high temperature stud and put on the exhaust flange surface of the cylinder head.

 Caution

- **Pay attention to the direction of the failure-proof identification point after installation, as shown in illustration.**

- (3) Put a washer on the hollow bolt, insert it into the ball joint of the water outlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on turbocharger. Screw in at least 3 teeth without tightening.

Torque: $40 \pm 2 \text{ N}\cdot\text{m}$

- (4) Screw the water outlet pipe bracket into threaded hole of the turbocharger with 1 fixing bolt. Screw in at least 3 teeth without tightening.

Torque: $8 + 3 \text{ N}\cdot\text{m}$

⚠ Caution

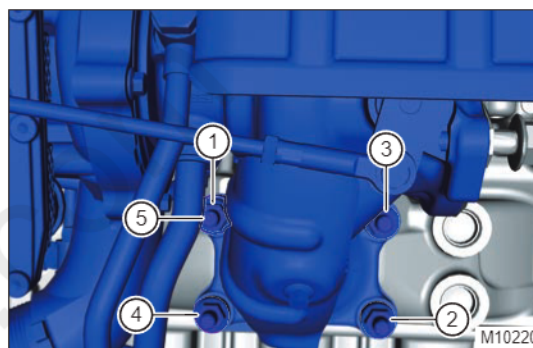
- **First tighten the hollow bolts according to the torque requirements, and then tighten the bracket fixing bolts.**

- (5) Put the turbocharger mounting hole on the cylinder head exhaust flange stud carefully. Put 1 cushion on each bolt. Install 4 high temperature nuts, and tighten them diagonally in the order shown in illustration.

Hint:

The serial number 5 is to re-tighten position 1 once.

Torque: $33 \pm 3 \text{ N}\cdot\text{m}$



- (6) Dip a small amount of oil on the oil return pipe seal ring (the oil type is the same as the engine oil), rotate the end with seal ring into the oil return hole in the middle of turbocharger, and screw in 1 fixing bolt at least 3 teeth without tightening.

Torque: $8 + 3 \text{ N}\cdot\text{m}$

- (7) Install 2 bolts into the installation hole of oil return pipe, then put the gasket, and screw 2 bolts into the installation hole of oil return flange surface on cylinder block. Screw in at least 3 teeth without tightening.

Torque: $8 + 3 \text{ N}\cdot\text{m}$

⚠ Caution

- **First tighten 2 hollow bolts between oil return pipe and cylinder block according to the torque requirements, and then tighten 1 fixing bolt between oil return pipe and turbocharger.**

- (8) Loosen 2 fixing bolts on oil inlet pipe assembly bracket.

Torque: $8 + 3 \text{ N}\cdot\text{m}$

- (9) Loosen the hollow bolt between oil inlet pipe assembly and cylinder block.

Torque: $25 + 5 \text{ N}\cdot\text{m}$

Hint:

The purpose of loosening is to install the oil inlet pipe assembly to turbocharger side.

- (10) Put a washer on the hollow bolt, insert it into the ball joint of the oil inlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on turbocharger. Final tightening.

Torque: 25 ± 5 N·m

⚠ Caution

- **First tighten the hollow bolts at both ends of the oil inlet pipe assembly according to the torque requirements, and then tighten 2 fixing bolts on oil inlet pipe bracket.**

- (11) Put a washer on the hollow bolt, insert it into the ball joint of the water inlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on turbocharger. Final tightening.

Torque: 40 ± 2 N·m

- (12) Connect intercooler inlet pipe assembly 1 and turbocharger, then tighten the worm clamp.

Torque: 5 ± 1 N·m

- (13) Connect the turbocharger exhaust electric valve connector.
 (14) Install the precatlytic converter assembly.
 (15) Install the turbocharger bracket.
 (16) Install the heating inlet pipe assembly 1.
 (17) Install turbocharger heat insulator assembly.
 (18) Install the intake hose assembly.
 (19) Install the air filter assembly.
 (20) Add the coolant.
 (21) Add oil to proper position.
 (22) Install the engine compartment trim cover assembly.

5.5 Turbocharger Cooling Water Outlet Pipe

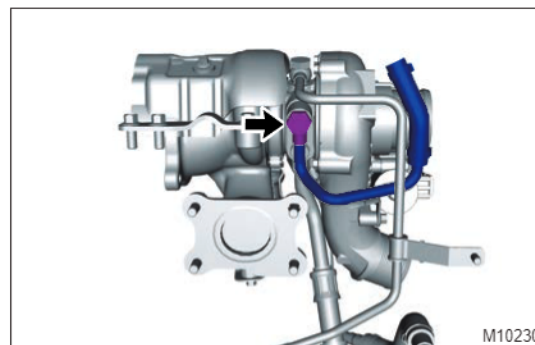
■ Removal

⚠ Warning

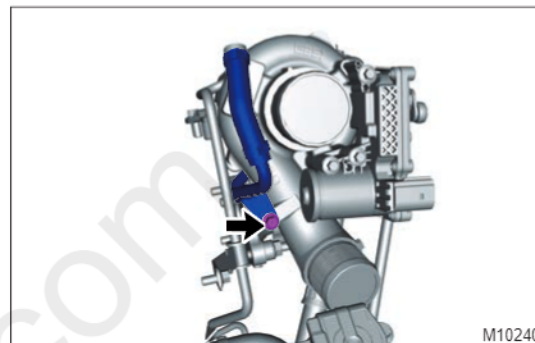
- **Before removing turbocharger cooling water outlet pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing cooling water outlet pipe assembly.**
- **Appropriate force should be applied, when removing turbocharger cooling water outlet pipe. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
 (2) Remove the engine compartment trim cover assembly.
 (3) Disconnect the negative battery cable.
 (4) Remove the air filter assembly.
 (5) Remove the intake hose assembly.
 (6) Drain the coolant.
 (7) Remove the turbocharger assembly.

- (8) Remove 1 hollow bolt between water outlet pipe and turbocharger water outlet port. Remove the copper washer carefully.



- (9) Remove 1 fixing bolt from water outlet pipe bracket.



- (10) Remove the turbocharger water outlet pipe assembly.

■ Installation

- (1) Put a washer on the hollow bolt, insert it into the ball joint of the water outlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on turbocharger. Screw in at least 3 teeth without tightening.

Torque: $40 \pm 2 \text{ N}\cdot\text{m}$

- (2) Screw the water outlet pipe bracket into threaded hole of the turbocharger with 1 fixing bolt. Screw in at least 3 teeth without tightening.

Torque: $8 + 3 \text{ N}\cdot\text{m}$

Caution

- **First tighten the hollow bolts according to the torque requirements, and then tighten the bracket fixing bolts.**

- (3) Put a clamping ring on water outlet pipe and insert it into the corresponding branch pipe of the heating steel pipe. Adjust the position of the clamping ring so that the center of clamp is aligned with the center of "T" shape at the end of water outlet pipe, and clamp it with clamp pliers.

Caution

- **When connecting supercharger cooling water outlet pipe and heating steel pipe, a small amount of lubricant can be applied if necessary, and the same type of coolant can be used for the engine.**

- (4) Install the turbocharger.
- (5) Install the intake hose assembly.
- (6) Install the air filter assembly.
- (7) Add the antifreeze.
- (8) Install the engine compartment trim cover assembly.

5.6 Turbocharger Water Inlet Pipe Assembly

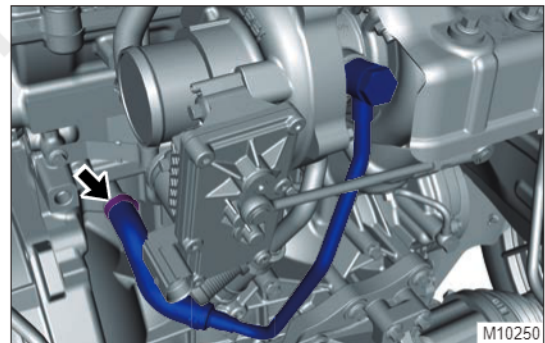
■ Removal

⚠ Warning

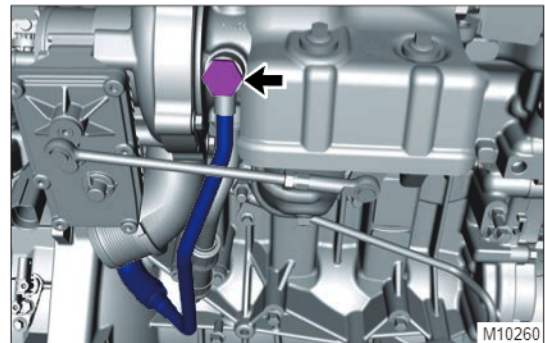
- **Before removing turbocharger water inlet pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing turbocharger water inlet pipe assembly.**
- **Appropriate force should be applied, when removing turbocharger water inlet pipe. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the intercooler intake pipe I assembly.
- (5) Drain the coolant.

- (6) Loosen clamping ring and disconnect connection between water inlet pipe and cylinder block pipe joint.



- (7) Remove 1 hollow bolt between water inlet pipe and turbocharger water inlet port. Remove the copper washer carefully.



- (8) Remove the turbocharger water inlet pipe assembly carefully.

■ Installation

- (1) Put a clamping ring on the cylinder block pipe joint, insert the water inlet pipe hose until it reaches the check drum of the cylinder block pipe joint, and adjust the water pipe so that the "T"-shaped mark faces the rear end of the cylinder, and then adjust the position of clamp so that the center of clamp is aligned with the "T" center of water inlet pipe, and then clamp tightly with clamp plier.

⚠ Caution

- **When connecting supercharger water inlet pipe and cylinder block pipe joint, a small amount of lubricant can be applied if necessary, and the same type of coolant can be used for the engine.**

- (2) Put a washer on the hollow bolt, insert it into the ball joint of the water inlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on turbocharger. Final tightening.

Torque: $40 \pm 2 \text{ N}\cdot\text{m}$

- (3) Install the intercooler inlet pipe I assembly.
- (4) Add the coolant.
- (5) Install the engine compartment trim cover assembly.

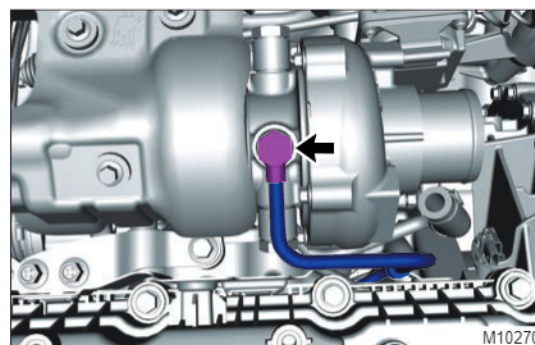
5.7 Turbocharger Oil Inlet Pipe Assembly

■ Removal

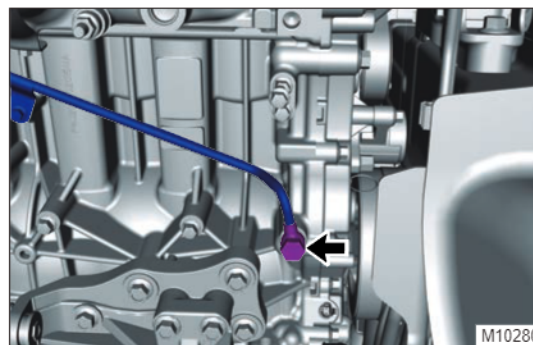
⚠ Warning

- **Before removing turbocharger oil inlet pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing turbocharger oil inlet pipe assembly.**
- **Appropriate force should be applied, when removing turbocharger oil inlet pipe assembly. Be careful not to operate roughly.**

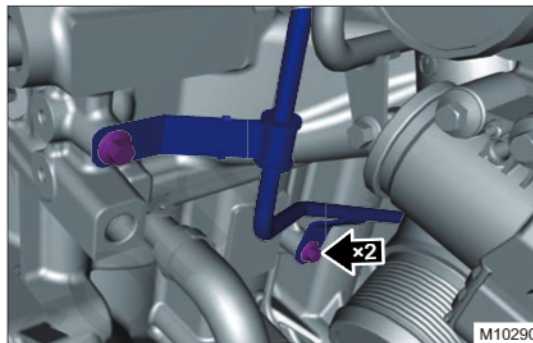
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the intake hose assembly.
- (6) Remove the rear right mounting link assembly.
- (7) Remove the rear right mounting cushion assembly.
- (8) Remove 1 hollow bolt between oil inlet pipe and turbocharger oil inlet port. Remove the copper washer carefully.



- (9) Remove 1 hollow bolt between oil inlet pipe and cylinder block. Remove the copper washer carefully.



- (10) Remove 2 fixing bolts from oil inlet pipe assembly.



- (11) Remove the turbocharger oil inlet pipe assembly carefully.

■ Installation

- (1) Put a washer on the hollow bolt, insert it into the ball joint of the oil inlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on turbocharger. Screw in at least 3 teeth without tightening.

Torque: 25 + 5 N·m

- (2) Install 2 fixing bolts to oil inlet pipe assembly bracket, and screw in at least 3 teeth without tightening.

Torque: 8 + 3 N·m

- (3) Put a washer on the hollow bolt, insert it into the ball joint of the oil inlet pipe, and put another washer on the hollow bolt, and screw it into the corresponding threaded hole on cylinder block. Screw in at least 3 teeth without tightening.

Torque: 25 + 5 N·m

⚠ Caution

- **First tighten the hollow bolts at both ends of the oil inlet pipe assembly according to the torque requirements, and then tighten 2 fixing bolts on oil inlet pipe bracket.**

- (4) Install the rear right mounting cushion assembly.
 (5) Install the rear right mounting link assembly.
 (6) Install the intake hose assembly.
 (7) Install the air filter assembly.
 (8) Add oil to proper position.
 (9) Install the engine compartment trim cover assembly.

5.8 Turbocharger Oil Return Pipe Assembly

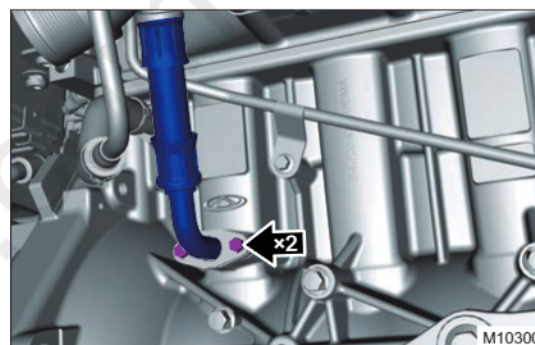
■ Removal

⚠ Warning

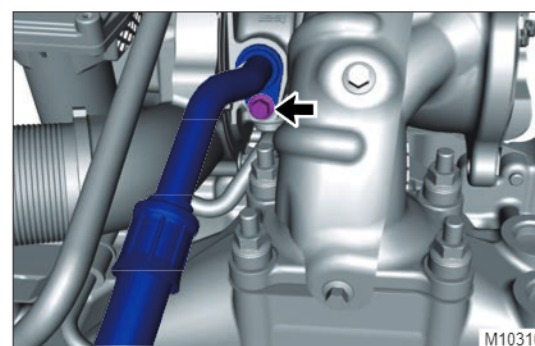
- Before removing turbocharger oil return pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear safety equipment to prevent accidents, when removing turbocharger oil return pipe assembly.
- Appropriate force should be applied, when removing turbocharger oil return pipe assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine lower protector assembly.
- (3) Remove the rear right mounting link assembly.
- (4) Remove the rear right mounting cushion assembly.

- (5) Remove 2 fixing bolts between oil return pipe assembly and cylinder block. Remove the washer carefully.



- (6) Remove 1 fixing bolt between oil return pipe assembly and turbocharger. Remove the oil return pipe assembly from turbocharger oil return hole.



■ Installation

- (1) Dip a small amount of oil on the oil return pipe seal ring (the oil type is the same as the engine oil), rotate the end with seal ring into the oil return hole in the middle of turbocharger, and screw in 1 fixing bolt at least 3 teeth without tightening.

Torque: 8 + 3 N·m

- (2) Install 2 bolts into the installation hole of oil return pipe, then put the gasket, and screw 2 bolts into the installation hole of oil return flange surface on cylinder block. Screw in at least 3 teeth without tightening.

Torque: 8 + 3 N·m

⚠ Caution

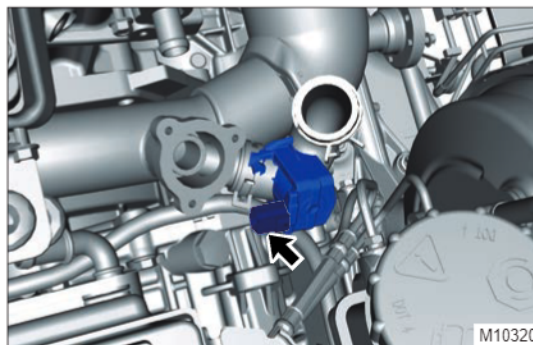
- **First tighten 2 hollow bolts between oil return pipe and cylinder block according to the torque requirements, and then tighten 1 fixing bolt between oil return pipe and turbocharger.**

- (3) Install the rear right mounting cushion assembly.
- (4) Install the rear right mounting link assembly.
- (5) Add oil to proper position.
- (6) Install the engine lower protector assembly.

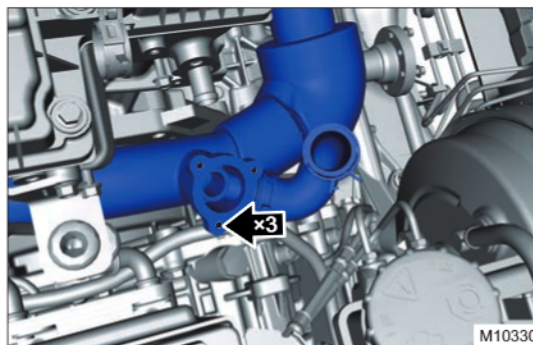
5.9 Relief Control Solenoid Valve**■ Removal****⚠ Warning**

- **Before removal of pressure discharge control solenoid valve assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing relief control solenoid valve assembly.**
- **Appropriate force should be applied, when removing relief control solenoid valve assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the engine compartment trim cover assembly.
- (4) Remove the intake hose assembly.
- (5) Disconnect the relief control solenoid valve connector.



- (6) Remove 3 fixing bolts from relief control solenoid valve.



- (7) Remove the relief solenoid valve assembly.

■ Installation

- (1) Install relief control solenoid valve and tighten 3 fixing bolts.

Torque: 8 + 3 N·m

- (2) Connect the relief control solenoid valve connector.
- (3) Install the intake hose assembly.
- (4) Install the engine compartment trim cover assembly.

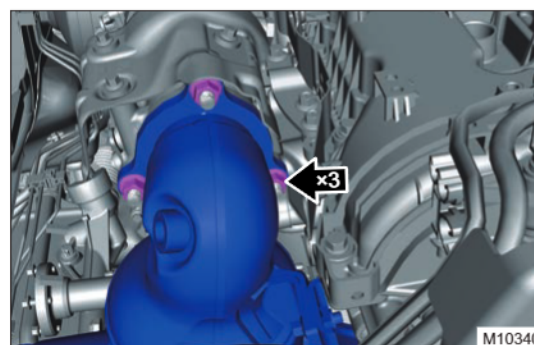
5.10 Precatalytic Converter Assembly

■ Removal

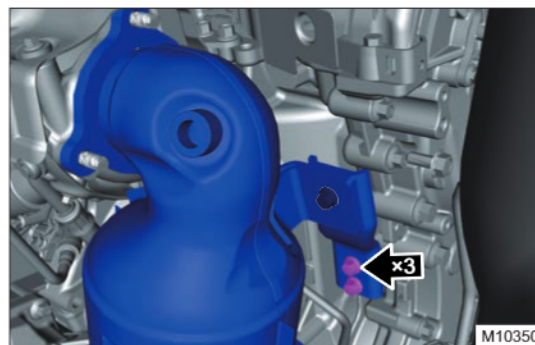
⚠ Warning

- **Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing precatalytic converter assembly.**
- **Appropriate force should be applied, when removing the precatalytic converter assembly. Be careful not to operate roughly.**

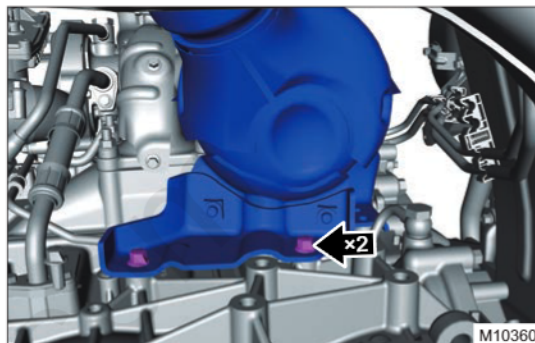
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the engine compartment trim cover assembly.
- (4) Remove the engine lower protector assembly.
- (5) Remove the rear right mounting link.
- (6) Remove the rear right mounting cushion assembly.
- (7) Remove the front right drive shaft assembly.
- (8) Remove the propeller intermediate shaft assembly (If equipped).
- (9) Remove the front wheel drive transfer (If equipped).
- (10) Remove the upstream oxygen sensor.
- (11) Remove 3 fixing nuts between precatalytic converter and turbocharger.



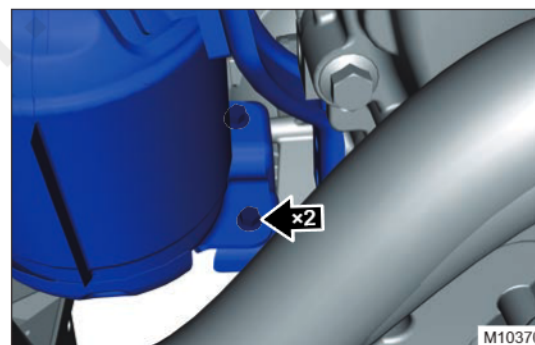
- (12) Remove 1 bolt between precatalytic upper bracket and precatalytic converter.
- (13) Remove 2 fixing bolts between precatalytic upper bracket and cylinder block. Remove the precatalytic upper bracket.



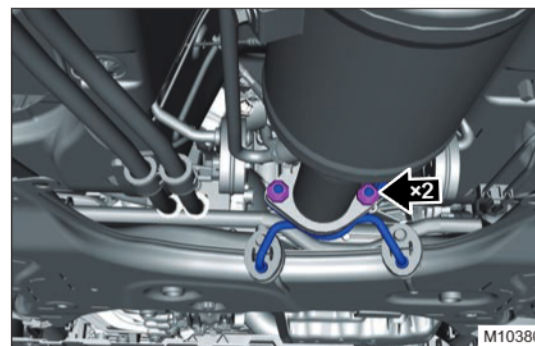
- (14) Remove 2 bolts between bracket and cylinder block.



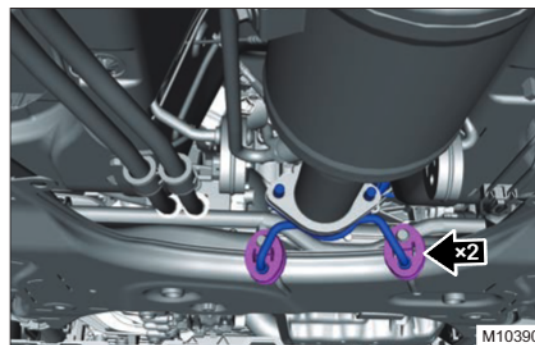
- (15) Remove 2 bolts between bracket and precatalytic converter, and remove the bracket.



- (16) Remove 2 nuts between precatalytic converter and front muffler.



- (17) Disconnect the connection between precatalytic converter and body hook.



- (18) Remove the precatalytic converter assembly carefully and slowly.

■ Installation

- (1) Install the precatalytic converter, move the precatalytic to a proper position, and insert the corresponding stud of turbocharger into three holes on precatalytic converter. Insert it into the two mounting holes of front muffler at the same time. Install the nuts at both ends and pre-tighten them.
- (2) Connect the precatalytic converter and body hook.
- (3) Install and tighten 2 fixing bolts between precatalytic upper bracket and cylinder block.
Torque: $25 \pm 3.5 \text{ N}\cdot\text{m}$
- (4) Install the bracket and pre-tighten the 2 fixing bolts on the cylinder block.
- (5) Tighten 3 nuts between precatalytic converter and turbocharger.
Torque: $45 \pm 5 \text{ N}\cdot\text{m}$
- (6) Tighten 2 bolts between precatalytic converter and bracket.
Torque: $25 \pm 3.5 \text{ N}\cdot\text{m}$
- (7) Tighten 1 coupling bolt between precatalytic converter and upper bracket.
Torque: $25 \pm 3.5 \text{ N}\cdot\text{m}$
- (8) Tighten 2 coupling bolts between bracket and cylinder block.
Torque: $25 \pm 3.5 \text{ N}\cdot\text{m}$
- (9) Tighten 2 coupling nuts between precatalytic converter and front muffler.
Torque: $40 \pm 5 \text{ N}\cdot\text{m}$

- (10) Remove the engine lower protector assembly.
- (11) Install upstream oxygen sensor.
- (12) Install the front wheel drive transfer.
- (13) Install the propeller intermediate shaft assembly.
- (14) Install the front right drive shaft assembly.
- (15) Install the rear right mounting cushion assembly.
- (16) Install the rear right mounting link.
- (17) Install the engine lower protector assembly.
- (18) Install the engine compartment trim cover assembly.

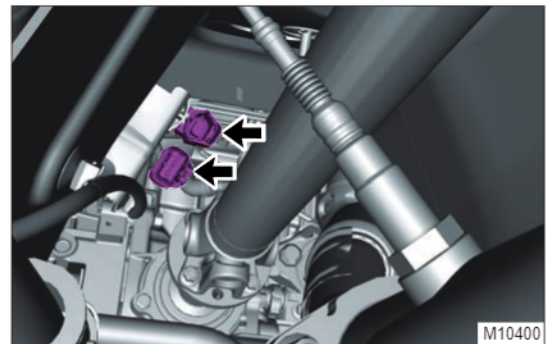
5.11 Front Muffler Assembly

■ Removal

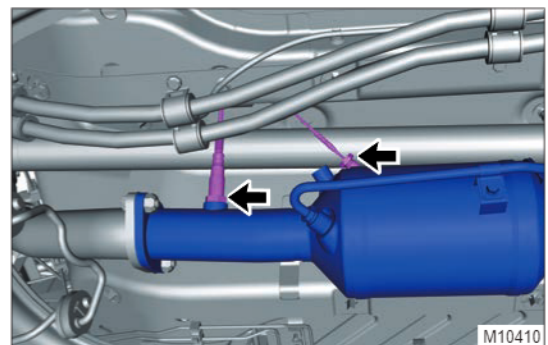
⚠ Warning

- **Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing front muffler assembly.**
- **Appropriate force should be applied, when removing the front muffler assembly. Be careful not to operate roughly.**

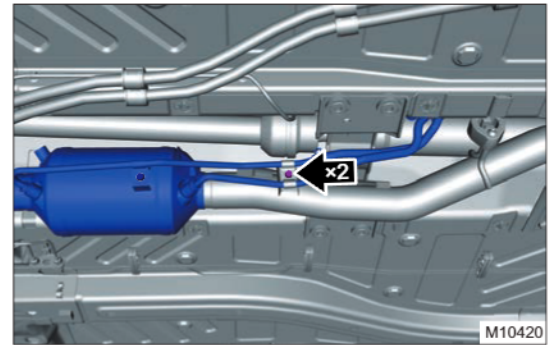
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Disconnect the downstream oxygen sensor connector.
- (4) Disconnect the GPF exhaust temperature sensor connector.



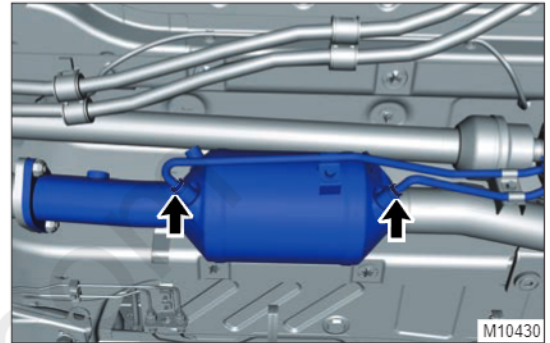
- (5) Remove the downstream oxygen sensor and GPF exhaust temperature sensor.



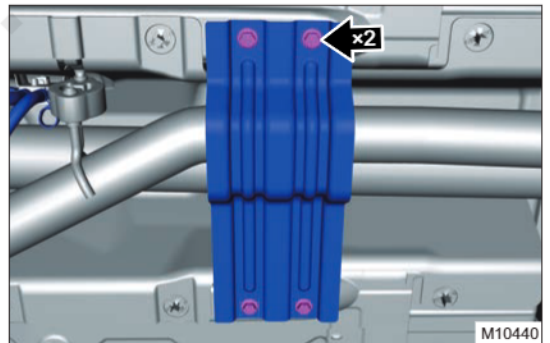
- (6) Remove the 2 bolts fixed to the differential pressure sampling pipe bracket.



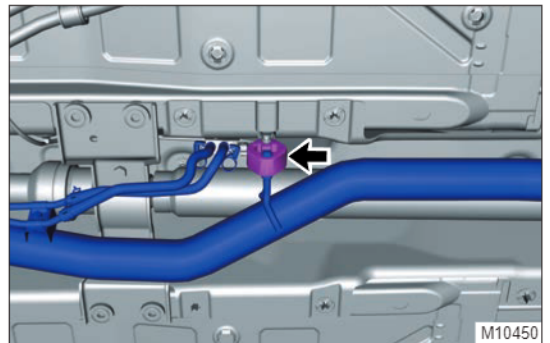
- (7) Remove 2 fixing bolts from differential pressure sampling pipe, separate pipe joint and GPF.



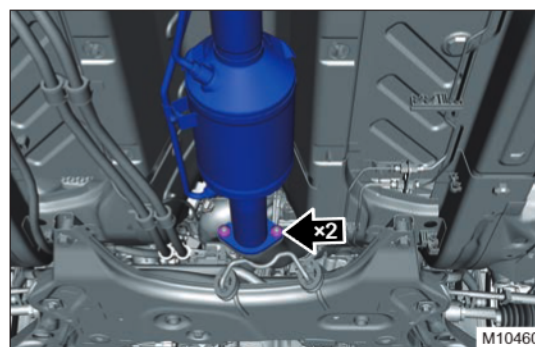
- (8) Remove 4 fixing bolts from center passage rear mounting board.



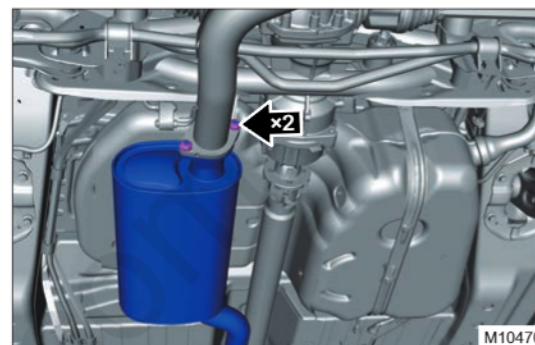
- (9) Separate 1 hanger block from front muffler.



- (10) Remove 2 fixing nuts between precatalytic converter and front muffler.



- (11) Remove 2 fixing nuts between front muffler and rear muffler.



- (12) Remove the front muffler assembly carefully.

■ Installation

- (1) Install the front muffler.

Torque: $40 \pm 5 \text{ N}\cdot\text{m}$

- (2) Connect front muffler body hanger block.
- (3) Install the differential pressure sampling pipe joint to fixed bracket.
- (4) Install the GPF exhaust temperature sensor.
- (5) Install the downstream oxygen sensor.
- (6) Install the center passage rear mounting board.

5.12 Rear Muffler Assembly

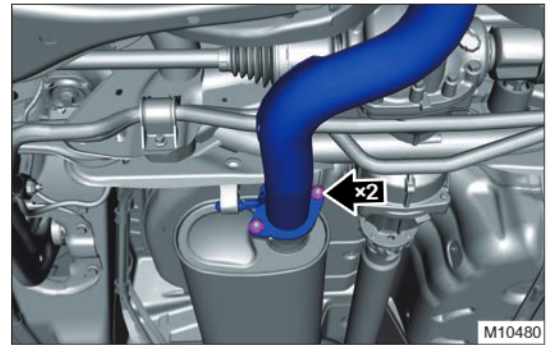
■ Removal

⚠ Warning

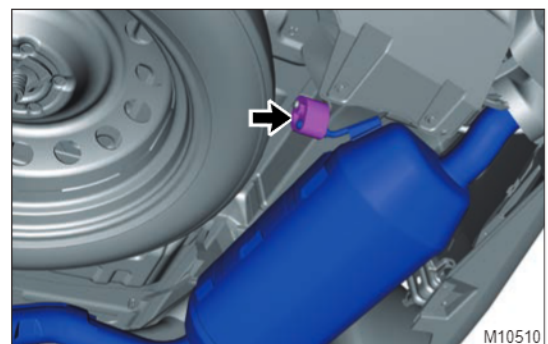
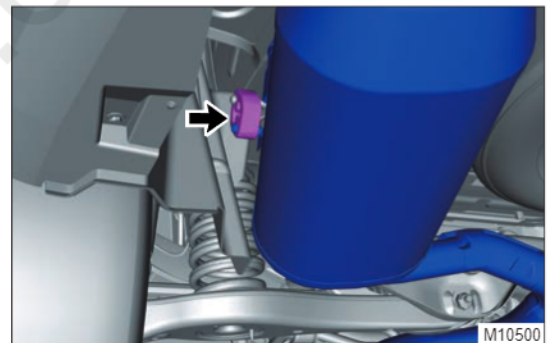
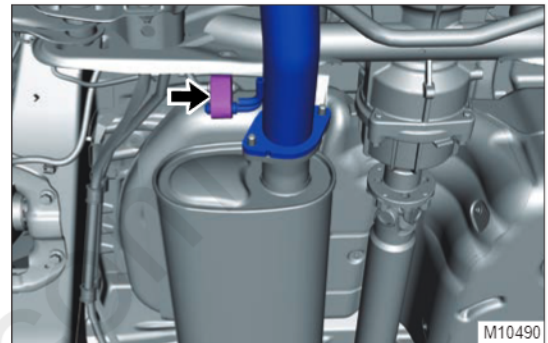
- Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear safety equipment to prevent accidents, when removing rear muffler assembly.
- Appropriate force should be applied, when removing the rear muffler assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.

- (3) Remove 2 fixing nuts between front muffler and rear muffler.



- (4) Disengage 3 fixing hanger blocks from rear muffler assembly.



- (5) Carefully remove the rear muffler assembly.

■ Installation

- (1) Install 3 fixing hanger blocks to rear muffler.
 (2) Tighten 2 fixing nuts between rear muffler and front muffler.

Torque: $45 \pm 5 \text{ N}\cdot\text{m}$

5.13 Center Passage Heat Insulator

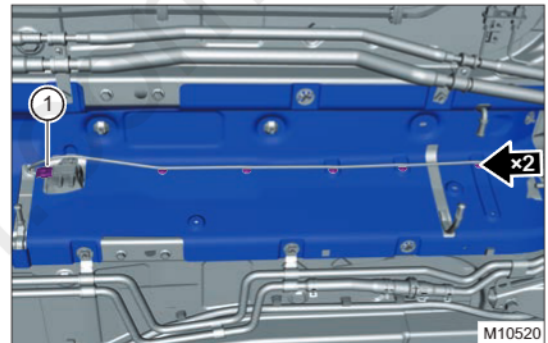
■ Removal

⚠ Warning

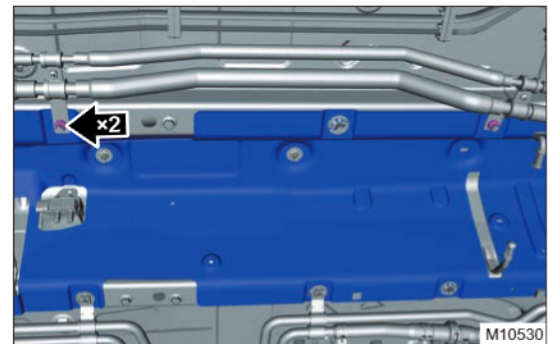
- Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear safety equipment to prevent accidents, when removing center passage heat insulator assembly.
- Appropriate force should be applied, when removing the center passage heat insulator assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the front muffler assembly.
- (4) Remove the propeller intermediate shaft assembly. (If equipped)

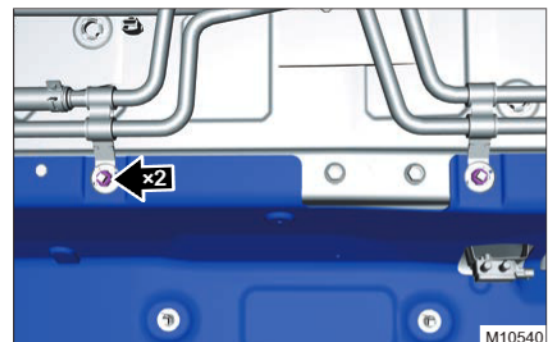
- (5) Disconnect the differential difference sensor connector (1).
- (6) Disengage 5 fixing clips from differential difference sensor connector wire harness.



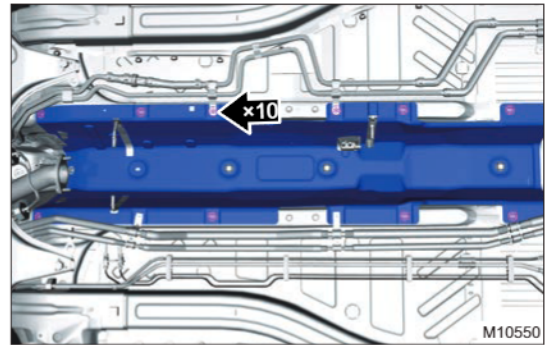
- (7) Remove 2 fixing nuts from rear A/C line.



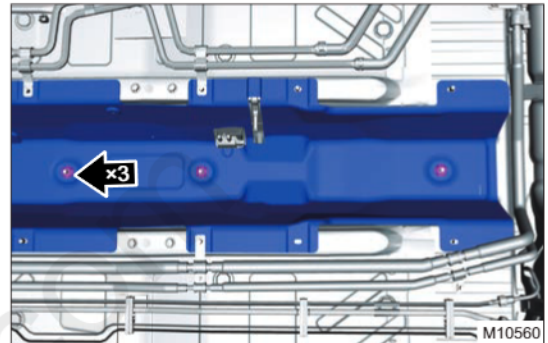
- (8) Remove 2 fixing nuts from rear heater water inlet and outlet pipe II.



- (9) Remove 10 clamping washers from center passage heat insulator.



- (10) Remove 3 fixing nuts from center passage heat insulator.



- (11) Remove center passage heat insulator carefully.

■ Installation

- (1) Install 9 clamping washers to tighten center passage heat insulator.
- (2) Install 3 fixing nuts on center passage heat insulator.
- (3) Install 2 fixing nuts to rear A/C line.
- (4) Install 2 fixing nuts to rear heater water inlet and outlet pipe II .
- (5) Connect the differential difference sensor connector. Clamp 5 fixing clips of wire harness.
- (6) Clamp 1 fixing clip of GPF differential difference sensor connector wire harness.
- (7) Install the propeller intermediate shaft assembly. (If equipped)
- (8) Install the front muffler assembly.

4.5 IGNITION SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) It is prohibited to use short circuit spark test to test ignition function during repair, otherwise it may damage the module.
- (2) During using, do not remove ignition coil from spark plug with bare hands with power on, and do not contact the metal part and rubber guide rod directly, to avoid electric shock.
- (3) Make sure that ground wire of ignition coil assembly is short to the nearest GND separately from ECU and other electrical device to reduce signal interfere as possible.
- (4) Ensure that connector or wire harness has no damage; the wire harness connector is connected correctly. Ensure that wire harness and connector have no short circuit or poor contact.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

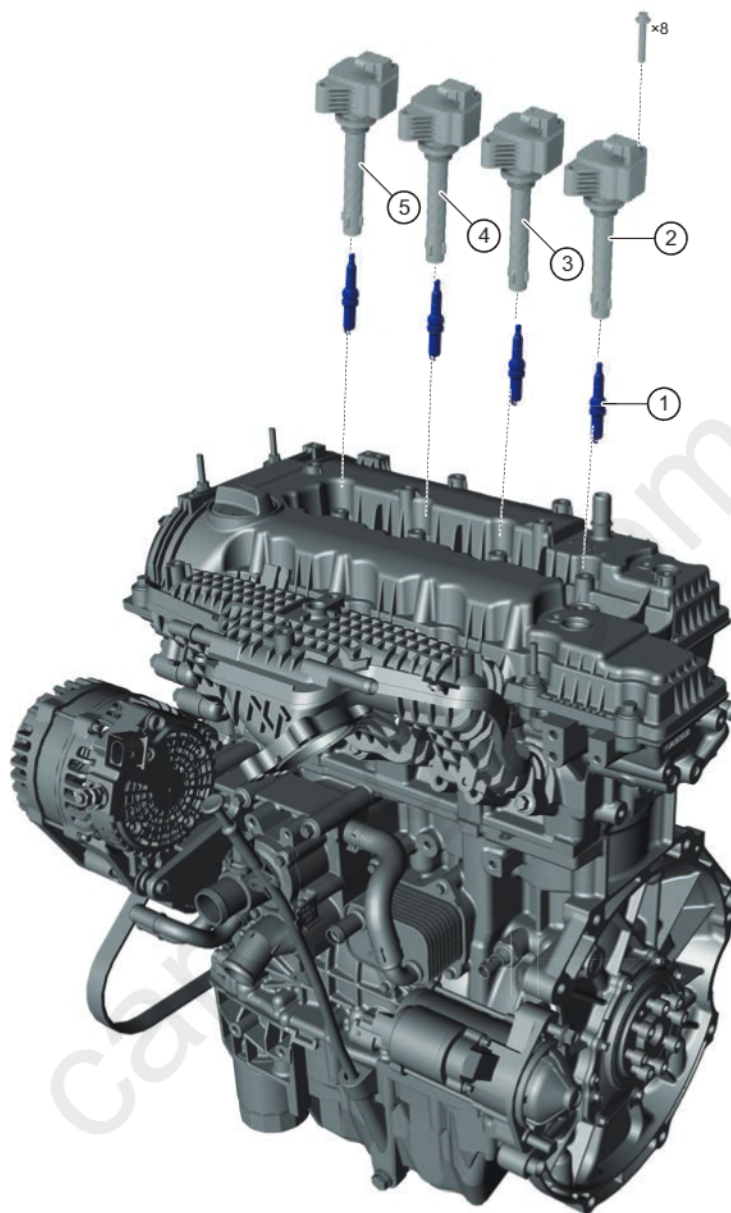
- (1) DO NOT remove the spark plugs when engine is hot; failure to do this may cause damage to the spark plug thread holes on cylinder head.
- (2) When installing spark plug and ignition coil, check if there is impurities in cylinder head mounting holes, and if the inner wall is smooth.
- (3) Do not make paint mark on spark plug assembly ceramic body. If there is paint or other organic mark, it is necessary to clean. Never apply grease such as lubricant and anti-rust oil etc. on spark plug assembly. If so, it is required to clean it.
- (4) Before removal, remove the dirt and foreign matter around ignition coil and ignition coil mounting hole to prevent them from dropping into cylinders.
- (5) After removing or when replacing ignition coil, do not place ignition coil on the ground or other dusty places, otherwise, dust or foreign matter may enter rubber guide and lead to ignition coil failure.
- (6) When replacing spark plug, remove and install ignition coil carefully. Do not rotate ignition coil (avoid scratching rubber guide).
- (7) Do not separate ignition coil rubber guide and ignition coil body. If so, it may cause the decrease of seal performance and fuel gas enter and corrode inner structure when reinstalling.

2 System Overview

2.1 System Description

Ignition system mainly consists of sensors, engine control module, ignition coils (integrated drive module can not be disassembled), spark plugs, etc. Ignition coil integrated drive module uses 4-line coil-on-plug system, and has over current and overtime protection function. The secondary (secondary high-voltage terminal) of each ignition coil is connected to spark plugs in engine cylinder respectively via high-voltage damping anti-interference rubber connecting rod. Ignition coil primary (original low-voltage terminal) is controlled by the internal integrated drive module via the pulse signal command issued by the engine control module (working state: power on, power off). Engine control module receives the top dead center position of each cylinder piston via camshaft position sensor, and uses the speed sensor signal to issue pulse drive command. Correct ignition advance angle according to knock sensor signal; Make ignition system operate normally.

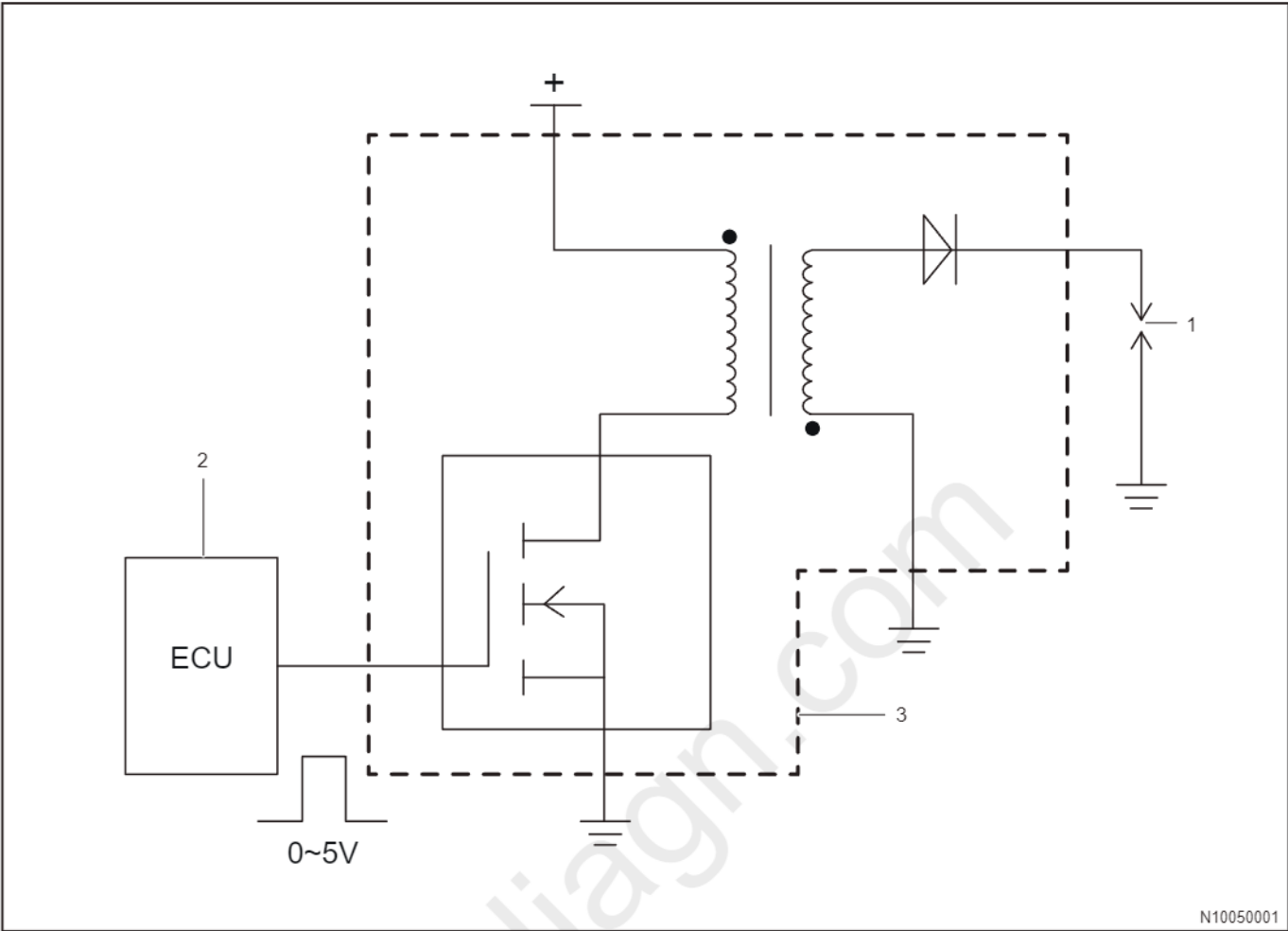
2.2 System Components Diagram



N10010

1	Spark Plug	4	Cylinder 2 Ignition Coil Assembly
2	Cylinder 4 Ignition Coil Assembly	5	Cylinder 1 Ignition Coil Assembly
3	Cylinder 3 Ignition Coil Assembly		

2.3 System Schematic Diagram



1	Spark Plug	3	Ignition Coil
2	Engine Control Unit		

2.4 Components Description

■ Ignition Coil

Ignition coil consists of primary winding, secondary winding, integrated module, iron core and housing etc. When the ground circuit of a primary winding is on, this primary winding starts charging (magnetizing). When ECU cut off pulse signal (high level to low level) circuit, charging (magnetizing) is terminated. At this time, high voltage will be induced in the secondary winding by the magnetic field coupling. In the process of passing the spark plug circuit, the spark plug will discharge (ignition).



■ Spark Plug

Spark plug consists of wired nut, insulator ceramic body, wired screw, central electrode, side electrode (the side electrode is weld to case) and case.

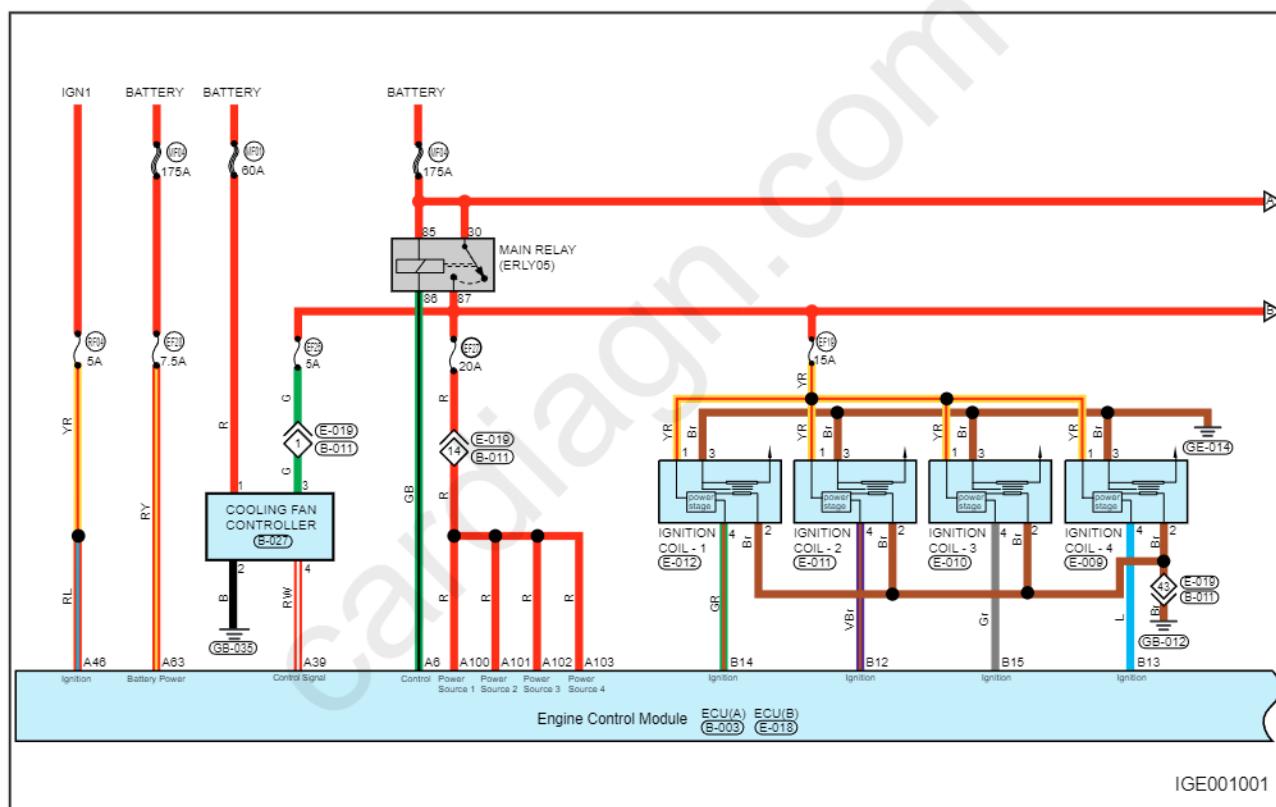
The high-voltage current passes through the center electrode of the spark plug to the side electrode, which forms a circuit. In this process, the high-voltage current break through the air to produce sparks, that is, ignite the combustible mixture in the cylinder.



N10190

3 System Circuit Diagram

3.1 Circuit Diagram



4 Diagnosis & Testing

4.1 Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Ignition System

Symptom	Possible Cause
Stall	Ignition coil
	Camshaft position sensor

Symptom	Possible Cause
	Spark plug
	Intake camshaft phaser control valve
	Exhaust camshaft phaser control valve
	Wire harness
	ECU
Knock	Ignition coil
	Knock sensor
	ECU
Difficult to start	Battery
	Ignition coil
	Spark plug
	Engine speed sensor
Engine hesitation, power drop, unstable performance	Ignition coil
	Intake camshaft phaser control valve
	Exhaust camshaft phaser control valve
	Engine speed sensor
	Spark plug
	Camshaft position sensor
	ECU

4.2 Spark Plug Common Problems

■ Normal

Spark plug porcelain small end is between white and yellowish, gray or brownish. Air-fuel ratio and ignition time are normal, there is no misfire, and cold-start enriching function is normal.

■ Carbon Accumulation

A layer of velvety black charcoal smoke attaches on the insulator small end, electrode and spark plug body		
Cause	Result	Treatment
Mixture is excessively rich due to improper adjustment of air fuel mixture.	Poor starting ability	Check air filter and adjust air-fuel ratio and cold starting system.
Traveling distance of vehicle is too short, engine temperature is low, and combustion is incomplete.		
Fuel quality is poor or fuel deteriorates, fuel is abnormal.		
Spark plug type is incorrect.		

■ Oil Dirt

A layer of black oily charcoal smoke and dirt attach on the insulator small end, electrode and spark plug body

Cause	Result	Treatment
Piston ring has bad elasticity or is worn excessively, and oil breaks into combustion chamber.	Difficult to start.	Check and repair engine, or replace spark plug.
Excessive matching clearance between piston skirt and cylinder wall causes oil breaking and air leakage.		
Air leakage occurs due to incorrect installation of piston ring in direction of inside and outside tangent angle, causing oil breaking into combustion chamber.		
Excessive clearance occurs between valve stem and valve guide due to excessive wear, or valve guide oil seal fails, causing oil leakage.		
Oil level is too high and oil breaks into combustion chamber.		

■ Lead Deposits

Brownish yellow enamels or greenish deposits exist on the insulator small end

Cause	Result	Treatment
The fuel additive contains lead, when engine runs under high load conditions with throttle partially opened for a long time, enamel is formed.	Causing misfire	Replace spark plug.

■ Red Deposits

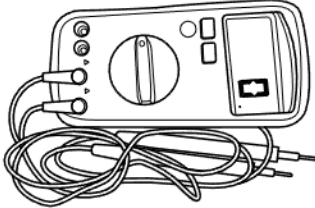
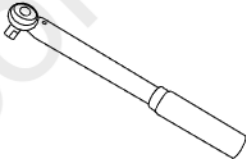
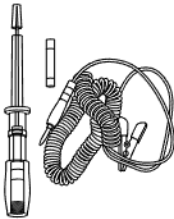
There are severe red brown deposits on insulator skirt and electrodes, and clear radial discharge traces can be seen on the surface of insulator small end

Cause	Result	Treatment
In the unleaded gasoline, Mn-based anti-riot agent MMT is used instead of lead tetraethyl, the oxide of Mn after combustion adheres on the surface of insulator and electrode.	At high temperature, these deposits are easily conductive, resulting in flashover on insulator skirt surface, unstable combustion, high engine speed, and jitter under heavy load conditions.	Use qualified fuel, replace spark plug.

5 ON-VEHICLE SERVICE

5.1 Tool

■ General Tool

Tool Name	Tool Drawing
Digital Multimeter	 S00002
5 - 25 N·m Torque Wrench	 S00079
LED Test Light	 S00077

5.2 Ignition Coil Assembly

■ Removal

 **Warning**

- Appropriate force should be applied, when removing ignition coil assembly. Be careful not to operate roughly.
- It is prohibited to use short circuit spark test to test ignition function during repair, otherwise it may damage the module.
- During using, do not remove ignition coil from spark plug with bare hands with power on, and do not contact the metal part and rubber guide rod directly, to avoid electric shock.

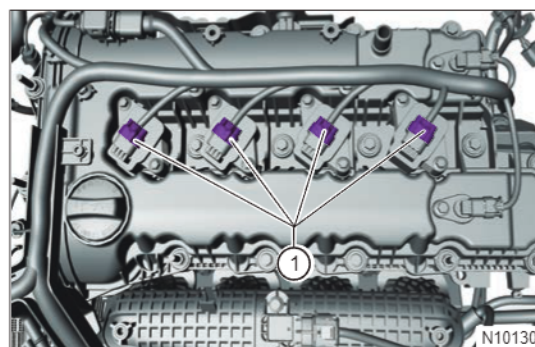
-
- (1) Turn off all electrical equipment and ENGINE START STOP switch.

(2) Remove the engine compartment trim cover assembly.

(3) Disconnect the negative battery cable.

(4) Remove the engine trim cover.

- (5) Disconnect the ignition coil assembly connectors (1), and move away the wire harness connector from ignition coil.



- (6) Remove 8 fixing bolts from ignition coil assembly (8# socket wrench).



- (7) Remove the ignition coil assembly.

⚠ Caution

- After removing ignition coil, do not place ignition coil on the ground or other dusty places, otherwise, dust or foreign matter may enter rubber guide and torsion ignition coil failure.
- Remove ignition coil carefully. Do not rotate ignition coil (avoid scratching rubber guide).
- Do not separate ignition coil rubber guide and ignition coil body. If so, it may cause the decrease of seal performance and air oil enter and corrode inner structure when reinstalling.

■ Inspection

⚠ Caution

- It is prohibited to use short circuit spark test to test ignition coil performance, otherwise it may cause damage to electronic controller.
- During inspection, do not remove ignition coil from spark plug with bare hands with power on, and do not contact the metal part and rubber guide rod directly, to avoid electric shock.

Terminal	Terminal Definition
1	Ground
2	Ground
3	Power supply
4	Pulse drive signal

- (1) Use a digital multimeter to measure if ignition coil power supply/ground is normal.
- (2) Use LED test light to measure the pulse drive signal of ignition coil and observe if LED test light flashes.

- (3) The ignition coil assembly can be exchanged for each cylinder to judge if the ignition coil assembly is in good condition.

■ Installation

Caution

- Make sure that ground wire of ignition coil assembly is short to the nearest GND separately from ECU and other electrical device to reduce signal interfere as possible.
- Ignition coil assembly rubber guide rod end is applied with specified grease of its self, which can help in assembly of ignition coil assembly and spark plug assembly. Do not remove it arbitrarily.
- Make sure that the connection of ignition coil high-voltage output terminal and spark plug is reliable, or it may cause high-voltage leakage, resulting in poor ignition.
- Before installation, check the mounting hole of cylinder head spark plug, and no impurities can be brought in during assembly.
- Install the ignition coil into cylinder head cover mounting hole and press it to close to mounting boss on cylinder head cover. Never turn ignition coil to left/right after pressing and do not tap ignition coil with a hammer etc.
- To prevent accidental scratches to ignition coil assembly, do not allow sharp edge to contact with rubber guide rod under ignition coil assembly during installation.

- (1) Install 8 fixing bolts on ignition coil assembly.

Torque: 8 ± 3 N m

- (2) Connect the ignition coil assembly connector.
- (3) Install the engine trim cover.
- (4) Install the engine compartment trim cover assembly.

5.3 Spark Plug Assembly

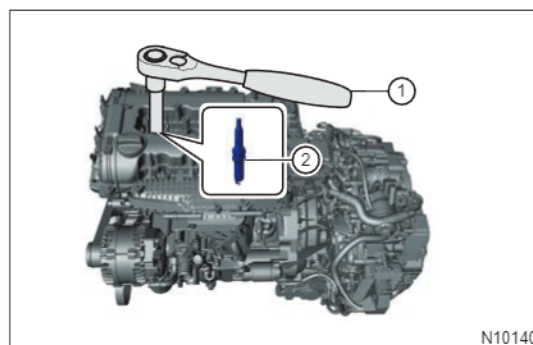
■ Removal

Warning

- Be sure to wear necessary safety equipment to prevent accidents, when removing spark plug.
- Appropriate force should be applied when removing spark plug. Be careful not to operate roughly.
- **DO NOT** remove the spark plugs when engine is hot; failure to do this may cause damage to the spark plug thread holes on cylinder head.
- Before removal, remove the dirt and foreign matter around spark plug holes to prevent them from dropping into cylinders.

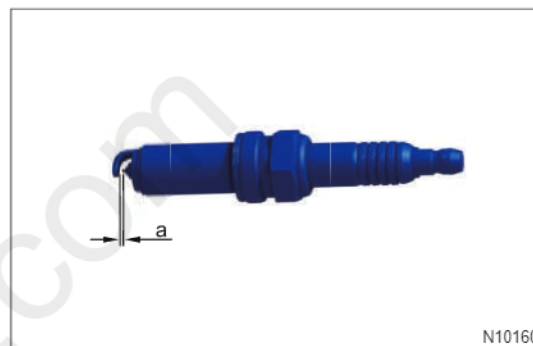
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine trim cover.
- (5) Remove the ignition coil assembly.

- (6) Using a special spark plug socket ratchet wrench (1), loosen the spark plug.
- (7) Remove the spark plug (2).



■ Inspection

- (1) Check the spark plug gap a: 0.7 - 0.8 mm
 - It is not necessary to adjust the gap.



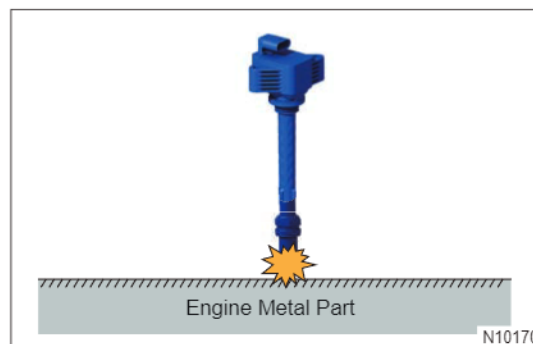
■ Spark Jump Test Method

- (1) Remove the spark plug from engine and connect it to high-voltage cable, put the spark plug case 5 - 7 mm away from engine body and start vehicle to check the spark jump.

⚠ Warning

- Always disconnect the injector circuit before test to avoid injection during spark jump test.

- (2) If there is a thick spark with blue-white color and popping occurs between spark plug and engine body and also spark generated between center electrode and side electrode, that indicates ignition system is normal.



- (3) If the spark is red and short or there is no spark, check ignition coil wire and ECU.

■ Installation

 Caution

- Check the spark plug type to confirm if it is suitable.
- Check if there is impurities in cylinder head mounting holes, the inner wall is smooth.
- Do not make paint mark on spark plug assembly ceramic body. If there is paint or other organic mark, it is necessary to clean. Never apply grease such as lubricant and anti-rust oil on spark plug assembly. If so, it is required to clean it.
- Please install spark plug with a special spark plug socket, and never damage the normal spark plug gap.
- Avoid to install the spark plug from higher position from mounting hole during installation to prevent spark plug side electrode gap from damaging, resulting in poor ignition.
- Always tighten the spark plug according to specified torque using a torque wrench when installing it.

- (1) Install 4 spark plugs respectively into the cylinder head mounting holes for pre-tightening tighten, and then retighten the spark plugs with a torque wrench.

Torque: 20 ± 3 N m

- (2) Install the ignition coil assembly.
- (3) Install the engine trim cover.
- (4) Install the engine compartment trim cover assembly.

4.6 Emission Control System

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.
- (2) Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

- (1) The specified grease must be used. Use of other grease will lead to oxygen sensor poisoning. The new sensor has been applied with grease and the grease must be applied to the mounting threads when reassembling.
- (2) Unneeded activated charcoal canister assembly should be handled by the specialized department according to local laws and regulations. Never discard it at will.
- (3) If the oxygen sensor falls, never pick it up to install and it needs to return to factory for testing.

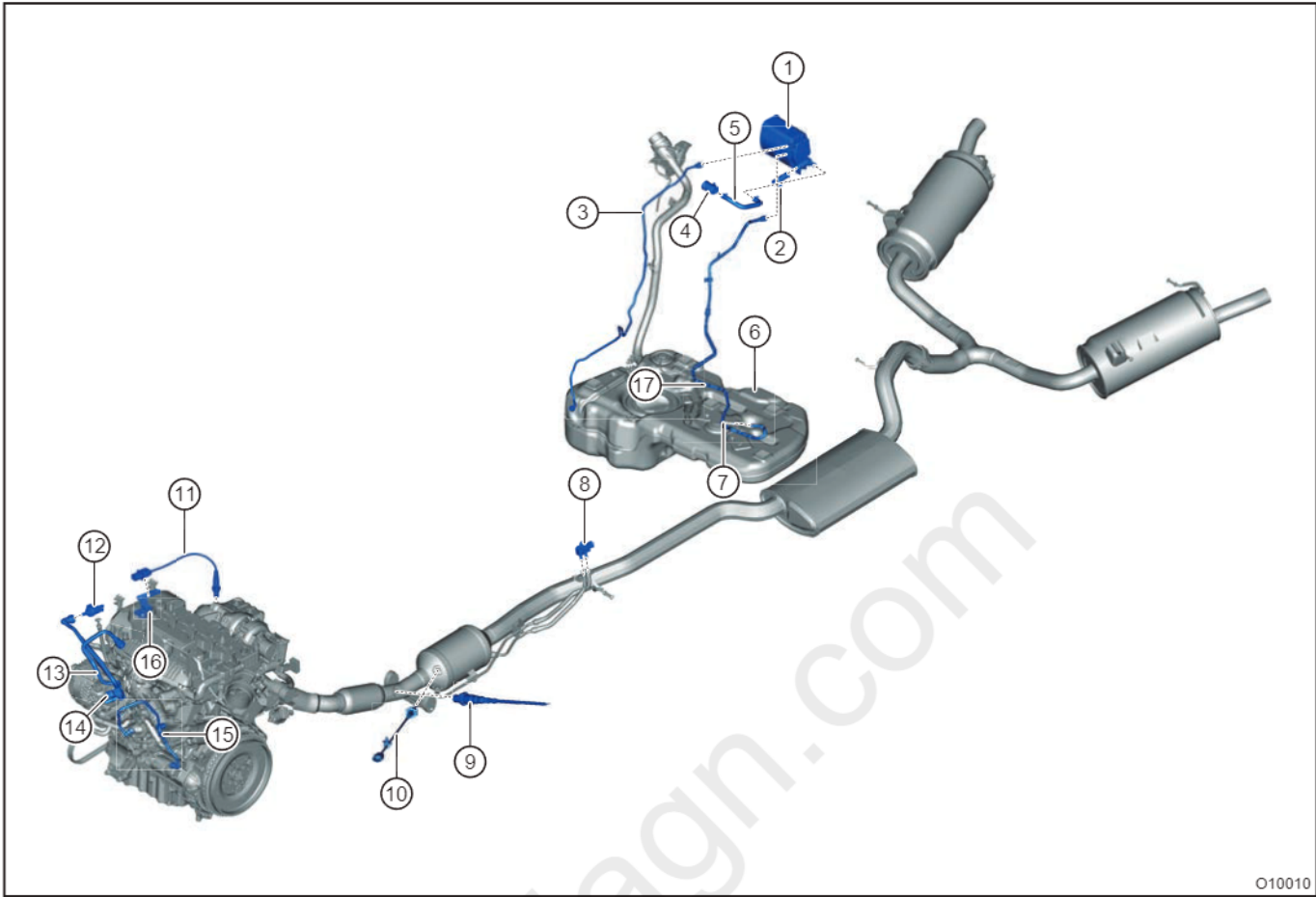
2 System Overview

2.1 System Description

Emission control system includes: Fuel vapor recovery/leakage diagnosis system, exhaust emission conversion system, Gasoline Particulate Filter (GPF) system and crankcase forced ventilation system.

- (1) The function of fuel vapor recovery/leakage diagnosis system: Fuel vapor (HC) is recovered and inhaled into engine cylinder for combustion, which can reduce emission and improve fuel economy. According to National VI regulation, fuel vapor recovery system adds leakage diagnosis function, the generated fuel vapor is not allowed to leak into atmosphere in the process of recovery, desorption and refilling etc. The system judge whether it leaks according to leakage diagnosis test. Once leakage occurs, the system will turn on malfunction light to warn and avoid polluting environment.
- (2) The function of exhaust emission conversion system: Through front and rear oxygen sensors determine whether oxygen is excess (namely oxygen content) in exhaust gas after engine combustion, convert oxygen content into voltage signal and transmit to alternator computer, then engine can realize closed-loop control which aims at excess air coefficient. Make sure three-way catalytic converter can convert harmful gases such as CO, HC and NOX from exhaust gas into harmless carbon dioxide, water and nitrogen by oxidation and reduction. Avoid polluting environment.
- (3) The function of Gasoline Particulate Filter (GPF) system: According to National VI regulation, GPF is added in order to avoid the emission of gasoline particulates, which can reduce the particulates leaked into the air and avoid polluting environment.
- (4) The function of crankcase forced ventilation system: The air in cylinder leaks into crankshaft space during normal engine operation. The leaked air contains unburned fuel and all exhaust air contents, which will cause the deterioration of lubricant and increase of crankshaft pressure and temperature. In order to avoid this, the gas leaked into crankshaft is inhaled into cylinder for combustion and recover HC, which reduces the air pollution.

2.2 System Components Diagram

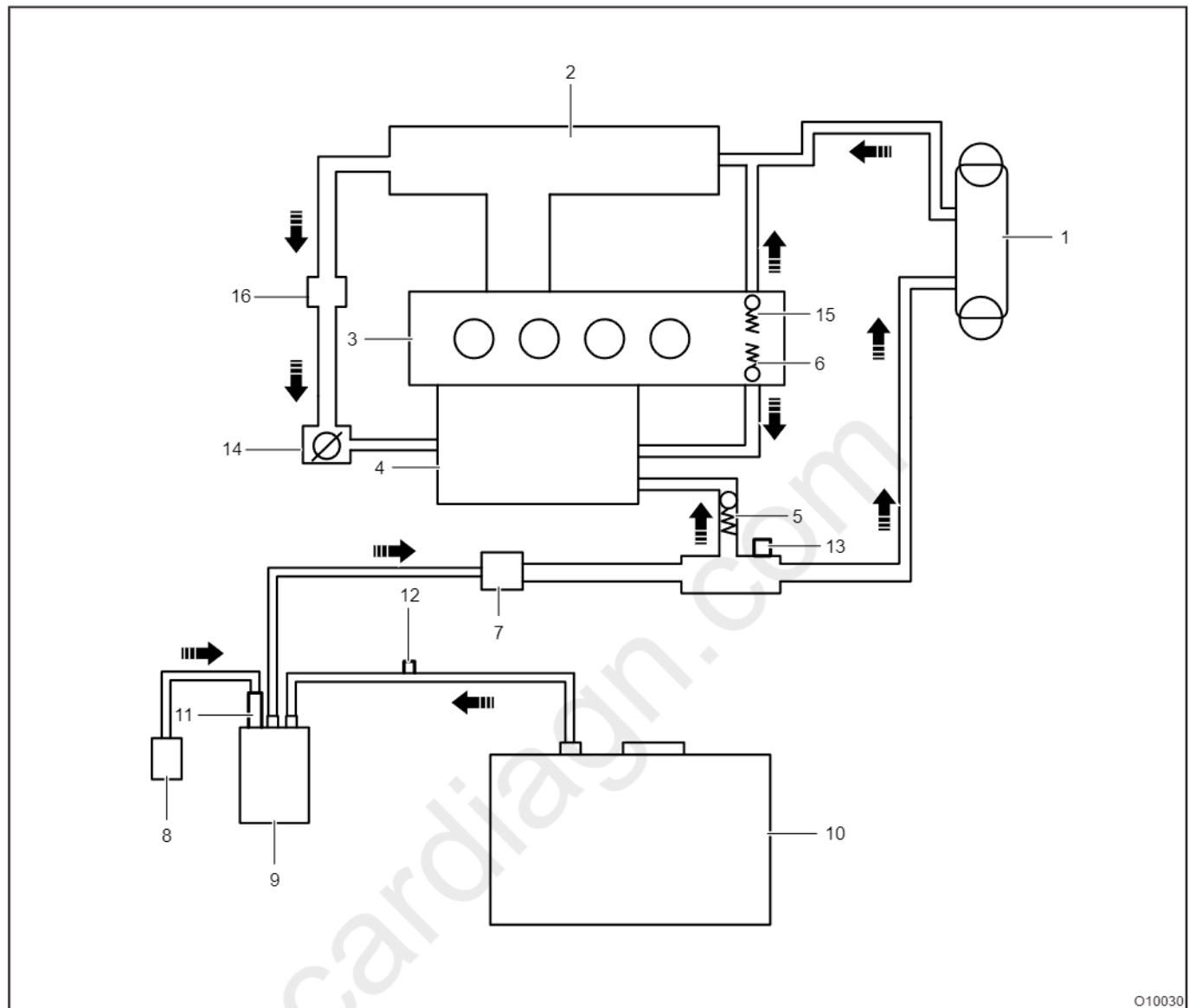


O10010

1	Charcoal Canister Solenoid Valve Assembly	7	Fuel Vapor Pipe II
2	Upstream Oxygen Sensor	8	Fuel Vapor Pipe I
3	Charcoal Canister Solenoid Valve Outlet Pipe	9	Dust Filter
4	Rear Oxygen Sensor	10	Activated Charcoal Canister Cut-off Valve
5	Exhaust Temperature Sensor	11	Activated Charcoal Canister Assembly
6	Pressure Difference Sensor	12	Activated Charcoal Breather Pipe

2.3 System Schematic Diagram

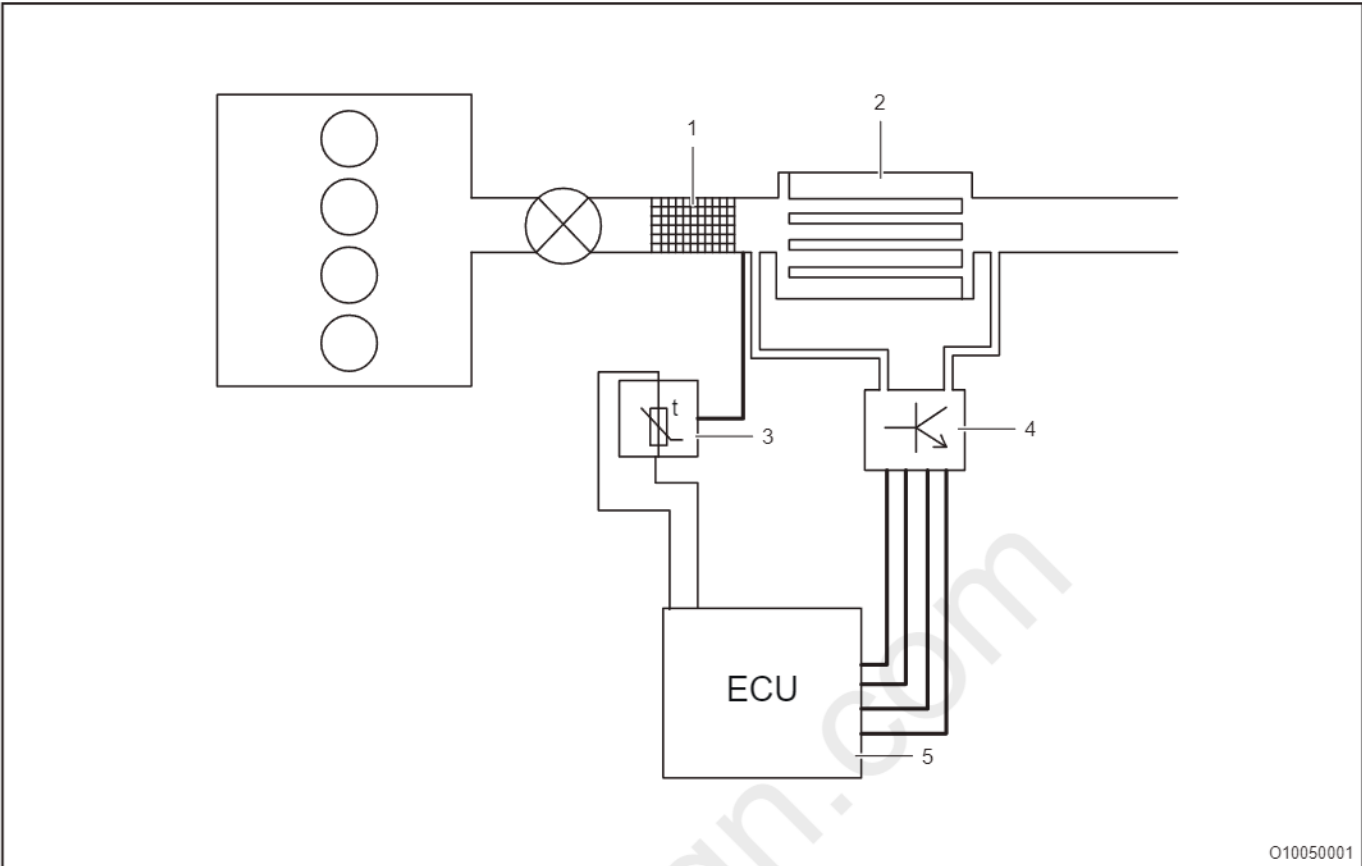
■ Fuel Vapor Recovery/Leakage Diagnosis System



1	Activated Charcoal Canister Assembly	5	Fuel Tank Pressure Sensor
2	Activated Charcoal Canister Cut-off Valve	6	Fuel Tank Assembly
3	Dust Filter	7	Charcoal Canister Desorption Pressure Sensor
4	Intake Hose Assembly		

Two desorption pipelines are equipped in fuel vapor recovery system. One desorption pipeline is connected to intake manifold through canister solenoid valve, which is low load desorption pipeline. Another desorption pipeline is connected to intake hose through canister solenoid valve pipeline (venturi tube), which is high load desorption pipeline. Principle of fuel vapor leakage diagnosis: After closing the charcoal canister ventilation valve, pump the fuel tank into a certain negative pressure through the intake manifold vacuum degree. If the negative pressure cannot be established, it is considered that there is a large leakage, i.e. a coarse leakage. Then close the canister solenoid valve, and form a closed space between canister solenoid valve rear pipe and fuel tank. When there are holes and no holes, the attenuation gradient of vacuum degree in this closed space is different, so it can be judged whether there is leakage.

Gasoline Particulate Filter (GPF) System



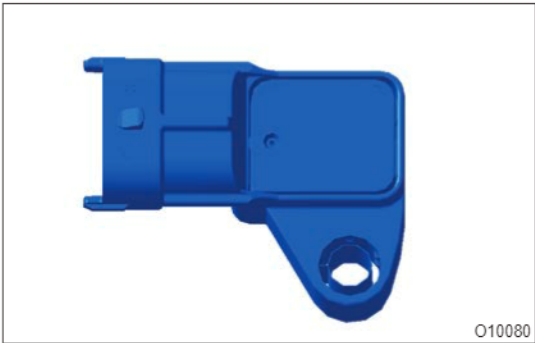
1	Precatalytic Converter Assembly	4	Pressure Difference Sensor
2	Gasoline Particulate Filter	5	Engine Control Unit
3	Exhaust Temperature Sensor		

GPF is a ceramic filter installed in gasoline engine emission system, which can capture gasoline particulates before they enter the atmosphere. Although GPF can capture the gasoline particulates in exhaust gas effectively, with the increase of captured gasoline particulates, exhaust back pressure will increase, which will effect the vehicle power and economy. When particulates in GPF are accumulated to a certain extent, particulates in GPF will be oxidized and burned by adjusting engine operation condition (such as fuel cut-off, delayed ignition angle), ECU controls the regeneration of GPF and remove particulates in GPF, and finally realize positive cycle of “capture-regeneration-capture” .

2.4 System Components Description

Charcoal Canister Desorption Pressure Sensor

As a varistor type, the sensor mainly detects whether the pressure (negative pressure) in high load desorption pipeline meets charcoal canister desorption requirement. Thereby complete high load desorption.



■ Fuel Tank Pressure Sensor

As a varistor type, the sensor mainly detects the pressure change in fuel tank, then judges whether the absorbed fuel vapor in charcoal canister is saturated and whether there is leakage in fuel vapor system.



O10090

■ Canister Solenoid Valve Outlet Pipe II (Venturi Tube)

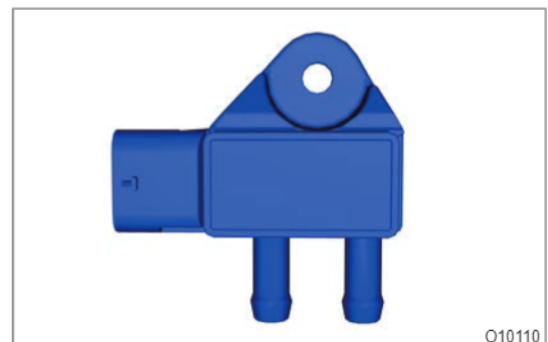
Venturi effect is adopted in the venturi tube. The principle of venturi tube is to change the air flow from coarse to fine, so as to speed up the air flow rate and form a "vacuum area" at the rear side of venturi tube outlet; this vacuum area will produce certain adsorption to the outside, thereby complete high load desorption.



O10100

■ Pressure Difference Sensor

The sensor is a dual-mode differential pressure sensor, and the output dual-mode signals are digital signals, which mainly detects pressure difference between the two ends of GPF, so as to indirectly judges the amount of captured particulates. Realize the "regeneration" condition.



O10110

■ Exhaust Temperature Sensor

The sensor is a positive temperature coefficient thermistor (PTC) whose resistance value becomes larger as the temperature increases and becomes smaller as the temperature decreases. It mainly detects GPF inlet temperature and make sure GPF can regenerate safely.



O10120

■ Charcoal Canister Solenoid Valve

Canister solenoid valve consists of solenoid coil, armature, valve body and other parts, and it is controlled by ECU by means of duty ratio control.



O10130

■ Activated Charcoal Canister Assembly

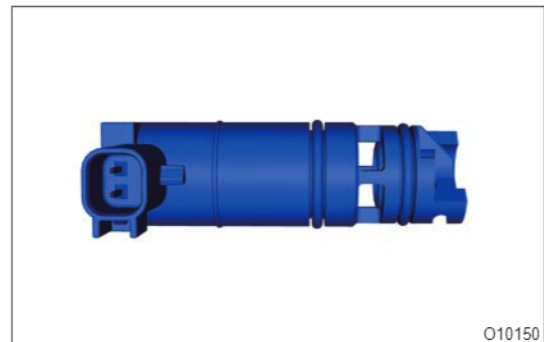
The inside of charcoal canister is filled with active carbon with strong adsorption. The excess fuel vapor in fuel tank is no longer discharged into the atmosphere, but introduced into the charcoal canister by hose. The active carbon absorbs the fuel vapor. When it meets engine desorption conditions, the canister solenoid valve is opened, and the absorbed fuel vapor is poured into the intake manifold for combustion, so as to achieve the purpose of fuel saving and environmental protection.



O10140

■ Activated Charcoal Canister Cut-off Valve

As a normal open valve, when power is on and when fuel vapor leakage diagnosis is performed, it performs closing action which cuts off the vent of charcoal canister to the atmosphere.



O10150

■ Upstream Oxygen Sensor

The upstream oxygen sensor is a ceramic body and is integrated with a micro pump for oxygen ion transportation. The pump supplies enough oxygen to the electrode on the exhaust gas contact side to keep the voltage on both sides constant, about 450 mV. The electronic controller converts the power consumption of pump into excess air coefficient. The output current is almost linearly related to λ , and $\lambda = 0.65 \sim \infty$, so it is also called a linear oxygen sensor. It can not only determine whether λ is greater than 1 or less than 1. Moreover, the specific value of λ can be measured in the lean and rich regions, so that the excess air coefficient in a larger range (i.e. broadband) can be measured, and continuous control of $\lambda < 1$ to $\lambda > 1$ can be realized.



O10160

Downstream Oxygen Sensor

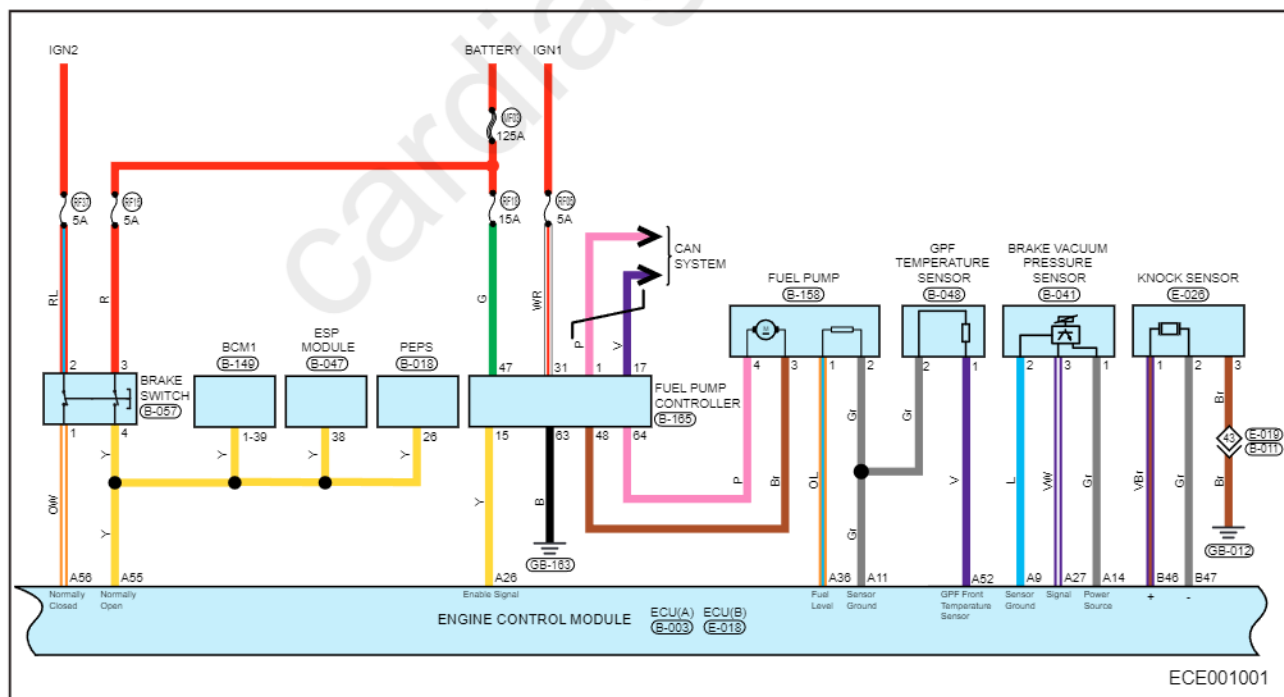
The sensing element of downstream oxygen sensor is a ceramic flat body with pores. The outer side of ceramic is surrounded by engine exhaust, and the inner side is open to atmosphere. Sensing ceramic body wall is a type of solid electrolyte with heating electrodes inside. Operation of oxygen sensor is realized by converting the concentration difference of oxygen ions inside and outside the sensing ceramic body into voltage signals for output. When the temperature of sensing ceramic body reaches 350 °C, it will have the characteristics of solid electrolyte. Oxygen ions can freely pass through it due to special material of ceramic body. It is precisely by taking advantage of this characteristic, it converts the concentration difference into the potential difference, thus forming the electrical signal output. If the gas mixture is rich, the concentration difference of oxygen ions inside and outside of ceramics body is higher, potential difference is higher, a large amount of oxygen ions move from inside to outside, and the output voltage is higher (- approximately 800 mV - 1000 mV); If the gas mixture is lean, the concentration difference of oxygen ions inside and outside of ceramics body is lower, potential difference is lower, only a few oxygen ions move from inside to outside, and the output voltage is lower (approximately 100 mV). Signal voltage changes suddenly when near the theoretical equivalent air-fuel ratio ($\lambda = 1$).



O10170

3 System Circuit Diagram

3.1 Circuit Diagram



4 DIAGNOSIS & TESTING

4.1 Problem Symptoms Table

Hint:

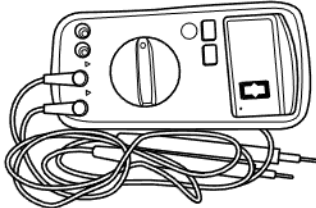
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Emission Control System

Symptom	Possible Cause
Fuel tank flat	Charcoal canister closed valve (damaged)
	Activated charcoal canister (blocked)
	Activated charcoal canister filter (blocked)
Lean mixture	Intake pressure sensor
	Oxygen sensor invalid
	Low fuel pressure in electric fuel pump
	Fuel injector blocked
Rich mixture	Fuel injector leakage
	Air filter blocked
	Oxygen sensor invalid
Lack of power	Oxygen sensor invalid
	Air flow meter malfunction
	Fuel pressure too low
	Cylinder compression pressure drop

5 ON-VEHICLE SERVICE

5.1 Tool

■ General Tool

Tool Name	Tool Drawing
Battery Tester	 S00002

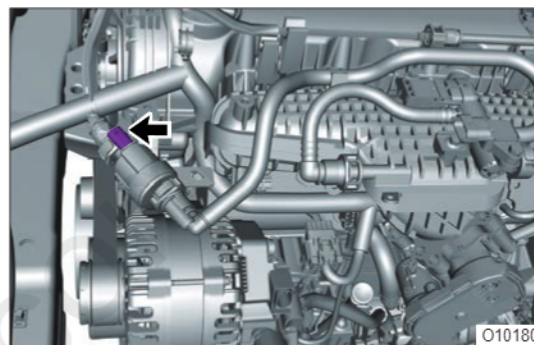
5.2 Charcoal Canister Solenoid Valve

■ Removal

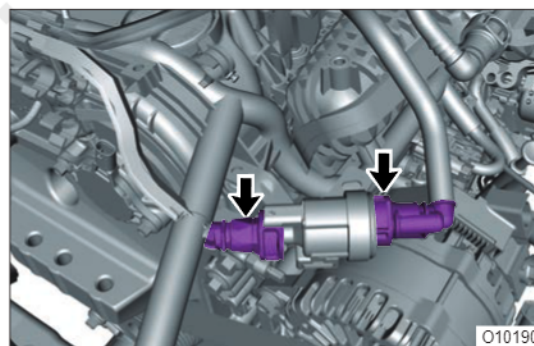
⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing canister solenoid valve.**
- **Appropriate force should be applied, when removing canister solenoid valve. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the negative battery cable.
- (4) Disconnect the canister solenoid valve connector.



- (5) Disconnect the fuel vapor pipe III and canister solenoid valve outlet pipe from canister solenoid valve assembly.



- (6) Remove the charcoal canister solenoid valve assembly.

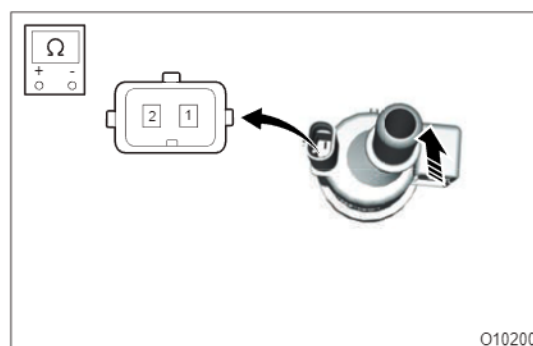
■ Inspection

- (1) Measure the resistance of canister solenoid valve with a digital multimeter.

Measurement Temperature	Specification (Ω)
20 °C	16 $\pm$ 2

Hint:

If resistance is not as specified, replace the canister solenoid valve assembly.



- (2) Connect the positive battery to canister solenoid valve No. 1 pin and connect the negative battery to canister solenoid valve No. 2 pin. Check if the canister solenoid valve opens. After it opened, bleed air to direction of canister solenoid valve (arrow), and air flows easily.

■ Installation

- (1) Install canister solenoid valve, and connect fuel vapor pipe III and canister solenoid valve outlet pipe to both ends of canister solenoid valve.
- (2) Connect the canister solenoid valve connector.
- (3) Install the engine compartment trim cover assembly.

5.3 Canister Solenoid Valve Outlet Pipe Assembly

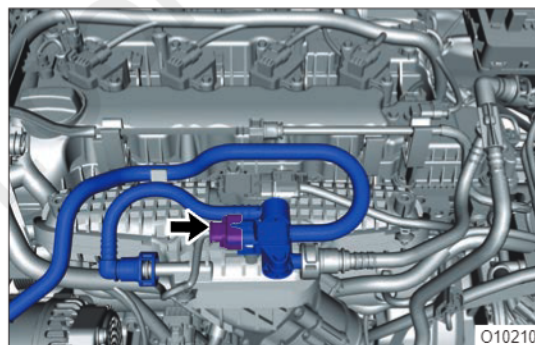
■ Removal

⚠ Caution

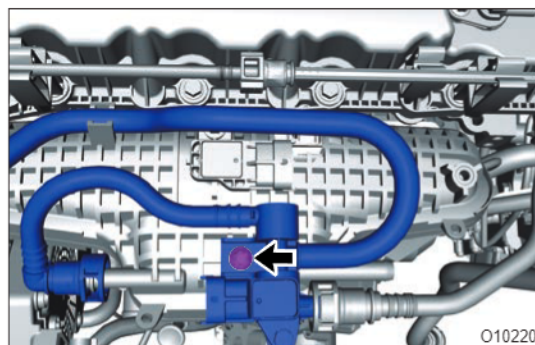
- **Be sure to wear safety equipment to prevent accidents, when removing canister solenoid valve outlet pipe assembly.**
- **Appropriate force should be applied, when removing canister solenoid valve outlet pipe assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

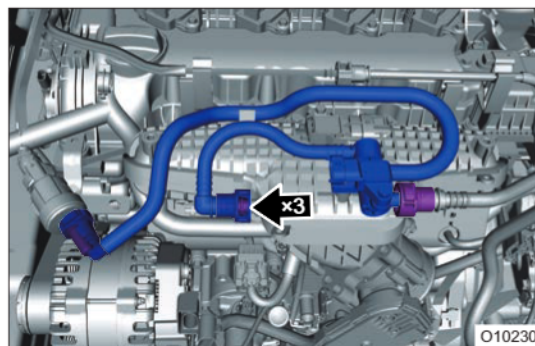
- (4) Disconnect the charcoal canister desorption pressure sensor connector.



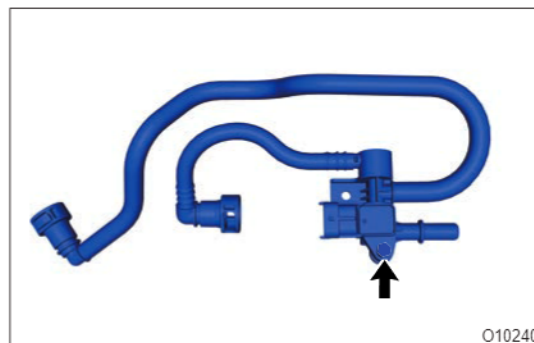
- (5) Remove 1 fixing bolt from canister solenoid valve outlet pipe three-way bracket.



- (6) Disconnect the connection between canister solenoid valve outlet pipe and canister solenoid valve.
- (7) Disconnect the connection between canister solenoid valve outlet pipe and intake manifold.
- (8) Disconnect the connection between canister solenoid valve outlet pipe and canister solenoid valve outlet pipe II.



- (9) Remove canister solenoid valve outlet pipe assembly and remove 1 fixing bolt from charcoal canister desorption pressure sensor to separate it.



■ Installation

- (1) Install charcoal canister desorption pressure sensor and fix 1 bolt.

Torque: 8 + 3 N·m

- (2) Install 1 fixing bolt to canister solenoid valve outlet pipe three-way bracket.

Torque: 7 ± 1 N·m

- (3) Connect the charcoal canister solenoid valve outlet pipe to charcoal canister solenoid valve.
 (4) Connect the charcoal canister solenoid valve outlet pipe to intake manifold.
 (5) Connect the canister solenoid valve outlet pipe II to canister solenoid valve outlet pipe.
 (6) Connect the desorption pressure sensor connector.
 (7) Install the engine compartment trim cover assembly.

5.4 Canister Solenoid Valve Outlet Pipe II Assembly

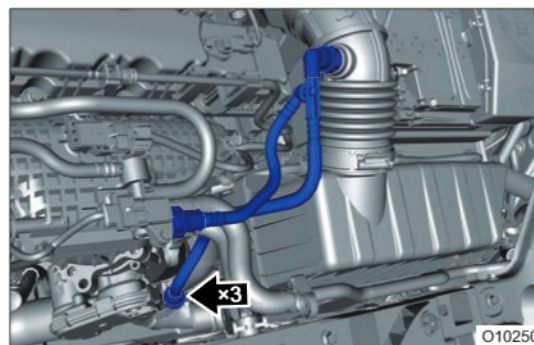
■ Removal

⚠ Caution

- **Be sure to wear safety equipment to prevent accidents, when removing canister solenoid valve outlet pipe II assembly.**
- **Appropriate force should be applied, when removing canister solenoid valve outlet pipe II assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
 (2) Remove the engine compartment trim cover assembly.

- (3) Disconnect the connection between canister solenoid valve outlet pipe II and canister solenoid valve outlet pipe.
 (4) Disconnect the connection between charcoal canister solenoid valve outlet pipe II and intercooler outlet pipe II.
 (5) Disconnect the connection between charcoal canister solenoid valve outlet pipe II and intake hose.



- (6) Remove canister solenoid valve outlet pipe II assembly.

■ Installation

- (1) Connect the canister solenoid valve outlet pipe II to canister solenoid valve outlet pipe.
- (2) Connect the canister solenoid valve outlet pipe II to intercooler outlet pipe II.
- (3) Connect the canister solenoid valve outlet pipe II to intake hose.
- (4) Install the engine compartment trim cover assembly.

5.5 Upstream Oxygen Sensor

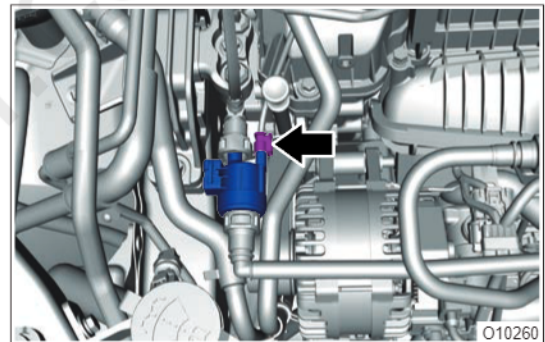
■ Removal

⚠ Warning

- Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Appropriate force should be applied when removing upstream oxygen sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.

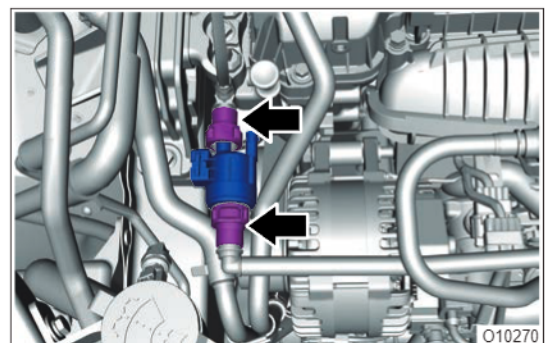
- (4) Remove the upstream oxygen sensor connector from fixing bracket and disconnect the connector.



- (5) Remove the upstream oxygen sensor from front part of precatalytic converter assembly.

Hint:

Remove it with special oxygen sensor socket.



■ Inspection

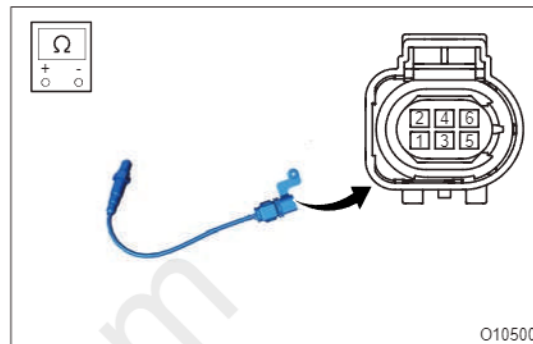
- (1) Measure the resistance of upstream oxygen sensor with a digital multimeter.

Multimeter Connection	Terminal Definition
Terminal 1	Controlled by oxygen pump
Terminal 2	(Reference ground) Analog ground
Terminal 3	Heater power supply
Terminal 4	Heater control
Terminal 5	Correction resistance
Terminal 6	Reference signal

Multimeter Connection	Condition	Specified Condition
Terminal 3 - Terminal 4	Normal Temperature	4 - 5 Ω
Terminal 1 - Terminal 5	Normal Temperature	114 Ω

Hint:

If result is not as specified, replace the upstream oxygen sensor.



■ Installation

⚠ Caution

- The specified grease must be used. Use of other grease will lead to oxygen sensor poisoning. The new sensor has been applied with grease and the grease must be applied to the mounting threads when reassembling.

Material No.: 5964080112 (120 g/pot) or 5964080145 (450 g/pot)

⚠ Warning

- If oxygen sensor falls, never install it directly.

- (1) Install upstream oxygen sensor with special oxygen sensor socket.

Torque: 45 ± 5 N·m

- (2) Install the upstream oxygen sensor connector.
- (3) Install the engine compartment trim cover assembly.

5.6 Downstream Oxygen Sensor

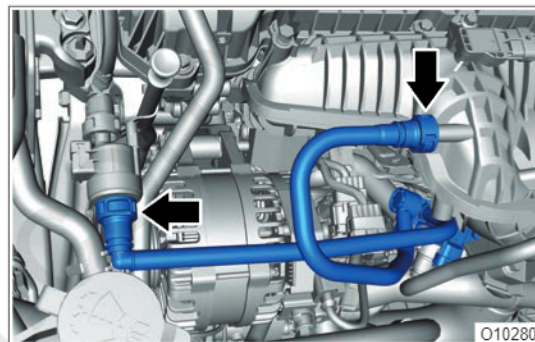
■ Removal

Warning

- Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Appropriate force should be applied when removing downstream oxygen sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Raise the vehicle to a proper position.

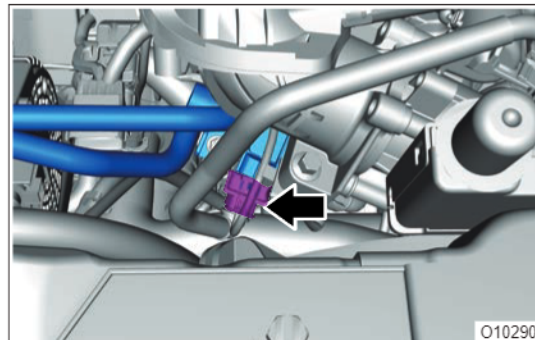
- (4) Disconnect the downstream oxygen sensor connector.



- (5) Remove the downstream oxygen sensor.

Hint:

Remove it with special oxygen sensor socket.

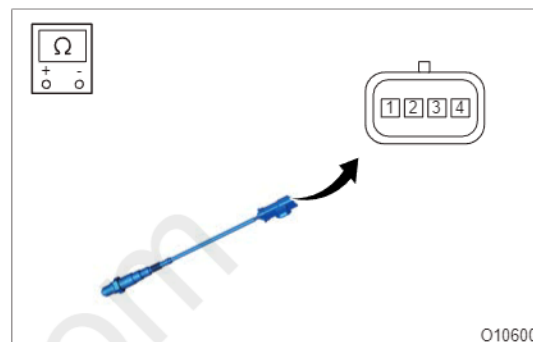


■ Inspection

- (1) Measure the resistance of upstream oxygen sensor with a digital multimeter.

Multimeter Connection	Terminal Definition
Terminal 1	Ground
Terminal 2	Signal
Terminal 3	Heat control
Terminal 4	Heater power supply

Multimeter Connection	Condition	Specified Condition
Terminal 3 - Terminal 4	Normal Temperature	5 - 22 Ω
Terminal 1 - Terminal 2	Always	No continuity
Terminal 1 - Terminal 4		
Terminal 2 - Terminal 3		
Terminal 2 - Terminal 4		



Hint:

If result is not as specified, replace the downstream oxygen sensor.

■ Installation

⚠ Caution

- The specified grease must be used. Use of other grease will lead to oxygen sensor poisoning. The new sensor has been applied with grease and the grease must be applied to the mounting threads when reassembling.

Material No.: 5964080112 (120 g/pot) or 5964080145 (450 g/pot)

⚠ Warning

- If oxygen sensor falls, never install it directly.

- (1) Install downstream oxygen sensor with special oxygen sensor socket.

Torque: 45 ± 5 N·m

- (2) Install the downstream oxygen sensor connector.

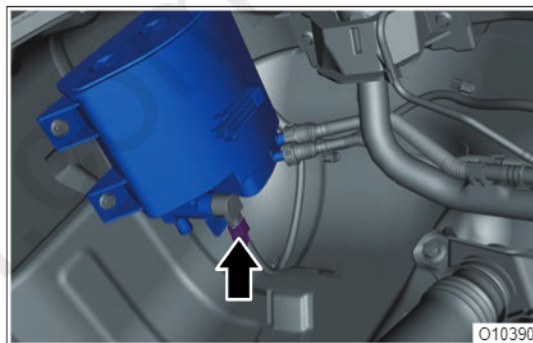
5.7 Activated Charcoal Canister Assembly

■ Removal

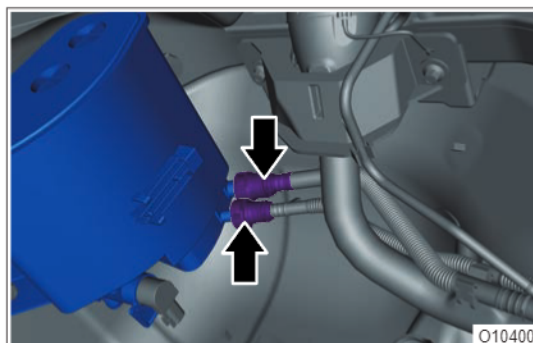
⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents when removing activated charcoal canister assembly.**
- **Appropriate force should be applied when removing activated charcoal canister assembly. Be careful not to operate roughly.**

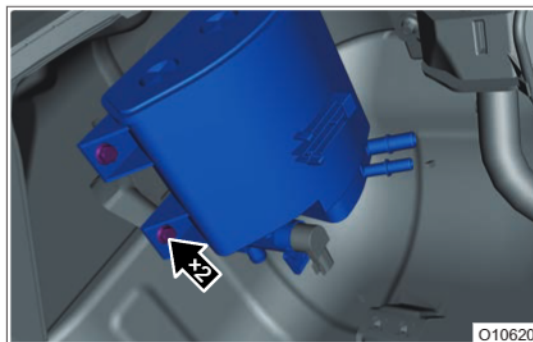
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the rear right wheel.
- (5) Remove the rear right wheel house protector assembly.
- (6) Remove the dust filter.
- (7) Disconnect the activated charcoal canister cut-off valve connector.



- (8) Disconnect the connection between charcoal canister and fuel vapor pipe I .
- (9) Disconnect the connection between charcoal canister and fuel vapor pipe II .



- (10) Remove 2 fixing bolts from charcoal canister assembly.

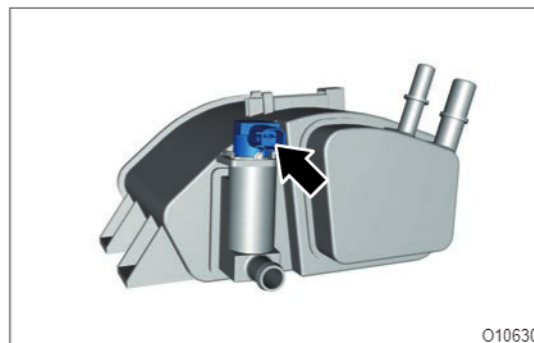


- (11) Remove charcoal canister assembly from charcoal canister bracket.

⚠ Caution

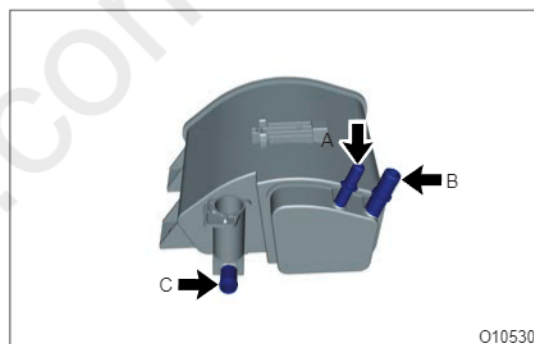
- **Unneeded activated charcoal canister assembly should be handled by the specialized department according to local laws and regulations. Never discard it at will.**

- (12) Remove charcoal canister cut-off valve from charcoal canister assembly.



■ Inspection

- (1) Close port C and blow compressed air into port A. Check that air flows out from port B. If result is not as specified, replace canister.
- (2) Close port C and blow compressed air into port B, check that air flows from port A. If result is not as specified, replace the canister.
- (3) Close port A and use vacuum pump to pump the vacuum from port B, check that air enters from port C. If result is not as specified, replace the filter and canister.



■ Installation

- (1) Install charcoal canister cut-off valve to charcoal canister assembly.
- (2) Install charcoal canister assembly to fixing bracket. Install 2 fixing bolts.

Torque: 19 ± 3 N·m

- (3) Connect fuel vapor pipe I to charcoal canister assembly.
- (4) Connect fuel vapor pipe II to charcoal canister assembly.
- (5) Connect the activated charcoal canister cut-off valve connector.
- (6) Install the dust filter.
- (7) Install rear right wheel house protector assembly.
- (8) Install the rear right wheel.
- (9) Install the intake hose assembly.
- (10) Install the engine compartment trim cover assembly.

5.8 Dust Filter

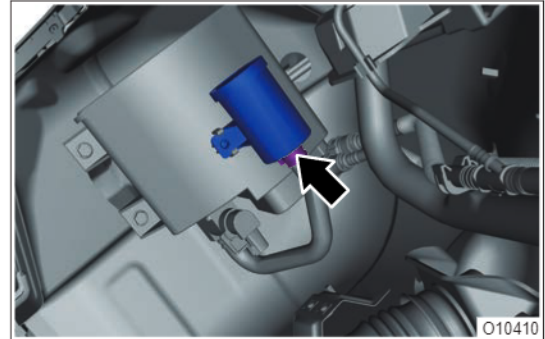
■ Removal

⚠ Warning

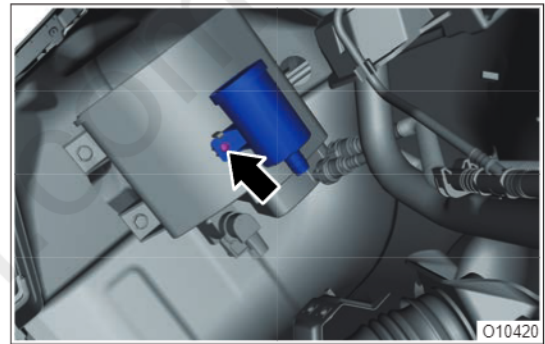
- **Be sure to wear necessary safety equipment to prevent accidents when removing dust filter.**
- **Appropriate force should be applied when removing dust filter. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the rear right wheel.
- (4) Remove the rear right wheel house protector.

- (5) Loosen elastic clamp, and disconnect connection of activated charcoal canister breather pipe and dust filter.



- (6) Remove 1 fixing bolt from dust filter.



- (7) Remove the dust filter.

■ Inspection

- (1) Check dust filter for blockage, damage.

■ Installation

- (1) Install 1 fixing bolt to dust filter.

Torque: 7 ± 1 N m

- (2) Connect activated charcoal canister breather pipe to dust filter.
- (3) Install rear right wheel house protector.
- (4) Install the rear right wheel.

5.9 Activated Charcoal Canister Breather Pipe Assembly

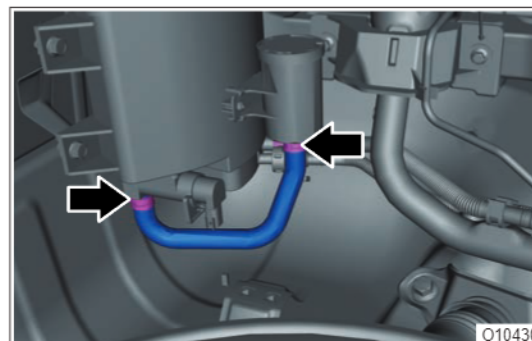
■ Removal

⚠ Warning

- Be sure to wear necessary safety equipment to prevent accidents when removing activated charcoal canister breather pipe assembly.
- Appropriate force should be applied when removing activated charcoal canister breather pipe assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the rear right wheel.
- (4) Remove the rear right wheel house protector.

- (5) Loosen elastic clamp, and disconnect connection of activated charcoal canister breather pipe and activated charcoal canister cut-off valve.
- (6) Loosen elastic clamp, and disconnect connection of activated charcoal canister breather pipe and dust filter.



O10430

- (7) Remove activated charcoal canister breather pipe assembly.

■ Inspection

- (1) Check activated charcoal canister breather pipe for blockage, damage.

■ Installation

- (1) Connect activated charcoal canister breather pipe to activated charcoal canister cut-off valve and install elastic clamp.
- (2) Connect activated charcoal canister breather pipe to dust filter and install elastic clamp.
- (3) Install rear right wheel house protector.
- (4) Install the rear right wheel.

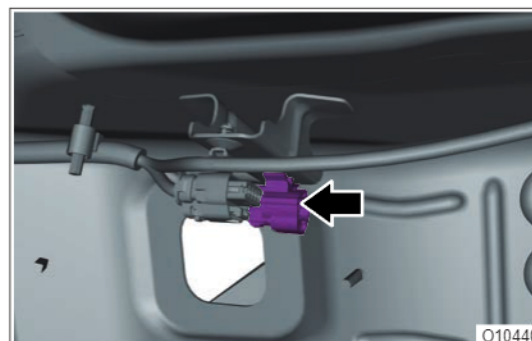
5.10 Exhaust Temperature Sensor

■ Removal

⚠ Warning

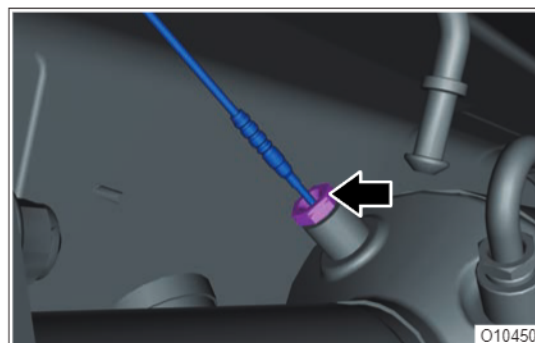
- Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Appropriate force should be applied when removing exhaust temperature sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Raise the vehicle to a proper position.
- (4) Disconnect the exhaust temperature sensor connector.



O10440

- (5) Remove exhaust temperature sensor from the front end of GPF.



■ Inspection

- (1) Heating the front end of sensor, measure resistance with multimeter ohm band. The resistance should change in accordance with temperature.
- (2) Turn digital multimeter to ohm band, connect two probes to two terminals (no polarity) respectively, the normal resistance should be 200 ~ 230 Ω at normal temperature (0 ~ 40 $^{\circ}\text{C}$). If the resistance is abnormal (out of range), the performance is invalid. Abnormal conditions usually include open (- resistance is ∞) or short (resistance is 0).

Temperature ($^{\circ}\text{C}$)	Resistance (Ω)
-40	170.68
0	201.50
10	209.15
50	239.49
100	276.90
150	313.72
200	349.96
250	385.61
300	420.68
350	455.16
400	489.06
450	522.37
500	555.10
550	587.24
600	618.80
650	649.77
700	680.16
750	709.96
800	739.18
850	767.81
900	795.86

■ Installation

- (1) Install the exhaust temperature sensor.

Torque: $35 \pm 5 \text{ N}\cdot\text{m}$

- (2) Connect the exhaust temperature sensor connector.

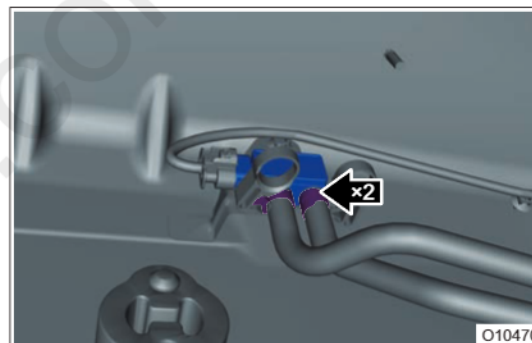
5.11 Pressure Difference Sensor

■ Removal

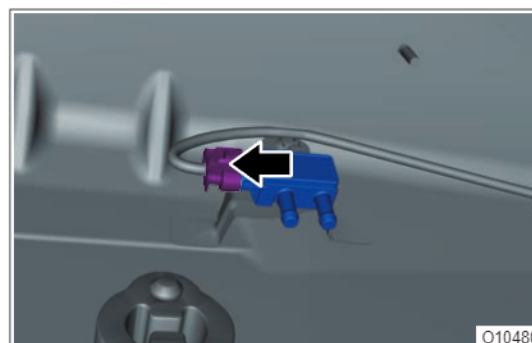
⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing pressure difference sensor.**
- **Appropriate force should be applied when removing pressure difference sensor. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Raise the vehicle to a proper position.
- (4) Loosen 2 elastic clamps and disconnect the connection between hose and pressure difference sensor.



- (5) Disconnect the pressure difference sensor connector.



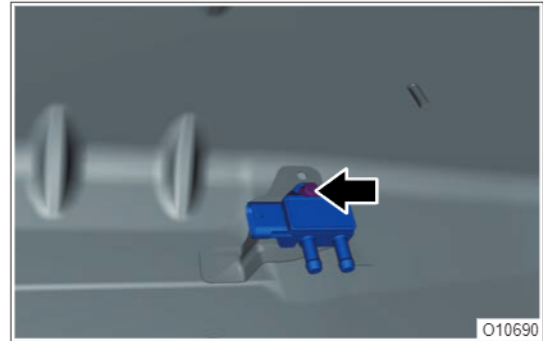
- (6) Remove 1 fixing bolt from pressure difference sensor.



- (7) Remove the pressure difference sensor assembly carefully.

■ Inspection

- (1) Turn digital multimeter to ohm band, ground the black probe 3#, connect red probe to pins 1# and 2# respectively. It is normal that resistance is greater than 2.5 MΩ.



- (2) Connect pin 4# VDD of sensor to 5V power supply, pin 3# GND to ground, and connect output pins 1# and 2# through SENT signal collector (oscilloscope). At normal temperature ($30 \pm 10^\circ$) and normal pressure ($101 \text{ kpa} \pm 5 \text{ kpa}$), the output value in decimal number 1184 ~ 1423 is normal.

Hint:

SENT is the abbreviation of Single Edge Nibble Transmission. As a point-to-point and one-way transmission scheme launched by Society of Automotive Engineers (SAE), it is used to transmit HD sensor data between vehicle sensor and electronic control unit (ECU). Sensor data is transmitted through a series of pulse sequence between two falling periods. SENT provides a reference calibration pulse at the beginning of signal and provides a check bit at the end. The length of message varies with half bit value. As a new interface standard of vehicle sensor, compared with analog output and PWM output, SENT (SAE J2716) has a good EMC performance with low cost which saves wire harness and pin connector, and it can transmit DTC, so that sensor system has an excellent malfunction diagnosis ability.

■ Installation

- (1) Install 1 fixing bolt to pressure difference sensor.
Torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$
- (2) Connect the differential difference sensor connector.
- (3) Connect hose to pressure difference sensor and install elastic clamp.

5.12 Fuel Tank Pressure Sensor

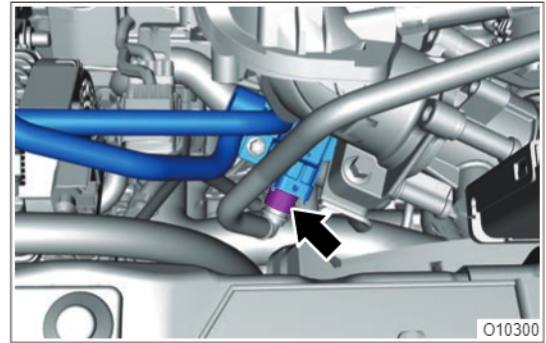
■ Removal

⚠ Warning

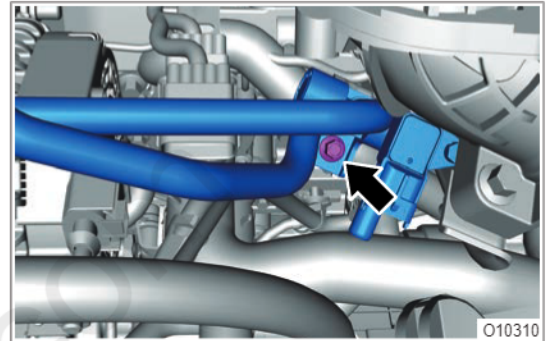
- Be sure to wear necessary safety equipment to prevent accidents, when removing fuel tank pressure sensor.
- Appropriate force should be applied when removing fuel tank pressure sensor. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the rear right wheel.
- (4) Remove the rear right wheel house protector.

- (5) Disconnect fuel tank pressure sensor connector.



- (6) Disconnect the fuel vapor hose pipe 1.



- (7) Remove the fuel vapor pipe 1 with fuel tank pressure sensor assembly.

■ Installation

⚠ Caution

- Before connecting the hose, check if there is any damage or foreign matter on the hose or joint.
- When pipe is connected using quick connector, pay attention to the fitting size and direction of the connector. During assembly, install the male connector into place along the axis direction of quick connector until it is bounced into mechanically and a "click" sound is heard. In order to check if the installation is in good condition, pull it forcibly in reverse direction.

- (1) Connect the fuel vapor hose pipe 1.
- (2) Connect the fuel tank pressure sensor connector.
- (3) Install rear right wheel house protector.
- (4) Install the rear right wheel.

4.7 EMISSION CONTROL SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- (2) If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

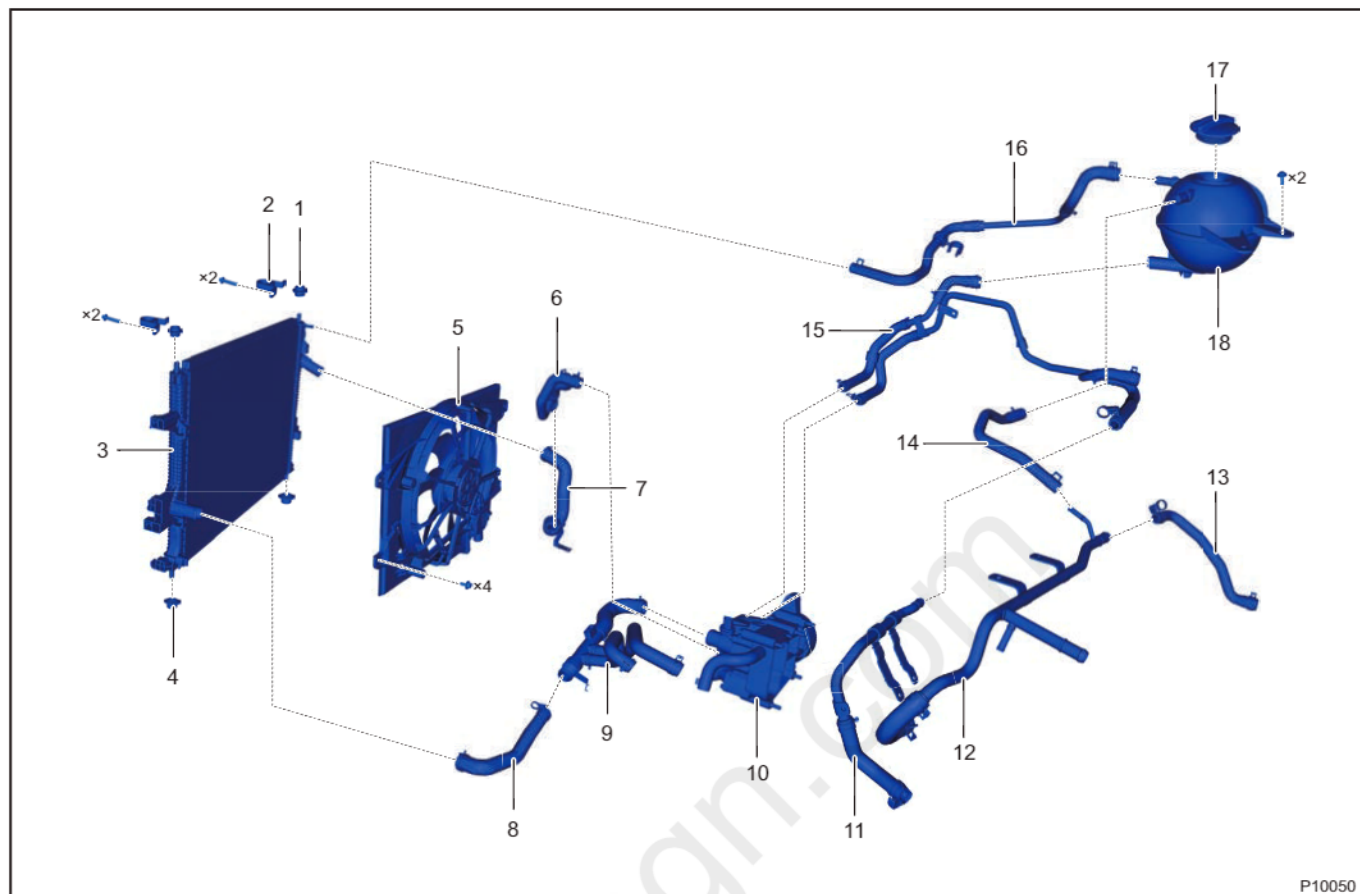
- (1) When testing cooling system, please pressurize the system to specified pressure. Otherwise, system components may be damaged.
- (2) DO NOT mix different colors or types of coolant.
- (3) Please select coolant which is suitable for local climate in different areas.

2 System Overview

2.1 System Description

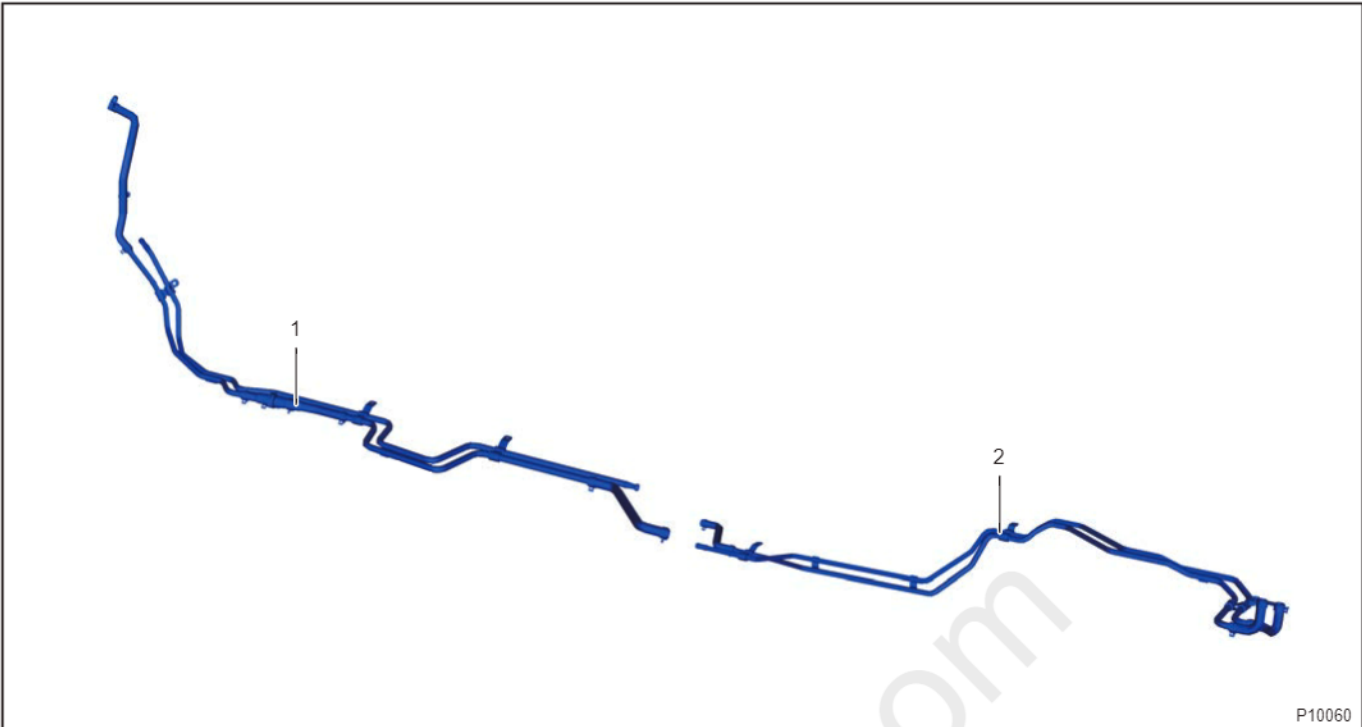
Engine cooling system adjusts engine operating temperature by the flow of coolant and makes engine operate normally under various operating conditions. And effectively improve the service life and fuel economy of the engine.

2.2 System Components Diagram



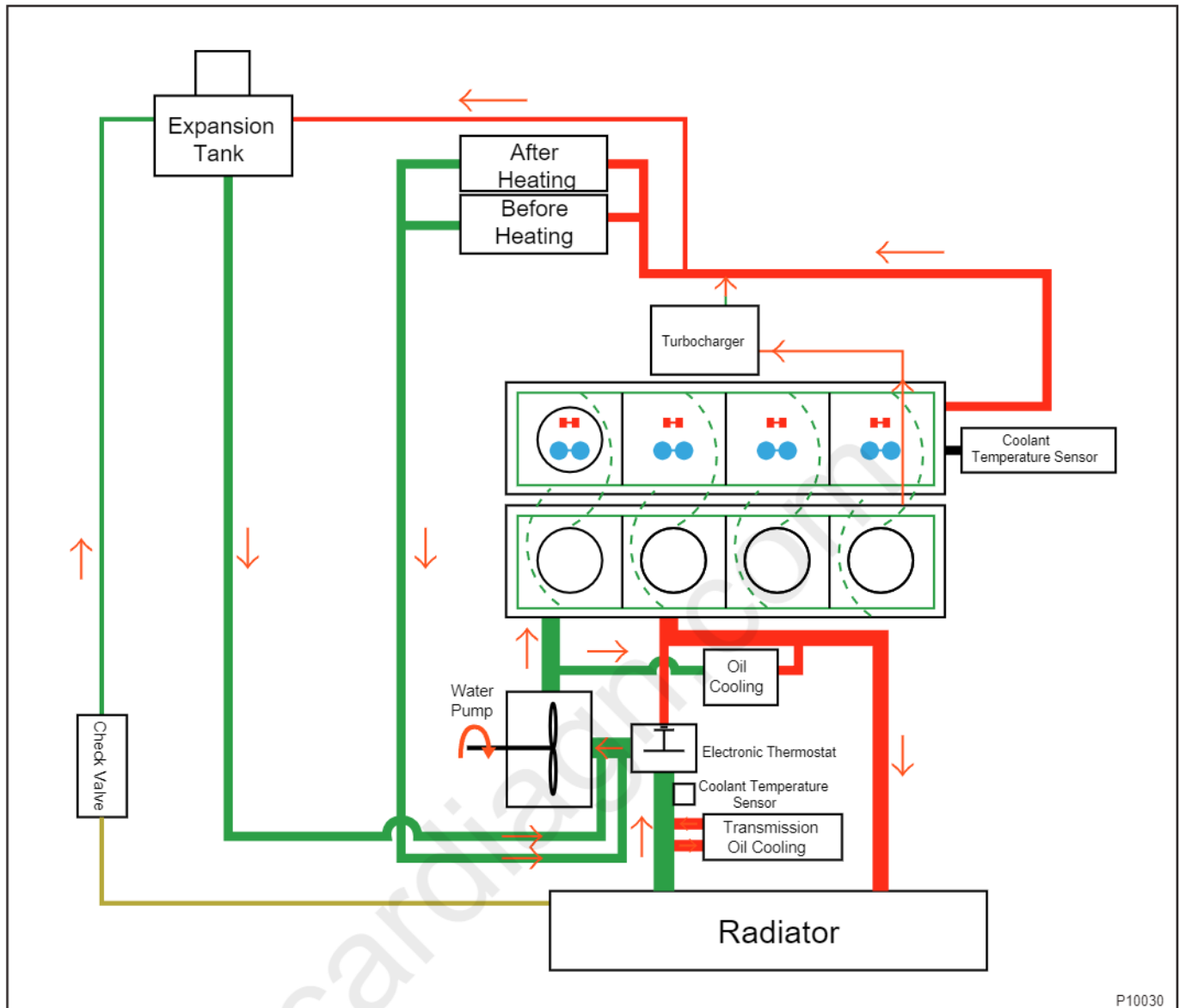
P10050

1	Rubber Bushing	10	Water Pump Module
2	Radiator Mounting Bracket	11	Rear Heater Outlet Pipe Assembly
3	Radiator Assembly	12	Heater Inlet Pipe Assembly I
4	Rubber Cushion	13	Heater Inlet Pipe Assembly II
5	Cooling Fan Assembly	14	Engine Discharge Pipe Assembly
6	Engine Outlet Pipe Assembly - Rear	15	Inlet Pipe Assembly
7	Engine Outlet Pipe Assembly - Front	16	Radiator Discharge Pipe Assembly I
8	Engine Inlet Pipe Assembly - Front	17	Expansion Tank Cap
9	Engine Inlet Pipe Assembly - Rear	18	Expansion Tank Body



1	Rear Heater Inlet and Outlet Pipe Assembly II	2	Rear Heater Inlet Pipe Assembly III
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2.3 System Schematic Diagram



P10030

After engine operates, the water pump starts operating. Coolant begins to flow circularly. Displacement of water pump depends on engine speed. The higher the speed, the larger the displacement, and vice versa. When the coolant temperature does not reach the opening temperature of electronic thermostat, the engine coolant circulates in cylinder block, the cylinder head, turbocharger and heater water tank under the operation of water pump, and the coolant does not radiate through the radiator. When coolant temperature reaches the opening temperature of electronic thermostat, coolant flowing out of cylinder block enters radiator for radiating. It then returns to cylinder block for circulation by water pump. Due to radiating in radiator, engine coolant temperature decreases quickly to prevent engine from overheating.

2.4 System Components Description

■ Expansion Tank Body

The expansion tank is an integral part of the vehicle cooling system. When the engine is running, the coolant will circulate continuously in the cooling water channel, and will flow through the expansion tank at halfway. If the pressure is too high or the coolant is too much, the excess gas and coolant will flow out of the bypass water channel of the expansion tank to avoid the high pressure of the cooling system.



P10080

■ Radiator Assembly

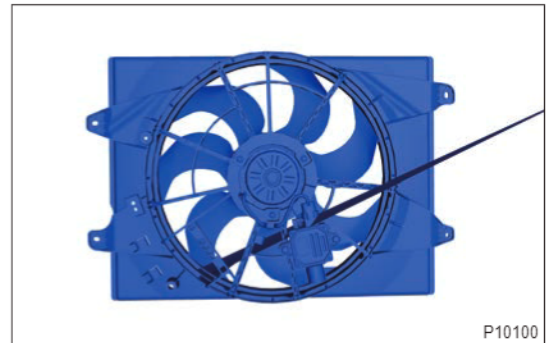
The radiator is composed of three parts: Inlet chamber, outlet chamber and radiator core. The coolant flows in the radiator core and the air flows outside the radiator core. The hot coolant cools down because radiating heat to air, and the cold air heats up because absorbing the heat from the coolant, so the radiator is a heat exchanger.



P10090

■ Cooling Fan Assembly

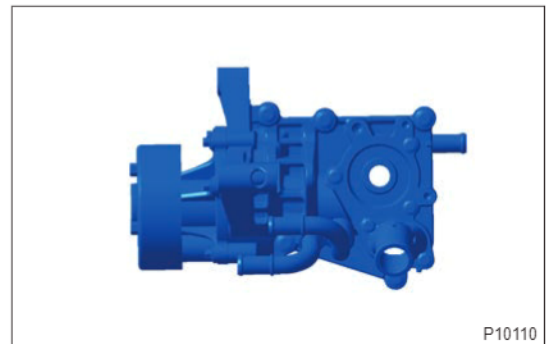
The rotation of radiator fan helps to radiate the radiator. Fan speed is controlled by ECU according to coolant temperature.



P10100

■ Water Pump Assembly

Pressurize coolant to ensure it can circulate in cooling system. Its displacement varies with engine speed.



P10110

■ Electronic Thermostat

The electronic thermostat can calculate the target temperature according to engine running speed, load state, intake air temperature, coolant temperature, etc., accurately regulate the coolant temperature to ensure that the engine always works at a reasonable temperature. According to the calculated value of the sensor signal, ECU provides the signal working voltage to heating resistance element in electronic thermostat, which makes the paraffin expand and displace. Through this displacement, the temperature regulating unit mechanically adjusts the large circulation and small circulation of water temperature. The operation of electronic thermostat shall meet the following conditions at the same time:

- (1) Under low speed and low load, electronic thermostat controls to open at 105 °C to improve fuel economy.
- (2) Under high speed and high load, electronic thermostat controls to open at 90 °C to ensure engine safety.
- (3) If there is fault in line, electronic thermostat can be opened mechanically. Initially opening temperature: 100 °C $\pm$ 2 °C, fully opening temperature: 110 °C $\pm$ 2 °C.
- (4) Opening stroke of thermostat: 8mm.



P10120

■ Coolant Temperature Sensor

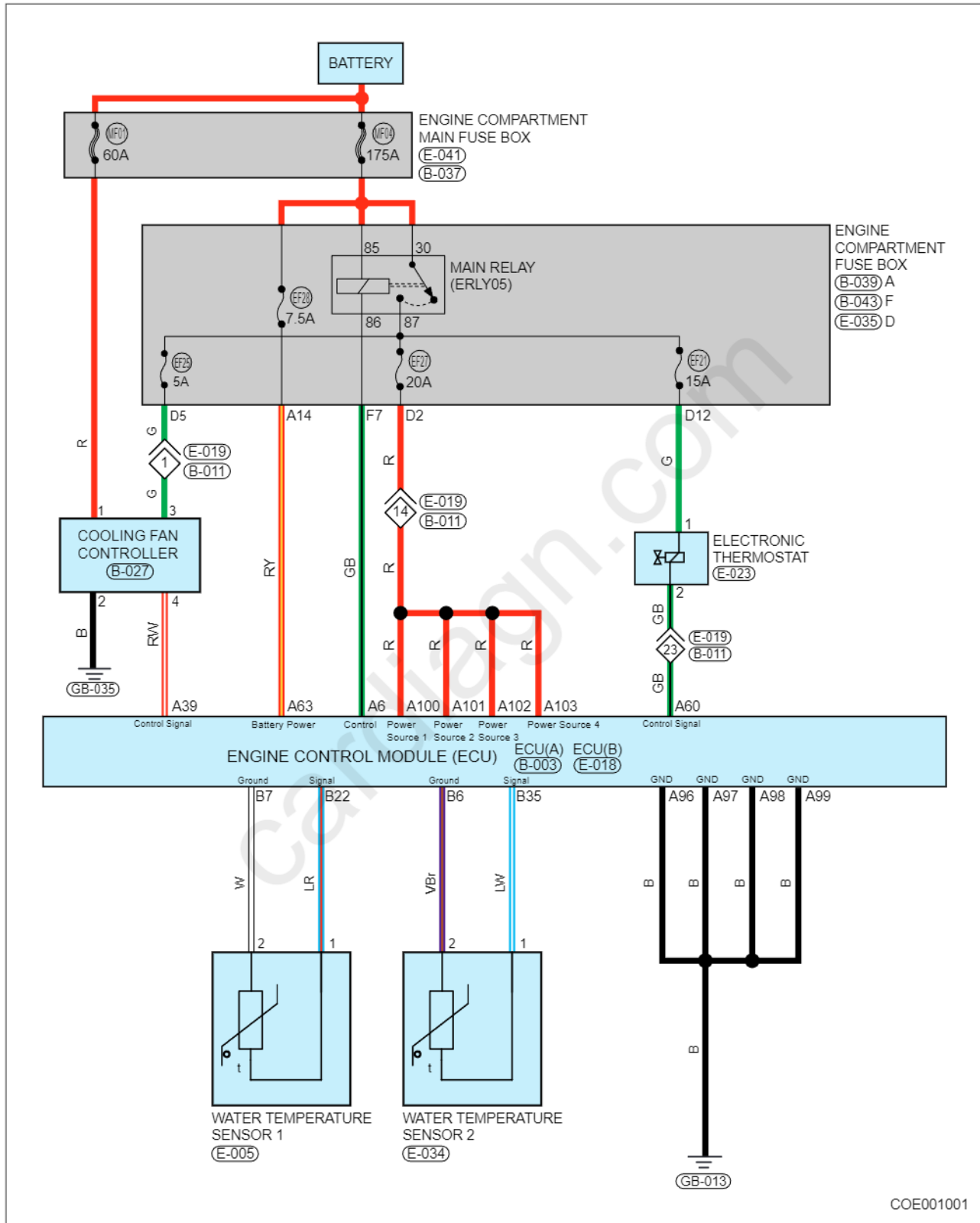
NTC thermistor packaged inside temperature sensor is used for coolant temperature sensor, its resistance changes in accordance with ambient temperature, thus accurately reflecting the small changes in coolant temperature. The temperature of contact medium can be reflected by measuring its output resistance, and the signals from both terminals of resistor are output to ECM. Engine coolant temperature can be obtained by ECU according to output signal of the sensor, thus judging the engine operating condition.



P10130

3 System Circuit Diagram

3.1 Circuit Diagram



4 DIAGNOSIS & TESTING

4.1 Problem Symptoms Table

Hint:

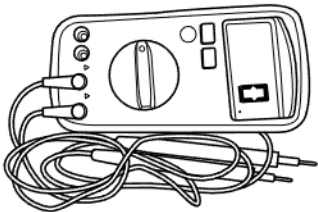
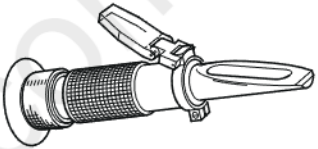
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Cooling System

Symptom	Possible Cause
Insufficient coolant	Coolant pipe (deteriorated and leaks)
	Expansion tank (leakage)
	Radiator assembly (leakage)
	Heater core (leakage)
	Electronic thermostat improperly sealed
	Water pump (improperly sealed)
	Engine cylinder head gasket (damaged)
	Engine cylinder head (cracked and Leakage)
	Engine cylinder block (water jacket leaks and cylinder block cracked)
Engine overheating	Low coolant level
	Air resistance exists in cooling pipe
	Expansion luggage cap damaged
	ECU fault
	Cooling fan assembly
	Electronic thermostat
	Radiator assembly
	Coolant temperature sensor
Engine undercooling	Electronic thermostat
	Cooling fan
Unable to reach normal engine temperature	Cooling fan (constantly operating)
	Electronic thermostat
Cooling fan does not operate or operate abnormally	Cooling fan
	Cooling fan controller
	Fan controller wire harness
	ECU fault

5 ON-VEHICLE SERVICE

5.1 Tool

■ General Tool

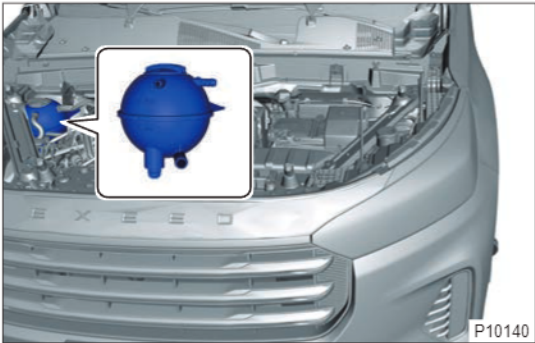
Tool Name	Tool Drawing
Digital Multimeter	 S00002
Freezing Point Tester	 S00005

5.2 Cooling System Leakage Test

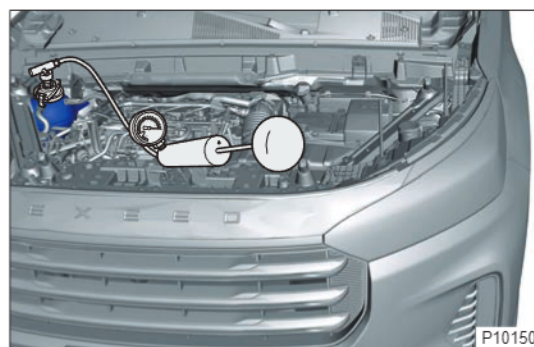
■ Test Procedures

 Warning
Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
 Caution
- When testing cooling system, please pressurize the system to specified pressure. Otherwise, system components may be damaged. - Before testing cooling system, do not perform operation until coolant temperature drops to normal level. Otherwise, it may cause scald.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Check if coolant level is between "MAX" and "MIN" lines. If coolant level is below "MIN" line, add coolant.



- (3) Connect cooling system pressure tester to coolant pressure release cap opening (expansion tank body cap opening) and tighten it slowly.



P10150

⚠ Caution

- **Make sure there is no leakage in connecting part of coolant system pressure tester, in order to avoid pressure leakage during test.**

- (4) Pressurize cooling system to 1.2 bar with the cooling system pressure tester, and then observe the pressure changes. If system pressure does not drop within 2 minutes, it indicates there is no leakage in system. If pressure changes greatly, it indicates that there is a leakage in system; find the leaking area and perform troubleshooting.

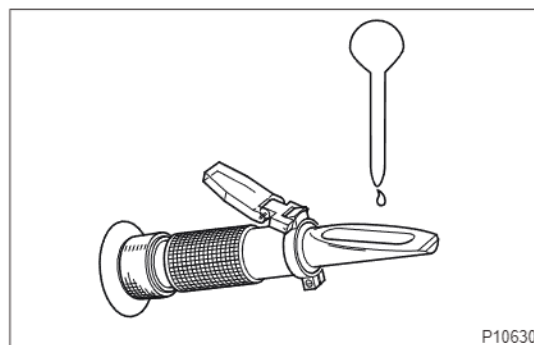
5.3 Coolant Freezing Point Test

■ Test Procedures

⚠ Caution

- **DO NOT mix different colors or types of coolant.**
- **Please select coolant which is suitable for local climate in different areas.**
- **Please read measured value at the scale line. In order to distinguish the scale line more clearly, drip a drop of water on the glass of freezing point tester with a pipette, then the scale line can be clearly distinguished via a "waterline" .**

- (1) As shown in illustration, drip a drop of coolant on the glass of freezing point tester with a pipette, and then observe freezing point value of coolant.

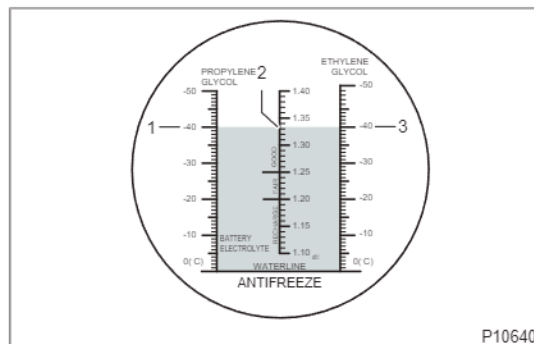


P10630

- (2) As shown in illustration, observe scale 3 of freezing point tester to read ethylene glycol coolant freezing point value. The freezing point value must be kept at -40°C (value varies with geography, climate or freezing point).

Hint:

Scale 1 is used to measure the freezing point value of propylene glycol coolant, and scale 2 is used to measure the battery electrolyte concentration.



P10640

- (3) If freezing point is beyond the specified value, replace the coolant.

5.4 Draining and Adding Coolant

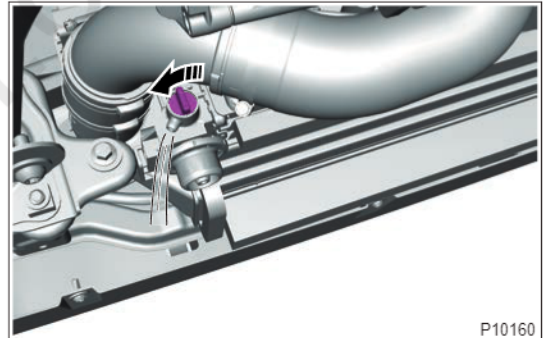
■ Draining Coolant

⚠ Warning

- **Never open expansion tank cap when engine is operating or temperature is high. Otherwise, it may cause scald.**
- **Be careful when opening expansion tank cap, the high-pressurized hot engine coolant and steam may flow out and cause serious burns.**
- **Wait until the engine has cooled down, and then cover the expansion tank cap with a piece of damp cloth and turn it one turn slowly (counterclockwise). Step back when releasing cooling system pressure. After confirming that all pressure has been released, turn the pressure release cap with cloth covered and remove it.**
- **Violating above descriptions may cause serious personal injury.**

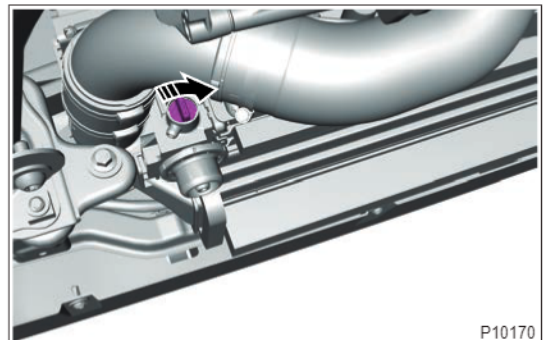
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the expansion tank cap when engine temperature is low.
- (4) Remove the engine lower protector assembly.

- (5) Put a coolant collector under the vehicle, rotate the radiator drain cock plug counterclockwise as shown in figure and drain the coolant in radiator and expansion tank.



P10160

- (6) After coolant stops flowing, re-tighten the radiator drain cock plug.



P10170

⚠ Caution

- **Tighten drain cock plug to prevent leakage.**
- **Wasted coolant should be handled by the specialized department according to local laws and regulations. Never discard it at will.**

■ Coolant Adding

⚠ Warning

- If it is necessary to add coolant when engine is hot, loosen expansion tank cap slightly first to release internal pressure and loosen the cap completely after waiting for a while, and then add coolant.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.

Coolant Capacity

Type	Capacity (L)
If equipped with rear heater	10.4 ± 0.2 L

- (1) Open expansion tank body cap until add coolant until coolant level reaches the "MAX" line.
- (2) Tighten expansion tank body cap, start and run engine. Maintain engine speed between 2000 and 2500 rpm to warm up the engine until cooling fan operates.

⚠ Caution

- If there is no coolant in expansion tank body after engine just starts, perform the followings: Stop the engine; wait until coolant cools down; add coolant to "MAX" line on expansion tank; run the engine at 2500 rpm until coolant level becomes stable.

- (3) Stop engine and wait until coolant temperature drops to the ambient temperature. Check that coolant level is between "MAX" and "MIN" lines. If coolant level is below the "MIN" line, repeat all the above procedures. Keep the coolant level between "MAX" and "MIN" lines.
- (4) Check each pipe for leaks, lack of antifreeze, if so, handle it.

⚠ Caution

- Do not open the expansion tank cap at high engine temperature to prevent burns.

5.5 Expansion Tank Body

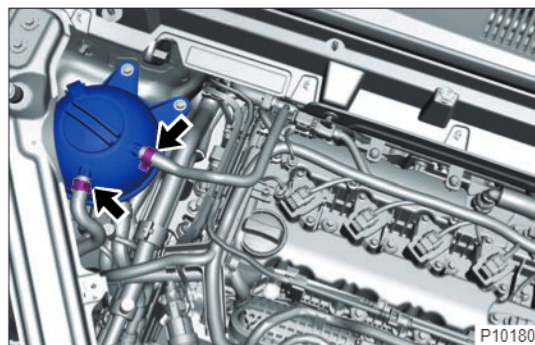
■ Removal

⚠ Warning

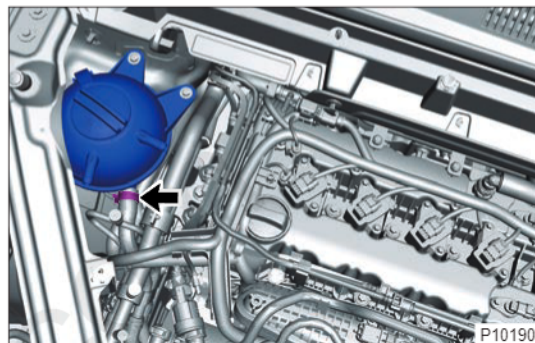
- Always make sure engine is cold before operating cooling system. Never open expansion tank body cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear necessary safety equipment to prevent accidents when repairing.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.

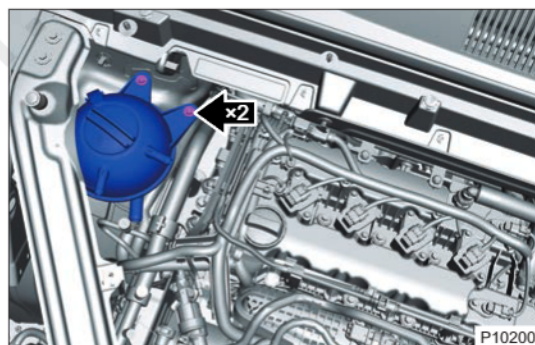
- (5) Loosen the elastic clamp and disconnect the connection between radiator discharge pipe 1 and expansion tank.
- (6) Loosen the elastic clamp and disconnect the connection between engine discharge pipe and expansion tank body.



- (7) Loosen elastic clamp and disconnect the connection between inlet pipe and expansion tank body.



- (8) Remove 2 fixing bolts from expansion tank body.



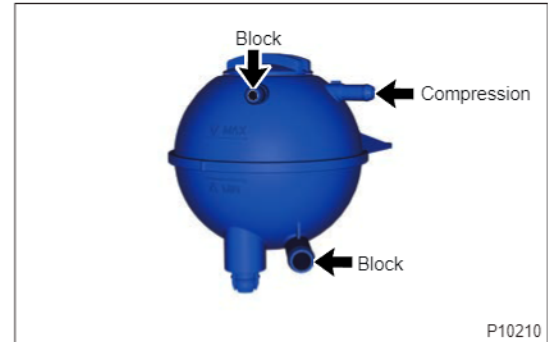
- (9) Remove the expansion tank body assembly carefully.

■ Inspect the expansion tank body

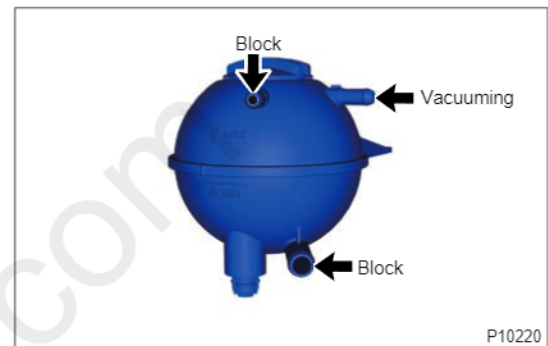
- (1) Check that the expansion tank is welded firmly, and there are no defects such as fractures and cracks at the weld.
- (2) The expansion tank should be colorless and transparent. During use of vehicle, expansion tank assembly is not allowed to have discoloration that affects the appearance and function, and scale line should be clearly visible.

■ Inspect the expansion tank cap

- (1) Block two holes of expansion tank and pressurize one of them. When pressure reaches the opening pressure of relief valve (120 - 150 kpa), the pressure in expansion tank should be maintained at the relief valve opening pressure value.



- (2) Block two holes of expansion tank and vacuumize one of them. When vacuum pressure reaches the opening pressure of vacuum valve (-2 - 10kpa), vacuum pressure in expansion tank should be maintained at the vacuum valve opening pressure value.



■ Installation

⚠ Caution

- When connecting engine discharge pipe and expansion tank body, align the “±” mark on pipe port with boss, and align center position of elastic clamp tabs with “I” position of “±” mark, align the edge of elastic clamp with lower edge of “二” position of “±” mark.
- When connecting engine inlet pipe and expansion tank body, align the “±” mark on pipe port with boss, and align center position of elastic clamp tab with “I” position of “±” mark, align the edge of elastic clamp with lower edge of “二” position of “±” mark.
- When connecting radiator discharge pipe | and expansion tank body, align the “⊥” mark on pipe port with boss, and align center position of elastic clamp tabs with “I” position of “⊥” mark, align the edge of elastic clamp with lower edge of “二” position of “⊥” mark.
- Check that coolant has been added to the specified level after installation.

- (1) Connect the inlet pipe to expansion tank body and install elastic clamp.

- (2) Install 2 fixing bolts to expansion tank body.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

- (3) Connect the engine discharge pipe to expansion tank body and install elastic clamp.

- (4) Connect the radiator discharge pipe | to expansion tank body and install elastic clamp.

- (5) Add the coolant.

- (6) Install the engine compartment trim cover assembly.

5.6 Inlet Pipe Assembly (If equipped with rear heater)

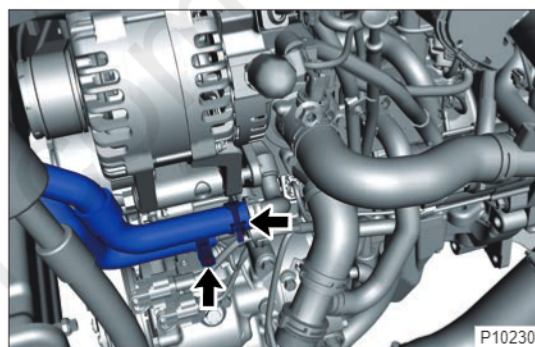
■ Removal

⚠ Warning

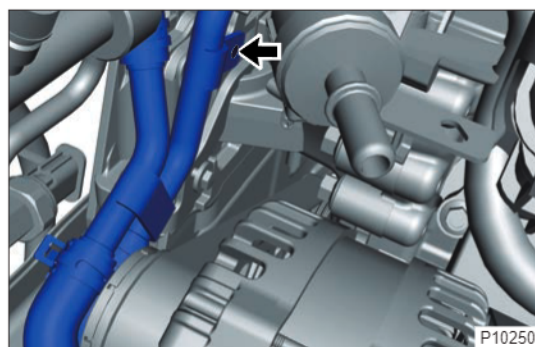
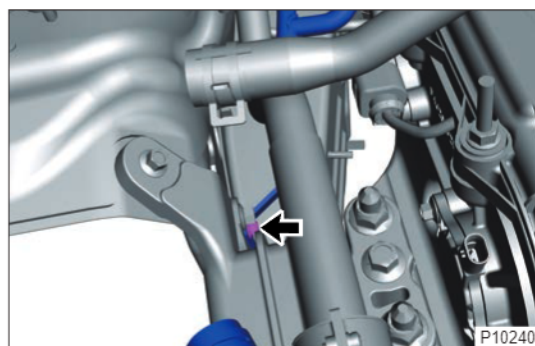
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear necessary safety equipment to prevent accidents when repairing.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Drain the coolant.
- (4) Remove the expansion tank body assembly.

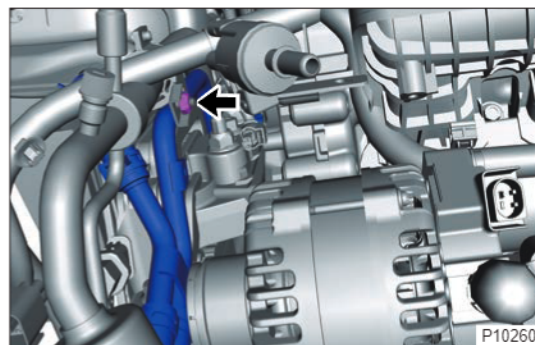
- (5) Loosen 2 elastic clamps and disconnect the connection between inlet pipe assembly and water pump module.



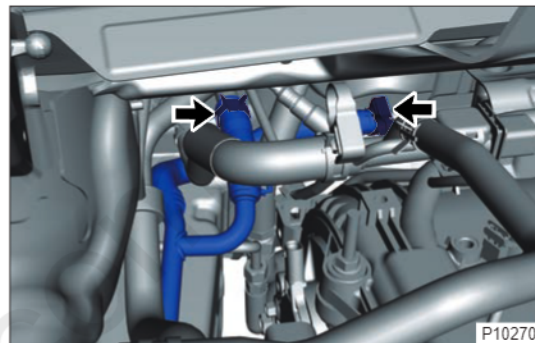
- (6) Remove 2 fixing bolts from inlet pipe assembly.



- (7) Remove 1 fixing nut that fixed the clip which between A/C coaxial line and inlet pipe assembly. Separate the two line.



- (8) Loosen elastic clamps and disconnect the connection between inlet pipe assembly and rear heater outlet pipe assembly.
- (9) Loosen elastic clamp and disconnect connection between inlet pipe assembly and heater water tank.



- (10) Remove the inlet pipe assembly carefully.

■ Installation

- (1) Install 2 fixing bolts to inlet pipe assembly.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

- (2) Tighten 1 fixing nut that fixed the clip which between A/C coaxial line and inlet pipe assembly.
- (3) Connect the inlet pipe to water pump module assembly. Install the elastic clamp.
- (4) Connect the inlet pipe to rear heater outlet pipe. Install the elastic clamp.
- (5) Connect inlet pipe to heater water tank. Install the elastic clamp.
- (6) Add the coolant.
- (7) Install the engine compartment trim cover assembly.

5.7 Heater Inlet Pipe Assembly | (If equipped with rear heater)

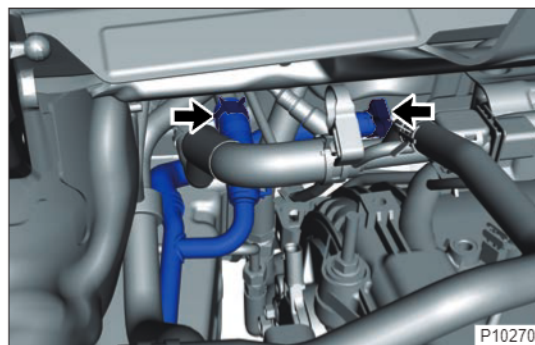
■ Removal

Warning

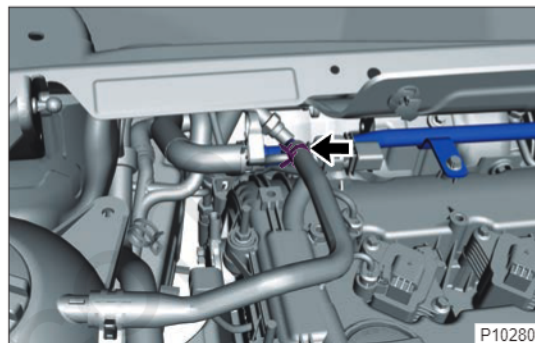
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the intake hose assembly.
- (4) Drain the coolant.

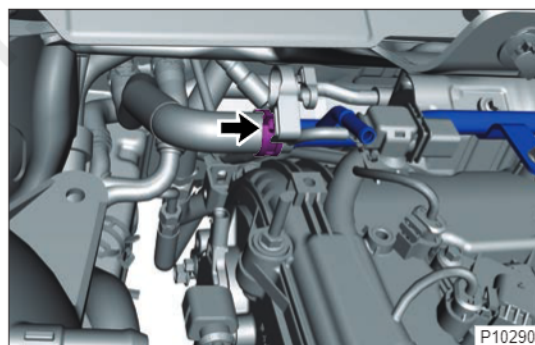
- (5) Loosen elastic clamps and disconnect the connection between inlet pipe assembly and rear heater outlet pipe assembly.
- (6) Loosen elastic clamp and disconnect connection between inlet pipe assembly and heater water tank.



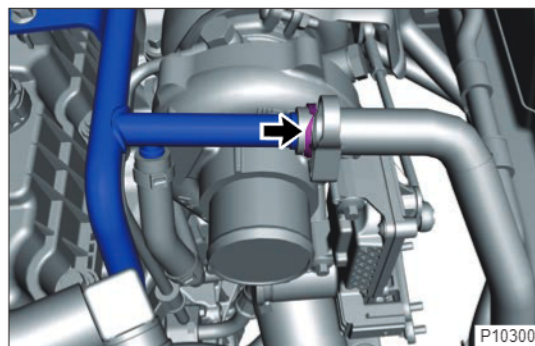
- (7) Loosen elastic clamps and disconnect the connection between engine discharge pipe and heater inlet pipe I.



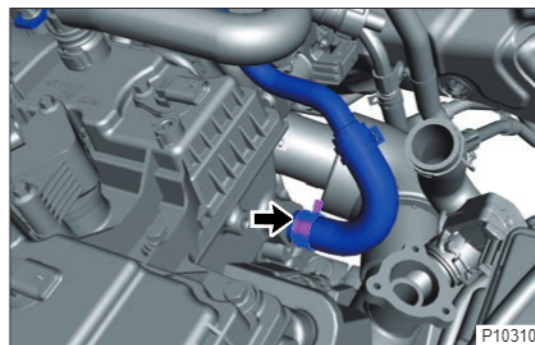
- (8) Loosen elastic clamps and disconnect the connection between heater inlet pipe II and heater inlet pipe I.



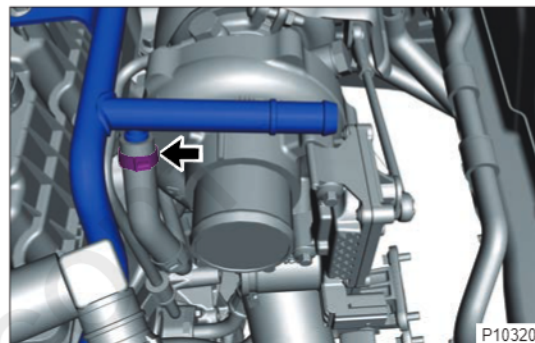
- (9) Loosen elastic clamps and disconnect the connection between rear heater inlet / outlet pipe and heater inlet pipe I.



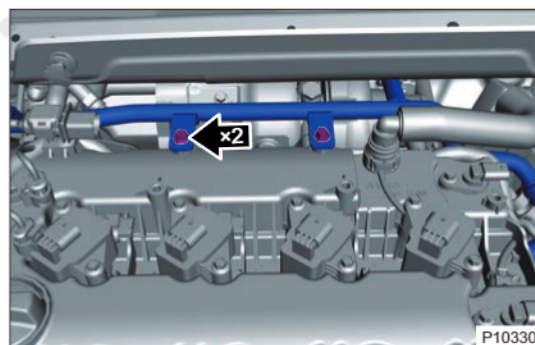
- (10) Loosen elastic clamps and disconnect the connection between cylinder head and heater inlet pipe I .



- (11) Loosen clamping ring and disconnect the connection between turbocharger water outlet pipe and heater inlet pipe I .



- (12) Remove 2 fixing bolts from heater inlet pipe assembly I .



- (13) Remove the heater inlet pipe assembly I carefully.

■ Installation

- (1) Install 2 fixing bolts to heater inlet pipe I .

Torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$

- (2) Connect heater inlet pipe I to cylinder head and install elastic clamp.
- (3) Connect the turbocharger outlet pipe to heater inlet pipe I and clamp the clamping ring.
- (4) Connect heater inlet pipe II to heater inlet pipe I and install elastic clamp.
- (5) Connect engine discharge pipe to heater inlet pipe I and install elastic clamp.
- (6) Connect rear heater inlet and outlet pipe to heater inlet pipe I and install elastic clamp.
- (7) Add the coolant.
- (8) Install the engine compartment trim cover assembly.

5.8 Cooler Upper Bracket Assembly

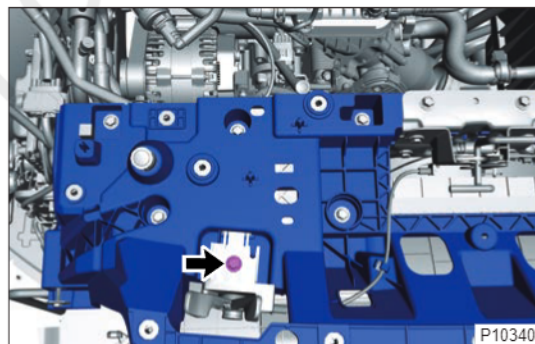
■ Removal

Warning

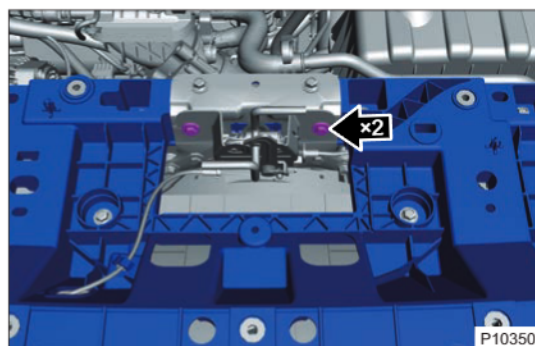
- Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear necessary safety equipment to prevent accidents, when removing the front plastic end.
- Appropriate force should be applied when removing the front plastic end. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the front bumper assembly.
- (6) Remove the right headlight assembly.
- (7) Remove the left headlight assembly.
- (8) Remove the right headlight crossmember assembly.
- (9) Remove the left headlight crossmember assembly.

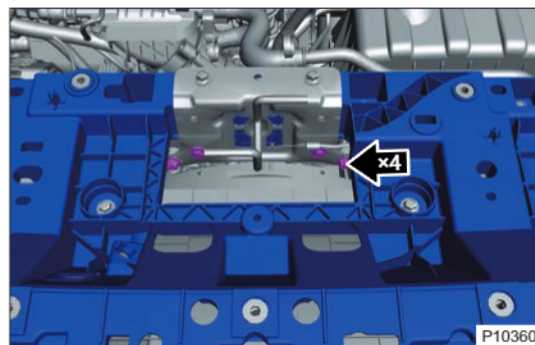
- (10) Remove 1 fixing bolt from engine hood secondary lock opening mechanism, then detach the cable.



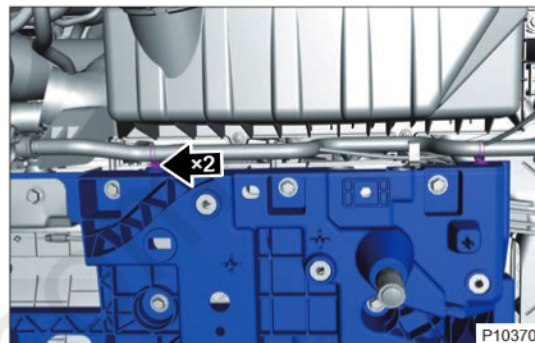
- (11) Remove 2 fixing bolts from engine hood lock assembly.



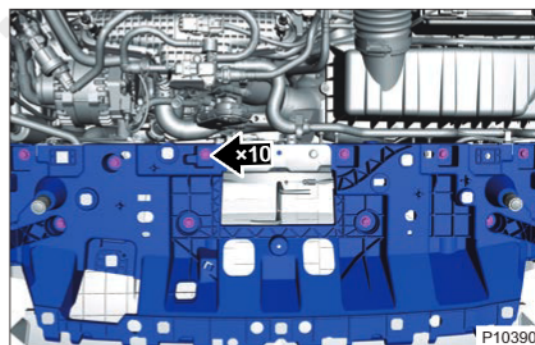
- (12) Remove 4 fixing bolts from lower part of engine hood lock moulding plate.



- (13) Disengage 2 clips of vacuum brake hose from cooler upper bracket.



- (14) Remove 10 fixing bolts from cooler upper bracket.



- (15) Remove cooler upper bracket assembly carefully.

■ Installation

- (1) Install 10 fixing bolts to cooler upper bracket.

Torque: $10 \pm 1.5 \text{ N m}$

- (2) Install 4 fixing bolts to lower part of engine hood lock moulding plate.
- (3) Install the engine hood lock assembly.
- (4) Install the engine hood secondary lock opening mechanism assembly.
- (5) Fix 2 clips to vacuum brake hose.
- (6) Install the left and right headlight crossmember assembly.
- (7) Install the left and right headlight assembly.
- (8) Install the front bumper assembly.
- (9) Install the air filter assembly.
- (10) Install the engine compartment trim cover assembly.

5.9 Front Plastic End Assembly

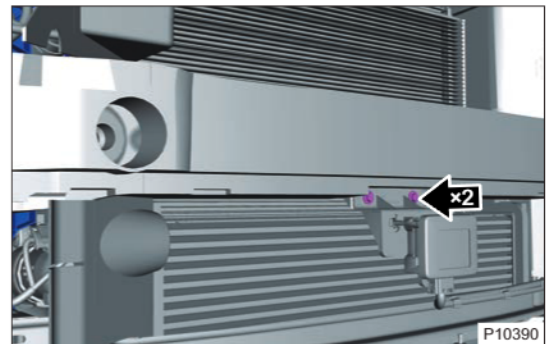
■ Removal

⚠ Warning

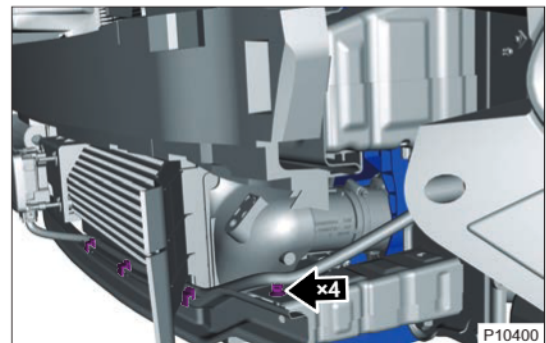
- Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear necessary safety equipment to prevent accidents, when removing the front plastic end.
- Appropriate force should be applied when removing the front plastic end. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the front bumper assembly.
- (6) Remove the right headlight assembly.
- (7) Remove the left headlight assembly.
- (8) Remove the right headlight crossmember assembly.
- (9) Remove the left headlight crossmember assembly.
- (10) Remove cooler upper bracket assembly.
- (11) Drain the coolant.
- (12) Recover the refrigerant.

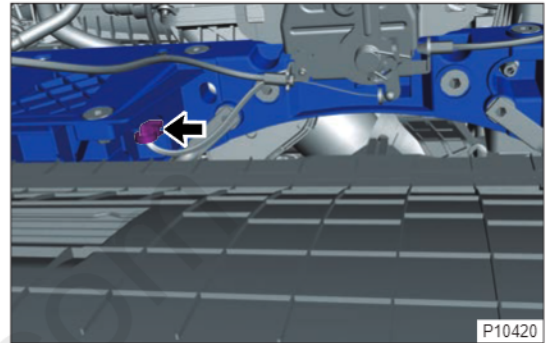
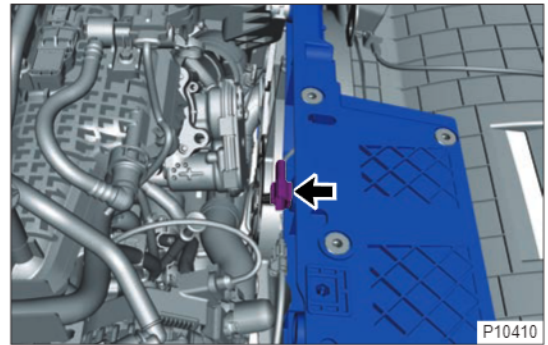
- (13) Remove 2 fixing bolts from microwave radar bracket.



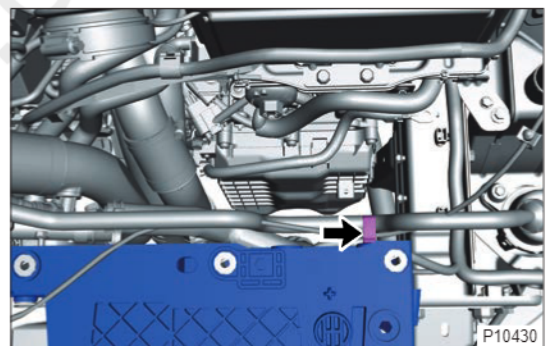
- (14) Disengage 4 clips of interior floor wire harness from lower support beam and remove the microwave radar assembly.



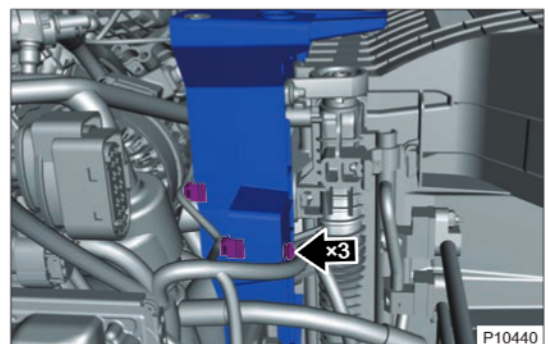
- (15) Disconnect the engine hood lock connector.
Disengage the connecting wire harness clip from front plastic end.



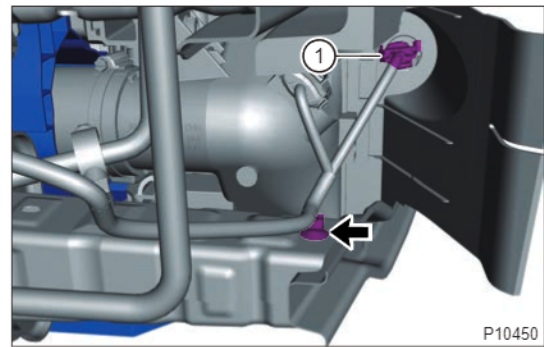
- (16) Disengage 1 fixing clip of engine hood lock cable from front plastic end, and remove the engine hood lock assembly.



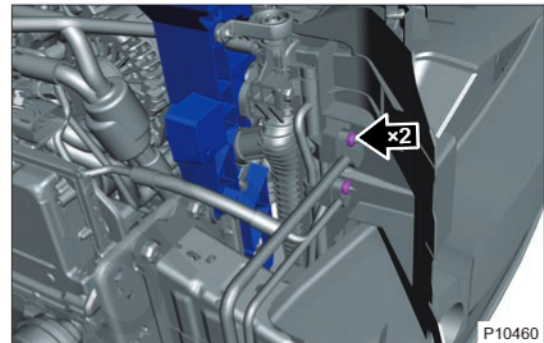
- (17) Disengage 3 clips of interior floor wire harness from front plastic end. Disengage the front bumper wire harness connector from front upper impact beam assembly.



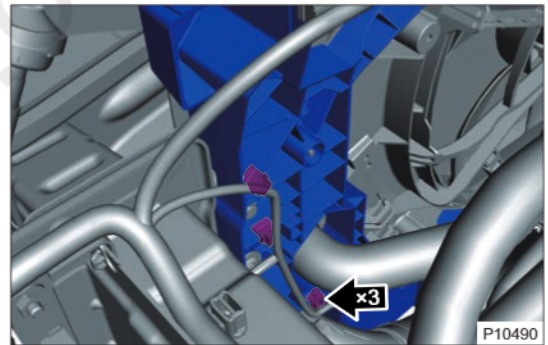
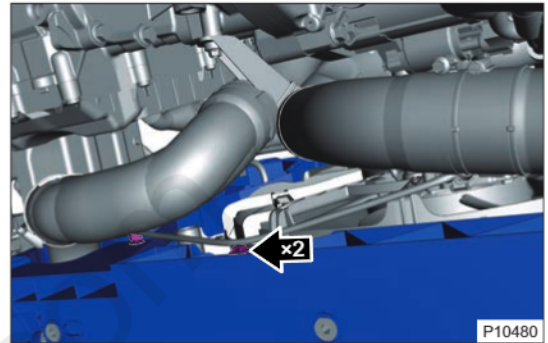
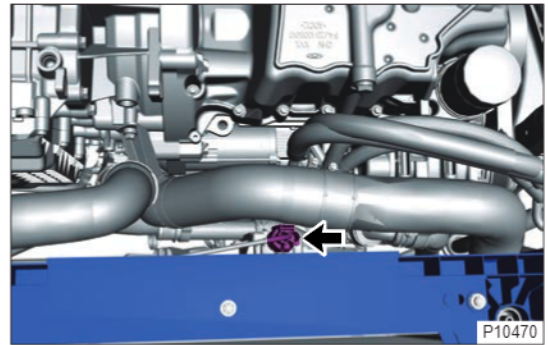
- (18) Remove the outside temperature sensor (1) from right air deflector assembly and disconnect the connector wire harness fixing clip.



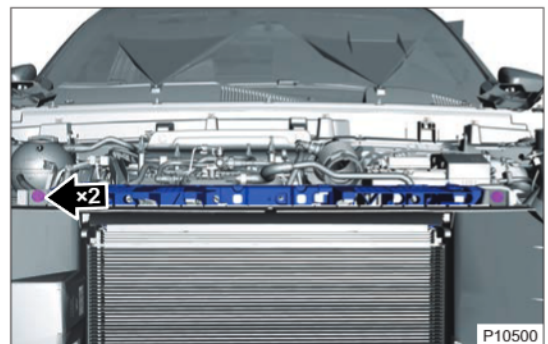
- (19) Disconnect the condenser pipeline.



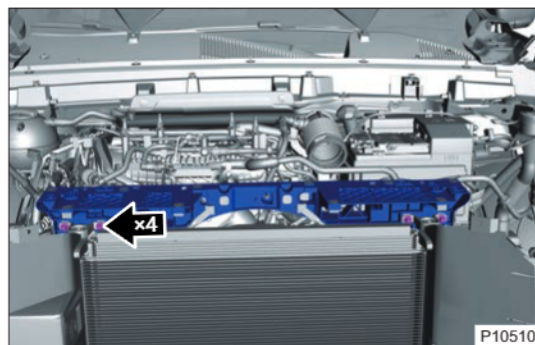
- (20) Disconnect the cooling fan module connector and disconnect 5 fixing clips from connector wire harness.



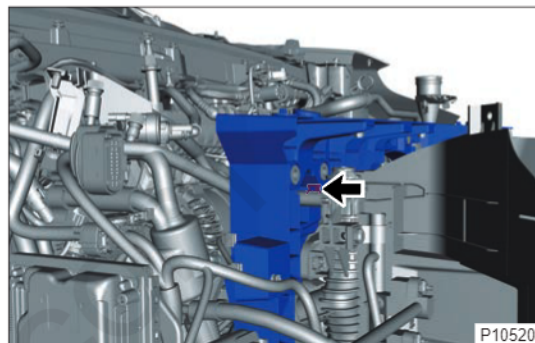
- (21) Remove the fixing clips on both sides of air deflector and remove the upper air deflector assembly.



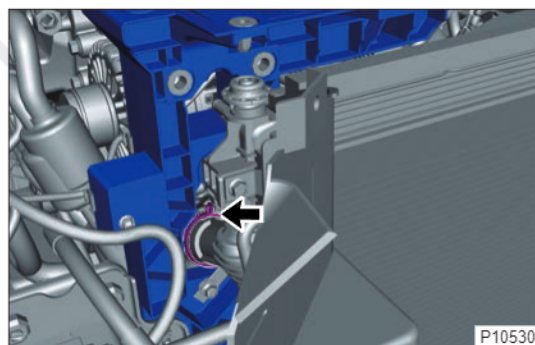
- (22) Remove 4 fixing bolts from left and right side of radiator and remove the mounting bracket.



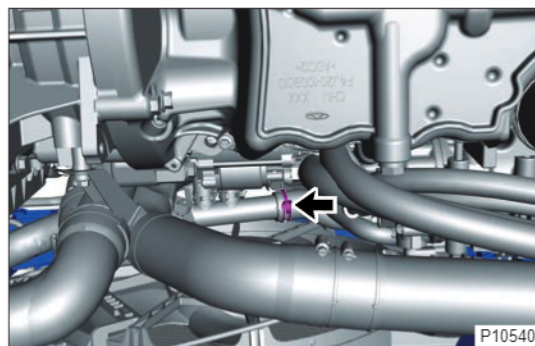
- (23) Loosen elastic clamp and disconnect the connection between radiator discharge pipe and radiator assembly.



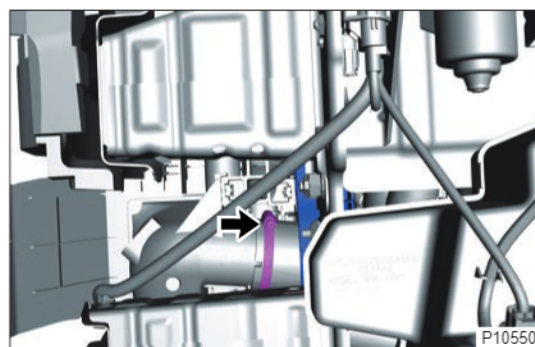
- (24) Loosen elastic clamp and disconnect the connection between engine outlet pipe assembly - front and radiator assembly.



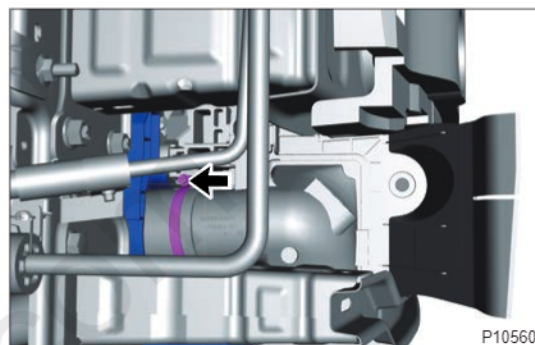
- (25) Loosen elastic clamps and disconnect the connection between engine inlet pipe - rear and engine inlet pipe - front.



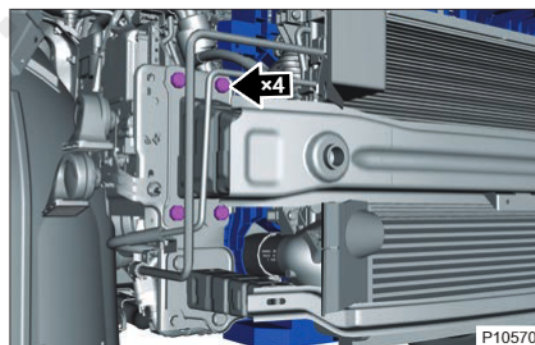
- (26) Loosen worm clamp and disconnect the connection between intercooler inlet pipe III and intercooler.



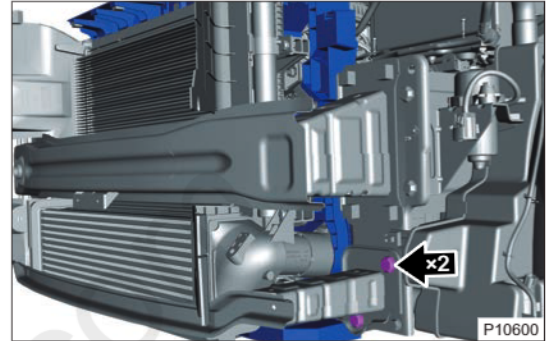
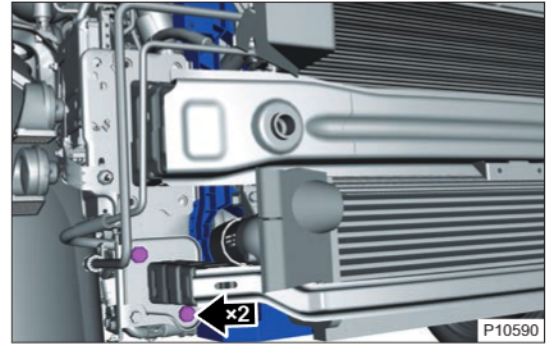
- (27) Loosen worm clamp and disconnect the connection between intercooler outlet pipe I and intercooler.



- (28) Remove 8 fixing nuts from front upper impact beam.



(29) Remove 4 fixing bolts from lower support beam.

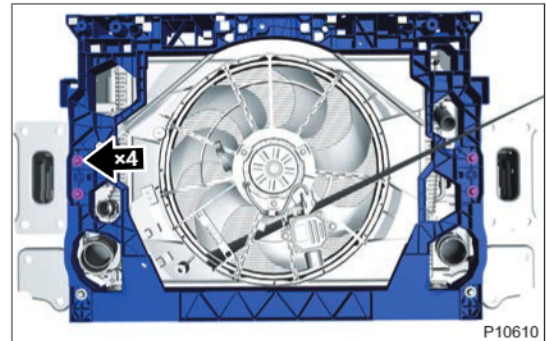


(30) Remove the front end structure assembly carefully.

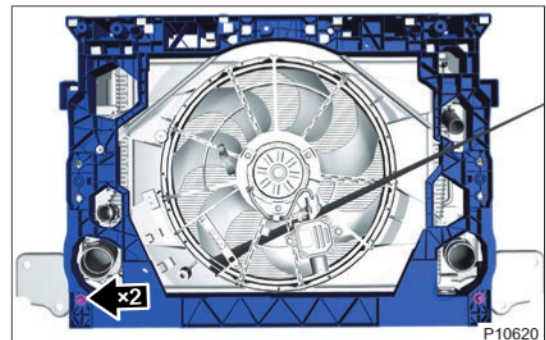
⚠ Caution

- Because the front end structure assembly is heavy, it needs to be removed carefully with the cooperation of many people, and be careful when operating to avoid accidents.

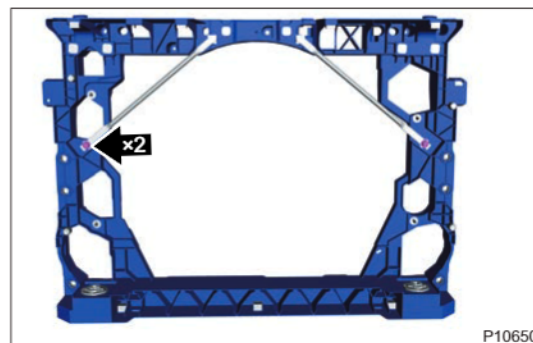
(31) Remove 4 fixing bolts between front upper impact beam assembly and front plastic end.



(32) Remove 2 fixing bolts between lower support beam assembly and front plastic end.



- (33) Remove the front plastic end assembly carefully.
Remove 2 fixing bolt from front left/right end bracket reinforcement lever.



■ Installation

- (1) Install 2 fixing bolts to front left/right end bracket reinforcement lever.
- (2) Install 2 bolts between lower support beam assembly and front plastic end.
- (3) Install 4 bolts between front upper impact beam assembly and front plastic end.
- (4) Align the front upper impact beam mounting hole with left/right side rail stud, and fix 8 nuts.

Torque: $38 \pm 3.8 \text{ N}\cdot\text{m}$

- (5) Connect intercooler pipeline.
- (6) Connect radiator pipeline.
- (7) Install 4 fixing bolts to radiator mounting bracket.

Torque: $12 \pm 1 \text{ N}\cdot\text{m}$

- (8) Install the upper air deflector.
- (9) Fix each wire harness/connector.
- (10) Connect the cooling fan module connector.
- (11) Install the outside temperature sensor.
- (12) Install the condenser pipeline.
- (13) Install 2 fixing bolts to microwave radar bracket.
- (14) Install cooler upper bracket assembly.
- (15) Install the left and right headlight crossmember assembly separately.
- (16) Install the left and right headlight assembly separately.
- (17) Install the front bumper assembly.
- (18) Install the A/C filter assembly.
- (19) Add the coolant.
- (20) Vacuum pumping/refrigerant recharging
- (21) Install the engine compartment trim cover assembly.

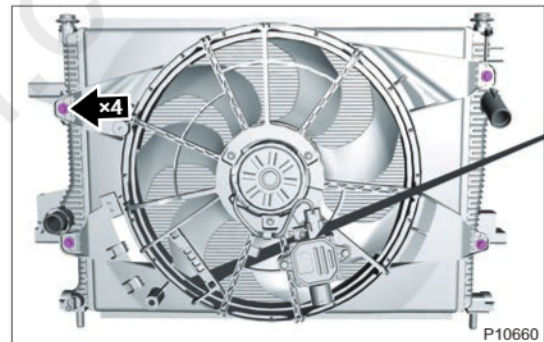
5.10 Radiator Assembly

■ Removal

⚠ Warning

- Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.
- Be sure to wear safety equipment to prevent accidents, when removing radiator assembly.
- Appropriate force should be applied, when removing the radiator assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the front bumper assembly.
- (6) Remove the right headlight assembly.
- (7) Remove the left headlight assembly.
- (8) Remove the right headlight crossmember assembly.
- (9) Remove the left headlight crossmember assembly.
- (10) Remove cooler upper bracket assembly.
- (11) Drain the coolant.
- (12) Recover the refrigerant.
- (13) Remove the plastic structure assembly.
- (14) Remove the front upper impact beam assembly.
- (15) Remove the lower support beam assembly.
- (16) Remove the front plastic end assembly.
- (17) Remove the left air deflector assembly.
- (18) Remove the right air deflector assembly.
- (19) Remove the intercooler assembly.
- (20) Remove 4 fixing bolts from cooling fan assembly and radiator assembly, and remove cooling fan assembly.



■ Inspection

- (1) Appearance inspection: Radiator is not allowed to be impacted and damaged, the fins are not allowed to be lodged and deformed. No residue is allowed inside the assembly and its section should smooth and flat.
- (2) Sealing inspection: Block water inlet and water outlet with expansion rubber plug, inject 30 - 80 KP compressed air to radiator. Soak radiator assembly into water tank, if there are bubbles, it indicates there is leakage in radiator assembly.

■ Installation

- (1) Remove 4 fixing bolts to cooling fan assembly.

Torque: 5 ± 1 N·m

- (2) Install the intercooler assembly.
- (3) Install the front plastic end assembly.
- (4) Install the left and right air deflector assembly.
- (5) Install the lower support beam assembly.
- (6) Install the front upper impact beam assembly.
- (7) Install the front end structure assembly.
- (8) Install cooler upper bracket assembly.
- (9) Install the left and right headlight crossmember assembly separately.
- (10) Install the left and right headlight assembly separately.
- (11) Install the front bumper assembly.
- (12) Install the A/C filter assembly.
- (13) Add the coolant.
- (14) Vacuum pumping/refrigerant recharging
- (15) Install the engine compartment trim cover assembly.

5.11 Cooling Fan Assembly

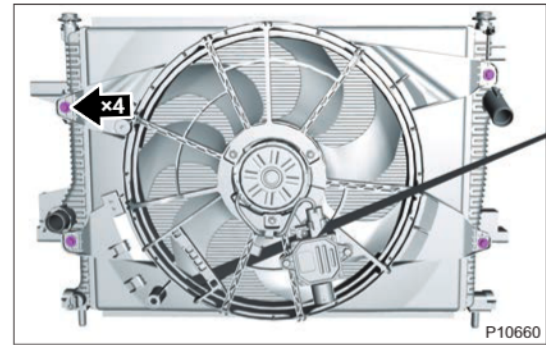
■ Removal

Warning

- **Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.**
- **Be sure to wear safety equipment to prevent accidents, when removing cooling fan assembly.**
- **Appropriate force should be applied, when removing cooling fan assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the front bumper assembly.
- (6) Remove the right headlight assembly.
- (7) Remove the left headlight assembly.
- (8) Remove the right headlight crossmember assembly.
- (9) Remove the left headlight crossmember assembly.
- (10) Remove cooler upper bracket assembly.
- (11) Drain the coolant.
- (12) Recover the refrigerant.
- (13) Remove the plastic structure assembly.
- (14) Remove the front upper impact beam assembly.
- (15) Remove the lower support beam assembly.
- (16) Remove the front plastic end assembly.
- (17) Remove the left air deflector assembly.
- (18) Remove the right air deflector assembly.
- (19) Remove the intercooler assembly.

- (20) Remove 4 fixing bolts from cooling fan assembly and radiator assembly, and remove cooling fan assembly.



■ Installation

- (1) Remove 4 fixing bolts to cooling fan assembly.

Torque: $5 \pm 1 \text{ N}\cdot\text{m}$

- (2) Install the intercooler assembly.
- (3) Install the front plastic end assembly.
- (4) Install the left and right air deflector assembly.
- (5) Install the lower support beam assembly.
- (6) Install the front upper impact beam assembly.
- (7) Install the front end structure assembly.
- (8) Install cooler upper bracket assembly.
- (9) Install the left and right headlight crossmember assembly separately.
- (10) Install the left and right headlight assembly separately.
- (11) Install the front bumper assembly.
- (12) Install the A/C filter assembly.
- (13) Add the coolant.
- (14) Vacuum pumping/refrigerant recharging
- (15) Install the engine compartment trim cover assembly.

5.12 Water Pump Module Assembly

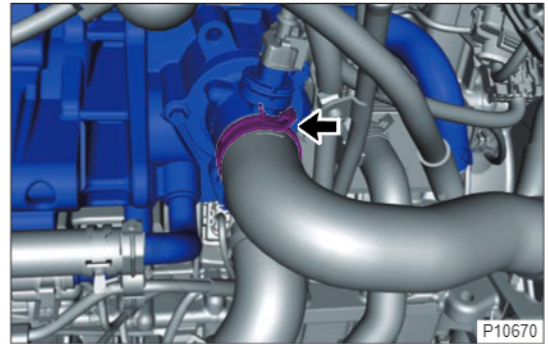
■ Removal

⚠ Warning

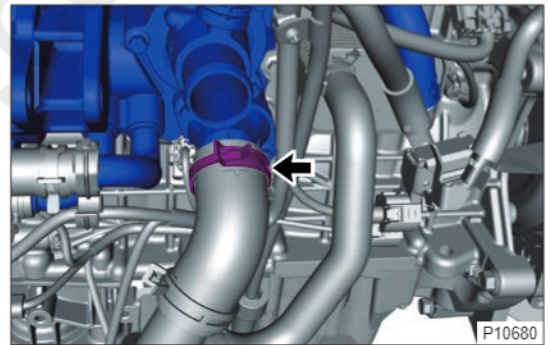
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear necessary safety equipment to prevent accidents, when removing water pump module.
- Appropriate force should be applied when removing water pump module. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine compartment lower protector assembly.
- (5) Remove the engine accessory belt.
- (6) Drain the coolant.
- (7) Remove the alternator assembly.
- (8) Remove the oil dipstick tube assembly.

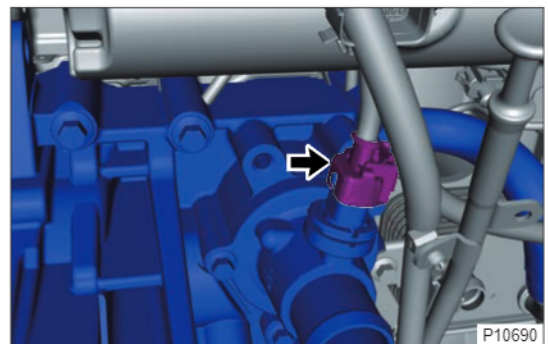
- (9) Loosen the elastic clamp and disconnect the connection between water pump module assembly and engine inlet pipe.



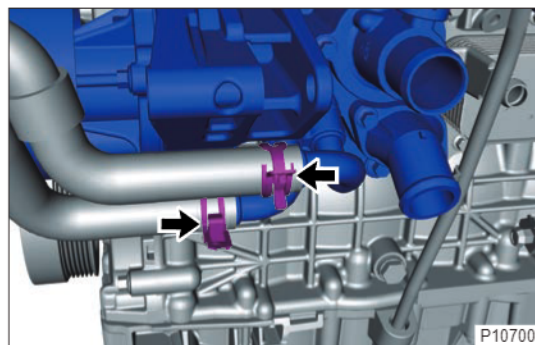
- (10) Loosen elastic clamp and disconnect connection between water pump module assembly and engine outlet pipe.



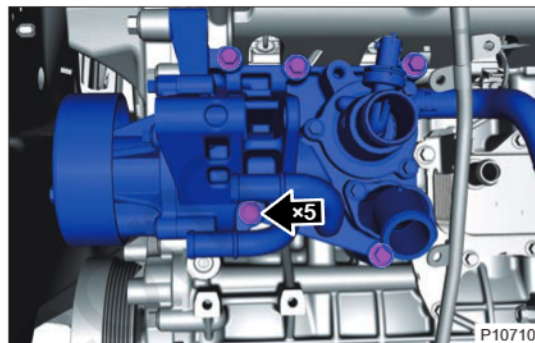
- (11) Disconnect the electronic thermostat connector.



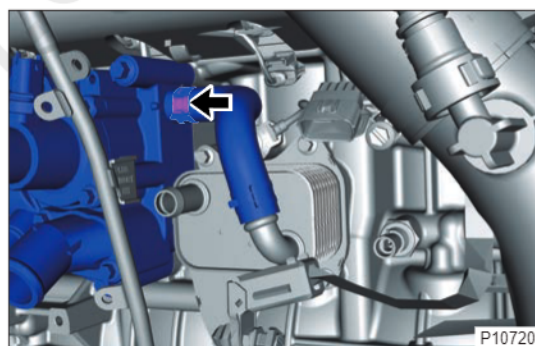
- (12) Loosen elastic clamp and disconnect connection between water pump module assembly and inlet pipe.



- (13) Remove 5 fixing bolts from water pump module.



- (14) Loosen clamping ring and disconnect connection between water pump module assembly and oil filter module inlet pipe.



- (15) Remove water pump module assembly carefully.

■ Installation

- (1) Connect the oil filter module inlet pipe to water pump module, and tighten the clamping ring.
- (2) Install the water pump module assembly to cylinder block installation surface, and install 5 bolts at the corresponding positions, first pretighten the water pump module so that it can be pressed tightly, and then tighten it to the specified torque.

Torque: 20 + 5 N•m

- (3) Connect the inlet pipe to water pump module, and install elastic clamp.
- (4) Connect the engine outlet pipe to water pump module, and install elastic clamp.
- (5) Connect the engine inlet pipe to water pump module, and install elastic clamp.
- (6) Connect the electronic thermostat connector.
- (7) Install the oil dipstick tube assembly.
- (8) Install the alternator assembly.
- (9) Add the coolant.

5.13 Electronic Thermostat Assembly

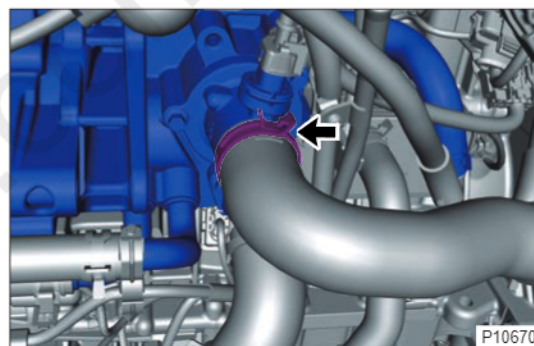
■ Removal

Warning

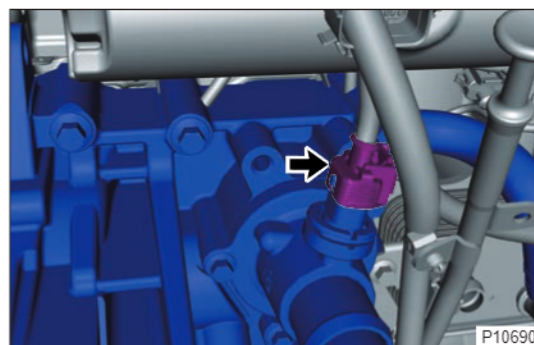
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear necessary safety equipment to prevent accidents, when removing water pump module.
- Appropriate force should be applied when removing water pump module. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.

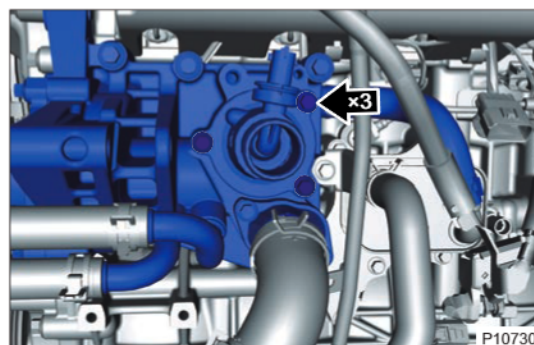
- (5) Loosen the elastic clamp and disconnect the connection between water pump module assembly and engine inlet pipe.



- (6) Disconnect the electronic thermostat connector.



- (7) Remove 3 fixing bolts from electronic thermostat.



- (8) Remove the electronic thermostat.

■ Inspection

- (1) Check electronic thermostat assembly grommet for damage.
- (2) As shown in illustration, check the electronic thermostat heating resistance with ohm band of multimeter.

Multimeter Connection	Specified value (Ω)
Terminal 1 - Terminal 2	15.3



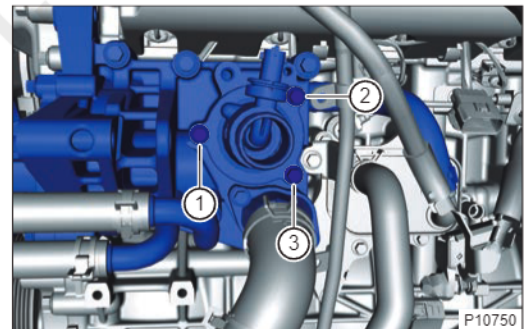
⚠ Caution

- If resistance is not as specified, replace the electronic thermostat.

■ Installation

- (1) Install the electronic thermostat to water pump module, pre-install 3 fixing bolts and tighten them with tool, then tighten them in the order shown in illustration (1-2-3-1).

Torque: 8 + 3 N·m



- (2) Connect the engine inlet pipe to water pump module, and install elastic clamp.
- (3) Connect the electronic thermostat connector.
- (4) Add the coolant.

5.14 Engine Outlet Port Cover Assembly

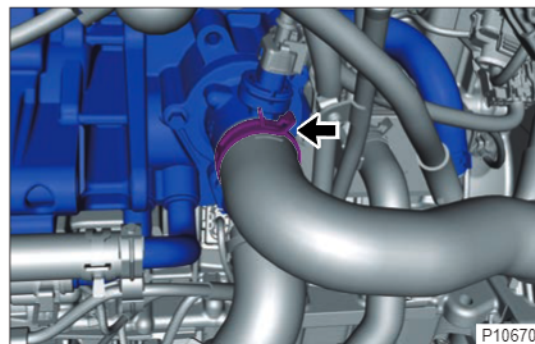
■ Removal

⚠ Warning

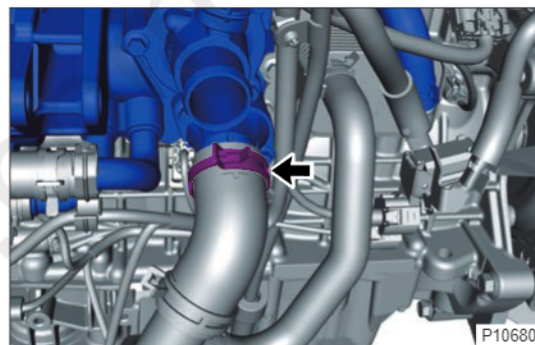
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear safety equipment to prevent accidents, when removing engine outlet port cover.
- Appropriate force should be applied, when removing engine outlet port cover. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.

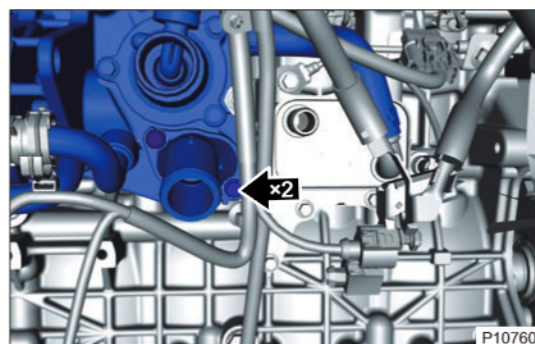
- (5) Loosen the elastic clamp and disconnect the connection between water pump module assembly and engine inlet pipe.



- (6) Loosen elastic clamp and disconnect connection between water pump module assembly and engine outlet pipe.



- (7) Remove 2 fixing bolts from engine outlet port cover.



- (8) Remove the engine outlet port cover.

■ Inspection

- (1) Check engine outlet port cover grommet for damage.
- (2) Install the grommet to engine outlet port cover and check if it is installed in place.

■ Installation

- (1) Install engine outlet port cover to water pump module, pretighten 2 fixing bolts and then tighten them.

Torque: 8 + 3 N•m

- (2) Connect the engine outlet pipe to water pump module, and install elastic clamp.
- (3) Connect the engine inlet pipe to water pump module, and install elastic clamp.
- (4) Add the coolant.
- (5) Install the engine compartment trim cover assembly.

5.15 Coolant Temperature Sensor

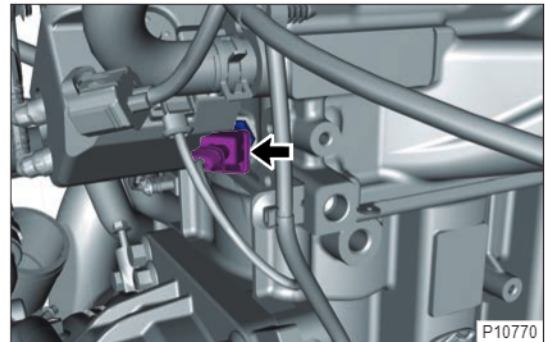
■ Removal

⚠ Warning

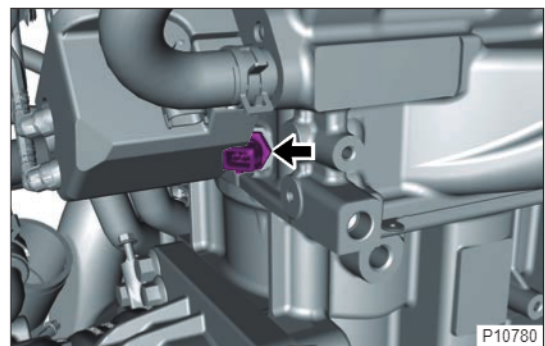
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear necessary safety equipment to prevent accidents, when removing coolant sensor | .
- Appropriate force should be applied when removing coolant temperature sensor | . Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the intake hose assembly.
- (5) Remove inter-cooling intake pipe II .
- (6) Drain the coolant.

- (7) Disconnect the coolant temperature sensor connector.



- (8) Remove the coolant temperature sensor.



■ Installation

- (1) Install the coolant temperature sensor.

Torque: 15 ± 1 N·m.

Seal gum: Loctite 577

- (2) Connect the coolant sensor connector.
- (3) Install intercooler inlet pipe II.
- (4) Install the intake hose assembly.
- (5) Add the coolant.
- (6) Install the engine compartment trim cover assembly.

5.16 Coolant Temperature Sensor

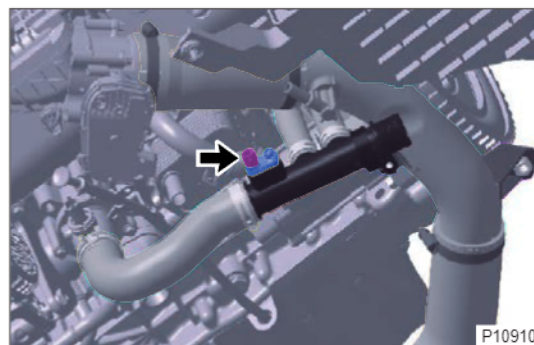
■ Removal

⚠ Warning

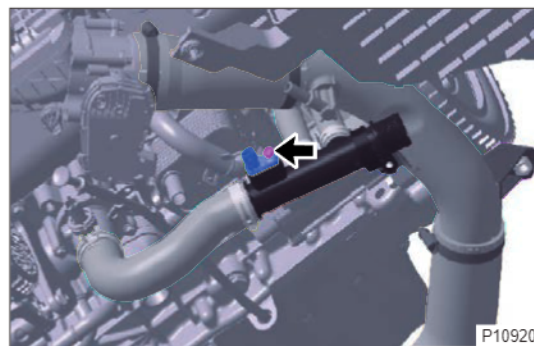
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear necessary safety equipment to prevent accidents, when removing coolant sensor II.
- Appropriate force should be applied when removing coolant temperature sensor II. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.

- (5) Disconnect the coolant temperature sensor connector.



- (6) Remove 1 fixing bolt of coolant temperature sensor from engine inlet pipe.



- (7) Remove the coolant temperature sensor carefully.

■ Installation

- (1) Install the coolant temperature sensor.

Torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$

- (2) Connect the coolant temperature sensor connector.
- (3) Add the coolant.
- (4) Install the engine compartment trim cover assembly.

5.17 Rear Heater Outlet Pipe Assembly | (If equipped with rear heater)

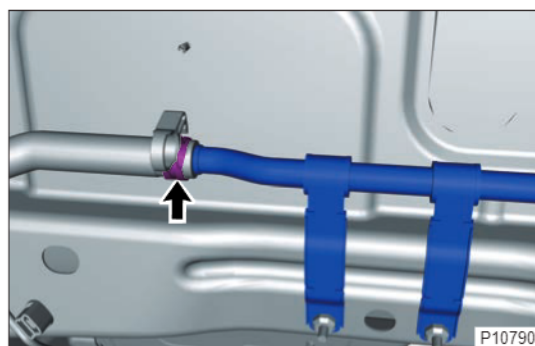
■ Removal

⚠ Warning

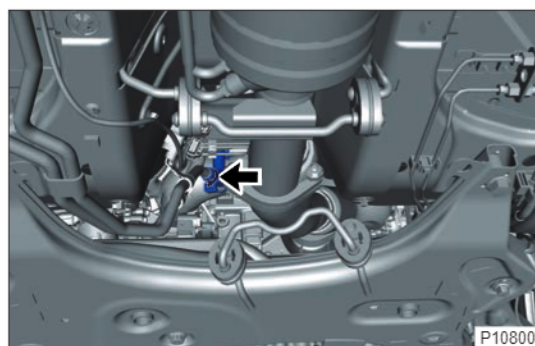
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear safety equipment to prevent accidents, when removing rear heater outlet pipe assembly.
- Appropriate force should be applied, when removing rear heater outlet pipe assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.

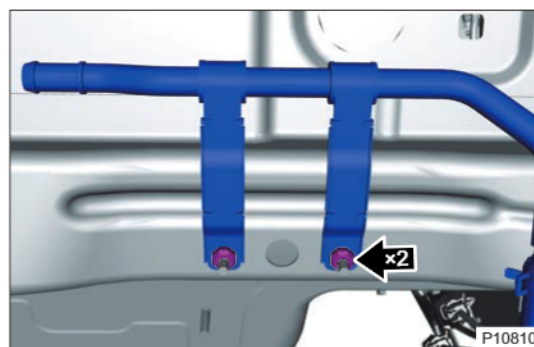
- (5) Loosen elastic clamps and disconnect the connection between inlet pipe and rear heater outlet pipe.



- (6) Loosen elastic clamps and disconnect the connection between rear heater inlet / outlet pipe II and rear heater outlet pipe.



- (7) Remove 2 fixing nuts from rear heater outlet pipe.



- (8) Remove the rear heater outlet pipe assembly carefully.

■ Installation

- (1) Install 2 fixing nuts to rear heater outlet pipe.
- (2) Connect the rear heater inlet and outlet pipe II to rear heater outlet pipe and install elastic clamp.
- (3) Connect the inlet pipe to rear heater outlet pipe and install elastic clamps.
- (4) Add the coolant.
- (5) Install the engine compartment trim cover assembly.

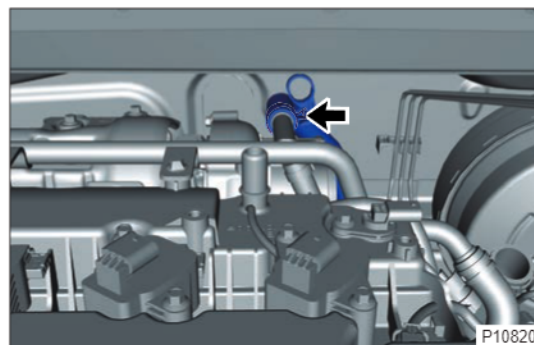
5.18 Rear Heater Inlet and Outlet Pipe Assembly II (If equipped with rear heater)

■ Removal

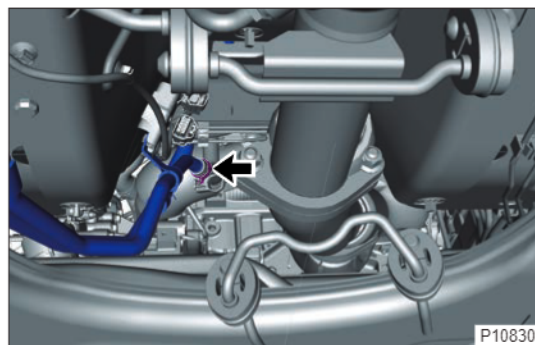
⚠ Warning

- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear safety equipment to prevent accidents, when removing rear heater inlet and outlet pipe assembly II.
- Appropriate force should be applied, when removing rear heater inlet and outlet pipe assembly II. Be careful not to operate roughly.

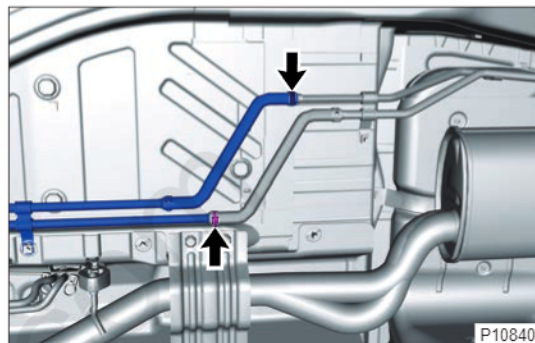
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.
- (5) Loosen elastic clamps and disconnect the connection between heater inlet pipe I and rear heater inlet and outlet pipe II.



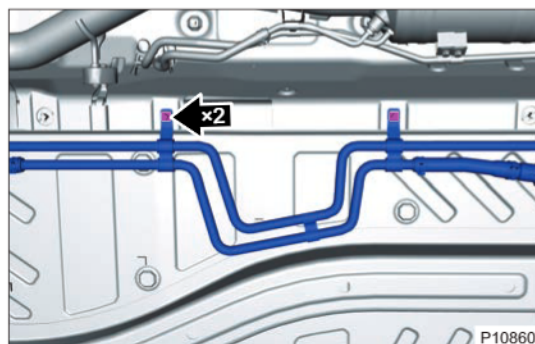
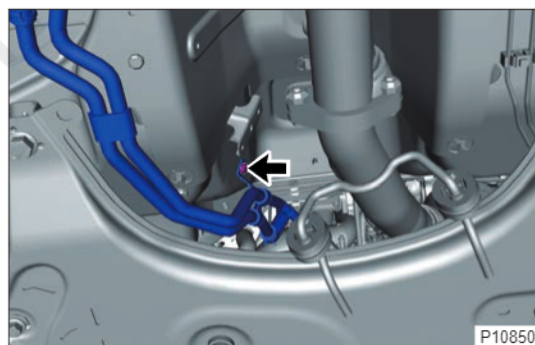
- (6) Loosen elastic clamps and disconnect the connection between heater outlet pipe and rear heater inlet and outlet pipe II.



- (7) Loosen elastic clamps and disconnect the connection between rear heater inlet/outlet pipe III and rear heater inlet/outlet pipe II.



- (8) Remove 3 fixing nuts from rear heater inlet and outlet pipe II.



- (9) Remove the rear heater inlet and outlet pipe assembly carefully.

■ Installation

- (1) Install 3 fixing nuts to rear heater inlet and outlet pipe II.
- (2) Connect rear heater inlet and outlet pipe III to rear heater inlet and outlet pipe II and install elastic clamp.
- (3) Connect heater outlet pipe to rear heater inlet and outlet pipe and install elastic clamp.
- (4) Connect heater inlet pipe I to rear heater inlet and outlet pipe II and install elastic clamp.
- (5) Add the coolant.
- (6) Install the engine compartment trim cover assembly.

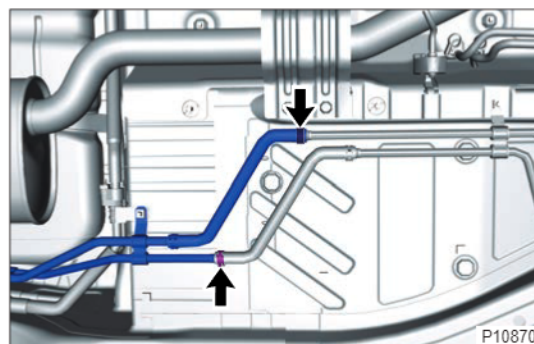
5.19 Rear Heater Inlet and Outlet Pipe Assembly III (If Equipped with Rear Heater)

■ Removal

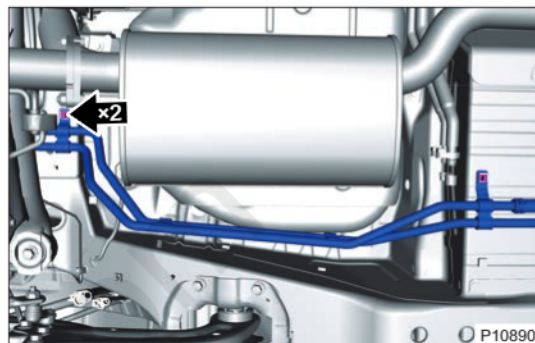
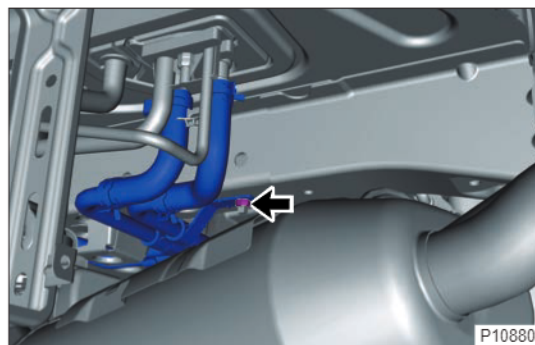
⚠ Warning

- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear safety equipment to prevent accidents, when removing rear heater inlet and outlet pipe assembly III.
- Appropriate force should be applied, when removing rear heater inlet and outlet pipe assembly III. Be careful not to operate roughly.

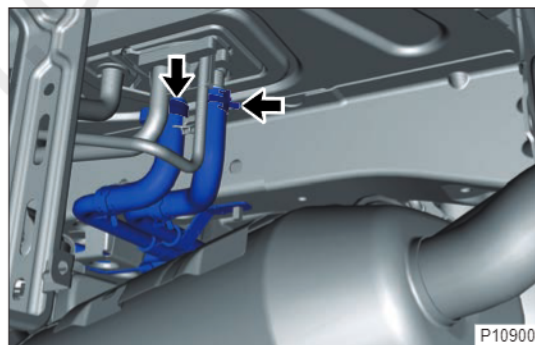
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Drain the coolant.
- (5) Loosen elastic clamps and disconnect the connection between rear heater inlet/outlet pipe II and rear heater inlet/outlet pipe III.



- (6) Remove 3 fixing nuts from rear heater inlet and outlet pipe III.



- (7) Loosen elastic clamps and disconnect the connection between rear HVAC assembly and rear heater inlet/outlet pipe III.



- (8) Remove the rear heater inlet and outlet pipe assembly carefully.

■ Installation

- (1) Install 3 fixing nuts to rear heater inlet and outlet pipe III.
- (2) Connect HVAC assembly to rear heater inlet and outlet pipe III and install elastic clamp.
- (3) Connect heater inlet/outlet pipe II to rear heater inlet/outlet pipe III and install elastic clamp.
- (4) Add the coolant.
- (5) Install the engine compartment trim cover assembly.

4.8 LUBRICATION SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Prolonged and repeated contact with engine oil will result in the removal of natural oils from skin, leading to dryness, irritation and dermatitis. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer.
- (2) Wear protective clothing and gloves.
- (3) Wash your skin thoroughly with soap and water, or use waterless hand cleaner to remove any used engine oil.
- (4) Never use gasoline, thinners or solvents.
- (5) Before performing the operation. Wait for the engine to cool down completely.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

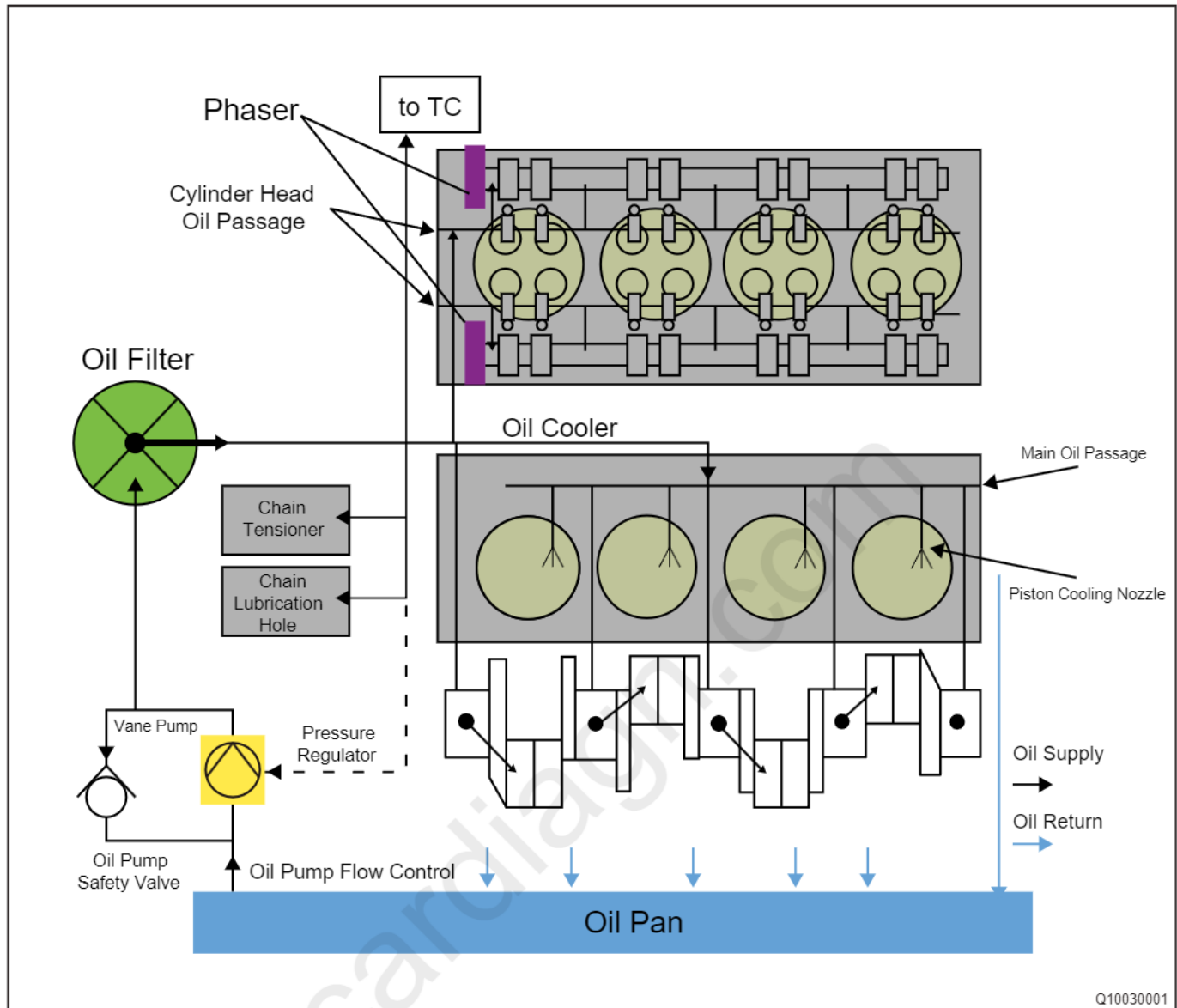
- (1) Wasted engine oil should be handled by specialized department according to local laws and regulations. Never discard it at will.
- (2) DO NOT use inferior engine oil.
- (3) DO NOT mix different types of engine oil.

2 System Overview

2.1 System Description

When engine is operating, an oil pump driven by crankshaft chain, sucks oil from oil pan and pumps it at pressure through an oil filter. This filtered oil then flows through oil passages, to moving surfaces of all engine drive parts and forms oil films between moving surfaces to reduce friction and finally returns to the oil pan, thus reducing friction resistance between drive parts, power consumption and increasing reliability and durability of engine operation. Oil pump of SQR4J20 engine is installed in oil pan. Crankshaft transmits power to it through chain. Oil pump is a two-stage variable displacement pump, the oil pressure adjustment solenoid valve is controlled by the ECU to change the displacement.

2.2 System Schematic Diagram



Crankshaft drives oil pump to suck oil from oil pan. The oil is filtered by oil filter and delivered to crankshaft connecting rod mechanism and cam valve mechanism, including some accessories such as turbocharger through main oil passage.

2.3 System Components Description

■ Oil Pump Assembly

Oil pump of SQR4J20 engine is installed in oil pan. Crankshaft transmits power to it through chain. Oil pump is a two-stage variable displacement pump, and its displacement is controlled by ECU through oil pressure regulating solenoid valve. Oil pump adopts vane type variable displacement structure, and main structure is stator and rotor; There are two oil pressure chambers on the outer ring of stator to apply pressure control to the stator, so that it can deflect clockwise or counterclockwise around the fulcrum, changing the eccentricity ratio of vane pump and adjusting displacement.

■ Oil Cooler Assembly

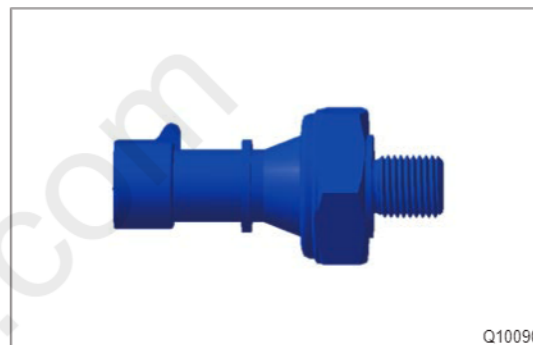
Oil cooler is on the circulation oil passage of lubrication system. During engine running, as oil viscosity becomes lean with temperature increasing, lubricating ability is reduced. Oil cooler is used to cool the lubricant, keep the oil temperature within normal operating range, reduce oil temperature and maintain a certain viscosity of lubricant.



Q10080

■ Oil Pressure Switch

Oil pressure switch is installed on the main oil passage of engine block and used to detect the value of engine oil pressure. When the value is lower than the specified value, oil pressure warning light is turned on.



Q10090

■ Oil Filter

It is used to remove impurities such as dust, metal particles, carbon deposits and soot particles in oil to protect the engine.



Q10100

■ Oil Collector

In order to make oil pump work well, filter large particle impurities in lubricant before entering oil pump.

3 DIAGNOSIS & TESTING

3.1 Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Lubrication System

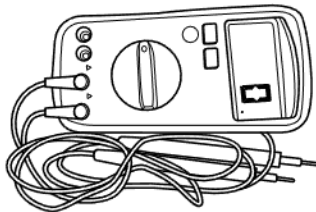
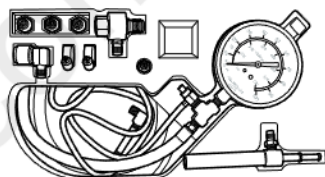
Symptom	Possible Cause
Low pressure in lubrication system	Oil pan (dirty, leaky)

Symptom	Possible Cause
	Oil collector (mesh dirty, blocked)
	Spark plug
	Line blocked
High pressure in lubrication system	Oil with high viscosity
	Oil passage blocked
	Oil pump (non-variable displacement)
Mix oil with water	Oil filter module assembly internal leakage
	Cylinder head gasket improperly sealed
	Cylinder block cracks
High oil consumption	Engine oil (excessive filling capacity)
	Oil filter module assembly (leaky)
	Crankshaft front oil seal (damaged)
	Crankshaft rear oil seal (damaged)
	Oil pressure switch (leaky)
	Oil drain plug (leaky)
	Oil pan (leaked)
	Cylinder head gasket (damaged)
	Piston ring (damaged)
	Each engine seal surface leakage
Oil pressure warning light comes on	Engine oil (insufficient oil, low oil viscosity)
	Oil filter element (blocked)
	Oil strainer (blocked)
	Crankshaft front oil seal (damaged)
	Crankshaft rear oil seal (damaged)
	Oil pressure switch (damaged)
	Instrument cluster (oil pressure warning light)
	Cylinder block (cracks occur in water jacket, resulting in coolant leaking into oil pan, which will cause oil dilution)
	Line (blocked)

4 ON-VEHICLE SERVICE

4.1 Tool

■ General Tool

Tool Name	Tool Drawing
Digital Multimeter	 S00002
Oil Pressure Tester	 S00035

■ Lubrication Areas on Engine

No.	Lubrication Area	Lubricant Type	Note
1	Oil Collector O-ring	Same type as engine oil	
2	Oil Filter O-ring	Same type as engine oil	Operation during maintenance
4	Dipstick Tube O-ring	Same type as engine oil	
5	Dipstick Handle O-ring	Same type as engine oil	
6	Oil Pump Rotor Cavity	Same type as engine oil	
7	Oil Filter Inlet Port	Same type as engine oil	

■ Seal Gum Application Areas on Engine

No.	Area with Seal Gum Applied	Seal Gum Type	Note
1	Mounting Flange Face between Oil Pan and Cylinder Block, Timing Chain Cover	Loctite 5900H	
2	Oil Pressure Switch Thread	Loctite 577	
3	Oil Pump Mounting Bolt	Loctite 243	
4	Collector Mounting Bolt	Loctite 243	
5	Oil Cooler Mounting Bolt	Loctite 243	

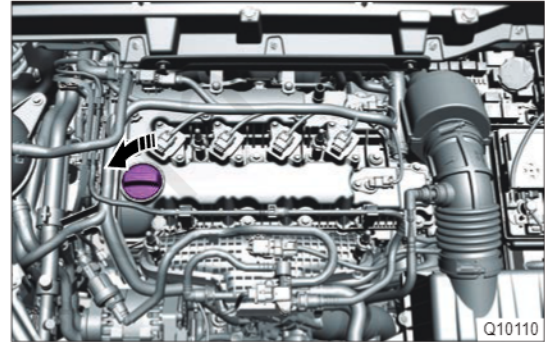
4.2 Engine Oil Draining, Adding and Inspection

■ Engine Oil Draining

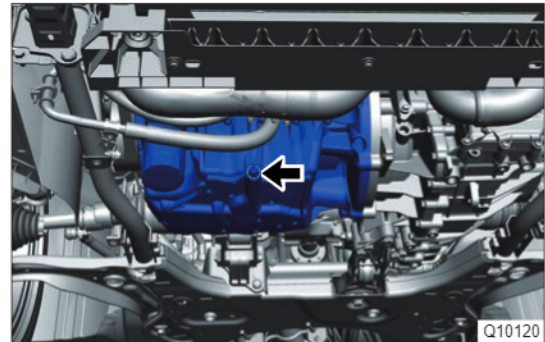
Warning

- Wait for the engine cool down completely before operation.
- Prolonged and repeated contact with engine oil will result in the removal of natural oils from skin, leading to dryness, irritation and dermatitis. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service. Be sure to take appropriate skin protection measures.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the engine compartment trim cover assembly.
- (4) Turn the oil filler door counterclockwise to open.



- (5) Raise the vehicle to a proper position.
- (6) Remove drain plug (17# socket wrench) and drain the oil into a container.



Caution

- Apply a certain pushing force to drain plug while loosening the plug by hand, and have the drain plug attached to thread tightly to prevent oil from overflowing in advance. Move away your hand quickly to prevent burn by oil with a certain temperature.
- Wasted engine oil should be handled by specialized department according to local laws and regulations. Never discard it at will.

- (7) Wipe off the drain plug and tighten it.

Torque: $35 \pm 3 \text{ N}\cdot\text{m}$

Caution

- The drain plug gasket must be replaced each time the drain plug is removed.

■ Engine Oil Adding

⚠ Caution

- **DO NOT** use inferior engine oil.
- **DO NOT** mix different types of engine oil.
- **Be careful not to spill engine oil on any part of the engine when adding engine oil.**

(1) It is recommended to add lubricant to upper center of dipstick, there are several situations:

	Engine Status	Recommended Value
Charging Capacity	Status without oil (apply to the first adding after assembling such as engine production and major maintenance)	4.6 ± 0.2
	Replace oil filter assembly and lubricant at same time	3.8 ~ 4.1
	Do not replace oil filter assembly, only replace lubricant	3.5 ± 0.2
Oil Type	C5 0W - 20	
Others	1. If lubricant needs to be added during maintenance, it is recommended to add to upper center of dipstick measurement part. 2. Do not exceed upper line of dipstick while adding lubricant, or it will affect the engine performance.	

(2) Start engine, and check the vehicle for leakage after replacing oil.

■ Inspection Method of Lubricant Level

- (1) Park the vehicle in a relatively horizontal position.
- (2) Keep engine running at least 2 minutes and leave is stopped for 3 ~ 5 minutes.
- (3) Pull out the dipstick, wipe off the measurement part and insert it into dipstick tube, then leave it for 3 ~ 5 s.
- (4) Pull out the dipstick steady and place the measurement part horizontally. Visually check that oil level of measurement part is within upper mark and lower mark, it indicates oil level is normal.

⚠ Caution

- **Do not start the engine during the measurement.**

4.3 Oil Filter

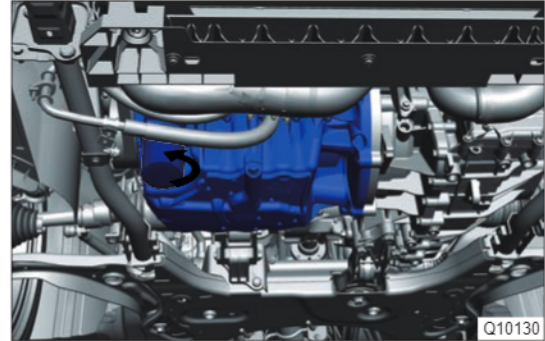
■ Removal

⚠ Warning

- **DO NOT** remove oil filter until engine cools down, avoiding being burned by high temperature lubricant and parts.
- **Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the engine lower protector assembly.
- (4) Drain engine oil.

- (5) Use a special tool to rotate counterclockwise until the oil filter is removed.



- (6) After oil filter is removed, there may be remaining oil in the oil filter. After removal it, the oil filter port should be upward, and dispose of used oil filter in an environmentally friendly way.

■ Installation

⚠ Caution

- Before installation, check whether there is any foreign matter on the installation surface of oil pan, such as the seal ring of used oil filter.
- Check oil filter seal ring for defect or foreign matter. When assembling, seal ring needs to be lubricated.

- (1) Re-tighten the pipe joint with tool.

Torque: $50 \pm 5 \text{ N}\cdot\text{m}$

- (2) Clean the mounting surface of oil filter, add a proper amount (recommended: 5 mL) of oil to oil filter, and evenly coat a little lubricant on the seal ring of the oil filter mounting surface.

- (3) Manually install the oil filter until the seal ring is in contact with the mounting surface, and then use a special wrench tool to rotate and tighten.

Torque: $22 \sim 25 \text{ N}\cdot\text{m}$

- (4) After installation, add lubricant to engine according to the recommended.

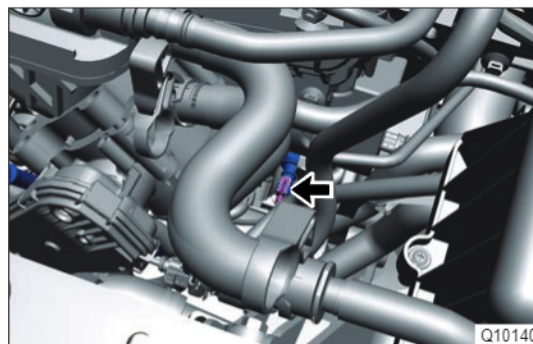
4.4 Oil Pressure Switch

■ Removal

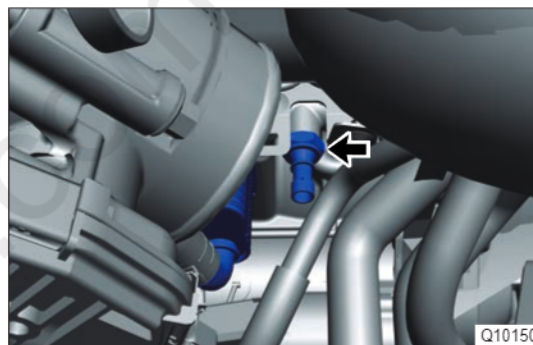
⚠ Caution

- DO NOT remove oil pressure switch until engine cools down, avoiding being burnt by high temperature lubricant and parts.
- Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover.
- (3) Disconnect the negative battery cable.
- (4) Disconnect the connection between intercooler outlet pipe assembly II and electronic throttle.
- (5) Disconnect the oil pressure switch connector.



- (6) Remove the oil pressure switch.

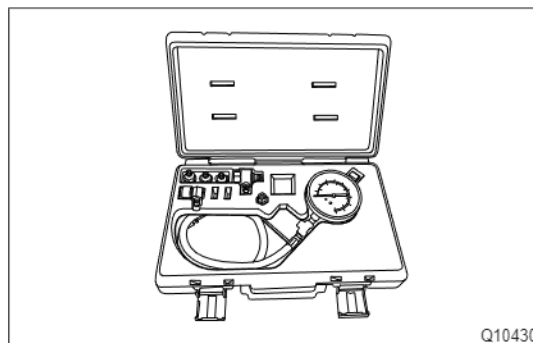


■ Inspection

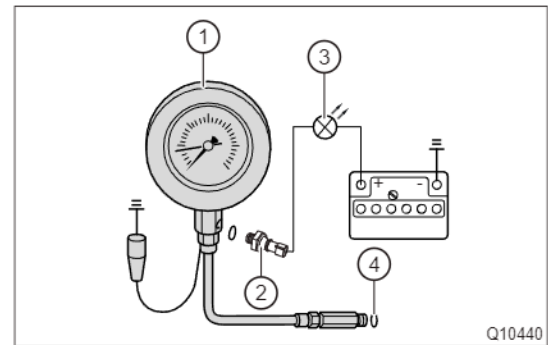
⚠ Caution

- Before inspecting oil pressure switch, please make sure that oil level is proper and coolant temperature is above 90°C, and that oil filter is used within 5000 Km.

- (1) Use an oil pressure gauge as shown in the illustration.



- (2) Install the oil pressure gauge into the threaded hole (4) of oil pressure switch as shown in the illustration.
- (3) Install the oil pressure switch (2) to the gauge (1), and connect the LED light (3).
- (4) When engine is not started, observe the pressure reading on gauge. Oil pressure alarm value is 30 - 50 kPa.



■ Installation

⚠ Caution

- Apply seal gum (Loctite 577) to threads when assembling oil pressure switch.

- (1) Apply a ring of sealant evenly to the threads head of oil pressure switch (2nd to 5th teeth).
- (2) Install the oil pressure switch on cylinder block and tighten it with an extended socket tool.

Torque: 12 ~ 15 N·m

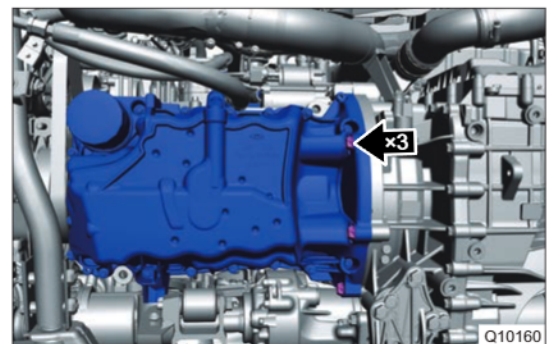
4.5 Oil Pan Assembly

■ Removal

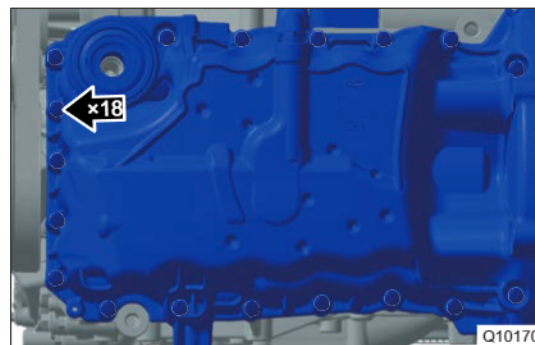
⚠ Warning

- **DO NOT** drain oil and remove oil pan until engine cools down.
- Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Drain engine oil.
- (4) Remove the engine compartment lower protector assembly.
- (5) Remove the engine accessory belt.
- (6) Remove fixing bolts from the compressor assembly, and move compressor assembly to a proper position.
- (7) Remove the oil filter assembly.
- (8) Remove the pipe joint.
- (9) Remove 3 fixing bolts between oil pan and transmission assembly.



(10) Remove 18 fixing bolts from all around oil pan.



(11) Clamp the oil pan special tool into joint, and tap all around oil pan slightly with a rubber hammer to remove oil pan assembly.

Caution

- Because the seal gum is sealed between oil pan and cylinder block, never use hard objects, such as a hammer, to tap it during removal, but it can be tapped slowly from left and right with a rubber hammer.
- A transmission carrier can be used to support the oil pan during removal, to prevent personal injury from sudden dropping of oil pan.
- DO NOT damage or miss dowel pin when removing oil pan.

(12) Remove the residual seal gum on oil pan and engine frame with flat scraper.

Caution

- Remove residue of seal gum on installation surface between oil pan and engine frame. Threaded hole can be cleaned with cleaner properly.

■ Inspection

- (1) Check the appearance of oil pan assembly for damage.
- (2) Check if the oil pan installation surface is within the specified range.

■ Installation

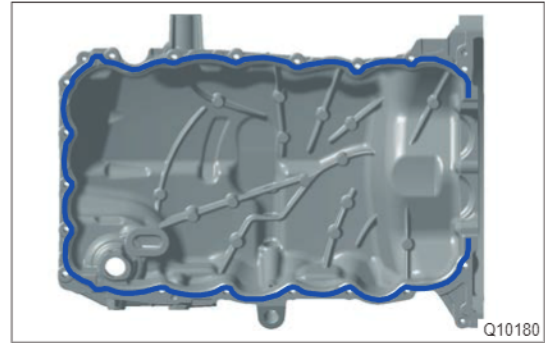
Caution

- When applying seal gum, check the type and expiration date of seal gum.
- Check installation surface for impact or damage.
- Remove impurities, iron chips and residue of seal gum on oil pan.
- Remove oil stain and residue of seal gum on the threaded hole of cylinder block and oil pan.
- Seal gum should not be applied too thick; otherwise it will overflow into oil pan due to squeezing, which will block the oil collector.
- Add engine oil until seal gum solidifies after installing oil pan.

- (1) As shown in illustration, apply seal gum to inside of oil pan installation bolt hole evenly.

Recommended seal gum: Loctite 5900H

Seal gum line diameter: 2 - 3 mm



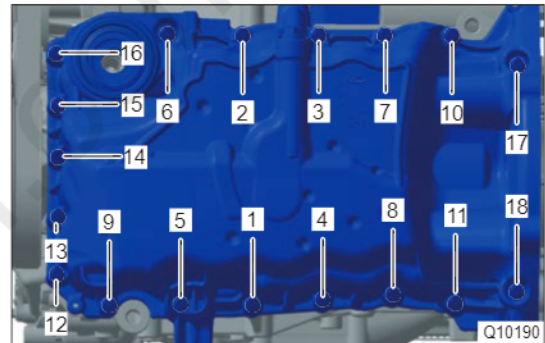
⚠ Caution

- The applied gum line should be continuous without broken.
- The assembly of oil pan must be finished within 10 minutes after applying gum.

- (2) Align oil pan with frame dowel pin, assemble oil pan and tap it slightly to fit it with frame closely.

- (3) As shown in illustration, pre-tighten oil pan fixing bolts until oil pan is pressed tightly. Then tighten bolts in order.

Torque: 8 + 3 N·m



- (4) Install the pipe joint assembly.
 (5) Install the oil filter assembly.
 (6) Install 1 fixing bolt to oil pan and drive shaft bracket.
 (7) Install 3 fixing bolts between oil pan and transmission assembly.
 (8) Install the compressor assembly.
 (9) Install the engine lower protector assembly.
 (10) Add engine oil to specified value.

4.6 Oil Collector

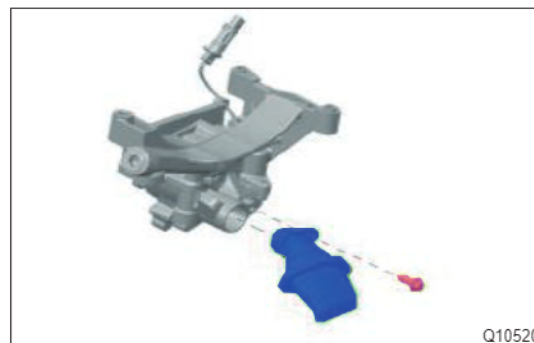
■ Removal

⚠ Warning

- **DO NOT** drain oil and remove oil pan until engine cools down.
- Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
 (2) Disconnect the negative battery cable.
 (3) Drain engine oil.
 (4) Remove the oil pan assembly.

- (5) Remove 1 fixing bolt from oil collector.



Q10520

- (6) Remove the oil collector carefully.

■ Inspection

- (1) Check collector O-ring for damage or cracks.
- (2) Check oil collector for dirty or blockage, and clean or replace it as necessary.

■ Installation

⚠ Caution

- **Add a certain amount of lubricant to oil collector mounting hole of oil pump before installing, so that oil pump rotor cavity can be lubricated. Recommended adding amount is: 5 mL.**

- (1) Apply a small amount of lubricant to O-ring surface of the oil collector.
- (2) Install oil collector to oil pump mounting hole, and align the fixing bolt hole.
- (3) Apply a circle of lock adhesive to fixing bolt threads head evenly. Ensure application amount for (3 - 5) teeth. Insert it to bolt hole and tighten.

Recommended lock adhesive: Loctite 243

Torque: 8 + 3 N·m

- (4) Install the oil pan assembly.
- (5) Add engine oil to specified value.

4.7 Oil Pump Assembly

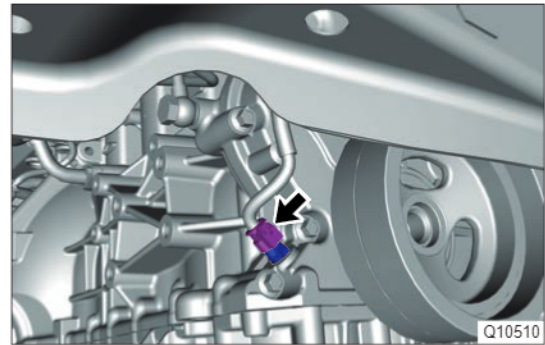
■ Removal

⚠ Warning

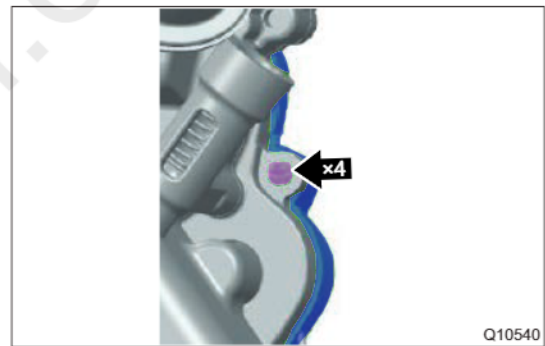
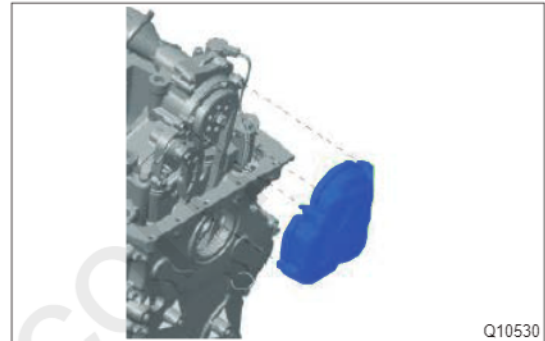
- **DO NOT drain oil and remove oil pan until engine cools down.**
- **Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Drain engine oil.
- (4) Remove the oil pan assembly.
- (5) Remove the oil collector assembly.

- (6) Disconnect the oil pump solenoid valve connector.



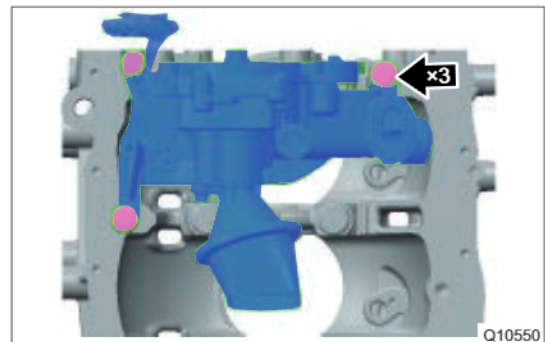
- (7) Use a flat tip screwdriver to push all the four buckles of sprocket cover into the mounting holes, and then pull them out smoothly.



⚠ Caution

- When installing and removing, the insertion and extraction directions of the sprocket cover buckle should be as far as possible along the mounting hole axis. When the sprocket cover buckles are seriously tilted, it will be difficult to install and even damage the buckles.

- (8) Remove 3 fixing bolts from oil pump assembly, carefully push out the lock buckle of connector, and remove the connector.



- (9) Push chain movable rail, move away chain from oil pump assembly, remove oil pump assembly carefully.

■ Inspection

- (1) Rotate oil pump shaft, check if rotation of oil pump is smooth.

■ Installation

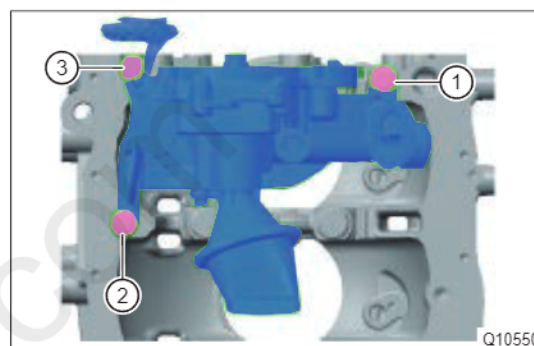
⚠ Caution

- **Wasted engine oil pump assembly should be handled by specialized department according to local laws and regulations. Never discard it at will.**

- (1) Align the oil pump set sleeve with the positioning hole on cylinder block and insert it so that the oil pump mounting surface and the cylinder block mounting surface fit together, and put the oil pump solenoid valve connector to outside.
- (2) Apply a circle of lock adhesive to 3 bolt threads heads evenly. Ensure application amount for (3 - 5) teeth. Insert it to bolt hole and tighten bolt in the order shown in illustration.

Recommended lock adhesive: Loctite 243

Torque: 20 + 5 N·m



- (3) Insert the solenoid valve connector into the mating hole from inside to outside through the cover inside. After inserting, hear the "click" sound or see that the lock buckle has been stuck on the outer edge of the mounting hole. The surface assembly is completed.
- (4) Push chain movable rail, and hang the chain on the sprocket of the oil pump. Slowly loosen the movable rail until the chain is in tension status.
- (5) Align the four buckles on sprocket cover with the buckle holes of oil pump, and insert them into the holes smoothly and forcefully until a "click" is heard, indicating assemble in place.

⚠ Caution

- **Complete assembly until the four buckles are inserted in place, and check whether the sprocket cover and oil pump fit properly.**

- (6) Install oil collector.
- (7) Install the oil pan assembly.
- (8) Connect the oil pump solenoid valve connector.
- (9) Add engine oil to specified value.

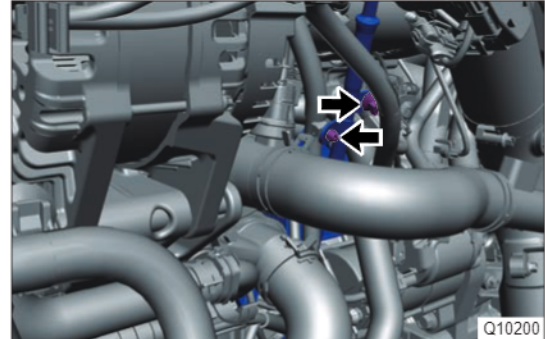
4.8 Oil Dipstick Tube (Dipstick) Assembly

■ Removal

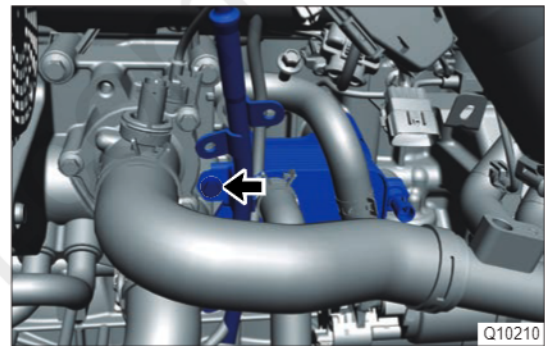
⚠ Warning

- **Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the engine compartment trim cover assembly.
- (4) Remove the engine trim cover assembly.
- (5) Remove the wire harness clip from oil dipstick tube.



- (6) Remove 1 fixing bolt between oil dipstick tube and water pump module mounting hole.



- (7) Remove the oil dipstick tube assembly carefully.

■ Installation

⚠ Caution

- Check O-ring before assembly to make sure it is not damaged, otherwise replace with a new one.
- Apply a small amount of lubricant to dipstick tube and dipstick handle O-ring before assembly.
- When inserting dipstick tube into timing chain cover mounting hole, insert lower end as far as possible along shaft line direction. If it tilts, it may be difficult to assemble O-ring, even damage O-ring.

- (1) Insert the dipstick tube into the mounting hole of oil pan along the axis of mounting hole.
- (2) Install 1 fixing bolt between oil dipstick tube and water pump module mounting hole.

Torque: 8 + 3 N·m

- (3) Fix wire harness clip to oil dipstick tube.
- (4) Install the engine compartment trim cover.

4.9 Oil Cooler Assembly

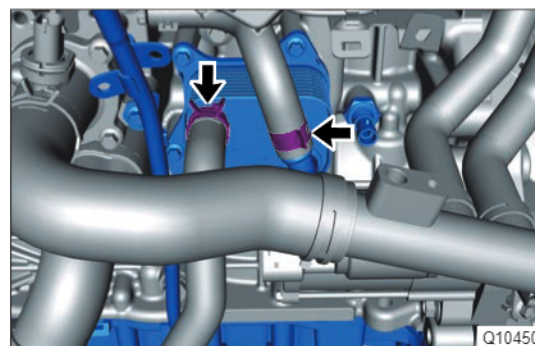
■ Removal

⚠ Warning

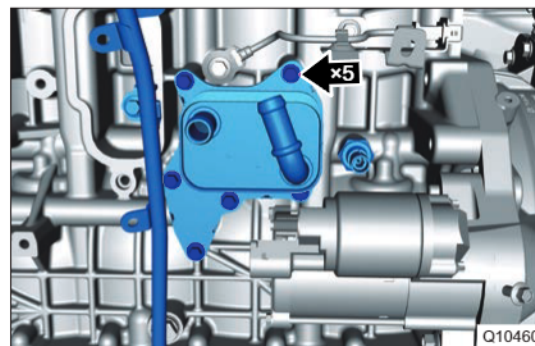
- **DO NOT** remove oil cooler assembly until engine cools down.
- Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
- If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.
- Be sure to wear safety equipment to prevent accidents, when removing oil cooler assembly.
- Appropriate force should be applied, when removing the oil cooler assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the starter assembly.
- (5) Remove the engine lower protector assembly.
- (6) Drain the coolant.

- (7) Loosen the elastic clamps and clamping ring, and disconnect the outlet pipe and inlet pipe from the oil cooler assembly.



- (8) Remove 5 fixing bolts from oil cooler assembly.

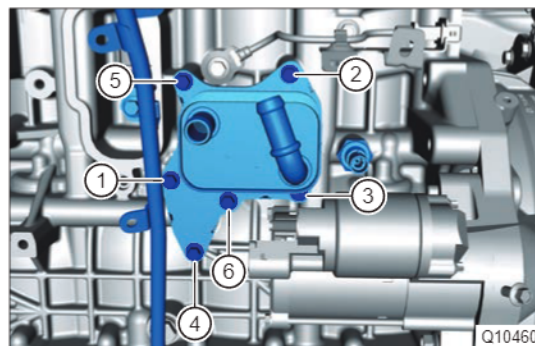


- (9) Remove the oil cooler assembly carefully.

■ Installation

- (1) Align the mounting holes of oil cooler bolt with the corresponding bolt holes on cylinder block, install 5 fixing bolts, and tighten the bolts in the order shown in illustration.

Torque: 8 + 3 N·m



- (2) Connect the outlet pipe and inlet pipe to oil cooler assembly.
- (3) Install the starter assembly.
- (4) Add the coolant.
- (5) Add oil to proper position.

4.9 STARTING AND CHARGING SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) Battery acid is highly corrosive, so it is necessary to wear protective gloves and goggles when working.
- (2) Do not dump the battery, because acid may spill from vent hole.
- (3) Never throw the used battery into household garbage. There is risk of explosion.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

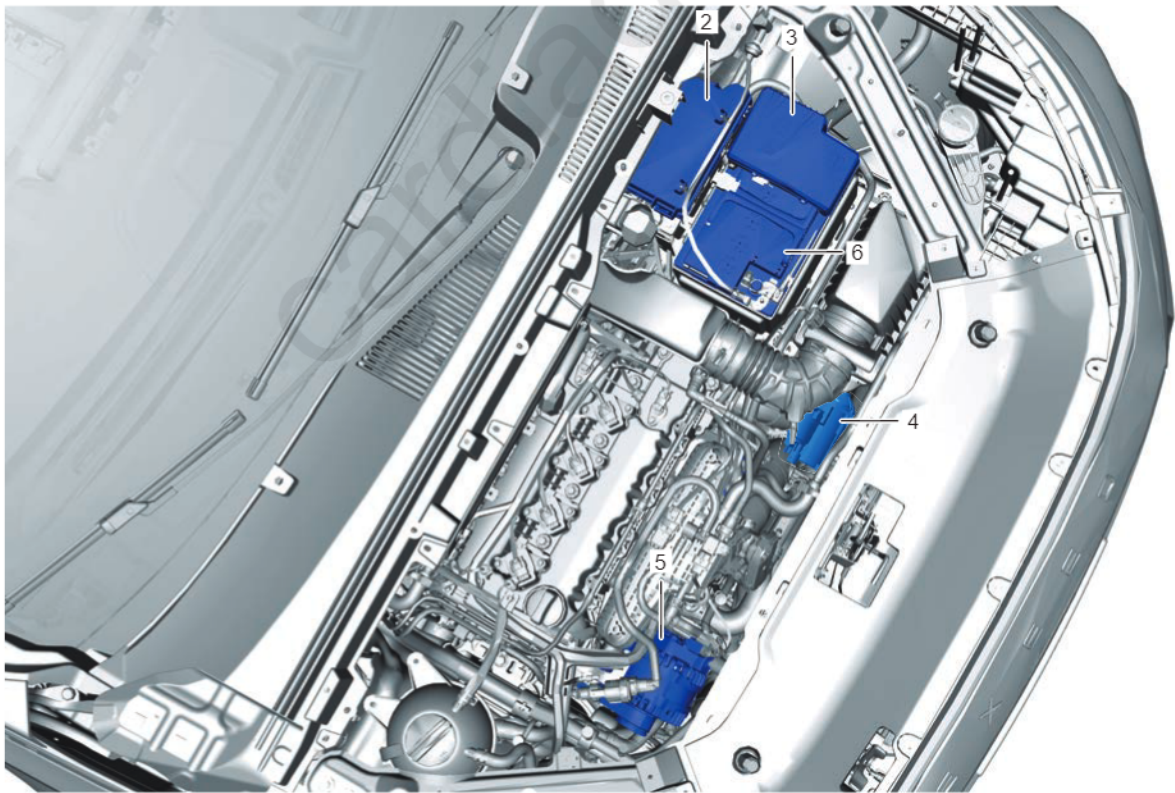
- (1) Deliver the used battery to designated recycling site.
- (2) Never allow the children approaching acid and battery.

2 System Overview

2.1 System Description

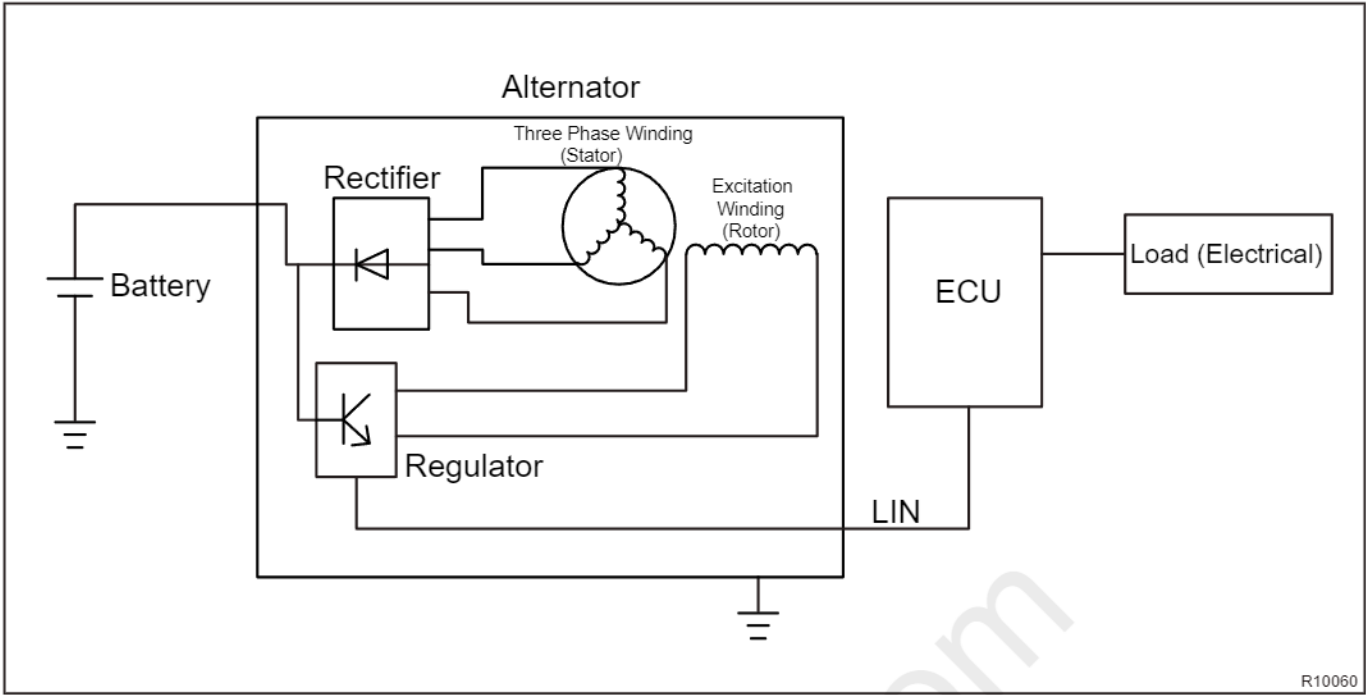
Starting system consists of battery, starting switch and starter, etc. Starting system converts electrical energy from battery into mechanical energy, allowing engine to crank initially, and disconnects power transmission between starter and engine when engine starts successfully. Charging system is consist of battery, alternator and charging state indicator device. Alternator is the main power supply component while vehicle is operating. It is used to supply power to all the electric equipment (except for the starting system) and charge the battery. Since alternator is rotated through drive belt which is driven by the engine, voltage will changes depending on engine speed. To meet electric device power supply and battery charging requirements, voltage regulator is equipped in charging system (inside alternator). The voltage regulator maintains voltage output stability of alternator by adjusting exciting current in alternator while engine speed and load is changing. Charging state indicator is used to show the charging system operation and indicate whether the battery is in a charging or discharging state.

2.2 System Components Diagram



R10010001

616



Three-phase alternating current generated by alternator is converted to direct current from alternating current by rectifier, and direct current is transmitted to the vehicle electrical system and battery.

2.4 Components Description

■ Battery Assembly

Main Function

When starting the engine, it is responsible for providing the working current required by the starter; When engine is running, it can help alternator to supply power to electric device; When engine is stationary, it can supply power to electric device separately; Moreover, battery is a large capacity capacitor which protects vehicle electrical device.



Battery

Model	Specification
Sail AGM	12V 70AH

■ Alternator Assembly

Alternator is a silicon rectifying alternator, which mainly consists of rotor, stator and rectifier.

When excitation direct current flows to rotor winding, rotor winding establishes a magnetic field and magnetizes the rotor claw poles, forming the corresponding poles.

The three-phase stator coil is installed on the outside of rotor, which is secured together with the front and rear end covers of alternator.

When the rotor of the generator is rotated by the drive belt, the magnetic pole lines cut the stator winding, causing a change in the magnetic flux in the stator winding, and an alternating induced electromotive force is generated in the stator winding, thereby generating alternating current. The generated three-phase alternating current is converted to direct current by rectifier, and direct current is transmitted to the vehicle electrical system and battery by further adjusting by regulator.



R10090

■ Starter Assembly

Starter consists of three parts: control mechanism, drive train mechanism and DC motor.

Control mechanism (solenoid switch): Controls engagement and disengagement between starter drive gear and engine flywheel gear and switches on/off the DC circuit.

Drive train mechanism: When engine starts, it engages starter drive gear with flywheel gear ring and transmits starter torque to the engine crankshaft; after engine starts, drive gear will automatically disengage from the flywheel gear, so that engine cannot drive starter at high speed, avoiding damage to the starter.

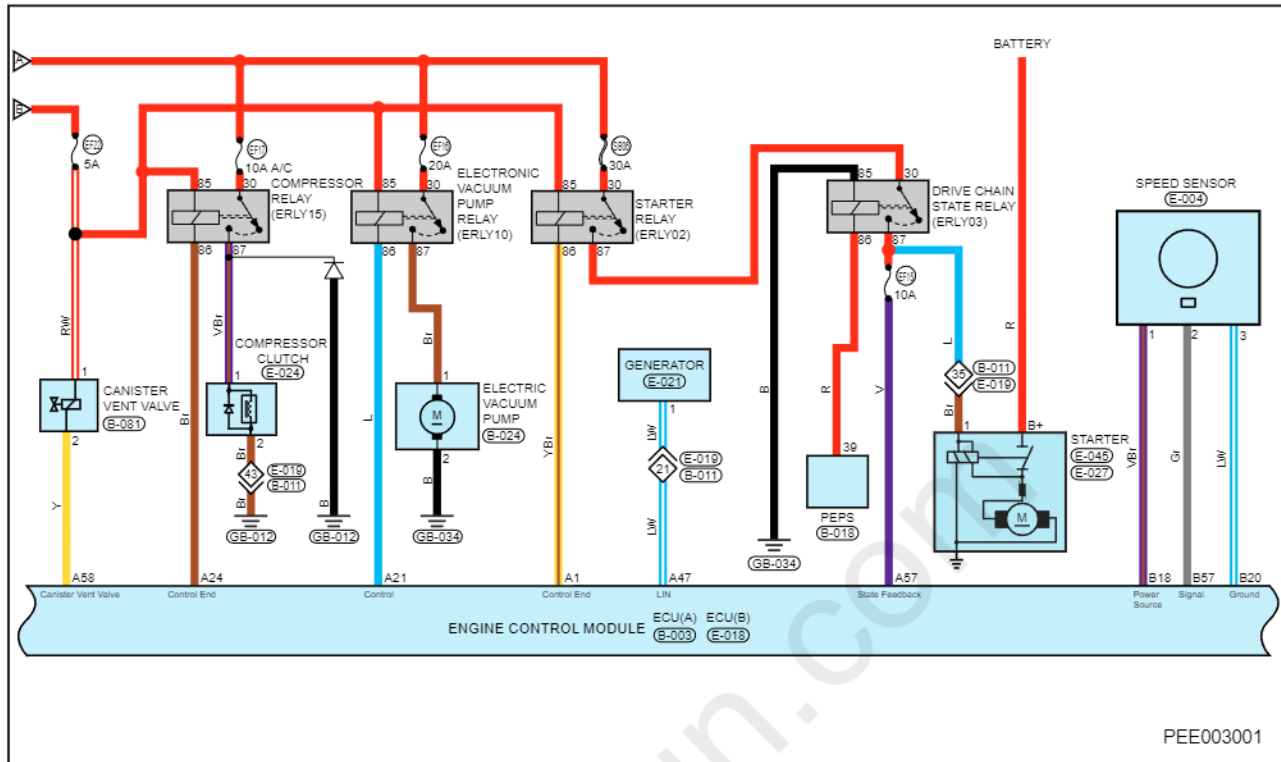
DC motor: Converts electrical energy from battery into electromagnetic moment.



R10100

3 System Circuit Diagram

3.1 Circuit Diagram



4 DIAGNOSIS & TESTING

4.1 Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Starting and Charging system

Symptom	Possible Cause
Housing is cracked	Housing cracked is the most serious and destructive malfunction. When vehicle is subjected to strong vibration, lead acid battery overheating, too high pressure or electrolyte frozen expansion, the housing of lead acid battery will be damaged. For such malfunction, replacing battery is the sole way for treatment.
Electrode is loose	The cause of loosen electrode is that excessive force is applied during removal and installation of wire harness and inspection of contact. It is necessary to replace the battery assembly.
Connecting part of electrode is corroded or burnt	Check if the generated electricity is normal and if the charging voltage is too high.
Battery swells	The causes are that battery is aging and resistance is excessively high. It is necessary to replace the battery.

4.2 Common Trouble Diagnosis

Operation Content	Operation Description
Appearance inspection: Confirm if there is any washer fluid, coolant, oil, sludge and other foreign matters adhered.	If the washer fluid, coolant, oil enters rotor slip ring, brush holder, it will cause oxidization to alternator rotor slip ring and poor contact to brush, resulting in charging light remaining on or flashing.
Turn over the center of alternator belt by hand and observe if the max. turning angle is over 90°.	Loose belt will cause low alternator speed, resulting in low electric energy production or failing to generate energy; if the angle is over 90°, check the belt tension.
Measure battery voltage with a multimeter.	Confirm if the battery is depleted (more than 12 V). If so, unplug the generator excitation coil connector and retest the battery voltage (more than 12 V). If such condition still exists, charge the battery.
Confirm if there is any looseness, short circuit, dirt on alternator B+, excitation end, battery pile line and ground line and also confirm if the connectors are connected firmly.	Confirm if the wire harness is connected normally. Poor contact will cause that the alternator voltage is high, the indicator light doesn't come on, remains on or flashes. If there is any looseness, please tighten it firmly.

Charging indicator light remains on (do not generate electricity or power is low, vehicle cannot start, etc.)

Operation Content	Operation Description
Unplug the alternator connector, start the engine and depress the accelerator (engine speed is above 1500rpm), turn off the vehicle load, measure B+ voltage to ground with multimeter and observe 2-3 minutes.	If B+ voltage is about 13.8 V, the alternator is normal. If B+ voltage is the battery voltage, it indicates alternator malfunction. Replace the alternator.
If the alternator operates normally, reconnect the alternator connector, start the engine and keep it idling, turn on some electrical load on vehicle, such as A/C, headlight, etc. Meanwhile, depress the accelerator pedal or decelerate the vehicle. Measure B+ voltage to ground with multimeter and observe 2 - 3 minutes.	When vehicle load or speed changes, the alternator normal voltage should change within 10.6 - 16 V. If the charging indicator remains on, check if communication is normal with an oscilloscope or other test software.

Charging indicator (unstable electricity generation)

Operation Content	Operation Description
Start the engine and keep it idling, remove alternator excitation coil and observe if the meter indicator flashes.	If the light flashes, it indicates that some excitation coil has outer leakage and intermittently ground. Check the circuit malfunction.

Indicator does not come on during self-check

Operation Content	Operation Description
Turn ENGINE START STOP switch to "ON" position, remove the engine excitation coil and measure the alternator excitation coil terminal voltage to ground with multimeter.	If the light flashes, it indicates that some excitation coil has outer leakage and intermittently ground. Check the circuit malfunction.

Adjusting voltage is high (headlight and other electrical appliances used on vehicle are burnt out)

Operation Content	Operation Description
Start the engine and keep it idling, measure B+ voltage to ground with multimeter and observe 2 - 3 minutes to check if the max. value exceeds 16 V.	If so, it indicates that the regulator in alternator is damaged which causes voltage out of control. Replace the alternator.

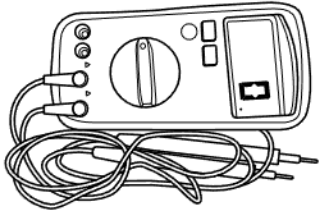
Instrument indicator or headlight dims and then goes off during vehicle driving (fail to generate energy, low electric energy production)	
Operation Content	Operation Description
Start the engine and keep it idling for 5 minutes (turn off the electrical appliances with large power, test with light load as possible), measure the alternator B+ voltage.	If the measured voltage is 13 V - 14.8 V, the alternator is normal; if not, the alternator is abnormal. Replace the alternator.

Abnormal noise occurs in alternator	
Operation Content	Operation Description
Check if the alternator mounting bolt is installed in place and tightened with specified torque.	Improper installation of bolt will cause pulley jumps as alternator operate, resulting in abnormal noise. Tighten the bolt.
Remove the alternator belt, rotate the pulley by hand. Listen and observe near the motor if there is any abnormal noise during alternator rotation.	Excessive belt tension or dirt in alternator will cause alternator bearing failure or poor rotor dynamic balance which causing abnormal noise. Replace the alternator.

5 ON-VEHICLE SERVICE

5.1 Tool

■ General Tool

Tool Name	Tool Drawing
Digital Multimeter	 S00002

■ Special Tools

Tool Name	Tool Drawing
Battery Tester	 S00064

5.2 Battery Assembly

■ Check Charging System Voltage

⚠ Warning

- Following the related specifications on appliances connected with battery, in repair manual and owner's manual.
- Battery acid is highly corrosive, so it is necessary to wear protective gloves and goggles when working.
- Keep away from open fire, spark, light devices without protective measures and no smoking. Never generate any sparks when operating cable/wire and electrical devices. Avoid short circuit in battery.
- Wear eye protective mask/glasses.
- Never allow the children approaching acid and battery.
- Deliver the used battery to designated recycling site. Never throw the used battery into household garbage.

- (1) Leave vehicle under no load test condition and idle the engine. Measure battery voltage with a digital multimeter.

Standard voltage: 13.5V - 14.8V

Hint:

If result is not as specified, replace the alternator.

- (2) Leave vehicle under load test condition and idle the engine. Measure battery voltage with a digital multimeter.

- 1) Set headlight to high beam.
- 2) Turn on blower and adjust blower speed to the highest.
- 3) Turn on the "A/C" switch.

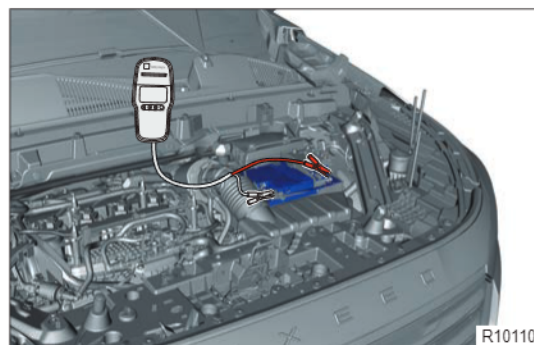
Standard voltage: 13.2V - 14.8 V

■ Usage of Battery Tester

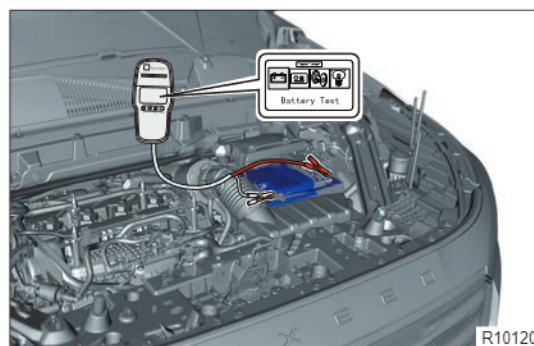
- (1) Connect the battery tester to battery.

Hint:

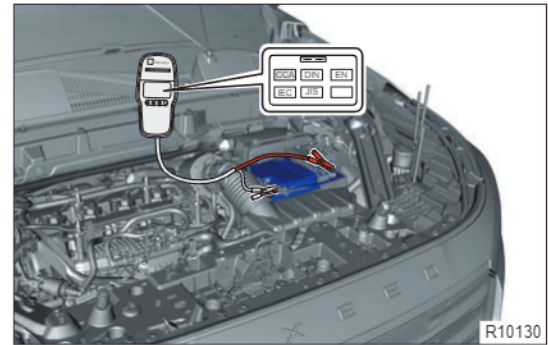
Connect red tube clamp to battery positive terminal while black tube clamp to battery negative terminal.



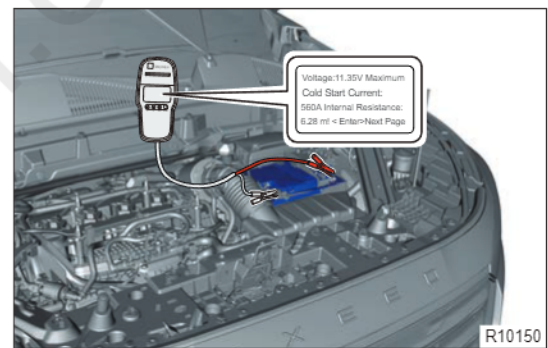
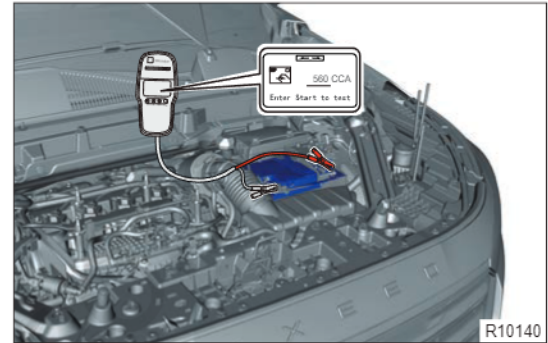
- (2) Operate tester to select "Battery Test" and click "Enter" .



- (3) Select “CCA” and click “确定” .



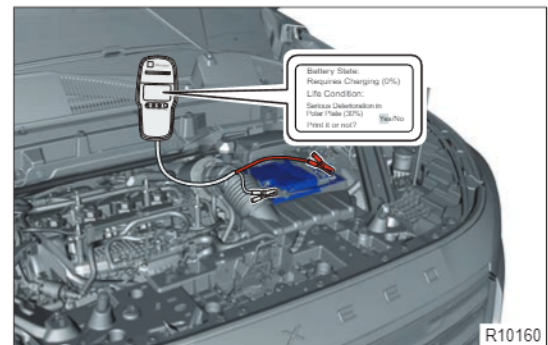
- (4) Operate “L and R” on tester to adjust and set the battery capacity (such as 560CCA, this value indicates the battery low temperature starting performance) and click “Enter” .



- (5) The battery condition is displayed on tester.

Hint:

Recharge or replace battery according to the tested data.

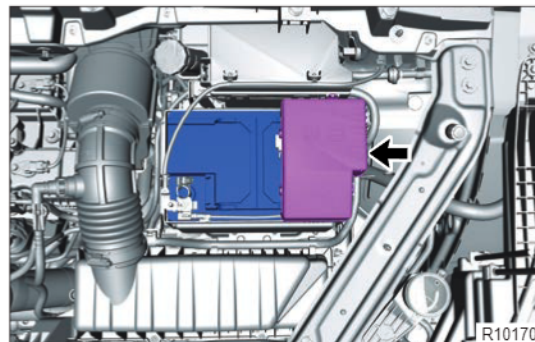


■ Removal

Warning

- Be sure to wear safety equipment to prevent accidents, when removing battery assembly.
- Appropriate force should be applied, when removing battery assembly. Be careful not to operate roughly.

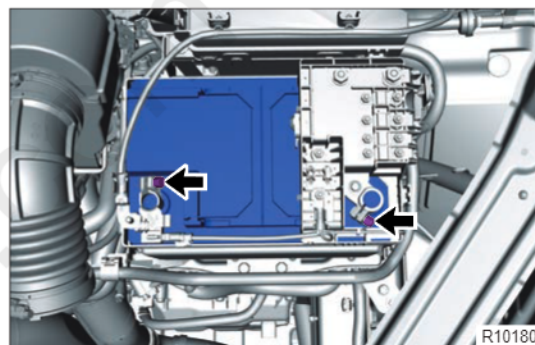
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove engine compartment fuse and relay box upper cover.



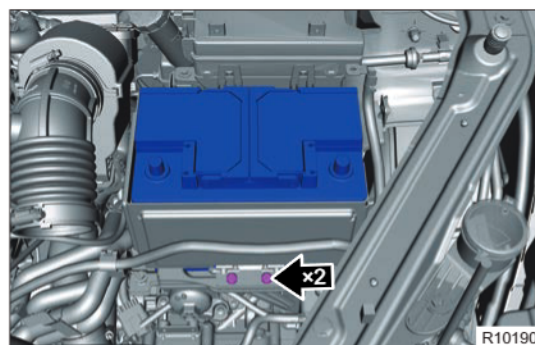
- (4) Remove the air filter assembly.
- (5) Loosen the locking nuts (10# socket wrench) of positive and negative battery terminals, and remove the positive and negative battery cables (1) (2).

Hint:

When removing the battery positive and negative battery terminals, remove negative terminal before positive terminal.



- (6) Remove 2 fixing bolts (10# socket wrench) and battery pressure plate.



- (7) Remove the battery assembly from protective cover carefully.

⚠ Caution

- When removing battery, be careful to prevent metal tools from contacting both electrodes of battery at the same time or touching the positive electrode and vehicle body.

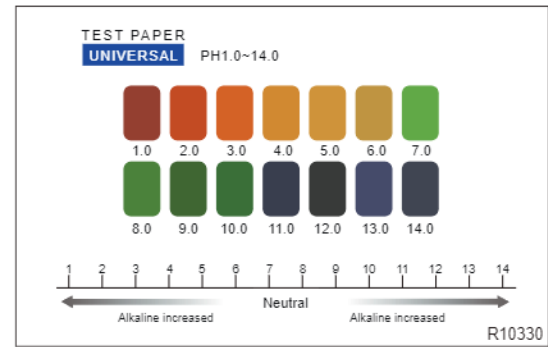
■ Battery Fluid Leakage Test

- (1) PH test paper is used for judgment.

Hint:

Test paper model: PH 1 - 14.

- (2) Take a piece of PH test paper (never allow it contacting with other fluid before test) to wipe the leaking area, so as to make the fluid adhere on the PH test paper. Then compare it with the color bar to judge the PH value.
- (3) If the PH value is less than 7, it is an acidic liquid, which indicates battery leakage.
- (4) If the PH value is 7 or higher, it is non-acidic liquid (- neutral or alkaline) which indicates “Petroleum jelly” fluid or other fluids leakage on battery surface.



■ Battery (Off-Vehicle) Charging

- (1) Because the battery has the characteristic of self-discharging, even if the battery is not in use, it is necessary to perform regular charging maintenance. When the discharging ratio for battery capacity is lower than 50%, the capacity cannot restore to 100% if charging with small current while the battery temperature increases and the plate active material will fall off easily if charging with large current, affecting the performance and life of battery.
 - Charging with constant voltage: Voltage is limited at 14.40 V. During charging, make sure the charger is connected to the maximum charging current so as to get the preset voltage value (14.40 V) according to the current battery status and temperature. After the voltage reaches the limiting value, the charging current will drop gradually until it closes to 0 A (maintain the condition charging current).

■ Battery (On-vehicle) External Power Supply Charging

- (1) If battery external power supply charging is necessary, it's important to keep external charger is properly connected. If charging process is not correct, the sensor cannot recognize the charging current, and SOC value cannot be calculated correctly. Positive clamp of external charging device must clamp positive terminal of battery, and negative clamp must be ground instead of negative terminal of battery. Battery sensor only properly balances the charge when there is a continuous current through it.

■ Installation

⚠ Caution

- Replace battery with a new one which conforms to the specifications.
- During installation, make sure the directions of positive and negative terminals are correct.
- Used battery contains sulfuric acid and lead, so never discard it at will. Please dispose of it at a qualified local waste treatment station.
- When installing the battery positive and negative battery terminals, install negative terminal before positive terminal.

- (1) Place the battery into battery tray carefully.
- (2) Install 2 fixing bolts to battery pressure plate.
Torque: 10 ± 1 N·m.
- (3) Install and tighten battery positive and negative battery terminals.
Torque: 5 ± 1 N·m.

- (4) Install engine compartment fuse and relay box upper cover.
- (5) Install the engine compartment trim cover assembly.

5.3 Battery Tray

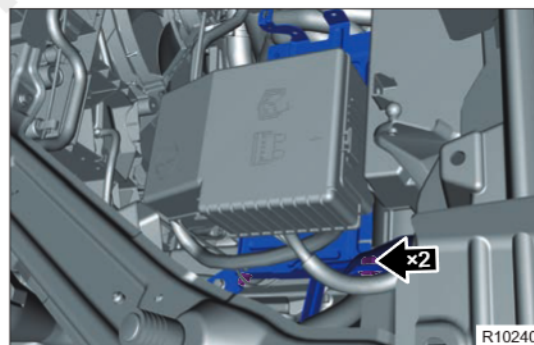
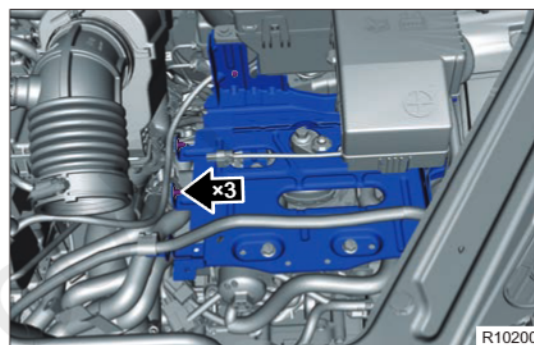
■ Removal

Warning

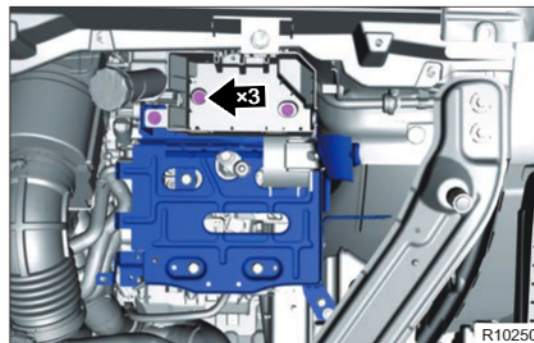
- Be sure to wear safety equipment to prevent accidents, when removing battery tray.
- Appropriate force should be applied, when removing battery tray. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the air filter assembly.
- (4) Remove the battery assembly.

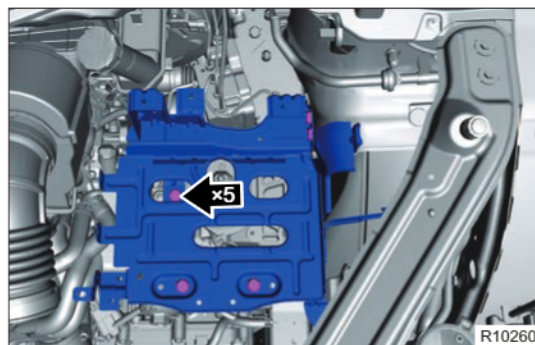
- (5) Detach 5 fixing clip from battery tray wire harness



- (6) Remove engine compartment fuse and relay box assembly.
- (7) Remove 3 fixing bolts and engine compartment fuse and relay box lower cover.

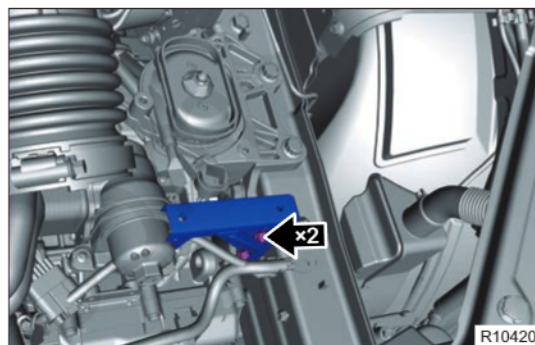


- (8) Remove 5 fixing bolts from battery tray.



- (9) Remove the battery tray assembly.

- (10) Remove 2 fixing bolts from battery tray mounting bracket.



- (11) Remove the battery tray mounting bracket.

■ Installation

- (1) Install 2 fixing bolts to battery tray bracket.

Torque: 20 ± 2 N·m

- (2) Install 5 fixing bolts to battery tray.

Torque: 20 ± 2 N·m

- (3) Install 3 fixing bolts to lower cover of engine compartment fuse and relay box.

Torque: 20 ± 2 N·m

- (4) Connect 5 wire harness clips to battery tray assembly.

- (5) Install the battery assembly.

- (6) Install the air filter assembly.

- (7) Install the engine compartment trim cover assembly.

5.4 Alternator Assembly

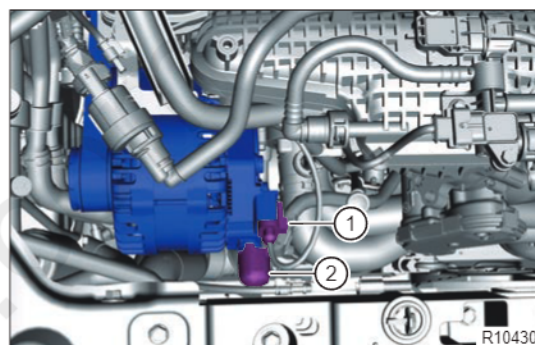
■ Removal

⚠ Warning

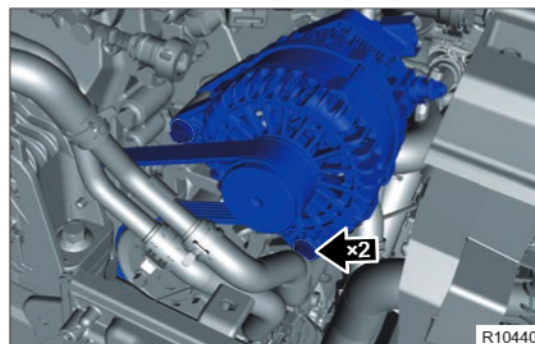
- When removing alternator assembly, be sure to wear safety equipment to prevent accidents.
- Appropriate force should be applied, when removing alternator assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine trim cover.
- (5) Remove the engine accessory belt.

- (6) Disconnect the alternator assembly connector (1) and remove alternator positive cable harness fixing nut (2).



- (7) Remove 2 fixing bolts from alternator assembly.



- (8) Remove the alternator assembly carefully.

■ Installation

- (1) Install alternator assembly to the corresponding position on water pump module, insert 2 fixing bolts and tighten it in order after pre-tightening 2 - 3 teeth with hand.

Torque: 40 + 5 N·m

⚠ Caution

- After alternator bolt is tightened, visually check for clearance between two sliding sleeves as well as between module sliding sleeve and the module. If clearance exists, it meets the installation requirement.

- (2) Install alternator positive wire harness port and secure the nut.

Torque: 13 ± 2 N m

- (3) Connect alternator assembly connector.
- (4) Install the alternator accessory belt.
- (5) Install the engine compartment trim cover.

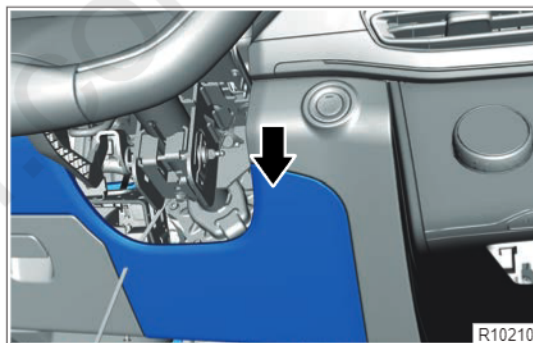
5.5 ENGINE START STOP Switch

■ Removal

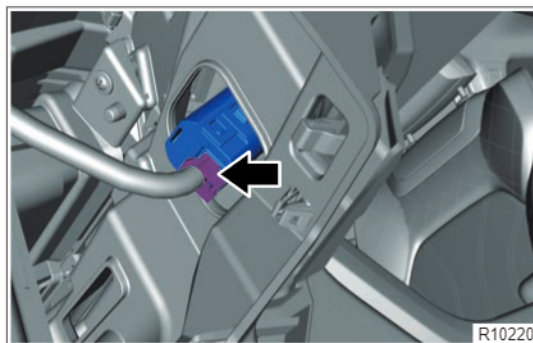
⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing ENGINE START STOP switch.**
- **Try to prevent interior protector from being scratched during removal and installation.**

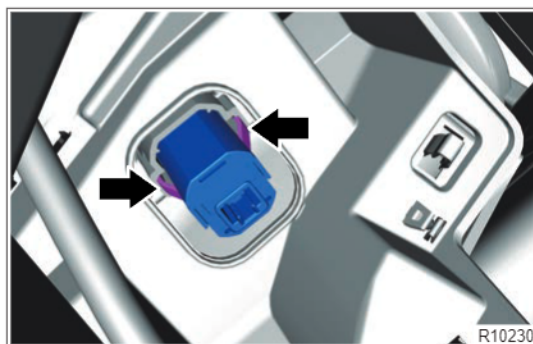
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Using an interior crow plate, remove the lower left protector body assembly.



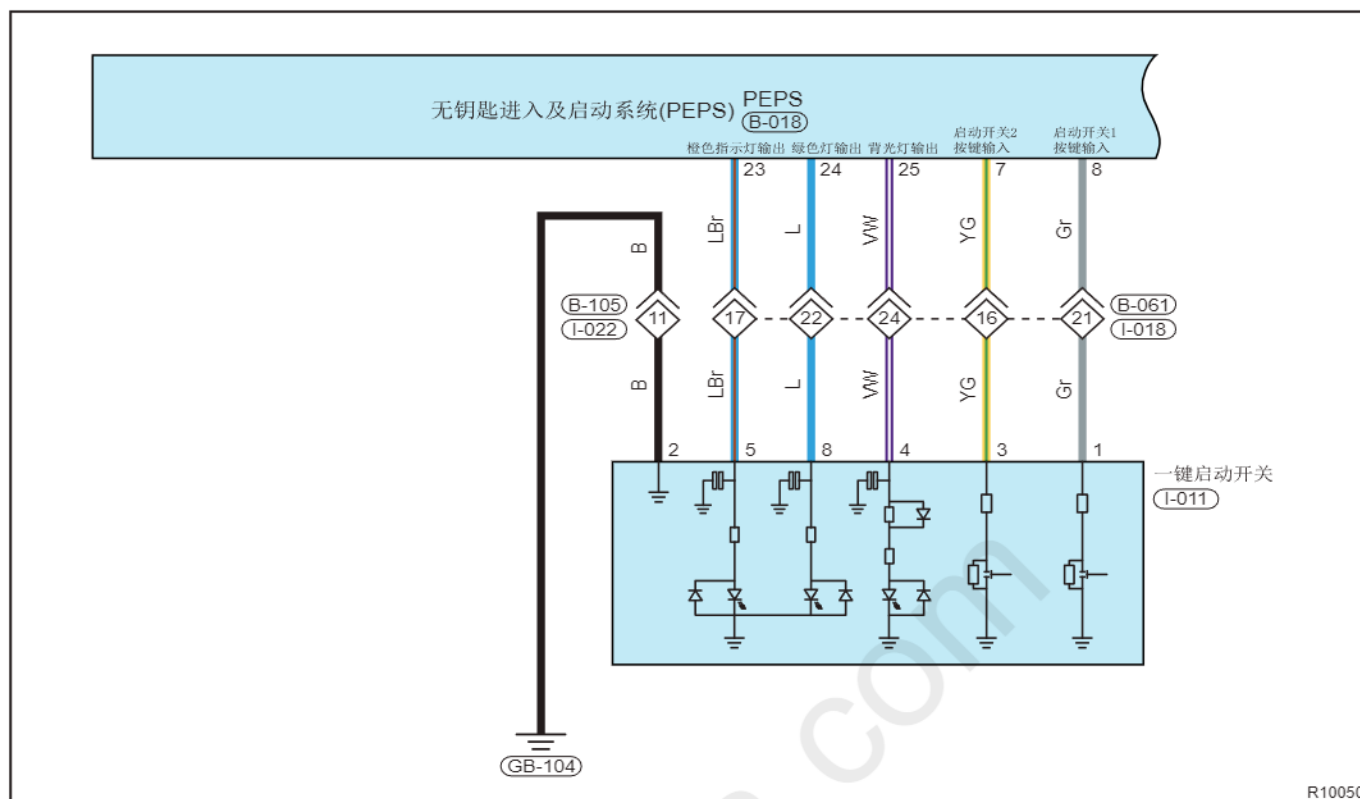
- (4) Disconnect ENGINE START STOP switch connector.



- (5) Press/Push fixing clips on both sides of ENGINE START STOP switch and remove ENGINE START STOP switch assembly.



■ Inspection



- (1) Using a digital multimeter, check the continuity of ENGINE START STOP switch according to the table below.

Multimeter Connection	Switch Condition	Specified Condition
Terminal 1 - Terminal 2	Not pressed	No continuity
Terminal 3 - Terminal 2	Not pressed	No continuity
Terminal 1 - Terminal 2	Pressed	Continuity
Terminal 3 - Terminal 2	Pressed	Continuity

⚠ Caution

- If measure result is not as specified, replace the **ENGINE START STOP** switch assembly.

■ Installation

- Install ENGINE START STOP switch to lower center protector body.
- Connect ENGINE START STOP switch connector.
- Install the lower left protector body assembly.

5.6 Starter Assembly

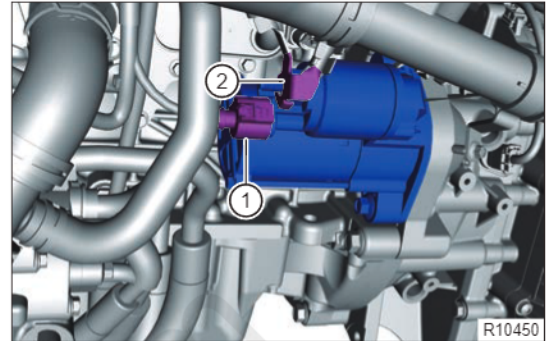
■ Removal

⚠ Warning

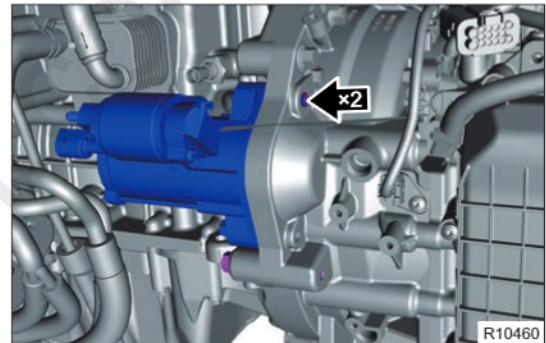
- Be sure to wear safety equipment to prevent accidents, when removing starter assembly.
- Appropriate force should be applied, when removing starter assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the air filter assembly.
- (4) Remove the intercooler inlet pipe II assembly.
- (5) Remove the engine lower protector assembly.
- (6) Remove the intercooler outlet pipe II assembly.

- (7) Disconnect the starter assembly connector (1) and remove positive cable fixing nut (2).



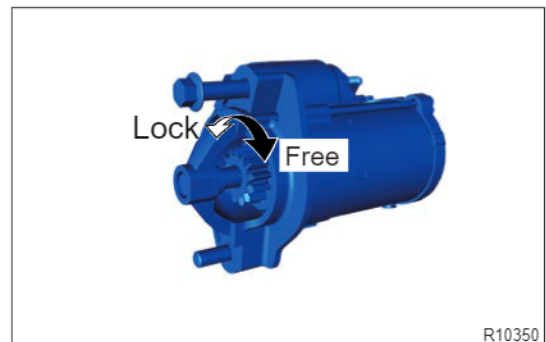
- (8) Remove 2 set bolts between starter assembly and transmission case.



- (9) Remove the starter assembly carefully.

■ Check the starter clutch

- (1) Rotate the clutch pinion gear clockwise to check that it rotates freely. Rotate the clutch pinion gear counterclockwise to check that it locks. If result is not as specified, replace the starter.

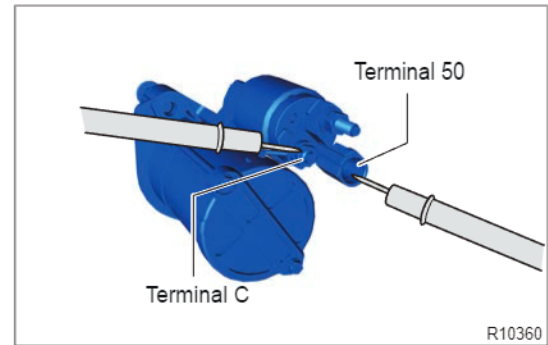


■ Check the pull-in coil

- (1) Measure the resistance between terminal 50 and terminal C.

Hint:

Standard resistance should be below 2Ω . If the resistance is abnormal, replace the starter assembly.



■ Check the starter assembly

⚠ Caution

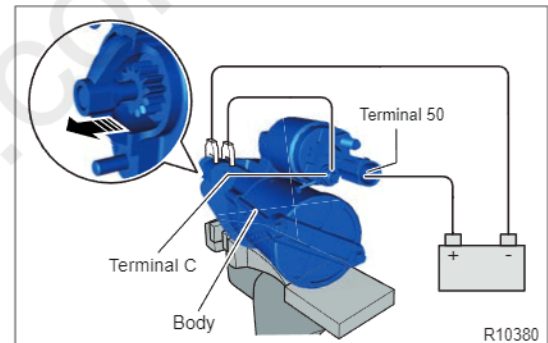
- These measurements must be performed within 3 to 5 seconds to avoid coil burnout.
- Place the starter assembly onto a vise. The jaws of vise should be covered by aluminum sheet or brass plate; otherwise, the starter assembly will be easily damaged when clamping it.

- (1) Perform pull-in test.

- Remove the nut and disconnect the field coil lead from terminal C.
- As shown in illustration, connect battery to solenoid switch, and check that starter clutch pinion sticks out normally.

Hint:

If starter clutch pinion does not move, replace the starter assembly.

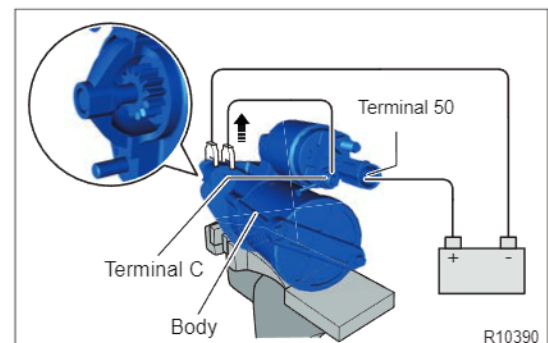


- (2) Perform pull-in test.

- Keep the starter clutch pinion sticking out and the connection condition of battery mentioned above, and disconnect the negative battery cable from terminal C.
- Check if starter clutch pinion keeps sticking out.

Hint:

If starter clutch pinion moves inward, replace the starter assembly.

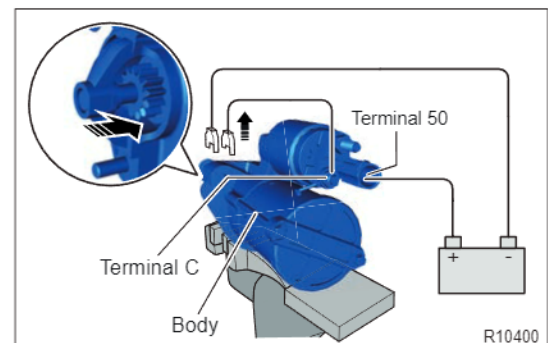


- (3) Check if starter clutch pinion returns back.

- Disconnect negative battery cable from starter body and check that starter clutch pinion returns back.

Hint:

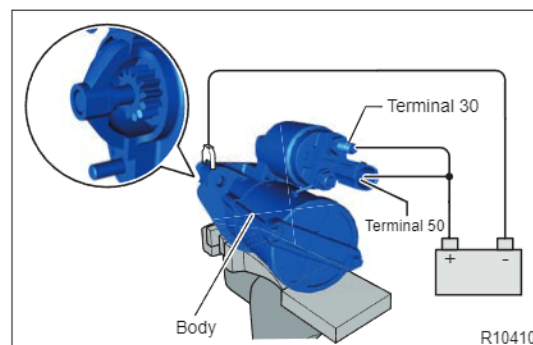
If starter clutch pinion moves inward, replace the starter assembly.



- (4) Check if starter rotates smoothly.
 - Connect the field coil lead to terminal C, and tighten it with a nut.
 - As shown in illustration, connect battery to starter; And check that starter rotates smoothly when the starter clutch pinion moves outward.

Hint:

The lead to be connected should avoid the pinion side to prevent lead stuck as pinion rotates.
If result is not as specified, replace the starter assembly.


Installation

- (1) Align starter with the corresponding holes on transmission, install 2 bolts and tighten it in order after pre-tightening 2-3 teeth with hand.

Torque: 40 + 5 N•m

- (2) Install positive wire harness port and secure the nut.

Torque: 13 ± 2 N m

- (3) Connect starter assembly connector.
- (4) Install intercooler inlet pipe II assembly.
- (5) Install the air filter assembly.
- (6) Install engine lower protector assembly.
- (7) Install intercooler outlet pipe II assembly.

4.10 FUEL SYSTEM

1 Warnings and Precautions

1.1 Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

- (1) As the pressure of high pressure fuel system is high, the pressure must be released before removal.
- (2) During removal, make sure the areas near stored parts are clean and free of dirt.
- (3) Perform removal after engine cools down.
- (4) Operation staff should wear protective glasses and rubber gloves during repair and avoid inhaling much fuel gas.

1.2 Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

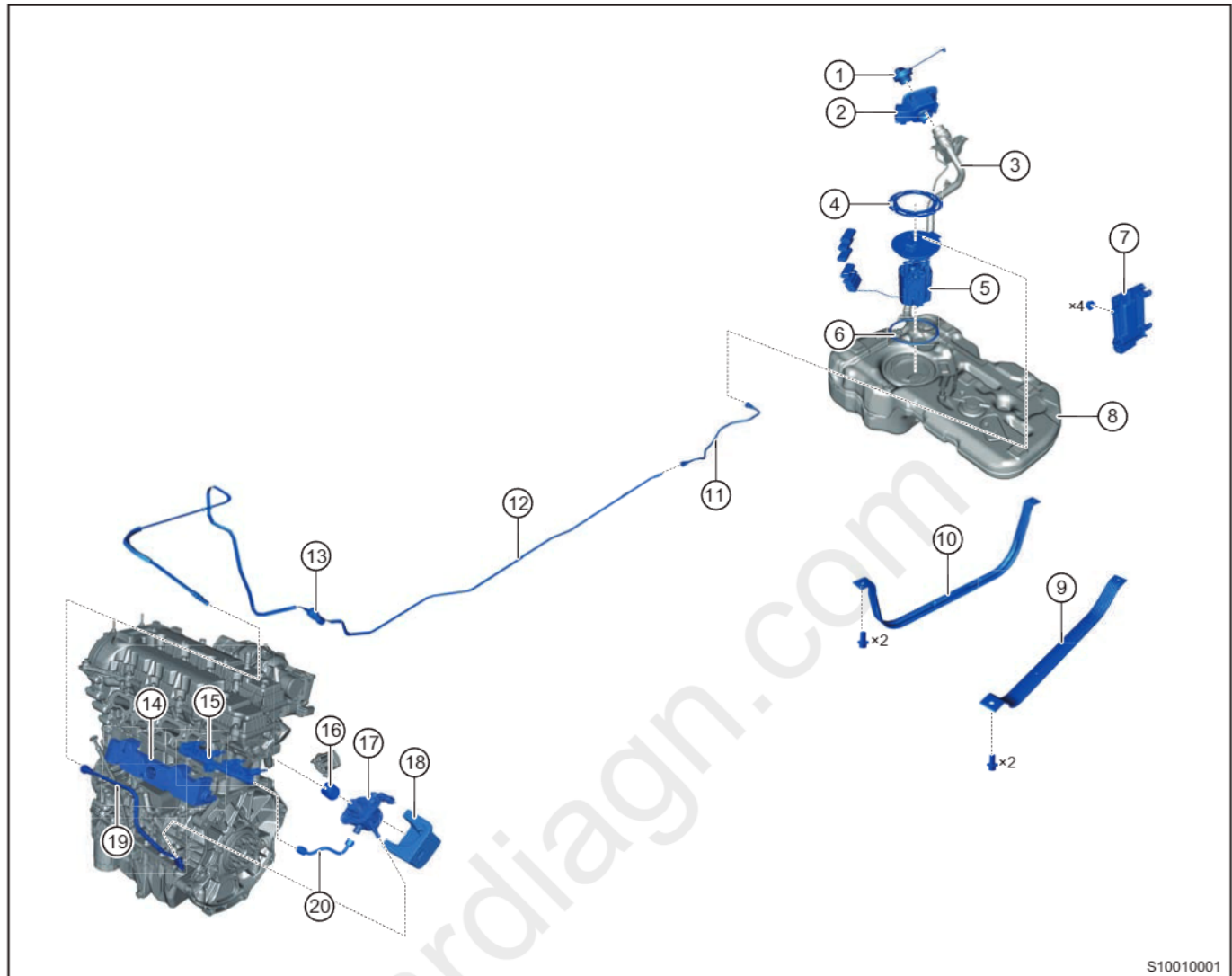
- (1) If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.
- (2) When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.

2 System Overview

2.1 System Description

Fuel supply system uses direct injection in cylinder. The high pressure fuel pump is driven by square cam on intake camshaft, thus sucking fuel from the low-pressure end for compression and boosting, and the pressure can be raised up to 200 bar. ECU monitors fuel rail pressure through oil pressure sensor. Fuel is sent to fuel rail after further adjustment by the fuel pressure regulator. The vehicle adopts a direct injection system with Bosch 4-hole nozzle and a side nozzle layout; According to the control signal of ECU, fuel is injected into the combustion chamber and mixed with gas for combustion. In low pressure fuel system, fuel pump is controlled by individual fuel pump control module by means of duty ratio control, and monitors the low-pressure end pressure through low pressure fuel pressure sensor realizing closed-loop control.

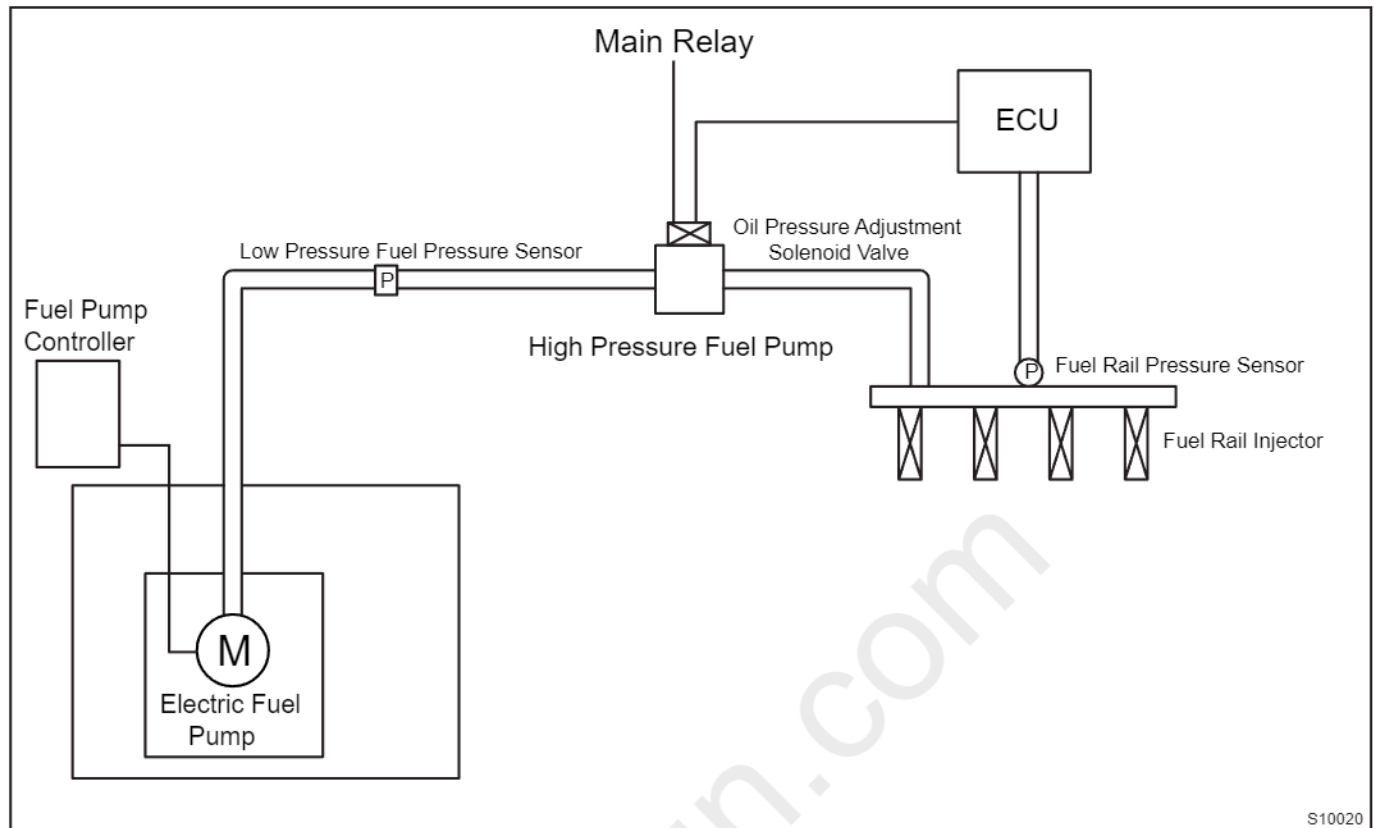
2.2 System Components Diagram



S10010001

1	Fuel Filler Cap	11	Fuel Pump Inlet Pipe to Outlet Pipe Assembly
2	Fuel Tank Cap Assembly	12	Inlet Pipe I - Outlet Pipe Assembly to Vehicle Body
3	Fuel Filler Pipe Assembly	13	Low Pressure Fuel Pressure Sensor
4	Fuel Pump Locking Ring	14	Fuel Rail Injector Sound Insulator
5	Fuel Pump Assembly	15	Fuel Rail Injector Assembly
6	Fuel Tank Seal Ring	16	Roller Tappet
7	Fuel Pump Control Module	17	High Pressure Fuel Pump
8	Fuel Tank Assembly	18	High Pressure Fuel Pump Sound Insulator
9	Fuel Tank Fixing Strap Assembly I	19	Inlet Pipe II
10	Fuel Tank Fixing Strap Assembly II	20	High Pressure Fuel Pipe (Fuel Pump - Fuel Rail)

2.3 System Schematic Diagram



2.4 System Components Description

■ Electric Fuel Pump

Electric fuel pump consists of pump body, DC motor and housing. Its basic operation principle is that DC motor drives the rotor in pump housing to rotate at high speed after it is energized. The section at lower end of rotor shaft combines with the section at the inner hole of impeller, so that rotor shaft drives impeller to rotate as rotor rotates. During high speed rotation of impeller, the low pressure vacuum is created at the inlet part, and then the filtered fuel is sucked from the inlet of pump cover. The sucked fuel enters the pump housing after being pressurized by fuel pump impeller and then it is pushed out of outlet to provide fuel with a certain pressure for the fuel system.



■ High Pressure Fuel Pump

High pressure fuel pump is an element specially used for direct injection engine. It functions to increase the system pressure and provide high pressure fuel for the fuel rail assembly. High pressure fuel pump supplies fuel for system as demands, thus providing a better fuel economy. It is made of stainless steel material and has a wide fuel application; also, it has the advantages of light weight, small volume, zero evaporative emission, etc.

The high pressure fuel pump uses a single plunger pump design integrated with regulator, flow control valve and pressure relief valve. Its operation principle is to drive high pressure pump plunger to move up and down by cam, thus achieving oil suction and outlet. Using the pressure sensor on fuel rail, ECU controls the flow of high pressure fuel pump through flow control valve according to the set control procedure, so as to perform closed loop control of pressure in high pressure fuel rail. Regulator functions to suppress the pressure pulsation at the low pressure end and improve the stability of system. Pressure relief valve will open when high pressure fuel rail pressure exceeds the safety limit, so as to protect the system.



S10100

■ High Pressure Fuel Pipe

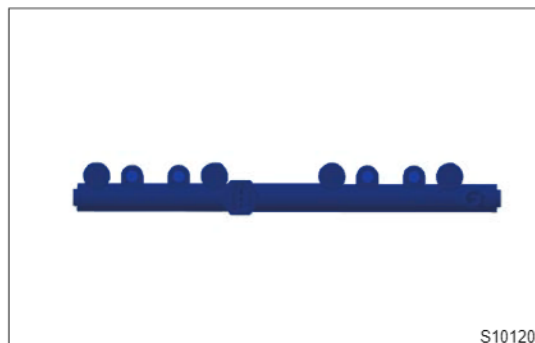
High pressure fuel pipe connects the high pressure fuel pump with the fuel rail injector assembly and delivers high pressure fuel to fuel rail injector assembly.



S10110

■ Fuel Rail Injector

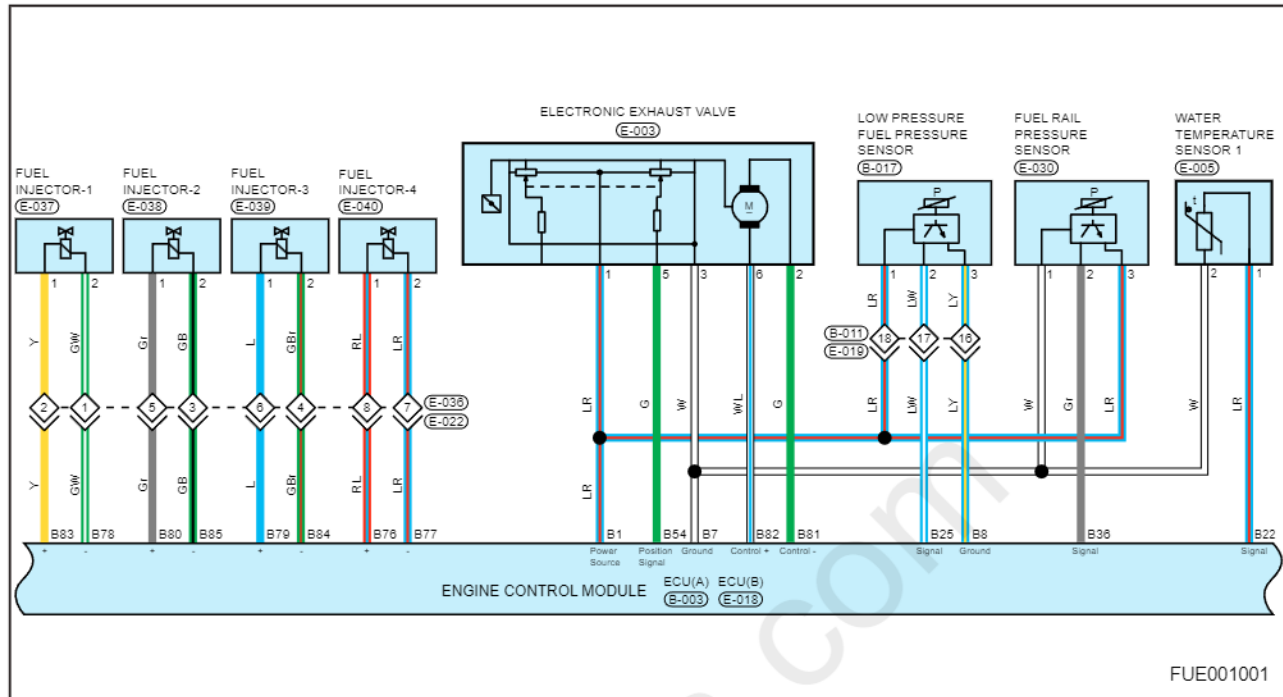
The high pressure fuel distribution pipe assembly is integrated with high pressure fuel distribution pipe (fuel rail), high pressure fuel injector and high pressure sensor. Its operation principle is to optimize design through structure of high pressure fuel distribution pipe, the accurate fuel rail pressure signal feedback can uniformly and precisely distribute fuel for engine through injector.



S10120

3 System Circuit Diagram

3.1 Circuit Diagram



4 DIAGNOSIS & TESTING

4.1 Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Fuel System

Symptom	Possible Cause
Fuel pressure in fuel supply system is too low	Electric fuel pump assembly (strainer blocked or fuel pressure regulator damaged)
	Low fuel level
Fuel pressure in fuel supply system is too high	Fuel injector (clogged)
	Electric fuel pump assembly (fuel pressure regulator damaged)
Electric fuel pump assembly has loud noise or a delay in operating	Low fuel level
	Electric fuel pump assembly
Fuel injector is clogged or leaks	Fuel injector
	Poor fuel quality
	Excessive impurities in fuel tank
Fuel injector does not work	Fuel supply system line (broken)
	Fuel injector (short in coil)

Symptom	Possible Cause
	Electric fuel pump assembly (damaged)
	Wire harness

■ Lubrication Areas During Assembly

Lubrication Area	Note
High Pressure Fuel Pump O-ring	Engine Oil

■ Non-reusable Part

Non-reusable Part	Note
High Pressure Fuel Pipe	Replacement required
Teflon Grommet of Fuel Injector	Replacement required

■ High Pressure Fuel System Pressure Release

- (1) Method 1: Stop vehicle for 8 hours or more.
- (2) Method 2: Unplug high pressure fuel pump connector, and idle the engine for 10 seconds. In this case, the malfunction light on instrument cluster of vehicle will come on. After repair, connect high pressure fuel pump connector and operate it again for a period of time, then the fault will disappear.

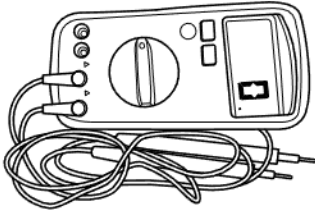
■ Low Pressure Fuel System Pressure Release

- (1) Method 1: Turn ENGINE START STOP switch OFF and leave vehicle for 30 minutes.
- (2) Method 2: Turn ENGINE START STOP switch OFF, remove fuel pump control module power supply fuse, start engine and make it stop automatically in Idling condition, then start engine twice or three times again, and release pressure residuals from fuel pipe by starting injection.

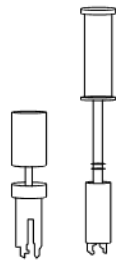
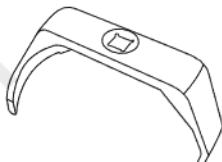
5 ON-VEHICLE SERVICE

5.1 Tool

■ General Tool

Tool Name	Tool Drawing
Digital Multimeter	 S00002

■ Special Tools

Tool Name	Part No.	Tool Drawing
Fuel Injector Remover	EPT - 0020	 S00084
Fuel Tank Pressure Cap Remover	ECH - 0006	 S00083

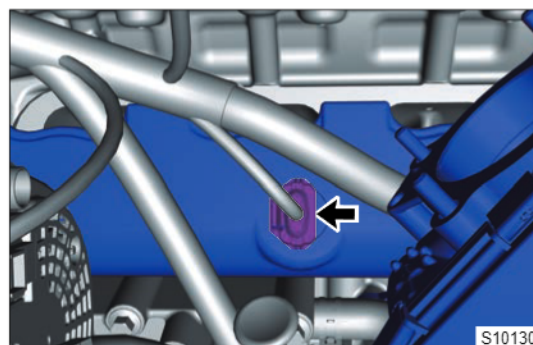
5.2 Fuel Rail Injector Assembly

■ Removal

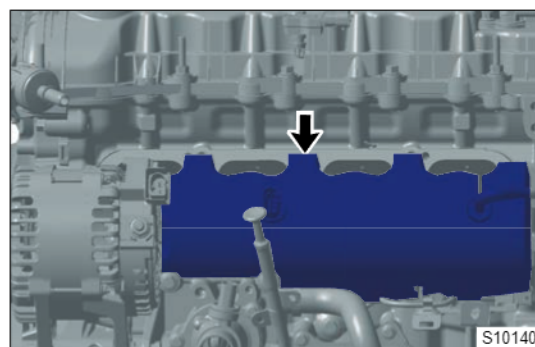
⚠ Warning

- As the pressure of high pressure fuel system is high, the pressure must be released before removal.
- During removal, make sure the areas near stored parts are clean and free of dirt.
- Teflon grommet at injector head cannot be reused after fuel rail injector is removal, and it must be replaced with a new one during installation, therefore, be sure to confirm if removal is necessary before removal.
- Perform removal after engine cools down.

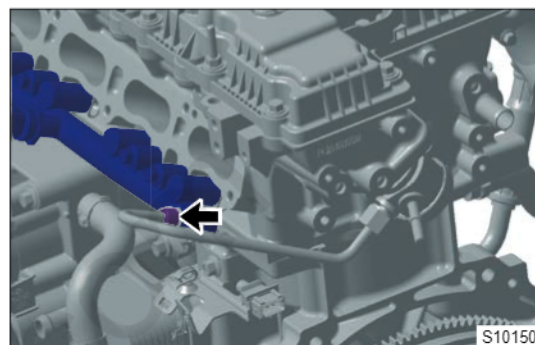
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the negative battery cable.
- (4) Remove the intake manifold assembly.
- (5) Disconnect the fuel rail pressure sensor connector.



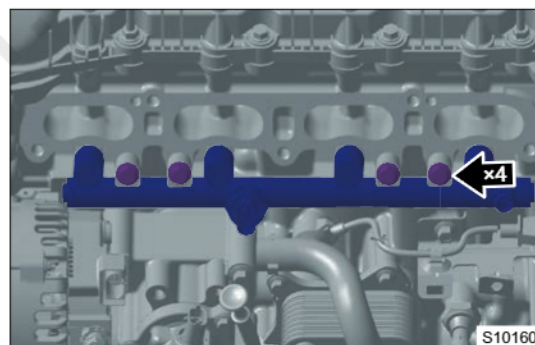
- (6) Remove the fuel rail injector sound insulator.



- (7) Loosen coupling nut between high pressure fuel pipe and fuel rail injector pipe joint.



- (8) Remove 4 fixing bolts from fuel rail injector and remove fuel rail injector assembly carefully.



■ Inspection

- (1) Check if wire harness connector of fuel rail injector assembly is abnormal.
- (2) Check connecting area between fuel rail and fuel injector for fuel leakage, and check mounting hole of fuel injector for air leakage or fuel leakage.
- (3) Use ohm band of multimeter to measure resistance between both pins of injector.

Normal value: $1.5 \Omega \pm 5 \%$ (at 23°C)

■ Installation

⚠ Caution

- If it is necessary to reassemble injector, assemble it after Teflon grommet at injector head is replaced.
- Make sure that engine cylinder head fuel injector mounting holes are clean and no foreign matter.
- Do not lubricate the sealing ring at head of fuel injector.
- During installation, align injector with mounting hole on cylinder head, and press it into mounting hole in axis direction of injector at a constant speed. If a press-fitting device is used, keep the force balance when pressing to prevent system from being damaged due to the unbalanced stress. The maximum pressing force should not be greater than 800N. After fuel rail is pressed into place, loosen the press-fitting device and insert bolt into the mounting hole on fuel rail injector, and screw 3-5 teeth into the screw hole on cylinder head.
- If no press-fitting device is available and fuel rail cannot be pressed into place, it is allowed to use a fuel rail bolt to bring it in, and tighten it several times in sequence of 3-2-4-1. It is not allowed to tighten an individual bolt directly. Tighten until fuel rail and cylinder head fit, then loosen all fuel rail bolts, and tighten fuel rail fixing bolts after fuel pipe is installed and tightened.

(1) Pre-tighten 2 - 3 teeth of high pressure fuel pipe and fuel rail injector pipe joint.

(2) Install 4 fixing bolts to fuel rail and loosen all fuel rail bolts after fuel rail and cylinder head fit.

⚠ Caution

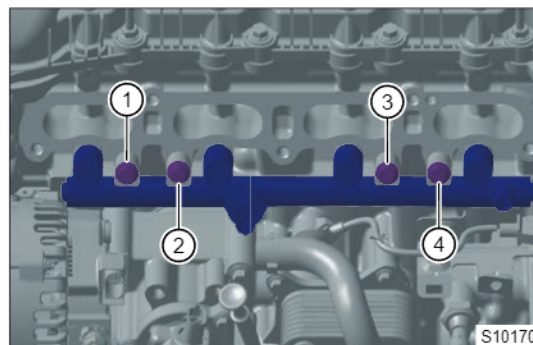
- **Tightening sequence of bolts: 3-2-4-1.**

(3) Tighten high pressure fuel pipe nuts.

Torque: 20 ± 2 N·m

(4) Tighten fuel rail fixing bolts several times in sequence of 3-2-4-1.

Torque: 25 ± 3 N·m



(5) Tighten high pressure fuel pipe nuts again.

Torque: 30 ± 2 N·m

- (6) Install fuel rail injector sound insulator.
- (7) Connect the fuel rail pressure sensor connector.
- (8) Install the intake manifold assembly.
- (9) Install the engine compartment trim cover assembly.

5.3 High Pressure Fuel Pump Assembly

■ Removal

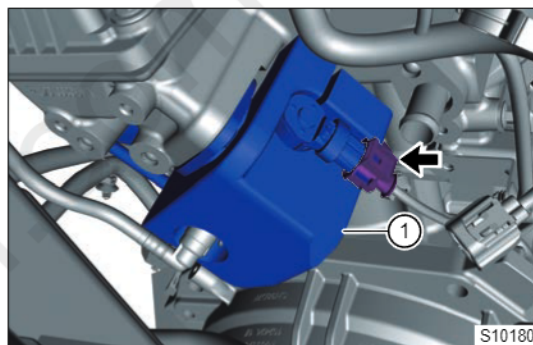
Warning

- As the pressure of high pressure fuel system is high, the pressure must be released before removal.
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- During removal, make sure the areas near stored parts are clean and free of dirt.
- There is residual fuel in high pressure fuel pump. Please pay attention to the leakage of fuel during removal to avoid fire.
- Perform removal after engine cools down.

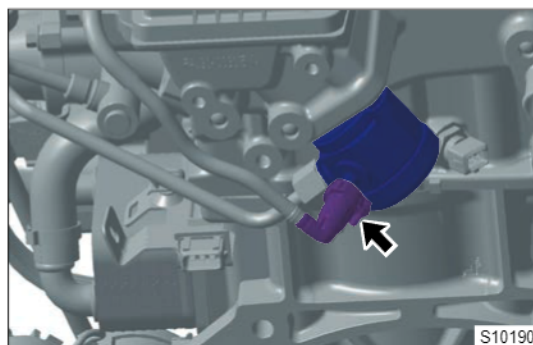
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the intake hose assembly.

- (5) Disconnect the high pressure fuel pump (fuel pressure regulating solenoid valve) connector.

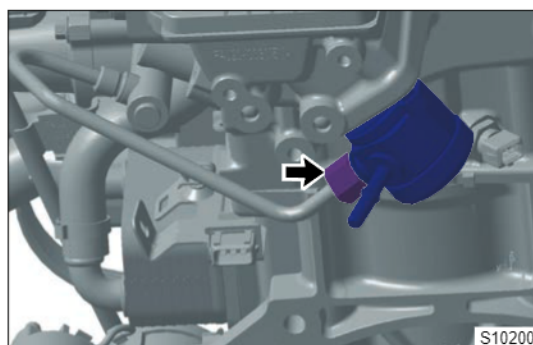
- (6) Remove high pressure fuel pump sound insulator (1) carefully.



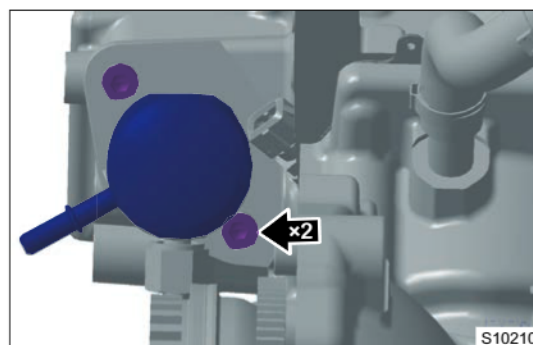
- (7) Disconnect connection between inlet pipe II and high pressure fuel pump.



- (8) Loosen high pressure fuel pipe joint, and disconnect connection between high pressure fuel pipe and high pressure fuel pump.



- (9) Remove 2 fixing bolts from high pressure fuel pump.



⚠ Caution

- During removal, loosen fixing bolts in turn, and then remove bolts completely. Never remove a bolt completely in one time.

- (10) Rotate high pressure fuel pump gently and pull it outwards. Never swing high pressure fuel pump in radial direction.

⚠ Caution

- When pulling out high pressure fuel pump, the roller tappet may fall naturally. In order to prevent damage in falling, hold it by hand when pulling out the high pressure fuel pump.

■ Check high pressure fuel pump

- (1) Check if high pressure fuel pump connector is abnormal.
- (2) Check resistance between both pins of high pressure fuel pump connector.
- (3) Measure resistance of high pressure fuel pump (fuel pressure regulating solenoid valve) coil.

Measurement Temperature (°C)	Coil Resistance (0 mileage) (Ω)		Coil Resistance (after driving) (Ω)	
	Minimum	Maximum	Minimum	Maximum
- 40	0.379	0.417	0.372	0.426
20	0.495	0.545	0.485	0.556
160	0.765	0.843	0.750	0.859

■ Check the roller tappet

- (1) Check if appearance of roller tappet is complete, if wear is serious, and if roller bearing can rotate smoothly.
- (2) Check if roller tappet diameter is obviously out of tolerance. If it is out of tolerance, replacement is recommended. Diameter: 26 mm (- 0.020, 0.055)

Hint:

If above problems occur, replacing with a new roller tappet is recommended.

■ Installation

⚠ Caution

- Before installation, make sure the part model of high pressure fuel pump is correct and available.
- Before installation, make sure sealing caps of high pressure fuel pump joint are complete. Never use high pressure fuel pump without sealing cap.
- High pressure fuel pump O-ring must be lubricated with lubricating oil before installation.
- During installation of high pressure fuel pump, never tighten a bolt firmly in one time, and they must be tightened in turn.

- (1) Apply a coat of oil to O-ring of high pressure fuel pump, install roller tappet and high pressure fuel pump and then place them into mounting hole. When replacing, be sure to align anti-rotating pin of roller tappet with anti-rotating groove in mounting hole.
- (2) Pre-tighten fixing bolts of high pressure fuel pump several turns in order, and never tighten a bolt completely in one time. Do not use sharp tools or tap components during installation to avoid damaging high pressure fuel pipe.

Torque: 27 + 3 N·m

- (3) Do not allow skin to contact the roller tappet directly during installation. During the operation, it is necessary to wear cleaning gloves to prevent roller tappet surface from being contaminated by sweat and foreign matters.

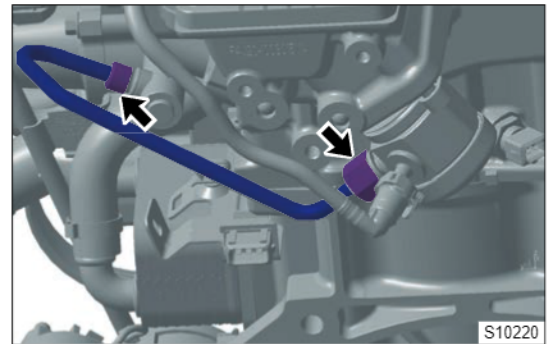
5.4 High Pressure Fuel Pipe

■ Removal

⚠ Warning

- As the pressure of high pressure fuel system is high, the pressure must be released before removal.
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- During removal, make sure the areas near stored parts are clean and free of dirt.
- Perform removal after engine cools down.

- (1) Release the high pressure fuel system pressure.
- (2) Turn off all electrical equipment and ENGINE START STOP switch.
- (3) Remove the intake hose assembly.
- (4) Remove the high pressure fuel pump sound insulator.
- (5) After pressure of high pressure fuel system is released completely, use a wrench to remove nuts on both sides of high pressure fuel pipe completely.



- (6) Remove high pressure fuel pipe.

⚠ Caution

- The removed high pressure fuel pipe should be marked with scraping marks and cannot be reused.

■ Installation

⚠ Caution

- High pressure fuel pipe is a non-reusable part, never reassemble it for a secondary use.
- Before installing high pressure fuel pipe, make sure that the part model is correct, the sealing caps on both ends of high pressure fuel pipe are intact. Never use any high pressure fuel pipe without sealing cap.
- Do not use sharp tools during installation to avoid scratching high pressure fuel pipe joint.
- During installation of high pressure fuel pipe, pay attention to avoid collision with the fuel rail injector joint and end of high pressure fuel pump joint.
- Before installing high pressure fuel pipe, confirm if fixing bolts of fuel rail injector are tightened. If they are tightened completely, loosen all of them and then install the high pressure fuel pipe.

- (1) Unplug protective cap of high pressure fuel pipe, and pre-tighten both ends of high pressure fuel pipe to high pressure fuel pump and fuel rail joint respectively in correct direction.

Torque: 20 ± 2 N·m

- (2) Tighten fuel rail fixing bolts several times in sequence of 3-2-4-1.

Torque: 25 ± 3 N·m

⚠ Caution

- Tightening sequence of bolts: 3-2-4-1.

- (3) Tighten high pressure fuel pipe nuts again.

Torque: 30 ± 2 N·m

5.5 Fuel Filler Cap Body Assembly

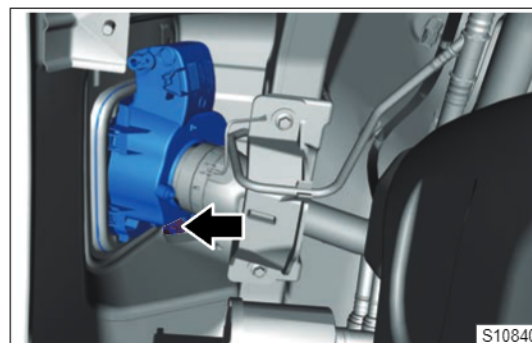
■ Removal

⚠ Warning

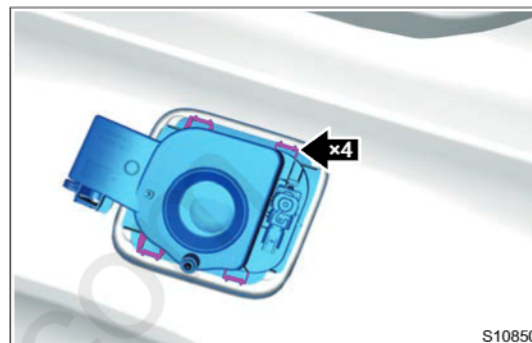
- Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion.
- When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.
- If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the rear right wheel.
- (4) Remove the rear right wheel house protector assembly.

- (5) Disconnect fuel filler cap body actuator connector.



- (6) Insert hand into and press 4 fixing clips of electric fuel filler cap assembly from interior, push them out and remove fuel filler cap body assembly.



■ Installation

- (1) Install fuel filler cap assembly, press fuel filler cap assembly to secure the clips in place.
- (2) Connect fuel filler cap body actuator connector.
- (3) Install rear right wheel house protector assembly.
- (4) Install the rear right wheel.

5.6 Electric Fuel Pump Assembly

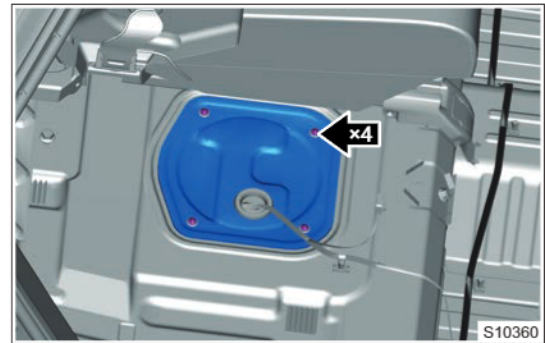
■ Removal

⚠ Warning

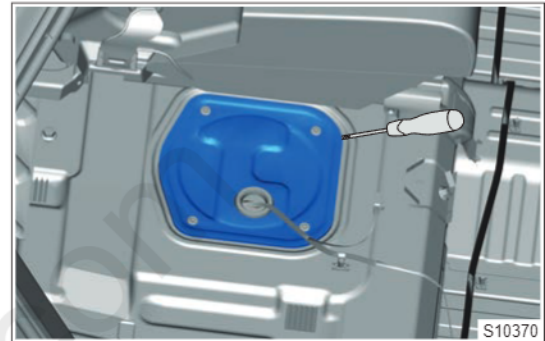
- Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion.
- When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.
- If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.
- Operation staff should wear protective glasses and rubber gloves during repair and avoid inhaling much fuel gas.
- Only use parts approved by Chery Automobile Co., Ltd. to replace the electric fuel pump assembly.
- Keep electric fuel pump assembly and work area clean when replacing electric fuel pump assembly; otherwise the electric fuel pump assembly element will be clogged.
- DO NOT damage the disconnected fuel system line or connectors. Cover the line joints or connectors with plastic bags or equivalent, preventing foreign matter from entering.
- Keep fuel tank and line clean.

- (1) Release the low pressure fuel system pressure.
- (2) Turn off all electrical equipment and ENGINE START STOP switch.
- (3) Disconnect the negative battery cable.
- (4) Remove the right seat assembly in middle row.

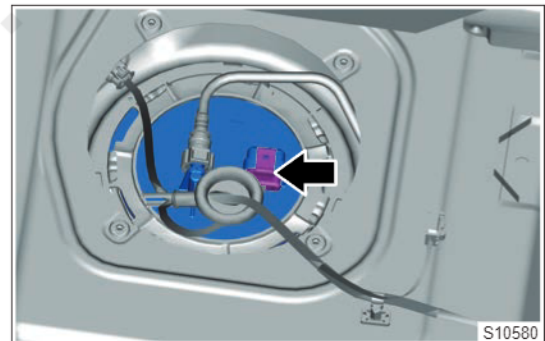
- (5) Remove 4 fixing screws from electric fuel pump assembly protective cap with cross screwdriver.



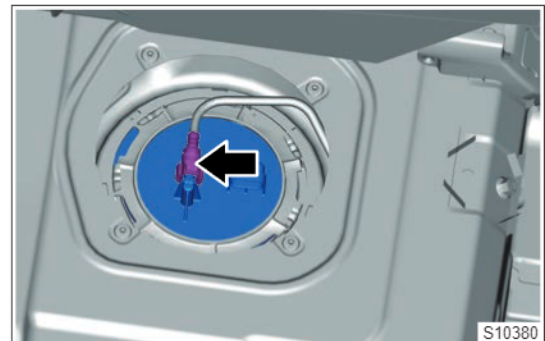
- (6) Remove the electric fuel pump assembly protective cap with flat tip screwdriver.



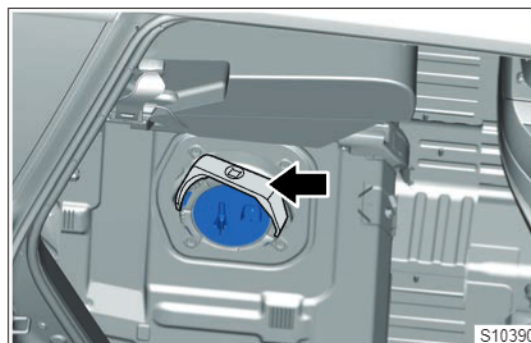
- (7) Disconnect the electric fuel pump assembly connector.



- (8) Disconnect connection between inlet pipe and electric fuel pump assembly.



- (9) Using a fuel tank pressure cap special tool, remove fuel tank pressure cap.



- (10) Remove electric fuel pump assembly from fuel tank, and dispose of fuel in electric fuel pump assembly.

⚠ Caution

- Operate carefully when taking the electric fuel pump assembly out of fuel tank, preventing damaging lines and floats.
- Cover the electric fuel pump assembly completely with a plastic bag or equivalent to prevent foreign matter from entering.
- Electric fuel pump assembly can be put into a container and taken out of the cabin, thus preventing fuel in the pump from dropping into the cabin.
- It is not allowed to perform running test for electric fuel pump assembly under dry state or in water. Otherwise service life will be reduced. In addition, do not inversely connect electric fuel pump assembly positive and negative poles.

■ Installation

⚠ Caution

- Replace fuel tank seal ring with a new one when installing electric fuel pump assembly, align it with installation position of fuel tank and do not run the electric fuel pump assembly with no fuel in fuel tank, preventing damaging electric fuel pump assembly.
- Before connecting the hose, check if there is any damage or foreign matter on the hose or joint.
- During installation, push in fuel pipe connector until a click sound is heard, then check that fuel pipe joint clip is on the collar of fuel pipe joint. After installing the pipe joint clip, check that fuel pipe joint cannot be pulled out. Be careful not to damage joint. If clip is damaged, replace it.
- Turn ignition switch to ON (without starting engine) to apply fuel pressure to fuel supply system, and then check connections for leakage.

- (1) Using a fuel tank pressure cap special tool, install fuel tank pressure cap.

Torque: 400 N·m.

- (2) Connect inlet pipe.
- (3) Connect the electric fuel pump assembly connector.
- (4) Install the right seat assembly of middle row.

5.7 Fuel Tank Assembly

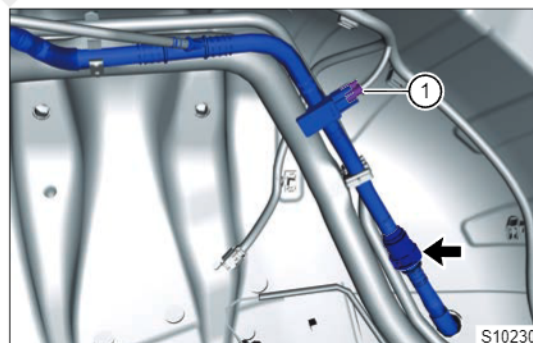
■ Removal

⚠ Warning

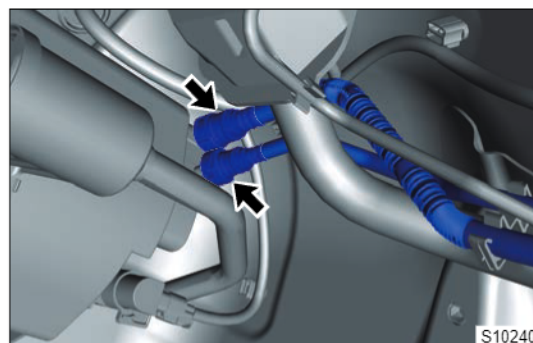
- Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion.
- When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.
- If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.
- Operation staff should wear protective glasses and rubber gloves during repair and avoid inhaling much fuel gas.
- **DO NOT** damage the disconnected fuel system line or connectors. Cover the line joints or connectors with plastic bags or equivalent, preventing foreign matter from entering.
- Keep fuel tank and line clean.

- (1) Release the low pressure fuel system pressure.
- (2) Turn off all electrical equipment and ENGINE START STOP switch.
- (3) Disconnect the negative battery cable.
- (4) Remove the intermediate propeller shaft.
- (5) Remove the front muffler assembly.
- (6) Remove the rear right wheel.
- (7) Remove the rear right wheel house protector.

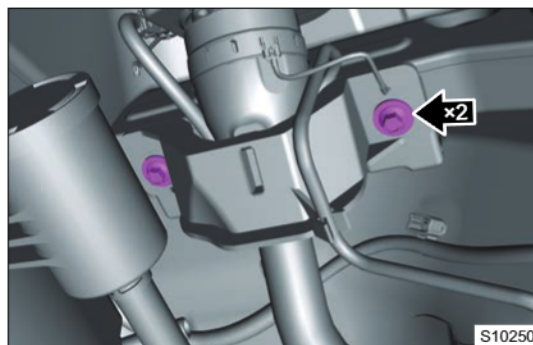
- (8) Disconnect the fuel tank pressure sensor connector (1).
- (9) Disconnect the fuel vapor hose pipe I.



- (10) Disconnect connection between fuel vapor hose pipe I and charcoal canister.
- (11) Disconnect the connection between fuel vapor pipe II and charcoal canister.

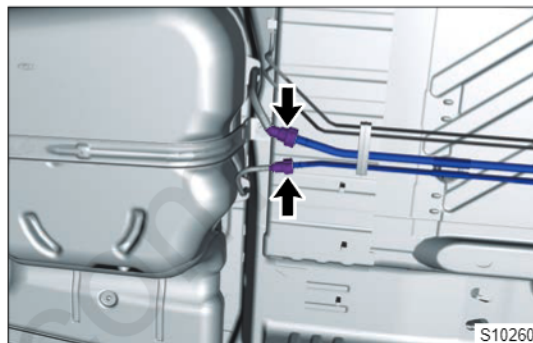


- (12) Remove 2 fixing bolts from fuel filler pipemounting bracket.



- (13) Disconnect the connection between inlet pipe and inlet pipe I.

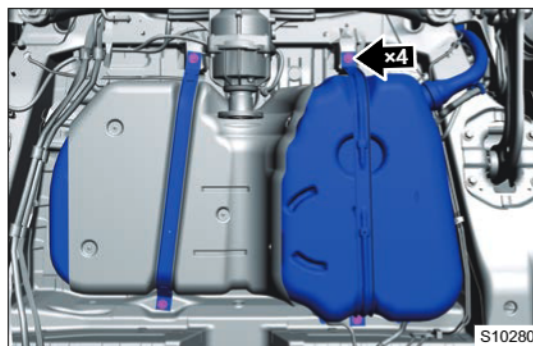
- (14) Disconnect the connection between fuel vapor pipe II and fuel vapor pipe III.



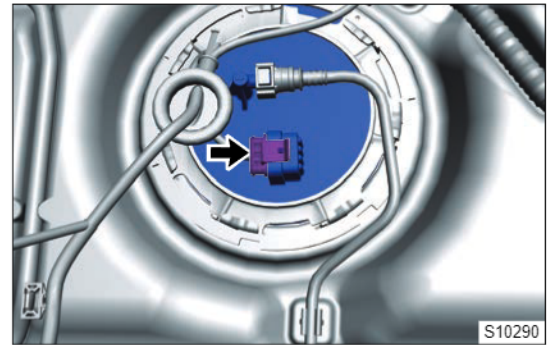
- (15) Support fuel tank assembly with a transmission carrier.



- (16) Remove 4 fixing bolts between fuel tank assembly fixing straps and body connection.

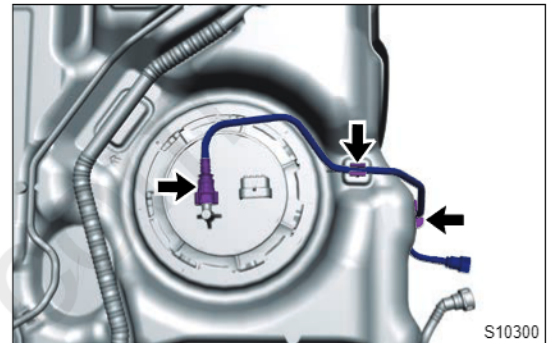


- (17) Disconnect the fuel pump assembly connector carefully.

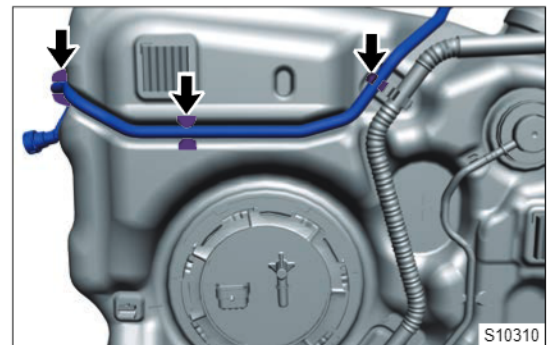


- (18) Lower lift to a proper position slowly, and remove fuel tank assembly carefully.

- (19) Disconnect the connection between fuel pump and inlet pipe and remove the inlet pipe from fuel tank fixing clip.

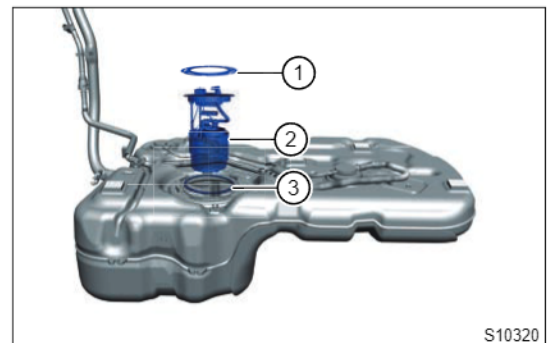


- (20) Remove the fuel vapor pipe II from fuel tank fixing clip.



- (21) Using a special tool, remove electric fuel pump pressure cap (1).

- (22) Remove electric fuel pump assembly (2) and seal ring (3) from fuel tank assembly.



■ Installation

⚠ Caution

- Before connecting the hose, check if there is any damage or foreign matter on the hose or joint.
- During installation, push in fuel pipe connector until a click sound is heard, then check that fuel pipe joint clip is on the collar of fuel pipe joint. After installing the pipe joint clip, check that fuel pipe joint cannot be pulled out. Be careful not to damage joint. If clip is damaged, replace it.
- Turn **ENGINE START STOP** switch to **ON** (without starting engine) to apply fuel pressure to fuel supply system, and then check connections for leakage.

- (1) Install electric fuel pump assembly and tighten fuel tank pressure cap.

Torque: 400 N·m.

- (2) Fix the fuel vapor pipe II and inlet pipe to fuel tank assembly clip. Connect the inlet pipe to electric fuel pump.
- (3) Connect the electric fuel pump assembly connector.
- (4) Install 4 fixing bolts to fuel tank assembly fixing strap.

Torque: 23 ± 2.5 N·m

- (5) Connect the fuel tank pressure sensor connector.
- (6) Connect each pipeline to corresponding joint.
- (7) Install rear right wheel house protector.
- (8) Install the rear right wheel.
- (9) Install the intermediate propeller shaft (If equipped).
- (10) Install the front muffler assembly.

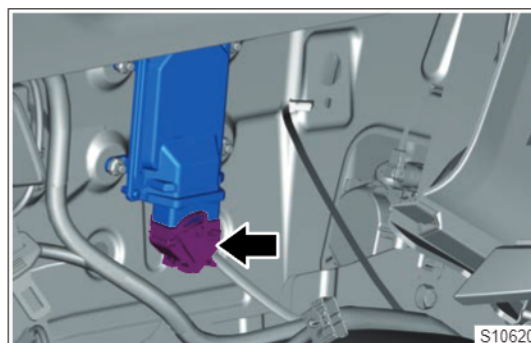
5.8 Fuel Pump Control Module

■ Removal

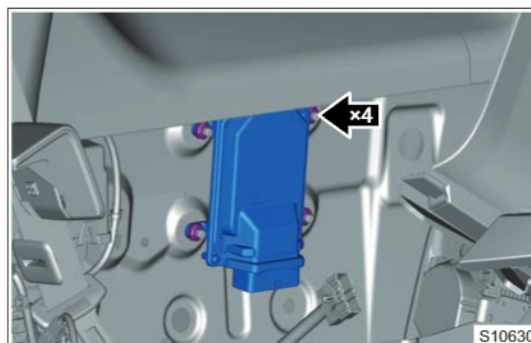
⚠ Warning

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body interior from being scratched during removal and installation.

- (1) Turn off all electrical equipment and **ENGINE START STOP** switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the left luggage compartment protector body.
- (4) Disconnect the fuel pump control module connector.



- (5) Remove 4 fixing nuts from fuel pump control module.



- (6) Remove the fuel pump control module.

■ Installation

- (1) Install 4 fixing nuts to fuel pump control module.

Torque: 7 ± 1 N·m.

- (2) Connect the fuel pump control module connector.
(3) Install the left luggage compartment protector body.

5.9 Fuel Rail Pressure Sensor

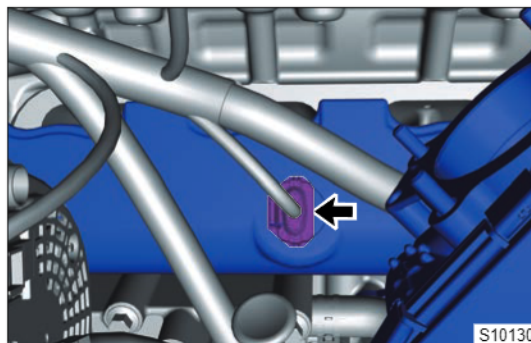
■ Removal

⚠ Warning

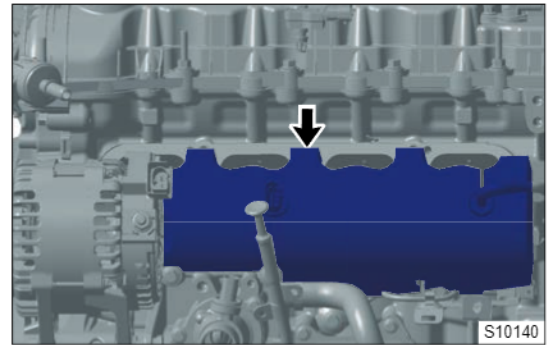
- Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion.
- When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.

- (1) Release the high pressure fuel system pressure.
(2) Turn off all electrical equipment and ENGINE START STOP switch.
(3) Disconnect the negative battery cable.
(4) Remove the intake manifold assembly.

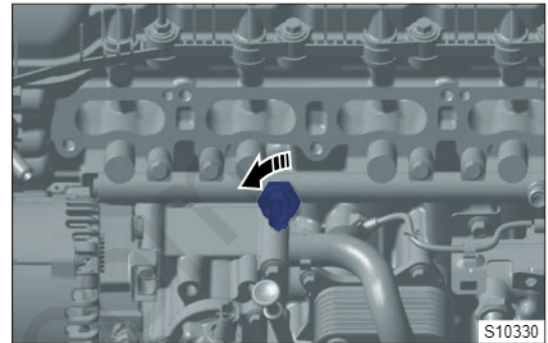
- (5) Disconnect the fuel rail pressure sensor connector.



- (6) Remove the fuel rail injector sound insulator.



- (7) Remove fuel rail pressure sensor counterclockwise in direction of arrow as shown in illustration.



■ Inspection

Use ohm band of multimeter to measure resistance among 3 pins of fuel rail pressure sensor (pay attention to the positive and negative orders).

Sensor Pin (corresponding to positive and negative poles of multimeter in front-and-rear sequence)	Normal Value
1 - 2	$301 \pm 100 \text{ k}\Omega$
1 - 3	$24 \pm 1 \text{ k}\Omega$
2 - 1	∞
2 - 3	∞
3 - 1	$24 \pm 1 \text{ k}\Omega$
3 - 2	$301 \pm 100 \text{ k}\Omega$

■ Installation

- (1) Install fuel rail pressure sensor.
- (2) Install fuel rail injector sound insulator.
- (3) Install the intake manifold assembly.

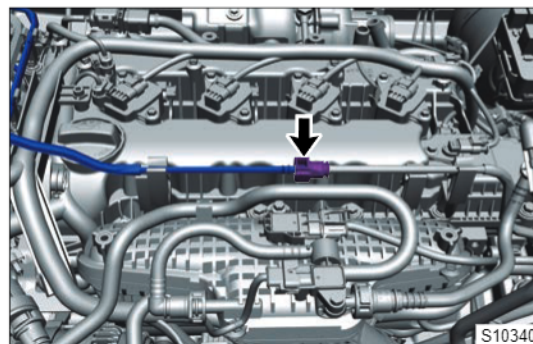
5.10 Low Pressure Fuel Pressure Sensor

■ Removal

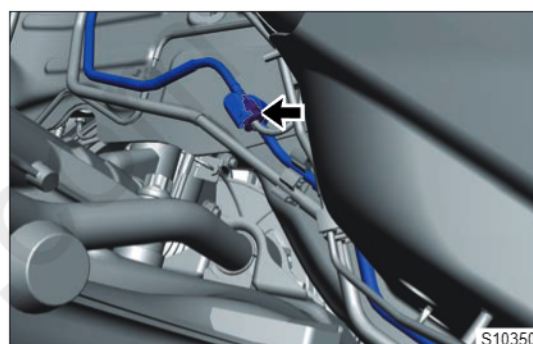
⚠ Warning

- Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion.
- When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.

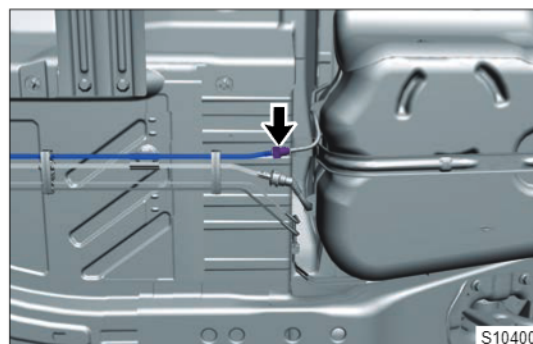
- (1) Release the high pressure fuel system pressure.
- (2) Turn off all electrical equipment and ENGINE START STOP switch.
- (3) Disconnect the negative battery cable.
- (4) Disconnect the connection between inlet pipe II and inlet pipe I.



- (5) Disconnect the low pressure fuel pressure sensor connector.



- (6) Disconnect the connection between inlet pipe and inlet pipe I.



- (7) Remove inlet pipe I assembly from double groove pipe clamp carefully.

■ Installation

- (1) Fix inlet pipe I to double groove pipe clamp.
- (2) Connect the low pressure fuel pressure sensor connector.
- (3) Connect pipe joints to inlet pipe and inlet pipe II.